**INVESTIGATION OF CARBON COMPONENTS IN ALLENDE CV3 MATRIX USING MULTI-PROBE MICROSCOPIC TECHNIQUES: FIB, STXM, TEM/STEM, AND NANOSIMS.**

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**Introduction:** Previous studies report that many kinds of carbon components are included in Allende CV3 (e.g., [1]). The carbon components investigated in the previous studies might not be intact because they were extracted through acid treatments. Although the carbon components are mainly contained in the matrix of Allende CV3, their natures and occurrences have not been described in detail so far. *In situ* sample extraction protocol without any chemical treatments should be applied for a carbon component analysis. In this study, we used a scanning transmission X-ray microscopy (STXM) analysis combined with a focused ion beam (FIB) technique to determine functional group analysis and speciation. In addition morphological information and isotopic compositions of the carbon components were investigated using TEM/STEM and NanoSIMS ion microprobe, respectively, to.

**Experiments:** In the present study, Allende CV3 chip sample was cut by ISOMET under non-water and -oil conditions at first. The cross section of the chip sample was coated with a gold for a SEM observation. . Several portions were selected from the matrix for STXM analysis through SEM observations. Ultra-thin foils for STXM analysis were prepared using a FIB. The foils were attached to a Mo-grid. STXM analyses were conducted for carbon, nitrogen, oxygen, and iron in the thin foils at BL-13A, PF and BL-4U, UVSOR. After STXM analysis, TEM/STEM observations were conducted for textural observations at Tohoku University. And then NanoSIMS isotope imaging analysis were applied to obtain their isotopic characteristics at the Kochi Institute for Core Sample Research, JAMSTEC.

**Results and discussion:** STXM analyses depict that the carbon components occur along with the grain-boundaries of fine-grained olivine crystals (diffusional) in the matrix of Allende CV3. Several dense carbon components occur in the diffusional carbon components (particulate). The constituent rates of particulate and diffusional carbons are approximately 50 % and 50 %, respectively. Based on C K-edge NEXAFS, the particulate carbon (aromatic-rich and carboxylic-poor) appears to be insoluble organic matter of Allende CV3 [2]. In the diffusional carbon portion, on the other hand, aromatic-poor and carboxylic-rich carbon components occur. Although each carbon portion has small differences on their functional group ratios, all or most can be classfied into IOM because all carbon NEXAFS have distinguishable aromatic carbon peak around 285 eV.

Then, Fe L- and O K-edge NEXAFS spectra and TEM/STEM observations proved that chromite-hercynite, pentandite, daubreelite crystals, and nano-globules are embedded in the particulate carbon portions. The presences of these minerals and nano-globules suggest that the particulate carbon originate from interplanerary dust particles (IDPs) (e.g., [3]). Chromite-hercynite might be related to CAIs, because such high-temperature condensation minerals can not be formed thorough thermal metamorphism on the Allende parent-body. The embedded materials (hromite-hercynite, pentandite, and daubreelite) might be protected or shielded by carbon components from acid or water attack when aqueous alteration occurred on the parent-body. We can obtained these materials as a acid residues (or "Q", had similar elemental and mineral composition (e.g., [4])) in previous studies. Based on Brearely (1999) [5], it is likely that pentandite and daubreeliteformed through the dehydration of Ni- and S-bearing Fe-enriched serpentine. We acquired $\delta^{13}C$ and $\delta^{15}N$ isotope images by NanoSIMS ion microprobe showing both $\delta^{13}C$ and $\delta^{15}N$ were homogeneous and terrestrial values within analytical errors. Hence, heterogeneously distributed of $^{12}C$ and $^{14}N$ images were related to carbon and nitrogen content of each portion. This isotopical homogeneity appear to be suggestive of aqueous alteration.

**Conclusions:** First, the particulate carbon component correspond to nano-globules included in carbonaceous chondrites. In some cases, silicate-minerals are surrounded with the nano-globules [6]. the particulate carbon component formed on the chromite-hercynite crystals in the solar nebula, and accreted onto the Allende parent-body. subsequently, the particulate carbon (or precursor of particulate carbon) was altered on the parent-body, and became the diffusional carbon.

**References:** [1] Harris and Heymann. (2000) *EPSL*, *183*, 355-359. [2] Cody et al., (2008) *EPSL*, *272*, 446-455. [3] Rietmeijer. (1988) *Astrophys. J., 331*, 137-138. [4] Anders et al., (1975) *Science*, *190*, 1262-1271. [5] Brearley. (1999) *Science, 285*, 1380-1382. [6] Nakamura-Messenger et al., (2012) *43rd LPSC*, #2551.