Science Objectives of the SELENE-II Lunar Landing Mission

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Abstract. Moon is placed as one of the most important targets of Japanese planetary exploration programs since 1990's. Three missions were approved and developed so far, *HITEN*, *LUNAR-A*, and *SELENE* so far. *HITEN* was succesfully achived to make insesion of lunar orbit in 1990. *SELENE* is about to launch in the near future (August, 2007) and will make precise remote sensing observations, however, *LUNAR-A* was canceled Feb. 2007 due to the dificulty of the penetrator technology. Japan Aerospace Exploration Agency (JAXA) has perspectives for the next two decades to promote lunar explorations both for science and future utilization.

SELENE-II mission, which was originally started as the *SELENE-B* (Okada et al., 2005), is now undertaken Pre Phase-A. This mission is featured as precise landing, surface mobility and long time staying which must be important technology for the future planetary explorations. This mission is also defined to promote science of the Moon, which motivated to develop some scientific instruments on board the lander and the rover. We have investigated scientific objectives by this landing mission both from geological and geophyisical point of view in order to maximize the scientific gain.

For the geological aspects of the Moon, the top priority of the lunar science is to clarify the process of magma ocean which was experienced at early stage of planetary evolution not only on the Moon but also on the larger size of solid planets and satellites. The results of Clementine, Lunar Prospector, and recent progress of sample analyses of lunar meteorites have revealed complexity of crustal evolution. We need detailed sample analyses at some representative geological units such as PKT (Procellarum KREEP Terrane), FHT (Feldspathic Highlands Terrane), and SPA(South Pole-Aitken Basin). In order to contribute to do this by landing mission, chemical analyses of the bulk sample of the landing site is no longer effective. We expect some crucial evidences in limited part of polymict pbreccias which can be found in "rake samples" in the regolith. Therefore, sample processing (cutting, polishing and so on) technique, and high precision chemical analyses of millimeter size region a re key technologies to achieve this science goal. The landing site is preferable to choose at SPA or adjacent area (e.g. South pole region or high latitude areas) at where the lander will be able to collect the SPA samples because we have not identified this type of samples among the returned or lunar meteorites so far.

Geophysical observations are also indispensable, and among them, seismic observation is the most important to clarify internal structure directly and clearly. The existence, size of core, and velocity profile of the mantle will provide us to estimate bulk abundance and thermal state which will drastically progress to infer the origin of the Moon. Seismic observation will also give us effective information for the future manned mission(s) to asses the seismic and meteoroid risk before to plan any type of permanent settlement. We are considering to deploy broad band seismometers with high sensitivity. By using 100 seconds period of seismometer with having a sensitivity equivalent or one order higher to that of the LUNAR-A seismometer, we expect to get information of the heterogeneity of the lunar crust and the upper mantle only by one observation station. If the largest class of moon quake which had been observed by the Apollo mission was occurred during the mission, we also expect to obtain the bulk layered structure by detecting free oscillations.

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