**TO THE SITE SELECTION FOR A LUNAR RESEARCH STATION.**

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**Introduction:** The more important real-estates in the entire Solar system are locations on the Moon, where there are the richest gas deposits, good landing sites and eternal sunlight. These are places where humanity can start production off the planet. These places are very rare and limited. The best location can forever provide a strategic advantage in the exploration of the Moon and deep space [1].

**Site Selection Requirements:** Among the main requirements for the placement of lunar research base, the following can be distinguished: location and size of the site, convenient and safe terrain, maximum degree of illumination, periodic visibility of the Earth, the ability to provide direct and constant radio communication with the Earth, maximum comfortable temperature on the surface, availability of rich deposits of water ice in the lunar soil, etc.

There are three sites in the South Polar Region that meet almost all of the basic requirements for the placement of a permanent lunar research station, a lunar range and a spaceport - site #1(C) on the De Gerlache crater rim, site #2(B) on the Shackleton crater rim, and site #3(D) on the rim of the Slater crater (Fig. 1, 2).

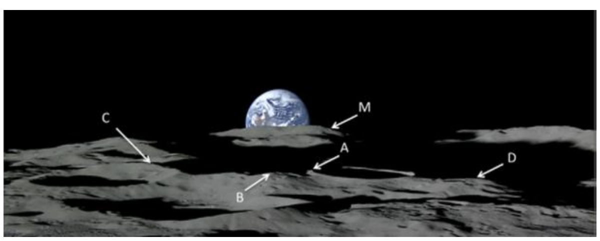


**Fig. 1**. Image of the South Pole according to the data of the Kaguya spacecraft [2]: A – area with a high degree of illumination on the edge of the Shackleton crater; C - the rim of the De Gerlache crater; B - the hill on the rim of Shackleton crater; D - the rim of Slater crater; M - Mount Malapert.

**Site Selection Methods:** Comparative analysis of digital elevation models with a resolution of about 1 m for the selected three sites (Fig. 3), the distribution of safe slopes based on 5 m (Fig. 4), the degree of illumination (Fig. 5), the number of peaks of eternal light with a degree of illumination ≥80% (Fig. 6), the visibility of the Earth (Fig. 7), average winter and summer temperatures (Fig. 8), surface structure on NAC LROC image mosaic (Fig. 9), the availability of gas deposits showed that for the most optimal location for the lunar

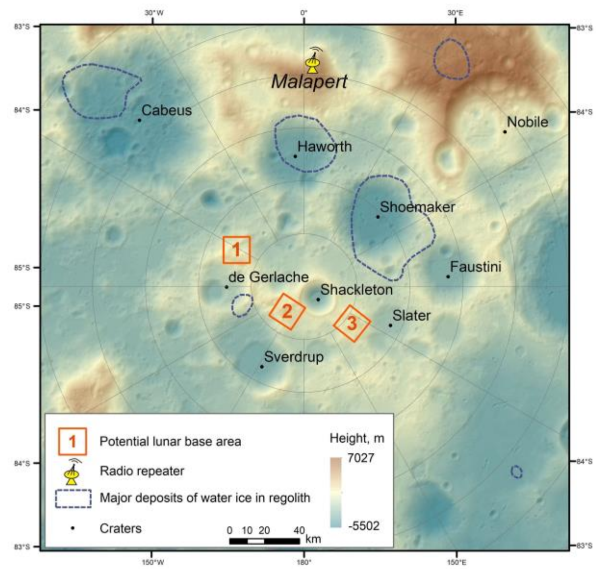


**Fig 2**. Survey map of the South Pole: 1 - site on the rim of the De Gerlache crater; 2 - site on the rim of Shackleton crater; 3 - site on the rim of Slater crater.

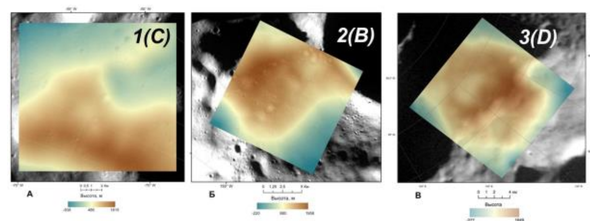


**Fig. 3**. Digital elevation models of sites #1, #2 and #3 by data on LRO spacecraft (NASA).

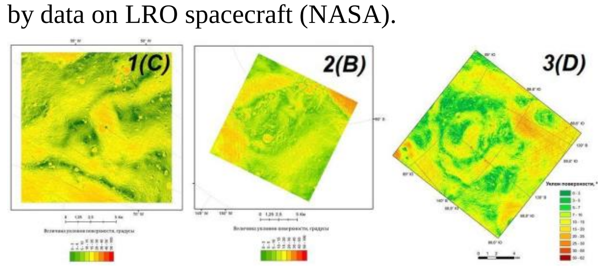


**Fig. 4**. Distribution of slopes based on 5 m on sites #1, #2 and #3.

base is site #2 (B). Relatively flat terrain and a large area of the site, approximately 10×12 km in size and with a total area of more than 100 km2, are the most favorable for placing all the necessary zones of the lunar base at a safe and convenient distance from each other for constant maintenance and visits during one working exit.

