Expected results on the lunar science from scientific observations in Approach mission

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The penetrator has been developed through Japanese lunar explorer 'LUNAR-A' mission. The penetrator is a hard-landing probe to deploy on-board sensors on planetary surface by free-fall from an orbiter. Through previous studies, we have already confirmed that the seismometers for the penetrator can maintain the performance to detect moonquakes even after a shock over the impact to the lunar surface (Yamada et al., 2009) and the communication instrument on the penetrator properly operate for data transmission (Tanaka et al., 2010). The penetrator is advanced system to deploy geophysical network on the planetary bodies and it is expected to be applied for future lunar and planetary explorations

To establish utility of the penetrator system and demonstrate scientific observations using the system, we have proposed a mission plan: Approach mission, so as to load two small-sized penetrators on a small satellite launched by the Epsilon Launch Vehicle. In this proposal, we aim to reduce size of the penetrator to two-thirds size keeping the already established high shock durability and the on-board sensors, and two penetrators enable achievement of redundancy and more progress in scientific results.

In this mission, we have plans of seismic and heat-flow observations using two penetrators. Due to small numbers of seismic stations, we apply travel time data from the meteoroid impact events located by the ground observation of the impact flash to determine the lunar crustal thickness. The better determination of the crustal thickness and utilization of recent lunar gravity data enable estimation of the lunar crustal volume and aluminum bulk abundance with better accuracy. If we can identify seismic waves which pass through the lunar deep region using two seismic station data, more information about the deep interior can be also expected. Then, heat flow observations on both areas where the radioactive elements are concentrated and poor are important to estimate bulk abundance of the radioactive elements. In this presentation, we report the results expected from the scientific observations in Approach mission quantitatively, and then discuss how we can progress the study about lunar origin and evolution from the results.

Keywords: Penetrator, Lunar interior exploration, Moonquake observation, Heat flow observation, Small-sized exploration satellite

