LUNAR PROSPECTOR DATA, SURFACE ROUGHNESS AND IR THERMAL EMISSION OF THE MOON. S.G. Pugacheva, V.V. Shevchenko. Sternberg State Astronomical Institute, Moscow University, 13 Universitetsky pr., 119992 Moscow, Russia, pugach@sai.msu.ru

Introduction: In the previous papers we considered correlation the Lunar Prospector thorium contents with structure of the lunar surface [1]. The surface roughness was estimated by means comparison of the local phase function and the average integrated lunar indicatrix. The average integrated lunar indicatrix was used as a background photometry model [2]. The great difference between the modeled and observed phase functions for phase angle in range about 18° demonstrates a high degree of the surface roughness. The value of this difference of intensities was used as a photometry parameter of the surface roughness. Comparison of the local cumulative number of the particles (N per 10^4 m^2) and photometry roughness parameter (ΔI) shows in Figure 1.

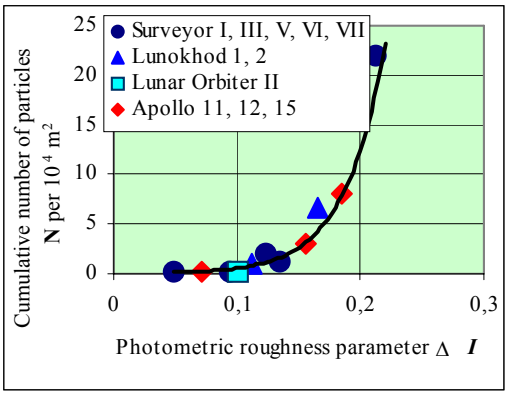

Figure 1. Comparison of the local cumulative number of particles N per 10^4 m^2 and photometry roughness parameter ΔI.

In this report we take data of the IR thermal radiation (10-12 micron), the rough structure of the lunar regolith and mineralogy characteristics upper layer of the surface.

Local thermal anomalies: A comparison of the analytic model of the lunar thermal field and radiation temperatures measured shows a systematic departure of the measured values from the average values [3]. The statistical analysis of the photometry database given lunar sites has allowed allocating 4 groups of thermal anomalies. Many anomalies stipulated by the relief concern to thermal anomalies. The thermal anomalies are dated for such large craters as Copernicus, Tycho, Stevinus and other craters. That is called by irregularities of the relief of the crater floor. On detail study of large-scale photographs some anomalies are identified with small-sized craters, others with separate clusters of stones. The difference of the surface temperature these thermal anomalies exceed 10 K. We have determined values of radiation temperature and have calculated the local cumulative number of the particles N per 10^4 m^2 for two thermal anomalies (crater Tycho and crater Copernicus) and photometric roughness parameters (ΔI). The difference of temperature of a surface in craters Tycho and Copernicus makes 20 K; the values number of the particles is equal 35 and 2, the photometric roughness parameters are 0,205 and 0,071 accordingly.

Statistical Analysis of Selected Lunar Features: The values of radiation temperature and local cumulative number of the particles were determined for areas of landing sites (Surveyor I, Surveyor III, Surveyor V, Surveyor VII, Apollo 11, Apollo 12, Lunokhod 1, Lunokhod 2, Surveyor VI). The values of thorium contents and iron contents have been found under catalogue Lawrence [4]. We have compared the data of thorium and iron contents and the IR radiation temperatures of the surface for landing sites. It's observed a good correlation between radiation temperature, the local Th-content, and FeO-content. The lines of the polynomial trend of the dependence of radiation temperature, thorium content and iron content, number of particles were shown on diagram (figure 2).

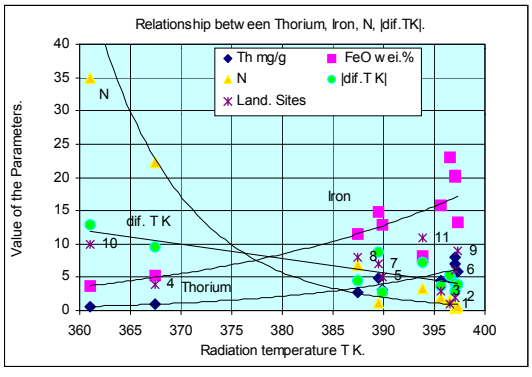

Figure 2. The Lunar Prospector data (thorium content and iron content) for areas of the landing sites.

The numbers of landing sites and thermal anomalies are indicated on the diagram. The separate points on diagram represent areas of landing sites: 1 - Surveyor I, 2 - Surveyor III,: 3 -

Surveyor V, 4 - Surveyor VII, 5 - Apollo 11, 6 - Apollo 12, 7 - Lunokhod 1, 8 - Lunokhod 2, 9 - Surveyor V and thermal anomalies of the craters: 10 - crater Tycho, 11 - crater Copernicus.

