HETEROGENEOUS MARS: EVIDENCE FROM NEW UNIQUE MARTIAN METEORITE NWA 7034

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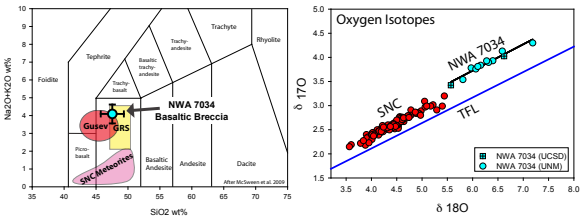
NWA 7034 is a new unique water-rich basaltic breccia from the early Amazonian epoch (~2.1 Ga) on Mars [1,2]. It shares some petrologic and geochemical characterisitics with known martian (SNC) meteorites, but also possesses some unique characteristics that excludes it from the current SNC grouping. The NWA 7034 meteorite is a geochemically enriched crustal rock bearing a striking compositional and average martian crust measured by recent NASA rover and orbiter missions (see figure 1).



The oxygen isotopes of NWA 7034 are also anomalous relative to SNC meteorites (figure 2). Furthermore, there are no other known achondrites or planetary samples with oxygen isotope values similar to NWA 7034, most achondrite groups have negative $\Delta^{17}O$ values or near-zero values as do rocks from the Earth and Moon -- the oxygen isotope composition of Venus and Mercury are currently unknown. There may be several possible explanations for the relatively high oxygen isotope values of NWA 7034. One possibility is that two or more distinct oxygen isotope reservoirs exist on Mars [3,4] – for example a reservoir represented by the SNC meteorites and another martian reservoir with higher $\delta^{18}O$, $\delta^{17}O$, and $\Delta^{17}O$ that we see present in NWA 7034. Earlier studies have shown that water in SNC has different $\Delta^{17}O$ values than the bulk solid, and we also observe this in NWA 7034. Thus there is already strong evidence for multiple distinct martian oxygen reservoirs, and NWA 7034 is first Mars sample showing that reservoir multiplicity extends to silicates and crustal rocks. Existence of a heterogeneous martian crust with multiple petrologic and isotopic reservoirs argues in favor of diverse mantle source regions and a mantle that is perhaps poorly mixed - calling into question magma ocean scenarios for early Mars.

References: [1] Agee C.B. et al. (2012) 43rd *LPSC* Abstract #2690. [2] Agee C.B. et al. (2012) 75th *MetSoc XXVII,* Abstract #5391. [3] Karlsson, H.R. et al. (1992) *Science* 255, 1409-1411. [4] Farquar, J. et al. (1998) *Science* 280, 1580-1582.