SYNCHROTRON-BASED ORGANICS AND MINERALOGICAL SURVEY OF THREE STARDUST TRACKS.

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Introduction: Wild2 particles captured in the Stardust cometary dust collector exhibit remarkable diversity between and within individual particle tracks in aerogel. Several particles studied during the Stardust Preliminary Examination are, so far, unique in the collection[1]. There is an urgent need to survey particles in tracks and to target specific particles for extraction and destructive analysis. Here we describe an *in aerogel* survey at the Advanced Light Source (LBNL) of three tracks using synchrotron-based Fourier Transform Infrared Spectroscopy (FTIR), microbeam X-ray fluorescence (μXRF), X-ray Absorption Near-Edge Spectroscopy (μXANES), X-ray Diffraction (XRD), and Scanning Transmission X-ray Microscopy (STXM).

Sample preparation: We extracted three tracks from aerogel tile 38 in aerogel keystones[2], and initially mounted them on polysilicon micropickleforks. These tracks, named Chiquita (103), Siria (104) , and Hebe (105) were ~300, ~1300 and ~2400 μm long, respectively. After FTIR and initial XRF mapping (below), 50-μm thick wafers were taken from near the tops of Siria and Hebe for subsequent STXM work. The remainders of the keystones were flattened onto 6-μm thick polypropylene film[2].

FTIR: FTIR mapping of keystones was done in transmission mode using FTIR 1.4.3. These keystones showed no evidence of the "labile organics" reported for other Stardust tracks[3].

X-ray microbeam analysis: We made detailed XRF maps of tracks in the flattened keystones on ALS μXAS 10.3.2 for major elements with Z>16. We did XANES and XRD analysis on hot spots in Ca, Cr, Mn, Fe and Ni.

STXM: We mapped wafers from the mouths of Siria and Hebe for Mg and Al at ALS STXM 11.0.2 at 125nm resolution, and on selected regions did Mg K-, Al K- and Fe L-edge XANES mapping at 25nm resolution. We also did CNO-XANES at ALS STXM 5.3.2 on the Siria wafer.

Track surveys: The two terminal particles of Chiquita were consistent with Fe metal and a sulfide. Numerous small Mn-rich particles were found in the bulb. The terminal particle of Siria is a Cr-, Mn-rich mineral with a Fe-XANES spectrum consistent with orthopyroxene. The Siria wafer contained tens of Mg-rich particles up to 1μm diameter in 6 distinct regions. From O-XANES we measured a density of 25±1 mg cm^3 for the background aerogel, rising to 43 mg cm^3 in the track wall. More than 50% of the analyzed Fe hot-spots in Hebe were consistent with sulfides, but other identified phases were glass, metal, and olivine. Hebe shows a strong longitudinal gradient in Ni/Fe. Particle heterogeneity was evident: Mg-K XANES imaging revealed a 400-nm olivine within several Fe-rich spots in a 2μm region. All three tracks were poor in Ca-bearing minerals. One particle in Hebe was K-rich, and several others were elevated in Se. We find strong heterogeneity between tracks, within tracks and within particles.

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