basement in this part of the PCF suggests that bending of the lithosphere below the thrust belt was dominant process that has created present-day large-scale architecture of the PCF.

Very different results were obtained for the eastern part of the study area located between Rzeszów and Przemyœl. Seismic data revealed large amount of tectonic deformations present within the Palaeozoic and Precambrian basement of the PCF. They consist of either horst-and-graben structures related probably to strike-slip movements or systems of large normal faults and rotated blocks located NW-SE. Also, it was concluded that normal faults present in the easternmost part of PCF developed partly as a synsedimentary features and were slightly inverted during late Sarmatian. Moreover, maximum of extension controlled by these faults was located not immediately in front of the thrust belt but significantly further towards the north. This implies that extension was not only related to the lithosphere fracturing due to its flexure below the Carpathians but was also controlled by intense faulting related to Miocene reactivation of the Tornquist-Teisseyre tectonic line. Tectonic inversion of normal faults can be attributed to last stages of compression within the Carpathian thrust belt.

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Basin evolution of several sub-basins of the Pannonian Basin System - constraints from subsidence analyses and basin modelling

Anco C. Lankreijer

Institute of Earth Sciences, Vrije Universiteit, Amsterdam, The Netherlands

Subsidence histories of the Vienna Basin, the Danube-Kisalfold Basin (Little Hungarian Plain Basin), the Styrian Basin and the East Slovakian Basin (Trans Carpathian Basin), in total based on over a hundred individual wells, are compared.

Striking is the contemporaneous onset of basin subsidence in all basins, together with the Karpatian maximum in subsidence rate for all basins. The Karpatian subsidence maximum indicates that Karpatian extension was the major feature governing basin evolution and all later phases are of lesser magnitude. In some cases aditional subsidence accelarations are observed, mainly for Pannonian times.

Uncertainties arize from the difficulties on excact quantification of age and paleowaterdepth. These problems are directly related to the time-transgressive character of the Pannoninan units. Karpatian and Badenian ages and paleowaterdepths are much better constrained.

Numerical absin modelling, adopting a modified McKenzie type extensional basin model is capable of explaining the observed subsidence reasonable well. Key features of the model are: (1) Karpatian extension only, (2) -Badenian-Pannonian postrift cooling, (3) relative small basins allow fast cooling, and (4) different amounts of crustal v.s. subcrustal extension.

Modelling also indicates that the Karpatian extension was the main basin forming process. However, there are numerous excellent documentations of later tectonics and changing stress fields. Apparently these are of a lesser magnitude with respect to basin subsidence.

Diversions from the postrift cooling trend in subsidence can be caused by: (1) uncertainties in data; (2) renewed extension phase in Pannonian times, with different impact; (3) lateral and temporal changes in rheology. Due to the problems age and waterdepth it was difficult to constrain the post-Karpatian evolution of the individual subbasins in detail.

Heat flow in the PANCARDI region and its geodynamic significance

László Lenkey[1,2], Péter Dövényi[1] and Frank Horváth[1]

[1] Geophysics Department, Eötvös University, Budapest, Hungary
[2] Institute of Earth Sciences, Vrije Universiteit, Amsterdam, The Netherlands

Heat flow is closely related to the structure and evolution of the Earth's lithosphere. More than 600 heat flow determinations and many thousands heat flow estimations were carried out in the PANCARDI region. The average heat flow in the Pannonian basin is about 90-100 mW/m^2, in contrast with a characteristic value of about 50-60 mW/m^2 in the surrounding region. The only exception is the central part of the Eastern Alps, where the heat flow is above 100 mW/m^2. Towards the Dinarides the heat flow is decreasing rapidly, and the Outer Dinarides is an extremely cold zone characterized by values of 30-40 mW/m^2. In the Inner Dinarides and in the transition zone towards the Pannonian basin geothermal highs occur. A large positive heat flow anomaly can be found at the southern part of the Pannonian basin, around Belgrade, which continues to the SE along the Vardar zone.

