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12-18.09.2016

Evolution of river valleys in Central Europe

Ed. Tomasz Kalicki, Marcin Frączek, Paweł Przepióra

Polish Association for Environmental Archaeology

Department of Geomorphology, Geoarchaeology
and Environmental Management,
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Abstract book and field guide was revieved and accepted by members of Scientific Committee of the FLAG Meeting

Cover design Paweł Przepióra
Cover phot: Flood plain and upper Kamienna river: Marcinków III site with subfossil oak, radiocarbon dated at 2020±40 BP cal. 120 BC-70 AD, in river bank (photo T. Kalicki).

Polish Association for Environmental Archaeology
Institute of Geographynof the Jan Kochanowski University in Kielce
Kielce 2016

ISBN 978-83-64038-45-7

Print:
Drukarnia COMPUS,
ul. Kopalniana 27, 27-200 Starachowice
www.compus.net.pl

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REFLECTION OF CLIMATIC CHANGES AND HUMAN ACTIVITY AND THEIR ROLE IN THE HOLOCENE EVOLUTION OF CENTRALEUROPEAN VALLEYS

Tomasz Kalicki
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland
tomaszkalicki@ymail.com

Central Europe includes the area from the basin of Rhine river in the west to the basin of upper Dnieper river in the east. It stretches southwards to the Alpine mountain ranges - Alps and Carpathians (Fig. 1).

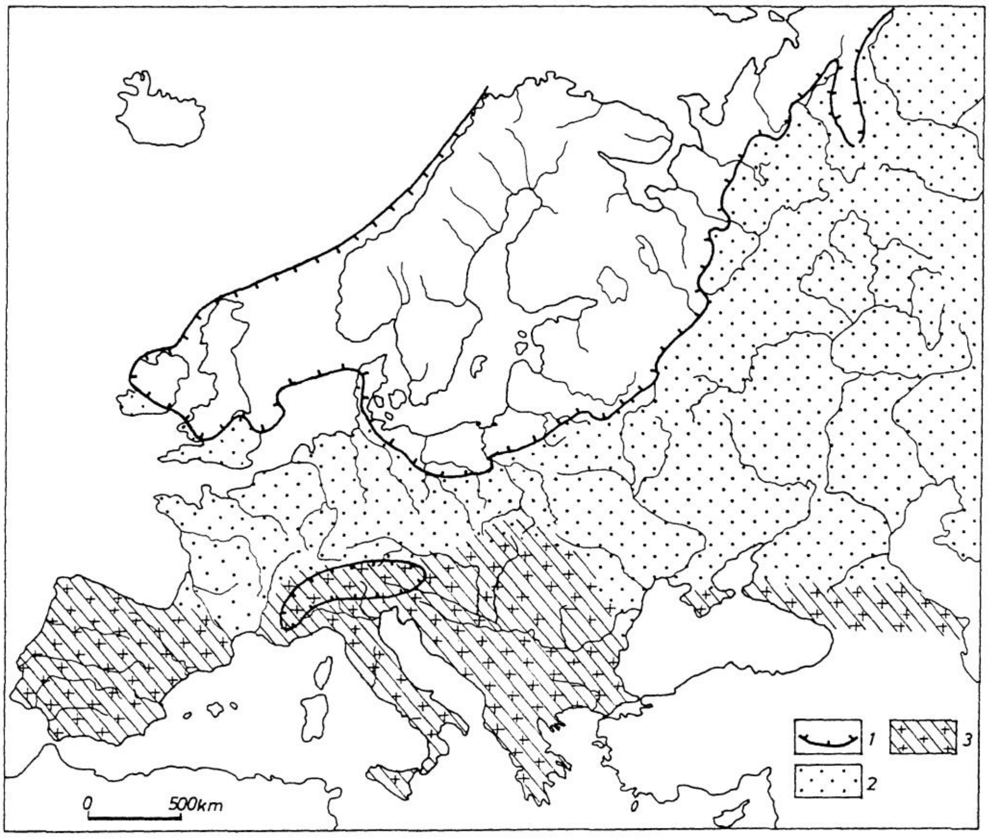


Fig. 1. Leading controlling factors of the evolution of fluvial systems in Europe during Late Glacial and Holocene (Starkel 1995, slightly modified)
1 – zone of last glaciation and deglaciation, 2 – former periglacial plains and uplands (climate and vegetation are main controling factors), 3 – mountains and basins controlled by tectonic factors

The section of the Vistula valley between Cracow and mouth of Raba river includes one of the most studied flood plain areas not only in Poland (Kalicki 2006; see this field guide – excursion 4^{th} day) but in the entire region. According to the hypothesis elaborated for the Vistula valley near Cracow, Central European river valleys of different type and different order response simultaneously to the Late Glacial and Holocene phases of an increase in fluvial activity conditioned by climatic changes. These phases reflect themselves as changes in river-beds (cut offs, avulsions), changes in river patterns or parameters of meanders, changes in sedimentation type on flood plains (peat growing, cover of peats by overbank deposits, buried soils), accumulation of large number of trunks in alluvia etc.

The analysis was based on critical review of relevant references and on the original research (Kalicki 2006). The survey of references revealed a significant heterogeneity found in the studies done in different areas of the region: Germany, Czech Rep., Austria, Poland and Belarus. This refers both the quantitative characteristics of those studies and very diverse study methods used at that the methods are not developed and approved equally in different countries. Even more, the manners and ways of data interpretation are quite different in each country that influences significantly final conclusions of studies. The misunderstanding becomes especially obvious because very few authors include in their papers basic data. This makes it difficult to determine the background information based on which they make their conclusions or to verify their interpretations.

The carried-out analysis of available data in regional scale and in each of subregional test areas (western, central and eastern), as well as analysis of records for climate change and human impact both in the morphology and different facies of alluvia, made it possible to derive some important conclusions (Kalicki 2006). Phases of an increase in river activity occurred in different types of valleys of lowlands. Also, the very significant temporary convergence of these Late Glacial and Holocene phases is recorded in all analyzed foremountain, upland and lowland river basins along the west-east transect, in spite of environmental and historical differences, such as growing eastwards of climate continentality and considerable difference in time and the degree of neolithization within western, eastern and central areas of the region. The climatic conditioning of these phases is also seen in the Neoholocene (Subboreal, Subatlantic), when climatic factor dominates also in areas under great anthropogenic pressure, permanently deforested and settled by agricultural cultures. Rivers in these areas, in spite of numerous direct and indirect anthropogenic impacts, underwent the natural rhythm of dynamical changes controlled by climatic oscillations - climate cooling, wetting and clustering of extreme events.

Phases of an increase in fluvial activity have had a crucial importance in forming of valleys in extraglacial areas. These oscillations of river activity have been of a minor importance in younger glaciated areas and in those ones situated in foreground of the last ice sheet, because the formation of the hydrographical network, especially in the first stage, was conditioned also by a number of other factors. However, since the Boreal, climatic factor has begun playing more and more essential role in river dynamics changes (Kalicki 2006).

Human impact on the evolution of large river valleys is revealed in facilitation of overbank accumulation, changes in grain size of floodplain deposits, acceleration of lateral migration and in changes of river bad parameters during last millennium, especially within last 500 years (Kalicki 2006).

REFERENCES

Atlas Polski, 2000, Encyklopedia feograficzna świata, Pres, Kraków.

Kalicki T., 2006, Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich (Reflection of climatic changes and human activity and their role in the Holocene evolution of Centraleuropean valleys), Prace Geograficzne IGiPZ PAN 204, pp. 348. (in Polish)

Kondracki J., 1998, Geografia regionalna Polski, PWN, Warszawa.

Starkel L., 1995, The place of the Vistula river valley in the late Vistulian – early Holocene evolution of the European valleys [in:] European river activity and climatic change during the Lateglacial and early Holocene (ed. B. Frenzel), Paläoklimaforschung 14, 75-88.

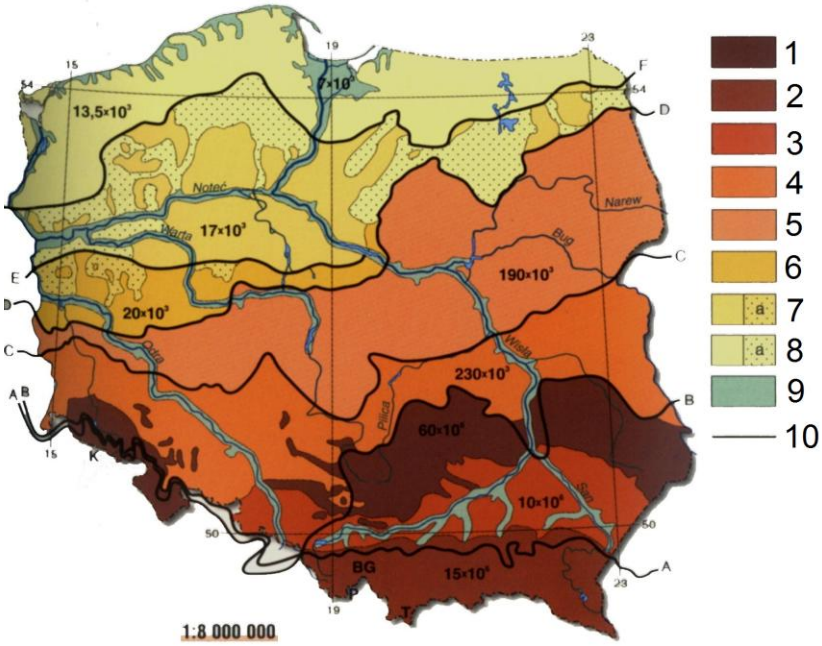


Fig. 1. Age of relief in Poland (Atlas Polski 2000 changed)
Areas modelled since about: 1 – 60 Ma years (Paleocene), 2 – 15 Ma (Miocene), 3 – 10 Ma (Pliocene), 4 – 230 ka (Oder glaciation), 5 – 190 ka (Wartha glaciation), 6 – 20 ka (Vistulian glaciation – LGM: Leszno phase), 7 – 18.8 ka (Vistulian glaciation – Poznań phase) a – sandurs, 8 – 16.2 ka (Vistulian glaciations – Pomeranian phase) a – sandurs, 9 – 13 ka (Late Glacial and Holocene): cliffs, beaches, spits, deltas, valley slopes and bottoms, 10 – maxiumu advance of ice sheets: A – San II, B – Oder (Saalian), C – Wartha, D – Vistulian, LGM Leszno phase, E - Vistulian, Poznań phase, F - Vistulian, Pomeranian phase

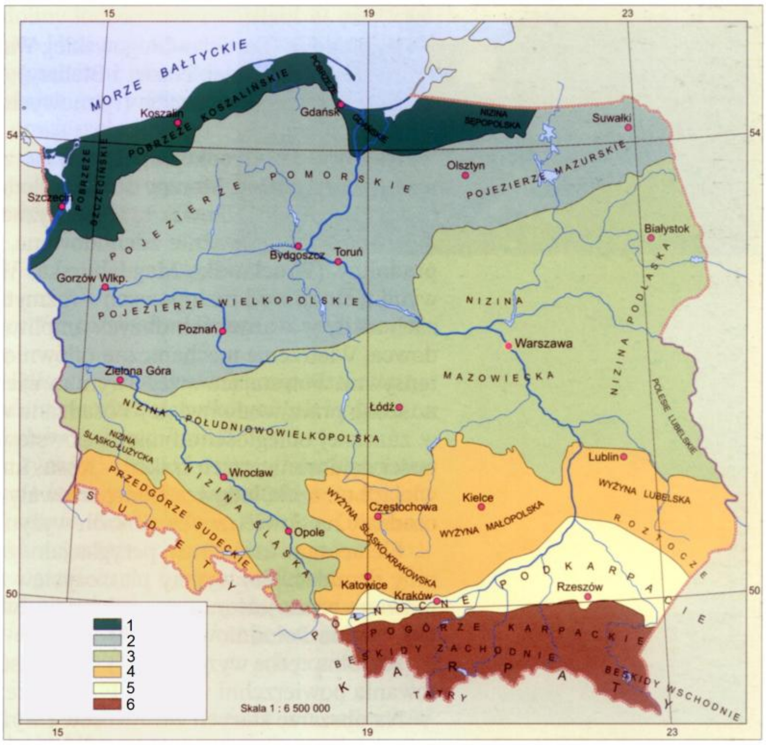


Fig. 2. Geomorphological zones of Poland (Kondracki 1998 changed)
1 – seaside, 2 – young glaciation, 3 – old glaciations (periglacial plain), 4 – old orogens (Caledonian and Hercynian) and uplands, 5 – Subcarpathian basins, 6 – Carpathians (Alpine orogen)

Fig. 3. Map of main physic-geographical region of Poland with sites present on the excursion

14.09.2016 Wednesday - First day of excursion

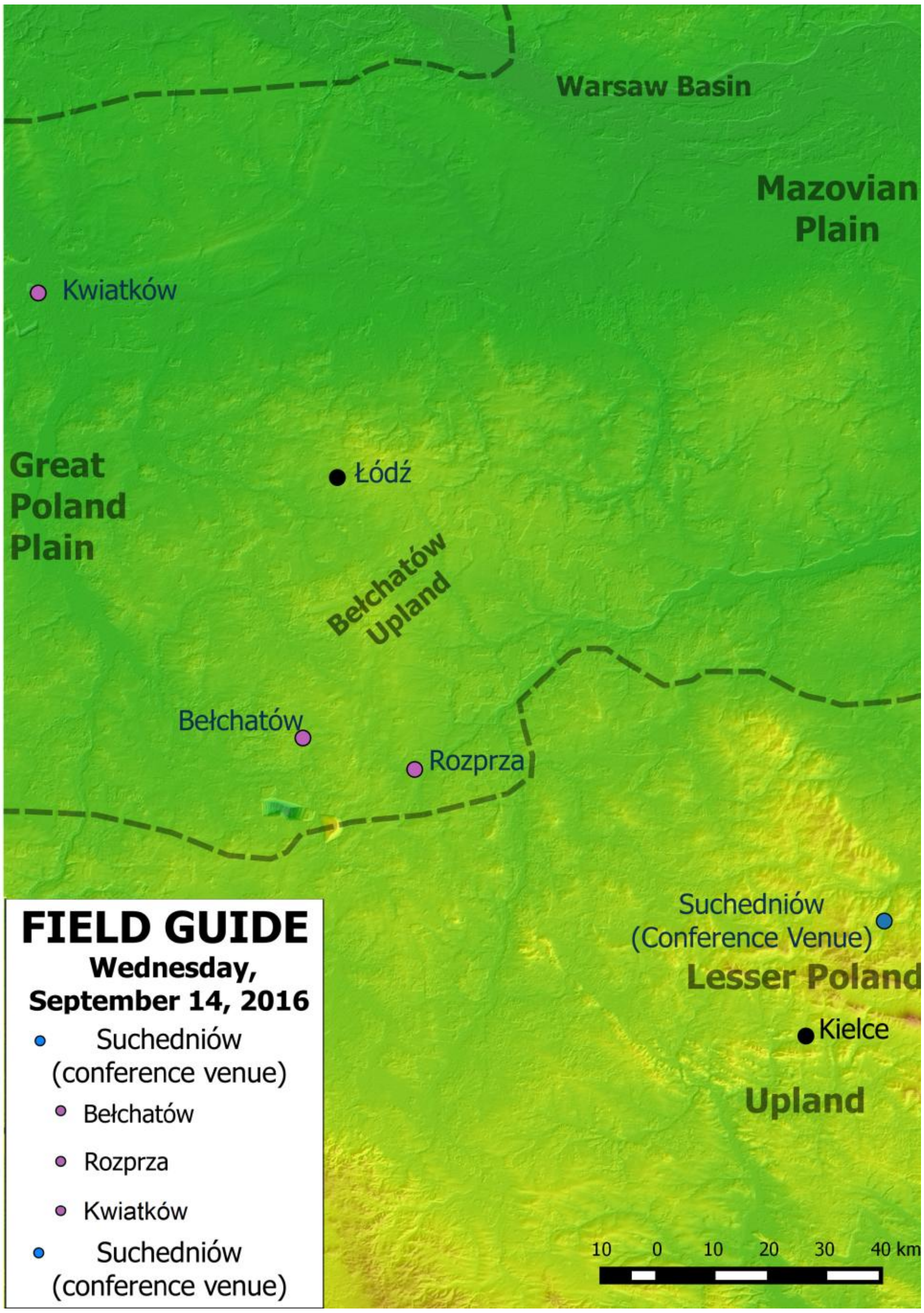
River valley evolution on Oder-Wartha glaciations area

7:00 Suchedniów (breakfast)

08:00 FIELD EXCURSION (pocket lunch)

- **Bełchatów** (overview of Quaternary sedimentation and stratigraphy on Polish Plain)
- **Rozprza** (Geoarchaeological studies of Medieval ring fort in Luciąrza river valley, Early Holocene flood events)
- **Kwiatków-Koźmin** (subfossil riparian forest from Alleröd-Younger Dryas)

Suchedniów (dinner)



INTRODUCTION

Piotr Kittel
University of Łódź, Department of Geomorphology and Palaeogeography
piotr.kittel@geo.uni.lodz.pl

From the geomorphological point of view, the Łódź Region area consists of:

- the Łódź Plateau in the central part of the area, which creates an elongated ridge elevated up to 284 m a.s.l. and characterized by diversified relief configuration dissected by a network of small rivers.
- the Warsaw-Berlin ice-marginal valley in the north, drained westwards by the lower Ner River and eastwards by the lower Bzura River.
- the north-south-oriented mid-Warta River valley in the west, the largest water artery of the region with relatively diversified terrain relief.
- the mid-Pilica River valley in the south-east.

The last ice cover was present in the Łódź Region in the Saalian Stage glaciations, i.e. Wartanian Cold Stage of Odranian Glaciation (after Marks 2011). The Weichselian Cold Stage was an ice-free period at the area. The closest position of the ice sheet front of about 20 km to the north took place during the Last Glacial Maximum (Roman 2003; Turkowska 2006). The Neogene evolution of river valley is best known for the middle Warta River, where the oldest evidences of the river activity were recognized (Dyjor 1987). During the Pleistocene interglacials, the valley was permanently reactivated (Forysiak 2005). Very intense development of geomorphological elements of the valley was in the Weichselian Cold Stage in periglacial conditions. Two or in some areas three terraces have been documented in river valleys of the Łódź Region (Turkowska 1988, 2006; Petera 2002, 2007; Wachecka-Kotkowska 2004; Forysiak 2005; Turkowska and Dzieduszyńska 2011).

The erosion at the end of the Wartanian Cold Stage resulted in part of valleys in formation of the highest, fluvioglacial terraces. The main river terraces were formed however in the Plenivistulian. The Plenivistulian terraces reach large horizontal extent usually and they are built from finer silty sandy deposits in the lower part and from coarser sandy or gravelly sandy deposits in upper part. The Weichselian was a period of the predomination of fluvial aggradation. Phases of intense deposition were interrupted however by erosional phases - the scale depended on conditions of particular valleys (Turkowska 1988, 2006). The best recognized Weichselian deposits of the Warta River valley in the Koło Basin indicates two main periods (at the beginning of the Middle Weichselian and in the LGM) of sand-bed braided river environment, which resulted in the significant alluvial accumulation. Sandy-silty deposits altered with organic horizons are characteristic for the MIS 3 in the mid-Warta R. valley (Forysiak et al. 1999; Petera 2002).

From a morphologic point of view, high terraces were formed in the Late Weichselian and usually it was connected with cut-offs of large palaeochannels in valley floors, as a result of a change in fluvial style from braided into meandering with large meanders (Turkowska 1988, 2006). An erosional phase and abandonment of large-scale palaeomeanders at the beginning of the Holocene is recorded widely in Polish territory and in Europe. The transformation of river channel pattern into an anabranching system in the Younger Dryas was recognized however in some valleys of the Łódź Region (Turkowska 1988; Petera 2002; Turkowska et al. 2004).

The earliest in the Łódź Region evidences of flooding in the Early Holocene have been recently recognized in Lutomiersk in the Ner River valley (Kittel et al., 2016). For the Holocene, Turkowska (1998, 2006) claims the periods of more intense fluvial activity at the Boreal/Atlantic and Atlantic/Subboreal transitions and in the Subatlantic Period. Kamiński

(1993) has placed the increase in fluvial processes in the Early Atlantic Period, the beginning of Subatlantic Period and the Middle Ages. Forysiak (2005) has registered the increase of groundwater level in the middle Warta River valley in the Middle and Early Atlantic Period and in the Subatlantic Period.

In the Subboreal Period, evidences of decreasing fluvial activity and drying of valley floors (Kamiński 1993, Kobojek 2000) as well as flood tendencies during the middle part of this period (Turkowska 1988, 1990; Kamiński 1993) were recognised in the river valleys of the region. Examples of the increased fluvial activity ca 2000 conv. BP are known from the Ner River valley (Turkowska 1988, 1990), the Wolbórka River valley (Turkowska 1988) and the Moszczenica River valley (Kamiński 1993) and before 1640 conv. BP, from the Krasówka River valley in the Szczerców Basin (Marosik 2002). Accumulation of sand loams in the historical period is well known in numerous river valleys of the region: Luciąża (Goździk 1982, Wachecka-Kotkowska 2004), lower Moszczenica section (Kamiński 1993), Ner and Dobrzynka (Kittel 2011, 2012). The records of the Neoholocene intensification of fluvial activity in the region were recently collected by Twardy et al. (2014) and Kittel (2015)

Records of the earliest direct impact of human societies on the river, which took place at the Bronze Age and the Iron Age transition, i.e. the beginning of Subatlantic Period, are available from the middle Ner River valley (Kittel et al. 2011). In the Pre-Roman Period, the fluvial activity, dated at around 2300-2200 conv. BP, caused covering of the cultural horizons with alluvium in the Przysowa River (Twardy et al. 2004). Water-logging of the valley bottoms as a result of the development of settlement was found near Łęczyca (Krzemiski and Maksymiuk 1966). The intensification of anthropogenic changes of the natural environment resulted in the formation of extensive overbank deposits covers in the historical times, with increasing intensity in the Modern Times (Twardy et al. 2014, Kittel 2015).

REFERENCES:

Dyjor S., 1987. Systemy kopalnych dolin Polski Zachodniej i fazy ich rozwoju w młodszym neogenie i eoplejstocenie. In: Jahn, A., Dyjor, S. (Eds.), Problemy młodszego neogenu i eoplejstocenu w Polsce. Ossolineum, Wrocław, 85-101.

Forysiak J. 2005. Rozwój doliny Warty między Burzeninem i Dobrowem po zlodowaceniu warty, Acta Geographica Lodziensia 90. pp. 116.

Goździk J. 1982. Środowisko przyrodnicze osadnictwa średniowiecznego okolic Rozprzy. Prace i Materiały Muzeum Archeologicznego i Etnograficznego w Łodzi, Seria Archeologiczna 29, 138 - 151.

Kamiński J. 1993. Późnoplejstoceńska i holoceńska transformacja doliny Moszczenicy jako rezultat zmian środowiska naturalnego oraz działalności człowieka, Acta Geographica Lodziensia, 64, pp. 104.

Kittel P. 2011. Slope and river inorganic deposits as indicators of marked human impact, in the light of research in the Ner River basin (central Poland), Archaeologia Polona 49, Special theme:Geoarchaeology in Poland, 71-86.

Kittel P. 2012. Budowa i ewolucja doliny Neru w rejonie stanowiska Lutomiersk-Koziówki w świetle badań geoarcheologicznych, Acta Geographica Lodziensia, 100, s. 113-133.

Kittel P. 2015. Age of Holocene Overbank Deposits in Central Poland, [in:] G. Baryshnikov, A. Panin, Gradualism vs catastrophism in landscape evolution. International Association of Geomorphologists (IAG) Regional conference, July 2-4, 2015, Barnaul, Russia, Extended Abstracts, Barnaul: Publishing House of Altai State University, 162-166.

Kittel P., Błaszczyk J., Cywa K., Muzolf B., Obremska M., Wacnik A., Tomczyńska Z., 2011. Traces of Prehistoric Human Impact on Natural Environment in the Ner River Catchment (Central Poland). [in:] Hildebrandt-Radke, I., Dörfler, W., Czebreszuk, J., Müller, J. (eds.), Anthropogenic Pressure in the Neolithic and the Bronze Age on the

Central European Lowlands. Studien zur Archäeologie in Ostmitteleuropa/Studia nad Pradziejami Europy Środkowej, B. 8/T. 8, Bogucki Wydawnictwo Naukowe, Dr. Rudolf Habelt GmbH, Poznań-Bonn, 129-141.

Kittel P., Płóciennik M., Borówka R.K., Okupny D., Pawłowski D., Peyron O., Stachowicz-Rybka R., Obremska M. , Cywa K. 2016. Early Holocene hydrology and environments of the Ner River (Poland). Quaternary Research 85, 187-203.

Kobojek E. 2000. Morfogeneza doliny Rawki, Acta Geographica Lodziensia, 77, Łódź.

Krzemiński T., Maksymiuk Z. 1966. Próba rekonstrukcji niektórych elementów krajobrazu pierwotnego okolic Łęczycy, [in:] A. Nadolski, A. Abramowicz, T. Poklewski (eds.), Łęczyca wczesnośredniowieczna, t. 1, Ossolineum, Łódź, 23-32.

Marks L. 2011. Chapter 23 - Quaternary Glaciations in Poland. In: Ehlers, J. Gibbard, P.L., Hughes, P.D. (Eds.), Developments in Quaternary Sciences, 15, 299-303.

Marosik P., 2002. Ukształtowanie terenu i warunki geologiczne na stanowisku archeologicznym nr 11 w Grabku oraz na obszarze przyległym w dnie doliny Krasówki. [in:] R. Grygiel (ed.) Badania archeologiczne na terenie odkrywki "Szczerców" Kopalni Węgla Brunatnego "Bełchatów" S.A., t. II. Fund. Bad. Archeolog. im. K. Jażdżewskiego, Fund. UAM, Łódź, 9-23.

Petera J. 2002. Vistuliańskie osady dolinne w basenie uniejowskim i ich wymowa paleogeograficzna. Acta Geographica Lodziensia 83, 1-164.

Petera J., 2007. Osady rzeki plenivistuliańskiej w Koźminie. Acta Geographica Lodziensia 93, 43-56.

Roman M., 2003, Rozwój rzeźby plejstoceńskiej okolic Gostynina. Acta Geographica Lodziensia 84, 1-154.

Turkowska K., 1988. Rozwój dolin rzecznych na Wyżynie Łódzkiej w późnym czwartorzędzie. Acta Geographica Lodziensia 57.

Turkowska K. 1990. Main fluvial episodes in the Ner Valley in the last 22 000 years; detailed study at Lublinek near Łódź, central Poland, Quaternary Studies in Poland, v. 9, s.84-99.

Turkowska K., 2006. Geomorfologia regionu łódzkiego. Wyd. UŁ, Łódź, pp. 238.

Turkowska K., Dzieduszyńska D., 2011. Local evidence of landform evolution vs. global changes – a case of younger dryas study in the upper Ner valley system, Central Poland, Geographia Polonica, 84 (Special Issue Part 1), 147–162.

Turkowska, K., Forysiak, J., Petera, J., Miotk-Szpiganowicz, G., 2004. A Warta River system during the Younger Dryas in the Koło Basin (Middle Poland). Quaestiones Geographicae 23, 83-107.

Twardy J., Kamiński J., Moszczyński J., 2004. Zapis gospodarczej i osadniczej działalności człowieka z okresu lateńskiego i rzymskiego w formach i osadach Polski Środkowej. [in:] D. Abłamowicz, Z. Śnieszko (eds.), Zmiany środowiska geograficznego w dobie gospodarki rolno-hodowlanej. Studia z obszaru Polski. Muz. Śląskie w Katowicach, Stow. Nauk. Archeol. Polsk, O/ Katow., Katowice, 197-221.

Twardy J., Forysiak J., Kittel P. 2014. Evolution of vegetation, relief and geology in Central Poland under anthropopressure. In: Kobojek E., Marszał T. (eds.), Origin of relief of Central Poland and its anthropogenic transformation in Łódź University geographical research. Łódź, 57-94.

Wachecka-Kotkowska L. 2004. Zmiany środowiska doliny dolnej Luciąży w holocenie, Acta Universitatis Lodziensis, Folia Geographica Physica, 6., 47-70.

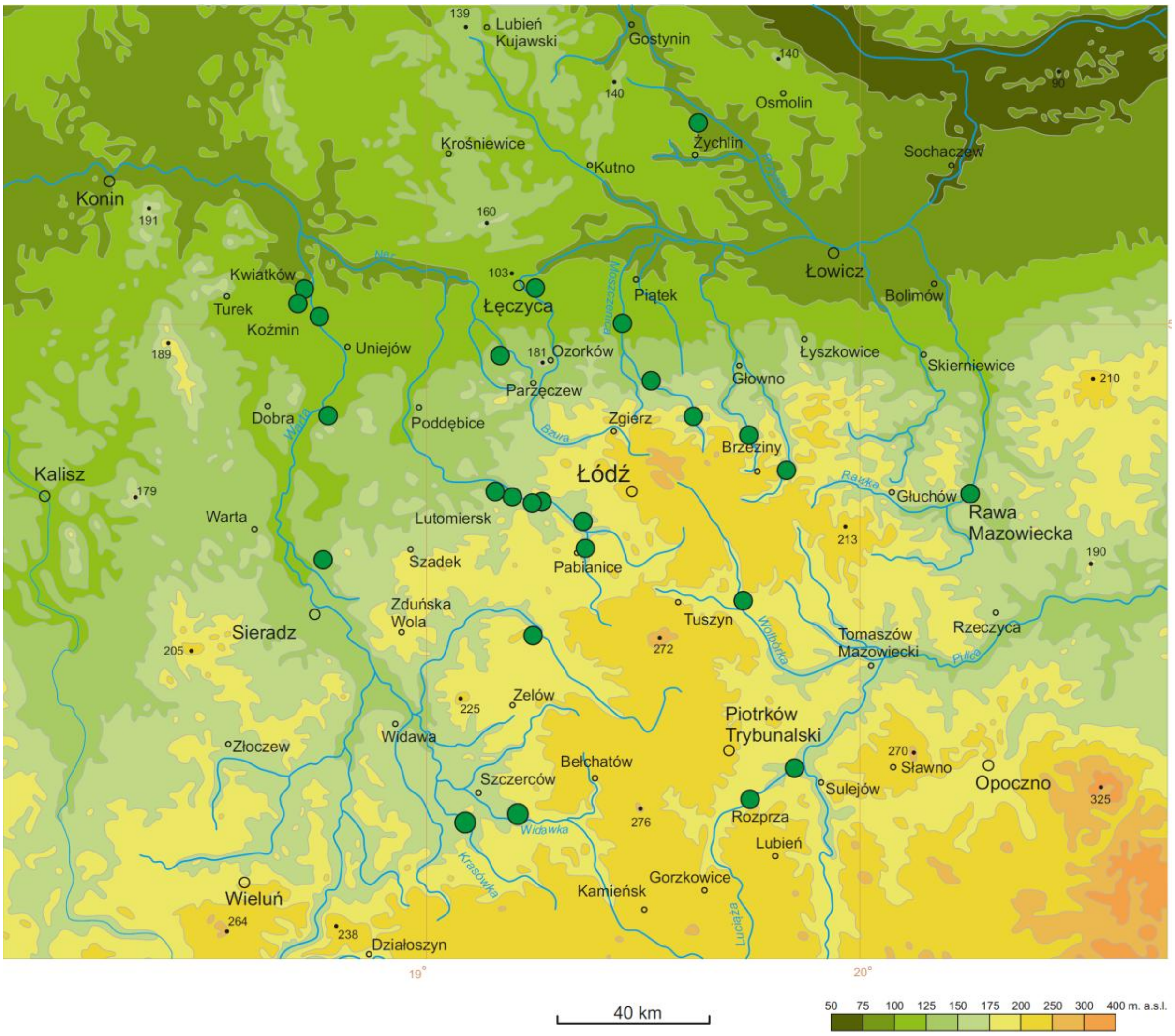


Fig. 1. Location of main sites with studied fluvial deposits in Łódź Region (Twardy et al. 2014)

Żłobnica site, Bełchatów Field view point

Glacial and interglacial deposits in the Szczerców Outcrop in the western part of the Kleszczów Graben, central Poland

Lucyna Wachecka-Kotkowska[1], Dariusz Krzyszkowski[2], Dariusz Wieczorek[3], Piotr Kittel[1]

[1]*University of Łódź, Department of Geomorphology and Palaeogeography, 90-139 Łódź, Narutowicza 88, Poland, lucyna.wachecka@geo.uni.lodz.pl, piotr.kittel@geo.uni.lodz.pl*
[2]*University of Wrocław, Institute of Geography and Regional Development, 50-137 Wrocław, Pl. Uniwersytecki 1, Poland, dariusz.krzyszkowski@uwr.edu.pl,*
[3]*Geoconsult Sp. z o.o., Jurajska 6/40, 25-640, Kielce, Poland, wieczorek@geoconsult.kie.pl*

The Kleszczów Graben, formed in the late Paleogene and Neogene, has become a place where there was an accumulation of sediments of considerable thickness. It was mostly filled by great thickness of the Miocene, Pliocene and Quaternary deposits. Here in the Miocene formed thick organic series, which have been converted into lignite (Fig. 1).

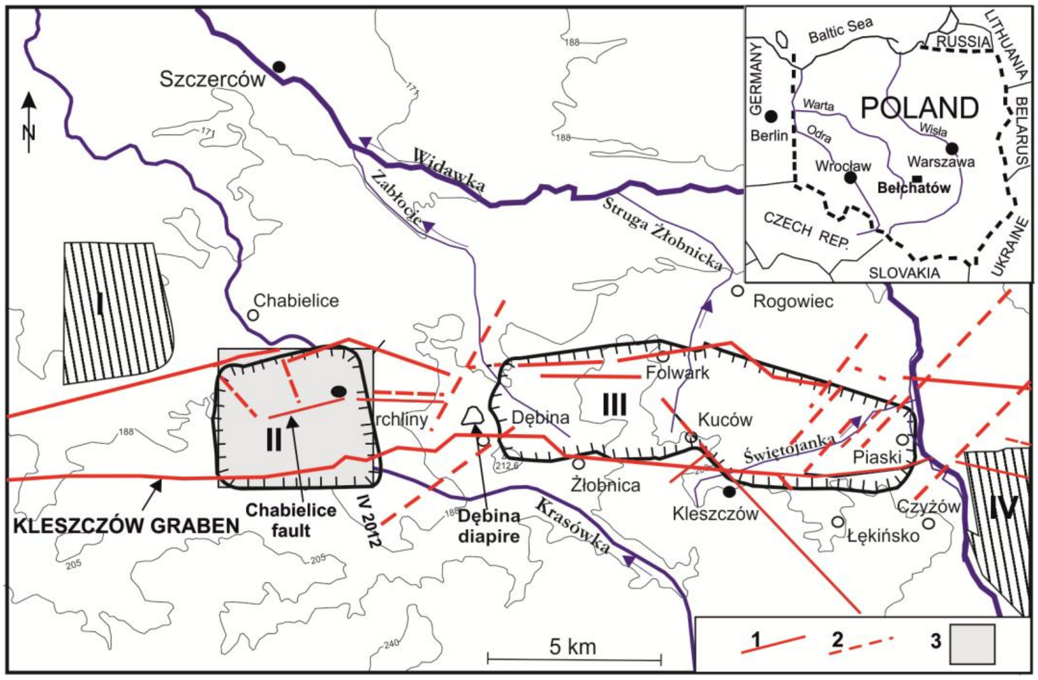


Fig. 1. Study area against the background of the KWB Belchatów Coal Mine facilities. Faults, mainly in the sub-Cenozoic basement; 1 - certain; 2 - presumable; 3. - investigated area. Mining fields: II – Szczerców; III - Belchatów. Outer mine piles: II – Szczerców; IV – Kamieńsk

Coal mining (KWB Bełchatów) in the two quarries [Bełchatów (older) and Szczerców (younger)] also gave the possibility of penetration of Quaternary sediments (Fig. 1). Those sediments in the lower and middle part of the geological profile are disturbed (Łękińsko Fm. − Stawek Fm.) and in the upper undisturbed (Chojny Fm. − Widawka Fm. and Szerokie Fm.) (see - Tab. 1.).

Tectonics	Lithostratigraphy			Chronostratigraphy			
	WIDAWKA FORMATION	SZEROKIE FORMATION		Szczerców quarry	Bełchatów quarry	HOLOCENE	
UPPER STRUCTURAL UNIT (UNDISTURBED)	PIASKI FORMATION (Szczerców quarry)	3	a		14 500 BP	WEICHSELIAN	UPPER
			b	43 500 BP	21 000 BP		MIDDLE
		2	c	24 080 BP 33 090 BP	27 000 BP		
			d		33 000 BP		
		1	e	45 000 BP > 47 000 BP	> 43 000 BP		
							LOWER
	ALEKSANDRÓW FORMATION			Eemian Interglacial palaeosoil?		EEMIAN	
	ROGOWIEC FORMATION (glacial)	A		?	TILL 7	SAALIAN	WARTANIAN 2
		B		?	TILL 6		
					palaeosoil?		interstadial?
		C		?	TILL 5		WARTANIAN 1
	CHOJNY FORMATION (glacial)	A B		PILICA INTERSTADIAL			PILICIAN
LOWER STRUCTURAL UNIT (DISTURBED)	STAWEK FORMATION (glacial)						?
	ŁAWKI FORMATION (glacial)			TILL 4	TILL 4		ODRANIAN
	ROKITY FORMATION (glacial)			?	TILL 3		?
	CZYŻÓW FORMATION	A		Podlesie Interstadial		CZYŻÓW COMPLEX	
		C	a, b, c	Czyżów Interstadial			
		F	a, b	Ferdynandovian Interglacial			
		B		Mazovian Interglacial - Holstenian			
		D	a, b, c	palaeosoil?			
		E	a, b, c				
	KUCÓW FORMATION (glacial)			TILL 2B	?	ELSTERIAN	SANIAN
				TILL 2	TILL 2		
				TILL 2A	TILL 2A		
	FOLWARK FORMATION (glacial)			TILL 1	TILL 1		NIDANIAN
	ŁEKIŃSKO FORMATION			PRE - TIGLIAN		LOWER PLEISTOCENE	
	P L I O C E N E						

Tab. 1. General Quaternary stratigraphy for the deposits filling the Kleszczów Graben

Field studies carried out in 2010−2015 in the Szczerców outcrop, allowed the sampling and palynological tests (Kuszell and Iwanuś, 2012), petrographic and heavy minerals analysis (Król et al., 2007; Dobosz 2012) and radiocarbon data (Pazdur 2011, Michczyński, 2012). Additionally, a structural study of sediments was also made with malacological and anisotropy of magnetic susceptibility (AMS) analyses. The results and other previous studies and works (Wieczorek and Stoiński 2013) led the authors to the characteristics of Quaternary deposits (Wieczorek et al. 2015), which in turn contributed to, among others, a comparison to Quaternary sediments in the Bełchatów outcrop (Krzyszkowski 1992, 1995, 1996).

Field research in the Szczerców outcrop ran mainly on the first and second mining floor, all revealing the formations of Quaternary sediments formation and older sediments in selected formations (Fig. 2). Least diagnosed bursts are the oldest glacial sediments, the Folwark and Kuców Formations, respectively Nidanian and Sanian. The Folwark Formation till and sand littered on the Neogene clays and sands (146−150 m a.s.l). Above them disturbed deposits of the Kuców Formation − sand, gravel, clay and till (140−170 m a.s.l.) have been diagnosed. Both sedimentary complexes were cut by faults. Within them distinguished were tills T1, T2a, T2, T2b (Krzyszkowski et al. 2015), formerly only tills T1, T2a, T2 were distinguished (see. Czerwonka and Krzyszkowski, 1992; Krzyszkowski, 1994).

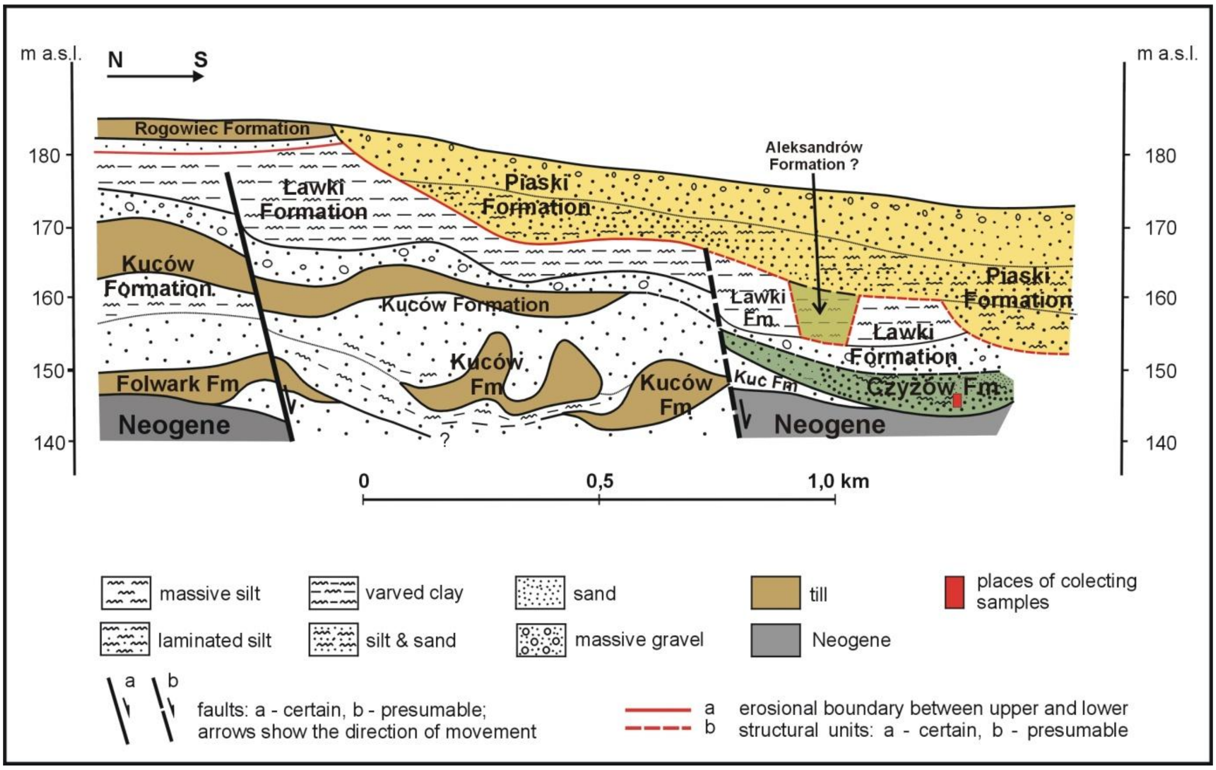


Fig. 2. Geological cross-section, Szczerców Field, Eastern part of outcrop, 2012

In a similar elevation (145−155 m a.s.l.), south of the Chabielice fault (part of the Kleszczów Graben), were found fluvial, interglacial various-grain sands, white, most likely the Czyżów formation (Holsteinian). These fluvial sediment, for which the source were older ice sheets, or Neogene surface. In the sediments were found and described pieces of wood remnants (Myśkow et al., 2015). Till T3 of the Rokity Formation has not yet been found (Figs 2 & 3).

Tills (T4), glaciolacustrine and glaciofluvial sediments of the Ławki Formation (early Saalian, MIS 6) unaccordingly lie on the Mazovian Interglacial sediments (MIS 11). They widely occur and are at elevations of about 160−180 m a.s.l., disturbed in the upper part of the structural floor. Detailed studies were carried out for rhythmithe sediments (gray silts and black clays) with a thickness of up to 20−30 meters (Wachecka-Kotkowska et. al 2012).

So far the Chojny Formation sediments were not documented here, but they are well known from the nearby Bełchatów outcrop (Krzyszkowski 1992, 1996). The Rogowiec Formation (Late Saalian, MIS 6) represent glacial till T7 (Dobosz, 2012) and glaciofluvial sands that lie on the erosional pavement (elevation 179−182 m a.s.l.). Bottom tills, T5 and T6, familiar with the Bełchatów opencast mine are not described here. Above Rogowiec Formation deposits, also on the pavement or glaciofluvial series of, in the axis of the Krasówka valley lie the Aleksandrów Formation sediments: gyttja, peat and rhythmithe silt and clay (Eemian/Early Weichselian MIS 5e−d).

On the Aleksandrów, Rogowiec, Ławki and possibly Czyżów (?) formations unaccordingly lie sands of the Piaski formation (Vistulian), accumulated in periglacial conditions. On the eastern wall of the Szczerców outcrop between 2010 and 2012 a thick profile of this formation was documented. These fluvial deposits and river-deluvial surge at elevations of 160−180 m a.s.l. Two series were the Middle Plenivistulian silty-sands (*SFh*, *Sr*, *Sh*; segment e, b/c) and the Upper Plenivistulian sands *Sh*, with strong abrasion traces in the quartz grains. Such age-reference series were given by radiocarbon data (Pazdur, 2011; Michczyński, 2012), which indicate the Middle Plenivistulian (MIS 3; 47 ka BP) as the beginning of the filling of the valley and Upper Plenivistulian (MIS 2; 24 ka BP) crowning a fluvioperiglacial series (Wachecka-Kotkowska et al., 2014). Based on the analysis of the geomorphological study area it can be assumed that Krasówka, Krasowa and Nieciecz created a "valley" using post-Wartanian tunnel valleys and kettle holes (Wieczorek and Stoiński, 2013).

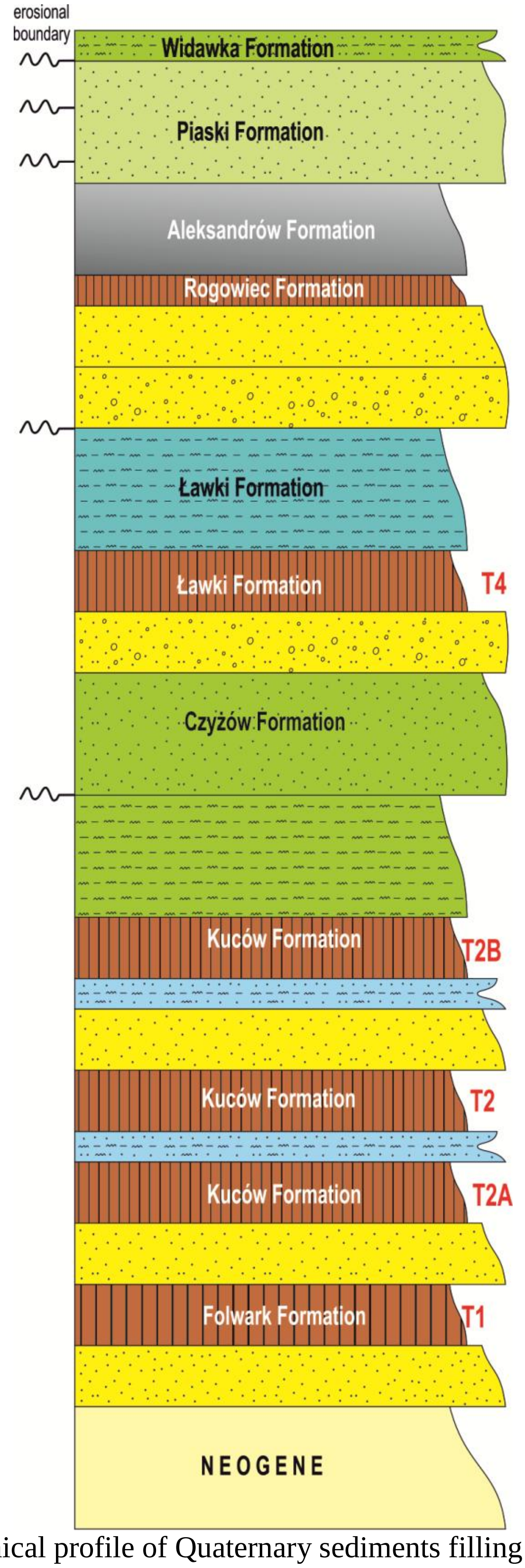


Fig. 3. Lithostratigraphical profile of Quaternary sediments filling the Kleszczów Graben (Explanation in the text)

The thickest sand series within the Quaternary sediments in the Szczerców outcrop is the Plenivistulian. The Vistulian deposits are partly covered by deposits of the Widawka and Szerokie formations (Holocene). Holocene sediments mainly represent medium and fine sands and sandy silts, gray and brownish-gray, river and river-deluvial. They occur on the surface in the bottom of the Krasówka river valley, where the water flow periodically arises (at 178−180 m a.s.l.), the thickness in the area fluctuates around 2 m.

Part of the research was conducted during updating the Szczerców map sheet (735) of the Detailed Geological Map of Poland, scale 1:50 000. The work was carried out on request of the Minister of the Environment, and financed by the National Fund for Environmental Protection and Water Management.

REFERENCES

Czerwonka, J.A., Krzyszkowski, D., 1992 Till characteristics and stratigraphy in the Bełchatów outcrop, central Poland, Quaternary Studies in Poland, 11, 43-64.

Dobosz T., 2012. Badania mineralogiczno-petrograficzne osadów plejstoceńskich z Odkrywki w Szczercowie dla potrzeb reambulacji ark. Szczerców (735) SMGP w skali 1:50 000. Wrocław.

Król J., Hałuszczak A., Dobosz T., 2007, Dokumentowanie profili geologicznych z odsłonięć KWB Bełchatów i KWB Konin etap I (obejmujący część pilotażową). I Rejon KWB Bełchatów odkrywka Szczerców. Centralne Archiwum Geologiczne, Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy w Warszawie.

Krzyszkowski D., 1992, Czwartorzęd rowu Kleszczowa. Litostratygrafia i tektonika. Studia Geograficzne, t. LIV. Wyd. Uniw. Wroc.

Krzyszkowski, D., 1994, Forms at the base of till units indicating deposition by lodgement and melt-out, with examples from the Wartanian tills near Bełchatów, central Poland. Sedimentary Geology, 91, 229-238.

Krzyszkowski, D., 1995, An outline of the Pleistocene stratigraphy of the Kleszczów Graben (Bełchatów outcrop), central Poland, Quaternary Science Reviews, 14, 61-83.

Krzyszkowski, D., 1996, Climatic control on Quaternary fluvial sedimentation in the Kleszczów Graben, central Poland. Quaternary Science Reviews, 15, 315-333.

Krzyszkowski D., Wachecka-Kotkowska L., Wieczorek D., Stoiński A., 2015, Petrography of glacial tills in the Szczerców Outcrop Central Poland – problems of stratigraphic interpretation. Studia Quaternaria, 32, 2, 99-108.

Kuszell T., Iwanuś D., 2012, Badania palinologiczne osadów mułkowo-ilastych pobranych ze ściany poziomu 1-go w Odkrywce Szczerców KWB Bełchatów - profil Parchliny. Wrocław (typescript in Polish).).

Michczyński A., 2012. Datowanie radiowęglowe 2 próbek (PARCH 4, PARCH 5). Raport nr 38/2012. Laboratorium Radiowęglowe, Instytut Fizyki, Politechnika Śląska.

Myśkow E., Krzyszkowski D., Wachecka-Kotkowska L., 2015, Makroskopowe szczątki roślinn z mezoplejstoceńskich osadów odkrywki Szczerców KWB Bełchatów. VII Konferencja Paleobotaniki Czwartorzędu "Dynamika zmian roślinności Niżu Polskiego w dobie późnoglacjalnych zmian klimatu i narastania antropopresji w holocenie. Łódź, 10-12 czerwca 2015 r., s. 45-47.

Pazdur A., 2011, Datowanie radiowęglowe 3 próbek (PARCH 1, PARCH 2, PARCH 3). Raport nr 2/2011. Laboratorium Radiowęglowe, Instytut Fizyki, Politechnika Śląska.

Wachecka-Kotkowska L., Krzyszkowski D., Krzymińska J., 2012, Climatic Control on Saalian Glacilacustrine Sedimentation in the Kleszczów Graben, Central Poland, Case of the Ławki Formation. (In:) INQUA-SESQ 2012 Meeting At the Edge of the Sea: Sediments, Geomorphology, Tectonics and Stratigraphy in Quaternary studies, Sassari, Sardinia, Italy, September 26-27 2012,100-101.

Wachecka-Kotkowska L., Krzyszkowski D., Król E., Klaczak K., 2014, Middle Weichselian Pleniglacial fluvial erosion and sedimentation in the Krasówka river valley, Szczerców field, Bełchatów open cast mine, central Poland. Annales Societatis Geologorum Poloniae, 84, 4, 323–340.

Wieczorek D., Stoiński A., 2013, Szczegółowa mapa geologiczna Polski w skali 1:50 000, arkusz Szczerców (735) wraz z objaśnieniami. Narod. Arch. Geolog., PIG-PIB Warszawa.

Wieczorek D., Stoiński A., Krzyszkowski D., Wachecka-Kotkowska L., Krzymińska J., 2015. The results of new studies of Quaternary sediments in the Kleszczów Graben, Szczerców Outcrop, Bełchatów Lignite Opencast Mine. Landform Analysis 29, 63–71.

Mazovian fluvial and lacustrine sediments of the Czyżów Complex based on the study of the Bełchatów outcrop, central Poland

Dariusz Krzyszkowski[1], Lucyna Wachecka-Kotkowska[2], Dariusz Wieczorek[3], Piotr Kittel[2]

[1]University of Wrocław, Institute of Geography and Regional Development, 50-137 Wrocław, Pl. Uniwersytecki 1, Poland, dariusz.krzyszkowski@uwr.edu.pl
[2]University of Łódź, Department of Geomorphology and Palaeogeography, 90-139 Łódź, Narutowicza 88, Poland, lucyna.wachecka@geo.uni.lodz.pl, piotr.kittel@geo.uni.lodz.pl
[3]Geoconsult Sp. z o.o., Jurajska 6/40, 25-640, Kielce, Poland, wieczorek@geoconsult.kie.pl

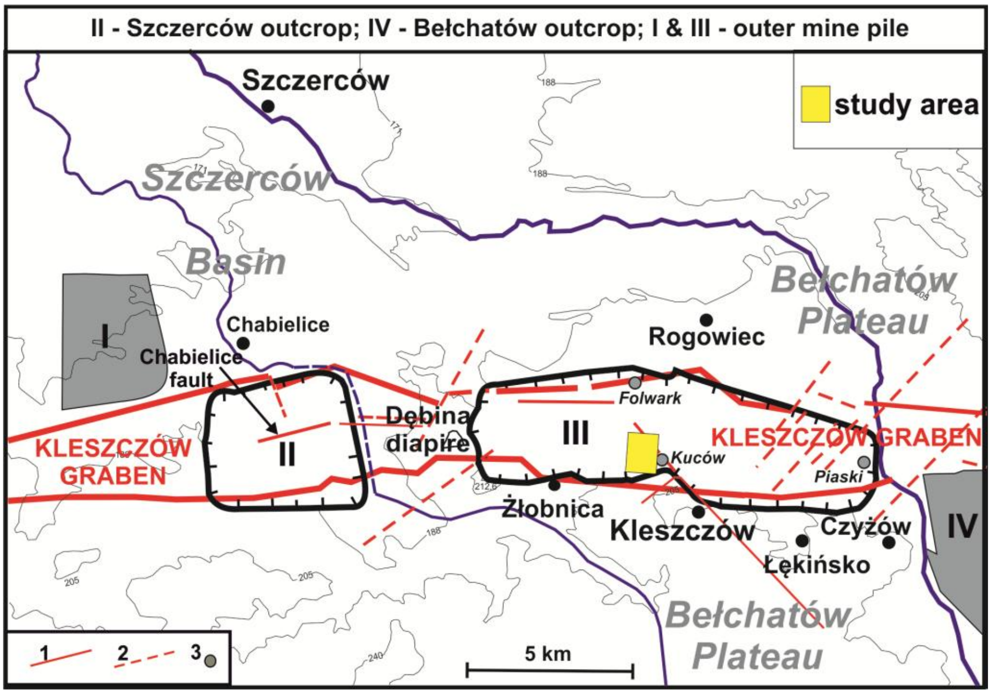


Fig. 1. Study area
1 - faults; 2 - probably faults; 3 - investigated sites

In the long sequence of Pleistocene events of central Poland stored in the sediments of the Kleszczów Graben (Fig. 1) the Mazovian Interglacial limnic deposits are an important link (Baraniecka 1971). They belong to the Czyżów Formation (Complex) that in the lithostratigraphic profile of the middle part of the Kleszczów Graben − Bełchatów outcrop − includes fluvial sands and gravels, and among them limnic deposits formed as: gyttjas, silts clay and clays, silts and peats (cf. Krzyszkowski, 1989, 1990, 1992, and Balwierz al., 2008; Allen and Krzyszkowski 2008). Palynological investigations of the Czyżów Formation organic deposits showed their affinity with the Mazovian Interglacial (Holsteinian; MIS 11).

Above the deposit of this formation there are glaciolacustrine (Ławki Fm.), glacial and glaciofluvial (Rogowiec Fm.), lacustrine (Aleksandrów Fm.), fluvial (Piaski and Widawka Fm.) and organogenic (Szerokie Fm.) deposits.

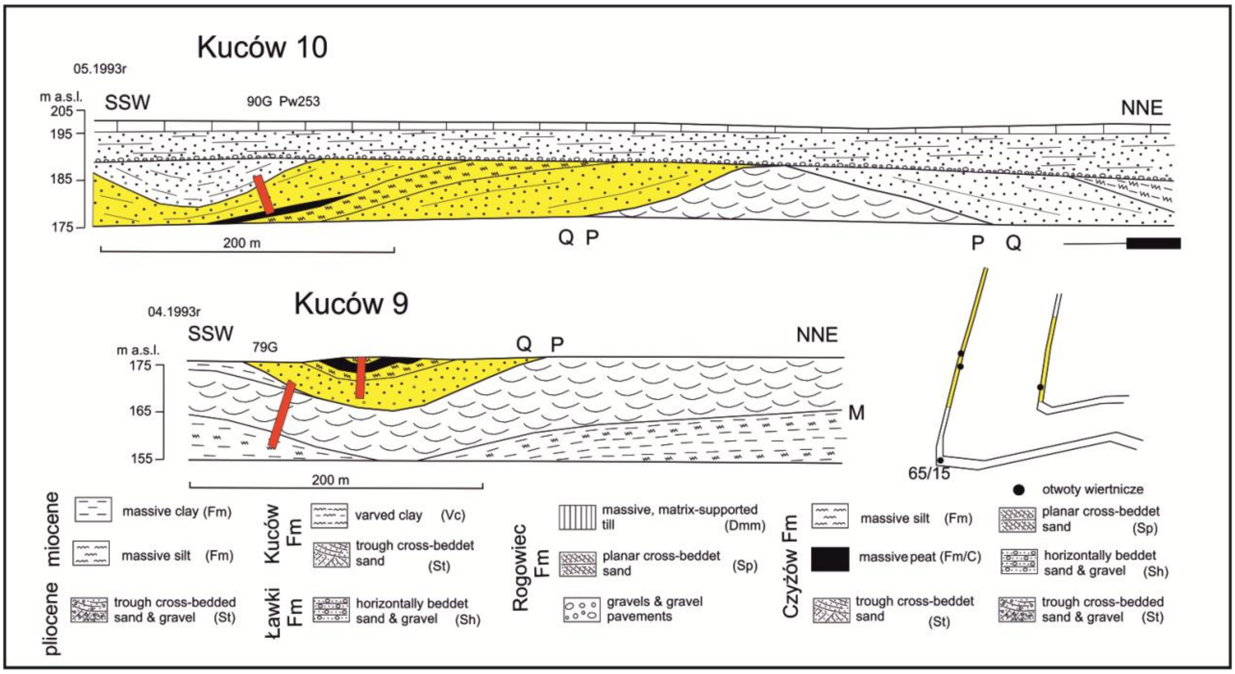


Fig. 2. Geological cross-section in central part of the Bełchatów outcrop (Kuców 9 & 10 sites)

The deposits of the Mazovian Interglacial have been found in the middle part of the Kleszczów Graben. Profiles Kuców 9 & 10 were documented in 1994 by Dariusz Krzyszkowski, and currently they are developed by a team of authors (Fig. 2). Analyzed sediments were lying in the middle part of the pit, at an altitude of 166−175 m a.s.l. (profile Kuców 9) and 175−205 m a.s.l. (profile Kuców 10), in the southern edge of the Kleszczów Graben. The Czyżów formation sediments have a characteristic color − silts are greenish and yellowish and sands, yellow-brownish or greenish. The 20-meter profile was also described as the Ławki Formation (Saalian, MIS6) − in the top, as well as Miocene and Pliocene sands and clays, as wide-radius synclines and anticlines − in the floor.

