TRACE ELEMENT GEOCHEMISTRY OF THE NAKHLITE NORTHWEST AFRICA 5790

M. E. Sanborn[1], M. Wadhwa[1], J. B. Balta[2], R. Mayne[3] and H. Y. McSween Jr[2]. [1]SESE, Arizona State University, Tempe, AZ, 85287-1404. E-mail: Matthew.Sanborn@asu.edu. [2]Dept. of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN. [3]Dept. of Geology, Texas Christian University, Fort Worth, TX.

Introduction: Northwest Africa (NWA) 5790 is a recently recovered hot desert nakhlite that brings the total number of samples of this SNC subgroup to 13. Petrographically similar to the other known nakhlites [1], NWA 5790 contains phenocrysts of augite and olivine, embedded in a fine-grained mesostasis. The mesostasis is composed primarily of feldspar, phosphate, olivine, pyroxene, and oxides. An initial investigation of NWA 5790 noted that the whole-rock rare earth element (REE) abundances were elevated in comparison to the other known nakhlites [2]. Here, we report REE and selected trace and minor element abundances measured in situ in individual minerals of NWA 5790 with the goal of constraining its petrologic history and understanding its relationship to the other nakhlites.

Results and Discussion: The concentrations of REE and other selected trace elements were measured in augite, olivine, mesostasis, and phosphate (apatite) of NWA 5790 using the Cameca IMS-6f ion microprobe at Arizona State University. The augite has a concave-downward REE pattern that is LREE-depleted ($[La/Sm]_{CI}$ ~0.4), with a small negative Eu anomaly (Eu/Eu* ~0.9) and a slight decrease from the middle- to the HREE ($[Gd/Lu]_{CI}$ ~1.5). This mineral exhibits a moderate range of REE abundances (La ~1.5-3.2 x CI). The REE as well as Ti, Y, and Zr abundances in the augite cores of the NWA 5790 nakhlite are higher than those in the other nakhlites (e.g., Nakhla and Lafayette) with the exception of MIL 03346 augite cores (which exhibit similar abundances to those of NWA 5790) [3,4]. The olivine in NWA 5790 is HREE enriched ($[Lu/Gd]_{CI}$~12) with low REE abundances (Lu~1.2 x CI). The fine-grained mesostasis was analyzed with a beam spot large enough to obtain a "bulk" analysis. It has a LREE-enriched pattern (La~60-95xCI; $[La/Lu]_{CI}$~5-6) that parallels that of the NWA 5790 whole-rock. Apatite usually occurs as very small grains in the mesostasis; however, at least one apatite grain was large enough to obtain a clean ion microprobe analysis. The apatite in NWA 5790 is significantly LREE-enriched ($[La/Lu]_{CI}$~50), and has the highest REE abundances of all the analyzed phases (La~1100xCI). This mineral also exhibits a significant negative Eu anomaly (Eu/Eu*~0.29) similar to that in other nakhlite apatites (e.g., [3]).

Conclusions: The REE patterns of the various mineral of NWA 5790 are similar to those observed in the other known nakhlites indicating that NWA 5790 crystallized from a parent melt that originated from the same geochemical source reservoir as the other nakhlites. However, the elevated whole-rock REE concentrations [2] coupled with the relatively higher REE, Ti, Y, and Zr abundances observed in the augite cores suggest that the NWA 5790 parent melt was more evolved than those of most previously studied nakhlites (e.g., Nakhla [3]).

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