Geophysical Research Abstracts, Vol. 9, 01138, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01138

Geochemical cap rock reactions associated with the option of CO_2 storage and enhanced gas recovery (CSEGR)

Hans-Dieter Vosteen (1) and Franz May (1)

(1) Federal Institute for Geosciences and Natural Resources (BGR), Germany
(Hans-Dieter.Vosteen@bgr.de / Phone: +49-511-6432050)

The CSEGR (CO_2 storage and enhanced gas recovery) project is part of the German GEOTECHNOLOGIEN project. It comprises a feasibility study. Background of the CSEGR project is the fact, that already by now more than half of the German natural gas reservoirs are in an advanced production state. They could therefore quite soon be used for CO_2 storage. Within this project, the feasibility of the CSEGR option, to extend the lifetime of two German natural gas fields by systematic injection of CO_2, will be studied. The two fields are representative for the Rotliegend red-bed natural gas fields (Altmark, Saxony-Anhalt) and for the Bunter sandstone natural gas fields (Barrien, Lower Saxony).

Within the CSEGR project the complete process chain from definition of CO_2-sources, transport and injection, characterization of the geological setting of the candidate sites to reservoir- and geochemical simulations will be performed. This will yield an estimation of the technical and economical feasibility for the supporting industry partners.

In principal, the existence of natural gas reservoirs proofs, that a respective geological structure is able to hinder gases or fluids to ascend into overlaying aquifers or further to the Earth's surface. In addition to that, parts of the already existing infrastructure of wells and pipelines could be used for CO_2 storage. Preliminary numerical simulation of the CSEGR option has shown that the risk of instant mixing of CO_2 and methane is very small, which is due to their different thermo-physical properties. Thus, a quality reduction of the produced natural gas will probably occur only at the end of the planned injection term.

On the other hand, field experiments have shown that contrary to methane, CO_2 easily dissolves in saline waters. Circulating CO_2-rich saline waters may lead to geochemical reactions with the surrounding rocks in cap rock and reservoir. Such reactions can lead to mineral dissolution or mineral precipitation. Mineral dissolution usually yields an increase in porosity. Depending on where it occurs, the increased porosity might either yield a larger storage capacity or reduced cap rock integrity. On the other hand a reduction of porosity and permeability due to mineral precipitation near to the injection well can yield technical problems during the injection of CO_2.

Qualitative conclusions, such as the identification of geochemical alteration reactions involving CO_2, can be derived by studying natural analogues. Natural analogues of subsurface CO_2 storage can be found in regions with distinctly elevated concentrations of CO_2. In Germany such highly mineralized and CO_2-rich waters can be found in regions of magmatic activity, e.g. in the surroundings of the Rhein rift system.

A total of 49 samples from bore cores and 27 samples of bore cuttings were taken from a 551 m deep borehole that was drilled to develop a CO_2 rich mineral water spring near the city of Bad Mergentheim. The samples represent different depth levels of the Rotliegend red bed sandstones, Zechstein and Bunter Sandstone. Some of these samples show visible alteration reactions that were caused by CO_2-rich waters. Additional samples from Bunter Sandstone were taken from an old borehole near Bad Oeynhausen. A set of 29 samples from drill cuttings from a periodically erupting well producing CO_2-rich bicarbonate water near the village of Namedy will provide an insight into the effects of CO_2-rich waters on greywacky- and claystone sequences, which could be representative for similar reactive caprock lithologies. All samples were studied by means of thin section microscopy, kathodoluminescence microscopy, XRF and XRD analyses.

These analyses provide input data for subsequent numerical simulation of transient reactive transport. The results of numerical simulation will yield a quantitative estimate of the reaction rates and of the amount of mineral dissolution or precipitation and of changes in brine composition, porosity and permeability of reservoir and cap rock.

They will yield short and long term changes in mineral composition, porosity and permeability of the cap rock due to CO_2 sequestration into the reservoir.