Topic	Global 1-D Earth models
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Below, data and background information on the most frequently used 1-D Earth reference models in global seismology have been compiled by using Appendix 1 of Shearer (1999), Kennett (1991) and personal information received from B. Kennett (2002).

1 PREM Model

For many years the most widely used 1-D model of seismic velocities in the Earth has been the Preliminary Reference Earth Model (PREM) of Dziewonski and Anderson (1981). This model was designed to fit a variety of different data sets, including free oscillation center frequency measurements, surface-wave dispersion observations, travel-time data for a number of body-wave phases, and basic astronomical data (Earth´s radius, mass, and moment of inertia). Table 1 summarizes, as functions of depth and Earth´s radius, the PREM velocities v_p and v_s for P and S waves, the density ρ, the shear and bulk quality factors, Q_μ and Q_κ, and the pressure P. Note, that density and attenuation (~ 1/Q) are known less precisely than the seismic velocities but these parameters are required for computing synthetic seismograms. In order to simultaneously fit Love- and Rayleigh-wave observations, PREM is transversely isotropic between 80 and 220 km depth in the upper mantle. Transverse isotropy is a spherically symmetric form of anisotropy in which SH and SV waves travel at different speeds. Table 1, however, lists only values from an isotropic version of PREM. The true PREM model is also specified in terms of polynomials between node points. Linear interpolation between the values given in Table 1 will produce only approximate results. All current Earth models have values that are reasonably close to PREM. The largest differences are in the upper mantle where PREM shows a discontinuity at 220 km which is not found in most other models. Fig. 2.53 in Chapter 2 depicts PREM together with the more recent model AK135 (see Table 3 below).

Table 1 Preliminary Reference Earth Model (isotropic version)

Depth (km)	Radius (km)	v_p (km/s)	v_s (km/s)	ρ (g/cm^3)	Q_μ	Q_κ	*P* (GPa)
0.0	6371.0	1.45	0.00	1.02	0.0	57823.0	0.0
3.0	6368.0	1.45	0.00	1.02	0.0	57823.0	0.0
3.0	6368.0	5.80	3.20	2.60	600.0	57823.0	0.0
15.0	6356.0	5.80	3.20	2.60	600.0	57823.0	0.3
15.0	6356.0	6.80	3.90	2.90	600.0	57823.0	0.3
24.4	6346.6	6.80	3.90	2.90	600.0	57823.0	0.6
24.4	6346.6	8.11	4.49	3.38	600.0	57823.0	0.6
71.0	6300.0	8.08	4.47	3.38	600.0	57823.0	2.2
80.0	6291.9	8.08	4.47	3.37	600.0	57823.0	2.5
80.0	6291.0	8.08	4.47	3.37	80.0	57823.0	2.5
171.0	6200.0	8.02	4.44	3.36	80.0	57823.0	5.5
220.0	6151.0	7.99	4.42	3.36	80.0	57823.0	7.1
220.0	6151.0	8.56	4.62	3.44	143.0	57823.0	7.1
271.0	6100.0	8.66	4.68	3.47	143.0	57823.0	8.9

Table 1 (continued)

