Geol. Paläont. Mitt. Innsbruck, ISSN 0378–6870, Band 25, S. 1–242, 2001

THE THERMAL REGIME OF THE EASTERN ALPS FROM INVERSION ANALYSES ALONG A N-S TRENDING PROFILE

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In the summer of 1999 at twenty-six locations in the Eastern Alps a collective of 118 rock samples were taken. Between 3-7 rock samples represent each of the main lithologic units which contribute at least one kilometer thickness of the Eastern Alpine crust. The rock samples represent different depth levels of the Eastern Alpine crust.

After the sampling campaign petrographic and geochemical investigations were carried out to permit an accurate rock naming. At the same time rock-physical laboratory measurements of bulk and pure density, thermal conductivity (measured on water saturated rocks at room temperature and on dry samples in the range from 0 – 800 °C), thermal heat capacity (at temperatures ranging from 20-300 °C) and heat production rate were executed.

The results of the measurements concerning temperature-dependence of thermal conductivity of different rocks were further on used to check a formula, set up by SASS et al. (1992) and originally tested for magmatic rocks in the temperature range from room temperature up to 250 °C. Additionally it was tried to determine coefficients, making it possible to predict temperature dependence of heat conductivity also for other rock types (e.g. different magmatic, metamorphic and sedimentary rocks) and for temperatures from 250 °C to at least 500 °C.

A further new objective was to create a pseudo depth profile of heat production for at least a part of the Eastern Alpine crust on the basis of measured data extracted out of rock-samples. Thereby it should be tried to resume an approach of HAWKESWORTH et al. (1974) who made an attempt to create a pseudo-depth-profile of heat production for a small area in the Tauern Window and basing also on measured data obtained from pick-samples. The authors projected rock samples, taken in the context of a geological mapping in a small area in the Tauern Window into their original depth of genesis to verify trends in the reduction of heat production with depth for the basement of this area.

In order to get reliable input parameters for stationary finite element simulation calculations on conductive heat transport all measured values were re-evaluated, using the Bootstrapping procedure. A FE-mesh was generated firstly based on the TRANSALP profile generated by LAMMERER et al. (1998) and adapted later on permanently to the newest results of the other TRANSALP working-groups. The simulation calculations were carried out with a FE-mesh with 2015 finite elements (6382 nodes). Later on the mesh had to be simplified to 936 finite elements (2989 nodes) because of fixed limitations in the inversion program. The results of the simulation calculations were calibrated by means of temperature and heat flow data from drill holes, tunnels and lakes in Germany, Austria and Italy.

Later on inversion calculations were executed with a FE program based on the Bayesian parameter estimation technique, which was originally developed by WANG (1989) and extended by LEHMANN (1998) regarding the temperature dependence of the rock-physical parameters. A substantial target of the inversion analyses was to estimate the uncertainty of the modelled conductive heat transfer processes in the basement of the Eastern Alps (one major aim is to define the variability of the heat flow from the mantle into the crust). Additionally Peclet number analyses were carried out to estimate the influence of transient effects (uplift and erosion) on the current temperature distribution.

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