Introduction

Late-Variscan granites of different petrogenesis, composition, and age constitute main parts of the Variscan crust in Northern Bavaria. In recent years granites have gained attention for geothermal prospecting. Enhanced thermal gradients can be realized, when granite terrains are covered by rocks with low thermal conductivity which can act as barriers for heat transfer (Sandford et al. 1998). The geothermal potential of such buried granites is primarily a matter of composition and related heat production of the granitoid and the volume of the magmatic body. The depth of such granitic bodies is critical for a reasonable economic exploration.

In the Franconian foreland of exposed Variscan crust in N Bavaria, distinct gravity lows are indicated in the map of Bouguer anomalies of Germany (Gabriel et al. 2010). Judging from the geological context it is likely that the Variscan granitic terrain continues into the basement of the western foreland. The basement is buried under a cover of Permo-Mesozoic sediments (Franconian Basin). Sediments and underlying Saxothuringian basement (at depth > 1342 m) form a granitic terrain continuing into the basement of the western foreland. The basement is buried under a cover of Permo-Mesozoic sediments (Franconian Basin).

Gravity Modelling

For the interpretation of the Bouguer anomalies in the Franconian Basin, gravity modelling using the software IGMAS+ (Interactive Geophysical Modelling Assistant; Transinsight GmbH, Dresden; Schmidt et al. 2011) has been performed. The model consists of 18 sections with orientation perpendicular to the NW-SE-striking fault system of the Franconian Line. The underground model is based on information from drillings, seismic 2D-profiles, and previous small scale gravity models.

The underground model contains four granitic bodies in the upper Saxothuringian crust. The depth of the granites was estimated by interpretation of high-pass filtered gravity anomalies and calculations using the half width and the slope of the gravity anomaly. The boundary between Saxothuringian and Moldanubian is marked by positive gravity anomalies caused by tectonically intercalated diabases with a higher density than the surrounding basement. The Moldanubian is characterized by granitic intrusions and therefore causes generally lower gravity values in the south of the modelling area.

Heat production of Variscan granites

Granites constitute a major part of the exposed Variscan basement in eastern Bavaria. The granites can be divided into the Older Intrusive Complex (OIC) and the Younger Intrusive Complex (YIC). Heat production of the Variscan granites is calculated from K-, U-, Th-concentrations measured with a portable gamma ray spectrometer (RS-230 BGO Super-Spec, RadiationSolutions and Geo-Radios). Calculations using the equation of Rybach (1988) rank the Variscan granites as moderate heat producing.

The impact of a heat producing body on the geothermal gradient in the Franconian Basin is modelled with the software COMSOL Multiphysics. The geothermal gradient is calculated for a heat producing, 300 Ma old granite beneath the Variscan Flysch and the Permo-Mesozoic sediments. The thermal conductivity of the stratigraphic units were measured on core samples from Obernsees.

Results

- four granitic bodies have been identified in the subsurface of the Franconian basin
- good correlation of measured and modelled gravity anomaly
- radiogenic heat production of granite contributes significantly to increased geothermal gradient

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