An internally consistent present-day thermo-petrological model of the Erzgebirge crust

(1 fig.)

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Studies of the thermal field in Europe identified the Erzgebirge and the adjacent Eger rift as areas of high surface heat flow. Interpretations of this anomaly, however, were different and included (1) an increased mantle heat flow, (2) fluid advection, and (3) the occurrence of high heat-production granites. Improved geophysical data from seismic lines and gravity studies, a better knowledge on variation of heat production in Variscan basement rocks, re-evaluation of previous T measurements in deep boreholes, and consideration of the p-T dependence of petrophysical properties improved our knowledge on structure and composition of the crust and allowed to test these hypotheses.

In the Erzgebirge, surface heat flow (q_S) ranges between 61 and 108 mW/m^2 but displays strong correlation with lithology (Fig. 1). Sites of high heat flow correlate with the distribution of late Variscan granites, those of lower heat flow refer to the outcropping early Variscan metamorphic basement. These major groups of upper crustal basement rocks are distinctly different in radiogenic heat production (A). Most granitic rocks are classified as high-heat production (HHP) granites and display values of A up to 15 µW/m^3, depending on geochemical type, intensity of alteration, and degree of magma differentiation. The A values of the majority of Erzgebirge granites largely exceed those of average Phanerozoic granite (2.8 µW/m^3) and av-

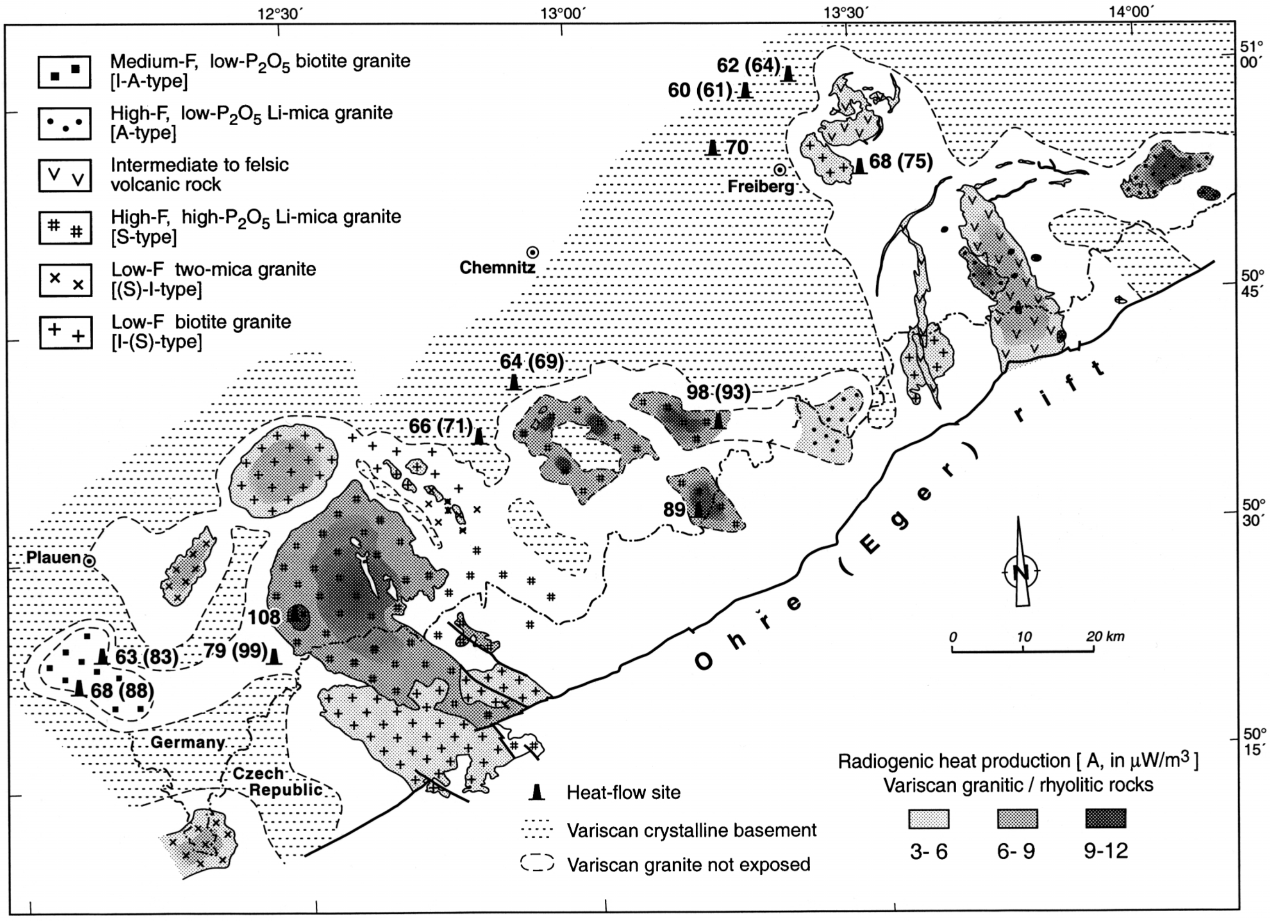

Fig. 1 Distribution and heat production of Variscan granites/rhyolites from the Erzgebirge. Numbers at the heat-flow sites refer to the corrected q_S, those in parentheses to the measured q_S.

erage felsic I- and S-type granites (3.0 μW/m^3). The *A* values of upper crustal metamorphic rocks are distinctly lower and range between 1.5 and 3.5 μW/m^3, with the majority of values between 2 and 3 μW/m^3. Thus, high heat flow is correlated with the distribution of HHP granites. Strong contrast in *A* between the igneous and metamorphic basement required correction of the measured q_S for heat-refraction effects (see Fig. 1). These corrected values provided the input for any further calculation.

Heat-budget calculations in the off-granite regions of the Erzgebirge allowed calculating the heat flow at the crust/mantle boundary (q_M). They took advantage of the improved knowledge on the variability of *A* in the entire crustal segment as well as the crustal models derived from geophysical/petrological studies. A slightly different interpretation of the seismic and gravity data in terms of composition and thickness of the middle and lower crust results in Moho heat flow varying between 20 and 28 mW/m^2. This range does not lend support to an abnormally high mantle heat flow as a prime cause for the Erzgebirge heat-flow anomaly.

Interestingly, thermal anomalies in the Eger rift (not affected by fluid advection) are of the same order as those in the adjacent Erzgebirge and also are spatially associated with HHP granite occurrences. Thus, it is fair to assume that heating effects in conjunction with recent intracontinental rifting and asthenosphere upwelling discussed to operate in parts of the area, have not yet reached the surface and, therefore, are not reflected by surface heat flow. Ongoing thermobarometric studies of lower crustal and mantle xenoliths entrained in Cenozoic basalts are expected to demonstrate that the deeper parts of the rift zone are affected by transient heating and deviate from the steady-state geotherm.

Preliminary calculations of geotherms using the parameters discussed and state-of-the-art temperature and pressure-dependent thermal conductivities show the Moho temperature in the range of about 420–500 °C. These temperatures are lower than previous estimates (550–700 °C) of steady-state Moho temperatures made for the Saxothuringian zone.