ABSTRACT BOOK AND FIELD GUIDE

Geoarchaeology of river valleys

Ed. Tomasz Kalicki, Joanna Krupa

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"Geoarchaeology of river valleys"

and workshop/round table of

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Cover photo (by Tomasz Kalicki)
Inka ruins of Machu Picchu on slopes Huayna Capac in Urubamba river valley (Peru)

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"IMPACT OF PREHISTORIC MINNING AND METALLURGY ON FLUVIAL SYSTEMS"

DATING THE EARLIEST HUMAN OCCUPATION OF WESTERN EUROPE: NEW EVIDENCES FROM THE FLUVIAL TERRACES SYSTEM OF THE SOMME BASIN (NORTH FRANCE)

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Dating the earliest human occupation of Western Europe and reconstructing its relations with climatic and environmental constrains is becoming a central question, especially with the discovery of the Palaeolithic artefacts allocated to the Early Pleistocene in south-east Britain and in central France. In this context, the Quaternary sequences of the Somme basin, where is located Saint-Acheul, the type-site of the Acheulean, is a key location. Research undertaken for more than 15 years on both fluvial and loess sequences of the Somme basin and on the main river valleys of northern France (Seine and Yonne) provide a unique dataset for the study of the relations between human occupations and environmental variations.

Studies have been based on an interdisciplinary approach combining stratigraphy, sedimentology, palaeontology and geochronology using the following methods: U-series, ESR, OSL, and ESR/U-series. Meanwhile, the palaeoenvironmental interpretation of the Pleistocene sequences containing the Palaeolithic levels has been refined with several biological proxies (molluscs, beetles, mammals, pollen, plant remains) and sedimentological data (grain size, geochemistry, magnetic susceptibility, palaeopedology, micromorphology) obtained on both loess and fluvial sequences. Moreover the investigations lead on the bottom valley fluvial sequence (the Lateglacial and Holocene) allowed to the elaboration of a model concerning the response of the Somme fluvial system to climatic changes for the last Myrs. Our data have highlighted the impact of the 100 kyr cycles on terraces formation since ±1Myr, and the fluvial terraces system of the Somme basin has become a reference model for the study of the response of fluvial systems to Milankovich cycles in areas characterised by slow continuous uplift. Compilation of the whole results from modern archaeological excavations within this chronoclimatic reference system of northern France shows that human occupation of this area has been discontinuous and highly influenced by climatic and environmental factors. Indeed human occupations are quite systematically related to full interglacial or to transitional climatic contexts (early or late glacial), as it is demonstrated from a large number of sites for the last climatic cycle (Eemian-Weichselian). In the Seine basin, the oldest *in situ* Acheulean archaeological level has been evidenced within a tufa sequence dated from MIS 11 (La Celle) but older sites including Acheulean hand axes are known in the middle terraces (early MIS 14?).

In the Somme terraces system *in situ* Acheulean settlements where dated to early MIS 12 at ±450 ka in the 1990s, but new field discoveries allowed to push significantly the age of the oldest human occupation during the early middle Pleistocene.

The first one discovered in 2009 in Amiens was recently dated at ±550 ka using ESR and terrace stratigraphy (early MIS 13). The newest findings have been done in 2011-2012 in Abbeville, where artefacts occur in calcareous fluvial deposits of the ”High terrace” (+40 m relative height above the modern valley bedrock). According to terrace stratigraphy, ESR dating (quartz) and large mammal assemblages, these artefacts can be dated at about 600 ka. They are thus contemporaneous of the site of Mauer, the type-site of *Homo heidelbergensis.*

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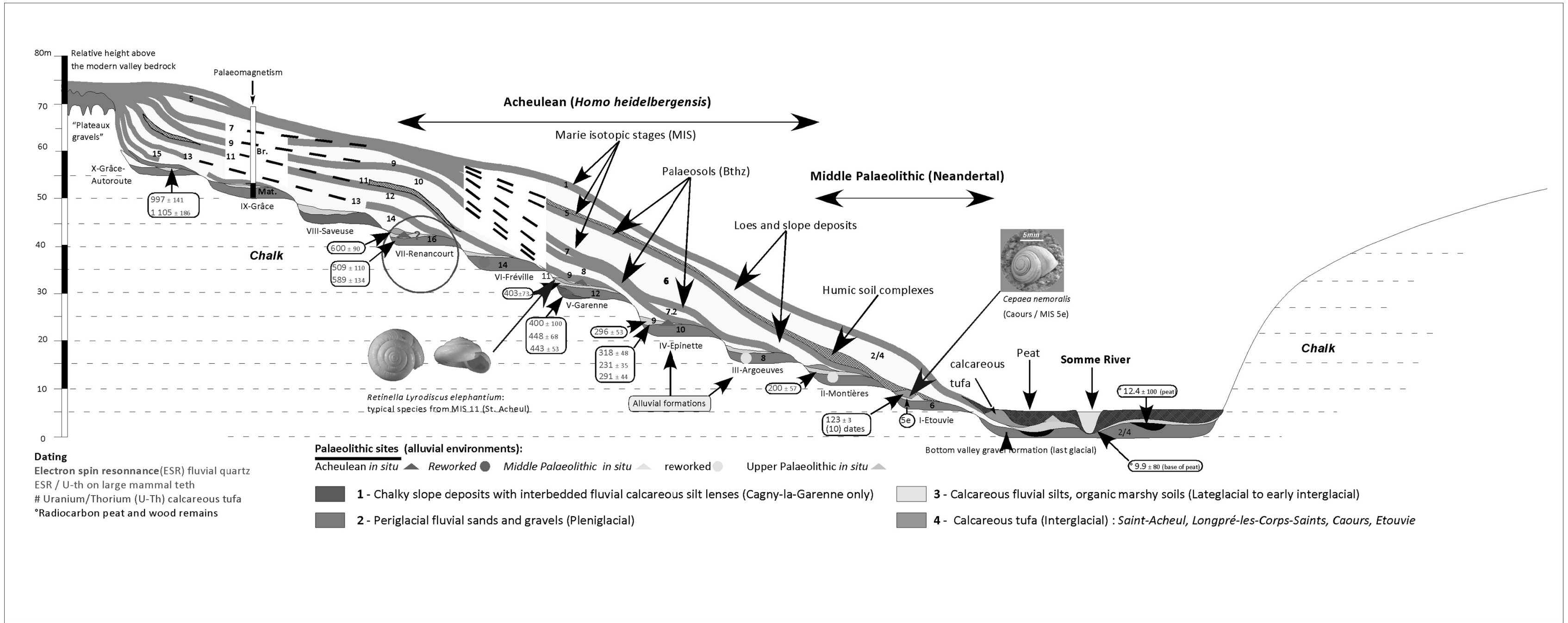

Fig. 1. Summarized cross-section of the terraces system of the Somme valley in the area of Amiens, location of the Palaeolithic sites,dating and chronostratigraphic interpretation (according to Antoine et al. 2007, modified)

ODRA - BIG RIVER ON THE EUROPEAN PLAIN IN THE LATE PLEISTOCENE

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The development of the river system after regression Saale Glaciation in western Poland was not well understood. Based on theoretical assumptions assumed that before the forehead glacier was formed Wroclaw-Magdeburg-Bremen's ice-marginal valley (Keilhack 1906, Kasior 1954, Berendt et al. 1995;). This glacial valley in the area of Silesia and Lusatia never had clearly defined borders. Its course was set on the basis of a clear incision, which creates a current Odra valley between Opole and Ścinawa which flows into the Baruth-Głogów ice-marginal valley created in the Weichselian glaciation. Westward from Ścinawa the flow set wide depression in speeding up the Elster. Further its course to the North Sea were determined along the Elster and Aller and Wesser valleys to Bremen. This course of ice-marginal valley was portrayed almost exclusively in the geographical works of popular science (Liedtke 1981). In the works devoted to the development of river terraces and archaeological sites more attention was paid to the terraces of the last cold stage. The problem of ice-marginal valley has not been reported. In Polish literature simply stated that the Wroclaw-Magdeburg ice-marginal valley did not exist because of Ścinawa river flowed north to the depression, which was established in the next glaciation the Baruth-Głogów ice-marginal valley (Szczepankiewicz 1968; Brodzikowski 1978).

It was only the work of J. Moll (1997) and later (Boos et al. 2001, Kasse et al. 2003, Hiller et al. 2004) showed that in the Lusatia ice-marginal valley was transformed into a river valley. Because all publications as well as the post-war Polish geological maps showed different age sediments assumed that flowed through the Nysa Łużycka (Lusatian Neisse). Then do not draw attention to the fact that exactly on the border between Germany and Poland was made classic geological fault.

A breakthrough in the diagnosis of the river system, which was built after the Warthanian stadial in SW Poland allowed the archaeological research carried out in Wrocław, at Hallera str. Site (Skrzypek et al. 2011, Wiśniewski et al. in print). This position, although it is far from Nochten by almost 200 km allowed us to demonstrate the high river terraces situated dated to about 50-60 thousand years. The position 15 m above Odra river alluvium from Weichselian glaciation forced to re-interpretation of what was filling the Oder valley. Terrain analysis showed that between Ścinawa and Nochten former lower valley was covered with alluvial fans which have their sources in the Karkonosze Mts. (Giant Mountains), highest mountains of Bohemian Massif.

On the basis of new geological data can be demonstrated that the Wrocław-Magdeburg-Bremen ice-marginal valley evolved into a river valley (Fig. 1, Badura et al. in print). The estimated depth of 25-30 m of valley incision indicates that the river could not leave its channel until the next ice-sheet transgression. So all the Eemian interglacial and large part of the Weischelian glacial Odra flowed into the North Sea former ice-marginal valley. On the glacier foreland in the Weiselian glaciation (LGM) created a new system ice-marginal valleys. For this new drainage system has been Oder, Bóbr and Neisse rivers was captured (Brose et al. 1987). Changing the Oder flow caused the rock material transported by rivers flowing from the Karkonosze Mts. was not discharged to the west, but was deposited in a local basin. At the end of the Weiselian glaciation three major rivers flowing from the Sudetes Mts. buried the Odra valley, and thus interrupting the continuity of morphological its old bed.

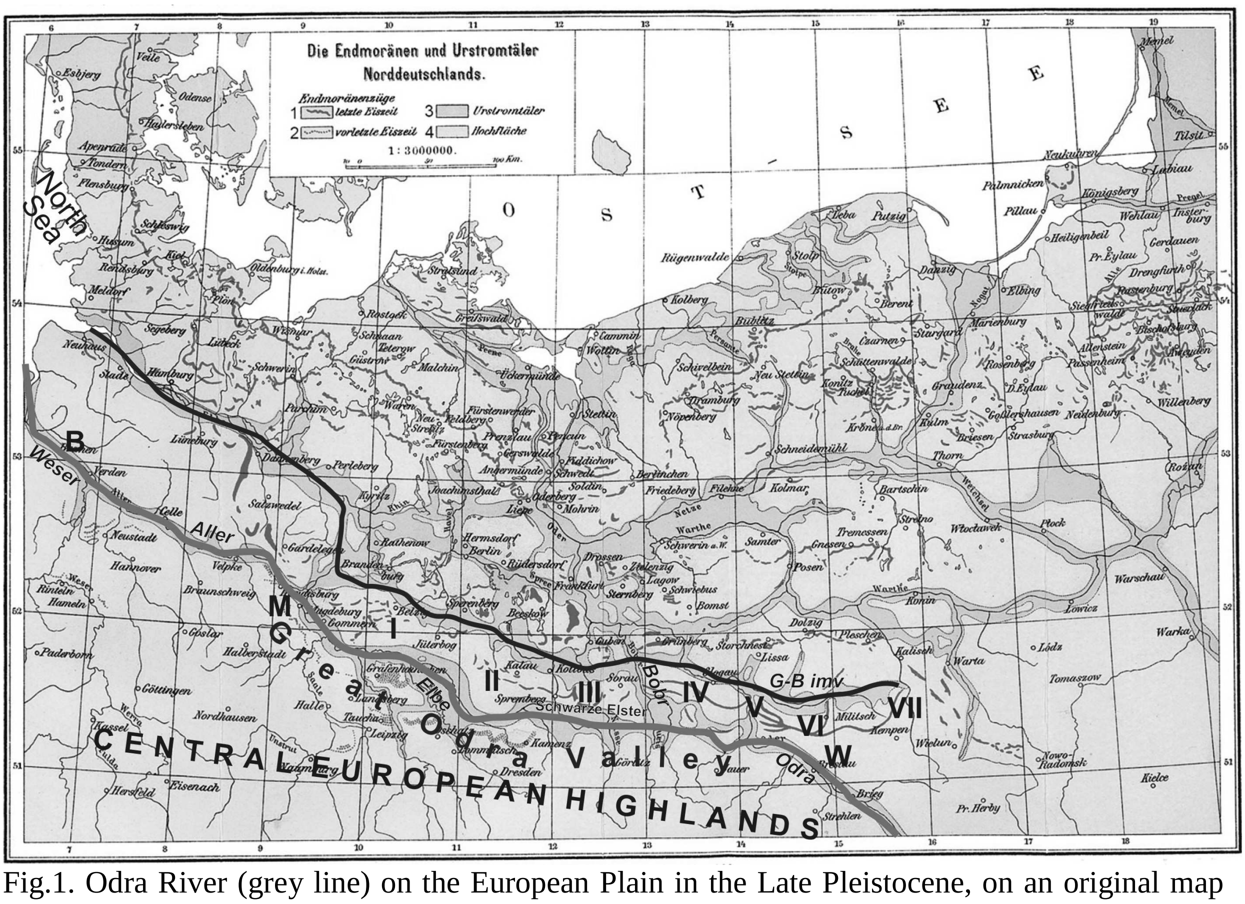

Fig.1. Odra River (grey line) on the European Plain in the Late Pleistocene, on an original map by Keilhack (1909), LGM - black line

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DEVELOPMENT OF SETTLEMENT IN LIWIEC VALLEY DURING PREHISTORIC TIMES – PRELIMINARY RESULTS

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The area of study includes the valley of Liwiec river, which lies on the boundary of Mazovia and Podlasie District. Liwiec is 143,55 km long and flows through Siedlce. Plain and Węgrów Depression, which are part of Mazovia Lowland (Kondracki 2000). This region characterized by typical post-glacial relief. The undulating morainic plain is varied by locally occurring end morainic hills, eskers, kames and also sandur covered with aeolian sands (Wrotek, 2002, 2006). The characteristic feature of this area is occurrence of numerous swampy depressions.

