Formational and evolutional processes of Regolith on the surface of Itokawa

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Formation of regolith on asteroid is different from that on the Moon, due to the significant difference in surface accelerations. While impact ejecta are locally deposited around craters on the Moon, on an asteroid they are ballistically spread over the entire surface and often escape. Whereas repetitious impacts on the Moon form locally concentrated, size-sorted regolith, on asteroids such ballistically distributed ejecta deposits form globally continuous, poorly-sorted regolith. This view plausibly explains the generally uniform appearances of S-type asteroids previously explored by spacecraft, however the existence of globally-segregated smooth terrains on Itokawa requires additional explanation. Because the size of Itokawa is by far the smallest asteroid ever studied at high resolution (e.g., the mass of Itokawa is six orders of magnitudes smaller than Ida, which is six orders of magnitudes smaller than the Moon), there may be new processes of regolith evolution not seen before. In November, 2005, the Hayabusa spacecraft performed touch-down rehearsals, imaging navigation tests, and two touch downs, which provided close-up images with the range distance between 63m and less than 2km. By rectifying these close-up images into images from higher altitudes, we determine the exact locations for all of the close-up images, which are confirmed by the spacecraft's attitude and orbital information. All of these images show that unconsolidated gravels are covering the surface of the asteroid, which should have experienced several evolutionary processes of its regolith. In this talk, we propose that the regolith, accumulated as a consequence of a rubble pile asteroid, segregated as a result of their global migrations.