FAULT CONTROLLED EVOLUTION OF THE VIENNA BASIN

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Abstract: Evolution of the basin has been studied by analysing available field structural data, as well as data compiled from previous mainly published key works as were - map of the preTertiary basement relief, map of the basement units, distribution of sedimentation depocentres, facial character of sediments, subsidence curves and reflexion seizmic profiles. Analysing these data active faults pattern was interpreted for each stratigraphic level of the basin, responsible for the shape of sedimentation depocentres. Comparing these synsedimentary faults with fault-slip related paleostress fields, kinematical/dynamical role of faults has been deduced. This approach led to dynamical reconstruction of the basin tectonic evolution.

Key words: fault kinematics, paleostresses, Neogene evolution, Vienna basin

Introduction

The Vienna basin tectonic evolution has complex history due to the exclusive position of the basin in between two different dynamically active Tertiary megablocks - central and outer Western Carpathians, colliding with corner of the Bohemian massif during the formation of the Western Carpathians loop. Complex process of the Western Carpathians propagation to the N and NE prevented by foreland including stress axes as well as rigid body block rotation, fault kinematics fluctuation, fault controlled sedimentation and basin desintegration is recorded in the shape of the basinal sedimentation depocentres and facial type of sedimentary fill. Evolution of the basin has been studied by analysing available field structural data, as well as data compiled from previous mainly published key works as were - map of the preTertiary basement relief, map of the basement units, distribution of sedimentation depocentres, facial character of sediments, subsidence curves and reflexion seizmic profiles. Analysing these data active fault pattern was interpreted for each stratigraphic level of the basin, responsible for the shape of sedimentation depocentres.

Comparing these synsedimentary faults with fault-slip related paleostress fields, kinematical/dynamical role of faults has been deduced. This approach led to dynamical reconstruction of the basin tectonic evolution.

<u>Oligocene/Eggenburgian – Early Karpathian</u> (23,4-17 Ma)

First stack of Apulian continental crustal block with NEP happened due to CC collision of northwardly propagated Apulia with Bohemian massif. Terrane in between Apulian promontory and stable Europa plate was extremely shortened, uplifted (Tauren windows, where lowermost crystalline fundament is exhumed). It led to the process of the lateral extrusion combined with gravitational spreading of elastic Carpatho/Pannonian crustal units to the east (Ratschbacher et al. 1991). This so called tectonic escape to the still free space (future Carpatho/Pannonian realm) was controlled by strike-slip fauts operating as border faults of crustal wedges moving to the east. During this process already consolidated paleo-mesoalpine structures were within active strike-slip shear zones reworked. The Early Miocene sedimentation of wrench furrows (sensu Montenat et al. 1987) took place within this zones in the regime of dextral transpression (Marko et al. 1991). These basins created E – W trending narrow and long furrows filled up by porely sorted and shortly transported Eggenburgian – Early Karpathian in age sediments. The Early Miocene wrench furrows were formed at the western part of the internides as well at the eastern part - East Slovakian basin (Vass 1998). To the end of this period due to cca 15^{o} CCW un-block rotation of Carpathians dextral transpression within strike-slips corridors converted to sinistral one and corridors had rotaded to ENE - WSW direction. During the Early Miocene period structural evolution was controlled by northward propagation of Apulia promontory and pre-Miocene CCW rotation of Africa plate (Żytko 1982).

<u>Late Karpathian – Lower Baddenian</u> (17 – 15,5 Ma)

In between the Early and the Late Karpathian Carpatho/Pannonian units began to move to the north. While Alpine segment of orogene has been already stopped due to collision with Bohemian massif, extruded Carpatho/Pannonian units were pushed to the open space – to the bay of weak crust filled up by Carpathian paleogene flysch sediments. Separation of Carpatho/Pannonian segment from Alpine one and its propagation to the north was realized thanks to N – S dextral strike-slips. One of them is supposed to be in the basement of the Vienna basin (Krs & Roth 1979, Balla 1988). Within this period started formation of spectacular oroclinal loop. The loop has been traditionally regarded as ductile in nature structure due to bended shape of Alpine units. Others prefer gradual formation of Carpathain loop thanks to independent propagation of detached crustal segments to the Carpathian gulf rimmed by Bohemian massif Tornquist-Teiseire line and Moesia.

During the Late Karpathian ALCAPA invaded to the north, oceanic crust subduced underneath propagating continental Carpatho/Pannonian crustal blocks (Doglioni et al. 1981), was partially melted and produced early volcanic activity of the Western Carpathians.