Depth (km)	Radius (km)	v_p (km/s)	v_s (km/s)	ρ (g/cm^3)	Q_μ	Q_κ	*P* (GPa)
371.0	6000.0	8.85	4.75	3.53	143.0	57823.0	12.3
400.0	5971.0	8.91	4.77	3.54	143.0	57823.0	13.4
400.0	5971.0	9.13	4.93	3.72	143.0	57823.0	13.4
471.0	5900.0	9.50	5.14	3.81	143.0	57823.0	16.0
571.0	5800.0	10.01	5.43	3.94	143.0	57823.0	19.9
600.0	5771.0	10.16	5.52	3.98	143.0	57823.0	21.0
600.0	5771.0	10.16	5.52	3.98	143.0	57823.0	21.0
670.0	5701.0	10.27	5.57	3.99	143.0	57823.0	23.8
670.0	5701.0	10.75	5.95	4.38	312.0	57823.0	23.8
771.0	5600.0	11.07	6.24	4.44	312.0	57823.0	28.3
871.0	5500.0	11.24	6.31	4.50	312.0	57823.0	32.8
971.0	5400.0	11.42	6.38	4.56	312.0	57823.0	37.3
1071.0	5300.0	11.58	6.44	4.62	312.0	57823.0	41.9
1171.0	5200.0	11.78	6.50	4.68	312.0	57823.0	46.5
1271.0	5100.0	11.88	6.56	4.73	312.0	57823.0	51.2
1371.0	5000.0	12.02	6.62	4.79	312.0	57823.0	55.9
1471.0	4900.0	12.16	6.67	4.84	312.0	57823.0	60.7
1571.0	4800.0	12.29	6.73	4.90	312.0	57823.0	65.5
1671.0	4700.0	12.42	6.78	4.95	312.0	57823.0	70.4
1771.0	4600.0	12.54	6.83	5.00	312.0	57823.0	75.4
1871.0	4500.0	12.67	6.87	5.05	312.0	57823.0	80.4
1971.0	4400.0	12.78	6.92	5.11	312.0	57823.0	85.5
2071.0	4300.0	12.90	6.97	5.16	312.0	57823.0	90.6
2171.0	4200.0	13.02	7.01	5.21	312.0	57823.0	95.8
2271.0	4100.0	13.13	7.06	5.26	312.0	57823.0	101.1
2371.0	4000.0	13.25	7.10	5.31	312.0	57823.0	106.4
2471.0	3900.0	13.36	7.14	5.36	312.0	57823.0	111.9
2571.0	3800.0	13.48	7.19	5.41	312.0	57823.0	117.4
2671.0	3700.0	13.60	7.23	5.46	312.0	57823.0	123.0
2741.0	3630.0	13.68	7.27	5.49	312.0	57823.0	127.0
2771.0	3600.0	13.69	7.27	5.51	312.0	57823.0	128.8
2871.0	3500.0	13.71	7.26	5.56	312.0	57823.0	134.6
2891.0	3480.0	13.72	7.26	5.57	312.0	57823.0	135.8
2891.0	3480.0	8.06	0.00	9.90	0.0	57823.0	135.8
2971.0	3400.0	8.20	0.00	10.03	0.0	57823.0	144.2
3071.0	3300.0	8.36	0.00	10.18	0.0	57823.0	154.8
3171.0	3200.0	8.51	0.00	10.33	0.0	57823.0	165.2
3271.0	3100.0	8.66	0.00	10.47	0.0	57823.0	175.5
3371.0	3000.0	8.80	0.00	10.60	0.0	57823.0	185.7
3471.0	2900.0	8.93	0.00	10.73	0.0	57823.0	195.8
3571.0	2800.0	9.05	0.00	10.85	0.0	57823.0	205.7
3671.0	2700.0	9.17	0.00	10.97	0.0	57823.0	215.4
3771.0	2600.0	9.28	0.00	11.08	0.0	57823.0	224.9
3871.0	2500.0	9.38	0.00	11.19	0.0	57823.0	234.2
3971.0	2400.0	9.48	0.00	11.29	0.0	57823.0	243.3
4071.0	2300.0	9.58	0.00	11.39	0.0	57823.0	252.2

Table 1 (continued)

Depth (km)	Radius (km)	v_p (km/s)	v_s (km/s)	ρ (g/cm^3)	Q_μ	Q_κ	*P* (GPa)
4171.0	2200.0	9.67	0.00	11.48	0.0	57823.0	260.8
4271.0	2100.0	9.75	0.00	11.57	0.0	57823.0	269.1
4371.0	2000.0	9.84	0.00	11.65	0.0	57823.0	277.1
4471.0	1900.0	9.91	0.00	11.73	0.0	57823.0	284.9
4571.0	1800.0	9.99	0.00	11.81	0.0	57823.0	292.3
4671.0	1700.0	10.06	0.00	11.88	0.0	57823.0	299.5
4771.0	1600.0	10.12	0.00	11.95	0.0	57823.0	306.2
4871.0	1500.0	10.19	0.00	12.01	0.0	57823.0	312.7
4971.0	1400.0	10.25	0.00	12.07	0.0	57823.0	318.9
5071.0	1300.0	10.31	0.00	12.12	0.0	57823.0	324.7
5149.5	1221.5	10.36	0.00	12.17	0.0	57823.0	329.0
5149.5	1221.5	11.03	3.50	12.76	84.6	57823.0	329.0
5171.0	1200.0	11.04	3.51	12.77	84.6	57823.0	330.2
5271.0	1100.0	11.07	3.54	12.82	84.6	57823.0	335.5
5371.0	1000.0	11.11	3.56	12.87	84.6	57823.0	340.4
5471.0	900.0	11.14	3.58	12.91	84.6	57823.0	344.8
5571.0	800.0	11.16	3.60	12.95	84.6	57823.0	348.8
5671.0	700.0	11.19	3.61	12.98	84.6	57823.0	352.2
5771.0	600.0	11.21	3.63	13.01	84.6	57823.0	355.4
5871.0	500.0	11.22	3.64	13.03	84.6	57823.0	358.0
5971.0	400.0	11.24	3.65	13.05	84.6	57823.0	360.2
6071.0	300.0	11.25	3.66	13.07	84.6	57823.0	361.8
6171.0	200.0	11.26	3.66	13.08	84.6	57823.0	363.0
6271.0	100.0	11.26	3.67	13.09	84.6	57823.0	363.7
6371.0	0.0	11.26	3.67	13.09	84.6	57823.0	364.0

