DIFFERENTIATION OF SEDIMENTS IN THE SUCHEDNIÓW WATER RESERVOIR (ŚWIĘTOKRZYSKIE VOIVODESHIP, POLAND)

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ABSTRACT

The Suchedniów water reservoir was built in 1974 in the middle section of Kamionka river (Świętokrzyskie voivodeship in Poland) in the area of earlier industrial water reservoirs existing here during the Old Polish Industrial District time. Research carried out after drainage of this reservoir in 2017 showed that the pond has preserved forms and sediments documenting contemporary anthropogenic activity (fireproof clay layer, inland fan delta), historical marks (lacustrine sediments of older reservoirs), as well as traces of catastrophic event (sandy mega ripple marks formed after suddenly drainage caused by dam breaking in 1974). Field and laboratory analysis allowed to gather information on the grain size differentiation of sediments in the reservoir area.

Keywords: sedimentology, Suchedniów water reservoir, lacustrine sediments, fan delta, mega ripple marks

INTRODUCTION

The beginning of the metallurgy in the Holy Cross Mountains is date to the Roman period [1], [2], and later development based on hydropower it had its beginning in the Middle Ages. There were many forges and watermills in the Old Polish Industrial District area (northern part of Holly Cross Mountains). Those objects were built near the rivers on which were created industrial ponds, in this way forming anthropogenic small-scale water retention system (ASWRS), typical for many bigger and smaller watercourses in this region. The fall of these forges at the beginning of the 20th c. led to the disappearance of ASWRS, and in the place of some of the old ponds were built bigger reservoirs [3]. An example is the Suchedniów water reservoir, built in 1974 in the middle section of Kamionka river (right-side tributary of Kamienna river), in the northern part of the Świętokrzyskie voivodeship [4], [5]. In 2017, hydrotechnical works were carried out on the reservoir area to restore its retention functions. After draining the reservoir was began works to deepen its basin, in this way gave the opportunity to study sediments accumulated for over 40 years.

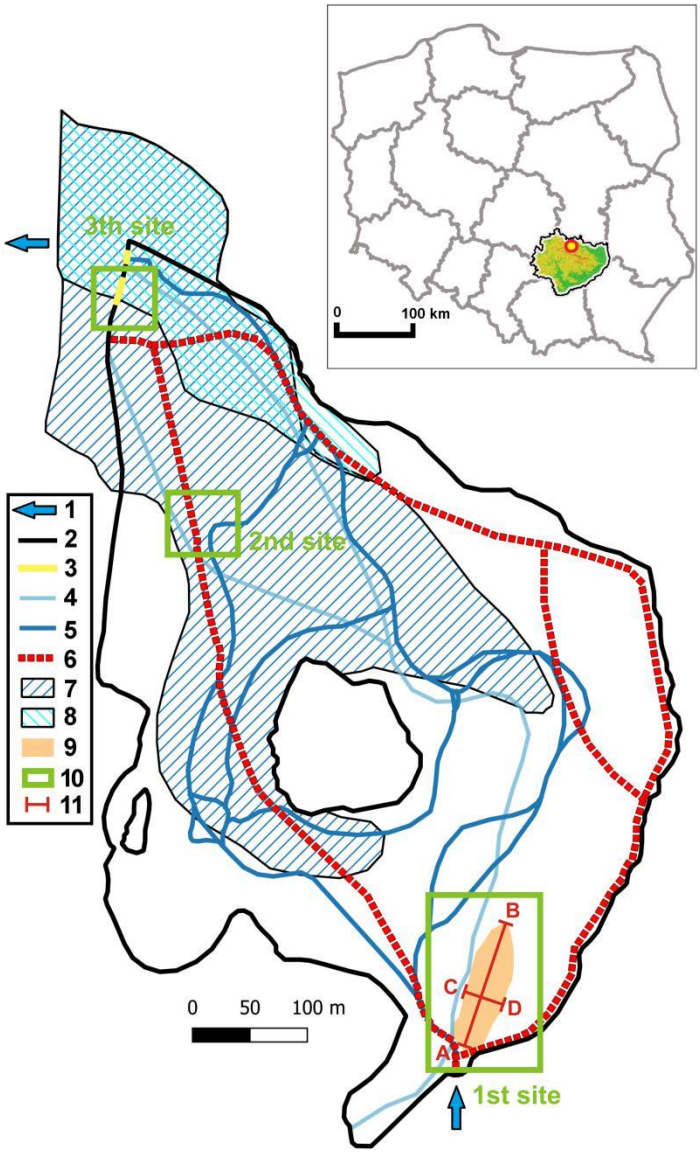

Figure 1. Location and situation map of Suchedniów water reservoir

1 - river flow direction, 2 - border of modern reservoir, 3 - dam, 4 - riverbed before 1974, 5 - riverbed after reservoir drainage in 2017, 6 - drainage channels in 2017, 7 – water reservoir in 1855-1907, 8 – water reservoir in 1907-1914, 9 - fan delta formed in 2009-2011, 10 - analyzed sites, 11 - profiles

AIM OF THE STUDY AND METHODS

The aim of the research was to obtain data about the forms and sediments accumulated in the Suchedniów water reservoir and to capture the diversity of sedimentary environments in its basin. Field work was based on opencast profiles and drillings (using a hand drill and COBRA impact drill).

