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MORPHOLOGY AND SEDIMENTS OF THE UPPER MIERZAWA FLOODPLAIN (POLISH UPLANDS)

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Abstract
The flat and wet upper Mierzawa river floodplain conditions the growth of peats. Sediments of this floodplain show a facial differentiation typical for a meandering river. The variation of sedimentation types and content of clastic material in peats reflected an increase and decrease of river activity during the Holocene, probably related to climate fluctuations (i.a. 8.2 ka event) and/or human impact (last centuries).

Keywords: Mierzawa floodplain, morphology, geological structure, palaeogeography

INTRODUCTION

The small Mierzawa river (length about 65 km, the 3rd order) is located in the Polish Uplands region [1], in the W part of the Nida Basin (Fig. 1). It is belonging to the Vistula catchment [2]. Its upper section is situated in SW part of the Mesozoic margin of Holy Cross Mountains. There are carbonate rocks of the Cretaceous in basement. Their outcrops occur locally (Fig. 2, 3) [3].:

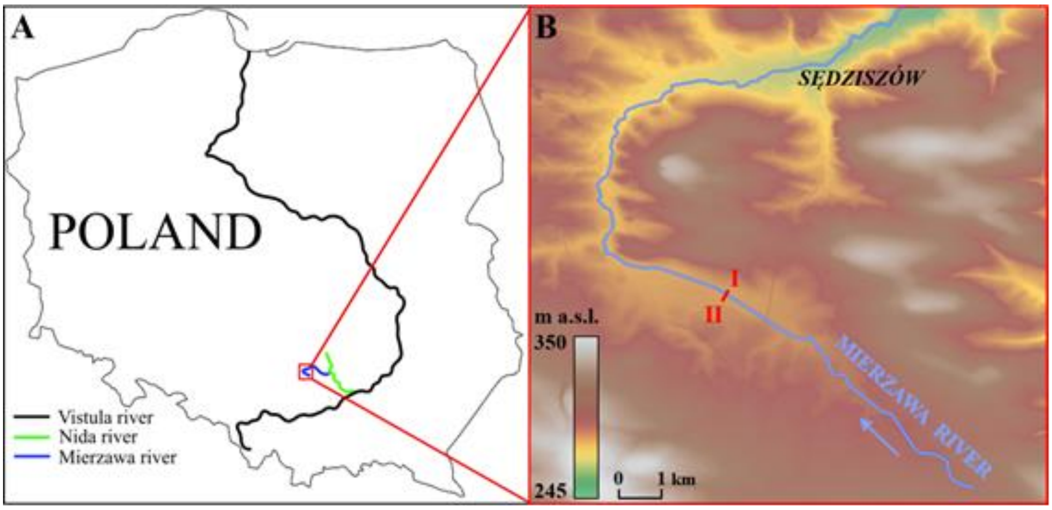

Figure 1. The Mierzawa river in Poland (A) and upper section with study cross section (I-II) on Digital Elevation Model (B); geoportal.gov.pl

The upper Mierzawa river valley is cut about 20 m into marls and opokas (Upper Cretaceous) and filled with the Quaternary sediments (Fig. 2, 3). There are glacial, limnoglacial (South and Mid-Polish Glaciation) and slope deposits (Vistulian Glaciation), the Vistulian sandy terrace (2.5-4.0 m), and also the Holocene sediments of two floodplain levels (sands, silts and peats). The alluvium of the valley floor were accumulated in the Neoholocene. The peats (thickness about 0.5-2.0 m) occurring at this level (i.a. the peat bog in the river source area) grew during the Subatlantic [3] [4].

