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Influence of faults on the thermal field and fluid system in a geothermal site (Groß Schönebeck, NE-German Basin)

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Faults disturb the conformal succession of geological layers, and therefore they might act as pathways or barriers to fluid flow. To make use of geothermal energy reserves, it is important to understand the physical processes controlling heat transfer and fluid motion and the impact of faults in the subsurface. Numerical simulations represent a useful and increasingly common tool for geothermal exploration and reservoir engineering as they consider both, the structural setting of the subsurface and the physical processes of the coupled fluid and heat transport.
For our coupled fluid and heat transport simulations, we improved an existing 3D structural model of the geothermal site Groß Schönebeck (Moeck et al. 2005), located in the North East German Basin. The coupled non-linear partial differential equations describing fluid flow and heat transport in a saturated porous medium are numerically solved by the finite element software FEFLOW® (Diersch, 2002). Simulation results are validated with borehole data.
The geological model covering an area of 55 x 50 km resolves a succession of Carboniferous to Quaternary age and reaches down to 5 km depth. An up to 1200 m thick Upper Permian (Zechstein) salt layer decouples two fault systems. We focus on the subsalt fault system which comprises the reservoir target zone. There, major NW-SE trending faults intersect with minor NE-SW oriented faults. These faults are integrated as vertical discrete elements within the numerical model. By discrimination of critically stressed and extensional faults within the current stress field, the hydraulic conductivity of the faults is assessed (Moeck et al. 2009). We investigate the influence of faults on the fluid system and thermal field by comparing the results from models that do not integrate faults with fault models. We find that faults may have a local, strong impact on the hydrothermal field. As such, the results provide essential information on the fluid motion and temperature variations and can support geothermal exploration.

References:

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