Archaeologic investigations in the region of Liwiec river have been carried out since the end of XIX c. by Warpechowski, Wawrzeniecki, Gloger (Kalaga, Głowacz 1986, Kalaga 1989) and Łuniewski (Figiel 1998). Their interests concentrated near Węgrów and Liw. Since the 80's in XX c. in the Liwiec valley have been carried out project of Archaeological Map of Poland (AZP). The main performers of AZP in this region were: J. Kalaga, W. Wróblewski, J. Andrzejowski, M. Wielgus, B. Moszczyńska, K. Cwetsch, B. Bryńczak and M. Figiel.

According to above authors the most popular regions for Prehistoric settlement were situated near the river and its tributaries. Artefacts have been finding the most often in the river valley, not so often in the areas that lies far off river, what was caused by "light" soils that occurs in the river valley bottom. Fluviosols developed on sandy loam and only locally gleyosols on loam rich in clay. On the terraces and denudated morainic plain, cambisols and luvisols developed on silty and sandy loam, only locally arenosols and podsols on sands (Olędzki 2007). The other very important factor of settlement attraction in that region was the river, which was navigable most of the year and people could use it as a communicative route. Those two factors have made a very good conditions for development of agriculture in Prehistoric times. Furthermore, most settlement points have been situated in the regions that have had a good access to water. However the plains, situated far off water in this case Liwiec river and its tributaries were not that attractive for Prehistoric settlement (Wróblewski 1984, Bryńczak 2003).

The oldest artifacts that have been found in the examined area come from the Mesolithic period. Their location is very irregular along the whole Liwiec valley. In the course of time there have been appearing more and more new settlement marks, camps and settlements that were situated far off the river. The most representative are the Middle Age and the Iron Age periods. Also it is noticeable concentration of artifacts near some towns and villages, what indicates on special attraction of those places. The most attractive regions in the Prehistoric times were: estuary of Liwiec river with neighbourhood of Kamieńczyk village and also Węgrów, Liw, Jarnice and area between Liwiec and its tributary Kostrzyń river. In those places there are most archaeological sites. Many of discovered archaeologic sites are multicultural, what is an argument for continuation of settlement patterns from earlier periods.

In the Liwiec valley have been found many Prehistoric cemeteries as well as single graves. The oldest cemetery is dated on Globular Amphora culture of the Neolithic period, which have been found near Niwiski village (Cwetsch 1986). Most of cemeteries come from the late Iron Age, representing the Przeworsk culture, Lusatian culture (late Bronze Age and early Iron Age) and also Flared Graves culture from the Iron Age. These objects often accompany or are neighboring with discovered settlements or campsites, more rarely early Medieval fortresses.

In studied area 9 early Medieval fortresses have been found, mostly from the Early Middle Ages and Middle Ages period, which are located in Barchów, Grodzisk, Klimy, Krzymosze, Kucyk, Łochów, Mordy, Węgrów and Wyłazy. They are quite much distant from oneself. Their common feature is the location at the riverside, often in the meander or in the anabranched channel of Liwiec and its tributary. The best preserved are early Medieval fortresses in Barchów, Grodzisk, Krzymosze and Wyłazy, the others objects are seriously changed by human or even entirely destroyed.

The preliminary analysis of the settlement in the Liwiec valley have confirmed results of studies from other regions, that the valley with valley slopes and margin zone constituted the preferred area of settling in Prehistoric times (Cwetsch 1986, Wróblewski 1989, Figiel 1998). In each periods the width of the settled zone developed from a few up to a dozen or so metres. The earliest were settled areas near the river channel and its tributaries. In the course of time settlements were located more often on the valley slope and terrace, and in the late Middle Ages the settlement have been moved deeper into plains (Kalaga, Głowacz 1986). Watershed areas were free from the settlement (Wróblewski 1989). It is possible, that a safety played an important role in the location of early Medieval fortresses. As they were located between anabranched channel of river, bluffs, or even on the hummocks situated in the bottom of muddy valley.

Additionally, important thing apart from embankments was a moat surrounding the early Medieval fortress (Wróblewski 1991).

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THE OBRESOC PROJECT AND THE CENTRAL-EUROPE FLOODPLAINS PALAEODYNAMIC DURING THE LBK PERIOD: THE CASE OF UPPER VISTULA RIVER

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OBRESOC project try to combine environmental and archaeological data on the first LBK farmers (5600-4750 BC)? The precise paleoclimatic records of this period are still rare in continental Europe and environments can rarely be dated with any greater precision than approximately a century or more. Yet, to measure the responsiveness and resilience of the LBK socio-natural system to climatic impacts, it is necessary to generate proxies with a high chronological resolution. The latter need to be studied within large populated areas and along main pathways such as fluvial valleys (eg. Vistula, Tisza, Rhine rivers and Paris basin). Most scientists have focussed on studying loess regions/settlements relationships since the middle of the 20th century (Clarke, Lüning, Barker, Kruk…), but there is little evidence on (1) how and with what intensity valley bottoms were exploited at that time, nor (2) what configuration and characteristics they presented, and (3) what were the impacts of hydrosedimentary dynamics, on LBK societies and afterwards on LBK sites themselves. Archaeological data located in fluvial environments appear relatively few at the scale of the LBK region, that opens questions about the real societal choices or the post-depositionnal effects (versus the hidden reserve, Berger 2011). Recent data have demonstrated that soil cover was different in the Central European (Rittweger 2000), like in western European floodplains (Berger 2005).

Our research have concentrated on a large transect of cores in well-studied areas, with a high palaeohydrological potential. The valley of the upper Vistula is well documented since many years (Kalicki 1991, 2006) that allow us to fastly locate the fluvial data corresponding to the Early Neolithic period. Vistula river downstream of Cracow Gate flows through the western part of the Sandomierz Basin. Erosional relief of these areas, developed on the Miocene clays, was covered with the diversified Quaternary sediments. From the north the river valley is delimited by the erosional edge of the Proszowice Upland, to which adhere two Pleistocene Vistula terraces (8-12 and 15-25 m above the river bed) covered with the Vistulian loess. From the south the valley is bordered by the Gdów Upland which is dissected by several small tributaries of the Vistula river. At their outlets there appear the Neoholocene alluvial fans accumulated in backswamps. The flood plain is 3-7 km wide and elevated about 4-5 m over the Vistula bed. It has very complicated morphology and structure with numerous palaeomeanders or their systems cut off in different periods of the Lateglacial and Holocene, and rest of the Young Pleniglacial and Late Glacial alluvial braided plains functioned as backswamps during the whole Holocene. Alluvia are 4-15 m thick and they are formed by channel deposits: sands with gravels in lower part and sands in the upper one, and higher in profile by overbank deposits – sandy silts, silts and clays. The investigates sedimentary archives are abandoned palaeomeanders at Lasówka and Rybitwy (KR-L1, KR-R1) and backswamp on floodplain at Brzegi (BRZ-0) located some kilometres downstream of Cracow downtown in southern part of wide valley floor, which (i) acting as sediment traps hosting well-preserved environmental proxies, (ii) containing well-datable materials for constructing age-depth models, and (iii) can provide over a thousand year proxy records per site.

On all cores, high resolution analyses of abandoned channel fill deposits (grain size, geophysics, geochemical, micromorphology) and biotic proxies (charcoal fluxes, pollen, macro-remains assemblages, ostracods and calcium carbonate biomarkers) were performed to reconstruct paleoenvironmental dynamics. These include changes in fluvial activity, forest fires, and vegetation evolution, which may be linked to agricultural and pastoral activities as well as climatic and hydrogeomorphic changes.

First results show a synchronous evolution of the hydrologic regime of some major European watersheds. This puts forward the occurrence of a climatic shift during the VIth millennia, as a result of changes in the North-Atlantic Thermohaline Circulation. We will discuss the impact of such changes on fluvial regimes, soils and vegetation in valley bottoms, as well as the implications on LBK communities.

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THE EARLY UPPER PALEOLITHIC SITE LUBOTYŃ 11 IN THE GŁUBCZYCE PLATEAU, SOUTHERN POLAND

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The territory of southern Poland marks the northern border of the Szeletian settlement. Within the territory of Poland, the Szeletian settlement is noted in three regions: Silesia, Krakow-Czestochowa Upland and the Carpathians. Few Szeletian sites known from the excavations within the Polish territory indicated that the settlement was short-term and not intense. Thus, Lubotyń 11 site in the SE part of the Głubczyce Plateau that has been being excavated by us since 2006 merits more attention as this place is the richest Szeletian site found so far in Poland and also one of the best preserved within the whole area occupied by this culture. As one of very few, allows us not only to analyse archaeological materials but its environmental context as well.

The camp in Lubotyń is a very typical example of the Palaeolithic site location taking advantage of all terrain features: situated along the route linking the south and north, an excellent vantage point – lying on the top of the highest elevation in the area – and rich flint outcrops in the direct vicinity of the site. Loess, in which the relics were deposited, protected the site and contributed to preservation of a utility level of the camp and charcoals.

The site occupies the top part of a moraine hill (309.8 m), connected with the Oder glaciation, built of gravel and sand formations intersected by frost wedges and covered with a relatively thin (1-2) loess cover. In the contact of the loess cover and fluvioglacial sands and gravels, in some part of the examined space a black layer very sated with charcoals was found, being the remnants of the utility level of the camp. At least two hearths were identified in the layer. This layer and the loess covering it constitute the main source of artefacts.

More than 10,000 flint artefacts come from the excavations. Almost all artefacts are made of flint found in the direct vicinity of the site or at the site. There are few items made of other raw materials: quarzite of southern (Moravian) provenience and radiolarite, probably also of the southern origin. The structure of the inventory is typical for a basic site: core frequency is less than 3 per cent; the tools constitute a bit more than 6 per cent, a debitage dominates, with a very distinct predominance of flakes over blades.

Regular flake cores dominate or flake-blade cores. The share of blade cores is relatively high. The forms without preparation or with very limited preparation dominate. There are few discoidal cores and one Levallois core. The group of tools consists of tools typical for Szeletian units. The tools made mainly from flakes, rarely from blades or non-industrial pieces, include mostly non-characteristic flakes or bits, more rarely retouched flakes. Among the other types of tools, end-scrapers dominate. The next group of tools are side-scrapers, notched tools and denticulate tools, single splintered pieces, one atypical perforator and a racklet. There are no burins.

The special group of tools are leaf points. There are only few of them in the tool group, together with fragments and unfinished forms. Most of them are preserved fragmentally. The points preserved intact have round bases, three of them are the typical Szeletian leaf-point with bifacial retouch. Bifacial retouch (partial) is a feature characteristic for the group, also on the other tools, mainly side-scrapers, retouched blades and flakes, as well as on single end-scrapers.

We have some palaeobotanical data coming from the palynological analysis and results of the analysis of wood macroremains. The data show a very interesting picture. Among few pollens, there is mainly birch (*Betula*), much less often pine (*Pinus*) and one alder pollen (*Alnus*). Shrubs are represented by a single dwarf birch pollen (*Betula nana* type), sea-buckthorn (*Hippophaë*) and juniper (*Juniperus*). All charcoals belong to pine (*Pinus*). We can talk about an environment of forest-tundra type, characteristic for the interstadials of middle part of the OIS-3 in Poland.

^{14}C datings coming from samples taken from hearts and settlement layer confirm generally such age. But they cannot be unambiguously interpreted. So far, six datings within the range from 44 000 ±1000 to 35 100±800 ^{14}C BP come from the site. After calibration, the dates may be widely placed between 50 000 and 38 000 years BP, i.e. in period between GI-13 and GS-9 of MIS3.

The camp in Lubotyń is not the only Szeletian site in this region. In the vicinity three another sites has been revealed (Pilszcz 63, Pilszcz 64 and Dzierżyslaw 79), at the moment known only from the surface surveys. At these sites, the strong prerequisites indicating the presence of next traces of the Szeletian settlement were found.

All the sites mentioned above are clustered in a very small and exceptionally important region, in the southern part of the Głubczyce Plateau. This region constitutes a direct foreground of the Moravian Gate, a depression between the Carpathians and the Sudeten constituting the Oder valley. During the Palaeolithic, the gate was an important point linking the southern Poland, mainly Silesia, with Moravia.

LATE PLEISTOCENE SETTLEMENT IN THE RIVER VALLEYS: A CASE STUDY OF THE MAGDALENIAN SITE WIERZAWICE 31

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In the study of settlement processes after LGM the spread and development of the Magdalenian settlements crucial. Eastern borders of the mentioned taxonomic unit covers with eastern Polish borders. Recent years have led to the discovery indicating more clearly that the south-eastern Polish territories were an important cultural centre of the Magdalenian settlement. With regard to a very important point on the map of the Magdalenian settlement it is worth mentioning the site in Wierzawice, district Leżajsk, which has been explored since 2009.

The site is located in the south from Leżajsk, within the central-eastern part of the Sandomierz Basin, on the eastern periphery of the Kolbuszowa Plateau. The site is located 188 m above sea level, about 10 m above the present day valley floor, on a gentle slope of the hill. The distance from the site to the present-day bed of the San river is about 2 km. Archaeological artefacts have been located within the illuvial horizon of the lessives soil developed on the slope created in periglacial conditions.