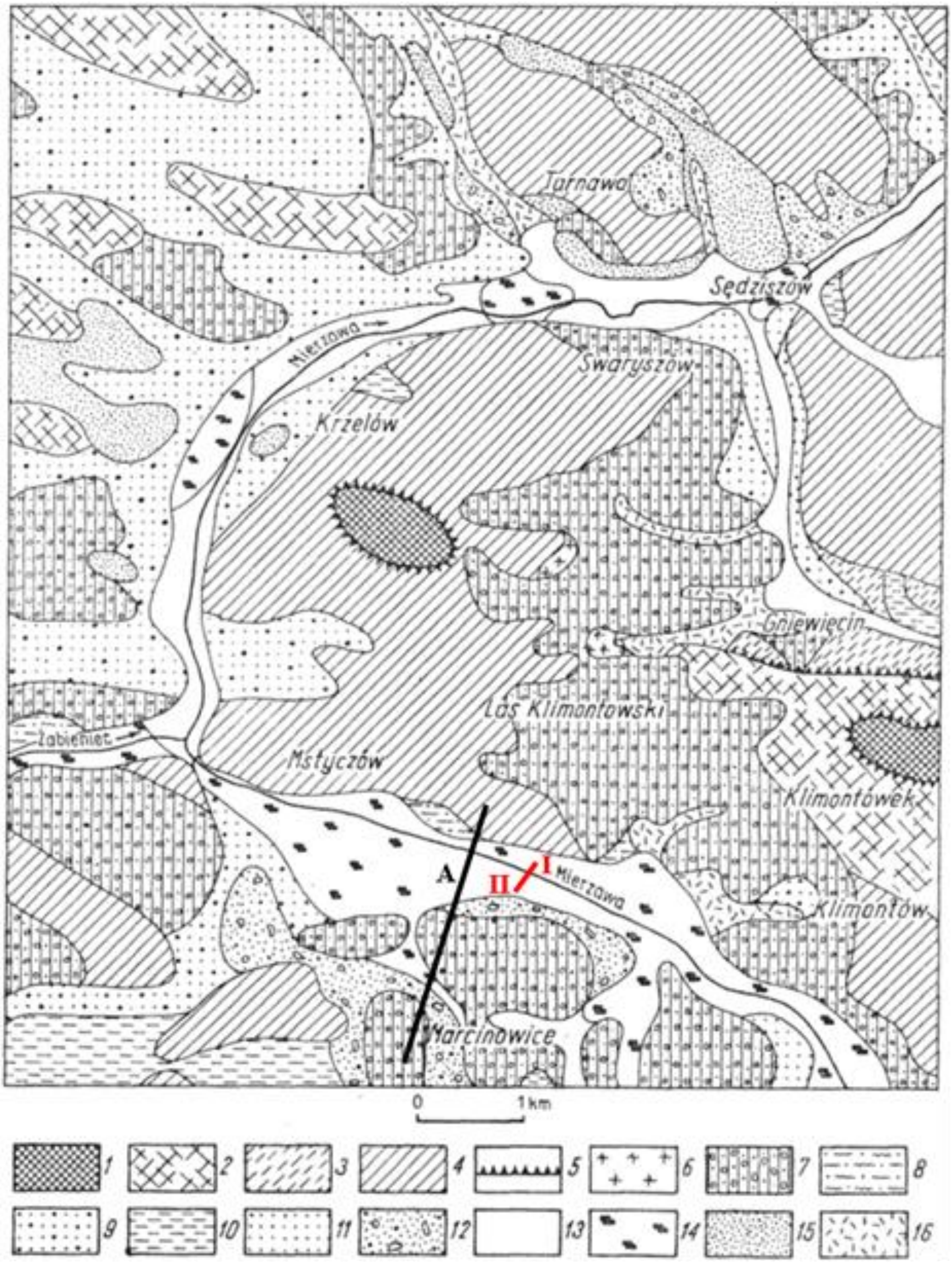

Figure 2. The geological structure of the part of the upper Mierzawa river basin [3 modified]
1 – Cretaceous buttes rising 320-326 m a.s.l., 2 – Palaeogene planation surfaces, 3 – erosional terrace situated 270-280 m a.s.l., 4 – denudational slopes in Cretaceous deposits, 5 – margins of planation surfaces and erosional terrace, 6 – loess-like silts, 7 – tills, 8 – sandy silts, 9 – fluvial-periglacial sands, 10 – loesses, 11 – silty sands with admixture of gravel in subsurficial zone, 12 – solifluction flows, 13 – sands with gravels and river silts, 14 – peats, 15 – dunes, 16 – deluvial deposits in lateral valleys, A – cross-section by [3] (see Fig. 3), I-II – cross-section by authors (see Fig. 5)