2 IASP91 velocity model

According to Kennett (1991) and Kennett and Engdahl (1991), the IASP91 model is a parameterized velocity model, in terms of normalized radius. It has been constructed to be a summary of the travel-time characteristics of the main seismic phases.

The crust consists of two uniform layers with discontinuities at 20 and 35 km. Between 35 and 760 km the velocities in each layer are represented by a linear gradient in radius. The major mantle discontinuities are set at 410 km and 660 km. The upper mantle model is designed for the specific purpose of representing the 'average' observed times for P and S waves out to 30° as well as providing a tie to teleseismic times. Since the distribution of seismic sources and recording stations is far from uniform, the IASP91 model will include geographical bias as well as the constraints imposed by the specific parameterization.

The distribution of P- and S-wave velocities, v_p and v_s, in the lower mantle is represented by a cubic radius between 760 km and 2740 km. The velocities in the lowermost mantle are taken as a linear gradient in radius down to the core-mantle boundary at 3482 km. In the core and inner core the velocity functions are specified as quadratic polynomials in radius.

Table 2.1 presents the parameterized form and Table 2.2 the tabulated form of the IASP91.

Table 2.1 Parameterized form of the IASP91 model
(x = normalised radius r/a where a = 6371 km)

Depth (z km)	Radius (r km)	v_p (km/s)	v_s (km/s)
6371-5153.9	0-1217.1	11.24094	3.56454
		-4.09689 x^2	-3.45241 x^2
5153.9-2889	1217.1-3482	10.03904	0
		3.75665 x	
		-13.67046 x^2	
2889-2740	3482-3631	14.49470	816616
		-1.47089 x	-1.58206 x
2740-760	3631-5611	25.1486	12.9303
		-41.1538 x	-21.2590 x
		+51.9932 x^2	+27.8988 x^2
		-26.6083 x^3	-14.1080 x^3
760-660	5611-5711	25.96984	20.76890
		-16.93412 x	-16.53147 x
660-410	5711-5961	29.38896	17.70732
		-21.40656 x	-13.50652
410-210	5961-6161	30.78765	15.24213
		-23.25415 x	-11.08552
210-120	6161-6251	25.41389	5.75020
		-17.69722 x	-1.27420
120-35	6251-6336	8.78541	6.706231
		-0.74953 x	-2.248585
35-20	6336-6351	6.50	3.75
20-0	6351-6371	5.80	3.36

