

POLYMICT CO3.05 CHONDRITE NORTHWEST AFRICA 4530: AN ANOMALOUS OXIDIZED SAMPLE FROM THE REGOLITH OF THE CO CHONDRITE PARENT BODY

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Petrography: NWA 4530 is a very fresh (W0), highly un-equilibrated CO chondrite exhibiting some unusual features. It is a polymict breccia, with predominantly lobate, distended and highly irregular chondrules, some with fine-grained accretionary rims. An unknown chondrule-like component (designated as GF) is also common and occurs as fragments with miniscule mesostasis. Classic chondrule types are few in number and consist mostly of densely packed Type I PO and POP with no detectable mesostasis. There is no apparent correlation of Cr₂O₃ with FeO in FeO-rich olivine with distance from core to rim, but there is a correlation of Cr₂O₃ with FeO in forsteritic cores. Cr-rich olivine rims were not observed. Amoeboid olivine inclusions are the most common type of CAI. The fine-grained matrix is unrecrystallized with very fine-grained magnetite, sulfides, silica, glasses, and silicates. Rare, small cohenite grains were also found. Irregular-shaped sulfides are much larger and range in size from 0.02 to 0.12 mm. Complex nuggets are of two types: (1) pentlandite, troilite, and Cr-magnetite, (2) three sulfide-bearing nuggets, that consist of a solitary pentlandite grain, are surrounded by troilite with wispy oriented inclusions of an unknown sulfide. Magnetite is a common inclusion in chondrules. Both the composition (0.47-3.1 wt.% Cr₂O₃ with minor amounts of MgO, Al₂O₃, P₂O₅, CaO and NiO) and distribution of magnetite are similar to what is observed in CK chondrites. No NiFe metal was observed anywhere. Large (up to 2 × 1.5 mm), angular igneous-textured clasts contain 79 vol.% forsterite, 18 vol.% troilite + pentlandite and 3 vol.% diopside.

Silicate Compositions: Overall olivine compositions range from Fa_{0.03} to Fa₇₂ (FeO/MnO = 61-133). Cr₂O₃ in ferroan olivine fragments has a range of 0.10 to 0.48 wt.% with a peak at 0.34 wt.% (N = 84). Chondrule type GF has more ferroan olivine, with lower Fa range (Fa₂₈₋₃₄) and lower Cr₂O₃ content (0.04-0.27, mean = 0.18). Unzoned igneous-textured clast olivine is Fa_{2.7} (FeO/MnO = 31) and diopside is Fs_{1.2}Wo₃₉. Average matrix analysis (partial, N = 27) by defocused microbeam is (in wt %): Na₂O = 0.81; K₂O = 0.25; S = 2.48; P₂O₅ = 0.44; Cr₂O₃ = 0.45; and NiO = 0.45; S/Si = 0.19; Na/Al = 0.31.

Oxygen isotopes: Results obtained by laser fluorination of acid-washed material ($\delta^{18}\text{O} = -4.228$; $\delta^{17}\text{O} = -7.052$; $\Delta^{17}\text{O} = -4.829$ per mil) plot on the trend for CO chondrites.

Discussion: Most components in NWA 4530 are consistent with CO3 chondrites, although chondrule type GF is not common in other examples. This specimen is more highly oxidized than most and is devoid of metal, implying that the regolith on the CO chondrite parent body may be fairly heterogeneous. The range in Cr₂O₃ contents in olivine and the matrix composition are consistent with a designation as CO3.0 to CO3.05 [1].

Reference: [1] Grossman J. and Brearley A. (2005) *Meteorit. Planet. Sci.* **40**, 87-122.