In-situ analysis of organic component in the Allende meteorite matrix

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Although the carbon compounds are mainly contained in the matrix of Allende CV3, their natures and occurrences have not been described in detail. In this study, we applied a scanning transmission X-ray microscopy (STXM) analysis combined with a focused ion beam (FIB) technique to *in-situ* their functional groups analysis. Thin foil sample for the STXM analysis was prepared using FIB from portions of interest under *in-situ* sample extraction protocol with no chemical treatments. Subsequnetly, TEM analysis was also conducted for the textural observation.

The carbon compounds were found along with the grain-boundaries of fine-grained olivine crystals (diffusional). Several dense carbon compounds were also found in the diffusional carbon components (particulate). Based on carbon K-edge NEXAFS, the particulate carbon (aromatic-rich and carboxylic-poor) was similar to insoluble organic matter of Allende CV3 reported in Cody et al. [1]. The diffusional carbon portion, on the other hand, mainly consists of aromatic-poor and carboxylic-rich components. Iron L- and oxygen K-edge NEXAFS spectra and TEM observations showed that submicron-sized spinel and chromite crystals are embedded in the particulate carbon, which may be the fragments of high temperature condensation minerals such as CAIs.

Our FIB-STXM analyses revealed existences of two types of carbon components in the Allende CV3. Assuming that each carbon components had different origins, (i) the particulate carbon component might had formed on the spinel and chromite crystals in the solar nebula, and accreted into the Allende parent-body. In some cases, silicate-minerals are surrounded by the nano-globules in carbonaceous chondrites [2]. On the other hand, (ii) it is possible that the diffusional carbon component formed through aqueous alteration occurred in the Allende parent-body, because these NEXAFS spectra are similar to diffuse organic matter in the Orgueil and Murchison [3], except for the carbonate peak.

[1] Cody et al., (2008) *MAPS* **43**, 353–365.
[2] Nakamura-Messenger et al., (2012) *43rd LPSC*, #2551.
[3] Le Guillou et al., (2014) *GCA* **131**, 368–392.