NWA10758: A New CV3 Chondrite Bearing a Giant CAI with Hibonite-Rich Wark-Lovering Rim.

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Introduction: Northwest Africa (NWA) 10758 is a newly identified carbonaceous chondrite that is a Bali-like oxidized CV3. The large Ca-Al rich inclusion (CAI) in this sample is ~ 2.4 x 1.4 cm. The CAI is transitional in composition between type A and type B, with interior mineralogy dominated by melilite, plus less abundant spinel and Al-Ti rich diopside, and only very minor anorthite (Fig. 1A). This CAI is largely free of secondary alteration in the exposed section we examined, with almost no nepheline, sodalite or Ca-Fe silicates. The Wark-Lovering (WL) rim on this CAI is dominated by hibonite, with lower abundances of spinel and perovskite, and with hibonite locally overlain by melilite plus perovskite (as in Fig. 1B). Note that the example shown in 1B is exceptional. Around most of the CAI, hibonite + spinel + perovskite form the WL rim, without overlying melilite. The WL rim can be unusually thick, ranging from ~20 microns up to ~ 150 microns. A well-developed, stratified accretionary rim infills embayments of the CAI, and thins over protuberances in the convoluted CAI surface.

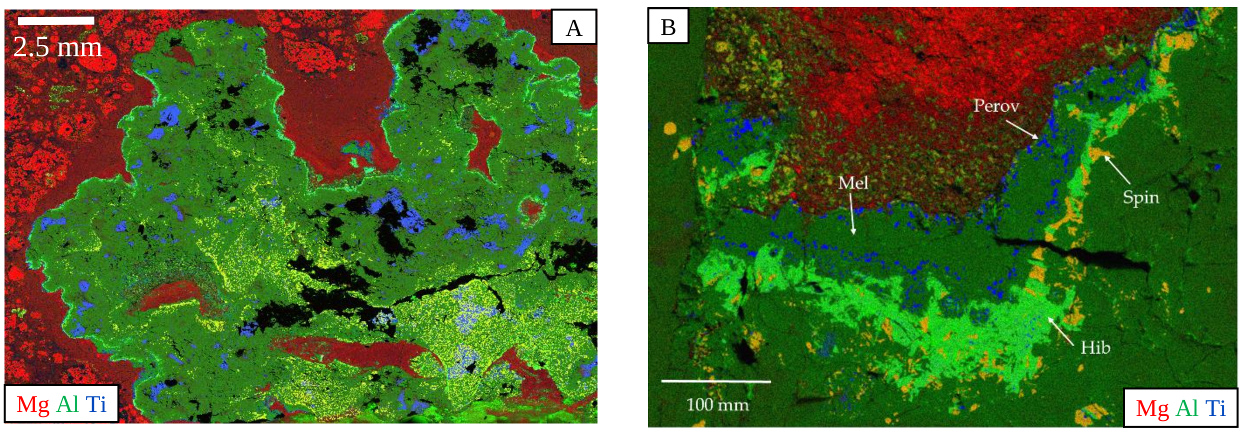

Figure 1. X-ray maps of a portion of the CAI (A) and a close-up view of a portion of the Wark-Lovering rim (B). In both maps, melilite is dark green, hibonite is bright green, spinel is yellow, and olivine is red. In (A), Al-Ti diopside is blue. In (B), perovskite is blue.

Primary Mineral Compositions: Al-Ti diopside in this CAI contains 18-23.5 wt. % Al_2O_3 and 13-18 wt. % TiO_2 (all Ti expressed as TiO_2). Charge balance calculations indicate that >90% of the Ti in these Al-Ti rich diopsides is Ti_2O_3. Melilite in the interior of the CAI ranges from gehlenite ($Ca_2Al(AlSiO_7)$) contents of 72% up to 95%, increasing toward the rim in the profile collected. Melilite, in the profile collected, averages 85% gehlenite. Melilite that overlies hibonite in the Wark-Lovering rim (in Fig. 1B) is 95.3-97.9 % gehlenite. Melilite underlying this portion of the Wark-Lovering rim contains 89-93 % gehlenite. Olivine in the accretionary rim ranges from Fo_{70} near the margin of the CAI to Fo_{60} near the boundary between accretionary rim and chondrite matrix. Fine-grained olivines in the chondrite matrix have compositions that are dominantly in the range Fo_{45-55}. Magnetite is an abundant component of the chondrite matrix, and is also present, but less abundant, in the accretionary rim.

Alteration Characteristics: The matrix and some chondrules in NWA10758 contain abundant magnetite, with no metal and only rare occurences of sulfide. Secondary Ca-Fe alteration phases (hedenbergite and andradite) are also extremely rare. These features – abundant magnetite with sulfide mostly oxidized, and rare Ca-Fe mineralization, plus minimal nepheline and sodalite, are the classic attributes of Bali-like alteration. In contrast, Allende-like oxidized CV chondrites exhibit much less magnetite, more abundant Ni-rich sulfide, sodalite, nepheline and Ca-Fe alteration [1-4]. NWA10758 matrix is fine-grained, very magnetite rich, and lacks the elongated fayalitic olivine grains that are so characteristic of Allende matrix.

Concluding Remarks: Despite the widespread and abundant oxidation and alteration of the matrix in this CV3 chondrite, the large CAI is almost entirely free of secondary alteration. Both the unusally thick hibonite-rich Wark-Lovering rim, and the interior of the CAI will be targets for a variety of isotope measurements (Ca,Ti, O and Al/Mg) in future studies.

References: [1] McSween, H.Y. (1977) *Geochimica et Cosmochimica Acta*, 41:1777–1790. [2] Weisberg, M.K. et al. (1997) *Meteoritics & Planetary Science* 32:A138-A139. [3] Krot, A. N. (1998) *Meteoritics & Planetary Science* 32: 1065-1085. [4] Bland P. A. et al. (2000) *Meteoritics & Planetary Science* 35:A28.