Table 2.2 The IASP91 velocity model

Depth (km)	Radius (km)	v_p (km/s)	v_s (km/s)
6371.00	0.	11.2409	3.5645
6271.00	100.000	11.2399	3.5637
6171.00	200.000	11.2369	3.5611
6071.00	300.000	11.2319	3.5569
5971.00	400.000	11.2248	3.5509
5871.00	500.000	11.2157	3.5433
5771.00	600.000	11.2046	3.5339
5671.00	700.000	11.1915	3.5229
5571.00	800.000	11.1763	3.5101
5471.00	900.000	11.1592	3.4956
5371.00	1000.00	11.1400	3.4795
5271.00	1100.00	11.1188	3.4616
5171.00	1200.00	11.0956	3.4421
5153.90	1217.10	11.0914	3.4385
5153.90	1217.10	10.2578	0.
5071.00	1300.00	10.2364	0.
4971.00	1400.00	10.2044	0.
4871.00	1500.00	10.1657	0.
4771.00	1600.00	10.1203	0.
4671.00	1700.00	10.0681	0.
4571.00	1800.00	10.0092	0.
4471.00	1900.00	9.9435	0.
4371.00	2000.00	9.8711	0.
4271.00	2100.00	9.7920	0.
4171.00	2200.00	9.7062	0.
4071.00	2300.00	9.6136	0.
3971.00	2400.00	9.5142	0.
3871.00	2500.00	9.4082	0.
3771.00	2600.00	9.2954	0.
3671.00	2700.00	9.1758	0.
3571.00	2800.00	9.0496	0.
3471.00	2900.00	8.9166	0.
3371.00	3000.00	8.7768	0.
3271.00	3100.00	8.6303	0.
3171.00	3200.00	8.4771	0.
3071.00	3300.00	8.3171	0.
2971.00	3400.00	8.1504	0.
2889.00	3482.00	8.0087	0.
2889.00	3482.00	13.6908	7.3015
2871.00	3500.00	13.6866	7.2970
2771.00	3600.00	13.6636	7.2722
2740.00	3631.00	13.6564	7.2645
2740.00	3631.00	13.6564	7.2645
2671.00	3700.00	13.5725	7.2302
2571.00	3800.00	13.4531	7.1819
2471.00	3900.00	13.3359	7.1348

Table 2.2 (continued)

Depth (km)	Radius (km)	v_p (km/s)	v_s (km/s)
2371.00	4000.00	13.2203	7.0888
2271.00	4100.00	13.1055	7.0434
2171.00	4200.00	12.9911	6.9983
2071.00	4300.00	12.8764	6.9532
1971.00	4400.00	12.7607	6.9078
1871.00	4500.00	12.6435	6.8617
1771.00	4600.00	12.5241	6.8147
1671.00	4700.00	12.4020	6.7663
1571.00	4800.00	12.2764	6.7163
1471.00	4900.00	12.1469	6.6643
1371.00	5000.00	12.0127	6.6101
1271.00	5100.00	11.8732	6.5532
1171.00	5200.00	11.7279	6.4933
1071.00	5300.00	11.5761	6.4302
971.00	5400.00	11.4172	6.3635
871.00	5500.00	11.2506	6.2929
771.00	5600.00	11.0756	6.2180
760.00	5611.00	11.0558	6.2095
760.00	5611.00	11.0558	6.2095
671.00	5700.00	10.8192	5.9785
660.00	5711.00	10.7900	5.9500
660.00	5711.00	10.2000	5.6000
571.00	5800.00	9.9010	5.4113
471.00	5900.00	9.5650	5.1993
410.00	5961.00	9.3600	5.0700
410.00	5961.00	9.0300	4.8700
371.00	6000.00	8.8877	4.8021
271.00	6100.00	8.5227	4.6281
210.00	6161.00	8.3000	4.5220
210.00	6161.00	8.3000	4.5180
171.00	6200.00	8.1917	4.5102
120.00	6251.00	8.0500	4.5000
120.00	6251.00	8.0500	4.5000
71.00	6300.00	8.0442	4.4827
35.00	6336.00	8.0400	4.4700
35.00	6336.00	6.5000	3.7500
20.00	6351.00	6.5000	3.7500
20.00	6351.00	5.8000	3.3600
0.	6371.00	5.8000	3.3600

3 Model AK135

The AK135 velocity model has been augmented with a density and Q model by combining the study of travel times with those of free oscillations. This velocity and density model is the product of two pieces of work.

(1) The velocity model below 120 km depth comes from the work of Kennett et al. (1995). The original continental structure for the uppermost layering is given in Tab. 3.1 below. This model probably gives a reasonable representation of spherically averaged structure below 760 km depth. The upper mantle, as in IASP91, is an artificial construct which gives a good fit to the ensemble of observed travel times out to 30 degrees. The structure in D" should also be regarded as representative.

