

Investigation and Development of Seismic Observation Package for Asteroid and Small Body Explorations

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Exploration of small bodies in the solar system provides us important constraints on formation and early evolution of the solar system. Japanese Hayabusa mission, who carried out a sample return from an asteroid, was one of the most successful Japanese planetary missions and it opened a new possibility of future Japanese missions to asteroids and small bodies. While returned sample provide a unique opportunity to investigate the origin and evolution of the planetary bodies, in-situ observation also provides some complementary information that can only be obtained on site. Inner structure of asteroids and small bodies is one of the key parameters that need to be constrained through in-situ observation and seismic observation will be an effective approach to reveal the geophysical feature on the interior.

Here we discuss our investigation on seismic observation on asteroids and small bodies, especially on Phobos, which is the target of Japanese Mars Moon Exploration Mission (MMX). We will mainly discuss two subjects; 1. Estimation of seismic signal on small bodies and 2. Possible configuration for seismic observation on small bodies.

In the first section, we evaluate seismic signals from meteorite impacts and possible artificial impact. We calculate synthetic seismograms through normal modes summation and compare seismic signals from various sources. We also investigate the difference in seismic signal that arise from different inner structure models. The small bodies are likely to be covered with regolith and mega-regolith as it was observed on the Moon. For relatively large bodies, it is possible that solid non-contaminated layer (or core) exists under the mega-regolith. Such information on deep interior will provide an important constraints on the origin of the small body. Seismic observation is an effective to probe such deep structure that is difficult to observe from orbital observations and it will be important to carry out quantitative evaluations to optimize our observations.

Secondly, we will present our proposal for seismic observation package on asteroids and small bodies. The discussion is based on our proposal submitted to MMX science instruments. The observation package consists of a 3 axes short period seismometers and an active seismic source. While natural events are important seismic source to probe the deep structure, it is important that we constrain relatively shallow structure with known and controlled seismic source. We will discuss possible achievements we expect from possible seismic source that we are able to provide. We also present our preliminary estimates on observation plans and expected output from our present configuration of seismic package for MMX. We point out some improvements that we are currently investigating and introduce possibilities of future missions that we will be able to contribute to.

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