HYDRATED, UNMETAMORPHOSED CLASTS IN THE NWA 1232 CO3 CARBONACEOUS CHONDRITE.

M. Matsumoto[1], K. Tomeoka[1], Y. Seto[1], A. Miyake[2], M. Kiriishi[1], M. Umehara[1], Y. Yamamoto[1], D. Nishio-Hamane[3].
[1]Kobe University, Japan. Email: matsu@ruby.kobe-u.ac.jp [2]Kyoto University, Japan. [3]University of Tokyo, Japan.

Introduction: CO parent bodies are generally believed to have escaped significant brecciation. However, NWA 1232 CO3 chondrite is a breccia consisting of two distinct lithologies (A and B) that have experienced different degrees of thermal metamorphism; their metamorphic grades are estimated to be 3.4 and 3.7, respectively [1]. We found that lithology A contains numerous small clasts (100–1800 µm) that are clearly different in metamorphic grade from the host lithology and are partially hydrated. Here, we present the results of petrographic, SEM, TEM, and SR-XRD studies of the small clasts in lithology A of NWA 1232.

Results and Discussion: The small clasts are widely distributed throughout lithology A; a total of 265 clasts were identified in an area of 740 mm^2. 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 matrix.

Olivine phenocrysts in most of the chondrules in the clasts are low in Fe contents ($Fa_{\sim 1}$) and show almost no Fe-Mg zoning, which correspond to type 3.0. Enstatite phenocrysts, mesostasis, and opaque nodules have been partially replaced by an O-Fe-Si-Mg-rich material. TEM observations reveal that the O-Fe-Si-Mg-rich material is largely amorphous and contains fine grains (10–20 nm) of hydrous phyllosilicates. Most of the phyllosilicate crystals consist of layers of a ~0.7 nm interlayer spacing, with a minor abundance of layers of 1.0–1.1 nm spacing. These layers probably correspond to serpentine and smectite, respectively.

The matrix of the clasts consists largely of an amorphous material mineralogically and compositionally similar to the O-Fe-Si-Mg-rich material within the chondrules. The O-Fe-Si-Mg-rich material in the matrix contains grains (0.1–2 µm) of magnetite, forsteritic olivine, enstatite, Fe-rich olivine, and troilite, most of which appear to have been disaggregated from chondrules. These characteristics are similar to those of the amorphous material in the matrix and rims of the ALH A77307 CO3.0 chondrite [2].

SEM observations indicate that the boundaries between the clasts and the host lithology A matrix are sharp and the matrix shows no evidence of having been involved in the alteration of the clasts. TEM observations show that the matrix consists mainly of fine-grained Fe-rich olivine and contains no phyllosilicates.

Our study shows that the small clasts in lithology A have not experienced any significant thermal metamorphism but experienced aqueous alteration. In contrast, the surrounding host lithology has experienced significant thermal metamorphism but no aqueous alteration. These indicate that the aqueous alteration in the clasts and the thermal metamorphism in the host lithology did not occur in situ. It is likely that the small clasts were produced by fragmentation of a hydrated region different from the region where lithology A was finally lithified. Subsequently, they were transported and mixed with the components of lithology A. After lithification, clearly, no thermal metamorphism occurred.

References: [1] Kiriishi M. and Tomeoka K. 2008. *Journal of Mineralogical and Petrological Sciences* 103:161–165. [2] Brearley A. J. 1993. *Geochimica et Cosmochimica Acta* 57:1521–1550.