STARDUST AEROGEL BASELINE DATA: RECOVERY AND USE . A. J. G. Jurewicz[1] , S. M. Jones[2] , M. Zolensky[3], D. Frank[3], L. Dupray[4], and B. deHoog[1], [1]ASU/CMS (PO Box 871404, Tempe AZ 85287, ajurewicz@asu.edu), [2]NASA-JPL, Pasadena CA [3]NASA-JSC, Houston TX, [4]Portland, Or.

Introduction: This work reports on pre-flight Stardust aerogel fabrication data and test results currently being recovered and organized in order to be made available to the scientific community. Since the return of the Stardust samples, there have been many requests about the aerogel density profiles by investigators. This prompted us to attempt to recompile the density data that had been recorded and stored prior to the Stardust launch and then compare the pre-launch values with ones determined from the returned aerogel cells.

Using pre-flight data, it can be shown that at least some of the density profiles of Stardust cometary aerogel changed after insertion into the flight tray. Hence, capture properties may have changed somewhat over the course of the mission. This result is consistent with aerogel being an amorphous, visco-elastic solid responding to internal and/or external stress.

Pre-post flight comparisons are possible as a result of our (continuing) work to upgrade the Stardust archive at JSC. Data from pre-flight Stardust aerogel fabrication and testing are being recovered and organized for use by the scientific community.

Background: We report on (1) the little-known Stardust archive, existing data and efforts to make this data accessible to the scientific community, and (2) differences between pre- and post-flight aerogel.

Stradust archive history. Prior to launch, a massive amount of information about the development, production, testing and characterization of the Stardust aerogel intended for post-flight use by those analyzing the returned samples was archived at both JSC and JPL by the JPL's Aerogel Team. Patterened after a commercial ISO 2001 system, each cell was assigned a name based on (1) the extraction number plus a (2) number and letter designating position in autoclave. Then, tracking sheets followed each group of aerogel through the fabrication process. Other procedures (gelation, extraction, inspection, etc.) each were also recorded on special tracking sheets (Fig. 1).

Aerogel Team members who conducted the development, production, testing and characterization of the flight aerogel were, unfortunately, not on the Stardust Preliminary Examination Team, so the value of this comprehensive archive of information lay unrecognized. Archival materials were not catalogued and some may have been misplaced. Moreover, computer hardware and software were not archived with the

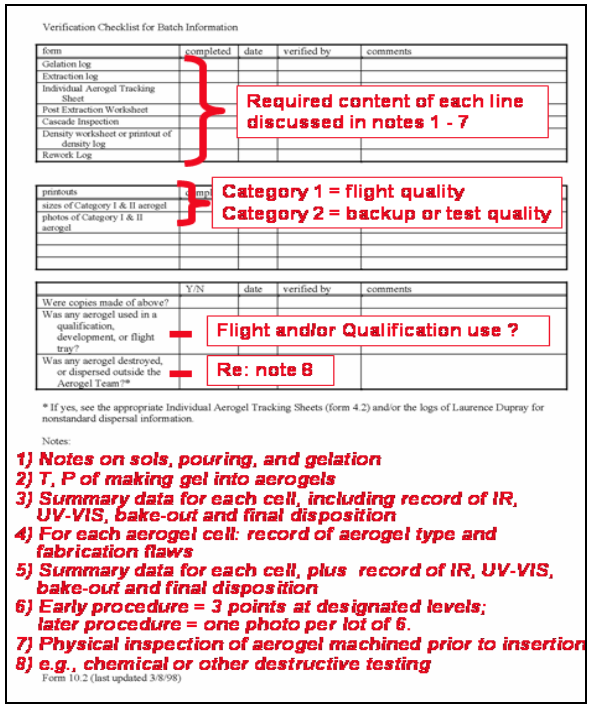

Figure 1. Annnotated Batch Verification Sheet. *Data records range from silicate particle-size distributions in the sol through final properties, including density profiles, fabrication flaws, UV-vis and IR characteristics. GCMS and other chemical data was collected for starting materials and representative aerogel.*

data, and some electronic files are a challenge to recover.

Stadust aerogel density. The density of Stardustaerogel was measured pre-and post- flight using a non-destructive technique, the Minimum Deviation Method, or Gladstone method[1]. A line of light emitted from a He/Ne laser was shone through the corner of the cell. The refraction is a function of refractive index (IR), which is a calibrated function of areogel density.

Because the aerogel precursor was pumped in lots of six, the density profile pre-flight was only taken on one cell per lot to minimize handling [2]. This data went into the Stardust archives, but was saved on a JAZ disc that was considered unreadable until recently.

The Stardust Archive – status: Currently, the archive is five very large boxes of electronic and paper media. This reservoir of baseline data for the Stardust aerogel resides in the Data Center of the NASA-JSC

ARES division. The plan is to eventually enable on-line access; it's current status is described below.