At the Kuców 9 site the fluvial and limnic lied in syncline depression, originated on the Pliocene top set, and at the Kuców 10 site those sediments filled the erosional, valley form (Fig. 3). The Czyżów Formation bottom part had an accumulated (Kuców 9) or erosional contact (Kuców 10) with the Pliocene mixed colored clays. Top part of the Czyżów Formation deposits were covered by the Ławki Formation sandy gravels and gravels. The boundary between those formations had an erosional contact.

The described deposits lied shallow, as for the Kleszczów Graben, *ca* 20 m below the Bełchatów Plateau surface, but still in the lower, disturbed tectonic (structural) unit. This could be due to the position of the two profiles located above faults zones limiting the Kleszczów Graben.

In both profiles three fold divisions of the Czyżów Formation of an overall thickness of 13 m: the lower, strictly mineral (5.5 m), the middle, organic-mineral (2.5 m) and the upper, mineral (5 m). The middle part of the Kuców 9 was more expressive than the Kuców 10 site. Organic-mineral deposit was reported by pollen analysis (by M. Nita, unpublished; Fig. 4).

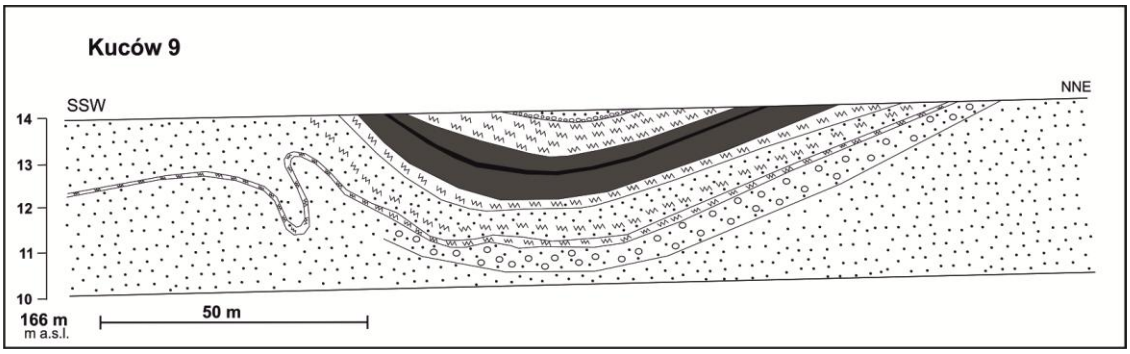


Fig. 3. Detailed cross-section of syncline depression, Kuców 9 site, Bełchatów field (lithological explanation on Fig. 2)

Mineral deposits were investigated by grain-size, mineralogical and by shape and roundness of the quartz grain analyses (by D. Krzyszkowski, partly unpublished).

On the poster the succession of facies in the profiles of the Kuców 9 & 10 has been showed, in deposits located in the marginal parts of the fossil river valley and palaeolake (Fig. 3). In the floor were seen sands and gravels: *St*, *Sh* and *Sp*. In the middle member, sands *St/Sh* passed upwards in gyttja, silt and clay *Fm*, *FmC* and peat (*C*). On the roof *Sh* facies (pale yellow) dominate.

Palynological studies of sediments from the middle member suggests that the interglacial succession is not full (Fig. 4). The upper part of the interglacial deposits are not preserved. Those small succession may be to the lower tundra phase, the Ist and IInd phases of the Mazovian Interglacial acc. to Szafer's classification (see Mojski 2005). The highest phase may be referred to the IIIrd phase of the warm period.

The results of mineralogical analysis showed differences between lithostratigraphic units (Fig. 5). In the lower part, within the Pliocene sediments of Pleistocene ground/basement resistant minerals were dominating (staurolite − 30%, zircon − 40% and tourmalite − 30%). The fluvial sediments of the Czyżów formation a greater range of minerals has been reported (tourmalite − 20-40%, staurolite − 20-40%, cyanite − 10-20% and zircon −10-15%). However, in the upper part, covering interglacial deposits, the spectrum of heavy minerals for glacial sediment of the Ławki formation middle resistant minerals have been dominant (garnet − 40% and amphibole − 5%) over those more resistant to weathering (staurolite − 10%, tourmalite − 10% cyanite − 10% zircon − 5%).

Bottom part of the profile included trough, river deposits, above the limnic (delta), formed in several episodes. In the top generally sandy fluvial overbank facies have occurred. At the beginning of the Mazovian Interglacial, and maybe even at the end of the preceding glaciation occurred an accumulation of sand and gravel in the river environment. Then began lake and/or delta sedimentation, and then there was the activation of the river processes through periodic flooding of the valley bottom part. Hiatus covering the range from the Pliocene to the interglacial period, and especially the lack of tills from the South Polish Glaciations did not allow to specify the lithostratigraphic situation of the Czyżów Formation deposits in these profiles. While the results of the borehole 65/15 (Krzyszkowski 1989) indicate the presence of South Polish Glaciations clay (Elsterian). Thus, in the overall analysis necessary were comparisons with other fuller sites (eg. at the Radziechowice site; Borówko-Dłużakowa 1981).

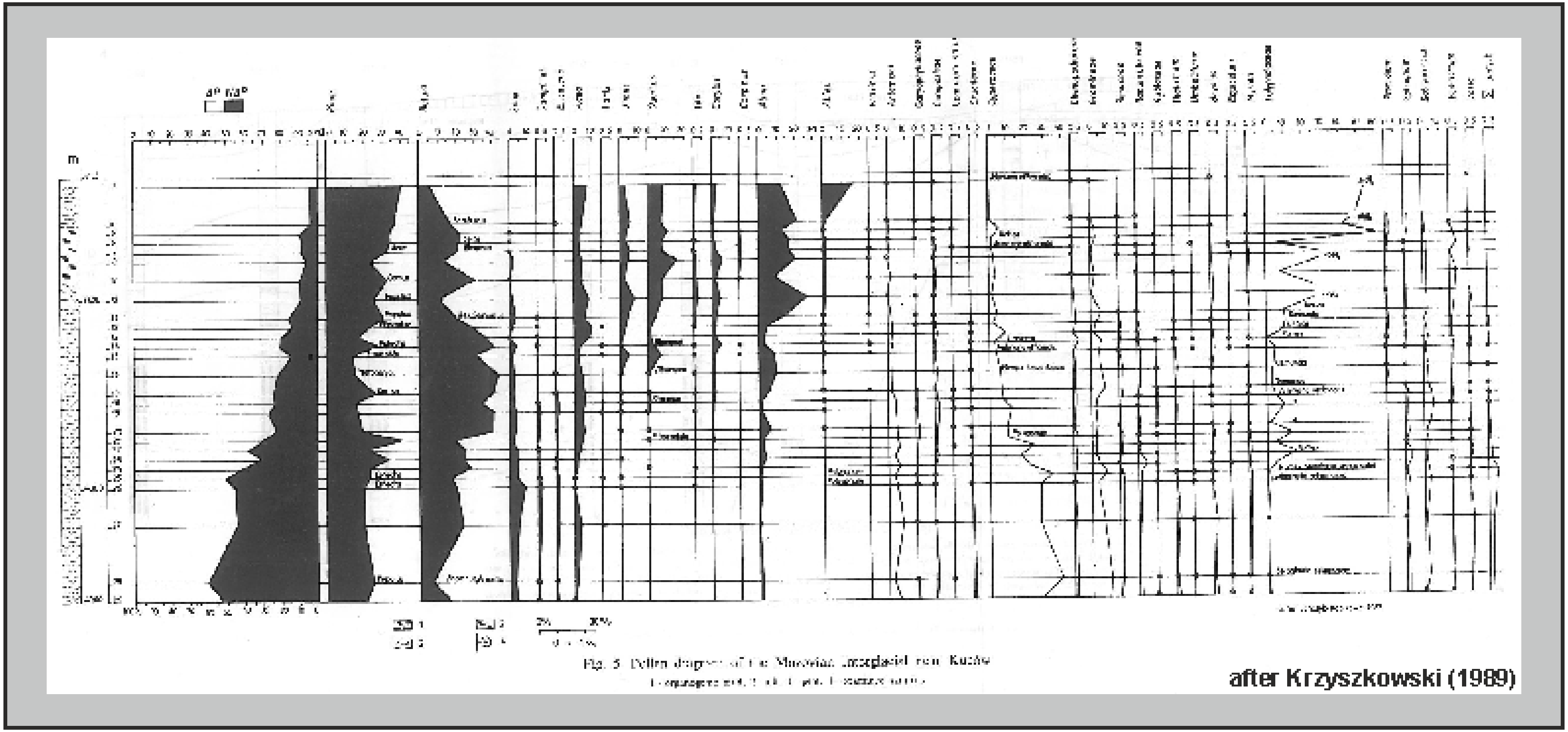


Fig. 4. Pollen diagram for the middle part of the Kuców profile

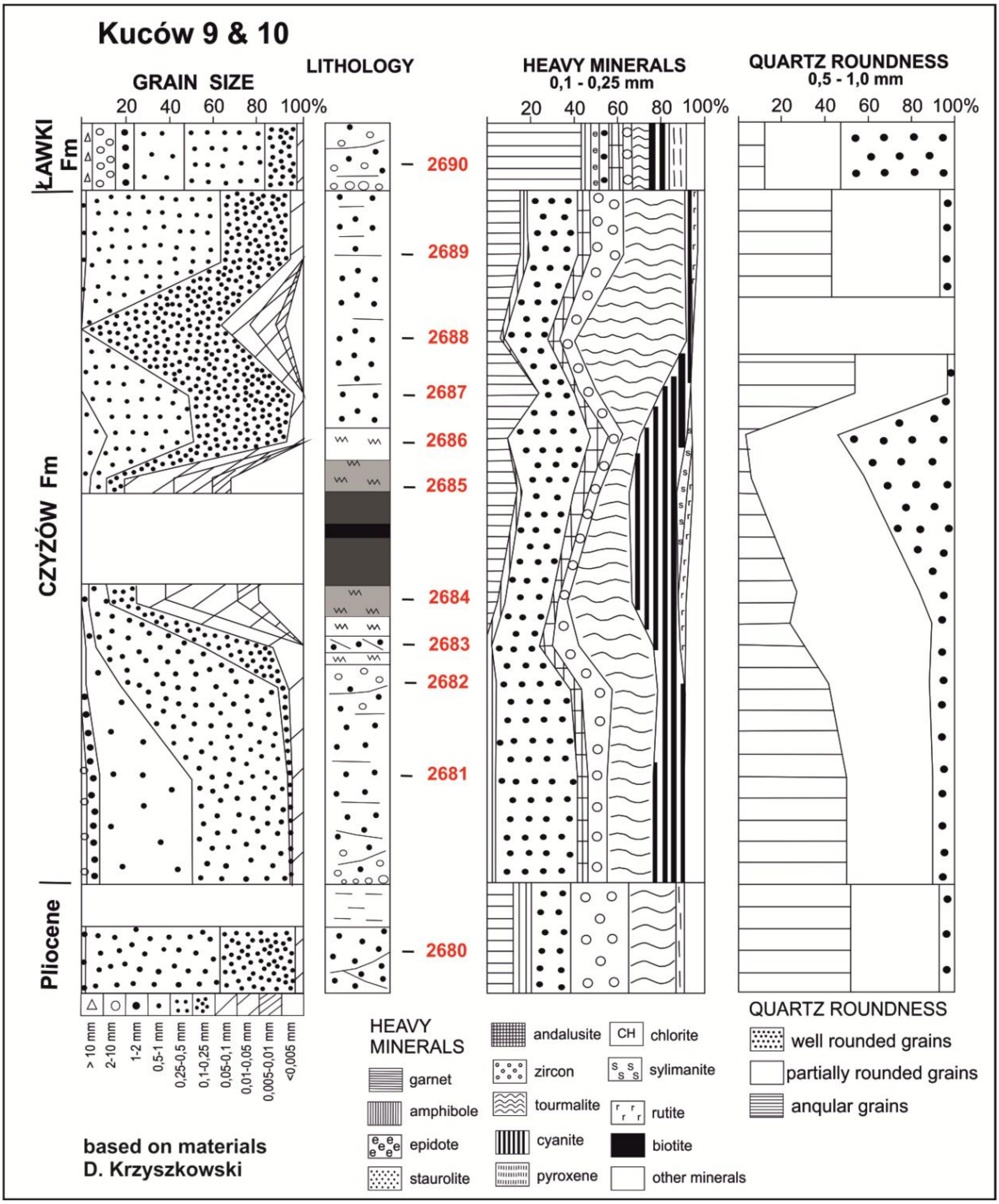


Fig. 5. Chosen textural and petrographic features of the deposits in central part of the Bełchatów Field (Kuców 9 & 10 sites)

REFERENCES

Allen, P., Krzyszkowski, D., 2008, Till base deformation and fabric variation in Lower Rogowiec (Wartanian, Younger Saalian) Till, Bełchatów outcrop, central Poland. Annales Societatis Geologorum Poloniae, 78,1, 19-35.

Balwierz Z., Goździk J., Marciniak B., 2008, Geneza misy jeziornej i warunki środowiskowe akumulacji limniczno-bagiennej w interglacjale mazowieckim w rowie Kleszczowa (środkowa Polska). Biuletyn Państwowego Instytutu Geologicznego, 428, 3-21.

Baraniecka M.D., 1971. Dorzecze Widawki na tle obszaru marginalnego stadiału mazowiecko-podlaskiego (Warty) w Polsce. Biuletyn Instytutu Geologicznego, 254, 13, 11-36. Borówko-Dłużakowa Z., 1981. Interglacjał mazowiecki na Wyżynie Wieluńskiej. Biuletyn Instytutu Geologicznego, 321, 259-275.

Krzyszkowski D., 1989. The Deposits of the Mazovian (Holsteinian) Interglacial in the Kleszczów Graben (Central Poland). Bulletin of the Polish Academy of Sciences. Earth Sciences. 37, 1-2, 121-130.

Krzyszkowski D., 1990. Litostratygrafia osadów czwartorzędowych w rowie Kleszczowa. Geologia, 16,1, 111-137.

Krzyszkowski D., 1992. Czwartorzęd rowu Kleszczowa. Litostratygrafia i tektonika. Studia Geograficzne, t. LIV. Wyd. Uniw. Wrocławskiego.

Mojski E., 2005. Ziemie polskie w czwartorzędzie. Zarys morfogenezy. PIG & MŚ, Warszawa.

ROZPRZA SITE: MAIN STAGES OF THE MID-LUCIĄŻA RIVER VALLEY EVOLUTION IN THE HOLOCENE

Piotr Kittel[1], Jerzy Sikora[2], Piotr Wroniecki[3]

[1] Department of Geomorphology and Palaeogeography, Faculty of Geographical Sciences, University of Lodz, Łódź, Poland, piotr.kittel@geo.uni.lodz.pl

[2] Department of Historical Archaeology and Weapon Studies, Institute of Archaeology, University of Lodz, Łódź, Poland, jerzy.sikora@uni.lodz.pl

[3] independent researcher, ul. Białobrzeska 15/154, 02-370 Warszawa, Poland, piotr.wroniecki@gmail.com

The site Rozprza (51˚18'07'' N; 19˚40'04'' E; 182-183 m a.s.l.) is situated in Central Poland ca. 60 km south of Łódź. The Luciąża is a 3rd-order river, tributary of the Pilica River in the mid-Vistula River basin. The length of the river is 53 km, average discharge 1.9 m^3/s and its basin area covers 765 km^2.

Geomorphological research of the Luciąża River valley was conducted by Goździk (1982) and later by Wachecka-Kotkowska (2004a, 2004b). These previous studies enhanced the geomorphology of the valley and recognition of the late Quaternary major stages of its evolution. In the Rozprza area, two Vistulian (Weichselian) river terraces (high terrace and low terrace) and one (highest) Wartanian glacifluvial terrace were recognised. The western morainic upland is formed by tills, while the eastern one by glacifluvial sands and gravels (Wachecka-Kotkowska 2004a). The valley floor is strongly expanded in the Rozprza area. The remains of the moat are situated, on the Plenivistulian terrace remnant adjoining the Late Vistulian and Holocene floodplain.

The research on the geomorphology and Holocene evolution of the Luciąża River valley is a part of a geoarchaeological investigation of the remnants of the stronghold in Rozprza. The stronghold remnants are situated in the central part of the middle sector of the Luciąża valley. The present regulated channel of the Luciąża River is situated ca. 250 m to the west of the stronghold and the Rajska River – 350 m to the east. Archaeological research documented three main phases of the medieval occupation of the site: an open settlement from the 2nd half of the 10th century AD, the earlier ring-fort functioning as a local administration and military center from the 11th to the 13th c. and the motte-and-bailey stronghold as a seat of a noble family from the mid-14th to the 15th/16th c. AD.

The large scale aerial photography, geochemical and geophysical testing, combined with detailed topographical and geological mapping, allowed for the discovery of traces of the motte's moat system and also of geomorphological features of the valley floor, eg. palaeochannels. Both natural and anthropogenic structures have been verified by geological augering and part of them by trenching. Detailed geological survey was carried in order to recognize the surficial geology of the stronghold's proximity and the geological structures recorded by aerial photographs and geophysical surveys. Geological cross-sections of the valley floor in the ring-fort's surrounding were elaborated in detail (Kittel et al. 2015, Sikora et al. 2015). New results provided data useful in the detailed reconstruction of the geomorphological situation of the stronghold, the river pattern of an area, local floodplain development and medieval ring-fort history. Reconstructions of depositional changes of fills of moats and palaeochannels were based on 14C datasets.

Non-invasive prospection and subsequent excavations enabled the recognition of sub-fossil palaeomeanders of different sizes. A large palaeomeander was recorded as a strong curvilinear magnetic anomaly with a double arc shape in the western part of the ring-fort. In the eastern part of the survey area, the narrow, linear, partly wavy, positive anomalies and zones of positive point and point dipolar magnetic anomalies were interpreted as a system of small palaeomeanders (Kittel et al., 2015). The fill of the large palaeochannel (width ca. 10 m, radius ca. 15 m.) reached up to 1.3 m of thickness and consisted of organic mud overlain by coarse-detritus gyttja. The palaeochannel fill is underlain by channel alluvia of sands and gravels with organic admixtures and laminations of organic mud (one of them dated to 12,720±80 BP), and overlain by the overbank alluvia of sandy organic mud. Radiocarbon data from the very bottom of the palaeochannel (11,070±80 BP) evidences the channel's cut-off to the Allerød - Younger Dryas transition. However, the results of preliminary pollen analysis documents the Early Holocene age of the organic deposits in the bottom (A. Wacnik – pers. com.). The data from the coarse-detritus gyttja top shows that the oxbow basin existed up to 3270±40 BP. And latter (after 2230±50 BP), an overbank deposition started in flood basins. The latter sandy-silty overbank deposits covering the whole flood plain are not older than 1490±40 BP, but most probably they were accumulated in Modern Times (they cover the layers with the late medieval artefacts).

Numerous palaeochannels ^{14}C dated to the Late Vistulian filled with organic deposits (mainly peat and gytia) were recorded during hand augering in the flood plain in Rozprza area. They are few metres width and cut up to 2 m. Some narrow Late Holocene palaeochannels were documented also by hand augering and two of them have been dated previously to the Middle and Late Holocene (Kittel et al. 2015) and later excavated in the trenches. However during the excavations, Late Medieval artefacts and numerous wooden construction elements dendrochronologically dated to the 14th century AD were recorded. In both cases, older (medieval) oxbows were adapted for constructions of an artificial water reservoirs, probably connected with linen production (the retteries) as confirmed by preliminary plant macro-remains analysis (R. Stachowicz Rybka – pers. com.). One of the excavated basins was later filled with earthworks rich in Late Medieval artefacts and ecofacts. The second was filled with coarse-drained sands partly laminated with organic mud, and rich in plant detritus and Late Medieval and Early Modern artefacts. They were deposited most probably during episodic overbank flows in the Modern Period. The accumulation of the top most silty-sandy overbank deposits could be dated not earlier than to the 16th c. AD.

The geological survey allowed for the recognition of the moats' fill in detail. They were filled with organic (gyttja and peat) and partially inorganic deposits containing rich remains of woods. The medieval age of the features was confirmed by radiocarbon dating of samples collected from the moat's bottom with the use of hand auger: 1080±60 BP, i.e. 895-1017 AD and 1040±60 BP; i.e. 897-1038 AD (Kittel et al. 2015). The motte's moat has been established however in the mid-14th century, as confirmed by dendrochronological and AMS data. The fill of the main moat was a subject of a detailed palaeoenvironmental study (Kittel et al. 2016). The accumulation of overbank silty sandy organic mud took place within the moat ditch system as late as in the 18th or 19th c AD.

The medieval stronghold in Rozprza was situated on the surface of a very low (up to 1-1.5 meters) sandy remnant of the Plenivistulian terrace in the wide valley floor of the mid-Luciąża River. The ring-fort was protected by the surrounding swampy areas of valley floor with older flood basins filled in the Roman Period by muddy overbank alluvium, ox-bows and narrow river channels. The Late Vistulian/Early Holocene palaeochannels were filled with organic deposits and covered with overbank muds in the Prehistory. The motte with moat system was established in the mid-14th century AD and functioned up to 15th/16th century without signs of flooding. The moat transformed from open water into a swampy basin in the mid-16th c AD. It records a rather dry phase in 16th century AD. The overbank silty-sandy cover with the thickness up to 0.6 m was deposited in the wide area of flood plain in the period from the 18th or even 19th century AD, as confirmed by results from the moat ditch. This shows that the Luciąża River valley floor in Rozprza was not flooded from the 14th to the 18th century AD. Thus, there is no record of alluviation in the Luciąża River floodplain in Rozprza from the beginning of the Little Ice Age, as it was confirmed for numerous river valleys in Poland. The undisturbed condition in the early phase of Little Ice Age should be connected with local specificity of the evolution of the mid-Luciąża River valley in the Late Middle Ages and the Early Modern Times.Therefore the Luciażą River valley floor could have been occupied during this entire period.

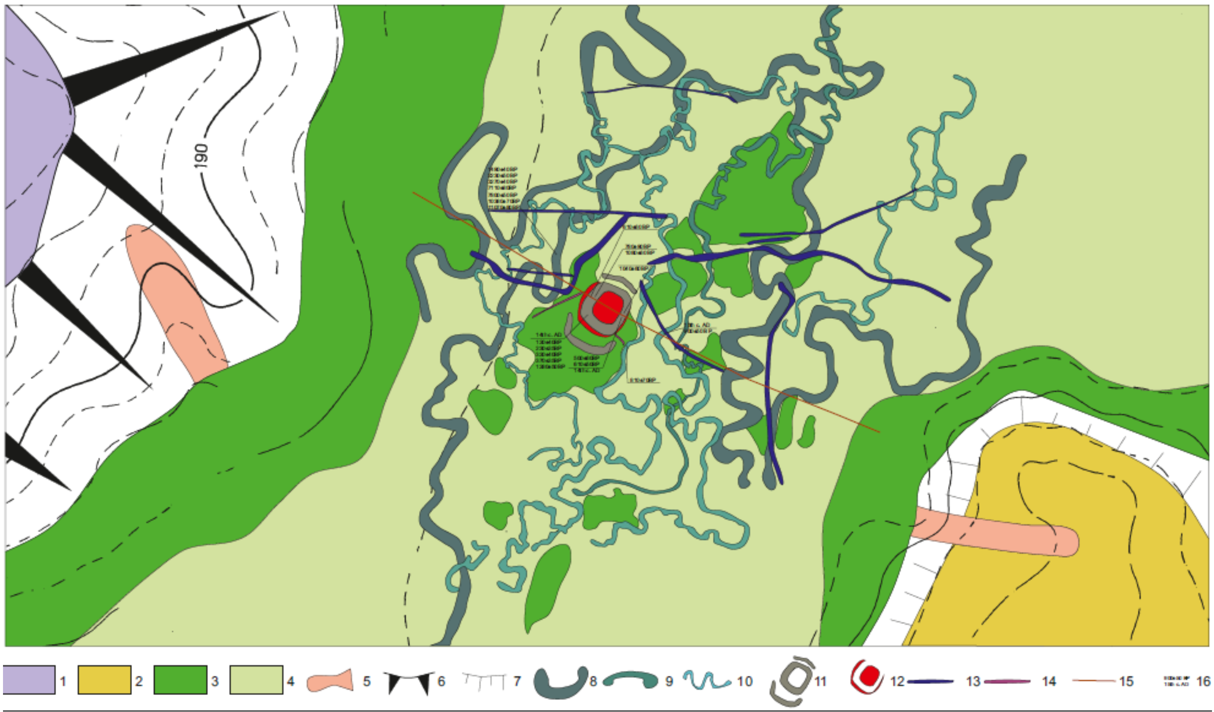


Fig. 1. Geomorphological map of the Rozprza ring-fort vicinity
1 – moraine plateau, Wartanian; 2 – glaciofluvial terrace, Wartanian; 3 – river terrace, Plenivistulian; 4 – valley floor, Late Vistulian and Holocene; 5 – denudational valleys; 6 – long valley slopes; 7 – short terrace slopes; 8 – large palaeomeanders (after aerial photos and geophysical survey), Late Vistulian; 9 – small palaeomeanders (after aerial photos and geophysical survey), Middle Holocene (?); 10 – small palaeomeanders (after aerial photos and geophysical survey), Late Holocene (Middle Ages?); 11 – moats; 12 – motte ramparts; 13 – dykes, embankments and/or ways (after aerial photos); 14 – artificial channels(?); 15 – location of the cross-section; 16 – radiocarbon data of organic deposits (BP), data from cores marked in italic, dednrochronological and archaeological data of artefacts from moat fills (AD)

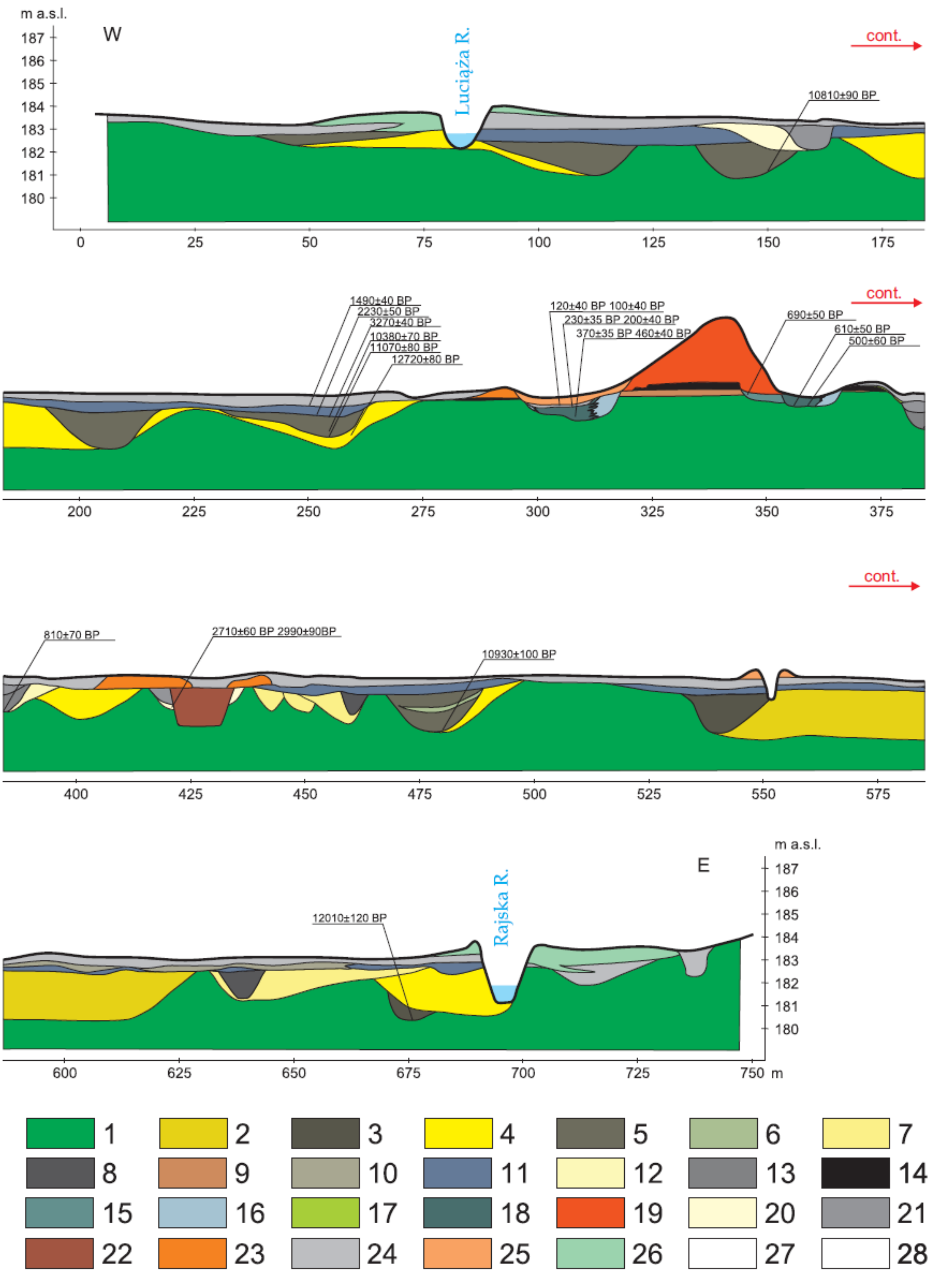


Fig. 2. Geological cross-sections of the Luciąża River valley floor in the ring-fort vicinity (location of cross-section see Fig. 1):

1 – fluvial various-grained sands, Plenivistulian; 2 – fluvial medium- and coarse-grained sands laminated with organic mud with plant macro-remains (channel alluvia), Allerød; 3 – gyttja and organic mud with sandy laminations in places (palaeochannel fill), Younger Dryas-Holocene; 4 – fluvial medium- and coarse-grained sands laminated with organic mud with

plant macro-remains (channel alluvia), Younger Dryas; 5 – gyttja and peat (palaeochannel fill), Early Holocene; 6 – sand and mud (palaeochannel fill), Early Holocene; 7 – fluvial medium- and coarse-grained sands laminated with organic mud (channel alluvia), Mid-Holocene; 8 – organic mud and sands (palaeochannel fill), Mid-Holocene; 9 – weakly humic various-grained sands with iron precipitation (buried soil with cultural layer), Mid- and Late Holocene; 10 – overbank organic mud laminated with sands, Late Holocene; 11 – overbank organic mud with plant macro-remains of flood basins, Late Holocene; 12 – fluvial medium-grained sands laminated with organic mud with plant macro-remains (channel alluvia), Late Holocene, Early Middle Ages; 13 – gyttja (palaeochannel fill), Late Holocene, Early Middle Ages; 14 – humic various-grained sands with charcoal (buried soil with cultural layer), Late Holocene, Early Middle Ages; 15 – various-grained sands and organic mud (moat fill), Late Holocene, Early Middle Ages; 16 – deluvial various-grained sands laminated with organic mud (slope deposits in moat), Late Holocene, Late Middle Ages; 15 – deluvial coarse-grained sands with charcoal and potsherds (slope deposits), Late Holocene, Late Middle Ages; 18 – gyttja, peat and organic mud (moat fill), Late Holocene, Late Middle Ages; 19 – humic sands and sands with charcoal and artefacts (relicts of ring-fort rampart), Late Holocene, Middle Ages and Modern Period; 20 – fluvial medium-grained sands laminated with organic mud with plant macro-remains (channel alluvia), Late Holocene, Late Middle Ages; 21 – organic mud and gyttja with sands (palaeochannel fill), Late Holocene, Late Middle Ages; 22 – organic mud and various-grained sands with wood elements and plant macro-remains (rettery fill), Late Holocene, Late Middle Ages; 23 – organic mud with various-grained sands (embankment), Late Holocene, Late Middle Ages and Modern Period; 24 – overbank organic mud with sands, Late Holocene, Modern Period; 25 – humic various-grained sands with organic mud (embankment), Late Holocene, 20th cent.; 26 – overbank various-grained sands with organic mud (levee), Late Holocene, 20th cent.

Acknowledgements:
The research project has been financed by grants from The National Science Centre based on the decision No. "DEC-2013/11/B/HS3/03785". Non invasive survey was partially financed with grant of Polish Ministry of Culture and National Heritage in 2013 (01619/13).

REFERENCES:

Goździk, J., 1982. Środowisko przyrodnicze osadnictwa średniowiecznego okolic Rozprzy, Prace i Materiały Muzeum Archeologicznego i Etnograficznego w Łodzi - Seria Archeologiczna, 29: 138-151.

Kittel, P., Sikora J., Wroniecki, P., 2015. The morphology of the Luciąża River valley floor in the vicinity of the Rozprza medieval ring-fort in light of geophysical survey. Bulletin of Geography. Physical Geography Series, 8, 95-106. doi:http://dx.doi.org/10.2478/7033.

Kittel, P., Antczak, O., Brooks, S.J., Elias, S.A., Krąpiec, M., Luoto, T.P., Okupny, D., Pawłowski, D., Płóciennik, M., Rzodkiewicz, M., Sikora, J., Stachowicz-Rybka, R., Wacnik, A., 2016. Fluvial archive in the moat fill - palaeoenvironmental research in the Luciąża River valley in Rozprza, Central Poland, this abstracts book.

Sikora J., Kittel P. Wroniecki, P., 2015. From a point on the map to a shape in the landscape. Non-invasive verification of medieval ring-forts in Central Poland: Rozprza case study, Archaeologia Polona, 53, 510-514.

Wachecka-Kotkowska, L., 2004a. Ewolucja doliny Luciąży – uwarunkowania klimatyczna a lokalne, Acta Geographica Lodziensia, 86: 1-161.

Wachecka-Kotkowska, L., 2004b. Zmiany środowiska doliny dolnej Luciąży w holocenie. Acta Universitatis Lodziensis. Folia Geographica Physica, 6: 47–70.

KWIATKÓW SITE: MID-WARTA RIVER VALLEY EVOLUTION

Danuta Dzieduszyńska[1], Piotr Kittel[1], Marek Krąpiec[2], Joanna Petera-Zganiacz[1], Juliusz Twardy[1]

[1] *Department of Geomorphology and Palaeogeography, Faculty of Geographical Sciences, University of Lodz, Łódź, Poland,danuta.dzieduszynska@geo.uni.lodz.pl, piotr.kittel@geo.uni.lodz.pl, joanna.petera@geo.uni.lodz.pl, juliusz.twardy@geo.uni.lodz.pl*
[2] *Faculty of Geology, Geophysics and Environmental Protection, AGH – University of Science and Technology, Kraków, Poland, mkrapiec@agh.edu.pl*

The Kwiatków site (N 52°05'59", E 18°40'52", 95.6 m a.s.l.) and the Koźmin Las site (N 52°04'52", E 18°40'03", 97.5 m a.s.l.) are situated in n the Central Poland, in the mid-Warta River valley in the Koło Basin. They were discovered in an area of Miocene lignite exploitation by the Adamów Lignite Mine. The area was covered with ice sheet for the last time during the Wartanian Stage of the Odranian Glaciation. The Weichselian Cold Stage was an ice-free period there. The closest position of the ice sheet front occurred about 20 km to the north during the Last Glacial Maximum (LGM) (Marks 2011). The main Warta River valley geomorphological elements in the Koło Basin are: fragments of erosional terraces of the Warsaw-Berlin ice-marginal valley, the Middle Weichselian high terrace (3.5 - 8 m above the Warta River level) and the low terrace of the Late Weichselian/Holocene age (1 - 4.5 m above the Warta River level) (Forysiak 2005). Geomorphologically, both sites lie on the surface of the low terrace, in the area of the multichannel pattern.

A detailed study at the Koźmin Las site was undertaken in 2010 and 2011 in an open test pit of about 160 square metres. The subject of the interdisciplinary study was a horizon of the subfossil forest buried by alluvial deposits. Totally over 300 wood fragments were excavated in the form of stumps, collapsed trunks and branches, mostly of pine (*Pinus sylves*tris L.) remains and fragments of birch (Dzieduszyńska et al. 2012, 2014). Most stumps are in the *in situ* position with well-preserved root systems. The length of trunks reaches up to 7 m (usually 2 - 3 m) and their diameters are locally over 0.2 m. Dendrochronological analyses of 114 wood samples show that the forest consisted predominantly of pines of an average age of 50 - 70 years and existed probably not longer than about 150 years. The time of the forest development has been estimated to the period from 13,000/12,900 to 12,700/12,600 cal. BP. It was destroyed as a result of a deterioration of hydrological conditions together with sudden catastrophic event, such as strong wind (Dzieduszyńska et al. 2014). Some trunks were transported in a fluvial environment after their collapse (Kittel et al. 2012).

The research at Koźmin Las site was the first dendrological study in Central Poland on tree remains dated to the Late Weichselian (Dzieduszyńska et al. 2014). The *in situ* pine-birch forest from the Younger Dryas, but in the bad state of preservation, was excavated on the floodplain of the Spree River in the Cottbus area (Eastern Germany) (Friedrich et al. 1999, Spurk et al. 1999). More frequent are subfossil tree remains within Holocene deposits (Kalicki and Krąpiec 1995, Kalicki 2006).

The low terrace is formed at the Koźmin Las site by organic deposits with tree remains covered with 2.0-2.5 m thick inorganic silty sandy overbank deposits (Dzieduszyńska and Petera-Zganiacz 2012, Twardy 2014, Petera-Zganiacz et al. 2015). The Late Weichselian forest remains were preserved by a thick cover of silty organic deposits and silty sandy overbank alluvia and also by a high and stable ground water level (Fejfer et al. 2014). Wood remains were covered probably rapidly with a thick layer of silts and sands. The period of accumulation of organic deposits with the forest remains was dated from 13,000 to

11,600/11,250 cal. BP (Dzieduszyńska et al. 2014) and the inorganic alluvia were deposited in the very end of the Younger Dryas (Petera-Zganiacz et al. 2015a) or in the Early Holocene (Kittel 2015).

The Kwiatków site was discovered during archaeological excavations of a vast settlement complex from the pre-Roman and Roman periods (2nd century BC - 3rd cent. AD). The site is situated on the sandy surface of the lower terrace. During the exploration of deep archaeological features, the organic mud horizon with subfossil trees has been recorded, similar to that known from the Koźmin Las site. In the year 2014, the excavation of buried trees was undertaken at the Kwiatków site within three large tranches of approximately 100 square metres each. Totally over 600 wood fragments of collapsed trunks and also few stumps were discovered, mostly of pine (*Pinus sylves*tris L.) remains.

Dendrochronological analysis was made for 407 selected samples of wood coming from subfossil trunks and branches. Amongst the pine trees examined, young specimens prevailed. The trees older than 150 years appeared only occasionally, and the oldest specimen grew 234 years.

Amongst the samples analysed dendrochronologically, the ones cut from pine trunks predominated. On account of the sequence lengths as well as the lowest anatomical perturbations, they were used for construction of the local chronology. The average curve, produced from the tree-ring sequences best correlating mutually, spans 265 years. The approximate age of the pine chronology was determined on the basis of the AMS radiocarbon dating of samples containing one annual growth rings. The results of wiggle matching indicate that the subfossil pine chronology represents the period 11763-11498 (±45) cal BC (13713-13448 (±45) cal BP).

A large (100 features) complex of wells has been discovered during archaeological works at the Kwiatków site. The wells were deeped in the ground at ca. 1.5-3.0 m with the wooden construction preserved usually to the height of 1 m. Their bottoms always reached the horizon of organic mud with the tree remains. Water from inorganic silty-sandy series overlaying the organic deposits was available in the wells. It shows a very suitable geological condition for water intake, but the quality of water was not very high because of direct contact with organic-reach sediments and high admixture of iron compounds within layers (Petera-Zganiacz et al. 2015b).

The main building material utilized for construction of the wells was oak (Quercus), in few cases also elm (Ulmus), ash tree (Fraxinus) and alder (Alnus) wood. The obtained dendrochronological dates indicate that the wells were constructed in the early Roman Period (between 86 AD and ca. 180 AD). In many cases, the wells were filled with organic mud in the lower part and fine- and medium-grained sand laminated with organic silt in the upper part. The lower organic mud unit was accumulated in the period of the wells' functioning. The upper silty-sandy unit is the overbank alluvium. It means that almost a part of wells were filled with overbank deposits in the time when they were still in use. It is the evidence of intense flash floods in the early Roman Period (2nd cent. AD) in the Koło Basin (Kittel et al. 2015).

Acknowledgements:
The research project has been financed by grants from The National Science Centre based on the decisions No. "N N306 788240" and "2013/09/B/ST10/02249".

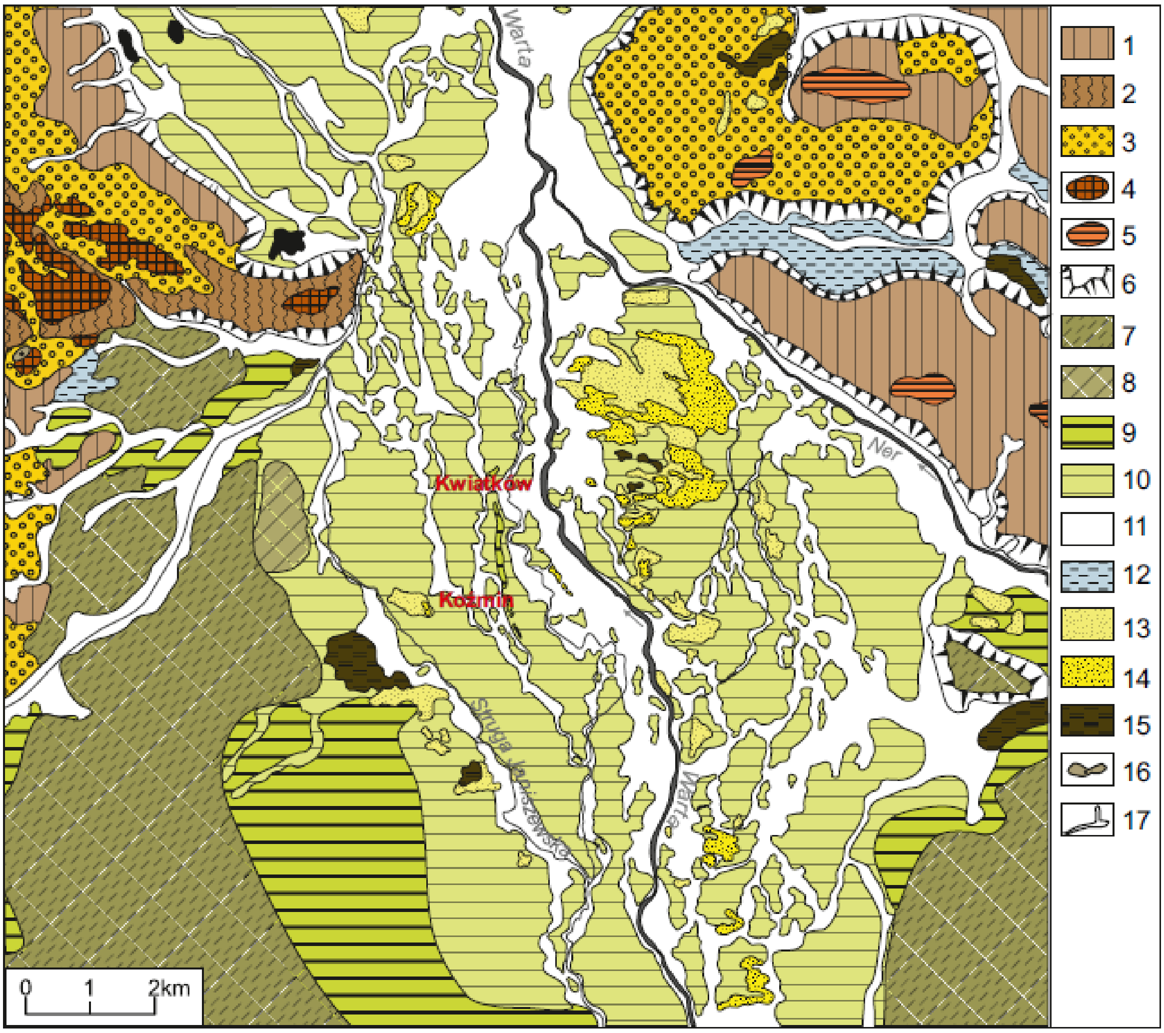


Fig. 1. Location of the investigated area in relation to gemorphological situation (after Forysiak 2005 and Płaza et al. 2014)
1 – morainic plain; 2 – hummocky morainic plain; 3 – fluvioglacial plain; 4 – end-morainic hillocks; 5 – kames; 6 – slopes; 7 – lower terrace of marginal valley; 8 – erosional terrace; 9 – alluvial high terrace; 10 – alluvial low terrace; 11 – valley floor; 12 – lacustrine plain; 13 – aeolian plain; 14 – dunes; 15 – peatlands; 16 – closed depressions; 17 – valleys of various origin

Fig. 2. Radiocarbon and OSL dates of deposits at Koźmin Las site (after Dzieduszyńska et al., 2014a, 2014b)

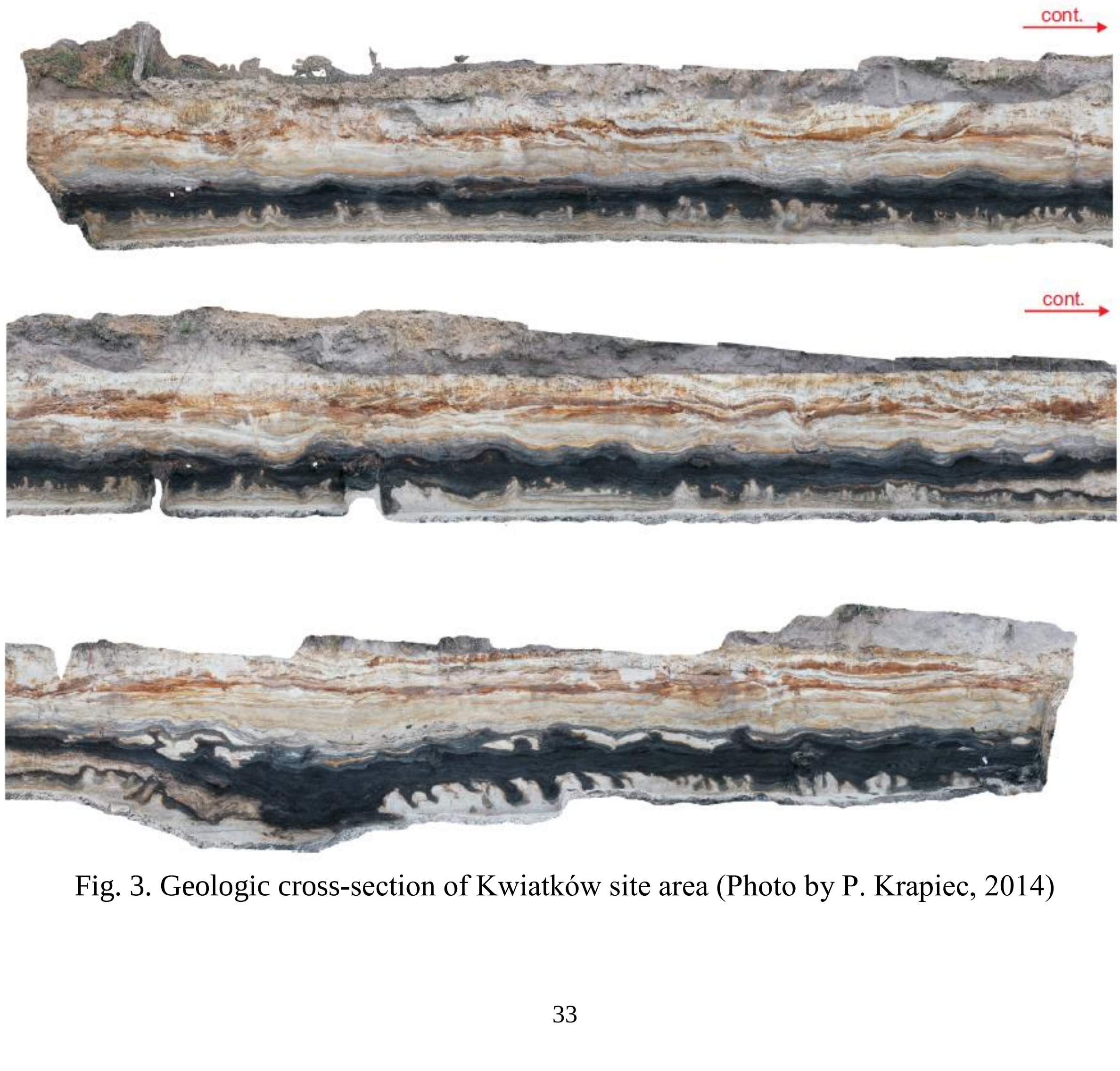


Fig. 3. Geologic cross-section of Kwiatków site area (Photo by P. Krapiec, 2014)

Fot. 1. View of buried forest at Koźmin Las site (Photo by J. Petera-Zganiacz, 2011)

Fot. 2. The cross-section of the wooden well at Kwiatków site chronologically dated to ca. 140 AD and filled with overbank deposits (Photo by E. Schellner, 2012) (after Kittel et. al. 2015)

REFERENCES

Dzieduszyńska D., Petera-Zganiacz J., 2012. Geologic position of the Younger Dryas subfossil forest in the Warta River Valley, central Poland. Bulletin of the Geological Society of Finland 84, 69-79.

Dzieduszyńska D., Kittel P., Petera-Zganiacz J., Twardy J., 2012. Paleogeograficzne elementy rozwoju doliny Warty w Kotlinie Kolskiej w świetle badań w stanowisku „Koźmin Las". Acta Geographica Lodziensia 100, 35-49.

Dzieduszyńska D., Kittel P., Petera-Zganiacz J., Brooks S., Korzeń K., Krąpiec M., Pawłowski D., Płaza D., Płóciennik M., Stachowicz-Rybka R., Twardy J., 2014a,

Environmental influence on forest development and decline in the Warta River valley (Central Poland) during the Late Weichselian. Quaternary International 324, 99-114.
Dzieduszyńska, D., Petera-Zganiacz, J., Twardy, J., Kittel, P., Moska, P., Adamiec, G., 2014b, Optical dating and sedimentary record from the terrace depositional profile of the Warta River (Central Poland). Geochronometria 41 (4): 361-368. DOI 10.2478/s13386-013-0173-y.
Fejfer M., Zborowska M., Adamek O., Dzieduszyńska D., Kittel P., Petera-Zganiacz J., Twardy J., 2014. Properties and dimensional stability of 12 500-year-old subfossil pine wood, Drewno 2014, Vol. 57, No. 193, 81-95.
Forysiak J., 2005. Rozwój doliny Warty między Burzeninem a Dobrowem po zlodowaceniu warty. Acta Geographica Lodziensia 90, 1-116
Friedrich M., Kromer B., Spurk M., Hofmann J., Kaiser K.F., 1999. Paleoenvironment and radiocarbon calibration as derived from Late glacial/Early Holocene tree-ring chronologies. Quaternary International 61, 27-39.
Kalicki T., 2006. Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich. Prace Geograficzne IGiPZ PAN 204, 1-348.
Kalicki T., Krąpiec M., 1995. Problems of dating alluvium using buried subfossil tree trunks: lessons from the "black oaks" of the Vistula Valley, Central Europe. The Holocene 5 (2), 243-250. Kittel P., 2015. The alternative interpretation of chronology of flood events in the mid-Warta River valley: Record of Early Holocene alluviation in the Koło Basin (central Poland). Quaternary International 386, 116-121.
Kittel P., Petera-Zganiacz J., Dzieduszyńska D., Twardy J., Krąpiec M., Bijak Sz., Bronisz K., Zasada M., Płaza D., 2012. Badania „kopalnego lasu" ze schyłku vistulianu w dolinie Warty (Kotlina Kolska, środkowa Polska). Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej 1, 30, 238-245.
Kittel P., Krąpiec M., Petera-Zganiacz J., Piotrowska M., Rzepecki S., Schellner E., Twardy J. 2015. The Record of Catastrophic Flood in the Roman Period in Koło Basin (Central Poland), [w:] G. Baryshnikov, A. Panin, Gradualism vs catastrophism in landscape evolution. International Association of Geomorphologists (IAG) Regional conference, July 2-4, 2015, Barnaul, Russia, Extended Abstracts, Barnaul: Publishing House of Altai State University, 47-50.
Marks L., 2011. Chapter 23: Quaternary Glaciations in Poland. In: Ehlers J., Gibbard P.L., Hughes P.D. (eds.), Developments in Quaternary Sciences 15, 299-303.
Petera-Zganiacz J., Dzieduszyńska D., Twardy J., Pawłowski D., Płóciennik M., Lutyńska M., Kittel P., 2015a. Younger Dryas flood events: A case study from the middle Warta River valley (Central Poland). Quaternary International 386, 55-69.
Petera-Zganiacz J., Piotrowska M., Twardy J., Dzieduszyńska D., Rzepecki S., Okupny D., 2015b. Geomorfologiczne oraz geologiczne uwarunkowania budowy i funkcjonowania studni z okresu wpływów rzymskich na wielokulturowym stanowisku archeologicznym w Kwiatkowie (Kotlina Kolska), Prace i Materiały Muzeum Archeologicznego i Etnograficznego w Łodzi, Seria Archeologiczna 46, 211-228.
Płaza D. K., Twardy J., Kittel P., 2014, Z badań nad schyłkowo paleolitycznym osadnictwem w Kotlinie Kolskiej, Acta Geographica Lodziensia 102, 87-95.
Spurk M., Kromer B., Peschke P., 1999. Dendrochronologische, palynologische und Radiokarbon-Untersuchungen eines Waldes aus der Jüngeren Tundrenzeit. Quartär 49/50, 34-38.
Twardy J., 2014. Litologiczna charakterystyka osadów w stanowisku Koźmin Las i ich interpretacja paleogeograficzna. Acta Geographica Lodziensia 102, 23-38.

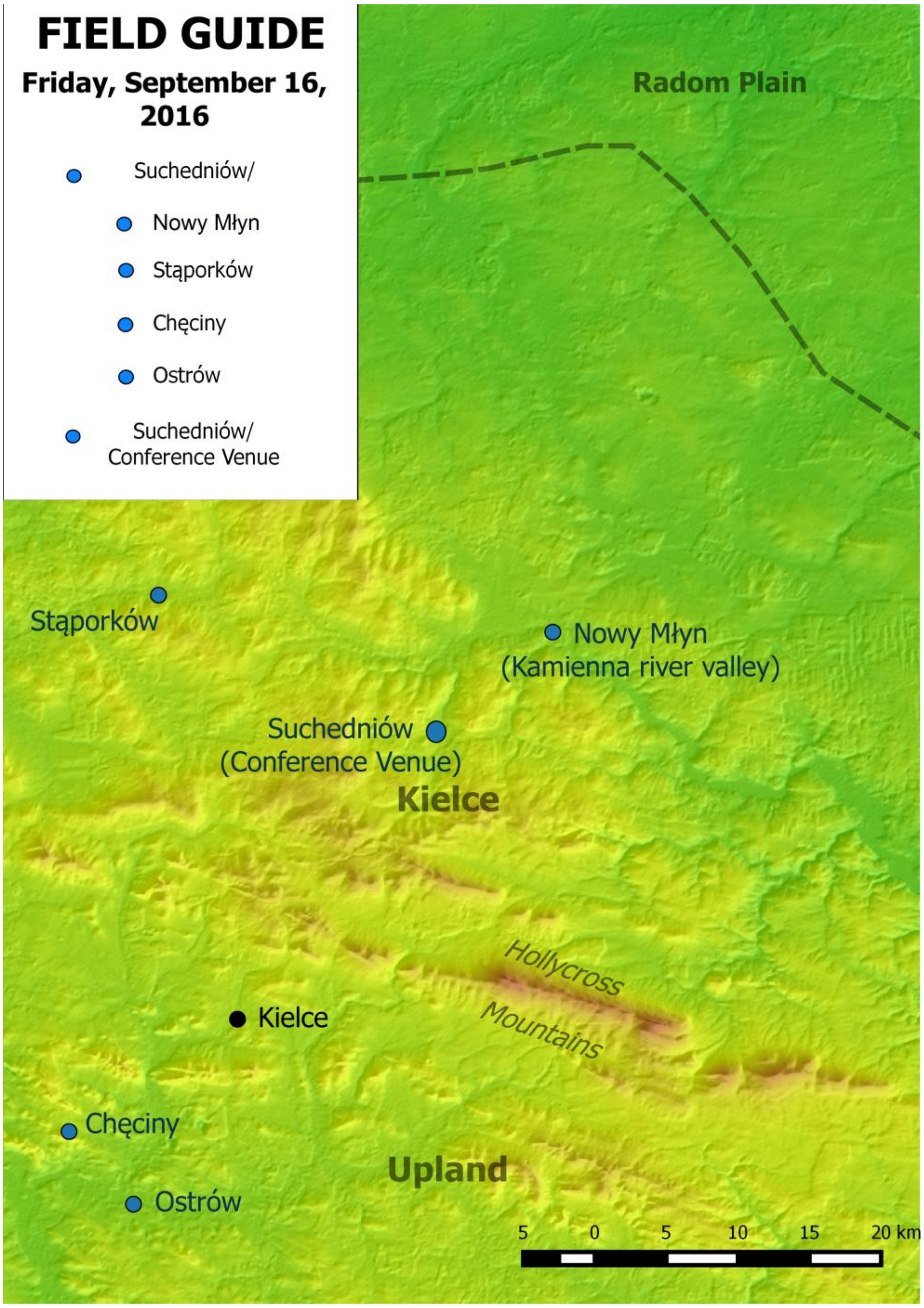
15.09.2016 Thursday - Second day of excursion

River valley evolution of Middle Mountain and Upland area

7:00 Suchedniów (breakfast)
08:00 FIELD EXCURSION (pocket lunch)

- **Krzemionki Opatowskie** (Neolithic flint mines)
- **Chodelka Basin** (Quaternary evolution of the Vistula river gap section)
- **Kazimierz Dolny** (Medieval old city, loess erosional landscape)

Suchedniów (dinner)



KRZEMIONKI OPATOWSKIE SITE
ARCHEOLOGICAL MUSEUM AND RESERVE

Jerzy Tomasz Bąbel

In the Mesozoic margin of the Świętokrzyskie Mountains there are outcrops of various kinds of flint and many prehistoric mines. Places where striped flint was mined were found at Korycizna, Borownia and Ruda Kościelna. In terms of area of the mining field, one of Europe's biggest sites is the complex of flint mines at Krzemionki near Ostrowiec Świetokrzyski. Its perfectly preserved ground landscape and underground structure give it extraordinary importance.