Archaeological materials include a small area of several square meters. Lithics occur as clusters separated by areas where the remains are less numerous and scattered. The clusters are very consistent in diameter often less than 20 cm. They include mostly 200-400 finds, mainly debitage and chips, less often microliths.

The most spectacular discovery of the current research is to reveal a very well-preserved stone structure, which can be interpreted as a remain of the hearth. Some stones - both pebbles and plates show the signs of intentional action – chipping or polishing. Additionally the numerous traces of haematite use are visible. The preservation state of the site allows us to trace the planigraphic systems and thus the activity zones in the camp. Obtained data lead us to make an interpretation of the site as a short-term, once occupied hunting camp. ^{14}C and TL datings indicate that it was used in GI-1c, which makes it one of the youngest Magdalenian sites in Central Europe.

The site in Wierzawice is one of the few known today the Magdalenian sites in the region. Apart from that it should be mentioned a small inventories uncovered in Grodzisko Dolne, Hłomcza and Łąka and a single discovery of a harpoon in Przemyśl. These points are closely related to the course of the San river and, as in the case of Łąka, its tributary – the Wisłok river. Thus, they indicate a very important role played by the San river valley as a route of the Magdalenian settlement spread to its eastern borders.

HUMAN IMPACT AND ALLUVIAL SOILS IN THE ŽITNÝ OSTROV ISLAND (SLOVAKIA)

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The paper presents results of a palaeobotanical research of two terrestrialized palaeomeanders from Žitný ostrov island (SW Slovakia). Dudváh river palaeomeander (infilled with mineral deposits, Štúrová site, Pišút et al. 2010) and Danube river palaeomeander (organic alluvial soil, Vrakúň site, Pišút et al. 2011, 2012) were analysed by means of pollen and macrofossil analysis.

The meanders were cut-off during the Subboreal period when the land was still mostly covered with mixed Pannonian forest of association Fraxino pannonicae–Ulmetum. In low-lying depressions, *Alnus glutinosa* formed typical alder carrs (Alnion glutinosae). Until the mid-19th century the whole region was strongly influenced by shallow groundwater and periodical floods, as reflected by pollen of aquatics and marsh species. The largest decline of alluvial forest occurred during the Subatlantic period. Local hydroseral succession of vegetation in abandoned oxbows exhibit characteristic phases with some similar features in both studied sites.

The study brings new data on past distribution of several species, which are currently listed as endangered, rare and protected (e.g. *Cladium mariscus*, *Nymphaea alba*, *Nuphar lutea*, *Trapa natans*) and elucidates a formation of local vegetation over the past millennia. Present-day habitat is a result of landscape changes, which have been associated with draining, intensified agriculture, ruderalisation and spread of invasive species.

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A NATURAL OR AN ARCHAEOLOGICAL OBJECT? GEOMAGNETIC RESEARCH AND EXCAVATIONS ON THE WIELKA WIEŚ SITE 25 NEAR WOJNICZ IN THE DUNAJEC RIVER VALLEY (SOUTHERN POLAND)

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Wielka Wieś site 25 (AZP 105-65;68) is located approximately 3 km south of Wojnicz in the district of Tarnów (Małopolska province), in the Dunajec river valley. From the east its boundaries are formed by the palaeochannel of the Dunajec river whose channel is still visible in the relief and where you can find a row of ponds and small ponds. From the west side it is enclosed by the Panieńska Hill and the trunk road (DK 975) which separates it from the hill. The site was located during the surface research in 1989 (Cetera et al. 1989). In the area closely adjacent to the site of Wielka Wieś 25 the site Wielka Wieś 26 (AZP 105-65; 69) was located (Cetera et al. 1989: 316).

After verifying the excavations we see that we have to do with one site with two independent phases of settlement. The settlement of the Lusatian culture is concentrated in the south-western part (Wielka Wieś site 26 and the southern part of the Wielka Wieś site 25). During the excavation works several storage pits were discovered with ceramic material which dates back to period V Bronze/Hallstatt C. Given that most buildings which have been discovered in the immediate vicinity of the trunk road date back to this phase of settlement we can assume with a high degree of probability that the centre of the Lusatian settlement was located further west of the area of the existing road and at the foot of the Panieńska Hill.

Excavations on the site were preceded by studies using the geomagnetic method. The fluxgate type of magnetometer of the Geoscan Research company, model FM 256 was applied, with the measurement resolution 0.1 nT and measurement time equal 0.1 second. The research was conducted in the grid with a side 0.50x0.25 m (along measurement lines with the distance from each other by 0.5 m, every 0.25 m on the line) within squares with the side 20x20 m. Measurements were carried out in the so-called Zig-Zag mode (the instrument was moved during the registration of measurements in both directions). After completion of each measurement within the given square, the position of the instrument's probes was corrected. The research included the total surface area of 1.28 ha.

The apparatus used for research is the gradiometer, i.e. an instrument which examines the difference between the value of the magnetic field strength on two different heights (thus on the maps of results we can see the negative values). In case of Geoscan Research apparatus the distance between the probes is 0.5 m. Gradient measurement allows to more effectively section off the shallow objects interfering with the magnetic field than the measurements of the total magnetic field strength. The instrument FM 256 does not measure the total value of the magnetic field strength of the Earth but only the value of its vertical component. The apparatus allows to observe the changes of the field's strength in the layer to the depth of about 0.5–1.0 m. In case of tracking the strongly interfering objects of the magnetic field (e.g. pottery kilns, bloomeries), the tracking depth increases to several meters.

The preliminary results of the study were obtained using the program Geoplot 3.0 (Geoscan Reserach) and Surfer 9. The results are presented as gray-tone maps, black corresponds to extreme positive values of the Earth's magnetic field and white to negative ones. The maps depicts the probable locations of archeological objects on the site. Punctual object like pits or hearts are visible as well as one linear object of an indeterminate character which runs along the eastern part of the site.

During the excavation research four types of archaeological objects were identified. These include resource pits, post-pillar holes, cottages and hearths. Moreover, a long, linear object was observed, located parallel to the abandoned channel of the Dunajec river. During excavations the linear object was only noticeable on the NE part of the site. It was elongated in shape, about 150 m long and 1.5-2.0 m wide. The outlines of the dark gray color layer of the filling up was well visible against the surrounding soil of a lighter colour. During the exploration of the filling up single little fragments of pottery and daub were found. Small dimensions and a bad state of the preservation of artifacts made it impossible to determine the chronology. But one of the pits was cut into the filling up of the elongated object and it contained pottery from the Roman period. Therefore, the layer of the elongated object must be slightly older than the pit. All the facts mentioned above suggested an anthropogenic character of the linear object yet the cross-section excluded this possibility. The vertical projection showed a natural geological character of the object. There are two ways in which we can explain the origin of this elongated object:

- it is coluvial (deluvial member), slightly slope to the valley axis and deposited under the edge of the valley site during Roman phase of catastrophic events clustering and then cover with overbank alluvia,
- it is flood channel cut and fill in the flood plain (terrace?) during this phase.

A series of borings should clear up this question.

The other objects at the site can be classified as four types of archaeological objects. The first group- resource burrows- can be dated back to the period V Bronze/Hallstatt C and is connected with the settlement of the Lusatian culture. Objects of this type occurred mostly at the Wielka Wieś site 25 on its south-western part and at the Wielka Wieś site 26, in both cases they were located directly by the existing trunk road DK 975.

The next group of objects, in the form of post-pillar holes, most often accompanied the cottages creating their supporting structures or accompanied them most probably creating pens of the zeriba type. Unfortunately, due to small size, thickness and a small amount of magnetic material these objects were not perceptible on the geophysical map, contrary to cottages - another type of objects which were singled out and which, despite quite small thickness (~20-40 cm), were captured on the geomagnetic map. Objects on the rectangular plan had the dimensions of 2x3 m. Dwellings sunk in the ground had pillar structures. The structure corresponds to the analogous dwellings attributed to the Przeworsk culture, e.g. constructions from the Wojnicz site 3 (Cetera et al. 1989), which was confirmed by the study of ceramic material.

The largest group of objects, which was documented on the site included hearths. During the excavation research more than 100 objects of this type were noted. In the vast majority they were made of burnt clay, wood ash and burnt stones. Very occasionally they included the ceramic material. Due to the structure and shape of hearths (the rectangular outline dominates), hearths can be connected with the settlement of the Przeworsk culture. Hearths of this type were discovered on the sites of Przeworsk culture, among others, at Tarnowiec, district of Tarnów (Szpunar, Okoński 2004), Koszyce Wielkie, district of Tarnów (Szpunar, Szpunar 2004), Strzelce Wielkie, district of Brzesko (Kordecki, Okoński 1999), Gorzyce, district of Tarnów (Szpunar, Szpunar 1991), Wojnicz, district of Tarnów (Dzięgielewska 2010).

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RECONSTRUCTING LOCAL ENVIRONMENT IN BISCHWIHR HELPED BY GEOARCHAEOLOGICAL INVESTIGATIONS IN THE COLMAR REGION (FR-ALSACE - RHINE VALLEY)

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Influenced by the Rhine river and later by the Ill river, structuring hydrographical elements of the upper Rhine graben, the micro region of Colmar has been the object of researches which aimed to understand its Quaternary evolution through different environmental thematic. Helped by preventive archaeological excavations conducted these last years in Alsace, extensive geoarchaeological studies in this area led to show off paleoenvironmental indicators completing these researches: historical modification of the Ill river plan and development of a particular pedogenesis in hydromorphic condition which has not completely restrain the occupation of the region.

The archaeological survey and the excavation of the site of Bischwihr (*Muelhaecker*) allowed to collect and to complete data which characterize the specific evolution of the site since the last Quaternary glaciations (i.e. identification of paleotopography, determination of sedimentary sequences, pedogenesis and occupation stages).

These data associating environmental and archaeological indicators aimed to be developed and compared to other sites of the Colmar region to emphasize their postglacial evolutions.

MORPHOLOGY 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

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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.

Exiting the Cracow Gate, the Vistula river continues through the western part of the Sandomierz Basin. Erosional relief of these areas, developed on the Miocene clays, was covered with the diversified Quaternary sediments. From the north the river valley is delimited by the erosional edge of the Proszowice Upland, to which adhere two Pleistocene Vistula terraces (8-12 and 15-25 m above the river bed) covered with the Vistulian loess. The terraces are drained by a few permanent streams flowing down from the upland and a network of dry fluvio-denudational valleys (dellen). The flood plain is 3-7 km wide and elevated by 4-5 m over the Vistula bed. It has very complicated structure. At its borders, especially in the south in wide depressions of the Drwień and Drwinka rivers, in a few places beneath the terrace edge, and downstream of Niepołomice also between meander belts, there survived fragments of the Young Pleniglacial and Late Glacial alluvial braided plains. Elsewhere, in the valley bottom numerous abandoned channels can be found – single or their systems. They indicate the Holocene lateral migration and avulsions of the meandering river bed. Alluvia of the flood plain are 4-15 m thick. They are formed by channel deposits: sands with gravels in lower part and sands in the upper one, and higher in profile by overbank deposits – sandy silts, silts and clays. From the south the valley is bordered by the Gdów Upland which is dissected by several small tributaries of the Vistula river.

At their outlets there appear alluvial fans. Their development was especially intensive in the Neoholocene, when they were being formed on the Holocene sediments of backswamps.

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 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.

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NATURAL FACTORS OF LOCATION OF THE NEOLITHIC SETTLEMENTS IN LOWER PART OF WIERZYCA VALLEY (POMERANIA REGION, NORTH POLAND)

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The Wierzyca valley, in the section below Pelplin, constitutes a border between the regions of Central Kociewie and Eastern Kociewie. In its course the Wierzyca river uses a system of subglacial channels. The channel section are separated by gorge sections. Within the channel sections there are widenings of the valley with a basin character. Between Pelplin and Brody Pomorskie the Wierzyca valley is relatively wide and deeply cut into the surface of the rolling modulating morainic plateau. The surface of the area surrounding the Wierzyca valley is built of basal and flow tills. At the bottom of the valley there are sandy sediments of fluvioglacial and fluvial origin. As it was already mentioned, within the analyzed section of the Wierzyca valley there is a clear widening. On sandy-clayey sediments, Pesta, silty-peat, humus alluvial soils were created there and on. These soils, due to their physical properties were much easier for cultivation than brown or black soils on the morainic plateau. It can be concluded that it was the character of the soil cover and access to water that was the main location factor with respect to the Neolithic settlement in his area. Another advantage of the settlement location in the valley was protection against unfavorable impact of climatic conditions, mainly north-western winds prevailing there. Another factor facilitating the settlement is the relief of the valley bottom. The outwash terraces occurring in the valley above the floodplain, offered shelter during floods. Taking into consideration the above mentioned natural conditions occurring in the Wierzyca valley, it can be stated that his valley, and especially its lower part, was indeed an ideal place for settlement. These conditions were appreciated already in the Neolithic period.

In this part of valley are localized several archaeological points of settlements. For example Rożental and Brody Pomorskie. All points below to Funnel Beaker culture.

METHOD OF CHANNEL MAPPING AS A SOURCE OF INFORMATION ABOUT HUMAN IMPACT AND POSSIBILITIES FOR GEOARCHAEOLOGICAL INTERPRETATION: CASE STUDY FROM BIESZCZADYMOUNTAINS (POLISH CARPATHIANS)

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Bieszczady Mts. are the most eastern part of Polish Carpathians, Alpine orogeny. The study area is located in south-east part of Poland. Research has been carried out on Bystry and Roztoczka flows. They are located on the opposite slopes of Okrąglik, which is a good starting point for the implementation comparative study.

