Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PPS005-03 Room: 301A Time: May 26 09:30-09:45

Distributions and morphological characteristics of bright spots on boulders covering the surface of asteroid Itokawa

Hiroto Takeuchi[1*], Hideaki Miyamoto[1], Satoshi Maruyama[1]

[1]University Museum, University of Tokyo

Asteroids have experienced significant changes through their evolutional stages of development. Among the most important unanswered questions is that the timescales of these changes are mostly unknown. In order to develop a new technique to provide additional constraints on the developmental stages of the asteroid, we focus on never-before-investigated enigmatic features found on the exposed surfaces of boulders that partly cover the Itokawa asteroid, as a possible new technique for this purpose.
Hayabusa obtained more than 1400 images of Asteroid 25143 Itokawa, which includes about 10 high-resolution (several to tens mm/pixel) images. The surface of Itokawa observed in these images is considerably different from previously observed asteroids due in large part to overlapping boulders, which are densely distributed over most of the surface. Some of these boulders show relatively bright dots or scar-like features, which are referred to here as bright spots.
In this detailed investigation using high-resolution image data, the spatial distribution and shapes of the boulders and boulder-marking bright spots are mapped, their characteristics carefully compiled (including exposed surface area, brightness, lengths of the major or minor axes (i.e., elliptical approximation), the central coordinate, the mean brightness of the total exposed surface of the boulder, the perimeter, and Feret's diameter), and analyzed. Results from this investigation include the identification of 394 bright spots on 123 boulders among a total of ~3000 boulders. In general, higher resolution images have larger numbers of bright spots, which indicates that there may be many bright dots below the resolution limit. The outlines of both bright spots and boulders are carefully mapped. The results of this detailed mapping investigation are compiled into a database.
Several important characteristics of bright spots are identified based on the database. Especially, we find that the cumulative size distributions of bright spots have the power-indexes within the range of -3 to -2. This is interesting because the power-index of cumulative crater size distribution is approximately -3 ± 1, which is similar to those of bright spots. Moreover, the cumulative size distributions of micro-craters of lunar rocks obtained by Apollos 15-17 are also within a range of -3 to -2 (Schneider and Horz., 1974). Because there are some bright spots whose sizes of major axis are more than ten centimeters, chemical anomalies such as a chondrule are difficult to be attributed to the bright spots. Thus, these indicate that bright spots are micro-craters, which are formed by micrometeoroid impacts.
If our interpretation is correct, bright spots can be useful to estimate a timescale after a fresh surface of a boulder is exposed to the space. According to the data obtained by long-duration exposure facility (LDEF) at near-earth orbit, the flux of micrometeoroid and micrometeorite, which may be the origin of bright spots, is 10-12/m^2s. Because the number densities of bright spots obtained for boulders range from 1/$m^2$to 50/m^2, the ages estimated by considering the micrometeoroids impacts to LDEF are 40,000 to 2,000,000 years. Thus, the surfaces of boulders were exposed to the space within these estimated timescale. In other words, all of the boulders covering the surface of Itokawa was formed no older than 2Ma, which is consistent with the

collisional lifetime of Itokawa.

Keywords: asteroid, age, boulder, exploration