The representation of the velocity model is via point-wise values in velocity and linear interpolation in radius is used as the basis of the travel-time calculations. Note that AK135, unlike IASP91, is not a parameterized model. Any suitable interpolation scheme may be used where appropriate. A software conversion is available for reading velocity models into the IASP travel-time software and ellipticity corrections have been constructed for all the phases represented by that software. The software can be obtained from http://rses.anu.edu.au/ seismology/ ttsoft.html.

(2) Modified density and Q models come from a study by Montagner and Kennett (1996). This study introduces a density model and Q to the velocity distribution from the travel-time work to try to fit observations of free oscillation frequencies. An averaged uppermost structure is imposed on the AK135 velocities. The version of the model represented here is isotropic, even though the paper investigates the inclusion of anisotropy as well.

The complex density structure in the upper mantle with a density inversion reflects the absence of a low velocity zone in the wave-speed model. For a spherical average either a low shear-wave zone or a low density zone is needed to match the free oscillation frequencies. The Q values are those needed to bring the 1 Hz travel-time velocities into a match with the free oscillations and also give a good fit to observed Q values for the normal modes.

NB: The upper mantle density model should be treated with caution and may well change with further work.

Table 3 AK135 velocity model for travel times

3.1 Continental structure

Depth (km)	v_p (km/s)	v_s (km/s)
0.000	5.8000	3.4600
20.000	5.8000	3.4600
20.000	6.5000	3.8500
35.000	6.5000	3.8500
35.000	8.0400	4.4800
77.500	8.0450	4.4900
120.000	8.0500	4.5000

3.2 Average structure

Depth (km)	Density (g/cm³)	v_p (km/s)	v_s (km/s)	Q_α	Q_μ
0.00	1.0200	1.4500	0.0000	57822.00	0.00
3.00	1.0200	1.4500	0.0000	57822.00	0.00
3.00	2.0000	1.6500	1.0000	163.35	80.00
3.30	2.0000	1.6500	1.0000	163.35	80.00
3.30	2.6000	5.8000	3.2000	1478.30	599.99
10.00	2.6000	5.8000	3.2000	1478.30	599.99
10.00	2.9200	6.8000	3.9000	1368.02	599.99
18.00	2.9200	6.8000	3.9000	1368.02	599.99
18.00	3.6410	8.0355	4.4839	950.50	394.62
43.00	3.5801	8.0379	4.4856	972.77	403.93
80.00	3.5020	8.0400	4.4800	1008.71	417.59
80.00	3.5020	8.0450	4.4900	182.03	75.60
120.00	3.4268	8.0505	4.5000	182.57	76.06
165.00	3.3711	8.1750	4.5090	188.72	76.55
210.00	3.3243	8.3007	4.5184	200.97	79.40
210.00	3.3243	8.3007	4.5184	338.47	133.72
260.00	3.3663	8.4822	4.6094	346.37	136.38
310.00	3.4110	8.6650	4.6964	355.85	139.38
360.00	3.4577	8.8476	4.7832	366.34	142.76
410.00	3.5068	9.0302	4.8702	377.93	146.57
410.00	3.9317	9.3601	5.0806	413.66	162.50
460.00	3.9273	9.5280	5.1864	417.32	164.87
510.00	3.9233	9.6962	5.2922	419.94	166.80
560.00	3.9218	9.8640	5.3989	422.55	168.78
610.00	3.9206	10.0320	5.5047	425.51	170.82
660.00	3.9201	10.2000	5.6104	428.69	172.93
660.00	4.2387	10.7909	5.9607	1350.54	549.45
710.00	4.2986	10.9222	6.0898	1311.17	543.48
760.00	4.3565	11.0553	6.2100	1277.93	537.63
809.50	4.4118	11.1355	6.2424	1269.44	531.91
859.00	4.4650	11.2228	6.2799	1260.68	526.32
908.50	4.5162	11.3068	6.3164	1251.69	520.83
958.00	4.5654	11.3897	6.3519	1243.02	515.46
1007.50	4.5926	11.4704	6.3860	1234.54	510.20
1057.00	4.6198	11.5493	6.4182	1226.52	505.05
1106.50	4.6467	11.6265	6.4514	1217.91	500.00
1156.00	4.6735	11.7020	6.4822	1210.02	495.05
1205.50	4.7001	11.7768	6.5131	1202.04	490.20
1255.00	4.7266	11.8491	6.5431	1193.99	485.44
1304.50	4.7528	11.9208	6.5728	1186.06	480.77
1354.00	4.7790	11.9891	6.6009	1178.19	476.19
1403.50	4.8050	12.0571	6.6285	1170.53	471.70
1453.00	4.8307	12.1247	6.6554	1163.16	467.29
1502.50	4.8562	12.1912	6.6813	1156.04	462.96
1552.00	4.8817	12.2558	6.7070	1148.76	458.72
1601.50	4.9069	12.3181	6.7323	1141.32	454.55
1651.00	4.9321	12.3813	6.7579	1134.01	450.45

