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X-ray diffraction analysis of micrometeorites recovered from Antarctica

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1 Introduction

Antarctic micrometeorites (AMMs) are extraterrestrial dust particles, formed early in the history of the solar system. They have asteroidal and cometary origins, and represent the dominant source of extraterrestrial matter accreted by the Earth.

The 39th Japanese Antarctica Research Expedition conducted a large-scale micrometeorite collection in the ice field around the Yamato Mountain (Yada et al., 2000). In this report, we describe the results of mineralogical analysis of micrometeorites recovered from Antarctica.

2 Experiment

Several hundreds of lithic particles, recovered from ice field in Antarctica, were picked up under a binocular microscope, and 120 particles were identified as AMMs based on SEM/EDS chemical analysis and attached to the tops of carbon fibers 5μm in diameter. We have carried out X-ray diffraction analysis of AMMs at beamline 3A and experimental procedures are detailed in Nakamura et al., 2011.

We selected a few AMMs according to the results of diffraction analysis X-ray which escaped high temperature heating during the atmospheric entry, and embedded them in epoxy resin. After that, we sliced the samples to produce ultrathin section with ultra-mycrotomy. The ultrathin sections were analyzed by 200-KeV FE-TEM equipped with EDS, which is able to determine nano-scale mineralogy. Rest of the particles, which remained in the resin, were polished and analyzed by EPMA/WDS, which is able to determine the local and bulk chemical composition. We accomplished this multistage detailed analysis, and revealed the mineralogy and the physicochemical properties of each small cosmic dust particle.

3 Results and Discussion

We found out a particle named KTP2H6 (Fig.1) which comes from D-type asteroids, and escaped severe heating during the atmospheric entry. Tagish lake meteorite is also known as the D-type asteroid origin, but such meteorites are very rare. KTP2H6's diffraction pattern is shown in Fig.2. Saponite and magnetite are the major phases. Saponite crystallizes when anhydrous minerals, such as olivine and pyroxene, are aqueously altered in the asteroid, and it decomposes by heating at low temperature. That means KTPH2 well preserves pristine information of a D-type asteroid and contributes for understanding of mineralogical variation of the D-type asteroids.

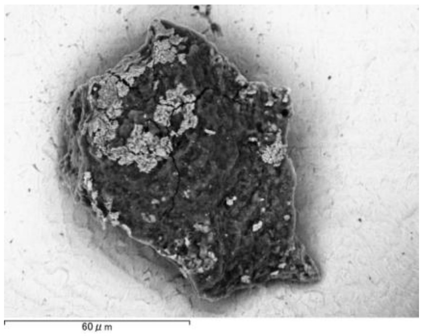

Fig. 1: Back-scattered electron image of KTP2H6, consisting of saponite (dark) and magnetite (blight).

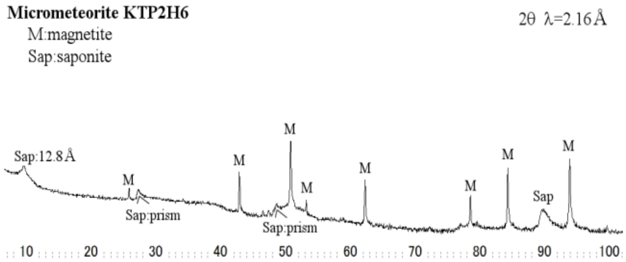

Fig. 2: X-ray diffraction pattern of KTP2H6

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References

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