

THE CHEMICAL COMPOSITION OF THE SOIL LAYER OF THE LUNAR GRAVITY ANOMALIES. S. G. Pugacheva, V. V. Shevchenko, Sternberg Astronomical Institute, Moscow State University, 119991 Moscow, Universitetsky prospect 13, Russian Federation, sve-pugacheva@yandex.ru

Introduction: The Moon's gravitational field had been studied long before the launch of the first artificial satellites of the Moon. M.U. Sagitov and N.P. Grushinsky, employees of Sternberg Astronomical Institute of Moscow State University, have calculated gravity on the lunar triaxial ellipsoid using astrometric observations [1]. They have proposed a model in which the gravitational field of the Moon can be represented by a field of a triaxial ellipsoid, the polar axis of which is perpendicular to the ecliptic, and the large lunar ellipsoid equatorial axis is directed towards the Earth. The studies have shown that the force of gravity on the Moon increases from the poles to the equator by approximately 0.0004 of its full size. Later on the gravitational field was determined by observation of artificial satellites of the Moon. The observations confirmed that the ellipsoid of the Moon is prolate towards the Earth. The Ferrari's model of the triaxial ellipsoid of the Moon shows that the height of the surface level over the ball towards the Earth is 400 meters and 300 meters - from the back side of the Moon.

In 1968, based on the study of the radial acceleration of the Moon's artificial satellite, Lunar Orbiter 5, American scientists P. Muller and U. Seagren found large *positive* anomalies over the Mare Imbrium, the Mare Serenitatis, and the Mare Crisium. At the altitude of the satellite (100 km), gravity anomalies reached *200 mGal* and more. In particular, over the Mare Imbrium gravity anomaly was equal to *250 mGal*, over the Mare Serenitatis - *220 mGal*, over the Mare Crisium - *130 mGal*. Origin of positive anomalies is related to the concentration of heavy masses in the ground, these structures are called mascons. Gravity map of the Moon made by the Lunar Prospector probe in 1998-1999. Mascons are marked with red and orange: 5 most significant of them are associated with five lunar seas [2].

GRAVITY ANOMALIES OF THE MOON.

New data on the gravitational field of the Moon were obtained from two Grail spacecrafts. The spacecrafts were launched on September 10, 2011 and received the names of Ebb and Flow. The probes flew on the same orbit, one after the other at a height of 55 km above the lunar surface. The distance between the spacecrafts was recorded with micron accuracy and varied depending on the magnitude of the gravitational field when spacecrafts were passing over the visible morphological objects, which

included mountains, craters, and also massive objects hidden under the surface of the Moon. According to the GRAIL mission data, there has been made a unique map of the Moon's gravitational field [3, 4]. The probes revealed the existence of long, hundreds of kilometers, gravity anomalies, here and there coming out to the surface. Most probably, they indicate that under the surface there are long and elongated, narrow "shafts" of dense magma solidified a long time ago. Many volcanic structures have been found by the Grail spacecraft. These are tectonic structures, basins of impact craters, ancient linear gravity anomalies [5, 6]. The article presents the data of the chemical composition of the surface soil layer of the lunar Maria. All measurements have been performed according to the theoretical models of light scattering on the basis of survey of the lunar surface by in-orbit spacecrafts and analysis of the lunar soil samples [7, 8].

Conclusion: It can be assumed that mascons include rich KREEP rocks with a high content of thorium and iron oxide. KREEP rocks in the areas of the lunar Maria covered by volcanic lava are probably located on the surface or at a shallow depth. Formation of mascons is connected with intensive development of basaltic volcanism on the Moon in the early periods of its existence.

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Table. The chemical composition of the soil layer of the Lunar Maria [9].

Latin Name	Latitude	Longitude	Diameter	Gravity Anomalies	The chemical elements of the soil layer (LP GRS).		
	Degree	Degree	Length, km	Mascous, mGal (Height - 55 km)	Thorium, ppm (max)	Iron, Fe wt.% (max)	Iron, FeO wt.% (max)
Mare Frigoris	56,0	1,4	1596	-150	5,1389	9,0100	14,4570
Mare Imbrium	32,8	-15,6	1123	500	4,9317	1,3671	19,8330
Mare Fecunditatis	-7,8	51,3	909	50	3,0125	10,9910	17,1490
Mare Tranquillitatis	8,5	31,4	873	300	2,8770	13,6030	17,9800
Mare Nubium	-21,3	-16,6	715	100	6,6729	10,4880	18,8850
Mare Serenitatis	28,0	17,5	707	550	2,5475	12,6630	19,1600
Mare Australe	-38,9	93,0	603	50	1,6886	5,6499	9,4480
Mare Insularum	7,5	-30,9	513	100	9,2249	13,8330	16,4990
Mare Marginis	13,3	86,1	420	-100	1,8784	8,7426	13,1860
Mare Crisium	17,0	59,1	418	400	2,3439	20,2840	16,3160
Mare Humorum	-24,4	-38,6	389	500	2,9814	11,6290	19,9440
Mare Cognitum	-10,0	-23,1	376	500	6,0428	14,1450	17,2160
Mare Smythil	1,3	87,5	373	400	2,2096	7,6565	13,0180
Mare Nectaris	-15,2	35,5	333	500	2,7012	7,9968	14,3270
Mare Orientale	-19,4	-92,8	327	300	1,5046	4,2351	10,7610
Mare Ingenii	-33,7	163,5	318	-50	2,4299	6,0284	10,6160
Mare Moscoviense	27,3	147,9	277	300	1,7539	5,8142	9,7030
Mare Humboldtianum	56,8	81,5	273	200	1,8494	3,9886	9,7047
Mare Vaporum	13,3	3,6	245	-100	5,0098	9,9862	16,7510
Mare Undarum	6,8	68,4	243	-100	1,8078	6,6982	9,7361
Mare Anguis	22,6	67,7	150	500	1,5970	7,0656	7,3916
Mare Spamans	1,1	65,1	139	-100	2,4312	10,4280	10,4280