COMETARY TRACKS IN AEROGEL: THE CHALLENGE OF MAKING REGISTERED 3D VOLUMETRIC OPTICAL AND STEREOSCOPIC SPECTRAL-CHEMICAL DATA ACCESSIBLE. D. S. Ebel[1,2] and K. V. Fendrich[1], [1]Dept. of Earth and Planetary Sciences, American Museum of Natural History, Central Park West at 79th St, New York, NY 10024, [2]Dept. of Earth and Environmental Sciences, Columbia University, New York (debel@amnh.org).

Introduction: In 2006, NASA's Stardust mission returned a capsule to Earth with particles collected from the coma of comet 81P/Wild 2. Cometary particles were collected by impact into low-density silica aerogel at a relative velocity of 6.1 km/s [1]. Upon impacting the aerogel, particles left behind tracks of melted and compressed aerogel and void space, shedding material along the way. To maximize the scientific return from these samples, we spent years measuring them as nondestructively as possible, while they remained embedded in "keystones" of the aerogel capture medium [2].

At the Microscopy and Imaging Facility at the American Museum of Natural History (AMNH), a Zeiss LSM510 Laser Scanning Confocal Microscope (LSCM) and later a Zeiss LSM510 LSCM were used to perform 3-dimensonal (3D) mapping of whole Stardust tracks at high resolution (<80 nm/pixel) [3]. The laser wavelength choices on the LSM710 allowed multi-wavelength imaging, allowing identification of regions of aerogel compression due to autofluorescence of aerogel [4]. Many of the LSCM results have been complemented with chemical data acquired using the GSECARS X-ray fluorescence (S-XRF) microprobe on beamline 13-IDE at the Advanced Photon Source of Argonne National Laboratory, Dept. of Energy [5]. Many of the S-XRF data comprise stereoscopic pairs taken at two angles, allowing discrimination of particles in tracks from those that contaminate the aerogel keystone surfaces.

To improve LSCM image quality, particles manufactured in aerogel were imaged to obtain experimental point-spread functions using identical instrumentation as for the comet tracks [6]. These data are an important part of the track imaging project because they allow deconvolution of spectra using the Huygens software [7, 8].

Objective: Our goal is to archive all the data that we have collected, such that S-XRF spectral maps may be registered (matched spatially) to 3D LSCM image stacks. **These combined data sets could be exploited to determine the locations of chemically interesting grains in whole tracks and to harvest (extract) grains of particular potential interest**.

Data: LSCM data from the LSM510 and LSM710 instruments are produced in raw form compatible with the Zeiss "Zen" proprietary software. TIFF stacks very rich (16-bit depth) in contrast detail can be produced from them and the included metadata can be extracted with available free software.

S-XRF chemical maps acquired prior to 2012 were in a format that could not be read by the current software provided by APS beamline staff. We have worked with Matt Newville from the University of Chicago (XRF software developer and beamline scientist at the Center for Advanced Radiation Sources at the APS, Argonne National Lab) to convert as much of the old data as possible into an accessible format. We succeeded in converting data on 4 tracks from 2011. Data from 2006-2009 are unfortunately still problematic and we have not been able to reach a resolution.

Outlook: We have well organized data (7 TB) for 9 fully 3D LCSM-mapped tracks for which we also have 2D chemical maps and stereo-pair S-XRF maps. We have begun working with PDS Small Bodies Node to convert our data into PDS-supported formats. Our hope is that our work would provide a robust template for ingestion of data obtained from returned samples into the PDS.

Inclusion of S-XRF data into the PDS would depend on progress with the conversion of old data, or creation of new software. No data archive similar to our data exists in PDS. Our effort halted with the end of award funding near the start of the pandemic. The author is collaborating with JSC curation to make all of our whole-track, high-resolution 3D LSCM images and S-XRF maps available for future investigations.

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