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Quantitative river channel analysis based on georeferenced historical maps - documenting vertical movements in the Little Hungarian Plain

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The Little Hungarian Plain is situated at the western margin of the Pannonian Basin and can be divided into two geomorphologically distinct parts: the Győr Basin to the North and the Marcal Basin to the South. In the northwestern area of the Little Hungarian Plain the Variscan, weakly metamorphic basement is directly overlain by Miocene and Pannonian marine sediments in the northwestern area of the Little Hungarian Plain. In its central and southeastern parts, the crystalline basement is covered by thick Mezozoic carbonates followed by Neogene sediments. The major structural feature of this area - the Rába line - marks this subsurface transition.

During late Miocene extension and the following convergent deformation phase the Little Hungarian Plain preserved its basin characteristics (Fodor et al., 2005; Horváth & Cloetingh, 1996) in contrast to adjacent areas. This convergent phase, resulting from the inversion of the Pannonian Basin, is also considered as the neotectonic phase of the region (Fodor et al., 2005; Bada et al., 1999; Horváth, 1995). The Little- and the Great Hungarian Plains are divided by the Transdanubian Mountain Range with a low mean elevation, but a very high relief. The formation of this landscape with alternating plains and mountain ranges is partly due to recent vertical crustal movements with values up to -2.2 mm/a in the northern part of the Little Hungarian Plain (Joó, 1992; Joó et al., 2006). Thus the thickness of Quaternary deposits in this area exceeds 700 m (Scharek et al., 1994). The vertical movements have a strong influence on the landscape evolution. For example, the region of the Transdanubian Mountain Range is

subject to uplift and fluvial erosion (Horváth & Cloetingh, 1996), whereas in the northern part of the Little Hungarian Plain (Győr Basin) alluvial sedimentation prevails, in the southern part (Marcal Basin) erosion is dominant. According to Pécsi (1997) the area between the Parndorf plateau and the city of Győr is composed of several alluvial fans of different age without any significant differences in elevation. Towards the East, the terraces of the Danube can be distinguished by geomorphological and geochronological methods and indicate a rapid incision of the Danube into the uplifting northern part of the Transdanubian Mountain Range during a period of climatic change during the transition between glacial and interglacial periods (Ruszkiczay-Rüdiger et al., 2005).

Vertical crustal movements have also a strong influence on the evolution of drainage networks (Ouchi, 1985). Studies of river avulsion of the Tisza River in eastern Hungary showed a tight relationship between river channel geometry and basin subsidence (Timár, 2003). However, artificial river adjustments have a long tradition in this region (compare with Lászlóffy 1938). Therefore, georeferenced historical maps (e.g. Timár & Molnár, 2003; Timár 2004; Timár et al., 2006), which show the rivers in a more natural state than today, have been used for quantitative geomorphological interpretation; they provide numerous new and important results for landscape evolution and geomorphic analysis.

Drainage basin analysis and calculation of river channel properties (e.g. river sinuosity) were conducted based on the exactly georeferenced historical map sheets of the second military survey of the Habsburg empire (Timár & Molnár, 2003). The main rivers analysed were the Lajta, Répce, Rábca, Ikva and Wulka rivers. Thalweg sinuosity values along the river channel (Timár & Rácz, 2002) shows a high variation partly linked to local fault activity. The variations also document the very young phases of basin subsidence.

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References

Bada G., Horváth F., Gerner P., Fejes I. (1999): Review of the present-day geodynamics of the Pannonian basin: progress and problems. *Geodynamics*, **27**, 501-527.

Baranyi S., Deák J., Dreher J., Mahler H., Major P., Neppel F., Papesch W., Rajner V., Rank D., Reitinger J., Schmalfuss R. (1994): Wasserhaushaltsstudie für den Neusiedlersee mit Hilfe von Geochemie und Geophysik. In: Lobitzer H., Császár G., Daurer A.: Jubiläumsschrift 20 Jahre Geologische Zusammenarbeit Österreich-

Ungarn, 2, Geologische Bundesanstalt, Wien, 419-435.

Fodor L., Bada G., Csillag G., Horváth E., Ruszkiczay-Rüdiger Zs., Palotás, K., Síkhegy, F., Timár G., Cloetingh S., Horváth F. (2005): An outline of neotectonic structures and morphotectonics of the western and central Pannonian Basin. *Tectonophysics*, **410**, 15-41.

Horváth F. (1995): Phases of compression during the evolution of the Pannonian Basin and its bearing on hydrocarbon exploration. *Marine and Petroleum Geology*, **12**(8), 837-844.

Horváth F., Cloetingh S. (1996): Stress-induced late-stage subidence anomalies in the Pannonian basin. *Tectonophysics*, **266**, 287-300.

Joó I. (1992): Recent vertical surface movements in the Carpathian Basin. *Tectonophysics*, **202**, 129-134.

Joó I., Balázsik V., Guszlev A., Végső F. (2006): A függőleges felszínmozgások feltételezett "okozói" hatásának szétválasztása és bemtutatása a Középső-Tisza és a Körösök vidékén. *Geodézia és Kartogfáfia*, **4**, 17-23

Lászlóffy W. (1938): Magyarország vízborította és árvízjárta területei az ármentesítő az ármentesítő és lecsapolási megkezdése munkálatok előtt (térkép). A Magyar Királyi Földművelésügyi Minisztérium Vízrajzi Intézete, Budapest.

Ouchi S. (1985): Response of alluvial rivers to slow active tectonic movement. *Geological society of America Bulletin*, **96**, 504-515.

Pécsi M. (1997): Szerkezeti és váztalajképződés Magyarországon. *Magyar Tudományos Akadémia*, Budapest, 296p.

Ruszkiczay-Rüdiger Zs., Fodor L., Bada G., Leél-Össy Sz., Horváth E., Dunai T.J.,(2005): Quantification of Quaternary vertical movements in the central Pannonian Basin: A review of chronologic data along the Danube River, Hungary. *Tectonophysics*, **410**, 157-172.

Scharek P., Tullner T., Turczi G. (1994): The first digital geological atlas in Hungary. *EGIS'94 Conference Proceedings*, 1994-1995.

Székely B., Reinecker J., Dunkl I., Frisch W., Kuhlemann J. (2002): Neotectonic movements and their geomorphic response as reflected in surface parameters and stress petterns in the Eastern Alps. *EGU Stephan Mueller Special Publication Series*, **3**, 149-166.

Timár G. (2003): Controls on channel sinuosity changes - Case study of the Tisza

River, the Great Hungarian Plain. *Quaternary Science Reviews*, **22**, 2199-2207.

Timár G. (2004): GIS integration of the second military survey sections – a solution valid on the territory of Slovakia and Hungary. *Kartografické Listy*, **12**, 119-126.

Timár G., Molnár G. (2003): A második katonai felmérés térképeinek közelítő vetületi és alapfelületi leírása a térinformatikai alkalmazások számára. *Geodézia és Kartográfia*, **55**(5), 27-31.

Timár G., Molnár, G., Székely, B., Biszak, S., Varga, J., Jankó, A. (2006): Digitized maps of the Habsburg Empire –The map sheets of the second military survey and their georeferenced version. Arcanum, Budapest, 59 p.