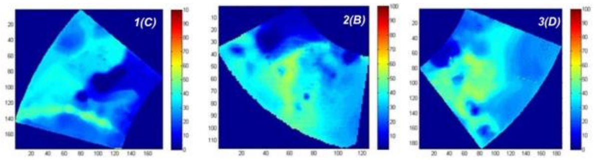


**Fig. 5**. Degree of illumination of sites #1, #2 and #3.

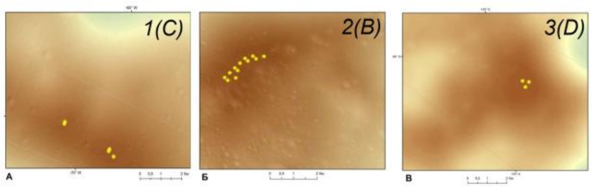


**Fig. 6**. Peaks of eternal light with a degree of illumination ≥80% [3] on sites #1, #2 and #3.

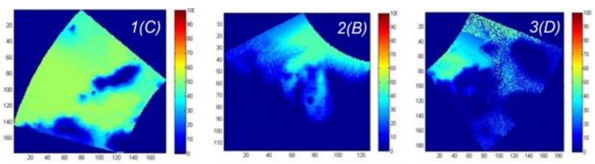


**Fig. 7**. The visibility of the Earth.

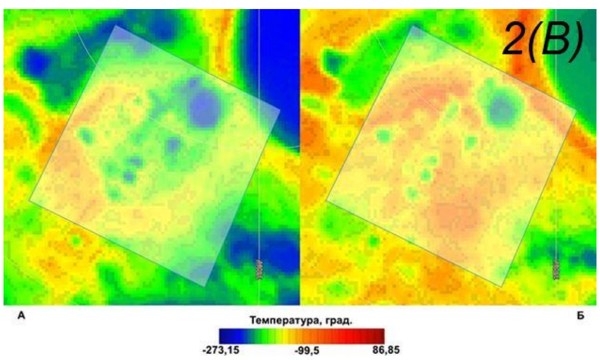


**Fig. 8**. Average winter (left) and summer (right) temperatures at site #2 [4].

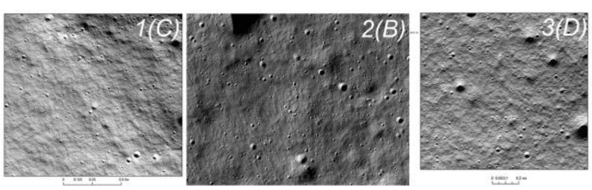


**Fig. 9**. Surface structure on NAC LROC image mosaic.

On the rim of the Shackleton crater at 7.5 km from energy zone #1 in the area with the maximum degree of illumination in antiphase with energy zone #1, it is proposed to place a backup energy zone #2 (Fig. 10). In a zone 10-15 km from the main zone on a gentle slope facing the far side of the Moon, the Earth is never visible. This zone is protected from radio interference from the Earth and is favorable for the deployment of a network of radio astronomy antennas of any scale. On Mount Malapert (M) at the meridian 2°E a repeater can be installed to provide direct and permanent communication with the Earth, a scientific station can also be located here for direct observation of the Earth and near-Earth space (Fig. 2, 11).

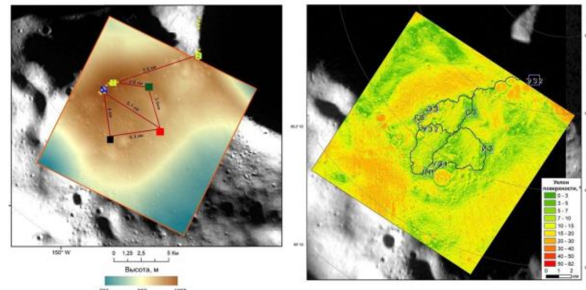

**Fig. 10**. Scheme of approximate placement of lunar infrastructure zones (left) and communication routes with slopes up to 5° on a base of 5 m between them at site #2: blue - main zone, yellow - energy zones #1 and #2, black - landing site, red - research zone, green - raw material zone.

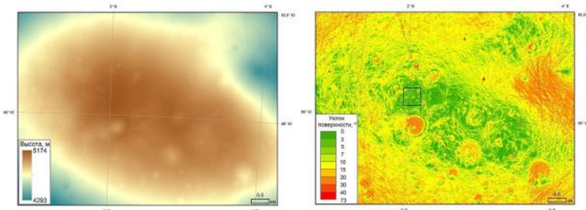

**Fig. 11**. Digital elevation model with a resolution of 10 m according to LOLA LRO data on the top of Mount Malapert (left) and slope distribution (right). The square size is 500×500 m.

Site #2 (B) allows you to place at a safe distance from each other and for visiting within one working exit from the main zone a research zone, energy zones #1 and #2, a landing site, a raw material zone, recycling zones #1 and #2 (Fig. 10). The raw material zone is intended for extraction and enrichment of volatile components (water ice).

**Summary:** The scenario of the lunar program and logistics, the delivery of the necessary equipment and the amount of work on the surface, the constant provision of energy and local resources, etc. will largely depend on the choice of the optimal site for the lunar base, including its location and size, comfortable and safe terrain, maximum degree of illumination etc. Such a site will significantly reduce the cost of servicing the lunar base in the future and, in fact, will forever provide a strategic advantage over other less convenient sites.

**References:** [1] Slyuta E. N. (2022) Znanie - Sila #3, 13-21 (in Russian). [2] Bussey D.B.J. et al. (2010) Icarus 208, 558-564. [3] Mazarico E. et al. (2011) Icarus 211, 1066-1081. [4] Williams et al. (2019) *LPSC L* Abstract #2852.