The obtained material was analyzed in grain size terms using sieve and laser method (Mastersizer 3000). The results were converted by the Folk-Ward's distribution parameters using the "GRANULOM" program. Based on this data prepared 5 sedimentary maps using information obtain from 45 profiles and geological drillings

made in the entire reservoir area. Each map represents a different range of depths of accumulated deposits (to 1 m). These materials have been developed using QGIS program.

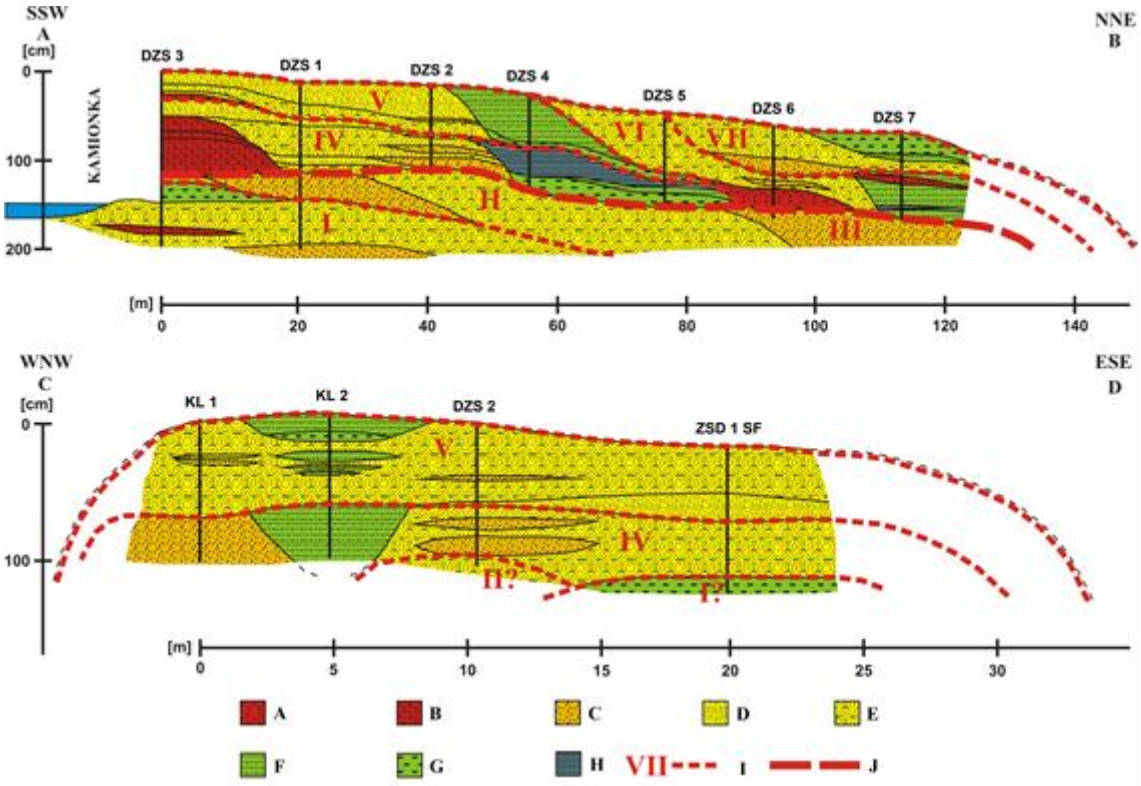

Figure 2. The fan delta (1st site): longitudinal (A-B) and cross-section (C-D) profile

Lithology: Lithology: A - sand with gravels, B - silty sand with gravels, C - medium sand, D - fine sand, E - silty-clayey sand, F - silty-sandy clay, G - coarse silt, H - fine silt, I - sedimentary phases, J - contact of units

RESULTS

During the field work there were identified three characteristic sites, representing different sedimentary environments.

The first of them was located in the south-eastern part of the reservoir basin (Fig. 1) represents the inland delta (fan delta) deposits [6]. Its youngest part was created in 2009-2011, when in the reservoir was accumulated material from embankments of the S7 expressway that was built in this time [7], [8], [9], [10], [11]. Embankments has been cut by the river that transport sediments and accumulate them in the Suchedniów water reservoir, forming in the river estuary to the pond very well visible fan delta. This form is built by alternating fine-grained and medium-grained sands with fine-grained admixture (3-45%). Sorting of individual sediment layers varies from well to poorly sorted. In the longitudinal section can be distinguished 5 phases of the delta accretion, by sediments accumulated by the floods. In cross-section accumulated sediments occur very well visible erosion cuts and small channels filled by very fine material (Fig. 2) [6], [10], [11].

