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Interaction between the Hontomín cap rock and CO_2-rich brine during geological CO_2 sequestration

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The cap rock of the CO_2 injection test site at Hontomín (northern Spain) is made of marls and shales (87 % of calcite, 4% of quartz, 8% of illite and 1% of albite). The reservoir brine is rich in NaCl (I = 0.66 M) and sulfate, being in equilibrium with respect to gypsum and calcite. The present study aims at evaluating the interaction between these rocks and the CO_2-rich brine of Hontomín to estimate a risk of CO_2 leakage. The approach consists of (1) laboratory experiments and (2) reactive transport modeling of the processes:

(1) The experiments are of two types: a) Column experiments packed with crushed Hontomín-rock samples carried out from atmospheric pCO_2 and 25 C to pCO_2 of 80 bar and 40 C and b) Core-percolation experiments carried out under supercritic conditions (pCO_2 of 80 bar and 40 C). The brine that circulates through the columns is synthetic with similar composition of that of Hontomín. Preliminary results under atmospheric pCO_2 show that the acid brine reacts with the rocks and induces significant dissolution of calcite and some of illite.

(2) At the moment, 1D reactive transport modeling using the CrunchFlow code (Steefel, 2009), allows a good match of the observed variation with time of the aqueous concentrations of Ca, Si and sulfate and pH after reacting with the crushed samples (1-2 mm in size) under atmospheric pressure. The good match was possible by adjusting the values of the mineral surface areas of the involved minerals. According to these results, porosity of the cap prediction of the magnitude of the geochemical processes during cap rock-brine interaction at Hontomín under supercritical CO_2 conditions.

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