

Effect of pH on the kinetics of peridotite serpentinization: An experimental study

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Serpentinization produces molecular hydrogen (H₂) that is capable of supporting communities of microorganisms in hydrothermal fields (Kelley et al., 2001; Schrenk et al., 2013). Serpentinization is associated with a fluid pH ranging from 3 to 12.5 (Charlou et al., 2002). However, little is known about effect of pH on serpentinization processes. In this study, we performed hydrothermal experiments at 300 °C and 3.0 kbar to quantify effect of pH on the rates of peridotite serpentinization and molecular hydrogen (H₂) generation. The results reveal that acidic (pH=0.5) and alkaline solutions (pH=13.5) slightly increased their rates of peridotite serpentinization, which is associated with an increase in hydrogen production. In contrast, highly acidic solutions (2 M HCl) impeded the hydrothermal alteration of peridotite by around 2 times, and hydrogen production decreased by around 1-2 orders of magnitude. For olivine-experiments, however, highly acidic solutions (2 M HCl) accelerated the hydrothermal alteration of olivine and hydrogen production. The contrast reflects the influence of pyroxene, which was dissolved at much faster rates in highly acidic solutions and released SiO₂. Consequently, serpentinization processes can be greatly influenced. The experimental results of this study provide important understanding for serpentinization processes in hydrothermal fields.

References:

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