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Hydrogen in an early magma ocean: Implications for Earth's core composition

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The accretion of planets from primordial materials and their subsequent differentiation to form a core and a mantle are fundamental questions in terrestrial and solar system. Many of the questions about the processes are still open and much debated. For example, could the presence of water during the metallic phase segregation affect the planet-accretion models?

The existing studies on the elemental metal-silicate partitioning under hydrous conditions were extended recently to a range of P, T, f_{O2} and water content (5 - 20 GPa, 2000 - 2500 K, from 1 to 5 log units below the iron-wüstite buffer, and for X_{H2O} varying from 500 ppm to 1.5 wt%) [1]. These experimental results show that except for Fe, there is no effect of water on the partitioning of moderately siderophile elements. It allowed us to build consistent models of planetary accretion from reducing to oxidized conditions.

Furthermore, by compiling all existing data on metal-silicate partitioning of hydrogen (including those of the present work) [2-5] we found that hydrogen can present two different behaviors during Earth's core formation: lithophile and siderophile characters, depending mainly on the pressure and the chemical composition of the early core and magma ocean. We will discuss our results in the light of all existing data in terms of existing species (in the C-H-O system) in an early magma ocean and the debate about metal-silicate partitioning of hydrogen.

References:

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