Solute transport in porous media during drying: the chlorine isotopes point of view

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Injection of CO_2 into saline aquifers (in CCS or EOR context) may cause formation dry-out and precipitation of salt near the injection well that could potentially lead to the alteration of the transport properties of the reservoir rock. Here, we investigate experimentally the possibility that chlorine isotopes could be used as a geochemical tool to constrain the interplay of solute transport processes occuring during CO_2 injection. $\delta^{37}Cl$ is already used as a tracer of solute transport (especially diffusion) and salt precipitation [1 - 3] so that it is likely to be useful to characterise their complex dynamics in porous media during evaporation.

Drying experiments were carried out on Lavoux carbonate plugs initially saturated with a 100 g/L NaCl brine. Chromatographic and stable isotope analyses were performed from these samples in order to obtain Cl-content and $\delta^{37}Cl$ profiles along the length of the plugs for different water saturation levels (S_w=1; S_w=0.82; S_w=0.68).

The results show a clear evolution of Cl ions distribution and isotope composition during evaporation of water in the carbonate plugs. Cl ions are transported by convective capillary flow toward the evaporative surface where they precipitate in the form of salt efflorescence when the solubility limit is reached. Because of the induced concentration gradient, backward diffusion also takes place and tends to homogenize the Cl-ion concentration in space [4] [5]. A 1-D model based on these processes was used to interpret our experimental data. The results show that fractionation factors for both precipitation and diffusion have to be considered to explain the measured $\delta^{37}Cl$ profiles, providing new insights regarding the use of Cl isotopes to characterize drying of porous media.

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