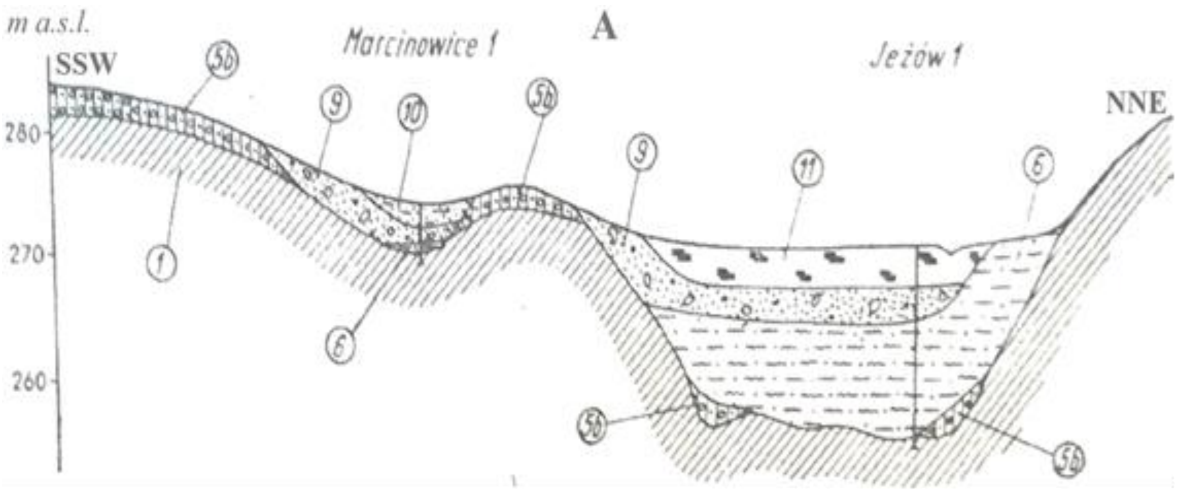

Figure 3. The geological section A across the upper Mierzawa basin [3] (location see Fig. 2)
1 – marls and opokas (Upper Cretaceous), 5b – till with granites and quartzites
(South-Polish Glaciation), 6 – ice-dammed lake sandy silts (Mid-Polish Glaciation),
9 – sandy solifluction flows with admixture of gravels, loesses and tills (North-Polish Glaciation),
10 – sands with gravels and organic matter (Holocene), 11 – peats and organic silts (Holocene)

AIM AND METHODS

The aim of the study is to determine the morphology and geological structure of the upper Mierzawa floodplain and indication of some stages of its development recorded in sediments.

An interdisciplinary approach was employed, using a wide range of methods: geologic, sedimentologic, geomorphic and cartographic using GIS (Geographic Information System). Geological hand-made drillings were made in the floodplain and sediment samples were taken for laboratory research. Sedimentological analysis and absolute dating of deposits were used in the study. The grain-size of sediments was determined by macroscopic measurement. Lithology, structural and textural features of sediments were indicated, also deposit members were separated. The organic matter content in sediments was marked using the loss on ignition method [5] in the Geomorphological and Hydrological Laboratory of the Jan Kochanowski University in Kielce (Poland). The combustion in a chamber kiln was repeated three times at a temperature of 500 degrees Celsius, until the total disappearance of organic matter. The obtained results (mineral material weight) were used to calculate the percentage of organic matter in sediments. Radiocarbon dating [6] was done in the Laboratory of Absolute Dating in Skała (Poland). The results were presented in graphic form (Digital Elevation Model and geological cross-section) using "GRANULOM", "QGIS" and "INKSCAPE" programs.

RESULTS

The graphic elaborations of GIS data and of laboratory analysis results show the morphology (Fig. 4) and structure (Fig. 5) of the flat Mierzawa river valley floor. There is a peat bog on clayed sands with gravels. Rectilinear undercuts in relief of valley bottom may be traces of peat exploitation..

