Seismicity of the United States, 1568–1989 (Revised)

By CARL W. STOVER *and* JERRY L. COFFMAN

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ABSTRACT

Macroseismic effects of the principal earthquakes occurring in the United States from 1568 through 1989 are described. Principal earthquakes are defined as those of Modified Mercalli intensity ≥ VI or Richter magnitude ≥ 4.5. Exceptions are the State of Alaska and the offshore areas of California, Oregon, and Washington, where the magnitude cutoff is ≥ 5.5. A tabular list of earthquake data giving date, location, magnitude, intensity, and reference information for each earthquake is provided for 47 States (earthquakes in the categories described above were not reported in Iowa, Maryland, Wisconsin, or the District of Columbia). Following each table is a brief narrative of the damaging effects of each earthquake of intensity ≥ VI. The narrative includes, where reported, a description of property damage and geologic effects as well as an estimate of the total area over which the shaking was sensibly felt by humans. Isoseismal maps, depicting the areal distribution of effects, and photographs of property damage and geologic effects complement the narratives of selected earthquakes.

INTRODUCTION

This publication is a history of the principal earthquakes in the United States from 1568 through 1989. It contains all pertinent information on the date, location, size, and effects of these historical events. We have included only those earthquakes of Modified Mercalli intensity ("MM intensity" or "MMI") ≥ VI and magnitude ≥ 4.5. Exceptions are the State of Alaska and offshore areas of California, Oregon, and Washington, where the magnitude range was increased to ≥ 5.5 because of the high seismicity of those regions. This publication supersedes the compilation by Coffman and others (1982), published jointly by the U.S. Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA).

This publication differs from the publication by Coffman and others (1982) "Earthquake History of the United States," as listed below:

1. It is organized by State and has many new or revised isoseismal maps.
2. Epicentral locations were evaluated, and some were revised.
3. Many more earthquakes were added, making the data more complete.
4. All maximum intensities were reevaluated, and a uniform criteria for intensity assignment was used, thereby changing some of the intensities previously published.
5. Magnitudes are listed by type and source and are completely referenced.

The summaries of earthquake damage and other effects enumerated in this publication have been compiled from many sources (see table 1). Selection of information to be included for each earthquake was based on the authors' experience in evaluating and publishing earthquake data as well as on a review of the type of data most often requested from the USGS National Earthquake Information Center by scientists and laymen.

The earthquakes described herein are listed alphabetically by State name and chronologically by date of occurrence (1568 through 1989). Further, earthquakes in Canada and Mexico that caused damage in the United States are included in the chapter for the State in which the damage occurred. Each State chapter includes the following: a map showing the distribution of earthquakes; a tabular listing of location, magnitude, maximum intensity, and references; brief summaries of damage caused by earthquakes of MMI ≥ VI; isoseismal maps showing felt areas for selected earthquakes; and photographs of damage and geologic changes induced by destructive earthquakes.

Intensity and damage summaries for earthquakes that occurred in 1987–89 have been compiled from unpublished USGS data and are supplemented by data published in journal articles for the most damaging events. Thus, the summaries for 1987–89 reflect the data available at the time of compilation.

ACKNOWLEDGMENTS

The isoseismal maps were drafted by F.W. Baldwin; L.R. Brewer prepared the tables and text for publication; and B.G. Reagor did the programming to format the tables. G.A. Bollinger, Virginia Polytechnic and State University, provided many discussions on the data and critically reviewed the final manuscript. T.R. Toppazada, California Division of Mines and Geology, reviewed the data for California and Nevada. R.L. Street, University of Kentucky, provided data for historical earthquakes in the Eastern and Central United States. Many of the photographs in this report were provided by the NOAA National Geophysical Data Center, Earthquake Hazards Photograph Library, Boulder, Colorado. After 32 years of providing earthquake information to the public, Carl W. Stover retired from government service on January 3, 1993.

MAGNITUDES

Magnitude, a logarithmic measure of the "size" of an earthquake, is related to the energy released as seismic waves at the focus of an earthquake. Although the magnitude scale has neither "top" nor "bottom" values, the highest magnitude known to have been calculated was about 9.5, the lowest about –3.0. On this logarithmic scale, a magnitude 6.0 shallow-focus earthquake represents elastic-wave energy about 30 times larger than that generated by a magnitude 5.0 earthquake, 900 times (30×30) larger than that of a magnitude 4.0 shock, and so forth. Many factors influence the determination of earthquake magnitude, including focal depth, distance between earthquake focus and observing station, frequency content of the sampled energy, and earthquake radiation pattern (variation of vibrational amplitude with azimuth). Magnitude values calculated by the USGS are based on the following six formulas:

Surface-Wave Magnitude:

$$M_S=\log (A/T)+1.66(\log D)+3.3, \quad (1)$$

as adopted by the International Association of Seismology and Physics of the Earth's Interior (Båth, 1966, p. 153), where A is the maximum vertical surface-wave ground amplitude in micrometers; T is the period in seconds, and $18\le T\le 22$; and D is the distance in geocentric degrees (station to hypocenter), and $20\le D\le 160°$. No depth correction is made for depths less than 50 km, and, generally, M_S magnitudes are not computed for depths greater than 50 km.

Body-Wave Magnitude:

$$m_b=\log (A/T)+Q(D,h), \quad (2)$$

as defined by Gutenberg and Richter (1956), except that T, the period in seconds, is restricted to $0.1\le T\le 3.0$, and A, the ground amplitude in micrometers, is not necessarily the maximum of the P-wave group. Q is a function of distance (D) and depth (h), as published by Gutenberg and Richter (1956), where $D\ge 5°$.

Local Magnitude (Western United States):

$$M_L=\log A-\log A_o, \quad (3)$$

as defined by Richter (1958, p. 340), where A is the maximum trace amplitude in millimeters, written by a Wood-Anderson torsion seismometer, and $\log A_o$ is a standard value as a function of distance, where the distance is < 600 km. Values of M_L are also calculated from other seismometers by converting recorded ground motion to the expected response of the torsion seismometer. M_L magnitudes are listed for events with depths less than 70 km. M_L is the only true "Richter magnitude" (originally defined for California only), but general usage has extended that description to include other areas and types of magnitude as well. There is a potential for misuse in this practice, however. When technical or scientific applications are to be made, it is essential to specify the type of magnitude being used and not to resort to a generic "Richter magnitude."

Local and Regional Magnitude (Eastern United States):

$$M_n=3.75+0.90 (\log D) + \log (A/T) \quad (4)$$

$0.5°\le D\le 4.0°$

$$M_n=3.30+1.66(\log D)+\log (A/T) \quad (5)$$

$4.0°\le D\le 30.0°$,

as proposed by Nuttli (1973) for North America east of the Rocky Mountains, where A/T is expressed in micrometers per second, calculated from the vertical-component 1-second L_g waves, and D is the distance in geocentric degrees. The designator M_{bLg} often is used in place of M_n.

Moment Magnitude:

$$M=2/3(\log M_o)-10.7, \quad (6)$$

as defined by Hanks and Kanamori (1979), where the seismic moment (M_o—commonly expressed in dyne-cm but may be expressed in Newton-meters; 1 Newton-meter = 10^7 dyne-cm) is equal to the product of the area of the earthquake fault, multiplied by the average fault slip over that area and by the shear modulus of the fault rocks; seismic moment may also be determined from the long-period body- and mantle-wave moment tensor inversion method of Dziewonski and others (1981); or, in California, seismic moment is estimated from measurements on Wood-Anderson seismograms (Bolt and Herraiz, 1983).

Other Magnitudes:

Variations of M_S, m_b, and M_n magnitudes have been designed by seismologists for local seismographic networks or for particular geographic regions so that the results are compatible with the magnitude values derived from the standard formulas above. These variations are defined below.

M_D designates magnitude estimates derived from the duration or coda length of earthquake vibrations. M_D is commonly computed from the difference, in seconds, between P_n- or P_g-wave arrival times and the time the final coda amplitude decreases to the pre-event background-noise amplitude. Duration or coda-length magnitude scales normally are adjusted to agree with M_L or M_n estimates, so that resulting magnitudes can be accepted as compatible. Thus, the M_D formulas vary for different geographic regions and for different seismograph systems.

M_{fa} is a body-wave (m_b) magnitude commonly computed from the felt area for earthquakes occurring before seismic instruments were in general use. The computations are based on isoseismal maps or defined felt areas using either the intensity-attenuation method of Nuttli (1973), the magnitude–felt area relation of Nuttli and Zollweg (1974), or the intensity–felt area relation of Sibol and others (1987).

M_{La} is a local magnitude (comparable to M_L) computed for earthquakes in California and adjacent areas and Hawaii. The computation is based on the area of perceptibility shown on isoseismal maps or on the area enclosed within a particular intensity level as defined by Toppozada (1975).

M_{Sn} is a surface-wave (M_S) magnitude that is based on the source parameters for mid-plate earthquakes as defined by Nuttli (1983).

Some seismograph network operators determine a magnitude formula for their specific network by comparing their computed magnitude values with magnitudes published by other sources, such as the USGS m_b, M_L, or M_n magnitudes. In this publication, those types of magnitudes will be designated m_x for body-wave magnitudes (m_b) and M_x for local magnitudes (M_L or M_n). M_L applies west of the Rocky Mountains, M_n east of the Rocky Mountains.

M_R magnitude represents the average of M_S magnitudes computed by different seismograph stations or taken from other seismic networks after standardization as defined and published by Rothé (1969).

A magnitude labeled as "Ukn" means that the computational method was unknown and could not be determined from the published sources.

The published sources for the "Other" and Moment (M) magnitudes are shown by an alphabetic code. These codes are defined in table 2.

INTENSITY, FELT AREA, AND ISOSEISMAL MAPS

The term "intensity," as applied to earthquakes, represents a number assigned to the effects on people (number affected, frightened, etc.), manmade structures (toppled chimneys, collapsed walls, etc.), and the Earth's surface (landslides, faulting, etc.). The intensities listed in this publication were assigned according to the effects outlined in the Modified Mercalli intensity scale of 1931 (Wood and Neumann, 1931), which has 12 discrete steps (see scale on p. 6). Modifications applied by the authors to this scale are described below. The single intensity value listed as a size parameter for each earthquake is the value assigned to the maximum reported effects of that particular earthquake. The maximum intensity is based on documented effects or damage at a place (usually a city or town) and are not necessarily the same as epicentral intensity (I_o), which is the estimated intensity at the location of the earthquake.

Some of the maximum intensities in this publication have been changed from previously published values (namely in Coffman and others, 1982), mainly owing to new sources of information, or reevaluation of existing information, or both. Interestingly, many of those changes have resulted in the downgrading of intensities from MM intensity VI to V. This action has eliminated many earthquakes from this compilation if their associated magnitude was less than 4.5 (< 5.5 for Alaska and offshore California, Oregon, and Washington). All Rossi-Forel intensities gleaned from earlier publications were converted to MMI values using table 4 from Barosh (1969).

The Modified Mercalli intensity scale of 1931 has been further modified by the authors for assigning intensity values. These modifications were made for several reasons: The recent changes the USGS has made in the format of the questionnaire used to collect earthquake information have improved both the qualitative and quantitative data on the effects of shaking; the field experience of the authors (including personal observation of damage) has provided insight for more accurate intensity evaluation; and the subjective effects on people described in the MM intensity scale are not reliable considerations for assigning values above the intensity IV level. These modifications to the MM intensity scale of 1931 are described in more detail below:

IV—Felt by many to all. Trees and bushes were shaken slightly. Buildings shook moderately to strongly. Walls creaked loudly. Observer described the shaking as "strong."

V—Felt, frightened, and awakened effects were not used at this or higher intensity levels. Hanging pictures fell. Spilled liquid effects were not used to assign any intensity. Trees and bushes were shaken moderately to strongly. People had difficulty standing or walking. Felt moderately by people in moving vehicles.

VI—At this level, there must be reports of physical damage to man-made structures as described in the MM intensity scale. The only exception is that intensity VI is still assigned if many small objects fell from shelves and (or) many glassware items or dishes were broken.

VII—Only damage to buildings or other man-made structures (as described in the MMI scale) is considered.

VIII–XII—The MM intensity scale is used as written, except that neither landslides nor effects on people were used for assigning an intensity. Geologic effects were used only if the earthquake occurred in an isolated area having no nearby structures that could be damaged.

The "felt areas" listed in the tables were taken from different published sources or were estimated by the authors from previously published or newly drawn isoseismal or intensity maps; the felt areas are listed to the nearest 1,000 km^2. When an earthquake occurred in a State bordering an ocean, Canada, or Mexico, the total felt area sometimes could not be estimated precisely. In those instances, the felt area was estimated only for the land area in the United States.

Isoseismal maps depict the extent of the felt area of an earthquake and separate the effects into areas of different levels of intensity. The outer isoseismal line defines the total, or projected, contiguous geographical area over which the earthquake was sensibly felt by people. The isoseismal maps that illustrate this compilation either are modified versions of previously published maps or are new maps prepared by the authors (see figs. 7–64).

New isoseismal maps also have been compiled from MMI values assigned by the authors after reevaluating original sources of data. These intensity values were assigned only to the effects of shaking; geologic effects alone were not considered unless the area was uninhabited and there were no structures to damage. However, maximum MM intensities assigned by other researchers to geologic effects in remote areas (mainly in Nevada) have not been changed.

The isoseismal maps contained in this publication were mostly selected to represent geographic coverage. If States had a number of damaging earthquakes, only the isoseismal maps for the most damaging events were included.

SEISMICITY MAPS

The seismicity and intensity maps for the United States, Alaska, Hawaii (figs. 1–6), and those at the beginning of each State chapter, show the areal distribution of earthquakes of magnitude 4.5 or larger. Those earthquakes are depicted by open symbols that increase in size with increase in magnitude or intensity.

To depict the earthquakes by magnitude on the maps, we assigned arbitrary magnitudes to events that had no computed magnitudes. This was accomplished by correlating the maximum intensity with the average magnitude of earthquakes in four geographical areas (Western U.S., Eastern U.S., Hawaii, and Alaska) that had both magnitudes and intensities. The results for four areas are listed below:

Western United States	
MMI	Magnitude
V	<5.0
VI	5.0
VII	5.5
VIII	6.0
IX	6.5
X–XII	7.0

Eastern United States	
MMI	Magnitude
VI	<5.0
VII	5.0
VIII	5.5
IX	6.0
X–XII	6.5

Hawaii	
MMI	Magnitude
V	<5.5
VI	5.5
VII	6.0
VIII	6.5
IX	7.0
X–XII	7.5

Alaska	
MMI	Magnitude
V	<6.0
VI	6.0
VII	6.5
VIII	7.0
IX	7.5
X–XII	8.0

DAMAGE SUMMARIES

The effects of all earthquakes of MMI VI or higher are summarized for each State, and descriptive information that substantiates the maximum intensity assigned to each earthquake is listed. The data sources used to compile the effects (see table 1) are listed by source-reference numbers in parentheses at the end of each earthquake description. For example, "(Ref. 1, 2, 250)" means that those three references were used to compile that particular summary, including the epicenter.

Earthquakes are listed chronologically by date and time of occurrence (in Universal Coordinated Time—UTC). When the UTC date differs from the local date (i.e., the date/time of the earthquake at its epicenter), the local date is given in parentheses following the UTC date. When more than one earthquake occurred on the same date, origin times are repeated after the date to prevent ambiguity (HST, Hawaii-Aleutian standard time; AST, Alaska standard time; PST, Pacific standard time; MST, Mountain standard time; CST, Central standard time; EST; Eastern standard time).

All published magnitude values cannot be listed in the tables because of lack of space or other reasons. However, those available values that are not listed are included at the end of the earthquake summaries, e.g., Magnitude 7.0 M_S GR—GR refers to a magnitude reference code; these codes are listed in table 2.

Dollar estimates of property damage are available for most destructive earthquakes. These estimates, where quoted, use the dollar value for the year in which the earthquake occurred. Table 3 lists the numbers of deaths caused by destructive U.S. earthquakes.

Information on the effects of many large earthquakes in Alaska's Aleutian Islands is not commonly available because of the remoteness of that region and the sparseness of its population. Therefore, the summaries for many large-magnitude earthquakes in Alaska give only date, region of occurrence, and magnitude.

EXPLANATION OF TABLES

Each State chapter includes a table that lists the basic parameters of the principal earthquakes in that State. Dates and origin times for each earthquake have been converted to the date and time of the Greenwich meridian and labeled as Universal Coordinated Time (UTC). The origin times for some earthquakes may differ from that given in the source reference. If so, the listed origin time was estimated using more accurate sources of data, such as seismograms, earthquake phase data, U.S. Weather Service reports, or other data sources.

Latitude and longitude values are listed in decimal degrees. The number of digits following the decimal point does not indicate the level of accuracy, however: it only duplicates the value published in the original source reference.

More than one location has been published for many earthquakes in the United States. We, therefore, have selected for this publication the epicenter/hypocenter that, in our judgment, most accurately represents the location of each earthquake. Some of these epicenters either have been revised from those previously published or have been assigned new, previously unpublished epicenters, based on felt-area descriptions and locations of damage. All epicenters/hypocenters included in the tables have been given a reference number (see table 1).

Only in recent years has the depth of an earthquake in the United States been reliably computed. Therefore, the State tables do not give depth values for most pre-1930 earthquakes.

Magnitudes are listed for all earthquakes that had a published value. Some erroneous m_b magnitudes computed and published in the Preliminary Determination of Epicenters during the 1960's have been eliminated. Published magnitudes that were based on maximum MM intensity, however, are not included. Many original magnitudes have been recomputed on the basis of recent research and new computational techniques. Consequently, magnitudes selected to be listed in the State chapters are values that the authors believe most accurately represent the "size" of the earthquake. The M_{fa} magnitudes, identified by the code "SC" in the tables for States east of the Rocky Mountains, were computed by the authors using the intensity–felt area relation of Sibol and others (1987). When magnitudes were published as a range (i.e., 6–6¼), the average of this range is the value listed in the tables. Additional magnitudes are listed in parentheses at the end of the summary of effects for many earthquakes.

The alphabetic codes associated with the magnitudes represent the source reference for that magnitude. These alphabetic codes are defined in table 2. West of longitude 126 W. (offshore from California, Oregon, and Washington) only earthquakes with magnitudes ≥ 5.5 were included.

The MMI values given in the State tables represent the maximum intensity observed for those earthquakes listed. However, for a few earthquakes in Canada or Mexico that caused damage in the United States, the maximum intensity given is that observed nearest the epicenter. If that maximum intensity is not known, the maximum intensity observed in the United States is then listed (see the State chapter for details). A "Felt" in the MM intensity column indicates that insufficient information was available to assign an intensity value. The source references for intensity are listed by number in the State tables and defined in table 1.

The felt area given in the tables should be considered only as an estimate because the limit of perceptibility of shaking requires detailed reports that are unavailable for many earthquakes.

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(From Wood and Neumann, 1931)

I **Not felt**—or, except rarely under especially favorable circumstances.

Under certain conditions, at and outside the boundary of the area in which a great shock is felt: sometimes birds, animals, reported uneasy or disturbed; sometimes dizziness or nausea experienced; sometimes trees, structures, liquids, bodies of water, may sway—doors may swing very slowly.

II **Felt indoors by few, especially on upper floors**, or by sensitive, or nervous persons.

Also, as in grade I, but often more noticeably: **sometimes hanging objects may swing**, especially when delicately suspended; sometimes trees, structures, liquids, bodies of water may sway; doors may swing very slowly; sometimes birds, animals reported uneasy or disturbed; sometimes dizziness or nausea experienced.

III **Felt indoors by several, motion usually rapid vibration.**

Sometimes not recognized to be an earthquake at first. **Duration estimated in some cases.** Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away. **Hanging objects may swing slightly.** Movements may be appreciable on upper levels of tall structures. Rocked standing motor cars slightly.

IV **Felt indoors by many, outdoors by few.**

Awakened few, especially light sleepers. **Frightened no one**, unless apprehensive from previous experience. Vibration like that due to passing of heavy or heavily loaded trucks. Sensation like heavy body striking building or falling of heavy objects inside. **Rattling of dishes, windows, doors**; glassware and crockery clink and clash. **Creaking of walls, frame,** especially in the upper range of this grade. **Hanging objects swung**, in numerous instances. Disturbed liquids in open vessels **slightly**. Rocked standing motor cars noticeably.

V **Felt indoors by practically all, outdoors by many or most: outdoors direction estimated.**

Awakened many, or most. **Frightened few**—slight excitement, a few ran outdoors. Buildings trembled throughout. **Broke dishes**, glassware, to some extent. **Cracked windows**—in some cases, but not generally. **Overturned vases, small or unstable objects**, in many instances, with occasional fall. **Hanging objects, doors, swing** generally or considerably. Knocked pictures against walls, or swung them out of place. Opened, or closed, doors, shutters, abruptly. **Pendulum clocks stopped**, started or ran fast, or slow. **Moved small objects, furnishings**, the latter to slight extent. **Spilled liquids** in small amounts from well-filled open containers. **Trees, bushes, shaken slightly.**

VI **Felt by all**, indoors and outdoors.

Frightened many, excitement general, some alarm, many ran outdoors. **Awakened all.** Persons made to move unsteadily. **Trees, bushes, shaken slightly to moderately.** Liquid set in strong motion. Small bells rang—church, chapel, school, etc. **Damage slight** in poorly built buildings. **Fall of plaster** in small amount. **Cracked plaster** somewhat, especially fine cracks in chimneys in some instances. **Broke dishes**, glassware, in considerable quantity, also some windows. **Fall of knickknacks, books, pictures. Overturned furniture** in many instances. **Moved furnishings** of moderately heavy kind.

VII **Frightened all**—general alarm, all ran outdoors.

Some, or many, found it difficult to stand. Noticed by persons driving motor cars. **Trees and bushes shaken moderately to strongly.** Waves on ponds, lakes, and running water. Water turbid from mud stirred up. Incaving to some extent of sand or gravel stream banks. Rang large church bells, etc. Suspended objects made to quiver. **Damage negligible** in buildings of good design and construction, **slight** to moderate in well-built ordinary buildings, **considerable** in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. **Cracked chimneys** to considerable extent, **walls** to some extent. **Fall of plaster** in considerable to large amount, also some stucco. **Broke numerous windows, furniture** to some extent. Shook down loosened brickwork and tiles. Broke weak chimneys at the roofline (sometimes damaging roofs). **Fall of cornices** from towers and high buildings. Dislodged bricks and stones. **Overturned heavy furniture**, with damage from breaking. **Damage considerable** to concrete irrigation ditches.

VIII **Fright general**—alarm approaches panic.

Disturbed persons driving motor cars. **Trees shaken strongly**—branches, trunks, broken off, especially palm trees. Ejected sand and mud in small amounts. Changes: temporary, permanent; in flow of springs and wells; dry wells renewed flow; in temperature of spring and well waters. **Damage slight** in structures (brick) built especially to withstand earthquakes. **Considerable** in ordinary substantial buildings, partial collapse: racked, tumbled down, wooden houses in some cases; threw out panel walls in frame structures, broke off decayed piling. **Fall of walls. Cracked, broke, solid stone walls seriously. Wet ground** to some extent, also ground on steep slopes. **Twisting, fall, of chimneys, columns, monuments**, also factory stacks, towers. **Moved conspicuously, overturned, very heavy furniture.**

IX Panic general.

Cracked ground conspicuously. Damage considerable in (masonry) structures built especially to withstand earthquakes: threw out of plumb some wood-frame houses built especially to withstand earthquakes; **great** in substantial (masonry) buildings, some collapse in large part; or wholly shifted frame buildings off foundations, racked frames; serious to reservoirs; underground pipes sometimes broken.

X **Cracked ground**, especially where loose and wet, up to widths of several inches; fissures up to a yard in width ran parallel to canal and stream banks.

Landslides considerable from river banks and steep coasts. Shifted sand and mud horizontally on beaches and flat land. Changed level of water in wells. Threw water on banks of canals, lakes, rivers, etc. **Damage serious** to dams, dikes, embankments. **Severe** to well-built wooden structures and bridges, some destroyed. Developed dangerous cracks in excellent brick walls. Destroyed most masonry and frame structures, also their foundations. Bent railroad rails slightly. Tore apart, or crushed endwise, pipelines buried in earth. Open cracks and broad wavy folds in cement pavements and asphalt road surfaces.

XI Disturbances in ground many and widespread varying with ground material.

Broad fissures, earth slumps, and land slips in soft, wet ground. Ejected water in large amounts charged with sand and mud. Caused sea waves ("tidal" waves) of significant magnitude. **Damage severe** to wood-frame structures, especially near shock centers. **Great** to dams, dikes, embankments often for long distances. Few, if any (masonry) structures remained standing. Destroyed large well-built bridges by the wrecking of supporting piers, or pillars. Affected yielding wooden bridges less. Bent railroad rails greatly, and thrust them endwise. Put pipelines buried in earth completely out of service.

XII **Damage total**—practically all works of construction damaged greatly or destroyed.

Disturbances in ground great and varied, numerous shearing cracks. Landslides, falls of rock of significant character, slumping of river banks, etc., numerous and extensive. Wrenched loose, tore off, large rock masses. Fault slips in firm rock, with notable horizontal and vertical offset displacements. Water channels, surface and underground, disturbed and modified greatly. Dammed lakes, produced waterfalls, deflected rivers, etc. Waves seen on ground surfaces (actually seen, probably, in some cases). Distorted lines of sight. Threw objects upward into the air.

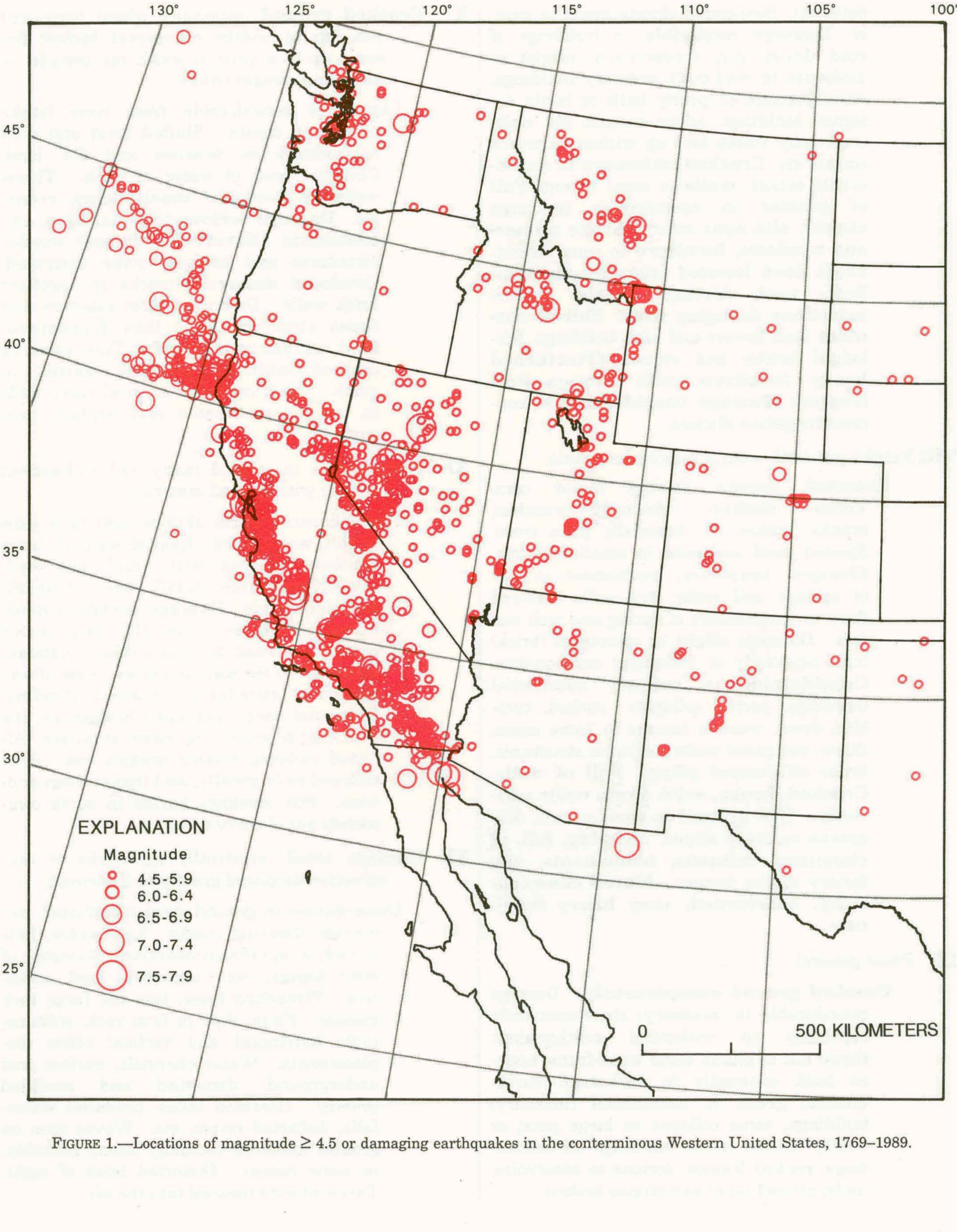

FIGURE 1.—Locations of magnitude ≥ 4.5 or damaging earthquakes in the conterminous Western United States, 1769–1989.

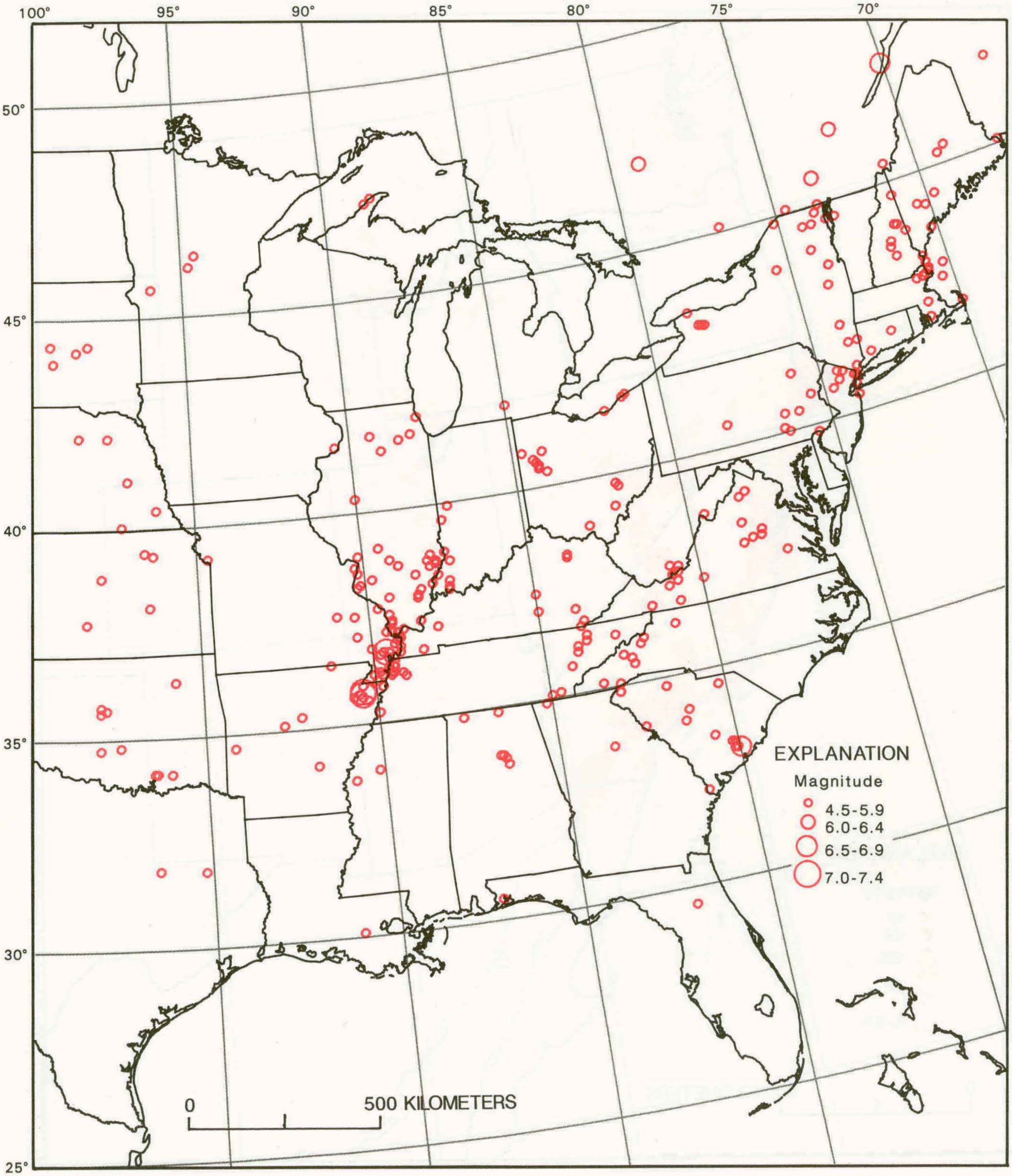

FIGURE 2.—Locations of magnitude ≥ 4.5 or damaging earthquakes in the conterminous Eastern United States, 1568–1989.

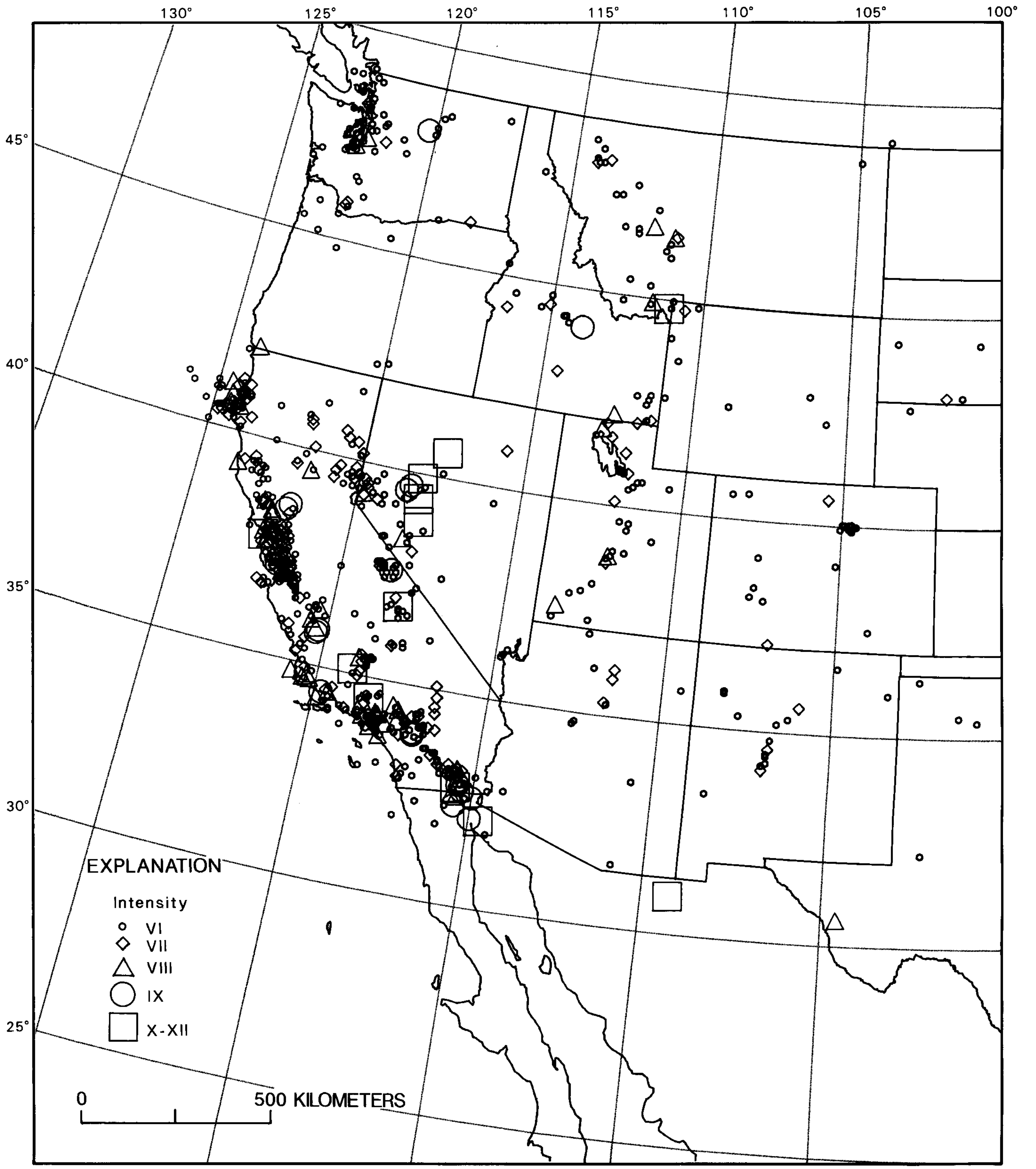

FIGURE 3.—Locations of earthquakes causing damage (MMI ≥ VI) in the conterminous Western United States, 1769–1989.

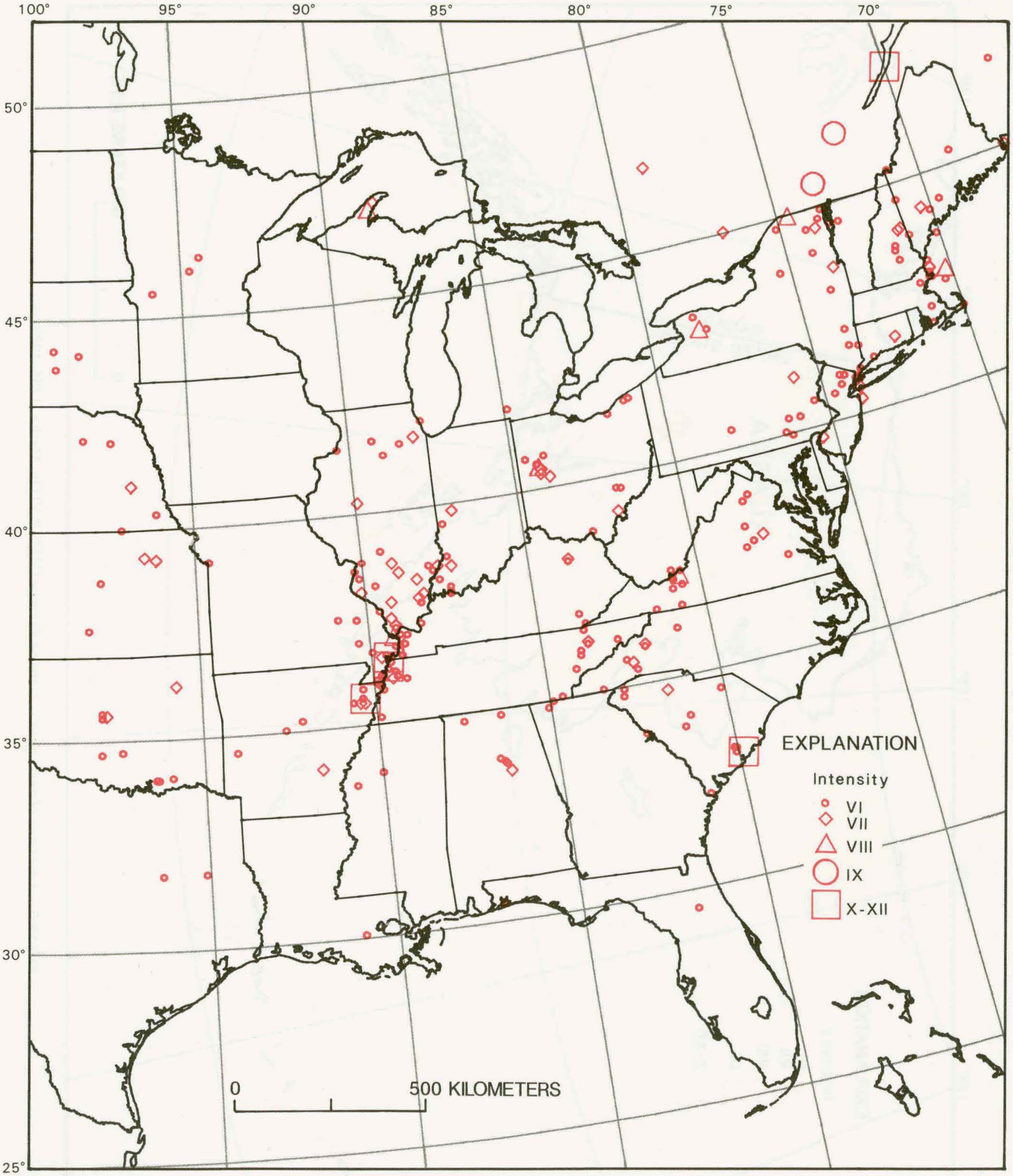

FIGURE 4.—Locations of earthquakes causing damage (MMI ≥ VI) in the conterminous Eastern United States, 1568–1989.

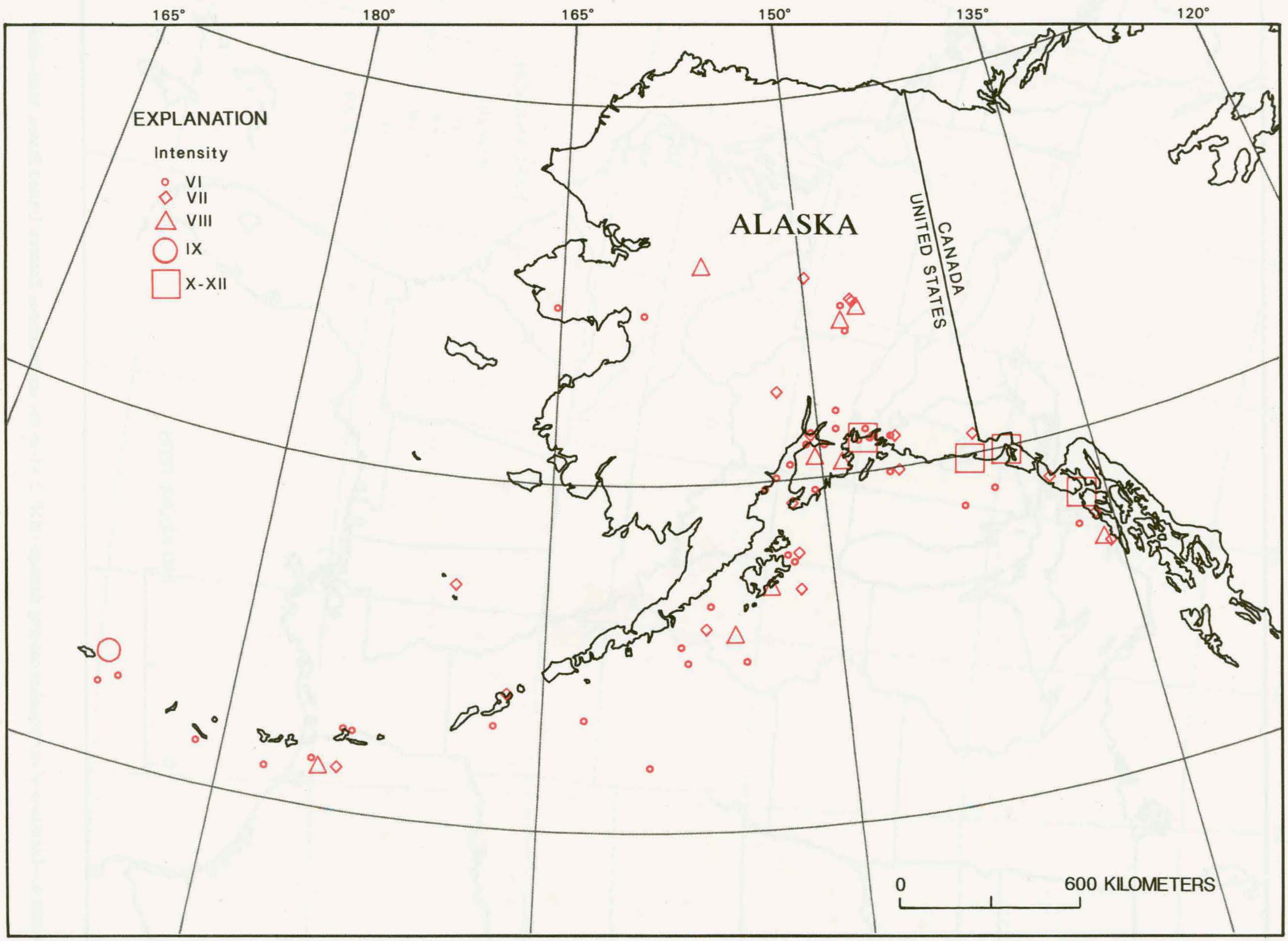

FIGURE 5.—Locations of earthquakes causing damage (MMI ≥ VI) in Alaska, 1786–1989.

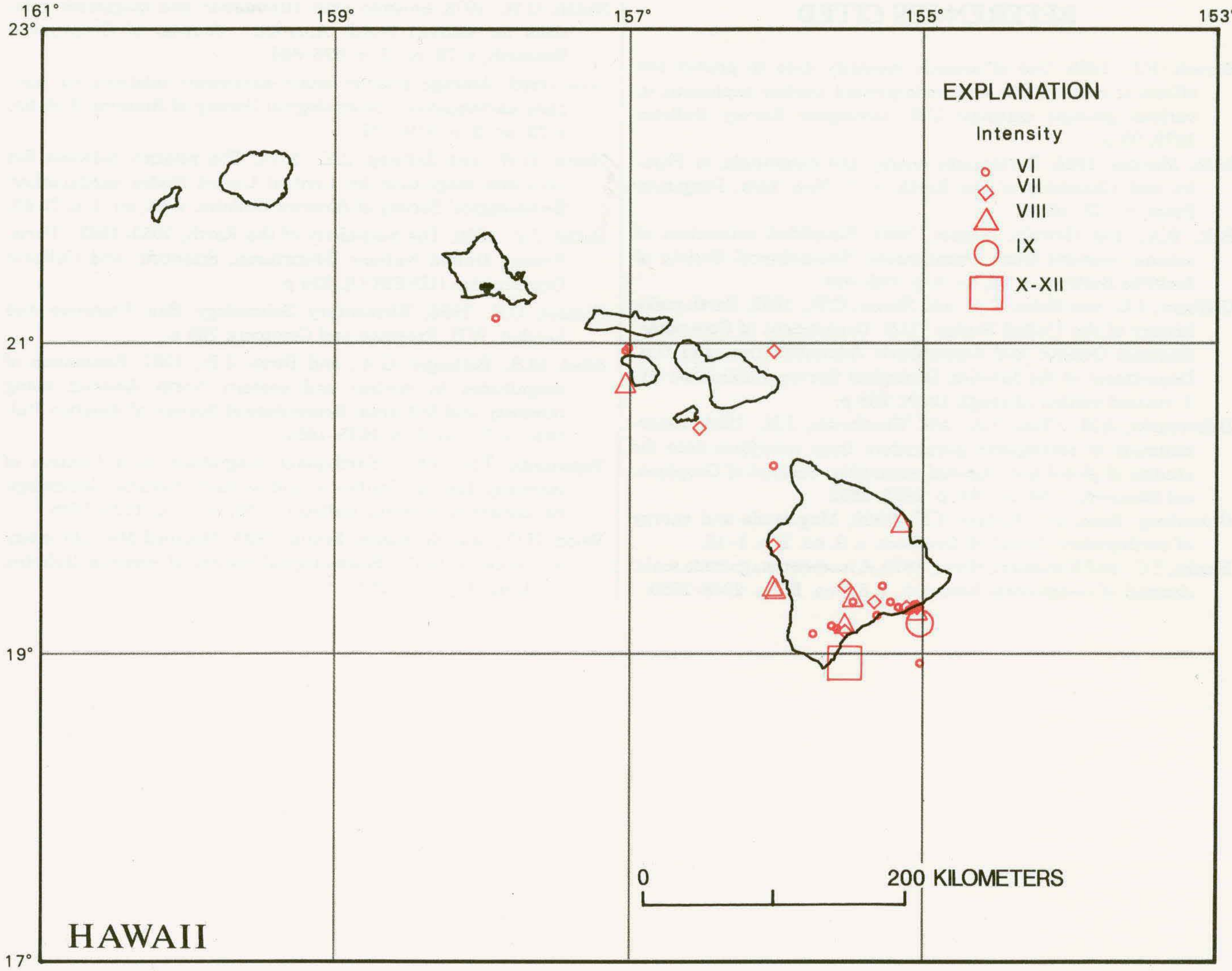

FIGURE 6.—Locations of earthquakes causing damage (MMI ≥ VI) in Hawaii, 1834–1989.

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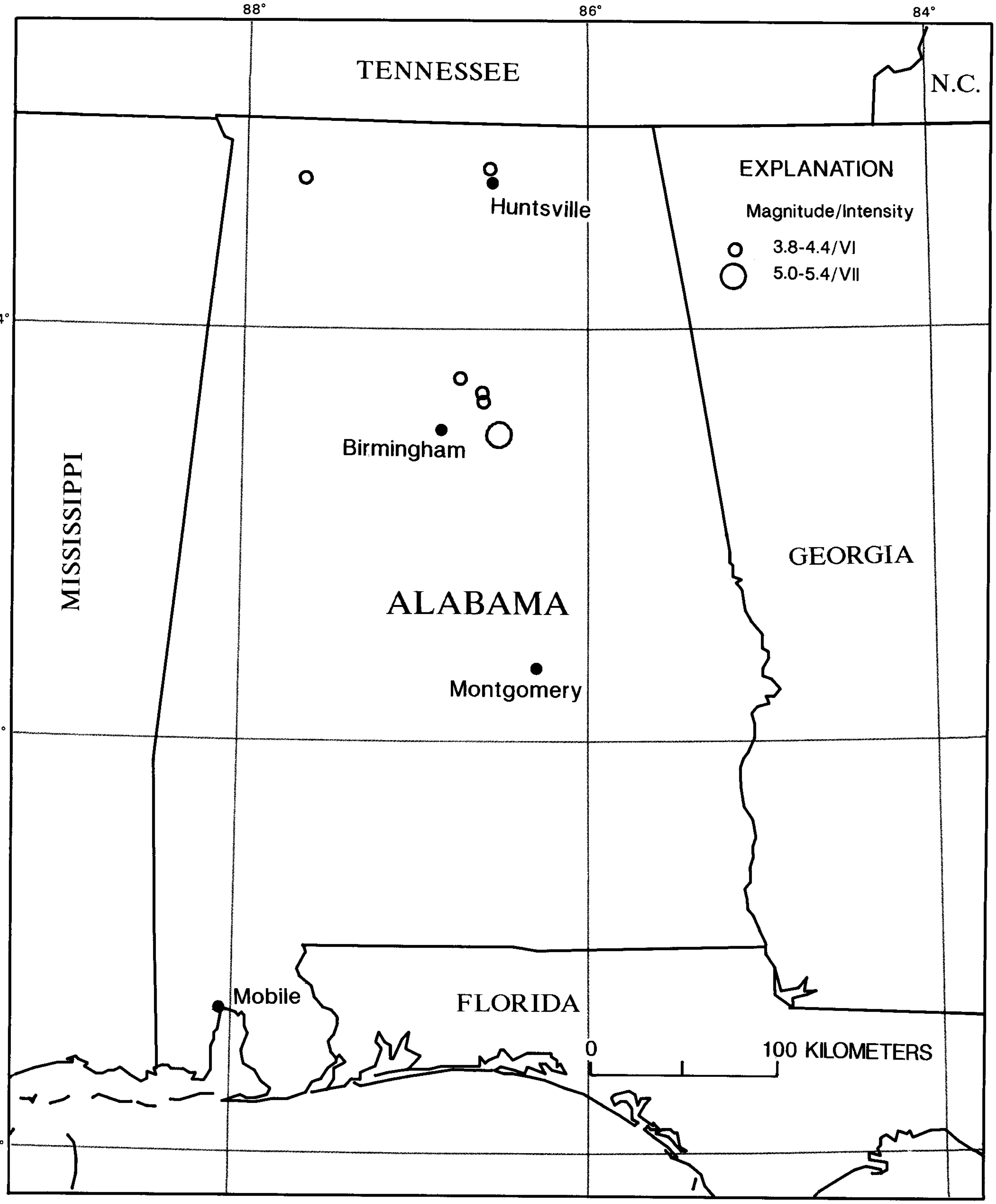
ALABAMA



Earthquakes in Alabama with magnitudes ≥ 4.5 or intensity ≥ VI.

ALABAMA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MM	Ref	(1,000 km²)
1916	10	18	22 04	33.5 N	86.5 W	—	272	—	—	5.10M_{fa} SC	—	VII	38	384
1931	05	05	12 18	33.7 N	86.6 W	—	38	—	—	4.00M_{fa} SC	—	VI	38	17
1957	04	23	09 23 39.0	33.770N	86.723W	005	349	—	—	4.10M_{fa} SC	—	VI	30	28
1959	08	12	18 06 01.4	34.789N	86.562W	005	349	—	—	3.80M_{fa} SC	—	VI	32	7
1975	08	29	04 22 52.1	33.659N	86.588W	004	349	3.5	—	4.40M_x JLM	—	VI	48	25
1989	08	20	00 03 17.8	34.736N	87.645W	010	74	—	—	3.90M_n GS	—	VI	579	6

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1916. Oct. 18. Irondale, Jefferson County, Ala. On the basis of the number of chimneys destroyed, this earthquake was more severe in Irondale than in any other town between Easonville and Birmingham. At Irondale, about 5 km north of Birmingham, 14 chimneys in a two-block area were partly destroyed, and six chimneys on a brick store were leveled almost to the roof. Many other chimneys either were leveled to the roofs or were cracked so badly that they had to be rebuilt. At Pell City, a few bricks were dislocated from one of the courthouse chimneys, and near Easonville, a few chimneys were damaged lightly. Poorly built chimneys on the eastern edge of Birmingham were damaged heavily.

A careful study of the Red Gap fault, which extends from near Gate City to beyond Irondale, did not reveal direct evidence of recent earth movement. The most significant geologic result was the effect of the earthquake on underground water, particularly in Irondale. Five wells in a one-block area of Irondale went dry immediately after the shock, and the water level in many others was lowered. At Pell City, the shock lowered the water level in one well about 50 cm. Several small aftershocks occurred through Oct. 28. Also felt in Georgia, Indiana, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee (see fig. 7). (Ref. 38, 105, 272, 508.)

1931. May 5. Near Birmingham, Jefferson County, Ala. This earthquake knocked bricks from a chimney at Birmingham, and shook objects from walls of a blacksmith shop at Cullman. Also felt in Georgia and possibly in South Carolina. (Ref. 38, 105, 508.)

1957. Apr. 23. Near Birmingham, Jefferson County, Ala. Several chimneys sustained minor damage at Birmingham; concrete steps were cracked and several small cracks formed on interior walls. Items on tables tumbled to the floor. Also felt in Georgia and Tennessee. Magnitude 4.2 M_{fa} BAR, 4.2 M_{fa} DG. (Ref. 30, 349, 508.)

1959. Aug. 12. Hazel Green, Madison County, Ala. This earthquake was strongest in Madison County in northern Alabama. North of Huntsville, at Hazel Green, bricks toppled from chimneys and alarmed residents ran from their houses. One chimney and a new concrete-block building were damaged at nearby Meridianville. Plaster cracked slightly at Huntsville, and merchandise was thrown from shelves. Also felt at several towns in Tennessee. Magnitude 3.8 M_n BAR, 3.8 M_{fa} DG. (Ref. 32, 349, 508.)

1975. Aug. 29 (Aug. 28). Palmerdale, Jefferson County, Ala. The earthquake cracked a sheetrock ceiling and shifted lamps on tables at Palmerdale, north of Birmingham. It caused slight damage at Watson, where furniture was displaced slightly. Also felt in southern Tennessee. Magnitude 4.4 M_n SLM. (Ref. 48, 349.)

1989. Aug. 20 (Aug. 19). Near Littleville, Colbert County, Ala. A Colbert County official reported that, south of Florence between Littleville and Russellville, a basement wall collapsed beneath a house. Only slight damage was reported north of the epicenter at Florence, where windows were cracked and hairline cracks formed in plaster. Also felt in Lauderdale, Lawrence, and Morgan Counties in northwest Alabama and Lawrence County in south-central Tennessee. (Ref. 74, 579.)

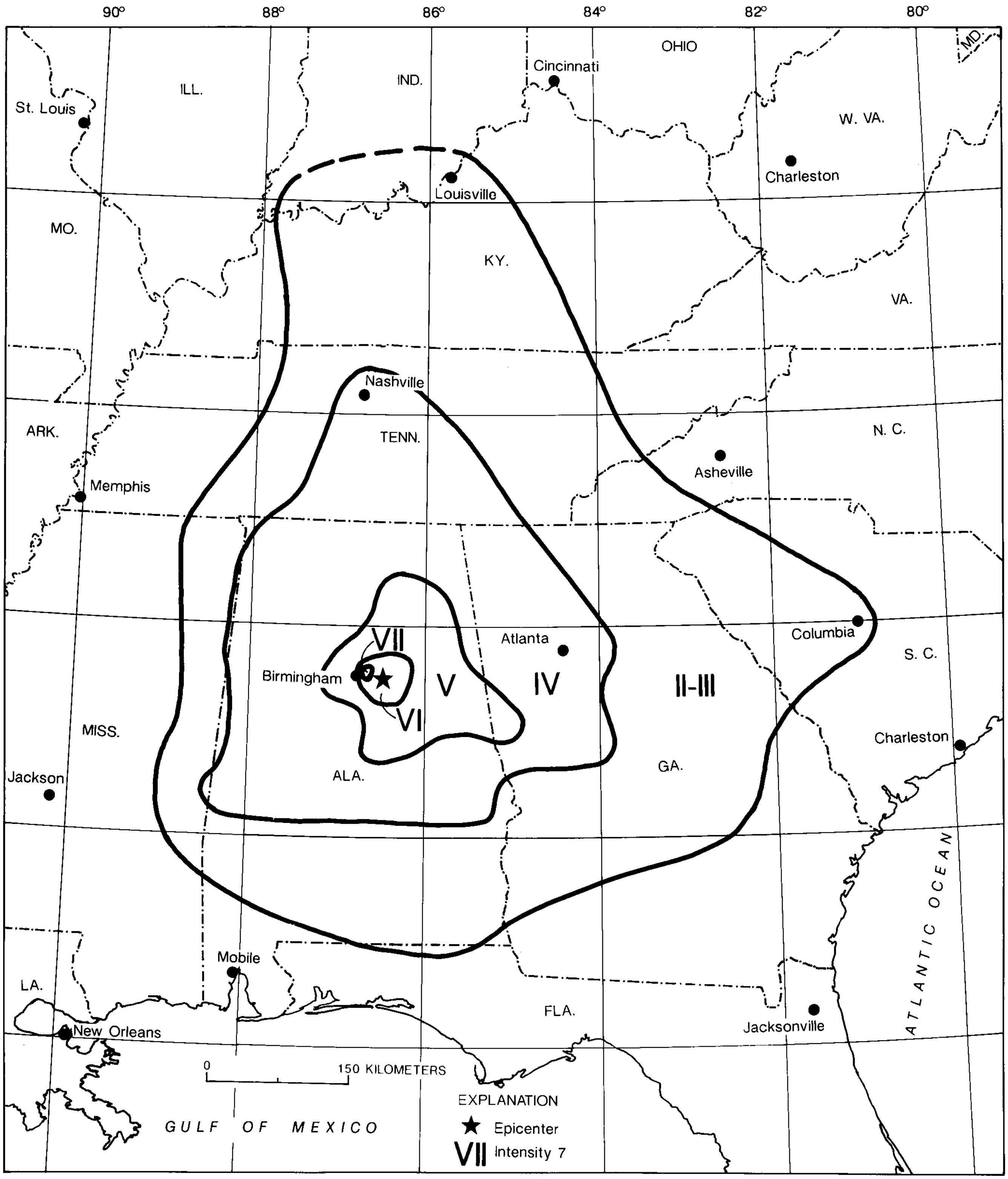
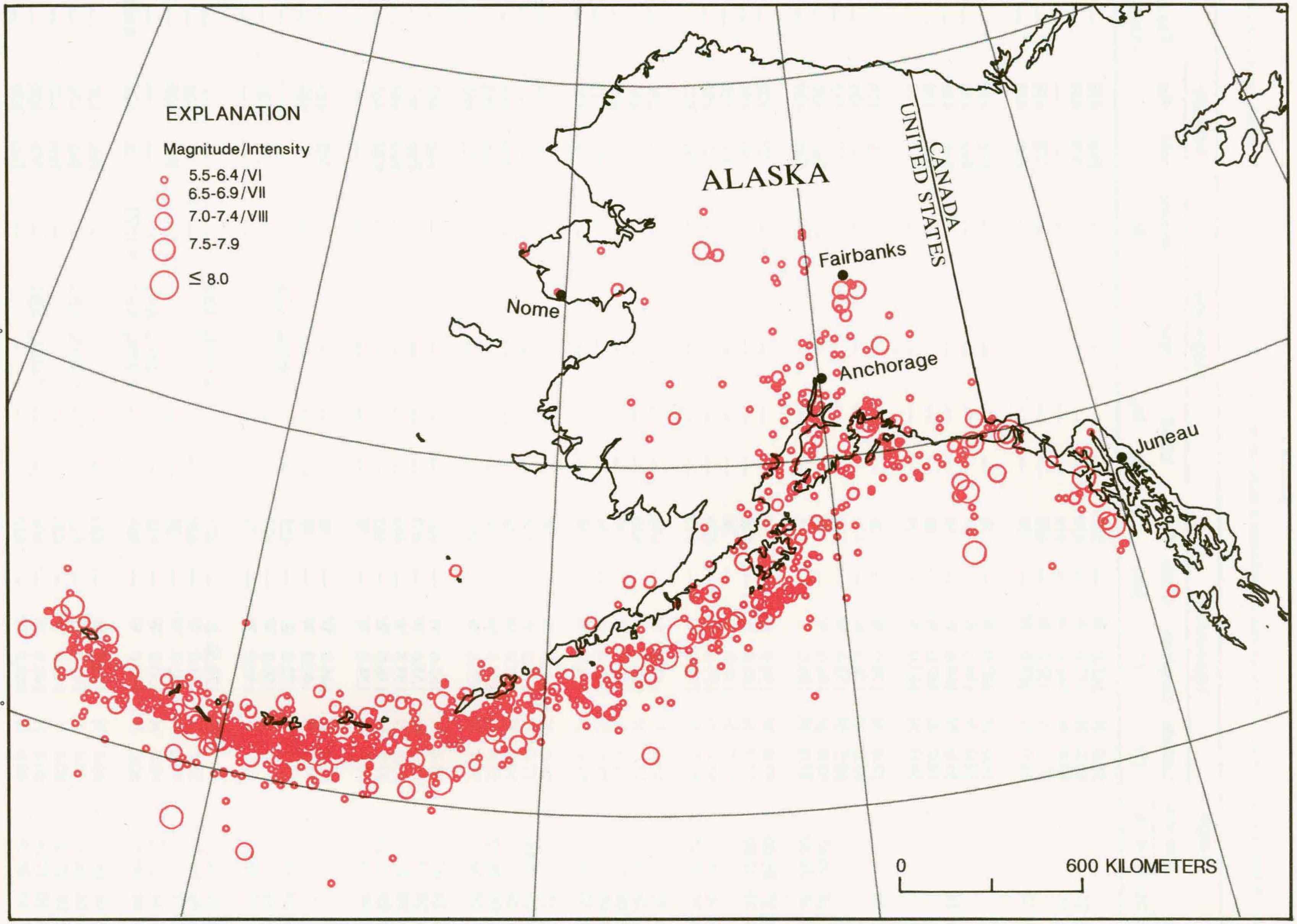


FIGURE 7.—Isoseismal map for the Alabama earthquake of October 18, 1916. Isoseismals are based on intensity estimates from data listed in reference 272 of table 1.



Earthquakes in Alaska with magnitudes ≥ 5.5 or intensity ≥ VI.

ALASKA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MM	Ref	(1,000 km²)
1786				55.0 N	162.0 W	—	255	—	—	—	—	Felt	436	—
1788	07	22		56.0 N	157.0 W	—	456	—	—	—	—	VII	456	—
1788	08	07		55.0 N	161.0 W	—	456	—	—	—	—	—	—	—
1792				57.0 N	152.0 W	—	456	—	—	—	—	VII	456	—
1796	05	20		54.0 N	167.0 W	—	38	—	—	—	—	Felt	436	—
1802				54.0 N	167.0 W	—	38	—	—	—	—	Felt	436	—
1812				52.0 N	174.5 W	—	38	—	—	—	—	Felt	436	—
1817	03	14		53.0 N	168.0 W	—	38	—	—	—	—	Felt	436	—
1818	04			54.0 N	167.0 W	—	38	—	—	—	—	Felt	436	—
1826	06			54.0 N	167.0 W	—	38	—	—	—	—	—	—	—
1836	04	14		57.0 N	170.0 W	—	38	—	—	—	—	VII	520	—
1836	08			57.0 N	170.0 W	—	436	—	—	—	—	VI	436	—
1840	04			60.5 N	152.0 W	—	515	—	—	—	—	VI	515	—
1843	12	15	10 45	57.0 N	136.0 W	—	38	—	—	—	—	Felt	420	—
1843	12	16	22 30	57.0 N	136.0 W	—	38	—	—	—	—	Felt	420	—
1843	12	17	01 00	57.0 N	136.0 W	—	38	—	—	—	—	VI	420	—
1844	04	13	10 00	57.0 N	152.0 W	—	456	—	—	—	—	VI	456	—
1847				57.0 N	136.0 W	—	38	—	—	—	—	VII	520	—
1847	04	16	16	55.0 N	158.0 W	—	456	—	—	—	—	VI	456	—
1848	03	30	10 45	57.0 N	136.0 W	—	515	—	—	—	—	VI	515	—
1848	06	30	10	55.0 N	155.0 W	—	456	—	—	—	—	VI	456	—
1854	01	28	18	57.0 N	152.0 W	—	456	—	—	—	—	V	456	—
1857	09	08	21	58.0 N	152.0 W	—	38	—	—	—	—	V	420	—
1866	09	06		58.0 N	152.0 W	—	38	—	—	—	—	VII	515	—
1867	07	20	09	62.0 N	161.0 W	—	38	—	—	—	—	V	436	—
1868	05	15		55.0 N	161.0 W	—	38	—	—	—	—	—	—	—
1872	08	23	18 02	52.0 N	172.0 W	—	516	—	—	—	—	—	—	—
1878	08	29		54.0 N	167.0 W	—	38	—	—	—	—	VII	463	—
1879	06	03	20 32	52.0 N	174.5 W	—	38	—	—	—	—	Felt	463	—
1880	09	29	04	55.8 N	155.6 W	—	463	—	—	—	—	VIII	463	—
1880	09	29	07	55.8 N	155.6 W	—	463	—	—	—	—	Felt	463	—
1880	09	29	13	55.8 N	155.6 W	—	463	—	—	—	—	Felt	463	—
1880	09	29	23	55.8 N	155.6 W	—	463	—	—	—	—	Felt	463	—
1880	10	26	22 20	57.0 N	136.0 W	—	463	—	—	—	—	VIII	463	—
1883	10	06	18	59.0 N	154.0 W	—	38	—	—	—	—	—	—	—
1896	05			61.0 N	146.0 W	—	38	—	—	—	—	VII	420	—
1897	01	11		60.0 N	140.0 W	—	38	—	—	—	—	V	420	—
1898	06	29	18 36	52.0 N	172.0 E	—	425	—	—	7.60M_S AB2	—	—	—	—
1898	08	01		61.0 N	150.0 W	—	420	—	—	—	—	VI	420	—
1898	08	25	08	61.0 N	146.0 W	—	38	—	—	—	—	—	—	—
1898	10	11	16 37	50.71 N	179.50 E	—	477	—	—	6.90M_S AB2	—	—	—	—
1899	04	02	03 30	55.0 N	161.0 W	—	420	—	—	—	—	V	420	—
1899	07	11		61.0 N	151.0 W	—	38	—	—	—	—	Felt	420	—
1899	07	14	13 32	60.0 N	150.0 W	—	412	—	—	7.20M_S AB2	—	—	—	—
1899	09	04	00 22	60.0 N	142.0 W	—	404	—	—	7.90M_S AB2	8.15PT	X	424	610&
1899	09	04	04 27	60.0 N	142.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	04	04 40	60.0 N	142.0 W	—	412	—	—	6.90M_S AB2	—	Felt	420	—
1899	09	04	05 26	60.0 N	142.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	10	17 04	60.0 N	140.0 W	—	404	—	—	7.40M_S AB2	—	VII	420	—
1899	09	10	20 20	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	10	20 35	60.0 N	140.0 W	—	420	—	—	—	—	—	—	—
1899	09	10	20 42	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1899	09	10	20 47	60.0 N	140.0 W	—	420	—	—	—	—	—	—	—
1899	09	10	21 41	60.0 N	140.0 W	—	404	—	—	8.00M_s AB2	8.15PT	XI	420	700&
1899	09	10	21 49	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	11	03 18	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	11	03 26	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	11	03 34	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	16	04 33	59.0 N	138.0 W	—	420	—	—	—	—	VII	420	—
1899	09	17	12 50	59.0 N	136.0 W	—	412	—	—	6.90M_s AB2	—	Felt	420	—
1899	09	23	08 13	55.0 N	161.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	23	11 04	60.0 N	143.0 W	—	412	—	—	6.90M_s AB2	—	—	—	—
1899	09	23	12 50	59.0 N	143.0 W	—	412	—	—	7.00M_s AB2	—	—	—	—
1899	09	26	12 31	60.0 N	143.0 W	—	420	—	—	—	—	Felt	420	—
1899	09	27	00 28	60.0 N	143.0 W	—	420	—	—	—	—	Felt	420	—
1899	12	14	09 30	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	12	20	10 30	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	12	20	15 30	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1899	12	21	05 15	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1900	02	16	22 10	60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1900	10	09	12 25	57.09 N	153.48 W	—	477	—	—	7.70M_s AB2	7.85PT	VIII	424	310&
1900	12	27	10 15	58.0 N	150.0 W	—	420	—	—	—	—	Felt	420	—
1901	03			65.0 N	152.0 W	—	38	—	—	—	—	Felt	420	—
1901	12	30		59.4 N	153.5 W	—	403	—	—	—	—	Felt	403	—
1901	12	30	22 34	52.0 N	160.0 W	—	426	—	—	7.00M_s AB1	—	VI	426	—
1901	12	31	09 02 30.0	51.45 N	171.02 W	—	477	—	—	7.10M_s AB2	—	—	—	—
1902	01	01	05 20 30.0	52.38 N	167.45 W	—	404	—	—	7.00M_s AB2	—	—	—	—
1903	01	17	16 05	50.85 N	175.16 W	—	477	—	—	7.00M_s AB2	—	—	—	—
1903	02	05	18 26	52.0 N	175.0 E	—	425	—	—	6.80M_s AB2	—	—	—	—
1903	03			61.0 N	146.0 W	—	38	—	—	—	—	V	420	—
1903	06	02	13 17	61.56 N	158.54 W	—	477	—	—	6.90M_s AB2	—	—	—	—
1903	06	03	03 30	61.0 N	146.0 W	—	38	—	—	—	—	Felt	38	—
1903	07	26		59.0 N	138.0 W	—	38	—	—	—	—	—	—	—
1904	08	27	21 56	64.66 N	148.08 W	—	477	—	—	7.30M_s AB2	—	VI	38	—
1905	02	14	08 46	50.73 N	178.55 W	—	477	—	—	7.30M_s AB2	—	—	—	—
1905	03	22	03 38	51.28 N	174.83 E	—	477	—	—	7.00M_s AB2	—	—	—	—
1905	09	15	06 02	52.06 N	171.45 W	—	477	—	—	7.40M_s AB2	—	—	—	—
1905	12	08		61.0 N	160.0 W	—	427	—	—	—	—	V	420	—
1905	12	10	12 36	53.88 N	161.66 W	—	477	—	—	6.90M_s AB2	—	—	—	—
1906	08	17	00 10 42	51.05 N	179.69 E	—	477	—	—	7.80M_s AB2	—	—	—	—
1906	12	23	17 22	56.85 N	153.90 W	—	477	—	—	7.30M_s AB2	—	—	—	—
1907	08	22	22 24 00	57.0 N	161.0 W	120	258	—	—	6.50m_b GR	—	Felt	420	—
1907	09	02	16 01	52.59 N	169.73 E	—	477	—	—	7.40M_s AB2	—	—	—	—
1907	09	24	12 59	59.5 N	135.5 W	—	420	—	—	—	—	V	420	—
1907	12	29		66.0 N	168.0 W	—	38	—	—	—	—	—	—	—
1908	02	14	11 25	61.0 N	146.25 W	—	38	—	—	—	—	VI	420	—
1908	05	15	08 31 36	59.0 N	141.0 W	—	258	—	—	7.00M_s AB2	—	VI	38	—
1909	02	16	16 50	60.0 N	140.0 W	—	420	—	—	—	—	VI	420	—
1909	04	10	19 36	52.0 N	175.0 E	—	412	—	—	7.00M_s AB2	—	—	—	—
1909	05	06		59.5 N	139.5 W	—	38	—	—	—	—	V	420	—
1909	09	08	16 49 48	52.5 N	169.0 W	090	258	—	—	7.40m_b GR	—	V	420	—
1910	05	13	07 58 06	57.0 N	160.0 W	100	258	—	—	6.75m_b GR	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km²)
1910	08	05		60.0 N	160.0 W	—	420	—	—	—	—	V	420	—
1910	09	01		54.0 N	168.0 W	—	420	—	—	—	—	Felt	420	—
1910	09	09	01 13 18	50.75 N	179.38 E	—	477	—	—	7.00M_S AB2	—	V	38	—
1911	09			60.0 N	140.0 W	—	420	—	—	—	—	Felt	420	—
1911	09	17	03 26	51.0 N	180.0 E	—	412	—	—	7.10M_S AB2	—	—	—	—
1911	09	22	05 01 24	60.5 N	149.0 W	060	258	—	—	6.90M_S GR	—	VIII	38	310&
1911	11	13	16 13 12	52.0 N	173.0 E	—	428	—	—	6.90M_S AB2	—	—	—	—
1912	01	04	15 46 54	52.0 N	179.0 W	—	258	—	—	6.70M_S ABE	—	—	—	—
1912	01	31	20 11 48	61.0 N	147.5 W	080	258	—	—	7.00m_b ABE	—	Felt	420	388&
1912	06	04		57.0 N	156.0 W	—	427	—	—	—	—	Felt	437	—
1912	06	05		57.0 N	156.0 W	—	437	—	—	—	—	Felt	437	—
1912	06	07	09 55 54	59.0 N	153.0 W	—	258	—	—	6.40M_S GR	—	Felt	437	—
1912	06	10	16 06 06	59.0 N	153.0 W	—	258	—	—	6.90M_S AB2	—	—	—	—
1912	07	07	07 57	63.07 N	146.14 W	—	477	—	—	7.20M_S AB2	—	Felt	437	518
1912	08	17		58.5 N	157.0 W	—	38	—	—	—	—	V	38	—
1912	11	07	07 40 24	57.5 N	155.0 W	090	258	—	—	7.30m_b ABE	—	Felt	38	—
1912	12	05	12 27 36	57.5 N	154.0 W	090	258	—	—	6.90m_b ABE	—	—	—	—
1913	03	31	03 41 06	51.0 N	179.0 W	060	258	—	—	6.90M_S GR	—	—	—	—
1913	04	29	23 30	50.0 N	171.0 E	—	265	—	—	—	—	—	—	—
1913	04	30	11 35	50.0 N	174.0 W	—	265	—	—	—	—	—	—	—
1913	06	22	13 49 52	48.0 N	178.0 W	—	265	—	—	7.20Ukn DDA	—	—	—	—
1914	01	30	03 42 32	50.0 N	170.0 W	—	265	—	—	— —	—	—	—	
1914	07	17	07 06 25	47.5 N	174.0 W	—	265	—	—	— —	—	—	—	
1915	04	03	20 29 36	48.5 N	171.5 W	—	265	—	—	— —	—	—	—	
1915	08	16	00 56 22	48.5 N	179.0 W	—	265	—	—	— —	—	—	—	
1916	02	06	21 51 19	48.5 N	178.5 E	—	265	—	—	7.70Ukn DDA	—	—	—	—
1916	02	15	11 35 52	61.5 N	145.0 W	—	265	—	—	— —	—	—	—	
1916	02	20	17 47 35	51.0 N	169.0 W	—	265	—	—	— —	—	—	—	
1916	04	18	04 01 48	53.25 N	170.0 W	170	258	—	—	7.40m_b ABE	—	—	—	—
1916	12	14	16 52 16	49.0 N	174.0 E	—	265	—	—	—	—	—	—	—
1917	05	31	08 47	54.79 N	159.12 W	—	477	—	—	7.90M_S AB1	—	V	272	—
1917	06	04	01 29 18	53.5 N	159.0 W	—	265	—	—	—	—	—	—	—
1917	06	07	02 47 43	54.5 N	160.0 W	—	265	—	—	—	—	—	—	—
1917	07	25	03 19 00	53.5 N	159.0 W	—	265	—	—	—	—	—	—	—
1917	07	25	22 32 43	53.5 N	159.0 W	—	265	—	—	—	—	—	—	—
1917	12	21	17 54 16	53.5 N	152.0 W	—	265	—	—	—	—	—	—	—
1917	12	28	21 14 30	55.5 N	152.0 W	—	265	—	—	—	—	—	—	—
1918	04	15	08 27 40	59.2 N	151.0 W	—	265	—	—	—	—	—	—	—
1918	09	30	13 34 20	51.0 N	179.5 W	—	265	—	—	—	—	—	—	—
1918	12	09	18 03 45	52.0 N	178.0 W	—	265	—	—	—	—	—	—	—
1919	05	22	11 52 36	52.0 N	178.0 W	—	265	—	—	—	—	—	—	—
1919	12	15	01 10	57.5 N	137.0 W	—	272	—	—	—	—	VI	272	—
1920	08	26	22 59 54	52.5 N	170.0 W	—	265	—	—	—	—	—	—	—
1920	10	28	07 23 40	51.0 N	179.5 W	—	265	—	—	—	—	—	—	—
1920	11	29	08 02 30	60.5 N	147.0 W	—	272	—	—	—	—	—	—	—
1922	04	02	19 17 42	53.3 N	164.5 W	—	265	—	—	—	—	—	—	—
1922	07	02	13 35 48	54.0 N	160.5 W	—	265	—	—	—	—	—	—	—
1923	04	25	19 31 53	59.0 N	138.0 W	—	258	—	—	5.75M_S GR	—	Felt	272	—
1923	05	04	16 26 39.3	55.55 N	156.75 W	000	432	—	—	7.10M_S GR	—	—	—	—
1923	06	19	22 43 30	61.8 N	151.0 W	—	265	—	—	—	—	Felt	434	—
1923	07	17	01 02 11	63.0 N	147.0 W	—	258	—	—	5.60M_S GR	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	Felt area
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1923	07	22	14 17 54	51.6 N	172.0 E	—	265	—	—	—	—	—	—	—
1923	11	17	02 53 20	51.0 N	179.5 W	160	265	—	—	—	—	—	—	—
1924	01	07	09 55 42	55.0 N	160.0 W	—	265	—	—	—	—	—	—	—
1924	08	13	13 30 19	52.0 N	178.0 W	—	265	—	—	—	—	—	—	—
1924	08	21	18 50 45	51.0 N	179.5 W	—	265	—	—	—	—	—	—	—
1924	09	14	13 12 52	50.1 N	178.7 E	—	265	—	—	—	—	—	—	—
1925	01	30	17 28 20	52.8 N	174.0 E	096	265	—	—	—	—	—	—	—
1925	02	23	23 53 36	60.0 N	146.0 W	—	265	—	—	—	—	VII	38	—
1925	08	19	05 24 50	52.5 N	170.0 W	—	265	—	—	—	—	—	—	—
1925	09	05	16 30 17.5	54.68 N	170.63 E	—	432	—	—	—	—	—	—	—
1926	07	14	22 22 25	66.0 N	163.0 W	—	258	—	—	5.60M_s GR	—	—	—	—
1926	08	09	03 39 22	52.0 N	176.0 W	—	265	—	—	—	—	—	—	—
1926	10	13	06 02 20.1	51.35 N	179.64 W	—	432	—	—	—	—	—	—	—
1926	10	13	14 17 46.4	54.54 N	179.91 E	—	432	—	—	—	—	—	—	—
1926	10	13	19 08 10.3	51.63 N	175.65 W	000	432	—	—	7.00M_s ABE	—	—	—	—
1927	03	25	12 54 50	54.5 N	156.5 W	—	265	—	—	—	—	Felt	218	—
1927	04	16	08 14 51	51.0 N	179.5 W	—	265	—	—	—	—	—	—	—
1927	07	28	16 17 40	54.7 N	157.8 W	—	265	—	—	—	—	Felt	435	—
1927	08	01	17 05 55	51.0 N	179.5 W	—	265	—	—	—	—	—	—	—
1927	08	01	18 46 18	51.0 N	179.5 W	—	265	—	—	—	—	—	—	—
1927	08	06	00 13 52	54.5 N	156.5 W	—	265	—	—	—	—	—	—	—
1927	10	24	15 59 44.8	57.69 N	136.07 W	000	432	—	—	7.10M_s ABE	—	VII	218	—
1928	05	16	05 13 06	49.3 N	179.3 W	—	265	—	—	—	—	Felt	1	—
1928	06	21	16 27 13	60.0 N	146.5 W	—	258	—	—	6.80M_s AB1	—	VI	1	—
1929	01	21	10 30 53	64.0 N	148.0 W	—	258	—	—	6.25M_s GR	—	VI	2	—
1929	03	07	01 34 37.9	50.88 N	169.71 W	000	432	—	—	7.50M_s ABE	7.83KAN	Felt	2	—
1929	03	07	05 45 09.0	50.81 N	169.95 W	000	432	—	—	—	—	—	—	—
1929	03	10	22 46 57.7	51.93 N	168.86 W	000	432	—	—	—	—	—	—	—
1929	05	20	04 52 56.3	52.17 N	175.52 W	000	432	—	—	—	—	—	—	—
1929	06	26	06 29 18	50.2 N	174.7 E	—	265	—	—	—	—	—	—	—
1929	07	03	00 53 00	62.5 N	149.0 W	—	258	—	—	6.25M_s GR	—	—	—	—
1929	07	04	04 28 35	64.0 N	148.0 W	—	258	—	—	6.50M_s GR	—	—	—	—
1929	07	05	14 19 01.9	51.42 N	178.34 W	000	432	—	—	7.00M_s ABE	—	—	—	—
1929	07	05	14 35 05	51.0 N	179.5 W	—	265	—	—	—	—	—	—	—
1929	07	05	22 36 17.8	52.12 N	177.86 W	000	432	—	—	—	—	—	—	—
1929	07	06	02 03 49.0	51.45 N	177.32 W	000	432	—	—	—	—	—	—	—
1929	07	07	21 23 10.2	51.60 N	177.87 W	000	432	—	—	7.30M_s ABE	—	—	—	—
1929	07	11	20 57 02.2	51.88 N	178.19 W	000	432	—	—	—	—	—	—	—
1929	07	12	15 54 33	62.8 N	151.0 W	—	265	—	—	—	—	—	—	—
1929	07	17	08 38 02.3	51.22 N	178.82 W	000	432	—	—	—	—	—	—	—
1929	10	14	10 09 48	53.2 N	162.6 W	—	265	—	—	—	—	—	—	—
1929	11	09	01 40 15	50.0 N	174.0 W	—	265	—	—	—	—	—	—	—
1929	12	17	10 58 36.9	53.67 N	171.46 E	000	432	—	—	7.80M_s ABE	—	—	—	—
1929	12	17	12 12 00.5	52.01 N	173.47 E	—	432	—	—	—	—	—	—	—
1930	02	02	14 55 55.4	51.17 N	179.75 E	—	432	—	—	—	—	—	—	—
1930	04	26	16 18 18	51.7 N	179.3 E	—	265	—	—	—	—	—	—	—
1930	05	20	11 15 03	51.7 N	179.3 E	—	265	—	—	—	—	—	—	—
1930	06	13	00 53 56	50.5 N	170.2 W	—	265	—	—	—	—	—	—	—
1930	10	25	12 03 18	61.7 N	154.2 W	—	265	—	—	—	—	Felt	3	—
1930	12	06	07 03 28	53.0 N	172.0 W	080	258	—	—	6.50M_s GR	—	—	—	—
1931	01	27	14 29 03	60.75 N	149.0 W	—	258	—	—	5.60M_s GR	—	—	—	—
1931	03	29	17 24 58	51.0 N	170.0 W	—	258	—	—	6.00M_s GR	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1931	05	29	05 16 32	63.0 N	149.0 W	—	258	—	—	$5.60M_s$ GR	—	IV	4	—
1931	05	30	11 34 16	52.2 N	173.3 E	—	265	—	—	6.00Ukn PAS	—	VI	38	—
1931	08	14	16 12 03	52.5 N	168.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1931	10	17	12 34 50	63.0 N	147.0 W	—	258	—	—	$5.60M_s$ GR	—	V	38	—
1931	12	24	03 40 40	60.0 N	152.0 W	100	258	—	—	$6.25M_s$ GR	—	IV	4	—
1932	01	13	16 17 27	52.0 N	179.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1932	03	08	04 29 30	51.5 N	178.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1932	03	25	23 54 51	62.5 N	153.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1932	03	25	23 58 31	62.5 N	152.5 W	—	258	—	—	$6.90M_s$ GR	—	VII	38	—
1932	04	29	18 18 23	51.5 N	178.0 W	—	258	—	—	$6.25M_s$ GR	—	—	—	—
1932	06	08	07 52 47	62.5 N	153.3 W	—	265	—	—	$6.00M_s$ PAS	—	III	5	—
1932	08	12	03 23 57	52.25 N	169.0 W	—	258	—	—	$6.75M_s$ GR	—	—	—	—
1932	09	14	08 43 23	61.0 N	148.0 W	050	258	—	—	$6.25M_s$ GR	—	V	5	—
1932	10	16	12 08 01	54.25 N	160.0 W	050	258	—	—	$6.75M_s$ GR	—	—	—	—
1932	10	30	20 46 56	55.0 N	159.75 W	—	258	—	—	$6.75M_s$ GR	—	—	—	—
1933	01	04	03 59 28	61.0 N	148.0 W	—	258	—	—	$6.25M_s$ PAS	—	VI	38	—
1933	03	28	04 20 26	58.25 N	149.0 W	—	258	—	—	$5.60M_s$ GR	—	III	6	—
1933	04	27	02 36 04	61.25 N	150.75 W	—	258	—	—	$6.90M_s$ ABE	—	VII	38	—
1933	04	27	11 55 38	52.5 N	167.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1933	05	01	18 49 47	51.75 N	173.0 W	—	258	—	—	$6.50M_s$ GR	—	—	—	—
1933	06	12	15 23 38	61.5 N	150.5 W	—	258	—	—	$5.60M_s$ GR	—	Felt	6	—
1933	06	13	22 19 47	61.0 N	151.0 W	—	258	—	—	$6.25M_s$ GR	—	IV	6	—
1933	06	19	18 47 43	61.25 N	150.5 W	—	258	—	—	$6.00M_s$ GR	—	Felt	6	—
1933	06	28	23 34 58	53.5 N	165.0 W	—	258	—	—	$6.00M_s$ GR	—	Felt	6	—
1933	07	19	10 45 29	51.75 N	174.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1933	07	19	10 55 53	51.75 N	174.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1933	07	19	13 32 21	51.75 N	174.0 W	—	258	—	—	$6.25M_s$ GR	—	—	—	—
1933	07	19	14 59 52	51.75 N	174.0 W	—	258	—	—	$6.25M_s$ GR	—	—	—	—
1933	07	22	20 55 13	53.0 N	169.5 W	—	258	—	—	$6.75M_s$ GR	—	—	—	—
1933	07	26	04 57 26	63.0 N	147.0 W	—	258	—	—	$5.60M_s$ GR	—	—	—	—
1933	07	28	11 48 08	52.6 N	168.7 W	—	265	—	—	—	—	V	6	—
1933	09	24	15 19 41	51.75 N	177.0 W	070	258	—	—	$6.75M_s$ GR	—	—	—	—
1933	10	14	22 19 01	53.75 N	164.0 W	—	258	—	—	$6.25M_s$ GR	—	—	—	—
1933	11	02	12 26 54	52.0 N	176.0 W	—	258	—	—	$6.50M_s$ GR	—	—	—	—
1934	01	11	10 21 55	50.5 N	177.5 W	—	265	—	—	—	—	—	—	—
1934	05	04	04 36 07	61.25 N	147.5 W	080	258	—	—	$7.10m_b$ ABE	—	VI	7	—
1934	05	14	22 12 46	57.75 N	152.25 W	060	258	—	—	$6.50M_s$ GR	—	VI	7	—
1934	06	02	16 45 29	61.25 N	147.0 W	—	258	—	—	$6.25M_s$ GR	—	IV	7	—
1934	06	18	09 13 50	60.50 N	151.0 W	080	258	—	—	$6.75M_s$ GR	—	V	7	—
1934	07	20	02 10 44	52.0 N	173.0 W	—	258	—	—	$6.00M_s$ GR	—	—	—	—
1934	07	28	21 36 57	55.5 N	156.75 W	—	258	—	—	$6.75M_s$ GR	—	—	—	—
1934	08	02	07 13 08	61.5 N	147.5 W	—	258	—	—	$6.00M_s$ GR	—	V	7	—
1934	11	05	23 02 20	52.0 N	175.0 W	—	258	—	—	$6.50M_s$ GR	—	—	—	—
1935	01	23	07 24 00	52.25 N	169.5 W	—	258	—	—	$6.75M_s$ GR	—	Felt	8	—
1935	02	22	17 05 54	52.25 N	175.0 E	—	258	—	—	$7.10M_s$ ABE	—	—	—	—
1935	09	04	01 27 39	63.75 N	152.5 W	—	258	—	—	$6.25M_s$ GR	—	III	8	—
1936	01	18	01 20 00	62.0 N	152.0 W	—	258	—	—	$5.60M_s$ GR	—	—	—	—
1936	03	10	12 05 08	51.8 N	171.0 W	—	265	—	—	—	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1936	04	23	23 14 21	50.25 N	179.0 E	—	258	—	—	6.25M_s GR	—	—	—	—
1936	05	08	17 22 18	61.0 N	153.0 W	170	258	—	—	5.75m_b GR	—	II	9	—
1936	10	23	06 24 25	61.3 N	150.7 W	—	265	—	—	—	—	VI	9	—
1937	04	29	18 52 40	54.3 N	161.5 W	—	265	—	—	—	—	—	—	—
1937	05	04	05 08 41	59.2 N	153.8 W	—	265	—	—	—	—	—	—	—
1937	07	18	01 01 15	54.0 N	166.5 W	070	258	—	—	6.25M_s GR	—	—	—	—
1937	07	22	17 09 28.0	64.6 N	147.1 W	—	265	—	—	7.30M_s ABE	—	VIII	10	640
1937	07	25	13 13 01	60.2 N	148.9 W	—	265	—	—	—	—	—	—	—
1937	09	03	18 48 12	52.5 N	177.5 W	080	258	—	—	7.20m_b ABE	—	Felt	10	—
1937	10	24	11 35 57	60.0 N	150.5 W	—	265	—	—	—	—	V	38	—
1938	07	24	13 12 13	53.5 N	167.0 W	050	258	—	—	6.25M_s GR	—	—	—	—
1938	11	10	20 18 41.2	55.48 N	158.37 W	000	432	—	—	8.30M_s ABE	8.25KAN	VI	11	—
1938	11	11	00 57 41.1	55.07 N	158.84 W	000	432	—	—	—	—	—	—	—
1938	11	11	08 30 50.9	55.98 N	154.72 W	000	432	—	—	—	—	—	—	—
1938	11	15	09 52 01.8	54.97 N	160.91 W	057	432	—	—	—	—	—	—	—
1938	11	16	05 36 09.0	55.02 N	156.83 W	000	432	—	—	—	—	—	—	—
1938	11	17	03 54 34.0	55.45 N	157.55 W	000	432	—	—	7.30M_s ABE	—	—	—	—
1938	11	18	23 24 50.4	56.10 N	155.95 W	000	432	—	—	—	—	—	—	—
1938	12	09	03 55 24.4	57.74 N	153.03 W	000	432	—	—	—	—	—	—	—
1938	12	23	18 14 44.5	55.86 N	157.28 W	000	432	—	—	—	—	—	—	—
1938	12	30	12 10 48	59.0 N	153.0 W	100	258	—	—	5.50m_b GR	—	—	—	—
1939	02	24	14 15 55.7	54.05 N	162.01 W	079	432	—	—	6.25M_s GR	—	V	38	—
1939	05	09	07 28 28.0	56.24 N	155.17 W	026	432	—	—	—	—	—	—	—
1939	05	10	07 44 16	51.7 N	178.5 W	—	265	—	—	—	—	—	—	—
1939	07	02	19 42 52	51.7 N	178.5 W	—	265	—	—	—	—	—	—	—
1939	08	20	07 17 26	54.0 N	164.0 W	075	258	—	—	6.25M_s GR	—	V	38	—
1939	08	21	15 19 03	51.5 N	177.0 E	—	258	—	—	6.00M_s GR	—	—	—	—
1939	09	11	07 53 26	53.4 N	168.7 W	—	265	—	—	—	—	—	—	—
1939	09	15	21 48 58	51.3 N	175.1 E	—	265	—	—	—	—	—	—	—
1939	12	07	11 16 19	51.7 N	178.5 W	—	265	—	—	—	—	—	—	—
1940	02	07	17 16 02	51.5 N	175.0 E	070	258	—	—	6.90m_b ABE	—	—	—	—
1940	02	12	09 17 46	55.0 N	161.5 W	—	258	—	—	6.75M_s GR	—	V	38	—
1940	04	16	06 07 47.6	52.30 N	173.56 E	000	432	—	—	6.80M_s ABE	—	—	—	—
1940	04	16	06 43 02.4	52.69 N	173.25 E	000	432	—	—	7.10M_s ABE	—	—	—	—
1940	04	19	00 06 45	52.4 N	173.5 E	—	265	—	—	— —	—	—	—	
1940	05	04	07 24 03.4	52.25 N	172.94 W	000	432	—	—	— —	—	—	—	
1940	05	11	13 54 37.1	52.15 N	173.30 W	000	432	—	—	— —	—	—	—	
1940	05	23	06 01 24.4	51.21 N	173.31 E	000	432	—	—	—	—	—	—	—
1940	06	18	18 38 59.6	52.52 N	173.26 E	000	432	—	—	—	—	—	—	—
1940	07	14	05 52 53.5	52.0 N	178.2 E	065	265	—	—	7.40m_b ABE	—	—	—	—
1940	07	15	23 56 14	52.0 N	178.0 E	065	265	—	—	5.75M_s GR	—	—	—	—
1940	07	19	04 47 28	52.29 N	174.01 E	000	432	—	—	—	—	—	—	—
1940	07	19	16 27	61.0 N	150.0 W	—	38	—	—	—	—	VI	13	—
1940	08	22	03 27 18	53.0 N	165.5 W	—	258	—	—	7.00M_s ABE	—	V	13	—
1940	09	08	10 15 08	53.3 N	170.5 E	—	265	—	—	—	—	—	—	—
1940	10	11	07 53 09	60.0 N	150.5 W	—	265	—	—	6.00M_s GR	—	IV	13	—
1940	11	16	02 27 07.7	52.14 N	174.28 E	065	432	—	—	—	—	—	—	—
1941	04	01	10 40 59	56.0 N	153.5 W	—	258	—	—	6.50M_s GR	—	—	—	—
1941	04	21	02 54 04	53.6 N	166.6 W	—	265	—	—	—	—	—	—	—
1941	04	21	18 32 05	53.6 N	166.6 W	—	265	—	—	—	—	Felt	14	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1941	07	30	01 51 21	61.0 N	151.0 W	—	258	—	—	6.25M_S GR	—	VI	38	—
1941	08	04	10 53 12.4	51.44 N	178.59 E	090	260	—	—	6.75M_S GR	—	—	—	—
1941	08	06	06 15 06	55.75 N	163.0 W	150	258	—	—	6.75m_b GR	—	—	—	—
1941	09	28	05 34 12	56.5 N	157.5 W	100	258	—	—	6.50m_b GR	—	—	—	—
1941	11	06	12 29 46	54.0 N	161.5 W	—	258	—	—	6.00M_S GR	—	—	—	—
1942	03	20	01 12 59	52.8 N	168.2 W	—	265	—	—	— —	—	—	—	
1942	09	02	03 17 17	53.4 N	168.7 W	—	265	—	—	— —	—	—	—	
1942	09	04	17 46 16	53.4 N	168.7 W	—	265	—	—	—	—	—	—	—
1942	09	09	01 25 17	53.5 N	165.9 W	080	265	—	—	6.90m_b ABE	—	—	—	—
1942	12	05	14 28 40	59.5 N	152.0 W	100	258	—	—	6.50m_b GR	—	—	—	—
1942	12	09	22 18 59	53.6 N	166.6 W	—	265	—	—	—	—	—	—	—
1943	01	27	02 45 12	51.4 N	179.2 W	—	265	—	—	—	—	—	—	—
1943	06	28	15 05 21	51.7 N	178.5 W	—	265	—	—	—	—	—	—	—
1943	07	09	23 28 29	52.0 N	166.9 W	—	265	—	—	—	—	—	—	—
1943	11	03	14 32 17.5	61.90 N	150.84 W	000	432	—	—	7.40M_S ABE	—	V	38	—
1944	07	27	00 04 23	54.0 N	165.5 W	070	258	—	—	7.10m_b ABE	—	—	—	—
1944	08	14	11 07 23	59.0 N	155.0 W	100	258	—	—	6.25m_b GR	—	—	—	—
1944	12	12	04 17 10	51.5 N	179.5 E	—	258	—	—	6.90M_S ABE	—	—	—	—
1945	03	18	18 54 41	55.0 N	156.5 W	—	265	—	—	—	—	—	—	—
1945	06	01	15 13 40	53.4 N	168.7 W	080	265	—	—	—	—	—	—	—
1945	07	11	00 30 34	59.2 N	152.4 W	—	265	—	—	—	—	—	—	—
1945	11	03	22 09 03	58.5 N	151.0 W	050	258	—	—	6.75M_S GR	—	—	—	—
1945	11	16	18 02 22	58.0 N	136.5 W	—	258	—	—	5.60M_S GR	—	IV	18	—
1945	12	25	01 25 45	52.2 N	173.9 E	—	265	—	—	—	—	—	—	—
1946	01	12	20 25 40.2	59.11 N	148.94 W	056	432	—	—	6.70M_S ABE	—	IV	19	—
1946	02	04	03 44 48	53.0 N	176.0 W	160	258	—	—	6.75m_b GR	—	—	—	—
1946	04	01	12 28 56.0	53.32 N	163.19 W	000	432	—	—	7.30M_S ABE	—	VI	38	—
1946	04	01	12 52 43.0	54.08 N	162.61 W	000	432	—	—	—	—	—	—	—
1946	04	01	12 55 47.0	54.17 N	163.22 W	000	432	—	—	—	—	—	—	—
1946	04	01	13 28 50	53.4 N	163.1 W	—	265	—	—	—	—	—	—	—
1946	04	01	15 20 22	53.4 N	163.1 W	—	265	—	—	—	—	—	—	—
1946	04	01	15 50 34	53.4 N	163.1 W	—	265	—	—	—	—	—	—	—
1946	04	01	16 59 14.0	53.88 N	163.48 W	000	432	—	—	—	—	—	—	—
1946	04	01	18 57 35.4	53.95 N	163.50 W	000	432	—	—	—	—	—	—	—
1946	04	02	04 13 38.1	53.63 N	163.73 W	000	432	—	—	—	—	—	—	—
1946	04	02	05 38 15.7	53.98 N	162.69 W	000	432	—	—	—	—	—	—	—
1946	04	02	05 57 12.4	54.12 N	162.06 W	000	432	—	—	—	—	—	—	—
1946	04	02	14 27 27.4	53.96 N	163.18 W	000	432	—	—	—	—	—	—	—
1946	04	02	16 30 25.2	53.96 N	163.59 W	000	432	—	—	—	—	—	—	—
1946	04	03	08 58 33.3	53.85 N	163.42 W	000	432	—	—	—	—	—	—	—
1946	04	04	16 31 07.7	53.56 N	163.15 W	000	432	—	—	—	—	—	—	—
1946	04	04	21 25 41.8	53.93 N	163.19 W	000	432	—	—	—	—	—	—	—
1946	04	06	04 52 34.1	53.42 N	163.59 W	000	432	—	—	—	—	—	—	—
1946	06	03	13 44 08	52.1 N	171.2 W	—	265	—	—	—	—	—	—	—
1946	07	12	21 56 27	53.5 N	169.0 W	100	258	—	—	6.75m_b GR	—	—	—	—
1946	07	25	16 42 07	51.4 N	179.2 W	—	265	—	—	—	—	—	—	—
1946	08	02	01 37 56	53.4 N	163.1 W	—	265	—	—	—	—	—	—	—
1946	08	07	19 31 29	51.5 N	173.5 W	—	265	—	—	—	—	—	—	—
1946	10	30	07 47 34	54.25 N	164.0 W	—	258	—	—	6.90M_S GR	—	—	—	—
1946	11	01	11 14 24	51.5 N	174.5 W	040	258	—	—	7.00M_S GR	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr Mo Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Hypocenter Longitude (°)	Hypocenter Depth (km)	Hypocenter Ref	Magnitude USGS m_b	Magnitude USGS M_S	Magnitude Other	Magnitude Moment M	Intensity MM	Intensity Ref	Felt area (1,000 km²)
1946 11 12	05 56 20	53.6 N	164.4 W	—	265	—	—	—	—	—	—	—
1946 12 25	11 13 10	51.5 N	180.0 E	090	258	—	—	6.50m_b GR	—	—	—	—
1947 01 23	15 57 40	53.3 N	162.5 W	—	265	—	—	—	—	—	—	—
1947 07 28	03 48 52	63.4 N	147.9 W	—	265	—	—	—	—	IV	20	—
1947 10 07	01 53 21	64.2 N	148.3 W	—	265	—	—	—	—	—	—	—
1947 10 15	19 34 37	64.2 N	148.3 W	—	265	—	—	—	—	—	—	—
1947 10 16	02 09 52.5	64.28 N	148.23 W	066	260	—	—	7.20M_s ABE	—	VIII	20	—
1947 10 20	01 43 16	64.2 N	148.3 W	—	265	—	—	—	—	—	—	—
1948 01 16	11 08 38.2	52.09 N	174.73 E	033	260	—	—	6.70Ukn PAS	—	—	—	—
1948 02 11	15 41 56	63.8 N	145.4 W	—	265	—	—	—	—	IV	21	—
1948 05 14	22 31 43.4	54.71 N	160.88 W	000	432	—	—	7.50M_s ABE	—	—	—	—
1948 05 15	02 41 50.7	54.81 N	161.61 W	048	432	—	—	—	—	—	—	—
1948 05 17	17 48 38.6	55.08 N	160.99 W	044	432	—	—	—	—	—	—	—
1948 05 26	09 16 53	56.3 N	153.8 W	—	265	—	—	6.00Ukn PAS	—	—	—	—
1948 08 19	13 50 46	63.0 N	150.5 W	100	258	—	—	6.25m_b GR	—	V	21	—
1948 09 19	06 14 04	51.6 N	177.8 W	—	265	—	—	—	—	—	—	—
1948 12 12	13 17 18	51.6 N	177.2 E	—	265	—	—	6.63Ukn PAS	—	—	—	—
1949 02 02	17 41 29	53.0 N	173.0 W	220	258	—	—	6.80m_b ABE	—	—	—	—
1949 06 15	01 47 17	51.4 N	179.2 W	—	265	—	—	—	—	—	—	—
1949 08 25	04 14 21	52.2 N	179.3 W	—	265	—	—	6.75Ukn PAS	—	—	—	—
1949 09 27	15 30 45	59.75 N	149.0 W	050	258	—	—	6.70M_s ABE	—	V	38	—
1949 10 31	01 39 29.5	56.05 N	135.69 W	—	448	—	—	6.25M_s GR	—	—	—	—
1950 03 27	13 04 02	53.3 N	172.2 E	—	265	—	—	6.70Ukn PAS	—	—	—	—
1950 04 04	02 21 07	51.5 N	173.5 W	—	265	—	—	—	—	—	—	—
1950 04 04	02 24 45	51.5 N	173.5 W	—	265	—	—	—	—	—	—	—
1950 04 05	01 17 13	52.1 N	177.5 W	—	265	—	—	—	—	—	—	—
1950 05 25	08 34 37	65.5 N	151.5 W	—	265	—	—	6.00Ukn PAS	—	—	—	—
1950 07 12	11 09 10	52.5 N	167.5 W	—	265	—	—	6.25Ukn PAS	—	—	—	—
1950 07 19	10 51 57	51.5 N	179.5 E	—	265	—	—	—	—	—	—	—
1950 08 26	04 39 27	65.0 N	162.0 W	—	266	—	—	6.50Ukn PAS	—	IV	23	—
1950 09 02	02 47 13	52.5 N	170.0 W	—	265	—	—	6.40Ukn PAS	—	—	—	—
1950 09 16	21 58 15	52.0 N	177.0 E	100	266	—	—	6.60Ukn PAS	—	—	—	—
1950 11 22	10 16 28	51.5 N	176.5 W	060	266	—	—	6.75Ukn PAS	—	Felt	24	—
1951 01 18	21 15 45	52.1 N	177.5 W	—	265	—	—	6.38Ukn PAS	—	—	—	—
1951 02 12	03 31 40	51.9 N	179.4 E	—	265	—	—	—	—	—	—	—
1951 02 13	22 12 53.8	55.55 N	156.35 W	000	432	—	—	7.10M_s ABE	—	—	—	—
1951 03 31	09 20 34	60.4 N	153.6 W	223	265	—	—	—	—	—	—	—
1951 05 10	19 44 47	51.5 N	179.5 E	—	265	—	—	—	—	—	—	—
1951 06 01	20 02 13	53.1 N	172.5 W	065	265	—	—	—	—	—	—	—
1951 06 25	16 12 37	61.1 N	150.1 W	128	265	—	—	6.25Ukn PAS	—	V	24	—
1951 07 19	20 41 28	51.6 N	177.8 W	065	265	—	—	5.88Ukn PAS	—	Felt	294	—
1951 10 01	10 11 50	55.0 N	164.0 W	—	265	—	—	—	—	—	—	—
1951 11 08	13 45 07.3	54.33 N	160.69 W	033	260	—	—	6.25Ukn PAS	—	—	—	—
1951 12 30	17 42 14	62.0 N	148.8 W	—	265	—	—	—	—	IV	24	—
1952 01 12	20 11 37	52.5 N	167.5 W	—	265	—	—	6.50Ukn PAS	—	—	—	—
1952 01 19	07 15 31	52.5 N	167.5 W	—	265	—	—	—	—	—	—	—
1952 01 21	03 42 55	52.5 N	167.5 W	—	265	—	—	6.75Ukn PAS	—	—	—	—
1952 01 24	09 14 04	52.5 N	167.5 W	—	265	—	—	—	—	—	—	—
1952 02 02	10 20 07	51.4 N	179.2 W	096	265	—	—	—	—	Felt	25	—
1952 03 22	18 15 42	51.5 N	173.5 W	—	265	—	—	6.38Ukn PAS	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MM	Ref	(1,000 km²)
1952	05	01	15 04 14	51.3 N	175.1 E	—	265	—	—	—	—	—	—	—
1952	06	14	02 05 38	59.2 N	152.4 W	065	265	—	—	—	—	Felt	25	—
1952	07	07	02 52 59	54.2 N	164.5 W	—	265	—	—	6.25Ukn PAS	—	—	—	—
1952	07	29	19 54 28	53.0 N	175.0 W	—	265	—	—	—	—	Felt	25	—
1952	08	27	11 27 50	55.6 N	160.4 W	033	265	—	—	—	—	—	—	—
1952	08	28	10 52 42	55.6 N	160.4 W	033	265	—	—	—	—	—	—	—
1952	09	07	04 30 14	51.5 N	173.5 W	033	265	—	—	—	—	—	—	—
1952	09	24	20 29 24	56.3 N	158.6 W	096	265	—	—	—	—	—	—	—
1952	11	15	05 01 12	52.5 N	171.3 W	—	265	—	—	—	—	—	—	—
1952	11	29	23 46 27	56.3 N	153.8 W	—	265	—	—	6.75Ukn PAS	—	Felt	25	—
1952	12	04	03 51 40	52.0 N	178.2 E	128	265	—	—	6.00Ukn BRK	—	—	—	—
1952	12	07	00 50 17	52.5 N	174.2 E	—	265	—	—	6.25Ukn PAS	—	VI	38	—
1952	12	12	00 47 55	56.3 N	153.8 W	—	265	—	—	—	—	—	—	—
1952	12	28	04 55 07	65.8 N	167.8 W	—	265	—	—	—	—	IV	25	—
1953	01	05	07 48 21.6	53.32 N	171.04 E	000	432	—	—	7.10M_S ABE	—	Felt	26	—
1953	02	09	21 32 37	52.6 N	169.4 W	—	265	—	—	—	—	—	—	—
1953	02	10	10 07 58	52.6 N	169.4 W	—	265	—	—	—	—	—	—	—
1953	02	25	21 16 12	56.0 N	156.2 W	—	265	—	—	6.75Ukn PAS	—	—	—	—
1953	03	23	12 36 13	52.6 N	169.4 W	—	265	—	—	—	—	—	—	—
1953	03	25	05 51 21	52.6 N	169.4 W	—	265	—	—	—	—	—	—	—
1953	04	19	22 47 39	50.5 N	179.0 W	—	26	—	—	5.50M_R ROT	—	Felt	26	—
1953	05	12	12 39 06	52.3 N	177.3 W	096	265	—	—	—	—	V	26	—
1953	05	13	04 16 29	52.5 N	174.2 E	065	265	—	—	5.50M_R ROT	—	—	—	—
1953	06	15	17 47 14	56.3 N	153.8 W	—	265	—	—	6.50Ukn PAS	—	—	—	—
1953	06	16	19 48 25	55.6 N	160.4 W	033	265	—	—	6.20Ukn PAS	—	—	—	—
1954	03	03	20 46 08.2	61.54 N	146.78 W	056	447	—	—	6.25Ukn KIR	—	V	27	—
1954	03	28	17 10 40	52.8 N	168.2 W	—	265	—	—	—	—	—	—	—
1954	03	28	20 36 21	51.6 N	175.8 E	—	265	—	—	6.50Ukn BRK	—	—	—	—
1954	03	28	20 58 10	51.6 N	175.8 E	065	265	—	—	5.50M_R ROT	—	—	—	—
1954	04	17	20 10 37	51.5 N	179.0 W	—	265	—	—	6.75Ukn BRK	—	Felt	27	—
1954	04	24	08 33 04.1	62.99 N	148.54 W	090	447	—	—	—	—	III	27	—
1954	04	28	04 50 52	51.6 N	175.8 E	—	265	—	—	—	—	—	—	—
1954	06	17	01 42 23.2	56.29 N	154.09 W	000	447	—	—	6.50Ukn PAS	—	—	—	—
1954	08	05	08 49 53	51.7 N	175.8 E	065	265	—	—	6.00Ukn PAS	—	—	—	—
1954	10	03	11 18 45.9	60.71 N	150.52 W	073	447	—	—	6.75Ukn PAS	—	VIII	27	32&
1954	12	30	11 32 30	52.5 N	168.4 W	065	265	—	—	6.63Ukn PAS	—	Felt	266	—
1955	01	13	02 03 43	53.2 N	167.4 W	—	265	—	—	6.88Ukn PAS	—	Felt	28	—
1955	01	13	02 35 46	53.2 N	167.4 W	—	265	—	—	6.50Ukn PAS	—	Felt	28	—
1955	01	13	02 44 46	53.2 N	167.4 W	—	265	—	—	—	—	—	—	—
1955	01	21	14 18 35	53.2 N	167.9 W	—	265	—	—	—	—	Felt	28	—
1955	03	14	13 12 04.0	52.5 N	173.5 W	100	266	—	—	7.00Ukn PAS	—	—	—	—
1955	04	28	19 05 02	51.8 N	178.1 W	—	265	—	—	6.50Ukn PAS	—	IV	28	—
1955	05	29	13 31 24.8	55.66 N	154.37 W	000	447	—	—	5.75Ukn PAS	—	—	—	—
1955	05	29	21 03 09.3	55.84 N	154.27 W	000	447	—	—	5.50Ukn PAS	—	—	—	—
1955	06	02	00 18 57	51.4 N	179.8 W	—	265	—	—	6.75Ukn PAS	—	—	—	—
1955	06	02	02 02 11	51.4 N	179.8 W	—	265	—	—	6.00M_R ROT	—	—	—	—
1955	06	05	01 53 17	51.5 N	179.8 W	—	265	—	—	6.38Ukn PAS	—	—	—	—
1955	06	20	12 07 31	51.4 N	179.5 W	033	265	—	—	6.75Ukn PAS	—	—	—	—
1955	07	03	08 00 59	51.5 N	177.2 E	033	265	—	—	5.75Ukn KIR	—	—	—	—
1955	07	03	14 26 34	51.6 N	177.6 E	033	265	—	—	6.50Ukn PAS	—	—	—	—
1955	07	04	14 19 52	51.4 N	177.4 E	065	265	—	—	6.63Ukn PAS	—	—	—	—
1955	07	17	21 58 23	54.4 N	168.3 W	—	265	—	—	5.88Ukn PAS	—	III	28	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (—) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1955	07	19	23 52 23.1	56.33 N	153.16 W	000	447	—	—	6.00Ukn PAS	—	—	—	—
1955	07	26	04 04 19.4	56.51 N	153.25 W	000	447	—	—	6.00Ukn PAS	—	—	—	—
1955	07	27	18 19 10.1	56.59 N	152.78 W	000	447	—	—	6.25Ukn PAS	—	—	—	—
1955	08	02	22 12 47	51.7 N	175.9 E	065	265	—	—	—	—	—	—	—
1955	08	29	15 34 00	51.8 N	178.1 W	—	265	—	—	5.75Ukn UPP	—	—	—	—
1955	09	13	02 00 40	52.0 N	176.0 W	—	266	—	—	5.88Ukn PAS	—	—	—	—
1955	09	30	19 44 24	51.5 N	176.5 W	—	266	—	—	—	—	—	—	—
1955	10	09	23 13 49	51.3 N	177.1 E	065	265	—	—	6.00Ukn KIR	—	—	—	—
1955	10	31	01 05 52	51.5 N	175.2 W	—	265	—	—	5.88Ukn PAS	—	—	—	—
1955	11	15	10 06 47.2	55.27 N	155.64 W	000	447	—	—	6.38Ukn PAS	—	—	—	—
1956	01	14	14 08 52	51.8 N	172.9 W	065	265	—	—	6.00Ukn PAS	—	—	—	—
1956	02	19	04 13 14.5	58.52 N	153.74 W	000	447	—	—	5.60Ukn KIR	—	—	—	—
1956	03	02	11 56 22.7	63.57 N	149.33 W	079	447	—	—	5.50M_R ROT	—	IV	29	—
1956	04	18	11 00 22	51.8 N	177.7 W	033	265	—	—	6.75Ukn PAS	—	—	—	—
1956	04	22	17 21 52.5	53.79 N	161.48 W	000	447	—	—	6.00Ukn PAS	—	—	—	—
1956	05	06	20 57 18.1	54.50 N	162.47 W	000	447	—	—	5.75Ukn PAS	—	—	—	—
1956	06	04	07 09 19	52.1 N	170.6 W	—	265	—	—	6.25Ukn PAS	—	—	—	—
1956	08	24	04 27 34	52.74 N	172.6 E	—	265	—	—	6.50Ukn PAS	—	—	—	—
1956	08	30	04 24 21.5	53.69 N	163.88 W	000	447	—	—	6.00Ukn PAS	—	—	—	—
1956	10	19	20 47 31	52.27 N	177.40 E	—	265	—	—	6.75Ukn PAS	—	—	—	—
1956	11	17	20 27 17.2	54.55 N	133.67 W	000	448	—	—	6.50Ukn PAS	—	IV	29	—
1956	12	02	02 59 55	52.51 N	169.05 W	—	265	—	—	5.50Ukn MOS	—	—	—	—
1956	12	03	07 20 06	52.64 N	168.61 W	—	265	—	—	6.63Ukn PAS	—	—	—	—
1956	12	04	10 42 07	52.55 N	169.15 W	—	265	—	—	—	—	—	—	—
1956	12	08	16 10 25	51.37 N	179.17 W	—	265	—	—	6.50Ukn PAS	—	—	—	—
1957	01	02	00 39 22.9	52.36 N	168.36 W	000	432	—	—	6.50Ukn PAS	—	—	—	—
1957	01	02	02 17 37.0	52.41 N	168.39 W	000	432	—	—	6.75Ukn PAS	—	—	—	—
1957	01	02	03 12 52.8	52.51 N	168.10 W	000	432	—	—	6.63Ukn PAS	—	—	—	—
1957	01	02	03 30 34.2	52.72 N	168.00 W	000	432	—	—	6.00M_R ROT	—	—	—	—
1957	01	02	03 48 47.0	52.51 N	168.03 W	000	432	—	—	6.70M_S AB3	—	—	—	—
1957	01	02	04 03 30.0	52.65 N	168.61 W	000	432	—	—	6.70Ukn UPP	—	—	—	—
1957	01	02	10 49 32.8	52.66 N	168.00 W	000	432	—	—	6.50Ukn PAS	—	—	—	—
1957	01	02	12 47 07.2	52.57 N	168.09 W	000	432	—	—	—	—	—	—	—
1957	01	03	00 41 03.0	52.91 N	167.88 W	000	432	—	—	6.40M_R ROT	—	—	—	—
1957	01	09	07 52 56.4	52.80 N	167.44 W	000	432	—	—	6.50Ukn PAS	—	—	—	—
1957	01	25	03 36 55.0	51.76 N	177.03 W	047	265	—	—	6.50Ukn PAS	—	—	—	—
1957	02	21	14 30 11.0	53.02 N	171.27 W	126	265	—	—	6.75Ukn PAS	—	—	—	—
1957	03	09	14 22 31.9	51.292N	175.629W	033	479	—	—	8.10M_S ABE	8.82RK	VIII	38	—
1957	03	09	15 41 51.5	50.74 N	176.16 W	000	432	—	—	6.00Ukn ROT	—	Felt	30	—
1957	03	09	19 37 37.0	51.546N	173.759W	033	479	—	—	—	—	Felt	30	—
1957	03	09	20 22 03.3	52.12 N	169.55 W	000	432	—	—	—	—	—	—	—
1957	03	09	20 39 16.5	52.43 N	169.58 W	000	432	—	—	7.10M_S ABE	—	—	—	—
1957	03	10	03 06 18.8	51.698N	173.981W	033	479	—	—	6.63Ukn PAS	—	Felt	30	—
1957	03	10	03 09 05.6	51.396N	174.289W	033	479	—	—	6.60Ukn UPP	—	Felt	30	—
1957	03	10	07 23 24.2	51.117N	175.944W	033	479	—	—	—	—	Felt	30	—
1957	03	10	11 20 45.6	51.88 N	170.91 W	000	432	—	—	6.50Ukn UPP	—	—	—	—
1957	03	10	12 36 05.8	51.18 N	170.84 W	000	432	—	—	6.00M_R ROT	—	—	—	—
1957	03	10	12 45 37.4	50.566N	176.831W	033	479	—	—	6.40Ukn UPP	—	Felt	30	—
1957	03	10	13 10 13.4	51.28 N	179.99 W	000	432	—	—	6.10M_R ROT	—	—	—	—
1957	03	10	13 28 36.4	51.083N	178.626W	030	479	—	—	6.00M_R ROT	—	—	—	—
1957	03	10	15 26 29.1	51.575N	172.990W	033	479	—	—	6.75Ukn BRK	—	Felt	30	—
1957	03	10	16 37 53.2	51.568N	173.166W	033	479	—	—	6.00M_R ROT	—	Felt	30	—
1957	03	10	19 40 59.8	51.348N	173.335W	033	479	—	—	—	—	Felt	30	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	Felt area
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1957	03	10	23 56 49.5	52.70 N	168.40 W	000	432	—		— —	—	—	—	—
1957	03	11	00 08 11.5	52.50 N	169.50 W	000	432	—		— —	—	—	—	—
1957	03	11	03 12 47.0	50.826N	177.250W	033	479	—	—	6.88Ukn PAS	—	Felt	30	—
1957	03	11	03 35 05.5	50.660N	176.960W	033	479	—	—	6.00M_R ROT	—	Felt	30	—
1957	03	11	04 05 18.2	50.948N	176.915W	033	479	—	—	—	—	Felt	30	—
1957	03	11	07 08 05.4	50.968N	177.222W	033	479	—	—	—	—	Felt	30	—
1957	03	11	09 58 44.4	52.66 N	169.02 W	000	432	—	—	7.00M_S ABE	—	—	—	—
1957	03	11	14 55 25.1	51.094N	178.535W	033	479	—	—	6.90M_S ABE	—	Felt	30	—
1957	03	11	15 35 59.8	51.013N	178.972W	030	479	—	—	6.50Ukn PAS	—	Felt	30	—
1957	03	12	07 28 53.7	51.526N	173.505W	033	479	—	—	6.38Ukn PAS	—	Felt	30	—
1957	03	12	07 39 22.7	51.014N	178.246W	030	479	—	—	6.38Ukn PAS	—	Felt	30	—
1957	03	12	08 03 18.8	50.992N	178.027W	033	479	—	—	—	—	Felt	30	—
1957	03	12	11 44 56.3	51.187N	177.388W	033	479	—	—	7.00M_S ABE	—	Felt	30	—
1957	03	12	12 46 12.1	52.95 N	168.42 W	000	432	—	—	6.00M_R ROT	—	—	—	—
1957	03	12	17 00 29.3	51.447N	174.890W	033	479	—	—	—	—	Felt	30	—
1957	03	12	23 45 32.8	51.675N	173.327W	033	479	—	—	—	—	Felt	30	—
1957	03	13	02 48 20.8	51.70 N	171.17 W	000	432	—	—	6.10M_R ROT	—	Felt	30	—
1957	03	13	03 33 03.4	51.362N	174.793W	033	479	—	—	—	—	Felt	30	—
1957	03	13	09 09 34.9	52.51 N	170.06 W	000	432	—	—	—	—	—	—	—
1957	03	13	15 42 12.8	51.131N	178.681W	033	479	—	—	6.75Ukn PAS	—	Felt	30	—
1957	03	13	19 59 24.1	53.96 N	165.44 W	000	432	—	—	6.20M_R ROT	—	—	—	—
1957	03	14	01 52 19.4	52.59 N	168.48 W	000	432	—	—	5.70Ukn UPP	—	—	—	—
1957	03	14	14 47 50.6	51.098N	176.824W	033	479	—	—	7.10M_S ABE	—	Felt	30	—
1957	03	14	15 51 06.4	50.991N	177.187W	033	479	—	—	—	—	Felt	30	—
1957	03	15	02 52 09.0	52.73 N	166.94 W	000	432	—	—	6.75Ukn PAS	—	—	—	—
1957	03	15	04 13 02.4	51.114N	176.031W	033	479	—	—	—	—	Felt	30	—
1957	03	16	02 34 17.7	51.159N	178.797W	033	479	—	—	7.00M_S ABE	—	Felt	30	—
1957	03	16	03 34 05.9	51.861N	173.734W	033	479	—	—	—	—	Felt	30	—
1957	03	17	07 53 52.2	51.57 N	179.49 W	000	432	—	—	6.10M_R ROT	—	Felt	30	—
1957	03	17	16 17 18.2	52.02 N	166.03 W	042	432	—	—	6.40M_R ROT	—	—	—	—
1957	03	17	22 44 44.8	53.79 N	165.29 W	000	432	—	—	6.50Ukn PAS	—	—	—	—
1957	03	18	02 25 33.0	52.19 N	171.05 W	051	432	—	—	6.20M_R ROT	—	—	—	—
1957	03	18	05 08 33.1	50.75 N	179.06 W	000	432	—	—	—	—	Felt	30	—
1957	03	19	08 14 09.8	52.65 N	167.76 W	000	432	—	—	—	—	—	—	—
1957	03	19	11 28 56.0	51.070N	176.835W	033	479	—	—	6.00M_R ROT	—	Felt	30	—
1957	03	19	12 50 57.2	51.249N	175.326W	033	479	—	—	6.75Ukn PAS	—	Felt	30	—
1957	03	19	15 47 31.7	51.582N	172.162W	033	479	—	—	—	—	—	—	—
1957	03	19	17 04 25.4	52.13 N	170.74 W	000	432	—	—	—	—	—	—	—
1957	03	20	00 00 57.8	51.605N	172.710W	033	479	—	—	—	—	Felt	30	—
1957	03	20	00 22 22.8	52.40 N	168.66 W	000	432	—	—	—	—	—	—	—
1957	03	21	12 31 33.3	52.31 N	170.87 W	000	432	—	—	—	—	—	—	—
1957	03	22	14 21 05.5	52.61 N	165.76 W	000	432	—	—	7.00M_S ABE	—	—	—	—
1957	03	22	17 09 49.3	52.11 N	171.03 W	000	432	—	—	—	—	—	—	—
1957	03	24	11 06 10.0	52.29 N	169.53 W	000	432	—	—	6.20M_R ROT	—	—	—	—
1957	03	24	11 36 49.6	52.27 N	171.53 W	000	432	—	—	6.00M_R ROT	—	—	—	—
1957	03	25	00 39 27.6	52.79 N	167.02 W	000	432	—	—	6.00M_R ROT	—	—	—	—
1957	03	28	20 08 20.0	51.62 N	171.26 W	000	432	—	—	5.75Ukn MOS	—	—	—	—
1957	03	29	05 10 28.7	53.40 N	166.84 W	000	432	—	—	6.50Ukn PAS	—	—	—	—
1957	03	29	22 49 50.8	52.65 N	168.38 W	000	432	—	—	6.13Ukn PAS	—	—	—	—
1957	03	30	00 42 40.4	51.47 N	179.57 W	000	432	—	—	—	—	—	—	—
1957	03	30	09 17 08.0	51.817N	175.208W	033	479	—	—	6.20Ukn UPP	—	Felt	30	—
1957	03	31	10 08 34.3	51.181N	178.478W	033	479	—	—	6.10M_R ROT	—	Felt	30	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1957	04	01	11 35 31.0	50.66 N	173.12 W	000	265	—	—	6.00 M_R ROT	—	—	—	—
1957	04	02	00 39 45.0	51.11 N	173.02 W	000	265	—	—	6.10 M_R ROT	—	—	—	—
1957	04	02	20 16 59.0	51.04 N	173.01 W	000	265	—	—	6.10 M_R ROT	—	—	—	—
1957	04	02	21 27 56.0	50.85 N	173.16 W	000	265	—	—	6.20 M_R ROT	—	—	—	—
1957	04	04	00 13 02.2	58.06 N	155.18 W	074	447	—	—	6.00 M_R ROT	—	IV	30	—
1957	04	05	02 49 40.0	52.09 N	172.10 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1957	04	09	11 02 12.0	51.27 N	178.56 W	000	265	—	—	6.00 M_R ROT	—	—	—	—
1957	04	10	09 09 22.0	50.50 N	176.86 W	020	265	—	—	6.20 M_R ROT	—	—	—	—
1957	04	10	11 29 58.2	55.84 N	153.88 W	000	432	—	—	6.90 M_S ABE	—	—	—	—
1957	04	12	04 17 45	51.5 N	178.5 W	—	266	—	—	5.00Ukn MOS	—	—	—	—
1957	04	14	20 59 01.0	50.14 N	178.81 W	000	265	—	—	6.00 M_R ROT	—	—	—	—
1957	04	15	10 38 42.0	51.48 N	179.02 W	039	265	—	—	6.00 M_R ROT	—	—	—	—
1957	04	15	21 33 06.0	52.07 N	167.04 W	000	265	—	—	6.43 M_R ROT	—	—	—	—
1957	04	17	13 24 56.0	52.52 N	168.69 W	000	265	—	—	6.00 M_R ROT	—	—	—	—
1957	04	19	15 44 56.0	51.47 N	168.21 W	000	265	—	—	6.70 M_R ROT	—	—	—	—
1957	04	19	22 19 30.0	52.20 N	166.28 W	004	265	—	—	7.30Ukn PAS	—	—	—	—
1957	04	25	14 07 53.0	60.02 N	146.38 W	000	447	—	—	—	—	—	—	—
1957	04	28	14 48 54.0	52.59 N	168.52 W	000	265	—	—	5.90 M_R ROT	—	—	—	—
1957	04	29	04 30 06.0	52.40 N	168.80 W	000	265	—	—	5.50Ukn MOS	—	—	—	—
1957	05	02	11 29 14.0	52.74 N	168.76 W	000	265	—	—	6.30 M_R ROT	—	—	—	—
1957	05	02	11 38 54.0	52.67 N	168.78 W	000	265	—	—	6.40 M_R ROT	—	—	—	—
1957	05	18	05 24 06.0	51.19 N	171.27 W	000	265	—	—	6.20 M_R ROT	—	—	—	—
1957	05	20	01 50 54.0	51.28 N	179.57 E	000	265	—	—	5.80 M_R ROT	—	—	—	—
1957	05	22	13 29 48.0	50.46 N	176.90 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1957	05	24	03 36 37.0	53.24 N	167.50 W	036	265	—	—	6.13Ukn BRK	—	—	—	—
1957	05	31	22 17 09.0	51.19 N	179.24 W	000	265	—	—	6.20 M_R ROT	—	—	—	—
1957	06	11	23 53 56.0	51.59 N	176.04 W	000	265	—	—	6.10 M_R ROT	—	—	—	—
1957	06	13	10 40 41.0	51.51 N	175.14 W	000	265	—	—	6.75 M_S AB3	—	—	—	—
1957	06	14	06 24 25.0	51.95 N	176.11 W	040	265	—	—	6.25Ukn BRK	—	—	—	—
1957	06	15	18 18 24.0	52.31 N	171.32 W	028	265	—	—	6.00Ukn BRK	—	—	—	—
1957	06	23	03 27 00.4	57.92 N	137.75 W	000	448	—	—	5.62Ukn BRK	—	Felt	30	—
1957	06	29	07 48 15.0	51.71 N	166.64 W	000	265	—	—	6.30Ukn UPP	—	—	—	—
1957	07	03	12 24 38.0	50.17 N	179.12 W	000	265	—	—	6.13Ukn PAS	—	—	—	—
1957	07	23	00 45 10.0	51.36 N	177.19 W	000	265	—	—	6.40Ukn PAS	—	—	—	—
1957	07	25	07 42 24.0	51.22 N	177.21 W	000	265	—	—	6.25Ukn BRK	—	—	—	—
1957	08	01	16 18 48	52.0 N	170.0 W	—	266	—	—	5.60Ukn MAT	—	—	—	—
1957	08	13	12 00 04.5	60.91 N	147.43 W	022	447	—	—	—	—	—	—	—
1957	08	19	21 31 55.0	51.17 N	171.16 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1957	09	02	14 20 14.0	51.69 N	168.01 W	000	265	—	—	6.20 M_R ROT	—	—	—	—
1957	09	06	04 54 39.0	50.50 N	177.28 W	000	265	—	—	5.70Ukn UPP	—	—	—	—
1957	09	07	10 06 45.0	51.23 N	178.58 W	000	265	—	—	6.10 M_R ROT	—	—	—	—
1957	10	04	23 55 43.0	52.56 N	177.80 E	000	265	—	—	5.50 M_R ROT	—	—	—	—
1957	10	10	18 54 09.0	53.87 N	165.41 W	079	265	—	—	5.75Ukn BRK	—	—	—	—
1957	10	23	05 56 56.0	52.53 N	169.69 W	038	265	—	—	6.25Ukn PAS	—	—	—	—
1957	10	30	02 13 08.0	53.12 N	166.82 W	000	265	—	—	— —	—	—	—	
1957	11	07	04 15 35	52.0 N	179.0 E	150	266	—	—	5.50 M_R ROT	—	—	—	—
1957	11	16	01 48 47.0	51.43 N	177.01 W	000	265	—	—	5.70Ukn MAT	—	—	—	—
1957	11	18	10 12 00.0	51.29 N	179.32 W	000	265	—	—	6.00 M_R ROT	—	—	—	—
1957	11	20	12 40 27.0	53.79 N	164.71 W	000	265	—	—	6.40Ukn BRK	—	—	—	—
1957	11	23	00 58 45.0	52.96 N	167.58 W	068	265	—	—	6.20 M_R ROT	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MM	Ref	(1,000 km²)
1957	11	26	11 35 44.0	51.18 N	176.38 W	000	265	—	—	6.20M_R ROT	—	—	—	—
1957	12	03	01 46 05	51.5 N	178.0 W	—	266	—	—	6.20M_R ROT	—	—	—	—
1957	12	03	21 46 18.0	52.64 N	169.80 W	000	265	—	—	5.60Ukn MAT	—	—	—	—
1957	12	13	20 26 20.0	52.12 N	169.67 W	000	265	—	—	6.00M_R ROT	—	—	—	—
1958	01	13	00 02 27.0	52.37 N	176.73 E	121	265	—	—	6.50Ukn UPP	—	—	—	—
1958	01	24	23 17 30.5	60.16 N	151.76 W	052	447	—	—	6.40Ukn PAS	—	IV	31	—
1958	02	12	23 43 52.0	51.79 N	175.20 W	050	265	—	—	6.00Ukn PAS	—	—	—	—
1958	02	22	10 50 26.0	50.32 N	175.49 W	000	265	—	—	6.75Ukn PAS	—	—	—	—
1958	02	22	13 21 50.0	50.39 N	175.40 W	000	265	—	—	—	—	—	—	—
1958	02	22	17 05 03.0	52.15 N	174.91 W	000	265	—	—	5.50Ukn MAT	—	—	—	—
1958	02	25	01 56 39.0	51.42 N	179.42 E	000	265	—	—	5.75Ukn MOS	—	—	—	—
1958	03	18	22 20 00.0	50.24 N	172.95 W	000	265	—	—	6.20Ukn UPP	—	—	—	—
1958	03	20	01 38 05.0	50.49 N	172.84 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1958	04	07	15 30 40.3	65.99 N	156.55 W	000	447	—	—	7.30M_S ABE	—	VIII	31	650
1958	04	08	00 14 16.0	65.87 N	155.95 W	000	447	—	—	6.10M_R ROT	—	Felt	31	—
1958	04	09	06 15 11.6	56.14 N	139.23 W	000	448	—	—	5.50M_R ROT	—	V	31	—
1958	04	13	09 07 24.6	65.83 N	155.55 W	000	447	—	—	6.75Ukn PAS	—	V	31	—
1958	04	27	19 03 53.0	52.94 N	169.50 W	000	265	—	—	5.90M_R ROT	—	—	—	—
1958	05	10	22 54 39.5	65.12 N	152.09 W	000	447	—	—	6.38Ukn PAS	—	V	31	—
1958	05	11	05 23 55.6	65.01 N	151.97 W	000	447	—	—	6.38Ukn PAS	—	V	31	—
1958	05	12	05 38 18.0	52.21 N	169.54 W	—	265	—	—	—	—	—	—	—
1958	05	15	04 24 50.0	51.86 N	173.64 W	000	265	—	—	—	—	—	—	—
1958	05	17	15 38 22.0	51.59 N	179.29 W	000	265	—	—	—	—	—	—	—
1958	05	22	11 32 51.0	50.69 N	175.02 W	000	265	—	—	—	—	—	—	—
1958	05	25	00 35 23.0	51.48 N	177.42 W	000	265	—	—	5.62Ukn PAS	—	—	—	—
1958	05	25	14 54 30.0	51.27 N	177.11 W	000	265	—	—	5.63Ukn PAS	—	—	—	—
1958	05	26	10 56 45.0	53.26 N	169.61 W	130	265	—	—	6.13Ukn PAS	—	—	—	—
1958	05	30	18 04 53.0	52.73 N	168.62 W	000	265	—	—	6.13Ukn PAS	—	—	—	—
1958	06	01	18 21 17.5	60.57 N	143.56 W	000	447	—	—	—	—	—	—	—
1958	06	04	14 29 54.0	52.69 N	167.22 W	019	265	—	—	6.13Ukn PAS	—	—	—	—
1958	06	08	00 38 53.0	53.20 N	166.79 W	—	265	—	—	6.00M_R ROT	—	—	—	—
1958	06	09	15 59 06.0	52.95 N	167.22 W	—	265	—	—	—	—	—	—	—
1958	06	10	00 10 30	52.95 N	167.25 W	000	265	—	—	—	—	—	—	—
1958	06	12	20 53 01.0	52.98 N	166.97 W	—	265	—	—	6.50Ukn PAS	—	—	—	—
1958	06	12	21 34 12	53.4 N	166.3 W	200	449	—	—	5.50M_R ROT	—	—	—	—
1958	07	01	05 53 14.0	51.59 N	176.87 W	067	265	—	—	6.00Ukn PAS	—	—	—	—
1958	07	07	05 16 02.0	50.06 N	179.94 E	000	265	—	—	5.50M_R ROT	—	—	—	—
1958	07	10	06 15 53.6	58.34 N	136.52 W	000	448	—	—	7.90M_S ABE	8.26KAN	XI	31	570&
1958	07	13	08 10 01.7	57.91 N	136.95 W	000	448	—	—	5.63Ukn BRK	—	Felt	31	—
1958	07	17	19 02 13.0	51.54 N	176.68 W	000	265	—	—	5.75Ukn BRK	—	—	—	—
1958	07	17	20 59 24.0	51.45 N	176.69 W	000	265	—	—	6.00Ukn BRK	—	—	—	—
1958	07	18	00 39 21.0	51.45 N	176.60 W	—	265	—	—	5.75Ukn BRK	—	—	—	—
1958	07	21	14 37 24.0	51.50 N	178.43 W	057	265	—	—	6.25Ukn BRK	—	—	—	—
1958	07	24	13 08 05.0	52.74 N	169.77 W	000	265	—	—	5.75Ukn MAT	—	—	—	—
1958	08	13	20 12 59.0	50.59 N	177.75 W	000	265	—	—	6.40Ukn PAS	—	—	—	—
1958	08	14	14 55 12.0	51.59 N	175.39 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1958	08	16	13 17 54.0	51.43 N	176.11 W	000	265	—	—	6.13Ukn PAS	—	—	—	—
1958	08	17	09 08 35.0	51.38 N	176.23 W	000	265	—	—	6.00M_R ROT	—	Felt	266	—
1958	08	31	23 00 17.0	63.22 N	144.32 W	017	447	—	—	5.90Ukn BRK	—	V	31	—
1958	09	09	22 23 36	53.97 N	171.14 E	000	265	—	—	—	—	—	—	—
1958	09	24	03 44 17.6	59.63 N	142.93 W	000	447	—	—	6.25Ukn PAS	—	—	—	—
1958	10	01	17 47 17.0	52.67 N	165.40 W	000	265	—	—	6.25Ukn PAS	—	—	—	—
1958	10	20	00 55 32.0	51.90 N	175.15 W	000	265	—	—	5.70Ukn UPP	—	Felt	31	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1958	10	28	23 50 07.0	51.53 N	179.30 E	000	265	—	—	5.75Ukn MAT	—	—	—	—
1958	10	29	07 44 10.0	51.49 N	179.41 E	000	265	—	—	6.25Ukn PAS	—	—	—	—
1958	10	29	07 55 13.0	51.37 N	179.15 E	000	265	—	—	—	—	—	—	—
1958	11	02	10 44 47.0	51.57 N	175.19 W	000	265	—	—	5.63Ukn MAT	—	—	—	—
1958	11	18	07 45 22.0	51.66 N	179.37 E	000	265	—	—	5.75Ukn MAT	—	—	—	—
1958	11	19	15 02 15.7	60.46 N	150.91 W	046	447	—	—	5.90M_R ROT	—	Felt	31	—
1958	12	19	18 36 24.0	51.46 N	177.68 W	000	265	—	—	5.60Ukn MAT	—	—	—	—
1959	01	16	01 31 26	52.34 N	177.11 W	041	265	—	—	6.20M_R ROT	—	—	—	—
1959	01	29	20 21 27.0	51.88 N	173.79 W	000	265	—	—	5.88Ukn PAS	—	—	—	—
1959	01	29	20 58 20.0	52.14 N	173.86 W	000	265	—	—	5.50Ukn PAS	—	—	—	—
1959	02	05	01 04 50.5	57.43 N	156.88 W	068	447	—	—	—	—	—	—	—
1959	02	06	14 33 05.0	51.72 N	176.02 W	044	265	—	—	6.00Ukn PAS	—	—	—	—
1959	02	09	04 42 35.0	50.00 N	177.64 W	000	265	—	—	6.20M_R ROT	—	—	—	—
1959	02	17	12 03 04.0	51.10 N	171.23 W	—	265	—	—	6.13Ukn PAS	—	—	—	—
1959	02	28	01 32 24.0	53.02 N	168.06 W	000	265	—	—	5.50Ukn MAT	—	—	—	—
1959	04	14	07 20 27.3	57.95 N	155.01 W	067	447	—	—	6.00M_R ROT	—	—	—	—
1959	04	19	15 03 30.7	58.20 N	151.74 W	037	477	—	—	6.25Ukn PAS	—	—	—	—
1959	04	22	10 55 11.0	53.80 N	166.87 W	051	265	—	—	6.00Ukn PAS	—	—	—	—
1959	05	12	21 40 23.0	51.54 N	177.14 W	000	265	—	—	5.80M_R ROT	—	—	—	—
1959	05	12	21 59 56.0	51.21 N	176.95 W	000	265	—	—	6.00Ukn PAS	—	—	—	—
1959	05	18	07 24 08.0	52.51 N	173.69 E	000	265	—	—	6.10M_R ROT	—	—	—	—
1959	06	04	12 31 56.4	59.98 N	152.70 W	099	447	—	—	5.50Ukn PAS	—	III	32	—
1959	07	13	12 28 47.0	52.01 N	172.00 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1959	07	14	11 33 51.4	56.83 N	157.73 W	043	447	—	—	—	—	—	—	—
1959	07	16	15 17 28.0	50.47 N	177.32 W	000	265	—	—	—	—	—	—	—
1959	08	07	10 43 31.1	56.41 N	153.58 W	000	447	—	—	5.75Ukn PAS	—	—	—	—
1959	08	07	21 45 25.5	56.45 N	153.51 W	000	447	—	—	6.00M_R ROT	—	—	—	—
1959	08	28	12 07 47.4	63.42 N	148.85 W	044	447	—	—	6.00M_R ROT	—	Felt	32	—
1959	09	05	21 28 41.0	51.30 N	179.36 E	000	265	—	—	5.63Ukn MAT	—	—	—	—
1959	09	21	16 16 19.9	62.47 N	158.68 W	000	447	—	—	5.50M_R ROT	—	—	—	—
1959	10	08	02 35 21.0	52.35 N	170.81 W	000	265	—	—	—	—	—	—	—
1959	11	30	15 18 36.2	59.73 N	151.29 W	000	447	—	—	6.10M_R ROT	—	Felt	32	—
1959	12	14	22 00 51.0	52.45 N	168.21 W	000	265	—	—	6.40M_R ROT	—	—	—	—
1959	12	18	16 24 50.0	52.56 N	168.39 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1959	12	23	03 49 07.5	56.45 N	157.64 W	055	447	—	—	—	—	—	—	—
1959	12	26	18 19 07.8	59.67 N	151.26 W	000	447	—	—	6.25Ukn PAS	—	III	32	—
1960	01	13	16 29 42.0	51.73 N	179.93 E	000	265	—	—	—	—	—	—	—
1960	01	16	20 49 31.1	63.29 N	150.41 W	125	447	—	—	5.90M_R ROT	—	III	33	—
1960	02	19	05 09 28.1	60.87 N	150.36 W	044	447	—	—	—	—	V	33	—
1960	02	26	23 29 24.0	51.32 N	177.97 W	000	265	—	—	6.13Ukn PAS	—	Felt	33	—
1960	02	27	08 10 04.0	51.53 N	177.96 W	000	265	—	—	6.10M_R ROT	—	Felt	33	—
1960	03	04	02 15 58.0	50.60 N	176.85 W	000	265	—	—	5.90M_R ROT	—	—	—	—
1960	03	15	09 20 56.0	50.64 N	174.55 W	000	265	—	—	—	—	—	—	—
1960	04	10	20 26 11.0	52.88 N	167.05 W	000	265	—	—	—	—	—	—	—
1960	05	13	16 07 11.2	54.81 N	161.35 W	000	447	—	—	6.25Ukn PAS	—	IV	33	—
1960	06	17	16 35 33.0	51.90 N	173.15 W	000	265	—	—	6.13Ukn PAS	—	Felt	33	—
1960	06	22	23 28 47.0	51.68 N	173.43 W	000	265	—	—	6.13Ukn PAS	—	—	—	—
1960	06	29	17 06 57.0	52.69 N	168.04 W	000	265	—	—	5.90M_R ROT	—	—	—	—
1960	06	30	19 58 37.7	60.30 N	150.90 W	055	447	—	—	5.90M_R ROT	—	Felt	33	—
1960	07	03	20 20 46.0	50.28 N	177.10 W	000	265	—	—	6.90m_b AB3	—	Felt	33	—
1960	07	03	22 52 24.0	50.28 N	177.19 W	000	265	—	—	—	—	—	—	—
1960	07	05	05 07 56.0	51.50 N	178.27 W	000	265	—	—	—	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1960	08	02	06 14 45.0	51.61 N	178.30 W	000	265	—	—	—	—	Felt	33	—
1960	08	04	07 34 48.0	51.41 N	179.04 E	000	265	—	—	6.13Ukn PAS	—	Felt	33	—
1960	08	04	14 05 28.7	51.4 N	178.9 E	034	266	—	—	—	—	—	—	—
1960	08	05	22 27 41.0	51.34 N	178.83 E	052	265	—	—	5.70Ukn MAT	—	—	—	—
1960	08	25	17 41 54.0	52.52 N	169.67 W	000	265	—	—	6.00M_R ROT	—	—	—	—
1960	09	01	15 37 13.0	56.25 N	153.59 W	000	447	—	—	6.13Ukn PAS	—	—	—	—
1960	09	02	22 02 44.0	52.21 N	171.51 W	000	265	—	—	5.88Ukn PAS	—	—	—	—
1960	09	12	02 44 39.7	60.5 N	153.8 W	195	266	—	—	5.50M_R ROT	—	IV	33	—
1960	10	01	16 10 52.0	51.79 N	172.40 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1960	10	14	21 19 13.0	51.83 N	172.25 W	041	265	—	—	6.50Ukn PAS	—	—	—	—
1960	11	06	22 10 03.0	52.69 N	168.07 W	000	265	—	—	6.20M_R ROT	—	—	—	—
1960	11	13	09 20 30.9	51.23 N	168.86 W	000	432	—	—	6.70M_S ABE	—	—	—	—
1960	12	03	07 07 42.6	52.7 N	177.4 W	160	266	—	—	5.50M_R ROT	—	III	33	—
1960	12	21	14 39 58.9	61.81 N	152.35 W	100	447	—	—	5.75Ukn PAS	—	Felt	33	—
1961	01	05	14 06 32.0	51.83 N	175.94 W	051	265	—	—	6.75Ukn PAS	—	Felt	34	—
1961	01	11	11 59 52.0	51.98 N	170.87 W	000	265	—	—	6.20M_R ROT	—	—	—	—
1961	01	12	14 13 30.9	57.81 N	155.47 W	075	447	—	—	—	—	—	—	—
1961	01	14	16 38 54.8	53.9 N	163.4 W	038	266	—	—	5.75Ukn PAL	—	—	—	—
1961	01	20	17 09 12.3	56.52 N	152.42 W	000	447	—	—	6.38Ukn PAS	—	—	—	—
1961	01	29	13 23 54.7	52.0 N	175.9 W	041	266	—	—	—	—	—	—	—
1961	01	30	12 12 36.3	65.23 N	150.25 W	000	447	—	—	5.50Ukn PAL	—	V	34	—
1961	01	31	00 48 35.5	56.17 N	153.77 W	000	447	—	—	6.25Ukn PAS	—	—	—	—
1961	02	27	13 06 35.8	52.7 N	168.8 W	056	266	—	—	—	—	—	—	—
1961	03	28	12 29 15.0	51.90 N	176.15 W	062	265	—	—	6.25Ukn PAS	—	Felt	34	—
1961	04	21	21 26 42.1	51.9 N	173.9 W	036	266	—	—	5.63Ukn PAL	—	—	—	—
1961	05	17	19 29 19.3	52.2 N	173.9 E	021	266	—	—	6.00Ukn PAS	—	Felt	34	—
1961	06	26	14 47 21.0	52.08 N	174.62 E	000	265	—	—	6.20M_R ROT	—	—	—	—
1961	06	29	14 02 42.5	52.4 N	173.4 W	076	266	—	—	—	—	—	—	—
1961	08	08	12 18 19.0	51.15 N	170.63 W	000	265	—	—	6.13Ukn PAS	—	—	—	—
1961	08	25	06 59 27.6	53.52 N	161.26 W	000	447	—	—	— —	—	—	—	
1961	09	02	00 26 03.0	52.18 N	171.05 W	000	265	—	—	5.50Ukn MAT	—	—	—	—
1961	09	04	09 49 15.0	51.58 N	178.25 W	052	265	—	—	6.25Ukn BRK	—	—	—	—
1961	09	05	11 34 31.4	59.77 N	150.80 W	000	447	—	—	6.13Ukn PAS	—	VI	34	—
1961	09	11	02 46 50.3	51.4 N	180.0 E	060	266	—	—	5.90M_R ROT	—	—	—	—
1961	09	25	02 27 13.5	60.36 N	152.88 W	117	447	—	—	5.88Ukn PAS	—	Felt	34	—
1961	09	27	11 20 45.0	52.40 N	168.68 W	000	265	—	—	5.63Ukn MAT	—	—	—	—
1961	09	27	19 20 44.0	52.46 N	168.79 W	000	265	—	—	6.00M_R ROT	—	—	—	—
1961	09	27	19 27 00.0	52.35 N	168.75 W	000	265	—	—	6.00M_R ROT	—	—	—	—
1961	10	31	01 43 54.0	51.83 N	175.82 E	022	265	—	—	5.50M_R ROT	—	—	—	—
1961	12	09	02 15 20.8	56.35 N	153.49 W	000	447	—	—	5.63Ukn BRK	—	—	—	—
1961	12	30	00 39 27.1	52.3 N	177.6 E	056	266	—	—	6.75Ukn PAS	—	—	—	—
1962	01	01	02 41 11.6	52.2 N	177.7 E	048	266	—	—	—	—	—	—	—
1962	01	03	17 53 10.0	52.31 N	177.48 E	077	265	—	—	—	—	—	—	—
1962	01	23	15 59 27.4	52.8 N	169.0 W	065	266	—	—	—	—	—	—	—
1962	03	11	15 23 42.0	52.29 N	178.46 E	110	265	—	—	6.10Ukn UPP	—	—	—	—
1962	04	01	12 11 59.5	63.4 N	150.7 W	108	449	—	—	5.50M_R ROT	—	Felt	449	—
1962	04	05	03 40 08.9	53.7 N	163.6 W	065	266	—	—	5.50Ukn MOS	—	—	—	—
1962	05	10	00 03 39.9	61.96 N	150.11 W	082	447	—	—	6.00Ukn BRK	—	V	35	—
1962	05	10	05 12 12.0	52.39 N	171.03 W	000	265	—	—	6.00Ukn BRK	—	—	—	—
1962	06	29	16 28 03.8	62.40 N	152.17 W	023	447	—	—	6.00M_R ROT	—	IV	35	—
1962	07	07	06 12 48.9	51.43 N	178.76 E	060	266	—	—	5.88Ukn PAS	—	—	—	—
1962	07	16	12 54 43.1	62.27 N	152.58 W	050	447	—	—	6.00Ukn PAL	—	V	35	—
1962	08	18	16 43 55.9	62.26 N	152.54 W	046	447	—	—	6.13Ukn PAS	—	V	35	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1962	08	18	17 46 15.7	62.21 N	152.50 W	040	447	—	—	6.38Ukn PAS	—	V	35	—
1962	08	31	17 02 45.0	51.32 N	179.75 W	037	265	—	—	6.75Ukn PAS	—	Felt	35	—
1962	08	31	17 56 10.0	51.27 N	179.86 E	055	265	—	—	—	—	—	—	—
1962	09	01	03 46 01.0	51.29 N	179.70 W	000	265	—	—	6.50Ukn PAS	—	Felt	35	—
1962	09	01	04 41 41.5	51.3 N	179.9 W	037	266	—	—	6.00M_R ROT	—	Felt	35	—
1962	09	01	07 51 08.0	51.32 N	179.86 W	046	265	—	—	6.50Ukn PAS	—	—	—	—
1962	10	21	02 05 23.7	61.39 N	149.21 W	071	447	—	—	6.00M_R ROT	—	VI	35	—
1962	12	08	22 55 01.2	50.5 N	176.8 W	033	266	—	—	5.70Ukn BRK	—	—	—	—
1962	12	21	06 27 44.0	52.58 N	168.71 W	000	265	—	—	6.10Ukn UPP	—	—	—	—
1962	12	21	08 42 43.0	52.47 N	168.54 W	000	265	—	—	6.50Ukn PAS	—	—	—	—
1962	12	21	09 00 41.4	52.4 N	168.5 W	033	266	—	—	6.20M_R ROT	—	—	—	—
1962	12	21	09 10 01.6	52.5 N	168.5 W	033	266	—	—	6.20M_R ROT	—	—	—	—
1962	12	22	15 20 25.0	52.46 N	168.83 W	000	265	—	—	6.25Ukn PAS	—	—	—	—
1963	01	01	23 39 06.0	56.57 N	157.56 W	051	265	—	—	6.50Ukn PAS	—	—	—	—
1963	01	28	13 00 46.1	54.58 N	161.65 W	051	447	—	—	6.50Ukn PAS	—	—	—	—
1963	03	24	21 35 23.2	51.8 N	178.1 W	047	266	5.5	—	6.00Ukn PAS	—	Felt	36	—
1963	04	02	16 18 55.3	53.1 N	171.7 W	140	266	5.7	—	6.38Ukn PAS	—	—	—	—
1963	04	03	15 54 51.7	61.2 N	147.8 W	071	266	5.7	—	5.50M_R ROT	—	Felt	36	—
1963	04	06	11 19 23.2	63.4 N	149.6 W	042	266	5.3	—	6.00M_R ROT	—	—	—	—
1963	04	07	15 27 59.4	53.7 N	170.0 W	174	266	6.0	—	6.00M_R ROT	—	—	—	—
1963	04	29	21 44 17.2	51.3 N	178.7 E	056	266	5.9	—	6.00Ukn PAS	—	—	—	—
1963	04	30	07 07 53.3	51.3 N	178.6 E	045	266	5.8	—	—	—	—	—	—
1963	05	04	05 56 01.1	51.8 N	175.4 W	041	266	5.1	—	6.00M_R ROT	—	—	—	—
1963	05	08	08 50 56.3	54.9 N	163.8 W	090	266	5.6	—	6.00M_R ROT	—	IV	36	—
1963	05	12	20 08 40.8	57.3 N	154.0 W	060	266	5.9	—	6.50Ukn PAS	—	IV	36	—
1963	06	24	04 26 31.0	59.45 N	152.05 W	000	447	5.7	—	6.75Ukn PAS	—	VII	36	—
1963	06	27	07 08 01.8	60.5 N	140.8 W	031	266	5.9	—	—	—	—	—	—
1963	08	18	18 43 16.0	50.59 N	177.01 W	017	265	5.5	—	—	—	—	—	—
1963	09	26	05 28 02.0	50.11 N	176.92 W	000	265	5.3	—	5.88Ukn PAL	—	—	—	—
1963	12	11	17 08 09.0	51.42 N	179.30 W	000	265	5.3	—	6.00M_R ROT	—	Felt	36	—
1964	01	12	06 00 12.9	53.17 N	166.30 W	033	299	5.5	—	5.50M_s BRK	—	Felt	37	—
1964	02	06	13 07 21.1	55.75 N	155.79 W	000	432	—	—	7.00M_s ABE	—	V	37	—
1964	03	28	03 36 14.0	61.04 N	147.73 W	033	451	—	8.3	8.40M_s ABE	9.23KAN	X	37	1800&
1964	03	28	04 54 07.9	59.8 N	149.4 W	025	266	6.1	—	—	—	—	—	—
1964	03	28	05 33 52.3	60.05 N	146.40 W	020	299	5.6	—	5.50m_b ISC	—	—	—	—
1964	03	28	05 35 39.1	57.20 N	153.00 W	033	299	5.7	—	5.80m_b ISC	—	—	—	—
1964	03	28	06 08 46.5	60.15 N	148.50 W	035	299	5.6	—	5.50m_b ISC	—	—	—	—
1964	03	28	06 32 38.5	60.09 N	147.62 W	033	299	5.5	—	5.50m_b ISC	—	—	—	—
1964	03	28	06 41 28.0	59.94 N	147.85 W	015	299	5.5	—	5.50m_b ISC	—	—	—	—
1964	03	28	06 43 54.4	58.26 N	151.25 W	004	299	6.1	—	5.63Ukn BRK	—	—	—	—
1964	03	28	06 53 35.9	58.79 N	149.54 W	020	299	5.7	—	5.70m_b ISC	—	—	—	—
1964	03	28	07 10 22.0	58.83 N	149.29 W	017	299	6.1	—	6.20Ukn PAS	—	Felt	37	—
1964	03	28	07 30 29.5	57.31 N	151.71 W	015	299	5.7	—	5.38M_s BRK	—	II	37	—
1964	03	28	08 33 48.3	58.08 N	151.00 W	032	299	5.6	—	6.50Ukn PAS	—	—	—	—
1964	03	28	08 39 55.2	57.52 N	151.48 W	020	299	5.4	—	5.50m_b ISC	—	II	37	—
1964	03	28	09 01 00.9	56.42 N	152.01 W	023	299	6.0	—	6.20Ukn PAS	—	—	—	—
1964	03	28	09 52 56.0	59.72 N	146.47 W	030	299	5.5	—	6.20Ukn PAS	—	—	—	—
1964	03	28	10 35 38.0	57.17 N	152.45 W	026	299	6.0	—	6.30Ukn PAS	—	Felt	37	—
1964	03	28	11 08 28.3	60.05 N	148.39 W	032	299	5.7	—	5.60Ukn PAS	—	—	—	—
1964	03	28	12 20 50.0	56.45 N	153.94 W	025	299	6.1	—	6.50Ukn PAS	—	Felt	37	—
1964	03	28	14 47 37.3	60.36 N	146.61 W	012	299	5.7	—	6.30Ukn PAS	—	Felt	37	—
1964	03	28	14 49 14.2	60.51 N	146.70 W	010	299	5.8	—	6.50Ukn PAS	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1964	03	28	23 46 20.1	57.42 N	151.09 W	020	299	5.2	—	5.60M_S BRK	—	—	—	—
1964	03	29	01 09 37.2	59.86 N	149.08 W	023	299	5.5	—	5.38Ukn PAS	—	—	—	—
1964	03	29	01 29 34.1	57.52 N	151.30 W	022	299	5.6	—	5.88M_S BRK	—	—	—	—
1964	03	29	06 04 44.3	56.13 N	154.30 W	028	299	5.6	—	5.60Ukn PAS	—	—	—	—
1964	03	29	16 40 58.8	59.79 N	146.82 W	014	299	5.6	—	5.80Ukn PAS	—	—	—	—
1964	03	30	02 03 04.9	59.14 N	147.86 W	026	299	5.1	—	4.90m_b ISC	—	—	—	—
1964	03	30	02 18 06.8	56.65 N	152.82 W	022	299	5.8	—	6.60Ukn PAS	—	—	—	—
1964	03	30	07 09 33.8	59.89 N	145.66 W	013	299	5.6	—	6.20Ukn PAS	—	—	—	—
1964	03	30	16 09 27.7	56.58 N	152.04 W	018	299	5.5	—	5.88Ukn PAL	—	—	—	—
1964	04	02	11 41 10.7	58.8 N	149.6 W	020	266	5.4	—	5.50m_b ISC	—	—	—	—
1964	04	02	22 34 32.5	59.76 N	144.07 W	022	299	5.0	—	5.88Ukn PAL	—	—	—	—
1964	04	03	08 38 42.9	59.60 N	144.67 W	010	299	5.4	—	5.50m_b ISC	—	—	—	—
1964	04	03	22 33 43.1	61.62 N	147.39 W	041	299	5.7	—	6.00Ukn PAS	—	V	37	—
1964	04	04	04 54 01.3	60.11 N	146.71 W	036	299	5.6	—	5.63Ukn BRK	—	—	—	—
1964	04	04	08 40 30.8	56.52 N	152.56 W	019	299	5.3	—	6.00Ukn PAL	—	—	—	—
1964	04	04	09 10 55.1	56.85 N	152.69 W	014	299	5.9	—	5.88Ukn PAL	—	Felt	37	—
1964	04	04	17 46 09.0	56.30 N	154.40 W	024	299	5.7	—	6.50Ukn PAS	—	—	—	—
1964	04	04	17 59 44.0	56.51 N	154.33 W	022	299	5.5	—	6.13Ukn PAS	—	—	—	—
1964	04	04	22 16 54.4	59.34 N	145.24 W	010	299	5.1	—	5.63Ukn PAL	—	—	—	—
1964	04	05	01 22 14.0	56.28 N	153.34 W	024	299	5.4	—	6.00Ukn PAS	—	—	—	—
1964	04	05	01 41 43.8	56.15 N	153.43 W	027	299	5.2	—	5.88Ukn PAL	—	—	—	—
1964	04	05	19 28 16.4	60.25 N	146.71 W	002	299	5.8	—	5.50Ukn PAL	—	—	—	—
1964	04	07	19 28 25.2	55.70 N	151.83 W	020	299	5.6	—	5.50m_b ISC	—	—	—	—
1964	04	09	13 06 19.2	59.93 N	145.04 W	018	299	5.1	—	5.63Ukn PAL	—	—	—	—
1964	04	10	01 08 01.1	58.38 N	150.60 W	019	299	5.5	—	5.13Ukn PAL	—	—	—	—
1964	04	10	21 44 12.3	60.15 N	153.51 W	045	299	5.6	—	5.63Ukn PAL	—	—	—	—
1964	04	12	01 24 31.2	56.60 N	152.20 W	022	299	5.6	—	6.25Ukn PAS	—	—	—	—
1964	04	13	14 04 59.2	57.51 N	151.30 W	021	299	5.5	—	5.40m_b ISC	—	—	—	—
1964	04	13	21 25 33.7	57.45 N	153.87 W	036	299	5.5	—	5.50m_b ISC	—	—	—	—
1964	04	14	22 55 30.0	57.97 N	152.57 W	020	299	5.4	—	5.50m_b ISC	—	VI	37	—
1964	04	15	15 30 47.0	56.53 N	154.39 W	034	299	5.7	—	5.40M_S BRK	—	—	—	—
1964	04	16	19 26 56.7	56.41 N	152.90 W	025	299	5.6	—	6.63Ukn PAS	—	—	—	—
1964	04	17	04 49 29.1	56.43 N	152.88 W	014	299	5.3	—	5.60M_S BRK	—	—	—	—
1964	04	20	11 56 38.5	61.51 N	147.20 W	006	299	5.7	—	6.50Ukn PAS	—	Felt	37	—
1964	04	21	05 01 35.7	61.50 N	147.30 W	038	299	5.4	—	6.00Ukn PAS	—	Felt	37	—
1964	05	01	06 01 54.9	60.38 N	145.86 W	020	299	5.4	—	5.50m_b ISC	—	—	—	—
1964	05	06	15 26 36.2	56.61 N	152.12 W	015	299	5.4	—	5.63Ukn PAL	—	—	—	—
1964	05	08	16 21 50.9	56.73 N	153.91 W	026	299	5.3	—	5.50Ukn PAL	—	—	—	—
1964	05	08	21 34 38.7	60.81 N	143.47 W	018	299	5.4	—	5.50Ukn PAL	—	—	—	—
1964	05	08	23 40 44.5	52.26 N	169.31 W	012	299	5.2	—	5.50Ukn PAL	—	—	—	—
1964	05	17	00 50 18.3	59.46 N	142.62 W	035	299	—	—	5.75Ukn PAS	—	—	—	—
1964	05	17	04 41 44.9	53.54 N	159.56 W	033	299	5.5	—	5.40m_b ISC	—	—	—	—
1964	05	29	10 17 35.0	60.16 N	146.45 W	008	299	5.6	—	5.50Ukn PAL	—	Felt	37	—
1964	06	28	19 09 04.9	58.23 N	150.42 W	024	299	5.5	—	5.50m_b ISC	—	—	—	—
1964	06	29	07 21 34.2	62.78 N	151.85 W	041	299	5.6	—	5.40M_S BRK	—	IV	37	—
1964	07	11	20 25 38.0	59.72 N	146.25 W	017	299	5.6	—	5.63Ukn PAL	—	—	—	—
1964	08	02	08 36 17.3	56.18 N	149.90 W	031	299	5.4	—	6.00Ukn PAS	—	III	37	—
1964	08	24	21 56 54.5	58.39 N	150.40 W	024	299	5.8	—	5.50m_b ISC	—	—	—	—
1964	09	01	17 16 39.7	51.06 N	170.58 W	018	299	5.5	—	5.50m_b ISC	—	—	—	—
1964	09	16	01 50 33.4	60.04 N	146.78 W	017	299	5.7	—	5.75Ukn PAS	—	Felt	37	—
1964	09	23	04 59 49.7	53.78 N	163.70 W	036	299	5.5	—	5.40m_b ISC	—	—	—	—
1964	09	25	15 42 18.8	50.27 N	176.63 E	036	299	5.5	—	5.40m_b ISC	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1964	10	10	20 06 34.7	60.38 N	145.97 W	001	299	5.4	—	5.60M_S BRK	—	—	—	—
1964	12	13	00 33 26.9	64.878N	165.570W	028	299	5.4	—	6.00Ukn PAL	—	VI	37	—
1964	12	17	23 44 45.4	51.211N	177.813W	030	479	5.5	—	5.50m_b ISC	—	Felt	37	—
1965	01	30	04 37 21.4	51.68 N	179.67 W	088	299	5.6	—	5.10m_b ISC	—	—	—	—
1965	02	04	04 53 57.2	51.18 N	178.49 E	030	299	5.8	—	5.30m_b ISC	—	—	—	—
1965	02	04	05 01 21.6	51.29 N	178.55 E	036	299	6.0	—	8.20M_S ABE	8.68KAN	VI	75	—
1965	02	04	05 19 18.4	50.4 N	173.2 E	035	299	5.7	—	5.50m_b ISC	—	—	—	—
1965	02	04	05 48 50.5	51.40 N	174.84 E	033	299	—	—	5.75M_S BRK	—	—	—	—
1965	02	04	06 04 58.2	51.74 N	175.02 E	037	299	6.1	—	6.13Ukn BRK	—	—	—	—
1965	02	04	06 37 05.5	52.57 N	172.05 E	035	299	—	—	5.50m_b ISC	—	—	—	—
1965	02	04	06 39 30.1	51.64 N	175.83 E	030	299	5.9	—	5.88Ukn BRK	—	—	—	—
1965	02	04	06 52 52.4	52.20 N	173.17 E	033	299	5.5	—	5.40m_b ISC	—	—	—	—
1965	02	04	07 11 21.4	51.03 N	177.86 E	024	299	5.9	—	5.50m_b ISC	—	—	—	—
1965	02	04	07 14 58.8	51.88 N	173.94 E	025	299	5.8	—	5.70m_b ISC	—	—	—	—
1965	02	04	07 23 12.9	51.8 N	173.4 E	021	299	5.5	—	5.60m_b ISC	—	—	—	—
1965	02	04	07 43 41.0	52.64 N	172.79 E	015	299	5.5	—	5.40m_b ISC	—	—	—	—
1965	02	04	08 04 10.3	52.18 N	172.87 E	030	299	5.9	—	5.30m_b ISC	—	—	—	—
1965	02	04	08 06 17.2	51.92 N	174.30 E	044	299	5.6	—	5.50m_b ISC	—	—	—	—
1965	02	04	08 06 29.0	51.67 N	174.80 E	040	299	—	—	5.50m_b ISC	—	—	—	—
1965	02	04	08 33 41.3	51.93 N	174.03 E	031	299	5.7	—	5.60m_b ISC	—	—	—	—
1965	02	04	08 40 42.1	51.39 N	179.59 E	040	299	6.4	—	7.00M_S ABE	—	—	—	—
1965	02	04	08 59 20.0	52.55 N	173.71 E	034	299	5.5	—	5.40m_b ISC	—	Felt	75	—
1965	02	04	09 51 59.2	51.56 N	175.72 E	004	299	5.6	—	5.30m_b ISC	—	—	—	—
1965	02	04	12 06 05.7	52.74 N	172.05 E	030	299	5.8	—	6.50Ukn PAS	—	Felt	75	—
1965	02	04	14 18 26.5	53.03 N	171.08 E	016	299	5.7	—	6.25Ukn PAS	—	Felt	75	—
1965	02	04	15 51 25.8	53.05 N	170.83 E	040	299	5.7	—	6.25Ukn PAS	—	Felt	75	—
1965	02	04	22 30 05.6	51.82 N	174.32 E	031	299	5.4	—	5.50m_b ISC	—	—	—	—
1965	02	05	06 25 23.1	51.8 N	177.0 E	040	299	5.5	—	5.10m_b ISC	—	—	—	—
1965	02	05	06 39 49.2	51.77 N	174.84 E	025	299	5.7	—	6.38Ukn PAS	—	—	—	—
1965	02	05	09 32 06.3	52.37 N	174.33 E	016	299	5.9	—	6.50Ukn PAS	—	—	—	—
1965	02	05	13 38 46.9	51.99 N	173.96 E	037	299	—	—	5.60m_b ISC	—	—	—	—
1965	02	05	14 08 23.2	51.74 N	174.38 E	035	299	5.8	—	5.40m_b ISC	—	—	—	—
1965	02	05	19 00 41.9	52.0 N	173.2 E	027	299	5.5	—	5.40m_b ISC	—	—	—	—
1965	02	05	20 47 12.4	51.83 N	174.41 E	030	299	5.7	—	5.70m_b ISC	—	—	—	—
1965	02	05	22 16 01.2	51.53 N	176.64 E	036	299	5.6	—	5.30m_b ISC	—	—	—	—
1965	02	06	01 40 34.6	53.14 N	161.85 W	043	299	6.4	—	6.63Ukn PAS	—	IV	75	—
1965	02	06	04 02 52.2	52.05 N	175.60 E	032	299	5.9	—	6.00Ukn PAL	—	—	—	—
1965	02	06	16 50 28.9	53.26 N	161.74 W	033	299	6.1	—	6.50Ukn PAS	—	IV	75	—
1965	02	06	21 02 58.5	52.81 N	171.98 E	010	299	5.6	—	5.00m_b ISC	—	—	—	—
1965	02	07	02 17 10.1	51.34 N	173.44 E	045	299	6.0	—	5.80m_b ISC	—	—	—	—
1965	02	07	04 11 20.2	52.03 N	175.48 E	025	299	5.5	—	5.40m_b ISC	—	—	—	—
1965	02	07	09 25 52.1	51.37 N	179.20 E	038	299	5.3	—	6.25Ukn PAS	—	—	—	—
1965	02	09	04 34 59.7	52.27 N	179.64 E	040	299	5.5	—	5.00m_b ISC	—	—	—	—
1965	02	09	17 37 14.4	52.73 N	171.99 E	028	299	5.7	—	5.80m_b ISC	—	—	—	—
1965	02	12	00 43 17.8	51.46 N	175.84 E	034	299	5.4	—	5.75Ukn PAS	—	—	—	—
1965	02	12	00 55 09.5	52.32 N	172.84 E	039	299	5.5	—	6.00Ukn PAS	—	—	—	—
1965	02	15	01 25 08.0	51.11 N	179.39 E	042	299	5.8	—	6.00Ukn PAS	—	—	—	—
1965	02	17	10 18 50.0	51.64 N	176.63 E	034	299	5.6	—	6.50Ukn PAS	—	—	—	—
1965	02	18	23 13 39.5	51.45 N	179.28 E	048	299	5.4	—	6.00Ukn PAS	—	Felt	75	—
1965	02	19	18 52 39.4	51.13 N	178.47 E	012	299	5.6	—	5.50m_b ISC	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. *Leader (--) indicates information is not available*]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1965	02	22	09 14 51.7	51.91 N	173.49 E	032	299	5.5	—	5.38Ukn PAL	—	—	—	—
1965	02	25	05 22 14.5	52.11 N	173.16 E	033	299	5.6	—	5.70m_b ISC	—	—	—	—
1965	03	01	19 21 59.9	52.17 N	174.05 E	013	299	5.5	—	5.50m_b ISC	—	—	—	—
1965	03	03	16 47 25.0	53.02 N	171.35 E	014	299	5.6	—	5.90m_b ISC	—	—	—	—
1965	03	04	06 30 18.8	52.04 N	175.14 E	057	299	5.5	—	5.30m_b ISC	—	—	—	—
1965	03	05	06 14 59.8	51.25 N	179.58 E	005	299	5.6	—	5.50m_b ISC	—	—	—	—
1965	03	05	13 42 44.5	52.22 N	174.98 E	033	299	5.3	—	5.50m_b ISC	—	—	—	—
1965	03	05	17 59 13.6	52.29 N	174.33 E	031	299	5.7	—	5.60m_b ISC	—	—	—	—
1965	03	13	07 33 23.5	53.17 N	162.07 W	036	299	5.5	—	5.50m_b ISC	—	—	—	—
1965	03	17	14 27 11.7	52.80 N	171.97 E	014	299	6.0	—	5.70m_b ISC	—	Felt	75	—
1965	03	30	02 27 03.4	50.32 N	177.93 E	020	299	—	—	7.40M_S ABE	7.64KA	Felt	75	—
1965	03	31	10 46 10.9	50.29 N	178.35 E	048	299	5.6	—	5.30m_b ISC	—	—	—	—
1965	04	04	13 30 37.4	51.83 N	175.38 E	032	299	5.7	—	6.00Ukn PAS	—	—	—	—
1965	04	08	13 43 52.6	52.22 N	173.45 E	037	299	5.4	—	5.70Ukn PAS	—	—	—	—
1965	04	10	16 54 56.1	53.11 N	170.95 E	008	299	5.8	—	5.38Ukn PAL	—	—	—	—
1965	04	16	23 22 18.6	64.69 N	160.23 W	005	299	5.8	—	5.88Ukn PAS	—	VI	75	—
1965	04	20	06 43 06.6	52.42 N	172.04 E	016	299	5.5	—	5.10Ukn PAL	—	Felt	75	—
1965	04	22	18 35 59.0	51.85 N	176.16 E	015	299	5.1	—	5.60Ukn PAL	—	—	—	—
1965	04	26	20 29 07.5	54.25 N	162.51 W	051	299	5.9	—	5.13Ukn PAL	—	IV	75	—
1965	05	05	23 02 02.1	52.56 N	173.65 E	031	299	5.6	—	5.30m_b ISC	—	—	—	—
1965	05	11	17 37 39.1	61.33 N	149.52 W	061	299	5.5	—	5.75Ukn PAS	—	IV	75	—
1965	05	23	23 46 14.3	52.17 N	175.17 E	031	299	6.1	—	6.00Ukn PAS	—	—	—	—
1965	05	25	13 07 49.3	51.23 N	178.76 E	035	299	5.5	—	5.88Ukn PAL	—	—	—	—
1965	06	03	07 43 38.1	51.91 N	175.83 E	046	299	5.5	—	5.30m_b ISC	—	—	—	—
1965	06	09	13 26 51.6	52.55 N	173.31 E	017	299	5.6	—	5.10m_b ISC	—	—	—	—
1965	06	11	02 37 35.0	51.80 N	174.17 E	032	299	5.5	—	5.60m_b ISC	—	—	—	—
1965	06	15	04 46 13.8	50.07 N	178.26 E	026	299	5.5	—	5.13Ukn PAL	—	—	—	—
1965	06	19	06 38 11.8	52.39 N	172.14 E	038	299	5.5	—	5.38Ukn PAL	—	—	—	—
1965	06	23	11 09 16.5	56.61 N	152.68 W	031	299	5.7	—	6.38Ukn PAS	—	—	—	—
1965	06	30	08 33 27.5	51.81 N	176.62 E	015	299	5.7	—	5.63Ukn PAS	—	—	—	—
1965	07	02	20 58 38.1	53.03 N	167.55 W	040	299	6.7	—	6.50M_S ABE	—	VI	75	—
1965	07	21	17 52 27.0	53.31 N	170.38 E	011	299	5.7	—	5.70m_b ISC	—	—	—	—
1965	07	22	01 18 52.2	50.96 N	175.95 E	044	299	5.6	—	5.30m_b ISC	—	—	—	—
1965	07	25	21 46 46.1	51.52 N	175.95 E	037	299	5.5	—	5.75Ukn PAS	—	—	—	—
1965	07	29	08 29 22.0	51.11 N	171.30 W	018	299	6.3	—	6.70M_S ABE	—	Felt	75	—
1965	07	29	12 20 23.2	50.88 N	171.57 W	037	299	5.5	—	5.50m_b ISC	—	—	—	—
1965	07	29	15 08 32.7	51.00 N	171.30 W	003	299	5.5	—	5.40m_b ISC	—	—	—	—
1965	08	11	18 29 38.5	59.36 N	146.08 W	015	299	5.5	—	5.30m_b ISC	—	—	—	—
1965	09	02	04 26 37.8	51.91 N	175.51 E	030	299	5.7	—	5.38Ukn PAL	—	—	—	—
1965	09	04	14 32 50.2	58.29 N	152.50 W	030	299	6.2	—	6.80M_S ABE	—	Felt	75	—
1965	09	08	03 26 21.0	57.48 N	152.10 W	025	299	5.6	—	5.38Ukn PAL	—	Felt	75	—
1965	09	08	11 16 33.6	55.71 N	155.30 W	024	299	5.5	—	5.50Ukn PAL	—	—	—	—
1965	09	18	20 46 36.7	59.38 N	145.18 W	005	299	5.3	—	6.00Ukn PAL	—	—	—	—
1965	09	27	05 09 07.5	51.86 N	175.60 E	000	299	5.5	—	5.38Ukn PAL	—	—	—	—
1965	10	01	08 52 01.9	50.02 N	178.28 E	005	299	6.3	—	6.50Ukn PAS	—	Felt	75	—
1965	10	12	13 40 59.4	56.1 N	153.6 W	029	299	5.5	—	5.40m_b ISC	—	—	—	—
1965	10	19	20 48 45.9	52.37 N	174.33 E	029	299	5.6	—	5.88Ukn PAL	—	—	—	—
1965	10	20	11 08 10.3	51.254N	173.762W	020	479	5.6	—	5.25Ukn PAL	—	—	—	—
1965	10	23	06 00 52.5	53.85 N	165.30 W	039	299	5.5	—	5.38m_b ISC	—	—	—	—
1965	11	22	14 00 29.3	51.576N	175.948W	046	479	5.6	—	5.50m_b ISC	—	Felt	75	—
1965	11	22	20 25 31.4	51.32 N	179.67 W	041	299	5.9	—	5.80m_b ISC	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1965	11	23	02 17 49.8	51.41 N	179.67 W	045	299	5.6	—	5.75Ukn PAL	—	Felt	75	—
1965	12	04	02 11 50.3	51.07 N	170.49 W	019	299	5.7	—	5.60m_b ISC	—	—	—	—
1965	12	05	18 14 51.0	52.61 N	173.27 E	038	299	5.6	—	5.38Ukn PAL	—	—	—	—
1965	12	22	19 41 21.6	58.35 N	153.13 W	038	299	6.5	—	6.88Ukn PAS	—	V	75	—
1965	12	23	20 47 37.6	60.57 N	140.64 W	025	299	5.8	—	5.70m_b ISC	—	—	—	—
1965	12	30	02 06 30.4	54.09 N	164.28 W	019	299	5.7	—	5.75Ukn PAL	—	Felt	75	—
1966	01	13	10 41 12.9	52.94 N	172.04 E	021	299	5.6	—	5.70m_b ISC	—	—	—	—
1966	01	16	09 11 47.5	52.85 N	172.00 E	008	299	5.5	—	5.50m_b ISC	—	—	—	—
1966	01	20	14 46 05.2	52.98 N	171.74 E	022	299	5.6	—	5.30m_b ISC	—	—	—	—
1966	01	22	14 27 07.9	56.03 N	153.78 W	030	299	5.8	—	6.00Ukn PAS	—	—	—	—
1966	01	27	19 39 05.9	51.31 N	178.27 E	038	299	5.5	—	5.30m_b ISC	—	—	—	—
1966	02	26	00 33 47.3	52.70 N	173.52 E	017	299	5.5	—	5.40m_b ISC	—	—	—	—
1966	04	06	22 28 37.5	56.47 N	154.64 W	028	299	5.5	—	5.10m_b ISC	—	—	—	—
1966	04	08	22 10 57.7	56.62 N	152.29 W	031	299	5.0	—	5.63Ukn PAL	—	—	—	—
1966	04	11	23 00 22.9	56.57 N	152.07 W	024	299	5.4	—	5.88Ukn PAL	—	—	—	—
1966	04	16	01 27 14.1	56.93 N	153.61 W	023	299	5.7	—	6.25Ukn PAS	—	—	—	—
1966	04	22	23 27 20.3	57.37 N	152.27 W	023	299	5.9	—	5.80m_b ISC	—	Felt	81	—
1966	05	15	14 46 08.7	51.216N	178.317W	030	479	5.7	—	5.88Ukn PAS	—	III	81	—
1966	05	19	07 06 28.5	54.04 N	164.08 W	037	299	—	—	6.00Ukn PAS	—	IV	81	—
1966	06	02	03 27 54.1	51.01 N	175.98 E	048	299	5.9	—	6.00Ukn PAS	—	—	—	—
1966	06	08	19 56 22.9	53.17 N	171.03 E	025	299	5.4	—	5.50m_b ISC	—	—	—	—
1966	06	11	18 13 40.0	51.265N	178.349W	035	479	5.5	—	5.50m_b ISC	—	—	—	—
1966	07	04	02 55 37.7	51.78 N	176.44 E	041	299	5.5	—	5.50m_b ISC	—	—	—	—
1966	07	04	18 33 37.1	51.9 N	179.8 E	015	266	6.0	—	6.88M_s ABE	6.86KA	III	81	—
1966	08	07	02 13 04.3	50.57 N	171.22 W	029	299	6.2	—	7.00m_b ABE	—	Felt	81	—
1966	08	12	20 17 00.9	52.67 N	161.53 W	032	299	5.6	—	5.50m_b ISC	—	—	—	—
1966	08	17	20 58 35.0	52.16 N	175.02 E	023	299	5.5	—	5.40m_b ISC	—	Felt	81	—
1966	08	30	20 20 55.0	61.34 N	147.44 W	045	299	5.8	—	5.88Ukn PAS	—	V	81	78&
1966	08	30	20 23 18.2	61.5 N	147.5 W	033	299	5.5	—	5.30m_b ISC	—	V	81	—
1966	10	07	20 55 56.0	61.66 N	150.06 W	054	299	5.6	—	5.30m_b ISC	—	IV	81	—
1966	11	11	15 31 04.4	52.26 N	169.07 W	037	299	5.4	—	5.50m_b ISC	—	—	—	—
1967	01	18	08 18 22.0	52.534N	168.202W	033	266	5.8	—	6.00Ukn PAS	—	—	—	—
1967	01	28	13 52 58.2	52.375N	169.515W	043	266	5.9	6.7	6.38Ukn PAS	—	Felt	40	—
1967	01	28	17 42 01.8	52.401N	169.386W	050	266	5.6	—	6.00Ukn PAS	—	—	—	—
1967	02	07	14 53 13.9	56.661N	157.177W	063	74	5.5	—	5.60m_b ISC	—	—	—	—
1967	04	29	03 55 19.9	51.146N	178.256W	025	479	5.9	—	6.00m_b ISC	—	III	40	—
1967	04	29	12 25 31.7	51.106N	178.258W	025	479	5.3	—	5.60m_b ISC	—	II	40	—
1967	05	27	17 22 58.5	51.866N	176.124E	032	74	5.7	—	6.00Ukn PAS	—	—	—	—
1967	06	01	03 36 18.0	53.60 N	165.64 W	049	299	5.7	—	5.70m_b ISC	—	IV	40	—
1967	06	03	09 08 54.0	58.35 N	151.31 W	013	299	5.7	—	5.40m_b ISC	—	—	—	—
1967	06	19	17 07 47.1	52.76 N	166.90 W	044	299	5.7	—	6.00Ukn PAS	—	—	—	—
1967	06	20	07 38 50.0	52.79 N	167.06 W	045	299	5.4	—	5.50Ukn PAL	—	—	—	—
1967	06	21	18 04 49.5	64.756N	147.372W	017	452	5.4	5.6	6.10M_L JDH	—	VII	452	135
1967	06	21	18 13 02.9	64.8 N	147.4 W	017	74	5.6	5.9	6.10M_L JDH	—	VII	452	—
1967	06	21	18 24 45.7	64.8 N	147.4 W	017	74	5.4	5.5	5.90M_L JDH	—	VII	452	—
1967	06	23	11 54 33.5	64.816N	147.450W	009	74	—	—	5.60M_L JDH	—	VI	40	—
1967	07	01	23 10 08.6	54.44 N	157.94 W	038	299	6.2	—	6.75Ukn PAS	—	IV	40	—
1967	07	06	13 42 27.6	52.58 N	168.13 W	049	299	5.9	—	6.38Ukn PAS	—	—	—	—
1967	09	28	15 44 52.0	59.43 N	147.12 W	004	299	5.4	—	5.60M_s BRK	—	Felt	40	—
1968	01	04	00 57 41.0	52.17 N	171.36 W	008	299	5.7	—	6.13Ukn PAS	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1968	01	14	12 40 48.5	52.8 N	171.4 W	044	74	5.6	—	5.50m_b ISC	—	—	—	—
1968	01	14	17 43 06.0	52.65 N	171.25 W	003	299	5.5	—	6.25Ukn PAS	—	IV	41	—
1968	03	10	03 49 28.1	52.201N	177.243W	012	479	5.4	—	5.60Ukn PAL	—	IV	41	—
1968	04	23	20 29 14.6	58.69 N	149.93 W	022	299	6.3	—	6.12Ukn PAS	—	Felt	41	—
1968	05	28	22 29 58.1	52.19 N	172.85 E	021	299	5.6	5.7	5.60m_b ISC	—	—	—	—
1968	06	10	12 41 04.3	56.29 N	161.55 W	165	299	5.6	—	5.50m_b ISC	—	—	—	—
1968	08	11	12 37 29.1	52.13 N	179.97 W	166	299	5.5	—	5.60m_b ISC	—	Felt	41	—
1968	10	29	22 16 16.5	65.46 N	150.07 W	007	299	6.0	6.5	7.10M_L GS	—	VII	41	420
1968	12	14	09 59 02.3	51.479N	175.745E	033	74	5.2	5.8	6.25Ukn PAS	—	—	—	—
1968	12	15	02 14 17.8	51.56 N	175.86 E	033	299	5.7	6.2	6.38Ukn PAS	—	—	—	—
1968	12	15	02 28 31.9	51.67 N	175.76 E	029	299	5.4	6.1	5.40m_b ISC	—	—	—	—
1968	12	17	12 02 14.8	60.15 N	152.82 W	082	299	5.9	—	6.50Ukn PAS	—	VI	41	260&
1969	01	03	13 28 14.1	51.14 N	179.39 W	038	299	5.7	5.2	5.60Ukn BRK	—	II	259	—
1969	03	15	13 35 35.3	51.31 N	179.02 W	044	299	5.6	5.2	5.50m_b ISC	—	Felt	42	—
1969	04	04	08 45 19.1	51.17 N	173.67 E	035	299	5.6	5.3	5.60m_b ISC	—	—	—	—
1969	05	14	19 32 55.0	51.29 N	179.85 W	022	299	6.2	7.0	6.50M_L GS	—	V	42	—
1969	05	23	13 04 37.0	53.36 N	160.12 W	032	299	5.6	5.3	5.50m_b ISC	—	—	—	—
1969	06	18	23 44 11.2	52.627N	167.893W	018	74	5.4	5.6	5.40m_b ISC	—	—	—	—
1969	06	20	02 37 51.5	53.172N	162.435W	044	74	5.7	5.1	5.80m_b ISC	—	—	—	—
1969	06	22	10 45 24.8	51.46 N	179.95 W	056	299	6.1	—	6.10m_b ISC	—	Felt	42	—
1969	07	27	21 21 40.6	59.414N	145.318W	033	74	5.3	5.3	5.50Ukn PAS	—	—	—	—
1969	07	28	06 29 54.0	57.43 N	153.89 W	027	299	5.3	4.8	5.50M_s BRK	—	—	—	—
1969	09	12	08 57 06.9	51.27 N	179.17 W	038	299	6.0	6.6	6.30M_L GS	—	Felt	42	—
1969	09	12	15 00 18.3	51.29 N	179.14 W	048	299	5.6	—	5.70m_b ISC	—	—	—	—
1969	10	18	08 43 58.0	52.52 N	173.42 E	009	299	5.6	5.3	5.50m_b ISC	—	IV	42	—
1969	10	21	20 53 47.5	51.306N	179.235W	048	74	5.9	5.4	6.00Ukn PAS	—	—	—	—
1969	10	31	11 33 04.3	51.059N	178.901W	025	479	6.0	6.3	6.50Ukn PAS	—	IV	42	—
1969	11	06	20 20 19.2	51.128N	178.829W	025	479	5.5	5.7	5.50m_b ISC	—	Felt	42	—
1969	11	12	19 09 02.0	52.975N	168.276W	053	74	5.4	—	5.75M_s BRK	—	—	—	—
1969	11	20	23 46 11.6	56.6 N	153.2 W	033	74	5.1	5.5	5.60M_L GS	—	IV	42	—
1969	11	24	22 51 49.6	56.14 N	153.66 W	028	299	5.5	5.7	6.00M_L GS	—	IV	42	—
1970	01	16	08 05 39.0	60.28 N	152.66 W	085	299	5.5	—	6.10M_L GS	—	V	43	—
1970	01	22	03 55 30.0	51.32 N	177.16 E	012	299	5.3	5.5	5.20m_b ISC	—	—	—	—
1970	02	24	08 05 39.6	59.567N	143.874W	015	74	5.0	5.6	5.40M_L GS	—	—	—	—
1970	02	27	07 07 56.5	50.13 N	179.59 W	007	299	6.0	5.9	6.25Ukn PAS	—	III	43	—
1970	02	28	10 52 32.4	52.589N	175.054W	158	479	6.0	—	6.70Ukn BRK	—	III	43	—
1970	03	11	22 38 32.4	57.39 N	153.97 W	016	299	6.0	6.0	6.40M_L GS	—	V	43	—
1970	03	17	22 00 12.4	59.2 N	147.9 W	047	74	5.1	4.8	5.50M_L GS	—	II	43	—
1970	03	19	23 33 28.7	51.34 N	173.75 E	008	299	5.8	6.2	6.50Ukn PAS	—	IV	43	—
1970	04	11	04 05 41.1	59.7 N	142.7 W	007	299	5.2	6.2	5.80M_L GS	—	III	43	—
1970	04	16	05 33 17.5	59.8 N	142.6 W	007	74	5.5	6.8	6.20M_L GS	—	IV	43	—
1970	04	18	08 50 40.0	59.82 N	152.79 W	089	299	5.7	—	5.40m_b ISC	—	V	43	—
1970	04	19	01 15 47.0	59.60 N	142.72 W	020	299	5.8	6.0	5.80M_L GS	—	Felt	43	—
1970	05	20	20 30 54.7	51.188N	178.456W	030	479	5.7	—	5.60m_b ISC	—	—	—	—
1970	06	02	02 59 29.5	61.54 N	151.79 W	080	299	5.5	—	5.50m_b ISC	—	IV	43	—
1970	06	13	05 27 55.6	51.370N	178.311W	040	479	5.5	—	5.50m_b ISC	—	—	—	—
1970	06	22	14 39 30.6	55.194N	156.501W	033	74	5.5	5.2	5.70M_L GS	—	—	—	—
1970	07	18	01 48 38.7	51.130N	178.486W	025	479	5.8	5.9	5.90M_s BRK	—	IV	43	—
1970	08	14	03 39 34.0	64.98 N	147.83 W	017	299	5.0	5.0	5.60M_L GS	—	V	43	—
1970	08	18	17 52 08.4	60.70 N	145.38 W	030	299	5.6	5.9	5.90M_L GS	—	IV	43	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date (Yr Mo Da)	Origin time (UTC) (h m s)	Hypocenter Latitude (°)	Hypocenter Longitude (°)	Hypocenter Depth (km)	Hypocenter Ref	Magnitude USGS m_b	Magnitude USGS M_S	Magnitude Other	Magnitude Moment M	Intensity MM	Intensity Ref	Felt area (1,000 km²)
1970 11 03	02 30 11.8	62.01 N	151.05 W	070	299	5.6	—	5.25M_s BRK	—	V	43	—
1970 12 01	21 09 37.1	51.212N	175.189W	021	479	5.6	5.8	6.00Ukn PAS	—	II	43	—
1970 12 02	02 34 56.5	51.192N	175.160W	018	479	5.4	—	5.50Ukn PAS	—	II	43	—
1970 12 10	10 15 06.9	52.93 N	169.70 W	044	299	5.5	5.3	5.50m_b BRK	—	—	—	—
1971 01 07	02 50 00.9	52.265N	173.199W	088	479	5.8	—	5.70m_b ISC	—	IV	44	—
1971 01 25	16 08 16.4	51.246N	177.616W	030	479	5.9	6.3	6.25Ukn PAS	—	IV	44	—
1971 01 26	19 32 04.9	51.665N	174.916W	036	74	5.4	5.5	5.30m_b ISC	—	III	44	—
1971 02 01	05 19 22.6	51.474N	172.889W	020	479	5.5	5.8	6.00Ukn PAS	—	—	—	—
1971 02 07	02 29 26.4	51.124N	176.766W	017	479	6.0	—	6.50Ukn PAS	—	V	44	—
1971 02 07	02 42 02.7	50.997N	177.031W	020	479	5.8	—	5.50m_b ISC	—	III	44	—
1971 02 11	12 55 51.6	50.960N	177.222W	020	479	5.5	5.2	5.50m_b ISC	—	—	—	—
1971 03 26	17 35 18.0	60.342N	140.991W	007	74	5.5	5.7	5.90M_L GS	—	IV	44	—
1971 03 27	17 09 52.6	52.614N	174.537W	122	479	5.6	—	5.60m_b ISC	—	II	44	—
1971 03 30	11 30 40.7	50.981N	177.363W	020	479	5.7	5.4	5.10M_L GS	—	III	44	—
1971 04 05	09 04 42.8	53.359N	170.553W	153	74	5.8	—	5.90Ukn PAS	—	—	—	—
1971 05 02	06 08 27.8	51.228N	177.173W	030	479	6.0	7.1	6.80Ukn PAS	—	IV	44	—
1971 05 20	02 35 37.6	52.281N	173.340W	058	479	5.5	—	5.40m_b ISC	—	—	—	—
1971 05 21	18 56 43.0	52.653N	173.257W	015	479	5.7	5.3	5.70M_L GS	—	II	44	—
1971 06 02	19 06 32.9	61.055N	151.147W	029	299	5.0	—	5.50M_L GS	—	IV	44	—
1971 06 11	13 58 37.7	51.487N	176.084E	032	74	5.9	6.5	6.10Ukn PAS	—	IV	44	—
1971 07 21	12 03 41.1	51.946N	170.540W	036	299	4.9	5.7	5.70M_s BRK	—	—	—	—
1971 07 25	15 41 21.3	52.151N	173.095E	028	74	5.8	6.3	6.00Ukn PAS	—	II	44	—
1971 07 29	22 18 20.1	52.080N	173.376E	042	74	5.6	5.6	5.60m_b ISC	—	—	—	—
1971 09 04	15 53 25.4	54.981N	163.357W	107	74	5.8	—	5.70m_b ISC	—	IV	44	—
1971 10 19	11 02 37.7	52.656N	166.967W	022	74	5.6	—	5.60m_b ISC	—	—	—	—
1971 11 22	00 46 11.1	52.269N	174.317E	043	74	5.6	5.5	6.00Ukn PAS	—	IV	44	—
1972 01 03	17 06 22.3	51.136N	178.900E	046	74	5.5	5.4	5.40m_b ISC	—	II	45	—
1972 02 21	19 34 50.9	55.902N	158.265W	060	74	5.7	—	5.70m_b ISC	—	V	45	—
1972 03 20	23 31 47.7	50.947N	179.231W	016	454	6.0	5.4	6.00m_b ISC	—	—	—	—
1972 03 24	03 38 27.1	56.142N	157.180W	069	74	6.0	—	6.00m_b ISC	—	IV	45	—
1972 04 21	01 28 09.5	54.007N	166.853W	103	74	5.8	—	6.00Ukn PAS	—	V	74	—
1972 06 06	02 19 42.5	51.313N	178.231W	035	479	5.3	—	5.60M_L GS	—	III	45	—
1972 06 12	19 47 35.6	53.250N	166.780W	027	299	5.8	5.8	5.80M_s BRK	—	Felt	45	—
1972 07 30	21 45 14.1	56.820N	135.685W	025	74	6.5	7.6	7.40M_s ABE	7.60SR	VII	45	130&
1972 08 03	04 40 53.3	50.957N	178.099W	019	479	5.8	6.2	6.10Ukn PAS	—	VI	45	—
1972 08 03	06 59 44.6	50.944N	178.139W	020	479	5.5	5.4	5.60m_b ISC	—	III	45	—
1972 08 04	11 38 08.3	56.205N	135.342W	020	74	5.6	5.8	6.00Ukn PAS	—	V	45	—
1972 08 12	09 42 06.3	50.972N	179.273W	017	454	5.9	5.7	5.80M_L GS	—	III	45	—
1972 08 15	10 56 12.8	56.252N	135.495W	021	74	5.6	4.8	5.40m_b ISC	—	V	45	—
1972 08 23	08 47 15.9	58.227N	153.513W	060	299	5.5	—	5.50m_b ISC	—	IV	45	—
1972 08 28	15 21 01.2	51.013N	179.261W	021	454	5.5	—	5.40m_b ISC	—	IV	45	—
1972 10 13	04 46 11.0	52.833N	163.064W	038	74	5.9	5.4	6.40Ukn PAS	—	—	—	—
1972 11 21	17 01 55.3	52.449N	173.611E	050	74	5.5	—	5.50m_b ISC	—	V	45	—
1972 12 26	22 03 42.0	51.405N	176.213W	034	479	5.5	—	5.40m_b ISC	—	V	45	—
1973 02 20	07 40 35.2	58.263N	149.816W	012	299	5.5	5.1	5.40m_b ISC	—	—	—	—
1973 03 19	11 41 07.7	52.835N	173.773E	081	74	5.8	—	5.70m_b ISC	—	V	46	—
1973 03 23	06 55 33.1	51.301N	174.217E	027	74	5.8	5.9	5.70m_b ISC	—	Felt	46	—
1973 03 27	12 32 05.0	52.576N	172.872E	043	74	5.6	5.2	5.60m_b ISC	—	V	46	—
1973 04 16	14 48 00.3	50.902N	178.810W	020	479	5.5	—	5.50m_b ISC	—	IV	46	—
1973 05 24	18 47 10.7	51.425N	173.286W	020	479	5.4	5.1	5.50m_b ISC	—	IV	46	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MM	Ref	(1,000 km²)
1973	05	26	12 19 34.2	51.287N	179.708W	035	299	5.8	—	5.70m_b ISC	—	V	46	—
1973	05	29	01 46 44.9	51.685N	176.239E	046	74	5.2	5.7	5.50M_s BRK	—	—	—	—
1973	05	29	06 14 22.3	54.011N	163.760W	030	74	6.0	5.5	5.30M_s BRK	—	V	46	—
1973	06	15	12 11 02.3	51.304N	179.392W	048	74	5.8	—	5.80m_b ISC	—	IV	46	—
1973	06	23	05 26 48.5	51.402N	176.673W	039	479	5.5	—	5.40m_b ISC	—	V	46	—
1973	07	01	13 33 34.6	57.840N	137.330W	033	74	6.1	6.7	6.70Ukn PAS	—	V	46	—
1973	07	03	16 59 35.1	57.980N	138.021W	033	74	6.0	6.0	6.40Ukn PAS	—	V	46	—
1973	08	16	12 16 59.0	51.149N	176.608W	020	479	5.6	5.8	5.80M_s BRK	—	IV	46	—
1973	08	16	14 25 31.4	51.134N	176.535W	020	479	5.6	—	5.30m_b ISC	—	III	46	—
1973	08	22	18 14 37.2	57.067N	154.101W	038	74	5.9	5.6	5.50M_s BRK	—	Felt	46	—
1973	09	06	10 59 36.7	61.039N	146.828W	029	74	5.5	5.3	5.50M_L PMR	—	III	46	—
1973	11	06	09 36 07.4	51.428N	175.356W	037	479	5.8	6.4	6.20Ukn PAS	—	IV	46	—
1973	11	06	18 26 35.1	51.331N	175.201W	027	479	5.9	6.3	6.20Ukn PAS	—	IV	46	—
1973	11	09	14 13 03.5	52.444N	178.353E	182	74	5.6	—	5.50m_b ISC	—	—	—	—
1973	12	02	22 09 54.5	52.283N	168.735W	040	74	5.6	5.0	5.60m_b ISC	—	—	—	—
1973	12	14	17 37 34.7	51.172N	177.827W	030	479	5.8	—	5.80M_L ADK	—	V	46	—
1974	01	31	19 55 26.2	52.357N	168.740W	036	74	5.6	5.0	5.60m_b ISC	—	—	—	—
1974	02	06	04 04 07.2	53.799N	164.672W	002	74	5.9	6.5	6.30Ukn PAS	—	V	47	—
1974	03	27	16 28 47.3	50.109N	179.657W	037	74	5.6	4.8	5.60m_b ISC	—	—	—	—
1974	03	29	21 50 35.3	57.585N	153.922W	044	74	5.7	5.2	5.50M_L PMR	—	IV	47	—
1974	04	06	01 53 47.3	55.102N	160.440W	027	74	5.7	5.1	5.80m_b ISC	—	V	47	—
1974	04	06	03 56 01.8	55.120N	160.443W	040	74	6.0	5.3	6.00m_b ISC	—	V	47	—
1974	05	27	14 01 43.5	60.328N	146.016W	021	74	5.5	5.7	5.40M_L PMR	—	III	47	—
1974	06	15	02 37 13.8	52.262N	178.791E	157	74	5.7	—	5.50m_b ISC	—	—	—	—
1974	08	01	05 07 59.0	56.516N	152.315W	010	74	5.2	6.1	5.30m_b ISC	—	—	—	—
1974	08	01	05 55 38.2	56.670N	152.105W	033	74	5.7	6.3	5.70m_b ISC	—	—	—	—
1974	08	01	07 59 55.4	56.515N	152.431W	021	299	5.2	6.0	5.10m_b ISC	—	—	—	—
1974	08	13	03 46 20.6	51.293N	178.068W	033	479	5.8	—	5.90M_s BRK	—	V	47	—
1974	08	14	05 34 54.3	51.281N	178.118W	034	479	5.7	—	5.20M_s BRK	—	II	47	—
1974	08	16	09 41 31.9	51.228N	177.791W	031	479	5.7	5.8	5.90M_L ADK	—	IV	47	—
1974	08	20	20 45 01.4	52.243N	174.972E	058	74	5.6	—	5.10M_s BRK	—	III	47	—
1974	08	24	10 41 11.2	52.407N	168.273W	041	74	5.7	5.6	5.50M_L ADK	—	—	—	—
1974	11	11	05 17 51.4	51.454N	178.079W	047	479	5.8	—	5.20M_s BRK	—	V	47	—
1974	11	14	04 48 54.7	58.797N	154.620W	037	74	5.5	5.6	5.40M_L PMR	—	IV	47	—
1974	12	07	07 34 11.0	51.857N	170.795W	033	74	5.5	5.8	5.10M_s BRK	—	—	—	—
1974	12	25	02 49 13.0	51.697N	174.635E	040	74	5.7	5.8	5.90M_L ADK	—	IV	47	—
1974	12	29	18 25 00.7	61.597N	150.511W	067	74	5.6	—	5.60m_b ISC	—	V	47	—
1975	01	01	03 55 12.0	61.909N	149.738W	066	74	5.9	—	5.90m_b ISC	—	V	48	—
1975	01	13	09 19 10.3	52.220N	171.142W	042	74	5.7	5.6	5.50M_s BRK	—	—	—	—
1975	02	02	07 24 53.3	53.053N	173.446E	025	74	5.9	5.5	5.90m_b ISC	—	II	48	—
1975	02	02	08 43 39.1	53.113N	173.497E	010	74	6.1	7.6	7.40M_s ABE	—	IX	48	—
1975	02	22	08 36 07.4	51.377N	179.419W	048	74	6.3	6.5	6.00Ukn PAS	—	V	48	—
1975	04	11	10 47 15.3	54.097N	163.248W	020	74	5.5	5.2	5.70M_s BRK	—	IV	48	—
1975	05	25	19 04 34.4	57.375N	150.119W	033	74	5.6	5.4	5.70M_L PMR	—	—	—	—
1975	07	25	10 40 25.0	55.055N	160.377W	017	74	5.8	5.2	5.60m_b ISC	—	IV	48	—
1975	08	02	10 18 17.9	53.387N	161.485W	033	74	6.2	6.0	5.70M_s BRK	—	V	48	—
1975	10	17	19 39 12.5	57.446N	149.008W	033	74	5.7	5.5	5.50m_b ISC	—	—	—	—
1975	11	01	00 48 23.4	53.655N	163.366W	025	74	5.7	5.7	5.70m_b ISC	—	—	—	—
1975	11	30	20 30 17.0	52.599N	167.184W	024	74	5.7	6.3	6.60Ukn PAS	—	—	—	—
1976	08	22	02 01 47.4	60.220N	153.304W	144	74	5.5	—	5.50m_b ISC	—	V	49	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (—) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1976	10	21	14 54 35.6	52.229N	169.390W	036	74	5.4	—	5.50m_b ISC	—	—	—	—
1976	10	22	18 35 25.9	56.143N	153.274W	026	74	5.5	4.8	5.40m_b ISC	—	—	—	—
1977	03	26	04 36 14.7	52.295N	168.257W	038	74	5.7	6.0	6.10M_S BRK	—	IV	39	—
1977	05	30	15 16 01.6	52.428N	169.707W	033	74	5.6	6.0	6.00Ukn PAS	—	IV	39	—
1977	09	04	15 40 57.3	51.207N	178.388E	034	74	5.6	6.4	6.10M_S PAS	—	II	39	—
1977	09	04	17 10 30.6	51.096N	178.265E	031	74	5.5	6.4	6.20M_S PAS	—	II	39	—
1977	09	04	17 16 14.7	51.097N	178.233E	033	299	5.5	—	5.40m_b ISC	—	—	—	—
1977	09	04	17 24 42.8	51.144N	177.954E	008	74	5.8	6.6	6.40M_S PAS	—	II	39	—
1977	09	04	23 20 44.9	51.179N	178.249E	041	74	5.5	5.3	5.50M_S BRK	—	—	—	—
1977	10	26	15 10 58.8	51.146N	178.327E	033	74	5.6	5.2	5.50m_b ISC	—	—	—	—
1977	11	04	09 52 58.6	51.436N	175.935W	037	479	5.7	6.7	6.60M_S PAS	—	VI	39	—
1977	11	05	14 44 06.4	51.403N	175.565W	041	479	5.3	5.6	5.70M_S BRK	—	—	—	—
1977	11	23	16 55 20.4	52.195N	171.546W	053	74	5.5	5.5	5.50M_S BRK	—	—	—	—
1977	12	17	17 27 27.5	52.210N	170.025W	040	74	5.3	5.5	5.30m_b ISC	—	—	—	—
1978	03	16	02 09 38.4	52.295N	168.622W	049	74	5.5	5.3	5.70M_S ISC	—	—	—	—
1978	03	23	07 23 13.4	52.010N	169.465W	023	74	5.6	5.8	5.90M_S ISC	—	—	—	—
1978	04	11	05 12 55.5	53.604N	163.712W	032	74	5.5	5.6	5.60M_S ISC	—	—	—	—
1978	04	12	03 42 03.5	56.423N	152.691W	014	74	6.0	6.6	6.30M_S PAS	—	V	240	—
1978	05	11	00 23 37.8	51.436N	176.023W	040	479	5.6	5.9	5.80M_S BRK	—	IV	240	—
1978	05	24	06 16 55.4	51.232N	179.213W	025	74	6.0	6.7	6.20M_S PAS	—	IV	240	—
1978	07	13	13 25 19.7	52.242N	168.816W	033	74	5.8	5.6	5.40M_S BRK	—	—	—	—
1978	07	19	09 32 08.6	56.769N	151.647W	033	74	5.7	5.5	4.90M_L PMR	—	—	—	—
1978	08	18	18 52 28.4	59.885N	153.532W	123	74	5.4	—	5.70m_b BRK	—	VI	240	—
1978	12	15	08 30 34.7	52.110N	175.227E	047	74	5.6	5.6	5.60M_S ISC	—	V	240	—
1979	01	16	07 13 31.0	52.499N	167.921W	044	74	5.5	5.2	5.10M_S BRK	—	—	—	—
1979	01	25	19 30 06.1	60.131N	153.121W	105	74	5.5	—	5.40m_b ISC	—	IV	262	—
1979	01	27	18 57 55.0	54.768N	161.250W	017	74	6.0	6.0	5.80M_S BRK	—	V	240	—
1979	02	13	05 34 25.9	55.453N	157.162W	033	74	5.9	6.7	6.50M_S PAS	—	IV	262	—
1979	02	28	21 27 07.2	60.642N	141.598W	013	455	6.4	7.1	7.00M_S ABE	7.55HLS	VII	424	500&
1979	05	20	08 14 00.1	56.647N	156.725W	071	74	6.4	—	7.00m_b ABE	—	VI	262	—
1979	05	25	16 45 27.3	52.611N	167.019W	023	74	6.0	6.2	6.00M_S BRK	—	IV	262	—
1979	09	01	05 27 17.6	53.978N	165.204W	069	74	5.8	—	6.30m_b PAS	—	IV	262	—
1979	09	23	10 17 20.8	52.292N	174.034E	043	74	5.8	5.6	5.60M_S ISC	—	IV	262	—
1979	10	18	03 35 26.9	51.859N	177.129E	062	74	6.0	—	6.20m_b BRK	—	III	262	—
1980	01	19	07 02 35.1	51.120N	178.438W	033	479	5.8	5.7	5.70M_S BRK	—	Felt	300	—
1980	03	24	03 59 51.3	52.969N	167.670W	033	74	6.2	6.9	6.90M_S PAS	—	V	300	—
1980	03	24	04 02 19.3	52.600N	167.453W	033	74	6.1	—	6.00m_b ISC	—	—	—	—
1980	05	03	09 30 08.5	51.233N	173.679E	033	74	5.8	5.3	6.40m_b PAS	—	—	—	—
1980	08	01	23 07 14.7	59.617N	148.937W	026	74	5.4	5.1	5.70M_L PMR	—	IV	300	—
1980	08	03	07 11 43.0	51.999N	169.284W	033	74	4.8	5.5	5.20M_L PMR	—	—	—	—
1980	11	21	14 56 14.2	51.473N	175.948W	040	479	5.6	5.7	6.00m_b PAS	—	V	300	—
1981	01	30	08 52 44.1	51.744N	176.274E	033	74	6.3	7.0	6.70M_S PAS	—	V	325	—
1981	01	30	14 49 22.3	51.573N	176.075E	019	74	5.6	5.3	5.50M_S BRK	—	III	325	—
1981	02	01	13 17 11.3	51.337N	176.777E	023	74	5.6	5.5	5.60M_S BRK	—	—	—	—
1981	02	05	10 52 01.9	50.174N	176.334W	022	479	5.7	5.0	5.00M_S ISC	—	—	—	—
1981	03	24	18 21 27.9	52.673N	168.037W	033	74	5.5	5.3	5.50M_L PMR	—	—	—	—
1981	06	05	07 09 19.1	52.281N	165.199W	033	74	5.5	—	4.90M_L PMR	—	III	325	—
1981	07	13	22 10 05.1	50.254N	173.190W	016	479	5.5	4.7	5.30M_L PMR	—	—	—	—
1981	11	09	16 45 05.9	53.221N	165.747W	033	74	5.5	5.3	5.40M_S BRK	—	IV	325	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1982	01	25	05 29 33.5	53.222N	165.719W	060	74	6.1	—	6.40m_b PAS	5.93HAV	IV	350	—
1982	04	23	23 18 23.5	51.178N	179.844W	043	74	5.6	5.1	5.20M_S BRK	5.64HAV	III	350	—
1982	06	04	03 01 04.2	51.280N	177.154W	039	479	5.8	—	5.70M_S BRK	6.00HAV	V	350	—
1982	07	01	07 41 53.2	51.426N	179.943W	047	74	6.3	5.5	5.40M_L PMR	5.84HAV	IV	350	—
1982	07	31	06 29 15.5	51.755N	176.137E	038	74	6.2	6.0	6.10M_S BRK	6.20HAV	III	350	—
1982	08	06	04 53 59.2	51.600N	175.921W	043	479	5.4	—	5.50m_b ISC	5.48HAV	IV	350	—
1982	09	06	07 48 54.9	56.844N	151.588W	033	74	5.7	5.6	5.40M_S BRK	5.77HAV	III	350	—
1982	09	12	09 22 23.1	52.640N	166.941W	033	74	5.7	5.9	5.60M_S PAS	6.23HAV	—	—	—
1982	09	12	16 50 37.7	52.819N	167.053W	033	74	5.5	5.1	5.30M_L PMR	5.64HAV	—	—	—
1982	10	04	07 46 53.1	51.421N	176.615W	036	479	5.5	5.0	5.20M_L PMR	5.42HAV	Felt	350	—
1982	12	02	09 43 53.4	51.883N	170.447W	033	74	5.5	4.8	5.50m_b ISC	—	—	—	—
1983	01	14	18 20 52.6	55.911N	154.154W	033	360	5.6	5.8	—	6.05HAV	—	—	—
1983	01	24	13 02 37.2	51.381N	176.251E	033	360	5.4	5.7	—	5.84HAV	—	—	—
1983	02	14	03 20 03.7	54.809N	159.108W	016	360	5.9	6.3	6.50M_S BRK	6.52HAV	V	360	—
1983	02	14	08 10 02.7	54.862N	158.875W	014	360	6.0	5.6	6.00M_L PAL	5.95HAV	V	360	—
1983	04	03	19 14 05.0	51.976N	179.259E	116	360	5.6	—	5.60m_b ISC	5.54HAV	—	—	—
1983	06	09	18 46 02.7	51.249N	174.056W	023	479	6.2	5.8	5.80M_S BRK	5.56HAV	III	360	—
1983	06	28	03 25 17.6	60.182N	141.253W	012	360	6.0	5.4	5.90M_L PMR	5.86HAV	IV	360	—
1983	07	12	15 10 03.7	61.035N	147.185W	030	360	6.2	6.4	6.20M_S PAS	6.46HAV	VI	360	675
1983	09	07	19 22 05.0	60.978N	147.320W	030	360	6.2	6.2	6.20M_S BRK	6.34HAV	VI	360	230
1983	12	27	23 05 52.9	53.586N	164.376W	040	360	5.6	5.3	5.80M_L PAL	—	V	360	—
1984	05	06	19 54 49.3	51.389N	176.621W	037	479	5.6	—	5.60M_L PMR	5.58HAV	V	370	—
1984	07	27	15 57 50.9	50.324N	176.870W	021	479	5.8	5.0	5.70M_L PMR	5.57HAV	IV	370	—
1984	08	14	01 02 08.4	61.857N	149.104W	019	74	5.7	5.2	5.70M_L PMR	5.82HAV	VI	370	74&
1984	09	20	04 17 24.4	60.322N	146.001W	018	74	5.5	5.2	5.20M_L PMR	5.47HAV	IV	370	—
1984	09	23	17 06 36.3	53.577N	165.424W	033	74	5.7	5.5	5.90M_L PMR	5.89HAV	IV	370	—
1984	11	08	13 02 00.1	52.181N	170.999W	033	74	5.4	5.3	5.50M_L PMR	5.90HAV	—	—	—
1984	11	19	04 10 42.4	51.170N	179.096E	038	74	5.6	5.5	5.70M_L PMR	5.87HAV	II	370	—
1984	11	19	12 06 37.9	51.580N	175.243W	039	479	5.6	—	5.50M_L PMR	5.66HAV	IV	370	—
1985	01	02	05 32 49.1	55.428N	157.835W	033	74	5.6	5.6	6.10M_L PMR	5.95HAV	III	371	—
1985	01	09	19 28 21.2	60.289N	140.744W	014	74	5.7	5.1	5.40M_L PMR	—	IV	371	—
1985	03	09	14 08 04.3	66.239N	150.029W	011	74	5.9	6.0	6.00M_L PMR	6.14HAV	V	371	—
1985	03	10	13 30 29.5	66.136N	150.148W	010	74	5.2	4.9	5.60M_L PMR	5.45HAV	Felt	371	—
1985	05	09	19 05 21.5	51.465N	177.913E	033	74	5.7	6.0	6.20M_S BRK	6.25HAV	IV	371	—
1985	05	09	19 14 07.7	51.302N	178.024E	033	74	5.4	6.0	5.90M_S BRK	—	III	371	—
1985	05	24	22 04 45.4	51.193N	178.367W	033	479	5.8	5.8	5.80M_L PMR	6.14HAV	III	371	—
1985	07	17	19 31 29.5	51.443N	172.883W	016	479	5.5	5.9	5.70M_S BRK	6.05HAV	III	371	—
1985	07	31	07 37 54.6	52.404N	173.487E	045	74	5.7	5.0	5.70m_b ISC	5.61HAV	IV	371	—
1985	08	09	13 03 10.6	52.424N	173.648E	037	74	5.5	4.9	5.40M_L PMR	5.38HAV	IV	371	—
1985	08	30	17 31 11.9	53.097N	172.629E	033	74	5.1	5.0	5.60M_L PMR	—	—	—	—
1985	09	15	01 28 16.7	59.102N	136.423W	001	74	5.4	5.9	5.10M_L PMR	6.30HAV	V	371	—
1985	10	01	15 54 51.1	52.296N	168.856W	033	74	5.7	5.4	5.30M_L PMR	5.67HAV	III	371	—
1985	10	09	09 33 32.4	54.765N	159.613W	030	74	6.2	6.6	6.60M_S BRK	6.58HAV	V	371	—
1985	10	25	02 09 04.3	52.072N	171.350W	033	74	5.6	5.5	5.60M_L PMR	5.95HAV	II	371	—
1985	10	26	15 59 36.0	54.838N	159.534W	033	74	5.6	—	5.30M_L PMR	5.36HAV	V	371	—
1985	10	30	19 05 37.5	51.801N	175.533E	033	74	5.6	5.4	5.50M_L PMR	5.82HAV	II	371	—
1985	10	31	19 33 06.5	53.249N	166.936W	030	74	5.8	5.7	5.80M_S PAS	6.14HAV	IV	371	—
1985	11	14	22 17 44.5	54.756N	159.787W	033	74	5.5	5.7	5.70M_L PMR	6.05HAV	V	371	—
1985	12	28	07 44 38.2	56.580N	156.509W	058	74	5.3	—	5.70m_b PAL	—	—	—	—
1985	12	30	12 41 02.7	61.541N	150.340W	062	74	5.5	—	5.20M_L PMR	—	V	371	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1986	01	18	01 59 00.9	51.387N	173.055W	016	562	5.8	5.3	5.00M_L PMR	5.54HAV	—	—	—
1986	03	04	08 47 14.6	51.553N	166.943W	033	562	5.6	4.6	5.60M_L PMR	5.42HAV	—	—	—
1986	03	09	13 49 28.2	54.256N	167.864W	033	562	5.2	5.5	5.50M_S BRK	5.72HAV	Felt	562	—
1986	04	11	17 22 20.8	54.164N	167.883W	033	562	5.3	5.9	6.00M_S BRK	5.98HAV	IV	562	—
1986	05	07	20 43 33.3	51.234N	174.741W	025	562	6.1	6.0	6.10M_L PMR	6.24HAV	Felt	562	—
1986	05	07	22 47 12.3	51.325N	174.751W	031	562	6.4	7.7	7.90M_S BRK	7.95HAV	VII	562	—
1986	05	07	22 55 05.0	51.500N	174.800W	033	562	5.6	—	—	—	—	—	—
1986	05	07	22 57 47.6	51.575N	174.219W	015	562	5.7	—	—	—	—	—	—
1986	05	07	23 07 45.0	51.317N	174.598W	020	562	5.5	—	—	—	—	—	—
1986	05	07	23 36 18.3	51.297N	174.132W	020	562	5.7	—	—	—	—	—	—
1986	05	07	23 51 01.9	51.273N	174.836W	020	562	5.8	—	—	—	—	—	—
1986	05	07	23 52 20.5	52.300N	174.423W	015	562	5.7	—	—	—	—	—	—
1986	05	08	01 11 02.1	50.960N	176.655W	020	562	5.9	—	5.90M_L PMR	—	—	—	—
1986	05	08	01 15 14.9	51.028N	176.778W	020	562	5.6	—	—	—	—	—	—
1986	05	08	02 04 00.2	51.002N	176.886W	020	562	5.5	—	5.50M_L PMR	—	—	—	—
1986	05	08	04 03 49.7	50.971N	176.449W	020	562	5.8	5.5	5.70M_L PMR	—	—	—	—
1986	05	08	05 37 21.6	51.166N	175.329W	015	562	6.0	6.2	6.20M_L PMR	6.42HAV	—	—	—
1986	05	09	01 05 31.2	51.061N	176.902W	023	562	5.5	5.6	5.40M_L PMR	—	III	562	—
1986	05	09	01 08 10.5	51.062N	176.856W	018	562	5.6	5.5	5.50M_L PMR	—	IV	562	—
1986	05	09	19 04 28.4	51.283N	174.200W	021	562	5.8	5.6	5.50M_S BRK	5.89HAV	—	—	—
1986	05	09	19 24 42.0	51.268N	174.036W	020	562	5.3	5.8	—	—	—	—	—
1986	05	11	19 40 30.7	51.359N	173.696W	018	562	5.6	5.2	4.90M_L PMR	5.68HAV	—	—	—
1986	05	11	22 48 47.2	51.371N	174.616W	029	562	5.5	5.2	5.70M_L PMR	5.65HAV	IV	562	—
1986	05	14	01 58 30.9	51.364N	173.437W	021	562	5.5	4.7	—	5.34HAV	—	—	—
1986	05	15	06 38 37.9	52.432N	174.719W	015	562	5.7	6.4	5.50M_L PMR	6.38HAV	VI	562	—
1986	05	17	16 20 24.3	52.443N	174.271W	015	562	5.8	6.6	6.50M_S BRK	6.40GS	VI	562	—
1986	06	03	23 05 28.8	51.256N	174.631W	020	562	5.4	5.1	5.80M_L PMR	—	II	562	—
1986	06	04	15 48 20.8	65.636N	152.604W	010	562	5.2	4.7	5.70M_L PMR	—	V	562	150
1986	06	09	02 17 38.2	54.142N	168.132W	033	562	5.0	4.7	5.60M_L PMR	5.24HAV	—	—	—
1986	06	18	08 05 16.4	51.465N	176.833W	041	562	5.8	6.3	6.00M_L PMR	6.46HAV	IV	562	—
1986	06	19	09 09 09.2	56.331N	152.914W	017	562	6.0	6.3	5.40M_L PMR	6.75HAV	IV	562	—
1986	07	05	03 01 32.6	51.248N	179.746W	033	562	5.6	5.2	5.20M_L PMR	5.65HAV	—	—	—
1986	07	19	04 31 55.9	53.352N	165.882W	033	562	5.5	5.1	5.90M_L PMR	5.58HAV	IV	562	—
1986	07	19	05 04 08.2	53.339N	165.859W	033	562	5.1	4.5	5.60M_L PMR	5.18HAV	IV	562	—
1986	07	19	06 53 17.8	53.600N	167.171W	033	562	5.5	5.7	5.80M_L PMR	5.95HAV	IV	562	—
1986	07	19	22 32 36.0	53.521N	167.301W	033	562	5.6	5.6	5.60M_S BRK	5.98HAV	V	562	—
1986	07	25	09 01 32.6	51.079N	176.137W	021	562	5.3	5.6	5.30M_L PMR	5.81HAV	IV	562	—
1986	07	25	09 04 16.3	51.056N	175.996W	020	562	5.4	5.6	—	—	Felt	562	—
1986	08	01	21 05 40.1	51.262N	174.224W	022	562	5.5	5.0	4.60M_L PMR	5.40HAV	IV	562	—
1986	08	03	13 29 10.4	51.026N	176.749W	022	562	5.4	5.6	5.60M_L PMR	5.89HAV	IV	562	—
1986	09	12	23 57 15.6	56.201N	153.405W	031	562	6.1	6.3	6.00M_S BRK	6.51GS	IV	562	—
1986	09	16	20 57 21.9	56.222N	153.600W	033	562	5.3	5.5	5.10M_L PMR	5.87HAV	III	562	—
1986	10	26	04 43 27.4	53.758N	170.049W	214	562	5.4	—	5.90m_b BRK	5.74HAV	—	—	—
1986	11	06	18 27 02.9	51.242N	176.631W	039	562	5.1	5.5	5.20M_L PMR	5.90HAV	IV	562	—
1986	11	14	21 42 45.9	51.442N	173.845W	025	562	5.5	—	4.90M_L PMR	—	—	—	—
1987	01	05	12 11 55.7	52.448N	169.381W	033	74	6.1	6.7	6.50M_S BRK	6.73HAV	V	577	—
1987	02	18	00 00 52.5	51.298N	179.279W	033	74	6.2	5.9	5.50M_L PMR	6.23HAV	V	577	—
1987	02	18	05 28 23.2	51.344N	179.298W	033	74	5.5	4.7	5.40M_L PMR	—	III	577	—
1987	02	27	08 31 54.4	53.470N	167.291W	010	74	6.2	6.7	6.80M_S BRK	6.89HAV	V	577	—
1987	03	21	10 41 35.9	52.056N	177.547W	093	74	6.0	—	6.20M_S BRK	6.37HAV	V	577	—
1987	03	22	02 49 15.9	51.594N	173.574W	020	74	5.9	6.0	5.80M_L PMR	6.15HAV	IV	577	—
1987	04	18	02 01 38.8	61.374N	150.656W	068	74	5.7	—	5.60M_S BRK	5.31HAV	V	577	—
1987	05	02	19 21 29.6	54.801N	160.103W	033	74	5.1	4.6	5.80M_L PMR	5.26HAV	V	577	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1987	05	06	04 06 14.1	51.272N	179.898W	020	74	6.3	6.4	$6.10M_L$ PMR	6.57HAV	V	577	—
1987	05	10	09 39 06.6	51.394N	179.820W	033	74	5.0	—	$5.50M_L$ PMR	—	—	—	—
1987	06	21	05 46 10.0	54.211N	162.601W	034	74	6.2	6.2	$6.60M_L$ PMR	6.50HAV	V	577	—
1987	06	21	05 55 26.9	54.285N	162.597W	033	74	5.5	—	$5.40M_L$ PMR	—	III	577	—
1987	07	05	09 23 00.0	51.486N	174.660W	033	74	5.5	5.2	$5.40M_L$ PMR	5.63HAV	II	74	—
1987	07	06	00 23 25.6	51.508N	174.721W	033	74	5.8	5.5	$5.80M_L$ PMR	5.89HAV	IV	577	—
1987	07	24	05 25 10.5	56.231N	153.650W	033	74	5.5	5.3	$5.70M_L$ PMR	5.65HAV	III	577	—
1987	08	14	17 39 32.2	53.416N	169.113W	118	74	5.7	—	—	5.98HAV	IV	74	—
1987	08	22	05 09 14.4	52.164N	174.066E	033	74	5.5	4.8	$5.20M_L$ PMR	5.21HAV	IV	577	—
1987	09	10	03 48 44.8	51.931N	176.006W	049	74	5.1	—	$5.50M_L$ PMR	—	IV	74	—
1987	10	20	09 23 36.2	52.577N	172.320E	033	74	5.5	5.6	$5.50M_L$ PMR	5.95HAV	—	—	—
1987	11	17	08 46 53.3	58.586N	143.270W	010	74	6.6	6.9	$7.00M_L$ PMR	7.16HAV	V	577	375&
1987	11	17	09 38 12.3	58.608N	143.096W	010	74	5.5	—	$5.20M_L$ PMR	—	—	—	—
1987	11	18	13 01 55.2	58.642N	143.190W	010	74	5.2	5.6	$5.60M_L$ PMR	5.78HAV	—	—	—
1987	11	23	07 18 20.5	61.616N	141.323W	005	74	5.7	5.0	$5.40M_L$ PMR	5.50HAV	IV	577	—
1987	11	30	19 23 19.5	58.679N	142.786W	010	74	6.7	7.6	$7.10M_L$ PMR	7.86HAV	VI	577	470&
1987	11	30	19 48 26.0	58.239N	142.742W	010	74	5.9	—	$5.60M_L$ PMR	—	Felt	74	—
1987	12	01	12 03 59.7	57.953N	142.611W	010	74	5.4	5.7	$5.60M_L$ PMR	5.77HAV	—	—	—
1988	01	13	01 01 50.2	51.309N	174.654W	033	74	5.6	5.2	—	5.51HAV	—	—	—
1988	01	23	02 45 35.7	51.400N	174.268W	048	74	5.5	4.7	—	5.02HAV	—	—	—
1988	02	07	08 46 58.6	60.296N	152.972W	138	74	5.6	—	$5.60m_b$ BRK	6.46HAV	V	578	175
1988	02	07	18 15 05.6	50.785N	173.465E	033	74	6.2	6.0	$5.90M_S$ PAS	6.30HAV	III	578	—
1988	02	13	23 56 58.7	50.636N	173.410E	033	74	5.2	5.5	—	5.21HAV	—	—	—
1988	02	13	23 57 45.6	52.296N	173.379W	054	74	5.7	—	—	—	II	74	—
1988	02	16	04 22 36.1	51.564N	175.041E	033	74	5.9	5.7	$5.60M_L$ PMR	5.98HAV	—	—	—
1988	02	16	05 44 38.6	51.495N	175.054E	033	74	5.5	5.0	$5.00M_L$ PMR	5.54HAV	—	—	—
1988	02	24	02 54 22.6	51.723N	176.797W	060	74	5.5	—	—	5.34HAV	III	74	—
1988	03	06	22 35 38.1	56.953N	143.032W	010	74	6.8	7.6	$7.40M_L$ PMR	7.74HAV	V	578	580&
1988	03	06	23 14 38.4	57.499N	142.803W	010	74	6.2	—	$6.30M_L$ PMR	—	—	—	—
1988	03	08	16 27 18.8	51.340N	176.862E	033	74	5.5	5.5	$5.50M_L$ PMR	5.81HAV	—	—	—
1988	03	25	21 58 20.5	54.776N	159.840W	033	74	5.4	4.6	$5.90M_L$ PMR	—	IV	74	—
1988	03	29	08 31 31.9	52.278N	168.182W	033	74	5.4	5.5	$5.10M_L$ PMR	5.79HAV	—	—	—
1988	04	26	01 47 35.0	57.534N	143.073W	010	74	5.4	5.6	$5.90M_L$ PMR	5.83HAV	Felt	578	—
1988	05	22	09 39 55.9	53.619N	163.267W	033	74	5.7	5.7	$5.70M_L$ PMR	5.95HAV	—	—	—
1988	05	25	14 05 17.6	50.549N	174.571W	040	74	5.7	4.9	$5.30M_S$ BRK	5.58HAV	—	—	—
1988	11	06	08 20 57.0	51.311N	178.148W	033	74	5.5	4.8	—	—	III	578	—
1988	11	15	08 41 42.3	52.109N	171.103W	023	74	5.9	5.4	$5.50M_S$ BRK	5.91HAV	Felt	74	—
1988	11	30	08 55 30.6	61.348N	152.270W	144	74	5.5	—	—	5.73HAV	V	578	90
1989	01	08	19 57 06.0	51.435N	174.880W	033	74	5.7	5.5	$5.70M_S$ BRK	6.00HAV	III	579	—
1989	01	08	20 26 25.1	51.432N	174.799W	033	74	5.1	5.6	$5.70M_L$ PMR	5.44HAV	III	579	—
1989	01	08	22 37 30.9	51.393N	174.758W	033	74	5.6	5.4	$5.80M_L$ PMR	5.76HAV	III	579	—
1989	02	22	10 25 45.2	56.152N	153.642W	033	74	5.7	5.8	$5.80M_L$ PMR	5.95HAV	—	—	—
1989	04	09	05 07 50.6	51.510N	178.386W	033	74	5.2	4.7	$5.70M_L$ PMR	5.25HAV	III	579	—
1989	04	23	19 21 06.4	66.960N	156.289W	006	74	5.7	5.1	$5.30M_L$ PMR	5.45HAV	IV	579	—
1989	05	19	02 21 56.3	54.305N	165.574W	104	74	6.1	—	$5.40M_S$ BRK	6.15HAV	V	579	—
1989	06	16	10 51 21.5	57.755N	153.992W	058	74	5.8	—	—	5.67HAV	V	579	—
1989	07	03	17 09 55.8	51.617N	175.208W	033	74	5.7	5.7	$5.70M_S$ BRK	6.05HAV	IV	579	—
1989	09	04	13 14 58.2	55.543N	156.835W	011	74	6.5	6.9	$6.90M_L$ PMR	7.06HAV	V	579	—
1989	09	20	13 19 31.9	51.184N	178.821E	033	74	5.5	5.8	$5.80M_S$ BRK	6.22HAV	Felt	74	—
1989	10	07	15 48 29.0	51.314N	179.028W	020	74	6.1	6.7	—	6.79HAV	IV	579	—
1989	10	07	16 42 30.7	51.188N	179.234W	033	74	5.7	5.9	$5.70M_L$ PMR	6.19HAV	III	74	—
1989	10	07	17 42 36.4	51.137N	179.221W	033	74	5.6	5.7	—	5.44HAV	—	—	—
1989	10	07	17 52 47.3	51.115N	179.241W	033	74	5.5	5.6	—	—	—	—	—

