HIGH SPATIAL RESOLUTION 3D LOCAL TOMOGRAPHY OF PARTICLE TRACKS AND FRAGMENTATION IN AEROGEL. D. S. Ebel[1] and M. L. Rivers[2]. [1]Dept. of Earth and Planetary Sciences, American Museum of Natural History, Central Park West at 79th St., New York, NY 10024. (debel@amnh.org) [2]Consortium for Advanced Radiation Sources, Univ. of Chicago.

Introduction: Synchrotron x-ray computed micro-tomography (XR-CMT) non-destructively yields 3-Dimensional images of bulk volumes, that we applied to meteorites [1-4], and lunar glass spherules [5]. We've succeeded in imaging, at high spatial resolution, particle tracks and fragmentation histories in aerogel tile (25mm deep) shot with Allende (CV3) dust (into the 7x40mm top surface) using a gas gun (F. Hörz, pers. comm.). STARDUST mission will return samples like these, but optical methods are non-optimal for full 3D imaging before destructive slicing and particle removal.

Methods: Samples rotate on a highly automated high-precision stage, about a chosen center. X-rays (μW) do not heat the sample. From X-ray images taken on a CCD at successive angles, we make a 3-dimensional (3D) array, 650x650x515 centered on the rotation center, of equidimensional volume elements (voxels), each with an x-ray attenuation represented by a 12-bit integer. High-attenuation (denser) particles are bright, aerogel brighter than air in tracks. 3D arrays can be 'sliced', sub-sampled, thresholded, contrast-enhanced. 2D 'slices' are pixels representing a plane of voxels in the sample.

To image a large aerogel tile at high spatial resolution, portions of the tile must rotate in and out of the field of view of the x-ray beam/CCD collector. For rocky materials with high attenuation, large samples are impractical, and our work has been confined to samples under 1cm maximum cross-section. With low-density aerogel, however, we were able to image portions (interior volumes) of the above tile (7x40mm cross-section) at both 14.49 and 3.66 micron/pixel resolution. This imaging is the first application of 'local' or 'lambda' tomography to aerogel of which we are aware. Further discussion of technique, and results of this work can be found at:

http://research.amnh.org/users/debel/tomo2/aerogel1.html

Results: Particles, tracks, and sintered aerogel are easily observed in orthogonal planes through volumes. We cropped one carrot-shaped track from the larger 14.5μm/pxl volume. Two particle fragments are visible, separated by tens of μm, but at the ends of laterally downward branching tracks that stem from the main track. In software, we spliced together sequential volumes at 3.66 μm/pxl, and follow individual tracks downward into the tile.

Conclusion: Synchrotron x-ray 'lambda' microtomography can successfully produce 3D density maps of analogs of the expected STARDUST comet sample return tiles. Rotation centers can be spaced evenly through the tile volume, to image the entire tile at very high spatial resolution (e.g., 1.5 μm/pxl). Alternatively, tracks can be followed downward by imaging selected volumes. Resulting volumes can be stitched together, cropped, etc. as desired. This non-destructive imaging will recover maximum information content from aerogel tiles prior to cutting, particle extraction, and other invasive investigations. XR-CMT is versatile and applicable to initial characterization for low-density samples from future missions [6]

References: [1] Weisberg M.K. et al. 2002. *Meteoritics & Planetary Science Suppl.* 37: A149. [2] Hertz J. et al. 2003. Abs. #1059. 34th Lunar & Planet. Science Conf. [3] Murray J. et al. 2003. Abs. #1999. 34th LPSC [4] Ebel D.S. et al. 2004. *Meteoritics Planet. Sci Suppl.* 39: A33. [5] Ebel D.S. et al. 2005. Abs. #1505. 36th LPSC. [6] Flynn G.J. et al. 2000. Abs. #1893. 31st LPSC.