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Geochemical changes in pore water and reservoir rock due to CO2 injection

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In response to current global warming, carbon capture and storage has been identified as one of the promising option. Thus, it can be an interim solution that is indeed a bridge to the future renewable energy without altering the present mode of energy consumption. Although large natural CO2 sinks are terrestrial eco-system and oceans, geological media or more specifically large sedimentary basins are now the most feasible options for carbon sequestration. At the study site, a former gas field (Altmark), which is located in the South of the Northeast German Basin, CO2 is planned to be injected into the reservoir with high pressure (> 50 bar) and temperature (125°C). Afterwards, CO2 dissolves into the pore water leading to acidification and follow up reactions such as dissolution/precipitation, which potentially change the porosity-permeability of the reservoir and the wetting properties of the mineral surfaces. The Altmark site was chosen due to its large storage capacity, well explored reservoir, high seal integrity due to the presence of massive salt layer (cap rock) and existing infrastructure required for enhanced gas recovery. The main objective of the current study is to quantify the CO2 trapping in aqueous solution under in situ reservoir condition. Therefore, it is necessary to investigate the geochemical changes in fluid composition due to dissolution of minerals under controlled laboratory conditions and to quantify the concentrations of complexing agents that might influence the concentration of total dissolved CO2 in aqueous solution over time. To observe these geochemical and hydraulic changes due to the injection of CO2, a closed system (batch system) technique is developed to study the influence of salinity, temperature, pressure and kinetics on mineral reactions. In addition to the closed system, a flow through (open) autoclave system was constructed. Water saturated sedimentary rock cores (e.g. from the Altmark site; 5cm long, 3cm diameter) are going to be flushed by a pre-equilibrated mixture of CO2 and water at a constant rate for several months. Fluid samples will be collected at regular intervals and analyzed by IC and ICP-OES/MS. XRF and SEM analysis will also be performed for the solid phase. The outcome of the laboratory experiments will be used as input parameters for the geochemical modeling in order to provide the parameters to calculate the subsurface volume available for storage of dissolved CO2 (“solubility trapping”).