When and how did the Earth inherit its Water (H_2O)?

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Two end member scenarios have been proposed for the addition of water (H_2O) during the formation of the Earth. The first adds H_2O continuously during accretion [e.g., 1] and the second adds H_2O after accretion as a "late veneer". Is it possible that the question of how H_2O was added to the Earth can be answered by comparing the Earth to the Moon and Mars? The moon contains a small amount of H_2O [2] and petrologic evidence indicates that the oxidation state of the lunar interior is reduced (fO_2 of IW – 1, [3]). The oxidation state of the Martian mantle and crust varies between IW and QFM [4] and petrologic evidence indicates that some Martian magmas contained ~ 1.8 wt. % H_2O [5]. The Earth is the most oxidized with mantle fO_2 values between QMF – 1 and NNO + 2, and hydrous subduction zone magmas contain 3 to 6 and up to 12 wt. % H_2O [6]. Hydrous magmatism extended into the Archean with komatiites and boninites containing up to 6 wt. % H_2O [7]. Sharp *et al* [8] suggest that hydrogen (H_2) degassing can explain the difference between water content and fO_2 of the Earth – moon system. They propose that H_2 degassing explains the high fO_2 of the Earth's mantle, and suggest that 33% of the H_2O in the early Earth was reduced to H_2 to oxidize Fe. When accretionary heating occurs, early hydrous melting ensues [e.g., 9] and an H_2O-bearing magma ocean forms and then cools and crystallizes. This crystallization process leads to vapor-saturation of magma near the surface and degassing of H_2O and H_2, and results in the oxidation of Fe metal in the silicate part of the planet. Is it possible that the final oxidation state of the planet's interior depends on the amount of H_2O, initially accreted and incorporated into the magma ocean? The observed relation between wetness and fO_2 is then a primary consequence of the amount of H_2O added during accretion.

[1] Morbidelli *et al* (2000) *MAPS* **35**, 1309-1320. [2] Saal *et al* (2008) *Nature* **454**, 192-195. [3] Wadhwa (2008) Rev. Mineral. **68**, 493-510. [4] Wadhwa (2001) *Science* **291**, 1527-1530. [5] McSween *et al* (2001) *Nature* **409**, 487-490. [6] Grove *et al* (2012) *Ann. Rev. Earth. Planet. Sci.* **40**, 413-439. [7] Parman *et al* (1997) *Earth Planet. Sci. Lett.* **150**, 303-323. [8] Sharp *et al* (2013) *Earth Planet. Sci. Lett.* **380**, 88-97. [9] Pommier *et al* (2012) *Earth Planet. Sci. Lett.* **333-334**, 272-281.