

## Quantification and kinetics of H<sub>2</sub> generation during hydrothermal serpentinization experiments

FAUGUEROLLES C.<sup>1</sup>, CASTELAIN T.<sup>1</sup>, VILLENEUVE J.<sup>1</sup>  
AND PICHAVANT M.<sup>1</sup>

<sup>1</sup>ISTO, Orléans (Fr.) - colin.fauguerolles@univ-orleans.fr

To quantitatively evaluate the flux of H<sub>2</sub> associated with serpentinization and document the kinetics of the H<sub>2</sub>-producing reaction, serpentinization experiments have been performed on fine-grained (<60 μm) natural harzburgites powders from the Pindus ophiolite. Experiments are carried out in large-volume Dickson-Seyfried bombs at 250 and 300°C for a total pressure of 500 bar and durations up to 3 months. Either Ti or Au-Ti bags were used as containers, together with artificial seawater (3.2% NaCl). A constant water-rock ratio of ~1.8 was imposed. For each temperature two types of experiments were conducted in parallel. In the first type, the hydrothermal fluid is periodically sampled and its H<sub>2</sub> concentration determined by gas chromatography (GC). In the second type, the H<sub>2</sub> fugacity inside the reaction bag is permanently monitored with a H<sub>2</sub> semi-permeable membrane made of Au<sub>20</sub>Pd<sub>80</sub>. Product phases identified after the experiments include serpentine (>80 vol%), magnetite and brucite consistent with a serpentinization reaction.

At 300°C, the GC measurements show that the H<sub>2</sub> concentration increases up to ~50 mmol.kg<sup>-1</sup> in less than ~10 days. A plateau of ~110 mmol.kg<sup>-1</sup> is reached after ~50 days. H<sub>2</sub> concentrations and time evolutions are similar for Ti and AuTi bags. At 250°C, the plateau is lower (~50 mmol.kg<sup>-1</sup>) and attained after 12 days. An increase of the membrane fH<sub>2</sub> is observed after the 2<sup>nd</sup> (300°C) and the 3<sup>rd</sup> (250°C) day. The maximum rate of fH<sub>2</sub> increase occurs during the 6<sup>th</sup> (300°C) and the 5<sup>th</sup> (250°C) day. At 300°C, the fH<sub>2</sub> is stabilized at 12.4 bar after 16 days, corresponding to a fO<sub>2</sub> of ~NNO-3.9. At 250°C, using a membrane with a lower free volume, the fH<sub>2</sub> is stabilized at 38 bar after 70 days, corresponding to a local fO<sub>2</sub> of ~NNO-5.5.

Our intrinsic fH<sub>2</sub> measurements are the first performed on a serpentinization reaction and suggest that H<sub>2</sub> generation is surprisingly rapid. The establishment of a quantitative link between the H<sub>2</sub> concentration and the fH<sub>2</sub> is in progress.