MINERALOGICALLY-CONTROLLED OXYGEN-ISOTOPE EXCHANGE IN REFRACTORY INCLUSIONS FROM CO CARBONACEOUS CHONDRITES DURING FLUID-ROCK INTERACTION.

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Introduction: The oxygen isotopic composition of the Sun inferred from the solar wind sample returned by *Genesis* is ^{16}O-rich (Δ^{17}O ~ –28±2‰) [1]. The majority of Ca,Al-rich inclusions (CAIs) studied in CO, CR, CM, and CH chondrites of petrologic types ≤ 3.0 are uniformly ^{16}O-rich (Δ^{17}O ~ –24‰), suggesting formation in a gas of approximately solar composition [e.g., 2–6]. Among the rare exceptions are CAIs incompletely melted during chondrule formation. Wark-Lovering (WL) rims around these CAIs are partly or completely destroyed, the melted minerals are ^{16}O-depleted to various degrees (Δ^{17}O up to –5‰), and the Al-Mg systematics of the CAIs are reset or disturbed [6–8]. Here we report on the mineralogy, oxygen and Al-Mg isotope systematics of grossite-bearing CAIs from the DOM 08006 (CO3.0) and DOM 08004 (CO3.1) chondrites measured *in situ* using the Univ. of Hawai'i Cameca ims-1280.

Mineralogy: The grossite-bearing CAIs in DOM 08006 and DOM 08004 are composed of grossite±corundum, ±hibonite, gehlenitic melilite, and perovskite, and, if not fragmented, are surrounded by WL rims of ±spinel, gehlenitic melilite, ±Al-diopside, ±forsterite, and ±low-Ca pyroxene [9]. One grossite-bearing CAI, *51-1*, occurs as a relict object inside an Al-rich magnesian porphyritic anorthite-pyroxene chondrule. It is surrounded by a spinel-perovskite layer that experienced incomplete melting during host chondrule formation and is overgrown by Cr-bearing spinel. Both meteorites experienced aqueous alteration, but apparently under different physico-chemical conditions: DOM 08006 experienced Semarkona-like alteration that resulted in formation of secondary magnetite, phyllosilicates, and Fe,Ni-carbides [10,11], whereas DOM 08004 experienced Kaba-like alteration that resulted in formation of magnetite, phyllosilicates, ferroan olivine, and nearly pure fayalite [11,12].

Oxygen isotopes: In DOM 08006, the grossite-bearing CAIs are isotopically rather uniform: corundum, hibonite, grossite, spinel, melilite, Al-diopside, forsterite and low-Ca pyroxenes have similar ^{16}O-rich compositions (Δ^{17}O ~ –25 to –20±2‰, 2σ; Fig. 1). In DOM 08004, the grossite-bearing CAIs are isotopically heterogeneous with grossite (Δ^{17}O ~ –10 to 0‰), and, in most cases, melilite (Δ^{17}O ~ –15 to –1‰) being systematically ^{16}O-depleted relative to the coexisting hibonite, spinel, and Al,Ti-diopside (Δ^{17}O ~ –24‰; Fig. 1).

Al-Mg systematics: Magnesium-isotope compositions have been measured so far only in DOM 08004 CAIs [9]. CAIs *16-1* and *26-1* show no resolvable excess of ^{26}Mg*: $(^{26}Al/^{27}Al)_0 = (–0.1±6.8)×10^{–7}$ and $(–0.5±9.6)×10^{–7}$, respectively. CAIs *44-2*, *75-1*, *77-1*, and the relict CAI *51-1* have nearly canonical $(^{26}Al/^{27}Al)_0$: 4.4±0.3, 4.5±0.4, 4.3±0.3, and $(4.1±0.3)×10^{–5}$, respectively [9]. The lower than canonical $(^{26}Al/^{27}Al)_0$, ~$5.2×10^{–5}$, are probably due to improper Al/Mg sensitivity factor for grossite, that was assumed to be the same as for hibonite [3].

Conclusions: We infer that CAIs in DOM 08006 (CO3.0) retained their initial O-isotope compositions. Oxygen isotopic heterogeneity in CAIs from DOM 08004 (CO3.1) resulted from exchange between the initially ^{16}O-rich (Δ^{17}O ~ –24‰) melilite and grossite and ^{16}O-poor (Δ^{17}O ~ 0‰) fluid during hydrothermal alteration on the CO chondrite parent body. Δ^{17}O of the fluid can be inferred from O-isotope compositions of aqueously-formed fayalite and magnetite that precipitated from the fluid [12]. Hydrothermal alteration has not affected O-isotope compositions of spinel, hibonite, and Al-diopside, or the Al-Mg systematics of the DOM 08004 CAIs. This and previous studies [3,13] suggest that O-isotope exchange during fluid-rock interaction affected most CAIs in CO≥3.1 and CV≥3.1 chondrites.

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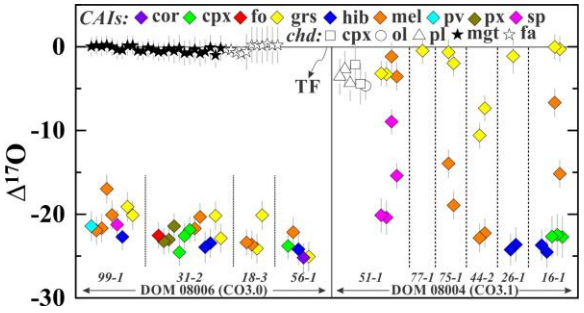

Fig. 1. Oxygen-isotope compositions of grossite-bearing CAIs in DOM 08006 (CO3.0) and DOM 08004 (CO3.1). CAI minerals: cor = corundum; cpx = Al-diopside; grs = grossite; hib = hibonite; mel = melilite; ol = forsterite; pv = perovskite; px = low-Ca pyroxene; sp = spinel. Chondrule minerals: cpx = high-Ca pyroxene; ol = olivine; pl = plagioclase. CAIs in DOM 08006 are isotopically uniform, whereas those in DOM 08004 are isotopically heterogeneous with grossite and melilite being ^{16}O-depleted compared to Al-diopside, hibonite, and spinel, suggesting O-isotope exchange with an aqueous fluid. Data for aqueously-formed fayalite (fa) and magnetite (mgt) are from Y-81020 (CO3.0) and EET 90043 (CO3.1) [12].