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Models of the thermal field in the North German Basin

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Geothermal heat may be an attractive source for a future sustainable supply of energy. However, a regional assessment of geothermal resources involves an improved understanding of the main physical mechanisms involved in the transport of heatin the subsurface. We present results from 3D numerical simulations of heat transport for different parts of the North German Basin and assess the relative influence of conductive versus convective heat transfer. This basin contains more than 12 km thick sediments including a layer of strongly mobilized Upper Permian (Zechstein) salt. We use differently detailed 3D structural models of the area that resolve the configuration of the basin fill, of the crystalline crust and of the lithospheric mantle to evaluate the relative influence of different depth levels on the shallow thermal field. We assess the sensitivity of the results with respect to variations in contrasting thermal rock properties of the sedimentary cover and with respect to the impact of different configurations of the crystalline crust and the lithospheric mantle. We find that conductive heat transport is the dominant mechanism on the scale of the lithosphere and that the configuration of the deeper lithosphere controls the long-wavelength pattern of the temperature distribution. The latter is superposed by short- wavelength temperature variations resulting from the spatial interaction of thermal rock properties in the sedimentary fill with a dominant influence from the thickness and geometry of the thermally highly conductive salt layer. However, the thermal field of the upper 2 km is additionally affected by fluid flow, causing advective cooling on a basin scale and free thermal convection locally.