ABSTRACT FINAL ID: P43A-1645;

TITLE: Coordinated Analyses of Diverse Components in Whole Stardust Cometary Tracks

SESSION TYPE: Poster

SESSION TITLE: P43A. Extraterrestrial Dust: Laboratory Analysis of Mission-Returned Samples and Hypervelocity Dust Impacts II Posters

AUTHORS (FIRST NAME, LAST NAME): Keiko Nakamura-Messenger[2, 1], Lindsay P Keller[1], Scott R Messenger[1], Simon J. Clemett[3, 1], Lan-Anh N. Nguyen[2, 1], David Frank[4, 1]

INSTITUTIONS (ALL): 1. NASA Johnson Space Center, Houston, TX, United States.
2. ESCG/Jacobs, Houston, TX, United States.
3. ESCG/ERC Inc. , Houston, TX, United States.
4. ESCG/Hamilton Sundstrand, Houston, TX, United States.

Title of Team:

ABSTRACT BODY: Analyses of samples returned from Comet 81P/Wild-2 by the Stardust spacecraft have resulted in a number of surprising findings that show the origins of comets are more complex than previously suspected. However, these samples pose new experimental challenges because they are diverse and suffered fragmentation, thermal alteration, and fine scale mixing with aerogel. Questions remain about the nature of Wild-2 materials, such as the abundances of organic matter, crystalline materials, and presolar grains. To overcome these challenges, we have developed new sample preparation and analytical techniques tailored for entire aerogel tracks [Nakamura-Messenger et al. 2011]. We have successfully ultramicrotomed entire “carrot” and “bulbous” type tracks along their axis while preserving their original shapes. This innovation allowed us to examine the distribution of fragments along the track from the entrance hole all the way to the terminal particle (TP).
We will present results of our coordinated analysis of the “carrot” type aerogel tracks #112 and #148, and the “bulbous” type aerogel tracks #113, #147 and #168 from the nanometer to the millimeter scale. Scanning TEM (STEM) was used for elemental and detailed mineralogy characterization, NanoSIMS was used for isotopic analyses, and ultrafast two-step laser mass spectrometry (ultra L2MS) was used to investigate the nature and distribution of organic phases. The isotopic measurements were performed following detailed TEM characterization for coordinated mineralogy. This approach also enabled spatially resolving the target sample from fine-scale mixtures of compressed aerogel and melt.
Eight of the TPs of track #113 are dominated by coarse-grained enstatite (En90) that is largely orthoenstatite with minor, isolated clinoenstatite lamellae. One TP contains minor forsterite (Fo88) and small inclusions of diopside with % levels of Al, Cr and Fe. Two of the TPs contain angular regions of fine-grained nepheline surrounded by enstatite. Their O isotopic compositions are in the range of meteoritic materials, implying that they originated in the inner Solar System. Complex aromatic hydrocarbons are distributed along aerogel tracks and in TPs. These organics are likely cometary but were affected by shock heating.
Three TPs of track #147 and two of track 168 have completely different mineralogy. TP2 of track #147 entirely consists of Fe-Ni alloy (5 at% Ni) and TP3 contains Fa28 with partial olivine-pyroxene intergrowth and minor albite. TP4 contains pentlandite, Fe-olivine, albite and high Ca pyroxene with Na and Cr (kosmochlor component). TP1 of #168 contains Fe-olivine, albite and pentlandite, and the concentric TP2 has a core of olivine grains with co-existing indigenous amorphous SiO2 surrounded by a carbon mantle, which in turn is surrounded by a layer of compressed aerogel.
The TP of the carrot track #112 is a 16O-rich forsteritic olivine grain that likely formed in the inner Solar System. The track also contains submicron-sized diamond grains of likely Solar System origin.

KEYWORDS: [6015] PLANETARY SCIENCES: COMETS AND SMALL BODIES / Dust, [6210] PLANETARY SCIENCES: SOLAR SYSTEM OBJECTS / Comets.

(No Image Selected)

SPONSOR NAME: Lindsay Keller

Additional Details

Previously Presented Material:

Contact Details

CONTACT (NAME ONLY): Keiko Nakamura-Messenger

CONTACT (E-MAIL ONLY): keiko.nakamura-1@nasa.gov