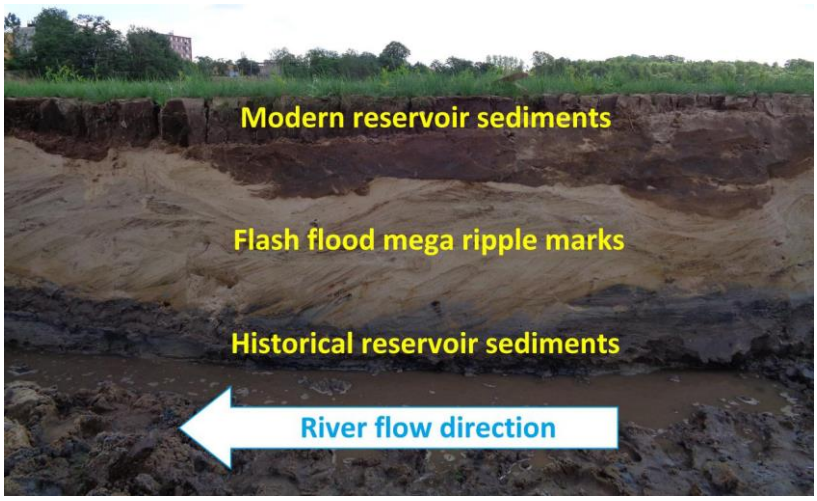

Figure 3. Three well visible layers representing different sedimentary environments (2nd site)

The second site, in the middle part of the study area, was located on the bank of the channel draining the reservoir in 2017 (Fig. 1). In the profile, are visible three levels representing different sedimentary environments. In the lowest part, on well-sorted fine-grained sands, lies a dark layer of silty sands with single gravels and small interbeddings with large fragments of detritus (branches). These sediments are covered with a medium sands with single gravels forming visible mega ripple marks. The upper part of the profile is built by silty sands with single gravels (Fig. 3).
The third site was located in the north-western part of the reservoir near the dam (Fig. 1). Material accumulated here has considerable thickness and characteristic red colour. Dominate here sandy fractions with visible gravels increase to the top of the sediments. The admixture of the silty fraction is small (around 5%) (Fig. 4) [10], [11].

Figure 4. Characteristic red sediments accumulated near the dam (3rd site)

DISCUSSION

The texture and structure of sediments in the Kamionka river estuary to the water reservoir indicates that they represent material accumulated in the fan delta [8], [12], [6], [3], [10], [11]. In the profiles are very well visible many erosion channels filled with sediments. The diversity of sediments in this part of the reservoir is associated primarily with the intensive accumulation of material transported by the river in 2009-2011. These are mainly sands and silty sands with an admixture of coarser factions (Fig. 2).
In the middle part of the reservoir are preserved probably lacustrine sediments of the previous pond from the early 20th c., the existence of which is documented in historical and cartographic materials. They are represented mainly by fine sediments. The sandy mega ripple marks lying on them are most probably a remnant of the sudden drainage of the reservoir after the dam break in 1974 (Fig. 2) [7], [9], [13], [10], [11]. In these sands there is also an admixture of the coarser fraction.

A red sediments occur at the site located near the dam (Fig. 4). Characteristic of this material is typical for fireproof clay, locally excavated and processed in nearby factory once manufacturing ceramic products in the 20th c. [14]. It is possible that these sediments may also come from nearby expressway S7 embankments, from where was transported by the river and accumulate in the water reservoir [15], [9]. The coarsest factions are represented by sharp-edged crumbs, which indicates short or lack of the fluvial transport. It probably comes from weathered concrete dam elements in the edge of this part of the reservoir (concrete and quartzite fragments).

Grain size maps show places where the selected fractions dominate on which depth. Coarse-grained material, mostly sands with single gravels were accumulated in the central (after sudden drainage of the reservoir from 1974), north-western (near the dam) and south-eastern part of the water reservoir (near the estuary, partly related to the accumulation of fan delta sediments, and near the anthropogenic beach). This material can be associated with different human activities. The finest fraction dominates in the eastern and north-western part of the study area. These sediments occur throughout the entire reservoir, but have a different thickness and depth of occurrence. This material usually represents the lacustrine sediments of the modern reservoir, as well as the previous industrial pond, that traces of it were found in the north-western part of the studied area (Fig. 5).

