NANO-SCALE ANATOMY OF STARDUST COMETARY TRACKS CONTINUED: BULBOUS TRACKS 147 &168.

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Introduction: Comet Wild-2 dust grains captured by the Stardust spacecraft show a wide range of chemical compositions, both among and within individual particle tracks [1]. This sample diversity complicates answering basic questions such as the bulk composition of the comet and modal mineralogy. We have developed new sample preparation and analytical techniques tailored for analysis of entire Wild-2 aerogel tracks, and successfully ultramicrotomed a "carrot" type A track along its axis while preserving its original shape [2]. This innovation allowed us to examine the distribution of fragments along the entire track from the entrance hole all the way to the terminal particle. This report focuses on our systematic disassembly and coordinated analysis of two Stardust bulbous type tracks from the mm to nm-scale.

Experimental: The walls of tracks #147 (4600μm long with 7 terminal particles, TPs) and #168 (2640μm long, 3 TPs) were photo-documented using an extended depth-of-field image processing technique that generates a single in-focus image from a series of photographs. The TPs were removed, embedded in epoxy, and ultramicrotomed separately. Scanning TEM was used for elemental and detailed mineralogy characterization. This approach also enabled spatially resolving the target sample from fine-scale mixtures of compressed aerogel and melt.

Results and Discussion: We obtained preliminary mineralogical analyses of 3 TPs and particles recovered from a crack near the entrance area (30μm) from Track #147, and 2 TPs from T168. T147,TP2 (18μm) entirely consists of Fe-Ni alloy (5 at% Ni). T147,TP3 (19μm) contains Fa 28 with partial olivine-pyroxene intergrowth and minor albite. T147,TP4 (12μm) contains pentlandite, Fe-olivine, albite and high Ca pyroxene with Na and Cr (kosmochlor component). The Fe-olivine+albite+Ca-pyroxene assemblage is common in other Wild-2 samples as well [3]. No surviving crystalline cometary materials were observed from track walls yet, but only mixed and melted materials of aerogel and cometary constituents. T168,TP1 (10μm) contains Fe-olivine, albite and pentlandite. T168,TP2 (8μm) has concentric texture with a core of olivine grains (100nm in size) with coexisting indigenous amorphous SiO_2 surrounded by a carbon mantle (800nm thickness), which in turn is surrounded by a layer of compressed aerogel. A nebular origin as possible precursors to type II chondrules in ordinary chondrites has been proposed for the Fe-olivine+albite+Ca-pyroxene assemblages in Wild2 [3]. However, in T147, this assemblage coexists with pentlandite which would not have been a stable phase in the nebula [4]. In future work, NanoSIMS will be used for isotopic analyses, and ultrafast two-step laser mass spectrometry (*ultra* L^2MS) to investigate the nature and distribution of organic phases. The albite in T168,TP1 may be large enough to measure Mg/Al system using NanoSIMS. We also plan to measure H, N, C isotopes of the carbon shell of T168,TP2 and O isotopes of the silicates inside.

References: [1] Brownlee, D.E. et al. (2006) Science 314, 1711. [2]Nakamura-Messenger K. et al. (2011) *MAPS.* in press. [3]Joswiak, D. *et al.* (2009) *MAPS.* 44, 1561. [4] Brearley A.J. (1999) *Science* 285, 1380.