Scientific outcomes expected from gravity experiments of Japanese SELENE mission

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SELENE is conducting two types of gravity measurements, that is, relay sub-satellite transponder (RSAT) and VLBI radio source (VRAD) experiments. RSAT is a subsystem on the relay sub-satellite. Main function of RSAT is to relay Doppler tracking signals between main orbiter over lunar far side and ground-based antenna. Then RSAT enables precise gravity mapping over the far side of the moon. On the other hand, VRAD measures angular distances between radio sources on two sub-satellites and quasers. Two experiments are complimentary and can yield new selenodetic data sets. Specification and current status of instruments are described in detail by Iwata et al. (this issue), and Matsumoto et al. (this issue) argues expected accuracies of spherical harmonics of the lunar gravitational fields. We focus on scientific outcomes expected from RSAT / VRAD experiments in combination with other instruments.

Primary goal of RSAT is to recover lunar gravity field globally and up to degree as high as 70 in spherical harmonics. Together with topography measured by SELENE laser altimeter (LALT), new gravity model allows us to investigate subsurface structures such as thickness of mare basalt and mantle uplift beneath lunar basins. Our particular interest is, of course, gravity field over the lunar far side. Targets of close examination include mare pond in South-pole Aitken basin and cryptmare in Lomonosov-Fleming basin in cooperation with radar sounder experiment (LRS).

VRAD improves the second degree spherical harmonics of the lunar gravitational fields. New precise measurements of C20 and C22 are anticipated to result in as accurate estimate of moment of inertia of the moon as 0.01 %. This value of accuracy can be translated to about 1.5 % uncertainty of core density of the moon assuming that density and depth of crust and radius of core are determined by other observations. We need to put constraints on those unknown parameters from gamma ray (GRS), X-ray (XRS), and spectral (MI / SP) experiments.

A second characteristics of VRAD is the sensitivity to space craft motion perpendicular to LOS. This characteristics plays very important role in study of structures at terminators near 90 degree east and 90 degree west. We examine fault system surrounding Orientale basin to understand formation of multi-ring basin.