Noble gas systematics of Martian meteorite Northwest Africa 10416

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Northwest Africa (NWA) 10416 is an olivine phyric Martian basalt with a trace element composition similar to (LREE) depleted shergotittes [1]. It is the second Martian basalt recovered to date that has crystaline, igneous feldspar, the other being NWA 8159 [2]. To better understand the petrogenentic relationship between NWA 10416 and other Martian meteorites, here we report He, Ne, Ar, Kr, and Xe isotopic measurements, (U-Th)/He chronometry, and $^{40}Ar/^{39}Ar$ chronometry.

Preliminary $^{40}Ar/^{39}Ar$ data are indicative of a 400 – 500 Ma crystallization age. Comparable ages have been obtained from the chemically similar depleted Shergottites Dar al Gani (DaG) 476 [3] and Yamato 980459 [4]. High temperature extractions likely associated with gas released from large (up to 1 mm) olivine crystals yield ages that exceed 1 Ga, which suggests that excess Ar is present in olivine crystals or they are of xenocrystic origin. The trapped component identified by isochron analysis indicates that NWA 10416 equilibrated with a Martian interior noble gas reservoir or has subsequently acquired terrestrial noble gases due to Antarctic weathering. Additional $^{40}Ar/^{39}Ar$ measurements on mineral separates are underway.

Cosmic ray exposure ages were calculated from ^{3}He, ^{21}Ne, and ^{38}Ar measurements using the production rate estimates of [5] and chemical composition determined by ICP-MS. All three systems yield exposure ages of 1.05 ± 0.15 Ma. Like the $^{40}Ar/^{39}Ar$ data, similar exposure ages have been obtained from DaG 476 [6] and Yamato 980459 [7]. (U-Th)/He ages obtained from three whole-rock fragments of NWA 10416 are concordant at ~20 Ma, consistent with >95% loss of He during the ejection event that occurred at ~1 Ma.

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[1] Herd et al. (2016) LPSC Abstract #2527. [2] Walton et al. (2016) LPSC Abstract #1639. [3] Borg et al. (2003) GCA 67, 3519-3536. [4] Shih et al. (2005) AMR 18, 46-65. [5] Eugster & Michel (1995) GCA 59, 177-199. [6] Park et al. (2003) LPSC Abstract #1213. [7] Nishiizumi & Hillegonds (2004) Antarctic Meteorites XXVIII, 60-61.