NORTHWEST AFRICA (NWA) 15468: A NEW KIND OF ORDINARY CHONDRITE WITH A SHOCKING HISTORY.

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Introduction: Northwest Africa (NWA) 15468 was approved in 2023 as an OC4-melt breccia, with reported olivine compositions (Fa8.0-9.2) far too magnesian for H, L, or LL chondrites [1]. Reported O-isotope data are above the terrestrial fractionation line, but not consistent with the known ordinary chondrite (OC) groups [1]. Preliminary results on three polished thin sections and bulk material from a donated thick slice of NWA 15468 are given below.

Results: Modal abundance of metal ranges from ~12 to ~24 area% in thin section, which is higher than in H chondrites (~10 vol% [2]). Texturally heterogenous, metal and sulfide forms discrete masses, as well as networks of both fine and coarse veins, with chlor-apatite and chromite occurring as bridging segments between longer metal and sulfide veins. Veins both outline and cut across chondrules and individual grains. Analysis using electron backscatter diffraction (EBSD) shows that low Ni metal (Ni = 5.1-7.1 wt%) is triple-junctioned polycrystalline kamacite or a poorly indexing **bcc** phase (probably martensite); there is no chemical difference between the two. High-Ni metal (Ni = 35-44 wt%) is polycrystalline tetrataenite. Chondrules range from fairly well-defined, through deformed or fragmental, to irregular components merging with interchondrule material. Areas in one thin section appear to show incipient melting of olivine. Feldspathic material is almost entirely glass, although crystalline feldspar, including a large (150 x 100 µm) crystal with twins offset by faults was confirmed via EBSD. Almost all phosphate is chlor-apatite; a single area in one section had relatively coarse (250 x 100 µm exposed area) merrillite.

EBSD data suggests that the meteorite was strongly shocked, with $GOS_{d>50}$ (grain-scale-average misorientations for olivine grains with an area equivalent to a circular grain > 50 µm) = 4.14±1.96, which indicates a weighted shock stage (WSS) ~ 4 [3, 4]. EBSD data provides evidence for shock at high temperatures, with model deformation temperature (T_{deform}) = 958±88 ºC [3].

Bulk chemical data show that NWA 15468 resembles an OC. The refractory lithophiles Zr-Cr, have a mean CI-Mg-normalized abundance of 1.04±0.16 in NWA 15468, which is within the errors of the OC mean of 0.91±0.07 for those elements. Lithophile element abundances show a greater depletion of alkalis (Na-Cs) in NWA 15468 compared to OCs. Bulk Fe is lower in NWA 15468 than H chondrites, indicating that coarse metal veins were undersampled. Despite this, the siderophile elements show a strong volatility trend, far more pronounced than for average OCs. This provides additional evidence for higher-temperature processing of NWA 15468, either in a nebular or parent body setting, distinct from H, L or LL chondrites.

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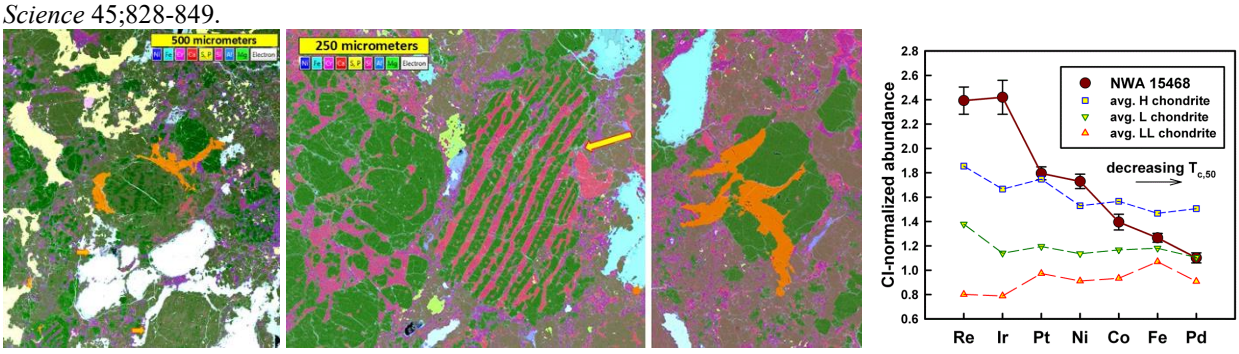
References: [1] Gattacceca J. et al. (2024) *Meteoritics & Planetary Science* 59:1820-1823. [2] Brearley A. J. and Jones R.H. (1998) Reviews in Mineralogy 36: Planetary Materials (Papike J. J. ed.). [3] Ruzicka A. M. et al. (2024) *Geochmica et Cosmochimica Acta* 378:1-35. [4] Jamsja N. and Ruzicka A. (2010) *Meteoritics & Planetary Science* 45;828-849.



Left 3:Element maps, olivine (dark green), low-Ca pyroxene (dull green), metal (light blue to white), trolite (yellow), chromite (pink), feldspathic material (magenta), Ca-pyroxene (red), chlor-apatite (orange), weathering (blue-gray). Arrows in left image point to high-Ni metal. Arrow in center image points to fault offsetting olivine bars. Right: Bulk abundances of siderophile elements.