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Influence of temperature and reactive surface on dissolution rates of carbonates in CO2-bearing brine

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Chemical interaction processes between injected CO2, saline fluids and potential reservoir materials are experimentally investigated in this study as part of the joint project CO2-MoPa (*). The aim of the study is to derive dissolution rates of different polymineral and monomineral natural materials that can be used as input-parameter for dimension and risk analyses.

In order to determine kinetic data like the dissolution rate geochemical data were collected by teflon reactor experiments. Several potential reservoir rocks include carbonates as cement. Therefore as starting material calcite grains (Cc) of different size fractions (160 – 250 μm / 250 – 500 μm) were used. All experiments run with a complex synthetic brine (TDS: $\sim$ 150 g/l) according to a natural upper cretaceous formation water. Dry ice was used as CO2-source. The run temperatures were fixed at two temperatures (100°C / 150°C). The run duration varied between 1 and 30 days. The pressure inside the teflon reactor was 100 bar in all experiments.

The Ca-concentration changes during the experiment were monitored by ICP-OES measurements of the initial and the post-run fluids (inorganic geochemistry lab, D. Garbe-Schönberg, IfG, CAU Kiel). These Ca-concentration changes were used to derive dissolution rates (R) of Cc. The following dependencies of the derived R-values were observed:

(a) During the first 10 days an increase of the run temperature (100°C / 150°C) causes a higher R of Cc by a factor of 2. The equilibrium state was reached after 20 days for both temperatures.

(b) The different size fractions (160 – 250 μm / 250 – 500 μm) result in different reactive surfaces. The reactive surface of the smaller Cc grains (set A) is by a factor of 1.9 larger than the 250 – 500 μm fraction (set B). During the first 5 days the R-values of set A experiments are a factor of 10 smaller than the R-values of set B experiments. Between 5 and 20 days the factor continuously decreases to 2. Equilibrium state of both size fractions was reached after 30 days.

To conclude, our preliminary results exhibit no significant influences of the run temperature and the reactive surface on the dissolution rate of Cc. The lower dissolution rate at larger reactive surface is contrary to literature observations. The reason for that is not yet clear. Additional experiments with other size fractions are therefore under progress.

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