calcite cement, started after the regional folding was completed.

At Tylmanowa, two conjugate sets of deformation bands cut subvertically dipping sandstone beds. The linear acute bisector between the sets is horizontal and perpendicular to the regional fold axis. The bands accommodate dip-slip reverse movement. They were formed after regional folding was completed. The bands display feldspar cataclasis but do not display quartz cataclasis. They were formed before complete induration of the sandstone.

Summing up, it appears that the regional folding within the Magura nappe started no-later than during the deposition of the studied Lower Eocene sandstone. The folding was completed before calcite cementation and before complete induration of the sandstone.

The gravity field of the Pancardi Region and its geodynamic implications

Péter Szafian[1,2], Frank Horváth[1], Gábor Tari[3] and Sierd Cloetingh[2]

[1] Department of Geophysics, Eötvös University, Budapest, Hungary
[2] Institute of Earth Sciences, Vrije Universiteit, Amsterdam, The Netherlands
[3] AMOCO Production Company, Houston, Texas, U.S.A.

A new, unified Bouguer anomaly map of the Eastern Alps, Carpathian arc, Dinarides and the Pannonian basin has been compiled from previously prepared and recently published gravity maps and data. This map gives a general picture of the gravity field of the studied area and reveals several interesting features that are essential in understanding the geodynamics of the Pannonian basin and the surrounding mountains. In order to constrain the crustal structure and tectonic history of the region 2D gravity models are presented along a Western Carpathians-Pannonian basin-Southern Carpathians transect, and at the Alpine-Pannonian transition zone. These models are based on deep seismic lines, where available, and detailed geological sections. The results confirm that the whole territory of the Pannonian basin can be characterized with a wide rift mode extension, while some deep depressions show the characteristics of the narrow rift mode and the core complex mode extension combined with detachment faulting. Furthermore the modelling results and the Bouguer anomaly map suggest that the different parts of the Carpathian arc are at different stages of their evolution: the subducted oceanic slab under the Western Carpathians has already been detached and assimilated to the astehenosphere, while a lithospheric root is still present under the Eastern and Southern Carpathians. These findings are compatible with the observation that the last major phase of crustal shortening terminated at the early Middle Miocene in the Western Carpathians, but continued throughout the Pliocene in the Eastern and Southern Carpathians. In order to give an explanation we utilized the idea of strain partitioning which results from the oblique convergence and transpression between the European lithosphere and the different terranes that formed the Pannonian basin and the Carpathian arc.

Alpine tectonics in the East Carpathian/Pannonian transitional zone (Hungary/Romania)

Gábor Tari[1], Istvan Dunkl[2], Tamas Toth[3] and Frank Horváth[3]

[1] AMOCO Production Company, Houston, Texas, U.S.A.
[2] Geological Institute, University of Tubingen, , Germany
[3] Geophysical Department, Eötvös University, Budapest, Hungary

Based on the style of Miocene faulting observed on industry seismic reflection profiles and the characteristically retrograde metamorphism of the pre-Tertiary basement, a metamorphic core complex origin was predicted for some of the basement highs in the SE Pannonian basin. Indeed, recent apatite/zircon fission-track age-dating of amphibolite to greenschist facies basement rocks in this critical region verified this earlier speculation.

Similarly to the NW Pannonian Basin, the Middle Miocene syn-rift extension can be subdivided into an Karpatian metamorphic core complex style extension followed by a Badenian(?) wide rift style one. The earlier, ENE-WSW oriented extension is largely responsible for the formation of a regional detachment system which displays a distinctly down-to-the-ENE polarity. The probable breakaway zone for this system is located around Kelebia and the metamorphic core complex in lower plate position is represented by the Algyo basement high of Hungary. Outcropping basement highs in the Apuseni Mts. of Romania, such as the Codru-Moma, Padurea Craiului and Plopis ranges are bounded by antithetic, down-to-the-WSW normal faults and thus they are interpreted as large fault-block ranges in upper plate position.

The still continuing but diminishing continental extension during the Late Miocene could not advance to the localization of extension into a narrow rift zone in the Pannonian region, except some subbasins such as the Mako and Bekes

basins. These basins are underlain by anomalously thin crust (20-22 km) and lithosphere (55-60 km) in a spatially coincident manner.