ALASKA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1989	10	07	18 50 40.8	51.076N	179.306W	033	74	5.5	5.3	5.40M_L PMR	5.68HAV	III	74	—
1989	10	07	19 06 34.7	51.173N	179.412W	033	74	4.9	—	5.50M_L PMR	—	—	—	—
1989	10	09	18 01 07.8	51.780N	171.869E	026	74	6.0	5.3	5.40M_L PMR	5.73HAV	—	—	—
1989	12	01	05 06 12.1	51.631N	178.102W	043	74	5.6	5.0	5.70M_L PMR	5.59HAV	IV	74	—
1989	12	21	16 53 19.3	62.421N	155.620W	000	74	5.4	5.5	5.50M_L PMR	—	IV	579	—

INTRODUCTION

Only those earthquakes of Modified Mercalli intensity ≥ VI or magnitude ≥ 5.5 are listed in the Alaska table. Earthquakes without published magnitude or intensity values and those having intensities < VI were estimated to fall within the magnitude ≥ 5.5 range if they met the following criteria:

1. Pre-1913 earthquakes (the year instrumental epicenters were first published) had to be well documented. It is believed that most shocks before 1913 would have to have a magnitude larger than 5.0 to generate sufficient interest for detailed information to be published;
2. The hypocenter had to be computed using a set of phase data comparable (in terms of reporting seismograph stations and distances recorded) to one published in the International Seismological Summary (ISS) or International Seismological Centre (ISC) bulletins with a computed magnitude ≥ 5.5. The earthquake must have occurred within 3 years of the ISS or ISC event.

The origin times in the Alaska table may not be identical to those shown in the source reference. If not, the listed origin times were estimated from more accurate sources, such as seismograms, earthquake phase data, U.S. Weather Service reports, and others. Some corrections in dates also were necessary because all sources did not list the same date.

Many of the published origin times were given in "local time" (i.e., the time on the clock at the location reporting the earthquake). Most of these local times in the 1800's were local solar meridian time. We, therefore, converted all the local times to UTC. Other origin-time corrections resulted from differences between local time and the time that the phase data were recorded on seismograms. In those instances, the arrival times published from phase data were used to compute new origin times.

The Alaska table cannot be considered to be a complete listing of magnitude ≥ 5.5 earthquakes. However, it is as complete as possible on the basis of the selection criteria listed above and on the data available to us. In the early days of seismology, the only earthquakes recorded were those having large magnitudes or those located near populated centers. Because of this, the list of earthquakes can be considered complete only after about 1964, when the installation of worldwide seismograph stations and the use of computers allowed the routine computation of hypocenters and magnitudes for smaller earthquakes.

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1786. Date unknown. Alaska Peninsula. Following an eruption of Pavlof Volcano, and during a severe earthquake, the north crater of the volcano collapsed with a tremendous noise. (Ref. 38, 255, 426, 436, 520.)

1788. July 22. Shumagin Islands–Kodiak Island region, Alaska. Strong ground motion and landslides occurred on both Kodiak and Unga Islands. Land subsidence also was reported on Kodiak near the harbor. The earthquake is described as "a great shock that ruptured at least a 600-km segment of the plate boundary" (extending from Kodiak Island perhaps to Unga Island or beyond). A tsunami perhaps as high as 10 m inundated Three Saints Bay and caused extensive loss on Kodiak Island. Aftershocks on Kodiak Island lasted a month or longer. (Ref. 38, 426, 456, 520, 610.)

1788. Aug. 7. Unga Island, Alaska. A strong earthquake may have ruptured the plate boundary "from Unga to Sanak on Aug. 7. There was such a terrible flood on Unga Island that many Aleuts were killed, and the water rose to 50 sazhens (about 91 m)." The tsunami was much smaller at Pavlof Bay (on the south coast of the Alaska Peninsula) and did not affect the north side of Unimak Island. There is some doubt that this is a second earthquake in 1788 (Ref. 456, 520.)

1792. Date unknown. Kodiak Island, Alaska. A strong earthquake occurred on Kodiak Island, "continuing for 18 hours." All cabins collapsed, and rocks slid down the hillsides. A vessel that was entering Three Saints Bay (Kodiak Island) at the time of the earthquake "encountered a strong agitation and suffered greatly from the unusual and highly anomalous wave patterns." (Ref. 456.)

1796. May 20. Umnak Island, Alaska. An earthquake shook Umnak, and a new island (St. John Bogoslov) appeared in the Unalaska district. A rumble resembling shots from a cannon came from the mountains off the northeast point of Umnak. Rocks were thrown from the new island as far as Umnak Island. (Ref. 38, 436, 520.)

1802. Date unknown. Unalaska Island, Alaska. Makushin Volcano erupted "with great violence," and an earthquake destroyed "a considerable number of the earth huts." (Ref. 38, 436, 520.)

1812. Date unknown. Atka Island, Alaska. Sarychef Volcano erupted, and a violent earthquake terrified residents on Atka. (Ref. 38, 255, 426, 436, 520.)

1817. Mar. 14. Umnak Island, Alaska. A violent earthquake occurred. Yunaska Volcano erupted, sending ash as far as Unimak Island. (Ref. 38, 255, 436, 520.)

1818. Apr. Unalaska Island, Alaska. An earthquake occurred following the strong rumbling of Makushin Volcano. To the residents on Unalaska, it seemed that the nearby island of Amakhnak had collapsed. (Ref. 38, 436, 520.)

1826. June. Unalaska Island, Alaska. Two violent earthquakes occurred, during which flames shot out of Makushin Volcano. (Ref. 38, 255, 436, 520.)

1836. Apr. 14. Pribilof Islands, Alaska. Shocks were so strong on St. Paul and St. George Islands that people could not remain standing. The first shocks collapsed many cliffs on the coast of St. George and caused others to settle. A barn collapsed on St. Paul. (Ref. 38, 255, 426, 520.)

1836. Aug. Pribilof Islands, Alaska. The earthquake was less violent and the rumblings were more muted than the shocks and noises experienced in April 1836. (Ref. 38, 255, 426, 436, 520.)

1840. Apr. Alaska Peninsula. A strong earthquake occurred at Nikolaev Redoubt in Kenai Bay (Kenai Village, Cook Inlet). Stoves fell to pieces and chimneys collapsed. (Ref. 515, 520.)

1843. Dec. 17 (Dec. 16). Sitka, Alaska. At 4 p.m. local time, a strong 3-second earthquake "rent houses" and moved trees back and forth. Cracking noises were heard. Two light foreshocks occurred on Dec. 15 and 16. (Ref. 38, 420, 515, 520.)

1844. Apr. 13. Kodiak Island, Alaska. A strong earthquake accompanied by a loud noise occurred at Pavlof (St. Paul) Harbor. The shock continued for more than 2 minutes and sent residents fleeing from their homes. Older residents reported this shock was the strongest in memory. The epicenter is uncertain. (Ref. 456, 515, 520.)

1847. Date unknown. Sitka, Alaska. This earthquake generally was felt along the Alaska coast and was severe at Sitka. The Governor's mansion was destroyed. Flame and ashes arose from the summit of Mount St. Elias. The epicenter is uncertain (Ref. 38, 436, 520.)

1847. Apr. 16, 16 UTC. Chirikof Island, Alaska. A large earthquake on Ukamok (Chirikof Island) cracked the ground in many places and collapsed cliffs. On Unga Island, Alaska, a "fairly large" earthquake occurred early in the morning. At 10 a.m. (20 UTC), it "grew" to the point that it was impossible to remain standing. At about the same time, a large earthquake was felt on the Alaska Peninsula. These two events, 4 hours and 320 km apart in time and space, are considered to describe one earthquake; however, the possibility exists that two earthquakes occurred. (Ref. 515, 456, 520.)

1848. Mar. 30. Sitka, Alaska. A large earthquake knocked down chimneys, damaged stoves, and cracked stones on many houses. The 15-second shock, which was accompanied by a muffled underground noise, terrified residents. The trembling continued almost without interruption until Apr. 27. (Ref. 515, 520.)

1848. June 30. Chirikof Island, Alaska. An earthquake on Ukamok (Chirikof Island) began about midnight. Several minutes later, the earth shook so hard that it was impossible to remain standing. It was accompanied by a wind-like noise and a rumbling. (Ref. 456, 515, 520.)

1866. Sept. 6. Kodiak Island, Alaska. A violent earthquake struck Pavlof (St. Paul) Harbor. It "half destroyed" the landing on Woody Island and damaged many buildings, stoves, and chimneys. Huge rocks were thrown down the mountains. (Ref. 38, 426, 515, 520.)

1868. May 15. Shumagin Islands, Alaska. "During a slight earthquake the elevation is said to have amounted locally at Unga to over 20 feet." (Ref. 38, 420, 610.)

1872. Aug. 23. Aleutian Islands region, between the Andreanof and Fox Islands, Alaska. It is suggested that, on Aug. 23, a tectonic displacement of the Aleutian continental shelf or slope was accompanied by an earthquake of large magnitude. A tsunami of 1.3 m was observed in Hilo harbor, lesser heights were observed at Hanalei, Honolulu, and Nawiliwili, Hawaii. It was also recorded at Honolulu, Hawaii; Astoria, Oreg.; and San Francisco and San Diego, Calif. From the reports of the arrival of the tsunami in Hawaii and marigraphic evidence of its arrival in Oregon and California, its source has been determined to be off the Aleutian Islands. (Ref. 516, 610.)

1878. Aug. 29. Unalaska Island, Alaska. The village of Makushin was destroyed by an earthquake. Major volcanic eruptions and earthquakes occurred on several Aleutian islands in late August and early September 1878. (Ref. 38, 426, 463, 520.)

1880. Sept. 29, 04 UTC (Sept. 28). Chirikof Island, Alaska. A major earthquake occurred, followed by three severe aftershocks at 07, 13, and 23 UTC. Many deep fissures 38–51 cm in width were observed on Chirikof after the shocks. In a one-story log cabin, shelves were thrown from walls, a brick stove was upset, flooring was twisted out of shape, and heavy barrels were pitched from one side of the room to the other. Outside, no one was able to remain standing owing to a violent jerking and rotary motion of the earth, which continued for at least 20 minutes.

At low tide, the sea rose several times and traveled onshore about 55 m. On the south side of the island, a small, shallow creek widened about 2 m, and its depth increased. On the southwest shore of the island, heavy breakers were observed where they had not been seen previously. On the west side of the island, the tide did not rise as high as before the shocks. From the beginning of the earthquake series through Oct. 16, 1880, an uninterrupted trembling motion, interspersed with heavy subterranean rumbling sounds, was observed.

During these earthquakes, the northwest part of the island, bounded by a northeast-trending fault, tilted to the southeast. The fault on the southeast boundary displaced vertically about 1.8 m. Evidence of this faulting is still preserved in dammed streams and uplifted, wave-cut terraces. (Ref. 426, 463, 520.)

1880. Oct. 26. Sitka, Alaska. A severe earthquake along with cracking and splitting earth noises occurred at Sitka. At the warm springs 32 km southeast of Sitka, the springs spouted like geysers. The shocks were severe at Whale Bay, about 58 km southeast, and a "tidal wave of huge dimensions ran into the bay." The shock was violent on Tihiagreff Island (north of Baranof Island). At Hoonah village, people were thrown around "like chips in an eddy." Aftershocks continued through Nov. 14. (Ref. 426, 463.)

1883. Oct. 6. Alaska Peninsula. Mount St. Augustine burst into volcanic activity. It was accompanied by a severe earthquake and tsunami. A wave estimated at 7.6–9.1 m flooded Port Graham, followed by 2 waves of lesser height (Ref. 38, 426.)

1896. Late May. Prince William Sound region, Alaska. About 12 km north of Orca, this severe earthquake bent trees almost to the breaking point and made it difficult to remain standing. Waves appeared in the ground. Water in the creek splashed from one side to the other. (Ref. 38, 420, 426.)

1898. Aug. 1. Susitna Station, Alaska. Trees swayed violently. (Ref. 420.)

1899. July 11 or July 14. Cook Inlet, Alaska. A "severe" earthquake occurred at Tyonek. Possibly, there is a misprint in the date in ref. 420 (the table in ref. 420 lists earthquakes in chronological order, but the July 11 event is listed between two events on July 14), and the date should be July 14, 1899 (magnitude 7.2, epicenter at lat 60°N., long 150°W.). Tyonek is located at lat 61°N., long 151°W. (Ref. 38, 412, 420.)

1899. Sept. 4, 00 22 UTC (Sept. 3). Near Cape Yakataga, Alaska. During September, the Yakutat Bay region was shaken by a series of severe earthquakes. The first earthquake at 00 22 UTC was moderately strong at Yakutat but was extremely violent at Cape Yakataga, about 160 km west. The shock broke off the tops of trees, generated landslides, and raised the ocean beach about 1 m. Although no loss of life or property occurred in the region, reported effects include uplift of the coast, landslides, difficulty in standing upright, water waves on the bay, and shaking of houses. Faulting probably occurred at Cape Yakataga. The shock was felt at about 30 known locations, the most distant on the lower Yukon River, about 1,100 km from Yakutat Bay. Strong aftershocks were observed on Sept. 4. Magnitude of first shock, 8.3 M_S CFR. (Ref. 38, 404, 412, 420, 424.)

1899. Sept. 10, 17 04 and 21 41 UTC. Yakutat Bay, Alaska. During September, the Yakutat Bay region was shaken by a series of major earthquakes, the most violent of which were felt at all settlements within a radius of 400 km. Several heavy shocks occurred on Sept. 4 and 10, but the main earthquake that caused great topographic changes occurred at 21 41 UTC, Sept. 10 (see fig. 8.)

A U.S. Geological Survey team did not study the region until 6 years after the shocks, but the topographic changes were obvious. Dead barnacles and other shellfish were found everywhere, and several uplifted beaches were observed. A maximum uplift of 14.5 m occurred on the west coast of Disenchantment Bay, and changes of 5 m or more affected a large area. Subsidence of as much as 2 m was observed in a few areas. Phenomena observed included surface faulting, avalanches, fissures, spouting from sand craterlets, and slight damage to buildings. A destructive tsunami 10.6 m in height occurred in Yakutat Bay, and tsunamis also were observed at other places along the Alaskan coast.

The earthquake altered the regimen of glaciers in the area. The shattering of Muir Glacier started the rapid discharge of icebergs and the later retreat of this and other ice tongues in Glacier Bay. Avalanching resulted in the later advance of at least nine glaciers in Yakutat Bay and perhaps many others in more remote regions. Some severely crevassed glacier fronts, which were found 6 years later, had taken several years for the fractured parts to reach the sea.

The first earthquake on Sept. 10 lasted 90 seconds and was heavier at Yakutat than that of Sept. 4 (00 22 UTC). It was strong enough to throw people off their feet at Disenchantment Bay. The main earthquake on Sept. 10 was felt over a largely unsettled region, and so the total felt area is unknown. Prospectors camped on Disenchantment Bay felt over 50 shocks on Sept. 10, two of which were strong. Residents at Yakutat village also described as severe two of the many shocks observed on that day. Ten or more earthquakes were felt in the Coast and Geodetic Survey camp near the Copper River delta, and several of them were violent. Several shocks were also felt on Sept. 10 in the Chugach Mountains near Prince William Sound; five were reported about 300 km to the northeast on the Yukon River; and several were felt to the southeast at Juneau and Skagway. Many large aftershocks occurred in September and the following months. Magnitude 7.8 M_S CFR (first shock), 8.6 M_S CFR (second shock). (Ref. 38, 404, 420, 426.)

1899. Sept. 16 (Sept. 15). Yakutat Bay, Alaska. Two strong earthquakes were felt at Yakutat village, each lasting as long as it took to run outdoors. At Skagway, this shock was more pronounced than those of Sept. 4 and 10. A section of one of the long piers at Skagway sank into the water. Several buildings moved "a foot or two" on their foundations, and two small buildings toppled. (Ref. 420.)

1899. Sept. 23, 11 04 and 12 50 UTC. Near the Copper River delta, Alaska. Eight shocks were noted in the Coast and Geodetic Survey camp, one of which was strong enough to awaken everyone in the camp. A plumb bob vibrated through 25 cm from northwest to southeast; the vibrations were distinct and slow. Possibly felt at Sitka. (Ref. 412, 420.)

1900. Oct. 9. Kodiak Island region, Alaska. The wharf at Woody Island was partly destroyed; chimneys, windows, and crockery were destroyed in Kodiak. About 50 slight aftershocks continued through the next day. Felt along all of southern Alaska and probably to the west of Kodiak. Magnitude 8.3 M_S CFR. (Ref. 420, 424, 477.)

1901. Dec. 30. Kenai, Alaska. A strong volcanic eruption occurred. The accompanying earthquake caused several tsunamis. This event is listed as "destructive" in Ref. 426. (Ref. 38, 426.)

1901. Dec. 31 (Dec. 30). Cook Inlet, Alaska. A strong volcanic eruption occurred. The accompanying earthquake caused several tsunamis. Magnitude 7.8 M_S CFR. (Ref. 38, 477.)

1902. Jan. 1 (Dec. 31, 1901). Fox Islands, Aleutian Islands, Alaska. Magnitude 7.8 M_S CFR. (Ref. 404.)

1903. June 2. Southwest Alaska. Magnitude 8.3 M_S CFR. (Ref. 38, 477.)

1904. Aug. 27. Rampart, Alaska. Buildings swayed and cracked. Magnitude 8.3 M_S CFR, 7.7 M_S GR, 7.8 m_b ABE. (Ref. 38, 477.)

1905. Feb. 14 (Feb. 13). Andreanof Islands, Aleutian Islands, Alaska. Magnitude 7.9 M_S CFR, 7.7 M_S GR, 7.5 m_b ABE. (Ref. 477.)

1906. Aug. 17 (Aug. 16). Rat Islands, Aleutian Islands, Alaska. Magnitude 8.3 M_S CFR, 8.0 M_S GR. (Ref. 477.)

1907. Sept. 2. Aleutian Islands, Alaska. Magnitude 7.4 M_S GR, 7.3 m_b ABE. (Ref. 477.)

1908. Feb. 14. Prince William Sound, Alaska. This earthquake was strong at Valdez, where it upset bottles and vases and threw objects from shelves in all the stores. The Valdez-Sitka and Valdez-Seward submarine cables were broken close to Valdez, well inside Valdez Narrows. A ship approaching the Valdez dock reported it "felt as though the ship struck on bottom." Also felt at Cordova, Ellamar, Katalla, Landlock, and Latouche. (Ref. 38, 420.)

1908. May 15 (May 14). Southeast Alaska. At Katalla, the ceiling in one house was cracked, furniture was displaced, and dishes were knocked from shelves. Rockslides were reported at Cape Yakataga. Felt from Sitka to Seward. Magnitude 7.0 M_S GR, 7.1 m_b ABE. (Ref. 38, 258, 420.)

1909. Feb. 16. Near Yakutat, Alaska. This earthquake was felt more strongly at Skagway and Yakutat than at Juneau, Seward, and Sitka. (Ref. 420.)

1910. Sept. 9 (Sept. 8). Rat Islands, Aleutian Islands, Alaska. The earthquake displaced furniture

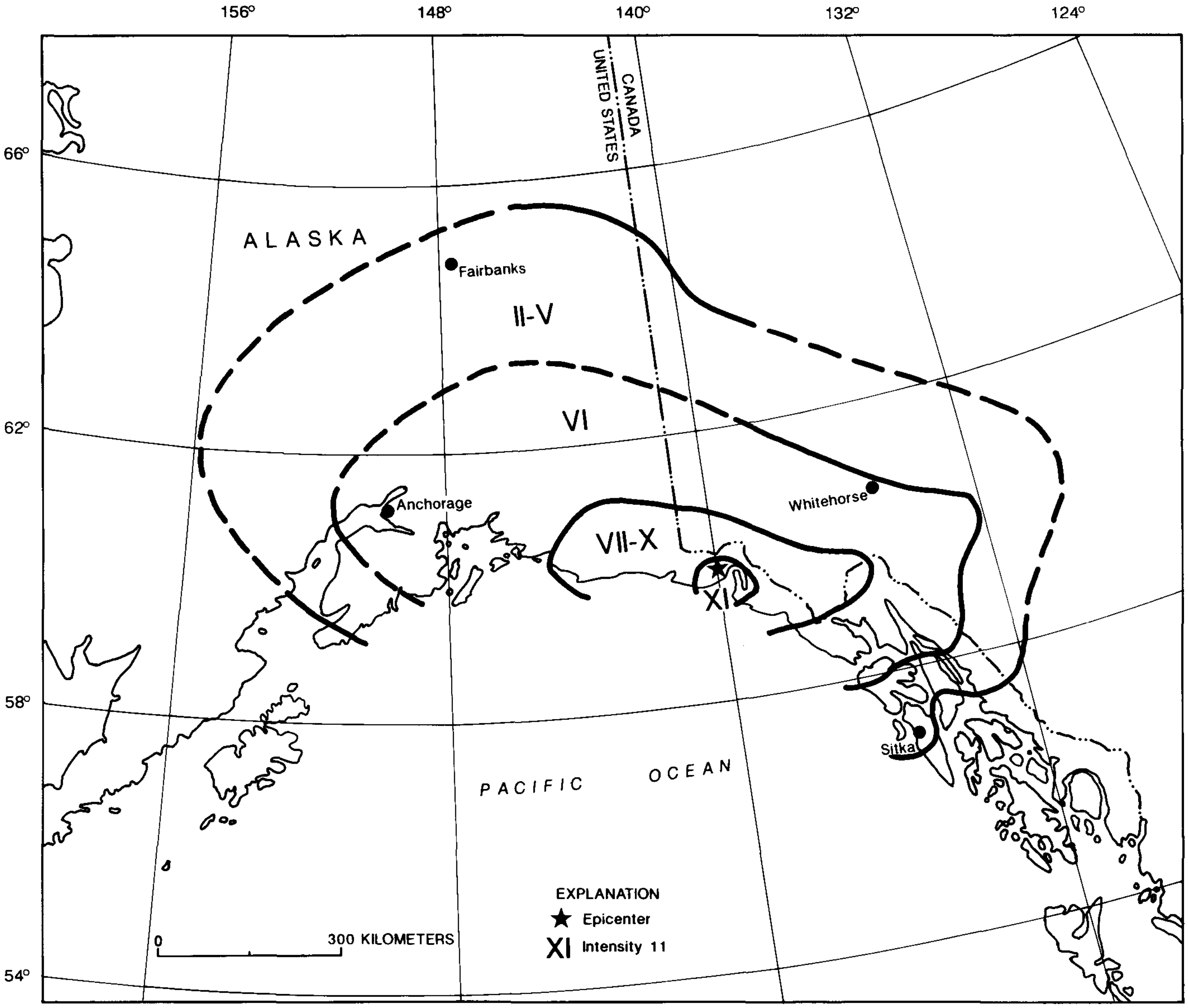


FIGURE 8.—Isoseismal map for the Yakutat Bay, Alaska, earthquake of September 10, 1899. This map is a simplified version of figure 4 in reference 424 of table 1.

in some houses. Magnitude 7.1 M_S GR, 7.1 m_b ABE. (Ref. 38, 477.)

1911. Sept. 17 (Sept. 16). Rat Islands, Aleutian Islands, Alaska. Magnitude 7.0 m_b ABE. (Ref. 412.)

1911. Sept. 22 (Sept. 21). Prince William Sound region, Alaska. This severe earthquake broke a submarine cable near Valdez, close to a point where the cable was broken in the earthquake of Feb. 14, 1908. Objects fell from shelves at Valdez. Large rockslides occurred at the head of the sound. At Golden, on the shores of Wells Bay in northern Prince William Sound, rockslides buried a gulch. One huge slide, carrying with it a part of a small glacier, "passed within a few hundred feet of the town." The shock also was "heavy" in the mountains of Kenai Peninsula, which borders the western shore of Prince William Sound. An observer north of Kenai Lake reported that it was difficult to remain upright, trees swayed, and rocks rolled down the mountain slopes. Several aftershocks were observed in the area. (Ref. 38, 258, 420.)

1911. Nov. 13. Near Islands, Aleutian Islands, Alaska. Magnitude 7.0 m_b ABE. (Ref. 428.)

1912. Jan. 4. Andreanof Islands, Aleutian Islands, Alaska. Magnitude 7.0 M_S GR, 7.0 m_b ABE. (Ref. 258.)

1912. June 10. Cook Inlet, Alaska. Magnitude 7.0 M_S GR, 7.3 m_b ABE. (Ref. 258.)

1912. July 7 (July 6). Central Alaska. This earthquake was violent at Fairbanks and strong at Kennicott. The earth "heaved and rolled" at the north base of Mount McKinley, and the country was scarred with landslides. Magnitude 7.4 M_S GR, 7.3 m_b ABE. (Ref. 38, 437.)

1919. Dec. 15 (Dec. 14). Juneau area, Alaska. Buildings were badly shaken by "one of the heaviest earthquakes experienced here in years." (Ref. 38, 272.)

1923. May 4. Alaska Peninsula area, Alaska. Magnitude 7.0 m_b ABE. (Ref. 432.)

1925. Feb. 23. Gulf of Alaska. Several chimneys were destroyed and walls were cracked at Anchorage and Seward. One bridgehead was cracked, and the submarine cable between Seward and Valdez was severed. Part of a dock collapsed at Valdez. Two shocks, the second of which was stronger, followed the first within a few seconds. Several aftershocks were observed to Feb. 28. (Ref. 38, 218, 265, 610.)

1926. Oct. 13, 19 08 UTC. Andreanof Islands, Aleutian Islands, Alaska. Magnitude 7.1 M_S GR, 7.1 m_b ABE. (Ref. 432.)

1927. Oct. 24. Southeast Alaska. Submarine cables were broken between Petersburg and Wrangell and between Juneau and Skagway. At Sitka, cracks formed in buildings and people were thrown from their feet. Near Hoonah, water in Icy Straits was "churned and muddy," and strong "tide rips" were reported on Cross Sound. A few windows were broken at Juneau, and several hundred were broken at Petersburg. At Seattle, Wash., small waves were observed on water in swimming pools. Felt throughout southeast Alaska, west to Cordova, and to the north of Fairbanks. Magnitude 7.1 M_S GR, 7.1 m_b ABE. (Ref. 38, 218, 432, 477.)

1928. June 21. Gulf of Alaska. Three distinct shocks were felt in the Cordova area, the second of which was the strongest. Men were thrown from their bunks 48 km north of Cordova; plaster cracked at Cordova; and landslides occurred at several places in the mountains. The earthquake was "heavy" at Valdez. Also felt at Anchorage, Chickaloon, Matanuska, and Seward. Magnitude 7.0 M_S GR, 7.3 m_b ABE. (Ref. 1, 258, 477.)

1929. Jan. 21. Near Fairbanks, Alaska. The first earthquake was the most severe at Fairbanks, where it lasted several seconds. Windows were broken, furniture was displaced, and many residents rushed into the streets. Heavy rumbling was heard. The shocks lasted about 4 hours and continued into the next day. (Ref. 2, 258.)

1929. Mar. 7, 01 34 UTC (Mar. 6). Fox Islands, Aleutian Islands, Alaska. This earthquake was felt onboard several ships at sea and severely at Dutch Harbor, Alaska. A small tsunami was recorded at Hilo, Hawaii. Magnitude 8.3 M_S CFR, 8.1 M_S GR, 7.9 m_b ABE. (Ref. 2, 432, 610.)

1929. July 5, 14 19 UTC. Andreanof Islands, Aleutian Islands, Alaska. Magnitude 7.0 M_S GR, 6.9 m_b ABE. (Ref. 432.)

1929. July 7. Andreanof Islands, Aleutian Islands, Alaska. Magnitude 7.3 M_S GR, 7.4 m_b ABE. (Ref. 432.)

1929. Dec. 17, 10 58 UTC. Near Islands area, Aleutian Islands, Alaska. Magnitude 7.6 M_S GR, 7.4 m_b ABE. (Ref. 432.)

1931. May 30, 11 34 UTC. Attu Island, Alaska. The earthquake broke dishes and overturned small objects on Attu. Almost all canned goods in a store were thrown to the floor. (Ref. 38, 265.)

1932. Mar. 25, 23 58 UTC. South-central Alaska. This earthquake was strongest at Seward, where it broke a water main; landslides occurred on the railroad to the north. (Ref. 5, 38, 258.)

1933. Jan. 4 (Jan. 3). Southern Alaska. Ground cracks formed in the streets of Seward and at several other points in Alaska. The valley leading north from Seward was noticeably disturbed; cracks formed in the Forestry Bureau road for a distance of about 32 km to Kenai Lake. Felt at several towns in the region. Magnitude 7.0 M_S GR, 7.1 m_b ABE. (Ref. 6, 38, 258, 477.)

1933. Apr. 27 (Apr. 26). Near Anchorage, Alaska. Houses were shaken from their foundations at Old Tyonek, west of Anchorage across Cook Inlet. Plate-glass windows were broken in several stores in Anchorage, and merchandise tumbled from shelves. Telegraph lines were down for a distance of 80 km from Anchorage. The shock was felt strongly on Kodiak Island and along the Aleutian Islands. Many aftershocks occurred. Magnitude 7.0 M_S GR, 7.1 m_b ABE. (Ref. 6, 38, 258.)

1934. May 4 (May 3). Southern Alaska. At Anchorage, windows were broken, stock in stores was jarred from shelves, and telephone lines were "knocked out of commission." Felt at several towns in the region. (Ref. 7, 258.)

1934. May 14. Kodiak Island region, Alaska. Kodiak and Whale Islands were shaken severely. Plaster cracked at Kodiak and stock fell from shelves. A landslide occurred near Kodiak. The shock "probably was almost as severe" on Afognak and Whale Islands. (Ref. 7, 258.)

1935. Feb. 22. Near Islands, Aleutian Islands, Alaska. Magnitude 6.9 M_S GR, 6.7 m_b ABE. (Ref. 258.)

1936. Oct. 23 (Oct. 22). Near Anchorage, Alaska. The earthquake was described as the strongest shock in three years at Anchorage, where property loss was estimated at $500. The shock was described as "heavy" at Seward and "strong" at Susitna. Many aftershocks occurred. (Ref. 9, 265.)

1937. July 22. Central Alaska. Only slight damage was caused by this major earthquake because the epicentral area was sparsely populated. Fairbanks sustained considerable minor damage, consisting mostly of broken windows and loss of merchandise in stores. Slight damage also was reported at Anchorage, about 580 km south of Fairbanks. At Salcha Bluff, southeast of Fairbanks, the highway was blocked for several meters by a landslide. Near there, mud boils appeared and cracks as wide as 38 cm formed. Water in the nearby slough rose considerably above its normal level and did not subside for several days.

At mile 33 station of the Alaska Road Commission, a two-story log structure was knocked askew and several windows were broken. About 22 km from Fairbanks, small cracks formed in the road, and near the mile 18 roadhouse, silt and sand from many cracks covered the highway. The main earthquake was felt over most of central Alaska. Aftershocks occurred for several months. Magnitude 7.3 M_S GR. (Ref. 10, 265.)

1938. Nov. 10. Shumagin Islands region, Alaska. A major submarine earthquake, centered in a sparsely populated area, was felt strongly at False Pass, Unimak Island. It also was reported at Port Moller and Anchorage. The earthquake generated a small tsunami, which was recorded at Dutch Harbor, Seward, and Sitka, Alaska, and at Hilo and Honolulu, Hawaii. Magnitude 8.7 M_S CFR, 8.3 M_S GR, 8.2 m_b ABE. (Ref. 11, 38, 432, 610.)

1938. Nov. 17 (Nov. 16). Alaska Peninsula area, Alaska. Magnitude 7.2 M_S GR, 7.2 m_b ABE. (Ref. 432.)

1940. Apr. 16, 06 07 UTC (Apr. 15). Near Islands, Aleutian Islands, Alaska. Magnitude 7.1 M_S GR, 7.1 m_b ABE. (Ref. 432.)

1940. Apr. 16, 06 43 UTC (Apr. 15). Near Islands, Aleutian Islands, Alaska. Magnitude 7.2 M_S GR. (Ref. 432.)

1940. July 19, 16 27 UTC. Kenai Peninsula area, Alaska. Slight damage occurred at Anchorage, where walls were cracked and small objects were displaced. (Ref. 13, 38.)

1940. Aug. 22 (Aug. 21). Near Unalaska Island, Alaska. Magnitude 7.1 M_S GR, 7.2 m_b ABE. (Ref. 258.)

1941. July 30 (July 29). Kenai Peninsula area, Alaska. At Anchorage, one building was shaken from its foundation and four "pipes" (probably water pipes) were broken. Plaster fell, dishes broke, windows cracked, and stock toppled to the floor. Three aftershocks were observed. (Ref. 14, 38, 258.)

1943. Nov. 3. South-central Alaska. This earthquake was felt at Anchorage, where an abrupt, heaving motion swung doors and rattled windows. Magnitude 7.3 M_S GR, 7.2 m_b ABE. (Ref. 38, 432.)

1944. Dec. 12 (Dec. 11). Rat Islands, Aleutian Islands, Alaska. Magnitude 7.0 M_S GR, 7.1 m_b ABE. (Ref. 258.)

1946. Jan. 12. Gulf of Alaska. Magnitude 7.2 M_S GR, 7.2 m_b ABE. (Ref. 432.)

1946. Apr. 1, 12 28 UTC. Unimak Island region, Alaska, southeast of Scotch Cap Lighthouse. This major earthquake caused only minor damage to buildings on Unimak Island, but it generated a tsunami that devastated the lighthouse and swept away its five occupants. The height of the wave at the lighthouse was estimated at about 35 m. Tsunami damage also occurred at Dutch Harbor and Ikatan Island in the Aleutian Islands, on the west coasts of North and South America, and in Hawaii. At Hilo, Hawaii, the tsunami took 159 lives and caused $26 million loss to property. The tsunami caused one death in California. Magnitude 7.4 M_S GR, 7.2 m_b ABE. (Ref. 19, 38, 432, 533, 610.)

1946. Nov. 1 (Oct. 31). Andreanof Islands, Aleutian Islands, Alaska. Magnitude 7.0 M_S ABE, 6.9 m_b ABE. (Ref. 258.)

1947. Oct. 16 (Oct. 15). Fairbanks area, Alaska. This major earthquake centered southeast of Nenana on the Salcha River fault. Small fissures formed in the ground near the Nenana Airport, southwest of Fairbanks. Streets "upheaved" at Nenana in several places, and several long cracks formed in the ground. Cracks in river mud and ice occurred from Shaw Creek on Richardson Highway to the headwaters of the Kantishna and Tolavana Rivers. Cracks 56 cm wide, as much as 30 cm deep, and several meters long were reported about 24 km below Chena Bluffs on the Tanana River. A few pressure ridges were observed where large, frozen blocks came together.

Alaska Railroad officials reported that rails were bent between Julius, Nenana, and Browne, and that some changes were observed in the elevation of the roadbed. Landslides occurred on the Richardson Highway, and rockslides were observed between Fairbanks and Nenana on the Tanana River.

In Fairbanks, merchandise in stores was damaged heavily, many windows were broken, and a powerline short-circuit occurred near the University of Alaska. Changes in the flow of water in several wells were reported both at Fairbanks and Nenana. Trees and poles were shaken violently. At the town of Clear, south of Nenana, some prefabricated buildings were damaged.

The felt area is rather well defined to the south and west but is uncertain to the north and east because of the sparse population. The earthquake was felt over most of central and southern Alaska and at two places in the Yukon Territory of Canada, an area within a radius of about 500 km of the epicenter. This earthquake series consisted of more than 200 foreshocks and aftershocks. The strongest aftershock occurred on Oct. 20. Magnitude 7.0 M_S GR, 6.9 m_b ABE. (Ref. 20, 38, 260.)

1948. May 14. Alaska Peninsula area, Alaska. Magnitude 7.5 M_S GR, 7.3 m_b ABE. (Ref. 432.)

1949. Sept. 27. Gulf of Alaska. Magnitude 7.0 m_b ABE. (Ref. 258.)

1951. Feb. 13. Alaska Peninsula area, Alaska. Magnitude 7.1 M_S GR, 7.1 m_b ABE. (Ref. 432.)

1952. Dec. 7 (Dec. 6). Shemya Island, Alaska. This earthquake disconnected a water main and electrical cables and cracked a cement floor at Shemya Air Force Base. (Ref. 25, 38, 265.)

1953. Jan. 5 (Jan. 4). Near Islands area, Aleutian Islands, Alaska. Felt on Attu Island, Alaska. Magnitude 7.0 m_b ABE. (Ref. 26, 432.)

1954. Oct. 3. Kenai Peninsula, Alaska. At Anchorage, the violent shaking broke water connections in two 14-story buildings. North of Potter, more than 42 m of railroad track was "knocked out of commission." Minor landslides spilled down on the Seward-Anchorage Highway. Cracks in concrete walls, fallen plaster, and shattered plate-glass windows were reported at Anchorage, Homer, Kenai, Seward, Sterling, and Valdez. Magnitude 6.5 Ukn BRK. (Ref. 27, 38, 447.)

1957. Mar. 9, 14 22 UTC. Andreanof Islands, Aleutian Islands, Alaska. This great earthquake destroyed two bridges on Adak Island, damaged houses, and left a 4.5-m crack in a road. On Umnak Island, part of a dock was destroyed, and Mount Vsevidof erupted after being dormant for 200 years. Further, this shock generated a 15-m tsunami that smashed into the coastline at Scotch Cap and an 8-m tsunami that washed away many buildings and damaged oil lines extensively at Sand Bay. This tsunami continued to Hawaii, where it destroyed two villages and inflicted about $5 million in property damage on Oahu and Kauai Islands. The tsunami also caused minor damage in San Diego Bay, Calif., before traveling to such distant countries as Chile, El Salvador, Japan, and other areas in the Pacific region. More than 300 aftershocks were reported along the southern edge of the Aleutians, from Unimak Island to Amchitka Pass. Magnitude 7.7 m_b ABE, 8.3 Ukn PAS. (Ref. 30, 38, 479, 610.)

1957. Mar. 9, 20 39 UTC. Fox Islands, Andreanof Islands, Alaska. Felt on Adak Island. Magnitude 7.1 Ukn PAS, 7.0 m_b ABE. (Ref. 30, 432, 479.)

1957. Mar. 11, 09 58 UTC (Mar. 10). Fox Islands, Aleutian Islands, Alaska. Magnitude 6.9 Ukn PAS, 7.1 Ukn BRK, 6.9 m_b ABE. (Ref. 432.)

1957. Mar. 11, 14 55 UTC. Andreanof Islands, Aleutian Islands, Alaska. Felt on Adak and Umnak Islands. Magnitude 7.0 m_b ABE, 6.7 Ukn PAS, 7.1 Ukn BRK. (Ref. 30, 479.)

1957. Mar. 12, 11 44 UTC. Andreanof Islands, Aleutian Islands, Alaska. Felt on Adak and Umnak Islands. Magnitude 7.1 m_b ABE, 7.3 Ukn PAS. (Ref. 30, 479.)

1957. Mar. 14, 14 47 UTC. Andreanof Islands, Aleutian Islands, Alaska. Felt on Adak Island. Magnitude 7.0 m_b ABE, 7.2 Ukn PAS, 7.4 Ukn BRK. (Ref. 30, 479.)

1957. Mar. 16, 02 34 UTC (Mar. 15). Andreanof Islands, Aleutian Islands, Alaska. Felt on Adak Island. Magnitude 7.0 m_b ABE, 6.7 Ukn PAS. (Ref. 30, 479.)

1957. Mar. 22, 14 21 UTC. Fox Islands, Aleutian Islands, Alaska. Magnitude 6.9 m_b ABE, 7.0 Ukn PAS, 7.0 Ukn BRK. (Ref. 432.)

1957. Apr. 10, 11 29 UTC. Kodiak Island region, Alaska. Magnitude 7.0 m_b ABE, 7.1 Ukn PAS, 7.2 Ukn BRK. (Ref. 432.)

1957. Apr. 19, 22 19 UTC. Fox Islands, Aleutian Islands, Alaska. Magnitude 6.5 M_S ABE, 7.1 m_b ABE. (Ref. 265.)

1957. June 13. Andreanof Islands, Aleutian Islands, Alaska. Magnitude 6.7 m_b ABE. (Ref. 265.)

1958. Apr. 7. Central Alaska. A major earthquake on this date caused mud flows, widespread breakage of lake and river ice, and formation of many ground cracks within a 65- to 80-km radius of Huslia (west of Fairbanks). Observers also reported pressure ridges, thawing of ice on lakes, and craters 6 m across and about 2 m deep in the ground. Ground cracks occurred at Tanana. Minor damage to roofs and foundations of buildings was reported at Huslia. Slight damage also was observed at several central Alaska towns. Magnitude 7.3 Ukn PAS, 7.1 m_b ABE. (Ref. 31, 447.)

1958. July 10, 06 15 UTC (July 9). Southeast Alaska. This was the largest earthquake in southeast Alaska since the Yakutat shocks of 1899. The only permanent settlement in the epicentral region was Yakutat; therefore, effects on man-made works were moderate for such a large earthquake. On Khantaak Island (in Yakutat Bay), three persons were killed when the north end of the island slumped into the sea, and two people were missing and presumed dead in Lituya Bay from a wave generated by the collapse of 300 million m^3 of rock into Gilbert Bay. At Yakutat, bridges, docks, and oil lines were damaged, a water tower fell, and a few cabins were destroyed. Many sand blows and ground fissures were observed on the low coastal plain southeast of Yakutat, and large landslides were reported in the mountains. A cabin collapsed and the ground was fissured at Dry Bay (East River); many sand blows and ground cracks occurred at Dry Bay (Akwe River); and submarine cables were severed in the Haines-Skagway area and at Lena Point (north of Juneau). Slight damage also occurred at Auke Bay, Baranof, Juneau, Pelican, and Sitka.

A massive rockslide at the head of Lituya Bay caused water to surge about 530 m, generating a "gravity wave" that swept out of the bay. A fishing boat anchored in Anchorage Cove was carried in front of the largest wave crest, and those onboard estimated they cleared La Chaussee Spit (at the mouth of Lituya Bay) by 30 m or more. Two people on another fishing boat disappeared after being caught in the huge wave. This major earthquake was felt over a large area of southeast Alaska, as far south as Seattle, Wash., and east to Whitehorse, Y.T., Canada (see fig. 9). Magnitude 7.1 m_b ABE, 7.9 Ukn PAS, 8.0 Ukn BRK. (Ref. 31, 38, 448, 533, 610.)

1960. Nov. 13 (Nov. 12). Fox Islands, Aleutian Islands, Alaska. Magnitude 7.1 m_b ABE, 7.0 Ukn PAS, 7.2 Ukn BRK. (Ref. 432.)

1961. Sept. 5. Kenai Peninsula, Alaska. Slight damage in the form of cracked plaster and broken dishes and mirrors occurred at Seward. The shock also was felt at several other towns in the region. Magnitude 5.75 Ukn BRK. (Ref. 34, 447.)

1962. Oct. 21 (Oct. 20). Anchorage area, Alaska. Slight damage to telephone lines, merchandise in stores and houses, and plaster was observed in the Anchorage-Girdwood-Wasilla area. Also felt at Kenai, Soldotna, and Susitna Station. (Ref. 35, 447.)

1963. June 24 (June 23). Cook Inlet, Alaska. At Seldovia, a brick chimney toppled; at Homer, a ceiling beam burst and posts were torn from the ground; and at Barbara Point (8 km north of Seldovia), a heavy fireplace slab was displaced about 15 cm, and a concrete foundation was cracked. Rockslides were observed in the area. The shock also was felt at Anchorage, Cordova, and Homer area. Magnitude 6.5–6.75 Ukn BRK. (Ref. 36, 447.)

1964. Feb. 6, 13 07 UTC. Near Chirikof Island, Alaska. Magnitude 7.1 m_b ABE, 6.9 Ukn PAS, 6.9 Ukn PAL, 6.6 Ukn BRK. (Ref. 37, 432.)

1964. Mar. 28 (Mar. 27). Prince William Sound, Alaska. This great earthquake and ensuing tsunami took 125 lives (tsunami 110, earthquake 15), and caused about $311 million in property loss. Earthquake effects were heavy in many towns, including Anchorage, Chitina, Glennallen, Homer, Hope, Kasilof, Kenai, Kodiak, Moose Pass, Portage, Seldovia, Seward, Sterling, Valdez, Wasilla, and Whittier.

Anchorage, about 120 km northwest of the epicenter, sustained the most severe damage to property. About 30 blocks of dwellings and commercial buildings were damaged or destroyed in the downtown area. The J.C. Penney Company building was damaged beyond repair; the Four Seasons apartment building, a new six-story structure, collapsed; and many other multistory buildings were damaged heavily. The schools in Anchorage were almost devastated. The Government Hill Grade School, sitting astride a huge landslide, was almost a total loss. Anchorage High School and Denali Grade School were damaged severely. Duration of the shock was estimated at 3 minutes.

Landslides in Anchorage caused heavy damage. Huge slides occurred in the downtown business section, at Government Hill, and at Turnagain Heights. The largest and most devastating landslide occurred at Turnagain Heights. An area of about 130 acres was devastated by displacements that broke the ground into many deranged blocks that were collapsed and tilted at all angles. This slide destroyed about 75 private houses. Water mains and gas, sewer, telephone, and electrical systems were disrupted throughout the area.

The earthquake was accompanied by vertical displacement over an area of about 520,000 km^2. The major area of uplift trended northeast from southern Kodiak Island to Prince William Sound and trended east-west to the east of the sound. Vertical displacements ranged from about 11.5 m of uplift to 2.3 m of subsidence relative to sea level. Off the southwest end of Montague Island, there was absolute vertical displacement of about 13–15 m. Uplift also occurred along the extreme southeast coast of Kodiak Island, Sitkalidak Island, and over part or all of Sitkinak Island. This zone of subsidence covered about 285,000 km^2, including the north and west parts of Prince William Sound, the west part of the Chugach Mountains and a part of the lowlands north of the mountains, most of Kenai Peninsula, and almost all the Kodiak Island group.

This shock generated a tsunami that devastated many towns along the Gulf of Alaska and left serious damage at Alberni and Port Alberni, Canada, along

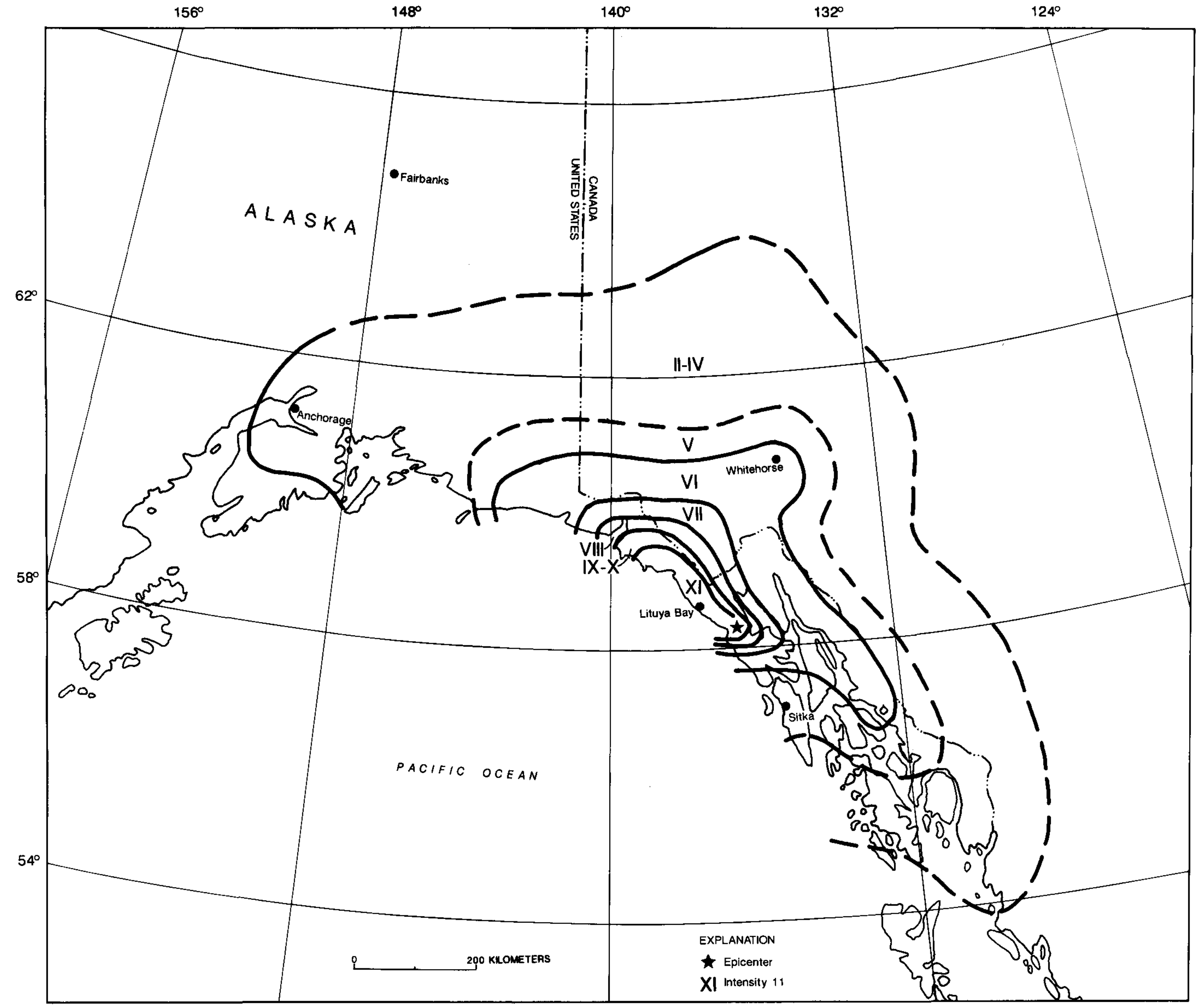


FIGURE 9.—Isoseismal map for the southeast Alaska earthquake of July 10, 1958. This map is a simplified version of figure 6 in reference 424 of table 1.

the West Coast of the United States (15 killed), and in Hawaii. The maximum wave height recorded was 67 m at Valdez Inlet. Seiche action in rivers, lakes, bayous, and protected harbors and waterways along the Gulf Coast of Louisiana and Texas caused minor damage. It was also recorded on tide gages in Cuba and Puerto Rico.

This great earthquake was felt over a large area of Alaska and in parts of western Yukon Territory and British Columbia, Canada (see fig. 10). Magnitude 7.9 m_b ABE, 8.4 Ukn PAS, 8.6 Ukn BRK, 8.6 Ukn PAL. (Ref. 37, 38, 451, 523, 533, 611.)

1964. Apr. 14. Kodiak Island region, Alaska. At Kodiak, light fixtures broke and several cracks formed in one building. The City Hall, fire station, and library building were "further weakened." (Ref. 37, 299.)

1964. Dec. 13 (Dec. 12). Nome area, Alaska. At Nome, a water pipe broke; concrete floor, walls, and plaster cracked; and crusted snow broke into chunks. Also felt strongly at Teller. Several aftershocks were felt in the Nome area. (Ref. 37, 299.)

1965. Feb. 4, 05 01 and 08 40 UTC (Feb. 3). Rat Islands, Aleutian Islands, Alaska. On Adak Island, cracks occurred in prefabricated wood buildings; on Shemya Island, cracks were observed in an asphalt runway. Hairline cracks also formed in the runways at the U.S. Coast Guard Loran Station on

Five-story J.C. Penney Building, 5th Avenue and Downing Street, Anchorage, Alaska, partly collapsed by the March 28, 1964 (Mar. 27 AST), earthquake. Note undamaged buildings nearby.

Attu Island. This earthquake generated a tsunami reported to be about 10.7 m high on Shemya Island. Loss caused by flooding on Amchitka Island was estimated at about $10,000. An aftershock at 07 40 UTC was assigned MMI VI. Magnitude 7.7 m_b ABE, 7.7 Ukn PAS, 7.7 Ukn BRK (first shock); 7.0 m_b ABE, 6.9 Ukn PAS (second shock). (Ref. 75, 299, 610.)

1965. Mar. 30, 02 27 UTC (Mar. 29). Rat Islands, Aleutian Islands, Alaska. Felt on Adak and Amchitka Islands. Magnitude 7.4 m_b ABE, 7.2 Ukn PAS, 6.9 Ukn BRK, 7.7 Ukn PAL. (Ref. 75, 299.)

1965. Apr. 16. Central Alaska. Slight damage to walls and dishes occurred at Elim. River ice was cracked at Kaltag and Unalakleet. Thunderous earth noises were reported. Felt over a small area of central Alaska. (Ref. 75, 299.)

1965. July 2. Fox Islands, Aleutian Islands, Alaska. In one house on Umnak Island, dishes were broken and books were thrown over all the room. A minor tsunami having a 9-cm amplitude was registered on Unalaska Island. Also observed at Cold Bay. Magnitude 7.0 m_b ABE, 6.9 Ukn PAS, 6.8 Ukn BRK, 6.7 Ukn PAL. (Ref. 75, 299.)

1966. Aug. 7 (Aug. 6). Andreanof Islands, Aleutian Islands, Alaska. Felt on Adak Island. Magnitude 6.4 M_S ABE, 6.7 Ukn PAS, 7.0 Ukn BRK. (Ref. 81, 299.)

1967. June 21, 18 04, 18 13, and 18 24 UTC. Fairbanks area, Alaska. Three moderate earthquakes caused minor damage to property in the Fairbanks area. The most extensive loss occurred at the State Court and Office Building in Fairbanks. Both interior and exterior walls cracked, parts of hanging ceilings and light fixtures fell, plumbing broke, and cabinets and shelves overturned. Several chimneys fell in the area, a tall chimney stack buckled, windows broke, and considerable loss of merchandise was reported in stores.

Three ground cracks about 2 m apart were observed at Badger Pass and Peede Road, and blue mud seeped through the cracks. On Richardson Highway, water spouted from ground cracks, a sewer line broke, and chimneys were offset. Small landslides occurred. About 6,000 aftershocks were recorded through June 28. About 60 aftershocks were observed by residents, and some caused additional

Landslide and slumping effects in the Turnagain Heights area, Anchorage, Alaska, caused by the March 28, 1964 (Mar. 27 AST), earthquake.

damage. Magnitude 5.5 Ukn PAS (first shock). (Ref. 40, 74, 452.)

1967. June 23. Fairbanks area, Alaska. The State Court and Office Building in Fairbanks sustained additional damage. Merchandise fell in stores. (Ref. 40, 74.)

1968. Oct. 29. Central Alaska. The epicentral area, southeast of Rampart on the Yukon River, was shaken badly but sustained no serious damage because most of the buildings were constructed of logs. Stock tumbled from shelves, residents ran from buildings, and equipment not bolted down was displaced. In the Hunter Creek area, about 16 km from Rampart, many landslides were observed on the south-facing slopes. Lake ice was cracked extensively in places. At Nenana, about 80 km southeast of Rampart, cracks formed in the ground and plaster was broken. More than 2,000 aftershocks were recorded through Nov. 12. Magnitude 6.4 M_S BRK, 6.9 Ukn PAS, 7.0 Ukn GOL. (Ref. 41, 299.)

1968. Dec. 17. Southern Alaska. Slight damage occurred at Kenai. Felt from Cantwell southeast to Kodiak. Magnitude 6.4 M_S BRK. (Ref. 38, 41, 299.)

1972. July 30. Southeast Alaska. At Sitka, a few chimneys fell and some minor landslides were reported. Slight damage also was sustained at Hoonah, Juneau, Pelican, and Yakutat. The Fairweather fault ruptured over a length of 75 km. Seiches were observed in swimming pools as far south as Seattle, Wash. At least 19 aftershocks were felt at Sitka through Aug. 29. A tsunami of 10 cm was recorded at Juneau and 8 cm at Sitka. The main shock was felt over a large area of southeast Alaska and British Columbia, Canada. Magnitude 7.4 m_b AB3, 7.2 Ukn PAS, 7.1 Ukn BRK. (Ref. 45, 74, 610.)

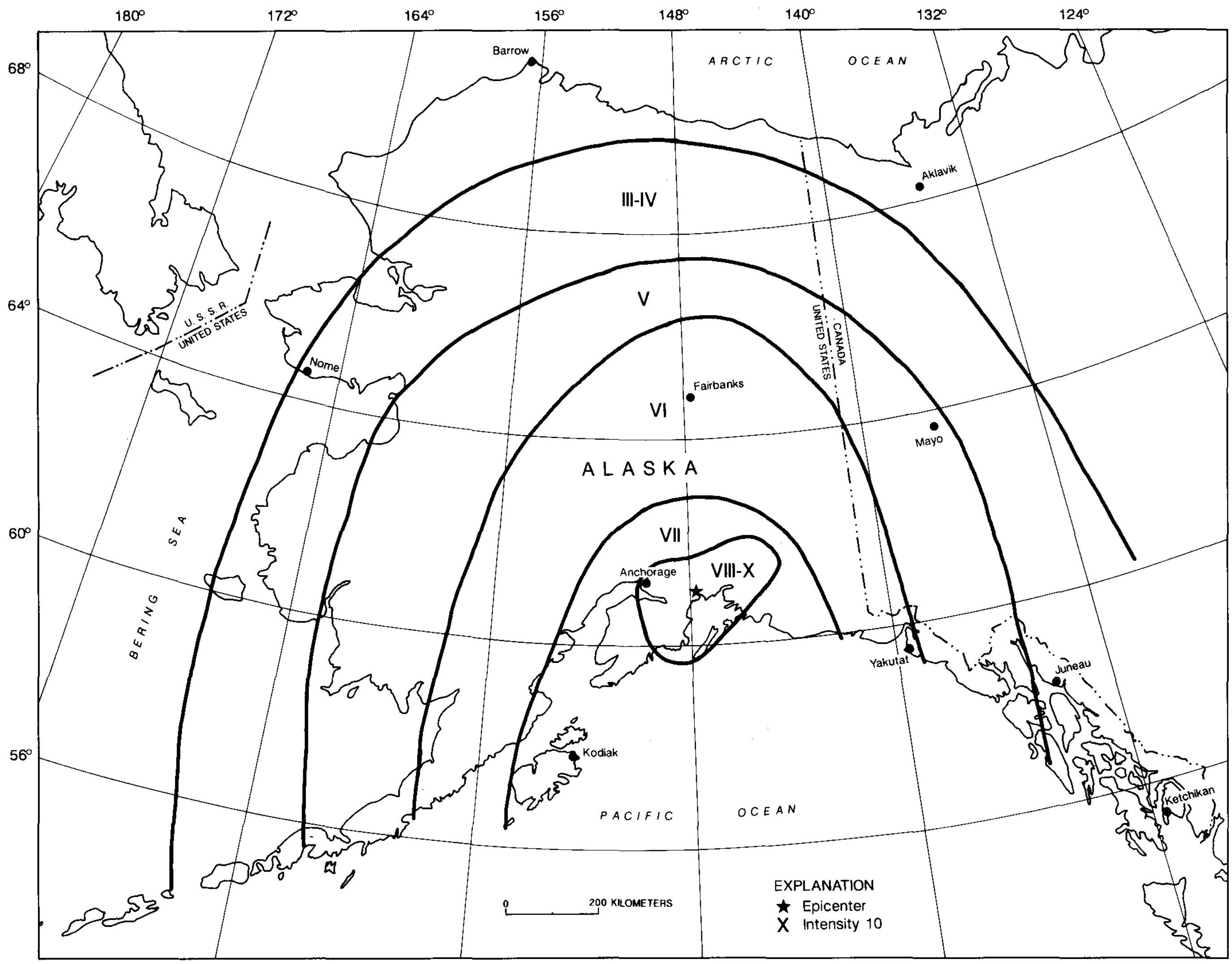


Figure 10.—Isoseismal map for Prince William Sound, Alaska, earthquake of March 28, 1964. This map is a simplified version of the map in reference 528 of table 1.

1972. Aug. 3 (Aug. 2), 04 40 UTC. Andreanof Islands, Aleutian Islands, Alaska. Minor damage occurred on Adak Island. Magnitude 6.4 M_S BRK. (Ref. 45, 479.)

1975. Feb. 2, 08 43 UTC (Feb. 1). Near Islands, Aleutian Islands, Alaska. A major earthquake injured several residents and caused severe damage on Shemya Island. The Shemya Air Force Base runway sustained cracks. Crevasses having as much as 16.5 m of vertical displacement were observed on Shemya. Landslides occurred, water tanks twisted, and underground water pipes broke. Many aftershocks were felt during the weeks following the main shock. Also felt on Attu Island. Magnitude 7.0 m_b AB3, 7.5 Ukn PAS, 7.4 Ukn BRK. (Ref. 48, 74.)

1977. Nov. 4 (Nov. 3). Andreanof Islands, Aleutian Islands, Alaska. This earthquake downed plaster and moved heavy furniture on Adak Island and cracked chimneys on Atka Island. Magnitude 7.0 M_S BRK. (Ref. 39, 479.)

1978. Aug. 18. Southern Alaska. At Clam Gulch, southwest of Anchorage on the Kenai Peninsula, hairline cracks formed in cinder-block walls, and plasterboard was cracked. Felt over a small area of south-central Alaska. (Ref. 74, 240.)

1979. Feb. 28. Southeast Alaska. This major earthquake was located about 50 km northwest of Mt. St. Elias, near the east end of the Chugach Mountains. It affected the area only slightly because it centered in an unpopulated area of ice fields. Seven major earthquakes have been located in the region between Controller Bay and northern Chichagof Island in southeast Alaska from 1899 to 1979, three of which were of magnitude 8 or larger. This earthquake was strongest at the Icy Bay Lumber Camp, about 76 km south of the epicenter, where a parked logging truck was bounced sideways across the road, trees and bushes were shaken strongly, and people had difficulty in standing. Minor damage occurred in Alaska at Border City, Cape Yakataga, Juneau area, Valdez, and Yakutat; minor damage occurred in Yukon Territory, Canada, at Beaver Creek, Burwash Landing, Destruction Bay, and Kluane Lake Fishing Camp. A 15-cm tsunami was recorded at Yakutat. Magnitude 7.3 M_S BRK, 7.1 m_b AB3. (Ref. 424, 455, 610.)

1979. May 20 (May 19). Alaska Peninsula area. Minor damage at Larsen Bay included cracks in plaster and drywall and hairline cracks in exterior walls. Also felt at a few other towns in the area. Magnitude 6.5 m_b PAS, 6.2 m_b BRK. (Ref. 74, 262.)

1983. July 12, 15 10 UTC. Prince William Sound, Alaska. The epicenter of this earthquake is near that of the great 1964 earthquake (which had a magnitude of 8.3). At Valdez, an estimated $1 million in damage occurred at the airport terminal building. Its exterior concrete-block walls cracked from roof to ground, and its inside walls also sustained cracks. Ceiling tiles fell in the high school and elementary school buildings; cracks formed in streets and sidewalks. Minor damage also was observed at Girdwood. This shock was felt from Yakutat on the south to Fairbanks on the north and east to Whitehorse, Y.T., Canada. Magnitude 6.3 M_S BRK, 6.3 m_b BRK, 6.4 m_b PAS. (Ref. 360.)

1983. Sept. 7. Prince William Sound, Alaska. This moderate earthquake, whose epicenter is near that of the great 1964 earthquake, caused property damage at Gakona and Valdez. Damage was most severe at Valdez, where chimneys and foundations cracked and hairline cracks formed in interior walls. The flow of water in wells was disturbed at Gakona, and small landslides and slumping of roadfill occurred. Magnitude 6.3 m_b BRK, 6.4 m_b PAS. (Ref. 360.)

1984. Aug. 14 (Aug. 13). Southern Alaska. Slight damage in the form of shattered windows and broken dishes occurred at Palmer, Sutton, and Willow. Buildings were shaken strongly, and people had difficulty standing. Small landslides were observed at Palmer and on Glenn Highway, near Sutton. The earthquake shook objects from walls and knocked merchandise from store shelves throughout the area. Residents observed several slight aftershocks during the week. (Ref. 74, 370.)

1985. Oct. 9 (Oct. 8). Shumagin Islands area, Alaska. Magnitude 6.6 M_S PAL, 6.0 M_S PAS. (Ref. 74, 371.)

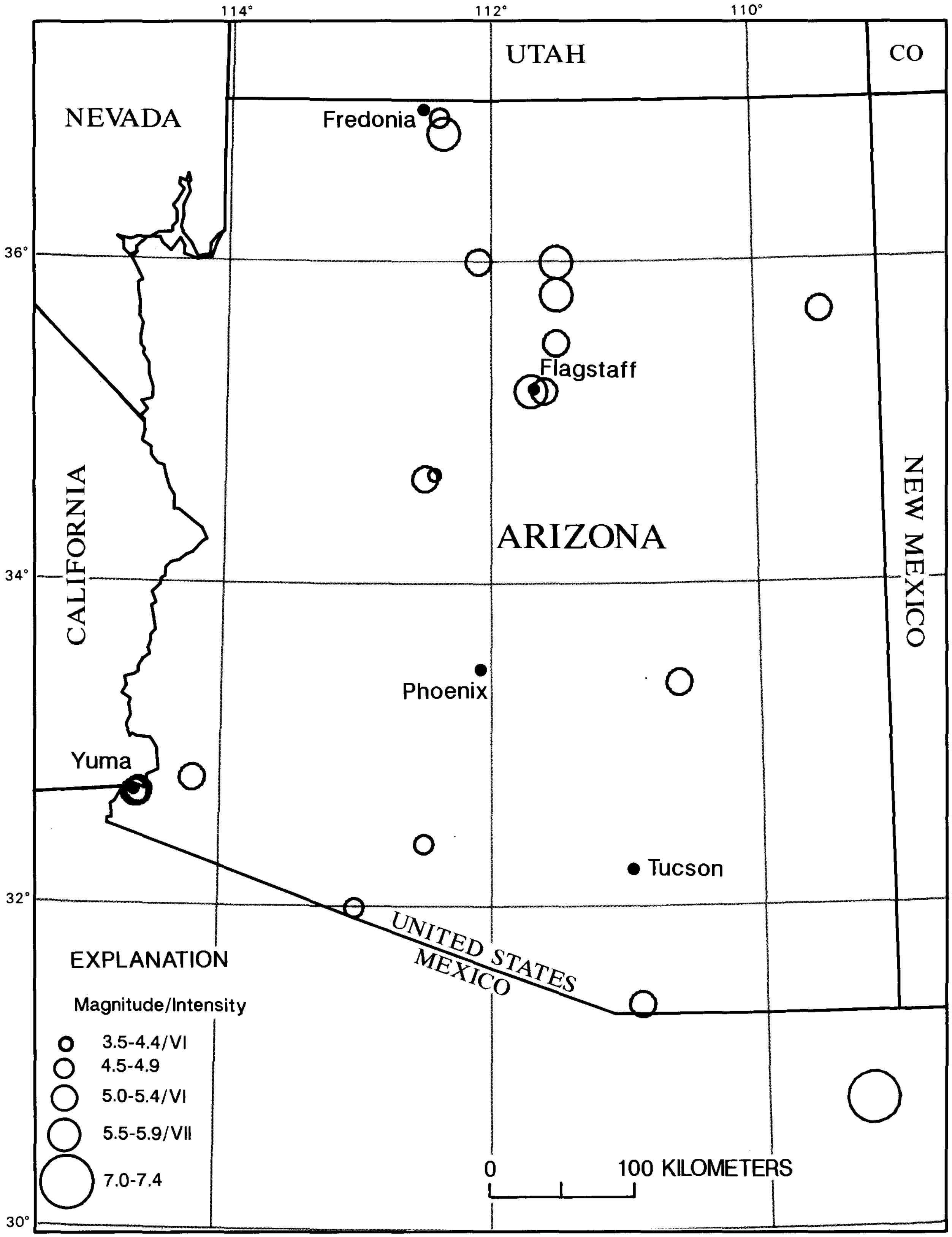
1986. May 7, 22 47 UTC. Andreanof Islands, Aleutian Islands, Alaska. This earthquake caused moderate damage to structures on Adak Island and slight damage on Atka Island. Damage to buildings on Adak Island consisted of cracked masonry and concrete walls, failure of partitions and suspended ceilings, spalling on concrete beams and piers, and differential settlement of house foundations. Soil liquefaction was observed in localized areas of backfilled soil, and sand boils were observed. Laterally spreading cracks and differential ground settlement occurred along a small wharf. This earthquake caused a small tsunami that was recorded throughout the Pacific Ocean. Magnitude 7.9 M_S BRK. (Ref. 562, 610.)

1986. May 15 (May 14). Andreanof Islands, Aleutian Islands, Alaska. On Atka Island, underground pipes were broken, bridges were slightly damaged, and hairline cracks formed in interior walls. Magnitude 6.4 M_S BRK. (Ref. 562.)

1986. May 17. Andreanof Islands, Aleutian Islands, Alaska. An airstrip on Atka Island was damaged and officially closed. Underground pipes were broken, furniture was overturned, and landslides were reported. Magnitude 6.5 M_S BRK. (Ref. 562.)

1987. Nov. 30, 19 23 UTC. Gulf of Alaska. Damage at Yakutat, northwest of Juneau, consisted mainly of broken glassware and cracks in plaster, drywall, windows, and a foundation. Light damage occurred at several other towns. Also, cracks in wet ground were reported at Yakutat. Strong building vibrations made it difficult to stand or walk. Two ships in the epicentral area were damaged, and three others in the area felt the shaking strongly. A small tsunami was recorded at Seward, Sitka, and Yakutat. This earthquake had the largest magnitude of any event in the region since that on Oct. 9, 1900. Magnitude 7.7 M_S BRK. (Ref. 74, 577, 610.)

ARIZONA



Earthquakes in Arizona with magnitudes ≥ 4.5 or intensity ≥ VI.

ARIZONA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1878 12 17	23 30	32.7 N	114.6 W	—	343	—	—	—	—	VI	343	—
1887 05 03	09	30.8 N	109.25 W	—	343	—	—	—	7.36NS	XII	471	1590
1888 08 19	11 00	32.7 N	114.6 W	—	343	—	—	—	—	VI	343	—
1890 06 11	01 54	32.7 N	114.6 W	—	343	—	—	—	—	VI	343	—
1892 02 02	08 30	35.2 N	111.6 W	—	343	—	—	—	—	VI	343	—
1906 01 25	21 32 30	35.2 N	111.7 W	—	38	—	—	—	—	VII	38	233
1910 09 24	04 05	35.8 N	111.5 W	—	343	—	—	—	—	VII	343	116
1912 08 18	21 12	36.0 N	111.5 W	—	56	—	—	—	—	VII	38	142
1916 03 30	05 47	31.4 N	110.9 W	—	272	—	—	—	—	VI	343	—
1935 01 02	07 30	32.8 N	114.2 W	—	38	—	—	—	—	VI	38	—
1935 01 10	08 10	36.0 N	112.1 W	—	8	—	—	—	—	VI	8	—
1950 01 17	00 51	35.7 N	109.5 W	—	23	—	—	—	—	VI	38	—
1951 04 12	06 20 10	32.0 N	113.0 W	—	294	—	—	4.50M_L PAS	—	—	—	—
1959 07 21	17 39 29	36.80 N	112.37 W	000	265	—	—	5.60M_L PAS	—	VI	32	21
1959 10 13	08 15 00	35.5 N	111.5 W	—	266	5.0	—	5.00M_L PAS	—	V	32	—
1961 06 18	08 12 07.1	32.4 N	112.5 W	—	266	—	—	4.70M_L PAS	—	—	—	—
1962 02 15	07 12 42.9	36.9 N	112.4 W	026	266	—	—	4.50M_L PAS	—	V	35	2
1969 12 25	12 49 10.1	33.4 N	110.6 W	015	74	4.4	—	—	—	VI	343	—
1976 02 04	00 04 58.1	34.655N	112.500W	012	74	4.9	—	5.10M_L GS	4.62EBE	VI	49	25
1976 02 23	14 09 54.4	34.679N	112.432W	010	74	—	—	3.50M_L GS	—	VI	49	2

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1878. Dec. 17. Yuma, Ariz. This shock cracked walls in several houses in Yuma. Almost all the buildings in town were shaken. Also felt in Calif. The epicenter of this event probably was in Baja California, Mexico. (Ref. 343.)

1887. May 3. Northern Sonora, Mexico. This earthquake occurred in a sparsely settled region of Northern Sonora, Mexico. It caused widespread damage to property, 51 deaths (ref. 494 reports 150 deaths at Bavispe, Sonora), and many injuries. From Guaymas, Sonora, Mexico to Nogales, Ariz.; Benson and Tucson, Ariz.; El Paso, Tex.; and at towns as far away as Albuquerque, N. Mex., water in tanks slopped over, railroad cars were set in motion on tracks, chimneys were thrown down, and buildings were cracked. Other U.S. cities that sustained moderate to heavy damage include: Bisbee, Fairbank, Fort Huachuca, Saint David, San Simon, Solomonville, Tombstone, Tres Alamos, and Willcox, Ariz.; and Deming, Sabinal, and Silver City, N. Mex. Near the epicenter, liquefaction effects induced significant ground failure that led to the collapse of buildings and other structures.

At Tepic, Sonora, a town about 190 km south of Tombstone, Ariz., the walls and roofs of every house were shattered—many of the walls had fallen out, and the roofs had collapsed. The plaza and streets at Tepic were "ripped up" by fissures, some as wide as 15 cm, and irrigation ditches around the town were broken. At Moctezuma, about 32 km south of Tepic, the houses were wrecked, and all inhabitants were living outside. At Oputo, about 56 km northeast of Tepic, a church collapsed and killed 40 people who had run there for shelter from the earthquake. American prospectors in that area reported that a ground fissure about 0.8 m wide was created by the earthquake.

The 76-km-long fault scarp produced by this earthquake is clearly exposed on the east side of the San Bernardino Valley of Northern Sonora, southeast of Douglas, Ariz. The maximum displacement on the Pitaycachi fault is 4.5 to 5.1 m, and evidence exists for previous ruptures on the fault. A significant region of liquefaction was reported as far as 100 km from the fault, and landslides were observed at farther distances. In late 1972, the 1887 scarp was observed from the air along its total length. This study revealed many additional scarps, previously unmapped, paralleling the main fault trace. These scarps appear to represent active faulting over the previous several thousand years.

Seismic motion was felt from Toluca, Mexico (near Mexico City) on the south to Albuquerque and Santa Fe, N. Mex., on the north; and from Baja California, Mexico, and Yuma, Ariz., on the west to a point 100 km east of El Paso, Tex., on the east (see fig. 11). There also was a report that the earthquake was felt in California. Many aftershocks were observed. (Ref. 38, 343, 471, 494, 497.)

1888. Aug. 19. Yuma, Ariz. This earthquake shook down a few old sheds at Yuma. Everyone awoke and ran outside. (Ref. 343.)

1890. June 11 (June 10). Yuma, Ariz. A sharp earthquake that broke several windows at Yuma probably centered in Baja California, Mexico. (Ref. 343.)

1892. Feb. 2. Flagstaff, Ariz. At Flagstaff, the earthquake awakened many people who ran into the street. At Two Guns, a land bridge collapsed; a huge rock toppled onto the entrance of a cave; and stones shook loose from the walls inside the caverns. (Ref. 343.)

1906. Jan. 25. Flagstaff, Ariz. Chimneys were thrown down and walls were cracked at Flagstaff. At the courthouse and the Coconino County Hospital, plaster fell from the ceilings. At the school, plaster cracked in every room. Stones and dead trees were shaken down the San Francisco Peaks. Also felt in southern Utah and northwestern N. Mex. (Ref. 38, 343.)

1910. Sept. 24 (Sept. 23). Coconino National Forest, near Flagstaff, Ariz. At Cedar Wash, a house was moved off its foundation, its chimney was shaken down, and one corner of the house was cracked severely. Huge lava stones weighing many tons were torn from the old lava beds and thrown down the mountainside. About 80 km north of Flagstaff, in the Coconino Forest, boulders rolled down a mountain into the camp of a construction crew. Fifty-two shocks were felt by the construction crew between Sept. 10 and 23, 1910 (local time). The strongest shock was so violent that the construction crew temporarily abandoned the work site. Plaster cracked and fell at Flagstaff. (Ref. 343.)

1912. Aug. 18. Northern Arizona. Rockslides roared down the mountain in Lockett Tanks country, southeast of the Grand Canyon. Boulders were shaken from cliffs, and rocks were reportedly lifted free from the ground. An unconfirmed report stated that an earth fracture extended from Lockett Tanks to Coconino Mountain, a distance of more than 48 km. Also felt in N. Mex. and Utah. (Ref. 38, 56, 343.)

1916. Mar. 30 (Mar. 29). Nogales, Santa Cruz County, Ariz. The earthquake cracked walls at Nogales and knocked down plaster at the courthouse. People ran from the Nogales theater. (Ref. 272, 343.)

1935. Jan. 2 (Jan. 1). Wellton, Yuma County, Ariz. Walls and plaster cracked at Wellton, east of Yuma. Everyone felt the ground quiver and their houses shake. (Ref. 38, 343.)

1935. Jan. 10. Grand Canyon, Ariz. Walls or plaster cracked and windows broke at Grand Canyon. Minor rockslides were reported. (Ref. 8, 343.)

1950. Jan. 17 (Jan. 16). Apache County, Ariz. South of the Ganado Trading Post, several cracks formed in the ground. A 6.5-m-high offset fissure occurred in the creek bed beneath a timber bridge (near lat 35.55°N., long 109.10°W.). (Ref. 23, 38, 343.)

1959. July 21. Arizona-Utah border. Minor damage to chimneys and walls was reported at Fredonia, Ariz., and Kanab, Utah, about 15 km north of Fredonia. In addition, windows broke in houses and stores and dishes fell from shelves at Fredonia. Almost all merchandise was shaken from shelves in stores. A rockslide at Mather Point in the Grand Canyon was attributed to the shock. (Ref. 32, 265.)

1969. Dec. 25. Southern Arizona. The tremor broke dishes and windows in the Globe-Miami area, east of Phoenix in Gila County. Hundreds of residents were awakened by the strong shaking. Walls were cracked on the San Carlos Reservation. (Ref. 74, 343.)

1976. Feb. 4 (Feb. 3). Western Arizona. Slight damage occurred in Chino Valley, Cottonwood, and Miller Valley (a suburb of Prescott). At Chino Valley, one ceiling beam loosened slightly at the Buckaroo Shopping Center, and plaster separated from the ceiling. Waves on the ground were reported by one observer in the area. Water became muddy in a well. At Miller Valley, small cracks formed in the west wall at a supermarket. Magnitude 5.2 M_L PAS. (Ref. 49, 74.)

1976. Feb. 23. Western Arizona. Plaster was cracked at Chino Valley, about 25 km north of Prescott. (Ref. 49, 74.)

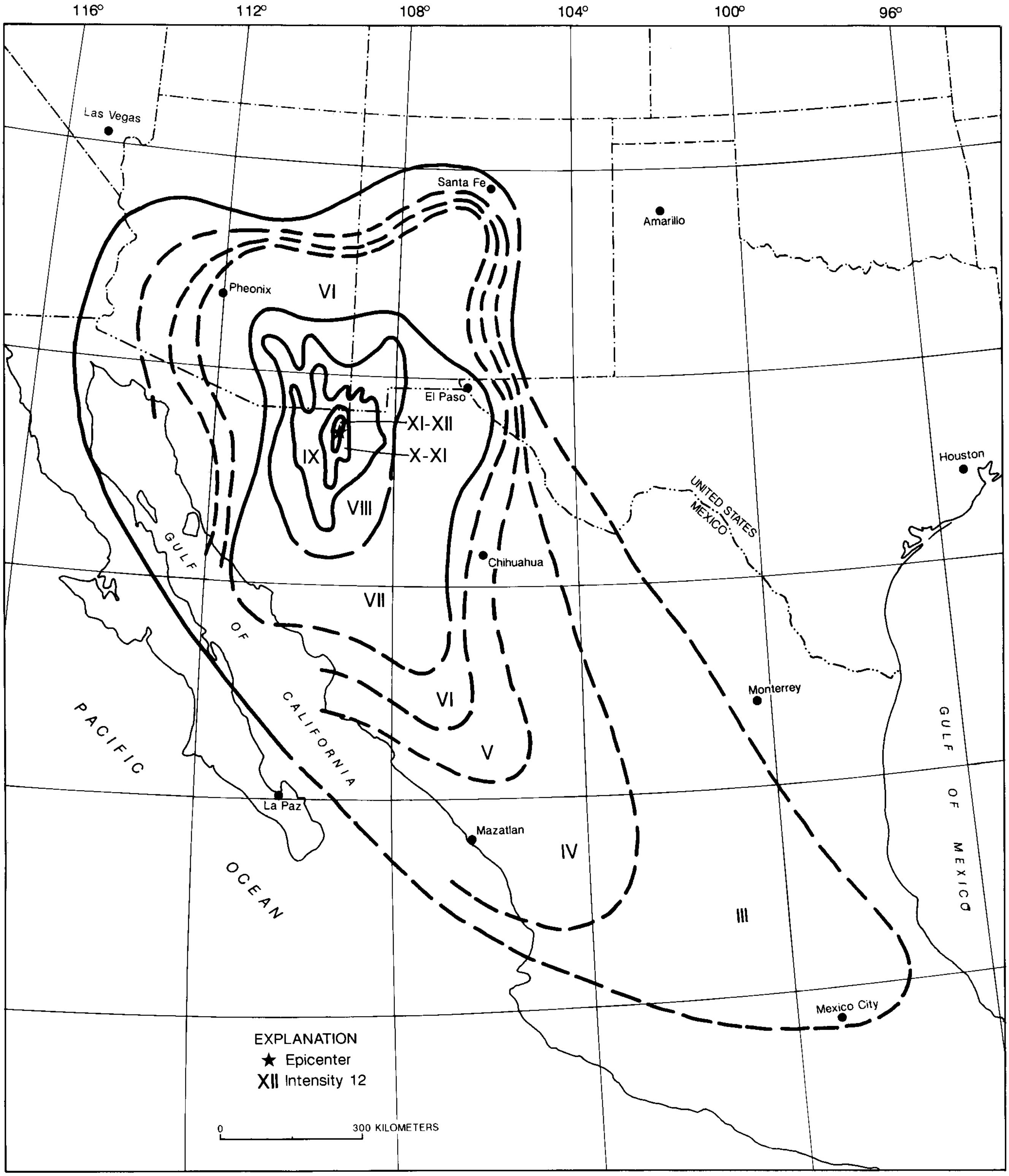
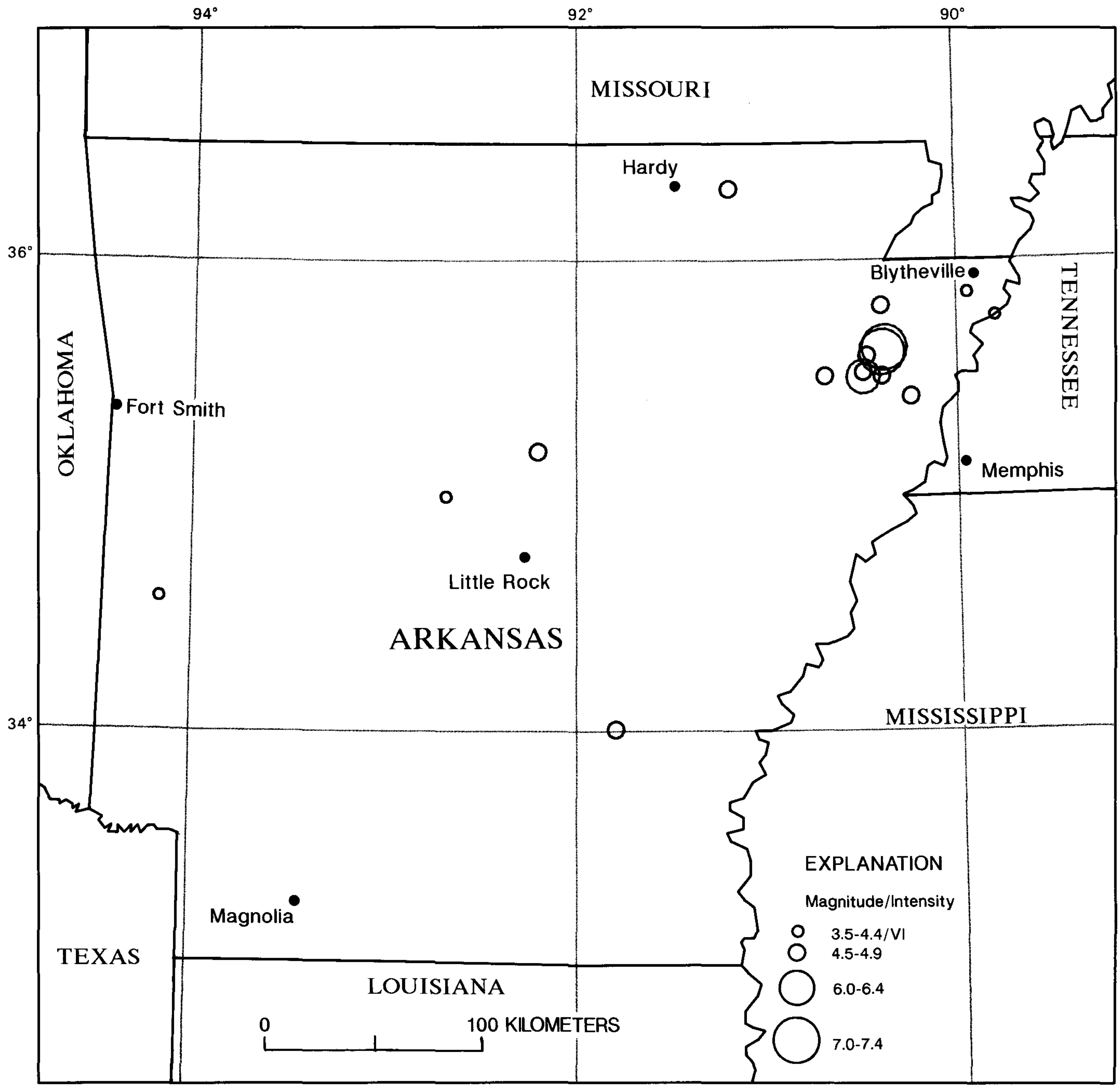


FIGURE 11.—Isoseismal map for the Sonora, Mexico, earthquake of May 3, 1887, which caused damage in the United States. This map is a simplified version of the map in reference 343 of table 1.

ARKANSAS



Earthquakes in Arkansas with magnitudes ≥ 4.5 or intensity ≥ VI.

ARKANSAS

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km²)
1811	12	16	08 15	35.6 N	90.4 W	—	114	—	—	7.20M_{fa} NU	7.68NLI	XI	114	5000
1811	12	16	14 15	35.6 N	90.4 W	—	345	—	—	7.00M_{fa} SEE	—	X	529	—
1843	01	05	02 45	35.5 N	90.5 W	—	113	—	—	6.00M_{fa} NTI	—	VII	113	1500
1843	02	17	05	35.5 N	90.5 W	—	113	—	—	4.80M_{fa} NTI	—	V	113	250
1878	11	19	05 52	35.5 N	90.7 W	—	529	—	—	4.90M_{fa} NTI	—	VI	529	350
1883	12	05	15 20	36.3 N	91.2 W	—	105	—	—	4.80M_{fa} BAR	—	V	105	250
1911	03	31	16 57	34.0 N	91.8 W	—	529	—	—	4.70M_{fa} SC	—	VII	529	99
1923	10	28	17 10	35.5 N	90.4 W	—	105	—	—	4.80M_{fa} SC	—	VII	105	120
1927	05	07	08 28	35.8 N	90.4 W	—	218	—	—	4.80M_{fa} BAR	—	VI	529	100
1938	09	17	03 34 28.3	35.413N	90.254W	001	349	—	—	4.80M_{fa} DG	—	V	105	250
1956	01	29	04 44 15.5	35.756N	89.803W	016	349	—	—	4.00M_{fa} DG	—	VI	29	13
1969	01	01	23 35 38.7	34.991N	92.688W	007	349	4.2	—	4.40M_n DG	4.33STT	VI	42	62
1970	11	17	02 13 54.1	35.856N	89.947W	014	349	3.6	—	4.30M_n DG	4.00STT	VI	43	92
1976	03	25	00 41 20.8	35.585N	90.478W	017	349	4.9	—	4.90M_n DG	4.61HRN	VI	49	280
1977	06	02	23 29 10.6	34.560N	94.172W	010	349	4.3	—	3.60M_n DG	—	VI	39	4
1982	01	21	00 33 54.8	35.18 N	92.21 W	003	350	4.5	—	4.70M_n TUL	3.86SRT	VI	350	31

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1811. Dec. 16, 08 15 UTC. Northeast Arkansas. On the basis of the large area of damage (600,000 km²), the widespread area of perceptibility (5,000,000 km²), and the complex physiographic changes that occurred, the Mississippi River valley earthquakes of 1811–12 rank as some of the largest in the United States since its settlement by Europeans. The area of strong shaking associated with these shocks is two to three times larger than that of the 1964 Alaska earthquake and 10 times larger than that of the 1906 San Francisco earthquake.

The magnitudes of these series of earthquakes, usually named the New Madrid, Mo., earthquakes, vary considerably between the m_b and M_S values estimated by Nuttli (ref. 114, 569). The m_b (or M_{fa} as listed above) was estimated from isoseismal maps, and the M_S (or M_{Sn} as listed below) was estimated from a spectral scaling relation by Nuttli (ref. 569) for mid-plate earthquakes. The value of M_S (or M_{Sn}) magnitude has a functional relationship to the m_b (or M_{fa}). The authors have chosen to include the M_{fa} magnitude in the above list because it was estimated from isoseismal maps, as were most of the historical earthquakes.

The first and second earthquakes occurred in Arkansas (Dec. 16, 1811—two shocks—M_{fa} 7.2, M_{Sn} 8.5 and M_{fa} 7.0, M_{Sn} 8.0) and the third and fourth in Missouri (Jan. 23, 1812, M_{fa} 7.1, M_{Sn} 8.4; and Feb. 7, 1812, M_{fa} 7.4, M_{Sn} 8.8). Otto Nuttli (ref. 330), however, has postulated another strong earthquake in Arkansas on Dec. 16 at 18 00 UTC (M_{Sn} 8.0). This would make a total of five earthquakes of magnitude M_{Sn} 8.0 or higher occurring in the period Dec. 16, 1811 through Feb. 7, 1812. Ref. 330 was published shortly after the death of Otto Nuttli, but his sources of data were never published; therefore, source data on the fifth earthquake are not included in the Arkansas table.

The first earthquake caused only slight damage to man-made structures, mainly because of the sparse population in the epicentral area. The extent of the area that experienced damaging earth motion (MMI ≥VII) is estimated to be 600,000 km². However, shaking strong enough to alarm the general population (MM intensity ≥V) occurred over an area of 2.5 million km² (see generalized isoseismal map, fig. 12). This map covers an area from Canada to New Orleans, La., and from the headwaters of the Mississippi River to the Atlantic Ocean.

At the onset of the earthquake the ground rose and fell—bending the trees until their branches intertwined and opening deep cracks in the ground.

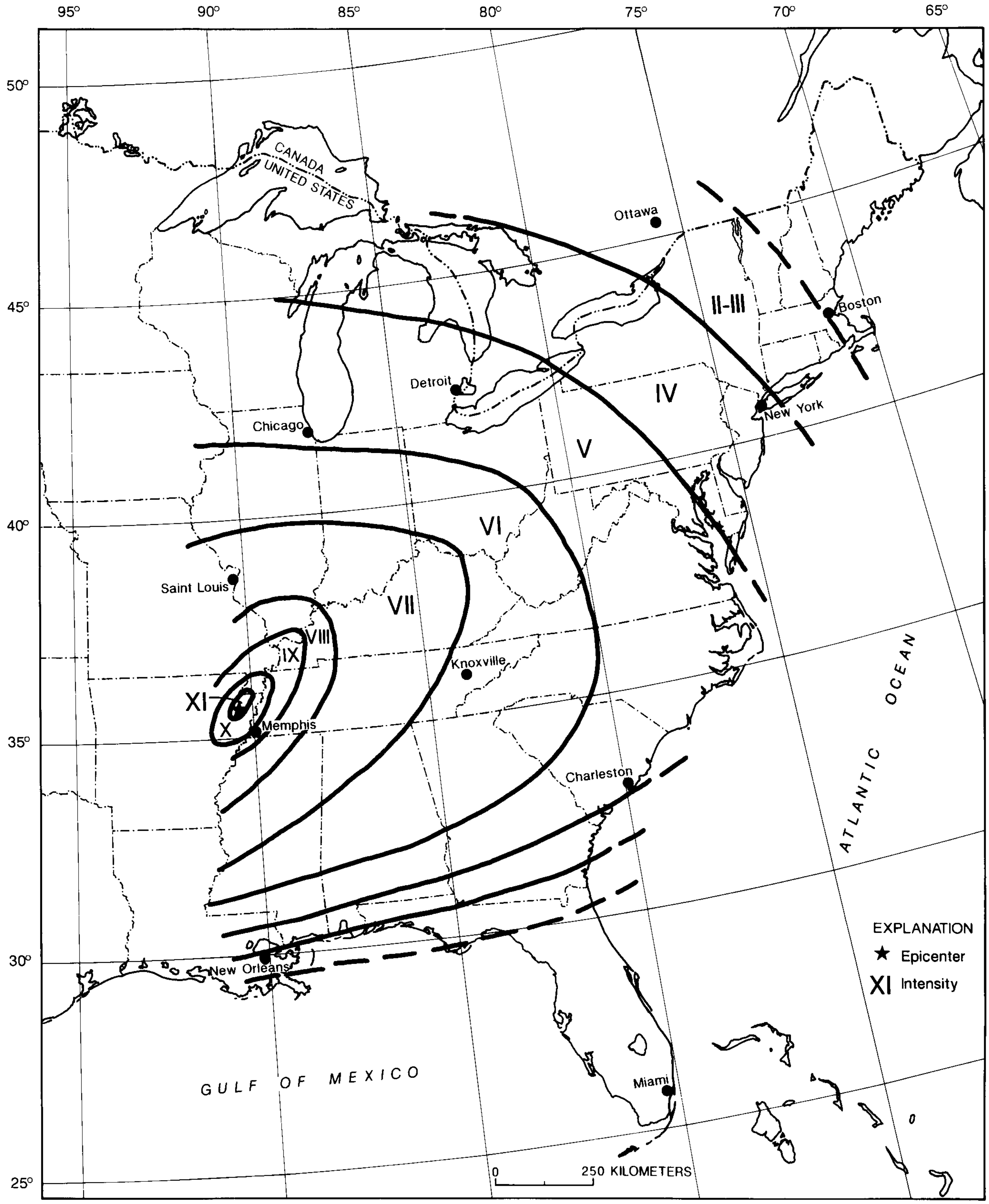


FIGURE 12.—Isoseismal map for the Arkansas earthquake of December 16, 1811, 08:15 UTC (first of the 1811–1812 New Madrid series). This map is a simplified version of figure 1 in reference 114 and figure 2 in reference 557 of table 1.

Landslides swept down the steeper bluffs and hillsides; large areas of land were uplifted; and still larger areas sank and were covered with water that emerged through fissures or craterlets. Huge waves on the Mississippi River overwhelmed many boats and washed others high on the shore. High banks caved and collapsed into the river; sand bars and points of islands gave way; whole islands disappeared. Surface rupturing did not occur, however. The region most seriously affected was characterized by raised or sunken lands, fissures, sinks, sand blows, and large landslides that covered an area of 78,000–129,000 km^2, extending from Cairo, Ill., to Memphis, Tenn., and from Crowleys Ridge to Chickasaw Bluffs, Tenn.

Although the motion during the first shock was violent at New Madrid, Mo., it was not as heavy and destructive as that caused by two aftershocks about 6 hours later. Only one life was lost in falling buildings at New Madrid, but chimneys were toppled and log cabins were thrown down or were heavily damaged. Chimneys also were downed as far distant as Cincinnati, Ohio; St. Louis, Mo.; and in many places in Kentucky, Missouri, and Tennessee.

The Lake County uplift, about 50 km long and 23 km wide, upwarps the Mississippi River valley as much as 10 m in parts of southwest Kentucky, southeast Missouri, and northwest Tennessee. The uplift apparently resulted from vertical movement along several, ancient, subsurface structures; most of this uplift has occurred during earthquakes. The Lake County uplift can be subdivided into several topographic bulges, including Tiptonville dome, Ridgely Ridge, and the south end of Sikeston Ridge. A strong correlation exists between modern seismicity and the uplift, indicating that stresses that produced the uplift still exist today.

Tiptonville dome, which is 14 km in width and about 11 km in length, shows the largest upwarping and the highest topographic relief on the uplift. It is bounded on the east by Reelfoot scarp, which has a zone of normal faults (displacement about 3 m) at its base. Although most of Tiptonville dome formed between 200 and 2,000 years ago, additional uplifting deformed the northwest and southeast parts of the dome during the earthquakes of 1811–12.

A notable area of subsidence is Reelfoot Lake in Tennessee, just east of Tiptonville dome. Subsidence there ranged from 1.5 to 6 m, although larger amounts were reported. It may be that the lake was enlarged by compaction, upwarping, and subsidence occurring simultaneously during the New Madrid earthquakes.

Other areas subsided by as much as 5 m, although 1.5 to 2.5 m was more common. Lake St. Francis, in eastern Arkansas, which was formed by subsidence, is 64 km long by 1 km wide. Coal and sand were ejected from fissures in the swamp land adjacent to the St. Francis River, and the water level is reported to have risen there by 8 to 9 m.

Large waves were generated on the Mississippi River by fissures opening and closing below the surface. Local uplifts of the ground and water waves moving upstream gave the illusion that the river was flowing upstream. Ponds of water also were agitated noticeably.

Otto Nuttli (ref. 330) reported that more than 200 moderate to large earthquakes occurred on the New Madrid fault between Dec. 16, 1811, and Mar. 15, 1812 (5 of M_S about 7.7; 10 of M_S about 6.7; 35 of M_S about 5.9; 65 of M_S about 5.3; and 89 of M_S about 4.3). Nuttli also noted that about 1,800 earthquakes of m_b about 3.0 to 4.5 occurred in that same period. Magnitude of main shock 8.5 M_{Sn} NLI. (Ref. 38, 114, 301, 330, 529, 558.)

1811. Dec. 16, 14 15 UTC. Northeast Arkansas. On the basis of the effects reported at the same locations, the MM intensity of this earthquake has been inferred to be similar to that of the earlier shock at 08 15 UTC (see description above). Thus, the inference is that, if the documented intensities are the same or are similar at identical locations, then the maximum intensities at the epicenter must be about the same; therefore, the intensity at the epicenter of this earthquake must be at the MM intensity X–XI level. The maximum documented intensity for both earthquakes on Dec. 16, 1811, is MM intensity VIII at Richmond, Ky. Magnitude 8.0 M_{Sn} STT. (Ref. 345, 529.)

1843. Jan. 5 (Jan. 4). Northeast Arkansas. This earthquake is the strongest to occur in this region since the 1811-12 sequence. Damage was severe at Memphis, Tenn., where walls cracked, windows broke, and one building collapsed. The earth sank in places near New Madrid, Mo., and unconfirmed reports state that a lake was formed and several hunters were drowned. Chimneys were thrown down at Helena, Ark., and Hickman, Ky. The earthquake was felt on the seacoast of Georgia and the Carolinas and northeastward to Providence, R.I., a distance of 1,400 km. The southern limit of the felt area appears to have included Natchez, Miss.; the western limit passed beyond the frontier military posts; and the northern limit reached Iowa and Indiana. Magnitude 6.3 M_S NTL, 6.0 M_{fa} NTI. (Ref. 38, 109, 113, 529.)

Lower end of Reelfoot Lake, Tennessee, showing trunks of trees killed when the land was submerged by the December 16, 1811, northeast Arkansas earthquake. (Photograph by M.L. Fuller taken about 100 years after the earthquake.)

1878. Nov. 19 (Nov. 18). Arkansas. The earthquake was severe east of Kansas City along the Missouri River from Lexington to Glasgow, Mo., but the maximum disturbance occurred along the Mississippi River valley between Cairo, Ill., and Memphis, Tenn. Northwest of Memphis, several stone buildings were damaged in Stone County at Batesville, Ark., and the tops of chimneys were toppled in Poinsett County at Harrisburg, Ark.; loose bricks fell from chimneys at Cairo, Ill. Felt in Alabama, Arkansas, Illinois, Kansas, Kentucky, Missouri, and Tennessee. Magnitude 4.9 M_{fa} NTI. (Ref. 38, 105, 109, 529.)

1911. Mar. 31. Near Rison and Warren, Ark. The earthquake cracked walls, broke windows and dishes, and sent people rushing into the streets at Pine Bluff, Ark., south of Little Rock in Jefferson County. Walls cracked at the 14th Avenue school at Pine Bluff, and plaster fell on the pupils. Minor damage also occurred at Argenta, Dumas, Monticello, Rison, and Warren, Ark. The shock was felt throughout southeast Arkansas, northeast Louisiana, and along the Mississippi River from Memphis, Tenn., to Vicksburg, Miss. The felt area generally was confined to the soft sediments of the Mississippi River valley. Magnitude 4.3 M_{fa} BAR, 4.2 M_{fa} SG. (Ref. 38, 105, 109, 529.)

1923. Oct. 28. Marked Tree, Ark. This shock downed several old chimneys, shattered windows, and cracked walls at Marked Tree (Poinsett County), about 70 km northwest of Memphis, Tenn. It reportedly disturbed the surface of the St. Francis River. Also felt in Illinois, Kentucky, Mississippi, Missouri, and Tennessee. Magnitude 4.5 M_{fa} BAR. (Ref. 38, 105, 529.)

1927. May 7. Between Jonesboro and Marked Tree, Ark. At least one chimney was damaged at Jonesboro, and windowpanes and dishes were broken in the Memphis, Tenn., area. In the area of Reelfoot Lake, Tenn., the earthquake left "gravel pilings." Felt from Decatur, Ala., to Carbondale, Ill., and from Pocahontas, Ark., to Jackson, Tenn. Also reported in

Mississippi and Missouri. Magnitude 4.8 M_{fa} BAR. (Ref. 38, 105, 109, 218, 529.)

1956. Jan. 29 (Jan. 28). Arkansas-Tennessee border. A few chimneys and walls were cracked at Covington, Tenn., northeast of Memphis. Also felt in Arkansas. Magnitude 4.1 M_{fa} BAR, 4.0 M_{fa} DG. (Ref. 29, 349.)

1969. Jan. 1. Central Arkansas. Walls and floors cracked and dishes broke at Little Rock, Ark. Felt in northern and central Arkansas, southern Missouri, and at Memphis, Tenn. Magnitude 4.5 M_n BAR, 3.3 M_S BAR. (Ref. 42, 349.)

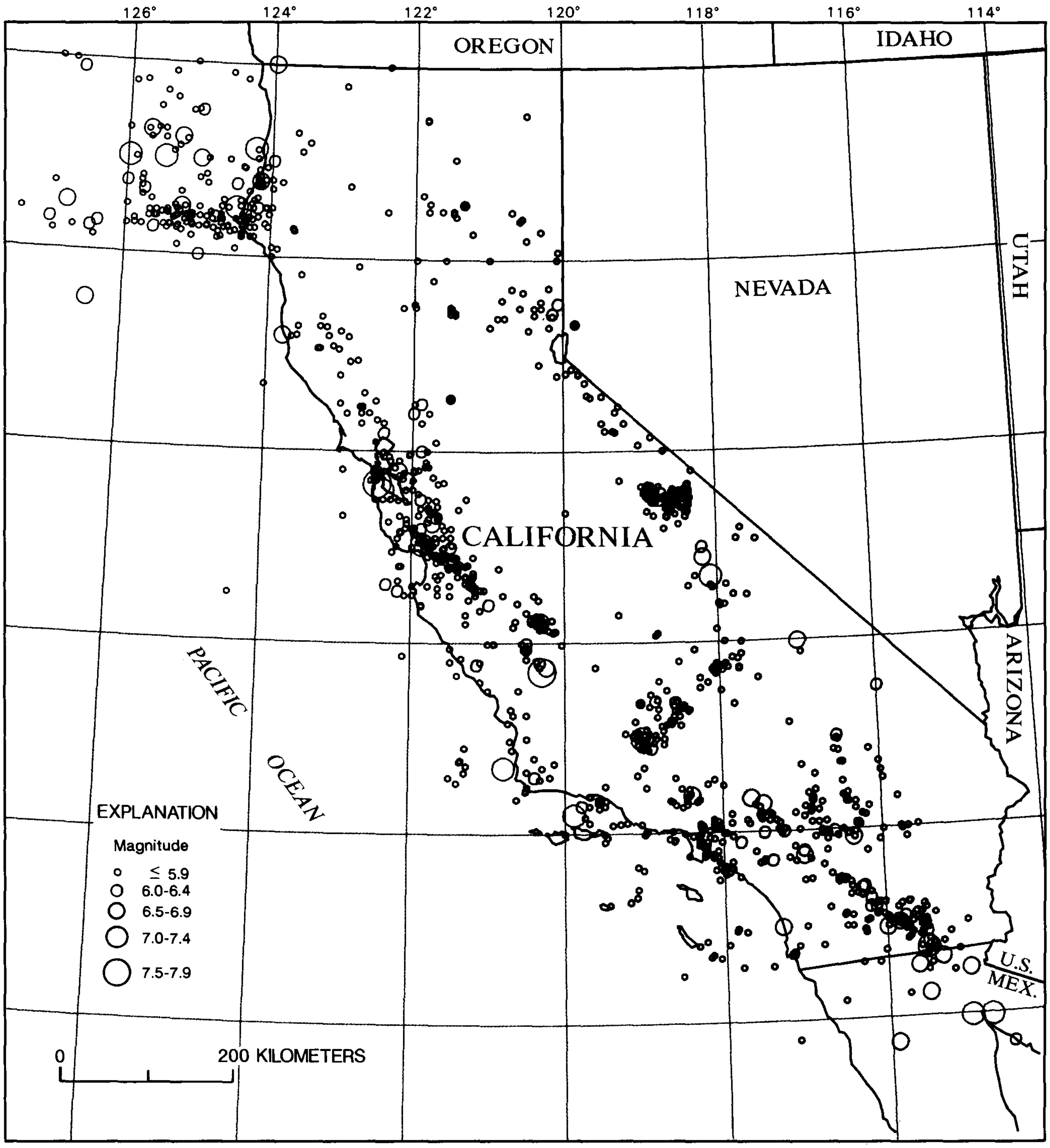
1970. Nov. 17 (Nov. 16). Northeast Arkansas. Plaster cracked and fell at Manila (Mississippi County), about 28 km west of the epicenter. At Keiser, about 27 km south of Manila, the shock shifted furniture, cracked plaster, and caused three electrical wall outlets to burn their wires. Also felt in Illinois, Kentucky, Mississippi, Missouri, and Tennessee. Magnitude 4.4 M_n BAR, 2.9 M_S BAR, 4.4 m_b NUT, 2.9 M_S NUT. (Ref. 43, 263, 349.)

1976. March 25 (Mar. 24). Northeast Arkansas. Slight damage characterized by cracks in plaster and drywall, downed ceiling tiles, and broken windows occurred in several towns in Arkansas, Mississippi, Missouri, and Tennessee. Also felt in Alabama, Illinois, Indiana, and Kentucky. Magnitude 5.0 M_n BAR. (Ref. 49, 349.)

1977. June 2. Western Arkansas. Chimneys and exterior walls were cracked at Board Camp; foundations and sidewalks were cracked at Hatfield. Both towns are in Polk County, near the Oklahoma border. Magnitude 4.0 M_n SLM, 4.63 M JOH. (Ref. 39, 349.)

1982. Jan. 21 (Jan. 20). Area of Enola-Naylor, Faulkner County, Ark. This earthquake is the strongest of a swarm of more than 30,000 shocks that began in the area on Jan. 12, 1982. Several of the shocks were felt in the region. Leveling lines run by the Arkansas State Surveyor show an uplift of about 0.2 m in the area of the epicenters. On Highway 36, west of Naylor, hairline cracks formed in a concrete cellar, and tiles fell off a tile-lined well. In addition, a fireplace and sheetrock walls sustained cracks. Also felt in Mississippi and Missouri. Magnitude 4.5 M_n TEC. (Ref. 350, 511.)

CALIFORNIA



Earthquakes in California with magnitudes ≥ 4.5 or intensity ≥ VI.

CALIFORNIA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter						Magnitude				Intensity		Felt area
				Latitude		Longitude		Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)		(°)		(km)		m_b	M_S		M			(1,000 km^2)
1769	07	28		33.9	N	117.8	W	—	368	—	—	6.00M_{La} ELL	—	VIII	493	—
1770				34.5	N	118.0	W	—	493	—	—	—	—	Felt	493	—
1790				37.5	N	118.8	W	—	368	—	—	—	—	Felt	493	—
1800	10	11		36.9	N	121.6	W	—	368	—	—	—	—	VII	368	—
1800	11	22	21 30	33.0	N	117.3	W	—	368	—	—	6.50M_{La} DMG	—	VII	38	—
1803	04			34.5	N	118.0	W	—	493	—	—	—	—	Felt	493	—
1803	05	25		32.8	N	117.1	W	—	368	—	—	—	—	VI	56	—
1806	03	25	08 00	34.4	N	119.7	W	—	368	—	—	—	—	VI	368	—
1808	06	21		37.8	N	122.5	W	—	368	—	—	6.00M_{La} ELL	—	VIII	368	—
1812				37.5	N	122.5	W	—	493	—	—	—	—	Felt	493	—
1812	05			33.7	N	117.9	W	—	493	—	—	—	—	Felt	493	—
1812	12	08	15 00	34.37	N	117.65	W	—	521	—	—	6.90M_{La} DMG	—	VIII	368	—
1812	12	21	19 00	34.2	N	119.9	W	—	368	—	—	7.10M_{La} DMG	—	VIII	368	—
1821	01	01		32.8	N	117.1	W	—	493	—	—	—	—	Felt	493	—
1827	09	24	04 00	34.0	N	119.0	W	—	368	—	—	5.50M_{La} DMG	—	VI	368	—
1829	09			37.5	N	122.5	W	—	56	—	—	—	—	VII	56	—
1830				35.5	N	120.6	W	—	368	—	—	—	—	VII	368	—
1836	04	25	13	36.5	N	122.0	W	—	56	—	—	—	—	Felt	493	—
1836	06	10	15 30	37.8	N	122.2	W	—	368	—	—	6.80M_{La} DMG	—	VIII	368	—
1838	06			37.6	N	122.4	W	—	368	—	—	7.00M_{La} DMG	—	VIII	368	—
1840	01	16		36.5	N	122.1	W	—	56	—	—	—	—	VI	56	—
1841	07	03	22 07	36.6	N	122.0	W	—	368	—	—	—	—	VI	368	—
1849	09	17		33.0	N	116.5	W	—	56	—	—	—	—	Felt	493	—
1849	09	22	23	33.0	N	116.5	W	—	56	—	—	—	—	Felt	493	—
1851	05	15	16 10	37.8	N	122.4	W	—	368	—	—	—	—	VI	38	—
1852	11	23	07	37.5	N	122.4	W	—	56	—	—	—	—	Felt	493	—
1852	11	29	20 00	32.5	N	115.0	W	—	521	—	—	6.50M_{La} DMG	—	IX	368	260
1852	12	17		35.5	N	121.0	W	—	56	—	—	—	—	VI	56	—
1853	02	01	21 00	35.6	N	121.1	W	—	368	—	—	—	—	VI	368	—
1853	10	23	11 00	40.8	N	124.2	W	—	368	—	—	—	—	VI	368	—
1855	01	25	06 00	39.5	N	120.3	W	—	368	—	—	5.50M_{La} DMG	—	VI	56	—
1855	03	20	00 30	40.75	N	124.20	W	—	56	—	—	—	—	V	56	—
1855	07	11	04 15	34.1	N	118.1	W	—	368	—	—	6.00M_{La} ELL	—	VIII	38	—
1855	08	27	11 00	38.1	N	122.5	W	—	368	—	—	4.90M_{La} DMG	—	VI	368	—
1856	01	02	18 15	37.5	N	122.5	W	—	368	—	—	5.30M_{La} DMG	—	VI	368	—
1856	02	15	13 25	37.5	N	122.3	W	—	368	—	—	5.50M_{La} DMG	—	VII	368	—
1856	09	21	07 30	33.0	N	117.0	W	—	368	—	—	—	—	VI	368	—
1857	01	09	16 24	35.7	N	120.3	W	—	521	—	—	7.60M_{La} DMG	7.92HK	IX	379	290#
1858	11	26	08 35	37.5	N	121.9	W	—	368	—	—	6.10M_{La} DMG	—	VII	38	—
1858	12	16	02 30	34.0	N	117.5	W	—	368	—	—	—	—	VI	368	—
1858	12	16	10 00	34.0	N	117.5	W	—	521	—	—	6.00M_{La} ELL	—	VIII	368	—
1859	10	05	20 16	37.8	N	122.4	W	—	368	—	—	—	—	VI	368	—
1860	11	13	00 00	40.8	N	124.2	W	—	368	—	—	—	—	VII	368	—
1861	07	04	00 11	37.8	N	122.0	W	—	368	—	—	5.60M_{La} DMG	—	VIII	38	—
1862	05	27	20 00	32.7	N	117.2	W	—	368	—	—	5.90M_{La} DMG	—	VII	368	45&
1863	12	19	22 38	37.5	N	122.2	W	—	368	—	—	4.80M_{La} DMG	—	V	368	23
1864	02	26	13 47	37.1	N	121.7	W	—	368	—	—	5.90M_{La} DMG	—	VI	368	—
1864	03	05	16 49	37.7	N	122.0	W	—	368	—	—	5.70M_{La} DMG	—	VI	38	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter						Magnitude				Intensity		Felt area
				Latitude		Longitude		Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)		(°)		(km)		m_b	M_S		M			(1,000 km^2)
1864	05	21	02 01	37.6	N	122.1	W	—	368	—	—	5.30M_{La} DMG	—	VI	368	36
1864	07	22	06 40	37.6	N	122.0	W	—	368	—	—	4.70M_{La} DMG	—	V	368	20
1864	08	18	13 18	39.3	N	121.0	W	—	368	—	—	4.50M_{La} DMG	—	V	56	14
1865	03	08	14 30	38.4	N	122.6	W	—	368	—	—	4.70M_{La} DMG	—	VII	38	—
1865	05	24	11 21	37.1	N	121.8	W	—	368	—	—	5.50M_{La} DMG	—	VI	368	—
1865	10	01	17 15	40.8	N	124.1	W	—	368	—	—	5.40M_{La} DMG	—	VII	368	30&
1865	10	08	20 46	37.2	N	121.9	W	—	368	—	—	6.30M_{La} DMG	—	VIII	56	100&
1866	03	26	20 12	37.1	N	121.6	W	—	368	—	—	5.40M_{La} DMG	—	VII	368	—
1866	07	15	06 30	37.5	N	121.3	W	—	368	—	—	5.80M_{La} DMG	—	V	368	120
1868	09	04	16 00	36.6	N	118.4	W	—	368	—	—	—	—	VI	368	—
1868	09	17	16 55	38.6	N	119.7	W	—	368	—	—	5.20M_{La} DMG	—	V	368	42
1868	10	21	15 53	37.7	N	122.1	W	—	368	—	—	6.80M_{La} DMG	—	IX	368	125&
1869	10	08	09 30	39.1	N	123.1	W	—	368	—	—	5.00M_{La} DMG	—	VII	368	—
1869	12	21	04 00	39.5	N	120.6	W	—	368	—	—	4.80M_{La} DMG	—	V	368	28
1870	02	17	20 12	37.2	N	122.1	W	—	368	—	—	5.80M_{La} DMG	—	VII	368	—
1870	04	02	19 48	37.9	N	122.3	W	—	368	—	—	5.30M_{La} DMG	—	VI	368	35&
1871	03	02	21 05	40.4	N	124.2	W	—	368	—	—	5.90M_{La} DMG	—	VII	38	29&
1871	07	05	21 06	36.4	N	118.0	W	—	368	—	—	5.20M_{La} DMG	—	VI	38	—
1872	03	26	10 30	36.7	N	118.1	W	—	368	—	—	7.30M_{La} ELL	7.75HHT	X	38	480&
1872	03	26	14 06	36.9	N	118.2	W	—	368	—	—	6.50M_{La} DMG	—	V	368	300
1872	03	28	13 00	39.5	N	120.4	W	—	368	—	—	4.90M_{La} DMG	—	VI	368	32
1872	04	03	12 15	37.0	N	118.2	W	—	368	—	—	6.10M_{La} DMG	—	V	368	160
1872	04	11	19 00	37.5	N	118.5	W	—	368	—	—	6.60M_{La} DMG	—	IX	368	350
1872	04	18	12 00	36.5	N	117.8	W	—	368	—	—	—	—	VI	56	—
1872	05	03	01 00	33.0	N	115.0	W	—	368	—	—	5.50M_{La} DMG	—	VI	368	—
1872	05	17	21 00	36.6	N	118.1	W	—	368	—	—	—	—	VI	368	—
1873	11	23	05 00	42.0	N	124.0	W	—	38	—	—	6.70M_{La} DMG	—	VIII	368	181&
1875	01	24	12 00	40.2	N	120.5	W	—	368	—	—	5.80M_{La} DMG	—	VI	368	—
1875	09	30	12 30	40.7	N	124.0	W	—	368	—	—	5.50M_{La} DMG	—	VII	368	—
1876	05	29	18 55	38.4	N	122.9	W	—	368	—	—	4.20M_{La} DMG	—	VI	368	8
1878	05	09	04 25	40.1	N	124.0	W	—	368	—	—	5.80M_{La} DMG	—	VII	368	—
1878	06	12	07 20	34.0	N	118.0	W	—	463	—	—	—	—	VI	463	—
1879	02	04	08 08	36.3	N	119.3	W	—	463	—	—	—	—	VI	463	—
1880	01	09	13 45	36.7	N	121.3	W	—	463	—	—	—	—	Felt	463	—
1880	12	19	23 35	34.0	N	117.5	W	—	463	—	—	—	—	VI	463	—
1881	01	07	02 25	40.0	N	122.0	W	—	368	—	—	5.00M_{La} DMG	—	V	368	—
1881	02	02	00 11	36.0	N	120.5	W	—	368	—	—	5.60M_{La} DMG	—	VII	368	—
1881	04	10	10 00	37.4	N	121.4	W	—	368	—	—	5.90M_{La} DMG	—	VI	368	140
1882	03	06	21 45	36.9	N	121.2	W	—	368	—	—	5.70M_{La} DMG	—	VI	368	100
1882	06	27	13 32	37.2	N	122.0	W	—	463	—	—	—	—	VII	463	—
1883	03	30	15 45	36.9	N	121.6	W	—	368	—	—	5.60M_{La} DMG	—	VII	368	70
1883	09	05	12 30	34.2	N	119.9	W	—	368	—	—	6.00M_{La} DMG	—	VI	368	—
1884	01	28	07 30	41.1	N	123.6	W	—	368	—	—	5.70M_{La} DMG	—	V	368	—
1884	03	26	00 40	37.1	N	122.2	W	—	368	—	—	5.90M_{La} DMG	—	VI	368	—
1884	06	14	16 43	40.6	N	125.8	W	—	463	—	—	—	—	Felt	463	—
1885	01	31	05 45	40.4	N	120.6	W	—	368	—	—	5.70M_{La} DMG	—	VII	38	110
1885	03	31	07 56	36.7	N	121.3	W	—	368	—	—	5.50M_{La} DMG	—	VII	38	—
1885	04	02	15 25	36.8	N	121.4	W	—	368	—	—	5.40M_{La} DMG	—	V	368	81
1885	04	12	04 05	36.4	N	121.0	W	—	368	—	—	6.20M_{La} DMG	—	VII	368	240

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	Felt area
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1885 08 01	00 10	38.8 N	123.0 W	—	368	—	—	—	—	VI	368	—
1886 04 14	03 20	37.2 N	117.7 W	—	54	—	—	—	—	VI	54	—
1887 12 03	18 55	39.3 N	123.6 W	—	368	—	—	$4.90M_{La}$ DMG	—	VII	368	—
1888 02 18	10 50	39.2 N	123.6 W	—	368	—	—	$4.90M_{La}$ DMG	—	V	368	—
1888 02 29	22 50	38.3 N	122.7 W	—	368	—	—	$4.20M_{La}$ DMG	—	VI	368	9
1888 04 14	03 30	41.5 N	120.5 W	—	368	—	—	$4.60M_{La}$ DMG	—	VI	368	—
1888 04 29	04 48	39.7 N	120.7 W	—	368	—	—	$5.90M_{La}$ DMG	—	VII	38	—
1888 09 17	11 51	37.1 N	121.8 W	—	368	—	—	$4.50M_{La}$ DMG	—	V	368	15
1888 11 18	22 28	37.9 N	122.3 W	—	368	—	—	$4.30M_{La}$ DMG	—	VII	38	11
1889 02 07	05 20	34.1 N	116.7 W	—	368	—	—	$5.30M_{La}$ DMG	—	V	56	69
1889 04 15	03 28	37.1 N	121.9 W	—	368	—	—	$4.80M_{La}$ DMG	—	VI	368	38
1889 05 19	11 10	38.0 N	121.9 W	—	368	—	—	$6.00M_{La}$ DMG	—	VII	38	—
1889 06 20	06 00	40.5 N	120.7 W	—	368	—	—	$5.90M_{La}$ DMG	—	VII	38	120
1889 07 31	12 47	37.8 N	122.2 W	—	368	—	—	$5.20M_{La}$ DMG	—	VII	38	53
1889 08 28	02 15	34.1 N	117.9 W	—	368	—	—	$5.20M_{La}$ DMG	—	VI	38	52
1889 09 30	05 20	37.2 N	118.7 W	—	368	—	—	$5.60M_{La}$ DMG	—	V	56	92
1890 02 09	12 06	33.4 N	116.3 W	—	368	—	—	$6.30M_{La}$ DMG	6.73HK	VI	38	—
1890 04 24	11 36	36.9 N	121.6 W	—	368	—	—	$6.00M_{La}$ DMG	—	VIII	368	—
1890 07 26	09 40	40.5 N	124.2 W	—	368	—	—	$6.00M_{La}$ DMG	—	VII	38	100&
1891 01 02	20 00	37.3 N	121.8 W	—	368	—	—	$5.50M_{La}$ DMG	—	VI	38	50&
1891 10 12	06 28	38.3 N	122.4 W	—	368	—	—	$5.50M_{La}$ DMG	—	VIII	368	54
1892 02 24	07 20	32.55 N	115.63 W	—	521	—	—	$6.70M_{La}$ DMG	7.75HHT	VIII	368	—
1892 04 19	10 50	38.4 N	122.0 W	—	368	—	—	$6.40M_{La}$ DMG	—	IX	38	—
1892 04 21	17 43	38.5 N	121.9 W	—	368	—	—	$6.20M_{La}$ DMG	—	IX	38	170&
1892 04 30	00 09	38.4 N	121.8 W	—	368	—	—	$5.50M_{La}$ DMG	—	VI	368	—
1892 05 28	11 15	33.2 N	116.2 W	—	368	—	—	$6.30M_{La}$ DMG	—	V	56	—
1892 06 14	13 25	34.2 N	117.5 W	—	368	—	—	$4.90M_{La}$ DMG	—	V	368	—
1892 11 13	12 45	36.8 N	121.5 W	—	368	—	—	$5.60M_{La}$ DMG	—	VI	38	—
1893 04 04	19 40	34.3 N	118.6 W	—	368	—	—	$5.40M_{La}$ DMG	—	VIII	368	71
1893 05 19	00 35	34.1 N	119.4 W	—	368	—	—	$5.50M_{La}$ DMG	—	V	368	39&
1893 06 30	13 30	38.0 N	122.4 W	—	368	—	—	$4.60M_{La}$ DMG	—	V	56	19
1893 08 09	09 15	38.4 N	122.6 W	—	368	—	—	$5.10M_{La}$ DMG	—	VII	38	—
1894 07 30	05 12	34.3 N	117.6 W	—	368	—	—	$5.90M_{La}$ DMG	—	VI	368	—
1894 09 30	17 36	40.3 N	123.7 W	—	368	—	—	$5.80M_{La}$ DMG	—	VII	368	80&
1894 10 23	23 03	32.8 N	116.8 W	—	368	—	—	$5.70M_{La}$ DMG	—	VI	368	—
1896 08 17	11 30	36.7 N	118.3 W	—	368	—	—	$5.90M_{La}$ DMG	—	VI	56	—
1897 06 20	20 14	37.0 N	121.5 W	—	38	—	—	$6.20M_{La}$ DMG	—	VIII	38	130&
1898 03 31	07 43	38.2 N	122.4 W	—	368	—	—	$6.20M_{La}$ DMG	—	VIII	368	120&
1898 04 15	07 07	39.2 N	123.8 W	—	368	—	—	$6.90M_S$ AB2	—	VIII	38	—
1899 04 16	13 40	41.0 N	126.0 W	—	521	—	—	$7.00M_S$ ELL	—	VI	368	—
1899 04 30	22 41	36.9 N	121.7 W	—	368	—	—	$5.60M_{La}$ DMG	—	VII	38	52&
1899 06 02	07 19	37.7 N	122.5 W	—	368	—	—	$5.40M_{La}$ DMG	—	VII	368	—
1899 07 06	20 10	37.2 N	121.5 W	—	368	—	—	$5.80M_{La}$ DMG	—	VII	56	98
1899 07 22	00 46	34.2 N	117.4 W	—	368	—	—	$5.50M_{La}$ DMG	—	VI	368	70
1899 07 22	20 32	34.3 N	117.5 W	—	368	—	—	$6.50M_{La}$ DMG	6.35HHT	VIII	38	—
1899 10 13	05 00	38.4 N	122.7 W	—	368	—	—	—	—	VII	38	2
1899 12 25	12 25	33.8 N	117.0 W	—	368	—	—	$6.40M_S$ ELL	6.73HK	IX	38	—
1900 04 30	22 41 14	36.9 N	121.6 W	—	3	—	—	$4.50M_{La}$ DMG	—	V	56	30

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1901	03	03	07 45	36.0 N	120.5 W	—	38	—	—	6.40M_{La} ELL	—	VIII	38	104&
1902	05	19	18 31	38.3 N	121.9 W	—	381	—	—	5.40M_{La} DMG	—	VII	381	52
1902	06	11	02 45	33.7 N	117.1 W	—	380	—	—	4.50M_{La} DMG	—	V	380	33
1902	07	28	06 57	34.8 N	120.4 W	—	381	—	—	5.40M_{La} DMG	—	VII	381	—
1902	07	31	09 20	34.7 N	120.3 W	—	381	—	—	5.40M_{La} DMG	—	VIII	381	—
1902	08	01	03 30	34.6 N	120.4 W	—	380	—	—	—	—	VIII	380	—
1902	12	12		34.8 N	120.4 W	—	380	—	—	—	—	VII	38	—
1903	06	11	13 12	37.4 N	121.9 W	—	381	—	—	5.80M_{La} DMG	—	VII	38	100&
1903	07	24	20 26	39.5 N	122.0 W	—	38	—	—	4.50M_{La} DMG	—	VII	38	25
1903	08	03	06 49	37.3 N	121.8 W	—	381	—	—	5.80M_{La} DMG	—	VII	38	130&
1903	12	25	17 45	34.0 N	118.0 W	—	38	—	—	— —	VI	38	—	
1904	04	16	09 20	40.5 N	122.4 W	—	380	—	—	4.50M_{La} DMG	—	V	56	14
1904	07	30	10 26	38.5 N	122.0 W	—	380	—	—	4.50M_{La} DMG	—	V	56	15
1905	01	06	14 30	35.5 N	118.7 W	—	380	—	—	5.00M_{La} DMG	—	V	380	50
1905	07	15	20 41	34.1 N	117.3 W	—	380	—	—	—	—	VI	56	—
1905	09	03	05 40	34.0 N	118.3 W	—	380	—	—	—	—	VI	56	—
1905	12	23	22 23	35.3 N	118.8 W	—	380	—	—	—	—	VI	56	—
1906	03	03	20 25	33.0 N	117.0 W	—	380	—	—	4.50M_{La} DMG	—	V	380	25
1906	04	18	13 12 21	37.67 N	122.48 W	020	378	—	—	7.80M_s AB2	7.68TW	XI	38	425&
1906	04	19	00 30	32.9 N	115.5 W	—	381	—	—	6.20M_s ELL	6.27HHT	VIII	38	100#
1906	04	23	09 10	41.0 N	124.0 W	—	38	—	—	6.40M_s ELL	—	VII	38	—
1906	05	02	05 30	38.5 N	123.0 W	—	38	—	—	—	—	VI	38	—
1906	05	07	04 10	39.2 N	122.9 W	—	380	—	—	—	—	VI	56	—
1906	05	07	05 00	39.2 N	122.9 W	—	380	—	—	—	—	VI	56	—
1906	12	07	06 40	35.3 N	120.7 W	—	380	—	—	—	—	VI	56	—
1907	09	20	01 54	34.2 N	117.1 W	—	381	—	—	5.30M_{La} DMG	5.28HHT	VII	38	130
1908	01	27	02 00	40.3 N	120.3 W	—	380	—	—	—	—	VII	38	—
1908	04	25	11 33	36.6 N	121.8 W	—	380	—	—	4.50M_{La} DMG	—	V	56	25
1908	08	18	10 59	40.8 N	124.0 W	—	380	—	—	5.00M_{La} DMG	—	VII	38	16&
1908	11	04	08 37	36.0 N	117.0 W	—	38	—	—	6.50M_s CFR	—	VI	382	150
1909	02	14	15 55	38.1 N	121.7 W	—	380	—	—	4.50M_{La} DMG	—	V	380	15
1909	03	03	12 00	39.4 N	120.9 W	—	380	—	—	5.00M_{La} DMG	—	V	56	50
1909	05	18	01 19	41.0 N	124.0 W	—	38	—	—	—	—	VII	38	—
1909	06	23	07 24	39.4 N	120.8 W	—	380	—	—	5.70M_{La} DMG	—	VII	38	130
1909	10	29	06 45	40.5 N	124.2 W	—	381	—	—	6.40M_{La} DMG	—	VIII	38	260
1909	11	22	15 21	36.7 N	121.4 W	—	380	—	—	4.50M_{La} DMG	—	V	56	15
1910	03	11	06 52	36.9 N	121.8 W	—	381	—	—	5.80M_s ELL	—	VI	38	155
1910	03	19	00 11	40.0 N	125.0 W	—	38	—	—	6.00M_s CFR	—	V	56	—
1910	04	11	07 57	33.7 N	117.4 W	—	380	—	—	5.00M_{La} DMG	—	V	56	30
1910	05	06	16 40	37.33 N	118.42 W	—	324	—	—	5.60M_{La} DMG	—	VI	56	130
1910	05	13	06 20	33.7 N	117.4 W	—	380	—	—	5.00M_{La} DMG	—	V	56	40
1910	05	15	15 47	33.7 N	117.4 W	—	381	—	—	6.00M_s CFR	5.28HHT	VII	38	75
1910	12	31	12 11	36.83 N	121.42 W	—	324	—	—	5.00M_{La} DMG	—	VI	56	20
1911	03	11	21 29	36.83 N	121.42 W	—	324	—	—	4.50M_{La} DMG	—	VI	56	—
1911	07	01	22 00 03	37.25 N	121.75 W	—	258	—	—	6.60M_s GR	—	VIII	56	155
1911	08	11	23 40	33.8 N	116.7 W	—	380	—	—	4.50M_{La} DMG	—	VI	56	—
1912	01	05	03 52	37.33 N	118.42 W	—	324	—	—	5.50M_{La} DMG	—	VI	56	130
1912	08	31	04 53	38.92 N	120.33 W	—	324	—	—	4.50M_{La} DMG	—	V	56	25
1912	09	12	17 27	37.33 N	122.17 W	—	324	—	—	4.50M_{La} DMG	—	V	56	26&
1912	12	14		34.0 N	119.0 W	—	38	—	—	—	—	VI	56	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1914	11	09	02 31	37.17 N	122.00 W	—	324	—	—	4.70M_{La} DMG	—	VII	38	78
1914	12	28	10 42	37.17 N	122.17 W	—	324	—	—	4.50M_{La} DMG	—	V	56	26
1915	01	12	04 31	34.6 N	120.2 W	—	381	—	—	5.20M_{La} DMG	—	VIII	38	130
1915	02	22		40.58 N	121.83 W	—	324	—	—	—	—	VII	56	—
1915	04	05	23 11	38.58 N	119.50 W	—	324	—	—	5.00M_{La} DMG	—	V	56	65
1915	05	06	12 09	39.5 N	126.5 W	—	324	—	—	6.75M_S GR	—	V	56	—
1915	05	29	06 46	36.08 N	118.83 W	—	324	—	—	5.00M_{La} DMG	—	V	56	40
1915	06	23	03 59	32.8 N	115.5 W	—	381	—	—	6.25M_S CFR	5.48HHT	VIII	383	200
1915	06	23	04 56	32.8 N	115.5 W	—	381	—	—	6.25M_S CFR	5.48HHT	VIII	383	200
1915	10	08	05 25 42	37.83 N	122.25 W	—	324	—	—	4.50M_{La} DMG	—	VI	38	9
1915	11	21	00 13 42	32.0 N	115.0 W	—	258	—	—	7.10M_S GR	6.93HHT	IX	492	310
1915	12	31	12 20	41.0 N	126.0 W	—	258	—	—	6.50M_S CFR	—	III	56	—
1916	07	05	04 40	40.58 N	124.25 W	—	324	—	—	—	—	VI	38	—
1916	07	16	11 50	34.7 N	117.0 W	—	380	—	—	4.50M_{La} DMG	—	V	56	25
1916	08	06	19 38	36.67 N	121.25 W	—	324	—	—	5.30M_{La} DMG	—	VII	38	78
1916	08	08	16 52 41	37.0 N	122.0 W	—	324	—	—	5.00Ukn JON	—	V	56	—
1916	09	30	02 11	33.5 N	116.5 W	—	380	—	—	5.00M_{La} DMG	—	V	56	52
1916	10	23	02 44	34.9 N	118.9 W	—	258	—	—	6.00M_S CFR	5.95HHT	VII	38	130
1916	10	23	02 54	34.7 N	119.0 W	—	380	—	—	5.50M_{La} DMG	—	V	56	70
1916	11	10	09 11	35.5 N	116.0 W	—	521	—	—	6.10M_S GR	—	V	56	—
1916	12	01	22 53	35.17 N	120.75 W	—	324	—	—	—	—	VII	38	—
1917	03	03	16 00	40.83 N	124.17 W	—	324	—	—	4.60Ukn JON	—	V	56	—
1917	04	13	03 59	34.3 N	119.5 W	—	380	—	—	4.50M_{La} DMG	—	V	56	21
1917	05	28	06 06	32.8 N	115.3 W	—	380	—	—	5.50M_{La} DMG	—	VI	56	104
1917	07	06	11 01	36.58 N	118.08 W	—	324	—	—	—	—	VI	38	—
1917	07	09	22 22	35.25 N	120.50 W	—	324	—	—	—	—	VI	38	—
1917	07	26	08 33	35.0 N	120.5 W	—	315	—	—	4.80Ukn JON	—	V	56	—
1917	10	26	09 18 51	37.4 N	121.8 W	—	315	—	—	4.80Ukn JON	—	Felt	491	—
1918	03	12	10 30	39.58 N	120.83 W	—	324	—	—	—	—	VII	38	—
1918	04	21	22 32 25	33.75 N	117.00 W	—	258	—	—	6.80M_S GR	6.73HK	IX	384	390
1918	04	22	21 15	33.8 N	117.6 W	—	380	—	—	—	—	VI	38	—
1918	05	01	04 32	32.7 N	115.5 W	—	56	—	—	5.00M_{La} DMG	—	VI	56	80
1918	06	06	22 32	33.8 N	117.0 W	—	380	—	—	5.00M_{La} DMG	—	VI	56	78
1918	07	15	00 23 00	41.0 N	125.0 W	—	258	—	—	6.50M_S GR	—	VI	38	—
1918	11	19	20 18	34.0 N	118.5 W	—	38	—	—	—	—	VI	38	—
1919	01	04	23 00	40.58 N	121.82 W	—	324	—	—	—	—	VI	56	—
1919	02	16	15 57	35.0 N	119.0 W	—	38	—	—	5.00M_{La} DMG	—	VII	38	78
1919	02	25	22 38	38.33 N	122.5 W	—	324	—	—	4.60Ukn JON	—	V	56	—
1919	09	15	14 07	40.83 N	124.17 W	—	324	—	—	—	—	VII	38	—
1919	11	25	11 03	37.08 N	121.83 W	—	324	—	—	4.50M_{La} DMG	—	V	56	11&
1919	12	19	13 58 13	38.3 N	119.5 W	—	54	—	—	5.20M_X SJG	—	—	—	—
1920	01	01	02 35	33.2 N	116.7 W	—	380	—	—	5.00M_{La} DMG	—	VI	56	—
1920	06	22	02 47	34.0 N	118.5 W	—	38	—	—	4.90M_L PAS	—	VIII	385	28
1920	07	16	18 08	34.1 N	118.3 W	—	380	—	—	—	—	VI	386	1
1920	07	16	21 27	34.1 N	118.3 W	—	380	—	—	—	—	VI	386	2
1920	07	16	21 30	34.1 N	118.3 W	—	380	—	—	—	—	VI	386	6
1920	07	23	03 55	40.50 N	121.83 W	—	324	—	—	—	—	VII	38	—
1920	10	05	19 03 58	36.58 N	121.67 W	—	324	—	—	5.20Ukn JON	—	V	324	—
1920	12	05	11 58	34.5 N	119.5 W	—	380	—	—	4.50M_{La} DMG	—	V	56	20
1922	01	26	09 31 20	41.0 N	126.0 W	—	258	—	—	6.00M_S GR	—	—	—	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (–) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	Felt area
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1922	01	31	13 17 22	41.0 N	125.5 W	—	258	—	—	7.30M_S ABE	—	V	56	180&
1922	03	10	11 21 20	35.75 N	120.25 W	—	258	—	—	6.50M_S GR	6.0ELL	IX	38	230
1922	03	16	23 11	35.75 N	120.33 W	—	324	—	—	5.00Ukn JON	—	V	324	—
1922	08	18	05 12	35.75 N	120.33 W	—	324	—	—	5.00M_{La} DMG	—	V	56	65
1923	01	22	09 04 18	40.5 N	124.5 W	—	258	—	—	7.20M_S GR	—	VIII	56	200&
1923	02	09	11 14	40.83 N	124.17 W	—	324	—	—	5.00Ukn JON	—	II	324	—
1923	04	29	02 31 29	41.0 N	125.0 W	—	258	—	—	5.60M_S GR	—	—	—	—
1923	07	23	07 30 26	34.00 N	117.25 W	—	258	—	—	6.25M_S GR	5.95HK	VII	388	180#
1923	11	05	22 07	32.5 N	115.5 W	—	38	—	—	5.00M_{La} DMG	—	VII	38	—
1923	11	07	23 57	32.5 N	115.5 W	—	38	—	—	5.70Ukn JON	—	VII	38	—
1924	01	09	10 22	40.83 N	124.17 W	—	324	—	—	4.80Ukn JON	—	IV	56	—
1924	03	09	11 33 29	36.58 N	121.67 W	—	324	—	—	4.60Ukn JON	—	IV	272	—
1924	04	03	23 54	37.33 N	121.67 W	—	324	—	—	4.50M_{La} DMG	—	V	56	19
1924	12	28	04 21	36.67 N	121.67 W	—	324	—	—	4.00M_{La} DMG	—	VI	56	17
1925	01	26	05 45 45	40.83 N	124.17 W	—	324	—	—	4.80Ukn JON	—	II	56	—
1925	04	16	03 30	32.5 N	115.5 W	—	38	—	—	—	—	VI	56	—
1925	06	04	12 02 52	41.5 N	125.0 W	—	258	—	—	6.00M_S GR	—	—	—	—
1925	06	29	14 42 16	34.3 N	119.8 W	—	258	—	—	6.25M_S GR	6.82HK	IX	389	130&
1925	07	03	16 37	34.3 N	119.8 W	—	380	—	—	—	—	VI	380	—
1925	07	03	18 19	34.3 N	119.8 W	—	380	—	—	—	—	VI	380	—
1925	08	08	10 13	33.5 N	117.0 W	—	380	—	—	4.50M_{La} DMG	—	V	380	25
1926	02	18	18 20 45	34.0 N	119.5 W	—	38	—	—	5.50Ukn JON	—	VI	56	—
1926	04	03	20 09	34.0 N	116.0 W	—	38	—	—	5.50M_{La} DMG	—	V	380	155#
1926	06	29	23 21	34.5 N	119.5 W	—	38	—	—	5.50M_{La} DMG	—	VII	38	78
1926	06	30	13 31	35.6 N	118.8 W	—	380	—	—	5.00M_{La} DMG	—	V	380	78
1926	07	25	17 57 54	36.5 N	120.8 W	015	390	—	—	5.00M_{La} DMG	—	VI	218	70
1926	10	22	12 35	36.617N	122.350W	—	521	—	—	6.10M_S GR	—	VII	218	90&
1926	10	22	13 35 22	36.550N	122.183W	—	521	—	—	6.10M_S GR	—	VII	218	90&
1926	10	24	22 51 49.5	37.017N	122.208W	—	391	—	—	5.50M_{La} DMG	—	IV	218	104
1926	12	10	08 38 53	40.75 N	126.00 W	—	258	—	—	6.00M_S GR	—	—	—	—
1926	12	27	09 19	36.17 N	120.32 W	—	324	—	—	5.00M_{La} DMG	—	IV	218	65
1927	01	01	08 16 45	32.5 N	115.5 W	—	258	—	—	5.75M_S GR	—	VIII	38	130
1927	01	01	09 13 30	32.5 N	115.5 W	—	258	—	—	5.50M_S GR	—	VIII	38	130
1927	02	15	23 54 03.5	36.950N	122.267W	—	391	—	—	5.00M_{La} DMG	—	V	56	78&
1927	05	28	17 36 17	37.33 N	122.92 W	—	324	—	—	4.90Ukn JON	—	V	56	17&
1927	08	04	12 24	34.0 N	118.5 W	—	38	—	—	5.30Ukn JON	—	VI	218	21&
1927	08	20	20 05 44	41.0 N	124.6 W	—	324	—	—	5.30Ukn JON	—	VIII	38	40&
1927	09	18	02 07 07	37.5 N	118.75 W	—	258	—	—	6.00M_S GR	5.48HHT	VI	56	194
1927	11	04	13 50	34.7 N	120.8 W	—	521	—	—	7.00M_S ABE	7.28HK	VIII	392	80
1927	11	19	03 32 30	35.0 N	120.5 W	—	38	—	—	5.00Ukn JON	—	VI	218	—
1928	01	09	02 45	37.00 N	121.58 W	—	324	—	—	4.60Ukn JON	—	V	315	—
1928	04	15	21 57 12	39.93 N	122.78 W	015	393	—	—	4.50$_{La}$ DMG	—	VI	393	30
1928	04	18	21 40	34.1 N	119.3 W	—	315	—	—	5.20Ukn JON	—	III	315	—
1928	06	04	05 30	40.75 N	122.92 W	—	324	—	—	4.50Ukn JON	—	VI	1	—
1928	08	09	06 35	37.33 N	121.92 W	—	324	—	—	4.80Ukn JON	—	Felt	1	—
1928	09	05	14 42	34.0 N	116.0 W	—	38	—	—	5.00M_{La} DMG	—	V	38	—
1928	10	02	19 01	32.9 N	115.7 W	—	380	—	—	5.00M_{La} DMG	—	Felt	1	65#
1929	03	13	02 28	35.0 N	119.0 W	—	380	—	—	4.50M_{La} DMG	—	IV	2	15
1929	07	08	16 46 07	33.91 N	118.04 W	013	394	—	—	4.70M_L RIC	—	VII	394	7
1929	09	26	20 00 22.7	34.83 N	116.52 W	—	395	—	—	5.10M_L RIC	—	Felt	2	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1929	10	15	22 03 10	36.17 N	120.67 W	—	324	—	—	4.60Ukn JON	—	III	2	—
1929	11	28	19 49	36.9 N	118.2 W	—	2	—	—	5.50M_{La} DMG	—	VII	38	90
1929	12	04	12 29	40.5 N	124.0 W	—	324	—	—	4.50M_{La} DMG	—	V	324	15&
1930	01	09	08 06 13	36.8 N	121.5 W	—	380	—	—	4.50M_{La} DMG	—	V	380	5&
1930	01	09	08 16	36.8 N	121.5 W	—	380	—	—	4.50M_{La} DMG	—	V	380	5&
1930	01	16	00 24 34	34.2 N	116.9 W	—	258	—	—	5.25M_S GR	—	VII	38	130&
1930	01	16	00 34	34.2 N	116.9 W	—	38	—	—	5.10Ukn PAS	—	VII	38	130&
1930	02	26	02 30	33.0 N	115.5 W	—	38	—	—	5.00M_L RIC	—	VII	3	52&
1930	03	01	23 44	33.0 N	115.5 W	—	38	—	—	4.50M_L RIC	—	VII	3	28
1930	03	02	01 50	33.0 N	115.5 W	—	380	—	—	4.50M_{La} DMG	—	IV	3	26
1930	07	07	12 08 55	35.5 N	118.0 W	—	315	—	—	4.70Ukn JON	—	IV	315	—
1930	08	05	11 25	34.5 N	119.5 W	—	38	—	—	5.00M_{La} DMG	—	VI	3	24&
1930	08	31	00 40 38	34.030N	118.643W	015	474	—	—	5.25M_S GR	—	VII	38	31&
1930	09	23	02 56 55	40.83 N	124.17 W	—	324	—	—	5.00M_{La} DMG	—	VII	38	12&
1930	10	29	12 37	40.67 N	121.92 W	—	324	—	—	4.50M_{La} DMG	—	VI	3	7
1930	12	11	08 58 55	40.08 N	124.50 W	—	324	—	—	5.00M_{La} DMG	—	V	3	40&
1930	12	11	12 27	40.92 N	124.08 W	—	324	—	—	5.00Ukn JON	—	IV	315	—
1930	12	12	09 32	39.83 N	123.58 W	—	324	—	—	4.50M_{La} DMG	—	V	3	9&
1930	12	12	20 16	40.67 N	124.32 W	—	324	—	—	4.50M_{La} DMG	—	V	3	10
1930	12	14	01 38	40.50 N	124.08 W	—	324	—	—	4.80Ukn JON	—	IV	315	—
1930	12	15	08 38	40.83 N	124.17 W	—	324	—	—	4.60Ukn JON	—	III	315	—
1931	01	06	23 28 40	36.50 N	124.40 W	—	324	—	—	5.00Ukn JON	—	V	4	12&
1931	02	23	10 01	35.83 N	120.50 W	—	324	—	—	4.70Ukn JON	—	V	4	13
1931	03	10	03 28 53	40.0 N	125.0 W	—	324	—	—	5.60M_S GR	—	V	4	—
1931	07	21	12 08	35.25 N	120.67 W	—	324	—	—	4.80Ukn JON	—	IV	4	10&
1931	08	23	18 01 46	40.0 N	125.0 W	—	258	—	—	5.30M_S GR	—	VI	4	12&
1931	09	02	15 34 28	41.8 N	123.0 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1931	09	09	13 40 30	40.80 N	125.00 W	—	324	—	—	5.80M_S GR	—	VI	4	39&
1931	12	04	00 53 00	36.50 N	121.67 W	—	324	—	—	5.10Ukn JON	—	IV	315	—
1932	01	05	13 59 04	40.42 N	124.42 W	—	324	—	—	4.50M_L BRK	—	IV	5	—
1932	02	26	16 58	36.0 N	121.0 W	—	324	—	—	5.00M_L BRK	—	IV	5	—
1932	03	02	17 14 36	40.2 N	127.0 W	—	324	—	—	5.60M_L BRK	—	—	—	—
1932	04	16	18 48 10	36.67 N	121.22 W	—	324	—	—	4.50M_L BRK	—	III	324	—
1932	06	06	08 44 22	40.75 N	124.50 W	—	258	—	—	6.40M_S GR	—	VIII	5	130&
1932	06	14	09 44 17	37.25 N	122.08 W	—	324	—	—	4.50M_L BRK	—	V	5	15&
1932	07	26	06 51 58.3	35.800N	118.533W	016	292	—	—	4.50M_L PAS	—	VI	5	30
1932	07	30	07 13 59.7	34.850N	116.583W	016	292	—	—	4.50M_L PAS	—	—	—	—
1932	10	09	22 51	32.666N	115.500W	016	292	—	—	4.50M_L PAS	—	IV	5	—
1932	10	25	01 07 23	37.75 N	122.50 W	—	324	—	—	5.10Ukn JON	—	IV	5	—
1932	10	25	03 28	37.333N	118.666W	016	292	—	—	4.50M_L PAS	—	—	—	—
1932	11	03	18 54 40	37.16 N	122.16 W	—	324	—	—	4.90Ukn JON	—	V	5	—
1933	02	03	03 26	37.333N	118.833W	016	292	—	—	5.00M_L PAS	—	IV	6	—
1933	02	24	19 33	32.833N	115.750W	016	292	—	—	4.50M_L PAS	—	—	—	—
1933	03	11	01 54 07.8	33.616N	117.966W	016	292	—	—	6.30M_L PAS	6.15HK	VIII	397	213#
1933	03	11	02 04	33.750N	118.083W	016	292	—	—	4.90M_L PAS	—	—	—	—
1933	03	11	02 09	33.750N	118.083W	016	292	—	—	5.00M_L PAS	—	—	—	—
1933	03	11	02 10	33.750N	118.083W	016	292	—	—	4.60M_L PAS	—	—	—	—
1933	03	11	02 16	33.750N	118.083W	016	292	—	—	4.80M_L PAS	—	—	—	—
1933	03	11	02 17	33.600N	118.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1933	03	11	02 27	33.750N	118.083W	016	292	—	—	4.60M_L PAS	—	—	—	—
1933	03	11	02 30	33.750N	118.083W	016	292	—	—	5.10M_L PAS	—	—	—	—
1933	03	11	02 59	33.750N	118.083W	016	292	—	—	4.60M_L PAS	—	—	—	—
1933	03	11	03 23	33.750N	118.083W	016	292	—	—	5.00M_L PAS	—	—	—	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1933	03	11	04 36	33.750N	118.083W	016	292	—	—	4.60M_L PAS	—	—	—	—
1933	03	11	04 39	33.750N	118.083W	016	292	—	—	4.90M_L PAS	—	—	—	—
1933	03	11	04 40	33.750N	118.083W	016	292	—	—	4.70M_L PAS	—	—	—	—
1933	03	11	05 10 22.0	33.700N	118.066W	016	292	—	—	5.10M_L PAS	—	—	—	—
1933	03	11	05 13	33.750N	118.083W	016	292	—	—	4.70M_L PAS	—	—	—	—
1933	03	11	05 18 04.0	33.566N	117.983W	016	292	—	—	5.20M_L PAS	—	—	—	—
1933	03	11	06 58 03.0	33.683N	118.050W	016	292	—	—	5.50M_L PAS	—	—	—	—
1933	03	11	08 08	33.750N	118.083W	016	292	—	—	4.50M_L PAS	—	—	—	—
1933	03	11	08 54 57.0	33.700N	118.066W	016	292	—	—	5.10M_L PAS	—	—	—	—
1933	03	11	09 10	33.750N	118.083W	016	292	—	—	5.10M_L PAS	—	—	—	—
1933	03	11	11 04	33.750N	118.133W	016	292	—	—	4.60M_L PAS	—	—	—	—
1933	03	11	14 25	33.850N	118.266W	016	292	—	—	5.00M_L PAS	—	—	—	—
1933	03	11	14 57	33.883N	118.316W	016	292	—	—	4.90M_L PAS	—	—	—	—
1933	03	11	16 53	33.750N	118.083W	016	292	—	—	4.80M_L PAS	—	—	—	—
1933	03	12	06 16	33.750N	118.083W	016	292	—	—	4.60M_L PAS	—	—	—	—
1933	03	12	17 38	33.750N	118.083W	016	292	—	—	4.50M_L PAS	—	—	—	—
1933	03	12	23 54	33.750N	118.083W	016	292	—	—	4.50M_L PAS	—	—	—	—
1933	03	13	04 32	33.750N	118.083W	016	292	—	—	4.70M_L PAS	—	III	259	—
1933	03	13	13 18 28.0	33.750N	118.083W	016	292	—	—	5.30M_L PAS	—	IV	6	—
1933	03	14	12 19	33.750N	118.083W	016	292	—	—	4.50M_L PAS	—	—	—	—
1933	03	14	19 01 50.0	33.616N	118.016W	016	292	—	—	5.10M_L PAS	—	—	—	—
1933	03	15	11 13 32.0	33.616N	118.016W	016	292	—	—	4.90M_L PAS	—	IV	6	—
1933	05	16	11 45 26.0	37.60 N	122.00 W	—	324	—	—	4.50M_L BRK	—	VII	38	40&
1933	06	22	12 36 28.0	37.583N	118.800W	016	292	—	—	4.90M_L PAS	—	IV	6	20
1933	06	22	12 41 02.0	37.583N	118.800W	016	292	—	—	4.90M_L PAS	—	IV	6	20
1933	08	06	03 32	33.333N	116.300W	016	292	—	—	4.70M_L PAS	—	IV	6	—
1933	09	28	11 53	40.08 N	123.92 W	—	324	—	—	4.60Ukn JON	—	IV	6	—
1933	10	02	09 10 17.6	33.783N	118.133W	016	292	—	—	5.40M_L PAS	—	VI	6	16&
1933	10	25	07 00 46.0	33.950N	118.133W	016	292	—	—	4.30M_L PAS	—	VI	6	6&
1933	12	13	15 34 37	37.20 N	122.00 W	—	324	—	—	5.00Ukn JON	—	IV	6	13&
1934	01	04	21 53	32.700N	115.116W	016	292	—	—	4.50M_L PAS	—	—	—	—
1934	01	09	14 10	34.100N	117.683W	016	292	—	—	4.50M_L PAS	—	V	7	20&
1934	01	20	21 17	33.616N	118.116W	016	292	—	—	4.50M_L PAS	—	IV	7	—
1934	03	02	21 30	33.083N	115.983W	016	292	—	—	4.50M_L PAS	—	III	7	—
1934	04	23	21 20	36.750N	121.400W	—	324	—	—	3.50M_L BRK	—	VI	259	2
1934	06	05	21 48	35.80 N	120.33 W	016	292	—	—	5.00M_L PAS	—	V	7	28&
1934	06	05	22 52	35.80 N	120.33 W	016	292	—	—	4.00M_L PAS	—	VI	7	—
1934	06	06	22 14	40.0 N	121.0 W	—	7	—	—	4.50M_L BRK	—	IV	7	12
1934	06	08	04 30	35.80 N	120.33 W	016	292	—	—	5.00M_L PAS	—	VII	7	75&
1934	06	08	04 47	35.80 N	120.33 W	016	292	—	—	6.00M_L PAS	6.10ELL	VIII	7	88&
1934	06	08	05 42	35.80 N	120.33 W	016	292	—	—	4.50M_L PAS	—	III	7	—
1934	06	14	19 26	35.80 N	120.33 W	016	292	—	—	4.50M_L PAS	—	IV	7	—
1934	07	06	22 48 55.1	41.22 N	125.27 W	005	260	—	—	6.50M_S GR	—	V	7	20&
1934	11	17	17 42	40.50 N	124.08 W	—	324	—	—	5.00Ukn JON	—	V	7	—
1934	12	03	01 54	35.95 N	121.50 W	—	324	—	—	4.50M_L BRK	—	IV	259	—
1934	12	15	17 00 01.0	40.60 N	124.20 W	—	324	—	—	4.80Ukn JON	—	V	7	—
1934	12	17	11 10	34.583N	120.333W	016	292	—	—	4.50M_L PAS	—	VI	259	—
1934	12	24	16 26	35.900N	120.500W	016	292	—	—	5.00M_L PAS	—	IV	7	—
1934	12	30	13 52 14	32.25 N	115.50 W	—	258	—	—	6.50M_S CFR	6.35HHT	IX	7	155#
1934	12	31	18 45 15	32.0 N	114.75 W	—	258	—	—	7.10M_S ABE	7.02HHT	X	7	200#
1935	01	02	22 40 58	40.25 N	125.25 W	—	258	—	—	5.70M_S GR	—	V	8	—
1935	05	16	03 25	37.380N	118.920W	016	292	—	—	4.50M_L PAS	—	IV	8	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1935	06	03	17 08	41.00 N	124.00 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1935	06	19	09 55	37.250N	118.500W	016	292	—	—	4.50M_L PAS	—	V	8	33
1935	07	13	10 54 16.5	34.200N	117.900W	016	292	—	—	4.70M_L PAS	—	V	8	25&
1935	09	03	06 47	34.033N	117.316W	016	292	—	—	4.50M_L PAS	—	V	8	—
1935	09	08	14 40	32.900N	115.216W	016	292	—	—	4.50M_L PAS	—	IV	8	—
1935	09	08	17 03	32.900N	115.216W	016	292	—	—	5.00M_L PAS	—	IV	8	—
1935	10	11	14 06	32.900N	115.216W	016	292	—	—	5.00M_L PAS	—	III	259	—
1935	10	24	14 48 07.6	34.100N	116.800W	016	292	—	—	5.10M_L PAS	—	V	8	45&
1935	10	24	14 51	34.100N	116.883W	016	292	—	—	4.50M_L PAS	—	IV	8	—
1935	10	24	14 52	34.100N	116.883W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1935	11	04	03 55	33.500N	116.916W	016	292	—	—	4.50M_L PAS	—	IV	259	22&
1935	12	20	07 45	33.166N	115.500W	016	292	—	—	5.00M_L PAS	—	IV	8	—
1935	12	25	17 15	33.600N	118.016W	016	292	—	—	4.50M_L PAS	—	V	8	—
1936	02	23	22 20 42.7	34.127N	117.338W	010	292	—	—	4.50M_L PAS	—	V	9	28
1936	04	07	22 53	32.900N	115.216W	016	292	—	—	4.50M_L PAS	—	V	9	—
1936	05	07	11 47	33.133N	116.083W	016	292	—	—	4.50M_L PAS	—	V	9	—
1936	05	09	20 20 40	40.50 N	121.65 W	—	324	—	—	4.50Ukn JON	—	V	9	—
1936	05	10	17 40 13.2	37.610N	118.368W	010	292	—	—	5.00M_L PAS	—	V	9	45
1936	05	27	19 55	36.50 N	121.17 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1936	06	03	09 15	40.16 N	126.45 W	—	324	—	—	5.80M_L BRK	—	V	9	18&
1936	09	18	14 40 32.1	32.856N	115.710W	010	292	—	—	4.50M_L PAS	—	—	—	—
1936	10	10	01 25 32.0	40.3 N	126.0 W	—	265	—	—	5.00M_L BRK	—	—	—	—
1936	11	18	18 02 18.5	34.460N	120.522W	010	292	—	—	4.50M_L PAS	—	IV	9	—
1937	02	07	04 41 34	40.50 N	125.25 W	—	258	—	—	5.75M_S GR	—	V	10	26&
1937	02	17	03 33	36.70 N	121.20 W	—	324	—	—	4.50M_L BRK	—	IV	259	—
1937	03	05	12 47	36.70 N	121.70 W	—	324	—	—	4.50M_L BRK	—	V	10	5&
1937	03	08	10 31 12	37.80 N	122.20 W	—	324	—	—	4.50M_L BRK	—	VII	10	20&
1937	03	25	16 49 01.8	33.408N	116.261W	010	292	—	—	6.00M_L PAS	5.60HHT	VI	10	80#
1937	03	26	21 09 06	40.25 N	126.75 W	—	258	—	—	5.50M_S GR	—	—	—	—
1937	03	27	07 42	33.466N	116.583W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1937	08	06	03 24	38.8 N	120.1 W	—	10	—	—	4.50M_L BRK	—	V	259	8
1937	09	01	13 48 08.2	34.210N	117.530W	010	292	—	—	4.50M_L PAS	—	V	10	17
1937	09	01	16 35 33.5	34.183N	117.548W	010	292	—	—	4.50M_L PAS	—	V	10	—
1937	10	27	15 53	36.60 N	121.50 W	—	324	—	—	4.50M_L BRK	—	IV	10	—
1937	11	22	04 12 53.8	34.370N	120.623W	010	292	—	—	4.50M_L PAS	—	V	10	5&
1938	01	04	00 29	33.466N	116.583W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1938	02	12	20 00 14.0	37.000N	122.000W	—	324	—	—	4.50M_L BRK	—	VI	11	8&
1938	02	15	07 45 39.8	34.173N	116.257W	010	292	—	—	4.50M_L PAS	—	V	259	—
1938	04	13	19 29	32.883N	115.583W	016	292	—	—	4.50M_L PAS	—	V	259	—
1938	04	28	06 07 28.0	32.717N	118.172W	010	292	—	—	4.50M_L PAS	—	IV	259	—
1938	05	10	10 32	36.200N	121.300W	—	324	—	—	4.50M_L BRK	—	IV	259	—
1938	05	31	08 34 55.4	33.699N	117.510W	010	292	—	—	5.50M_L PAS	—	V	11	50#
1938	06	06	02 42	32.900N	115.216W	016	292	—	—	5.00M_L PAS	—	IV	259	—
1938	07	01	18 13	41.00 N	124.00 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1938	07	05	18 06 55.8	33.682N	117.553W	010	292	—	—	4.50M_L PAS	—	V	259	—
1938	08	18	07 39 45.4	34.847N	116.143W	010	292	—	—	4.50M_L PAS	—	IV	259	—
1938	08	31	03 18 14.3	33.759N	118.253W	010	292	—	—	4.50M_L PAS	—	VI	11	5&
1938	09	12	06 10	40.00 N	124.00 W	—	324	—	—	5.50M_S GR	—	VI	11	35&
1938	09	17	14 23 04.1	35.630N	117.513W	—	292	—	—	5.00M_L PAS	—	IV	259	—
1938	09	27	12 23 48	36.45 N	121.25 W	—	324	—	—	5.00M_L PAS	—	V	11	23&
1938	10	18	05 05	40.00 N	124.00 W	—	324	—	—	4.50M_L BRK	—	III	259	—
1938	11	15	13 48	39.25 N	123.00 W	—	324	—	—	—	—	VI	11	7
1938	11	22	15 30	35.93 N	120.48 W	—	324	—	—	4.50M_L PAS	—	IV	259	—
1938	12	01	16 17	37.50 N	121.80 W	—	324	—	—	4.50M_L BRK	—	VI	11	—
1938	12	03	17 42 52.6	37.453N	118.603W	010	292	—	—	5.70M_L PAS	—	VI	11	62

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr Mo Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Hypocenter Longitude (°)	Hypocenter Depth (km)	Hypocenter Ref	Magnitude USGS m_b	Magnitude USGS M_S	Magnitude Other	Magnitude Moment M	Intensity MMI	Intensity Ref	Felt area (1,000 km^2)
1938 12 03	18 41 16.4	37.808N	118.323W	010	292	—	—	$4.50M_L$ PAS	—	—	—	—
1939 01 07	20 21 50.2	36.007N	117.720W	010	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1939 02 23	08 45 51.7	34.912N	118.973W	010	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1939 02 23	09 18 46.7	34.885N	119.002W	010	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1939 03 12	22 04	41.0 N	125.9 W	—	324	—	—	4.90Ukn JON	—	II	11	—
1939 03 17	13 09	40.75 N	126.00 W	—	324	—	—	5.00Ukn JON	—	III	11	—
1939 04 19	07 41	32.583N	117.800W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1939 05 01	21 53 18.0	40.20 N	124.70 W	—	12	—	—	$4.50M_L$ BRK	—	V	259	—
1939 05 08	02 48 05.3	34.903N	119.038W	010	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1939 05 12	19 25 02.3	33.466N	116.433W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1939 06 24	13 02 06	36.80 N	121.45 W	—	324	—	—	$5.50M_L$ BRK	—	VII	259	26&
1939 06 25	01 49	32.700N	118.200W	—	292	—	—	$4.50M_L$ PAS	—	III	259	—
1939 07 17	09 24 54	36.85 N	121.68 W	—	324	—	—	$4.50M_L$ BRK	—	V	12	—
1939 11 07	18 52 08.4	34.000N	117.283W	016	292	—	—	$4.70M_L$ PAS	—	IV	259	—
1939 12 27	19 28 49.0	33.783N	118.200W	016	292	—	—	$4.70M_L$ PAS	—	VI	12	15&
1939 12 28	12 15 38.0	35.80 N	120.33 W	—	324	—	—	$5.00M_L$ BRK	—	VI	12	42&
1940 02 08	08 05 59.0	40.00 N	121.60 W	—	324	—	—	$5.70M_L$ BRK	—	VII	13	72
1940 02 13	23 53	40.0 N	124.0 W	—	324	—	—	—	—	VI	259	25&
1940 02 19	12 06 55.7	34.017N	117.050W	016	292	—	—	$4.60M_L$ PAS	—	V	259	—
1940 02 24	09 38	37.500N	118.533W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1940 02 28	17 28 07.0	33.133N	116.083W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1940 05 18	05 03 58.5	34.083N	116.300W	016	292	—	—	$5.40M_L$ PAS	—	V	259	65
1940 05 18	05 51 20.3	34.067N	116.333W	016	292	—	—	$5.20M_L$ PAS	—	IV	259	—
1940 05 18	06 04 30.6	34.067N	116.317W	016	292	—	—	$4.60M_L$ PAS	—	—	—	—
1940 05 18	07 21 32.7	34.067N	116.333W	016	292	—	—	$5.00M_L$ PAS	—	—	—	—
1940 05 18	13 47 19.0	34.050N	116.283W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 05 19	02 26 02.0	34.050N	116.283W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 05 19	02 27 30.0	34.050N	116.283W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 05 19	04 36 40.9	32.733N	115.500W	016	292	—	—	$7.10M_S$ ABE	6.93HHT	X	13	170#
1940 05 19	04 48 47.0	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	Felt	13	—
1940 05 19	04 55 00.0	32.767N	115.483W	016	292	—	—	$5.50M_L$ PAS	—	Felt	13	—
1940 05 19	05 04	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	Felt	13	—
1940 05 19	05 44 37.0	32.766N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	Felt	13	—
1940 05 19	05 51 34.0	32.767N	115.483W	016	292	—	—	$5.50M_L$ PAS	—	IX	13	—
1940 05 19	05 57 17.0	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	Felt	13	—
1940 05 19	06 17 42.0	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	Felt	13	—
1940 05 19	06 33 20.0	32.767N	115.483W	016	292	—	—	$5.00M_L$ PAS	—	Felt	13	—
1940 05 19	06 35 40.0	32.767N	115.483W	016	292	—	—	$5.50M_L$ PAS	—	Felt	13	—
1940 05 19	07 01	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 05 19	15 30 33.0	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 05 22	10 58 31.0	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 05 23	11 00	32.767N	115.483W	—	259	—	—	—	—	VI	259	—
1940 05 23	17 30	32.769N	115.483W	—	259	—	—	—	—	VI	259	—
1940 05 23	18 45	32.767N	115.483W	—	259	—	—	—	—	VI	259	—
1940 06 01	05 27 01.2	34.083N	116.333W	016	292	—	—	$4.70M_L$ PAS	—	IV	259	—
1940 06 01	23 59 36.0	32.767N	115.483W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 06 02	06 13 10.2	34.083N	116.333W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1940 06 04	10 35 08.3	33.000N	116.433W	016	292	—	—	$5.10M_L$ PAS	—	V	259	—
1940 07 08	10 57 36.5	37.616N	118.800W	016	292	—	—	$4.80M_L$ PAS	—	IV	259	—
1940 07 22	23 00 32.9	37.633N	118.767W	016	292	—	—	$4.60M_L$ PAS	—	IV	259	—
1940 09 07	13 02 06.0	36.500N	121.500W	—	324	—	—	$4.50M_L$ BRK	—	III	259	—
1940 09 27	17 03 36	40.5 N	125.0 W	—	324	—	—	$4.50M_L$ BRK	—	IV	259	—
1940 10 11	05 57 12.3	33.767N	118.450W	016	292	—	—	$4.75M_L$ PAS	—	VI	13	18&
1940 10 21	06 49 33.0	33.117N	116.417W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1940 10 22	11 01	40.5 N	124.1 W	—	324	—	—	$4.50M_X$ JON	—	VI	13	5&

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1940	11	19	18 35	40.75 N	124.90 W	—	324	—	—	4.70M_L BRK	—	VI	13	21&
1940	12	20	23 40 42.0	40.00 N	124.00 W	—	324	—	—	5.50M_S GR	—	VI	13	23&
1941	01	23	12 03	40.5 N	125.0 W	—	324	—	—	4.70M_L BRK	—	V	14	5&
1941	02	09	09 44 04.0	40.50 N	125.25 W	—	258	—	—	6.60M_S GR	—	VI	14	50&
1941	02	11	04 51	40.00 N	125.00 W	—	324	—	—	4.50M_S GR	—	—	—	—
1941	02	23	18 36 14.0	33.500N	116.483W	016	292	—	—	4.50M_L PAS	—	III	259	—
1941	05	01	13 29	40.00 N	121.00 W	—	324	—	—	4.50M_L BRK	—	IV	14	—
1941	05	13	16 01 54.0	40.30 N	126.40 W	—	324	—	—	6.00M_S GR	—	V	14	—
1941	05	16	02 36 42.0	40.30 N	125.00 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1941	05	28	06 23 18.0	37.08 N	121.75 W	—	324	—	—	4.50M_L BRK	—	V	14	12&
1941	07	01	07 50 54.8	34.367N	119.583W	016	292	—	—	5.90M_L PAS	5.92HHT	VIII	14	52#
1941	07	01	23 54	34.333N	119.583W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1941	07	12	16 18	34.333N	119.583W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1941	07	22	18 52 05.0	32.733N	115.450W	016	292	—	—	4.50M_L PAS	—	V	259	—
1941	09	08	03 12 45.0	34.333N	119.583W	016	292	—	—	4.50M_L PAS	—	V	14	—
1941	09	14	16 43 31.8	37.567N	118.733W	016	292	—	—	5.80M_L PAS	—	VI	259	90
1941	09	14	16 54 58.0	37.567N	118.733W	016	292	—	—	4.50M_L PAS	—	—	—	—
1941	09	14	18 21 18.7	37.567N	118.733W	016	292	—	—	5.50M_L PAS	—	VI	259	—
1941	09	14	18 39 11.9	37.567N	118.733W	016	292	—	—	6.00M_L PAS	5.48HHT	VI	259	90
1941	09	14	21 16 01.0	37.570N	118.730W	016	292	—	—	5.00M_L BRK	—	III	259	—
1941	09	21	19 53 07.2	34.867N	118.933W	016	292	—	—	5.20M_L PAS	—	V	14	60&
1941	10	03	16 13 08.0	40.40 N	124.80 W	—	324	—	—	6.40M_S GR	—	VI	259	30&
1941	10	06	06 59	40.40 N	125.00 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1941	10	22	06 57 18.5	33.817N	118.217W	016	292	—	—	4.90M_L PAS	—	VII	14	5&
1941	10	22	10 32 21.8	33.867N	118.217W	016	292	—	—	3.80M_L PAS	—	VI	14	—
1941	10	23	20 44 31.0	37.567N	118.733W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1941	10	25	07 09	39.50 N	122.17 W	—	324	—	—	4.60M_x JON	—	V	14	—
1941	11	14	08 41 36.3	33.783N	118.250W	016	292	—	—	5.40M_S GR	—	VIII	259	9&
1941	12	24	07 30 12.0	32.60 N	116.10 W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1941	12	31	06 48 44.0	37.567N	118.733W	016	292	—	—	5.40M_L PAS	—	VI	14	72&
1941	12	31	18 05 44.0	37.567N	118.733W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	01	01	03 41 01.0	37.567N	118.733W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1942	02	01	15 18 28.0	34.400N	116.917W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1942	02	01	16 03 34.0	34.400N	116.917W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	02	04	03 32 03.0	37.567N	118.733W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1942	03	03	01 03 24.0	34.000N	115.750W	016	292	—	—	5.00M_L PAS	—	IV	259	—
1942	05	23	15 47 29.0	32.983N	115.983W	016	292	—	—	5.00M_L PAS	—	V	15	16+
1942	07	06	21 11 40.0	37.567N	118.733W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1942	08	07	01 15 33.0	34.300N	116.417W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	09	03	14 06 01.0	34.483N	118.983W	016	292	—	—	4.50M_L PAS	—	V	15	—
1942	09	04	06 34 33.0	34.483N	118.983W	016	292	—	—	4.50M_L PAS	—	V	15	—
1942	10	21	16 22 13.0	32.966N	116.000W	016	292	—	—	6.50M_S GR	6.59HHT	VI	15	90#
1942	10	21	16 25 19.0	32.967N	116.000W	016	292	—	—	5.00M_L PAS	—	—	—	—
1942	10	21	16 26 54.0	32.967N	116.000W	016	292	—	—	5.00M_L PAS	—	—	—	—
1942	10	21	16 34 39.0	32.967N	116.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	10	21	16 38 06.0	32.967N	116.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	10	21	19 10 28.0	32.967N	116.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	10	21	21 49 28.0	32.967N	116.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	10	22	01 50 38.0	33.233N	115.717W	016	292	—	—	5.50M_L PAS	5.79TH	V	259	—
1942	10	22	18 13 26.0	32.967N	116.000W	016	292	—	—	5.00M_L PAS	—	—	—	—
1942	10	26	03 02 15.0	33.233N	115.717W	016	292	—	—	4.50M_L PAS	—	III	259	—
1942	10	26	06 15 04.0	33.233N	115.717W	016	292	—	—	4.50M_L PAS	—	—	—	—
1942	10	29	15 56 00.0	32.967N	116.000W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1942	10	29	16 21 57.0	32.967N	116.000W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1942	10	30	05 35 45.0	32.967N	116.000W	016	292	—	—	4.50M_L PAS	—	IV	259	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1942	11	02	12 59 42.0	32.967N	116.000W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1942	11	03	05 06 29.0	32.967N	116.000W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1942	11	09	20 34 25.0	34.617N	116.000W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1942	12	05	18 52 07.0	37.567N	118.733W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1942	12	17	15 07 43.0	38.87 N	119.90 W	—	324	—	—	$5.10M_L$ BRK	—	V	15	—
1942	12	20	05 47 39.0	38.72 N	119.73 W	—	324	—	—	$4.50M_L$ BRK	—	Felt	15	—
1943	01	02	14 11 18.0	33.417N	116.417W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1943	03	17	00 40 44.0	32.733N	115.433W	016	292	—	—	$4.50M_L$ PAS	—	V	16	—
1943	03	30	21 07 28.0	39.430N	120.400W	—	324	—	—	$5.30M_L$ BRK	—	V	259	39
1943	05	31	20 16 53.0	37.383N	118.600W	016	292	—	—	$4.50M_L$ PAS	—	V	16	24
1943	06	18	16 15 46.0	33.117N	116.117W	016	292	—	—	$4.50M_L$ PAS	—	IV	16	—
1943	08	29	03 45 13.0	34.267N	116.967W	016	292	—	—	$5.50M_L$ PAS	—	VI	259	37&
1943	09	16	07 52 22.0	36.017N	117.933W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1943	10	02	06 56 41.0	40.50 N	124.60 W	—	324	—	—	$4.60M_L$ BRK	—	IV	259	—
1943	10	14	14 28 44.0	34.333N	116.883W	016	292	—	—	$4.50M_L$ PAS	—	III	259	—
1943	10	15	16 50 01.0	34.350N	116.867W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1943	10	26	04 50 33.0	37.43 N	121.68 W	—	324	—	—	$4.90M_L$ BRK	—	VI	16	65&
1943	10	31	13 12 10.0	33.783N	116.200W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1943	11	02	16 47 59.0	32.967N	116.000W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1943	11	02	17 50 41.0	32.967N	116.000W	016	292	—	—	$4.50M_L$ PAS	—	IV	259	—
1943	11	16	21 38 47.0	37.78 N	122.12 W	—	324	—	—	$3.60M_L$ BRK	—	VI	16	—
1943	11	17	11 28 41.0	33.917N	116.700W	016	292	—	—	$4.50M_L$ PAS	—	IV	16	—
1943	12	22	15 50 28.0	34.333N	115.800W	016	292	—	—	$5.50M_L$ PAS	—	IV	16	—
1944	01	12	15 02 40.0	40.30 N	124.90 W	—	324	—	—	$5.10M_L$ BRK	—	V	17	—
1944	01	16	02 25 29.0	40.30 N	125.10 W	—	324	—	—	$5.10M_L$ BRK	—	IV	17	—
1944	06	10	11 11 50.5	34.013N	116.772W	010	292	—	—	$4.50M_L$ PAS	3.38TH	V	17	—
1944	06	12	10 45 34.7	33.977N	116.720W	010	292	—	—	$5.10M_L$ PAS	—	VI	17	41&
1944	06	12	11 16 36.0	33.995N	116.712W	010	292	—	—	$5.30M_L$ PAS	—	VI	17	41&
1944	06	13	08 27 32.0	34.667N	120.500W	016	292	—	—	$4.60M_L$ PAS	—	V	17	—
1944	06	19	00 03 33.0	33.867N	118.217W	016	292	—	—	$4.50M_L$ PAS	—	VI	17	16&
1944	06	19	03 06 07.0	33.867N	118.217W	016	292	—	—	$4.40M_L$ PAS	—	VI	17	13&
1944	07	03	05 38 23.5	35.350N	117.827W	—	292	—	—	$4.70M_L$ PAS	—	V	17	—
1944	07	29	11 37 15.0	40.30 N	125.80 W	—	324	—	—	$4.50M_L$ BRK	—	—	—	—
1944	11	08	11 08 44.0	41.50 N	125.00 W	—	324	—	—	$4.70M_L$ BRK	—	—	—	—
1944	12	23	08 16 22.0	36.400N	117.917W	016	292	—	—	$4.70M_L$ PAS	—	IV	17	—
1945	01	07	22 25 33.0	36.730N	121.200W	—	324	—	—	$4.70M_L$ BRK	—	VI	18	34&
1945	03	20	21 55 07.0	34.250N	116.167W	016	292	—	—	$5.00M_L$ PAS	—	IV	259	—
1945	04	01	23 43 42.0	34.000N	120.017W	016	292	—	—	$5.40M_L$ PAS	5.14TH	IV	18	2&
1945	05	02	19 47 54.0	41.200N	123.500W	—	324	—	—	$5.00M_L$ BRK	—	V	18	9
1945	05	17	15 06 47.0	36.82 N	121.37 W	—	324	—	—	$4.60M_L$ BRK	—	VI	18	15
1945	05	19	15 07 04.0	40.25 N	126.50 W	—	258	—	—	$6.20M_s$ GR	—	V	18	4&
1945	06	14	03 30 13.0	37.083N	117.500W	016	292	—	—	$5.00M_L$ PAS	—	—	—	—
1945	08	15	17 56 24.0	33.217N	116.133W	016	292	—	—	$5.70M_L$ PAS	—	VI	18	39#
1945	08	27	09 13 04.0	37.27 N	121.80 W	—	324	—	—	$4.50M_L$ BRK	—	VI	18	34&
1945	09	28	22 24 05.0	41.90 N	126.70 W	—	324	—	—	$6.12M_s$ CFR	—	—	—	—
1946	01	08	18 54 18.0	33.000N	115.833W	016	292	—	—	$5.40M_L$ PAS	—	V	19	31#
1946	01	13	16 31 15.0	37.317N	118.650W	016	292	—	—	$4.70M_L$ PAS	—	VI	259	—
1946	03	15	13 21 00.9	35.753N	117.987W	016	292	—	—	$5.20M_L$ PAS	—	VI	259	—
1946	03	15	13 49 35.9	35.725N	118.055W	022	292	—	—	$6.30M_L$ PAS	6.06TH	VII	19	222&
1946	03	15	14 00 35.4	35.715N	118.073W	016	292	—	—	$5.30M_L$ PAS	—	VI	259	—
1946	03	15	19 18 53.6	35.715N	117.977W	016	292	—	—	$5.40M_L$ PAS	—	Felt	259	—
1946	03	15	21 54 33.4	35.752N	118.029W	016	292	—	—	$5.20M_L$ PAS	—	Felt	259	—
1946	03	16	09 46 17.9	35.745N	118.038W	016	292	—	—	$5.10M_L$ PAS	4.54TH	Felt	19	—
1946	03	17	08 16 36.0	35.632N	118.268W	—	292	—	—	$4.60M_L$ PAS	4.10TH	Felt	19	—
1946	03	18	10 05 55.1	35.723N	118.035W	016	292	—	—	$4.90M_L$ PAS	4.35TH	IV	259	—

