Geological characterization of high-priority landing sites for the Luna-Glob mission

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Abstract:
11 landing sites ellipses [1] and 2 ellipses in the crater Boguslawsky [2] (15 x 30 km) have been selected for the Russian Moon mission Luna-Glob (Luna-25) in an area between 65-85°S, 0-60°E at the south pole of the Moon and need to be prioritized. A major goal of Luna-Glob is a compositional analysis of the regolith, which may contain ice. Challenges will be the testing of the soft landing techniques and the long-term operation of the lander in the lunar polar region. A geological characterization took place for prime landing sites (ellipses-1, 4, 6 and ellipses Boguslawsky-1, 2) [3] and [2], respectively. We report on the characterization of the potential lower priority landing sites 2, 3, 5, 7, 8, 9, 10, 12. Our analysis makes use of data returned from instruments onboard of the Lunar Reconnaissance Orbiter: LROC (WAC and NAC), LOLA, LEND and Diviner. Based on these data we produce a priority list of the potential landing sites. Our analysis indicates that landing ellipses 2, 3, 8, 10 should be primary targets for a landing.

Geological characterization:
In the investigated ellipses, material from the impact event, which generated the South Pole-Aitken basin (SPA) and ejecta material from pre-Nectarian (pN), Nectarian (N) and Imbrian (I) basins is likely to be found.

A crater statistic was made in each morphological unit. This statistics provide craters density and an approximate age for each territory. In the studied ellipses a significant concentration of boulders is seen. The boulder abundance is determined by using the rock abundance map made by Diviner and the high resolution images LROC.

Maps from LEND in the top $\sim$1 m layer of the lunar regolith [4] were used to assess the water equivalent hydrogen (WEH) distribution in the different ellipses. The highest concentration of WEH was found in ellipses 7 and 10 with a value of $\sim$0.2 wt%. A medium concentration was seen in ellipses -1, 4, 6, 8 with value 0.15 wt% and a low concentration in ellipses-5, 9, Boguslawsky-1, 2 (<0.05 wt%).

Results:
The surface morphology in each ellipse was investigated and mapped. Four surface types were determined: (1) Undulated flatlands/plain or rolling plains with low or medium density of small craters. (2) Regions located on the inner or outer slopes of big impact craters (average tilt can be >7°) showing a low concentration of small craters. (3) Regions with high concentrations of secondary impact craters and impact ejections. (4) Hills area formed by impact ejections.

Based on our analysis, we classify high priority landing sites: 2, 3, 8, 10; alternative landing sites: 5, 9 and sites, which we do not recommend for landing: 7, 12.

References:
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[4] Sanin et al., 2017. https://doi.org/10.1016/j.icarus.2016.06.002