NEW LUNAR METEORITE NORTHWEST AFRICA 773: DUAL ORIGIN BY CUMULATE CRYSTALLIZATION AND IMPACT BRECCIATION.

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Introduction: Northwest Africa 773 was recovered from Dchira, Western Sahara in fall, 2000 [1]. It consists of two lithologies: a green olivine-rich cumulate, and a black impact breccia. In this abstract, we describe this meteorite and our efforts to ascertain its parent body.

Mineralogy and Petrology: Approximately one-half of the meteorite consists of cumulate olivine gabbronorite. The other half consists of heterolithic impact breccia with a regolith component. Partial maskelynitization of feldspar indicates shock stage S2. Terrestrial weathering has caused some fracturing, but pre-terrestrial minerals in the meteorite appear fresh.

Cumulate olivine gabbronorite. The cumulate lithology consists primarily of olivine (Fo_{69}), pigeonite ($Wo_{11}En_{65}$), augite ($Wo_{36}En_{49}$), plagioclase ($An_{89}Or_{02}$) and K,Ba-feldspar (hyalophane, $An_{03}Or_{93}Cs_{04}$). Olivine is the most abundant phase (51 vol.%), followed by pigeonite (22%), augite (10%), plagioclase (14%), alkali feldspar (1.5%). Chromite, ilmenite, troilite, Fe,Ni-metal, and phosphate(s) are also present. Olivine occurs in a network of coarse, equant to prismatic, subhedral crystals. The pyroxenes generally occur as anhedral crystals between olivine grains. Feldspars are interstitial to the mafic silicates. Ratios of Fe/Mn in olivine (99, by weight), pigeonite (53), and augite (46) are similar to lunar values [2].

A small (14.5 mg) sample of the cumulate lithology shows that it is enriched in light rare earth elements (REE) by ~ 40X CI and heavy REE by ~ 20X CI. The REE pattern exhibits a well-defined negative Eu anomaly.

Impact breccia. The breccia is composed of lithic and mineral fragments in a fine, granular matrix. Lithic fragments include pieces of the cumulate rock, a variety of basalts, FeO-rich symplectites, and unusual clasts characterized by fayalite, silica, plagioclase, and hyalophane. Mineral fragments include fayalite, silica glass, and hedenbergitic ($Wo_{36}En_{05}$) pyroxene. Regolith agglutinates have also been identified in the breccia. The breccia is somewhat more enriched in REE (light REE ~ 60X CI) than the cumulate, but exhibits a similar pattern of light REE enrichment and deep Eu anomaly.

Oxygen isotopes: Two fragments broken from NWA 773 yield whole-rock oxygen isotopic compositions of $\delta^{18}O = +4.99$, $\delta^{17}O = +2.50$ for the cumulate; and $\delta^{18}O = +4.93$, $\delta^{17}O = +2.60$ for the breccia. These compositions are lower than previously analyzed lunar meteorites [3], but are on the terrestrial fractionation line and within the field of whole-rock values of Apollo samples [4].

Noble gases: Analyses of three grain size fractions yield solar gas concentrations and isotopic ratios similar to lunar meteorite QUE 94281, a regolith breccia [5]. The ratio of solar $^{4}He/^{20}Ne$ of ~ 9 is typical for gas-rich lunar meteorites, and much lower than values for non-lunar meteorites.

Conclusions: NWA 773 formed by a combination of cumulate crystallization of olivine gabbronorite and brecciation of multiple lithologies, including a regolith component. Mineralogy, Mn/Fe ratios, a KREEP-like trace element pattern with a deep Eu anomaly, oxygen isotopic composition, and noble gas concentrations indicate a lunar origin for NWA 773.

References: [1] Grossman J. N. (2001) *Meteorit. Bull., 85,* in press. [2] Papike J. J. (1998) *in Revs. Mineral. 36*, 7.1-7.11. [3] Clayton R. N. and Mayeda T. K. (1996) *GCA 60*, 1999. [4] Clayton R. N. and Mayeda T. K. (1975) *Proc. Lunar Sci Conf. 6*, 1761. [5] Polnau E. and Eugster O. (1998) *MAPS 33,* 313.