The mines were found on 19 July 1922 by the geologist Jan Samsonowicz. Research and excavation works in the area were directed by Zygmunt Szmit (1923, 1927), Józef Żurowski (1925-1927), Stefan Krukowski (1923, 1928-1937), Michał Drewko (1945, 1948), Tadeusz Żurowski (1953, 1958-1961), Jan Kowalczyk, Bogdan Balcer and Zygmunt Krzak (1969-1970), Jerzy Bąbel (1979-1984, 2001-2004), Sławomir Sałaciński, Marek Zalewski, Witold Migal (1985-1988), Wojciech Borkowski (1989-2000), Artur Jedynak and Kamil Kaptur (2008-2009)

The mines were exploited ca. 3900 to 1600 BC. (radiocarbon dating) by different peoples who left artefacts categorized by archaeologists into cultures- e. g. the culture of funnel- shaped cups, culture spherical amphorae, Mierzanowice culture. It is possible that deposits of striped flint were known even earlier, to the Mesolithic hunters.

Growing population and burning-down type of farming were vital factors which led to development of flint mining in Świętokrzyskie region. Axes made of flint, used mostly for cutting down trees and clearing land as well as for cutting wood, were distributed in the range 128 of 250 km from the mines (the culture of funnel- shaped cups, ca. 3900- 2900 BC.). However, most shafts at Krzemionki were made by miners who belonged to the culture of spherical amphorae (2900- 2500 BC.). Axes for special purposes which they produced are found in the range as big as 600 km. In the early Bronze Age (Mierzanowice culture, ca. 2200- 1600 BC.) tools and weapons (axes and arrow- heads) made of flint were distributed in the range of ca. 85 km.

Photo A. Jedynak

Photo A. Jedynak

Fig. Underground mine exhibition gallery at Krzemionki Opatowskie

The mining field in Krzemionki is located in an area of Jurassic (Upper Oxfordian) limestone outcrop in a syncline edge. The parabola- shaped field is ca. 5 km long and from 20 to 220 meters wide, covering the area of ca. 785 thousand m 2. The number of mining units is estimated at over five thousand. The flint - bearing layer is a bank of flint concretions of various sizes, located in two layers whose depths decrease towards the edge of the syncline. The shafts were set out 5 to 30 meters apart, and their depths and shapes depend on local geological conditions of flint- bearing layers. Ball-shaped and flattened flint concretions were extracted in a few ways, from excavating shallow cavities (two meters deep and four or five meters wide), through niche mines (ca. 4,5 m deep) and chamber- pillar mines to 8- 9 m deep chamber mines covering the area of ca. 400 m 2. The advance of more complex flint mining technology in the Neolithic Age resulted in development of specialization: this is when professional flint miners emerged. A mine crew consisted of five to ten people.

Flint was mined in the warm (shallow cavities) and cold season (deep chambers). Sheds were built over chamber shafts to protect the mine from rain and snow. The miners used sets of tools made from pieces of flint, other rocks and deer antlers. They served as wedges, mallets, levers, hoes and pickaxes. There was also an ingenious system of transporting flint output up to the surface. The miners worked underground in a contracted position: half- lying, crouching or kneeling. In order to save work, excavations were only 55-110 cm high. Loosened limestone rubble was disposed of either to the surface, where it was stored in characteristic heaps surrounding the shafts, or was used for backfilling abandoned chambers. To prevent mine roofs from collapsing, pillars of solid rock were left (chamberpillar mines) or supports made of limestone slabs and rubble. Air circulation in the mine was provided by fires made in the shafts and their entrances. The mine was lit by burning resinous chips and perhaps with tallow lamps.

The gained material was segregated underground and only the best quality flint was transported to the surface. Just near the shaft it was segregated once again and underwent preliminary working. Concretions were broken on a stone anvil and worked with shaping tools made of stone, flint, bone and hard wood. Large amounts of flint waste and abortive 129 semi- products of axes and other tools remained left near shaft entrances (site workshops). Selected semi- products or roughly shaped lump were taken for further working in productions settlements located in the basin of the Kamienna river, where, for instance, axes were polished and finished. Apart from temporary camps built by the miners, there was no permanent settling in the mining area because of lack of potable water. Sometimes they used rainwater which remained in karst formations lying about 250 or 350 metres south of the mining field.

Pictures of symbols representing deities worshipped by the miners, made in charcoal on rock faces and pillars, were found in the mine. They include a woman in labour, a bull’s head or horns, a pair of feet. Located in the workplace, they were supposed to help the miners with excavating limestone rock. Probably they symbolize the Great Goddess and her partner, the God of Storm, whose weapon was a lightning represented by a hatched and axe. This cult is connected with the special role of a striped flint axe in the animal and crop farming communities of the culture of spherical amphorae. It is supposed that in rites it symbolized presence of a deity. It also meant social prestige and was a warrior’s weapon, magically protecting the owner from evil. This is why it was buried together with the dead.

After prehistoric miners had stopped exploitation of the deposits, the area remained hidden in ancient forest until it was infringed by modern agriculture in the beginning of the 20 th century, when the village of Krzemionki was located nearby. The dwellers- lime producers destroyed the ancient mines (among other things, the “Great Chambers” in the tourist route No 1) in order to gain limestone for production of lime and as fluxing agent for Ostrowiec steelworks. This kind of exploitation was stopped when an archaeological reserve was established. Its organization began in 1926. The reserve is situated 8 km north-east of Ostrowiec, near the road to Lipsko. Underground exhibition gallery ca.0,5 km long passing through Neolithic mining units was opened for tourists 1 July 2004.

LATE QUATERNARY EVOLUTION OF THE VISTULA RIVER LESSER POLAND GAP SECTION

Tomasz Kalicki
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland
tomaszkalicki@ymail.com

The study reach between Zawichost and Puławy, of the length of 70 km, is located in the Vistula gap through the southern Polish Uplands (Fig. l). In this reach only minor tributaries yield into the Vistula river. The Vistula catchment is about 55 000 km^2 and the mean annuał discharge is about 460 m^3s^{-1}. In the discussed area the Vistula regime is pluvialnival. The Carpathian tributaries have influence on two periods of floods, i. e. the spring (March) nival flood period (absolute maximum discharge 5440 m^3s^{-1}) and the summer (June) pluvial flood period (absolute maximum discharge 7459 m^3s^{-1}). Maximum floods cause water level to increase by 6 m.

The Vistula, leaving the Sandomierz Basin lined with the Miocene clays, cuts through the area of the southern Poland Uplands built of the resistant Mesozoic rocks. Downstream, the river again enters the basin of the not resistant Paleogene and Neogene layers. The antecedent gap is located on the Upper Cretaceous rocks dipping to the north - gaizes, marls and chaiks. The naturę and width of the Vistula gap varies and depends on the substratum resistance (Fig. l). The valley, 4 km wide on the average, narrows even to 1,2 km dissecting the hardest layers of the Uppermost Mastrycht near the town of Kazimierz Dolny. On the other hand, the valley widens to 10-12 km on the outcrops of soft chalk in the area of the Chodelka Basin (Pożaryski, Kalicki 1995).

Alluvia fill the 30 m deep valley which was formed in the Małopolski interglacial (Pożaryski 1953, 1955; Pożaryski et al. 1993, 1994a, b, 1999). The coarse gravels lying at the bottom are related to this interglacial as well as to the next, Ferdynandów, one. Deposits of the Mazovian interglacial s. l. have not been preserved in the valley. They were washed away after the retreat of the last Oder ice sheet from the gap area, i. e. in the period of the Lubawa to Eemian interglacials. In that period a new valley was incised which coincides with the old, pre-Odranian valley (Fig. 1B) but not in all sections. In the new Vistula valley sandy-gravel channel alluvia were deposited. At their top there are river sediments associated with the Vistulian, forming the high III (11.0-18.5 m) and medium II (3-9 m) sandy terraces. In the Holocene the sandy floodplain I, covered with overbank deposits, was formed (1-3.5 m)(Pożaryski, Kalicki 1995).

Depending on local conditions particular sections of the valley developed autonomousły and provided records of the sequence of events (Fig. 2). The floodplain (IC) distinguished by W. Pożaryski (1955), which seems to be uniform, is differentiated as to the structure and to the age. This complicate structure is most often masked by a thick cover of overbank deposits.

In the narrow, gap-type reaches there are cut-fill body of the floodplain of various age. Here the palaeomeanders are preserved only sporadically. A small width of the valley restrained free meandering so the river had likely a permanent tendency to anastomosing as well as to hindered preservation of the older series of channel alluvia. However, records of changes in the type and rate of sedimentation on the floodplain are found in few preserved older fragments. The evidence of changes is provided by subsequent members (covers) of overbank deposits separated by the buried soils. In the younger inserts, overbank facies have been laid down directly on the channel deposits. In these sections the overbank deposits of the same age are, therefore, facially differentiated and occur at various levels (Kalicki 2000)(Fig. 2A).

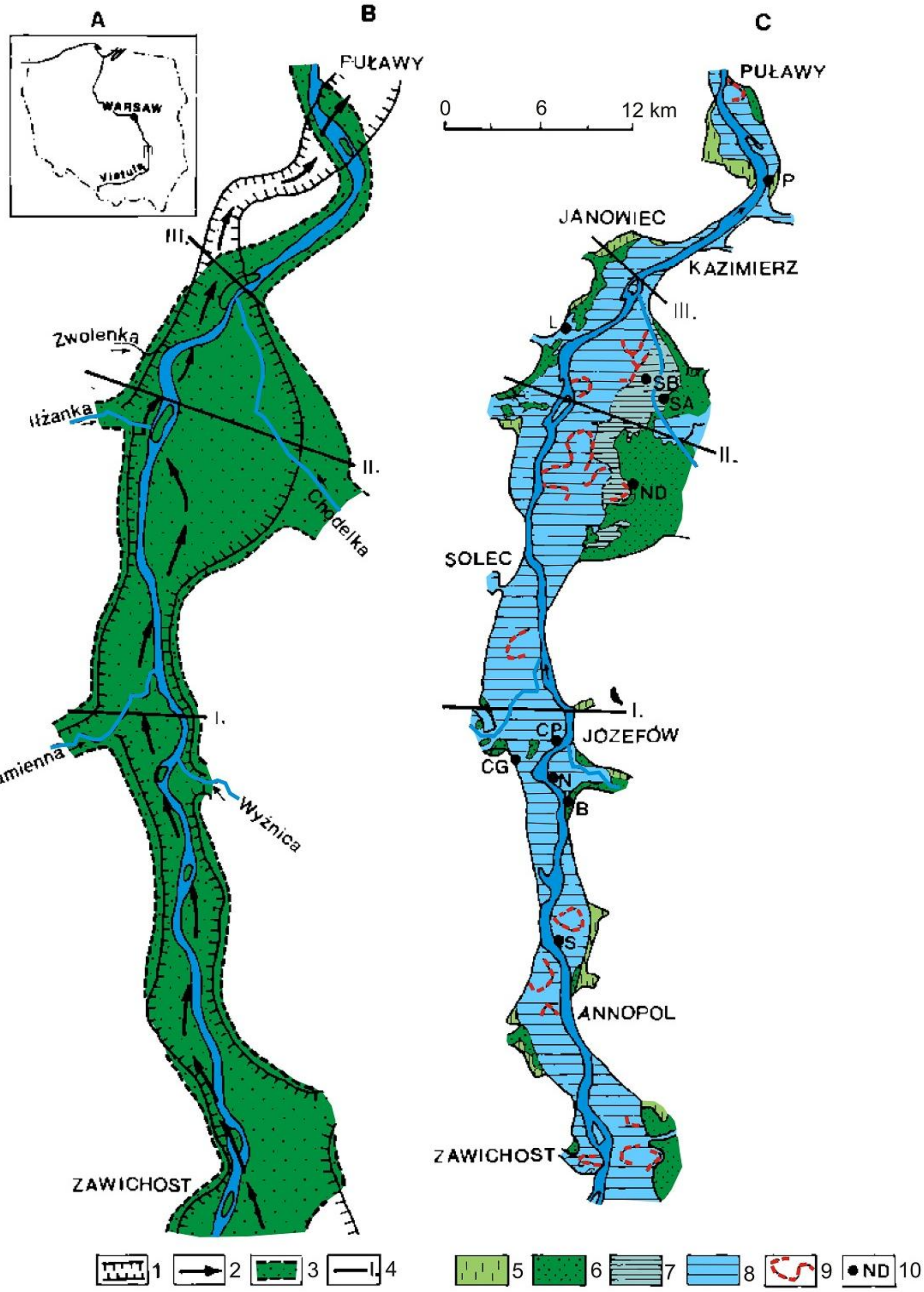


Fig. 1. Location (A), geological (B) (Pożaryski *et al.* 1994, modified) and morphological (C) (Pożaryski 1955, modified) maps of Vistula gap section (Pożaryski, Kalicki 1995)
l - pre-Odranian Vistula valley, 2 - axis of pre-Odranian Vistula valley, 3 - post-Odranian Vistula valley, 4 - section lines across the valley (see Pożaryski, Kalicki 1995), 5 - Pleistocene high terraces (III), 6 - Late Glacial middłe terraces (II), 7 - Holocene "old mada" flood plain (I), 8 - Holocene "young mada" flood plain (I), 9 - palaeomeanders, 10 – studied sites: B - Basonia, CG - Ciszyca Górna, CP - Ciszyca Przewozowa, L - Lucimia, N - Nieszawa, ND - Niedźwiada, P - Parchatka, Ś - Świeciechów, SA - Szczekarków A, SB - Szczekarków B

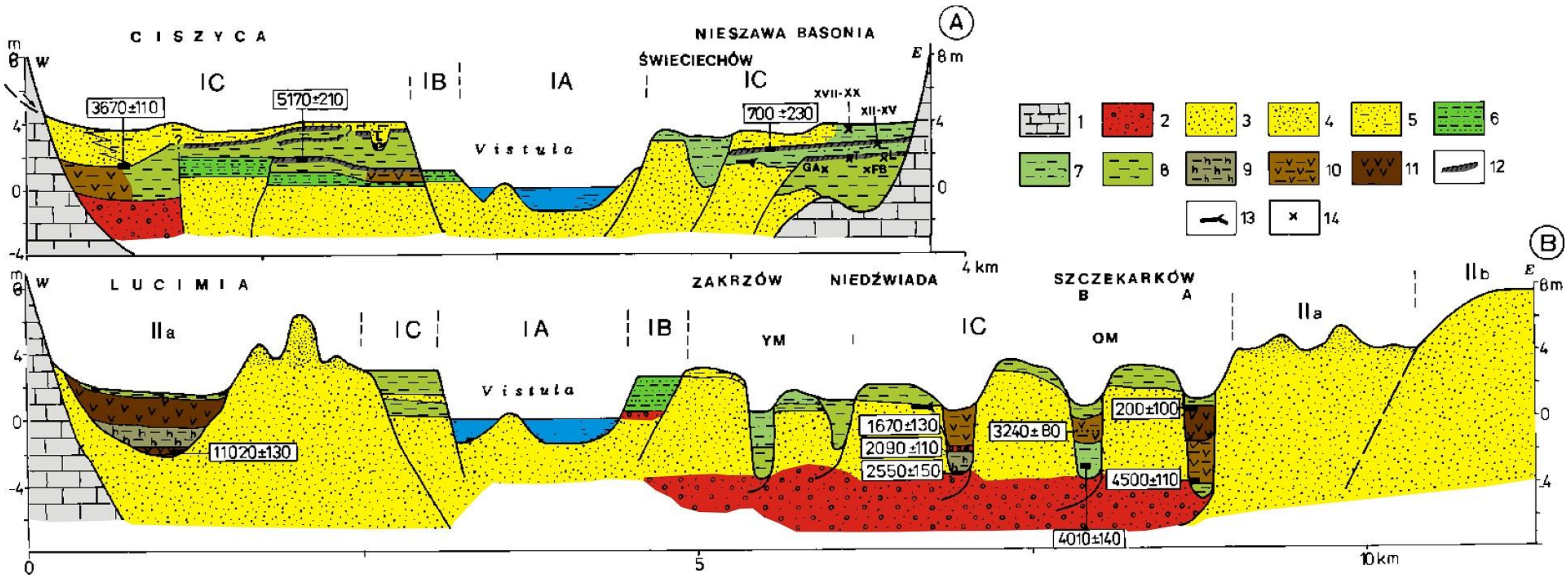


Fig. 2. Schematic geological sections across the Vistula river valley floor in the narrow section (A) and wide section (B) (by T. Kalicki in Pożaryski, Kalicki 1995, completed Kalicki 2006)

l - marls and chalk, 2 - gravel with sands. 3 - sands, 4 - eolian sands and dunes, 5 - silty sands, 6 - intercalation of sands and silts, 7 - sandy silts, 8 - silts, 9 - organic silts, 10 - peaty silts, 11 - peats, 12 - buried soils, 13 - subfossil trees, 14 - archaeological artefacts; FB - Funnel Beaker Culture, GA - Globular Amphora Culture, T - Trzciniec Culture, L - Lusalian Culture

In the widening of the Chodelka Basin the floodplain structure is analogous with that of the Sandomierz Basin (e.g. Kalicki 1991, 2006). A number of cut-fill inserts of alluvia of various agę, associated with the meandeńng river, occur here one beside the other at the same level. Moreover, the madas show here a facial differentiation related to the floodplain morphology and to the distance from the active channel (Kalicki 2000)(Fig. 2B).

The braided Vistula river formed medium terraces (IIb, a) by the decline of the Pleniglacial, and likely at the beginning of the Latę Glacial. This process was completed before the Alleröd which is evidenced by the dating of the peat bottom in Lucimia on the terrace IIa (Pożaryski, Kalicki 1995).

Probably in the Alleröd, the concentration of the channel took place and resulted in the river incision. Due to the lowering of the groundwater table related to the above incision the development of aeolian processes on the upper sandy terraces was possible on the higher sandy terraces and the dunes might have developed. Dissection in the study section reached down to 3 m below the present-day water level in the Vistula river (Falkowski 1982) or much deeper as suggested Pożaryski and Kalicki (1995). A very deep incision of the river is indirectly confirmed by the lack of the Late Glacial overbank deposits on the terrace IIa.

The deposition of peats in the deflation depression on the upper terraces by the decline of the Alleröd (Lucimia) could have been caused by local factors, such as the damming of the Zwolenka stream outflow by dunes, or can be related to a general development - the beginning of the Young Dryas accumulation and rise in the ground-water level. Due to slow, although permanent, tendency to the rise of the channel level and of the floodplain the peatbogs or swamps could survive during the whole Holocene.

In the Atlantic the clayey madas *(Mz*=7.0-7.5 phi) were deposited on the Vistula flood-plain. The soils were developing as well which provides evidence of a small intensity of the flood accumulation. At the turn of the Atlantic and the Subboreal, the channel was ca. 5 m below (Szczekarków A) and the floodplain ca. 2 m above the present-day water level (Ciszyca Przewozowa). Moreover, in these periods, during the intensified activity of the Vistula river the faster sedimentation of silty overbank deposits *(Mz*=6.1-6.7 phi) resulted in the fossilization of the soils on the older fragments of the floodplain (Ciszyca Przewozowa - 5170 BP). The changes in the channel pattern took place in wider fragments, which is evidenced by the cutting off of the paleomeanders in Szczekarków before 4500 BP and 4010 BP.

In the Subboreal, the Lusatian culture sites were located in the valley bottom, though on the higher and older parts of the flood plain, accreted by the Atlantic and the Subboreal overbank deposits (Ciszyca Przewozowa), or on the parts adjacent to the slope of the valley (Basonia). The layer of the clastic deposits, found in the organic fill of the paleomeander at Szczekarków B (ca 3240 BP) correlate very well with the flood phase reported from the region near Cracow (Kalicki 1991, 2006). The increase of human activity on the loess areas (Kruk et al. 1995) caused formation of the alluvial fans at the outlets of erosion valleys and of the upland tributaries, which changed the type of sedimentation in the back-swamps near the valley scarps (Ciszyca Górna)(Pożaryski, Kalicki 1995).

At the beginning of the Subatlantic (2550 BP), some changes of the Vistula channel in the Chodelka Basin took place and the meander at Niedźwiada was cut off. Sandy intercalations, sometimes with gravels, in the fill of this palaeomeander, were accumulated in the Roman time (between 2090 and 1670 BP). The changes of the channel and of the sedimentation pattern are likely the traces of lateral migration and floods, which were very frequent in the upper Vistula drainage basin (Kalicki 2006). However, as we know due to the graves of the Cloche Grave Culture (3rd c. BC), of Early Roman time (lst half of the 1st c. AD) and of the Late Roman Przeworsk culture (2nd/3rd c. AD), found on the valley bottom (Biernacki 1975), people settled the flood plain also during the phase of increase river activity.

The following phase of the intensified accumulation of the overbank deposits was the younger Medieval (700 BP), which resulted in the formation of the subsequent buried soil (Nieszawa, Basonia, Swieciechow), covered with silts (Mz=5.8-6.5 phi)(Pożaryski, Kalicki 1995). Numerous sub-fossil oaks of this period, reported from the alluvia in the Sandomierz Basin (Kalicki, Krąpiec 1996), provide evidence for the increased river activity, not only in the gap section. Development of the age-distinct layers of soil in the overbank deposits of the Vistula flood plain is to the contrary of the Falkowski's (1982) hypothesis that the accumulation rate of overbank deposits increased in a stable and rapid manner since the Atlantic.

A common change in the sedimentation conditions was observed on the whole flood plain exactly in the last centuries (Pożaryski, Kalicki 1995). Sedimentation is limited mainly to the inter-embankment zone and on remaining area of the flood plain occurs only sporadically during catastrophic floods after break of embankmet e.g. in 2010. In the vicinity of the river there is a change in the grain size composition of the overbank deposits, silts being transformed into sandy silts (Mz=2.9-3.8 phi) of levee (e.g. Parchatka)(Pożaryski, Kalicki 1995, Warowna 2003) with artefacts from 17th-20th c. (Basonia)(Falkowski 1982). In the narrower stretches of the valley the youngest overbank deposits covered the whole bottom and overlaid the Medieval silty sediments without any buried soil, which has not developed yet. An increased frequency, and the likely important magnitude of floods resulted in fossilization of the youngest soil having developed on the clayey overbank deposits (Ciszyca Przewozowa) in the uppermost fragments of the flood plain. This soil has been covered with sandy silts (Mz=5.4 phi). In the wider fragments of the valley the youngest overbank deposits of the levee facies were deposited along the Vistula river whereas clayey silts (Mz=7.0 phi), similar to the Atlantic overbank sediments with respect to the grain size, were accumulated on the organic deposits of the peat bogs (Lucimia) and of the paleomeanders (Szczekarkow A), which were situated at a far distance from the channel and in the low-lying areas (to 1.5 m above the river level). All these changes were probably caused by the increasing anthropogenic modification of the Vistula's drainage basin.

At first, the river channel showed a tendency to turn wild (from the 15th c. onwards), and then, from the 19th c., Vistula river changed its pattern to the braided one (Falkowski 1982). The changes of the river channel arc very well documented by the old maps from the last 230 years (Kalicki, Plit 2003). During this period the zone of active alluvial plain of the Vistula river was relatively narrow (2-4 km wide) and in many cases it corresponds well to the youngest part of the flood plain, called by Pożaryski (1955) "silty-sandy terrace". However, according to the cartographic and geological data, older fragments of the flood plain occurred also in this belt. According to the buried soil sequences in the overbank deposits (e.g. Ciszyca Przewozowa), these rests of the older flood plain (in Polish "kępy") persisted in this zone from the Mezoholocene. Since the end of the 18th c. the channel of Vistula has been getting constantly shorter, and the biggest changes occurred in the period between the World Wars. The primary reason of the changes in the Vistula river and its tributaries in the area of Chodelka Basin was the anthropogenic impact, and especially construction of embankments along the channels. These works caused the change in the Vistula river pattern from the multi-channel (until the end of the 19th century) to single-channel. Episodic sand bars occur in the riverbed only during the period with lowest discharges.

REFERENCES

Biernacki Z., 1975, Holocene and late Pleistocene alluvial sediments of the Vistula river near Warsaw, Biuletyn Geologiczny UW 19, 199-219.

Falkowski E., 1982, The pattern of changes in the middle Vistula valley floor [in:] Evolution of the Vistula river valley during the last 15 000 years, part I, (ed. L. Starkel), Geogr. Studies, Spec. Issue 1, 79-92.

Kalicki T., 1991, The evolution of the Vistula river valley between Cracow and Niepołomice in late Vistulian and Holocene times, [in:] Evolution of the Vistula river valley during the last 15 000 years, part IV (ed. L. Starkel), Geographical Studies, Special Issue 6, 11-37.

Kalicki T., 2000, Grain size of the overbank deposits as carriers of paleogeographical information, Quaternary International 72, 107-114.

Kalicki T., 2006, Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich, Prace Geograficzne IGiPZ PAN 204, pp. 348.

Kalicki T., Krąpiec M., 1996, Reconstruction of phases of the "black oaks" accumulation and of flood phases, [in:] Evolution of the Vistula river valley during the last 15 000 years, part VI (eds. L. Starkel, T. Kalicki) Geographical Studies, Special Issue 9, 78-85.

Kalicki T., Plit. J., 2003, Historical changes of the Vistula channel and its reflection in the flood plain between Józefów and Kazimierz Dolny [in:] Holocene and Late Vistulian paleogeography and paleohydrology (ed. A. Kotarba), Prace Geogr. IGiPZ PAN 189, 179-207.

Kruk J., Milisauskas S., Alexandrowicz S. W., Śnieszko Z., 1996, Osadnictwo i zmiany środowiska naturalnego wyżyn lessowych. Studium archeologiczne i paleogeograficzne nad neolitem w dorzeczu Nidzicy, Instytut Archeologii i Etnologii PAN.

Pożaryski W., 1953, Plejstocen w przełomie Wisły przez Wyżyny Południowe, Prace Inst. Geol. 9.

Pożaryski W., 1955, Osady rzeczne w przełomie Wisły przez Wyżyny Południowe, Prace Inst. Geol.

Pożaryski W., Kalicki T., 1995, Evolution of the gap section of the Vistula valley in the Late Glacial and Holocene [in:] Evolution of the Vistula river valley during the last 15 000 years, part V (ed. L. Starkel), Geographical Studies, Special Issue 8, 111-137.

Pożaryski W., Maruszczak H., Lindner L., 1993, Stratygrafia osadów środkowoplejstoceńskich w przełomie Wisły przez wyżyny południowopolskie w świetle analiz TL, Przegl. Geol. 41, 2, 103-106.

Pożaryski W., Maruszczak H., Lindner L., 1994a, Chronostratygrafia osadów plejstoceńskich i rozwój doliny Wisły środkowej ze szczególnym uwzględnieniem przełomu przez wyżyny południowopolskie, Prace PIG 147, 1-58.

Pożaryski W., Maruszczak H., Lindner L., 1994b, Rozwój plejstoceńskiej doliny Wisły środkowej ze szczególnym uwzględnieniem przełomu przez wyżyny południowopolskie, Przegl. Geol. 42, 7, 523-531.

Pożaryski W., Maruszczak H., Lindner L., 1999, Młodoczwartorzędowe tarasy akumulacyjne i osady deluwialne w dolinie środkowej Wisły, Przegl. Geol. 47, 9, 808-812.

Warowna J., 2003, Wpływ zabudowy hydrotechnicznej na warunki sedymentacji w korycie powodziowym Wisły na odcinku Zawichost-Puławy, Wyd. UMCS, Lublin.

MEDIEVAL OLD CITY KAZIMIERZ DOLNY
comp. Marcin Frączek

Although Kazimierz is referred to in historical records as early as 1249, in the 11th century there was a settlement here called Wietrzna Góra. In the 13th century, in the reign of Władysław Łokietek, a stone tower (now called "the Tower") which served as a watchtower for defence purposes was built. It has survived to the present day, and in the past was a sentry box, used as a watchtower to protect the trade route. The town grew and spread towards the *banks of the Vistula and to the north, where the first fort was situated. Around the middle of the 14th century the Firlejs formed a second fort through the Vistula River, on the south side, at the level of Janowiec. „Kazimierz" was probably named after King Kazimierz the Just, and not as is commonly assumed, from King Casimir the Great. It is true that it was King Casimir the Great who made the greatest contribution to the settlement, transforming a medieval settlement into a royal town in accordance with Polish law, by building a harbor on the river, a castle, providing funds for a parish church and giving it a coat of arms - the letter „K" underneath the royal crown. Also during the reign of Casimir the Great (Kazimierz Wielki), at the foothill where the castle and parish church were built, a tiny market square market was created, with wooden houses lining each side.*

In 1406 when the town was granted foundation rights and privileges according to Magdeburg law by Władysław Jagiełło and when officially an independent kehilla was created here, a new larger square market was marked out, surrounded with three wooden-brick frontages of single-storied houses. After the fires in the years 1561and 1585 they were replaced by one-storied brick tenement houses.

The town, which was royal property, developed because of its location on the Vistula River, which at that time was the most important major transport route in the country, along which grain was transported from Małopolska to Gdańsk. Of significance also was its location at the crossroads of the Vistula river with the trade route as it was used by merchants traveling from the eastern boundary of the Republic of Poland, and Lithuania and Ukraine in the direction of Śląsk and Wielkopolska, and further – to Saxony and Brandenburg[1.5]. Favorable legal circumstances, and also a huge demand for grain in Western Europe, meant that the town developed in the mid-16th century. The inhabitants specialized in transportation of goods down-river, building boats[1.6], the timber, grain, wine and cattle trade also expanded, and there was a salt warehouse also. With the expansion of trade the craft industry also flourished. The town, was at the height of its prosperity, had a bath house, hospital, numerous breweries and cooper's workshops. From the 40 to 60 vast granaries, decorated in the northern style were built on the bank of the Vistula but only a few have survived today. In the second half of the 16th century and the first of the 17th century, many merchant families grew rich as brokers in the grain trade, the most noteworthy of which were the Przybyła, Górski, Sawer, Czarnota, Celej, Woja and Wosiński families. Jewish merchant families also prospered, despite attempts by the inhabitants of the town to exclude the Jewish merchants from the grain trade.

In 1561 a fire destroyed almost the whole town including numerous much of the Gothic architecture, which was soon rebuilt in the Lublin renaissance style. At that time a new building was constructed combining the late Gothic with Renaissance style of architecture and which was reminiscent of the traditional folklore icons with typical provincial work.

The Swedish wars and invasions by Rakoczy weakened the navigation system on the Vistula and thereby saw the decline of Kazimierz as a merchant town. In 1655 the Swedish army destroyed the town, and in 1656 the commander-in-chief, hetman Czarniecki's army murdered almost all members of the local kehilla. Kazimierz, was plundered and set on fire again and again, in the following years was unable to regain its former splendor. In his efforts to rebuild Kazimierz Dolny from its ruins, in 1676 king Jan III Sobieski granted the local Jews privileges and exemptions to enable them to conduct their businesses and so the Jewish merchants gained a stronghold in the grain trade.

At the beginning of the 18th century the town was hit by a plague, and when it receded the surviving residents erected three wooden crosses on the hill, next to the one on which the castle stands. Known as the Three Crosses Mountain, nowadays it is one of the main tourist attractions in Kazimierz.

In 1771, whilst attempting to save the town, destroyed by the ravages of war and due to foul air, King Stanisław August gave the local Jews equal rights with other citizens. He allowed them to purchase land and build houses within the e town and removed all trade restrictions. Thus the town's economy saw a revival in the second half of the 18th century and a rapid rise in the economic situation and population of the municipality as regards economy and population. A Jewish banker, Szmul Jakubowicz, known as Zbytkower owned several granaries, would lend the money to King Stanisław August Poniatowski himself.

Following the first partition (i.e. in 1795) Kazimierz Dolny was annexed by Austria, and from 1809 it became part of the Duchy of Warsaw, and from 1815 – the Kingdom of Poland.

Around 1827 a tzadik Ezechiel ben Cwi-Hirsz Taub (who died in 1857) settled in Kazimierz Dolny. His manor house became the hub of Hassidic life, famous for lively songs and spirit of life.

In 1866 a great fire destroyed the town, an economic decline followed and the town lost its municipal rights (which were reinstated in 1927). However, in this period of time, Kazimierz became a subject of interest for history lovers researching the old history of Poland, making inventories and recording images of existing architecture and objects of art, and so at the end of the 18th century Kazimierz was „rediscovered" as a place of special interest to artists. Somewhat later – at the turn of the 19th and 20th century – the town became a popular holiday resort.

The outbreak of World War I brought the town's years of prosperity to an end, and resulted in widespread destruction in Kazimierz. Immediately after the war work to rebuild the town began. Many inventories were made and existing objects and buildings were photographed and documented. In the summer of 1923 open-air workshops for the Warsaw School of Fine Arts were held for the first time, organized by Tadeusz Pruszkowski. The town's architecture and its Polish and Jewish residents appeared in many paintings here at that time. The inter-war period saw a rapid development of the tourist industry – numerous villas, guest houses and a hotel were built. The population of the town was mainly Jewish and in 1921 made up 41% of the total inhabitants.

During World War II the Germans created a ghetto and forced labor camp in Kazimierz Dolny. In March 1942 when the ghetto was closed down about 3000 Jews were deported to the transit camp in Opole Lubelskie, and later to Bełżec death camp. During the German occupation the Polish partisans were extremely active in the area surrounding Kazimierz Dolny. From here, in 1942, during the repressions, the Nazis carried out the bloody pacification of the town and nearby villages, murdering about 300 people. In 1944 in battles with the Soviet army, the town was devastated. Then in January of 1945 the Soviet army moved on the offensive, liberating central parts of Poland. After the war, thanks to the efforts of people like Karol Siciński, re-building work and reconstruction of certain buildings soon commenced. Today, Kazimierz is one of the most popular tourist attractions of Lublin region, – as one of its kind – both a rural and urban landscape, combining architecture with a picturesque location.

Historical article excerpted from www.sztetl.org.pl

REFERENCES

Faryna-Paszkiewicz H., 1996, Kazimierz nad Wisłą, [in:] Miasto tyłem do rzeki. Materiały z sesji naukowej, Warszawa 22-23 czerwca 1995 roku, red. B. Wierzbicka, Warszawa.

Husarski W., 1957, Kazimierz Dolny, Warszawa.

Adamczyk-Garbowska M., ed., 2006, Kazimierz vel Kuzmir. Miasteczko różnych snów, Lublin

Kołodziejczyk I., 1933, Kazimierz Dolny. Jego zabytki i okolice. Przewodnik, Kazimierz Dolny.

Kubicki R., Wijaczka J., 2003, Żydzi w Janowcu i Kazimierzu Dolnym w XVI–XIII wieku, [in:] Historia i kultura Żydów Janowca nad Wisłą, Kazimierza Dolnego i Puław. Fenomen kulturowy miasteczka – sztetl. (ed. F. Jaroszyński,) Materiały z sesji naukowej „V Janowieckie Spotkania Historyczne" 28.06.2003, Janowiec nad Wisłą.

Kazimierz Dolny – view on Old Town and Vistula river gap section

Kazimierz Dolny – erosional valley (holweg) on loess plateau

16.09.2016 Friday - Third day of excursion

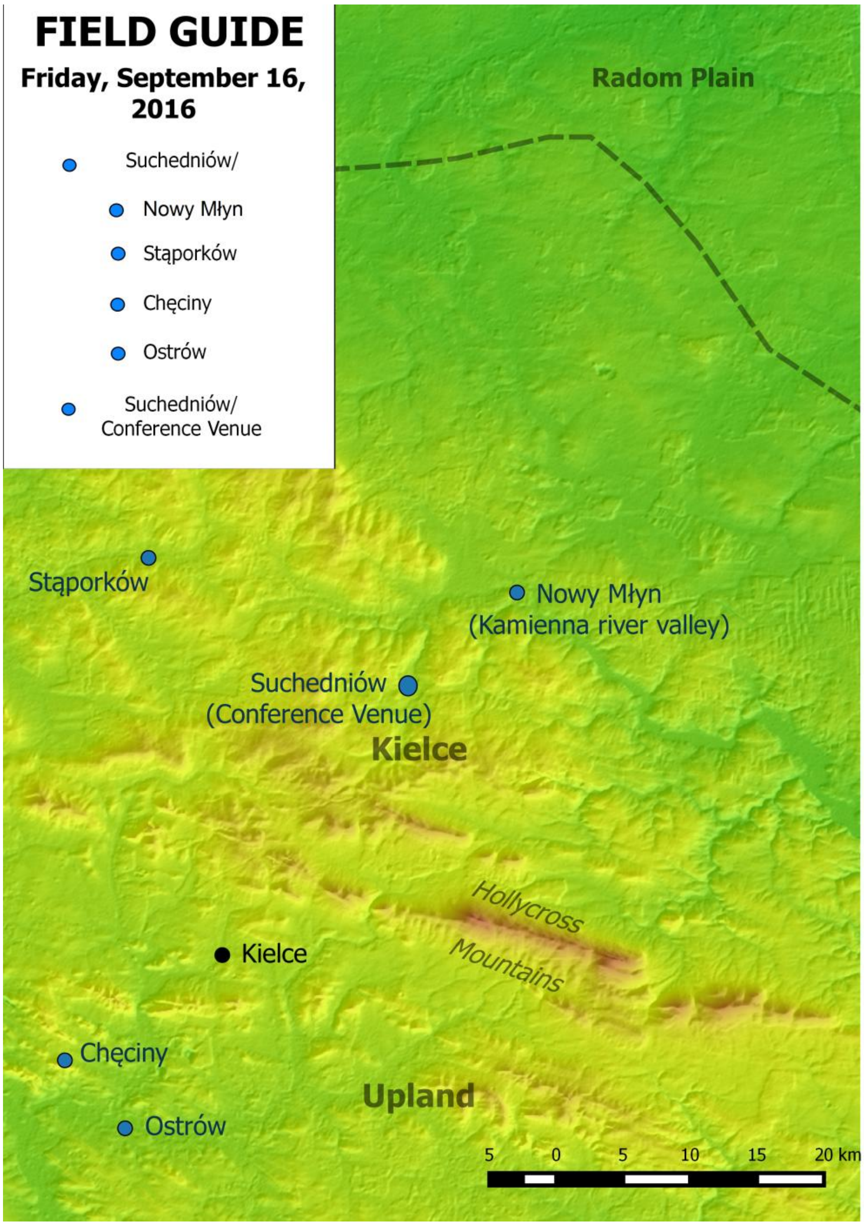
River valley evolution of Holy Cross Mountains region

7:00 Suchedniów (breakfast)

08:00 FIELD EXCURSION (pocket lunch)

- **Suchedniów** (Subatlantic changes of Kamionka river basin – anthropogenic and natural factors
- **Skarżysko Kamienna-Nowy Młyn** (Lateglacial and Holocene evolution of Kamienna river valley, Rydno – prehistoric red ochre quarry and settlement complex)
- **Stąporków** (Late Quaternary evolution of Czarna Konecka valley)
- **Chęciny** (Medieval castle, geological and geomorphological regional overview)
- **Ostrów-Łaziska** (Late Glacial and Holocene evolution of Czarna Nida valley)

Suchedniów (dinner)



RIVER VALLEY EVOLUTION OF HOLY CROSS MOUNTAINS REGION

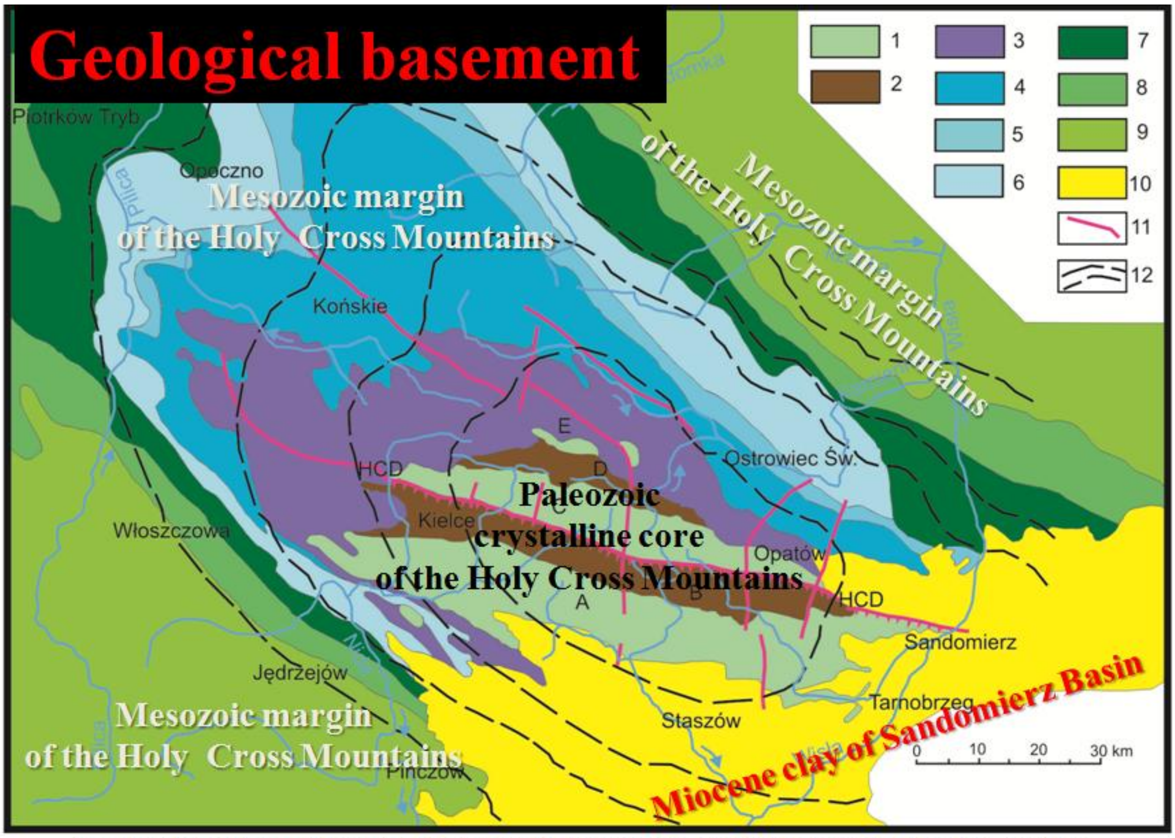
Tomasz Kalicki, Joanna Krupa, Paweł Przepióra, Edyta Kłusakiewicz, Piotr Kusztal, Marcin Frączek, Maria Górska-Zabielska, Mariusz Nowak, Dominik Pawłowski, Libor Petr, Michał Przeździecki, Andrzej Przychodni

INTRODUCTION

comp. Tomasz Kalicki, Paweł Przepióra

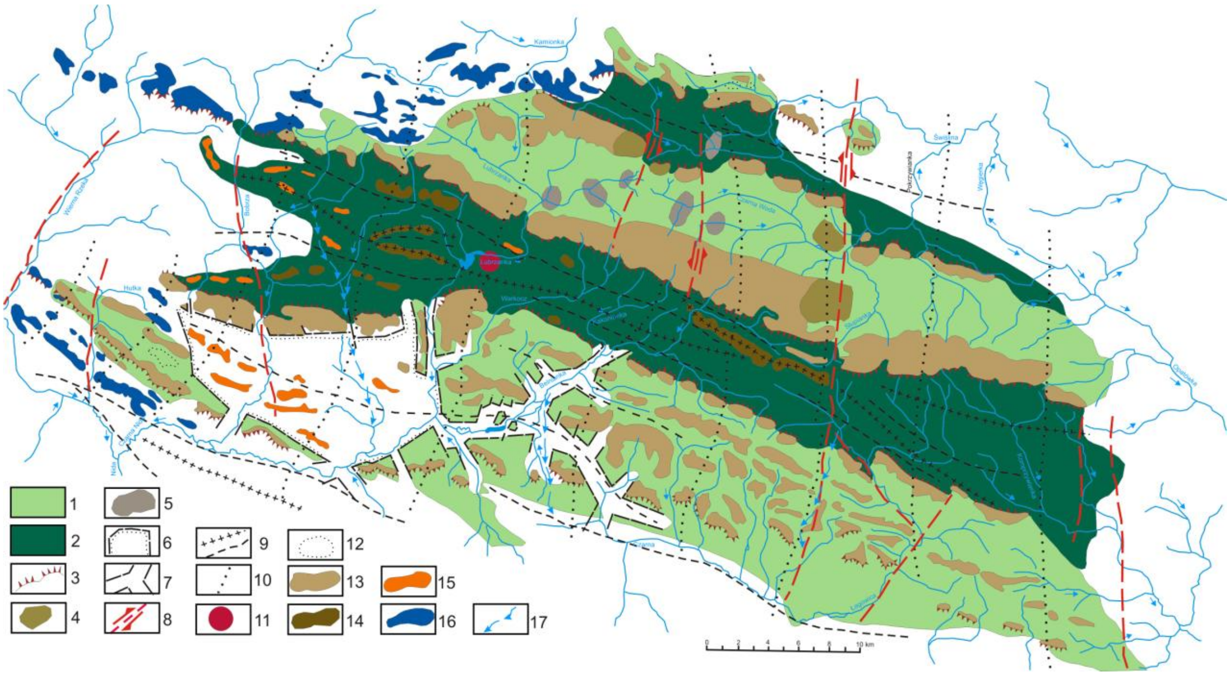
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland

tomaszkalicki@ymail.com; pawelprzepiora1988@gmail.com



Reconstruction of Laramide morphostructure on the Holy Cross Mts. section of the Middle Polish Elevation on the sub-Quaternary basement (Kowalski 2002, completed)

1 - Paleozoic structural units neotectonic uplifted (A, C, E): A - Chęciny-Klimontów Anticlinorium, C – Łysogóry Anticline (unit), E – Bronkowice-Wydryszów Anticline, 2 - Paleozoic structural units neotectonic thrown down (B, D): B – Kielce-Łagów Synclinorium, D – Bodzentyn Syncline
3 – Triassic, 4 – Lower Jurassic, 5 – Middle Jurassic, 6 – Upper Jurassic, 7 – Lower Cretaceous, 8 – Middle Cretaceous, 9 – Upper Cretaceous, 10 – Miocene (Carpathian Foredeep sea sediments), 11 – faults, 12 – isobases of reconstructed Laramide tectonic structure; HCD – Holy Cross (Świętokrzyska) Dislocation



River network against the background of the Paleozoic core of the Holy Cross Mts. neotectonic active basement (Kowalski 2002, completed)

1 – Paleozoic block-folded units, neotectonic uplifted, 2 - Paleozoic block-folded units, neotectonic thrown down, 3 – escarpments of uplifted units changed by denudation, 4 – areas neotectonic uplifted in transpression conditions, 5 – areas neotectonic thrown down in transpression conditions, 6 – neotectonic basins in the frame of elevated structures, 7 - neotectonic grabens in the frame of elevated structures, 8 – Paleozoic faulta neotectonic renewed; 9 – Paleozoic anticlines (a) and synclines (b) neotectonic activated, 10 – neotectonic active transversal elevations, 11 – present-day earthquake epicenter, 12 – sites of present-day reological activity, 13 – erosion-denudation ridges and hills among elevated units, 14 – horsts and hills neotectonic rejuvenated in the frame of thrown down units, 15 – monadnock ridges and hills from the Paleogene denudation period in the frame of thrown down units and tectonic basins, 16 – denudation ridges and hills in the Mesozoic margin rocks, 17 – Paleogene course of rivers

REFERENCES

Kowalski B., 2002, Geneza układu sieci rzecznej w Górach Świętokrzyskich, Prace Instytutu Geografii AŚ Kielce 7, 315-351.

NATURAL AND ATHROPOGENIC FACTOR IN THE SUBATLANTIC EVOLUTION OF KAMIONKA RIVER VALLEY

Paweł Przepióra
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland
pawelprzepiora1988@gmail.com

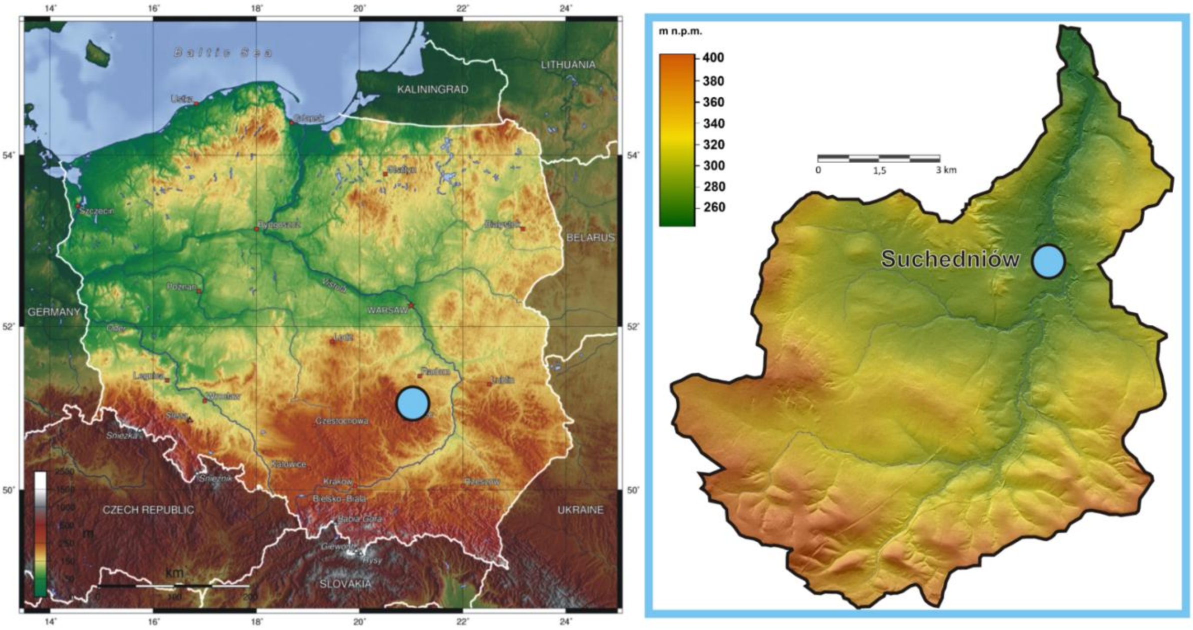


Fig. 1: Location of the Kamionka catchment area and Suchedniów (www.mapywig.org, by M. Frączek)

Kamionka catchment (Fig. 1) is located in the northern part of the Świętokrzyskie province in central Poland (Polish Uplands and Old Mountains zone). Kamionka (17 km long) is a mountain river. Its slope is about $5^{o}/_{oo}$. The basin (about 107 km^2) is located on the Suchedniów Plateau, built from the Lower Triassic sandstone. Valleys are filled with the Pleistocene fluvioglacial sediments, which cut by Kamionka river. Depressions are filled with layers of sand and gravel with many boulders applied during the Oder (Saalian) glaciation. These type of deposits cover almost half of the whole catchment area and it is concentrated in the middle section of the valley (Fig. 2). These sands are building mostly higher terraces, sand and gravel hills, which are remodeled as a result of increased human activity. Its very well visible in sandpit near of the S7 expressway.

According to TL datings (120-90 ka), texture and structure of alluvia high terrace was formed by braided river during the Young Plenniglacial. In gap section periglacial processes on the slope formed lenses of colluvia in the alluvia series (interfinger of colluvia and alluvia – profile PK 1 downstream of Suchedniów). Vistulian terrace was dissected by the river with macromeanders during the Late Glacial (Przepióra et al. 2014).

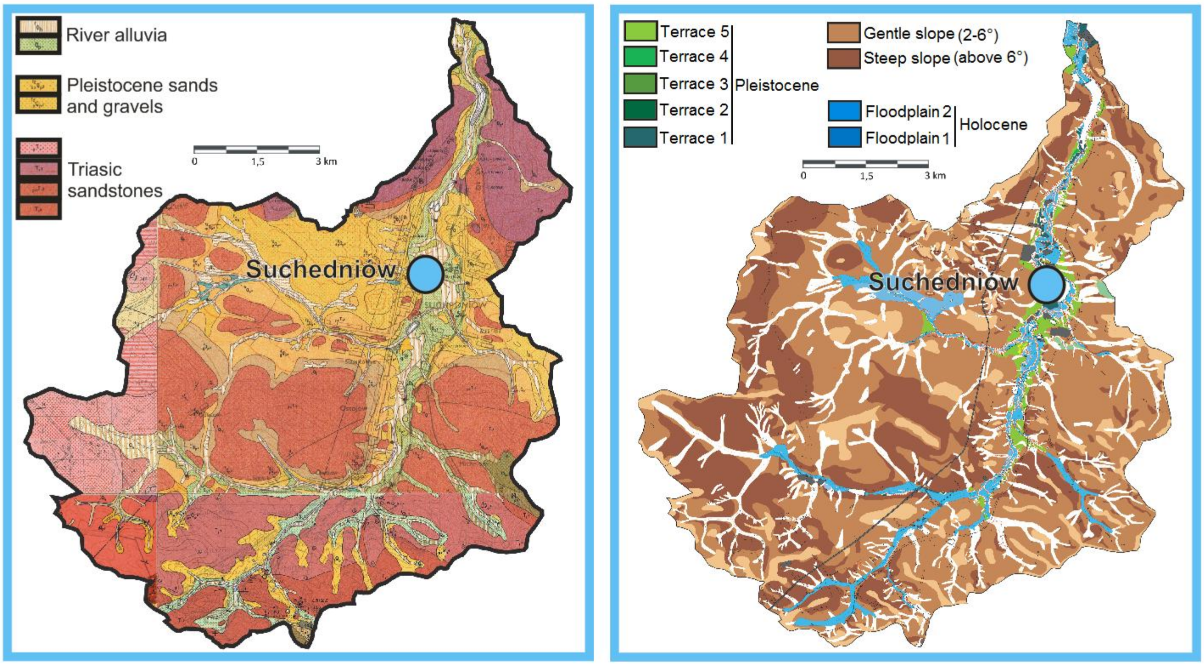


Fig. 2: Geological (Krajewski 1955, Filonowicz 1979) and geomorfological map (by P. Przepióra) of Kamionka river drainage basin

SUCHEDNIÓW SITE: ANTHROPOGENIC CHANGES OF RIVER COURSE AND CATASTROPHIC EVENTS

Paweł Przepióra
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland
pawelprzepiora1988@gmail.com

In central part of the Kamionka river catchment is located Suchedniów, small town where from the Middle Ages was developed iron industry. Rich deposits of iron ore contributed to the development of mining and following the iron industry in the whole Suchedniów area. Those actions starts changes in water circulation in Kamionka drainage basin. Changes in this area have become better recognized through historical materials from the period of the 19th century by the old maps, documents and photographs (Piasta 2012). Kamionka river was used as a source of energy for many blacksmith shop and forges. This is evidenced by the many traces left by establishments operating on the river bank (water reservoirs, raceway shafts etc.).

In the Suchedniów area are very well preserved numerous anthropogenic changes within the river bed. For hundreds of years the city was made numerous river regulation to the needs of industrial activity. They work at least three modern forges in Suchedniów, which still existed at the turn of the 19-20th century (Piasta 2012). The work of these forges led to changes in the riverbed by embankments and artificial channels. Also they were built numerous water reservoirs, which were part of the hydro infrastructure driving nearby forges. In the center of Suchedniów preserved numerous traces of the forges infrastructure, reflected among other things in the park area of the city (canals, shafts). They also point to this archival material and maps.

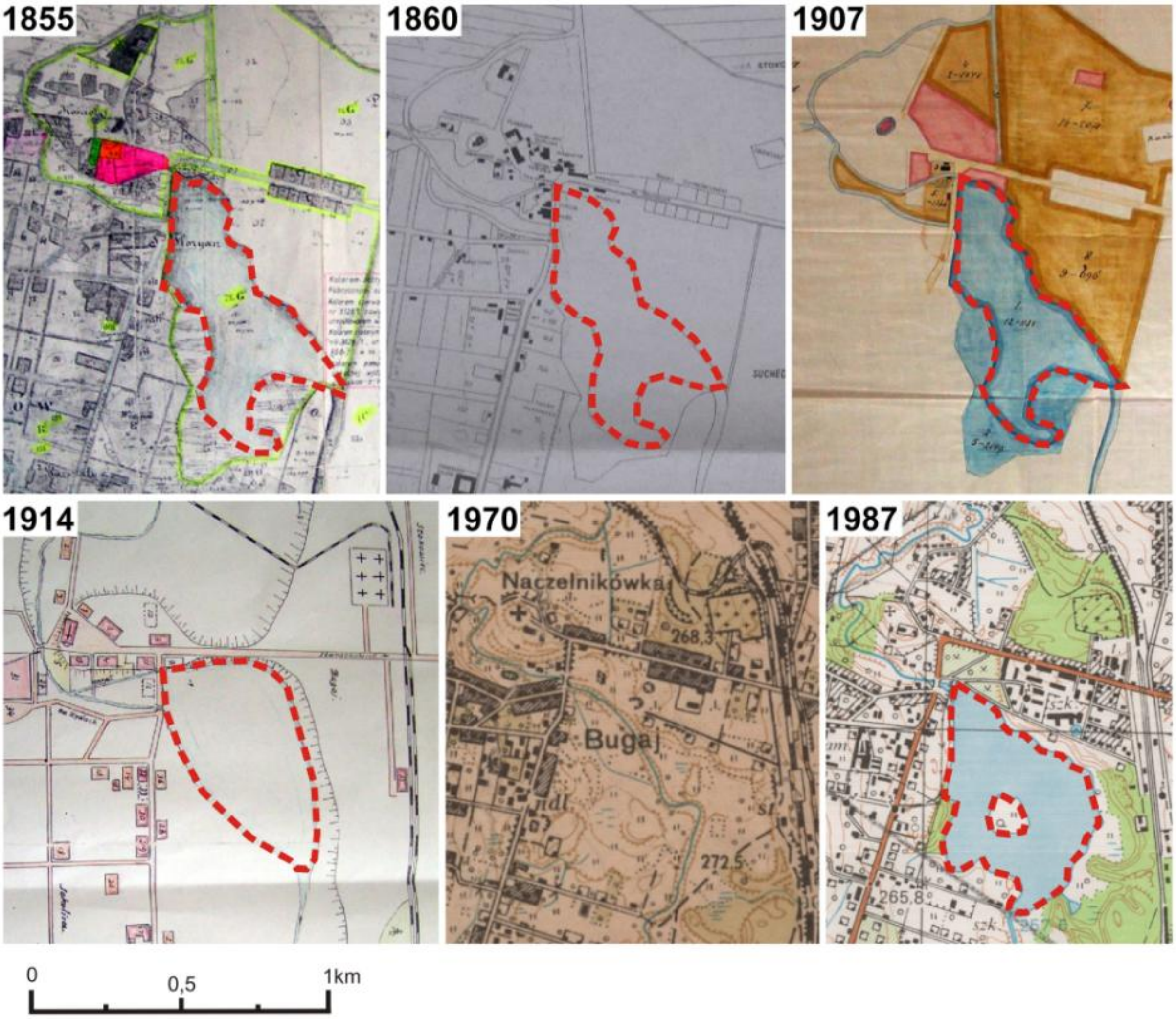


Fig. 1: Phases of different lakes in Suchedniów city based on archival maps (Piasta 2012, comp. by P. Przepióra)

Some of the biggest and modern forges was working in the Suchedniów. Nearby the city park was located one of them. It was working to the end of 19th century. It left many traces in relief just like 200 m lenght shaft and dry channel. Many historical materials show how many changes of this area was become after the iron industry was slowly disappear. In maps from 1855 we can see, that in city park area was functioning a lake that was a part of infrastructure of nearby forge. The forge was located in west to the reservoir. When the forge was out of service, the reservoir also was changing and at the beginning of the 20th century, this area become dry and no longer use. From 1974 we got here new Suchedniów Lake used as small retention reservoir (Fig. 1).

