PETROLOGIC-ISOTOPIC CHARACTERIZATION OF NAKHLITE NORTHWEST AFRICA 12542

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Nakhlites are Martian augite-olivine-rich rocks which have been interpreted as a probably launch-paired group of igneous cumulates from one or more layered lava flows or intrusive sills which crystallized at ~1.3 Ga on Mars [1, 2, 3]. They have isotopic and chronologic affinities with the three known chassignites, which may represent samples from the basal zone(s) of the same target region(s) that yielded nakhlites.

Northwest Africa 12542, the 11th known nakhlite recovered in Mauritania in late 2018, is a 1082 gram oriented black stone partly coated by remnant fusion crust exhibiting flow lines (see Figure 1). The specimen has a cumulate texture, with larger grains of minimally zoned olivine (up to 2 mm, $Fa_{65.7\text{-}70.2}$, FeO/MnO = 50-55) and chromian titanomagnetite (up to 1 mm, Al_2O_3 = 3.2 wt.%, Cr_2O_3 = 4.5 wt.%) together with twinned, prismatic grains of augite (up to 2 mm long, $Fs_{22.8\text{-}28.9}Wo_{39.2\text{-}38.2}$, FeO/MnO = 34-37) with thin rims of ferroan augite ($Fs_{45.6}Wo_{40.2}$, FeO/MnO = 41). Intercumulus regions contain pyrrhotite, K-feldspar ($Or_{75.2}Ab_{23.6}An_{1.1}$), intermediate plagioclase, ferrosilite ($Fs_{54.9}Wo_{3.1}$, FeO/MnO = 36), ferroan pigeonite ($Fs_{65.2\text{-}66.1}Wo_{6.6\text{-}5.8}$, FeO/MnO = 23-28), cruciform grains of titanomagnetite and very rare chlorapatite together with K-bearing glass. Secondary chlorophaeite-like material (orange in thin section) is present in some intercumulus regions and also filling fractures in olivine phenocrysts (see Figures 2, 3). The most similar nakhlite specimen would be NWA 817, but we do not consider these two stones to be paired.

Figure 1: Whole NWA 12542 stone showing flow striations in remnant fusion crust and pits from desert wind ablation. Long dimension = 10 cm. Photo © Neil Buckland.

Figure 2: Partially cross-polarized thin section image showing dominant twinned augite, subordinate olivine, opaque Fe-Ti oxides, and orange "chlorophaeite" in the groundmass and within olivine grains.

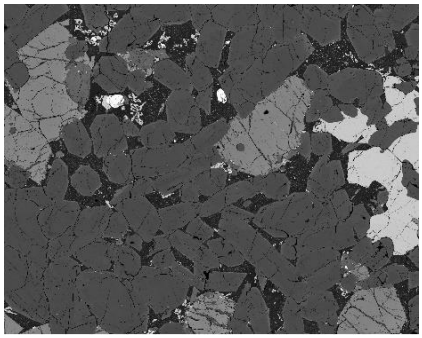
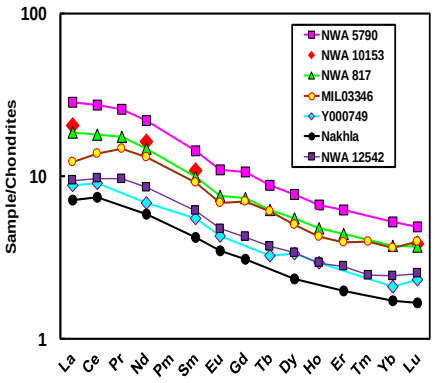


Figure 3: BSE image showing augite (gray), olivine (light gray, with veinlets of "chlorophaeite"), Fe-Ti oxide (lightest gray) and intercumulus material (dark) + cruciform oxides and pyrrhotite (bright).

Elemental and isotopic compositions: Analyses of a small subsample gave Mg/(Mg+Fe) = 0.505 and FeO/MnO = 41. The chondrite-normalized REE pattern (Figure 4) is light-REE enriched and resembles that for the Yamato 00 specimens [4]. Hf and Nd isotopic analyses are in progress to assess whether the crystallization age is similar to those for other nakhlites [5, 6]. Cosmic ray exposure ages based on analyses of ^{21}Ne, ^{3}He and ^{38}Ar are 10-12 Myr, in agreement with such ages for most other nakhlites [7].



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