

Morphology of craters on the asteroid Itokawa

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Observations of the asteroid 25143 Itokawa by the HAYABUSA spacecraft reveal various features on the asteroid surface. These possess unfamiliar morphologies relative to those found on previously explored asteroids that could indicate a unique cratering process and subsequent geological modification. We describe the wide range of crater morphologies on Itokawa, and discuss their possible implications for the origin and internal structure of the asteroid, and for the characteristic cratering process on its surface.

More than ten facets are recognized on the shape of Itokawa through a preliminary investigation. Some of them possess very evident circular rims and mildly depressed topography. Little Woomera, a facet at the 'tail' of the asteroid with a diameter of about 50 m provides a good example of one of the largest of these circular depressions on the asteroid. The rims are not only morphologically evident, but are also prominent due to their brightness relative to the surrounding material. The Depth to Diameter ratios (h/D) of large crater candidates are small, in striking contrast to other large and deep craters on other asteroids. Although it would be too hasty to judge whether the low h/D of the large circular depressions are the result of the primary cratering process, or a consequence of subsequent modification, preliminary analyses suggest that shallowing by debris filling at Little Woomera seems to be limited at least. Close observations of Little Woomera show that only a small

portion of its floor is covered with fine materials. In any case, shape and distribution of large craters would give important information either on the internal structure of the asteroid or on its pre-existing surface curvature.

Even though most craters and possible crater candidates are inconspicuous and difficult to identify in camera images, a few medium (10-40 m in diameter) sized craters are fairly evident. They are much smaller than most facets, and larger than most typical boulders. Thus, they are easily recognizable as local circular depressions that are not lost among the numerous boulders on the surface of the asteroid. Medium sized craters also possess considerable fill of fine sediment, and their smooth floors stand out in rough terrain of the asteroid. They resemble ponds present on the surface of the asteroid 433 Eros. The smooth floor is a characteristic feature of these craters not seen in larger craters such as Little Woomera. Detailed investigations of these middle-sized craters, in particular whether their fill is flat relative to gravity, will provide considerable insight into how these craters form, and what processes may be responsible for the displacement of the regolith.

The morphology of small craters on the rough terrain of Itokawa remains generally unclear. A rapid analysis indicates that their number per unit area is limited. Careful investigations may be required to identify real impact craters from other pits and depression present on the surface. Rough terrains of Itokawa suggest that armoring and morphological concealing of craters by boulders may be a major reason for the apparent paucity of small craters. Even if a crater forms on the boulder-dominant target, its recognition as a crater could be difficult. In the case that the crater depth is comparable to the surface irregularities resulting from boulders, their morphological concealment should be evident. If some of these small craters are buried with regolith, their concealment could be enhanced. We will attempt to determine and classify the morphological concealment of craters on Itokawa through photogeological technique and surface shape modeling. Such an analysis may give additional

insights into the sub-surface structure and surface transport mechanisms of regolith on Itokawa.