Large anthropogenic changes also occurred in the 20th century. On this section the Kamionka river were significantly narrowed by high embankments. Construction of a new water reservoir has led to create new ground shafts. The site of the former pond was which has been raised by embankments and was built there a city park (Przepióra et al. 2013). In 1974, was completed construction work of a new reservoir. The photos from 1974 show us a high level of transformation of this part of river made by social act (Fig. 2).

Fig. 2: Anthropogenic changes of Kamionka riverbed in 1974 under costruction of Suchedniów Lake (Piasta 2012)

In the same year there was a heavy rainfall which overflowed the reservoir. This led to the brake of the shaft and the emergence of high wave flood downstream of the dam. The water level rose by more than two meters and flood nearby Powstańców st. and some buildings. We know from local people who remember that event that flood wave was so high, that accumulate fish on the road. The wave flooded nearby streets and buildings located at 4-5 meter embankments (Piasta 2012). Narrowed riverbed has contributed to an increase in strength of the wave during the transport of anthropogenic catastrophic flash flood. There preserved traces of this event, just like 1 meter sandstone boulder deposited in the river bed as well as many fragments of concrete from destroyed dam and river strengthening (Przepiora et al. 2015). The place where dam become destroyed now is located a transfer relief. This shows the scale of the event. For good example, in 2010 become another catastrophic anthropogenic spate downstream of the dam. It was also made by heavy rain and the Suchedniów Lake can't take any more water. The water level was more than 2 m higher (Fig. 3).

This type of catastrophic floods in the Holocene on the river did not take place until the regulation of the river. Riverbed has been narrowed and banks of channel raised by the construction of embankments. Bad management of water reservoir in Suchedniów significantly reduced its retention capabilities. These factors have led to a significant pile up water below the water reservoir after heavy rains (Przepióra 2013, Przepióra et al. 2013, 2015, 2016).

The level of anthropogenic transformation of this part of the river shows old photographs and maps. Kamionka river in the middle of the 20th century got a braided pattern. Due to a subsequent adjustment of the riverbed leading to straighten the river at over 300 meters. Anthropogenic changes in this section of the river led to the change in strength of the material transport. Below the dam narrowed riverbed has greater transport strength. At the nearby bend river is losing energy and deposits thicker material forming coarse grain bars. The edges of the trough are strengthened by debris. This material is included in the transportation by Kamionka river (Przepiora et al. 2015).

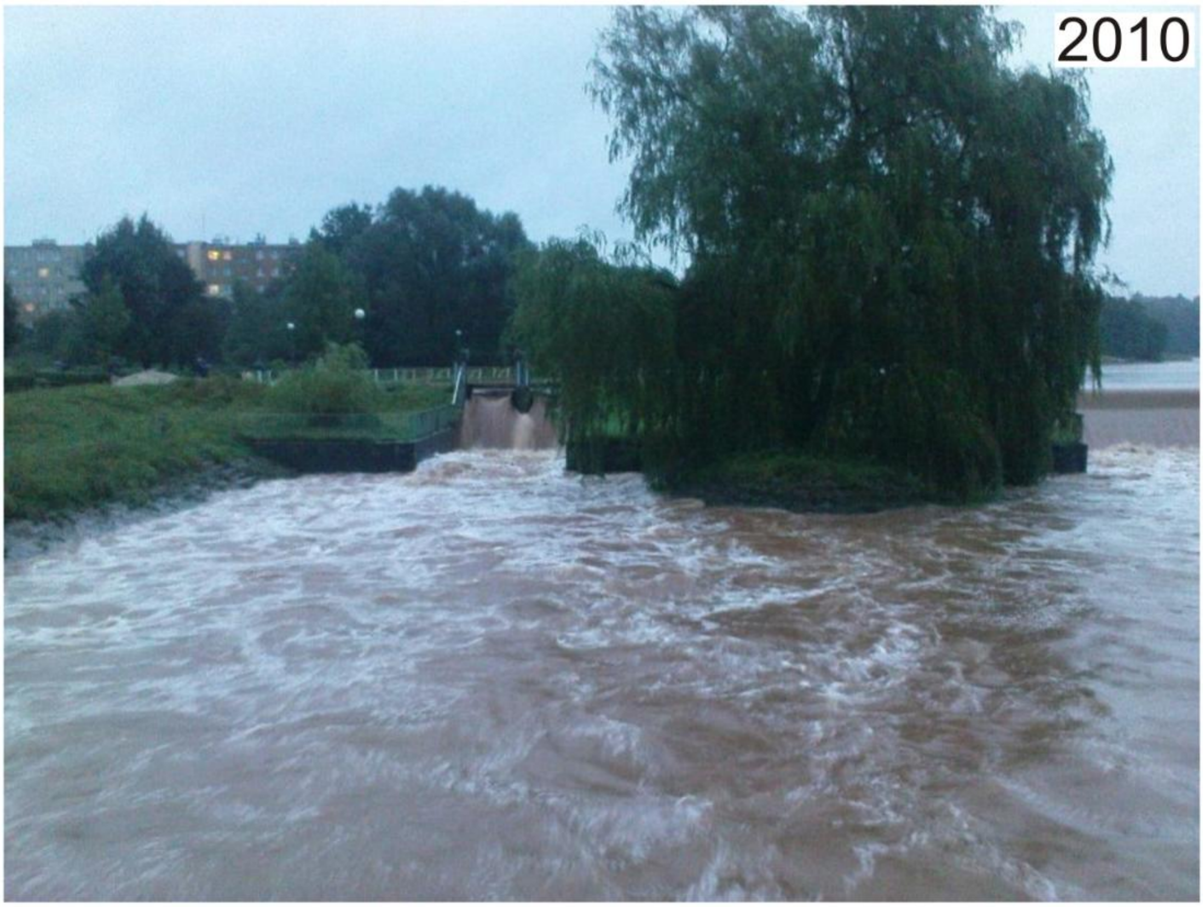


Fig. 3. Anthropogenic spate below the dam in 2010 (www.naszsuchedniow.blog.onet.pl)

REFERENCES

Piasta S., 2012, Leksykon Suchedniowa, Towarzystwo Przyjaciół Suchedniowa, Kielce.

Przepióra P., 2013, Anhtropogenic changes of Kamionka Valley based on carthopgraphic and historical sources. Sbornik abstrakt 19. Kvarter, ÚGV PřF MU, Brno, 53.

Przepióra P. Frączek. M., Król G., 2016, Wpływ działalności przemysłowej na wybrane komponenty środowiska przyrodniczego w okolicach Suchedniowa, Streszczenia abstraktów, Ogólnopolska Konferencja Naukowa „Edukacja–Zdrowie–Środowisko", Uniwersytet Jana Kochanowskiego w Kielcach, 38.

Przepióra P., Kalicki T., Podrzycki Ł., 2014, Structure and origin of Kamionka river terrace in Suchedniów – first results, Sbornik abstrakt 20. Kvarter (eds. H. Uhlířová, J. Březina, V. Káňa), 28.11.2014, Brno, 44.

Przepióra P., Kłusakiewicz E., Kalicki T., 2015, Changes in the water cycle in the Kamionka river catchment based on historical maps and materials. Sbornik abstrakt 21. Kvarter, Masarykova univerzita, 41.

Przepióra P., Król G., Kalicki T., 2013, Anhtropogenic changes of Kamionka Valley based on carthopgraphic and historical sources. Abstract book and field guide – Geoarcheology of river valleys, Kielce, 108-109.

DEVELOPMENT OF UPPER KAMIENNA RIVER VALLEY DOWSTREAM OF SKARŻYSKO-KAMIENNA

Edyta Kłusakiewicz, Tomasz Kalicki, Paweł Przepióra, Marcin Frączek
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland
edytakapusta@interia.eu; tomaszkalicki@ymail.com; pawelprzepiora1988@gmail.com; marcinfraczek1987@gmail.com;

The study section, about 7.3 kms long, of Upper Kamienna river is located between Skarżysko-Kamienna and Marcinków, in northeast part of Holy Cross (Świętokrzyskie) Province. Area is located in Mesozoic margin of the Holy Cross Mountains. Geological background of the region represent Triassic and Jurassic sandstones with intercalation of clay, clay stones, mudstones, marls and iron store.

Upper Kamienna river valley is located in subprovince of Little Poland (Małopolska) Upland, macroregion of Kielce Upland and in the border of two mesoregions: Suchedniów Plateau and Iłża Foreland. Suchedniów Plateau is built mainly from massive layers of Lower Triassic sandstone (Bunter Sandstone), and Iłża Foreland is Jurassic monoclinal altitudes with SW–SE direction (Kondracki 2009). The geology of this area is complicated by the system of flexures, synclines and anticlines (Radłowska 1963; Bartosik 1972).

The Quaternary deposits (especially from the Oder glaciations) are the most dominant on this area and they reach about 20-30 m of thickness (Filonowicz 1979). The oldest deposits come from the Oder glaciations and it is a complex of fluvioglacial deposits (sands and gravels). There are two Pleistocene terraces built by sandy-gravel alluvia of braided river. Dunes and windblown sandy cover formed some buried soils on the terrace. An increase of aeolian activity could be connected with climatic (Late Glacial) and anthropogenic (Holocene) factors.

The course of the Kamienna river valley is conditioned tectonically. Its pattern and sinuosity are dependent on the longitudinal faults of Wierzbnica-Chlewiska dislocation that caused the change of river direction on northeast on Grzybowa Góra and Marcinków Górny section. Therefore, whole river catchment (about 2007,9 km^2 of area) has a characteristic longitudinal shape (Karaszewski 1985). Another feature is pronounced dominance of right-side tributaries than left-side ones.

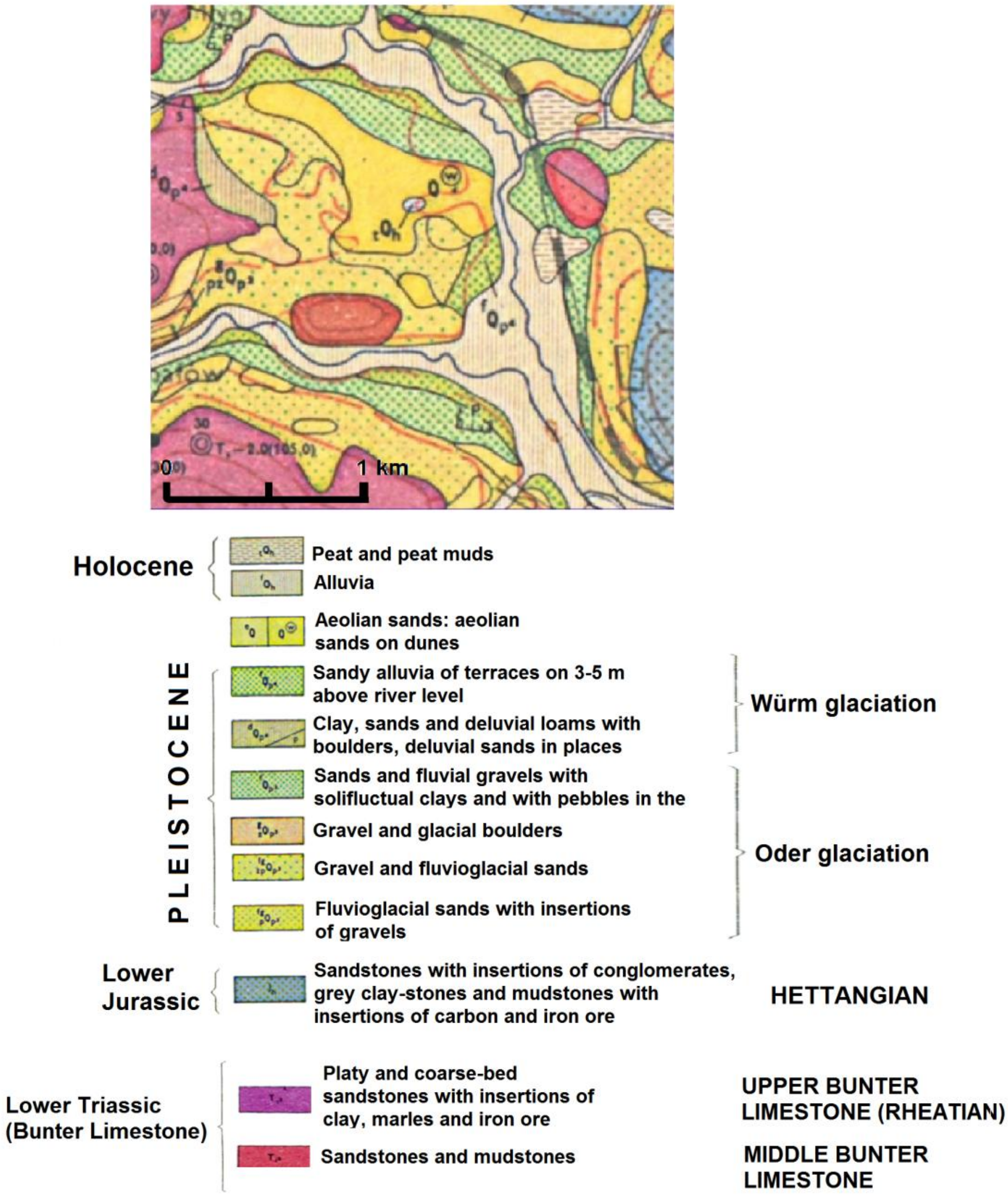


Fig. 1. The geological map of study area in Kamienna river valley (Filonowicz 1979)

According geomorphological map (Barwicka 2011, Barwicka, Kalicki 2012, 2013) the studied area is divided on two levels of the Pleistocene terrace (from Oder glaciation and fragmentarily from Vistulian) and extensive the Holocene flood plain of Kamienna river and its tributaries. The remain from Oder glaciation as a hill of terminal moraine was identified on the right side of Kamienna valley. Dunes and windblown sands occur on limited areas. The anthropogenic forms concern especially near Skarżysko-Kamienna.

The Holocene flood plain creates one morphological level resulted from lateral migration of the river. From Skarżysko-Kamienna it reaches from 150 to 750 m of width, and in gap section it narrows significantly to 10-100 m of width on eastern part and 200-350 m od width on western side. This form is characterized by very complicated architecture, it means within one morphological level it can be identified a several alluvial bodies of the different ages. Alluvia has facial differentiation (overbank and channel deposits) and finning upward sequence both typical for a meandering river (Barwicka, Kalicki 2012, 2013) (Fig. 3, 4).

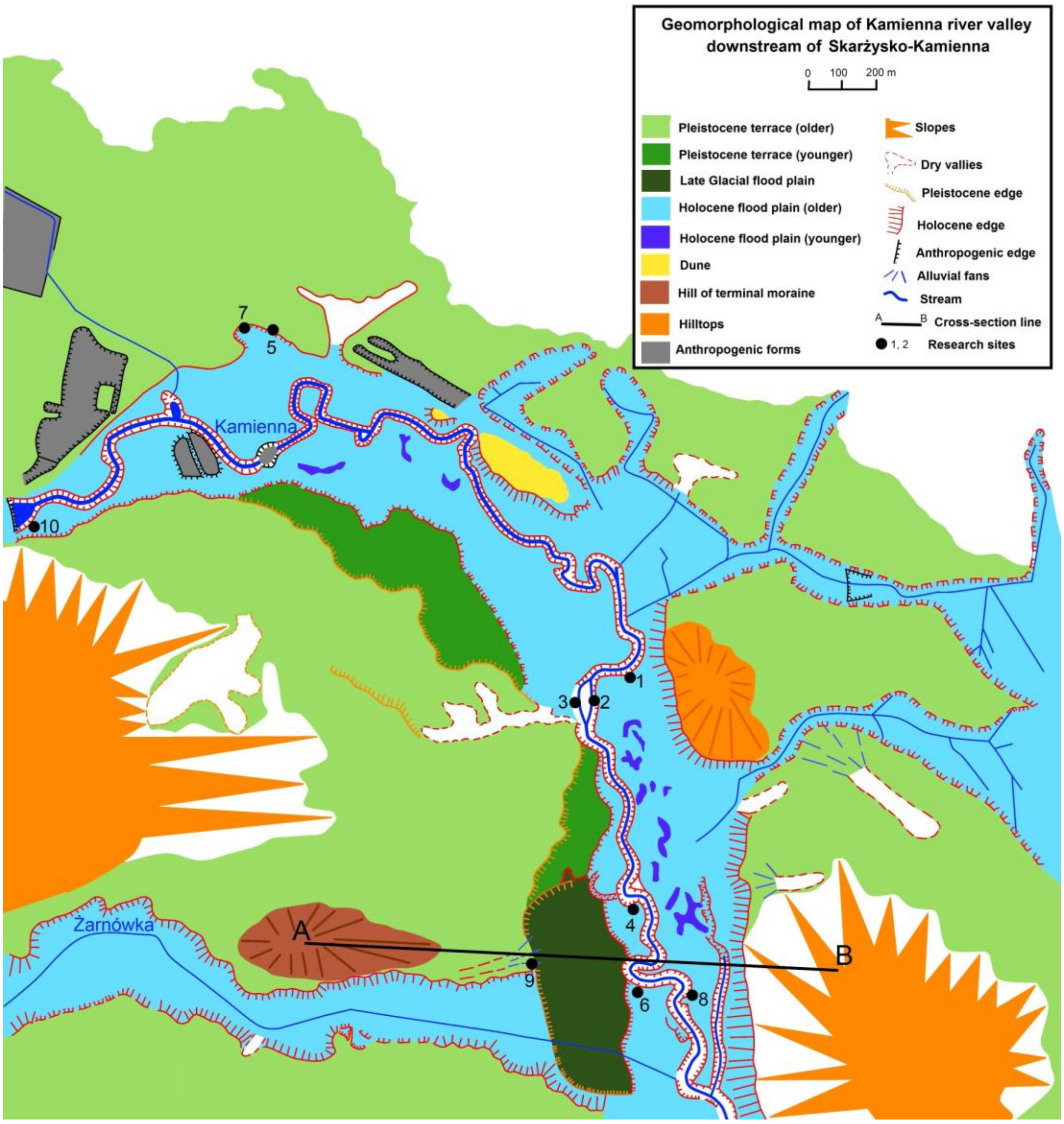


Fig. 2. Geomorphological map of the studied area (Barwicka 2011)

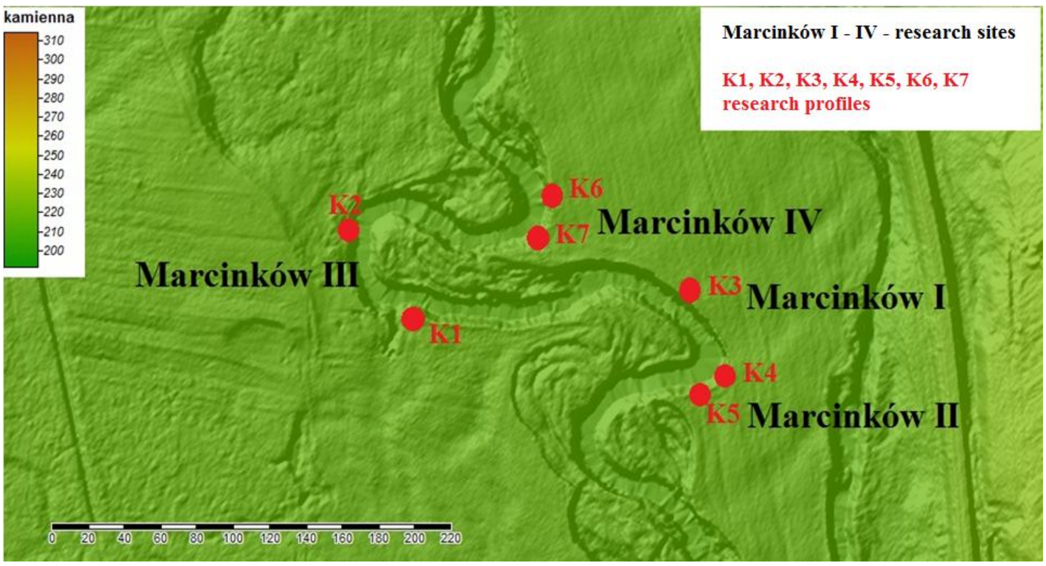


Fig. 3. Location of study sites and profiles

An incision of the Vistulian terrace and development of flood plain had started since the Late Glacial and Holocene transition (Fig. 4).

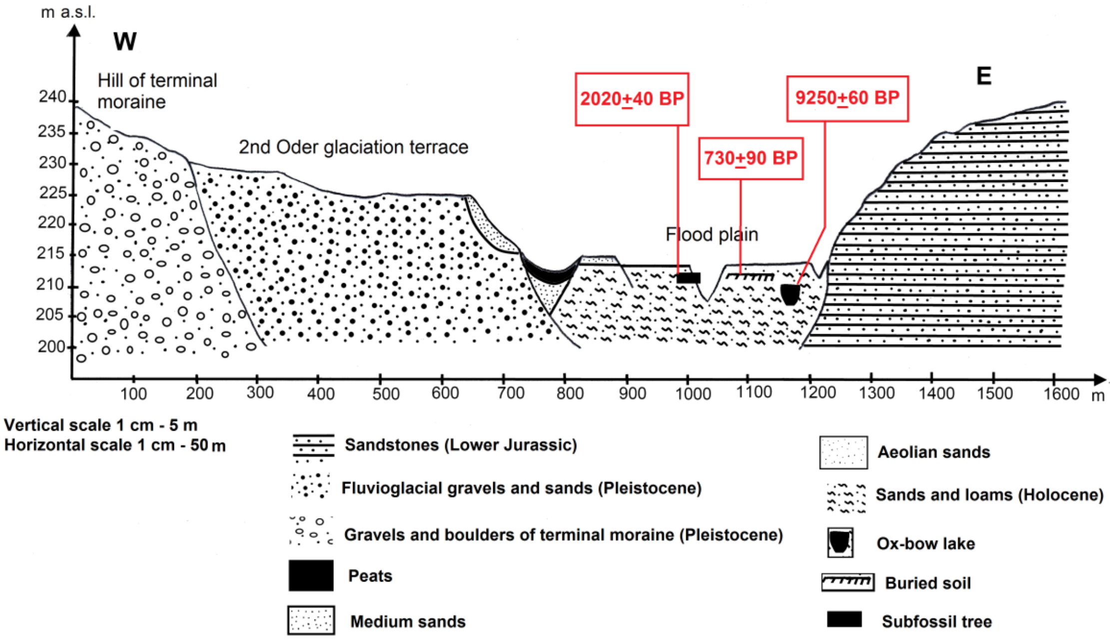


Fig. 4. Schematic section cross the Upper Kamienna River Valley dowstream of Skarżysko-Kamienna (by T. Kalicki)

It is stated by the oldest palaeochannel fill that was dated at 9250±60 BP cal. 8630-8300 BC (Marcinków II site) (Barwicka, Kalicki 2012, 2013) (Fig. 5).

Fig. 5. Profiles with the Early Holocene palaeochannel fill (right) and the Subatlantic buried soil (left) (Barwicka, Kalicki 2013)

Fill of this palaeochannel is recognized as peat deposits covered by clastic material, mainly fine sand and silty sand (Marcinków II/Kamienna 4 and Marcinków II/Kamienna 5 profiles) (Fig. 6). Another kind of organic deposits occurs in a palaeochannel on right side of river (Marcinków III/Kamienna 2 profile), it means a silts mixed with detritus. This layer is covered by the level of overbank deposits with buried soil, built from fine material (sandy loam). In study profiles can be also observed a visible tendency of the finning upward sequence.

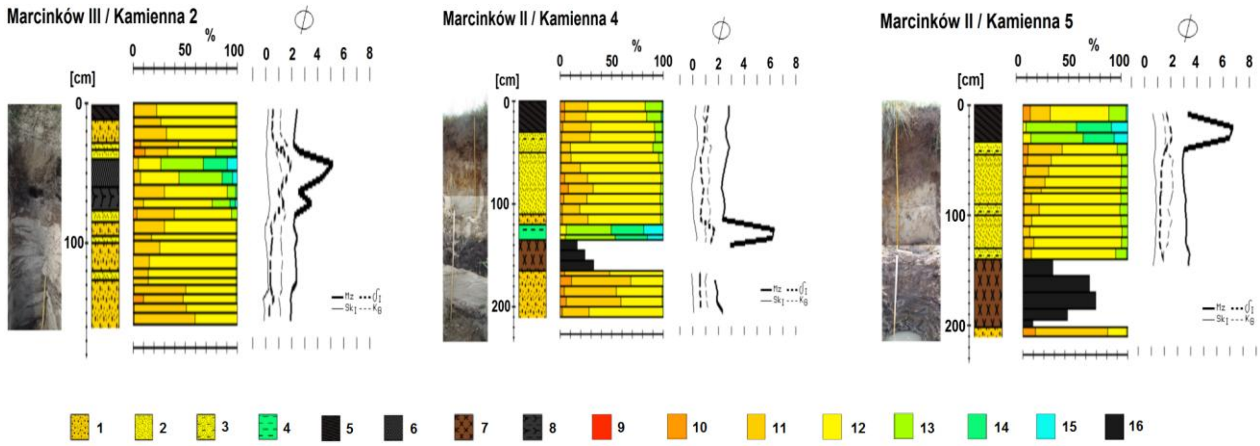


Fig. 6. Lithology, grain size and Falk-Ward distribution parameters of alluvia in palaeochannel fill profiles with the organic layers

Lithology: 1 – medium sand, 2 – fine sand, 3 – silty sand, 4 – loamy silt, 5 – soil, 6 – buried soil, 7 – peat, 8 – silts with the detritus; Fractions: 9 – gravels, 10 – coarse sand, 11 – medium sand, 12 – fine sand, 13 – coarse silt, 14 – fine silt, 15 – clay; 16 – organic content; Falk-Ward parameters: Mz – mean size, δ_I – standard deviation, Sk_I – skewness, K_G – kurtosis

Due to lateral migration of the river numerous subfossil trees (black oaks in Polish language) occur in alluvia on study section. Two of them were radiocarbon and dendrochronological dated at 2020±40 BP cal. 120 BC-70 AD (Marcinków III site; Barwicka, Kalicki 2013) and 186-45 BC (Marcinków IV/Kamienna 7 profile) respectively (Fig. 7). Fallen of trees took place in a phase of an increase of river activity in the Roman time. This phase (2,2-1,7 ka BP) is very well reflected in the whole Upper Vistula river basin (Kalicki 1991, 2006, Kalicki, Krąpiec 1996).

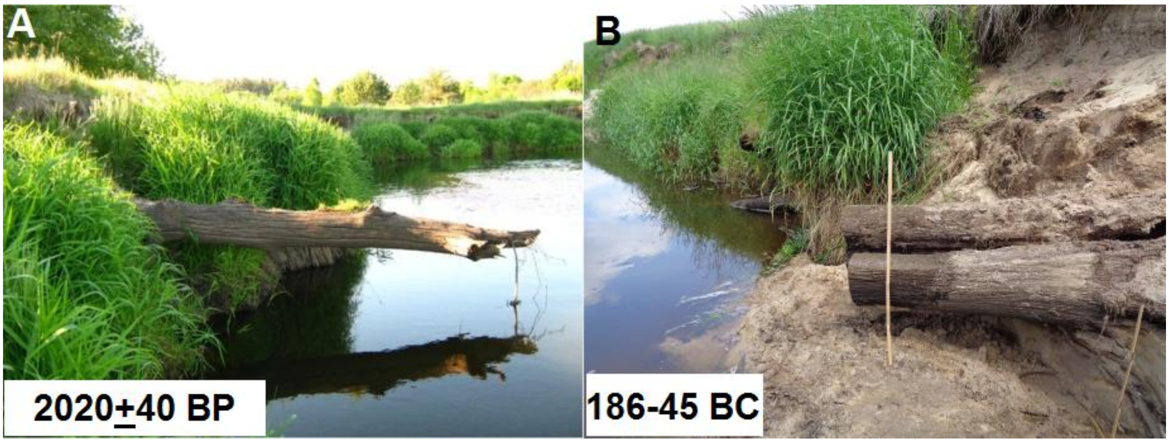


Fig. 7. Subfossil trees in Kamienna river alluvia (photo 2011 and 2015)

Within investigated alluvia processes of fossilization had place whereby came to the development of levels of buried soil. Its creation was connected with an increase of the accumulation rate of overbank deposits, the slowed alluvial soil build-up, disappearing aeolian processes and weakened water accumulation (Kalicki 2006). One of phase of the fossilization had place at 730±90 BP cal. 1150-1420 AD (Barwicka, Kalicki 2013)(Fig. 4). Buried soil along the river channel indicate an increase of vertical accretion in last centuries triggered off human impact and flood events during Little Ice Age.

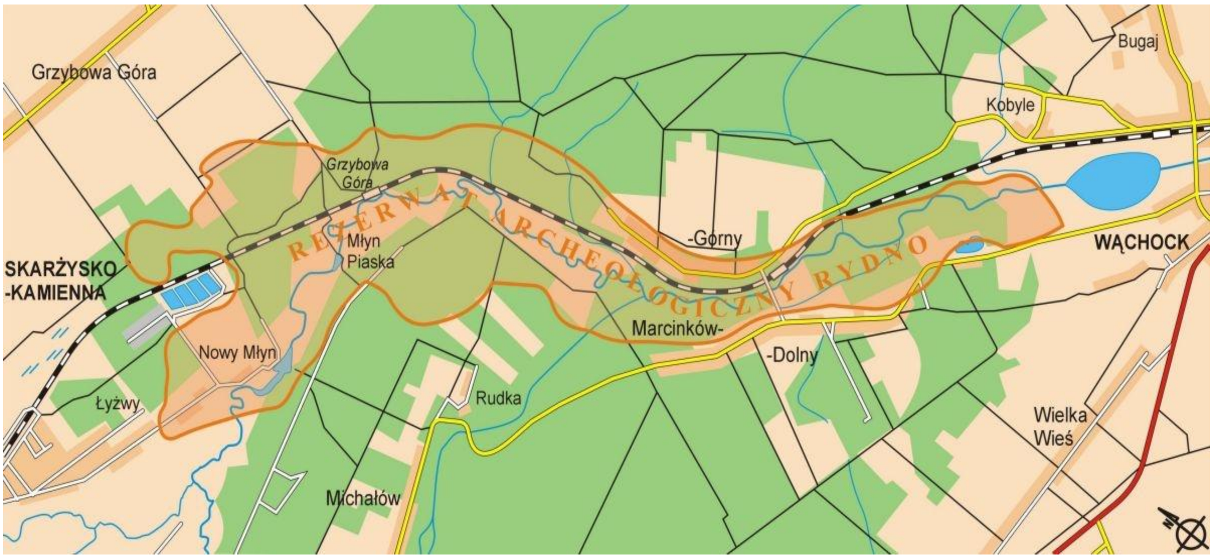


Fig. 8. Rydno Archaeological Reserve area (www.rydno.com)

The research area is located within the Rydno Archaeological Reserve (Fig. 8), established on 1957 and focuses a settlement sites with places of hematite and chocolate flint mining and processing during Stone Age (Kardyś 2007). The begging of antrophopressure in the Palaeolithic were connected rather with passive use of natural resources without the environmental transformation. Neolithic revolution and the development of ancient production of the Holy Cross metallurgy caused the increased deforestation of Kamienna river valley area. During the Middle Ages a numerous forges has been built, and in 19th and the beginning of 20th century Old-Polish Industrial Region operated. After this time remains after blast-furnace works, rolling mills, foundries and mines had preserved. Water-mills which were founded mainly in last centuries caused a significant changes in river channel morphology, which especially reflected by mill streams and place of water lifting (Fig. 9, 10).

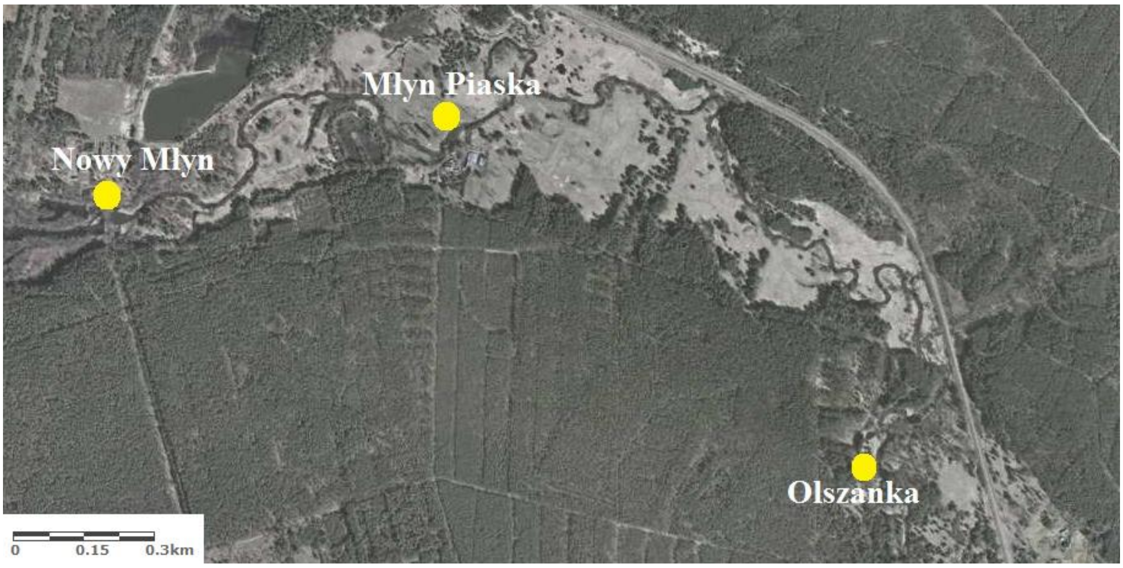


Fig. 9. Location of water-mills (www.mapy.geoportal.gov.pl)

Fig. 10. Remains of water-mill in Olszanka (photo E. Kłusakiewicz 2015)

Conclusions

Kamienna river valley has transformed strongly since the Late Glacial and Holocene transition. In this time the incision took place and the development of flood plain with the complicate structure (some alluvial bodies) occurred. The changes in fluvial activity reflected in relief and sediments as channel changes (palaeochannel fills - the oldest from the Eoholocene), subfossil trees from the Roman time and layer of buried soil from the Little Ice Age. An increasing anthropopressure had influence on environment changes in upper Kamienna river valley (e.g. deforestation) and within river channel by hydrotechnical buildings.

REFERENCES

Barwicka A., 2011, Budowa geologiczna i rzeźba doliny Kamiennej poniżej Skarżyska-Kamiennej. Uniwersytet Humanistyczno-Przyrodniczy, Wydział Matematyczno-Przyrodniczy, Kielce (Master degree tapescript).

Barwicka A., Kalicki T., 2012, Development of the Kamienna river flood plain near Marcinków [in:] Geomorphic processes and geoarchaeology. From Landscape archaeology to archaeotourism. Extended abstracts. Moscow-Smolensk 20-24.08.2012, 40-41

Barwicka A., Kalicki T., 2013, Development of Kamienna river flood plain in Rydno Archaeological Reserve (Holy Cross Mountains, Poland) [in:] 9. Konference environmentalni archeologie KEA 2013, Sbornik abstraktu (eds. A. Bernardova, J. Benes), 28-30.01.2013, Czeskie Budziejowice, 13.

Filonowicz P., 1979, Objaśnienia do Szczegółowej mapy geologicznej Polski. Arkusz Skarżysko-Kamienna 1:50 000. Wydawnictwo Geologiczne, Warszawa.

Kalicki T., 1991, The evolution of the Vistula river valley between Cracow and Niepołomice in late Vistulian and Holocene times, [in:] Evolution of the Vistula river valley during the last 15 000 years, part IV (ed. L. Starkel), Geographical Studies, Special Issue 6, 11-37.

Kalicki T., 2006, Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich. Polska Akademia Nauk, Instytut Geografii i Przestrzennego Zagospodarowania im. Stanisława Leszczyńskiego. Prace Geograficzne nr 204, Warszawa.

Kalicki T., Krąpiec M., 1996, Reconstruction of phases of the "black oaks" accumulation and of flood phases, [in:] Evolution of the Vistula river valley during the last 15 000 years, part VI (eds. L. Starkel, T. Kalicki), Geographical Studies, Special Issue , 78-85.
Karaszewski W., 1985, Jura dolna okolic Starachowic, Skarżyska-Kamiennej i Szydłowca – Budowa geologiczna. Biuletyn Instytutu Geologicznego, 350: 91-106.

RYDNO – ARCHAEOLOGICAL COMPLEX ON THE KAMIENNA RIVER

Michał Przeździecki
University of Warsaw, Institute of Archaeology
m.przezdziecki@uw.edu.pl

Rydno archaeological complex, which spreads along the valley of the Kamienna River between Skarżysko and Wąchock (Góra Rocha), is an exceptional place in terms of the cultural heritage associated with the Świętokrzyskie (Holy Cross) Mountains region. From the perspective of the regional physiographic division acc. Jerzy Kondracki (2014: 271, 272), this area, measuring 3 km^2, is located on the border of two mesoregions: Suchedniów Plateau and Iłża Highland. Within the discussed location, the upper Kamienna River cuts into Triassic and Liassic sandstones and overlying the Quaternary glaciofluvial sediments (Oder Maximum Advance) (Lindner 1992: 525–523).

Rydno is unique on the world scale as it is a cluster of sites, mostly the Late Palaeolothic, but also the Mesolithic, associated with extraction, processing, and distribution of red ochre.

It comprises a prehistoric red ochre quarry and settlement complex, which consists of several hundred various functional units (camp sites, dwelling structures, flint workshops, pigment processing units).

The site of Rydno was discovered early in the 20th century by then beginner geologists Jan Samsonowicz and Jan Czarnocki. Its name was coined by Stefan Krukowski – an eminent scholar specialized in prehistory, outstanding explorer of the region, but also an eccentric, famous for inventing bizarre words and terms. Ludwik and Irena Sawicki were the first archaeologists to work at the complex. They performed surveys on the northern bank of the Kamienna River near the villages of Nowy Młyn (sites I–III) and Grzybowa Góra (sites I–IV) in 1923–1925. Since then, research in the area of Rydno has been continued almost without interruption by subsequent generations of prehistorians (Schild et al. 2011: 21–48).

It should be emphasized that the sandy alluvial terrace of the Kamienna River was practically devoid of vegetation at the beginning of the 20th century, which enhanced the aeolian processes and consequently led to the development of extensive deflated areas. As a result of deflation, flint artefacts deposited in the sand were exposed, since being heavier, they remained on the spot and formed easily visible concentrations on the surface. The sizes of these concentrations, sometimes termed as *nests*, ranged from a few up to between 10 and 20 m^2, and the number of artefacts from several hundred to several thousand flint items. It should be remembered that structures of such origin can be post-depositional mixtures of materials associated with different cultural units, which arises from the fact that the area could have been occupied repeatedly by a variety of communities in different periods. Unfortunately, deflation caused degradation of particular settlement layers and, consequently, mixing of previously homogeneous assemblages. Obviously, this process also resulted in destruction of potential features (hearths, pits, stone structures, etc.).

At the moment the valley of the Kamienna River is reforested, and the traces left by prehistoric settlement activity are revealed mainly as a consequence of archaeological research carried out in connection with investment projects related to the exploitation of building sands (e.g. Łyżwy I–III fields).

The unique character of Rydno complex is related to the presence of ochre of an intense red colour. It was available there in three forms: hematite gravels, quartz gravels and red clay. Remains of a quarry preserved as a network of pits and trenches of a depth of approx. 1 m (altogether covering approx. 25 a), located on Łyżwy-Nowy Młyn Hill, are evidence for sourcing of the material. Radiocarbon dates indicate that the area was exploited from *circa* 15.5 kya to 11.5 kya, i.e. when the Final Palaeolithic societies functioned in Central Europe. It is confirmed by the presence of copious artefacts dated to the Allerød Arch Backed Piece Technocomplex and the Tanged Points Technocomplex, which developed during the Younger Dryas (Dryas III) and the first half of the Preboreal. On the other hand, the oldest dates are reflected in the presence of sparse Hamburgian (Bølling or Older Dryas) and Late Magdalenian (Older Dryas) sites, situated at a certain distance from the quarry.

Another element present within Rydno complex, which also confirms an exceptional nature of the area, is a notable concentration of sites from the Stone Age. Dispersed on both sides of the Kamienna River valley, they form a large settlement group, which constitutes, acc. Romuald Schild (2011), a type of socioeconomic centre. So far, nearly 400 settlement locations (mainly remains of camps) have been discovered. They are relics of occupation left by representatives of a variety of cultural units, mostly from the Final Palaeolithic (Late Pleistocene) and the Mesolithic (Early Holocene).

The proximity of deposits of chocolate flint of an excellent quality as well as favourable environmental and topographic conditions were other factors which also determined the form of the complex.

A number of ethnographic analogies indicate that the significance of the areas which supplied mineral resources valuable for particular societies goes beyond their utilitarian character. These locations were also usually of a symbolic importance, moreover, the sourcing of the raw material bore ritual traits and was strictly regulated, e.g. it took place at a precisely defined time. From that perspective, the extraction, processing, and distribution of ochre constituted a substantial element of interactions between groups and broadly understood exchange of goods associated with that phenomenon.

REFERENCES

Kondracki J., 2014, Geografia regionalna Polski, Kraków.

Lindner L., (ed.), 1992, Czwartorzęd. Osady, metody badań, stratygrafia, Warszawa.

Schild R., Królik H., Tomaszewski A.J., Ciepielewska E., 2011, Rydno. A Stone Age Red Ochre Quarry and Socioeconomic Center. A Century of Research, Warszawa.

WATER-MILL IN NOWY MŁYN IN UPPER KAMIENNA RIVER VALLEY

Edyta Kłusakiewicz, Tomasz Kalicki

Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland

edytakapusta@interia.eu; tomaszkalicki@ymail.com

Water-mills are the hydrotechnical buildings which etched into the modern landscape of numerous river channels. They are characteristic objects also for upper Kamienna river valley.

Water-mill in Nowy Młyn is located in the eastern part of Skarżysko-Kamienna, about 4.5 km from downtown (Fig. 1).

Fig. 1. Location of water mill

The beginning of building in Nowy Młyn is 1930 as grains water-mill. It was built on the stone foundation, and it has a skeletal construction, gable roof, wooden, turbine chamber and drive on water turbine. Nowadays, its milling was constructed on the two pairs of rollers. The overspill consists from the loose stones. The towering weir is built as wooden footbridge (Krygier 1961; Szlęk-Sitkiewicz et al. (ed.) 2004).

Fig. 2. Water-mill in Nowy Młyn in: A – about 1960; B – in 2015 (Krygier 1961; E. Kłusakiewicz 2015)

The described object works today as water power plant, however its facilities are not complite and they become more and more devestated. Although water-mill is covered by Conservator of Historical Monuments protection, it is falling into ruin (Szlęk-Sitkiewicz et al. (ed.) 2004).

The building and the operation of water-mill caused the creation of anthropogenic forms. They are connected with indirect activity of building and among them dykes, ditches and mill stream can be distinguished.

Because of the function of water-mills came to the numerous changes within natural environment of river channel. Above the place of water lifting occured a decrease of stream capacity and an intensive accumulation of dragged and suspended material. Behind weir the importance of deep erosion increased, the participation of coarse fraction grew and the new long profile established. In case of small streams water-mills caused the increase of retention and the alignment of river state (Podgórski 2004).

REFERENCES
Krygier E., 1961, Katalog zabytków budownictwa przemysłowego w Polsce. Tom III, Zeszyt 3. Powiat Iłża, miasto Skarżysko-Kamienna, miasto Starachowice – województwo kieleckie. Zakład Narodowy Imienia Ossolińskich, Wydawnictwo Polskiej Akademii Nauk, Wrocław – Warszawa – Kraków.
Podgórski Z., 2004, Wpływ budowy i funkcjonowania młynów wodnych na rzeźbę terenu i wody powierzchniowe Pojezierza Chełmińskiego i przyległych części dolin Wisły i Drwęcy. Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń.
Szlęk-Sitkiewicz A., Szumielewicz J., Staśkowiak A., eds, 2004, Woda – aspekty ekologiczne Doliny Kamiennej. Skarżyskie Zeszyty Ligi Ochrony Przyrody. Zeszyt nr 8. Skarżysko-Kamienna.

GEOLOGICAL-GEOMORPHOLOGICAL STRUCTURE OF THE CZARNA KONECKA RIVER VALLEY DOWNSTREAM OF STĄPORKÓW (POLISH UPLANDS)

Piotr Kusztal, Tomasz Kalicki
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland

Study section of the Czarna Konecka river valley is located dowstream of Stąporków on Polish Uplands (Fig. 1). There is NE part of the Mesozoic margin of Holy Cross Mountains with Jurassic (Lias) sandstone (Żarnów series) in basement.

Czarna Konecka is a river of the third order within the left bank of the Vistula river basin. In the upper reaches its subsequent valley runs along erosion depression between Mesozoic hills (Fig. 1).

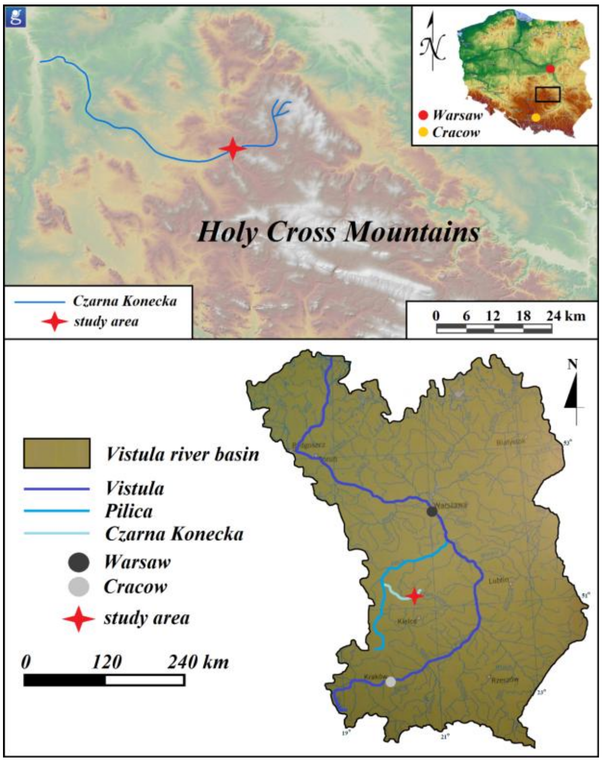


Fig. **1**. Location of study area in relation to the Holy Cross Mountains and to the Vistula river basin (Sztolcman 2003, www.mapy.geoportal.gov.pl/imap)

During Middle Polish glaciations period (Gowarczów phase) study area was in the immediate front of the ice sheet and dammed lake created here (Lindner 1996)(Fig. 2). Traces of this as limnoglacial deposits occur in sockless of erosion-accumulative terraces (profiles 5, 2), but only in the eastern part of the study section. In the western part near a moraine hill (kame?) Ostre Górki terraces are accumulative and are composed of thick series of sandy channel alluvia. After the retreat of the ice sheet and draining the dammed-lake began forming the upper Czarna Konecka river valley. The river cuts into the limnoglacial deposits currently occurring in the erosion sockle of middle terraces (see site 2 - Fig. 9, 10).

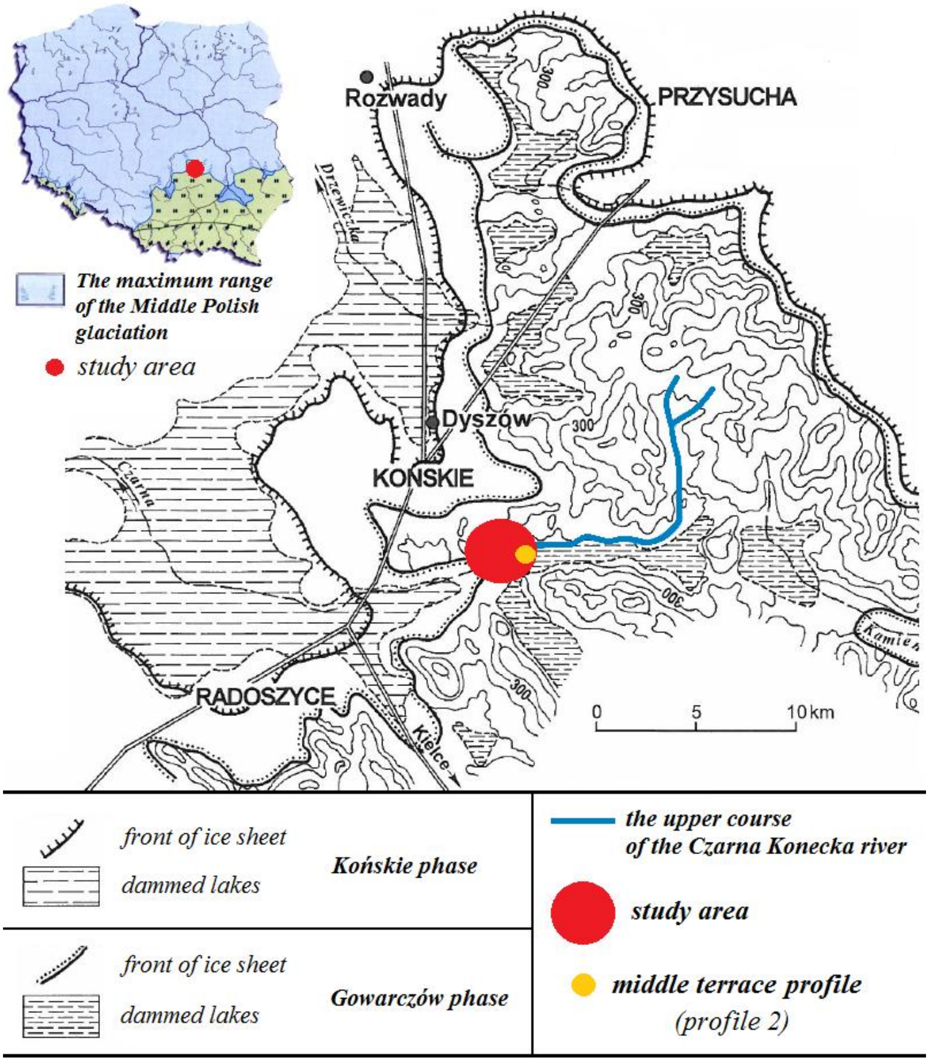


Fig. 2. Limit of maximum advance of ice sheet in the Czarna Konecka river valley during Middle Polish (Oder, Drenthe, Saalian) glaciations (Lindner, Federowicz 1996)

In the valley between Janów and Wąsosz Stara Wieś there are sediments which are diverse in age and origin (Jurkiewicz 1968, Kusztal et al. 2015, Kalicki et al. 2016a, b) (Fig. 3, 4):

- aeolian – dunes and wind-blow sands on the high terrace (7.5-7.0 m),
- fluvioglacial – lower part of erosion sockless of right-bank of high terrace (7.5-7.0 m),
- glacial – upper part of erosion sockless of right-bank of high terrace (7.5-7.0 m) and moraine hills,
- limnoglacial – erosion sockless of left-bank of middle terrace (5.0-4.5 m),
- deluvial – foot of the moraine hills and steep slopes,

- fluvial – terraces and flood plain,
- organogenic - oxbow lake fills of flood plain,
- limnic – oxbow lake fills of flood plain,
- anthropogenic – artificial embankments and mounds.

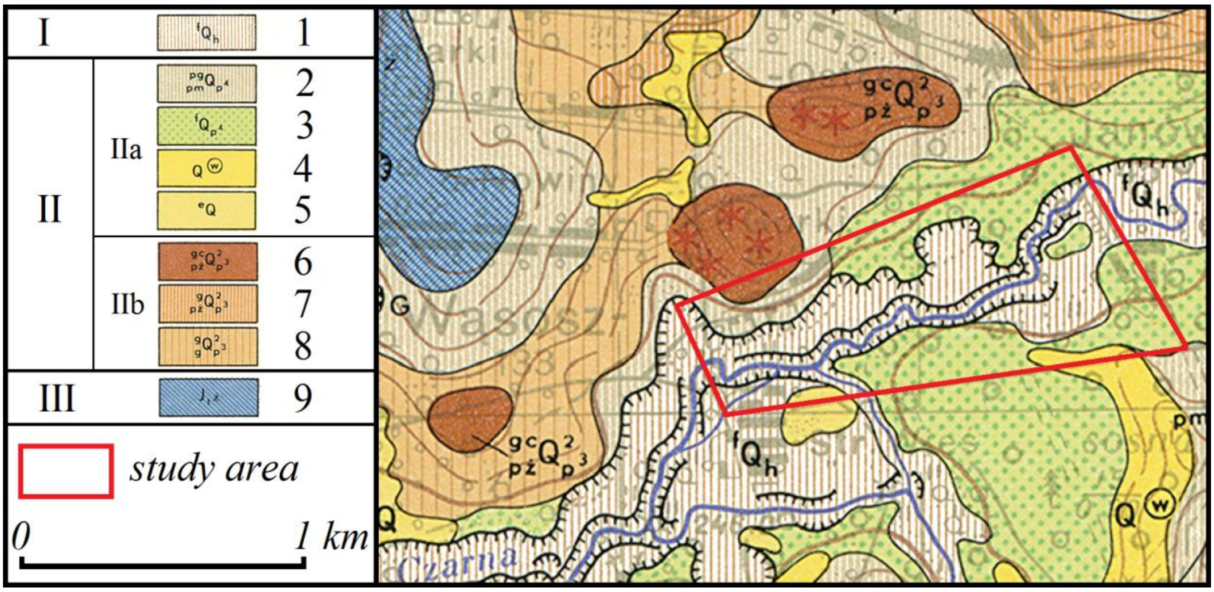


Fig. 3. Fragment of Detailed Geological Map of Poland 1:50 000 (Jurkiewicz 1968)
I – Holocene, II – Pleistocene, IIa – Vistulian, IIb – Oder glaciation, III – Mesozoic;
1 – fluvial deposits, 2 – deluvial sands and silts, 3 – river sands and silts, 4 – dune sands,
5 – aeolian sands, 6 – moraine sands, gravels and boulders, 7 – sands, gravels and glacial boulders, 8 – boulder clay, 9 – Jurassic sandstone

Within the valley can be divided some morphological levels of different age and structure (Kalicki et. al. 2016a, b)(Fig. 4). Vistulian (?) erosion-accumulative high terrace (approx. 7.5-7.0 m above river level) composed of sandy channel sediments of braided river (profile Czarna 5). Vistulian (?) middle terrace (5.0-4.5 m a.r.l.) is erosion-accumulative in the east (profile Czarna 2 – see below) and accumulative in the west (profile Czarna 3) of study area. It has also been formed by braided river. Lateglacial low terrace (approx. 4.5-3.0 m a.r.l.) was already shaped by the meandering river. Along the river extend relatively narrow strips floodplain high (3.0-2.0 m a.r.l.) and low (1.0 m a.r.l.). Alluvia these two levels show a clear facial differentiation typical meandering river sediments. Lateral channel migration has created a meandering hill (profile Czarna 3) and a few Holocene cut-fill alluvial bodies. Two of them were dated on Early 7350±90 BP cal. 6411-6052 BC (MKL 3029) and Late Atlantic 5570±50 BP cal. 4497-4337 BC (MKL 2983) (Kalicki et al. 2016a, b). There are numerous subfossil tree trunks in both the channel sediments (profile Czarna 3) and abandoned channel fill (profile Czarna 4 and 1)(Kusztal et al. 2015, Kłusakiewicz et al. 2016). Some of these subfossil trees were ^{14}C dated at 2610±40 BP cal. 849-750 BC (MKL-2984) (Czarna 4 profile) and 1700±40 BP cal. 240-420 AD (MKL 2862) (Czarna 1 profile)(Kalicki et al. 2016a, b). There were fallen in the beginning of Subatlantic and in Late Roman period and were accumulated on the limit between channel deposits and sandy bars in the first stage of abandoned channel filling. The fillings oxbow lakes (profiles Czarna 4 and 1) indicate distinct variation of sedimentation types, referring to changes in the frequency of flooding in the Holocene. These type changes were ^{14}C dated in Czarna 4 profile at 2470±60 BP cal. 772-413 BC (MKL 3031) and 1410±70 BP cal. 567-672 AD (MKL-3030) - beginning and end of peaty silts accumulation respectively and in Czarna 1

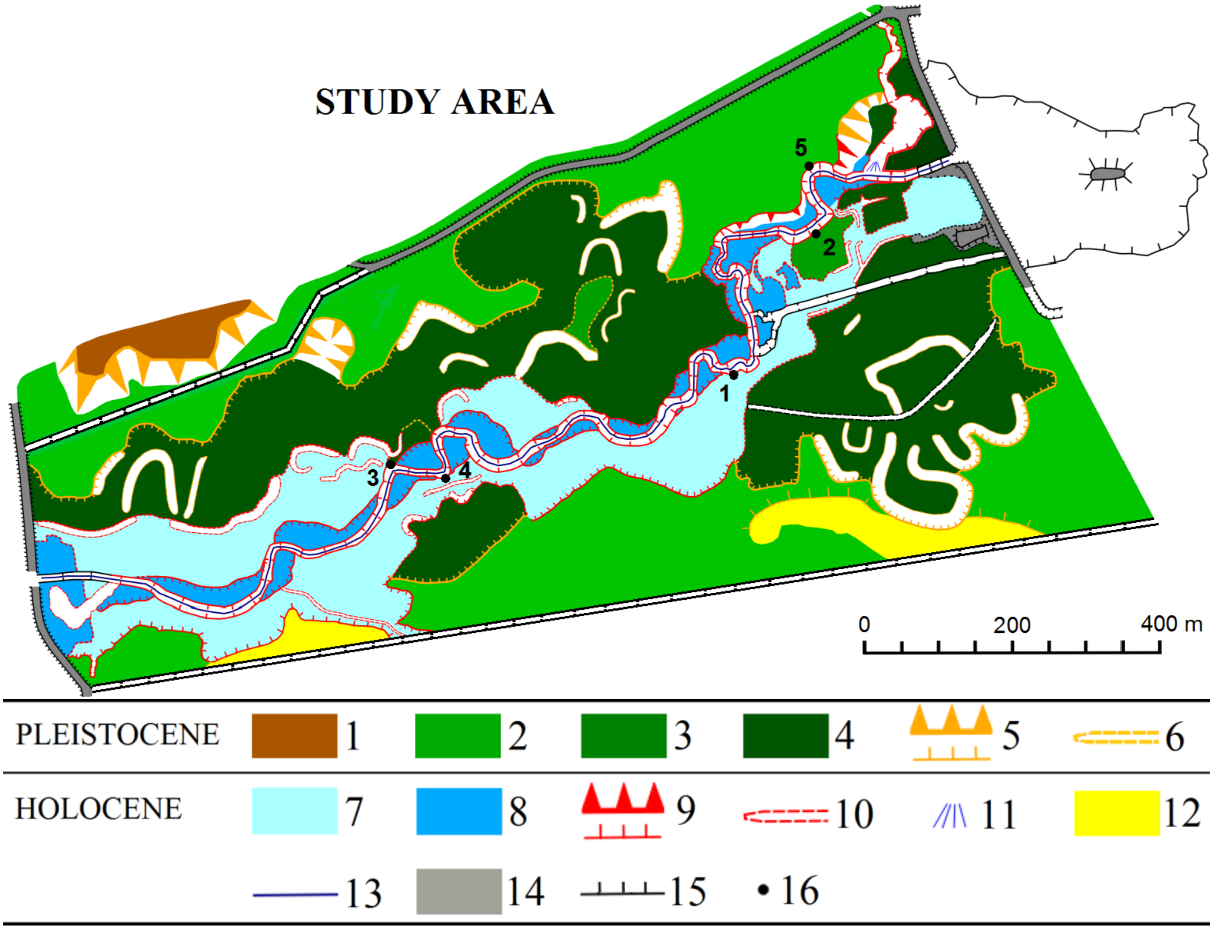


Fig. 4. Detailed geomorphological map of Czarna Konecka river valley between Janów and Wąsosz Stara Wieś (Kusztal 2016)
1 – terminal moraine hill, 2 – high terrace (7.5-7.0 m a.r.l)., 3 – middle terrace (5.0-4.5 m a.r.l.), 4 – low terrace (4.5-3.0 m a.r.l.), 5 – edges, 6 – dry valleys, 7 – high flood plain (3.0-2.0 m a.r.l.), 8 – low flood plain (1.0 m a.r.l.), 9 – edges, 10 – dry valleys, 11 – alluvial fans, 12 – Pleistocene and Holocene dunes, 13 – present-day bed of Czarna Konecka river, 14 – anthropogenic mounds, 15 – anthropogenic edges, 16 – study profiles.

profile at 630±60 BP cal. 1270-1420 AD (MKL 2861) when peats were covered with levee deposits (intercalations of sands and silts). The last date could be connected with Medieval increase anthropogenic changes of drainage basin and valley floor but also with clustering of catastrophic events during the Little Ice Age (Kalicki et al. 2016a, b).

