THREE-DIMENSIONAL MORPHOLOGIES AND ELEMENTAL DISTRIBUTIONS OF STARDUST IMPACT TRACKS.

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Introduction: Impact tracks formed by cometary dust capture in silica aerogel collectors in the Stardust mission [1] have a variety of shapes, showing diversity of the cometary dust [2]. We have investigated 3-D structures and elemental compositions of eight impact tracks using synchrotron radiation x-ray analyses (microtomography and XRF) [3]. In this study, additional three tracks were investigated by the same analytical method.

Experiments: In addition to the previous tracks (type-A [2]: T46 (*Gobou*), T68 (*Skyrocket*), T96 (*Ichiro*), T97, T98 (*Heiji*), T99 (*Spiral-B*), T100 (*Spiral-A*) and type-C [2]: T67 (*Namekuji*)), one type-A tracks (T66) and two type-B/C tracks (T65, T140) were examined. Keystones having the impact tracks were imaged at beamline BL47XU or BL20B2 of SPring-8, Japan, using projection microtomography [4] at 8-10 keV with the voxel (pixel in 3-D) size of 0.21, 0.50, 1.05 or 2.74 μm depending on the track sizes. Distributions of elemental mass (mainly Fe) along the tracks were obtained by XRF at 15 keV with a basaltic glass standard.

Results and Discussion: Track cavities including radial cracks, condensed aerogels and captured grains including terminal grains were recognized three-dimensionally. The quantitative size parameters of the tracks, such as length, width and volume, were obtained based on the voxel size. By assuming cylindrical symmetry of the tracks (track diameter as a function of the depth) the entrance hole sizes were determined precisely. The sizes of the original cometary dust impactors were also estimated from the total Fe contents of the tracks (*i.e.*, Fe contents of the impactors) by assuming the Fe content of CI and densities (1 g/cm^3 for fine aggregate and 3 g/cm^3 for crystalline grains). They were compared with the entrance hole size, and deviation from the Fe content of CI was discussed.

The quantitative track shapes shows that some bulbous portions are more or less present as well as thin trackseven in type-A (carrot-like) tracks. Distributions of the Fe mass along the tracks were compared with the track shapes. Fe is enriched in bulbous portions and some of large captured grains. In bulbous portions, Fe is distributed unevenly towards the deeper parts, suggesting movement of disaggregated fine particles during the capture.

References: [1] Brownlee D. et al. (2006) *Science*, *314*, 1711. [2] Hörtz F. et al. (2006) *Science*, *314*, 1716. [3] Tsuchiyama A. et al. (2008) *LPSC*, XXXIX. [4] Uesugi K. et al. (2003) *Journal de Physique*. IV France, *104*, 45.