Geophysical Research Abstracts
Vol. 21, EGU2019-9146, 2019
EGU General Assembly 2019

Transport behavior in deep groundwater systems considering variations in salinity

Torben Weyand and Jürgen Larue
(torben.weyand@grs.de)

In early long-term safety analyses for repositories for radioactive waste, the transport of contaminants from the repository up to near-surface groundwater was examined based on the assumption of a freshwater groundwater system. To calculate the density-driven flow considering variations in salinity in deep groundwater was not possible for large model domains over long simulation times due to limitations in computer speed and capacity. It was assumed - but not shown - that the transport of contaminants in brine systems is slowed down drastically compared to freshwater systems. Simulating the density-driven flow for large model domains over long simulation times is still a geoscientific challenge.

The aim of this study is to calculate the transport of an ideal tracer considering variations in salinity of deep groundwater systems to study the transport behavior of contaminants in freshwater/brine systems. To simulate groundwater flow, the "Simulation of Processes in Groundwater" code (SPRING) is used. SPRING is suited for multidimensional hydrogeological modelling of density-driven groundwater flow through porous media considering variations in salinity. Advection, diffusion and dispersion are regarded as transport processes.

A two-dimensional model based on geological data and cross sections of a real site is set up using several parameter variations regarding hydrogeological parameters and hydraulic boundary conditions. This study shows a representative selection of several numerical simulations regarding variations in the salinity distribution in deep aquifers over geological timeframes. The hydrogeological model has twelve different geological layers and considers several confined aquifers as potential migration paths for contaminants. The groundwater density depends on the salt concentration and is considered up to 1.250 kg/m^3.

As initial condition, the model domain is completely filled with freshwater and a Dirichlet boundary condition for the salt concentration at the bottom of the model is used to represent the influence of salt layers. The density-driven flow is simulated over several million years until a quasi-steady state is reached. In a first step the historical evolution of the salinity gradient is calculated and compared with the investigated data of the site. As result the variation in salinity is shown for different time steps. At selected time steps several ideal tracers are released and the transport considering the density-driven flow is calculated. The results show the distribution of the tracer concentration in the hydrogeological system for each tracer. The transport behavior considering variations in salinity is analyzed and the delay in transport due to different freshwater/brine distributions can be determined.