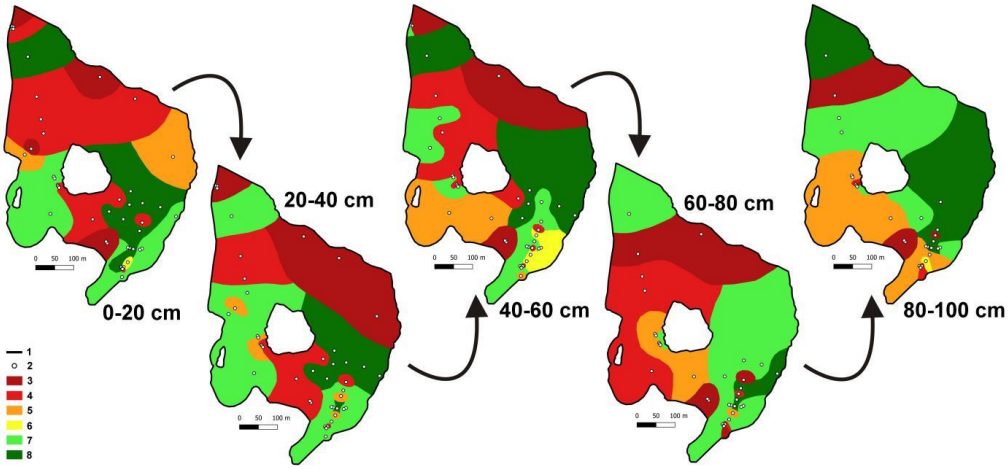

Figure 5. Suchedniów reservoir sedimentary maps: 1 – border of modern water reservoir, 2 - profiles and drillings, 3 - sand with single gravels, 4 - silty sand with gravels, 5 - medium sand, 6 - fine sand, 7 – sandy silt, 8 – silt and clay

Irregular arrangement and sometimes shallow drillings (hard to reach, wet areas) are the cause of the lack of precision in some parts of the analyzed reservoir, for this the results shown in graphical form are presented in a subjective way.

CONCLUSIONS

In the reservoir basin has preserved forms and sediments documenting anthropogenic activity as well as catastrophic events. This applies to the deposits of the modern reservoir (fireproof clay layer, fan delta) and historical (lacustrine sediments in the north-western part of the modern reservoir). The intensive silting of the reservoir represent periods of increased anthropogenic activity in the catchment area (e.g. construction of the S7 expressway). Sandy mega ripple marks can be associated with the dam break in 1974 and sudden drainage of the reservoir.

The grain size maps show a large facies diversity throughout the entire study area. Characteristics and thickness of some sediments occurring in the Suchedniów reservoir basin represent different sedimentary environments.

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CHANGES IN THE COURSE OF THE KRASNA RIVER IN THE ESTUARY SECTION (POLISH UPLANDS)

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ABSTRACT

The aim of the study was identify the riverbed changes of the Krasna river in its whole length during last centuries based on archival cartographic materials. Additionally in the estuary section, about 2 km long, which was noticed the largest riverbed changes visible on the maps, verified cartographic changes are done geomorphological and geological mapping of the Quaternary sediments. Krasna river is located in the northern part of the Świętokrzyskie voivodship in the Polish Uplands area. It is left tributary of the Czarna Konecka, with a 28 km length. The basin area have about 121 km^2. It was located in the Old Polish Industrial District. Krasna river was one of the most industrialized rivers of Old Polish Industrial District in 19th c,. the waters of the lower section of Krasna river were driven the forges and water mills. The activity of the forges and water mills contributed to changes in the course of the Krasna riverbed, visible on cartographic materials as well as in sediments. In the early 30th year in 20th c., old forges were transformed into water mills. In later years, the mill buildings were transformed into sawmills existing until the middle of the 20th c. On the flood plain, remnants of the iron metallurgy have survived in such forms as shafts and channels as well as in sediments as slags or bricks. With the fall of industrial activity, the renaturalization processes was started in the Krasna river valley and the riverbed itself. This led to the restoration of a natural environment before human changes impact and river come back to its natural course.

Keywords: geomorphology, cartography, Krasna river, Old Polish Industrial District, channel changes

LOCATION

The studied area is located in the northern part of the Świętokrzyskie Voivodeship (Fig.1). The northern part of the Krasna catchment with the estuary of the river is located within the borders of the Opoczno Hills, which are part of the Przedbórz Upland, whereas the southern part lies on the Suchedniów Plateau, which is part of the Kielce Upland [1]. The river is a left-bank tributary of the Czarna Konecka river and is 28.4 km long.

There have been many anthropogenic changes related to industrial activity in Krasna river in last centuries. The water of the lower section of Krasna river was powering water wheels of industrial machines from Krasna to Stara Wieś [2]. Nowadays, the industry in this section does not exist anymore. In contrast, the upper section has remained largely unchanged in last centuries, as it is a very large swampy area, which now, due to the large and unique natural values, has been protected under the Natura 2000 program [3].