The data collected during Archaeological Map of Poland (Polish Archaeological Record) from the study section are few, only 4 points (traces of settlements) from the Stone Age. Two of them are located on the high terrace. The next two are already on the low terrace, which confirms indirectly probably its Lateglacial age. On this terrace (site 7) developed Early Medieval and Medieval settlement, which indicates that the area was overflood in this period. However anthropogenic changes could triggered changes of sedimentation type on flood plain. Archaeological data indicate that the settlement entered the valley floor (flood plain) only in modern times (Kusztal, Kalicki 2016b).

In last centuries, the valley has been transformed anthropogenically as document cartographic and historical data. This led to the occurrence of catastrophic event in 20th century, eg. flood after break the dam and accumulation very coarse alluvium with artefacts downstream of drained lake. Present-day, the morphology of the river bed and the valley strongly influences the activity of beavers (Kusztal, Kalicki 2016a).

REFERENCES

Jurkiewicz I., 1968 – Objaśnienia do szczegółowej mapy geologicznej Polski (arkusz Radoszyce 1:50 000). Wydawnictwa Geologiczne, Warszawa.

Jurkiewicz I., 1968 – Szczegółowa mapa geologiczna Polski w skali 1:50 000 (arkusz Radoszyce). Państwowy Instytut Geologiczny, Warszawa.

Kalicki T., Kusztal P., Frączek M., 2016a, Facial differentiation of alluvia in the Czarna Konecka river valley downstream of Stąporków (Polish Uplands), Book of abstracts "State of geomorphological research in the year 2016" (eds. Václav Škarpich, Tomáš Galia, Veronika Kapustová, Jan Lenart), Ceska Asociace Geomorfologu, 11-13.05. 2016 Frydlant nad Ostravici, 30.

Kalicki T., Kusztal P., Frączek M., 2016b, Geological-geomorphological mapping of the Czarna Konecka river valley downstream of Stąporków (Polish Uplands), X Universitetskiye geologicheskiye chteniya „Sovremennyye problemy geologicheskogo kartirovaniya", 14-15.04.2016, Mińsk, Białoruś, 59-61.

Kłusakiewicz E., Kusztal P., Kalicki T., Frączek M., Przepióra P., 2016, Subfosylne drzewa w aluwiach wybranych rzek Gór Świętokrzyskich – pierwsze wyniki, Abstrakty III Ogólnopolska Konferencja Młodych Naukowców „Przyroda–Las–Technologia", 19-20.02.2016, Poznań, 41.

Kusztal P., Kalicki T., 2016a, Human activities in the Czarna Konecka river valley between Janów and Wąsosz Stara Wieś, Book of abstracts "State of geomorphological research in the year 2016", (eds. Václav Škarpich, Tomáš Galia, Veronika Kapustová, Jan Lenart), Ceska Asociace Geomorfologu, 11-13.05. 2016 Frydlant nad Ostravici, 43.

Kusztal P., Kalicki T., 2016b, Relief and Prehistoric settlement in the Czarna Konecka river valley downstream of Stąporków (Polish Uplands) – preliminary results, 12 Konference Environmentalni Archeologie „Před neolitem…", 7-9.02.2016, Praga, Czechy, 32-33.

Kusztal P., Nowak M., Kalicki T., Frączek M., Krupa J., 2015, Osady i morfologia doliny Czarnej Koneckiej poniżej Stąporkowa, Sbornik abstrakt 21. Kvarter (eds. H. Nohalova, V. Káňa, J. Březina), 27.11.2015, Brno, 30.

Lindner L., 1984 – Region świętokrzyski. (w:) B. Słowańska, I. Dziekońska (red.) Budowa Geologiczna Polski (stratygrafia, część 3b – kenozoik, czwartorzęd). Wydawnictwa Geologiczne, Warszawa, 1: 65-73, 113-145, 255-286, 326-330.

Lindner L., Fedorowicz S., 1996 – Wiek TL osadów plejstoceńskich w Janowie nad Radomką i problem zasięgu lądolodów w czasie zlodowaceń środkowopolskich (odry, warty) w strefie NW obrzeżenia Gór Świętokrzyskich. Przegląd Geologiczny 44, 9, 935-937.

Sztolcman J., 2003 – Ilustrowany Atlas Polski. PASCAL, Warszawa.

CZARNA 2 PROFILE: SEDIMENTS OF MIDDLE TERRACE OF CZARNA KONECKA RIVER

Piotr Kusztal[1], Tomasz Kalicki[1], Marcin Frączek[1], Joanna Krupa[1], Maria Górska-Zabielska[2], Mariusz Nowak[1]

Jan Kochanowski University in Kielce, Institute of Geography, [1]Department of Geomorphology, Geoarchaeology and Environmental Management, [2]Department of Geoturism and Environmental Geology, Kielce, Poland

Profile Czarna 2 is located on left side of the river (Fig. 4). It shows structure of middle terrace (4.5 m a.s.r.) (Fig. 1, 2, 3).

Fig. 1. General view of profile Czarna 2 at middle terrace of Carna Konecka river (2015)

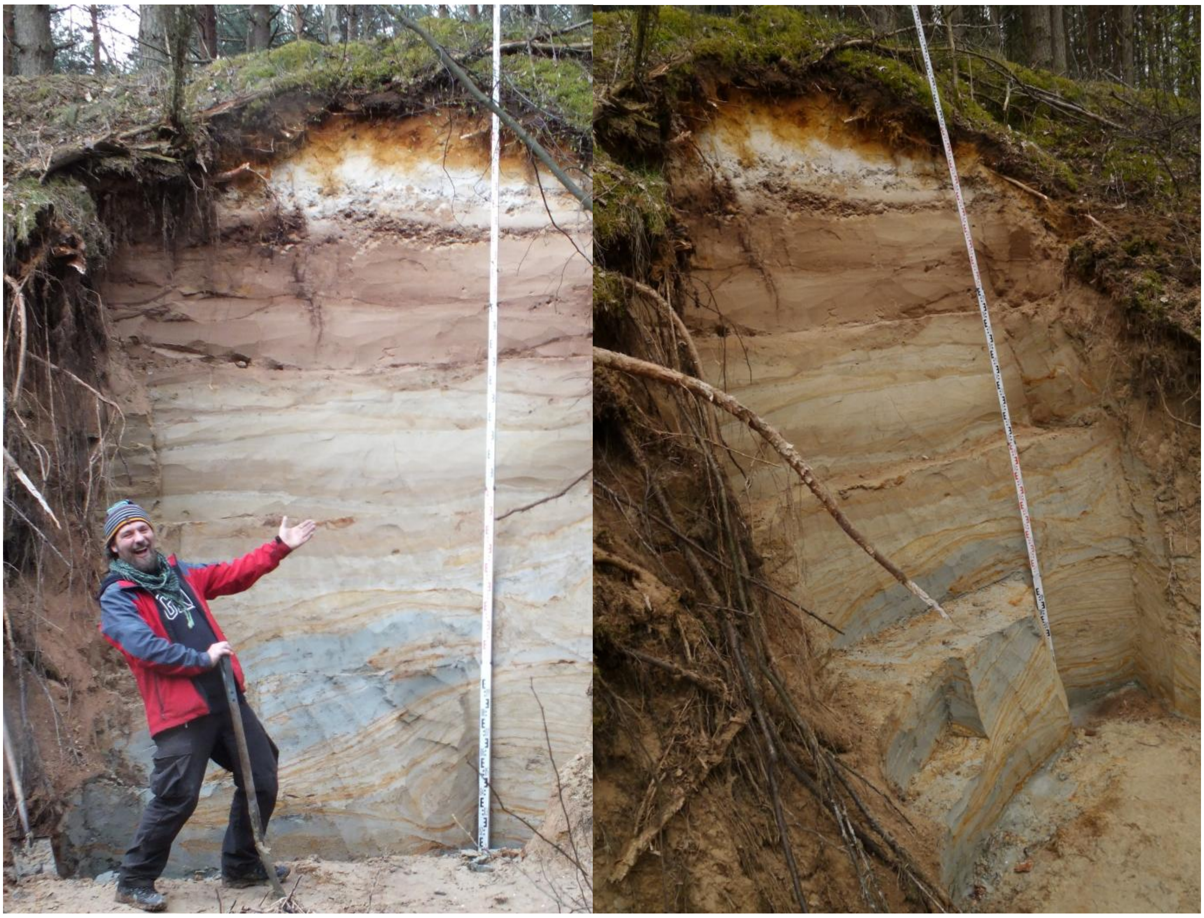


Fig. 2. Alluvium of middle terrace on erosional sockle (limnoglacial deposits) in profile Czarna 2 (2015)

Fig. 3. Dammed-lake sediments with cryoturbations in profile Czarna 2 (2015)

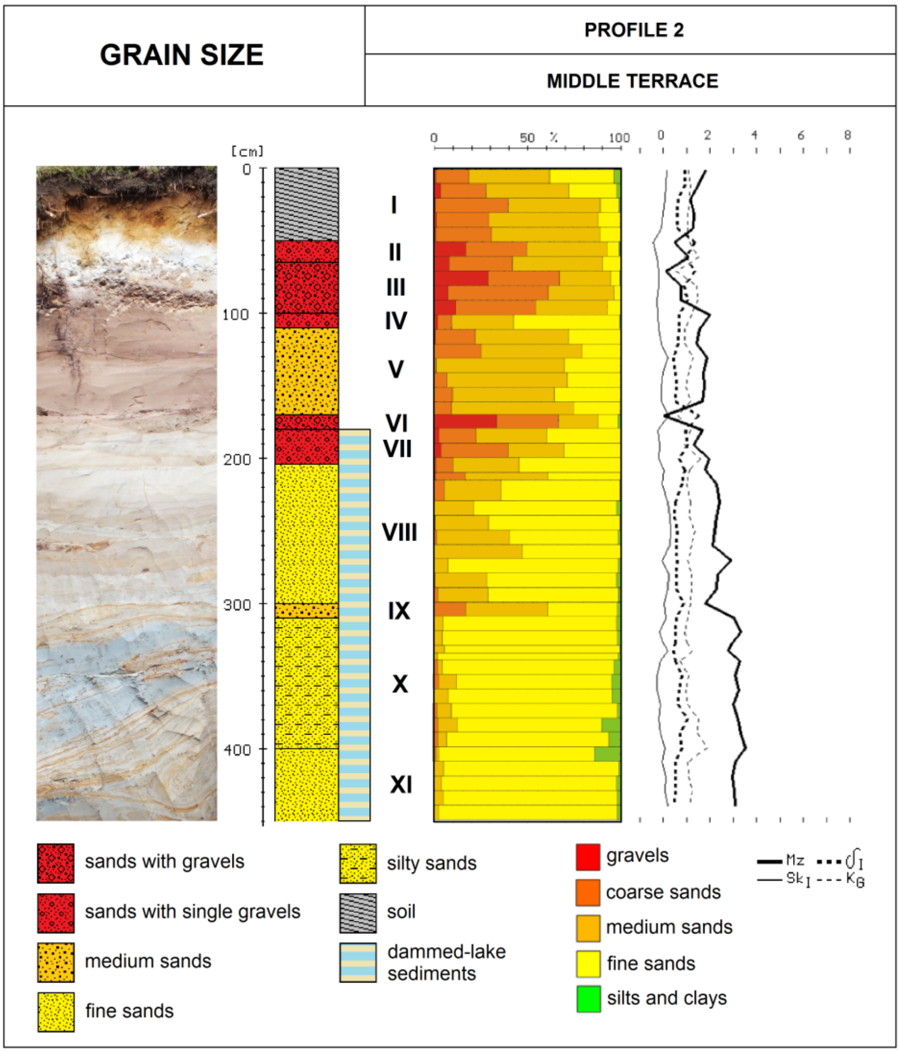


Fig. 4. Grain size and Falk-Ward distribution parameters (profile Czarna 2)

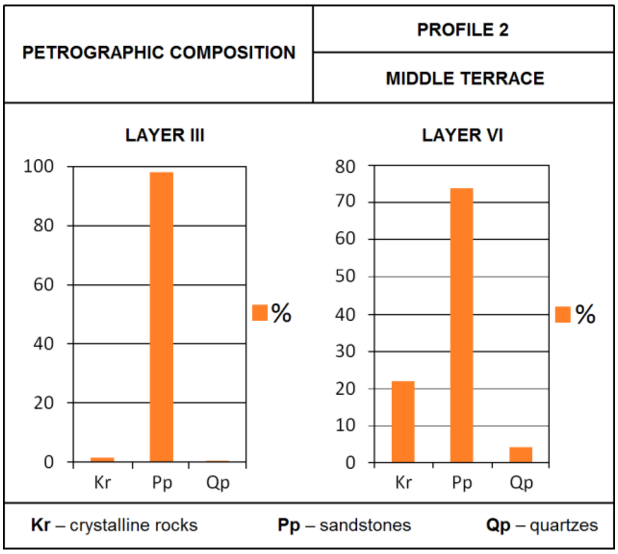


Fig. 5. Petrographic composition (gravels 4-10 mm) (layers III, VI) (profile Czarna 2) (anal. by M. Górska-Zabielska)

Some layers (11) can be distinguished in the profile (Fig 4). They consist of two series which are diverse in age and origin. Lower series (layers XI-VII) consist cryoturbated layers of clay and sand of limnoglacial deposits (Fig. 3). Upper series (layers VI-I) is composed of channel alluvia in the form of two fluvial members. Sandstones is dominating in petrographic composition of gravels in both members but content of crystalline rocks is higher in lag deposits of lower member (Fig. 5). It indicate a erosion of fluvioglacial sediments and source for alluvia of this terrace.

Middle terrace is erosion-accumulative form(Fig. 6). Its erosion base is composed of limnoglacial deposits (Oder glaciation). It was covered of sandy channel alluvia of braided river which function after retreat of ice sheet (after Gowarczów phase). Two fluvial members beginning with lag deposits show accumulation in the initial period of flow of the river, and later cut of fluvial sediments and limnoglacial deposits (Kalicki et al. 2016).

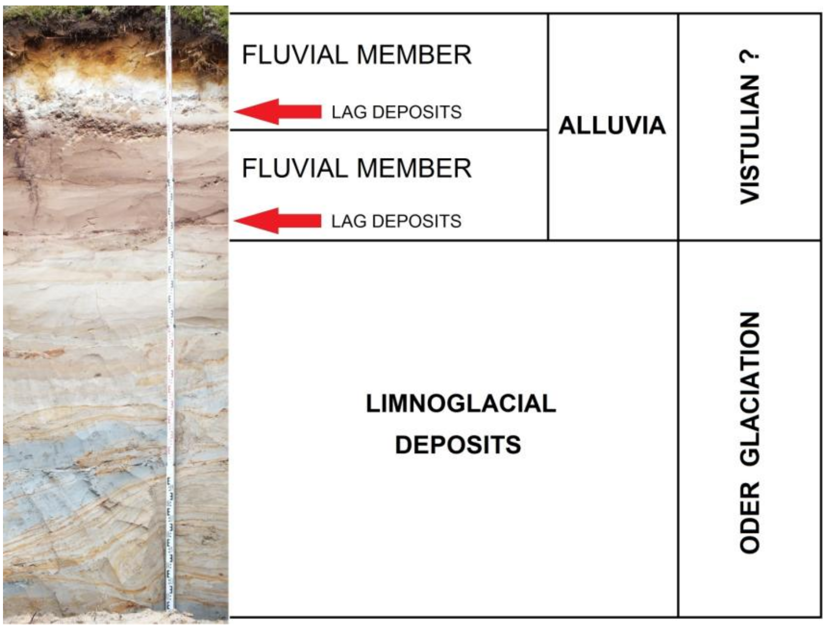


Fig. 6. Stratigraphy and origin of sediments in profile Czarna 2 (by P. Kusztal, T. Kalicki)

REFERENCES
Kalicki T., Kusztal P., Frączek M., 2016, Geological-geomorphological mapping of the Czarna Konecka river valley downstream of Stąporków (Polish Uplands), X Universitetskiye geologicheskiye chteniya „Sovremennyye problemy geologicheskogo kartirovaniya", 14-15.04.2016, Mińsk, Białoruś, 59-61.

THE ROYAL CASTLE AT CHĘCINY
comp. Marcin Frączek

The construction of the fortress probably began around XIII/XIV century. Around this date the upper part of the castle, comprising of upper courtyard with housing unit and two rounded defensive towers was built. The castle had its own chapel, located by the eastern tower.

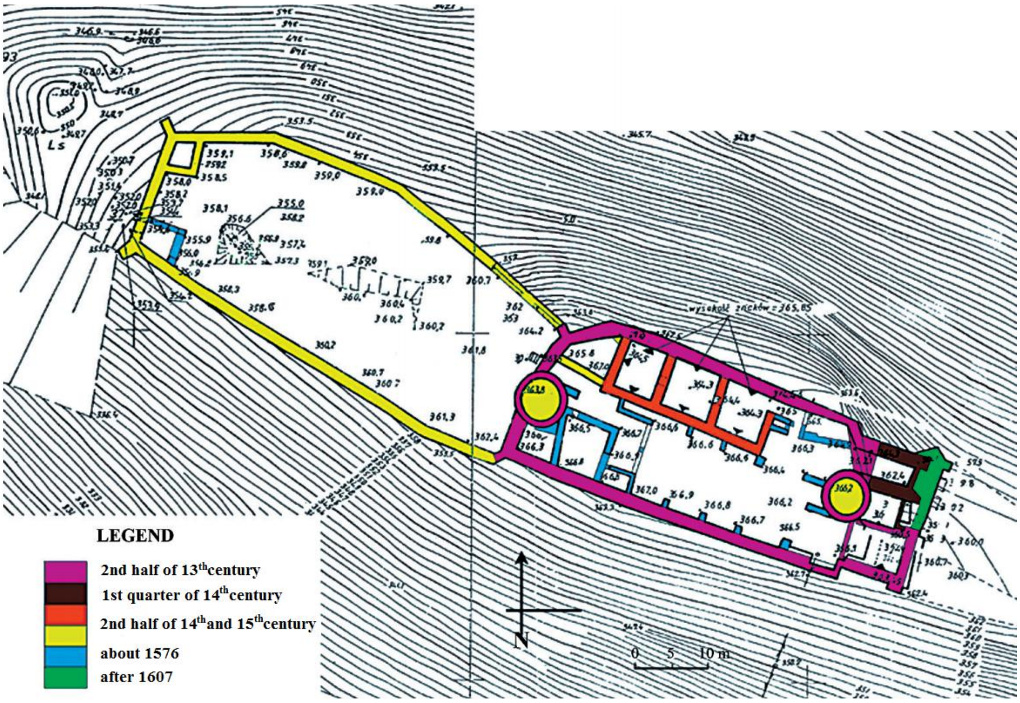


Fig. 1 Chronological dissection of the walls of the Chęciny castle according to Bohdan Guerquin (a working version most likely produced directly upon conclusion of the research carried out in the years 1959-1961)

The castle treasure was being kept in the room above the chapel. It is certain that the castle existed in 1306, when king Władysław Łokietek presented it to the Archbishop of Kraków, Jan Muskata. In following years a dispute on ownership title of then Lesser Poland has been raised between the king and the bishop. As a result of the dispute, after detection of a plot against the royal power, the castle was returned to the king. King Łokietek soon made the royal castle in Chęciny the centre of his political and military power. In 1318 the treasure of the Archdiocese of Gniezno was transferred and hidden inside the castle to prevent it from being captured by Teutonic Knights. The castle played a significant role as a place of concentration of Polish troops departing for Battle of Płowce with the Teutonic Knights in 1331. In the first half of the XIV century the stronghold was enlarged by King Casimir III the Great. Then the lower courtyard with a rectangle tower was constructed, forming the existing shape of the castle. At that time Chęciny became a residence of the king's second wife

Adelaide of Hesse. It was also a residence of Elisabeth of Poland, Queen of Hungary, Sophia of Halshany and her son Władysław III of Varna and Italian by origin – Polish Queen Bona Sforza, who departed Poland in 1556. Later it was used for many years as a state prison with main dungeon located underneath the eastern tower. Among imprisoned here were: Michael Küchmeister von Sternberg future Grand Master of the Teutonic Knights, Andrzej Wingold, King Jogaila's half-brother. The castle briefly regained its former glory due to reconstruction initiated by Stanisław Branicki, Starost of Chęciny.

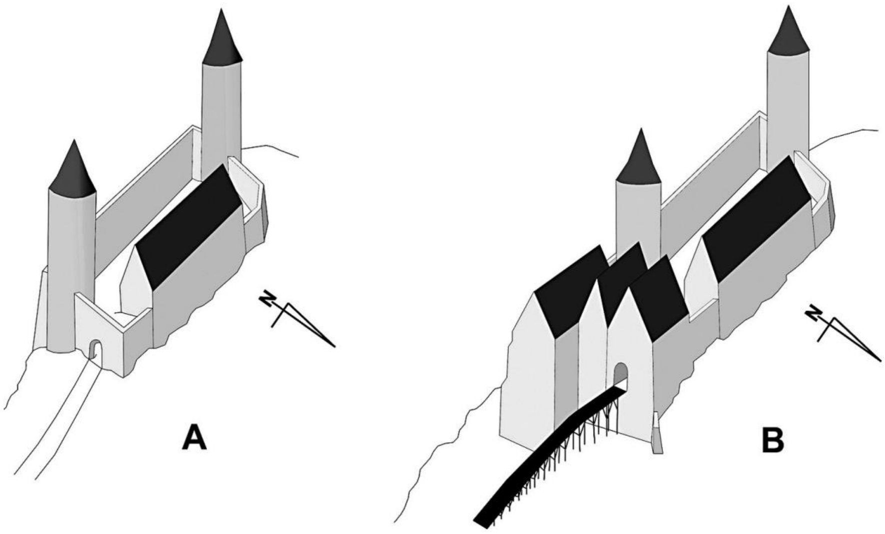


Fig. 2 Chęciny, the castle. A schematic axonometry of the first two functional and spatial phases of the object, according to Cz. Hadamik: A – hypothetical look of the castle in the first functional and spatial phase (until 1306), B – hypothetical look of the castle in the second functional and spatial phase (from 1307 until c. the mid-14th century)

However, in the second half of the 16th century, the castle began to decline. In 1588 the parliament ordered to transfer the castle's inventories to the Chęciny Parish Church. In 1607 the Castle was captured and burned by the Zebrzydowski Rebellion. In 1657 the Castle was again partially destroyed by the Rakoczy troops. During the Swedish Deluge the Castle turned into a ruin and remains in that state to this day. The ruins of the Castle have been preserved several times. First major construction works were undertaken in 1877. Between First and Second World Wars the castle was preserved by then mayor of the city Edmund Padechowicz. After the Second World War the castle was again preserved and partially reconstructed with middle tower rebuilt. Since then the eastern tower serves as a scenic viewpoint.

Historical article excerpted from www.checiny.pl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GEOMORPHOLOGY AND GEOARCHEOLOGY OF CZARNA NIDA VALLEY

Joanna Krupa
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland
joanna.krupa@ujk.edu.pl

The study area is situated in the Czarna Nida valley in the Polish Uplands, ca. 20 km south of Kielce (Fig.1). The Czarna Nida river with its length 63,8 km (from the source of Lubrzanka) and medium-size catchments area 1224,1 km^2 is a left-bank tributary of Nida river (upper Vistula drainage basin).

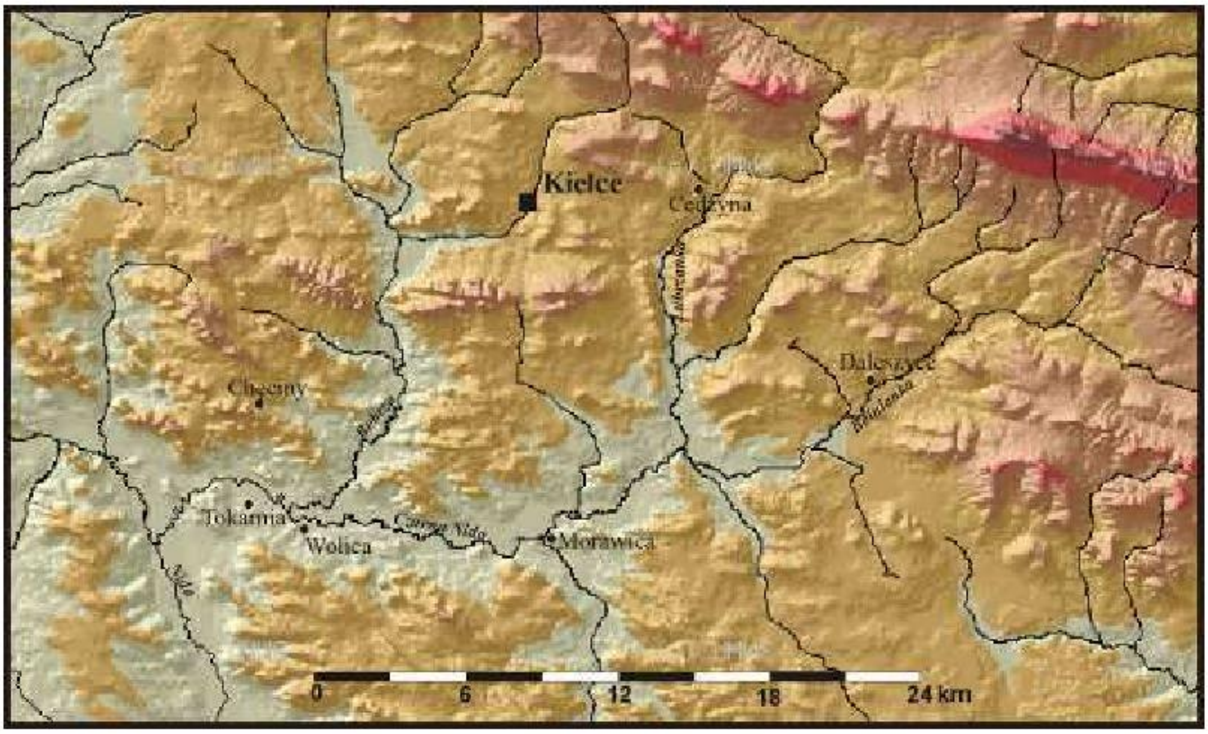


Fig. 1 Location of the study area

It arises in Holy Cross Mountains by the confluence of Lubrzanka and Belnianka rivers and then cross Szydlowskie Foothills, a part of the Mesozoic margin of this mountains. Slope of the river varies form 6,5‰ in the upper and 1,3‰ in the lower section. Mean discharge near Tokarnia is 5,99 m^3/s with maximum during snowmelt flood in March (rise of water level up to 2,5 m). During Last Glaciations catchments was situated in the perigalcial zone. Presently located in the temperate zone with an average annual precipitation about 600 mm. Investigations have focused on a study reach 30 km long with relatively broad valley floor 1-2 km.

Late Glacial and Holocene evolution

The scope of research included detailed geomorphological mapping, transverse transects, detailed sedimentological analysis, paloebotanical data, archaeological data, supplemented with the results of TL (termoluminescence) and radiocarbon dating (Fig. 2). Interdiciplinary research were carried out in the years 2009-2012 (Krupa 2013, 2015).

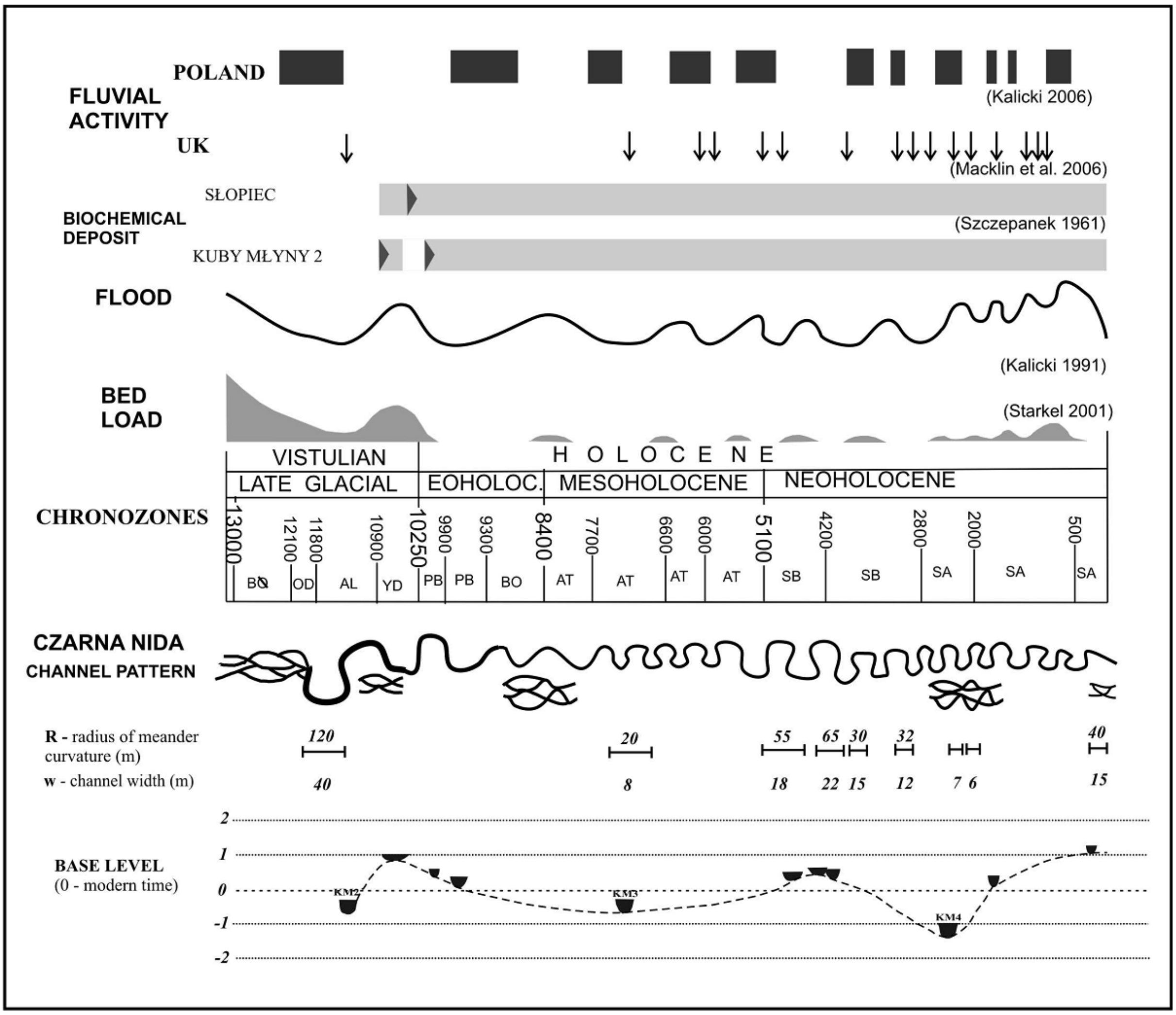


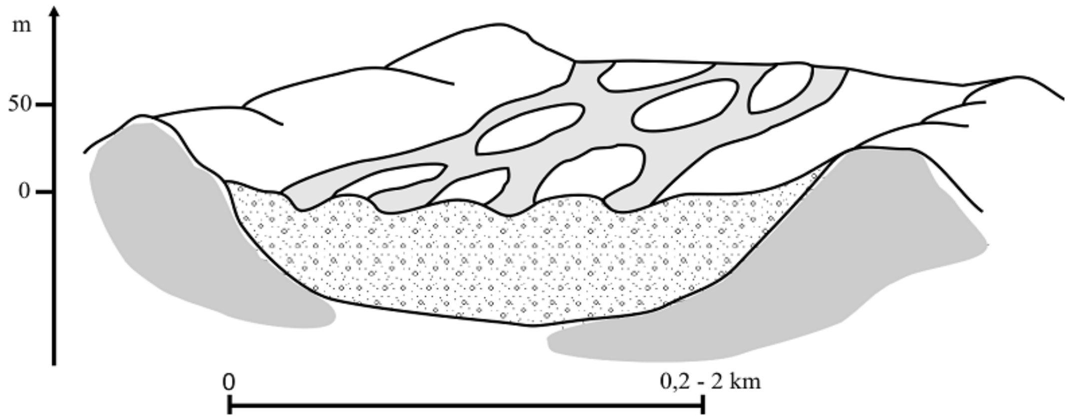
Fig. 2. Fluvial activity of Czarna Nida and corresponding paleogaographical factors (according to different authors): fluvial activity in Poland (Kalicki 2006); fluvial activity in the UK (Macklin i in. 2006); biochemical deposit – Słopiec (Szczepanek 1961); flood frequency (Kalicki 1991); suspensed-material load (Starkel i in. 2002)

The evidence of the Czarna Nida evolution stages is the distribution of landforms in the valley (Fig. 3).

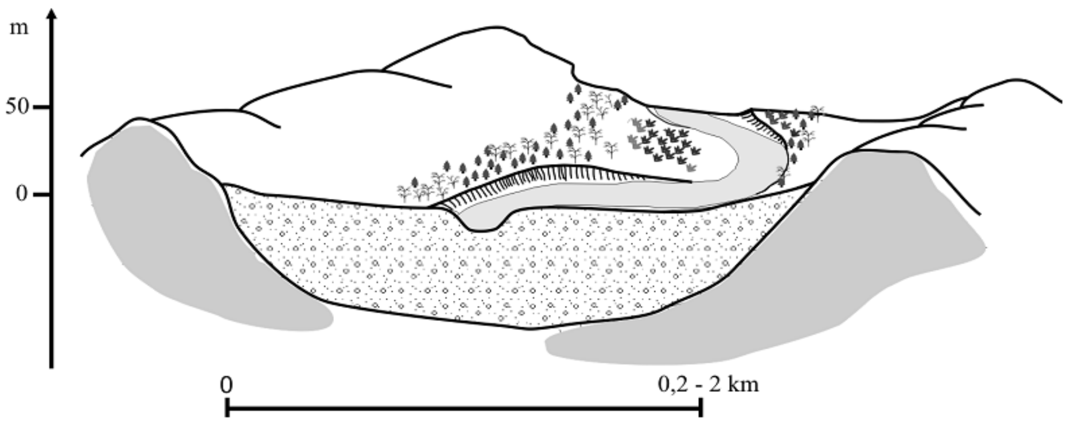
REFERENCES

Krupa J., 2013, Naturalne i antropogeniczne procesy kształtujące dno doliny Czarnej Nidy w późnym vistulianie i holocenie, Folia Quaternaria 81, 5-174.

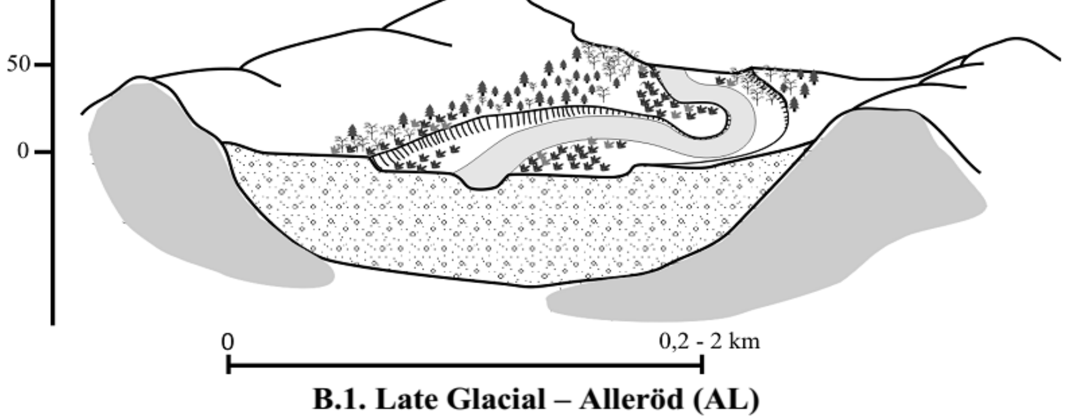
Krupa J., 2015, Natural and anthropogenic channel pattern changes in the mid-mountain valley during the Late Glacial and Holocene, Polish Uplands, Quaternary International. 370, 55-65.



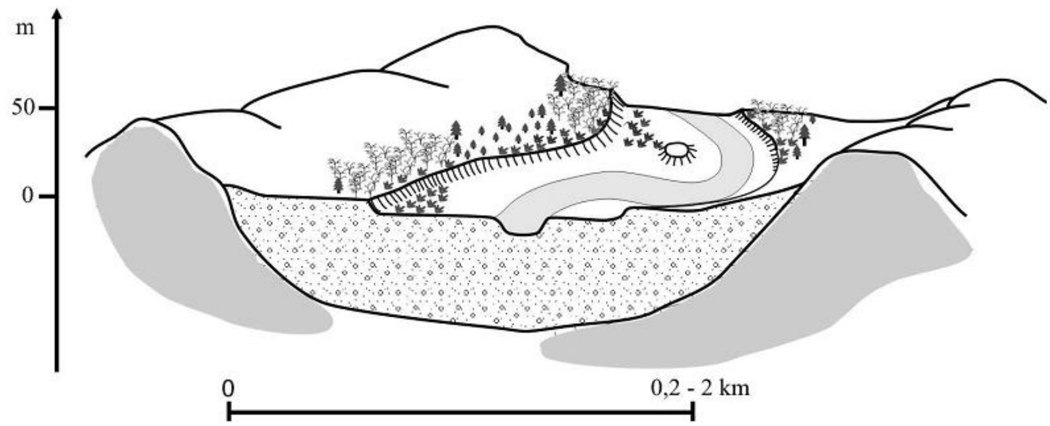
A. Last Glacial Maximum – Younger Pleniglacial (LGM – YPL)



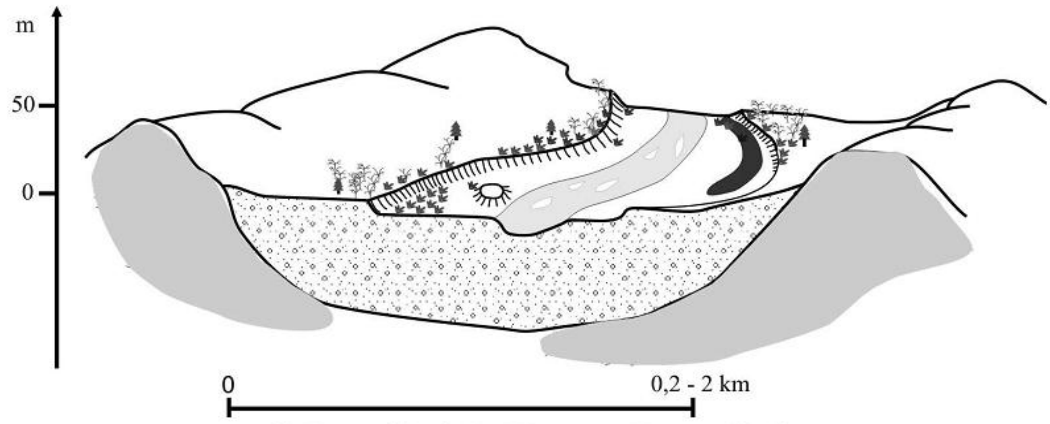
B. Late Glacial (LG)



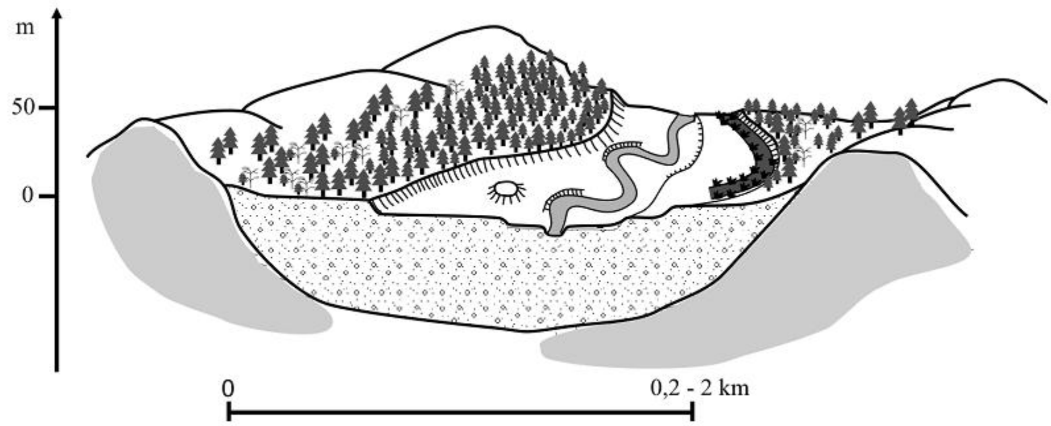
B.1. Late Glacial – Alleröd (AL)



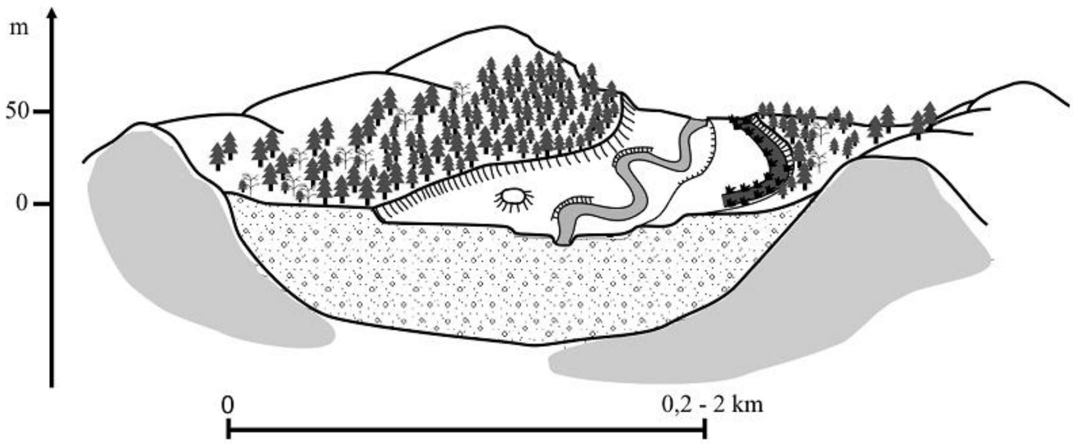
B.2. Late Glacial – Alleröd (AL)



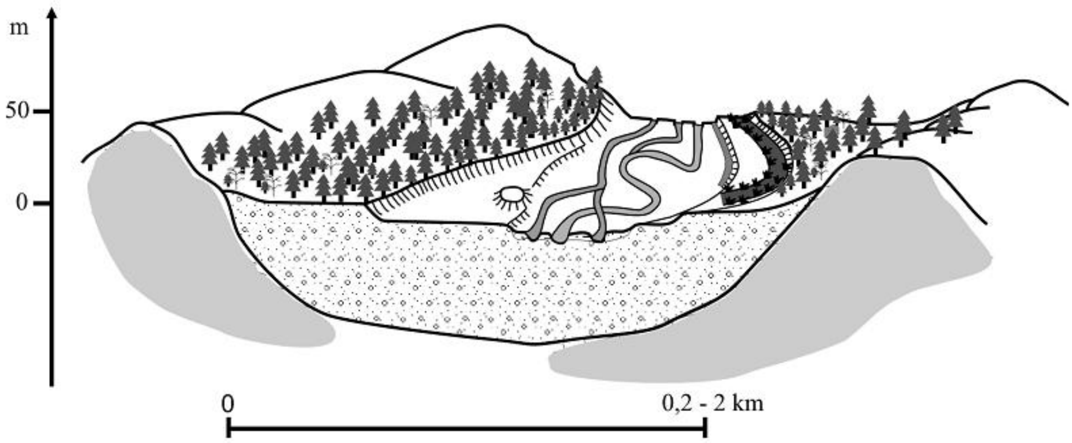
C. Late Glacial – Younger Dryas (YD)



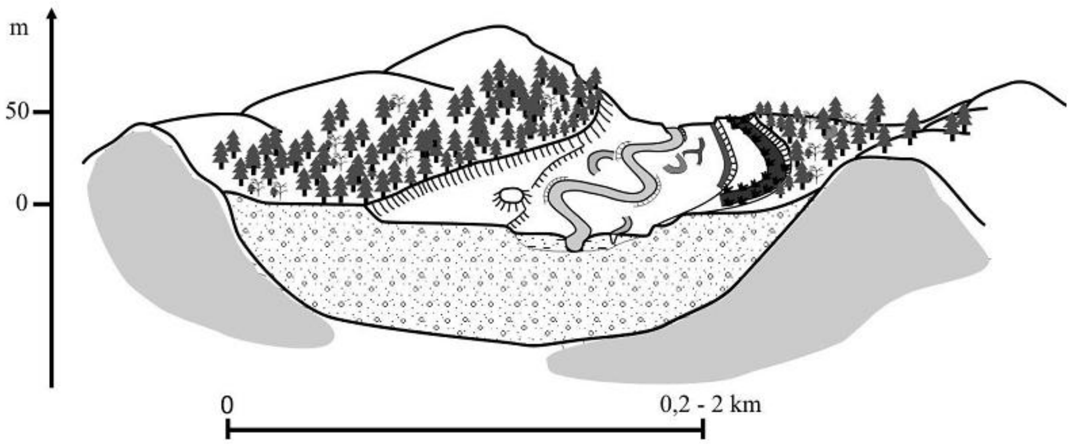
D. Holocene – Preboreal (PB)



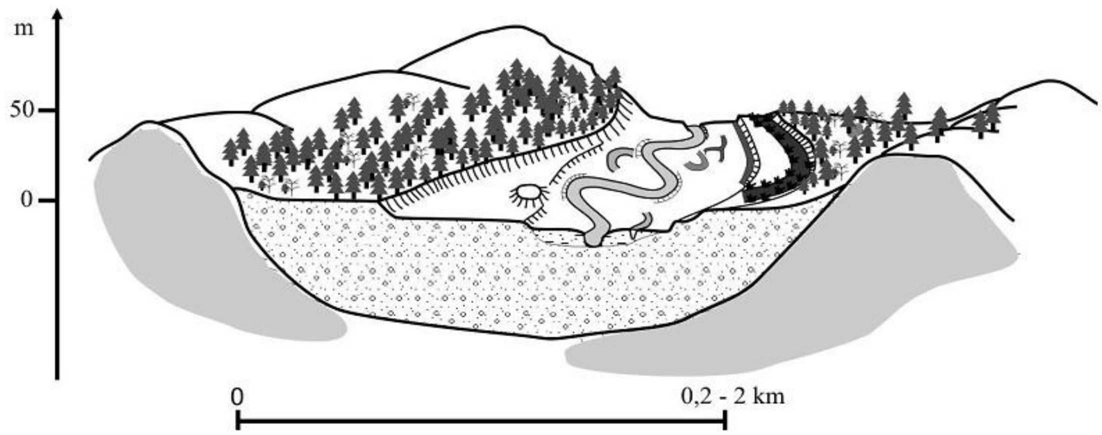
E. Holocene – Boreal (BO)



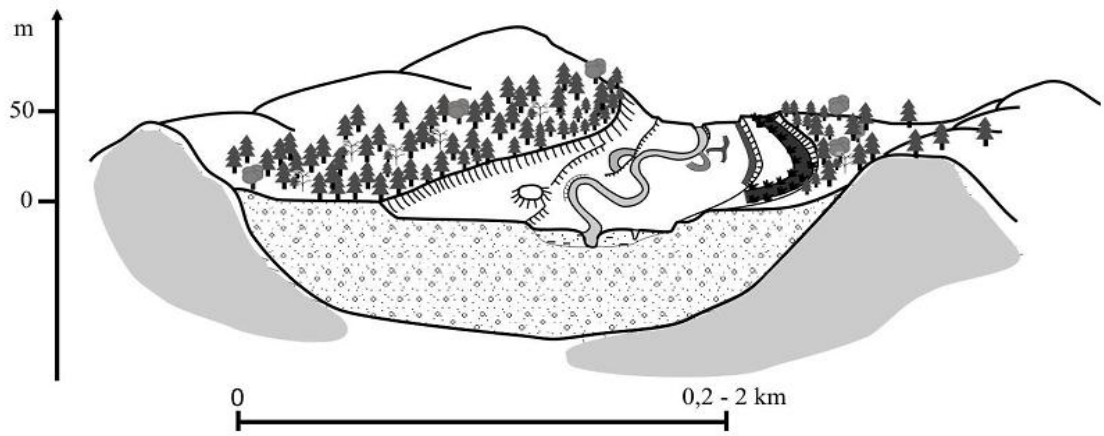
E. Holocene – Boreal (BO)



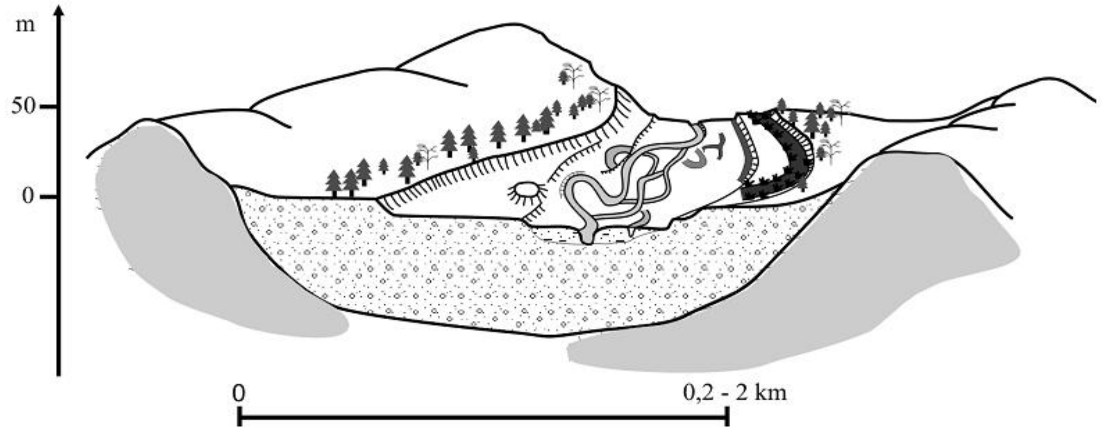
F. Holocene – Atlantic (AT)



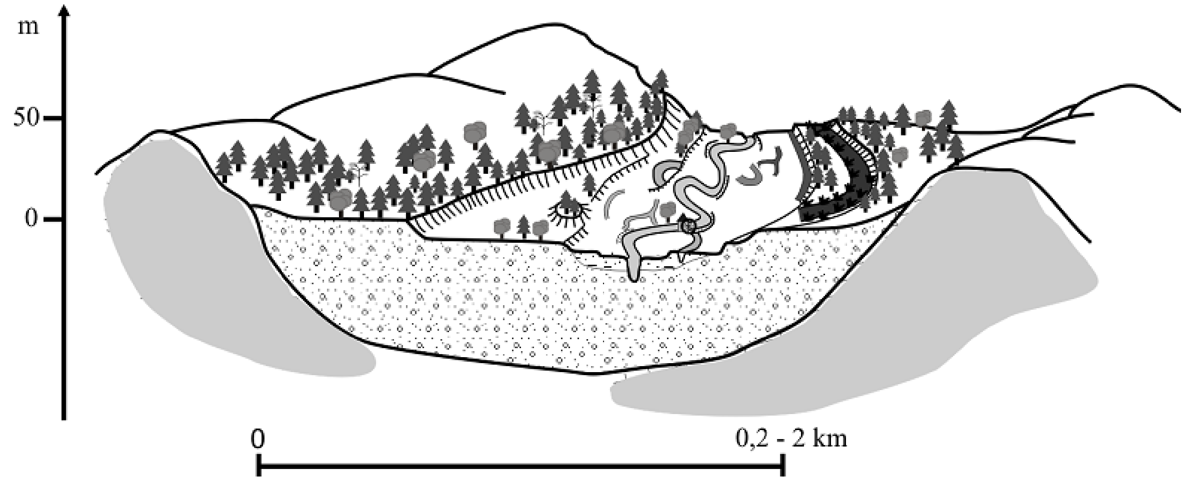
G. Holocene – Subboreal (SB)



H. Holocene – Subatlantic (SA-1)



I. Holocene – Subatlantic (SA-2) (Roman Period)



J. Holocene – Subatlantic (SA-3) (Modern)

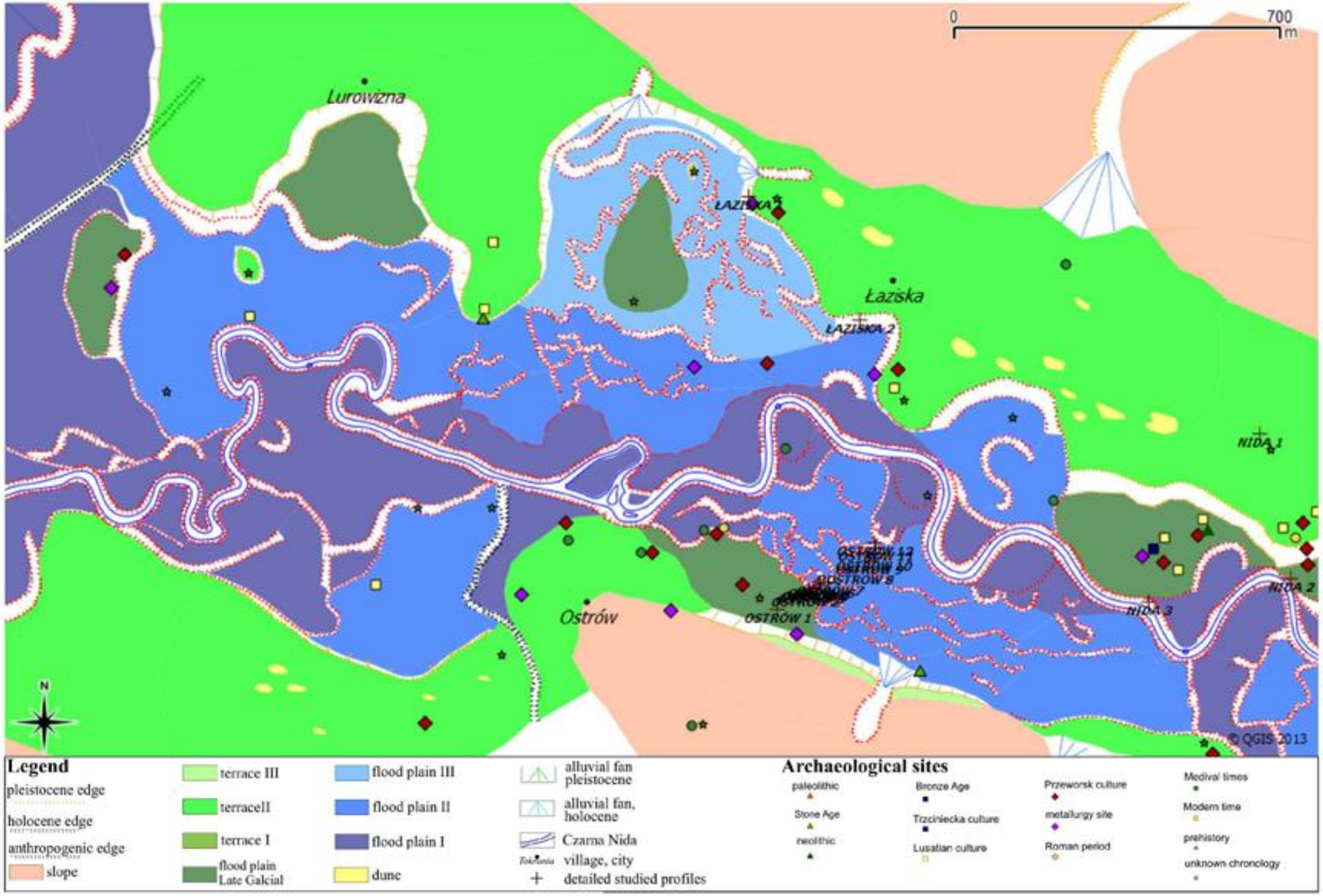
Fig. 3. Evolution model of Czarna Nida valley

OSTRÓW- ŁAZISKA SECTION

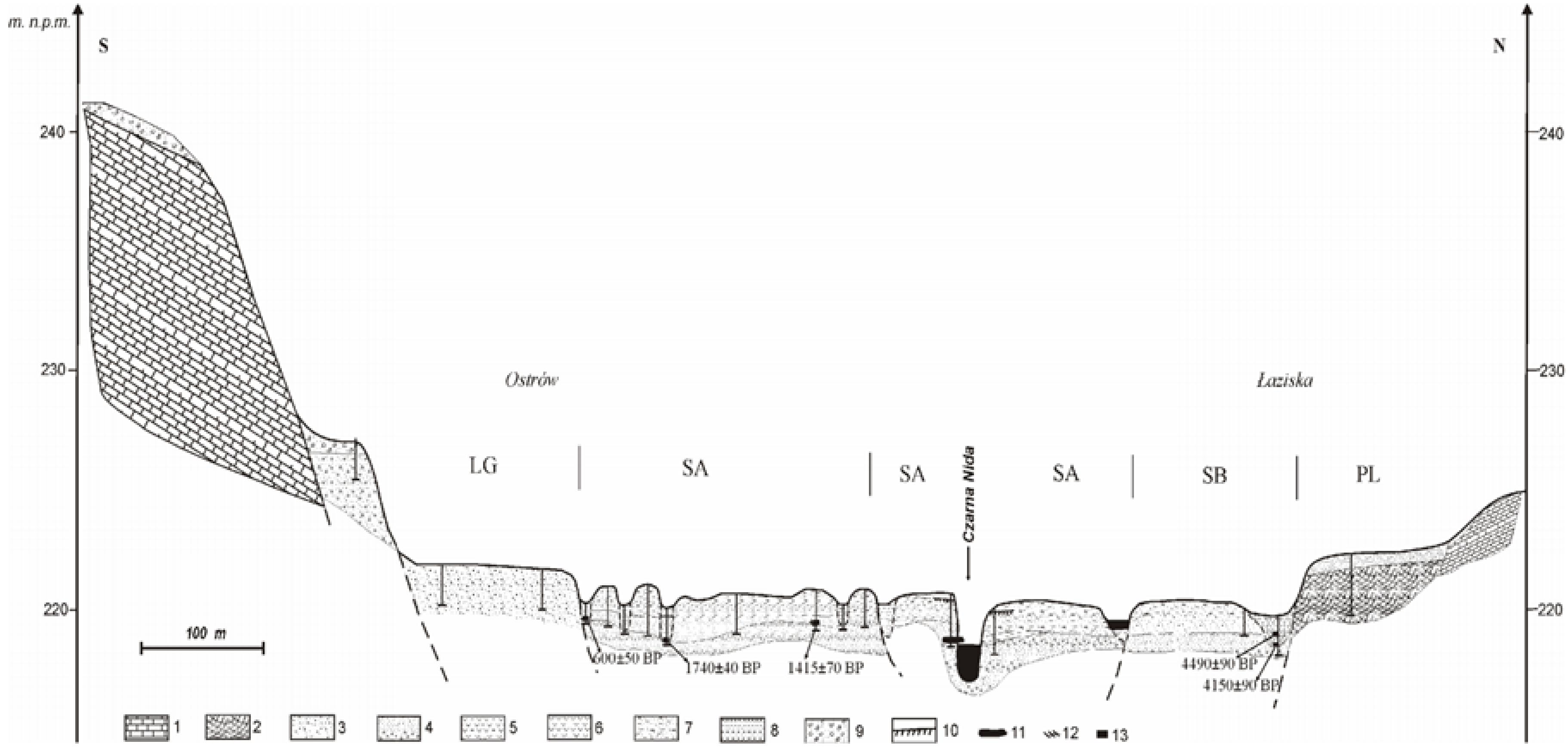
Joanna Krupa
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland
joanna.krupa@ujk.edu.pl

The Pleistocene terraces are preserved as narrow strips bordering the alluvial valley, e.g. above Ostrow village. Terraces, 2-4 meters height, are erosional and accumulativeerosional, with sandy-gravel deposit horizontal and cross bedded, which are dated by the termoluminescence from 16,39±2,46 ka to 14,56±2,18 ka BP. The bedding types and vertical sequence resemble braided river system. Locally, eg. near Ostrow and Nida villages, sand dunes occur on the top of the terraces. Due to archeological survey this is overflood area settled since prehistoric time. Fine grained (silty-sands) overbank deposit cover meander hill (near Kuby Mlyny site) build of channel alluvia of braided river, that indicate the incision phase at turn of Younger Pleniglacial and Late Glacial. Channel pattern changes initiated lateral erosion and macromeandering phase with facial differentiated alluvia accumulation. Wide flood plain, that generally stands 2-5 meters above river level, present complex structure. In the valley floor, within one morphological unit, comprise alluvial inset fills of different age formed by the river of various channel pattern: large meanders, small meanders, multichannel.

