

Properties of Small Asteroid Itokawa Revealed by Hayabusa & Implications for Asteroid Research

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In September 2005 the Hayabusa spacecraft arrived at a 500-m sized S-type near-Earth asteroid Itokawa and made remote-sensing observations in the vicinity of the asteroid as well as the touchdowns onto the asteroid surface. It was the first time to obtain the close-up data of such a small asteroid. Itokawa was quite different from the one having been expected as an extrapolation of the larger asteroids observed by past spacecrafts. Its density is as low as 1.9 g/cm³ while so far observed S-type asteroids have density of about 2.6 g/cm³. The surface is divided into dichotomous terrains; boulder-rich rough terrain and smooth terrain. In the rough terrain great number of boulders exists, while smooth terrain is found to be composed of relatively uniformly sized small pebbles. The well defined craters are rare over the whole surface. Itokawa is considered as the rubble-pile asteroid. It is considered to have formed through reaccumulation among some fragments produced in a catastrophic disruption of a preexisting larger asteroid. The rubble pile structure for larger asteroids had been predicted theoretically for a long time but it was a puzzle why rubble pile asteroids had not been found actually. Hence it was a surprise that the first rubble pile was found for the smallest asteroid such as Itokawa, and this unexpected result posed us a new puzzle. Some new scenario of asteroid evolution which is compatible with all existing data including newly obtained Itokawa data is now required. Further understanding of physics of collisional disruption and physics on the granular media seem to be key issues to solve the problem from the viewpoint of the internal structure and the surface topography.