Lunar Prospector data and IR thermal radiation: The relation between the local thorium abundances and thermal radiation has been established for 150 points of catalogue database [5]. The Lunar Prospector thorium contents and radiation temperatures were determined for each point of the catalogue. The parameters of the photometric roughness were computed by means of individual phase functions. A result of statistic analysis is established five types of clusters determined from surface roughness. Coefficient of the correlation between local Th-content and IR radiation temperature is equal 0,89 for constant means of photometric roughness. The data of a statistical analysis are adduced in a figure 3.

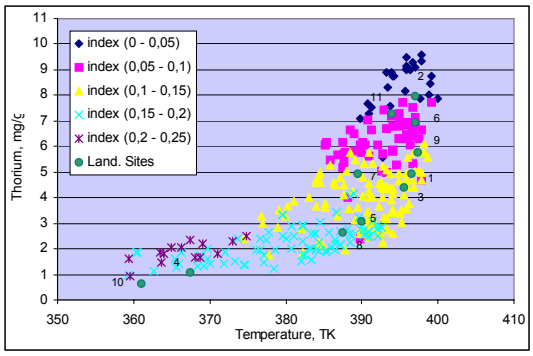

Figure 3. These data show the results of comparison of the radiation temperature and local thorium content as function of the photometric roughness parameter (index ΔI).

The sites of the lunar surface reduced on the diagram (figure 3) were marked on the map of the Moon (figure 4).

Established, that the some regions present very-high thorium contents and thermal radiation, but low values parameter of the surface roughness. The maximum high values of thorium contents are identified with rough structure of the regolith disturbed by the emplacement of ejecta materials and could indicate the surface distribution of KREEP materials. Ejecta material enriched KREEP basalt has by the least value of the photometric roughness of particles and high thorium contents. That sites located in border of the circular mares (Mare Imbrium and Mare Nubium) and Oceanus Procellarum. The highland locales are characterized by rather low concentration of thorium content and thermal radiation. The values of the roughness parameter are higher, that is characteristic for highland rocks. The heightened contents of thorium in some regions of highland indicate on presence mafic melt breccias surrounding mare basalts.

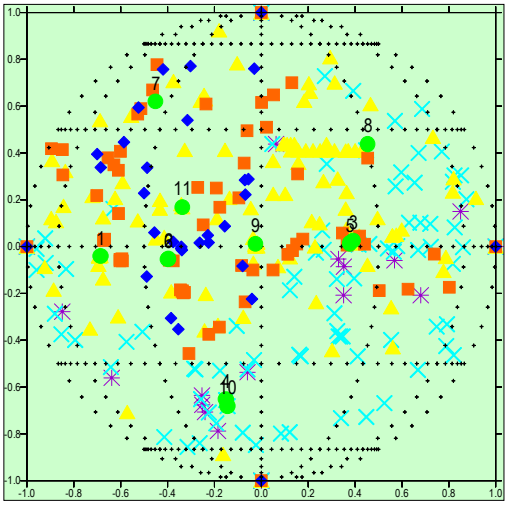

Figure 4. The Saari and Shorthill catalogue [6] data are located on the map. The photometric roughness parameters are shown as color signs. The form and colour of the signs correspond to the data of the diagram of figure 3.

Conclusion: We may propose that possible KREEP-rich materials and the anomalies of the radiation temperature associated with photometry roughness of the crater floor. Probably, Th and FeO enter into composition of ejecta lunar materials; these are located on the surface or small depth. KREEP-rich materials are concentrated to mare basalt with a high content Th. The local assimilation KREEP-rich materials ascribed to volcanic extrusions released or localized by impact and essentially influence on thermal balance of the Moon.

References: [1] Shevchenko V.V., Pugacheva S.G., Pinet P, Chevrel S., Daydou Y... Abstracts of Papers Submitted to the 27th General Assembly European Geophysical Society. Nice, France, April 21-26, 2002, PS4-1FR1A-004]. [2] Shevchenko V.V. (1980) *The modern selenography.* "Nauka Press"(In Russian). [3] Pugacheva S.G., Shevchenko V.V. (2001) *Astron. Vestnik.,* vol.35, no.3, pp.199-207. [4] Lawrence D.J. et al. (2000) JGR, 105, No. E8, 20,307-20,331. [5] Pugacheva S.G. et al. (2001) *The optical and thermal parameters of the Moon's surface.* "Yanus-K" (In Russian), [6] Shorthill R.W. et al. (1969). *Photometric Properties of Selected Lunar Features.* Nasa CR-1429.