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The CO2seals project: Investigation of the CO2 capillary sealing efficiency of low-permeable clay-bearing rocks and potential alteration mechanisms

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The safe long-term storage of gas/CO2 in spatially limited underground volumes requires the combination of a structural trap with intact structural integrity and a suitable low permeability cap rock (seal). The occurrence of natural gas reservoirs proves that certain lithotypes do provide efficient seals which can prevent leakage of gas to the atmosphere over long geological time periods (millions of years). In order to assess the risk of CO2 leakage through caprocks above potential storage sites to the surface one has to consider both, the present sealing capacity of the rock and its likelihood to alter in contact with CO2.
In the CO2seals project the prominent (coupled) processes associated with the transport and retention of CO2 in caprocks are being investigated, comprising capillary sealing, viscous flow, diffusion and adsorption. As shown in a study by Wollenweber et al. (in press), exposure to CO2 can significantly reduce the capillary sealing efficiency of clay-rich rocks. On the other hand, sorption of CO2 on clay minerals may "slow down" the process of leakage, by acting as an additional storing barrier (Busch et al., 2006). To investigate the processes of CO2-water-clay interactions, batch and flow reactor experiments on single clay minerals and synthetic mineral assemblages are being performed. First results suggest that CO2 leads to a shrinkage of the clay minerals (loss if interlayer water) and that iron (Fe) may be released from smectites. Additionally, first results of permeability studies and adsorption measurements will be presented.

Literature

BUSCH, A., ALLES, S., GENSTERBLUM, Y., PRINZ, D., DEWHURST, D.N., RAVEN, M.D., STANJEK, H., KROOSS, B.M., (2006): Carbon dioxide storage potential of shales. Int. J. Greenhouse Gas Control 2, 297-308.
WOLLENWEBER J., ALLES, A., BUSCH, A., KROOSS, B.M., STANJEK, H., LITTKE, R. (in press). Experimental investigation of the CO2 sealing efficiency of caprocks. Int. J. Greenhouse Gas Control