The cut off and changes of sedimentation type on flood plain of Czarna Nida river correlate very well with phases of an increase of river activity (for example 8500–8000, 6600–6000 BP) distinguished for the Centraleuropean rivers (Kalicki 2006). However some of them must (for example 7680, 2530 BP) be connected also with local events what is typical for small catchments and rivers as Czarna Nida. An increase of sedimentation rate near the river channel in the last millennium occurred as a reflection of Iron Age metallurgy.



Geomorphological map of Ostrów Łaziska section



Schematic section across flood plain in the middle course near Ostrów - Łaziska.1 – limestone, 2- cross bedded sands, 3 – medium and coarse sands, 4 – gravels with sands, 5 – peaty silts, 6 – peats, 7 – sandy silts, 8 – silts,9 – slope deposit, 10 – buried soil, 11 – subfossil tree, 12- branches and detritus, 13 –14C datings; PL – pleniglacial, LG – Late Glacial,PB – preboreal, AT – atlantic, SB – subboreal, SA - subatlantic

Vistulian terrace and Lateglacial large palaeomeander (macromeander) at Łaziska

Joanna Krupa
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland
joanna.krupa@ujk.edu.pl

In the northern part of the valley preserve Vistulian terrace, 0,5 km wide, bouild of sandy sediments of braided river, which are dated by the termoluminescence from 16,39±2,46 ka to 14,56±2,18 ka BP (Fig. 1, 2).

Fig. 1. Vistulian terrace near Łaziska

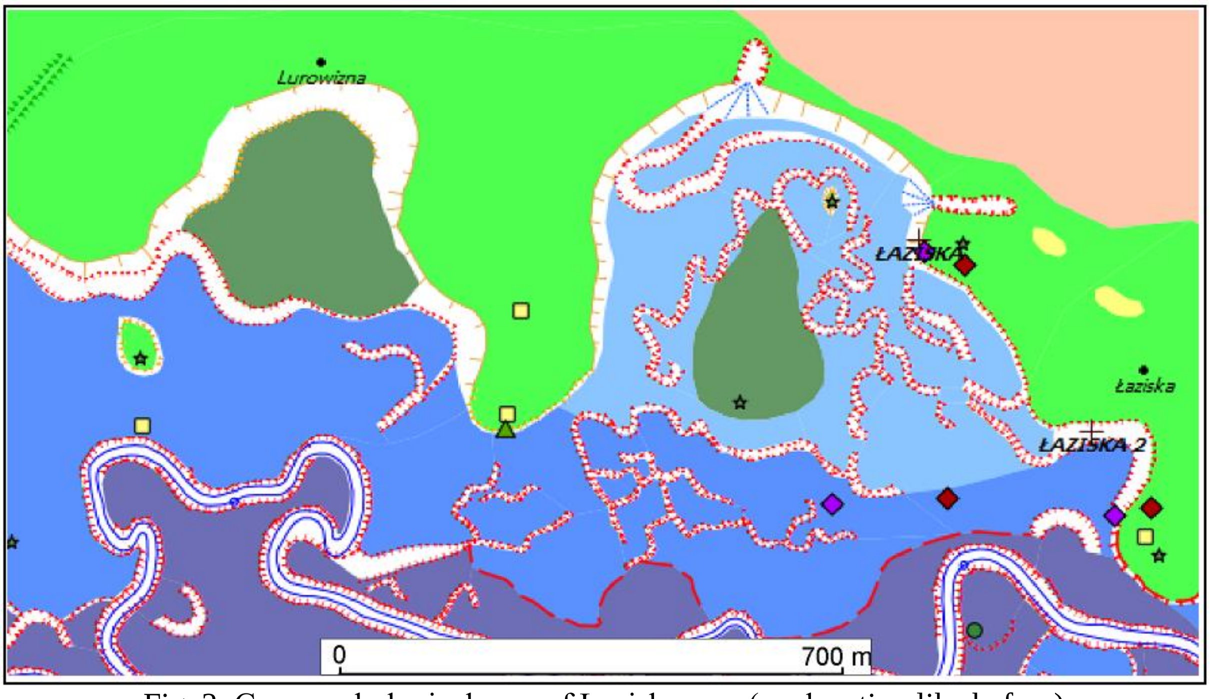


Fig. 2. Geomorphological map of Łaziska area (explanation like before)

Terrace is cut by two large meanders Łaziska 1 and Lurowizna. Paleochannel width varies from 35-42 m, the curvature radius 130-145 m and meander width 320-380 m. Abandoned meanders of large parameters recognized in some places are associated with the Late Glacial development phase of channels typical for Centraleuropean rivers. Narrow thalweg and wide zone of first point bar are typical for morphology of these palaeomeanders similar to the Late Glacial macromeanders of present day channel of tundra zone. Inside paleochannel is meandering hill, that is relict of Vistulian terrace, built of sandy-gravel alluvia eolian transformed in the top. There are traces of prehistoric settelemnts (AZP 88-62). Higher parts of fans were inhabited by people of the Lusatian and Przeworsk cultures. Large paelomender system was re-used and transformed during Holocene. Within them preserve system of winding paleomeanders of small parameters. During younger stages paleochannel was inudated by small alluvial fans at the mouth of fluvial-denudation valley cutting Vistulian terrace.

Holocene palaeomeander Łaziska 2

Tomasz Kalicki[1], Joanna Krupa[1], Dominik Pawłowski[2], Libor Petr[3]
[1]Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland
[2]Adam Mickiewicz University, Institute of Geology, Poznań, Poland
[3]Masaryk University, Brno, Czech Republik
tomaszkalicki@ymail.com; joanna.krupa@ujk.edu.pl; dominikp@amu.edu.pl; petr.libor@gmail.com

Site is located east of large paleomeander (Łaziska 1)(Fig. 2 in the previous subchapter). Paleomeander (Łaziska 2) cut Vistulian terrace. Paleochannel width is 20 m, the curvature radius 55 m and meander width 100 m. Meander was cut about 4500 years ago, as confirmed radiocarbon dating from the bottom: 4490±90BP (cal. 3400-2900 BC) and 4150±90 BP (cal. 2910-2480 BC). The the fill of 110 cm thick can be devided into two members, lower – organic, and upper silty sandy 30 cm thick. The top of organic sediments was radiocarbon dating at 1190±35 BP (MKL-2855) cal. 765-902 AD. This indicates a change in the sedimentation type probably during the last millennium (Fig. 1).

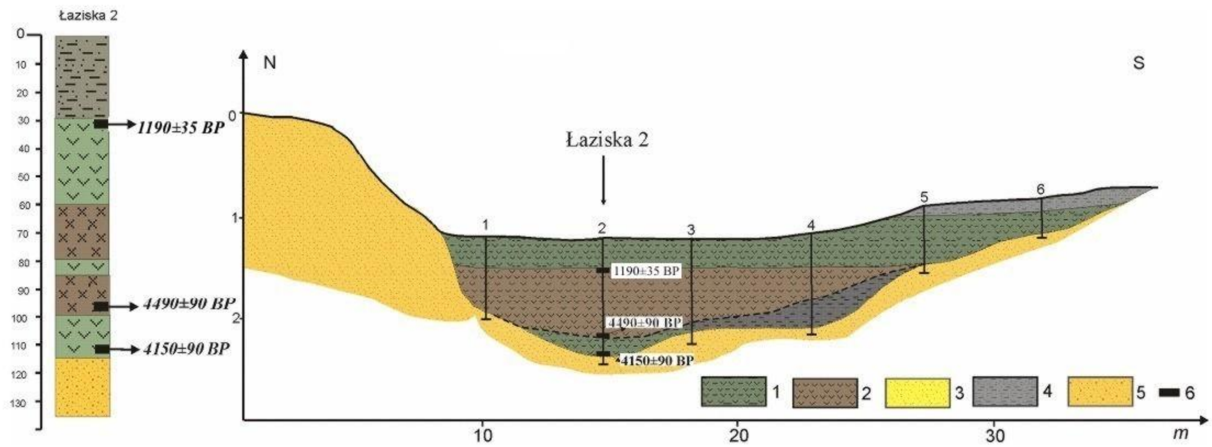


Fig. 1. Section across paleomeander at Łaziska 2
1-peaty silts, 2-peats, 3-fine sands, 3-sandy silts, 5-medium and coarse sands, 6-^{14}C dating

Cladocera and pollen analysis of the sediments filled palaeomeander were done. The sediment samples for Cladocera analysis were processed according to the standard procedure (Frey 1986); the samples were treated with hot 10% KOH. The material was then deflocculated using a magnetic stirrer and sieved through a 50 mm mesh. The slides were prepared from 0.1 ml of each sample and examined with a microscope (100× magnification). The taxonomy of the cladoceran remains in this paper follows that presented by Szeroczyńska and Sarmaja-Korjonen (2007), and the ecological preferences of the cladoceran taxa were determined based on Bjerring et al. (2009). Chydorid carapaces (representing asexual reproduction) and ephippia (representing sexual reproduction) were also enumerated. The total chydorid ephippia (TCE) was expressed as a percentage of the sum of the chydorid shells and the chydorid ephippia (Sarmaja-Korjonen, 2003).

The study sediments contain 10 Cladocera species belonging to 3 families: Bosminidae, Daphniidae, and Chydoridae (Fig. Cladocera). Five local cladoceran assemblage zones (LCAZ) have been distinguished:

ON-1 (depth 114–108 cm) Littoral taxa dominated with *Alona affinis*, *Chydorus sphaericus*, *Acroperus harpae*, and *Pleuroxus uncinatus*. There is a high incidence (30%) of pelagic forms (*Bosmina* (*Eubosmina) coregoni* and *Bosmina longirostris*). At depths 120-114, 108-106 cm no Cladocera remains occur;

ON-2 (depth 104–86 cm) Pelagic forms, (*B. (E.) coregoni* and *B. longirostris* occurs occasionally. Macrophyte/sediment-associated taxa as *A. affinis*, *Ch. sphaericus* dominated. *Pl. uncinatus*, *Alona rectangula*, and *Alonella excisa* were also noted. At depth 88-80 cm no Cladocera remains occur;

ON-3 (depth 80–44 cm) Cladocera numbers increased, with over 1,500 specimens cm^{-3}. Littoral species are dominated by *Ch. sphaericus*, *A. affinis*, and *Al. excisa*. Sediment-associated, *Pl. uncinatus* as well as pelagic occurrence of *Simocephalus* sp. were also noted. At depth 44-34 cm cm no Cladocera remains occur;

ON-4 (depth 34-28 cm) Only a two littoral, macrophyte/sediment taxa - *A. affinis* and *Ch. sphaericus* are observed.. At depths 32-28 and 26-2 cm no Cladocera remains occur;

ON-5 (depth 2–0 cm) Few littoral taxa such as macrophyte-associated taxa (*Al. excisa* and *Ac. harpae*) and macrophyte/sediment taxa (*A. affinis*, *A. rectangula*) as well as pelagic occurrence of *Simocephalus* sp were noted.

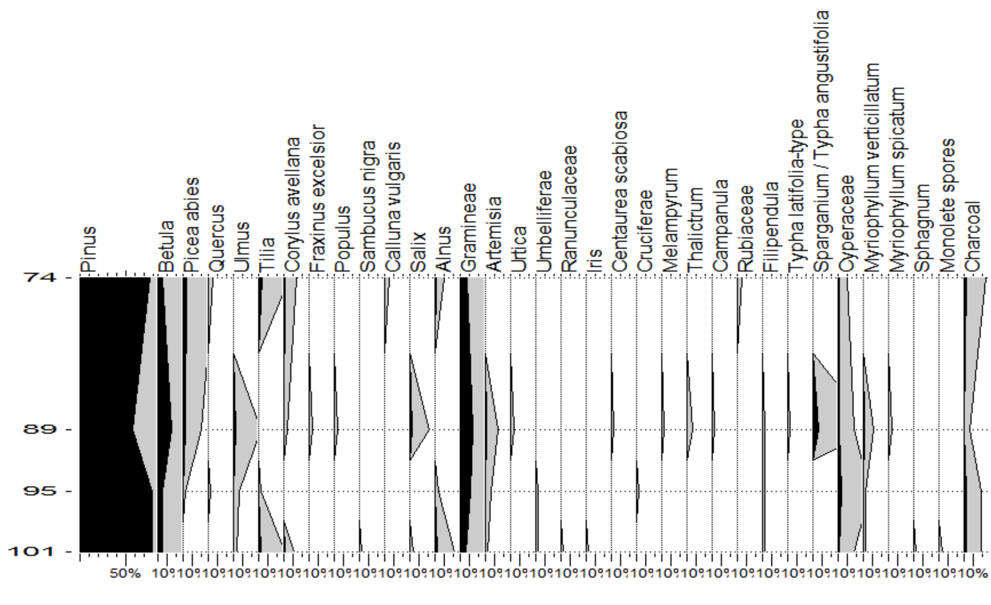


Fig. 2. Expertise palinological diagram from lower part of palaeomeander fill at Ostrów (by L. Petr)

Pinus is dominating species in expertise pollen diagram. Also admixture of some leaf tree species occur which appeared since the Atlantic. It confirms the Subboreal age of these sediments (Fig. 2).

Subboreal cut-fill body is cut by paleochannel of much smaller parameters probably of the Subatlantic age, accompany the modern channel (Fig. 2 in the previous subchapter).

REFERENCES

Bjerring R., Becares E., Declerck S., Gross E.M., Hansson L-A., Kairesalo T., Nykänen M., Halkiewicz A., Kornijów R., Conde-Porcuna J.M., Seferlis M., Noges T., Moss B., Amsinck S.L., Vad Odgaard B., Jeppesen E., 2009, Subfossil Cladocera in relation to contemporary environmental variables in 54 Pan-European lakes, Freshwater Biology 54, 2401–2417.

Frey D.G., 1986, Cladocera analysis [in:] Handbook of Holocene paleoecology and paleohydrology (ed. B. E. Berglund), John Wiley and Sons, Chichester, 667–692.

Sarmaja-Korjonen K., 2003, Chydorid ephippia as indicators of environmental change-biostratigraphical evidence from two lakes in southern Finland, The Holocene 13, 691–700.

Szeroczyńska K., Sarmaja-Korjonen K., 2007, Atlas of subfossil Cladocera from central and northern Europe, Świecie, Friends of Lower Vistula Society, 1–87.

Pleistocene terrace III at Ostrów (site 3)

Joanna Krupa

Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland

joanna.krupa@ujk.edu.pl

Between Morawica and Ostrów valley slop is very small 0,98‰, and sinuosity index is 1,31. In this section on the left site of the valley preserved narrow strip of 9 -10 m high terrace. In its profile sandy with gravel alluvia are covered by rubble slope deposit (Fig. 1).

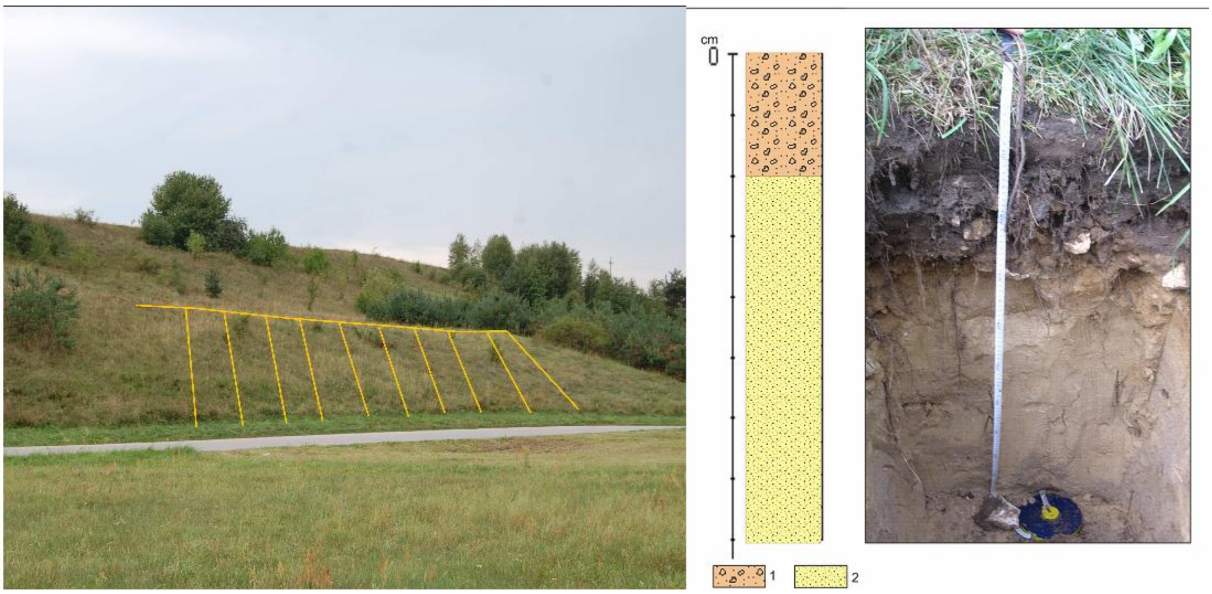


Fig. 1.Alluvia and terrace III (10 m) near Ostrów
1-slope deposits, 2-sandy-gravel alluvia

Roman-Medieval multichannel system at Ostrów

Joanna Krupa
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland
joanna.krupa@ujk.edu.pl

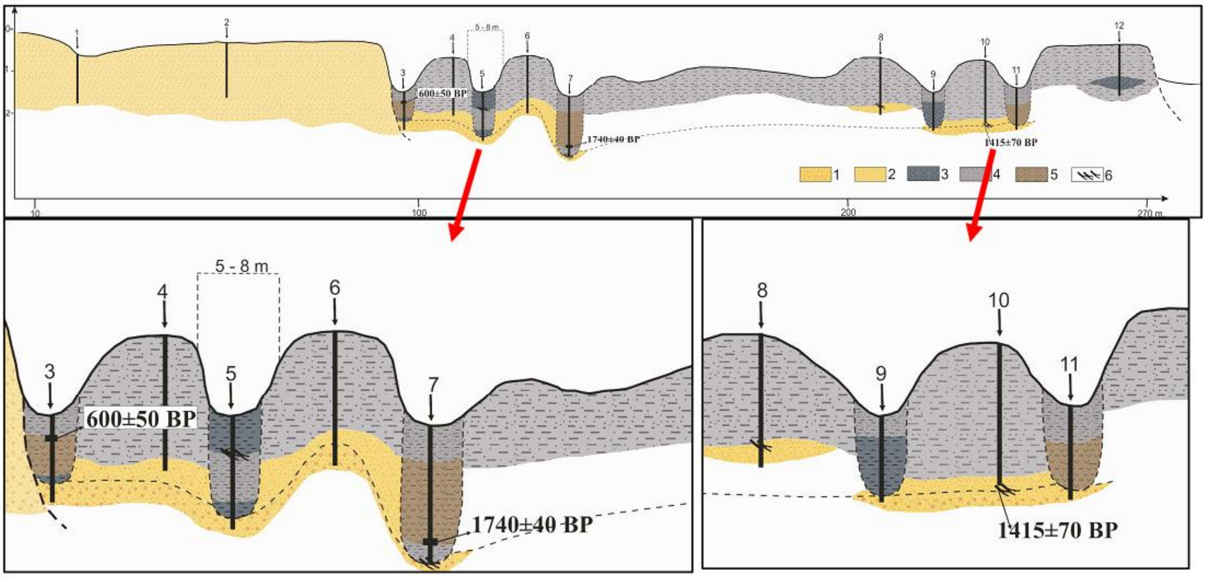


Fig. 1. Section across valley bottom with remains of multichannel system
1 – gravel with sands, 2 – sands, 3 – silts, 4 – sandy silts, 5 - peaty silts and silty peats, 6 - branches and detritus

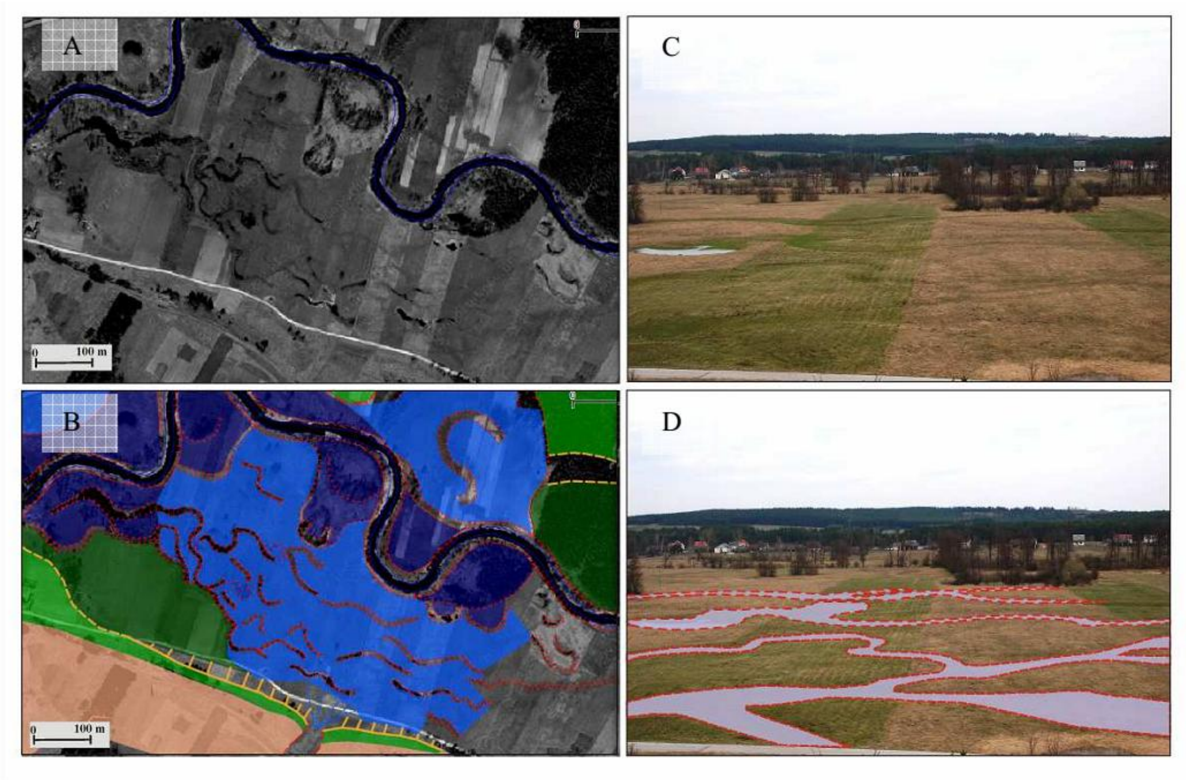


Fig. 2. Multichannel system near Ostrów (areal photographs 1969) (A), geomorphological map (B), view in the field (C), reconstruction (D).

Multichannel systems are preserved in some places of the flood plain (seegeomorphological map in introduction). Due to their morphological position, morphometric characteristic and structure of alluvia can be classified as an anabranching channel active during the Holocene (Roman time)(Fig. 1, 2).

In the valley edge multichannel system cut the terrace build of sandy and gravel sediment, its hight and structure indicates that is the fragment of the valley form the period of large meanders. Multichannel segment of the floodplain is bouild of sandy sediments (Mz = 3,13-2,05 ϕ and $\delta 1$ = 0,31-1,56), covered by sandy silts 1-1,50 m thick. Branches and detritus from the upper part of sandy series were dated on 1415 ± 70 (cal. 530AD-780AD) BP. Paleochannels fill silty-organic sediment 70 cm to 150 cm thick with organic matter content 28,8-54,8% (Ostrow 3) and 48,4-44,8% (Ostrow 7). Two basal part of abandoned channel fill were dated older and deeper on 1740 ± 40 BP (cal. 210AD-410AD) and younger 600 ± 50 BP (cal. 1280AD-1420AD).

Subatlantic buried soil at Zbrza

Joanna Krupa

Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarcheaology and Environmental Management, Poland

joanna.krupa@ujk.edu.pl

Fossil soils identified in many outcrops indicate phases in silty (mud) accumulation, increased rate of accretion and soils fossilization along modern channel in the last millennium 1230±70 BP (cal. 660-900 AD) (Zbrza 1).

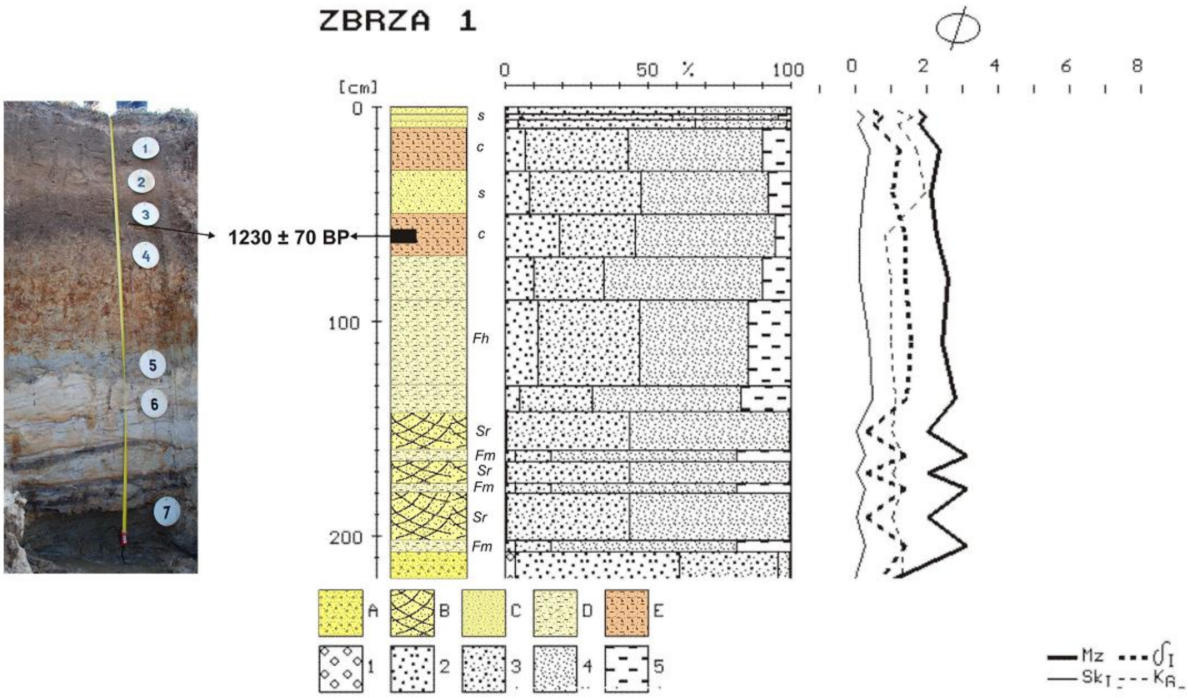


Fig. 9 Profiles of floodplain deposits Zbrza 1 A – medium sands, B- cross bedded sands , C – sands, D – silty sands, E – buried soil. kopalnej, 1 – gravels, 2 –medium sands, 3 – fine grained sands, 5 - silty sands, Folk-Ward's statistical parametres of grain size: Mz – mean diameter, δ –standard deviation (sorting)

ANCIENT METALLURGY ON THE NIDA RIVER AS A POTENTIAL ENCLAVE OF BLOOMERY CENTRE IN THE ŚWIETOKRZYSKIE MOUNTIANS (HOLLY CROSS MOUNTAINS)

Andrzej Przychodni
Voyevodship Office of National Heritage in Kielce
andrzejp@korzenie.gimnazjum.com.pl

Research of Przychodni and Orzechowski (2002) and Przychodni (2002) suggesting the functioning of iron-producing centre in the basin of the Upper Nida during Roman times, which could have been similar in its character to the enclaves of the Świetokrszyskie Mountains iron-producing district, existing on the River Iłżanka and the Krępianka (see Belenin 1992). The majority of newly discovered facts associatged with iron-processing are concentrated within the area on the middle Czarna (Black) Nida. Areal documentation of site location preferences indicates a certain regularity in locating them close to the bloomery furnace clusters in Bilcza (site number 1 on the Fig. 1) on the lower slopes of valleys of small water courses (streams or rivulets).

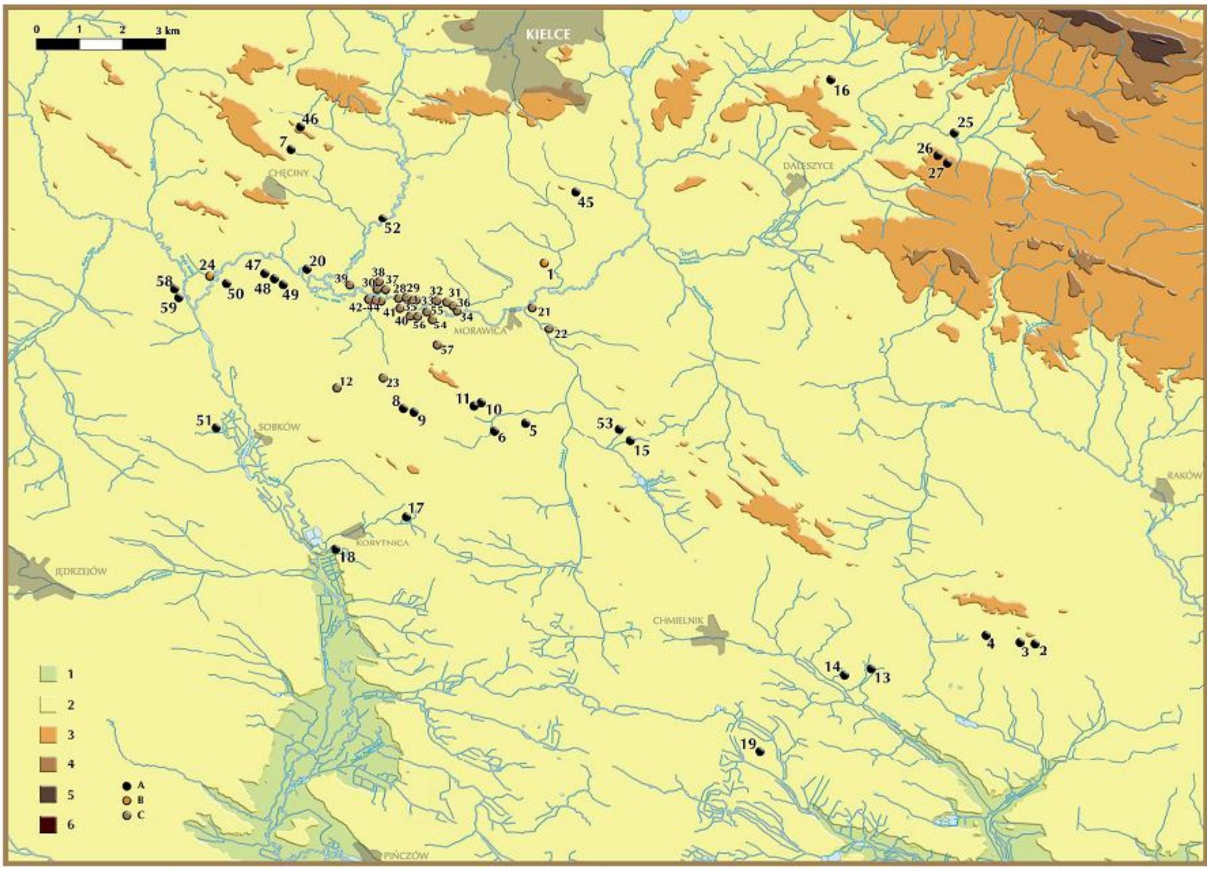


Fig. 1 Bloomery sites in the tributary of the Upper and Middle Nida, the Wschodnia, the Kakonianka and the Warkocz
1 – 100-200 m a.s.l., 2 – 200-300 m a.s.l., 3 – 300-400 m a.s.l., 4 – 400-500 m a.s.l., 5 – 500-600 m a.s.l.. A – sites know from surface research, B – excaveted sites, C – sites discovered and verified during 2003-2005. Site number correspond to cataloge numbers.

On the basis of sparsely represented but precisely dated finds, the chronological framework of the Przeworsk culture settlement in this area can be determined from phase A2 of the late Pre-Roman period util late Roman period, or even 4th or 5th century A.D.

(Godłowski 1985, Kaczanowski, Madyda-Legutko 1986, Bochniak, Przychodni 2002). It should be metioned that there is a possibility of close links exisiting between the testimony of ancient iron processing and the evidence for the functioning of an ironprocessing centre on the Nida, confirmed by burials containing smith's tools in Korytnica, Sobkow dis. and Szaniec, Busko-Zdroj dis. (Skurczyński 1947, Skurczyński 1956, Wielowiejski 1960, Kokowski 1981, Żygadło 2002, Przychodni 2005). The chronological position of the centre on the Nida was defined by the ^{14}C analysis of the charcoal samples taken from furnace pits located on the site 8/45 in Bilcza. Lack of data from other sites of this centre makes it impossible at present to deduce whether metallurgic activity on the Nida River was undertaken earlier, later or simultaneously with iron producing in the Świetokrszyskie Mountians iron producing district, It cannot be positively stated either, whether "black metallurgy" in this area was of only ephemeral character, or if it was a more permanent activity of the people inhabiting the region in the Remon period. At present, it seems that the centre of ancient metallurgy on the Nida River encompasses lower and middle parts of the Czarna Nida tributary: the Chodcza, the Morawka, the Bobrza and Czarna Nida itself, a part of lower Biała (White) Nida tributary and a fragment of the left-bank Upper Nida tributary (Fig. 1). Raw material resource for the metallurgy activity in the region were the local bog iron ores, found at the bottom part of the river valleys. Most probably the presence of larger iron ore deposit influenced the decision of cemmencing iron-production. At the same time, it must be admitted that metallurgic activity on the Nida was not as intensive as the production in the Mazovia iron-producing centre, which was also based on bog iron ore (Woyda 2002). The hypothesis concering the possibility as identifying the metallurgy centre an the Nida as an enclave of the Świetokrzyskie Mountains district is based on the fact that a schame of double-tuyere ironworks consisting of rows of furnace triples was used on the site Bilcza (Fig 2). This feature of "production space organization" indicates links with the concept of "organized" furnace cluster in the Świetokrzyskie Mountains area (Belenin 1992). It needs mentioning, that using clay tuyere blocks for building the furnaces is a feature sporadically noticed outside the Świetokrzyskie Mountians centre.

Fig. 2 Bilcza-Zastawie, site 8/45. Plan structures discovered during 1999-2000

REFERENCES

Bielenin K., 1992, Starożytne górnictwo i hutnictwo żelaza w Górach Świętokrzyskich, Kielce.

Godłowski K., 1985, Przemiany kulturowe i osadnicze w południowej i środkowej Polsce w młodszym okresie przedrzymskim i w okresie rzymskim, Prace Komisji Archeologicznej 23, Wrocław-Warszawa-Kraków-Gdańsk-Łódź.

Kaczanowski P., Madyda-Legutko R., 1986, Stan i potrzeby badań nad młodszym okresem przedrzymskim i okresem rzymskim w Małopolsce [in:] Stan i potrzeby..., 89-119.

Kokowski A., 1981, Pochówki kowali w Europie od IV w. p.n.e. do VI w. n.e., Archeologia Polski 26, 1, 191-218.

Przychodni A., 2002, Ośrodek starożytnej metalurgii żelaza nad Nidą [in:] Hutnictwo świętokrzyskie oraz inne centra i ośrodki, Kielce, s. 45-60.

Przychodni A., 2005, Groby kowali z cmentarzyska kultury przeworskiej w Korytnicy, powiat jędrzejowski, woj. świętokrzyskie, stanowisko 1/22., AAC.

Przychodni A., Orzechowski Sz., 2002, Zespół pieców dymarskich z Bilczy, gm. Morawica, woj. świętokrzyskie, [in:] Uczniowie Agricoli, Materiały z konferencji górniczej w Kowarach z 1999 roku (ed. A. Grodzicki, M. W. Lorenc), Jelenia Góra, 56-73.

Skurczyński S. ks., 1947, Archeolog na probostwie [in:] Pamiętnik Kielecki, Przeszłość kulturalna regionu, Kielce, 9-40.

Skurczyński S. ks., 1956, Szaniec, pow. Busko, ZOW, t. 24, Warszawa, s. 43.

Wielowiejski J., 1960, Przemiany gospodarczo-społeczne u ludności południowej Polski w okresie późnolateńskim i rzymskim, MS, t. 6, Warszawa.

Woyda S., 2002, Mazowieckie Centrum Metalurgiczne z młodszego okresu przedrzymskiego i okresu wpływów rzymskich [in:] Hutnictwo świętokrzyskie oraz inne centra i ośrodki, Kielce,. 121-154.

Żygadło L., 2002,Narzędzia żelazne związane z obróbką metali w kulturze przeworskiej [in:] Hutnictwo świętokrzyskie oraz inne centra i ośrodki, Kielce.

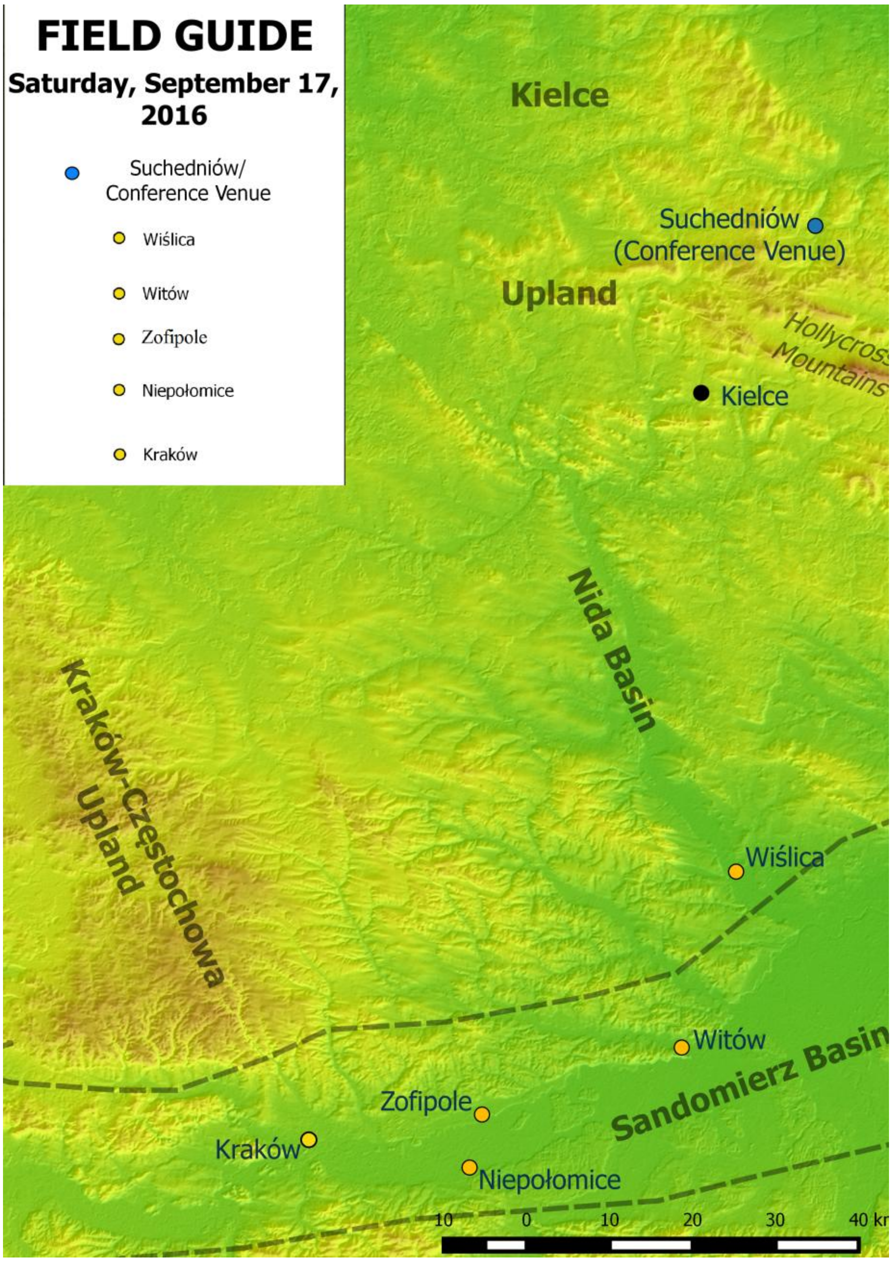
17.09.2016 Saturday - Fourth day of excursion

River valley evolution of Nida Basin and Subcarpathian Basin area

7:00 Suchedniów (breakfast)
08:00 FIELD EXCURSION (pocket lunch)

- **Wiślica** (sediments of Nida river valley, gypsum domes; Old City+ surprise)
- **Witów** (Tertiary/Quaternary alluvia (molasa) in the Subcarpathian Basin)
- **Zofipole** (Late Glacial and Holocene evolution of the upper Vistula river valley; geoarchaeology of Roman period)
- **Niepołomice** (Old city, Medieval castle)

Cracow (OFFICIAL END OF THE FIELD TRIP)
Suchedniów (bus will come back to hotel)



RELIEF AND SEDIMENTS OF NIDA RIVER VALLEY NEAR WIŚLICA

Emanuela Malęga, Tomasz Kalicki
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland
emanuela.malega@gmail.com; tomaszkalicki@ymail.com

Wiślica is located in southern part of Nida Basin (Polish Uplands) in the Nida river valley, tributary of upper Vistula river (Fig. 1). Due to the geomorphological regionalization this area belongs to Wiślica Funnel, depression located between two elevations Wodzisław Hummock and Pińczów Hummock (Gilewska 1972). It is a tectonic Solec trough, where the Cretaceous marls are covered with Miocene (Tortonian) rocks. In relief, the most important is the role of gypsum folded anticline and syncline in the course of the NW-SE. Karstic phenomena developed on gypsum. On the anticline lines were formed inversion karst basins

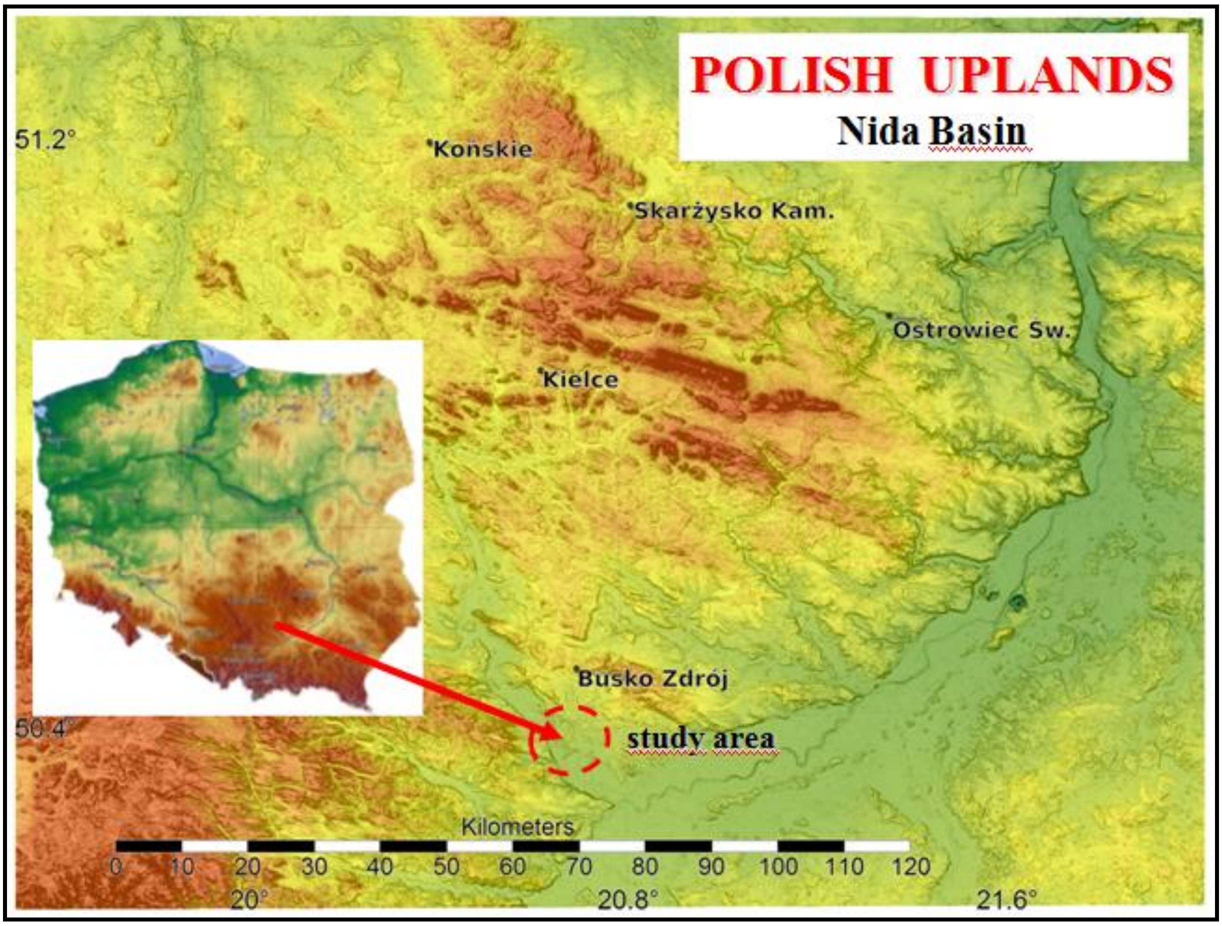


Fig. 1. Location of the study area NMT

occupied by swamps and bogs lying directly on the Cretaceous marls. On the syncline lines formed sink holes, dry karst valleys (eg. Skorocice) etc (Flis 1954). Active karst phenomena also led to the changes of direction of hydrographic pattern. A number of geological and geomorphologic data indicates the existence young subsidence movements in the area of Wiślica Funnel (Gilewska 1972).

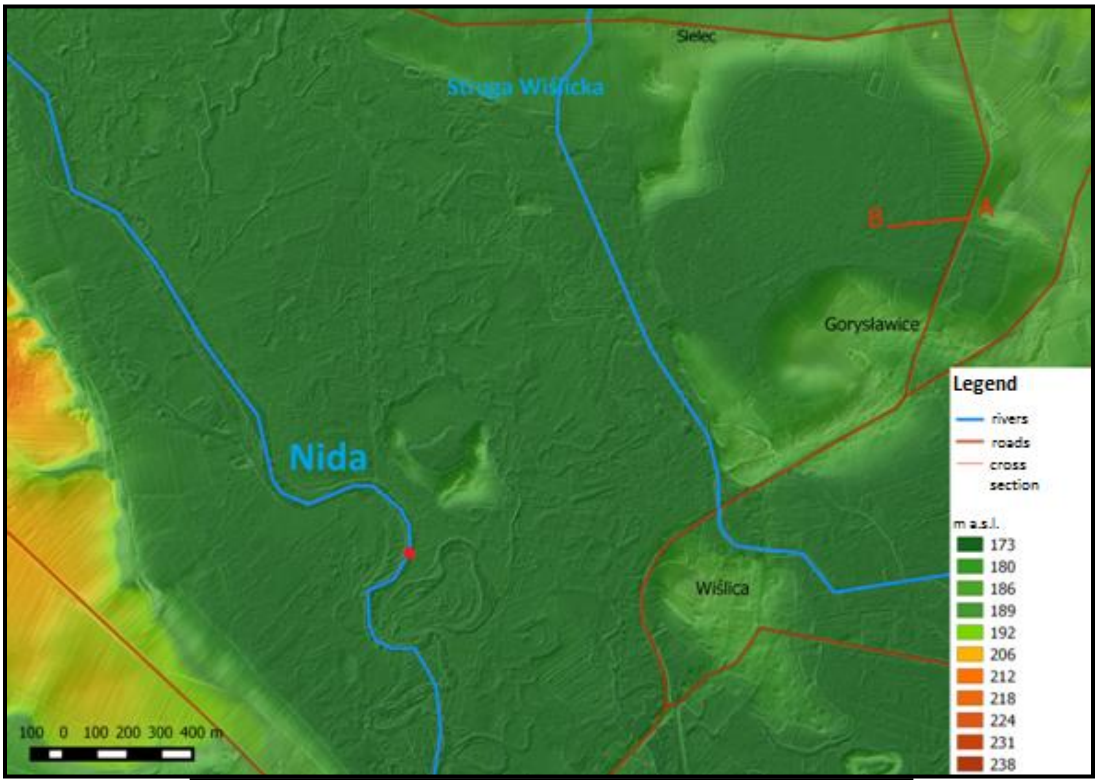
On the surface of the gypsum in Ponidzie region, there are very interesting forms a dome-shaped sculpture - gypsum dome. They have different sizes - from approx. 1 m to over 12 m in diameter and medium relative height of 60 cm. They are formed by the bent up layers or layer coarse crystalline gypsum (selenite) (Bąbel 2006a, b). Overall, in whole Ponidzie region occur about 35 domes in the 17 areas where the highest density there is exactly in the area of Wiślica. The best example of such a dome gypsum is quite massive dome gypsum that contributes to the previously mentioned Wiślica fortified settlement. Primary form of such domes also appears in the Cave of the Bells in Skorocice, which was collapsed by the action of karstic processes.

Fig. 2. The dome of gypsum located at fortified settlement in Wiślica

Marls at Gorysławice and gypsum of Wiślica anticline (present-day Wiślica town is located on it) form the eastern limit of the subsequent Nida river valley on the study section. Western slope of the valley is rectilinear and steeper than eastern one and cover with the loess deposits. Flat valley bottom has a width of 1-3 km. It is asymmetric with wide and swampy left-side and narrow right-side (Fig. 3).

Within the valley bottom on one morphological level (Fig. 4) occur:

- plain of karstic depression on the line of gypsum anticline (Flis 1954) with palaeolakes filled with peats and present-day bogs (see Gorysławice site). In NE part of the analyzed area not found any traces of the river flow,
- alluvial plain formed by Nida river, probably with the several cut-fill alluvial bodies of the different age referring to changes of river pattern during the Late Glacial and Holocene. These bodies are evidenced by oxbow lakes preserved in the morphology. There are at least two of their generations: older one, preserved in the form of a straight stretching swamps, with a fairly straightforward course, may suggest anastomosing pattern of Nida river and younger one in the form of palaeomeander preserved along the the modern riverbed. Alluvia are clearly facial differentiated (see Babia Dupa site)
- gypsum dome. Monoclinal gypsum elevations and gypsum tumuli create small overflood islands rising directly above the valley floor.



A - B – geological cross-section at Gorysławice site

geological profiles at Babia Dupa site

Fig. 3. Hypsometry of Nida valley near Wiślica with location of study cross section and profiles (NMT model)

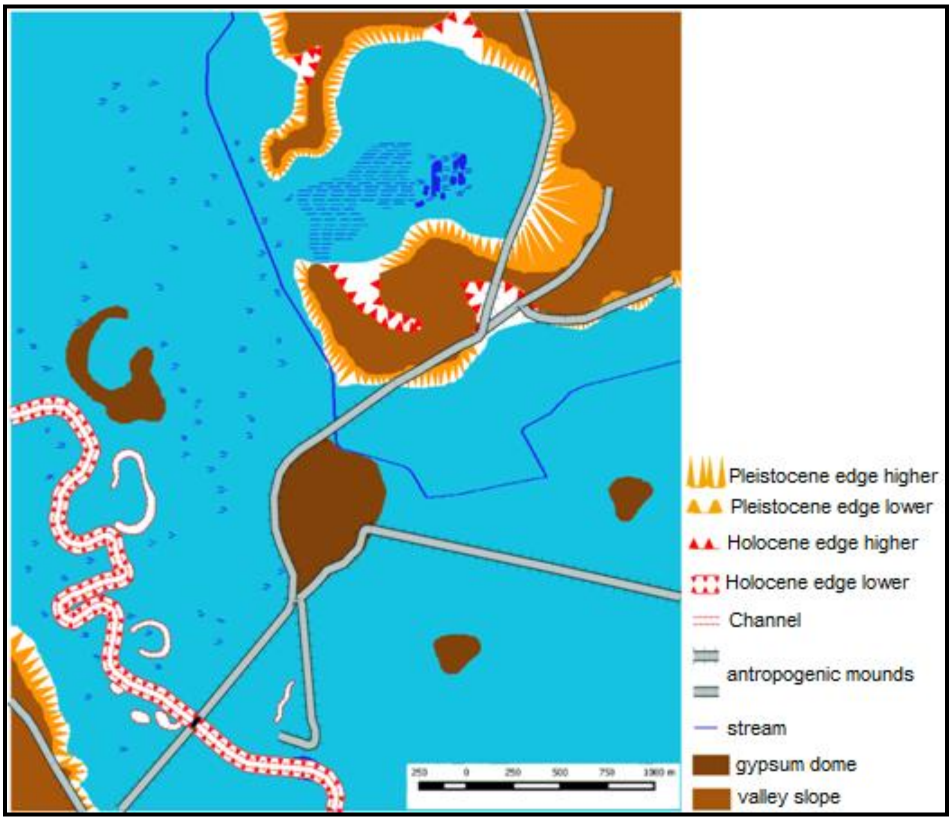


Fig. 4. Geomorhological map of Nida River Valley near Wiślica (by E. Malęga)

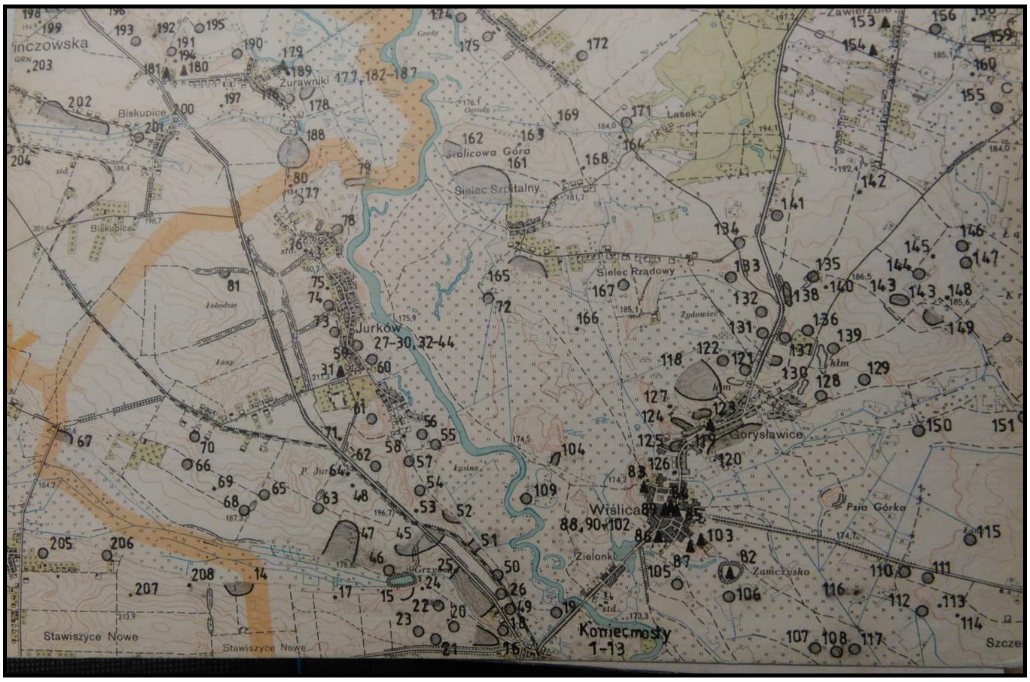


Fig. 5. Neolithic settlement near Wiślica (data from Archaeological Map of Poland)

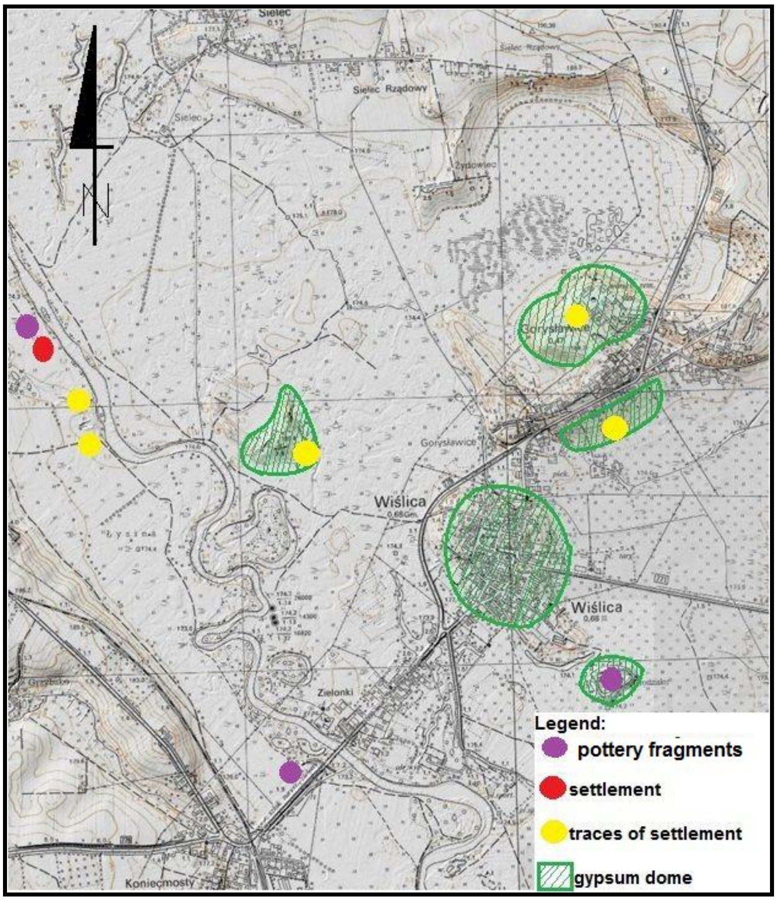


Fig. 6. Distribution of Neolithic artifacts based on data from Archaeological Map of Poland

According to the data from Archaeological Map of Poland both slopes of the valley was densely settled in the Neolithic (Malęga et al. 2016a, b)(Fig. 5, 6). However only a single Neolithic sites occur on the floodplain (4 sites) and on the border between the plain and upper terrace (3 sites). There were mainly settled gypsum domes which. constituted a favorable environment for settlement. Gypsum hill at Wiślica was settled since Neolithic. Later on one of these domes, directly at Wiślica, at the turn of 9th and 10th century A.D. was located a small fortified settlement, and in the 11th c. stronghold.

