Physicochemical reactivity of a Ca-montmorillonite in a CO_2-H_2O-NaCl medium

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Clay-rich materials have a low permeability, a high sorption and ion exchange capacity, and, in some cases, a swelling ability. For that, the clay-rich materials have been proposed as natural and/or engineered barriers in sequestration of acid gas, confinement of pollutants and trapping hydrocarbon oil and gas for geological disposal facilities. The clay-rich barriers may be submitted to changes of water content, temperature variation, pressure variation, fluid interaction, mass transport, etc. These perturbations could modify the physicochemical performance of the barrier, mainly on the sensitivity interfaces, for example, reservoir-caprock (barrier) interface for the sequestration of acid gas. The clay-rich materials have a complex mineral composition, sometimes, the presence of accessory minerals becomes difficult the understanding of their physicochemical reactivity. The aim of this research work was then to study the physicochemical reactivity of a homoionic calcium-montmorillonite (Ca-Mont) at high pressure (200 bars) and temperature (150 °C) in a CO_2-H_2O-NaCl medium by using an agitated batch-reactor (autoclave) during 15 days of reaction. A multi-techniques approach was performed in order to characterize (before and after reaction) the solid phase (SEM/EDS, STEM/EDS, ESEM, XRD, Infrared Spectrometry and N_2 adsorption) and the liquid phase (ICP-MS and Ionic Chromatography).

The preliminary results showed that the main reactions for this complex system were the clay-fine particles dissolution, the cation exchange process, the red iron-oxides precipitation "coagulated in the clay-aggregates" and silicates precipitation. Consequently, the moderated textural modifications of initial clay-material were also identified.