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EXAMINATION OF SEDIMENTARY DEPOSITION IN THE ACTIVE FLOODPLAINS OF BEREG-PLAIN

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ABSTRACT. In the last decade more and more science deals with the problems of the floodplain sedimentation and the higher peaks of the flood water-level, with the same discharge drew the attention to these issues. This process can be explained by the diminution of the cross-section. Since the width of the active floodplain is stabile, the diminution is the consequence of the alluviation (the rise of the bottom level). The chosen sample areas – three floodplain dilatations (the water slows down here so the sedimentation is more considerable) - are situated in the right bank of the River Tisza between Tarpa and Jánd. We tried to prove the existence of the sedimentation with Digital Elevation Model (DEM) made from 1:10000 maps, comparing the mean altitude of the active floodplains and reclaimed sides. Regarding the supposable that the altitudes of the two areas were the same before the diking of the artificial levees, the recent differences occurred in the period passed from the diking of the levees to the mapping served as a basis of the DEM. The examination based on digital base was completed with the sedimentology analysis of the drilled layers of an alluviating floodplain dead bed. Regarding the altitudes of the active floodplain and the reclaimed side in the three sample areas the same results were yielded using two different methods. The mean altitude of the active floodplains exceeded with 0.2-1.1 m the altitude of the reclaimed sides. Going downstream the rate of the sedimentation is decreasing with the decrease of the gradient.

Keywords: Tisza, floodplain, active floodplain, dead-bed, accumulation

INTRODUCTION

The examination of sedimentary deposition was very important in the last decade because the four extremely high floods in the turn of the millennium (1998, 1999, 2000 and 2001) confirmed the earlier proved tendency that the peaks of flood water-levels are raising. Among the possible reasons - e. g. the increase of the down-flow coefficient due to the deforestation or owing to the expansion of the paved surface in the catchment area (Illés – Konecsny 2000, Konecsny 2002, 2003) or because of the more and more frequent extreme weather phenomena etc. - the decrease of the cross-section of the active floodplain is arisen. The water experts drawn attention to e. g. the opening of Q-H curves which refers to increasingly higher peak stage beside the same water discharge (Nagy et al. 2001). This can be explained with the diminution of the cross-section of water discharge. Since the width of the active floodplain is stabile, the diminution is the consequence of the alluviation (the rise of the bottom level). The examinations begun towards three directions in order to reveal more correctly the slightly known phenomenon:

1. Manual field measurements: the determination of the thickness of the freshly deposited flood sediment, the sedimentology examinations of the alluviation of the dead beds in the active floodplain, the state survey of the VO. Stones, surveying the cross-sections of the active floodplain and the reclaimed side with a level instrument, comparing their mean altitude (Borsy 1972, Schweitzer et al. 2002, Kiss et al. 2002, Oroszi – Kiss 2004, Oroszi et al. 2006, Sándor – Kiss 2007, Babák 2006, Vass 2007, Vass et al. 2009).
2. The determination of the heavy metal content of the sediments in the active floodplain: identifying the time (e. g. Chernobyl nuclear catastrophe) of the heavy metal accumulation in every layer of the active floodplain can make the age of the layers deposited onto them definable so the rate of the accumulation can also be determined (Wyzga et al. 1999, Zhao et al. 1999, Kiss et al. 2000, Kiss – Sipos 2001, Braun et al. 2003, Szalai et al. 2005, Sándor – Kiss 2006, Soster et al. 2007, Szabó – Posta 2008, Dezső et al. 2009).
3. Measurements in the third group do not require field observations by all means but using former contour maps with scale as large as possible, the rate of the sedimentary deposition can be determined with the help of the relief map DEM made of the digitalized contour lines (Gábris et al. 2002).

In our study we obtained data from sediment-coverings and grain-size distributions (granulometric graphs) to calculate the rate of sedimentary-filling.

Description of the the study-areas

Our study-area – a dilations on the active-floodplain (where the rate of sedimentation is higher, caused by the slowing and expanding mass of water) – is located on the right bank of the river, in the vicinity of village of Jánd (Fig. 1). There were two stages of construction of levees on the right bank of the river: firstly between 1846-1849 for the segment between Borzsa-torok and Tarpa; and secondly between 1855-1856 for the segment between Tarpa and Mátyus (Ihrig

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1973). In our study-area the active-floodplain evolution took from 1856 (building the levees) up to our samplings in 2008-2009. Levees on the left bank were made later (1926-1928), coeval with the levees of the right bank of river Szamos. Besides building of levees, there were cutoffs (crosscuttings) of matured meander on the study-areas. As a result of this, active-channel was shifted in long distances.

