AN EXTRACTION AND CURATION TECHNIQUE FOR PARTICLES CAPTURED IN AEROGEL COLLECTORS. A. J. Westphal, C. Snead, G. Domínguez, *Space Sciences Laboratory, University of California at Berkeley, Berkeley, CA 94720-7450, USA, (westphal@ssl.berkeley.edu)*, J. P. Bradley, *IGPP, Lawrence Livermore National Laboratory, Livermore, CA 94035, USA*, M. E. Zolensky, *NASA-JSC, Houston, TX 77058, USA*, G. Flynn, *SUNY-Plattsburgh, Plattsburgh, NY 12901, USA*, D. Brownlee, *Department of Astronomy, University of Washington, Seattle, WA 98195, USA*.

In 2006, the STARDUST mission will return samples of cometary, interplanetary and interstellar dust captured in aerogel collectors. The curation strategy (or strategies) for STARDUST remain to be defined. Here we present a technique for curation of particles captured in aerogel which will simultaneously preserve the entire particle track, and could allow for the elemental *in situ* analysis of both the particle residue at the terminus of the track and any particle residues located along the track. This builds on work that we have previously reported elsewhere[1].

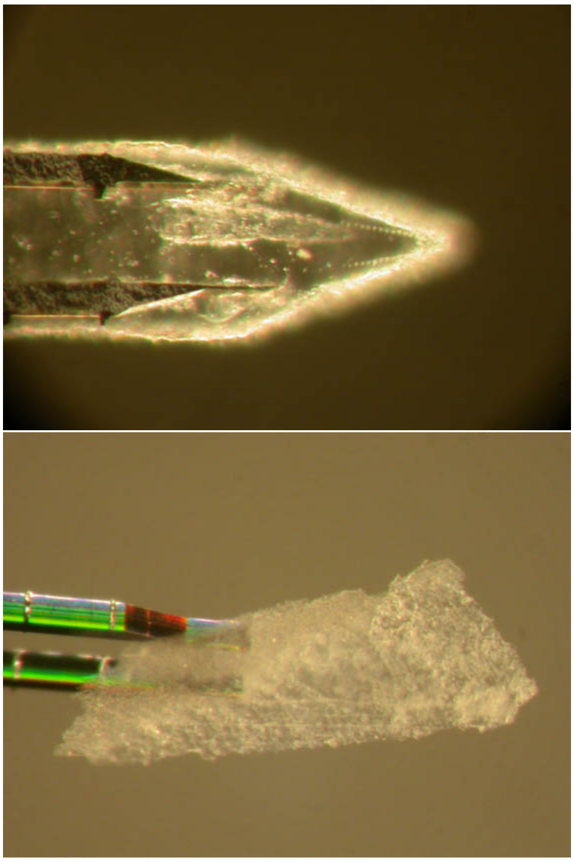

Fig. 1: Top view (top) and side view (bottom) of an extracted aerogel keystone. The tines of the μFL are 182 μm apart. The wedge was extracted from the ODCE[2] collector.

The first step in this extraction and curation technique is the extraction of a block of aerogel which is sufficiently large that it completely contains the particle along with its track, but is sufficiently small that disturbance of the rest of the aerogel collector is minimized. Using pulled glass microneedles and robotically-driven high-precision micromanipulators, we have developed a technique for extracting aerogel wedge-shaped "keystones" that satisfy this requirement. In Fig. 1 we show top and side views of such an extracted wedge, containing a captured particle (Fig. 2) and its track. In Fig. 3, we show the excavated "pit", demonstrating that there is essentially no disturbance beyond the extraction region. Even very long tracks — at least up to 1000 μm long — may be extracted robustly using this technique (Fig. 4).

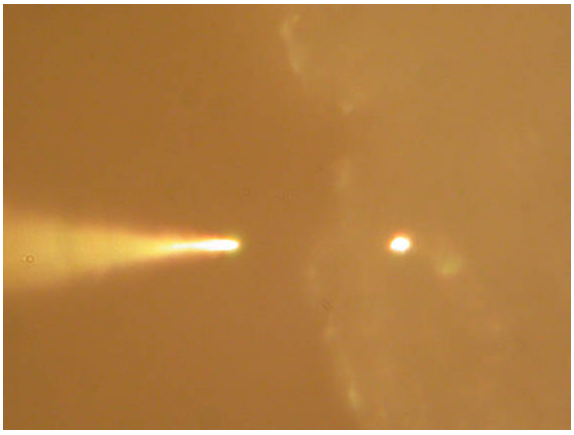

Fig. 2: High-magnification side view of the captured $\sim 5\mu$m dust grain in the wedge shown in Fig. 1. The extraction microneedle is on the left.

Since aerogel is intrinsically extremely fragile, care must be taken in handling these aerogel keystones. In collaboration with Christopher Keller (MEMS Precision Instruments) we have developed micromachined silicon fixtures ("micro-fork lifts" or μFLs) that we use to physically remove the keystones from the aerogel collectors. Again using micromanipulator-driven microneedles, slots are automatically machined in the aerogel of the appropriate width, depth and spacing to accommodate the μFLs. The μFLs are then inserted into the aerogel keystone, and the entire keystone is lifted out of the collector. Since the μFLs are attached to macroscopic fixtures, the keystone and its fixture can be readily handled and stored manually.