CALIFORNIA—Continued

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Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1946	03	18	15 49 25.7	35.780N	117.922W	016	292	—	—	4.80M_L PAS	4.30TH	V	259	—
1946	03	18	15 50 42.6	35.747N	117.908W	004	292	—	—	5.30M_L PAS	4.99TH	V	259	—
1946	03	24	20 00 03.0	35.728N	118.098W	016	292	—	—	4.50M_L PAS	—	—	—	—
1946	05	02	01 26 12.0	37.68 N	121.60 W	—	324	—	—	4.60M_L BRK	—	V	19	8
1946	05	29	17 51 03.0	36.77 N	121.42 W	—	324	—	—	4.50M_L BRK	—	V	259	—
1946	06	04	12 05 24.0	33.917N	115.700W	016	292	—	—	4.80M_L PAS	—	IV	259	—
1946	06	15	19 46 53.0	32.600N	116.317W	016	292	—	—	4.80M_L PAS	—	V	19	—
1946	07	07	06 55 15.0	40.500N	121.500W	—	324	—	—	5.00M_L BRK	—	V	19	18&
1946	07	18	14 27 58.0	34.533N	115.983W	016	292	—	—	5.60M_L PAS	5.39TH	V	259	70
1946	08	30	11 16 45.0	33.233N	115.700W	016	292	—	—	4.60M_L PAS	—	—	—	—
1946	09	28	07 19 09.0	33.950N	116.850W	016	292	—	—	5.00M_L PAS	—	VI	19	23&
1946	12	18	14 20 28.0	40.30 N	124.60 W	—	324	—	—	4.70M_L BRK	—	V	259	9&
1947	02	05	06 14 23	36.23 N	120.65 W	—	324	—	—	5.00M_L BRK	—	VI	20	—
1947	02	06	17 20 40.1	35.677N	118.067W	016	292	—	—	4.60M_L PAS	—	V	259	—
1947	03	30	07 44	40.38 N	124.68 W	—	324	—	—	4.60M_L BRK	—	V	259	5&
1947	04	10	15 58 06.0	34.983N	116.550W	016	292	—	—	6.20M_L PAS	6.51HK	VII	20	151&
1947	04	10	16 03	34.967N	116.550W	016	292	—	—	5.10M_L PAS	—	Felt	259	—
1947	04	10	17 18 22.0	34.950N	116.533W	016	292	—	—	5.00M_L PAS	—	—	—	—
1947	04	11	07 47	34.967N	116.550W	016	292	—	—	5.00M_L PAS	4.76TH	Felt	20	—
1947	04	19	02 29 09.0	34.967N	116.550W	016	292	—	—	4.70M_L PAS	4.38TH	—	—	—
1947	05	11	05 06 20.0	34.233N	116.333W	016	292	—	—	4.90M_L PAS	—	Felt	20	—
1947	05	27	20 59 42	40.40 N	124.70 W	—	324	—	—	5.20M_L BRK	—	VI	20	6&
1947	06	22	23 29 33	37.00 N	121.77 W	—	324	—	—	4.70M_L BRK	—	VI	20	35&
1947	07	24	22 10 46.0	34.017N	116.500W	016	292	—	—	5.50M_L PAS	—	V	20	60#
1947	07	24	22 54 26.0	34.017N	116.500W	016	292	—	—	4.90M_L PAS	—	IV	259	—
1947	07	25	00 46 31.0	34.017N	116.500W	016	292	—	—	5.00M_L PAS	4.64TH	—	—	—
1947	07	25	01 56 47.0	34.017N	116.500W	016	292	—	—	4.60M_L PAS	4.15TH	—	—	—
1947	07	25	06 19 49.0	34.017N	116.500W	016	292	—	—	5.20M_L PAS	5.15TH	IV	259	—
1947	07	25	16 14 53.0	34.017N	116.500W	016	292	—	—	4.50M_L PAS	4.26TH	IV	259	—
1947	07	26	02 49 41.0	34.017N	116.500W	016	292	—	—	5.10M_L PAS	—	Felt	259	—
1947	07	26	23 04 25.0	34.017N	116.500W	016	292	—	—	4.50M_L PAS	—	—	—	—
1947	08	10	21 58 24	36.88 N	121.42 W	—	324	—	—	4.40M_L BRK	—	VI	20	10&
1947	09	08	05 52	39.30 N	120.20 W	—	324	—	—	4.50M_L BRK	—	V	20	—
1947	09	08	07 13	39.30 N	120.20 W	—	324	—	—	4.70M_L BRK	—	VI	20	—
1947	09	23	13 52 55.0	40.40 N	125.20 W	—	324	—	—	5.30M_L BRK	—	V	259	19&
1947	11	02	07 01	40.10 N	125.30 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1947	11	10	02 22 55.0	34.400N	116.417W	016	292	—	—	4.50M_L PAS	—	III	259	—
1947	11	18	21 59 03.0	33.267N	119.450W	016	292	—	—	5.00M_L PAS	4.78TH	V	20	—
1948	01	10	00 45 50	42.0 N	127.0 W	—	324	—	—	5.30M_L BRK	—	—	—	—
1948	02	11	03 29 28.0	36.10 N	118.80 W	—	324	—	—	4.90M_L BRK	—	VI	21	30
1948	02	19	08 25 09.0	41.00 N	124.90 W	—	324	—	—	4.80M_L BRK	—	III	259	—
1948	02	20	04 21 24.0	33.917N	118.217W	016	292	—	—	3.60M_L PAS	—	VI	21	2
1948	02	24	08 15 10.0	32.500N	118.550W	016	292	—	—	5.30M_L PAS	5.12TH	IV	21	—
1948	03	01	08 12 13.0	34.167N	117.533W	016	292	—	—	4.70M_L PAS	—	VI	21	31&
1948	03	28	22 38 03.0	36.850N	121.570W	—	324	—	—	4.60M_L BRK	—	V	21	10&
1948	03	28	22 45 00.0	36.850N	121.570W	—	324	—	—	4.50M_L BRK	—	V	21	10&
1948	04	16	22 26 24.0	34.017N	118.967W	016	292	—	—	4.70M_L PAS	—	VI	21	4&
1948	06	18	10 35 00.0	39.07 N	123.28 W	—	324	—	—	3.80M_L BRK	—	VI	21	1
1948	07	26	17 50 01.4	35.582N	118.158W	005	292	—	—	4.50M_L PAS	—	V	259	—
1948	08	18	19 11 57.0	40.50 N	124.70 W	—	324	—	—	5.00M_L BRK	—	V	259	—
1948	11	12	23 10 25.0	40.40 N	124.32 W	—	324	—	—	4.50M_L BRK	—	Felt	324	—
1948	12	04	23 43 17.0	33.933N	116.383W	016	292	—	—	6.50M_L PAS	5.95HK	VII	21	180#
1948	12	05	00 07 21.0	33.933N	116.367W	016	292	—	—	4.90M_L PAS	4.44TH	Felt	259	—
1948	12	05	00 42 35.0	33.967N	116.433W	016	292	—	—	4.60M_L PAS	4.48TH	—	—	—
1948	12	11	16 12 20.0	33.967N	116.450W	016	292	—	—	4.50M_L PAS	—	IV	259	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1948	12	20	04 42 46.0	35.80 N	121.50 W	—	324	—	—	4.50M_L BRK	—	III	259	—
1948	12	29	12 53 28.0	39.550N	120.080W	—	324	—	—	6.00M_L BRK	—	VII	21	104
1948	12	31	14 35 46.0	35.67 N	121.40 W	—	324	—	—	4.60M_L BRK	—	V	21	—
1949	01	01	01 17 54.0	36.90 N	121.62 W	—	324	—	—	4.50M_L BRK	—	VII	21	9&
1949	01	03	13 43 40.0	34.967N	116.550W	—	292	—	—	4.80M_L PAS	—	IV	259	—
1949	01	20	07 59 23.0	39.55 N	120.08 W	—	324	—	—	4.80M_L BRK	—	IV	259	—
1949	02	11	21 05 24.0	37.083N	117.750W	016	292	—	—	5.60M_L PAS	5.25TH	VI	22	77
1949	02	27	13 35 47.0	41.20 N	125.20 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1949	03	09	12 28 39.0	37.02 N	121.48 W	—	324	—	—	5.20M_L BRK	—	VII	22	52&
1949	03	24	20 56 56.0	41.30 N	126.00 W	—	324	—	—	5.90M_L BRK	—	Felt	324	—
1949	04	13	07 58 26.0	37.667N	118.383W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1949	05	02	11 24 58.0	34.017N	115.767W	016	292	—	—	4.60M_L PAS	—	Felt	259	—
1949	05	02	11 25 47.0	34.017N	115.683W	016	292	—	—	5.90M_L PAS	—	V	22	82#
1949	05	10	04 06 33.0	34.017N	115.683W	016	292	—	—	4.70M_L PAS	—	—	—	—
1949	05	25	17 31 46.0	34.017N	115.683W	016	292	—	—	4.50M_L PAS	—	—	—	—
1949	06	10	03 06 40.0	37.30 N	121.67 W	—	324	—	—	4.60M_L BRK	—	VI	22	21&
1949	06	27	10 35 31.0	35.80 N	121.10 W	—	324	—	—	4.50M_L BRK	—	IV	259	—
1949	08	08	11 00 03.0	37.95 N	122.32 W	—	324	—	—	3.30M_L BRK	—	VI	22	1&
1949	08	21	20 48 16.0	40.27 N	121.23 W	—	324	—	—	4.50M_L BRK	—	IV	259	—
1949	08	27	14 51 46.0	34.500N	120.500W	016	292	—	—	4.90M_L PAS	4.39TH	VI	22	1&
1949	09	19	05 08 13.5	33.960N	118.187W	000	292	—	—	3.10M_L PAS	—	VI	22	2
1949	10	22	21 45 20.0	36.58 N	121.17 W	—	324	—	—	4.70M_L BRK	—	V	259	—
1949	10	28	02 29 16.0	40.90 N	124.20 W	—	324	—	—	4.50M_L BRK	—	V	259	—
1949	11	04	20 42 38.0	32.200N	116.550W	016	292	—	—	5.70M_L PAS	—	VI	22	33#
1949	11	05	04 35 24.0	32.200N	116.550W	016	292	—	—	5.10M_L PAS	4.32TH	VI	22	15#
1949	12	09	12 39 02.0	37.467N	118.367W	016	292	—	—	4.60M_L PAS	—	IV	22	—
1950	01	14	19 52 30	40.217N	124.417W	—	324	—	—	4.60M_L BRK	—	VI	23	—
1950	01	27	10 47 20	42.0 N	125.1 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1950	02	26	00 06 22.0	34.617N	119.083W	016	292	—	—	4.70M_L PAS	—	VI	23	6&
1950	03	20	15 22 17.0	40.450N	121.467W	—	324	—	—	5.50M_L BRK	—	V	23	10
1950	03	23	04 16 50.0	40.500N	121.500W	—	266	—	—	4.60M_L BRK	—	—	—	—
1950	04	15	11 56 32.0	35.750N	119.617W	016	292	—	—	4.60M_L PAS	—	IV	259	—
1950	06	09	13 07 44	41.283N	125.733W	—	324	—	—	4.80M_L BRK	—	—	—	—
1950	07	27	11 29 26.0	33.117N	115.567W	016	292	—	—	4.80M_L PAS	—	VI	23	—
1950	07	27	22 51	33.117N	115.567W	016	292	—	—	4.50M_L PAS	—	—	—	—
1950	07	28	03 25	33.117N	115.567W	016	292	—	—	4.70M_L PAS	—	V	259	—
1950	07	28	17 27	33.117N	115.567W	016	292	—	—	4.70M_L PAS	4.77TH	Felt	23	—
1950	07	28	17 50 48.0	33.117N	115.567W	016	292	—	—	5.40M_L PAS	5.22TH	VI	23	32#
1950	07	28	17 58 12.0	33.117N	115.567W	016	292	—	—	4.80M_L PAS	—	—	—	—
1950	07	29	00 17	33.117N	115.567W	016	292	—	—	4.50M_L PAS	4.63TH	Felt	23	—
1950	07	29	14 36 32.0	33.117N	115.567W	016	292	—	—	5.50M_L PAS	—	VIII	23	44#
1950	07	29	15 09	33.117N	115.567W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1950	07	29	18 43 00.0	33.117N	115.567W	016	292	—	—	4.70M_L PAS	—	IV	259	—
1950	08	01	08 37 20.0	33.117N	115.567W	016	292	—	—	4.70M_L PAS	—	VI	259	—
1950	08	14	19 16 00.0	33.117N	115.567W	016	292	—	—	4.70M_L PAS	—	—	—	—
1950	09	05	19 19 56.0	33.650N	116.750W	016	292	—	—	4.80M_L PAS	—	VI	23	26&
1950	10	08	12 24 19	40.283N	124.800W	—	324	—	—	4.60M_L BRK	—	—	—	—
1950	11	14	02 35 50	40.483N	121.500W	—	324	—	—	4.60M_L BRK	—	V	23	—
1950	11	14	06 34 32	40.483N	121.500W	—	324	—	—	4.50M_L BRK	—	Felt	23	—
1950	11	17	03 46 51.0	33.917N	118.317W	016	292	—	—	3.80M_L PAS	—	VI	23	—
1950	12	14	08 59 34.0	40.083N	120.067W	—	324	—	—	4.50M_L BRK	—	Felt	23	—
1950	12	14	13 24 19	40.083N	120.067W	—	324	—	—	5.60M_L BRK	—	VII	23	80
1951	01	13	20 31 32	40.4 N	125.0 W	—	324	—	—	4.80M_L BRK	—	IV	24	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1951	01	24	07 17 02.6	32.983N	115.733W	016	292	—	—	5.60M_L PAS	—	VII	24	56#
1951	01	25	21 00 18	37.750N	122.183W	—	324	—	—	2.90M_L BRK	—	VI	24	—
1951	02	15	10 47 59.0	33.483N	116.500W	016	292	—	—	4.80M_L PAS	—	V	24	18&
1951	02	15	10 49 57.0	33.483N	116.500W	016	292	—	—	4.80M_L PAS	—	V	24	18&
1951	04	01	19 21 08	40.467N	125.300W	—	324	—	—	5.00M_L BRK	—	III	24	—
1951	06	25	19 45 41.7	35.772N	117.948W	012	292	—	—	4.60M_L PAS	—	V	24	—
1951	07	29	10 53 45.0	36.583N	121.183W	—	324	—	—	5.00M_L BRK	—	VI	24	30&
1951	08	06	09 05 02	36.617N	121.217W	—	324	—	—	4.90M_L BRK	—	VI	24	6&
1951	10	08	04 10 35.0	40.283N	124.800W	—	324	—	—	5.80M_L BRK	—	VII	24	28&
1951	10	31	20 58 19	36.900N	121.417W	—	324	—	—	4.80M_L BRK	—	V	24	6&
1951	11	13	11 24 42	40.4 N	125.3 W	—	324	—	—	4.80M_L BRK	—	V	24	—
1951	11	14	08 39 53	40.433N	124.050W	—	324	—	—	4.70M_L BRK	—	VI	24	8&
1951	12	05	15 53 14.0	33.100N	115.400W	016	292	—	—	4.50M_L PAS	—	VII	24	15+
1951	12	26	00 46 54.0	32.817N	118.350W	016	292	—	—	5.90M_L PAS	—	VI	24	35&
1951	12	28	02 49 27.0	37.567N	118.583W	016	292	—	—	5.20M_L PAS	—	V	24	33
1952	02	09	08 43 30.9	36.607N	117.905W	008	292	—	—	4.10M_L PAS	—	VI	25	—
1952	02	13	15 13 37.0	32.867N	118.250W	016	292	—	—	4.70M_L PAS	—	IV	25	—
1952	02	17	12 36 58.3	33.997N	117.270W	016	292	—	—	4.50M_L PAS	—	IV	25	—
1952	05	06	17 21 10	41.9 N	124.6 W	—	324	—	—	4.70M_L BRK	—	IV	259	—
1952	07	21	11 52 14.0	35.000N	119.017W	016	292	—	—	7.20M_L BLT	7.48HK	XI	25	353&
1952	07	21	11 54	35.000N	119.033W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	11 55	35.000N	119.033W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	11 57	35.000N	119.033W	016	292	—	—	4.50M_L PAS	—	Felt	25	—
1952	07	21	11 58	35.000N	119.033W	016	292	—	—	4.60M_L PAS	—	Felt	25	—
1952	07	21	11 59	35.000N	119.033W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	12 02	35.000N	119.033W	016	292	—	—	5.60M_L PAS	—	Felt	25	—
1952	07	21	12 05 31.0	35.000N	119.000W	016	292	—	—	6.40M_L PAS	6.27HK	V	25	—
1952	07	21	12 06	35.000N	119.000W	016	292	—	—	4.80M_L PAS	—	—	—	—
1952	07	21	12 07	35.000N	119.000W	016	292	—	—	4.70M_L PAS	—	Felt	25	—
1952	07	21	12 10	35.000N	119.000W	016	292	—	—	4.50M_L PAS	—	Felt	25	—
1952	07	21	12 12	35.000N	119.000W	016	292	—	—	4.60M_L PAS	—	Felt	25	—
1952	07	21	12 19 36.0	34.950N	118.867W	016	292	—	—	5.30M_L PAS	—	Felt	25	—
1952	07	21	12 22	35.000N	119.000W	016	292	—	—	4.90M_L PAS	—	—	—	—
1952	07	21	12 25	35.000N	119.000W	016	292	—	—	4.70M_L PAS	—	Felt	25	—
1952	07	21	12 40	35.000N	119.000W	016	292	—	—	4.90M_L PAS	—	Felt	25	—
1952	07	21	13 08	35.000N	119.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	13 13	35.000N	119.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	13 25 12.0	35.000N	119.000W	—	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	13 59	35.000N	119.000W	—	292	—	—	4.60M_L PAS	—	—	—	—
1952	07	21	15 13 58.0	35.183N	118.650W	016	292	—	—	5.10M_L PAS	—	VI	25	—
1952	07	21	15 53	35.000N	119.000W	016	292	—	—	4.50M_L PAS	—	V	25	—
1952	07	21	16 38	35.000N	119.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	17 42 44.0	35.233N	118.533W	016	292	—	—	5.10M_L PAS	—	—	—	—
1952	07	21	18 00	35.000N	119.000W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	21	18 23 38.0	35.300N	118.533W	016	292	—	—	4.50M_L PAS	4.31TH	—	—	—
1952	07	21	19 41 22.0	35.133N	118.767W	016	292	—	—	5.50M_L PAS	—	V	25	—
1952	07	21	23 53 28.0	34.983N	119.033W	016	292	—	—	4.50M_L PAS	4.20TH	—	—	—
1952	07	22	01 41 02.0	35.133N	118.517W	016	292	—	—	4.50M_L PAS	4.70TH	—	—	—
1952	07	22	08 47 34.0	35.083N	118.750W	016	292	—	—	4.70M_L PAS	4.56TH	IV	25	—
1952	07	22	09 10 25.0	35.233N	118.600W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	07	22	13 31 43.0	35.000N	119.000W	016	292	—	—	4.80M_L PAS	4.62TH	V	25	—
1952	07	22	22 31 33.0	35.033N	118.933W	016	292	—	—	4.70M_L PAS	4.69TH	—	—	—
1952	07	23	00 38 32.0	35.366N	118.583W	016	292	—	—	6.10M_L PAS	5.70HHT	VI	25	—
1952	07	23	00 47 38.0	35.367N	118.583W	016	292	—	—	4.60M_L PAS	—	—	—	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1952	07	23	03 19 23.0	35.367N	118.583W	016	292	—	—	$5.00M_L$ PAS	—	V	25	—
1952	07	23	03 49 28.0	35.283N	118.550W	016	292	—	—	$4.70M_L$ PAS	—	—	—	—
1952	07	23	04 01 40.0	35.367N	118.583W	016	292	—	—	$4.70M_L$ PAS	4.79TH	—	—	—
1952	07	23	05 46 03.0	35.383N	118.567W	016	292	—	—	$4.70M_L$ PAS	—	—	—	—
1952	07	23	07 37 00.0	35.283N	118.550W	016	292	—	—	$4.80M_L$ PAS	4.42TH	—	—	—
1952	07	23	07 53 19.0	35.000N	118.833W	016	292	—	—	$5.40M_L$ PAS	5.23TH	VII	25	—
1952	07	23	13 17 05.0	35.217N	118.817W	016	292	—	—	$5.70M_L$ PAS	5.76TH	VII	25	—
1952	07	23	16 18 38.0	35.333N	118.600W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1952	07	23	16 48 53.0	35.333N	118.600W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1952	07	23	17 22 24.0	35.335N	118.475W	007	292	—	—	$4.50M_L$ PAS	—	III	25	—
1952	07	23	18 13 51.0	35.000N	118.833W	016	292	—	—	$5.20M_L$ PAS	—	VI	25	—
1952	07	24	05 02 49.6	35.340N	118.473W	002	292	—	—	$4.50M_L$ PAS	—	—	—	—
1952	07	25	13 13 08.3	35.310N	118.498W	003	292	—	—	$5.00M_L$ PAS	—	Felt	25	—
1952	07	25	19 09 44.6	35.317N	118.495W	006	292	—	—	$5.70M_L$ PAS	5.76TH	VI	25	—
1952	07	25	19 43 23.7	35.315N	118.515W	011	292	—	—	$5.70M_L$ PAS	5.94TH	VI	25	—
1952	07	25	20 06 06.1	35.298N	118.435W	—	292	—	—	$4.80M_L$ PAS	—	IV	25	—
1952	07	26	22 41 03.0	35.183N	118.600W	016	292	—	—	$4.60M_L$ PAS	—	—	—	—
1952	07	29	07 03 47.0	35.383N	118.850W	016	292	—	—	$6.10M_L$ PAS	6.27HK	VII	25	—
1952	07	29	08 01 46.0	35.400N	118.817W	016	292	—	—	$5.10M_L$ PAS	—	V	25	—
1952	07	29	15 49 50.0	35.183N	118.600W	016	292	—	—	$4.90M_L$ PAS	—	Felt	25	—
1952	07	29	19 51 32.0	35.333N	118.917W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1952	07	31	12 09 09.0	35.333N	118.600W	016	292	—	—	$5.80M_L$ PAS	5.48TH	VI	25	—
1952	07	31	17 19 08.0	35.283N	118.583W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1952	07	31	19 53 14.0	35.333N	118.917W	016	292	—	—	$4.50M_L$ PAS	—	IV	25	—
1952	08	01	03 16 11.6	35.283N	118.550W	016	292	—	—	$4.50M_L$ PAS	—	—	—	—
1952	08	01	13 04 30.0	34.900N	118.950W	016	292	—	—	$5.10M_L$ PAS	—	V	25	—
1952	08	07	16 31 51.0	35.033N	119.050W	016	292	—	—	$4.90M_L$ PAS	—	V	25	—
1952	08	10	12 23 18.0	35.288N	118.412W	004	292	—	—	$4.60M_L$ PAS	—	—	—	—
1952	08	13	04 29 40.6	35.293N	118.400W	014	292	—	—	$4.60M_L$ PAS	—	Felt	25	—
1952	08	13	17 39 25.0	35.150N	118.683W	016	292	—	—	$4.70M_L$ PAS	—	VI	25	—
1952	08	18	04 40 10.0	35.033N	119.050W	016	292	—	—	$4.70M_L$ PAS	—	IV	25	—
1952	08	19	19 12 26.0	35.050N	119.233W	016	292	—	—	$4.50M_L$ PAS	—	V	25	—
1952	08	22	22 41 24.0	35.333N	118.917W	016	292	—	—	$5.80M_L$ PAS	5.78TH	VIII	25	120&
1952	08	23	10 09 07.1	34.520N	118.198W	013	292	—	—	$5.00M_L$ PAS	4.85TH	VI	25	60&
1952	08	25	06 20 26.0	35.100N	118.967W	016	292	—	—	$4.70M_L$ PAS	—	V	25	—
1952	08	30	04 55 59.8	35.315N	118.482W	005	292	—	—	$4.70M_L$ PAS	—	V	25	—
1952	09	02	12 41 32.0	35.133N	118.700W	016	292	—	—	$4.60M_L$ PAS	—	V	25	—
1952	09	02	20 45 56.0	34.967N	119.000W	016	292	—	—	$4.70M_L$ PAS	—	V	25	—
1952	09	12	10 35 25.0	35.000N	119.050W	016	292	—	—	$4.50M_L$ PAS	—	V	25	—
1952	09	15	04 40 13.2	35.317N	118.487W	004	292	—	—	$4.90M_L$ PAS	—	—	—	—
1952	09	22	11 41 25	40.200N	124.417W	—	324	—	—	$5.20M_L$ BRK	—	VII	25	10&
1952	11	07	08 55 35.0	35.000N	119.083W	016	292	—	—	$4.60M_L$ PAS	—	V	25	—
1952	11	22	07 46 36.0	35.768N	121.145W	010	476	—	—	$6.00M_L$ BRK	—	VII	25	82&
1953	02	23	07 42 51	41.500N	125.133W	—	324	—	—	$4.70M_L$ BRK	—	—	—	—
1953	03	22	05 19 00	38.817N	119.983W	—	324	—	—	$5.00M_L$ BRK	—	V	26	—
1953	04	29	12 47 45.0	35.000N	118.733W	016	292	—	—	$4.70M_L$ PAS	—	IV	26	—
1953	05	25	03 24 01.0	35.000N	119.017W	016	292	—	—	$4.80M_L$ PAS	—	V	26	—
1953	05	25	04 07 59	39.3 N	123.3 W	—	324	—	—	$3.20M_L$ BRK	—	VI	26	—
1953	06	14	04 17 29.9	32.950N	115.717W	016	292	—	—	$5.50M_L$ PAS	—	VII	26	30#
1953	06	14	04 29 58.0	32.950N	115.717W	016	292	—	—	$4.80M_L$ PAS	—	V	26	—
1953	10	07	14 59 21.0	35.033N	118.850W	016	292	—	—	$4.90M_L$ PAS	—	V	26	—
1953	11	24	05 46 06.0	35.883N	116.967W	016	292	—	—	$4.90M_L$ PAS	—	IV	26	—
1953	12	15	12 44 36.0	35.217N	118.817W	016	292	—	—	$4.60M_L$ PAS	—	V	26	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1954	01	12	23 33 49.0	35.000N	119.017W	016	292	—	—	5.90M_L PAS	5.63TH	VII	27	100&
1954	01	27	14 19 48.0	35.150N	118.633W	016	292	—	—	5.00M_L PAS	4.84TH	V	27	31
1954	02	10	23 58 38.0	34.933N	119.067W	016	292	—	—	4.50M_L PAS	—	V	27	—
1954	02	12	09 44 28.0	33.333N	116.433W	016	292	—	—	4.50M_L PAS	—	IV	27	—
1954	02	24	22 30 22.0	35.067N	119.067W	016	292	—	—	4.50M_L PAS	—	IV	27	—
1954	03	19	09 54 29.0	33.283N	116.183W	016	292	—	—	6.20M_L PAS	6.35HK	VI	27	104#
1954	03	19	09 55 56.0	33.283N	116.183W	016	292	—	—	5.00M_L PAS	—	—	—	—
1954	03	19	09 57 07.0	33.283N	116.183W	016	292	—	—	4.60M_L PAS	—	—	—	—
1954	03	19	10 15 22.0	33.283N	116.183W	016	292	—	—	4.50M_L PAS	—	Felt	27	—
1954	03	19	10 19 57.0	33.283N	116.183W	016	292	—	—	4.50M_L PAS	—	Felt	27	—
1954	03	19	10 21 17.0	33.283N	116.183W	016	292	—	—	5.50M_L PAS	5.20TH	Felt	27	—
1954	03	20	04 19 19.0	33.283N	116.183W	016	292	—	—	4.90M_L PAS	—	—	—	—
1954	03	23	04 14 50.0	33.283N	116.183W	016	292	—	—	5.10M_L PAS	4.80TH	V	27	—
1954	04	22	18 50 13	36.900N	121.683W	—	324	—	—	4.30M_L BRK	—	VI	27	6&
1954	04	25	20 33 28	36.933N	121.683W	—	324	—	—	5.30M_L BRK	—	VIII	27	35&
1954	05	23	23 52 43.0	34.983N	118.983W	016	292	—	—	5.10M_L PAS	4.78TH	IV	27	32&
1954	08	26	13 48 03.0	33.917N	119.500W	016	292	—	—	4.80M_L PAS	—	VI	27	15&
1954	10	30	02 02 43.0	34.033N	115.550W	016	292	—	—	4.60M_L PAS	—	IV	27	—
1954	11	10	18 07 21	39.067N	123.033W	—	324	—	—	4.40M_L BRK	—	VI	27	6
1954	11	25	11 16 35	40.267N	125.633W	—	324	—	—	6.10M_L BRK	—	V	27	23&
1954	12	07	04 32 36	40.5 N	126.0 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1954	12	17	07 08 58	37.717N	122.133W	—	324	—	—	4.50M_L BRK	—	VI	27	12&
1954	12	21	19 56 24.4	40.783N	124.167W	000	480	—	—	6.50M_L BRK	—	VII	27	130&
1954	12	30	09 16 13.0	40.783N	123.867W	—	324	—	—	4.70M_L BRK	—	VI	27	—
1955	02	11	19 44 31.5	35.320N	118.493W	015	292	—	—	4.50M_L PAS	—	IV	28	—
1955	03	02	15 59 01	36.000N	120.933W	—	324	—	—	4.80M_L BRK	—	VI	28	25&
1955	04	29	15 14 38	38.950N	122.767W	—	324	—	—	3.60M_L BRK	—	VI	28	2
1955	05	07	11 50 39	38.933N	122.867W	—	324	—	—	4.60M_L BRK	—	VI	28	5
1955	05	28	19 44 20.0	35.533N	118.263W	012	292	—	—	4.50M_L PAS	—	V	28	—
1955	08	08	03 21 50.5	35.395N	118.620W	004	292	—	—	4.70M_L PAS	—	V	28	15
1955	08	27	07 00 26	40.383N	124.500W	—	324	—	—	4.50M_L BRK	—	III	28	—
1955	09	05	02 01 18	37.367N	121.783W	—	324	—	—	5.50M_L BRK	—	VII	28	45&
1955	10	24	04 10 44	37.967N	122.050W	—	324	—	—	5.40M_L BRK	—	VII	28	31&
1955	11	02	19 40 06	36.000N	120.922W	—	324	—	—	5.20M_L BRK	—	VI	28	18&
1955	12	17	06 07 29.0	33.000N	115.500W	016	292	—	—	5.40M_L PAS	—	VII	28	23+
1955	12	17	06 52 03.0	33.000N	115.500W	016	292	—	—	4.60M_L PAS	—	Felt	259	—
1956	01	03	00 25 48.9	33.725N	117.498W	014	292	—	—	4.70M_L PAS	—	VI	29	23&
1956	02	07	03 16 38.6	34.587N	118.613W	003	292	—	—	4.60M_L PAS	4.52TH	V	29	8&
1956	02	09	14 32 38.0	31.750N	115.917W	016	292	—	—	6.80M_L PAS	6.51HHT	VI	29	86#
1956	03	10	05 56 14	40.300N	124.233W	—	324	—	—	4.50M_L BRK	—	V	29	6&
1956	03	16	20 29 33.6	34.307N	116.758W	001	292	—	—	4.80M_L PAS	4.54TH	V	259	21&
1956	04	05	04 29 13	38.533N	122.517W	—	324	—	—	4.40M_L BRK	—	VI	29	12&
1956	05	11	16 30 50.5	34.230N	116.795W	013	292	—	—	4.70M_L PAS	—	V	29	23&
1956	07	09	02 21 55	42.0 N	122.4 W	—	324	—	—	4.90M_L BRK	—	—	—	—
1956	07	23	08 03 48	36.3 N	121.3 W	—	324	—	—	4.70M_L BRK	—	V	29	10&
1956	10	11	16 48 50	40.667N	125.767W	—	324	—	—	6.00M_L BRK	—	V	29	9&
1956	10	11	17 18 19	40.750N	125.800W	—	324	—	—	4.80M_L BRK	—	Felt	29	—
1956	10	11	17 22 30	40.7 N	125.8 W	—	324	—	—	4.80M_L BRK	—	Felt	29	—
1956	11	16	03 23 09.0	35.950N	120.467W	—	324	—	—	5.00M_L BRK	4.69TH	VI	29	21&
1957	01	24	20 54 49.9	33.110N	116.523W	004	292	—	—	4.60M_L PAS	—	V	30	15&
1957	01	29	21 19 53	35.867N	122.117W	—	324	—	—	4.90M_L BRK	—	V	30	13&
1957	02	01	07 52 15.4	33.985N	116.340W	011	292	—	—	4.60M_L PAS	—	V	30	8&
1957	03	18	18 56 28.0	34.118N	119.220W	014	324	—	—	4.70M_L PAS	—	VI	30	6&
1957	03	22	19 44 21	37.667N	122.483W	—	324	—	—	5.30M_L BRK	—	VII	30	31&
1957	03	23	08 13 48	37.700N	122.517W	—	324	—	—	4.20M_L BRK	—	VI	30	9&

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km²)
1957	04	25	21 57 38.7	33.217N	115.808W	000	292	—	—	5.20M_L PAS	—	VII	30	31&
1957	04	25	22 24 12.0	33.183N	115.850W	016	292	—	—	5.10M_L PAS	—	Felt	30	—
1957	05	26	15 59 33.6	33.232N	116.005W	015	292	—	—	5.00M_L PAS	—	IV	259	18#
1957	06	21	00 41 25	37.700N	119.283W	—	324	—	—	4.60M_L BRK	—	V	30	—
1957	09	03	16 38 41	41.533N	125.583W	—	324	—	—	4.50M_L BRK	—	—	—	—
1957	09	28	21 04 39	36.600N	121.233W	—	324	—	—	4.50M_L BRK	—	IV	30	—
1957	10	31	02 47 46	39.183N	123.683W	—	324	—	—	4.70M_L BRK	—	V	30	6&
1958	05	24	23 04 47	40.300N	124.050W	—	324	—	—	4.90M_L BRK	—	V	259	9&
1958	07	14	05 25 55.3	34.348N	119.492W	016	292	—	—	4.70M_L PAS	—	V	31	13&
1958	09	21	07 24 55	36.350N	121.117W	—	324	—	—	4.60M_L BRK	—	VI	31	—
1958	10	01	21 42 11	39.567N	120.300W	—	324	—	—	4.60M_L BRK	—	VI	31	13
1958	10	10	13 05 16	35.933N	120.500W	—	324	—	—	4.50M_L BRK	—	V	31	9&
1958	12	01	03 21 18.0	32.250N	115.750W	016	292	—	—	5.80M_L PAS	—	VI	31	39#
1958	12	11	09 52 27	37.700N	122.567W	—	324	—	—	4.70M_L BRK	—	VI	31	17&
1959	01	05	12 36 03.3	36.148N	118.025W	003	292	—	—	4.70M_L PAS	4.52TH	V	32	—
1959	03	02	23 27 17	36.983N	121.600W	—	324	—	—	5.30M_L BRK	—	VI	32	27&
1959	04	01	18 18 30	39.717N	120.200W	—	324	—	—	5.60M_L BRK	—	VII	32	85
1959	04	06	06 08 22	39.3 N	123.2 W	—	324	—	—	3.60M_L BRK	—	VI	32	3
1959	05	26	15 58 01	36.717N	121.617W	—	324	—	—	4.60M_L BRK	—	VI	32	12&
1959	06	01	16 35 36.0	32.717N	116.033W	016	292	—	—	4.60M_L PAS	—	—	—	—
1959	06	14	01 26 32	39.667N	120.550W	—	324	—	—	4.50M_L BRK	—	V	32	12
1959	06	18	00 29 40	37.550N	118.567W	—	324	—	—	4.70M_L PAS	—	V	32	8
1959	07	01	23 49 23.4	35.185N	119.100W	009	292	—	—	4.70M_L PAS	4.25TH	V	32	15
1959	07	24	01 23 09	41.133N	125.300W	—	324	—	—	5.80M_L BRK	—	IV	32	—
1959	08	04	07 36 59.0	37.350N	118.550W	016	292	—	—	5.20M_L PAS	4.54TH	V	32	31
1959	10	01	04 35 35	34.455N	120.522W	014	292	—	—	4.50M_L PAS	—	V	259	12&
1959	10	24	15 35 15.3	35.745N	118.023W	007	292	—	—	4.20M_L PAS	—	VI	32	—
1959	10	31	19 42 14	41.3 N	125.5 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1959	12	05	08 13 42	40.300N	125.417W	—	324	—	—	5.10M_L BRK	—	V	32	5&
1959	12	22	02 38 57	40.267N	124.517W	—	324	—	—	4.70M_L BRK	—	V	32	8&
1959	12	29	02 32 53	36.900N	121.483W	—	324	—	—	4.70M_L BRK	—	VI	32	13&
1960	01	20	03 25 53.0	36.783N	121.433W	—	324	—	—	5.00M_L BRK	—	VI	33	28&
1960	06	05	07 47 07.0	37.517N	118.733W	016	292	—	—	5.20M_L PAS	4.90TH	V	259	12
1960	06	06	01 17 45.5	40.84 N	124.91 W	000	480	—	—	5.70M_L BRK	—	VI	33	21&
1960	07	01	22 13 44.6	35.147N	117.132W	008	292	—	—	4.50M_L PAS	—	—	—	—
1960	08	09	07 39 18	40.317N	127.067W	—	324	—	—	6.20M_L BRK	—	V	33	17&
1960	12	27	10 35 26	41.517N	125.050W	—	324	—	—	5.40M_L BRK	—	V	33	—
1960	12	27	11 08 44	41.500N	125.000W	—	324	—	—	4.70M_L BRK	—	—	—	—
1961	01	28	08 12 46.2	35.778N	118.048W	006	292	—	—	5.30M_L PAS	—	VI	34	52
1961	02	02	00 04 16.0	37.450N	118.633W	016	292	—	—	5.30M_L PAS	—	V	34	35
1961	02	02	00 07 42.0	37.417N	118.667W	016	292	—	—	5.10M_L PAS	—	V	34	35
1961	04	06	04 04 45	40.183N	124.750W	—	324	—	—	5.10M_L BRK	—	V	259	9&
1961	04	09	07 23 16	36.683N	121.300W	—	324	—	—	5.60M_L BRK	—	VII	34	35&
1961	04	09	07 25 41.0	36.683N	121.300W	—	324	—	—	5.50M_L BRK	—	VII	38	—
1961	04	29	09 19 30	40.417N	127.450W	—	324	—	—	5.50M_L BRK	—	—	—	—
1961	07	31	00 07 08	35.817N	120.367W	—	324	—	—	4.70M_L BRK	—	V	34	13&
1961	08	23	01 00 47.8	33.050N	116.238W	012	292	—	—	4.70M_L PAS	4.58WYS	V	34	9&
1961	09	12	19 18 45.5	32.567N	115.452W	012	292	—	—	4.80M_L PAS	—	IV	259	10#
1961	10	19	05 09 43.9	35.832N	117.762W	—	292	—	—	5.20M_L PAS	—	VI	34	31
1961	10	20	19 49 50.5	33.653N	117.993W	005	292	—	—	4.30M_L PAS	—	VI	34	3&
1961	11	15	05 38 55.5	34.942N	118.987W	011	292	—	—	5.00M_L PAS	—	VI	34	26&
1962	02	01	06 37 57.0	34.883N	120.683W	016	292	—	—	4.50M_L PAS	—	V	35	8&
1962	03	05	20 57 46	40.3 N	125.5 W	—	324	—	—	4.60M_L BRK	—	IV	259	2&
1962	04	13	15 38 51.9	38.222N	119.455W	006	324	—	—	5.10M_L BRK	—	V	35	19
1962	04	14	07 53 14.7	40.268N	125.310W	—	324	—	—	5.40M_L BRK	—	—	—	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	Felt area
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1962	04	15	08 41 02.3	36.415N	120.617W	021	324	—	—	4.70M_L BRK	—	IV	259	—
1962	04	27	09 12 32.1	33.738N	117.187W	006	292	—	—	4.10M_L PAS	—	VI	35	12
1962	06	06	17 50 07.2	39.116N	123.097W	010	613	—	—	5.20M_L BRK	—	VII	35	19&
1962	07	14	19 43 46.2	40.427N	125.512W	030	324	—	—	5.10M_L BRK	—	V	35	7&
1962	08	23	19 29 14.8	41.84 N	124.39 W	059	480	—	—	5.60M_L BRK	—	VI	35	39&
1962	09	04	17 17 26.0	41.01 N	124.21 W	045	480	—	—	4.90M_L BRK	—	VI	35	18&
1962	09	16	05 36 16.0	35.755N	118.043W	004	292	—	—	4.90M_L PAS	—	V	35	41
1962	10	14	10 14 28.1	38.680N	124.028W	000	324	—	—	4.70M_L BRK	—	III	35	—
1962	10	29	02 42 53.9	34.325N	116.865W	009	292	—	—	4.80M_L PAS	—	VI	35	25&
1963	03	01	00 25 57.9	34.932N	118.975W	014	292	—	—	5.00M_L PAS	—	V	36	21&
1963	05	22	22 41 04.8	37.272N	122.318W	—	324	—	—	4.60M_L BRK	—	VI	36	4&
1963	05	23	09 06 04.7	32.982N	115.565W	025	292	—	—	4.60M_L PAS	4.60WYS	Felt	36	—
1963	05	23	15 53 01.8	33.027N	115.682W	000	292	—	—	4.80M_L PAS	—	VI	36	10#
1963	06	07	12 04 42.2	37.975N	122.048W	—	324	—	—	3.90M_L BRK	—	VI	36	4&
1963	07	08	04 19 08.4	40.800N	125.800W	033	266	4.7	—	4.10M_L BRK	—	—	—	—
1963	07	30	06 34 57.3	34.153N	116.210W	013	292	4.7	—	4.70M_L PAS	—	V	36	—
1963	09	14	19 46 17.0	36.890N	121.597W	003	467	5.4	—	5.40M_L BRK	—	VII	36	13&
1963	09	14	20 28 11.2	36.925N	121.618W	006	467	4.3	—	4.60M_L BRK	—	Felt	36	—
1963	09	23	14 41 52.6	33.710N	116.925W	017	292	5.3	—	5.00M_L PAS	—	VI	36	26#
1963	12	06	08 34 21.5	37.648N	118.397W	002	292	4.4	—	4.70M_L PAS	—	VI	36	26
1964	01	06	23 47 12.8	34.380N	116.475W	012	292	—	—	4.50M_L PAS	—	V	37	12
1964	02	26	20 32 51.4	40.308N	124.892W	—	324	—	—	4.50M_L BRK	—	V	37	3&
1964	03	03	20 02 33	40.3 N	125.3 W	—	324	4.8	—	4.50M_L BRK	—	—	—	—
1964	06	11	22 18 12	40.7 N	127.0 W	—	324	5.4	—	5.50M_L BRK	—	—	—	—
1964	06	21	15 32 51.8	32.692N	117.162W	003	292	—	—	3.70M_L PAS	—	VI	37	5#
1964	11	16	02 46 41.7	37.055N	121.692W	—	324	5.2	—	5.00M_L BRK	—	VII	37	31&
1964	12	22	20 54 33.2	31.810N	117.130W	002	292	—	—	5.60M_L PAS	—	VI	37	23#
1965	01	01	08 04 18.0	34.140N	117.515W	006	292	5.2	—	4.40M_L PAS	—	VI	75	10&
1965	02	12	10 50 18.0	40.3 N	124.9 W	000	324	5.3	—	4.50M_L BRK	—	Felt	75	—
1965	04	15	20 08 33.3	34.132N	117.427W	006	292	5.1	—	4.50M_L PAS	—	VI	75	10&
1965	06	03	16 26 29.0	38.3 N	119.2 W	033	266	4.8	—	4.50M_L PAS	—	V	75	10
1965	06	16	02 42 06.1	33.055N	115.620W	000	292	4.4	—	4.40M_L PAS	—	VI	75	3
1965	07	16	07 46 22.4	34.485N	118.522W	015	292	4.5	—	4.00M_L PAS	—	VI	75	8
1965	08	26	13 38 14.0	33.233N	116.087W	—	292	4.5	—	4.50M_L PAS	—	Felt	75	—
1965	09	10	21 28 34.3	38.010N	121.823W	—	324	4.9	—	4.90M_L BRK	—	VI	75	8&
1965	09	16	04 10 23.4	40.39 N	125.60 W	033	299	5.6	—	5.00M_L PAS	—	IV	75	—
1965	09	19	15 42 07.8	35.987N	120.038W	—	324	4.9	—	4.80M_L BRK	—	V	75	9
1965	09	22	21 49 25.9	37.417N	118.478W	008	292	—	—	4.50M_L PAS	—	IV	75	12
1965	09	25	17 43 44.1	34.713N	116.503W	011	292	5.0	—	5.20M_L PAS	—	VII	75	77
1965	09	25	17 48 02.4	34.713N	116.475W	005	292	—	—	4.90M_L PAS	—	Felt	75	—
1965	09	26	07 00 01.8	34.713N	116.027W	008	292	—	—	5.00M_L PAS	—	V	259	40&
1965	10	17	09 45 19.0	33.975N	116.775W	017	292	4.8	—	4.90M_L PAS	—	VI	75	15
1965	11	12	23 55 09.8	33.980N	118.392W	006	292	3.7	—	3.00M_L PAS	—	VI	75	2&
1966	04	10	22 27 00.9	41.3 N	125.6 W	033	266	5.0	—	4.50M_L BRK	—	—	—	—
1966	05	13	17 25 55.9	36.917N	121.567W	—	324	4.6	—	4.50M_L BRK	3.92BAK	V	81	2&
1966	05	24	03 49 55.1	39.783N	121.770W	020	324	4.5	—	4.60M_L BRK	—	VI	81	31
1966	06	28	04 08 56.2	35.960N	120.505W	—	398	4.9	—	5.10M_L BRK	5.52BAK	Felt	81	—
1966	06	28	04 26 13.4	35.955N	120.498W	—	398	5.3	—	5.60M_L KJ	6.05BAK	VII	81	60&
1966	06	28	04 28 36.0	35.950N	120.500W	000	292	—	—	4.50M_L BRK	—	—	—	—
1966	06	29	19 53 25.9	35.943N	120.525W	—	398	5.0	—	5.00M_L BRK	5.48BAK	IV	81	—
1966	08	07	17 36 27.3	31.7 N	114.5 W	033	266	—	—	6.30M_L PAS	6.27HHT	VI	81	115#
1966	09	12	16 41 02.6	39.438N	120.160W	010	457	5.7	—	6.00M_L BRK	5.90KA	VII	81	175&
1966	09	12	17 20 11	39.42 N	120.15 W	003	324	4.8	—	5.30M_L BRK	—	V	81	—
1966	09	14	22 00 28	39.42 N	120.15 W	003	324	4.3	—	4.60M_L BRK	—	IV	81	—
1966	09	14	22 40 28	39.42 N	120.15 W	003	324	4.5	—	4.60M_L BRK	—	IV	81	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MMI	Ref	(1,000 km^2)
1966	10	02	05 12 34.5	33.968N	118.327W	002	292	3.9	—	3.50M_L PAS	—	VI	81	—
1966	11	26	04 30 58.7	40.3 N	125.4 W	033	266	4.6	—	4.80M_L BRK	—	—	—	—
1966	11	26	05 56 39.6	40.3 N	125.3 W	033	266	4.4	—	4.70M_L BRK	—	—	—	—
1966	12	17	15 16 26.2	40.38 N	125.70 W	000	299	4.7	—	4.50M_L BRK	—	—	—	—
1967	03	02	14 12 48.8	36.503N	117.632W	010	292	4.7	—	4.40M_L PAS	—	V	259	—
1967	05	21	14 42 34.4	33.507N	116.583W	019	292	4.7	—	4.70M_L PAS	—	VI	40	23&
1967	06	15	04 58 05.5	33.997N	117.975W	010	292	4.3	—	4.10M_L PAS	—	VI	40	6&
1967	06	26	15 15 35	39.3 N	123.3 W	002	324	4.2	—	3.50M_L BRK	—	VI	40	4
1967	07	22	09 23 26.6	36.535N	121.163W	—	324	4.0	—	3.80M_L BRK	—	VI	40	—
1967	09	07	12 39 17.2	37.035N	121.777W	008	324	—	—	4.70M_L BRK	4.31BAK	VI	40	17&
1967	09	28	15 38 36.1	37.230N	121.620W	008	324	—	—	4.90M_L BRK	—	VI	40	19&
1967	11	24	13 57 00.4	40.4 N	125.1 W	017	74	4.6	—	—	—	—	—	—
1967	12	10	12 06 50.3	40.5 N	124.6 W	005	74	5.8	—	5.60M_L BRK	—	VI	40	15&
1967	12	10	12 33 54.2	40.5 N	125.0 W	015	74	4.6	—	4.00M_L BRK	—	Felt	40	—
1967	12	18	17 24 32.0	37.010N	121.788W	013	324	5.0	—	5.30M_L BRK	4.64BAK	VI	40	27&
1967	12	30	08 04 39.4	40.51 N	124.43 W	003	299	4.6	—	4.50M_L BRK	—	V	40	—
1968	04	09	02 28 59.1	33.190N	116.128W	011	292	6.1	—	6.40M_L PAS	6.47HK	VII	41	158#
1968	04	09	03 03 53.5	33.113N	116.038W	005	292	5.1	—	5.20M_L PAS	—	III	41	—
1968	04	09	03 48 10.3	33.105N	116.037W	005	292	4.7	—	4.70M_L PAS	—	VI	41	—
1968	04	09	18 31 03.8	33.315N	116.305W	013	292	4.7	—	4.70M_L PAS	—	III	41	—
1968	04	16	03 30 29.9	33.048N	115.987W	008	292	4.4	—	4.80M_L PAS	4.70TH	V	41	—
1968	04	25	19 49 45.2	38.477N	122.725W	008	324	4.6	—	4.60M_L BRK	—	VII	41	13&
1968	04	29	00 21 38.6	39.540N	122.023W	023	324	5.0	—	4.70M_L BRK	—	VI	41	27
1968	05	09	23 27 46.5	41.2 N	125.7 W	033	74	4.7	—	4.40M_L BRK	—	—	—	—
1968	06	03	07 05 55.0	40.4 N	124.8 W	033	74	4.5	—	3.60M_L BRK	—	—	—	—
1968	06	26	01 42 14.6	40.29 N	124.67 W	000	480	5.5	—	5.90M_L BRK	—	VII	41	13&
1968	06	26	10 47 45.0	40.2 N	124.3 W	010	324	5.1	—	4.80M_L BRK	—	IV	41	—
1968	06	29	19 12 20.2	34.3 N	119.7 W	002	74	5.0	—	4.20M_L PAS	—	V	41	—
1968	06	29	19 13 57.0	34.267N	119.567W	010	292	—	—	4.40M_L PAS	—	VI	41	—
1968	07	05	00 45 17.2	34.119N	119.702W	006	292	5.7	—	5.20M_L PAS	—	VI	41	21&
1968	07	07	14 33 30.8	34.177N	119.755W	013	292	4.6	—	4.50M_L PAS	—	IV	41	—
1968	12	17	22 53 51.2	33.045N	115.863W	008	292	4.6	—	4.70M_L PAS	—	IV	259	6#
1969	01	23	23 01 01.0	33.887N	116.040W	018	292	4.9	—	4.80M_L PAS	—	V	42	13
1969	02	07	21 25 48.9	40.343N	124.365W	013	324	5.2	—	4.70M_L BRK	—	VI	42	10&
1969	02	28	04 56 12.4	34.565N	118.113W	005	292	4.6	—	4.30M_L PAS	—	VI	42	12&
1969	04	28	23 20 42.9	33.343N	116.347W	020	292	5.7	—	5.80M_L PAS	5.75THH	VII	42	78#
1969	05	19	14 40 33.0	33.348N	116.188W	009	292	4.5	—	4.50M_L PAS	—	V	42	17#
1969	06	07	11 27 12	40.8 N	125.8 W	003	324	—	—	4.00M_L BRK	—	VI	42	—
1969	06	23	01 21 16.5	41.8 N	125.8 W	033	74	4.7	—	4.00Ukn BRK	—	—	—	—
1969	06	28	04 07 26.7	40.3 N	124.4 W	039	74	4.5	—	3.90M_L BRK	—	V	42	6&
1969	07	01	12 00 45.6	40.300N	124.300W	026	74	4.6	—	3.90M_L BRK	—	V	42	—
1969	10	02	04 56 46.5	38.467N	122.692W	010	399	5.2	4.8	5.60M_L BRK	—	VIII	42	27&
1969	10	02	06 19 57.1	38.455N	122.692W	010	399	5.1	—	5.70M_L BRK	—	VIII	42	27&
1969	10	03	13 10 10.3	37.625N	118.925W	—	292	4.6	—	4.90M_L PAS	—	V	42	—
1969	10	14	13 18 42.8	32.923N	116.272W	010	292	4.5	—	4.50M_L PAS	—	V	42	—
1969	10	22	22 51 32.1	34.77 N	121.35 W	007	299	5.9	5.2	5.40M_L PAS	—	V	42	—
1969	10	23	00 03 34.4	34.90 N	121.30 W	010	74	5.0	—	4.10M_L PAS	—	—	—	—
1969	10	24	08 29 12.1	33.292N	119.193W	010	292	5.1	5.0	5.10M_L PAS	—	V	42	—
1969	10	24	20 26 42.5	33.338N	119.105W	—	292	4.9	—	4.70M_L PAS	—	Felt	42	—
1969	10	27	10 59 42.8	36.790N	121.393W	013	324	4.6	—	4.60M_L BRK	4.16JM	VI	42	10&
1969	10	27	13 16 02.3	33.545N	117.807W	007	292	4.5	—	4.50M_L PAS	—	V	42	12&
1969	10	31	10 39 29.0	33.430N	119.097W	007	292	4.9	—	4.80M_L PAS	—	IV	42	—
1969	11	04	00 40 44.8	34.76 N	121.37 W	010	299	4.9	—	4.50M_L PAS	—	—	—	—
1969	11	05	17 54 10.7	34.72 N	121.28 W	011	299	5.8	5.8	5.60M_L PAS	—	V	42	—
1969	11	05	18 48 45.1	34.65 N	121.31 W	010	299	5.1	—	4.50M_L PAS	—	Felt	42	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1969	11	09	01 27 42.0	34.54 N	121.40 W	010	299	4.7	—	4.10M_L PAS	—	—	—	—
1969	11	10	19 21 27.3	34.6 N	121.5 W	033	74	4.6	—	4.00M_L PAS	—	—	—	—
1970	01	03	02 51 58.4	37.298N	122.088W	—	324	4.0	—	3.70M_L BRK	—	VI	43	3
1970	03	31	07 02 28.6	36.868N	121.418W	008	324	4.2	—	4.70M_L BRK	4.50JM	V	43	12&
1970	06	07	04 12 10.3	40.3 N	125.9 W	033	74	5.0	—	4.70M_L BRK	—	IV	43	—
1970	06	12	03 30 04.0	37.802N	121.933W	009	324	4.6	—	4.30M_L BRK	—	VI	43	3&
1970	06	12	16 03 32.1	37.805N	122.938W	009	324	—	—	4.20M_L BRK	—	VI	43	—
1970	08	04	04 14 21.4	36.647N	122.185W	008	324	4.5	—	4.70M_L BRK	—	VI	43	14&
1970	09	12	14 30 53.0	34.270N	117.540W	008	292	5.4	—	5.40M_L PAS	—	VII	43	65&
1970	09	13	21 10 23.0	40.2 N	125.1 W	033	74	5.4	—	5.40M_L BRK	—	V	43	—
1971	02	09	14 00 41.8	34.412N	118.400W	008	400	6.2	6.5	6.40M_L KJ	6.62HK	XI	44	212#
1971	02	09	14 01 08.0	34.412N	118.400W	008	292	—	—	5.80M_L PAS	—	—	—	—
1971	02	09	14 01 50.0	34.412N	118.400W	008	292	—	—	4.50M_L PAS	—	—	—	—
1971	02	09	14 02 31.0	34.412N	118.400W	008	292	—	—	4.70M_L PAS	—	—	—	—
1971	02	09	14 02 44.0	34.412N	118.400W	008	292	—	—	5.80M_L PAS	—	—	—	—
1971	02	09	14 07 45.0	34.412N	118.400W	008	292	—	—	4.50M_L PAS	—	—	—	—
1971	02	09	14 08 38.0	34.412N	118.400W	008	292	—	—	4.50M_L PAS	—	—	—	—
1971	02	09	14 08 53.0	34.412N	118.400W	008	292	—	—	4.60M_L PAS	—	—	—	—
1971	02	09	14 10 21.5	34.362N	118.307W	005	292	—	—	4.70M_L PAS	4.92TH	—	—	—
1971	02	09	14 10 28.0	34.412N	118.400W	008	292	—	—	5.30M_L PAS	4.60TH	V	44	—
1971	02	09	14 34 36.1	34.343N	118.637W	—	292	—	—	4.90M_L PAS	4.23TH	—	—	—
1971	02	09	14 43 46.7	34.308N	118.453W	006	292	4.7	—	5.20M_L PAS	—	Felt	44	—
1971	02	09	15 58 20.7	34.335N	118.330W	014	292	5.1	—	4.80M_L PAS	—	IV	44	—
1971	02	10	05 18 07.2	34.425N	118.413W	006	292	4.7	—	4.50M_L PAS	—	Felt	44	—
1971	02	21	05 50 52.6	34.397N	118.438W	007	292	—	—	4.70M_L PAS	—	IV	44	—
1971	02	21	07 15 11.8	34.392N	118.427W	007	292	—	—	4.50M_L PAS	—	IV	44	—
1971	02	27	00 31 39.9	40.4 N	124.8 W	033	74	5.3	5.1	5.20M_L BRK	—	V	44	11&
1971	03	07	01 33 40.5	34.353N	118.455W	003	292	4.4	—	4.50M_L PAS	—	IV	44	—
1971	03	09	15 35 16.2	36.800N	122.145W	008	324	4.8	—	4.60M_L BRK	—	V	44	9&
1971	03	31	14 52 22.5	34.285N	118.515W	002	292	4.8	—	4.60M_L PAS	—	VII	44	16&
1971	04	16	12 58 31.7	36.800N	122.183W	008	324	4.8	—	4.50M_L BRK	—	V	44	—
1971	09	12	19 32 38.0	41.298N	123.673W	023	324	4.9	—	4.60M_L BRK	—	V	44	8&
1971	09	30	22 46 11.3	33.033N	115.820W	008	292	4.9	—	5.10M_L PAS	—	VI	44	17#
1971	11	20	13 59 04.3	40.300N	124.400W	025	74	5.0	4.6	4.90M_L BRK	—	V	44	—
1972	01	22	02 57 19.9	37.568N	118.367W	003	324	4.4	—	4.50M_L BRK	—	V	45	—
1972	02	24	15 56 51.3	36.588N	121.197W	008	324	4.9	—	5.10M_L BRK	4.94SOM	VI	45	18&
1972	02	27	22 13 08.6	36.553N	121.093W	008	324	4.5	—	4.70M_L BRK	5.21JM	V	45	—
1972	03	01	09 28 56.7	40.5 N	125.2 W	033	74	5.4	5.9	5.20M_L BRK	—	V	45	—
1972	09	04	18 04 40.9	36.642N	121.263W	005	324	4.9	—	4.70M_L BRK	4.82JM	VI	45	14&
1972	09	23	02 44 05.4	41.7 N	125.5 W	021	74	4.8	5.1	4.90M_L BRK	—	—	—	—
1972	10	03	06 30 02.2	36.800N	121.533W	008	324	4.8	—	4.80M_L BRK	4.87JM	VI	45	9&
1972	11	14	02 10 13.8	40.30 N	124.67 W	023	324	4.9	4.8	4.70M_L BRK	—	V	45	—
1973	02	21	14 45 57.2	34.099N	119.039W	017	458	5.7	5.2	5.90M_L PAS	5.28HK	VII	46	52&
1973	03	12	12 50 12.9	40.343N	124.102W	—	401	4.3	—	4.50M_L BRK	—	V	46	—
1973	06	15	19 18 51.7	41.2 N	125.5 W	033	74	5.2	—	5.00M_L BRK	—	—	—	—
1973	07	14	08 00 20.0	34.436N	116.833W	008	74	—	—	4.80M_L PAS	—	V	46	10
1973	08	06	23 29 16.6	33.970N	119.478W	013	74	4.6	—	5.00M_L PAS	—	V	46	8&
1973	08	09	02 18 24.6	40.228N	124.415W	003	401	5.1	4.7	4.90M_L BRK	—	VI	46	8&
1973	09	13	17 30 39.8	32.952N	116.279W	008	74	4.5	—	4.80M_L PAS	—	V	46	8#
1973	10	03	10 07 27.3	37.190N	121.590W	008	401	4.6	—	4.70M_L BRK	4.16SOM	V	46	9&
1973	10	28	22 00 02.7	32.680N	118.077W	008	74	4.2	—	4.50M_L PAS	—	IV	46	—
1973	11	12	18 17 13.6	37.203N	121.982W	013	401	4.2	—	4.50M_L BRK	—	V	46	9&
1973	12	21	19 12 44.0	40.578N	124.662W	013	401	5.2	4.9	4.80M_L BRK	—	V	46	3&
1974	01	06	13 55 23.0	41.050N	121.483W	001	401	4.5	—	4.20M_L BRK	—	VI	47	3
1974	03	03	11 37 36.8	41.9 N	125.4 W	033	47	5.1	—	4.40M_L BRK	—	—	—	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1974	03	16	15 57 40.7	40.374N	124.714W	023	299	4.7	—	$4.50M_L$ BRK	—	IV	47	—
1974	03	21	21 16 05.3	38.612N	122.663W	001	401	3.8	—	$3.30M_L$ BRK	—	VI	47	—
1974	07	03	05 00 58.6	40.424N	125.136W	012	74	5.4	5.2	$5.10M_L$ BRK	—	V	47	—
1974	09	21	10 37 41.8	33.853N	117.110W	013	402	4.2	—	$3.90M_L$ PAS	—	VI	47	—
1974	11	28	23 01 24.7	36.913N	121.478W	009	401	5.0	4.5	$5.20M_L$ BRK	—	VI	47	18&
1974	12	06	12 13 08.3	32.708N	115.392W	024	402	4.5	—	$4.50M_L$ PAS	—	V	47	—
1975	01	06	11 17 12.3	35.931N	120.534W	010	74	4.5	4.1	$4.50M_L$ PAS	—	V	48	18&
1975	01	12	01 37 08.2	40.328N	124.412W	033	401	4.7	—	$4.50M_L$ BRK	—	VI	48	7&
1975	01	12	21 22 15.0	32.815N	117.974W	008	355	5.1	—	$4.80M_L$ PAS	—	IV	48	—
1975	01	13	11 21 50.2	33.815N	118.076W	007	355	3.8	—	$3.60M_L$ PAS	—	VI	48	2&
1975	01	21	16 47 34.7	32.944N	115.492W	002	355	—	—	$3.30M_L$ PAS	—	VI	48	—
1975	01	23	17 02 30.3	32.949N	115.504W	005	355	4.9	4.6	$4.90M_L$ PAS	—	VI	48	14+
1975	01	23	23 24 34.8	32.993N	115.506W	005	355	4.3	—	$4.10M_L$ PAS	—	VI	48	—
1975	01	28	13 53 16.4	40.415N	125.446W	010	74	4.9	5.0	$4.80M_L$ BRK	—	V	48	—
1975	03	03	15 35 45.0	33.925N	118.302W	012	355	—	—	$3.40M_L$ PAS	—	VI	48	—
1975	05	13	00 21 35.7	35.000N	119.090W	017	355	4.6	—	$4.50M_L$ PAS	—	V	48	20
1975	06	01	01 38 48.8	34.517N	116.490W	001	355	5.1	—	$5.00M_L$ PAS	—	VII	38	—
1975	06	07	08 46 23.2	40.538N	124.287W	022	401	5.4	5.7	$5.30M_L$ BRK	—	VII	48	23&
1975	06	20	05 48 24.0	32.780N	115.433W	004	355	4.3	—	$4.20M_L$ PAS	—	VI	48	—
1975	08	01	16 27 17.8	39.438N	121.537W	005	401	4.8	3.2	$4.70M_L$ BRK	—	IV	48	—
1975	08	01	20 20 04.8	39.439N	121.528W	008	401	4.4	—	$4.50M_L$ BRK	—	—	—	—
1975	08	01	20 20 12.9	39.439N	121.528W	—	401	5.8	5.6	$5.70M_L$ BRK	6.14HBK	VIII	38	120
1975	08	01	20 25	39.439N	121.528W	—	401	—	—	$4.70M_L$ BRK	—	Felt	48	—
1975	08	01	20 29	39.439N	121.528W	—	401	—	—	$4.60M_L$ BRK	—	Felt	48	—
1975	08	02	00 14 07.7	33.513N	116.559W	013	401	4.6	—	$4.80M_L$ PAS	4.49HB	III	48	—
1975	08	02	20 22 16.3	39.445N	121.463W	004	401	5.3	4.5	$5.10M_L$ BRK	—	Felt	48	—
1975	08	02	20 59	39.432N	121.466W	—	401	5.2	4.7	$5.20M_L$ BRK	—	VI	48	—
1975	08	03	01 03 05.8	39.488N	121.518W	008	401	5.0	—	$4.60M_L$ BRK	—	Felt	48	—
1975	08	03	06 35 16.5	36.457N	120.340W	005	401	5.1	4.0	$4.90M_L$ BRK	—	VI	48	18
1975	08	03	06 38	36.457N	120.340W	005	401	4.1	—	$4.50M_L$ BRK	—	—	—	—
1975	08	06	03 50 29.9	39.479N	121.524W	008	401	5.1	4.0	$4.70M_L$ BRK	—	IV	48	—
1975	08	08	07 00 50.1	39.502N	121.512W	008	401	5.0	—	$4.90M_L$ BRK	—	IV	48	—
1975	08	10	05 16 40.5	37.370N	119.985W	007	401	4.0	—	$4.20M_L$ BRK	—	VI	48	26
1975	08	11	06 11 36.3	39.446N	121.481W	004	401	4.8	3.8	$4.30M_L$ BRK	—	V	48	19
1975	08	15	22 27 51.8	36.497N	120.398W	006	401	4.5	—	$4.50M_L$ BRK	—	V	48	—
1975	09	09	02 43 42.5	40.916N	124.397W	027	74	4.9	—	$4.60M_L$ BRK	—	V	48	—
1975	09	13	21 20 59.8	36.000N	120.558W	014	401	4.9	4.3	$4.80M_L$ BRK	—	VI	48	16&
1975	09	27	22 34 38.1	39.511N	121.537W	008	401	5.3	3.5	$4.60M_L$ BRK	—	V	48	—
1975	11	14	09 29 49.4	40.570N	124.436W	022	401	4.9	4.5	$4.80M_L$ BRK	—	VI	48	—
1975	11	15	06 13 27.6	34.305N	116.335W	005	355	4.6	—	$4.60M_L$ BRK	—	IV	48	—
1976	01	01	17 20 12.9	33.966N	117.897W	005	355	4.6	—	$4.30M_L$ PAS	—	VI	49	6&
1976	01	14	21 43 59.3	36.108N	120.162W	005	401	5.1	—	$4.90M_L$ BRK	—	VI	49	34
1976	01	20	13 59 37.2	40.384N	125.336W	033	74	4.8	—	$4.60M_L$ BRK	—	IV	49	—
1976	04	08	15 21 37.9	34.357N	118.669W	017	355	4.7	3.9	$4.50M_L$ PAS	—	VI	49	18
1976	06	20	10 15 24.8	40.427N	120.568W	005	355	4.4	—	$4.50M_L$ BRK	—	V	49	—
1976	08	11	15 24 55.4	33.482N	116.513W	015	355	—	—	$4.30M_L$ PAS	—	VI	49	15
1976	08	20	22 05 53.0	37.787N	121.980W	004	401	—	—	$4.00M_L$ BRK	—	VI	49	—
1976	10	17	05 38 11.3	34.462N	118.426W	016	355	4.3	—	$3.90M_L$ PAS	—	VI	49	8
1976	11	04	10 41 37.5	33.131N	115.623W	001	355	4.6	5.3	$5.10M_L$ PAS	4.93HH	VI	49	25+
1976	11	22	17 55 11.5	33.933N	118.628W	010	355	—	—	$4.20M_L$ PAS	—	VI	49	4&
1976	11	26	11 19 25.2	41.289N	125.709W	015	74	6.0	6.8	$6.30M_L$ BRK	—	V	49	6&
1976	12	23	09 38 58.4	41.783N	125.953W	015	74	5.5	5.5	$5.10M_L$ BRK	—	—	—	—
1977	01	08	09 38 07.5	37.905N	122.183W	009	401	4.8	—	$4.30M_L$ BRK	—	VI	39	7&
1977	02	22	06 24 06.1	38.480N	119.283W	022	355	5.0	—	$4.80M_L$ BRK	—	V	39	22
1977	06	21	02 43 06.6	37.665N	121.670W	011	401	4.7	3.5	$4.40M_L$ BRK	4.14BAK	VI	39	16&

CALIFORNIA—Continued

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Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1977	07	12	01 43 28.5	40.277N	123.692W	020	401	5.0	3.8	4.10M_L BRK	—	V	39	—
1977	07	18	21 49 28.6	40.380N	125.361W	015	74	4.8	3.9	4.70M_L BRK	—	—	—	—
1977	08	12	02 19 26.1	34.380N	118.459W	010	355	4.1	—	4.50M_L PAS	—	VI	39	7&
1977	10	21	06 12 36.0	32.896N	115.505W	005	355	3.7	—	4.10M_L PAS	—	VI	39	—
1977	11	14	02 05 48.3	32.830N	115.478W	004	355	5.0	—	4.10M_L PAS	—	VI	39	—
1977	11	22	21 15 53.9	39.403N	123.273W	018	401	5.2	—	4.80M_L BRK	—	VII	39	15&
1978	03	26	00 27 04.4	39.233N	123.233W	010	613	4.9	—	4.50M_L BRK	—	VI	240	8&
1978	05	23	21 42 02.9	40.438N	124.850W	020	401	4.4	—	4.60M_L BRK	—	IV	240	—
1978	08	01	09 02 34.5	41.453N	121.875W	002	401	4.5	—	4.60M_L BRK	—	V	240	—
1978	08	01	09 46 44.6	41.457N	121.870W	002	401	4.3	5.1	4.50M_L BRK	—	Felt	401	—
1978	08	13	22 54 52.8	34.397N	119.682W	013	468	5.5	5.6	5.10M_L PAS	5.79ED	VII	240	25&
1978	08	29	00 14 46.4	37.362N	121.737W	008	401	—	—	4.10M_L BRK	—	VI	240	13&
1978	09	04	04 52 32.3	38.818N	119.810W	018	401	3.9	—	4.60M_L BRK	—	V	240	16
1978	09	04	21 54 53.2	38.813N	119.815W	019	401	4.7	—	5.30M_L BRK	—	VI	240	45
1978	09	25	02 10 51.0	41.062N	125.380W	005	401	4.6	4.3	4.60M_L BRK	—	—	—	—
1978	10	04	16 42 48.6	37.510N	118.693W	005	355	5.4	5.1	5.70M_L PAS	5.45ED	VI	240	105
1978	10	04	17 39 03.4	37.535N	118.683W	007	355	5.0	—	5.30M_L PAS	—	—	—	—
1978	10	05	06 41 30.2	37.485N	118.664W	011	355	—	—	4.50M_L PAS	—	Felt	355	—
1978	10	06	21 26 34.4	40.375N	124.273W	020	401	4.8	4.2	4.60M_L BRK	—	V	240	—
1978	11	20	06 55 09.1	34.156N	116.978W	015	355	4.0	—	4.30M_L PAS	—	VI	240	12&
1979	01	01	23 14 38.9	33.948N	118.688W	010	474	5.1	4.7	4.80M_L PAS	—	VI	262	21&
1979	01	24	21 14 27.2	37.520N	118.593W	010	401	—	—	4.60M_L BRK	—	IV	262	28
1979	02	03	09 58 16.0	40.923N	124.418W	022	401	5.2	4.6	5.20M_L BRK	—	VII	262	11&
1979	02	22	15 57 28.8	40.000N	120.088W	005	401	5.0	4.6	5.30M_L BRK	—	VI	262	46
1979	03	15	20 17 49.3	34.305N	116.439W	000	355	5.0	4.9	5.00M_L PAS	—	Felt	262	—
1979	03	15	21 07 16.5	34.325N	116.444W	001	355	5.5	5.6	5.30M_L PAS	5.52ED	VII	262	77
1979	03	15	21 34 25.5	34.347N	116.448W	000	355	—	—	4.50M_L PAS	—	Felt	262	—
1979	03	15	23 07 58.0	34.336N	116.440W	002	355	4.5	4.4	4.90M_L PAS	—	Felt	262	—
1979	04	07	06 18 33.0	41.987N	126.816W	015	74	5.5	5.3	5.00M_L BRK	5.62ED	—	—	—
1979	05	08	05 11 07.7	37.303N	121.683W	006	401	4.3	4.0	4.80M_L BRK	—	VI	262	10&
1979	06	14	07 39 28.3	35.729N	118.023W	005	355	4.2	—	4.60M_L PAS	—	VI	262	4
1979	06	29	05 53 20.3	34.246N	116.898W	009	472	4.1	—	4.60M_L WK	—	VI	262	13
1979	06	30	00 34 11.5	34.245N	116.891W	010	472	4.6	—	4.90M_L WK	—	VI	262	20
1979	06	30	07 03 52.8	34.249N	116.896W	010	472	4.0	—	4.50M_L WK	—	Felt	262	—
1979	08	06	17 05 22.7	37.102N	121.503W	006	401	5.4	5.7	5.90M_L BRK	5.78ED	VII	262	63&
1979	10	07	20 54 41.4	38.223N	119.355W	009	355	4.1	—	5.00M_L BRK	—	IV	262	15
1979	10	08	03 34 24.0	38.205N	119.323W	009	355	—	—	4.60M_L BRK	—	Felt	262	—
1979	10	15	23 16 54.1	32.634N	115.324W	010	355	5.7	6.9	6.40M_L PAS	6.49ED	IX	262	128#
1979	10	15	23 19 28.7	32.748N	115.586W	005	355	—	—	5.00M_L PAS	5.03FRK	—	—	—
1979	10	16	01 00 14.0	32.877N	115.556W	005	355	4.3	—	4.70M_L PAS	—	—	—	—
1979	10	16	03 10 47.8	32.951N	115.535W	004	355	4.5	—	4.60M_L PAS	—	—	—	—
1979	10	16	03 39 35.0	32.949N	115.550W	005	355	4.4	—	4.60M_L PAS	—	—	—	—
1979	10	16	05 49 11.0	32.941N	115.538W	005	355	4.9	—	5.10M_L PAS	—	—	—	—
1979	10	16	06 19 49.2	32.937N	115.532W	002	355	4.8	5.4	5.10M_L PAS	5.16ED	—	—	—
1979	10	16	06 55 23.5	32.988N	115.541W	004	355	4.3	—	4.70M_L PAS	—	—	—	—
1979	10	16	06 58 43.2	32.999N	115.569W	001	355	5.2	5.7	5.50M_L PAS	4.96ED	VI	262	—
1979	10	16	11 46 56.1	32.913N	115.560W	005	355	4.5	—	4.80M_L PAS	—	—	—	—
1979	10	16	23 16 32.2	33.022N	115.506W	003	355	5.4	4.8	5.00M_L PAS	—	—	—	—
1979	10	17	22 45 33.8	33.040N	115.503W	002	355	4.8	—	4.70M_L PAS	—	Felt	262	—
1979	10	24	15 23 50.6	40.428N	124.703W	024	401	4.8	—	4.50M_L BRK	—	IV	262	—
1979	11	08	04 30 27.9	40.323N	125.173W	005	401	4.7	3.7	4.50M_L BRK	—	—	—	—
1979	12	21	20 40 23.4	32.483N	115.194W	005	355	4.5	—	4.80M_L PAS	—	VI	262	10+
1980	01	24	19 00 09.5	37.855N	121.816W	012	466	5.3	5.9	5.80M_L BRK	5.77BMU	VII	300	75&

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1980	01	24	19 01 02.2	37.837N	121.802W	011	466	—	—	$5.10M_L$ BRK	—	Felt	300	—
1980	01	24	19 03 20.0	37.837N	121.849W	018	466	—	—	$4.80M_L$ BRK	—	Felt	300	—
1980	01	25	05 24 36.5	37.884N	121.833W	008	466	4.2	—	$4.60M_L$ BRK	4.12BAK	IV	300	—
1980	01	27	02 33 36.0	37.737N	121.740W	015	466	5.0	5.0	$5.40M_L$ BRK	5.36BMU	VII	300	25&
1980	02	25	10 47 38.5	33.496N	116.513W	015	355	5.1	4.7	$5.50M_L$ PAS	4.88FRK	VI	300	46#
1980	03	03	14 17 01.0	40.450N	125.267W	005	401	5.0	5.2	$5.10M_L$ BRK	—	IV	300	—
1980	04	13	06 15 56.3	36.772N	121.520W	007	401	4.5	—	$4.70M_L$ BRK	—	V	300	20&
1980	05	25	16 33 44.2	37.590N	118.847W	008	401	6.1	6.1	$6.10M_L$ BRK	6.21ED	VII	300	272
1980	05	25	16 49 26.2	37.622N	118.902W	001	401	5.5	—	$6.00M_L$ BRK	—	Felt	300	—
1980	05	25	17 06 24.4	37.533N	118.930W	005	401	—	—	$4.60M_L$ BRK	—	Felt	300	—
1980	05	25	17 08 28.3	37.593N	118.847W	016	401	4.2	—	$4.70M_L$ BRK	—	Felt	300	—
1980	05	25	17 48 30.0	37.593N	118.893W	004	401	3.9	—	$4.60M_L$ BRK	—	Felt	300	—
1980	05	25	18 34 14.4	37.542N	118.907W	004	401	4.1	—	$4.60M_L$ BRK	—	Felt	300	—
1980	05	25	19 04 33.9	37.542N	118.900W	005	401	—	—	$4.50M_L$ BRK	—	Felt	300	—
1980	05	25	19 44 51.0	37.545N	118.842W	013	401	5.5	5.8	$6.10M_L$ BRK	5.90ED	VII	300	224
1980	05	25	20 23 25.5	37.617N	118.887W	005	401	—	—	$4.50M_L$ BRK	—	Felt	300	—
1980	05	25	20 35 48.0	37.607N	118.858W	005	401	5.2	5.3	$5.70M_L$ BRK	—	Felt	300	—
1980	05	25	20 38 38.5	37.632N	118.858W	005	401	—	—	$4.50M_L$ BRK	—	Felt	300	—
1980	05	25	20 59 22.6	37.568N	118.818W	008	401	4.2	—	$5.00M_L$ BRK	—	Felt	300	—
1980	05	26	00 57 02.3	37.572N	118.943W	001	401	4.2	—	$4.50M_L$ BRK	—	Felt	300	—
1980	05	26	01 19 02.2	37.573N	118.948W	007	401	4.4	—	$4.60M_L$ BRK	—	Felt	300	—
1980	05	26	05 56 26.3	37.568N	118.897W	007	401	4.0	—	$4.70M_L$ BRK	—	Felt	300	—
1980	05	26	10 20 31.1	37.605N	118.810W	008	401	4.0	—	$4.50M_L$ BRK	—	Felt	300	—
1980	05	26	12 24 25.1	37.567N	118.883W	007	401	4.7	—	$5.10M_L$ BRK	—	IV	300	—
1980	05	26	14 37 30.8	37.537N	118.882W	008	401	4.1	—	$4.50M_L$ BRK	—	Felt	300	—
1980	05	26	16 20 21.6	37.547N	118.912W	005	401	4.7	—	$4.80M_L$ BRK	—	Felt	300	—
1980	05	26	18 57 55.9	37.542N	118.890W	008	401	5.0	—	$5.70M_L$ BRK	—	Felt	300	—
1980	05	26	19 24 09.4	37.513N	118.878W	007	401	—	—	$4.70M_L$ BRK	—	Felt	300	—
1980	05	27	14 50 56.6	37.492N	118.830W	016	401	5.7	6.0	$6.20M_L$ BRK	5.86ED	VI	300	240
1980	05	27	19 01 07.9	37.592N	118.787W	006	401	4.3	—	$4.80M_L$ BRK	4.54ARC	Felt	300	—
1980	05	28	05 16 23.0	37.573N	118.900W	004	401	4.1	—	$4.90M_L$ BRK	4.61ARC	Felt	300	—
1980	05	28	05 48 29.5	37.618N	118.873W	006	401	4.0	—	$4.60M_L$ BRK	—	Felt	300	—
1980	05	29	03 38 48.5	34.975N	120.714W	006	355	—	—	$4.60M_L$ PAS	—	V	300	27&
1980	05	31	00 58 17.3	37.492N	118.860W	009	401	4.1	—	$4.50M_L$ BRK	4.36ARC	Felt	300	—
1980	05	31	15 16 11.4	37.598N	118.792W	008	401	4.1	—	$4.90M_L$ BRK	4.71ARC	IV	300	—
1980	06	01	06 47 36.0	37.468N	118.853W	008	401	3.7	—	$4.70M_L$ BRK	—	Felt	300	—
1980	06	11	04 40 58.5	37.542N	118.892W	008	401	3.9	—	$4.70M_L$ BRK	3.99ARC	V	300	—
1980	06	29	07 46 13.5	38.005N	118.688W	005	401	4.2	—	$5.00M_L$ BRK	—	VI	300	—
1980	08	01	16 38 55.9	37.548N	118.893W	008	401	4.7	5.0	$5.40M_L$ BRK	—	V	300	40
1980	08	01	16 48 54.6	37.547N	118.883W	013	401	4.2	—	$4.60M_L$ BRK	—	—	—	—
1980	09	24	08 08 38.6	36.243N	120.165W	008	401	4.8	—	$4.50M_L$ BRK	—	V	300	—
1980	10	31	12 55 36.6	32.660N	115.579W	003	355	4.2	—	$4.60M_L$ PAS	—	VI	300	5+
1980	11	08	10 27 34.0	41.117N	124.253W	019	74	6.2	7.2	$6.90M_L$ BRK	7.24ED	VII	300	97&
1980	11	08	10 47 32.9	40.357N	125.205W	015	74	4.8	—	$4.80M_L$ BRK	—	—	—	—
1980	11	08	10 51 18.4	40.269N	125.441W	015	74	4.7	—	$4.80M_L$ BRK	—	—	—	—
1980	11	08	11 20 38.7	40.247N	124.742W	015	74	5.0	—	$4.70M_L$ BRK	—	—	—	—
1980	11	08	16 52 29.0	40.425N	125.459W	015	74	4.4	4.3	$4.90M_L$ BRK	—	Felt	300	—
1980	11	08	17 14 40.0	40.450N	125.602W	008	401	4.3	—	$4.50M_L$ BRK	—	Felt	300	—
1980	11	08	22 47 52.8	40.648N	125.262W	021	401	4.6	4.2	$5.00M_L$ BRK	—	Felt	300	—
1980	11	08	23 07 06.3	40.448N	125.682W	008	401	4.6	5.0	$4.80M_L$ BRK	—	Felt	300	—
1980	11	09	04 09 08.8	40.501N	125.343W	015	74	5.0	4.3	$5.40M_L$ BRK	—	—	—	—
1980	11	10	23 59 27.1	40.562N	125.669W	013	74	4.8	3.1	$4.80M_L$ BRK	—	Felt	300	—

CALIFORNIA—Continued

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Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1980	11	28	18 21 12.9	39.262N	120.467W	010	401	4.9	—	5.10M_L BRK	—	VI	300	36
1980	12	24	15 48 33.6	37.577N	118.867W	016	401	4.2	—	4.70M_L BRK	—	V	300	—
1981	01	07	11 42 33.1	36.857N	121.623W	007	401	4.3	—	4.50M_L BRK	—	V	325	17&
1981	01	15	12 47 51.6	37.378N	121.723W	009	401	4.8	4.0	4.80M_L BRK	—	V	325	19
1981	03	03	10 45 12.9	37.557N	121.937W	010	401	4.2	4.0	4.40M_L BRK	—	VI	325	5&
1981	03	15	06 07 45.9	40.393N	125.160W	008	401	4.5	4.5	4.70M_L BRK	—	III	325	—
1981	04	19	09 02 50.4	35.851N	117.842W	003	355	4.4	—	4.50M_L PAS	—	V	325	—
1981	04	26	12 09 28.4	33.098N	115.618W	002	355	5.5	6.0	5.60M_L PAS	5.91ED	VII	325	73#
1981	05	26	11 41 10.2	40.380N	124.353W	021	401	4.3	—	4.60M_L BRK	—	IV	325	—
1981	07	02	08 10 54.0	41.103N	124.218W	024	74	4.4	3.5	4.50M_L BRK	—	V	325	—
1981	07	17	16 37 32.6	40.20 N	124.25 W	013	401	4.9	4.1	4.60M_L BRK	—	VI	325	8&
1981	09	04	15 50 50.4	33.661N	119.091W	005	355	5.4	5.9	5.30M_L BRK	5.85ED	VI	325	33&
1981	09	16	12 41 14.2	40.31 N	124.61 W	025	401	4.8	3.9	4.70M_L BRK	—	V	325	8&
1981	09	30	11 53 26.9	37.588N	118.887W	005	355	5.6	5.8	6.00M_L PAS	5.64ED	VI	325	92
1981	09	30	13 05 48.4	37.648N	118.865W	005	355	4.7	—	5.30M_L PAS	—	V	325	92
1981	10	23	17 28 16.8	33.626N	119.019W	014	355	4.7	—	4.60M_L PAS	—	V	325	6&
1981	10	23	19 15 52.3	33.619N	119.015W	012	355	4.6	—	4.60M_L PAS	—	IV	325	6&
1981	11	10	22 34 35.4	35.024N	119.138W	002	355	4.7	—	4.80M_L PAS	—	V	325	24&
1982	01	13	12 26 25.8	40.419N	125.101W	010	74	4.9	5.1	4.80M_L BRK	—	Felt	350	—
1982	02	06	12 02 03.6	41.003N	125.008W	004	401	5.1	5.1	5.20M_L BRK	—	IV	350	—
1982	03	07	20 51 00.3	35.740N	117.763W	005	355	4.7	—	4.70M_L PAS	—	V	350	—
1982	03	22	08 53 28.6	33.058N	116.211W	005	355	4.4	—	4.50M_L PAS	—	IV	350	—
1982	06	15	23 49 21.3	33.558N	116.660W	012	355	4.5	—	4.90M_L PAS	4.64FRK	V	350	26
1982	08	10	02 11 29.8	36.592N	121.242W	007	401	3.9	—	4.50M_L BRK	—	IV	350	—
1982	08	11	07 46 43.2	36.630N	121.305W	009	401	4.6	—	4.60M_L BRK	—	V	350	—
1982	08	18	08 43 49.8	37.017N	121.733W	011	401	4.3	—	4.50M_L BRK	—	V	350	9&
1982	10	01	14 29 02.5	35.731N	117.751W	009	355	4.9	—	4.90M_L PAS	—	VI	350	29
1982	10	25	22 26 04.3	36.325N	120.502W	011	401	5.3	5.2	5.40M_L PAS	4.79ED	VI	350	93&
1982	12	16	06 53 01.3	40.498N	124.257W	018	401	4.8	4.5	4.40M_L BRK	—	VI	350	8&
1983	01	07	01 38 10.9	37.640N	118.898W	007	401	5.1	5.0	5.40M_L BRK	—	VI	360	76
1983	01	07	03 24 19.4	37.635N	118.988W	007	401	5.1	5.0	5.30M_L BRK	—	VI	360	59
1983	01	25	10 10 41.2	37.505N	118.900W	002	401	4.4	—	4.80M_L BRK	—	Felt	360	—
1983	05	02	23 42 38.1	36.233N	120.309W	010	360	6.2	6.5	6.70M_L BRK	6.19GS	VIII	360	205&
1983	05	02	23 46 06.0	36.225N	120.295W	008	401	5.5	—	5.60M_L BRK	—	—	—	—
1983	05	03	00 17 59.0	36.210N	120.326W	008	360	4.8	—	4.40M_L BRK	4.60BRK	Felt	360	—
1983	05	03	00 57 44.2	36.270N	120.315W	008	360	5.1	—	4.80M_L BRK	4.87BRK	Felt	360	—
1983	05	03	01 41 46.0	36.142N	120.219W	007	360	4.3	—	4.54M_L BRK	4.34BRK	Felt	360	—
1983	05	03	08 55 02.0	36.144N	120.267W	010	360	4.4	—	4.50M_L BRK	4.40BRK	Felt	360	—
1983	05	03	15 41 41.6	36.235N	120.302W	008	360	4.7	—	4.80M_L BRK	4.84BRK	Felt	360	—
1983	05	04	07 28 40.4	36.263N	120.335W	005	360	4.7	4.6	4.70M_L BRK	4.69BRK	Felt	360	—
1983	05	05	10 20 44.1	36.285N	120.368W	011	360	4.5	—	4.61M_L BRK	4.46BRK	—	—	—
1983	05	09	02 49 11.5	36.246N	120.299W	012	360	5.1	4.7	5.20M_L BRK	4.49BRK	VI	360	110&
1983	05	09	03 26 37.4	36.240N	120.299W	012	360	4.7	—	4.60M_L GM	—	Felt	360	—
1983	05	12	13 41 06.8	36.167N	120.268W	011	360	4.2	—	4.50M_L BRK	—	Felt	360	—
1983	05	24	09 02 17.7	36.254N	120.333W	009	360	4.6	—	4.60M_L BRK	4.60BRK	V	360	23
1983	05	29	06 55 33.1	40.457N	125.444W	010	74	5.1	5.1	5.40M_L BRK	—	III	360	—
1983	06	11	03 09 52.2	36.255N	120.450W	002	360	5.3	5.4	5.10M_L BRK	5.28BRK	VI	360	—
1983	06	29	08 08 35.7	32.588N	117.431W	006	355	4.4	—	4.60M_L PAS	—	V	360	19#
1983	07	03	18 40 08.2	37.550N	118.862W	009	401	4.8	—	5.30M_L BRK	5.03BRK	V	360	39
1983	07	05	14 27 26.7	38.070N	119.018W	010	401	4.6	—	4.80M_L BRK	—	V	360	—
1983	07	09	07 40 51.3	36.251N	120.400W	009	360	5.3	4.9	5.30M_L BRK	5.15BRK	V	360	59
1983	07	13	21 16 48.5	33.208N	115.530W	012	360	4.3	—	4.10M_L PAS	—	VI	360	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1983	07	22	02 39 54.1	36.241N	120.409W	007	360	6.0	5.7	6.00M_L BRK	5.90BRK	VI	360	108&
1983	07	22	03 43 01.4	36.222N	120.406W	008	360	5.3	—	5.00M_L BRK	4.88BRK	V	360	—
1983	07	25	22 31 39.6	36.229N	120.398W	008	360	5.6	5.1	5.30M_L BRK	5.16BRK	VI	360	60&
1983	08	24	13 36 30.5	40.377N	124.832W	018	401	5.5	5.8	5.50M_L BRK	5.61BRK	VI	360	10&
1983	08	29	10 10 30.9	35.836N	121.345W	007	476	5.3	4.3	5.20M_L BRK	5.31BRK	VI	360	21&
1983	09	09	09 16 13.5	36.232N	120.265W	007	360	5.3	5.4	5.40M_L BRK	5.28BRK	V	360	—
1983	09	11	11 48 06.6	36.242N	120.383W	010	360	5.0	—	4.70M_L PAS	4.48BRK	IV	360	—
1983	09	30	16 14 00.9	37.553N	118.840W	010	401	—	—	4.80M_L BRK	4.49BRK	IV	360	—
1983	10	21	22 44 13.3	35.926N	118.334W	000	355	4.4	—	4.50M_L PAS	—	III	360	—
1983	11	11	12 07 43.8	40.388N	124.902W	015	401	4.9	3.8	4.30M_L BRK	—	Felt	360	—
1983	12	20	10 41 05.0	40.331N	125.117W	005	299	5.6	5.4	5.60M_L BRK	5.90ED	V	360	—
1984	01	23	05 40 20.3	36.392N	121.878W	008	401	5.1	4.6	5.10M_L BRK	4.98BRK	V	370	32&
1984	01	23	06 59 51.3	36.388N	121.872W	008	401	—	—	4.50M_L BRK	4.28BRK	Felt	370	—
1984	02	27	01 36 20.6	37.375N	118.598W	010	401	4.3	—	4.50M_L BRK	—	III	370	—
1984	02	28	15 16 06.7	40.357N	125.897W	005	401	4.9	4.4	5.20M_L BRK	—	IV	370	—
1984	04	24	21 15 19.0	37.320N	121.698W	008	401	5.7	6.1	6.20M_L BRK	6.16GS	VIII	370	120&
1984	04	28	22 48 21.0	37.622N	118.897W	003	401	4.3	—	4.80M_L PAS	—	IV	370	—
1984	08	04	21 45 53.2	40.255N	124.578W	005	401	4.7	4.6	4.70M_L BRK	5.36GS	V	370	—
1984	09	10	03 14 10.1	40.503N	126.831W	010	74	6.1	6.7	6.60M_L BRK	6.67GS	V	370	24&
1984	09	20	18 30 42.5	40.382N	125.617W	005	401	4.7	—	4.80M_L BRK	—	IV	370	—
1984	10	10	21 22 58.9	33.138N	116.501W	012	370	4.3	—	4.50M_L PAS	—	IV	370	—
1984	10	25	10 36 02.4	34.737N	120.148W	006	370	4.5	—	4.50M_L PAS	—	VI	370	10&
1984	10	26	17 20 43.5	34.016N	118.988W	013	370	4.3	—	4.60M_L PAS	—	V	370	10&
1984	11	23	18 08 25.5	37.458N	118.605W	012	401	5.6	5.7	6.10M_L BRK	5.80GS	V	370	114
1984	11	23	19 12 34.6	37.433N	118.612W	014	370	4.8	4.7	5.50M_L BRK	—	IV	370	—
1984	11	25	23 10 09.4	37.447N	118.612W	005	401	4.3	3.1	4.70M_L BRK	—	Felt	370	—
1984	11	26	16 21 47.2	37.448N	118.653W	009	401	5.1	4.7	5.60M_L BRK	5.14GS	V	370	88
1984	11	26	16 31 21.4	37.422N	118.635W	010	401	—	—	4.50M_L BRK	—	—	—	—
1984	11	28	16 23 26.1	37.425N	118.630W	008	401	4.3	—	4.70M_L BRK	—	Felt	370	—
1984	11	28	16 57 37.9	37.463N	118.582W	005	401	4.2	—	4.60M_L BRK	—	—	—	—
1985	01	24	11 27 21.6	38.157N	118.853W	008	401	—	—	5.20M_L BRK	4.82BRK	IV	371	25
1985	02	08	06 58 16.9	35.452N	118.898W	011	371	4.6	—	4.60M_L PAS	—	V	371	15
1985	03	25	16 05 13.6	37.448N	118.545W	006	371	4.8	—	5.00M_L PAS	4.49BRK	V	371	15
1985	05	04	03 22 46.2	37.469N	118.598W	006	371	3.7	—	4.70M_L PAS	—	IV	371	—
1985	08	04	11 29 16.2	36.122N	120.138W	011	401	4.7	—	4.70M_L BRK	4.64BRK	IV	371	—
1985	08	04	12 01 57.0	36.130N	120.127W	011	401	5.4	5.9	5.60M_L BRK	6.09GS	VI	371	97&
1985	08	22	00 21 44.1	35.883N	117.717W	006	371	4.3	—	4.50M_L GP	—	IV	371	—
1985	08	27	03 04 06.8	37.412N	118.633W	006	401	—	—	4.50M_L BRK	4.14BRK	III	371	—
1985	10	02	23 44 12.4	34.023N	117.245W	015	371	4.1	—	4.80M_L PAS	—	VI	371	13
1985	11	28	15 13 57.2	36.562N	121.060W	010	401	4.4	4.4	4.60M_L BRK	4.61BRK	IV	371	15&
1986	01	14	03 09 36.3	36.572N	121.205W	007	562	5.0	—	4.80M_L BRK	4.59BRK	IV	562	8&
1986	01	26	19 20 51.2	36.810N	121.275W	007	562	5.3	5.3	5.50M_L BRK	5.48BRK	VII	562	36&
1986	02	11	01 15 57.2	41.634N	125.353W	010	562	5.0	5.0	4.90M_L BRK	5.31BRK	—	—	—
1986	03	31	11 55 40.1	37.488N	121.693W	008	562	5.5	5.5	5.70M_L BRK	5.56BRK	VI	562	41&
1986	05	31	08 47 56.1	36.618N	121.255W	004	562	4.6	3.7	4.70M_L BRK	4.55BRK	IV	562	—
1986	07	08	09 20 44.5	33.999N	116.606W	012	597	5.8	6.0	5.60M_L GP	6.19GS	VII	562	134#
1986	07	13	13 47 08.2	32.970N	117.869W	006	597	5.6	5.8	5.30M_L GP	5.83HAV	VI	562	49#
1986	07	13	14 01 33.0	32.989N	117.849W	012	597	4.8	—	4.60M_L GP	—	—	—	—
1986	07	20	14 29 45.5	37.580N	118.449W	006	597	5.6	5.6	5.90M_L BRK	5.38BRK	V	562	—
1986	07	20	18 38 52.9	37.538N	118.440W	009	562	3.9	—	4.70M_L BRK	4.30BRK	IV	562	—
1986	07	21	14 42 26.5	37.537N	118.450W	009	562	6.0	6.2	6.40M_L BRK	6.25BRK	VI	562	258
1986	07	21	14 45 21.0	37.583N	118.417W	006	562	—	—	4.60M_L PAS	—	—	—	—
1986	07	21	14 51 10.1	37.570N	118.525W	001	562	5.1	—	5.70M_L BRK	5.04BRK	V	562	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1986	07	21	14 53 58.1	37.583N	118.583W	006	562	—	—	4.90M_L PAS	—	—	—	—
1986	07	21	14 54 39.2	37.583N	118.417W	006	562	—	—	4.50M_L PAS	—	—	—	—
1986	07	21	14 57 50.9	37.527N	118.357W	007	562	4.7	—	4.80M_L BRK	4.46BRK	—	—	—
1986	07	21	15 11 30.8	37.597N	118.485W	006	597	—	—	4.70M_L PAS	—	—	—	—
1986	07	21	15 19 34.9	37.488N	118.370W	016	562	—	—	4.70M_L BRK	4.38BRK	—	—	—
1986	07	21	15 26 49.2	37.533N	118.425W	018	562	—	—	4.60M_L BRK	4.18BRK	—	—	—
1986	07	21	15 46 23.0	37.551N	118.420W	001	562	—	—	4.50M_L BRK	4.12BRK	—	—	—
1986	07	21	16 26 44.7	37.487N	118.393W	008	562	—	—	4.60M_L BRK	4.18BRK	—	—	—
1986	07	21	17 05 33.4	37.532N	118.462W	009	562	3.6	—	4.50M_L BRK	4.18BRK	—	—	—
1986	07	21	17 20 00.4	37.447N	118.367W	011	562	—	—	4.50M_L BRK	4.10BRK	—	—	—
1986	07	21	22 07 17.0	37.483N	118.367W	006	562	5.5	5.0	5.60M_L BRK	5.03BRK	Felt	562	—
1986	07	21	22 09 22.1	37.613N	118.569W	006	562	—	—	4.70M_L PAS	—	—	—	—
1986	07	22	00 09 53.8	37.610N	118.430W	004	562	4.0	—	4.50M_L BRK	4.27BRK	—	—	—
1986	07	22	13 33 59.8	37.517N	118.477W	009	562	4.2	—	4.70M_L BRK	4.41BRK	IV	562	—
1986	07	22	13 49 00.3	37.498N	118.520W	019	562	4.5	—	5.00M_L BRK	4.58BRK	—	—	—
1986	07	22	18 29 43.8	37.493N	118.382W	007	562	3.7	—	4.70M_L BRK	4.15BRK	—	—	—
1986	07	23	15 39 11.7	37.538N	118.463W	006	562	4.1	—	4.70M_L BRK	4.40BRK	—	—	—
1986	07	29	09 57 57.2	37.595N	118.477W	007	562	3.7	—	4.60M_L BRK	4.34BRK	IV	562	—
1986	07	30	06 41 52.9	37.582N	118.468W	007	562	4.1	—	4.80M_L BRK	4.42BRK	IV	562	—
1986	07	31	07 22 40.2	37.463N	118.367W	007	562	5.5	5.2	5.80M_L BRK	5.42BRK	VI	562	100
1986	07	31	07 28 04.7	37.445N	118.377W	011	562	—	—	4.50M_L BRK	4.12BRK	—	—	—
1986	08	01	14 27 16.4	37.501N	118.398W	006	562	4.2	—	4.80M_L BRK	—	Felt	562	—
1986	08	01	14 28 19.6	37.468N	118.448W	014	562	4.9	—	5.10M_L BRK	4.83BRK	Felt	562	—
1986	10	15	02 28 47.8	33.953N	116.572W	009	562	4.3	—	4.70M_L GP	—	V	562	—
1986	10	31	03 57 28.9	38.420N	119.323W	001	562	—	—	4.60M_L BRK	4.40BRK	IV	562	—
1986	11	21	23 33 01.7	40.372N	124.443W	015	562	5.3	5.1	5.10M_L BRK	5.14BRK	VII	562	14&
1986	11	21	23 34 18.0	40.367N	124.450W	015	562	5.1	—	5.10M_L BRK	5.06BRK	Felt	562	—
1987	02	14	07 26 51.7	36.148N	120.335W	013	74	5.3	4.6	5.30M_L BRK	4.95BRK	V	577	—
1987	07	31	23 56 58.3	40.418N	124.373W	016	74	5.6	6.0	5.60M_L BRK	5.55BRK	VI	577	18&
1987	10	01	14 42 20.0	34.061N	118.078W	010	598	5.8	5.7	5.90M_L PAS	5.91HAV	VIII	581	110&
1987	10	01	14 45 41.4	34.049N	118.100W	014	598	—	—	4.70M_L GP	—	Felt	74	—
1987	10	01	14 49 05.9	34.060N	118.100W	012	598	—	—	4.70M_L PAS	—	Felt	74	—
1987	10	01	15 12 31.7	34.052N	118.090W	011	598	4.6	—	4.70M_L GP	—	Felt	74	—
1987	10	04	10 59 38.2	34.074N	118.098W	008	598	5.2	4.8	5.30M_L PAS	5.22HAV	VII	577	—
1987	11	24	01 54 14.5	33.082N	115.775W	005	598	5.7	6.2	5.80M_L PAS	6.05HAV	VI	577	77#
1987	11	24	02 14 35.4	33.036N	115.820W	005	598	—	—	4.50M_L PAS	—	—	—	—
1987	11	24	02 15 23.2	33.048N	115.798W	005	598	—	—	4.80M_L GP	—	—	—	—
1987	11	24	02 53 00.7	33.040N	115.812W	003	598	4.4	—	4.70M_L PAS	—	—	—	—
1987	11	24	13 15 56.5	33.013N	115.838W	002	598	6.0	6.6	6.00M_L GP	6.52HAV	VII	577	100#
1987	11	24	13 34 39.9	32.942N	115.763W	014	598	4.8	—	4.80M_L PAS	—	—	—	—
1987	11	26	17 39 01.9	33.030N	115.890W	002	598	4.5	—	4.30M_L PAS	—	—	—	—
1987	11	27	01 10 10.5	32.996N	115.816W	006	598	4.1	—	4.70M_L PAS	—	—	—	—
1988	01	06	22 49 48.3	36.777N	120.867W	006	74	4.1	—	4.50M_L BRK	4.34BRK	III	578	—
1988	01	28	02 54 02.3	32.919N	115.678W	004	602	4.6	—	4.70M_L GP	—	V	578	4+
1988	02	11	15 25 55.6	34.077N	118.047W	012	602	4.8	—	4.70M_L GP	—	VI	578	28&
1988	02	20	08 39 57.5	36.803N	121.302W	009	74	4.5	4.0	5.10M_L BRK	4.98BRK	V	578	20&
1988	06	10	23 06 43.0	34.943N	118.743W	007	602	5.2	4.9	5.40M_L GP	—	V	578	37&
1988	06	13	01 45 36.8	37.385N	121.772W	007	74	4.9	5.0	5.30M_L BRK	4.91BRK	VI	578	37&
1988	06	26	15 04 58.5	34.136N	117.710W	008	602	4.5	—	4.70M_L GP	5.03BRK	V	578	12&
1988	06	27	18 43 22.3	37.130N	121.878W	013	74	4.8	4.1	5.30M_L BRK	—	VI	578	11&
1988	07	05	18 18 47.5	36.392N	117.973W	005	74	4.4	—	4.80M_L BRK	—	IV	578	—
1988	07	26	03 26 56.0	36.563N	121.182W	003	74	4.9	4.0	4.70M_L BRK	4.77BRK	III	578	—
1988	07	28	11 20 24.2	36.407N	117.998W	005	74	—	—	4.50M_L BRK	—	III	578	—
1988	08	10	18 24 51.3	36.413N	117.988W	005	74	—	—	4.60M_L BRK	—	II	578	—
1988	10	11	13 30 09.3	40.427N	125.515W	019	74	4.4	—	4.60M_L BRK	4.19BRK	—	—	—

CALIFORNIA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1988	11	10	05 08 03.0	37.373N	121.757W	007	74	4.5	4.0	4.80M_L BRK	4.61BRK	V	578	14&
1988	11	20	05 39 28.7	33.507N	118.071W	006	74	5.0	—	4.50M_L GP	—	V	578	22&
1988	12	03	11 38 26.4	34.149N	118.135W	013	602	4.4	4.2	4.90M_L GP	—	VI	578	42&
1988	12	16	05 53 05.0	33.979N	116.681W	008	602	4.8	—	4.80M_L GP	—	V	468	25&
1989	01	15	15 39 55.1	32.948N	117.736W	006	603	4.5	—	4.20M_L GP	—	IV	579	—
1989	01	19	06 53 28.8	33.919N	118.627W	012	603	5.2	4.8	5.00M_L GP	—	VI	579	40&
1989	04	03	17 46 34.4	37.422N	121.795W	009	74	4.5	4.3	4.70M_L BRK	—	VI	579	15&
1989	04	07	20 07 30.3	33.619N	117.902W	013	603	5.0	—	4.50M_L GP	—	VI	579	14&
1989	06	04	21 33 59.7	34.597N	116.838W	002	603	4.2	—	4.50M_L GP	—	V	579	7
1989	06	12	16 57 18.5	34.022N	118.178W	016	603	4.3	—	4.40M_L GP	—	VI	579	14&
1989	08	08	08 13 27.5	37.130N	121.952W	015	74	4.9	4.5	5.40M_L BRK	—	VII	579	26&
1989	08	08	15 53 28.4	37.150N	121.973W	015	74	4.2	—	4.50M_L BRK	—	V	579	—
1989	09	21	17 41 18.0	40.327N	124.705W	016	74	4.8	4.7	4.80M_L BRK	5.14BRK	V	579	8&
1989	10	18	00 04 15.2	37.036N	121.883W	019	74	6.5	7.1	7.00M_L BRK	7.18BRK	IX	579	170&
1989	10	18	00 25 04.9	37.043N	121.807W	005	74	5.0	—	4.80M_L BRK	—	—	—	—
1989	10	18	00 41 24.7	37.198N	122.105W	019	74	4.8	—	5.10M_L BRK	—	—	—	—
1989	10	18	02 15 49.9	36.995N	121.763W	004	74	4.4	—	4.50M_L BRK	—	—	—	—
1989	10	18	04 50 27.7	37.193N	122.017W	014	74	4.6	—	4.30M_L BRK	—	—	—	—
1989	10	18	05 18 34.1	36.980N	121.847W	011	74	4.5	—	4.20M_L BRK	—	—	—	—
1989	10	18	06 39 10.1	36.932N	121.712W	012	74	4.6	—	4.30M_L BRK	—	—	—	—
1989	10	19	09 53 50.4	36.932N	121.690W	012	74	4.3	3.6	4.50M_L BRK	—	Felt	74	—
1989	10	19	10 14 35.1	36.963N	121.843W	013	74	4.6	4.2	4.60M_L BRK	—	Felt	74	—
1989	10	21	00 49 43.7	37.047N	121.877W	014	74	4.4	—	4.60M_L BRK	—	Felt	74	—
1989	10	21	22 14 57.0	37.057N	121.905W	013	74	4.5	—	4.90M_L BRK	—	Felt	74	—
1989	10	25	01 27 26.6	37.078N	121.832W	014	74	4.6	3.6	5.00M_L BRK	—	IV	579	—
1989	11	02	05 50 11.0	37.057N	121.797W	012	74	4.5	—	4.90M_L BRK	—	V	579	—
1989	11	03	19 09 1.6	38.567N	119.652W	011	74	—	—	4.50M_L BRK	—	IV	579	—
1989	11	05	13 37 34.3	37.058N	121.915W	015	74	—	—	4.50M_L BRK	—	Felt	74	—
1989	12	28	09 41 08.2	34.192N	117.386W	015	603	—	—	4.50M_L GP	—	V	579	11

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1769. July 28. Los Angeles, Calif., region. The Portola expedition felt four violent earthquakes while camped on the Santa Ana River, near the present site of Olive. Many strong aftershocks were observed through Aug. 3 as the expedition moved northwestward to near San Gabriel and then westward across Los Angeles to the Pacific. This probably was a major earthquake. (Ref. 38, 368, 493, 521.)

1800. Oct. 11. Near San Juan Bautista, San Benito County, Calif. Although the houses at San Juan Bautista were built with double walls, all were damaged from roof to foundation and were uninhabitable. Some small cracks were observed in the ground at the rancheria; another deep fissure formed in the area of the Pajaro River. A strong shock on Oct. 18 was accompanied by "such a loud noise as to deafen them." (Ref. 38, 368, 493.)

1800. Nov. 22. San Diego, Calif., region. Walls of adobe buildings were damaged in San Diego, and walls of a new church were cracked at San Juan Capistrano. (Ref. 38, 368.)

1803. May 25. San Diego, Calif. The mission church at San Diego sustained slight damage. (Ref. 56, 368.)

1806. Mar. 25. Santa Barbara, Calif. An earthquake cracked the walls of a chapel at Santa Barbara. (Ref. 56, 368.)

1808. June 21. San Francisco, Calif. Adobe walls were damaged severely at the Presidio of San Francisco. One of the rooms collapsed at the commandant's house, and the soldiers' quarters were ruined and nearly fell. Through July 17 and 18 shocks were felt. (Ref. 38, 56, 368.)

1812. Dec. 8. Southwest San Bernardino County, Calif. The most severe loss occurred at the Missions of San Juan Capistrano and San Gabriel. The masonry church at San Juan Capistrano Mission was destroyed, killing 40 people attending services. Other buildings at the mission were left "in bad condition." The church at San Gabriel also sustained much damage, and many cracks formed in the bell tower. The upper part of the tower later fell, as did the weathervane. The living quarters of the ministers and offices of the mission also were damaged extensively. Three tremors described as "horrible" probably caused damage at San Buenaventura Mission (Ventura). Walls of buildings were impaired at Mission San Fernando Rey, but no damage was reported at San Diego or San Luis Rey Missions.

This earthquake may have ruptured the San Andreas fault at Wrightwood. The rupture may have extended at least 25 km to the northwest, where it is preserved in the peat bog at Pallet Creek. The fault rupture at Pallet Creek is comparable to that formed by the 1857 earthquake in the southern Coast Ranges. The main earthquake was felt from San Buenaventura Mission west to San Bernardino Valley and south to San Diego. (Ref. 38, 56, 368, 521.)

1812. Dec. 21. West of Ventura, Calif., in Santa Barbara Channel. This major earthquake caused damage in Santa Barbara, Ventura, and northern Los Angeles Counties. One fatality was reported, but many lives probably were saved by a strong foreshock about 15 minutes earlier that sent alarmed residents fleeing from buildings. The earthquakes also may have generated a tsunami because there were several reports of sea waves following the earthquakes. The sea waves reportedly did not cause loss of life or substantial loss of property.

At Santa Barbara Mission, all buildings sustained many cracks, and one chapel was flattened. The ground "opened up" in this area to such an extent "that it caused horror." At the Santa Barbara Presidio, all the buildings were left uninhabitable. The church at La Purisima Concepcion Mission (Lompoc) was ruined; some of the other buildings were "flattened to the ground;" and others required extensive repair. Part of the adobe garden wall collapsed, and that part remaining nearly fell. Damage at the Santa Ynez Mission was considerable but not so severe as at Santa Barbara and Purisima Missions. A corner of the church fell; many new houses were demolished; and many support walls were cracked. Property loss was less severe at the San Buenaventura Mission (Ventura) and the San Fernando Rey Mission. Aftershocks were reported at Santa Barbara through April 1813. (Ref. 38, 56, 368, 521.)

1827. Sept. 24 (Sept. 23). Los Angeles, Calif. People in Los Angeles ran outdoors in panic. The 1827 report of the San Buenaventura Mission (Ventura) notes that all the buildings were in "bad condition" because of the earthquakes. The same earthquake, therefore, may have affected both Los Angeles and Ventura. (Ref. 56, 368.)

1829. September. San Francisco, Calif. Several severe shocks at San Francisco were strong enough to force open locked doors and windows. No damage has been documented for this earthquake. The intensity was taken from ref. 56. (Ref. 56, 493.)

1830. Date unknown. San Luis Obispo, Calif. All the buildings at San Luis Obispo were damaged, including the hospital and part of the rancheria, which lay in ruins. The farm and building of S. Miguelito were destroyed, and the house of Santa Margarita sustained cracked and broken walls. (Ref. 38, 368.)

1836. June 10. San Francisco Bay area, Calif. This strong earthquake affected an area along the foothills from San Pablo to Mission San Jose. Large fissures formed in the ground in the area of maximum disturbance. The earthquake caused havoc in Monterey and Santa Clara and frightened all residents. The first shock was the most violent, and smaller aftershocks continued for a month. This earthquake may have ruptured the Hayward fault. Its intensity is similar to that of an earthquake in the same area on October 21, 1868. (Ref. 38, 56, 368, 493.)

1838. June. San Francisco area, Calif. This earthquake was associated with a probable rupture on the San Andreas fault, from near Santa Clara to San Francisco (about 60 km). It is suggested that the fault rupture may have extended throughout all or most of the line that was active in the 1906 earthquake. Walls were cracked at Mission Dolores (San Francisco), and some adobe walls were cracked and glassware and crockery were broken at Monterey. (Ref. 56, 368, 521.)

1840. Jan. 16. Santa Cruz, Calif. An earthquake threw down a church tower at Santa Cruz. A "tidal wave" (tsunami) was reported. Shocks continued to Jan. 18. (Ref. 56, 493.)

1841. July 3. Monterey, Calif. This earthquake left the bay and shore covered with dead and beached fish. The shaking was so severe at Monterey than an observer had to support himself against a tree to keep from falling. The main earthquake was reported felt onboard ships in the harbor and on inland farms. About 120 shocks were felt in Monterey in the summer of 1841, but they were seldom severe. (Ref. 38, 56, 368.)

1851. May 15. San Francisco, Calif. A severe earthquake lasting half a minute was felt onboard ships in the harbor. It threw merchandise to the floor in San Francisco stores and sent residents rushing outdoors. No damage has been documented for this earthquake. The intensity was taken from ref. 38 and 56. (Ref. 38, 56, 368.)

1852. Nov. 29. Baja California, Mexico. A violent earthquake threw down large fragments of Chimney Rock (now called Picacho Peak) and parts of the surrounding mountains near Fort Yuma, Calif. (located across the Colorado River from what is now Yuma, Ariz.). Sand and water issued from fissures that formed all along the riverbanks and in the low alluvial plain surrounding Fort Yuma. People at the fort had difficulty standing or walking because of the shaking. Felt as far away as San Diego.

Observers on the steamer Uncle Sam, which was about 48 km south of Fort Yuma near Ogdens Landing (on the Colorado River), described the effects of the earthquake as follows: "The waters of the river were thrown into a sort of boiling motion with a strong rippled surface. The riverbanks on one side caved in and, on the other side, separated into a thousand cracks from which dust, sand, mud, and water were ejected. The river formed new bends, leaving portions of its old bed so suddenly that thousands of fish were left lying on the muddy bottom."

The earthquake caused significant changes in the course of the Colorado River near Pilot Knob, about 10 km downstream from Yuma. The schooner Capacity, which was anchored in about 3.5 m of water at the mouth of the Colorado River (about 32 km south of Fort Yuma), was left in about 0.5 m of water after the earthquake.

Residents at Fort Yuma observed large steam geysers at Laguna de los Volcanoes (in Baja California, about 73 km southwest of Fort Yuma). The steam column was estimated to be more than 300 m in height. Aftershocks, some of which also generated geysers, continued until September 1853. (Ref. 368, 461, 521.)

1852. Dec. 17. San Luis Obispo, Calif. Two sharp earthquakes cracked walls of two adobe houses at San Luis Obispo and threw down part of the wall of another dwelling. (Ref. 38, 56.)

1853. Feb. 1. San Luis Obispo, Calif., area. An adobe house was cracked at San Simeon, and its occupants ran outside. One report described this earthquake as a violent shock that damaged houses. (Ref. 38, 56, 368.)

1853. Oct. 23. Off the coast of Humboldt County, Calif., in Humboldt Bay. At Eureka, houses rolled and undulated like ships at sea, and many residents were thrown from their beds. Three heavy shocks were reported. (Ref. 38, 56, 368.)

1855. Jan. 25 (Jan. 24). Sierra County, Calif., area. Buildings in the area were shaken severely by this heavy shock. A large pinnacle of rocks on the Downieville (Sierra) Buttes was thrown down. At the Blue Banks Mine (probably in Sierra or Nevada County), miners at the 122-m level ran outside the mine. Felt from Gibsonville (Sierra County) on the north to Nashville (El Dorado County) on the south and to Keystone Ranch (Yuba County) on the west. The epicenter probably was near the Nevada border. (Ref. 56, 368.)

1855. July 11 (July 10). Near San Gabriel, Los Angeles County, Calif. Bells at the San Gabriel Mission church were thrown down. Twenty-six buildings were damaged in Los Angeles, including the Star Hotel, whose walls were cracked. An adobe building sitting directly on the Raymond fault also was wrecked. Two unusually "heavy" sea waves rolled in at Point San Juan soon after the last of four shocks. (Ref. 38, 56, 368.)

1855. Aug. 27. North of San Francisco, Calif. This earthquake moved furniture at St. Ann's Valley (San Francisco) and cracked an adobe house on a ranch. It was described as violent at Petaluma and at San Francisco de Solano Mission. (Ref. 56, 368.)

1856. Jan. 2. South of San Francisco in San Mateo County, Calif. At San Francisco, masonry walls were cracked and iron shutters were warped. The shock was felt south to Monterey, where some frightened residents ran outside. (Ref. 56, 368, 610.)

1856. Feb. 15. South of San Francisco in San Mateo County, Calif. This strong earthquake threw down cornices, cracked brick walls, and knocked people from their feet in San Francisco. The water in San Francisco Bay was disturbed. Felt from Petaluma (Sonoma County) east to Stockton (San Joaquin County) and south to Monterey. (Ref. 38, 56, 368, 610.)

1856. Sept. 21 (Sept. 20). Near Santa Ysabel, San Diego County, Calif. At Santa Ysabel, plaster was shaken down and ceilings fell. The shock also stampeded cattle and terrified residents. Plaster was cracked at San Diego. (Ref. 56, 368.)

1857. Jan. 9. Near Fort Tejon, San Luis Obispo County, Calif. This earthquake occurred on the San Andreas fault, which ruptured from near Parkfield (in the Cholame Valley) almost to Wrightwood (a distance of about 300 km); horizontal displacement of as much as 9 m was observed on the

Carrizo Plain. It caused one fatality. A comparison of this shock to the San Francisco earthquake, which occurred on the San Andreas fault on Apr. 18, 1906, shows that the fault break in 1906 was longer but that the maximum and average displacements in 1857 were larger.

Property loss was heavy at Fort Tejon, an Army post about 7 km from the San Andreas fault. Two buildings were declared unsafe, three others were damaged extensively but were habitable, and still others sustained moderate damage. About 20 km west of Fort Tejon, trees were uprooted, and buildings were destroyed between Fort Tejon and Elizabeth Lake. One person was killed in the collapse of an adobe house at Gorman. Strong shaking lasted from 1 to 3 minutes.

Instances of seiching, fissuring, sandblows, and hydrologic changes were reported from Sacramento to the Colorado River delta. Ground fissures were observed in the beds of the Los Angeles, Santa Ana, and Santa Clara Rivers and at Santa Barbara. Sandblows occurred at Santa Barbara and in the flood plain of the Santa Clara River. One report describes sunken trees, possibly associated with liquefaction, in the area between Stockton and Sacramento.

Changes in the flow of streams or springs were observed in the areas of San Diego, Santa Barbara, Isabella, and at the south end of San Joaquin Valley. The waters of the Kern, Lake, Los Angeles, and Mokulumne Rivers overflowed their banks. Changes in the flow of water in wells were reported from the Santa Clara Valley in northern California.

Felt from Marysville south to San Diego and east to Las Vegas, Nev. (see fig. 13). Several slight to moderate foreshocks preceded the main shock by 1 to 9 hours. Many aftershocks occurred, and two (Jan. 9 and 16) were large enough to have been widely felt. (Ref. 38, 121, 368, 379, 517, 521, 599.)

1858. Nov. 26. North of San Jose in Alameda County, Calif. The earthquake was severe at San Jose, where an adobe house and the corner of a new building were knocked down. A cornice was thrown off a building in San Francisco, and part of a chimney collapsed at Mountain View. Felt to Downieville (Sierra County) on the north, Mariposa on the east, and Monterey on the south. (Ref. 38, 56, 368.)

1858. Dec. 16, 02 30 UTC (Dec. 15). Near San Bernardino, Calif. This minor earthquake broke dishes and cracked walls at San Bernardino. It also was felt in Los Angeles. (Ref. 368.)

1858. Dec. 16, 10 00 UTC. Near San Bernardino, Calif. At Agua Manza, near San Bernardino, one house collapsed. The gable end of a house was knocked down by the shock at San Bernardino. (Ref. 368, 521.)

1859. Oct. 5. San Francisco, Calif. A severe local earthquake cracked walls in several brick buildings in San Francisco, downed plaster, and rang bells. (Ref. 56, 368.)

1860. Nov. 13 (Nov. 12). Near Eureka, Humboldt County, Calif. Plaster walls cracked and chimneys settled at Eureka; a house under construction shifted about 5 cm on its foundation. (Ref. 56, 368.)

1861. July 4 (July 3). Near Dublin, Contra Costa County, Calif. Near the present town of Dublin, at Dougherty's Ranch, the roof of the ranch kitchen was thrown off, chimneys were downed, and several men in the fields were thrown to the ground. A fissure about 20 km long, probably the result of surface rupture along the Calaveras fault, opened along the west side of San Ramon Valley. A new spring of water appeared. Although strong at San Francisco, the shock caused no loss to property. Felt north to Sacramento and south to Santa Cruz. (Ref. 38, 56, 368, 493.)

1862. May 27. Near San Diego, Calif. This strong earthquake caused widespread minor damage in the Old Town and La Playa areas of San Diego. Many adobe and brick buildings sustained cracks, some of which extended completely through the walls. In some frame buildings, windows and doors were loosened in their frames and some door hinges were broken off.

Landslides occurred along the steep bluffs from La Playa to Point Loma. At La Playa, north of Point Loma, cracks formed on the beach, and water was emitted from the sand on the tidal flats. Water from the bay surged inland over the beach between 3 and 4 ft. Cracks also formed in the wet, sandy ground near the San Diego River, which "washed over its banks." This earthquake was felt north to Anaheim and Los Angeles. About 100 aftershocks occurred at San Diego to June 14, 1862. (Ref. 38, 56, 368, 532, 610.)

1864. Feb. 26. North of Watsonville in Santa Clara County, Calif. This earthquake cracked adobe walls at Monterey and tipped over or displaced light objects at Watsonville. Described as severe at San Francisco and Santa Cruz, the shock was felt north to Napa and south to San Luis Obispo. (Ref. 56, 368.)

1864. Mar. 5. East of San Francisco in Alameda County, Calif. Walls cracked considerably, plaster cracked, and a few plate-glass windows shattered at San Francisco, where the earthquake apparently was strongest. A few buildings in San Jose also sustained cracks in plaster. Felt north to Santa Rosa (Sonoma County) and Sacramento and south to San Juan Mission (San Benito County) and Visalia (Tulare County). (Ref. 38, 368.)

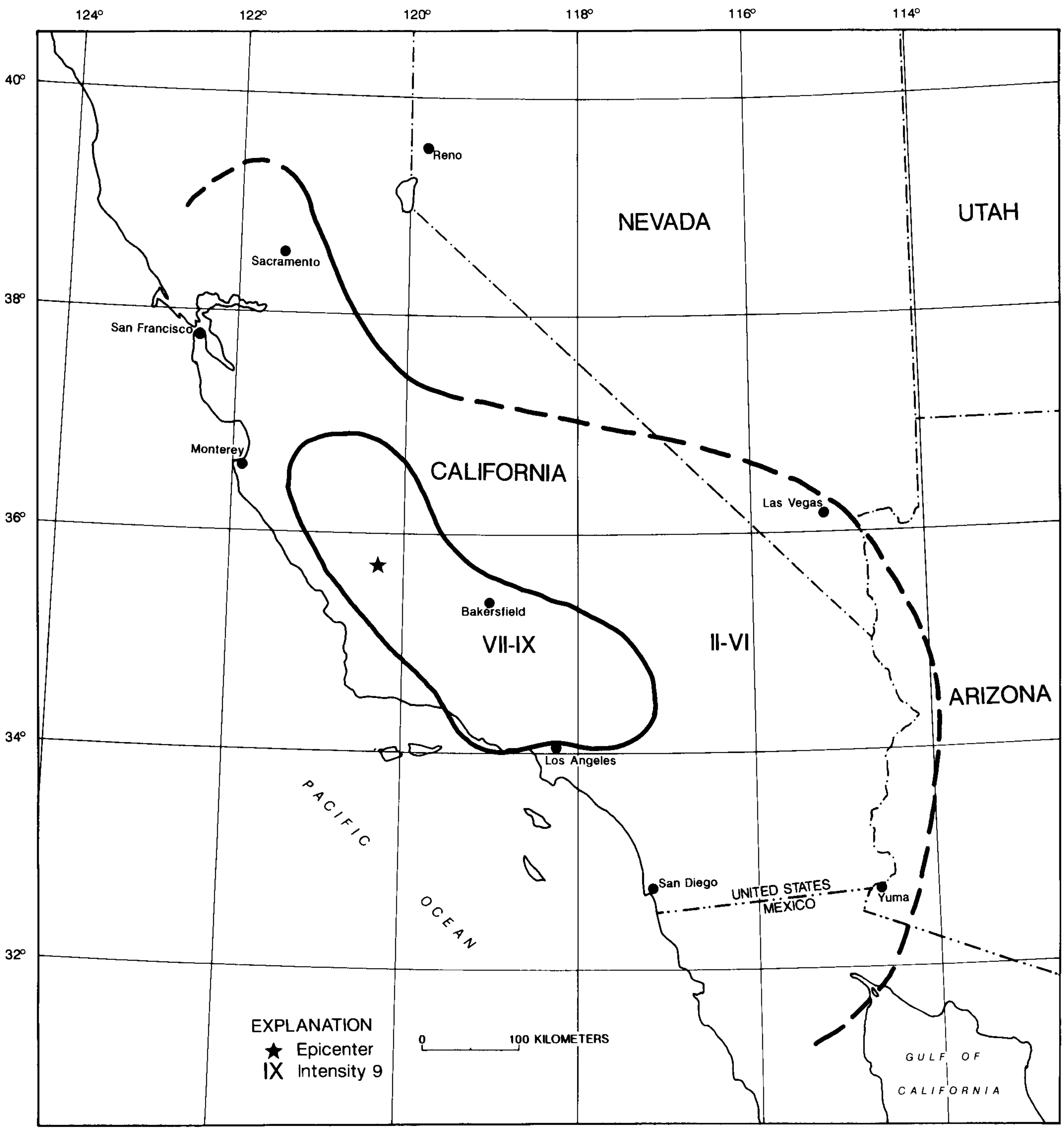


FIGURE 13.—Isoseismal map for the Fort Tejon, California, earthquake of January 9, 1857. This map is a simplified version of figure 2 in reference 379 of table 1.

1864. May 21 (May 20). Southeast of San Francisco in Alameda County, Calif. At San Francisco a few windows were broken. Felt from Monterey on the south to Sacramento and Santa Rosa (Sonoma County) on the north. (Ref. 56, 368.)

1865. Mar. 8. Bennett Valley, Sonoma County, Calif. Chimneys fell, plaster cracked, and clocks stopped running in Bennett Valley, east of Santa Rosa. The earthquake was described as severe at Santa Rosa. A foreshock was felt in the Santa Rosa–San Francisco area 8 hours earlier. The main shock was felt south to San Francisco and San Leandro. (Ref. 38, 56, 368.)

1865. May 24. South of San Jose, Santa Clara County, Calif. Crockery was broken at San Juan Bautista. The earthquake was "remarkably heavy" in the south San Francisco Bay counties. Felt from San Francisco on the north to Monterey on the south. (Ref. 56, 368.)

1865. Oct. 1. Near Eureka, Humboldt County, Calif. Chimneys and brickwork were damaged at Eureka. At Fort Humboldt, south of Eureka on Humboldt Bay, all fort buildings were impaired, redwood trees were uprooted, and a fissure formed along the edge of the parade ground. This shock was reported only in Humboldt and Trinity Counties. (Ref. 38, 56, 368.)

1865. Oct. 8. Santa Cruz Mountains, Santa Clara County, Calif. This strong earthquake caused severe damage in several towns, including New Almaden, Petaluma, San Francisco, San Jose, Santa Clara, and Santa Cruz. Property loss was estimated at $500,000.

The shock knocked several houses off foundations at New Almaden and almost destroyed a large brick storehouse. At San Francisco, several poorly constructed buildings on made land were destroyed, the City Hall was ruined, and water pipes and gas pipes were broken; a crack about 2.5 cm wide formed in Howard Street. On the marshy lands in the Howard Street area, the ground heaved in some places and sank in others.

Almost all buildings in Santa Clara and Petaluma were affected to some extent, and every brick building was wrecked at Santa Cruz. The walls of the jail and church fell at San Jose, and several chimneys were knocked down. At Watsonville, the earth cracked in several places, and water flowed through the cracks. Ground cracks also were reported near the San Andreas fault at Mountain Charlie's on the Santa Cruz Road. The tide at Santa Cruz was affected.

This earthquake caused damage from San Juan Bautista on the south to Napa on the north. Aftershocks were reported in several towns. (Ref. 38, 56, 368, 517, 530, 533, 610.)

1866. Mar. 26. Near Gilroy, Santa Clara County, Calif. Several chimneys were downed in Gilroy. Felt from Santa Rosa (Sonoma County) south to Monterey. (Ref. 56, 368.)

1868. Sept. 4. West of Lone Pine in Tulare County, Calif. A series of earthquakes occurred at the headwaters of the Kern River and at Lone Pine from Sept. 4 to Sept. 17. The earth shook terribly, tall trees swayed, and huge masses of boulders and earth detached from the surrounding cliffs and tumbled down along the river. At Lone Pine, 40 shocks were reported in 1 hour on Sept. 4. Foreshocks occurred on Sept. 3. (Ref. 38, 56, 368.)

1868. Oct. 21. Near Hayward, Alameda County, Calif. Because of its location in a highly populated area, this earthquake was one of the most destructive in the history of California. Property loss was extensive at towns in the San Francisco Bay area, and 30 people were killed. The total property loss was about $350,000. This earthquake was known as the "great San Francisco earthquake" until the shock on Apr. 18, 1906. Compared to the 1906 shock, the fault trace of the 1868 earthquake—about 32 km—was much shorter, and the amount of movement (0.9 m—whether it was horizontal or vertical is not clear) was much less.

Damage was most severe in Hayward and nearby towns along the Hayward fault. Slip was observed on the Hayward fault from San Leandro to Warm Springs, a distance of about 32 km; in places, the fault trace opened 25–30 cm. At Hayward, almost every building was damaged extensively or wrecked. San Jose, which lay in the hills several meters west of the fault trace, had many wrecked buildings and demolished chimneys. At San Leandro, the second floor of the courthouse collapsed, and other buildings were wrecked. At San Francisco, the Custom house sustained severe damage, and many cornices, awnings, and walls fell, but, as occurred later in the shock of 1906, well-constructed buildings on firm ground sustained little damage.

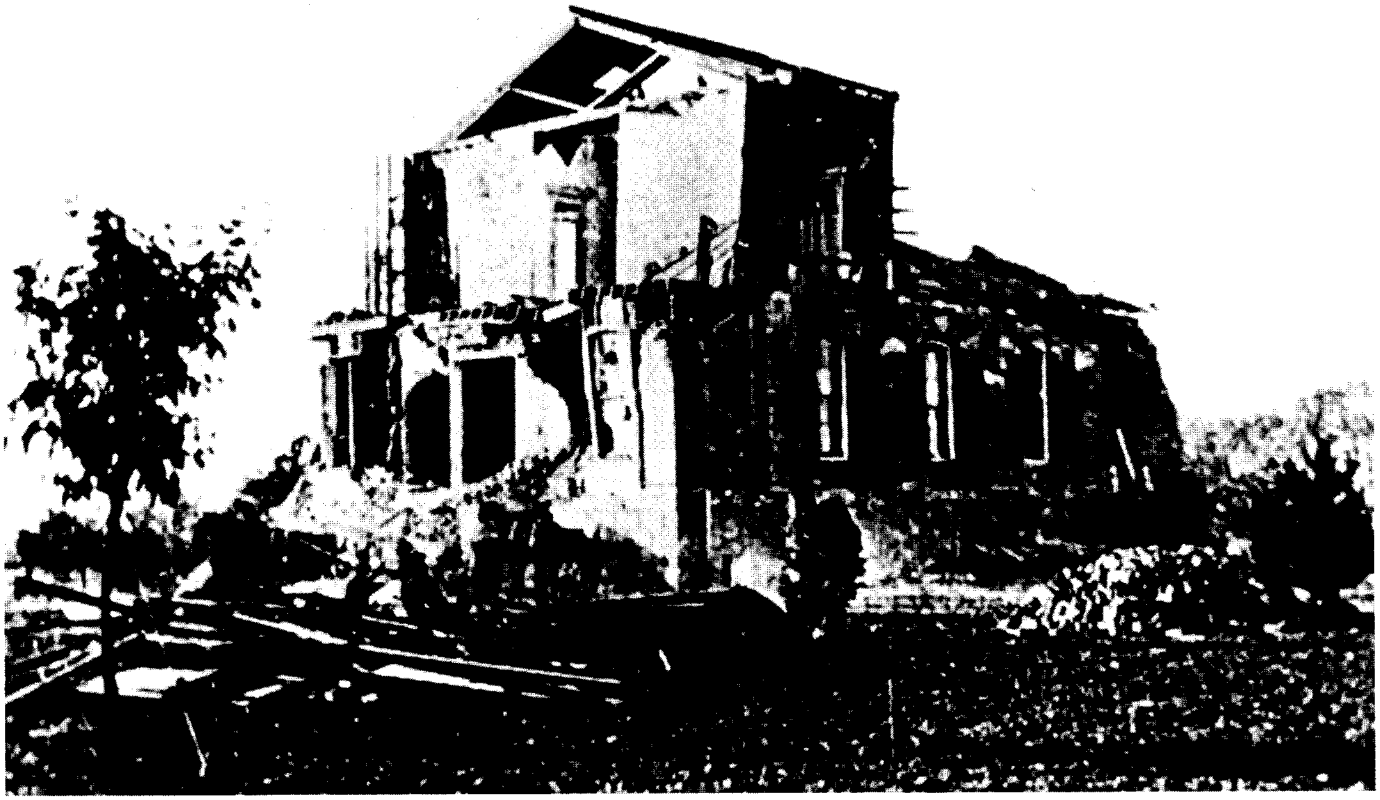
Damage occurred from Gilroy and Santa Cruz on the south to Santa Rosa on the north. The area shaken at MM intensity VIII or higher includes about 2,300 km^2. Strong aftershocks continued into November 1868. (Ref. 38, 56, 368, 517, 521, 530, 533.)

1869. Oct. 8. Near Ukiah, Mendocino County, Calif. This earthquake downed chimneys at Ukiah and in "the Clear Lake country." Felt from Healdsburg (Sonoma County) north to Potter Valley. (Ref. 56, 368.)

1870. Feb. 17. Near Santa Cruz, Calif. At Los Gatos, several chimneys were knocked down, and at Santa Cruz, chimneys were dislocated. Felt south to Monterey and north to Sacramento. (Ref. 56, 368.)

1870. Apr. 2. Near Oakland, Contra Costa County, Calif. Minor damage occurred in Oakland and San Francisco. The shock also was felt in Santa Cruz, Santa Rosa, and Stockton. (Ref. 56, 368.)

1871. Mar. 2. Near Mattole, Humboldt County, Calif. Almost every chimney was knocked to the ground at Mattole, and ground fissures were



Courthouse at San Leandro, California, wrecked by the October 21, 1868, earthquake. (Photograph by University of California, Berkeley.)

observed near Mattole. Many chimneys also were ruined at Bucksport, Hydesville, Petrolia, and Rohnerville. The earthquake shook cornices from some buildings at Eureka and damaged the light-keeper's house at Mendocino. A dozen aftershocks were reported at Mattole. (Ref. 38, 56, 368.)

1871. July 5. Near Lone Pine, Inyo County, Calif. Near Lone Pine, some wells went dry and others became muddy. People ran out of buildings at Swansea. This possible foreshock to the 1872 Owens Valley earthquake was felt northwest to Bear Valley in Mariposa County. (Ref. 38, 56, 368.)

1872. Mar. 26, 10 30 UTC. Owens Valley, near Lone Pine, Inyo County, Calif. The most devastating effects of this earthquake occurred at Lone Pine, where 52 of 59 houses (mostly constructed of adobe or stone) were destroyed and 27 people were killed. A few fatalities also were reported in other parts of Owens Valley. One report states that the main buildings were thrown down in almost every town in Inyo County. About 100 km south of Lone Pine, at Indian Wells, adobe houses sustained cracks. Property loss has been estimated at $250,000.

Faulting occurred on the Owens Valley fault along a line a few km east of the Sierra Nevada escarpment. The faulting near Lone Pine involved both dip-slip and right-lateral components of movement. The largest amount of surface deformation was observed between the towns of Lone Pine and Independence, but fault scarps formed along a length of at least 160 km—from Haiwee Reservoir, south of Olancha, to Big Pine; cracks formed in the ground as far north as Bishop. The largest horizontal displacement of 7 m was measured on the fault scarps west of Lone Pine. The vertical offsets clearly were smaller, averaging about 1 m with the downthrown block on the east.

A comparison of this earthquake to the earthquakes of 1857 and 1906 on the San Andreas fault shows the felt area and maximum fault displacements to be comparable. However, the shocks on the San Andreas fault ruptured the fault for significantly larger distances—300 km in 1857 and 430 km in 1906.

This earthquake stopped clocks and awakened people at San Diego to the south, Red Bluff to the north, and Elko, Nev., to the east. MM intensity VIII or larger was observed over an area of about 25,000 km^2, and MM intensity IX or larger was observed over an area of about 5,500 km^2 (see fig. 14). The shock was felt over most of California and much of Nevada. Thousands of aftershocks occurred, some severe. (Ref. 38, 368, 521, 531, 533.)

A 23-ft-high fault scarp caused by the March 26, 1872, Owens Valley, California, earthquake. (Photograph by W.D. Johnson.)

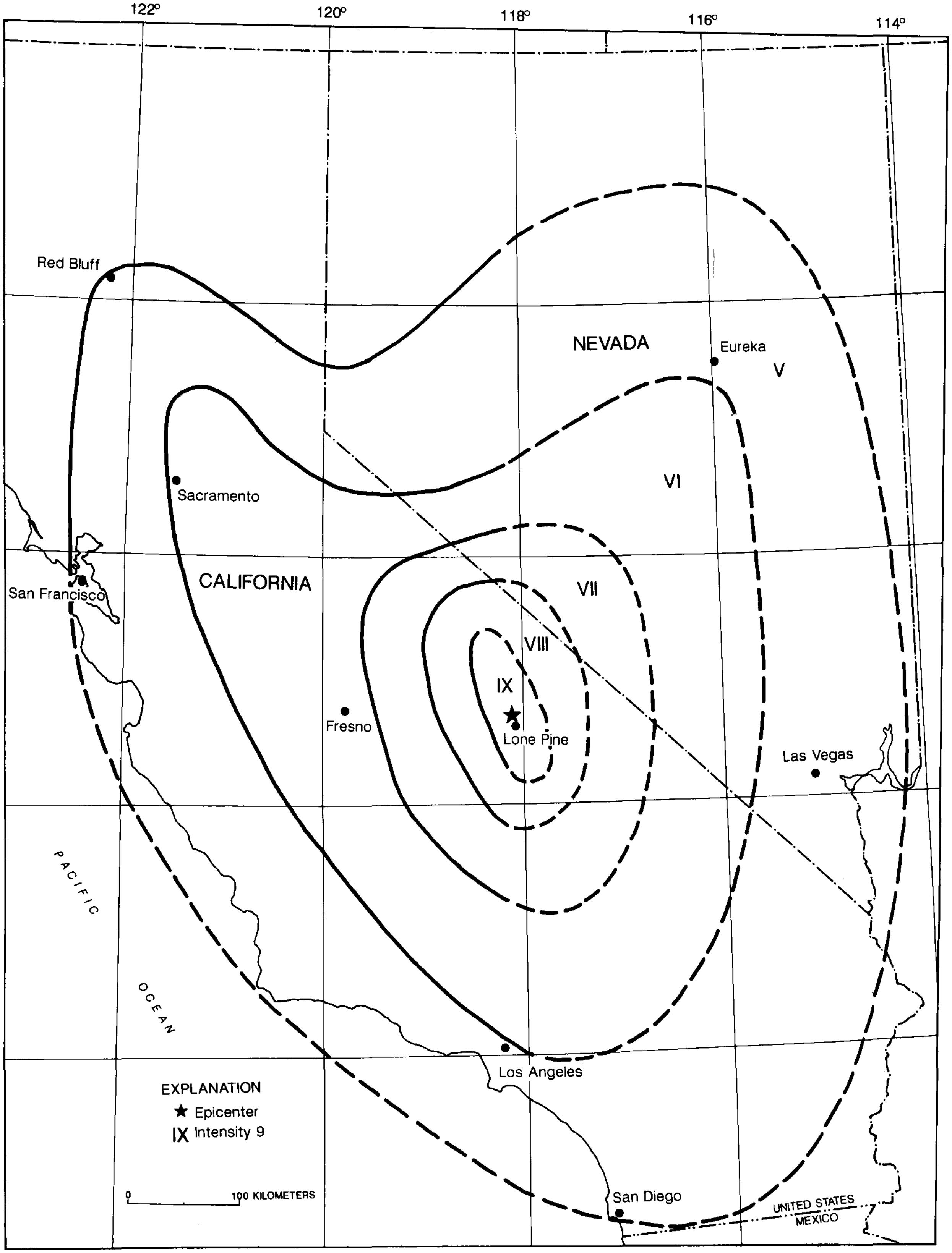


FIGURE 14.—Isoseismal map for the Owens Valley, California, earthquake of March 26, 1872. This map is a simplified version of the map in reference 368 of table 1.

1872. Mar. 28. Near Sierraville, Sierra County, Calif. In Sierraville, bottles and chinaware in stores were broken. In Reno, Nev., the earthquake reportedly was stronger than the large Owens Valley earthquake, 2 days earlier. Also felt at Grass Valley. (Ref. 368.)

1872. Apr. 11. Near Round Valley, Inyo County, Calif. At Round Valley, stone buildings were knocked down and a frame structure was twisted on its foundation. Although this shock was felt at Susanville in Lassen County, the main shock of the Owens Valley earthquake on Mar. 26, 1872, was not reported felt there. (Ref. 368.)

1872. Apr. 18. Near Cerro Gordo, Inyo County, Calif. This rather small aftershock of the Owens Valley earthquake was reported only from Cerro Gordo. It was described as being of "unusual severity." (Ref. 56, 368.)

1872. May 3 (May 2). Imperial Valley area, Calif. A building was cracked and people ran into the streets in Arizona City (Yuma). It also was reported at San Bernardino, 300 km northwest of Arizona City. (Ref. 368.)

1872. May 17. Owens Valley, near Lone Pine, Calif. Furniture in a house was violently disturbed at Lone Pine, and one person was thrown from his chair. (Ref. 56, 368.)

1873. Nov. 23 (Nov. 22). Near Crescent City, Del Norte County, Calif. All chimneys were knocked down in the Smith River valley. Chimneys also fell at Crescent City, and hardly a brick building in the town escaped damage. Chimneys were damaged in many places as far north as Port Orford, Oreg., and east to Jacksonville, Oreg. Cracks in the ground were observed on the trail from Crescent City to Gasquet in Del Norte County. Felt south to San Francisco and north to Portland, Oreg. (Ref. 38, 56, 368, 521.)

1875. Jan. 24. South of Janesville in Plumas County, Calif. One chimney was downed at Janesville, and stone walls sustained cracks at Susanville (Lassen County). This shock awakened residents as far south as Sacramento. (Ref. 56, 368.)

1875. Sept. 30. Near Eureka, Humboldt County, Calif. At Eureka, most chimneys were cracked and some were knocked down. Residents of Weaverville in Trinity County were awakened. (Ref. 368.)

1876. May 29. Freestone, Sonoma County, Calif. At Freestone, some plaster was cracked and bottles and crockery were overturned. (Ref. 368.)

1878. May 9 (May 8). Near Petrolia, Humboldt County, Calif. At Petrolia, all chimneys in the city were knocked down. The earthquake also triggered large landslides along the coast in southern Humboldt County. (Ref. 368.)

1878. June 12 (June 11). Los Angeles, Calif. This earthquake shook down plaster and broke glassware at Los Angeles. Four distinct shocks occurred on June 12. (Ref. 463.)

1879. Feb. 4. Visalia, Tulare County, Calif. Two shocks occurred at Visalia, the second of which was the strongest. The second shock, which was felt over all the surrounding country, cracked walls and overturned furniture. (Ref. 56, 463.)

1880. Dec. 19. San Bernardino, Calif. Walls of the courthouse building were cracked from top to bottom. Three shocks were reported at Los Angeles. The main shock was felt south to San Diego. (Ref. 56, 463.)

1881. Feb. 2 (Feb. 1). North of Imusdale, San Luis Obispo County, Calif. In Imusdale, at the north end of Cholame Valley, several chimneys were knocked down and an adobe storeroom and part of an adobe barn collapsed. Large cracks extending across the road were reported. (Ref. 56, 368.)

1881. Apr. 10. Southwest of Modesto, Stanislaus County, Calif. Minor damage to property was reported from Hollister to Stockton. Chimneys were damaged in the Modesto region. Felt from Greenville (Plumas County) on the north to Visalia (Tulare County) on the south. (Ref. 38, 56, 368.)

1882. Mar. 6. East of Hollister, San Benito County, Calif. Windowpanes were broken at Salinas, and crockery was broken at Hollister. The shock, which was rather strong at Charleston and Merced, was reported from San Francisco on the north to San Luis Obispo on the south. Many aftershocks occurred. (Ref. 38, 56, 368.)

1882. June 27. Santa Cruz area, Calif. Chimneys were overturned and windows were broken in the Santa Cruz Mountains. The walls of several buildings were cracked severely at San Jose, and crockery and glassware were broken at San Francisco. Reports from towns along the coast between Hollister and Petaluma (and as far east as Stockton) state that this shock was the most severe since the October 1868 earthquake. (Ref. 56, 463.)

1883. Mar. 30. Near Gilroy, Santa Clara County, Calif. This earthquake knocked down chimneys at Old Gilroy and Sargents. Plaster fell in all brick buildings at Hollister, and several large windows were broken; slight damage was sustained at Santa Cruz and Watsonville. At Gilroy, 8 to 12 aftershocks were reported, two of which were felt widely. The main shock was felt from Sacramento south to San Luis Obispo. (Ref. 38, 56, 368.)

1883. Sept. 5. Off the coast near Santa Barbara, Calif. Plaster fell at Santa Barbara, and bottles were overturned at Los Alamos. Felt along the coast from Cayucos (near San Luis Obispo) south to Wilmington (Los Angeles County). (Ref. 38, 56, 368.)

1884. Mar. 26 (Mar. 25). Near Santa Cruz, Calif. Plaster fell, walls cracked, and windowpanes broke at Santa Cruz. Similar effects were reported at San Francisco. Felt along the coast from Monterey north to Santa Rosa (Sonoma County). (Ref. 56, 368.)

1885. Jan. 31 (Jan. 30). Near Susanville, Lassen County, Calif. Chimneys were damaged in the Honey Lake Valley towns of Buntingville and Susanville. Shocks were most severe near Janesville. Felt north to Alturas (Modoc County), south to Sacramento, and at a few towns in Nevada. More than 100 aftershocks were felt in the area to Feb. 8, 1885. (Ref. 38, 56, 368.)

1885. Mar. 31 (Mar. 30). South of Hollister, San Benito County, Calif. Chimneys were thrown down at Mulberry, and plaster fell at Hollister. Extensive fissures formed in the soft riverbanks at the junction of the Pajaro and San Benito Rivers. The shock was reported felt as far north as San Rafael. One foreshock and three aftershocks were felt at Hollister on Mar. 31. (Ref. 38, 56, 368.)

1885. Apr. 12 (Apr. 11). Southern San Benito County, Calif. This earthquake threw down two chimneys at Las Tablas, 48 km northwest of San Luis Obispo. Slight damage was reported at Monterey (where cracks in adobe walls were widened), Salinas, and San Luis Obispo. Felt north to Marysville (Yuba County), south to Ventura, and east to Keeler (Inyo County). Toppozada and Wong (ref. 612) have determined that this event was located about 50 km northwest of the May 2, 1983, Coalinga earthquake. Toppozada (1991, oral commun.) has also determined that the April 2, 1885 earthquake was located about 50 km southeast of its listed location and was near the location of this April 12 event. (Ref. 38, 56, 368.)

1885. Aug. 1 (July 31). Near Cloverdale, Sonoma County, Calif. A strong local earthquake cracked walls in several buildings at Cloverdale. It was not reported in nearby towns. (Ref. 38, 368.)

1886. Apr. 14 (Apr. 13). Inyo County, Calif. This local earthquake broke considerable crockery and dishes in Lida Valley on the California-Nevada border. A dull, thunderlike noise preceded the shock. (Ref. 54.)

1887. Dec. 3. Near Halfway House, Mendocino County, Calif. At Halfway House, on the road from Mendocino to Ukiah, chimneys were downed and a stove overturned. A chimney was cracked at Christine, and clocks stopped at Ukiah. (Ref. 56, 368.)

1888. Feb. 29. North of Petaluma, Sonoma County, Calif. A sharp earthquake cracked the walls of several buildings at Petaluma. Felt north to Geyserville (Sonoma County) and south to San Francisco. (Ref. 38, 56, 368.)

1888. Apr. 14 (Apr. 13). Alturas, Modoc County, Calif. The earthquake rang a school bell and knocked down plaster at Alturas. It was reported felt only at a few towns in the area. (Ref. 368.)

1888. Apr. 29 (Apr. 28). Near Cromberg, Plumas County, Calif. Chimneys were downed at Cromberg, at the north end of Mohawk Valley. Rockslides were reported north of Downieville on the North Fork of the North Yuba River and in Rattlesnake Canyon. South of Cromberg, walls of the courthouse were cracked at Nevada City, and tops of chimneys were knocked off at Grass Valley. Felt from San Francisco northeastward into Nevada. Many aftershocks were felt during the night in the Downieville area. (Ref. 38, 56, 368.)

1888. Nov. 18. San Francisco Bay area, Calif. Several chimneys were overthrown at East Oakland and Oakland, which lie at the southern limit of the felt area. Felt from Napa south to San Lorenzo. Two slight aftershocks were felt at Oakland. (Ref. 38, 56, 368.)

1889. Apr. 15 (Apr. 14). Near Santa Cruz, Calif. This shock cracked plaster in several houses in Santa Cruz. Felt from Corral de Tierra (Monterey County) north to Martinez (Contra Costa County). (Ref. 56, 368.)

1889. May 19. West of Antioch, Contra Costa County, Calif. Many chimneys were demolished at Antioch, and two small fissures formed on Main Street. At Collinsville, one house was toppled and chimneys were knocked down. Slight loss to property also was reported at Lodi, Napa, Rio Vista, and San Francisco. Felt north to Nevada City, south to Santa Cruz, and east to Sonora (Tuolumne County). (Ref. 38, 368.)

1889. June 20 (June 19). North of Susanville, Lassen County, Calif. The earthquake was most severe in the Susanville–Willow Creek area, where chimneys were thrown down, and the water in Eagle Lake was muddied. As many as 75 aftershocks occurred, 28 of which were felt within 2 hours of the main event. Felt north to Alturas (Modoc County), south to Sacramento, and east to Virginia City, Nev. (Ref. 38, 56, 368.)

1889. July 31. San Francisco Bay area, Calif. Chimneys were knocked down at Oakland and San

Leandro, and a brick pier was cracked at the Chabot Observatory in south Oakland. Felt from Salinas (Monterey County) north to Healdsburg (Sonoma County) and east to Modesto (Stanislaus County). Aftershocks were reported felt at San Francisco. (Ref. 38, 56, 368.)

1889. Aug. 28 (Aug. 27). Near Pomona, Los Angeles County, Calif. Windows and crockery were cracked and broken at Pomona, where two distinct shocks threw several people to the floor. Several towns between Los Angeles and Ontario reported minor damage, including fallen plaster and bottles knocked from store shelves. Felt mainly over an east-west area from San Jacinto in the east to Santa Monica in the west. (Ref. 38, 56, 368.)

1890. Feb. 9. Northeast San Diego County, Calif. It is inferred from the lack of reports of damage that the epicenter was in the sparsely populated region between Los Angeles and Yuma, Ariz. Windows were broken at Pomona, and residents were awakened, but little loss was reported in the region. Telegraph dispatches from all towns along the Southern Pacific Line (from Pomona to Yuma) reported the shock was of equal intensity at each town. A possible foreshock on Feb. 6 was reported felt from San Bernardino to San Diego. (Ref. 38, 56, 368.)

1890. Apr. 24. Near Corralitos, Santa Cruz County, Calif. This severe earthquake caused extensive loss of chimneys and some damage to brick and frame buildings from San Juan Bautista to Green Valley. Chimneys were knocked over at Watsonville and Corralitos, and buildings were twisted on their foundations at Corralitos. The San Andreas fault probably ruptured in the area where it crosses the Pajaro River. Fissures were reported on or near the fault, and a railroad bridge across the Pajaro River (near the fault) shifted about 5 m out of alignment. Aftershocks occurred for many days. (Ref. 38, 56, 368.)

1890. July 26. Near Ferndale, Humboldt County, Calif. A severe earthquake knocked down chimneys at Grizzly Bluff (near Ferndale) and at the Walker residence (near Petrolia). Although strong at Eureka and Mendocino City, the shock caused little or no damage. A spring at the Walker "place" that had stopped flowing 3 days before the shock became murky and flowed at a faster rate than before. An aftershock at 16 00 UTC was reported at Ferndale, Hydesville, and Rohnerville. The main shock was reported from Crescent City and Sisson (Mt. Shasta City) in the north to Petaluma (Sonoma County) in the south. (Ref. 38, 56, 368.)

1891. Jan. 2. Near San Jose, Santa Clara County, Calif. At Mount Hamilton, several large pieces of plaster were dislodged and ceilings cracked. Plaster was knocked to the floor at Santa Cruz, and windows were broken at San Jose. Although this earthquake was strong at Gilroy, little or no damage was reported. Felt to Vallejo in the north, Monterey in the south, and Merced in the east. (Ref. 38, 56, 368.)

1891. Oct. 12 (Oct. 11). Near Napa, Calif. In Napa and Sonoma, many chimneys were overthrown and several brick buildings were cracked and thrown out of plumb. Not one house in Sonoma Valley escaped damage of some kind. A foreshock was felt at Napa and Sonoma at 05 15 UTC, and many aftershocks were observed. The main shock was felt north to Lakeport and Colusa and south to Salinas. (Ref. 38, 56, 368.)

1892. Feb. 24 (Feb. 23). California-Mexico border area. At the old Carrizo station in San Diego County, all adobe buildings were destroyed. In Paradise Valley, a church and schoolhouse built on stilts were knocked down and demolished; chimneys and plaster were broken in San Diego. Ground fissures were reported at McCain Valley and Jewel Valley; rockslides were observed between Campo and Carrizo and at Dulzura and Jewel Valley.

About 155 tremors were felt at Campo during the 12 hours following the main shock, and aftershocks continued there every few days into April 1892. Observers reported that 135 aftershocks were felt as far away as National City, on San Diego Bay. Felt north along the coast to Santa Barbara, east to Yuma, Ariz., and south to San Quintin, Baja California. One report stated that the tremor was felt at Visalia, Tulare County, about 700 km north of San Quintin. (Ref. 38, 56, 368, 521.)

1892. Apr. 19. Near Vacaville, Solano County, Calif. This earthquake caused severe damage at Allendale, Dixon, Vacaville, and Winters. Property loss was estimated at $225,000, and one fatality was reported.

At Allendale, between Vacaville and Winters, several buildings in the area collapsed, shifted off their foundations, or were wrenched apart. Ground fissures formed near Allendale, which suggests possible faulting. At Vacaville, almost all brick structures were destroyed, many frame buildings were impaired, and chimneys were twisted or knocked to the ground. Similar damage was reported from Winters (Yolo County). Although damage in general was less serious in Dixon, many school buildings were almost ruined. MM intensity VIII or higher was observed over an area of 1,100 km^2. Felt north to Redding, east to Virginia City, Nev., and south to Salinas and Fresno. (Ref. 38, 56, 368, 533, 599.)

Brick walls of a hotel in Winters, California, collapsed by the April 19, 1892, earthquake. (Photograph from California Geology.)

1892. Apr. 21. Near Winters, in Solano County, Calif. Weakened structures in the communities hit by the Apr. 19 earthquake were further damaged. At Winters, where the damage was most severe, many buildings that withstood the Apr. 19 shock were leveled. Not one building on Main Street was left habitable. At Esparto, every brick chimney fell and wood-frame buildings were wrenched out of shape. Many chimneys were wrecked at Sacramento and Woodland, but additional loss was slight at Dixon and Vacaville. The area shaken at MM intensity VIII or larger was about 890 km^2, but the general felt area was about the same as that of the Apr. 19 shock. (Ref. 38, 56, 368.)

1892. Apr. 30 (Apr. 29). Near Davis, Solano County, Calif. This aftershock of the Apr. 19 earthquake knocked a few loose bricks from buildings at Davisville (Davis) and sent people at Sacramento running from their houses. Felt from San Jose north to Yuba City and east to Carson City, Nev. (Ref. 56, 368.)

1892. Nov. 13. West of Hollister, San Benito County, Calif. At Hollister, a chimney was displaced and plaster fell; at Monterey, chimneys were cracked; and at Salinas, windows and dishes were broken. Three less severe aftershocks were felt at Hollister. Felt from Monterey north to Napa. (Ref. 38, 56, 368.)

1893. Apr. 4. Near Newhall, Los Angeles County, Calif. Northwest of Newhall, an old but sturdy adobe house was shaken down at the Newhall Ranch. In the area of Newhall and Pico Canyon, chimneys were wrecked, the ground was fissured, and boulders were shaken down the hillsides. Aftershocks were reported almost daily at Tapo Ranch in the Simi Hills. Felt from Santa Barbara east to San Bernardino. (Ref. 38, 56, 368.)

1893. Aug. 9. East of Santa Rosa, Sonoma County, Calif. Most of the loss to property occurred at Santa Rosa: chimneys were downed, plaster in the courthouse was cracked and broken, and windows were broken. At Petaluma, plaster was cracked and crockery was thrown from shelves. Felt north to Middletown (Lake County), south to Alameda, and east to Sacramento. (Ref. 38, 368.)

1894. July 30 (July 29). Northwest of San Bernardino, Calif. An earthquake caused minor damage from the Los Angeles basin to Mojave in

Kern County. At Los Angeles, three distinct tremors broke a few windowpanes and knocked bottles of ink off shelves. Earlier in the evening, several foreshocks were reported at Riverside. Felt north to Mojave and south to San Diego. (Ref. 56, 368.)

1894. Sept. 30. Southern Humboldt County, Calif. This earthquake knocked down chimneys in southern Humboldt County. It was felt strongly on two schooners at sea, about 56 km southwest of Shelter Cove. An aftershock was felt at Eureka and Mendocino at 17 58 UTC. The main shock was reported north to Crescent City, south to Ukiah, and east to Redding and Sisson (Mt. Shasta City). (Ref. 38, 368).

1894. Oct. 23. Near San Diego, Calif. Plaster was broken and brick walls were cracked in San Diego; mission bells rang in San Juan Capistrano (Orange County). A dust cloud was seen along the summit of the mountains above Buckman's Springs, and boulders were heard rolling down the canyons. Several aftershocks were felt in the area through Oct. 28. Felt north to Los Angeles and San Bernardino. (Ref. 38, 56, 368.)

1896. Aug. 17. Near Independence, Inyo County, Calif. This earthquake probably occurred along or near the eastern front of the Sierra Nevada. "Crumbled adobes slid to the ground" at Independence. Loose plaster was knocked down at Hanford, and clocks stopped as far distant as Bakersfield and Merced. The shock was felt from Big Pine (Inyo County), west to Merced, and south to Bakersfield. (Ref. 56, 368.)

1897. June 20. Near Gilroy, Santa Clara County, Calif. The earthquake caused much loss to brick buildings in the Gilroy–San Felipe area. Few brick structures escaped damage at Hollister; chimneys were thrown down and fire walls fell into the street at Salinas. Damage in Gilroy was similar to that in Hollister and Salinas. A fissure was observed near Soap Lake House on the Pacheco Pass Road, and a fissure 295 m long formed on a ranch near San Felipe. Because the Calaveras fault crosses the Pacheco Pass Road 5 km northwest of San Felipe, the fissures could have resulted from rupture on the Calaveras. Felt from Woodland on the north to San Luis Obispo on the south and Visalia (Tulare County) on the east. (Ref. 38, 56, 368.)

1898. Mar. 31 (Mar. 30). Southern Sonoma County, Calif. At Mare Island Naval Yard and Tubbs Island, several buildings either partly or totally collapsed. Property loss was estimated at $350,000. The earthquake also caused severe damage at Schellville, Greenwood Estate, and along Petaluma Creek in Sonoma County, where houses were moved off their foundations. Extensive cracks developed in the ground at Greenwood Estate, Mare Island Naval Yard, and Schellville. Moderate damage occurred in San Francisco. Felt north to Chico, east to Carson City, Nev., and south to Monterey. Magnitude 6.5 M_S ELL. (Ref. 56, 368, 521, 615.)

1898. Apr. 15 (Apr. 14). Near Greenwood, Mendocino County, Calif. Two wood-frame houses were wrecked at Greenwood, and one was toppled at Noyo. Chimneys were knocked down in several towns in Mendocino County, including Fort Bragg, Little River, Mendocino, Pine Grove, and Ukiah. Property loss at Point Arena included cracking of the lighthouse tower. Cemetery monuments fell or were twisted on their bases at Mendocino. Landslides and fallen trees made the mountain roads east of Mendocino impassable. A foreshock was felt at Mendocino at 06 45 UTC, and many aftershocks were felt there. The main shock was felt north to Eureka, east to Red Bluff and Willows, and south to San Francisco. Magnitude 6.7 M_S ELL. (Ref. 38, 56, 368, 521, 615.)

1899. Apr. 16. Off the coast of Humboldt County, west of Eureka, Calif. This long-duration earthquake caused some minor impairment to a flue at a lumber mill in Eureka. It was described as one of the most severe shocks ever experienced. Felt along the coast from Crescent City on the north to Albion (Mendocino County) on the south. (Ref. 38, 56, 368, 521.)

1899. Apr. 30. Near Watsonville, Santa Cruz County, Calif. Damage from this earthquake included downed chimneys and displaced cemetery monuments in Green Valley and Watsonville, fallen plaster in Hollister, and broken crockery and windowpanes in Salinas. Felt from southern Sonoma and Napa Counties on the north to northern Monterey County on the south. (Ref. 38, 56, 368.)

1899. June 2 (June 1). Near San Francisco in northern San Mateo County, Calif. In San Francisco, chimneys were knocked down, parts of several cornices fell, and windows and glassware were broken. Chimneys also were toppled in Oakland. This moderate earthquake was felt south to Santa Cruz, north to Calistoga and Sacramento, and east to Modesto (San Joaquin County). (Ref. 38, 368.)

1899. July 6. Northeast of Watsonville in Santa Clara County, Calif. Several chimneys were toppled at Watsonville; a few lamp chimneys and windows were broken in Salinas. At Pleasanton (Alameda County), about 85 km north of Watsonville, brick buildings were cracked, and some wooden structures were "more or less twisted." Because the intensities at sites between these two towns were not high (MM intensity V–VI), there may have been two earthquakes at about the same time—one near Watsonville and the other near Pleasanton. Felt north to Napa, south to San Luis Obispo, and east to Merced and beyond. (Ref. 56, 368.)

1899. July 22, 00 46 UTC (July 21). West of Squirrel Inn, San Bernardino County, Calif. This foreshock to the earthquake at 20 32 UTC (see below) knocked off tops of chimneys at Squirrel Inn. Landslides were reported in the Cajon Pass area. Felt north to Barstow, west to Santa Monica (Los Angeles County), and south to San Diego. (Ref. 368.)

1899. July 22, 20 32 UTC. Lytle Creek Canyon, San Bernardino County, Calif. North of San Bernardino, in Lytle Creek Canyon, one old adobe house was knocked down. Streams greatly increased their flow of water in the mountains north of Cucamonga and San Bernardino, and extensive landslides were observed. This severe earthquake caused loss to property from Anaheim to Barstow. Felt north to Barstow, west to Ventura, and south to San Diego. Nine aftershocks were felt in the San Bernardino area. Magnitude 5.6 M_S ELL (Ref. 38, 56, 368, 521.)

1899. Oct. 13 (Oct. 12). Near Santa Rosa, Sonoma County, Calif. This earthquake toppled some chimneys and knocked plaster from walls in Santa Rosa. It was felt only to Petaluma, about 23 km south of Santa Rosa. Aftershocks were reported in the area. (Ref. 38, 368.)

1899. Dec. 25. Hemet–San Jacinto, Riverside County, Calif. Property damage from this earthquake was most severe at Hemet and San Jacinto, west of Palm Springs. Six people were killed by falling adobe walls at Saboba, a few kilometers east of San Jacinto. The estimated property loss of about $50,000 appears to be low.

Only two chimneys remained standing in Hemet, where brick buildings partly collapsed and wood-frame buildings shifted off their foundations. A ground fissure about 46 m long extended under a house near Hemet; the house was wrenched and twisted severely. The fissure may have been surface rupture in the San Jacinto fault zone. Many brick buildings were partly wrecked at San Jacinto. At Riverside, chimneys were overthrown, and brick buildings were cracked. This severe shock was felt north to Bakersfield (Kern County), south to Jacumba (San Diego County), and northeast to Needles (San Bernardino County). It also was reported felt at Seligman, Ariz. Many aftershocks occurred on Dec. 25 and 26. Magnitude 6.6 M_{La} DMG. (Ref. 38, 56, 368, 384.)

1901. Mar. 3 (Mar. 2). Near Parkfield, Monterey County, Calif. Chimneys were toppled at Bradley, Echo Valley, Parkfield, Slacks Canyon, Stone Canyon, and Warthan Canyon. At Parkfield, three houses were twisted out of shape and one was almost wrecked. Slight loss to property also was incurred at Adelaida, El Monte, Estrella, Monterey, Paso Robles, and San Miguel. Ground cracks as much as several meters in length and 15-30 cm in width and vertical displacement of about 30 cm were observed in Stone Canyon. Felt from San Francisco on the north to San Luis Obispo on the south and Porterville (Tulare County) on the east. Magnitude 5.8 M_{La} DMG. (Ref. 38, 56, 381.)

1902. May 19. South of Elmira, Solano County, Calif. Almost all chimneys fell at Elmira, and every flue was out of line; a few chimneys toppled at Vacaville, where many brick buildings were cracked badly. Only slight damage occurred at Fairfield, Nevada City, and Suisun City. Felt north to Colusa, south to San Francisco, and east to Ione (Amador County) and beyond. (Ref. 38, 56, 381.)

1902. July 28 (July 27). Near Los Alamos, Santa Barbara County, Calif. At Los Alamos, store buildings were damaged, chimneys were broken, and walls were cracked. Two tanks, each containing about 3,000 barrels of oil, were destroyed on the property of the Western Union Oil Company. An adobe house at the Orena Ranch, a few kilometers south of Lompoc, was affected severely and later destroyed by the July 31 aftershock. At Lompoc, chimneys toppled, one brick building was ruined, and pipelines were broken; at Santa Maria, several chimneys fell from buildings. Felt along the coast from San Luis Obispo to Ventura. Many aftershocks occurred. (Ref. 38, 56, 381.)

1902. July 31; Aug. 1 (July 31). Near Los Alamos, Santa Barbara County, Calif. Two strong earthquakes affected Los Alamos and environs, and many slight shocks were felt during the day. The two events are described together because the effects for each cannot be separated. These earthquakes "completed the ruin" begun on July 28. All houses were damaged at Los Alamos, and not one chimney was left upright. The main effects were confined to an area about 24 km long and 6 km wide. Fissures formed in the ground, landslides occurred, and water began flowing in a formerly dry streambed. The shocks were felt along the coast from Cayucos (San Luis Obispo County) to Oxnard (Ventura County). (Ref. 38, 56, 380, 381.)

1902. Dec. 12. Near Los Alamos, Santa Barbara County, Calif. At Santa Maria, plaster fell in many houses and walls of a brick school were cracked. Dishes and glassware were thrown from shelves at Los Alamos. (Ref. 38, 56, 380.)

1903. June 11. Near San Jose, Santa Clara County, Calif. One chimney fell, other chimneys lost their tops, and a brick wall was downed at San Jose. A few chimneys also toppled at Hayward, Livermore, Santa Cruz, and Watsonville. Felt north to Fort Ross (Sonoma County) and south to King City (Monterey County). Because an earthquake also was reported at San Luis Obispo, it is possible that there were two different events. Magnitude 5.4 M_S ELL. (Ref. 38, 56, 381, 521.)

1903. July 24. Near Willows, Glenn County, Calif. At Willows, plaster fell from many buildings and several brick walls were cracked. Felt from Sacramento north to Greenville (Plumas County) and from Willows east to Nevada City (Yuba County). (Ref. 38, 56.)

1903. Aug. 3 (Aug. 2). Near San Jose, Santa Clara County, Calif. Few large buildings in San Jose were left undamaged, and many were damaged severely. Scores of chimneys were shaken down; brickwork on many of the larger buildings was ruined; and stone trimmings fell to the streets. At Evergreen, a few kilometers southwest of San Jose, one house was shifted on its foundation, and another house lost its chimney. Chimneys were broken to the roofline in Santa Clara. Only slight loss to property was reported at Edenvale, Mount Hamilton, Oakland, San Francisco, Santa Cruz, and Stockton. Felt from Guerneville on the north to Jamesburg on the south to Stockton on the east. Magnitude 5.3 M_S ELL. (Ref. 38, 381, 521.)

1903. Dec. 25. Los Angeles, Calif., region. Plaster and bricks were knocked down in Los Angeles, and bottles were thrown to the floor in a drug store. The shock also was reported at Pasadena, Riverside, San Bernardino, and Sierra Madre. (Ref. 38, 56.)

1905. July 15. Near San Bernardino, Calif. No damage could be documented for this earthquake. The intensity listed was taken from ref. 56. (Ref. 56, 380.)

1905. Sept. 3 (Sept. 2). Los Angeles, Calif., region. Plaster fell in the "Baker block" of Los Angeles, and a heavy bookcase was overturned in the City Hall. (Ref. 56, 380.)

1905. Dec. 23. Bakersfield, Kern County, Calif. Wide cracks formed in buildings in Bakersfield, and large quantities of plaster fell as a result of this strong local earthquake. Objects were thrown from shelves. Two small foreshocks occurred. (Ref. 38, 56, 380.)

1906. Apr. 18. Near San Francisco, Calif. This earthquake is one of the most devastating in the history of California. The earthquake and resulting fires caused an estimated 3,000 deaths and $524 million in property loss. Damage in San Francisco resulting only from the earthquake was estimated at $20 million; outside the city, it was estimated at $4 million. The sensible duration of the shaking in San Francisco was about 1 minute.

The earthquake damaged buildings and structures in all parts of the city and county of San Francisco, although over much of the area, the damage was moderate in amount and character. Most chimneys toppled or were badly broken. In the business district, which was built on ground made by filling in the cove of Yerba Buena, pavements were buckled, arched, and fissured; brick and frame houses of ordinary construction were damaged extensively or destroyed; sewers and water mains were broken; and streetcar tracks were bent into wavelike forms.

On or near the San Andreas fault, buildings were destroyed (one was torn apart), and trees were knocked to the ground. The surface of the ground was torn and heaved into furrow-like ridges. Roads crossing the faultline were impassable, and pipelines were broken. One pipeline that carried water from San Andreas Lake to San Francisco was broken, shutting off the water supply to the city. The fires that ignited soon after the onset of the earthquake quickly raged through the city because of the lack of water to control them. They destroyed a large part of San Francisco and intensified the loss at Fort Bragg and Santa Rosa.

This earthquake caused the most lengthy rupture of a fault that has been observed in the contiguous United States. The displacement of the San Andreas Fault was observed over a distance of 300 km from San Juan Bautista to Point Arena, where it passes out to sea. Additional displacement was observed farther north at Shelter Cove in Humbolt County, and, assuming the rupture was continuous, the total length of rupture would extend to 430 km. The largest horizontal displacement—6.4 m—occurred near Point Reyes Station in Marin County.

In areas where dislocation of fences and roads indicated the amount of ground movement, motions of 3 to 4.5 m were common. Near Point Arena, in Mendocino County, a fence and a row of trees were displaced almost 5 m. At Wright's Station, in Santa Clara County, a lateral displacement of 1.4 m was observed. Vertical displacement of as much as 0.9 m was observed near Fort Ross in Sonoma County. Vertical displacement was not detected toward the south end of the fault.

Although Santa Rosa lies about 30 km from the San Andreas fault, damage to property was severe, and 50 people were killed. The earthquake also was severe in the Los Banos area of the western San Joaquin Valley, where the MM intensity more than

The new stone-faced brick library at Stanford University, Palo Alto, California, was destroyed by the San Francisco, California, earthquake on April 18, 1906. (Photograph by W.C. Mendenhall.)

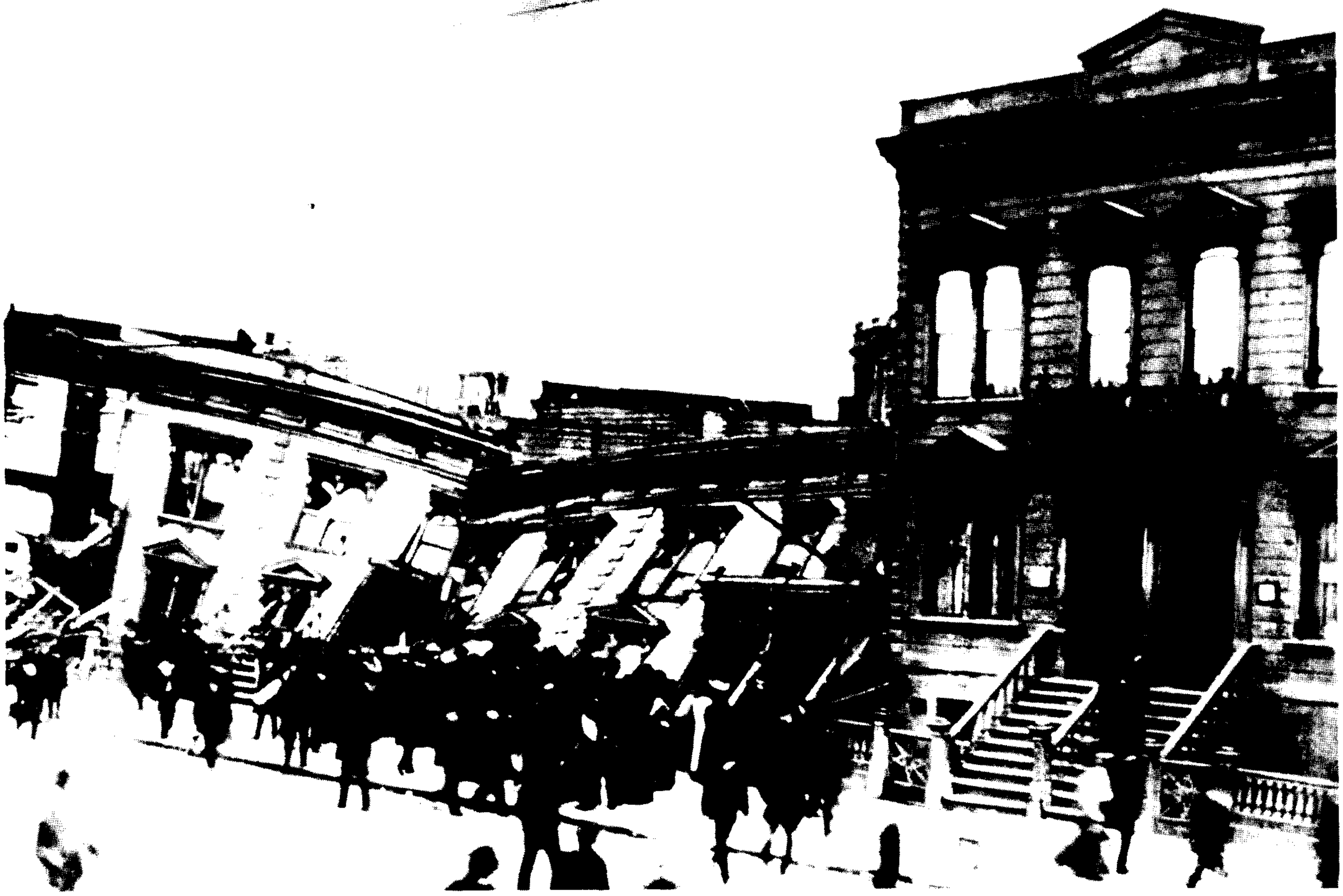
48 km from the fault zone was IX. Santa Rosa lies directly inland from the region of greatest motion on the San Andreas fault.

Trees swayed violently, and some were broken off above the ground or thrown down. The water in springs and artesian wells either increased or decreased its flow. A few sand craterlets formed in areas where water was ejected through cracks or fissures.

The region of destructive intensity extended over a distance of 600 km. The total felt area included most of California and parts of western Nevada and southern Oregon (see fig. 15). The maximum intensity of XI was based on geologic effects, but the highest intensity based on damage was IX. Several foreshocks probably occurred, and many aftershocks were reported, some of which were severe. Magnitude 8.3 M_S CFR, 8.25 M_S GR, 7.4 m_b ABE, 7.8 M_{La} DMG (Ref. 38, 56, 378, 381, 517, 533, 567, 571, 572, 573.)

1906. Apr. 19 (Apr. 18). Near Brawley, Imperial County, Calif. A strong earthquake almost destroyed the Van Ness and Marlour buildings in Brawley. Walls fell into the streets, and chimneys fell to the ground. Not one brick or adobe building in the Brawley area escaped damage. Observers reported that banks along the New River collapsed. Water tanks were destroyed at Cocopar, Baja California. Slight damage was reported at Calexico, El Centro, Holtville, and Imperial. Felt north to Los Angeles, south to Baja California, and east to Yuma, Ariz. Magnitude 6+ M_S CFR, 5.8 M_{La} DMG. (Ref. 38, 56, 381.)

1906. Apr. 23. Near Ferndale, Humboldt County, Calif. Chimneys were toppled and loose objects were knocked down at Ferndale. The earthquake stopped clocks at Cape Mendocino, Eureka, and Trinidad Head. It was reported felt into Oregon. (Ref. 38, 56.)



Ground slumping tilted a row of two-story buildings in San Francisco, California, during April 18, 1906, earthquake. This block of structures was destroyed by the ensuing fire.

1906. May 2 (May 1). Near Guerneville, Sonoma County, Calif. At Guerneville, much plaster cracked and articles were thrown about. (Ref. 38, 56.)

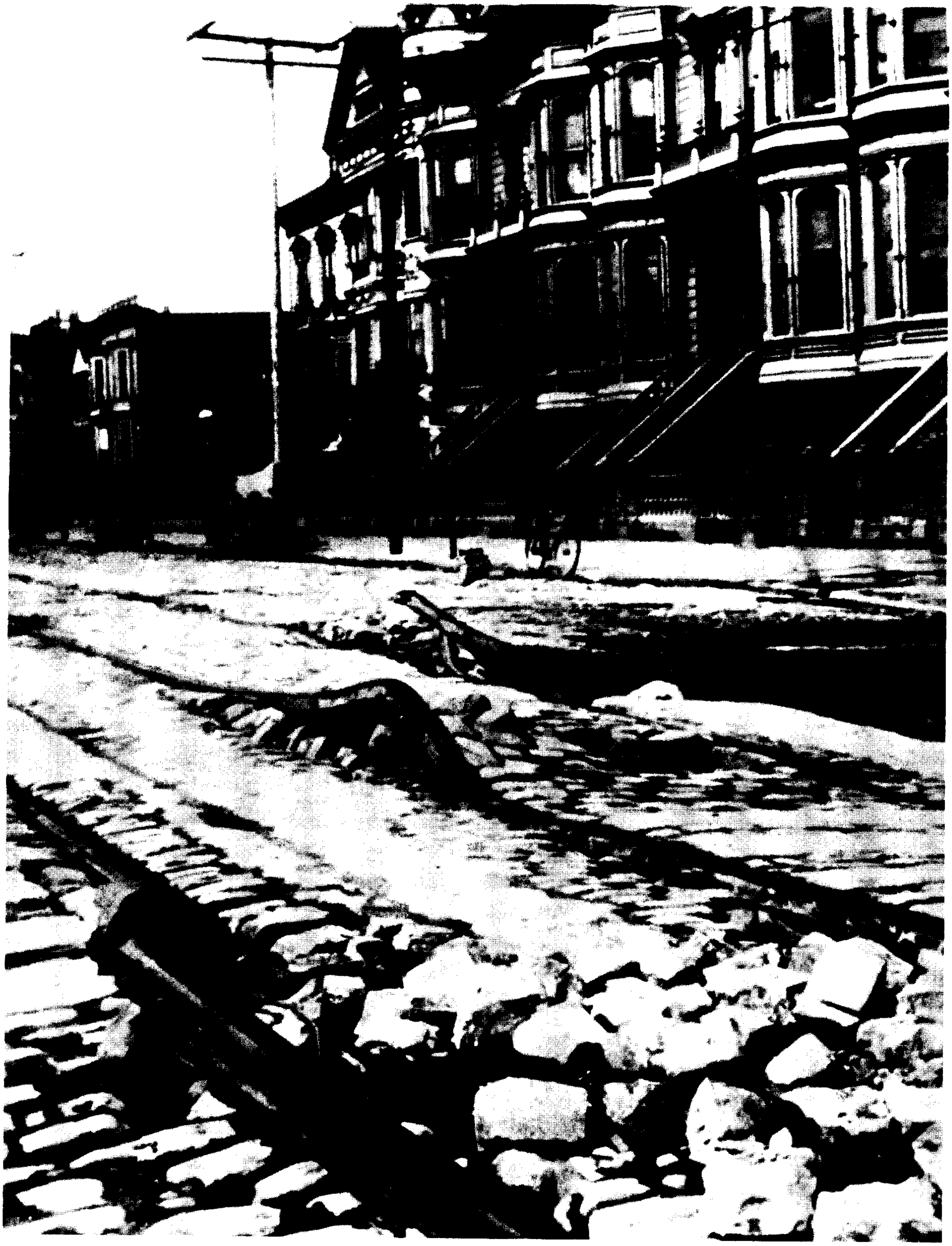
1906. May 7, 04 10 and 05 00 UTC (May 6). Near Upper Lake, Lake County, Calif. These earthquakes were reported to be violent at Upper Lake, about 80 km north of Santa Rosa. Many clocks stopped during the second shock. No damage could be documented for this earthquake. The intensity listed was taken from ref. 56. (Ref. 56, 380.)

1906. Dec. 7 (Dec. 6). Near Piedras Blancas, San Luis Obispo County, Calif. This earthquake cracked the tower at the Piedras Blancas Lighthouse. It also was reported at Cambria, San Luis Obispo, and Santa Maria. (Ref. 56, 380.)

1907. Sept. 20 (Sept. 19). Near San Bernardino, Calif. A few walls of buildings were cracked and dishes were broken at San Bernardino, and the Shaver Building was damaged at San Jacinto. Many landslides occurred in the mountain district north of San Bernardino, and a pipeline in the Santa Anita Mountains was broken. At the Declez quarry, large rocks were thrown down the mountainside. Felt from Los Angeles south to San Diego and east to Salton. Magnitude 6 M_S CFR. (Ref. 38, 56, 381.)

1908. Jan. 27 (Jan. 26). Honey Lake region, Lassen County, Calif. Chimneys were toppled at Amedee and Milford in the Honey Lake region. Aftershocks were reported. (Ref. 38, 56, 380.)

1908. Aug. 18. Near Eureka, Humboldt County, Calif. A few chimneys toppled at Eureka; buildings walls and plate-glass windows cracked; and statues on the courthouse fell or were broken. At the Seazy Ranch, about 10 km north of Eureka near Freshwater, a fissure extending about 0.8 km in length formed in the ground. Several chimneys were thrown down in the area. (Ref. 38, 56, 380.)



Streetcar rails on Howard Street, San Francisco, California, compressed by April 18, 1906, earthquake. (Photograph by G.K. Gilbert.)

Fence offset 2.6 m on the main fault, 0.4 km northwest of Woodville, by the April 18, 1906, California, earthquake. (Photograph by G.K. Gilbert.)

1908. Nov. 4. Inyo County, Calif. This earthquake was the strongest of a series of shocks that occurred in late October and early November. The epicentral area was uninhabited except for a few prospectors, and several of them left the area because of the continuing earthquakes. This shock was felt in Tehachapi and probably to San Bernardino. No damage could be documented for this earthquake. The intensity listed was taken from ref. 382. (Ref. 38, 56, 380, 382.)

1909. May 18 (May 17). Upper Mattole, Humboldt County, Calif. This earthquake ruined all chimneys at Upper Mattole and displaced monuments in the cemetery. The shock was reported only in Humboldt County at Blocksburg, Eureka, and Rohnerville. (Ref. 38, 56.)

1909. June 23 (June 22). South of Downieville in Sierra County, Calif. Minor damage to chimneys, plaster, lumber flumes, and dishes occurred in parts of Sierra and Plumas Counties. The region most strongly affected by the earthquake included the area south and southeast of Downieville, where chimneys were broken and plaster was knocked down. Plaster was shaken from ceilings at Sacramento, and walls were cracked slightly. The shock also was felt at Sparks, Nev. Many aftershocks were reported in the epicentral region. (Ref. 38, 56, 380.)

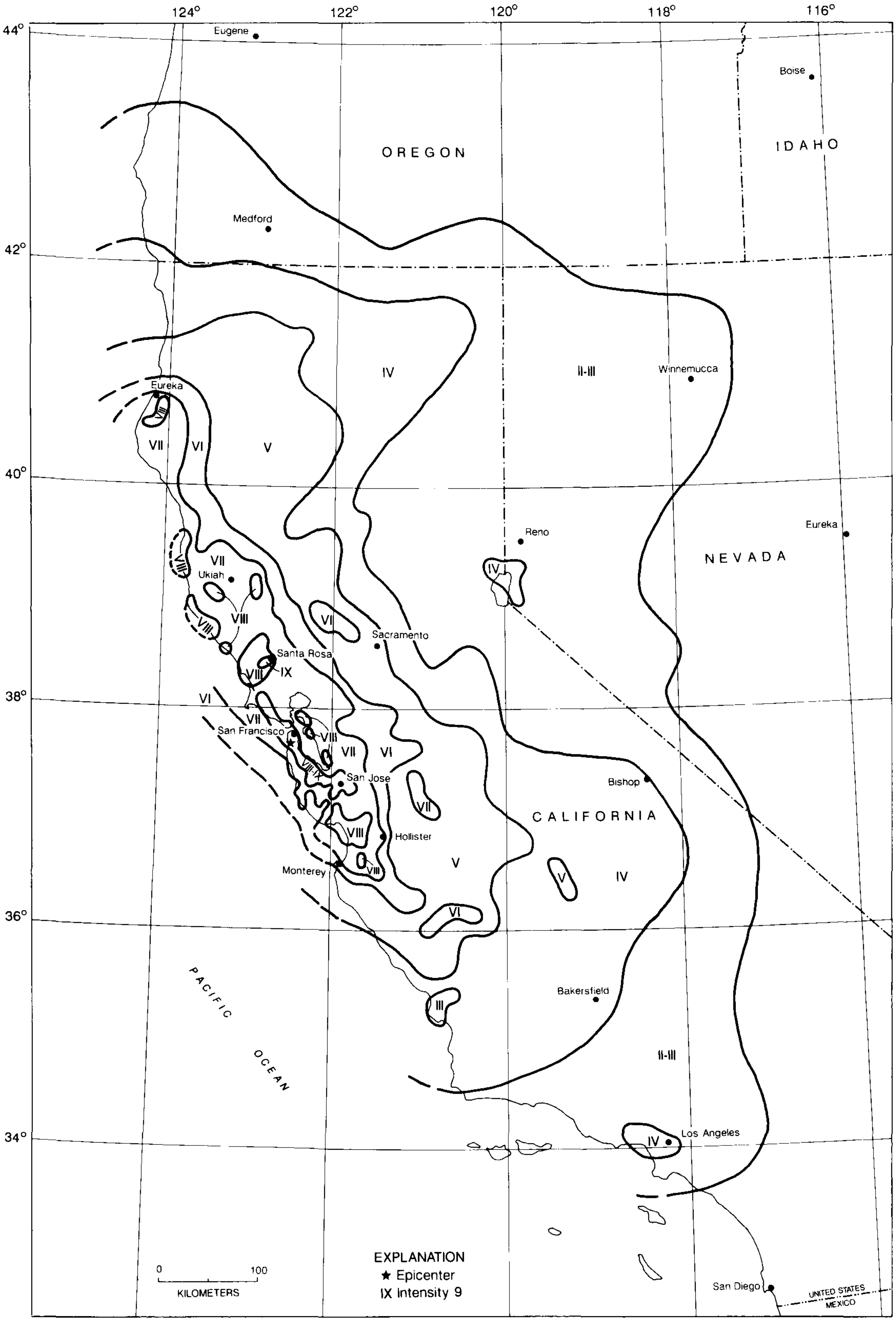


FIGURE 15.—Isoseismal map for the San Francisco, California, earthquake of April 18, 1906. Isoseismals are based on MM intensity estimates from data listed in references 381, 517, 571, 572, and 573 of table 1.

1909. Oct. 29 (Oct. 28). Near Scotia, Humboldt County, Calif. The most serious loss of property, estimated at $100,000, occurred in the Fortuna-Rohnerville area. All chimneys were toppled at Rohnerville, and concrete construction was wrecked. At Upper Mattole, about 40 km south of Rohnerville, most chimneys were wrecked. At Rio Dell, every chimney was downed, houses moved on foundations, and water pipes were broken. At Eureka, Fortuna, Ferndale, and Scotia, a few buildings were damaged, and many chimneys were leveled. Felt north to Gold Beach and Grants Pass, Oreg., south to Point Arena, and east to Chico and Nevada City. It also was observed onboard a ship at sea, 40 km southwest of Cape Mendocino. Aftershocks continued for weeks. Magnitude 6+ M_S CFR, 5.8 M_S ELL. (Ref. 38, 56, 381, 521, 523.)

1910. Mar. 11 (Mar. 10). Near Watsonville, Santa Cruz County, Calif. Plaster fell at Santa Cruz; a marble slab was knocked out of the wall; and windows were broken. Windows and crockery broke at Watsonville. The intensity was about the same down the Pajaro Valley to Monterey Bay; aftershocks were felt over that area also. Felt north to Santa Rosa (Sonoma County), south to Priest Valley (Monterey County), and east to Modesto (Stanislaus County). Magnitude 5.5 M_{La} DMG. (Ref. 38, 56, 381.)

1910. May 6. Near Bishop, Inyo County, Calif. This earthquake generated rockslides in Owens River Valley and Rock Creek Canyon, northwest of Bishop, and overturned shelves at Bishop. New cracks opened in a building at Visalia, about 130 km southwest of the epicenter in Tulare County. The event was felt east into Nevada, northwest to Sacramento, and south to Bakersfield (Kern County). The felt area was similar to that of the shock on Sept. 30, 1889, southwest of Bishop. (Ref. 56, 324, 381.)

1910. May 15. Lake Elsinore region, Riverside County, Calif. Chimneys were shaken down at Corona, Riverside, and Temescal. At Wildomar, bricks fell from chimneys and rocks rolled down the hillside. At Beaumont, a concrete-block building was cracked and plate-glass windows were broken. Felt from Barstow on the north to San Diego on the south and from Redondo Beach on the west to Palm Springs on the east. Moderate foreshocks occurred on Apr. 11 (07 57 UTC) and May 13 (06 20 UTC); slight aftershocks occurred on May 15 (20 57 UTC) and May 22 (04 15 UTC). Magnitude 6.0 M_{La} DMG, 5.5 M_S ELL. (Ref. 38, 56, 381, 521.)

1910. Dec. 31. East of Salinas in San Benito County, Calif. The earthquake was reported to be the "heaviest since 1906" at Salinas, where a water main and dishes were broken. The shock was "hard" at Hollister but caused little damage. It also was reported in Sonoma County, about 220 km to the north. (Ref. 38, 56, 324.)

1911. Mar. 11. Near Hollister, San Benito County, Calif. At Hollister, chimneys and windows were damaged, plaster cracked, and objects were thrown from walls. Effects of the earthquake were light at Salinas (Monterey County) and Campbell, Los Gatos, and San Jose (Santa Clara County). (Ref. 38, 56, 324.)

1911. July 1. Near Coyote, Santa Clara County, Calif. This earthquake destroyed chimneys and cracked brick walls at Gilroy, Los Gatos, Morgan Hill, San Jose, Santa Clara, and other nearby towns. One three-story brick building at Mount Hamilton (Lick Observatory) was damaged so severely it had to be rebuilt, and chimneys on several houses were damaged. Near Coyote, three 7.5-m-high water tanks were knocked down. Slight damage to some buildings was reported at San Francisco. The shock was observed north to Woodland (Yolo County) and south to San Ardo (Monterey County). Isolated reports of this shock were received from as far east as Reno and Carson City, Nev. Several light aftershocks were felt through December 1911. Magnitude 6.2 M_{La} DMG, 6.6 M_S CFR, 6.5 M_S ELL. (Ref. 38, 56, 258, 381, 521.)

1911. Aug. 11. Near San Jacinto, Riverside County, Calif. A few walls sustained cracks and crockery was broken at San Jacinto. The shock was sharp at Redlands and San Bernardino but was slight at Los Angeles. A light foreshock occurred on Aug. 11 at 18 20 UTC. (Ref. 56, 380.)

1912. Jan. 5 (Jan. 4). Near Bishop, Inyo County, Calif. Breakable goods and merchandise were damaged in some stores at Bishop, and loose articles were knocked to the floor. The shock also was reported at Bakersfield, Fresno, and Visalia, and one doubtful report was received from Blair, Nev. (Ref. 56, 324.)

1912. Dec. 14. Southeast of Oxnard, Ventura County, Calif. Two sharp earthquakes overturned desks at the Ocean View School and wrecked two nearby barns. The tremors were "very marked in the country districts." (Ref. 38, 56.)

1914. Nov. 9 (Nov. 8). Santa Clara County, Calif. Near Laurel (Santa Cruz County), two chimneys were knocked down and articles were thrown from shelves. North of Laurel, two water pipes were broken at the Montezuma School. Six chimneys and several windowpanes were cracked at Los Gatos, and small amounts of plaster fell to the floor. Felt from Santa Rosa on the north to San Joaquin Valley on the east and to Soledad (Monterey County) on the south. (Ref. 38, 324, 381, 414.)

1915. Jan. 12 (Jan. 11). Near Los Alamos, Santa Barbara County, Calif. Some chimneys were shaken down at Los Alamos; almost every chimney was damaged to some extent; and water pipes were pulled apart at their unions. Chimneys also were downed at Careaga, Santa Ynez, and at several ranches in Santa Barbara County. Brick buildings were damaged at Lompoc, about 20 km southwest of Los Alamos. In the epicentral area, cracks formed in the alluvial soil and many small landslides occurred. Felt north to San Jose, east to Bakersfield, and southeast along the coast to Los Angeles. Many aftershocks occurred for about a month. (Ref. 38, 56, 381.)

1915. Feb. 22. Near Whitmore, Shasta County, Calif. A highly localized shock in the mountains near Whitmore, northwest of Lassen Peak, caused severe dislocation of the ground at a ranch about 30 km from the foot of Lassen Peak. The earth cracked near the ranch, and fissures formed at points along the road leading to the ranch. Water spurted from the ground in many places; bubbling springs formed; and a barn sagged where the earth sank beneath its foundation. Other unusual phenomena also were reported. This event may have been a landslide because it was not recorded on seismographs at Berkeley. (Ref. 38, 56, 324, 381.)

1915. June 23, 03 59 and 04 56 UTC (June 22). North of Calexico, Imperial Valley, Calif. Two destructive earthquakes wrecked buildings, overturned chimneys, and knocked down walls in the Calexico–El Centro area. The second shock, which was as strong as the first, completed the destruction of the buildings that already were weakened. This shock killed six people in Mexicali, Mexico. A foreshock occurred at 03 40 UTC.

The area of heaviest property damage extended from Mexicali north to Calexico, El Centro, and Heber, where almost every brick and adobe building was damaged. Property loss, estimated at $900,000 for both Mexico and the United States, was due as much to the poor quality of construction as to the intensity of the earthquake. Damage at El Centro, the largest city in the Imperial Valley at this time, was estimated at $600,000. Property damage in Calexico, Heber, and Mexicali was almost as severe, but the rebuilding cost was less because the towns were much smaller than El Centro.

A few cracks formed in the alluvium parallel to the levees in the Imperial Valley, but the irrigation ditches were damaged only slightly, if at all. Many unstable banks of the Alamo and New Rivers slid into the water; cracks formed in the marshy bed of the New River northwest of El Centro. Residents about 25 km north of the mud volcanoes, which are west of Laguna de los Volcanes, Mexico (about 40 km south of Calexico), reported that columns of steam were seen rising from the vents for several days following the earthquakes and that occasional explosions were heard from that direction.

A foreshock occurred about 20 minutes before the first shock, and several aftershocks occurred through August 1915. The main earthquakes were felt north to Los Angeles and San Bernardino, east to Parker and Yuma, Ariz., and south at least to Ensenada, Mexico, and probably farther. Magnitude 5.6 M_{La} DMG (both earthquakes), 6.0 M_S ELL (03 59), 5.9 M_S ELL (04 56). (Ref. 38, 381, 383, 521.)

1915. Oct. 8 (Oct. 7). Near Piedmont, Alameda County, Calif. This sharp earthquake knocked down a few chimneys at Piedmont, and windows were broken. A small amount of plaster fell on the campus at Berkeley. Felt from Sebastopol, Sonoma County, to Santa Clara. Three aftershocks were reported. (Ref. 38, 56, 324, 442.)

