MULTILITHOLOGIC, EXTRA-ORDINARY CHONDRITE NORTHWEST AFRICA 5717: FURTHER EVIDENCE FOR UNRECOGNIZED METAL-POOR, NON-CARBONACEOUS CHONDRITIC PARENT BODIES. T. E. Bunch[1], D. Rumble, III[2], J. H. Wittke[1], A. J. Irving[3] and D. Pitt [1]Dept. of Geology, Northern Arizona University, Flagstaff, AZ 86011 (tbear1@cableone.net), [2]Geophysical Laboratory, Carnegie Institution, Washington, DC 20015, [3]Dept. of Earth & Space Sciences, University of Washington, Seattle, WA 98195.

A large (7.31 kilogram) chondrite found in Algeria in 2008 contains two low subtype lithologies, neither of which resembles common ordinary chondrite groups. This specimen appears to be related to other ungrouped metal-poor chondrites described by us previously [1].

Figure 1. *Complete 16.4 cm wide slice of NWA 5717 that shows* ***Lithology A*** *(dark) and* ***Lithology B*** *(light).*

Petrography: Northwest Africa 5717 consists of a unique assemblage of mostly two different chondrite lithologies. ***Lithology A*** is the apparent host and consists of tightly-packed chondrules that are surrounded by a sparse, cataclastic matrix (8 vol.%) composed of abraded chondrule rim material (see Figure 2A). Many of the chondrules have a thin rim of metal, sulfide, and fine-grained silicates. Chondrules are typically sub-round to sub-angular and range in size from 0.04 to 4.1 mm (mean 0.455 mm). Metal, sulfides and iron oxides comprise 4 vol.%. ***Lithology B*** occurs as lumpy to swirling arrays of white to gray Mg-rich chondrules that range in size from 0.05 to 3.6 mm, together with a prominent subset of microchondrules (5 vol.%) 0.012 to 0.050 mm in diameter, within a finer grained matrix (6 vol.%) (see Figure 2B). A few large (4 to 8.4 mm), irregular-shaped chondrule-like objects are composed mostly of enstatite. Strong compositional zoning is common in chondrule olivine and pyroxenes, which are set in a mesostasis of clear, isotropic glasses and quench crystals. Metal and sulfides (overall 15 vol.%) occur mostly as sub-rounded aggregates in the matrix.

Figure 2. *Macroscopic slice images (2.3 cm wide) of two distinct lithologies: more ferroan* ***Lithology A*** *(above) and the more magnesian* ***Lithology B*** (below).

Mineral Compositions: Olivine in ***Lithology A*** has $Fa_{9.7\text{-}20.8}$ cores (mean FeO/MnO = 40, Cr_2O_3 0.18-0.57 wt.%) and $Fa_{16.2\text{-}35.6}$ rims (mean FeO/MnO = 36); Cr_2O_3 content of ferroan olivine is 0.23-0.91 (mean 0.53) wt.%. In contrast, olivine in ***Lithology B*** has $Fa_{0.03\text{-}3.4}$ cores (mean FeO/MnO = 61, Cr_2O_3 0.24-0.84 wt.%) and $Fa_{17.2\text{-}27.5}$ rims; Cr_2O_3 contents in ferroan olivine ($>Fa_8$) are 0.28-0.78 (mean 0.47) wt.%. Mg-rich cores in both lithologies (which have very different Fa contents) show higher Cr_2O_3 contents relative to their Fe-rich rims (which have similar Fa contents in both lithologies). Chondrule enstatite is $Fa_{0.04\text{-}5.8}Wo_{0.7}$. The average composition (N = 6) of mesostasis glass is, in wt.%: SiO_2 71.3, TiO_2 0.47, Al_2O_3 12.8, Cr_2O_3 0.04, FeO 5.7, MgO 1.45, CaO 1.38, Na_2O 4.65, K_2O 1.23, P_2O_5 0.45.

