



Signals for Early Atmospheric Escape from D/H ratios in Mudstones from Gale Crater

MSL's SAM investigation measured the deuterium to hydrogen ratio (D/H) of the water released at high temperatures from a Yellowknife Bay mudstone sample – a measurement that can be used to track atmospheric escape processes.

- Deuterium and Hydrogen are present in two separate locations within a clay mineral: strongly bound in the clay matrix and in the interlayer water. The D/H ratio was found to be lower in the sample released in SAM's ovens by high temperature dehydroxylation of the OH groups in the mineral matrix, than in the water molecules that can more easily exchange with the present atmosphere. The ratio of this high-temperature water to the D/H ratio in Earth's oceans (called SMOW, or standard mean ocean water) is only ~2.7 compared to the current Mars atmospheric value of ~5.75.
- Since these atoms have not undergone as much equilibration with the atmosphere, they can be used to estimate a value for the D/H ratio in the water that deposited these mudstones ~3 billion years ago. Assuming that this ratio was similar on early Mars and early Earth, this indicates that some of the observed atmospheric escape must have happened before the clays of Yellowknife Bay were formed, relatively early in the history of the planet.

