A NEW PERSPECTIVE ON THE Pb ISOTOPIC COMPOSITION OF MARS

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SNC (Shergottite, Nakhlite, Chassignite) meteorites and the ungrouped orthopyroxenite ALH84001 are mafic to ultra-mafic Martian samples. As such, they can be used to constrain the timing and geochemical characteristics of Martian mantle reservoirs. This study aims to reinvestigate the Pb isotopic history of Mars utilizing *in situ* measurements of plagioclase/maskelynite in Nakhla and ALH84001. Given external, independent chronological constrains, the Pb isotopic composition of feldspars can be used to determine the μ ($^{238}U/^{204}Pb$) and κ ($^{232}Th/^{238}U$) of a rock's source reservoir. In doing so, this study aims to provide more comprehensive understanding on the U-Th-Pb systematics in the Martian mantle. Pb isotopic compositions of feldspars were obtained *in situ* using a Cameca 1280 SIMS in multicollector mode [1].

Crystallization ages for ALH84001 and Nakhla are 4.091 ± 0.030 Ga and 1.33 ± 0.14 Ga, respectively [2, 3]. Combining solution analyses of whole rock and orthopyroxene mineral residues from Bouvier *et al*., 2005 [4] with the new feldspar data for ALH84001, data define a line that corresponds to a Pb-Pb age of 4.117 Ga ± 0.016 Ga (2σ, MSWD =3). The least radiogenic Pb isotopic compositions of feldspars in ALH84001 plot on the 4.117 Ga "geochron" and yield an approximate μ value of 6 and a κ value of 4.5. Similarly, the least radiogenic Pb isotopic compositions of feldspar in Nakhla plot on the 1.33 Ga "geochron" and correspond to an approximate μ value of 2 and a κ value of 4.5.

In contrast to solution analyses, the least radiogenic Pb isotopic compositions measured via SIMS in both samples here plot on the "geochron" defined by the crystallization age. As such, we are able to define the most accurate μ and κ values to date for the samples from Martian meteorite collection. The μ values for the source reservoirs of Nakhla and ALH84001 are different by an order of 2-3, suggesting that they must have formed early and remained isolated from each other for at least 2.7 Ga. The similarity in κ values between samples measured here and in the literature [3, 5] indicates little to no fractionation of U from Th during the formation of Martian source reservoirs.

References:

[1] Whitehouse et al. 2005. *Chemical Geology* 222:112-131. [2] Lapen et al. 2010. *Science* 328: 347-351. [3] Bouvier et al. 2009. *Earth and Planetary Science Letters* 280:285-295. [4] Bouvier et al. 2005. *Earth and Planetary Science Letters* 240:221-233. [5] Bellucci et al. 2014. *In Lunar and Planetary Institute Science Conference Abstracts*, pp. 1327.