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Heat flow pattern and thermal history of the West Carpathian-Pannonian basins in respect to the uplift and erosion of the adjacent fold-and-thrust belts

Juraj Franců (1), Jan Šafanda (2), Vladimír Čermák (2), Oldřich Krejčí (1), and Paul Andriessen (3)

(1) Czech Geological Survey, Leitnerova 22, 65869 Brno, Czech Republic (juraj.francu@geology.cz), (2) Geophysical Institute, Czech Academy of Sciences, Praha, Czech Republic, (3) VU University Amsterdam, Faculty of Earth and Life Sciences De Boelelaan 1085/C214, 1081HV Amsterdam, The Netherlands

The West Carpathians with the Carpathian Foredeep and Neogene basin related to the Pannonian region represent a thermally heterogenous area. The heat flow pattern shows a strong relationship to the lithospheric dynamics with lows in the foreland and highs in the hinterland. The lowest heat flow values, 50 – 60 mW.m-2 occur in the Vienna basin and in the south-western part of the Carpathian Foredeep as a result of the thicker lithosphere. The highest heat flow values, up to 110 – 120 mW.m-2 observed in the Makó, Dereczke and East Slovak basins are associated with local lithospheric thinning and astenosphere doming in areas affected by wrench faulting.
New measurements of thermal maturity of organic matter along with illite-smectite expandability on shales and siltstones in deep boreholes provide consistent evidence of the maximum thermal stress during the burial catagenesis. Apatite and zircon fission tracks analysed on selected samples complement the information on the time of cooling/uplift of the strata. The maturity data are used for calibration of the thermal history models of both subsiding basins and uplifted blocks. Thermal models built for the selected profiles document the possible heat flow evolution scenarios with time as a result of extensional and compressional tectonic settings. Several systematic trends are observed in the thermal maturity pattern. 1) Both the Carpathian Foredeep and Vienna Basin occur in a very low heat flow area. The vitrinite reflectance increases with depth very slowly when compared with the Danube, Makó, and East Slovakian basins of the Pannonian system. 2) The external units of the Carpathian Flysch Belt (CFB) are more mature than the Carpathian Foredeep suggesting partial uplift and erosion prior to emplacement in their final position. 3) The Flysch Belt below the Vienna Basin (VB) is more mature than the Miocene but is less mature than CFB northeast off the VB. This indicates that Paleogene overthrust units (CFB) were considerably eroded in the fold-and-thrust belt, which served as the source during the post-Lower Miocene time. 4) The Magura nappe (M) is always more mature than the external Zdanice and Subsilesian units. 5) The Magura borehole data show often an inverse catagenetic trends with reversal at the transition to the underlying more external thrust sheet. This is interpreted as evidence that M was exposed to deeper burial and higher temperatures prior to emplacement on top of the external units. The modelling results provide an improved quantitative estimation of uplift and subsidence and source-to-sink relationships for the selected Miocene to Quaternary time slices.