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Deep fluid migration combining numerical modelling and hydrochemical data

F. Magri (1), U. Bayer (1,2), A. Pekdeger (2), M. Tesmer (2)

(1) GeoForschungsZentrum Potsdam, Germany, (2) Freie Universität Berlin, Germany (fabienma@gfz-potsdam.de)

In the North East German Basin (NEGB) deep-seated waters migrate toward shallow aquifers. Owing to water-rock interactions, deep fluids are highly saline and dense. Upward flows of these heavy waters suggest that forces overcoming the gravitational field must exist in addition to any natural topography-driven flow. In order to understand the mechanisms of brine migration within the NEGB, numerical simulations of coupled fluid flow, heat and mass transport (i.e. thermohaline) have been carried out together with hydrochemical investigations. The numerical model contains the major stratigraphic and hydrogeologic units from Quarternary to the Upper Permian and is further supported by a vast set of hydrochemical data. According to the hydrochemical analyses most of the deep seated brines result from ablation of salt structures. Mixing processes as well as local hydrochemical and isotopic anomalies suggested that fluid migration takes place between the aquifers on a large regional scale. The numerical results showed that thermal disturbances provided by the presence of salt domes within the basin generate upward flow of dissolved halite. Thermal buoyant forces are dominant even along salt flanks where gravitational forces were expected to be stronger. Furthermore, the influence of a locally fractured aquitard (the Rupelton) on the dynamic of the convective cells has been investigated. Both numerical and hydrochemical investigations are in good agreement with the observed data.