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Investigation of thermosensitive tracers for the investigation of the thermal regime in CO2 sequestration reservoirs

Martin Nottebohm and Tobias Licha
Germany (martin.nottebohm@geo.uni-goettingen.de)

The aim of the lab experiments presented here is to find a set of suitable tracers which are sensitive to the temperatures in potential CO2 sequestration testsites. In CO2 sequestration the temperature of the reservoir is essential to understand the different ways how CO2 effectes the reservoir conditions and the characteristics of CO2 itself. For example there is a phase transfer of CO2 from gaseous to supercritical at 31°C and 74 bar. Also the kintetics of the dissolution of all phases may be effected by temperature significantly.

Previous experiments with different phenolacetates for the application as thermosensitive tracers in geothermal reservoirs has been proven succesful candiates to indicate temperaturs in reservoirs (Nottebohm et al. 2010). It was demonstrated that reaction rates of hydrolysis are strongly effected by additional groups on the phenolic ring thus providing a whole range of reactive vs. residence time and in turn tracer test set-ups. These substituents on the phenolic ring can influnce reaction kinetics differently. Dependig on the position they may act as sterical hinderance groups and depending on the substitutent group they may have mesomeric and inductive effects. Further these effects are pretictable within Hammetts law and the halflife of degredation can be controlled by the factor of 100. Also it has been shown that the reaction rates are stongly catalysed by OH-. Based on these results 2-ethylbutyl-2-naphthol-6-sulfonate has been studied in detail as an example for a practical tracer for site characterization. This substance has a lot of benefits. As an ionic substance it shows no distribution into scCO2. Its hydrolysis product is highly fluorescent and therefore easy to detect in trace-level concentrations in brines. Also quite similar substances (Naphthalenesulfonates) have been shown to be stable under geothermal conditions and have been already used as conservative tracers (Rose et al. 2001). The investigated half-life of 2-ethylbutyl-2-naphthol-6-sulfonate under typical CO2 sequestration testsite conditions (50°C, pH 6) is approximately 400 days and therefore practical for the application in a mid-term tracer test.

Assuming a mainly constant temperature and pH in the system the investigated substances should be excellent candidates for the application as temperature sensitive tracers at CO2 sequestration testsites. However, due to the complexity in natural systems a field test is strongly recommended.

References:

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