Geophysical Research Abstracts,
Vol. 11, EGU2009-8358, 2009
EGU General Assembly 2009

What causes the increased heat flow of the Northeast German Basin?

B. Norden (1), A. Förster (1), and N. Balling (2)

(1) GFZ German Research Centre for Geosciences, Potsdam, Germany (norden@gfz-potsdam.de), (2) University of Aarhus, Department of Earth Sciences, Aarhus, Denmark

The Northeast German Basin (NEGB) exhibits a terrestrial surface heat flow higher than the global average for continents. At 13 deep borehole locations, surface heat flow was determined ranging from 68 to 91 mW m^{-2} with a mean of 77 $\pm$ 3 mW m^{-2}. The heat-flow determination is based on continuous temperature logs, measured thermal conductivity, and log-derived radiogenic heat production. The surface heat flow is supposed to represent unperturbed crustal heat flow, free of effects from surface palaeoclimatic temperature variations, from regional as well as local fluid flow, and from thermal refraction in the vicinity of salt structures.

To shed light on the causes of the increased heat flow, 2-D numerical lithospheric thermal models are developed for a 500 km section across the NEGB, along the DEKORP-BASIN 9601 deep seismic line extended to the north-east. While the 9-km-thick sequence, containing sediments of Permian to Cenozoic age, is well known from a large number of boreholes and commercial reflection seismic lines, the detailed structure and composition of the underlying crust is known with less confidence. In general, the crustal basement of the NEGB, from the north to the south, is comprised of Baltica crust, Caledonian crust, and Variscan crust. A detailed conceptual model of the crustal structure and composition, thermal conductivity, and heat production distribution of the NEGB was generated by integrating available geophysical and geological data (e.g. from seismics and seismology, gravity, geology from drillings, and petrology). On the basis of this first integrated conceptual model the thermal impact of different boundary conditions for the thickness of thermal lithosphere was tested. The best fit of the thermal model with measured surface heat flow was achieved with a thickness of thermal lithosphere of about 75 km. This thickness is somewhat less than typical values for stabilized Phanerozoic lithosphere (100-120 km). The best-fit model shows Moho temperatures of about 800 ˚C in the central part of the basin. In the southernmost part of the section, beneath the Harz Mountains, higher Moho temperatures up to 900 to 1000 ˚C are shown. The heat flow from the mantle is in the order of about 35 to 40 mW m^{-2} along the section. While the high surface and mantle heat flow in the NEGB obviously are of large wave length caused by lithosphere thickness, changes in crustal structure and composition are responsible for short wave length anomalies. For example, a sharp increase of surface heat flow is expected across the Elbe Fault System to the south, mostly resulting from a granitic/granodioritic upper and middle crust and from the lack of a typical lower crust composed of mafic granulite.