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Upper Miocene and Pliocene history of the northern Danube Basin

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The Upper Miocene and Pliocene development of the northern Danube Basin (nDB) is recorded in its sedimentary record, where three tectono-sedimentary cycles were documented: (1) lacustrine cycle deposited in time span 11.6 – 8.9 My (Ivánka and Beladice formations), (2) alluvial cycle deposited in time span 8.9 – 4.1 My (Volkovce Formation) and (3) Late Pliocene alluvial cycle, dated 4.1 – 2.6 My (Kolárovo Formation).

The Upper Miocene basin evolution was influenced by a geodynamic background, set up by asthenospheric mantle upheaval acting together with the overriding slab pull - caused by the subduction retreat in front of the Eastern Carpathians. The change of tectonic regime is marked by frequent angular discordance between the Sarmatian and Lower Pannonian sediments at the basin margin, as well as by the tectonically accelerated subsidence of basin depocentres. Due to wide rifting, halfgrabens and grabens developed along tectonic lines, working in paleostress field with $\sigma 1$ of NE – SW orientation. During this time subsidence reached its maximum, paleodepth of individual depocentres was up to 200 - 300m.

The following synrift stage with moderate subsidence represents gradual change from lacustrine to alluvial environment. Filling up of the basin, during the Upper Pannonian and Lower Pliocene represented much slower sedimentation than the previous deposition during the Lower to Middle Pannonian. The minimal fault activity documents still the same paleostress field. The tectonic background of subsidence during this time is not satisfactory solved; however it seems that the mechanism of subsidence could be principally controlled by the deep sub-crustal erosion above the mantle upheaval allowing sinking of the thinned (overheated) crust below the load of massive sedimentary pile reaching in this time more than 4000m.

The Lower Pliocene cooling down of overheated lithosphere led to the change of its elastic properties towards more brittle behaviour. Decreased crust elasticity and increase of its rigidity contributed to entrance of a trans-pressive tectonic regime during the Late Pliocene and Quaternary, which led to accelerated uplift of the Western Carpathians (WC) and erosion of the uplifted sedimentary formations at the DB northern margin. The measured activity of faults documents a paleostress field with $\sigma 1$ of NW – SE direction.

The Upper Miocene and Pliocene paleogeography of the WC and nDB can be judged also from mass balance relations point of view, e.g. relations between the uplifting source and sinking areas. The Upper Miocene tectonically quiet period with absence of greater amount of coarse grained sediments in majority of the DB sedimentary fill indicates development of a moderate topography in hinterland of the basin. This facts are in good agreement with documented development of main planation surfaces of the WC Mid-mountain level dated between 11.6 – 6 My.

Uplift of the WC mountain chain documented between 6 – 4 My is not visible in basin sedimentary record, no abrupt change or erosion surface can be found on seismic lines crossing the basin centre. This tectonic event can be supported only by the onset of coarser deltaic sedimentation in the Volkovce Formation upper part, when a fan delta of paleo Hron river entered the basin. Upper Pliocene (4.1 – 2.6 My) and Quaternary acceleration of the mountain chain uplift led to the present day landscape and river net development; the paleo Váh river entered the nDB, which surface was divided into uplifting hilly land and subsiding plain.

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