

NWA 7034 MARTIAN BRECCIA: DISTURBED Rb-Sr SYSTEMATICS, PRELIMINARY ~4.4 Ga Sm-Nd AGE.

L. E. Nyquist¹, C.-Y. Shih², Z. X. Peng², and C. Agee³. ¹KR, NASA Johnson Space Center, Houston, TX 77058. laurence.e.nyquist@nasa.gov. ²NASA-JSC-JETS, Houston, TX 77058. ³Institute of Meteoritics & Dept. Earth Planet. Sci., Univ. New Mexico, Albuquerque, NM 87131.

Introduction: Agee et al. [1] reported a Rb-Sr age of 2.089 ± 0.081 Ga for the unique Martian meteoritic breccia NWA 7034 making it the oldest Martian basalt, dating to the early Amazonian epoch [2] of Martian geologic history. We have attempted to confirm this exciting result. Our new Rb-Sr analyses show the Rb-Sr isotopic system to be disturbed, but preliminary Sm-Nd data suggest an even older age of ~4.4 Ga for at least some breccia components.

Rb-Sr Data: We analysed ten bulk rock and mineral separate samples. Our data for the bulk rock are in close agreement to those for sample DRK-1 reported by [1] and has less radiogenic $^{87}\text{Sr}/^{86}\text{Sr}$ ratios than the bulk rock (WR) analysed by them. We were unable to isolate a mineral separate with Rb/Sr as high as their WR and especially their separate LGT-1, which defines the ~2.1 Ga age [1]. An imprecisely fitted isochron to eight samples omitting two plagioclase separates gives an apparent age of 2.7 ± 0.6 Ga (MSWD = 114). Two plagioclase separates are displaced to relatively high Rb/Sr ratios apparently reflecting late redistribution of Rb. This isochron age agrees within extreme error limits with the Rb-Sr age of [1], confirming a relatively ancient age for NWA 7034.

Sm-Nd Age: Sm-Nd analyses have been completed for three samples: bulk rock (WR), bulk rock leachate (WR(l)), and the residue after leaching of a pyroxene separate (Px1(r)). REE patterns determined by ICP-MS on 1% aliquots of the sample solutions (WR(l): La ~200X, LREE enriched; Px1(r): La ~6X, LREE depleted) verify the primary contributions to WR(l) and Px1(r) as phosphates and pyroxene, respectively. The REE pattern for WR is similar to that reported for the bulk rock by [1], and the Sm-Nd data for WR agree with those reported by [1] for a bulk sample. The isochron age for WR(l)+2WRs+Px1 gives an apparent age of 4.39 ± 0.08 Ga (MSWD=0.017). This isochron primarily dates pyroxene in NWA 7034, since the data for WR(l) and WR plot close together.

Initial Nd- and Sr-isotopic composition: For the 4.39 ± 0.08 Ga age, $\epsilon_{\text{Nd}} = 0.23 \pm 0.38$ (rel. to CHUR) and initial $^{87}\text{Sr}/^{86}\text{Sr}$ (I_{Sr}) = 0.7018 ± 0.0003 using the bulk rock data. If these results are confirmed by later analyses, it would imply that the LREE enrichment in NWA is an early feature, dating close to the time of Martian differentiation. In a two-stage model, the (T, I_{Sr}) parameters of NWA 7034 implies derivation from a mantle source with high $^{87}\text{Rb}/^{86}\text{Sr}$ ~1.0, ~3X higher than required for hypothetical enriched mantle sources of the enriched shergottites.

Conclusions: Our data confirm an ancient age for NWA 7034 as first reported by [1]. However, the brecciated nature of NWA 7034 is manifest in its isotopic systematics, and their reliable determination requires analysis of multiple samples. We anticipate that further Sm-Nd analyses now underway will provide valuable insight into the petrogenesis of Noachian era [2] protolith from which NWA 7034 apparently derives.

References: [1] Agee C. B. et al. 2013. *Science*, 90, 1151–1154. [2] Hartmann W. K. and Neukum G. 1997. *Space Science Reviews* 96:1651–194.