

Mineralogical study of phyllosilicate-rich unmelted micrometeorites recovered from "Cape Tottuki" in Antarctica

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In the present study, seventy six particles recovered from ice at "Cape Tottuki" in Antarctica were identified as Antarctic micrometeorites (AMMs) by SEM/EDS chemical analysis. Among them, twenty eight relatively less heated AMMs were analyzed by synchrotron X-ray diffraction (S-XRD) using Gandlfi camera, which reveals bulk mineralogy of individual AMMs. Based on the results of S-XRD, we have selected four primitive AMMs. They were embedded in resin and were sliced to be ultrathin sections by ultra microtomy. 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.

The results of the multistage analysis indicated that KTP2H6 is a member of Tagish Lake type micrometeorites, which are believed to come from D-type asteroids in the outer main asteroid belt. HTP2H6 consists mainly of fine-grained saponite and magnetite. The survival of hydrous mineral saponite indicates that the particle almost escaped deceleration heating when it entered the Earth's atmosphere, because saponite is decomposed at 700 degrees Celsius during the brief heating. AMMs had been stayed deeper in the blue ice field in Antarctica for about 30 thousand years, however, the crystal structure was well preserved. Thus, KTP2H6 preserve material characteristics of D-type asteroids.

KTP3I6 was also identified as Tagish Lake type micrometeorites, but it was slightly heated in the atmosphere. Although its phyllosilicate and carbonate phases were decomposed to amorphous phase and magnesiowustite, respectively, we could know the type of phyllosilicate from chemical composition. Si-rich compositions of phyllosilicates indicate that saponite is a major phyllosilicate before decomposition in the atmosphere. Magnesiowustite showed very Fe-rich composition, indicating that the particle had had Fe-rich carbonate. Fe/Mg ratios of the carbonates in KTP3I6 are the highest among carbonates found in Tagish lake meteorite and Tagish Lake-type micrometeorites. This means that the particle is identified as D-type asteroids material, but its formation process is different from the Tagish Lake meteorite. Therefore, we propose KTP3I6 is one of the varieties of D-type asteroids property. In addition, two anhydrous AMMs were also investigated in detail, however, they were highly decomposed during the atmospheric entry and also altered in the Antarctic ice layer.

Keywords: micrometeorites, Tagish Lake meteorite, D-type asteroids, carbonaceous chondrites