On the right valley slope, on clayey sands with gravels, there are peaty silts with a small thickness up to 30-40 cm and the organic matter content growing towards the valley axis from 15-20% to 30-35% (drilling 1 and 2). On the floodplain, these are peats, where the clay content increases towards the top, and the amount of organic matter decreases from 70-80% to 40-50% (drilling 3). In the direction of the present-day riverbed, sandy inserts appear, separating the two levels of peat - the lower one with an organic substance content of 80-90% and the upper one with the content of about 50% (drilling 11). The sandy inserts were accumulated during the formation of the sandy alluvia that accompany the contemporary Mierzawa riverbed (drilling 10). On the left side of the riverbed there is a peat plain more than 200 m wide. Within it, organic sediments with a thickness about 1 m are divided into two layers and separated by a sandy insert several centimetres thick. The lower layer is made of peats with an organic content of 70-50% with a tendency to increase their clay content towards the top. The upper layer is made of peaty silts with an organic matter content about 20% (drilling 4).

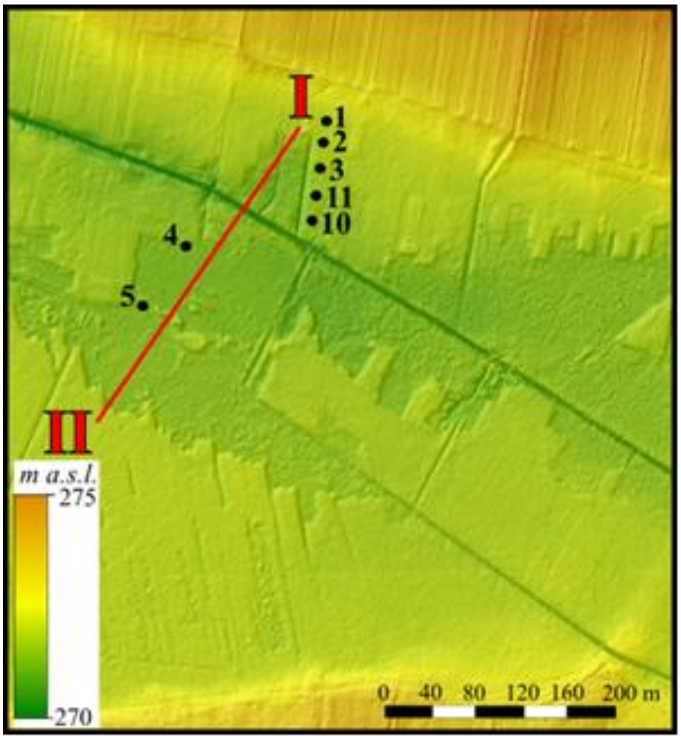

Figure 4. The study cross-section (I-II) on Digital Elevation Model (DEM)

At a distance about 100 m from the present-day Mierzawa river, a very big thickness of organic sediments (over 3 m) was found (drilling 5), which may fill the abandoned channel There are 4 members within the filling. The lowest one (I: depth 3.5-2.6 m) is heterogeneous and consists of layers of peaty silts (organic matter content 5-25%), silts and lamina of clayey peats (organic matter content approx. 50%).

