A geochemical approach to evaluate the petrophysical properties of a porous media

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Injection of CO_2 into geological formations leads to perturbation of the geochemical system equilibrium between the porous rock and the formation waters. Coupled physical and chemical processes thus occur along the injected CO_2 pathway in the reservoir and may have consequences on the reservoir petrophysical properties. Assessing the extent of petrophysical properties variations in the reservoir is crucial regarding injectivity and containment safety issues during massive CO_2 injection over decades. To date, few monitoring techniques are available and provide a poor spatial resolution of petrophysical properties or are difficult to set up. We thus propose to test the possibility that Chlorine isotopes could be used as a geochemical tool to assess petrophysical properties evolution in a reservoir over time.

In order to investigate this possibility, several types of experiments will be performed. Indeed, chlorine isotope fractionation can occur during several processes present during fluid transport in a reservoir rock. Autoclave experiments will be conducted to identify a possible Chlorine fractionation between coexisting brine and CO_2 at reservoir P-T conditions. Drying experiments on a brine-saturated rock sample will be conducted to investigate the overall effect of dry CO_2 injection on Chlorine isotope variations in a well-bore. Percolation and diffusion experiments will be launched with different types of rocks and at P-T conditions relevant to the geological storage of CO_2 and studied both from a petrophysics and Chlorine isotope point of view.

The results obtained will constitute a first step towards the characterization of the chlorine isotope fractionation associated with changes in the fluid transport processes due to petrophysical properties modifications of in a reservoir rock undergoing a CO_2 injection.