Cutoff of the Foltoskert-bend (Fig. 2.) happened later than the other meanders in the Upper-Tisza. As "Tisza Atlasz, 1892" shows, at the end of the 19th century Tisza yet flowed in its original channel (as it also can been seen in the second military-mapping); but as „A Tisza hajdan és most" (1934) („Tisza in olden times and now, 1934") shows, in the early 1930's Tisza already has been flowed in its presently known, artificial channel. Exact date of cutoff is unknown, but based on the experts of FETIKÖVIZIG (Environmental Protection and District Water Authority in the Upper-Tisza) (personal communication; dept. in Vásárosnamény) it must have happened before 1914. Therefore, duration of sedimentation of the dead-bed (up to our sampling time) took over a time-period of about 100 years.

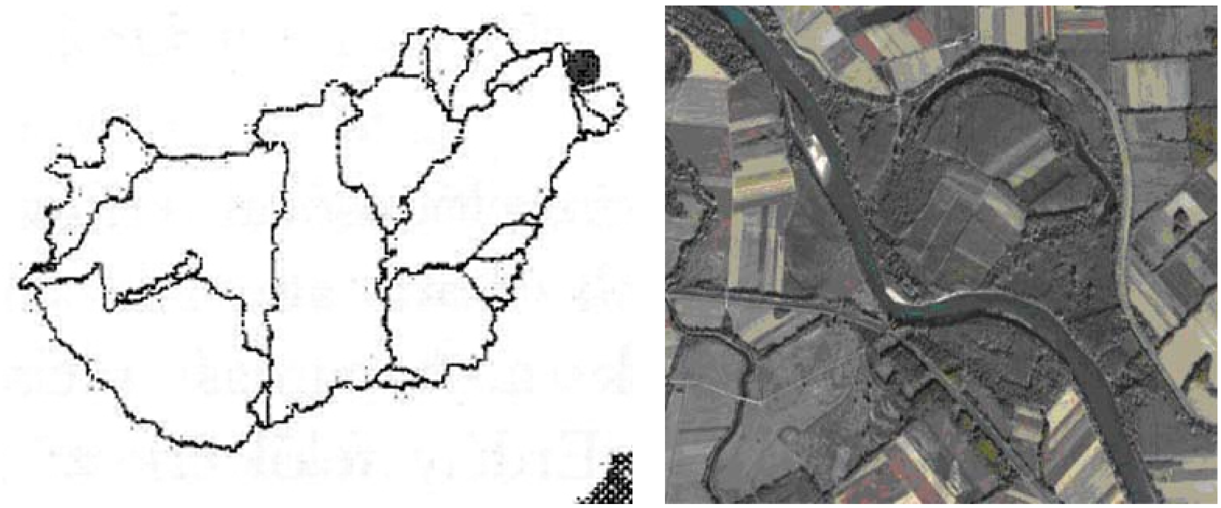

Fig. 1 Floodplain dilatation in Bereg-plain

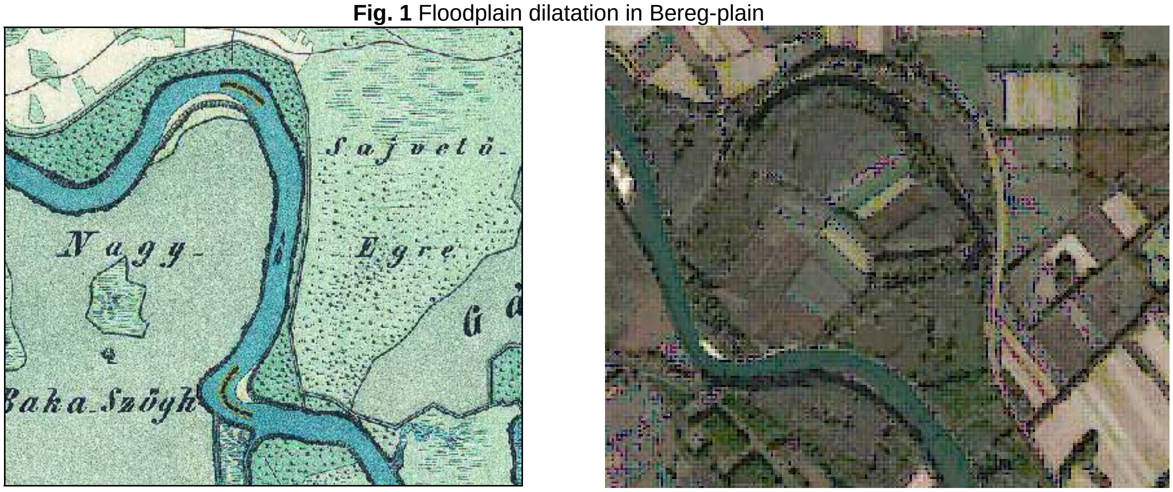

Fig. 2 The active floodplain of *Foltos-kert* in the second military mapping of the Habsburg Empire and in the Google Earth map

