CV4 METAMORPHISM: OXYGEN ISOTOPES IN THE NORTHWEST AFRICA 8418 CHONDRITE

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Introduction: NWA 8418 is officially classified as C3 [1], but we proposed [2] that it is a CV4 based on its large chondrules (mean diam. ~0.9 mm), abundant large CAIs (up to ~ 1 cm), complete replacement of melilite in the CAIs by fine-grained intergrowths of plagioclase + pyroxene + olivine, the preservation of some clinoenstatite, the presence of cryptocrystalline mesostasis in chondrules, and an average matrix olivine composition of ~ Fa_{38} that is distinctly more Mg-rich than Fa_{50} in CV3. NWA 8418 is also notable for the presence of abundant coarse chlorapatite rims on CAIs and abundant fine-grained troilite everywhere (even in CAI interiors). We report here new oxygen isotope SIMS data, collected using the Univ. of Hawaii Cameca ims 1280 ion microprobe.

Results: Figure 1a shows data for several CAIs and one amoeboid olivine aggregate (AOA). Shown for comparison are bulk data [1] obtained by K. Ziegler at the Univ. of New Mexico. All of the CAI SIMS data disperse along the Carbonaceous Chondrite Anhydrous Minerals mixing line (CCAM). Spinel is ^{16}O-rich, normal for CAI spinel but remarkable in this case because all of the spinel contains ~ 10-21 wt. % FeO. Coarse-grained pyroxene (7–13 wt.% TiO_2, 18–21 wt.% Al_2O_3) in a Type B CAI is variably ^{16}O-depleted, again unusual because Type B CAI pyroxene typically is similar in ^{16}O-enrichment to spinel (but see [3]). This especially is true for aluminous diopside in the Wark-Lovering (WL) rim sequence, which is uniformly ^{16}O-rich in all CV3 CAIs but not in NWA 8418. Primary anorthite in NWA 8418 CAIs is ^{16}O-depleted but not uniformly so. Ferroan olivine in an AOA is ^{16}O-rich, similar to AOAs in CV3 chondrites. Data for chondrule olivines are given in Fig. 1b. The data disperse along the Primitive Chondrule Mineral (PCM) line, above CCAM, similar to chondrules in Allende and Kaba [4, 5]. Interestingly, bulk NWA 8418 values plot on CCAM.

Discussion: All of the oxygen isotope data shown in Fig. 1a, b are similar to those for equivalent components in CV3 chondrites, but the differences are unexpected and interesting. Spinel, for example, has largely exchanged its MgO for FeO during parent body metamorphism, yet its oxygen isotopes are basically unchanged. Olivine in the measured AOA is now uniformly FeO-rich, yet it also remains ^{16}O-rich. Finally, both igneous Ti-Al pyroxene and diopside in the WL rims are variably ^{16}O-depleted in contrast to their equivalents in CV3 CAIs.

Conclusions: NWA 8418 is closely related to CV chondrites, yet its mineralogical and petrologic properties indicate that it has experienced much more significant thermal metasomatism on the parent body to a degree that we classify it as CV4. The oxygen isotope data support this idea, showing that *e.g.* the CAIs are isotopically similar to those in CV3 chondrites yet clearly have experienced a greater degree of isotopic exchange. That both AOA olivine and CAI spinel retain their original ^{16}O-rich signatures despite wholesale exchange of FeO for MgO may provide constraints on the time *vs.* temperature thermal history of this meteorite.

References: [1] *Meteoritical Bulletin* **104**; [2] Mallozzi L. et al. *LPSC XXXXIX (2018), Abstr. #2555*. [3] Kawasaki N. et al. (2018) *GCA*, **221**, 318. [4] Rudraswami N. et al. (2011) *Geochimica et Cosmichimica Acta* **75**, 7596. [5] Hertwig et al., (2018) *Geochimica et Cosmichimica Acta* **224**, 116.

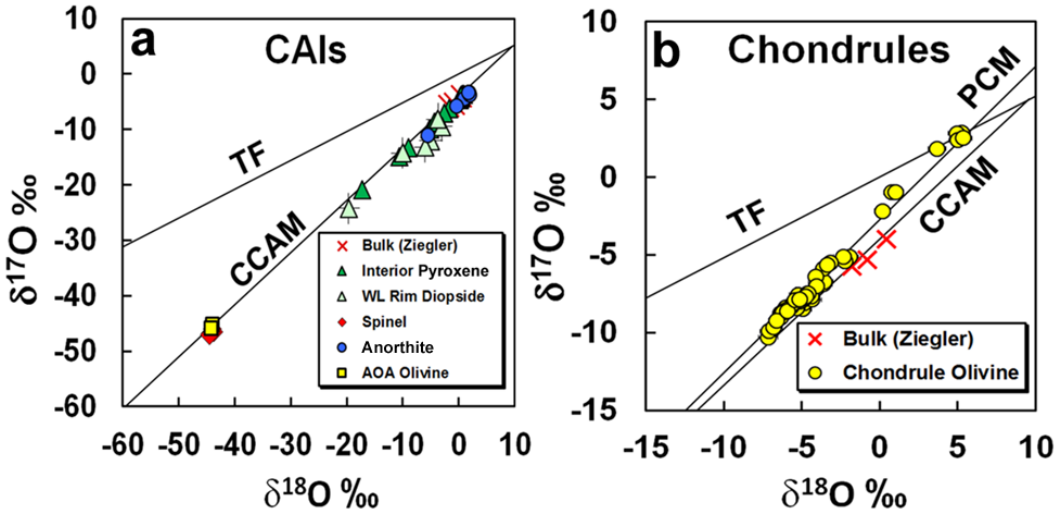

Fig. 1