The Lunar Orbiter Image Recovery Project (LOIRP)
Comparison of LO Copernicus Central Uplift with LRO LROC Mosaic

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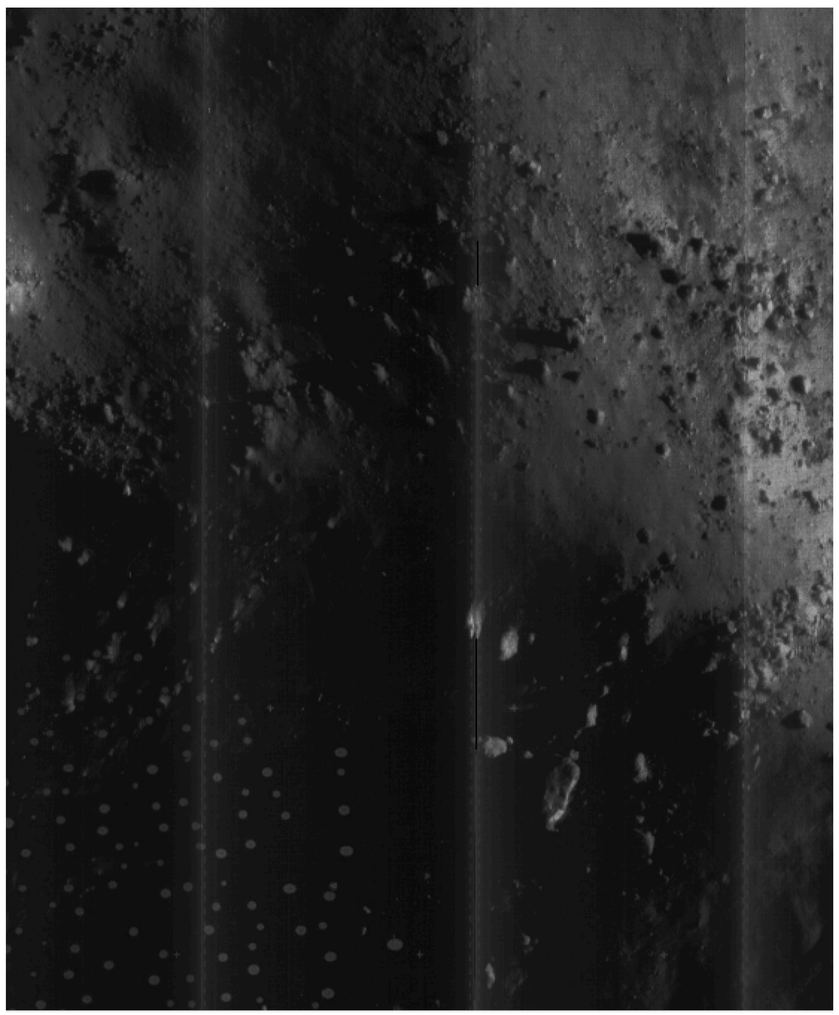
Early Space Era Satellite Data and Its Importance to Lunar Science and Exploration

In 1966-1967 NASA sent five spacecraft to the Moon to map potential landing areas for the Apollo program as well as for the first global map of a planetary body other than the Earth. Lunar Orbiter's I-III were in equatorial orbits with a periselene of ~44km and an aposelene of ~4000 km. Lunar Orbiter's IV-V were in polar orbits at various altitudes for global mapping and follow up on LO-I-II. Using a visible light 70mm film camera, each spacecraft took ~210 medium resolution and ~210 high resolution images.

The LOIRP project has focused first on recovering LO-II, LO-III, and LO-V images as they have the most relevance to modern high resolution images. To date we have recovered and restored over 550 of the ~1200 images from these three missions. Raw tape data as well as finished .tiff files are being provided to the Planetary Data System. LOIRP has shown the viability of our restoration process and these images are released to the public at the NLSI website.

Film Scan of LO-V-151H

The LO 640 mm camera mapped the Moon with maximum resolutions ~ 2 meters on the LO-V Mission. The Solar Azimuth is 91.58 degrees. This resolution was not equaled until the LRO mission presently in orbit.



This version of the LO-V-151-H image is from the USGS archives and was scanned from the original GRE film from the Lunar Orbiter mission. The image resolution is ~2 meters per pixel. The dynamic range of the GRE film is reduced (250-1) compared to the original analog data from the spacecraft due to the method of filming used at the time.

