SELECTION OF LANDING SITE FOR POTENTIAL LUNAR BASE ON MONS MALAPERT

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Introduction:
Polar areas of the Moon are one of the most perspective regions of exploration of this body including building there a lunar base(s). Presence of water ice in regolith of many polar localities is important both as a resource for needs of lunar base(s) and as a subject of scientific studies. The mountain Mons Malapert near the South pole (about 86°S 0°E) was mentioned as a perspective place for potential lunar base [1, 2, 3]. Malapert mountain rises above the surrounding surface by ~5 km, has reliable visibility from and to Earth and long periods of sunlight (87 to 91% of the year). Its 5×15 km top at the base of hundreds of meters is almost flat (<5°) although most slopes are relatively steep (20–25°). The Mons Malapert mountain massif was interpreted by [4] as a part of the South Pole – Aitken (SPA) basin rim. This abstract considers issue of selection of potential landing sites for the Mons Malapert base, while issues of topography, geology and trafficability of this locality are discussed in [5]. In the following consideration we suggest that top of Malapert Mons is the locality of potential base or locality of some its parts (radio antenna, solar batteries, instruments for distant observations).

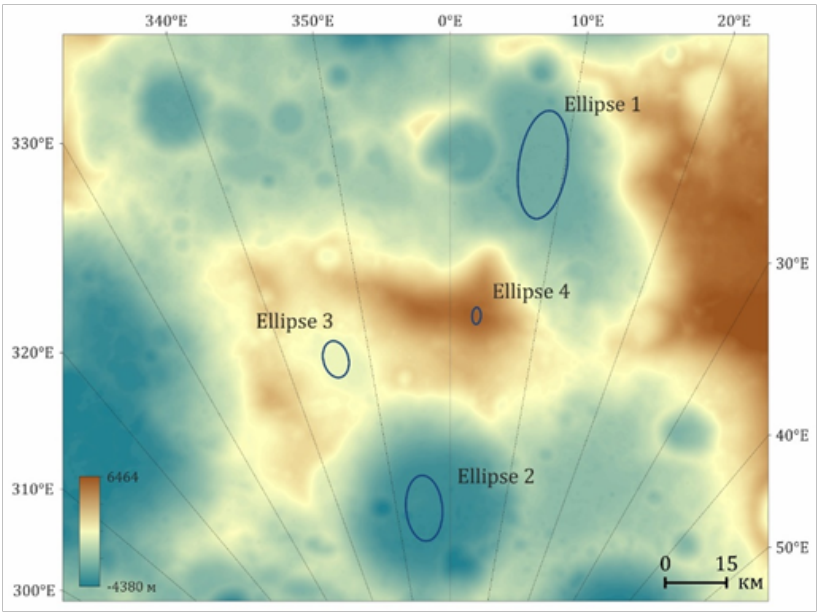

Fig. 1 Potential ellipses of landing sites in the vicinities of Mons Malapert.

Selection of landing sites.
The main problem of selection of landing site(s) in this region is deficit of large enough flat areas to be possible landing ellipses. Four nearly flat places in the vicinity of the mountain were initially considered as possible landing sites (ellipse 1 — north-east, ellipse 2 — south (crater Haworth) and ellipse 3 — south-west of region) and one — ellipse 4 on the top of mountain (fig. 1). These ellipses have the following sizes: ellipse 1 — 12×26 km; 2 — 9×16 km; 3 — 6×9 km; 4 – 2×4 km. Ellipses 1–3 are not included in the subsequent

analysis, because their location is too far (several tens of kilometers) from the mountain, steep slopes of which make difficult the rovers' drive and logistics between the landing site and the base [5]. As an alternative option can be construction of base in the footnote of the mountain and location of radio antenna, solar batteries and other facilities on the top/slope. However, this task, no matter needs a transportation of goods to the tens of kilometers and then, lifting of the antenna and other issues to the mountain top.

We have chosen the ellipse 4 as the main landing site, if base construction going to be located on the top of the mountain. For slope analysis LOLA-based GDR DTM with 20 m/pix resolution was used. Using this DTM, five classes of slopes for ellipse 4 were calculated (<7° — 28%; 7°-10° — 21%; 10°–15° — 39%; 15°-20° – 10% and >20° - 2%). Allowable slopes for safe landing (<10°) compose only 49% of the ellipse, that undoubtedly, brings certain risks in landing processes. However, measuring the surface roughness at the latest stages of landing combined with possibility for horizontal maneuver like it was done in the case of NASA Curiosity and Chinese Yutu 1 and 2 should decrease the risk of robotic landing. Landing the piloted spacecraft showed its relative safe as early as in the Apollo era.

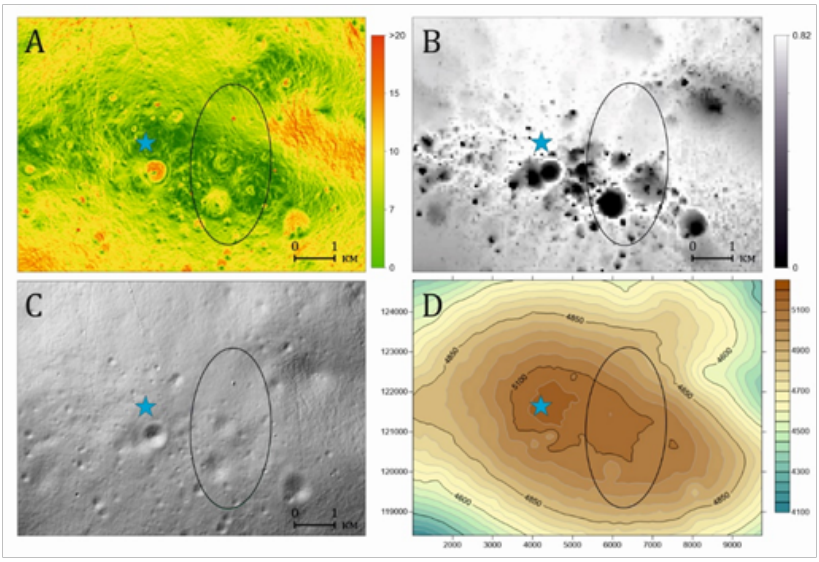

Fig. 2. Eastern top of the Mons Malapert with landing ellipse 4 (4×2 km in size) and potential base place (blue star). A – slopes; B — solar illumination; C — hillshade relief (270° azimuth and 45° sunlight angle); D — topographic map.

In the future research, the preflight estimating of the slopes' steepness at this landing ellipse on the baseline of the lander's pads may be done by different techniques including by measuring the shaded area percentage in the LROC NAC images taken at different Sun elevation [6, 7]. Rock boulders' presence was explored by radar Mini-RF data [8, 9] and showed reasonably good, acceptable for landing, values for this region.

Suggested location of lunar base disposed on the top of eastern site of the mountain with coordinates 2°E 85°59'15"S. Distance between potential base and suggested landing site is more than one kilometer, that provides comfortable distance for logistic and protection from regolith dust, lifted by the landers.

Results and discussion.

As it was shown above, Mons Malapert is a perspective place to construct lunar base at its top. Although most slopes are significantly steep ~20 to 25 and 30° [5], on the top of mountain there is nearly flat surface (less than 5° at the baseline of hundreds meters) 5×15 km in size. Within this flat area we suggest to put the base and at some distance from it the landing area: 2×4 km ellipse centered at 2°59'34"E 86°0'9"S. More studies are needed to measure topographic and soil-mechanics characteristics of this and adjacent areas.

Ackhowledgments:
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