Electronic media. Original electronic media includes: 1Gb - and 2Gb Jaz discs, CD's, and floppies in both PC and Mac formats. Some electronic materials are a relatively recent acquisition; they were transferred to JSC from JPL after the Stardust Mission office closed. These are mostly duplicates of material already held by JSC. Curiously, electronic baseline GCMS data appear to be missing, but may still be held at JPL, perhaps in the Quality Control division archives.

We have aquired a "new" 2Gb Jaz drive, which allowed us to recover aerogel density data "missing" since 1997. CD's are in good condition, but their old Windows 95 files are no longer supported by Microsoft. Luckily, the first author had not upgraded her home software since 2002, and the PC files can still be read; Mac files have not yet been converted. Most of the floppy discs are corrupt and data has been lost.

In any case, we have approximately 40Gb of data (~24,400 files) which need to be sorted to eliminate incomplete versions and duplications, as well as organized for ease of retrieval by the scientific community.

Paper media. All paper media in the archives at JSC appears to be in good condition. Items include: tracking information and notes taken in the laboratory during aerogel fabrication; photographs; summary reports; and hard-copies of data files. These print-outs of data files sometimes duplicate files archived electronically; however some, like GCMS data, likely fill gaps in the electronic media. Most of the paper media, including the large binder of GCMS data, has not yet been copied and reviewed for it's relevance to the flight aerogel. However, it is next on the list of priorities, and should be evaluated by March 2010.

Comparison of post-flight with archived data: The initial use of this archive has been to look for-changes in the aerogel density during the course of the mission. Fig. X and Y show that for representative-cometary cells, the aerogel has, indeed, changed it's density profile. Since aerogel is visco-elastic, it has responded to low stresses by flow, probably non-linearly over the course of the mission. This may be due to relaxation of internal stresses inherent in the fabrication, or else a response to the stress of insertion into the tray. It is important to understand this effect both for modeling the Stardust particle-collection process and to plan aerogel use for future missions. We will collect more data as cells are extracted from the flight trays for analysis.

We also note that, at some point, the archival missteps are intrinsic to the way Phase C/D transitions to Phases E and F in the Discovery Mission process. Ways to insure the integration of pre-flight data into the post-flight examination should be discussed in the small-mission sample-return communities to enhance the scientific return of future sample-return missions.

References: [1] Phillips, W. R., *Mineral Optics: Principles and Techniques, Chapter 3,* 47-68. W. H. Freeman, San Francisco, 1971. [2] Jones S. M. (2007) *J. Sol-Gel Sci. Tech, 44(*3), 255-258.

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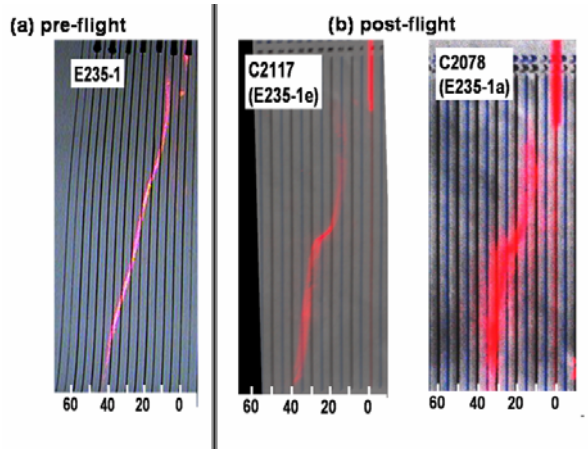

Figure 2 Density profiles pre-post flight. *(a) E235-1x represents pre-flight density profiles flight-cells for C2013, C2078, C2093, C2100, and C2117. Pink/red is light refracted through the corner of the cell (b) C2078(E235-5a) and C2117 (E235-1a) post-flight.We note that C2062 (lot E235-5x) which originally had a similarly-linear density profile was similarly changed.*

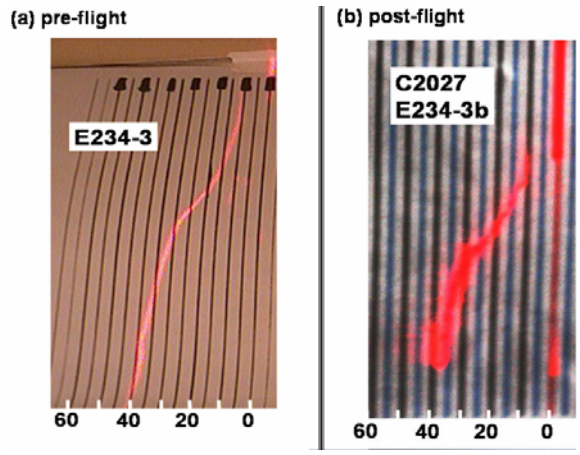

Figure 3. Pre-post flight aerogel from batch E234-3. *C2027 was poured with a stepped gradient, and does not show significant deviations from the original density profile. The collection surface is the low-density, and had some physical damage post-flight.*