The study of river habitat is the basis for river ecological restoration and basin environmental management. It is the only method for assessing impact human interference in the surrounding environment. This baseline reference provides a sound basis for describing the physical character and assessing the habitat quality of 100 to 1000 m lengths of river shown on different thematic maps (Fig. 1)(Buffagini, Erba 2002, Krzemień 2006). The use of a standard field method, with associated accreditation controls, stratified random sampling strategy and computer database all provide a robust foundation for habitat quality assessment. The outputs have a sound statistical basis and satisfy the practical needs of river management as well as providing policy-makers with relevant information. We can observe effects of deforestation and what results of it in the future. All collected in this way information may be used in further geoarchaeological research.

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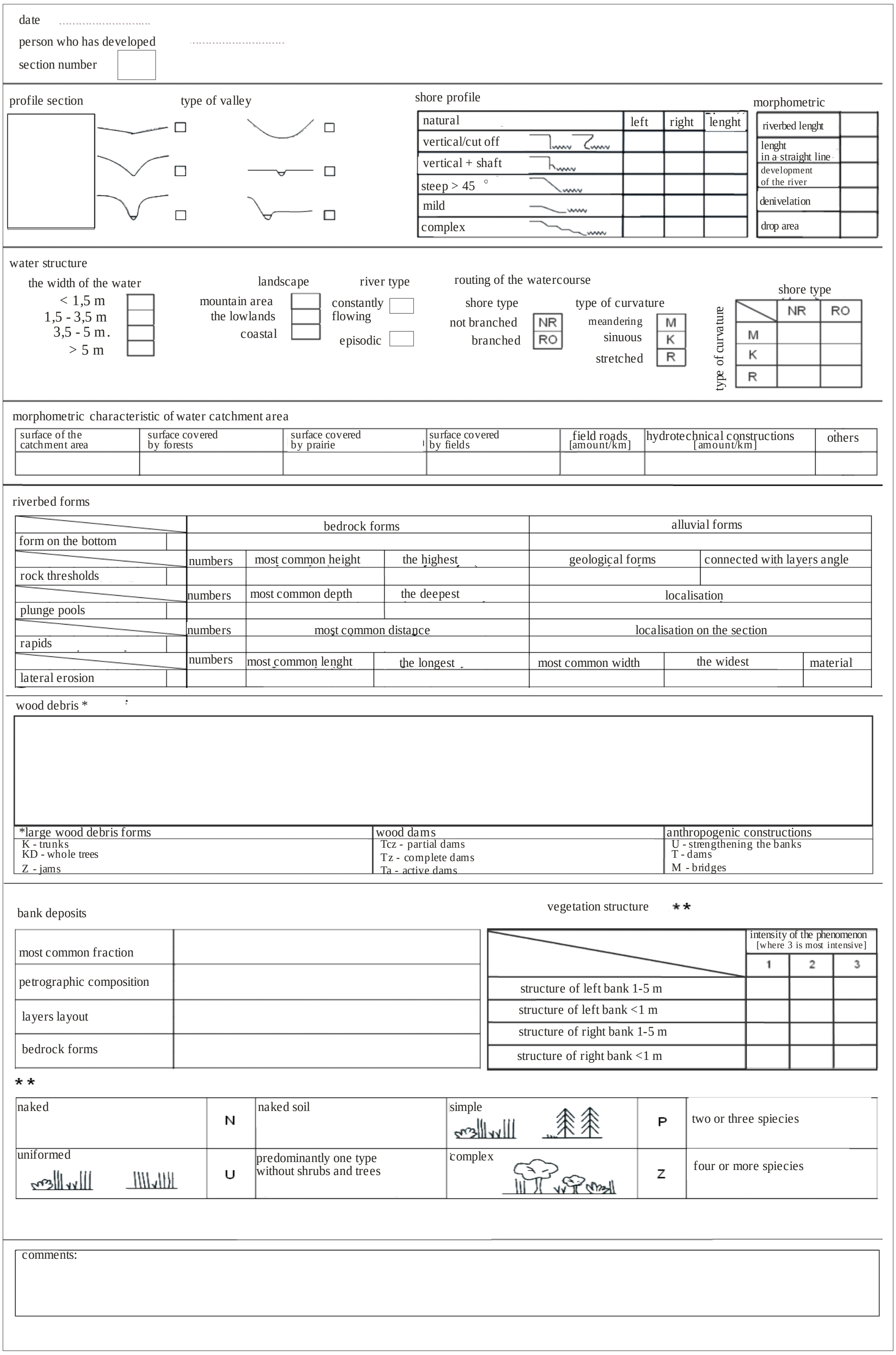

date ....

person who has developed ....

section number

profile section | type of valley | shore profile | morphometric

shore profile	left	right	lenght
natural			
vertical/cut off			
vertical + shaft			
steep > 45 °			
mild			
complex			

morphometric	
riverbed lenght	
lenght in a straight line	
development of the river	
denivelation	
drop area	

water structure

the width of the water: < 1,5 m; 1,5 - 3,5 m; 3,5 - 5 m.; > 5 m

landscape: mountain area; the lowlands; coastal

river type: constantly flowing; episodic

routing of the watercourse

shore type: not branched NR; branched RO

type of curvature: meandering M; sinuous K; stretched R

shore type

type of curvature	NR	RO
M		
K		
R		

morphometric characteristic of water catchment area

surface of the catchment area	surface covered by forests	surface covered by prairie	surface covered by fields	field roads [amount/km]	hydrotechnical constructions [amount/km]	others

riverbed forms

		bedrock forms		alluvial forms		
form on the bottom						
	numbers	most common height	the highest	geological forms	connected with layers angle	
rock thresholds						
	numbers	most common depth	the deepest	localisation		
plunge pools						
	numbers	most common distance		localisation on the section		
rapids						
	numbers	most common lenght	the longest	most common width	the widest	material
lateral erosion						

wood debris *

*large wood debris forms	wood dams	anthropogenic constructions
K - trunks KD - whole trees Z - jams	Tcz - partial dams Tz - complete dams Ta - active dams	U - strengthening the banks T - dams M - bridges

bank deposits

most common fraction	
petrographic composition	
layers layout	
bedrock forms	

vegetation structure **

	intensity of the phenomenon [where 3 is most intensive] 1	2	3
structure of left bank 1-5 m			
structure of left bank <1 m			
structure of right bank 1-5 m			
structure of right bank <1 m			

**

naked	N	naked soil	simple	P	two or three spiecies
uniformed	U	predominantly one type without shrubs and trees	complex	Z	four or more spiecies

comments:

Fig. 1.Mapping diary form based on RHS and UJ diary for Carpathian rivers

HISTORICAL HUMAN ACTIVITY IN RIVER VALLEYS. CASE STUDY FROM BIESZCZADY MOUNTAINS

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Bieszczady Mts. are the most eastern part of Polish Carpathians, Alpine orogen. Carpathian settlement started during the Bronze age with the peak of population in the Middle Ages. In the alluvial profiles of the San drainage basin we found traces of large Medieval deforestation (Kukulak 2004). Review of literature is due that the pace of deforestation in upper San river basin was unequal over the last 4-5 centuries. Following the initial phase increased emigration and logging in the 16th century, the first anthropopressure culmination, there has been marketing recourse in the 17th and early 18th century. In the early 19th and 21th centuries was the second culmination of anthropopressure forced mainly increases population and cereal crops and root expansion. Decline 19th and 20th centuries was further period of development and the wood processing industry related deforestation. These two phases alternately in the environment valley appear to have the biggest influence on the course of fluvial processes in upper San river basin and its tributaries. There are layers of detritus and fragments of woods in the limit between overbank and channel facies. Depopulation of this area after Second World War Bieszczady led to reforestation (Winnicki, Zemanek 1998).

Detailed studies concentrated on accumulation and transport of wood debris by the river channel, changes of number of organic in alluvia etc. connected with different scale of human impact on this territory. (Fig. 1, 2)

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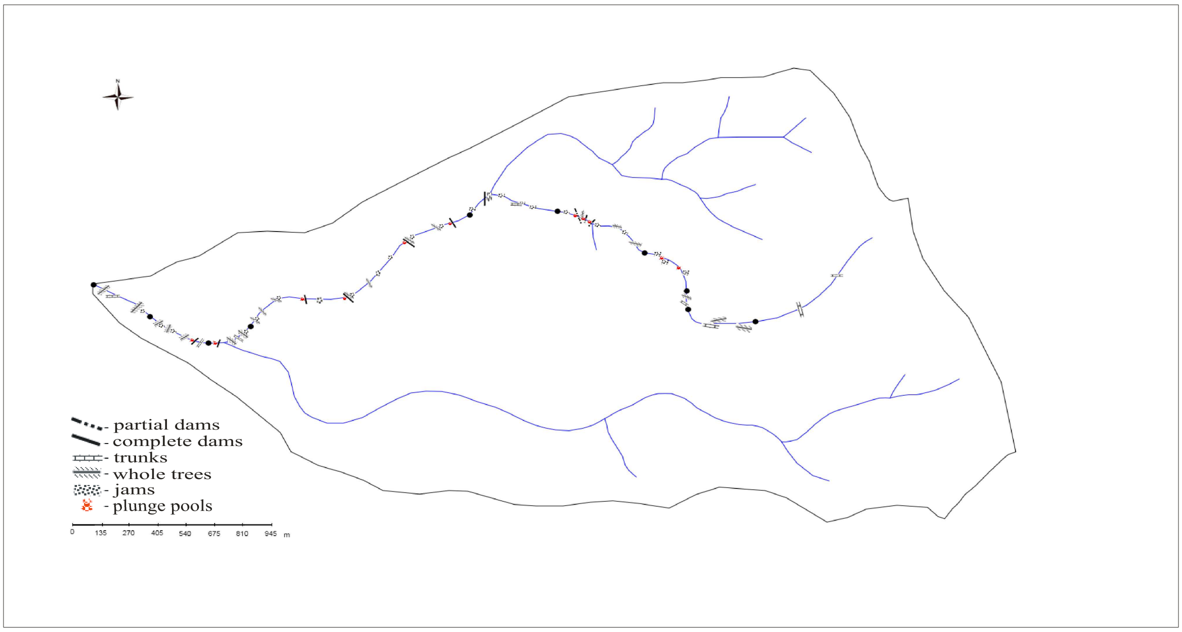

Fig. 1. Location of large wood debris on Roztoczka flow

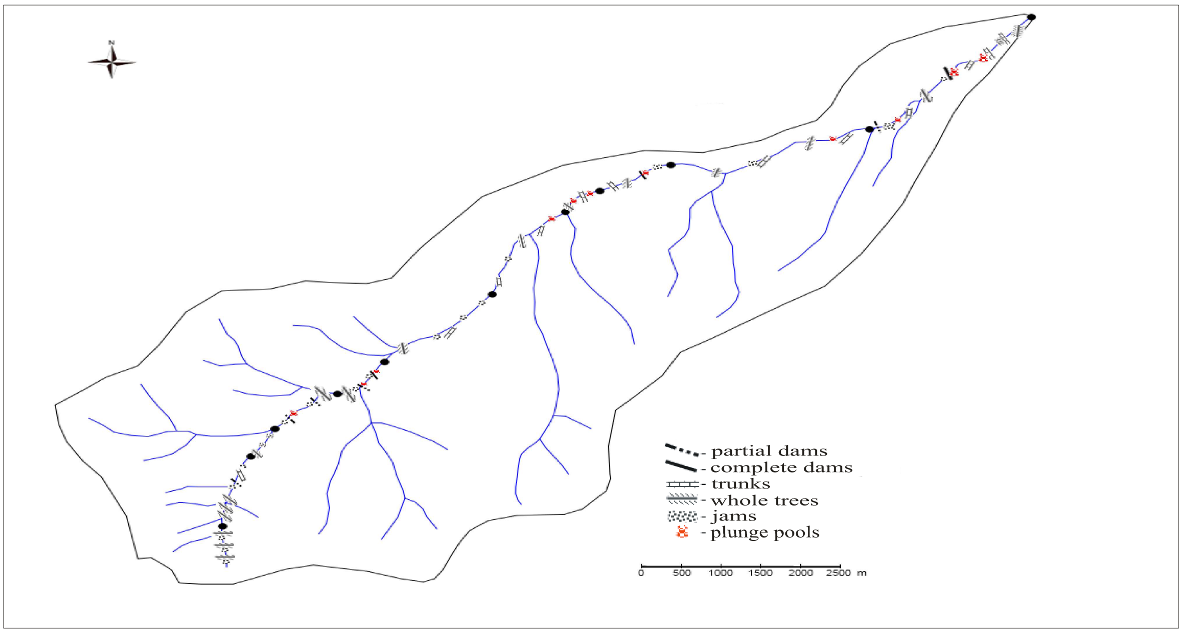

Fig. 2. Location of large wood debris on Bystry flow

THE TEMPORAL AND SPATIAL QUANTIFICATION OF HOLOCENE SEDIMENT DYNAMICS IN A MESO-SCALE CATCHMENT IN NORTHERN BAVARIA/GERMANY

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The Aufsess river catchment (97 km^2) in northern Bavaria, Germany, is studied to establish the Holocene sediment budget and to investigate the sediment dynamics since the early times of farming in the 3rd millennium BCE. The temporal characterization of the sediment dynamics is based on an intensive dating program with 73 OSL and 14 ^{14}C ages. To estimate soil erosion and deposition, colluvial and alluvial archives are investigated in the field by piling and trenching, supported by laboratory analyses. The sediment budget shows that 58% of these sediments are stored as colluvium in on- and foot-slope positions, 9% are stored as alluvium in the floodplains and 33% are exported from the Aufsess river catchment. Colluviation starts in the End-Neolithic (ca. 3100 BCE), while first indicators of soil erosion derived alluviation is recorded ca. 2-3 ka later. The pattern of sedimentation rates also displays differences between the colluvial and alluvial system, with a distinct increase in the Middle Ages (ca. 1000 CE) for the alluvial system, while the colluvial system records low sedimentation rates for this period. A contrast is also observed since Modern Times (ca. 1500 CE), with increasing sedimentation rates for the colluvial system, whereas the alluvial system records decreasing rates. The different behavior of the colluvial and alluvial system clearly shows the non-linear behavior of the catchment's fluvial system. The results further suggest that human impact is most probably the dominant factor influencing the sediment dynamics of the catchment since the introduction of farming.

