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Organic geochemical characterization of reservoir rocks, cap rocks and formation fluids from the CO_2 storage site at Ketzin, Germany

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The European project CO_2SINK (CO_2 Storage by Injection into a natural saline Aquifer at Ketzin) is the first project on the on-shore underground storage of carbon dioxide in Europe. Near the city Ketzin (north-east Germany) a geological formation of the younger Triassic (Stuttgart Formation) was chosen as reservoir for the long-term storage of the carbon dioxide.

Within the scope of the Ketzin project we will analyse the organic matter in core rock and fluid samples to investigate the biogeochemical effects and changes on the geological formation caused by the injection of carbon dioxide. These investigations will help to evaluate the efficiency and reliability of the long-term storage of CO_2 in such a geological system.

Organic geochemical analyses will be performed on core rock samples drilled in 2007 at the Ketzin CO_2 storage site in Germany. In total, three bore holes were constructed: one injection well and two observation wells. In addition to the molecular analysis of the microbial community we will investigate rock samples from different depths for total, dissolved and extractable organic carbon including lipid biomarkers, such as organic acids and intact polar lipids as well as the isotopic analysis of individual organic compounds. With the analysis of intact phospholipids (IPL) we will be able to further characterize the indigenous microbial community. Intact phospholipids are found in all living cells as membrane components (Zelles, 1999). Their interpretation is based on the premise that different microorganisms contain different phospholipids with ester- and/or ether-bound fatty acids (White et al., 1979) and thus, the distribution of IPLs and PLFAs (phospholipids fatty acid) can be applied to characterise and compare microbial communities. The data obtained from these analyses will provide valuable information on the active microorganisms as well as shifts in community composition. The characterization of the organic matter in the reservoir rock allows conclusion on the origin of the organic matter and the identification of potential substrates as well as metabolites of the microorganisms within the reservoir and cap rock.

Additional interest concerns the changes which occur due to the injection of carbon dioxide into the geological formation. In June 2008 the injection of CO_2 into the saline aquifer near Ketzin started. From the biogeochemical point of view the injection of carbon dioxide leads to the question which impact the storage may have on the existing deep microbial ecosystem and reverse. In an earlier study on the underground storage of carbon dioxide in the Frio Formation (USA) high DOC contents and increased concentrations of organic acids in formation waters have been described after injection of carbon dioxide (Kharaka et al., 2006). In Ketzin we will monitor changes in the chemical composition of the formation waters within the reservoir by periodic down hole sampling of the formation waters in the injection as well as the two observation wells. These changes may affect the indigenous biocenosis according to e.g. the availability of new carbon and energy sources. Possible subsequent changes in the microbial community structure may affect the mineralogical structure in turn.

Furthermore, it is planned to analyse core samples for their in-situ potential to release organic compounds potentially mobilised by the injected carbon dioxide. This organic matter may build up a new carbon pool which may be used by the microorganisms of the deep biosphere. Considering this, microbial community changes in terms of abundance as well as composition are conceivable.

References

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