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Quantification and kinetics of H2 generation during hydrothermal serpentinisation experiments

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H_2-rich hydrothermal fluids generated by serpentinisation of mantle rocks at slow-spreading ridges have been revealed by recent studies [1, 2]. Fluxes and the future of the H_2 produced by this process are poorly constrained [1, 3]. In this study, we aim to quantitatively evaluate the H_2 production fluxes associated with these hydrothermal systems and to document the kinetics of the hydrogen-producing reaction.

For this matter, hydrothermal serpentinisation experiments are being undertaken on mixtures composed of a natural peridotite from the Pindus ophiolite and olivine crystals from San Carlos. The experiments are conducted at a temperature of $\sim 300^{\circ}$C and a pressure of 450-500 bars in large-volume Dickson-Seyfried bombs for periods of $\geq$ 1 month. Starting materials are powders between 1 - 100 μm for the peridotites and individual grains ranging from 1 - 2 mm for the San Carlos olivine. They are reacted with a homemade artificial seawater in such proportion that water-rock ratio = 1.8. The reactants are loaded in a modified Ti cell fitted with a semi-permeable Au-Pd membrane simultaneously allowing direct sampling of the hydrothermal fluid and *in situ* monitoring of the pH_2 during the advancement of the reaction. The gas fraction of the fluid sampled is then analyzed by gas chromatography (GC).

The pH_2 readings show traces of H_2 to be present from the second day of experiment. The increase of the pH_2 reaches a maximum after $\sim$ 6 days and the pH_2 finally stabilizes after $\sim$ 16 days at $\sim$ 12.5 bars, which corresponds to a local fO_2 of about NNO-4. The GC measurements, performed after 30, 43, 51 and 65 days, yield respectively, H_2 concentrations of 82.4, 89.7, 90.3 and 101 mmol.kg^{-1} of water, in reasonable agreement with results from previous studies [4-6]. Further experiments are being undertaken in order to: duplicate observations, especially the pH_2 readings, more closely link the GC measurements and the *in situ* pH_2 readings, especially during the first 15 days of experiment, and relate H_2 production with the mineralogical composition of products of the serpentinisation reaction. The possible influence of the oxidation of the Ti cell on the H_2 production will be also checked by using a Au bag instead of a Ti cell. However, from our results, it appears that H_2 generation via serpentinisation is surprisingly rapid.

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