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MID-HOLOCENE ALLUVIAL RECORDS IN THE PARIS BASIN (FRANCE): MALACOLOGICAL CONTRIBUTION TO PALAEOENVIRONMENTAL RECONSTRUCTIONS

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In the context of rescue archeology, an intensive fieldwork has been undertaken since past decades on alluvial sequences from the Paris Basin in Northern France. Palaeoenvironmental reconstructions were conducted using a multidisciplinary approach based on several bioproxies (Limondin-Lozouet, Antoine 2001, Pastre et al. 1997, 2000, 2001, 2003). Among them, molluscs appear particularly important as they are one of the best preserved groups within alluvial sequences. For the first half of the Holocene, tufa deposits formed in riverbeds. These deposits yield detailed and homogeneous malacological successions describing the spread and development of forested areas. The biogeography of some identified species enables to build a biostratigraphical framework showing climatic changes (Preece, Bridgland 1999, Limondin-Lozouet, Preece 2004). For the second part of the Holocene, since approximately 4500 B.P., the said tufa deposits are replaced by silts mainly containing aquatic molluscs. As the latters are not relevant to reconstruct landscapes, it is therefore necessary to select sequences located outside riverbeds. This work consequently focuses on alluvial plains in the context of the Neolithic and of the Metal Ages. In this respect, it has been observed from palaeoenvironmental reconstructions conducted at different spatial scales a repetition of similar malacological assemblages through time in a large regional frame. Firstly, during the Atlantic, alluvial plains remained dominated by woodlands. Secondly, at the end of this chronozone and during the Subboreal, an increase of moisture is registered. Despite the expansion of marshy biotopes, forest clearance occurs progressively. Anthropogenic actions thus appear fully involved in this phenomenon. Finally, from the beginning of the Subatlantic, at the transition from the Bronze and the Iron Age, wet biotopes shrink and vegetation of alluvial plains is now mainly composed by lawn grass. These malacological results demonstrate that paces and modalities of the transformations which affected the structure of alluvial landscapes followed a common trajectory across the Paris Basin. These changes that affected environments are connected with climatic evolutions and human activities.

That is why malacological results are then discussed in the light of human occupation and geomorphological and palynological regional syntheses.

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GEOLOGY OF THE CONFLUENCE OF THE DYJE (THAYA) AND MORAVA (MARCH) RIVERS

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The most recent development of the Dyje (Thaya), Morava (March) and Kyjovka confluence area starts during LGM (22,400±3,660 – 2,500 yr BP, Hv-7150, Lanžhot) and the beginning of Late Glacial (16,170 ± 480 yr BP, Hv-9728, Břeclav–Poštorná) with aggradation of fluvial gravels in the valley bottom by braided streams. Due to absence of protecting vegetation cover, the „cold“ flood loams were deposited in the valleys during late glacial. After the change from the braided to the meandering stream there is not influx of new clastics. Because of strong reduction of high water stands also the deposition of overbank sediments practically ceased as well. The rivers just displace the upper parts of the gravels (abandoned channel Břeclav-Poštorná 7,990±75 yr BP., Hv-9729). Upon the original gravel surface (braidplain) the sand dunes were deposited. A relatively high age of the aeolian sands evidence by Mesolithic artefacts fossil soils (ca 12,000-8,000 yr BP) as well as by thein absence upon the younger redeposited gravels, even when they occur at the same level. The marked evelations of dunes out of the reach of floods were settled since the very beginning and the more or loess continuous occupation lasted till the half of the 13. century. At the Pleistocene-Holocene transition the incision of streams, like in other European rivers, takes places and a lower gravel surface develops upon which the younger „warm“ flood loams (start ca 4,000 yr BP) are laid down. This deposition was in places interrupted by shorter breaks documented by subfossil soils. Due to the most recent human interference the surface of the wind blown sands was exposed and local redeposition took places. The sands were finally stabilized by artificial forestation in 19. century.

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PREHISTORIC AND EARLY HISTORIC SETTLEMENT IN THE CONTEXT RIVER VALLEYS – MIDDLE OBRA REGION (WIELKOPOLSKA). SPATIAL ANALYSIS WITH GIS

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The influence of the relief as well as of other environmental features like soils or hydrological regime on the prehistoric settlement pattern is commonly accepted. The settlement pattern a preferences change in time on different areas so it is difficult to formulate general rules of human behaviour throughout history. On the lowland areas of the temperate zone, with lack of radical relief changes and widespread access to the water resources the crisp preferences and significant changes of the settlement predilections are difficult to observe. A new method, based on fuzzy set theory, has been proposed for the problem of transformations of settlement processes due to relief and hydrological regime in the middle part of the Great Poland Lowland (Nizina Wielkopolska). The data used in the problem coming from DETD Level 2 terrain model and data of polish Archaeological Record Project.

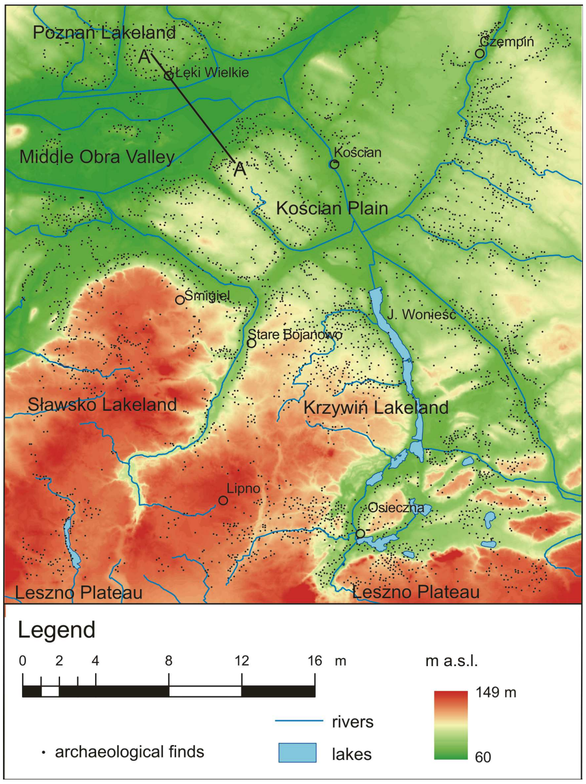


Fig. 1. Study area with the location of transect A

The selected area, located in the southern part of the Great Poland Lowland (Nizina Wielkopolska) is typical of the Middle-European Lowland landscape (Fig. 1).

The area consists of the boggy Warta-Odra Pradolina in the north, and the flat lakeless Kościan Plain (Równina Kościańska) formed from the morainic plateau and cut with glacial channels to the south, where it turns into the Sławsko and Krzywiń Lakelands (Pojezierze Sławskie and Krzywińskie), as well as into the most morphometrically diverse morainic Leszno Plateau (Wysoczyzna Leszczyńska). In the glacial troughs rivers are flowing in an irrigation channels. Land reclamation in the studied area was performed from the 18th century.

Site locations encountered in any areas often manifest themselves in the form of point patterns in two-dimensional space. Data observed in respect of such phenomena consist of the objects of study — archaeological remnants of different scale. In most cases the manner in which these points are arranged contain useful information of the settlement process and its dynamics during the time as well as information about external factors affecting settlement process. This information is subtle as well as difficult to detect, to extract and to quantify.

Archaeological traces are mapped usually in sparse form. Statistical methods used to investigate the settlement pattern transform a sparse data into the continuous surface. Three spatial statistic methods have been used to investigate the settlement changes on Lower Obra region in prehistory and the Middle Ages:

- trend analysis to investigate more generalized process of settlement pattern formation,
- Kernel density estimation to find existing clusters of settlements,
- multivariate analysis to investigate relationships between natural landscape properties and settlement preferences.

At the beginning of the analysis process, the sites were tested, in k-estimate Monte Carlo test, if their pattern is not random (Cressie 1993, Baddeley, Turner 2006, Jasiewicz, Hildebrandt 2007).

Trends analysis show relatively stable settlement pattern along all archaeological periods (the sites tend to concentrate in the northern and the middle part of the area - better soils and small landscape differences). In the Early Medieval Age, the settlement centre shifts to the south of the area (the early Polish statehood). The temporarily settled sites tend to scatter all over the area, except for the Neolithic period, when the settlement pattern for both the temporarily and permanently settled sites was almost the same.

Density estimation presents similar but more precise view of the settlement pattern than the trend analysis.

The third method applied to spatial data was the multivariate analysis described previously by Jasiewicz and Hildebrandt (2009 a, b). That complex method used multivariate (mostly hydro-geomorphologic) set of variables to detect spatial dependence between site location and natural features.

A multivariate statistical analysis based on the continuous reclassification of relief in derivative maps was used. Eight geomorphologic variables were selected for analysis (Tab. 1).

Tab. 1. Characteristics of hydro-geomorphologic variables used for the analysis

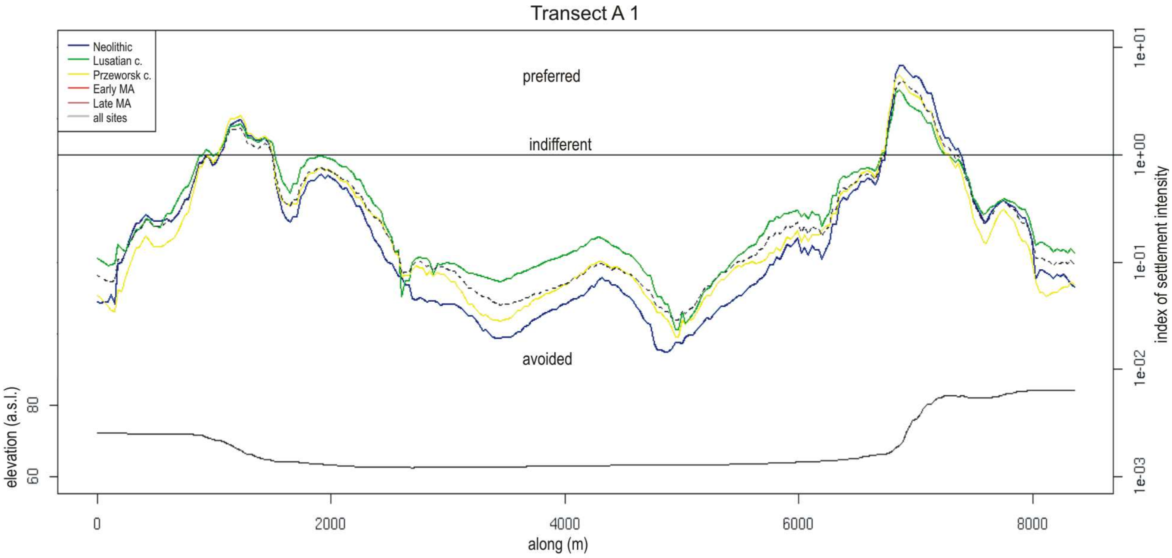
Abbreviation of geomorphologic variable	*Geomorphologic variable*	*Description of variable*	***Socio-economic interpretation***
RELEV	Relative elevation	An elevation related to the hypothetical surface of initial points of the drainage network	Observation points, defense
EDGES	Distance to the (lower) plateau edge	The edge was defined as the zone where the hypothetical trend surface of the contact of 2nd and 3[rd] order streams (according to Strahler's (1952) classification) intersects the recent terrain surface. The edge was defined as the zone where the hypothetical trend surface of the contact of 2nd and 3rd order streams (according to Strahler's (1952) classification) intersects the recent terrain surface.	Distance to valleys and water
WATER	Distance to main streams and lakes	Distance from the main rivers and water bodies	Distance to water bodies
DRAIN	Distance to recent drainage network	Distance from all streams and drainage channels Strahler (1952), Kvamme (2005)	Distance to possible natural springs
RAD	Diffuse irradiance	The volume of received diffuse irradiance [W.m-2] (winter)	Solar energy, farming
SLOPE	Slope gradient	Slope inclination	
WET	Wetness index	topographic index (or Wetness index)CTI ¼ ln(SCA/tan ϴ)	Buildings, farming
LS	Transport capacity index	Transport capacity index (length of slope*inclination) LS ¼ (L/22.13)*0.3*(16.8 *sin ϴ - 0.5)	Erosion intensity, ground stability

In the studied area, both temporal and spatial variability of the settlement preferences is observed. The most preferred areas are the slope and near-edge zones of the river valleys and small valleys (Williams et al., 1973). This is confirmed by the weight analysis for the individual periods and types of sites. WATER, WET, and SLOPE are also important factors. Detailed analysis of the models shows slightly more complicated relationships. The EDGE variable indicates that the near-edge areas are very popular, both towards the valley and the plateau. The diversification begins outside the edge zones. Valley tracts, apart from the edge zones, are characterized as having the least interest, whereas the decline in the interest is smaller in the plateau zone. The significantly less interest in the valley zones might be explained by the increased flood probability, as well as by the wetness of the valley tracts (Rotnicki, 1991), which is demonstrated by the WET variable. This conclusion is correlated with the model for the WATER variable, where the decrease in preferences in the zones in the vicinity of water is also noticeable. The greatest interest is manifested in the areas 150–250 m away from large water bodies. The relationship between the distance from water and the intensity of the settlement in the section more than 250 m far from water is linear and decreases with the distance from water. Interesting relations are demonstrated by the SLOPE variable. It turns out that the least interest is manifested in the flat areas with slopes less than 1 degree, whereas the greatest interest is in areas with slopes of 1–3 degrees. This is caused most probably by the fact that the flat areas are the bottoms of glacial valleys, which in this region do not receive much interest. The WET variable has a similar meaning. The relationship is linear, and the greatest interest is manifested in the areas of the least potential wetness. The weights of the remaining factors are decidedly smaller. Additionally, the RELEV variable is of almost no significance for the settlement pattern. This probably results from the lack of distinct elevations in the examined area, including natural defensive and observation points, the presence of which could have changed the pattern. The preferences peaks noticeable on the model curve for the RELEV variable are connected with the settlement concentration in the edge zones.