REFERENCES

Bąbel M., 2006a, Geologia gipsów nadnidziańskich, IV Świętokrzyskie Spotkania Geologiczno-Geomorfologiczne „Regionalne aspekty funkcjonowania systemów dolinnych", Jodłowy Dwór" pod Świętym Krzyżem, AŚ Kielce, 11-12.

Bąbel M., 2006b, Tumulusy gipsowe Ponidzia, IV Świętokrzyskie Spotkania Geologiczno-Geomorfologiczne „Regionalne aspekty funkcjonowania systemów dolinnych", Jodłowy Dwór" pod Świętym Krzyżem, AŚ Kielce, 12-15.

Flis J., 1954, Kras gipsowy Niecki Nidziańskiej, Prace Geogr. IG PAN 1.

Gilewska S., 1972, Wyżyny Śląsko-Małopolskie [in:] Geomorfologia Polski t. 2 (red. M. Klimaszewski), PWN, Warszawa.

Malęga E., Biesaga P., Kalicki T., 2016a, Neolithic settlement and relief of Nida river valley near Wiślica (Polish Uplands) – preliminary results,, 12 Konference Environmentalni Archeologie „Před neolitem…", 7-9.02.2016, Praga, Czechy, 39.

Malęga E., Biesaga P., Kalicki T., 2016b, Relief and settlement pattern in the Nida river valley near Wiślica, Book of abstracts "State of geomorphological research in the year 2016", (eds. Václav Škarpich, Tomáš Galia, Veronika Kapustová, Jan Lenart), Ceska Asociace Geomorfologu, 11-13.05. 2016 Frydlant nad Ostravici, 45-46.

GORYSŁAWICE SITE – RELIEF AND SEDIMENTS OF KARSTIC DEPRESSION

Emanuela Malęga, Tomasz Kalicki
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland
emanuela.malega@gmail.com; tomaszkalicki@ymail.com

In the cross-section of the flat Nida river valley floor northward of Wiślica and Gorysławice occur two different parts of valley bottom:

- karstic depression with radius about 300 m and with "gap section" (about 400 m wide) south-westward connected it with the Nida river flood plain;
- alluvial flood plain of Nida river valley.

Geological section is located in the karstic depression northward of Gorysławice and it was made with seven boreholes. For detailed analysis were selected five cores (Fig. 1, 2).

Calcareous silts with malacofauna cover with peaty silts (near the valley slope) and peats (far from the slope) occur in all boreholes. Thickness of organic sediments increase toward to central part of depression and axis of Nida river valley. The bottom of this strata (profile of borehole G 6) was radiocarbon dated at 4280±50 BP (MKL-3131) cal. 3027-2857 BC (Fig. 2). This may indicate the presence of episodic lake or pond with stagnant water here. Since the Subboreal until now peat bog and swamp occur with small ponds („water windows"). Any traces of river flow have been found within the depression.

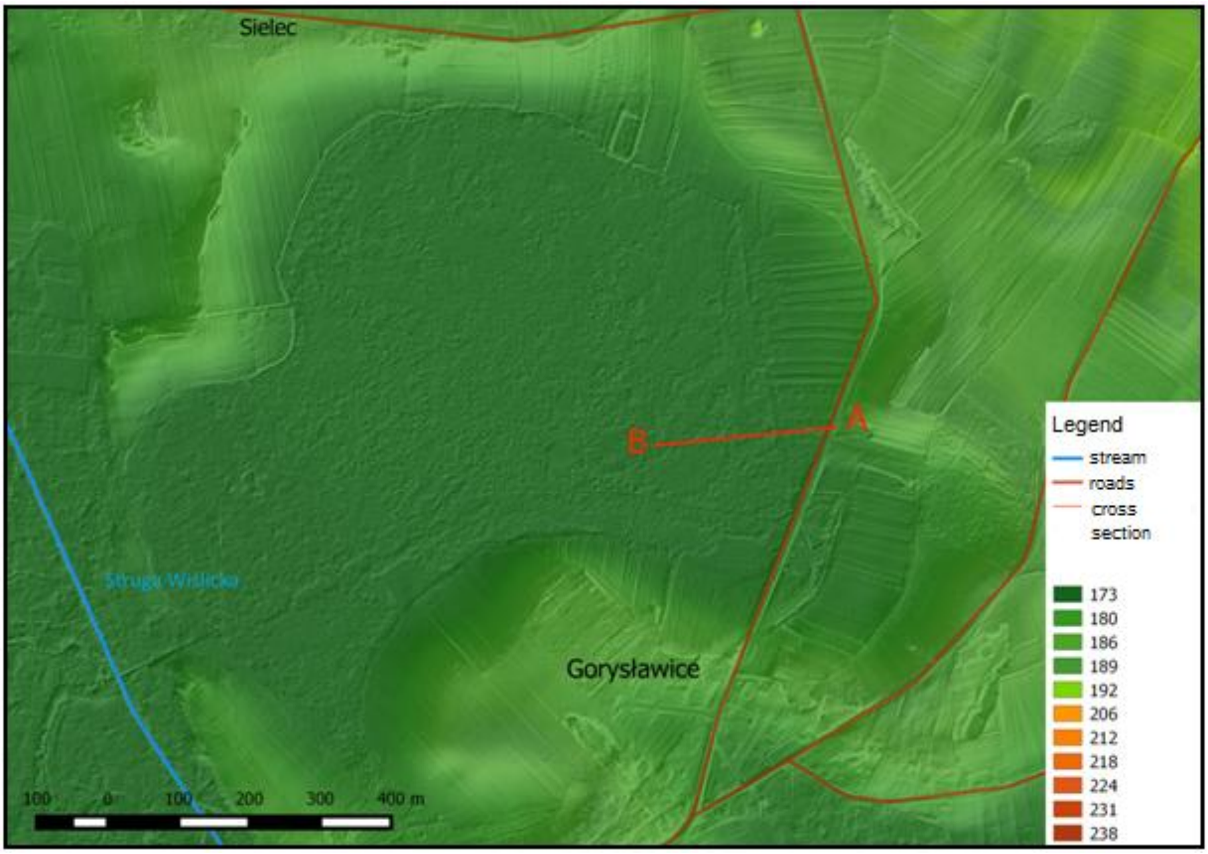


Fig. 1. Location of geological section A-B across karstic depression

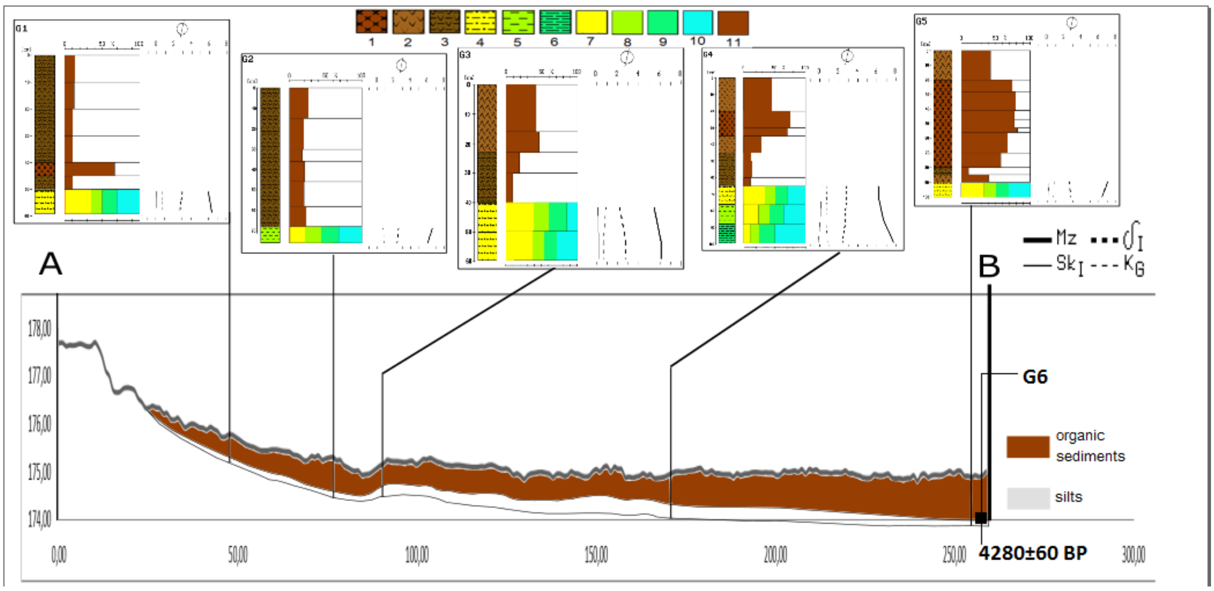


Fig. 2. Geological section across the karstic depression (by E. Malęga)

Lithology: 1 – peats, 2 – clayey peats, 3 – peaty silts, 4 – sandy silts, 5 – silts, 6 – clayey silts; Fractions: 7 – fine sand (2-4φ), 8 - coarse and medium silt (4-6φ), 9 - fine silt (6-8φ), 10 - clay (above 8φ); 11 - organic matter content

Folk-Ward's distribution parameters: Mz – mean diameter, δ_I –standard deviation (sorting), Sk_I – skewness, K_G - kurtosis

BABIA DUPA SITE – FACIAL DIFFERENTIATION OF NIDA RIVER ALLUVIA

Emanuela Malęga, Tomasz Kalicki
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland
emanuela.malega@gmail.com; tomaszkalicki@ymail.com

Study profiles were located on Nida river flood plain on the left-side river bank near gypsum dome (local name of it is Babia Dupa). Three profiles were studied on outcrop about 30 m long.

Organic sediments cover with overbank deposits occurred in BD 3 profile (Fig. 1, 2). The organic layers are probably palaeochannel fill with buried soil in the top. According to radiocarbon dating overbank deposition started about 1160±60 BP (MKL-3132) cal. 763-994 AD. Overbank alluvia has generally finning upward sequence with two members and it was accumulated in two phases of accretion. Its indicate that this accumulation could be connected with the meandering river (last stage of evolution of the Nida river). Presence of buried soil indicate also changes in fluvial activity and in rate of overbank accumulation in last millennium.

Fig. 1. Geological profile Babia Dupa 3 (BD 3)

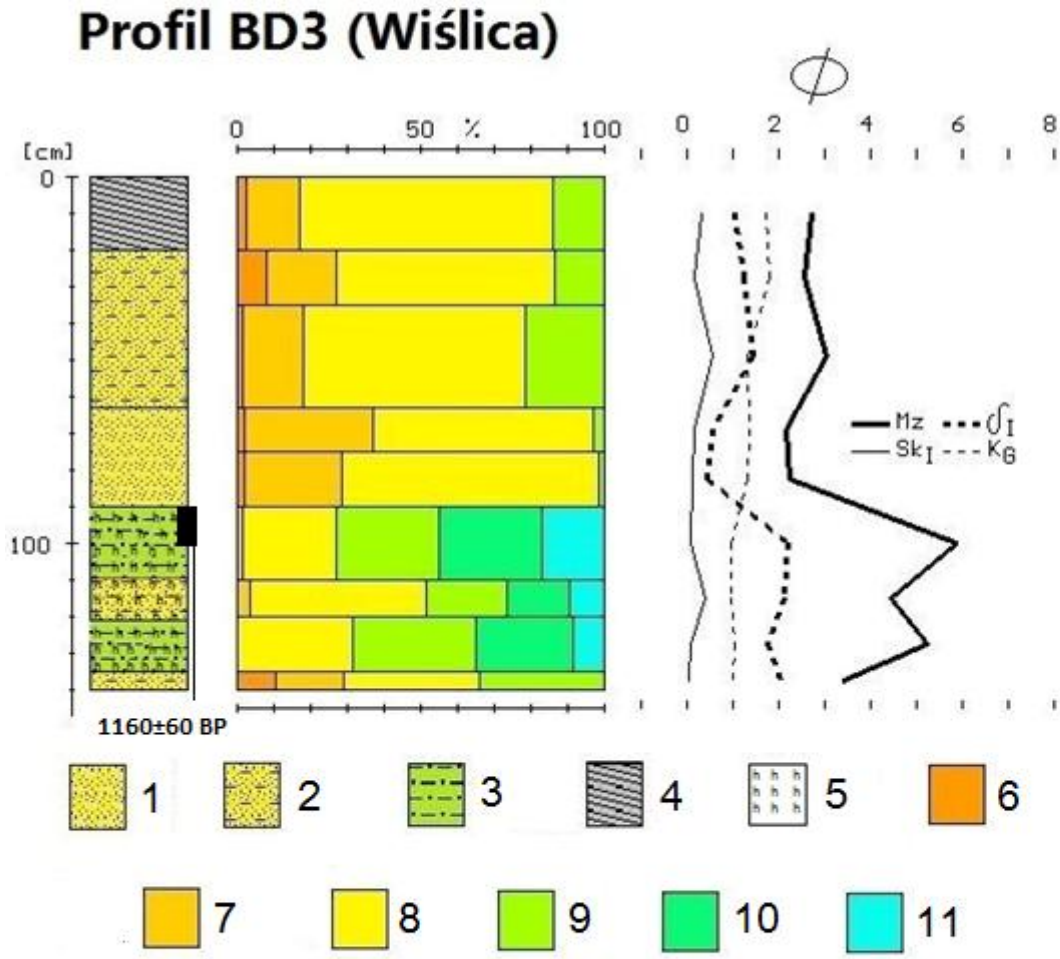


Fig. 2. Lithology, grain size and Falk-Ward distribution parameters of Nida river sediments at Babia Dupa 3 (BD 3) profile near Wiślica (by E. Malęga)

Lithology: 1 – sands, 2 – silty sands, 3 – sandy silts, 4 – soil, 5 – organic sediments; Fractions: 6 – coarse sand (-1 to 1φ), 7 - medium sand (1-2φ), 8 - fine sand (2-4φ), 9 - coarse and medium silt (4-6φ), 10 - fine silt (6-8φ), 11 - clay (above 8φ);

Folk-Ward's distribution parameters: Mz – mean diameter, δ_I –standard deviation (sorting), Sk_I – skewness, K_G - kurtosis

WIŚLICA TOWN
comp. Marcin Frączek

Wiślica is one of the oldest settlement in medieval Minor Poland. The name comes from the river Vistula. The settlement was mentioned for the first time on the sources from 1135. Wiślica, though today only a small village, is one of the most ancient settlements in Poland, and has played an important role in Polish history. The town was founded more than 1000 years ago, close to the important commercial routes, running from Kraków to Sandomierz. At that time it was probably the capital of the famous tribe Vistulans. The land of Vistulans, after coming under temporary rule of Great Moravian and Bohemia, was incorporated into Poland by Mieszko I in 990. The first guarded settlement was probably founded at the end of the 9th century.

Fig. 1 The Hillfort, 9th/10th century

In the late 1950s, archaeologists discovered the foundations of the St. Nicholas church, dating back to the 10th or 11th century, which is exposed at the museum pavilion. The church was small: 6.65 m long and 3.40 m. wide, with one aisle, and a semicircular apse. It is one of the oldest churches in market settlements of the Małopolska region.

The famous gypsum baptismal font located under the foundation of the church became a scientific sensation and the subject of heated discussions after its discovery. Probably it was served as a font for collective baptising in the 9th century. If so, it would be the place of the earliest baptism on Polish grounds. This event is mentioned in Life of st. Methodius as, so-called Pannonian Legend.

At the beginning of 13th century, Wiślica constituted important military and administrative centre. Wiślica's castellans were affluent and significant clerks in Minor Poland. By the first middle of XIII century sixteen years long competition between princes Henry Bearded and Conrad Masovian and their sons Henry the Pious and Boleslav Kondratowicz took place. In battles was also took part mighty clans. What remained undestroyed after the clashes of princes, demolished Tatar invasion in 1241. Administrative centre was moved from the destroyed Wiślica to the Korczyna New Town.

It was probably during the reign of Łokietko, when Wiślica was given civic rights, however no documents remain which can prove it. We have first trustworthy information about location from 1345, when Casimir the Great prohibited tax collectors from collecting duty. But it is not impossible that Wiślica was located, according to the German law, by the *middle of 13th century by Boleslav the Bashful. When the authority of Łokietek was powerful enough, he called together knight's rallies to Wiślica, hence it gained all-Polish fame. In 1409 Ladislas Jagiełło issuing trappings confirmed Magdeburg law for Wiślica.*

Fig. 2 St. Nicolaus Church, 10th century

Fig. 3 Unique Slab of Orants, 1175 AD

In the 12th century Wiślica became an important centre of court, intellectual and political life. It was given the status of outstanding cultural centre by the wife of prince Casimir the Just. In the years 1166–1173 the town was the capital of the duchy of Wiślica. This is probably when the truly royal, unique in Poland, residential complex consisting two big palaces and the additional round chapels was erected. Also another church was founded.

Its remains are hidden in Basilica vaults among the relicts of third Wiślica's sanctuary. Their discoveries turned out to be a great sensation, especially the floor of the burial crypt of the first Romanesque church built in this place around 1170. It is the priceless work of the art and monument of Romanesque style.

Located in the burial crypt of the 12th-century church, so-called Slab of Orants is a gypsum panel with engravings filled with black paste mixed with charcoal. It's showing two fields with plain figures separated and surrounded by decorated strips fringes, showing mythological creatures: griffins, a female centaur and the tree of life. Probably the figures represents prince Henry of Sandomierz and Kazimir the Just with their families. It is also a burial place of Henry of Sandomierz. The church with Slab of Orants was replaced in the 13th century by bigger, three-aisled basilica. Its remains are still visible in the vaults and are represented by decorative ceramic floor.

In town often took place nobility conventions, what caused Wiślica bloomed. The city is crossed by transit route from Ruthenia to Krakow and also from Prussia to Hungary. Wiślica quickly became a place of trade and craft, inns, mills and bakeries came into being, beer famous even on the king's court consequence, in 1633 Wiślica was made by Parliament tax-free for five years.

After Swedish Wars (1655-1660) complete decline of Wiślica took place. By establishing two more markets, King John Sobieski did his best to save the situation in the town. Successive efforts to raise the town from downfall were undid by Poland's partition. Initially, Wiślica occurred in the Austrian annexation, and after 1815 within Congressional Kingdom boundary, and later on within Polish Kingdom.

After January uprising, it lost its civic rights, though it remained significant trade center in the region. Settlement was destroyed during the First World War.

After the campaign, situation of inhabitants in several towns of Radom's District was really poor because their home towns were destroyed, inter alia in Wiślica. During the first weeks of war 32 people were shot at the meadow near Wiślica. This event caused great fear toward German terror increased. All Jewish people were driven out in 1942. However, Wiślica's community had never reconciled themselves to German captivity. For this reason underground army was born. In revenge to committing acts of sabotage, Nazis applied mass repressions and executions. From August 1944 till January 1945 Germans created labour-camps, banding people together in barns and farm buildings. They were forced to work for Germans, among other things clearing the streets of snow.

In July 1944, on the territories liberated by partisans, so-called Pińczowska's Republic was established, with Wiślica included. Absolute liberation from occupant hands took place from 12 to 13 January 1945. Years of occupation brought thousands of casualties in that area. Just in Wiślica 3.5 thousand inhabitants(70%) were killed. Most of them there are Jews murdered in 1942 in Treblinka and people who took on try to save their neighbours, e.g. Klajnplaca, whom was hidden by Zenon Romański, Barucha with 4 years old daughter and five others shot on manure. Piter and Bronislav Kupisz were also shot for hiding three Jews. Nowadays, Wiślica inhabits 680 people, mostly farmers. Into Wiślica commune come villages: Brzezie, Chotel Czerwony, Gluzy, Górki, Gorysławice, Hołudza, Jurków, Kobylniki, Koniecmosty, Kuchary, Łatanice, Ostrów, Sielec, Skorocice, Skotniki Dolne, Skotniki Górne, Szczerbaków, Szczytniki, Wawrowice i Wiślica.

The area that surrounding Wiślica conduces rest. There are beautiful forests, meadows and calmly flowing river Nida here. The enthusiasts for history can visit in Wiślica square marketplace dated on town location period and houses standing by it form 19th and 20th century.The oldest tenement house originates from 17th century. The most valuable monument is gothic collegiate church dedicated to Saint Mary the Virgin's Birth.

Historical article excerpted from www.sztetl.org.pl

WITÓW SITE: ORIGIN AND AGE OF THE „*WITÓW SERIES*" NEAR CRACOW

comp. Tomasz Kalicki based on paper Brud (2004)

Gravel pit at Witów is located on the left-side bank of the Vistula river (Fig. 1) in the western part of Sandomierz Basin (Fig. 2, 3). In the gravel pit, Witów Series and the Quaternary deposits are visible.

Witów Series (ca. 22 m) consists of thick beds of sand (crumbling sandstones) with gravel, gravels and cobbles, sometimes very coarse-grained, and sometimes with the boulders admixture. Maximum diameters of clasts reaches up to 0.7 m. Clasts are formed mainly from the most resistant sandstones of Carpathian origin. They are accompanied by crystalline rocks and limestones of the similar origin. Witów Series was formed by braided river. In the intercalations of siltstones and in sandstones fossil plant remains (Late Miocene to Pliocene age) are found. Also joints and faults are present. Basing on results of sedimentological studies, macro- and microfaunistic and palynological analyses, as well as petrographic research, the Witów Series has been interpreted as a succession of a braided river shed into a retreating marine basin. Results of petrographic analyses and faunistic studies indicated that the source area for this series was located in the Outer Carpathians. No traces of material supply from the Małopolska (Lesser Poland) Upland have been found. Age estimation of floristic remains point to the Late Miocene-Pliocene.

Lower part of Quaternary sediments consists of mixed gravels, material from Witów Series and that of glacial origin - mainly Scandinavian crystalline rocks and flints (San II glaciation). In the top of the outcrop loess Vistulian age occur.

REFERENCES

Brud S., 2004, Palaeogeography of the western Sandomierz Basin n Late Neogene and Early Quaternary times (Carpathian Foredeep, South Poland), Annales Societatis Geologorum Poloniae 74, 63-93.

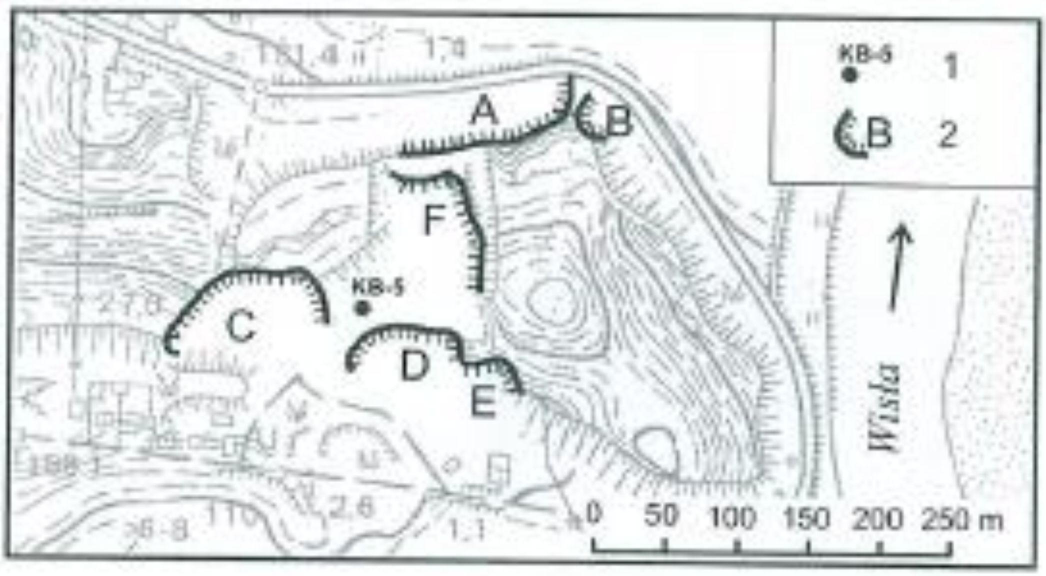


Fig 1. Location of the Witów site (Brud 2004)
1 – borehole KB-5, 2 – present-day course of escarpment at the Witów pit

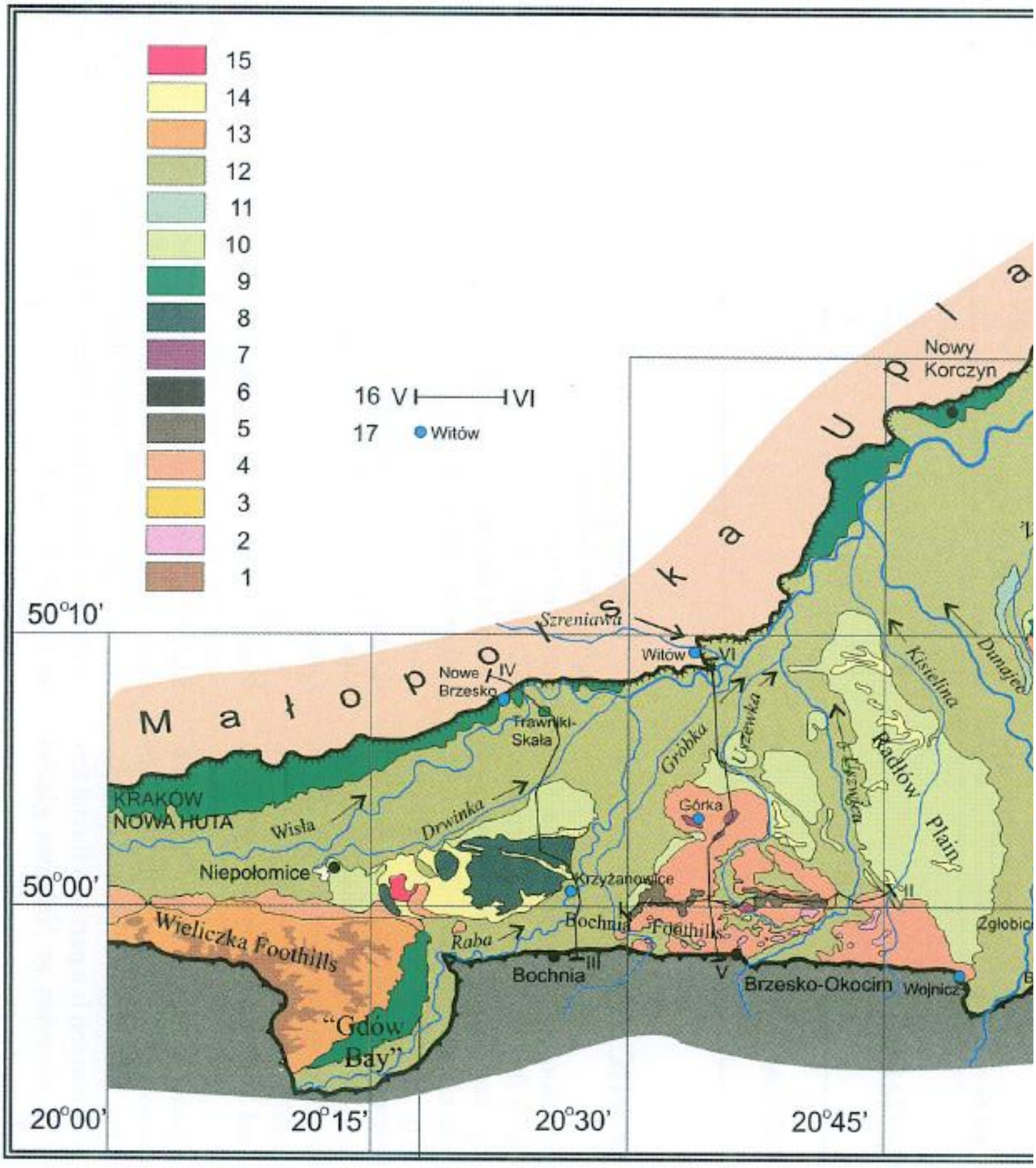


Fig. 2. Geologic-geomorphological map of the western part of the Sandomierz Basin (Brud 2004)

1 – planation surfaces elevated 300-280 m and 270-250 m a.s.l. 2 – Eopleistocene gravel covers at ca. 250-240 m a.s.l., 3 – Błonie gravel horizon at 70 m above Dunajec river bed and 260 m a.sl. (Narevian or Nidanian glaciations?); San glaciations: 4 – fluvioglacial covers, 5 – morainic plateaus, 6 – morainic hills, 7 – kames; Middle Polish (Oder, Wartha) glaciations: 8 – terraces 25-13 m above river beds (a.r.b.); Vistulian glaciations and Holocene: accumulational terraces 9 – 25-20 m a.r.b., 10 – 12-8 m a.r.b., 11 – 7-5 m a.r.b., 12 – flood plains 4-3 m a.r.b., 13 – loess and regolith covers upon planated surfaces in the Wieliczka Foothils and Outer Carpathian margin, 14 – wind-blown sands and dune areas, 15 – peat-covered plains, 16 – geological cross-section, 17 – study sites

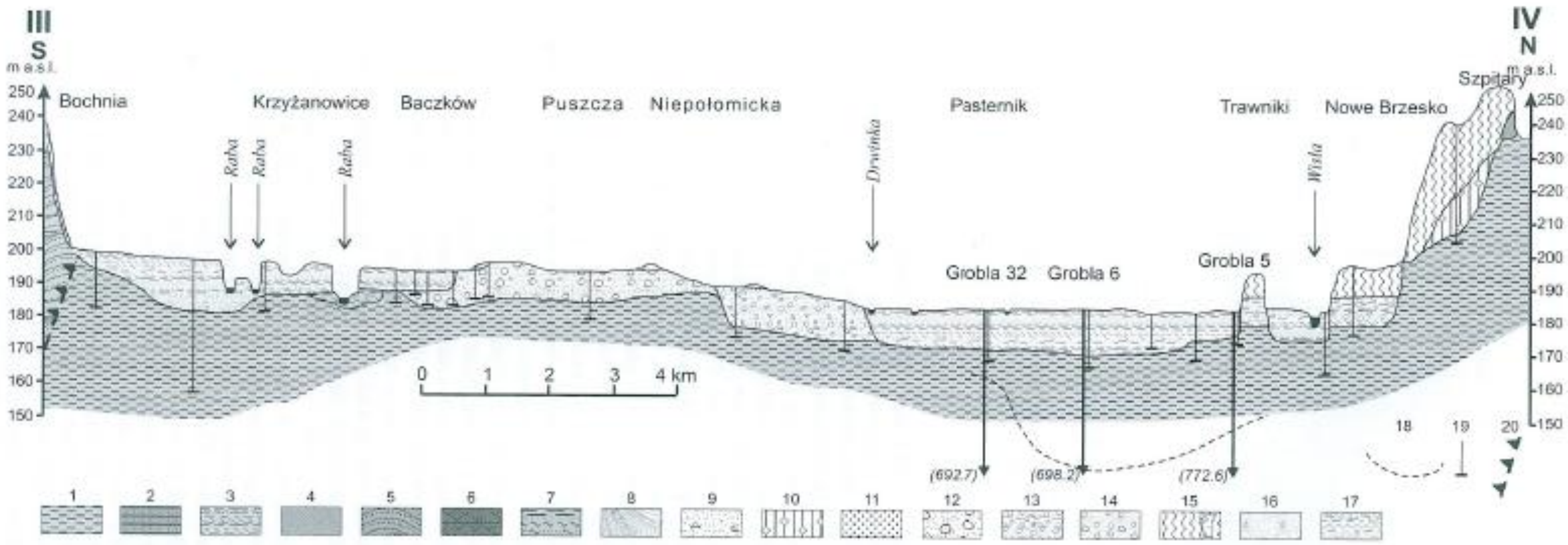
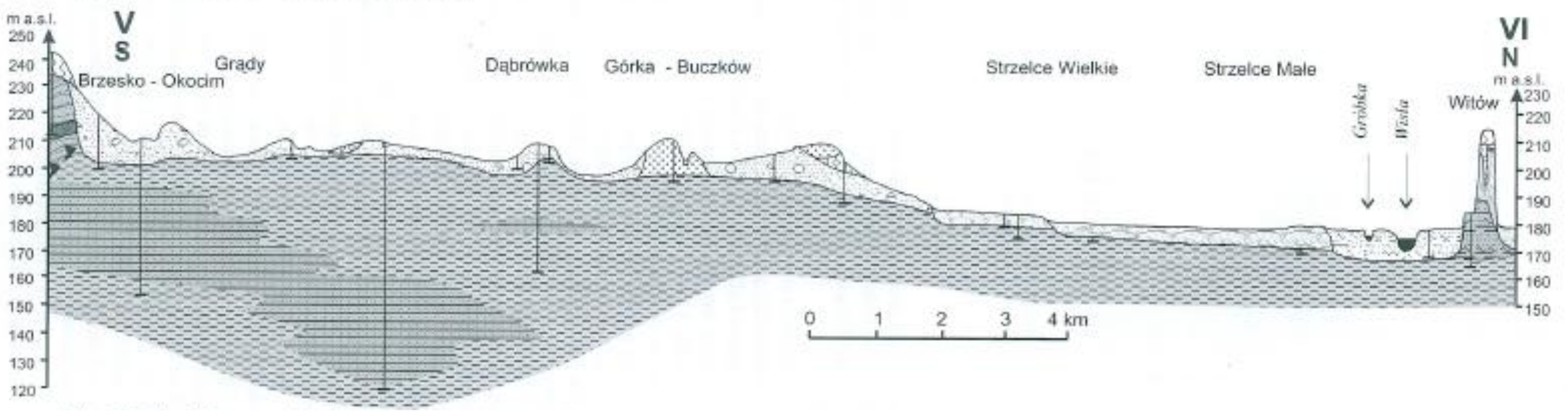


Fig. 3. Geological cross-sections III-IV and V-VII (Brud 2004)

Miocene: 1 – Clays, 2 – sandstones, 3 – clays, silts, 4 – clays, silty sands, pebble mudstones of submarine slumps, 5 – sandstones, sands, sands with intercalations of silts and clays (Zgłobice Unit), 6 – gypsum, 7 – clays, silts, sands (lower part of the Witów series), 8 – sands, gravels (upper part of the Witów series); Quaternary: South-Polish Glaciacion; 9 – fluvioglacial sands and gravels, 10 – tills, 11 – sands and silts of kames; Middle-Polish Glaciations: 12 – gravels and sands of the Raba river terrace (alluvial fan); Vistulian Glaciation and Holocene: 13 – gravels and sandy gravels of the Vistula river upper terrace (“loess terrace”), 14 – sands with gravels of the Vistula river high terrace, 15 – loess, loess-like loams, slopewash sediments, and infills of young erosional scours, 16 – aeolian sands and dunes, 17 – gravels, sands, muds of the Vistula and Raba river flood plain; top of Miocene strata based on oil-industry borehole data, 19 – cartographic boreholes, 20 – Carpathian frontal thrust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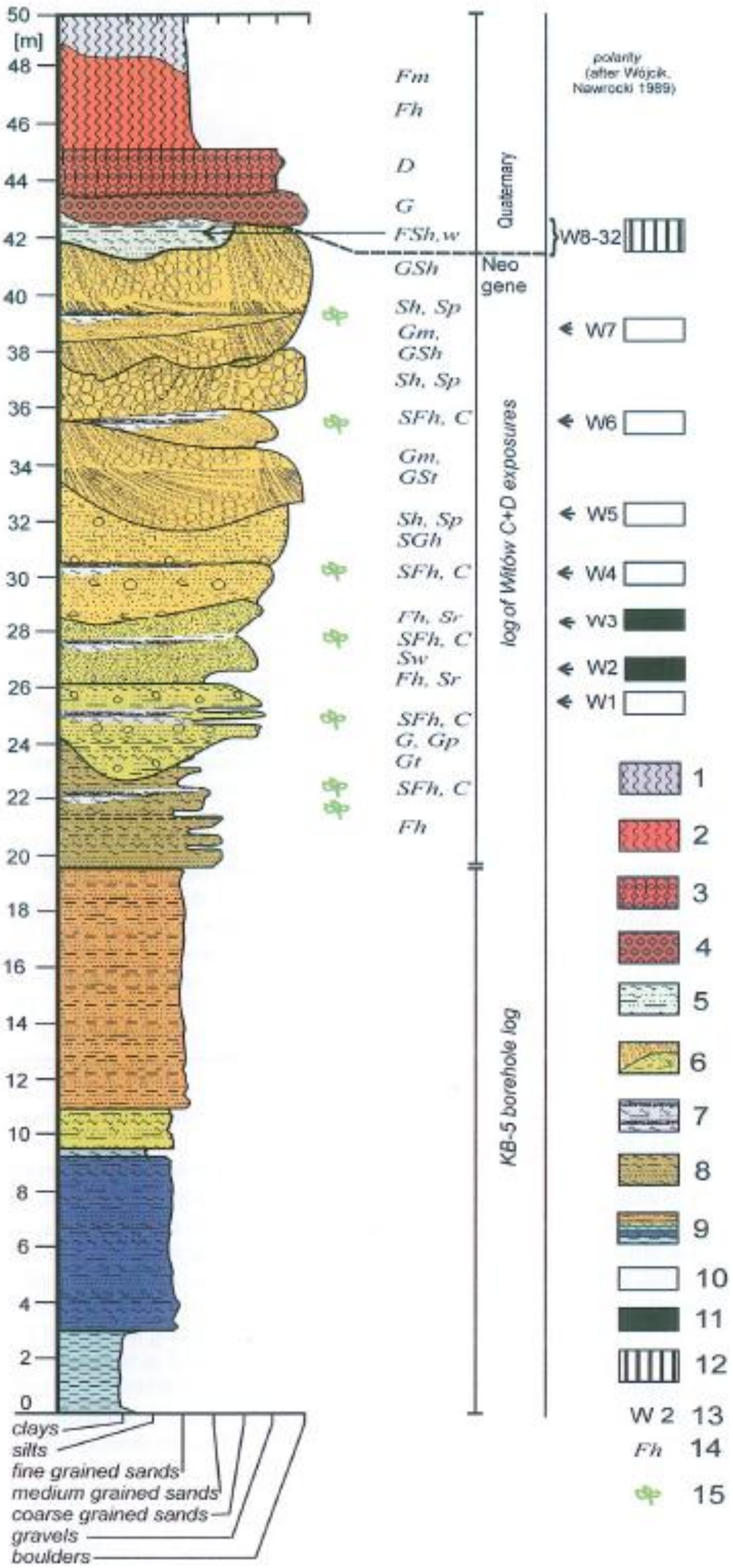

Fig. 4. Synthetic log of the Witów Series compiled from sections of the Witów exposures and borehole KB-5 (Brud 2004)

1 – archaeological layer, 2 – loess, 3 – tills, 4 – fluvioglacial gravels, 5 – sandy silts, 6 – fluvial gravels and sands, 7 – silts and clays with plant remains, 8 – sandy silts with plant debris, 9 – silts, clays, silty sands, 10 – reverse polarity, 11 – normal polarity, 12 – mixed polarity, 13 – sampling sites, 14 – symbols of lithofacies, 15 – plant macroremains

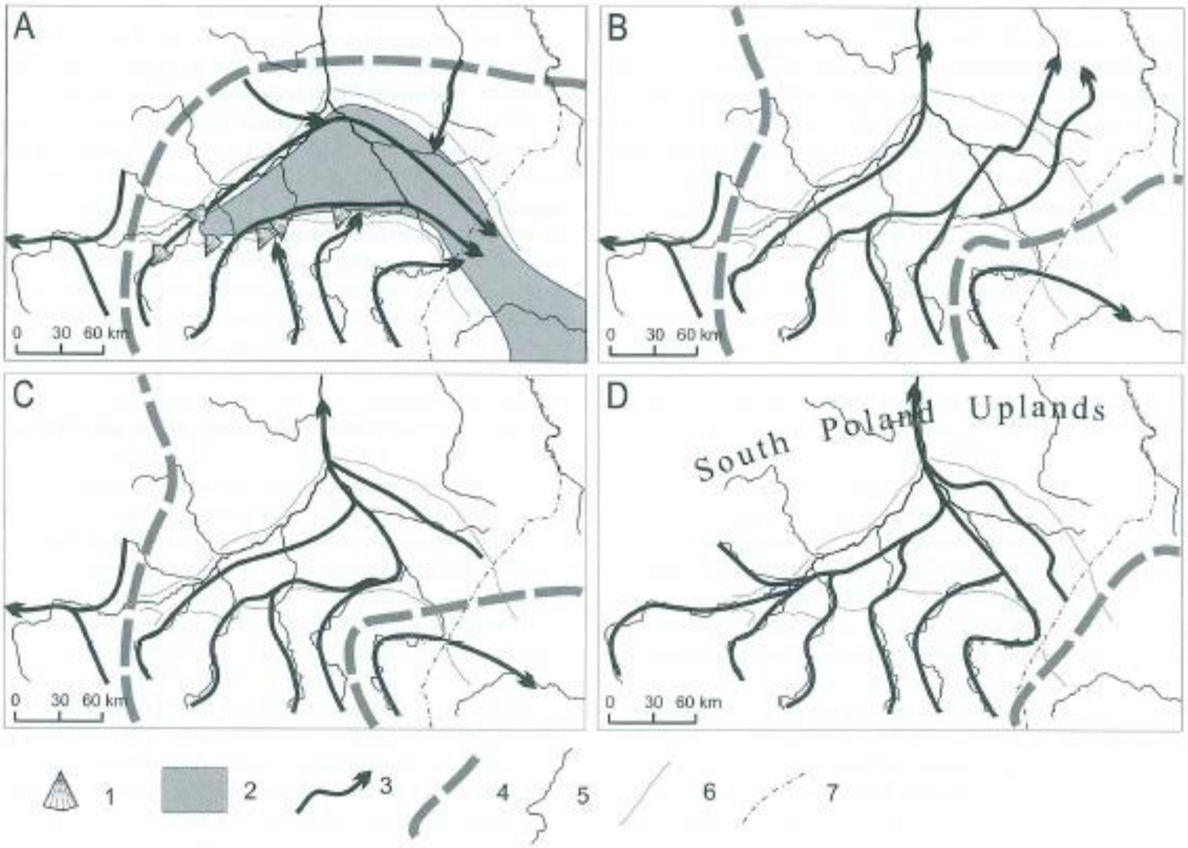

Fig. 5. Drainage pattern changes in the Sandomierz Basin during: A – the Late Sarmatian), B – Late Pliocene and Eopleistocene, C – South-Polish Glaciations, D – "Great" (Holsteinian) Interglacial (Brud 2004)
1- fan-deltas shed into the retreating marine basin, 2 – inferred extent of the marine basin during Late Sarmatian-Pannonian times, 3 – palaeoflow directions, 4 – watershed zones, 5 – contemporary drainage pattern, 6 – boundaries of the Sandomierz Basin, 7 – state boundary

STRUCTURE, AGE AND THE LATEGLACIAL-HOLOCENE EVOLUTION OF THE UPPER VISTULA RIVER FLOOD PLAIN DOWNSTREAM OF CRACOW (SANDOMIERZ BASIN)

Tomasz Kalicki
Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management, Kielce, Poland
; tomaszkalicki@ymail.com

Studied section is located in most western part of Sandomierz Basin in the front of Carpathians. It is about 50 km long reach downstream of Cracow up to Raba river mouth, tributary of the Vistula river from Carpathians (Fig. 1).

Aim of studies was an influence of climatic changes and human impact on the Lateglacial and Holocene evolution of the Vistula valley near Cracow. The interdisciplinary research were done with complex of palaeogeographical methods as sedimentological, geomorphological maping, palaeobotanical (pollen diagrams, macrofossils), palaeozoological, palaeohydrological, cartographic, archaeological and historical sources, dendrochronological, radiocarbon datings etc.

The Vistula river valley, up to 8 km wide, was cut in Miocene clay. Two the Pleistocene terraces (10-12 and 15-25 m high) covered with loess and the Pleistocene high alluvial fans of the tributaries Prądnik and Dłubnia rivers (on the left river-side) as well as the Pleistocene alluvial fan of the Raba river (on the right river-side) and flood plain could be distinguished in the section across the Vistula river valley downstream of Cracow. The flat Vistula river flood-plain showing numerous abandoned channels is 4-5 m high and 2-7 km wide (Kalicki 1991, 2006)(Fig. 1).

The alluvia range from 4 to 15 m thick. Since the 19^{th} century the uppermost 6-7 m layer of the alluvia has been recognized as a Holocene sediments. According to various authors, the basal gravels probably date from different periods.

Within the valley floorbetween Cracow and Niepołomice in the N-S transect several morphological zones and cut-fill alluvial bodies of different ages may be distinguished (Kalicki 1991, 2006)(Fig. 1, 2). Immediately below the higher terrace edge there are the rest of braided alluvial plain older then 13 000 BP and single abandoned channels - large from the Alleröd and smaller from the Early Atlantic (Kalicki 1991, 2006). The palaeomeanders are preserved in shape of semicircular recesses in the edge. In the second zone there are small the Atlantic palaeomeanders and their systems (Kalicki 1991). Along both sides of the present Vistula river channel there is the third zone of the Subboreal and Subatlantic meanders with large meanders dating from the last centuries (Trafas 1975). In the fourth zone there are systems of the small Boreal meanders (Kalicki 1991). In the south there extends a wide zone without meanders, 1 m lower. This zone is built various units of the Plenniglacial and Late Glacial deposits of braided river (Kalicki 1991, 2006) covered by the Holocene overbank sediments of backswamp facies with some buried soils from the Early and Middle Holocene (Kalicki et al. 2011)(Fig.3). This zone is partly buried below the Late Atlantic alluvial fans of small Forecarpathians tributaries (Kalicki 1997).

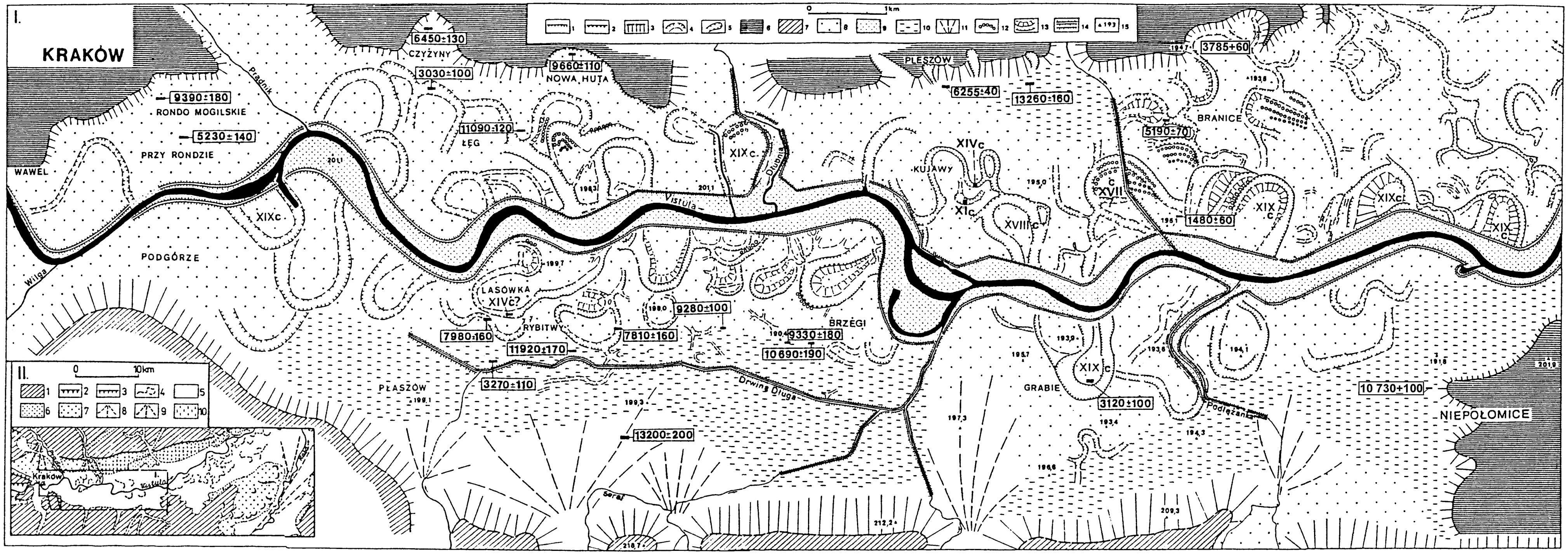

Fig.1 . Geomorphological map of the Vistula river valley between Cracow and Niepołomice (I) and geomorphological sketch of the Vistula river valley between Cracow and Raba river mouth (Kalicki 1991, partly modified and complited Kalicki 2006):

I: 1 – edges below 3 m high, 2 – edges 3-5 m high, 3 - edges above 5 m high, 4 – palaeomeanders, 5 – small erosional valleys, 6 – the Pleistocene terraces of the Vistula river, 7 – Gdów Upland, 8 - Lateglacial and Holocene Vistula's flood plain, 9 – modern flood plain (inter-dike area), 10 – Young Pleniglacial and Lateglacial braiding alluvial plain as backswamps during the Holocene (wide depresion on flood plain), 11 – Holocene alluvial fans (mainly post-Atlantic), 12 – point bars, 13 – sloping surface on the convex meander side, 14 – dikes, 15 – altitude (m a.s.l.)

II: 1 - Proszowice Plateau and Gdów Upland (Miocene clay hills cover by loess), 2 – tectonic scarps up to 100 m high, 3 – erosional edges more than 20 m high, 4 – palaeomeanders, 5 – Lateglacial and Holocene flood plain, 6 – Younger Pleniglacial terrace, 7 – Older Pleniglacial terrace, 8 - Holocene alluvial fans, 9 – Vistulian alluvial fans, 10 – loess overlying the terrace sheets

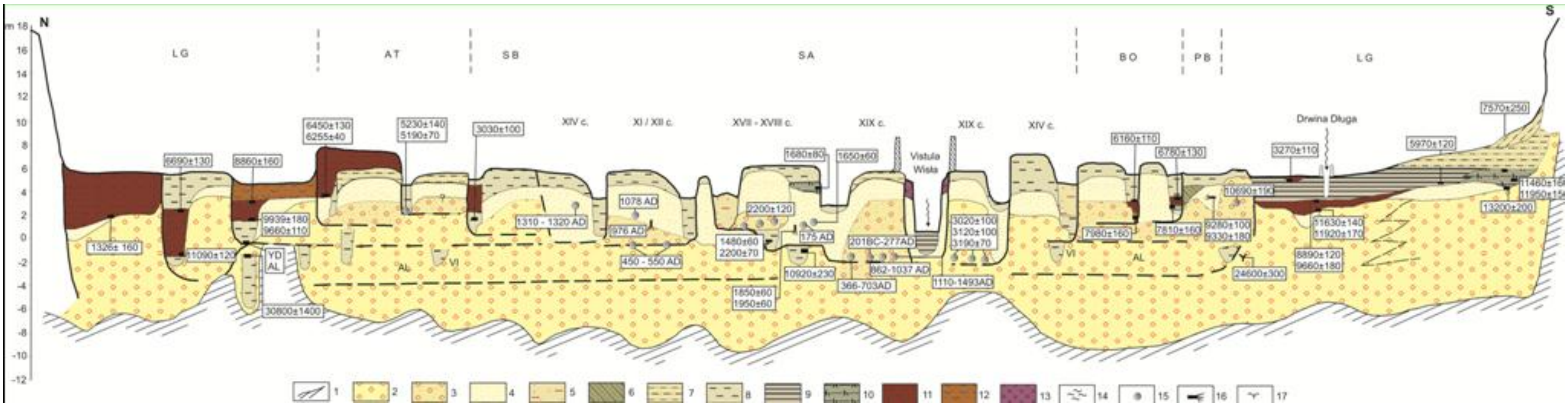

Fig. 2. Schematic geological section across the Vistula flood plain between Cracow and Niepołomice (Kalicki 2006)
1 - Miocene clays, 2 - gravels, 3 - gravels and sands, 4 - sands, 5 – silty sands, 6 - sands with silty intercalations, 7 - sandy silts, 8 - silts, 9 – clayey silts, 10 – organic silts, 11 – peaty silts and clayey peats, 12 - peats, 13 - industrial mada (silts), 14 – gyttja, 15 - subfossil tree trunks, 16 – trunks cut by man, 17 – reindeer's antler;
Age designations: AL - Alleröd, AT - Atlantic, BO - Boreal, LG - Lateglacial, SB - Subboreal, SA - Subatlantic

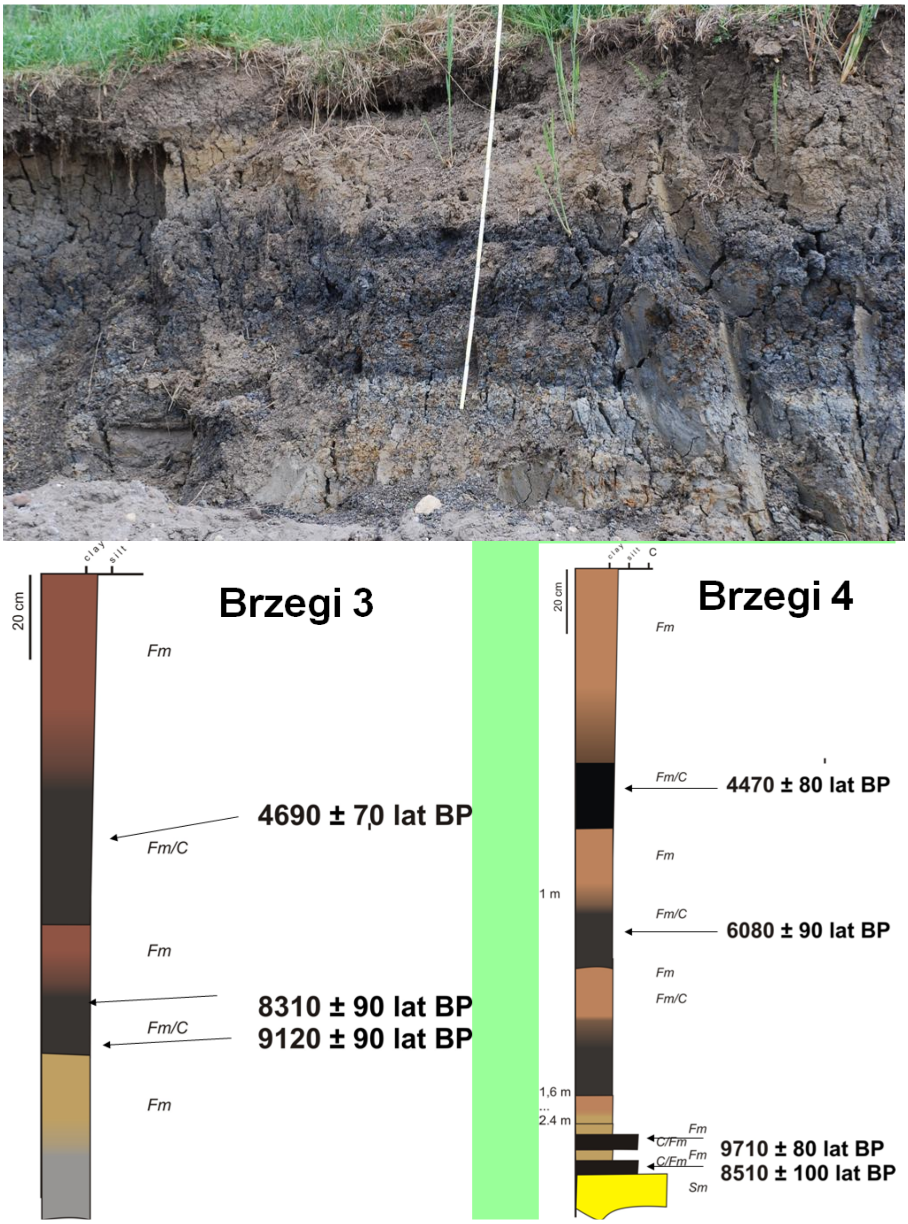

Fig. 3. Buried soils (radiocarbon dated) in backswamp sediments of the Vistula river at Brzegi (photo T. Kalicki; Kalicki et. al. 2011)
Symbol of lithofacies (acc. to Zieliński 2014): Fm – silts and clays with massive structure, C – detritus, organic sediments

The wide (3-7 km) flood plain downstream of Niepołomice has very complicate structure too (Kalicki 2006)(Fig 4, 5). At the marginal parts, especially in the wide depression draining by Drwinka river on the southern side, locally below the edge of the loess terrace on the northern side and sometimes in the middle of the valley floor as erosional remnants, relicts of the Young Pleniglacial and Lateglacial braided alluvial plains are preserved. These erosional remnants prove avulsions of the Vistula river. There were dated at the Atlantic and Subboreal limit (Starkel et al. 1991, Kalicki et al. 1996)(Fig. 6). In morphology and sediments of this section preserved also remnants of two channel belts of the Vistula river from the Boreal (Kalicki et al. 2005). The different segments (inserts) of flood plain in both sections record the evolution of the Vistula valley during the last 13 000 years.