1915. Nov. 21 (Nov. 20). Baja California, Mexico. A major earthquake left large cracks in a levee at Laguna de los Volcanes, Mexico, an uninhabited area about 40 km south of Calexico, Calif. Two hunters near Laguna de los Volcanes, Mexico, reported that a column of steam shot up about 180–200 m high and was followed by a column of black mud that reached about the same height. This column alternated between steam and mud for about 1 hour. The observers, although on level ground, had trouble standing during the earthquake. Cracks were observed on both sides of the New River for a distance of about 3 km. Felt only slightly at Los Angeles, but felt strongly at Calexico and San Diego and at Yuma, Ariz. Magnitude 7.1 M_S ABE, 6.8 m_b ABE. (Ref. 38, 258, 492.)

1915. Dec. 31. Off coast of Humboldt County, Calif. Felt inland only slightly at Eureka and Shively. Magnitude 6.5 M_S ELL, 6.5 M_S GR (Ref. 56, 258, 521.)

1916. July 5 (July 4). Near Ferndale, Humboldt County, Calif. About 3 km west of Ferndale, two chimneys were cracked, and a woodpile was overturned. One plate-glass window at Ferndale was broken, and vases were thrown from shelves. (Ref. 38, 56, 324.)

1916. Aug. 6. Near Paicines, San Benito County, Calif. Chimneys on a hotel at Paicines were destroyed; damage was slight at Hollister. Huge boulders rolled onto the highway at Chittenden Pass in Santa Cruz County. Felt to San Francisco on the north, Monterey on the west, and Paso Robles on the south. (Ref. 38, 56, 324, 381.)

1916. Oct. 23, 02 44 UTC (Oct. 22). Near Lebec, Kern County, Calif. The epicentral area of this earthquake was sparsely populated, and so intensity information was meager. In San Emigdio Canyon (Kern County), the top one-third of a large rock chimney was knocked off, and many rocks rolled off nearby mountains. Near Frazier Mountain (Ventura County), about 10 km southwest of Tejon Pass, a crack opened in the ground; on the Snedden Ranch in Lockwood Valley, an adobe house was cracked so severely that it could not be repaired. On the north side of Lockwood Valley, at the Frazier Borax mine, the shock detached the porch from a frame house. On Alamo Mountain, about 18 km southwest of Tejon Pass, limbs fell from pine trees and rocks fell from the canyon walls at several places. Near Gorman, a crack several meters in length and a few centimeters in width formed in the cement surface of the highway. Cracks also were reported in the highway at Bailey's Patrol Station, northwest of Quail Lake.

A strong aftershock was observed in the area 10 minutes later, and several lighter aftershocks were reported. The main earthquake was felt from Shafter (Kern County) on the north to Los Angeles on the south and from Roosevelt (Los Angeles County) on the east to Los Olivos (Santa Barbara County) on the west. Isolated felt reports, however, were received from such distant points as Fresno and San Diego. Magnitude 5.5 M_S GR, 5.2 M_{La} DMG. (Ref. 38, 56, 258, 534.)

1916. Dec. 1. Near Avila, San Luis Obispo County, Calif. Some smokestacks toppled at the Union Oil Company refinery buildings in Avila. Plaster fell in several houses; much glass was broken; and merchandise fell from shelves. In Dairy Canyon, about 3 km north of Avila, a landslide covered the railroad tracks. One brick fell from a building in San Luis Obispo. Water in the San Luis Obispo Bay was disturbed. The shock was "severe" at Port San Luis but was slight to the southeast, at Santa Maria (Santa Barbara County). (Ref. 38, 56, 324.)

1917. May 28 (May 27). Imperial Valley, near Holtville, Calif. Walls were cracked at Brawley, and residents were panic stricken. Felt in Imperial, Riverside, and San Diego Counties and probably into northern Mexico. (Ref. 56, 380.)

1917. July 6. Owens Valley, Inyo County, Calif. This earthquake caused a break about 30.5 m long in the flume of the Los Angeles aqueduct south of Owens Lake. Chimneys cracked in the area, and rocks rolled down the mountain. Nine shocks occurred from July 7 to 9. The shock was reported from Little Lake in the south to a point 18 km northwest of Independence in the north. (Ref. 38, 56, 324.)

1917. July 9. Lopez Canyon, San Luis Obispo County, Calif. Chimneys cracked and rocks rolled down the hillsides in Lopez Canyon, near San Luis Obispo. Four foreshocks and three aftershocks were felt in the area from July 7 at 20 57 UTC to July 10 at 00 45 UTC. (Ref. 38, 56, 324.)

1918. Mar. 12. Downieville, Sierra County, Calif. Chimneys were knocked over at Downieville. This sharp shock was reported only in Sierra County. An aftershock was reported 2 hours later. (Ref. 38, 56, 272, 324.)

1918. Apr. 21. Near San Jacinto, Riverside County, Calif. Major damage occurred in San Jacinto, about 120 km southeast of Los Angeles and at Hemet, about 3 km south of San Jacinto. Several residents were injured, and one was killed. An earthquake of similar intensity occurred in the same area on December 25, 1899.

In the business section of San Jacinto, a town of about 1,000 population, only one new concrete building and one frame building remained standing after the earthquake. Most of the ruined buildings were of poor construction, however. Property damage at Hemet was not as severe as in San Jacinto. No buildings were wrecked, and no buildings of good construction were damaged seriously. Total property loss in the two towns was estimated at $200,000.

Light damage to structures occurred in several towns within a 160-km radius of San Jacinto. Concrete irrigation canals were broken in several places in the Hemet–San Jacinto area.

Many lengthwise cracks were observed in the highway between San Jacinto and Hemet, but cracks were not observed at the sides of this highway. About 1.5 km from the center of San Jacinto, the concrete highway was buckled, and a section about 1 m wide was torn up. Cracks in the ground were noted in four areas, but all were believed to be due to the shaking, not to the surface rupture along the San Jacinto fault. Many small sand craters were observed on a farm about 1.5 km northwest of San Jacinto. Felt from Taft (Kern County) in the north along the coast to San Diego (and probably into Mexico) and from Needles (San Bernardino County) in the east, south to Yuma, Ariz. Many aftershocks occurred, including a strong tremor on June 6, 1918. Two moderate shocks on Apr. 22 (16 07 and 16 14 UTC) shook down loose bricks and tottering walls in Hemet and San Jacinto. Magnitude 6.9 M_S ELL, 6.6 M_{La} DMG (Ref. 38, 56, 258, 381, 384, 521, 533, 599.)

Collapsed building at San Jacinto, California, caused by the April 21, 1918, earthquake. (Photograph by University of California, Berkeley.)

1918. Apr. 22. Near Corona, Riverside County, Calif. Chimneys were cracked, and plaster was thrown down at Corona. (Ref. 38, 56, 380.)

1918. May 1 (Apr. 30). Calexico, Imperial County, Calif. Plate-glass windows were broken at Calexico, and stock was thrown from shelves at El Centro. Felt over an area that included San Diego County on the west, San Jacinto on the north, western Arizona on the east, and an unknown distance into Mexico on the south. (Ref. 56, 272.)

1918. June 6. Near Hemet, Riverside County, Calif. A strong aftershock of the event on Apr. 21, 1918, cracked plaster 7 km southeast of Hemet, loosened rocks on the mountainside, and cracked the ground around large trees. It was felt in Imperial, Los Angeles, Riverside, San Bernardino, and San Diego Counties. (Ref. 56, 380.)

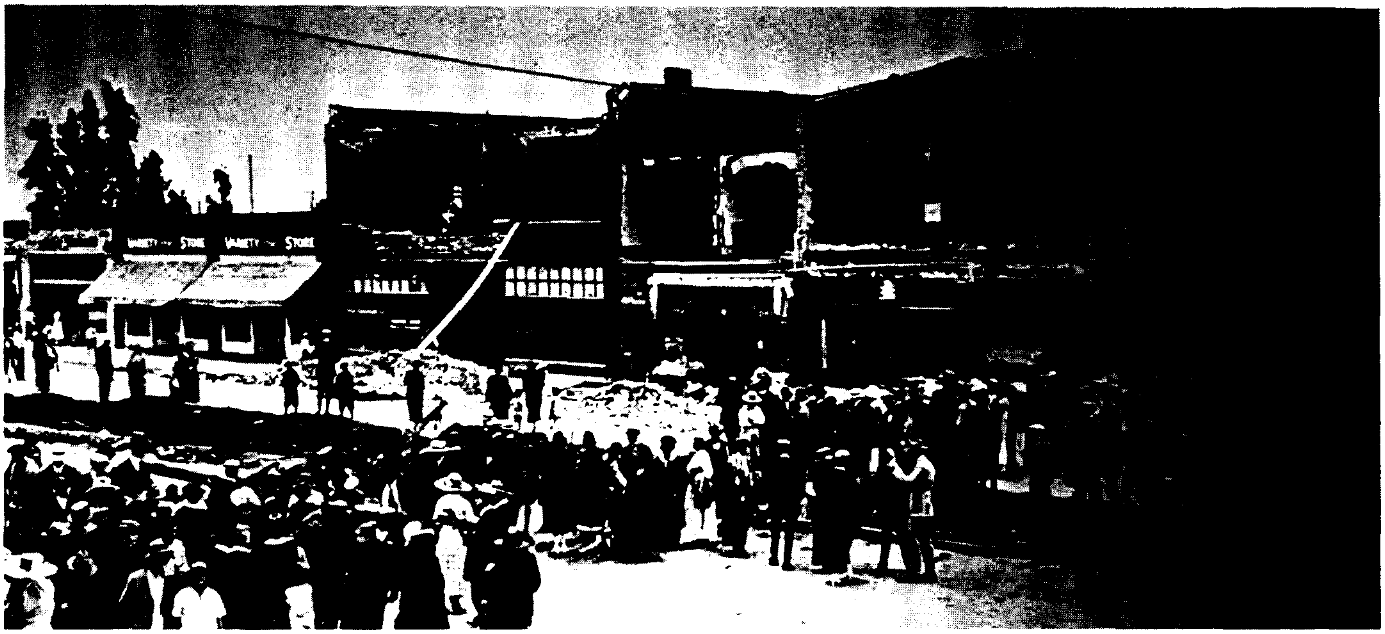
1918. July 15 (July 14). Off the coast of northern Humboldt County, Calif. Buildings swayed alarmingly at Eureka, and most residents ran outside. The shock also was felt in Mendocino and Trinity Counties. Magnitude 6.5 M_S ELL, 5.9 M_{La} ELL. (Ref. 38, 56, 258, 521.)

1918. Nov. 19. Near Venice, Los Angeles County, Calif. At Venice, plaster was downed and dishes were thrown to the floor; at Santa Monica, chimneys were cracked. The earthquake was reported only in Los Angeles and Orange Counties. (Ref. 38, 56.)

1919. Jan. 4. East of Redding, Shasta County, Calif. In the Clover Creek area, between Fern and Whitmore, the earthquake damaged chimneys and broke dishes. A surface fracture cut across a road near Fern and caused vertical displacement of several feet. This local event was not felt at Millville, about 30 km distant, and was not recorded on seismographs. This event may have been a landslide similar to one that occurred at the same location on Feb. 22, 1915. (Ref. 56, 324.)

1919. Feb. 16. Near Maricopa, Kern County, Calif. The earthquake cracked buildings at Maricopa and the Grapevine pump station. At Belridge, an oil tank was split, and at Lebec, rocks rolled down the hillsides. This shock also was felt in Fresno, Los Angeles, San Luis Obispo, and Tulare Counties. Magnitude 5.7 Ukn JON. (Ref. 38, 56.)

1919. Sept. 15. Near Eureka, Humboldt County, Calif. Some chimneys were demolished at Eureka, and windows were broken. Three aftershocks occurred within about 5 hours. (Ref. 38, 56, 324.)



Collapsed exterior wall of Hotel Inglewood, Inglewood, California, caused by the June 22, 1920 (June 21 PST), earthquake. (Photograph by University of California, Berkeley.)

1920. Jan. 1 (Dec. 31, 1919). Near Warner Springs, San Diego County, Calif. Adobe walls were cracked at Warner Springs. The shock also was observed in Imperial, Los Angeles, and Riverside Counties. (Ref. 56, 380.)

1920. June 22 (June 21). Near Inglewood, Los Angeles County, Calif. This earthquake mainly damaged poorly built structures in the area of Inglewood, about 16 km south of downtown Los Angeles. Property loss was estimated at more than $100,000. The destructive effects of the shock were most prominent along Commercial Street, where damage commonly was more severe to two-story buildings than to one-story buildings.

The Inglewood grammar school was wrecked, and walls of the Inglewood Hotel and a nearby electric substation fell into the street. Many chimneys on private houses in Inglewood were broken at the roofline. The water mains and plant of the Inglewood Water Company were damaged. At Hyde Park, 3 km northeast of Inglewood, about 30 percent of the chimneys were overthrown, and brick facings on the fronts of five school buildings were knocked down. In a cemetery east of Inglewood, tombstones were twisted and overturned. Many aftershocks occurred, but most were felt only in the Inglewood area. (Ref. 38, 56, 385, 537.)

1920. July 16, 18 08, 21 27, and 21 30 UTC. Los Angeles, Calif. A series of more than 100 earthquakes occurred in the Los Angeles area from Feb. 1 to Sept. 30, 1920. The strongest shocks were observed on July 16. Damage from the July 16 events included cracked walls, fallen plaster from ceilings and walls, and fallen bricks from cornices and chimneys. Most of the earthquakes were felt only in the Los Angeles area. The second shock on July 16 was felt at Mount Wilson and Pasadena, and the third was felt at Pomona and Santa Ana. (Ref. 56, 380, 386.)

1920. July 23 (July 22). Hot Springs, Shasta County, Calif. Chimneys and dishes were broken and dishes were shaken from shelves at Hot Springs. It was felt from Redding northeast to Fall River Mills and McArthur and along the McCloud River. Three sharp aftershocks were observed on July 23 at 14 00, 16 00, and 20 00 UTC. (Ref. 38, 56, 324, 537.)

1922. Jan. 31. Off the coast of Humboldt County, Calif. This potentially damaging earthquake was felt from Eugene, Oreg., to San Francisco. Magnitude 7.6 M_S CFR, 7.3 M_S GR, 7.3 m_b ABE. (Ref. 56, 258, 272.)

1922. Mar. 10. Cholame Valley area, San Luis Obispo County, Calif. Houses were damaged severely along the San Andreas fault zone in Monterey and San Luis Obispo Counties. Chimneys fell at Parkfield and in southern Cholame Valley. One house was jolted from its foundation onto the ground, and its porch was displaced 30 cm away from the house. Another severely damaged house was twisted into two parts. A large water tank on a ranch at Cholame was knocked down and broken into pieces, and oil pipelines broke between Shandon and Antelope. A ground crack, 15–30 cm wide and about 800 m long, was reported in Cholame Valley. Small ground cracks also formed in the San Andreas fault zone. Felt from San Jose on the north to Los Angeles on the south and east to Springville (Tulare County). A moderate aftershock occurred on Mar. 16 at 23 11 UTC. Magnitude 6.3 M_{La} DMG, 6.3 M_S ELL. (Ref. 38, 56, 258, 324, 381, 521.)

1923. Jan. 22. Off the coast of Humboldt County, Calif. Houses were damaged severely at Ferndale, Petrolia, and Upper Mattole; many chimneys were downed; and water lines were broken. At Pepperwood, one house was shaken from its foundation and split apart, and another was twisted from its base. Chimneys also were knocked over at Alton, Dyerville, Fortuna, Loleta, Ocean House, and Scotia. Several landslides occurred in the canyon. Felt from Walker (Siskiyou County) south to San Francisco and beyond and east to Grass Valley (Nevada County). It also was observed on several ships at sea. Many aftershocks occurred in the Petrolia–Upper Mattole region. Magnitude 7.2 M_S ABE, 7.3 M_S CFR, 6.5 M_{La} DMG. A small tsunami was recorded. (Ref. 38, 56, 258, 381, 610.)

1923. July 23 (July 22). Near Redlands, Riverside County, Calif. Many chimneys were broken in Redlands, San Bernardino, and along Base Line Road, west of Harlem Springs. The fronts of three buildings were cracked badly in Redlands, and a few fire walls were thrown down. At San Bernardino, two cornices were thrown down; parts of brick walls collapsed; and pavement buckled. Damage to walls and chimneys also occurred at Colton, Loma Linda, and Patton. Felt north to Mojave (Kern County) southeast to Calexico (Imperial County) and east to Big Bear Valley (San Bernardino County). Magnitude 6.25 M_S CFR, 6.0 M_{La} DMG, 6.3 M_S ELL. (Ref. 258, 381, 388.)

1923. Nov. 5. Baja California, Mexico. At Calexico, Calif., a hotel shifted several centimeters on its foundation, and other structures sustained minor damage. The intensity of the earthquake was similar at El Centro, where five pronounced shocks were reported. The earthquake also was felt at Brawley and San Diego. (Ref. 38, 56.)

1923. Nov. 7. Baja California, Mexico. This earthquake was stronger than that on Nov. 5, 1923. Additional property damage occurred at Calexico, Calif., and one fire resulted. Felt only in Imperial and San Diego Counties. (Ref. 38, 56.)

1924. Dec. 28 (Dec. 27). Salinas, Monterey County, Calif. Considerable minor damage to plaster occurred at Salinas, where residents rushed into the streets in panic. The dining room of one house was "practically a wreck" from fallen plaster. Felt from King City (Monterey County) north to Palo Alto (Santa Clara County) and west of the Mount Hamilton Range. (Ref. 56, 324, 539.)

1925. Apr. 16 (Apr. 15). Baja California, Mexico. At Calexico, Calif., plaster was shaken from walls at the public library and residents ran outside. (Ref. 38, 56, 218.)

1925. June 29. Near Santa Barbara, Calif., in the Santa Barbara Channel. This destructive earthquake caused property damage estimated at $8 million and killed 13 people. Most of the damage occurred at Santa Barbara and nearby towns along the coast, but the earthquake caused moderate damage at many points north of the Santa Ynez Mountains, in the Santa Ynez and Santa Maria River valleys. North of Santa Barbara, the earth dam of the Sheffield Reservoir was destroyed, but the water released caused little damage.

In Santa Barbara, few buildings on State Street escaped damage. Because parts of the main business district and the area near the seashore were built on land fill, many of the structures there were demolished, and others were so shattered that they had to be razed. In general, however, buildings of reinforced concrete were damaged little, except where workmanship was poor; frame buildings covered with stucco, sheathing, or lath also withstood the shock well. Loss to the sewage system was heavy only in areas of land fill, but the disposal plant was destroyed above the surface of the ground.

Among the most conspicuous building failures in Santa Barbara were the Arlington Hotel (a composite building of irregular shape), the Californian Hotel (a new four-story brick building), the San Marcos office building (a four-story reinforced concrete structure), the El Camino Real Hotel (a two-story brick and wood structure), and the Potter Theater building (a three-and-one-third-story brick and wood structure). Other public buildings seriously damaged included the courthouse, jail, library, schools, and churches.

Structures built on solid ground or pavement of all types withstood the earthquake well. The only severely damaged pavement was that on the boulevard paralleling the beach, where the shoulders of the pavement were displaced 20–36 cm horizontally. The pavement sustained cracks as wide as 40 cm at

Wall of the Hotel Californian at Santa Barbara, California, downed by the June 29, 1925, earthquake. (Photograph by University of California, Berkeley.)

several points along the beachfront. Concrete curbs buckled in almost every block in Santa Barbara.

The earthquake caused damage on the Southern Pacific Company Railroad from Gaviota (mile 331 as measured from San Francisco) on the north to Ventura (mile 598) on the south. Heavy subsidence of the larger fills and slope failure of the sides of deep cuts were noted on the railroad track from Naples to Santa Barbara. Many of the bluffs in the Naples area, adjacent to the ocean, fissured and caused extensive landslides. A section of ground (about 2 acres), adjacent to the track between Naples and Santa Barbara, subsided about 30 cm.

Felt from Paso Robles (San Luis Obispo County) on the north to Santa Ana (Orange County) on the south and to Mojave (Kern County) on the east. Several strong aftershocks occurred on July 3, and lighter shocks occurred throughout July 1925. Magnitude 6.3 M_S CFR, 6.1 M_{La} DMG. (Ref. 38, 258, 381, 389, 533, 540, 541, 542.)

1925. July 3, 16 37 and 18 19 UTC. Near Santa Barbara, Calif. The first aftershock of the June 29 earthquake toppled a few damaged chimneys at Santa Barbara and left cracks in walls. The second tremor was larger than the first because as surface waves were reported only for the second tremor (from Honolulu, Hawaii, and Cambridge, Mass.). The lack of information on damage from the second shock probably is due to its occurrence so soon after the first shock. (Ref. 56, 218, 380.)

1926. Feb. 18. Near Santa Barbara, Calif. Windows were broken in a Santa Barbara school, and a water main was broken in the roundhouse. Telephone equipment was damaged at Simi (Ventura County). Felt along the coast from San Luis Obispo on the northwest to south of Santa Ana, a distance of about 320 km. Magnitude 5.0 M_{La} DMG. (Ref. 38, 56, 218.)

1926. June 29. Near Santa Barbara, Calif. Some chimneys fell at Santa Barbara, and one child was killed by falling bricks. A streetcar was derailed; telephone wires became tangled; plate-glass windows were broken; and old cracks in walls enlarged. The shock was felt strongly at Buellton and Ventura and was reported as far southeast as the Los Angeles beaches. (Ref. 38, 56, 218, 533.)

El Camino Real Hotel and garage in Santa Barbara, California, severely damaged by the June 29, 1925, earthquake.

1926. July 25. Near Idria, San Benito County, Calif. Rocks rolled down the hillside in the area of Idria and Panoche. The earthquake cracked plaster in the San Joaquin Valley. It was felt southeastward across the San Joaquin Valley to Kernville and north and northwestward to Sacramento and San Jose. (Ref. 56, 218, 390.)

1926. Oct. 22, 12 35 and 13 35 UTC. Off the coast of Monterey County, Calif. Two large-magnitude earthquakes caused considerable damage in the Monterey Bay region. The first shock was severe at Santa Cruz, where many chimneys were knocked down, and old brick buildings sustained damage. A few chimneys also were knocked down at Carmel and Monterey. A lamp was thrown from its base, and a lens was broken at the lighthouse on Ano Nuevo Island, northwest of Santa Cruz. Lighter effects were reported as far away as San Francisco (120 km from the epicenter), where the tile surfaces of a few buildings were damaged, windows were broken, and plaster was cracked extensively.

The second shock, an hour later, was almost as widely felt as the first, and appears to have been stronger than the first earthquake at towns north of Monterey Bay. The shaking again was heavy on Ano Nuevo Island. The shocks were felt over about the same area—north to Middletown (Lake County), south along the coast to Lompoc (Santa Barbara County), and east to Turlock (Stanislaus County). Many small aftershocks occurred. Magnitude 6.1 M_S CFR (both earthquakes), 6.1 M_{La} DMG (12 35 UTC). (Ref. 56, 218, 381, 391, 521.)

1927. Jan. 1, 08 16 and 09 13 UTC. Imperial Valley, Calif. Two strong earthquakes began a long series of shocks, although none of the aftershocks exceeded MM intensity VI. Refer to June 23, 1915, above, for a description of a similar double earthquake occurrence at about the same location. Many buildings were damaged severely at Calexico (Imperial County), and several people were injured by collapsing roofs and walls. At Mexicali, Mexico, some buildings were destroyed and many were damaged. Water mains were broken in both towns. Slight damage to buildings also was reported at El Centro, Heber, and Imperial. Felt northwest to Orange County and east into Arizona. Hundreds of aftershocks occurred. (Ref. 38, 56, 258, 381.)

1927. Aug. 4. Santa Monica Bay, Calif. Only minor damage occurred in the area. A water main was broken in downtown Los Angeles. The shock was reported north to Ventura, east to San Bernardino, and south to Anaheim (Orange County). Magnitude 5.0 M_{La} DMG. (Ref. 38, 56, 218.)

1927. Aug. 20. Off the coast of Humboldt County, Calif. At Eureka and Arcata, chimneys were destroyed, windows and water pipes broke, and walls cracked. Plaster fell in buildings, and some doors jammed. People driving automobiles had steering problems. Cracks formed in mud and gravel in Redwood Park (Eureka), and moderate landslides occurred. Chimneys also were damaged at Fortuna, Ferndale, Freshwater, and Scotia. Felt north to the Smith River area near the Oregon-California border and south to Westport, in Mendocino County. Magnitude 5.0 M_{La} DMG. (Ref. 38, 218, 324, 543.)

1927. Sept. 18 (Sept. 17). Northwest of Bishop, Inyo County, Calif. The intensity of this earthquake probably was highest near Bishop, where several chimneys were downed, many windows were cracked or broken, and parked cars moved back and forth. The shock also appears to have been strong in the sierra regions of Fresno and Madera Counties. A landslide caused damage at the powerhouse in Owens River Canyon, north of Bishop. Felt from Mono County in the north to Los Angeles County in the south and from Kings County in the west to western Nevada in the east. A slight aftershock was felt on Sept. 19 at 05 23 UTC. Magnitude 5.5 M_{La} ELL. (Ref. 56, 218, 258, 521, 535.)

1927. Nov. 4. Off the coast of Santa Barbara County, west of Lompoc, Calif. The most severe damage to property occurred in the areas west and north of Lompoc. Chimneys were wrecked at several towns, including Arroyo Grande, Berros, Guadalupe, Halcyon, Lompoc, Los Alamos, and Nipomo. On the Roberd's ranch, an earthquake fountain created between 10 and 20 sand craters; lurches and cracks were observed in the water-soaked soil. The Roberd ranch house was shifted on its foundation about 5 cm, and small outbuildings were pushed from their foundations. The walls of a poorly built block building collapsed at White Hills. At Santa Maria and other towns in the area, chimneys were damaged, old brick walls and interior walls formed cracks, and cornices fell.

Near Surf, west of Lompoc, the Southern Pacific Railroad bridge was thrown out of alignment near its center; a concrete highway was cracked; and small rockslides and earthslides occurred. Cracks formed in the ground about 6.5 km north of Arlight. Felt from Morgan Hill south to Redondo Beach and from the coast east to Kernville. A tsunami was recorded on tide gages at San Francisco, La Jolla, San Diego, and Fort Point, and waves were observed at Pismo, Port San Luis (1.5 m), and Surf (1.8 m). Many aftershocks occurred. Magnitude 7.3 M_S GR, 7.3 m_b ABE, 7.5 M_S CFR, 6.2 M_{La} DMG. (Ref. 38, 56, 381, 392, 521, 610.)

1927. Nov. 19 (Nov. 18). Near Santa Maria, Santa Barbara County, Calif. Chimneys, weakened by the shock on Nov. 4, 1927, fell at Santa Maria, and windows cracked. Plaster was cracked at Betteravia. Felt from San Miguel (San Luis Obispo County) and Parkfield (Monterey County) on the north to towns in the area of Santa Barbara Channel on the south. (Ref. 38, 56, 218.)

1928. Apr. 15. West of Paskenta, Tehama County, Calif. At Paskenta, one chimney was cracked and standing automobiles were moved back and forth. At a ranch near Newville, south of Paskenta, a chimney was knocked off one house. In Lyonsville, at the northeast edge of the macroseismic region, a laborer reported three tombstones fell and six graves collapsed. Felt from Rockport (Mendocino County) in the west to Stirling City (Butte County) in the east and from Jelly (Tehama County) in the north to Lakeport (Lake County) in the south. Magnitude 5.7 Ukn JON. (Ref. 393.)

1928. June 4 (June 3). Near Weaverville, Trinity County, Calif. This earthquake, which was as strong at Carrville and Trinity Center, threw chimneys down at Weaverville. It was felt west to Eureka and Scotia. Magnitude 4.5 M_{La} DMG. (Ref. 1, 324.)

1929. July 8. Near Whittier, Los Angeles County, Calif. This earthquake was strongest in an area southeast of Whittier. Within that area, a schoolhouse and two private dwellings were damaged seriously, and several others were damaged by falling chimneys. At nearby Santa Fe Springs, the shock broke flanges on oil towers and left a few short, parallel cracks in loose ground; two oil wells were plugged by incaving.

Felt generally from Mount Wilson on the north to beyond Santa Ana on the south and from Hermosa Beach in the west to Riverside in the east. Many aftershocks occurred within a few hours of the main earthquake and continued to occur at increasingly long and irregular intervals through March 1931. Several small foreshocks were felt in the Whittier area from May 4–18, 1929. (Ref. 2, 394.)

1929. Nov. 28. Southeast of Aberdeen, Inyo County, Calif. About 8 km southeast of Aberdeen, concrete reservoirs were cracked and dishes were broken. A large landslide was reported about 25 km northwest of Independence at the headwaters of Goodale Creek. Five heavy shocks were reported at Fresno. The earthquake generally was felt northwest to Stockton (San Joaquin County), south to Kernville, and east to Mina, Nev. Magnitude 4.9 Ukn JON. (Ref. 2, 38.)

1930. Jan. 16, 00 24 and 00 34 UTC (Jan. 15). Near Summit, San Bernardino County, Calif. Two strong earthquakes knocked down chimneys and broke dishes in Fawnskin and Summit. The first shock was heavier. The tremors were felt strongly as far as Los Angeles. Magnitude 5.9 Ukn JON (00 24 UTC), 5.5 Ukn JON (00 34 UTC). (Ref. 3, 38, 258.)

1930. Feb. 26 (Feb. 25). Near Westmorland, Imperial County, Calif. At Westmorland, chimneys were knocked down, and walls were cracked. Modern buildings were undamaged. East of Westmorland, craterlets formed where mud and water were forced from the ground. Felt in Imperial, Riverside, and San Diego Counties and at a few towns in western Arizona. Several foreshocks and many aftershocks occurred. Magnitude 5.7 Ukn JON. (Ref. 3, 38.)

1930. Mar. 1. Near Brawley, Imperial County, Calif. At Brawley chimneys and overhanging cornices toppled, roofs displaced, and walls were cracked severely. Aftershocks were felt through Mar. 6, 1930. (Ref. 3, 38.)

1930. Aug. 5, 11 25 UTC. Near Santa Barbara, Calif. Two local earthquakes broke windows at Santa Barbara and cracked walls at Ventura. One aftershock was observed. Magnitude 4.7 Ukn JON. (Ref. 3, 38.)

1930. Aug. 31 (Aug. 30). Santa Monica Bay, Calif., west of the Los Angeles Basin. A cornice fell from a building at Venice, and ground cracks formed long the edge of Palisades Park bluff at Santa Monica, north of Venice. Small earthslides and rockslides were reported. At Los Angeles, minor cracks formed in buildings, plaster fell, and dishes broke. Light damage also occurred at Chatsworth, Hollywood, Owensmouth, and Pasadena. Felt throughout the Los Angeles Basin—from Kern County in the north to San Diego County in the south and east to the Palm Springs area. A tsunami of 0.6 m was observed at Santa Monica.

A comparison of the Jan. 1, 1979, Malibu earthquake and the 1930 Santa Monica earthquake suggests that they occurred on the Anacapa-Dume and Santa Monica faults, respectively. The epicenters of these earthquakes can be interpreted to define an 8- to 10-km north-south distance between the two faults, which suggests that the faults are unlikely to rupture simultaneously in one large event. (Ref. 3, 38, 396, 474, 610.)

1930. Sept. 23 (Sept. 22). Near Eureka, Humboldt County, Calif. Chimneys were toppled at Arcata, Eureka, and Fields Landing. Slight damage occurred at Capetown, Crannell, and Korbel. Felt south to Briceland, north to the Oregon border, and about 90 km inland from the coast. Two light aftershocks occurred on Sept. 23. Magnitude 5.1 Ukn JON. (Ref. 3, 38, 324.)

1930. Oct. 29. Near Whitmore, Shasta County, Calif. This earthquake caused damage at La Moine (50 km north of Redding) and Whitmore (40 km east of Redding). A series of 13 shocks was felt from Mineral and Viola in the east to Redding and La Moine in the west. (Ref. 3, 324.)

1931. Aug. 23. Off the coast, southwest of Cape Mendocino, Calif. This earthquake was strongest south of Eureka, along the lower course of the Eel River. At the Punta Gorda Lighthouse, the mantle on the revolving lamp was broken. Damage, if any, was superficial at other towns. Felt north to southern Oregon and south into Mendocino County. Magnitude 5.9 M_x JON. (Ref. 4, 258.)

1931. Sept. 9. Off the coast of Humboldt County, northwest of Cape Mendocino, Calif. This earthquake was strongest at towns along the lower course of the Eel River. Chimneys were damaged south of Eureka, at Weott, and bricks were dislodged a few kilometers east of Weott, at Blocksburg. Branches fell from trees in wooded areas of Humboldt County. Several aftershocks were reported. Magnitude 6.3 M_x JON. (Ref. 4, 324.)

1932. Feb. 26. Near Big Sur, Calif. The location given in the California list for this earthquake has been redetermined by Toppozada (1991, oral commun.) to have occurred about 70 km to the north-northwest, in the coastal area south of Big Sur.

1932. June 6. Off the coast of Humboldt County, west of Eureka, Calif. This earthquake, the strongest in the region since Jan. 22, 1923, killed one person at Eureka and injured several others. Property damage was severe at Eureka, where hundreds of chimneys were damaged and many fell, plate-glass windows were shattered, and water mains were broken. Several small houses were shaken down in Arcata, and most chimneys were damaged. Hardly a chimney remained standing at Fields Landing, and a 15-cm crack formed in the highway. Many chimneys also toppled at Loleta, where a brick wall was shaken into the street.

A 70-cm ground crack developed on Cock Robin Island, at the mouth of the Eel River, and many blowholes, some as much as 2.5 m in diameter, were observed. Felt north to Coos Bay, Oreg., south to

Wood-frame building in Long Beach, California, damaged by the March 11, 1933 (Mar. 10 PST), earthquake.

San Jose, and east to Nevada City (Nevada County). Several aftershocks occurred. Magnitude 5.9 M_{La} DMG. (Ref. 5, 38, 258, 381, 533, 544.)

1932. July 26 (July 25). Near Springville, Tulare County, Calif. An earthquake loosened several tons of rock from a peak on the south edge of Sequoia National Park, near Mineral King, and cracked brick chimneys at Springville (about 45 km southeast of Tulare). Magnitude 4.9 Ukn JON. (Ref. 5, 292.)

1933. Mar. 11, 01 54 UTC (Mar. 10). Southeast of Long Beach, near Newport Beach, Calif. Although only moderate in terms of magnitude, this earthquake caused serious damage to weak masonry structures on land fill from Los Angeles south to Laguna Beach. Property damage was estimated at $40 million, and 115 people were killed.

Severe property damage occurred at Compton, Long Beach, and other towns in the area. Most of the spectacular structural damage was due to land fill, or deep water-soaked alluvium or sand, and to badly designed buildings. Minor disturbances of ground water, secondary cracks in the ground, and slight earth slumps occurred, but surface faulting was not observed. Along the shore between Long Beach and Newport Beach, the settling or lateral movement of road fills across marshy land caused much damage to the concrete highway surfaces and to approaches to highway bridges.

At Compton, almost every building in a three-block radius on unconsolidated material and land fill was destroyed. At Long Beach, buildings collapsed, houses were pushed from foundations, walls were knocked down, and tanks and chimneys fell through roofs. Damage to school buildings, which were among the structures most commonly and severely damaged by this earthquake, led to the State Legislature passing the Field Act, which now regulates building-construction practices in California.

This destructive earthquake was associated with the Newport-Inglewood fault. Shocks similar in magnitude and intensity to this event have occurred in this area in the past—notably July 28, 1769; Dec. 8, 1812; and July 11, 1855.

The earthquake was felt almost everywhere in the 10 southern counties of California and at some points farther to the northwest and north in the Coast

Front wall of the John Muir School, Pacific Avenue, Long Beach, California, downed by the March 11, 1933 (Mar. 10 PST), earthquake. (Photograph by W.L. Huber.)

Range, the San Joaquin Valley, the Sierra Nevada, and the Owens Valley (see fig. 16). It also was reported in northern Baja California. A sharp foreshock occurred near Huntington Beach on Mar. 9, and many aftershocks occurred through Mar. 16. For several years, minor aftershocks continued to occur, most often centering near the two ends of the disturbed segment of the Newport-Inglewood fault. Magnitude 6.25 M_S GR, 6.3 M_S CFR, 6.2 M_{La} DMG, 6.43 M_L KJ. (Ref. 6, 292, 381, 397, 460, 533.)

1933. May 16. Near Niles, Alameda County, Calif. All chimneys were thrown down and some houses were damaged in the area of Overacker Station, between Niles and Irvington. North of Niles, cornices fell from buildings at Walnut Creek; chimneys fell, and the City Hall was damaged at Martinez. Rockfalls blocked the road in Niles Canyon. Felt north to Marysville (Yuba County), from the coast east to Merced, and south to Spreckels (Monterey County). Magnitude 5.8 Ukn JON. (Ref. 38, 324, 536.)

1933. Oct. 2. Near Los Angeles, Calif. Widespread minor damage occurred in the business section of Los Angeles, including broken windows and dishes, cracked plaster, and damaged street lamps. Minor damage also occurred at Bell, Compton, Long Beach, and other towns in the area. Felt north along the coast to Santa Barbara, south to San Diego, and east to Victorville and San Bernardino. Magnitude 5.4 M_S GR. (Ref. 6, 38, 292.)

1933. Oct. 25 (Oct. 24). Near Los Angeles, Calif. At Huntington Park, some chimneys were downed, windows were broken, and brick was damaged slightly. The shock generally was felt in the suburbs of Los Angeles. (Ref. 6, 259, 292.)

1934. Apr. 23. Near Aromas, Monterey County, Calif. A local earthquake downed chimneys at Aromas and knocked merchandise from shelves.

Jefferson Junior High School in Long Beach, California, destroyed by the March 11, 1933 (Mar. 10 PST), earthquake.

Felt at Hollister, Salinas, Spreckels, and Watsonville. An earlier shock was reported at 16 08 UTC. (Ref. 259, 324, 559.)

1934. June 5, 22 52 UTC. Adelaida, San Luis Obispo County, Calif. A foreshock of the June 8 earthquakes, this local event knocked down two walls and several trees at Adelaida. It was reported only at a few towns in the area. (Ref. 7, 292.)

1934. June 8, 04 30 and 04 47 UTC (June 7). Near Parkfield, Monterey County, Calif. A series of earthquakes occurred in the Parkfield area from June 5 to 14. The strongest foreshock—on June 8 at 04 30 UTC—caused damage in and around Parkfield and Stone Canyon. The principal earthquake, which occurred 17 minutes later, caused severe damage at Parkfield—a concrete-block house was wrecked, walls fell, and chimneys were downed. Highway bridges near Parkfield shifted slightly on their footings. Chimneys were knocked down in the area along the San Andreas fault—from Stone Canyon to the southern boundary of Monterey County.

On Middle Mountain, northwest of Parkfield, two zones of cracks about 7.5 m wide formed in the soil parallel to the surface traces of two faults in the San Andreas system. The largest single crack was about 17 m long and 46 cm deep. Neither vertical nor horizontal displacement, however, was observed along the cracks. Felt to Alviso in the north, Santa Ana in the south, and Kernville in the east. Magnitude 6.0 M_S GR, 6.0 M_S CFR, 5.6 M_{La} DMG. (Ref. 7, 38, 292, 381, 536.)

1934. Dec. 17. Near Los Alamos, Santa Barbara County, Calif. A few chimneys and plaster fell at Los Alamos, and plaster and chimneys

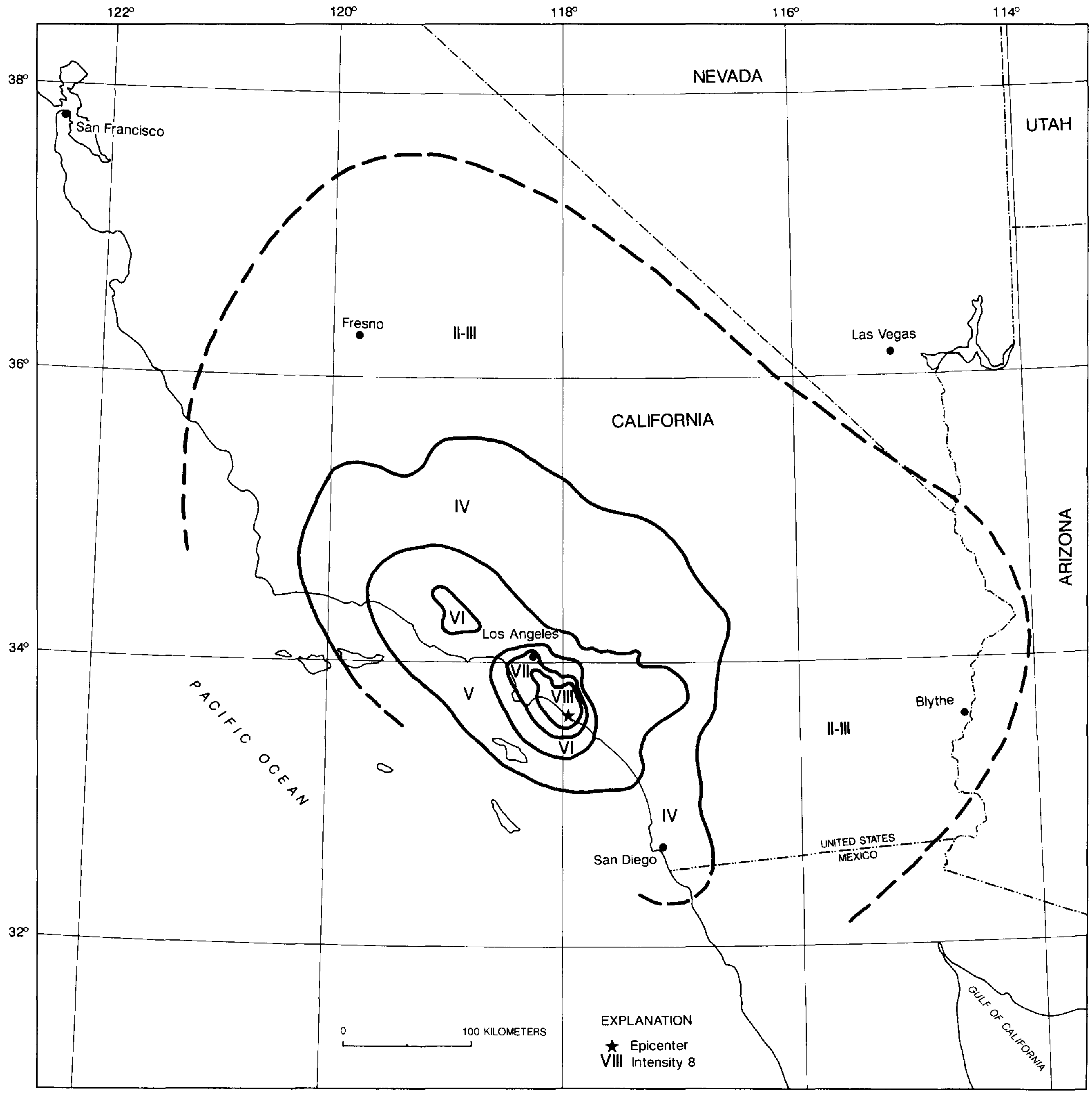


FIGURE 16.—Isoseismal map for the Long Beach, California, earthquake of March 11, 1933. Isoseismals are based on intensity estimates from data listed in references 6, 259, 381, and 397 of table 1.

sustained cracks. Felt along the coast of Santa Barbara and San Luis Obispo Counties. Several aftershocks were reported at Los Alamos. Magnitude 4.8 M_X JON. (Ref. 259, 292.)

1934. Dec. 30. Baja California, Mexico. Bridges were damaged, railroad tracks were twisted, and adobe houses were wrecked in the epicentral region in the Laguna Salada district south of Calexico. The strong shock cracked chimneys, walls, and windows in several California towns in the Imperial Valley. Many aftershocks occurred. Magnitude 6.7 M_X JON. (Ref. 7, 38, 258.)

1934. Dec. 31. Baja California, Mexico. This earthquake was stronger than that of Dec. 30, 1934, and its epicenter was in the same general area. In the epicentral region, irrigation ditches were damaged, roads were buckled, and crevices opened in the ground. The shock was felt strongly throughout the Imperial Valley in southern California. At Calipatria, chimneys and walls were thrown down and windows were broken, and at Gadsden, Ariz., considerable damage to brick and masonry was reported. Slight damage occurred at several towns in California and western Arizona. The earthquake also was felt slightly at Las Vegas, Nev. Magnitude 7.1 M_S CFR, 7.0 M_S GR. (Ref. 7, 38, 258.)

1937. Mar. 8. San Francisco Bay region, Calif. An earthquake caused minor damage at Albany, Berkeley, El Cerrito, Elmhurst, and Oakland. Damage was heaviest in north Berkeley, where one poorly built house was condemned; several chimneys fell and many were twisted and cracked; walls were cracked; and plaster fell from walls. Felt north to Santa Rosa (Sonoma County) and south to Aptos (Santa Cruz County). (Ref. 10, 259, 324.)

1937. Mar. 25. Terwilliger Valley, San Diego County, Calif. This earthquake caused less damage than might have been expected because its origin was in a mountainous district having few residents within about 50 km. Slight to moderate damage to chimneys, windows, plaster, or walls was reported from Anza, Garnet, Hemet, Keen Camp, Palm Springs, Ramona, and Warner Springs. Felt over most of southern California. Magnitude 6.0 M_S CFR, 6.0 M_S GR, 5.9 M_{La} ELL. (Ref. 11, 259, 292, 545.)

1938. Feb. 12. Near Santa Cruz, Calif. One chimney toppled, and chimneys and windows cracked at Santa Cruz; plaster fell at Coyote and Morgan Hill. Felt north to San Rafael (Marin County) and south to Big Sur (Monterey County). (Ref. 11, 259, 324.)

1938. Aug. 31 (Aug. 30). Near Long Beach, Los Angeles County, Calif. A heavy china cabinet was overturned at Keystone (6 km north of Wilmington); beds were displaced about 20 cm; and cracks formed in plaster. Cracks also formed in walls from top to bottom. Merchandise was knocked from shelves in stores and dishes were knocked to the floor at Long Beach and Huntington Beach. Felt along the coast between Santa Monica and Laguna Beach and inland to Mount Wilson. Several aftershocks occurred. (Ref. 11, 259, 292.)

1938. Sept. 12 (Sept. 11). South of Pepperwood, Humboldt County, Calif. One chimney fell at Pepperwood, and chimneys were cracked or twisted at Eel Rock and Ferndale. In the Redwoods, the ground was covered with branches fallen from trees. Felt along the coast north to Brookings, Oreg., east to Forbestown, Calif. (Butte County), and south to Elk, Calif. (Mendocino County). (Ref. 11, 259, 324.)

1938. Nov. 15. Near Talmage, Mendocino County, Calif. The heaviest reported damage occurred at Talmage, where one chimney fell and others were cracked. Some walls of buildings were cracked at Potter Valley. Felt generally in Lake, Mendocino, and Sonoma Counties. (Ref. 11, 259, 324.)

1938. Dec. 1. Alameda County, north of San Jose, Calif. Some chimneys were cracked at San Jose, and plaster cracked at Saratoga. Felt slightly at a few other towns in the area. (Ref. 11, 324.)

1938. Dec. 3, 17 42 UTC. Inyo County, northwest of Bishop, Calif. West of Bishop, a large boulder crashed into a house and caused much damage. Other slides in the mountains reportedly occurred nearby. In the Owens River Gorge, buildings and pipelines were damaged by loosened rocks that cascaded down the mountains. Felt from Stockton (San Joaquin County), south to Bakersfield, and east into western Nevada. (Ref. 11, 292.)

1939. June 24. Southwest of Hollister, San Benito County, Calif. About 14 km southwest of Hollister, structural damage was sustained at the Mano ranch and the Orhwall ranch. Several chimneys fell or were twisted at the rooflines; many adobe walls were severely cracked; and several cracks in the ground were observed. The highway also was cracked in several places. At the San Benito Winery, chimneys were toppled and damage was considerable. Felt along the coast as far north as Half Moon Bay (San Mateo County), south to Nipomo (San Luis Obispo County), and inland to Tranquillity (Fresno County). (Ref. 12, 259, 324, 381.)

1939. Dec. 27. Near Long Beach, Los Angeles County, Calif. Moderate damage to property occurred at Huntington Beach and Long Beach. At Long Beach, several street lights were broken, a fireplace was shaken down, and chandeliers in stores were knocked from ceilings to the floor. At Huntington Beach, floors buckled in one house, and plaster fell from walls. Felt along the coast from Newport Beach north to Venice, inland to Altadena and San Bernardino, and southeast to Palm Springs. (Ref. 12, 292, 324.)

1939. Dec. 28. Near Cholame, San Luis Obispo County, Calif. Slight damage occurred at San Lucas, where dishes were broken and plaster was cracked. The general limits of the felt area extended from Santa Cruz south along the coast to Point Arguello and inland to Hollister, Lost Hills, and Fresno. (Ref. 12, 324.)

Furniture store in Brawley, California, destroyed by the Imperial Valley earthquake of May 19, 1940 (May 18 PST). (Photograph by F. Ulrich.)

1940. Feb. 8. North of Paradise, Butte County, Calif. Damage was confined to a few twisted and cracked chimneys and several broken windows and dishes in the Chico-Paradise area. The press reported that several chimneys were downed at Chico. Several landslides and dislodged rocks were reported along roads. Felt north to Dunsmuir (Siskiyou County), south to Stockton (San Joaquin County), west to the Platina area (Tehama County), and east to Reno, Nev. Magnitude 6.0 M_S CFR, 6.0 M_S GR. (Ref. 13, 259, 324.)

1940. Feb. 13. Near Branscomb, Mendocino County, Calif. Chimneys were cracked at Branscomb, and furnishings were displaced. The shock also was fairly strong in Humboldt County, at Ferndale and Scotia, and in Mendocino County, at Elk, Ukiah, and Westport. (Ref. 259, 324.)

1940. May 19, 04 36 and 05 51 UTC (May 18). Imperial Valley, near El Centro, Calif. The main earthquake took nine lives and caused property damage estimated at $6 million. Damage from a strong aftershock near Brawley at 05 51 UTC is included in this estimate.

The first shock damaged about 80 percent of the buildings in Imperial. Many buildings in the business district were condemned, and older residences sustained severe damage. Four people were killed in the collapse of a grocery store. Damage to a lesser extent occurred at El Centro and Holtville. Elevated water tanks at Holtville and Imperial collapsed, and a water tank at Brawley was damaged.

The downtown business area at Brawley was damaged severely by the second shock, and about 25 percent of the houses in the residential area were damaged. About half of the business structures had to be condemned. Many breaks in water mains occurred and water pipes were broken.

Damage to the structures and canals of the Imperial Irrigation District in the United States and Mexico was widespread. Breaks occurred over almost the entire length of the Ash Canal, from Holtville to the Mexico border. The Alamo Canal, the main feeder for the entire system, had eight major breaks; a section of the Solfatara Canal in Baja California was destroyed south of Cocopar. The earthquake demolished the New River flume, a 427-m-long timber structure on the West Side Main Canal south of Mexicali.

Right-lateral offset occurred along the Imperial fault. The pattern of offset indicates that the main part of the offsets occurred along a surface fracture about 20 to 25 km long, extending from the epicenter of the main shock southeast, about 5 km past Cocopar. Rupture of the northwest section of the fault may have occurred during a damaging aftershock at 05 51 UTC. Where the surface fracture crosses the All American Canal east of Calexico, the largest displacement of 4.5 m occurred. At one point on the Solfatara Canal, the slip was as much as 3.7 m.

In Baja California, the Inter-California Railroad track was displaced at Grape, and about 300 m of railroad track settled north of Grape. At Cocopar, the track shifted 2 m, and at Meloland, it shifted about 46 cm.

Many sand boils were observed near Gadsden on the Yuma Project in Baja California. Geysers spouting water several meters high also were reported. Canals, drainage channels, flumes, and bridges were damaged near Gadsden. The main earthquake was felt over much of southern California, southwest Arizona, and northern Baja California. About 48 aftershocks occurred through the end of 1940. Those on May 23 caused more damage at Brawley. Magnitude of first shock 6.9 m_b ABE, 6.7 M_S GR, 7.1 M_S CFR, 6.4 M_{La} DMG, 7.2 M_S ELL, 7.2 M_L KS. (Ref. 13, 292, 381, 521, 533, 546, 547.)

1940. May 23, 11 00, 17 30, and 18 45 UTC. Near Brawley, Imperial County, Calif. Three strong aftershocks of the Imperial Valley earthquakes (see May 19, 1940, above) cracked chimneys, walls, and plaster and broke windows and dishes at Brawley. (Ref. 259.)

1940. Oct. 11 (Oct. 10). Santa Monica Bay, Calif. This earthquake was strongest at Keystone (6 km north of Wilmington), where chimneys and walls were cracked, and dishes were broken. Slight damage also was reported at Long Beach, Los Angeles, Manhattan Beach, Maywood, and Redondo Beach. Felt along the coast north to Santa Barbara, south to San Diego, and east to the Big Bear Lake area (San Bernardino County). Magnitude 4.6 M_x JON. (Ref. 13, 259, 292.)

1940. Oct. 22. Near Scotia, Humboldt County, Calif. At Scotia, three underground pipes, windows, and plaster walls were broken. Felt over a small area of Humboldt County, extending along the coast from about Arcata to Shelter Cove and inland to the Bridgeville area. Several aftershocks were reported at Scotia. (Ref. 13, 259, 324.)

1940. Nov. 19. Off the coast of Humboldt County, west of Eureka, Calif. Loose bricks were thrown from a chimney at Upper Mattole, and furnishings were shifted. Slight damage also occurred at Garberville and Westport. Felt along the coast north to the Arcata area, south to Elk (Mendocino County), and east to the Forest Glen area (Trinity County). (Ref. 13, 259, 324.)

1940. Dec. 20. Southwest of Benbow, Humboldt County, Calif. This slight earthquake broke dishes and knocked books down at Fort Bragg and cracked plaster and overturned small objects at Benbow. Felt along the coast from Arcata south to Ukiah and east to Weaverville (Trinity County). (Ref. 13, 259, 324.)

1941. Feb. 9. Off the coast of Humboldt County, west of Ferndale, Calif. At Punta Gorda Light Station, slight cracks in plaster were observed. At Shelter Cove, the bluff slid in several places. Felt along the coast from San Francisco on the south to Port Orford, Oreg., on the north. Magnitude 6.4 M_L ELL. (Ref. 14, 258, 259, 381.)

1941. July 1, 07 50 UTC (June 30). Near Santa Barbara, Calif. Moderate damage to property occurred in the Carpinteria–Santa Barbara area. Property damage was estimated at $100,000. About 25 chimneys and several walls fell at Carpinteria, and the cornice of a building was shaken to the ground. At Santa Barbara, one chimney toppled, bricks were dislodged from buildings, several buildings were cracked, and plate-glass windows were shattered. In addition, sidewalks buckled in places, and many water mains were broken. Several aftershocks occurred. The main earthquake was felt from near Stockton (San Joaquin County) in the north to Havilah (Kern County) in the south and from Coalinga (Fresno County) in the west to Mina, Nev., in the east. Magnitude 5.9 M_S GR, 5.9 M_S CFR, 5.5 M_{La} DMG. (Ref. 14, 292, 381, 533.)

1941. Sept. 14, 16 43, 18 21, and 18 39 UTC. Near Mammoth Lakes, Mono County, Calif. Five earthquakes occurred on this date, the three largest at the times given. Rockslides in the mountains blocked roads and trails, and one cabin was destroyed. Cracks formed in walls and chimneys at the Pineridge Shaver Ranger Station, and several chimneys were damaged at Yosemite Valley. Slight damage also was reported at Benton, Doyles, Miami Ranger Station, and Pinedale. Magnitude 5.8 M_S GR (first shock); 6.0 M_S CFR, 6.0 M_S GR (third shock), 5.6 M_{La} DMG (first and third shocks). (Ref. 259, 292, 381.)

1941. Oct. 3. Off the coast of Humboldt County, Calif. This earthquake was strongest at Eureka, where chimneys twisted and cracked, and plaster cracked and fell. Slight damage also occurred at Ferndale, Fields Landing, Korbel, Pepperwood, Punta Gorda, Rio Dell, Rockport, and Upper Mattole, where chimneys and walls cracked and plaster fell. Felt north to southwest Oregon and south, along the coast, to the San Francisco Bay area. Magnitude 6.4 M_S CFR. (Ref. 259, 324.)

1941. Oct. 6 (Oct. 5). Off the coast of Humboldt County, Calif. Magnitude 5.25 M_S GR, 5.4 M_x JON.

1941. Oct. 22, 06 57 UTC (Oct. 21). Near Gardena, Los Angeles County, Calif. Property damage generally was confined to an area that included Compton, Hynes, Moneta, Gardena, Los Angeles, and the West Dominguez Oil Field, east of Gardena. Widespread minor damage—mainly cracked walls, fallen plaster, and broken windows and dishes—occurred at Gardena and Compton. At Keystone (6 km north of Wilmington), chimneys were twisted, plaster and dishes were broken, and walls were cracked; at Moneta, the east and west fire walls on one brick building were knocked down. Felt along the coast from Montalvo (Ventura County) on the north to Newport Beach on the south and inland to Riverside and San Bernardino Counties. (Ref. 14, 259, 292.)

1941. Oct. 22, 10 32 UTC. Near Gardena, Los Angeles County, Calif. This slight aftershock of the earthquake described above (06 57 UTC) cracked chimneys, walls, and plaster at Hondo. At Gardena and Pacific Palisades, the shock cracked plaster and overturned small objects. It also was observed by residents in a few other towns in the area. (Ref. 14, 259, 292.)

1941. Nov. 14. Near Gardena, Los Angeles County, Calif. This strong earthquake caused property damage estimated at $1.1 million in the Gardena-Torrance area. No deaths or injuries were reported, perhaps because the earthquake occurred a little after midnight (local time) when most residents were at home sleeping. In nearby oil fields, two tanks were demolished, two were buckled, and a pipeline was broken.

Damage was most severe in Torrance, where hardly a building escaped damage. Two schools sustained heavy structural damage, and one was condemned; the fire station was abandoned because of heavy damage. The shock also moved several houses off their foundations. About 50 percent of all brick chimneys and fireplaces either were twisted, broken loose, or thrown down.

Severe damage also occurred in the city of Gardena. The walls of a two-story structure fell on and destroyed the roof of an adjoining building. The Gardena Elementary School building was condemned; the Bank of America Building was damaged severely; and the roof of a newspaper building almost collapsed. Several fire walls and many chimneys were knocked down or otherwise damaged. Felt from Carpinteria (Santa Barbara County) on the north to San Diego on the south and inland to Cabazon and San Jacinto in Riverside County. Magnitude 5.5 M_x JON. (Ref. 14, 259, 292, 533, 599.)

1941. Dec. 31, 06 48 UTC (Dec. 30). Near Bishop, Inyo County, Calif. A moderate earthquake twisted chimneys and cracked plaster at the Adams Main Powerhouse in Owens River Gorge, near Bishop. Reports of damage were not received from other towns in the area. Felt from Georgetown (Eldorado County) on the north to Kernville on the south and from Coalinga on the west to Mina, Nev., on the east. Magnitude 5.4 M_S GR. (Ref. 14, 259, 292.)

1942. Oct. 21, 16 22 UTC. Near Borrego Valley, Imperial County, Calif. At Carrizo Gorge, about 19 km north of Jacumba, landslides broke timbers and wiring on a railroad bridge. Slight damage was observed at several towns in the area. Several aftershocks occurred, the strongest at 01 50 UTC on Oct. 22. Felt from the coast east to Mobile, Ariz., and from Crucero (San Bernardino County) on the north to Baja California on the south. Magnitude 6.5 M_S CFR, 6.0 M_{La} DMG. (Ref. 15, 292, 381.)

1943. Aug. 29 (Aug. 28). Near Lake Arrowhead, San Bernardino County, Calif. The earthquake was most severe in the Big Bear Lake–Lake Arrowhead–Seven Oaks area. At Redlands, plaster fell, dishes broke, and bricks fell into a chimney. Slight damage also occurred at Lake Arrowhead. One foreshock and two aftershocks were recorded. The main shock was felt north to Mojave (Kern County), south to San Diego, and from the coast east to Ludlow. (Ref. 16, 259, 292.)

1943. Oct. 26 (Oct. 25). Near San Jose, Santa Clara County, Calif. In San Jose, a gas main was broken, plate-glass windows were shattered, and plaster was knocked off walls. A water line was broken at Sunnyvale. Slight damage to plaster occurred at several towns in the area. Felt along the coast from Santa Rosa (Sonoma County) south to San Ardo (Monterey County) and east as far as Bridgeport (Mono County), near the Nevada border. (Ref. 16, 259, 324.)

1943. Nov. 16. Near San Leandro, Alameda County, Calif. At San Leandro, chimneys were cracked, windows were broken, and plaster and knickknacks fell to the floor. One chimney pulled away from the wall of a house, leaving a 6.5-cm crack at the eaves. Felt slightly over a small area in and around San Leandro. (Ref. 16, 259, 324.)

1944. June 12, 10 45 and 11 16 UTC. East of Banning, Riverside County, Calif. Plaster cracked and fell, dishes broke, and vases overturned at Banning; plaster cracked at Corona. Several light aftershocks were reported. The felt area extended from Oxnard (Ventura County), along the coast, south to San Diego and northeast to Ludlow (San Bernardino County). (Ref. 17, 259, 292.)

1944. June 19, 00 03 and 03 06 UTC (June 18). Near Redondo Beach, Los Angeles County, Calif. Two sharp earthquakes caused minor damage to property in the Los Angeles area at Compton, Gardena, Huntington Park, Lynwood, and Maywood. The damage commonly included cracked chimneys and plaster and broken windows. Other damage included the dislodging of a large marble slab from the front of a store in Redondo Beach. Both shocks were felt along the coast south to San Diego and east to the Palm Springs area (Riverside County). Several light aftershocks were observed in the area. (Ref. 17, 259, 292.)

1945. Jan. 7. Near Hollister, San Benito County, Calif. This minor earthquake cracked chimneys and plaster at Hollister and broke windows and displaced stock on store shelves. It also knocked books and pictures from shelves at Paicines and San Benito. Two chimneys were damaged at the old Santa Anita ranch. Felt from San Francisco, south along the coast, to Big Sur (Monterey County) and east as far as Yosemite National Park. (Ref. 18, 259, 324.)

1945. May 17. Near Hollister, San Benito County, Calif. Buildings were damaged slightly at Hollister, where brick fell from chimneys; chimneys were cracked; several windows were broken; and plaster fell from walls. Considerable damage also was done to stock in stores. Felt north to San Francisco, east to Merced, and south to San Ardo (Monterey County). (Ref. 18, 259, 324.)

1945. May 19. Off the coast of southern Humboldt County, Calif. This earthquake was felt through most of the coastal towns, from Crescent City south to Fort Bragg and Willits. Magnitude 6.2 M_S CFR, 6.0 M_L BRK. (Ref. 18, 258.)

1945. Aug. 15. Near Borrego Valley, San Diego County, Calif. Some damage to cables and powerlines was reported at Fullerton, and plaster was cracked at Fall Brook and San Jacinto. Felt from Los Angeles south along the coast to San Diego and east to the Twentynine Palms area (San Bernardino County). (Ref. 18, 259, 292.)

1945. Aug. 27. Near San Jose, Santa Clara County, Calif. One chimney was shaken loose and plaster was cracked at San Jose. Felt to Saint Helena (Napa County) on the north, Big Sur on the south, and Pinecrest (Tuolumne County) on the east. (Ref. 18, 259, 324.)

1946. Jan. 13. West of Bishop, Inyo County, Calif. Near Bishop, at the Owens River Gorge, this earthquake cracked chimneys, walls, and plaster and displaced heavy furniture. Many rocks rolled down the sides of the canyon. Felt over a small area, which included Hawthorne, Nev. (Ref. 259, 292.)

1946. Mar. 15, 13 21, 13 49, and 14 00 UTC. North of Walker Pass, Kern County, Calif. The main shock at 13 49 UTC caused moderate damage at Onyx, about 19 km southwest of the epicenter. Damage to wood, brick, masonry, and concrete was reported to be conside rable. Chimneys, walls, plaster, and windows cracked; dishes broke; and plaster, books, and pictures fell. Cracks formed in the ground and concrete along the Los Angeles Aqueduct. Rockslides occurred in the canyons. Elsewhere in the region of Walker Pass and the South Fork of the Kern River, adobe houses were damaged, brick chimneys cracked, and plaster fell.

The earthquakes were felt from Commache (Calaveras County) on the north to San Diego (an isolated report) on the south and from Cambria (San Luis Obispo County) on the coast to Death Valley (see fig. 17). Several aftershocks occurred. Magnitude of second shock 6.25 M_S CFR, 6.25 M_S GR, 6.1 M_{La} DMG. (Ref. 19, 259, 292, 381.)

1946. Sept. 28 (Sept. 27). Near Banning, Riverside County, Calif. Slight damage was reported at Banning, Cabazon, Cathedral City, Palm Springs, and Twentynine Palms. Felt in parts of Los Angeles, Riverside, San Bernardino, and San Diego Counties. (Ref. 19, 259, 292.)

1947. Feb. 5 (Feb. 4). East of King City, Monterey County, Calif. Buildings swayed visibly at Lonoak (Priest Valley), where plaster cracked and fell and small objects fell. Felt over a small area of Fresno, Monterey, and San Benito Counties. (Ref. 20, 259, 324.)

1947. Apr. 10, 15 58 UTC. Near Manix, San Bernardino County, Calif. This moderate shock was strongest in the Newberry Springs area, about 40 km east of Barstow. One schoolhouse was condemned at Newberry Springs, and three adobe and brick houses were damaged severely. Minor damage, including one toppled chimney, fallen walls, cracks in chimneys and concrete, and cracked and slumped highways, were reported in the area. Also, cracks formed in the banks of the Mojave River. Felt over most of the southern half of California, a small part of southwest Nevada, and at several towns in western Arizona (see fig. 18). Several light aftershocks occurred. Magnitude 6.4 M_S CFR, 6.4 M_S GR, 6.3 M_{La} DMG. (Ref. 20, 259, 292, 381.)

1947. May 27. Off the coast of Humboldt County, Calif. This moderate earthquake cracked plaster at Upper Mattole and shook trees and bushes strongly. Felt over a small area in Humboldt County. (Ref. 20, 259, 324.)

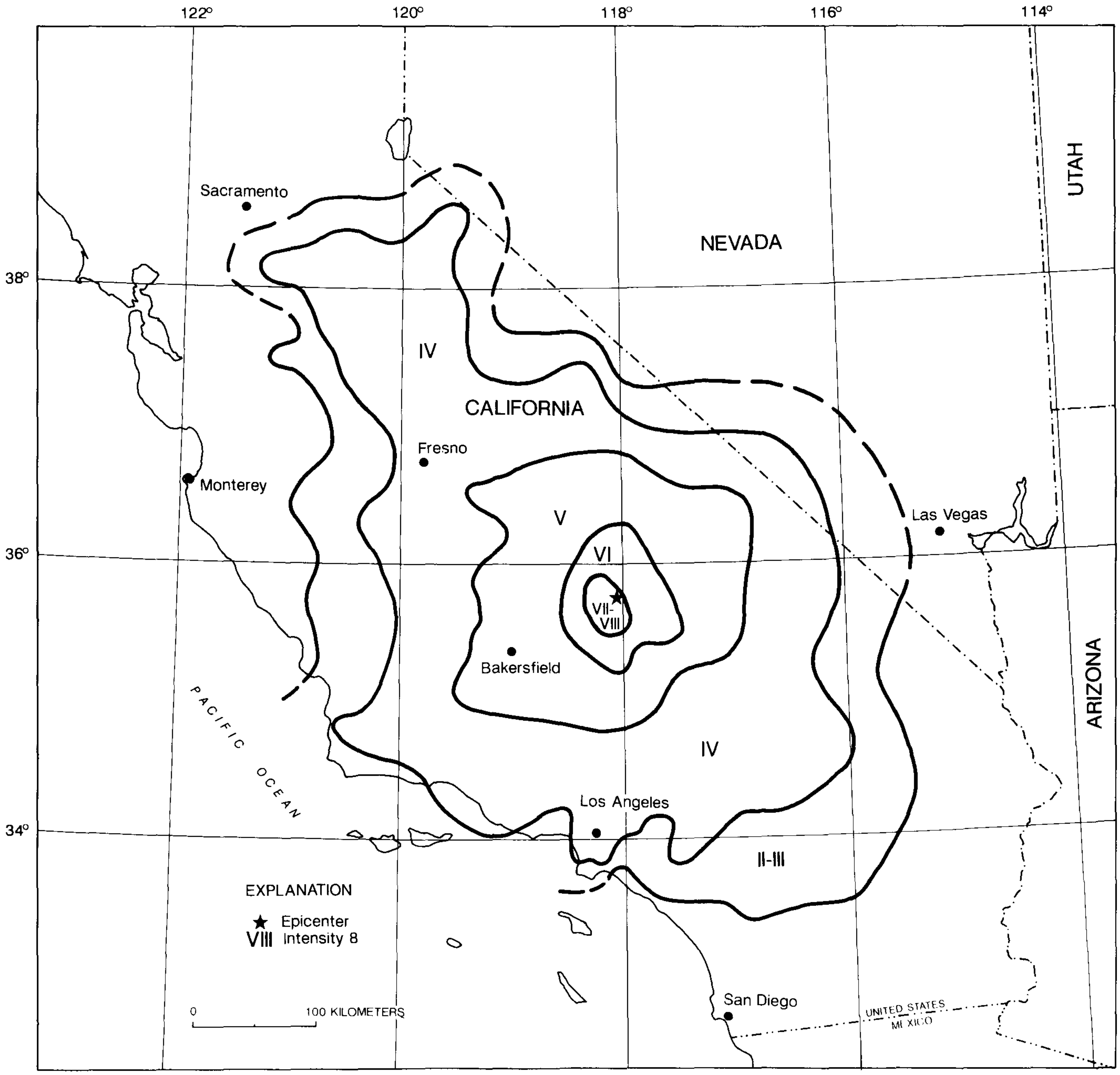


FIGURE 17.—Isoseismal map for the Kern County, California, earthquake of March 15, 1946. Isoseismals are based on intensity estimates from data listed in references 19, 259, and 381 of table 1.

1947. June 22. Near Santa Cruz, Calif. Chimneys were damaged at Corralitos and Watsonville; windows were broken at Santa Cruz; and plaster fell at Gilroy, Hollister, and Watsonville. It was reported that boulders blocked a highway near Chittenden Pass and that landslides closed Hecker Pass in Santa Clara County. Felt over most of the San Francisco Bay area. (Ref. 20, 259, 324.)

1947. Aug. 10. Near Hollister, San Benito County, Calif. The shock was strongest at Hollister, where stones were dislodged from a masonry pillar, plate-glass windows were cracked, a water main was broken, and stock was knocked from store shelves. The felt area extended from Glenwood (Santa Cruz County) southeast to Los Banos Creek (Merced County) south to San Ardo (Monterey County) and northwest to Big Sur on the coast. (Ref. 20, 259, 324.)

1947. Sept. 8, 07 13 UTC (Sept. 7). Placer County, Calif., southwest of Reno, Nev. A series of small earthquakes was observed in the Reno, Nev.,

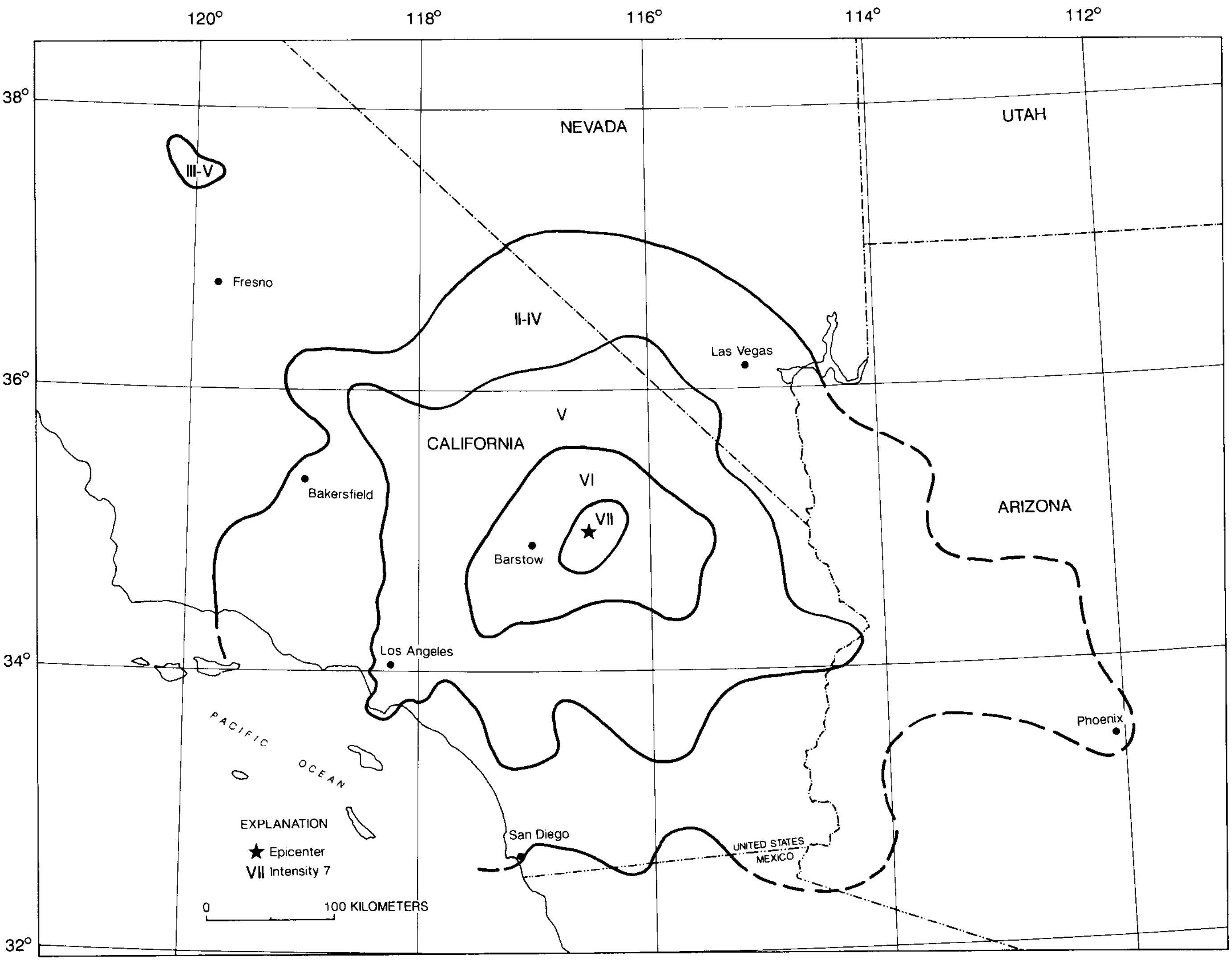


FIGURE 18.—Isoseismal map for the San Bernardino County, California, earthquake of April 10, 1947. Isoseismals are based on intensity estimates from data listed in references 20 and 259 of table 1.

area. The main shock knocked plaster from the ceiling in one house southeast of Reno and loosened mortar in the stone walls. Unusual activity in the hot springs was observed after the tremors. The earthquakes were felt over a small area of western Nevada and probably in a few towns in California. (Ref. 20, 259, 324.)

1948. Feb. 11 (Feb. 10). East of Tipton, Tulare County, Calif. A moderate earthquake cracked plaster at Ducor, Kingsburg, Lindsay, Springville, and Tipton. School buildings near Fresno, Dinuba, and Clovis were closed because of cracked walls. Felt extensively in the southern Sierra Nevadas and along the east side of the southern Joaquin Valley. (Ref. 21, 259, 324.)

1948. Feb. 20 (Feb. 19). Near Los Angeles, Calif. This shock sent many people running into the streets in the Los Angeles area. Slight damage to plaster was reported at North Hollywood. Felt over a small area of Los Angeles County. (Ref. 21, 259, 292.)

1948. Mar. 1. Northwest of San Bernardino, Calif. Slight damage to plaster and walls was reported at Burbank and Pasadena. Near Devore, cracks formed in the concrete floor of a cabin and dishes were broken. Felt over an area that included parts of Kern, Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties. (Ref. 21, 259, 292.)

1948. Apr. 16. Southeast of Oxnard, Ventura County, Calif. This earthquake was strongest at Oxnard, where plaster cracked and fell, dishes were broken, and lamps were knocked over. Felt at towns near the coast, southeast to Long Beach, and inland about 40 km. (Ref. 21, 259, 292.)

1948. June 18. Near Ukiah, Mendocino County, Calif. Chimneys were cracked and vases overturned at Ukiah, and plaster was damaged at Lakeport and Talmage. Felt over a small area of Lake, Mendocino, and Sonoma Counties. (Ref. 21, 259, 324.)

1948. Dec. 4. Near Desert Hot Springs, Riverside County, Calif. The earthquake probably was caused by displacement on the Mission Creek fault, one of the major branches of the San Andreas fault system in southern California. The highest intensities in the area were reported from the upper Coachella Valley from Thousand Palms to White Water, which also was the most densely populated area near the epicenter.

Considerable structural damage and slight cracks in the ground were observed in Desert Hot Springs. Some minor structural damage also occurred at Palm Springs. At Willis Palms, cracks formed in the ground and cliffs, riverbanks slumped, and springs increased in flow. Landslides and cracks in the ground were reported in the Indio Hills. Felt throughout southern California and at a few towns in western Arizona, southwest Nevada, and northern Baja California (see fig. 19). About 72 aftershocks were accurately located in a zone 18 km long, parallel to (but 5 km north of) the trace of the Mission Creek fault. Magnitude 6.5 M_S CFR, 6.5 M_S GR, 6.2 M_{La} DMG. (Ref. 21, 259, 292, 381, 548.)

1948. Dec. 29. West of Reno, Nev., in Sierra County, Calif. The town of Verdi, Nev., which lies at the sharp bend of the Truckee River, sustained the most damage to property. The west wall of the old general store at Verdi collapsed, and the building was wrecked. Chimneys on houses were toppled or twisted out of line, sections of parapet walls on a schoolhouse fell, and many windows were broken. Minor damage also occurred at Reno and at Chilcoot, Calif. Felt over a large area of central California and western Nevada. Magnitude 6.0 M_S CFR, 6.0 M_S GR, 5.7 M_{La} DMG. (Ref. 21, 259, 324, 381.)

1949. Jan. 1 (1948. Dec. 31). Near Watsonville, Santa Cruz County, Calif. Near Chittenden, six houses standing on stilts or blocks were displaced a few centimeters on their foundations, chimneys were broken off two of the houses, and a small landslide nearby partly blocked the Old Chittenden Road. Slight damage also occurred at Hollister and Santa Cruz. Felt over a small area of the coastal region of central California from Oakland (Alameda County) south to Big Sur (Monterey County). (Ref. 21, 259, 324.)

1949. Feb. 11. Southeast of Bishop, Inyo County, Calif. Slight damage, in the form of cracks in brick, walls, and plaster, was reported at Ash Mountain (Sequoia National Park), Bakersfield, Big Pine, and Olancha. Felt over a large area of south-central California and into Nevada as far as Beatty and Goldfield. (Ref. 22, 259, 292.)

1949. Mar. 9. Northwest of Hollister, San Benito County, Calif. Although felt strongly in the area, this shock was most severe at Hollister. Three chimneys were toppled, and a brick wall separating two stores split lengthwise. One market sustained severe cracks in plaster and walls. Considerable loss also was sustained from damaged merchandise in stores. Slight damage was reported from several other towns in the area. Felt over the western half of north-central California from Santa Rosa (Sonoma County) south to Paso Robles (San Luis Obispo County). A few aftershocks were reported, the largest on Mar. 14 at 06 10 UTC. Magnitude 5.8 M_L KJ. (Ref. 22, 259, 324, 460.)

1949. Mar. 24. Off the coast of southern Humboldt County, Calif. Reported felt along the California and Oregon coasts. Magnitude 6.2 M_S CFR, 6.2 M_S GR. (Ref. 324.)

1949. June 10 (June 9). Near San Jose, Santa Clara County, Calif. A series of three earthquakes occurred, the strongest at 03 06 UTC. At San Jose, a water main was split open, windows were shattered in houses, and stock tumbled from store shelves. The main shock was felt north to Petaluma (Sonoma County) and south to Big Sur (Monterey County). (Ref. 22, 259, 324.)

1949. Aug. 8. Near Richmond, Contra Costa County, Calif. Slight damage was reported at Richmond (windows broke and dishes fell from shelves) and Vallejo (plaster cracked). Felt over a small area of the San Francisco Bay region. (Ref. 22, 259, 324.)

1949. Aug. 27. Near Point Concepcion, Santa Barbara County, Calif. Slight damage occurred at Arlight and Sudden, where a chimney fell and dishes broke, and at Lompoc, where dishes broke and knickknacks fell. Felt over a small area along the coast in Santa Barbara and San Luis Obispo Counties. (Ref. 22, 259, 292.)

1949. Sept. 19 (Sept. 18). Near Huntington Park, Los Angeles County, Calif. Broken windows and dishes and cracks in cement driveways were reported in Los Angeles. The shock also was felt strongly at Long Beach and San Gabriel. It was reported over a small area of central Los Angeles County. (Ref. 22, 259, 292.)

1949. Nov. 4. Baja California, Mexico. A moderate earthquake caused minor property damage at Guadalupe, Mexico. In California, slight damage also occurred at Borrego Valley, Campo, Coronado, Del

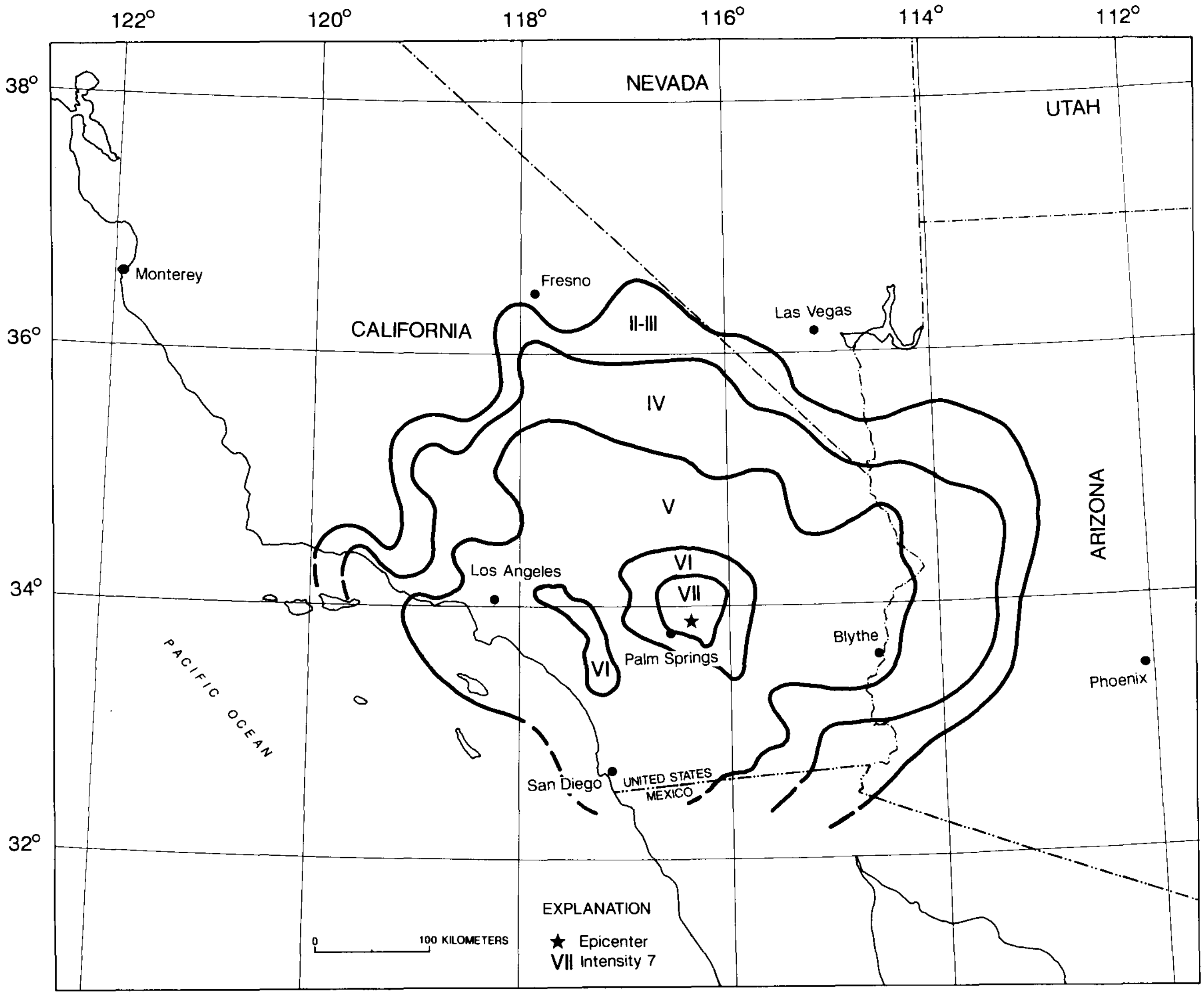


FIGURE 19.—Isoseismal map for the Riverside County, California, earthquake of December 4, 1948. Isoseismals are based on intensity estimates from data listed in references 21 and 259 of table 1.

Mar, San Diego, Santee, San Ysidro, and Spring Valley. Felt from Baja California north to Palmdale (northern Los Angeles County). (Ref. 22, 259, 292.)

1949. Nov. 5 (Nov. 4). Baja California, Mexico. An aftershock of the Nov. 4 earthquake (see above) caused slight damage to plaster and walls at Grossmont, La Jolla, and San Diego. (Ref. 22, 259, 292.)

1950. Jan. 14. Near Punta Gorda, Humboldt County, Calif. The earthquake was strongest at the Punta Gorda Light Station, where cracks formed in plaster, in the light tower, and in the concrete floor. Felt over a small area along the coast of Humboldt County in northern California. (Ref. 23, 259, 324.)

1950. Feb. 26 (Feb. 25). North of Santa Paula, Ventura County, Calif. A few bricks fell from an old chimney at Ventura, and a window was broken. Damage to plaster and fallen merchandise was reported from Oxnard and Santa Paula. The felt area extended along the coast from Lompoc (Santa Barbara County) to Van Nuys and in the east from Wheeler Ridge (Kern County) to Palmdale. (Ref. 23, 259, 292.)

1950. July 27, 11 29 UTC; July 28, 17 50 UTC; and July 29, 14 36 UTC. Near Calipatria, Imperial County, Calif. A series of damaging earthquakes occurred in the Imperial Valley from July 27 to July 29. The first two earthquakes caused only slight damage in the Brawley-Calipatria area. Damage from this series of earthquakes was estimated at $300,000.

Near Calipatria, several concrete stand-pipes were broken and a small railroad bridge was shifted 15 to 20 cm. Many sand boils were formed; irrigation ditch banks sloughed; and the ground settled and cracked. An old sheet piling broke when the levee settled at the North End Dam, about 3 km west of Calipatria. The main shock on July 29 was felt from the Mexican border to Banning, Calif., and Parker, Ariz., and from San Diego, Calif., to Yuma, Ariz. Aftershocks occurred through Aug. 14, 1950, and probably beyond. Magnitude 5.4 M_S GR (second shock); 5.4 M_S GR (third and main shocks). (Ref. 23, 259, 292, 560.)

1950. Aug. 1. Near Calipatria, Imperial County, Calif. An aftershock of the July 29 earthquake collapsed a small part of a wall at Calipatria and knocked a few bricks from houses. In addition, ground cracks in the area of the North End Dam opened wider, and new sand boils were observed at the dam site and along the levees of the Vail Canal. Felt over a small area of southern California and at Somerton, Ariz. (Ref. 23, 259, 292.)

1950. Sept. 5. Near Idyllwild, Riverside County, Calif. Dishes were broken at Idyllwild and San Jacinto, plaster was cracked at San Jacinto, and a clock was thrown from its shelf at Idyllwild. Felt from Barstow (San Bernardino County) in the north to San Diego in the south and from the coast to Twentynine Palms in the east. (Ref. 23, 259, 292, 561.)

1950. Nov. 17 (Nov. 16). Near Hawthorne, Los Angeles County, Calif. Scattered reports of cracked plaster and broken dishes were received from southwest Los Angeles. This was the strongest of three small earthquakes that were felt in the area between 01 59 and 19 46 UTC on Nov. 17. The shocks were felt only in Los Angeles County. (Ref. 23, 259, 292.)

1950. Dec. 14, 13 24 UTC. Near Herlong, Lassen County, Calif. This main shock of a series caused considerable structural damage at Herlong. Many structures sustained cracks from about 0.3 to 0.6 cm in width to as much as 24 m in length. Many chimneys were broken, trusses and roof rafters were split, and several buildings were displaced on their foundations. Damage to water mains, steam pipes, and sewers also was reported. Felt from Alturas (Modoc County) south to Sacramento and east to Lovelock, Nev. Several foreshocks and aftershocks were felt in the area. Magnitude 5.6 M_S GR. (Ref. 23, 259, 324, 561.)

1951. Jan. 24 (Jan. 23). Near Westmorland, Imperial County, Calif. About 5.5 km southwest of Westmorland, in the Imperial Valley Irrigation District, 30 m of ground running northwest-south east settled 2.5 cm; a water main in the Trifolium area was cracked; and canal banks were cracked. Slight damage also was reported in the nearby towns of Brawley, Calexico, Coachella, El Centro, Holtville, and Imperial. Felt over a large area of southern California and into southwest Arizona. (Ref. 24, 259, 292.)

1951. Jan. 25. Near San Leandro, Alameda County, Calif. Windows were broken or cracked and dishes fell from shelves at Oakland. Large chunks of plaster fell in the San Leandro Post Office, and dishes broke in houses. Felt over a small area of Alameda and Contra Costa Counties. (Ref. 24, 259, 324.)

1951. July 29. Pinnacles National Monument area, San Benito County, Calif. Chimneys twisted, plaster fell, and concrete pipes were damaged slightly at Pinnacles. Plaster fell in some houses in San Benito, and the highway from San Benito to Hernandez Valley was covered with boulders. Outside stucco and plaster walls were damaged slightly at Bitterwater (Lonoak). Felt from Pescadero (San Mateo County) in the north to San Luis Obispo in the south and Caruthers (Fresno County) in the east. (Ref. 24, 259, 324.)

1951. Aug. 6. Pinnacles National Monument area, San Benito County, Calif. Plaster was downed and vases were overturned south of Hollister, at the Harris Ranch. This earthquake was felt over the coastal area of west-central California. Two aftershocks were felt at 09 54 and 17 21 UTC. (Ref. 24, 259, 324.)

1951. Oct. 8 (Oct. 7). Off Cape Mendocino, Humboldt County, Calif. Damage was considerable to a partly completed bridge over the Van Duzen River near Alton: columns were out of plumb, spans were out of position, diagonals were bent, and anchor bolts and grout pads were damaged. Cracks about 36 m in length formed in the pavement of both approaches to the bridge and in fill beside the approaches. Chimneys were broken or toppled at Bridgeville, Fortuna, Grizzly Bluff (a fireplace also was damaged considerably), Metropolitan, Rio Dell, Scotia, and Weott. This strong shock was felt along the coast from Orick (Humboldt County) in the north to Manchester (Mendocino County) in the south and east to Red Bluff (Tehama County) and Richvale (Butte County). Magnitude 6.0 M_S CFR. (Ref. 24, 259, 324, 563.)

1951. Nov. 14. South of Eureka, Humboldt County, Calif. A large window was broken in the Humboldt Times building in Eureka; windows and dishes were broken at Fields Landing; and plaster was cracked in a store at Fortuna. Felt over a small area in the Eel River Valley in northwest California. (Ref. 24, 259, 324, 563.)

1951. Dec. 5. Near Brawley, Imperial County, Calif. About 16 km north of Brawley, a crack about 30 m long and 4 cm wide formed in a gravel road; canal banks were damaged; plumbing broke in several houses; windows broke and stucco was damaged; and ceiling lights crashed to the floor. A bridge across the Highland canal also was damaged. One artesian well ejected water 3 m during the shock, and another well ran muddy water. Felt over a small area of the Imperial Valley in southeast California. (Ref. 24, 259, 292, 563.)

1951. Dec. 26 (Dec. 25). Near the southeast point of San Clemente Island, Calif. This Christmas Day earthquake caused slight damage to plaster, windows, or chimneys at Avalon, Long Beach (a large piece of tile also fell), San Diego, San Clemente Island, and San Pedro. The sharp shock was felt over a large area of southwest California and probably into northern Baja California. Magnitude 5.9 M_S CFR, 5.9 M_S GR. (Ref. 24, 259, 292.)

1952. Feb. 9. Northeast of Lone Pine, Inyo County, Calif. A series of three earthquakes occurred in the Lone Pine area. A building was cracked by the main shock at 08 43 UTC, and plaster fell in several houses. A cafe sustained a large crack that extended halfway around the building and completely through the wall. Felt only at a few towns in Inyo County. (Ref. 25, 259, 292.)

1952. July 21, 11 52 UTC. South of Bakersfield, Kern County, Calif. This earthquake was the largest in the conterminous United States since the San Francisco shock of 1906. It claimed 12 lives and caused property damage estimated at $60 million. MM intensity XI was assigned to a small area on the Southern Pacific Railroad southeast of Bealville. There, the earthquake cracked reinforced-concrete tunnels having walls 46 cm thick; it shortened the distance between portals of two tunnels about 2.5 m and bent the rails into S-shaped curves. At Owens Lake (about 160 km from the epicenter), salt beds shifted, and brine lines were bent into S-shapes.

Many surface ruptures were observed along the lower slopes of Bear Mountain, in the White Wolf fault zone. The somewhat flat, poorly consolidated alluvium in the valley was erratically cracked and recontoured. The cracking along Bear Mountain indicated that the mountain itself moved upward and to the north. Southwest of Arvin, on the San Joaquin Valley floor, ground cracks traversed and split the concrete foundation of one house, causing partial collapse. The ground slumped; cotton rows were offset more than 30 cm; and pavement on one highway was crumpled for more than 300 m. East of Caliente, one large crack, about 1.5 m at its widest point and more than 60 cm deep, was observed. Fill areas in the mountainous region along U.S. Highway 466 (now State Highway 58) settled from a few centimeters to more than 30 cm in places, and a large part of the highway was cracked and wrinkled. Northeast of that highway, the ground was displaced vertically about 60 cm and horizontally about 45 cm.

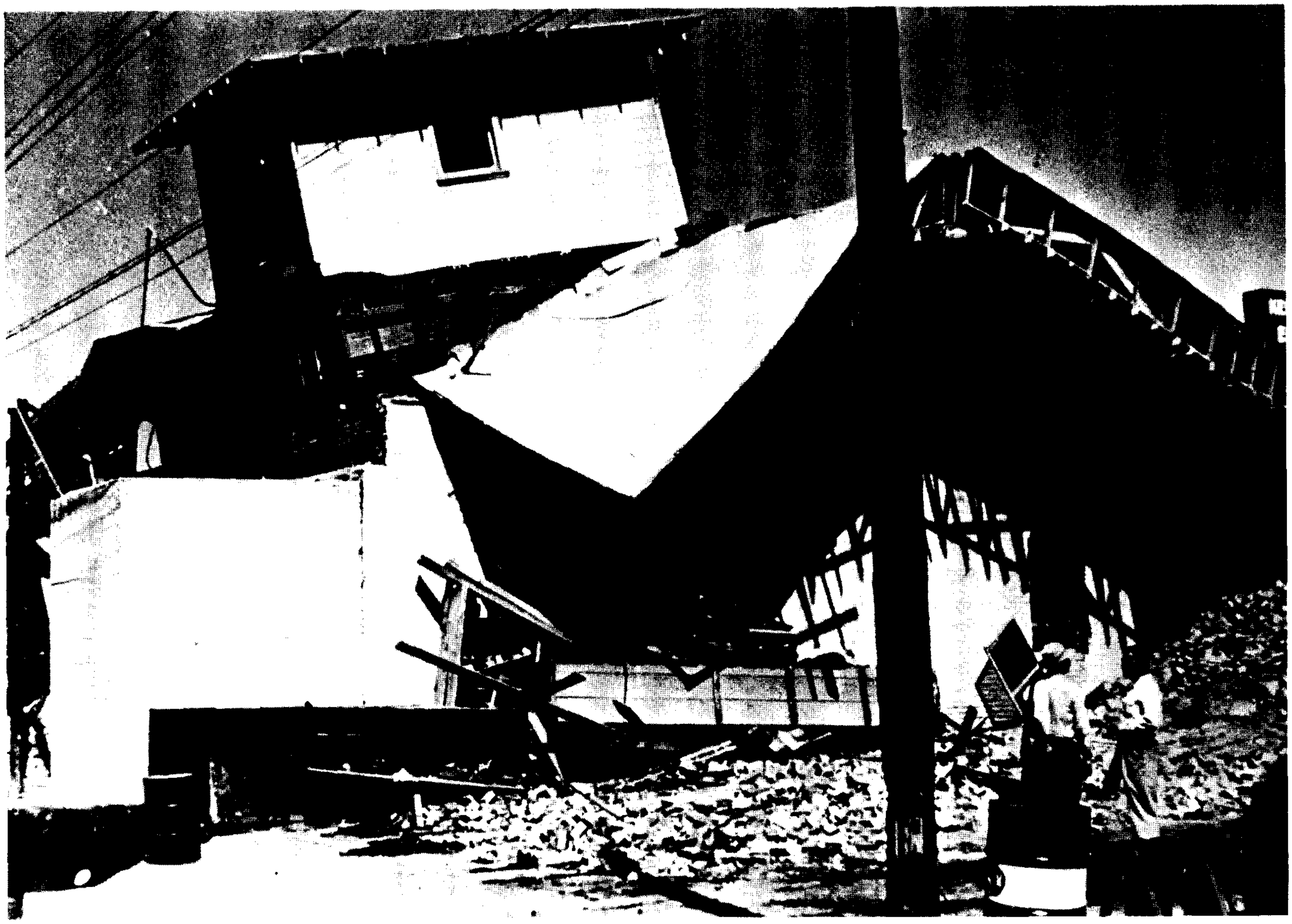
Maximum MM intensities in nearby cities did not exceed VIII. At Tehachapi, Bakersfield, and Arvin, old and poorly built masonry and adobe buildings were cracked, and some collapsed.

Property damage was heavy in Tehachapi, where both brick and adobe buildings were hit hard, and 9 people were killed. Three people were killed in other towns. Although damage was severe, the total extent of damage to property did not exceed that in Long Beach in 1933. Only a few wood-frame structures were damaged seriously in this earthquake, compared to the 1933 shock in which many such structures were thrown off foundations.

The generally moderate damage in Bakersfield was confined mainly to isolated parapet failure. Cracks formed in many brick buildings, and older school buildings were damaged somewhat. In contrast, however, the Kern General Hospital was damaged heavily. Multistory steel and concrete structures sustained minor damage, which commonly was confined to the first story. Similar kinds of damage also occurred at Arvin, which lies southeast of Bakersfield and west of Tehachapi.

Reports of long-period wave effects from the earthquake were widespread. Water splashed from swimming pools as far distant as the Los Angeles area, where damage to tall buildings was nonstructural but extensive. Water also splashed in pressure tanks on tops of buildings in San Francisco. At least one building was damaged in San Diego, and in Las Vegas, Nev., a building under construction required realignment of the structural steel.

The main shock was felt over most of California and in parts of western Arizona and western Nevada (see fig. 20). It was observed at such distant points as Stirling City, Calif., Phoenix, Ariz., and Gerlach, Nev. The California Institute of Technology at Pasadena recorded 188 aftershocks of magnitude 4.0 and higher through September 26, 1952; six aftershocks on July 21 were of magnitude 5.0 and higher. Magnitude 7.8 M_S ABE, 7.3 m_b ABE, 7.7 M_S CFR, 7.7 M_S GR, 7.0 M_{La} ELL, 7.21 M_L KJ. (Ref. 25, 38, 292, 460, 521, 533, 549.)



Building in Bakersfield, California, damaged by the Kern County earthquake of July 21, 1952. (Source of photograph unknown.)

1952. July 21, 12 05 UTC. Kern County, Calif., aftershock. This earthquake was felt at Huasna. Magnitude 6.4 M_S CFR. (Ref. 25, 292.)

1952. July 21, 15 13 UTC. Kern County, Calif., aftershock. A strong aftershock (time reported as 07 20 PST) caused additional damage to buildings in the Arvin area. (Ref. 25, 259, 292.)

1952. July 23, 00 38 UTC (July 22). Kern County, Calif., aftershock. A large aftershock of the July 21 earthquake caused damage to an old brick building in Arvin that was damaged in the main shock. Slight damage also occurred south of Bakersfield and at Fresno. This shock was reported mainly in Kern County. Magnitude 6.1 M_S CFR. (Ref. 25, 259, 292.)

1952. July 23, 07 53 (July 22), 13 17, and 18 13 UTC. Kern County, Calif., aftershocks. One house at Arvin that sustained only minor damage in the main event on July 21 was almost destroyed by the aftershock at 07 53 UTC. Walls and fronts of buildings of weakened structures collapsed; gas and water mains were broken; and transformers were torn off. The second aftershock also caused serious damage to already weakened buildings at Arvin and Tehachapi, and the third caused only minor damage at Arvin. These aftershocks were reported only at a few towns in Kern County. (Ref. 25, 259, 292.)

1952. July 25, 19 09 and 19 43 UTC. Kern County, Calif., aftershocks. Some pipeline damage and changes in ground level occurred 8 km south of Bakersfield (at Fairfax) as a result of these strong aftershocks. Light damage to buildings was reported from several towns in the area. Ground cracks were enlarged in Tejon Canyon, 16 km southeast of Arvin.

Railroad tracks near Bealville, California, bent and twisted by the July 21, 1952, earthquake. (Photograph from the National Geophysical Data Center, NOAA.)

Landslides occurred in the Caliente Creek Canyon, Oiler Canyon Grade, State Highway 178 (between Bakersfield and Kernville), and White Wolf Ranch. Both shocks were felt over a wide area of south-central California. (Ref. 25, 259, 292.)

1952. July 29, 07 03 UTC (July 28). Kern County, Calif., aftershock. Another strong aftershock of the July 21 earthquake caused severe damage to buildings that were damaged in the main earthquake. One store at Bakersfield sustained additional damage, including a collapsed parapet and a crumbled wall. Cracks formed in several large buildings, and bricks tumbled from the tops of previously damaged structures. At least 10 fires were ignited in the area. Moderate damage to chimneys and walls occurred at Edison. This aftershock was felt widely in south-central California. Magnitude 6.1 M_S CFR. (Ref. 25, 259, 292.)

1952. July 31, 12 09 UTC. Kern County, Calif., aftershock. Another aftershock at Arvin jarred bricks loose and broke windows. Slight damage also occurred at Bakersfield and in the area of Taft. Felt over a small area of south-central California. (Ref. 25, 259, 292.)

1952. Aug. 13, 17 39 UTC. Kern County, Calif., aftershock. The earthquake caused slight damage to brick at Arvin. The shock also was reported felt in Los Angeles. (Ref. 25, 259, 292.)

1952. Aug. 22. East of Bakersfield, Kern County, Calif. Heavy damage, estimated at $10 million, occurred in the downtown area of Bakersfield. Two people were killed and several were injured.

Damage was confined mainly to brick buildings in a 64-block area of downtown Bakersfield. Larger, multistory, concrete and steel frame buildings sustained rather light damage. There were few complete collapses of buildings, but out of 396 structures that were damaged, 90 or more had to be razed. Many of these buildings had suffered considerable damage

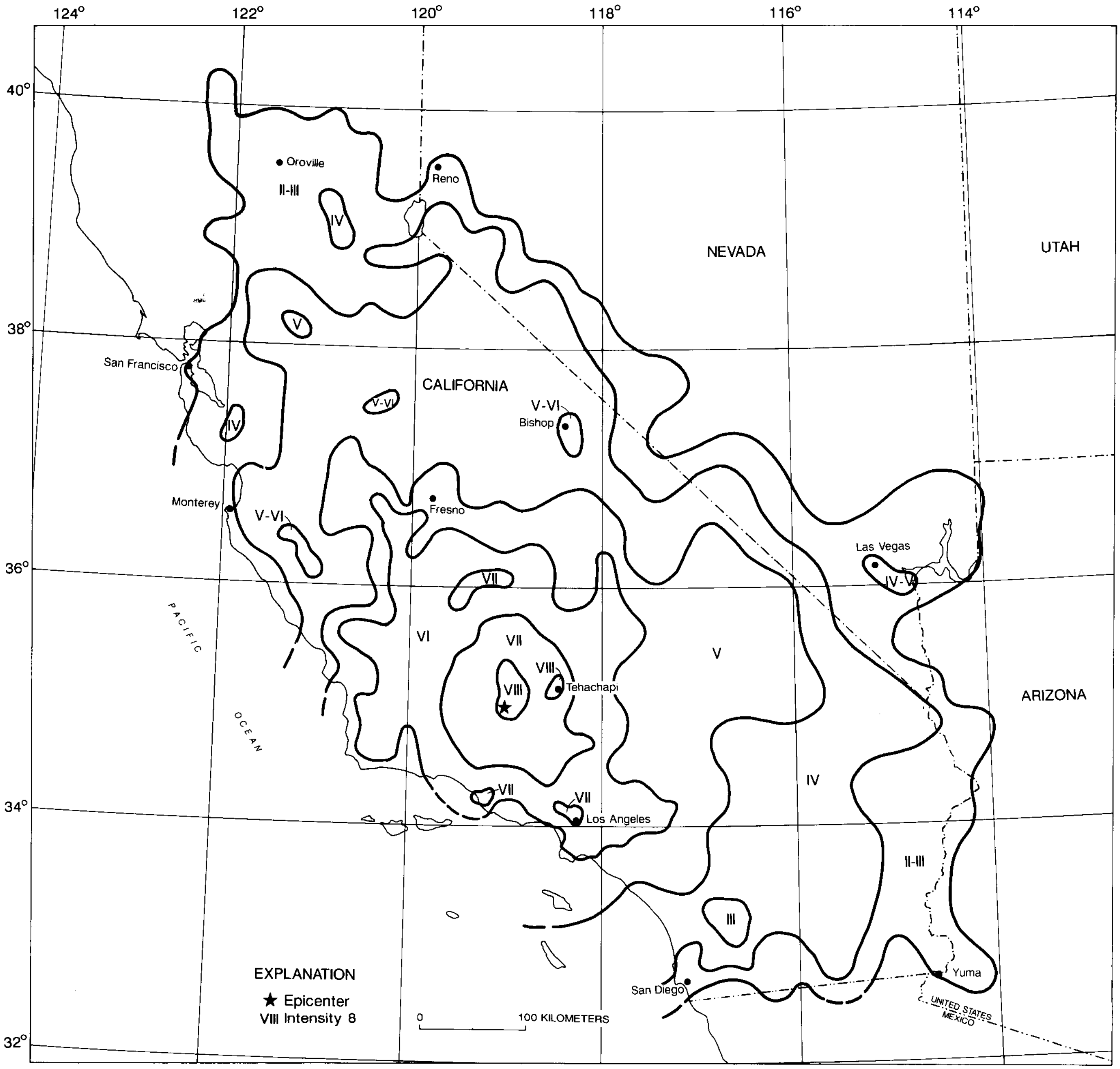


Figure 20.—Isoseismal map for the Kern County, California, earthquake of July 21, 1952. Isoseismals are based on intensity estimates from data listed in references 25, 259, and 549 of table 1.

from the earthquake on July 21, 1952, and the aftershocks. Outside the downtown area, chimneys twisted and fell, and plaster and walls cracked. Felt over a large part of south-central California—from Hollister south to Los Angeles and from the coast east to the Nevada border. (Ref. 25, 292, 549.)

1952. Aug. 23. Near Acton, Los Angeles, County, Calif. Southwest of the epicenter, slight damage was reported in Ventura County at Camarillo, Moorpark, and Oxnard. Chimneys were cracked at Moorpark, and a water tower was damaged at Amboy (San Bernardino County). The higher intensities reported north into Kern County and at Amboy (northeast of San Bernardino) may be due to confusion with other shocks on Aug. 22. (Ref. 25, 259, 292.)

1952. Sept. 22. Southwest of Petrolia, Humboldt County, Calif. At Petrolia, some houses were displaced as much as 5 cm on their foundations. Several chimneys fell and many were others were damaged. An oil well casing cracked at the Petrolia Oil Well Company, and a bunkhouse was displaced from its foundation. This shock generally was felt from the Eureka area on the north, south along the coast to Elk (Mendocino County), and east from the coast to the Ruth area (Trinity County). (Ref. 25, 259, 324.)

1952. Nov. 22 (Nov. 21). Near Bryson, Monterey County, Calif. Chimneys twisted and fell in the Bradley area and at San Luis Obispo; five or more old chimneys were knocked down at Bryson. Cracks formed in walls of buildings and in the ground in the Bryson area. Felt along the coast from San Francisco on the north to the Los Angeles area on the south and as far east as Olancha (Tulare County). Magnitude 6.0 M_S CFR, 6.0 M_S GR. (Ref. 25, 259, 476.)

1953. May 25, 04 07 UTC (May 24). Near Calpella, Mendocino County, Calif. This earthquake reportedly cracked walls and twisted doors out of line at Calpella. Felt only at a few other towns in the area. (Ref. 26, 259, 324.)

1953. June 14, 04 17 UTC (June 13). Brawley area, Imperial County, Calif. Damage was considerable near Brawley, where chimneys cracked and fell. At the Thistle Lateral Canal (5 km south of Westmorland), the shock damaged one of the canal structures and cracked several meters of bank along the canal. The ground settled extensively at the Tokay Canal. Felt north to the Palm Springs area (Riverside County), west to San Diego, and southeast to Yuma, Ariz. Several aftershocks occurred. (Ref. 26, 259, 292.)

1954. Jan. 12. West of Wheeler Ridge, Kern County, Calif. The epicenter of this earthquake was close to that of the major shock of July 21, 1952. This shock caused minor damage at the Maricopa Seed Farm, about 25 km east of Maricopa. The damage included broken bracing rods in three steel-frame corrugated-iron buildings and a shattered base of one elevated water tank. Near the farm, unanchored platform pole transformers were toppled. Slight damage was reported from many towns in the area. The earthquake also was observed slightly in tall buildings in Sacramento, San Diego, and San Francisco. (Ref. 27, 259, 292.)

1954. Mar. 19, 09 54 UTC. Santa Rosa Mountains, Riverside County, Calif. Minor damage reported at several towns in the area included fallen plaster from walls, broken windows and dishes, broken water pipes, cracked swimming pools, and damaged stock in stores. The main shock was felt over a large area of southern California and parts of western Arizona and southwest Nevada. Of the many aftershocks that were located, the largest occurred on Mar. 19 at 10 21 UTC. Magnitude 6.2 M_S CFR, 6.2 M_{La} ELL (main shock). (Ref. 27, 259, 292, 521.)

1954. Apr. 22. East of Watsonville, Santa Cruz County, Calif. Plaster fell and walls cracked at Gilroy, and dishes broke and knickknacks fell at Aptos. Felt over a small area of the coastal region of west-central California. (Ref. 27, 259, 324.)

1954. Apr. 25. East of Watsonville, Santa Cruz County, Calif. Several poorly built houses, east of Watsonville along the Chittenden Road, were damaged severely when they were shifted on their foundations; ground cracks formed along the Pajaro River. Several chimneys toppled at Aromas and in the Interlaken District. The shock was strong enough to shatter a few windows and knock plaster from walls in the San Francisco Bay area. It was felt along the coast from Santa Rosa (Sonoma County) on the north to San Ardo (Monterey County) on the south and east as far as Fresno. (Ref. 27, 259, 324.)

1954. Aug. 26. Off the coast of Ventura County, near Anacapa Island, Calif. This slight earthquake shook plaster from the ceiling of the Ventura County Courthouse. Felt slightly at several towns in the area. (Ref. 27, 259, 292.)

1954. Nov. 10. Near Lakeport, Lake County, Calif. Slight damage in the form of cracks in windows, concrete, and plaster occurred at Nice, Potter Valley, Talmage, Willits, and Witter Springs. The earthquake was observed over a small area of Lake and Mendocino Counties. (Ref. 27, 259, 324.)

1954. Nov. 25. Off Cape Mendocino, Calif. The shock caused no damage but was felt over a large area of Humboldt and Mendocino Counties. Magnitude 6.5 M_S CFR. (Ref. 27, 259, 324.)

1954. Dec. 17 (Dec. 16). East of San Leandro, Alameda County, Calif. Chimneys and a water main were broken at Oakland, and plaster fell. Cracks in plaster and walls were reported at Hayward and San Leandro. Felt over a moderate area of west-central California. (Ref. 27, 259, 324.)

1954. Dec. 21. Near Eureka-Arcata, Humboldt County, Calif. This earthquake and a strong aftershock on Dec. 30 caused property damage estimated at $2.1 million. One person was killed when he fell into Humboldt Bay, and several people were injured by falling objects.

The shock caused only slight structural damage to reinforced concrete and concrete block and wood-frame buildings in the Eureka-Arcata areas. The Eureka City Hall and the Humboldt County Courthouse in Eureka were cracked extensively. The main damage in both Arcata and Eureka was to chimneys, plaster, plate-glass windows, and merchandise in stores, but several old and poorly constructed brick walls bulged, and some parapet damage was sustained. Damage to structures and underground pipelines occurred in areas of unstable ground. Previous ground settling, as well as subsidence at the time of the shock, were observed in some of the damaged areas. Between Eureka and Arcata, U.S. Highway 101 was cracked and bulged in places.

Felt from southern Oregon on the north to San Francisco on the south and to Lake City (Modoc County) on the east. A strong aftershock occurred on Dec. 30. Magnitude 6.6 M_S CFR (main shock). (Ref. 27, 259, 480, 533, 550.)

1954. Dec. 30. Near Eureka-Arcata, Humboldt County, Calif. An aftershock of the Dec. 21 earthquake broke plate-glass windows, cracked chimneys, and further damaged the Eureka water-supply pipeline. (Ref. 27, 259, 324, 550.)

1955. Mar. 2. Near San Ardo, Monterey County, Calif. About 1.5 km west of San Lucas, a brick chimney collapsed on a house. Plaster was cracked at Adelaida, Indian Valley (northeast of San Miguel), and Templeton. Felt north along the coast to Pescadero (San Mateo County), south to Lompoc (Santa Barbara County), and east to Avenal (Kings County). (Ref. 28, 259, 324.)

1955. Apr. 29. Near Lower Lake, Lake County, Calif. Chimneys, windows, and dishes were broken, and plaster and walls were cracked at Lower Lake. Felt mainly in Lake County over a small area. (Ref. 28, 324.)

1955. May 7. Near Lower Lake, Lake County, Calif. A few weak chimneys on older houses fell at Lower Lake, and plaster cracked and fell. Minor damage also was sustained at Clearlake Highlands—walls, ceilings, and floors cracked; a chimney was damaged; and much plaster fell. Felt mainly in Lake County over a small area. Several slight aftershocks were reported. (Ref. 28, 259, 324.)

1955. Sept. 5 (Sept. 4). East of San Jose, Santa Clara County, Calif. This earthquake caused extensive minor damage, estimated at $100,000 in the San Jose area. The damage consisted mainly of toppled chimneys and broken plate-glass windows. Damage was most severe in the Willow Glen District of San Jose, about 13 km west of the epicenter, where about 100 chimneys were damaged and many collapsed. One house was displaced on its foundation. Walls were cracked at the County Hospital and County Jail, and a brick garden wall toppled. Felt north to Santa Rosa (Sonoma County), south to San Ardo (Monterey County), and east to the La Grange area (Stanislaus County). (Ref. 28, 259, 324.)

1955. Oct. 24 (Oct. 23). Concord–Walnut Creek area, Contra Costa County, Calif. This earthquake killed one person and caused property damage estimated at $1 million. The damage generally was minor, however, consisting mainly of cracked walls and plaster, broken windows, and loss from damaged merchandise. Damage was most severe at Walnut Creek where walls cracked, 80 plate-glass windows were broken, and much damage occurred to store merchandise. Minor damage to brick chimneys (some toppled) and walls occurred at several other towns in the region. Felt over a moderate area of west-central California. Several aftershocks occurred. Magnitude 5.4 M_S CFR. (Ref. 28, 259, 324, 533.)

1955. Nov. 2. Near San Ardo, Monterey County, Calif. This earthquake cracked plaster at Bryson, King City, and San Miguel and broke dishes at San Ardo. Felt over a small area along the coastal region of west-central California. (Ref. 28, 259, 324.)

1955. Dec. 17, 06 07 UTC (Dec. 16). Near Brawley, Imperial County, Calif. This main shock of a series caused minor damage at Brawley. The ceiling in a hardware store buckled; cracks formed in walls of buildings and existing cracks were enlarged; 12 water mains broke; street lights and about 20 plate-glass windows broke; and merchandise in stores was damaged. Slight damage also was reported at Calexico, El Centro, Holtville, and Imperial. Felt over a moderate area of southern California and western Arizona. About 81 earthquakes were felt in Brawley through 11 51 UTC, Dec. 19. (Ref. 28, 259, 292, 564.)

1956. Jan. 3 (Jan. 2). Near Glen Ivy, Riverside County, Calif. Broken windows, dishes, and plaster were reported from several nearby towns. Rockslides were reported in the area of Glen Ivy, in Temescal Canyon. Felt along the coast of southern California. (Ref. 29, 259, 292.)

1956. Feb. 9. Baja California, Mexico. Near El Alamo, Mexico, a new fault line, 29 km long, was reported, and new springs formed along the fault line. Minor damage, consisting mainly of broken windows, cracked plaster, and damaged stock in stores, was reported from Yuma, Ariz., and from several towns in southern California. Felt over a large area of southern California and western Arizona. Many aftershocks occurred through Apr. 26, 1956. (Ref. 29, 38, 259, 292.)

1956. Apr. 5 (Apr. 4). Near Saint Helena, Napa County, Calif. In the Angwin–Saint Helena Sanitarium area, residents reported many instances of cracks in plaster walls and concrete foundations. Tile flooring was cracked at the sanitarium. At Saint Helena, plaster fell from a ceiling and pine walls were cracked. Felt over a small part of the coastal area of north-central California. (Ref. 29, 259, 324.)

1956. Oct. 11, 16 48 UTC. Off the coast of Humboldt County, Calif. With the exception of a few broken dishes at Eureka, no damage was reported. Felt over a small area of Humboldt County. Magnitude 6.0 M_S CFR. (Ref. 29, 259, 324.)

1956. Nov. 16 (Nov. 15). Northwest of Parkfield, Monterey County, Calif. Plaster cracked at the Mee Ranch (Lonoak). The shock was reported felt in Fresno, Kings, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Santa Cruz Counties. (Ref. 29, 259, 324.)

1957. Mar. 18. South of Oxnard, Ventura County, Calif. Minor damage at Oxnard, Port Hueneme, and Ventura consisted mainly of cracked walls, fallen plaster, and loss from breakage of stock in stores. Felt over a small area of southern California, mainly in Ventura County. (Ref. 30, 259, 324.)

1957. Mar. 22 and 23. West of Daly City, San Mateo County, Calif. These earthquakes caused property damage estimated at $1 million and injured about 40 people. The first and strongest shock caused one death. Minor damage at several houses was reported along the ocean in the Westlake-Palisades tract, west of Daly City. Many chimneys were damaged at Daly City. In San Francisco, damage to chimneys, plaster, windows, and merchandise was widespread. The pavement along the edge of Lake Merced sloughed off into the lake, and both ends of a pedestrian bridge collapsed. Landslides blocked State Highway 1 near Mussel Rock, and the shoulder of the highway was cracked extensively.

The main shock was felt over a moderate area of west-central California, and many aftershocks were observed. The shock on Mar. 23 caused slight damage at Menlo Park and San Francisco. Magnitude 5.3 M_S CFR, 5.27 M_L KJ (both Mar. 22). (Ref. 30, 259, 324, 460, 533, 599.)

1957. Apr. 25, 21 57 UTC. Southwest end of Salton Sea, Imperial County, Calif. The most severe effects of this earthquake occurred in the Calipatria area, about 2.5 km north of Vail Canal, where a strip of land about 0.6 km wide and 1.5 km long was broken and cracked; water seeped from hundreds of blowholes that formed. Only slight damage was reported at other towns in the area. The main shock was felt over much of southern California and western Arizona. Many aftershocks occurred. (Ref. 30, 259, 292.)

1958. Sept. 21 (Sept. 20). Southeast of Soledad, in San Benito County, Calif. This local earthquake cracked a fireplace and broke dishes in the San Benito area. A landslide and damage to two other houses were reported in the area also. (Ref. 31, 324.)

1958. Oct. 1. Southeast of Sierraville, Sierra County, Calif. This earthquake cracked chimneys at Hallelujah Junction (about 30 km northwest of Reno, Nev.) and broke dishes at Reno. Felt over a small area of northeast California and western Nevada. (Ref. 31, 259, 324.)

1958. Dec. 1 (Nov. 30). Baja California, Mexico. A series of moderate earthquakes in Mexico caused minor damage in California at Calexico, Nestor, Potrero, and Seeley. The damage included fallen plaster from walls and slight cracks in chimneys, walls, and windows. The main shock at 03 21 UTC was felt over much of southern California and in parts of western Arizona. (Ref. 31, 259, 292.)

1958. Dec. 11. Southwest of San Francisco, Calif. Cracked plaster and windows, broken dishes, and damaged stock in stores were reported from several Bay area towns. Near Daly City, a minor landslide occurred on State Highway 1. Felt over a small area of west-central California. (Ref. 31, 259, 324.)

1959. Mar. 2. Near Gilroy, Santa Clara County, Calif. Residents of several towns near Gilroy reported slight damage, including broken windows, cracked plaster, and loss from fallen stock. One minor earthslide occurred east of Watsonville, and boulders rolled onto a highway between Gilroy and Watsonville. In San Francisco, 70 windowpanes were broken in one store. Felt along the coastal area from Jenner on the north to Big Sur on the south and inland to Gustine. (Ref. 32, 259, 324.)

1959. Apr. 1. Northeast of Loyalton, Sierra County, Calif. Most of the serious property damage occurred at Loyalton, where several chimneys fell, windows were broken, and plaster and walls were cracked. Felt over a large area of northeast California and western Nevada. (Ref. 32, 259, 324.)

1959. Apr. 6 (Apr. 5). North of Ukiah, Mendocino County, Calif. Chimneys cracked and windows broke at Redwood Valley. Felt in Lake and Mendocino Counties in northwest California. (Ref. 32, 259, 324.)

1959. May 26. Near Salinas, Monterey County, Calif. Windows and dishes were broken at Salinas, and a wall was cracked. Slight damage also occurred at Camp McCallum and Hollister. Felt most strongly in the area around Monterey Bay. (Ref. 32, 259, 324.)

1959. Oct. 24. Near Owens Peak, Kern County, Calif. A series of four earthquakes occurred in the Owens Peak area, the first of which was the strongest. Two hunters in the area reported that boulders tumbled down the mountainside and that a landslide occurred. Tops of dead trees were snapped off. Several shocks also were reported by residents of nearby Onyx. (Ref. 32, 259, 292.)

1959. Dec. 29 (Dec. 28). Northwest of Hollister, San Benito County, Calif. A few chimneys toppled at Hollister, and a large piece of timber fell from the roof of the City Hall building. Felt over the coastal area of west-central California from San Francisco south to San Miguel (San Luis Obispo County). (Ref. 32, 259, 324.)

1960. Jan. 20 (Jan. 19). South of Hollister, San Benito County, Calif. Minor damage occurred south of Hollister at a winery and a nearby ranch. At the winery, small bits of a ceiling fell, a chimney cracked at its roofline, cracks formed in pavement, and an underground pipeline broke. At the ranch, walls were cracked and an existing crack in a reservoir was enlarged. Felt along the coastal areas north of San Luis Obispo to San Francisco and inland to Merced. (Ref. 33, 259, 324.)

1960. June 6 (June 5). Off the coast of Humboldt County, Calif. Slight damage occurred at Eureka, where plaster fell in the old City Hall. At Crannell, north of Eureka, a brick chimney on one house was twisted slightly. Felt mainly in Humboldt and Trinity Counties. (Ref. 33, 259, 480.)

1961. Jan. 28. Near Walker Pass, Kern County, Calif. Slight damage was reported at Johannesburg, where the floor of a carport was cracked, and at Bodfish, where dishes were broken. At Kernville, rocks rolled down the mountainside. Felt over a large area, mainly in Kern and Tulare Counties. Many aftershocks were recorded. (Ref. 34, 259, 292.)

1961. Apr. 9, 07 23 and 07 25 UTC (Apr. 8). South of Hollister, San Benito County, Calif. Two strong earthquakes damaged many buildings at Hollister, but major damage was confined to the County Courthouse, the Dabo Hotel, and the Elks building. Property damage was estimated at $250,000. South of Hollister, on Cienega Road, a 15-m-long fissure occurred near a winery, which also sustained severe damage. Some chimneys in the area were damaged or fell, and water lines were ruptured. Felt along the coast of west-central California from the San Francisco Bay area south to Creston (San Luis Obispo County). (Ref. 34, 38, 259, 324.)

1961. Oct. 19 (Oct. 18). East of Brown, Kern County, Calif. This shock shifted heavy machinery and changed the water level in one well near Brown. The only damage was reported from Mojave, where slight cracks formed in a bathroom. The earthquake was reported in a few scattered areas of northern Los Angeles and San Bernardino Counties in south-central California. (Ref. 34, 259, 292.)

1961. Oct. 20. Near Huntington Beach, Orange County, Calif. This earthquake was one of a series of nine sharp tremors, that were felt mainly in Orange County. The main shock caused slight damage, including broken windows, cracked plaster and walls, and damaged stock in stores, in several towns in the County. (Ref. 34, 259, 292.)

1961. Nov. 15 (Nov. 14). Near Wheeler Ridge, Kern County, Calif. At Wilsona, in Antelope Valley, cracks formed in the walls of a building, the bottom of swimming pool, and in the ground. Damage was not reported from other towns in the area. This shock was felt mainly in Kern County, but also was observed in scattered areas of Kings, Los Angeles, Santa Barbara, Tulare, and Ventura Counties. (Ref. 34, 259, 292.)

1962. Apr. 27. Near Perris, Riverside County, Calif. Damage was slight at Romoland where windows and dishes were broken and at Winchester where cracks formed in walls, plaster, and windows. Felt over a small area of southern California, mainly in Riverside and San Bernardino Counties. (Ref. 35, 259, 292.)

1962. June 6. Near Lakeport, Lake County, Calif. In the area near Lakeport, water in Scott Creek (which was almost dry before the shock) rose about 0.5 m and flowed steadily for 11 days. The water in several wells in Scott Valley rose 2–3 m and turned milky white for 3–5 days. About 16 km southwest of Lakeport, a geyserlike spout of water was observed in Clear Lake. Slight damage, which occurred mainly in the Lakeport-Ukiah area, included fallen bricks from fireplaces and cracks in chimneys and walls. One chimney fell at Finley. Felt mainly in Lake and Mendocino Counties. (Ref. 35, 259, 324.)

1962. Aug. 23. Off the coast of Del Norte County, Calif. Slight damage occurred, mainly in the Crescent City–Smith River areas of Del Norte County. Damage consisted of broken windows, cracks in chimneys and walls, and loss from fallen stock in stores. The tops of some redwood trees were snapped off. Felt over a moderate area of northern California and southwest Oregon. (Ref. 35, 259, 480.)

1962. Sept. 4. Northwest of Arcata, Humboldt County, Calif. Plaster fell at the Eureka County Courthouse; new cracks formed in the walls of the old high school building; and windows broke at a drugstore. At Orick, plaster and walls were cracked and stock fell in stores. Felt over a small area of northern California, mainly in Humboldt County. (Ref. 35, 259, 480.)

1962. Oct. 29 (Oct. 28). Near Big Bear, San Bernardino County, Calif. A window was broken and stock fell from shelves at Big Bear City, and a water main was broken at Redlands. Rocks rolled onto the highway between Bear Valley and Lucerne Valley. Felt mainly in Riverside and San Bernardino Counties. Many aftershocks were recorded. (Ref. 35, 259, 292.)

1963. May 22. West of Sunnyvale, in Santa Cruz County, Calif. One roof reportedly caved in at Sunnyvale. Felt over a small part of the coastal area of west-central California. (Ref. 36, 259, 324.)

1963. May 23, 15 53 UTC. Imperial Valley, Calif. The main shock of a series on May 22–23 caused minor damage at Brawley (plate-glass window broke; plaster cracked) and Westmorland (plaster fell; windows and dishes broke). Felt mainly in the Imperial Valley of southern California. (Ref. 36, 259, 292.)

1963. June 7. West of Antioch, Contra Costa County, Calif. Slight damage occurred at Antioch, where cracks formed in the walls and foundation of a school, old cracks were enlarged, and beams and doors "twisted." Plaster was cracked at Clayton, Concord, and Cowell. Felt in the San Francisco Bay area, mainly in Contra Costa County. (Ref. 36, 259, 324.)

1963. Sept. 14, 19 46 UTC. Near Watsonville, Monterey County, Calif. The earthquake caused minor damage east of Watsonville in the Chittenden–Soda Lake area. In this small area along the San Andreas fault, the second floor of a wood-frame house was displaced; a water tank shifted on its foundation; one stone chimney was shaken loose, and one was cracked; and footings of a bridge across the Pajaro River were damaged slightly. Landslides were reported in the Soda Lake and Pajaro Gap areas. Felt along the coastal area of west-central California from Bolinas to Big Sur. (Ref. 36, 259, 467.)

1963. Sept. 23. Near San Jacinto, Riverside County, Calif. Chimneys were cracked and twisted at Hemet. Plaster cracked and fell at Hemet and San Jacinto, and windows and dishes were broken. Felt over a large part of southern California—from Los Angeles east to Twentynine Palms (San Bernardino County) and south to San Diego. (Ref. 36, 259, 292.)

1963. Dec. 6. Near Toms Place, Mono County, Calif. Plaster was cracked at Bishop and in the Paradise area northwest of Bishop. Also, a 230-kV-transformer bushing was cracked at Bishop. Felt over a moderate area of east-central California and western Nevada. (Ref. 36, 259, 292.)

1964. June 21. California-Mexico border region. Plaster fell from a 2-m-long crack in the ceiling of a building at San Diego, and new cracks formed in the beams at the post office. Slight damage also was reported at Coronado. Felt over a small area of southwest California. (Ref. 37, 259, 292.)

1964. Nov. 16 (Nov. 15). Near Corralitos, Santa Clara County, Calif. The most serious damage to property occurred in Corralitos. Several chimneys were toppled there, other chimneys were twisted, and water service was disrupted. Minor damage occurred at several towns in the Corralitos area. Felt along the coast of west-central California from Napa on the north to San Simeon (San Luis Obispo County) on the south. Magnitude 4.5 m_b NUT, 4.3 M_S NUT. (Ref. 37, 259, 263, 324.)

1964. Dec. 22. West of Ensenada, Mexico. The San Diego area sustained the most severe damage, which included fallen stones from a chimney, exterior crack in a fire station wall, broken windows, and fallen light fixtures. Slight damage also occurred at Boulevard, Imperial Beach, La Mesa, and Potrero. Felt along the coast from Los Angeles to Tijuana (Mexico) and inland to Calipatria (Imperial County). Magnitude 5.0 m_b NUT, 5.5 M_S NUT. (Ref. 37, 259, 263, 292.)

1965. Jan. 1. Southwest of Fontana, San Bernardino County, Calif. Glassware and dishes were broken at Fontana, and the ceiling of one house was shattered. A cement sidewalk was cracked at Lytle Creek, northwest of San Bernardino. Felt over a small area, mainly in Riverside and San Bernardino Counties. (Ref. 75, 259, 292.)

1965. Apr. 15. San Bernardino Valley, Calif. The press reported broken windows and merchandise shaken from shelves throughout the San Bernardino Valley, including Chino, Colton, Fontana, Rialto, and San Bernardino. Felt in Los Angeles, Orange, Riverside, and San Bernardino Counties. (Ref. 75, 259, 292.)

1965. June 16 (June 15). Imperial Valley, Calif. This was the main shock of a series that occurred in the Imperial Valley June 15–17. Slight damage was sustained at Westmorland, where plate-glass windows and dishes were broken, and at Imperial, where walls were cracked. Felt over a small area of Imperial County. (Ref. 75, 259, 292.)

1965. July 16 (July 15). Near Saugus, Los Angeles County, Calif. Stucco was cracked in several places in a house at Saugus, and one existing crack in cement was enlarged. Felt mainly in Kern and Los Angeles Counties. (Ref. 75, 259, 292.)

1965. Sept. 10. Near Pittsburg, Contra Costa County, Calif. Windows were broken in two houses at Concord, and in two stores at Pittsburg. At Cowell, chimneys were cracked and dishes were broken. Small rockslides were observed in Mount Diablo State Park. Felt over a small part of the San Francisco Bay region, mainly in Contra Costa County. (Ref. 75, 259, 324.)

1965. Sept. 25, 17 43 UTC. Southeast of Newberry, San Bernardino County, Calif. The main shock of a series of three events on Sept. 25 and 26 first increased and then decreased the flow of a spring at the Camp Cady Ranch, south of Manix Station. Gas pipes were damaged at Newberry, causing an explosion; an underground water tank was cracked at Hodge; and plaster cracked and fell at Kelso. The main shock was felt over a large area of southern California and at a few towns in southern Nevada and southwest Arizona. Two strong aftershocks were felt in the area at 17 48 UTC on Sept. 25 and 07 00 UTC on Sept. 26. Magnitude 4.7 m_b NUT, 4.4 M_S NUT. (Ref. 75, 259, 263, 292.)

1965. Oct. 17. Near Palm Springs, Riverside County, Calif. At Palm Springs, windows cracked and dishes broke, and at Cathedral City, a garden wall cracked. Felt mainly in Riverside and San Bernardino Counties. (Ref. 75, 259, 292.)

1965. Nov. 12. South of Glendale, Los Angeles County, Calif. Minor cracks formed in concrete on the 30th floor of the Occidental Center in Los Angeles, and plaster was cracked slightly in the Federal Building in Glendale. Felt only in a small area of southwest Los Angeles County. (Ref. 75, 259, 292.)

1966. May 24 (May 23). Near Chico, Butte County, Calif. This light shock generated a rockslide at Las Plumas, near Oroville, and cracked plaster northeast of Chico, at Forest Ranch. Felt over a moderate area in east-central California. Magnitude 3.8 m_b NUT, 4.0 M_S NUT. (Ref. 81, 259, 263, 324.)

1966. June 28, 04 26 UTC (June 27). Near Parkfield, Monterey County, Calif. This earthquake occurred in a sparsely populated region near Parkfield, so little building damage was sustained. The main damage included broken windows, cracked walls and swimming pools, and overturned tombstones in the Parkfield cemeteries.

Minor surface faulting, about 35 km long, occurred in a narrow zone along the San Andreas fault—from a few kilometers northwest of Parkfield almost to Cholame. About 1.5 km northeast of Cholame, the white dividing line on Highway 466 was offset about 10 cm. At that same site, a small concrete bridge sustained minor cracks and the pavement buckled. Bridges on the Parkfield-Cholame Highway, which parallels and crosses the fault trace several times, sustained minor damage. It was felt generally from Santa Cruz to Oxnard and northeastward into the Sierra Nevada foothills. It was preceded by a strong shock at 04 08 UTC on June 28 and followed by shocks of lower magnitude on June 28 and 29. More than 200 aftershocks occurred through December 1966. Magnitude 6.0 M_S ELL, 5.7 M_{La} ELL, 5.91 M_L KJ. (Ref. 81, 259, 398, 521, 551.)

1966. Aug. 7. Gulf of California, Sonora, Mexico. This earthquake cracked the ground 48 km south of San Luis and Rio Colorado in the El Golfo de Santa Clara area of Mexico. Damage in the United States was most severe at Yuma, Ariz., where a sidewalk sagged about 10 cm and the facades of several buildings sustained cracks. Slight damage also occurred at Blythe, Holtville, and Winterhaven, Calif., and at Picacho and Somerton, Ariz. The earthquake was felt widely in southern California and southwest Arizona and also was reported felt at Boulder City, Nev. (Ref. 38, 81, 259, 266.)

1966. Sept. 12, 16 41 UTC. Near Boca, Nevada County, Calif. Minor but extensive fractures in the ground were observed in the area northeast of Truckee, extending 16 km on a trend N. 30° E. from Prosser Reservoir to Hoke Valley. Chimneys toppled and masonry walls were cracked at Boca, Hirschdale (near Boca Dam), Hobart Mills (near Prosser Dam), Loyalton, and Sierraville. Pipelines were ruptured at Loyalton and Boca Dam. Several bridges on Highway 80 sustained minor damage, and Boca and Prosser earthfill dams were cracked. Landslides, rockslides, and slumping occurred on area highways and on the Southern Pacific Railway roadbed. This was the main shock of a series occurring near Boca. It was felt over a large area of east-central California and northwest Nevada. Magnitude 5.2 m_b NUT, 5.6 M_S NUT. (Ref. 81, 259, 263, 324, 457, 555.)

1966. Oct. 2 (Oct. 1). Palos Verdes Peninsula, Los Angeles County, Calif. On Palos Verdes Peninsula, two windows were broken, the curb and street were split, and the ground pulled away from the courtyard wall. Felt mainly in southwest Los Angeles County and western Orange County. (Ref. 81, 259, 292.)

1967. May 21. Near Anza, Riverside County, Calif. The shock rolled rocks onto Highway 74 from Nightingale to Palm Desert. A water reservoir at Norco sustained about $40,000 damage. Near Anza, well water appeared murky later in the day. Although this earthquake was felt mainly in Riverside, San Bernardino, and San Diego Counties, it was reported in scattered towns in Los Angeles and Orange Counties. (Ref. 40, 72, 292.)

1967. June 15 (June 14). Near Whittier, Los Angeles County, Calif. At Whittier, a plate-glass window broke at a market, a water pipe broke in an office building, and a wall cracked in a garage. Hairline cracks formed in a house foundation at San Gabriel, and plaster fell from a house in north Los Angeles. Felt mainly in the Whittier and San Gabriel Valley areas of Los Angeles County. (Ref. 40, 72, 292.)

1967. June 26. Near Redwood Valley, Mendocino County, Calif. Brick chimneys and dishes were damaged at Ukiah, and chimneys and walls were cracked in Redwood Valley, about 11 km north of Ukiah. At Coyote Dam, northeast of Ukiah, concrete spalled slightly on the curb of the intake tower access bridge. Felt over a small area of Lake and Mendocino Counties. (Ref. 40, 72, 324.)

1967. July 22. Near Paicines, San Benito County, Calif. At the Bear Valley Fire Control Station at Paicines, bricks and plaster were cracked and furniture was displaced. Felt only at a few towns in San Benito County and at Coalinga in Fresno County. (Ref. 40, 72, 324.)

1967. Sept. 7. Near Corralitos, Santa Cruz County, Calif. The only damage reported was at San Jose, about 40 km north of the epicenter, where cracks in a cement fence and in plaster were enlarged. Felt from Point Reyes Station (Marin County) south to King City (Monterey County). Magnitude 4.0 M_b NUT, 4.1 M_S NUT (Ref. 40, 72, 263, 324.)

1967. Sept. 28. Northeast of Morgan Hill, Santa Clara County, Calif. Rockslides were observed within 5 km of the epicenter. At San Jose, exterior walls of a house were cracked. Felt from Marin County south to Monterey County and east to Merced County. Magnitude 4.3 m_b NUT, 4.1 M_S NUT. (Ref. 40, 72, 263, 324.)

1967. Dec. 10, 12 06 UTC. Off the coast of Humboldt County, Calif. Minor damage occurred at several towns, including Crannell (chimney twisted), Denny (brick chimney cracked), Ferndale (windows cracked), and Scotia (plate-glass window cracked). The first shock was felt mainly in Humboldt County. Two aftershocks were observed, the strongest at 12 33 UTC. Magnitude 5.6 m_b NUT, 5.5 M_S NUT. (Ref. 40, 72, 74, 263.)

1967. Dec. 18. Near Corralitos, Santa Cruz County, Calif. Minor damage occurred mainly in the area of Corralitos, Gilroy, and Watsonville. It included cracks in chimneys and plaster, broken windows, and damage to fallen stock in stores. Felt from Marin County south to Monterey County and east to Merced County. Magnitude 4.8 m_b NUT, 4.7 M_S NUT. (Ref. 40, 72, 263, 324.)

1968. Apr. 9, 02 28 and 03 48 UTC (Apr. 8). Borrego Mountain earthquake, near Ocotillo Wells, San Diego County, Calif. Along the Coyote Creek fault, surface rupture 31 km in length was observed. Highway 78 sustained cracks adjacent to Ocotillo Wells. Rockslides occurred in Palm Canyon, Split Mountain, and Font's Head in the Anza–Borrego Desert State Park, and huge boulders blocked the Montezuma-Borrego Highway. The walls of one house at Ocotillo Wells were split over doorways and at corners of rooms, and the bedroom was separated from the rest of the house. The main shock at 02 28 UTC was felt over a large area, including southern California, southwest Arizona, and southern Nevada (see fig. 21). Several aftershocks were reported. The largest one at 03 48 UTC knocked plaster to the floor in a theater at Calexico. Magnitude 7.0 M_S ABE, 6.6 m_b ABE, 6.8 M_S ELL, 6.3 M_{La} ELL, 6.0 m_b NUT, 6.7 M_S NUT, 6.93 M_L KJ (main shock). (Ref. 41, 263, 292, 521, 552, 554.)

1968. Apr. 25. Near Santa Rosa, Sonoma County, Calif. Damage in the Santa Rosa area was limited to broken chimneys, windows, plaster, and stock in stores. One chimney toppled in the Larkfield housing tract north of Santa Rosa, about 20 percent of the chimneys were damaged visibly, and many windows were broken. Considerable damage to plaster was reported in light wood-frame buildings. Several tombstones were rotated in the cemetery north of Santa Rosa. Felt over a small area of west-central California from Mendocino County on the north to San Mateo County on the south. Magnitude 4.6 M_S NUT. (Ref. 41, 263, 324.)

1968. Apr. 29 (Apr. 28). South of Willows, Glenn County, Calif. Most of the damage from this shock was to merchandise in stores in the Chico area. One water well near Tehama went dry after the earthquake. At Chico, a sliding glass door and a glass trophy shelf were broken at a high school. Felt mainly in Butte, Glenn, and Tehama Counties in northern California. (Ref. 41, 324.)

1968. June 26, 01 42 UTC (June 25). Near Petrolia, Humboldt County, Calif. Several chimneys were toppled in the Honeydew-Petrolia area, and much damage to plaster and windows was reported. In Mattole Valley, a porch on a building collapsed and several fireplaces were damaged. Landslides and cracks in the ground were observed near the mouth of the Mattole River. Felt mainly in Humboldt and Mendocino Counties in northern California. Several aftershocks were felt in the area.

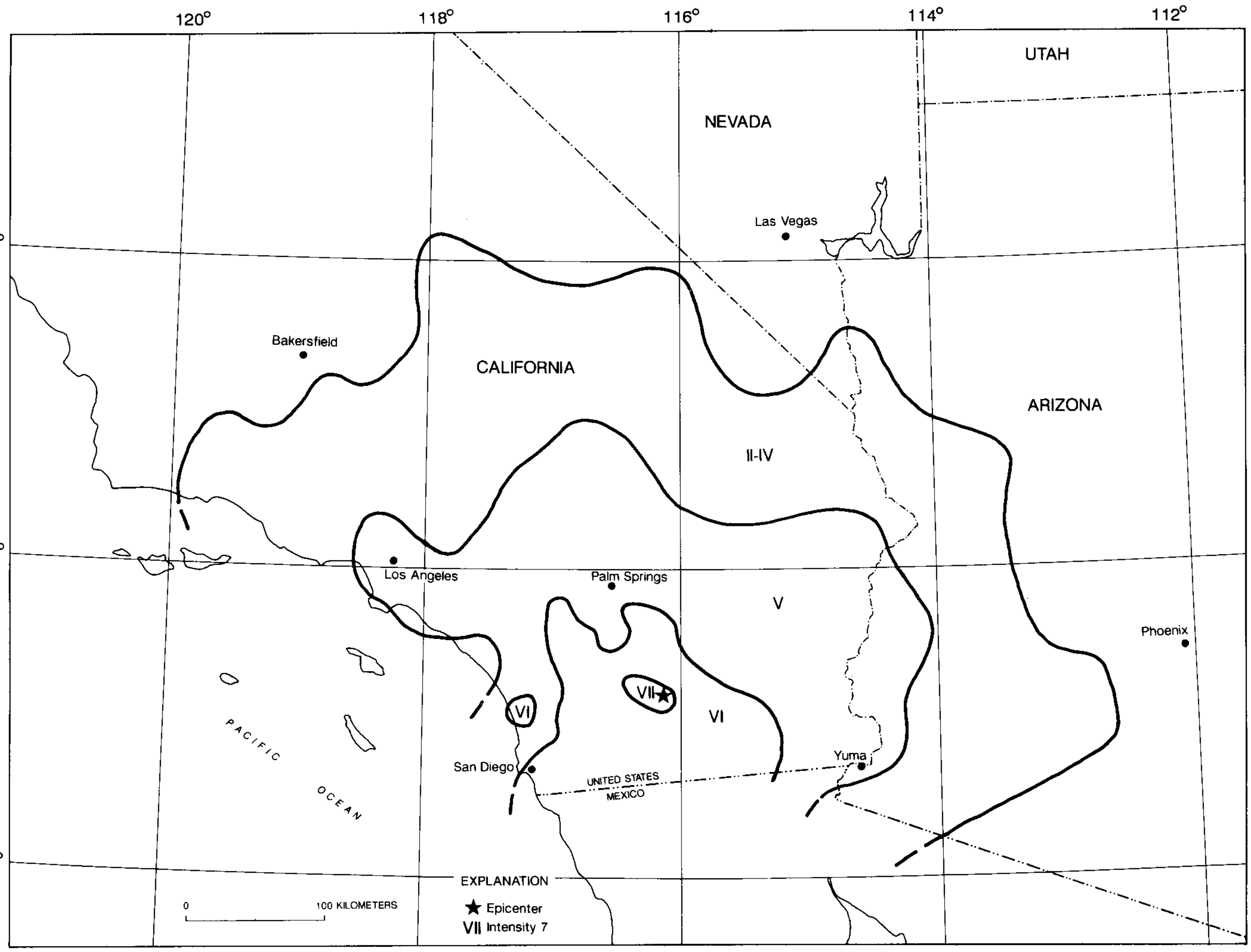


FIGURE 21.—Isoseismal map for the Borrego Mountain, California, earthquake of April 9, 1968. Isoseismals are based on intensity estimates from data listed in references 41 and 72 of table 1.

Magnitude 5.4 M_S ELL, 4.9 m_b NUT, 5.6 M_S NUT. (Ref. 41, 263, 480, 521.)

1968. June 29. Off the coast of southern California in Santa Barbara Channel. At Goleta, a bridge at one overcrossing had spalled concrete chips and cracked tar and mortar. Much stock was damaged in the stores at Goleta. The only other town reporting the shock was Santa Barbara. Several light tremors were felt in the area from June 23 to July 31, the strongest on July 5 at 00 45 UTC (see next paragraph). (Ref. 41, 292.)

1968. July 5 (July 4). Off the coast of southern California in Santa Barbara Channel. Only minor damage was sustained at Carpinteria (light fixtures and plaster fell; one chimney cracked), Goleta (plate-glass windows broke; tile panels and lights fell), and Santa Barbara (tile panels fell). Felt over a moderate area of southwest California from Santa Barbara and Kern Counties south to Orange County. Magnitude 5.2 m_b NUT, 4.8 M_S NUT. (Ref. 41, 72, 263, 292.)

1969. Feb. 7. Off the coast of Humboldt County, Calif. Chimneys were twisted at Petrolia and landslides occurred. One tombstone toppled at Ferndale, and several small cracks formed in the walls of a school building. Slight damage to merchandise occurred in several stores in Rio Dell and Scotia. Felt over a small area of Humboldt, Mendocino, and Trinity Counties. More than 40 aftershocks were recorded. (Ref. 42, 72, 324.)

1969. Feb. 28 (Feb. 27). Near Palmdale, Los Angeles County, Calif. Slight damage occurred at Palmdale, where fluorescent lights fell and windows were broken. Felt mainly in the Palmdale area of northern Los Angeles County. (Ref. 42, 72, 292.)

1969. Apr. 28. Near Borrego Springs, San Diego County, Calif. At Borrego Springs, large pieces of the ceiling fell at a bank, light fixtures were damaged, and brick walls were cracked. Several plate-glass windows were shattered in the town, and loss of merchandise in stores was common. Several rockslides occurred in the Santa Rosa Mountains, northeast of Borrego Springs. Felt over much of southern California and northern Baja California and at a few towns in southwest Arizona and southern Nevada. Magnitude 5.5 m_b NUT, 5.1 M_S NUT. (Ref. 42, 72, 263, 292.)

1969. June 7. Off the coast of Humboldt County, Calif. Near Capetown (between Ferndale and Petrolia), the top of a chimney fell, one chimney was cracked, and dishes were broken. The shock was felt only slightly at three other towns in Humboldt County. (Ref. 42, 72, 324.)

1969. Oct. 2, 04 56 and 06 19 UTC (Oct. 1). Near Santa Rosa, Sonoma County, Calif. These earthquakes caused one fatality and left severe property damage in Santa Rosa: several old brick and wood-frame buildings were damaged beyond repair; chimneys were destroyed; sidewalks buckled; and underground pipes ruptured. Other buildings in Santa Rosa that sustained substantial damage included Fremont Elementary School, Sonoma County Social Service Building, J.C. Penney Company store, and Veterans Memorial Building. Total damage was estimated at $8.35 million.

Significant cracking or offset of roads was not observed, except for some settlement of fill at one freeway overpass. On the north side of Santa Rosa, about 36 transverse fractures were observed in the asphalt of Poppy Drive; and fresh, irregular cracks formed in the dry dirt roads in the Rural Cemetery near Poppy Drive. Many tombstones in cemeteries were thrown down or twisted. Both earthquakes were felt over a moderate area of west-central California—from Sonoma County east to Sacramento County and south to Santa Cruz County. Several aftershocks were felt in the Santa Rosa area. Magnitude 4.8 m_b NUT, 4.5 M_S NUT (first shock.) (Ref. 42, 72, 263, 399, 599.)

1969. Oct. 27, 10 59 UTC. Near Hollister, San Benito County, Calif. Slight damage occurred at Hollister, where a wall joint opened slightly, plaster was cracked, and stock was damaged in stores. Felt over a small area of central California. (Ref. 42, 72, 324.)

1970. Jan. 3 (Jan. 2). Near Cupertino, Santa Clara County, Calif. At Cupertino, plaster broke and fell and bottles toppled from shelves in a store. This light shock was felt over a small area, mainly in the Cupertino region west of San Jose. (Ref. 43, 72, 324.)

1970. June 12, 03 30 UTC (June 11). Near Danville, Contra Costa County, Calif. This earthquake was the strongest of a series of shocks that occurred in the Danville area in May and June. One chimney fell in Danville, and a brick pillar partly crumbled at the Greenbrook Clubhouse. Also damaged in Danville were several outside brick facades, a fence, and several windows. Felt over a small area of the San Francisco Bay region, mainly in the Danville area. (Ref. 43, 72, 324.)

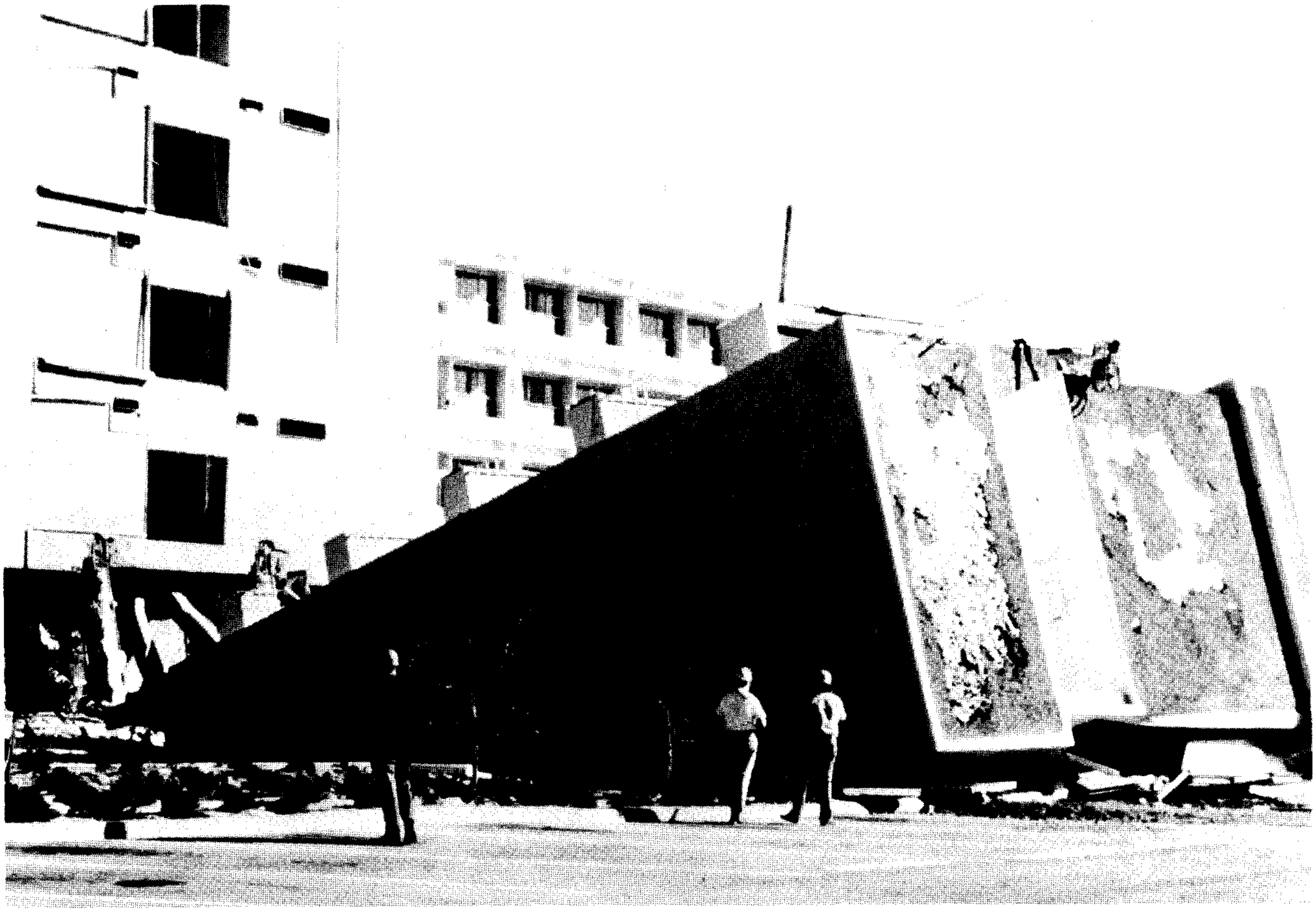
1970. June 12, 16 03 UTC. Near Danville, Contra Costa County, Calif. At the Danville Post Office, a wooden upright support beam was damaged slightly and existing plaster cracks were enlarged. Much stock was damaged in local stores. Felt mainly in the area of Danville. (Ref. 43, 72, 324.)

1970. Aug. 4 (Aug. 3). Off the coast of central California in Monterey Bay. Plaster cracked and fell at Monterey; a window broke; and a few telephone lines were knocked down. Damage was slight at Carmel Valley, where beams in one building twisted and cracked. Felt from the San Francisco Bay area south to Monterey County. Magnitude 4.4 m_b NUT, 3.6 M_S NUT. (Ref. 43, 72, 263, 324.)

1970. Sept. 12. Lytle Creek area, San Bernardino County, Calif. This was the main shock of a series that centered northwest of San Bernardino near Lytle Creek. Chimneys and tombstones were twisted and overturned and cracks formed in the ground at Lytle Creek. Several roads in the area were blocked by rockslides. Felt over a large area of southern California. Magnitude 5.7 M_L KJ. (Ref. 43, 72, 292.)

1971. Feb. 9, 14 00 UTC. North of San Fernando, Los Angeles County, Calif. This destructive earthquake occurred in a sparsely populated area of the San Gabriel Mountains, near San Fernando. It lasted about 60 seconds, and, in that brief span of time, took 65 lives, injured more than 2,000, and caused property damage estimated at $505 million.

The earthquake created a zone of discontinuous surface faulting, named the San Fernando fault zone, which partly follows the boundary between the San Gabriel Mountains and the San Fernando–Tujunga Valleys and partly transects the northern salient of the San Fernando Valley. This latter zone of tectonic ruptures was associated with some of the heaviest property damage sustained in the region. Within the entire length of the surface faulting, which extended roughly east-west for about 15 km, the maximum vertical offset measured on a single



Collapsed stair tower at the west end of wing B, Olive View Hospital, Sylmar area, California, caused by the February 9, 1971, San Fernando earthquake. (Photograph from the National Geophysical Data Center, NOAA.)

scarp was about 1 m, the maximum lateral offset about 1 m, and the maximum shortening (thrust component) about 0.9 m.

The most spectacular damage included the destruction of major structures at the Olive View and the Veterans Administration Hospitals and the collapse of freeway overpasses. The newly built, earthquake-resistant buildings at the Olive View Hospital in Sylmar were destroyed—four five-story wings pulled away from the main building and three stair towers toppled. Older, unreinforced masonry buildings collapsed at the Veterans Administration Hospital at San Fernando, killing 49 people. Many older buildings in the Alhambra, Beverly Hills, Burbank, and Glendale areas were damaged beyond repair, and thousands of chimneys were damaged in the region. Public utilities and facilities of all kinds were damaged, both above and below ground.

Severe ground fracturing and landslides were responsible for extensive damage in areas where faulting was not observed. The most damaging landslide occurred in the Upper Lake area of Van Norman Lakes, where highway overpasses, railroads, pipelines, and almost all structures in the path of the slide were damaged severely. Several overpasses collapsed. Two dams were damaged severely (Lower Van Norman Dam and Pacoima Dam), and three others sustained minor damage. Widespread landslides and rockfalls blocked many highways in the area.

Felt throughout southern California and into western Arizona and southern Nevada (see fig. 22). No foreshocks were recorded, but aftershocks were reported in the area for several months. Magnitude 6.5 M_L BRK, 6.5 M_{La} ELL, 6.2 m_b NUT, 6.6 M_S NUT, 6.35 M_L KJ. (Ref. 44, 72, 263, 400, 521, 553, 599.)

1971. Mar. 31. Near San Fernando, Los Angeles County, Calif. This was the most damaging aftershock of the Feb. 9 earthquake. The main damage was reported in the Granada Hills–Northridge–Porter Ranch area of San Fernando Valley. More than 300

Partial collapse of first floor of Olive View Hospital Medical treatment and care unit, Sylmar area, California, caused by February 9, 1971, San Fernando earthquake. (Photograph from the National Geophysical Data Center, NOAA.)

buildings sustained some kind of damage, including cracked foundations, shifted walls, damaged or destroyed chimneys, and broken windows. Many outdoor concrete garden walls fell, and some water lines were damaged. Felt over a large area of southern California, including Kern, Los Angeles, Orange, Riverside, San Bernardino, Santa Barbara, and Ventura Counties. Magnitude 4.2 m_b NUT, 4.3 M_S NUT. (Ref. 44, 72, 263, 292.)

1971. Sept. 30. West of Brawley, Imperial County, Calif. Near Westmorland, dishes and food were knocked to the floor. An observer northwest of Brawley reported she was knocked to the floor and that dishes fell from shelves. Felt over a small area of southern California and at Ehrenberg, Ariz. A few small aftershocks were felt in the epicentral area. (Ref. 44, 72, 292.)

1972. Feb. 24. Southeast of Hollister, San Benito County, Calif. This was the main shock of a series that occurred on this date. Many rockfalls along the San Benito River and the renewed movement of an old landslide east of Paicines were the main ground disturbances. Much cracking of the ground was observed on or near the old landslide. Mouldings separated slightly from walls at the Bear Valley Fire Control Station. At the nearby Melendy Ranch, a brick chimney on the ranch house was damaged severely. The main shock was felt over a moderate area of west-central California. Fourteen aftershocks of magnitude 2.5 to 3.6 were recorded on Feb. 24, and many were recorded for several days thereafter. (Ref. 45, 72, 324.)

1972. Sept. 4. Southeast of Hollister, San Benito County, Calif. Slight damage was reported at the Bear Valley Fire Control Station, including small cracks in brick and mortar and plaster, and displacement of a vertical pipe in the ceiling, which damaged the sheetrock. Many rockfalls occurred

Collapsed overpass at the Route 14–Route 5 interchange, northwest of San Fernando, California, caused by the February 9, 1971, earthquake. (Photograph by the Newhall Signal.)

along the banks of the San Benito River; landslides and cracks in the ground were observed at Paicines. Felt over a small area of west-central California. Several light aftershocks were reported. Magnitude 4.6 m_b NUT, 4.3 M_S NUT. (Ref. 45, 72, 263, 324.)

1972. Oct. 3 (Oct. 2). South of San Juan Bautista in Monterey County, Calif. In the San Juan Bautista area, old asphalt road cracks were widened, and fresh cracks formed in areas previously repaired. At the San Juan Bautista Mission, the top section of an old adobe wall was thrown down. Plaster cracked and fell at ranch houses southeast of San Juan Bautista. Much merchandise was thrown from shelves in San Juan Bautista and the surrounding area. Felt over a small area of west-central California. Several foreshocks and aftershocks were recorded. Magnitude 4.1 m_b NUT, 4.1 M_S NUT. (Ref. 45, 72, 263, 324.)

1973. Feb. 21. Off the coast of Ventura County, near Point Mugu, Calif. Property damage in the Oxnard, Point Mugu, and Port Hueneme areas was estimated at about $1 million. The heaviest damage occurred in downtown Oxnard, where walls failed in a few unreinforced brick buildings. Many chimneys were damaged, mainly in the older part of Oxnard; false ceilings and acoustical tiles fell to the floor and many plate-glass windows were broken. Chimneys were twisted and overturned northeast of Point Mugu at the Camarillo State Hospital. Some large boulders fell onto the Pacific Coast Highway in the Point Mugu area, and a long narrow crack was observed in the highway in the Solromar area. Several hundred sand craters (as much as 2 m in diameter) formed in Mugu Lagoon, and water spouted from a few of them. Lurch cracks associated with clusters

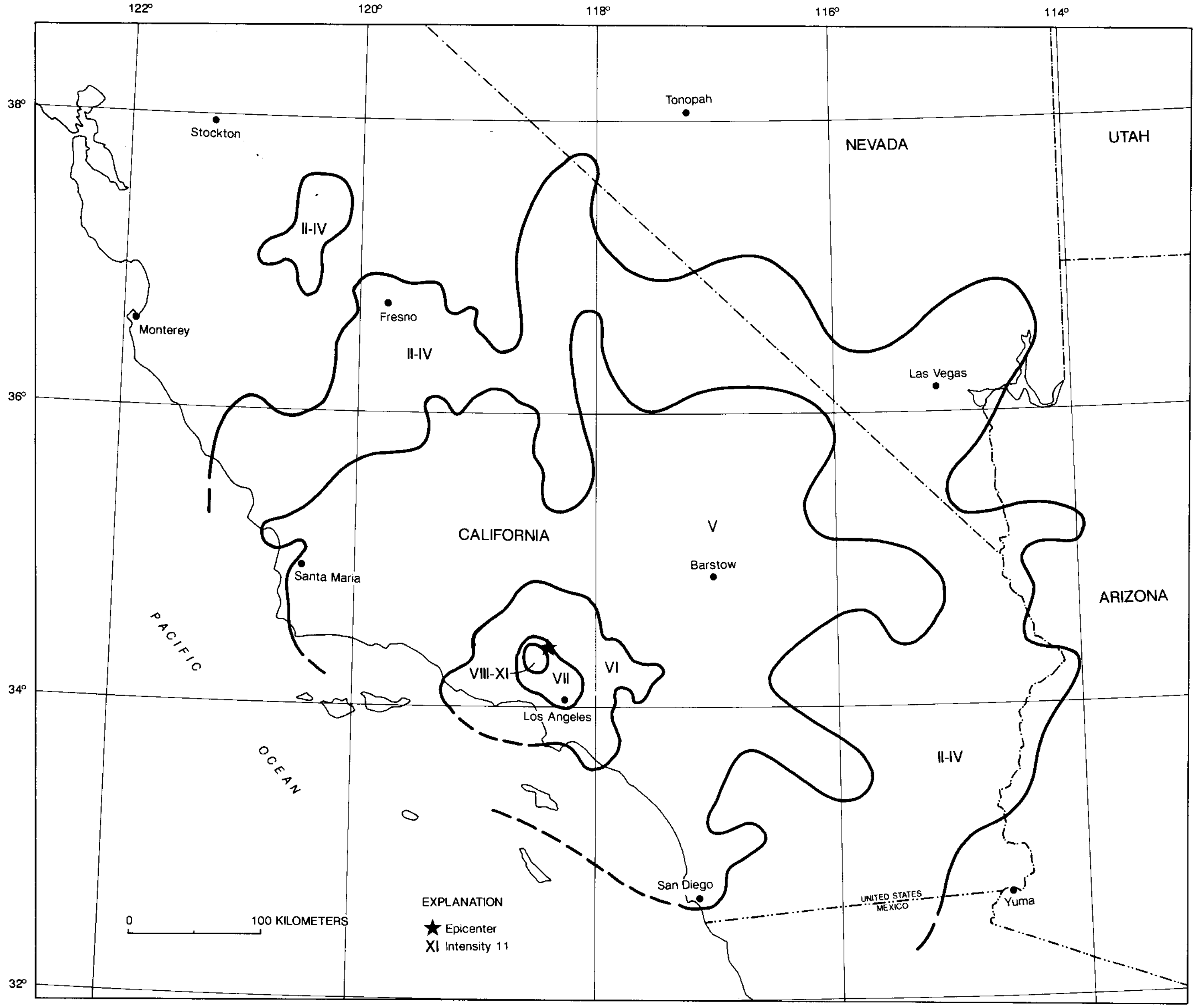


FIGURE 22.—Isoseismal map for the San Fernando, California, earthquake of February 9, 1971. Isoseismals are based on intensity estimates from data listed in references 44 and 72 of table 1.

of craters occurred as far as 8 km inland from the lagoon.

The main shock of this series of earthquakes was felt over a large area of southern California—from Lompoc (Santa Barbara County) northeast through the Bakersfield area to northeast Kern County, southeast to the Palm Springs area, and then southwest to the San Diego area. Many aftershocks were recorded. Magnitude 5.6 M_L BRK. (Ref. 46, 72, 458.)

1973. Aug. 9 (Aug. 8). Off the coast of Humboldt County, Calif. Damage sustained in the Ferndale-Scotia area consisted mainly of broken windows, cracked and broken plaster, and loss from damaged merchandise in stores. Felt over a small area of Humboldt and Mendocino Counties. (Ref. 46, 72, 401.)

1974. Jan. 6. Southwest of Nubieber in Shasta County, Calif. The earthquake knocked plaster to the floor at Bieber and ruptured a gas pipe at Nubieber. It was felt over a small area, including parts of Lassen, Modoc, Shasta, and Siskiyou Counties. (Ref. 47, 401.)

1974. Mar. 21. Near Healdsburg, Sonoma County, Calif. The floor at the Union Oil workshop at Cloverdale was cracked; boulders rolled down hillsides; and several cracks formed in the earth. Felt over a small area of Napa and Sonoma Counties. (Ref. 47, 107, 401.)

1974. Sept. 21. Near Sunnymead, Riverside County, Calif. Three walls were cracked at a ranch in Sunnymead, and damage was reported at San Bernardino. Felt over a small area of Riverside and San Bernardino Counties. (Ref. 47, 402.)

1974. Nov. 28. Near Hollister, San Benito County, Calif. Widespread minor damage occurred at Hollister, including fallen bricks from one chimney, broken windows, cracked water pipe, and cracks in wall and ceiling. Felt over a moderate area of west-central California. (Ref. 47, 401.)

1975. Jan. 12, 01 37 UTC (Jan. 11). Near Petrolia, Humboldt County, Calif. A small amount of chimney damage was reported at Petrolia, and one television antenna fell. Felt along the coast of Humboldt County from Trinidad on the north to Piercy (northern Mendocino County) on the south. (Ref. 48, 87, 401.)

1975. Jan. 13. Near Long Beach, Los Angeles County, Calif. Plaster cracked and fell at Long Beach. The press reported minor damage at Lakewood. The tremor was felt along the coast of Los Angeles County south to the Vista area and from the coast east to Bloomington (San Bernardino County). (Ref. 48, 87, 355.)

1975. Jan. 21. Near Calipatria, Imperial County, Calif. At Calipatria, bricks were separated and plaster fell. This earthquake was part of a series that centered in the Brawley area through early February. It was felt over a small area of Imperial County near the U.S.-Mexico border. (Ref. 48, 87, 355.)

1975. Jan. 23, 17 02 UTC. South of Calipatria, Imperial County, Calif. This was the main shock of a swarm that struck Imperial Valley in late January and early February. It generated surface ruptures along a 10.4-km segment of a newly recognized fault southeast of Brawley, now designated the Brawley fault. Displacement, which apparently was vertical at the surface, reached a maximum of more than 0.2 m at Keystone Road. The shock knocked down several light fixtures and bits of plaster from a store ceiling in Brawley; it also broke windows in houses and cracked plaster. Plaster also fell at Calipatria and a large crack formed in one wall. Residents throughout the Imperial Valley reported feeling this shock. (Ref. 48, 355, 565.)

1975. Jan. 23, 23 24 UTC. Near Brawley, Imperial County, Calif. Ceiling tiles fell to the floor at two stores in Brawley, and a small crack formed in a store wall. This earthquake was reported only at Brawley. (Ref. 48, 355.)

1975. Mar. 3. Near Compton, Los Angeles County, Calif. Joints in a concrete walk were separated and plaster was cracked at Compton. Windows were broken at Gardena. (Ref. 48, 355.)

1975. June 1 (May 31). Galway Lake area, San Bernardino County, Calif. Property damage was not reported from the epicentral area, which is in the Mojave Desert and virtually uninhabited. Ground ruptures observed followed a preexisting, unmapped fault in the Galway Lake area. The ruptures began about 1 km north of Galway Lake and extended south toward Emerson Lake, a distance of 6.8 km. Boulders were overturned in the area, and cracks formed in the ground. Felt mainly in San Bernardino County. (Ref. 38, 355.)

1975. June 7. Near Fortuna, Humboldt County, Calif. At Fortuna, 10 weak chimneys toppled and 20 others were damaged; sidewalks cracked and some sank. Minor damage to chimneys also occurred at Carlotta, Fernbridge, Ferndale, Hydesville, Loleta, Petrolia, Rio Dell (water main also broke), Rohnerville, Scotia, and Waddington. Landslides were observed in the Fortuna–Rio Dell areas. Felt along the coast from Crescent City south to Albion (Mendocino County) and from the coast east to Lewiston (Trinity County). (Ref. 48, 401.)

1975. June 20 (June 19). Near Calexico, Imperial County, Calif. Slight damage was reported, but not described, at Calexico. The shock was felt at a few other towns in Imperial County and in southwest Arizona. (Ref. 48, 355.)

1975. Aug. 1, 20 20 UTC. Near Oroville, Butte County, Calif. Structural damage, consisting mainly of cracks in chimneys and walls, broken windows and plaster, and loosened light fixtures, occurred at several schools, hospitals, and houses in the Oroville-Thermalito area. Many chimneys toppled or had to be taken down in Oroville and Palermo. Property damage was estimated at $2.5 million.

This earthquake was associated with the first recorded surface faulting in the western foothills of the Sierra Nevada. New fractures in the ground were observed in a 3.8-km-long north- to north-northwest-trending zone. The block east of the fault moved upward relative to that on the west, as shown by about 55 mm of slip across the surface ruptures and 180 mm of vertical movement of benchmarks near the rupture zone. Felt over a large area of northern California and western Nevada. (Ref. 38, 401, 566, 599.)

1975. Aug. 2. Oroville area, Butte County, Calif. The University of California at Berkeley assigned MM intensity VI to this earthquake but did not describe the damage. Felt throughout Butte and surrounding counties. (Ref. 48, 401.)

1975. Aug. 3, 06 35 UTC (Aug. 2). Near Firebaugh, Fresno County, Calif. A water line broke and plaster cracked at Firebaugh; a church was damaged at Three Rocks. Felt mainly in Fresno and surrounding counties. Magnitude 4.9 M_L PAS. (Ref. 48, 401.)

1975. Aug. 10 (Aug. 9). South of Mariposa, Calif. Rockslides and broken windows were reported at Mariposa; slight damage was reported at San Joaquin in Fresno County. Felt over a small area of central California. (Ref. 48, 401.)

1975. Sept. 13. West of Avenal in Monterey County, Calif. Cracks formed in plaster and ground at Avenal. Felt along the coast of Monterey and San Luis Obispo Counties and east to Fresno County. Magnitude 5.0 M_L PAS. (Ref. 48, 401.)

1975. Nov. 14. Near Eureka, Humboldt County, Calif. Damage was slight at Eureka, where windows were broken. Dishes and dolls were broken at a store in Ferndale. The press reported that the shock was felt north to Oregon and south to San Francisco. (Ref. 48, 401.)

1976. Jan. 1. Near Brea, Los Angeles County, Calif. This New Year's Day earthquake disturbed millions of residents in the Los Angeles region but caused no injuries and only slight damage. Damage occurred at Brea (windowpane broke and fireplace cracked), La Habra (water pipe broke), and Yorba Linda (walls and ceilings cracked). A strong-motion record obtained at Whittier, about 13.8 km west of the epicenter, recorded a maximum acceleration of 0.28 *g* (gravity). The shock also was felt in Orange, Riverside, and San Bernardino Counties. (Ref. 49, 355.)

1976. Jan. 14. North of Avenal in Fresno County, Calif. At Avenal, plaster was cracked and a light fixture was knocked from the ceiling at a school. The shock also was felt in Kings, Monterey, and San Luis Obispo Counties. Magnitude 4.6 M_L PAS. (Ref. 49, 401.)

1976. Apr. 8. Near Granada Hills, Los Angeles County, Calif. Plaster was cracked at Granada Hills, and slight damage was reported, but not described, at Inglewood. Felt from Bakersfield (Kern County) to San Diego. Magnitude 4.8 M_L BRK. (Ref. 49, 355.)

1976. Aug. 11. Near Borrego Springs in Riverside County, Calif. In Borrego Springs, mudslides and cracks in the ground were reported in Anza-Borrego State Park. A cement curb buckled at Palm Desert. Felt in Imperial, Orange, San Bernardino, and San Diego Counties. (Ref. 49, 355.)

1976. Aug. 20. Near Danville, Contra Costa County, Calif. This earthquake was the largest of a series in the San Francisco Bay area Aug. 15–16 and 20–22. The only reported damage occurred in Danville, where plaster was cracked in some houses. Felt throughout the San Francisco Bay area. (Ref. 49, 401.)

1976. Oct. 17 (Oct. 16). Near Newhall, Los Angeles County, Calif. Slight damage was observed at Newhall, where a water main was broken, and at Tarzana, where plaster and masonry sustained cracks. The shock also was felt in Kern and Ventura Counties. Magnitude 4.1 M_L BRK. (Ref. 49, 355.)

1976. Nov. 4. Northwest of Brawley, Imperial County, Calif. A series of earthquakes was recorded on this date, but only slight damage occurred. Plaster and drywall were cracked at Brawley; fences were displaced slightly, and cracks formed in plaster and tiles at El Centro; and cracks formed in plaster and ground at Westmorland. Felt over a large area of southern California (including Imperial, Riverside, and San Diego Counties) and southwest Arizona (including the towns of San Luis and Yuma). Magnitude 5.5 M_L BRK. (Ref. 49, 355.)

1976. Nov. 22. West of Los Angeles, Calif. Windows were broken and plaster was cracked at North Hollywood; slight damage was reported at Long Beach and Los Angeles (cracks in plaster). Felt over a small area along the west coast of Los Angeles County. (Ref. 49, 355.)

1977. Jan. 8. Near Oakland, Contra Costa County, Calif. This main shock of a series of 58 tremors caused minor damage at several towns, including Berkeley (broken windows, enlarged cracks in walls); El Cerrito (dislodged chimney brick, cracks in walls); Napa (cracks in plaster and drywall); Oakland (cracks in plaster in several houses); San Francisco (chandelier knocked down, cracks in ceilings); and Walnut Creek (cracks in drywall). Felt along the coast of California from Sonoma County south to Santa Cruz County. (Ref. 39, 401.)

1977. June 21 (June 20). Southwest of French Camp in Alameda County, Calif. This earthquake cracked sidewalks slightly at French Camp and left cracks in plaster and drywall at El Granada. It was felt along the coast from Point Reyes Station (Marin County) south to Santa Cruz and from the coast east to the Sonora area (Tuolumne County). (Ref. 39, 401.)

1977. Aug. 12 (Aug. 11). Near San Fernando, Los Angeles County, Calif. One person was injured at San Fernando when a shelf of dishes fell on her. Windows were broken in Los Angeles, Northridge, and Van Nuys; exterior walls were cracked at Reseda; and plaster was cracked at Studio City. Water sloshed onto sides of pools at Glendale and Van Nuys. Felt alcng the coast of southern California from Santa Barbara south to San Pedro (Los Angeles County) and from the coast east to Palmdale and Riverside. (Ref. 39, 355.)

1977. Oct. 21 (Oct. 20). Imperial Valley, Calif. At Brawley, plaster was cracked and small objects were shifted. Felt in many towns in the Imperial Valley. (Ref. 39, 355.)

1977. Nov. 14 (Nov. 13). Near El Centro, Imperial County, Calif. At El Centro, plaster fell in the Post Office and some windows were broken; at Imperial, cracks formed in plaster walls. Slight damage (cracks in windows) also was reported at Somerton, Ariz. Felt over a small area of southern California and southwest Arizona. (Ref. 39, 355.)

1977. Nov. 22. Near Willits, Mendocino County, Calif. Moderate structural damage occurred at Willits, where 65 chimneys were damaged, and windows and walls were cracked and broken. Cracks and offsets of as much as 12 mm were formed in the walls of a store on Main Street; concrete columns were cracked and the ceiling dropped as much as 50 mm. A few interior walls collapsed in older houses. An interior wall collapsed in one house, and its chimney fell apart both inside and outside the house. East of Willits, in Little Lake Valley, a chimney was cracked above the roofline, heavy furniture was displaced, toilet-tank lids flew off their bases, and a water pipe broke. Felt along the coast from Scotia (Humboldt County) in the north to Stewarts Point (Sonoma County) in the south and from the coast east to the Willows area (Glenn County). (Ref. 39, 401.)

1978. Mar. 26 (Mar. 25). Near Ukiah, Mendocino County, Calif. Near Ukiah, huge storage tanks in a new warehouse at the Parducci Winery were damaged by sloshing liquids. Loss to merchandise at stores in the Ukiah area totaled about $10,000. Windows were broken at Comptche. Felt northwest to Westport (Mendocino County), south along the coast to Stewarts Point (Sonoma County), and from the coast east to Clearlake Highlands (Lake County). (Ref. 240, 401.)

1978. Aug. 13. Near Goleta, Santa Barbara County, Calif. This moderate earthquake injured 65 people and caused property damaged estimated at $12 million. The most severe damage occurred at Santa Barbara and at the University of California Santa Barbara campus at Goleta. There, nine buildings sustained extensive cracks in shear walls. Plaster, ceilings, and light fixtures were damaged throughout the campus. A few old adobe or wood-frame buildings were damaged severely. In the commercial district of Goleta and in the Santa Barbara area, similar but less severe property damage was sustained. In Santa Barbara, multistory, reinforced-concrete structures sustained diagonal cracks in the shear walls of their lower stories. The roof on a restaurant being remodeled collapsed. The most common damage to residential and small commercial buildings consisted of differential settlement of foundations, failure of reinforced chimneys, cracked and fallen plaster, and breakage of glass.

Three overpasses on U.S. Highway 101 in the Goleta area sustained severe damage. The most extensive damage occurred at the Ward Memorial bridges, where the superstructures shifted relative to the abutments, causing the concrete to crack and spall in several places. West of Goleta, a freight train derailed when passing over a "kink" in the tracks, apparently caused by failure of the roadbed fill. Several rockslides occurred on U.S. Highway 101 between Goleta and Santa Barbara.

Felt over a moderate area of southern California—from Morro Bay (San Luis Obispo County) on the north to Santa Ana (Orange County) on the south and from the coast east to Bakersfield (Kern County) and Lake Hughes (Los Angeles County). (Ref. 38, 240, 468, 599.)

1978. Aug. 29 (Aug. 28). Near San Jose, Santa Clara County, Calif. At San Jose, acoustical ceiling tiles fell to the floor in a market. In addition, walls and ceilings sustained cracks in a house and its walls were elevated 1.7 cm from the floor. Felt over a small area of northern California, mainly in Alameda, Contra Costa, Santa Clara, and Santa Cruz Counties. (Ref. 240, 401.)

1978. Sept. 4, 21 54 UTC. Lake Tahoe region, El Dorado County, Calif. This is the largest of a series of earthquakes that occurred in the area south of Lake Tahoe on Sept. 3 and 4. Cracks in drywall and hairline cracks in exterior walls were sustained at Mt. Aukum, Calif., and Genoa, Nev. Water splashed onto sides of lakes and pools at Mt. Aukum. Felt from Dobbins (Yuba County) and Stockton (San Joaquin County) on the west to Vernon, Nev., in the east and from Surcliffe, Nev., on the north to Mariposa, Calif., on the south. (Ref. 240, 401.)

1978. Oct. 4, 16 42 UTC. Lake Crowley area, Mono County, Calif. The strongest effects from this earthquake occurred in the Bishop area. Large amounts of merchandise fell from store shelves throughout the area, and pictures were knocked from walls. Minor landslides occurred in the canyon areas near Bishop, and boulders rolled onto roads. Slight

Books shaken off shelves in library of the University of California, Santa Barbara, at Goleta, California, by the August 13, 1978, earthquake.

damage to walls, plaster, and windows occurred at Benton, Bishop, Easton, Friant, Mammoth Lakes, and Paradise Camp. Felt over a large area of northern California and into western Nevada—from Sacramento on the north to Santa Barbara on the south and east to Mina and Beatty, Nev. Magnitude 5.8 M_L BRK. (Ref. 240, 355.)

1978. Nov. 20 (Nov. 19). Near Redlands, San Bernardino County, Calif. This earthquake caused slight damage at Redlands, where interior plaster walls cracked and split and hairline cracks formed in exterior walls. Felt in parts of Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties. (Ref. 240, 355.)

1979. Jan. 1. Near Malibu, Los Angeles County, Calif. Windows were reported broken in Culver City, Malibu, Santa Monica, Tustin, and Venice. Slight damage to walls (mainly cracks) occurred at Studio City and Woodland Hills. Boulders fell onto the Pacific Coast Highway in the Malibu area, and mud and boulders tumbled onto other roads in Malibu. The main earthquake was felt along the coast from Santa Barbara south to Bonita (San Diego County) and from the coast east to the area of Barstow (San Bernardino County) and Palm Springs (Riverside County). The California Institute of Technology recorded about 50 aftershocks in the next 2 hours. (Ref. 262, 474.)

1979. Feb. 3. Off the coast of Humboldt County, Calif. Many store windows were broken and stock tumbled from shelves in stores in the downtown areas of both Arcata and Eureka. At Eureka, chimneys were cracked and broken (one fell through a roof); drywall, plaster and exterior walls were cracked; three water mains were broken; and ceiling tiles and light fixtures fell in some stores. Felt in parts of Del Norte, Humboldt, Mendocino, Siskiyou, and Trinity Counties and in southwest Oregon. (Ref. 262, 401.)

1979. Feb. 22. Honey Lake Valley, Lassen County, Calif. This earthquake interrupted telephone service in the epicentral area but caused only minor property damage. Drywall was cracked at Doyle, near the Nevada border, and desks were displaced. The earthquake was felt over a large area of northeast California and western Nevada. It was preceded by a small foreshock and was followed by aftershocks through Feb. 23. (Ref. 262, 401.)

1979. Mar. 15, 21 07 UTC. Near Landers, San Bernardino County, Calif. This earthquake was the strongest of a series of shocks in the area on Mar. 15. A surface rupture formed in the Homestead Valley area along the east bank of Pipes Wash and at three sites west of the Pipes Wash fault. The highest intensity was observed at Landers, where moderate damage to buildings and their contents occurred (downed chimney, cracked walls, broken windows and dishes), and electric and telephone services were disrupted for several hours. Slight damage to plaster and walls was reported from several other towns in the area. The main shock was felt in Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties and at a few towns in southwest Arizona and western Nevada. (Ref. 262, 355.)

1979. May 8 (May 7). Near San Jose, Santa Clara County, Calif. This earthquake was strongest in East San Jose, where windows were broken, plaster was cracked, pictures fell from walls, and a refrigerator fell over. Felt mainly in the coastal area around San Francisco Bay. (Ref. 262, 401.)

1979. June 14 (June 13). Near Onyx, Kern County, Calif. Minor damage consisting of large cracks in plaster walls and cracks in brick fences and sidewalks occurred at Onyx. The earthquake was felt only at a few towns in the epicentral area. (Ref. 262, 355.)

1979. June 29 (June 28). Big Bear Lake, San Bernardino County, Calif. This earthquake was felt strongly in the Big Bear Lake recreation area, where large cracks formed in plaster, a foundation cracked, a plate-glass window shattered, and several burglar alarms were triggered. Felt in the Los Angeles Basin and as south as San Diego. (Ref. 262, 472.)

1979. June 30, 00 34 UTC (June 29). Near Big Bear Lake, San Bernardino County, Calif. This earthquake is the largest of a series in the area that began on June 29. At Big Bear City, several windows were broken, walls were cracked, and a large section of acoustical-tile ceiling fell. At Sugarloaf, chimney bricks loosened and ceiling tile and a foundation cracked. Felt west to Long Beach, south to San Diego, and north to Yermo (San Bernardino County), but the felt area east of Big Bear City is unknown. (Ref. 262, 472.)

1979. Aug. 6. Near Gilroy, Santa Clara County, Calif. No fatalities occurred, but 16 people were injured in Hollister and Gilroy. Property damage in the two towns, estimated at $500,000, consisted mainly of damaged chimneys, broken glassware in stores, and structural damage to five buildings in Gilroy.

Many chimneys were damaged in older houses near Gilroy's downtown area. A crack split a wall in the City Hall, and the ceiling in a court room of the Municipal Courthouse caved in. Beams and uprights were damaged at Fords Department Store and the store was closed. At Hollister, a parapet toppled and caved in the roof of a real estate office; a ceiling partly collapsed at a new building on San Felipe Road. The J.C. Penney Store sustained a 3-m hole in its ceiling, and extensive cracks formed in the ceiling throughout the store. A service station at nearby Casa de Fruta sustained extensive damage, including fallen bricks from the chimney, bulging of exterior walls, and separation of interior walls from ceiling or floor. The fire station at Pacheco Pass, about 16 km northeast of Hollister, sustained extensive damage, and the nearby lookout station was vacated because of structural damage.

Ground displacement was observed along the Calaveras fault zone from Hollister north to the Anderson Lake area, about 39 km. The maximum horizontal displacement, 5–6 mm, occurred about 10 km east of Gilroy, where the Calaveras fault zone intersects Highway 152. Ground lurching, settlement, and slumping were observed in many places between Anderson Lake and Hollister. Felt from about 60 km north of Bakersfield, north to Sacramento, east to the area of Reno–Lake Tahoe, Nev., and west to the Pacific Ocean. During August, most of the 31 located aftershocks were clustered in the area south of the epicenter of the main shock. Magnitude 5.6 M_{La} ELL. (Ref. 262, 401, 521.)

1979. Oct. 15, 23 16 UTC. Imperial Valley area, on the Baja Calif., Mexico-California border. This major earthquake injured 91 people and caused an estimated $30 million in property damage in the Imperial Valley area. It destroyed two houses and 11 commercial buildings and damaged 1,565 houses and 440 commercial buildings. The most severe damage (MM intensity IX) was to the Imperial County Services building in El Centro, which had to be razed. The support pillars failed on this six-story reinforced concrete-frame structure, causing partial collapse of the east part of the building. It was designed under the 1967 provisions of the California Uniform Building Code. Other property damage caused by this earthquake at El Centro, Brawley, and Calexico and at Mexicali, Mexico, is typical of MM intensity VII, which is the highest intensity assigned to any location except the Imperial County Services building.

Movement along the Imperial fault also caused damage to the irrigation system in the Imperial Valley. The All American Canal, which brings water from the Colorado River to the Imperial Valley, was damaged most severely. East of Calexico, the earthquake shook down levees on both sides of the canal. The banks settled more than 1 m in places.

Ground displacement on the Imperial fault extended from about 4 km north of the International Border to about 4 km south of Brawley. The maximum lateral displacement—about 55 cm—was observed in Heber Dunes; the maximum vertical displacement—19 cm—occurred southeast of Brawley. Ground rupture followed the same trace as that in the shock on May 18, 1940, and showed many of the same features and characteristics. Aftershock activity shifted to the north in both earthquakes, and both sustained damaging aftershocks near Brawley. There also is evidence that the Brawley fault experienced sympathetic movement in both earthquakes.

Felt over a large area, including southern California, southern Nevada, western Arizona, and an unknown area in Mexico. Many aftershocks occurred, the most damaging of which were on Oct. 16 and Dec. 21 (see descriptions below). Magnitude 7.0 M_L BRK, 6.0 M_{La} ELL. (Ref. 38, 262, 355, 521.)

1979. Oct. 16, 06 58 UTC (Oct. 15). Imperial Valley area aftershock. Aftershocks of the major earthquake on Oct. 15 caused additional damage at Brawley and Imperial. According to the press, near midnight on Oct. 15, an aftershock at Imperial buckled the floor in one house, displaced walls, and crumbled the porch steps. (Ref. 262, 355.)

1979. Dec. 21. Imperial Valley area aftershock. Another aftershock of the major earthquake on Oct. 15 left large cracks in exterior walls at Imperial and cracked windows and stone fences. Felt over a small area of southern California and western Arizona. (Ref. 262, 355.)

1980. Jan. 24, 19 00 UTC. North of Livermore Valley in Contra Costa County, Calif. This earthquake injured 44 people and caused an estimated $11.5 million in property damage (of which $10 million damage occurred at the Lawrence Livermore Laboratory at Livermore). The shock was associated with surface rupture along the Greenville fault. The rupture propagated more than 15 km to the southeast along the Marsh Creek–Greenville faults, ceasing in the area of Interstate Highway 580.

Most of the damage to property, including that at the Lawrence Livermore Laboratory, was nonstructural. It consisted mainly of fallen ceiling tiles, fallen bricks from chimneys, broken gas lines and water lines, broken windows, and displacement of mobile houses from supporting foundations. However, at the Ordway Ranch (on Vasco Road north of Livermore), a brick-and-stone fireplace was cracked and displaced from the wall, as was a smaller fireplace in another room. At Interstate 580 and Greenville Road (about 4 km north of the Lawrence Livermore Laboratory), pavement on the overpass settled about 30 cm and concrete on one abutment cracked and spalled.

Faulting was observed for a distance of about 6 km along the Greenville fault, beginning near the overpass

Support pillar failure on the ground level of the Imperial County Services building, El Centro, California, caused by the October 15, 1979, Imperial Valley earthquake.

at Interstate Highway 580 and Greenville Road. Where the fault crosses Vasco Road, right-lateral offset was as much as 2 cm; on Laughlin Road and to the northwest for about 300 m, right-lateral offset of 5 to 10 mm was observed. Felt over a large area of central California and at a few towns in western Nevada. A small foreshock occurred at 18 58 UTC on Jan. 24, and a sequence of 59 aftershocks followed in the next 6 days. A second principal earthquake occurred on Jan. 27 (see description below). (Ref. 300, 466.)

1980. Jan. 27 (Jan. 26). Near Livermore, Alameda County, Calif. A second damaging earthquake, near the south end of the Greenville fault (about 14 km south of the Jan. 24 epicenter), occurred on Jan. 27. Six persons were injured at Livermore by flying glass and falling ceiling tiles and supports. It caused 1–2 mm of additional right-lateral movement on the Greenville fault across Laughlin Road as well as additional movement and displacements along the surface rupture of Jan. 24, north of Vasco Road.

The most severe property damage reported was in the Tassajaro Valley area and at Danville, about 17 and 28 km, respectively, northwest of the epicenter. In Tassajaro Valley (east of Danville), about 50 houses sustained minor damage, including one fireplace damaged, walls and concrete cracked, walls separated from ceiling, windows broken, and a chimney toppled. Damage at Danville included one brick chimney broken at the roofline; a fireplace damaged; a stone wall demolished; and walls, ceilings, sidewalks, and patio cracked. Light damage was sustained at several other towns in the area. Felt over a moderate area of central California. (Ref. 300, 466.)

1980. Feb. 25. Southeast of Anza, Riverside County, Calif. Slight damage consisting of broken windows, large cracks in drywall and plaster, loosened bricks on chimneys, and a broken gas line occurred in the Anza–Idyllwild–Palm Desert area.

Several small landslides forced the closing of State Highway 74 between Spring Crest and Palm Desert; cracks as wide as 3.8 cm were reported in State Highway 74. Felt over a large area of southern California and an unknown area in Mexico. It was reported from Eagle Mountain (Riverside County) and Palo Verde (Imperial County) on the east to Los Angeles and San Diego on the west. (Ref. 300, 355.)

1980. May 25, 16 33 and 19 44 UTC. Mammoth Lakes area, Mono County, Calif. In the Mammoth Lakes region, property damage caused by these earthquakes (plus a third strong shock on May 27, 14 50 UTC) to schools, other public buildings, highways, and merchandise in stores has been estimated at $1.5 million. Nine people were injured by the two largest earthquakes, mainly from falling rocks. Landslides and rockfalls were common in this area and in Yosemite National Park.

The most severe property damage occurred at Mammoth Lakes: chimneys toppled, water mains broke, windows shattered, and plaster cracked. The 20-year-old Mammoth Elementary School was damaged severely by faulting beneath the school building. Ground cracks were abundant in fill along both paved and dirt roads. A 17-km-long zone of discontinuous surface fractures associated with the Hilton Creek fault was observed. It had a net vertical displacement of less than 50 mm and more than 200 mm of slip on single fractures.

The first earthquake was felt over a large area of California and western Nevada—from Reno and Las Vegas, Nev., to the coast at Los Angeles and San Francisco. The second shock was felt over a similar area. Hundreds of aftershocks, many of which were felt in the Mammoth Lakes area, occurred through 1980. Magnitude 6.4 M_L PAS (first shock), 6.6 M_L PAS (second shock). (Ref. 300, 401, 599.)

1980. May 27, 14 50 UTC. Owens Valley area, Mono County, Calif. It was difficult to differentiate the effects of this earthquake from those caused by the two shocks on May 25. It was felt over a similar area, however, and four people were injured. Minor damage was reported in several towns in the area. Landslides and falling rocks were common in Yosemite National Park. Old U.S. Highway 395, east of Mammoth Lakes, was closed because of severe cracks. Felt from Eureka and Las Vegas, Nev., in the east to La Honda (San Mateo County) and Los Angeles on the coast. Many aftershocks were felt in the Mammoth Lakes area. Magnitude 6.4 M_L PAS. (Ref. 300, 401.)

1980. June 29 (June 28). Owens Valley area, Mono County, Calif. Slight damage at Mono Hot Springs included cracks in plaster walls, foundation, and exterior stone walls. Felt over a small area of California and western Nevada. Magnitude 4.7 M_L PAS. (Ref. 300, 401.)

1980. Oct. 31. Near Calexico, Imperial County, Calif. Hairline cracks formed in plaster and drywall at Calexico. Furniture was overturned and windows were cracked. The shock was reported felt only at a few towns in the area. (Ref. 300, 355.)

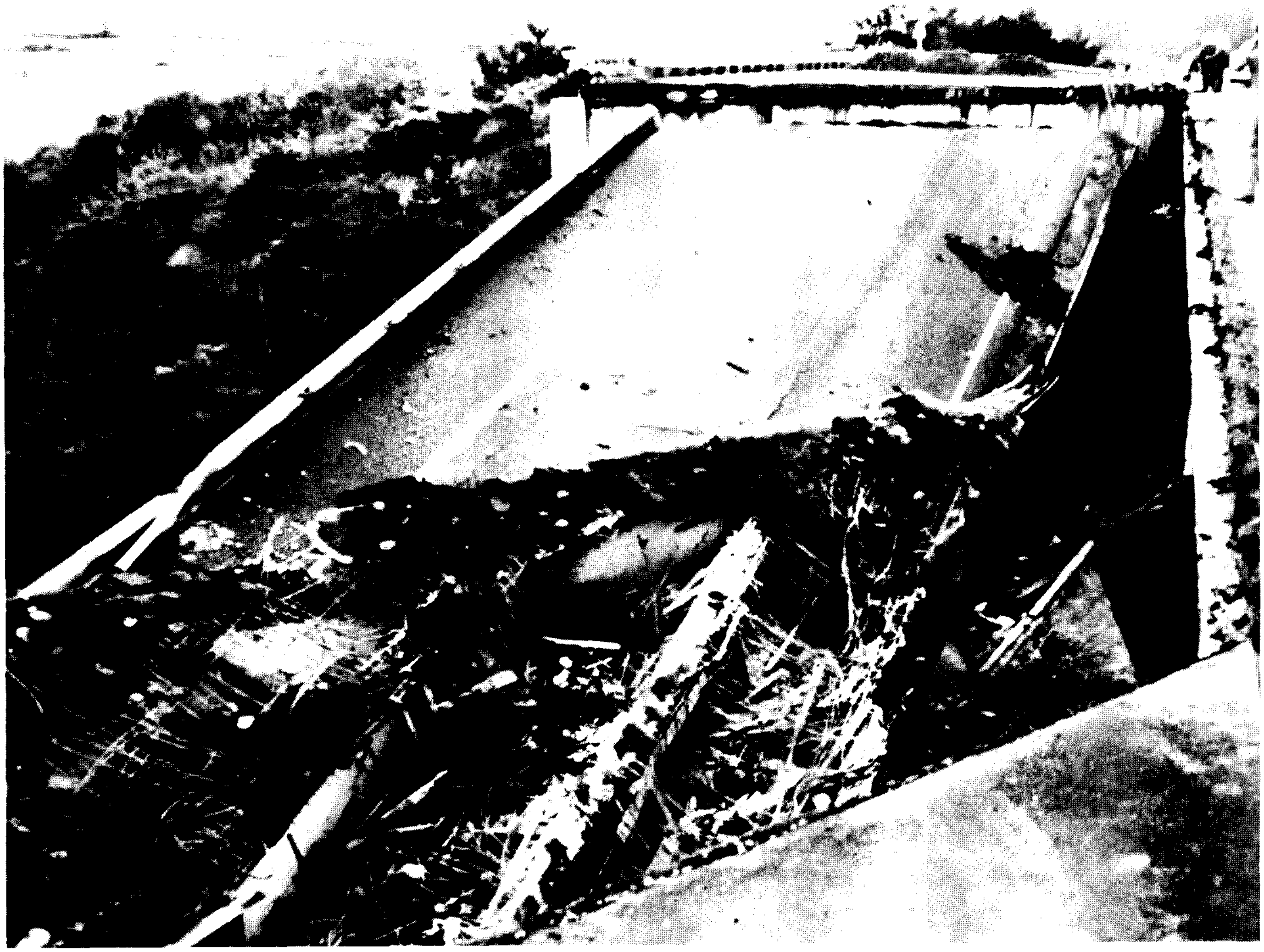
1980. Nov. 8, 10 27 UTC. Off the coast of Humboldt County, Calif. A major earthquake, the largest in this area in 24 years, injured six people and caused property damage estimated at $2 million. Most of the damage occurred east of Fields Landing, where two sections of an overpass on U.S. Highway 101 collapsed onto the railroad tracks below. At Fields Landing, two houses were displaced from their foundations, one unreinforced chimney fell, and gas, water, and sewer lines were broken. This shock and most of its aftershocks occurred on a large, left-lateral, strike-slip fault that strikes about N. 50° E. from the Mendocino Fracture Zone. Felt over a large area, including parts of Oregon, western Nevada, and northern California—from Eugene, Oreg., south to the San Francisco Bay area and from the coast east to Fallon, Nev. Many aftershocks occurred. Magnitude 7.2 M_S ABE. (Ref. 74, 300, 599.)

1980. Nov. 28. East of Truckee, Nevada County, Calif. Centered in a sparsely populated mountainous area, this earthquake caused only minor damage at Georgetown and Soda Springs. At Georgetown, large cracks formed in exterior walls and drywall, bricks fell from walls, and hairline cracks occurred in plaster walls; at Soda Springs, windows were broken and merchandise was thrown from shelves. Felt from the San Francisco Bay area to Reno, Nev. (Ref. 300, 401.)

1981. Mar. 3. Near Fremont, Alameda County, Calif. A rockslide blocked the Niles Canyon Road between Fremont and Sunol. Windows were broken and burglar alarms were activated in one store. Felt from Sonoma County south along the coast to Monterey and east to Waterford (Stanislaus County). (Ref. 325, 401.)

1981. Apr. 26. Near Westmorland, Imperial County, Calif. Property damage in the Calipatria-Westmorland area was estimated at $1–3 million. At Westmorland, 12 buildings sustained severe damage, 30 minor damage, and 70 percent of the 900 dwellings sustained damage of some kind. City officials ordered the razing of 10 downtown buildings and condemned five dwellings.

The main effects in Calipatria and Westmorland were downed chimneys, cracked and destroyed foundations, partial collapse of exterior adobe and wood



Tompkins Hill Road overpass collapsed on U.S. Highway 101, about 2 mi south of Fields Landing, California, during November 8, 1980, earthquake. (Photograph by R.T. Kilbourne, California Division of Mines and Geology.)

walls, collapse of interior walls, and broken underground pipes. In the rural areas, the main damage consisted of broken concrete-lined irrigation canals, which were not reinforced. Concrete cracked on two stretches of the Vail Canal between Calipatria and Westmorland, and the earthen embankment beneath the cracked concrete washed away. Also, the concrete on several bridges was cracked and chipped; cracks in road pavement and ground were ubiquitous. This earthquake was the largest in a swarm of at least 40 shocks in the area from Apr. 24–28. It was felt over a large part of southern California, southwest Arizona, and an unknown area in Mexico. (Ref. 325, 355.)

1981. July 17. Near Honeydew, Humboldt County, Calif. Light furniture was overturned and much glassware and dishes were broken at Honeydew. This shock also was felt in Mendocino and Sonoma Counties. (Ref. 325, 401.)

1981. Sept. 4. Off the coast of Los Angeles County, Calif. This was the largest magnitude earthquake in the area since the San Fernando Valley shock of February 1971. Some windows were broken at Marina del Rey and exterior walls were cracked. Telephone service was interrupted briefly in some areas, burglar alarms were activated, and elevators became inoperative. Felt in southern California from San Luis Obispo to the U.S. Mexico border. (Ref. 325, 355.)

1981. Sept. 30, 11 53 UTC. Near Mammoth Lakes, Mono County, Calif. This earthquake was the first, and the largest, of a swarm of shocks in the area. It knocked out electric service at the Mono County sheriff's substation in Crowley Lake and at

Vail Irrigation Canal, between Calipatria and Westmorland, California, damaged by the April 26, 1981, Imperial Valley earthquake. (Photograph by the Imperial Valley Press.)

the Mammoth Lakes Airport. Chimneys cracked at Mammoth Lakes, and hairline cracks formed in plaster and drywall. A shopping center under construction sustained damaged walls and broken windows. Flowing spring water was muddied at the Hot Creek Fish Hatchery, near Mammoth Lakes, and gas lines were broken. Felt over a large area of California and at a few towns in western Nevada. Magnitude 5.9 M_L BRK. (Ref. 325, 355.)

1982. Oct. 1. Near Inyokern, Kern County, Calif. Many large cracks formed in interior drywalls at Barstow and Inyokern; bricks shifted in a fireplace at Ridgecrest, and hairline cracks formed in interior stucco walls. Items were thrown from store shelves in several towns. Felt in Inyo, Kern, Los Angeles, San Bernardino, and Tulare Counties. (Ref. 350, 355.)

1982. Oct. 25. Near Coalinga, Fresno County, Calif. Tiles fell from interior walls at Coalinga, and many items were thrown from store shelves. At Avenal, small amounts of plaster fell from a ceiling, and some cracks formed in interior plaster walls. A hunter reported that, about 40 km northwest of Coalinga, cracks formed in the wet ground. Felt from Kern County on the south to Santa Clara County on the north and from the coast in San Luis Obispo County to Mono County on the eastern slope of the Sierra Nevada. (Ref. 350, 401.)

