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X-ray diffraction analysis of pristine micrometeorites recovered from the Antarctic surface snow

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1 Introduction

Micrometeorites (MMs) are extraterrestrial materials that retain various information about the outer regions of the solar system. MMs recovered from the Antarctic surface snow are characterized by a high content of Fe-sulfides and an unfractionated elemental abundance patterns (CI norm.) of their fine-grained matrix, because they experienced a lower degree of terrestrial alteration than MMs from Antarctic blue ice field [1-2]. In order to investigate bulk mineralogy of individual MMs, we performed synchrotron X-ray diffraction analysis on each MM.

2 Samples and analytical techniques

The surface snow was collected near the Jangbogo Antarctic Research Station by Korea Polar Research Institute in 2014. We separated particles by melting and filtering snow of ~400kg in a clean room. Several thousands of lithic particles were picked up under the binocular microscope and 126 particles were identified as MMs based on SEM/EDS chemical analysis. After that, they were attached to the tops of carbon fibers 5μm in diameter. Individual MMs were analyzed for bulk mineralogy by synchrotron-radiation X-ray diffraction analysis at photon factory beamline 3A. The MMs were set in a Gandolfi camera, and the average exposure time was 45 minutes. The diffraction patterns were recorded in an imaging plates, and the data were read by FLA7000 imaging plate reading system in order to analyze diffraction patterns using a GANCON software.

3 Results and discussion

Synchrotron-radiation X-ray diffraction analysis found that the particle JBS14-0M-THP13D10 (Fig. 1a) has a unique mineralogy. Diffraction pattern of this particle (Fig. 2) indicates that this particle consists mainly of salt minerals, halite (NaCl) and sylvite (KCl), which is inconsistent with the result of SEM/EDS analysis revealing C-rich chondritic elemental abundance with Mg, Si, Fe, and S being major elements of this particle (Fig. 1b). This incoherence suggests that these elements are contained in amorphous material.

In the previous study, salt minerals were found in the ordinary chondrites Zag and Monahans [3]. A recent study suggests that the salt minerals in chondrites are derived from the primitive small bodies, such as C-, P-, or D-type asteroids being rich in organics and water [4]. The results of this study could be strong evidence for this suggestion. The salt minerals survived in this MM because of short residence time in the snow.

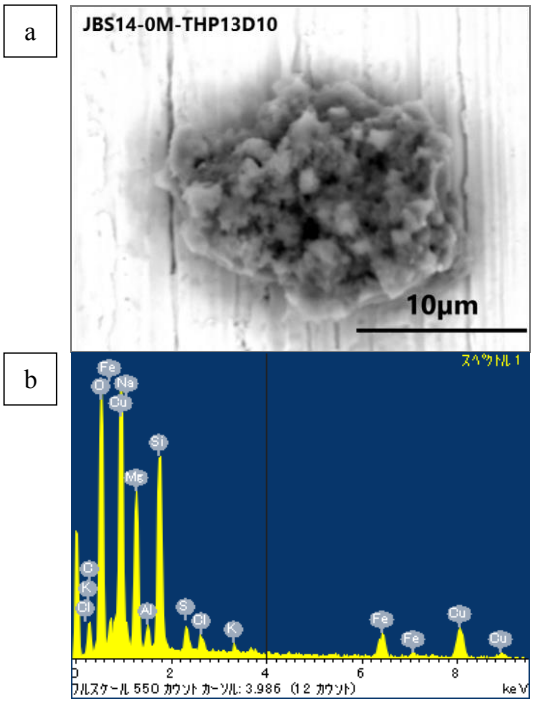

Fig. 1: (a) Back-scattered electron image and (b) bulk composition of JBS14-0M-THP13D10.

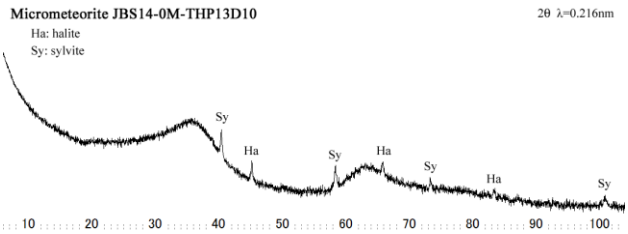

Fig. 2: A diffraction pattern of JBS14-0M-THP13D10.

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References

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