SHOCK STATE OF ITOKAWA REGOLITH GRAINS.

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Introduction: One of the fundamental aspects of any astromaterial is its shock history, since this factor elucidates critical historical events, and also because shock metamorphism can alter primary mineralogical and petrographic features, and reset chronologies.

Shock State by Optical Petrography: We determined the shock state of the Itokawa samples in the conventional manner under crossed polars in a standard petrographic microscope. Our biggest problem was the fact that we only attempted this analysis after SIMS measurements had been completed for many of the samples, which had excavated holes measuring several microns surrounded by thin amorphous regions, which we had to ignore. To date we have examined 30 separate Itokawa grains by this technique, which range in petrographic grade from LL4 to LL6. Practically all crystallites in the grains exhibit minor to pronounced undulatory extinction. Some grains display distinct mosaicism. We saw no instances of shock veins in the equilibrated (LL5-6) grains, but there were amorphous regions in the unequilibrated LL4 grains. We observed no obvious parting or planar deformation features. Given the natural variability of shock effects [1], these petrographic observations indicate shock stage S2 indicating a maximum shock pressure of 5-10 GPa, which is considerably lower than that suggested by our electron backscattered diffraction (EBSD) study of 8 Itokawa grains, which was shock state S4 [2], indicating maximum shock of 30-35GPa.

Conclusions: It is clear from our study that EBSD and standard petrographic techniques are not equally sensitive to very fine-scale shock effects. EBSD appears to have greater potential to elucidate shock effects at the finest scale. We are currently examining ordinary chondrite meteorites by EBSD to determine if we see the same puzzling effect.

References: [1] Stöffler D. et al. 1991. *GCA* 55:3845–3867. [2] Zolensky M.E. et al. 2012. 43rd Lunar & Planetary Science Conference, Abstracts.