Modeling mineralogical changes due to CO_2 injection with varying impurity composition

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A set of 1D radial multiphase reactive transport simulations using TOUGHREACT have been performed in order to analyze the impact of varying CO_2 stream compositions on petrophysical rock properties. On the basis of a base scenario defined within the project CLUSTER [1] two generic storage formations have been investigated. These two comprise saline aquifers in Bunter Sandstone with rock properties and mineralogical compositions typical for the North German Basin. While one of the sandstone formations includes carbonate cement and relatively high porosity and permeability values, the other includes silicate cements and lower porosity and permeability values. Modeling parameters, such as spatial discretization and simulation time, have been varied and the effects of different combinations of impurities have been analyzed. For the simulations, a methodological modelling approach, developed within the CLUSTER project [2], was used. This approach allows for simulating temporally varying impurity concentrations. In the simulations SO_2, NO_2, O_2 and H_2 have been investigated as potentially reactive impurities.

Modeling results show that mineralogical changes strongly depend on the impurities present in the CO_2 stream and, as would be expected, on the primary mineral phases. In particular, coupled dissolution and precipitation of Ca- and Fe-bearing minerals occur. These processes are controlled by acidification and redox reactions following the dissolution of CO_2 and impurities. Yet, only negligible changes in porosity and permeability have been observed suggesting no significant geotechnical consequences on the storage formations.

[1] Kahlke et al. (2017) *TCCS-9 conference*. [2] Wolf et al. (2017) *Procedia Earth Planet. Sci.* **17**, 480-483.