In the Neolithic avoided area were the river valley bottoms, preferred the near-edge parts of the plateau (Fig. 2). In the Late Bronze/Early Iron Age (Lusatian Culture) preferred were the valley tracts. The Przeworsk culture (Iron Age–the La Tène period–the Roman Iron Age) - avoided the river valley areas and in the terrains of the plateau, preferred the near-edge areas. In the Early Middle Age preferred low areas in the river valleys. In the Late Middle Age preferred plateau, avoided the bottom river valleys.

Evaluation of the model shows that no more than 50–60 percent of settlement variability can be explained by hydro-geomorphologic factors. Instead, environmental factors constrain decisions by eliminating areas unsuitable to settlement based on hydro-climatic conditions, but they do not fully determine human spatial behaviour (Barcelo´ et al., 2002).

Those settlement transformations are connected with the hydroclimatic changes that occurred in the Late Holocene. The wet climate, with high flood probability, of the Late Atlantic period (Neolithic) did not favor settlements in the valley bottoms. The drier Subboreal period (Lusatian culture) (of the lower hydrological regime) favored directing the settlements towards the river valleys. The wetter climate at the turn of the Subboreal and Sub- Atlantic (Przeworsk culture), and the process of rising water levels connected with it, caused settlements to migrate towards the plateau. The same phenomenon is clearly visible at the turn of the Early and Late Middle Ages.



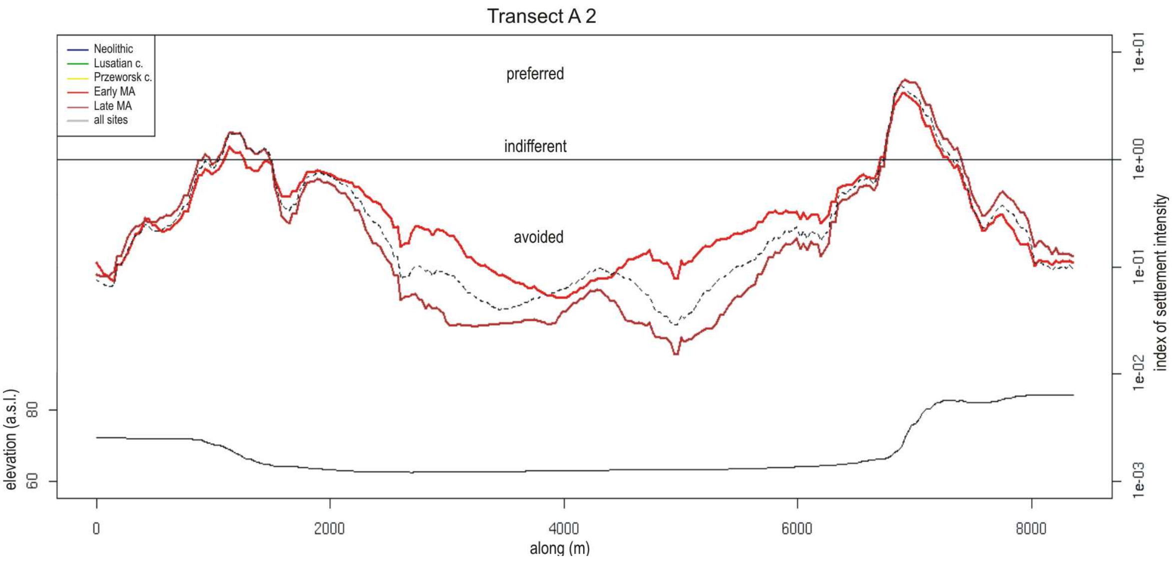


Fig. 2. Settlement preferences with regard to hydro-geomorphologic features of the area – transect A – Warta-Odra ice-marginal valley

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FLOODPLAIN DYNAMICS AND HEAVY METAL CONTAMINATION

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Medieval mining in Kutná Hora region (Czech Republic) and its impact on landscape (mostly fluvial) sediments was explored. The mining reached its top in 13th and 14th century (mainly silver mining), it was reduced in 15th century by political (Hussite war) and by economic reasons. Second peak of production (mainly copper mining) was reached in the first half of 16th century. Then it was practically finished.

This researched focused on research of the heavy metals contamination in soils and fluvial sediments of Vrchlice, Klejnárka and Labe Rivers. There were performed two researches of vertical changes in contamination (by author). This prezentation also includes the metaanalysis of all existing data (mostly processed only for hygienic research).

There are now 379 samples took in 265 sites. The samples are almost homogenous in case of data obtaining method – solution in HNO3, only 12 samples were dissolved in solution of HNO3 and HCl. The data are not homogenous in case of number of analysed metals (3 to 12 metals – As, Be, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, V, Zn) and of sampling depth (mostly top soil to 30 cm, then different depths to 1 m).

The researched focused on analysing patterns of contamination by principle component analysis. The elements are divided into two main groups generally interpretable as contamination group (As, Cd, Cu, Hg, Pb, Zn) and background group (Be, Co, Cr, Ni, V). But this division (made mostly on topsoil samples) does not respect some observations made in special way (vertical sampling through fluvial sediments).

There were also tested hypotheses, if the contamination can be used as a proxy information about dynamics and development of fluvial sediments. There were performed two GIS analyses. First was focused on As concentration in two depths. The aim was to discover, if the contamination is distributed the same, or the different, way. The contamination in point sites was interpolated by kriging and then reclassified. Then the diversity (Shannons and Simpsons index of diversity) of rasters was calculated. The contamination in deeper sediments seems to be more spatially diversified then the diversity in topsoil sediments.

Second GIS analysis was focused on possibility of differentiation of contamination factors. This method could be used as a proxy of sediment provenance research. The factor analyses were performed and then the factor scores of sites were interpolated by kriging. In the results, we could distinguish groups of elements / factors which had clearly different patterns of spatial distribution.

The research showed, that the use of contamination as a proxy information is very useful. It also stated some questions which we hope to answer in future research.

ICE-MARGINAL VALLEY AS A POTENTIAL MIGRATIONS CORRIDORS AT CENTRAL EUROPE

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In European lowlands, flights of the Quaternary river terraces provide an unrivalled record of drainage evolution and hydrological changes through the whole this period. Europe is similar to the climatic forcing model of Vandenberghe (1995, 2001), based upon glacial–interglacial adjustments and landscape development. Glacifluvial landscape give a background for the later geomorphic evolution of landscape.

Cold-climate systems dominated by seasonally variable runoff typifies these systems providing a highly distinctive palaeohydrology. Under periglacial conditions this seasonality is driven principally by low temperatures during winter months leading to the storage of snow on the sparsely vegetated land. The spring-melting of the stored precipitation then results in greatly peaked, 'nival' discharge. Nival flooding provides sufficient energy flow during the short flood-period that enables transport of coarse granular materials such as gravels and sands, by low-gradient streams. This contrasts markedly with interglacial conditions during which dense vegetation cover, coupled with the increased permeability of the soils causes cushioning of runoff following precipitation events.

Ice -marginal valleys belongs to glacial assemble of landscape forms. They had played not only important role at the drainage system during deglaciation (interglacials) periods, but could be potential migration corridors at Central Europe. Wide flat space is suitable and comfortable for human activity (Fig. 1, Fig. 2).

Quaternary geology and geomorphic development of lowland palaeolandscape of Central Europe is very close to development of glacial and glacifulvial relief referring in many European papers (Gregory, Benito 2003, Gregory,2006, Louis, 1934, Lang et al. 1988, Rose 1995, Schirmer 1995, Starkel 2003), Germany (Keilhack 1909, Liedke 1957, 1961, 1962, 2001, Marcinek 1961), Poland (Kozarski 1961, 1988, Mojski 1982, Marks 2002, Kalicki 2006), Estonia (Raukas et al 1971). Many lowland rivers across northwest Europe exhibit broadly similar behavioral and environmental responses to glacial–interglacial transitions (Vandenberhe 1993, 2001, Colins 2006). The pattern of phases of instability and stability over time recorded in the

Late glacial and Holocene fluvial landforms and sediments across northwest Europe. Glacifluvial landscape give background to the development of the

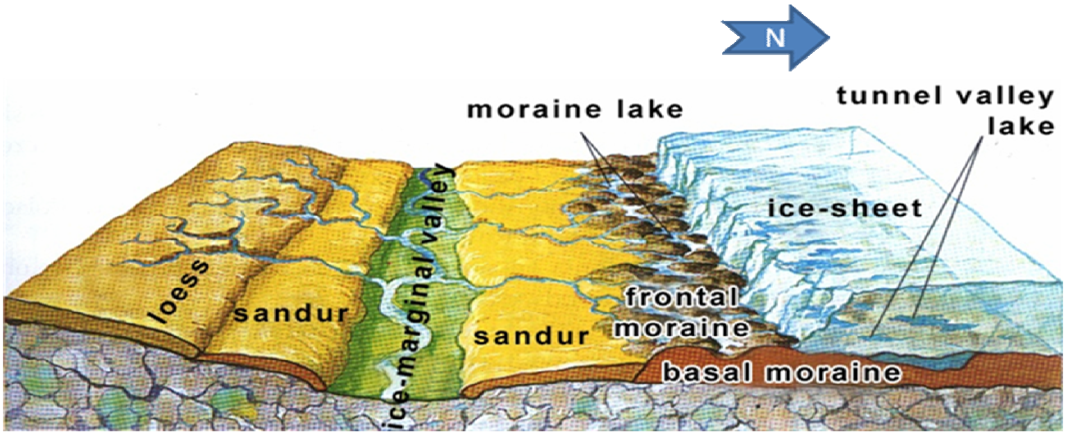

Fig 1.Conceptual model of ice-marginal valley as a geomorphic object *sensu* Goudie (2010) in Central Europe base on geomorphologic and Quaternary geology evidences (blue arrows - north direction)

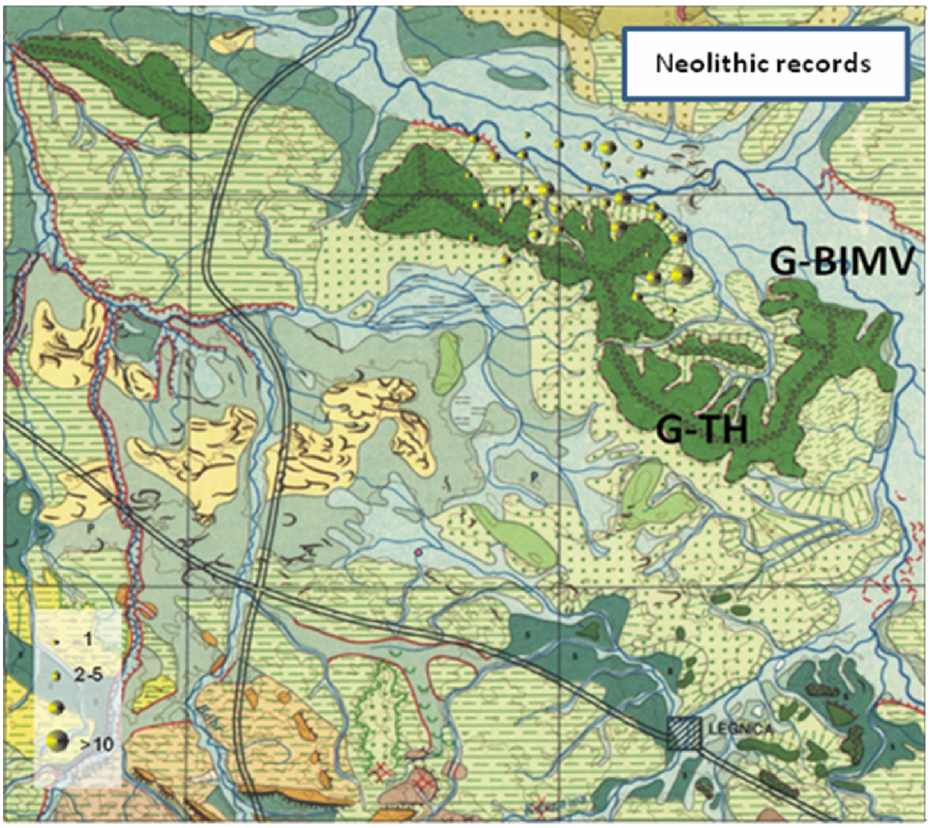

Fig 2 Detailed geomorphological mapping (Starkel 1980) B-GIMV Baruth-Głogów ice-marginal- valley, GTH-Glacitectonic Silesian Hills with the frequency of the PNRAS records of Neolithic human activity(neolithic records) for Głogów-Baruth ice-marginal valley. *Abrev.* PNRAS = Polish National Record of Archeological Sites. Polish *Abrev.* AZP

Late Glacial and Holocene of fluvial system at European Lowland (Lang et al. 1988, Ehlers et al. 1995, 2011, Hagedorn 1995, Schirmer, Starkel 2003).