1982. Dec. 16 (Dec. 15). Near Fortuna, Humboldt County, Calif. Chimneys were cracked and windows were broken at Ferndale and Fortuna. Windows were broken, and items were thrown from store shelves at Rio Dell. Felt mainly in Humboldt County. (Ref. 350, 401.)

1983. Jan. 7, 01 38 and 03 24 UTC (Jan. 6). Mammoth Lakes area, Mono County, Calif. The first earthquake damaged a few buildings at Mammoth Lakes and knocked out electric service at Crowley Lake and Mammoth Lakes. The second one collapsed a metal hangar at the Mammoth Lakes Airport and toppled display cases. The first shock was felt from western Nevada to Merced County in the west and from El Dorado County in the north to Kern County in the south; the second one was reported from a similar but slightly smaller area. Magnitude 5.6 M_L PAS (both shocks). (Ref. 360, 401.)

Building on 5th Street, Coalinga, California, destroyed by the May 2, 1983, earthquake. (Photograph by the Fresno Bee.)

1983. May 2, 23 42 UTC. Near Coalinga, Fresno County, Calif. This earthquake caused an estimated $10 million in property damage (according to the American Red Cross) and injured 94 people. Damage was most severe in Coalinga, where the 8-block downtown commercial district was almost completely destroyed. Here, buildings having unreinforced brick walls sustained the heaviest damage. Newer buildings, however, such as the Bank of America and the Guarantee Savings and Loan buildings, sustained only superficial damage. The most significant damage outside the Coalinga area occurred at Avenal, 31 km southeast of the epicenter.

A disaster assessment by the American Red Cross listed the following statistics on damage in the area: almost destroyed—309 single-family houses and 33 apartment buildings; major damage—558 single-family houses, 94 mobile homes, and 39 apartment buildings; and minor damage—811 single-family houses, 22 mobile homes, and 70 apartment buildings. Most public buildings, including the City Hall, hospital, schools, fire house, post office, and police station, sustained only minor damage.

Only six bridges of 60 surveyed in the area sustained measurable structural damage. This damage consisted of hairline cracks and spalling at the top of the support columns, fracturing and displacement of wingwalls and parapets, and settlement of fill.

All public utilities were damaged to some degree. The water system continued to function despite many leaks in its transmission piping. Gas was shut off for several days because of broken piping and leaks, but only temporary interruptions of electric and telephone services were reported. One large section of old concrete sewer pipe west of the downtown area partly collapsed, but this system also continued to function.

In the oil fields near Coalinga, surface facilities such as pumping units, storage tanks, pipelines, and support buildings were all damaged to some degree.

Building at 187 South 6th Street, Coalinga, California, severely damaged by the May 2, 1983, earthquake. (Photograph by the Fresno Bee.)

One oil company administration building, about 7 km north of Coalinga, sustained major structural damage and its two brick chimneys were toppled. Subsurface damage, including collapsed or parted well casing, was observed only on 14 of 1,725 active wells.

This earthquake triggered thousands of rockfalls and rockslides as far as 34 km northwest, 15 km south, and 26 km southwest of the epicenter. Only a few slope failures occurred east of the epicenter because of the absence of steep slopes in that direction.

This damaging earthquake was caused by an 0.5-m uplift of Anticline Ridge northeast of Coalinga, but surface faulting was not observed. Ground and aerial searches immediately after the earthquake revealed ground cracks and fissures within about 10 km of the instrumental epicenter, none of which appeared to represent movement on deeply rooted fault structures. About 5 weeks later, on June 11, however, an aftershock caused surface faulting about 12 km northwest of Coalinga (see description below.)

Felt from the Los Angeles area north to Susanville (Lassen County) and from the coast east to western Nevada (see fig. 23). Through July 31, more than 5,000 aftershocks were recorded, of which 894 had a magnitude of 2.5 or larger. Most of the larger magnitude shocks were felt in Coalinga. Magnitude 6.1 M_L PAS, 6.7 M_L GM. (Ref. 360, 593.)

1983. May 9, 02 49 (May 8). Coalinga, Fresno County, Calif., aftershock. This is one of the strongest aftershocks of the May 2 earthquake. It injured two residents at Coalinga, but additional structural damage was not observed. Felt over a moderate area in central California and at Schurtz in western Nevada. Magnitude 5.2 M_L PAS, 5.3 M_L GM. (Ref. 360.)

1983. June 11 (June 10). Coalinga, Fresno County, Calif., aftershock. This strong aftershock of the May 2, 1983, earthquake caused surface faulting about 12 km northwest of Coalinga along a 3.3-km-long stretch of the previously unnamed Numez fault. Maximum reverse and right-lateral components of slip in the north segment of the fault were 64 and 20 cm, respectively. Slip along the northern quarter of the southern segment of the fault was similar to that along the north segment. Maximum reverse and right-lateral components of slip in the southern three-fourths of the south segment were 8 and 11 cm, respectively. Maximum net slip for the north and south segments of the fault were 65 and 13 cm, respectively.

In the area northwest of Coalinga, along Los Gatos Creek Road, one house that was damaged heavily in

State Theater on Elm Avenue, Coalinga, California, damaged the May 2, 1983, earthquake.
(Photograph by the Fresno Bee.)

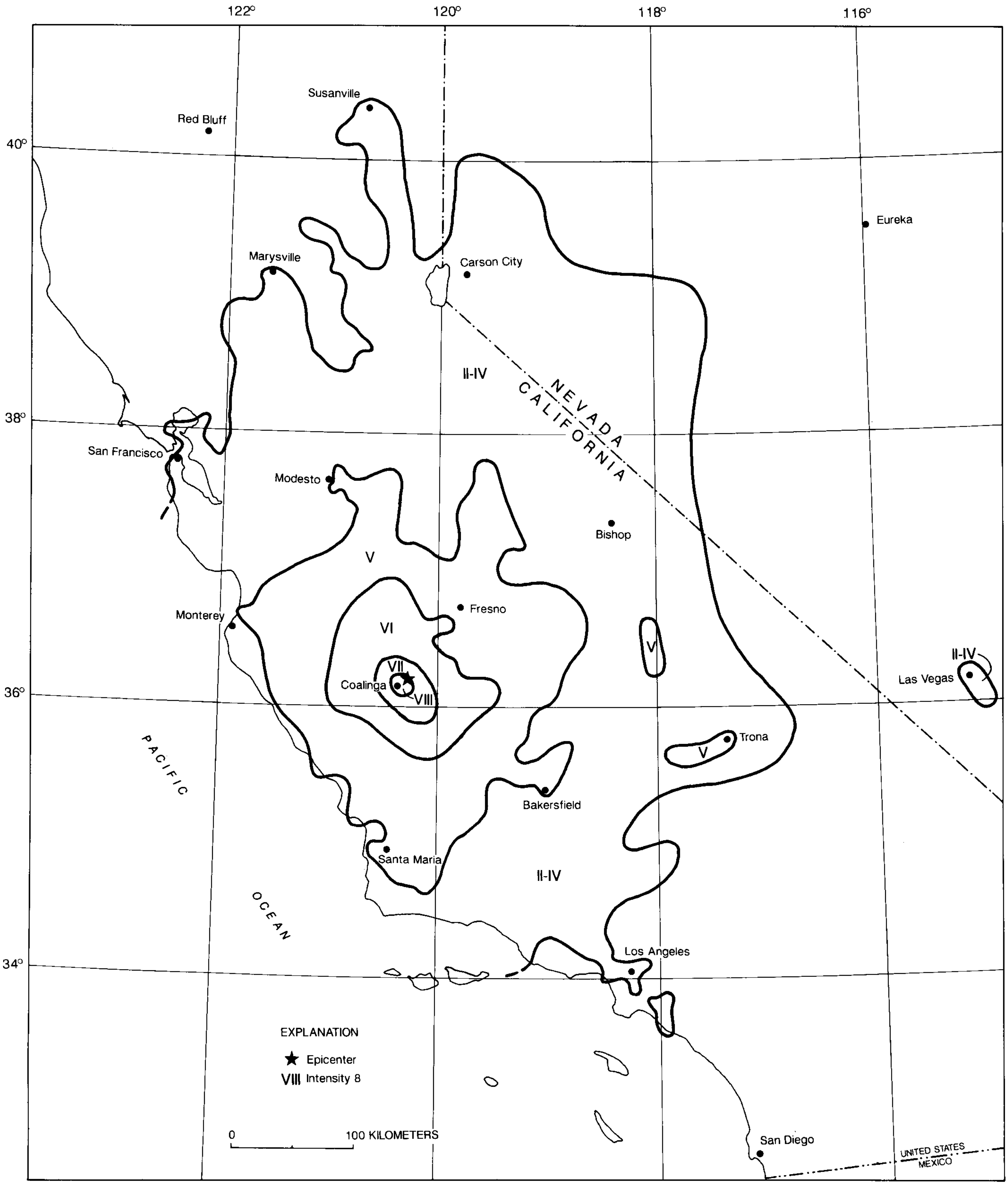


FIGURE 23.—Isoseismal map for the Coalinga, California, earthquake of May 2, 1983. This map is a simplified version of figure 13 in reference 360 of table 1.

the main shock on May 2 was reported destroyed. Several houses sustained minor damage, and a few mobile homes were shifted off their supports. Felt over a small area in central California. Magnitude 5.1 M_L PAS, 5.2 M_L GM. (Ref. 360, 593.)

1983. July 13. Imperial Valley area, Calif. Slight damage occurred at Niland, a few kilometers north of Calipatria, where windows were broken, large cracks formed in walls, and plaster fell to the floor. Felt only at a few towns in the area. (Ref. 360.)

1983. July 22, 02 39 UTC (July 21). Coalinga, Fresno County, Calif., aftershock. A large aftershock of the Coalinga earthquake of May 2, 1983, caused minor damage to property at Coalinga (fluorescent lights fell in store; chimneys, walls, and foundation cracked; minor landslides occurred) and injured two people. Slight damage also was observed at Lemoore Naval Air Station and Stratford. Felt over a large area in central California—from Sacramento on the north to Bakersfield and beyond on the south and from the coast east to the Nevada border. Magnitude 5.6 M_L PAS, 6.0 M_L GM. (Ref. 360.)

1983. July 25. Coalinga, Fresno County, Calif., aftershock. Another aftershock of the Coalinga earthquake of May 2, 1983, caused minor damage and two injuries at Coalinga. Some chimneys were damaged, mobile homes were displaced from their supports, cracks formed in interior and exterior walls, and windows were broken. Damage to utilities included one ruptured gas line, two cracked water mains, and temporary interruption of telephone service. Felt over a small section of central California. Magnitude 5.4 M_L PAS, 5.3 M_L GM. (Ref. 360.)

1983. Aug. 24. Off the coast of Humboldt County, Calif. This earthquake broke windows and overturned small objects at Scotia. Felt mainly in Humboldt, Mendocino, and Trinity Counties of northern California. Several moderate aftershocks occurred on Aug. 26, Nov. 11, and Dec. 20. (Ref. 360, 401.)

1983. Aug. 29. Northwest of San Simeon in Monterey County, Calif. About 20 km northwest of San Simeon, near Ragged Point, a few buildings were reported damaged, and cracks formed in chimneys. Felt mainly in Monterey, San Benito, and San Luis Obispo Counties. (Ref. 360, 476.)

1984. Apr. 24. Near Morgan Hill, Santa Clara County, Calif. The Morgan Hill earthquake injured 27 people and caused property damage estimated at $8 million. Most of the loss occurred in Santa Clara County, where 522 private dwellings and 43 commercial buildings were damaged severely. MM intensity VIII effects were confined to a small area east of Morgan Hill on two streets: Oak Ridge Lane and Oak Ridge Court, both in the Jackson Oaks subdivision, near Anderson Lake.

Five houses were condemned in the Jackson Oaks area of Morgan Hill, two of which fell off their concrete foundations and partly collapsed. A ranch house at Jackson Ranch (east of Anderson Lake) reportedly shifted off its foundation and collapsed. Other damage included cracks in exterior walls around garage doors and windows and a house thrown out of plumb but still on its foundation. Seventeen mobile homes were shaken off their support systems in Morgan Hill, and many partly fell. Three schools in Morgan Hill sustained damage to walls, ceiling panels, and light fixtures. Several underground water lines were broken.

Near Coyote, at the United Technologies Chemical Systems Plant, damage was estimated at $1.5 million. Column base connections were damaged on several steel-frame buildings, and diagonal steel braces buckled. Concrete buildings at the plant had cracked walls and broken weld connections, and one wall panel was separated from its roof. At the IBM Santa Teresa Laboratories, south of Coyote, suspended ceiling panels and a light fixture fell, and an underground sprinkler pipe ruptured. This structure was designed for seismic loading and therefore did not sustain significant structural damage.

Other effects in the Morgan Hill area included slight damage to Leroy Anderson Dam, Coyote Lake Dam, Coyote Creek Bridge, and Anderson Reservoir Bridge, fallen chimneys, small landslides, and changes in flow of water in springs or wells. At Coyote Lake Dam, about 25 km southeast of the main shock, a large acceleration of gravity (1.29 *g*) was recorded on strong-motion instruments. This damaging earthquake was felt over a large area of California and western Nevada. (Ref. 370, 401.)

1984. Oct. 25. Near Santa Ynez, Santa Barbara County, Calif. Minor damage occurred at Santa Ynez and north of Los Olivos at the Firestone Winery. Effects at the winery included damage to several steel storage tanks and to the foundations of several large oak vats. The warehouse sustained one stress crack, and the water line to the sprinkler system ruptured. At Santa Ynez, brick fences were cracked; large cracks formed at the joints between a concrete-block wall and a wood-frame wall; and interior plaster walls were cracked. Felt over a small area of Santa Barbara and Ventura Counties. (Ref. 370.)

1985. Aug. 4, 12 01 UTC. Near Avenal, Kings County, Calif. A few stores and houses were damaged at Avenal, and six residents were injured.

Damaged home in the Jackson Oaks subdivision of Morgan Hill, California, caused by the April 24, 1984, earthquake. (Photograph by the Morgan Hill Times.)

Damage included the partial collapse of porches at two houses, cracked and broken chimneys, cracks in sidewalks and walls, broken water mains, and broken windows and glassware. About 8 km northeast of Avenal, four adobe houses sustained cracks in the walls and ceilings, parts of the ceilings fell, and concrete porches were cracked. Several water lines and one gas main were broken at Kettleman City, and a cast-iron elbow on a water tank was broken. Felt over a large area of central California. More than 130 aftershocks were recorded in the next 27 hours. Magnitude 5.8 M_L PAS. (Ref. 371, 401.)

1985. Oct. 2. Near Grand Terrace, San Bernardino County, Calif. Plaster fell at the Grand Terrace fire station, and minor cracks formed in its ceiling. In a log house at Lake Gregory Village, one beam was split and others were cracked. Felt in parts of Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties. (Ref. 371.)

1986. Jan. 26. Near Paicines, San Benito County, Calif. At a winery in Paicines, a huge vat full of wine was displaced 6 m from its foundation and shattered. Damage to wine vats at the winery was estimated at $800,000. Damage to property in the form of broken gas pipes and ruptured water lines occurred at Hollister. At Tres Pinos, two chimneys fell at the 19th Hole Bar, and the kitchen stove was displaced. At a ranch in the Santa Ana Valley, masonry walls at the entrance to the driveway were partly collapsed. Felt generally north to San Joaquin County, south to San Luis Obispo County, and from the coast east to Fresno County. (Ref. 562.)

1986. Mar. 31. Near San Jose, Santa Clara County, Calif. This earthquake injured six residents and caused slight damage to property in Fremont, Mount Hamilton, Newark, and San Jose. The main damage was characterized by broken water lines, fallen ceiling tiles, cracks in chimneys and walls, and damaged stock. Known as the Mt. Lewis earthquake, it was preceded by two minor foreshocks on Mar. 24 and Mar. 31 and was followed by 22 aftershocks. The main earthquake was felt along the coast north to Sonoma County and south to San Luis Obispo County. (Ref. 562.)

1986. July 8. Near North Palm Springs, Riverside County, Calif. This strong earthquake injured 40 people in the North Palm Springs area and caused property damage estimated at $6 million. Sixteen business structures and four houses were destroyed; 102 houses (mostly mobile homes) and 117 business structures were damaged to some degree. The earthquake disrupted electrical and telephone service, broke water lines and gas lines, and caused failure of two pumping stations in the Metropolitan Water District. North of Palm Springs, en echelon fractures formed along the Banning fault for a distance of about 9 km on both sides of State Highway 62. Several highways were closed temporarily by minor landslides.

Major damage to a highway bridge was observed on Interstate 10 in Coachella Valley northwest of Palm Springs. The bridge was displaced laterally, leaving a small gap between the deck and abutment. Three houses were destroyed and chimneys fell in the Whitewater Canyon area. Also sustaining damage was the Southern California Edison Devers substation, 3 km northwest of North Palm Springs. Many of the ceramic columns were broken at the substation, and one transformer was displaced about 4 cm, shearing retaining bolts. Several light aftershocks were reported felt. The main shock was felt over a large area, including parts of western Arizona, southern California, and southern Nevada. (Ref. 562, 597.)

1986. July 13. Off the coast of San Diego County, Calif. This earthquake caused damage in San Diego County estimated at $700,000 and injured one person. Damage in San Diego and nearby towns consisted mainly of broken plate-glass windows, cracked walls and plaster, and broken chimneys. Through Apr. 30, 1987, 99 aftershocks of magnitude greater than 3.0 occurred. Felt over most of southern California and reported as far away as Las Vegas, Nev., and Yuma, Ariz. (Ref. 562, 597.)

1986. July 17. North Palm Springs, Riverside County, Calif., aftershock. At Whitewater, chimneys were broken at the roofline, tombstones were toppled, foundation and interior walls were cracked, and underground pipes were broken. Rockslides were reported on Whitewater Road. Felt mainly in southern California, but also was reported at Las Vegas, Nev. (Ref. 562.)

1986. July 21, 14 42 UTC. Near Chalfant, Mono County, Calif. Known as the Chalfant Valley earthquake, this shock injured two people and caused an estimated $2.7 million damage to property in the Bishop-Chalfant area. At Bishop, a few chimneys cracked, windows broke, ceiling tile and plaster fell, and exterior walls cracked in several buildings. The brick facade on a bank on Main Street also sustained cracks. Most of the damage at Chalfant was due to mobile homes being shaken off their supports, which damaged water and gas lines. Fractures in the ground were observed in the White Mountain frontal fault zone. Many small landslides and spectacular rockfalls occurred in the epicentral area.

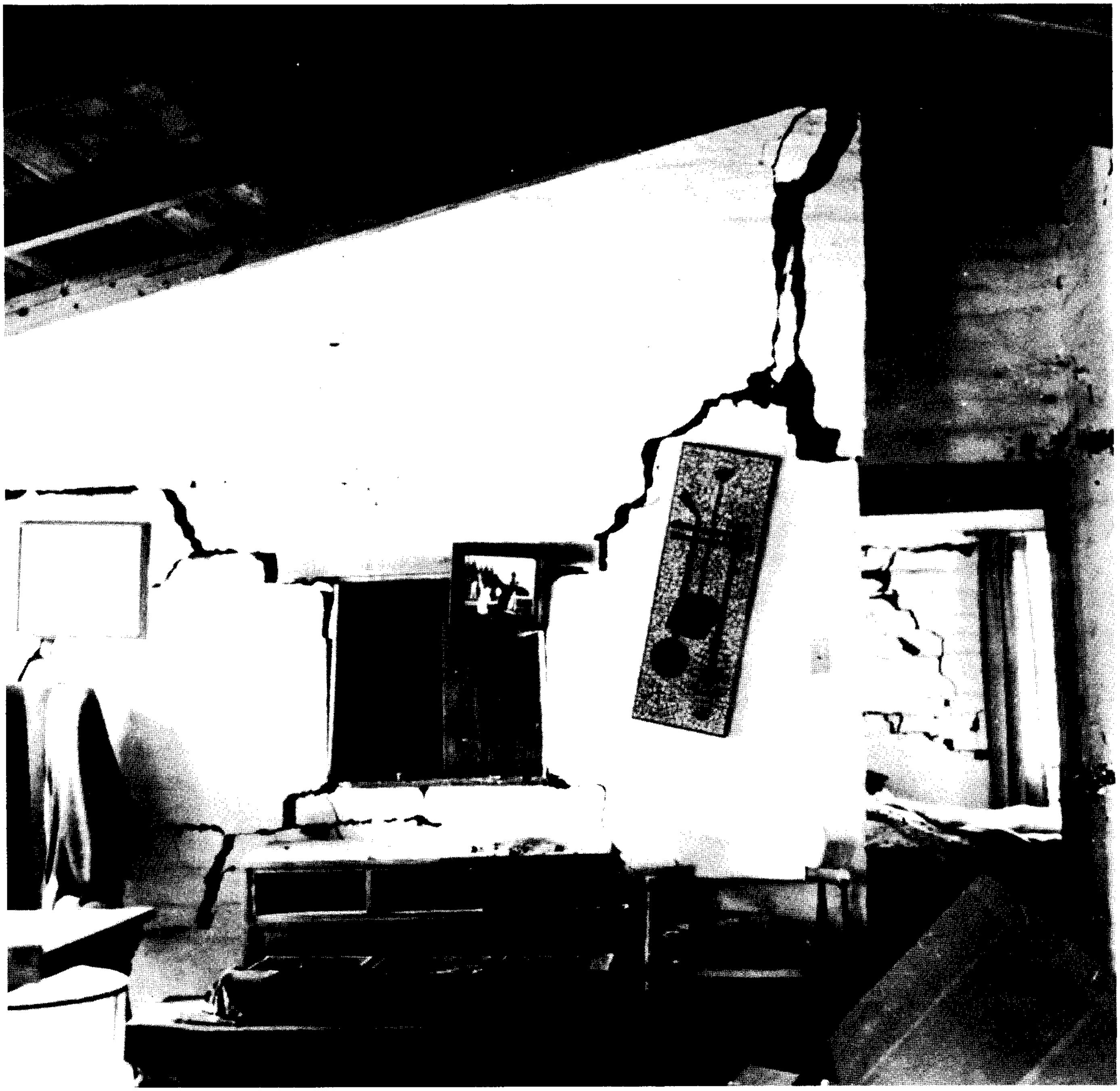
The shock was felt mainly in California and western Nevada but was reported in multistory buildings as far distant as Salt Lake City, Utah. A foreshock occurred on July 20 at 14 29 UTC, and an aftershock occurred on July 31 at 07 22 UTC (see next paragraph). Thousands of smaller aftershocks occurred through Sept. 30, 1986. Magnitude 5.9 M_L PAS, 6.6 M_L REN. (Ref. 562.)

1986. July 31 (July 30), 07 22 UTC. Near Bishop, Inyo County, Calif. A strong aftershock of the Chalfant Valley earthquake (July 21, 14 42 UTC) broke plate-glass windows in Bishop and toppled stock from shelves. Light fixtures were knocked down at the National Weather Service office. Felt over a small area of California and western Nevada. Magnitude 5.9 M_L PAS, 5.5 M_L REN. (Ref. 562.)

1986. Nov. 21, 23 33 UTC. Near Petrolia, Humboldt County, Calif. The most severe damage occurred at Petrolia, where chimneys were cracked and twisted and small appliances were overturned. An old building at the Mattole Union Elementary School was knocked off its cinder-block foundation. Slight damage also occurred in several other towns in the area.

A strong aftershock occurred at 23 34 UTC, but its effects could not be differentiated from those of the earthquake about 1 minute earlier. The first earthquake was felt over a moderate area of northern California, mainly in Humboldt, Mendocino, and Trinity Counties. (Ref. 562.)

1987. July 31. Near Petrolia, Humboldt County, Calif. Minor damage was reported at Petrolia, where underground pipes and windows were broken, cracks formed in chimneys and in wood foundations, and water in springs or wells was muddied. One report from Ferndale indicated that chimneys were toppled, windows were broken, and sidewalks were cracked. Felt only in Humboldt,



Adobe walls of a recently remodeled house in Whitewater Canyon, northwest of Palm Springs, California, cracked by the July 8, 1986, earthquake. (Photograph by G. Borchardt, California Division of Mines and Geology.)

Mendocino, Siskiyou, and Trinity Counties in northern California. (Ref. 74, 577.)

1987. Oct. 1. Near Whittier Narrows, Los Angeles County, Calif. The Whittier Narrows earthquake caused eight fatalities, injured several hundred, and left property damage estimated at $358 million in the east Los Angeles area, mainly at Whittier. MM intensity VII to VIII covered an area of about 500 km^2—from Monrovia and Pasadena in the north to beyond Whittier in the southeast. MM intensity VI was assigned to an additional area of 1,500 km^2.

Business structures in the old Whittier commercial district were the most severely damaged by the main earthquake. In the 24-square-block shopping area known as Whittier Village, 12 commercial buildings had to be razed, and another 20 buildings were declared unsafe. An inspection of residential houses in Los Angeles, Orange, and Ventura Counties indicated that 123 single-family houses and 1,347 apartment units were destroyed, and about 513 single-family houses and 2,040 apartment units sustained major damage. Property damage on the Los Angeles campus of California State University (about 10 km west of the epicenter) was estimated at more than $20 million.

The most severe damage to transportation systems was to the Interstate 605–Interstate 5, a major nine-span bridge that was built in 1964. The five supporting columns sustained severe shear fractures and the overpass was closed temporarily. Minor damage also occurred on 23 other bridges in the area.

Damage and dysfunction of lifelines included the often observed failure of ceramic elements on high-voltage substation equipment, damage to large liquid-storage tanks, and saturation of the telephone system with inappropriate calls. The natural-gas transmission system was not damaged, and only one cast-iron pipe failed in the distribution system. However, about 1,400 gas leaks occurred on customer property, and many fires were ignited.

This earthquake sequence ruptured a small and previously unidentified, gently north-dipping, west-striking thrust fault beneath the uplifted Puente Hills and Elysian Park–Montebello Hills. However, tectonic slippage was not observed during a field study of the faults in the epicentral area. Geologic surface expression appeared to be limited to secondary nontectonic breaks caused by acceleration at the surface. Although many ground cracks formed along the base of the Puente Hills between Turnbull Canyon and Norwalk Boulevard, ground breakage in that area was limited to slope failures, including extensional cracks, minor landslides, and rockfalls. Ground-surface cracks also were observed at Worsham Creek oil field and Whittier Narrows golf course.

The main shock was followed by about 500 locatable aftershocks, an unusually small number for an earthquake of this magnitude. The largest aftershock, which occurred on Oct. 4 about 3 km northwest of the epicenter of the main shock (see description below), caused further damage to weakened buildings. (Ref. 74, 577, 580, 581, 582, 598.)

1987. Oct. 4, aftershock. Near Whittier Narrows, Los Angeles County, Calif. A strong aftershock of the Oct. 1 Whittier earthquake killed one person, injured several, and caused additional property damage in Alhambra, Los Angeles, Pico Rivera, and Whittier. Several chimneys twisted, fell, or broke at the roofline; stone fences cracked and toppled; windows broke; and large cracks formed in sidewalks and highways. The press reported that one of the two bell towers collapsed on the San Gabriel Civic Auditorium. Also felt in Orange, Riverside, San Bernardino, and San Diego Counties. (Ref. 74, 577, 598.)

1987. Nov. 24, 01 54 (Nov. 23) and 13 15 UTC. West of Westmorland, Imperial County, Calif. The Superstition Hills earthquakes caused an estimated $3 million property damage in Imperial County. Epicenters of the shocks were in the western Imperial Valley on a fault system comprising the northwest-striking Superstition Hills fault and a previously unknown northeast-striking structure. The earthquake sequence consisted of foreshocks, the first main shock, and aftershocks on the northeast trend, followed by the second main shock about 11 hours later and aftershocks on the northwest trend. Significant surface ruptures occurred along the Superstition Hills fault.

Damage reported in the epicentral region at El Centro, Imperial, and Westmorland included fallen chimneys, broken underground pipes, broken windows, and large displacements in highways or streets. The Worthington Road Bridge across the New River needed to be replaced, owing to liquefaction damage to the approach fill on both sides of the bridge. Damage at the Desert Test Range Control Center near Westmorland, which included equipment falling through a window and small water tanks tipping against the building, was sufficient to stop operations for several days.

Damage to canal facilities in the Southern California Irrigation District was estimated to be between $600,000 and $750,000. The first main shock caused minor buckling of the concrete lining in canals on the west side of the valley; the second main shock collapsed thousands of feet of concrete canal lining, mainly in the northwest corner of the valley nearest the earthquake epicenters.

The shock at 01 54 UTC was associated with left-lateral surface rupture on many faults in and near the Superstition Hills. A maximum surface slip of 12.5 cm was observed on the Elmore Desert Ranch fault. The shock at 13 15 UTC ruptured the surface of the right-lateral Superstition Hills fault for a distance of 27 km southeastward from its epicenter. This right-lateral movement continued to increase over the following 339 days. The maximum vertical slip observed on the southernmost ruptured part of the Superstition Hills fault zone (named the Wienert fault) was 25 cm, but that rupture also continued to increase. Both shocks were felt over most of southern

California and in parts of western Arizona and southern Nevada. (Ref. 74, 577, 587, 588, 598, 601.)

1988. Feb. 11. Near Whittier, Los Angeles County, Calif. A small aftershock of the Whittier earthquake of Oct. 1, 1987, cracked chimneys, drywall, plaster, and windows at Los Angeles, Pasadena, Pico Rivera, and Whittier. Further, foundations of houses were cracked and exterior walls were damaged at Pico Rivera and Whittier. Also felt in Kern, Orange, Riverside, San Bernardino, and San Diego Counties. (Ref. 578, 602.)

1988. June 13 (June 12). Near San Jose, Santa Clara County, Calif. Slight damage occurred at San Jose, where open cracks formed in stone or brick fences and interior walls were cracked. Hairline cracks formed in drywall and plaster at nearby Santa Clara. Felt north along the coast to Humboldt County, east to Amador and Tulare Counties, and south to Monterey and Kern Counties. (Ref. 74, 578.)

1988. June 27. Near Santa Cruz, Calif. Slight damage occurred at Holy City (near Los Gatos, Santa Cruz County), where cracks formed in plaster, drywall, and a house foundation. Press reports described minor damage in Santa Clara County, at the Sunnyvale Town Center, where chunks of concrete fell from the parking garage, and at Los Gatos, where storefront windows were shattered. After the earthquake, the flow of water increased in a well at Holy City. Felt north along the coast to Marin County, south to Monterey County, and east to Fresno County. (Ref. 74, 578.)

1988. Dec. 3. Near Whittier, Los Angeles County, Calif. Windows were broken at Whittier, and hairline cracks formed in plaster, drywall, and a house foundation. Several bricks were knocked to the ground at the San Gabriel Mission. Press reports noted that several people were injured in the San Fernando Valley and that electricity was knocked out briefly. Also felt in Kern, Orange, Riverside, San Bernardino, San Diego, and Ventura Counties. Several small aftershocks were reported. (Ref. 578, 602.)

1989. Jan. 19 (Jan. 18). Off the coast near Malibu, Los Angeles County, Calif. An earthquake off the coast of California, south of Malibu, caused minor damage in Los Angeles County at Hollywood, Lancaster, Malibu, Monterey Park, and Whittier. Typical damage included broken windows; cracks in chimneys, foundations, fences, and walls; and damaged stock in stores. An observer at Monterey Park also reported that large amounts of plaster fell from walls and that some walls fell. Rocks rolled onto the highway in Santa Monica and on Malibu Canyon Road. According to press accounts, this shock was felt from Santa Barbara south to San Diego and east to San Bernardino. Several aftershocks occurred. (Ref. 579, 603.)

1989. Apr. 3. Northeast of San Jose, Santa Clara County, Calif. At San Jose and Santa Clara, many cracks formed in drywall, plaster, and foundations of houses. One large window was knocked out of an airport control tower in San Jose. Felt north to Marin and Solano Counties, south to San Luis Obispo County, and east to Stanislaus County. (Ref. 74, 579.)

1989. Apr. 7. Near Newport Beach, Orange County, Calif. Slight damage was reported in Orange County at Corona Del Mar, Costa Mesa, and Newport Beach. Typical damage consisted of broken windows; fallen bricks from chimneys; cracked chimneys, walls, and plaster; and damaged merchandise in stores. In addition, ceiling tiles fell in several stores in Newport Beach, and part of a wall of a brick building toppled. Felt north to Los Angeles County, south to San Diego County, and east to Riverside and San Bernardino Counties. (Ref. 579, 603.)

1989. June 12. Near Bell Gardens, Los Angeles County, Calif. Minor damage reported west of Whittier, at Bell Gardens, included large cracks in exterior walls of a reinforced-concrete building and hairline cracks in plaster and drywall. Slight damage (fallen plaster and cracked ceiling) also was reported in the downtown Los Angeles area. Also felt in Orange, Riverside, San Bernardino, and Ventura Counties. An aftershock was felt about one-half hour after the main shock. (Ref. 579, 603.)

1989. Aug. 8. Near Redwood Estates, Santa Clara County, Calif. This earthquake caused one death and moderate damage to property in Santa Clara County near San Jose. Toppled and broken chimneys were reported at Cupertino (west of San Jose), Los Gatos (about 15 km northeast of the epicenter), and Redwood Estates (about 7.5 km northeast of the epicenter). Other damage observed included broken underground pipes, cracks in foundations and walls, walls separated from ceilings, and toppled water heaters and propane tanks. Light damage occurred at several other towns in Santa Clara and Santa Cruz Counties, including Ben Lomond, Brookdale, Holy City, Santa Cruz, and Saratoga. Felt to Sonoma County in the north, San Luis Obispo County in the south, and Stanislaus County in the east. (Ref. 74, 579.)

1989. Oct. 18, 00 04 UTC (Oct. 17). In the Santa Cruz Mountains in the forest of Nisene Marks State Park, about 16 km northeast of Santa Cruz and about 7 km south of Loma Prieta Mountains, Calif. This major earthquake

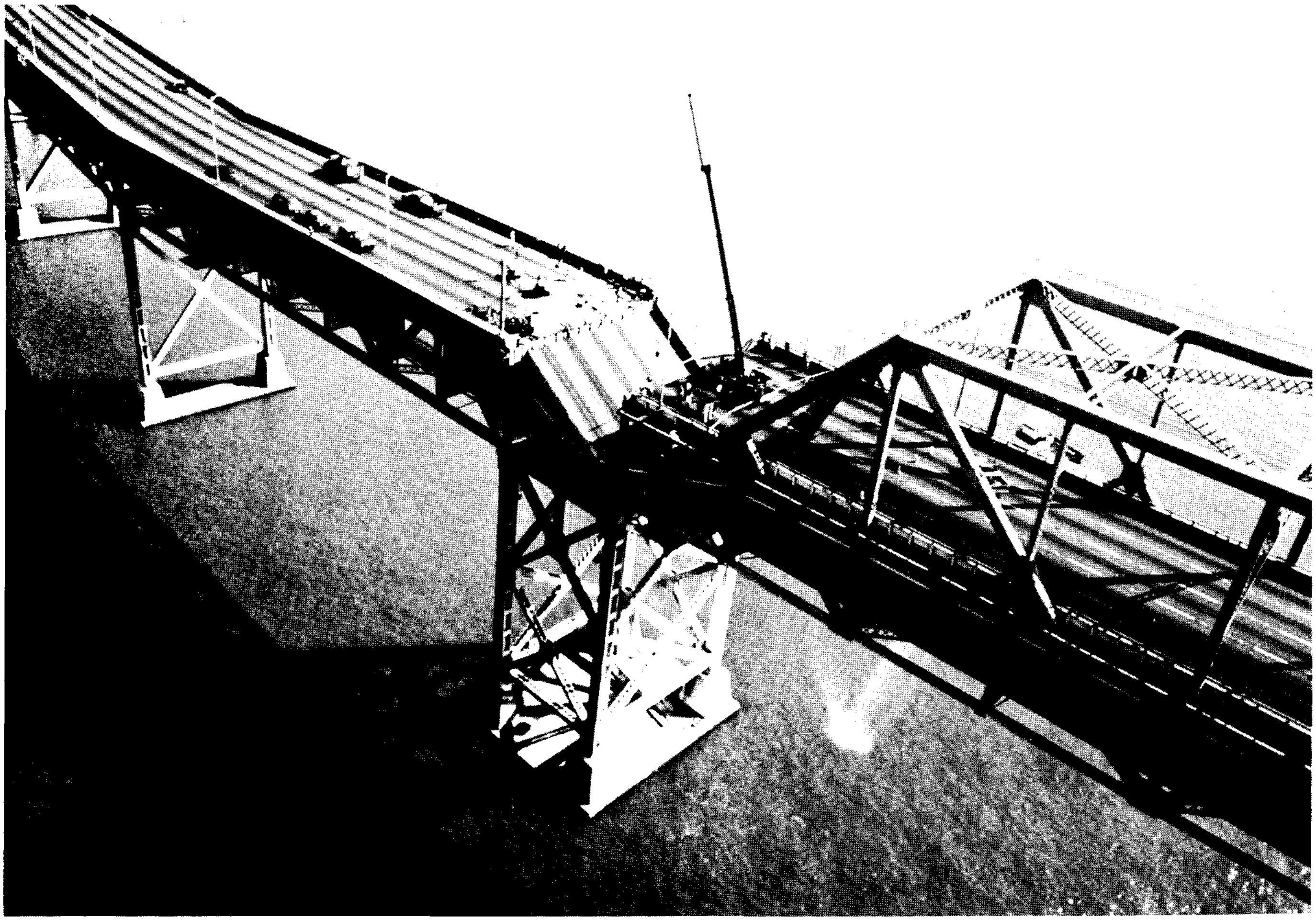
Collapsed apartment building in the Marina District, San Francisco, California, caused by the October 18, 1989 (Oct. 17 PST), Santa Cruz Mountains (Loma Prieta) earthquake. (Photograph by the Earthquake Engineering Research Institute.)

caused 63 deaths, 3,757 injuries, and an estimated $6 billion in property damage. It was the largest earthquake to occur on the San Andreas fault since the great San Francisco earthquake in April 1906.

The most severe property damage occurred in Oakland and San Francisco, about 100 km north of the fault segment that slipped on the San Andreas. MM intensity IX was assigned to San Francisco's Marina District, where several houses collapsed, and to four areas in Oakland and San Francisco, where reinforced-concrete viaducts collapsed: Nimitz Freeway (Interstate 880) in Oakland, and Embarcadero Freeway, Highway 101, and Interstate 280 in San Francisco. Communities sustaining heavy damage in the epicentral area included Los Gatos, Santa Cruz, and Watsonville.

Liquefaction, as evidenced by sand boils, lateral spreading, settling, and slumping, occurred as far as 110 km from the epicenter. It caused severe damage to buildings in San Francisco's Marina district as well as along the coastal areas of Oakland and Alameda in the east San Francisco Bay shore area. Liquefaction also contributed significantly to the property damage in the Santa Cruz and Monterey Bay areas, which lie near the epicentral zone. Structures damaged by liquefaction include buildings, bridges, highways, pipelines, port facilities, airport runways, and levees. Subsurface soil conditions, which amplified accelerations in the San Francisco Bay area, strongly influenced structural damage patterns and probably contributed to liquefaction problems in loose, sandy fills underlain by deep, cohesive soil deposits.

Engineered buildings, including those near the epicenter, performed well during the earthquake. Hospital buildings in the region sustained only minor system and cosmetic damage, and operational interruptions did not occur. Only five schools sustained severe damage, estimated at $81 million.



Span of the San Francisco–Oakland Bay bridge, collapsed by the October 18, 1989 (Oct. 17 PST), Santa Cruz Mountains (Loma Prieta), California, earthquake. (Photograph by E.V. Leyendecker.)

Most of the spectacular damage to buildings was sustained by unreinforced masonry buildings constructed of wood-frame roof and floor systems supported by unreinforced brick walls. These structures failed in areas near the epicenter as well as in areas far from the epicenter, at San Francisco and Monterey. The severe shaking near Santa Cruz caused heavy damage to the unreinforced masonry buildings in that area, particularly in the Santa Cruz Pacific Garden Mall, which consisted of several blocks of unreinforced masonry store buildings.

More than 80 of the 1,500 bridges in the area sustained minor damage, 10 required temporary supports, and 10 were closed owing to major structural damage. One or more spans collapsed on three bridges. The most severe damage occurred to older structures on poor ground, such as the Cypress Street Viaduct (41 deaths) and the San Francisco–Oakland Bay Bridge (one death). Damage to the transpotation system was estimated at $1.8 billion.

Most of the more than 1,000 landslides and rockfalls occurred in the epicentral zone in the Santa Cruz Mountains. One slide, on State Highway 17, disrupted traffic for about 1 month.

The earthquake produced a pattern of northwest-trending extensional fractures in the north end of the aftershock zone northwest of the epicenter, but throughgoing right-lateral surface faulting was not found above the rupture defined by the main shock and its aftershocks. Six feet of right-lateral strike-slip

Nimitz Freeway along Cypress Street (Interstate 880) in Oakland, California, collapsed by the October 18, 1989 (Oct. 17 PST), Santa Cruz Mountains (Loma Prieta) earthquake. (Photograph by E.V. Leyendecker.)

and 4 feet of reverse-slip was inferred from geodetic data. The only surface fracturing that might be attributed to primary tectonic faulting occurred along a trace of the San Andreas near Mount Madonna Road in the Corralitos area, where en echelon cracks showed 2 cm of right-lateral displacement.

Extensional fractures (maximum net displacement of 92 cm) were observed about 12 km northwest of the epicenter, in the Summit Road–Skyland Ridge area, east of State Highway 17, whereas zones of compressional deformation were found along the northeast foot of the Santa Cruz Mountains between Blossom Hill and Palo Alto. In Los Altos and Los Gatos, ground deformation appeared to be associated closely with zones of heavy structural damage and broken underground utility lines.

Other towns in the area that also experienced severe property damage include Boulder Creek, Corralitos, Hollister, Moss Landing, and several smaller communities in the Santa Cruz Mountains.

This earthquake was felt over most of central California and in part of western Nevada (see fig. 24). The rate of aftershock activity decreased rapidly with time, but the total number of aftershocks was less than that expected from a generic California earthquake of similar magnitude. Fifty-one aftershocks of magnitude 3.0 and larger occurred during the first day after the main shock, and 16 occurred during the second day. After 3 weeks, 87 magnitude 3.0 and larger aftershocks had occurred. (Ref. 74, 574, 579, 594, 595, 596, 606, 607.)

Ground failure along the San Andreas fault zone, causing slumping and cracking of Hazel Dell Road, north of Watsonville, California, during the October 18, 1989 (Oct. 17 PST), Santa Cruz Mountains (Loma Prieta) earthquake.

House on Rebecca Drive, Boulder Creek, California, destroyed by the October 18, 1989 (Oct. 17 PST), Santa Cruz Mountains (Loma Prieta) earthquake.

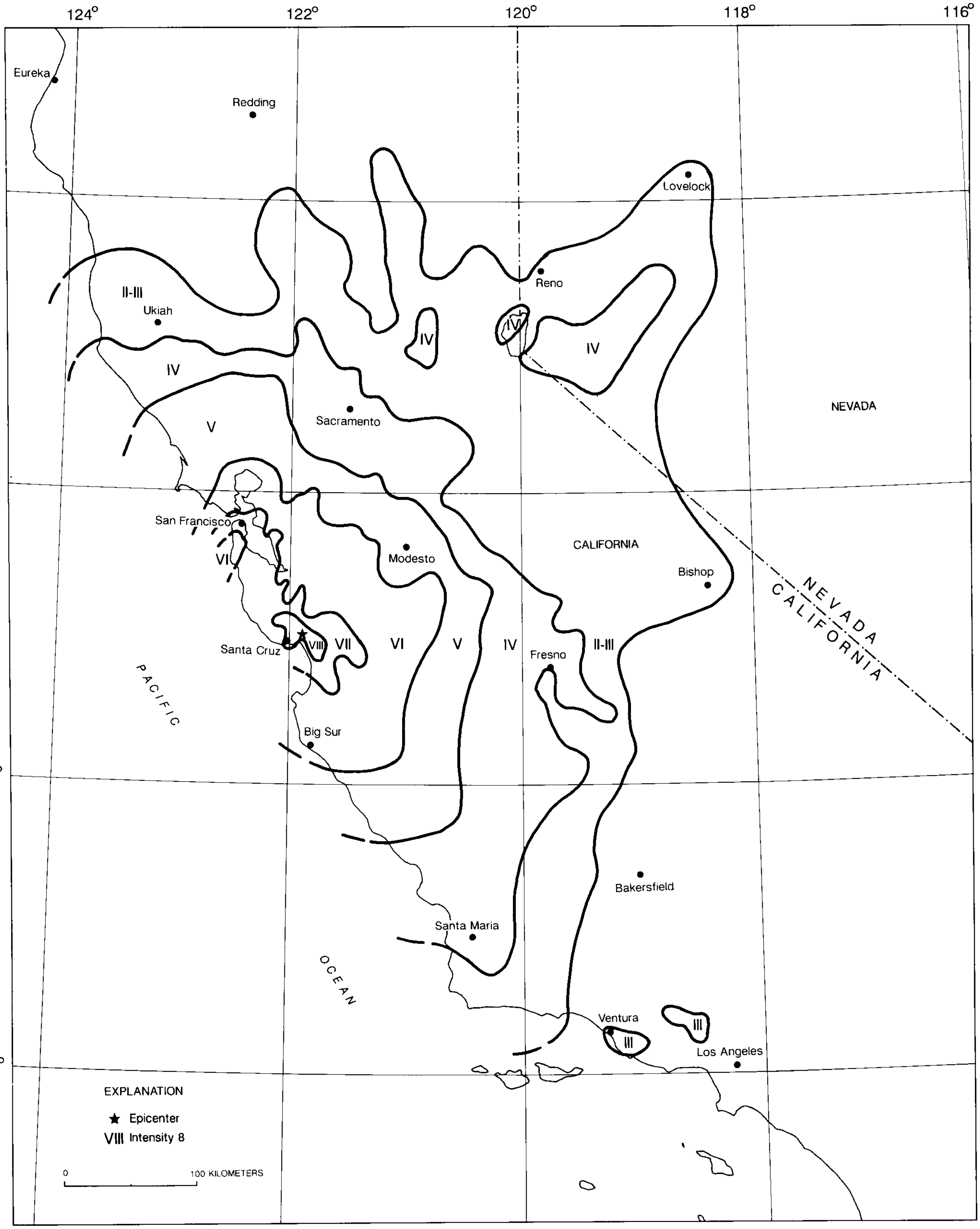
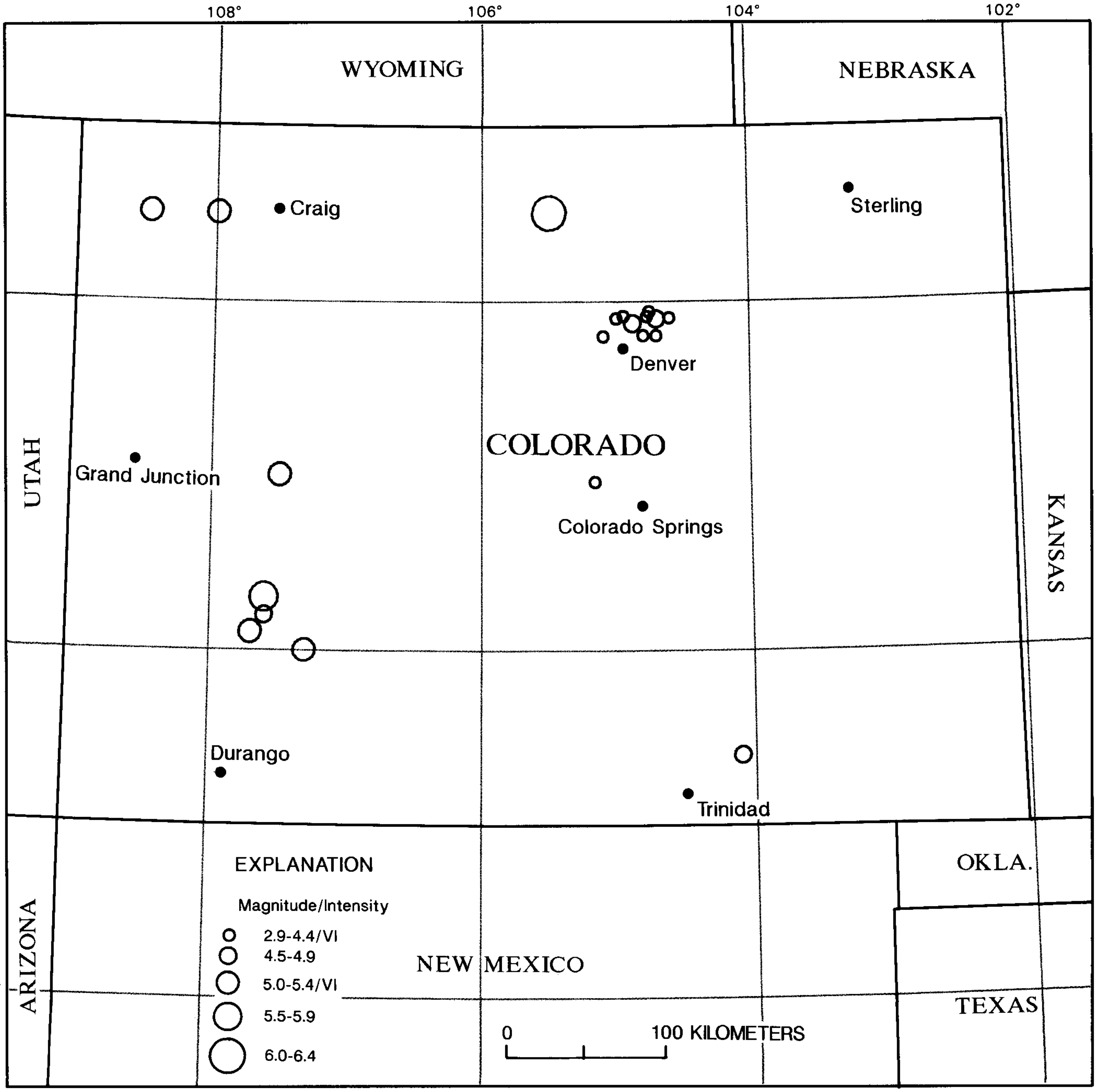


FIGURE 24.—Isoseismal map for the Santa Cruz Mountains (Loma Prieta), California, earthquake of October 18, 1989. This map is a simplified version of figure 1 in reference 574 of table 1.

COLORADO



Earthquakes in Colorado with magnitudes ≥ 4.5 or intensity ≥ VI.

COLORADO

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MMI	Ref	Felt area (1,000 km²)
1871	10			40.5 N	108.5 W	—	487	—	—	—	—	VI	487	—
1882	11	08	01 30	40.5 N	105.5 W	—	487	—	—	6.20M_{fa} KRK	—	VII	273	485
1891	12		21	40.5 N	108.0 W	—	273	—	—	—	—	VI	273	—
1913	11	11	21 55	38.1 N	107.7 W	—	487	—	—	—	—	VI	487	14
1944	09	09	04 12 20	39.0 N	107.5 W	—	266	—	—	—	—	VI	38	19
1955	08	03	06 39 42	38.0 N	107.3 W	—	273	—	—	—	—	VI	28	5
1960	10	11	08 05 30.5	38.3 N	107.6 W	049	33	—	—	5.50m_b BRK	—	VI	33	39
1962	02	05	14 45 51.1	38.2 N	107.6 W	025	266	—	—	4.70M_L GOL	—	V	35	—
1962	12	04	17 49 59.4	39.8 N	104.7 W	033	266	—	—	3.20M_L GOL	—	VI	35	12
1962	12	05	13 48 00.4	39.9 N	104.6 W	033	266	—	—	3.80M_L GOL	—	VI	35	16
1965	02	16	22 21 43.7	39.9 N	105.0 W	005	74	—	—	3.00M_L GOL	—	VI	75	1
1965	09	14	22 46 24.1	39.9 N	104.6 W	005	266	—	—	3.60M_L GOL	—	VI	75	3
1965	09	29	18 59 56.1	39.8 N	105.1 W	005	266	—	—	3.50M_L GOL	—	VI	75	4
1965	11	21	04 02 28.7	39.8 N	104.8 W	005	266	—	—	3.80M_L GOL	—	VI	75	7
1966	10	03	02 26 02.3	37.4 N	104.1 W	010	266	—	—	4.60M_L GOL	—	VI	81	45
1966	11	14	20 02 35.9	39.9 N	104.7 W	005	266	—	—	3.50M_L GOL	—	VI	81	4
1967	04	10	19 00 25.5	39.94 N	104.75 W	005	266	—	—	4.30M_n HER	—	VI	40	16
1967	04	27	17 24 42.3	39.91 N	104.77 W	005	266	4.5	—	3.80M_L GOL	—	VI	40	4
1967	08	09	13 25 06.2	39.9 N	104.7 W	005	74	5.3	—	4.90m_b NUT	—	VII	40	50
1967	11	27	05 09 24.6	39.87 N	104.88 W	005	274	5.2	—	4.60m_b NUT	—	VI	40	56
1979	01	06	01 58 55.3	38.96 N	105.16 W	005	262	—	—	2.90M_L GS	—	VI	262	11
1981	04	02	16 10 06.4	39.91 N	104.95 W	009	325	4.3	—	3.80M_L GS	—	VI	325	6

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1871. October. Lily Park, Moffat County, Colo. An avalanche of rock cascaded from the high cliffs of the canyon walls at Lily Park. The ground heaved and fell. It is possible that the date of this earthquake is Nov. 9, 1871. (Ref. 487.)

1882. Nov. 8 (Nov. 7). Near Denver, Colo. This earthquake probably was the largest event to occur in Colorado in the period of historic record. It caused minor damage in Colorado and southern Wyoming and was felt slightly in Utah and Kansas (see fig. 25). The location of this earthquake is very uncertain and has been postulated to have occurred in western Colorado or southern Wyoming.

In Denver, electricity was cut off after an iron bolt that connected an engine-driving pulley was broken in two at the electric power building; another bolt was bent out of shape. Buildings trembled violently and residents ran out of doors. Plaster fell and windows broke as far north as Laramie, Wyo., and plaster fell from the ceiling of a building at the University of Colorado in Boulder. Observers also reported that the walls of the railroad depot in Louisville were cracked, that timbers cracked in a house at La Porte, and that walls of one house were cracked severely and plaster fell near Thompson, Colo. An aftershock on Nov. 8 was reported to be almost as strong as the main shock in Laramie and Denver. (Ref. 273, 283, 440, 487, 488, 499.)

1891. Dec. Lily Park, Moffat County, Colo. The earth was convulsed by waves that rolled at intervals of a few seconds. Thousands of tons of boulders rolled down Fitzpatrick's Cliff. A house moved, calendars and pictures on the walls oscillated, dishes rattled, and people ran outside. A cow was knocked against a house. (Ref. 273, 487, 488.)

1913. Nov. 11. Near Ridgway, Ouray County, Colo. Damage at Ridgway included damage to the school ceiling and broken dishes. The shock was reported as strong at towns near Ridgway, including Montrose, Ouray, and Telluride; rocks rolled down cliffs at Ouray. Three shocks were reported. (Ref. 38, 487, 488.)

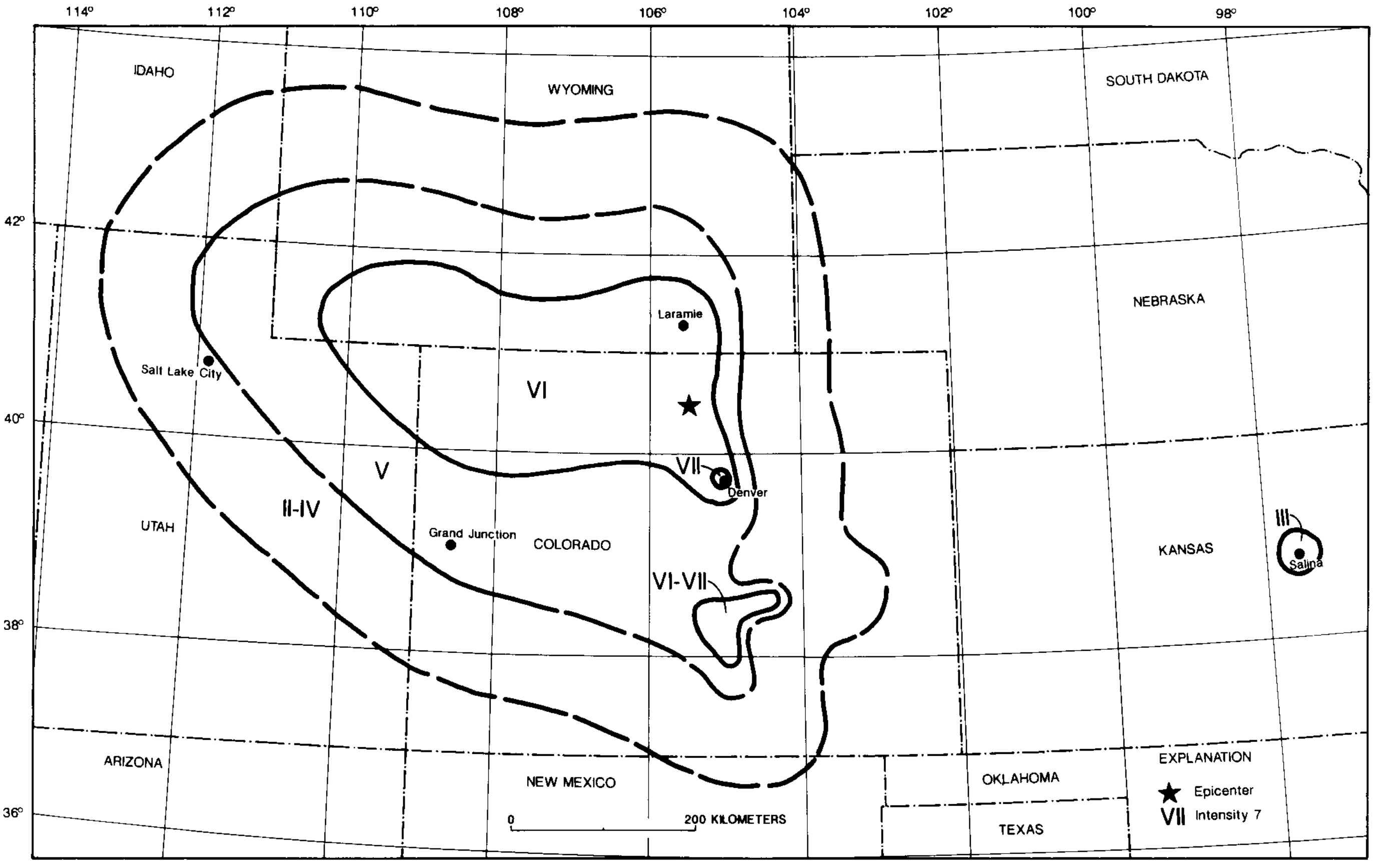


FIGURE 25.—Isoseismal map for the Colorado earthquake of November 8, 1882. This map is a simplified version of figure 1 in reference 499 of table 1.

1944. Sept. 9 (Sept. 8). Near Basalt, southwest Eagle County, Colo. Walls and chimneys cracked at Basalt; bricks fell from chimneys; and rocks rolled onto the road. A strongly built log house was moved slightly out of line at Riland. (Ref. 17, 38, 266, 487, 488.)

1955. Aug. 3 (Aug. 2). Lake City, Hinsdale County, Colo. Residents at Lake City reported cracks formed in a chimney and in the ground; one chimney fell. Also felt at Ouray, west of Lake City; Silverton (San Juan County), southwest of Lake City; and Creede (Mineral County), southeast of Lake City. (Ref. 28, 273, 487.)

1960. Oct. 11. Near Montrose, Colo. At Montrose, southeast of Grand Junction, a foundation cracked in three places in a house, and all cupboards loosened from walls. Damage at nearby towns consisted of a cracked chimney at Ophir, cracked and broken windows at Placerville and Powderhorn, fallen plaster at Lake City, and cracked walls at Telluride. (Ref. 33, 487.)

1962. Dec. 4. Near Denver, Colo. At Dupont, a picture window broke and a bed moved 15 cm from the wall. At Irondale, windows broke at a school, electrical wall outlets were left hanging by their wires, and brick tiles loosened. (Ref. 35, 266, 487.)

1962. Dec. 5. Near Denver, Colo. This earthquake caused cracks in plaster and a wall in the Derby-Dupont area, about 13 km northeast of Denver. Plaster cracked in the Derby area. (Ref. 35, 266, 487.)

1965. Feb. 16. Near Denver, Colo. At Northglenn, a large crack formed in one house. At Commerce City, a washer moved from the wall and furnishings shifted. (Ref. 74, 75, 487.)

1965. Sept. 14. Near Denver, Colo. Plaster cracked and dishes and windows broke at Denver; chimneys and plaster cracked at Broomfield; and plaster cracked in the Commerce City–Derby area. Felt from 40 km south of Denver northwest to Boulder. (Ref. 75, 266, 487.)

1965. Sept. 29. Near Denver, Colo. Plaster and windows cracked at Commerce City, a refrigerator

Cracks in highway overpass pillar in the Denver, Colorado, area caused by the August 9, 1967, earthquake. (Photograph by the Denver Post.)

was moved several inches at Northglenn. The shock was felt from Denver northwest to Boulder and Nederland. (Ref. 75, 266, 487.)

1965. Nov. 21 (Nov. 20). Near Denver, Colo. The earthquake broke many windows at Northglenn and Thornton and cracked plaster at Commerce City (one window also broke), Hudson (fallen plaster), and Louisville. (Ref. 75, 266, 487.)

1966. Oct. 3 (Oct. 2). Near Trinidad, Las Animas County, Colo. Minor damage reported in Las Animas County includes cracks in houses at Aguilar and Segundo, cracks in plaster and windows at Trinchera, and broken windows and cracks in plaster at Trinidad. Felt over a large area of southeast Colorado and northeast New Mexico. Magnitude 3.6 M_S NUT (Ref. 81, 263, 266, 487.)

1966. Nov. 14. Near Denver, Colo. A slight earthquake in the Denver area cracked plaster and lengthened old cracks in Commerce City and knocked merchandise from shelves in a supermarket. (Ref. 81, 266, 487.)

1967. Apr. 10 Near Denver, Colo. In the Denver–Commerce City region, plaster cracked and fell, windows broke, and a house foundation cracked. North of Denver, at the Rocky Mountain Arsenal, 118 small windows were broken; at Boulder, walls cracked at a high school. Water pipes broke at one Commerce City residence, and cracks in a parking lot were reported in the Derby area of Commerce City. Minor damage occurred in several other towns in the area, including Brighton, Golden, Lafayette, Lakewood, Thornton, and Westminster. (Ref. 40, 266, 487.)

1967. Apr. 27. Near Denver, Colo. This earthquake caused slight damage in Commerce City and Boulder. Plaster cracked and nails were forced out of walls at Commerce City, and walls and a tile ceiling were cracked at Boulder. (Ref. 40, 266, 487.)

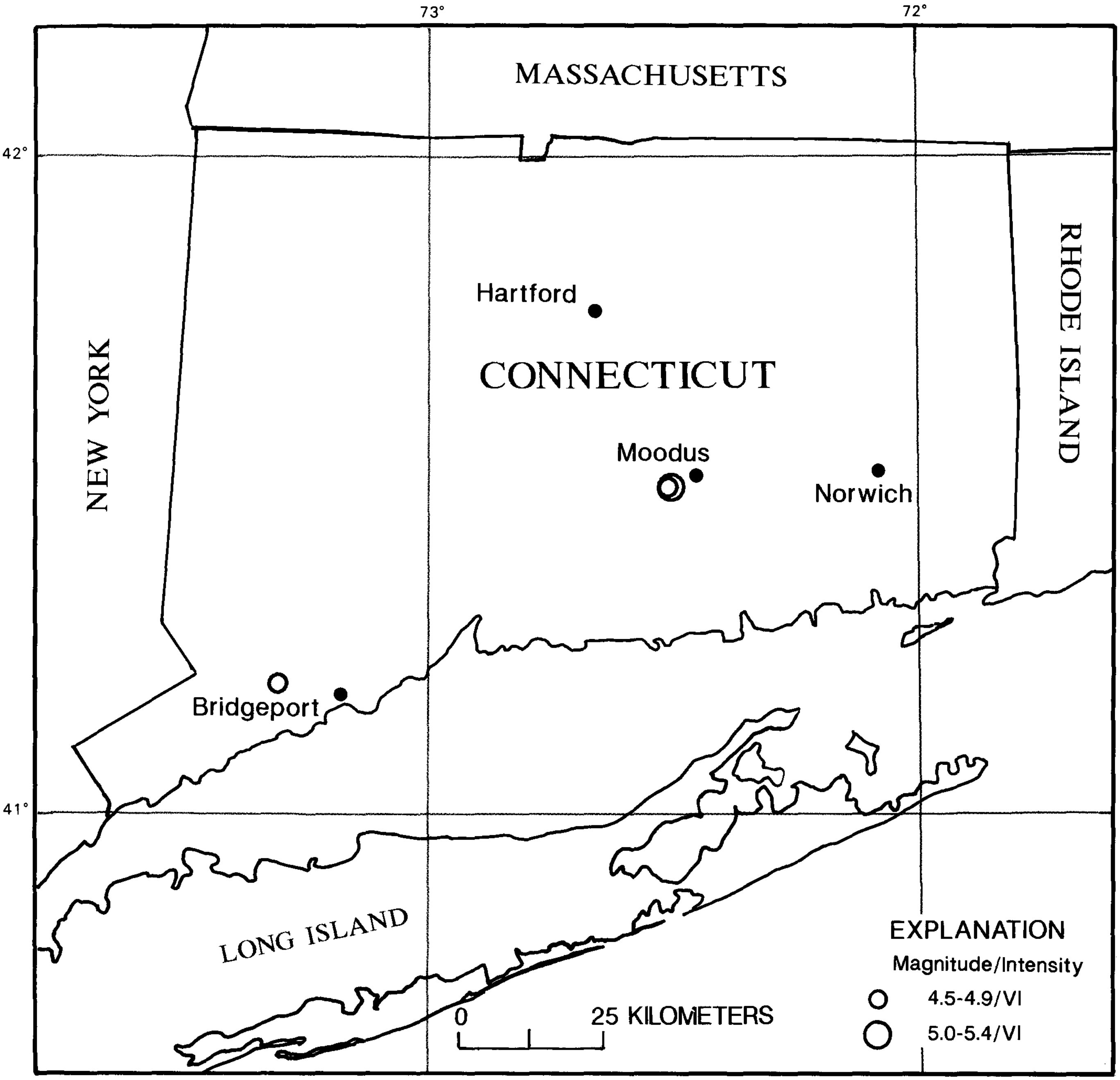
1967. Aug. 9. Near Denver, Colo. The main damage occurred in Northglenn, a northern suburb of Denver, but minor damage occurred in many area towns. At Northglenn, concrete pillars were damaged at a church; foundations, concrete floors, and walls cracked; windows broke; and tile fell at a school. At one residence, a piano shifted about 15 cm and a television set overturned. Some bricks fell from a chimney in downtown Denver, damaging a car. This was the largest of a series of earthquakes in the northeast Denver area that were believed to be induced by pumping of waste fluids into a deep disposal well at the Rocky Mountain Arsenal. The Colorado School of Mines recorded more than 300 earthquakes from this zone during 1967. Felt north to Laramie, Wyo., south to Pueblo, west to Vail, and east to Sterling. Magnitude 4.4 M_S NUT (Ref. 40, 74, 263, 487.)

1967. Nov. 27 (Nov. 26). Near Denver, Colo. Damage occurred mainly in the suburban area of northeast Denver, at Commerce City. It consisted chiefly of cracked plaster, enlargement of existing cracks, and loss from fallen merchandise in stores. Masonry walls and basement floors in the area also were cracked. Felt north to Laramie, Wyo., south to Pueblo, west to Glenwood Springs, and east to Sterling. (Ref. 40, 263, 274, 487.)

1979. Jan. 6 (Jan. 5). Cripple Creek, Teller County, Colo. Plaster cracked and furniture shifted at Cripple Creek, west of Colorado Springs. Also felt in Florissant and the nearby area. Magnitude 3.3 M_n TUL. (Ref. 262, 487.)

1981. Apr. 2. Near Denver, Colo. At Thornton, cracks formed in plaster and concrete-block walls. At Commerce City, many large cracks occurred in plaster walls. Magnitude 4.5 M_n TUL. (Ref. 325, 487.)

CONNECTICUT



Earthquakes in Connecticut with magnitudes ≥ 4.5 or intensity ≥ VI.

CONNECTICUT

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter						Magnitude				Intensity		Felt area
				Latitude		Longitude		Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)		(°)		(km)		m_b	M_S		M			(1,000 km²)
1568				41.5	N	72.5	W	—	126	—		— —	4.85JOH	VI	126	—
1791	05	16	13 00	41.5	N	72.5	W	—	78	—		— —	—	VII	78	—
1845	10	26	23 15	41.2	N	73.3	W	—	78	—		— —	—	VI	76	—

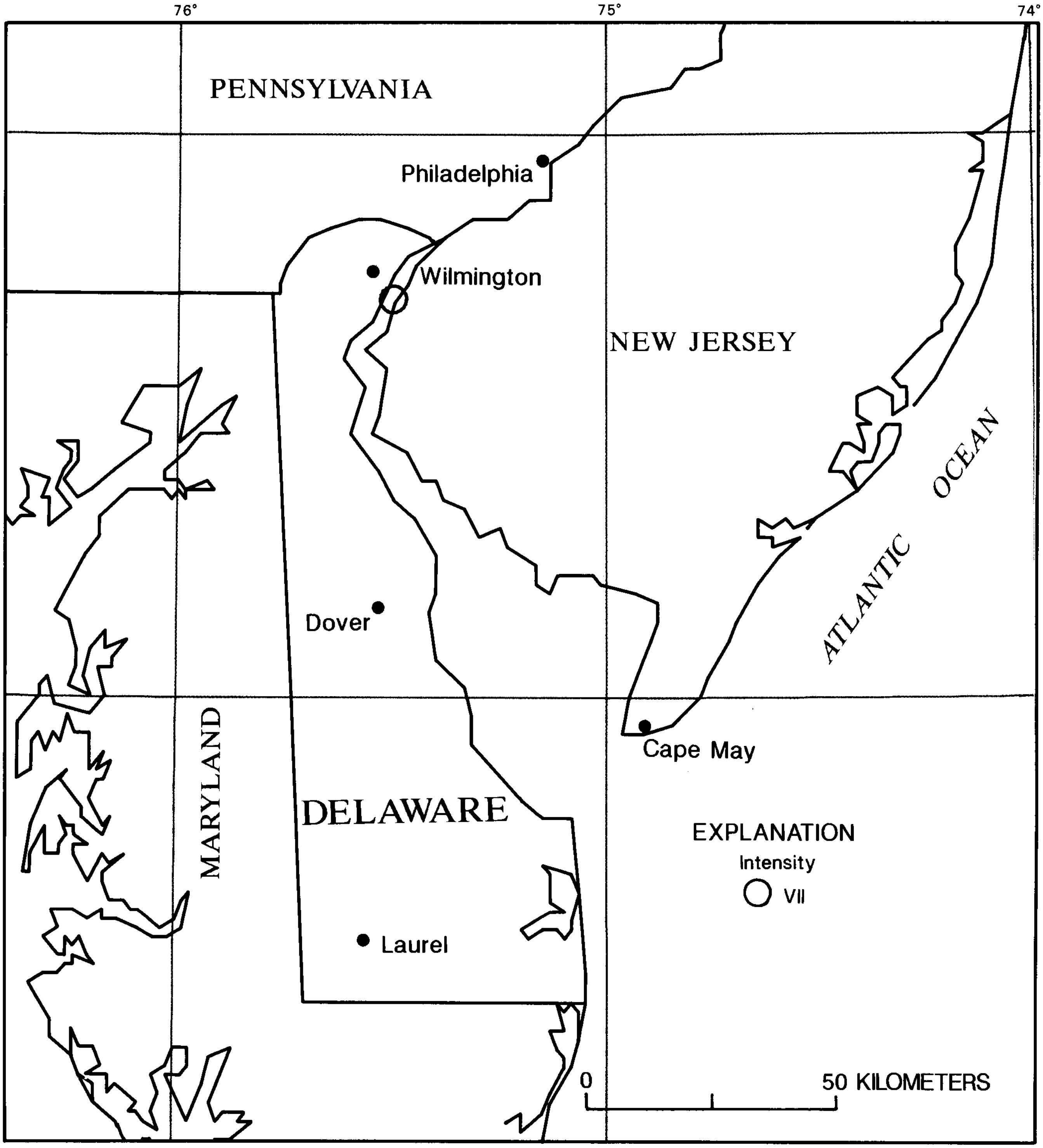
[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1.]

1568. Date unknown. Moodus–East Haddam, Middlesex County, Conn. Ref. 126 assigns MM intensity VI to this earthquake. The original source of the intensity data is the Massachusetts Historical Society Collection, 4th series, v. 6, 1863, by R. Williams. (Ref. 126.)

1791. May 16. Near Moodus, Middlesex County, Conn. The region around East Haddam, on the Connecticut River northeast of New Haven, has been the scene of a series of local disturbances since this country was settled. The region southeast of Middletown has been referred to in Indian tradition as Morehemoodus, or "place of noises." The first reported earthquake began on May 16 with two heavy shocks in quick succession. Stone walls were shaken down, tops of chimneys were knocked off, and latched doors were thrown open. A fissure several meters long formed in the ground. In a short time, 30 lighter shocks occurred, and more than 100 continued during the night. Reported felt at Boston, Mass., and New York City, N.Y. (Ref. 38, 76, 78.)

1845. Oct. 26. Near Stamford, Fairfield County, Conn. The shock was severe in Fairfield County, Conn. At Stamford and Weston, sections of a stone fence were damaged; at Huntington, books were thrown from a table; and at Greenfield Hill, milk pans were thrown down. Also felt in New Jersey and New York. (Ref. 76, 78.)

DELAWARE



Damaging earthquake in Delaware, intensity ≥ VI.

DELAWARE

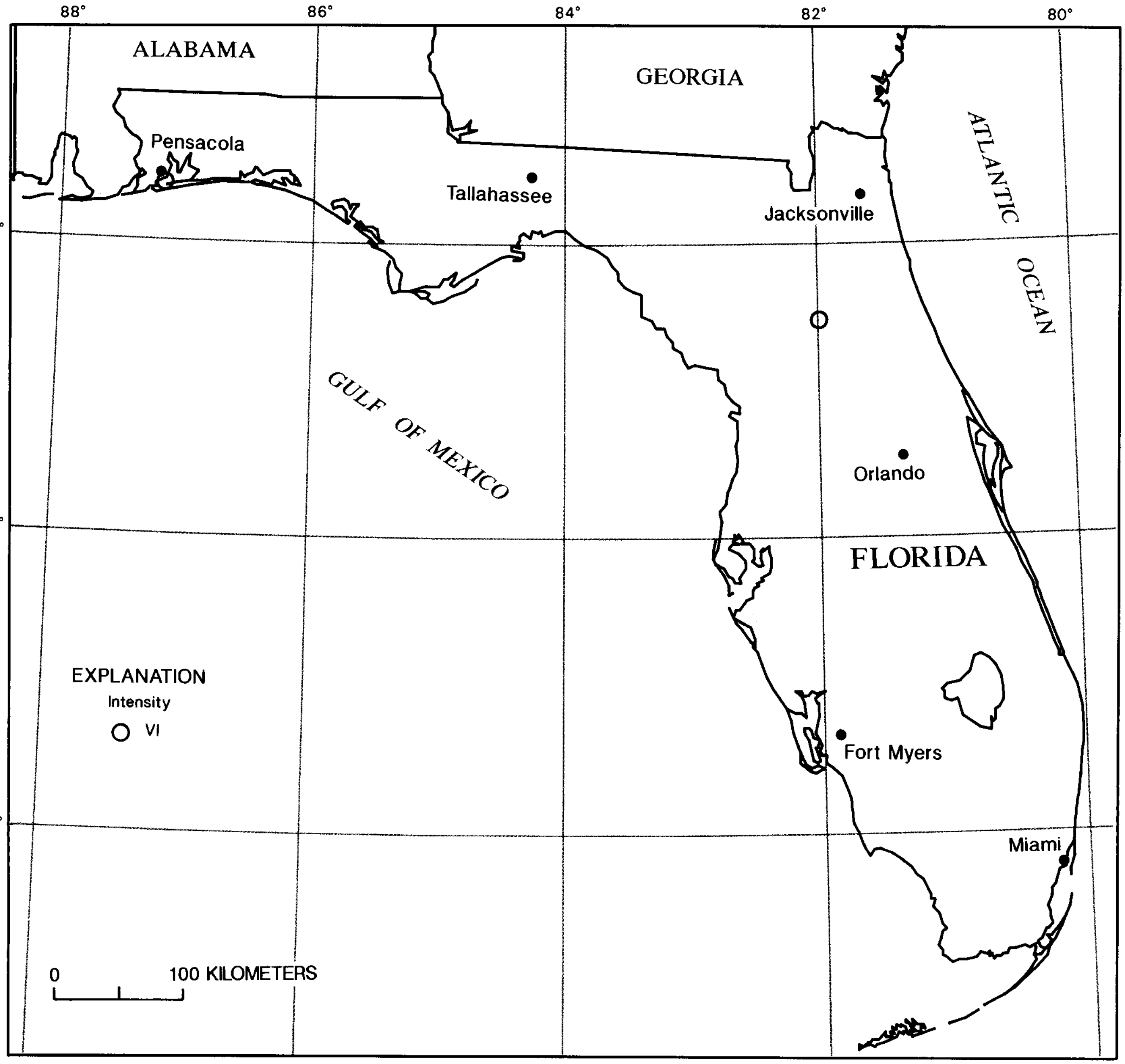
[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter					Magnitude				Intensity		Felt area
				Latitude		Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)		(°)	(km)		m_b	M_S		M			(1,000 km²)
1871	10	09	14 40	39.7	N	75.5 W	—	38	—	—	—	—	VII	38	—

[Reference (Ref.) number given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1871. Oct. 9. New Jersey–Delaware border area. Chimneys toppled and windows broke in northern Delaware at Wilmington. Damage also was reported at New Castle (10 km south of Wilmington) and at Oxford, Pa. (about 40 km west of Wilmington). Also reported felt in New Jersey. (Ref. 38.)

FLORIDA



Damaging earthquakes in Florida, intensity ≥ VI.

FLORIDA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

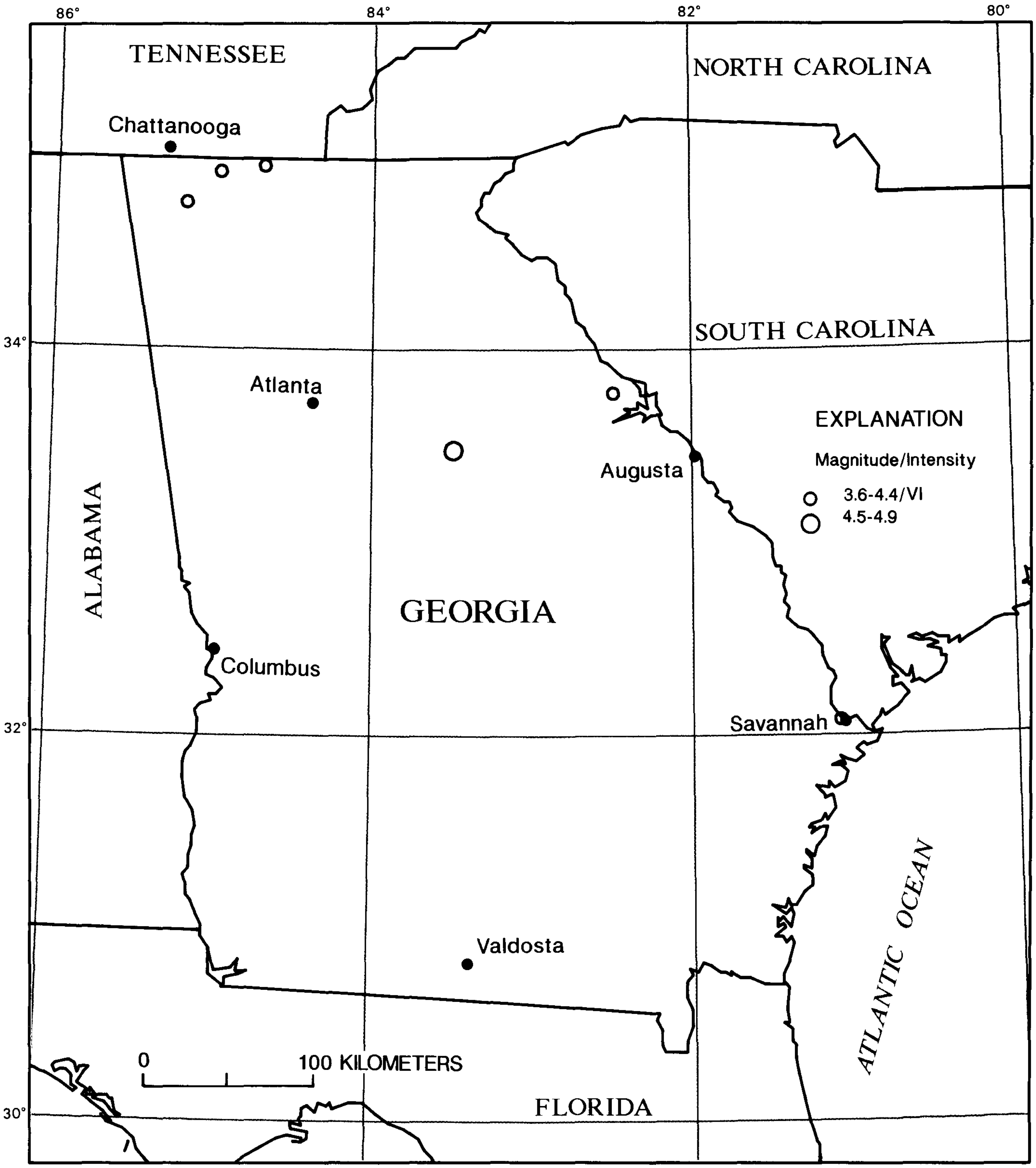
Date			Origin time (UTC)	Hypocenter							Magnitude					Intensity		Felt area
				Latitude		Longitude		Depth	Ref	USGS		Other		Moment	MMI	Ref		
Yr	Mo	Da	h m s	(°)		(°)		(km)		m_b	M_S			M				(1,000 km²)
1780	02	06		30.4	N	87.2	W	—	101	—		—	—	—	VI	101		—
1879	01	13	04 45	29.5	N	82.0	W	—	38	—		—	—	—	VI	38		25&

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1.]

1780. Feb. 6. Northwest Florida. Regimentals and arms racks fell from walls in many barracks; everything in the rooms was moved; doors were sprung. Chimneys were thrown together causing fires. Neighboring houses clashed together, and people buried in the ruins cried for help. This event occurred during a "fearful" storm that was accompanied by violent thunder and lightning and raging seas. Possibly a hurricane. (Ref. 101.)

1879. Jan 13 (Jan. 12). Near St. Augustine, St. Johns County, Fla. Plaster was shaken down and articles were thrown from shelves at St. Augustine and, to the south, at Daytona Beach. At Tampa, a trembling motion was preceded by a rumbling sound. Felt from a line joining Tallahassee, Fla., to Savannah, Ga., on the north to a line joining Punta Rassa and Daytona Beach, Fla., on the south. Two shocks occurred, each lasting 30 seconds. (Ref. 38, 101, 134.)

GEORGIA



Earthquakes in Georgia with magnitudes ≥ 4.5 or intensity ≥ VI.

GEORGIA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1875	11	02	02 55	33.8 N	82.5 W	—	38	—	—	4.30M_{fa} SC	—	VI	38	65
1903	01	24	01 15	32.1 N	81.1 W	—	38	—	—	4.10M_{fa} SC	—	VI	38	26
1914	03	05	20 05	33.5 N	83.5 W	—	38	—	—	4.50M_{fa} SC	—	V	135	246
1976	02	04	19 53 53.0	34.971N	84.702W	014	349	—	—	3.60M_n DG	—	VI	49	8
1984	10	09	11 54 26.2	34.775N	85.193W	015	370	—	—	4.00M_n GS	4.22GT	VI	370	8
1986	07	11	14 26 14.8	34.937N	84.987W	013	562	3.7	—	3.80M_n GS	—	VI	562	13

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1875. Nov. 2 (Nov. 1). Northern Georgia. The earthquake was strong enough to move a mirror back and forth from the wall and to shake doors and windows. Felt from Spartanburg and Columbia, S.C., to Atlanta and Macon, Ga., and from Gainesville (northeast of Atlanta) to Augusta, Ga. Several aftershocks were reported. (Ref. 38, 211, 473.)

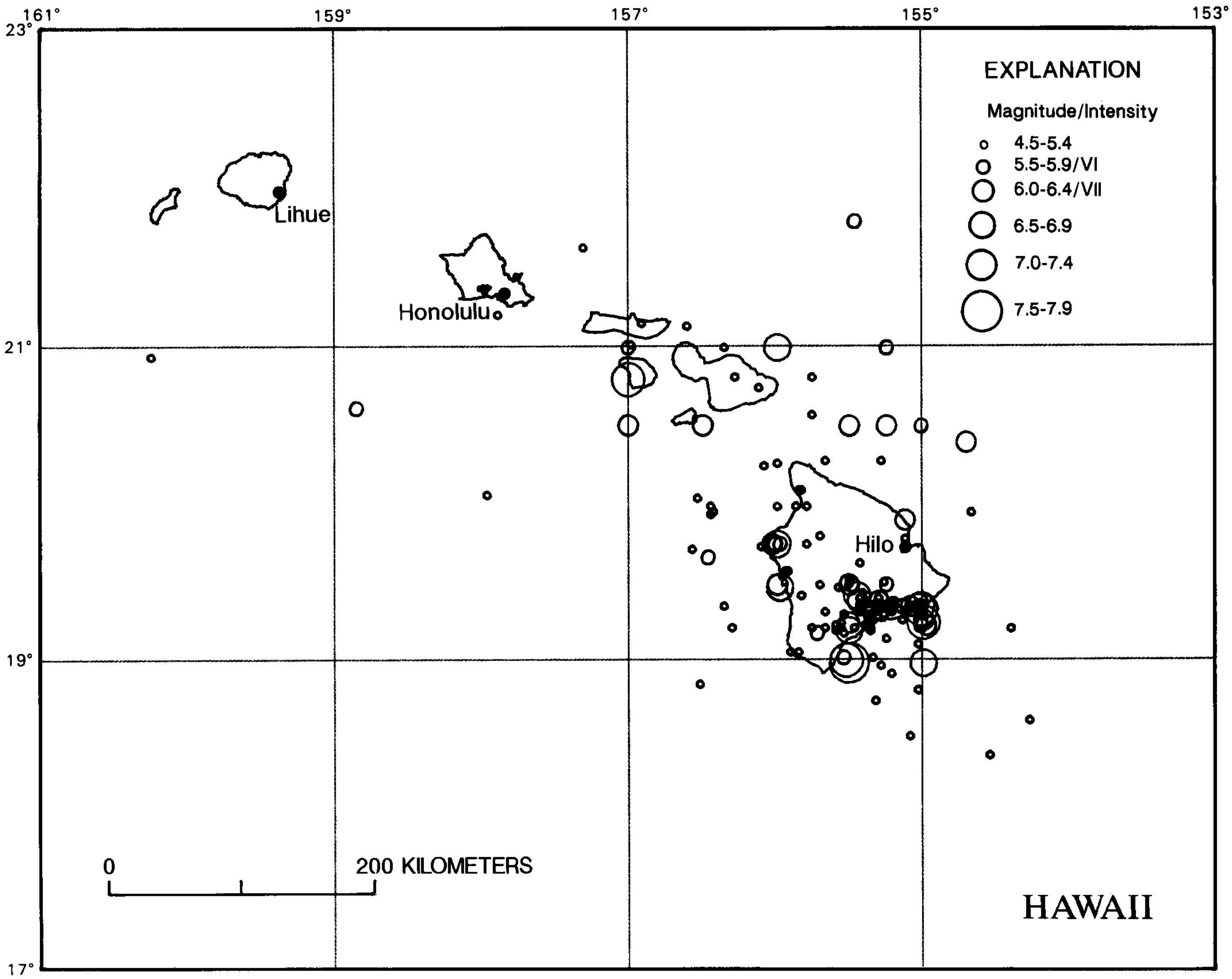
1903. Jan. 24 (Jan. 23). Near Savannah, Bryan County, Ga. The highest intensity was reported at Tybee Island, Ga., east of Savannah, on the Atlantic Ocean. Houses were shaken strongly in that area. (Ref. 38.)

1976. Feb. 4. Northern Georgia, south of Conasauga, Tenn. Near Conasauga in the Lake Ocoee Dam area of Polk County, cracks formed in masonry, chimneys, and a concrete-block building. Also felt at several towns in northern Georgia. Magnitude 3.0 M_n BLA. (Ref. 49, 349.)

1984. Oct. 9. Near Ringgold, Catoosa County, Ga. The most serious damage occurred a few km south of Ringgold, where cracks formed in plaster and sheetrock walls, a house foundation, and exterior brick-veneer walls. One tractor plow was overturned. Light damage also was reported at Chickamauga, LaFayette, Summerville, and Trenton, Ga., and at Chattanooga, Tenn. Also felt in Alabama and Tennessee. Magnitude 4.2 M_n SLM, 3.8 M_D TEC. (Ref. 370.)

1986. July 11. Northwest Georgia, near Chattanooga, Tenn. Damage reported at Cohutta, Ga., near the Tennessee border, southeast of Chattanooga, consisted of cracks in a house foundation, chimneys, and outside brick walls. Slight damage also was reported at Dalton and Tunnel Hill, Ga., and Chattanooga and Turtletown, Tenn. Felt in northern Georgia, southeastern Tennessee, and southwestern North Carolina. Magnitude 3.8 M_D GT. (Ref. 562.)

HAWAII



Earthquakes in Hawaii with magnitudes ≥ 4.5 or intensity ≥ VI.

HAWAII

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1823	06		08 00	19.25 N	155.0 W	—	500	—	—	—	—	IX	500	—
1834	02	20	04 30	19.25 N	155.0 W	—	405	—	—	—	—	VI	405	—
1838	12	12	23 30	19.25 N	155.0 W	—	405	—	—	—	—	VI	405	—
1840	02	02	00 00	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1841	04	08	10 15	19.25 N	155.0 W	—	405	—	—	—	—	VI	405	—
1844	02	19	05 00	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1848	07	09	14 45	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1857	07	30	11 30	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1859	11	21	12 50	20.0 N	156.0 W	—	423	—	—	—	—	V	423	—
1860	07	19	02 30	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1861	06	02	07 00	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1861	12	05	22 20	21.0 N	157.0 W	—	423	—	—	—	—	VI	423	—
1868	03	29	00 15	19.0 N	155.5 W	—	406	—	—	7.00M_{fa} WY	—	VIII	406	—
1868	04	03	02 25	19.0 N	155.5 W	—	38	—	—	7.90M_{fa} WY	—	X	406	—
1868	04	04	10 57	20.5 N	156.5 W	—	406	—	—	—	—	VII	406	—
1868	05	25	10 30	19.0 N	155.5 W	—	405	—	—	—	—	V	405	—
1868	07	25	09 10	19.0 N	155.5 W	—	405	—	—	—	—	V	405	—
1868	11	17	08 30	19.0 N	155.5 W	—	405	—	—	—	—	V	405	—
1869	02	19	10 30	19.0 N	155.5 W	—	405	—	—	—	—	V	405	—
1869	02	22	12 10	19.0 N	155.5 W	—	405	—	—	—	—	V	405	—
1869	08	15	14 30	19.0 N	155.5 W	—	405	—	—	—	—	V	405	—
1870	03	22	07 00	19.0 N	155.5 W	—	405	—	—	—	—	V	405	—
1870	08	07	14 43	20.5 N	157.0 W	—	500	—	—	6.00M_{fa} WY	—	V	500	—
1871	02	20	08 42	20.8 N	157.0 W	015	422	—	—	7.00M_{fa} COX	—	VIII	422	—
1871	09	13	10 45	19.25 N	155.0 W	—	405	—	—	—	—	VII	405	—
1872	04	22	03 00	19.25 N	155.5 W	—	500	—	—	—	—	V	500	—
1874	05	15	22 15	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1874	12	29	16 30	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1875	11	23	22 00	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1877	05	31	14 50	19.25 N	155.0 W	—	405	—	—	6.25M_{fa} Wy	—	VI	405	—
1879	05	16	08 00	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1879	11	04	19 25	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1880	09	24	01 45	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1880	09	25	14 30	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1881	04	22	01 00	21.0 N	157.0 W	—	423	—	—	—	—	V	423	—
1881	09	13		21.0 N	156.0 W	—	463	—	—	—	—	V	463	—
1881	09	30	15 23	19.5 N	156.0 W	—	463	—	—	6.00M_{fa} Wy	—	VIII	463	—
1885	01	13	16 29	21.0 N	156.0 W	—	423	—	—	6.00M_{fa} Wy	—	VI	423	—
1887	01	24	09 57	19.25 N	155.50 W	—	500	—	—	6.00M_{fa} Wy	—	VIII	500	—
1888	08	20	18 05	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1890	08	07	09 40	19.25 N	155.0 W	—	405	—	—	—	—	VI	405	—
1894	12	03	14 00	19.25 N	155.0 W	—	405	—	—	—	—	Felt	405	—
1895	12	09	09 34	21.0 N	157.0 W	—	423	—	—	—	—	V	423	—
1896	09	13	15 30	19.25 N	155.0 W	—	405	—	—	6.00M_{fa} Wy	—	V	405	—
1904	04	04	18 09	19.25 N	155.0 W	—	463	—	—	—	—	V	463	—
1904	06	04	22 57	21.0 N	156.0 W	—	272	—	—	—	—	V	272	—
1905	05	04	02 00	19.25 N	155.0 W	—	405	—	—	—	—	V	405	—
1908	09	21	06 31	19.0 N	155.0 W	—	412	—	—	6.80M_s ABE	—	VI	405	—
1912	10	13	16 00	20.5 N	155.5 W	—	423	—	—	—	—	V	423	—
1913	09	08	22 08	19.0 N	155.5 W	—	38	—	—	—	—	V	38	—
1913	10	25	11 28	19.0 N	155.5 W	—	38	—	—	—	—	V	38	—
1914	03	30	06 34	21.0 N	157.0 W	—	417	—	—	—	—	Felt	417	—
1918	06	14	21 43	19.0 N	155.5 W	—	417	—	—	—	—	V	417	—

HAWAII—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1918	11	02	10 01 10	19.4 N	155.3 W	—	265	—	—	6.20M_{fa} Wy	—	VII	38	—
1919	01	29	03 22	19.0 N	155.5 W	—	417	—	—	—	—	V	38	—
1919	09	15	03 50	19.0 N	155.5 W	—	38	—	—	6.10M_{fa} Wy	—	VII	38	—
1923	01	14	12 59 25	19.0 N	155.5 W	—	417	—	—	—	—	VI	417	—
1923	12	26	05 16	21.0 N	157.0 W	—	417	—	—	—	—	IV	417	—
1924	08	20	16 50	19.25 N	155.55 W	—	500	—	—	5.00M_{fa} Wy	—	V	500	—
1924	09	11	03 33	19.0 N	155.5 W	—	445	—	—	—	—	V	416	—
1926	02	07	21 59	21.0 N	157.0 W	—	218	—	—	—	—	V	218	—
1926	02	28	17 11	19.0 N	155.5 W	—	408	—	—	—	—	V	408	—
1926	03	20	09 03	20.5 N	155.5 W	—	423	—	—	6.00M_{fa} Wy	—	V	423	—
1926	04	22	15 03	19.5 N	155.5 W	—	408	—	—	—	—	VI	218	—
1927	03	20	15 21 42	20.5 N	155.25 W	—	218	—	—	6.0M_{fa} Wy	—	V	408	—
1927	08	03	20 12	19.0 N	155.5 W	—	218	—	—	—	—	VI	218	—
1929	09	26	04 50 56	19.75 N	156.0 W	—	258	—	—	5.60M_S GR	—	VII	38	—
1929	09	27	21 20	19.75 N	156.0 W	—	408	—	—	—	—	VI	408	—
1929	09	28	17 38	19.75 N	156.0 W	—	408	—	—	—	—	VII	38	—
1929	09	29	01 48	19.75 N	156.0 W	—	408	—	—	—	—	VI	408	—
1929	09	30	22 25	19.75 N	156.0 W	—	408	—	—	—	—	VI	408	—
1929	10	06	07 51 31	19.75 N	156.0 W	—	258	—	—	6.50M_S GR	—	VII	38	—
1930	05	26	06 47	19.4 N	155.4 W	—	500	—	—	4.70M_{fa} WY	—	V	500	—
1932	07	08	08 30 49	19.4 N	155.3 W	010	408	—	—	—	—	V	408	—
1935	01	02	17 17	19.418N	155.283W	004	8	—	—	5.90M_{fa} Wy	—	V	408	—
1935	06	28	19 30 05	19.50 N	155.25 W	—	258	—	—	5.60M_S GR	—	VI	408	—
1935	10	01	10 28	19.635N	155.434W	—	418	—	—	—	—	IV	408	—
1935	11	21	11 41	19.516N	155.518W	—	418	—	—	5.60M_{fa} Wy	—	V	408	—
1938	01	23	08 32 43	21.0 N	156.0 W	—	258	—	—	6.75M_S GR	—	VII	11	—
1939	05	15	20 57 31	19.367N	155.133W	016	266	—	—	—	—	VI	408	—
1939	07	14	14 21	19.318N	155.116W	—	418	—	—	5.50M_{fa} Wy	—	V	500	—
1940	06	17	10 26 47	20.4 N	154.7 W	—	265	—	—	6.00M_S GR	—	V*	13	—
1940	06	17	18 17	20.5 N	155.25 W	—	408	—	—	—	—	V	408	—
1940	06	17	23 09	20.5 N	155.25 W	—	408	—	—	—	—	V	408	—
1940	07	16	03 17 33	20.5 N	155.0 W	—	258	—	—	5.60M_S GR	—	V	408	—
1940	09	02	08 44 42	21.0 N	155.25 W	—	258	—	—	5.60M_S GR	—	IV	408	—
1941	09	25	17 48 38	19.5 N	155.5 W	—	258	—	—	6.00M_S GR	—	VII	38	—
1941	11	16	20 11	20.0 N	155.8 W	—	408	—	—	—	—	V	38	—
1941	11	18	13 26	20.0 N	155.8 W	—	408	—	—	—	—	V	38	—
1943	11	11	02 52	19.0 N	155.5 W	—	408	—	—	—	—	V	408	—
1944	12	27	14 11 40	19.5 N	155.5 W	—	258	—	—	5.60M_S GR	—	VI	38	—
1945	05	19	12 18	19.5 N	155.5 W	—	408	—	—	—	—	V	38	—
1948	06	28	11 41	21.2 N	157.9 W	005	421	—	—	4.80M_{fa} UH	—	VI	421	—
1949	05	02	15 02	19.5 N	155.7 W	—	22	—	—	—	—	V	38	—
1950	05	30	01 16 15	19.5 N	156.0 W	—	258	—	—	6.25M_S GR	—	VII	408	—
1951	04	23	00 52 23	19.2 N	155.5 W	—	418	—	—	6.50M_S PAS	—	VII	24	—
1951	08	21	10 56 57.5	19.483N	155.967W	—	408	—	—	6.90M_S GR	—	VIII	419	—
1951	09	16	11 42 51	19.32 N	155.42 W	—	481	—	—	—	—	V	481	—
1951	11	08	19 34 12	19.192N	155.720W	—	409	—	—	—	—	VI	481	—
1952	03	18	03 58	19.125N	155.033W	—	408	—	—	—	—	V	408	—
1952	04	07	07 09 51	21.0 N	157.0 W	060	25	—	—	—	—	IV	238	—
1952	05	23	22 12 26	19.483N	155.983W	010	408	—	—	6.00M_S PAS	—	VI	238	—
1953	01	15	12 05	19.317N	155.433W	024	408	—	—	5.20M_S BRK	—	V	408	—

HAWAII—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	Felt area
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1953	08	22	05 47	19.75 N	155.8 W	—	408	—	—	—	—	V	408	—
1954	03	30	16 40 02.0	19.380N	155.025W	009	418	—	—	6.00M_S PAS	—	VI	410	—
1954	03	30	18 41 56.0	19.353N	155.020W	009	418	—	—	6.50Ukn PAS	—	VII	410	—
1954	07	03	21 52 35	19.4 N	155.2 W	012	408	—	—	5.40M_L HVO	—	VI	408	—
1955	03	08	08 21 26.1	19.335N	154.997W	000	482	—	—	5.40M_L HVO	—	IV	408	—
1955	03	28	02 02 20	19.4 N	155.3 W	—	408	—	—	—	—	VI	408	—
1955	04	01	14 24 25.5	19.407N	155.305W	010	482	—	—	5.20M_L HVO	—	V	38	—
1955	08	07	17 17 44	20.0 N	155.8 W	040	408	—	—	—	—	V	38	—
1955	08	14	12 28 00.0	19.313N	155.285W	029	482	—	—	5.70M_L HVO	—	VI	28	—
1956	05	14	07 53 36	20.283N	155.283W	020	418	—	—	4.50M_L HVO	—	V	38	—
1956	10	16	10 44 55	19.667N	156.467W	025	418	—	—	5.50M_L HVO	—	V	38	—
1957	07	04	10 53 59	19.8 N	155.7 W	015	418	—	—	4.50M_L HVO	—	IV	30	—
1957	07	26	11 40 30	20.250N	156.083W	005	418	—	—	4.60M_L HVO	—	IV	30	—
1957	08	18	10 41 56	21.800N	155.467W	010	418	—	—	5.60M_L HVO	—	V	38	—
1958	12	27	19 17 24	19.783N	155.117W	045	418	—	—	4.50M_L HVO	—	III	31	—
1959	02	20	06 00 28	19.350N	155.150W	005	32	—	—	4.50M_L HVO	—	III	32	—
1960	01	19	04 26 49.2	19.320N	155.670W	007	418	—	—	4.50M_L HVO	—	III	33	—
1960	12	25	12 56 27.8	19.222N	155.764W	001	418	—	—	4.50M_L HVO	—	III	33	—
1961	01	21	11 39 36.8	19.225N	155.666W	010	418	—	—	4.60M_L HVO	—	III	34	—
1961	07	23	15 24 15.5	19.377N	155.282W	026	418	—	—	4.60M_L HVO	—	V	34	—
1961	09	23	03 01 33.3	19.320N	155.113W	004	418	—	—	4.50M_L HVO	—	V	34	—
1961	09	25	05 28 53.5	19.302N	154.998W	009	418	—	—	4.50M_L HVO	—	V	34	—
1962	02	11	02 00 48.3	19.224N	154.398W	003	418	—	—	4.50M_L HVO	—	—	—	—
1962	06	28	04 27 14.2	19.399N	155.454W	010	418	—	—	6.10M_L HVO	—	VI	35	—
1962	07	25	03 48 15.8	19.540N	155.961W	002	418	—	—	4.70M_L HVO	—	V	35	—
1963	01	08	19 39 45.0	19.390N	155.218W	031	418	—	—	4.60M_L HVO	—	V	36	—
1963	08	26	18 49 18.1	19.375N	155.370W	006	418	4.4	—	4.70M_L HVO	—	IV	36	—
1963	09	21	16 24 20.6	19.428N	155.823W	006	418	4.6	—	4.70M_L HVO	—	IV	36	—
1963	10	23	20 24 06.9	19.376N	155.416W	009	418	5.0	—	4.60M_L HVO	—	V	36	—
1964	09	18	10 25 29.1	19.315N	155.115W	005	37	4.8	—	4.90M_L HVO	—	IV	37	—
1964	10	11	10 06 43.6	18.856N	156.517W	006	418	5.3	—	5.30M_L HVO	—	V	423	—
1964	12	03	08 28 41.0	19.405N	155.277W	025	418	4.7	—	4.50M_L HVO	—	V	37	—
1964	12	10	11 53 44.6	19.266N	155.139W	008	418	5.1	—	4.60M_L HVO	—	III	37	—
1965	02	13	23 06 29.6	18.754N	155.314W	015	418	—	—	4.60M_L HVO	—	IV	75	—
1966	08	19	15 21 39.5	18.537N	155.087W	051	418	—	—	4.60M_L HVO	—	III	81	—
1966	09	05	16 33 21.9	19.353N	155.437W	008	81	4.7	—	4.50M_L HVO	—	IV	81	—
1967	07	22	07 34 10.1	20.753N	156.121W	008	418	—	—	4.60M_L HVO	—	II	40	—
1968	02	22	19 20 40.3	19.223N	156.297W	005	418	—	—	4.50M_L HVO	—	—	—	—
1968	04	28	14 08 59.0	19.375N	155.298W	030	41	4.7	—	4.50M_L HVO	—	IV	41	—
1969	05	10	01 33 28.0	19.359N	155.073W	013	418	4.9	—	4.30M_L HVO	—	IV	42	—
1969	11	10	05 12 12.8	19.187N	155.542W	033	418	3.7	—	4.60M_L HVO	—	III	42	—
1969	11	24	19 12 21.6	19.731N	156.099W	002	418	3.8	—	4.70M_L HVO	—	III	42	—
1970	09	21	11 26 36.5	19.332N	155.203W	011	418	—	—	4.50M_L HVO	—	IV	43	—
1970	10	25	19 55 29.1	21.146N	156.612W	011	418	4.5	—	4.80M_L HVO	—	IV	43	—
1971	08	01	18 52 39.5	18.402N	154.545W	007	418	4.8	—	4.60M_L HVO	—	—	—	—
1971	08	16	01 35 09.1	19.367N	155.278W	034	418	4.5	—	4.80M_L HVO	—	IV	44	—
1971	12	28	01 11 51.8	19.262N	155.372W	005	418	—	—	4.70M_L HVO	—	III	44	—
1971	12	29	02 59 12.0	19.248N	155.382W	008	418	—	—	4.60M_L HVO	—	IV	44	—
1971	12	29	11 38 43.1	19.249N	155.363W	007	418	—	—	4.60M_L HVO	—	III	44	—
1972	02	29	22 08 23.9	19.360N	156.351W	008	418	4.9	—	4.90M_L HVO	—	IV	45	—
1972	07	14	19 36 57.7	19.033N	155.330W	038	418	—	—	4.50M_L HVO	—	III	45	—
1972	09	05	11 31 33.8	19.331N	155.206W	010	418	4.4	—	5.00M_L HVO	—	IV	45	—

HAWAII—Continued

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Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1972	12	23	19 04 52.7	19.589N	155.926W	015	418	4.9	—	5.10M_L HVO	—	V	45	—
1972	12	23	20 43 07.0	19.578N	155.936W	015	418	—	—	4.60M_L HVO	—	IV	45	—
1973	04	23	07 07 53.1	19.963N	154.672W	032	418	4.2	—	4.80M_L HVO	—	IV	46	—
1973	04	26	20 26 30.6	19.903N	155.130W	048	464	6.0	6.1	6.20M_L HVO	—	VIII	46	—
1973	10	09	11 53 45.3	19.338N	155.267W	033	418	4.8	—	4.60M_L HVO	—	IV	46	—
1973	12	13	04 25 56.1	19.374N	155.292W	035	418	4.4	—	4.60M_L HVO	—	IV	46	—
1974	01	12	16 04 34.2	19.332N	155.120W	009	418	4.8	—	4.70M_L HVO	—	III	47	—
1974	06	19	15 05 42.6	19.380N	155.422W	010	418	5.1	—	4.70M_L HVO	—	V	47	—
1974	08	28	07 49 41.0	19.328N	155.205W	010	418	4.8	—	4.50M_L HVO	—	III	47	—
1974	11	30	13 54 23.8	19.442N	155.416W	008	418	5.1	5.5	5.40M_L HVO	—	IV	47	—
1974	12	16	09 17 29.8	19.406N	155.434W	009	418	5.0	—	4.70M_L HVO	—	V	47	—
1974	12	25	17 47 49.4	19.348N	155.280W	032	418	4.5	—	4.60M_L HVO	—	IV	47	—
1974	12	31	22 40 48.4	19.305N	155.366W	006	418	5.5	5.2	5.40M_L HVO	—	V	47	—
1975	01	01	12 41 11.1	19.217N	155.356W	005	418	4.7	—	4.60M_L HVO	—	IV	48	—
1975	01	01	13 18 59.6	19.059N	155.899W	010	74	4.5	—	—	—	Felt	74	—
1975	01	01	13 20 54.5	19.475N	155.580W	010	74	5.1	5.3	—	—	Felt	74	—
1975	01	01	13 44 36.3	19.071N	155.854W	010	74	4.7	—	4.90M_L HVO	—	Felt	74	—
1975	01	02	13 27 43.4	19.232N	155.391W	009	418	4.5	4.2	4.90M_L HVO	—	V	48	—
1975	01	03	17 32 49.5	19.207N	155.364W	010	418	4.7	—	4.90M_L HVO	—	V	48	—
1975	01	05	01 32 05.5	19.247N	155.373W	007	418	5.1	5.3	4.90M_L HVO	—	V	48	—
1975	03	30	00 56 26.5	19.283N	155.374W	006	418	—	—	4.60M_D HVO	—	—	—	—
1975	05	22	08 32 58.4	20.288N	155.657W	012	418	4.4	—	4.70M_L HVO	—	V	48	—
1975	05	28	12 02 08.8	18.641N	154.273W	042	418	4.6	—	5.10M_D HVO	—	—	—	—
1975	07	08	00 47 42.6	19.536N	155.504W	003	418	3.9	—	4.70M_L HVO	—	IV	48	—
1975	11	06	12 05 28.4	19.343N	155.313W	019	418	4.4	—	4.50M_L HVO	—	V	48	—
1975	11	29	13 35 40.7	19.362N	155.039W	002	418	5.8	5.1	5.90M_L HVO	—	VI	48	—
1975	11	29	14 47 40.1	19.341N	155.004W	009	418	6.0	7.1	7.20M_S PAS	7.45AND	VIII	48	—
1975	11	29	18 44 00.2	19.145N	155.252W	005	418	4.9	—	4.60M_L HVO	—	—	—	—
1975	11	30	06 15 27.4	19.419N	155.373W	012	418	—	—	4.50M_L HVO	—	—	—	—
1976	01	15	22 59 26.2	19.413N	155.295W	018	418	4.8	—	4.50M_L HVO	—	V	49	—
1976	01	29	20 19 56.6	19.373N	154.988W	010	418	4.5	—	4.70M_L HVO	—	IV	49	—
1976	02	21	05 51 17.4	20.267N	155.990W	021	418	4.9	4.0	5.00M_L HVO	—	VI	49	—
1976	04	02	18 14 06.7	19.342N	155.106W	010	418	4.5	—	4.50M_L HVO	—	V	49	—
1976	04	21	18 13 35.9	18.816N	155.032W	012	418	—	—	4.50M_L HVO	—	—	—	—
1976	05	24	09 24 07.8	20.995N	156.362W	020	418	—	—	4.90M_D HVO	—	V	49	—
1976	12	18	14 01 00.7	19.330N	155.115W	010	418	5.0	—	4.80M_L HVO	—	V	49	—
1977	01	14	23 26 42.5	19.329N	155.119W	010	418	4.2	—	4.70M_L HVO	—	IV	39	—
1977	01	22	22 36 28.5	20.940N	160.260W	033	74	4.7	—	5.10M_L HVO	—	—	—	—
1977	02	04	01 20 59.9	19.347N	155.074W	010	418	4.5	—	4.50M_L HVO	—	IV	39	—
1977	04	21	04 49 23.2	19.326N	155.325W	012	418	—	—	5.00M_L HVO	—	V	39	—
1977	06	06	09 42 19.1	19.362N	155.081W	009	418	4.8	—	5.10M_L HVO	—	V	39	—
1977	09	07	23 51 06.9	19.373N	155.322W	031	418	—	—	4.50M_L HVO	—	III	39	—
1979	03	06	15 07 58.5	19.520N	155.270W	027	418	5.0	4.3	4.70M_L HVO	—	V	489	—
1979	03	10	13 55 14.6	19.334N	155.111W	010	418	4.8	—	4.50M_L HVO	—	IV	262	—
1979	03	22	06 46 59.8	20.100N	155.841W	016	418	4.6	—	4.50M_L HVO	—	V	262	—
1979	03	28	07 30 09.8	20.090N	155.835W	012	418	4.4	—	4.90M_L HVO	—	V	262	—
1979	03	30	09 06 39.6	20.608N	158.862W	010	299	4.7	3.9	5.50M_L HVO	—	V	262	—
1979	08	14	12 51 42.2	20.814N	156.290W	024	418	4.1	—	4.50M_L HVO	—	V	262	—
1979	09	22	07 59 37.6	19.347N	155.071W	009	418	5.7	4.8	5.50M_L HVO	—	VI	262	—
1980	01	20	01 28 48.6	19.312N	155.541W	027	418	—	—	4.60M_L HVO	—	V	300	—
1981	01	12	14 18 10.6	19.356N	155.305W	031	418	4.4	—	4.50M_L HVO	—	V	325	—
1981	01	14	04 20 16.5	19.368N	155.324W	029	418	4.5	—	4.80M_D HVO	—	V	325	—
1981	03	05	14 09 39.8	21.017N	156.988W	010	74	5.0	—	5.10M_L HVO	—	VI	325	—
1981	03	06	02 43 36.4	21.159N	156.910W	000	418	4.5	—	4.50M_L HVO	—	III	325	—
1981	08	10	19 40 35.0	19.306N	155.359W	004	418	4.7	—	4.50M_L HVO	—	IV	325	—

HAWAII—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1981	11	10	13 02 56.6	19.343N	155.211W	010	418	5.3	—	4.90M_D HVO	—	V	325	—
1982	01	21	21 52 41.2	19.230N	155.592W	010	418	5.4	4.9	5.40M_L HVO	—	VI	350	—
1982	01	21	22 29 13.9	19.218N	155.552W	014	418	5.6	4.8	5.40M_L HVO	—	VI	350	—
1982	05	14	16 26 31.7	20.001N	155.864W	020	418	4.5	—	4.80M_L HVO	—	V	350	—
1982	05	19	03 36 19.8	19.954N	156.436W	001	418	4.8	3.7	4.80M_L HVO	—	V	350	—
1983	03	08	16 41 03.4	19.199N	155.593W	011	418	—	—	4.50M_L HVO	—	IV	360	—
1983	03	21	03 18 39.2	19.357N	155.050W	007	360	4.9	—	4.80M_L HVO	—	V	360	—
1983	09	09	16 30 55.3	19.332N	155.122W	009	360	5.5	5.0	5.40M_L HVO	—	V	360	—
1983	11	16	16 13 00.1	19.429N	155.452W	011	360	6.4	6.7	6.60M_L HVO	—	VIII	360	—
1984	06	09	03 34 10.6	20.055N	157.975W	030	370	—	—	5.00M_L HVO	—	—	—	—
1985	02	22	05 48 29.4	19.378N	155.211W	009	371	5.0	—	4.80M_L HVO	—	V	371	—
1985	12	12	19 01 22.9	20.578N	155.755W	025	371	4.3	—	4.70M_L HVO	—	V	371	—
1986	04	23	04 43 51.3	19.305N	155.271W	031	562	—	—	4.50M_L HVO	—	IV	562	—
1986	04	26	17 19 46.5	20.811N	155.749W	033	562	5.1	—	4.90M_L HVO	—	V	562	—
1987	02	04	02 22 32.7	20.053N	156.530W	010	74	5.2	4.9	5.20M_L HVO	5.44HAV	V	577	—
1988	03	02	08 41 56.5	19.329N	155.213W	010	74	4.9	—	4.70M_D HVO	—	V	578	—
1988	03	25	00 29 50.5	19.992N	156.454W	000	74	5.3	4.5	—	—	IV	578	—
1988	03	28	03 33 40.8	19.936N	156.445W	001	74	5.6	5.1	5.30M_S BRK	5.44HAV	V	578	—
1988	04	02	04 48 07.1	19.714N	156.570W	010	74	4.7	—	—	—	Felt	578	—
1988	06	07	10 48 45.0	19.319N	155.117W	010	74	4.4	—	4.70M_D HVO	—	V	578	—
1988	07	04	05 38 09.3	19.221N	155.459W	011	74	5.1	—	5.20M_L HVO	—	IV	578	—
1988	07	31	14 04 33.0	18.924N	155.207W	017	74	4.5	—	4.60M_D HVO	—	—	—	—
1989	04	04	19 09 57.0	18.972N	155.288W	024	74	4.6	—	4.40M_D HVO	—	IV	579	—
1989	06	26	03 27 03.9	19.362N	155.083W	009	74	5.8	6.1	6.20M_D HVO	6.43HAV	VII	579	—
1989	12	05	22 16 58.6	21.633N	157.323W	010	74	4.0	—	4.60M_L HVO	—	IV	579	—
1989	12	28	09 13 17.3	19.333N	155.212W	009	74	5.0	4.5	5.00M_L HVO	—	V	579	—

INTRODUCTION

All earthquakes included in the hypocenter list above are of magnitude ≥ 4.5 or Modified Mercalli intensity ≥ VI. Those without a computed magnitude were estimated to be ≥ 4.5. Since the routine computation of magnitudes for Hawaiian earthquakes began in about 1956, most of the earthquakes that do not have recorded magnitudes occurred before that year.

Epicenters included in this table that are without magnitudes are estimated to be equivalent to a magnitude ≥ 4.5. These estimates were derived by comparing pre-1956 felt or damage reports to reports from well-documented earthquakes in later years that had computed magnitudes. From that comparison, two criteria emerged that defined an estimated magnitude ≥ 4.5 earthquake. These were: (1) reported felt on more than one island, or (2) reported as experiencing "severe" shaking. Only the earthquakes meeting one of these criteria were included in the table.

Estimates of intensity also were necessary for many of the earthquakes in the hypocenter list that had a general description of the shaking but no assigned intensity. The estimates of maximum intensity are based on the following: (1) shaking described as severe—intensity V; (2) shaking reported islandwide on Hawaii Island—intensity IV; and (3) shaking reported felt only on parts of Hawaii Island—intensity III.

Felt areas were not computed in Hawaii. Reliable estimates are not possible owing to the small land area of that State.

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1823. June (date unknown). Kaimu, Hawaii. A strong earthquake threw down a 4-ft-wide by 6-ft-high stone wall, caused large fissures and sand blows in the ground, and damaged a native dwelling. (Ref. 500.)

1834. Feb. 20 (Feb. 19). Hilo, Hawaii. A heavy shock threw down stone walls and upset small jars. The undulating motion made it difficult to stand or walk. (Ref. 38, 405.)

1838. Dec. 12. Hilo, Hawaii. This earthquake threw down stone walls and cracked plaster. The strong motion made it difficult to walk. (Ref. 405.)

1841. Apr. 8. Hilo, Hawaii. Plaster cracked and fell to the floor in every room of a house. Water was splashed out of a bucket. (Ref. 405.)

1861. Dec. 5. Honolulu, Hawaii. Plaster fell from the ceilings of several houses, and people rushed into the streets. (Ref. 423)

1868. Mar. 29 (Mar. 28). Island of Hawaii. This is a foreshock of the Apr. 3 event. At Kahuku, a stone house was destroyed, the chimney of the Mission parsonage was thrown down, and the walls of the stone church were cracked. At Kona, stone walls were thrown down, masses of rock were thrown off the cliff at the bay, stone buildings were damaged, and the cisterns of the Kona Plantation were cracked. At Waiohinu, walls were shaken down, and the stone church was cracked from top to bottom. Also slightly felt at Hilo. (Ref. 406, 500.)

1868. Apr. 3 (Apr. 2). Near south coast of Hawaii. This major earthquake caused 77 deaths (tsunami, 46; landslide, 31). It knocked almost all wooden houses off their foundations in the Keiawa, Punaluu, and Ninole areas. In those areas, straw houses supported by posts in the ground reportedly were "torn to shreds." At Kau, the more substantial houses and every stone wall were thrown down. At Waiohinu, a large stone church collapsed within 10 seconds of the onset of shaking. The shock "ruined" the few stone buildings in Hilo and shook down almost every wall. Brooks became muddy.

At Kealakekua, strong trees were bent backward and forward "like reeds in a storm." Ground waves as much as 0.6 m from ground to crest were observed at Kohala. The motion was so violent at Ulupalakua that it was difficult for people to stand. Reports from Keaiwa and Kiolakaa suggest that vertical accelerations larger than 1 *g* may have occurred.

Extensive surface effects were observed in the epicentral region. Ground fissures extended from Pahala to Kilauea. At Kohuku, a fissure about 5 km long was reported. A volcanic eruption took place from that fissure a few days later, on Apr. 7.

Landslides, which occurred beyond Hilo as far as Waipio and Hamakua, buried 10 houses in the area. A mass of earth as much as 3 km wide and 9 m thick swept down the hillside at Kapapala, carrying with it trees, animals, and people. Thirty-one people were killed.

Along the Puna coast from Kapoho to Apua, the land subsided in places as much as 2 m. At Kaimu, trees stood about 2.5 m deep in sand and water. The plain at Kalapana sank about 2 m, and water stood as much as 1.5 m deep over 8 hectares (20 acres) of formerly dry land.

A tsunami that struck the Kau-Puna coast added to the devastation. The waves, which were most destructive at Honuapo, Keauhou, and Punaluu. At Keauhou (now Keauhou Landing) the water rose 12–15 m, destroying all the houses and warehouses and drowning 46 people. At Hilo, the height of the wave was about 3 m, and at Kealakekua, 2 m. The tsunami also was observed on Maui and Oahu. Also felt on Lanai, Maui, Oahu, and Kauai (about 560 km from the epicenter). (Ref. 38, 406, 500, 570, 610.)

1868. Apr. 4. Near the island of Hawaii. This earthquake was described as "almost as noticeable" as the main shock on Apr. 2. Dishes were shaken from shelves on Kauai. It was "severe" at Honolulu on Oahu. (Ref. 406, 423.)

1871. Feb. 20 (Feb. 19). Near Lanai, Hawaii. This major earthquake caused severe damage on the islands of Lanai, Molokai, and Maui, and minor damage on Hawaii and Oahu. It was felt throughout the islands.

On Lanai, in the Palawai Valley, a large part of the Pali Kaholo bluff fell into the sea, and enormous fragments broke from the towering ocean walls between Manele Bay and Kamaiki Point. Masses of the red basalt were torn from the turrets of Puupehe, located on the southeast coast of Lanai. Huge boulders were hurled from the mountainsides, and ravines were filled with debris of rocks and trees. "Several great clefts opened" on different parts of the island.

On Molokai, in the Pukoo area, the earth opened for a distance of several meters; stone houses in the area cracked in every direction. A 1.5-m-deep hole opened in the ground at Pukoo. At Kaluaaha, a small addition on the northwest corner of the old stone Mission house was thrown down and a part of the east gable end crashed down through the veranda roof below. Stone walls fell in every direction. In one place on the shore, a hole about 0.6 m in diameter and 5.5 m deep was formed by the sinking earth.

On Maui, at Lahaina, all adobe and stone houses were cracked and some were damaged so severely that they were uninhabitable. The old Mission church was damaged, and its walls were cracked. All fence walls reportedly fell to the north. A stone building and the courthouse were damaged. The main road to Lahaina cracked open for several meters. Close to the pier, the earth cracked open for a length of 14.6 m. Damage was much less severe on other parts of Maui—stone walls were thrown down at Kaeleku, Kapueokahi, and Wailuku; cliffs collapsed at Keanae, Koali, Muole, Pukuila, and Wailua. (Ref. 422.)

1871. Sept. 13. Hilo, Hawaii. A severe earthquake knocked down walls. (Ref. 405.)

1877. May 31. Hilo, Hawaii. A severe and long-lasting earthquake damaged walls and threw objects to the floor in a house. (Ref. 405.)

1881. Sept. 30. Kona, Hawaii. Many buildings and cisterns were shattered at Kona. Stone houses were damaged severely, and several kilometers of stone-wall fencing was destroyed. Every movable object in houses was jumbled and thrown together. It was described as a severe and destructive earthquake. The shaking at Hilo also was violent. (Ref. 405, 407, 463.)

1885. Jan. 13. Island of Maui, Hawaii. The main earthquake, which caused some damage at Kahului, Maui, was felt severely at Honolaa and Heeia, Hawaii. Also felt at Honolulu. (Ref. 405, 423.)

1887. January 24. Kau District, Hawaii Island. Many houses were moved several inches from their foundations. Water tanks were thrown down and broken. Contents of homes and stores were thrown about and broken. Six aftershocks were felt in the following half hour. (Ref. 405, 500).

1890. Aug. 7 (Aug. 6). Hilo, Hawaii. Stone walls were knocked down. In some houses, tables and pianos were moved 15 cm from the wall. Small objects were thrown down in almost every room in one house. (Ref. 405.)

1908. Sept. 21 (Sept. 20). Hilo, Hawaii. An earthquake caused some damage in stores and a warehouse. It threw down vases, crockery, and pictures, and stopped clocks. It caused the water in the rivers and in Hilo harbor to rise 1.2 m. (Ref. 405, 412, 610.)

1918. Nov. 2. Mauna Loa, Hawaii. Water tanks and stone walls were damaged at Kapapala Ranch. The earthquake was felt strongly at Hilo and Kona. (Ref. 38, 265.)

1919. Sept. 15 (Sept. 14). Kilauea, Hawaii. Chimneys fell and walls cracked in the Kau section. Slight damage was reported at Hilo. Felt on Maui and Oahu. (Ref. 38.)

1923. Jan. 14. Island of Hawaii. This strong earthquake shook down stone walls and caused some slight damage at Hilea. It was felt on Oahu and throughout Hawaii Island. (Ref. 417.)

1926. Apr. 22. Island of Hawaii. At Hilo, one building shook about 20 cm off its foundation. Unstable objects were overturned. Felt widely over the island. (Ref. 218, 408.)

1927. Aug. 3. Hilo, Hawaii. Slight damage occurred at Hilo. Felt throughout the island. (Ref. 38, 218.)

1929. Sept. 26 (Sept. 25), Sept. 27–30. Kona, Hawaii. The strongest shock of a series occurred on Sept. 26. This earthquake generally was felt throughout the inhabited Hawaiian Islands. Walls fell in the Kona district, and many houses were damaged. Water tanks, underground pipes, and fences throughout the Kona district were demolished. Aftershocks occurring on Sept. 27, 28, 29, and 30 added greatly to the damage to tanks, masonry, stone fences, chimneys, roadways, and weak buildings on slopes. Also felt on Maui and Oahu Islands. (Ref. 38, 258, 408, 500.)

1929. Sept. 28. Island of Hawaii. At Hilo, a church was cracked severely and a street was damaged. Strongly felt. Also see the description for events on Sept. 26, 1929. (Ref. 38, 408.)

1929. Oct. 6 (Oct. 5). Holualoa, Hawaii. Walls fell and houses were displaced on their foundations at Holualoa. Road fills were cracked and embankments overthrown at the road spurs in North Kona; telephone poles were tipped over throughout North Kona. Water tanks in Kealakekua were burst or thrown off their foundations, and some weak structures collapsed. At Puuwaawaa Ranch, unbraced foundation posts fell over, masonry in the main house basement was partly thrown down, new "avalanches" fell in the gulches of Puuwaawaa hill, boulder fences were generally collapsed, and a chimney stump was broken for the second time. Also felt on Lanai, Maui, and Oahu. (Ref. 38, 258, 408, 500.)

1935. June 28. Island of Hawaii. Some damage occurred at Hilo. Generally felt throughout the island of Hawaii. (Ref. 258, 408.)

1938. Jan. 23 (Jan. 22). North of island of Maui, Hawaii. This strong earthquake, which was felt throughout the islands, caused property damage estimated at $150,000 on Maui. Several landslides occurred throughout the island, some chimneys fell, walls were cracked, and pipelines were damaged. Two large oil tanks were shattered at Hana. Ranches on southern Maui sustained heavy damage to water tanks and stone walls. Walls collapsed from Ohia to Mapulehu. The Olinda Reservoir was cracked severely, and the steel storage dam on the Wailuku-Kahului line was damaged.

Many severe cracks formed in roadbeds throughout Maui. At Kula, cracks as wide as 3.8 cm formed in the Haleaka road. On Molokai, at Mapulehu, cracks 5 to 7.5 cm in width and as much 30.5 m in length formed on the east Molokai road. Minor damage also occurred on the islands of Kauai, Lanai, Oahu, and northern Hawaii. Flashes of light were observed in the sky before and during the earthquake. (Ref. 11, 258, 408, 500.)

1939. May 15. Island of Hawaii. Slight damage to masonry structures and plaster occurred at Hilo. Generally felt over the island of Hawaii. (Ref. 266, 408.)

1940. June 17, 10 26 UTC. North of island of Hawaii. At Kaunakakai, on Molokai, glass was cracked, vases overturned, and water spilled from containers; on Maui, sharp shocks broke medicine bottles and stopped clocks; on Hawaii, dishes fell from shelves in Hilo. Residents were awakened on the islands of Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu. Loose objects rattled violently. (Ref. 38, 258, 500.)

1941. Sept. 25. Island of Hawaii. Felt sharply throughout Hawaii Island. At Pahala, roadfills cracked, shoulders along roadways failed, pipes were sprung, plaster cracked, and goods fell from shelves and broke. At the Kapapala Ranch, several stone walls were partly thrown down and two windows and many dishes were broken. Many earthslides from the walls of Halemaumau caused large dust clouds; boulders shook loose from steep slopes at the head of Wood Valley and on Hilina Pali. An old crack in a building reopened at Hilo. Also felt on Oahu at Honolulu. (Ref. 38, 258, 500.)

1944. Dec. 27. Island of Hawaii. Near Hilea, stone fences were thrown down. At Pepeekeo and Naalehu, objects toppled from shelves. Also felt on Oahu. (Ref. 38, 258, 408.)

1948. June 28. Off island of Oahu, Hawaii. This sharp earthquake caused minor damage on Oahu. Four large plate-glass windows broke in downtown Honolulu; fluorescent lamps displaced from their sockets; plaster cracked in at least 20 buildings; and one chimney cracked. At the Fort Shafter military installation, a 21-m-long crack formed in the wall of the new barracks. A landslide blocked Kamehameha Highway in Kipapa Gulch, and another landslide occurred on Moanalua Road at Red Hill. Several sidewalks in Kaimuki were cracked severely. Also felt slightly on the islands of Hawaii, Kauai, and Molokai. (Ref. 38, 421.)

1950. May 30 (May 29). Kona, Hawaii. This widely felt earthquake damaged water tanks and stone walls in Kona. At Captain Cook, Machado's store shifted about 2.5 cm from its foundation and four large water tanks split open. Cracks 2.5 cm wide were observed along the highway from Honaunau to Captain Cook, and shoulders gave way. Residents at Hilo reported broken chinaware. (Ref. 258, 408, 500.)

1951. Apr. 23 (Apr. 22). Near Kilauea caldera, Hawaii. This strong earthquake generally was felt throughout the island of Hawaii and by many residents on Maui and Oahu. It caused slight damage on Hawaii, including broken windows and dishes and a broken water pipe. The roadbed between the Volcano House and Kilauea Overlook settled, and much damage was sustained by roads in the National Park. Small earth slips occurred in road cuts between Kilauea caldera and Hilo and north of Hilo along the Hamakua coast. Minor cracks formed in the highway at the northeast rim of Kilauea caldera. Cracks in the soil, apparently caused by lurching, formed at several places north and east of Kilauea caldera. Surface faulting was not observed. (Ref. 24, 418, 500.)

1951. Aug. 21. Near Napoopoo, Hawaii. This earthquake probably was caused by movement on the Kealakekua fault. It inflicted property damage that extended from Holualoa on the north to Honuapo on the southeast, a distance of 80 km. Damage was most severe in the central Kona district, along a 16-km stretch from Captain Cook to Hookena. Here, several houses, churches, and a school building were damaged severely, and about 200 water tanks were demolished or damaged beyond repair (mainly owing to damage to footings). Many stone walls were thrown down. Roads were partly blocked by small rock slides; road pavement and shoulders were cracked badly; and telephone communications and electric power were disrupted. Tombstones were shifted, rotated, or overturned in many cemeteries in the area.

The earthquake was felt strongly throughout the island of Hawaii and slightly on Maui and Oahu (at Honolulu, about 290 km from the epicenter). Many aftershocks, all of lower intensity, occurred through September 1951. A small tsunami was observed at Hilo, Honolulu, and the Kona Coast area (maximum at Napoopoo—0.9 m). Residents of Naalehu and Pahala reported bright flashes of white light at the time of the earthquake. (Ref. 408, 419, 481, 610.)

1951. Nov. 8. Island of Hawaii. At Kahuku Ranch headquarters, 15 km north of South Point, on the southern part of Hawaii Island, stone walls were damaged extensively and dishes were thrown from shelves. Felt throughout the island. (Ref. 409, 481.)

1952. May 23. Island of Hawaii. Slight damage reported in the central Kona district included cracks in pavement, landslides from roadcuts, damaged water tanks, broken dishes and windows, and overturned tombstones. Dishes were broken as far distant as Naalehu, about 60 km southeast of the epicenter. Felt throughout the island and by some residents on Maui. (Ref. 238, 408.)

1954. Mar. 30, 16 40 and 18 41 UTC. Island of Hawaii. The foreshock at 16 40 UTC collapsed several domestic water tanks at Kalapana and Opihikao. During the stronger shock 2 hours later, extensive damage occurred in the Hilo and Puna districts. In Hilo, several chimneys and stone walls were thrown down, plaster cracked, and windows broke. Between Kalapana and Opihikao, stone fences were thrown down, people driving automobiles were disturbed, and some residents found it difficult to walk or stand. Also felt on Maui and Oahu. (Ref. 410, 418.)

1954. July 3. Island of Hawaii. This strong earthquake, widely felt over the southern part of the island, caused minor damage at Hilo. Many heavy rockfalls occurred in the area of Halape during and after the earthquake. (Ref. 408.)

1955. Mar. 28 (Mar. 27). Hawaii Volcanoes National Park. This earthquake broke water lines and cracked houses in the residential area of Hawaii Volcanoes National Park. It also opened cracks across the Mamalahoa Highway, east of park headquarters. (Ref. 408.)

1955. Aug. 14. Island of Hawaii. At a farm about 64 km southwest of Hilo, walls were cracked and dishes were knocked from shelves. Felt throughout the island of Hawaii and on Kauai, Maui, and Oahu. (Ref. 28, 408, 482.)

1962. June 28 (June 27). Island of Hawaii. This earthquake, which occurred near the Kaoiki fault system, caused the most severe damage to houses at Kapapala. Paint on walls was chipped, large kitchen appliances were moved several centimeters, and loose china fell from shelves. Damage reported at Hilo includes cracks in walls, plaster, and windows, and broken dishes. Landslides occurred at Kawalii Gulch near Laupahoehoe, on Kealakekua Bay, and in the remote Waipio Valley on the northern end of the island. Also felt slightly on Maui and Oahu. One report of this earthquake came from the North Kohala district, a region where earthquakes are not commonly felt. More than 1,500 aftershocks were recorded in the next 3 days, and intense aftershock activity continued for several weeks. Magnitude 5.75 M_S BRK, 5.25–5.5 M_S PAL. (Ref. 35, 411, 418.)

1973. Apr. 26. Near northeast coast of island of Hawaii. This damaging earthquake was felt from the east coast of Hawaii Island through the main islands of Kahoolawe, Kauai, Lanai, Molokai, and Oahu, a distance of about 595 km. Property damage in and near Hilo was estimated at $5.75 million, and 11 people were injured.

Damage to buildings, roads, and utilities led authorities to declare a state of emergency. Ground effects, mainly landslides but including ground cracks induced by lateral displacement and local subsidence, were severe locally. Subsidence damaged the main wharf in Hilo, and landslides damaged roads and structures over a large area.

It was reported that 17 houses in the Hilo area were shaken from their foundations and that five collapsed. One structure in downtown Hilo collapsed, and the outside walls of an apartment building—a two-story concrete-block structure—were torn loose at two ends. Tombstones and chimneys overturned in several towns; water pipes and tanks were damaged. Several schools sustained damage, and four were closed temporarily. At Papaikou, the roof on the Kalaniaonaole School dropped 7–10 cm, and its ceiling was warped. Magnitude 6.3 M_S PAS, 6.1 M_S BRK. (Ref. 46, 418, 423, 464.)

1975. Nov. 29, 13 35 UTC. Island of Hawaii. Campers at Halape saw dust clouds rising from rockfalls that the earthquake sent crashing down the face of Puu Kapukapu. Felt strongly in Hilo and Puna. (Ref. 48, 418.)

1975. Nov. 29, 14 47 UTC. Southeast coast of island of Hawaii. The largest earthquake in more than a century (since April 2, 1868) struck Hawaii on the morning of Nov. 29, killing two people, injuring several, and inflicting property damage estimated at $4.1 million in Hawaii (including damage caused by the tsunami). It was accompanied by a damaging tsunami, massive ground movements, hundreds of aftershocks, and a brief, small-volume volcanic eruption. The earthquake was felt throughout Hawaii Island, and on Lanai, Molokai, and Oahu.

Most of the buildings in the epicentral area sustained little or no structural damage from ground shaking. Structural and nonstructural damage in Hilo, 45 km north of the epicenter, was slight to moderate but was more extensive than elsewhere on the island.

Structural damage on the southeast part of the island included minor cracks, floor-to-wall separations a few millimeters wide, and bowing of walls in

Hilo at a hospital, schools, and libraries. Floor sections dropped 5 to 10 mm in some of the buildings; hotel, apartment, and commercial buildings sustained structural and equipment damage. A damage survey of the area revealed that slight to moderate structural damage was sustained by five churches (Hilo, 4; Opihikao, 1), 11 commercial buildings (Hilo, 10; Mountain View, 1), and 80 private dwellings (Hilo, 51; Puna, 23; Hamakua, 2; Kau, 3; and Kona, 1). Five poorly constructed or old houses were demolished (Hilo, 4; Kau, 1). Houses shifted on their foundations at Kalapana, Kurtistown, Pahoa, and Hawaiian Paradise Park. Water tanks were destroyed at Opihikao, Pahoa, and Volcano.

The summit and south flank areas of Kilauea Volcano were displaced by vertical and horizontal movements of several meters, forming many ground cracks and faults. Roads in Hawaii Volcanoes National Park were damaged by extensive ground cracking. Landslides occurred on Coast Road.

Fault displacements resulted in widespread subsidence (locally as much as 3.5 m near Halape), leaving coconut palms stranded in the sea and almost submerging a small nearby island. Inland, an almost continuous zone of ground cracking and faulting, having vertical offsets as much as 1.5 m, occurred along the Hilina fault system over a 25-km^2 area. To the south and southwest of this zone of maximum faulting, vertical displacements of as much as 0.5–1.0 m were common along other faults.

A large part of the coastal area between Cape Kumukahi and Punaluu subsided during or soon after the earthquake. A leveling survey of the bench marks near the Keauhou tide gage (2 km east of Halape) indicated that the coast subsided about 3.5 m.

The tsunami generated by this major earthquake consisted of five or more distinct waves in some places. The only locally generated tsunami in Hawaii this century to be destructive, it killed two people at Halape, where it was about 7.9 m high, and caused property damage estimated at $1.2 million at Punaluu, Honuapo, Kaalualu Bay, Hilo, and Kailua-Kona. At Punaluu (7.6 m), 30 km southwest of Halape, several wood-frame houses were flattened or washed off their foundations; nearby county park facilities were damaged severely, and buildings at the Seamountain Resort sustained heavy nonstructural damage. Tsunami damage also was severe at Honuapo (6.6 m), 6 km southwest of Punaluu. The highest wave reached a maximum height of 14.6 m above the postsubmergence shoreline, 1.5 km east of Halape. The tsunami was recorded in Alaska, California, Japan, Okinawa, Samoa, and on Johnston and Wake Islands. (Ref. 48, 418, 453, 501, 610.)

1976. Feb. 21 (Feb. 20). Island of Hawaii. This minor earthquake caused damage to walls at Kawaihae. Also felt on Maui and Oahu. (Ref. 49, 418.)

1979. Sept. 22 (Sept. 21). Island of Hawaii. In the Hilo area, several hundred houses were damaged and several businesses lost merchandise. Foundations were damaged; water lines ruptured; and windows broke. At Reeds Island, a fireplace and house foundation sustained damage. (Ref. 262, 418.)

1981. Mar. 5. Near island of Molokai, Hawaii. The pipe that carries water from Waikolu Valley to Kalaupapa sustained four breaks and some cracks. Underground water pipes cracked near Kalaupapa on Molokai. Also felt on Hawaii, Lanai, Maui, and Oahu. (Ref. 74, 325.)

1982. Jan. 21, 21 52 and 22 29 UTC. Island of Hawaii. The first earthquake caused widespread minor damage in the Kau area; two small landslides occurred in Laupahoehoe Gulch. At Pahala, rock walls fell and chimneys cracked. The second shock, 37 minutes later, was not as strong, but it caused a rockfall in Kaawali Gulch that injured one person. Both shocks also were felt on Maui and Oahu. (Ref. 350, 418.)

1983. Nov. 16. Island of Hawaii. This earthquake, the most destructive in Hawaii since a magnitude 7.1 event occurred there in 1975, caused heavy property damage on the island of Hawaii and injured six people. The Small Business Administration reported 35 commercial buildings sustained varying degrees of damage, 317 houses had minor damage, and 39 houses had major damage. Unanchored chimneys fell. Roads, bridges, and other government facilities also were damaged.

At Volcano, many houses and garages were moved off their foundations, causing extensive damage to ceilings and walls. Highways in the area were cracked severely and were closed temporarily. Elevated water tanks were thrown down; water tanks on gravel bases were moved as much as 5 cm, and some had their roofs damaged or knocked off by sloshing water. Three chimneys collapsed. Moderate damage on Hawaii Island also occurred at Hawaiian Volcano Observatory, Hilo, Kipapala Ranch, Kaumana, Kilauea Military Camp, and Wood Valley.

Landslides and ground cracking occurred in many areas on southern Hawaii Island. The most severe ground failures were on Crater Rim Drive, a road around Kilauea crater. The road extended near the edge of the crater wall in several places, and a

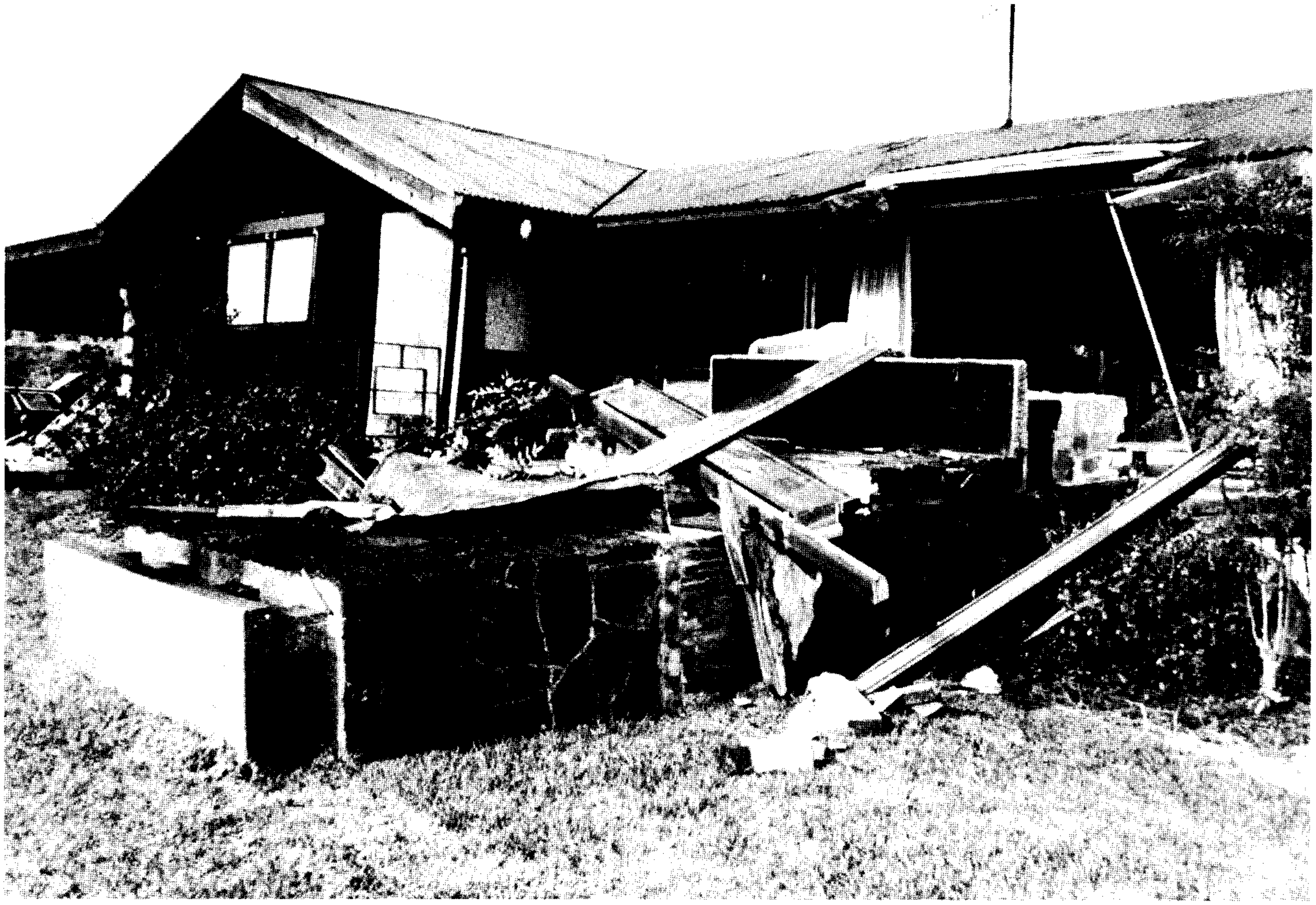
Ground failure on Crater Rim Drive, around Kilauea crater on the island of Hawaii, caused by the November 16, 1983, earthquake. (Photograph by J.D. Griggs.)

section of the road fell into the crater. In other areas, cracks as much as 1–1.5 m wide and 3–6 m deep formed in the road. Also, many sections of trails in Hawaiian Volcanoes National Park collapsed into the main caldera of Kilauea Volcano. At South Point and Kealakekua Bay, parts of the cliffs fell into the ocean. Felt on Kauai, Lanai, Maui, Molokai, and Oahu. (Ref. 360.)

1989. June 26 (June 25). Near Kalapana, Puna District, Hawaii. This strong earthquake injured five people in the Puna area and destroyed five houses. Additional structural damage to residential property in the County of Hawaii included major damage to 10 houses and minor damage to 100 houses. Many of the houses sustained cracks in walls, ceilings, and concrete pads, and slight shifting of their foundations. Total damage to property was estimated at $1 million (Robert Y. Koyanagi, oral commun., Hawaiian Volcano Observatory, Aug. 10, 1989.)

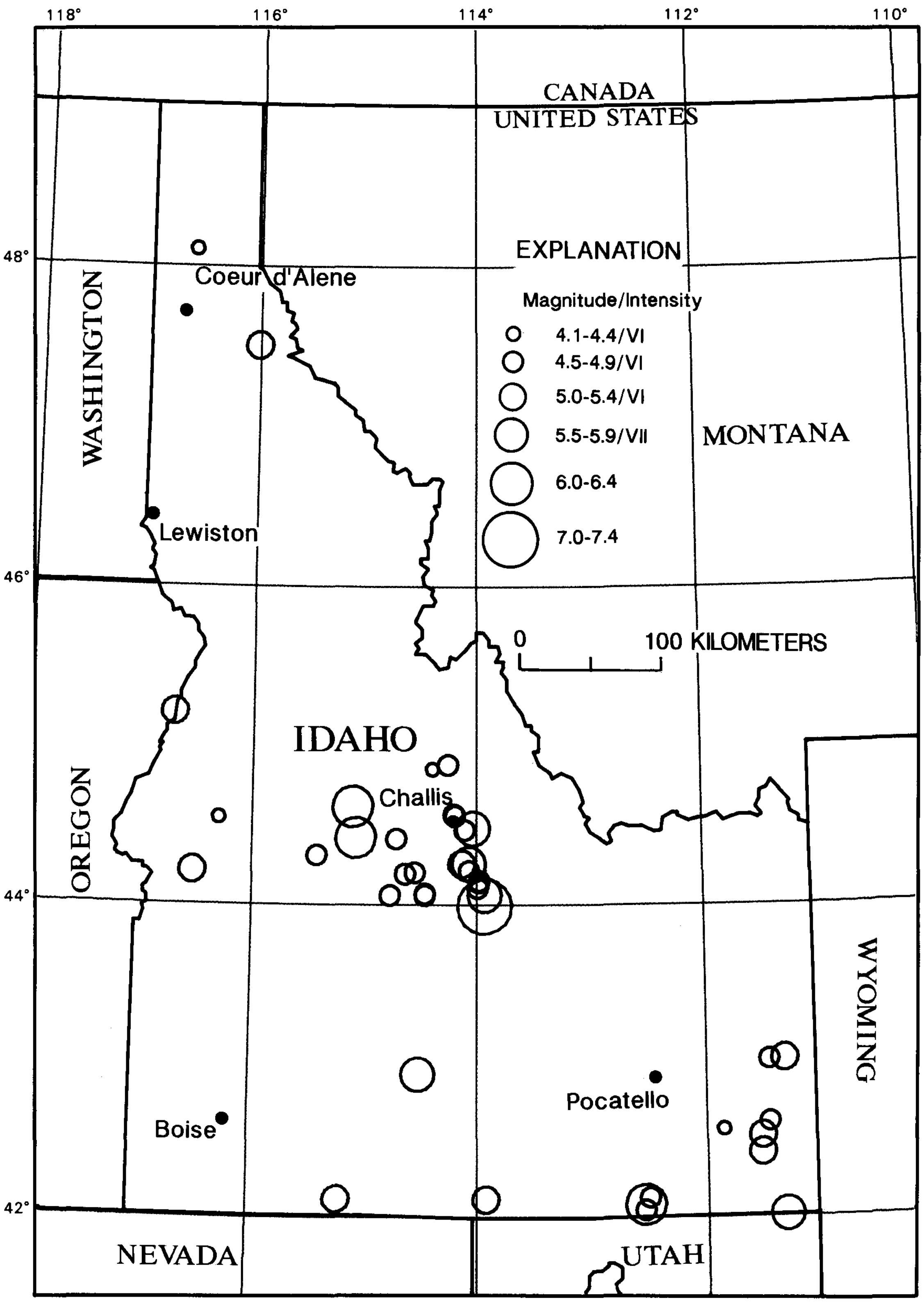
Damage to structures in the Puna area included the collapse of at least five houses in Kaimu, Kalapana, and Royal Gardens. Ground cracks were observed across the coast road in Kalapana, and landslides were reported in Puna and along the Hamakua coast between Honokaa and Hilo. Only slight damage to houses was reported at Hilo. Power outages occurred in the Hilo, Kau, and Puna districts.

A small tsunami was recorded on tide gauges at Hilo, Honuapo, and Kapoho. The main shock was felt on Maui, Oahu, and Hawaii Islands. Several aftershocks occurred. (Ref. 74, 579.)



Chimney in Volcano, Hawaii, toppled by the November 16, 1983, earthquake. (Photograph by the Hawaii Tribune-Herald, Ltd.)

IDAHO



Earthquakes in Idaho with magnitudes ≥ 4.5 or intensity ≥ VI.

IDAHO

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1884	11	10	08 50	42.0 N	111.3 W	—	298	—	—	—	—	VII	52	15
1905	11	11	21 29	42.9 N	114.5 W	—	38	—	—	—	—	VII	38	—
1913	10	14	23 00	45.2 N	116.7 W	—	56	—	—	—	—	VI	56	—
1916	05	13	02 26	44.2 N	116.5 W	—	498	—	—	5.30Ukn PAS	—	VII	38	130
1917	12	12	10 50	43.0 N	111.3 W	—	38	—	—	5.30Ukn JON	—	V	272	21
1924	11	25	07 10	42.5 N	111.5 W	—	38	—	—	—	—	VI	218	52
1928	09	05	05 36	42.1 N	115.2 W	—	54	—	—	5.20Ukn JON	—	—	—	—
1937	11	19	00 50 20	42.1 N	113.9 W	—	54	—	—	5.40M_x SJG	—	IV	10	—
1942	11	01	18 50 06	48.1 N	116.6 W	—	266	—	—	—	—	V	15	65
1944	07	12	19 30 20.7	44.412N	115.063W	010	354	—	—	6.10M_s GR	—	VII	17	153
1945	02	14	03 01 11.3	44.607N	115.087W	010	354	—	—	6.00Ukn PAS	—	VI	18	128
1947	09	25	01 34 30	44.3 N	115.4 W	—	20	—	—	4.70M_x JON	—	VI	259	—
1957	12	19	06 25	47.5 N	116.0 W	—	38	—	—	—	—	VI	30	@
1960	08	07	16 27 16.2	42.4 N	111.5 W	049	266	—	—	—	—	VI	33	2
1963	01	27	15 24 43.8	44.190N	114.528W	011	354	—	—	4.80M_n DW	—	VI	36	15
1963	09	11	02 08 43.7	44.177N	114.615W	008	354	4.9	—	4.80M_n DW	—	VI	36	9
1963	09	12	06 23 48.9	44.181N	114.621W	009	354	4.4	—	4.70M_n DW	—	IV	36	—
1963	10	17	01 22 07.7	44.4 N	114.7 W	030	74	4.7	—	—	—	—	—	—
1969	04	26	10 41 53.1	44.058N	114.444W	018	354	4.9	—	4.90M_n DW	—	VI	42	23
1969	09	19	13 33 15.0	42.99 N	111.43 W	005	74	4.5	—	4.90M_L GS	—	—	—	—
1975	03	28	02 31 06.0	42.06 N	112.52 W	005	298	6.1	6.0	6.00M_L UU	6.13BAS	VIII	48	160
1975	03	29	13 01 19.9	42.03 N	112.52 W	007	298	4.7	—	4.70M_L UU	4.93BAS	V	48	—
1977	11	27	09 25 55.6	44.537N	116.276W	009	354	4.2	—	4.40M_n DW	—	VI	39	24
1978	10	24	20 30 59.3	42.55 N	111.84 W	007	240	4.2	—	4.10M_L UU	—	VI	240	5
1978	10	29	13 46 45.6	44.866N	114.243W	012	354	4.2	—	4.70M_n DW	—	V	240	25
1978	11	30	06 53 40.1	42.11 N	112.49 W	004	240	4.6	—	4.70M_L UU	—	V	240	18
1982	10	14	04 10 24.3	42.59 N	111.43 W	007	350	4.6	—	4.70M_L UU	—	VI	350	13
1983	10	28	14 06 06.5	43.974N	113.916W	014	354	6.2	7.3	7.20M_L BRK	6.95ED	IX	360	855
1983	10	28	15 14 07.7	44.127N	113.968W	010	360	4.3	—	4.60M_L UU	—	—	—	—
1983	10	28	19 51 25.0	44.045N	113.918W	013	354	5.4	5.1	5.80M_L UU	5.58ED	Felt	360	—
1983	10	29	23 29 11.8	44.244N	114.055W	010	354	5.4	5.0	5.80M_L UU	5.48ED	Felt	360	—
1983	10	29	23 39 05.4	44.241N	114.109W	011	354	5.5	5.0	5.40M_L UU	4.71GM	Felt	360	—
1983	10	30	01 24 51.3	44.089N	113.977W	013	360	4.3	—	4.80M_L UU	4.36GM	—	—	—
1983	10	30	01 59 02.0	44.200N	114.056W	016	360	4.2	—	4.70M_L UU	4.18GM	—	—	—
1983	11	06	21 04 48.7	44.140N	113.963W	011	360	4.3	—	4.60M_L UU	4.16GM	III	360	—
1984	01	24	21 07 57.5	44.047N	114.442W	010	370	4.5	—	4.60M_L MMT	—	IV	370	15
1984	08	22	09 46 30.2	44.467N	114.008W	010	370	5.0	5.1	5.80M_L UU	—	V	370	173
1985	02	06	19 34 19.4	44.551N	114.176W	010	371	4.7	—	4.80M_D BU	—	V	371	15
1985	03	17	06 56 17.1	44.553N	114.182W	010	371	4.5	—	4.70M_D BU	—	V	371	15
1986	09	26	22 48 57.9	44.043N	114.756W	005	562	4.6	—	4.50M_L GS	—	IV	562	—
1988	01	10	23 22 19.5	44.840N	114.377W	005	74	4.8	—	4.40M_L GS	—	III	578	—
1988	07	14	17 31 33.0	44.456N	114.083W	005	74	4.9	4.1	—	—	IV	578	110
1988	11	19	20 00 53.1	42.007N	111.477W	005	74	5.0	—	4.30M_LUU	—	Felt	578	—

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1884. Nov. 10. Paris, Franklin County, Idaho. The earthquake damaged houses considerably in Paris, about 100 km southeast of Pocatello, near the Idaho-Utah-Wyoming border. It knocked down chimneys and shook stock from shelves in Richmond, Utah, about 125 km north of Salt Lake City. In an area north of Ogden, Utah, the tremor shook a Utah and Great Northern Railroad train. Also reported felt at Salt Lake City, Utah, and Franklin, Idaho. (Ref. 52, 298.)

1905. Nov. 11. Near Shoshone, Lincoln County, Idaho. Cracks formed in the walls of the courthouse and schools in Shoshone, and plaster fell from ceilings in almost all the buildings. Felt from Salt Lake City, Utah, to Baker, Oreg. (Ref. 38.)

1913. Oct. 14. North-central Idaho. A tremor broke windows and dishes in the area of Idaho and Adams Counties. (Ref. 56.)

1916. May 13 (May 12). Boise, Idaho. The earthquake wrecked several brick chimneys at Boise and sent residents rushing into the street. The shock was described as "violent" at Emmett, 40 km north of Boise, and at Weiser, 96 km west of Boise. Reclamation ditches in the area were damaged. Pressure in a new gas well increased noticeably immediately after the shock. Also felt in western Montana and eastern Oregon. (Ref. 38, 272, 498.)

1924. Nov. 25. Near Wardboro, Franklin County, Idaho. A slight earthquake in Franklin County on this date broke windows at Wardboro, cracked ceilings at Montpelier, and displaced furniture at Geneva and Montpelier. (Ref. 38, 218.)

1944. July 12. Near Sheep Mountain, southwest Idaho. This earthquake apparently was most severe in the area of Fontez Creek, near Sheep Mountain, Idaho, where buildings were shaken so severely that occupants thought the structures were falling apart. A new cabin set on concrete piers was displaced on its foundation. Along Seafoam Creek, rocks and boulders were thrown down the hillside.

Cracks about 30.5 m long formed in the ground in the Duffield Canyon trail along Fontez Creek. Cracks 2.5 to 7.5 cm wide extended for several meters in a continuous break near Seafoam. A section of the Rapid River Canyon wall (near Lime Creek) fell into the river. Also felt in Montana, Oregon, and Washington (see fig. 26). Seventeen shocks were reported felt, the first of which was the strongest. (Ref. 17, 354.)

1945. Feb. 14 (Feb. 13). Idaho City, Boise County, Idaho. This tremor broke dishes at Idaho City and cracked plaster at Weiser, northwest of Boise in Washington County. Also felt in Montana, Oregon, and Washington. (Ref. 18, 354.)

1947. Sept. 25 (Sept. 24). Boise, Ada County, Idaho. Several large cracks formed in a well-constructed brick building at Boise, but damage generally was slight. (Ref. 20, 259.)

1957. Dec. 19 (Dec. 18). Northern Idaho. Timbers fell and mine walls collapsed at the Galena Silver mine near Wallace, Shoshone County. (Ref. 30, 38.)

1960. Aug. 7. Near Soda Springs, Caribou County, Idaho. Southeast of Pocatello and about 14 km east of Soda Springs, cracks formed in plaster and a concrete foundation at a ranch. (Ref. 33, 266.)

1963. Jan. 27. Clayton, Custer County, Idaho. Plaster and windows cracked at Clayton, northeast of Boise. Large boulders rolled down a hill at Livingston Camp, about 22 km south of Clayton. Several aftershocks were felt in the area. (Ref. 36, 354.)

1963. Sept. 11 (Sept. 10). Central Idaho. Plaster fell in buildings at Redfish Lake, south of Stanley in Custer County; a windowpane was broken at a fire station in Challis National Forest. (Ref. 36, 354.)

1969. Apr. 26. Ketchum, Blaine County, Idaho. Cracks formed in concrete floors of structures in Warm Springs and Ketchum. Plaster was cracked at Livingston Mill, 20 km south of Clayton. (Ref. 42, 354.)

1975. Mar. 28 (Mar. 27). Eastern Idaho. In the Ridgedale area of the sparsely populated Pocatello Valley, this earthquake shifted several ranch houses on their foundations and toppled many chimneys. At Malad City, 20 km northeast of the epicenter, about 40 percent of the chimneys on old buildings were damaged. Total property damage was estimated at $1 million.

Geologists observed one zone of ground fractures—about 0.6 km long and 5 cm wide—in the south-central section of the valley. The shock triggered many snow avalanches northeast of the valley. Fourteen aftershocks ranging in magnitude from 3.8 to 4.7 were located through Mar. 31. Felt in parts of Colorado, Idaho, Nevada, Utah, and Wyoming. (Ref. 48, 298.)

1977. Nov. 27. Cascade, Valley County, Idaho. Property damage was reported only at Cascade, a few kilometers east of the epicenter, near Cascade Dam. The tremor cracked foundations and sheetrock walls, separated ceiling beams, and left water muddy in wells and springs. Also felt in Oregon. (Ref. 39, 354.)

1978. Oct. 24. Southeast Idaho. Cracks formed in plaster and a concrete foundation at Thatcher in Franklin County. This earthquake was felt mainly in Bannock and Franklin Counties of southeast Idaho, and at Plymouth, Utah, south of Pocatello, Idaho. (Ref. 240.)

1982. Oct. 14 (Oct. 13). Near Soda Springs, Caribou County, Idaho. In the Soda Springs area, about 45 km southeast of Pocatello, bricks fell from chimneys and cracks formed in the foundation of a house and in interior drywalls. Also felt in Utah and Wyoming. (Ref. 350.)

1983. Oct. 28. Borah Peak, Custer County, Idaho. The Borah Peak earthquake is the largest ever

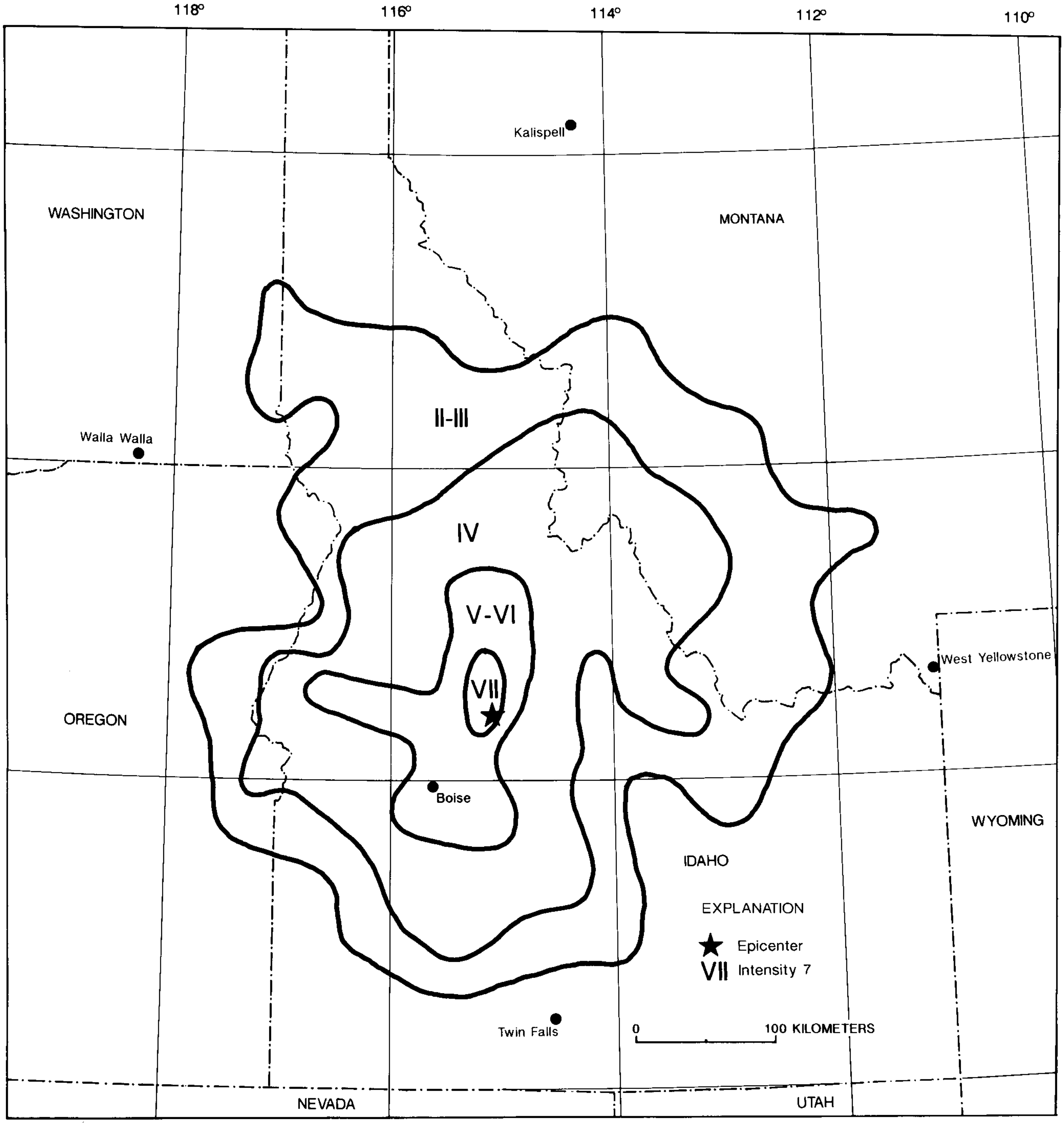


FIGURE 26.—Isoseismal map for the southwest Idaho earthquake of July 12, 1944. Isoseismals are based on intensity estimates from data listed in references 17 and 259 of table 1.

recorded in Idaho—both in terms of magnitude and in amount of property damage. It caused two deaths in Challis, about 200 km northeast of Boise, and an estimated $12.5 million in damage in the Challis-Mackay area. A maximum MM intensity IX was assigned to this earthquake on the basis of surface faulting. Vibrational damage to structures was assigned intensities in the VI to VII range (see fig. 27.)

Spectacular surface faulting was associated with this earthquake—a 34-km-long northwest-trending zone of fresh scarps and ground breakage on the southwest slope of the Lost River Range. The most

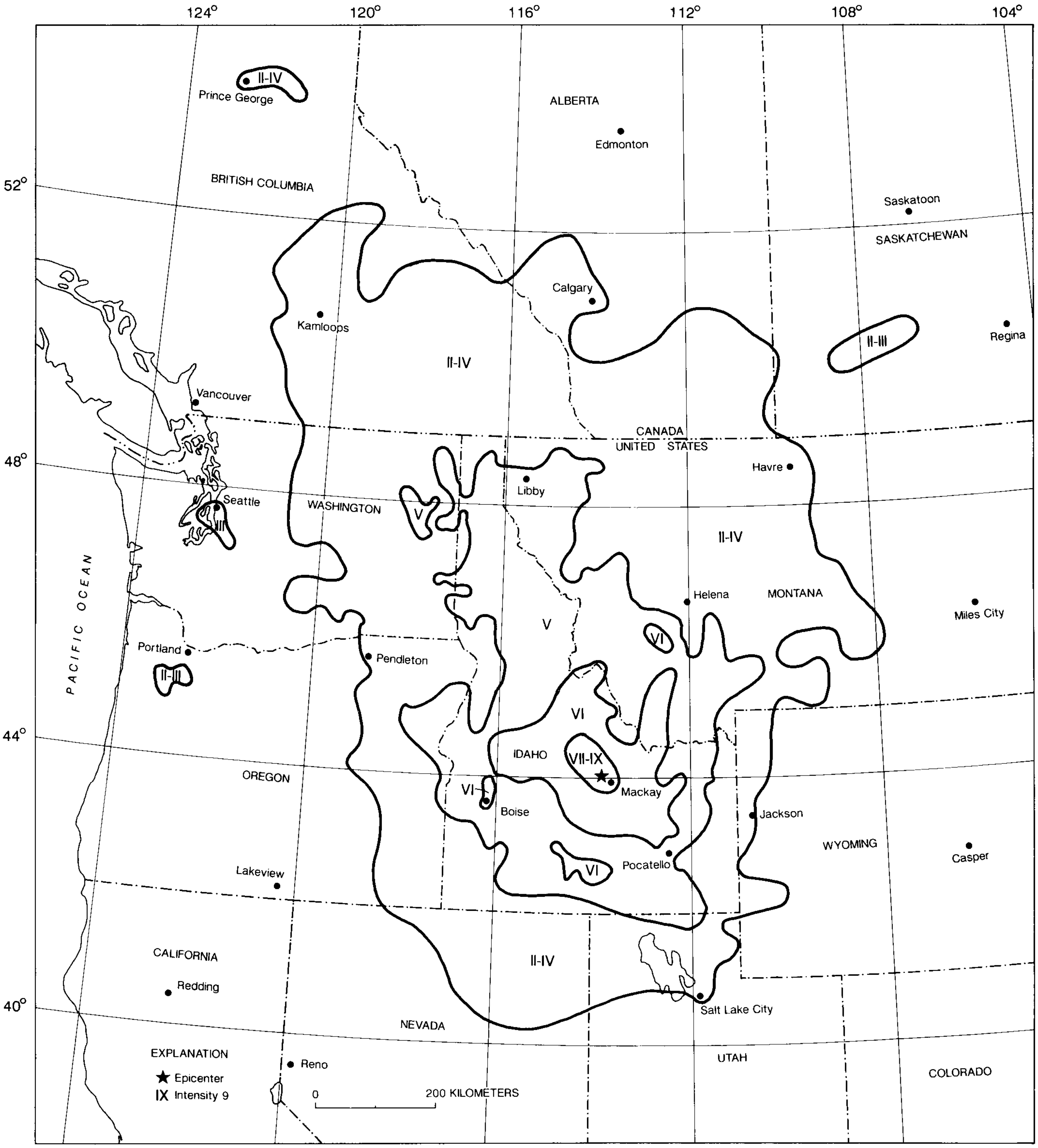
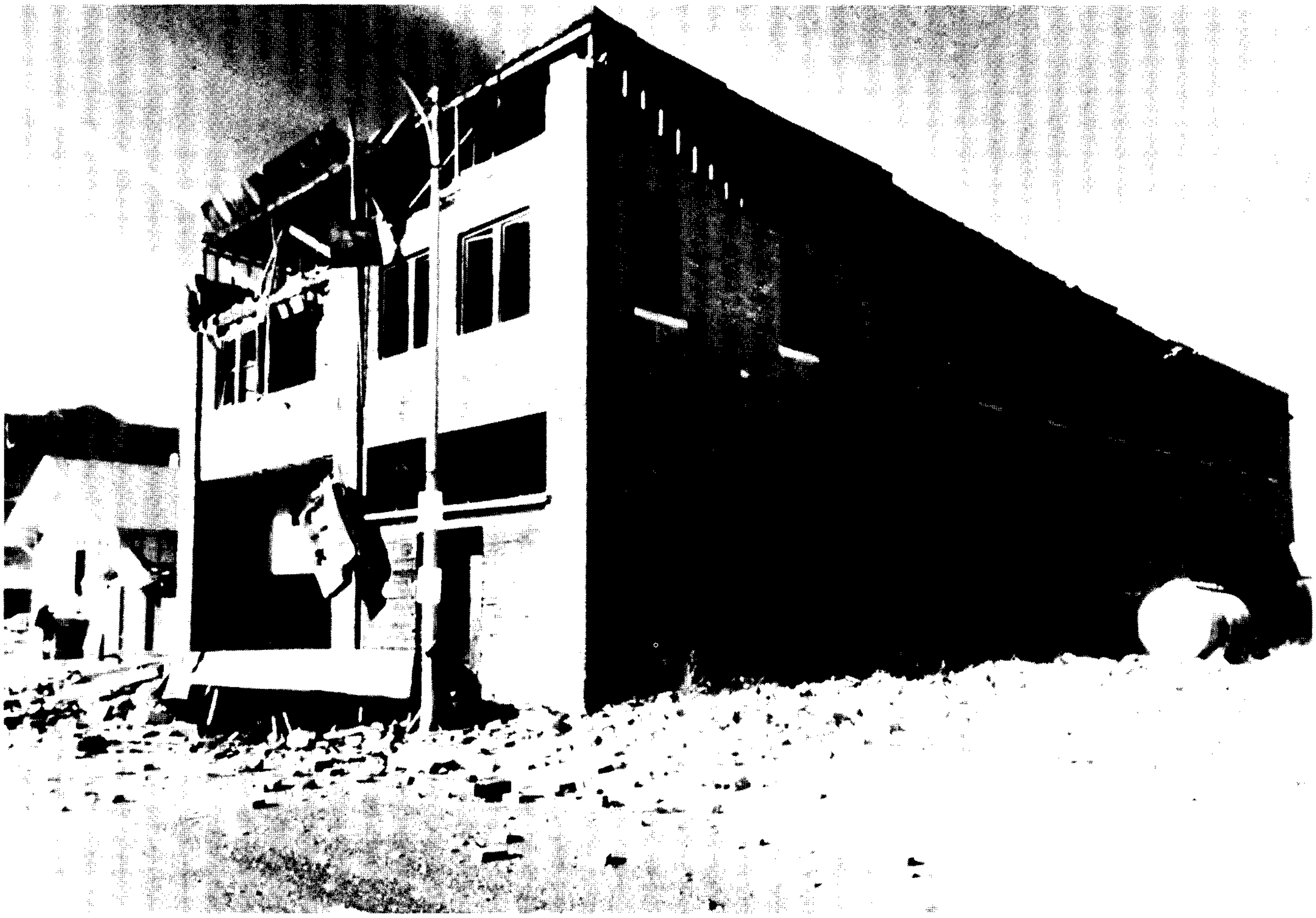


FIGURE 27.—Isoseismal map for the Borah Peak, Idaho, earthquake of October 28, 1983. This map is a simplified version of figure 28 in reference 360 of table 1.

extensive breakage occurred along the 8-km zone between West Spring and Cedar Creek. Here, the ground surface was shattered into randomly tilted blocks several meters in width. The ground breakage was as wide as 100 m and commonly had four to eight en echelon scarps as high as 1–2 m. The throw

Fault scarp more than 1.8 m in height, northwest of Mackay, Idaho, caused by the October 28, 1983, earthquake.



Brick walls of the old Custer Hotel, in Mackay, Idaho, damaged by the October 28, 1983, earthquake. (Photograph by the Idaho Falls, Idaho, Post-Register.)

on the faulting ranged from < 50 cm on the southernmost section to 2.7 m south of Rock Creek at the western base of Borah Peak.

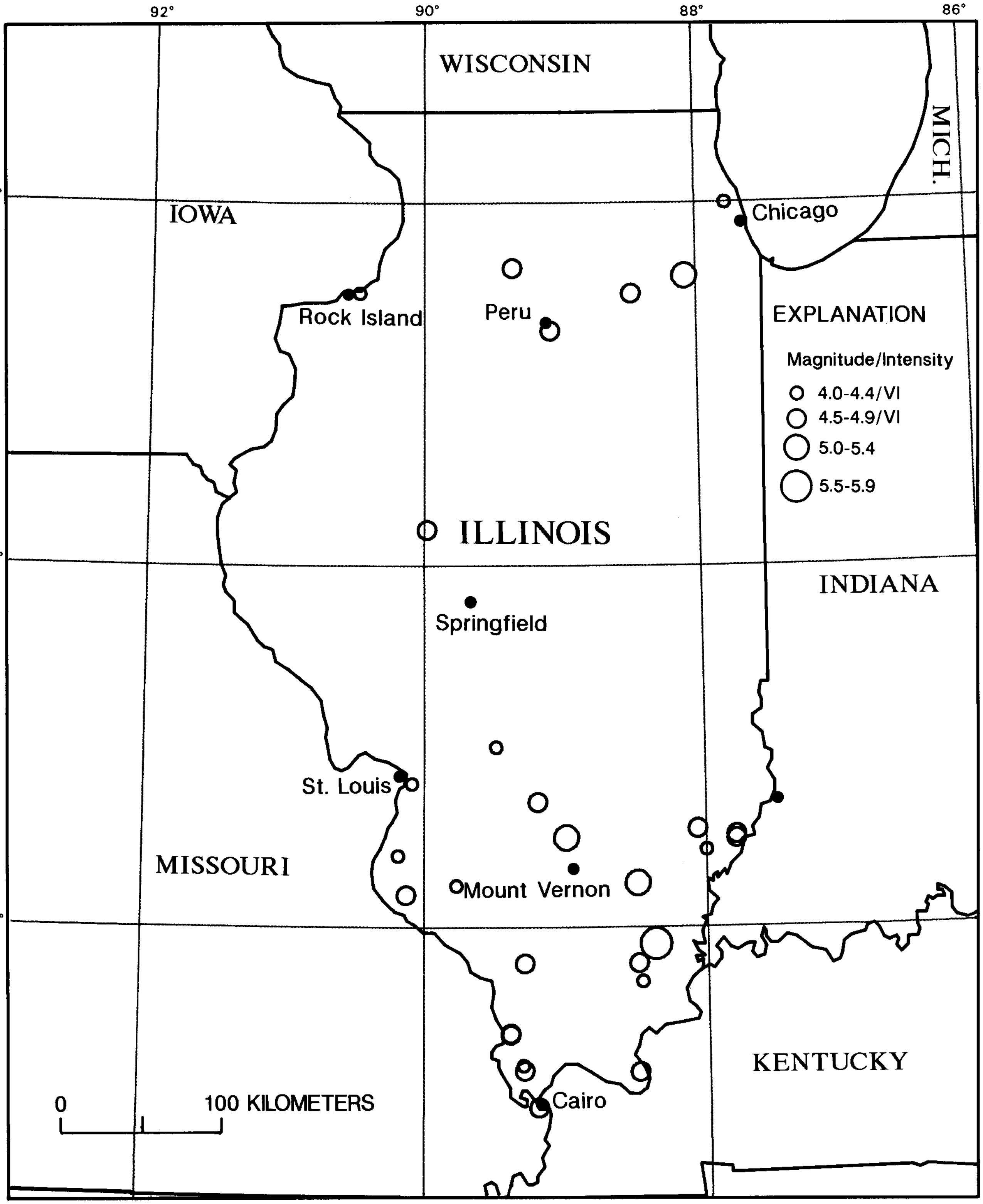
Other geologic effects included rockfalls and landslides on the steep slopes of the Lost River Range, water fountains and sand boils near the geologic feature of Chilly Buttes and the Mackay Reservoir, increase or decrease in flow of water in springs, and fluctuations in well water levels. A temporary lake was formed by the rising water table south of Dickey.

The most severe property damage occurred in the towns of Challis and Mackay, where 11 commercial buildings and 39 private houses sustained major damage and 200 houses sustained minor to moderate damage.

At Mackay, about 80 km southeast of Challis, most of the commercial structures on Main Street were damaged to some extent; building inspectors condemned eight of them. Damaged buildings were mainly of masonry construction, including brick, concrete block, or stone. Visible damage consisted of severe cracking or partial collapse of exterior walls, cracking of interior walls, and separation of ceilings and walls at connecting corners. About 90 percent of the residential chimneys were cracked, twisted, or collapsed.

At Challis, less damage to buildings and chimneys was sustained, but two structures were damaged extensively: the Challis High School and a vacant concrete-block building (100 years old) on Main Street. Many aftershocks occurred through 1983. Also felt in parts of Montana, Nevada, Oregon, Utah, Washington, Wyoming, and in the Provinces of Alberta, British Columbia, and Saskatchewan, Canada. (Ref. 354, 360, 608.)

ILLINOIS



Earthquakes in Illinois with magnitudes ≥ 4.5 or intensity ≥ VI.

ILLINOIS

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km²)
1804	08	20	20 10	42.0 N	87.8 W	—	105	—	—	$4.40M_{fa}$ SC	—	VI	105	78
1838	06	09	14 45	38.5 N	89.0 W	—	113	—	—	$5.20M_{fa}$ SC	—	VII	113	500
1857	10	08	10 00	38.7 N	89.2 W	—	113	—	—	$4.90M_{fa}$ SC	—	VII	113	200
1876	09	25	06	38.5 N	87.8 W	—	105	—	—	$4.50M_{fa}$ SC	—	VI	105	150
1876	09	25	06 15	38.5 N	87.8 W	—	353	—	—	$4.80M_{fa}$ SC	—	VII	529	150
1881	05	27		41.3 N	89.1 W	—	105	—	—	$4.60M_{fa}$ SC	—	VI	105	181
1882	09	27	10 20	39.0 N	89.5 W	—	113	—	—	$4.40M_{fa}$ SC	—	VI	38	100
1883	04	12	08 36	37.0 N	89.2 W	—	38	—	—	—	—	VI	173	—
1887	08	02	18 36	37.2 N	88.5 W	—	529	—	—	$4.90M_{fa}$ SC	—	VI	529	450
1891	09	27	04 55	38.25 N	88.50 W	—	302	—	—	$5.20M_{fa}$ SC	—	VII	302	560
1903	02	09	00 21	37.8 N	89.3 W	—	105	—	—	$4.90M_{fa}$ SC	—	VII	529	202
1905	08	22	05 08	37.2 N	89.3 W	—	529	—	—	$4.80M_{fa}$ SC	—	VI	529	375
1909	05	26	14 42	41.6 N	88.1 W	—	529	—	—	$5.10M_{fa}$ SC	—	VII	38	430
1909	07	19	04 34	40.2 N	90.0 W	—	38	—	—	$4.80M_{fa}$ SC	—	VII	38	121
1912	01	02	16 21	41.5 N	88.5 W	—	38	—	—	$4.50M_{fa}$ SC	—	VI	38	150
1917	04	09	20 52	38.1 N	90.2 W	—	113	—	—	$5.10M_{fa}$ SC	—	VII	529	408
1922	03	22	22 29 10	37.4 N	89.4 W	—	529	—	—	$4.80M_{fa}$ SC	—	VII	529	135
1922	03	23	02 22	37.4 N	89.4 W	—	529	—	—	$4.60M_{fa}$ SC	—	VI	529	175
1922	11	27	03 31	37.8 N	88.5 W	—	105	—	—	$4.80M_{fa}$ SC	—	VII	529	130
1934	11	12	14 45	41.5 N	90.5 W	—	149	—	—	$4.00M_{fa}$ SC	—	VI	38	13
1939	11	23	15 14 52.0	38.180N	90.137W	000	349	—	—	$4.60M_{fa}$ SC	—	V	38	440
1947	06	30	04 23 53	38.4 N	90.2 W	—	20	—	—	$4.20M_{fa}$ SC	—	VI	38	40
1953	09	11	18 26 28	38.8 N	90.1 W	—	105	—	—	$4.00M_{fa}$ SC	—	VI	26	15
1955	04	09	13 01 23.3	38.232N	89.785W	011	349	—	—	$4.30M_{fa}$ SC	—	VI	28	54
1958	11	08	02 41 12.6	38.436N	88.008W	005	349	—	—	$4.40M_{fa}$ SC	—	VI	31	75
1965	08	14	13 13 56.9	37.226N	89.307W	001	349		—	$3.80M_n$ SLM	3.44STT	VII	75	1
1968	11	09	17 01 40.5	37.911N	88.373W	021	349	5.3	—	$5.50M_n$ SLM	5.27HRN	VII	490	1473
1972	09	15	05 22 15.9	41.645N	89.369W	011	349	3.7	—	$4.50M_n$ DG	4.03STT	VI	45	230
1974	04	03	23 05 02.8	38.549N	88.072W	014	349	4.5	—	$4.70M_n$ DG	4.36STT	VI	47	400
1984	06	29	07 58 29.3	37.700N	88.470W	002	370	—	—	$4.10M_n$ GS	—	VI	370	7
1987	06	10	23 48 54.8	38.713N	87.954W	010	74	4.9	5.1	$5.20M_n$ SLM	4.96JOH	VI	592	433

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1804. Aug. 20. Fort Dearborn (Chicago), Ill. The earthquake was felt at the south end of Lake Michigan and at Fort Wayne, Ind. (about 320 km from the epicenter). (Ref. 38, 105, 353.)

1838. June 9. Southern Illinois. Several catalogs place the epicenter of this earthquake near St. Louis, Mo., because of a report of a chimneys being thrown down at St. Louis and because it was "severely felt" at St. Charles, Mo. Although reported effects do not support an intensity of VII, that intensity is assigned because of the similarity of the distribution of intensity to that of the earthquake of Oct. 8, 1857. Felt reports recorded at common points are one-half to one unit of intensity higher for the 1857 earthquake. Also felt in Illinois, Indiana, and Kentucky. Magnitude M_S 5.7 M_{fa} BAR. (Ref. 113, 353, 529.)

1857. Oct. 8. Southern Illinois. This severe earthquake was centered in the Mississippi River valley between St. Louis, Mo., and Centralia, Ill. At Centralia, the first of three reported shocks threw down chimneys; at St. Louis, it moved furniture, dislocated bricks, and felled plaster. The largest buildings rocked and articles fell from mantles. Reports indicate that the Mississippi River was in tumult. Felt in many towns in Illinois, along the Mississippi River south of Hannibal, Mo., in western Kentucky, and in parts of Indiana and Iowa. (Ref. 105, 109, 113, 353, 529.)

1876. Sept. 25, 06 and 06 15 UTC. Wabash River valley. These earthquakes were felt most strongly between Friendsville and Mt. Carmel, Ill., and Evansville, Ind. They were described as "heavy" at Friendsville. The second shock threw down chimneys at Vincennes, Ind., alarmed residents at Evansville, Ind., and caused slight damage at Louisville and Owensboro, Ky. They were felt from St. Louis, Mo., to Indianapolis, Ind., and Louisville, Ky. (Ref. 38, 105, 353, 463, 529.)

1881. May 27. La Salle, Ill. Before daybreak, a shock in the southwest part of La Salle, about 90 km northeast of Peoria, formed six parallel fissures that were traceable for 183 m in a northwest-southeast direction. Walls, foundations, and furnaces in bottle and glass factories cracked in many places. (Ref. 105, 463.)

1882. Sept. 27. Southern Illinois. A chimney was cracked severely at Greenfield, Green County, Ill., and a crack in the wall of a building was widened considerably at Salem, Marion County. People were awakened and small objects were displaced throughout the area. The felt area extended from Mexico, Mo., to Vincennes, Ind., and Henderson, Ky., in an east-west direction, and from Springfield to Pickneyville, Ill., in a north-south direction. (Ref. 38, 113, 353, 463.)

1883. Apr. 12. Cairo, Pulaski County, Ill. A strong local earthquake rattled windows for 30 seconds and awakened everyone in Cairo, in southern Illinois near the Kentucky-Missouri border. People were injured slightly in the collapse of an old frame house. (Ref. 38, 105, 173, 463.)

1887. Aug. 2. Southern Illinois. This severe shock broke windows at Cobden, Ill., cracked brick walls at Jonesboro, Ill., and Russellville, Ky., and loosened some plaster at Nashville, Tenn. Also felt in Indiana and Missouri and as far south as Huntsville, Ala. Magnitude 4.7 M_{fa} BAR. (Ref. 38, 529.)

1891. Sept. 27 (Sept. 26). Near Mount Vernon, Jefferson County, Ill. Several chimneys were toppled at Mount Vernon, and the ceiling and sidewalls of the Methodist Church were damaged. Chimney damage also was reported at Browns and Nashville, Ill., and Cloverport, Ky. Plaster was knocked down at Jerseyville, Murphysboro, and Warsaw, Ill. Also felt in all or parts of Indiana, Iowa, Kentucky, Missouri, Ohio, and Tennessee (see fig. 28). Magnitude 5.8 m_b BAR. (Ref. 302, 353, 529.)

1903. Feb. 9 (Feb. 8). Mississippi River valley. This earthquake threw down chimneys in Jackson County at Grand Tower and Murphysboro, Ill., and damaged chimneys east of Murphysboro, at Carterville and Harrisburg, Ill. It was strongly felt from Jeffersonville, Mo., to Louisville, Ky., and from Cairo, Ill., to Hannibal, Mo. (Ref. 38, 105, 353, 529.)

1905. Aug. 22 (Aug. 21). Southern Illinois. Chimneys were shaken down at Cairo, Pulaski County, Ill., and, about 40 km southwest, at Sikeston, Mo. Chimneys also were broken or partly collapsed at nearby Charleston, Mo., and, about 175 km southeast, at Clarksville, Tenn. The earthquake was felt most strongly along the Mississippi and Ohio River valleys, including parts of Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri, and Tennessee (Ref. 109, 353, 529.)

1909. May 26. Aurora, Kane County, Ill. This earthquake has been related to the La Salle anticline in the Illinois Basin. Many chimneys fell, a stove overturned, and gas line connections broke at Aurora, west of Chicago. Several chimneys were downed at Forreston, Naperville, Streator, Triumph, and Troy Grove, and one fell at Waukegan. Brick walls cracked at Bloomington, and sidewalks cracked and many chimneys were damaged at Freeport. At Platteville, Wis., about 130 km northwest of Chicago, an old building was cracked; houses were jostled out of plum at Beloit, Wis., about 240 km northwest of Chicago. Felt from Missouri to Michigan and Minnesota to Indiana. Magnitude 5.1 M_{fa} BAR. (Ref. 38, 105, 353, 529.)

1909. July 19 (July 18). Between Havana and Petersburg, Ill. Chimneys were demolished on more than 100 buildings in Menard County at Petersburg, northwest of Springfield. At a farm west of Petersburg, 20 windows broke and bricks pushed out above the doors. Fallen chimneys also were reported northwest of Springfield at Davenport, Iowa, and west of Springfield at Hannibal, Mo. Several newspaper articles describe this earthquake but do not report property damage. (Ref. 38, 105, 353, 529.)

1912. Jan. 2. Near Aurora, Freeport, Morris, and Yorkville, Ill. The highest intensity was reported at those towns in Kane, Stephenson, Grundy, and Kendall Counties, respectively. Slight damage to chimneys was reported at Batavia and Geneva, Ill., north of Aurora, in Kane County. Two distinct shocks were observed at some places. The stronger shock also was felt in parts of Indiana, Iowa, Kentucky (Fulton County), and Wisconsin. (Ref. 38, 105, 353, 529.)

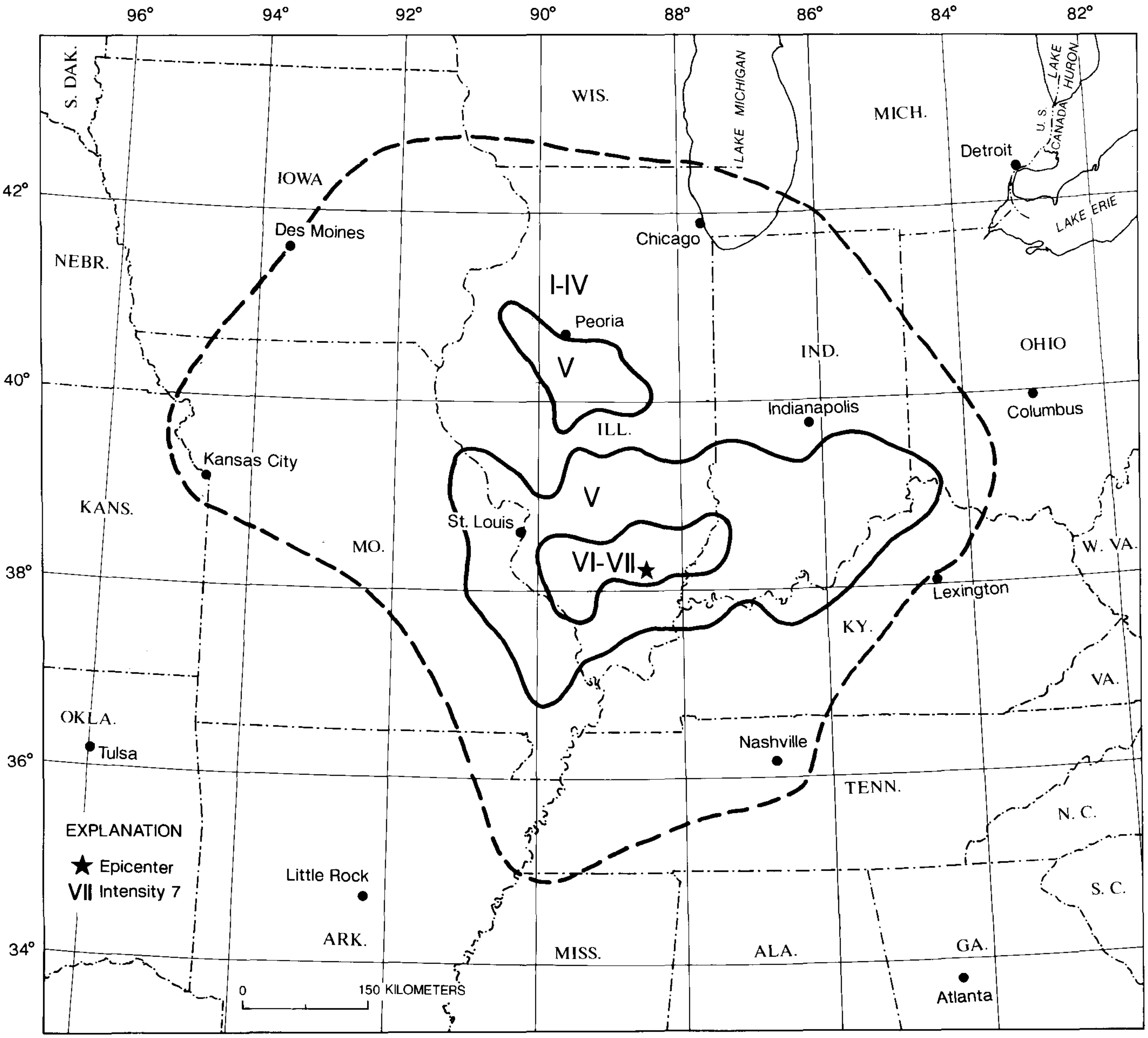


FIGURE 28.—Isoseismal map for the southern Illinois earthquake of September 27, 1891. Isoseismals are based on intensity estimates from data listed in references 302 and 529 of table 1.

1922. Mar. 22. Southern Illinois. This strong earthquake knocked down 25 chimneys at Illmo, Scott County, Mo., and sent people rushing out of stores. Dishes fell from shelves at Carbondale, Ill. Also felt in Kentucky and Tennessee. (Ref. 529.)

1922. Mar. 23 (Mar. 22). Southern Illinois. At Illmo, Mo., south of Cape Girardeau in Scott County, the earthquake knocked down "many more chimneys" (see above description of the main shock on Mar. 22). The shock was "violent" at Belleville, Ill., and "severe" at Jonesboro, Ill. Stovepipes were downed at Cape Girardeau, Mo., and people were knocked off their feet. Also felt at Evansville, Ind. (Ref. 529.)

1917. Apr. 9. Southern Illinois in the Mississippi River valley. At St. Louis, Mo., several chimneys were knocked down, windows were broken, and people were thrown to the pavement. At Granite City, Mo., buildings shifted on their foundations. At DeSoto, Mo., in Jefferson County, bricks fell from chimneys and the walls of several buildings were cracked. Many windows were broken and buildings rocked at Ste. Genevieve and St. Mary, Mo., south of St. Louis near the Illinois border. Heavy rumbling preceded and accompanied the earthquake in places. Felt from Kansas to Ohio and from Wisconsin to Mississippi (see fig. 29). (Ref. 38, 113, 353, 529.)

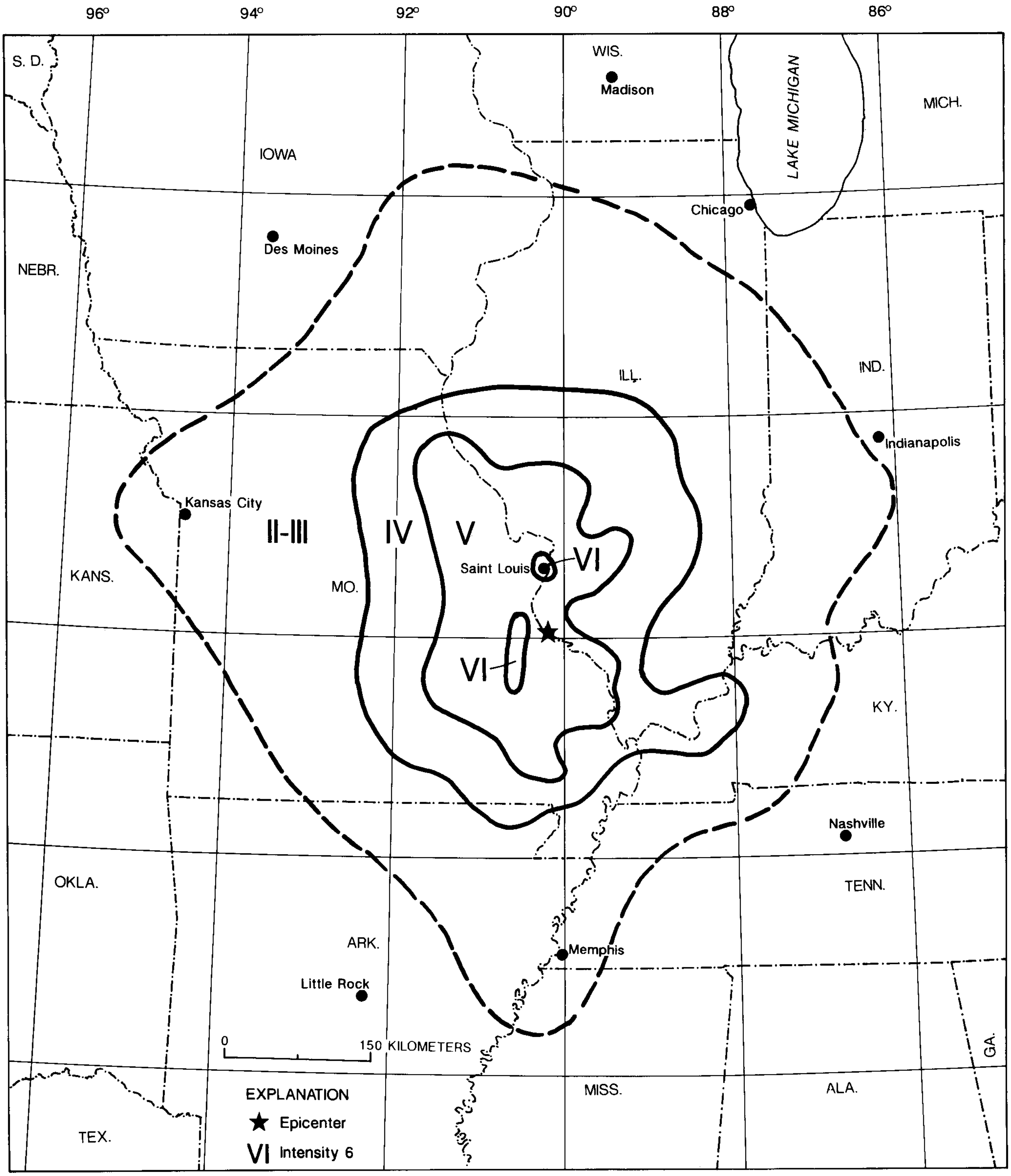


FIGURE 29.—Isoseismal map for the southern Illinois earthquake of April 9, 1917. Isoseismals are based on intensity estimates from data listed in references 272 and 529 of table 1.

1922. Nov. 27 (Nov. 26). Near Eldorado, Saline County, Ill. The earthquake broke several windows and downed chimneys at Eldorado. One chimney flue was demolished and stovepipes fell at Harrisburg, 8 km southwest of Eldorado. Generally felt in southern Illinois, western Indiana, northern

Kentucky, eastern Missouri, and western Tennessee. (Ref. 105, 109, 353, 529.)

1934. Aug. 20 (Aug. 19). Mississippi River valley near the Illinois-Missouri border. In the area near Charleston, Mississippi County, Mo., chimneys were thrown down or lost bricks, windows were broken, and plaster was cracked. Destructive intensity covered an area of 600 km^2, including Charleston, Mo., Arlington and Wickliffe, Ky., and Cairo and Mounds, Ill. Felt north to Alton, Ill.; east to Paducah and Marion, Ky.; south to Paris and Ripley, Tenn., and Corning and Paragould, Ark.; and west to Poplar Bluff and Greeneville, Mo. (Ref. 7, 38, 149, 149, 353.)

1934. Nov. 12. Near Rock Island, Ill. In Rock Island and Moline, Ill., and Davenport, Iowa, bricks fell from a few chimneys and pendulum clocks stopped. In Rock Island, a stucco cornice was dislodged from St. Joseph's School; some loose plaster was shaken from ceilings in the men's dormitory at Augustana College, and loose bricks were shaken from a few buildings. (Ref. 7, 38, 129, 149, 353.)

1947. June 30 (June 29). Waterloo-Dupo, Ill., area, south of St. Louis, Mo. At St. Louis, several chimneys were toppled and a sidewalk was cracked. (Ref. 20, 38, 105, 353.)

1953. Sept. 11. Southwest Illinois. At Roxana, north of East St. Louis, in Madison County, cracks formed in a concrete-block foundation and in plaster. Also felt in eastern Missouri. (Ref. 26, 105, 353.)

1955. Apr. 9. West of Sparta, Randolph County, Ill. Concrete foundations and plaster walls were cracked at Evansville, Ill. (about 20 km west of Sparta), and at Lemay, University City, and Webster Groves, Mo. Also felt in Kentucky and Missouri. Magnitude 4.5 M_{fa} BAR. (Ref. 28, 349, 353.)

1958. Nov. 8 (Nov. 7). Southeast Illinois, near the Indiana border. Plaster fell at Dale (Hamilton County) and Albion (Edwards County), and a basement wall cracked at Maunie (White County). Also felt in Indiana, Kentucky, and Missouri. Magnitude 4.5 M_{fa} BAR. (Ref. 31, 38, 105, 349, 353.)

1965. Aug. 14. Southwest Illinois. This strong local earthquake at Tamms (Alexander County) downed chimneys, cracked walls, muddied water, and knocked stock from shelves. (Ref. 75, 349, 353.)

1968. Nov. 9. Southern Illinois. This was the strongest felt earthquake in southern Illinois since the 1895 Missouri event. Property damage in the area consisted mainly of fallen bricks from chimneys, broken windows, toppled television aerials, and cracked or fallen plaster. In the epicentral area, near Dale, Hamilton County, MM intensity VII was characterized by downed chimneys, cracked foundations, overturned tombstones, and scattered instances of collapsed parapets.

Most buildings that sustained damage to chimneys were 30 to 50 years old. A large two-story brick house near Dale, Ill., sustained several thousand dollars damage. About 10 km west of Dale, near Tuckers Corners, a concrete and brick cistern collapsed. A large amount of masonry damage occurred at the City Building at Henderson, Ky., 80 km east-southeast of the epicenter. Moderate damage to chimneys and walls occurred in several towns in south-central Illinois, southwest Indiana, and northwest Kentucky. Felt over all or parts of 23 States (see fig. 30): from southeast Minnesota to central Alabama and Georgia and from western North Carolina to central Kansas. People in multistory buildings in Boston, Mass. and southern Ontario, Canada, felt the earthquake. Magnitude 5.2 M_S NTT, 5.5 m_b NUT, 5.38 M JOH (Ref. 41, 263, 349, 353, 490.)

1972. Sept. 15 (Sept. 14). Northern Illinois. Cracks in chimneys, tombstones, elevated water tanks, and plaster occurred at Amboy (Lee County), south of Rockford. Chimney and plaster cracks were observed at Holcomb, northeast of Amboy, in Ogle County. Also felt in Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. Magnitude 3.3 M_S NTT, 4.4 m_b NUT. (Ref. 45, 263, 349, 353.)

1974. Apr. 3. Southeast Illinois. Minor damage, generally in the form of cracked and broken chimneys, occurred in Wabash County. At West Salem, a few chimneys and tombstones were shaken down and other chimneys were damaged. Slight damage occurred at many towns in Indiana and Illinois. Also felt in Arkansas, Iowa, Kentucky, Michigan, Missouri, Ohio, Tennessee, Virginia, and Wisconsin. Magnitude 4.7 M_n SLM. (Ref. 47, 349, 353.)

1984. June 29. Southern Illinois. At Harrisburg, in Saline County, one house sustained structural damage. Also felt in western Kentucky and southeast Missouri. Magnitude 3.8 M_n SLM. (Ref. 370.)

