COMETARY DUST RESIDUE IN LARGE STARDUST FOIL CRATERS: HOW MUCH SURVIVES, AND HOW TO SAFELY EXTRACT IT FOR ANALYSIS.

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Introduction: Craters on Stardust foils show impacts by Wild 2 dust of a wide size range [1]. Sections from focussed ion beam (FIB) instruments reveal composition and structural preservation of dust in smaller craters [2]. There has been reluctance to attempt such preparations for larger craters (up to >200 µm), as their size and shape make widespread surface contamination by re-deposition of FIB-ablated material probable, and the extraction angle is too steep for an in-chamber micromanipulator. Before any preparation, it is important to know where residue is present. Auger mapping has been applied very successfully [3] but is slow to document large areas. Although energy dispersive X-ray (EDX) mapping can find residue on walls and lips of craters [4], occasionally ideal targets for NanoSIMS [5], deeper parts are not seen by typical inclined EDX detectors. Here we explain methods to locate residue across the whole crater surface, quantify the amount, and change crater shapes for safe extraction of material.

Methods: Light gas gun shots were performed at Canterbury, using powders of lead sulfide, Bjurbole and Allende meteorites, and poly methylmethacrylate (PMMA), fired onto 100 µm thick Al1100 foil at ~ 6 km s^{-1}. A Zeiss EVO 15LS scanning electron microscope (SEM) was used for stereo imagery of PbS craters, to measure C/Al count ratios in PMMA craters for comparison to carbon thin-film calibration, and to map Bjurbole impact residue. Silicon drift detector (SDD) take-off angle was increased by long sample working distance, allowing examination of over 97% of the crater area, but this was relatively slow (16 hrs). An annular four-channel Bruker XFlash 5060F SDD, placed beneath the pole-piece of a Zeiss Supra 55 field emission SEM, gave hyperspectral X-ray maps of a whole Allende crater in < 45 mins. Digital elevation models (DEM) were created for the PbS craters, prior to and after deformation with a carefully controlled, shaped, steel needle.

Results and Conclusions: The mapped area and estimated thickness of Bjurbole residue suggest that ~ 55 % of the impacting particle was preserved, but measurement of carbon film thickness revealed that < 3 % of each PMMA particle survived. The DEM showed that craters on Stardust foil can be made much broader and shallower, bringing all residue to locations for safe extraction by proven methods. It is now possible to locate, measure and extract residues from larger Stardust craters. This will release another important repository of cometary dust from Wild 2.

References: [1] Price M. C. et al. 2010. *Meteoritics & Planetary Science* 45:1409-1428. [2] Leroux H. et al. 2008. *Meteoritics & Planetary Science* 43:143-160. [3] Stadermann F. J. et al. 2009. Abstract #2120. 40th Lunar and Planetary Science Conference. [4] Kearsley A. T. et al. 2008. *Meteoritics & Planetary Science* 43:41-73. [5] Stadermann F. J. et al 2008. *Meteoritics & Planetary Science* 43:299-313.