

THE MORPHOLOGICAL FEATURES OF THE LUNAR CRATERS WITH ANOMALOUSLY HIGH CONTENT OF THORIUM. S. G. Pugacheva, E.A. Feoktistova, V. V. Shevchenko, Sternberg Astronomical Institute, Moscow State University, 119991 Moscow, Universitetsky prospect 13, Russian Federation, sve-pugacheva@yandex.ru

Introduction: The article describes the morphological features of the moon areas with anomalously high content of thorium. The areas with high content of thorium are located in vicinity of Maria of the Moon visage. In the last years, the anomalously high content of thorium was found at the far side of the Moon, in the South Pole-Aitken basin, as well as in the area of Compton-Belkovich ancient impact craters (the Compton-Belkovich thorium anomaly). The areas of the thorium anomalies were discovered by the gamma spectrometer of the space probe Lunar Prospector in 1998. Thorium content in the sub-soil surface layer of the Moon is provided in the catalogues and mapped [1, 3].

Thorium anomalies at the near side Moon. According to lunar soil samples collected by Apollo-17 and Luna-16 expeditions all the Maria on the Moon area of volcanic origin. Age of mare basalt is evaluated starting from 3.8 up to 3.1 milliards years [2]. Photographs taken by in-orbit satellites of the Moon show the lunar Maria covered with volcanic lava, meandering lava flows, cones, domes and destroyed depressions. Traditionally, it is accepted to single out two landscapes of the Moon: highlands – bright surfaces, and Maria – dark surfaces. In 2000, the third surface type was proposed, occupying the major part of the “mare-type” surface – basaltic volcanism, which was called PKT (Procellarum KREEP Terrane) (fig.1.) Almost all of them are surrounded by the lunar Procellarum KREEP Terrane [NASA/GSFC/Arizona State University]

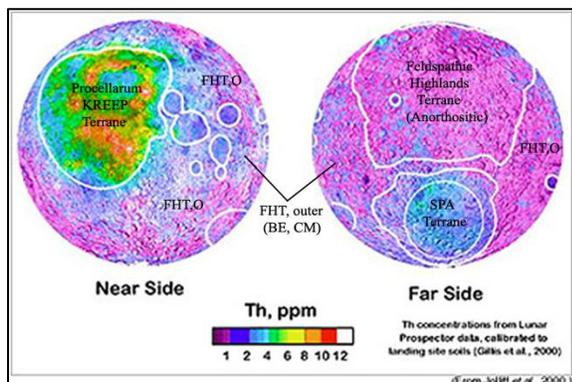


Fig.1. Pore spaces filled with thorium can be seen in PKT areas at the Moon surface space images. The names of the craters with anomalously high content of thorium is shown in Fig.2.

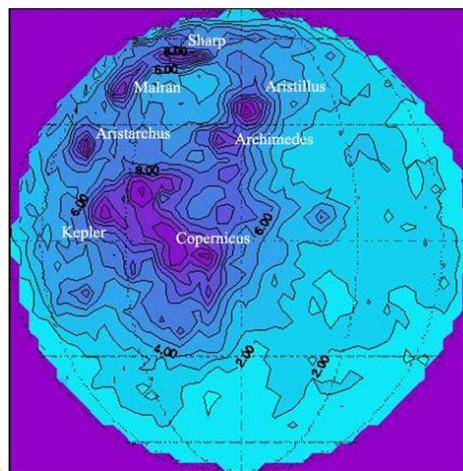


Fig. 2. The names of craters located in thorium anomalies at the PKT. These data are in units of ppm. Thorium data as described by Lawrence [3].

We have built profiles of the thorium content of the lunar craters [Fig.3]. The maximum content of thorium found on the outer slopes of the craters and bright rays. Accumulations of thorium are located around the crater.

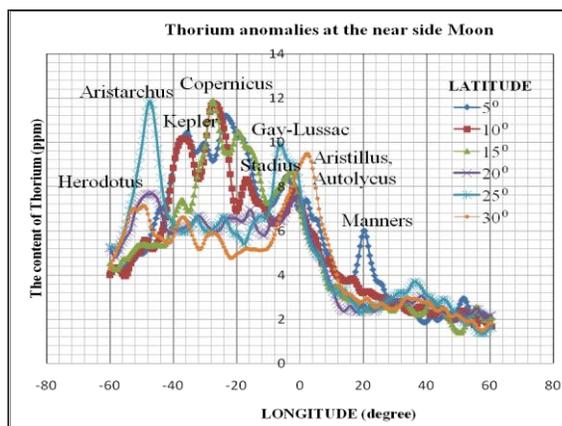


Fig.3. Figures are profiles of Thorium content in the soil regions, which are located along the Latitude. Thorium profiles constructed based on the data Lunar Prospector.

