EPSC Abstracts
Vol. 10, EPSC2015-47, 2015
European Planetary Science Congress 2015

Petrological Mapping of the Crater Boguslawsky

C. Wöhler (1), N. A. Evdokimova (2), E. A. Feoktistova (3), A. Grumpe (1), K. Kapoor (1), A. A. Berezhnoy (3), V. V. Shevchenko (3)
(1) Image Analysis Group, TU Dortmund University, Dortmund, Germany, (2) Space Research Institute, Moscow, Russia, (3) Sternberg Astronomical Institute, Moscow State University, Moscow, Russia.

Abstract

An analysis of orbital spectral data of the crater Boguslawsky, the intended target region of the Russian Luna-Glob mission, is performed. We have constructed a high-resolution DEM of the crater Boguslawsky, based on which the temperature regime on the surface is investigated. The depth of the OH absorption feature is analysed. The content of the main elements is estimated, and a petrologic map is constructed accordingly.

1. Crater Boguslawsky as a Proposed Landing Site for Russian Luna-Glob mission

The crater Boguslawsky with a diameter of about 95 km [1] is located in the southern lunar highlands. This crater has been chosen as a landing site of the Russian Luna-Glob mission [1]. According to the geologic study in [2], the crater is of Nectarian age, and its floor corresponds to a single geologic unit except a part of the eastern wall which is covered by ejecta material of the smaller crater Boguslawsky D. In [1], the Boguslawsky region is assigned to six different geological units based on a variety of orbital image, laser altimetry and radar data sets as well as counts of small craters and boulders.

2. DEM and Temperature Regime

A digital elevation model (DEM) of the Bogulawsky region has been constructed based on a combination of GLD100 stereo data [3] and Moon Mineralogy Mapper (M^3) radiance data [4] using the method described in [5] (Fig. 1a). The obtained DEM and spectral reflectance data were used for the raytracing-based approach in [6] to model the surface temperature in the vicinity of the crater Cabeus. An alternative, simpler temperature estimation approach is described in [7], where the surface radiance is modelled as the weighted sum of a standard laboratory radiance spectrum and a black body emission spectrum. This method, however, does not yield accurate results for surface temperatures below 250–300 K. Hence, we implemented a further method which extends the thermal equilibrium based approach in [8] by an iterative mutually consistent estimation of spectral reflectance and surface temperature. The result obtained for morning illumination (about 81 hours after local sunrise) is shown in Fig. 1b. For comparison, a map of the DIVINER-based surface temperature [9] at the same illumination is shown in Fig. 1c.

3. Possible OH Presence

The three described methods were used to investigate the influence of the method used for thermal emission removal on the depth of the hydroxyl (OH) absorption near 3 µm wavelength. A M^3-based map of the R_{2657} / R_{2817} reflectance ratio, which can be used as a proxy for the OH absorption depth, is shown in Fig. 1d. The general behaviour is such that the warmer southwestern crater wall displays a weaker OH absorption than the cooler crater floor.

4. Elemental Composition and Petrological Mapping

Global maps of M^3-derived spectral parameters describing the two primary absorption features near 1 µm and 2 µm were used in combination with Lunar Prospector Gamma Ray Spectrometer (LP GRS) [10] data to infer a regression model of the wt% values of Ca, Al, Fe and Mg [7] (cf. also [11]) (Fig. 1e). Using spectral parameter maps of the Boguslawsky region of full M^3 resolution, we then constructed elemental abundance maps and a petrological map of the relative abundances of three endmember rocks (basalt, Mg-rich rock, anorthosite) (Fig. 1f). The floor and walls of Bogulawsky are mainly of typical highland character, only a few small regions on the crater floor (e.g. in the southern part of the western landing ellipse; red, orange and green in Fig. 1f) have a high basalt and/or Mg-rich rock content.

5. Conclusions

We constructed maps of the surface temperature, the OH absorption depth, the main elemental abundances and a petrologic map. The obtained results can be used for preparation of the scientific program of the Russian Luna-Glob mission.

References

[1] Hiesinger, H. et al. (2014) *Geology of the Lunar Glob Landing Sites in Boguslawsky Crater*. LPSC XXXXV, abstract #2370.

[2] Ivanov, M. A. et al. (2014) *Geological context of potential landing site of the Luna-Glob mission.* Solar Syst. Res. 48(6), 391-402.

[3] Scholten, F. et al. (2012) *GLD100: The near-global lunar 100 m raster DTM from LROC WAC stereo image data.* JGR 117, E00H17, DOI: 10.1029/2011JE003926.

[4] Pieters, C. M. et al. (2009) *The Moon Mineralogy Mapper (M³) on Chandrayaan-1*. Current Science 96(4), 500-505. Data download from http://pds-imaging.jpl.nasa.gov/volumes/m3.html

[5] Grumpe, A. et al. (2014) *Construction of lunar DEMs based on reflectance modelling.* ASR 53(12), 1735-1767.

