Physical properties of Phobos surface for landing mission

*Kazunori Ogawa[1], Hideaki Miyamoto[2], Koji Wada[3], Naoya Sakatani[4], Naoyuki Hirata[1], Hiroshi Kikuchi[2], Shoichiro Yokota[5]

1. Kobe University, 2. University of Tokyo, 3. Planetary Exploration Research Center, Chiba Institute of Technology, 4. Meiji University, 5. Japan Aerospace Exploration Agency

Japan Aerospace Exploration Agency and Japanese planetary science communities are currently planning a sample return mission to Phobos, Martian Moons Explorations (MMX). In this mission, spacecraft rendezvouses with Phobos and conducts remote sensing observations for over several months, and makes one or several times of landing on the Phobos surface to collect regolith samples. Spacecraft then returns to the Earth and throw a sample container to the Earth ground. Scientific objectives of this mission are focused on the origin of the Martian moons and understanding of the Mars system environment from past to present.
Physical properties and environment of the Phobos surface are critical information for such landing mission to design spacecraft and instruments such as sampling mechanisms. For assuring the safety in the spacecraft landing sequence and correct operations of instruments, the surface condition should be predicted or constrained as accurately as possible. On the other hand, our current knowledge of the Phobos surface is poor because its surface has never been explored directly. In past planetary missions, some remote observations were conducted by Mars probes such as Viking and Mars Pathfinder. Some data of ground radar observations are also available to predict condition of the surface layer.
In this study, we integrated these results of past observations and theoretical models concerning planetary surfaces, and estimate the physical condition of the Phobos surface for future landing missions. The examination items are mechanical, thermal, and electrical properties, geography, distribution of boulders, dust, gas, and radiation environment, gravity, magnetic field, etc. While past observations suggested the Phobos surface is covered with fine grained regolith, the key parameters in the all properties are a typical grain size and porosity of the top surface layer. We assumed three end-member models for these parameters to be estimated: asteroid Itokawa-like, Earth's moon-like, and Saturnian satellite Atlas-like conditions. Possible ranges of the grain size and porosity, and other depended parameters are constrained by these models. In this presentation, the total environment of the Phobos surface is discussed with the grain size and porosity as the point of departure.

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