

Role of local heterogeneities on the localization of dissolution and precipitation reactions during acidic fluid percolation through different limestone samples

Linda Luquot (1,2) and Jesus Carrera (2)

(1) Hydrosiences Montpellier - CNRS, Hydrosiences Montpellier, Montpellier, France (linda.luquot@umontpellier.fr), (2) IDAEA-CSIC Barcelona, Spain

CO₂ sequestration in deep geological formation is considered an option to reduce CO₂ emissions in the atmosphere. After injection, the CO₂ will slowly dissolve into the pore water producing low pH fluids with a high capacity for dissolving carbonates. Limestone rock dissolution induces geometrical parameters changes such as porosity, pore size distribution, or tortuosity which may consequently modify transport properties (permeability, diffusion coefficient). Characterizing these changes is essential for modelling flow and CO₂ transport during and after the CO₂ injection. Indeed, these changes can affect the storage capacity and injectivity of the formation.

Very few published studies evaluate the transport properties changes (porosity, permeability, pore size distribution, diffusion coefficient) due to fluid-rock interactions (dissolution and/or precipitation).

Here we report experimental results from the injection of acidic fluids (some of them equilibrated with gypsum) into limestone core samples of 25.4 mm diameter and around 25 mm length. We studied two different limestone samples: one composed of 73% of calcite and 27% of quartz, and the second one of 100% of dolomite. Experiments were realized at room temperature. Before and after each acidic rock attack, we measure the sample porosity, the diffusion coefficient and the pore size distribution.

We also imaged the 3D pore network by X-ray microtomography to evaluate the same parameters. During percolation experiments, the permeability changes are recorded and chemical samples taken to evaluate calcite dissolution and gypsum precipitation. Several dissolution/precipitation-characterization cycles are performed on each sample in order to study the evolution and relation of the different parameters.

These experiments show different dissolution regimes depending of the fluid acidity and of the limestone samples in particular the initial local heterogeneity, and pore size distribution.