

## Oxygen isotopes and the oxidation states of the terrestrial planets

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Rocky bodies in the solar system formed with intrinsic oxygen fugacities 5 orders of magnitude greater than that of a solar gas. Water was almost certainly the primary agent for oxidation. Tracing the hydrogen and oxygen isotopic evolution of planet-forming materials should inform our understanding of the mechanisms of oxidation. Historically, hydrogen isotopes (D/H) have been used as a primary tracer of water. However, D/H in water in the solar protoplanetary disk varied by mixing of low-D/H H<sub>2</sub> and higher D/H H<sub>2</sub>O reservoirs that intermingled as water was continually destroyed and reformed [1]; the concept of a monotonic rise in D/H with distance from the star is not evidenced. Water was the carrier of high <sup>18</sup>O/<sup>16</sup>O and high <sup>17</sup>O/<sup>16</sup>O in the solar system [2], and we have used this characteristic as a tracer in N-body simulations tracking water and its oxidation products. In general, we find that simulations that reproduce the difference in oxidation state between the mantles of Earth and Mars also reproduce the observed higher <sup>18</sup>O/<sup>16</sup>O and <sup>17</sup>O/<sup>16</sup>O ( $\Delta^{17}\text{O}$ ) in Mars relative to Earth. This confirms the link between oxidation and water, although the primary carrier of the signal in the simulations is FeO rather than H<sub>2</sub>O itself.

[1] Furuya et al. (2013, ApJ **779**); [2] Yurimoto & Kuramoto (2004, Science **305**, 1763), Lyons and Young (2005, Nature **435**, 317), Young (2007, EPSL **262**, 468).