1987. June 10. Near Olney, Richland County, Ill. Minor damage in the form of cracks in chimneys, hairline cracks in plaster and drywall, and cracks in house foundations was reported in

City Building in Henderson, Kentucky, damaged by the November 9, 1968, southern Illinois earthquake. (Photograph by the Gleaner Journal.)

several towns in Illinois and Indiana. The most serious damage was observed at Olney, Ill., where chimneys toppled and bricks fell from chimneys; at West York, Ill. (about 60 km northeast of Olney), where chimneys were broken at their rooflines; at Evansville, Ind. (about 100 km southeast of Olney), where underground pipes were damaged and large cracks formed in sidewalks and streets; and at Louisville, Ky. (about 200 km southeast of Olney), where one downed chimney and widespread minor damage were reported.

Felt over a large area of the United States, including all or parts of 17 States—from Illinois east to Pennsylvania and West Virginia, west to Kansas and Nebraska, south to Alabama and Georgia, and north to Minnesota, Wisconsin, and southern Ontario, Canada. This was the largest earthquake in the area in 19 years—since Nov. 9, 1968. (Ref. 74, 577, 583, 592.)

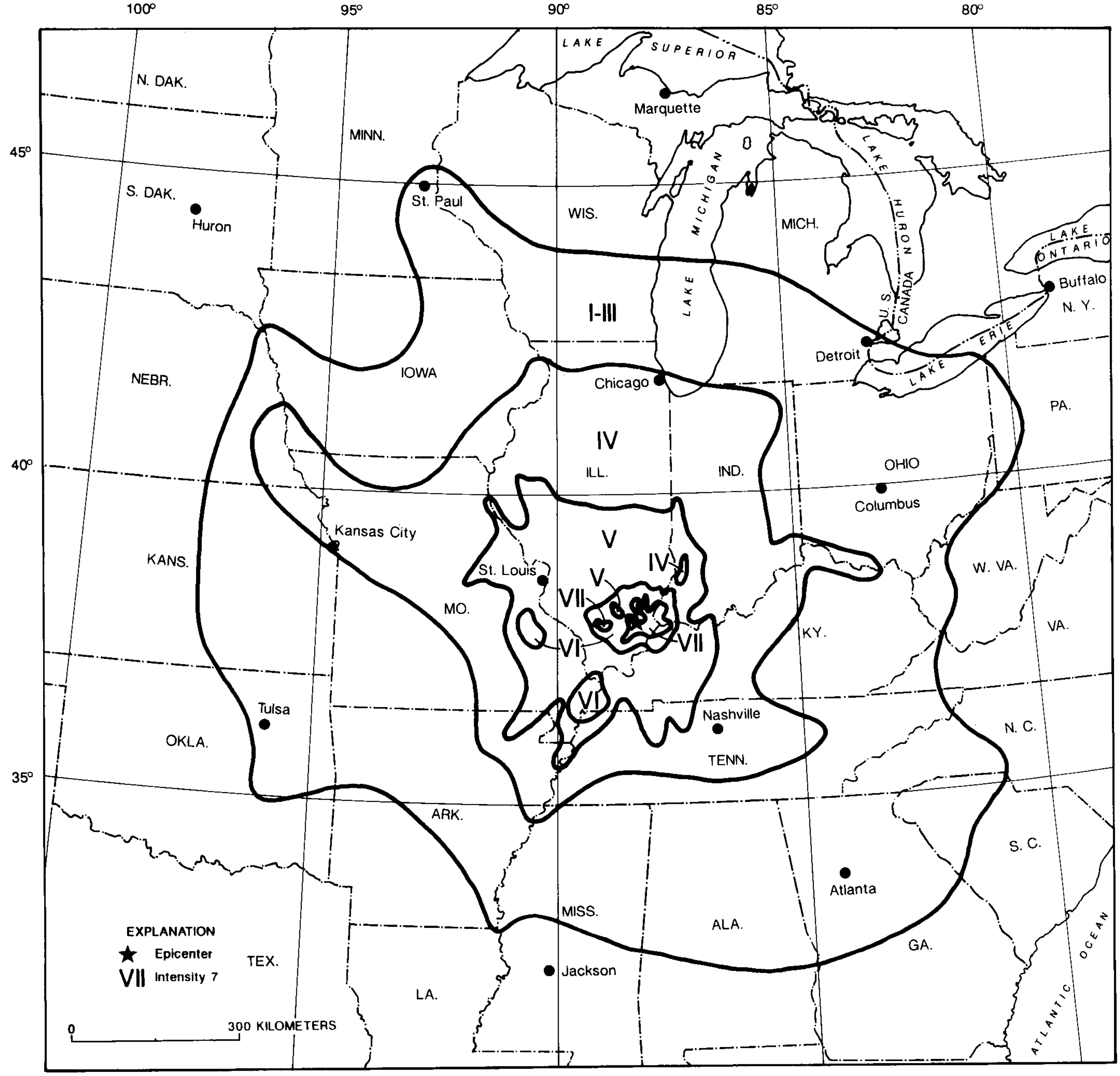
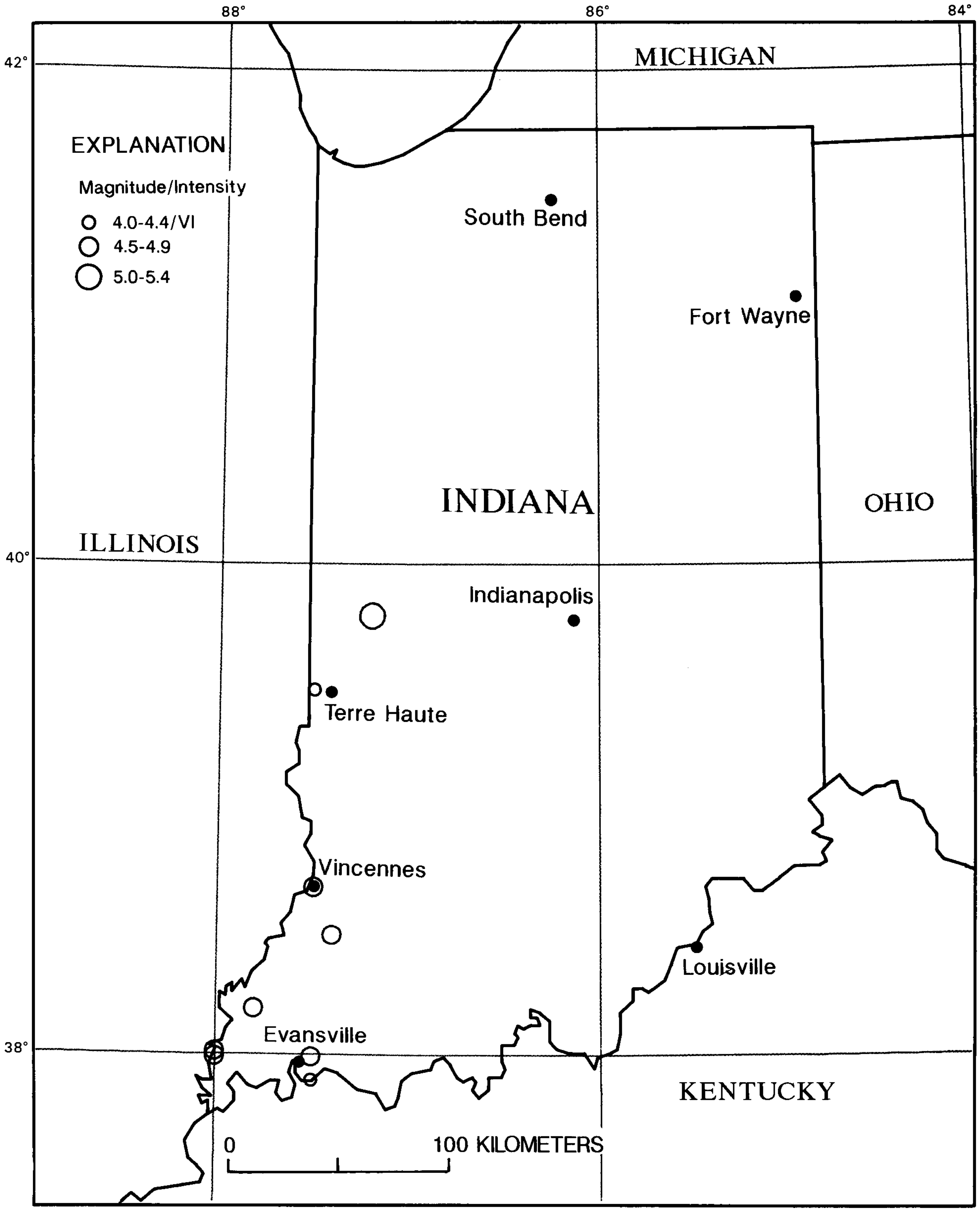


FIGURE 30.—Isoseismal map for the southern Illinois earthquake of November 9, 1968. This map is a simplified version of figure 3 in reference 490 of table 1.

INDIANA



Earthquakes in Indiana with magnitudes ≥ 4.5 or intensity ≥ VI.

INDIANA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter						Magnitude				Intensity		Felt area
				Latitude		Longitude		Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)		(°)		(km)		m_b	M_S		M			(1,000 km²)
1827	07	05	11 30	38.0	N	87.5	W	—	529	—	—	$4.80M_{fa}$ SC	—	VI	353	430
1827	08	07	04 30	38.0	N	88.0	W	—	529	—	—	$4.80M_{fa}$ SG	—	V	529	—
1827	08	07	07	38.0	N	88.0	W	—	105	—	—	$4.70M_{fa}$ BAR	—	V	105	—
1887	02	06	22 15	38.7	N	87.5	W	—	38	—	—	$4.60M_{fa}$ SC	—	VI	529	170
1891	07	27	02 28	37.9	N	87.5	W	—	38	—	—	$4.10M_{fa}$ SC	—	VI	38	22
1899	04	30	02 05	38.5	N	87.4	W	—	529	—	—	$4.90M_{fa}$ SC	—	VII	38	179
1909	09	27	09 45	39.8	N	87.2	W	—	529	—	—	$5.10M_{fa}$ SC	—	VII	38	377
1921	03	14	12 15	39.5	N	87.5	W	—	113	—	—	$4.40M_{fa}$ SC	—	VI	529	89
1925	04	27	04 05	38.2	N	87.8	W	—	529	—	—	$4.80M_{fa}$ SC	—	VI	67	325

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1827. July 5. Near New Harmony, Posey County, Ind. The earthquake cracked a brick store at New Harmony, Ind., and "greatly alarmed" some people. It was described as violent at New Madrid, Mo., and severe at St. Louis. It also alarmed many at Cincinnati, Ohio, and Frankfort, Ky. Magnitude 4.8 M_{fa} BAR. (Ref. 105, 353, 529.)

1887. Feb. 6. Near Vincennes, Knox County, Ind. This shock was strongest in southwest Indiana and southeast Illinois. Plaster was shaken from walls at Vincennes, Ind., and west of Terre Haute, at Martinsville, Ill.; a cornice reportedly fell from a building at Huntington, Ind. It was felt distinctly at Evansville, Ind., but only slightly in the outskirts of St. Louis, Mo. Also reported felt at Louisville, Ky. (Ref. 38, 105, 353, 529.)

1891. July 27 (July 26). Evansville, Vanderburgh County, Ind. A strong local earthquake damaged a wall on a hotel, broke dishes, and overturned furniture at Evansville. The shock also was strong near Evansville at Mount Vernon and Newburgh, Ind., and at Hawesville, Henderson, and Owensboro, Ky. Magnitude 3.8 M_{fa} BAR. (Ref. 38, 105, 529.)

1899. Apr. 30 (Apr. 29). Near Vincennes, Knox County, Ind. Brick walls cracked and several chimneys fell at Vincennes, and the tops of many chimneys were shaken down at Princeton in Gibson County. Toppled chimneys also were reported at Greencastle, Putnam County, northeast of Terre Haute. The shock was "heavy" at Jeffersonville, near Louisville, Ky. Also felt in Illinois and Kentucky. Magnitude 4.6 M_{fa} BAR. (Ref. 38, 105, 353, 529.)

1909. Sept. 27. Wabash River valley, between Terre Haute and Vincennes, Ind. At Terre Haute (Vigo County), two chimneys were thrown down, plaster was cracked, and pictures were shaken from walls. At Covington, north of Terre Haute in Fountain County, a few chimneys were downed and windows were broken. Chimneys were "jarred loose" south of Vincennes at Princeton, Ind., one chimney was shaken to pieces at Olivette, Mo. (a suburb of St. Louis), and a brick wall was shaken down at St. Louis, Mo. Also reported felt in Arkansas, Illinois, Iowa, Kentucky, Ohio, and Tennessee (see fig. 31). Magnitude 4.8 M_{fa} BAR. (Ref. 38, 105, 353, 529.)

1921. Mar. 14. Near Terre Haute, Vigo County, Ind. This earthquake broke windows in many buildings and sent residents rushing into the streets at Terre Haute. Small articles were overturned at Paris, Ill., about 35 km northwest of Terre Haute. Magnitude 4.4 M_{fa} BAR. (Ref. 113, 529.)

1925. Apr. 27 (Apr. 26). Wabash River valley, near Princeton, Gibson County, Ind. Chimneys were downed at Princeton and at Carmi, Ill., 100 km southwest; chimneys were "broken" at Louisville, Ky. Crowds fled from the theatres at Evansville, Ind. The felt area includes parts of Indiana, Illinois, Kentucky, Missouri, and Ohio. Magnitude 4.8 M_{fa} BAR. (Ref. 67, 105, 218, 353, 529.)

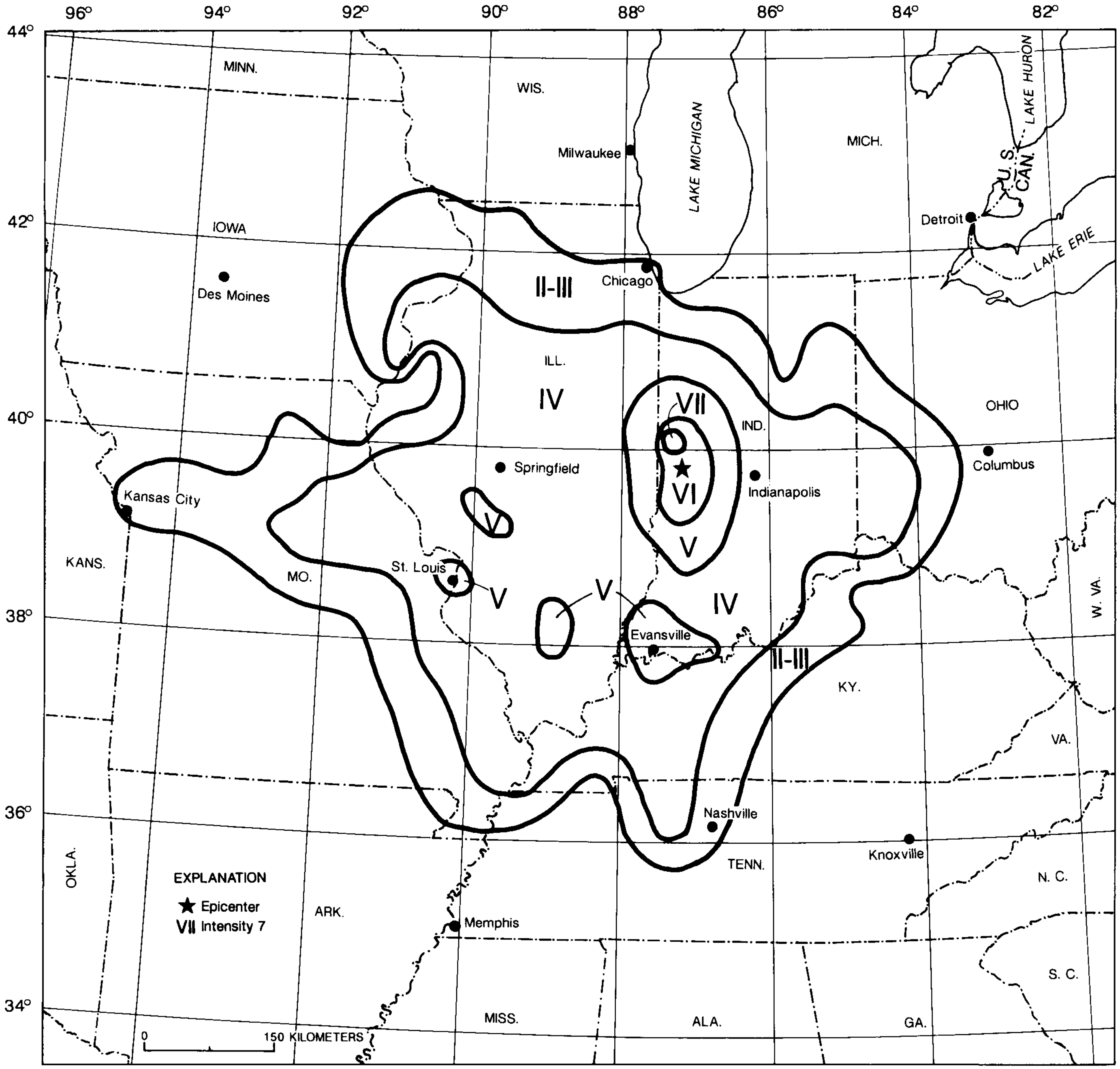
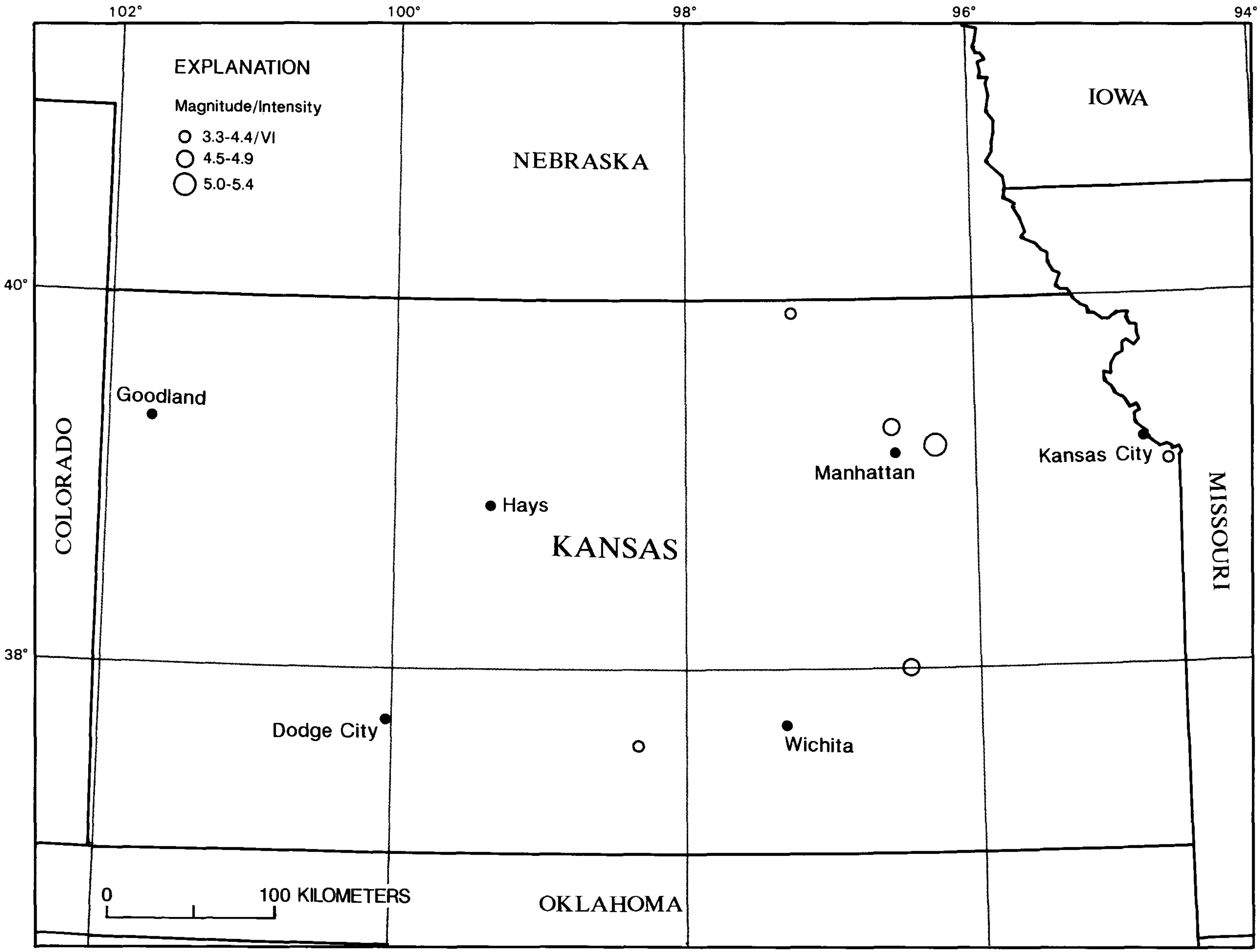


FIGURE 31.—Isoseismal map for the Wabash River valley, Indiana, earthquake of September 27, 1909. Isoseismals are based on intensity estimates from data listed in reference 529 of table 1.



Earthquakes in Kansas with magnitudes ≥ 4.5 or intensity ≥ VI.

KANSAS

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1867 04 24	20 22	39.2 N	96.3 W	—	174	—	—	5.10M_{fa} BAR	—	VII	38	500
1897 12 02	07 10	38.0 N	96.5 W	—	174	—	—	4.50M_{fa} BAR	—	VI	174	116
1906 01 08	00 15	39.3 N	96.6 W	—	63	—	—	4.90M_{fa} BAR	—	VII	109	95
1931 08 09	06 18 37	39.1 N	94.7 W	—	105	—	—	3.80M_{fa} BAR	—	VI	174	1
1956 01 06	11 58 07.4	37.583N	98.346W	029	349	—	—	4.40M_{fa} DG	—	VI	29	41
1979 06 30	20 46 42.3	39.922N	97.287W	007	349	—	—	3.30M_n GS	—	VI	262	3

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1867. Apr. 24. Manhattan, Riley County, Kans. This earthquake inflicted several minor injuries, cracked walls, and loosened stones from buildings. At Manhattan, a 0.6-m wave was observed moving south to north on the Kansas River. Chimneys were downed in Louisville (Pottawatomie County) and Leavenworth. One side of a large building that housed a newspaper office was knocked down at Paola, south of Kansas City, in Miami County. East of Manhattan, the earth opened and ejected much water on a farm about 5 km south of Wamego.

Additional minor damage occurred in Iowa at Dubuque (plaster fell); in Kansas at Junction City (a well being dug was destroyed), Kansas City (plaster was shaken down), Lawrence (several stones were knocked off a church), Olathe (roof shingles were knocked to the ground), and Wamego (walls were cracked and plaster was broken); and in Missouri at Chillicothe (plaster fell from ceilings), St. Joseph (walls of new school house were cracked), and Warrensburg (plaster fell from ceiling). This earthquake is one of the important shocks that define the Midcontinent seismic trend. Also felt in Indiana and Illinois.

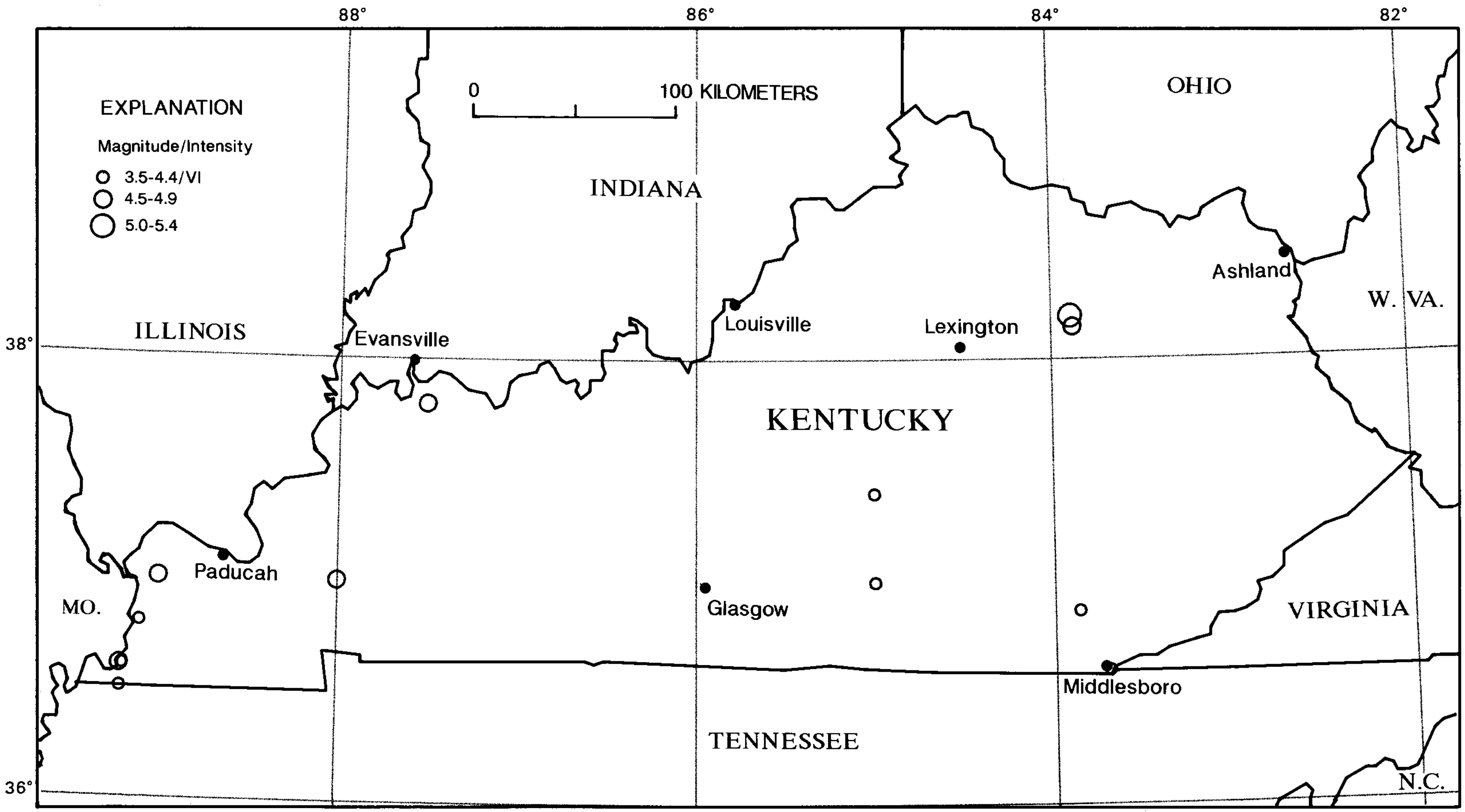
The felt area shown in the Kansas hypocenter list (500,000 km²) is based on information in the original source reference, which states that the earthquake was felt only in the territory east of the epicenter. Information on this shock is sparse for the region west of the epicenter, and so the felt area given is only a rough estimate. (Ref. 38, 63, 105, 174, 353.)

1906. Jan. 8 (Jan. 7). Manhattan, Riley County, Kans. The earth movement at Manhattan sent residents fleeing from their houses. Only a few chimneys fell, but something was broken in almost every house. Plaster was knocked from walls in the surrounding towns of Junction City, Wamego, and Westmoreland. Also felt in Missouri and Nebraska. (Ref. 63, 109, 174, 353.)

1931. Aug. 9. Near Merriam, Johnson County, Kans. A strong local earthquake broke dishes and bounced pictures from walls at Merriam and overturned furniture at Turner. Also felt in Missouri. (Ref. 4, 105, 174, 353.)

1956. Jan. 6. South-central Kansas. Chimneys sustained slight damage at Coldwater and Medicine Lodge, Kans., near the Oklahoma border. Plaster fell to the floor at Wilmore, Kans., and Alva, Okla. Walls were reported cracked in a few towns. This earthquake was centered near the northern margin of the Anadarko Basin. Magnitude 4.3 M_{fa} BAR. (Ref. 29, 105, 349, 353.)

1979. June 30. Mahaska, Washington County, Kans. Large amounts of plaster cracked and fell and the foundation of a concrete-block building cracked at Mahaska, on the Kansas-Nebraska border, north of Salina. Slight damage also occurred in the towns of Haddam, Narka, and Morrowville. Also felt in Nebraska. (Ref. 262, 349.)



Earthquakes in Kentucky with magnitudes ≥ 4.5 or intensity ≥ VI.

KENTUCKY

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1779				37.0 N	85.0 W	—	38	—	—	—	—	Felt	130	—
1791	04		12	37.5 N	85.0 W	—	145	—	—	—	—	Felt	145	—
1841	12	28	05 50	36.6 N	89.2 W	—	105	—	—	4.60M_{fa} SG	—	V	38	—
1850	04	05	02 05	37.0 N	88.0 W	—	529	—	—	4.90M_{fa} SG	—	V	159	—
1858	09	21		36.5 N	89.2 W	—	105	—	—	4.20M_{fa} BAR	—	VI	159	—
1878	03	12	10 00	36.8 N	89.1 W	—	105	—	—	4.20M_{fa} SC	—	VI	463	40
1883	01	11	07 12	37.0 N	89.0 W	—	529	—	—	4.60M_{fa} SC	—	VI	529	185
1916	12	19	05 42	36.6 N	89.2 W	—	105	—	—	3.80M_{fa} BAR	—	VI	109	@
1925	09	02	11 56	37.8 N	87.5 W	—	353	—	—	4.60M_{fa} SC	—	VI	113	200
1954	01	02	03 25	36.6 N	83.7 W	—	38	—	—	4.30M_{fa} SC	—	VI	27	60
1976	01	19	06 20 39.6	36.866N	83.861W	001	349	4.0	—	3.80M_n SLM	—	VI	49	15
1980	07	27	18 52 21.4	38.193N	83.891W	006	349	5.1	4.7	5.00M_n SLM	5.03HRR	VII	300	667
1988	09	07	02 28 09.5	38.143N	83.878W	010	74	4.5	—	4.60M_n BLA	—	VI	578	103

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1791 or 1792. April or May. Kentucky. This earthquake is assumed to have caused damage. Furniture was agitated by the shock. Felt in northern and eastern parts of Kentucky. Few settlements existed farther west to report this event. The shock was preceded by a rumbling noise. (Ref. 38, 145.)

1858. Sept. 21. Line Shore, Fulton County, Ky. The earthquake was so severe at Line Shore, a community south of Hickman, that a woman 200 m from her house fell down four times before reaching her door. She thought that her house was going to collapse. (Ref. 105, 159.)

1878. Mar. 12. Columbus, northwest Hickman County, Ky. A severe earthquake in western Kentucky overturned furniture at Columbus, about 55 km southwest of Paducah. A section of a bank on the Mississippi River caved in. (Ref. 105, 463.)

1883. Jan. 11. Mississippi River valley. A moderate tremor shook an area from St. Louis, Mo., to Memphis, Tenn. At Paducah, Ky., several brick walls were cracked slightly, and at Hopkinsville, windows were broken. Small boats were "dashed about" on the river at Mound City, Ill. In the St. Louis area, buildings swayed gently and engine bells rang. At Clarksville, Tenn., cooking utensils and other small articles were displaced. Mag. 4.6 M_{fa} BAR. (Ref. 105, 353, 463, 529.)

1916. Dec. 19 (Dec. 18). Hickman, Fulton County, Ky. Bricks were shaken from chimneys at Hickman in southwest Kentucky. Two strong local shocks were felt. (Ref. 105, 109, 272, 353.)

1925. Sept. 2. Near Henderson, Ky. Landslides occurred at Henderson, about 15 km south of Evansville, Ind., and one chimney fell. Plaster was knocked from ceilings and walls at Owensboro, Ky., west of Henderson; a few bricks were displaced on chimneys at Evansville, Ind.; and a chimney toppled at Louisville, Ky., about 100 km northeast of Henderson. Several strong shocks were felt, but the last one was the strongest. The felt area of the main earthquake includes southern Illinois, southern Indiana, western Kentucky, southeastern Missouri, and northern Tennessee. Magnitude 4.8 M_{fa} BAR. (Ref. 105, 113, 353, 529.)

1954. Jan. 2. (Jan. 1). Southeast Kentucky. The earthquake left cracks in foundations of houses and dislodged loose bricks in Bell County at Middlesboro. Tables slid across the floor, and residents were alarmed. Also felt in parts of North Carolina, Tennessee, and Virginia. (Ref. 27, 38, 508.)

1976. Jan. 19. Southeast Kentucky. Minor property damage occurred in Knox and Bell Counties. Damage reports from the area of maximum intensity include broken windows at Artemus; cracks in plaster and walls at Barbourville, Hinkle, Kettle Island, Pineville, and Woodbine; cracks in a brick school building at Walker; and cracks in a concrete sidewalk at Green Road. Material fell from a ceiling

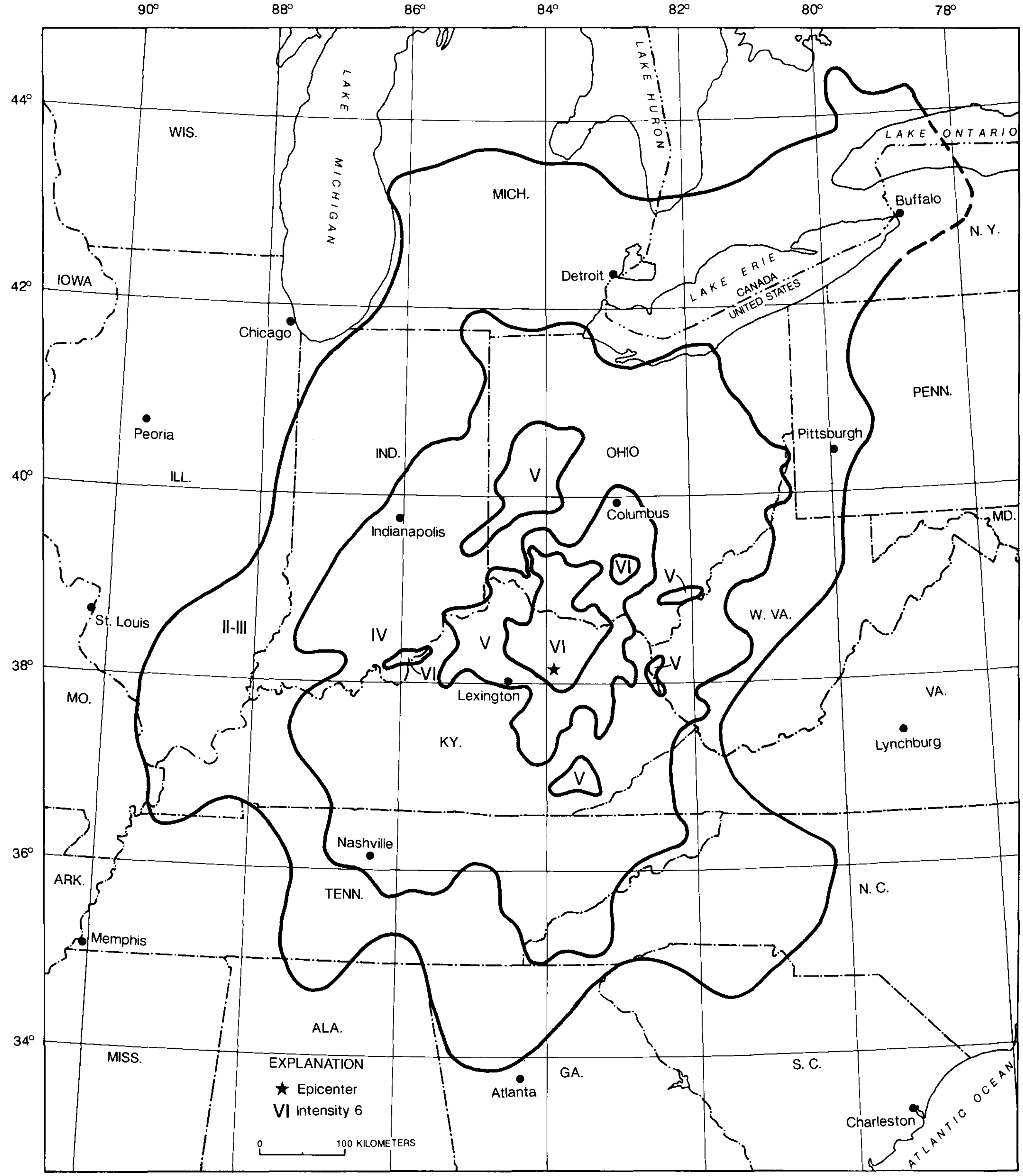


FIGURE 32.—Isoseismal map for the northern Kentucky earthquake of July 27, 1980. This is a simplified version of figure 21 in reference 300 of table 1.

Cemetery monument in Washington, Kentucky, twisted by the July 27, 1980, Sharpsburg earthquake. (Photograph by M. Hopper.)

at Lexington, and rocks slid on tracks at the Eastover mine. Also felt in northwest North Carolina, northeast Tennessee, western Virginia, and southwest West Virginia. (Ref. 49, 349.)

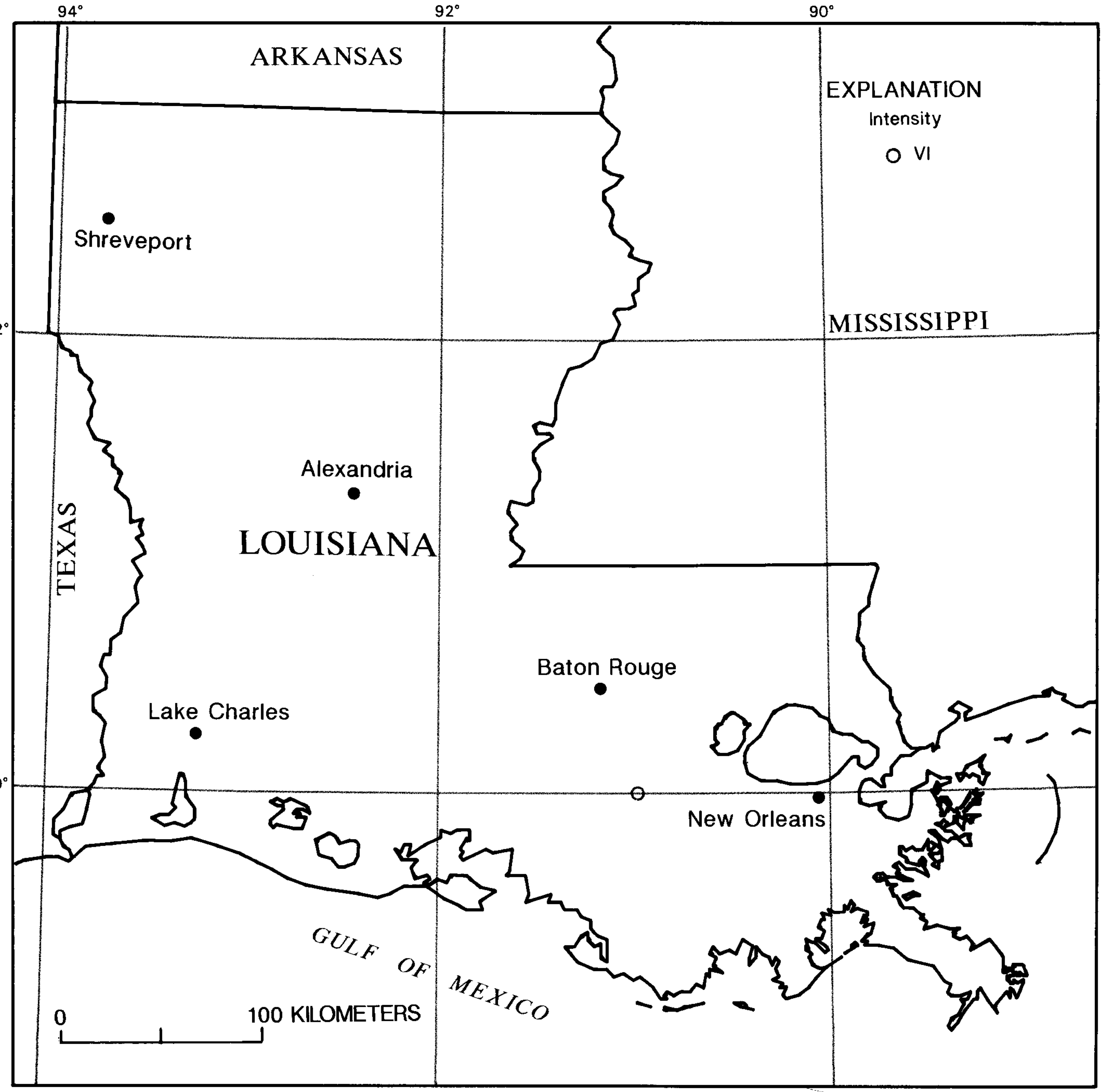
1980. July 27. Northeast Kentucky, near Sharpsburg, Bath County. This earthquake, the strongest in the history of Kentucky, was felt over all or parts of 15 States and in Ontario, Canada (see fig. 32). Damage occurred in Indiana, Kentucky, and Ohio.

Property damage was estimated at $1 million at Maysville, about 50 km north of the epicenter, in Mason County, where 37 commercial structures and 269 private residences were damaged to some extent. Multistory all-brick structures in the downtown area, many of which were built in the mid-1800's, were affected the most. Broken chimneys represented the most common type of damage observed: several toppled or were broken at or near the roofline, some had bricks loosened or broken off their tops, and others sustained cracks of varying lengths and widths. This type of damage was a community-wide effect only in Maysville.

Cracks formed in the ground about 12 km from the epicenter. East of the epicenter, at Owingsville, ground cracks were estimated to be 6 to 10 cm deep and 30 m long. West of the epicenter, near Little Rock, ground cracks extending toward a cistern were observed on Stoner Road. Magnitude 4.7 M_S NLI, 5.2 M_n TUL, 5.0 M_n PAL, 5.05 M JOH. (Ref. 38, 300, 340, 349.)

1988. Sept. 7 (Sept. 6). Northeast Kentucky, near Sharpsburg, Bath County. An earthquake northeast of Lexington caused slight damage in Bath, Menifree, Montgomery, and Nicholas Counties. Cracks in chimneys and foundations occurred east of Lexington, at Jeffersonville and Means, and northeast of Lexington, at Moorefield. Large cracks formed in exterior walls at Olympia, north of Means, in Bath County. Felt over a large area in several States, including parts of Indiana, Kentucky, Ohio, Tennessee, and West Virginia. (Ref. 74, 578.)

LOUISIANA



Damaging earthquake in Louisiana, intensity ≥ VI.

LOUISIANA

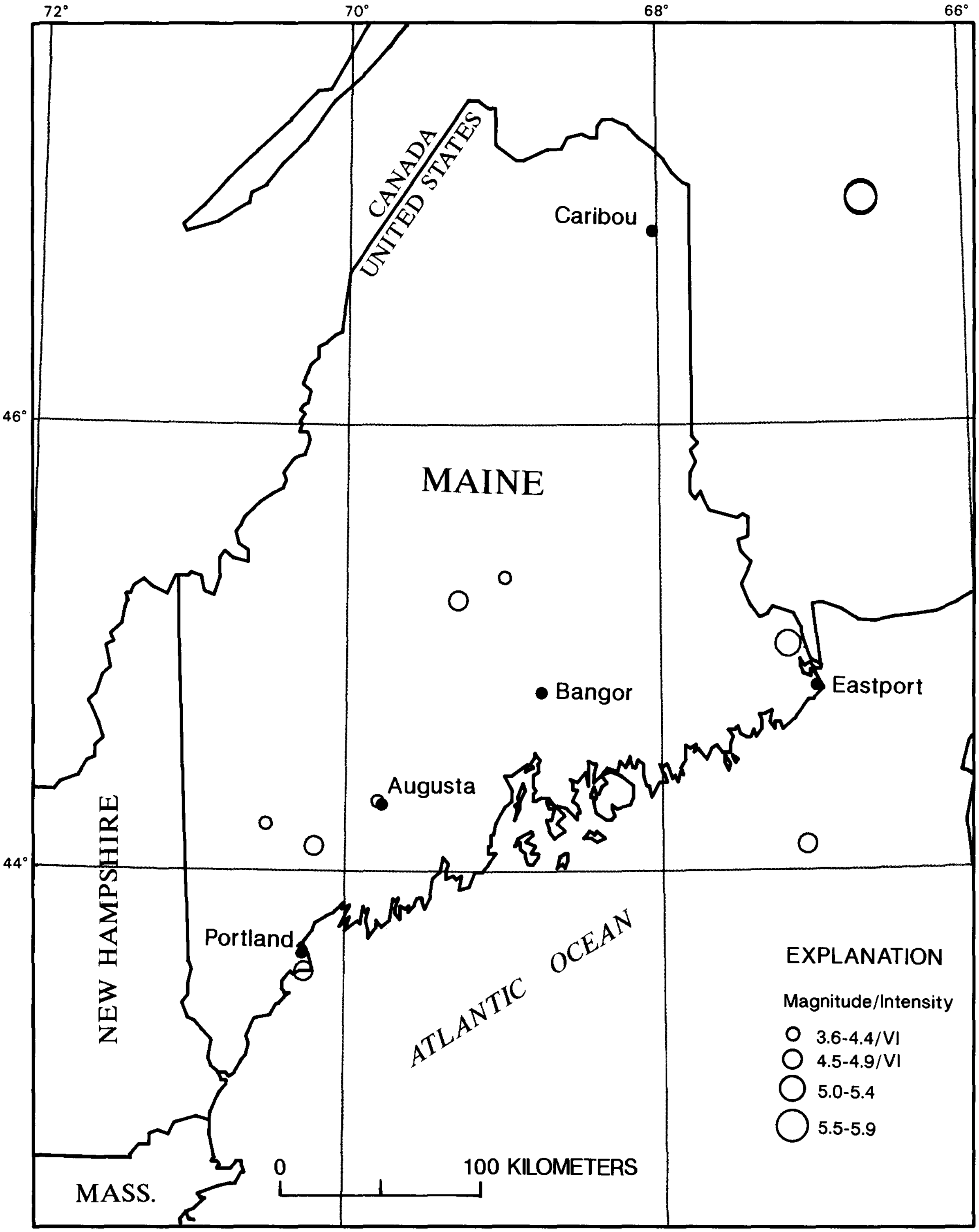
[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)			Hypocenter						Magnitude				Intensity		Felt area
						Latitude		Longitude		Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h	m	s	(°)		(°)		(km)		m_b	M_S		M			(1,000 km²)
1930	10	19	12	17		30.0	N	91.0	W	—	3	—	—	4.20M_{fa} BAR	—	VI	38	48&

[Reference (Ref.) numbers given in parentheses at the end of the description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1930. Oct. 19. Near Napoleonville, Assumption Parish, La. The earthquake damaged chimneys and broke windows at Napoleonville and cracked plaster at White Castle, northwest of Napoleonville. Many people in the area rushed into the streets. Magnitude 4.4 M_n SLM. (Ref. 3, 38, 105.)

MAINE



Earthquakes in Maine with magnitudes ≥ 4.5 or intensity ≥ VI.

MAINE

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1857 12 23	18 30	44.1 N	70.2 W	—	76	—	—	—	—	VI	78	11&
1870 02 08		44.1 N	67.1 W	—	76	—	—	—	—	VI	76	—
1904 03 21	06 04	45.0 N	67.2 W	—	38	—	—	5.10M_{fa} SC	—	VII	38	388
1905 07 15	10 10	44.3 N	69.8 W	—	76	—	—	4.40M_{fa} SC	—	VI	126	100
1918 08 21	04 11 54	44.2 N	70.5 W	—	78	—	—	4.20M_{fa} SC	—	VII	76	9
1928 02 08		45.3 N	69.0 W	—	1	—	—	3.60M_{fa} SC	—	VI	38	2
1947 12 28	19 58 18	45.2 N	69.3 W	—	77	—	—	4.50M_L EPB	—	V	20	12
1957 04 26	11 40 08.6	43.535N	70.255W	005	349	—	—	4.70M_n ST	4.40ST	VI	30	82&
1982 01 09	12 53 51.8	46.984N	66.656W	010	74	5.7	5.2	5.80M_n BLA	5.47EPB	VI	350	570&
1982 01 11	21 41 07.9	46.975N	66.659W	006	74	5.4	4.5	5.50M_n BLA	—	VI	350	260&

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1857. Dec. 23. Near Lewiston, Androscoggin County, Me. At Lewiston, chimneys were thrown down and the ceiling of the depot building was shaken down. Residents described the earthquake as the most severe ever felt in the area. Glass was broken at Augusta and Gardiner, northeast of Lewiston, and residents rushed outside. Felt from Portland north to Waterville and from the coast west to Paris. (Ref. 76, 78.)

1870. Feb. 8. Bay of Fundy. This earthquake was reported in Maine and the Maritime Provinces of Canada. Little information is available on which to base an intensity evaluation. The intensity value listed here was assigned in ref. 76. (Ref. 76.)

1904. Mar. 21. Southeast Maine. This strong earthquake overthrew chimneys in Washington County, in the area of Calais and Eastport, Me., and at St. Stephen, New Brunswick. Felt throughout most of New England and the Provinces of New Brunswick and Nova Scotia. It was observed west to the Hudson River and Montreal, Canada, and south to southern Connecticut. (Ref. 38, 76.)

1905. July 15. Southern Maine. In Gardiner, south of Augusta, several chimneys in disrepair toppled; bricks were shaken from chimneys in Androscoggin County at Auburn and Monmouth. Felt from northeastern Massachusetts through southern New Hampshire to central Maine. (Ref. 38, 76, 78, 126.)

1918. Aug. 21 (Aug. 20). Southern Maine. West of Augusta, at Norway and South Paris, bricks tumbled from chimneys and a few chimneys were cracked. "A hundred or more chimneys will need topping out before winter." Stovepipes were "unjointed" in houses at Norway, and bed slats dropped to the floor. A temporary change of about 10 cm in the level of Lake Sebago, northwest of Portland, was observed. (Ref. 38, 76, 78, 272.)

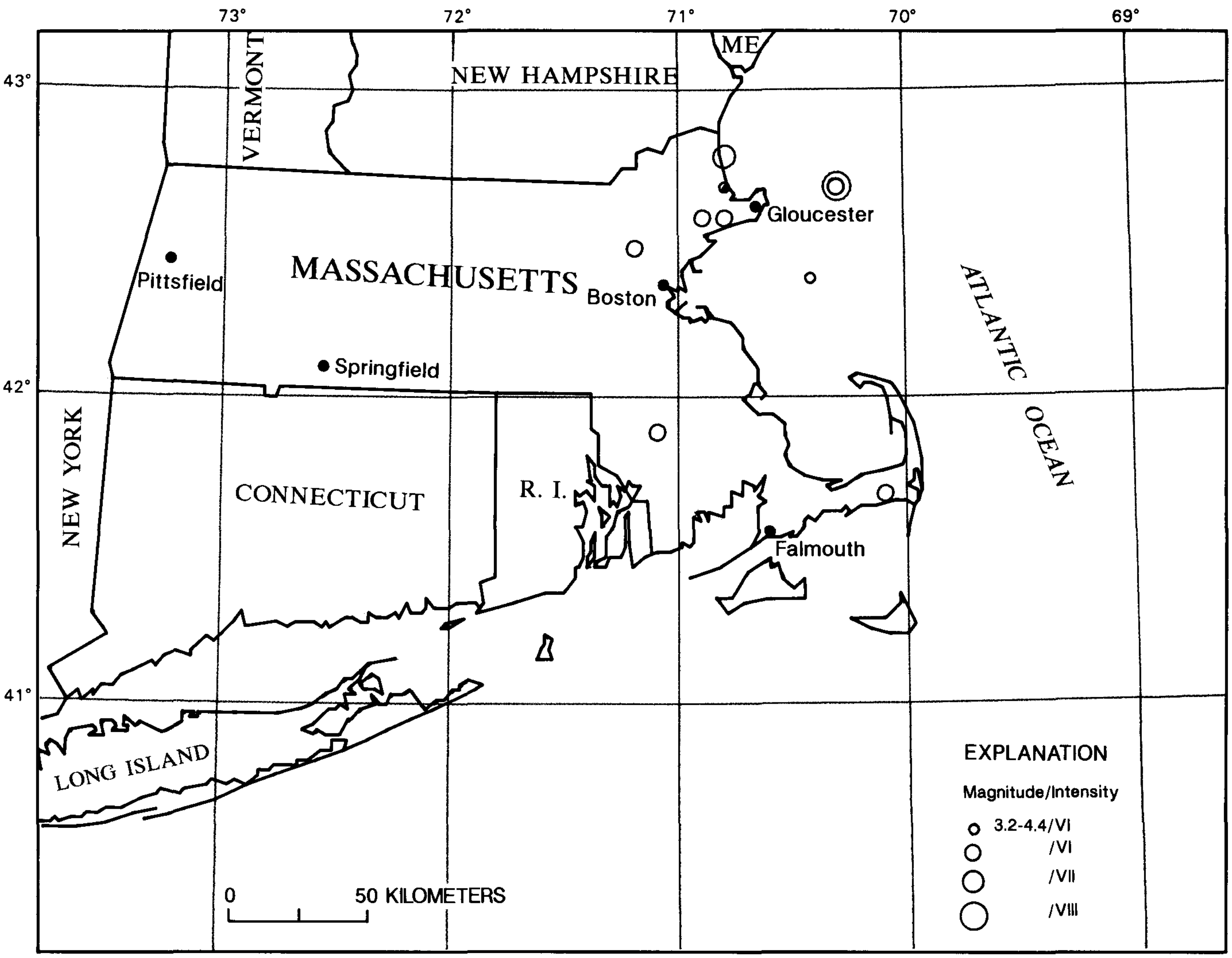
1928. Feb. 8. Milo, Piscataquis County, Me. This local event cracked plaster walls and knocked dishes from shelves at Milo, north of Bangor. It was a distinct tremor, followed at 5- to 6-minute intervals by smaller shocks. (Ref. 1, 38.)

1957. Apr. 26. Near coast of Maine. Minor damage occurred in Cumberland County at Portland and Westbrook, Me. Chimneys split and windows and dishes broke at Westbrook; plaster and walls cracked and merchandise fell from shelves at Portland. Reports of minor damage also were received from observers on ships about 32 km offshore. (Ref. 30, 38, 349.)

1982. Jan. 9. New Brunswick, Canada. Cracks in streets, chimneys, and foundations, the most common type of damage sustained, occurred at several towns in Aroostook County, in northern Maine. In addition, cracks formed in sidewalks, plaster, and drywall in several towns. Tombstones were displaced at Lubec, and underground pipes were put out of service at Stockholm. Moderate aftershocks occurred on Jan. 11 (see description below), Mar. 31, Apr. 11, and June 16. The main earthquake was felt in Canada from the Gaspe Peninsula in the north to Prince Edward Island in the east and west to Montreal. In the United States, it was felt in Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. Magnitude 5.8 M_n EPB. (Ref. 74, 350.)

1982. Jan. 11. New Brunswick, Canada. This earthquake is an aftershock of the event on Jan. 9 (see description above). Minor damage, including cracks in foundations and walls, occurred in Aroostook County, Maine, at Caribou, Haynesville, Loring Air Force Base, Presque Isle, and Saint Francis. Felt in Canada from the Saint Lawrence River south to Nova Scotia and in the States of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. Magnitude 5.5 M_n EPB. (Ref. 74, 350.)

MASSACHUSETTS



Damaging earthquakes in Massachusetts, intensity ≥ VI.

MASSACHUSETTS

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	Felt area
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1627		42.6 N	70.8 W	—	126	—	—	—	—	VI	76	—
1638 06 11	07	46.5 N	72.5 W	—	76	—	—	—	—	IX	76	—
1663 02 05	22 30	47.6 N	70.1 W	—	76	—	—	—	—	X	76	1900&
1727 11 10	03 40	42.8 N	70.8 W	—	38	—	—	—	—	VII	78	296&
1744 06 14	15 15	42.6 N	70.9 W	—	78	—	—	—	—	VI	78	157&
1755 11 18	09 11 35	42.7 N	70.3 W	—	78	—	—	—	—	VIII	78	1000&
1761 03 12	07 15	42.7 N	70.3 W	—	78	—	—	—	—	V	78	127&
1766 02 02		42.0 N	68.0 W	—	76	—	—	—	—	VI	76	—
1800 12 25		41.9 N	71.1 W	—	76	—	—	—	—	VI	76	—
1817 10 05	16 45	42.5 N	71.2 W	—	38	—	—	—	—	VI	78	55&
1847 08 08	15 00	41.7 N	70.1 W	—	78	—	—	—	—	VI	76	34&
1963 10 16	15 30 59.7	42.401N	70.422W	014	349	—	—	3.90M_n ST	3.40ST	VI	36	18&
1963 10 30	22 36 57.9	42.7 N	70.8 W	—	36	—	—	3.20M_L WES	2.58ST	VI	36	6&

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1.]

1627. Date unknown. Essex, Mass. This local earthquake at Essex, about 40 km northeast of Boston, was reported to be as violent as the shock of June 11, 1638 (see description below). (Ref. 59, 76, 126.)

1638. June 11. Probably in the St. Lawrence River valley, Canada. Tops of chimneys were thrown down and dishes were knocked from shelves in the Salem-Lynn area, north of Boston, and at Plymouth, on the coast about 55 km southeast of Boston. At Plymouth, people had to hold on to posts to keep from falling. Ships near the coast reportedly were shaken. Also felt in Connecticut and Rhode Island. Aftershocks continued for 20 days. (Ref. 38, 59, 76.)

1663. Feb. 5. St. Lawrence River valley region, Canada. This major earthquake caused vast landslides along the St. Maurice, Batiscan, and St. Lawrence Rivers. The earthquake was felt sharply in New England. On the shores of Massachusetts Bay, the tops of chimneys were broken on houses and pewter was jarred from shelves. (Ref. 38, 59, 76.)

1727. Nov. 10 (Nov. 9). Northern Cape Ann region, east of Newbury, Essex County, Mass. At Newbury, many stone walls and chimney bricks were shaken down, and almost all tops of chimneys were knocked off. Considerable changes occurred in the flow of water in springs and, in some springs, changes occurred in the character of the water. "Some firm land became quagmire, and marshes were dried up." The rise and fall of the ground made it difficult to walk, and houses shook and rocked as if they would fall apart. Sand blows were reported near Spring Island. Felt from the Kennebec River in Maine to the Delaware River on the New York–Pennsylvania border and from ships at sea to the "extreme western settlements." Aftershocks occurred in the area for several months. The strongest aftershock (MM intensity V) occurred in the Newbury area on Dec. 28, 1727, and Jan. 4 and Feb. 10, 1728 (local dates). (Ref. 38, 59, 78.)

1744. June 14. Southern Cape Ann, Mass., region (near Salem, Essex County, Mass.). Bricks were shaken from several chimneys in Boston and other towns, and pieces of stone fence were thrown down in the country. Many persons were alarmed at Newbury and Ipswich, Mass. The shock was reported from Falmouth, Me., to New York City. Several aftershocks occurred. (Ref. 38, 78.)

1755. Nov. 18. East of Cape Ann, Mass. This earthquake caused the heaviest damage in the region around Cape Ann and Boston. At Boston, much of the damage was confined to an area of infilled land near the wharfs. There, about 100 chimneys were leveled with the roofs of houses, and many others (1,200 to 1,500) were shattered and partly thrown down. Some chimneys, which were broken off below their tops, tilted dangerously 3 or 4 cm; others were twisted or partly turned. The gable ends of several brick buildings (12 to 15) were thrown down, and the roofs of some houses were damaged by the fall of chimneys. Stone fences were thrown down throughout the countryside, particularly on a line extending from Boston to Montreal. New springs formed, and old springs dried up. At Scituate (on the coast southeast of Boston), Pembroke (about 15 km southwest of Scituate), and Lancaster (about 40 km west of Boston), cracks opened in the earth. Water and fine sand issued from some of the ground cracks at Pembroke.

The earthquake generated a tsunami that left vessels aground and fish on the banks after the water withdrew from St. Martin's Harbor in the West Indies. When the water flowed back into the harbor, it rose about 2 m higher than normal and inundated the low-lying lands.

This earthquake was reported from Halifax, Nova Scotia, south to the Chesapeake Bay in Maryland and from Lake George, N.Y., east to a ship 320 km east of Cape Ann. The location of the ship is thought to be near the epicenter, because the shock was felt so strongly that those onboard believed the ship had run aground. Several aftershocks occurred. (Ref. 59, 78, 502.)

1761. Mar. 12. East of Cape Ann, Mass. This earthquake is included in the list of magnitude ≥ 4.5 or intensity ≥ VI events based on the large felt area documented on land from the estimated offshore location. While no damage was documented the large felt area and strong shaking indicates that this event is as large or larger than a magnitude 4.5 earthquake.

1766. Feb. 2. Off the coast of Massachusetts. This shock was felt throughout Massachusetts, Rhode Island, and other parts of New England. It was reported that the earthquake was "accompanied by a remarkable meteor." Note: Existing felt reports do not substantiate the MM intensity VI published in ref. 76 for this earthquake and the one in 1800 (see next paragraph), but an intensity of that level probably was assigned because the shocks were felt over such wide areas. (Ref. 59, 76.)

1800. Dec. 25. Eastern Massachusetts. A severe shock was felt at Boston and Concord, Mass; Newport, R.I.; and elsewhere (see 1766 description above). (Ref. 59, 76.)

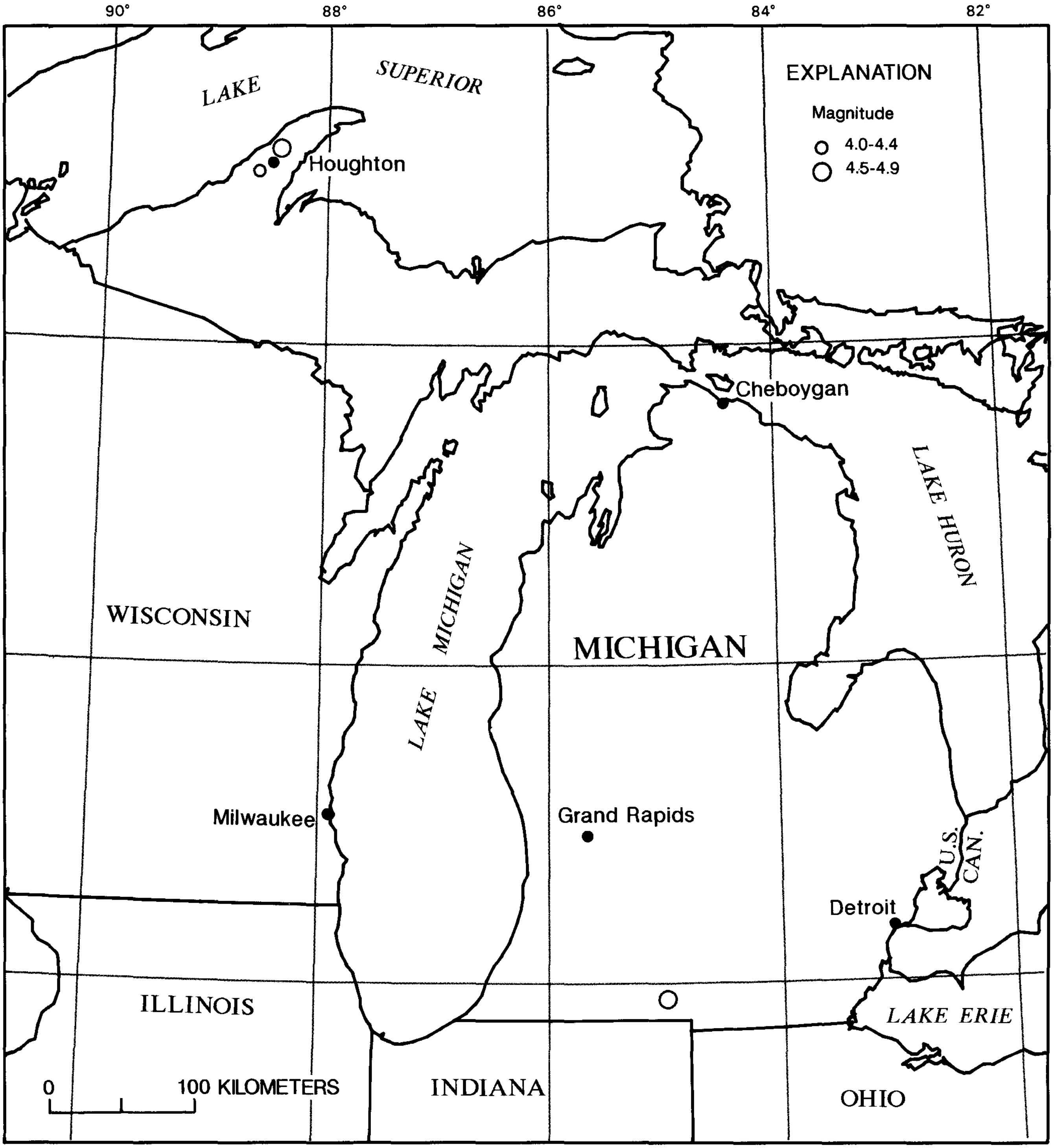
1817. Oct. 5. Northeast Massachusetts. Walls were thrown down at Woburn, in Middlesex County, according to ref. 59. Ref. 78 states that the "walls" referred to by ref. 59 possibly were stone fences, characteristic of rural New England pasture land, rather than house walls. Such walls were constructed of glacial boulders piled loosely on top of each other to form a stone fence. Felt in Connecticut, Massachusetts, New Hampshire, New York, and probably Rhode Island and Vermont. (Ref. 38, 59, 76, 78.)

1847. Aug. 8. Near Harwich, Barnstable County, Mass. A section of "the plastering" was thrown down at the Harwich Baptist Church; mirrors hanging on the wall were broken at Nantucket (south of Hyannis) and Sandwich (northeast of Hyannis). In the Yarmouth area, northeast of Hyannis, glass was broken and crockery shook from shelves. Felt throughout eastern Massachusetts. (Ref. 76, 78.)

1963. Oct. 16. Near the coast of Massachusetts. Slight damage at Somerville, north of downtown Boston, consisted of fallen plaster, cracks in walls, and fallen stones from building foundations. Also felt in Maine, New Hampshire, and Rhode Island. (Ref. 36, 38, 349.)

1963. Oct. 30. Northeast of Peabody, Essex County, Mass. Slight damage occurred at Framingham, Peabody, and Swampscott. At Framingham, in Middlesex County, southwest of Boston, 3 m of stone foundation on a 155-year-old house collapsed. Northwest of Boston, at Peabody, cracks in wall plaster and a sidewalk occurred; and southeast of Peabody, at Swampscott, basement stairs were thrown out of alignment. Also felt in New Hampshire. (Ref. 36, 38.)

MICHIGAN



Earthquakes in Michigan with magnitudes ≥ 4.5 or intensity ≥ VI.

MICHIGAN

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1905 07 27	00 20	47.24 N	88.45 W	—	326	—	—	4.50M_{fa} SC	—	VII	38	40
1906 05 26	14 42	47.10 N	88.64 W	—	336	—	—	4.20M_{fa} SC	—	VIII	38	2
1947 08 10	02 46 41.3	41.928N	85.004W	002	349	—	—	4.60M_n BAS	—	VI	20	158

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1905. July 27 (July 26). Calumet, Houghton County, Mich. This earthquake was associated with unstable geological conditions induced by mining operations in the area. The shock downed many chimneys and broke plate glass windows at Calumet, in northwest Michigan. Accompanied by a terrific explosion, the shock was felt throughout the Keweenaw Peninsula in Michigan and as far east as Marquette. Magnitude 4.5 M_{fa} BAR. (Ref. 38, 326, 353.)

1906. May 26. Houghton, Mich. At the Atlantic mine, near Houghton (about 20 km southwest of Calumet), rails were twisted and a notable sinking of the earth was observed above the workings of the mine. These effects were not observed elsewhere. About 50 shocks were reported. Magnitude 3.6 M_{fa} BAR. (Ref. 38, 336, 353.)

1947. Aug. 10 (Aug. 9). Southern Michigan. Damage was heaviest in the area southeast of Kalamazoo at Athens, Bronson, Coldwater, Colon, Matteson Lake, Sherwood, and Union City. Chimneys were damaged, windows and plaster were broken, and brick cornices were downed. Also felt in Indiana, Illinois, Ohio, Wisconsin, and Ontario, Canada. (see fig. 33). Magnitude 4.7 M_{fa} BAR. (Ref. 20, 349, 353.)

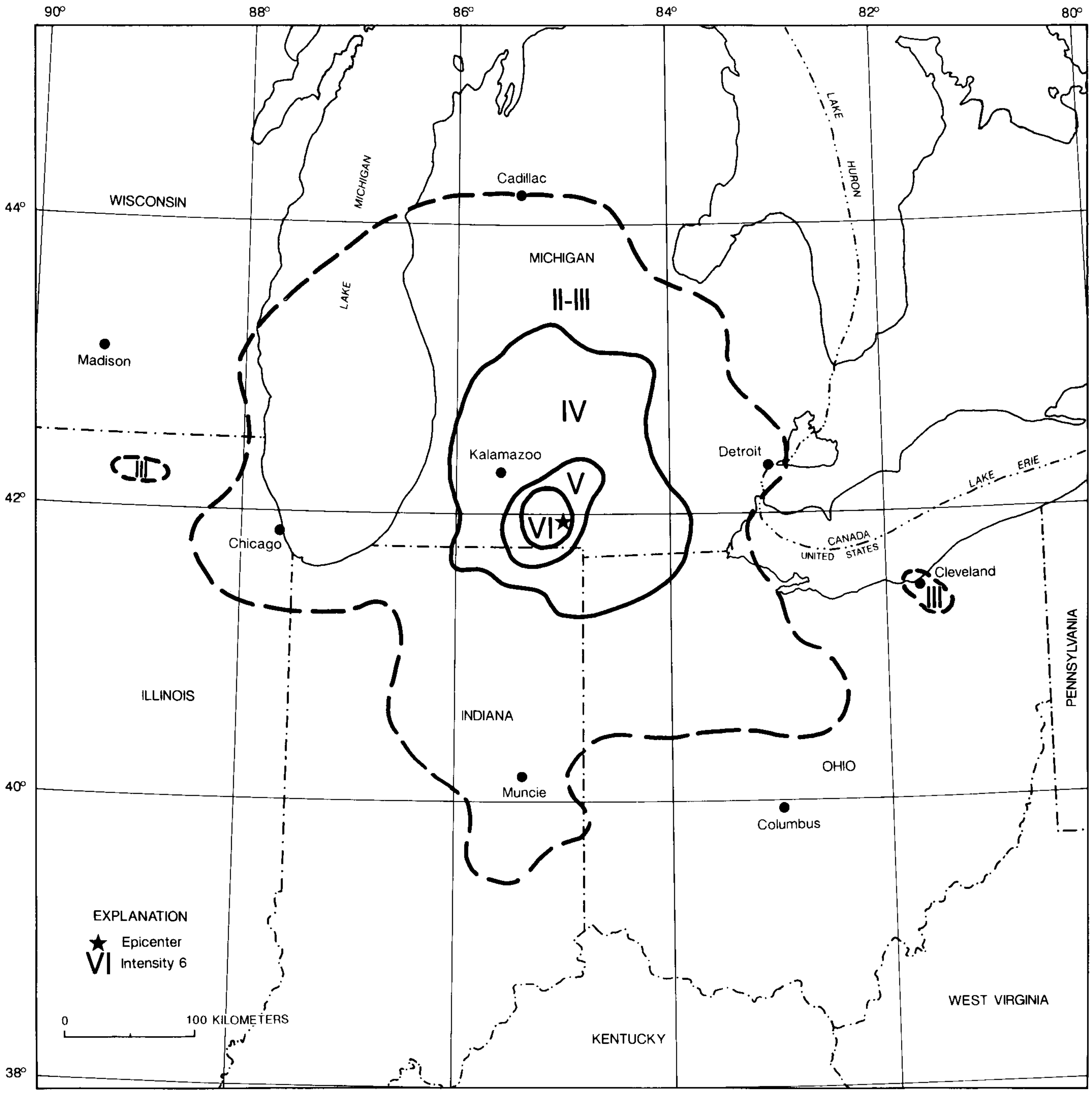
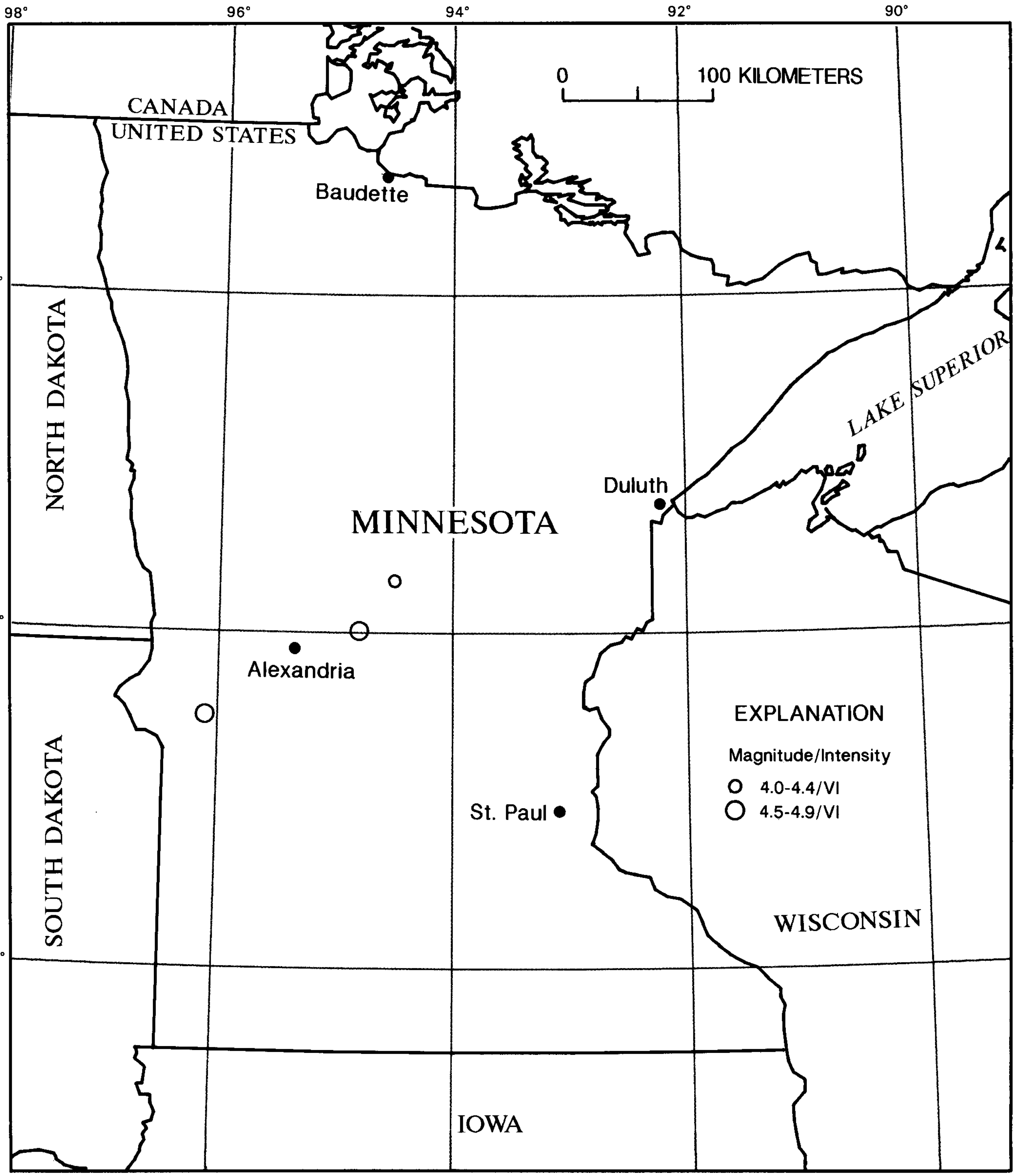


FIGURE 33.—Isoseismal map for the southern Michigan earthquake of August 10, 1947. Isoseismals are based on intensity estimates from data listed in reference 20 of table 1.

MINNESOTA



Earthquakes in Minnesota with magnitudes ≥ 4.5 or intensity ≥ VI.

MINNESOTA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1860		46.0 N	94.8 W	—	105	—	—	—	—	VI	272	—
1917 09 03	21 30	46.3 N	94.5 W	—	38	—	—	4.30M_{fa} SC	—	VI	38	48
1975 07 09	14 54 21.3	45.498N	96.100W	008	349	5.0	—	4.60M_n DG	4.29HRN	VI	48	75

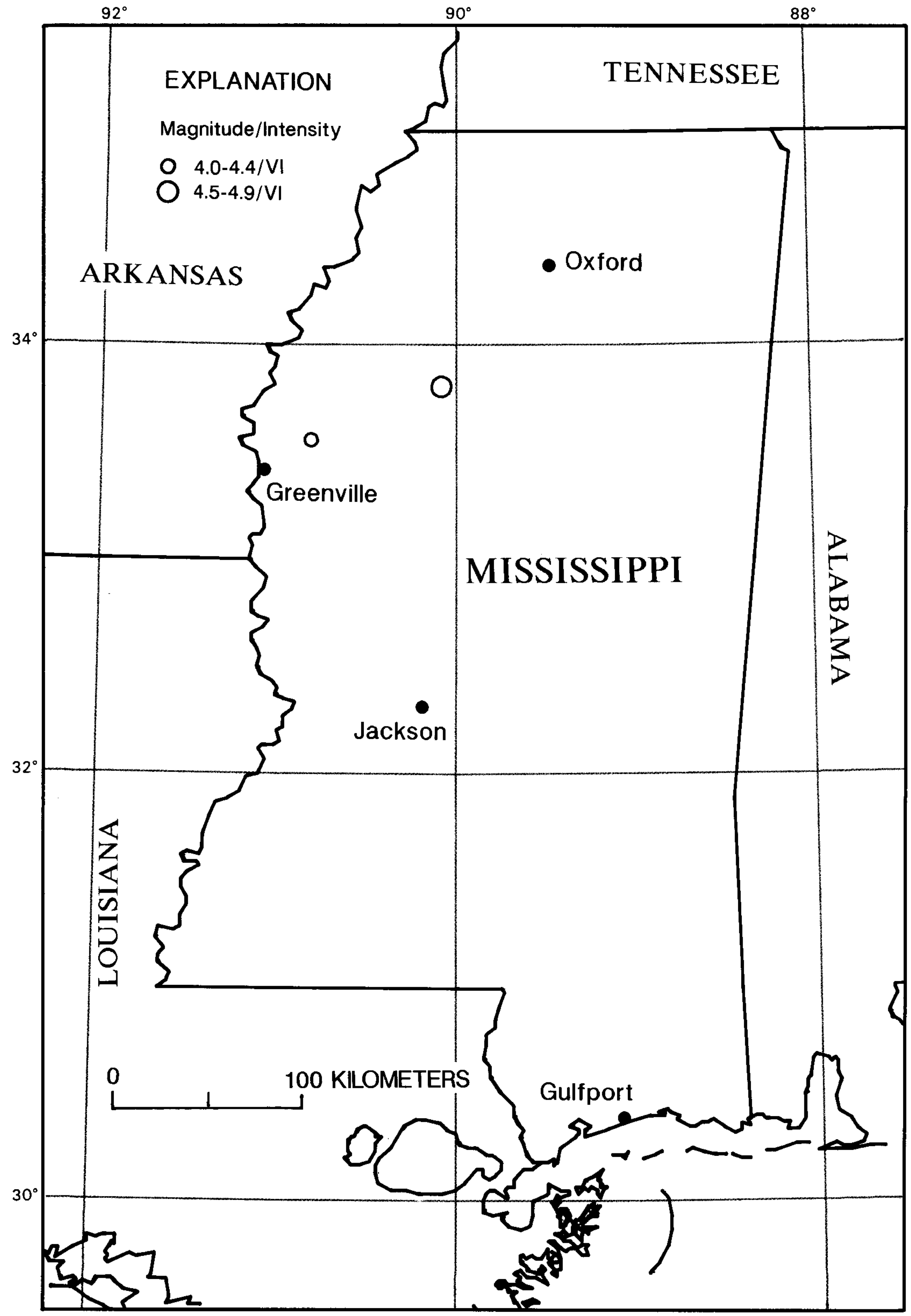
[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1860. Date unknown. Long Prairie, Todd County, Minn. Little is known about the effects of this earthquake. MM intensity VI is assigned to the shock because it is described as "a harder shock" than that on Sept. 3, 1917. Ref. 272 describes an earthquake on a Sunday afternoon between the years 1865 and 1870. The above reports probably refer to an earthquake between 1860 and 1870. (Ref. 105, 272.)

1917. Sept. 3. Staples, Todd County, Minn. The earthquake was most severe at Staples, a railway village on the north edge of Todd County, where chimneys toppled and many windows were broken. The shock also cracked the wall of a brick building, the concrete floor in the city clerk's office, and concrete sidewalks. Several courses of bricks were dislodged from a chimney at Brainerd, east of Staples, and a chimney was thrown down near Lincoln, south of Staples. Also observed in Minneapolis, 190 km southeast of Staples. (Ref. 38, 105, 272, 491.)

1975. July 9. Western Minnesota. The earthquake caused minor damage to walls and foundations of basements in Stevens County around Morris. Also felt in Iowa, North Dakota, and South Dakota. Magnitude 4.8 M_n SLM. (Ref. 38, 48, 349.)

MISSISSIPPI



Earthquakes in Mississippi with magnitudes ≥ 4.5 or intensity ≥ VI.

MISSISSIPPI

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

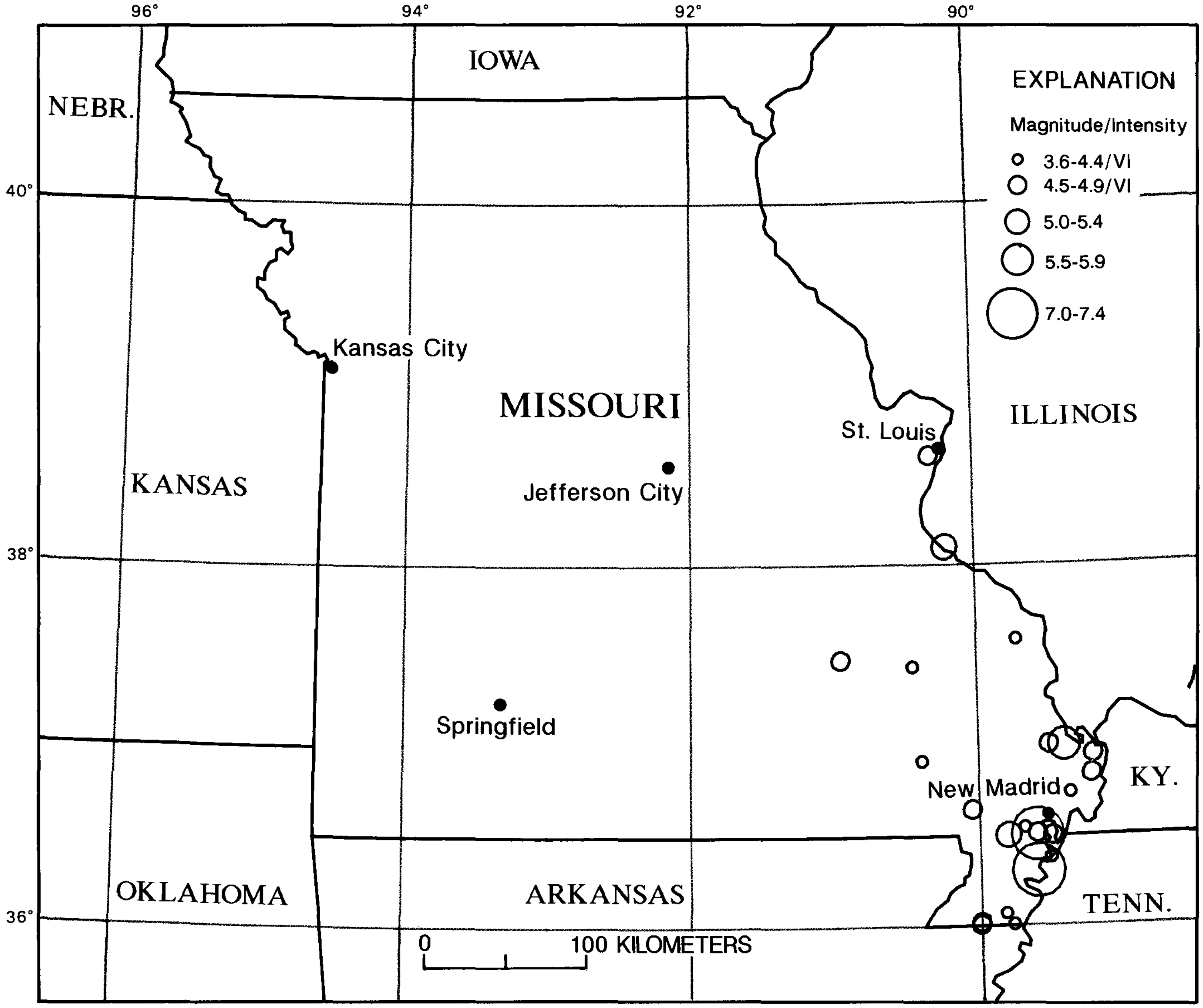
Date			Origin time (UTC)			Hypocenter				Magnitude				Intensity		Felt area
						Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h	m	s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1931	12	17	03	36		33.8 N	90.1 W	—	4	—	—	4.60M_{fa} SC	—	VI	4	175
1967	06	04	16	14	12.6	33.552N	90.836W	006	349	3.8	—	4.40M_n DG	4.28HRN	VI	40	54

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1931. Dec. 17 (Dec. 16). Charleston, Tallahatchie County, Miss. Several chimneys were thrown down at Charleston, and the walls and foundation of the Agricultural High School were cracked. Minor damage to chimneys also occurred at Tillatoba and Water Valley; several buildings were damaged slightly and plaster fell at Belzoni. Also felt in Alabama, Arkansas, and Tennessee. (Ref. 4, 105.)

1967. June 4. Near Greenville, Washington County, Miss. A few instances of cracked plaster were reported at Greenville. One person near the epicenter observed a crack in his lawn about 0.5–1.3 cm wide and 12 m long. Also felt in Arkansas, Louisiana, and Tennessee. A slight aftershock was observed in the Greenville area on June 29. Magnitude 4.5 M_n BAR, 3.0 M_S NUT, 4.5 m_b NUT.. (Ref. 40, 263, 349.)

MISSOURI



Earthquakes in Missouri with magnitudes ≥ 4.5 or intensity ≥ VI.

MISSOURI

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1812	01	23	15 00	36.3 N	89.6 W	—	301	—	—	7.10M_{fa} NU	7.55NLI	XI	473	5000
1812	02	07	09 45	36.5 N	89.6 W	—	301	—	—	7.40M_{fa} NU	7.88NLI	XII	473	5000
1812	11	09	22	36.5 N	89.6 W	—	143	—	—	—	—	VI	143	—
1895	10	31	11 08	37.0 N	89.4 W	—	38	—	—	5.90M_{fa} SC	—	VIII	527	2037
1902	01	24	10 48	38.6 N	90.3 W	—	38	—	—	4.50M_{fa} SC	—	VI	38	130
1903	11	04	18 18	36.5 N	89.5 W	—	529	—	—	4.60M_{fa} SC	—	VI	38	168
1903	11	04	19 14	36.5 N	89.8 W	—	529	—	—	5.10M_{fa} SC	—	VII	529	340
1909	10	23	07 10	37.0 N	89.5 W	—	38	—	—	4.50M_{fa} BAR	—	V	38	125
1915	12	07	18 40	36.0 N	90.0 W	—	529	—	—	4.50M_{fa} BAR	—	V	109	120
1924	01	01	03 05	36.0 N	90.0 W	—	529	—	—	4.50M_{fa} SC	—	VI	529	150
1934	08	20	00 47 27	36.95 N	89.2 W	—	38	—	—	4.70M_{fa} SC	—	VII	38	85
1955	01	25	07 24 39.1	36.073N	89.827W	008	349	—	—	4.40M_{fa} SC	—	VI	28	85
1956	11	26	04 12 43.3	36.914N	90.387W	001	349	—	—	4.30M_{fa} SC	—	VI	29	70
1962	02	02	06 43 30.0	36.374N	89.511W	004	349	—	—	4.30M_n BAR	4.22HRN	VI	35	90
1963	03	03	17 30 10.6	36.642N	90.050W	009	349	—	—	4.80M_n DG	4.64HRN	VI	38	208
1965	10	21	02 04 39.1	37.479N	90.944W	007	349	5.1	—	4.80M_n DG	4.59HRN	VI	75	420
1967	07	21	09 14 48.8	37.440N	90.443W	012	349	3.9	—	4.30M_n STT	4.03HRN	VI	40	53
1974	05	13	06 52 18.7	36.739N	89.357W	004	349	4.3	—	3.60M_{fa} SC	—	VI	47	2
1975	06	13	22 40 27.5	36.543N	89.682W	009	349	4.3	—	3.90M_n DG	3.73HRN	VI	48	13
1977	01	03	22 56 48.5	37.583N	89.714W	005	349	—	—	3.60M_n DG	—	VI	39	6
1987	09	29	00 04 57.2	36.840N	89.210W	005	74	4.6	—	4.50M_n GS	—	V	577	35
1989	04	27	16 47 49.8	36.006N	89.768W	010	74	4.6	—	4.30M_n GS	—	VI	579	57

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1812. Jan. 23. New Madrid, Mo. This is the third principal shock of the 1811–12 sequence. The first earthquake of this series on Dec. 16, 1811, was located in northeast Arkansas. It is difficult to assign intensities to the principal shocks that occurred after 1811 because many of the published accounts describe the cumulative effects of all the earthquakes. Using the Dec. 16 earthquake as a standard, however, a comparison between it and the shock on Jan. 23 indicates that the intensities were about equal at similar locations. The meizoseismal area was characterized by general ground warping, ejections, fissuring, severe landslides, and caving of stream banks. Magnitude 8.4 M_{Sn} NLI. (Ref. 143, 301, 353, 473, 529.)

1812. Feb. 7. New Madrid, Mo. This is the fourth and largest earthquake of the 1811–12 series. Several destructive shocks occurred on Feb. 7, the last of which equaled or surpassed the magnitude of any previous event. The town of New Madrid was destroyed. At St. Louis, many houses were damaged severely and their chimneys were thrown down. The meizoseismal area was characterized by general ground warping, ejections, fissuring, severe landslides, and caving of stream banks. Magnitude 8.8 M_{Sn} NLI. (Ref. 114, 143, 301, 353, 473, 529.)

1812. Nov. 9. New Madrid, Mo. This earthquake caused "much motion to furniture" at Cape Girardeau, about 75 km north of New Madrid. (Ref. 143.)

1895. Oct. 31. Near Charleston, Mississippi County, Mo. This is the largest earthquake to occur in the central Mississippi River valley since the 1811-12 series in the area of New Madrid, Mo. Structural damage and liquefaction phenomena were reported along a line from Bertrand, Mo., in the west to Cairo, Ill., in the east. Many sand blows were observed in an area southwest of Charleston, Mo., and south of Bertrand, Mo. Isolated occurrences of sand blows also were reported north and south of Charleston.

The most severe damage occurred in Charleston, Puxico, and Taylor, Mo.; Alton and Cairo, Ill.; Princeton, Ind.; and Paducah, Ky. The earthquake caused

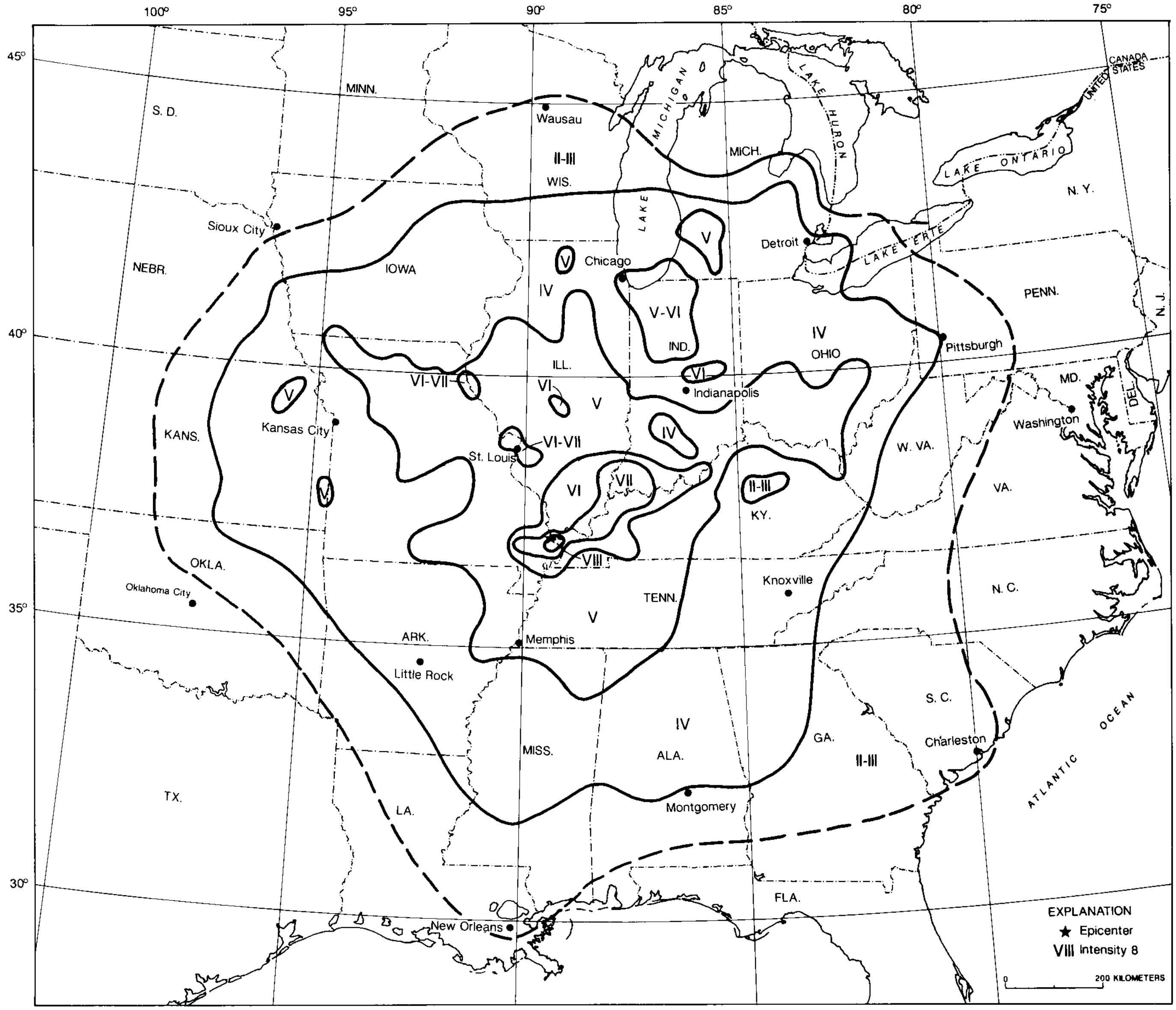


FIGURE 34.—Isoseismal map for the Charleston, Missouri, earthquake of October 31, 1895. Isoseismals are based on intensity estimates from data listed in references 527 and 529 of table 1.

extensive damage (including downed chimneys, cracked walls, shattered windows, and broken plaster) to school buildings, churches, private houses, and to almost all the buildings in the commercial section of Charleston.

East of Charleston, at Cairo, Ill., few buildings escaped at least the loss of a chimney or a broken window. The courthouse, library, and a church at Cairo sustained extensive damage, and the brick walls of many buildings in the downtown section were cracked badly. Other damage included a cracked pier on the Illinois Central Railroad bridge over the Ohio River and downed chimneys at Gadsden, Ala.; Evansville and New Waverley, Ind.; Covington, Spottsville Depot, and Uniontown, Ky.; St. Louis, Mo.; and Memphis, Tenn. Minor damage to property occurred throughout the region.

Felt from Chatham, Ontario, Canada, to New Orleans, La., and from Washington, D.C., to Wichita, Kans., an area that includes 23 States (see fig. 34). Magnitude 6.7 M_{Sn} NTL. (Ref. 38, 109, 113, 353, 366, 527, 529.)

1902. Jan. 24. Near St. Louis, Mo. Two distinct earthquakes were felt in western Illinois, Kansas, and Missouri. The shocks were particularly severe in the western part of St. Louis. A street car conductor stated that the Eads Bridge swayed perceptibly. Felt from Leavenworth, Kans., and Kansas City, Mo., to Springfield, Ill. (Ref. 38, 105, 109, 353.)

1903. Nov. 4, 18 18 and 19 14 UTC. Near Charleston, Mississippi County, Mo. Two earthquakes occurred on this date, the second of which was the strongest. The first shock which damaged chimneys at New Madrid, Mo., was felt in Arkansas, Illinois, Kentucky, Mississippi, and Tennessee. During the second shock at 19 14 UTC, chimneys were downed at Cape Girardeau and New Madrid, Mo. Minor damage also was reported at Malden, Mo., Oxford, Miss., and Quincy, Ill. This earthquake was felt over an area similar to that of the first shock but also was reported in Indiana. Magnitude 4.9 M_{fa} BAR (first shock); 4.7 M_{fa} BAR (second shock). (Ref. 38, 105, 109, 353, 529.)

1924. Jan. 1 (1923, Dec. 31). Missouri. A few plate-glass windows were broken at Osceola (Mississippi County), Ark., and a few windowpanes were broken at Little Rock, Ark. Also felt in Illinois, Kentucky, Missouri, and Tennessee. Magnitude 4.6 M_{fa} BAR. (Ref. 529.)

1955. Jan. 25. Mississippi River valley, near Finley, Tenn. Windows were shattered and plaster walls and ceilings were cracked in southeast Missouri and western Tennessee (in Dyer County at Finley). Windows cracked northwest of Finley at Hayti, Mo. Felt from Lepanto, Ark., north to Paducah, Ky., and east to Birmingham, Ala. Also felt in southern Illinois and northern Mississippi. Magnitude 4.5 M_{fa} BAR. (Ref. 28, 349, 353.)

1956. Nov. 26 (Nov. 25). Wayne County, Mo. Minor damage in the form of shattered windows and cracked walls was reported at Grubville, Richmond Heights (suburb of St. Louis), and St. Louis; a concrete porch was cracked at Sturdivant. The felt area includes parts of Arkansas, Illinois, Kentucky, Missouri, and Tennessee. Magnitude 4.3 M_{fa} BAR. (Ref. 29, 38, 349, 353.)

1962. Feb. 2. New Madrid, Mo., near Catron and Marston. At Catron, two water pipes broke and walls and plaster cracked; at Marston, chimneys were damaged and windows cracked. Also felt in parts of Arkansas, Illinois, Kentucky, and Tennessee. Magnitude 3.5 M_S NUT, 4.3 m_b NUT. (Ref. 35, 38, 263, 349, 353.)

1963. Mar. 3. Near Poplar Bluff, Butler County, Mo. Minor damage in the form of fallen and cracked plaster; cracks in foundations, walls, sidewalks, chimneys, and windows; fallen bricks from chimneys; and damaged water lines occurred in many towns in southeast Missouri. In addition, cracks in plaster and walls occurred in several towns in Arkansas, Illinois, Kentucky, and Tennessee. Also reported felt in parts of Indiana, Kansas, and Mississippi. (see fig. 35). Magnitude 4.7 M_n BAR, 4.1 M_S BAR, 4.8 m_b NUT, 4.1 M_S NUT, 4.66 M JOH. (Ref. 38, 263, 349, 353.)

1965. Oct. 21 (Oct. 20). Eastern Missouri. Plaster was knocked down at St. Louis, northeast of the epicenter. Minor damage also occurred at Augusta (cistern cracked), Illmo (basement floor cracked), Pacific (sewer vent line cracked), and Reynolds (bricks fell from flue). Minor cracks in plaster, walls, and windows were reported from several towns in Illinois, Iowa, and Kansas. Also felt in Kentucky, Nebraska, Oklahoma, and Tennessee. Magnitude 4.9 M_b NUT, 4.1 M_S NUT. (Ref. 75, 263, 349, 353.)

1967. July 21. Near Poplar Bluff, Butler County, Mo. Plaster fell at Poplar Bluff, and plaster cracked north of Poplar Bluff at Elvins and Fredericktown. Felt mainly in southeast Missouri and southern Illinoi s. Magnitude 4.3 M_n BAR, 2.8 M_S BAR. (Ref. 40, 349, 353.)

1974. May 13. New Madrid, Mo., region. The City swimming pool at East Prairie, northeast of New Madrid, was "badly damaged," and plaster was cracked in several buildings. Also felt in Arkansas, Illinois, Kentucky, and Tennessee. Magnitude 4.1 M_n SLM. (Ref. 47, 349.)

1975. June 13. New Madrid, Mo., region. Damage was slight at Lilbourn, southwest of New Madrid, where plaster cracked and fell. Furniture overturned and broke at nearby Marston. Also felt in Arkansas, Kentucky, and Tennessee. Magnitude 4.3 M_n SLM. (Ref. 48, 349.)

1977. Jan. 3. Cape Girardeau, Mo., region. Plaster cracked and small objects fell at Old Appleton, about 35 km north of Cape Girardeau. Also felt in Illinois. Many aftershocks were felt on Jan. 3. Magnitude 3.4 M_n SLM. (Ref. 39, 349.)

1989. Apr. 27. Near Steele, Pemiscot County, Mo. At Steele, near the Arkansas-Missouri-Tennessee border in southeast Missouri, large cracks formed in exterior walls of a brick building and plaster and drywall sustained hairline cracks. Chimneys, plaster, and drywall were cracked at nearby Hayti, and items fell from shelves in stores. Felt in parts of Arkansas, Illinois, Kentucky, Missouri, and Tennessee. Magnitude 4.2 M_n SLM. (Ref. 74, 579.)

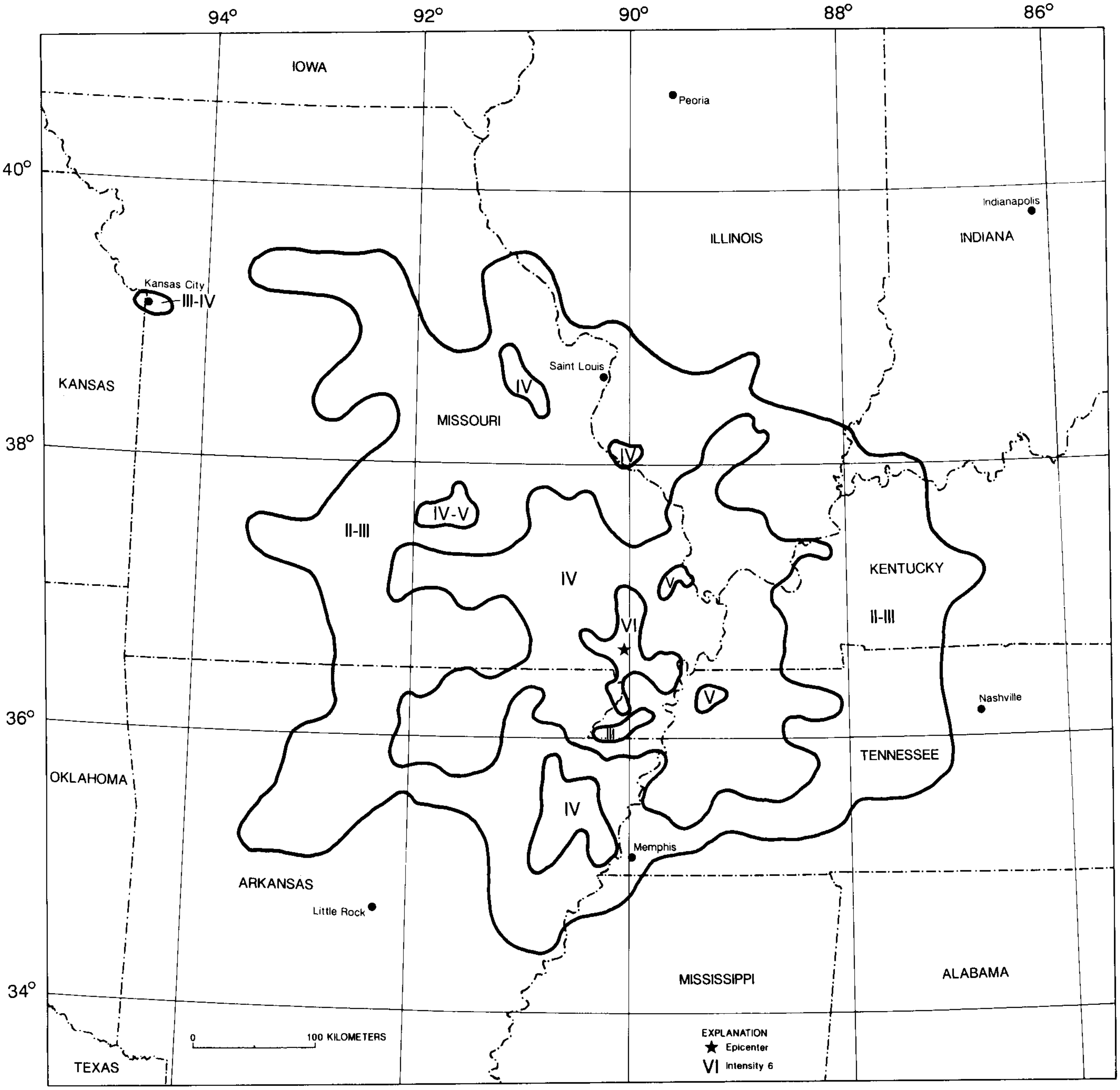
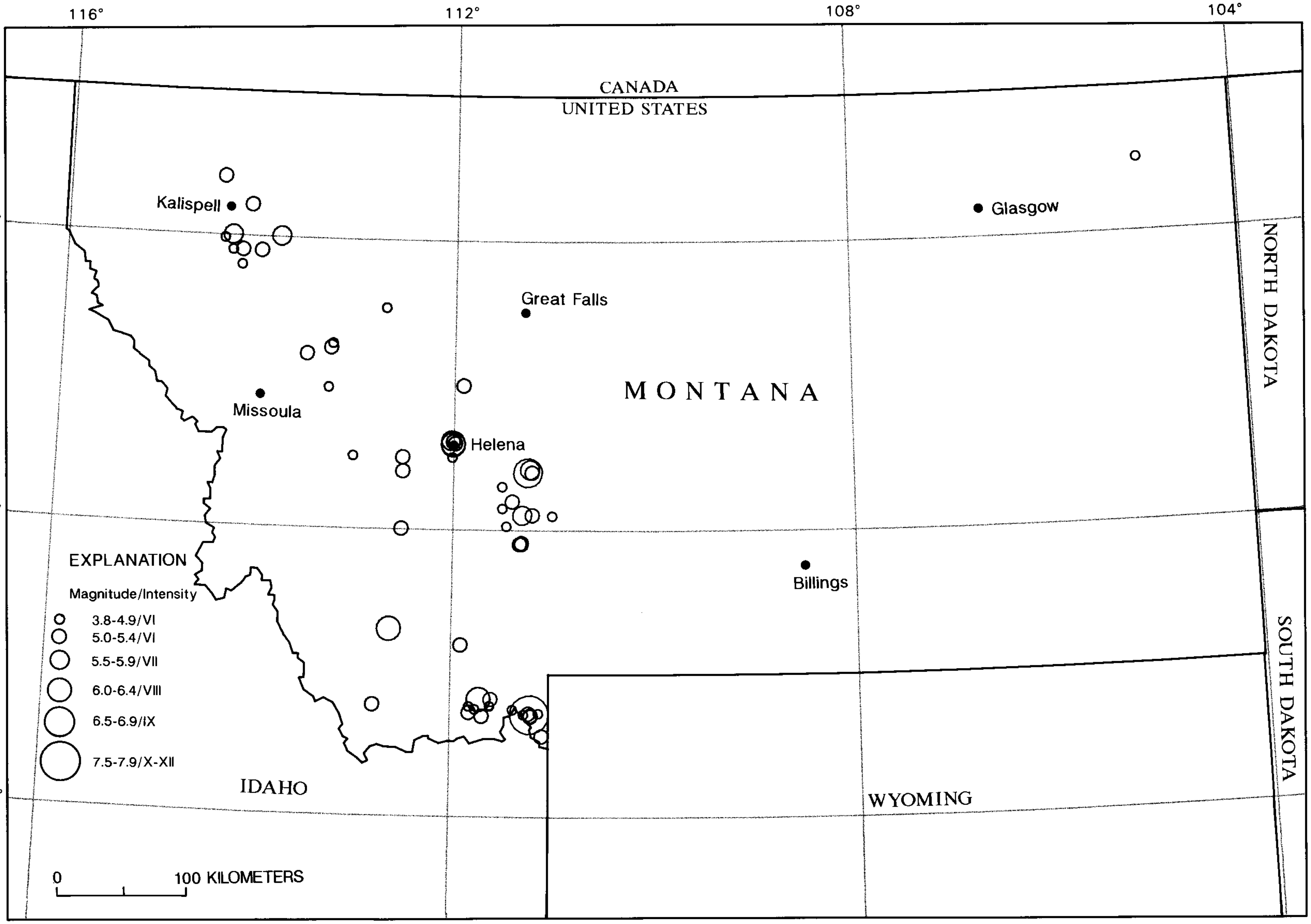


FIGURE 35.—Isoseismal map for the southeast Missouri earthquake of March 3, 1963. Isoseismals are based on intensity esimates from data listed in reference 36 of table 1.



Earthquakes in Montana with magnitudes ≥ 4.5 or intensity ≥ VI.

MONTANA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1872	12	10	23 30	46.4 N	112.5 W	—	38	—	—	5.00M_{fa} MMT	—	VI	38	30
1895	09	06	19 20	46.0 N	112.5 W	—	249	—	—	5.00M_{fa} MMT	—	V	249	30
1897	06	05	12 22	46.6 N	112.0 W	—	249	—	—	5.00M_{fa} MMT	—	V	249	30
1897	11	04	09 29	45.3 N	112.6 W	—	38	—	—	6.40M_{fa} MMT	—	VI	38	500
1903	03	15	17 57	46.6 N	112.0 W	—	249	—	—	—	—	VI	249	—
1908	12	27		45.2 N	111.9 W	—	316	—	—	—	—	VI	38	—
1910	04	19	08 30	46.0 N	112.5 W	—	249	—	—	5.40Ukn MMT	—	V	316	70
1925	06	28	01 21 05	46.40 N	111.24 W	025	208	—	—	6.75M_s GR	6.62DOR	VIII	38	1000
1925	06	28	02 05 27	46.4 N	111.2 W	—	218	—	—	—	—	VII	312	518
1925	06	28	04 20	46.4 N	111.2 W	—	312	—	—	—	—	VI	312	130
1925	07	10	14 42	46.4 N	111.2 W	—	312	—	—	—	—	V	218	130
1926	12	13	00 44	46.1 N	111.2 W	—	38	—	—	5.40M_{fa} MMT	—	V	38	78
1928	02	29	22 38	46.5 N	112.0 W	—	249	—	—	4.90M_x REN	—	IV	1	—
1929	02	16	03 00	46.1 N	111.3 W	—	38	—	—	5.60M_{fa} MMT	—	V	38	161
1935	10	07	19 30	47.0 N	111.9 W	—	249	—	—	—	—	VI	38	—
1935	10	12	07 50 39	46.6 N	112.0 W	005	8	—	—	5.90M_{fa} MMT	—	VII	38	181
1935	10	15	20 30	46.6 N	112.0 W	—	8	—	—	—	—	VI	249	—
1935	10	19	04 48 02	46.6 N	112.0 W	—	8	—	—	6.25M_s GR	—	VIII	38	570
1935	10	27	19 21	46.6 N	112.0 W	—	316	—	—	—	—	VI	38	—
1935	10	31	18 37 47	46.6 N	112.0 W	—	8	—	—	6.00M_s GR	—	VIII	38	315
1935	11	04	11 23	46.6 N	112.0 W	—	8	—	—	—	—	VI	249	—
1935	11	22	03 58	46.6 N	112.0 W	—	38	—	—	3.80M_L KJ	—	VI	38	34
1935	11	28	14 41 48	46.6 N	112.0 W	—	8	—	—	5.00M_L KJ	—	VI	38	233
1936	02	14	00 30	46.6 N	112.0 W	—	38	—	—	—	—	VI	259	—
1938	06	13	11 30	45.9 N	111.3 W	—	11	—	—	—	—	VI	249	—
1938	06	14	05 32	45.9 N	111.3 W	—	11	—	—	—	—	VI	249	—
1939	05	12	00 00	45.9 N	111.3 W	—	12	—	—	—	—	VI	12	—
1940	12	23	21 50 29	46.5 N	112.5 W	—	266	—	—	—	—	VI	38	18
1943	06	25	04 25 00	48.5 N	105.0 W	—	330	—	—	4.00M_n EPB	—	VI	38	3
1945	09	23	09 57 48	48.0 N	114.3 W	—	266	—	—	5.50M_{fa} MMT	—	VI	18	95
1946	12	11	13 09	48.4 N	114.4 W	—	249	—	—	—	—	VI	19	8
1947	03	14	18 00	47.2 N	113.5 W	—	38	—	—	—	—	VI	38	@
1947	11	23	09 46 03.3	44.820N	111.713W	005	576	—	—	6.25M_s GR	6.12DOR	VIII	20	340
1950	08	20	01 44 55	47.25 N	113.25 W	—	266	—	—	—	—	VI	23	10
1952	04	01	00 37 41	48.0 N	113.8 W	—	25	—	—	5.50M_{fa} MMT	—	VII	25	77
1952	04	22	16 54 42.5	46.2 N	111.4 W	—	25	—	—	—	—	VI	25	4
1953	08	08	16 50	47.9 N	114.0 W	—	249	—	—	—	—	VI	26	—
1958	05	28	16 45 54	46.5 N	113.0 W	—	31	—	—	4.40M_L EPB	—	VI	31	13
1959	08	18	06 37 13.5	44.712N	111.215W	005	576	—	—	7.70M_L BOT	7.28DSR	X	38	1175
1959	08	19	19 06 27.0	44.818N	111.588W	005	576	—	—	5.00Ukn BRK	—	V	249	—
1959	08	19	21 45 57.4	44.773N	111.606W	005	576	—	—	4.70Ukn BRK	—	Felt	32	—
1959	08	20	19 11 26.8	44.704N	111.678W	005	576	—	—	5.00Ukn BRK	—	V	38	—
1959	08	23	08 40	44.7 N	111.2 W	—	32	—	—	—	—	VI	38	—
1959	09	05	12 04	44.7 N	111.2 W	—	32	—	—	—	—	VI	38	—
1959	09	13	19 49 34.8	44.722N	111.127W	005	576	—	—	4.40M_L EPB	—	VI	32	—
1959	11	03	17 03 08	44.7 N	111.2 W	—	32	—	—	—	—	VI	32	—
1963	02	16	03 01 41.0	46.1 N	111.0 W	033	266	4.5	—	—	—	V	36	15
1964	10	09	02 26 02.4	47.8 N	114.2 W	033	266	4.6	—	—	—	V	37	—
1964	10	14	16 03 53.6	47.9 N	114.3 W	033	266	4.6	—	—	—	Felt	37	—
1964	10	21	07 38 27.0	44.730N	111.807W	005	576	5.8	—	5.00M_s NUT	5.22DOR	V	37	65

MONTANA—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1965	01	06	02 01 20.7	44.772N	112.746W	005	576	5.1	—	5.00M_n DW	—	VI	75	37
1965	10	08	19 34 59.8	44.713N	111.272W	005	576	4.9	—	4.70m_b ISC	—	V	75	—
1966	03	07	18 09 42.6	46.3 N	111.5 W	013	266	4.8	—	4.70m_b ISC	—	V	81	35
1969	04	01	16 45 09.1	47.90 N	114.30 W	010	74	4.7	—	4.30M_L GS	—	VII	42	26
1969	04	01	17 05 18.1	47.98 N	114.38 W	015	74	4.5	—	—	—	Felt	74	—
1969	09	15	00 02 39.0	47.9 N	114.2 W	019	74	4.3	—	4.10M_L GS	—	VI	42	5
1969	11	07	00 11 29.1	47.9 N	114.2 W	004	74	4.3	—	—	—	VI	42	@
1972	11	02	03 41 31.3	46.15 N	111.50 W	005	74	4.2	—	4.50M_L GS	—	V	45	3
1974	07	01	18 23 07.3	44.56 N	111.09 W	005	47	4.8	—	5.10M_L GS	—	—	—	—
1975	02	04	01 32 52.1	48.21 N	114.11 W	008	48	4.6	—	5.00M_L GS	—	VI	48	50
1977	03	11	05 09 38.3	46.024N	111.457W	005	465	4.6	—	4.80M_L GS	—	VI	39	—
1977	10	19	16 50 50.9	44.77 N	111.81 W	010	39	—	—	4.70M_L GS	—	VI	39	—
1978	04	23	23 24 37.0	46.97 N	113.27 W	005	240	4.5	—	4.90M_L GS	—	V	240	94
1979	05	08	00 58 44.8	44.75 N	111.38 W	005	262	—	—	4.60M_L GS	—	IV	262	—
1982	10	26	08 26 29.9	44.75 N	111.75 W	005	350	—	—	4.60M_L GS	—	IV	350	—
1983	03	17	07 25 56.6	47.526N	112.702W	005	360	4.2	—	3.80M_L MSO	—	VI	360	54
1985	04	01	09 13 14.2	47.276N	113.233W	010	371	4.8	—	4.90M_D BU	—	V	371	68

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1872. Dec. 10. Western Montana. This earthquake apparently was centered at some distance west of Helena. It was felt most strongly in Beartown (overturned a stove and broke much glass), Deer Lodge (cracked walls of the penitentiary and threw several people off their feet), and Philipsburg (cracked windows). This shock opened a crack in the plastering of a stone-block building on Main Street in Helena and shook violently the massive newspaper building. It was observed as far west as Missoula and south to Warm Springs. Two aftershocks occurred on Dec. 11. (Ref. 38, 249, 316.)

1897. Nov. 4. Near Dillon, Beaverhead County, Mont. The earthquake was severe at Dillon, where cracks formed in the courthouse and in many other buildings. Chimneys fell and plate glass was broken in Butte, north of Dillon. The shock was widely felt in Idaho, western Montana, and Utah. (Ref. 38, 249, 316.)

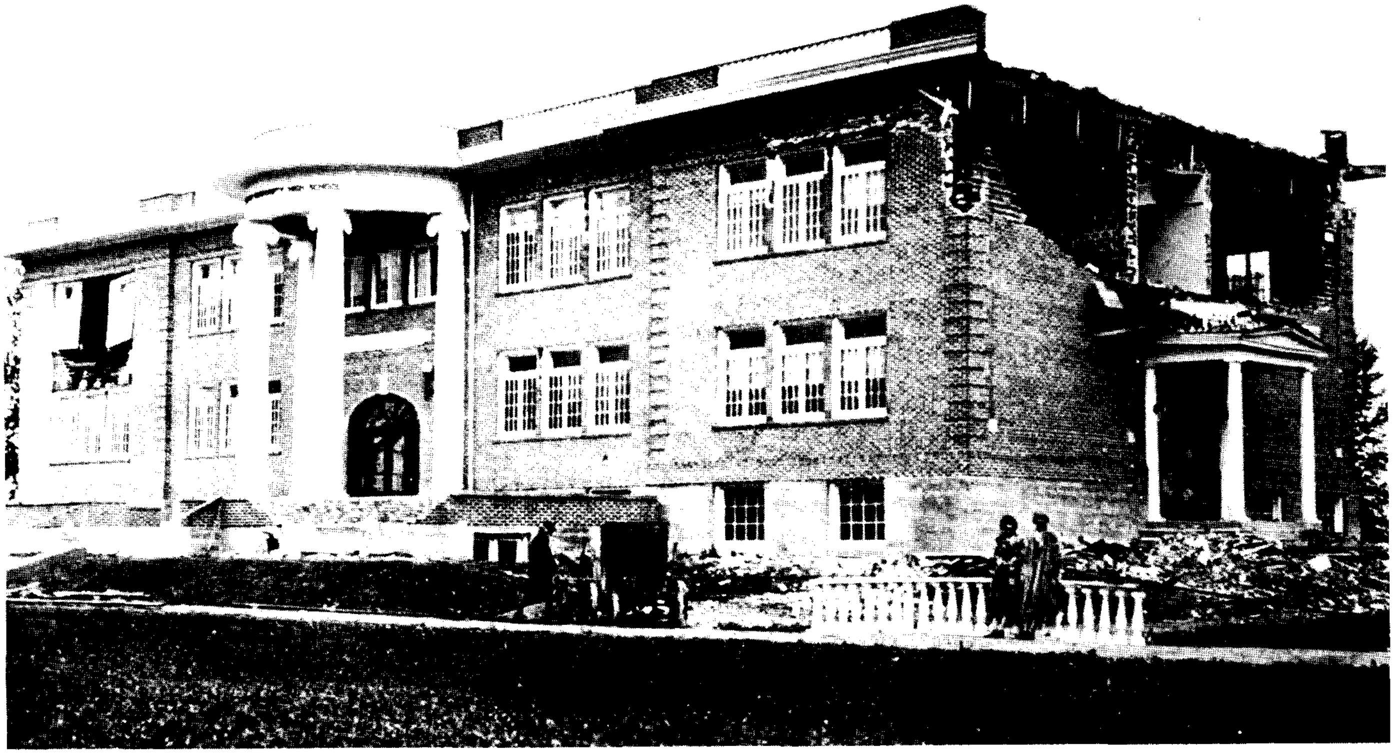
1903. Mar. 15. Helena, Mont. The earthquake was severe at Helena, where windows broke and rafter beams in less substantial buildings cracked. Cracks also formed in pillars of the rotunda at the State Capitol. (Ref. 249.)

1908. Dec. 27. Crater Lake, Madison County, Mont. At Crater Lake, about 10 km southeast of Virginia City, several buildings were cracked, plaster was cracked, and people were panic-stricken. Dishes were shaken from shelves and tables, and the electric powerplant was put out of commission. Of the 30 or more foreshocks, two were severe enough to crack plaster. (Ref. 38, 316.)

1925. June 28, 01 21 (June 27). Clarkston Valley, north of Gallatin County, Mont. The most severe damage from this strong earthquake occurred in Gallatin County at Manhattan, Three Forks, Logan, and Lombard. Because no large cities were near the epicenter, property damage did not exceed $150,000.

At Manhattan, the community high school and the grade school were both damaged severely, but reinforced concrete buildings were undamaged. Many chimneys were toppled.

At Three Forks, walls of the schoolhouse bulged on all sides, and its foundation and basement were damaged. A church, whose walls were not tied together by an upper floor, also sustained heavy damage. Later shocks demolished the walls. Almost all masonry buildings showed cracks and damage, but



Community High School at Manhattan, Montana, damaged by the June 28, 1925 (June 27 MST), earthquake. (Photograph by J.T. Pardee.)

because most of the buildings were of frame construction, they sustained only cracks in plaster and some fallen chimneys.

At Logan, the poorly designed and constructed schoolhouse was damaged heavily. However, a large brick roundhouse sustained only a few cracks. As at Three Forks, most of the buildings at Logan were of frame construction and therefore sustained only cracks in plaster and destruction of chimneys.

At Lombard, where the Chicago, Milwaukee and St. Paul Railway crosses the Northern Pacific Railway, large boulders were dislodged to such an extent that trains were delayed on the Northern Pacific line. Also, a huge rock slide blocked the Deer Park entrance of the Lombard Tunnel on the Chicago, Milwaukee and St. Paul Railway and the canyon of Sixteenmile Creek, causing a lake to form.

Cracks occurred in graded and filled roads but not in cuts or where the natural surface had not been disturbed. Approaches to many bridges settled as much as 30 cm. One spring formed near Josephine and began to flow, but other springs and sources of water in the neighborhood ceased to flow. Felt from the North Dakota line to Washington, and from southern Canada to southern Wyoming (see fig. 36). Aftershocks continued for several months. (Ref. 38, 168, 208, 218, 312, 316.)

1925. June 28, 02 05 UTC (June 27). Near Three Forks, Gallatin County, Mont. This was described as the strongest aftershock of the damaging earthquake at 01 21 UTC. Most observers reported that it was almost as strong as the main shock, but it was of shorter duration. It caused additional rock slides, threw down chimneys, and toppled previously damaged brick walls. Bricks fell from buildings at Belgrade, Logan, Manhattan, Maudlow, and Three Forks; about 5 km south of Manhattan, the upper part of a brick chimney was twisted. The shock was so violent at Deer Park that people could hardly stand; some Three Forks residents were thrown to the floor. The aftershock at 04 20 UTC was "violent" at Anaconda. (Ref. 38, 168, 218, 312.)

1935. Oct. 7. Craig, Lewis and Clark County, Mont. This local earthquake damaged chimneys and cracked plaster and walls. Pendulum clocks stopped and objects fell from shelves. (Ref. 8, 38, 249.)

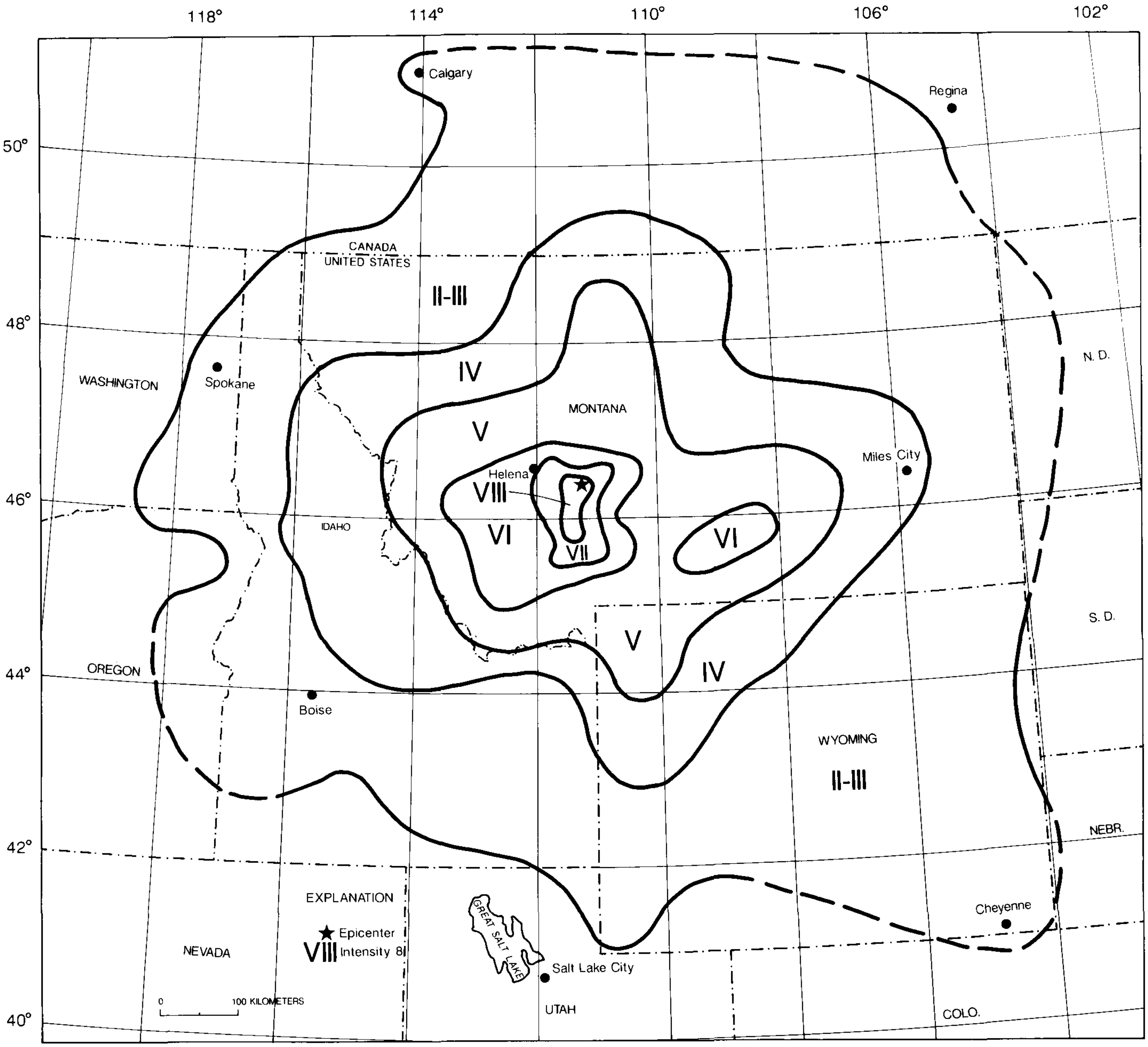


FIGURE 36.—Isoseismal map for the Gallatin County, Montana, earthquake of June 28, 1925. Isoseismals are based on intensity estimates from data listed in references 168 and 218 of table 1.

1935. Oct. 12. Helena, Mont. This was the first destructive foreshock of the 1935 series of earthquakes at Helena on Oct. 12, 18, and 31. An estimated total of $4 million in property damage was caused by the series. The fault zone from which the tremors originated lies on the south side of Prickly Pear Valley, north and northeast of Helena. The heavy damage sustained was due to the fact that the shocks occurred almost directly beneath Helena and that each successive shock further damaged previously weakened buildings.

Damage in East Helena from the first tremor was confined to toppled chimneys, broken plaster, and cracked windows. Cracks formed in walls of buildings in Helena, but damage was generally slight. Chimneys toppled at Fort Harrison, plaster was torn from walls, and a hospital was damaged. Total property damage, about $50,000, generally was confined to a few structures. (Ref. 8, 38, 316, 503, 533.)

1935. Oct. 15. Helena, Mont. Some damage to property occurred at Helena, and students were dismissed from schools. (Ref. 8, 38, 249.)

Front brick walls collapsed at the National Biscuit Company building in Helena, Montana, by the October 19, 1935 (Oct. 18 MST), earthquake. (Photograph by F. Ulrich.)

1935. Oct. 19 (Oct. 18). Helena, Mont. This is the main earthquake of the 1935 series of shocks at Helena. Two people were killed by falling bricks, several were injured, and property damage was estimated at about $3 million. The earthquake damaged about 300 buildings, of which more than 200 lost their chimneys. Damage was most severe in old 2- and 2 1/2-story brick houses on alluvial soil in northeast Helena, but severe damage also occurred in the southern business section of Helena. Downed chimneys and cracked plaster were common throughout the city, and in sections, almost all chimneys were destroyed. Gables commonly were damaged, regardless of the structural material used or the location of the building.

The most severely damaged structure in the area was the Helena High School, constructed a few months earlier, in August 1935. Many large buildings were damaged heavily, including the City Hall, Kessler Brewery, and St. Joseph's Orphanage, but damage was slight to structures on solid bedrock (e.g., the State Capitol, Federal Building, and St. Helena Cathedral). In general, wood buildings covered with wood siding and structures having a framework of reinforced concrete or steel sustained little damage. Tombstones in all the cemeteries in the area were twisted or overturned.

The ground cracks observed were shallow, narrow, surface cracks in alluvial material caused by shaking of the ground, and none represent slip along the fault plane. East of town, water flowed from the cracks that formed in the ground. The largest crack, a maximum of 13 cm wide and 91 m long, was observed on the gravel road leading into the Stanchfield Gun Club.

Changes in the volume of flow of many wells and springs occurred. The most noted change was an increase in flow of springs or the formation of new springs. Seven Mile Creek, which was almost dry before the earthquake, was about 1.5 m wide and 30 to 45 cm deep when it was observed on Oct. 31. Also felt in parts of Idaho, Washington, Wyoming, and in adjacent areas of Canada. (Ref. 8, 38, 316, 503.)

1935. Oct. 27. Helena, Mont. Described as strong, this aftershock of the Oct. 19 earthquake

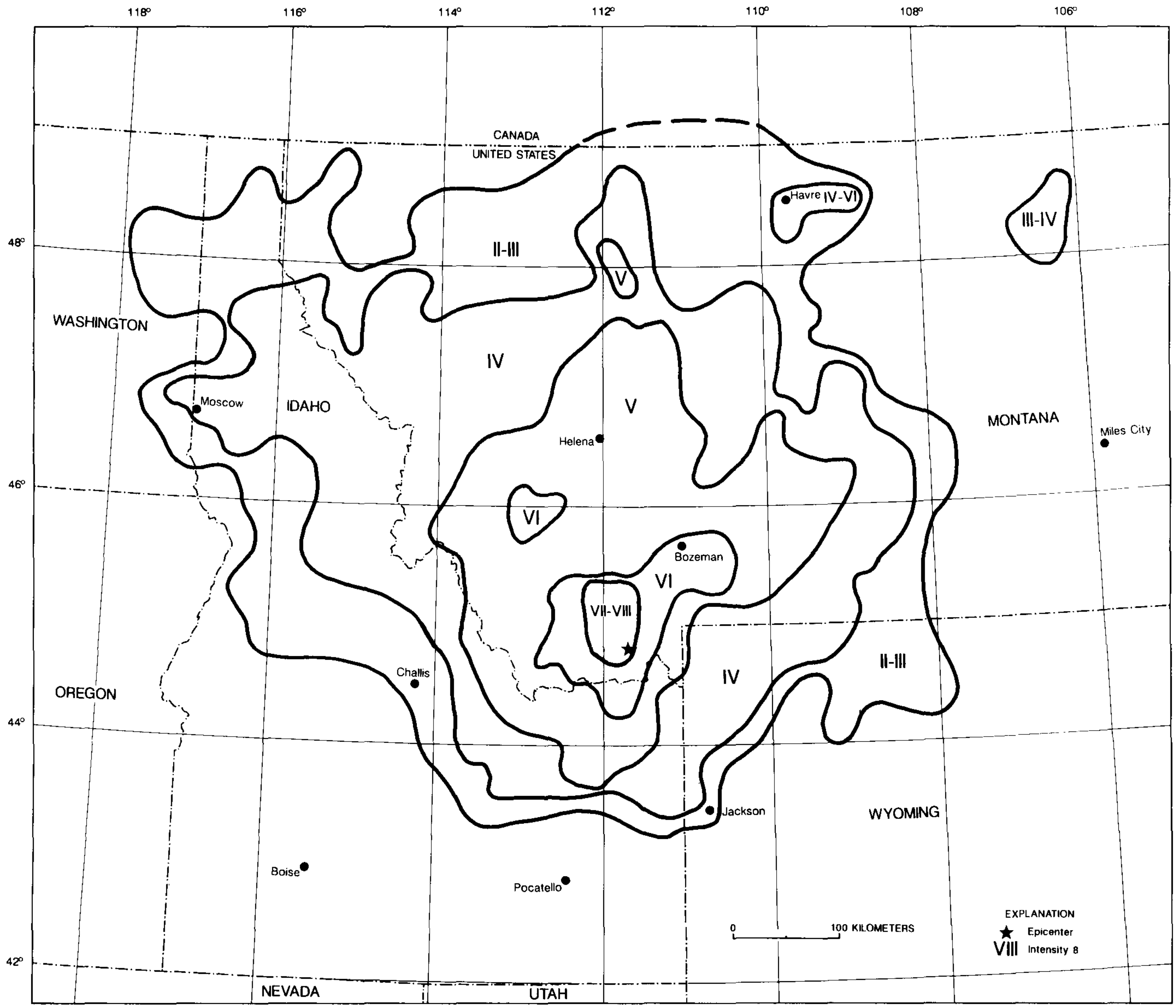


FIGURE 37.—Isoseismal map for the southwest Montana earthquake of November 23, 1947. Isoseismals are based on intensity estimates from data listed references 20 and 259 of table 1.

shook down previously weakened chimneys at Helena. (Ref. 8, 38, 316.)

1935. Oct. 31. Helena, Mont. This aftershock was almost as severe as the main tremor on Oct. 19. Two people were killed at Helena, and about $1 million in property damage occurred, bringing the death toll from this series to four and the damage total to $4 million. (Ref. 512 reports a total of 6 deaths and $5.5 million damage). It intensified the damage in all the towns and damaged structures weakened by previous shocks. Most residents described it as sharper and more pronounced than the main earthquake on Oct. 19.

Many buildings previously damaged were demolished, including the new Helena High School and the Kessler Brewery. Damage was most severe in the neighborhood of the City Hall on Main Street and in the residential district on 9th Street. On the west side of town, damage from this shock was more severe than that caused by the Oct. 19 earthquake. Damage to frame buildings was slight, except to their chimneys and brick-veneer facing.

The ground in Helena Valley again was cracked. Water was observed spurting 30 cm or more from cracks, and dust was emitted from others. All chimneys in this neighborhood were downed, and a bridge was shifted slightly. Several tombstones turned over in the Resurrection Cemetery, about 5 km north of Helena. Also felt in parts of Idaho, Washington, Wyoming, and Canada. Magnitude 5.5 M_L KJ. (Ref. 8, 38, 316, 460, 512.)

1935. Nov. 4. Helena, Mont. A series of strong tremors, the strongest at 11 23 and 12 42 UTC, threw down weakened structures at Helena. Walls of the Federal Reserve Bank cracked. One additional building was designated as unsafe for habitation. (Ref. 8, 249.)

1935. Nov. 22 (Nov. 21). Helena, Mont. Buildings previously weakened were damaged slightly at Helena. (Ref. 8, 38.)

1935. Nov. 28. Helena, Mont. Brick walls damaged by earlier earthquakes were further weakened at Helena, and a few were thrown down. This event was described as the fourth strongest of the Helena series of earthquakes. (Ref. 8, 38.)

1936. Feb. 14 (Feb. 13). Helena, Mont. This strong tremor caused some minor damage and much alarm at Helena. (Ref. 9, 38, 259.)

1938. June 13. Trident, Gallatin County, Mont. This shock was strongest at Trident, where plaster cracked slightly in several houses and objects fell from shelves. (Ref. 11, 249.)

1938. June 14 (June 13). Trident, Gallatin County, Mont. Strongest at Trident, this shock cracked plaster in several houses and threw down rocks in a quarry at a cement plant. Though alarmed, residents reported that it was slightly less severe than the earthquake 10 hours earlier. (Ref. 11, 249.)

1939. May 12 (May 11). Trident, Gallatin County, Mont. Plaster cracked and people ran outdoors at Trident. (Ref. 12.)

1940. Dec. 23. Helena, Mont. At Helena, plaster cracked in a few buildings and one wall cracked. At East Helena, windows cracked. About 10 km north of Helena, in Scratch Gravel Hills, rocks rolled from cliffs. City officials reported an increase in the flow of water into the Hale Reservoir. (Ref. 13, 38, 266.)

1943. June 25 (June 24). Southern Sheridan County, Mont. In Froid, a well-constructed granary was cracked so severely that grain spilled out. Cracks formed in plaster and chimneys at Homestead, Redstone, and Reserve. (Ref. 38, 330.)

1945. Sept. 23. Northwest Montana. The earthquake cracked chimneys and broke windows at Elmo and cracked plaster at Bigfork, near Flathead Lake, south of Kalispell. One window was broken at Polson, south of Elmo. Also felt in Idaho and Washington. (Ref. 18, 266.)

1946. Dec. 11. Northwest Montana. This earthquake was described as sharp at Kalispell, where plaster and chimneys cracked, bricks fell, and dishes broke. Plaster also cracked at Whitefish. (Ref. 19, 249.)

1947. Mar. 14. Seeley Lake, Missoula County, Mont. Plaster cracked and fell to the floor at Seeley Lake, northeast of Missoula. (Ref. 38.)

1947. Nov. 23. Southwest Montana. Chimneys fell, twisted, or cracked in several towns in Madison County, including Alder, Cameron, Ennis, Laurin, and Virginia City. New springs formed in several areas, and creeks became muddy. Huge rocks rolled down the mountainside. Brick, masonry, and concrete structures sustained much damage. Also felt in parts of Idaho, Washington, and Wyoming (see fig. 37). (Ref. 20, 38, 576.)

1950. Aug. 20 (Aug. 19). Western Montana. Two wells became muddy in Sanders County, in the Niarada area; a minor rockslide occurred at Mud Lake Lookout. (Ref. 23, 266.)

1952. Apr. 1 (Mar. 31). Northwest Montana. Brick, masonry, and concrete sustained slight damage at Flathead Lake, south of Kalispell. Chimneys twisted and fell, and walls and chimneys cracked. (Ref. 25.)

1952. Apr. 22. Western Montana. The earthquake was strongest in the area near Townsend and Toston, southeast of Helena, in Broadwater County. Bricks fell from a chimney; plaster fell inside a camphouse; and a parked jeep was moved about 1 m. (Ref. 25.)

1953. Aug. 8. Flathead Lake area, Lake County, Mont. A sharp, jarring movement caused doors to sag on two sheds on the east shore of Flathead Lake, about 20 km south of Bigfork. At Yellow Bay, cracks formed in an old building. (Ref. 26, 249.)

1958. May 28. Western Montana. At Philipsburg, Granite County, bricks fell from several buildings, plaster cracked, and windows broke. In the Porters Corner area, near Philipsburg, a heavy candy case was displaced about 10 cm. (Ref. 31.)

1959. Aug. 18 (Aug. 17). Hebgen Lake, Mont. This earthquake caused 28 fatalities and about $11 million in damage to highways and timber. It is characterized by extensive fault scarps, subsidence and uplift, a massive landslide, and a seiche in Hebgen Lake. A maximum MM intensity X was assigned to the fault scarps in the epicentral area. The instrumental epicenter lies within the region of surface faulting. Area of perceptibility (see fig. 38), maximum intensity, and Richter magnitude all were larger for this earthquake than for any earlier earthquake on record in Montana (from May 1869).

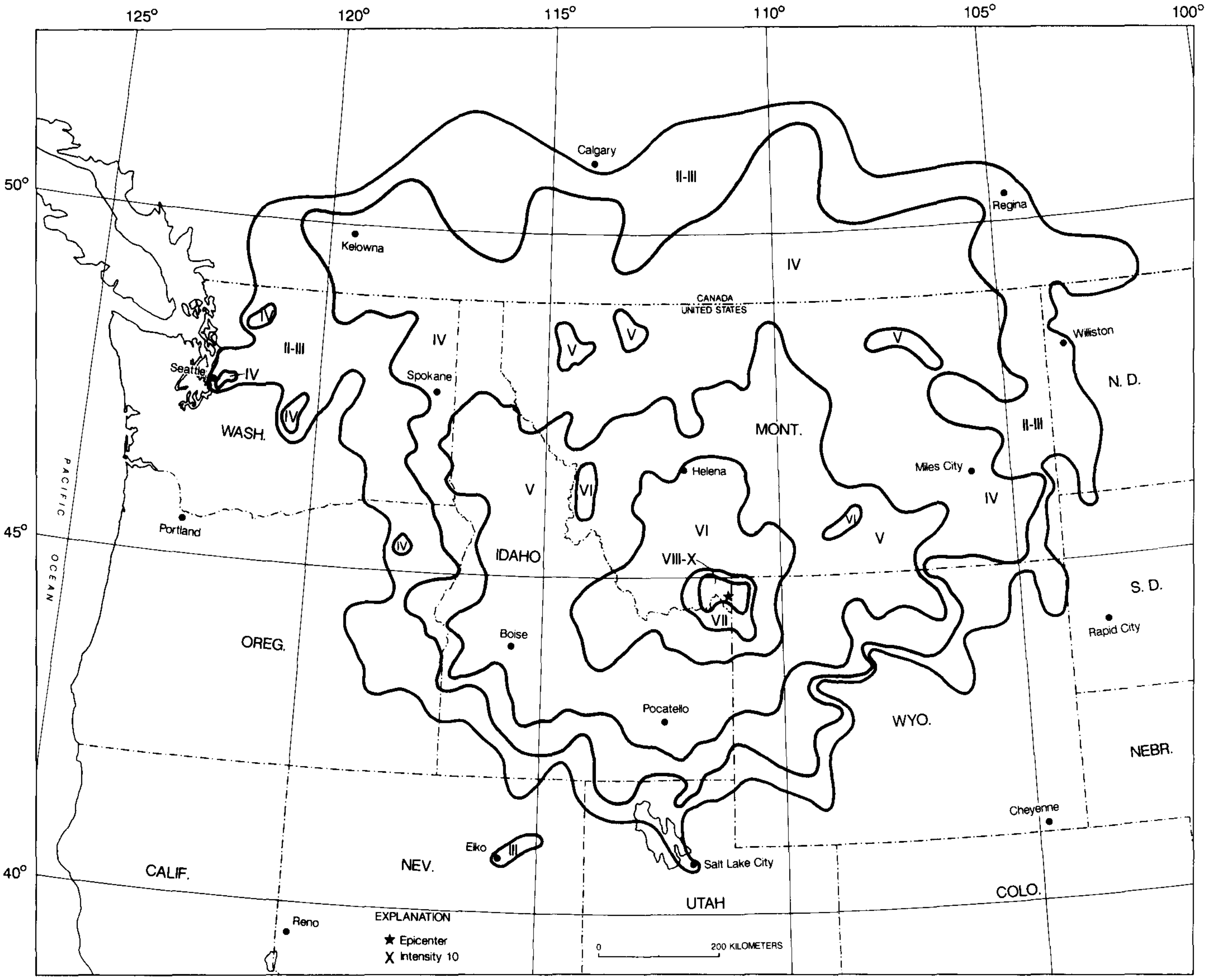


FIGURE 38.—Isoseismal map for the Hebgen Lake, Montana, earthquake of August 18, 1959. Isoseismals are based on intensity estimates from data listed in references 32, 259, and 438 of table 1.

The most spectacular and disastrous effect of the earthquake was the huge avalanche of rock, soil, and trees that cascaded from the steep south wall of the Madison River Canyon. This slide formed a barrier that blocked the gorge and stopped the flow of the Madison River and, within a few weeks, created a lake almost 53 m deep. The volume of material that blocked the Madison River below Hebgen Dam has been estimated at 28–33 million m^3. Most of the 28 deaths were caused by rockslides that covered the Rock Creek public campground on the Madison River, about 9.5 km below Hebgen Dam.

New fault scarps as high as 6 m formed near Hebgen Lake. The major fault scarps formed along preexisting normal faults northeast of Hebgen Lake. Subsidence occurred over much of an area that was about 24 km north-south and about twice as long east-west. As result of the faulting near Hebgen Lake, the bedrock beneath the lake was permanently warped, causing the lake floor to drop and generate a seiche. Maximum subsidence was 6.7 m in Hebgen Lake Basin. About 130 km^2 subsided more than 3 m, and about 500 km^2 subsided more than 0.3 m. The earth-fill dam sustained significant cracks in its concrete core and spillway, but it continued to be an effective structure.

Many summer houses in the Hebgen Lake area were damaged: houses and cabins shifted off their foundations, chimneys fell, and pipelines broke. Most small-unit masonry structures and wooden buildings

Landslide and slumping damage to State Highway 287, along the shore of Hebgen Lake, Montana, caused by the August 18, 1959 (Aug. 17 MST), earthquake. (Photograph by J.R. Stacy.)

along the major fault scarps survived with little damage when subjected only to vibratory forces. Roadways were cracked and shifted extensively, and much timber was destroyed. Highway damage near Hebgen Lake was due to landslides slumping vertically and flowing laterally beneath pavements and bridges, which caused severe cracks and destruction. Three of the five reinforced bridges in the epicentral area also sustained significant damage.

High intensities were observed in the northwest section of Yellowstone National Park. Here, new geysers erupted, and massive slumping caused large cracks in the ground from which steam emitted. Many hot springs became muddy.

On the basis of vibration damage (and excluding geologic effects), damage to buildings along the fault zone was singularly unspectacular (MM intensity VIII at places, intensity VII generally). Minor damage occurred throughout southern Montana, northeast Idaho, and northwest Wyoming. Felt as far as Seattle, Wash., to the west; Banff, Canada, to the north; Dickinson, N. Dak., to the east; and Provo, Utah, to the south. This area includes nine Western States and three Canadian Provinces. Aftershocks continued for several months. Magnitude 7.5 Ukn PAS, 7.5 M_S ABE, 7.3 m_b ABE. (Ref. 38, 281, 310, 438, 504, 576.)

1959. Aug. 23. Hebgen Lake, Mont., aftershock. A strong earthquake generated a rockslide above Hebgen Dam that blocked the road. (Ref. 32, 38.)

1959. Sept. 5. Hebgen Lake, Mont., aftershock. This event broke plumbing and dishes at

Damaged and collapsed buildings at the Blarneystone Ranch, near Hebgen Lake, Montana, caused by the August 18, 1959 (Aug. 17 MST), earthquake. Note the fault scarp running beneath the building. (Photograph by I.J. Witkind.)

Canyon, in Yellowstone National Park. Rockslides smashed the viewing platform in the Grand Canyon of the Yellowstone. (Ref. 32, 38.)

1959. Sept. 13. Hebgen Lake, Mont., aftershock. Grayling Creek, which flows into Hebgen Lake at Parade Rest Ranch, was muddied. Rocks fell in the Hebgen Lake area. (Ref. 32, 266, 576.)

1959. Nov. 3. Hebgen Lake, Mont., aftershock. At Duck Creek (intersection of U.S. 191 and Montana State 1), a stove was moved about 30 cm from the wall and a sewing machine was displaced from the window to the middle of the room. (Ref. 32.)

1965. Jan. 6 (Jan. 5). Southwest Montana. A 10.7-m flagpole was broken in three places and dishes were thrown from shelves at Dewey, about 30 km southwest of Butte. The shock was felt strongly to the south at Dell, Beaverhead County. Also felt in Idaho. Magnitude 4.9 m_b NUT, 4.5 M_S NUT. (Ref. 75, 263, 354, 576.)

1969. Apr. 1. Northwest Montana. At Big Arm, on the southwest shore of Flathead Lake, the shock shifted a building several centimeters on its foundation, buckled a boathouse, damaged a dock, and muddied well water. At nearby Dayton, four chimneys were destroyed. The tremor twisted a chimney at Proctor, and caused deep wells to increase their flow of water. At Lake Mary Ronan, chimneys and concrete floors cracked and paneling on walls loosened. Also felt in Idaho. Magnitude 4.3 m_b NUT, 3.7 M_S NUT. (Ref. 42, 74, 263.)

1969. Sept. 15 (Sept. 14). Northwest Montana. At Big Arm, a crack extending in both horizontal and vertical directions formed in a building. One basement wall also was cracked. (Ref. 42, 74.)

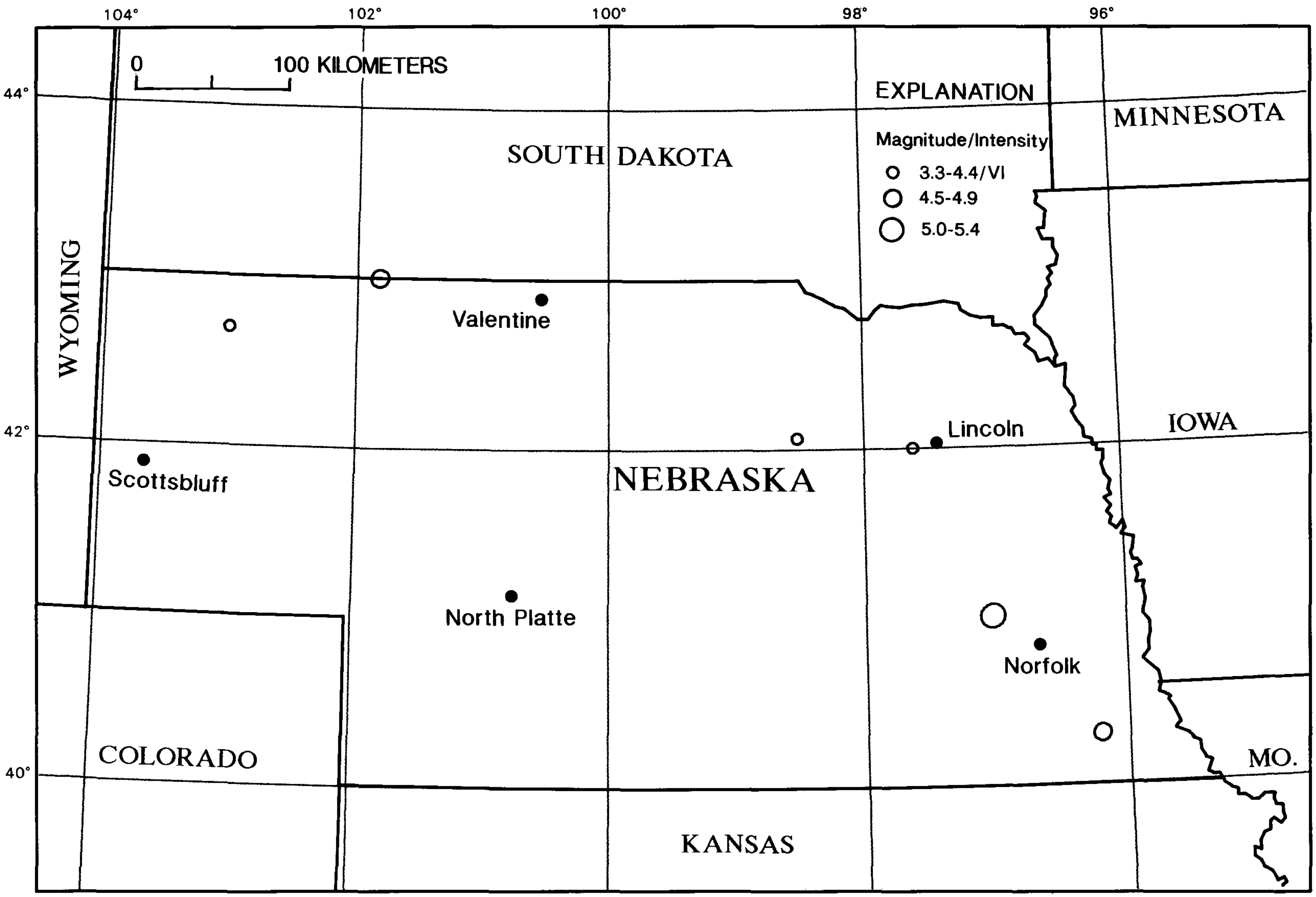
1969. Nov. 7 (Nov. 6). Northwest Montana. Slight damage occurred at Dayton, on the west shore of Flathead Lake, where plaster fell and small objects overturned. (Ref. 42, 74.)

1975. Feb. 4 (Feb. 3). Northwest Montana. Basement walls cracked and dishes broke at Creston, about 12 km east of Kalispell. Cracks formed in plaster at Kalispell and, about 30 km northeast, at Martin City. Also felt in Alberta and British Columbia, Canada. (Ref. 48.)

1977. Mar. 11 (Mar. 10). Southwest Broadwater County, Mont. Cracks formed in plaster at Harrison, about 65 km southeast of Butte. Also felt at Hudson, Maudlow, Radersburg, and Trident, and southeast to Yellowstone National Park, Wyo. (Ref. 39, 465.)

1977. Oct. 19. Northwest of West Yellowstone, Mont., in Madison County. Cracks formed in plaster at West Yellowstone. Buildings shook in Lima, and vehicles rocked in Clinton. (Ref. 39.)

1983. Mar. 17. Near Lincoln, Lewis and Clark County, Mont. Damage at Lincoln included cracks in chimneys, foundations of houses, interior walls, and windows. Items were thrown from shelves at Augusta, about 65 km northeast of Lincoln, and furniture was displaced in the Great Falls area of Cascade County, east of Augusta. (Ref. 360.)



Earthquakes in Nebraska with magnitudes ≥ 4.5 or intensity ≥VI.

NEBRASKA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1877	11	15	17 45	41.0 N	97.0 W	—	105	—	—	5.10M_{fa} SC	—	VII	105	450
1902	07	28	18 00	42.0 N	97.6 W	—	105	—	—	4.40M_{fa} SC	—	VI	105	90
1934	07	30	07 20	42.7 N	103.0 W	—	38	—	—	4.30M_{fa} SC	—	VI	38	60
1935	03	01	11 00	40.3 N	96.2 W	—	38	—	—	4.60M_{fa} SC	—	VI	38	210
1964	03	28	10 08 46.5	42.997N	101.798W	030	349	5.1	—	4.50M_n DG	—	VII	37	150
1975	05	13	07 53 40.0	42.070N	98.503W	001	349	4.3	—	3.30M_n DG	—	VI	48	—

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1877. Nov. 15. Eastern Nebraska, between Lincoln and Columbus. This is the largest earthquake known to have originated in Nebraska. Its proposed epicenter lies on the western flank of the Keweenawan mafic belt. Damage was most severe at Columbus, in Colfax County, northwest of the epicenter, where the 30-second shock split the courthouse walls in nine places and damaged the schoolhouse walls. Two severe shocks about 350 km west of Lincoln, at North Platte, cracked walls and overturned printing cases. About 200 km north of Lincoln, at Sioux City, Iowa, a high school sustained cracks in a wall. Felt over all or parts of Iowa, Kansas, Minnesota, Missouri, Nebraska, South Dakota, and Wisconsin. Magnitude 5.0 M_{fa} BAR. (Ref. 38, 105, 353, 463.)

1902. July 28. Battle Creek, Madison County, Nebr. This earthquake was reported to be most strong at Battle Creek, where it lasted for 30 seconds and spilled water from buckets. At nearby Tilden, one chimney was destroyed, plaster was cracked, and dishes fell from shelves. Reported in western Iowa and as far east as Chicago, Ill. Magnitude 4.5 M_{fa} BAR. (Ref. 38, 105, 353.)

1934. July 30. Chadron, Dawes County, Nebr. Chimneys were damaged, plaster fell, and objects toppled from shelves at Chadron. Felt in western Nebraska and in the adjacent States of South Dakota and Wyoming. Magnitude 4.5 M_{fa} BAR. (Ref. 38, 105, 353.)

1935. Mar. 1. Tecumseh, Johnson County, Nebr. This earthquake has been attributed to slippage on the Humboldt fault along the east side of the Nemaha Ridge. Many chimneys cracked and a few collapsed at Tecumseh, and windows broke and cracks formed in plaster and stone walls. Two shocks, about 4 minutes apart, were felt; the first was the strongest. Also felt in Iowa, Kansas, and Missouri. Magnitude 3.0 M_S BAR, 4.7 M_{fa} BAR. (Ref. 38, 353.)

1964. Mar. 28. Near Merriman, northwest Cherry County, Nebr. Many cracks formed in the roadway south of Merriman, and steep slopes slumped into the Niobrara River. Merchandise in stores was broken, dishes were broken, and stucco under windows cracked. At Alliance, about 135 km southwest of Merriman, part of a chimney cap fell on a house; at Rushville, about 35 km southwest of Merriman, plaster fell and a wall cracked. Also felt in Montana, South Dakota, and Wyoming (see fig. 39). Magnitude 4.7 M_n BAR. (Ref. 37, 349, 353.)

1975. May 13. Near Bartlett, Wheeler County, Nebr. The shock cracked stucco in Bartlett and knocked cans from shelves in a store. Also reported felt northeast of the epicenter at Hudson, South Dakota. Magnitude 3.5 M_n SLM. (Ref. 48, 349.)

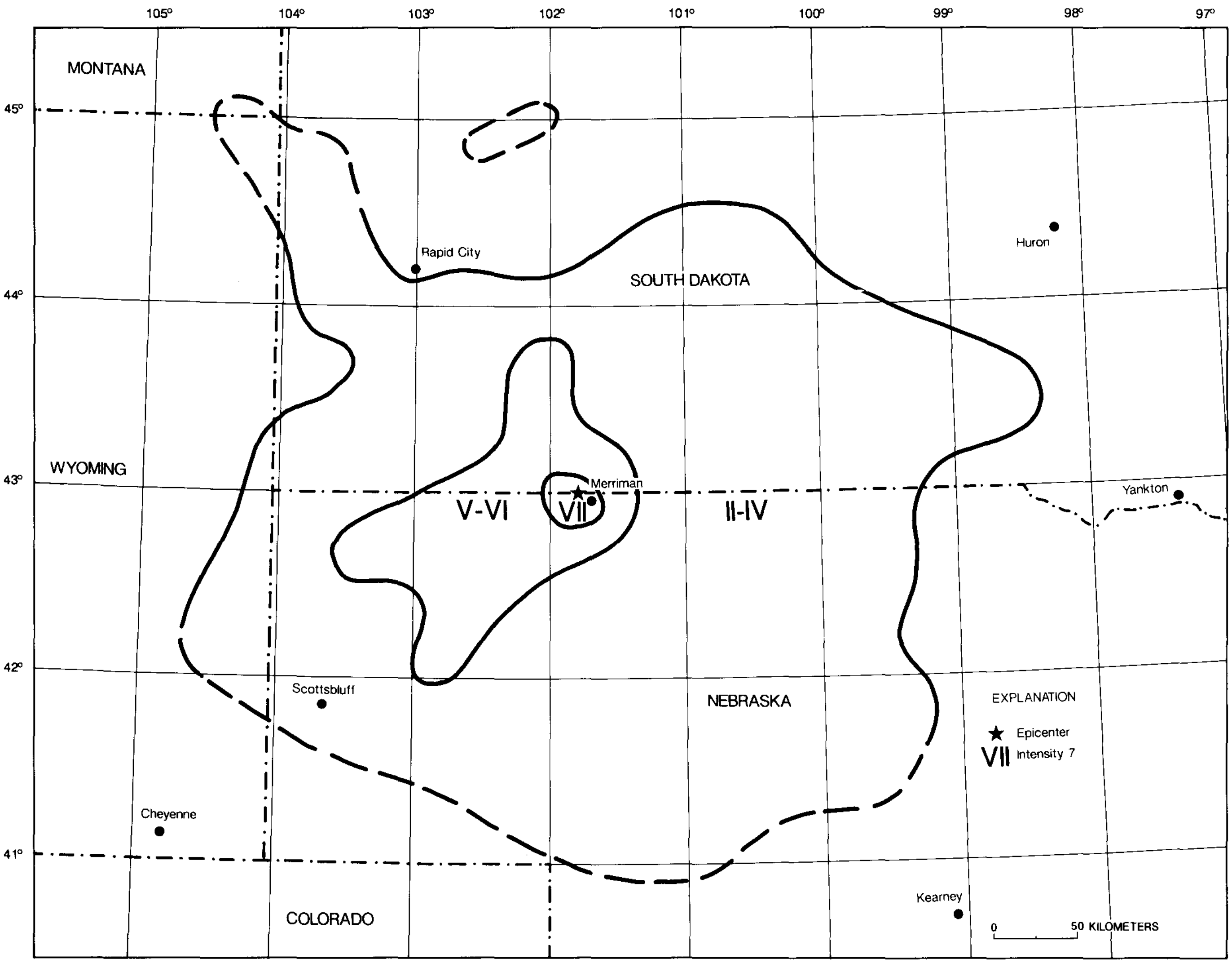
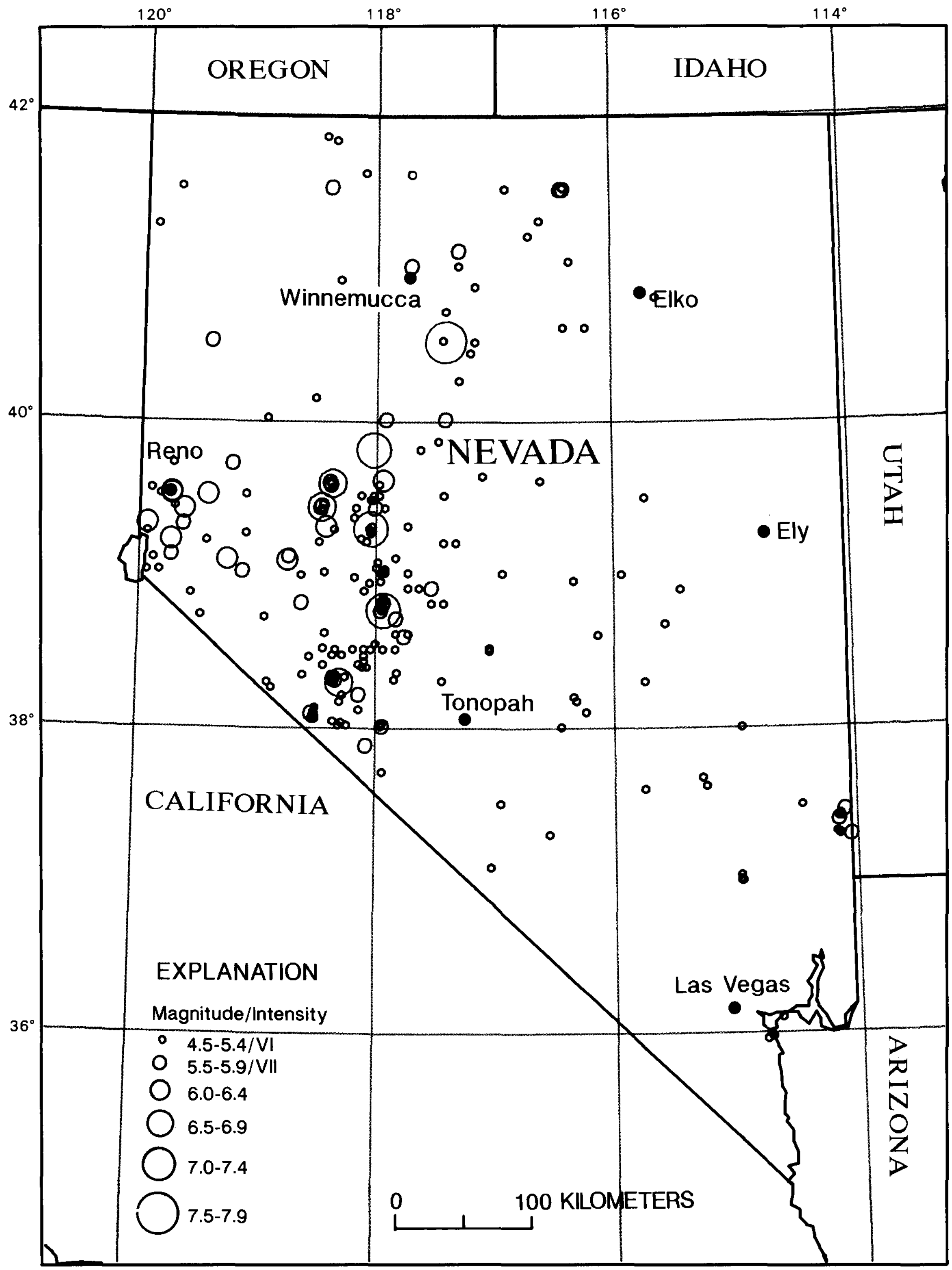


FIGURE 39.— Isoseismal map for the northwest Nebraska earthquake of March 28, 1964. Isoseismals are based on intensity estimates from data listed in reference 37 of table 1.

NEVADA



Earthquakes in Nevada with magnitudes ≥ 4.5 or intensity ≥ VI.

NEVADA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1857	09	03	03 05	39.3 N	120.0 W	—	368	—	—	6.00M_{La} DMG	—	V	368	—
1860	03	15	19 00	39.5 N	119.5 W	—	368	—	—	6.30M_{La} DMG	—	VI	368	—
1868	05	30	05 10	39.3 N	119.7 W	—	368	—	—	5.80M_{La} DMG	—	VII	54	190
1869	12	27	01 55	39.4 N	119.7 W	—	368	—	—	6.10M_{La} DMG	—	VII	368	180
1869	12	27	10 00	39.1 N	119.8 W	—	368	—	—	5.90M_{La} DMG	—	VII	368	—
1872	03	23	21 41	40.0 N	117.5 W	—	54	—	—	5.50M_{fa} SJG	—	VI	38	31
1872	11	12		39.0 N	117.0 W	—	521	—	—	6.00M_{La} ELL	—	Felt	54	129
1873	11	05	17 00	40. N	118. W	—	54	—	—	5.50M_{fa} SJG	—	Felt	54	—
1875	04	02	02 00	39.5 N	115.8 W	—	54	—	—	—	—	VI	54	—
1877	07	10	07 10	39.3 N	120.0 W	—	54	—	—	5.00M_{fa} SJG	—	IV	54	—
1887	06	03	10 48	39.2 N	119.8 W	—	54	—	—	6.30M_{La} DMG	—	VIII	368	—
1888	01	30	06 35	39.0 N	120.0 W	—	54	—	—	4.50M_{fa} SJG	—	V	54	—
1894	11	18	10 49	39.2 N	119.5 W	—	54	—	—	—	—	VI	56	—
1896	01	27	21 01	39.1 N	119.8 W	—	54	—	—	—	—	VI	54	—
1897	05	15	19 04	39.3 N	119.7 W	—	54	—	—	—	—	V	54	—
1901	07	26	22 20	40.8 N	115.7 W	—	54	—	—	5.00M_{fa} SJG	—	VII	54	9
1903				39.5 N	118.1 W	—	54	—	—	—	—	VI	328	—
1910	11	07	17 20	37.5 N	117.0 W	—	54	—	—	—	—	VI	56	—
1910	11	19	02 25	38.0 N	118.0 W	—	54	—	—	—	—	Felt	56	—
1910	11	21	23 23	38.0 N	118.0 W	—	54	—	—	—	—	VII	56	—
1910	11	22	06 05	38.0 N	118.0 W	—	54	—	—	—	—	Felt	56	—
1914	02	18	18 17	39.5 N	119.8 W	—	54	—	—	6.00M_{fa} SJG	—	VI	38	42
1914	04	24	08 35	39.5 N	119.8 W	—	54	—	—	6.40M_{fa} SJG	—	VII	56	260
1915	10	03	01 49	40.5 N	117.5 W	—	54	—	—	—	—	V	327	—
1915	10	03	06 52 48.0	40.5 N	117.5 W	—	258	—	—	7.70M_s AB1	7.14WAL	X	56	788
1916	02	03	05 03 04	41.0 N	117.8 W	—	54	—	—	5.90M_{fa} SJG	—	V	272	278
1916	08	03	13 49 19	41.5 N	116.5 W	—	54	—	—	5.60M_x SJG	—	IV	272	—
1916	08	03	14 22 38	41.5 N	116.5 W	—	54	—	—	5.80M_x SJG	—	Felt	56	—
1916	08	04	04 12 52	41.5 N	117.0 W	—	54	—	—	5.00M_x SJG	—	Felt	54	—
1916	10	11	05 49 09	41.5 N	116.5 W	—	54	—	—	5.00M_x SJG	—	Felt	56	—
1917	03	28	11 16 00	41.6 N	117.8 W	—	54	—	—	4.70Ukn JON	—	IV	315	—
1917	04	11	18 59 55	40.0 N	118.0 W	—	54	—	—	5.10M_x SJG	—	III	272	—
1925	08	21	11 13 57	38.0 N	118.3 W	—	54	—	—	4.80M_x SJG	—	V	56	—
1928	03	26	16 26 07	38.3 N	117.5 W	—	54	—	—	4.70M_x SJG	—	Felt	54	—
1928	04	17	10 39 15	39.50 N	119.83 W	—	324	—	—	4.50M_x SJG	—	IV	1	—
1929	09	10	20 01	41.2 N	116.8 W	—	54	—	—	4.60M_x SJG	—	IV	54	—
1930	04	09	21 56 47	39.25 N	120.00 W	—	324	—	—	4.30M_x SJG	—	VI	3	49
1930	04	12	12 56 40	39.25 N	119.17 W	—	324	—	—	4.50M_x SJG	—	VI	3	30
1932	12	21	06 10 05	38.75 N	118.0 W	—	258	—	—	7.20M_s GR	—	X	38	795
1932	12	22	07 49 30	38.75 N	118.0 W	—	315	—	—	4.50Ukn SJG	—	Felt	315	—
1932	12	22	10 34 15	38.75 N	118.0 W	—	315	—	—	4.90M_x SJG	—	Felt	315	—
1932	12	23	20 06	38.75 N	118.0 W	—	315	—	—	4.50Ukn SJG	—	—	—	—
1932	12	24	12 40 49	38.8 N	118.0 W	—	54	—	—	5.00M_x SJG	—	Felt	54	—
1932	12	25	03 54 45	38.8 N	118.0 W	—	54	—	—	5.50M_x SJG	—	Felt	356	—
1932	12	25	18 36 35	38.8 N	118.0 W	—	54	—	—	4.50M_x SJG	—	Felt	54	—
1932	12	26	05 03	38.75 N	118.0 W	—	315	—	—	5.30M_x SJG	—	Felt	356	—
1932	12	28	03 07 55	38.8 N	118.0 W	—	54	—	—	4.60M_x SJG	—	Felt	54	—

NEVADA— Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr Mo Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1932 12 29	06 20 28	38.8 N	118.0 W	—	54	—	—	5.20M_X SJG	—	Felt	54	—
1932 12 29	06 38 03	38.8 N	118.0 W	—	54	—	—	5.00M_X SJG	—	Felt	54	—
1932 12 29	06 45 08	38.8 N	118.0 W	—	54	—	—	5.00M_X SJG	—	Felt	54	—
1932 12 30	04 17 52	38.8 N	118.0 W	—	54	—	—	4.60M_X SJG	—	Felt	54	—
1932 12 30	16 03 10	38.8 N	118.0 W	—	54	—	—	4.60M_X SJG	—	Felt	54	—
1932 12 31	17 30	38.6 N	117.9 W	—	54	—	—	4.60M_X SJG	—	—	—	—
1933 01 02	15 44 08	38.8 N	118.0 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1933 01 02	17 06 44	38.8 N	118.0 W	—	54	—	—	4.70M_X SJG	—	—	—	—
1933 01 04	01 01 15	38.8 N	118.0 W	—	315	—	—	5.10M_X SJG	—	Felt	54	—
1933 01 05	06 50 20	38.75 N	118.00 W	—	258	—	—	5.70M_s GR	—	Felt	356	—
1933 01 06	13 05 56	39.0 N	117.8 W	—	54	—	—	5.10M_X SJG	—	—	—	—
1933 01 06	13 33	39.0 N	118.0 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1933 01 11	17 29 38	38.9 N	117.8 W	—	54	—	—	5.20M_X SJG	—	—	—	—
1933 01 17	01 02 08	38.8 N	118.0 W	—	315	—	—	4.80M_X SJG	—	—	—	—
1933 01 29	13 51 11	38.5 N	118.0 W	—	54	—	—	5.00M_X SJG	—	—	—	—
1933 02 13	22 08 45	38.7 N	117.9 W	—	265	—	—	5.50M_X SJG	—	IV	6	—
1933 03 12	20 44 20	38.8 N	117.6 W	—	54	—	—	5.00M_X SJG	—	IV	54	—
1933 04 07	00 17 56	38.0 N	118.0 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1933 04 30	16 16 50	39.8 N	118.1 W	—	315	—	—	4.50M_X SJG	—	—	—	—
1933 05 09	09 46 25	38.5 N	117.9 W	—	54	—	—	5.10M_X SJG	—	III	54	—
1933 06 04	14 08 22	38.50 N	118.16 W	016	324	—	—	5.20M_X SJG	—	V	6	—
1933 06 11	08 34 31	38.8 N	117.5 W	—	315	—	—	5.20M_X SJG	—	IV	54	—
1933 06 25	20 45 27.0	39.08 N	119.33 W	—	324	—	—	6.10M_s GR	—	VII	6	175
1933 07 17	20 57 14	39.2 N	118.15 W	—	315	—	—	4.60M_X SJG	—	—	—	—
1933 07 21	02 55	38.45 N	118.16 W	—	324	—	—	4.70M_X SJG	—	IV	6	—
1933 07 21	03 07	38.42 N	118.16 W	—	324	—	—	4.70M_X SJG	—	Felt	324	—
1933 10 27	10 58 54	38.9 N	117.6 W	—	6	—	—	5.50M_X SJG	—	V	6	—
1934 01 30	19 23 29	38.3 N	118.4 W	—	38	—	—	5.50M_s CFR	—	VII	54	—
1934 01 30	20 16 31	38.28 N	118.36 W	—	324	—	—	6.50M_s CFR	—	VIII	7	205&
1934 01 30	20 34	38.3 N	118.4 W	—	315	—	—	4.50M_X JON	—	Felt	7	—
1934 01 30	21 04 23	38.3 N	118.4 W	—	54	—	—	4.90M_X SJG	—	IV	7	—
1934 01 30	23 39 38	38.3 N	118.4 W	—	324	—	—	5.40M_X SJG	—	Felt	7	—
1934 01 31	00 24 22	38.3 N	118.4 W	—	54	—	—	5.00M_X SJG	—	Felt	266	—
1934 01 31	03 54 49	38.3 N	118.4 W	—	54	—	—	5.00M_X SJG	—	Felt	7	—
1934 01 31	14 26 39	38.3 N	118.4 W	—	54	—	—	4.60M_X SJG	—	Felt	266	—
1934 02 01	11 00 54	38.3 N	118.4 W	—	54	—	—	5.00M_X SJG	—	IV	7	—
1934 02 01	11 18 51	38.50 N	118.25 W	—	324	—	—	5.20M_X SJG	—	V	7	—
1934 02 01	11 45 54	38.3 N	118.4 W	—	54	—	—	5.40M_X SJG	—	V	7	—
1934 02 01	12 10 23	38.3 N	118.4 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1934 02 01	13 20 45	38.3 N	118.4 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1934 02 01	18 34 44	38.3 N	118.4 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1934 02 03	16 31	38.3 N	118.4 W	—	54	—	—	4.50M_L PAS	—	—	—	—
1934 02 09	09 20 34	38.3 N	118.4 W	—	54	—	—	5.50M_L PAS	—	IV	7	—
1934 02 10	13 13 46	38.3 N	118.4 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1934 02 12	22 00 54	38.3 N	118.4 W	—	54	—	—	4.70M_X SJG	—	—	—	—
1934 02 16	01 54 53	38.3 N	118.4 W	—	54	—	—	4.80M_X SJG	—	—	—	—
1934 02 20	05 36 59	38.3 N	118.4 W	—	54	—	—	4.80M_X SJG	—	—	—	—
1934 03 13	16 20 19	38.0 N	118.0 W	—	7	—	—	4.70M_X JON	—	V	315	—

NEVADA— Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km²)
1934	03	19	10 40 57	38.35 N	117.88 W	—	54	—	—	4.50M_X JON	—	IV	7	—
1934	03	28	09 37	37.3 N	116.6 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1934	03	30	16 26	37.67 N	115.33 W	016	292	—	—	4.90M_X JON	—	—	—	—
1934	03	31	00 11 48	38.1 N	116.3 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1934	04	02	08 05	38.0 N	118.0 W	—	324	—	—	4.50M_L PAS	—	—	—	—
1934	04	15	12 09	38.0 N	115.0 W	—	54	—	—	5.00M_{fa} WOO	—	—	—	—
1934	04	21	23 22	39.0 N	117.0 W	—	54	—	—	4.50M_L BRK	—	—	—	—
1934	04	22	11 24	38.0 N	118.0 W	—	54	—	—	4.60M_X SJG	—	—	—	—
1934	12	04	06 17 46	38.4 N	118.5 W	—	54	—	—	4.50M_X SJG	—	—	—	—
1935	01	21	00 08 49	38.5 N	117.9 W	—	54	—	—	4.60M_X SJG	—	—	—	—
1936	01	14	05 29 11	39.5 N	117.5 W	—	54	—	—	4.60M_X SJG	—	IV	54	—
1936	01	30	18 32	38.0 N	118.0 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1936	02	27	00 40	41.0 N	119.0 W	—	54	—	—	4.50M_L BRK	—	—	—	—
1936	03	26	22 43 40	39.1 N	117.9 W	—	54	—	—	4.50M_X SJG	—	IV	54	—
1936	07	02	16 29	39.2 N	117.5 W	—	324	—	—	5.00M_{fa} WOO	—	Felt	324	—
1936	09	07	11 48	36.0 N	114.8 W	—	54	—	—	4.50Ukn SJG	—	IV	54	—
1936	09	21	07 31	40.25 N	117.38 W	—	315	—	—	4.50M_L PAS	—	IV	54	—
1936	09	22	10 39 07	40.43 N	117.28 W	—	315	—	—	4.70M_X SJG	—	—	—	—
1937	02	19	09 09 10	38.3 N	118.3 W	—	10	—	—	5.00M_L BRK	—	V	10	29
1937	02	19	23 06	38.0 N	118.0 W	—	10	—	—	4.50M_L BRK	—	IV	259	—
1937	04	25	04 27 48	39.0 N	117.0 W	—	10	—	—	4.50M_L BRK	—	V	10	37
1937	05	25	05 35 20	41.5 N	119.8 W	—	54	—	—	4.60M_X JON	—	—	—	—
1937	06	18	09 07 26	41.25 N	120.0 W	—	324	—	—	5.25M_s GR	—	V	10	75
1937	08	19	07 05 15	38.1 N	118.2 W	—	54	—	—	4.60M_X SJG	—	V	10	—
1938	07	28	00 38 30	37.6 N	115.8 W	016	266	—	—	4.50M_L PAS	—	—	—	—
1938	07	31	10 37 07	38.3 N	115.8 W	—	266	—	—	4.50M_L PAS	—	—	—	—
1938	11	01	13 53 20	39.0 N	116.0 W	—	54	—	—	4.50M_L PAS	—	—	—	—
1939	01	11	22 00	39.0 N	119.2 W	—	324	—	—	5.50M_{fa} WOO	—	VI	12	24
1939	04	28	21 59	39.0 N	117.0 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1939	05	04	20 44 46.8	35.967N	114.817W	—	292	—	—	5.00M_L PAS	—	VI	12	18
1939	05	11	18 04	38.58 N	117.83 W	—	324	—	—	5.50M_L BRK	—	VI	12	115
1939	05	11	20 59 30	38.58 N	117.83 W	—	266	—	—	4.70M_X SJG	—	Felt	259	—
1939	05	13	02 49 06	38.58 N	117.83 W	—	266	—	—	4.80M_X SJG	—	—	—	—
1939	05	17	18 18 48	38.58 N	117.83 W	—	266	—	—	4.50M_X SJG	—	—	—	—
1939	06	21	11 28 30	38.6 N	117.8 W	—	12	—	—	4.50M_L BRK	—	—	—	—
1940	03	10	18 01 54.0	37.0 N	115.0 W	016	292	—	—	5.00M_{fa} WOO	—	IV	54	—
1940	03	11	00 06 30	37.0 N	115.0 W	016	292	—	—	4.50M_L PAS	—	Felt	54	—
1940	04	07	08 42	37.0 N	115.0 W	016	292	—	—	4.50M_L PAS	—	IV	259	—
1940	07	08	10 04 45	38.58 N	117.83 W	—	13	—	—	4.50M_L BRK	—	IV	259	—
1941	07	18	03 53 42	40.0 N	119.0 W	—	324	—	—	5.00M_L BRK	—	Felt	14	—
1941	08	29	13 09 53.0	41.5 N	118.5 W	—	258	—	—	5.50M_s GR	—	Felt	54	—
1942	07	11	16 41 56	38.5 N	117.1 W	—	266	—	—	5.00M_L BRK	—	IV	15	—
1942	07	11	16 45	38.5 N	117.1 W	—	15	—	—	4.50Ukn SJG	—	IV	15	—
1942	08	18	21 55 24	38.6 N	118.5 W	—	16	—	—	5.00M_L BRK	—	VI	15	18
1942	12	03	09 44 42	39.7 N	119.3 W	—	324	—	—	5.50M_L BRK	—	VI	15	57
1943	08	09	05 30 04	38.2 N	118.2 W	—	16	—	—	5.50M_L BRK	—	VI	16	92
1945	09	18	22 39	40.6 N	116.5 W	—	54	—	—	5.10M_L PAS	—	IV	54	—
1946	01	15	22 31 56	40.50 N	117.25 W	—	54	—	—	5.10Ukn SJG	—	—	—	—
1946	03	17	14 45 53	38.3 N	117.9 W	—	324	—	—	5.00M_L BRK	—	V	19	31
1946	04	27	02 18 24	38.5 N	118.0 W	—	54	—	—	4.70M_L PAS	—	—	—	—
1948	03	28	18 26 20	39.0 N	119.9 W	—	21	—	—	4.60M_L BRK	—	III	54	—
1948	11	02	16 48 08	35.98 N	114.78 W	—	259	—	—	—	—	VI	21	@

NEVADA— Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MMI	Ref	Felt area (1,000 km^2)
1949	01	02	22 03 54	38.7 N	119.0 W	—	22	—	—	4.50M_L BRK	—	IV	259	—
1949	07	18	15 31 05	39.7 N	119.8 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1950	10	17	03 54 33	39.60 N	116.69 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1950	10	23	08 12 46	39.5 N	117.5 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1951	01	22	15 14 53	39.08 N	119.95 W	—	324	—	—	4.80M_L BRK	—	V	24	—
1951	06	16	05 52 56	37.08 N	117.08 W	016	292	—	—	4.50M_L PAS	—	—	—	—
1952	05	09	15 31 32	39.42 N	119.78 W	—	324	—	—	5.10M_L BRK	—	VI	25	8
1952	05	24	04 15 15.0	36.1 N	114.7 W	016	292	—	—	4.90M_L PAS	—	VI	25	—
1952	11	13	00 55 16	38.5 N	118.5 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1952	11	18	04 04 08	39.8 N	117.7 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1953	08	09	22 00 02	37.5 N	114.5 W	—	54	—	—	4.50M_L REN	—	—	—	—
1953	09	26	03 34 29	39.53 N	119.98 W	—	324	—	—	5.30M_L BRK	—	VI	26	41
1954	07	02	10 43 13	38.17 N	116.37 W	—	324	—	—	4.90M_L BRK	—	III	27	—
1954	07	06	11 13 20	39.42 N	118.53 W	—	324	—	—	6.80M_L BRK	6.20ELL	IX	27	347
1954	07	06	11 18 04	39.42 N	118.53 W	—	324	—	—	5.50M_L BRK	—	Felt	27	—
1954	07	06	11 26 55	39.42 N	118.53 W	—	324	—	—	4.80M_L BRK	—	Felt	27	—
1954	07	06	11 41 00	39.42 N	118.53 W	—	324	—	—	4.50M_L BRK	—	Felt	27	—
1954	07	06	11 49 00	39.42 N	118.53 W	—	324	—	—	5.70M_L BRK	—	Felt	27	—
1954	07	06	12 53 59	39.42 N	118.53 W	—	324	—	—	4.50M_L BRK	—	Felt	27	—
1954	07	06	13 15 11	39.42 N	118.53 W	—	324	—	—	5.20M_L BRK	—	—	—	—
1954	07	06	13 36 01	39.42 N	118.53 W	—	324	—	—	4.50M_L BRK	—	Felt	27	—
1954	07	06	14 55 15	39.42 N	118.53 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1954	07	06	22 07 41	39.3 N	118.5 W	—	324	—	—	6.00M_L BRK	6.22SAW	VII	259	—
1954	07	07	06 11 08	39.42 N	118.53 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1954	07	08	02 13 55	39.42 N	118.53 W	—	324	—	—	4.80M_L BRK	—	IV	27	—
1954	07	08	04 08 19	39.42 N	118.53 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1954	07	08	12 55 10	39.42 N	118.53 W	—	324	—	—	4.70M_L BRK	—	V	27	—
1954	07	08	19 31 57	39.42 N	118.53 W	—	324	—	—	5.30M_L BRK	—	V	27	—
1954	07	09	08 50 03	39.42 N	118.53 W	—	324	—	—	4.90M_L BRK	—	IV	27	—
1954	07	10	01 22 20	39.42 N	118.53 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1954	07	11	07 04 00	39.42 N	118.53 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1954	07	11	09 58 12	39.42 N	118.53 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1954	07	12	10 17 06	39.42 N	118.53 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1954	07	12	16 05 25	39.42 N	118.53 W	—	324	—	—	4.60M_L BRK	—	IV	27	—
1954	07	20	00 11 38	38.2 N	116.4 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1954	07	30	02 00 10	39.42 N	118.53 W	—	324	—	—	5.10M_L BRK	—	Felt	54	—
1954	07	31	17 24 14	39.42 N	118.53 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1954	08	02	10 18 53	39.42 N	118.53 W	—	324	—	—	5.40M_L BRK	—	V	27	—
1954	08	03	21 24 54	39.42 N	118.53 W	—	324	—	—	4.70M_L BRK	—	Felt	54	—
1954	08	05	05 03 08	39.42 N	118.53 W	—	324	—	—	4.70M_L BRK	—	Felt	54	—
1954	08	24	05 51 32	39.58 N	118.45 W	—	324	—	—	6.80M_L BRK	6.55SAW	IX	27	490
1954	08	24	05 57 46	39.58 N	118.45 W	—	324	—	—	5.20M_L BRK	—	Felt	54	—
1954	08	25	02 17 13	39.58 N	118.45 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1954	08	25	22 21 10	39.58 N	118.45 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1954	08	26	12 56 15	39.58 N	118.45 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1954	08	29	03 41 06	39.58 N	118.45 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1954	08	29	03 58 05	39.58 N	118.45 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1954	08	31	22 20 32	39.58 N	118.45 W	—	324	—	—	5.80M_L BRK	5.80ELL	VII	27	—
1954	09	01	05 18 46	39.58 N	118.45 W	—	324	—	—	5.50M_L BRK	—	Felt	27	—
1954	09	09	09 21 05	39.58 N	118.45 W	—	324	—	—	4.90M_L BRK	—	Felt	54	—
1954	12	16	11 07 11	39.283N	118.117W	015	358	—	—	7.20M_L BRK	7.25HHT	X	27	600
1954	12	16	11 11 34	39.8 N	118.1 W	040	358	—	—	7.10M_L BRK	6.90SAW	X	27	—
1954	12	16	11 50 36	39.28 N	118.12 W	—	324	—	—	5.00M_L BRK	—	—	—	—

NEVADA— Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Date Mo	Date Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Hypocenter Longitude (°)	Hypocenter Depth (km)	Hypocenter Ref	Magnitude USGS m_b	Magnitude USGS M_S	Magnitude Other	Magnitude Moment M	Intensity MMI	Intensity Ref	Felt area (1,000 km^2)
1954	12	16	11 57 30	39.28 N	118.12 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1954	12	16	13 15 03	39.28 N	118.12 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1954	12	16	14 16 57	39.28 N	118.12 W	—	324	—	—	5.80M_L BRK	—	—	—	—
1954	12	16	14 24 10	39.28 N	118.12 W	—	324	—	—	5.30M_L BRK	—	IV	27	—
1954	12	16	15 09 42	39.28 N	118.12 W	—	324	—	—	5.10M_L BRK	—	—	—	—
1954	12	16	21 48 43	39.28 N	118.12 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1954	12	17	10 15 26	39.28 N	118.12 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1954	12	17	10 33 29	39.28 N	118.12 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1954	12	17	20 27 06	39.28 N	118.12 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1954	12	18	01 45 36	39.28 N	118.12 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1954	12	20	17 36 47	39.28 N	118.12 W	—	324	—	—	5.00M_L BRK	—	Felt	27	—
1955	01	01	12 13 54	39.0 N	118.0 W	—	54	—	—	5.10M_L BRK	—	—	—	—
1955	01	05	08 20 40	39. N	118. W	—	54	—	—	—	—	V	54	—
1955	01	09	09 10 50	39.0 N	118.0 W	—	28	—	—	5.00M_L BRK	—	—	—	—
1955	01	11	10 21 40	39.0 N	118.0 W	—	54	—	—	4.70M_L BRK	—	—	—	—
1955	01	19	02 10 10	39.35 N	118.25 W	—	324	—	—	4.60M_L BRK	—	IV	28	—
1955	01	25	23 26 46	39.0 N	118.0 W	—	54	—	—	4.70M_L BRK	—	—	—	—
1955	02	11	16 12 32	39.47 N	118.10 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1955	02	19	23 50 07	39.3 N	117.8 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1955	03	08	20 05 17	39.20 N	118.55 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1955	03	11	14 23 16	39.3 N	118.1 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1955	03	13	08 41 04	39.57 N	118.05 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1955	03	14	18 23 47	39.42 N	118.25 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1955	05	08	10 38 31	38.933N	118.117W	—	324	—	—	4.50M_L BRK	—	—	—	—
1955	05	30	21 28 26	39.42 N	118.00 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1955	06	08	12 22 11	38.88 N	118.17 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1955	06	19	19 20 00	38.97 N	118.25 W	—	324	—	—	5.20M_L BRK	—	—	—	—
1955	06	19	19 25 16	39.0 N	118.5 W	—	324	—	—	5.00M_L BRK	—	—	—	—
1955	08	08	10 35 35	38.33 N	118.67 W	—	324	—	—	5.20M_L BRK	—	V	28	23
1955	09	29	05 40 51	39.22 N	118.20 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1955	11	02	06 15 17	39.50 N	118.05 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1955	11	21	20 25 33	39.42 N	118.08 W	—	324	—	—	5.50M_L BRK	—	—	—	—
1955	12	22	12 05 07	38.98 N	118.70 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1955	12	22	12 06 54	38.98 N	118.70 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1955	12	31	13 51 04	39.00 N	118.03 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1956	03	08	07 26 20	39.03 N	118.07 W	—	324	—	—	4.60M_L BRK	—	V	29	—
1956	07	06	03 31 35	38.45 N	118.62 W	—	324	—	—	4.90M_L BRK	—	IV	29	—
1956	07	26	09 53 17	39.55 N	118.45 W	—	324	—	—	5.10M_L BRK	—	V	29	—
1956	11	16	08 26 10	41.03 N	116.45 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1956	12	31	17 37 45	38.25 N	118.93 W	—	324	—	—	5.00M_L BRK	—	VI	29	15
1956	12	31	17 39 24	38.28 N	118.97 W	—	324	—	—	5.10M_L BRK	—	VI	29	15
1957	10	17	10 14 09	39.28 N	118.43 W	—	324	—	—	4.60M_L BRK	—	IV	30	—
1958	01	04	17 27 34	38.9 N	115.5 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1958	04	19	09 01 02	36.0 N	114.8 W	—	54	—	—	—	—	VI	31	—
1959	03	23	07 10 20	39.60 N	118.02 W	—	324	—	—	6.30M_L BRK	—	VI	32	170
1959	05	21	17 51 40	39.47 N	118.12 W	—	324	—	—	4.80M_L BRK	—	—	—	—
1959	06	23	14 35 00	39.08 N	118.82 W	—	324	—	—	6.10M_L BRK	—	VI	32	105
1959	06	23	15 04 34	39.1 N	118.8 W	—	324	—	—	5.50M_L BRK	—	V	32	—
1960	01	26	04 17 36	38.0 N	116.5 W	—	33	—	—	4.90M_L BRK	—	—	—	—
1961	07	04	04 56 00	40.90 N	118.40 W	—	324	—	—	5.40M_L BRK	—	V	34	26
1961	07	04	11 09 11	40.13 N	118.60 W	—	324	—	—	5.00M_L BRK	—	IV	34	—
1961	08	04	16 56 09.1	39.2 N	117.4 W	012	324	—	—	4.50M_L BRK	—	—	—	—

NEVADA— Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MMI	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1962	04	25	08 48 58.2	38.5 N	118.1 W	025	35	—	—	$4.60M_L$ BRK	—	V	35	—
1962	07	20	09 02 10.0	39.5 N	118.2 W	033	266	—	—	$4.70M_L$ BRK	—	V	35	35
1962	09	07	23 19 12.8	41.3 N	116.7 W	033	266	—	—	$4.60M_L$ PAS	—	—	—	—
1962	12	15	06 34 59.8	40.7 N	117.5 W	—	266	—	—	$4.90M_L$ BRK	—	—	—	—
1963	03	25	09 28 43.0	36.0 N	114.8 W	019	266	4.3	—	$4.90M_L$ PAS	—	VI	36	45
1964	03	22	16 30 55.2	38.8 N	118.7 W	016	266	4.5	—	$5.50M_L$ BRK	—	V	37	28
1964	10	23	13 57 10.6	38.5 N	118.4 W	026	266	5.0	—	$5.30M_L$ BRK	—	V	37	—
1964	10	30	19 03 12.3	37.7 N	118.0 W	020	266	4.4	—	$4.50M_L$ BRK	—	VI	37	—
1965	04	13	13 14 22.1	38.9 N	117.7 W	033	266	4.6	—	$4.60M_L$ BRK	—	—	—	—
1966	01	28	18 00 09.1	41.6 N	118.2 W	020	266	4.4	—	$4.80M_L$ BRK	—	III	81	—
1966	04	02	12 48 38.8	38.4 N	118.2 W	009	266	4.0	—	$4.80M_L$ BRK	—	VI	81	—
1966	08	16	18 02 32.9	37.46 N	114.15 W	007	298	5.6	—	$5.60M_L$ UU	5.31DOS	V	81	66
1966	08	16	19 50 09.5	37.4 N	114.2 W	033	266	4.6	—	$4.50M_L$ PAS	—	—	—	—
1966	08	17	23 07 58.9	37.3 N	114.1 W	033	266	4.9	—	$5.50M_L$ BRK	—	Felt	81	—
1966	08	18	06 15 01.3	37.3 N	114.2 W	034	266	4.2	—	$4.50M_L$ PAS	—	—	—	—
1966	08	18	09 15 37.5	37.3 N	114.2 W	033	266	4.6	—	$5.00M_L$ PAS	—	IV	81	—
1966	08	18	17 35 06.4	37.4 N	114.2 W	033	266	5.2	—	$5.00M_L$ PAS	—	IV	259	—
1966	08	19	10 51 37.9	37.438N	114.191W	007	298	4.2	—	$4.70M_L$ UU	—	—	—	—
1966	08	22	08 27 30.2	37.3 N	114.2 W	033	266	4.3	—	$4.60M_L$ BRK	—	—	—	—
1966	09	04	11 23 18.1	37.4 N	114.2 W	033	266	4.2	—	$4.80M_L$ BRK	—	—	—	—
1966	09	22	18 56 41.0	37.3 N	114.2 W	033	266	4.5	—	$5.30M_L$ PAS	—	Felt	81	—
1966	09	22	18 57 36.5	37.4 N	114.2 W	033	74	5.3	—	$5.50M_L$ PAS	—	V	81	—
1966	09	22	19 59 39.8	37.3 N	114.2 W	033	266	4.4	—	$4.50M_L$ PAS	—	—	—	—
1966	09	23	11 56 09.4	37.3 N	114.1 W	033	266	4.5	—	$4.50M_L$ PAS	—	—	—	—
1966	10	02	15 39 41.2	37.3 N	114.2 W	033	266	4.5	—	$4.50M_L$ BRK	—	—	—	—
1966	10	22	17 16 26.4	40.6 N	116.3 W	032	266	4.5	—	$5.10M_L$ BRK	—	V	81	—
1966	10	25	16 39 32.9	37.3 N	114.2 W	033	266	4.4	—	$4.90M_L$ BRK	—	—	—	—
1966	10	26	15 17 38.6	37.3 N	114.2 W	033	266	4.3	—	$5.10M_L$ BRK	—	—	—	—
1967	02	16	15 05 54.3	37.42 N	114.18 W	033	266	4.8	—	$4.80M_L$ BRK	—	—	—	—
1967	05	07	18 01 35.7	37.040N	115.012W	015	74	4.7	—	$5.13M_L$ PAS	—	IV	40	—
1968	01	30	15 20 05.6	41.0 N	117.4 W	018	74	4.5	—	—	—	V	41	9
1968	02	06	00 41 38.0	38.02 N	118.35 W	—	324	4.6	—	$4.90M_L$ BRK	—	V	41	21
1968	02	06	03 48 10.8	38.00 N	118.37 W	—	324	4.4	—	$4.50M_L$ BRK	—	Felt	41	—
1968	05	22	13 21 55.7	38.6 N	116.2 W	013	74	5.1	—	$4.90M_L$ BRK	—	Felt	41	—
1968	05	29	11 41 07.1	39.07 N	118.05 W	003	324	4.9	—	$4.90M_L$ BRK	—	—	—	—
1968	07	06	14 02 40.0	41.1 N	117.4 W	—	324	5.1	—	$5.50M_L$ BRK	—	V	41	25
1970	03	28	09 38 44	38.95 N	116.40 W	—	324	4.5	—	$4.50M_L$ BRK	—	—	—	—
1971	12	08	17 18 56.0	37.615N	115.288W	008	292	4.8	—	$4.70M_L$ PAS	—	V	44	34
1972	12	09	02 44 45.7	38.676N	115.639W	010	74	4.4	—	$4.60M_L$ BRK	—	—	—	—
1973	03	02	11 28 42.3	41.831N	118.546W	005	74	4.2	—	$4.60M_L$ BRK	—	—	—	—
1973	03	03	03 00 03.3	41.810N	118.457W	005	74	4.7	—	$4.60M_L$ BRK	—	—	—	—
1978	02	14	04 35 24.0	39.63 N	117.18 W	005	240	4.4	—	$4.80M_L$ BRK	—	IV	240	—
1978	03	05	22 46 18.2	38.94 N	118.03 W	005	240	4.0	—	$4.60M_L$ BRK	—	V	240	—
1978	05	23	05 47 55.4	40.868N	117.257W	011	74	4.1	—	$4.60M_L$ BRK	—	V	240	—
1979	12	31	08 27 52.5	38.460N	118.428W	008	401	4.2	—	$4.80M_L$ BRK	—	V	262	—
1980	04	08	00 13 41.8	39.499N	119.178W	005	74	—	—	$4.70M_L$ BRK	—	V	300	21
1980	09	04	13 39 09.4	38.083N	118.570W	001	401	4.0	—	$4.60M_L$ BRK	—	V	300	21
1980	09	04	21 03 34.1	38.113N	118.560W	010	401	4.9	—	$4.90M_L$ BRK	—	III	300	—
1980	09	06	07 27 52.3	38.078N	118.572W	007	401	4.1	—	$4.60M_L$ BRK	—	Felt	300	—
1980	09	07	01 30 42.8	38.083N	118.575W	007	401	4.4	—	$5.10M_L$ BRK	—	Felt	300	—
1980	09	07	04 36 38.2	38.083N	118.600W	010	401	4.9	5.0	$5.50M_L$ BRK	—	V	300	56
1980	09	07	06 48 10.6	38.093N	118.570W	005	401	—	—	$4.70M_L$ BRK	—	Felt	300	—
1980	09	07	06 48 30.6	38.093N	118.570W	005	401	4.7	4.4	$5.30M_L$ BRK	—	Felt	300	—

NEVADA— Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr Mo Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Hypocenter Longitude (°)	Hypocenter Depth (km)	Hypocenter Ref	Magnitude USGS m_b	Magnitude USGS M_S	Magnitude Other	Magnitude Moment M	Intensity MMI	Intensity Ref	Felt area (1,000 km^2)
1980 09 08	04 26 19.8	38.045N	118.600W	008	401	—	—	4.60M_L BRK	—	IV	300	—
1980 09 16	04 24 41.1	38.047N	118.567W	007	401	4.2	—	4.70M_L BRK	—	IV	300	—
1980 11 11	10 19 03.0	38.040N	118.590W	005	401	—	—	4.70M_L BRK	—	III	300	—
1980 12 28	22 58 09.8	38.157N	118.360W	005	401	4.6	—	5.00M_L BRK	—	IV	300	10
1981 01 28	20 08 50.7	38.202N	118.335W	015	401	4.5	—	4.60M_L BRK	—	IV	325	—
1981 04 28	22 54 49.9	38.058N	118.587W	010	401	4.2	—	4.60M_L BRK	—	IV	325	—
1982 01 28	22 51 02.1	38.54 N	118.07 W	005	350	—	—	4.60M_L BRK	—	V	350	—
1982 04 15	21 52 09.1	38.052N	118.568W	007	401	4.5	—	5.10M_L BRK	—	IV	350	45
1982 09 24	07 40 24.6	37.870N	118.140W	017	401	5.0	4.6	5.50M_L BRK	—	V	350	50
1982 12 28	19 06 24.8	38.028N	118.418W	008	401	4.7	—	4.90M_L BRK	—	IV	350	—
1984 02 16	11 14 58.8	39.858N	117.556W	002	475	4.8	—	5.20M_L BRK	—	IV	370	—
1984 02 17	12 03 55.8	38.854N	119.630W	012	475	4.1	—	4.60M_D REN	—	V	370	—
1986 11 01	19 23 38.3	38.712N	119.540W	017	562	—	—	4.60M_L BRK	4.37BRK	V	562	15
1987 07 28	18 55 11.5	38.385N	118.168W	013	74	4.3	—	4.60M_L BRK	—	IV	577	—
1987 07 29	03 52 32.1	38.378N	118.137W	014	74	4.4	—	4.50M_L BRK	—	Felt	74	—
1988 09 19	02 56 31.7	38.461N	118.342W	009	74	4.5	—	5.30M_L BRK	—	V	578	24

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1860. Mar. 15. Near Carson City, Ormsby County, Nev. Rockslides were reported between Pyramid Lake and Carson City. Merchandise was shaken from shelves at Carson City. Also reported felt in parts of California and Utah. (Ref. 358, 368.)

1868. May 30, 05 10 UTC (May 29). Near Virginia City, Storey County, Nev. Brick buildings were cracked and bricks were shaken down at Virginia City. Plaster fell in almost all brick buildings. (Ref. 54, 368.)

1869. Dec. 27, 01 55 UTC (Dec. 26). Near Virginia City, Storey County, Nev. Masonry walls were damaged severely in Virginia City and at Washoe City, 5 km west. Plaster fell at Mokelume Hill, and a stone chimney fell at Spring Gulch. Minor damage also was reported in Calaveras County in California. (Ref. 368.)

1869. Dec. 27. Western Nevada aftershock. Considerable damage occurred at Carson City, Dayton, Genoa, Steamboat, and Virginia City. Damage also was reported at Downieville and Oroville, Calif. It is difficult to separate the damage caused by this shock from that of the main shock at 01 55 UTC, Dec. 27. (Ref. 38, 368.)

