Evidence from hydrogen isotopes in meteorites for a subsurface hydrogen reservoir on Mars

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The surface geology and geomorphology of Mars indicates that it was once warm enough to maintain a large body of liquid water on its surface, though such a warm environment might have been transient. The transition to the present cold and dry Mars is closely linked to the history of surface water, yet the evolution of surficial water is poorly constrained.

We have conducted *in situ* hydrogen isotope (D/H) analyses of quenched and impact glasses in three Martian meteorites (Yamato 980459, EETA79001, LAR 06319) by Cameca ims-6f at DTM following the methods of [1]. The hydrogen isotope analyses provide evidence for the existence of a distinct but ubiquitous water/ice reservoir (D/H = 2–3 times Earth's ocean water: SMOW) that lasted from at least the time when the meteorites crystallized (173–472 Ma) to the time they were ejected by impacts (0.7–3.3 Ma), but possibly much longer [2]. The origin of this reservoir appears to predate the current Martian atmospheric water (D/H = ~5–6×SMOW) and is unlikely to be a simple mixture of atmospheric and primordial water retained in the Martian mantle (D/H ≈SMOW [1]). Given the fact that this intermediate-D/H reservoir (2–3×SMOW) is observed in a diverse range of Martian materials with different ages (SNC meteorites, ALH 84001, Curiosity surface data), we conclude that this intermediate-D/H reservoir is likely a global surficial feature that has remained relatively intact over geologic time. We propose that this reservoir represents either hydrated crust and/or ground ice interbedded within sediments. Our results corroborate the hypothesis that a buried cryosphere accounts for a large part of the initial water budget of Mars.

[1] Usui et al. (2012) *EPSL* **357-358**, 119-129. [2] Usui et al. (2015) *EPSL* **410**, 140-151.