# CRATERS AND CHANNELS ON MALAPERT MOUNTAIN IN THE LUNAR SOUTH POLE REGION: CHALLENGES ASSOCIATED WITH HIGH-INCIDENCE-ANGLE IMAGERY.

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**Introduction:** Malapert Mountain[1] has been proposed as a location near the south lunar pole with the best conditions for line-of-sight communication with Earth, as well as nearly continuous sunlight[1]. Examination of currently-available images shows craters and channels of unknown origin near its peak, therefore Malapert Mountain is also of scientific interest.

**Lunar Orbiter Data:** Images of Malapert Mountain (85.5ºS, 0ºE) were obtained by the Lunar Orbiter IV spacecraft from May 17 through May 24, 1967 (Fig. 1a and 1b).

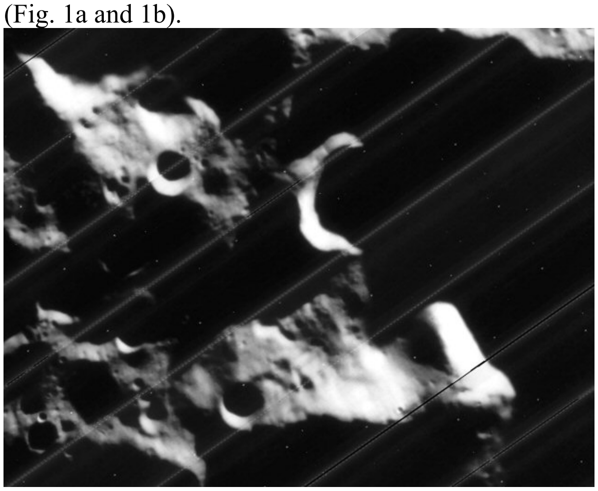


Figure 1a. Detail from LO IV 118 (1967/05/19), brightness and contrast stretched for clarity.

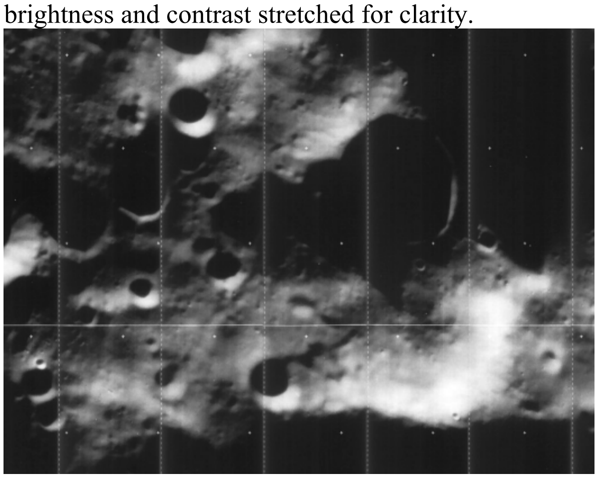


Figure 1b. Detail from LO IV 179 (1967/05/24), brightness and contrast stretched for clarity.

The incidence angle of the seven images studied ranges from 79.22º to 82.85º. Even though the changes in incidence and azimuth angle are small, the images show significant differences throughout the sequence.

A 7-km crater with a channel extending from it can be seen in the area west of Malapert Peak. Enlargements of this area are shown in Figs. 1c and 1d, corresponding to Figures 1a and 1b, respectively. The channel feature in the first image curves to the SE, whereas the channel in the final image is aligned ENE. It is likely that this difference is due to the slight changes in sun angle over the five days represented by the images.

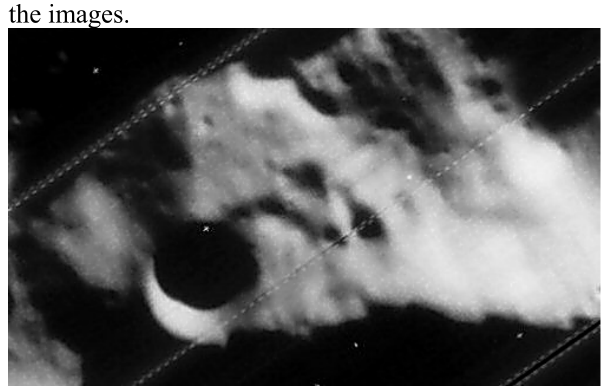


Figure 1c. Enlargement of crater at lower center of Figure 1a. Contrast and sharpness enhanced for clarity.

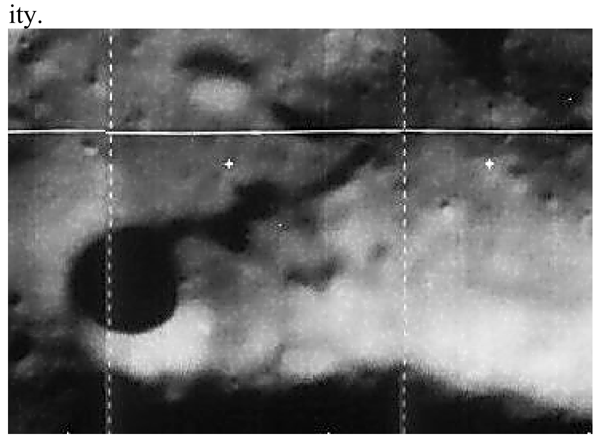


Figure 1d. Enlargement of crater as shown in Figure 1b. Contrast and sharpness enhanced for clarity.