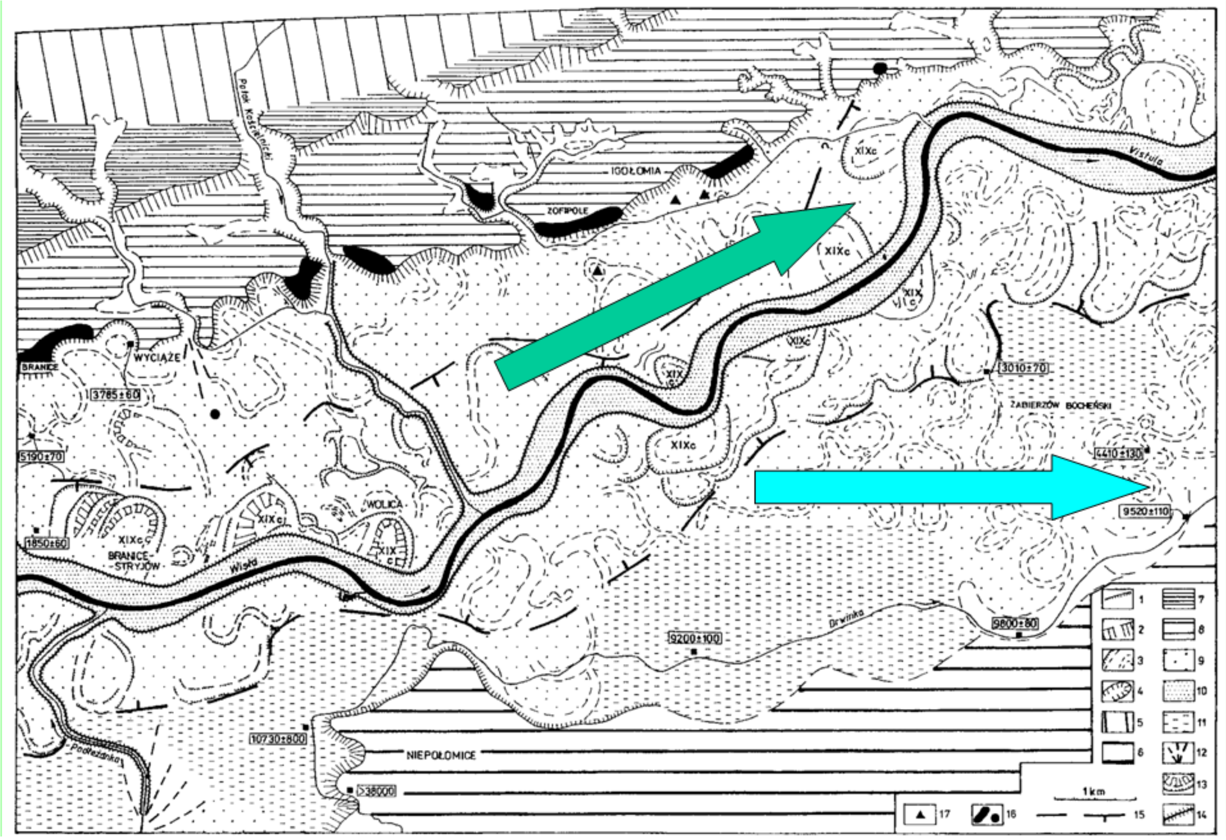

Fig. 3 . Geomorphological map of the Vistula river valley downstream of Niepołomice (Kalicki 2006). Green arrows markt two "meandering belts" from the Preboreal-Boreal period of anabranching pattern of the Vistula river in this section.
1 – edges below 5 m high, 2 – edges above 5 m high, 3 – palaeomeanders, 4 – small erosional valleys, 5 – Proszowice Upland (Miocene clay hills cover by loess), 6 – Pleistocene Raba alluvial fan, 7 – Pleistocene Vistula's higher terrace (alluvia cover by loess), 8 - Pleistocene Vistula's lower terrace (alluvia cover by loess), 9 – Lateglacial and Holocene Vistula's flood plain, 10 – modern flood plain (inter-dike area), 11 – Lateglacial braiding alluvial plain as backswamps during the Holocene (wide depresion on flood plain), 12 – Holocene alluvial fans, 13 – sloping surface on the convex meander side, 14 – dikes, 15 – meandering belt from the Roman time, 16 –settlements from Roman time, 17 – traces of settlement from Roman time

The dissection of the higher terrace started just after the maximum of last glaciation and proceeded very quickly since the Vistula river flew within present flood-plain before 13 000 BP (Fig. 6). At the beginning of the Alleröd there is a change of the Vistula from the braided river to the meandering one with the large meanders. Cooling of the Younger Dryas causes visible aggradation and the change of the Vistula into a braided river again (Kalicki 1991, 2006). At the beginning of the Preboreal start to function small meanders typical to the Holocene which were cut off in the cool and humid periods (Kalicki 1991, 2006). However, Vistula river downstream of Niepołomice had anabranching (anastomosing) pattern on section about 20 km long (Kalicki et al. 2005). From the beginning of the Preboreal till the end of the Atlantic there are tendencies to slow aggradation. There are the channel avulsions which are typical to the aggradational rivers. At the beginning of the Subboreal the Vistula starts its incision. This process is probably caused by local situation after two avulsion downstream of Niepołomice at the Atlantic and Subboreal limit. Besides planar changes, by straitening and shortening the river bed of some tens of km, the avulsions were also responsible for triggering incision (Kalicki 2006). The erosion reached its maximum about 2000-1500 BP when the river channel was almost on the Alleröd level. From the Late-Roman period to the end of Middle Ages there is an aggradation again which is caused by the activities of man. During the last centuries there has been gradual incision of the river (Trafas 1975).

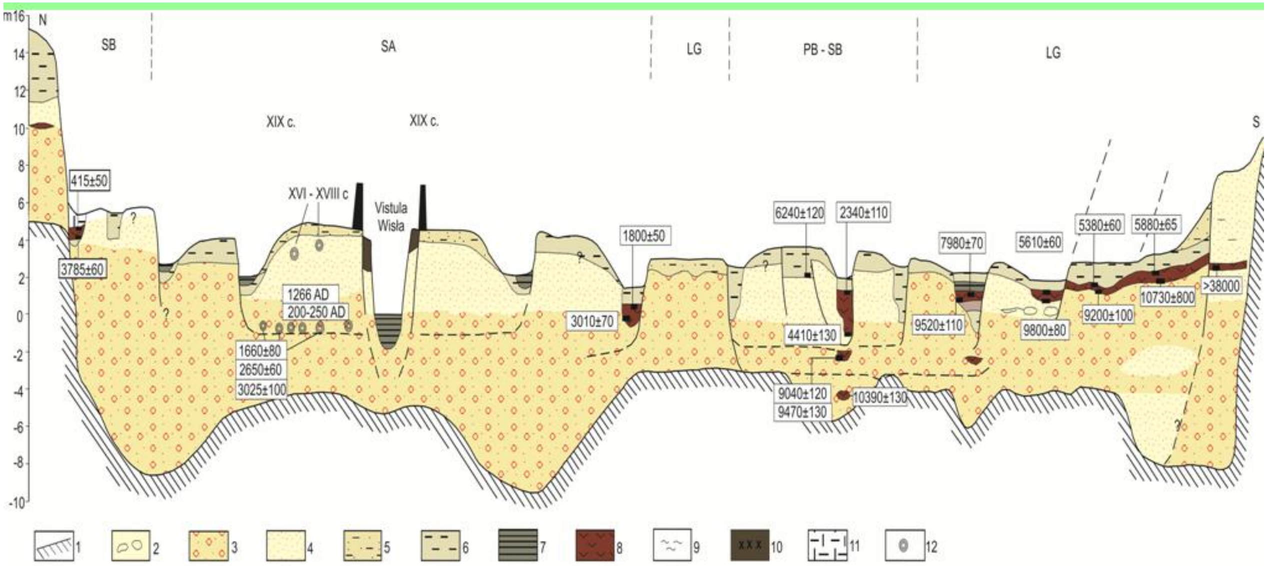

Fig. 4. Schematic geological section across the Vistula flood plain between Niepołomice Igołomia (Kalicki 2006)
l - Miocene clays, 2 - pebbles, 3 - gravels and sands, 4 - sands, 5 – sandy silts, 6 - silts, 7 - clayey silts, 8 - peats, 9 – gyttja, 10 – industrial mada (silts), 11 – loess deluvia, 12 - subfossil tree trunks, Age designations: AL - Alleröd, AT - Atlantic, BO - Boreal, LG - Lateglacial, SB - Subboreal, SA - Subatlantic.

Fig. 5. Atlantic system of palaeomeanders of Vistula river downstream of Niepołomice (Niepołomice Forest- Las Grobla) in Subcarpathian Basin abandoned after avulsion about 5000 BP (photo M. Doktor)

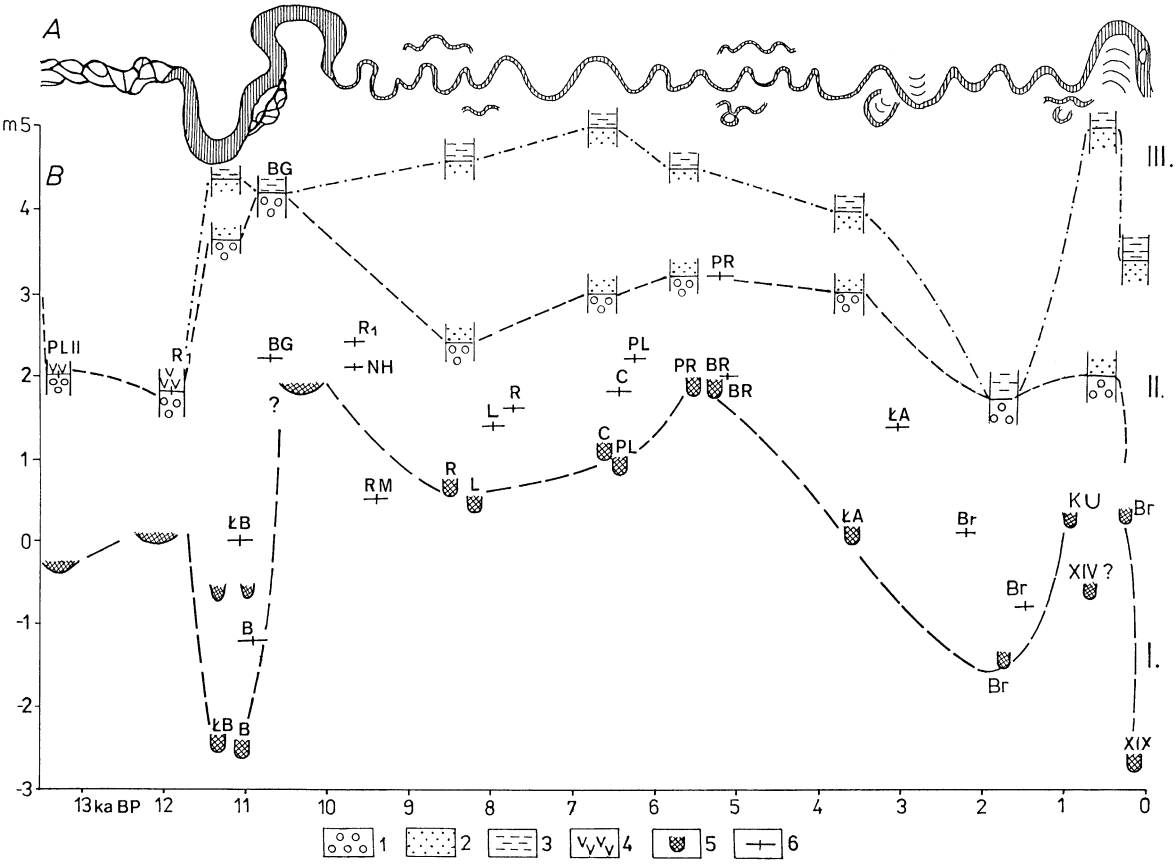

Fig. 6. Changes of both channel pattern (A) and vertical position of the Vistula river (B) during the Late Glacial and the Holocene (Kalicki 1991, partly changed and complited Kalicki 2006)

I – channel level, II - top of channel deposits, III - top of point bar deposits; 1 – gravels, 2 – sands, 3 – silts (overbank deposits), 4 – peats, 5 – basal part of abandoned channel fill

Changes of channel pattern from the Plenniglacial-Lateglacial braided river – Lateglacial macromeanders – Eoholocene anabranching river- Holocene small meanders – large meanders from the last centuries occurred in the Vistula river valley downstream of Cracow (Fig. 6, 7). The Holocene generation of the palaeomeanders have the differentiation too. In the Early Holocene narrow and sinuous river beds of irregular shapes functioned. The Early Atlantic palaeomeanders had clearly greater parameters but the Late Atlantic ones were smaller again. In the Subboreal there occurred a gradual grew of radius of palaeomeanders without changes of their width. Simultaneously the meanders take more regular shapes which proves the lateral migration of these river beds in the flood plain. The Middle Age meanders were very small again. The rapid growth of parameters of meanders occurs in the last centuries and there was a gradual tendency to braided pattern visible on old maps (Kalicki 1991, 2006).

Both in morphology and sediments there are clear traces of the Holocene flood phases (phases of an increase river activity). In these periods there occurred: changes of the channel by cut offs or avulsions, sediment changes on the flood plain - covering of organic sediments or cultural layers by overbank deposits (muds), beginning of peat growth, deposition of the tree trunks in alluvium. In the region of Cracow several such periods can be distinguished: Younger Dryas, 9800-9600, 8800-8000, 6700-6000, 5500-5000, 4500-4000, 3500-3000, 2700-2600, 2350-1800 BP, 5-6th, 10-11th, 13-14th, 16-19th centuries (Kalicki 1991, 2006)(Fig. 8). These phases were triggered by climatic changes and clustering of catastrophic events in European scale therefore there are in agreement with the humid climatic phases in the

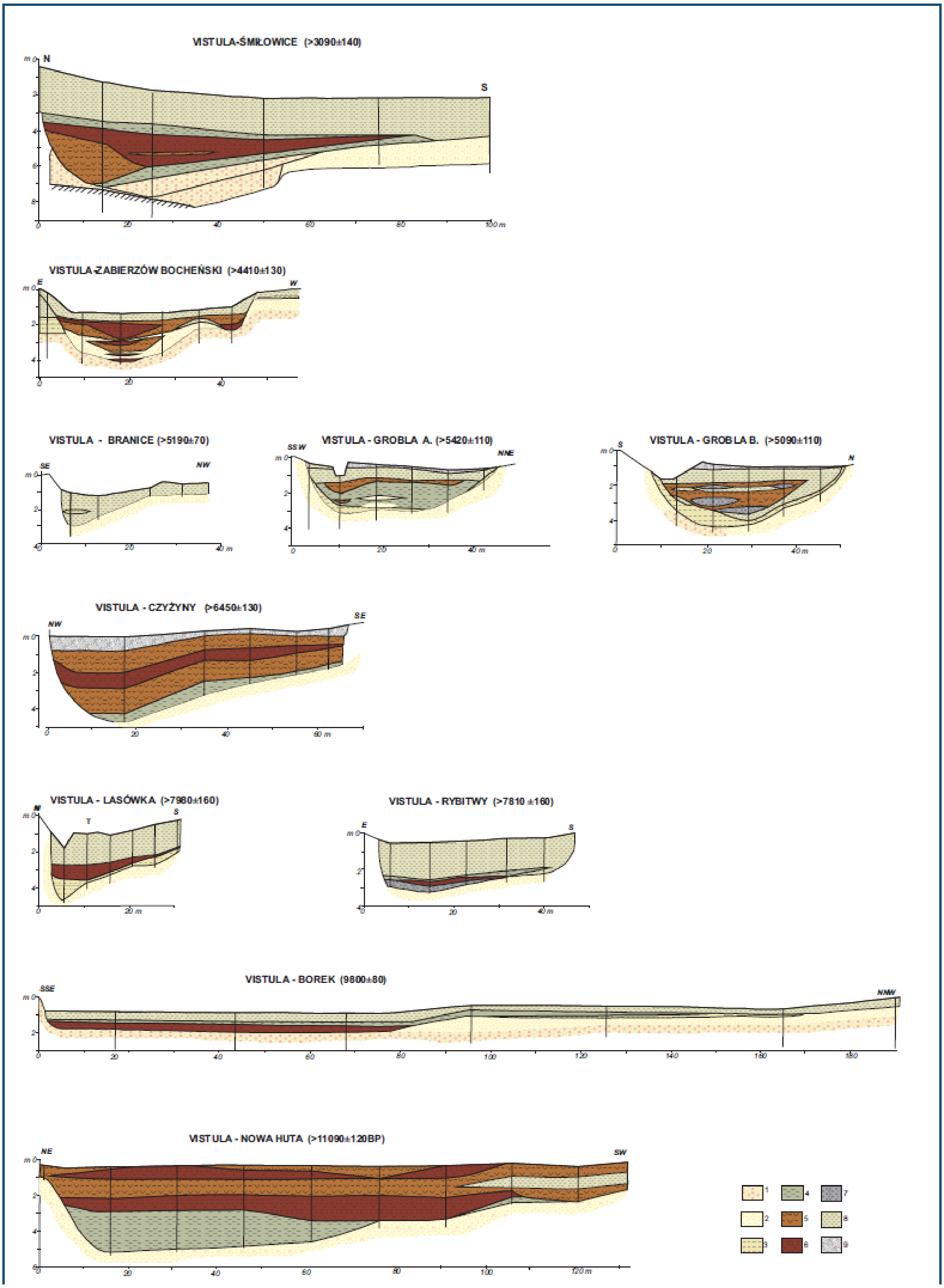

Fig. 7. Geological sections (all in the same scale) across of the Vistula paleomeanders near Cracow of the different age dated by radiocarbon and pałinological methods (Kalicki 2006) 1 – gravels with sands (channel facies), 2 – sands, 3 – silty sands or sandy silts, 4 – silts and clays od palaeochannel fills, 5 – organic silts, 6 – peats, 7 – overbank silts, 8 – mounds

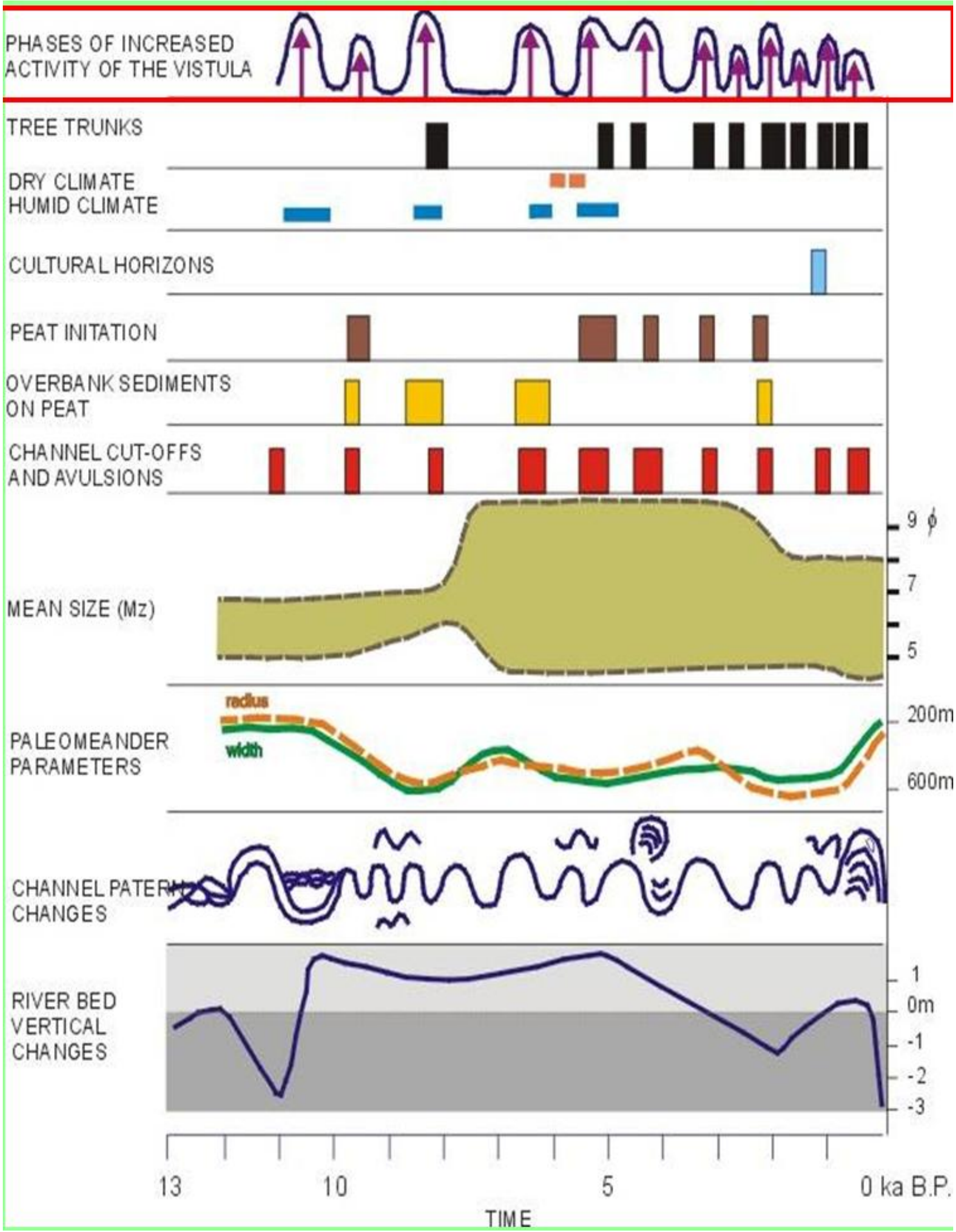

Fig. 8. Reflection of the climatic and anthropogenic changes in both morphology and alluvia of the Vistula river valley near Cracow during the last 13 000 years (Kalicki 2006)
From bottom to the top of Figure: A-I and K (after Kalicki 1991, modified): A - vertical changes of the Vistula river channel, B - channel pattern changes, cut off and avulsion, C - width (continuous line) and meander radius (broken line) changes, D - mean diameter Mz changes of abandoned channel and overbank deposits, E - cut offs and channel avulsions, F - superposition of the overbank sediments on organic deposits, G - peat initiation, H - cultural horizons beneath the overbank deposits, I - palaeobotanical data indicating a humid (continuous line) and a dry (broken line) climate, J - tree trunks in the alluvia (Krąpiec 1996), K - phases of an increase of the Vistula activity

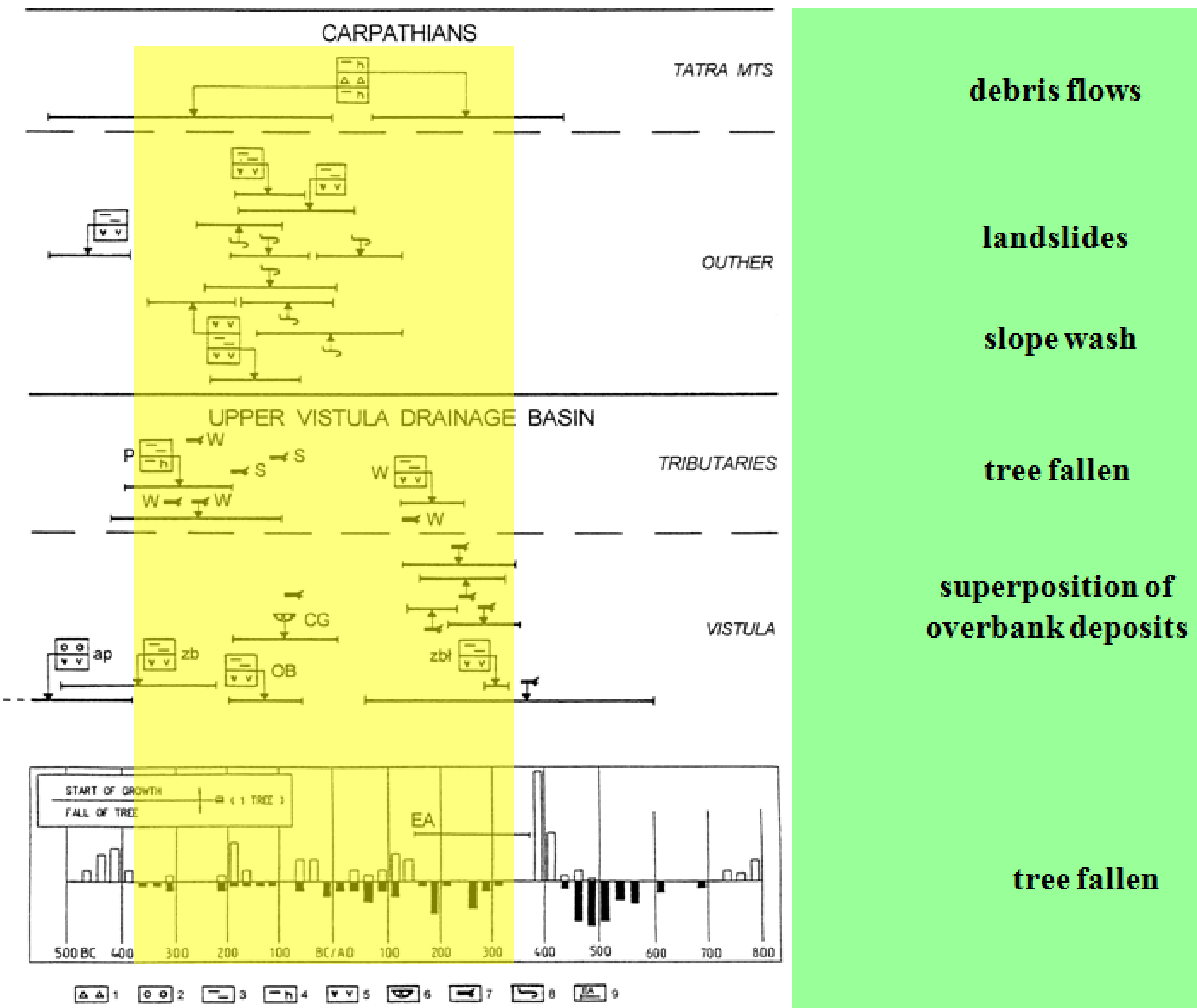

Fig. 9. Collection of radiocarbon datings documented an increase of dynamic of fluvial and slope geosystems in the region of Cracow during Pre-Roman and Roman periods
By Kalicki (2006) based on own data and data of landslides (Margielewski 1998, 1999, 2000), debris flows (Baumgart-Kotarba, Kotarba 1993) valleys (i.e. Tauber 1968, Mycielska-Dowgiałło 1972, Środoń 1980, Alexandrowicz et al. 1981, Rutkowski 1987, Klimek 1988, Alexandrowicz 1997), dendrochronological data from the Vistula valley near Cracow (Kalicki, Krąpiec 1996) and archaeological data (Dobrzańska, Kalicki 2003)
1 – sediments of debris flows, 2 – gravels, 3 – silts, 4 – organic silts, 5 – peats, 6 – abandoned channels, 7 – subfossil trees, 8 – landslides, 9 – period of maximum intensity of economic activity of Przeworsk Culture
S – San river, W – Wisłoka river, OB –Oświęcim Basin, CG – Cracow Gate, P – Prądnik river; study sites in the Vistula river valley near Cracow: ap – aleja Pokoju site, zb – Zabierzów Bocheński site, zbł – Zabierzów Bocheński-Łąki site

Carpathians and phases of an increase river activity in whole Central Europe (Kalicki 2006). Good example this type of clustering events is Roman time period (Fig. 9). Numerous of data from the different geosystems reflected destabilisation of climate in this epoch - increase of extreme events frequency connected with varies factors. The data from southern Poland indicate that in the studied period events connected with climate changes towards both to more ocean and more conntinental took place. Often rainy periods, some days with rain after advection of humid air masses from the west, belong to the first type and contribute to floods in the upper Vistula drainage basin and landslides in the Flysh Carpathians (Kalicki 1991, Margielewski 1998). Subfossil trees in alluvia (Krąpiec 1998) documented bank errosion during these floods. The short rainfalls formed flashfloods in small valleys (Alexandrowicz 1997) and debris flows on high mountain slopes (Baumgart-Kotarba, Kotarba 1993) are typical for the second type of climatic changes towards more continental.

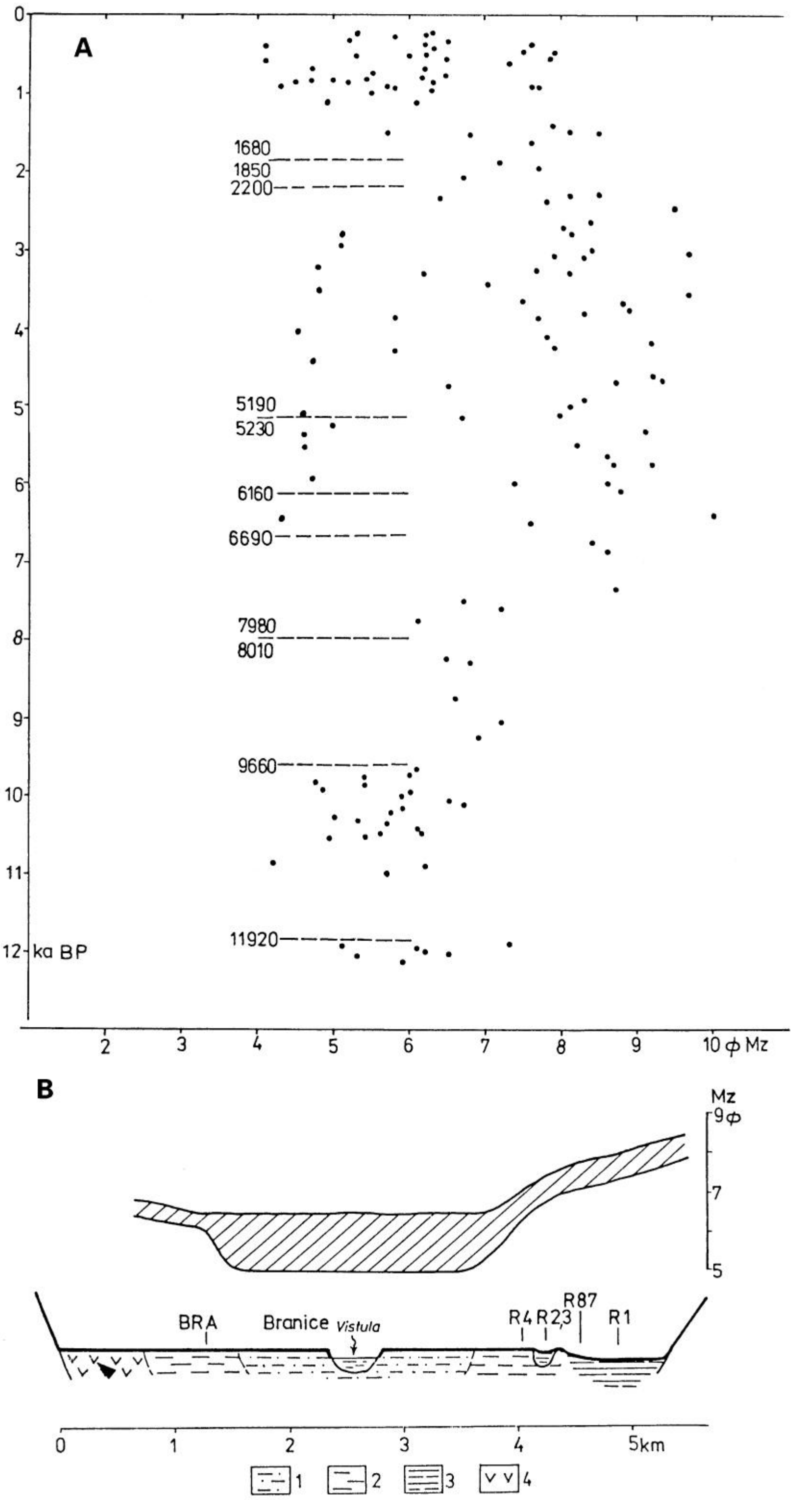

Fig. 10. Differentiation of grain size of overbank deposits of the Vistula river near Cracow both during Late Glacial and the Holocene (A) and from the last millennium in the section across the valley (B) (after Kalicki 1991, complited Kalicki 2006)
1 – sandy silts, 2 – silts, 3 – clayey silts, 4 - peats

In the Vistula valley there are also changes of silty overbank deposits – levee, flood plain, abandoned channels and backswamp facies (Kalicki 1991, 2000)(Fig. 10). Overbank deposits are differentiated with respect to the grain size composition that corresponds to climatic-vegetation changes at the turn of the Lateglacial and Holocene, to anthropogenic deforestation in the Neoholocene, and to the distance from an active channel. In the Late Glacial and the Early Holocene there were silty-sandy muds (Mz=4.50-6.25phi), in the Atlantic clayey silts (Mz = more than 8.5phi) and in the Subatlantic more silty and sandy muds again. The absolute mean size values in the youngest muds clearly depend on the distance from the active channel and on the morphological location (facies of sediments).

REFERENCES

Alexandrowicz S. W., 1997, Malacofauna of Holocene sediments of the Prądnik and Rudawa river valleys (southern Poland), Folia Quaternaria 68, 133-188.

Alexandrowicz S. W., Klimek K., Kowalkowski A., Mamakowa K., Niedziałkowska E., Pazdur M., Starkel L., 1981, The evolution of the Wisłoka valley near Dębica during the Late Glacial and Holocene, Folia Quaternaria 53, 1-91.

Baumgart-Kotarba M., Kotarba A., 1993, Późnoglacjalne i holoceńskie osady z Czarnego Stawu Gąsienicowego w Tatrach [in:] Z badań fizyczno-geograficznych w Tatrach (ed. A. Kotarba), Dokumentacja Geograficzna 4-5, 9-30.

Dobrzańska H., Kalicki T., 2003, Człowiek i środowisko w dolinie Wisły koło Krakowa w okresie od I do VII w. n.e., Archeologia Polski, 48/1-2, 25-55.

Kalicki T., 1991, The evolution of the Vistula river valley between Cracow and Niepołomice in late Vistulian and Holocene times [in:] Evolution of the Vistula river valley during the last 15 000 years, part IV (ed. L. Starkel), Geographical Studies, Special Issue 6, 11-37.

Kalicki T., 1997, The reflection of climatic changes and human activity on sediments of small Forecarpathian tributaries of the Vistula river near Cracow, Poland, Studia Geomorphologica Carpatho-Balcanica 31, 129-141.

Kalicki T., 2000, Grain size of the overbank deposits as carriers of paleogeographical information, Quaternary International 72, 107-114.

Kalicki T., 2006, Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich (Reflection of climatic changes and human activity and their role In the Holocene evolution of Centraleuropean valleys). Prace Geograficzne 204, pp. 348.

Kalicki T., Krąpiec M., 1996, Reconstruction of phases of the "black oaks" accumulation and of flood phases, [in:] Evolution of the Vistula river valley during the last 15 000 years, part VI (eds. L. Starkel, T. Kalicki) Geographical Studies, Special Issue 9, 78-85.

Kalicki T., Dobrzańska H., Calderoni G., 2005, Paleogeografia doliny Wisły poniżej Niepołomic w okresie rzymskim [in:] Współczesna ewolucja rzeźby Polski (eds. A. Kotarba, K. Krzemień, J. Świechowicz), VII Zjazd Geomorfologów Polskich, 19-22.09.2005 Kraków, 171-176.

Kalicki T., Krupa J., Szmańda J., 2011, Sedymentacja pozakorytowa Wisły w basenach powodziowych koło Krakowa. VI Świętokrzyskie Spotkania Geologiczno-Geomorfologiczne: Rekonstrukcja środowisk depozycyjnych na podstawie badań sedymentologicznych, geochemicznych i stratygraficznych, 17-18.05.2011 Ameliówka, 41-42.

Kalicki T., Starkel L., Sala J., Soja R., Zernickaya V. P., 1996, Subboreal paleochannel system in the Vistula valley near Zabierzów Bocheński (Sandomierz Basin) [w:] Evolution of the Vistula river valley during the last 15 000 years, part VI (eds. L. Starkel, T. Kalicki), Geographical. Studies, Special Issue 9, 129-158.

Klimek K., 1988, An early anthropogenic alluviation in the Subcarpathian Oświęcim Basin, Poland, Bulletin of the Polish Academy of Sciences, Earth Sciences 36, 2, 159-169.
Krąpiec M., 1996, Dendrochronology of „black oaks" from river valleys in Southern Poland, [in:] Evolution of the Vistula river valley during the last 15 000 years, part VI (eds. L. Starkel, T. Kalicki), Geographical. Studies, Special Issue 9, 61-78.
Krąpiec M. 1998, Oak dendrochronology of the Neoholocen in Poland, Folia Quaternaria 69, 5-133.
Margielewski W., 1998, Landslide phases in the Polish Outer Carpathians and their relation to climatic changes in the Late Glacial and the Holocene, Quaternary Studies in Poland 15, 37-53.
Margielewski W., 1999, Fazy osuwiskowe w Karpatach jako odzwierciedlenie zmian klimatycznych w późnym glacjale i holocenie, Sprawozdania z czynności i posiedzeń PAU, t. 62, s. 140-154.
Margielewski W., 2000, Gospodarcze znaczenie osuwisk Beskidu Makowskiego, Problemy Zagospodarowania Ziem Górskich 46, 15-34.
Mycielska-Dowgiałło E., 1972, Rozwój doliny środkowej Wisły w holocenie w świetle badań z okolic Tarnobrzega, Przegląd Geograficzny 44, 1, 73-83.
Rutkowski J., 1987, Vistula river valley in the Cracow Gate during the Holocene [in:] Evolution of the Vistula river valley during the last 15 000 years, part II (ed. L. Starkel), Geographical Studies, Special Issue 4, 31-50.
Starkel L., Gębica P., Niedziałkowska E., Podgórska-Tkacz A., 1991, Evolution of both the Vistula floodplain and lateglacial-early Holocene palaeochannel systems in the Grobla Forest (Sandomierz Basin) [in:] Evolution of the Vistula river valley during the last 15 000 years, part IV (ed. L. Starkel), Geographical Studies, Special Issue 6, 87-99.
Środoń A., 1980, Czarny dąb z Dąbia, Wszechświat 3, 74-75.
Tauber H., 1968, Copenhagen Radiocarbon Dates 9, Radiocarbon 10, 2.
Trafas K., 1975, Zmiany biegu koryta Wisły na wschód od Krakowa w świetle map archiwalnych i fotointerpretacji. Zeszyty Naukowe UJ, Prace Geogr. 40.

RELIEF AND LAND USE OF FLOOD PLAINS IN WESTERN PART OF SANDOMIERZ BASIN (SOUTHERN POLAND) FROM THE ROMAN TO THE BEGINNING OF THE EARLY MEDIEVAL PERIODS

Halina Dobrzańska[1], Tomasz Kalicki[2]
[1]Institute of Archaeology and Ethnology, Polish Academy of Science, Kraków,
[2]Jan Kochanowski University in Kielce, Institute of Geography, Department of Geomorphology, Geoarchaeology and Environmental Management,
halinadob@yahoo.pl; tomaszkalicki@ymail.com

Settlement zone to the east from Cracow extends for 30 km along the loess terrace of Vistula river up, to the city of Brzesko Nowe, Igołomia-Wawrzeńczyce commune. It is fairly well archaeologically and palaeogeographical (Kalicki 1991, 2006 there further references) recognized. Especially frequent are traces of the Przeworsk culture (Dobrzańska 1997 there further references) followed by finds from the Early Slavic culture (Parczewski 1988; Dobrzańska et al. 2009). The results create unique possibilities for analyses of the changes of land use in the studied area triggered by natural and human impact.

Settlement of the Celtic and Przeworsk cultures in the Vistula basin corresponded in time with the period of colder and humid climate, dated to 2350-1800 BP (Kalicki 1996). According to Frenzel (2000), climatic changes of that period (generally between 500 BC and AD 200-300) were caused by inflows humid air from northern Atlantic in summer half years.

Climatic fluctuations in Central Europe at the La Tène and Roman periods encompassed multifold processes. There were high levels of Polish and sub-Alpine lakes, advancing of mountain glaciers in the Alps (Goeschener-2) and Scandinavia, developing nival processes in the Ukrainian Carpathians, solifluction in the Alps and landslides in the Pirenees, Cantabrian Mountains, Carpathians and in at Britain, stalactite accumulation in the Jura caves, phase of increase of river activities (basins of the Vistula, Rhine, Danube, Rhone, and the Loire, in Great Britain, Poland, Belarus), avalanche frequency in the Scandinavian Mountain, etc. (see references in Dobrzańska and Kalicki 2003, 2004, Kalicki 2006). Numerous palaeogeographical evidences from various environments also indicate unstable climatic conditions and clustering extreme events caused by various factors – floods in large drainage basins and flash floods in small valleys, landslides in the Carpathians, debris flow in the Tatra Mts., etc. Analyses of data from south Poland confirm occurrences there events typical for both the oceanic climate (long-lasting rains, landslides) and the continental climate (rainfalls, slope erosion, debris flow, flash flood)(Kalicki 2006).

The next important phase of cooling climate with higher precipitation occurred between 500 and 800 AD with maximum about 500 AD. It is reflected in peat bogs, Scandinavian Mountains, lakes, river valleys (Rhone, Vistula, Oder), landslides in Carpathians etc. In the same time the climate in eastern Europe became drier. It indicates regional differentiation of climatic variations (see references in Dobrzańska and Kalicki 2003; 2004, Kalicki 2006).

In the Vistula valley downstream of Cracow, two avulsions at the turn of the Atlantic and Subboreal were followed by a distinctive incision of the river bed and formation of the lower level of the flood plain. During the Roman period, bank erosion of the Vistula and its tributaries related to climatic changes, was triggered by an increase of fluvial activity (*cf*. Dobrzańska and Kalicki 2003; 2004, there further references; Kalicki 2006)(Fig. 1).

Increasing lateral migration of the Vistula channel and the development of point bars caused accumulation of oak trunks in alluvia. Higher level of the flood plain were occasionally cover during periods of maximum flood (flood peak), while permanently flooded depressions accumulated clayey silts (overbank deposits). Slow aggradation, observed already in the Roman period, can be attributed to increasing human interference in the upper Vistula basin (Kalicki 1991) and/or to decreasing slope of the river (Kalicki 2006). Aggradation of the river bed was accompanied by accretion the valley floor.

The next period on intensive bank erosion, reflected by numerous fallen oaks in alluvia, came in AD 425-575. In beds of upland tributaries of the Vistula loess overbank deposits began to accumulate. This process should be attributed rather to local floods caused by short-lasting heavy rainfalls than to the anthropopression, as the Early Slavic settlement of that time was scattered and not intensive. Depopulation of the Vistula valley, combined with settlement intrusions into the southern part of the Cracow Upland brought a side-effect – areas deforested by earlier settlers now became the source area of the material building ”agriculture overbank deposits”. Accumulations of these sediments corresponded with a climatic phase - clustering of extreme events (Dobrzańska and Kalicki 2003; 2004; Kalicki 2006, there further references).

The edge of the loess terrace was not subjected to significant transformations, as the main series of loess delluvia at its foot developed only in the last centuries (Kalicki et al. 2005).

In the area of our interest settlements from the Roman period concentrated near and at the edge of the loess terrace of the Vistula river. It was favorable for agriculture – fields could be located on fertile soils of terrace flats, while garden-like cultivation was carried out at the terrace foot. Easy available were also resources (fodder) of the flood plain. Such a location was typical for all areas of the Lesser Polish loess uplands.

In the Roman period the terrace edge was utilize as production or production-habitation zone, especially when slopes were not very steep. Such a location was convenient for interred

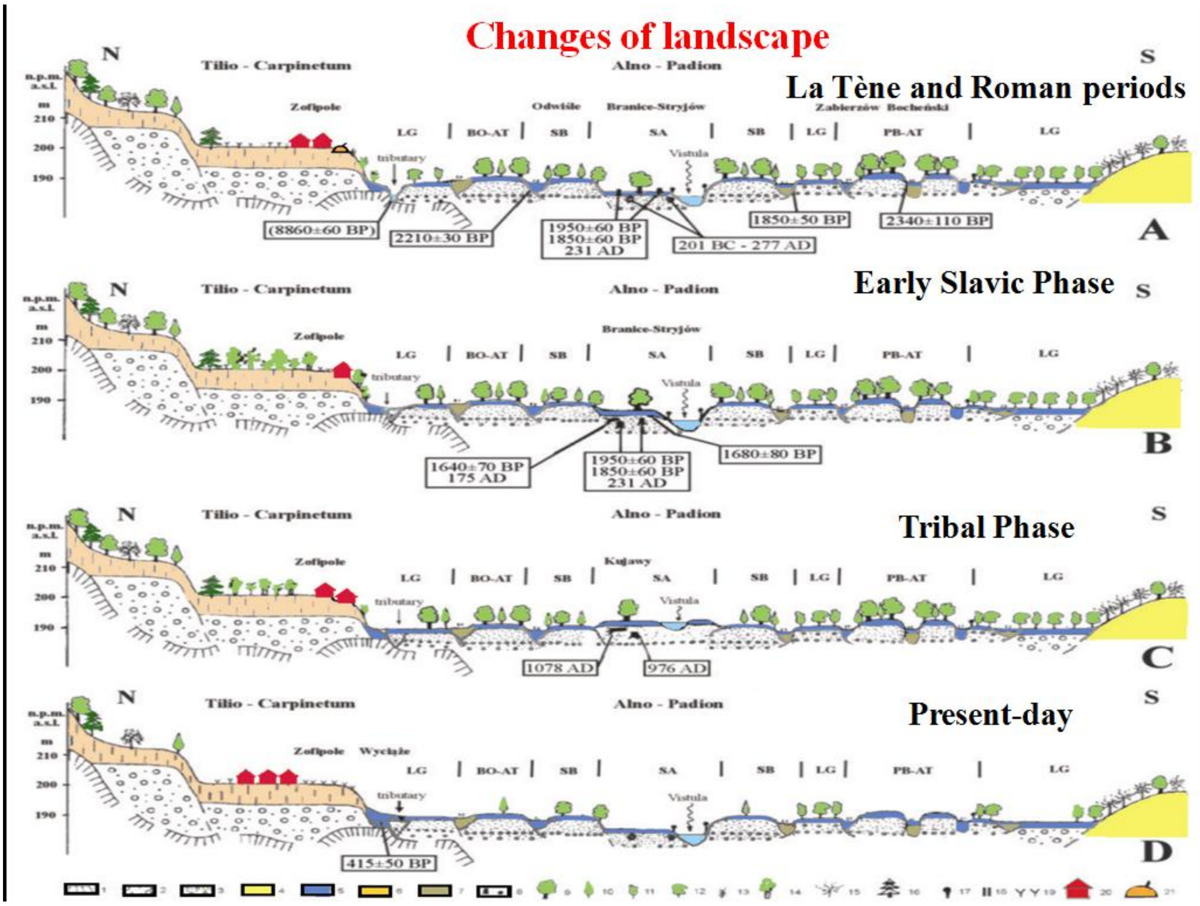

Fig. 1. Schematic palaeogeographical section across the Vistula river valley: A - Roman period (1st- 4th c. AD), B - Early Slav period (5th-6th c. AD), C – from 7th-12th c. AD, D – Modern Period (Dobrzańska et al. 2009)

1 – Miocene clay, 2 – Pleistocene gravels with sands, 3 – Holocene gravels with sands, 4 – sands, 5 – silts (overbank deposits), 6 – loess, 7 – peats, 8 – trees and trunks cut by man, 9 – *Quercus sp*., 10 – *Carpinus betulus*, 11 – *Alnus sp*., 12 – *Salix sp*., 13 – *Corylus avellana*, 14 – *Betula sp*., 15 – *Pinus sylvestris*, 16 – *Picea excelsa*, 17 – *Carex sp*., 18 – meadows, 19 – cereals, 20 – dwelling zone of the settlement, 21 - production zone of the settlement. Age designations: AT – Atlantic, BO – Boreal, LG – Lateglacial, PB – Preboreal, SB – Subboreal, SA – Subatlantic. Radiocarbon and dendrochronological dating in boxes. Dating of redeposited detritus in brackets.

structures, such pottery kilns. Structures of the production zone can be found also in lower parts of the terrace edge, or on elevations within the flood plain. It was possible because the valley bottom was drained as a result of Vistula incision (Dobrzańska, Kalicki 2003; 2004) that also opened access to resources of the plain. Due to the presence of small streams - tributaries of the Vistula flowing at the terrace foot - inhabitants of the area and people involved in various economic activities had unlimited access to the water. The Vistula itself was rather not used for that purpose. Instead, it played an important role of water route.

Local palaeogeographic situation during the Roman period created convenient conditions for penetration of the valley bottom by man, very important for Vistula settlements. People obtained there raw material for pottery production (overbank deposits, Miocene clay, oak timber and effective fuel (oak wood) for iron and bronze works (Dobrzańska, Kalicki 2003; 2004 there further references).

An example of iron production center at Igołomia from the Early Roman period (phase B2) indicates that demand for iron implements could be satisfied even with very limited local ore resources (Dobrzanska et al. 2009). However, due to this fact the iron production was episodic (frequent finds of furnace slag indicate that mainly half-products were produced).

In contrast to iron metallurgy, pottery production in the area of our interest was very well developed. Easy access to high quality clays, fuel and water created suitable condition for development of settlement structures and pottery production in the Late Roman period, phases C1a–C3 (Dobrzańska 2011, there further references).

One of the consequences of settlement and economic development between the 2nd half of the 2nd century till the end of the 3rd quarter of the 4th century was increased demand for wood. It slowed down regeneration of oak on the flood plain. At the same time we observe felling trees caused by bank erosion related to increased floods, caused in turn by climatic changes.

In the Early Slavic period, between the 2nd half of the 5th century and the 2nd half of the 7th century settlements were located close to the terrace edge. Inhabitants of Vistula settlements lived on husbandry and land cultivation (Parczewski 1988). Apart from agriculture, people were active in wood craft, tar production, manufacturing of hand-made pottery, and – occasionally – in bronze work (Dobrzańska et al. 2009).

Although the Vistula valley was quite intensively used in the La Tène from the 3rd c. BC till the first decades of the 1st c. AD (Poleska 2006), human pressure on natural environment at that time was incomparably smaller then during the peak of economic activities in that region (*cf. supra*). The same can we said about periods to follow. Therefore we cannot accept the notion that intensive exploitation of forest resources of the Vistula flood plain was started at the turn BC/AD and lasted to the mid 4th century (Madyda-Legutko et al. 2005). Detailed analysis of "Roman phase" distinguished by the referred authors (AD 1-325 AD) which "resulted from interaction of climatic and human factors" throws new light on fluctuating exploitation of the Vistula valley. Absence of evidences related to beginnings of oak regeneration in last decades BC and first decades AD might be related to activities of people of the Tyniec group, phase III, very active in various fields of highly specialized production (pottery, bronze and iron workshops; Poleska 2006). Loose settlement in phase B1 (B1b-B1c, *ca*. AD 30-80) and slightly more intensive yet still not demanding great amount of wood in phase B2 (AD 80-160), could had contributed to regrowth of trees. Then came the period when regeneration of oak completely died. It was in phase B2C1-C3 (AD 160-375), corresponding with culmination of Late Roman settlement and economic activities. Towards its end (AD 325-375), R. Madyda-Legutko et al. (2005) distinguish a period without felling trees but also without oak regenerations. It is being linked with "complete deforestation of the valley" (*sic*!) or perhaps with „unusual stabilization of the river" and „very wet time marked with intensive floods on flood plains of rivers" in south Poland and Germany. To back up this concept the authors recall dying oaks on north German peat bogs about AD 350 caused by increased ground waters (*cf*. Leuschner et al. 1986). However, such an interpretation is hardly acceptable in the light of palaeogeographic evidences from the Vistula valley near Cracow, as deep incision of the river must have drained habitats on the valley bottom. Research of Bednarz (1990) indicate that increased humidity in valleys is not harmful for oaks but rather facilitates their growth. Absence of felling during that short period was rather caused slowing-down river activity after the "La Tène-Roman phase" about 1800 BP (on that time are dated the youngest transformations of river channels and sedimentation types near Cracow, in the upper Vistula basin, and in basins of other Central European rivers; Kalicki 2006 there further references).

Decreased bank erosion of the Vistula terminated “delivery” of trees washed down from banks bordering its flood plain. Moreover, at that time river forest were already cleared to some extend by man, as testified tree trunks found *in situ* in alluvia. Certainly, we cannot speak about “complete deforestation” of the valley, as fluvial activities were limited to lower flood plain only. Only settlement decline about by invasion of Europe by Huns (AD 375) created favorable conditions for oak regeneration, observed about AD 400 (Dobrzańska, Kalicki 2003; 2004). It appears that decisive in this process were human-related factors and not drying climate (*cf*. Madyda-Legutko et al. 2005). It is because local palaeogeographic changes were not significant, the flood plain still existed, while floods – as before – effected only oxbows and depressions. Oak felling increased in the mid 5th century AD when activities of the river augmented.

Aggradations in the Vistula valley following the Roman period increased ground water level. In consequence, lower flood plain disappeared. Later on and active meander belt above the average bottom level was developed. In new palaeogeographic situation, when many placed of the plain were flooded, access to it became difficult. Nonetheless, in the Early Medieval period (Early Slavic and Tribal periods) it was still utilized with various intensity (Dobrzańska et al. 2009).

Observations presented above clearly contradict the notion that till the end of the 9th century AD flood plain of the Vistula valley was not used by man or used only in minimal degree (Madyda-Legutko et al. 2005, 314, 317). In our opinion, resources of the plain were exploited with various intensities in the period of 6th-10th centuries.

It is commonly accepted that in choosing settlement places man looked for environments best suited to his needs. Results of analysis of economic activities of inhabitants of the Vistula valley in the Roman and Early Migration periods leads to a few conclusions complying with this notion.

Settlement was closely related to morphological-hydrological situation. Sites were being located close to the terrace edge, between ecosystems of the loess terrace and the flood plain, with optimal conditions for multidirectional economic activities, both agricultural and non-agricultural. Moreover, terrace flats were very convenient for land communication in contrast to not easy accessible flood plain. The Vistula river served as water route, while small creeks supplied to inhabitants. Although natural resources available for inhabitants were the same, they were not utilized in the same way what was related to different settlement models. Settlement of the La Tène period is insufficiently recognized and cannot be characterized in detail. In the Roman Period (especially in the 3rd-4th cent.) an important role, apart from developed agriculture, was played by various non-agricultural activities. In contrast, economy of the Early Slavic period was practically entirely agrarian. These differences found their reflection in location of domestic and production structures. Settlement sites from the Roman Period can be divided into two zones. Houses were built on terrace flats close to the terrace edge, while production structures linked with use of fire – on terrace slopes. Sites from the Early Slavic period were mono-zonal. Dwellings were located on places of production zones of the Roman period settlements.

REFERENCES

Bednarz Z., 1990, *The influence of temperature and precipitation on ring widths of oak (Quercus robur L.) in the Niepołomice Forest near Cracow, southern Poland*, Tree-ring Bulletin 50, 1-10.

Dobrzańska H., 1997, *Kultura przeworska w okresie rzymskim* [in:] *Z archeologii Małopolski. Historia i stan badań zachodniomałopolskiej wyżyny lessowej* (ed. K. Tunia), Kraków, 331-382.

Dobrzańska H., 2011, *Roman period grey pottery production near Cracow: geographical, technological and social dimensions* [in:] *Drehscheibentöpferei im Barbaricum. Technologietransfer und professinalisierung eines Handwerks am Rande des Römischen Imperiums. Akten der Interbationalen Tagung in Bonn vom 11. bis 14. Juni 2009* (eds. J. Bemmann, M. Hegewisch, M. Meyer, M. Schmauder), Bonner Beiträge zur Vor- und Frügeschichtlichen Archäologie 13, 259-284.

Dobrzańska H., Kalicki T., 2003, *Człowiek i środowisko w dolinie Wisły koło Krakowa w okresie od I do VII w. n.e.*, Archeologia Polski, 48, 1-2, 25-55.

Dobrzańska H., Kalicki T., 2004, *Man and environment in the Vistula river valley near Cracow from the 1st to the 7th century AD* [in:] *The geoarchaeology of river valleys* (eds. H. Dobrzańska, E. Jerem, T. Kalicki), , Archaeolinqua, Ser. Minor 18, 105-141.

Dobrzańska H., Kalicki T., Szmoniewski B. Sz., 2009, *Uwarunkowania środowiskowe wytwórczości pozarolniczej w okresie rzymskim i wczesnośredniowiecznym w dolinie Wisły koło Krakowa* [in:] *Środowiskowe uwarunkowania lokalizacji osadnictwa* (eds. L. Domańska, P. Kittel, J. Forysiak), Bogucki Wydawnictwo Naukowe, Poznań, 155-174.

Frenzel B., 2000, Datiert der klimawirksame Eingriff des Menschen in den Haushalt der Natur erst aus dem beginnenden Industriezeitalter? [in:] Entwicklung der Umwelt seit der letzten Eiszeit, Rungespräche der Kommission für Őkologie 18, 33-46.

Kalicki T., 1991, *The evolution of the Vistula river valley between Cracow and Niepołomice in late Vistulian and Holocene times,* [in:] *Evolution of the Vistula river valley during the last 15 000 years, part IV* (ed. L. Starkel), Geographical Studies, Special Issue 6, 11-37.

Kalicki T., 1996, *Phases of increased river activity during the last 3500 years*, [w:] *Evolution of the Vistula river valley during the last 15 000 years, part VI* (eds. L. Starkel, T. Kalicki), Geographical. Studies, Special Issue 9, 94-101.

Kalicki T., 2006, *Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich*, Prace Geograficzne 204, p. 348.

Leuschner H. H., Delorme A., Höfle H. C., 1986, *Dendrochronological study of oak trunks found in bogs in Northwest Germany*, Proceedings of the International Symposium on Ecological Aspects of Tree-Ring Analysis. Tarrytown-New York, 93-318.

Madyda-Legutko R., Poleski J., Krąpiec M., 2005, *Studia nad geografią osadnictwa w górnym dorzeczu Wisły u schyłku starożytności i na początku średniowiecza* [in:] *Archeologia o początkach Słowian* (eds. P. Kaczanowski, M. Parczewski), Instytut Archeologii UJ, Kraków, 307-352.

Parczewski M., 1988, *Początki kultury wczesnosłowiańskiej w Polsce. Krytyka i datowanie źródeł archeologicznych.* Prace Komisji Archeologicznej PAN. Kraków.

Poleska P., 2006, *Celtycki mikroregion osadniczy w rejonie podkrakowskim,* Biblioteka Muzeum Archeologicznego w Krakowie II. Kraków.

NIEPOŁOMICE - OLD CITY AND MEDIEVAL CASTLE
comp. Marcin Frączek

The castle in Niepołomice began as one of many fortifications throughout Małopolska initiated by King Kazimierz the Great in the 14th century, however this one soon became his favourite residence which he used as a retreat from the royal seat in Kraków. Kazimierz wasn't the only king to favour the isolated outpost however, as his successors all invested themselves in further embellishing and expanding the castle into a magnificent royal residence where much time was spent. The castle's heyday came during the rule of Władysław Jagiełło who held meetings of the royal council here, often entertaining foreign dignitaries and passing official court judgements from Niepołomice rather than Wawel. It was also from here that the famous royal hunts set out, bringing back the big game trophies of bison, bears and boars that would line the castle halls. In the mid-16th century King Zygmunt August rebuilt the residence on the model of contemporary Renaissance palaces – the appearance of which has been restored today. The 'Second Wawel' (as it was known) maintained its splendour for another hundred years before the Swedish deluge brought an end to its golden age and, along with the country, the castle gradually fell into ruin during Poland's eras of partition and occupation.

A long and costly reconstruction began in 1991 and was finally completed in 2007. Today the castle is a multi-functional space hosting several museum exhibits, an excellent restaurant, 3-star boutique hotel, spa and conference facilities. Despite all that however, the space retains its authentic historical character. Perfect for a family outing, across from the Castle entrance is a park with a large playground, Queen Bona's picturesque gardens lie beside, and the Vistula River flows just beyond it.

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ISBN 978-83-64038-45-7