D/H IN NOMINALLY ANHYDROUS PHASES IN MARTIAN METEORITES: IMPLICATIONS FOR THE MARTIAN MANTLE. K. Tucker[1], R. Hervig[1], C. Till[1], M. Wadhwa[1]. [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287 (E-mail: Kera.Tucker@asu.edu).

Introduction: Hydrogen isotope compositions of the martian atmosphere and crustal materials can provide unique insights into the hydrological and geological evolution of Mars. While the present-day D/H ratio of the Mars atmosphere is well constrained (~6 times that of terrestrial ocean water), that of its deep silicate interior is less so. In fact, the hydrogen isotope composition of the primordial martian mantle is of great interest since it has implications for the origin and abundance of water on that planet. Martian meteorites could provide key constraints in this regard, since they crystallized from melts originating from the martian mantle and contain phases that potentially record the evolution of the H_2O content and isotopic composition of the interior of the planet over time. We report here the hydrogen isotopic systematics in nominally anhydrous phases (NAPs) in several shergottites and nakhlites that have a range of petrographic and geochemical characteristics, crystallization ages, ejection ages and terrestrial residence times, with the goal of better understanding the water content and hydrogen isotope compositions of the Mars mantle.

Results and Discussion: This study builds on our previous work ([1] and references therein) and presents additional analyses. In total, we report here the results of 113 individual analyses of H_2O contents and hydrogen isotopic compositions in maskelynites of the shergottites Zagami, Los Angeles, QUE 94201, SaU 005, and Tissint, and pyroxenes of the nakhlites Nakhla, Lafayette, and Yamato 000593. The following are the ranges of H_2O contents and δD values for the phases analyzed in each meteorite: 93-223 ppm H_2O and −93-+849‰ δD in Zagami; 138-276 ppm H_2O and −105-+402‰ δD in Los Angeles; 76−224 ppm H_2O and −29-+390‰ δD in QUE 94201; 212-324 ppm H_2O and +10-+763‰ δD in SaU 005; 74−1087 ppm H_2O and −115-+2870‰ δD in Tissint; 48−82 ppm H_2O and +92-+433‰ δD in Nakhla; 68−1825 ppm H_2O and −174-+675‰ δD in Lafayette; and 456-1242 ppm H_2O and −317-−201‰ δD in Yamato 000593.

The hydrogen isotopic variation between and within meteorites may be due to one or more processes including: interaction with the martian atmosphere, magmatic degassing, subsolidus alteration (including shock), and/or terrestrial contamination. Taking into consideration the effects of these processes, the hydrogen isotope composition of the martian mantle is likely to be similar to that of the Earth. Additionally, we calculated upper limits on the H_2O contents of the shergottite and nakhlite parent melts based on the minimum H_2O abundances measured in their maskelynites and pyroxenes, respectively. These calculations, along with some petrogenetic assumptions based on previous studies, were subsequently used to infer upper limits on the H_2O contents of the mantle source reservoirs of the depleted shergottites (~200-700 ppm) and the nakhlites (~10-100 ppm). This suggests that mantle source of the nakhlites may be systematically drier than that of the shergottites, and the upper mantle of Mars likely preserved significant heterogeneity in its H_2O content. Finally, this range of H_2O contents is not dissimilar to the range observed for the Earth's upper mantle.

References: [1] Tucker K. et al. (2015) 46^{th} LPSC, abstract #2915.