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Boguslawsky Crater, Moon: Studying the Luna-Glob Landing Site

H. Hiesinger (1), M. Ivanov (2), J. W. Head (3), A. T. Basilevsky (2), J. H. Pasckert (1), K. Bauch (1), C. H. van der Bogert (1), A. M. Abdrahimov (2); (1) Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany (hiesinger@uni-muenster.de), (2) Vernadsky Institute, Moscow, Russia, (3) Brown University, Providence, RI, USA.

Abstract

The main objective of the Russian Luna-Glob lander, which will land on the floor of Boguslawsky crater (~95 km in diameter, centered at 72.9S, 43.26E), is to test landing techniques. However, it will also carry a small scientific payload. Two landing ellipses, 30x15 km each, are under investigation: Ellipse West is at 72.9S, 41.3E, Ellipse East is at 73.3S, 43.9E [1].

1. Introduction

For our study, we used data from the Lunar Reconnaissance Orbiter [Wide and Narrow Angle Camera images (WAC, NAC), Diviner temperature data, MiniRF radar data, laser altimeter data (LOLA)] and Chandraayan (M^3). We geologically mapped the crater, investigated its morphology and morphometry, performed crater size-frequency distribution (CSFD) measurements to derive absolute model ages, calculated temperatures and thermal inertia, derived rock abundances, and counted rocks in selected areas of interest. We used CraterTools [2], CraterStats [3], and the production function (PF) and the lunar chronology of [4] to derive absolute model ages of our geologic units. LRO Diviner data were used to calculate relative rock abundances on the floor of Boguslawsky crater [5,6,7].

2. Results

The geologic map of [8] indicates that the pre-Nectarian Boguslawsky crater (pNc) is superposed on pre-Nectarian rugged basin (pNbr) material. Secondary crater material of close-by Upper Imbrian (Ic2) Schomberger crater partly covers Boguslawsky and thus is younger [8]. The floor of Boguslawsky shows Nectarian terra-mantling and plains material (Ntp). Boguslawsky D is superposed on the eastern rim of Boguslawsky crater and is of Eratosthenian age (Ec) [8]. Boussingault crater, which superposes Boguslawsly crater in the NE is somewhat younger than Boguslawsky crater, but is still of pre-Nectarian age [8].

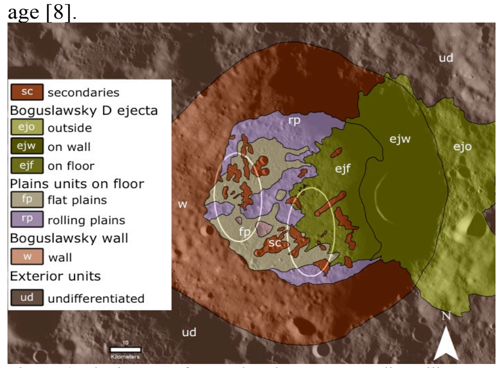

Fig. 1: Geologic map of Boguslawsky crater. Landing ellipses are shown in white.

On the basis of high-resolution LROC images, we identified six geologic units within Boguslawsky crater, including smooth plains *fp*, rolling plains *rp*, secondary craters *sc*, the crater wall *w*, and the ejecta blanket of the 24-km sized crater Boguslawsky D (Fig. 1), which has been subdivided into ejecta on the floor of Boguslawsky (*ejf*), its wall (*ejw*), and outside the crater (*ejo*). The surrounding terrain of Boguslawsky was mapped as undifferentiated material (*ud*) [1].

