EVIDENCE FOR A PREVIOUSLY UNRECOGNIZED NON-CARBONACEOUS CHONDRITIC PARENT BODY FROM PETROLOGIC AND OXYGEN ISOTOPE STUDIES OF UNGROUPED MG-RICH CHONDRITE NORTHWEST AFRICA 15468.

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Introduction: An unusual meteorite found in Mali in 2022 is a unique highly magnesian chondrite with supra-TFL oxygen isotopic composition that sets it apart from the well-known ordinary chondrite groups.

Petrography: Based on detailed studies of three specimens at separate institutions, we conclude that this meteorite is a Type 4 melt breccia with a heterogeneous distribution of metal (see Figures 1, 2). Magnetic susceptibility is relatively high ($\log\chi = 5.60\times10^{-9} m^3/kg$) reflecting the elevated metal abundance (despite the presence of iron oxides produced by moderate terrestrial weathering in some portions of the material).

***Figure 1**. Slice of NWA 15468 showing heterogeneous distribution of metal*

The unmelted portions of the studied specimens are composed of well-formed equilibrated chondrules (apparent diameter 500 ± 260 µm) containing forsteritic olivine ($Fa_{8.5\pm0.4}$, FeO/MnO = 16-20), magnesian orthopyroxene (predominantly enstatite, $Fs_{8.6\pm1.1}Wo_{0.7\pm0.5}$, FeO/MnO = 10-18), pigeonite ($Fs_{9.6\pm1.8}Wo_{6.7\pm0.1}$; $Fs_{6.6}Wo_{17.3}$; FeO/MnO = 8-12), subcalcic diopside ($Fs_{8.6\pm0.3}Wo_{25.2\pm0.2}$; $Fs_{5.0\pm0.2}Wo_{37.0\pm0.8}$, FeO/MnO = 7-14), diopside ($Fs_{4.3\pm1.0}Wo_{43.1\pm2.5}$, FeO/MnO = 6-10) and devitrified feldspathic glass set in a relatively coarse grained matrix containing abundant kamacite (altered to varying degrees to Fe oxides), taenite, chromite, troilite and chlorapatite, but evidently no plagioclase (see Figures 3 and 4). Partially melted portions have thin metal veins surrounding chondrule-bearing domains.

***Figure 2**. Large slice (11 cm by 8 cm) of NWA 15468 showing metal-laced, partially-melted region (top) and more metal-rich chondrule-bearing clast (bottom)*

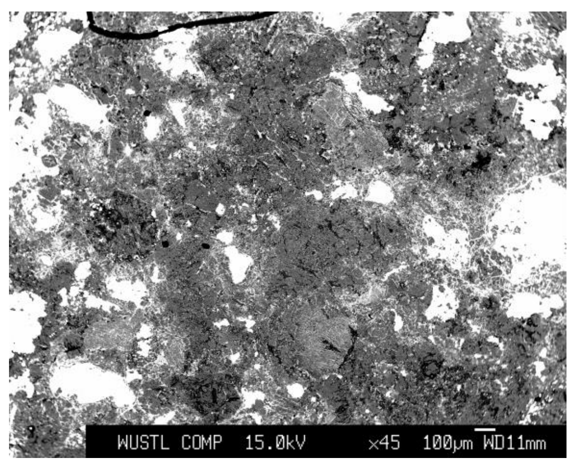

***Figure 3**. Back-scattered electron image showing rounded chondrules and metal (bright)*

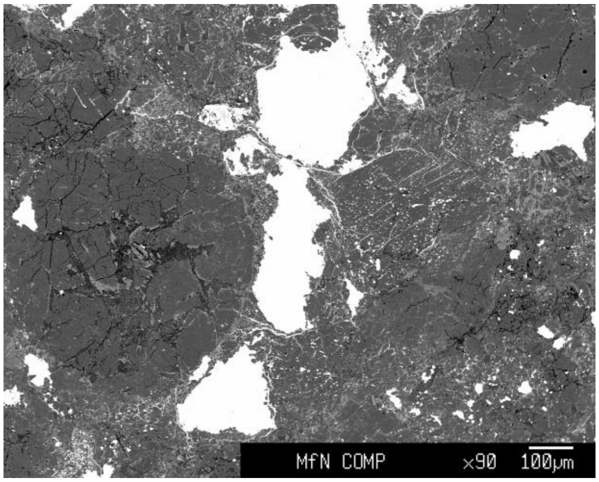

Figure 4. *Back-scattered electron image of a different sample showing chondrules and metal*

Oxygen Isotopes: Oxygen isotopes were measured at Brown University by laser fluorination on both unwashed and acid-washed subsamples with very similar results: $\delta^{17}O$ 3.909, 4.034; $\delta^{18}O$ 6.608, 6.974; $\Delta^{17}O$ 0.433, 0.366 per mil (TFL slope value = 0.526). All data were normalized to San Carlos olivine analyzed concurrently, per the recommendations and standardization of [1].

