Strategic plan for integrated science of SELENE mission (solid planetary sciences)

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Japanese lunar mission, SELENE, is scheduled to be launched in 2007. Currently developments of scientific instruments are close to completion. In order to make as much contribution to lunar science as possible from new observations, we propose a strategic plan for integrated science of SELENE mission. Our basic idea is to analyze observational data in four stages. First stage is to draw 2D geologic maps of both lunar maria and high land. Second stage is to reveal subsurface structure of maria, and highland if possible. Third stage is to investigate special topics such as differentiation of basaltic magma on the basis of 2D and 3D maps. And in last stage, we aim to study origin and evolution of the moon.

(1) Making 2D maps. Several lunar geologic maps have been already published, even in prior to Apollo era. Surprisingly, however, there is no consensus regarding identification and classification of geologic units among these maps. This is probably because surface materials have been scattered and diffused by repeated impacts. Most recent mineralogical and elemental maps by Clementine and Lunar Prospector do not seem helpful. Instead, we take notice of topographic boundaries such as lava front in mare Imbrium. Observations by LRS, LALT, and TC of SELENE will play important roles in this stage.

(2) Making 3D maps. We propose to investigate subsurface structures of 2 major provinces. That is (2-1) stratigraphy of basaltic lava flows in lunar maria, and (2-2) structures of upper crust, lower crust, and upper mantle. (2-1) could be data from LRS themselves. The observed stratigraphy can be tested by taking MI/SP spectrum within craters. As for (2-2), we determine mineralogy of each layer from MI/SP spectrum, and then the thicknesses of layers are estimated quantitatively by gravity data from RSAT/VRAD. The estimated structure is compared with electric conductivity from LMAG.

(3) Joint study of special topics. Every instrument teams have their own scientific objects and targets. We propose to study common targets in cooperation of several instruments on the basis of 2D and 3D maps developed in (1) and (2). An example is differentiation of mare basalts. Observations of LRS, LALT, and TC provide area and thickness of each lava flow. Physical properties of lava are determined from morphology at the terminals. Together with these analyses, mineralogy and elemental abundances by MI/SP, GRS, and GAP show differentiation of magma reservoir.

(4) Advanced topics. Scientific achievements up to (3) will promote further investigation regarding origin and evolution of the Moon. Bulk composition, dichotomy, evolution of magma ocean, lunar thermal history, and so on are targets in the last stage. However, we have to be careful. For studies of such advanced topics, we must invoke some prerequisites such as elemental composition of lower mantle and core, radius of core, and depth of magma ocean. We need to compensate a lack of observations, even after SELENE mission, by a COMMON SENSE in planetary science. A priori models of lunar interior and thermal evolution should be prepared before a launch of SELENE.