4.7.6. THERMAL STATE OF THE LITHOSPHERE IN THE BENDING ZONE OF EASTERN CARPATHIANS AND ADJACENT AREAS

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The tectonic regime of the Eastern Carpathians, dominated by the European plate subduction, controlled the shortening of the flysch and molasse basins developed on the continental margin of Eurasia, thinned in a previous extension process, and the building of the nappes during the Moldavidic tectogeneses. There is also a close connection between the evolution of the Eastern Carpathians and the formation and evolution of the two most important Neogene sedimentary basins in the study area, namely the Transylvanian Depression, in the hinterland, and the Focşani Depression, in the foreland.

The present paper is a synthesis of published results regarding the evolution of the thermal field during convergence-related processes in the Eastern Carpathians and in the adjacent Transylvanian Basin and the Eastern Carpathians bend foreland.

To obtain the thermal structure of lithosphere during and after the tectonic process which affected it, the heat transfer equation with advective and heat generation terms was solved in 2D by means of a finite differences approach (subduction, continental collision and slab break off) or a finite elements approach (sedimentation and erosion, recent volcanism).

The numerical scheme proposed in the finite difference model used the parameters values usual adopted in such studies and the velocity field values specific to the particular tectonic processes. The finite elements model, used in case of the two basins, incorporated the variation of the sedimentation rate, lateral and vertical variations of the thermal properties of sediments, sediment compaction, as well as the lateral variation of the crustal heat production and of the incoming heat from the mantle.

The thermal modelling of the convergence process in the Eastern Carpathians, along a lithospheric profile perpendicular to the convergence front, simulated the pre-Miocene oceanic subduction with a high angle followed by a continental collision with a small subduction angle to the depth of 40 km in the time interval 23-12 Ma, and a thermal relaxation in the last 12 Ma. The results of the modelling indicated the pre-collisional subduction as the most important factor in the long therm thermal field evolution in the convergence area of the Eastern Carpathians. More recent processes, such as the slab retreat and break-off invoked to explain the Neogene volcanism migration and the thermal effects of volcanic eruptions assessed with an instantaneous intrusion of a certain magma volume at the crust base, are likely to alter the thermal structures.

The thermal models simulating the geodynamic processes of basin evolution pointed out the strong dependence of the surface heat flux evolution on the sedimentation rates and, in case of Focşani Depression, the temperature variations as large as 70-100 ºC (about 80% of the initial temperature) occurring in the crystalline crust immediately under the sedimentary pile. The pressure-temperature-time paths of these rock volumes indicate significant metamorphic changes underwent as the pressure and temperature increased

during sedimentation. In case of the Transylvanian Basin thermal modelling showed that the low surface heat flux can be explained only by a depletion in crustal heat-production rate in the centre of the basin of about 15 mW m^{-2}, due to the existence of the ophiolite complex in that area obducted on a thinner upper crust. In case of the profile in the foreland of the Eastern Carpathians bend, the increase of the surface heat flux from 40 mW m^{-2} in the deepest part of the Focşani Depression to 70 mW m^{-2} at the depression margin and on the Moesian Platform is explained by the variable contribution of the heat generated in the upper crust due to its increasing thickness from 7 km to 21 km, respectively.

A synthesis of the thermal models presented in this study for the subduction-related processes (oceanic subduction, continental collision, slab retreat & break-off), sedimentation and magma generation) well illustrates the significant thermal effects of tectonic processes which affected the study area and their correlation with peculiarities of the seismic activity in the Vrancea area as shown by the superimposed distribution of intermediate-depth earthquakes hypocenters (Fig. 4.7.6.1).

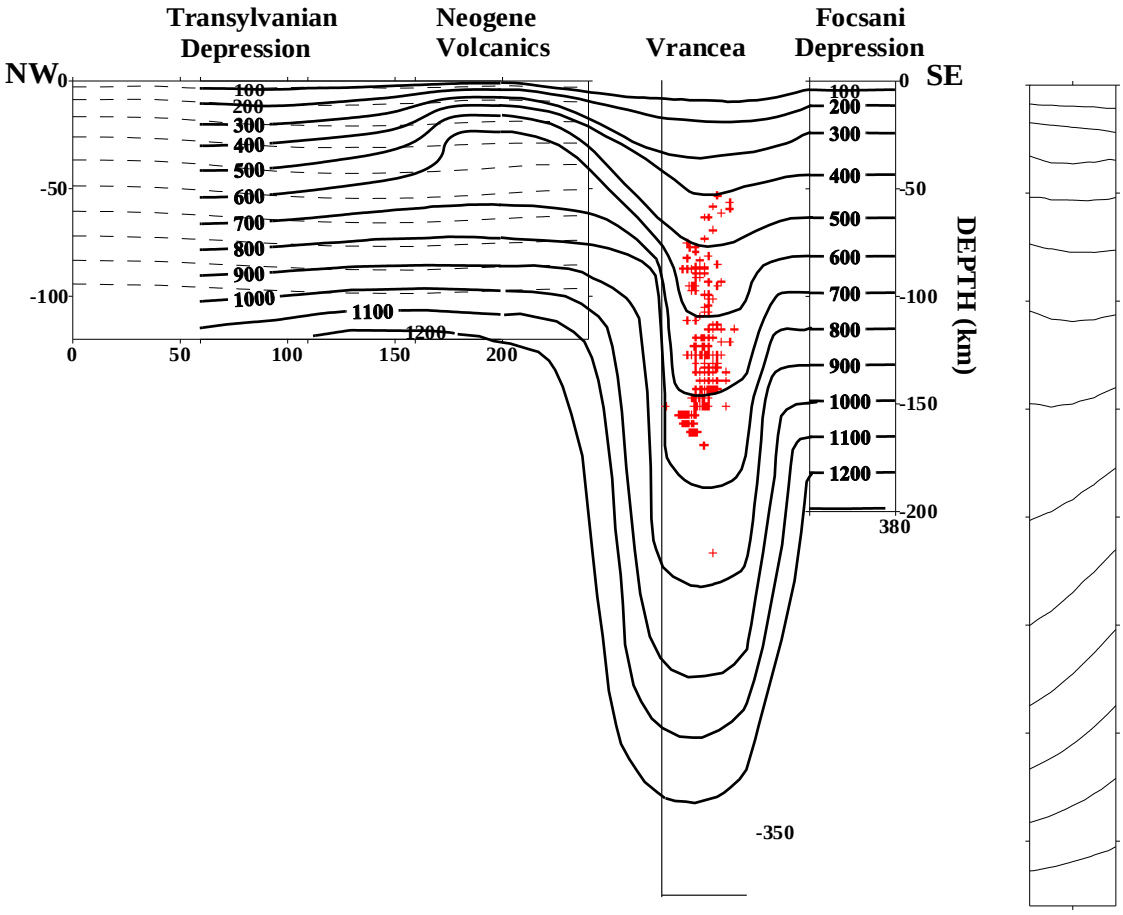

Fig. 4.7.6.1 Thermal structure of the lithosphere across Eastern Carpathians bending zone. Isotherms are in Celsius degrees; red crosses mark hypocenter locations.