Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PPS22-02 Room:A02 Time:May 28 09:30-09:45

Aqueously altered clasts in the NWA1232 CO3 carbonaceous chondrite

MATSUMOTO, Megumi[1*] ; TOMEOKA, Kazushige[2] ; SETO, Yusuke[2] ; MIYAKE, Akira[3] ; KIRIISHI, Miho[2] ; UMEHARA, Mariko[2] ; YAMAMOTO, Yukiko[2] ; HAMANE, Daisuke[4]

[1]CSREA, Kobe Univ., [2]Graduate School of Science, Kobe Univ., [3]Graduate School of Science, Kyoto Univ., [4]ISSP, Tokyo Univ.

CO parent bodies are generally believed to have escaped significant degree of brecciation. However, Northwest Africa 1232 (NWA1232) CO3 chondrite is a breccia consisting of three distinct lithologies (A, B, and C) that have experienced different degrees of thermal metamorphism [1,2]. Recently, we found that lithology A, which is the host lithology of NWA1232, contains numerous small clasts (100-1800 μm in diameter) of different metamorphic grades [3,4]. Most of the clasts show little evidence of thermal metamorphism and contain significant amounts of hydrous minerals. These characteristics have not been known in other CO3 chondrites and potentially provide new insights into the formation of CO3 chondrites. Here, we report the results of detailed mineralogical and petrographic study of the hydrous clasts in NWA 1232. We used SEM-EDS, TEM (STEM)-EDS, EPMA-WDS, and SR-XRD.

Small clasts occur abundantly throughout lithology A. Among them, hydrous clasts are most abundant and comprise ˜2 vol.% of lithology A. Each of the clasts typically consists of one chondrule surrounded by a fine grained matrix, exhibiting the appearance of a chondrule with a rim. Some clasts contain multiple chondrules and CAIs embedded in a matrix.

Most chondrules in the clasts are Mg-rich Type I, and their olivine phenocrysts have homogeneous low Fe compositions (˜Fa_1) and show almost no Fe-Mg zoning; these are similar to those in CO3.0 chondrites. Enstatite phenocrysts and mesostasis were partially replaced by fine grains (10-20 nm) of phyllosilicates and an Fe-Si-Mg-rich amorphous material. The amorphous material contains small amounts of fine olivine grains ($<$100 nm). High-resolution TEM observations reveal that the most abundant phyllosilicate exhibits ˜0.7 nm basal spacing; thus, it is serpentine. Minor amounts of smectite with 1.0-1.1 nm basal spacing, were also observed. These phyllosilicates are compositionally indistinguishable from the amorphous material.

The rim-like matrix surrounding the chondrules mainly consists of an Fe-Si-Mg rich amorphous material, and contains relatively coarse grains (1-2 μm) of magnetite, forsteritic olivine, enstatite, fine grains (100-500 nm) of olivine, troilite, and finer grains (10-20 nm) of serpentine. The amorphous material is compositionally indistinguishable from the serpentine and mineralogically and compositionally similar to that within the chondrules.

Our results suggest that the clasts have experienced weak aqueous alteration in the meteorite parent body. However, the evidence of aqueous alteration was not observed in the outside of the clasts. These suggest that the clasts were formed and transported from a region in the parent body that was different from the region where the meteorite was finally lithified, and subsequently they were incorporated into lithology A. We note that the mineralogical and compositional characteristics of chondrules and matrix in the clasts are similar to those in the primitive CO3.0 chondrite ALHA77307 [5].

References: [1] Kiriishi and Tomeoka (2008), JMPS, 103, 161-165. [2] Umehara et al. (2009), JAMS Annual Meeting (abstract). [3] Kiriishi et al. (2009), JAMS Annual Meeting (abstract). [4] Matsumoto et al. (2014), JpGU Meeting (abstract). [5] Brearley (1993), GCA, 57, 1521-1550.

Keywords: CO chondrite, clast, brecciation, aqueous alteration, TEM, SR-XRD