[6] Berezhnoy, A. A. et al. (2012) *Origin and stability of lunar polar volatiles.* ASR 50(12), 1638–1646.

[7] Wöhler, C. et al. (2014) *Integrated topographic, photometric and spectral analysis of the lunar surface: Application to impact melt flows and ponds.* Icarus 235, 86-122.

[8] Shkuratov, Y. et al. (2011) *Optical measurements of the Moon as a tool to study its surface.* PSS 59(13), 1326-1371.

[9] Paige, D. A. et al. (2010) *The Lunar Reconnaissance Orbiter Diviner Lunar Radiometer Experiment.* SSR 150(1-4), 125-160. Data download from http://pds-geosciences.wustl.edu/missions/lro/diviner.htm

[10] Lawrence, D. J. et al. (1998) *Global elemental maps of the Moon: The lunar prospector gamma-ray spectrometer*. Science 281 (5382), 1484-1489.

[11] Shkuratov, Y. et al. (2005) *Derivation of elemental abundance maps at intermediate resolution from optical interpolation of lunar prospector gamma-ray spectrometer data*. PSS 53(12), 1287-1301.

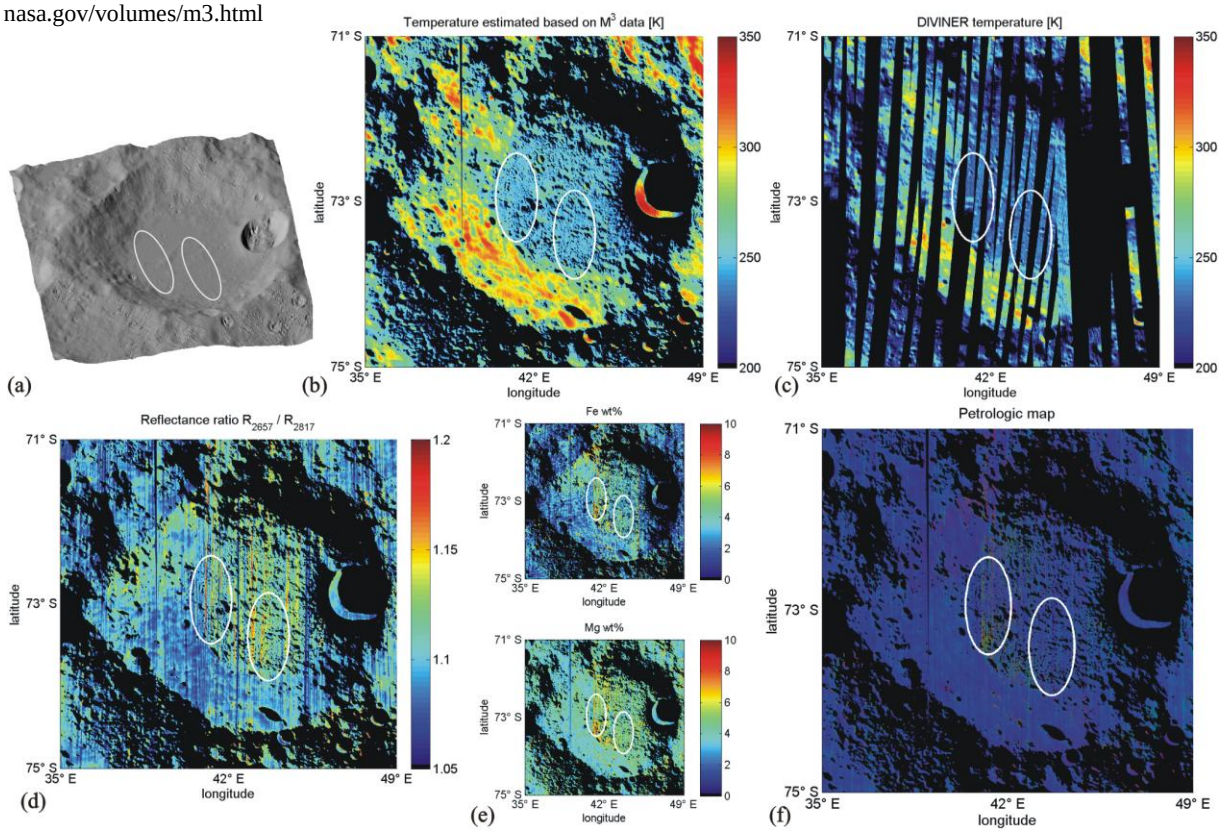

Figure 1: (a) DEM. (b) Map of DIVINER-based surface temperature map under morning illumination (about 81 hours after local sunrise). (c) Map of M³-based surface temperature under morning illumination (extension of method in [8]). (d) OH absorption depth as indicated by the R_{2657} / R_{2817} spectral ratio. (e) Estimated Fe (top) and Mg (bottom) abundances in wt%. (f) Petrological map. In all maps, black denotes missing data. Landing ellipses according to [1].