Glacitectonics huge elevations as Glacitectonic Silesian hills (Rotnicki 1976, Aber 1985, Badura, Przybylski 2002, van der Wateren1985) correspond with Baruth-Głogów ice-marginal valley at Silesian Lowland (Fig 2).

Area which are covered with loess sediments as ice-marginal valley terraces are predominant by human activity during the Neolithic (Kruk 1973, Pogorzelski 1993, Kruk et al. 1996, 1999, Hendel et al. *in press*,). These areas had been preferred by small groups (Pogorzelski 1993, Demindziuk 2000) what is confirmed by frequency of PNRAS (Fig 2).

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LATE HOLOCENE HUMAN IMPACTS TO THE MORAVA RIVER FLOODPLAIN DEVELOPMENT

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Studied area is located along the Morava river in the Lower Moravian Basin (Czech Republic). The Morava river floodplain is an excellent example of environmental archive which could help us to better understand the interplay between global climatic changes, regional environmental conditions, and human activities. The length of the meandering course of the Morava River through the studied area is approximately 12 km and it represents one of the last river segment modified by minimal channel regulations. River behavior and changes of the fluvial styles were reconstructed based on floodplain architecture analysis supported by geophysical survey. The age of the floodplain sediments was performed using radiocarbon and dendrochronological datings completed with radioactive Cs and persistent organic pollutant concentration analyses. Palynological results allow us to reconstruct the local vegetation changes.

The Late Glacial and Holocene floodplain sedimentary facies identified by geophysical survey and drill holes document several river aggradation and degradation stages. The last climatically driven erosion passed between 1,500 and 0 BC followed by deposition of the youngest fluvial sequence. These sediments deposited by the meandering river are exposed in the modern channel banks. The most radiocarbon ages document that the sediments were deposited during last millennium. The former investigators have supposed that the living style during the Great Moravian period (9th century AD) caused powerful environmental change. According to these ideas an intense forest clearance triggered groundwater level rise in the Morava river floodplain followed a forest vegetation change. More frequent floods should follow a consequence of these processes. However, our pollen records from the palaeomeander fills do not indicate such severe change. The later colonization of central Europe during the 12th and 13th centuries possibly upset the balance of the Morava river system leading to an increased sediment load. More intense erosion in the Morava river catchment was most probably the consequence of deforestation, resulting from intense agriculture and land use. The clayey silts derived from the bedrock Paleogene flysh claystones were eroded from newly created fields formed in highlands located around the Lower Moravian basin. The dominant late Holocene impacts on the Morava river behaviour had natural origin (e.g. Medieval Warm Period and Little Ice Age) and were occasionally accelerated by Medieval and modern human activities.

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ROLE OF RIVER VALLEYS IN PREHISTORIC CONTACTS BETWEEN HIGHLAND AND COASTAL POPULATIONS OF THE CENTRAL ANDES

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The western slopes of the Central Andes are characterized by large height differences due to intensive tectonic uplift of the Andes (Sébrier et al. 1988). Less than one hundred kilometers from the Pacific Ocean the main ridge of the Western Cordillera rises above 5000 m a.s.l. In such geological setting river erosion created dynamic relief, where deeply incised gorges and narrow ravines are adjacent to wet highland plateaus and high mountain ridges. About 10-20 km from the mouth rivers leave roughed Andean landscape and flow in wide valleys, cut into large, accumulative plains of the Pleistocene origin. Main river valleys are separated from each other by relatively low mountain ridges (400-1500 m a.s.l.), which descend practically down to the Ocean.

Due to very dynamic relief of terrain; which allows the occurrence of great altitude differences at small distance, Central Andean climate is highly diversified, ranging from extremely dry, hot coastal desert called *chala* (0-500 m a.s.l.), warm and dry *yunga* (500-2300 m a.s.l.), temperate *quechua* with seasonal rains (2300-3500 m a.s.l.), cool and rainy *suni* (3500-4000 m a.s.l.), windy, cold and rainy *puna* (4000-4800 m a.s.l.) to eternal snows of *janca* (above 4800 m a.s.l.) (Pulgar Vidal 1987). Combination of the climatic changes associated with height and interactions location in the tropical zone; the orographic barrier of the Andes blocking Atlantic circulation and cold Humboldt Current flowing along western coast of the South America, resulted in creation of mosaic of microclimatic regions with their corresponding natural ecosystems.

Such an unusual environment, where on the one hand within a few-hours walk from the settlement one can find several different ecological zones, while on the other hand one ecological zone cannot provide all necessary natural resources, resulted in the development of human adaptative strategy called vertical economy. Research based primarily on etnohistoric sources and secondary on archaeological record suggest that Andean highland groups established colonies in areas rich in mineral resources (metal ores, obsidian, salt) or areas suitable for cultivation of plants like maize, coca, chili or cotton (Murra 1972). This economic model has been suggested initially for Late Intermediate Period Altiplano groups and then applied also to research on other Andean societies. In the case of Central Coast various authors (Dillehay 1977; Silva Sifuentes 1998; Rostworowski de Diez Canseco 2002, 2004, 2005) proposed that a special role played *chaupiyunga* zone, where highland and coastal groups competed for the control of coca fields and, at the very same time, exchanged goods from different ecological zones. Highland influences in ceramic and mortuary architecture from *chaupiyunga* of Huaura valley, which is located about 25 km north from the study area, (Krzanowski 1991a; 1991b) seem to confirm this hypothesis.

However the model described above seems to be quite static and emphasizes more control over territory, than getting access to raw materials, which suits well the economy of agricultural societies, but is rather inadequate to understand the economy of more mobile groups. This problem becomes particularly important in the study of Late Intermediate Period highland population, which was presumably quite mobile due to their pastoral or agropastoral economy. Therefore the vertical economy should be reformulated to take into consideration also more dynamic adaptative strategies. One of them was probably transhumance between highland and coast, which due to increased mobility allowed taking advantage of seasonal abundance of natural resources in different ecological zones at different times of year. Presumably late pre-Hispanic transhumance took place between fog-alimented vegetation oases, called *lomas*, and highland pastures due to their ecological complementarity. During austral winter fogs bring humidity to *lomas*, which aliments lush vegetation, while at the same time dry period lasts in the highlands. On the contrary, during austral summer rains provide water to mountain pastors, while *lomas* dry out. Such a strategy was suggested only for Preceramic period (Lynch 1971), and was not considered an important adaptative strategy for later periods. Nevertheless transhumance is a common adaptative strategy of pastoral groups in arid and/or mountain regions, as showed by the examples of Carpathians (Kopczyńska-Jaworska 1969), Pyrenean (Blanks 1995) or Greek (Chang and Tourttelotte 1993) highlanders, pastors of western Himalayas (Davidson-Hunt 1991) and contemporary Andes (Stewart et al. 1976). Groups of highland pastors met in river valleys in *lomas* with farmers, presumably of coastal origin, during humid season in fog oases, where highland. Such an encounter was an opportunity to exchange goods and ideas, as suggested by early written sources (Ruiz Estrada 2006).

In order to confront model of *lomas*-highland transhumance with archaeological evidence, field research is conducted in Lomas de Lachay and Lomas de Iguanil, situated on the coast; about 100 km northward of Lima, as a part of project “People of the fog- human response to climate change in the late Pre-Colombian Andes. A case study form Lachay-Iguanil region” financed by Polish National Center of Science (project no. UMO-2011/03/N/HS3/00151).

Fig. 1. Large cemetery on non-active alluvial fan in Quebrada Teatino II (850-1532 AD)

Fig. 2. Channel-in terraces near Cerro Redondo

Four types of river valleys were distinguished in the study area: with permanent rivers; with episodic rivers; dry valleys in *lomas* and dry valleys in desert. Only in valleys with permanent river, like Rio Chancay, exist hydrological and ecological conditions which permit the existence of ecological zone called *chaupiyunga*, which was essential for prehistoric population's economy, because only there coca, chili and other plants of great symbolic importance may be cultivated. Moreover settlements were concentrated in this region due to the development of agriculture based on irrigation (Krzanowski 2008). Although located in the study area Rio Seco is a permanent river there is no *chaupiyunga* zone in this valley due to the fact that river source are situated too low. Together with relatively small drainage area it did not provide appropriate environmental conditions for development of permanent vertical colonies like those in Chillón and Huaura valleys. Analysis of satellite images and preliminary survey of the area showed no traces of large late Pre-Colombian settlements, which are frequent in Rio Chancay and Rio Huaura valleys.

Large valleys with present-day episodic rivers (Quebrada Doña Maria) were created in the Tertiary and Pleistocene. In the Holocene they were stable desert geosystems with episodic flows occurred in some sections of the valleys only during El Niño events. Therefore on non-active alluvial fans and lower parts of slopes were located ceremonial sites (pyramid) and cemeteries (Fig. 1), which are archaeologically dated to the period between the second part of Middle Horizon and the Late Horizon (ca. 800-1532 AD).

Dry valleys of secondary rivers located in *lomas* (Quebrada Hato Viejo; Quebrada Teatino I; Quebrada Teatino II) have almost no traces of present fluvial activity. In these stable geosystems of shrubby *lomas*, which provide good conditions for human settlements and agriculture development. Settlements were located in upper parts of valleys and on the Tertiary planation surfaces. In dry valleys of secondary river in lomas were also located extensive complexes of agricultural terraces (channel-in terraces, bench terraces) and water-control infrastructure (embankment walls, dams, reservoirs) (Fig. 2). In Lomas de Lachay there were at least three occupation phases significantly correlated with periods of an increased ENSO frequency. Rainfalls during El Niño episodes provided water for springs, which were essential for agricultural development and permanent settlements.

In dry valleys of secondary rivers located on leeward slopes (Quebrada Guayabito) where cactus *lomas* developed, the relief is very dynamic and was formed by catastrophic processes associated with El Niño episodes (flash floods, debris flows etc.). These processes encompass both valley bottoms occupied by alluvial plains of braided rivers and steep slopes with complex system of couloirs. These conditions did not permit the development of agriculture and settlements, especially in periods of increased El Niño frequency. Moreover due to the lack of vegetation caused by the lack of fog it was also unsuitable for animal grazing. As a result of adverse environmental conditions in desert valleys didn't play important role in interregional contacts. Development of herding in lomas is suggested by occurrence of corrals, paths connecting highlands with fog oases and by early colonial written sources informing about transhumance of highland groups (Rostworowski de Diez Canseco 2005) and fossilization of two buried soils (Fig. 3) discovered in Lomas de Lachay, associated with slope processes triggered by extensive grazing of animals. Lomas de Lachay are dominated by large, rectangular corrals (Fig. 4), which were presumably built the last centuries, usually located on river valley's floors, alluvial terraces and on gentle slopes However in Lomas de Iguanil and Lomas de Lachay were discovered small, circular corrals, some of which were associated with Pre-Colombian ceramic, which should be probably dated to late Pre-Colombian periods (1000-1532 AD).

Preliminary results suggest also a possibility of goods and idea exchange in Late Horizon (ca. 1470-1532 AD). On two Chancay culture people cemeteries, situated on alluvial fans and lower parts of valley slopes, Inka and Inka-influenced ceramics were found, which is probably a reflection of coastal-highland contacts. Moreover the occurrence of four settlements with architecture and ceramic of highland type suggests permanent settlements of highland groups in *lomas*. In addition to this some marine shells were found in these highland settlements. Contacts of coastal and highland populations in the lomas is also reflected in small cemetery with dominant highland ceramic and minor percentage of Chancay Black on White pottery, which probably reflects population of syncretic culture.

Intensification of coastal-highland contacts was associated with periods of an increased El Niño frequency, when springs were active in upper parts of river valleys, which allowed the existence of permanent settlements. Presumably the intensification of herding and coastal-highland contacts should be dated to late Pre-Colombian periods, especially Late Horizon. The development of pastoralism should be associated both with cultural changes and the gradual drying of *lomas* due to strong decrease of El Niño frequency. As a preliminary hypothesis it could be also suggested, that *lomas'* exchange was more an instrument of staple economy, whereas *chaupiyunga's* exchange was more associated with wealth economy.

Fig. 3. Buried soils (bs) in Quebrada Hato Viejo


Fig. 4. Large, rectangular corral from last centuries (1532-1977 AD)

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MAN, RIVER AND FLINT MINES. SOME ASPECTS OF USING OPEN SOURCE GIS PROGRAMS IN ARCHAEOLOGICAL ANALYSIS

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Krasne Siolo microregion is located in the western Belarus, about 65 km southeast of Grodno. It is a strip of elevations, called Belarusian Upland formed during the Middle Polish Glaciations, cut off by rows of left-bank tributaries of the Niemen river. In the 1920s, flint mines were discovered in a great abundance. They were later examined after the end of the II World War. Altogether, 1500 mines from the Neolithic period and early Bronze Age were found.

In order to conduct geoinformatic analyses a program called Open Source Quantum GIS (Qgis), in a version 1.7.4 Wrocław and 1.8. Lisboa, was used together with GRASS 6.4.2. software. In case of Eastern Europe, and in a particular Belarus, the problem constitutes the lack of possibility of obtaining digital maps and also lack of access to traditional paper maps in a scale lesser than 1:100 000 and orthophotomaps. Therefore, when it comes to the lie of the land, researches are based on the modern maps of this region and on historical maps dating from the Second Republic of Poland and period before I World War (www.mapywig.org). Moreover, mining fields were localized by the use of plans of a cement plant from the 1920s that are available in the collection of the National Archive in Katowice.

A trial was as well taken to use various satellite data (CGIAR SRTM DEM, ASTER GDEM, GMTED2010) that were made available by, among others, US Geological Survey. However, these kind of data turned out to be not precise enough and contained significant errors which excluded them from further use. Those errors were mainly caused by very strong transformations of the terrain due to mining activity of the cement plant and to some extent by big afforestation of the researched area.

