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Leakage from geological reservoirs: Monitoring and Modelling

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Carbon capture and storage (CCS) is considered to be one of the options, beside others, to mitigate climate change by reducing the amount of carbon dioxide (CO_2) released to the atmosphere. After injection of CO_2 into an appropriate storage formation the fraction retained depends on a combination of physical and geochemical trapping mechanisms. Cap rocks above the storage formation, normally layers of shale and clay rock, physically block the upward migration of CO_2. Capillary forces retain CO_2 in the pore spaces of the reservoir rocks. So called geochemical trapping occurs as CO_2 reacts with the formation fluids and the host rocks. Dissolution of CO_2 into the formation brine occurs over time scales of hundreds of years resulting in a formation water with increased density which tend to sink rather than rise towards the surface. Over thousands of years CO_2 might even be converted into solid carbonates storing it on the long term. Following the Intergovermental Panel on Climate Change (IPCC 2005) the following questions arise with regard to geological storage of CO_2: What actually happens to CO_2 in the subsurface and how do we know what is happening? Can we monitor CO_2 once it is injected? What techniques are available for monitoring whether CO_2 is leaking? Is it possible to predict the long term storage of CO_2 in geological reservoirs?

The fraction of CO_2 which needs to be retained in appropriate and managed geological reservoirs can be estimated from engineered and natural analogues. It is assumed that the amount of CO_2 retained in the storage reservoir is very likely to exceed 99 percent over 100 years and is likely to exceed 99 percent over 1,000 years (IPCC 2005). Studies are performed to come up with strategies of how to deal with non-permanent

storage based on different approaches. As can be expected, results are specific and vary with the applied methods and assumptions. However, if CCS is to be acceptable as a mitigation measure, there must be an upper limit to the amount of leakage that is allowed to take place which can either be quantified by monitoring or modelling techniques. We will present an overview about state of the art of monitoring and modelling procedures to analyse, actual and potential leakage of carbon dioxide from geological reservoirs. Special emphasis will be given to the pilot plant location of Ketzin, Germany (Förster et al. 2006).

References

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