TRACE ELEMENTS AND LU-HF SYSTEMATICS OF SHERGOTTITE NORTHWEST AFRICA 4480.

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Introduction: Northwest Africa (NWA) 4480 is a small (13 gram) unpaired shergottite recovered in Algeria in 2006 [1]. Our earlier isotopic work revealed that NWA 4480 has Nd and Hf isotope compositions between depleted and intermediate shergottites (Figure 1)[2], despite the apparent intermediate signature of REE abundances. This is a unique composition for a shergottite. There are a few other features make this meteorite unique. First, the CRE age of ~16 Myr [2] is much older than all except for Dhofar 019 (18.15 Myr) [3]. Second, NWA 4480 has hirefringent plagioclase instead of maskelynite [2]. Together, these signatures make NWA 4480 unique among the shergottites. It will be important to investigate detailed mineralogy, mineral chemistry, and precise crystallization age in order to constrain its petrogenesis, composition of source reservoir(s), and timing of shergottite magmatic activity.

Sample and Analytical Procedures: A polished section of NWA 4480 was examined by a SEM and EPMA at NASA-JSC, with a 20kV accelerating voltage and 20~30nA sample current. Trace element microanalysis was performed using a Photon Machines Analyte 193 laser ablation system coupled to a Varian 810-MS ICP-MS at University of Houston. Elemental abundances were determined in spot mode. Ablated spots were 50 μm in diameter. The standard used were the BHVO-2G and BIR-1G, with Mg, Ca as an internal standard for normalization. A 1.1 gram intact piece of NWA 4480 was gently crushed and sieved into three fractions. Material in the size smaller than 325 mesh (~ 100 mg) was used as another "fine-grained" whole rock fraction. All chemical separation procedures were carried out in clean lab facilities and Hf isotope analyses were carried out using the Nu Plasma II MC-ICP-MS at University of Houston.

Results and discussion: The chondrite-normalized rare earth abundances of the primary phases are presented in figure 2. NWA 4480 is composed of relatively fine grained (~150μm) pyroxene, plagioclase and olivine plus accessory minerals. Both pyroxene and olivine have light REE depleted signatures with pyroxene being more REE enriched compared to olivine. Plagioclase also shows light REE depletion with positive Eu anomalies. Overall, NWA 4480 REE compositions are similar to those of other basaltic shergottites characterized by light REE depleted compositions. The measured εHf value of "fine-grained" whole rock fraction is +39.3, which is slightly higher than our previous whole rock value of +37.2 [2], but here is not enough variation to tell preliminary age information. However, when we plot our data on a source mixing array using age range of 100 Ma to 2000 Ma, NWA 4480 plots completely off from both intermediate and depleted shergottites showing a unique source composition. Lu-Hf and Sm-Nd isotope work is in progress. Based on the Nd and Hf signature as well as old CRE age, and no recognized maskelynite, this shergottite could be a sample from single launch event from Mars.

References: [1] Irving A. J. et al. (2007) *Meteoritics & Planetary Science 42* :A73. [2] Irving A. J. et al. (2016) *LPS XLVII*, Abstract #2330. [3] Herzog G. F. and Caffee M. W. (2016) Treatise on Geochemistry : Meteorites and Cosmochemical Processes (Elsevier, 2014) vol. 1, 419–454.

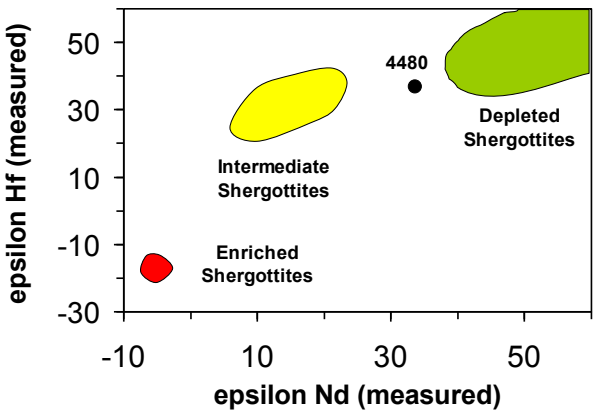

Figure 1. *Correlation of Nd and Hf isotopic compositions for shergottites.*

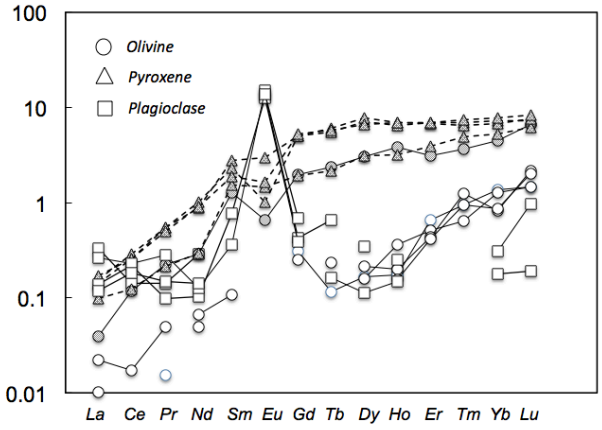

Figure 2. *Range of rare earth element abundances in olivine, pyroxene and plagioclase of NWA 4480.*