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Assessment of the impact of faults on the coupled fluid and heat transport in a geothermal site (Groß Schönebeck, NE-German Basin): First results from 3D finite element simulations

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Fractures and faults are likely to have a significant impact on physical processes controlling the fluid and heat transport in the subsurface. Depending on their hydraulic properties, faults can act either as preferential pathways or as barriers to fluid flow.
To effectively quantify the impact of the architecture of faults and their variable physical thermal and fluid properties on the resulting fluid system and thermal field, a 3D finite element model based on the structural model of the geothermal site "Groß Schönebeck" (NE-German Basin) (Moeck et al. 2005) is used to carry out coupled fluid and heat transfer simulations. The coupled system of equations describing thermal convection in a saturated porous media is numerically solved by the commercial software FEFLOW®.
The study area covers a surface of 55 km in E-W and 50 km in N-S direction. The geological model consists of 18 different sedimentary layers from Carboniferous to Quaternary strata. For the coupled fluid and heat transport simulations, lithology-dependent thermal and hydraulic properties like thermal conductivities, radiogenic heat production rates, volumetric heat capacities, porosities and permeabilities are assigned constant to each layer.
Major faults are approximated as vertical discrete elements within the numerical model.
We present and discuss results from these simulations by comparing them with results from coupled fluid and heat transfer simulations obtained from models that do not integrate faults.

References:

Diersch, H.-J.G., 2002. FEFLOW finite-element subsurface flow and transport simulation system. User's Manual/Reference Manual/White Papers, Release 5.0. WASY GmbH, Berlin.

Moeck, I., Holl, H.-G. and Schandelmeier, H., 2005. 3D Lithofacies Model Building of the Rotliegend Sediments of the NE German Basin AAPG International Conference & Exhibition (Paris France 2005), CD-ROM, paper #98619.