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

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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)

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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 kilometers (>40 km) based on preliminary cross-sectional balancing efforts. These findings have an important corollary for the relative, pre-extensional position of the Northern Calcareous Alps (NCA) and the Transdanubian Central Range (TCR). Taking also into account the displacement on Miocene strike-slip faults in the NCA, e.g. the Salzach-Ennstal-Mariazell-Puchberg fault with a sinistral displacement of about 60 km, the restoration of Neoalpine deformation brings the NCA and the TCR unexpectedly close to each other. In fact, some WNW-trending right-lateral strike-slip faults in the TCR (e.g. Telegdi-Roth line) are interpreted to be analogous to those described from the NCA (e.g. Wolfgangsee-, Windischgarsten- and Hochwart fault). These Cretaceous tear faults were reactivated during the Late Miocene as it can be documented by reflection seismic data in the subsurface of the Danube Basin and the NCA.

The structural correlation between the NCA and TCR based on the characteristic wrench fault pattern provides further evidence for the much debated interpretation of the TCR in terms of a Cretaceous nappe-system in an Upper Austroalpine (or "Ultrastyrian") structural position. Furthermore, the recognition of regional-scale right-lateral strike-slip faulting in these major Alpine units has a significant impact on the kinematic/dynamic reconstructions of the Alpine-Carpathian-Pannonian area during Cretaceous and Tertiary times.

Tectonomagmatic constraints on the dynamics of the final stages of subduction in the Eastern Carpathians

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Changes in volcanic activity can be related to variations in critical tectonic processes responsible for melt generation. A rigorous investigation of magmatism in the Carpathian arc may therefore more closely constrain the style and timing of subduction in the Carpatho-Pannonian region.

The East Carpathian volcanic arc constitutes the youngest and most voluminous segment of subduction-related magmatic rocks in Eastern Central Europe. A general age progression of the climax of magmatic activity is seen along the East Carpathians from older volcanic structures in the north-west to the youngest in the south-east, a feature which is particularly striking over the final 200km of volcanic structures in Romania. Magmatism continued into the Plio-Pleistocene, significantly later than the perceived end of subduction along the Inner Carpathian arc which took place during the Miocene.

Trace element ratios in magmatic rocks from the East Carpathians are typical for subduction-related magmas and suggest an input of fluids from a dehydrating subducting crustal slab. A simple model of upwelling of hot mantle due to slab delamination and subsequent mixing with lower and upper crust cannot explain the chemistry of the East Carpathian magmas. It is necessary to have subduction to produce the volcanism. However, the relationship between the timing of subduction and the climax of magmatism remains unclear.

The migration of magmatic activity from north to south may be explained by a corresponding migration of the magma generating zone along the arc. Oblique subduction of a narrow oceanic basin or slab roll-back could create the necessary tectonic conditions for migration. Continental crust may have initially entered the subduction system in the north whilst oceanic subduction continued in the south. Subducted lithosphere would thus initially delaminate and break-off in the north of the East Carpathian arc and progress southwards with time. As more buoyant continental crust entered the trench, a slower subduction rate would lead to slab breakoff at shallower depths. If the slab broke off at shallow levels (<50km) in the extreme south of the arc, it may account for some of the unusual geological features (e.g. the eruption of alkaline magmas).

Tertiary tectonic evolution of Southern Carpathians external area - reconstruction using kinematic and depth data

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The evolution of Southern Carpathians external area is analysed by means of paleostress determination, outcrop to regional scale structures, as well as depth interpreted data. The main latest Cretaceous - Tertiary deformations can be summarised as following:

After the middle and late Cretaceous orogenic phases, the Southern Carpathians - Moesian platform system was affected by strike-slip deformation with NE-SW oriented compression and NW-SE tension. During Paleogene - Early