MATERIALS AND METHODS

Because of the remarkable channel-shifts (0.7-1.3 km), it can been supposed that on a given area, e.g. on the late overbank sedimentation processes were ceased rapidly, which mechanisms now works in the vicinity of the new (active) channel, in a distance of about 1 km. During our studies in *Foltos-kert*, we took a section in a total length of 1250 m, with 8 drillholes (Fig. 3 and 4) ranging from the dead-bed in its sediment-upfilling stage up to the shifted active (new) channel. For comparison we also made three drillholes in the dead-bed of *Boroszló-kert* and in its overbank. Depths of these drillholes are between 240 and 580 cm. Resulted drill cores were sampled by 10 cm scaling: mechanical composition was defined by Köhn-pipette decanting method and with sifting. Content of organic matter was defined by Tyurin-method.

Based on 1:10000 topographical maps, we made TIN models, using contour-lines of the map. Sections with relative surface locations of drillholes were made by dumpy level. We fitted two databases to reveal morphological characteristics of the vicinity of drillholes and relative locations of drillholes (Fig. 3).

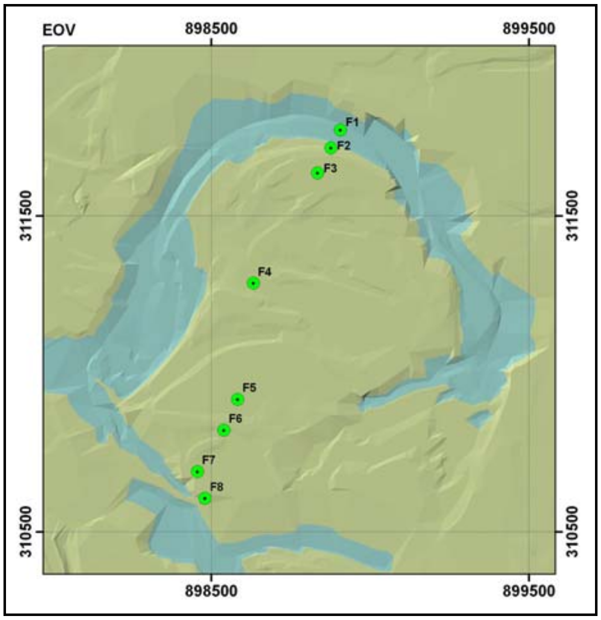

Fig. 3 DEM of Foltos-kert with drillholes

RESULTS

The F1-drillhole in *Foltos-kert* which is located in a dead-bed has got the lowest absolute-altitude (102.92 m), its depth is 310 cm (Figs. 3 and 4). F2-drillhole is located on the late margin of the dead-bed with an absolute altitude of 105.45 m and depth of drillhole is 460 cm. F3-drillhole is located on a overbank of the dead-bend. This is the highest point of the study-area (mBf: 107.03 m, depth of drillhole is 580 cm). Granulometric graphs of grain-size distributions of these three drillholes (alongside the dead-bed) confirms cutoff (crosscutting) of the river-bend (Fig. 5).

Proportion of sand in the case of F1-drillhole in depths between 310 and 100 cm (with grain diameters of 0.32-0.1 mm) varies between 60-83%, which can be regarded as river-bed sand. Cumulative proportion of clay and silt (with grain-diameters of 0.02-0.001 mm>) from 100 cm in depth up to surface increases up to 64-82%. Content of organic matter in F1-drillhole decreasing from surface down to layer-boundary: in deeper, sanded layers it decreases down to 1/3 part of its original proportion. Similar changes in mechanical composition and organic matter content also can been seen in the case of F2- and F3-drillholes, but with a smoother degree. Graphs of grain-size distrubutions for F4-drillhole in a distance of 580 to the dead-bed, with a depth of 550 cm imply a new mechanism (Fig. 5).

