CHARACTERIZING COMET 81P/WILD 2 WITH ACFER 094 ANALOG FOILS.

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Introduction: NASA's Stardust mission provided the first known cometary material for study, flying through comet 81P/Wild 2's tail at a relative velocity of 6.1 km/s. Aluminum foils present on the cometary collector largely succeeded in returning Wild 2 material. However, this material experienced extensive alteration due to the violent collection process [1].

Hypervelocity impact experiments simulating the Stardust capture conditions can improve our understanding of the collected Wild 2 material. In this study analog foils were created using material from Acfer 094 as the impactor; Acfer 094 is a primitive carbonaceous chondrite that is likely to be similar in composition to comet Wild 2 [2]. By comparing the residues found in the analog foils to the unaltered meteoritic material [3] and to similar studies of Stardust craters [4], we gain information on the impact process and the survival of material compositionally relevant to cometary matter. Here we report on FIB-TEM analyses of the Acfer 094 analog craters.

Experimental Methods: Material from Acfer 094 was ground into a fine powder before being fired at flight-spare Stardust foils with the University of Kent's light gas gun [5] under conditions similar to those experienced by Stardust. The foils were examined by SEM, and EDX spectra were obtained from a variety of craters to document compositional variety in the residues. Thin sections were extracted and thinned to electron transparency with a FEI Quanta 3D FIB-SEM and analyzed with a JEOL 2000 TEM at Washington University.

Results and Discussion: Twelve analog craters ranging in diameter from 0.8 to 2.3 µm were selected for TEM analysis based on initial SEM-EDX analyses to cover a range of Mg-Si-Fe compositions [3].

The impact residues from all of the craters are dominated by homogeneous layers of Mg-Si-Fe or Fe-Ni-S. Virtually no surviving crystalline material was found, in contrast with the results of similarly sized craters in the Stardust foils which contained crystals ~50 to ~500 nm in diameter in five of eight samples [4]. Incorporation of Al into the impactor melt residues coupled with S loss suggests peak temperatures and pressures were sufficient to result in melt rather than shock-induced phases.

Fe-vesicles, which are visible in larger analog craters created by aggregate impacts [6], were only seen in one crater from our study. This difference may indicate lower temperatures resulting in quicker solidification in our smaller samples, preventing the Fe dissociation and migration seen in other studies [6].

The lack of crystalline material in our samples agrees with other aggregate analog studies [6] though it differs from the Stardust foils [4], indicating that impact processes in the foils are not yet fully understood.

References: [1] Kearsley A. T. et al. 2008. *MAPS* 43:41. [2] Newton J. et al. 1995. *Meteoritics* 30:47. [3] Croat T. K. et al. 2015. *Met. Planet. Sci.* 78 abstract #5130. [4] Leroux H. et al. 2008. *MAPS* 43:143. [5] Burchell M. J. et al. 1999. *Meas. Sci. Tech.* 10:41. [6] Wozniakiewicz P. J. et al. 2012. *MAPS* 47:708.