Hansen, T.P. Guide to Lunar Orbiter Photographs, NASA SP-242, NASA Scientific and Technical Information Office, Washington D.C., 1970

The Boeing Company, Lunar Orbiter I Photographic Mission Summary, NASA CR-782, April 1967

LOIRP LO-V-151-H1 Copernicus Central Uplift

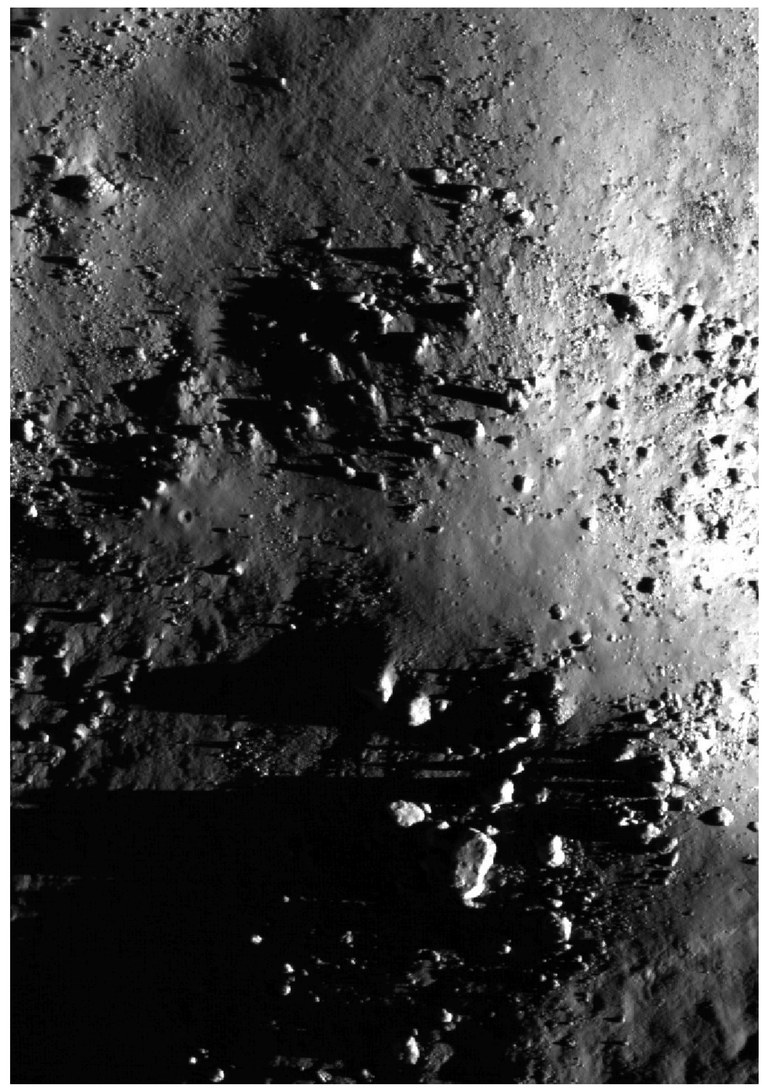
The LOIRP Image is derived from the original analog tapes from the LO ground stations and have 4x the dynamic range of the LO film archive. This image with a resolution of ~2 meters, was taken on August 16, 1967 at an Altitude of 103.15 km.

Gray Step No.	SO-243 R/O Density Range	Reassembled Record Density Range
1	0.21 - 0.29	Clipped by GRE
2	0.26 - 0.34	1.89 - 2.11 (clipped if R/O density below 0.30)
3	0.34 - 0.42	1.64 - 1.82
4	0.45 - 0.57	1.33 - 1.49
5	0.61 - 0.73	0.99 - 1.13
6	0.82 - 0.94	0.66 - 0.80
7	1.05 - 1.21	0.50 - 0.60
8	1.32 - 1.48	0.42 - 0.50 (may be clipped)
9	1.40 - 1.56	Clipped by GRE

This version of the LO-V-151-H image is from the original ground station tape from the Woomera ground station (tape W5-58). The original recording preserves the original dynamic rage of the image from the spacecraft 70mm film. The chart on the left shows the film density reading of the 70mm film. This information is encoded as a grey scale chart at the end of each framelet on the images. The chart shows that the low and the high greys were clipped on the GRE film. The increase in dynamic range is 4x or 1000-1. This difference is clearly seen when comparing the GRE image on the left to the LOIRP digitized image.

LROC Copernicus Central Uplift

The LROC imaging camera took a series of images of the Copernicus central uplift that were assembled into a mosaic. The resolution of this image is ~1.8m. The image was taken at ~102 km with a solar azimuth close to the same as LO.



The above image is a portion of the recently released LROC mosaic of the interior of the Copernicus crater. This image, with a resolution of ~1.8 meters was taken in late June of 2012. The solar azimuth and orientation of the LRO with respect to the ground track over the crater is virtually identical to the LO-151H image. This allows researchers to investigate the movement of rocks tumbling down the slopes of the central uplift (the peak is approximately the middle of the above images), as well as to determine whether or not rocks have broken due to small impacts or from the thermal stress of the dramatic temperature swings on the surface of the Moon.

http://wms.lroc.asu.edu/lroc_browse/view/copern_mosaic