COEXISTING NITROGEN- RICH AND POOR ORGANIC MATERIALS IN ULTRACARBONACEOUS ANTARCTIC MICROMETEORITE.


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Introduction: Ultracarbonaceous Antarctic micrometeorites (UCMMs), first discovered by Nakamura et al. (2005) [1], are unique extraterrestrial materials that represent large sizes of high carbon contents. Duprat et al. (2010) [2] have reported extreme D-rich organic matter with both crystalline and amorphous silicates from a UCMM, which appears to be compatible to cometary origin. However, little has been known about the nature of UCMMs. In this study, for an UCMM, which was found in ~200 MMNs collected in 250 kg of the surface snow at the Dome Fuji Station, Antarctica, we have carried out the systematic studies applying isotope microscopy, FIB extraction, STXM and TEM observation to study the origin and formation of UCMMs.

Experimental: A polished thick section of a UCMM DO05IB80 was used in this study. Isotope imaging was performed by a Cameca ims-1270 SIMS with SCAPS at Hokkaido Univ. An FIB section was extracted from the UCMM by a JB-4501 FIB-SEM microscope at Ibaraki Univ. C-, N-, and O-XANES spectra of the FIB section were acquired using STXM at the Beam line 5.3.2.2., Advanced Light Source, LBNL.

Results and discussion: Olivine, low Ca pyroxene, and pyrrhotite are identified from the UCMM by SEM-EDX. Isotope imaging has detected a large-sized, nitrogen-rich organic material of ~10 x 20 μm², as reflected by the distribution of 12C14N. The 32S distribution appears to overlap with the organic material. There is no significant difference in carbon, hydrogen, and nitrogen isotopic compositions of the UCMM from those of epoxy within analytical uncertainties. 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, nitrile, and amide, while that of N-poor region shows a less characteristic spectrum that is similar to those of typical chondritic and/or 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, 5]. Nitrogen isotopic composition of the Comet Wild 2 organics is indistinguishable from terrestrial values [4], which is consistent with that in this study. Furthermore, the organic features of the UCMM in its size and nitrogen functional chemistry are very similar to those of CR3 QUE99177 chondritic organic material [6]. Thus, the organic chemistry of the UCMM implies the very early stage of parent body aqueous alteration or before.