Distribution of sedimentation depocentres in the Vienna basin really shows dramatical change of structural plan during the Late Karpathian. Structural records show change of compression direction from N - S to NNE - SSW direction, which resulted in change of fault controlled sedimentation kinematics. Former E – W trend of basins was overprinted by NE – SW. NE – SW faults were activated as dominant normal and sinistral strike-slip ones, controlled sedimentation in the Vienna basin and simultaneously allowed northeastward escape of detached blocks after their collision with platforma at the north. During the Late Karpathian first core mountains with exhumed crystalline basement emerged, what is recorded by FT ages (Král 1977, Kováč et al. 1994) as well as by perifault debris sedimentation along uplifted core mountains (Vass et al. 1990). ENE – WSW wrench corridor was active as sinitral transtensional wrench zone. Former Early miocene wrench furrows were broken up and separated remnants were cca 30^{o} - 40^{o} CCW rotated (Kováč & Tunyi 1995). These rotations were coeval with rotations described in Pelso unit (Márton & Fodor 1995).

During the Baddenian due to the activity of major NE – SW sinistral strike-slips pull-apart Vienna basin has oppened (Royden et al.1982, Royden 1985). Baddenian depocentres of sedimentation has N - S trend due to normal faults which accomodated large magnitudes of strike-slip translations. Nevertheless Baddenian Vienna basin is not typical pull-apart, because it has not all atributes of pull-aparts. It was formed as fore-arc basin in relation to the Middle Baddenian volcanic arc. Vienna basin is anomalous from point of mechanism of formation too. Western part of it lies over the accretionary flysch wedge, so it ought to be in position of piggy-back basin, but eastern part lies over the Alpine-Carpathian units of internides.

While transtensional fore-arc basins were formed at the northern edge of the internides, extensional thermal back-arc basins due to lithospheric stretching and volcanism provoked by heat of rising Pannonian astenolith were formed at the Pannonian area.

<u>Middle – Upper Baddenian</u> (15,5 – 13,6 Ma)

For this period is typical NE – SW direction of compression and movement of the Carpatho/Pannonian lithospheric blocks. According paleomagnetic data the last CCW block rotations ceased in the western part of Western Carpathians in the Middle Baddenian, while the last rotations in the eastern part of the Western Carpathians were recorded at Sarmathian (Orlický 1996). During this period substantial part of volcanic activity had realized, Carpatho-Pannonian volcanic arc was formed. Huge bulk of volcanism was result of melting subduced oceanic/quasioceanic crustal slab, as well as rising of astenospheric astenolith in the Pannonian region (Póka 1988, Lexa et al. 1993). In conditions of thermal crustal extension back arc basins has been formed (Pannonian basin, Danube basin). Crustal stretching due to astenosphere heat was accomodated by extensional normal faulting (Tari et al. 1992, Horváth & Cloetingh 1996).

<u>Sarmathian - Pannonian</u> (11,5 - 9 Ma)

Active front of orogene has already removed far from Western Carpathians area. NE - SW compresion gradualy inverted to NW - SE pure extension. Former tectonic regime has survived within these conditions. Dominant role as sedimentation controling structures played NE - SW normal faults. During this period Carpathian lithospheric block propagated to the east. Due to the collision with East European Platform it has stopped movement to the east cca 9 Ma ago. This collision produced E - W compressional event (Decker & Pereson 1996), which affected even such distal terranes as Western Carpathians. E - W normal faults has been reactivated within this stress period and controlled formaion of E - W trending morphostructures - horsts and depressions. Due to steepening of subducing oceanic plate (Royden et al. 1982, Doglioni et al. 1991) and related roll back effect, E - W extension was induced in the Carpathian realm. Numerous N - S faults developed and were reactivated as normal ones within this youngest tensional event. These faults are the most numerous and conspicuous brittle features within the recent architecture of the Western Carpathians, what supports their young age.

<u>Plio - recent</u> (5,3 - 0 Ma)

Pliocene period is typical by lacustrine sedimentation much more modest comparing to former periods of Tertiary sedimentation. Important regional tectonic stresses, generated by subduction/collision of large lithospheric plates has ceased. Carpathian loop has been already done including Pieniny Klippen Belt structure. There are structural records within Western Carpathians and Pannonian area, that cca N - S (NNW - SSE) compression affected orogen during the end of this period (Csontos et al. 1991, Becker 1993, Hók et al. 1995) and survives within Western Carpathians up till recent as earthquakes focal mechanism analysis of seizmogenic faults proove (Pospíšil 1990).

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