

HIGHLIGHTS AND BREAKTHROUGHS

An alternative to alteration and melting processes in the Earth: Reaction between hydrogen (H₂) and oxide components in the Earth in space and time

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Abstract. Hydrogen-rich and water-rich fluids exert different control on dissolution mechanism of oxide and silicate minerals in the Earth's interior. With Mg-silicate-H₂ fluids, dissolution tends to be incongruent with the $(\text{Mg}/\text{Si})^{\text{fluid}} < (\text{Mg}/\text{Si})^{\text{Mg-silicate}}$ with formation of SiOH and SiH₄ complexes in the fluid (Shinozaki et al. 2013, 2014). In contrast, in Mg-silicate-H₂O systems, Mg-silicate minerals in the mantle (pyroxene and forsterite) dissolve stoichiometrically (congruently) in aqueous fluids to at least 10 GPa pressure. Metasomatic alteration by H₂-rich fluids enriches, therefore, the mantle in SiO₂ compared with alteration by H₂O fluid. This difference becomes increasingly important with mantle depth because the environment becomes more reducing, which results in an increase of H₂/H₂O fluids (Shinozaki et al. 2014, this issue). Chemical gradients with depth of the Earth could be affected by increased H₂/H₂O of mantle fluids whereby Mg/Si ratios, for example, will become variable. Silicate-H₂ alteration processes likely also played major roles during the early, core-forming stages of the Earth. Such a process could be responsible for Mg/Si changes in the early silicate Earth. **Keywords:** Silicate dissolution, fluid, spectroscopy, mantle, metasomatism

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