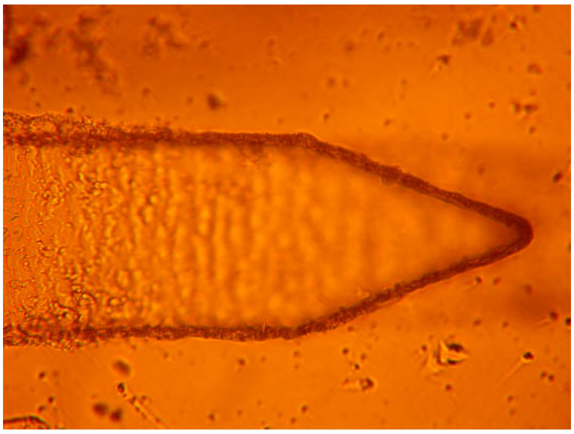

Fig. 3: Excavation pit of the extracted aerogel wedge.

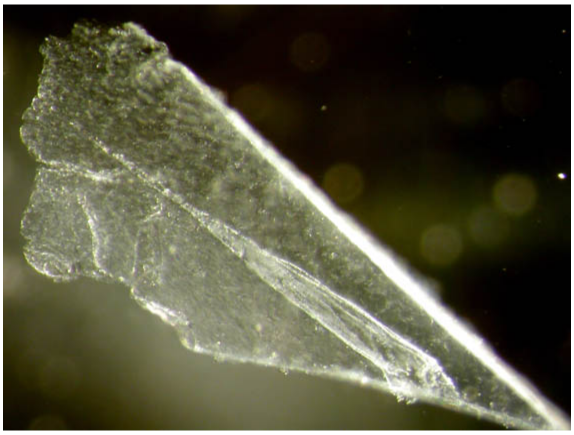

Fig. 4: Keystone containing a 1300 μm-long track, extracted from the ODCE collector.

The particle at the terminus of the track is trapped in the thin end of the keystone-shaped wedge. Viewed from the side, the thickness of the aerogel can be made to be less than 20μm, so the overburden of aerogel is less than 10 μm, corresponding to a column depth of $<$15 μg cm^{-2} for STARDUST aerogel (density=14 mg cm^{-3}).

In Fig. 5, we show the expected transmission of K-α x-rays as a function of atomic number Z, for STARDUST aerogel overburdens of 5μm, 10μm and 20μm. Even for the thickest overburden expected, the attenuation is only 50% for carbon K-alpha x-rays. This strongly suggests that elemental composition maps of the terminal particle residue and any residues located along the track could be made using, in order of sensitivity and spatial resolution, electron microprobe, x-ray microprobe, or PIXE. We describe x-ray microprobe analysis of the particle shown in Fig. 4 in a companion paper[3] in these proceedings. (Composition maps along the particle track will require a minor change in the extraction technique — a rotation of the extracted wedge with respect to the particle track, so that the track parallels one of the walls of the wedge.)

After preliminary characterization, the extracted impact events could be distributed to individual researchers. We have demonstrated previously[1] that small particles essentially free of aerogel can be extracted from aerogel collectors using actuatable silicon microtweezers. We are currently extending this technique to extraction of "naked" particles from aerogel wedges. We are also evaluating the use of precision FIB ion milling for exposure of the particle residues.

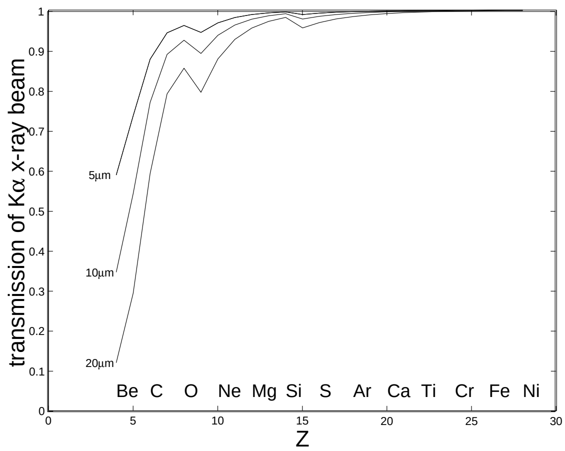

Fig. 5: Transmission coefficient of Kα x-rays through 14 mg cm^{-3} aerogel as a function of atomic number Z, for aerogel thicknesses 5μm, 10μm, 20μm.

References

[1] Westphal A. J. *et al.* (2002) *MAPS* **37**, 855

[2] Hörz F., Zolensky M. E., Bernhard R. P., See T. H. , Warren J. L. (2000) *Icarus* **147**, 559

[3] Flynn G., Westphal A. J., Snead C. (2003) "IN-SITU CHEMICAL AND MINERALOGICAL ANALYSIS OF AN EXTRATERRESTRIAL PARTICLE IN AEROGEL", these proceedings.