Storage of carbon dioxide in geological reservoirs – Dolostone and sandstone reactivity under *in situ* temperature, pCO_2 and brine, St. Lawrence Lowlands, Québec, Canada

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Abstract

Geological reservoirs are expected to react upon CO_2 injection, with the perturbation of their rock-fluid equilibrium. In order to understand and forecast their behaviour, free-drift experiments were performed at reservoir conditions on the core samples of two potential reservoirs that differ mainly by their lithology. Both come from two nearby exploration holes drilled through the Cambrian-Ordovician platform sequence of the St. Lawrence Lowlands, in the Bécancour area.

The first would-be reservoir features upper Cambrian sandstones of the Potsdam Group (fine and moderately sorted quartzites, commonly tightly cemented, but locally poorly consolidated; porosity up to 8%, 1.11 mD permeability). The second one occurs in the lower Ordovician dolostones of the Beekmantown Group (greenish-gray sandy dolostones and dolomitic sandstones; porosity up to 4 to 12 %, 1.57 mD permeability). Two 10 cm cores were sampled at 1157 m and 970 m depths, respectively.

Both samples were cut into 20-25 mm thick slices, sub-sampled into 25 mm plugs. Five of these were placed in two high pressure vessels, together with a synthetic brine similar to the *in situ* pore fluid (respectively 14.8 and 15.7 g/L $CaCl_2$, 0.84 and 0.72 g/L $MgCl_2$, 0.44 and 0.16 g/L KCl, 12.6 and 0.87 g/L NaCl for the sandstone and the dolostone). After stabilisation at reservoir temperature and pressure (50 °C, and 190 and 120 bar for the sandstone and for the dolostone, respectively), N_2 was replaced by CO_2, and the reactors let free to react over 50 weeks.

The fluids were sampled and analyzed once or twice a week for Al, Ca, Fe, K, Mg, Mn, Na, S and Si. One plug was removed each month and cut for element mapping of the reaction front and scanning electronic microscopy of the etched surface. Rock minerals (calcite, dolomite, quartz, feldspars...) were first dissolved, leading to enhanced porosity. Then, salt crystals (NaCl, KCl...), calcite and dolomite (re)-precipitation lead to some reservoir occlusion.

Finally, with all chemical results from this experiment and with all SEM pictures, we are able to predict the chemical reaction that could occurs in our storage project and could propose solutions during the injection phase.