



The interaction between Hontomín shale and CO₂-rich brine under supercritical CO₂ conditions. Percolation experiments

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Geological CO₂ sequestration at a pilot-plant scale is going to be performed at Hontomín (Spain). The main caprock is made up of marly shales, with an average composition (wt.%) of 56% calcite, 21% quartz, 17% illite, 3% clinochlore and albite and trace amounts of pyrite, gypsum and anhydrite. The reservoir brine is rich in NaCl and sulfate (I = 0.6 M) and equilibrated with respect to gypsum/anhydrite and calcite. The present study aims at evaluating the interaction between the shale and the CO₂-rich brine of Hontomín by performing (1) laboratory experiments and (2) 2D reactive transport modeling.

(1) Laboratory experiments: percolation experiments with artificially fractured cores (7.5 mm in diameter and 18 mm in length) under supercritical CO₂ conditions (pTotal = 150 bar, pCO₂ from 82 to 95 bar, T = 60 °C) are carried out to evaluate and quantify the influence of mineral dissolution/precipitation processes on fracture permeability. Two synthetic CO₂-rich brines, sulfate-free and sulfate-rich brines with similar composition to that of Hontomín, circulate at constant flow rate (0.2, 1 and 60 mL h⁻¹) through the fracture. Under supercritical pCO₂ the acid brine acidic (pH ~3) reacts with the shale and induces significant dissolution of calcite and aluminosilicates (mainly, chlorite and albite).

(2) 2D reactive transport modeling: CrunchFlow is utilized to match the observed variation with time of the aqueous concentrations of Ca, Si and sulfate and pH during the fracture-CO₂-rich brine interaction under supercritical pCO₂ conditions. Evaluation of the kinetic parameters, such as the values of the mineral surface area, will be performed. Solute transport is dominated by advection along the fracture and by diffusion through the rock matrix. This type of simulations is the basis for a prediction of the magnitude of the geochemical processes during the caprock-brine interaction at Hontomín under supercritical CO₂ conditions.

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