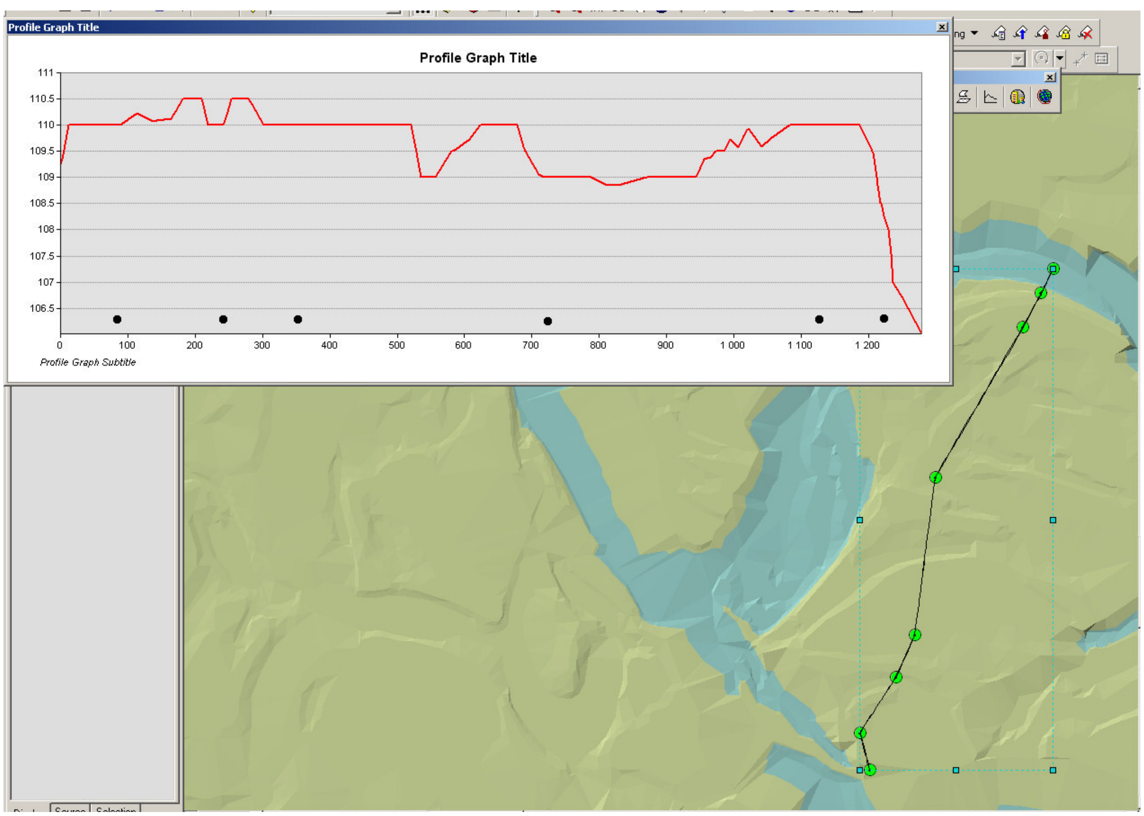

Fig. 4 Cross-section model of Foltos-kert with drillholes

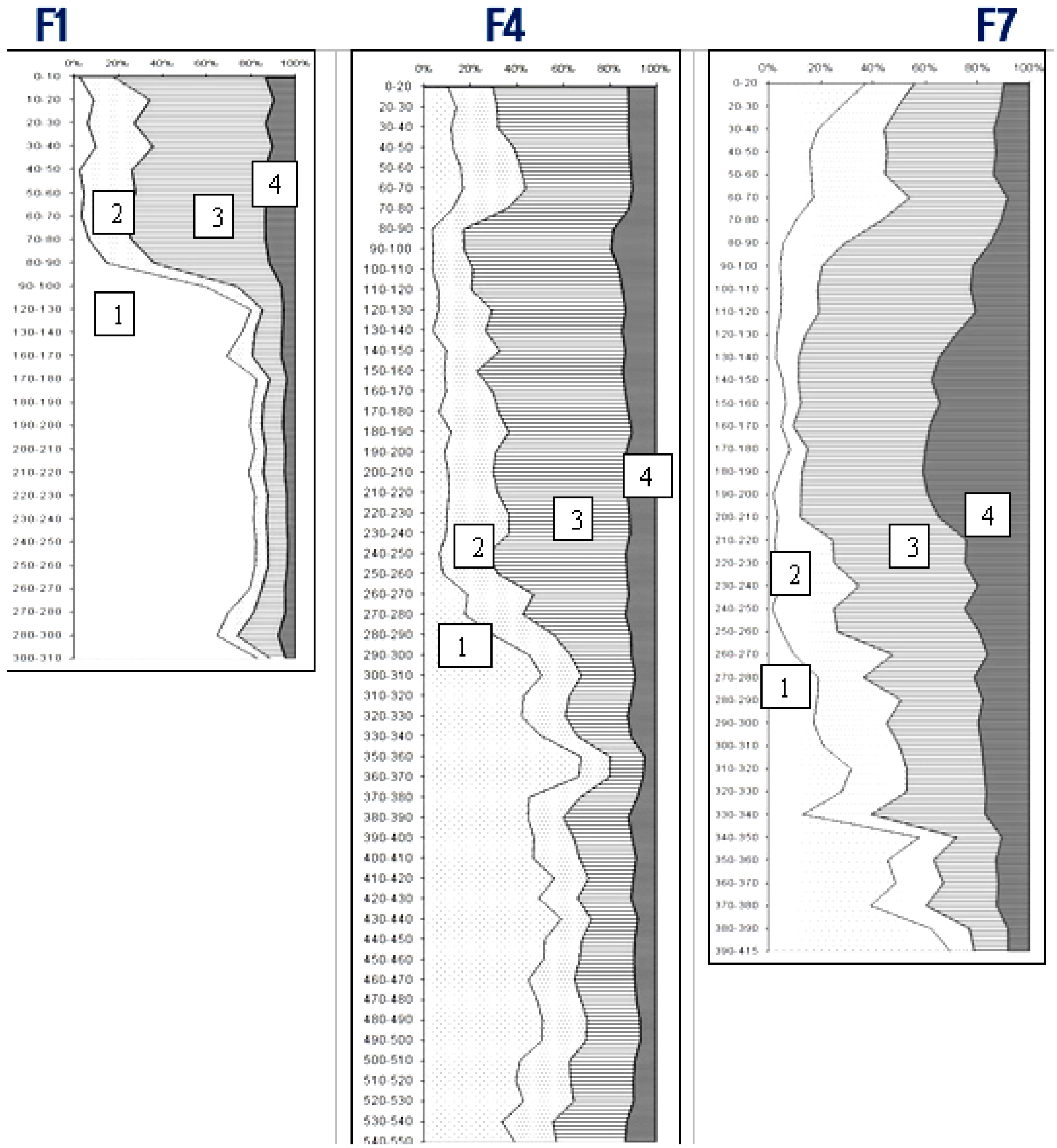

Fig. 5 The granulometric composition of the dead bed in *Foltos-kert,* 1: sand, 2: loess, 3: silt, 4: clay

The upper layer (80 cm in thickness) consists of sandy-silt, which is underlain by a layer of finer-grained accumulation. Proportion of sand in this sediment accumulation decreases from 12-17% down to 3-6%, while cumulative proportion of clay and silt increases from 56-70% up to 83%. Content of organic matter shows similar tendencies also: from surface down to 80 cm in depth it decreases from 3.54 % down to 1.9 %, while from 80 cm down to 130 cm, it also increases up to 2.57 %. Although the location of drilling is a little closer to the dead-bed, our data implies that sediments in the layer of the upper 80 cm are results of the shifted, new river bed; while fine-grained sediments of the uderlying layers in a thickness of 170 cm are from of the original (previous) channel in a greater distance. In the case of F4-drillhole, sedimentational mechanism of the F1-, F2- and F3-drillholes turns into its reverse, as coarse-grained sediments around the dead-bed are covered by fine-grained sediments originated from the shifted active-channel after cutoff. Towards to the active-channel, traces of this process became more frequently. Upper layer (0-90 cm) of F7-drillhole (mBf.:106.85 m) also can be referred to the