These isotopic compositions plot above the TFL, but not within or close to the fields for H, L or LL chondrites (see Figure 5). They are closest to the isotopic compositions for ungrouped "ordinary" chondrite Jiddat al Harasis 846 [2] and the so-called F chondrites, which include NWA 7135 [3], Acfer 370 [4] and dark inclusions in the Cumberland Falls aubrite [3, 5, 6].

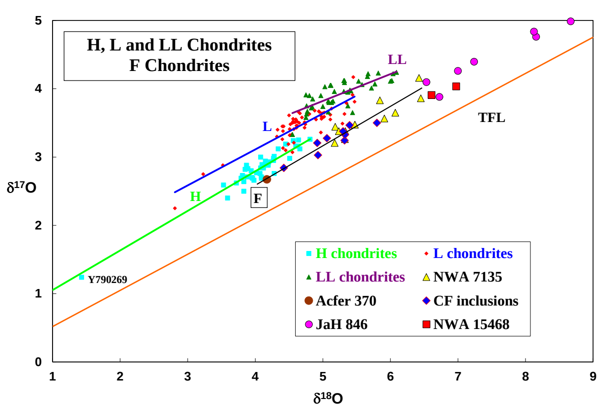

Figure 5. *Oxygen isotopic compositions of NWA 15468, Jiddat al Harasis 846, F chondrites and ordinary chondrites. CF = Cumberland Falls. Data sources include [2-7].*

Discussion: The mafic silicates in NWA 15468 are much more magnesian than those in typical H chondrites (which have olivine in the range Fa_{14-20}). They are even more magnesian than mafic silicates in anomalous low-FeO chondrites Cerro los Calvos (olivine Fa_{13}), LAP 04757 (olivine Fa_{13}) and Yamato 982717 (olivine Fa_{11}) [8]), two of which have oxygen isotopic compositions plotting within the field for H chondrites.

Despite the similarities in oxygen isotopic compositions among NWA 15468, JaH 846 and F chondrites, these specimens differ considerably in key mineralogic and mineral compositional attributes. JaH 846 is an unequilibrated Type 3 chondrite with a range in olivine compositions from $Fa_{0.6}$ to $Fa_{38.1}$, as well a much lower magnetic susceptibility ($\log\chi = 4.91\times10^{-9}m^3/kg$). The few known F chondrites also contain relatively forsteritic olivine (as their name implies), but unlike NWA 15468 they also contain reduced sulfides and phosphides, reflecting a much lower oxygen fugacity than that operative during the formation of NWA 15468.

Concluding Remark: Given the numerous objects populating the main asteroid belt that are vulnerable to transfer to Earth as meteorites, the existence of non-carbonaceous chondrite parent bodies with mineral compositions and supra-TFL oxygen isotopic compositions different from those yielding the familiar H, L and LL chondrite meteorites should not be surprising. NWA 15468 and JaH 846 appear to be rare examples of such materials.

References: [1] Sharp Z. and Wostbrock (2021) *Rev. Mineral. Geochem.* **86**, 179-196 [2] Irving A. *et al.* (2015a *76th Meteorit. Soc. Mtg.*, #5052 [3] Irving A. *et al.* (2015b) *76th Meteorit. Soc. Mtg.*, #5238 [4] Moggi-Cecchi V. *et al.* (2009) *72nd Meteorit. Soc Mtg.*, #5421 [5] Irving A. *et al.* (2016) *Lunar Planet. Sci.* **XLVII**, #2304 [6] Clayton R. and Mayeda T. (1978) *Geochim. Cosmochim. Acta* **42**, 325-327 [7] Clayton R. *et al.* (1991) *Geochim. Cosmochim. Acta* **55**, 2317-2337 [8] Yamaguchi A. *et al.* (2019) *Meteorit. Planet. Sci.* **54,** 1919-1929.

Acknowledgements: We thank Nicholas Gessler, Ziyao Wang and Shun-Chung Yang for their roles in acquiring samples of this highly unusual meteorite and providing material for our scientific studies. We are also grateful to Riley Havel for assistance with the oxygen isotope analyses.