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Scientific Characterization of Mare Moscoviense Region of Interest

A. Calzada (1) and S.C. Mest (2,3)

(1) Department of Earth and Planetary Sciences Birkbeck, University of London, Malet Street, Bloomsbury, London WC1E 7HX (2) Planetary Science Institute, 1700 E. Ft. Lowell, Suite 106, Tucson, AZ 85719-2395 and (3) Planetary Geodynamics Laboratory, Code 698, NASA GSFC, Greenbelt, MD 20771

Abstract

NASA´s Constellation Program has identified 50 Regions of Interest (ROI) with high scientific value in preparation for an eventual return to the Moon [1]. These 50 locations are geological diverse and geographically distributed to achieve a variety of goals and objectives and described by LEAG [2].

In order to evaluate its scientific interest, Mare Moscoviense (MMos) ROI was characterized using digital images and data provided by NASA´s Clementine and Lunar Reconnaissance (LRO) Missions as well as ArcGIS™ v.10.1 software to create a geomorphologic and geologic map.

The cartography and the input were analyzed to propose a set of three hypothetical traverses for future human or robotic expeditions within an area up to distances of 5, 10 and 20 km from the ROI location. The traverses has no constrains regarding schedule, distances or topography. Experiments proposed vary from petrologic and geochemical characterization such as samples and drill cores to geophysical experiments using gravimetry, magnetometry and seismicity methods.

1. Regional geology

The Moscoviense Basin (figure 1) is a multiringed basin on the northern hemisphere of the far side of the Moon (26.2ºN, 150.5ºE). The basin has 445 km of diameter and it covers an area of ~35,000 km^2. Its age was estimated in 3.85-3.92 Ga [3].

The basin is located within highland terrain and it was filled with mare basalts, which vary in composition including low-Fe low-Ti mare basalts, low-Ti basalts, high-Ti basalts and basalts related with Komarov impact crater that lies to the East [4, 5 ,6].

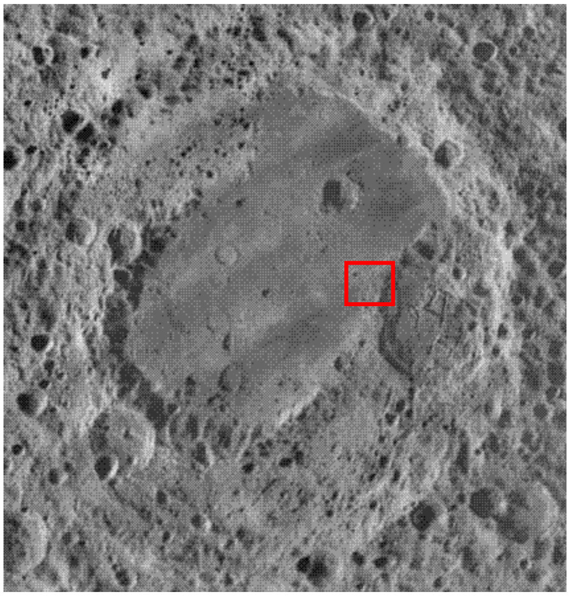

Figure 1 LRO WAC Image from Mare Moscoviense basin. Red box indicates the studied area. Credits: NASA/JPL/MSSS

2. Cartography

The cartography of MMos ROI was built using ArcGISTM v.10.1. Raster images used were obtained by NASA´s Clementine and LRO missions and they includes:

- Clementine mineral ration false color mosaic (200 meters/pixel resolution)

- LRO Wide Angle Camera (WAC) mosaic (100 meters/pixel resolution)

-LRO Narrow Angle Camera (NAC) mosaic (50 centimeters/pixel resolution)

- LRO Laser altimeter (LOLA) DEM.

Discrimination between materials was done based in their reflectance and absorption patterns over the UV/VIS spectrum. Topography from LRO LOLA allowed greater accuracy in delimiting the contacts and the mineral ration mosaic from Clementine displays element content enabling unit characterization.

Units depicted in the map (figure 2) are consistent with those described in previous works. Highland terrain, high-Ti basalts and basalts associated with Komarov crater are well represented. Other materials related with impact processes and wrinkle ridges are also observed within the area.

Figure 2 Geologic map of the MMos ROI. Star shows the hypothetical landing site. Points represents craters smaller than 1 Km. Black circles are crater rims. Lines in the south-west represent wrinkle ridge boundaries, and the line with diamonds is the ridge crest. Red unit: crater rim deposits; light brown unit: high Ti mare basalts; blue unit: highland unit; light green unit: yellow ejecta deposits, and orange unit: mare basalts associated with Komarov Crater.

3. Experiments

The primary goal of traverse development is to accomplish as many scientific goals as possible within 10, 20 and 40-km-diameter circles centered on the landing site (figure 3).

The experiments proposed can be performed either by human or robotic explorers. They include descriptions of the geologic context, photos and samples, as well as the tools used to perform traditional geologic fieldwork such as shovels and hammers. There are other geophysical experiments proposed such gravimeters (portable and absolute), a magnetometer, perforation tools, seismometers and experiments to measure thermal and electric properties.

4. Conclusions

The first step for a comprehensive study of the feasibility of the region for a future scientific mission is the elaboration of a map to place the geomorphological and geological characteristics of the region in context.

The three traverses proposed in this study were designed to analyze lithologies, impacts and other processes that allow us to elucidate the stratigraphy of the ROI and therefore a part of the basin history.

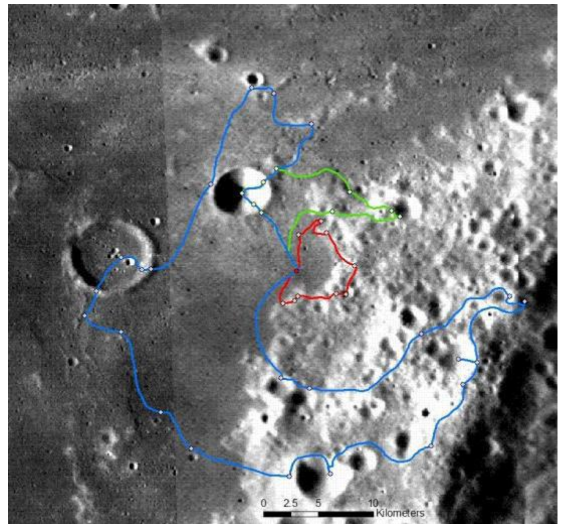

Figure 3 Hypothetical traverses proposed from the MMos ROI (landing site = red dot). Traverse 1 (red line) where the maximum distance from the LS is 5 km; Traverse 2 (green line) where the maximum distance from the LS is 10 km; Traverse 3 (blue line) where the, maximum distance from the LS is 20 km. White dots indicate stops along traverses.

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