1872. Mar. 23. Austin, southern Lander County, Nev. Plaster fell in the Austin Courthouse. The earthquake was described as a violent shock. (Ref. 38, 54.)

1875. Apr. 2 (Apr. 1). Near Eureka, Nev. One building was seriously damaged at Eureka. (Ref. 54.)

1887. June 3. Near Carson City, Ormsby County, Nev. The ground was reported to have been uplifted about 10 m north of Carson City (at Deadman's Ranch). Large fissures opened and spouted water and sand near Cradlebaugh's Bridge. The water level at Shaw's Hot Springs, near Carson City, dropped several centimeters a few weeks before the earthquake, and the water dried up after the shock. At Carson City, chimneys were reported to be in "bad condition" and brick and stone walls were cracked. At Genoa, houses were shifted on their foundations and bricks were thrown down. (Ref. 54, 368.)

1894. Nov. 18. Near Virginia City, Storey County, Nev. Some walls were damaged, plaster cracked, and windows broke at Virginia City. Many aftershocks occurred. (Ref. 54, 56.)

1896. Jan. 27. Near Carson City, Ormsby County, Nev. A large crack formed in the side of a government building in Carson City; plaster fell in the County Building. (Ref. 54, 56.)

1901. July 26. Near Elko, Nev. A brick schoolhouse and other buildings were damaged at Elko. A series of heavy shocks was reported. (Ref. 54, 56.)

1903. Fall. Near Wonder, Churchill County, Nev. Interviews with long-time residents of the area establishes (with a fair degree of certainty) the date as the fall of 1903 for this uncataloged earthquake in Churchill County. Evidence also suggests that as much as 19 km of surface faulting may have occurred on the Gold King fault as result of this shock. At the Stephens dwelling, about 8 km northeast of Wonder, an adobe house was damaged (probably by this earthquake) and its roof required repair. (Ref. 54, 328.)

1910. Nov. 7. Southeast of Goldfield, in Nye County, Nev. A few dishes and windows were broken at Goldfield. (Ref. 54, 56.)

1910. Nov. 21. Esmeralda County, Nev. The watchman's car was thrown from the track at Tonopah Junction; windows were broken. A succession of shocks occurred at the same time as a loud, rumbling noise. (Ref. 54, 56.)

1914. Feb. 18. Near Reno, Washoe County, Nev. Plaster cracked and a few bricks were thrown from chimneys at Reno and nearby Virginia City. Windows were broken at Sparks, and the shock was severe at Verdi. Also felt in California. (Ref. 38, 54, 56.)

1914. Apr. 24. Near Reno, Washoe County, Nev. This earthquake probably originated northeast of Reno. Many chimneys were toppled throughout Reno, including four that fell on buildings at the University of Nevada. The shock was described as "severe" about 25 km east of Reno, at Hazen. Also felt in California. Magnitude 5.5 M_S ELL, 5.0 M_{La} DMG. (Ref. 54, 56.)

1915. Oct. 3 (Oct. 2). Pleasant Valley, Nev. This earthquake occurred along a fault on the eastern side of Pleasant Valley, which lies about 64 km southeast of Winnemucca, in the north-central part of Nevada. The epicentral region was almost uninhabited, and, therefore, property damage was less than might have been expected. Damage was confined mainly to an area within 80 km of the fault in Humboldt, Lander, and Pershing Counties, including the towns of Battle Mountain, Kennedy, Lovelock, Winnemucca, and several ranches in Pleasant Valley. Four main scarps—the China Mountain, Tobin, Pearce, and Sou Hills—developed in a right-stepping en echelon pattern. The combined length of the scarps was 59 km, the average vertical displacement 2 m, and the maximum displacement (which occurred on the Pearce scarp) 5.8 m. Several northwest-striking segments of the scarps had a right-lateral component of displacement, generally less than 1 m.

At Kennedy, two adobe houses were destroyed, mine tunnels collapsed, and concrete mine foundations were cracked. At Winnemucca, adobe buildings generally were damaged, and several multistory brick buildings lost their coping and parts of upper walls; many chimneys were demolished above the rooflines. In addition, water tanks were thrown down at Battle Mountain, Kodiak, Lovelock, and Parran. Damage occurred on several ranches at the southern end of Pleasant Valley: an adobe house was shaken down; a masonry chicken house and a hog pen were destroyed; and houses were displaced from their foundations.

One of the most striking effects of this earthquake was the large increase (and decrease) in the flow of springs and streams throughout northern Nevada. Cracks formed in unconsolidated materials for considerable distances. Felt from the State of Oregon to southern California and from the Pacific coast to beyond Salt Lake City, Utah. (see fig. 40). Two foreshocks and many aftershocks occurred. Magnitude 7.3 m_b ABE, 7.75 M_S GR, 7.6 M_S CFR. (Ref. 56, 258, 327, 589.)

1930. Apr. 9. Near Lake Tahoe, Douglas County, Nev. At the southeast end of Lake Tahoe, chimneys were damaged. Plaster was cracked at Tahoe. Also felt in California. (Ref. 3, 324.)

1930. Apr. 12. Fernley, Lyon County, Nev. Chimneys and dishes broke at Fernley; plaster cracked at Fallon, southeast of Fernley, and objects fell from shelves. Also felt in California. (Ref. 3, 324.)

1932. Dec. 21 (Dec. 20). Cedar Mountain, Nev. This major earthquake originated in an uninhabited desert region of western Nevada, near Cedar Mountain, and therefore caused minimal property loss. Two cabins, one of stone and the other of adobe, were destroyed, and ore-treating plants and mines were damaged. The main shock was strong at Fallon, Mina, Luning, Tonopah, and at many other Nevada towns. Many chimneys were downed in Mineral County, at Luning and Mina. In addition, walls fell and cracks formed in the ground at Luning.

Extensive and complicated faulting occurred over an area 63 km long and 6 to 14.5 km wide in the valley between Gabbs Valley Range and Pilot Peak on the west and Paradise Range and Cedar Mountains on the east, northeast of Mina. In this area, 60 en echelon rifts as much as 6 km in length and 122 m in width were found. The rifts consisted of zones of fissures that commonly revealed vertical displacement, and in several places showed horizontal displacement. Boulders were shaken from cliffs and hillsides in many places; large landslides occurred; and the flow of ground water either increased or decreased in some springs and wells. Felt from the Rocky Mountains to the Pacific Ocean and from San Diego to southern Oregon. (see fig. 41). One foreshock and many aftershocks occurred. Magnitude 7.3 M_S CFR. (Ref. 38, 258, 356.)

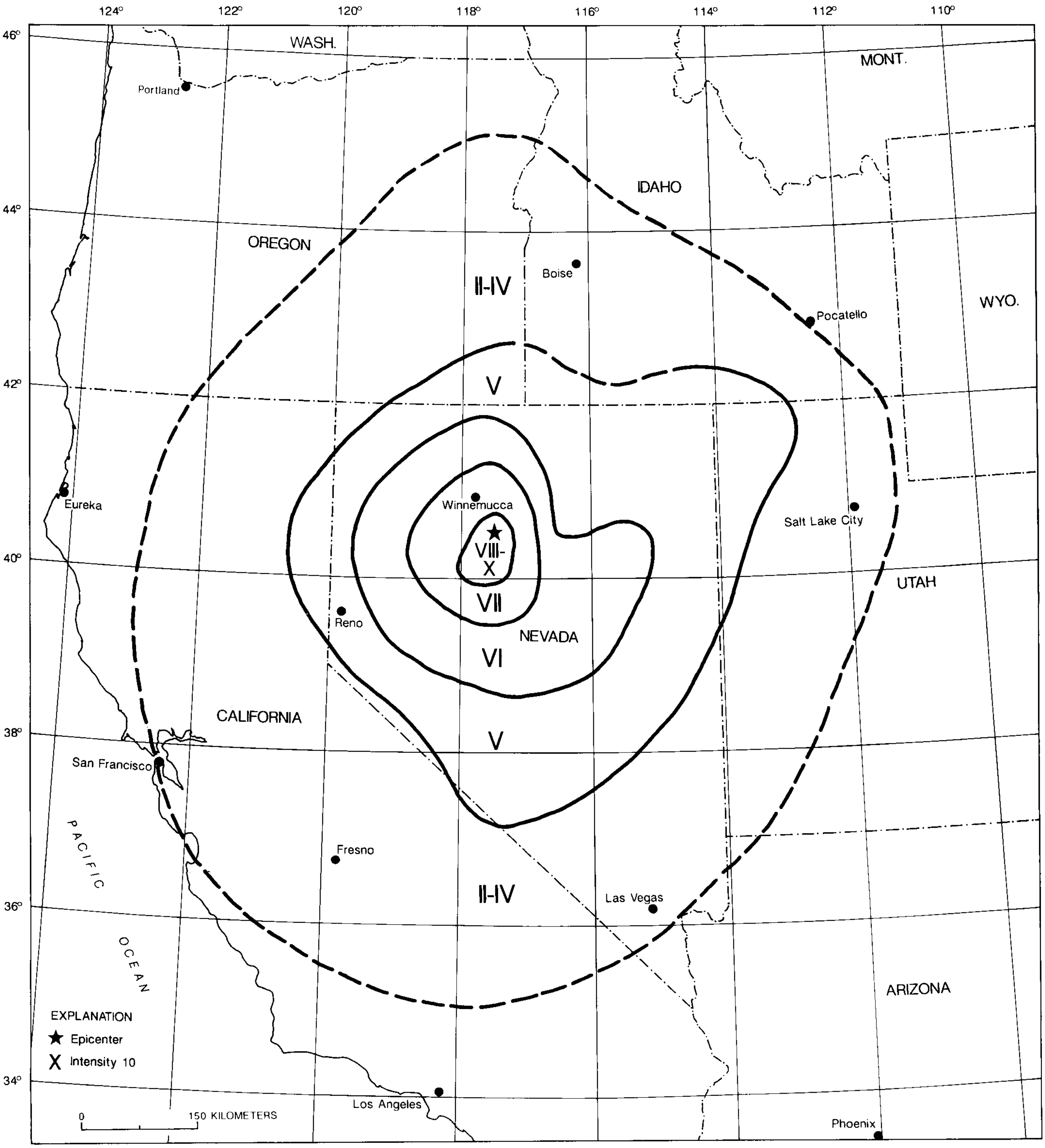


FIGURE 40.— Isoseismal map for the Pleasant Valley, Nevada, earthquake of October 3, 1915. Isoseismals are based on intensity estimates form data listed in references 272 and 327 of table 1.

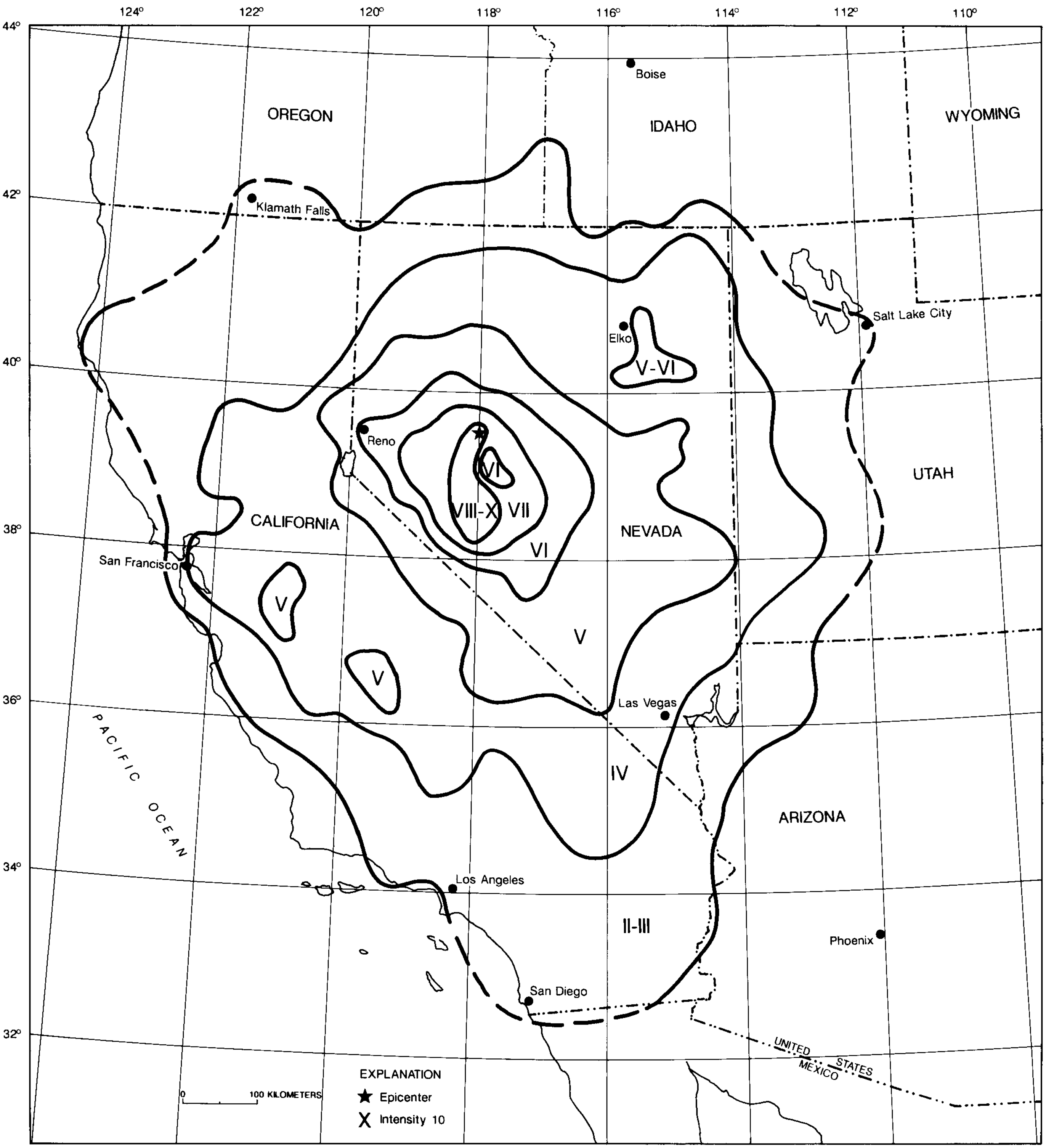


FIGURE 41.— Isoseismal map for the Cedar Mountain, Nevada, earthquake of December 21, 1932. Isoseismals are based on intensity estimates from data listed in references 5, 259, and 356 of table 1.

1933. June 25. Western Nevada. Many chimneys were downed southeast of Reno, at Virginia City, and in Lyon County, at Wabuska and Yerington. A church was damaged severely at Virginia City, and a wall separated from the rest of courthouse building at Yerington. Water spurted from cracks that formed in the ground at Yerington. Minor damage occurred in many nearby towns. Also felt in California. (Ref. 6, 324.)

1934. Jan. 30, 19 23 UTC. Excelsior Mountains, Nev. A strong foreshock of the damaging earthquake at 20 16 UTC downed chimneys and broke windows and dishes southeast of Hawthorne, at Mina (Mineral County). Also felt in California. (Ref. 38, 54, 335.)

1934. Jan. 30, 20 16 UTC. Excelsior Mountains, Nev. This strong earthquake centered in an uninhabited area having few structures, and damage therefore was slight. At Mina (Mineral County), a few chimneys were broken and a small section of a brick wall fell. At Marietta, two walls of an adobe cabin collapsed; at Candelaria, a stone cabin was partly destroyed; and at the Silver Dike mine in the eastern part of the Excelsior Mountains, a rockslide destroyed a pipeline and a pumphouse. Fissures formed in alluvium; landslides occurred; and changes in the flow of springs were observed.

Fissures in alluvium, mainly related to slumping rather than to primary faulting, were found in three places: above Pepper Spring, south of Garfield Flat; on the northwest side of Teel's Marsh; and at the Endowment mine, about 5 km north of Marietta. The average trend of the fissures was N. 10° W., and the length about 30.5 m. One graben was 6 m wide and, on its west side, was a slump hole about 0.6 m deep. At the Endowment mine, two fissures—one 6 m long and the second 30.5 m long—formed in the bed of the wash about 122 m beyond the end of the fault. An earthquake scarp about 1.4 km long developed on one of the faults 5 km north of Marietta, on the southern side of the Excelsior Mountains. This scarp had a maximum height of 12.7 cm, and the fissures were as wide as 7.6 cm. It appears that this was the surface expression of the movement that caused the earthquake.

Several landslides occurred, and boulders rolled down slopes throughout the Excelsior Mountains. The shock also was felt throughout central Nevada and central California as far as the west coast. Magnitude 6.3 M_S GR. (Ref. 7, 324, 335.)

1939. Jan. 11. Near Gardnerville, Douglas County, western Nevada. Damage was slight at Gardnerville, where cracks formed in plaster, and at Hudson, where dishes broke. Also felt in California. (Ref. 12, 324.)

1939. May 4. Near Boulder City, Clark County, southern Nevada. At Boulder City, about 15 km southeast of Las Vegas, plaster cracked and fell. In the Hoover Dam area, large rocks rolled onto roadways and made some of them impassable. A heavy dust cloud noted south of Hoover Dam probably resulted from landslides. Plaster was cracked in several houses in Mohave City and Oatman, Ariz. Also felt in California. (Ref. 12, 292, 343.)

1939. May 11. Northeast of Mina in Nye County, Nev. At Rawhide, vases were overturned and trees and bushes were shaken strongly. Plaster was cracked at Yerington. Felt north to Lovelock, south to Beatty, east to Eureka, and west to Yosemite National Park, Calif. Magnitude 5.5 M_S GR. (Ref. 12, 38, 324.)

1942. Aug. 18. Near Mount Montgomery, Mineral County, Nev. Dishes fell at Mount Montgomery, in southern Mineral County, and lath on veneer board panels cracked loose. Also felt in California. (Ref. 15, 16.)

1942. Dec. 3. Near Reno, Washoe County, Nev. At Reno, plaster was cracked in several buildings, and a heavy safe was shifted several centimeters. Rocks fell onto the highway in Truckee Canyon, east of Sparks. Also felt in California. (Ref. 15, 259, 324.)

1943. Aug. 9 (Aug. 8). Excelsior Mountains, Nev. Plaster and walls were cracked at Dyer (Esmeralda County) and at Fallon (Churchill County), 80 km northeast. Also felt in California. Several aftershocks were recorded. (Ref. 16.)

1948. Nov. 2. Hoover Dam, Nev., area. Southeast of Las Vegas, rocks rolled onto the highway leading to Hoover Dam and fell from canyon walls upstream and downstream from the dam. Dust clouds from landslides also were observed. At nearby Boulder City, some minor cracking of plaster occurred. (Ref. 21, 259.)

1952. May 9. Near Carson City, Ormsby County, Nev. New cracks formed in four State buildings at Carson City. Plaster and knickknacks fell at Virginia City, about 20 km north. Also felt in California. (Ref. 25, 324.)

1952. May 24 (May 23). Near Boulder City, Clark County, Nev. Slight damage occurred southeast of Las Vegas, at Boulder City (cracks in plaster and foundations) and at Whitney (cracks in walls). (Ref. 25, 292.)

1953. Sept. 26 (Sept. 25). Near Reno, Washoe County, Nev. Two chimneys toppled at Reno, and plaster cracked in buildings throughout the northwest part of town. Much damage occurred to plaster at the University of Nevada in the Mackay School of Mines Building. Slight damage also was reported in California. (Ref. 26, 324.)

1954. July 6, 11 13 UTC. Fallon-Stillwater area, Churchill County, Nev. In Fallon, the town nearest the epicenter, several old and poorly built concrete-block structures and unreinforced brick structures were damaged severely, and many brick chimneys fell. Several people were injured at the Naval Auxiliary Air Station, about 8 km southeast of Fallon, when the shock knocked heavy steel lockers onto them. Two areas outside Fallon that also sustained damage were the Lone Tree district to the south and the Stillwater district to the east. Ground motion and surface breakage were heavier in Stillwater.

Canals and drainage systems of the Newlands Reclamation Project near Fallon were damaged extensively. Many box-type culverts were damaged or collapsed. Failure of the Coleman Diversion Dam cut off irrigation water to most of the project.

Paved highways in the Fallon-Stillwater areas settled, cracked, and buckled in several places. One of the largest ground movements occurred in the Lone Tree area. One road dropped about 90 cm for a distance of several hundred meters and lurched about 90 cm horizontally toward a canal. In the Lone Tree and Stillwater areas, canal banks settled as much as 0.9 m, and bottoms of canals were raised as much as 0.6 m.

The main zone of ground fractures was observed on the east edge of Rainbow Mountain in the Stillwater Range, about 24 km southeast of Fallon. This earthquake and the large shock on Aug. 24 (see description below) resulted in surface evidence of faulting for about 40 km. This break is referred to as the Rainbow Mountain fault. Vertical displacement was evident along about two-thirds of the fault; the west side uplifted everywhere with respect to the east side. Scarps as high as 30 cm or more formed, and small grabens developed in places. Horizontal displacement was not found. The quake was also felt in California, Idaho, Oregon, and Utah (see fig. 42). Magnitude 6.6 M_S CFR, 6.3 M_S ELL. (Ref. 27, 324, 575.)

1954. July 6, 22 07 UTC. Fallon-Stillwater area, Churchill County, Nev., aftershock. U.S. Highway 50 settled to the extent that it had to be filled and resurfaced about 8 km southeast of Salt Wells. Many observed a large cloud of dust rising in that area, probably a result of landslides. Little additional damage to structures was reported from Fallon. Also felt in California. Magnitude 6.4 M_S CFR. (Ref. 27, 38, 259, 324.)

1954. Aug. 24 (Aug. 23). Fallon-Stillwater area, Churchill County, Nev. Ground surface movement was increased several centimeters at the break of the main fault of July 6, 1954 (11 13 UTC), along the east edge of Rainbow Mountain. Displacement owing to this shock was much more continuous than that of July 6, probably as a result of the larger relative movement (76 cm compared to 30 cm on July 6). The ground breakage extended north for about 18 km to the region southeast of Carson Sink. Only vertical movement was observed, however. Except for the Lovelock area, where this earthquake considerably damaged the Rogers Dam, damage to buildings, roads, and irrigation facilities occurred in the same general areas as for the shock on July 6. Also felt in California, Idaho, Oregon, and Utah (see fig. 43). Magnitude 6.8 M_S CFR, 6.9 M_S ELL. (Ref. 27, 324.)

1954. Aug. 31. Dixie Valley, Churchill County, Nev. A series of violent, earthquakes generated additional landslides in the Stillwater Range northeast of Stillwater. In West Lee Canyon, everything in one cabin was overturned, including the stove. Magnitude 6.3 M_S CFR. (Ref. 27, 324.)

1954. Dec. 16, 11 07 UTC. Dixie Valley–Fairview Peak area, Churchill County, Nev. The population was sparse in the epicentral region of this earthquake, and few man-made structures existed. Damage to structures, therefore, was minor despite the geologic and seismographic evidence of a major earthquake.

The earthquake was accompanied by offsets along many faults in four main zones of a north-trending belt 96 km long by 32 km wide. Minor geologic effects included changes in flow of springs and wells, formation of craters and water fountains, landslips and landslides, mudflows, and rockfalls.

The fault displacements mainly were along normal faults in the following areas: (1) west of Dixie Valley, (2) southeast of Dixie Valley, (3) east of Fairview Peak, and (4) east of Stingaree Valley. The maximum strike-slip component was 3.6 m of right-lateral movement at Fairview Peak, and the maximum vertical-slip component was 3.6 m at Bell Flat.

Heavy furniture was displaced at Frenchman Station, about 11 km west of major surface faulting, but damage to buildings was negligible. Differential settlement of about 10 cm that occurred under a wood-frame store resulted in minor cracking of the building. Damage at Fallon, about 48 km west of the nearest major surface break, was limited to a few toppled chimneys. Hundreds of aftershocks occurred. The

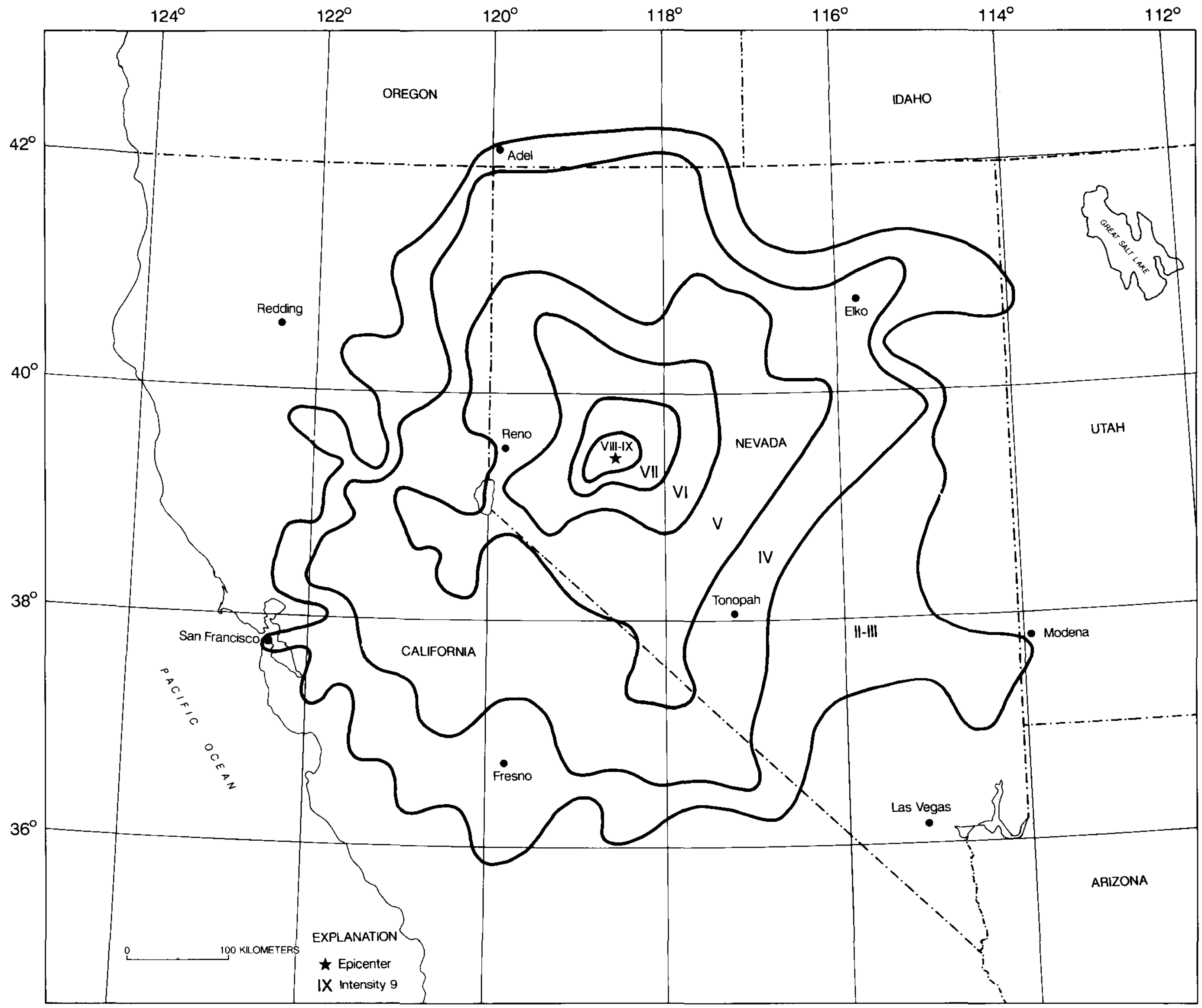


FIGURE 42.— Isoseismal map for the Fallon-Stillwater, Nevada, earthquake of July 6, 1954. Isoseismals are based on intensity estimates from data listed in references 27, 259, and 575 of table 1.

main earthquake also was felt in Arizona, California, Idaho, Oregon, and Utah (see fig. 44). Magnitude 7.1 M_S ABE, 6.9 m_b ABE, 7.1 M_S CFR. (Ref. 27, 358, 505.)

1954. Dec. 16, 11 11 UTC. Dixie Valley–Fairview Peak area, Churchill County, Nev., aftershock. See above description of the main earthquake at 11 07 UTC on Dec. 16. Because damage from the two earthquakes cannot be separated, they are treated as one event. Magnitude 6.8 M_S CFR. (Ref. 27, 358.)

1956. Dec. 31, 17 37 UTC. Near Hawthorne, Mineral County, Nev. Two moderate earthquakes (the second one at 17 39 UTC) cracked U.S. Highway 95, south of Hawthorne, and split Highway 50, near Frenchman Station. Also felt in California. (Ref. 29, 324.)

1956. Dec. 31, 17 39 UTC. Near Hawthorne, Mineral County, Nev. See above description of the earthquake at 17 37 UTC, Dec. 31, 1956. (Ref. 29, 324.)

1958. Apr. 19. Boulder City area, Clark County, Nev. This minor earthquake cracked plaster, broke dishes, and overturned books and pictures at Boulder City. (Ref. 31, 54.)

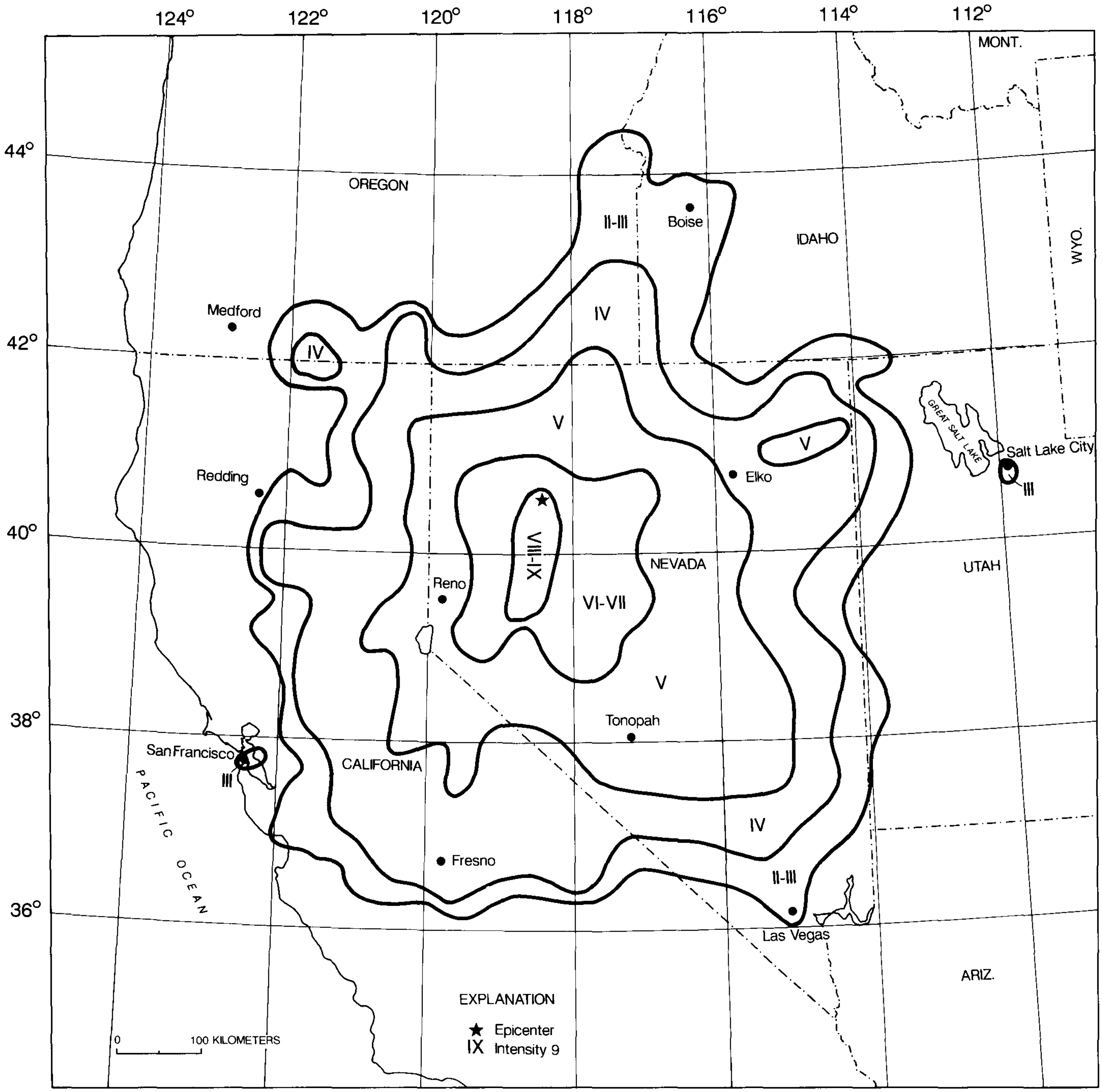


FIGURE 43.— Isoseismal map for the Fallon-Stillwater, Nevada, earthquake of August 24, 1954. Isoseismals are based on intensity estimates from data listed in references 27, 259, and 575 of table 1.

1959. Mar. 23 (Mar. 22). Dixie Valley area, Churchill County, Nev. Plaster cracked at Carson City and Frenchman Station, and the top of a new addition to the State printing office was damaged. A field investigation in Dixie Valley revealed no sign of fresh cracking on the Fairview Peak fault where it crosses U.S. Highway 50, the Dixie Valley Road northward to Horse Creek Road, nor the Horse Creek Road; fresh cracking was not noted on the extension of the Gold King fault at the south edge of Dixie Valley. Also felt in California. (Ref. 32, 259, 324.)

1959. June 23. Near Schurz, northeast Mineral County, Nev. This was the main shock of a series of four moderate earthquakes. Chimneys

Fault scarp in the Fairview Peak area, Nevada, formed by the December 16, 1954, earthquake. (Photograph from the National Geophysical Data Center, NOAA.)

twisted and cracked at Schurz, and a garage attached to a frame house separated 5 cm from the house. A new roadbed, about 8 km west of Schurz, was cracked; plaster cracked and knickknacks fell at Genoa. Some residents reported minor rockslides in the adjacent mountains. Also felt in California. (Ref. 32, 324.)

1963. Mar. 25. Near Boulder City, Clark County, Nev. Considerable minor damage—mainly cracked and fallen plaster and broken dishes—occurred at Boulder City. Several rockslides were observed in the Boulder City area. Power was interrupted for 20 minutes at Hoover powerplant and dam, and one generator possibly was misaligned. Also felt in Arizona, California, and Utah. (Ref. 36, 259, 266.)

1964. Oct. 30. Dyer area, Esmeralda County, Nev. A series of earthquakes occurred along the California-Nevada border, all of which were preceded by a roaring noise. The strongest shock (at 19 03 UTC) cracked a concrete-block foundation and a window at Dyer. (Ref. 37, 259, 266.)

1966. Apr. 2. South of Luning, Mineral County, Nev. This earthquake separated two parts of an old building at Luning. Small objects shifted and fell. (Ref. 81, 266.)

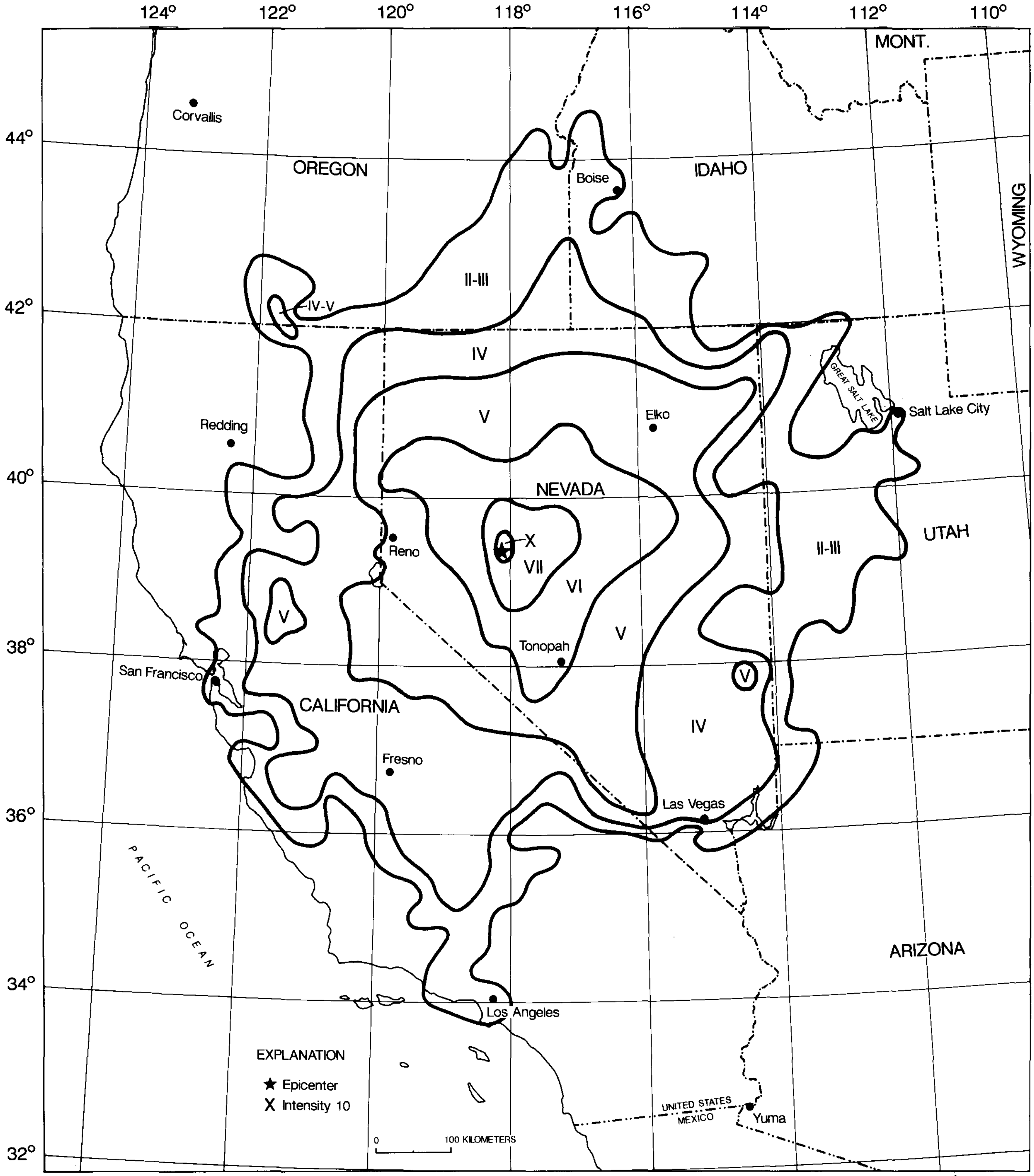
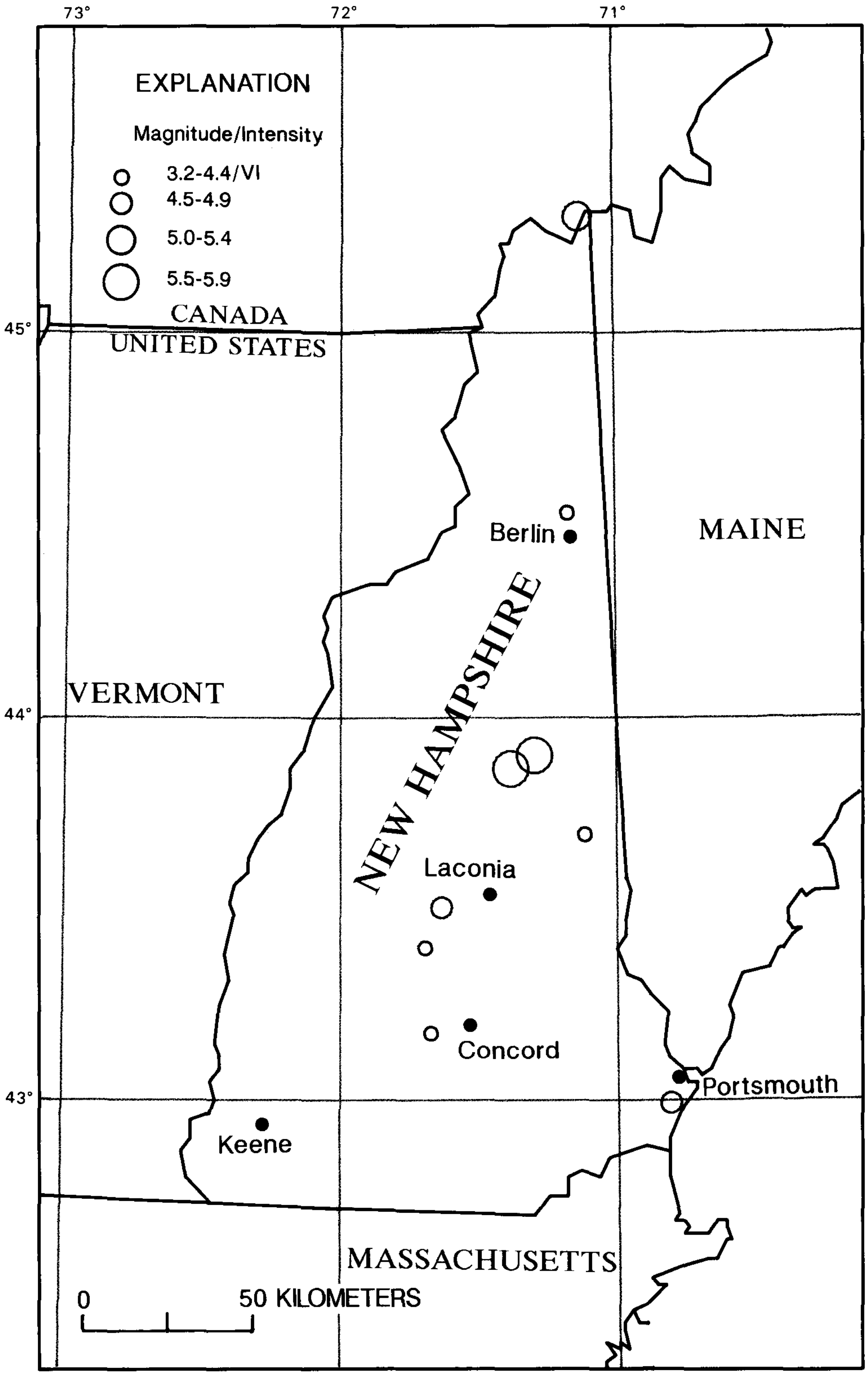


FIGURE 44.— Isoseismal map for the Dixie Valley–Fairview Peak, Nevada, earthquake of December 16, 1954. Isoseismals are based on intensity estimates from data listed in references 27 and 259 of table 1.

NEW HAMPSHIRE



Earthquakes in New Hampshire with magnitudes ≥ 4.5 or intensity ≥ VI.

NEW HAMPSHIRE

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1732	09	16	16 00	45.5 N	73.6 W	—	76	—	—	—	—	IX	76	—
1810	11	10	02 15	43.0 N	70.8 W	—	78	—	—	—	—	VI	76	21&
1925	10	09	13 55	43.7 N	71.1 W	—	76	—	—	4.00M_{fa} SC	—	VI	38	18
1940	12	20	07 27 26.2	43.872N	71.370W	010	349	—	—	5.50M_n ST	5.25ST	VII	13	356&
1940	12	24	13 43 45.0	43.908N	71.283W	008	349	—	—	5.50M_n ST	5.60ESM	VII	13	—
1964	06	26	11 04 49.0	43.405N	71.680W	001	349	—	—	3.20M_n DG	—	VI	37	12
1973	06	15	01 09 05.1	45.307N	71.119W	012	349	4.8	—	5.00M_n STR	4.48HRN	VI	46	182&
1977	12	25	15 35 54.0	43.185N	71.658W	012	349	—	—	3.20M_n WES	—	VI	39	3
1982	01	19	00 14 42.7	43.51 N	71.62 W	007	350	4.5	—	4.50M_n BLA	—	VI	350	127
1988	10	20	13 09 50.1	44.539N	71.158W	005	74	—	—	3.90M_n GS	—	VI	578	17

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1732. Sept. 16. St. Lawrence River valley, Canada. An earthquake that was violent in Montreal, Canada, also damaged houses at Piscataqua, N.H., in eastern Rockingham County. In Montreal, the shock damaged 300 houses, cracked walls, knocked down chimneys, and caused one death. Felt slightly at Boston, Mass., and Annapolis, Md. (Ref. 38, 59, 76.)

1810. Nov. 10 (Nov. 9). Between Portsmouth and Hampton, Rockingham County, N.H. The earthquake broke windows at Portsmouth, and caused earth noises like a heavy explosion. Felt from Concord, N.H., east to the coast and from Portland, Me., south to Charlestown, Mass. (Ref. 38, 76, 78.)

1925. Oct. 9. Eastern New Hampshire, near Lake Winnipesaukee. One chimney fell from an old colonial house at Sandwich, N.H., in Carroll County north of Laconia. Chimneys also were knocked down at Cornish, Me., about 60 km east of Sandwich, N.H. This severe shock broke windows in Carroll County at Ossipee, Sandwich, and Tuftonboro, N.H., and cracked a concrete sidewalk at Meredith, north of Laconia. Items were knocked from shelves and residents were frightened in many towns in the area. Felt to the north at Bethlehem (northern Grafton County), to the southwest at Keene (Cheshire County), and to the east at Portland, Me. (Cumberland County). (Ref. 38, 76, 78, 218.)

1940. Dec. 20 and Dec. 24. Near Ossipee Lake, Carroll County, N.H. The first earthquake and one of about the same intensity on Dec. 24 are described together. Their epicenters lie in the same general region west of Whittier, N.H. Although the second shock was of less duration, it was somewhat more intense than the first. However, the first shock undoubtedly weakened structures, which resulted in more severe damage from the second earthquake.

The town of Tamworth, on the edge of the Ossipee Mountains in central Carroll County, sustained the most damage. Old houses and chimneys in need of repair were most commonly damaged. Some chimneys were thrown down, and 20 others were damaged. Also, reports indicate that well water remained muddy for several days and that many cracks formed in the crusty snow. Other minor damage included cracked walls, broken water pipes, fallen plaster, and broken furniture.

At the Riverside Cemetery at Whittier, about 3 km south of Tamworth, five monuments were displaced. In the nearby towns of West Ossipee and Chocorua, many old chimneys in need of repair were damaged, and water in wells became muddy. At Wonalancet, 8 km northwest of Tamworth, the foundation of an old house (constructed of heavy timber) was damaged when it shifted about 30 cm. Heavy furniture, including a kitchen stove, moved several centimeters across the floor.

Minor damage occurred at several towns in Maine, Massachusetts, New York, and Vermont (see fig. 45). Reports of the shock also were received from Connecticut, New Jersey, Pennsylvania, and Rhode Island, as well as from Montreal and Quebec, Canada. Several small aftershocks occurred over the next several months. Magnitude 5.6 M_S GR (both), 5.44 M JOH (Dec. 20), 5.62 M JOH (Dec 24). (Ref. 13, 38, 349, 506.)

1964. June 26. Near Warner, Merrimack County, N.H. Plaster fell at Meriden, and trees and bushes were shaken lightly. Slight damage also was reported at Bradford, Merrimack County, N.H., and at Springfield, Vt. (Ref. 37, 38, 349.)

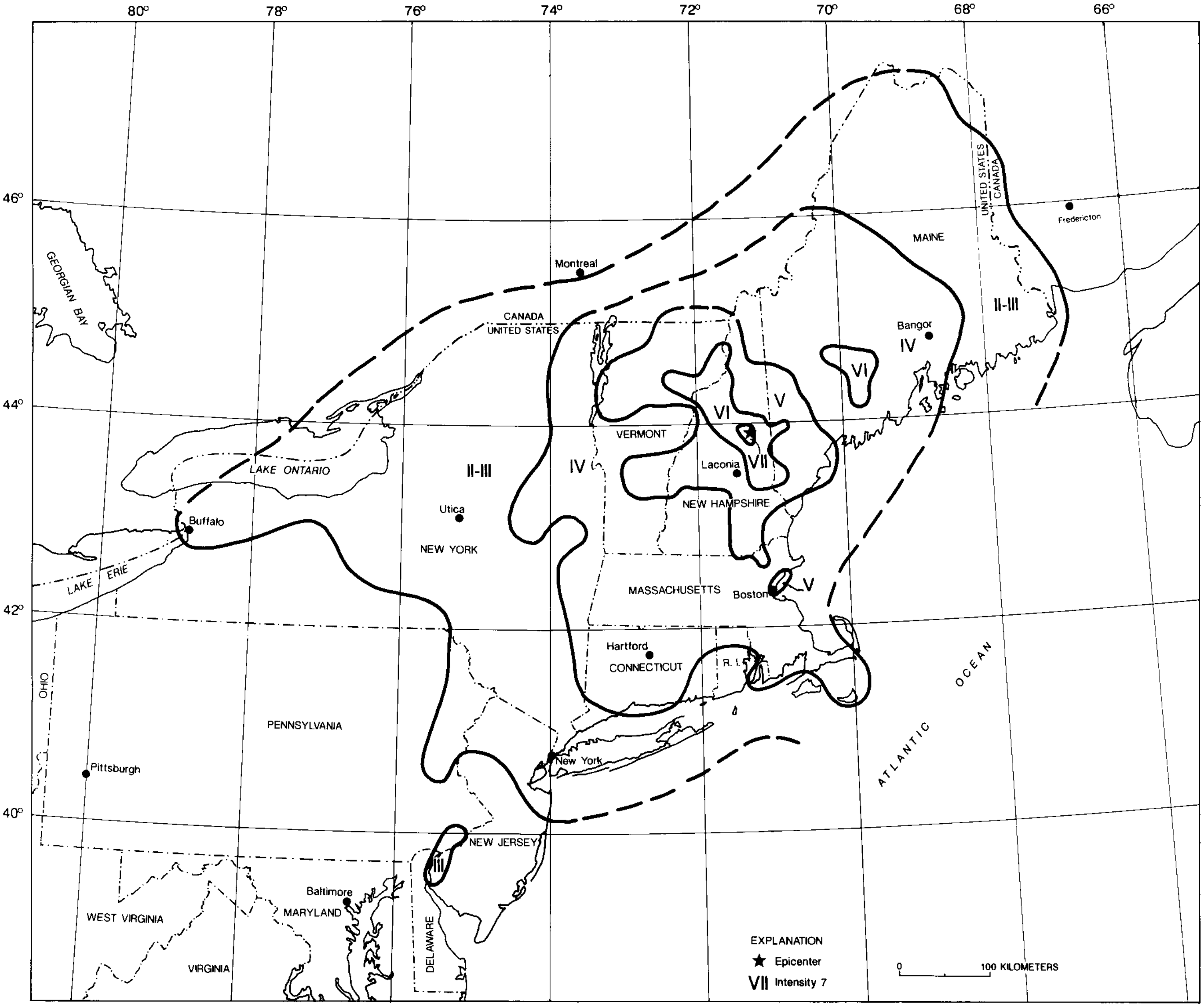


FIGURE 45.— Isoseismal map for the New Hampshire earthquake of December 20, 1940. Isoseismals are based on intensity estimates from data listed in references 13 and 506 of table 1.

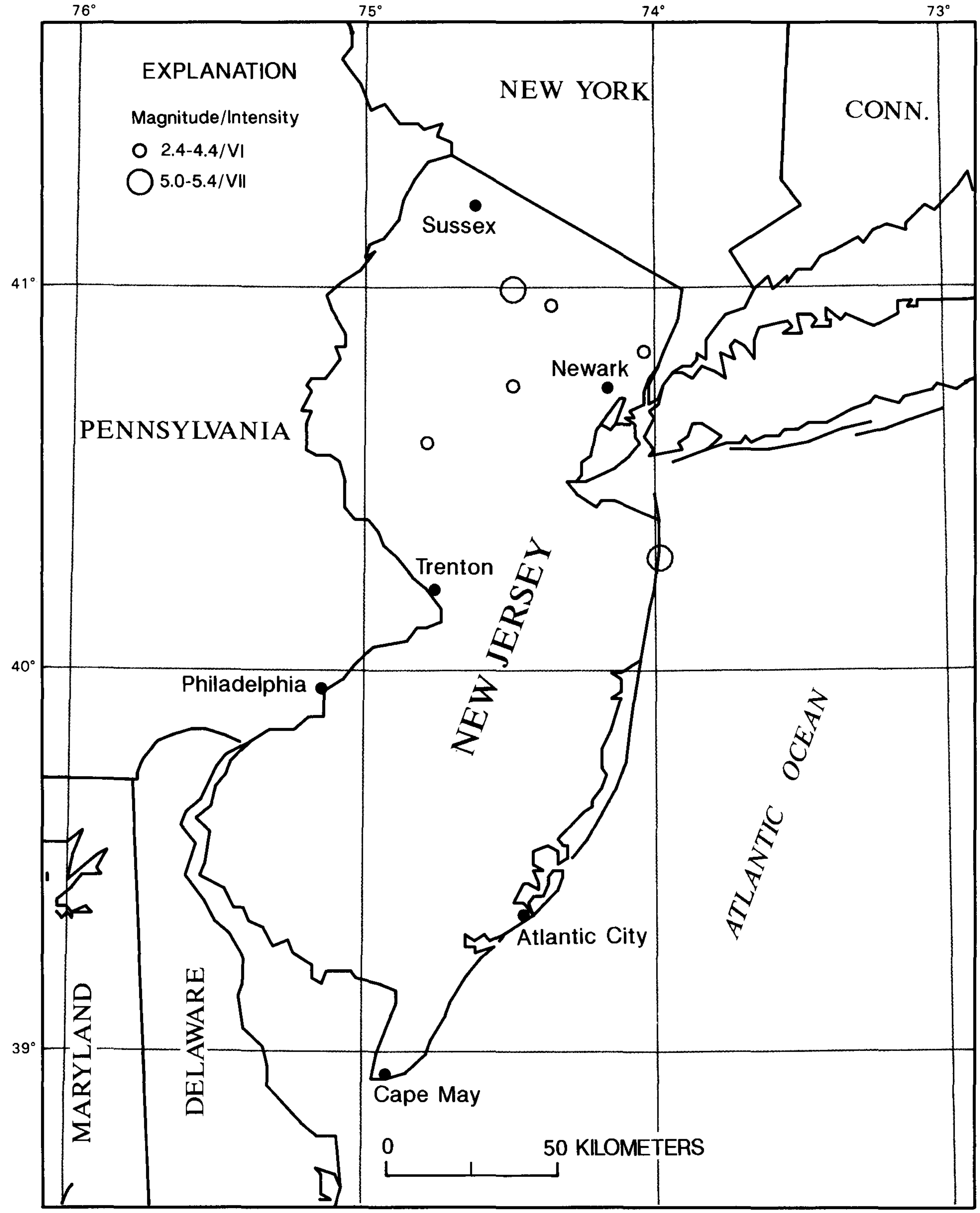
1973. June 15 (June 14). Quebec–New Hampshire border area. Cracks formed in the road surface in the area about Montpelier, Vt.; chimneys and grocery stock were damaged at Woburn, Quebec. The earthquake cracked plaster and broke windows in Quebec Province and in the States of Maine, Massachusetts, New Hampshire, New York, and Vermont. Also felt in Connecticut and Rhode Island. Magnitude 4.49 M JOH. (Ref. 46, 349.)

1977. Dec. 25. Near Concord, Merrimack County, N.H. The earthquake cracked plaster and windows in Concord. Felt over a small area of south-central New Hampshire. Magnitude 3.1 M_n PAL. (Ref. 39, 349.)

1982. Jan. 19 (Jan. 18). Near Laconia, Belknap County, N.H. Damage, mainly cracks in chimneys and walls, occurred in Drury and Westford, Mass.; Ashland, Bristol, Danbury, Laconia, and North Stratford, N.H.; and several towns in northeast Massachusetts and central Vermont. Other damage, widely reported in the area, included cracked plaster and broken merchandise and knick-knacks. Also felt in Quebec, Canada and in the States of Connecticut, Maine, New York, and Rhode Island. Magnitude 4.7 M_D WES. (Ref. 350.)

1988. Oct. 20. Near Berlin, Coos County, N.H. Minor damage at Berlin included cracked chimneys and house foundation, hairline cracks in interior walls, and displaced tombstones. At nearby Milan, interior walls sustained hairline cracks in plaster and drywall, and a house foundation was cracked. Felt over a small area of northwest Maine, northern New Hampshire, and northeast Vermont. (Ref. 74, 578.)

NEW JERSEY



Earthquakes in New Jersey with magnitudes ≥ 4.5 or intensity ≥ VI.

NEW JERSEY

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr Mo Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Hypocenter Longitude (°)	Hypocenter Depth (km)	Hypocenter Ref	Magnitude USGS m_b	Magnitude USGS M_S	Magnitude Other	Magnitude Moment M	Intensity MM	Intensity Ref	Felt area (1,000 km^2)
1783 11 30	03 50	41.0 N	74.5 W	—	76	—	—	5.30M_{fa} SET	—	VI	76	—
1895 09 01	11 09	40.75 N	74.5 W	—	369	—	—	4.10M_{fa} SC	—	VI	38	30
1927 06 01	12 20	40.3 N	74.0 W	—	38	—	—	—	—	VII	38	20&
1957 03 23	19 02 31	40.6 N	74.8 W	010	77	—	—	3.80M_{fa} SC	—	VI	30	7
1976 03 11	21 07 20.4	40.96 N	74.37 W	004	49	—	—	2.40M_n PAL	—	VI	49	@
1976 04 13	15 39 13.6	40.84 N	74.05 W	001	317	—	—	3.10M_n PAL	—	VI	49	@

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1783. Nov. 30 (Nov. 29). West of New York City, N.Y. This earthquake was felt from New Hampshire to Pennsylvania. A foreshock at 02 00 UTC on Nov. 30 and an aftershock at 07 00 UTC were reported only in New York and in Philadelphia, Pa. (Ref. 76.)

1895. Sept. 1. Near High Bridge, Hunterdon County, N.J. This earthquake knocked articles from shelves and rocked buildings in several towns in New Jersey, Pennsylvania, and New York. At Asbury Park, N.J., plaster was knocked from walls. At Philadelphia, Pa., windows were broken and crockery was overturned. Felt from Falls Church, Va., and Washington, D.C., to Connecticut. Magnitude 4.3 M_{fa} SET. (Ref. 38, 272, 369.)

1927. June 1. Near Asbury Park, Monmouth County, N.J. Several chimneys were downed, bricks fell from chimneys, and articles fell from shelves in an area from Asbury Park north to Long Branch, in northeast Monmouth County. Also, part of a ceiling fell at Long Branch, and plaster fell from walls and ceilings at Fairhaven, northwest of Long Branch. Many accounts of broken crockery and fallen plaster were reported from Westchester County, N.Y. Three shocks were felt along the New Jersey coast from Sandy Hook to Toms River. (Ref. 38, 218.)

1957. Mar. 23. Long Valley area, Morris County, N.J. At Long Valley (about 55 km west of Newark), walls were cracked and plaster fell to the floor. Chimneys cracked and windows and dishes broke at Lebanon (about 18 km southwest of Long Valley), and one chimney cracked and a well curb broke in the Hamden area (5 km southwest of Lebanon). (Ref. 30, 38, 77.)

1976. Mar. 11. Pompton Lakes area, Passaic County, N.J. Slight damage occurred about 35 km northwest of Newark, at Pompton Lakes (cracks in ceiling, fallen plaster), at nearby Kinnelon (cracks in plaster and windows), and north of Jersey City, at Ridgefield (cracks in ceiling). Felt in Bergen, Morris, and Passaic Counties in northeast New Jersey. (Ref. 49.)

1976. Apr. 13. Near Ridgefield, Bergen County, N.J. An earthquake slightly larger in magnitude than that on Mar. 11, 1976, centered in the same general area. Residents in Ridgefield, about 13 km north of Jersey City, reported that plaster was knocked to the floor. The shock was felt widely in the area. (Ref. 49, 317.)

NEW MEXICO

Earthquakes in New Mexico with magnitudes ≥ 4.5 or intensity ≥ VI.

NEW MEXICO

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1855	04	20	05	34.0 N	107.0 W	—	269	—	—	—	—	VI	269	—
1869	04	18	13	34.0 N	107.0 W	—	38	—	—	—	—	VII	38	—
1869	04	20		34.0 N	107.0 W	—	270	—	—	—	—	VI	270	—
1878	06	14		36.5 N	104.9 W	—	463	—	—	—	—	VI	463	—
1893	04	08	03 20	34.5 N	106.8 W	—	270	—	—	—	—	VI	255	—
1893	09	07		34.5 N	106.8 W	—	255	—	—	—	—	VII	38	—
1897				34.0 N	107.0 W	—	38	—	—	—	—	VI	38	—
1906	07	12	12 15	34.0 N	107.0 W	—	38	—	—	—	—	VII	257	104
1906	07	12	13 05	34.0 N	107.0 W	—	270	—	—	—	—	VI	270	—
1906	07	16	19 00	34.0 N	107.0 W	—	38	—	—	—	—	VII	257	104
1906	11	15	12 15	34.0 N	107.0 W	—	38	—	—	—	—	VII	257	205
1918	05	28	11 30	35.5 N	106.0 W	—	84	—	—	—	—	VII	38	25
1931	02	05	04 48	35.1 N	106.6 W	—	4	—	—	—	—	VI	38	@
1935	02	21	01 25	34.5 N	106.8 W	—	38	—	—	—	—	VI	38	—
1935	12	16	18	34.7 N	106.8 W	—	270	—	—	—	—	VI	270	—
1935	12	18	05 33 18	34.7 N	106.8 W	—	38	—	—	—	—	VI	270	5
1935	12	20	10 30	34.7 N	106.8 W	—	270	—	—	—	—	VI	270	—
1938	09	17	17 20 17	33.3 N	108.5 W	—	277	—	—	4.90M_n TAG	—	VI	38	21
1938	09	20	05 39 00	33.3 N	108.5 W	—	277	—	—	4.30M_n TAG	—	VI	259	—
1938	09	29	23 34 57	33.3 N	108.5 W	—	277	—	—	4.80M_n TAG	—	VI	259	20
1938	11	01	08 26 06	33.3 N	108.5 W	—	277	—	—	3.80M_n TAG	—	VI	11	—
1938	11	02	08 59 58	33.3 N	108.5 W	—	277	—	—	4.30M_n TAG	—	VI	259	—
1938	11	27	00 12 39	33.3 N	108.5 W	—	277	—	—	4.60M_n TAG	—	V	11	—
1939	01	20	12 17 20	33.3 N	108.5 W	—	277	—	—	3.70M_n TAG	—	VI	259	—
1939	06	04	01 19 10	33.3 N	108.5 W	—	277	—	—	4.60M_n TAG	—	VI	259	—
1947	11	06	16 50	35.2 N	106.3 W	—	259	—	—	—	—	VI	259	@
1960	07	23	14 15	34.35 N	106.85 W	—	261	—	—	—	—	VI	33	8
1961	07	03	07 06	34.10 N	106.95 W	—	261	—	—	—	—	VI	34	—
1966	01	23	01 56 38.1	36.98 N	107.02 W	003	264	5.1	—	5.10m_b NUT	4.98HDP	VII	81	27
1970	01	12	11 21 15.1	35.89 N	103.40 W	—	261	3.5	—	3.30M_L NMI	—	VI	43	10
1970	11	28	07 40 11.8	35.10 N	106.61 W	—	261	4.5	—	3.80M_L GS	—	VI	43	3
1971	01	04	07 39 07.0	35.10 N	106.60 W	—	261	4.7	—	3.50M_L NMI	—	VI	44	2
1973	12	24	02 20 14.9	35.26 N	107.74 W	018	74	4.4	—	4.10M_L GS	—	VI	46	20
1976	01	05	06 23 33.9	35.817N	108.212W	040	470	5.0	—	4.60M_L GS	—	VI	49	115
1977	03	05	03 00 55.8	35.748N	108.222W	044	470	4.6	—	4.20M_L GS	—	VI	39	51
1983	03	02	23 22 19.4	34.302N	106.892W	008	360	4.1	—	4.10M_L GS	—	VI	360	4
1985	08	16	14 56 52.9	34.130N	106.832W	007	371	—	—	4.10M_L GS	—	VI	371	4
1989	11	29	06 54 38.5	34.455N	106.891W	013	74	4.6	—	4.70M_D NMI	—	V	579	28

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1855. Apr. 20 (Apr. 19). Socorro area, N. Mex. The earthquake almost destroyed two houses at Socorro, about 110 km south of Albuquerque. The earth trembled; houses shook; and horses were frightened. (Ref. 269.)

1869. Apr. 18. Socorro area, N. Mex. Socorro Springs (at the base of Socorro Mountain) changed flow and became muddy, and its flow was diminished for many weeks. Some houses were damaged considerably at Socorro, about 110 km south of Albuquerque. Seven severe shocks occurred from Apr. 18–20. (Ref. 38, 270, 446.)

1869. Apr. 20. Socorro area, N. Mex. This severe aftershock cracked the walls of the church at

Socorro, about 110 km south of Albuquerque. Near Socorro, the hot springs spouted water "hotter than ever and of a reddish color." (Ref. 270, 446.)

1878. June 14. Cimarron, Colfax County, N. Mex. Windowpanes were broken by an earthquake at Cimarron, about 55 km southwest of Raton. (Ref. 463.)

1887. May 3. Northern Sonora, Mexico. Chimneys were thrown down in Albuquerque, N. Mex. See the Arizona chapter for a complete description of this damaging earthquake. (Ref. 38, 343, 471, 494, 497.)

1893. Apr. 8 (Apr. 7). Belen, Valencia County, N. Mex. This was the strongest of a series of shocks Apr. 6–8. It damaged almost all the houses in and around Belen and threw several entirely down. The earthquake was not felt farther south than Sabinal. The effects for these earthquakes were taken from two reports, one not indicating any damage and the other as described above. The assigned intensity is lower than the above damage would indicate. (Ref. 255, 270.)

1893. Sept. 7. Los Lunas, Valencia County, N. Mex. Five shocks threw down a score of old adobe buildings already weakened by previous earthquakes in Los Lunas. At Sabinal, a spring formed in a place that always had been dry and barren. The central area of the State was subjected to tremors for a period of three months, the most severe occurring on Sept. 7. (Ref. 38, 255.)

1897. Date unknown. Socorro area, N. Mex. This violent tremor overturned chairs and small objects at Socorro, about 110 km south of Albuquerque. The motion was so strong that one person could not walk. (Ref. 38, 270.)

1906. July 12, 12 15 UTC. Socorro area, N. Mex. About 110 km south of Albuquerque at Socorro, an earthquake threw down several chimneys, knocked plaster from the walls of many adobe houses and the courthouse, and hurled shelf goods, book cases, and dishes to the floor. The entire business block, extending from the plaza along the north side of Manzanares Avenue, was damaged heavily. A two-story brick house, one of the buildings most severely damaged, was abandoned because its walls were cracked badly and thrown out of plumb. Nearby, one of the walls of another cottage was damaged so severely that the occupants moved outside to a tent. Many other residences sustained damage to walls and furniture.

Many boulders rolled onto the branch railroad leading to Magdalena, west of Socorro, breaking one rail and many ties. Fissures formed in the ground near the Santa Fe depot in Socorro, and waves were seen on the ground surface. The earthquake shook residents of Carthage, Kelly, Magdalena, San Antonio, San Marcial, and other towns as far north as Albuquerque and as far south as Silver City (Grant County). Tremors were felt daily from July 2, 1906, well into 1907. (Ref. 38, 257, 270.)

1906. July 12, 13 05 UTC. Socorro area, N. Mex. This earthquake at Socorro, about 110 km south of Albuquerque, was described as almost as severe as the first tremor on July 12 (12 15 UTC). (Ref. 270.)

1906. July 16. Socorro area, N. Mex. Described as slightly stronger that the July 12 event, an earthquake caused additional damage in the form of downed chimneys, cracked houses, and damaged brick gables at Socorro, about 110 km south of Albuquerque. Many residents left their houses and lived in tents. The Socorro Hotel, a brick structure, was abandoned because of severe damage. The brick post office had a bulging wall, and its southeast corner was "thrown out." Three chimneys on the Socorro County Courthouse were destroyed, and two were downed at the high school. At San Marcial, the shock knocked down a few chimneys, cracked a few houses, and broke windows. At San Antonio, the earthquake caused plaster to fall, broke windows, and cracked most houses. This shock was reported felt at Raton, about 390 km northeast of Socorro, and Douglas, Ariz., 400 km southwest. (Ref. 38, 257, 270.)

1906. Nov. 15. Socorro area, N. Mex. This earthquake, which increased the property damage already sustained at Socorro, was described as the most severe shock of the year. Four rebuilt chimneys were shaken off the Socorro County Courthouse, and two others were cracked severely. Plaster fell at the courthouse, and a cornice on the northwest corner of the two-story adobe Masonic Temple was thrown onto its first floor. Several bricks fell from the front gable on one house. Plaster was shaken from walls in Santa Fe, about 200 km from the epicenter. Felt over most of New Mexico and in parts of Arizona and Texas. (Ref. 38, 257, 270, 272.)

1918. May 28. Near Cerrillos, Santa Fe County, N. Mex. Many chimneys and plastered ceilings fell at Cerrillos, about 35 km south of Santa Fe. A "heavy" break in the surface of the earth occurred at the edge of town. Glass was shaken from several windows. People in the street were thrown off their feet. Plaster was knocked down at Santa Fe, and adobe walls were cracked at Stanley, southwest of Cerrillos. (Ref. 38, 84, 270, 272.)

1931. Feb. 5. (Feb. 4). Albuquerque, Bernalillo County, N. Mex. Bricks and adobe walls cracked at Albuquerque, chimneys cracked, and part of one chimney fell. Large rocks rolled into the streets from sand hills about the city. Across the river and south of town, two adobe houses were damaged severely. (Ref. 4, 38, 270.)

1935. Feb. 21 (Feb. 20). Near Bernardo, Socorro County, N. Mex. Coping on a building cracked at Bernardo, and walls and plaster cracked. Adobe and concrete buildings sustained damage. (Ref. 8, 38.)

1935. Dec. 16. Belen, Valencia County, N. Mex. Plaster fell, small cracks formed in buildings, and dishes broke at Belen. This is one of a series of 81 earthquakes that were felt from Dec. 13, 1935, to Jan. 4, 1936. (Ref. 270.)

1935. Dec. 18 (Dec. 17). Belen, Valencia County, N. Mex. Plaster fell throughout the city of Belen, objects were shaken from shelves, and several brick and adobe buildings sustained cracks. (Ref. 38, 270.)

1935. Dec. 20. Belen, Valencia County, N. Mex. A large locomotive shook on the Santa Fe tracks at Belen, and switch engines were rocked hard enough to alarm engineers and firemen. (Ref. 270.)

1938. Sept. 17. Southwest New Mexico, near the Continental Divide. This shock was strongest in Graham County, Ariz., at Clifton and Duncan, and in the southern part of Catron County, N. Mex. At Duncan, Ariz., plaster and walls cracked and bottles fell from shelves. At a Forest Service ranger station near the head of the west fork of the Gila River in New Mexico, one chimney cracked, plaster fell, and trees and bushes were shaken strongly. This was the first of a series of earthquakes that occurred through July 1939. Magnitude 5.5 M_S GR. (Ref. 8, 38, 277, 343.)

1938. Sept. 20 (Sept. 19). Southwest New Mexico aftershock. An aftershock of the Sept. 17 earthquake cracked old adobe walls and knocked others down at Duncan, Ariz., in southeast Graham County. The tremor disrupted telephone service for hours, displaced furnishings in houses, and overturned vases. The main shock also was felt in Graham County, Ariz., at Clifton, Morenci, and Safford; in northern Cochise County, at San Simon; and at several towns in New Mexico. Many small shocks were reported from Sept. 17–20. (Ref. 11, 259, 277, 343.)

1938. Sept. 29. Southwest New Mexico aftershock. This aftershock of the Sept. 17 earthquake was strongest at Clifton (Graham County), Ariz., where about a large amount of plaster fell from a ceiling in one house. Felt in Graham and Cochise Counties, Ariz., and at several towns in New Mexico. (Ref. 259, 277, 343.)

1938. Nov. 1. Southwest New Mexico aftershock. Another aftershock of the Sept. 17 earthquake cracked plaster and chimneys at Cliff (Grant County), N. Mex. Rocks fell in the mountains near Buckhorn, northwest of Cliff. Also felt in Arizona. (Ref. 11, 277, 343.)

1938. Nov. 2. Southwest New Mexico aftershock. Another aftershock of the Sept. 17 earthquake cracked chimneys at White Creek Ranger Station near Cliff (Grant County). Also felt in Arizona. (Ref. 259, 277, 343.)

1939. Jan. 20. Southwest New Mexico aftershock. Walls were cracked in Grant County, at Gila, by an aftershock of the tremor on Sept. 17, 1938. (Ref. 259, 277.)

1939. June 4 (June 3). Southwest New Mexico aftershock. The last damaging aftershock of the Sept. 17, 1938, earthquake cracked plaster at Duncan, Ariz., in southeast Graham County. (Ref. 259, 277.)

1947. Nov. 6. San Antonito area, Bernalillo County, N. Mex. This local earthquake cracked a fireplace and plaster at Zamora Ranch and shook dishes from shelves at San Antonito. (Ref. 259.)

1960. July 23. Near Lajoya, Socorro County, N. Mex. A weak adobe wall toppled and some adobe buildings were cracked at Lajoya. Canned goods fell from shelves and people ran outdoors at nearby Bernardo. (Ref. 33, 261.)

1961. July 3. Socorro area, N. Mex. Plaster cracked in adobe buildings at Socorro, about 110 km south of Albuquerque. (Ref. 34, 261.)

1966. Jan. 23 (Jan. 22). Near Dulce, Rio Arriba County, N. Mex. This earthquake affected to some extent almost every house in Dulce and damaged chimneys throughout the area. Property damage was estimated at about $200,000. The earthquake was caused by normal faulting on a fault striking approximately north-northwest, that probably had its maximum activity in Miocene time. Distribution of aftershock epicenters suggests that the main shock triggered aftershock activity on adjacent faults. The aftershock activity continued in the area for a year.

Property damage was most severe at the Dulce Bureau of Indian Affairs School and dormitory complex and the Dulce independent schools. Much plaster fell from ceilings in the dormitories, and several brick walls sustained vertical fractures that extended from ground to roof. Brick walls in the steam-heating plant were displaced from vertical alignment as much as 3 cm, and two boilers (each weighing 10 tons) were displaced about 0.6 cm at their bases.

Also, an 18-m-high smokestack buckled, and only guy wires prevented it from falling.

Huge masses of shale and sandstone fell down the slopes from nearby Dulce Point. In addition, several small cracks formed in fill across the frozen roads in the Dulce area, but there was no evidence of ground displacement or fissuring. Also felt in southern Colorado. Magnitude 4.6 M_S NUT. (Ref. 38, 81, 263, 264, 533.)

1970. Jan. 12. Amistad area, Harding County, N. Mex. Part of a ceiling fell at Amistad, and some adobe bricks in a wall crumbled at the public school gymnasium. Plaster fell at nearby Nara Visa. Also felt at Texline, Tex. (Ref. 43, 261.)

1970. Nov. 28. Near Albuquerque, Bernalillo County, N. Mex. This minor earthquake cracked plaster, a garage floor, and a concrete-block wall and broke windows. One resident reported that the roof of a barn collapsed; another said a roof air conditioner fell through a skylight. (Ref. 43, 261, 364.)

1971. Jan. 4. Near Albuquerque, Bernalillo County, N. Mex. Considerable minor damage at Albuquerque included cracked windows and plaster in buildings and fallen merchandise in markets. An old adobe building sustained both interior and exterior cracks. Slight damage also occurred at nearby Alameda and Corrales. (Ref. 44, 261.)

1973. Dec. 24 (Dec. 23). Grants area, Cibola County, N. Mex. Plaster cracked and fell, cracks formed in an exterior wall, and paneling on walls pulled apart at Grants. Walls and chimneys were cracked at Laguna, about 50 km southeast of Grants. (Ref. 46, 74.)

1976. Jan. 5 (Jan. 4). Near Crownpoint, McKinley County, N.Mex. Damage, which generally was minor, consisted mostly of cracks in plaster and drywall in several Colorado and New Mexico towns and at Leupp, Ariz. At Cahone, Colo., a chimney was cracked. Also felt in Utah.

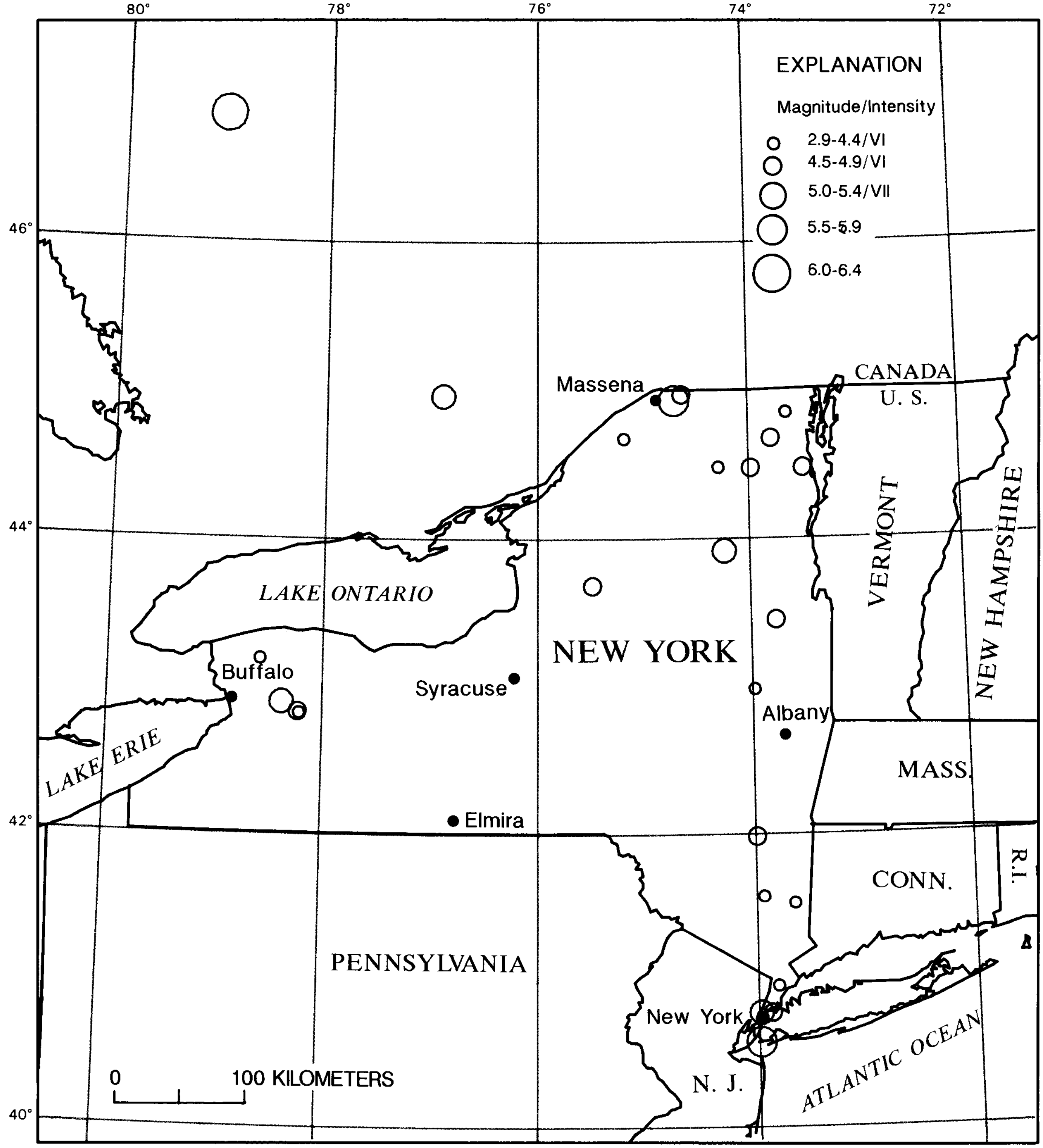
This earthquake and that on Mar. 5, 1977, are two of the largest ever observed in New Mexico outside the Rio Grande rift and within the Colorado Plateau. They occurred in the southern part of the San Juan Basin (known as the Chaco slope), a region that historically has had a low level of seismicity. (Ref. 49, 470.)

1977. Mar. 5 (Mar. 4). Near Crownpoint, McKinley County, N. Mex. Fences displaced slightly at Crownpoint, and existing cracks in walls widened considerably south of Crownpoint, at Prewitt. Also felt in Arizona and Colorado. See description above for the earthquake on Jan. 5, 1976. (Ref. 39, 470.)

1983. Mar. 2. Near Socorro, N. Mex. At San Acacia, plaster cracked in both exterior and interior walls of adobe buildings, dishes were broken, and stock was thrown from store shelves. The shock also was strong in Socorro County at Bosque, Lajoya, and Socorro. (Ref. 360.)

1985. Aug. 16. Near Socorro, N. Mex. At Socorro, about 110 km south of Albuquerque, cracks formed in sidewalks, plaster, windows, and the foundation of a brick building. Also, a few glassware items were broken. This earthquake was felt only at a few towns in the area. Magnitude 4.3 M_n TUL. (Ref. 371.)

NEW YORK



Earthquakes in New York with magnitudes ≥ 4.5 or intensity ≥ VI.

NEW YORK

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km^2)
1737	12	19	03 45	40.8 N	74.0 W	—	76	—	—	—	—	VII	76	—
1853	03	12	07 30	43.7 N	75.5 W	—	76	—	—	—	—	VI	76	—
1855	02	07	04 30	42.0 N	74.0 W	—	76	—	—	—	—	VI	76	—
1857	10	23	20 15	43.2 N	78.6 W	—	76	—	—	4.30M_{fa} SC	—	VI	76	65
1867	12	18	08 00	44.7 N	75.2 W	—	126	—	—	4.30M_{fa} SC	—	VI	126	65
1877	11	04	06 56	44.5 N	74.0 W	—	38	—	—	4.90M_{fa} SC	—	VII	38	200
1878	02	05	16 20	40.8 N	73.9 W	—	141	—	—	—	—	VI	463	—
1884	08	10	19 07	40.6 N	74.0 W	—	76	—	—	5.50M_{fa} SET	—	VII	76	540&
1897	05	28	03 16	44.5 N	73.5 W	—	126	—	—	4.70M_{fa} SC	—	VI	76	225
1914	02	10	18 31	44.98 N	76.92 W	—	76	—	—	5.20M_{fa} SC	—	VII	76	518
1916	02	03	04 24	43.0 N	74.0 W	—	126	—	—	4.10M_{fa} SC	—	VI	272	21
1928	03	18	15 20	44.5 N	74.3 W	—	38	—	—	4.10M_L EPB	—	VI	38	31
1929	08	12	11 24 48.7	42.910N	78.402W	009	349	—	—	5.20M_n ST	4.69ST	VIII	77	880
1931	04	20	19 54 30.6	43.471N	73.785W	005	349	—	—	4.70M_n ST	—	VII	4	70
1934	04	15	02 58 13.0	44.7 N	73.8 W	—	77	—	—	4.50M_L EPB	—	VI	126	21
1935	11	01	06 03 34.2	46.87 N	79.05 W	001	349	—	—	6.20M_s GR	5.59ST	VII	77	2590
1944	09	05	04 38 45.7	44.958N	74.723W	012	349	—	—	5.80M_n ST	5.52ST	VIII	17	1095
1944	09	05	08 51 06.0	44.999N	74.652W	001	349	—	—	4.50M_n BAS	—	—	—	—
1966	01	01	13 23 39.0	42.842N	78.249W	000	349	4.7	—	4.60M_n STR	4.26HRN	VI	81	26&
1967	06	13	19 08 55.5	42.837N	78.234W	001	349	3.9	—	4.40M_n STR	4.07HRN	VI	40	6
1974	06	07	19 45 35.7	41.595N	73.951W	003	349	—	—	2.90M_n DG	2.86ST	VI	47	@
1975	06	09	18 39 22.7	44.874N	73.651W	011	349	—	—	3.50M_n ST	3.28ST	VI	48	13
1983	02	26	19 59 35.4	41.552N	73.663W	007	360	—	—	2.90M_n GS	—	VI	360	4
1983	10	07	10 18 46.1	43.938N	74.258W	013	360	5.1	—	5.10M_L PAL	4.88SOM	VI	360	634
1985	10	19	10 07 40.3	40.983N	73.829W	006	371	3.6	—	4.00M_L PAL	—	VI	371	31

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1737. Dec. 19 (Dec. 18). New York City area, N.Y. Several chimneys were knocked down and bells were rung in New York City. It was felt in Boston, Mass., Philadelphia, Pa., and New Castle, Del. (Ref. 38, 59, 76.)

1853. Mar. 12. Near Lowville, Lewis County, N.Y. Machinery was knocked down at Lowville, about 100 km northeast of Syracuse. Also felt in Canada. (Ref. 59, 76.)

1855. Feb. 7 (Feb. 6). Hudson River valley area. This event was felt to the east as far as Springfield, Mass. Ref. 444 reports that this was a nontectonic event (a cryoseism) which was caused by freezing action in ice, ice-soil, and ice-rock materials. The intensity VI in the hypocenter list above was taken from ref. 76 but could not be documented with damage descriptions. (Ref. 76, 444.)

1857. Oct. 23. Near Buffalo, Niagara County, N.Y. Crocks fell from shelves at Buffalo; bells rang and walls vibrated and surged. A man sitting on a chair was thrown to the ground. Felt from Warren, Pa., to Port Hope on Lake Ontario, and in the Montreal, Canada, region. (Ref. 38, 76.)

1867. Dec. 18. Northern New York. This earthquake was described as "quite severe" at Hammond (St. Lawrence County). The earthquake awakened residents at Ogdensburg (St. Lawrence County) and Syracuse (Onondaga County), N.Y., Burlington, Vt., and Hamilton, Ontario. Felt from Whitehall, N.Y., near the Vermont–New York border, to Belleville, Ontario, and Sackville, New Brunswick. (Ref. 38, 59, 126, 591.)

1877. Nov. 4. Northern New York. Effects of the shock were most severe along the St. Lawrence River and Lake Champlain. In that area, chimneys

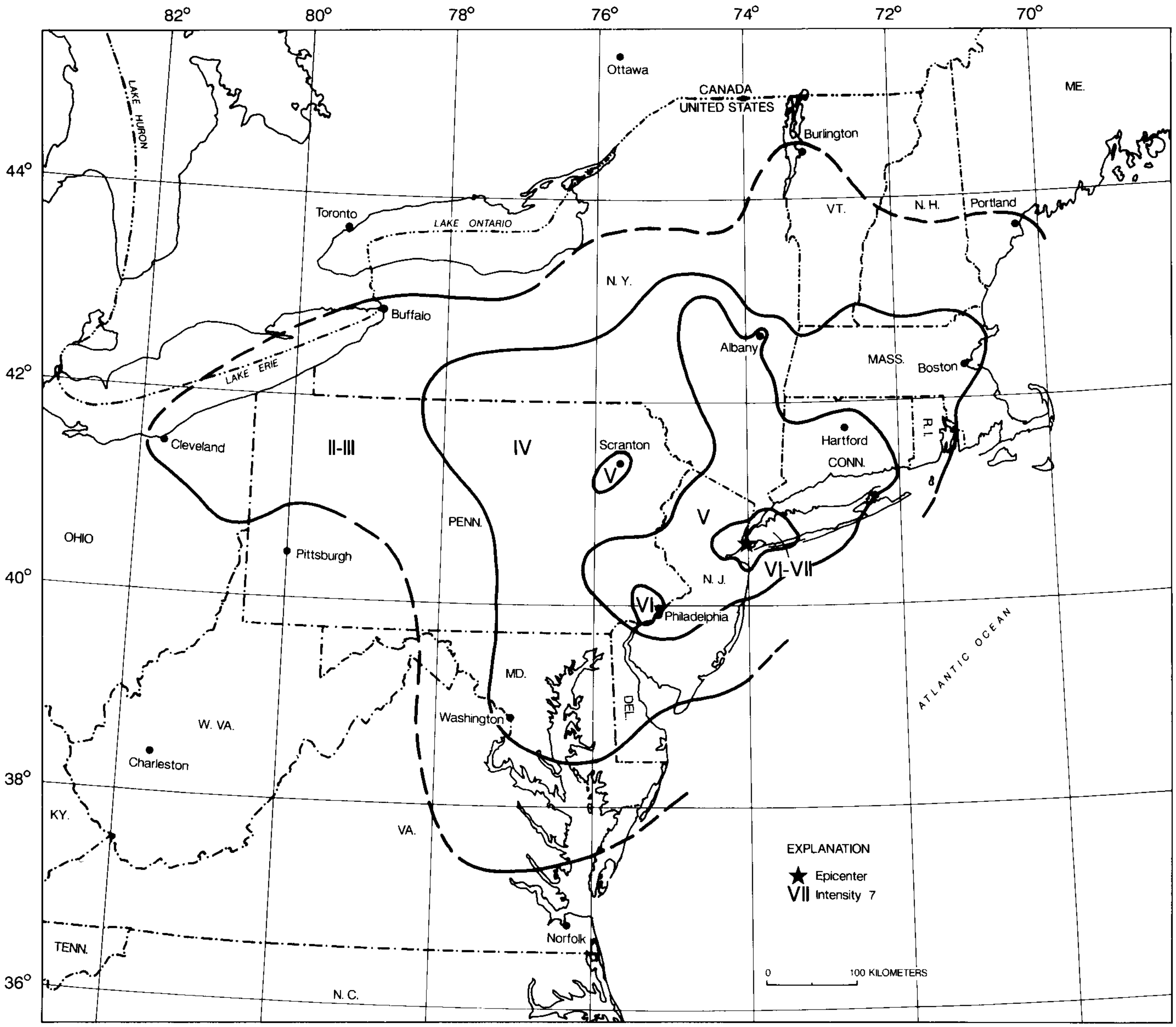


FIGURE 46.— Isoseismal map for the New York City, New York, earthquake of August 10, 1884. Isoseismals are based on intensity estimates from data listed in references 369, 463, 518, and 529 of table 1.

were downed, crockery was overturned, and ceilings were cracked. As far southwest as Auburn, N.Y., windowpanes were damaged. Felt from Pembroke, Ontario, to Trois-Rivieres, Quebec, on the north; to Boston, Mass., Providence, R.I., Hartford, Conn., and Auburn, N.Y., on the south. (Ref. 38.)

1878. Feb. 5. Flushing, Queens County, N.Y. A severe shock broke windows and crockery and shook houses at Flushing. (Ref. 141, 463.)

1884. Aug. 10. Near New York City, N.Y. This severe earthquake affected an area roughly extending along the Atlantic Coast from southern Maine to central Virginia and westward to Cleveland, Ohio (see fig. 46). Chimneys were knocked down and walls were cracked in several States, including Connecticut, New Jersey, New York, and Pennsylvania. Many towns from Hartford, Conn., to West Chester, Pa., reported fallen bricks and cracked plaster.

Property damage was severe at Amityville and Jamaica, N.Y., where several chimneys were "overturned" and large cracks formed in walls. Two chimneys were thrown down and bricks were shaken from other chimneys at Stratford (Fairfield County), Conn.; water in the Housatonic River was agitated violently. At Bloomfield, N.J., and Chester, Pa., several chimneys were downed and crockery was broken. Chimneys also were damaged at Mount Vernon, N.Y., and Allentown, Easton, and Philadelphia, Pa. Three shocks occurred, the second of which was most violent. This earthquake also was reported felt in Vermont, Virginia, and Washington, D.C. Several slight aftershocks were reported on Aug. 11. (Ref. 38, 76, 369, 463.)

1897. May 28 (May 27). Northeast New York. This earthquake was reported as severe, but little damage occurred. Felt in Massachusetts, New Hampshire, New York, and Vermont. Also felt in Canada. (Ref. 38, 76, 126.)

1914. Feb. 10. Ontario, Canada. A strong earthquake near Lanark, Ontario, broke water pipes at Canton (St. Lawrence County), N.Y., caused a cave-in at Binghamton (Broome County), and cracked the road at nearby Johnson City. Objects were thrown from shelves and walls at Albany and Syracuse. Also felt in Connecticut, Massachusetts, and Pennsylvania. Magnitude 5.5 Ukn EPB. (Ref. 38, 76.)

1916. Feb. 3 (Feb. 2). Schenectady, N.Y. A distinct earthquake at Schenectady (northwest of Albany) broke windows and dishes, threw people out of bed, and shook houses. Residents within a 40-km radius of Schenectady felt the shock. (Ref. 272.)

1928. Mar. 18. Saranac Lake, Essex County, N.Y. Dishes fell from shelves at Saranac Lake, and at Malone, about 60 km north, people rushed from their houses. The shock was widely felt in northeast New York and probably in adjacent Canada. (Ref. 1, 38.)

1929. Aug. 12. Attica, Wyoming County, N.Y. The earthquake was strongest in eastern Attica and the region to the east. In Attica, 250 chimneys were thrown down, several brick buildings were damaged, and a crack formed in the railroad embankment near the railroad station. East of town, almost every monument was knocked over in the Brainerd Cemetery. West of Attica Reservoir, several wells went dry and a crack formed in the bottom of one well. Several chimneys also fell a few km north of Attica, at Batavia, and at Warsaw, 20 km southeast; only slight damage occurred at other towns. It was felt from New Hampshire to Michigan and from Maryland to northern Ontario (see fig. 47). Magnitude 4.4 M_S NLI, 4.9 M JOH. (Ref. 2, 38, 77, 349.)

1931. Apr. 20. Lake George area, Warren County, N.Y. The most severe damage occurred at Warrensburg, a few kilometers north of Lake George, where several chimneys were thrown down and a church spire twisted. Minor damage also occurred at Glens Falls, Luzerne, and Lake George. Although widely felt, the shock was not as strong in the Catskills to the south as it was at equal distances in other directions. (Ref. 4, 349.)

1934. Apr. 15 (Apr. 14). Adirondack Mountains area, N.Y., near Lake Champlain. The earthquake was strongest in the Lake Champlain region, near Beekmantown (where a house shifted off its foundation); a few kilometers south at Keeseville; and at Saranac Lake (northern Essex County). Also felt in Vermont and at Montreal, Canada. (Ref. 7, 77, 126.)

1935. Nov. 1. Quebec-Ontario border, Canada. Heavy damage occurred in Timiskaming area, Canada. In the United States, chimneys and plaster sustained minor damage at Cortland, N.Y., about 50 km south of Syracuse. Felt in eastern Maine, south to Washington, D.C., and west to Wisconsin, including 17 States and three Canadian Provinces. Magnitude 5.9 M_S NLI. (Ref. 38, 77, 349.)

1944. Sept. 5 (Sept. 4). Between Massena, N.Y., and Cornwall, Ontario, Canada. This severe earthquake was felt from Canada south to Maryland and from Maine west to Indiana (see fig. 48). It caused property damage estimated at $2 million at Massena and Cornwall. Many chimneys in that area required rebuilding, and several structures were unsafe for occupancy until repaired. Residents of St. Lawrence County reported that many water wells went dry.

At Massena, in northern St. Lawrence County, 90 percent of the chimneys were destroyed or damaged and house foundations, plumbing, and masonry were damaged severely. Similar effects were reported at Cornwall. Cracks formed in the ground at Hogansburg, and brick-masonry and concrete structures were damaged. Chimneys were downed in several towns in New York, including Fort Covington, Keeseville, Malone, Norfolk, Ogdensburg, and Waddington. Magnitude 5.6 M_S NLI, 5.77 M JOH. (Ref. 17, 77, 194, 349, 533.)

1966. Jan. 1. Near Attica, Wyoming County, N.Y. Chimneys and walls were damaged slightly at Attica and 10 km south, at Varysburg. In addition, plaster fell at the Attica State Prison, and its main smokestack was damaged. Felt in western New York, northwest Pennsylvania, and southern Ontario, Canada. (Ref. 81, 105, 349.)

1967. June 13. Near Attica, Wyoming County, N.Y. At Attica, plaster fell, chimneys cracked, and fluorescent light fixtures were damaged. At Alabama, about 30 km north of Attica, ceiling tile fell in a church. This shock was felt over a small area of western New York. Magnitude 3.0 M_S NLI. (Ref. 38, 40, 349.)

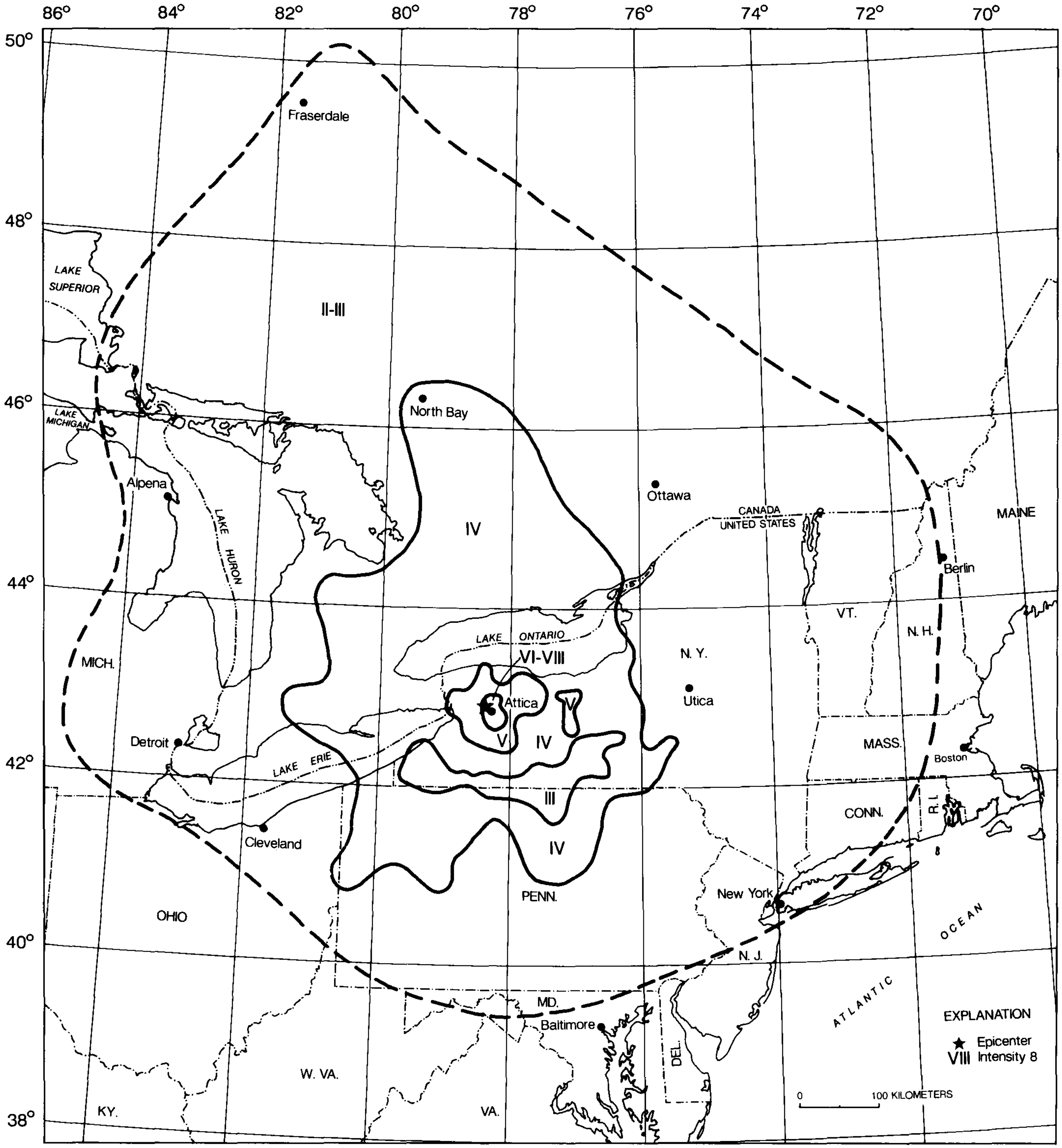


FIGURE 47.— Isoseismal map for the Attica, New York, earthquake of August 12, 1929. Isoseismals are based on intensity estimates from data listed in reference 2 of table 1.

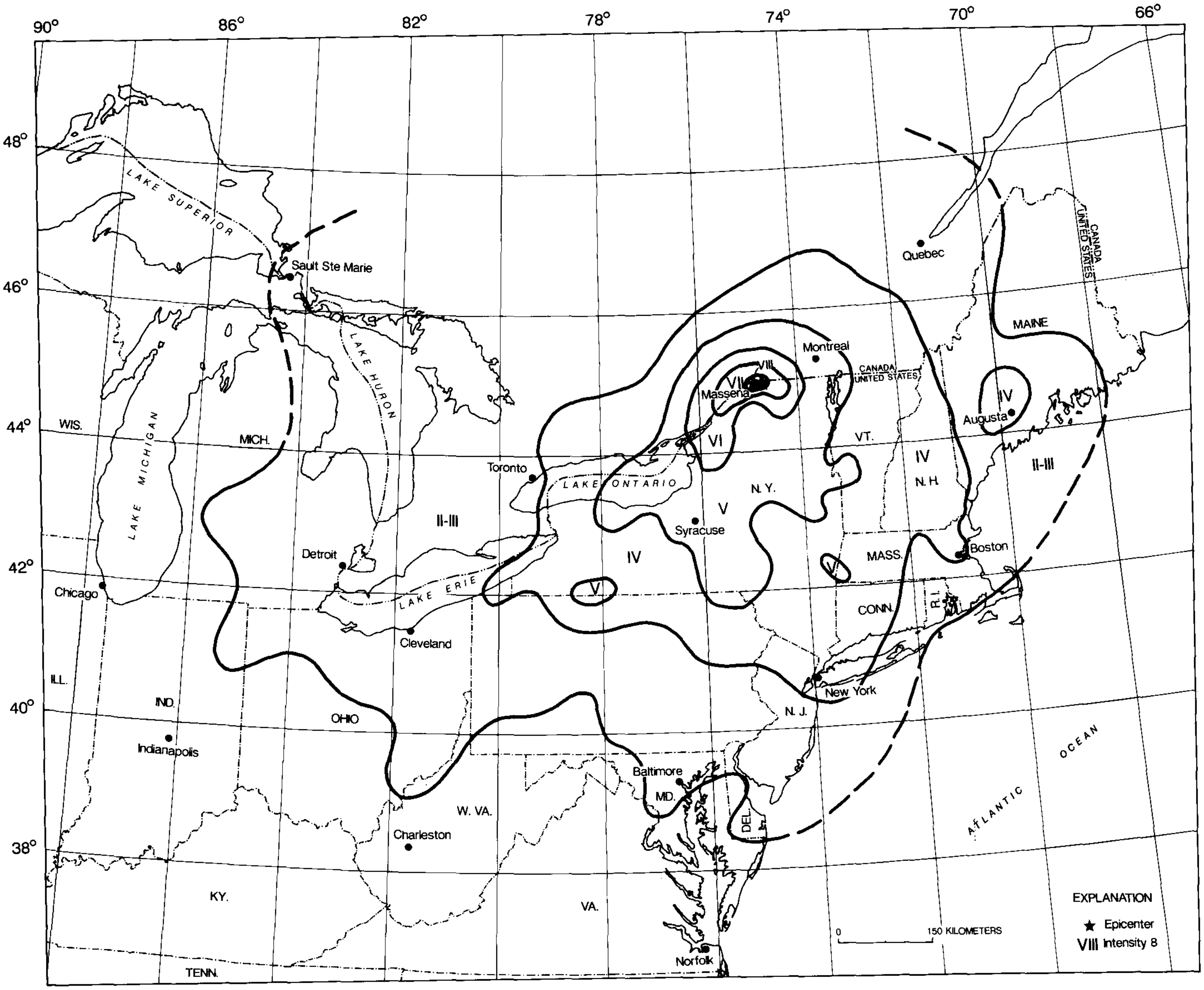


FIGURE 48.— Isoseismal map for the Massena, New York, earthquake of September 5, 1944. Isoseismals are based on intensity estimates from original U.S. Coast and Geodetic Survey questionnaires and from references 17 and 77 of table 1.

1974. June 7. Wappingers Falls area, Dutchess County, N.Y. Windows were broken in the area, and a bookcase toppled in one house. More than 100 aftershocks were recorded through June 13. Magnitude 3.8 M_n PAL. (Ref. 47, 349.)

1975. June 9. Northern New York. A chimney and fireplace were cracked at Beekmantown, on Lake Champlain north of Plattsburgh. About 35 km east of Beekmantown, at Fairfax, Vt., slight damage also was reported. Felt in southern Quebec, Canada, and in Massachusetts, New Hampshire, New York, and Vermont. Magnitude 4.2 M_n PAL. (Ref. 38, 48, 349.)

1983. Feb. 26. Near Lagrangeville, Dutchess County, N.Y. Slight damage to property was reported at two towns in Dutchess County. At Lagrangeville, chimneys and a house foundation were cracked; at Pawling, a few buildings were damaged and a church wall was cracked. The shock was felt only in western Connecticut and southeast New York. Magnitude 3.0 M_n PAL. (Ref. 360.)

1983. Oct. 7. Blue Mountain Lake area, Hamilton County, N.Y. At Blue Mountain Lake,

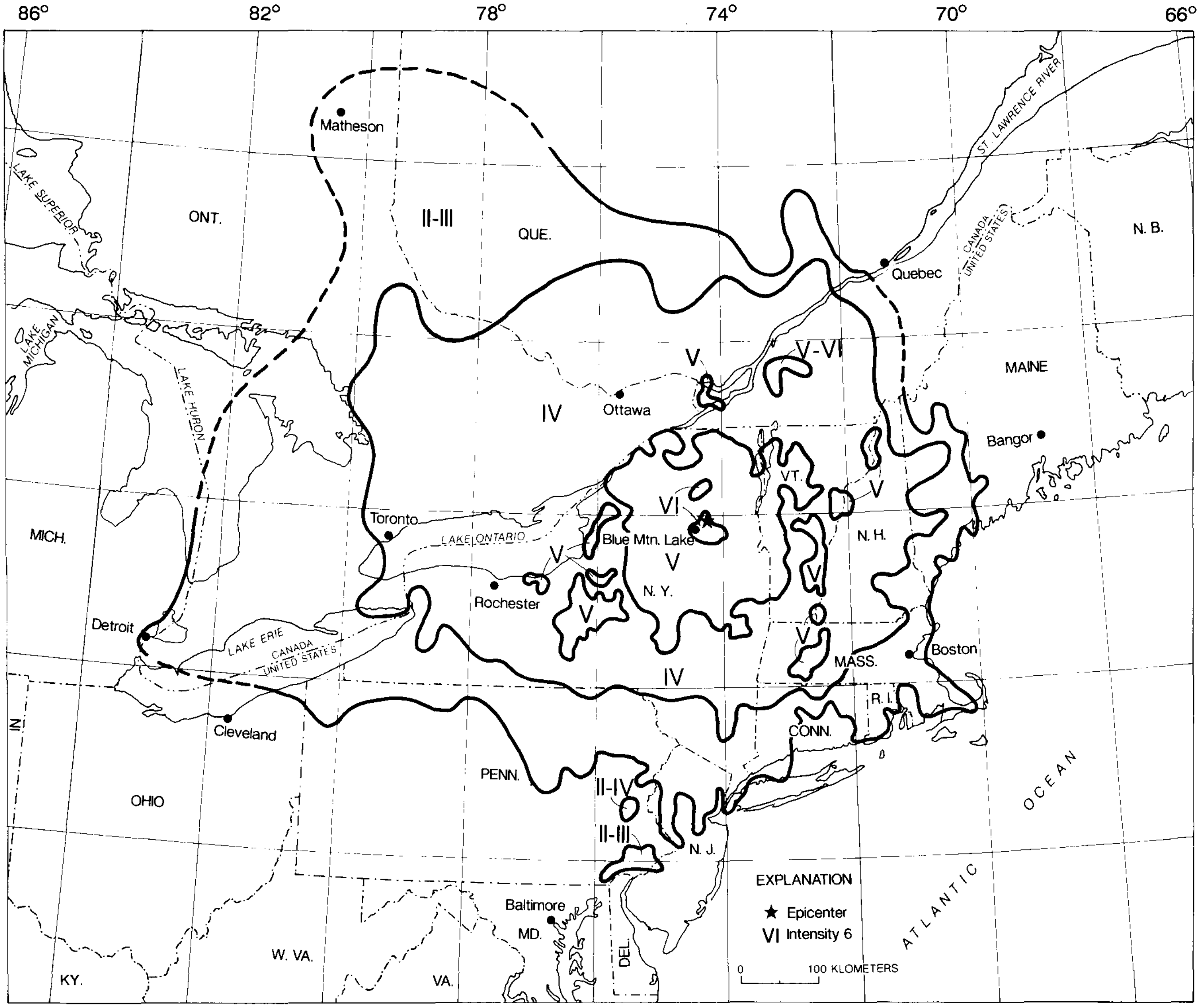
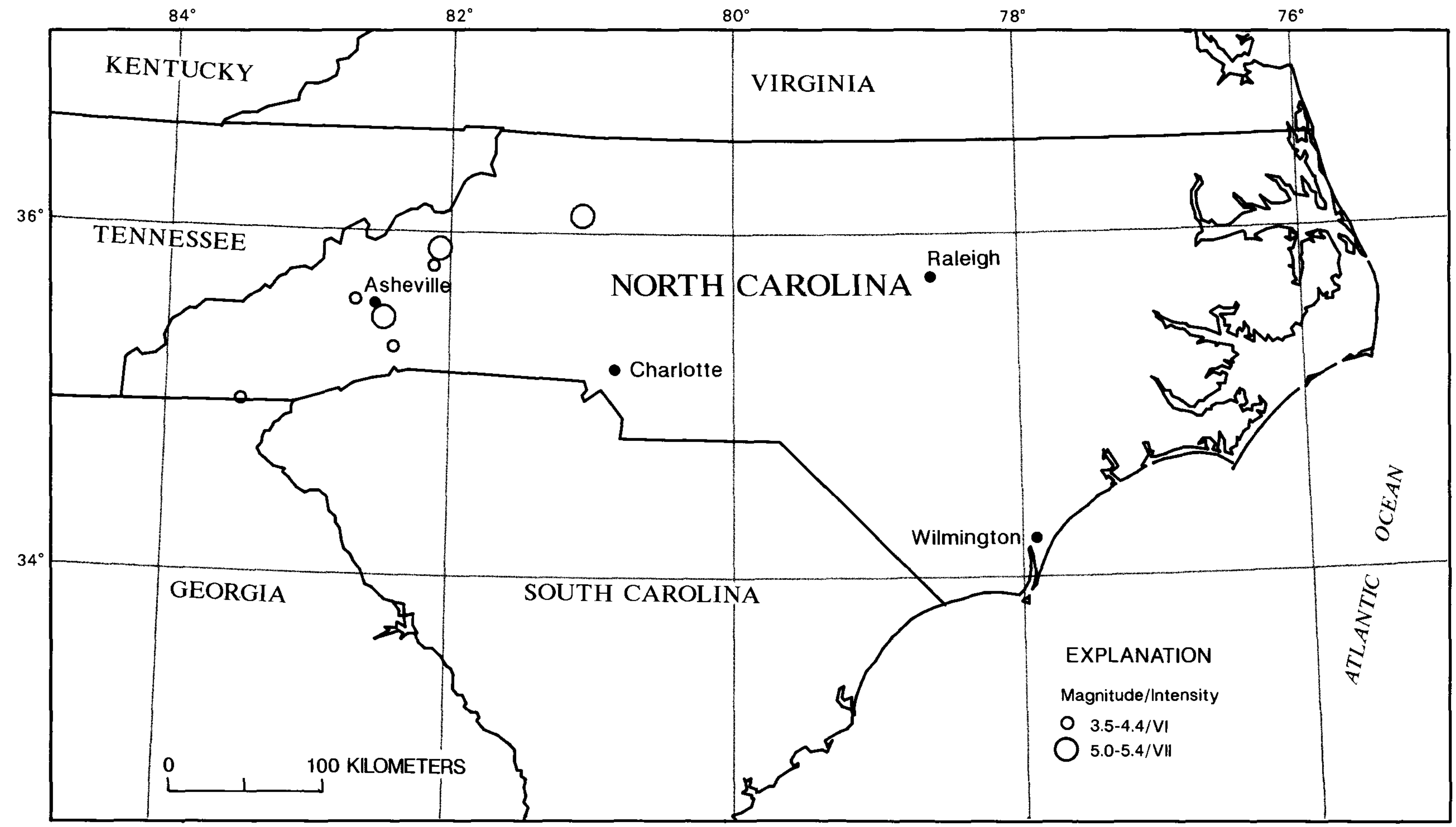


FIGURE 49.— Isoseismal map for the Blue Mountain Lake, New York, earthquake of October 7, 1983. This map is a simplified version of figure 37 in reference 360 of table 1.

one old chimney collapsed, about 20 tombstones slid or rotated, and some minor cracks formed in plaster walls. Several landslides were reported. Light damage also occurred at several other towns in the area, but the most common effects were cracked chimneys, broken dishes or glassware, and overturned or fallen objects. Although this earthquake caused only minor damage, it was felt over a wide region (see fig. 49), including two Provinces in Canada and 12 States. Magnitude 5.3 M_n BLA, 5.1 M_n SLM, 4.89 M JOH. (Ref. 360.)

1985. Oct. 19. Southeast New York. Windows were broken at Newburgh, N.Y. (about 140 km south of Albany), and Glenville, Fairfield County, Conn. Plaster and drywall also were cracked and glassware was broken in Newburgh. Light damage was sustained at a few towns in Connecticut, New Jersey, and New York. Felt over a large area of Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania. A moderate aftershock was felt in Connecticut, New Jersey, and New York on Oct. 21 (10 37 UTC). Magnitude 4.0 M_D WES. (Ref. 371.)



Earthquakes in North Carolina with magnitudes ≥ 4.5 or intensity ≥ VI.

NORTH CAROLINA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km^2)
1861	08	31	10 22	36.1 N	81.1 W	—	55	—	—	5.00M_{fa} SC	—	VI	38	784
1916	02	21	23 39	35.5 N	82.5 W	—	272	—	—	5.20M_{fa} SC	—	VII	67	600
1926	07	08	09 50	35.9 N	82.1 W	—	71	—	—	—	—	VII	68	@
1957	05	13	14 24 51.1	35.799N	82.142W	005	349	—	—	4.00M_{fa} SC	—	VI	132	16
1957	07	02	09 33 01	35.6 N	82.7 W	007	155	—	—	3.70M_{fa} SC	—	VI	132	3
1957	11	24	20 06 17	35.0 N	83.5 W	—	30	—	—	3.90M_{fa} SC	—	VI	132	12
1981	05	05	21 21 56.7	35.327N	82.422W	010	339	—	—	3.50M_n BLA	—	VI	325	10

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1861. Aug. 31. Near Wilkesboro, Wilkes County, N.C. Bricks were shaken from chimneys, doors were jarred open, and clocks stopped running at Wilkesboro, about 85 km west of Winston-Salem. Felt along the Atlantic Coast from Washington, D.C., southward to Charleston, S.C., and Columbus, Ga., and westward to Cincinnati, Ohio, Louisville, Ky., and Gallatin, Tenn. Magnitude 5.1 M_{fa} NUT. (Ref. 38, 55, 508.)

1916. Feb. 21. Near Waynesville, Haywood County, N.C. Tops of chimneys were thrown to the ground; windowpanes were broken in many houses; and people rushed into the streets at Waynesville. At Sevierville, Tenn., about 70 km northwest of Waynesville, bricks were shaken from chimneys. In Wear's Cove, about 16 km southwest of Sevierville, the flow of water in springs increased and in places water became muddy. Minor damage was reported in western Tennessee at Athens, Knoxville, Maryville, Morristown, and Newport, Tenn.; at Tryon, N.C.; and at Bristol, Va. Also reported felt in Alabama, Georgia, Kentucky, South Carolina, and West Virginia (see fig. 50). (Ref. 67, 71, 272, 508, 600.)

1926. July 8. Southern Mitchell County, N.C. A sharp local earthquake in Mitchell County caused minor damage—one downed chimney, cracks in chimneys and foundations of houses, broken water pipes and glassware, and shifting of houses on foundations. Ground cracks also were reported. Damage was confined to an area about 1 km long and 275 m wide. Town names were not mentioned in any of the accounts on this event. (Ref. 68, 71, 218, 508.)

1957. May 13. Near Woodlawn, McDowell County, N.C. A sprinkler pipe was shaken loose at a factory at Woodlawn, and books fell from library shelves. Slight damage to plaster occurred at several towns in the area. Old cracks in a wall were enlarged at Busick, near Mt. Mitchell in southern Yancey County. The shock was strong in other towns in Burke and McDowell Counties and was reported felt at two towns in South Carolina. Magnitude 4.1 M_{fa} DG. (Ref. 30, 132, 349, 508.)

1957. July 2. Buncombe County area, N.C. Minor damage reported in western North Carolina included cracks in walls and plaster at Asheville, cracks in retaining wall at Marshall, damaged chimneys and cracks in plaster at Swannanoa, and cracks in plaster at Weaverville. Also reported felt in Haywood and Madison Counties, N.C., and at Flag Pond, Tenn. (Ref. 38, 132, 155, 508.)

1957. Nov. 24. Northwest Jackson County, N.C. At Hartford, Tenn. (about 70 km southeast of Knoxville), slight damage to buildings included a crack in one wall and a kitchen that was separated from the rest of the house. The earthquake shifted furniture in Jackson County, at Cherokee and Sylva, N.C., about 50 km south of Hartford, Tenn. Also felt in South Carolina. Magnitude 4.0 M_{fa} BAR. (Ref. 30, 132.)

1981. May 5. Near Hendersonville, Henderson County, N.C. Cracks formed in windows and a concrete patio in Hendersonville, and one sidewalk shifted 5 cm. Cracks also occurred in drywall and a house foundation a few kilometers southeast of Hendersonville, at Zirconia. Water in several wells became muddy in the Dana area. Also felt in South Carolina, Tennessee, and Virginia. Magnitude 3.3 M_D TEC. (Ref. 325, 339.)

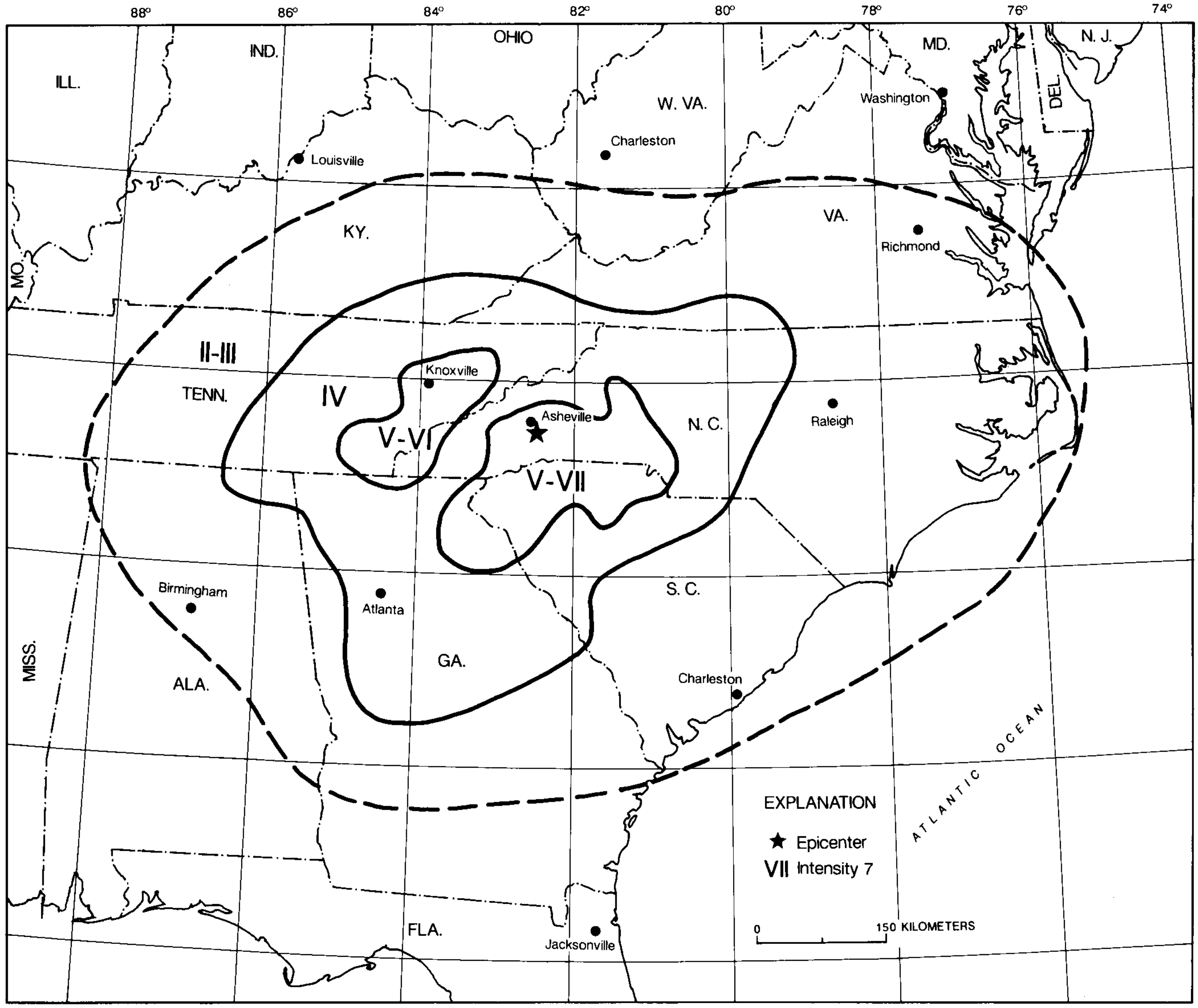
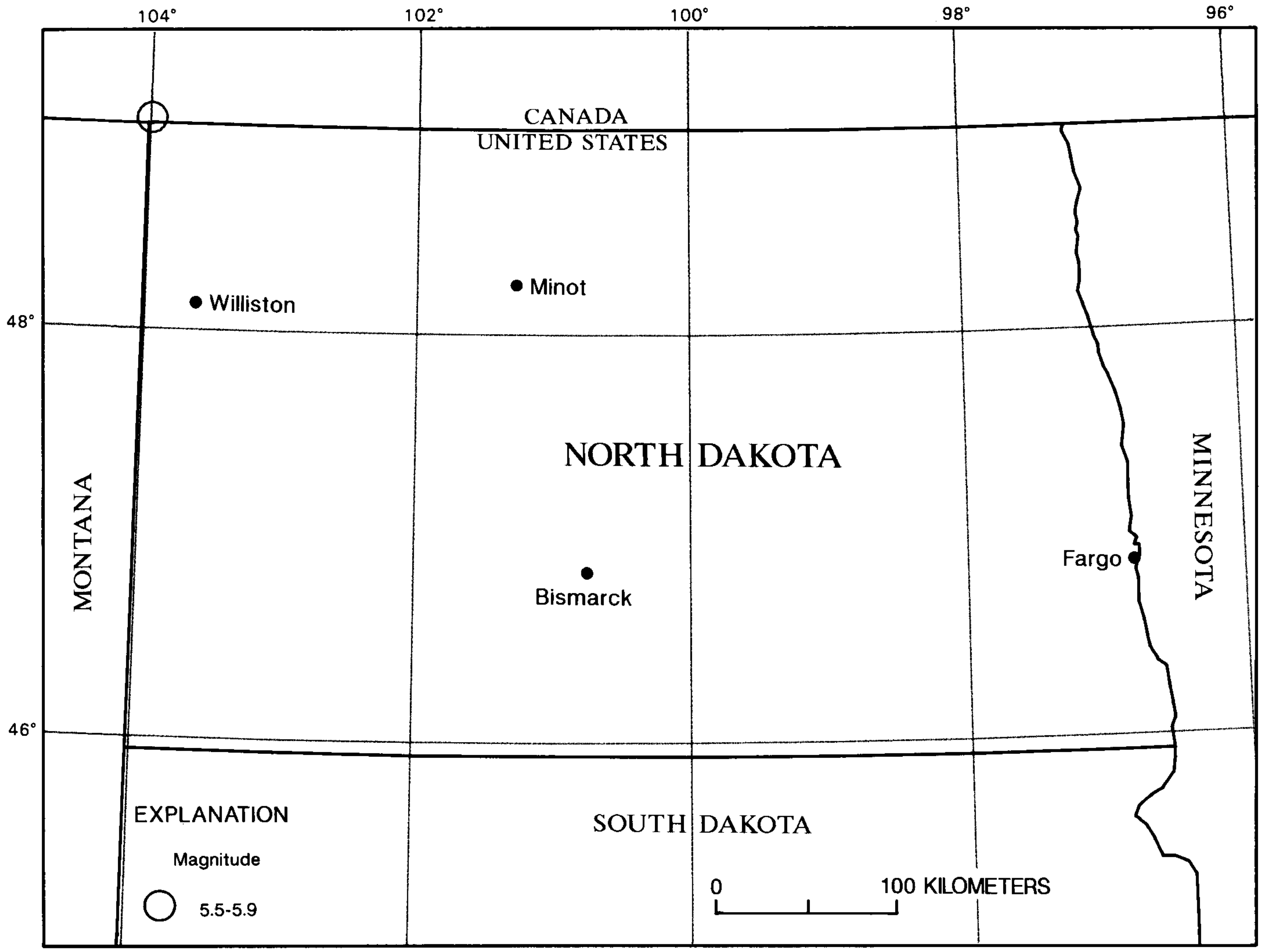


FIGURE 50.— Isoseismal map for the Waynesville, North Carolina, earthquake of February 21, 1916. Isoseismals are based on intensity estimates from data listed in reference 272 of table 1.

NORTH DAKOTA



Earthquake in North Dakota with a magnitude ≥ 4.5 or intensity ≥ VI.

NORTH DAKOTA

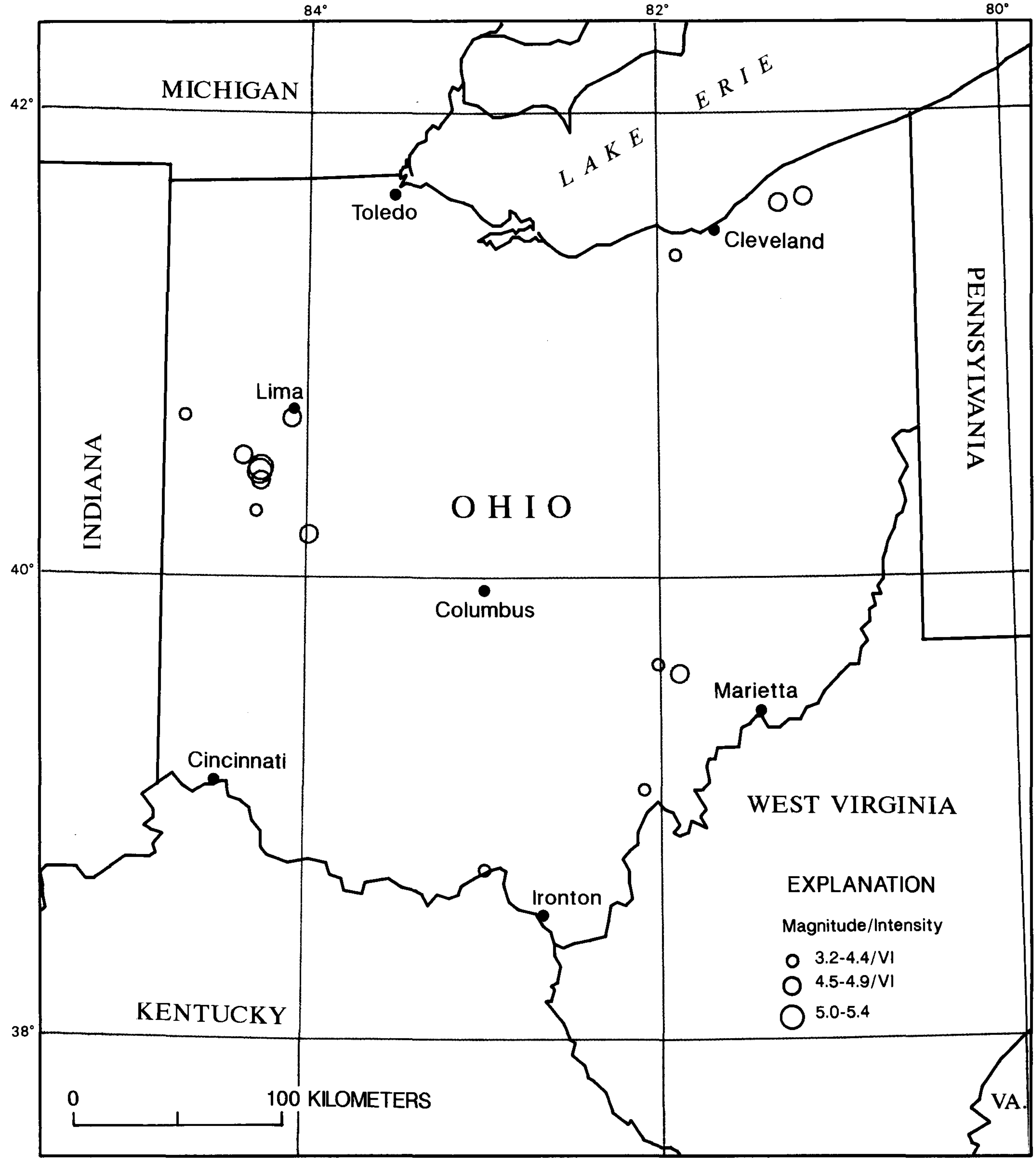
[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)			Hypocenter						Magnitude				Intensity		Felt area
						Latitude		Longitude		Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h	m	s	(°)		(°)		(km)		m_b	M_S		M			(1,000 km^2)
1909	05	16	04	15		49.0	N	104.0	W	—	413	—	—	5.50M_n EPB	—	VI	413	1300

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1.]

1909. May 16 (May 15). North Dakota–Montana–Saskatchewan border region. This moderate earthquake was felt widely over south-central Canada and the north-central United States, including the States of Montana and North Dakota. A retaining wall fell in Helena, southern Lewis and Clark County, Mont.; plaster was cracked at Havre (northwest of Helena, in Hill County). The shock also was "severe" in Dickinson (Stark County), N. Dak. Some windows were broken and articles fell from shelves at a few towns in Saskatchewan, Canada. (Ref. 249, 413.)

OHIO



Earthquakes in Ohio with magnitudes ≥ 4.5 or intenstiy ≥ VI.

OHIO

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km^2)
1776			14 00	39.6 N	81.9 W	—	116	—	—	—	—	VI	60	—
1875	06	18	12 43	40.2 N	84.0 W	—	38	—	—	4.70M_{fa} SC	—	VII	38	100
1884	09	19	19 14	40.7 N	84.1 W	—	38	—	—	4.80M_{fa} SC	—	VI	38	373
1900	04	09	14	41.4 N	81.9 W	—	116	—	—	3.40M_{fa} BAR	—	VI	105	—
1901	05	17	06 00	38.75 N	83.0 W	—	584	—	—	4.20M_{fa} SC	—	VI	584	42
1926	11	05	16 53	39.1 N	82.1 W	—	38	—	—	3.80M_{fa} SC	—	VII	38	1
1930	09	30	20 40	40.3 N	84.3 W	—	38	—	—	4.20M_{fa} BAR	—	VII	38	—
1931	09	20	23 05 03.4	40.429N	84.270W	005	349	—	—	4.70M_{fa} SC	—	VII	38	90
1937	03	02	14 47 33.3	40.488N	84.273W	002	349	—	—	5.00M_{fa} SC	—	VII	38	280
1937	03	09	05 44 35.5	40.470N	84.280W	003	349	—	—	5.40M_{fa} SC	—	VIII	38	390
1943	03	09	03 25 24.9	41.628N	81.309W	007	349	—	—	4.50M_n BAS	—	VI	105	150
1952	06	20	09 38 08.6	39.640N	82.023W	009	349	—	—	4.00M_{fa} SC	—	VI	38	13
1977	06	17	15 39 46.9	40.705N	84.707W	001	349	—	—	3.20M_n AAM	—	VI	39	@
1986	01	31	16 46 42.3	41.650N	81.162W	002	562	5.0	—	4.90M_n SLM	4.97GS	VI	562	322
1986	07	12	08 19 37.9	40.537N	84.371W	010	562	4.5	—	4.60M_n SLM	4.39SZ	VI	562	90

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1776. Date unknown. Near the Muskingum River. In the summer of 1776, an earthquake frightened people and animals and overthrew furniture. Duration of the shock was estimated at 2 to 3 minutes. (Ref. 60, 116.)

1875. June 18. Western Ohio. This earthquake was most severe west of Columbus, at Urbana (Champaign County) and Sidney (Shelby County), where chimneys were thrown down and walls were cracked. Also felt in southern Illinois, southwest Indiana, northwest Kentucky, and eastern Missouri. (Ref. 38, 105.)

1884. Sept. 19. Near Lima, Allen County, Ohio. Slight damage occurred at Lima, where the shock was "of considerable violence and caused much excitement." Plaster was shaken from ceilings east and southeast of Columbus at Zanesville, Ohio, and Parkersburg, W. Va. Windows and dishes were broken at Defiance and Norwalk, Ohio; to the west at Fort Wayne and Muncie, Ind.; to the north at Lansing, Mich.; and to the east at Wheeling, W. Va. Furniture was displaced and buildings were heavily shaken at Urbana, Ohio, in Champaign County, and at many other towns in the region. Also felt in Iowa, Kentucky, Pennsylvania, and western Ontario, Canada, and at Washington, D.C., by workmen on top of the unfinished Washington Monument (see fig. 51). Magnitude 4.8 M_{fa} BAR, 5.1 M_{fa} SG. (Ref. 38, 60, 105, 463, 529.)

1900. Apr. 9. Berea, southeast Cuyahoga County, Ohio. Two chimneys on one house toppled at Berea. This event was an explosion according to ref. 443. (Ref. 105, 116, 443.)

1901. May 17. Near Portsmouth, Scioto County, Ohio. The strongest effects of this earthquake were reported in Scioto County, near the Kentucky–Ohio–West Virginia border. At Portsmouth, tops of chimneys toppled, bricks tumbled from many chimneys, and windows in several houses were shattered. East of Portsmouth, at Sciotoville, many chimneys were damaged and dishes were thrown from cupboards. At Gallipolis, Gallia County, plaster in one house was shaken loose. Reported felt mainly in the area along the border of Kentucky, Ohio, and West Virginia, including Greenup and Lewis Counties, Ky., and Cabell and Kanawha Counties, W. Va., to the south; Adams and Brown Counties, Ohio, to the west; Muskingum and Washington Counties, Ohio, and Wood County, W. Va., to the northeast; and Highland County, Ohio, to the northwest. (Ref. 584.)

1926. Nov. 5. Southeast Ohio, near Pomeroy, Meigs County. This earthquake toppled chimneys

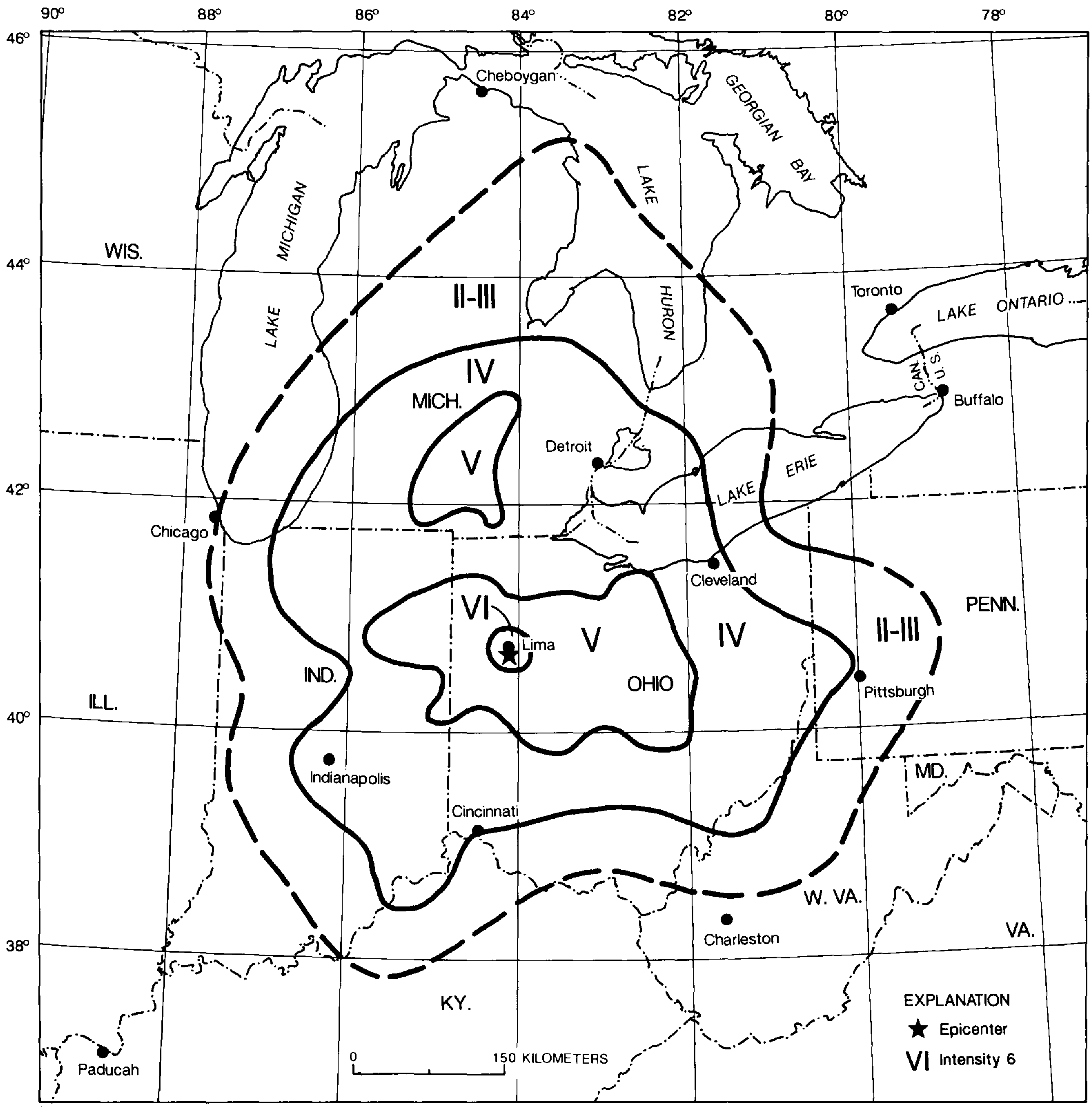


FIGURE 51.— Isoseismal map for the Lima, Ohio, earthquake of September 19, 1884. Isoseismals are based on intensity estimates from data listed in reference 463 of table 1.

at Keno and nearby Pomeroy and overturned a heating stove at Chester, west of Keno. Also, one stovepipe was knocked down at Success, and a flue was downed at Bashan. Explosive earth sounds were reported. Felt throughout Meigs County, Ohio, and at Letart, W.Va. Magnitude 3.6 M_{fa} BAR. (Ref. 38, 105, 218.)

1930. Sept. 30. Near Anna, Shelby County, Ohio. A brief but strong shock was felt over a wide area in Ohio. It was strongest at Anna, where a chimney at a schoolhouse toppled and plaster cracked and fell. Brief shocks were felt at Sidney, about 12 km south of Anna, on Sept. 29 at 21 15 UTC and Sept. 30 at 23 50 UTC. (Ref. 3, 38, 60.)

1931. Sept. 20. Anna, Shelby County, Ohio. Moderate damage occurred at Anna and in nearby towns in Shelby County. At Anna, several chimneys were downed, many chimneys were damaged, and two large cornice stones were thrown from the Lutheran Church. At Botkins, north of Anna, the roof of the public school was pulled apart and its ceiling collapsed; several chimneys also were thrown down or otherwise damaged. In southern Shelby County, at Houston and Sidney, chimneys fell and walls and windows were cracked. Felt over a large part of Ohio and in eastern Indiana and northern Kentucky. Magnitude 4.6 M_{fa} BAR, 3.6 M_S BAR, 4.5 M_{fa} DG. (Ref. 38, 105, 349, 353, 509.)

1937. Mar. 2. Western Ohio, near Anna and Sidney, Shelby County. Damage was heaviest to brick chimneys and buildings at Anna and Sidney—many chimneys fell, walls cracked, and plaster fell. Springs and other water wells increased their flow, but output from oil and gas wells was decreased.

At the Anna public school, walls of the building were cracked so severely that it was declared unsafe; two churches sustained minor damage. Chimneys also were damaged at nearby Botkins and Jackson Center and in southern Auglaize County, at Wapakoneta. Several tombstones were rotated in three cemeteries near Anna. Plaster fell in buildings as far away as Fort Wayne, Ind., and plaster cracked at Indianapolis. Two to five shocks were felt in many places. Also felt in the States of Indiana, Kentucky, Michigan, and West Virginia, and in Ontario, Canada. Magnitude 4.8 M_{fa} BAR, 4.7 M_{fa} DG. (Ref. 38, 349, 353, 509, 524.)

1937. Mar. 9 (Mar. 8). Western Ohio. An earthquake stronger than the shock on Mar. 2 centered near Anna in Shelby County. The three-story schoolhouse at Anna was cracked severely, and the churches that were damaged in the Mar. 2 shock were further damaged. Almost every chimney was broken or twisted, and house foundations and walls were cracked. A few chimneys fell at Sidney, about 12 km south of Anna, and plaster was damaged.

Subsurface changes caused by the two earthquakes included renewed activity of springs, conversion of ordinary wells to artesian wells, and an increase in the flow of other water wells; the output of both oil and gas wells was reduced. A spring at Huntsville (Logan County), dry for 8 years, began "spouting water" after the second shock, and the flow of artesian wells was increased at New Knoxville (about 45 km west of Huntsville). This shock was felt in upper stories of multistory buildings in Chicago and Milwaukee and in Toronto, Canada. Also felt in Kentucky, Michigan, Missouri, Pennsylvania, and West Virginia. Magnitude 5.5 M_S GR, 5.0 M_{fa} BAR, 4.7 M_S BAR, 4.9 M_{fa} DG. (Ref. 38, 349, 353, 524.)

1943. Mar. 9 (Mar. 8). Lake Erie area, Ohio. An earthquake broke windows and dishes and cracked plaster in the Lake Erie area. The widely felt shock was reported in Michigan, New York, Ohio, Pennsylvania, and Canada. Magnitude 4.7 M_{fa} BAR. (Ref. 105, 349.)

1952. June 20. Near Zanesville, Muskingum County, Ohio. One old chimney fell and doors were thrown open at Zanesville. Felt throughout southeast Ohio. Magnitude 4.1 M_{fa} BAR, 4.1 M_{fa} DG. (Ref. 38, 105, 349, 353.)

1977. June 17. Northwest Ohio. The earthquake caused slight damage in several towns in Mercer County. Plaster fell at Coldwater, and cracks formed in a sidewalk and a house foundation. Cracks in sidewalks, walls, and foundations also were reported north of Coldwater, at Celina and Rockford. It was reported only in Mercer County— from Celina south to Chickasaw, west to Fort Recovery, and north to Rockford. (Ref. 39, 349, 353.)

1986. Jan. 31. Northeast Ohio. This earthquake caused minor property damage in several towns in northeast Ohio and northwest Pennsylvania; 17 people were injured in the epicentral area.

Most of the damage to houses and commercial buildings occurred in Ashtabula, Geauga, Lake, Trumbull, and Wood Counties in Ohio and Crawford and Erie Counties in Pennsylvania. It mainly included fallen ceiling tiles and plaster; cracked chimneys, foundations, and brick walls; and broken windows and underground pipes. Changes in the flow of water were observed in more than a dozen wells in Lake and Geauga Counties, east of Cleveland. The changes included variations (starting, stopping) in the flow of water and sediment deposits in water. In Leroy Township, a small pond was formed from the flow of a new artesian well. Another artesian well suddenly began feeding water to an old water trough.

Over the next 2 months, 13 aftershocks of magnitude 0.5 to 2.5 were recorded in the area, and 13 more aftershocks of about magnitude 1.0 were detected through Apr. 15, 1987. The main earthquake was felt over a large area of the Eastern United States, covering all or parts of eight States (Illinois, Indiana, Kentucky, Michigan, New York, Pennsylvania, West Virginia) and Ontario, Canada (see fig. 52). It also was reported by people on the top floors of multistory buildings in Delaware, Maryland, New Jersey, Virginia, and Wisconsin, as well as Washington, D.C. Magnitude 5.3 M_n EPB, 4.88 M JOH. (Ref. 562.)

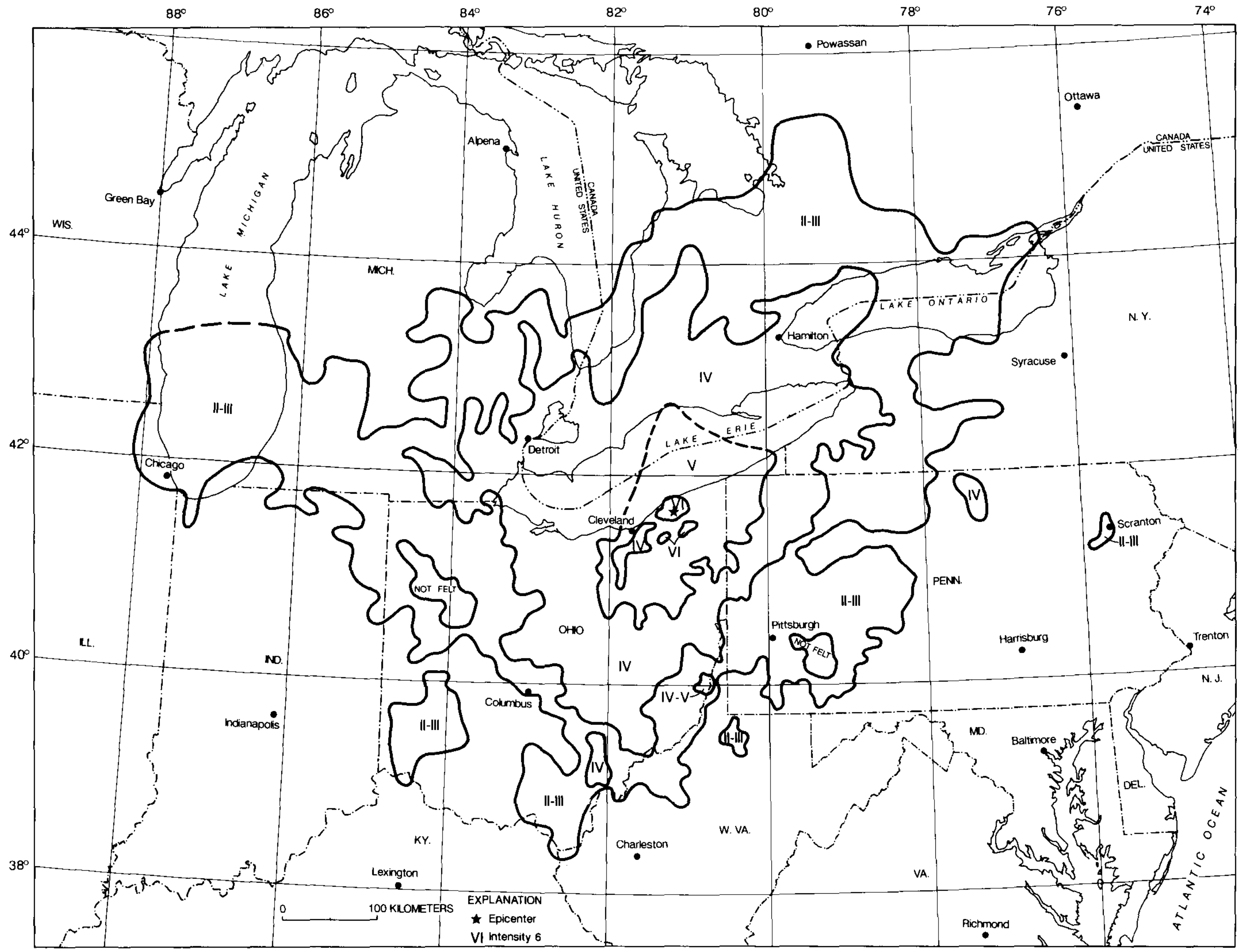
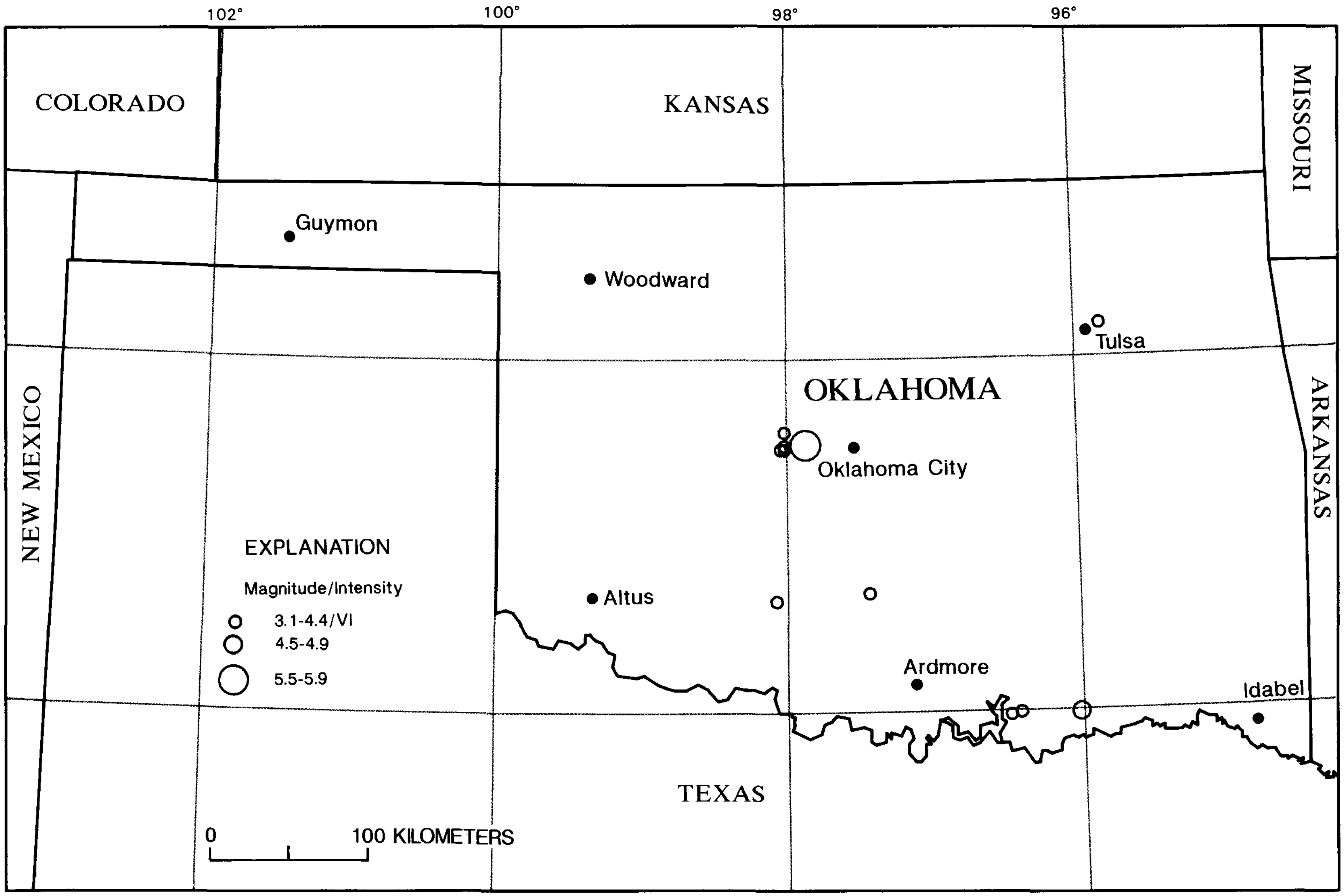


FIGURE 52.— Isoseismal map for the northeast Ohio earthquakes of January 31, 1986. This is a simplified version of figure 2 in reference 562 of table 1.

1986. July 12. Western Ohio. This earthquake occurred near Anna, in Shelby County—the same area where damaging shocks occurred in 1875, 1930–31, and 1937. It caused minor property damage in Shelby County, at Anna, and in Auglaize County, at Minster, New Bremen, and Saint Marys, Ohio. The damage, which was much less severe than that occurring in the earlier earthquakes, consisted mainly of cracks in chimneys and walls, fallen bricks from chimneys, and broken windows. Also felt in parts of Indiana, Michigan, and West Virginia. Magnitude 4.9 M_n EPB. (Ref. 562.)



Earthquakes in Oklahoma with magnitudes ≥ 4.5 or intenstiy ≥ VI.

OKLAHOMA

See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1882	10	22	22 15	34.0 N	96.0 W	—	342	—	—	4.90M_{fa} SC	—	VI	342	500
1918	09	11	05 30	35.5 N	98.0 W	—	105	—	—	3.30M_{fa} SC	—	VI	272	1
1929	12	28	00 30	35.5 N	98.0 W	—	2	—	—	3.90M_{fa} SC	—	VI	38	10
1933	08	19	19 30	35.5 N	98.0 W	—	38	—	—	3.40M_{fa} BAR	—	VI	38	@
1952	04	09	16 29 28.4	35.525N	97.850W	010	349	—	—	5.50M_s GR	—	VII	25	587
1953	03	17	14 25	35.6 N	98.0 W	—	105	—	—	3.80M_{fa} SC	—	VI	105	7
1956	10	30	10 36 21	36.2 N	95.8 W	—	105	—	—	4.00M_L SLM	—	VII	29	12
1959	06	17	10 27 10.6	34.639N	98.055W	005	349	—	—	4.20M_{fa} SC	—	VI	32	37
1968	10	14	14 42 54	34.0 N	96.4 W	—	237	—	—	3.50M_n BAR	—	VI	41	@
1975	11	29	14 29 44.9	34.681N	97.421W	014	349	—	—	3.60M_n TUL	—	VI	48	@
1982	05	03	07 54 48.7	33.99 N	96.47 W	005	350	—	—	3.10M_n TUL	—	VI	350	@

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1882. Oct. 22. Southeast Oklahoma. The most severe damage was limited to the shaking of loose bricks from chimneys at Ft. Smith, Ark. (northwest of Little Rock), and the knocking of bricks from the top of a wall at Bonham, Tex. (northeast of Dallas). Even though few felt reports were received from Oklahoma residents, ref. 342 suggests that the epicenter is in southeast Oklahoma instead of northeast Texas. Felt over a wide area, including Arkansas, Kansas, Missouri, Oklahoma, and Texas. (Ref. 342, 353.)

1918. Sept. 11 (Sept. 10). El Reno, Canadian County, Okla. A series of small earthquakes was reported in the El Reno area on Sept. 10 and 11. Some plaster fell at El Reno, and clocks stopped running during the strongest shock on Sept. 11. It also broke dishes and fruit jars at Union City (on the Canadian River, south of El Reno) and was felt at the nearby town of Yukon. Magnitude 3.6 M_{fa} BAR. (Ref. 38, 105, 272.)

1929. Dec. 28 (Dec. 27). El Reno, Canadian County, Okla. One chimney fell, plaster cracked, and people rushed from their houses at El Reno. Generally felt in El Reno, Oklahoma City, Union City, and in the adjacent region. Magnitude 4.0 M_{fa} BAR. (Ref. 2, 38, 353.)

1933. Aug. 19. El Reno, Canadian County, Okla. This severe earthquake broke dishes and cracked chimneys and walls slightly at El Reno. It was felt less strongly at Minco and Union City, south of El Reno. (Ref. 6, 38, 353.)

1952. Apr. 9. El Reno, Canadian County, Okla. This earthquake caused moderate damage at El Reno, Oklahoma City, and Ponca City, including toppled chimneys and smokestacks, cracked and loosened bricks on buildings, and broken windows and dishes. One crack in the State Capitol at Oklahoma City was 15 m long. Slight damage was reported from many other towns in Oklahoma and from some towns in Kansas and Texas. The earthquake was caused by slippage along the Nemaha fault. Felt over most of Oklahoma and in Arkansas, Iowa, Kansas, Missouri, Nebraska, and Texas (see fig. 53). Magnitude 5.0 M_{fa} DG, 5.1 M_{fa} BAR, 5.5 M_S BAR. (Ref. 25, 105, 228, 349, 364.)

1953. Mar. 17. Concho, Canadian County, Okla. Two moderately strong earthquakes near Concho damaged the foundation of a garage slightly and cracked plaster. Felt in several nearby towns in Canadian County. Magnitude 4.2 M_{fa} BAR. (Ref. 38, 105, 353.)

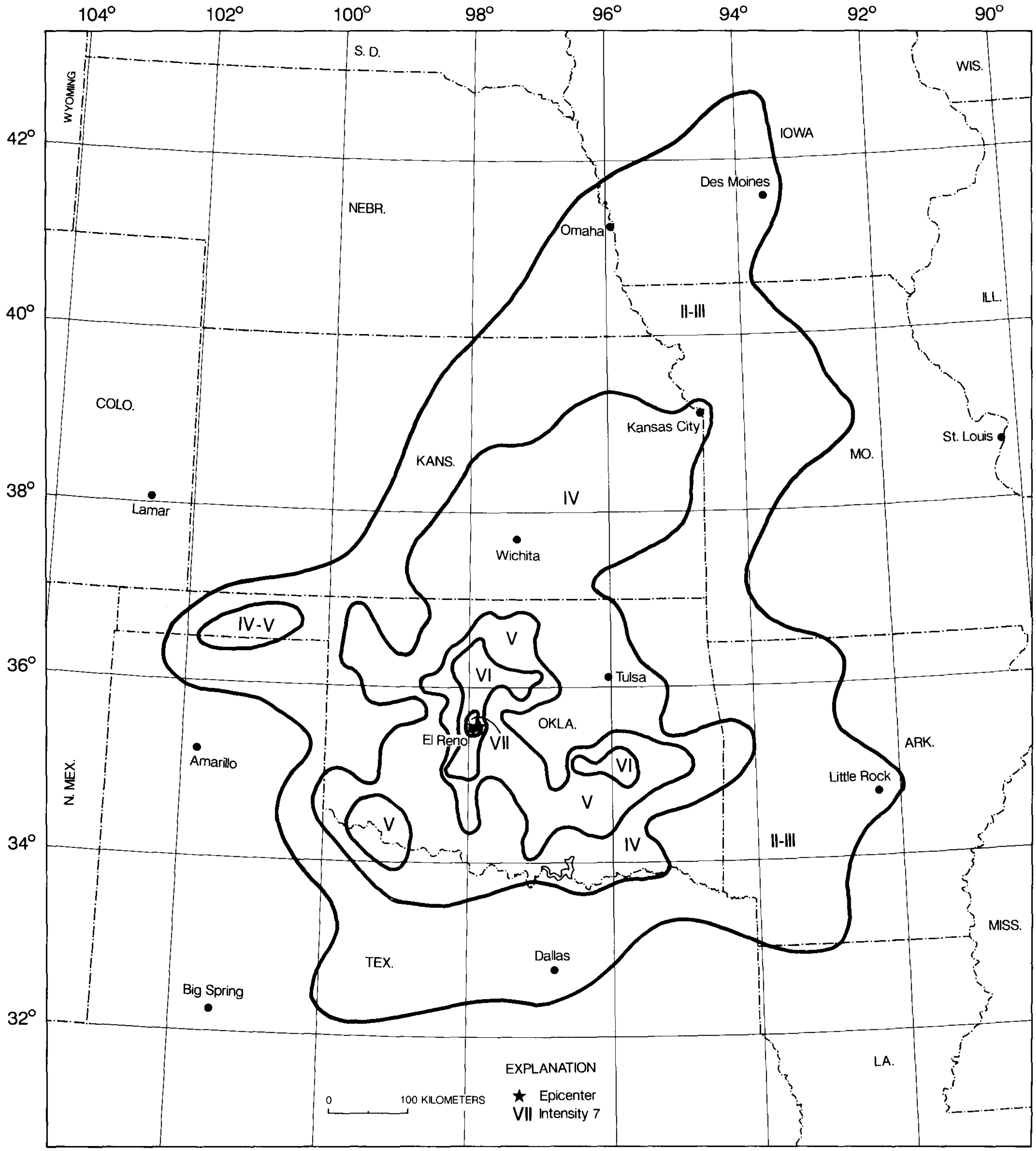


FIGURE 53.— Isoseismal map for the El Reno, Oklahoma, earthquake of April 9, 1952. Isoseismals are based on intensity estimates from data listed in reference 25 of table 1.

1956. Oct. 30. West of Catoosa, Rogers County, Okla. At the Foster Ranch, west of Catoosa, an oil well was shut down because of caving. Minor damage at Tulsa included cracks in plaster and in the foundation of one house. Buildings trembled violently. Magnitude 4.2 M_{fa} BAR. (Ref. 29, 105, 353.)

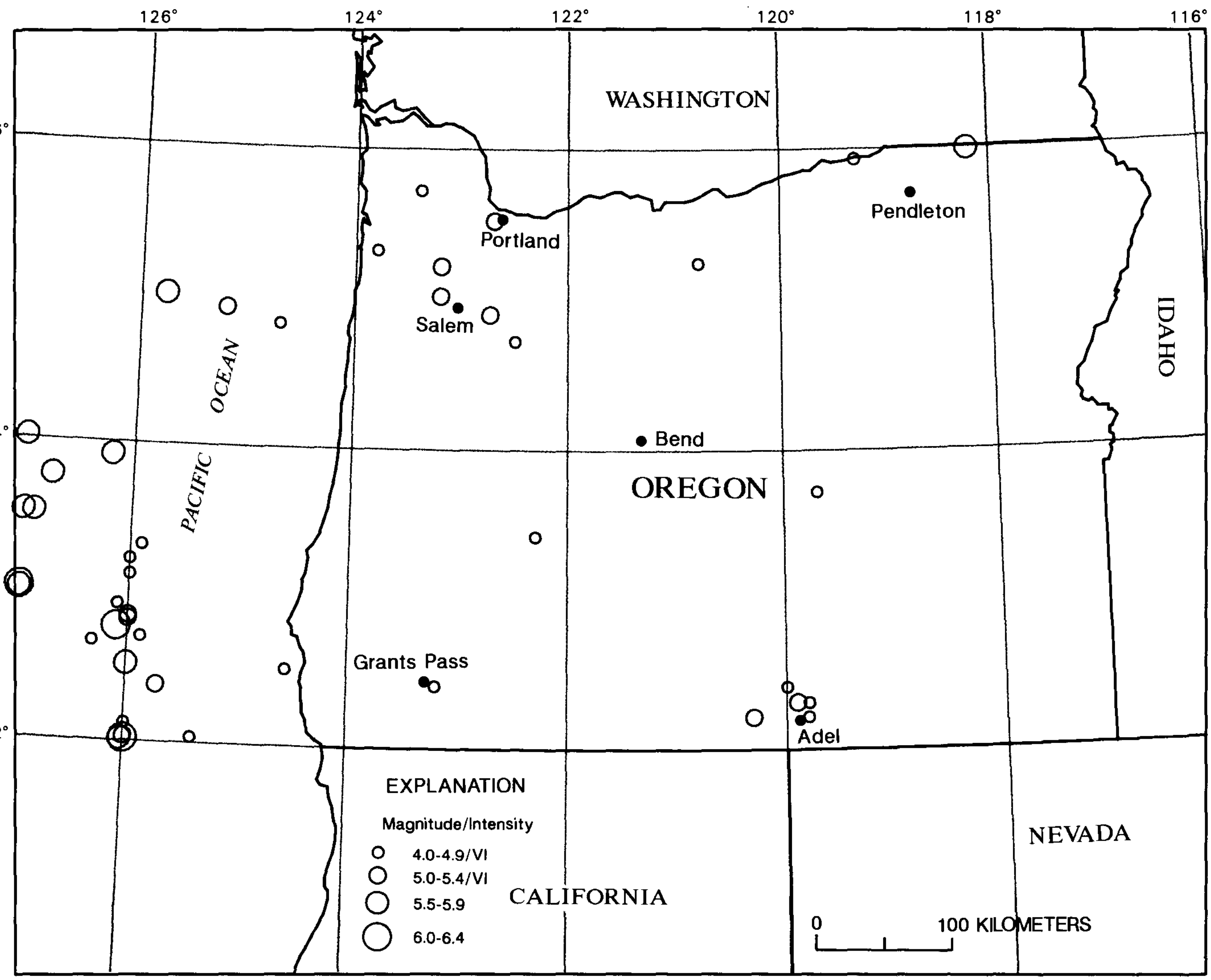
1959. June 17. Southwest Oklahoma. At Duncan, southwest of Oklahoma City, in Stephens County, cracks were observed in concrete curbing and in the foundation of a house. At Lawton, about 40 km west of Duncan, cracks formed in pavement and in plaster on walls. Thunderous, roaring earth sounds were heard. Also felt in Texas. Magnitude 4.3 M_{fa} BAR, 4.2 M_{fa} DG. (Ref. 32, 349, 353.)

1968. Oct. 14. Durant, Bryan County, Okla. Felt only in the immediate area of Durant, this earthquake cracked plaster, broke windows, enlarged cracks in walls, and formed a crack more than 1 m long on one wall. Magnitude 3.5 M_n BAR. (Ref. 41, 237.)

1975. Nov. 29. Near Foster, Garvin County, Okla. Foundations were cracked at two houses 5 km northwest of Foster. The shock was felt only at a few other towns in the immediate area. Magnitude 3.5 M_n SLM. (Ref. 48, 349.)

1982. May 3. Durant, Bryan County, Okla. The movement of a concrete house slab broke water pipes at Durant; a ceiling at the house also was cracked. Felt reports were not received from other towns in the area. (Ref. 350.)

OREGON



Earthquakes in Oregon with magnitudes ≥ 4.5 or intensity ≥ VI.

OREGON

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km²)
1892	02	04	04 30	45.5 N	122.7 W	—	56	—	—	5.00Ukn EPB	—	V	56	26&
1893	03	07	01 03	45.9 N	119.3 W	—	53	—	—	4.70M_{La} NQT	—	VI	56	—
1896	04	02	11 17	45.2 N	123.2 W	—	338	—	—	5.00Ukn EPB	—	V	56	—
1910	08	05	01 31 36	42.0 N	127.0 W	—	258	—	—	6.80M_S GR	—	Felt	338	—
1914	08	22	05 28 18	44.0 N	129.0 W	—	258	—	—	6.75M_S GR	—	—	—	—
1917	06	10	04 32 24	44.0 N	129.0 W	—	258	—	—	6.50M_S GR	—	—	—	—
1923	01	11	04 29	42.2 N	120.3 W	—	53	—	—	5.00M_{La} DMG	—	VI	56	69
1924	02	24	05 45 10	44.0 N	127.0 W	—	258	—	—	5.75M_S GR	—	—	—	—
1926	06	05	19 50 24	43.0 N	127.5 W	—	258	—	—	6.00M_S GR	—	—	—	—
1928	09	11	12 36 19	43.5 N	130.3 W	—	258	—	—	6.30M_S GR	—	—	—	—
1930	07	19	02 38	45.0 N	123.2 W	—	3	—	—	—	—	VI	3	—
1932	03	02	17 40 48	43.0 N	131.0 W	—	5	—	—	6.00m_b VIC	—	—	—	—
1932	06	20	09 26 27	43.0 N	127.5 W	—	338	—	—	5.50M_S GR	—	—	—	—
1933	03	26	19 05 53	43.5 N	129.0 W	—	338	—	—	5.50M_S GR	—	—	—	—
1936	04	30	10 55 38	44.0 N	128.5 W	—	53	—	—	5.50M_S GR	—	—	—	—
1936	07	16	07 07 48	45.966N	118.212W	005	260	—	—	5.75M_S GR	—	VII	9	190
1936	09	25	12 53 35	43.0 N	129.0 W	—	338	—	—	6.20M_S GR	—	—	—	—
1936	11	05	20 46 18	43.0 N	131.0 W	—	338	—	—	6.00m_b VIC	—	—	—	—
1937	11	10	07 19 23	43.0 N	127.0 W	—	258	—	—	5.75M_S GR	—	—	—	—
1938	05	28	10 14 01	42.75 N	126.1 W	—	258	—	—	6.00M_S GR	—	V	11	—
1938	08	03	13 32 36	43.9 N	126.2 W	—	338	—	—	5.60M_S GR	—	—	—	—
1940	11	17	03 56 30	44.8 N	130.0 W	—	338	—	—	6.00m_b VIC	—	—	—	—
1941	06	09	06 17 24	42.8 N	126.0 W	—	338	—	—	5.25M_S GR	—	—	—	—
1941	06	09	08 43 45	42.8 N	126.0 W	—	53	—	—	5.00M_S GR	—	—	—	—
1941	10	31	12 41 00	43.0 N	128.5 W	—	53	—	—	5.50M_S GR	—	—	—	—
1941	12	29	18 37	45.5 N	122.7 W	—	53	—	—	—	—	VI	53	10
1944	03	06	20 09 08	44.5 N	129.0 W	—	258	—	—	5.75M_S GR	—	—	—	—
1944	03	06	23 16 30	44.5 N	129.0 W	—	258	—	—	5.75M_S GR	—	—	—	—
1944	12	30	22 03 02	43.75 N	126.75 W	—	258	—	—	5.75M_S GR	—	—	—	—
1945	04	11	11 22 57	42.0 N	126.0 W	—	338	—	—	5.00Ukn EPB	—	—	—	—
1945	09	28	22 24 10	42.0 N	126.0 W	—	258	—	—	6.00M_S GR	—	—	—	—
1947	09	22	02 16 01	43.5 N	128.0 W	—	53	—	—	5.50m_b VIC	—	—	—	—
1948	05	25	15 13 07	44.0 N	127.0 W	—	258	—	—	5.50M_S GR	—	—	—	—
1948	05	25	15 32 02	43.5 N	127.0 W	—	338	—	—	5.80M_L PAS	—	—	—	—
1949	03	28	19 43 16	42.0 N	126.0 W	—	266	—	—	5.80Ukn EPB	—	—	—	—
1949	08	24	06 07 14	43.5 N	127.0 W	—	266	—	—	5.50M_S GR	—	—	—	—
1950	08	24	17 45 34	42.5 N	126.0 W	—	266	—	—	5.60Ukn EPB	—	—	—	—
1951	02	23	02 56 42	44.5 N	129.5 W	—	338	—	—	5.60m_b VIC	—	—	—	—
1951	06	16	23 46 58	44.5 N	130.0 W	—	357	—	—	5.50M_L BRK	—	—	—	—
1951	06	17	09 40 15	44.5 N	130.0 W	—	258	—	—	6.00M_L BRK	—	—	—	—
1952	08	20	15 24 59	43.0 N	127.0 W	—	357	—	—	6.00M_L BRK	—	—	—	—
1953	12	16	04 32 12	45.5 N	122.7 W	—	53	—	—	5.00M_L EPB	—	VI	26	9
1955	08	23	15 32 37	43.5 N	128.0 W	—	266	—	—	6.25Ukn PAS	—	Felt	324	—
1956	01	10	12 32 15	43.4 N	122.3 W	—	324	—	—	4.90M_L BRK	—	—	—	—
1956	07	06	02 22 00	42.5 N	126. W	—	266	—	—	5.00M_L BRK	—	—	—	—
1957	11	17	06 00 29	45.3 N	123.8 W	—	30	—	—	4.00M_L BRK	—	VI	30	13&
1958	03	12	12 09 16	42.4 N	120.0 W	—	324	—	—	4.50M_L BRK	—	—	—	—
1959	06	02	18 49 00	43.7 N	119.7 W	—	324	—	—	4.70M_L BRK	—	—	—	—
1959	08	21	00 28 17	44.8 N	124.7 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1959	09	26	08 20 48	43.7 N	128.3 W	—	324	—	—	6.10M_L BRK	—	—	—	—

OREGON— Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1960	11	08	11 36 27	44.9 N	125.2 W	—	324	—	—	5.00M_L BRK	—	IV	53	—
1961	08	19	04 56 24.1	44.7 N	122.5 W	033	266	—	—	4.50Ukn PAS	—	VI	34	18
1961	08	23	17 59 47	42.4 N	123.2 W	—	324	—	—	4.60M_L BRK	—	—	—	—
1963	03	07	23 53 26.5	44.877N	122.738W	—	324	4.6	—	4.40M_D YEL	—	V	36	—
1963	12	27	02 36 21.6	45.7 N	123.4 W	033	266	4.5	—	4.10M_D YEL	—	VI	36	10
1964	01	28	04 56 48.6	43.3 N	125.9 W	017	266	4.5	—	4.50M_L BRK	—	—	—	—
1964	07	13	06 47 54.1	44.7 N	129.9 W	033	266	5.5	—	5.00m_b ISC	—	—	—	—
1964	10	01	11 00 48.3	43.5 N	126.9 W	033	74	—	—	5.50M_L BRK	—	—	—	—
1965	05	31	05 07 43.4	44.1 N	128.8 W	033	266	5.5	—	5.10m_b ISC	—	—	—	—
1965	06	17	11 22 54.9	43.2 N	126.0 W	033	266	4.6	—	4.50M_L BRK	—	—	—	—
1965	06	20	17 23 56.8	43.1 N	126.0 W	033	266	4.6	—	4.60M_L BRK	—	—	—	—
1965	06	20	18 04 37.3	42.9 N	126.1 W	033	266	5.6	—	4.70M_L BRK	—	—	—	—
1965	07	25	08 34 43.2	42.1 N	126.0 W	033	266	4.6	—	—	—	—	—	—
1968	05	08	12 17 14.2	43.58 N	127.89 W	030	299	6.1	—	6.10m_b ISC	—	—	—	—
1968	05	08	22 17 13.8	43.871N	128.180W	033	74	5.0	—	5.50m_b ISC	—	—	—	—
1968	05	30	00 35 59.8	42.3 N	119.8 W	024	74	5.1	—	4.70m_b ISC	—	IV	41	—
1968	06	03	13 27 39.7	42.2 N	119.8 W	020	74	5.0	—	4.90M_L BRK	—	V	41	—
1968	06	04	02 34 15.7	42.3 N	119.9 W	021	74	4.7	—	5.10M_L BRK	—	VI	41	18
1968	06	04	06 22 19.0	42.2 N	119.8 W	033	74	4.3	—	4.50M_L BRK	—	Felt	41	—
1968	06	05	04 51 56.8	42.3 N	119.9 W	021	74	4.7	—	—	—	Felt	41	—
1970	11	26	03 11 42.8	43.776N	127.449W	014	74	5.6	5.9	6.00Ukn BRK	—	—	—	—
1972	04	08	06 24 13.7	42.646N	126.320W	011	74	5.6	—	4.90M_L BRK	—	—	—	—
1973	06	16	14 43 47.5	44.980N	125.774W	033	74	5.6	5.1	5.80m_b ISC	—	IV	46	—
1976	04	13	00 47 17.1	45.221N	120.771W	015	74	4.5	3.3	4.80M_L GS	—	VI	49	35
1976	12	09	09 50 59.5	44.525N	129.961W	018	74	5.3	5.5	5.20m_b ISC	—	—	—	—
1978	02	16	12 00 21.2	42.685N	125.890W	015	74	5.0	4.5	4.80M_L BRK	—	—	—	—
1980	08	03	14 43 04.2	42.498N	124.560W	015	74	4.5	—	4.60m_b ISC	—	—	—	—
1980	12	24	13 29 15.3	42.369N	125.726W	015	74	5.2	5.3	5.00M_L BRK	—	—	—	—
1981	11	03	13 47 34.1	43.542N	127.706W	010	74	6.0	6.2	5.80M_L BRK	6.43ED	—	—	—
1985	03	13	19 34 57.6	43.510N	127.561W	010	74	6.1	6.3	5.90m_b ISC	—	IV	371	—
1988	08	11	08 00 50.6	42.023N	125.400W	010	74	4.6	—	—	—	—	—	—
1988	10	23	13 48 35.6	44.423N	129.455W	010	74	5.3	5.5	—	5.50HAV	—	—	—

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1.]

1893. Mar. 7 (Mar. 6). Umatilla, Oreg. One wall of a large stone building was thrown down at Umatilla, about 75 km west of Milton-Freewater. Several shocks were felt by residents. (Ref. 53, 56.)

1923. Jan. 11 (Jan. 10). Lakeview, southern Lake County, Oreg. The shock was reported to be strongest in the Lakeview district. Plaster fell at Alturas (Modoc County), Calif. The intensity was taken from ref. 56 (Ref. 38, 53, 56.)

1930. July 19 (July 18). Near Perrydale, Polk County, Oreg. A crack formed in the roadbed near Perrydale, southwest of Portland. Plaster was cracked at McCoy, northwest of Salem. (Ref. 3.)

1936. July 16 (July 15). Milton-Freewater, Umatilla County, Oreg. This earthquake was strongest in the area of Milton-Freewater, where many chimneys were broken, several houses were displaced on their foundations, and cracks formed in the ground. Many capstones in area cemeteries were rotated. After the shock, water in several springs and wells started to flow again. Property damage was estimated at $100,000. Chimneys were reported damaged at Athena and Ferndale, Oreg., and Waitsburg and Walla Walla, Wash.

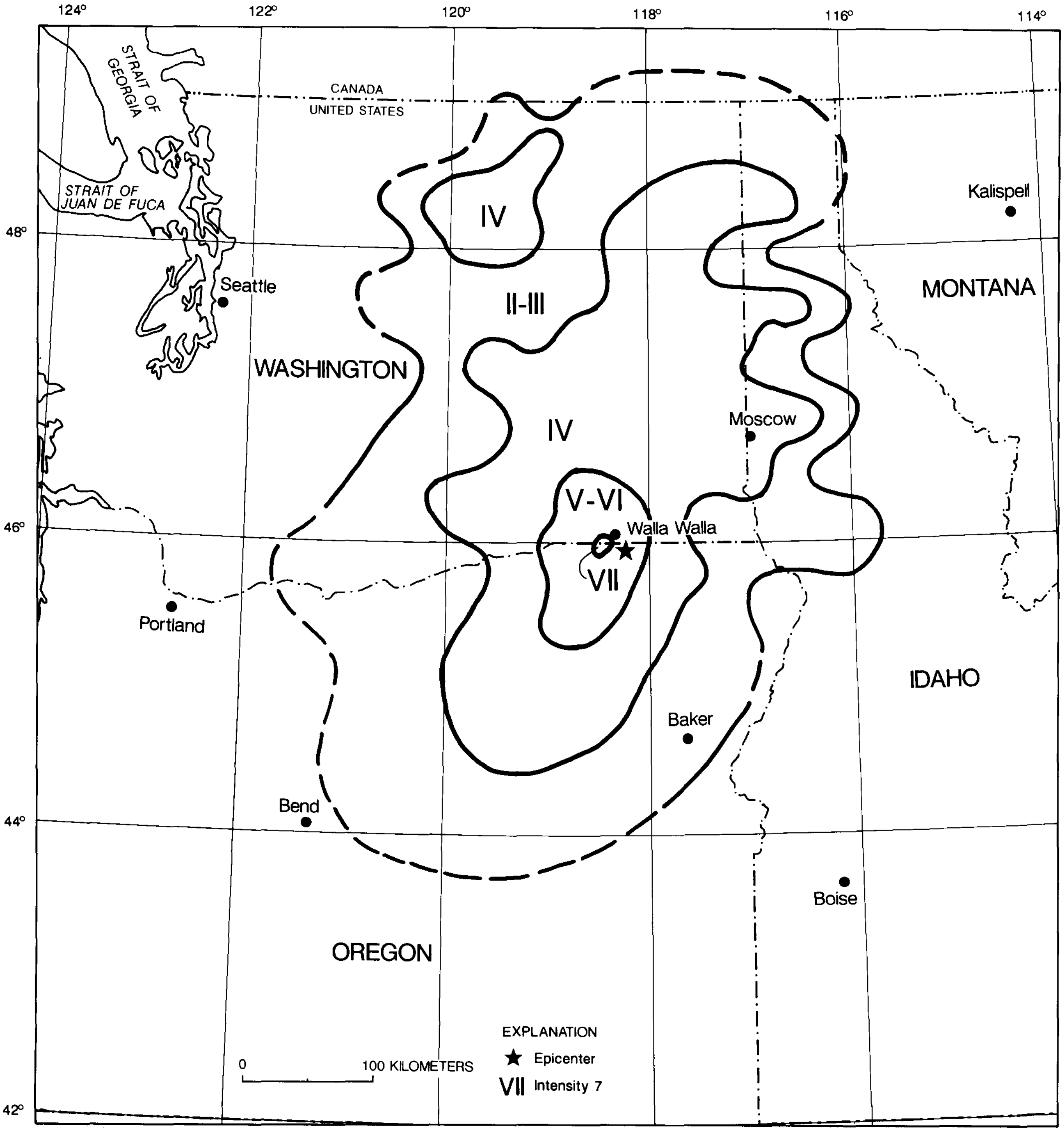


FIGURE 54.— Isoseismal map for the Milton-Freewater, Oregon, earthquake of July 16, 1936. Isoseismals are based on intensity estimates from data listed in references 9, 495, and 510 of table 1.

At Milton-Freewater, most chimneys were damaged at the roof level. One brick house at the penitentiary was condemned as unsafe. A new house, about 6.5 km west of Milton-Freewater, was almost wrecked, and two concrete houses, about 11 km west, were almost demolished. At nearby Umapine, one concrete house collapsed and a stucco house was damaged so badly that the family moved into the yard. The

Milton-Freewater school buildings were damaged, and repairs were estimated at $8,500. Most wells in the area increased or decreased their flow of water.

Between the towns of Milton-Freewater and Umapine, many ground cracks as much as 0.6 m in width developed. The general direction of the cracks was roughly parallel to the Touchet fault. The largest earth fractures were observed about 6.5 km west of Sunnyside, near Glencove. On a hillside, an irregular area about 24 m wide was broken by cracks into blocks of several sizes and shapes. The uphill side of the area, in one cross section, dropped about 2.5 m, and the lower side displaced to the north about 2.5 m, pushing over and covering a 15-m length of railway fence. The largest cracks were about 0.6 m wide, but most were not more than 8 cm wide. Water was forced out of the ground in many places. Also felt in Idaho (see fig. 54). Aftershocks occurred to Nov. 17, 1936. (Ref. 9, 260, 495, 510.)

1941. Dec. 29. Portland, Multnomah County, Oreg. This minor earthquake shattered a display window in downtown Portland, cracked chimneys about 50 km southwest of Portland, at Yamhill, and cracked plaster near Portland at Hillsboro and Sherwood and north of Portland, at Woodland, Wash. (Ref. 14, 53.)

1953. Dec. 16 (Dec. 15). Portland, Multnomah County, Oreg. The shock cracked plaster and chimneys and damaged fireplace tile slightly at Portland. A one-story building also was cracked, and a leak developed in an apartment building. In Vancouver, Wash., commercial buildings of block and concrete were damaged slightly and plaster was cracked. (Ref. 26, 53.)

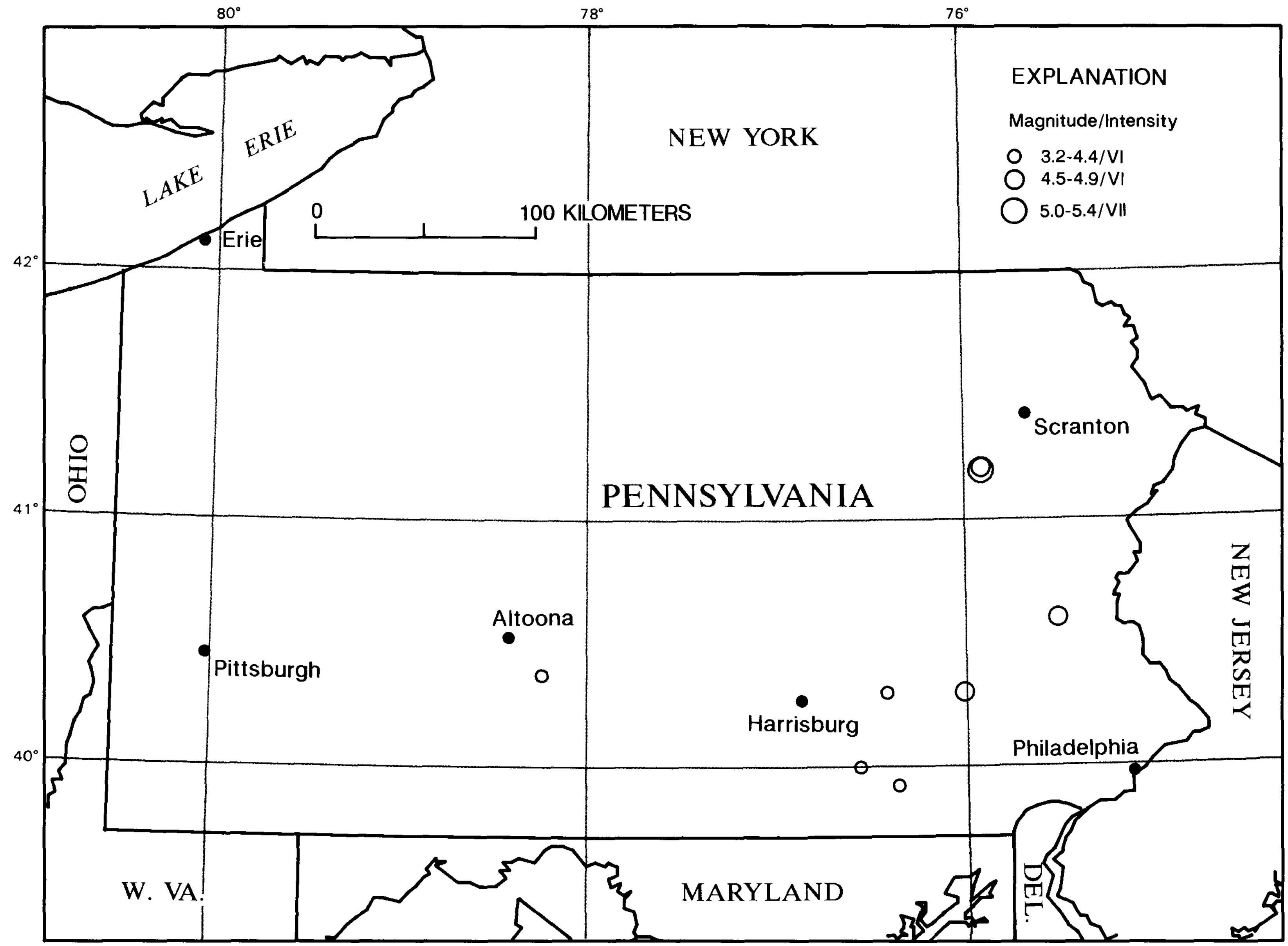
1957. Nov. 17 (Nov. 16). Northwest of Salem, Marion County, Oreg. Walls and plaster cracked and furnishings shifted in West Salem. Also felt in the State of Washington. (Ref. 30.)

1961. Aug. 19 (Aug. 18). Northwest Oregon. Damage was most severe at Lebanon (Linn County), where two chimneys toppled, store windows broke, and two traffic lights and five signs fell. Plaster walls were cracked at nearby Albany. Also felt in Washington. (Ref. 34, 266.)

1963. Dec. 27 (Dec. 26). Northwest Oregon. Slight damage, mainly in the form of cracked plaster, occurred in Washington County, at North Plains and Timber, Oreg., and in northern Cowlitz County, at Toutle, Wash. Also, furnishings and small objects shifted. A car on the Tillamook-Portland Highway swayed to the opposite side of the highway before being controlled. (Ref. 36, 266.)

1968. June 4, 02 34 UTC (June 3). Southern Oregon. Old chimneys fell or sustained cracks at Adel, in southern Lake County. Also, part of an old rock cellar fell, and the rest of the building was cracked. About 4 km northwest of Fort Bidwell, Calif., along Bidwell Creek, cracks formed in the ground, and a house foundation cracked and shifted. (Ref. 41, 74.)

1976. Apr. 13 (Apr. 12). Northern Oregon. This minor earthquake opened cracks in plaster and drywall at Dufur and Wamic, south of The Dalles, in Wasco County. Also felt in southern Washington. (Ref. 49, 74.)



Earthquakes in Pennsylvania with magnitudes ≥ 4.5 or intensity ≥ VI.

PENNSYLVANIA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1889 03 08	23 40	40.0 N	76.55 W	—	201	—	—	3.90M_{fa} SC	—	VI	142	10
1908 05 31	17 42	40.6 N	75.5 W	—	38	—	—	—	—	VI	38	@
1938 07 15	22 46 12.0	40.37 N	78.23 W	—	485	—	—	3.30M_{fa} DG	—	VI	38	@
1954 01 07	07 25	40.3 N	76.0 W	—	38	—	—	—	—	VI	38	—
1954 02 21	20 00	41.2 N	75.9 W	—	38	—	—	—	—	VII	38	@
1954 02 24	03 55	41.2 N	75.9 W	—	38	—	—	—	—	VI	38	@
1964 05 12	06 45 10.7	40.298N	76.411W	001	349	4.5	—	3.20M_n DG	—	VI	37	@
1984 04 23	01 36 00.1	39.921N	76.355W	005	370	4.2	—	4.10M_n GS	—	VI	370	49

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1889. Mar. 8. Near York, Pa. At York, about 70 km south of Harrisburg, the earthquake knocked down chimneys, bounced articles from shelves, and threw a man off a sofa. It was reported that a "ball of fire" passed over the area at the time the shock occurred. Also felt at Harrisburg, Philadelphia, Reading, and other towns. Magnitude 4.3 M_{fa} AS. (Ref. 38, 141, 142, 201.)

1908. May 31. Allentown, Lehigh County, Pa. This local shock toppled a few chimneys and threw people down at Allentown, about 150 km north of Philadelphia. Because this area is known for its limestone, the shock may have been due to a rockfall in a subterranean cavern. (Ref. 38.)

1938. July 15. Southern Blair County, Pa. Dishes broke and plaster fell at Henrietta and Clover Creek, south of Altoona. Water in several wells in Clover Creek Valley became cloudy, and water in one spring stopped flowing. (Ref. 38, 349, 485.)

1954. Jan. 7. Sinking Spring, Berks County, Pa. Coal-mining operations may have caused this tremor, which inflicted minor damage in the west section of Sinking Spring, near Reading. Plaster was torn from ceilings and walls, bricks were knocked loose from several chimneys, brick walls were cracked, windows were broken, furniture was upset, and dishes tumbled from shelves. Several brick and frame buildings sustained slight damage. Light aftershocks occurred through Sept. 24, 1954. (Ref. 27, 38, 459.)

1954. Feb. 21. Wilkes-Barre, Luzerne County, Pa. Effects from this local shock were confined to a five-block residential area in Wilkes-Barre, southwest of Scranton. Hundreds of houses were damaged; ceilings and cellar walls split; fences fell over; gas and water mains snapped; and sidewalks collapsed. Property damage was estimated at $1 million. This shock may have been due to coal-mining operations. (Ref. 27, 38, 459, 533, 605.)

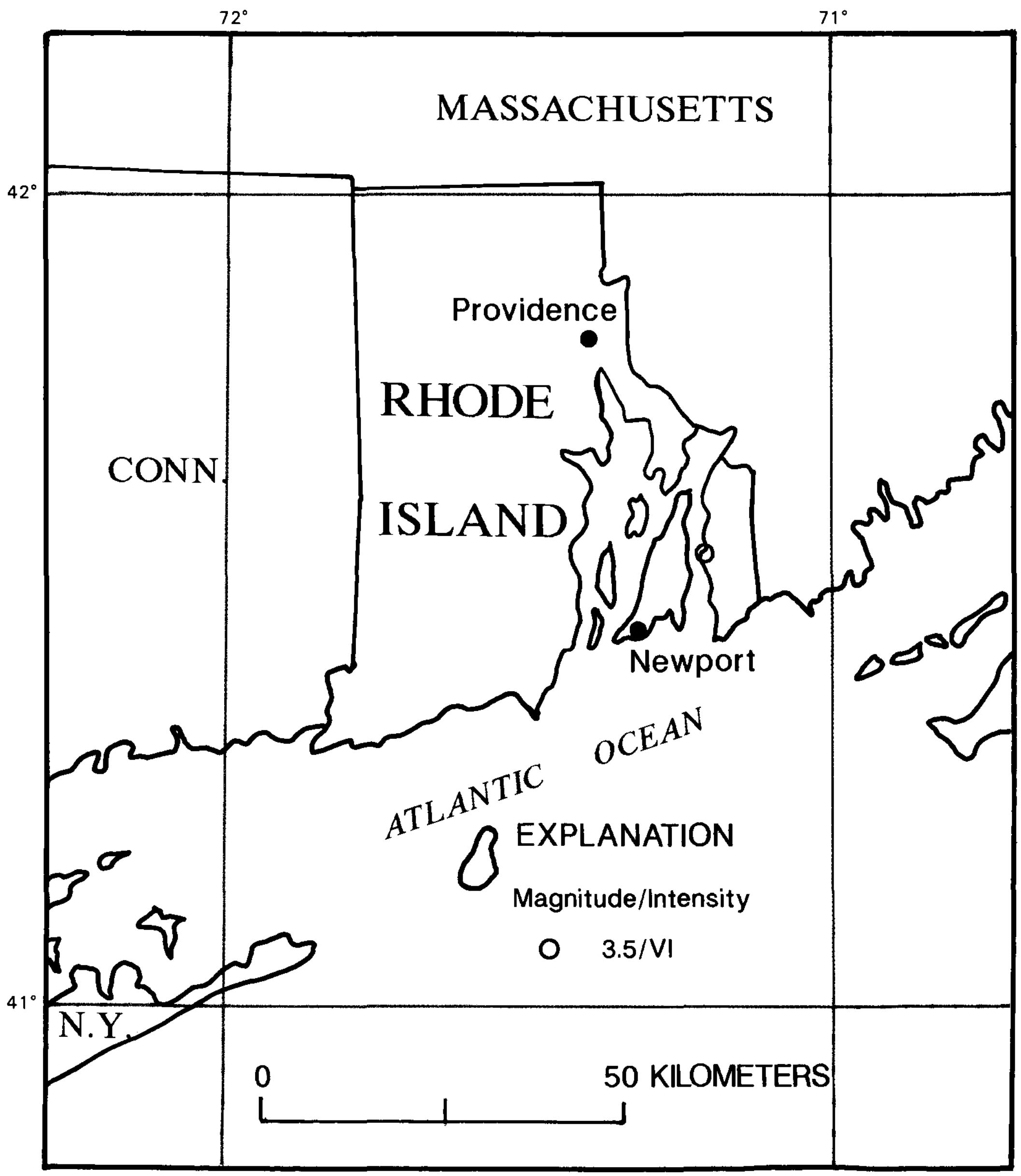
1954. Feb. 24 (Feb. 23). Wilkes-Barre, Luzerne County, Pa. Effects were similar to those that occurred on Feb. 21. Ceilings and walls cracked; curbs pulled away from sidewalks; street pavements buckled; water and gas mains broke. Coal-mining operations may have caused this tremor. (Ref. 27, 38, 459, 605.)

1964. May 12. Cornwall, Lebanon County, Pa. A wall was cracked and plaster fell at Cornwall, east of Harrisburg. Small landslides resulted from this local disturbance. (Ref. 37, 349.)

1984. Apr. 23 (Apr. 22). Lancaster County, Pa. This earthquake was centered near Marticville. It caused minor damage at Conestoga, where a garage shifted 1.3 cm off its foundation; plaster fell from a ceiling; and cracks formed in windows, concrete basement walls, and a cistern. Similar kinds of damage occurred at Lampeter, Mount Nebo, and New Providence. Also felt in Connecticut, Delaware, District of Columbia, Maryland, New Jersey, New York, Virginia, and West Virginia.

One foreshock occurred 5 days earlier and many slight aftershocks occurred. Aftershock data suggested a north-northeast fault dipping steeply east, with reverse, right-lateral slip consistent with a horizontal east-northeast axis of maximum compression. The geometry of the 1984 rupture conforms to the strike of Jurassic dikes and associated faults in the epicentral area. Magnitude 4.4 M_n TUL, 4.1 M_n PAL. (Ref. 370, 483.)

RHODE ISLAND



Damaging earthquake in Rhode Island, intensity ≥ VI.

RHODE ISLAND

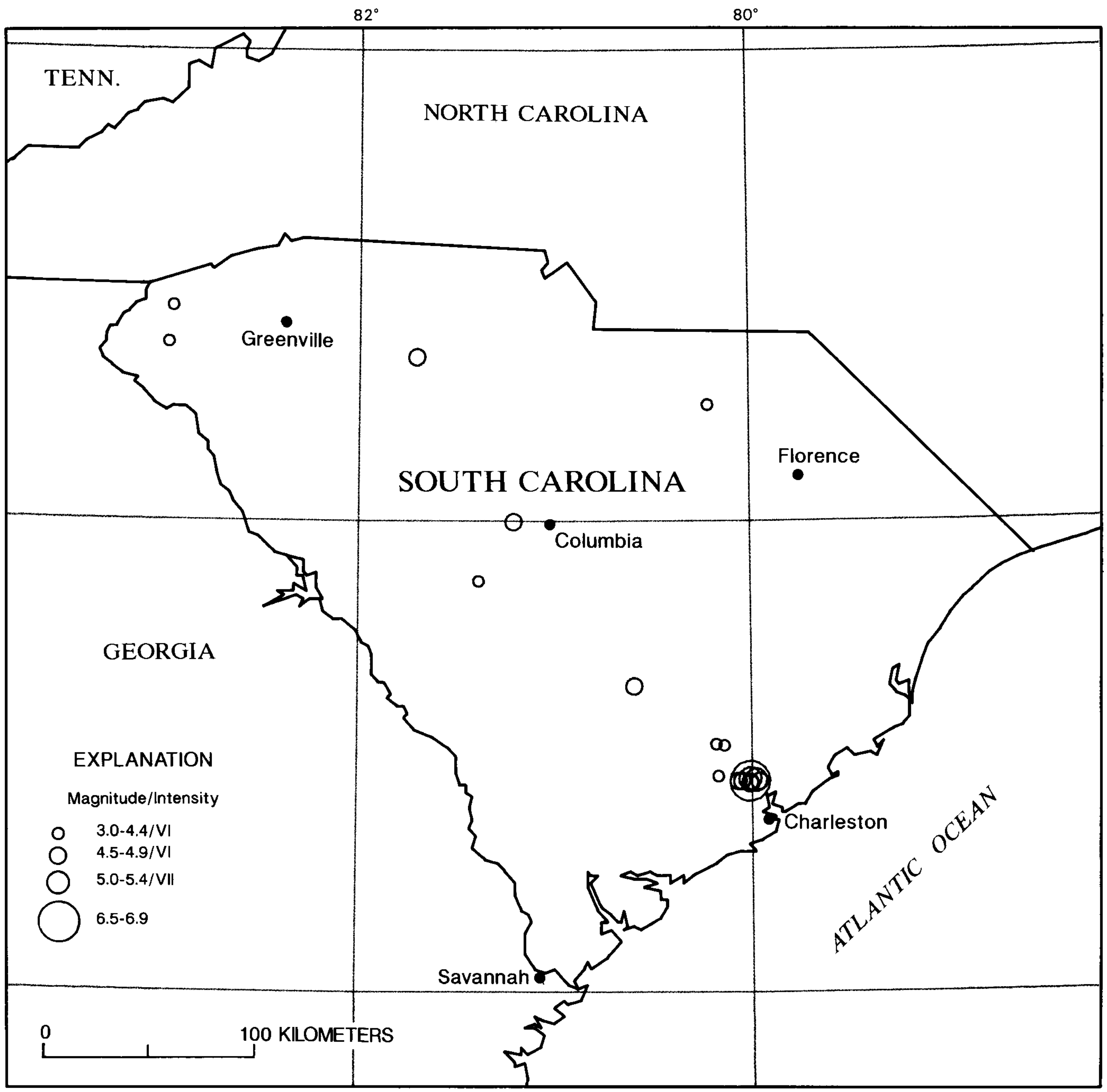
[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1976	03	11	08 29 32.2	41.56 N	71.21 W	000	49	—	—	3.50M_n CON	2.07ST	VI	49	23&

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1.]

1976. Mar. 11. Near Newport, in southeast Rhode Island. Plaster cracked at Rogers, Conn.; a lamp fell from a table at Newport, R.I.; and snow was knocked off a roof at Westport, Mass. Felt from Oakland, R.I., south to Newport and from Somerset, Mass., south to New Bedford and Westport. (Ref. 38, 49.)

SOUTH CAROLINA



Earthquakes in South Carolina with magnitudes ≥ 4.5 or intensity ≥ VI.

SOUTH CAROLINA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date	Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
		Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr Mo Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1817 01 08	09 00	32.9 N	80.0 W	—	288	—	—	5.00M_{fa} NUT	—	V	288	516&
1853 05 20		34.0 N	81.2 W	—	289	—	—	—	—	VI	289	—
1886 08 28	08 45	32.9 N	80.0 W	—	289	—	—	—	—	VI	289	—
1886 09 01	02 51	32.9 N	80.0 W	—	38	—	—	6.70M_{fa} BOL	7.02BOL	X	289	2000&
1886 09 06	04 06	32.9 N	80.0 W	—	96	—	—	—	—	VI	463	—
1886 09 17	06 29	32.9 N	80.0 W	—	289	—	—	—	—	VI	289	—
1886 09 21	10 15	32.9 N	80.0 W	—	96	—	—	—	—	VI	96	—
1886 09 27	19 02	32.9 N	80.0 W	—	96	—	—	—	—	VI	289	—
1886 10 22	10 20	32.9 N	80.0 W	—	38	—	—	—	—	VI	38	78&
1886 10 22	19 45	32.9 N	80.0 W	—	38	—	—	—	—	VII	38	78&
1886 11 05	17 20	32.9 N	80.0 W	—	38	—	—	—	—	VI	38	78&
1887 03 17	14 09	32.9 N	80.0 W	—	289	—	—	—	—	VI	289	—
1912 06 12	10 30	32.9 N	80.0 W	—	96	—	—	—	—	VI	289	150&
1913 01 01	18 28	34.7 N	81.7 W	—	38	—	—	4.80M_{fa} SC	—	VII	162	120
1945 07 26	10 32 16.4	33.750N	81.376W	005	349	—	—	4.30M_{fa} SC	—	VI	289	65
1959 08 03	06 08 36.8	33.054N	80.126W	001	349	—	—	4.40M_{fa} DG	—	VI	32	60&
1959 10 27	02 07 28	34.5 N	80.2 W	—	38	—	—	3.90M_{fa} SC	—	VI	38	12
1971 07 13	11 42 26.0	34.76 N	82.98 W	—	163	—	—	3.70M_n GB	—	VI	44	8
1972 02 03	23 11 09.7	33.306N	80.582W	002	349	4.5	—	4.50M_n GB	4.34HRM	V	45	76&
1974 11 22	05 25 56.7	32.926N	80.159W	006	349	4.7	—	4.30M_n GB	3.95HRM	VI	47	39&
1977 01 18	18 29 14.1	33.058N	80.173W	001	349	—	—	3.00M_n BLA	—	VI	39	@
1979 08 26	01 31 45.0	34.916N	82.956W	001	349	—	—	3.70M_n BLA	—	VI	262	11

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1853. May 20. Lexington, S.C. Just before sunrise, a severe earthquake broke windows and knocked crockery from shelves at Lexington, southwest of Columbia. (Ref. 289.)

1886. Aug. 28. Summerville, Dorchester County, S.C. A bed was “flung forward” against the wall in one house; window glass and crockery were broken. Several distinct aftershocks occurred that day. Also felt at Augusta, Ga., and Wilmington, N.C. (Ref. 289.)

1886. Sept. 1 (Aug. 31). Charleston, S.C. This is the most damaging earthquake to occur in the Southeast United States and one of the largest historic shocks in Eastern North America. It damaged or destroyed many buildings in the old city of Charleston and killed 60 people. Hardly a structure there was undamaged, and only a few escaped serious damage. Property damage was estimated at $5–6 million. Structural damage was reported several hundred km from Charleston (including central Alabama, central Ohio, eastern Kentucky, southern Virginia, and western West Virginia), and long-period effects were observed at distances exceeding 1,000 km (see fig. 55.)

Effects in the epicentral region included about 80 km of severely damaged railroad track and more than 1,300 km^2 of extensive cratering and fissuring. Damage to railroad tracks, about 6 km northwest of Charleston, included lateral and vertical displacement of tracks, formation of S-shaped curves, and longitudinal movement.

The formation of sand craterlets and the ejection of sand were widespread in the epicentral area, but surface faulting was not observed. Many acres of ground were overflowed with sand, and craterlets as much as 6.4 m across were formed. In a few locations, water from the craterlets spouted to heights of about 4.5 to 6 m. Fissures 1 m wide extended parallel to canal and stream banks. A series of wide cracks opened parallel to the Ashley River, and

Public building in Charleston, South Carolina, severely damaged by the September 1, 1886 (Aug. 31 EST), earthquake.

several large trees were uprooted when the bank slid into the river.

At Summerville, a small town of 2,000 population, 25 km northwest of Charleston, many houses settled in an inclined position or were displaced as much as 5 cm. Chimneys constructed independently of the houses commonly had the part above the roofline thrown to the ground. Many chimneys were crushed at their bases, allowing the whole chimney to sink down through the floors. The absence of overturning in piered structures and the nature of the damage to chimneys have been interpreted as evidence that the predominant motion was vertical.

