Distribution of bright spots on the surfaces of boulders on Itokawa

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Hayabusa obtained more than 1500 images of Asteroid 25143 Itokawa, which included about 10 several to tens mm/pixel high-resolution images. The surface of Itokawa seen in these images is considerably rough due to boulders that are overlapping each other and densely distributed. Some of these boulders show relatively high-brightness dots or scar-like features, which are called bright spots in this study. We are investigating the formational origin of bright spots.

As a first step to understand the origin of the bright dots, we study their special distributions in close-up images, such as ST_2539444467, ST_2539451609, ST_2539437177, ST_2539429953, ST_2539423137, ST_2563511720, ST_2563537820, and ST_2563607030. As a result, we find 394 bright spots on 123 boulders among ˜3000 boulders except for images of the Muses-C smooth terrain (ST_2539423137, ST_2563511720, ST_2563537820, and ST_2563607030). In general, higher resolution images have larger numbers of bright dots, which indicates that there might be many bright dots below the resolution limit.

In this study, the outlines of bright spots and boulders are mapped by using an image-processing software. We summarize the results of mapping as a database, which include quantitative shape-data of boulders, such as the planar dimension, the brightness, the size of major or minor axis with elliptical approximation, the central coordinate, the brightness weighted central coordinate, the perimeter and Feret's diameter.

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$\pm$1, which is similar to those of bright spots. Furthermore, the cumulative size distributions of micro-craters of lunar rocks obtained by Appolo17 are also within a range of -3 to -2 (Schneider and Horz., 1974). Because there are some bright spots whose size of major axis are more than ten centimeters, crystals such as chondrule are difficult to be attributed to the bright spots.

We interpret these indicate that bright spots are micro-craters, which are formed by micrometeoroid impacts to the space-weathered surfaces of boulders. According to the data obtained by long-duration exposure facility (LDEF) at near-earth orbit (Miao and Stark., 2001), the flux of micrometeoroid and micrometeorite which might be the origin of bright spots is 10-12/m^2s. When the number densities of bright spots are obtained in each boulders, those densities are 1/m^2 to 50/m^2. The ages estimated by considering the micrometeoroids impacts to LDEF are 30,000 to 2000,000 years.