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ANDESITIC-DACITIC ACHONDRITE NORTHWEST AFRICA 11119: EVIDENCE FOR EXTRATERRESTRIAL SILICA-RICH MAGMATISM.

P. Srinivasan[1,2,3], C. B. Agee[1,2], F. M. McCubbin[1,3], and K. Ziegler[1,4]. [1]Institute of Meteoritics, University of New Mexico, Albuquerque, NM 87131. [2]Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131. [3]NASA Johnson Space Center, Mail Code X12, 2101 NASA Parkway, Houston, TX 77058. [4]Center for Stable Isotopes, University of New Mexico, Albuquerque, NM 87131. Email: psrinivasan@unm.edu.

Figure 1. Deposit sample NWA 11119.

Introduction: We report here petrologic and isotopic data for unique ungrouped achondrite, Northwest Africa (NWA) 11119, which is a porphyritic volcanic rock with an andesitic to dacitic bulk composition. NWA 11119 possesses a modal abundance of free silica polymorphs (~22% tridymite + cristobalite), that is significantly higher than in any other known meteorite. Based on our preliminary study of NWA 11119, we conclude that its parent body experienced a relatively high degree of igneous differentiation, producing magmas with SiO_2-contents as high as ~63 wt%.

Petrology: NWA 11119 was found in Mauritania in December 2016. The single stone is 453 g, with 23 g on deposit at the Institute of Meteoritics (IOM) at the University of New Mexico (fig. 1). The main mass is highly friable and is covered with an unusual light green colored fusion crust. Broken surfaces reveal phenocrysts (up to 3 mm) of green, gemmy, Cr-bearing augite, white plagioclase, and gray crystals of the high-tempertature silica polymorphs, tridymite and cristobalite. These phenocrysts are set in a fine-grained matrix that resembles quench-melt crystals. Spherical vugs and irregular cavities were observed throughout the stone with mm-sized, faceted, silica crystals decorating the surfaces of the vugs/cavities. SEM and EMP analyses give a modal mineralogy of ~39% pyroxene, ~38% plagioclase, ~22% silica, and ~1% ulvöspinel, ilmenite, troilite, and zircon (fig. 2); no metal was detected. Phenocryst compositions are augite: Fs6.0±2.1Wo38.1±1.1, Fe/Mn=5.2±0.3, Cr_2O_3=0.79±0.11 (wt%), n=111; clinoenstatite: Fs9.5±0.3Wo4.6±0.1, Fe/Mn=6.7±0.2, n=47; plagioclase: An87.3±7.2Ab12.6±7.1Or0.1±0.2, n=69. XRD analyses show that the silica polymorph is a mix of cristobalite and tridymite. The matrix of NWA 11119 was analyzed by SEM EDS rastering giving a bulk composition of SiO_2=63.1±1.6, TiO_2=0.55±0.35, Al_2O_3=15.3±1.3, Cr_2O_3=0.40±0.12, FeO=4.0±1.6, MnO=0.56±0.22, MgO=4.6±1.1, CaO=9.9±0.4, Na_2O=1.6±0.1 (all wt%).

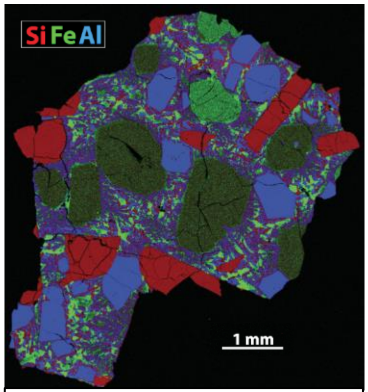

Figure 2. SEM image; red phases are silica polymorph, purple phases are plagioclase, green phases are pyroxenes.

Oxygen Isotopes: Oxygen isotopes were obtained from four acid-washed fragments (0.9–1.5 mg) of NWA 11119 using the laser fluorination technique. Oxygen isotope ratios give values of $\delta^{18}O$= 8.226, 7.781, 8.121, 7.671, $\delta^{17}O$= 3.364, 3.133, 3.398, 3.046, and $\Delta^{17}O$= -0.979, -0.975, -0.890, -1.004 per mil, respectively. NWA 11119 plots on the carbonaceous chondrite anhydrous mineral (CCAM) line on an oxygen three-isotope diagram, with values indistinguishable from NWA 7325 [1] and similar to some ureilites [2].

Discussion: Based on SiO_2 content, NWA 11119 can be categorized as transitional between andesite and dacite. However, it has an alkali content much lower than that of terrestrial andesites and dacites, and it lacks hornblende and biotite. It is also unlike basaltic-/trachy-andesite achondrite GRA 06128/9 which is much higher in alkalis and lower in silica [3]. The fact that NWA 7325 and NWA 11119 have nearly identical oxygen isotopes is consistent with a genetic link between the two, or derivation from a common parent body. However, the two meteorites are petrologically disparate; NWA 7325 is a mafic instrusive achondrite, with ~15% olivine, FeNi-metal present, and free silica absent [4]. Preliminary fO_2 calculations for NWA 11119 using silicate and oxide compositions with the program QUILF [5] place it near the FMQ buffer, which is much more oxidized than NWA 7325 (<IW buffer) [6]. On the other hand, NWA 11119 and NWA 7325 are both depleted in alkalis and both possess Cr-bearing augite/diopside. If these two meteorites originate from the same parent body, then it is likely that the parent body has a relatively complex igneous history.

References: [1] Barrat J. A. et al. 2015. *Geochimica et Cosmochimica Acta* 168:280-292. [2] Clayton R. N. and Mayeda T. K. 1996. *Geochimica et Cosmochimica Acta* 60:1999-2017. [3] Day J.M.D 2009. *Nature* 457:179-18. [4] Goodrich C. A. et al. 2017. *Geochimica et Cosmochimica Acta* 203:381-403. [5] Anderson D. J. et al. 1993. *Computers & Geosciences* 19:1333-1350. [6] Sutton S. R. et al. 2017. *Geochimica et Cosmochimica Acta* 204:313-330.