Table 3.2 (continued)

Depth (km)	Density (g/cm³)	v_p (km/s)	v_s (km/s)	Q_α	Q_μ
1700.50	4.9570	12.4427	6.7820	1127.02	446.43
1750.00	4.9817	12.5030	6.8056	1120.09	442.48
1799.50	5.0062	12.5638	6.8289	1108.58	436.68
1849.00	5.0306	12.6226	6.8517	1097.16	431.03
1898.50	5.0548	12.6807	6.8743	1085.97	425.53
1948.00	5.0789	12.7384	6.8972	1070.38	418.41
1997.50	5.1027	12.7956	6.9194	1064.23	414.94
2047.00	5.1264	12.8524	6.9416	1058.03	411.52
2096.50	5.1499	12.9093	6.9625	1048.09	406.50
2146.00	5.1732	12.9663	6.9852	1042.07	403.23
2195.50	5.1963	13.0226	7.0069	1032.14	398.41
2245.00	5.2192	13.0786	7.0286	1018.38	392.16
2294.50	5.2420	13.1337	7.0504	1008.79	387.60
2344.00	5.2646	13.1895	7.0722	999.44	383.14
2393.50	5.2870	13.2465	7.0932	990.77	378.79
2443.00	5.3092	13.3017	7.1144	985.63	375.94
2492.50	5.3313	13.3584	7.1368	976.81	371.75
2542.00	5.3531	13.4156	7.1584	968.46	367.65
2591.50	5.3748	13.4741	7.1804	960.36	363.64
2640.00	5.3962	13.5311	7.2031	952.00	359.71
2690.00	5.4176	13.5899	7.2253	940.88	354.61
2740.00	5.4387	13.6498	7.2485	933.21	350.88
2740.00	5.6934	13.6498	7.2485	722.73	271.74
2789.67	5.7196	13.6533	7.2593	726.87	273.97
2839.33	5.7458	13.6570	7.2700	725.11	273.97
2891.50	5.7721	13.6601	7.2817	723.12	273.97
2891.50	9.9145	8.0000	0.0000	57822.00	0.00
2939.33	9.9942	8.0382	0.0000	57822.00	0.00
2989.66	10.0722	8.1283	0.0000	57822.00	0.00
3039.99	10.1485	8.2213	0.0000	57822.00	0.00
3090.32	10.2233	8.3122	0.0000	57822.00	0.00
3140.66	10.2964	8.4001	0.0000	57822.00	0.00
3190.99	10.3679	8.4861	0.0000	57822.00	0.00
3241.32	10.4378	8.5692	0.0000	57822.00	0.00
3291.65	10.5062	8.6496	0.0000	57822.00	0.00
3341.98	10.5731	8.7283	0.0000	57822.00	0.00
3392.31	10.6385	8.8036	0.0000	57822.00	0.00
3442.64	10.7023	8.8761	0.0000	57822.00	0.00
3492.97	10.7647	8.9461	0.0000	57822.00	0.00
3543.30	10.8257	9.0138	0.0000	57822.00	0.00
3593.64	10.8852	9.0792	0.0000	57822.00	0.00
3643.97	10.9434	9.1426	0.0000	57822.00	0.00
3694.30	11.0001	9.2042	0.0000	57822.00	0.00
3744.63	11.0555	9.2634	0.0000	57822.00	0.00
3794.96	11.1095	9.3205	0.0000	57822.00	0.00
3845.29	11.1623	9.3760	0.0000	57822.00	0.00
3895.62	11.2137	9.4297	0.0000	57822.00	0.00

Table 3.2 (continued)

