THREE-DIMENSIONAL MICROSTRUCTURES OF ANTARCTIC MICROMETEORITES BY X-RAY COMPUTED MICRO-TOMOGRAPY USING SYNCHROTRON RADIATION AT SPRING-8.
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Introduction: X-ray CT is a non-destructive method for investigation of materials by using X-ray attenuation. 3-D internal structures can be obtained by constructing a number of successive cross-sectional CT images. Lately, an X-ray computed microtomographic system using synchrotron radiation has been developed at SPring-8 in Japan, which can give spatial resolution of about 1 μm [1]. As monochromatic X-ray beams are used in this system, we may obtain information of elemental distribution by using X-ray adsorption edge of the element. We have applied this system to Antarctic micrometeorites (AMMs).

Experiments: Four AMMs (Y98M03KS036, 068, 074 and 094) [2] were imaged at BL47XU in SPring-8. We selected large samples (about 100 μm) from the AMM catalogue [3]: one of them (KS074) looks unmelted and seems to include coarse-grained crystals and the other three are vesiclated to scoriaceous. The photon energy was 10 keV. For one sample (KS094) imaging at photon energies just below and above the Fe-K edge (7.112 keV) was also made to obtain Fe distribution images. Cross-sectional CT images are reconstructed by a convolution back projection method. It took about a few hours for imaging and 5–10 hours for reconstructing about 200 CT images for each 3-D structure.

Results and Discussion: "Coarse-grained crystals" in KS074 were imaged as grains of about 10 μm. Based on the CT-values, these grains must be olivine or pyroxene with rims rich-in FeO. The most vesiclated sample was KS068. Many vesicles are not connected to the outside three-dimensionally. Only small amounts of vesicles were observed in the samples, KS036 and KS094. Structures, which look like Fe-rich rims, were also observed although we cannot exclude a possibility that the structures are artifacts due to refraction of X-ray by the samples. The whole surface of KS068 is covered by this structure, while the surfaces of KS036, 074 and 094 are partially covered.

Examples of CT images of KS094 are shown in Fig. 1. Fe images were obtained by subtracting the 7.105 keV images from the 7.115 keV images (Fig. 1d). We can recognize Fe-poor grains, which are not seen in the 10 keV images. Heterogeneous distribution of Fe, which may reflect original Fe distribution more or less modified by heating during entrance into the Earth's atmosphere, is also seen.

This is the first study, in which 3-D microstructures of AMM were obtained with sufficient spatial resolution. Furthermore, we succeeded in obtaining 3-D structure of Fe, which is one of the most important elements in planetary samples, for the first time. The present microtomographic system is suitable for Fe-K imaging with sufficient spatial resolution due to the low Fe-K edge energy. The present results strongly showed that the method is useful for studying micrometeorites and probably some IDPs.

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References: [1] Uesugi K. et al. (2001) *Nucl. Instr. Methods. Ser.A,* in press; Tsuchiyama A. et al. (2001) *Antarctic Meteor., XXVI,* in press. [2] Yada T. and Kojima H. (1999) *Antarctic Meteor., XXIV,* 190–191. [3] http://dust.cc.gakushuin.ac.jp/dust/

NITROGEN MICRO-ANALYSIS OF GLASS INCLUSIONS IN CHONDRITIC OLIVINES BY NUCLEAR REACTION.
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Introduction: New results on nitrogen contents in glasses of glass inclusions, in addition to those already presented [1–3], allow as to speculate on the possible nature of the N species stored in glasses. The nitrogen measurements in glass inclusions were carried out utilizing the $^{14}N(d,p)^{15}N$ reaction (LPS, Saclay, France) [3].

Samples: Nitrogen content in glass inclusions in olivines have been measured in the following chondritic meteorites: *Carbonaceous chondrites:* CV3: Allende DI, (PTS, 4884-2B, AMNH, New York); Ningqiang, (PTS, no number, NM, Vienna); CO3: Dar al Gani 083, 291, 289, 005 (PTS all from NM, Vienna). CR: Renazzo (PTS L3428, NM, Vienna), Acfer 128 (PTS, NM, Vienna); El Djouf 001 (PTS AMNH, New York); C4: Hammadah al Hamra 073 (PTS NM, Vienna); CH3: Acfer 214 (PTS NM, Vienna).

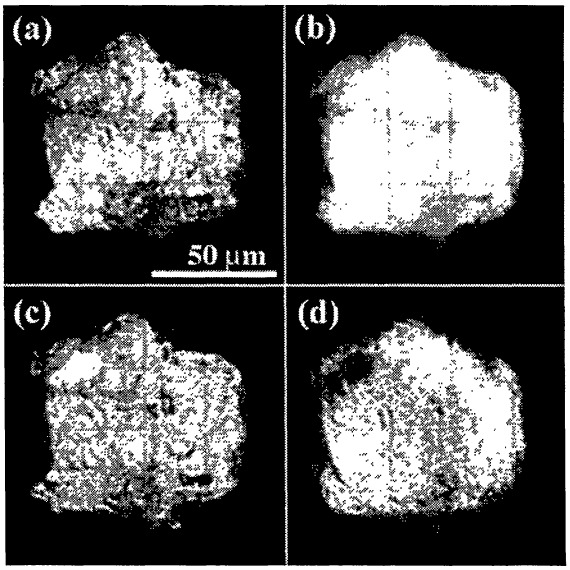

Fig. 1. CT images of the same slice of AMM, Y98M03KS094. (a) 10 keV. (b) 7.115 keV. (c) 7.105 keV. (d) Fe-K image. The gray scales are arbitrary. 0.5 μm x 0.5 μm pixel.

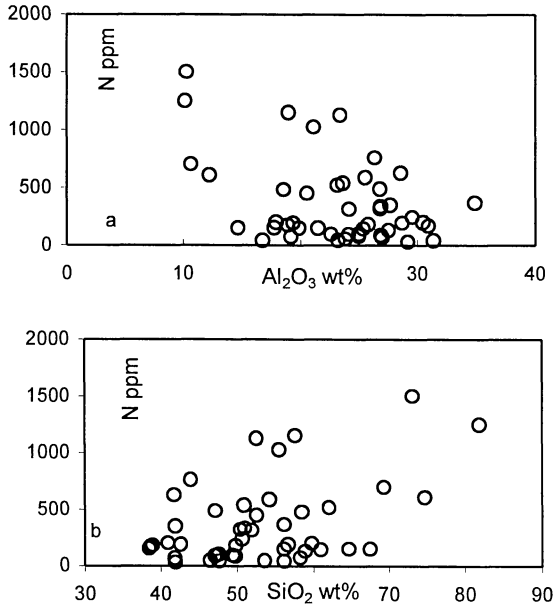

Fig. 1. Variation of Al_2O_3 and SiO_2 vs. N contents in glasses of glass inclusions in chondritic olivines.