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Geological sequestration of CO_2 in North Rhine Westphalia (Germany)

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To prevent atmospheric release of CO_2 from fossil fuel combustion and thereby reducing its potential for adverse climate change, we are investigating the possibility of geologic CO_2 sequestration in the state of North Rhine Westphalia in Germany.

Reservoir simulations for evaluating and selecting such a potential site are performed using TOUGHREACT. Here, we focus on two trapping mechanisms for CO_2 injected into the Bunter formation situated near the town of Minden: (1) hydrodynamic trapping and (2) mineral trapping.

Regarding to the hydrodynamic trapping, the results indicate that the injected CO_2 phase initially migrates towards the top confining layer (due to buoyancy), spreads along the caprock and then dissolves partially in the formation water. This dissolution of CO_2 results in an increase in brine density which causes the CO_2-enriched brine to migrate downward and, after sufficiently long time, finally settle at the bottom.

With respect to the geochemical modeling, the results show that in the short run (100 years) a dissolution of calcite in the rock occurs but the amount of dissolved calcite is negligible compared to the amount of mineral precipitation in subsequent reactions. In the long run (10,000 years), alumino-silicate reactions dominate the geochemical interactions. The simulations use the cubic law to calculate changes in permeability caused by changes in porosity during the simulation, however without considering their effect on fluid flow. The results indicate that a porosity decrease of 4.5 % may

cause a permeability decrease of 13 %.