NEW METEORITE TYPE NWA 8159 AUGITE BASALT: SPECIMEN FROM A PREVIOUSLY UNSAMPLED LOCATION ON MARS?

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Introduction: Up until recently the orthopyroxenite ALH 84001, a singleton martian meteorite type, was the only sample that did not fit within the common SNC types. However with the discovery of the unique basaltic breccia NWA 7034 pairing group [1] the diversity of martian meteorites beyond SNC types was expanded, and now with Northwest Africa (NWA) 8159, and its possible pairing NWA 7635 [2], the diversiy is expanded further with a third unique non-SNC meteorite type. The existence of meteorite types beyond the narrow range seen in SNCs is what might be expected from a random cratering sampling of a geologically long-lived and complex planet such as Mars.

Unique Martian Basalt: NWA 8159, a fine-grained, augite basalt, is a new type of martian meteorite, with SNC-like oxygen isotopes and Fe/Mn values, but having several characteristics that make it distinct from other known martian meteorite types. NWA 8159 is the only martian basalt type known to have augite as the sole pyroxene phase in its mineralogy. NWA 8159 is unique among martian meteorites in that it possesses both crystalline plagioclase and shock amorphized plagioclase, often observed within a single grain, the bracketing of plagioclase amorphization places the estimated peak shock pressures at >15 GPa and <23 GPa. Magnetite in NWA 8159 is exceptionally pure, whereas most martian meteorites contain solid-solution titano-magnetites, and this pure magnetite is a manifestation of the highest oxygen fugacity (fO_2) yet observed in a martian meteorite. Although NWA 8159 has the highest fO_2 of martian meteorites, it has a pronounced light rare earth (LREE) depletion pattern similar to that of very low fO_2 basaltic shergottites such as QUE 94201. Thus NWA 8159 displays a striking exception to well documented correlation between fO_2 and LREE patterns in SNC meteorites. Cr-isotopes of NWA 8159 ($\varepsilon^{53}Cr = 0.27 \pm 0.04$, $\varepsilon^{54}Cr = -0.05 \pm 0.09$) are the highest of the, up to now, six measured martian meteorites. Finally, NWA 8159 stands apart from other martian meteorites in that it has an an early Amazonian age [3] that is not represented in the SNCs, ALH 84001, or the NWA 7034 pairing group.

Sample from a New Martian Volcanic Field Area?: NWA 8159 appears to be from an eruptive flow or shallow intrusion that is petrologically distinct from shergottite basalts, and its crystallization age argues that it is also temporally distant from the known time interval of shergottite magmatic activity. The decoupling of fO_2 and LREE from classic SNC correlations also argues that NWA 8159 was possibly derived from a different mantle/crust source region suggesting the existence of a geochemically heterogeneous martian interior.

References: [1] Agee C. B. et al., 2013. *Science*, 339, 780-785. [2] Righter M. et al., 2014. Abstract #2550. 45th LPSC. [3] Simon J. I. et al., 2014. MetSoc (this meeting).