

Linking asteroids and interplanetary dust particles through the crater size-frequency distribution on Itokawa.

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The asteroid explorer Hayabusa revealed that the crater size-frequency distribution on Itokawa is far below the empirical saturation limit with much shallower slope compared with the extrapolation from the larger size. These facts may imply the young surface age of Itokawa, paucity of impactors, 'armouring' by surface boulders and/or selective removal of smaller craters by obliteration. However, we cannot fully explain the observations by the latter two effects because the typical thickness of the surface boulder layer is only a few meters.

The standard model of the asteroid collision evolution predicts the averaged lifetime of Itokawa-sized bodies in the main belt as tens of million years. Numerical integration of Itokawa's current orbit suggests the ν_6 secular resonance as the most likely source and the shorter lifetime as a Near Earth asteroid compared with the collisional lifetime. Furthermore, the Yarkovsky effect causes the orbital decay for objects with retrograde spin, such as Itokawa. Consequently, Itokawa could have been created by the destruction of the parent body in the main belt tens of million years ago and subsequently injected into the ν_6 resonance by the Yarkovsky effect.

If this scenario is true, we can deduce the size-frequency distribution of impactors orbiting just outside the ν_6 resonance from that of craters on Itokawa. We show that the theoretical size dependence of the Yarkovsky effect can match the Hayabusa's observations quantitatively.