Geophysical Research Abstracts
Vol. 13, EGU2011-12762, 2011
EGU General Assembly 2011

Transport and sealing properties of clay-rich lithotypes exposed to CO2

Alexandra Amann (1), Pieter Bertier (2), Jennifer Blume (3), Andreas Busch (4), Bernhard M. Krooss (1), Ines Rick (5), Margret Waschbüsch Waschbüsch (1), and Philipp Weniger Weniger (1)

(1) RWTH-Aachen, LEK, Geology, Aachen, Germany (amann@lek.rwth-aachen.de, +49 (0)241 / 80 92152), (2) Lehr- und Forschungsgebiet Ton- und Grenzflächenmineralogie, RWTH Aachen University, Germany, (3) Institut für Angewandte Geowissenschaften (AGW), Karlsruhe Institute of Technology (KIT), (4) Shell International Explorations and Production B.V., (5) Applied Geophysics and Geothermal Energy - E.ON Energy Research Center, Aachen

One prerequisite for the storage of CO2 in the subsurface is that an appropriate underground storage site is found, overlain by a sufficiently tight caprock. Often such caprocks comprise clay-rich lithotypes, which are characterised by high capillary entry pressures and very low permeabilities. In the ongoing CO2Seals project study the influence of CO2 on both the matrix and fracture flow properties of such lithologies (Amann et al., in press). Samples used in this study comprise well-characterized clay/shale samples from underground laboratories, one outcrop sample and samples from a prospective storage site.

Within this project various experimental and analytical methods are applied to assess rock properties relevant to the sealing capacity of tight lithologies. These comprise

- single-phase permeability experiments with CO2-saturated brine on intact & fractured/sheared material
- gas breakthrough tests with He and/or supercritical CO2, where the water-phase is displaced from the previously brine saturated sample
- CO2 high-pressure sorption experiments (up to 25 MPa)
- batch and flow reactor experiments with CO2-saturated brine on single-clay minerals
- CO2 contact angle & interfacial tension measurements

All rock samples are analysed before and after the exposure to CO2 with respect to their porosity, specific surface area and mineralogical composition. Water samples collected in distinct time intervals during the single-phase flow experiments are analysed for their elemental composition.

The experimental data show that CO2 is able to migrate into cap rocks, but at very low transport velocities. Absolute permeability coefficients extend down to the 10-23m^2-range. In many instances, transport is restricted to diffusion only, with effective diffusion coefficients in the order of 10-10m^2/s for He and 10-11-10 12m^2/s for CO2. CO2 sorption capacities on pure clay minerals and natural shale samples may be as high as 0.4 and 0.7 mmol/g (dry state), respectively. Analyses after exposure to CO2 revealed no substantial mineral alterations, which is certainly due to the fact that flow and reaction rates are very low and that only a small proportion of the sample gets in contact with the permeating fluid/CO2.

Acknowledgements: The CO2Seals project is incorporated into the GEOTECHNOLOGIEN R&D program funded by the German Federal Ministry of Education and Research (BMBF, Funding no.: 03G0681A). CO2Seals is co-funded and accompanied scientifically by the industry partner Shell International Exploration and Production, Netherlands.

We would like to thank several companies and institutions for kindly providing the sample material (Shell, the CO2SINK project consortium, NAGRA, ANDRA, SCK-CEN/ONFRAF-NIRAS, Fa. Holcim).

Literature: Amann A., Waschbüsch M., Bertier P., Busch A., Krooss B.M., Littke R. (in press). Sealing rock characteristics under the influence of CO2. In: GHGT10 Amsterdam, Energy Procedia, Elsevier.