Lithospheric Temperature Response to Magmatic Processes in West Bohemia

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The magnitude and timing of the transient thermal anomaly in the lithosphere induced by asthenosphere upwelling and by magma underplating of the crust on the southwestern end of the North Bohemian volcanic line was investigated by means of mathematical modelling. The generation and propagation of the heat pulse was simulated by numerically solving the transient heat conduction equation in the geothermal model of the lithosphere, taking into account the latent heat of the magma crystallization. Four alternative scenarios of magma underplating were considered: the instantaneous formation followed by conductive cooling, a) immediately or, b) after 11 Ma of keeping the magma molten and, c) gradual magma underplating within the period of 11 Ma, or d) of 40 Ma. The thickness and position of magma emplacement was estimated from the geological interpretation of the 9HR seismic reflection profile at 3 km at the depth range of 30–33 km, just below the Moho boundary in the area of the Teplá Upland. The shape of the emplacement was approximated by a vertical cylinder with a diameter of 90 km. The time scale of the process, 10–40 Ma, is based on the age of the volcanics found in the region. The initial magma temperature of 1300 °C was assumed on the basis of petrological and geochemical studies in similar zones in Germany.

We found that the transient heat flow anomaly from the magma emplacements near to the Moho amounts to about 5 mWm^{-2} on the surface and does not account fully for the increase of 10 to 20 mWm^{-2} observed in the area (about 80 mWm^{-2} compared to 60–70 mWm^{-2} in the surroundings). A substantial part of the observed heat flow surplus can be explained by the asthenosphere upwelling in the early stages of the magmatism some 40 Ma ago. Simulation of this process by considering 1300 °C hot asthenosphere upwelling from 100 km to 75 km below the area of the magma underplating yielded, for the considered geothermal model of the lithosphere, the background surface heat flow of 69 mWm^{-2}, increasing to 75 mWm^{-2} towards the central part (axisymmetric geometry) or to 78 mWm^{-2} (2-D geometry) for times of 40 Ma and longer. We conclude that a combined effect of the asthenosphere upwelling and magma underplating near the Moho can raise the surface heat flow to the observed levels. All these results are rather conservative estimates that did not take into account the possible small-scale mantle convection between the mechanical boundary layer and the thermal boundary layer (region between 800–1300 °C).

New Geophysical Contributions to the Geological Structure of the Contact Zone of the Bohemian Massif and the West Carpathians

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The paper presents some results of the project entitled "Structural-Geological Configuration of the West Carpathians and their Basement on the Basis of Geophysical Data from Border Areas with Poland and the Slovak Republic". The area of interest occupies the contact zone of the Bohemian Massif with the West Carpathians in the Czech territory and in the near-frontier areas of Poland and Slovakia. Magnetic, gravity, seismic, well-log and petrophysical data were gathered, reprocessed and newly interpreted regarding the latest methodical and geological knowledge. The following new maps were evaluted: Magnetic ΔT anomalies, Bouguer gravity, Horizontal gradient of gravity, Density boundary indications, Shaded relief of topography and Top of the crystalline basement map. The magnetic and gravity interpretation schemes were elaborated with the lists of anomalous geological sources. Finally, two interpretation cross-sections were outlined: Brno–Hodonín and Šternberk–Lysá pod Makytou.