Scientific results expected from SELENE lunar gravity mission

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Lunar gravity filed models based on conventional 2-way Doppler measurement have, as is well known, large error on the far-side and noisy as well. In order to solve this problem, RSAT/VRAD mission of SELENE proposes 4-way Doppler and differential VLBI measurements with 3-satellite constellation. Iwata (2006, this meeting) will report an overview of the gravity mission concept and status of mission instruments development.

We have been conducting feasibility study on SELENE lunar gravimetry by numerical simulation under realistic data acquisition limitation. The expected result includes; (1) the error on the far-side will dramatically be reduced, (2) many gravity coefficients will be determined by observation which were so far determined by a priori constraint, and (3) the lunar gravity coefficients below degree around 30 will be improved to the accuracy of one order of magnitude better than LP100J which is one of the current state-of-the-art lunar gravity field model.

The followings are anticipated contributions of SELENE gravity filed model from the viewpoint of integrated science which is proposed by Namiki et al. (2006, this meeting). At the first stage (to draw 2D geologic maps of both lunar maria and high land), it is expected that we will be able to find new masscons and cryptomares on the far-side. The findings of the cryptomares under thick regolith, together with mineral composition data, will contribute to study of volcanic activity in the early stage of lunar formation at the third stage of the integrated science (to investigate special topics such as differentiation of basaltic magma on the basis of 2D and 3D maps). At the second stage (to reveal subsurface structure of maria, and highland if possible), variation of lithospheric thickness and degree of isostasy will be inferred by combining gravity map and topography map obtained from laser altimeter (LALT) data. The differences between the near-side and the far-side will develop into discussion of lunar dichotomy.

One can discuss the existence of lunar core from moment of inertia which is derived from combination of low-degree gravity coefficients and dynamical flattening deduced from lunar laser ranging (LLR) data. It has been indicated from Lunar Prospector data analysis that the moon has a small core, but the uncertainties of gravity coefficients dominate the moment error and the result is still provisional (Konopliv et al., 1998). SELENE will contribute to put stronger constraint on the existence of lunar core through improvement in low-degree gravity coefficients. Furthermore, at the fourth stage (to study origin and evolution of the moon), we may be able to shed light on the origin of the moon when we come to know the core density through combination of the lunar moment inertia and core radius information obtained by Lunar-A type moonquake observation.