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小惑星イトカワ表面に存在する岩塊の表面組織の解読～小惑星のフィールド岩石学の試み～

Interpretation of the surface textures of boulders on Asteroid Itokawa: A trial of field petrology of an asteroid

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The Hayabusa spacecraft reached 25143 Asteroid Itokawa in 2005. It had obtained many images of the asteroid by the asteroid multi-band imaging camera (AMICA), altitude data of the asteroid by the light detection and ranging (LIDAR), near infrared reflectance spectra by the near-infrared spectrometer (NIRS) and chemical composition of the surface material by the X-ray spectrometer (XRS) for three months. It also tried to obtain the surface material at the MUSES-C regio. The Hayabusa spacecraft is now on the way to the earth. It will arrive at the earth in June, 2010. At the Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency (JAXA), a curation facility has been constructed. The preparation for the analysis of the surface material of Itokawa has been performed by the researchers of ISAS and some universities.
At the touchdown rehearsal on 12 November 2005, Hayabusa obtained high-resolution images of the surface of Itokawa by AMICA. We could examine fine morphological features of the boulders (gravel with >256 mm in diameter) and estimated their lithologies and origins. The quite high-resolution images allowed the meteorite researchers to collaborate with the researchers of remote-sensing to analyze the images.
We compared the estimated lithologies of the boulders on Itokawa and those of meteorites and discussed the similarities and differences between them. There are two major types of boulders on Itokawa. First type is characterized by the undulations (5-20 cm in dimension) and rounded edges. Second one is characterized by the flat surfaces with sharp edges. The former has heterogeneous breaking strength within a boulder. Their surface morphologies seem to be consistent with speculation that they are breccias. On the other hand, the latter has homogeneous breaking strength on several-meters scale. There is no comparable chondrite with such homogeneous strength. Because shock melt rocks that experienced extensive melting have breaking strength higher than the usual ordinary chondrites, the latter may have lithology similar to such rocks. Both of the boulders would not have been formed on Itokawa based on theoretical considerations. These boulders must have been formed on the parent body of Itokawa. We think that the high-resolution

images are powerful tool to estimate the geological history of an asteroid and that they will play an important role in the future small body missions.

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