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The role of different heat drivers within the Northeast German Basin - Results from 3D numerical modelling of the coupled fluid and heat transfer

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The goal of the present study is to investigate and quantify main physical heat driving processes affecting the present-day subsurface thermal field within a complex geological setting, the Northeast German Basin (NEGB). By means of 3D numerical simulations we explore the role of heat conduction, pressure and density driven groundwater flow as well as fluid viscosity related effects.

The NEGB is characterised by the presence of an Upper Permian Zechstein salt layer. Geologically, the Zechstein salt is highly structured due to local salt tectonic movements. Spatial variations in salt geometry are manifested by local salt structures piercing their sedimentary overburden and locally reaching nearly the surface. Gradients in thermal conductivities between the highly conductive salt and the relatively poorly conductive surrounding sedimentary clastics cause thermal anomalies to evolve nearby major salt structures. At the same time, the Zechstein salt is impervious to fluid flow thus acting as a natural no flow internal boundary. Due to its complex geometry, anomalous thermal and hydraulic properties the Zechstein salt layer plays a major role in controlling the internal temperature distribution within the basin.

Based on a 3D geological model of the NEGB different coupled fluid flow and heat transfer numerical simulations are carried out to study the basin-wide temperature distribution. Starting with relatively simple model configurations with respect to the processes being investigated, the model complexity has been gradually increased. The approach thus enables to identify the impact of each heat driving mechanism, their mutual interactions with other processes and net effects on the resulting hydrothermal system.