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Wrench tectonics control on Neogene-Quaternary sedimentation along the Mid-Hungarian Mobile Belt

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The Neogene Pannonian basin is underlain by a large orogenic collage which is built up by several tectonostratigraphic terrains. The basement of the Pannonian Basin became imbricate nappes during the Cretaceous Alpine collision. Nappes of Late Cretaceous in age have been proven below the Great Hungarian Plain (Grow et al 1994). The boundary of the two main terrains, the northwestern ALCAPA (Alpine-Carpathian-Pannonian) and the southeastern TISZA, is the Mid-Hungarian Mobile Belt. It is the most significant neotectonic zone of the Pannonian Basin.
The structural analysis of the middle section of the Mid-Hungarian Mobile Belt was carried out on a 120km x 50km area, between the Danube and the Tisza river, on the basis of interpretation of seismic data. The structural analysis of the Neogene-Quaternary sediments was supported by sequence stratigraphic interpretation of seismic, well log and core-sample data. Regional seismic profiles were both oriented in the dip direction, which highlights sediment supply routes into the basin, and strike-oriented. The studied segment of the Mid-Hungarian Mobile Belt consists of several long (some ten kilometres long) strike slip fault zones. The offset lengths of the individual strike slipe faults varies between a few and a dozens of kilometres.
Activity along the Mid-Hungarian Mobile Belt can be characterised by four periods, the size and shape of facies zones of each development period were controlled by tectonics:

1. During the early Miocene, the ALPACA moved eastward, bounded by sinistral strike-slipe system along its northern side and dextral strike-slipe fault system along its contact with the Southern Alps and the TISZA terrain. The largest movement took part during the Ottnangian-Karpatian (19-16.5 Ma). The TISZA unit moved northeastward over the remnant Carpathian Flysch Basin (Nemcok et al 2006). These terrains movements resulted in right lateral, convergent wide wrench along the Mid-Hungarian Mobile Belt. The ALPACA terrain, lying originally between the Central Alpine and Southern Alpine units, reached its recent position by some hundred kilometers strike slip movement, resulting in shifting of depocenters from the SW toward NE. The TISZA unit was characterised by clockwise motion, while counterclockwise rotation of the ALPACA is inferred in Late Oligocene-Miocene. Lower Miocene layers were deposited in depocenters whose subsidence was initiated by escape tectonics, NE-ward displacement of the ALCAPA terrane, and uplifting of the NW-SE oriented Neo-Vardar zone. The Neo-Vardar zone was represented by wide area of continental and alluvial depositional systems.

2. During the middle–late Badenian (15.5–13.6Ma), the ALCAPA collided with the European platform, and the eastward movement of the Tisza–Dacia became pronounced. Because of that the former right lateral motion along the Mid-Hungarian Mobile Belt ceased and a long period of left lateral strike slipe began. Earlier development of pull-apart basins, related to the extensive strike-slip faulting inside the ALCAPA, changed to the graben opening driven by the westward subduction and the eastward motion of the Tisza–Dacia. The middle-late Badenian period was characterised by sediments deposited in listric fault bounded half grabens, in crestal collapse grabens related to (flat-ramp) listric faults, in wide and/or narrow rift systems. Migration of volcanic activity and facies belts took place during relatively short period of times. Large displacements along listric faults have resulted in tilting of originally horizontal strata, and the formation of a regional unconformity between the middle Miocene and the upper Miocene sediments. Wrench fault related pull apart basins were filled by terrestrial to marine sediments.

3. During the Sarmatian–Pannonian (13.6–6.2 Ma), while the eastward motion of the ALPACA was strictly restricted, the Tisza-Dacia unit was able still to move eastward until the last parts of the remnant Carpathian Flysch Basin were overridden by the Carpathian orogen. An estimation of 8-10 km magnitude of Late Miocene strike slip was based on detailed seismic study on the Kiskőrös segment of the Mid-Hungarian Mobile Belt, while Detzky Lőrincz (1997) estimated 5-10 km strike slip for the Szolnok segment of the same Mobile Belt. The Tisza–Dacia unit collided with the European platform during the Pannonian (11.5–6.2 Ma), and the intra-Carpathian stress field changed to the present stress field. During the Pannonian sediments were transported from NW into the studied part of the Pannonian Basin. The main route of sediment supply was perpendicular to the strike of the Mid Hungarian Mobile Belt. The delta system could keep up with the (Pannonian) lake level rise so aggradation occured. Then the structural style chanced and at SB Pa-4 (appr. 6.8 Ma) a strong base level drop occured driven by the onset of inversion in the coeval marginal areas of the basin. Sedimentation continued at a lower base level from that time.
Coincidence of base level drop, rejuvenation of tectonic activity along the Mid-Hungarian Mobile Belt and presence of delta/shore facies zones being paralell with the Mobile Belt resulted giant incised canyon system in the Alpár area. The canyon system incised several hundred meters in the preexisting aggrading substrat, loosing topographic expression headwards and downdip (Juhász et al 2007). The individual valleys range from 5 to 10 km, with smaller tributaries. The valley depth is greatest 600-700 m)around their confluence. The canyons are filled with clay marls, and are overlain by fluvial sediments, suggesting a significant transgression in between. The canyon system is related to a large releasing bend and/or extensional duplex of the Mid-Hungarian Mobile Belt.

4. During the Pliocene–Quaternary, the postrift fill of the Pannonian Basin system, related to the regional thermal subsidence, started to undergo an inversion. Convergence vector again became parallel to the Africa–Europe convergence vector. Pliocene-Quaternary was characterised by 1-5 km left lateral wrenching along the Mid-Hungarian Mobile Belt. Based on high resolution seismic measurements on the Danube river Toth (2003) supposed an even more recent activity along the Paks-Szolnok wrench fault zone. The supposed late Quaternary activity of the Mid-Hungarian Mobile Belt is supported by recent hydrogeologic investigations. According to Mádl-Szőnyi et al (2005) and Simon et al (in press) from the Pre-Neogene basement originates an ascending overpressured highly saline water flow regime. Deep ascending water rises near to the surface, intercepting the aquifer and aquitard layers along conductive strike slipe faults of the Mid-Hungarian Mobile Belt and mixing with shallower groundwater.

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