Syn-Sedimentary Deformations in the Eocene Tatabánya Basin, Central Hungary

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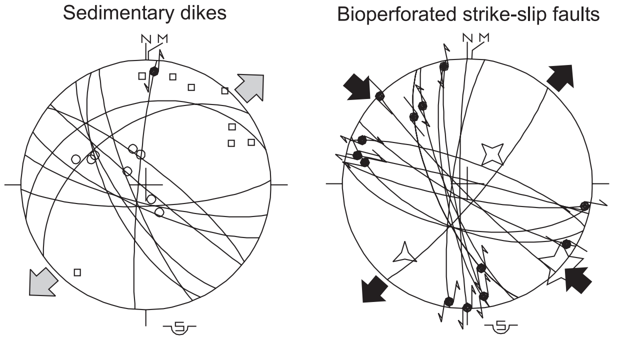
The Pannonian basin is characterised by important Neogene faulting, which was connected to the formation of an extensional basin system. The dense network of predominantly normal faults was partly issued from the reactivation of pre-Neogene faults and can partly be considered as newly formed structural elements. The Neogene reactivation of structures makes difficult the analysis of pre-Neogene, namely Eocene structural geometry and fault kinematics, which are connected to the formation of the Transdanubian Eocene basins. Due to the overprinting tectonic phases and the poor outcrop conditions, the origin of the Transdanubian Palaeogene Basins were long time debated; suggestions range from extensional to compressional through strike-slip character (Báldi and Nagy-Gellai 1990, Báldi-Beke and Báldi 1985, Fodor et al. 1992, Tari et al. 1993).

The Eocene sequence started with lagunal-marine coal-bearing sequences. It is covered with shallow marine marl, than open marine claystone. Sedimentation on the basin margins started somewhat later, probably during the marine sediments of the central basin part. Basin margins were characterised by limestones deposited in different sedimentary environment. Change in water depth, amount of nutrient determined the fossil content of the rocks. Carbonate mounds composed of large foraminifers (nummulites) separated lagunes with fine-grained bioclastic from slope, facing the basin centre with clastic sediments. Several sedimentary cycles can be detected in the carbonate sequences, partly governed by sea-level changes.

The margins of the Tatabánya basin offer good possibility to analyse the Eocene deformation pattern and its relationship to basin sedimentation. Several structures are coeval with the sedimentation or the diagenesis of the middle Eocene (late Lutetian–Bartonian) sequence. The basin margins are marked with syn-sedimentary monoclines, which are frequently cut through by syn-sedimentary faults. The surface-rupturing faults were partly eroded, partly mantled with breccias, fault-bounded conglomerate bodies (Kercsmár 1996, Bada et al. 1996). Abrasion frequently rounded clasts derived from these scarps. The faults, and the clasts of the fault scarps are frequently bioperforated, the infillings of which is Eocene (Kercsmár 2001). The limestones were frequently deformed during the diagenesis, due movement of underlying faulted monoclines. The syn-diagenetic structures include boudinage, intraformational breccias. Sedimentary dikes were also documented near basin margin faults. Seismic activity related to faults could induce redeposition of shallow water sediments toward basin margins in form of different cohesive gravity flows.



- **Fig. 1.** Fracture pattern and stress field of middle Eocene age at the eastern boundary of the Tatabánya basin. Grey arrows indicate estimated stress field, while black arrows show calculated compression and tension.

The basin is bounded by E-W, and NW-SE trending main structures in the southern and eastern basin margins. Some smaller structures are oriented NE-SW. Syn-sedimentary structures, and particularly the bioperforated fault planes with lineation permitted the approximation of middle Eocene stress field. The compression was oriented (W)NW–(E)SE, while the tension was perpendicular (Fig. 1). The direction of compression is perpendicular to the general trend of the Transdanubian Range Eocene basin; thus our data seems to be in agreement with the idea of Tari et al (1993) about the compressional (retroarc) origin of the basin. However, strike-slip and normal faults were more important in the formation of the Tatabánya basin than postulated NE-SW trending reverse faults or folds.

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Karst Phenomena as Indicators of Tectonic Styles

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The three main tectonic styles: normal faults, reverse faults and strike-slip faults can be recognized in up-to-date seismic time- or depth sections. Main criteria of each one are well described by several authors. Seismic examples of the different styles will be presented. The question is, when no seismic section is available, and the geologist in the field can only observe small sections of a fault plane how can he apply the seismic criteria in identifying the tectonic style. I had the opportunity of walking inside a flower structure, which is the main indicator of strike-slip movements. It happened in the Massif Centrale of France, where the brook Bonheur, having its source in the granite massif of Mont Aigoual, reaching its contact with the Devonian limestone, disappears. Its underground passage is 800 m long and when it reaches the surface again in a 100 to 120 m deep gully, it is called the Bramabiau – meaning the sound of belling stags – as water rushes out from the cave. Several photos will be presented to prove that the features of this cave fulfil the criteria of strike-slip movement. As the route of water penetrating limestone surfaces and causing karst phenomena is controlled by tectonics, we can use the inverse route: deduce the style of tectonic movements from the characteristics of karst phenomena.

Cretaceous Structural Evolution of the Bakony Mts., Hungary

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The Bakony Mts. is the SW part of the Transdanubian Range, situating SE from the Danube Basin. According to its Cretaceous structural setting, the Bakony Mts. is part of the Alpine nappe system (Tari 1995, Fodor et al. 2003). In our poster we present new paleostress data and other observation focused for the Cretaceous deformational phases of the Bakony Mts. In addition to the systematic compilation of the measured paleostress phases of the Cretaceous outcrops, and the tectonic settings, our data sets can have implications for the Cretaceous structural evolution of the Bakony area.

The most important structural element within this upper nappe of the Alpine nappe system is a pre-Tertiary double-syncline with Jurassic-Cretaceous formations in its core. The axes of the synclines are NE-SW. It is covered by almost-horizontal Senonian formation on the NE wing of the structure, but folds and thrust are covered by gently dipping Albian formation at the southern part of the Bakony. It indicates at least two tectonic phases within the nappe-formation.

There was an important tilting event during the late Early Cretaceous, when the synformal structure of the Transdanubian Range formed (Tari 1995). We detected at several outcrop gently dipping reverse faults and associated folds belonging to this (W)NW-(E)SE compressional phase (Kiss et al. 2001, Albert 2000). We have indications for the upper age limit of this deformation from a cross section near Ajka (Fig. 1.), where the NE-SW striking folds and thrust in the Triassic and Liassic carbonates are covered by flat-lying Albian cherty limestone (Fig. 1) (Fodor 1998). We have a looser time constraint at the SW part of the TR, Sümeg, the steeply dipping Aptian limestone is covered by flat lying Senonian formation (Haas et al. 1984). The steeply dipping Aptian layers show small-scale duplexes, formed at sub-horizontal bed position, by NW-SE compression.

The beginning of this compression could be post-Barremian based on the section of a quarry nearby Zirc, where the tilted Barremian limestone is discordantly covered by late Aptian crinoidal limestone (Fülöp 1964). The age of this deformation can be early Aptian. Pre-late Aptian deformation is also suggested by variable pebble composition of the late Aptian basal layers (Lelkes 1990).

We detected a well-dated middle Albian ENE-WSW extensional event at a Bakony Mts. At two outcrops nearby Zirc the formation of Albian clay is controlled by NNW-EES to N-S striking normal faults, sometimes with syn-sedimentary features (Fig. 1).

We observed a (N)NW-(S)SE compressional type stress field in Albian limestone at several sites. The phase is characterised