Two regional structure transect were constructed across the Hungarian and Romanian part of the Pannonian Basin and the Apuseni Mts. These perpendicularly oriented sections were also constrained by deep reflection seismic profiles (Pannonian Geotraverse 1 and 4) in order to gain insight into the lithospheric-scale structure of the region. These transects suggest large-magnitude extension during the Neogene, mostly due to the superimposed extensional styles.

Alpine tectonics in the East Alpine-Pannonian transition zone (Austria-Hungary)

Gábor Tari[1], Frank Horváth[2], Péter Szafian[2] and Istvan Dunkl[3]

[1] AMOCO Production Company, Houston, Texas, U.S.A.
[2] Geophysical Department, Eötvös University, Budapest, Hungary
[3] Geological Institute, University of Tubingen, Germany

Structural interpretation of reflection seismic profiles combined with well data reveals distinct modes of upper crustal extension in the NW Pannonian Basin. As the first manifestation of extensional collapse at the beginning of the Middle Miocene (~17.5 Ma, Ottnangian/Karpatian boundary) the Rechnitz metamorphic core complex has been formed in the Raba River extensional corridor.This metamorphic core complex style, ENE-WSW trending extensional phase can be characterized by a minimum of 80 km horizontal extension. Shortly after, and partly overlapping with this period, the style of syn-rift extension changed to a wide-rift style one (16.5-13.8 Ma, Early and Middle Badenian) producing a minimum of 40 km extension in a NW-SE direction across the East Alpine/Pannonian transition zone.

The predominance of low-angle normal faults in the Neogene structure of the Danube Basin excludes its pull-apart basin origin proposed by many. The numerous Miocene detachment faults interacted with earlier Cretaceous decollement levels, although in a more complicated manner than previously thought.

Widespread Upper Badenian and Sarmatian strike-slip faulting has little to do with the formation of the Danube Basin but it belongs to the post-rift phase and records a basin-wide inversional stage. The still continuing, but gradually diminishing continental extension during the Late Miocene and Pliocene (12.5-5.5 Ma, Sarmatian-Lower Pannonian) could not advance to the localization of extension into a narrow rift zone in the NW Pannonian Basin, except perhaps the center of the Danube Basin (zone of Pasztori and Kolarovo).

Regarding the whole lithosphere of the NW Pannonian Basin gravity modeling indicates that the present-day thickness minima for the crust and the upper mantle do not coincide. The some 160 km lateral offset between them indicates the detachment of the the upper crust from the mantle lid along a rheologically weak lower crust during Miocene times.

Geodynamic evolution of the area adjoining the Pannonian Basin and Dinarides

Vlasta Tari[1] and Jakob Pamic[2]

[1] INA-Naftaplin, Zagreb, Croatia
[2] Croatian Academy of Sciences, Zagreb, Croatia

Almost all recent geodinamic interpretations of the evolution of the Pannonian Basin (PB) are related to the Carpathians. However, the Dinarides, especially its northernmost parts played very important role in their evolution.

The central part of the northernmost Dinarides is genetically related to an ancient magmatic arc, as indicated by following units: (1) Upper Cretaceous-Paleogene trench sediments, in lower parts interlayered by basalts, rhyolites and pyroclastics which overlie (2) Jurassic-Cretaceous ophiolites associated in places with blueschists, (3) Alpine medium-pressure metamorphics originating from the trench sediments and associated volcanics, and (4) Alpine synkinematic granitoids.

The western part of the northernmost Dinarides, west of the Zagreb-Zemplen fault zone is mostly covered by the Sava nappe, composed of Upper Palaeozoic metaclastic and carbonate rocks, Schytian clastics, and Middle and Upper Triassic limestones and dolomites. The tectonic windows composed of Jurassic-Cretaceous basinal sediments of Dinaridic affinity are exposed below the Sava overthrust. Further to the east in the area of Zagreb, the Sava nappe is thrust onto the ophiolites.

In the northern part of the Dinarides subduction processes terminated with the Eocene compressional event and the uplift of the Dinarides.

West of the Zagreb-Zemplen line numerous intramontane shallow-marine, fluviatil and lacustrine basins during the Oligocene were generated. Penecontemporaneous andesites can be compositionally correlated with the easternmost Periadriatic tonalites, but the andesites are also found along the Drava and Sava strike-slip faults.