Finding of large-sized, nitrogen-rich organic materials in ultracarbonaceous Antarctic micrometeorite

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Ultracarbonaceous Antarctic micrometeorites (UCMMs), first discovered by [1], represent large sizes of high carbon contents. It has been reported extreme D-rich organic matter with both crystalline and amorphous silicates from a UCMM, which appears to be compatible to cometary origin [2]. However, little has been known about the nature of UCMMs. In this study, for an UCMM collected in 250 kg of the surface snow at the Dome Fuji Station, Antarctica, we have carried out the systematic studies applying isotope microscopy, focused ion beam (FIB) extraction, scanning transmission x-ray microscope (STXM) and transmission electron microscopy (TEM) observation to study the origin and formation of UCMMs.
Isotope imaging has detected a large-sized, nitrogen-rich organic material of ~10 x 20 μm^2. The distribution of sulfur is associated with with the organic material. There is no significant difference in carbon, hydrogen, and nitrogen isotopic compositions of the UCMM from those of epoxy resin. A STXM C- and N- maps of the FIB section show that organic N-rich and poor regions coexist in the object with a sharp boundary. N-XANES spectra of the N- rich regions exhibit intense peaks of imine (C=N), nitrile (C≡N), and amide (NHx(C=O)C), while that of N-poor region shows a less characteristic spectrum that is similar to those of typical chondritic and IDP organics [3]. It is noted that the N-XANES spectral patterns of the N-rich regions are very similar to those observed from the three samples of Comet 81P/Wild 2 dust particles [4]. Furthermore, the organic features of the UCMM in its size and N- functional chemistry are very similar to those of CR3 chondritic organic material [5]. Thus, the organic chemistry of the UCMM implies the very early stage of parent body aqueous alteration or before.

References

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