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Modelling conductive and convective processes for the area of Brandenburg (NE German Basin)

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Understanding the internal heat transfer in sedimentary basins requires an assessment of the different physical processes that control heat transport in the subsurface. As faults may provide permeable pathways to fluids or hydraulic barriers they may additionally influence the geothermal field. We present 3D finite element simulations based on a regional structural model for the area of Brandenburg (Northeast German Basin) to quantify the relative influence of different heat transport processes and to assess the role of faults on the geothermal field.
Ranging from the Permian to Cenozoic, the sediment fill resolved in the model is characterized by several aquifer complexes and a layer of mobilized Zechstein salt (Noack et al. 2010; Scheck and Bayer, 1999). The distribution of the salt plays a special role for both the thermal and fluid regime due to its high thermal conductivity and its function as a hydraulic barrier in the sedimentary succession. The southern basin margin is dissected by two major fault zones, which vertically offset the pre-Permian basement against the Permian to Cenozoic sediments by several km (Scheck et al. 2002).
3D conductive, coupled fluid and heat transport and full thermohaline models are carried out and compared to each other to assess the impact of moving fluids and to analyze to which degree variations in aquifer thickness and permeability control the regional thermal field. In a next step, fault zones are integrated into the numerical model and different scenarios are tested by varying the permeability of the fault zones.
We conclude that conduction is the dominant heat transport mechanism in the study area, whereas the thermal field in the shallow 2 km is additionally influenced by forced convective heat transfer and related advective cooling. Free convective thermal anomalies occur only locally (where the pressure forces are weak) and are controlled by the thickness and permeability of the respective layers. The fault model outcomes reveal a pronounced local influence of permeable fault zones. By contrast, impermeable faults resemble the thermal state of the regional model without faults.

References:

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