CAPTURE-PROCESSING OF STARDUST COMETARY SAMPLES: COMPARISONS OF CAPTURE-MELTED AND UNMELTED PARTICLES. C. H. van der Bogert[1], T. Stephan[2], and E. K. Jessberger[1], [1]Westfälische Wilhelms-Universität Münster, Institut für Planetologie, 48149 Münster, Germany (vander-bogert@uni-muenster.de), [2]University of Chicago, Department of Geophysical Sciences, Chicago, IL 60637, USA.

Introduction: Particles from the Jupiter family comet, Wild 2, were collected by the NASA Stardust spacecraft, using aerogel capture media [1]. Understanding the effects of aerogel capture on the particles themselves is a critical precondition for the interpretation of the particles as they relate to the properties of Wild 2 and other comets [e.g., 2 and references therein, 3], as well as for their comparison with interplanetary dust particle (IDP) collections.

Methods: TEM and TOF-SIMS analytical techniques were used for comparison of capture-melted particles and unmelted terminal particles to investigate their differing mineralogy, composition, and structural properties, and to evaluate the effects of capture [4, 5].

Samples: The samples in our study included materials from the margins of the impact track walls in the aerogel and terminal particles, representing both capture-melted and relatively pristine Wild 2 material.

Capture-melted particles. Samples from the impact track walls were frequently mixed composition glasses likely representing cometary material that melted and mixed with aerogel during the capture process. For example, TEM samples C2054,0,35,16,9 #44 and C2054,0,35,24,5 #19 were primarily silica-rich glass with varying Fe, Mg, and Si contents and small FeNi and FeS spherules [6]. The spherules were likely metallic phases that melted during the capture process and subsequently recrystallized. The sample compositions and textures are grossly homogeneous, and have CI-like abundances of major and minor elements [7, 8].

Terminal particles. Terminal particles survived capture with minimal internal impact effects. TEM samples C2027,2,69,2,5 #25 and C2027,3,32,2,6 #20 exhibited thin coatings of compressed/melted aerogel with patches of adhered material similar to the capture-melted particles. However, both samples were primarily single- to coarse-grained crystalline mineral phases (enstatite and anorthite) in contrast to the mixed glasses in the capture-melted particles [4, 5].

Discussion: Based on our analyses, we propose that the Stardust cometary particles, prior to their encounter with the aerogel, consisted of a mixture of single and multi-mineralic grains, embedded in a fine-grained, possibly high porosity, matrix. During impact into the aerogel, the matrix was stripped from the larger mineral grains, melted and mixed with aerogel, and deposited along the track walls. The larger mineral grains survived as terminal particles (Fig. 1). As observed in impact experiments with particulates into aerogel [e.g., 2 and references therein], these grains may also have suffered significant reduction in size during the capture process. The rounded surfaces of the studied grains are consistent with the abrasion and ablation of the original particle surfaces. This removed material likely was also incorporated into the track walls. Such sorting and grain-size reduction can explain the compositional and structural differences between the two types of particle fragments. This model, based on the differences between the captured materials, is consistent with the findings of Hörz et al. [3] for the formation of "type B" Stardust impact tracks. The samples studied here were extracted from such type B tracks.

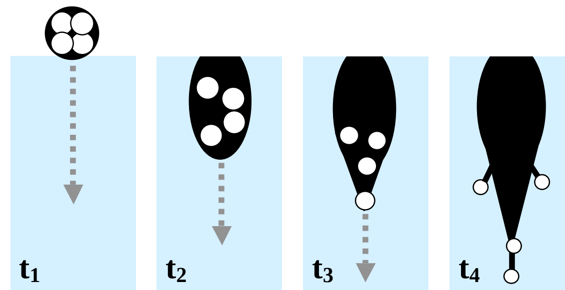

Figure 1. *Simplified time-step schematic of capture-sorting of fine-grained matrix (black) and discrete mineral grains (white), and grain-size reduction of the mineral grains during impact with aerogel.*

Recent work by Ishii et al. (2008) indicates that the composition, mineralogy, and crystallography of Stardust cometary samples are not consistent with chondritic porous IDPs (CP-IDPs), rather they resemble asteroidal materials [9]. It is clear that the samples we analyzed are not all comparable to CP-IDPs. The mineralogy of the terminal particles is like that of coarse-grained IDPs [e.g., 10]. However, the matrix that was largely destroyed during the capture process, could still be similar to CP-IDPs. Indeed, the admixture of ablated material from the terminal particles with CP-IDP-like matrix material and aerogel could explain the complex compositions of the capture-melted materials.

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Acknowledgements: This work was supported by the following grants: Deutsche Forschungsgemeinschaft #STE576/17-2, NASA #NNX07AL94G, and Oxford University/EU-ESTEEM #026019.