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Petrophysical laboratory invertigations of carbon dioxide storage in a subsurface saline aquifer in Ketzin/Germany within the scope of CO_2SINK

K. Zemke, J. Kummmerow, M. Wandrey, and & CO2SINK Group
GeoForschungsZentrum GFZ

Since June of 2008 carbon dioxide has been injected into a saline aquifer at the Ketzin test site [Würdemann et al., this volume]. The food grade CO_2 is injected into a sandstone zone of the Stuttgart formation at ca. 650 m depth at 35°C reservoir temperature and 62 bar reservoir pressure.
With the injection of CO_2 into the geological formation, chemical and physical reservoir characteristics are changed depending on pressure, temperature, fluid chemistry and rock composition. Fluid-rock interaction could comprise dissolution of non-resistant minerals in CO_2-bearing pore fluids, cementing of the pore space by precipitating substances from the pore fluid, drying and disintegration of clay minerals and thus influence of the composition and activities of the deep biosphere.
To testing the injection behaviour of CO_2 in water saturated rock and to evaluate the geophysical signature depending on the thermodynamic conditions, flow experiments with water and CO_2 have been performed on cores of the Stuttgart formation from different locations including new wells of ketzin test site.
The studied core material is an unconsolidated fine-grained sandstone with porosity values from 15 to 32 %.
Permeability, electrical resistivity, and sonic wave velocities and their changes with pressure, saturation and time have been studied under simulated in situ conditions. The flow experiments conducted over several weeks with brine and CO_2 showed no significant changes of resistivity and velocity and a slightly decreasing permeability. Pore fluid analysis showed mobilization of clay and some other components.
A main objective of the CO_2Sink laboratory program is the assessment of the effect of long-term CO_2 exposure on reservoir rocks to predict the long-term behaviour of geological CO_2 storage. For this CO2 exposure experiments reservoir rock samples were exposed to CO2 saturated reservoir fluid in corrosion-resistant high pressure vessels under in situ temperature and pressure conditions over a period of several months.
Before and after the CO_2 exposure experiment cyclic measurements of physical properties were carried out on these cores in a mechanical testing system. After experimental runs of up to 3 months no significant changes in flow and petrophysical data were observed. [For the microbilogical studies see Wandrey et al., this volume.]
To study the impact of fluid-rock interactions on petrophysical parameters, porosity and pore radii distribution have been investigated before and after the experiment by NMR relaxation and mercury-injection. NMR measurements on rock core plugs saturated with brine may return valuable information on the porous structure of the rock core. The distribution of NMR-T2 values (CPMG) reflects the pore sizes within the rock core. NMR pore size is a derivative of the ratio pore surface/volume. The mercury injection pore size is an area-equivalent diameter of the throats connecting the pore system.
Most of the tested samples show in the NMR measurements a slightly increasing porosity and a higher part of large pores. The mercury measurements and thin- section for microstructural characterisation after the CO_2 exposure will be done at a later date.