

Corrosion and scaling in low-enthalphy geothermal systems in northern Germany

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Due to the increasing demand for sustainable, environmentally friendly energy the further development of geothermal techniques and the exploration of adequate reservoirs are essential. We aim to optimize the energy yield and evaluate the potential risks during well operation which requires a detailed process understanding of geochemical reactions. Especially, changes of the thermodynamic conditions in the course of fluid production and re-injection might result in potential corrosion or mineral precipitation (scaling) in the well-tubings or in the installations above ground, which would severely affect the planned long-term operation of the system.

Within the North German Basin, the GFZ maintains the geothermal research well doublet (*in situ* laboratory) Groß Schönebeck (Germany). Here, Lower Permian (Rotliegend) sandstones are encountered at a depth of approximately 4400 m that are saturated with a Ca-Na-Cl type formation fluid of high salinity (TDS = 265 g/l) at approximately 150°C and 500 MPa. The formation fluid of this low enthalpy geothermal system contains relevant concentrations of several compounds (Fe, Pb, Sr, Ba, SO₄, Si, Cu, Hg and As), which might be of importance for scaling and corrosion effects [1]. During well operation (start in 2009) changes in fluid pH-value, redox potential, and dissolved O₂ will be monitored *in situ* and the chemical composition of fluid samples will be analyzed in the lab. Due to the high temperature, pressure and salinity of the fluid the development of adequate techniques is one of the challenges within this study. Moreover, a simulation of the fluid-material interactions in dependence of the p-T path the fluid will take during extraction/re-injection will be developed by geochemical and reactive transport simulation codes. Our overall goal is to transfer the results as obtained from Gross-Schönebeck to other locations considered for geothermal energy production. In this contribution, we will present an outline of the techniques developed for geochemical in-situ monitoring campaigns as well as first data of formation fluid characterization.

[1] Giese *et al.* (2002) *Geochemistry of the Formation fluid*. GFZ Scientific Technical Report STR02/14, 145-169.

Methane efflux from marine sediments: Kinetic, microbial and bioenergetic controls

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Anaerobic oxidation of methane (AOM) is an efficient subsurface barrier for the methane produced globally in marine sediments. Its efficiency is a crucial control on global marine CH₄ fluxes to the ocean-atmosphere and, thus, on climate. This contribution reviews the different approaches that have been used to simulate the AOM reaction kinetics. The model types are organized according to their chemical and/or biological complexity, from the abiotic, encounter limited (or bimolecular) model, to the biomass-explicit thermodynamic-kinetic model. The role of intermediate energy substrates, the regulation of AOM rates by microbial growth and decay processes, and the possible thermodynamic limitation of AOM is then discussed. In addition to microbial and geochemical controls, the efficiency of the AOM barrier is also constrained by the magnitude of methane transport. Thus, using a similar reactive-transport framework but different AOM kinetics, predictions of AOM rates and methane release from the sea floor are compared for the typical environmental settings where AOM occurs. The performance of the kinetics models are also addressed under fully-transient conditions triggered by a variable fluid-flow regime.