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Towards a dynamic model for the formation of the Pannonian basin

F. Horváth (1), O. Sztanó (1), A. Uhrin (2), L. Fodor (3), A. Balázs (1), M. Kóbor (4), and G. Wórum (4)

(1) Eötvös University, Budapest, Hungary, (2) Hungarian Geological Institute, Budapest, Hungary, (3) MTA-ELTE Research Group of Geology, Geophysics and Space Sciences, Budapest, Hungary, (4) Geomega Ltd, Budapest, Hungary

First applications of a McKenzie-type uniform stretching model to the formation of the Pannonian basin showed major inconsistencies between predicted vs. observed subsidence and thermal histories. An alternative model combining moderate crustal extension (stretching factor of 1.2 to 2.5) and major attenuation of the mantle lithosphere (stretching factor of 5 to 50) resulted in better predictions. It has remained unresolved, however, that this non-uniform stretching was a simple mechanical response of the rheologically layered lithosphere to external stress, or a manifestation of interaction between the lithosphere and upper mantle flows.

The open question of mantle dynamics can be more successfully addressed today, because of the following conditions:

- progress in understanding the infill of the basin during the postrift phase;
- better timing of the main Late Miocene through Quaternary stratigraphic horizons;
- availability of seismic data to map basin-scale stratigraphic architecture and
- lithological logs from a number of deep wells for reliable decompaction.

A systematic investigation of the western Pannonian basin (Transdanubia) has resulted in new subsidence history diagrams and maps of the late-stage deformations. It has been found that the rate of tectonic subsidence during the 11 Ma to 6 Ma time interval was very high (up to 600-800 m/my), which cannot be explained by simple thermal cooling. This period of fast subsidence was followed by uplift and basin-scale folding with amplitude up to 1000 m from about 6 Ma to the present. We show that the synforms are usually associated with the former depocenters and generated largely by compaction of the underlying sediments. Horizontal movements during the same time interval are dominantly ENE-WSW directed sinistral strike slips and the related shear features. Although these strike-slip zones are spectacular features in seismic cross-sections, the slip rates never exceeded 1 mm/y.

Geodynamics of the Pannonian basin has been controlled by rollback of the Carpathian slab and the stress field generated by the movement of the Adriatic plate. Early postrift rapid subsidence and the subsequent large scale uplift call for a dynamic influence from the mantle flow system generated by the rollback of the Carpathian slab. Strike-slip fault activity in the basin is obviously the consequence of the stress field induced by the rotation and push of the Adriatic plate.