PETROGRAPHY AND GEOCHEMISTRY OF NORTHWEST AFRICA 11115: A NEW, ENRICHED, HIGH THORIUM BASALTIC SHERGOTTITE.

M. Melwani Daswani[1], P. R. Heck[1, 2], N. D. Greber[1] and R. C. Greenwood[3], [1]Dept. of the Geophys. Sci., University of Chicago, Chicago, IL 60637, USA, melwani.mohit@gmail.com, [2]The Field Museum, Chicago, IL 60605, USA, [3]Planetary and Space Sciences, The Open University, Walton Hall, Milton Keynes, MK7 6AA, UK.

Introduction: The martian shergottite meteorites show a remarkable variety in petrography and geochemical composition. Northwest Africa (NWA) 11115 is a shergottite found in Morocco in 2016 – an aliquot of the main mass (~ 247 g) was donated to the Field Museum of Natural History (FMNH) by T. Boudreaux [1]. We report bulk-rock major and trace element abundances of NWA 11115, oxygen isotope systematics, and petrography of a thick section, and compare the geochemistry of the recent find to other martian meteorites.

Methods: SEM/EDS analyses were carried out at the FMNH and the University of Chicago on a thick section of NWA 11115. Approximately 31 mg of powder was fluxed with $LiBO_2$ and then used for whole-rock chemical analyses by LA-ICP-MS at the FMNH, using NIST SRM 610 and 612 as standards. Oxygen isotope analyses were determined for two bulk aliquots by laser fluorination at the Open University.

Results: *Petrography and mineralogy.* The section was composed (by vol.) of ca. 9% Ol, 32% Pyx (mainly pigeonite, $Wo_{11.1\pm2.9}Fs_{34.5\pm6.2}$, Fe/Mn=30.4±2.8 (N=24)) and 55% maskelynite ($An_{49.3\pm4.4}Ab_{48.7\pm3.9}Or_{2.0\pm0.6}$ (N=74)), with the remainder made up of sulfides, spinels (mainly cromite), and large (up to 1 mm length) phosphates. Abundant secondary calcite (almost certainly terrestrial) infills pores, especially within cracks in and around olivine grains. Olivine phenocrysts up to 2 mm are visible, as well as Pyx+Msk melt pockets. Olivine phenocrysts are strongly zoned from core to rim (~Fa_{30} to Fa_{55}), and smaller, groundmass Ol grains are more Fe-rich than phenocrysts.

Bulk-rock geochemistry. The bulk sample has a Mg#≈57. NWA 11115 shows an enriched REE pattern, similar to other enriched shergottites, especially NWA 856 (Fig. 1). However, the whole-rock K/Th ratio (~453) is different to all other known martian meteorites and the martian surface (Fig. 2).

Oxygen isotopes. The aliquots gave an average isotopic composition of: $\delta^{17}O$=2.823 ‰, $\delta^{18}O$=4.796 ‰, $\Delta^{17}O$=0.329 ‰ (where $\Delta^{17}O = \delta^{17}O - 0.52\ \delta^{18}O$), consistent with the Mars Fractionation Line [2].

Discussion: NWA 11115 is an enriched basaltic shergottite with some unusual properties. The K/Th ratio is distinctly low compared to other SNCs and the surface of Mars (analyzed by GRS, K/Th≈5300 [3]), which could be related to fractional crystallization, as in some Zagami lithologies [4]. But the K abundance is not especially low compared to other SNCs. Instead, NWA 11115 is Th enriched. Most likely, the large phosphate crystals are the hosts of the Th (as well as U, also relatively enriched). Finally, while NWA 11115 is clearly altered, trace element proxies for alteration (e.g. Sr/Nd) do not correlate with other SNCs known to have experienced hot desert alteration (e.g. Dhofar 019 and Dar al Gani 476/489 [5,6]).

References: [1] Meteoritial Bulletin no. 106, 2017 (in prep.). [2] Franchi I. A. et al. 1999. *Meteoritics & Planetary Science* 34:657–661. [3] Taylor G. J. et al. 2006. *Journal of Geophysical Research* 111:E03S06. [4] McCoy T. J. et al. 1999. *Geochimica et Cosmochimica Acta* 63:1249–1262. [5] Taylor L. A. et al. 2002. *Meteoritics & Planetary Science* 37:1107–1128. [6] Folco L. et al. 2000. *Meteoritics & Planetary Science* 35:827–839.

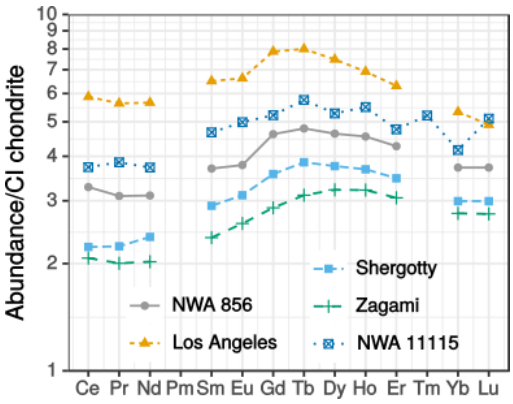

Figure 1. REE abundances in NWA 1115 (two averaged analyses of a glass bead; N=4+24) and other enriched shergottites, compared to CI chondrites.

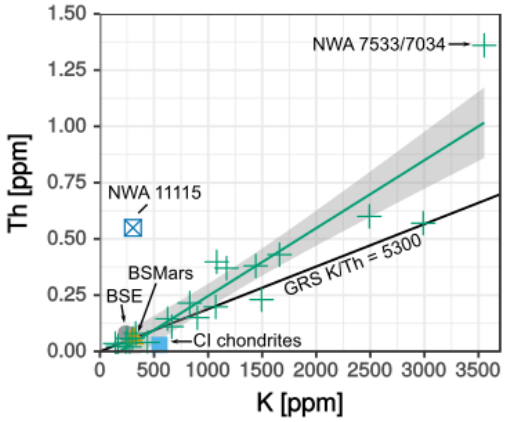

Figure 2. Whole-rock K and Th in NWA 11115, martian meteorites (green crosses) and the surface of Mars (black line). Green line is a regression on all martian meteorite data except for NWA 11115, grey field is a 95% confidence interval.