

# **In situ CO<sub>2</sub> mineralization in fractured serpentized peridotite basements: Insights from reactive-flow experiments**

MARGUERITE GODARD<sup>1</sup>, SOFIA ESCARIO<sup>2</sup>, RICHARD LEPROVOST<sup>2</sup> AND PHILIPPE GOUZE<sup>2</sup>

<sup>1</sup>Géosciences Montpellier CNRS

<sup>2</sup>Géosciences Montpellier, CNRS, Univ. Montpellier

Presenting Author: [marguerite.godard@umontpellier.fr](mailto:marguerite.godard@umontpellier.fr)

CO<sub>2</sub>-mineralization associated to the serpentinization of exhumed mantle peridotites is a major component of carbon exchanges between solid Earth and its outer envelopes, from oceanic ridges to subduction zones and in ophiolites. These natural systems represent analogues for investigating possible industrial geological CO<sub>2</sub> storage in peridotite basements. However, the linkages between the hydrodynamic, physical and chemical mechanisms driving these reactions whilst sustaining fluid flow remain poorly understood. We present here the results of a series of reactive percolation experiments set up for investigating the role of fluid CO<sub>2</sub> content (pCO<sub>2</sub>) and solute transport on CO<sub>2</sub>-mineralization in fractured peridotites.

The laboratory experiments consisted in injecting Ni-bearing saline fluids (0.5 M NaCl) enriched in CO<sub>2</sub> (pCO<sub>2</sub> of 20 MPa and 2 MPa) into artificially fractured serpentized peridotite cores (Oman ophiolite) at constant flow rates (6 and 2.4 mL·h<sup>-1</sup>). The experiments were conducted at constant temperature (170°C) and pressure (25 MPa) and lasted 6 to 11 days. All experiments displayed outlet fluids having high pH and high Si, Mg, Fe and Ca concentrations compared to inlet fluids hence revealing the dissolution of silicates. After experiments, all core samples showed evidences of dissolution (voids, etch-pits and saw-toothed textures) and the development of two reaction zones along fractures. The fracture interfaces showed the development of a highly porous zone characterized by the presence of secondary Ni-rich lizardite and Fe-Ni oxides and low carbonate contents. Away from the fracture, the formation of a diffuse low porosity zone with abundant carbonates indicates changes of the fluid reactivity as it migrated into the peridotite matrix.

Variable pCO<sub>2</sub> and flow rates induced differences in reaction pathways and efficiency from one experiment to the other. At low pCO<sub>2</sub>, olivine and pyroxenes were slightly altered to (Ca)-magnesite, hematite and (Ni-Fe) oxides and, at high pCO<sub>2</sub>, primary olivine, pyroxenes and lizardite were strongly altered to (Fe)-magnesite, hematite and amorphous silica. At constant pCO<sub>2</sub>, carbonation rates were correlated to flow rates.

These results provide a preliminary basis for assessing the sustainability and effective reaction rates of CO<sub>2</sub>-mineralization in serpentized peridotite basements.