DETERMINING THE ELEMENTAL AND ISOTOPIC MAKEUP OF COSMIC DUST FROM RESIDUES IN IMPACT CRATERS: PREPARATION FOR THE ISPE

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Introduction: The Stardust mission used both aerogel tiles and Al foils to gather dust from the coma of comet Wild 2. Although hypervelocity impacts in solid metal targets are generally highly disruptive, the residues were found to preserve significant portions of the original projectile material [1, 2]. Analyses of crater residues led to the identification of several surviving presolar grains among the cometary samples [3-5]. A second collector on the Stardust spacecraft was used to capture possible contemporary interstellar dust traversing the solar system. The study of these interstellar samples is analytically highly challenging and the upcoming preliminary examination (ISPE) will initially consist only of non-destructive surveys [6]. Previously, we have used the Auger spectrometer and the NanoSIMS for the elemental and isotopic characterization of cometary dust residues at high spatial resolution [4, 5, 7]. We have now tested various analytical approaches for the ISPE.

Details: The interstellar collector foils will not only have much fewer and smaller impact craters than the cometary ones, but the amount of residue per crater will also be significantly lower than in the cometary collection. This is due to the larger ratio of crater diameter to projectile diameter at the higher impact velocities that are expected for the interstellar grains. To partially simulate the conditions expected on the interstellar collector, we performed NanoSIMS isotopic and Auger elemental measurements of impact debris on a selection of the smallest cometary craters and on samples from LDEF experiments in low Earth orbit, where impact velocities were generally higher. This will allow us to test the suitability of high resolution Auger spectroscopy for the non-destructive elemental characterization of smaller and/or thinner residue deposits than previously studied. We also search for signatures of presolar grains in the residues to evaluate their survival characteristics under different impact conditions.

Results and Discussion: The Stardust measurements focused on the heavily cratered foil C2010W, and the LDEF samples were from capture cell experiment A0187-2 and Au craters A0187-1 [8]. We analyzed residues in craters as small as 200 nm and found that Auger spectroscopy was in all cases able to determine clear elemental signatures of the projectile residue and in many cases could even detect compositional heterogeneities among the debris. The Auger measurements were able to ‘see through’ the unavoidable minute layer of surface contaminants without requiring any sputter cleaning. Although NanoSIMS isotopic measurements are not planned for the ISPE, we found that we would achieve sufficient precision to detect presolar isotopic signatures in the residues, if such material is present.

References: [1] Hörz F. et al. 2006. *Science* 314:1716-1719 [2] Kearsley A. T. et al. 2008. *Meteorit. Planet. Sci.* in press. [3] McKeegan K. D. et al. 2006. *Science* 314:1724-1728. [4] Stadermann F. J. et al. 2008. *Meteorit. Planet. Sci*. in press. [5] Stadermann F. J. and Floss C. 2008. Abstract #1889. 39th LPSC. [6] Westphal A. J. et al. 2008. Abstract #1855. 39th LPSC. [7] Stadermann F. J. et al. 2007. Abstract #1334. 38th LPSC. [8] Stadermann F. J. et al. 1994. *LDEF - 69 months in space. NASA Conf. Proc*. 3275 3:461-473.