shifted new (active) bed, in which layer the upper 20 cm is consists of 38 % sand, according to its short distance to the active-bed (less than 100 m) (Fig. 5). Under the layer-boundary increasing rate of organic matter content is similar to F4-drillhole. It is interesting that fine-grained layers referred to the older channel (between 90 and 260 cm) is equal to similar depths of F4-drillhole, and their mechanical compositions are almost the same also, but F7-drillcore samples are slightly more fine-grained. The distance between F4- and F7-drillholes is 600 m. On our lowest point we measured accumulation in a thickness of 100 cm. On higher areas accumulation was 80-90 cm, based on F4-, F5-, F6-, F7-drillhole data. Based on these data, rate of accumulation was 0.9-1 cm/year in Foltos-kert during the last one-hundred years, since the cutoff.

CONCLUSIONS

Granulometric graphs of grain-size distributions of shallow-depth drillcores from a dilation of the floodplain-area of Upper-Tisza revealed that accumulation on the floodplain changed after crosscuttings the river-beds. These changes were determined by the distances of the previous and the new channels. Based on approximated date of crosscuttings, accumulation rate of this two a dilation in dead-bed was 0.9-1 cm/year. On higher areas we measured accumulation in a thickness of 80-90 cm, which is equal to a rate of accumulation of 0.8-0.9 cm/year.

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