The heat flow is influenced by near surface geological processes, like groundwater flow and sedimentation and erosion. Intensive karstic water flow is the reason of the low heat flow in the Outer

Dinarides and in the Transdanubian Central Range. Simple heat balance calculation shows that the background conductive heat flux in the Transdanubian Central Range is the same as in its surroundings. The large scale groundwater flow occuring in the porous Neogene/Quaternary sediments does not alter the regional heat flow significantly.

Rapid Neogene sedimentation decreased the surface heat flow in the Pannonian basin. After correction the average background heat flow in the Pannonian basin increases to 100-110 mW/m^2.

The Pannonian basin is characterized by thin lithosphere and crust. In the surrounding region the lithosphere is thick and the Moho is deep. The overall correlation between the heat flow distribution and lithospheric structure is good. It was shown that the Neogene subsidence and high heat flow of the Pannonian basin can be explained by stretching of the lithosphere. However, the high post-rift subsidence rate and high present day heat flow can be explained only by assuming higher stretching of the mantle than the crust. This assumption means that extra heat was added to the lithosphere during basin evolution, thus deeper mantle processes were also involved in the formation of the basin. This assumption is supported by the widespread Neogene volcanism all over the basin. Better understanding of the nature of this mantle process requires more tectonic, geochemical/petrological and modelling investigations.

Kinematics of retreating subduction in the Carpathians

Hans-Gert Linzer

Geological Institute, University of Tuebingen, Germany

The regional pattern of contraction directions and the evolution of the strain field from Paleogene to Neogene times enabled a stepwise reconstruction of the plate motions and the migration path of the Carpathian collision front. Brittle deformation structures in the Romanian Carpathians indicate three tectonic events related to major plate motions:

(1) Holocene to Pleistocene general E-W extension, N-S contraction in the Carpathian arc and local ESE-WNW contraction in the Vrancea area are related to the late roll-back stage and breakoff of the subducted slab in the bend area. The recent vertical position of the subducted slab below the Vrancea area of the Eastern Carpathians represents the final roll-back stage of a small fragment of oceanic lithosphere, formerly situated between the Moesian and East European plates.

(2) Pliocene to Middle Miocene fan-shaped orientations of contraction directions were caused by right-lateral oblique convergence in the Southern Carpathians, frontal convergence in the southern Eastern Carpathians and left-lateral convergence in the northern Eastern Carpathians. Kinematic axes and resultant vectors of displacement along the Carpathian arc and the Apuseni Mountains help to reconstruct the retreating subduction. The ages and locations of the eruption centers of the andesitic volcanic chain along the Carpathian arc in the overriding plate and the thrust directions are used as markers to reconstruct the roll-back area of the subducted slab between the Moesian and East European plates.

(3) Middle Miocene to Paleogene NE to ENE contraction caused right-lateral curved strike slip faults. The Carpathian nappes were thrust around the Moesian Plate during Paleogene and Early Neogene times and intruded into a small oceanic embayment between the Moesian and European plates. The suspected Jurassic oceanic crust was formed between the Moesian and European plates as the Penninic-Pieniny-Magura oceanic basins opened up. During Paleogene times, the Carpathian thrust-fold belt prograded from south to north.

The double-loop of the Carpathian fold and thrust belt was formed in Late Neogene times as a result of the eastward escaping Tisza-Dacia block, due to NE directed convergence of the Adriatic plate and the retreating subduction of an oceanic embayment between the Moesian and European plates.

Structural correlation between the Northern Calcareous Alps (Austria) and the Transdanubian Central Range (Hungary)

Hans-Gert Linzer[1] and Gábor Tari[2]

[1] Geological Institute, University of Tuebingen, Germany
[2] AMOCO Production, Houston, Texas, U.S.A.

In the East Alpine-Pannonian transitional area significant amount of syn-rift extension occurred during the Middle Miocene. In this recently defined Raba River extensional corridor a metamorphic core complex-style extensional period was shortly followed by and partly overlapped with a wide rift-style one. Based on the correlation of Eoalpine (Cretaceous) structural markers, about 80 km of ENE-WSW-directed extension can be documented for the Karpatian metamorphic core complex-style extension. The magnitude of Badenian wide-rift-style extension in a NW-SE direction is less constrained, but it is on the order of tens of