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Mineralogical characteristics of phyllosilicate-rich cosmic dust: a link between hydrated asteroids and interplanetary dust

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Introduction

We have characterized mineralogy of Antarctic micrometeorites by synchrotron radiation X-ray diffraction. The experiments were performed at the beamline 3A using an X ray monochromated to 2.16 Å. Individual micrometeorites, which are extraterrestrial dust coming from the space and recovered from Antarctica, were set in a Gandolfi camera to have powder X-ray patterns with an exposure duration from 0.5 to 5 hours [1-2]. More than 200 micrometeorites were characterized with this method at the present [3], but we still have many samples to be analyzed in order to derive a firm conclusion on the origin of micrometeorites.

Results and discussion

We have identified 31 micrometeorites that contain hydrous mineral phyllosilicates. The presence of phyllosilicates indicates that they came from hydrated planetary objects in space. The phyllosilicate-rich micrometeorites were classified based on mineral species of phyllosilicates and accessory minerals. We also characterized the intensity of atmospheric entry heating from the (001) spacing of saponite. Tweleve micrometeorites are composed of saponite, magnetite, pyrrhotite, and small amounts of carbonates (calcite, siderite, and magnesite)(Fig.1). Their mineralogy is very similar to that of meteorites coming from D-type asteroids. The D-type asteroids are distributed at the outer portion of the asteroid belt. The presence of saponite-dominated micrometeorites suggests that interplanetary dust in the solar system includes dust from D-type asteroids.

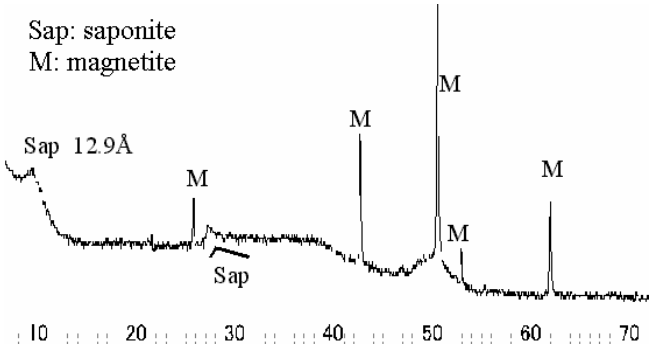

Fig. 1. X-ray diffraction patterns of saponite-rich micrometeorites

Nine micrometeorites are composed of saponite, serpentine, magnetite, pyrrhotite, and small amounts of carbonates (calcite, magnesite, and siderite). Saponite is more abundant than serpentine. Their mineralogy is almost identical to that of CI chondrites, coming from C-type asteroids. The severer is the heating in the atmosphere during entry from the space, the abundance of serpentine is lowered because of serpentine break down at low temperature. Thus, some micrometeorites cannot be distinguished whether they come from C-type (serpentine-rich) or D-type (saponite-rich) asteroids. Four micrometeorites are rich in serpentine and magnetite and absent in saponite (Fig.2), which is similar to the mineralogy of CM chondrites, originated from C-type asteroids.

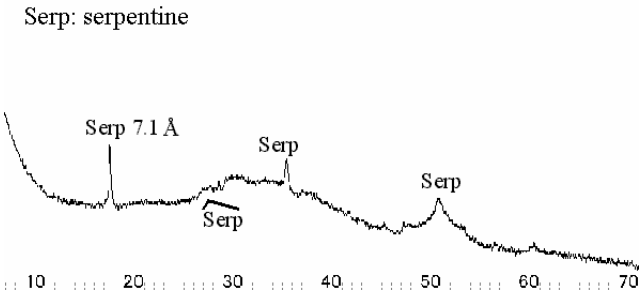

Fig. 2 X-ray diffraction patterns of serpentine-rich micrometeorites

Mineralogical characteristics of above 25 micrometeorites are similar to those of known hydrated carbonaceous chondrites, coming from C- or D-type asteroids. The abundance ratio of the two types micrometeorites may indicates the ratio of the dust in the interplanetary space. At the present, we infer even contribution from C- or D-type asteroids to the interplanetary dust, although the number of samples needs to be increased.

References

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