“COLD TRAPS” AND PSR NEAR SOUTH POLE OF THE MOON.
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Introduction. It has long been known that in the topographic depressions (for example in the impact craters), located near the Moon’s poles, there exist permanently shadowed regions (PSR) [1] and the surface temperature in these regions remain low for a prolonged period (billions of years). Therefore, it was suggested that such regions may contain volatiles such as water. Radar studies [2] and detection of the regions of high hydrogen content in the areas of impact craters, made by Lunar Prospector spacecraft [3], confirmed these assumptions. Such craters as Shoemaker, Faustini, Shackleton, Haworth and Sverdrup were called as the most likely candidates for the role of “cold traps” for volatiles in the South Pole region of the Moon. The most recent data obtained by the neutron spectrometer of LEND (LRO) showed the coincidence of the minima of the neutron flux with areas of these craters [4].

Fig. 1. The illumination in the South Pole region of the Moon. S – Shoemaker, F – Faustini, H – Haworth, Sc – Shackleton, Sv – Sverdrup, G – de Gerlach.

“Cold traps” and PSR. The neutron spectrometer LEND aboard the LRO spacecraft has detected an excess of hydrogen not only in the PSR but outside them [4]. One possible explanation of this may be that not only PSR can play role of “cold traps”. The existence of volatiles in the “cold traps” is determined by the temperatures in these traps which are dependant on insolation of given area. So PSR may not be a “cold trap” if it is heated by an illuminated area. “Cold traps” may also not be PSR if they are illuminated by the Sun either when the Sun illuminates them over a short period of time or at a low elevation angle of the Sun above the Moon’s horizon.

We investigated the distribution of the temperature and illumination in the South Pole region of the Moon with data obtained by LRO (LOLA) spacecraft [5].

Fig. 2. The distribution of maximum temperatures in the South Pole area of the Moon.

Fig. 1 shows the “cold traps” (in blue) and PSR (in red). The boundaries of the “cold traps” are shown for T < 110 K (this is an upper temperature limit for long-term presence of water ice [6]). Fig. 2 shows the distribution of maximum temperatures in the South Pole region of the Moon.

All the above craters contain both PSR and “cold traps”. At the same time PSR are situated not only in craters but also between them: the
area between the Shoemaker crater and the Haworth crater (area 1 on Fig. 1) is an example of this. This area has been previously singled out as permanently shadowed according to the KAGUYA spacecraft data [7].

KAGUYA spacecraft data was applied for three dimensional interpretation of the lunar South Pole region relief (Fig. 3). PSR distribution was superimposed with relief variation. There is good correlation between illumination and relief at this model and as follows from this model PSR are located not only in the craters and on their interior slopes but both between them and on the outer ones respectively.

![Fig. 3. 3D model of lunar South Pole region and PSR superimposed.](image_url)

The total area of PSR in the South Pole region of the Moon is more than 600 sq. km. The total area of “cold traps” exceeds this value and is more than 800 sq. km.