HYDROGEN ISOTOPES IN THE NAKHLITES: MAGMATIC AND ATMOSPHERIC MARTIAN RESERVIORS VS. TERRESTRIAL CONTAMINATION.

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Introduction: Erosion of Mars' atmosphere via solar wind has led to the preferential loss of the lighter hydrogen isotope from the atmosphere, producing a deuterium enrichment – the present-day martian δD of 4200 ‰ [1-2] is ~ 5× higher than that of VSMOW. This enrichment has been detected in a number of primary and secondary phases in the martian meteorites (e.g., [3-4]). However, varying degrees of terrestrial contamination, and the possible presence of a second magmatic martian hydrogen isotope reservoir, with a D/H ratio similar to VSMOW (e.g., [5]), have resulted in wide D/H variations both between and within individual meteorites. The purpose of this study is to determine the role of these three hydrogen isotope reservoirs in the formation, and subsequent alteration, of primary and secondary phases in the nakhlite group of martian meteorites.

Methods: Polished thin-sections of MIL 03346 and 090030 were prepared at the NASA Johnson Space Centre without the use of water, and thin-sections of Nakhla were prepared in the same way at the University of Hawaii (UH). We utilised the JEOL JSM-5900LV scanning electron microscope at UH to produce high-resolution backscatter electron images. Secondary-phase major-element chemistry was determined with a JEOL JXA-8500F electron microprobe, also at UH. D, H and Si isotopic compositions were analysed in situ with the UH Cameca ims 1280 ion microprobe, with a Cs+ primary beam.

Results and Initial Conclusions: D/H ratios for iddingsite-like alteration veins in Nakhla are widely variable (-98 to +1165 ‰), even between analyses from the same alteration vein. The iddingsite alteration veins in MIL 090030,23 (an interior thin-section) are much less variable, with a range of 134 to 311 ‰. Petrological analysis also suggests the alteration veins in Nakhla are more heterogeneous than those in MIL 090030. [6] reported the composition of alteration veins in Nakhla as an assemblage of silica gel, siderite and evaporites. Amorphous silica gel is more susceptible to hydrogen exchange with the atmosphere than minerals with structurally bound water, hence areas with lower D/H ratios are probably those rich in silica gel. MIL 03346,174, a thin-section with terrestrially exposed surfaces, contains iddingsite-like alteration veins with D/H ratios entirely within the terrestrial region (-240 to -69 ‰). However, as this thin-section was prepared with water, and exposed to atmospheric conditions since its preparation in 2006, we aim to analyse newly prepared exterior thin-sections of MIL 090030 to confirm this result. We also aim to analyse apatite grains in Nakhla and compare their D/H ratios with those of ALH 84001 apatites. These comparisons should help to determine if a separate magmatic hydrogen isotope reservoir did affect these samples, and may give some insight into the effect of shock on D/H ratios.

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