As an example, we give the crater Copernicus. The content of thorium in the center of the crater is 8 ppm and the maximum content of 12 ppm thorium match western and southern slopes of the crater [Fig.4].

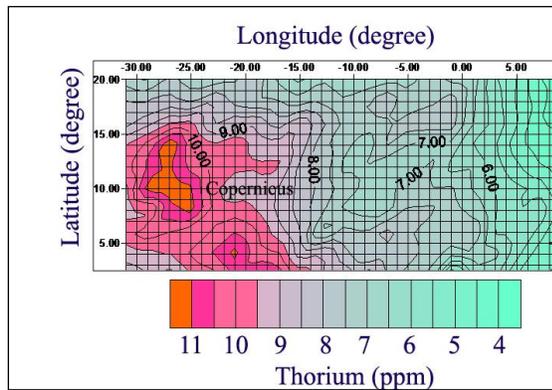


Fig.4. The content of thorium near the crater Copernicus.

Crater Copernicus – Latitude - 9.62N, Longitude -20.08W. Copernicus – ray crater, diameter of the beam of 800 km. The diameter of the crater is 96 km away. Shaft height about the bottom of the crater is 3800 m, above the surrounding surface of approximately 2200 m. The bottom of the crater bowl below the surrounding surface by about 1600, the bottom is not filled with lava. The volume of the crater – about 8400 km³.

Thorium anomalies at the far side Moon.

There are rather less areas with high content of thorium at the far side of the Moon. High content of thorium is registered in the South Pole-Aitken (SPA) basin and Mare Ingenii. As a result of detailed investigation of the Lunar Prospector space vehicle data, the new complex of the thorium anomalies has been explored in the area of large ancient Compton-Belkovich craters [3].

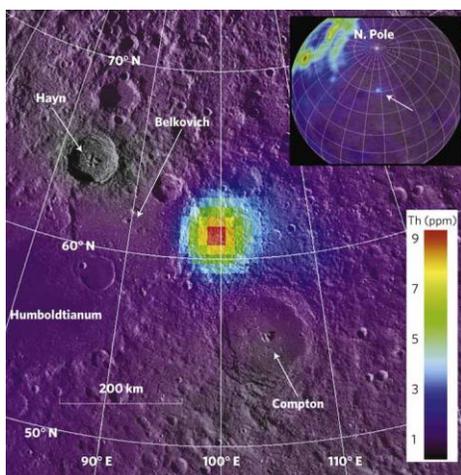


Fig.5. The Compton-Belkovich thorium anomaly [NASA, Washington University].

Initially, this area was interpreted as a surface with stones accumulation owing to material ejection when cratering due to a fall of meteorite.

Gamma ray spectrometer of the Lunar Prospector space vehicle fixed high temperature of the surface in this area, as well as high concentration of the radioactive element – thorium. Subsequently, this area got the name the Compton-Belkovich thorium anomaly [Fig.5.]

The thorium anomaly is located in 900 km from the major zone PKT. In the center of the image, a complex of craters from 25 to 35 km in diameter is located.

The Compton-Belkovich thorium anomaly is located in the north hemisphere of the Moon, the length of anomaly is 60.5°N – 61.5°N in latitude, 95°E – 101°E longitudinally, the area occupies the space of 70 km². The anomaly is located 2.9 km lower the zero altitude level. Thorium content in the central point of the anomaly is 10 ppm. The thickness of the crust in this area, according to the Grail data, is 20 km, the surface openness is 8%, density – 2375 kg m⁻³ [4, 5].

Conclusion.

Abounding reserves of thorium on the Moon are the important natural resource. Besides thorium, the metals required for the industry and innovative technologies development have been found out in the lunar regolith. These are vanadium, tantalum, niobium, cadmium, zirconium, yttrium and strontium rare earth metals. The lunar ground investigation via the space vehicles allow us to suppose that the rare earth rocks, thorium and ferric hydroxide underlie in the lunar Maria covered with volcanic lava, on the surface or shallow depth of the lunar surface.

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