**Radar Data:** A radar image of the area (Figure 2) was obtained from [2]. Textural differences are observed between the area nearest the crater and the area that is more distant. Mantling units exhibit low returns on depolarized 3.8-cm radar maps, indicating an absence of surface scatterers in the 1- to 50-cm-size range [3]. Mantling may be the cause of the change in texture which is observed in this area; however, the source of the mantling material is unknown.

[1] Informal name given to this feature. It does not have a name assigned by the I.A.U.

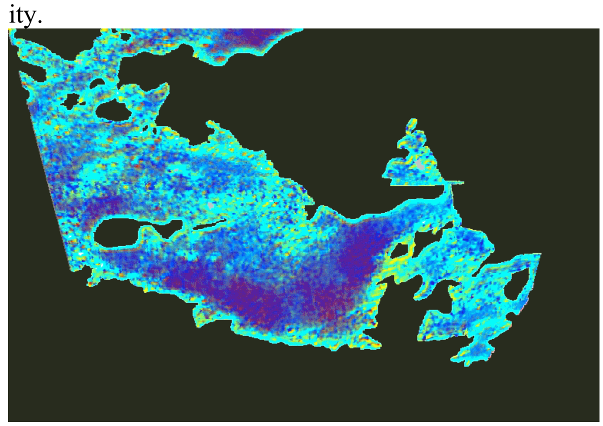
Figure 2. Radar image (at 3.5 cm) of Malapert Mountain acquired in 1999, showing the crater and channel. Note increased roughness of terrain at the distal end of the channel.

**Clementine Data:** Clementine imagery from the Malapert Mountain area, acquired in 1994, is shown in Figures 3a and 3b. Figure 3a shows the ENE channel clearly, as does the radar image. The radar image and the Clementine image have a similar illumination angle to the final image in the Lunar Orbiter sequence (Fig. 1b).

The rationale for the standard Clementine multispectral ratio (false color) image processing of the Moon is described by [4]. The ratios employ 3 spectral wavelengths and combine these into a red-green-blue color image. This rendition and the wavelength ratios chosen serve to cancel out the dominant brightness variations of the scene (controlled by albedo variations and topographic shading) and enhances color differences related to soil mineralogy and maturity. The lunar highlands, mostly old (~4.5 b.y.) gabbroic anorthosite rocks, are depicted in shades of red (old) and blue (younger). The lunar maria (~3.9 to ~1 b.y.), mostly iron-rich basaltic materials of variable titanium contents, are portrayed in shades of yellow/orange (iron-rich, low titanium) and blue (iron-rich, higher titanium).

The Clementine ratio image for the Malapert Mountain area is shown in Figure 3b. Areas in shadow were masked out of this image, because the ratio information there is of dubious value [5]. However, the image information in the better-lit portions of the scene are likely to be accurate. The peak of Malapert Mountain displays dark blues and reds, indicative of highlands material. The ligher blue downslope could be due to (a) low light effects; (b) younger highlands material, or (c) high-titanium basalt. Interpretation (a) above seems most likely, because the lighter blue color appears not only on the lower slope of the peak, but also along the upper edge, where the light rapidly falls into shadow. Interpretation of the blue color is dependent upon context, and more information about morphology is needed in order to establish the geological framework.

Figure 3a. Clementine color albedo image of Malapert Mountain. Brightness and contrast enhanced for clarity.



Fibure 3b. Clementine color ratio image of the Malapert Mountain area. Pixels with less than 30% brightness have been masked. See text for discussion.

**Conclusions:** It is too early to draw any conclusions from the available data. We await the Lunar Reconnaissance Orbiter to provide more and better information about this area. The DIVINER radiometer may detect temperature differences, which would suggest geothermal or volcanic activity. The Lunar Orbiter Laser Altimeter will provide improved information on the topography of the area, from which models can be constructed to understand how illumination angle and azimuth angle affect the appearance. The LAMP instrument will image the shadowed areas and give improved information on the overall morphology of the region. The Lunar Reconnaissance Orbiter Camera will provide meter-scale mapping over a two year period, which will show unambiguously how incidence and azimuth angles affect the appearance of features on Malapert Mountain.

**References:** [1] Sharpe and Schrunk (2002), *Space 2002*, 129. [2] Margot et al. (1999) *Science, 4,* 1658. [3] Gaddis et al. (1985) *Icarus, 61,* 461. [4] Pieters et al. (1994) *Science, 266,* 1844. [5] Lucey et al. (1998) *JGR, 103*, 3679.