INTERPRETING ITOKAWA'S CRATERING RECORD

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The ∼500 meter long near-Earth asteroid (NEA) Itokawa, recently visited by the Hayabusa spacecraft [see 1], has a cratering record that is significantly undersaturated for craters below ∼100 m in diameter, with meter-scale craters almost nonexistent. The cratering record in this size range is similar to that on Eros, where the depletion of small craters was shown to be consistent with erasure by seismic shaking [2,3]. Using the model of [4], which tracks crater production and erasure, and including a parameterized version of seismic shaking erasure from [2,3] which has been scaled to account for Itokawa being significantly smaller than Eros, we are able to reasonably reproduce Itokawa's cratering record. Even though Itokawa is an NEA, the majority of its craters would have been formed by main-belt impactors. We have tested the best-fit main-belt populations of [5] and [6,7], and find that [6,7] provides the best fit to Itokawa's crater size distribution. That impacting population is also found to be consistent with the cratering records on Gaspra, Ida and Eros. There is still an over-depletion of craters smaller than ∼10 m in diameter on Itokawa, beyond that which is easily explained by equilibrium seismic shaking erasure in our model. Possible explanations that we are exploring include stochastic effects such as a well-timed large impact, or a change in the physics of seismic shaking for very small asteroids.

The most significant uncertainty in this type of modeling is the scaling law used to convert impactor diameter into crater diameter. Using a hydrocode-based scaling law [8], we find that Itokawa's cratering record can be matched after ∼100 Myr of exposure, whereas using a scaling law based on explosion cratering in rock [9], we find that it takes ∼1000 Myr. Uncertainties in the scaling law, therefore, translate to substantial uncertainties in the estimate of Itokawa's age.

References [1] Fujiwara, A. et al., 2006; *Science* 312, 1330-1334. [2] Richardson, J. E. et al., 2004; *Science* 306, 1526-1529. [3] Richardson, J. E. et al., 2005; *Icarus* 179, 325-349. [4] O'Brien, D. P. et al., 2006; *Icarus* 183, 79-92. [5] O'Brien, D. P. and R. Greenberg, 2005; *Icarus* 178, 179-212. [6] Bottke, W. F. et al., 2005; *Icarus* 175, 111-140. [7] Bottke, W. F. et al., 2005; *Icarus* 179, 63-94. [8] Nolan, M. C. et al., 1996; *Icarus* 124, 359-371. [9] Holsapple, K. A. et al., 1993; *AREPS* 21, 333-373.