Geophysical Research Abstracts
Vol. 12, EGU2010-13581, 2010
EGU General Assembly 2010

High resolution temperature models for geothermal exploration in sedimentary basins: methods and applications

Jan-Diederik van Wees (1,2), Damien Bonte (2), Hanneke Verweij (1), and Leslie Kramers (1)

(1) TNO, Geo-Energy and Geo-Information, Utrecht, The Netherlands (jan_diederik.vanwees@tno.nl), (2) VU University Amsterdam, The Netherlands

Key to geothermal exploration success is sufficiently high temperature. This paper focusses on high resolution temperature prediction for geothermal exploration in sedimentary basins. In existing thermal basin models for oil and gas exploration, the focus is on predicting past temperature histories in the sedimentary cover for assessment of oil and gas maturation and expulsion. For detailed 3D models (i.e. involving millions of temperature nodes) these models take long to run and are hard to calibrate to both temperature data in wells and lithosphere boundary conditions. Moreover, spatial variations in basal heat flow is generally not controlled by tectonic boundary conditions.

Tectonic models, capable of modelling the thermal consequences of basin evolution, allow to asses spatial heat flow variability based on lithosphere deformation, and provide additional constraints and better quantitative understanding of temperature anomalies.

In order to improve modeling capability in terms of model resolution and incorporating tectonic effects, we have developed a novel 3D thermal basin model. In the model transient temperatures are calculated over the last 20 Million years for a 3D heat equation on a regular 3D finite difference grid, allowing for spatial variation in thermal properties, temporal variation in surface temperature and spatial and temporal variations in basal heat flow. Furthermore the model takes into account heat advection, including effects of sedimentation, and lithosphere deformation. The model is iteratively calibrated to temperature data at the well locations, typically taking less than 5 runs. In addition well locations basal heat flow conditions are interpolated based on tectonic constraints.

The capabilities of the model are demonstrated for various sedimentary basins, including the Netherlands. The models have been calibrated to extensive well data, showing considerable spatial variability which appears to be related to both tectonic variation as well as heterogeneity of thermal properties and overprinting by non-conductive processes.