The meizoseismal area of MM intensity X effects is an elliptical area, roughly 35 by 50 km, trending northeast between Charleston and Jedburg and including Summerville. Middleton Place, about in the center of this ellipse, is at the southeast end of a zone (perhaps 15 km long) of microearthquake activity that still continues today. This seismic activity may be a continuation of the 1886 aftershock series.

The intraplate epicenter of this major shock is not unique for large earthquakes in the Eastern and Central United States. Other intraplate earthquakes include those at Cape Ann, Mass. (1755), and New Madrid, Mo. (1811–12). Earthquakes occurring along boundaries of plates (e.g., San Francisco, 1906) are well understood in terms of plate tectonics, but those occurring within plates are not similarly understood. This problem still is being studied more than 100 years after the earthquake.

This earthquake was reported from distant places such as Boston, Mass.; Milwaukee, Wis.; Chicago, Ill.; Cuba, and Bermuda. Magnitude 6.6 M_{fa} NLI; 7.5 M_{Sn} NLI; 7.7 M_{Sn} BOL. (Ref. 38, 140, 289, 450, 526.)

Brick house at 157 Tradd Street, Charleston, South Carolina, damaged by the September 1, 1886 (Aug. 31 EST), earthquake. (Photograph by J.K. Hillers.)

1886. Sept. 6 (Sept. 5). Charleston, S.C. This minor aftershock knocked plaster from walls at Charleston. (Ref. 96, 463.)

1886. Sept. 17. Summerville, Dorchester County, S.C. This aftershock reportedly shifted the pillars of a Summerville hotel about 6.5 cm, cracking most of the pillars in the process. Brick fell from some chimneys and sheds. Also severely felt at Charleston. (Ref. 289.)

1886. Sept. 21. Summerville, Dorchester County, S.C. The medical college building, already weakened by previous earthquakes, was thrown down by this aftershock. Much loose plaster fell. Also felt in Georgia. (Ref. 96.)

1886. Sept. 27. Charleston, S.C. This aftershock cracked a brick building on Broad Street in Charleston. On East Bay Street, the rear wall of a store was separated about 10 cm from the adjoining wall. Loose plaster and bricks fell in some houses. Also felt in Georgia. (Ref. 96, 289, 463.)

1886. Oct. 22, 10 20 UTC. Charleston, S.C. Two of the most severe aftershocks of the Aug. 31 earthquake occurred in Charleston on this date (also see next paragraph). The first shock cracked the west wing of the Customs House and caused the wall supporting the roof on the west to "give way" slightly. Also felt in Georgia, North Carolina, and Tennessee. (Ref. 38, 289.)

1886. Oct. 22, 19 45 UTC. Summerville, Dorchester County, S.C. This was the most severe aftershock to date of the Aug. 31 earthquake. It threw down several chimneys and cracked several others at Summerville. The shock knocked bricks from several chimneys and shook down plaster at Columbia, about 160 km northwest of Charleston.

Damage on East Bay Street, Charleston, South Carolina, after the earthquake of September 1, 1886 (Aug. 31 EST). (Photograph by J.K. Hillers.)

Also felt in the District of Columbia, Georgia, North Carolina, Ohio, and Virginia. (Ref. 38, 289.)

1886. Nov. 5. Charleston, S.C. This aftershock shattered one or two chimneys at Charleston, and knocked down the tops of a few chimneys at Summerville. Also felt in the District of Columbia, Georgia, North Carolina, and Virginia. (Ref. 38, 289.)

1887. Mar. 17. Charleston, S.C. This violent aftershock widened existing cracks in buildings and knocked down plaster in Charleston. It was described as "more severe" in Summerville. (Ref. 289.)

1912. June 12. Summerville, Dorchester County, S.C. Several chimneys were cracked in Summerville, and a few had their tops thrown down; plaster fell in several houses. The shock was strong enough to move beds several cm across a floor in Charleston. Also felt in Georgia, North Carolina, and South Carolina. (Ref. 38, 96, 289.)

1913. Jan. 1. Union County, S.C. This earthquake overthrew chimneys throughout the area and damaged plaster and stone walls. At Union, chimneys were thrown down in all parts of town, and plastering was damaged severely in the new courthouse. Cracks formed in the stone walls of the jail and in the brick courthouse. At Monarch, about 2.5 km south of Union, a house was partly shaken down. Chimneys were downed at Cross Keys, Enoree, Gaffney, Kings Mountain, Pacolet, Pauline, and West Springs. A pig was killed by bricks falling from a chimney at West Springs. Also felt in Georgia, North Carolina, and Virginia. (Ref. 38, 162, 289.)

1945. July 26. Camden, Kershaw County, S.C. Brick walls and chimneys were cracked at Camden; one chimney was damaged at Chester, about 45 km northwest of Camden. Felt throughout most of South Carolina and at a few towns in Georgia, North Carolina, and Tennessee. Magnitude 5.6 M_S GR, 4.4 M_{fa} DG. (Ref. 38, 289, 349.)

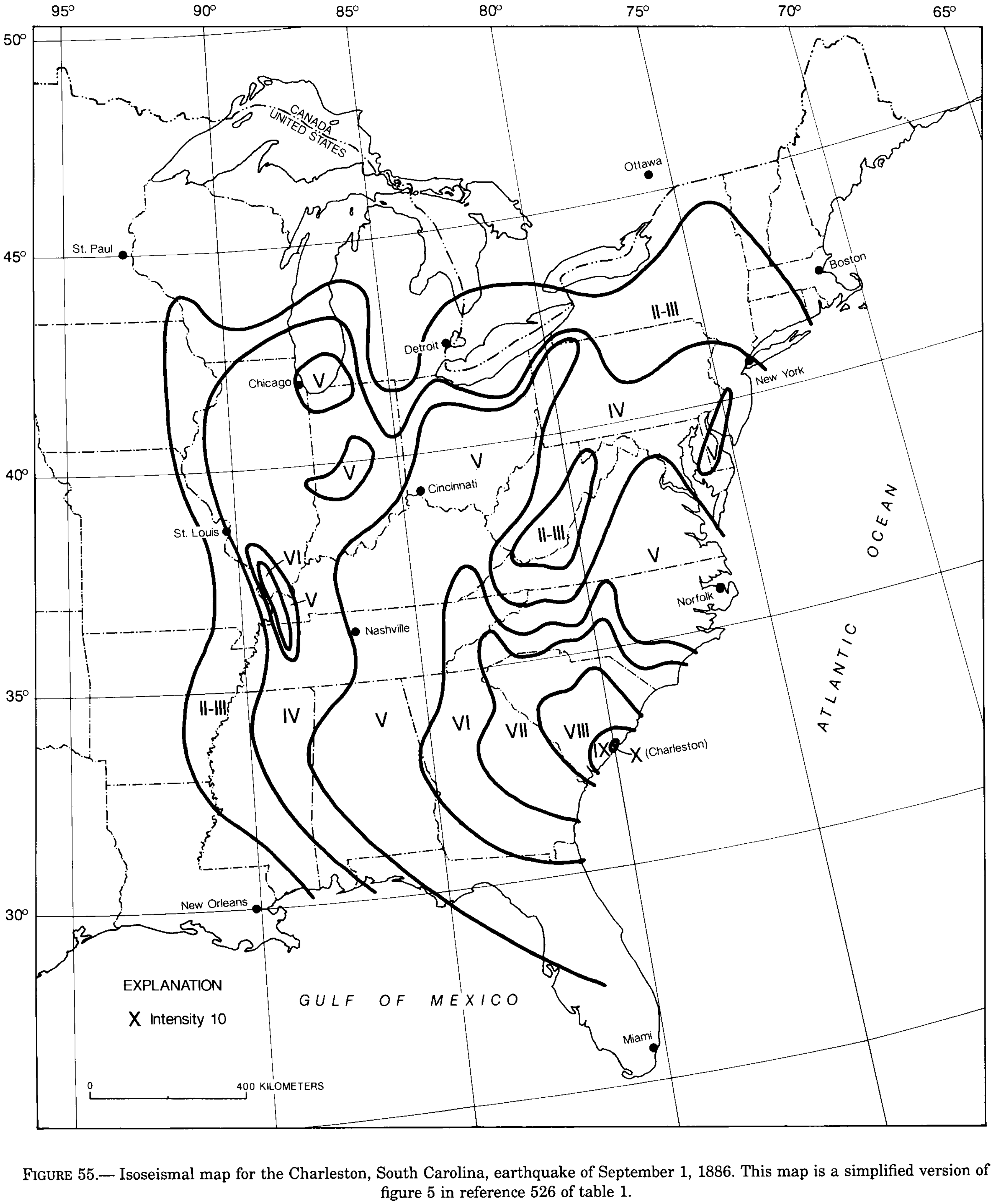


FIGURE 55.— Isoseismal map for the Charleston, South Carolina, earthquake of September 1, 1886. This map is a simplified version of figure 5 in reference 526 of table 1.

Craterlet from a sand spout at Ten Mile Hill, Berkeley County, South Carolina, formed by the September 1, 1886 (Aug. 31 EST), Charleston earthquake. (Photograph by J.K. Hillers.)

1959. Aug. 3. Charleston-Summerville, S.C. A chimney fell at Summerville, plaster was thrown to the floor, and a ceiling cracked. Damage to plaster and chimneys occurred at Charleston and on Wadmalaw Island. Also felt in Georgia. (Ref. 32, 349.)

1959. Oct. 27 (Oct. 26). Chesterfield, S.C. Plaster cracked and fell at Chesterfield, about 120 km northeast of Columbia, and a sheetrock wall cracked at McBee, about 30 km southwest of Chesterfield. Also felt in North Carolina. (Ref. 32, 38.)

1971. July 13. Near Newry, Oconee County, S.C. This earthquake cracked a chimney and displaced furniture at Newry, northwest of Clemson in northwest South Carolina. Also felt in Georgia. (Ref. 44, 163.)

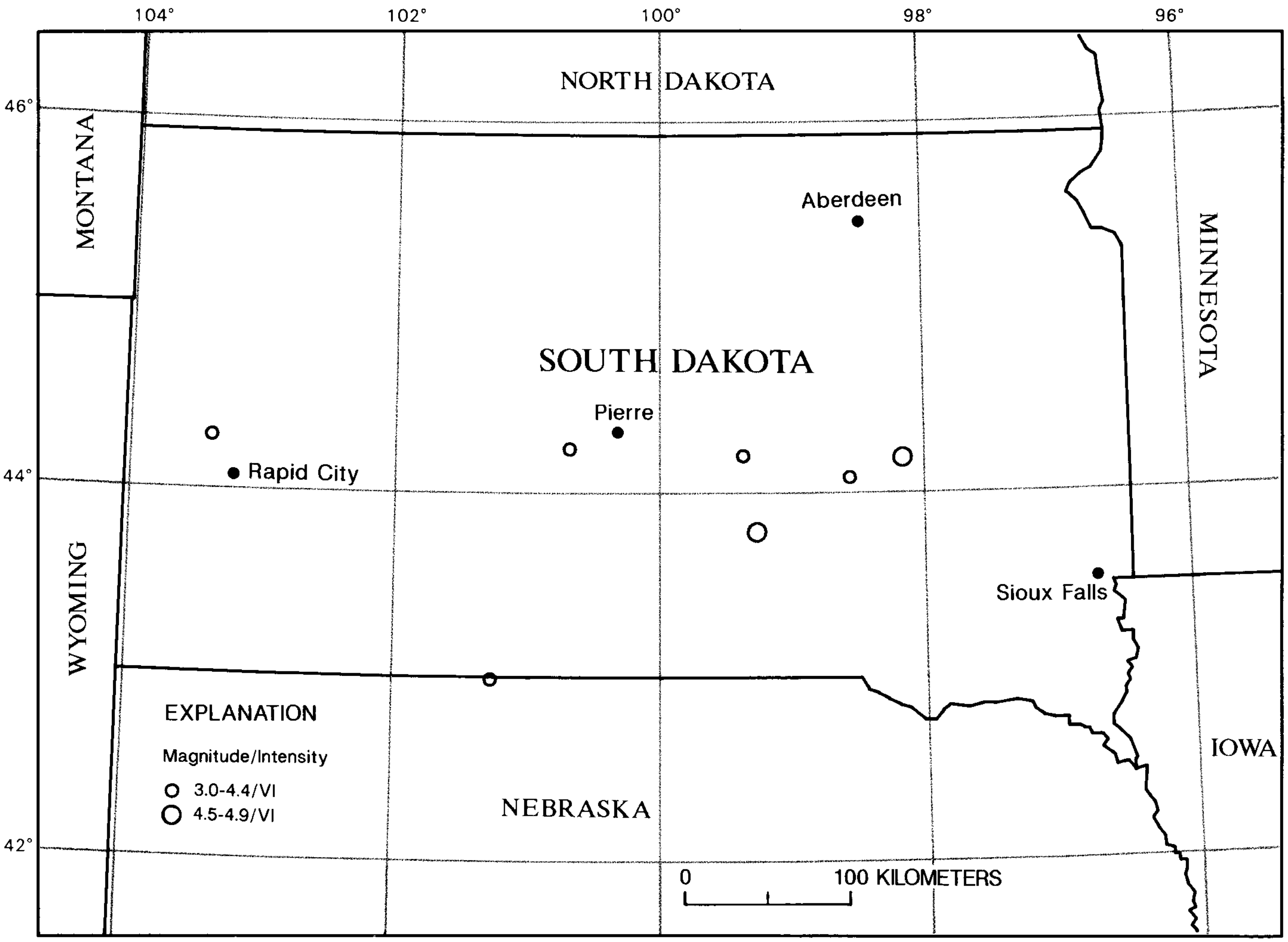
1974. Nov. 22. Charleston, S.C. In North Charleston, a resident in a ranch-style brick house reported cracks in the brick veneer, cracks in the driveway and sidewalk, and separation of an outside brick wall from the rest of the house. Throughout the city of Charleston, cracks formed in driveways, sidewalks, and plaster. At Summerville, damage included cracks in concrete-block footings, broken windowpanes, and enlarged cracks in a concrete patio floor. A 500-ton machine tool "jumped around" on its bed at the General Electric Plant at Ladson. Also felt in Georgia and North Carolina. Magnitude 4.3 M_{fa} NUT. (Ref. 38, 47, 263, 289, 349.)

1977. Jan. 18. Summerville, Dorchester County, S.C. Sidewalks were cracked in

Summerville and suburban subdivisions. Felt only at a few other towns in the area. (Ref. 39, 349.)

1979. Aug. 26 (Aug. 25). Northwest South Carolina. At Tamassee (Oconee County), west of Greenville, drywall cracked and fell and cracks formed in a concrete floor. The University of South Carolina reported about 20 aftershocks. Also felt in Georgia and North Carolina. (Ref. 262, 349.)

SOUTH DAKOTA



Earthquakes in South Dakota with magnitudes ≥ 4.5 or intensity ≥ VI.

SOUTH DAKOTA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h m s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MM	Ref	(1,000 km²)
1906	05	10	00 27	43.0 N	101.3 W	—	105	—	—	3.70M_{fa} SC	—	VI	105	45
1911	06	02	22 34	44.2 N	98.2 W	—	38	—	—	4.50M_{fa} BAR	—	V	105	100
1922	01	02	14 50	43.8 N	99.3 W	—	105	—	—	—	—	VI	105	—
1946	07	23	06 45	44.1 N	98.6 W	—	105	—	—	4.10M_{fa} SC	—	VI	38	22
1961	12	31	16 36 05.8	44.250N	100.724W	023	349	—	—	4.20M_{fa} SC	—	VI	34	34
1966	06	26	11 59 43.1	44.296N	103.428W	002	349	—	—	3.10M_n BAR	—	VI	38	3
1983	03	04	06 32 18.6	44.214N	99.409W	005	360	4.4	—	4.40M_L GS	—	VI	360	42

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1906. May 10 (May 9). South Dakota-Nebraska border. This earthquake was reported all along the Niobrara River valley from Rushville to Valentine, Nebr., and at Rosebud, S. Dak., about 100 km southwest of Pierre. Plants fell from a windowsill at Cody, Nebr. Residents of towns for 100 km in all directions felt the shock. (Ref. 105, 353.)

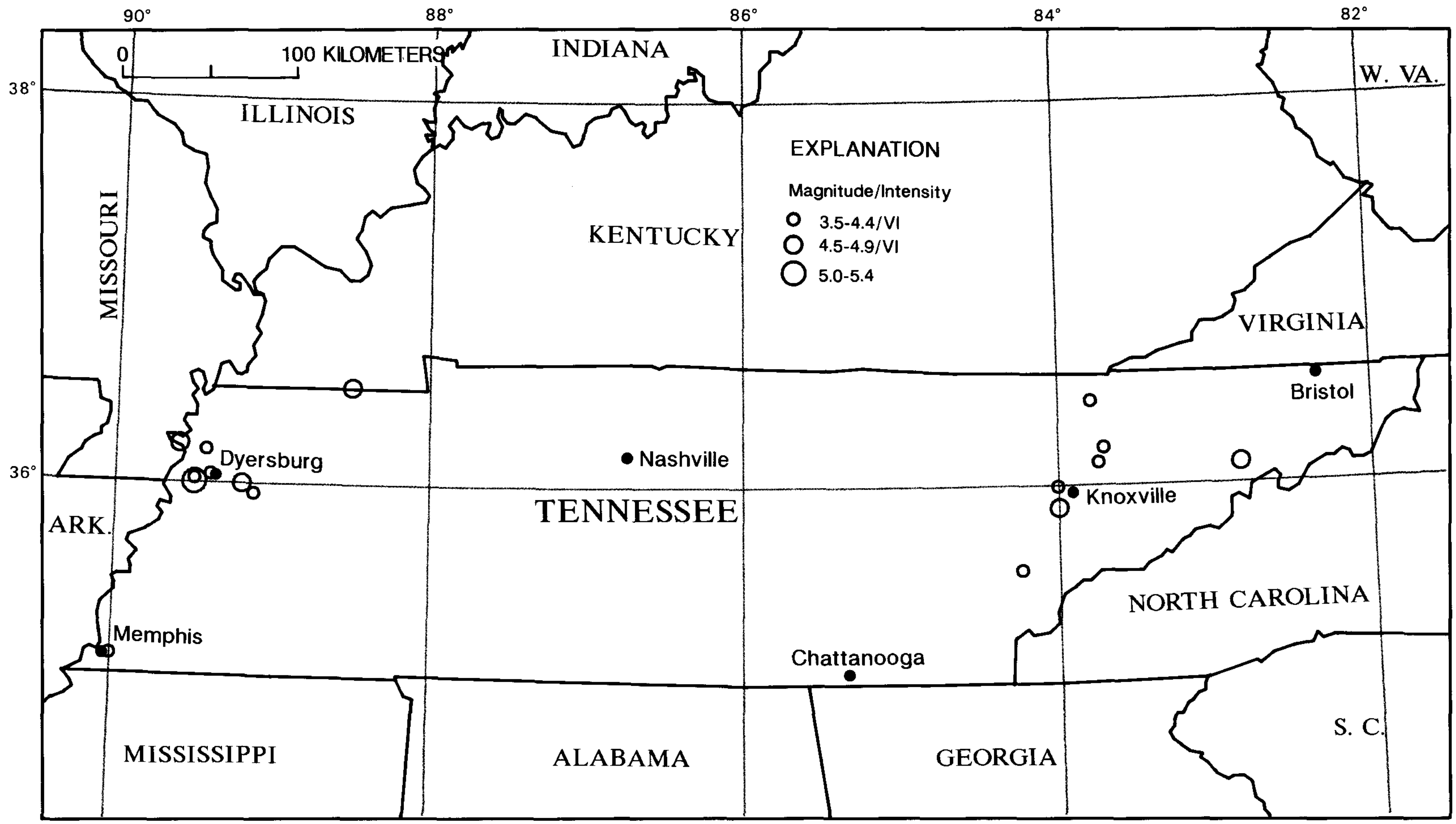
1922. Jan. 2. Near Winner, Tripp County, S. Dak. Chimneys were thrown down and dishes and windows were broken at Winner, about 130 km south of Pierre. (Ref. 105.)

1946. July 23. Wessington, Beadle County, S. Dak. A series of earthquakes broke five water mains in the Wessington area, east of Pierre, and awakened sleepers at nearby Huron. Generally felt from Pierre east to De Smet and northward, including Redfield. Magnitude 4.2 M_{fa} BAR. (Ref. 38, 105, 353.)

1961. Dec. 31. Pierre, Hughes County, S. Dak. Cracks formed in plaster and a concrete floor at Pierre and a clothes drier was moved several centimeters. Felt from Pierre west to Midland (Haakon County) and east to Huron (Beadle County). Magnitude 4.3 M_{fa} BAR, 4.2 M_{fa} DG. (Ref. 34, 349, 353.)

1966. June 26. Southwest South Dakota. At Keystone (in Lawrence County, near Rapid City), well water was muddied for several hours. At Rapid City, a patio and concrete steps were cracked and objects fell from walls. Felt over a small area of southwest South Dakota. (Ref. 38, 349, 353.)

1983. Mar. 4. Near Fort Thompson, Buffalo County, S. Dak. This moderate earthquake caused minor damage at Fort Thompson (cracks in walls and ceiling), Lower Brule (cracks in reinforced concrete foundation, ceilings, and walls), and Stephan (cracks in exterior brick walls). Also felt in western Minnesota and northern Nebraska. Magnitude 4.6 M_n TUL. (Ref. 360.)



Earthquakes in Tennessee with magnitudes ≥ 4.5 or intensity ≥ VI.

TENNESSEE

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	Felt area
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1844	11	28	13 00	36.0 N	84.0 W	—	38	—	—	4.20M_{fa} BAR	—	VI	38	—
1865	08	17	15 00	36.0 N	89.5 W	—	113	—	—	5.00M_{fa} SC	—	VII	38	250
1889	07	20	01 32	35.1 N	90.0 W	—	105	—	—	3.80M_{fa} BAR	—	VI	105	@
1898	06	14	15 26	36.5 N	88.5 W	—	529	—	—	4.50M_{fa} SG	—	V	529	110
1913	03	28	21 50	36.2 N	83.7 W	—	38	—	—	4.10M_{fa} SC	—	VII	38	7
1918	10	16	02 15	36.0 N	89.2 W	—	105	—	—	4.50M_{fa} SG	—	V	105	106
1928	11	03	04 02 49.8	36.112N	82.828W	005	349	—	—	4.50M_n DG	—	VI	1	100
1952	07	16	23 48 10	36.2 N	89.6 W	—	25	—	—	—	—	VI	25	—
1955	03	29	09 02 40	36.0 N	89.5 W	—	105	—	—	3.90M_{fa} SC	—	VI	28	10
1956	09	07	13 35 50.8	36.445N	83.787W	005	349	—	—	4.10M_{fa} SC	—	VI	29	22
1962	07	23	06 05 15.7	36.044N	89.399W	008	349	—	—	3.60M_n BAR	3.38STT	VI	35	10
1973	11	30	07 48 40.5	35.889N	83.993W	012	349	4.7	—	4.60M_n BLA	4.00STT	VI	46	120
1980	12	02	08 59 29.7	36.175N	89.429W	005	349	—	—	3.80M_n SLM	—	VI	300	2
1981	08	07	11 53 41.8	35.95 N	89.12 W	010	325	—	—	4.00M_n SLM	—	VI	325	10
1984	02	14	20 54 30.9	36.125N	83.737W	010	370	—	—	3.50M_D TEC	—	VI	370	@
1987	03	27	07 29 30.4	35.567N	84.229W	019	74	4.3	—	4.20M_n TEC	—	VI	577	23

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1844. Nov. 28. Knoxville, Knox County, Tenn. Bricks were thrown from the top of a chimney at Knoxville, and one chimney in the county was thrown down. In nearby Blount County, bricks were displaced from several chimneys and houses. Also felt at Athens. (Ref. 38, 508).

1865. Aug. 17. Near Memphis, Shelby County, Tenn. At Memphis, chimneys were thrown down. At New Madrid, Mo., chimneys were damaged and waves formed on the river, that were like those made by a passing steamboat. The earth appeared to undulate. Felt from St. Louis, Mo., to Jackson, Miss. Also felt in Illinois. Magnitude 5.3 M_{fa} BAR. (Ref. 38, 113, 353, 514.)

1889. July 20 (July 19). Memphis, Shelby County, Tenn. A severe local shock cracked walls and chimneys and frightened residents at Memphis. (Ref. 105, 353.)

1913. Mar. 28. Near Knoxville, Knox County, Tenn. This earthquake was of short duration, but caused general panic among residents. At Knoxville, bricks fell from chimneys, pictures fell to the floor, heavy furniture was overturned, and fire alarms were activated. A noticeable rise and fall of the ground was observed in a small area of Knox County. The Knox County Courthouse, a massive structure on a bluff overlooking the Tennessee River, trembled "like a leaf" for several seconds. Magnitude 4.0 M_{fa} BAR. (Ref. 38, 353, 508, 513.)

1928. Nov. 3 (Nov. 2). Southern Appalachians. This earthquake was felt strongly along the French Broad River between Asheville, N.C., and Newport, Tenn. At Newport (Cocke County), bricks were shaken from some buildings and plaster cracked. Three frame houses under construction northeast of Newport at Johnson City were shaken down; one building under construction north of Newport at Morristown was damaged; and the top of one chimney at Greenville, east of Morristown, was thrown down. Minor damage also occurred at Asheville, Bryson City, and Waynesville, N.C. Also felt in Alabama, Georgia, Kentucky, South Carolina, and Virginia. (Ref. 1, 349, 508.)

1952. July 16. Near Dyersburg, Dyer County, Tenn. Many cracks were reported in a concrete structure at Dyersburg. Also felt at Finley and Jenkinsville. (Ref. 25.)

1955. Mar. 29. Finley, Dyer County, Tenn. Plaster cracked in a house at Finley, and violent shaking and a roaring noise were reported. Also felt in Arkansas and Missouri. Magnitude 4.0 M_{fa} BAR. (Ref. 28, 105, 353.)

1956. Sept. 7. Knoxville, Knox County, Tenn. This earthquake caused the most severe effects at Knoxville, where one chimney was thrown down, plaster was knocked from walls, and windows were shattered. Also felt in parts of Kentucky, North Carolina, and Virginia. An aftershock was felt a few minutes after the main tremor. Magnitude 4.1 M_{fa} BAR, 4.1 M_{fa} DG. (Ref. 29, 349, 353, 508.)

1962. July 23. Dyersburg, Dyer County, Tenn. Walls and plaster cracked at Dyersburg, and one wall was damaged slightly at Miston, northwest of Dyersburg. Also felt in Arkansas and Missouri. (Ref. 35, 349, 353.)

1973. Nov. 30. Eastern Tennessee. The earthquake caused minor damage to chimneys, walls, and windows in the Maryville-Alcoa area in Blount County, and small cracks in walls at Knoxville (about 20 km north of Maryville). Plaster cracked and fell and windows broke at Maryville and at Vonore, about 20 km southwest. Slight damage also occurred in a few towns in Georgia, Kentucky, and North Carolina. Also felt in South Carolina, Virginia, and West Virginia. Magnitude 4.6 M_{fa} NUT. (Ref. 46, 263, 349.)

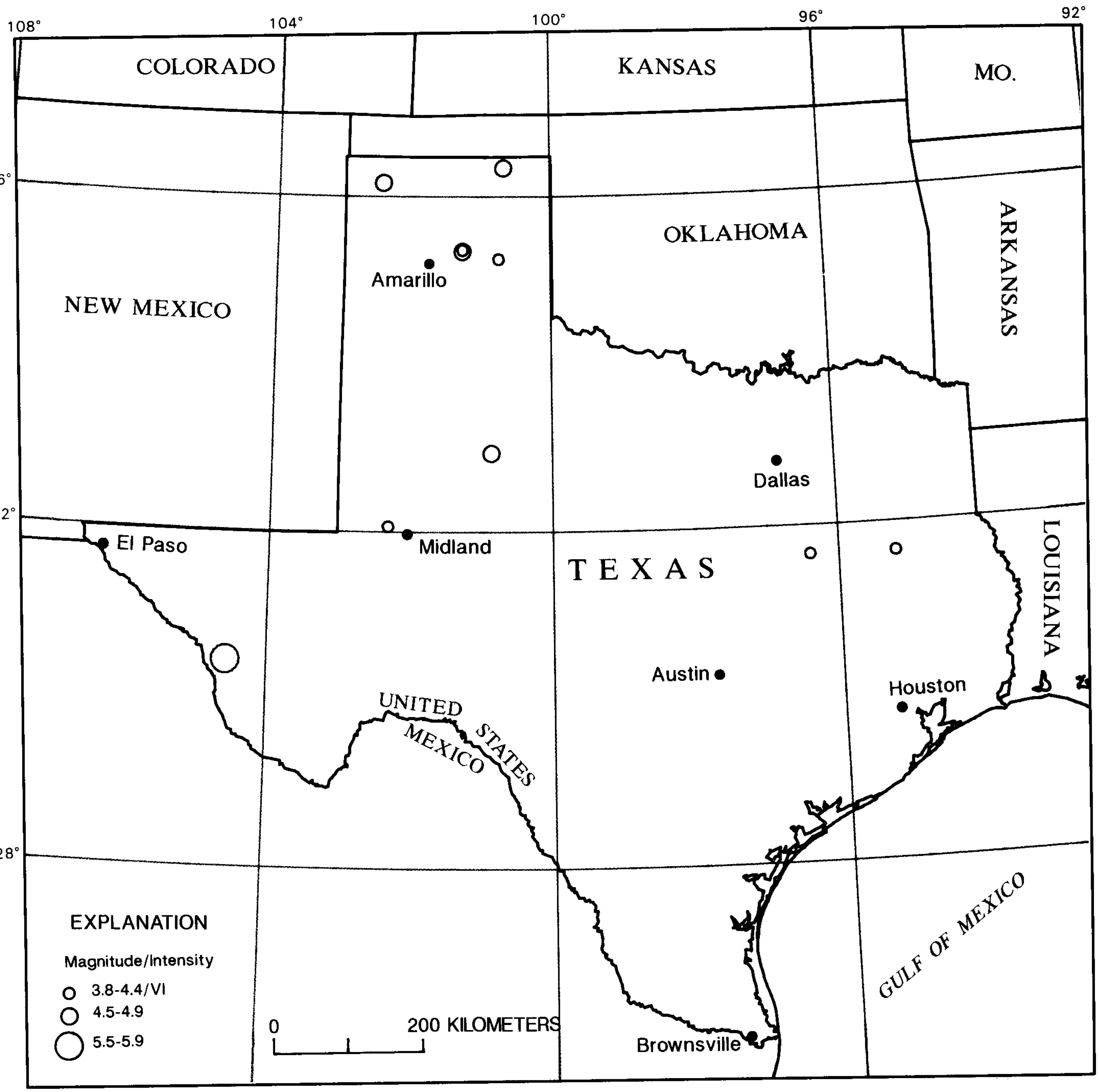
1980. Dec. 2. Northwest Tennessee. Cracks formed in a house foundation at Madie and in exterior brick walls at Ridgely in Obion County. In addition, windows were damaged at Caruthersville, Mo., and north of Dyersburg at Elbridge, Hornbeak, and Lane, Tenn. Magnitude 3.8 M_n TEC. (Ref. 300, 349.)

1981. Aug. 7. Western Tennessee. At Eaton, in Gibson County, southeast of Dyersburg, an earthquake cracked bathroom tile and two concrete patios. Also felt in Arkansas, Mississippi, and Missouri. Magnitude 4.0 M_n BLA, 4.0 M_n TEC. (Ref. 325.)

1984. Feb. 14. Eastern Tennessee. A few buildings sustained damage northeast of Knoxville, at Blaine, where some windows were broken. Windows were cracked and small objects overturned at New Market (Jefferson County), northeast of Knoxville. Magnitude 3.6 M_n BLA. (Ref. 370.)

1987. Mar. 27. Near Greenback, Loudon County, Tenn. In the area southwest of Knoxville, at Greenback and Friendsville, chimneys and foundations of buildings sustained cracks and hairline cracks formed in plaster and drywalls. Slight cracks in drywall and building foundations also were reported in Blount County, at Louisville and Tallassee. Felt over a moderate area of six States, including northern Georgia, southern Kentucky, western North Carolina, eastern Tennessee, southwest Virginia (Lee County), and northwest South Carolina (Pickens County). Magnitude 4.2 M_n TUL. (Ref. 74, 577.)

TEXAS



Earthquakes in Texas with magnitudes ≥ 4.5 or intensity ≥ VI.

TEXAS

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr	Mo	Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Longitude (°)	Depth (km)	Ref	Magnitude USGS m_b	M_S	Other	Moment M	Intensity MM	Ref	Felt area (1,000 km^2)
1891	01	08	06 00	31.7 N	95.2 W	—	342	—	—	3.80M_{fa} BAR	—	VI	342	@
1917	03	28	19 56	35.4 N	101.3 W	—	364	—	—	3.80M_{fa} SC	—	VI	364	5
1925	07	30	12 17	35.4 N	101.3 W	—	364	—	—	4.90M_{fa} SC	—	VI	364	520
1931	08	16	11 40 22.3	30.502N	104.575W	001	214	—	—	5.80M_n NTT	—	VIII	4	980
1932	04	09	10 17	31.7 N	96.4 W	—	342	—	—	3.90M_{fa} SC	—	VI	342	8
1936	06	20	03 24 03.5	35.310N	100.773W	005	349	—	—	4.40M_{fa} SC	—	VI	364	87
1948	03	12	04 29 06.3	36.221N	102.478W	005	349	—	—	4.50M_{fa} SC	—	VI	364	123
1966	08	14	15 25 53.7	32.115N	102.339W	003	349	3.4	—	4.30M_n BAR	—	VI	81	—
1974	02	15	13 33 49.2	36.399N	100.688W	000	349	4.5	—	4.50M_n DG	4.35HRN	V	47	45
1978	06	16	11 46 56.0	32.990N	100.875W	003	349	4.4	—	4.60M_n SLM	4.48VOS	V	240	52

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1887. May 3. Northern Sonora, Mexico. Chimneys were thrown down in El Paso, Tex. See Arizona section for a complete description of this earthquake. (Ref. 38, 343, 471, 494, 497.)

1891. Jan. 8. Rusk, Tex. A strong local earthquake thre w down chimneys at Rusk, southeast of Dallas, and awakened many residents. Two distinct shocks were felt. Some researchers have questioned the authenticity of this event, suggesting that it may have been a violent thunderstorm or a tornado. (Ref. 342, 353.)

1917. Mar. 28. Panhandle area, Carson County, Tex. Ceiling plaster fell to the floor of the bank and the walls of many buildings were cracked at Panhandle, east of Amarillo. Distinctly felt in northern Carson County and southern Hutchinson County. Magnitude 3.8 M_{fa} BAR. (Ref. 353, 364.)

1925. July 30. Panhandle area, Carson County, Tex. Plaster fell and jars were displaced from shelves at Plemons; ground settling resulted in damage to a section of track of the Santa Fe Railroad at Cuyler. Plaster was shaken from ceilings at Guymon, Okla., north of Panhandle. Also felt in Colorado, Kansas, Missouri, and New Mexico (see fig. 56). Magnitude 4.9 M_{fa} BAR. (Ref. 218, 353, 364.)

1931. Aug. 16. Near Valentine, Jeff Davis County, Tex. In terms of magnitude and damage, this is the largest earthquake known to have occurred in Texas. The most severe damage was reported at Valentine, where all buildings except wood-frame houses were damaged severely and all brick chimneys toppled or were damaged. The schoolhouse, which consisted of one section of concrete blocks and another section of bricks, was damaged so badly that it had to be rebuilt. Small cracks formed in the schoolhouse yard.

Some walls collapsed in adobe buildings, and ceilings and partitions were damaged in wood-frame structures. Some concrete and brick walls were cracked severely. One low wall, reinforced with concrete, was broken and thrown down. Tombstones in a local cemetery were rotated. Damage to property was reported from widely scattered points in Brewster, Jeff Davis, Culberson, and Presidio Counties.

Landslides occurred in the Van Horn Mountains, southwest of Lobo; in the Chisos Mountains, in the area of Big Bend; and farther northwest, near Pilares and Porvenir. Landslides also occurred in the Guadalupe Mountains, near Carlsbad, N. Mex., and slides of rock and dirt were reported near Picacho, N. Mex. Well water and springs were muddied throughout the area. Also felt in parts of Oklahoma, New Mexico (see fig. 57), and in Chihuahua and Coahuila, Mexico. Magnitude 6.4 M_{fa} SAN, 5.8 M_n NTT, 6.4 M_S GR, 5.7 M_{fa} SC. (Ref. 4, 99, 124, 353, 364.)

1932. Apr. 9. Wortham, Freestone County, Tex. At Wortham, northeast of Waco, weakly mortared concrete bricks fell from at least four chimneys. Felt in Freestone, Hill, Limestone, McLennan, and Navarro Counties. Magnitude 3.6 M_{fa} BAR, 3.9 M_{fa} CAR. (Ref. 342, 353.)

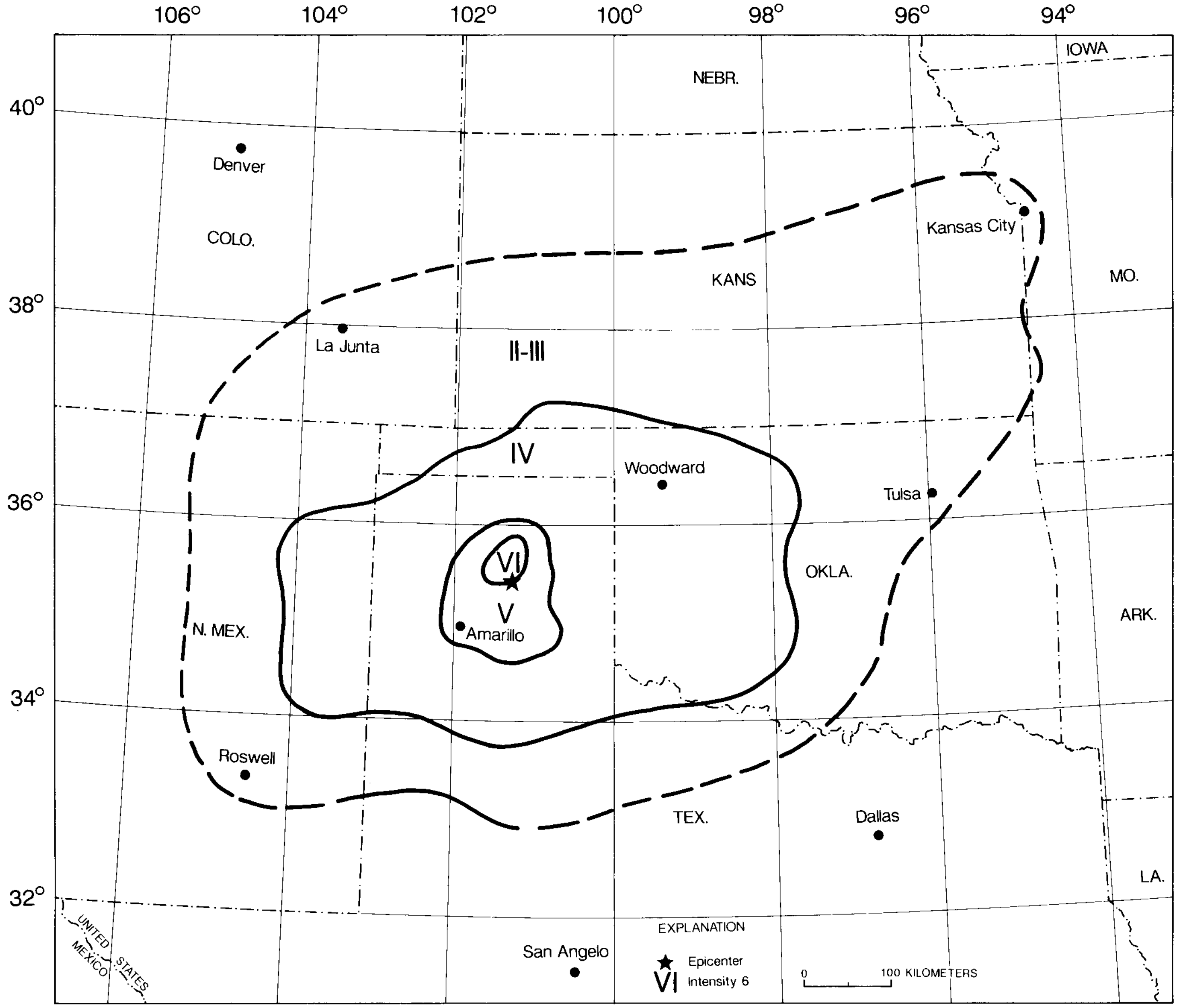


FIGURE 56.—Isoseismal map for the Texas Panhandle earthquake of July 30, 1925. Isoseismals are based on intensity estimates from data listed in references 218 and 364 of table 1.

1936. June 20 (June 19). Near Pampa, Gray County, Tex. The last shock of a series of three on this date cracked the cornice of the Pampa City Hall and enlarged an existing crack. Houses were jarred strongly at nearby Borger. Slight damage also was reported in Elkhart, Kans., and Kenton, Okla. Also felt at Richards, Colo. Magnitude 4.5 M_{fa} BAR, 4.5 M_{fa} DG. (Ref. 349, 353, 364.)

1948. Mar. 12 (Mar. 11). Hartley County in northwest Texas. Cracks in walls and plaster were reported from several towns in the epicentral region, including Amarillo, Panhandle, and Perico. Slight damage to plaster also was reported in Colorado, New Mexico, and Oklahoma. Also felt in Kansas. Magnitude 4.8 M_{fa} BAR, 4.8 M_{fa} DG. (Ref. 349, 353, 364.)

1966. Aug. 14. Kermit, Winkler County, Tex. At Kermit, windows were broken and several street signs were knocked down. Plaster was cracked in one church. Also felt at Wink, Tex., and Loco Hills, N. Mex. (Ref. 81, 349, 353.)

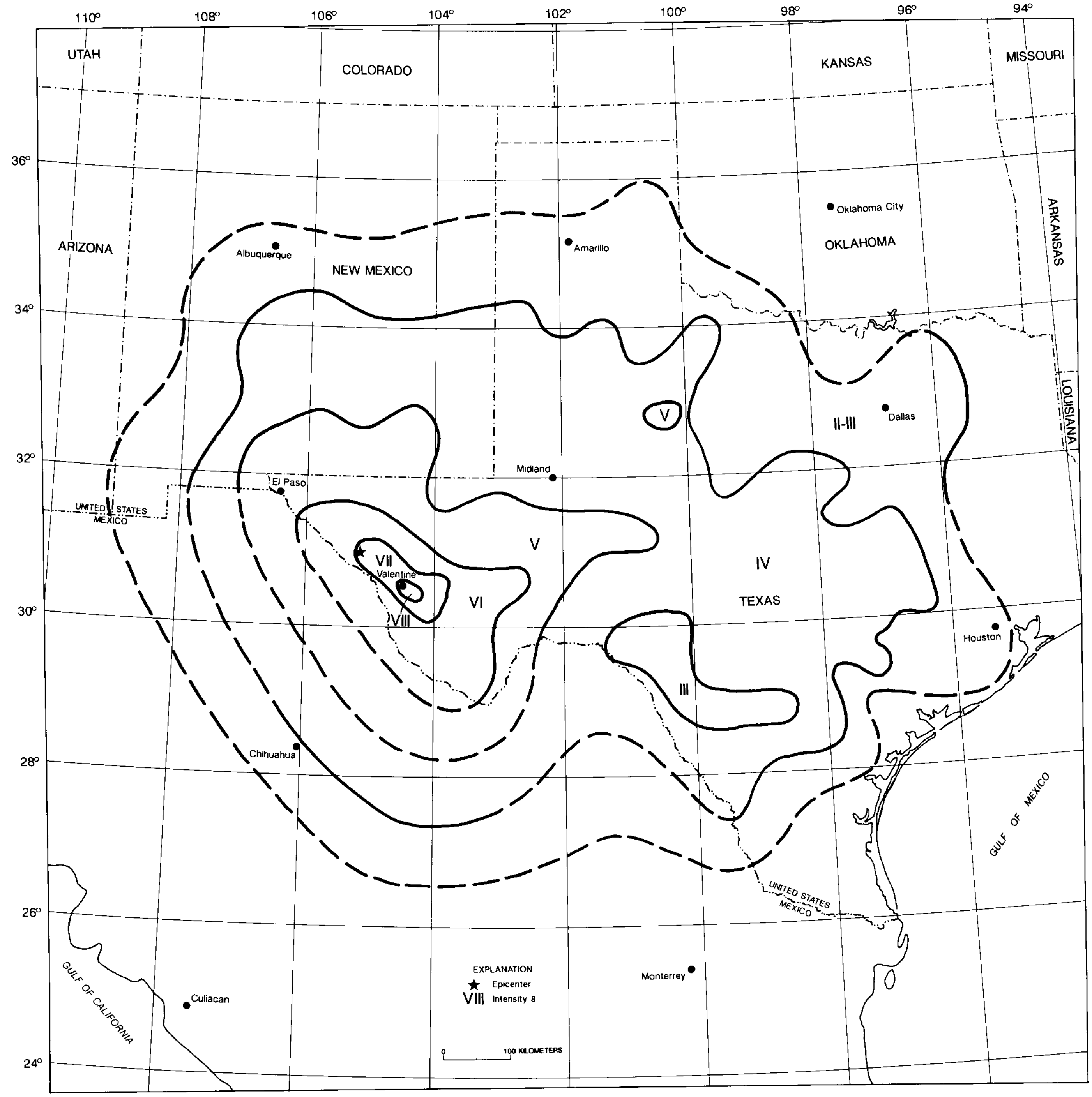
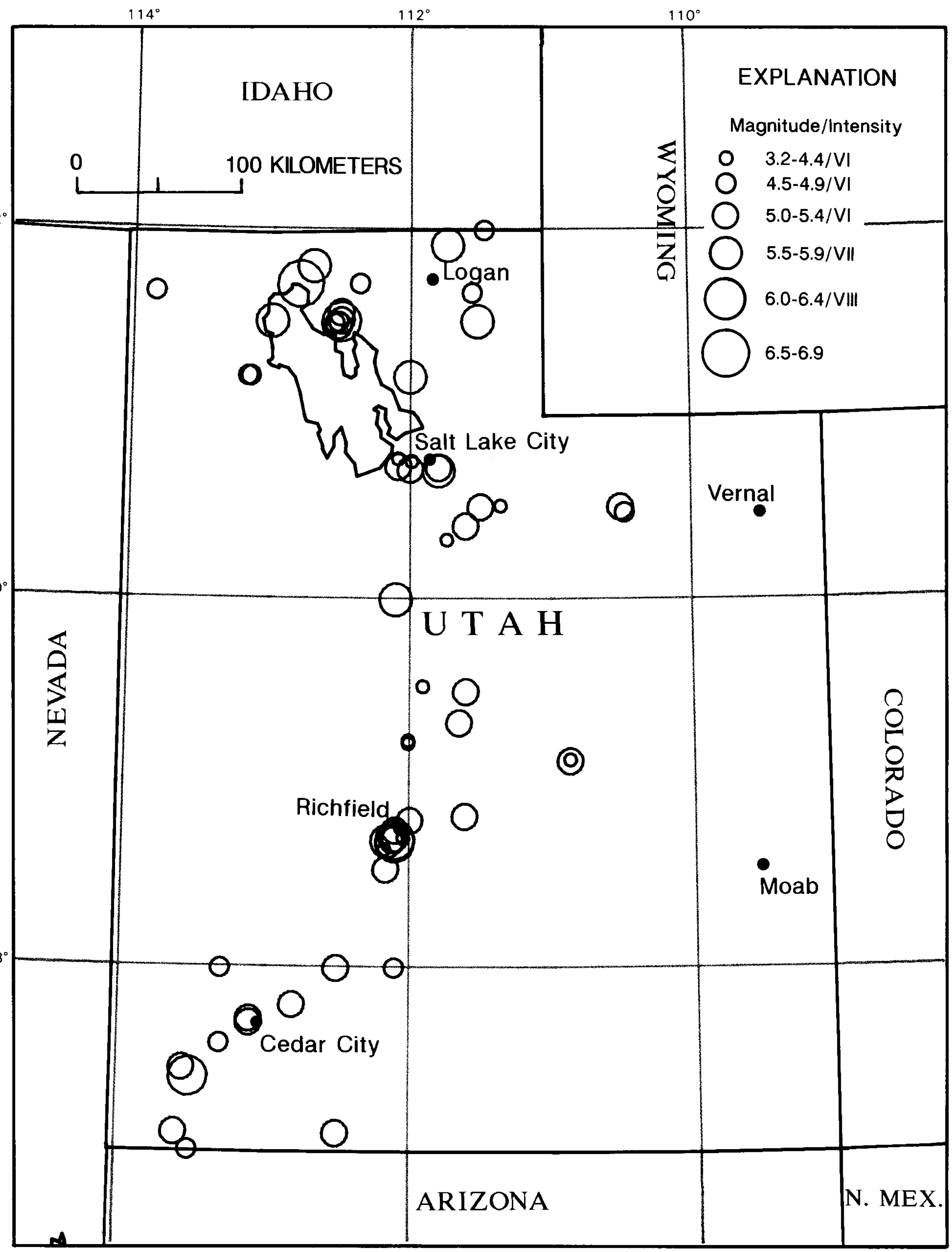


FIGURE 57.—Isoseismal map for the Valentine, Texas, earthquake of August 16, 1931. Isoseismals are based on intensity estimates from data listed in references 4, 124, and 342 of table 1.

UTAH



Earthquakes in Utah with magnitudes ≥ 4.5 or intensity ≥ VI.

UTAH

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date Yr Mo Da	Origin time (UTC) h m s	Hypocenter Latitude (°)	Hypocenter Longitude (°)	Hypocenter Depth (km)	Hypocenter Ref	Magnitude USGS m_b	Magnitude USGS M_S	Magnitude Other	Magnitude Moment M	Intensity MM	Intensity Ref	Felt area (1,000 km^2)
1876 03 22		39.5 N	111.6 W	—	298	—	—	—	—	VI	52	3
1887 12 05	15 30	37.1 N	112.5 W	—	38	—	—	—	—	VI	38	—
1891 04 20	13 55	37.1 N	113.6 W	—	298	—	—	—	—	VI	52	3
1894 07 18	22 50	41.2 N	112.0 W	—	38	—	—	—	—	VI	298	—
1900 08 01	07 45	40.0 N	112.1 W	—	298	—	—	—	—	VII	52	—
1901 11 14	04 32	38.7 N	112.1 W	—	38	—	—	—	—	VIII	52	130
1902 11 17	19 50	37.4 N	113.5 W	—	38	—	—	—	—	VIII	52	—
1902 12 05		37.4 N	113.5 W	—	298	—	—	—	—	VI	52	—
1909 10 06	02 41	41.8 N	112.7 W	—	298	—	—	—	—	VII	38	78
1910 01 10	13 00	38.7 N	112.1 W	—	298	—	—	—	—	VI	52	—
1910 01 12	03 00	38.7 N	112.1 W	—	298	—	—	—	—	VI	52	—
1910 05 22	14 28	40.7 N	111.8 W	—	298	—	—	—	—	VII	52	9
1914 05 13	17 15	41.2 N	112.0 W	—	298	—	—	—	—	VII	38	21
1915 07 15	22 00	40.4 N	111.6 W	—	52	—	—	—	—	VI	272	13
1921 09 29	14 12	38.7 N	112.1 W	—	298	—	—	5.20Ukn PAS	—	VIII	38	3
1921 09 30	02 30	38.7 N	112.1 W	—	298	—	—	—	—	VII	38	@
1921 10 01	15 32	38.7 N	112.1 W	—	298	—	—	—	—	VIII	38	@
1933 01 20	13 05	37.8 N	112.8 W	—	298	—	—	—	—	VI	6	3
1934 03 12	15 05 40	41.7 N	112.8 W	—	7	—	—	6.60M_S GR	6.54DOS	VIII	7	405
1934 03 12	17 29	41.5 N	112.5 W	—	315	—	—	4.80M_X JON	—	Felt	259	—
1934 03 12	18 12	41.5 N	112.5 W	—	315	—	—	5.10M_X JON	—	Felt	259	—
1934 03 12	18 20 13	41.5 N	112.5 W	—	258	—	—	6.00M_S GR	5.61DOS	VII	298	165
1934 03 15	12 01	41.5 N	112.5 W	—	315	—	—	5.10M_X JON	—	VI	259	—
1934 03 15	13 46	41.5 N	112.5 W	—	315	—	—	4.80M_X JON	—	III	259	—
1934 04 07	02 16	41.5 N	111.5 W	—	7	—	—	5.50M_X JON	—	III	7	—
1934 04 14	21 26 32	41.5 N	112.5 W	—	258	—	—	5.25M_S GR	—	Felt	259	78
1934 05 06	08 09 49	41.5 N	113.0 W	—	258	—	—	5.50M_S GR	—	VI	259	78
1936 09 21	06 20	38.0 N	113.3 W	—	298	—	—	4.70M_X JON	—	Felt	315	—
1942 08 30	23 08	37.7 N	113.1 W	—	298	—	—	—	—	VI	15	@
1942 09 26	15 50	37.7 N	113.1 W	—	298	—	—	—	—	VI	15	@
1943 02 22	14 20	40.7 N	112.0 W	—	265	—	—	—	—	VI	16	26
1945 11 18	01 07 41	38.8 N	112.0 W	—	298	—	—	—	—	VI	18	—
1949 03 07	06 50	40.7 N	111.8 W	—	298	—	—	—	—	VI	259	—
1949 11 02	02 29 38	37.0 N	113.5 W	—	265	—	—	4.70Ukn PAS	—	V	22	4
1950 01 18	01 55 51	40.5 N	110.5 W	—	24	—	—	5.30Ukn PAS	—	V	23	11
1958 02 13	22 52 00	40.5 N	111.5 W	—	31	—	—	—	—	VI	31	3
1959 02 27	22 19 52	38.0 N	112.5 W	—	32	—	—	—	—	VI	32	4
1961 04 16	05 02 39.3	39.33 N	111.65 W	—	234	—	—	—	—	VI	34	5
1962 06 05	22 29 45.0	38.0 N	112.1 W	033	35	—	—	4.50M_L PAS	—	—	—	—
1962 08 30	13 35 28.7	41.917N	111.733W	010	556	—	—	5.70M_L UU	5.85DOS	VII	35	170
1962 09 05	16 04 27.8	40.72 N	112.09 W	007	298	5.1	—	5.20M_L UU	5.02DOS	VI	35	42
1963 07 07	19 20 39.6	39.53 N	111.91 W	007	298	4.9	—	4.40M_L UU	4.97DOS	VI	36	4
1966 03 17	11 47 47.4	41.66 N	111.56 W	007	298	4.4	—	4.60M_L UU	5.22DOS	V	81	16
1967 10 04	10 20 12.8	38.54 N	112.16 W	007	298	5.2	—	5.20M_L UU	5.55DOS	VII	40	74
1970 03 29	12 40 40.3	41.66 N	113.84 W	007	298	4.6	—	4.70M_L UU	—	V	43	—
1972 01 03	10 20 38.9	38.65 N	112.17 W	007	298	4.6	—	4.40M_L UU	—	VI	45	5
1972 10 01	19 42 29.5	40.51 N	111.35 W	007	298	4.7	—	4.30M_L UU	—	VI	45	6
1977 09 30	10 19 20.4	40.47 N	110.47 W	006	319	5.0	—	4.50M_L CDL	—	VI	39	20
1978 03 09	06 30 51.9	40.76 N	112.09 W	009	298	—	—	3.20M_L UU	—	VI	240	@
1981 02 20	09 13 01.2	40.32 N	111.74 W	001	341	4.7	—	3.90M_L UU	—	VI	325	4
1981 04 05	05 40 39.7	37.59 N	113.30 W	001	341	4.2	—	4.60M_L UU	—	V	325	23
1982 05 24	12 13 26.6	38.71 N	112.04 W	005	350	4.7	—	4.00M_L UU	—	VI	350	2

UTAH—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1983	10	08	11 57 53.8	40.748N	111.993W	006	360	4.5	—	4.30M_L UU	—	VI	360	7
1986	03	24	22 40 23.4	39.236N	112.009W	001	562	4.7	—	4.40M_L UU	—	V	562	3
1986	03	25	02 53 01.2	39.223N	112.011W	001	562	4.5	—	3.90M_L UU	—	V	562	3
1987	09	25	04 27 58.1	41.210N	113.152W	010	74	4.7	4.6	4.70M_L UU	—	V	577	42
1987	10	26	04 16 00.9	41.203N	113.172W	009	74	4.3	—	4.80M_L UU	—	IV	577	37
1988	08	14	20 03 03.9	39.128N	110.869W	010	74	5.5	—	5.30M_L UU	—	VI	578	110
1988	08	18	12 44 53.4	39.132N	110.867W	012	74	4.5	—	4.40M_L UU	—	V	578	18
1988	11	19	19 42 37.3	41.996N	111.472W	006	74	4.9	—	4.80M_L UU	—	VI	578	28
1989	01	30	04 06 22.7	38.824N	111.614W	010	74	5.0	4.8	5.40M_L UU	5.31HAV	VI	579	148
1989	07	03	22 44 28.6	41.706N	112.373W	007	74	4.5	—	4.80M_L UU	—	V	579	4
1989	07	05	22 51 56.3	41.707N	112.371W	010	74	4.2	—	4.60M_L UU	—	IV	579	4

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1876. Mar. 22. Moroni, northern Sanpete County, Utah. A local earthquake on the Thousand Lake fault cracked two buildings and sent Moroni residents running from their houses. (Ref. 52, 298.)

1887. Dec. 5. Kanab, Kane County, Utah. A local earthquake on the Sevier fault caused minor damage at Kanab, near the Arizona border. Bricks fell from chimneys, a few houses were cracked, and people who were walking were thrown to the ground. Rocks fell from nearby cliffs, causing large clouds of dust. (Ref. 38, 52.)

1891. Apr. 20. St. George, southern Washington County, Utah. One chimney was thrown from a house, plaster was shaken from the walls, and dishes were broken at St. George, near the Arizona border west of Kanab. (Ref. 52, 298.)

1894. July 18. Northern Utah. Walls were cracked and dishes were shaken from tables at Ogden, north of Salt Lake City, in Weber County. Three distinct shocks were reported. (Ref. 38, 52, 298.)

1900. Aug. 1. Near Goshen, Utah County, Utah. At Goshen, southwest of Provo, dishes and a chimney were broken and plaster fell from walls. At nearby Santaquin, an adobe house was split in two and people were thrown from their beds. The mine shaft at the Mammoth mine at Santaquin was thrown out of line and the cage could not be lowered. (Ref. 52, 298.)

1901. Nov. 14 (Nov. 13). Southern Utah. An earthquake on the Tushar fault caused much damage to brick buildings and chimneys from Parowan (Iron County) on the south to Richfield (Sevier County) on the north. Extensive rockslides occurred between Beaver and Marysvale, in Piute County. Masses of fallen rock in Bullion and Cottonwood Canyons made the roads almost impassable. Water and sand were ejected from cracks that formed in the ground about 5 km east of Richfield; creeks in the area increased their flow. Many towns sustained minor damage. Aftershocks continued for several weeks. Also felt at Salt Lake City, 220 km to the north. (Ref. 38, 52.)

1902. Nov. 17. Pine Valley, Washington County, Utah. Every chimney was destroyed in Pine Valley, north of St. George, and rockslides occurred in the nearby mountains. At Santa Clara, south of Pine Valley, almost every chimney was knocked down. Buildings were damaged considerably at St. George; chimneys and plaster fell at Pinto. The earthquake reportedly was felt as far north as Salt Lake City. (Ref. 38, 52.)

1902. Dec. 5. Pine Valley, Washington County, Utah. Many aftershocks occurred at Pine Valley, keeping chimneys in "disrepair." Students were dismissed from school because of the shocks. (Ref. 52, 298.)

1909. Oct. 6 (Oct. 5). Hansel Valley, Utah. The earthquake was felt by people on a northbound train approaching Logan in Cache County. Waves reportedly rolled over a bathhouse pier at Saltair, a few kilometers west of Salt Lake City. Windows were cracked at Salt Lake City. Felt from Lehi, Utah (about 25 km northwest of Provo), north to Malad

City, Idaho, a distance of about 200 km. West of Logan, in the Garland-Tremonton area, 30 to 60 earthquakes were reported to December 1909. A few were strong enough to throw down chimneys. (Ref. 38, 52, 298.)

1910. Jan. 10. Richfield, Sevier County, Utah. A local earthquake on the Tushar fault broke windowpanes at Richfield. School was dismissed at nearby Elsinore, where six severe shocks were observed. (Ref. 38, 52, 298.)

1910. Jan. 12 (Jan. 11). Elsinore, Sevier County, Utah. Located on the Tushar fault, this local earthquake shook down chimneys and destroyed merchandise on Elsinore store shelves. (Ref. 52, 298.)

1910. May 22. Salt Lake City, Utah. Many chimneys were demolished and several buildings were damaged in Salt Lake City, but well-constructed buildings were damaged little. Slight damage was reported at Bingham and Garfield. This local shock centered on the Wasatch fault. (Ref. 52, 298.)

1914. May 13. Ogden, Weber County, Utah. Some chimneys toppled, walls cracked, and plate-glass windows broke at Ogden. Dishes were broken at Salt Lake City. (Ref. 38, 52, 298.)

1915. July 15. Provo, Utah County, Utah. An earthquake that was centered on the Wasatch fault cracked a few ceilings at Provo and shook dishes from shelves. (Ref. 52, 272.)

1921. Sept. 29. Elsinore, Sevier County, Utah. Elsinore is a small town in Sevier Valley, 240 km south of Salt Lake City. After about 2 weeks of light foreshocks at Elsinore, three damaging local earthquakes occurred: two on Sept. 29 (local time) and one on Sept. 30. The first strong earthquake threw down scores of chimneys, or broke them at roof level, and fractured and displaced walls. A new two-story brick schoolhouse was damaged when a fire wall fell and several pilasters on the front of the building were dislodged. Gables of houses were "thrown out." The front of one store building was cracked severely (it collapsed in the strong shock on Oct. 1.). Considerable damage also occurred at the nearby towns of Joseph, Monroe, and Richfield. The shocks continued from Sept. 12 to Dec. 20, 1921. (Ref. 38, 52, 298, 311.)

1921. Sept. 30 (Sept. 29). Elsinore, Sevier County, Utah. The second damaging earthquake of this series of shocks toppled many chimneys and increased the damage caused by the previous earthquake (see paragraph above). At Monroe, about 8 km south of Elsinore, this earthquake was more destructive than the first shock on Sept. 29 at 14 12 UTC. Felt slightly at Joseph and Richfield. (Ref. 38, 298, 311.)

1921. Oct. 1. Elsinore, Sevier County, Utah. The third destructive shock of this series of earthquakes at Elsinore downed chimneys that remained upright and caused additional structural damage. Heavy damage was sustained by buildings made of stone or "sun-dried brick" [adobe(?)]. Ten houses were wrecked and made uninhabitable. The store building that was cracked severely in the first shock on Sept. 29 collapsed during this earthquake. Large rockfalls occurred on both sides of Sevier Valley. Warm springs were discolored for hours. Additional damage was reported at Monroe, but the shock was only lightly felt at Joseph and Richfield. (Ref. 38, 52, 298, 311.)

1933. Jan. 20. Parowan, Iron County, Utah. A local earthquake on the Hurricane fault cracked plaster at Parowan and caused slight damage to brick, masonry, and concrete. Plaster also was cracked a few kilometers north, at Minersville. (Ref. 6, 52, 298.)

1934. Mar. 12, 15 05 UTC. Near Kosmo, Box Elder County, Utah. This earthquake occurred in Hansel Valley, a sparsely populated area. Two people were killed. Property damage was limited mainly to downed chimneys and cracked walls in poorly constructed brick buildings. Chimneys were downed in several towns in the County, including Hooper, Kelton, Kosmo, Locomotive Springs, Monument, and Snowville. Large rockslides occurred at Aragonite, Lakeside, Monument Rock, and Snowville. An outstanding feature of this earthquake was the large quantity of water emitted from the craterlets and fissures that developed in the area.

Most of the ground cracks that formed in the epicentral area occurred in poorly consolidated rocks on the salt flats. These cracks were traced for a distance of more than 8 km. Four distinct fractures, about 1 km apart, developed across a road about 5 km north of Kosmo. The vertical displacement along the fractures ranged from about 7.5 to 25.5 cm. Precise leveling surveys later revealed that areas of land sank as much as 39 cm. Horizontal displacement was not observed.

Many springs formed in the epicentral area. Most of them developed along well-defined fractures in the salt flats where water flowed along the fissure. Notable exceptions, however, were the springs that formed in Monument Rock where water flowed at individual centers and formed mud cones. In places, large holes developed around the springs by the caving of the soft material through which the water flowed. Two such holes on the salt flats northeast of Monument Rock ranged in diameter from 2.5 to 3 m, and one was 11 m deep. Also felt in Idaho, Montana, Nevada, and Wyoming (see fig. 58). (Ref. 7, 52, 258, 533.)

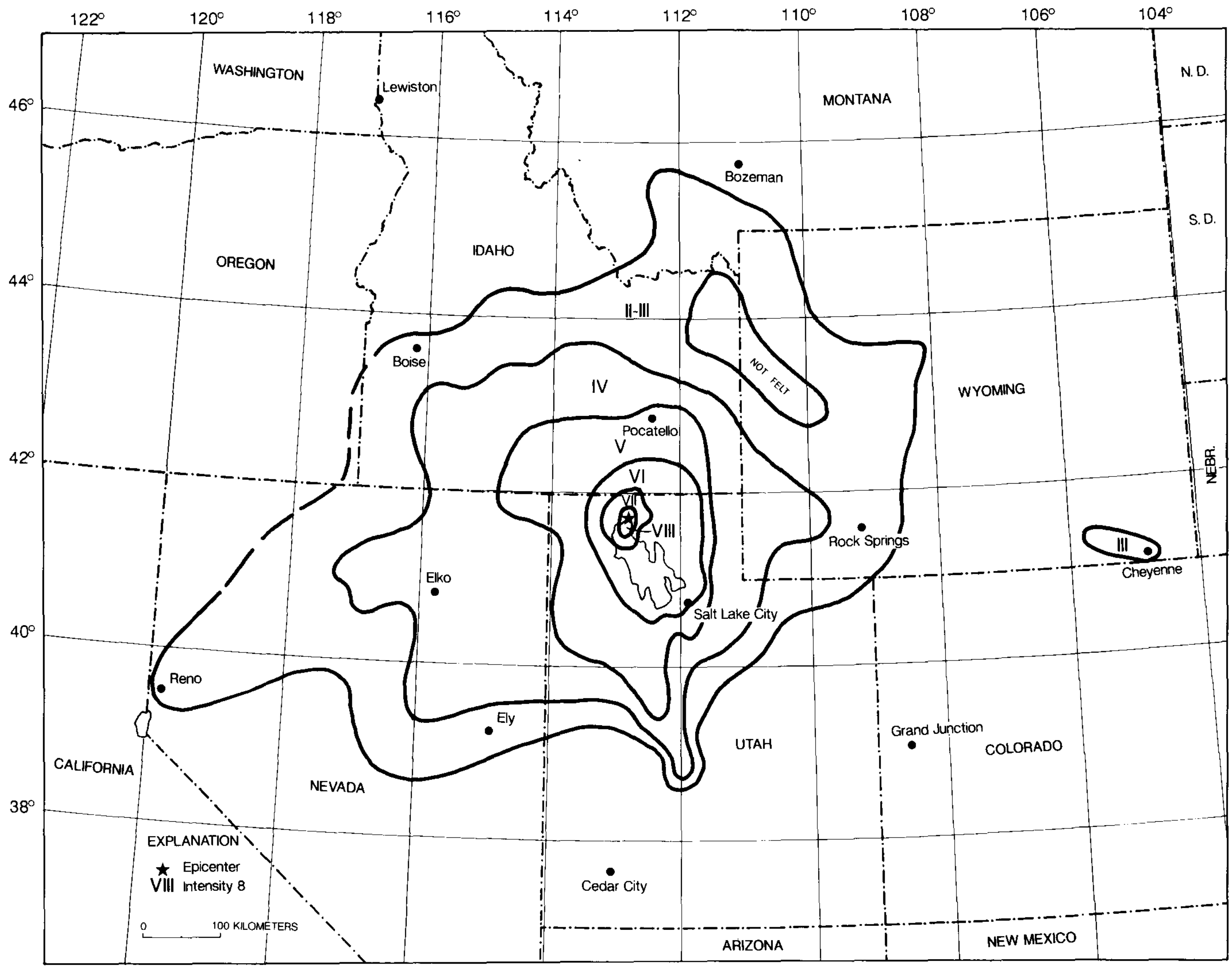


FIGURE 58.—Isoseismal map for the Kosmo (Hansel Valley), Utah, earthquake of March 12, 1934. Isoseismals are based on intensity estimates from data listed in references 7 and 259 of table 1.

1934. Mar. 12, 18 20 UTC. Near Kosmo, Box Elder County, Utah. See description in the paragraph above for the effects of this earthquake because damage for the two shocks could not be separated. This shock was reported to be slightly less severe than the first, but it was felt over a similar area of Idaho, Nevada, Utah, and Wyoming. (Ref. 258, 298.)

1934. Mar. 15, 12 01 UTC. Near Kosmo, Box Elder County, Utah. This earthquake damaged chimneys and overturned small objects in Locomotive Springs. It also was felt in Idaho. (Ref. 259, 298, 315.)

1934. May 6. Near Kosmo, Box Elder County, Utah. This strong earthquake apparently is an aftershock of the Mar. 12 event. A few windows were broken at Salt Lake City, and plaster was cracked at Preston, Idaho. (Ref. 52, 258, 259.)

1942. Aug. 30. Cedar City, Iron County, Utah. A local earthquake on the Hurricane fault shook bricks from a chimney in the northeast part of Cedar City. It knocked plaster from the walls of one house and cracked plaster at another. (Ref. 15, 259, 298.)

1942. Sept. 26. Cedar City, Iron County, Utah. A local earthquake on the Hurricane fault caused minor damage at Cedar City, including cracked walls, cracked plaster, and one broken plate-glass window. (Ref. 15, 298.)

1943. Feb. 22. Near Salt Lake City, Utah. This earthquake, believed to be centered on the Wasatch fault, shook plaster from the wall and ceiling at the

Bingham High School and knocked down a chimney at Camp Kearns Air Force Training Center. The shock also cracked chimneys and broke windows and dishes at Magna and cracked plaster and windows at Salt Lake City. (Ref. 16, 259, 265.)

1945. Nov. 18 (Nov. 17). South-central Utah. Slight damage occurred in Sevier County, at Glenwood and nearby Richfield. Chimneys and plaster were cracked and many residents were frightened. This local shock occurred on the Sevier fault. (Ref. 18, 298.)

1949. Mar. 7 (Mar. 6). Salt Lake City, Utah. A sharp local earthquake broke a pipeline, cracked walls in some houses, and broke windows at Salt Lake City. This shock, located on the Wasatch fault, also displaced furniture and tumbled dishes from shelves. (Ref. 22, 259, 298.)

1958. Feb. 13. North-central Utah. Plaster fell from ceilings and walls cracked in several buildings in Utah County, at Provo. Plaster also fell from a wall in the student service center at Brigham Young University. Felt mainly in the region east of Utah Lake. (Ref. 31, 259.)

1959. Feb. 27. Panguitch, western Garfield County, Utah. A minor earthquake knocked plaster from ceilings, cracked walls, and broke dishes and windows at Panguitch. Felt in several towns in southwest Utah. (Ref. 32, 259.)

1961. Apr. 16 (Apr. 15). Near Ephraim, Sanpete County, Utah. This earthquake caused minor damage at Ephraim and nearby towns to the north. Two chimneys fell, plaster was cracked, and bottles were knocked from shelves at Ephraim; chimneys were cracked at Chester; and plaster was cracked at Mount Pleasant and Spring City. (Ref. 34, 234.)

1962. Aug. 30. Cache Valley, Utah. The earthquake severely damaged many old, unreinforced brick buildings and other old structures on the east side of Cache Valley, Utah (from Logan to Lewiston). In Richmond (24 km north of Logan), where the most severe property damage occurred, 75 percent of the older brick chimneys collapsed and tombstones were overturned. One large church was damaged beyond repair. The walls of many houses were damaged badly, and building officials declared several houses were unsafe for occupancy. Heavy damage also occurred at Franklin, Lewiston, Logan, and Preston. Total property damage was estimated at $1 million.

Mudslides were noted west of Lewiston, along the Bear River, and at Cornish. At Fairview, Idaho, two large areas of land broke loose and slid down a hill. Felt in parts of Colorado, Idaho, Nevada, Utah, and Wyoming (see fig. 59). (Ref. 35, 298, 556.)

1962. Sept. 5. Near Salt Lake City, Utah. Property damage occurred mainly in the area from Provo to Salt Lake City. It consisted of damaged chimneys, broken windows, minor cracks in walls and plaster, and loss from fallen stock in stores. In Salt Lake City, an outside wall of an older house fell through the ceiling; sections of interior walls and ceiling plaster fell at two other houses. Some large buildings sustained cracks in interior walls. Most of the damage to schools was superficial, consisting mainly of plaster cracks and loosened acoustical tile. Other towns reporting slight damage from this earthquake were Draper, Lark, Magna, Morgan, and Provo. (Ref. 35, 298.)

1963. July 7. Central Utah. A minor earthquake, felt over a small area of Juab County, caused slight damage at Levan and Nephi. Plaster fell and chimneys were cracked at Levan; plaster, walls, and chimneys were cracked at Nephi. (Ref. 36, 298.)

1967. Oct. 4. Central Utah. This earthquake caused minor damage in the Marysvale-Koosharem area. At Marysvale, in northern Piute County, brick and stone houses sustained many cracks in ceilings and walls; a cupboard in one house pulled away from the wall. Well water was muddied about 1.6 km north of Marysvale. Chimneys partly collapsed at Joseph, 20 km north of Marysvale, and root cellars caved in at Circleville, 30 km south of Marysvale. Rockslides were reported at Junction City, in the canyon near Joseph, and 8 km south of Sevier. Also felt in northern Arizona. Magnitude 5.1 m_b NUT, 4.7 M_S NUT. (Ref. 40, 263, 298.)

1972. Jan. 3. Elsinore, Sevier County, Utah. An earthquake toppled chimneys and cracked walls at Elsinore and damaged the contents of houses considerably. Plaster was cracked at Central and Sevier. (Ref. 45, 72, 298.)

1972. Oct. 1. Midway, Wasatch County, Utah. This earthquake shook bricks from chimneys at Midway and cracked plaster at two schools. Slight damage (mainly cracks in plaster) also occurred at Salt Lake City, about 40 km northwest and, at Wallsburg about 15 km south. (Ref. 45, 72, 298.)

1977. Sept. 30. Northeast Utah. Damage was most severe at Mountain Home, east of Provo, in Duchesne County, where a septic system drain was broken and old mortar on a log house was cracked. There was an unconfirmed report of cracks in a stone fence and in interior plaster at Fruita and Grand Junction, Colo., more than 200 km southeast of the epicenter.

A few indications of minor earth movement were found in the epicentral area two days after the shock: one possible rockfall in Rock Creek Canyon and

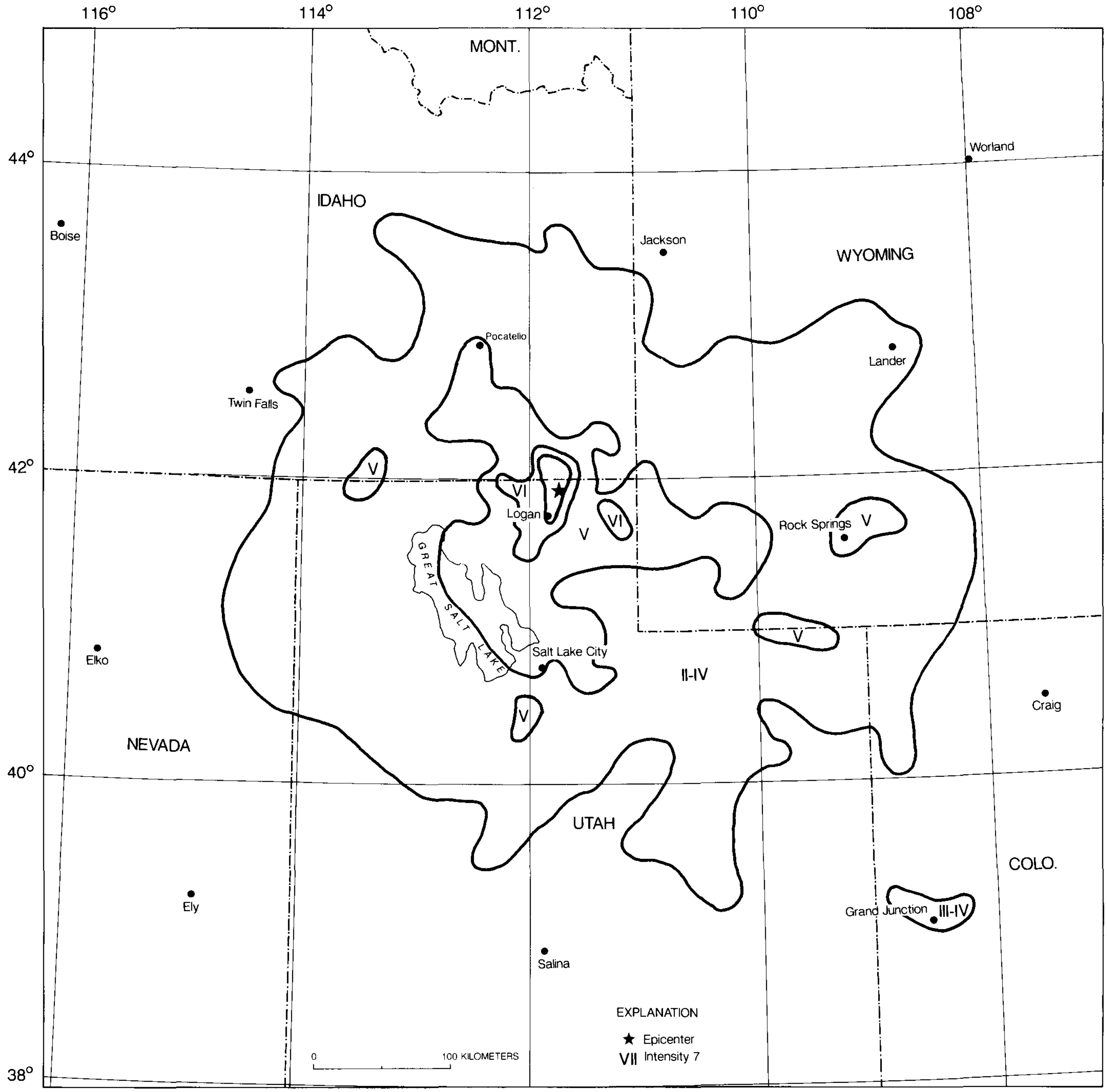


FIGURE 59.—Isoseismal map for the Cache Valley, Utah, earthquake of August 30, 1962. Isoseismals are based on intensity estimates from data listed in references 35 and 259 of table 1.

slumping of a rock slab in Farnsworth Canal, near Moon Lake. This earthquake occurred along a lineament that strikes N. 70° E. along the south flank of the Uinta Mountains and extends into the basin to the south. A lighter shock on Oct. 11 occurred along the same fault zone. Also felt in Idaho and Wyoming. Magnitude 5.1 M_L GS. (Ref. 39, 319.)

1978. Mar. 9 (Mar. 8). Magna, Salt Lake County, Utah. This minor earthquake broke windows and cracked exterior walls, plaster, and drywall at Magna, west of Salt Lake City. (Ref. 240, 298.)

1981. Feb. 20. Orem, Utah County, Utah. A house foundation cracked at Orem, north of Provo, and hairline cracks formed in plaster and drywall. At

Provo, about 100 km south of Salt Lake City, a hairline crack in a cinder-block wall was enlarged. (Ref. 325, 341.)

1982. May 24. Southwest Utah. This earthquake was observed mainly in Sevier Valley, between Aurora and Joseph. The heaviest damage occurred at Annabella, about 25 km south of Aurora, where bricks fell from chimneys, stone or brick fences fell or were cracked, exterior walls of houses were cracked, and a garage roof was shifted 2.5 cm. Slight damage also occurred in the nearby towns of Elsinore, Glenwood, Koosharem, and Monroe. (Ref. 350.)

1983. Oct. 8. Northern Utah. At West Valley City (in the western suburbs of Salt Lake City), one chimney toppled, cracks formed in chimneys and plaster walls, and glassware was broken. Bricks fell from a chimney south of Salt Lake City, at Granger, and hairline cracks formed in walls of buildings at Layton and Sandy. (Ref. 360.)

1988. Aug. 14. Near Clawson, Emery County, Utah. This earthquake was felt over a wide area but caused only minor damage to property. Bricks fell from chimneys at Clawson, Elmo, Orangeville, and Sunnyside, and chimneys were cracked at Ferron and Wellington. Other reported damage included broken windows, and cracks in plaster, drywall, exterior brick walls, and foundations.

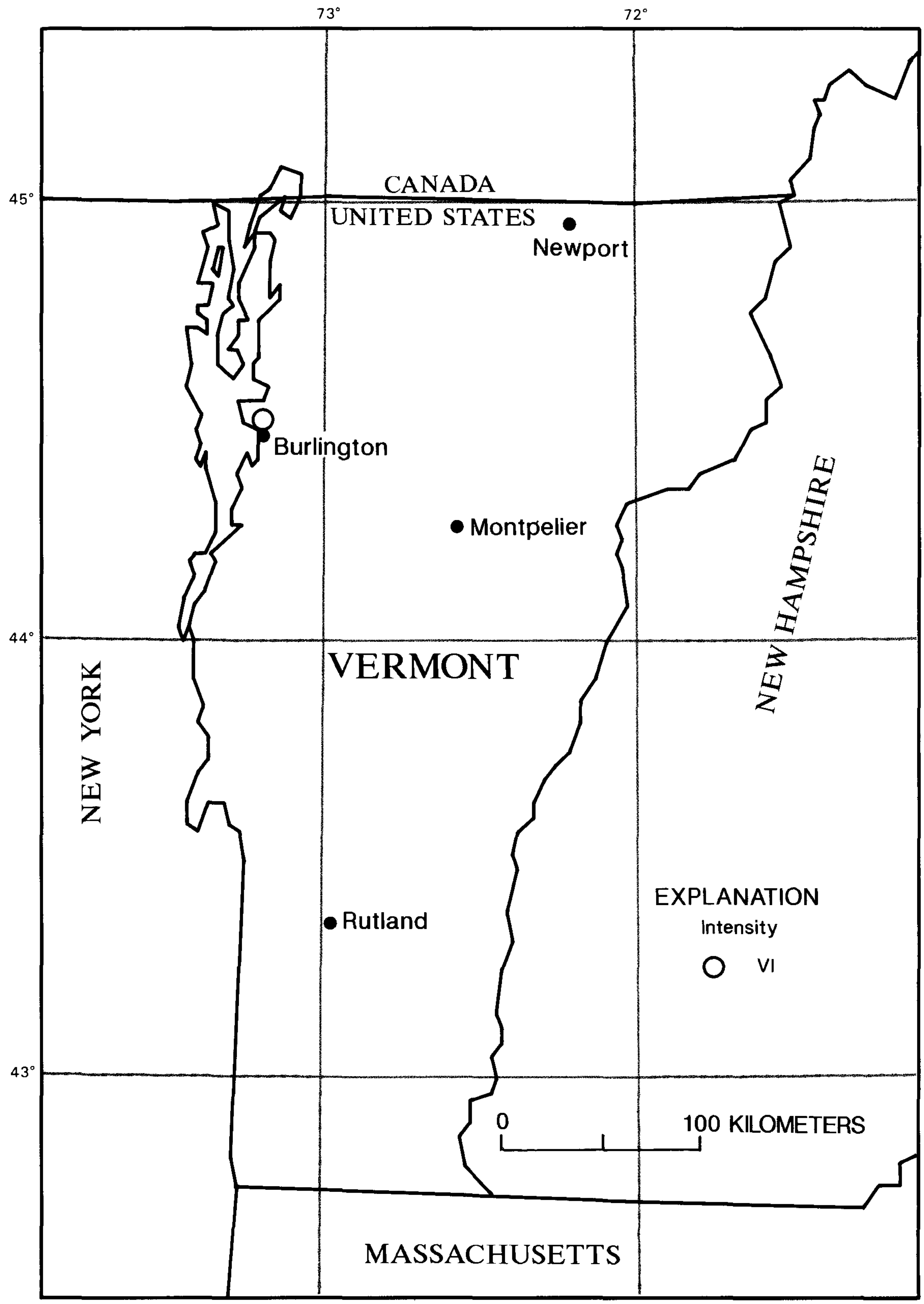
This earthquake caused hundreds of rockfalls within 40 km of its epicenter. Ground cracks due to liquefaction of saturated alluvium were reported 4 km from the epicenter, and similar ground cracks and a sand boil were observed in saturated alluvium 1.9 km from the epicenter. Flow of water into a spring in Tie Fork Canyon, 48 km from the epicenter, increased after the earthquake.

Two foreshocks occurred on Aug. 14 at 18 58 and 19 07 UTC, and the largest aftershock caused one rockfall on Aug. 18. More than 100 aftershocks were located through Sept. 30. Felt to Brigham City, 280 km to the northwest of the epicenter; Delta, 156 km to the west; Albuquerque, N. Mex., 567 km to the south; Bluff, 233 km to the southeast; and Golden, Colo., 475 km to the east. (Ref. 74, 578, 590.)

1988. Nov. 19. Northeast of Logan, Cache County, Utah. Slight damage reported at Garden City included hairline cracks in plaster and cracks in a fireplace and in the foundation of a reinforced concrete building. Some windows also were broken in the area. An observer at Logan reported broken pipelines and "some structural damage." Felt over a small area of northern Utah and southeast Idaho. (Ref. 74, 578.)

1989. Jan. 30 (Jan. 29). Near Salina, Sevier County, Utah. Slight damage in the form of cracks in chimneys, walls, windows, and foundations occurred at Ferron (Emery County), Koosharem (Sevier County), and Wales (Sanpete County). In addition, underground pipes were broken at Salina, and large amounts of plaster fell from a ceiling at Wales. Felt in northern Arizona, western Colorado, eastern Utah, and southwest Wyoming. Several small aftershocks were reported. (Ref. 74, 579.)

VERMONT



Damaging earthquake in Vermont, intensity ≥ VI.

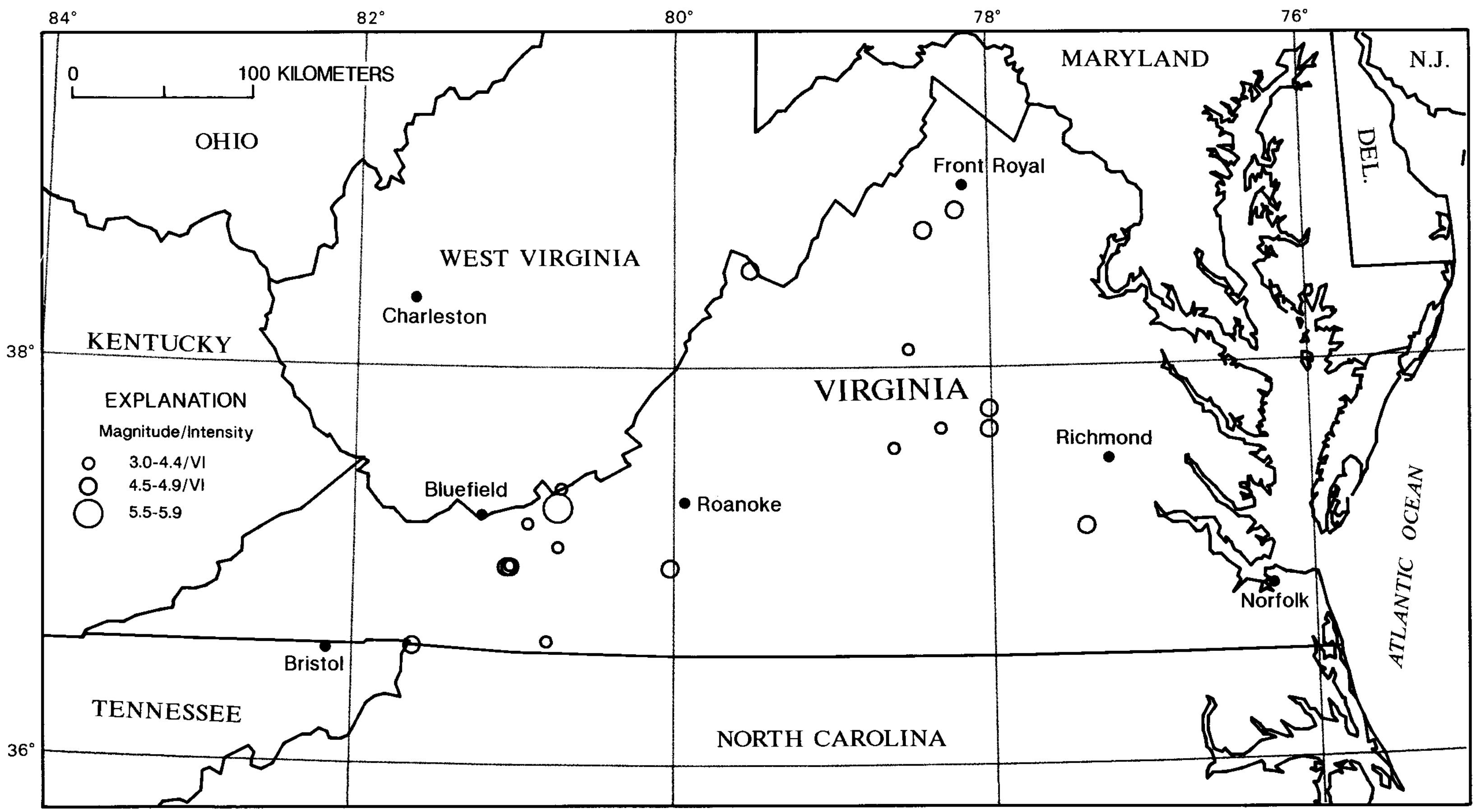
VERMONT

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)		Hypocenter				Magnitude				Intensity		Felt area
					Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m	s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1952	01	30	04 00		44.5 N	73.2 W	—	77	—	—	—	—	VI	25	@

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1.]

1952. Jan. 30 (Jan. 29). Burlington, Chittenden County, Vt. Ground cracks about 3 km long and 3.5 m apart were observed in the north end of Burlington. Minor damage resulting from this local shock included cracks in pavement, basement walls, and a gas main. (Ref. 25, 38, 77.)



Earthquakes in Virginia with magnitudes ≥ 4.5 or intensity ≥ VI.

VIRGINIA

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km²)
1774	02	21	19 11	37.2 N	77.4 W	—	314	—	—	4.50M_{fa} SC	—	VI	55	127
1828	03	10	03	37.0 N	80.0 W	—	55	—	—	4.60M_{fa} SC	—	V	55	490
1833	08	27	11	37.7 N	78.0 W	—	179	—	—	4.50M_{fa} NUT	—	V	167	135
1852	04	29	18	36.6 N	81.6 W	—	86	—	—	4.80M_{fa} SC	—	VI	55	359
1852	11	02	23 35	37.6 N	78.6 W	—	55	—	—	4.30M_{fa} SC	—	VI	167	66
1853	05	02	14 20	38.5 N	79.5 W	—	167	—	—	4.60M_{fa} NUT	—	V	38	159
1875	12	23	04 45	37.8 N	78.0 W	—	365	—	—	4.80M_{fa} SC	—	VII	365	120
1897	05	03	17 18	37.1 N	80.7 W	—	55	—	—	4.30M_{fa} SC	—	VI	167	64
1897	05	31	18 58	37.3 N	80.7 W	—	55	—	—	5.60M_{fa} SC	—	VIII	190	690
1898	02	05	20	37.0 N	81.0 W	—	86	—	—	4.40M_{fa} SC	—	VI	38	88
1898	11	25	20	37.0 N	81.0 W	—	86	—	—	4.50M_{fa} NUT	—	V	38	132
1899	02	13	09 30	37.0 N	81.0 W	—	55	—	—	4.50M_{fa} SC	—	V	55	265
1907	02	11	13 22	37.7 N	78.3 W	—	55	—	—	4.00M_{fa} SC	—	VI	55	14
1918	04	10	01 08 48	38.7 N	78.4 W	—	55	—	—	4.60M_{fa} SC	—	VI	55	184
1919	09	06	01 45 45	38.8 N	78.2 W	—	55	—	—	—	—	VI	55	—
1929	12	26	02 56	38.1 N	78.5 W	—	189	—	—	3.70M_{fa} SC	—	VI	38	3
1959	04	23	20 58 39.5	37.395N	80.682W	001	349	—	—	3.90M_{fa} SC	—	VI	105	8
1975	11	11	08 10 37.6	37.217N	80.892W	001	349	—	—	3.20M_n SLM	—	VI	48	1
1976	09	13	18 54 38.0	36.624N	80.768W	009	349	—	—	3.30M_n BLA	—	VI	49	17

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1774. Feb. 21. Near Petersburg, Prince George County, Va. A sharp earthquake that was felt over much of Virginia displaced houses "considerably off their foundations" at Blandford and Petersburg. Although the shock was severe at Richmond and terrified residents about 80 km north of Richmond at Fredericksburg, it caused no damage at those towns. Several "smart shocks" were reported in parts of Virginia from Feb. 20th to the 22nd. The main tremor rang bells at Salem (now Winston-Salem), N.C. Magnitude 4.5 M_{fa} NUT. (Ref. 55, 167, 314.)

1833. Aug. 27. Central Virginia. A rather strong shock agitated walls of buildings at Lynchburg (west of Richmond, in southern Amherst County) and rattled windows violently. Fences along the road were shaken near the Louisa County Courthouse, northwest of Richmond. It was described as "severe" at Charlottesville, about 85 km northeast of Lynchburg. Two miners were killed in a panic caused by the tremor at a mine near Richmond. Ref. 179 suggests a MM intensity VI at the epicenter, although no damage was documented. Also felt in the District of Columbia, Maryland, and North Carolina. Magnitude 4.5 M_{fa} NUT. (Ref. 38, 167, 179.)

1852. Apr. 29. Near Wytheville, Wythe County, Va. A severe earthquake that was observed over a large area threw down a chimney near Wytheville, in southwest Virginia, and shook down tops of chimneys at Buckingham Courthouse, about 55 km south of Charlottesville. Houses were shaken violently at Staunton, about 65 km west of Charlottesville. A brick was shaken from a chimney as far south as Davie County, N.C. Also felt in the District of Columbia, Maryland, New York, Ohio, and Pennsylvania. Magnitude 4.9 M_{fa} NUT. (Ref. 38, 55, 86, 167, 508.)

1852. Nov. 2. Central Virginia. Chimney damage occurred at Buckingham, about 55 km south of Charlottesville. This earthquake was reported to be "quite strong" at Fredericksburg, Richmond, and Scottsville. At Scottsville, where every house in the village was shaken, water in the canal was "troubled," and boats were tossed to and fro. Magnitude 4.3 M_{fa} NUT. (Ref. 55, 167.)

1875. Dec. 23 (Dec. 22). Central Virginia. The highest intensities from this earthquake occurred mainly at towns near the James River waterfront in Goochland and Powhatan Counties, and in Louisa County. In Richmond (Henrico County), the most severe damage was sustained in the downtown business and residential areas adjacent to the James River or on islands in the river. Damage included bricks knocked from chimneys, fallen plaster, an overturned stove, and several broken windows. Waves "suddenly rose several feet" at the James River dock at Richmond, causing boats to "part their cables" and drift below the wharf. At Manakin, about 20 km west of Richmond, shingles were shaken from a roof and many lamps and chimneys were broken. Several small aftershocks were reported through Jan. 2, 1876. Felt from Baltimore, Md., to Greensboro, N.C., and from the Atlantic Coast westward to Greenbrier and White Sulphur Springs, W.Va. Magnitude 4.5 M_{fa} NUT. (Ref. 55, 167, 365.)

1897. May 3. Southwest Virginia. This earthquake was most severe at Radford (about 65 km west of Roanoke), where a few chimneys were wrecked and plaster fell from walls. Chimneys were damaged at nearby Pulaski and at Roanoke. Felt in most of southwest Virginia and as far south as Winston-Salem, N.C. Magnitude 4.3 M_{fa} NUT. (Ref. 38, 55, 167, 272, 508.)

1897. May 31. Giles County, Va. This earthquake was the largest in intensity and areal extent in Virginia in historical times. MM intensity VII to VIII extended over an elliptical area—from near Lynchburg, Va., west to Bluefield, W.Va., and from Giles County south to Bristol, Tenn. (see fig. 60). The MM intensity VIII assigned to this earthquake is based on "many downed chimneys" and "changes in the flow of springs."

The shock was felt severely at Narrows, about 3 km west of Pearisburg. Here, the surface rolled in an undulating motion, water in springs became muddy, and water in some springs ceased to flow. The flow of water in springs also was disturbed in the area of Pearisburg, about 70 km west of Roanoke, and Sugar Run.

The shock was strong at Pearisburg, where walls of old brick houses were cracked and many chimneys were thrown down or badly damaged. Many chimneys also were shaken down at Bedford, Pulaski, Radford, and Roanoke, Va., and Bristol, Tenn.; many chimneys were damaged at Christiansburg, Dublin, Floyd, Houston, Lexington, Lynchburg, Rocky Mount, Salem, Tazewell, and Wytheville, Va.; Charlotte, Oxford, Raleigh, and Winston, N.C.; Knoxville, Tenn.; and Bluefield, W.Va. Felt from Georgia to Pennsylvania and from the Atlantic Coast westward to Indiana and Kentucky. Aftershocks continued through June 6, 1897. Magnitude 5.8 M_{fa} NUT. (Ref. 55, 167, 190, 525.)

1898. Feb. 5. Pulaski, Va. Bricks were thrown from chimneys, furniture was shifted in a few houses, and residents rushed into the streets at Pulaski, about 70 km southwest of Roanoke. Felt throughout southwest Virginia and south to Raleigh, N.C. (Ref. 38, 86, 167, 508.)

1907. Feb. 11. Near Arvonia, Buckingham County, Va. Chimneys were cracked at Ashby, about 20 km southeast of Arvonia, and a window was broken at a store at Buckingham, 25 km southwest of Arvonia. A "terrific" shock sent people rushing outdoors at Arvonia and displaced furniture. Felt strongly from Powhatan to Albemarle County. (Ref. 55, 167, 189.)

1918. Apr. 10 (Apr. 9). Luray, Page County, Va. In the Shenandoah Valley, at Luray, windows were broken and plaster was cracked severely. Ceilings of houses were cracked badly a few kilometers north of Luray, at Edinburg; windows were broken at Harrisonburg and Staunton, Va., and Washington, D.C. (at Georgetown University). In addition, a new spring formed in Page County, near Hamburg, almost in the middle of a road. A minor aftershock was reported in the area about 5 hours later. Also felt in Maryland, Pennsylvania, and West Virginia. (Ref. 38, 55, 186, 189, 272.)

1919. Sept. 6 (Sept. 5). Near Front Royal, Warren County, Va. This earthquake affected towns mainly in Warren and Rappahannock Counties. At Arco, in the Blue Ridge Mountains south of Front Royal, chimneys were damaged, plaster fell from walls, and springs and streams were muddied. Reports from the adjacent northern part of Rappahannock County state that similar shocks were felt and that streams were "rendered turbid." Also felt in parts of Maryland and West Virginia. Several aftershocks occurred. (Ref. 55, 187, 272.)

1929. Dec. 26 (Dec. 25). Charlottesville, Albemarle County, Va. A moderate tremor at Charlottesville shook bricks from chimneys in some places. Also felt in other parts of Albemarle County. (Ref. 38, 189.)

1959. Apr. 23. Giles County, Va. The earthquake was strongest in Giles County, at Eggleston and Pembroke. Residents there reported several damaged chimneys and articles shaken from shelves and walls. One chimney toppled at the Norfolk and Western Station in Eggleston. Also felt in West Virginia. Magnitude 3.8 M_{fa} DG. (Ref. 105, 349, 508.)

1975. Nov. 11. Southwest Virginia. Windows were broken in the Blacksburg area of Montgomery

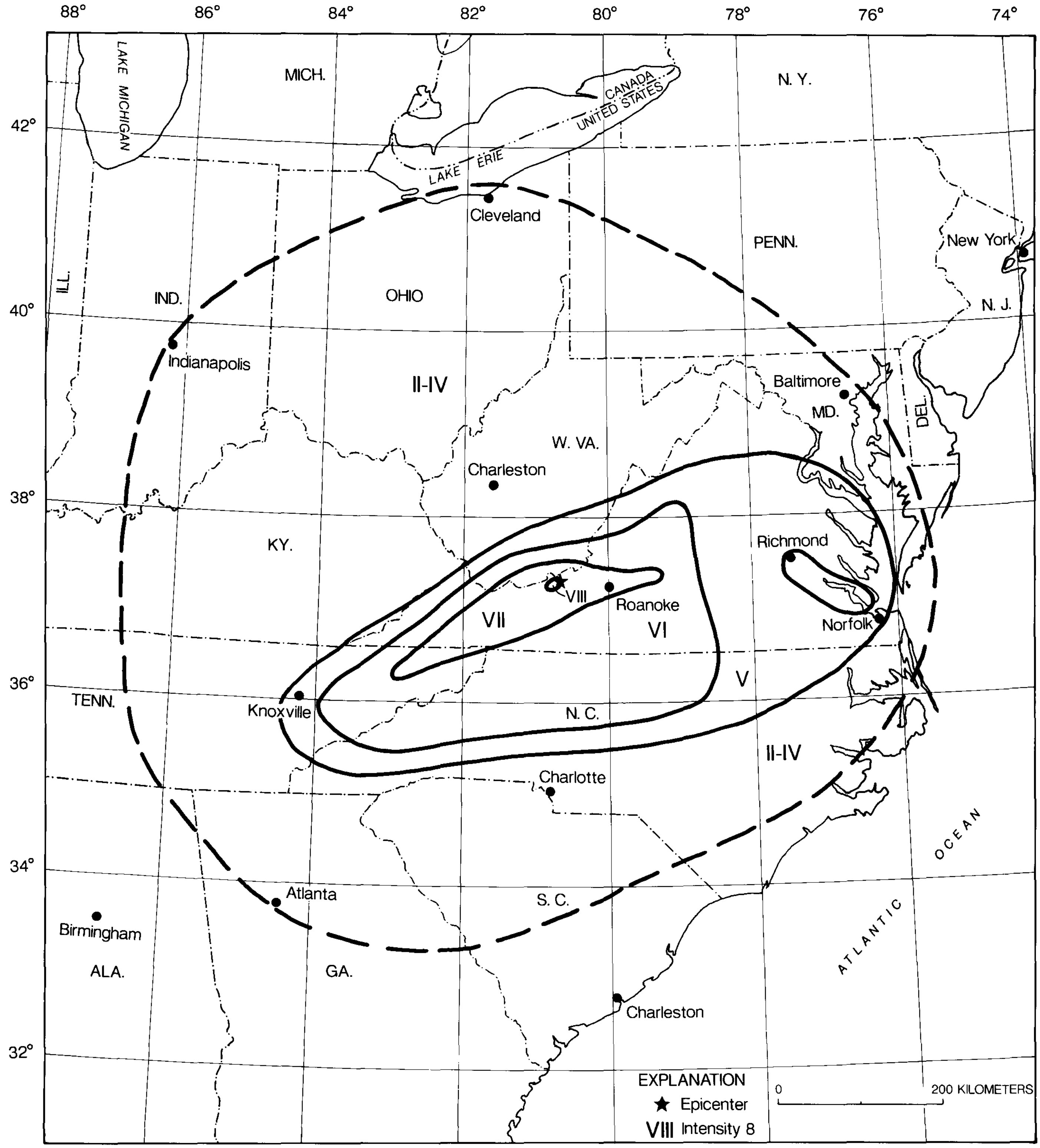
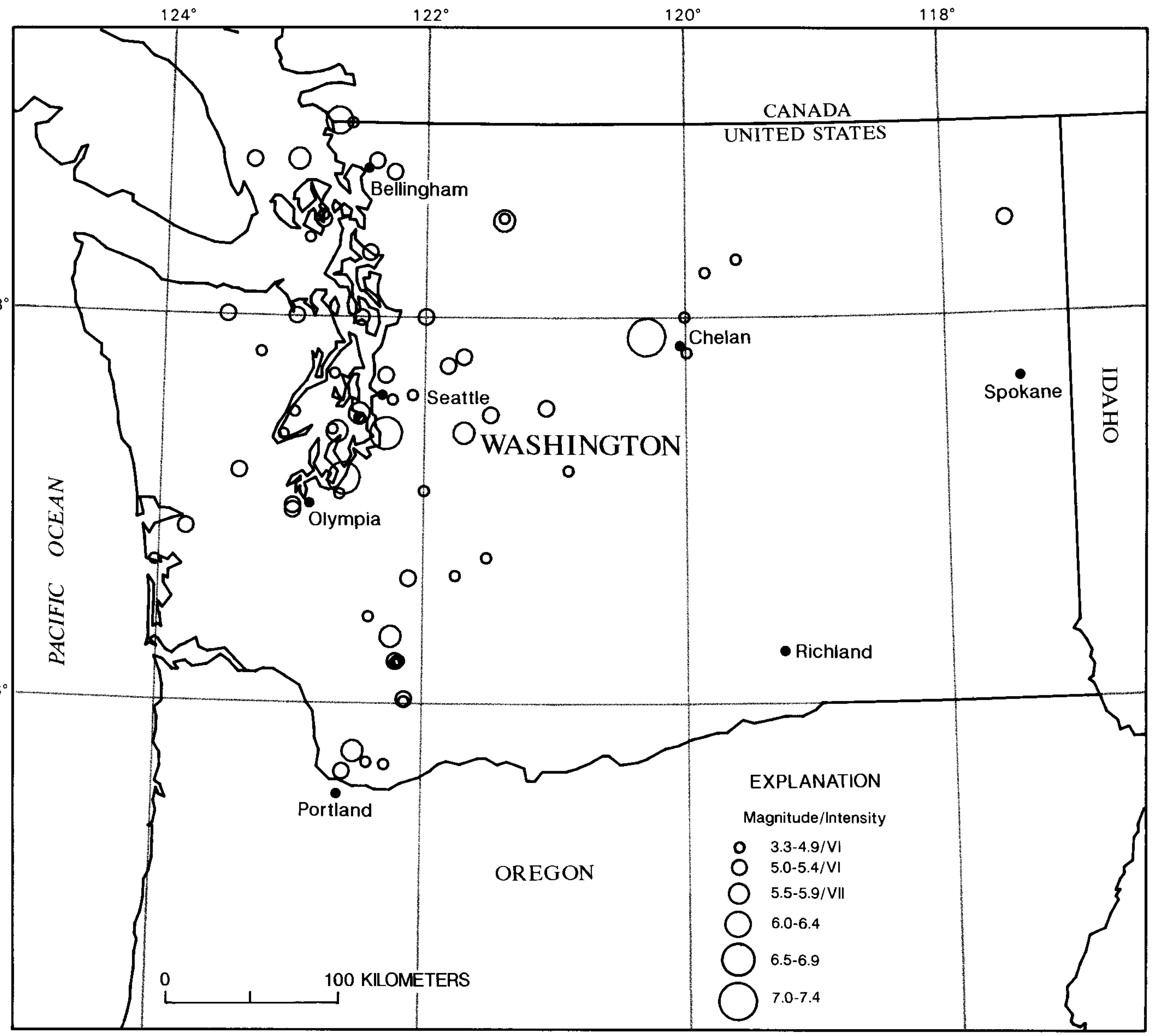


FIGURE 60.—Isoseismal map for the Giles County, Virginia, earthquake of May 31, 1897. This map is a simplified version of figure 15 in reference 525 of table 1.

County, and plaster was cracked at Poplar Hill (south of Pearisburg, in Giles County). Also felt in Pulaski County. (Ref. 48, 349.)

1976. Sept. 13. Southwest Virginia. Bricks fell from chimneys and pictures fell from walls in Surry County at Mount Airy, N.C. At the nearby town of Toast, N.C., cracks formed in masonry and plaster. The earthquake was observed in many towns in North Carolina and Virginia and in a few towns in South Carolina and West Virginia. (Ref. 49, 349.)

WASHINGTON



Earthquakes in Washington with magnitudes ≥ 4.5 or intensity ≥ VI.

WASHINGTON

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1872	12	15	05 40	47.9 N	120.3 W	—	373	—	—	7.00M_{La} SC	—	IX	373	650
1877	10	12	21 53	45.75 N	122.5 W	—	484	—	—	—	—	VII	38	40
1880	08	22	21 25	48.0 N	123.0 W	—	38	—	—	—	—	VI	375	—
1880	12	13	04 40	47.5 N	122.5 W	—	38	—	—	—	—	V	136	—
1882	05	01	06 50	47.0 N	123.0 W	—	463	—	—	—	—	VI	463	—
1891	03	08	03 40	47.5 N	121.5 W	—	616	—	—	5.00M_{La} JLQ	—	V	616	36
1891	11	29	23 21	48.0 N	123.5 W	—	56	—	—	—	—	VI	56	10
1892	04	17	22 50	47.0 N	123.0 W	—	38	—	—	—	—	VI	56	—
1896	01	04	06 15	48.5 N	122.8 W	—	56	—	—	—	—	V	56	—
1904	03	17	04 20	48.5 N	122.8 W	—	38	—	—	5.30M_{La} NQT	—	V	56	52
1906	01	03	13 42	48.5 N	117.5 W	—	375	—	—	—	—	VI	375	18
1909	01	11	23 44	49.0 N	122.7 W	—	38	—	—	6.00M_{La} NQT	—	VII	38	65&
1915	08	18	14 04	48.5 N	121.4 W	—	38	—	—	5.60M_{La} NQT	—	V	56	78
1920	01	24	07 09 16	48.8 N	123.0 W	—	374	—	—	5.50M_{La} NQT	—	VI	56	70
1923	02	12	18 19	48.8 N	122.4 W	—	56	—	—	—	—	VI	56	—
1928	02	02	12 52	47.8 N	121.7 W	—	1	—	—	—	—	VI	38	—
1931	04	18	04 00	48.75 N	122.25 W	—	4	—	—	—	—	VI	38	8+
1931	12	31	15 25	47.5 N	123.0 W	—	4	—	—	4.80M_{La} SC	—	VI	4	25
1932	07	18	06 01 55	47.75 N	121.83 W	—	496	—	—	5.20M_{La} NQT	—	VI	496	31
1932	08	06	22 16	47.7 N	122.3 W	—	38	—	—	—	—	VI	5	13
1939	11	13	07 45 54	47.5 N	122.5 W	—	258	—	—	5.75M_S GR	—	VII	12	159#
1940	10	27	22 29 18.0	47.2 N	123.4 W	—	14	—	—	5.10M_{La} ROG	—	V	13	31+
1941	04	07	09 25	48.3 N	119.6 W	—	38	—	—	4.50M_{La} ROG	—	VI	14	14
1943	11	29	00 43	48.4 N	122.9 W	—	38	—	—	4.80M_{La} ROG	—	VI	16	27+
1944	12	07	04 48	46.9 N	123.8 W	—	259	—	—	—	—	VI	259	@
1945	04	29	20 16 17.0	47.4 N	121.7 W	—	20	—	—	5.50M_S GR	—	VII	18	130
1946	02	15	03 17 48.3	47.400N	122.666W	018	260	—	—	5.75M_S GR	—	VII	19	168&
1946	06	23	17 13 19	49.76 N	125.34 W	030	617	—	—	7.30M_S GR	—	VIII	19	142#
1949	04	13	19 55 42.0	47.167N	122.617W	070	376	—	—	6.90m_b ABE	6.73BL	VIII	22	295#
1950	04	14	11 03 48.0	48.0 N	122.5 W	—	23	—	—	—	—	VI	23	67#
1954	05	15	13 02 14.0	48.0 N	122.0 W	—	266	—	—	5.00M_L EPB	—	VI	27	60
1957	01	26	01 16 06.0	48.333N	122.433W	—	30	—	—	5.00M_L EPB	—	VI	30	30+
1957	02	11	17 04 57.0	47.533N	121.066W	—	30	—	—	—	—	VI	30	10+
1958	04	12	22 37 11	48.0 N	120.0 W	—	31	—	—	4.10M_L EPB	—	VI	31	20
1958	10	07	05 07 52	46.716N	124.033W	—	31	—	—	3.30M_L EPB	—	VI	31	5#
1959	08	04	23 53 30	45.683N	122.267W	—	32	—	—	4.70M_L EPB	—	V	32	2
1959	08	06	03 44 35	47.817N	120.000W	—	32	—	—	4.40M_L EPB	—	VI	32	88
1959	11	23	18 15 25	46.667N	121.750W	—	32	—	—	4.80M_L EPB	—	V	32	3
1960	04	11	06 47 35	47.567N	122.250W	—	33	—	—	3.60M_D YEL	—	VI	33	2
1960	09	10	15 06 32.5	47.7 N	122.7 W	025	266	—	—	4.60M_D YEL	—	VI	33	41
1961	09	16	03 24 55.8	46.011N	122.128W	007	618	—	—	4.80M_L GW	—	V	34	18
1961	09	17	15 55 55.9	46.023N	122.122W	007	618	—	—	5.10M_L GW	—	VI	34	28
1961	11	07	01 29 08.4	45.7 N	122.4 W	033	266	—	—	4.50M_D YEL	—	VI	34	28&
1962	11	06	03 36 43.6	45.642N	122.588W	016	619	—	—	5.20M_L YEL	5.20YP	VII	38	70&
1962	12	31	20 49 35.3	47.1 N	122.0 W	033	266	—	—	4.70M_D YEL	—	VI	35	36
1963	01	24	21 43 11.8	47.6 N	122.1 W	017	266	—	—	4.50M_D YEL	—	VI	36	26
1964	07	02	17 03 42.4	47.7 N	128.3 W	033	266	4.9	—	5.50Ukn BRK	—	—	—	—
1964	07	14	15 50 04.8	49.0 N	122.6 W	013	266	4.6	—	4.50M_D YEL	—	VI	37	19
1965	04	29	15 28 43.7	47.4 N	122.3 W	059	266	6.5	6.5	6.60Ukn PAS	6.71LB	VIII	377	337&
1969	11	10	07 38 40.8	48.516N	121.400W	—	42	4.3	—	4.70M_L GS	—	V	42	18

WASHINGTON—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	Felt area
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1974	04	20	03 00 09.3	46.759N	121.523W	005	74	4.8	—	4.90M_L GS	—	V	47	—
1975	04	23	01 03 42.4	47.076N	122.647W	046	74	4.0	—	3.80M_L GS	—	VI	48	—
1976	05	16	08 35 14.8	48.80 N	123.36 W	062	74	5.1	—	5.40M_L EPB	—	VI	49	77
1976	09	08	08 21 01.6	47.382N	123.084W	048	74	4.6	3.9	4.80M_L GS	—	VI	49	20+
1978	03	11	15 52 11.2	47.42 N	122.71 W	025	240	4.3	3.2	4.80M_L WAS	—	VI	240	20
1979	03	11	14 39 32.8	46.45 N	122.40 W	016	262	3.8	—	3.80M_L GS	—	VI	262	10
1980	03	27	22 00 05.6	46.219N	122.197W	004	74	4.6	—	4.50M_L GS	—	—	—	—
1980	03	30	17 55 10.0	46.208N	122.183W	000	620	4.5	—	4.60M_D QAM	—	—	—	—
1980	03	31	11 34 09.8	46.210N	122.194W	000	620	4.6	—	4.60M_D QAM	—	—	—	—
1980	04	01	04 24 30.5	46.222N	122.184W	004	74	5.0	3.7	4.70M_L GS	—	—	—	—
1980	04	01	12 30 46.7	46.208N	122.182W	001	620	4.8	—	4.90M_D QAM	—	—	—	—
1980	04	01	08 54 25.4	46.218N	122.175W	004	74	4.5	—	4.50M_L GS	—	—	—	—
1980	04	01	23 14 38.6	46.206N	122.194W	005	74	4.5	—	4.60M_L GS	—	—	—	—
1980	04	02	09 37 13.1	46.220N	122.184W	003	74	4.8	3.7	4.70M_L GS	—	—	—	—
1980	04	03	02 43 19.4	46.208N	122.189W	000	620	4.5	—	4.80M_D QAM	—	—	—	—
1980	04	03	09 35 27.2	46.234N	122.173W	001	74	—	—	4.80m_b GS	—	—	—	—
1980	04	03	23 57 52.3	46.232N	122.218W	002	74	5.0	—	4.50M_L GS	—	—	—	—
1980	04	04	13 45 05.8	46.212N	122.176W	004	74	4.5	3.8	4.50M_L GS	—	—	—	—
1980	04	05	16 42 05.7	46.230N	122.194W	002	74	4.9	4.5	4.50M_L GS	—	—	—	—
1980	04	06	06 58 04.5	46.230N	122.194W	002	74	4.7	3.8	4.70M_L GS	—	—	—	—
1980	04	07	06 45 19.2	46.225N	122.177W	004	74	4.6	—	4.50M_L GS	—	—	—	—
1980	04	07	15 05 32.7	46.234N	122.206W	005	74	4.9	—	4.70M_L GS	—	—	—	—
1980	04	08	06 07 04.6	46.218N	122.186W	003	74	4.7	—	4.50M_L GS	—	—	—	—
1980	04	09	10 13 20.3	46.220N	122.154W	004	74	4.9	—	4.50M_L GS	—	—	—	—
1980	04	09	18 19 27.3	46.20 N	122.20 W	005	300	4.8	—	4.50M_L GS	—	—	—	—
1980	04	10	00 44 15.7	46.228N	122.182W	004	74	4.7	—	4.60M_L GS	—	—	—	—
1980	04	10	14 16 15.3	46.217N	122.177W	002	74	4.7	3.3	4.50M_L GS	—	—	—	—
1980	04	11	23 52 00.0	46.222N	122.164W	003	74	4.4	—	4.80M_L GS	—	—	—	—
1980	04	13	08 36 18.8	46.222N	122.176W	001	74	4.7	—	4.50M_L GS	—	—	—	—
1980	04	14	06 59 22.3	46.223N	122.188W	004	74	4.7	—	4.50M_L GS	—	—	—	—
1980	04	14	13 49 04.1	46.209N	122.190W	003	74	4.8	5.3	4.70M_L GS	—	—	—	—
1980	04	15	06 58 22.3	46.211N	122.201W	002	620	4.5	—	4.70M_D QAM	—	—	—	—
1980	04	15	17 54 54.3	46.220N	122.176W	003	74	4.9	3.6	4.70M_L GS	—	—	—	—
1980	04	16	15 22 05.6	46.225N	122.175W	003	74	4.9	—	4.90M_L GS	—	—	—	—
1980	04	16	15 40 23.5	46.223N	122.167W	004	74	4.8	—	4.50M_L GS	—	—	—	—
1980	04	17	17 43 22.6	46.221N	122.184W	003	74	4.7	3.6	4.60M_L GS	—	—	—	—
1980	04	18	00 53 40.4	46.213N	122.183W	000	620	4.7	—	4.70M_D QAM	—	—	—	—
1980	04	18	21 16 02.2	46.220N	122.185W	004	74	4.8	—	4.70M_L GS	—	—	—	—
1980	04	18	22 27 14.5	46.208N	122.178W	002	620	4.5	—	4.60M_D QAM	—	—	—	—
1980	04	19	22 28 28.2	46.226N	122.177W	003	74	4.7	—	4.60M_L GS	—	—	—	—
1980	04	20	19 19 33.0	46.215N	122.185W	005	74	4.8	3.9	4.80M_L GS	—	—	—	—
1980	04	21	15 13 55.5	46.113N	122.169W	010	74	4.5	—	4.50M_L GS	—	—	—	—
1980	04	22	19 28 18.8	46.217N	122.181W	004	74	4.6	—	4.60M_L GS	—	—	—	—
1980	04	23	12 30 53.1	46.260N	122.012W	005	74	4.5	—	4.70M_L GS	—	—	—	—
1980	04	24	17 34 10.4	46.220N	122.185W	004	74	4.7	3.8	4.80M_L GS	—	—	—	—
1980	04	25	23 20 27.9	46.257N	122.180W	005	74	5.0	—	—	—	—	—	—
1980	04	27	07 26 21.3	46.220N	122.184W	004	74	4.5	—	4.60M_L GS	—	—	—	—
1980	04	28	03 49 33.5	46.220N	122.180W	004	74	4.4	—	4.60M_L GS	—	—	—	—
1980	04	29	04 24 30.2	46.222N	122.170W	002	74	4.7	3.6	4.60M_L GS	—	—	—	—
1980	04	29	06 22 38.9	46.232N	122.192W	002	74	4.7	—	4.50M_L GS	—	—	—	—
1980	04	30	05 09 02.7	46.220N	122.174W	003	74	4.8	3.8	4.70M_L GS	—	—	—	—
1980	05	02	13 02 29.6	46.232N	122.196W	001	74	4.6	3.6	4.50M_L GS	—	—	—	—
1980	05	03	05 00 46.0	46.207N	122.181W	010	74	4.4	4.2	4.50M_L GS	—	—	—	—

WASHINGTON—Continued

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. &, land area only; #, land area only in the United States for an earthquake near a coastline; +, land area in the United States when the felt area did not extend to the coast; @, felt area is less than 1,000 km^2. Leader (--) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1980	05	04	11 58 27.4	46.226N	122.183W	002	74	4.6	4.0	4.60M_L GS	—	—	—	—
1980	05	05	05 43 04.1	46.216N	122.171W	003	74	4.6	3.7	4.60M_L GS	—	—	—	—
1980	05	06	17 04 50.9	46.357N	122.076W	001	74	4.7	4.2	4.70M_L GS	—	—	—	—
1980	05	07	11 09 18.0	46.221N	122.188W	001	74	4.7	—	4.60M_L GS	—	—	—	—
1980	05	08	07 48 46.1	46.227N	122.169W	001	74	5.0	4.0	4.70M_L GS	—	—	—	—
1980	05	09	07 01 01.3	46.224N	122.174W	002	74	4.8	—	4.60M_L GS	—	—	—	—
1980	05	09	18 06 26.5	46.221N	122.170W	002	74	4.4	3.7	4.60M_L GS	—	—	—	—
1980	05	11	04 00 18.1	46.220N	122.173W	001	74	4.7	—	4.50M_L GS	—	—	—	—
1980	05	12	16 26 29.7	46.220N	122.179W	002	74	4.8	4.4	4.90M_L GS	—	—	—	—
1980	05	12	20 33 40.7	46.251N	122.309W	010	74	4.4	—	4.60M_L GS	—	—	—	—
1980	05	14	02 18 57.8	46.224N	122.169W	002	74	4.6	—	4.50M_L GS	—	—	—	—
1980	05	15	11 41 34.6	46.213N	122.195W	002	74	4.9	3.6	4.60M_L GS	—	—	—	—
1980	05	16	12 34 54.1	46.222N	122.168W	002	74	4.6	3.7	4.70M_L GS	—	—	—	—
1980	05	18	15 32 11.4	46.214N	122.194W	004	74	4.7	5.2	5.00M_L GS	—	IV	300	349#
1981	02	14	06 09 27.2	46.351N	122.238W	007	74	5.1	4.8	5.50M_L GS	5.48BUR	VI	325	104&
1981	02	18	06 09 38.7	47.214N	120.905W	000	74	—	—	4.20M_L GS	—	VI	325	9
1989	03	05	06 42 00.6	47.813N	123.257W	046	74	4.6	—	4.50M_D WAS	—	V	579	—
1989	05	09	18 28 45.5	48.230N	119.853W	016	74	—	—	4.40M_L WAS	—	VI	579	22
1989	12	24	08 45 58.9	46.650N	122.116W	019	74	4.3	—	5.10M_L WAS	—	V	579	30

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1872. Dec. 15 (Dec. 14). Near Lake Chelan, Wash. This earthquake evidently had a large magnitude, because it was felt from British Columbia, Canada, to Oregon and from the Pacific Ocean to Montana (see fig. 61). It occurred in a wilderness area, which in 1872 had only a few inhabitants—local Indian tribes, trappers, traders, and military men. Because there were few man-made structures in the epicentral area near Lake Chelan, most of the information available is about ground effects, including huge landslides, massive fissures in the ground, and a 9-m-high geyser.

Extensive landslides occurred in the slide-prone areas of the Columbia River. One massive slide, at Ribbon Cliff (between Entiat and Winesap), blocked the Columbia River for several hours. A field reconnaissance to the Ribbon Cliff landslide area in August 1976 showed remnants of a large landslide mass along the west edge of Lake Entiat (Columbia River Reservoir), below Ribbon Cliffs and about 3 km north of Entiat. Although the most spectacular landslides occurred in the Chelan-Wenatchee area, landsliding was reported throughout the Cascades.

Most of the ground fissures occurred at the east end of Lake Chelan in the area of the Indian camp; in the Chelan Landing–Chelan Falls area; on a mountain about 19 km west of the Indian camp area; on the east side of the Columbia River (where three springs formed); and near the top of a ridge on a hogback on the east side of the Columbia River. These fissures formed in several localities of differing physiographic environments. Slope failure or settlement or slumping in water-saturated unconsolidated sediments may have produced the fissures in areas on steep slopes or near bodies of water. Sulfurous water was emitted from the large fissures that formed in the Indian camp area. At Chelan Falls, “a great hole opened in the earth” from which water spouted as much as 9 m in the air. The geyser activity continued for several days, and, after diminishing, left permanent springs.

In the epicentral area, one log building on unconsolidated river deposits near the mouth of the Wenatchee River was damaged. The upper logs and roof of the cabin were displaced, and the kitchen was separated from the main building. People there were

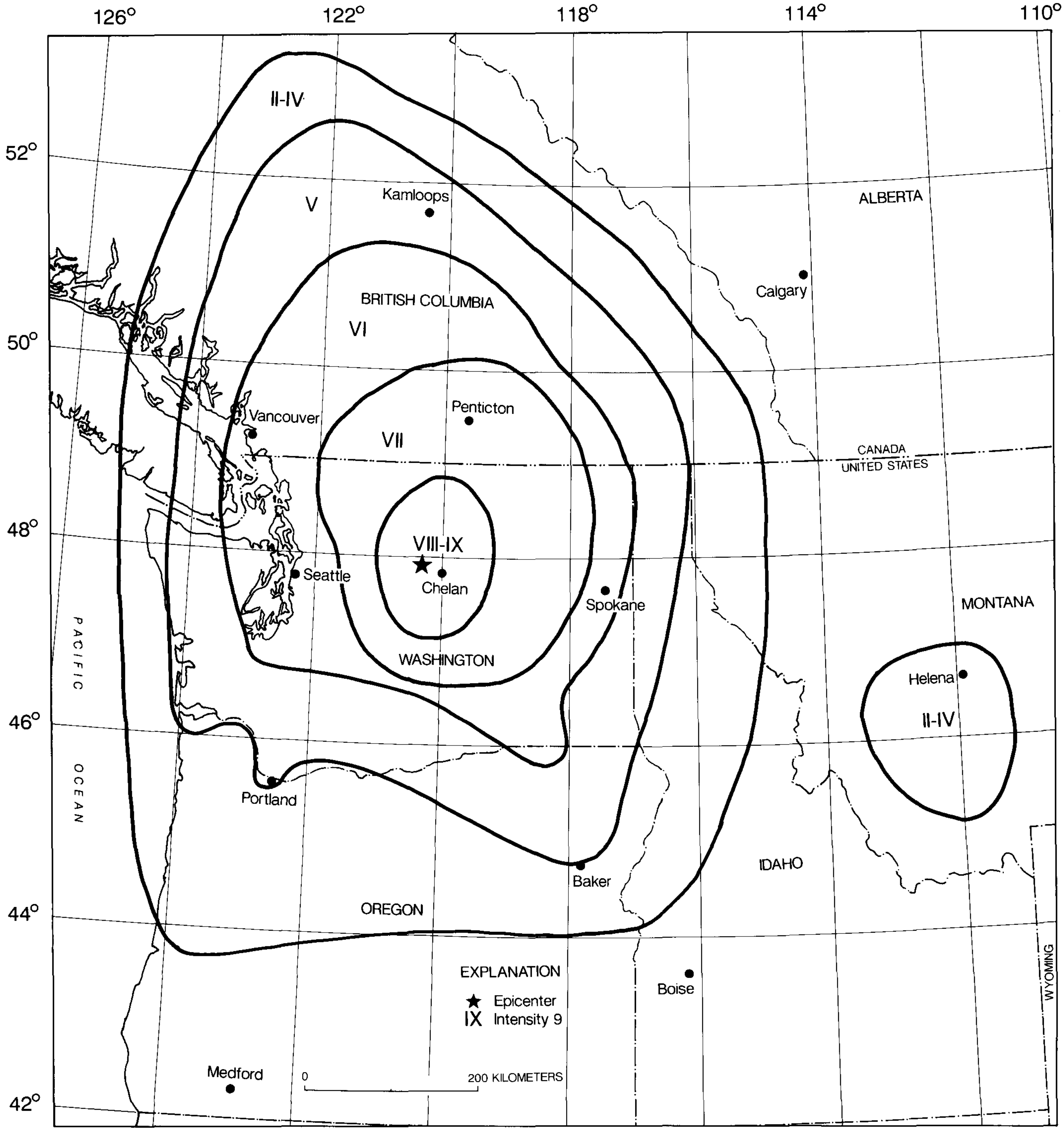


FIGURE 61.—Isoseismal map for the central Washington earthquake of December 15, 1872. This is a simplified version of an unpublished map by M.G. Hopper and S.T. Algermissen.

thrown to the floor; waves were observed in the ground; and loud detonations were heard. About 3 km above the Ribbon Cliff slide area, the logs on another log cabin caved in.

Damaging intensities in Washington (MM intensity VI) extended on the west throughout the now densely populated Puget Sound basin and on the southeast to beyond the Hanford nuclear reactor site. The earthquake also was reported in Idaho, Montana, Oregon, and Canada. Many aftershocks were observed in the area over the next 2 years. (Ref. 373, 375, 518.)

1877. Oct. 12. North of Portland, Oreg. in Clark County, Washington. Two earthquakes were reported felt in northern Oregon. The first light shock occurred east of Portland, at Cascade Locks (Hood River County) at about 09 00 (local time). The second shock, about 5 hours later, was sufficiently violent at Portland to overthrow two chimneys and break windows. At the county jail, a stove was knocked from its "moorings" and thrown over. The second shock also was felt at Cascade Locks, Hubbard, and Marshfield (18 km southeast of Portland). One report indicated that the earthquake was felt on Puget Sound and at points down the Columbia River. (Ref. 38, 53, 463, 484.)

1880. Aug. 22. Puget Sound area, Washington. In Victoria, B.C., Canada, loose bricks fell and plaster was cracked. Also felt at Port Townsend and Seattle and on southern Vancouver Island. (Ref. 38, 375.)

1882. May 1 (Apr. 30). Near Olympia, Washington. This severe earthquake threw down two chimneys, broke crockery, and stopped clocks on southern Puget Sound, at Olympia (Thurston County). Large trees swayed back and forth, the ground moved in a wavy motion, and people were thrown from their feet. Also felt at Fort Canby, Wash., Portland, Oreg., and Victoria, B.C., Canada. (Ref. 56, 463.)

1891. Nov. 29. Near Port Angeles, Wash. One building in Seattle swayed so much that an elevator became jammed. On the east side of Seattle, Lake Washington was disturbed and the water "rolled onto the beach 2 feet above the mark of the highest water and 8 feet above the present stage." At Port Townsend, northwest of Seattle, residents rushed from buildings, and windowpanes were broken in a hotel at Pysht (Clallam County). Also felt in Snohomish and Bellingham Bay. (Ref. 38, 56.)

1892. Apr. 17. Near Olympia, Washington. The shock was described as "severe" at Olympia, but "sharp" in the areas a few kilometers northeast, at Tacoma, Wash., and at Portland, Oreg., about 175 km south. People rushed into the street when buildings began to tremble in Portland. (Ref. 38, 56.)

1906. Jan. 3. Northeast Washington. At Nelson, B.C., Canada, plaster was knocked down, articles fell from shelves, and hanging pictures were displaced. Two shocks were felt from the south boundary of Spokane County, Wash., to a point north of Bradshaw, B.C., Canada. (Ref. 38, 375.)

1909. Jan. 11. British Columbia–Washington border. This earthquake caused minor damage in Whatcom and Skagit Counties. The shock cracked a sidewalk and damaged piers slightly at Anacortes, cracked walls near the Canadian border at Blaine, and cracked plaster and twisted sidewalks at Bellingham. It was "violent" at Crescent, Dungeness, Neah Bay, and Port Angeles. Crockery was broken at Victoria, B.C., Canada. Felt throughout much of British Columbia, Canada, and as far south as Portland, Oreg. (Ref. 38, 56, 375.)

1920. Jan. 24. (Jan. 23). Strait of Georgia, Northwest Washington. Windows were broken in Whatcom County, at Bellingham, and several brick walls were cracked at Bellingham and at Anacortes, a few kilometers south. Some damage to houses was reported in Canada, on Vancouver Island, and chimneys were cracked at New Westminster. Boulders were shaken off Crown Mountain, near Vancouver, and some windows were broken in the city. (Ref. 38, 56, 374.)

1923. Feb. 12. Near Bellingham, Whatcom County, Wash. Plaster cracked at Bellingham, in western Whatcom County. Also felt at Marietta, Wash., and Victoria, B.C., Canada. (Ref. 56, 375.)

1928. Feb. 2. Startup, southern Snohomish County, Wash. Plaster and wallpaper were cracked and residents were alarmed at Startup, northeast of Seattle. A strong shake and roaring noises were reported. (Ref. 1, 38.)

1931. Apr. 18 (Apr. 17). Near Bellingham, Whatcom County, Wash. A few bricks fell from chimneys at Acme (about 25 km southeast of Bellingham), and wallpaper was cracked at nearby Lawrence. Felt at several towns in the area, including Vancouver and Victoria, B.C., Canada. (Ref. 4, 38.)

1931. Dec. 31. Puget Sound area, Wash. At Lilliwaup, north of Olympia, in Mason County, a new concrete wall of a store was cracked and a basin hanging on a nail was knocked down. Articles were thrown from store shelves in several towns in the area. (Ref. 4, 38.)

1932. July 18 (July 17). Near the forks of Tolt River, King County, Wash. The epicenter of this earthquake was in the wilderness east of Seattle, along the western base of the Cascade Range; there were few inhabitants and few buildings or other structures for the earthquake to affect. Fissures or other displacements of the ground were not observed in this region.

Near the epicenter, on the South Fork, Tolt River, a tremendous detonation was heard and standing was almost impossible. One chimney was thrown down at

Tolt. Some buildings were damaged north of Seattle, at Lowell and Everett; and windows were broken and standing was difficult at Farrell's Ranch, northeast of Seattle and about 6 km east of Duvall. At cemeteries in Monroe and South Everett, several vases, small pots, and unattached statues were toppled. Felt to the east as far as Coulee City and Conconully, to the south as far as Chehalis and Centralia, and to the north as far as Bellingham, Wash., and Vancouver, B.C., Canada. The western felt limit is unknown. (Ref. 375, 496.)

1932. Aug. 6. Seattle, King County, Wash. A strong local shock demolished a few chimneys and severely damaged others at Seattle. Several slight shocks were felt in the area through early October. (Ref. 5, 38.)

1939. Nov. 13 (Nov. 12). Southern Puget Sound area, Washington. Slight damage to chimneys, plaster, and windows occurred in towns throughout the area. Chimneys were twisted or fallen south and west of Olympia at Brooklyn, Centralia, Elma, Fairfax, and Oakville, and east of Tacoma at Auburn. At Tacoma, many buildings sustained cracks; some chimneys were damaged; and pavement was cracked. Felt north to Canada and south to Oregon (see fig. 62). Four small aftershocks occurred in the next 9 days. (Ref. 12, 38, 258.)

1941. Apr. 7. Near Okanogan, Okanogan County, north-central Washington. An observer at Mazama, Okanogan County, reported that a stove was displaced and furniture was overturned. MM intensity V was assigned to effects at three other towns in Okanogan County: Nespelem, Okanogan, and Omak. (Ref. 14, 38.)

1943. Nov. 29 (Nov. 28). Puget Sound area, Wash. Chimneys were cracked and furniture was displaced west of Anacortes, at Richardson, San Juan County. Also felt at several other towns in the region. (Ref. 16, 38, 375.)

1944. Dec. 7 (Dec. 6). Near Aberdeen, Grays Harbor County, Wash. At Grays Harbor Junior College, at Hoquiam, a large brick chimney on top of a building rotated about 46 cm out of alignment and had to be replaced. (Ref. 17, 259.)

1945. Apr. 29. Near North Bend, King County, Wash. At North Bend, chimneys and plaster were cracked, and dishes, windows, and the town water main were broken. Near North Bend, at the Mount Si Ranger Station, tons of rock and earth cascaded down the cliffs. Bricks were dislodged from a dozen or more houses in the Cle Elum area of Kittitas County. Minor damage occurred at several towns in the region. Felt over most of Washington and in western Idaho and northern Oregon. (Ref. 18, 20.)

1946. Feb. 15 (Feb. 14). Puget Sound area, Wash. Although property damage at Seattle generally was moderate, it was marked by a few instances of spectacular damage (total estimate about $250,000). Structures that were most severely damaged included the Sears-Roebuck Building, Fisher flour mills and grain elevator on Harbor Island, Fry & Company packing plant, Seattle Port of Embarkation Building No. 14, and Smith Tower. Several old brick chimneys at Tacoma broke off at the roofline, and about 24 m of fire wall was knocked off the Olympia Hotel in Olympia, southwest of Tacoma. Light damage occurred at several nearby towns. Also felt in Canada and northwest Oregon. Three small aftershocks occurred through Feb. 22. (Ref. 19, 260.)

1946. June 23. Strait of Georgia, B.C., Canada. Heavy damage occurred in the epicentral area. The Canadian Hydrographic Department reported the bottom of Deep Bay in the Strait of Georgia sank from about 3 to 25 m. A 3-m vertical ground shift occurred on Read Island, and ground settlements as much as 30.5 m were observed at other points.

In the United States, some chimneys fell at East Sound, San Juan County, Wash.; a concrete mill was damaged at Port Angeles; and buildings were damaged slightly at Northport, Port Townsend, and to the south as far as Olympia. At Seattle, plaster fell in the County-City Building, and a few bricks fell from the Sears-Roebuck Building. Also felt at several towns in Oregon. (Ref. 19, 38, 258.)

1949. Apr. 13. Puget Sound area, Wash. This is the largest known earthquake in the history of Washington. Its epicenter lies between Olympia and Tacoma, along the southern edge of Puget Sound. Property damage in Olympia, Seattle, and Tacoma was estimated at $25 million; eight people were killed; and many were injured. Several structures were condemned, including two schools and a church at Centralia, south of Olympia; a junior high school at Auburn, northeast of Tacoma; and a library at Chehalis, near Centralia. School buildings in widely separated towns were damaged seriously. Water spouted from cracks that formed in the ground at Centralia, Longview, and Seattle. One new spring developed on a farm at Forest. Downed chimneys and walls were reported from towns throughout the area.

At Olympia, almost all large buildings were damaged to some extent, including eight structures on the Capitol grounds. Many chimneys and two large smokestacks fell. Public utilities sustained serious damage—water and gas mains were broken, and electric and telegraph services were interrupted.

At Seattle, houses on filled ground were demolished, many old brick buildings were damaged, and

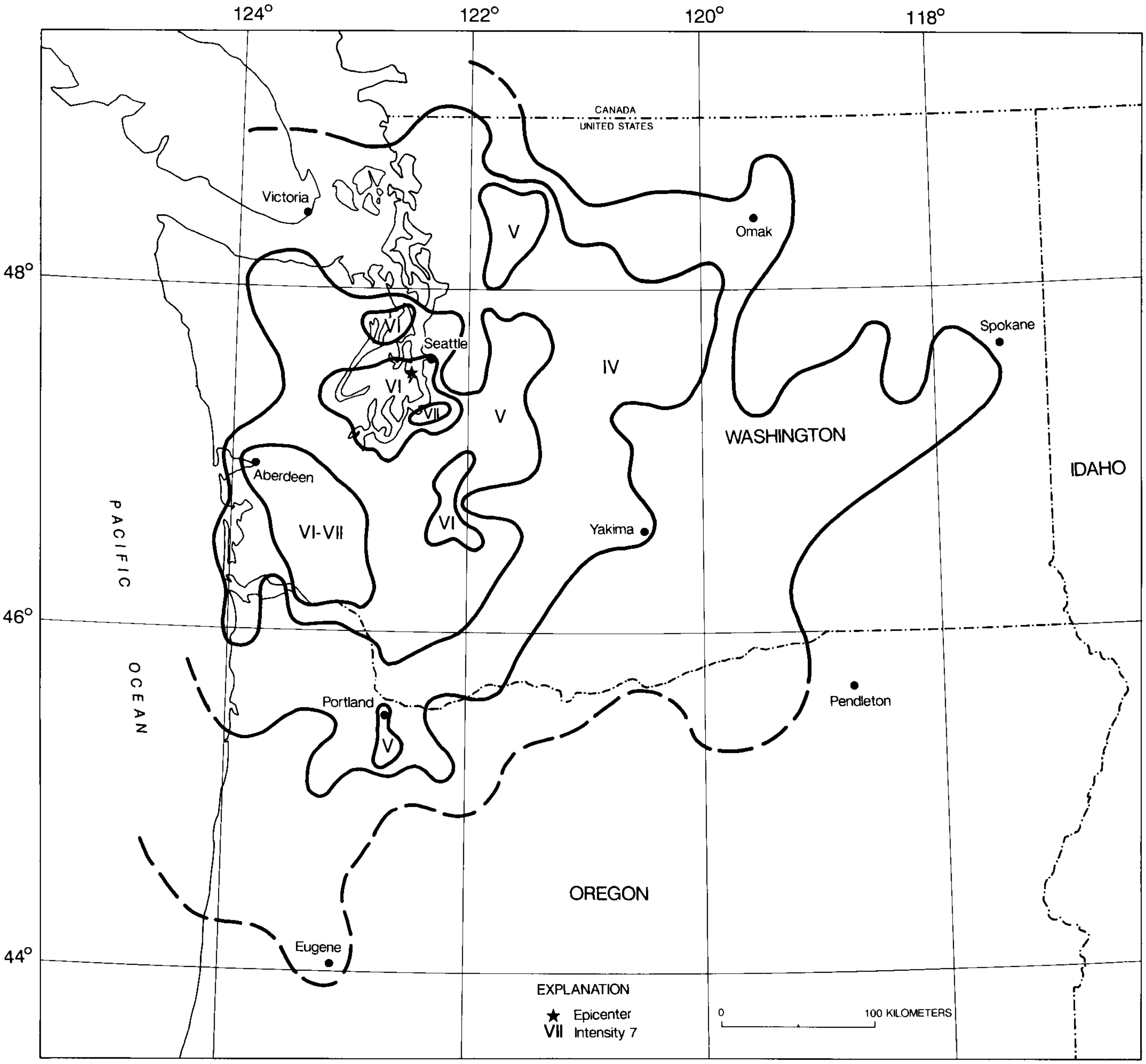


FIGURE 62.—Isoseismal map for the northwest Washington earthquake of November 13, 1939. Isoseismals are based on intensity estimates from data listed in references 12 and 259 of table 1.

chimneys toppled. One wooden water tank and the top of a radio tower collapsed.

About 50 km northeast of Olympia, at Tacoma, many chimneys were knocked to the ground and many buildings were damaged. Near Tacoma, a huge section of a 73-m cliff toppled into Puget Sound shortly after the earthquake; south of Tacoma, railroad bridges were thrown out of alignment. A 23-ton cable saddle was thrown from the top of the Tacoma Narrows bridge tower, causing considerable damage. Also felt in Idaho, Montana, Oregon, and in British Columbia, Canada (see fig. 63). Only one small aftershock occurred during the next six months. Magnitude 6.5 M_S ABE, 7.1 Ukn PAS, 7.0 M_S GR, 6.5 M_L KJ. (Ref. 22, 38, 376, 460, 533.)

1950. Apr. 14. Near Langley, Island County, Wash. Plaster cracked and fell and small objects overturned at Langley. A few cracks formed in

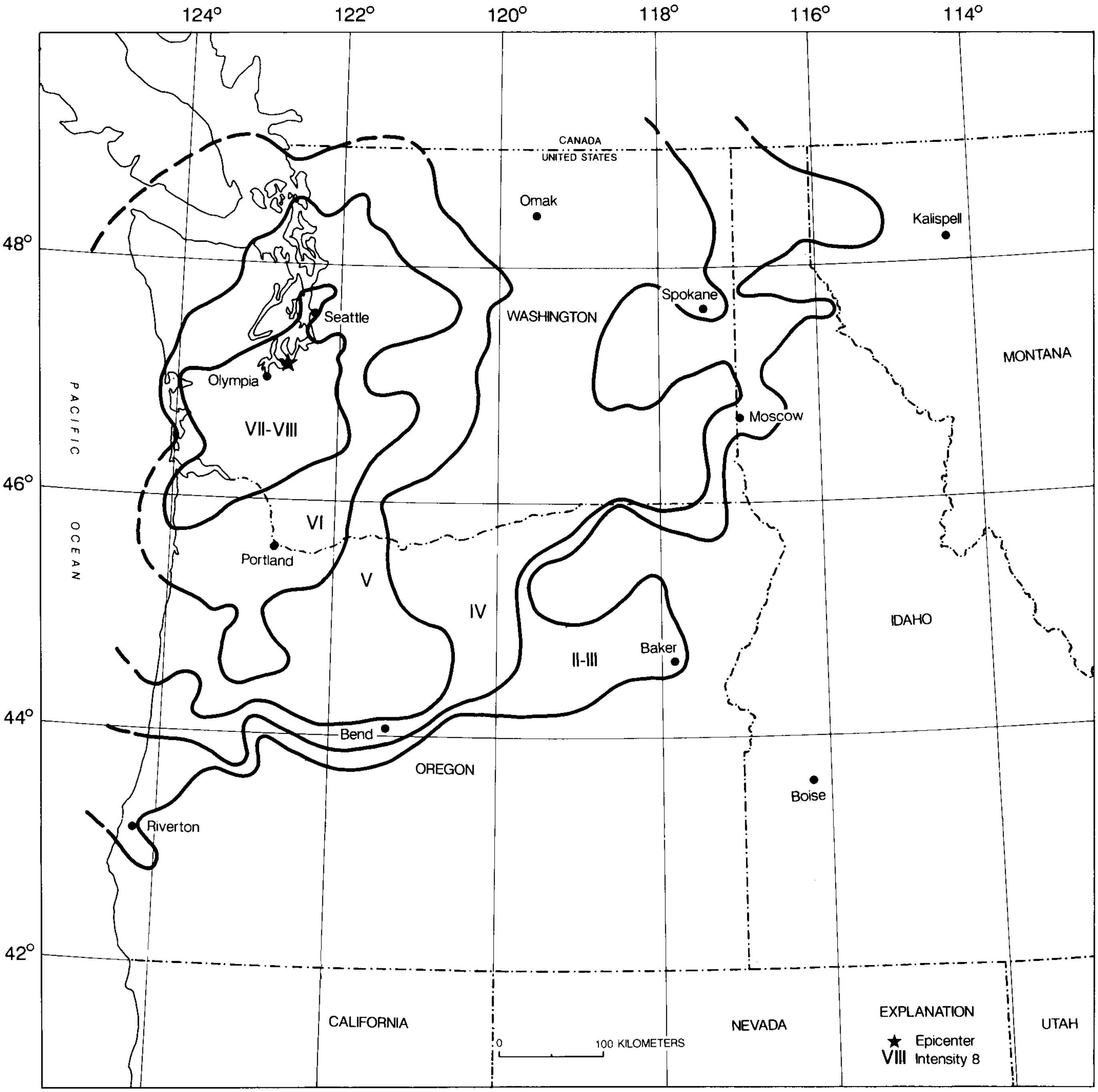


FIGURE 63.—Isoseismal map for the Puget Sound, Washington, earthquake of April 13, 1949. Isoseismals are based on intensity estimates from data listed in references 22 and 259 of table 1.

plaster northwest of Langley, at Port Townsend, and pendulum clocks stopped. Felt over a small area of northwest Washington. (Ref. 23, 38, 375.)

1954. May 15. Near Lake Stevens, Snohomish County, Wash. A moderate earthquake was felt throughout northwest Washington. Small cracks formed in walls at Belfair (northwest Mason County) and Lake Stevens; plaster cracked at Seattle (King County), and dishes broke at Skykomish (northeast King County). (Ref. 27, 38, 266.)

1957. Jan. 26 (Jan. 25). Northwest Washington. This earthquake was strongest at Clear Lake (southeast of Bellingham, in Skagit County), where plaster cracked and fell at a school and a knickknack shelf was displaced. Felt over most of northwest Washington. (Ref. 30, 38.)

1957. Feb. 11. Near North Bend, King County, Wash. One chimney was cracked and knickknacks fell at Fall City; plaster was damaged at North Bend and Snoqualmie. Observers over a small area of northwest Washington reported this earthquake. (Ref. 30.)

1958. Apr. 12. North-central Washington. Windows and dishes were broken in some houses at Chelan and at Pateros and Winthrop, north of Chelan in Okanogan County. Rocks fell on roadways near Chelan. Moderate to loud earth noises were heard in most areas. (Ref. 31, 38.)

1958. Oct. 7 (Oct. 6). Willapa Bay, Pacific County, Wash. At a motel in Tokeland (at the north end of Willapa Bay), several cracks formed in a patio. Felt over a small area of Grays Harbor and Pacific Counties in western Washington. (Ref. 31, 38.)

1959. Aug. 6 (Aug. 5). Near Chelan, Wash. This minor shock, which was observed over most of the State, caused slight damage in a few towns. At Chelan, about 180 km east of Seattle, bricks and part of a chimney fell; at Orondo, southwest of Chelan, chimneys were cracked; and at nearby Waterville, chimneys were cracked and bricks fell from several buildings. Rocks slid down the steep hills near Chelan and Waterville. (Ref. 32, 38.)

1960. Apr. 11 (Apr. 10). Near Seattle, King County, Wash. At Seattle, a concrete wall was cracked and a wood retaining wall was damaged. Felt over a small area, mainly in western King County. (Ref. 33, 38.)

1960. Sept. 10. Puget Sound area, Washington. A light earthquake cracked many concrete floors and walls in Bremerton, west of Seattle, and caused considerable plaster damage in Seattle. Felt over most of northwest Washington. (Ref. 33, 38, 266.)

1961. Sept. 17. Clark County, Washington near the Oregon-Washington border. Slight damage occurred at a few towns along the Columbia River. In southern Skamania County, chimneys and concrete foundations cracked at Stevenson, and an old house shifted about 2.5 cm on its foundation at North Bonneville. At Latourell Falls, Oreg., a few cracks formed in a concrete-block foundation. Felt over a small area of southwest Washington and northwest Oregon. (Ref. 34, 38, 266, 618.)

1961. Nov. 7 (Nov. 6). Clark County, Washington near the north Oregon-Washington border. Minor damage occurred in the Portland, Oreg., area. Part of a chimney fell and interior lights were broken at Portland; a concrete-block foundation of a service station was damaged at Glenwood, west of Portland; and windows were broken at Vernonia, north of Glenwood. Felt over a large area of southwest Washington and northwest Oregon. (Ref. 34, 38, 266.)

1962. Nov. 6 (Nov. 5). Clark County, Washington near the Oregon-Washington border. At Portland, Oreg., many chimneys were cracked severely, shaken down, or broken off. Tile ceilings were downed in several buildings; large cracks formed in walls; and plaster was knocked to the floor. Minor damage, consisting mainly of cracked plaster and chimneys and broken windows, occurred in many towns in both Oregon and Washington. Felt over a large area of southwest Washington and northwest Oregon. Magnitude 5 1/4–5 1/2 Ukn PAL, 4.9 M_D YP. (Ref.35, 38, 266, 619.)

1962. Dec. 31. Near Berkley, Pierce County, Wash. Residents in several towns (mainly in Pierce County) reported cracks in chimneys and plaster. Chimneys were cracked southeast of Tacoma, at Orting and Wilkeson, and walls were cracked at Buckley. Several rocks fell from a cut bank onto the road near Buckley. Cracks in chimneys also were reported in northern Yakima County, at Naches. (Ref. 35, 38, 266.)

1963. Jan. 24. Near Maple Valley, King County, Wash. At Maple Valley and Tacoma, cracks formed in plaster and walls and objects fell to the floor. Felt in many towns in western Washington. (Ref. 36, 38, 266.)

1964. July 14. Near Bellingham, Whatcom County, Wash. Slight damage, consisting mainly of cracks in plaster and walls, occurred at Bellingham, Custer, Nooksack, and Sumas. At Lumni Island, southwest of Bellingham, a fireplace chimney was split and mortar fell to the floor. In British Columbia, Canada, plaster cracked and fell at Abbotsford, and a ceiling cracked at White Rock. Loud earth noises were heard in several areas. Magnitude 3.7 M_S NUT. (Ref. 37, 38, 263, 266.)

1965. Apr. 29. Puget Sound area, Wash. This was the second largest earthquake in the history of Washington. It caused about $12.5 million in property damage and killed seven people. This shock was characterized by a rather large area of MM intensity VII and small pockets of MM intensity VIII in Seattle and suburbs and southeast of Seattle, in Issaquah. Pockets of high earthquake intensity, as typified by damage such as fallen chimneys, almost always were associated with variations in the local geology.

Chimneys were damaged extensively in West Seattle, and two schools were damaged severely. The

Roof of house in Seattle, Washington, damaged by the April 29, 1965, earthquake. (Photograph from the National Geophysical Data Center, NOAA.)

low-lying and filled areas along the Duwamish River and its mouth settled, causing considerable building damage. Harbor Island, at the mouth of the Duwamish River, was severely damaged. Slumping occurred along a steep slope near Admiral Way. A brick garage partly collapsed at Issaquah; one school was damaged extensively; and chimneys in the area sustained heavy damage. Many instances of parapet and gable failure occurred. Damage to utilities in the area was not severe.

In general, damage patterns repeated those observed in the April 1949 shock, although the 1949 event was more destructive. Buildings apparently damaged in 1949 often sustained additional damage in 1965. An example is the Alki Beach section of West Seattle, where almost every chimney was knocked down in 1965. Similar damage occurred there in the 1949 earthquake.

Buildings having unreinforced brick-bearing walls with sand-lime mortar were damaged most severely. Multistory buildings, however, generally had slight or no damage. Performance of wood frame dwellings almost always was excellent, and, where damage occurred, it was confined mainly to cracks in plaster or to failure of unreinforced brick chimneys at or above the roofline. Also felt in Idaho, Montana, Oregon, and in British Columbia, Canada. Little aftershock activity was observed. Magnitude 6.2 m_b NUT, 6.4 M_S NUT. (Ref. 38, 75, 263, 266, 377, 533.)

1975. Apr. 23 (Apr. 22). Puget Sound area, Wash. Slight damage occurred at Sumner, a few km east of Tacoma in Pierce County, where tar on a roof was cracked. Felt throughout the southern Puget Sound area. (Ref. 38, 48, 74.)

1976. May 16. Vancouver Island region, Canada. Minor damage occurred at Deming, Whatcom County, Wash., and Lake Cowichan and Victoria, B.C. At Deming, cracks formed in plaster and drywall; at Victoria, one chimney was damaged; and at Lake Cowichan, a water line was broken. Felt over a large area of British Columbia and northwest Washington. (Ref. 38, 49, 74.)

1976. Sept. 8. Puget Sound area, Washington. Broken glassware and other minor damage were reported at Tacoma, in Pierce County. Felt throughout the Puget Sound area. (Ref. 38, 49, 74.)

1978. Mar. 11. Puget Sound area, Wash. This minor earthquake cracked a rock-and-mortar wall at Crystal Mountain Ski Resort (in Mount Rainier National Park) and displaced open roof beams 1–2 cm. Felt over a moderate area of northwest Washington. (Ref. 38, 240.)

1979. Mar. 11. Southwest Washington. Minor damage in Cowlitz County, at Ariel, included cracks in chimneys, exterior cinder-block walls, brick walls, and sidewalks. A few windows were cracked at Castle Rock, northwest of Ariel. Felt over a small area of southwest Washington and northern Oregon. Magnitude 3.8 M_L GS. (Ref. 38, 262.)

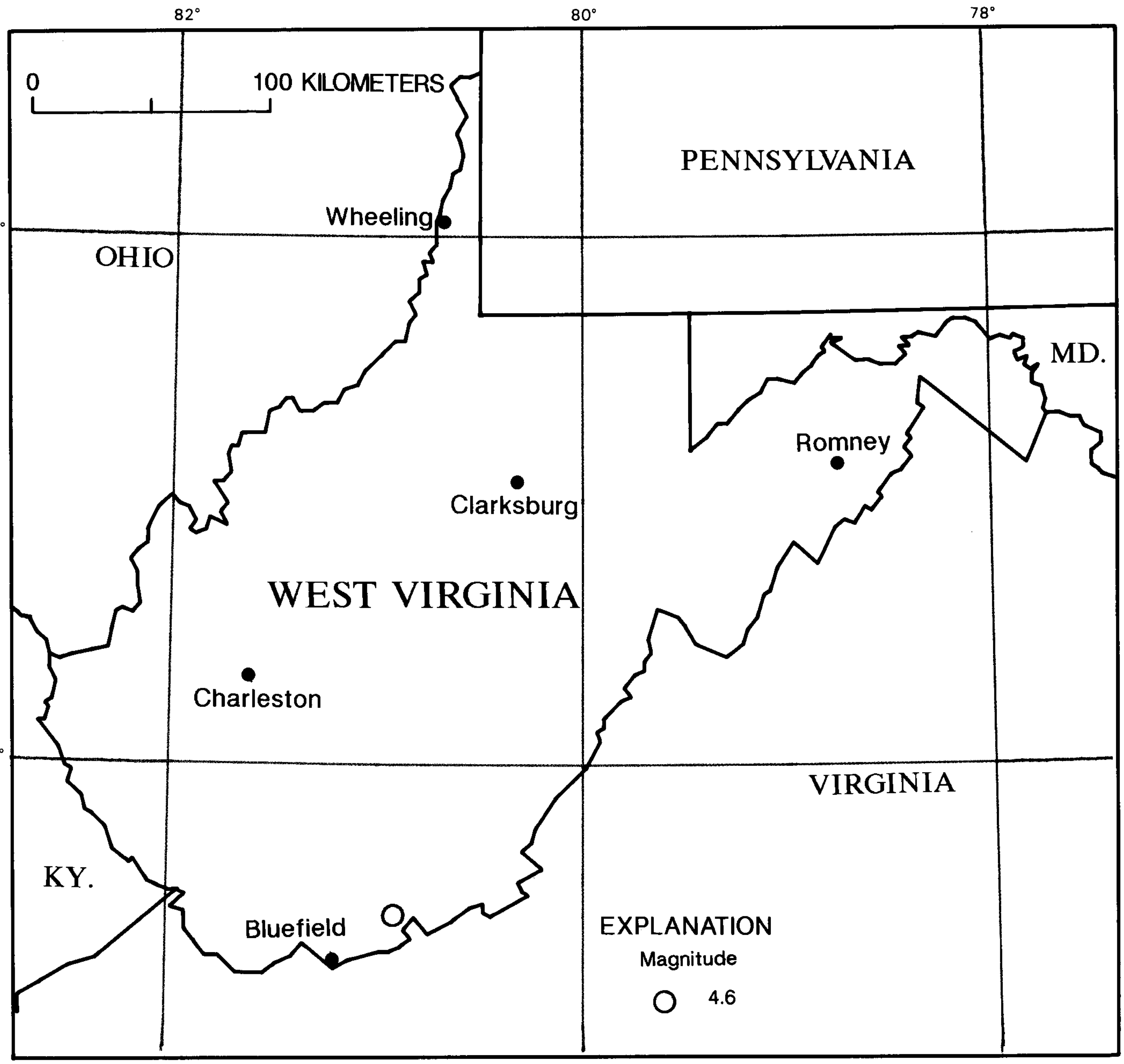
1980. May 18. Mount St. Helens, Wash., earthquake and volcanic eruption. An earthquake occurred at 15 32 UTC, only seconds before the explosion that began the eruption of Mount St. Helens volcano. This eruption and blast blew off the top of the volcano, reducing its elevation by 396 m, killed 31 people, and caused an estimated property damage of between $0.5 billion and $2 billion. About 53 earthquakes having magnitudes larger than 4.5 were located near Mount St. Helens before the main event and eruption. No earthquakes having magnitudes higher than 4.5 were located following the eruption. The sound from the explosion and the vibratory effects from the earthquake were inseparable, resulting in a felt area that was based on both (Ref. 74, 300, 609.)

1981. Feb. 14 (Feb. 13). Southwest Washington. Several towns in the area reported cracks in foundations, plaster, drywall, and windows. Damage to chimneys (broken at roofline, twisted, cracked) occurred in Lewis County, at Mossyrock (near the epicenter); in Pierce County, at Graham and Kapowsin; and at Grays River, in Wahkiakum County (west of the epicenter). In Cowlitz County, about 50 km southwest of the epicenter, sidewalks were cracked at Ariel, and plaster fell at Hazel Dell. Felt over a large area of western Washington and northwest Oregon. Several aftershocks were observed in the area. Magnitude 5.2 M_D WAS. (Ref. 74, 325.)

1981. Feb. 18 (Feb. 17). Central Washington. Bricks fell from chimneys in the Cle Elum area of Kittitas County. Hairline cracks in drywall as well as broken windows were reported at Puyallup, about 100 km west of the epicenter, near Tacoma. Minor damage to plaster, drywall, windows, and glassware was reported from several towns in the Cle Elum area. A sharp crack or explosive-like sound was reported by some residents. Magnitude 4.2 M_D WAS. (Ref. 74, 325.)

1989. May 9. Near Okanogan, Wash. This earthquake cracked chimneys, walls, and plaster at Okanogan, about 180 km northwest of Spokane. Objects fell from shelves and tables in several towns in north-central Washington. Felt in northern Okanogan County near the United States–Canadian border, west to Chelan County, south to Grant County, and east to Ferry and Lincoln Counties. (Ref. 74, 579.)

WEST VIRGINIA



Earthquake in West Virginia with a magnitude ≥ 4.5 and intensity ≥ VI.

WEST VIRGINIA

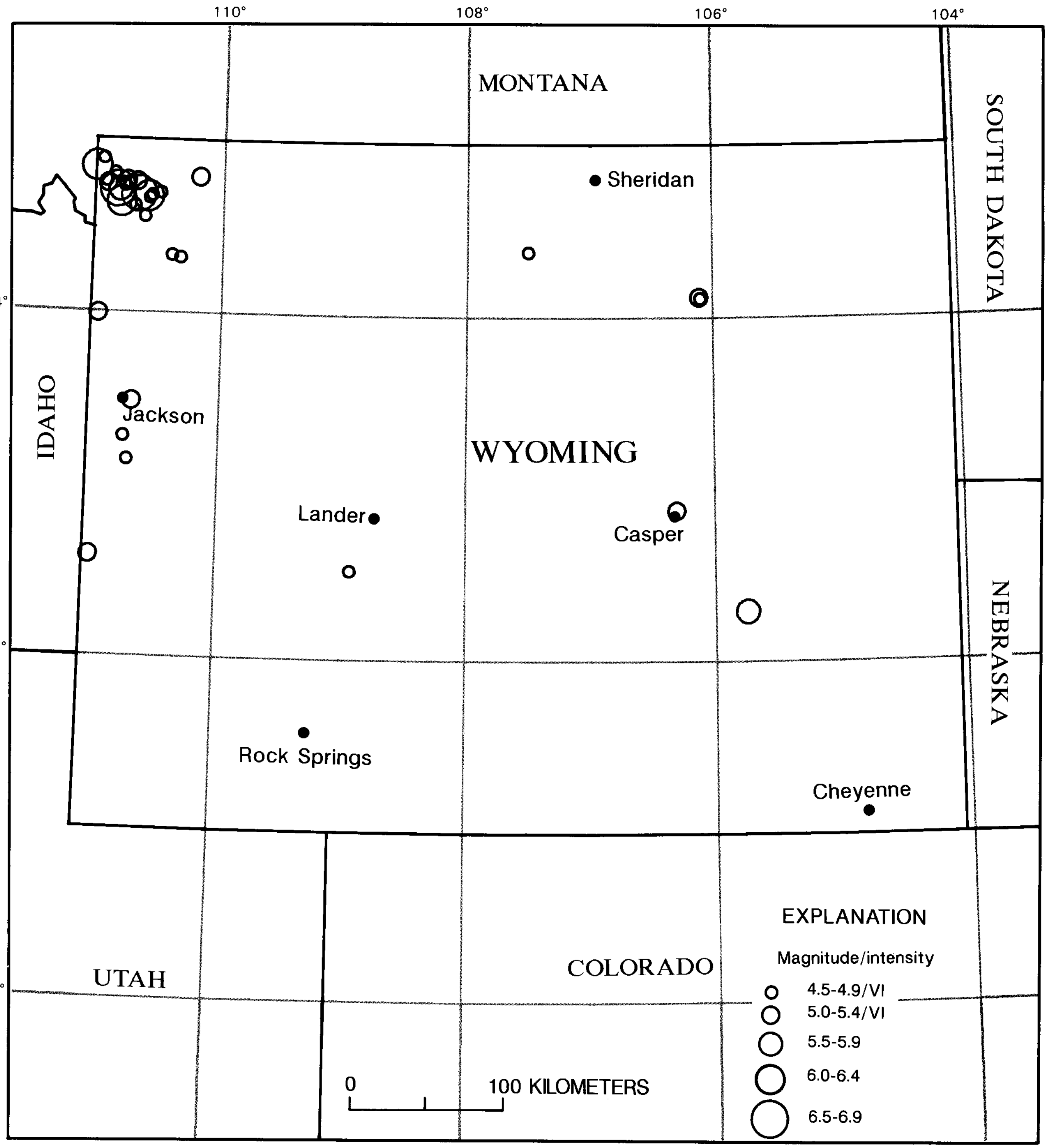
[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. Leader (--) indicates information is not available]

Date			Origin time (UTC)			Hypocenter				Magnitude				Intensity		Felt area
Yr	Mo	Da	h	m	s	Latitude (°)	Longitude (°)	Depth (km)	Ref	USGS m_b	USGS M_S	Other	Moment M	MM	Ref	Felt area (1,000 km^2)
1969	11	20	01	00	09.3	37.449N	80.932W	003	349	4.3	—	4.60M_n GB	4.53HRN	VI	42	300

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1969. Nov. 20 (Nov. 19). Southern West Virginia. Minor damage occurred in Giles County, Va., at Glen Lyn and Rich Creek, and at three towns in southern West Virginia. At Glen Lyn, a few bricks were knocked from a chimney, windows were broken, and plaster was broken from most of the walls in an old house. At Rich Creek, plaster cracked and fell and windows were broken. A cornice reportedly was shaken from one building in Henry County, at Collinsville, Va. Windows also were broken in southern Mercer County, W.Va., at Lerona, Oakvale, and Elgood. Felt over all or parts of nine States: Georgia, Kentucky, Maryland, North Carolina, Ohio, South Carolina, Tennessee, Virginia, and West Virginia. Magnitude 4.7 M_{fa} NUT, 4.54 M JOH. (Ref. 38, 263, 42, 349, 353, 508.)

WYOMING



Earthquakes in Wyoming with magnitudes ≥ 4.5 or intensity ≥ VI.

WYOMING

[See table 1 for hypocenter and intensity references and table 2 for definitions of magnitude source codes. @, felt area is less than 1,000 km^2. Leader (—) indicates information is not available]

Date			Origin time (UTC)	Hypocenter				Magnitude				Intensity		Felt area
				Latitude	Longitude	Depth	Ref	USGS		Other	Moment	MM	Ref	
Yr	Mo	Da	h m s	(°)	(°)	(km)		m_b	M_S		M			(1,000 km^2)
1897	11	14	13 30	42.9 N	106.3 W	—	38	—	—	—	—	VI	38	—
1925	11	18	01 45	44.4 N	107.5 W	—	280	—	—	—	—	V	280	30
1930	06	12	09 15	42.6 N	111.0 W	—	3	—	—	—	—	VI	3	—
1932	01	26	10 13	43.5 N	110.7 W	—	5	—	—	—	—	VI	279	3
1936	01	15	04 40	44.0 N	111.0 W	—	38	—	—	—	—	VI	38	3
1959	08	18	07 56 16.8	44.699N	110.705W	005	576	—	—	6.50Ukn BRK	—	Felt	32	—
1959	08	18	08 41 47.5	44.854N	111.049W	005	576	—	—	6.00Ukn BRK	—	VI	32	—
1959	08	18	11 03 48.1	44.719N	110.850W	005	576	—	—	5.60Ukn BRK	—	Felt	32	—
1959	08	18	15 26 05.9	44.721N	110.871W	005	576	—	—	6.50Ukn PAS	6.28DSR	Felt	32	—
1959	08	19	04 04 01.7	44.648N	110.840W	005	576	—	—	6.00Ukn BRK	5.98DOR	V	38	—
1959	08	19	19 43 47.2	44.756N	110.960W	005	576	—	—	5.00Ukn BRK	—	Felt	32	—
1963	03	08	08 35 48.9	44.8 N	110.2 W	033	266	3.8	—	—	—	VI	36	@
1963	09	24	06 35 52.1	44.9 N	111.0 W	033	266	4.7	—	—	—	V	36	—
1973	03	30	00 32 56.1	44.34 N	110.34 W	001	307	4.6	—	4.60M_D GM	—	Felt	46	—
1973	03	31	20 33 31.8	44.35 N	110.41 W	001	307	5.1	—	4.70M_D GM	—	Felt	46	—
1974	06	09	00 50 42.4	44.77 N	110.97 W	005	307	—	—	4.90M_L GS	—	II	47	—
1974	08	30	16 41 58.8	44.63 N	110.73 W	000	307	4.5	—	4.50M_L GS	—	V	47	—
1974	10	22	08 43 07.1	44.74 N	110.81 W	005	47	4.6	—	—	—	IV	47	—
1975	06	30	18 47 57.1	44.68 N	110.61 W	003	307	4.6	—	4.80M_L GS	—	—	—	—
1975	06	30	18 54 12.7	44.68 N	110.62 W	002	307	5.6	5.9	6.40M_L GS	—	VII	48	50
1975	06	30	19 00 27.4	44.77 N	110.72 W	005	48	5.1	—	5.30M_L GS	—	—	—	—
1975	06	30	19 56 33.7	44.71 N	110.52 W	005	48	4.7	—	4.50M_L GS	—	—	—	—
1975	06	30	20 20 56.6	44.69 N	110.59 W	005	48	4.9	—	4.60M_L GS	—	III	48	—
1976	12	08	14 40 59.1	44.76 N	110.79 W	005	49	5.5	—	4.60M_L GS	—	V	49	5
1976	12	09	22 36 23.7	44.77 N	110.80 W	005	49	4.5	—	5.10M_L GS	—	V	49	17
1976	12	19	17 10 15.6	44.77 N	110.80 W	005	49	4.9	—	4.50M_L GS	—	V	49	@
1980	02	22	10 18 27.7	44.81 N	110.90 W	000	308	4.5	—	4.70M_L GS	—	IV	300	—
1983	02	06	20 25 16.5	44.571N	110.643W	005	360	4.7	—	4.50M_L GS	—	V	360	5
1983	12	20	22 52 23.7	43.294N	110.767W	005	360	4.5	—	—	—	IV	360	—
1984	05	29	20 18 29.6	44.134N	106.099W	015	522	5.0	—	4.80M_n GDW	—	V	370	56
1984	09	08	00 59 31.1	44.138N	106.110W	015	522	5.1	—	5.00M_n GDW	4.94JOH	V	370	68
1984	10	18	15 30 22.0	42.317N	105.735W	022	522	5.4	5.1	5.50M_n GDW	—	VI	370	287
1984	11	03	09 30 08.4	42.534N	108.919W	005	522	5.0	4.1	4.50M_n GDW	—	VI	370	15
1985	09	07	03 47 29.2	43.156N	110.724W	005	371	—	—	4.60M_L GS	—	V	371	22

[Reference (Ref.) numbers given in parentheses at the end of each description refer to sources of data in table 1. Magnitude values are described in the Introduction, and codes are defined in table 2.]

1897. Nov. 14. Casper, Natrona County, Wyo. The northeast corner of the Grand Central Hotel at Casper sustained a 5- to 10-cm-wide crack that extended from the third to the first floor. The ceiling in the hotel lobby also was cracked. An almost deafening noise preceded the shaking. (Ref. 38, 359.)

1930. June 12. Grover, northern Lincoln County, Wyo. A minor earthquake cracked a brick building in Grover and a concrete swimming pool north of Grover. Cracks also formed in plaster, and clocks stopped running. Slight aftershocks continued until Nov. 16, 1930. (Ref. 3.)

1932. Jan. 26. Western Wyoming. At Jackson, in southern Teton County, an earthquake cracked floors and foundations, broke plaster, and tore wallpaper. Slight damage also occurred in the nearby towns of Grovont, Kelly, and Moran. One light foreshock was observed in the area on Jan. 25, and several minor aftershocks occurred through Jan. 28. (Ref. 5, 38, 279.)

Rockslide on Virginia Cascade Road in Yellowstone National Park, Wyoming, caused by the earthquake of June 30, 1975.

1936. Jan. 15 (Jan. 14). Yellowstone National Park, Wyo. An earthquake caused extensive cracks in two chimneys at the south entrance to the park, in northwest Wyoming. (Ref. 9, 38.)

1959. Aug. 18, 08 41 UTC. Yellowstone National Park, Wyo. An aftershock of the August 17, 1959, earthquake at Hegben Lake, Mont., broke a chimney at the Old Faithful Ranger Station in northwest Wyoming. Also felt at Fairfield, Idaho. (Ref. 32, 38, 576.)

1963. Mar. 8. Yellowstone National Park, Wyo. At the winter caretaker' s house in Canyon, large cracks separated the walls and ceilings in several rooms, and plaster cracked and fell. Aftershocks continued until Mar. 12. (Ref. 36, 266.)

1975. June 30. Yellowstone National Park, Wyo. This widely felt earthquake downed one chimney in the park at Norris Junction and formed cracks 90 m long in a parking lot. Rockfalls and landslides closed or hindered traffic on many roads in the park. Two new geysers formed; the Gibbon River was muddied; and the earth settled and cracked in the backcountry. Several aftershocks occurred through early July. Also felt in Montana, Idaho, South Dakota, Nebraska, Nevada, Utah, and Washington. Magnitude 6.1 Ukn BRK. (Ref. 38, 48, 307.)

1984. Oct. 18. Eastern Wyoming. Although this earthquake was felt over a large part of eight States (see fig. 64), only minor property damage occurred. The damage was characterized by cracked chimneys and

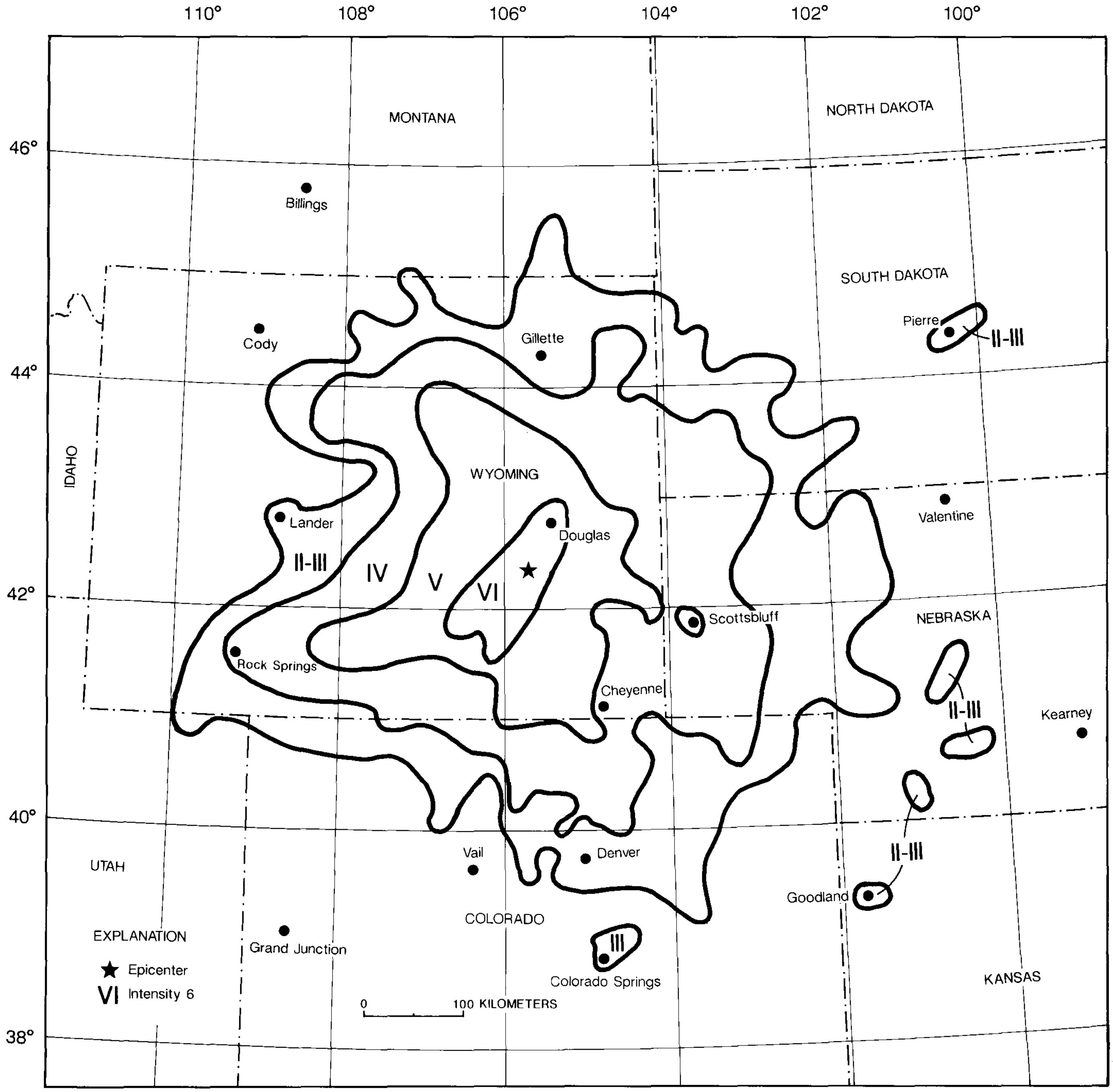


FIGURE 64.—Isoseismal map for the eastern Wyoming earthquake of October 18, 1984. This is a simplified version of figure 28 in reference 370 of table 1.

foundations and cracked brick and cinder-block walls at several towns, including Casper, Douglas, Guernsey, Hanna, Lusk, McFadden, Medicine Bow, Rock River, and Shirley Basin. Underground pipes were broken in Natrona County, at Casper, and in Carbon County, at Shirley Basin, about 40 km south of Casper. In addition, slight damage was reported at a few towns in Colorado, Nebraska, and South Dakota.

An unusual report of structural damage to two five-story buildings was received from Golden, Colo., about 300 km south of the epicenter. This damage, which consisted of foundation failure, cracks in walls, and a gas leak, may not have been caused by the earthquake. Felt in Colorado, Kansas, Montana, Nebraska, South Dakota, Utah, and Wyoming. Magnitude 5.5 M_L GS, 5.3 M_n TUL. (Ref. 370, 487, 522.)

1984. Nov. 3. Western Wyoming. At Lander, Fremont County, 50 buildings sustained cracks in walls, foundations, and windows; and glass was broken at the local hospital. About 30 km south of Lander, at South Pass City, cracks in windows and damage to glassware occurred, and residents had difficulty walking and standing. Magnitude 4.9 M_L BU, 5.1 M_L GS. (Ref. 370, 522.)

TABLES 1–3

TABLE 1.—*Hypocenter and intensity references*

[Please note that numbers in this table are not sequential because these references were selected from a master list compiled for other USGS publications]

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TABLE 1.—*Hypocenter and intensity references—Continued*

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TABLE 1.—*Hypocenter and intensity references—Continued*

[Please note that numbers in this table are not sequential because these references were selected from a master list compiled for other USGS publications]

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TABLE 2.—*Magnitude references*

AAM	University of Michigan, Ann Arbor, Mich.
ABE	Abe, Katsuyuki, 1981, Magnitude of large shallow earthquakes from 1904 to 1980: Physics of the Earth and Planetary Interiors, v. 27, p. 72–92.
AB1	Abe, Katsuyuki, and Noguchi, Shin'ichi, 1983, Determination of magnitude for large shallow earthquakes, 1898–1917: Physics of the Earth and Planetary Interiors, v. 32, p. 45–59.
AB2	Abe, Katsuyuki, and Noguchi, Shin'ichi, 1983, Revision of magnitudes of large shallow earthquakes, 1897–1912: Physics of the Earth and Planetary Interiors, v. 33, p. 1–11.
AB3	Abe, Katsuyuki, 1984, Complements to "Magnitudes of large shallow earthquakes from 1904 to 1980:" Physics of the Earth and Planetary Interiors, v. 34, p. 17–23.
ADK	Adak Observatory, U.S. National Oceanic and Atmospheric Administration, Adak Island, Aleutian Islands, Alaska.
AND	Ando, Masataka, 1979, The Hawaii earthquake of November 29, 1975: Low dip angle due to forceful injection of magma: Journal of Geophysical Research, v. 84, no. B13, p. 7616–7626.
ARC	Archuleta, R.J., Cranswick, E., Mueller, C., and Spudich, P., 1982, Source parameters of the 1980 Mammoth Lakes, California, earthquake sequence: Journal of Geophysical Research, v. 87, no. B6, p. 4595–4607.
AS	Armbruster, J.C., and Seeber, Leonardo, 1987, The 23 April 1984 Martic earthquake and the Lancaster seismic zone in eastern Pennsylvania: Seismological Society of America Bulletin, v. 77, no. 3, p. 877–890.
BAK	Bakun, W.H., 1984, Seismic moments, local magnitudes, and coda–duration magnitudes for earthquakes in central California: Seismological Society of America Bulletin, v. 74, no. 2, p. 439–458.
BAR	Barstow, N.L., Brill, K.G., Nuttli, O.W., and Pomeroy, P.W., 1981, An approach to seismic zonation for siting nuclear electric power generating facilities in the Eastern United States: Stone Ridge, N.J., Roundout Associates, Inc., report prepared for U.S. Nuclear Regulatory Commission, NUCREG/CR–1577, 315 p.
BAS	Basham, P.W., Weichert, D.H., and Berry, M.J., 1979, Regional assessment of seismic risk in Eastern Canada: Seismological Society of America, v. 69, no. 5, p. 1567–1602.
BL	Baker, G.E., and Langston, C.A., 1987, Source parameters of the 1949 magnitude 7.1 South Puget Sound, Washington, earthquake as determined from long-period body waves and strong ground motions: Seismological Society of America Bulletin, v. 77, no. 5, p. 1530–1557.
BLA	Seismological Observatory, Virginia Polytechnic Institute and State University, Blacksburg, Va.
BLT	Bolt, B.A., 1978, The local magnitude M_L of the Kern County earthquake of July 21, 1952: Seismological Society of America Bulletin, v. 68, no. 2, p. 513–515.
BMU	Bolt, B.A., McEvilly, T.V., and Uhrhammer, R.A., 1981, The Livermore Valley, California, sequence of January 1980: Seismological Society of America Bulletin, v. 71, no. 2, p. 451–463.
BOL	Bollinger, G.A., 1986, Historical seismicity of South Carolina [abs.]: Seismological Society of America, Eastern Section, Earthquake Notes, v. 57, no. 1, p. 15–16.
BOT	Bolt, B.A., 1984, The magnitude of the Hebgen Lake 1959 and Idaho 1983 earthquakes [abs.]: Seismological Society of America, Eastern Section, Earthquakes Notes, v. 55, no. 1, p. 13.
BRK	Seismographic Stations, University of California, Berkeley, Calif.
BU	Montana Bureau of Mines and Geology, Butte, Mont.
BUR	Burger, R.W., and Langston, C.A., 1985, Source mechanism of the May 18,1980, Mount St. Helens eruption from regional surface waves: Journal of Geophysical Research, v. 90, no. B9, p. 7653–7664.
CAR	Carlson, S.M., 1984, Investigations of recent and historical seismicity in east Texas: The University of Texas at Austin, Master of Arts thesis, 197 p.
CDL	Carver, D., Richins, W.D., and Langer, C.J., 1983, Details of the aftershock process following the 30 September 1977 Uinta Basin, Utah, earthquakes: Seismological Society of America Bulletin, v. 73, no. 2, p. 435–448.
CFR	Richter, C.F., 1958, Elementary Seismology: San Francisco, W.H. Freeman and Company, 768 p.
CON	University of Connecticut seismograph station, Groton, Conn.
COX	Cox, D.C., 1985, The Lanai earthquake of February 1871: Environmental Center,University of Hawaii, SR:0034, 50 p.
CWR	California Department of Water Resources, Sacramento, Calif.
DDA	Duda, S.J., 1965, Secular seismic energy release in the Circum-Pacific Belt: Tectonophysics, v. 2, no. 5, p. 409–452.

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DMG	California Division of Mines and Geology, Sacramento, Calif. [see ref. 368, 380, 381 in table 1].
DOR	Doser, D.I., 1989, Source parameters of Montana earthquakes (1925–1964) and tectonic deformation in the northern intermountain seismic belt: Seismological Society of America Bulletin, v. 79, no. 1, p. 31–50.
DOS	Doser, D.I., and Smith, R.B., 1982, Seismic moment rates in the Utah region: Seismological Society of America Bulletin, v. 72, no. 2, p. 525–551.
DSR	Doser, D.I., 1985, Source parameters and faulting processes of the 1959 Hebgen Lake, Montana, earthquake sequence: Journal of Geophysical Research, v. 90, no. B6, p. 4537–4555.
DW	Dewey, J.W., 1987, Instrumental seismicity of central Idaho: Seismological Society of America Bulletin, v. 77, no. 3, p. 819–836.
EBE	Eberhart–Phillips, D., Richardson, R.M., Sbar, M.L., and Herrmann, R.B., 1981, Analysis of the 4 February 1976 Chino Valley, Arizona, earthquake: Seismological Society of America Bulletin, v. 71, no. 3, p. 787–801.
ED	Ekstrom, G., and Dziewonski, A.M., 1985, Centroid–moment tensor solutions for 35 earthquakes in Western North America (1977–1983): Seismological Society of America Bulletin, v. 75, no. 1, p. 23–39.
ELL	Ellsworth, W.L, 1990, Historical seismicity, *in* Wallace, R.E., ed., The San Andreas fault system: U.S. Geological Survey Professional Paper 1515, p 153–181.
EPB	Seismological Service, Geological Survey of Canada [formerly Earth Physics Branch], Ottawa, Ont., Canada.
ESM	Ebel, J.E., Somerville, P.G., and McIver, J.D., 1986, A study of the source parameters of some large earthquakes of northeastern North America: Journal of Geophysical Research, v. 91, no. B8, p. 8231–8247.
FRK	Frankel, Arthur, 1984, Source parameters of the M_L about 5 earthquake near Anza, California, and a comparison with an Imperial Valley aftershock: Seismological Society of America Bulletin, v. 74, no. 5, p. 1509–1527.
GB	Bollinger, G.A., 1979, Attenuation of the L_g phase and the determination of Mb in the Southeastern United States: Seismological Society of America Bulletin, v. 69, no. 1, p. 45–63.
GDW	Gordon, D.W., 1990, U.S. Geological Survey unpublished data.
GM	U.S. Geological Survey, Menlo Park, Calif.
GOL	Geophysical Observatory, Colorado School of Mines, Golden, Colo.
GP	U.S. Geological Survey, Pasadena, Calif.
GR	Gutenberg, Beno, and Richter, C.F., 1954, Seismicity of the Earth and associated phenomena: New York, Hafner Publishing Inc., 310 p.
GS	U.S. Geological Survey, Golden, Colo.
GT	Georgia Institute of Technology, Atlanta, Ga.
HAV	Harvard University, Cambridge, Mass.
HB	Hartzell, S.H., and Brune, J.N., 1979, The Horse Canyon earthquake of August 2, 1975—two stage stress-release processs in a strike-slip earthquake: Seismological Society of America Bulletin, v. 69, no. 4, p. 1161–1173.
HBK	Hart, R.S., Butler, R., and Kanamori, H., 1977, Surface-wave constraints on the August 1, 1975, Oroville earthquake: Seismological Society of America Bulletin, v. 67, no. 1, p. 1–7.
HDP	Herrmann, R.B., Dewey, J.W., and Park, S-K., 1980, The Dulce, New Mexico, earthquake of 23 January 1966: Seismological Society of America Bulletin, v. 70, no. 6, p. 2171–2183.
HER	Herrmann, R.B., Park, S-K., and Wang, C-Y., 1981, The Denver earthquakes of 1967–1968: Seismological Society of America Bulletin, v. 71, no. 3, p. 731–745.
HH	Heaton, T.H., and Helmberger, D.V., 1978, Predictability of strong ground motion in the Imperial Valley: Modeling the M 4.9, November 4, 1976, Brawley earthquake: Seismological Society of America Bulletin, v. 68, no. 1, p. 31–48.
HHT	Hanks, T.C., Hileman, J.A., and Thatcher, W., 1975, Seismic moments of the larger earthquakes of the southern California region: Geological Society of America Bulletin, v. 86, p. 1131–1139.

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HLS	Hasegawa, H.W., Lahr, J.C., and Stephens, C.D., 1980, Fault parameters of the St. Elias, Alaska, earthquake of February 28, 1979: Seismological Society of America Bulletin, v. 70, no. 5, p. 1651–1660.
HRM	Herrmann, R.B., 1986, Surface-wave studies of some South Carolina earthquakes: Seismological Society of America Bulletin, v. 76, no. 1, p. 111–121.
HRN	Herrmann, R.B., 1979, Surface wave focal mechanisms for Eastern North America earthquakes with tectonic implications: Journal of Geophysical Research, v. 84, no. B7, p. 3543–3552.
HRR	Herrmann, R.B., Langston, C.A., and Zollweg, J.E., 1982, The Sharpsburg, Kentucky, earthquake of 27 July 1980: Seismological Society of America Bulletin, v. 72, no. 4, p. 1219–1239.
HVO	Hawaiian Volcano Observatory, U.S. Geological Survey, Hawaii National Park, Hawaii.
ISC	Bulletin of the International Seismological Centre, 1954–1989, Newbury, Berkshire, United Kingdom.
JDH	Jordan, J.N., Dunphy, G.J., and Harding, S.T., 1967, The Fairbanks, Alaska, earthquakes of June 21, 1967: U.S. Department of Commerce, Coast and Geodetic Survey, Preliminary Seismological Report, p. 1–33.
JLM	Jones, F.B., Long, L.T., and McKee, J.H., 1977, Study of the attenuation and azimuthal dependence of seismic wave propagation in the Southeastern United States: Seismological Society of America Bulletin, v. 67, no. 6, p. 1503–1513.
JLQ	Johnson, T.E., Ludwin, R.S., and Qamar, A.I., in press, The central Cascades earthquake of March 7, 1891: Washington Geology.
JM	Johnson, L.R., and McEvilly, T.V., 1974, Near-field observations and source parameters of central California earthquakes: Seismological Society of America Bulletin, v. 64, no. 6, p. 1855–1886.
JOH	Johnston, A.C., in press, The stable-continental-region earthquake data base, *in* Coppersmith, K.J., and others, eds., Methods for assessing maximum earthquakes in the Central and Eastern United States: Palo Alto, Calif., Electric Power Research Institute Project RP–2556–12.
JON	Jones, A.E., 1975, Recording of earthquakes at Reno, 1916–1951: Seismological Laboratory Bulletin, Mackay School of Mines–Nevada Bureau of Mines, University of Nevada–Reno, 199 p.
KA	Kanamori, Hiroo, and Anderson, D.L., 1975, Theoretical basis of some empirical relations in seismology: Seismological Society of America Bulletin, v. 65, no. 5, p. 1073–1095.
KAN	Kanamori, Hiroo, 1977, The energy release in great earthquakes: Journal of Geophysical Research, v. 82, no. 20, p. 2981–2987.
KIR	Kiruna Seismograph Station, University of Uppsala, Sweden.
KJ	Kanamori, Hiroo, and Jennings, P.C., 1978, Determination of local magnitude, M_L, from strong-motion accelerograms: Seismological Society of America Bulletin, v. 68, no. 2, p. 471–185.
KRK	Kirkham, R.M., and Rogers, W.P., 1986, An interpretation of the November 7, 1882, Colorado, earthquake: Colorado Geological Survey, Open-File Report 86–8, 36 p.
LB	Langston, C.A., and Blum, D.E., 1977, The April 29, 1965, Puget Sound earthquake and the crustal and upper mantle structure of western Washington: Seismological Society of America Bulletin, v. 67, no. 3, p. 693–711.
MAT	Matsushiro Seismological Observatory, Japan Meteorological Agency, Matsushiro, Japan.
MH	Mori, Juim, and Hartzell, Stephen, 1990, Source inversion of the 1988 Upland, California, earthquake—Determination of a fault plane for a small event: Seismological Society of America Bulletin, v. 80, no. 3, p. 507–518.
MMT	Montana College of Mineral Sciences and Technology, Butte, Mont.
MOS	Institute of Physics of the Earth of the U.S.S.R., Moscow.
MSO	University of Montana, Missoula, Mont.
NLI	Nuttli, O.W., 1983, Average seismic source-parameter relations for mid-plate earthquakes: Seismological Society of America Bulletin, v. 73, no. 2, p. 519–535.
NMI	New Mexico Institute of Mining and Technology, Socorro, N. Mex.
NQT	Noson, L.L., Qamar, A., and Thorsen, G.W., 1988, Washington State earthquake hazards: Washington Division of Geology and Earth Resources, Information Circular 85, p. 22.
NS	Natali, S.G., and Sbar, M.L., 1982, Seismicity in the epicentral region of the 1887 northeastern Sonoran earthquake, Mexico: Seismological Society of America Bulletin, v. 72, no. 1, p. 181–196.

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NTL	Nuttli, O.W., 1987, The effects of earthquakes in the Central United States: Central United States Earthquake Consortium, Monograph Series, v. 1, 33 p.
NTT	Nuttli, O.W., 1979, Seismicity of the Central United States, geology in the siting of nuclear power plants: Geological Society of America, Reviews in Engineering Geology, v. 4, p. 67–107.
NU	Nuttli, O.W., 1973, The Mississippi valley earthquakes of 1811 and 1812: Intensities, ground motion, and magnitudes: Seismological Society of America Bulletin, v. 63, no. 1, p. 227–248.
NUT	Nuttli, O.W., Bollinger, G.A., and Griffiths, D.W., 1979, On the relation between Modified Mercalli intensity and body-wave magnitude: Seismological Society of America Bulletin, v. 69, no. 3, p. 893–909.
PAL	Lamont-Doherty Geological Observatory, Columbia University, Palisades, N.Y.
PAS	Seismological Laboratory, California Institute of Technology, Pasadena, Calif.
PMR	Alaska Tsunami Warning Center, U.S. National Oceanic and Atmospheric Administration, Palmer, Alaska.
PT	Plafker, G., and Thatcher, W., 1982, Geological and geophysical evaluation of the great 1899–1900 Yakutat Bay, Alaska, earthquakes [abs.], *in* Coppersmith, K.J., and Schwartz, D.P., eds.: Chapman conference on fault behavior and the earthquake generation process, American Geophysical Union, p. 7.
QAM	Qamar, A., Rathburn, A., Ludwin R., Crosson, R.S., and Malone, S.D., 1986, Earthquake hypocenters in Washington and Northern Oregon—1980: Washington Division of Geology and Earth Resources, Innformation Circular 82, 64 p.
REN	Mackay School of Mines, University of Nevada–Reno, Reno, Nev.
RIC	Richter, C.F., 1935, An instrumental earthquake magnitude scale: Seismological Society of America Bulletin, v. 25, no. 1, p. 1–32.
RK	Ruff, Larry, Kanamori, Hiroo, and Sykes, Lynn, 1985, The 1957 great Aleutian earthquake [abs.]: EOS, Transactions, American Geophysical Union, v. 66, no. 18, p. 298.
ROG	Rogers, G.C., 1983, Seismotectonics of British Columbia: University of British Columbia, Canada, PhD. thesis, 247 p.
ROT	Rothé, J.P., 1969, The seismicity of the Earth: Paris, United Nations Educational, Scientific, and Cultural Organization, 336 p.
SAN	Sanford, A.R., and Toppozada, T.R., 1974, Seismicity of proposed waste disposal site in southeastern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Circular 143, 15 p.
SAW	Scholz, C.H., Aviles, C.A., and Wesnousky, S.G., 1986, Scaling differences between large interplate and intraplate earthquakes: Seismological Society of America Bulletin, v. 76, no. 1, p. 65–70.
SC	Stover, C.W., and Coffman, J.L., This publication.
SEE	Street, R.L., 1982, A contribution to the documentation of the 1811–1812 Mississippi valley earthquake sequence: Seismological Society of America, Eastern Section, Earthquake Notes, v. 51, no. 2, p. 39–52.
SET	Street, R.L., 1989, Personal communication, letter dated July 5, 1989.
SG	Street, R.L., and Green, R.F., 1984, The historical seismicity of Central United States, 1811–1928, University of Kentucky Research Foundation, Lexington, Ky., 550 p.
SJG	Slemmons, D.B., Jones, A.E., and Gimlet, J.I., 1965, Catalog of Nevada earthquakes, 1852–1960: Seismological Society of America Bulletin, v. 55, no. 2, p. 519–565.
SLM	Saint Louis University, Saint Louis, Mo.
SOM	Somerville, P.G., McLaren, J.P., LaFevre, L.V., Berger, R.W., and Helmberger, H.V., 1987, Comparison of source scaling relations of Eastern and Western North American earthquakes: Seismological Society of America Bulletin, v. 77, no. 2, p. 322–346.
SR	Schell, M.M., and Ruff, L.J., 1986, Southeastern Alaska tectonics: source process of the large 1972 Sitka earthquake [abs.]: EOS, Transactions, American Geophysical Union, v. 67, p. 304–305.
SRT	Street, R.L., 1984, Some recent Lg-phase displacement spectral densities and their implication with respect to the prediction of ground motions in Eastern North America: Seismological Society of America Bulletin, v. 74, no. 2, p. 757–762.
ST	Street, R.L., and Turcotte, F.T., 1977, A study of northeastern North America spectral moments, magnitudes, and intensities: Seismological Society of America Bulletin, v. 67, no. 3, p. 599–614.

TABLE 2.—*Magnitude references—Continued*

STR	Street, R.L., 1976, Scaling Northeastern United States/Southeasten Canadian earthquakes by their Lg waves: Seismological Society of America Bulletin, v. 66, no. 5, p. 1525–1537.
STT	Street, R.L., Herrmann, R.B., and Nuttli, O.W., 1975, Spectral characteristics of the L_g wave generated by Central United States earthquakes: Geophysical Journal of Royal Astronomical Society, v. 41, p. 51–63.
SZ	Schwartz, S.Y., and Christensen, D.H., 1988, The 12 July 1986 St. Marys, Ohio, earthquake and recent seismicity in the Anna, Ohio, seismogenic zone: Seismological Society of America, Eastern Section, Seismological Research Letters, v. 59, no. 2, p. 57–62.
TAG	Taggart, James, and Baldwin, Frank, 1982, Earthquake sequence of 1938–1939 in Mogollen Mountains, New Mexico: New Mexico Geology, v. 4, no. 4, p. 49–52.
TEC	Center for Earthquake Research and Information, Memphis State University, Memphis, Tenn.
TH	Thatcher, W., and Hanks, T.C., 1973, Source parameters of southern California earthquakes: Journal of Geophysical Research, v. 78, no. 35, p. 8547–8576.
THH	Thatcher, W., Hileman, J.A., and Hanks, T.C., 1975, Seismic slip distribution along the San Jacinto fault zone, southern California, and its implications: Geological Society of America Bulletin, v. 86, p. 1140–1146.
TUL	Oklahoma Geophysical Observatory, Oklahoma Geological Survey, Leonard, Okla.
TW	Thatcher, W., 1975, Strain accumulation and release mechanism of the 1906 San Francisco earthquake: Journal of Geophysical Research, v. 80, no. 35, p. 4862–4880.
UH	University of Hawaii, Honolulu, Hawaii.
UPP	Uppsala Seismograph Station, University of Uppsala, Sweden.
UU	Seismograph Stations, University of Utah, Salt Lake City, Utah.
VIC	Victoria Geophysical Observatory, Victoria, B.C., Canada.
VOS	Voss, J.A., and Herrmann, R.B., 1980, A surface-wave study of the June 16, 1978, Texas earthquake: Seismological Society of America, Eastern Section, Earthquake Notes, v. 51, no. 1, p. 3–14.
WAL	Wallace, R.E., 1984, Fault scarps formed during the earthquakes of October 2, 1915, in Pleasant Valley, Nevada, and some tectonic implications, *in* Faulting related to the 1915 earthquakes in Pleasant Valley, Nevada: U.S. Geological Survey Professional Paper 1274–A, p. A1–A33.
WAS	University of Washington, Seattle, Wash.
WES	Weston Observatory, Boston College, Weston, Mass.
WK	Webb, T.H., and Kanamori, Hiroo, 1985, Earthquake focal mechanism in the Eastern Transverse Ranges and San Emigdio Mountains, southern California, and evidence for a regional decollement: Seismological Society of America Bulletin, v. 75, no. 3, p. 737–757.
WOO	Wood, H.O., 1947, Earthquakes in southern California with geologic relations: Seismological Society of America Bulletin, v 37, no. 3, p. 217–258.
WY	Wyss, Max, and Koyanagi, Robert, in press, Isoseismal maps, macroseismic epicenters and estimated magnitudes of historical earthquakes in the Hawaiian Islands: U.S. Geological Survey Bulletin.
WYS	Wyss, Max, and Brune, J.N., 1968, Seismic moment, stress, and source dimensions for earthquakes in the California-Nevada region: Journal of Geophysical Research, v. 73, no., 14, p. 4681–1694.
YEL	Yelin, Tom, 1991, University of Washington, personal communication.
YP	Yelin, T.S., and Patton, H.J., 1991, Seismotectonics of the Portland, Oregon, region: Seismological Society of America Bulletin, v. 81, no. 1, p. 109–130.

TABLE 3.—*Deaths from earthquakes in the United States*

Date	Earthquake locality	No. of deaths
December 16, 1811–February 7, 1812	Northeast Arkansas–New Madrid, Missouri	Several
December 8, 1812	San Juan Capistrano, California	40
December 21, 1812	Santa Barbara, California	1
January 9, 1857	Fort Tejon, California	1
April 3, 1868	Hawaii Island, Hawaii (landslides—31, tsunami—46)	77
October 21, 1868	Hayward, California	30
March 26, 1872	Owens Valley, California	27
May 10, 1877	Hawaii Island, Hawaii	5
September 1, 1886	Charleston, South Carolina	60
April 19, 1892	Vacaville, California	1
December 25, 1899	San Jacinto, California	6
April 18, 1906	San Francisco, California (earthquake and fire)	about 3,000
June 23, 1915	Imperial Valley, California	6
April 21, 1918	San Jacinto, California	1
June 29, 1925	Santa Barbara, California	13
June 29, 1926	Santa Barbara, California	1
June 6, 1932	Eureka, California	1
March 11, 1933	Long Beach, California	115
October 19, 1935	Helena, Montana	2
October 31, 1935	Helena, Montana	2
May 19, 1940	Imperial Valley, California	9
April 1, 1946	Aleutian Islands, Alaska (tsunami—159 Hawaii, 5 Alaska, 1 California)	165
April 13, 1949	Puget Sound, Washington	8
July 21, 1952	Kern County, California	12
August 22, 1952	Kern County, California	2
December 21, 1954	Eureka, California	1
October 24, 1955	Concord, California	1
March 22, 1957	Daly City, California	1
July 10, 1958	Southeastern Alaska	5
August 18, 1959	Hebgen Lake, Montana	28
May 21, 1960	Chile, South America (tsunami in Hawaii)	61
March 28, 1964	Prince William Sound, Alaska (tsunami—98 Alaska, 11 California, 1 Oregon; earthquake—15 Alaska)	125
April 29, 1965	Seattle, Washington	7
October 2, 1969	Santa Rosa, California	1
February 9, 1971	San Fernando, California	65
November 29, 1975	Hawaii Island, Hawaii	2
October 28, 1983	Borah Peak, Idaho	2
October 1, 1987	Los Angeles–Whittier, California	8
October 4, 1987	Los Angeles–Whittier, California	1
August 8, 1989	Santa Cruz County, California	1
October 18, 1989	Santa Cruz County, California	63

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