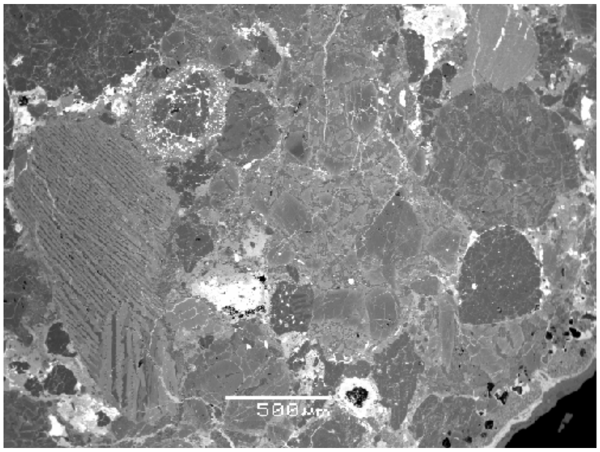

Figure 3. *BSE image of NWA 5717 showing the sparse, cataclastic matrix and FeO-poor (dark) and FeO- enriched (light) mafic components; metal and troilite are bright white.*

Oxygen Isotopes: Replicate analyses of acid-washed whole rock material from both lithologies by laser fluorination gave, respectively (in per mil): ***Lithology A*** $\delta^{18}O$ = 4.17, 4.47; $\delta^{17}O$ = 2.73, 2.90; $\Delta^{17}O$ = 0.539, 0.554; ***Lithology B*** $\delta^{18}O$ = 3.15, 3.68; $\delta^{17}O$ = 1.72, 2.01; $\Delta^{17}O$ = 0.061, 0.080. We are confident that our results represent the pre-terrestrial compositions of the components of this specimen, which exhibits only minor weathering (W2). These data and those for typical ordinary chondrites and ungrouped non-carbonaceous chondrites [1] are plotted in Figure 4.

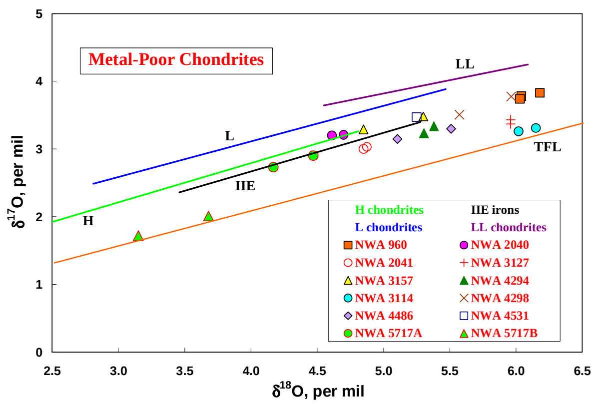

Figure 4. *Oxygen isotope compositions for both NWA 5717 lithologies and other non-carbonaceous chondrites (data from [1]). Lines for ordinary chondrites and IIE irons are best fit to values for many specimens (data sources given in [1]).*

Discussion: The oxygen isotopic compositions for NWA 5717 ***Lithology A*** are similar to those for H chondrites, yet the very low metal content together with other characteristics are completely inconsistent with an H classification. In many respects, ***Lithology A*** resembles certain anomalous metal-poor "ordinary" chondrites described previously [1], notably NWA 960, NWA 2040, NWA 3157, NWA 4298 and NWA 4531. Although $\Delta^{17}O$ values of NWA 5717 ***Lithology B*** are close to those of most enstatite-rich chondrites and achondrites (plotting close to the TFL), the $\delta^{17}O$ and $\delta^{18}O$ values are dissimilar in detail from those of all other meteorites, and the mafic minerals are significantly more ferroan.

Petrogenesis and Affinities: Whereas none of the lithologies in NWA 5717 appear to be related to carbonaceous chondrites (based on mineralogy and oxygen isotope compositions), neither are they like familiar ordinary chondrite groups. Furthermore, NWA 5717 must represent a mixture of at least two such ungrouped chondrite lithologies (both of petrologic type 3.05) within the fragmental regolith of a completely separate parent body from any recognized previously. To reiterate our conclusion from our previous work [1], it appears that there are a variety of different "near-TFL" and "supra-TFL" chondritic parent bodies. It is likely that some similar specimens have been overlooked in the past, because it has not been customary to measure oxygen isotopes on most chondrites judged on other grounds to be "ordinary".

Reference: [1] Rumble D. et al. (2007) *Lunar Planet. Sci.* **XXXVIII**, #2230.

Educational Website: Detailed descriptions and images of the many meteorites classified at Northern Arizona University can be found at: http://www4.nau.edu/meteorite.