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Global Topography and Gravity of the Moon Observed by KAGUYA

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KAGUYA

The Japanese lunar explorer KAGUYA (SELENE) was launched successfully on September 14th, 2007 by JAXA (Japan Aerospace Exploration Agency). KAGUYA takes polar orbits and obtained global topography and gravity of the Moon.

Topography

KAGUYA has a laser altimeter (LALT) which measures the distance between the satellite and the lunar surface with accuracy of 1 m by detecting the timing delay of the reflected laser light. The aim of the LALT is to obtain the lunar global topographic data including polar regions for the study of the origin and the evolution of the Moon. During the nominal operation period from December 2007 to October 2008, the LALT measured more than 10 million range data. The first precise global topography data have been produced by LALT. In the polar regions where CLEMENTINE did not cover, topographic features in the shadowed area are newly discovered. Solar illumination condition was calculated: the most sun lit rate is 89 % and 86 % of the lunar year for the north and south regions respectively [1]. Lunar mean radius is 1737.15±0.01 km and the COM-COF offset is 1.94 km. The amplitude of the power spectrum of topography spherical harmonics is larger than that of the previous model at L>30 [2].

Gravity

KAGUYA has two small spin-stabilized subsatellites, Rstar (OKINA) and Vstar (OUNA) for gravity measurement. We can track the three satellites by new methods: 4-way Doppler tracking between the main satellite and Rstar for the far-side gravity and multi-frequency differential VLBI tracking between Rstar and Vstar. The global lunar gravity field with unprecedented accuracy can be obtained.

From one year of KAGUYA tracking data (from 20 October, 2007, until 30 October, 2008) together with pre-Kaguya tracking data are used to create a spherical harmonics model of degree and order 100, SGM100g (SELENE Gravity Model). The large gravity error in the far-side in previous models is drastically reduced. Many circular features corresponding to impact structures are clearly identified (Fig. 1).

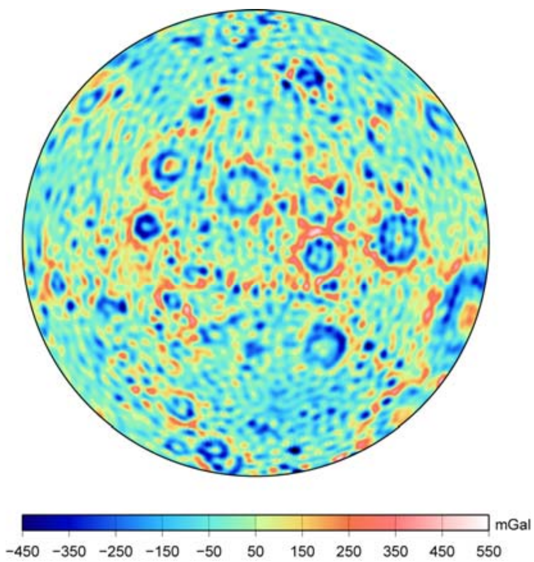

Figure 1 Free-air gravity model SGM100g. Lunar far-side.

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Impact basins on lunar far side and limb regions are classified into Type I and II basins on the basis of the magnitude of central gravity high in free-air and Bouguer gravity anomalies [3]. Topographic depression and rim of both Type I and II basins show good correlation between topography and free-air gravity anomaly suggesting elastic support of lunar lithosphere. The surface topography is a dominant source of free-air gravity anomalies and large impact structures are supported by lithosphere, which would imply the difference of thermal history between nearside and farside. We are now incorporating differential VLBI data between Rstar and Vstar to show better low degree gravity accuracy.

Crustal Thickness

From the gravity and topography data (SGM100g and STM359 grid-03), we obtain the distribution of the Moho depth as well as crustal thickness on the Moon. We assume a uniform density crust with compensation occurring at the lunar Moho. The shallowest lunar Moho interface or the thinnest crust region is located at Moscoviense basin. On the other hand, the deepest lunar Moho interface or the thickest crust region is located at rim of Dirichlet-Jackson Basin. We also estimate the correlation between gravity and topography and localized admittance values. Gravity and topography observation of KAGUYA will continue until early 2009.

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