

Supplemental Material

Carbonate mineralization in percolated olivine aggregates: Linking effects of crystallographic orientation and fluid flow

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Experimental setup and sample characteristics for the percolation experiment used in this study (after Peuble et al. (2014)).

The olivine cores studied here were prepared by crushing, sieving, cleaning, drying and sintering coarse grained olivine-rich beach sand sampled on the southern shore of Hawaii Island (USA). The methodology of sample preparation are detailed in Peuble et al. (2014).

The experiment that produced the studied reacted core sample is described in detail in Peuble et al. (2014). The reactive percolation experiment was performed on the ICARE Lab CO₂ sequestration evaluation flow system allowing the study of fluid-rock interactions in confined rock samples at controlled pressure, temperature and inlet fluid composition. It consisted in injecting CO₂-enriched Milli-Q water into the permeable olivine aggregate at *in-situ* reservoir conditions (T<200°C, P<20 MPa, P_{containment}<22 MPa). The ‘inlet fluid’ was prepared by mixing gaseous CO₂, NaHCO₃ and pure water. It contained traces of Si and Ca (25.2 and 6.70 µg.g⁻¹, respectively after ICP-MS analyses; see Table 2), which come from the Panreac NaHCO₃ (99.7 – 100.3 %; PA-ACS-ISO). The permeability changes induced by fluid-rock reactions were continuously monitored during the experiment and outlet fluids were regularly sampled. The methodology and technical characteristics of the ICARE Lab CO₂ sequestration device are described in detail in Luquot et al. (2012). The experimental setup and main results of this experiment are summarized in Tables 1 and 2 and extensively described in Peuble et al (2014).

References

- Luquot, L., Andreani, M., Gouze, P., and Camps, P. (2012) CO₂ percolation experiment through chlorite/zeolite-rich sandstone (Pretty-Hill Formation – Otway Basin–Australia). *Chemical Geology*, 294-29, 75-88.
- Peuble, S., Godard, M., Luquot, L., Andreani, M., Martinez, I., and Gouze, P. (2014) CO₂ geological storage in olivine rich basaltic aquifers: New Insights from flow-through experiments. *Applied Geochemistry*.

Table 1. Conditions of the percolation experiment.

Experimental conditions	
Sample name	H2
Temperature (°C)	180
Inlet fluid	MilliQ water enriched with 0.57 mol.L ⁻¹ of sodium bicarbonate
pCO ₂ (MPa)	10
P _{tot} (MPa)	12
Inlet fluid pH	6.5
Duration (hours)	55.80
Initial porosity (%)	6.02
Q (mL.h ⁻¹)	0.1
Total volume of injected fluid (mL)	5.58
Initial permeability (10 ⁻¹⁸ m ²)	41
Final permeability (10 ⁻¹⁸ m ²)	1.01
Initial magnetic susceptibility (10 ⁻⁸ m ³ .Kg ⁻¹)	21.4
Final magnetic susceptibility (10 ⁻⁸ m ³ .Kg ⁻¹)	21.1

Table 2. ICP-MS data: Composition of inlet fluid and of outlet fluids sampled during the percolation experiment.

Sampling time (h)	Si ($\mu\text{g}\cdot\text{g}^{-1}$)	Fe ($\mu\text{g}\cdot\text{g}^{-1}$)	Mg ($\mu\text{g}\cdot\text{g}^{-1}$)	Ca ($\mu\text{g}\cdot\text{g}^{-1}$)
Injected fluid	25.2	0.67	0.94	6.70
2.00	35.6	3.25	1.51	8.22
11.30	273.0	2.22	1.11	5.23
21.20	329.2	2.10	1.03	6.33
33.70	288.0	1.38	0.83	4.77
45.80	336.8	1.41	0.73	3.59
55.80	371.4	1.61	0.52	3.29