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Moonquake observation and lunar interior exploration by one penetrator station

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The penetrator developed through Japanese lunar explorer 'LUNAR-A' mission is system to deploy on-board sensors on the planetary surface by free-fall from an orbiter. The penetrator is smaller and lighter than typical soft-landers because it does not require complicated landing system and thermal control system, and it has an advantage to construct geophysical network on the planetary surface. However, on-board sensors require high shock durability to survive a penetrating impact. Through previous studies, we have already shown that 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).

Although high shock durability of the penetrator was established, deployment of the penetrator has not been executed due to cancel of the LUNAR-A mission. We, therefore, have a plan to load the penetrator on a small satellite launched by the Epsilon Launch Vehicle. In the plan, we can carry only one penetrator due to strict weight limitation of the vehicle. For the reason, we currently study the expected scientific results obtained from the observation by one penetrator station.

The seismometers deployed through the NASA Apollo missions have detected some types of moonquakes; deep moonquake, shallow moonquake and meteoroid impacts. The seismometer for the penetrator has performance capable of observing these moonquakes, and verification of activities of these lunar seismic events through comparison with results from the Apollo mission will be one of important topics. Then, we can expect to obtain information about the lunar crustal thickness and structure if we can locate meteoroid impacts by their impact flashes from ground observation. In this presentation, we report that expected detection numbers of the lunar seismic events can be observed by the penetrator and the scientific results, and appropriate installation locations of the one penetrator to obtain good scientific results be described. Then, we also discuss the prospects for future network observation using the penetrator after the small satellite exploration.

Keywords: Penetrator, Moonquake Observation, Lunar Interior Exploration, Small Satellite Exploration, Meteoroid Impact Flash