Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Earth and Planetary Science 7 (2013) 109 – 112

Procedia
Earth and Planetary Science

Water Rock Interaction [WRI 14]

Laboratory-scale interaction between CO_2-rich brine and reservoir rocks (limestone and sandstone)

Maria García-Rios, Linda Luquot, Josep M. Soler, Jordi Cama*

Institute of Environmental Assessment and Water Research (IDAEA), CSIC, Barcelona 08034, Catalonia, Spain.

Abstract

In the laboratory, synthetically fractured cores of limestone and sandstone were reacted with CO_2-rich brines at flow rates ranging from 0.2 to 60 mL h^{-1} and 80 bar pCO_2 and 60 °C (supercritical CO_2 conditions). Interaction between the sulfate-CO_2-rich brines and the primary minerals of the rock caused significant permeability variations. Calcite dissolution was clearly identified and in some case associated with gypsum (or anhydrite) precipitation.

Selection and/or peer-review under responsibility of the Organizing and Scientific Committee of WRI 14 – 2013

Keywords: limestone; CO_2 sequestration; dissolution; precipitation; brine; permeability

1. Introduction

The test site for CO_2 injection in Hontomín (northern Spain), is composed of limestones (calcite and dolomite) and sandstones (66 wt% calcite, 21 wt% quartz, 6.5 wt% microcline). CO_2 injection at depth will cause the formation of CO_2-rich acid brines, which will likely promote the dissolution of carbonate minerals (calcite and dolomite). Since the brine contains sulfate, gypsum (or anhydrite at depth) can also precipitate. These sulfate minerals may cover the surface of the dissolving carbonates causing their passivation. These reactions imply changes in porosity pore structure in the repository rocks. Therefore, changes in permeability and fluid flow are expected. Laboratory experiments at 80 bar pCO_2 and 60 °C were carried out to measure the progress of these reactions and the effect exerted on the porosity and permeability of these rocks.

* Corresponding author. Tel.: + 34934006176.
E-mail address: jordi.cama@idaea.csic.es.

Selection and/or peer-review under responsibility of the Organizing and Scientific Committee of WRI 14 – 2013
doi:10.1016/j.proeps.2013.03.013

2. Experimental methodology

A preliminary set of percolation experiments with limestone and sandstone cores (9 mm diameter, 18 mm length, 1 % - 2 % porosity) showed that permeabilities were extremely small (< 1×10^{-18} m^2), not allowing for the injection of the solutions through the cores (Figure 1).

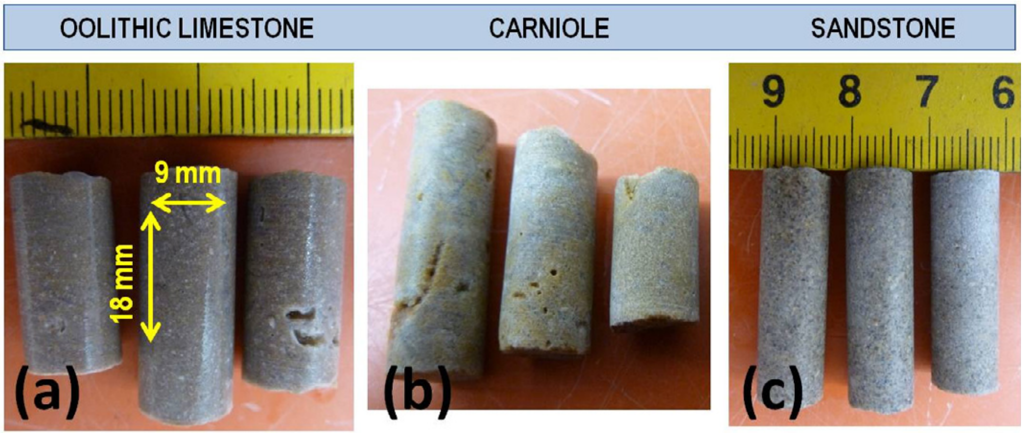

Fig. 1. Type of cores used in the permeability tests: (a) oolithic limestone; (b) carniole (vuggy limestone) and (c) sandstone.

Therefore, it was decided to use fractured rock cores for the experiments. Synthetic fractures were created by sawing the rock cores. Experiments using the fractured cores were performed under CO_2 supercritical conditions (pCO_2 = 8 MPa and T = 60 °C). A synthetic sulfate-rich brine nearly equilibrated with respect to gypsum was injected at different flow rates (0.2 to 60 mL/h).

3. Results and discussion

During the injection of the sulfate-CO_2-rich brine through a fractured limestone core we observed an increase in fracture permeability from 4.5×10^{-13} to 2.8×10^{-11} m^2 (Fig. 2).

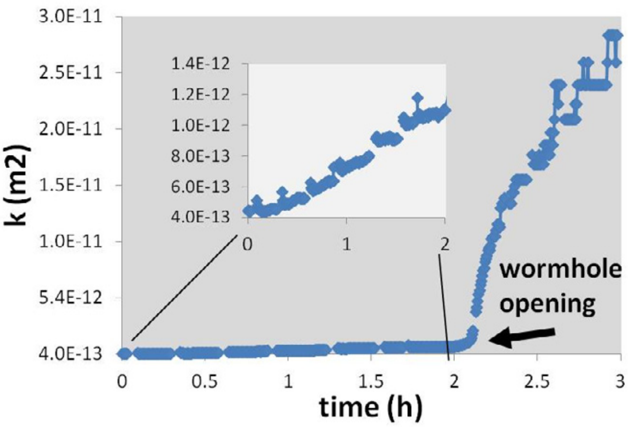

Fig. 2. Variation of fracture permeability with time in a limestone core. The flow rate was 5 mL h^{-1}.