CHLOROPHAEITE-BEARING NAKHLITE NORTHWEST AFRICA 10153: PETROLOGY, OXYGEN AND HAFNIUM ISOTOPIC COMPOSITION, AND IMPLICATIONS FOR MAGMATIC OR CRUSTAL WATER ON MARS.

A. J. Irving1, S. M. Kuehner1, K. Ziegler2, R. Andreasen3, M. Righter1, T. J. Lapen3 and D. Pitt 1Dept. of Earth & Space Sciences, University of Washington, Seattle, WA 98195, USA, irvingaj@uw.edu; 2Institute of Meteoritics, University of New Mexico, Albuquerque, NM, USA; 3Dept of Earth & Atmospheric Sciences, University of Houston, TX, USA.

Northwest Africa 10153 is the ninth known specimen in the nakhlite suite of meteorites, which have been interpreted (along with the three known chassignites) to be samples ejected from a single ~1.3 Ga zoned sill or lava flow complex on Mars [1, 2].

Petrography: The specimen has a cumulate igneous texture. Prismatic grains (up to 2.0 mm long) of compositionally zoned augite (Fs31.4-41.1, Wo49.6-41.1; FeO/MnO = 31-38) and subordinate but larger (2.2-3.0 mm), equant grains of olivine (cores Fa43.1-3.8, rims Fa28.2-31.8; FeO/MnO = 41-48) are the major constituents, along with interstitial birefringent plagioclase laths (An33.4, 25.4,Or3.3,3), chlorapatite, ulvöspinel and exsolved Fe-Ti oxide. Augite grains have prismatic growth twins and polysynthetic shock deformation twins oriented at a high angle to the c-axis.

An unusual feature is the interstitial occurrence of optically and compositionally heterogeneous iron silicate material (red-brown in thin section). The average composition (N = 5, in wt.%) is SiO2 43.3, Al2O3 1.6, Fe2O3 36.0, MgO 2.0, CaO 1.0, Na2O 0.4, K2O 0.4, with ~15% oxide sum deficiency (presumably as (OH) or H2O). This is very similar to that reported by [3] for chlorophaeite in hydrously altered terrestrial basalts. TEM studies are in progress to elucidate the nature of this material, which may resemble that found in some other nakhlites [4].

Oxygen Isotopes: Analyses of three acid-washed bulk rock subsamples by laser fluorination gave, respectively: δ18O 2.677, 2.870, 2.591; δ17O 4.579, 4.963, 4.446; Δ2H 0.259, 0.250, 0.244 per mil (for a TFL slope of 0.528).

Bulk Hf and Nd Isotopes: Representative clean bulk cutting dust contains 1.16 ppm Hf and has 176Hf/177Hf = 0.282471 ±14 (or εHf of -10.7). If a Lu content as in Nakhla is assumed, this Hf isotopic ratio would lie close to a 1.3 Ga reference isochron. Lu, Hf, Sm and Nd analyses of mineral separates are in progress.

Discussion: NWA 10153 is petrologically similar to Northwest Africa 998 [5], and unlike more rapidly quenched nakhlite specimens such as MIL 03346 [2] and NWA 5790/6814 [1, 6]. Thus it may derive from near the base of the nakhlite-chassignite cumulate pile [1]. Chlorophaeite may have formed at the last stages of igneous crystallization or possibly subsolidus. The Al-poor nature of this interstitial material (in contrast to palagonite [3]) is consistent with crystallization after plagioclase. Its water content might be of primary igneous origin, extraneous from wallrock or substrate adjacent to a lava flow or sill, or related to post-crystallization hydrothermal alteration of primary glass.