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Historic maps and landscape evolution: a case study in the Little Hungarian Plain

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Georeferenced historic maps provide a useful tool to derive geomorphologic landscape elements largely uninfluenced by anthropogenic activity, thus allowing the study of natural changes in the landscape evolution of increasingly densely populated areas. The study area, the Little Hungarian Plain (LHP), is located at the geologically and geomorphologically highly interesting region at the transition between the mountain chains of the Eastern Alps and the Carpathians. The area, as transport route and exchange zone of goods has had its specific importance since the Neolithic times. Consequently, the environment has been subject to human influence, especially since the onset of the industrial age. Geographically the LHP lies in the vicinity of major settlement areas (Vienna, Bratislava, Sopron, Győr) and stretches from the Leithagebirge, a mountainous area in Eastern Austria, to the City of Győr in Western Hungary. The political division of the area into two separate countries occurred after World War I. Thus, historic mapping in the Habsburg Empire and later in the Austro-Hungarian Monarchy that was organized and conducted before World War I allows a comprehensive overview of the study area. Map sheets of the 2nd Military Survey of the whole Monarchy were mapped in the time from 1807 to 1873 in the area of the entire Empire (Kretschmer et al., 2004). The Kingdom of Hungary, as part of the Empire was mapped in a homogenous campaign in the time from 1819 – 1869.

Beside the increasing human impact the area is characterized by active surface processes. The geologic evolution of the Little Hungarian Plain is dominated by tectonic processes related to the lateral extrusion of the Eastern Alps and the acceleration of northward movement of the Carpathians. Subsidence is accommodated mainly along high- and low angle normal faults with a high vertical movement component. Strike-slip movements at these faults are very rare. Most of these processes have been active also in the Holocene and recent as well. Joó (1992) measured recent vertical crustal movements with values up to -2.2 mm/a in the northern and with -0.6 mm/a in the southern part of the LHP, interpreting this as an evidence for ongoing faulting. The relative vertical movements occur along reactivated Neogene basement structures.

This differential subsidence affects the planform of river courses. The channel geometry of the Leitha, Répce, Rábca, Ikva and Wulka rivers running through the study area were extracted from the map sheets of the 2nd Military Survey that record the channel patterns and geomorphologic situation around 1840. The drainage pattern was analysed in order to detect a possible relation between channel geometry and on-going tectonic activity. Calculated indices (e.g. river sinuosity) show surprisingly strong local variations, considering the low relief and lithologic homogeneity of the area.Locations of the pronounced sinuosity variations coincide with projected surface traces of aforementioned Neogene faults, well-known from seismic sections. Neotectonic reactivation of these faults is further indicated by the local earthquake record and geomorphic features. Additional data, such as high-resolution digital elevation models (e.g. ALS DTM data) allow detection of micro-topographic changes at the surface that are probably related to neotectonic features. The combined analysis of information derived from historic maps, geomorphologic analysis and data derived from high-resolution digital elevation models improve the mapping of the faults at the surface.

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

Kretschmer, I., Dörflinger, J., Wawrick, F. (2004): Österreichische Kartographie. Wiener Schiften zur Geographie und Kartographie – Band 15. Inst. für Geographie und Regionalforschung, Universität Wien, Wien.