The western landing ellipse allows access to units *fp*, *rp*, *sc*, *hu*, and possibly *cw*. There is a 58% chance to land on flat plains, a 22.5% chance to land on rolling plains, a 17.5% chance to land on secondary craters, and a 2% chance to land on wall material. Accessible within the eastern landing ellipse are units *fp*, *rp*, *eb*, and *sc*. In this landing ellipse, the chance to land on ejecta material of Boguslawsky D is about 49.5%. Chances of landing on flat plains, secondary craters, and rolling plains are 22%, 17%, and 11.5%, respectively. Despite the large number of secondary craters on the floor of Boguslawsky, we were able to derive plausible absolute model ages for some of our geologic units. We favor a formation of Boguslawsky of at least 4 Ga ago. This model age is derived from a count area at the western crater wall, which might have been modified by mass wasting. Thus, our model age represents a minimum age, i.e., the crater might be older. According to our CSFDs, the rolling plains have a model age of about 3.96 Ga, thus being indistinguishable within the error bars from the CSFD of the Boguslawsky wall. The smooth plains show a model age of 3.77 Ga, which is very similar to the model age of the ejecta blanket of Boguslawsky D (3.74 Ga). Compared to the geologic map [8], the crater floor appears to be somewhat younger and Boguslawsky D appears to be older, i.e., it is Imbrian in age.

Morphometric measurements of Boguslawsky and several large craters in its vicinity indicate that the depth/diameter ratio of Boguslawsky is rather low. We interpret such a shallow morphology to result from infill, most likely by ejecta of close-by craters and basins [1].

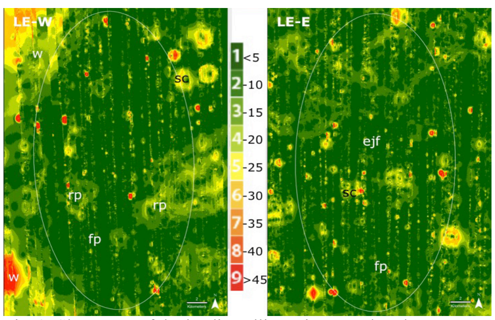

Fig. 2: Slope map of the landing ellipses in Boguslawsky crater

Within the two landing sites, slopes at ~30 m base length are generally less than 5-10 degrees. However, small impact craters (mostly <500 m diameter) can have local slopes of up to 45 degrees (Fig. 2) [1,9]. Both landing sites are characterized by about the same distribution of slopes (Fig. 3). However, we identified significant differences in slopes with respect to individual geologic units [9].

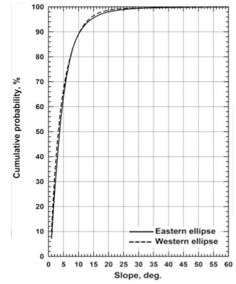

Fig. 3: Slope distribution of the two landing ellipses.

Rock abundances across the floor of Boguslawsky are variable as indicated by our thermal model [1,9]. We identified several areas with higher thermal inertia and, thus higher rock abundances. In these areas, manual boulder counts on LRO NAC images confirm a large number of boulders on the surface. For example, in an area of about 4 km^2, we counted more than 16,000 boulders between ~0.5 m and up to 13 m in size. Although we see several areas with bright radar signals indicative of a higher roughness or blockiness, NAC images often show a lack of larger boulders on the surface. We interpret this finding as evidence for most of the radar signal either coming from rocks below the NAC resolution, rocks being buried in the regolith, or both.

Despite the fact that one of the scientific objectives of Luna Glob is to search for water, LEND epithermal neutron counts of Boguslawsky crater are significantly higher (>9.8 counts per second, cps) than for hydrogen-rich regions such as, Cabaeus and Shoemaker craters (<9.8 cps), thus indicating lower abundances of hydrogen [10].

5. Summary

Boguslawsky crater represents a scientifically interesting landing site that will allow us to study the complex geology of an old crater in detail.

6. References

[1] Hiesinger et al. (2014) LPSC 45; [2] Kneissl et al. (2011), PSS 59; [3] Michael and Neukum (2010) EPSL 294; [4] Neukum et al. (2001), Space Sci. Rev. 96; [5] Christensen, P.R. (1986), Icarus 68; [6] Bandfield, J.L. et al. (2011), JGR 116; [7] Bauch et al. Submitted to PSS, [8] Wilhelms et al. (1979) USGS I-1162; [9] Hiesinger et al. (2014) European Lunar Symposium; [10] Litvak et al. (2012) JGR 117.