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Compositional changes of reservoir rocks through the injection of supercritical CO_2

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The European project CO2SINK is the first project on the on-shore underground storage of carbon dioxide in Europe. CO2SINK is part of the ongoing efforts to understand the impact, problems, and likelihood of using deep saline aquifers for long term storage of CO_2. In Ketzin (north-east Germany, 40 km west of Berlin) a saline sandstone aquifer of the younger Triassic (Stuttgart Formation) has been chosen as a reservoir for the long-term storage of carbon dioxide.
Our monitoring focuses on the composition and mobility of the organic carbon pools within the saline aquifer and their changes due to the storage of carbon dioxide. Supercritical carbon dioxide is known as an excellent solvent of non- to moderately polar organic compounds, depending on temperature and pressure (Hawthorne, 1990). The extraction of organic matter (OM) from reservoir rock, using multiple extraction methods, allows insight into the composition of the OM and the biomarker inventory of the deep biosphere. The extraction of reservoir rock using supercritical CO_2 may additionally simulate the impact of CO_2 storage on the deep biosphere by the possible mobilisation of OM.
We will present compound specific results from laboratory CO_2 extraction experiments on reservoir rocks from the CO_2 storage site in Ketzin, Germany. A total of five rock samples (silt and sandstones) from the injection well and two observation wells were applied to supercritical CO_2 extraction. In the experimental setup, a supercritical fluid extractor is used to simulate the conditions within the saline aquifer. The results show distinct quantitative and qualitative differences in extraction yields between the rock samples. This may be due to differences in mineralogy and porosity (12 – 27%; Norden et al., 2007a, b, c), which seem to be extraction-controlling key factors. Furthermore, the results illustrate that the amount of extracted materials depends on the length of the time interval in which CO_2 flows through the rock, rather than saturation of extracted compounds in the solvent when CO_2 is stationary.
Total extraction yields seem to be low compared to the OM present in the reservoir rock, but yields still have to be extrapolated to the large volumes of reservoir rock that are in contact with supercritical CO_2 at the test site. In the future, our lab results may be combined with models to determine how much of the mobilised organic acids and non organic material will occupy the entire reservoir (pore space) or could be used by organisms and induce growth.
Additionally, the rock samples were analysed after the extraction with supercritical CO_2, using a variety of organic and inorganic geochemical techniques. Thus, changes in the composition of the rocks were also observed. Here, amongst others, scanning electron microscopy was done and indicated corrosion effects on mineral surfaces due to exposure to supercritical CO_2.

References

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