Regolith simulant and environment model of Phobos for MMX mission

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Phobos and Deimos are considered to be scientifically important and potential human mission’s target. Martian Moons eXplorer (MMX) is the JAXA’s mission to explore Phobos, which is scheduled to be launched in 2024. The main spacecraft of MMX will perform in-situ observations of both Phobos and Deimos, land on Phobos, and bring samples back to Earth. Small landing modules may be included in the mission as for the Hayabusa-2 mission.

The designs of both the landing and sampling devices depend largely on the surface conditions of the target body and on how this surface reacts to an external action in the low gravity conditions of the target. Thus, the Landing Operation Working Team (LOWT) of MMX, which is composed of both scientists and engineers, is studying Phobos’ surface based on previous observations and theoretical/experimental considerations.

Though engineering motivation initiated this activity, the results will be extremely useful for scientific purposes. In this talk, we will summarize our current activities and what we found so far. For example, we developed simulant of Phobos to evaluate mechanical properties of Phobos. Two types of simulants are developed, such as a Tagish Lake-based simulant (UTPS-TB; Univ Tokyo Phobos Simulant, Tagish lake based; Fig) and mixtures of UTPS-TB and mars-like materials as powders of dunite/basalts (UTPS-IB; Univ Tokyo Phobos Simulant, impact hypothesis based). As for the UTPS-TB, we crushed Mg-rich phyllosilicates (asbestos-free serpentine), Mg-rich olivine, Magnetite, Fe-Ca-Mg carbonates, Fe-Ni sulfides into very fine particles, which are mixed with carbon nanoparticles and polymer organic materials. Then we mix them under wet condition and then dried them completely, the initial liquid content being adjusted to control the compressible strength. The reported compressible strength of Tagish lake varies from 0.7 MPa and larger, so we typically arranged the compressible strength to be as large as about 1MPa.

The MMX lander will be about 2.1m in width and may require the surface roughness to be smaller than 40cm at a landing site. Unfortunately, data from past missions have been obtained with a too low resolution to evaluate the landing hazard. Thus, we theoretically develop a DTM based image analyses as follows, whose results will also be reported in this talk.

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