Hydrothermal Brine Transport Near Basin/Fractured-Basement Interfaces

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ABSTRACT

Simulation of the hydrothermal transport of brine is key to understanding mass and heat transport across the basement/sediment interface in basins. Downward flow of cooler basin brines may displace and mobilize stagnant, hotter, chemically stratified, and often fracture-hosted brines in the basement. Previous conceptual studies postulated fingering as a major hydraulic mechanism, allowing for mutually up-/and downward flows of brines from the two reservoirs, a potential key factor in the formation of basin-hosted ore deposits and in establishing geothermal anomalies. With this idea in mind, we created the prototype of a hydrothermal simulation tool in which faults and fractures can be explicitly represented within a porous matrix. To understand how geometric complexity of the fractures affects thermo-haline transport, we performed a series of simulations utilizing an accurate equation of state. We designed synthetic geometries to study the propagation of salinity fronts using a simulator based on the CSMP++ library (Paluszny et al., 2007), honoring the governing equations for compressible porous media flow and saline transport (Geiger et al., 2006; Weis et al., 2014). This work is a further step towards modeling thermo-haline convection within realistic representations of discrete networks of thin fractures, a scenario typically observed in basement rocks of deep geothermal systems and at basement/sediment interfaces and related deposits of U, Pn, Zn, and others. References Geiger, S., Driesner, T., Heinrich, C.A., Matthai, S.K. (2006), Multiphase thermohaline convection in the Earth's crust: I. A new finite element - finite volume solution technique combined with a new equation of state for NaCl-H2O. Transport in Porous Media, 63, 399–434, doi: 10.1007/s11242-005-0108-z Paluszny, A., Matthai, S.K., Hohmeyer, M., (2007), Hybrid finite element–finite volume discretization of complex geologic structures and a new simulation workflow demonstrated on fractured rocks. Geofluids, 7: 186–208. doi:10.1111/j.1468-8123.2007.00180.x Weis, P., Driesner, T., Coumou, D., Geiger, S., (2014), Hydrothermal, multiphase convection of H2O-NaCl fluids from ambient to magmatic temperatures: a new numerical scheme and benchmarks for code comparison, Geofluids, 14(3): 347–371,doi: 10.1111/gfl.12080