

MINERALOGY AND PETROLOGY OF COMET WILD2 NUCLEUS SAMPLES

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Introduction: The sample return capsule of the Stardust spacecraft will be recovered in northern Utah on January 15, 2006, and under nominal conditions it will be delivered to the new Stardust Curation Laboratory at the Johnson Space Center two days later. Within the first week we plan to begin the harvesting of aerogel cells, and the comet nucleus samples they contain for detailed analysis. By the time of the LPSC meeting we will have been analyzing selected removed grains for more than one month. This presentation will present the first results from the mineralogical and petrological analyses that will have been performed.

Mineralogy/Petrology: Although one month does not appear to be much time, it is sufficient to permit numerous electron beam analyses (SEM, STEM, EELS, EBSD, microprobe, cathodoluminescence) to have been performed on microtomed slices and remaining potted butts, and we can expect to have some understanding of the following fundamental sample issues (below). We will also be performing numerous XRD analyses,

using several techniques, although preliminary results from these analyses may not be available in time for LPSC.

Examination Goals: The basic goals of the Mineralogy/Petrology subgroup of the Preliminary Examination Team are as follows.

(1) Comet nucleus mineralogy and petrology. What are the basic aspects of sample mineralogy? What is the grain size of the samples, and how crystalline are they? Does a record of the grain accretion process survive (i.e. microporosity or other physical properties)? Are phyllosilicates or other obvious products of aqueous reactions present? How do the samples compare to chondritic interplanetary dust particles (IDPs), Antarctic micrometeorites, and carbonaceous chondrite meteorites?

(2) How variable are the samples? For example, do all grains look exactly like anhydrous chondritic IDPs? Or is there a wide range of mineral assemblages and

petrological properties, indicating a wide range of preaccretionary histories for the grains? Are there entire grains that resemble presolar materials removed from chondrites?

(3) How do we recognize the many IDPs that should have been captured along with the cometary grains? During the cruise phase of the mission, when one collector tray was exposed to the interstellar flux, we undoubtedly collected stray IDPs into both trays. We expect that these should be identical to stratospheric IDPs, though with collection alteration (see below).

(4) How were the samples altered by the collection process? Based upon two decades of work on grain capture in aerogel both in the lab and on the Mir space station, we expect most captured samples to be fragmented and heated to a wide degree. How will the actual samples compare to our expectations? How difficult is it to distinguish the pre-capture state of the samples from the grain residues in the aerogel? We know from our previous work [1&2] that delicate materials like serpentine, saponite, carbonates and sulfides will survive

in some captured particles, though certainly not all. We do not know what the actual survival rate of delicate materials will be. We do not know what some expected materials, for example GEMS, would look like after capture. Obviously heating will cause equilibration of many materials to varying degrees. We will have to learn how to recognize naturally equilibrated minerals from those that have been heated during capture. Similarly we will have to learn how to distinguish naturally amorphous materials from grains that were melted during capture. We will also investigate the distribution of fragmented particles along the expected particle tracks. In addition to optical imaging, we will also be able to map these by tomographic techniques.

(5) Finally, what totally unexpected features have we encountered, and how do we learn to deal with them? We can expect to be surprised.

References: [1] Barrett R. et al. (1992) *Proceedings of the 19th Lunar and Planetary Science Conference*, 203-212; [2] Horz F. et al. (2000) *Icarus* **147**, 559-579.