Depth (km)	Density (g/cm³)	v_p (km/s)	v_s (km/s)	Q_α	Q_μ
3945.95	11.2639	9.4814	0.0000	57822.00	0.00
3996.28	11.3127	9.5306	0.0000	57822.00	0.00
4046.62	11.3604	9.5777	0.0000	57822.00	0.00
4096.95	11.4069	9.6232	0.0000	57822.00	0.00
4147.28	11.4521	9.6673	0.0000	57822.00	0.00
4197.61	11.4962	9.7100	0.0000	57822.00	0.00
4247.94	11.5391	9.7513	0.0000	57822.00	0.00
4298.27	11.5809	9.7914	0.0000	57822.00	0.00
4348.60	11.6216	9.8304	0.0000	57822.00	0.00
4398.93	11.6612	9.8682	0.0000	57822.00	0.00
4449.26	11.6998	9.9051	0.0000	57822.00	0.00
4499.60	11.7373	9.9410	0.0000	57822.00	0.00
4549.93	11.7737	9.9761	0.0000	57822.00	0.00
4600.26	11.8092	10.0103	0.0000	57822.00	0.00
4650.59	11.8437	10.0439	0.0000	57822.00	0.00
4700.92	11.8772	10.0768	0.0000	57822.00	0.00
4751.25	11.9098	10.1095	0.0000	57822.00	0.00
4801.58	11.9414	10.1415	0.0000	57822.00	0.00
4851.91	11.9722	10.1739	0.0000	57822.00	0.00
4902.24	12.0001	10.2049	0.0000	57822.00	0.00
4952.58	12.0311	10.2329	0.0000	57822.00	0.00
5002.91	12.0593	10.2565	0.0000	57822.00	0.00
5053.24	12.0867	10.2745	0.0000	57822.00	0.00
5103.57	12.1133	10.2854	0.0000	57822.00	0.00
5153.50	12.1391	10.2890	0.0000	57822.00	0.00
5153.50	12.7037	11.0427	3.5043	633.26	85.03
5204.61	12.7289	11.0585	3.5187	629.89	85.03
5255.32	12.7530	11.0718	3.5314	626.87	85.03
5306.04	12.7760	11.0850	3.5435	624.08	85.03
5356.75	12.7980	11.0983	3.5551	621.50	85.03
5407.46	12.8188	11.1166	3.5661	619.71	85.03
5458.17	12.8387	11.1316	3.5765	617.78	85.03
5508.89	12.8574	11.1457	3.5864	615.93	85.03
5559.60	12.8751	11.1590	3.5957	614.21	85.03
5610.31	12.8917	11.1715	3.6044	612.62	85.03
5661.02	12.9072	11.1832	3.6126	611.12	85.03
5711.74	12.9217	11.1941	3.6202	609.74	85.03
5762.45	12.9351	11.2041	3.6272	608.48	85.03
5813.16	12.9474	11.2134	3.6337	607.31	85.03
5863.87	12.9586	11.2219	3.6396	606.26	85.03
5914.59	12.9688	11.2295	3.6450	605.28	85.03
5965.30	12.9779	11.2364	3.6498	604.44	85.03
6016.01	12.9859	11.2424	3.6540	603.69	85.03
6066.72	12.9929	11.2477	3.6577	603.04	85.03
6117.44	12.9988	11.2521	3.6608	602.49	85.03
6168.15	13.0036	11.2557	3.6633	602.05	85.03
6218.86	13.0074	11.2586	3.6653	601.70	85.03

Table 3.2 (continued)

Depth (km)	Density (g/cm^3)	v_p (km/s)	v_s (km/s)	Q_α	Q_μ
6269.57	13.0100	11.2606	3.6667	601.46	85.03
6320.29	13.0117	11.2618	3.6675	601.32	85.03
6371.00	13.0122	11.2622	3.6678	601.27	85.03

Note: The bulk Q_κ given in Table 1 differs from the Q_α for P waves given in Table 3.2. The following relationship holds:

$$Q_\alpha^{-1} = L\, Q_\mu^{-1} + (1 - L) Q_\kappa^{-1}$$

where $L = (4/3)(\beta/\alpha)^2$, α = P-wave velocity v_p and β = S-wave velocity v_s. However, $Q_\mu = Q_\beta$ for S waves and $Q_\alpha = Q_\kappa$ in the liquid outer core because of μ and $Q_\mu = 0$.

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