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Implications of CO_2-saturated brine percolation in carbonate rocks under sequestration conditions: Experimental constraints

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A strategy for mitigating CO_2 atmospheric concentration is long-term underground storage. Modeling the consequences of this type of sequestration on rock and fluids properties is a prerequisite for designing injection procedures and evaluating long-term behavior of the system. However, fundamental parameters characterizing reactions in situ, and their consequences on the hydrodynamics properties of the reservoir are mostly lacking. Thus, experimental studies are required to improve modeling and predictions.

First, we present a new experimental procedure for studying reactions of CO_2-enriched fluids percolating natural rock samples in conditions similar to those in situ (i.e up to about T = 200˚C and P = 20MPa). To achieve it, we construct a new experimental bench and performed percolation experiments through core samples (diameter 9mm, length 18mm) and use X-ray micro-tomography technique to measure the pore structure changes (porosity, tortuosity, ...) due to the fluid-rock exchanges. This experiment allows acquiring permeability change during percolation and sampling fluid regularly for analysis so that all together both hydrodynamic and geochemical aspects of the process can be investigated.

Secondly, we discuss results of CO_2 percolation experiments through carbonate-rich samples. Experiments were conducted at 100˚C and 12MPa for several hours. We measure the evolution of sample permeability and Calcium concentration in the brine during the percolation and relate them with hydrodynamics properties changes measured on the micro-tomography images.