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Eclogitic clasts with omphacite and pyrope-rich garnet in the NWA 801 CR2 chondrite

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Abstract

We report mineral assemblages from three clasts in the Northwest Africa 801 CR chondrite. The clasts, 1–3 mm in size, are ellipsoidal to irregular shaped, and show similar granular texture. The constituent minerals in the clasts are omphacite-rich clinopyroxene and pyrope-rich garnet, in addition to olivine and orthopyroxene. The omphacite contains jadeite (34 mol%) and diopside-hedenbergite (37%), and a significant amount of an enstatite-ferrosilite component (19%), which distinguishes it from terrestrial omphacite. The omphacite has a disordered *C*2/*c* structure. Graphite, phlogopite, chlorapatite, Fe-Ni metal, troilite, and pentlandite are present as minor minerals in the clasts. The minerals commonly found in chondrites, such as plagioclase and spinel group minerals, are not found in these clasts. Aluminum and sodium in the clasts are completely partitioned into omphacite and garnet. The mineral assemblages and compositions of the clasts are similar to those in terrestrial eclogite, except for the occurrence of olivine and some mineral chemistry, and this is the first discovery of an extraterrestrial eclogitic mineral assemblage. The clasts formed under high-pressure conditions, 2.8–4.2 GPa and 940–1080 °C, as estimated from a set of conventional geothermobarometers, indicative of formation in a large parent body. Another possibility is impact-induced origin, although the formation conditions would have been different from those for known shock veins. Meteorites usually consist of minerals that formed under low-pressure conditions, except for ultrahigh-pressure minerals found in shock veins. However, this study suggests that the pressure conditions for meteorite formation vary much wider than previously understood.

Keywords: CR chondrite, clast, omphacite, pyrope, eclogite