
1Hawai‘i Institute of Geophysics and Planetology, University of Hawai‘i at Manoa, Honolulu HI 96822, USA (fagan@higp.hawaii.edu) 2Southwest Meteorite Lab, P.O. Box 95, Payson, AZ 85547, USA, 3Space Science Division, NASA Ames Research Center, Moffett Field, CA 94035, USA, 4Department of Geology, Northern Arizona University, Flagstaff, AZ 86011, USA, 5Physikalisches Institut, Universität Bern, CH-3012 Bern, Switzerland, 6SN2, NASA/Johnson Space Center, Houston TX 77258, USA, 7Enrico Fermi Institute, University of Chicago, Chicago, IL 60637, USA.

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 gabbro-norite. 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 gabbro-norite. The cumulate lithology consists primarily of olivine (Fo69), pigeonite (Wo11En65), augite (Wo36En49), plagioclase (An89Or02) and K,Ba-feldspar (hyalophane, An03Or93Cs04). 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 (Wo36En65) 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 gabbro-norite 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.