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Modeling dolomite - brine interaction in the context of geological CO_2 sequestration

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The repository rocks for CO_2 injection at the Hontomín test site in northern Spain are dominantly limestones and dolostones. Contact with CO_2-rich acid brines will induce the dissolution of carbonate minerals. Since the brine contains sulfate, gypsum (or anhydrite at depth) will precipitate, which may coat the surface of the dissolving carbonate grains and cause their passivation. These mineral reactions will also induce changes in porosity and permeability. Laboratory column experiments under controlled pCO_2 (initially up to 10 bar) will be performed to quantify these processes. Results were already obtained for experiments under atmospheric pCO_2.

Numerical modeling of the experiments has been performed using the CrunchFlow reactive transport code. These are one-dimensional simulations of the geochemical evolution of columns filled with dolomite grains (size 1-2 mm) that react with synthetic brines. pCO_2 ranges from atmospheric up to 10 bar, at room temperature.

Model and experimental results show that at under normal laboratory conditions (atmospheric pCO_2) dissolution of dolomite and precipitation of calcite and gypsum are taking place, yielding a considerable increase in porosity at the beginning of the column. Simulations considering supercritical pCO_2 and 70 C predict a more significant dissolution of dolomite and a large increase in porosity along the whole column. Dedolomitization (mole per mole replacement of dolomite by calcite) is a negligible process in these experiments.

Comparison between experimental and simulated results will allow obtainment of proper kinetic parameters and quantification of changes in the initial mineralogy. Simulations will also be applied to predict variations in rock porosity that might occur under repository conditions.