MINERALOGICAL COMPARISON OF NORTHWEST AFRICA 7317 AND TAFASSASSET: TWO EQUILIBRATED ROCKS RELATED TO CR CHONDRITES.

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Introduction: Most CR chondrites show evidence for aqueous alteration and classified into petrologic types 1 and 2 [1,2]. However, in recent years, CR samples experiencing thermal metamorphism (e.g., CR6) have been known [3]. Furthermore, there are more "differentiated" samples known such as Tafassasset and NWA 6704 whose O, Cr, and Ti isotopic compositions are plotted within the CR chondrite field [e.g., 4-6]. Therefore, it is of great interest to explore the petrogenetic relationship among these "CR-related" meteorites to better understand thermal evolution of the CR chondrite parent body [e.g., 3]. To begin with, we studied NWA 7317 CR6 chondrite and Tafassasset to compare their mineralogy and petrology.

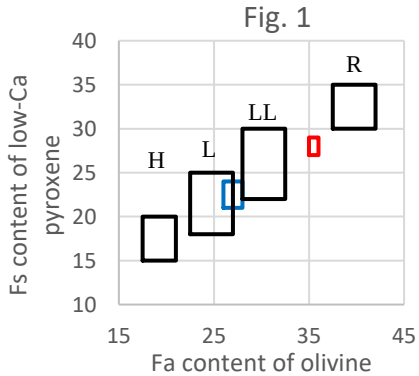
Samples and Methods: 1 polished thin section (PTS) of NWA 7317 and 2 PTSs of Tafassasset were observed with optical microscope and mineral compositions were analyzed by FE-EPMA (JEOL JXA 8530F @Univ. of Tokyo).

Results and Discussions: NWA 7317 shows a poikioblastic texture dominated by homogeneous olivine (Fa_{35-36}). Remnants of barred olivine chondrules are present. Accessory minerals are high-Ca pyroxene ($Fs_{11-13}Wo_{42-45}$), low-Ca pyroxene ($Fs_{27-29}Wo_{2-3}$), plagioclase ($An_{45-54}Or_{1-2}$), Fe-Ni metal, chromite and troilite. Tafassasset has a similar texture and mineral assemblages to NWA 7317, but two different Tafassasset PTSs show slightly different mineral abundances and textural heterogeneity is observed even in a single PTS. It is noted that the size of Fe-Ni metal in one of the PTSs are much larger (~2 mm) than that in the other (~0.8 mm, mostly 0.2 mm). In our Tafassasset PTSs, no relict chondrules are present. The olivine and pyroxene compositions of Tafassasset are mostly homogeneous in major elements: olivine (Fa_{26-28}), high-Ca pyroxene ($Fs_{9-13}Wo_{37-44}$), and low-Ca pyroxene ($Fs_{21-24}Wo_{2-12}$), but plagioclase ($An_{21-57}Or_{1-8}$) and Fe-Ni metal show wide compositional ranges.

NWA 7317 and Tafassasset have homogeneous major element compositions of olivine and pyroxene, but it is clear that Tafassasset has more magnesian olivine-pyroxene compositions than NWA 7317 (Fig. 1). This implies that the source materials of these two meteorites were different. Closer look of other mineral compositions also exhibits difference between NWA 7317 and Tafassasset, probably reflecting their distinct cooling histories. Al and Ti contents in low-Ca pyroxene are homogeneous in NWA 7317 (Al_2O_3: 0.6-0.9 wt%, TiO_2: 0.1-0.2 wt%), but those in Tafassasset show some variations (Al_2O_3: 0.2-0.7 wt%, TiO_2: 0.1-0.3 wt%) (Fig. 2). Similarly, Fe-Ni metal has different compositions between two meteorites. In NWA 7317, Fe-Ni metal is independently present as kamacite (6-7 wt% Ni) and taenite (17-25 wt% Ni). On the other hand, Fe-Ni metal in Tafassasset exhibits extensive chemical zoning (Ni content: 5-28 wt%). Such differences suggest that NWA 7317 cooled more rapidly than Tafassasset.

Conclusion: NWA7317 and Tafassasset are classified as equilibrated meteorites with CR chondrite affinities. However, their distinct mineral compositions indicate that their source mineral compositions were different. Furthermore, relatively faster cooling of Tafassasset as well as its heterogeneous texture compared to NWA 7317 suggests that Tafassasset is more "unequilibrated" than CR6 although there are several classifications proposed [e.g., 7].

References: [1] Weisberg M. K. et al. (1993) *Geochimica et Cosmochimica Acta* 57: 1567-1586 [2] Schrader D. L. et al. (2011) *Geochimica et Cosmochimica Acta* 75: 308–325 [3] Irving A. J. et al. (2014) *LPS XLV*, Abstract #2465. [4] Sanborn M. E. et al. (2019) *Geochimica et Cosmochimica Acta* 245: 577–596. [5] Gardner-Vandy K. G. et al. (2012) *Geochimica et Cosmochimica Acta* 85: 142–159. [6] Breton T.et al. (2015) *Earth and Planetary Science Letters* 425: 193-203. [7] Nehru C. E. et al. (2014) Annual Meeting of 77th Meteoritical Society, Abstract #5382. [8] Gardner-Vandy K. G. et al. (2013) *Geochimica et Cosmochimica Acta* 122: 36–57.



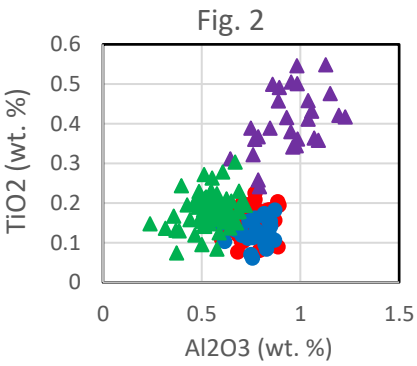


Fig. 1. Fa in olivine vs Fs in low-Ca pyroxene for ordinary chondrites [8], R chondrite [8] and this study. Red square is NWA 7317 and blue one is Tafassasset.

Fig. 2. Al_2O_3 vs. TiO_2 for pyroxene in NWA 7317 and Tafassasset. Red circles are high-Ca pyroxene and blue ones are low-Ca pyroxene in NWA 7317. Purple triangles are high-Ca pyroxene and green ones are low-Ca pyroxene in Tafassasset.