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Geochemical changes and microbial activities during CO_2 storage – Long-term experiments under *in situ* conditions within the frame of CO_2SINK

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Within the frame of the CO_2SINK project, CO_2 is injected into a saline aquifer of the Stuttgart formation (Triassic, Middle Keuper) at a depth of about 640 m below surface near Ketzin (Northeast German Basin, about 40 km west of Berlin) (Schilling *et al.*, 2009). The injection of CO_2 may induce a variety of geochemical changes in the reservoir system. Inorganic components may be dissolved from mineral phases (Wigand *et al.*, 2008) and mineral precipitation from fluid components (Ketzer *et al.*, 2009) may occur. In addition, organic molecules may be relocated, since supercritical CO_2 is an excellent solvent for organic components. These geochemical shifts probably affect the microbial community composition and activity. The dissolution and precipitation of minerals, as well as corresponding microbial processes (Bennet *et al.*, 2001) can affect reservoir permeability. In order to detect and quantify changes in geochemical characteristics and microbial processes during CO_2storage and to estimate their impact on storage efficiency long-term experiments under *in situ* P-T conditions are performed.

Freshly drilled sandstone sections from the target reservoir at Ketzin from a depth of about 630 m were incubated together with synthetic brine (20 % lower total dissolved solids than the Ketzin reservoir fluid) in high pressure vessels at 5.5 MPa and 40 ˚C since September 2007. Since outer core sections were contaminated with drilling mud, as shown with fluorescein tracer detection (Wandrey *et al.*, 2010), only clean inner core sections were used for long-term experiments to avoid contamination with microorganisms, as well as organic and inorganic mud components. After 15, 21 and 24 month fluid and rock samples were taken for chemical, microbial, mineralogical and petrophysical analyses.

In fluid samples the concentrations of Ca^{2+}, Mg^{2+}, and K^{+} were found to exceed those of the Ketzin reservoir fluid. Assuming chemical equilibrium between mineral and formation brine, observed effects are probably caused by mineral dissolution in response to CO_2 exposure. In consistence with inorganic concentration declines, XRD, SEM and EMP analyses suggest feldspar dissolution (Fischer *et al.*, EGU GA 2010). A shift to larger pore radii was observed as well (Zemke *et al.*, 2010).

Organic acids are a marker for the presence of active microorganisms. They are intermediate products of the bacterial metabolism. Furthermore, if excreted, organic acids can locally decrease the pH at the bacterial attachment site and may support mineral dissolution (Welch and McPhail *et al.*, 2003). After 15 month organic acid concentrations in vessel fluids were 2 to 7 times lower than the expected concentration (based on pore water analysis). To investigate the concentration trend during CO_2 exposure, the analysis of further samples is in progress.

In order to characterise the microbial community of the reservoir sandstone, initial 16S taxonomic studies were performed. So fare 16S rRNA gene sequences of chemoheterotrophic bacteria (*Methylophilales bacterium*, *Rhizobium radiobacter*, *Arthrobacter*, *Sphingomonas)*, and hydrogen oxidizing bacteria (*Ralstonia, Hydrogenophaga*) were obtained. During the long-term exposure experiment only minor changes of the microbial community composition were observed, reflecting the adaptation of the microorganisms to the modified conditions. The quantification of metabolic groups and relevant microbial activities, e.g. metal and sulfate reduction, using Real-Time PCR and FISH in untreated and CO_2 exposed samples will help to quantify bacterial processes and to assess their long-term influence on storage efficiency.

Bennet P.C., Rogers J.R., Choi W.J. (2001) Geomicrobiol J 18, pp. 3

Fischer S., Zemke K., Liebscher A., Wandrey M., CO_2SINK Group, EGU General Assembly 2010, Vienna

Ketzer J.M., Iglesias R., Einloft S., Dullius J., Ligabue R., de Lima V. (2009) Appl Geochem 24(5), pp. 760

Schilling F., Borm G., Würdemann H., Möller F., Kühn M., CO2SINK Group (2009) Energy Procedia 1, 2029-2035

Wandrey M., Morozova D., Zettlitzer M., Würdemann H., CO_2SINK Group (2010) Int J Greenhouse Gas Control, accepted

Welch S.A. and McPhail D.C. (2003) Advances in Regolith, pp. 437

Wigand M., Carey J.W., Schütt H., Spangenberg E., Erzinger J. (2008) Appl Geochem 23(9), pp. 2735

Zemke K., Wandrey M., CO_2SINK Group (2010) Int J Greenhouse Gas Control, accepted