UNUSUAL CLASTS INCLUDING PYROPE-ALMANDINE GARNET AND OMPHACITIC PYROXENE IN THE NORTHWEST AFRICA 801 CR2 CHONDRITE

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Introduction: CR chondrites are one of the most primitive chondrites, and often contain unusual clasts with amphibole and graphite [1,2]. These clasts are expected to give constraints on the complicated formation process of these primitive chondrites. Here we report our results on minerals in three clasts (#2, 3 and 6) of NWA 801 CR2 chondrite, extending the previous studies on them [2].

Petrography and mineralogy: These clasts were encountered in three sections, respectively, and are 1-3 mm in size. They are irregularly-shaped and holocrystalline in texture. The clasts are embedded in the matrix, and the boundaries between them and the matrix are very sharp. The constituent minerals are usually 5-20 μm in size. Major minerals are olivine (Fo_{67}) and low-Ca pyroxene (En_{74}). They are mostly homogeneous in composition, whereas low-Ca pyroxene rarely contain Mg-rich core ($<En_{94}$). Olivine occupies 68 vol.% (in average) in these clasts. On the other hand, the occurrence of low-Ca pyroxene is highly heterogeneous between these clasts (0-17 vol.%).

Although one of the unusual features of these clasts is the occurrence of lath-shaped graphite [2], it is heterogeneously encountered. A clast (#3) does not contain it. Another distinct feature is no occurrence of plagioclase and spinel group mineral in these clasts, although they contain 1.9-2.4 wt.% Al_2O_3 in the bulk compositions. Instead, these clasts always contain another pyroxene and garnet. The former contain 8.7% Al_2O_3 (in average), 3.2 Cr_2O_3, 6.4 FeO, 10.4 MgO, 9.0 CaO, and 6.5 Na2O, which suggests that this is omphacitic pyroxene. The garnet contains 20.5% Al_2O_3 (in average), 2.3 Cr_2O_3, 19.4 FeO, 12.7 MgO, 3.3 CaO, indicative of pyrope-almandine garnet. Laser micro Raman spectroscopic analysis supported this identification. The modal abundances of omphacitic pyroxene and garnet are 6-15 and 6-13 vol.%, respectively. Phlogopite, apatite, Fe-Ni metal, troilite and pentlandite are also encountered as minor minerals.

Discussion: Lath-shaped graphite and silicate texture suggest that these clasts formed by igneous process. However, the most striking feature of these clasts is the occurrence of omphacitic pyroxene and pyrope-almandine garnet, without plagioclase and spinel group mineral. Aluminum is partitioned into pyroxene and garnet. Omphacitic pyroxene and pyrope-rich garnet have been reported only from some shocked meteorites, Zagami (martian meteorite) [3] and Novo Urei (ureilite) [4], and a shock vein in Gujba (CB) [5]. Although the occurrence of these minerals is rare in meteorites, they are typical high pressure minerals. Therefore, we suggest that these clasts studied here formed under high-pressure conditions in the parent body.

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