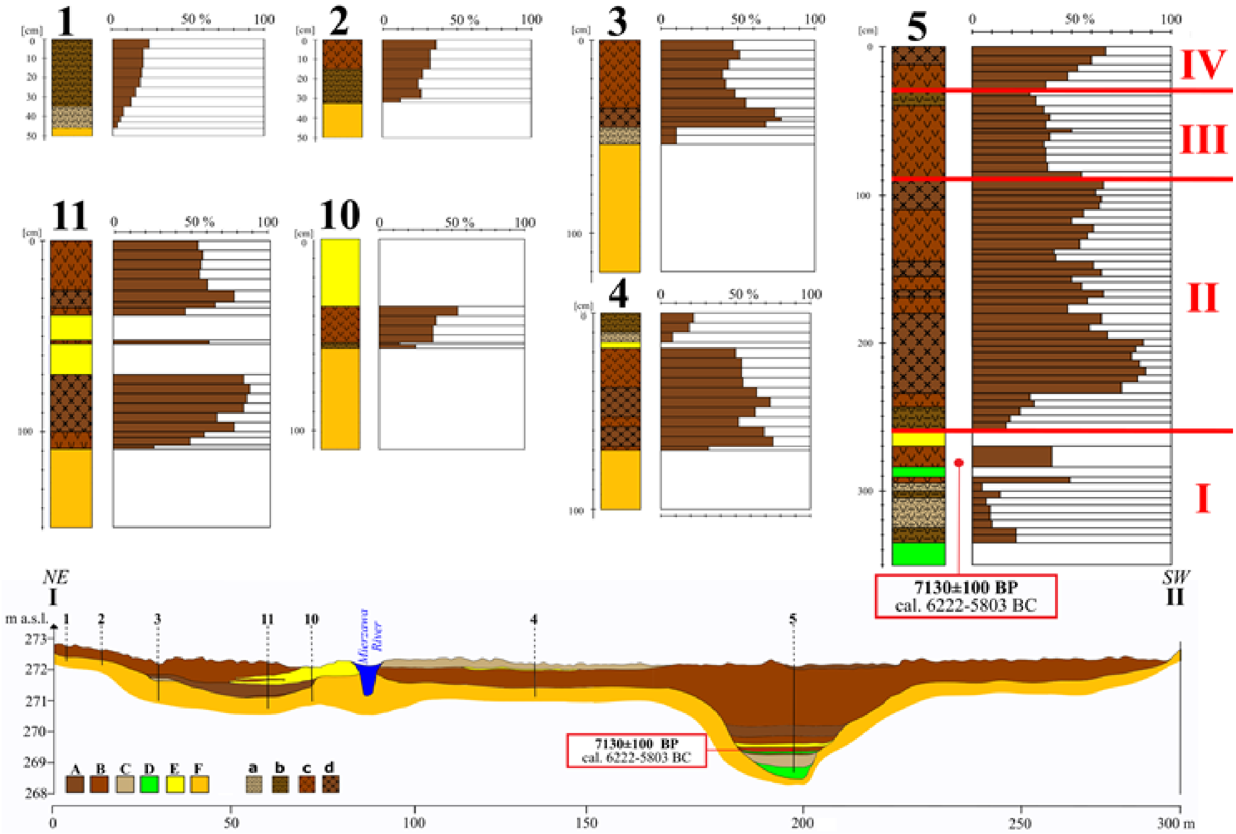

Figure 5. The schematic section across the upper Mierzawa river flood plain
A – peats, B – silty peats, C – sandy peaty silts, D – very fine sands, E – fine sands,
F – clayed sands with gravels, a – sandy peaty silts, b – peaty silts, c – silty peats, d – peats

The member ends with an insert of sands accumulated after 7130±100 BP (MKL-4452) cal. 6222-5803 BC [7]. The next three members form organic deposits. Within them, the lower member (II: depth 2.6-0.9 m) is made of peaty silts that turn upwards into peats with a variable content of organic matter from 90 to 40%. There is a general tendency to decrease the proportion of organics towards the top from 90% to 50%. The middle member (III: depth 0.9-0.3 m) is formed by clayey peats, quite homogeneous, as the content of organic matter remains within 30-40%. The upper member (IV: depth 0.3-0.0) consists of peats in which the content of organic matter grows significantly towards the top from 30 to 70%.

DISCUSSION AND CONCLUSIONS

The flat and wet floodplain of Mierzawa river with peat bog are dissected by cut and fill of alluvial body. There are sandy alluvia probably from the Subatlantic because sandy intercalations from the formation period of this cut and fill are in the peats 0.15 and 0.5 m deep on left and right site of flood plain respectively.

The variation of content of clastic material in peats reflected an increase and a decrease of river activity during the Holocene, probably related to climate fluctuations and/or human impact.

Changes of sedimentation type occur in abandoned channel fill after 7130±100 BP (MKL-4452) cal. 6222-5803 BC could be related to phase of increased fluvial activity ongoing 7.3-7.0 ka BP [8] (8.2 ka event [9]), between the Greenlandian and the Northgrippian ages/stages about 6200 BC [10][11].

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