Hence, prewar topographical maps were used and were given certain georeferences in relation to present in Qgis layers (including Google satellite photos). Project was created in WGS 84 Pseudo Mercator (EPSG 3857) system.

Model TIN 5 m was interpolated for analyses on the basis of DEM model and then 3D model of the whole microregion was created. Before TIN was made reconstruction of destroyed by the cement plant terrains during last 100 years took place together with recognition of waterway network which is partially changed nowadays. This step led to designing the most accurate model of the lie of the land of the examined Neolithic period. This seems to be the most crucial in terms of recognized mining fields among which only a small per cent have survived till present times. On the basis of available geological resources a geological sketch was made and verified during archaeological excavations (Fig. 1).

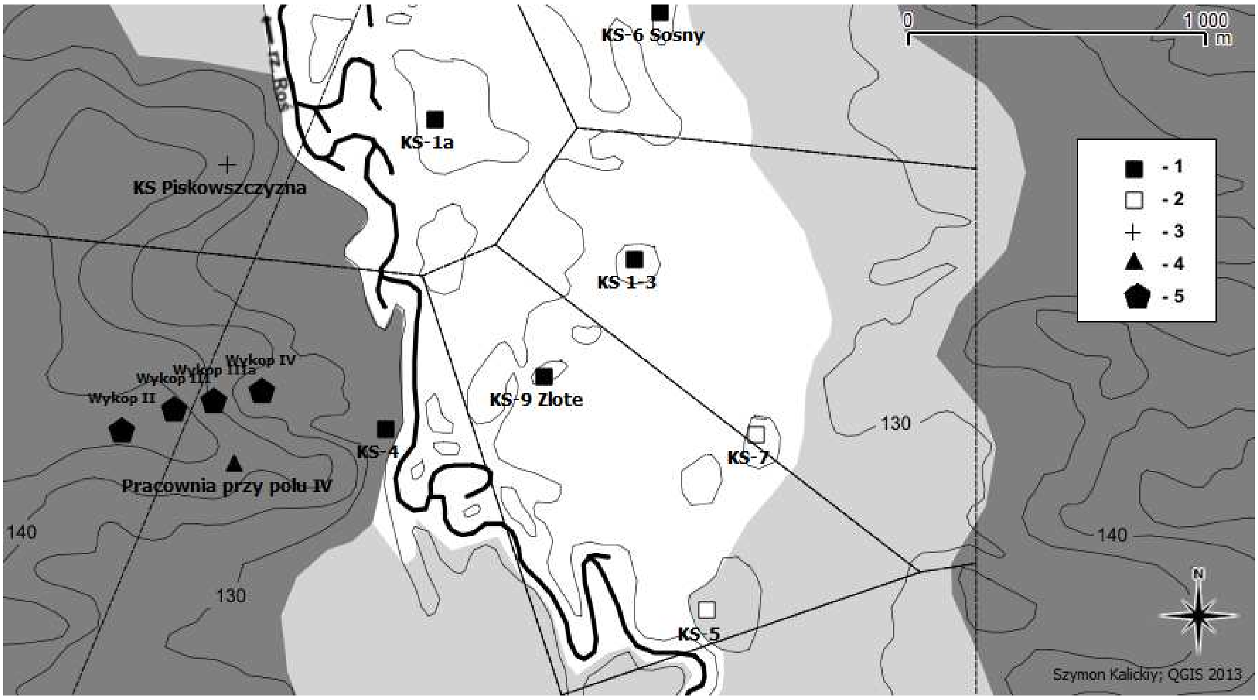

Fig. 1. Sites location dated to the Neolithic and early Bronze Age periods in the central part of discussed microregion together with Voronoi polygons network outlining exploited areas surrounding each settlement
white area – flood plain, gray area – river terraces, dark gray area – moraine upland, 1 - settlement sites, 2 - camps/remains of a settlement, 3 - supposed burial ground, 4 - flint workshop connected to flint mines, 5 - mining fields,

8 among 38 sites are located on a flood plain of Ros river and 12 on 1st or 2nd terrace. On the area of moraine uplands only 18 sites were confirmed as having a character of a settlement, workshop or burial ground.

Voronoja (Qgis) polygons method and Thiessesn (Grass) polygons method were employed during analysis of the settlement and certain mining fields, however, on account of relatively small number of discovered sites it did not bring expected results. Only a theoretical membership of some settlement points can be stated which were directed towards the use of specific environmental ecumene (e.g. flood plain) in comparison with sites that have a character of a settlement.

In case of mining fields, some of the observations done earlier in flint mines in Krzemionki (Poland, Świętokrzyskie voivodeship) are proved to be correct, that is, the scope of polygons shows the maximal range of underground mining excavations (confirmed on the preserved plans/maps) and also the potential possibility of distribution of mine slag heaps on the surface (Fig. 2).

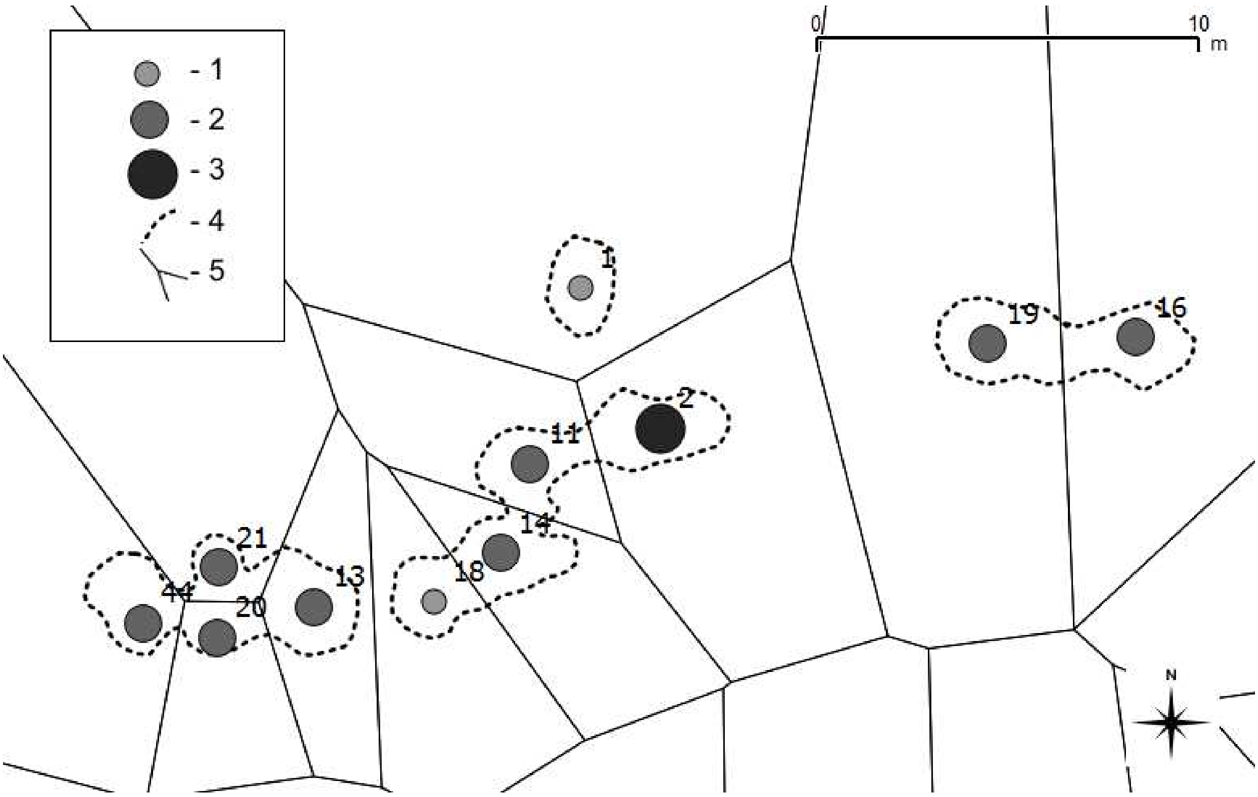

Fig. 2. Fragment of a mining field number III in a chalk tongue L2 with marked depths of mines and Voronoja polygons network corresponding to a theoretical layout and relationship of certain undergrounds to mines

1 - mines at a depth of 1-2 m, 2 - mines at a depth of 2-3 m, 3 - mines at a depth over 3 m, 4 - confirmed underground parts of flint mines, 5 - Voronoi polygons network

The buffer method applied to certain sites reveals their localization at a short distance from water and at the same time flood plain areas constitute a big per cent of sites that were used as potential agricultural or animal husbandry places during the Neolithic and Early Bronze Age periods. The second possibility is confirmed in a way by Globular Amphorae Culture (GAC) burial ground which includes one of the biggest known in this society grave of animal offering. At the same time, the buffer method confirms earlier observations concerning settlement sites. Moreover, visibility analysis of GAC burial ground located in chalk tongue number 3 was performed.

Flint deposits cover area of moraine upland which is cut by the small Ros river and its tributaries. The Ros river valley has got maximal width reaching 2 km and areas of 1st and 2nd terraces can be differentiated and also areas of flood plain. Conducted researches indicate the location of the settlement from the Stone Age period and also chronologically earlier settlement of various river deposits in the scope of the Ros river valley and also on slopes of moraine upland. In case of sites location, the crucial role seems to be played by direct access to running water. On terrains located further from the Ros river, moraine upland, only sites having a temporary character can be found or workshops set in the direct neighborhood from mining fields. By analogy, similar situation can be observed in microregion connected with the early Bronze Age mine called Rybniki-Krzemianka (Poland, Podlaskie voivodeship) or in the context of mines and flint deposits at Kamienna river in the area of Ostrowiec Świetokrzyski (Poland, Świętokrzyskie voivodeship).

NATURAL AND ANTHROPOGENIC CHANGES OF ENVIRONMENT IN THE MIDDLE ONDAVA BASIN (EASTERN SLOVAKIA) DURING THE NEOLITHIC PERIOD

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In the presentation we summarize results of the research project focused on palaeogeographical and archaeological characteristics of the Neolithic settlement in the middle Ondava Basin (north-western part of the Eastern Slovakian Lowland – Fig. 1) (Kalicki *et al.* 2004; 2005; Nowak *et al*. 2010). Since within the project the excavations on the Early Neolithic settlement at Moravany was carried out, the main topic of our interest was this period, which is dated ca. 5500-5100 BC. From the archaeological perspective it is determined by the Eastern Linear Pottery Culture, the first Neolithic culture in Eastern Slovakia.

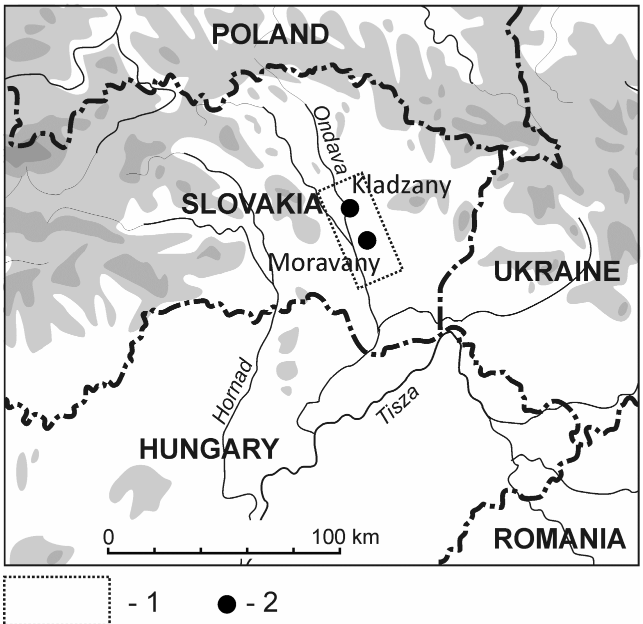

Fig. 1. Location of thy study area (1) and sites mentioned in the text (2)

Palaeogeographical studies were carried out inter alia in the neighbouring territory of this site, in the valley of small river Šarkan, in its alluvial fan, and in the Ondava floodplain. The discovery of black clays in the top layers of Tertiary sediments in the Šarkan valley indicates that buried soils were partly preserved on the slopes along the margins of the valley. They were dated at 19,890±120 BP (Poz-6322). The bottom of the valley is filled with silts. Several layers with a sandy-gravel admixture could be distinguished in this 3 metres thick silty member. These deposits, at different levels, reflect the channel changes during the infilling of the valley. Thanks to four AMS dates (Poz-10271: 146.4±–0.3 pMC; Poz-10272: 250±35 BP; Poz-10273: 145±35 BP; Poz-10274: 154.2±–0.3 pMC), and palaeobotanical analyses, we know that the alluvia of the valley are much younger than the Neolithic. In other words, there are no traces of the activity of Neolithic people. Šarkan's alluvial fan, covering the margin of the Ondava floodplain, is also more recent as indicated by the date of 365±30 BP (Poz-6323) of the lowest sediments on the Tertiary bedrock.

The recent Ondava river course is very young and was established as a consequence of the regulation and channelization of the river bed in the nineteenth and twentieth century. Before, the Ondava was an anastomosing river, divided into at least several meandering branches. Almost every spring the whole plain was flooded to a significant degree. The same phenomena took place in prehistoric periods. Sections and borings across the flood plain show meandering belts, located much closer to the eastern slope of the valley. Besides, the profiles with buried soils, black oaks, animal bones and prehistoric pottery occur in the valley bottom near the study area.

The most important results, in this respect, were obtained in Kladzany (Fig. 2). Here, the thickness of the Quaternary sediments in the valley bottom does not exceed a dozen or so meters. These sediments constitute of two series: the Vistulian gravels with sands and several meters of the Holocene loams.

The general structure of the river valley near Kladzany records the erosional phase of the end of the Pleistocene, which eroded the Tertiary base rock and cut the eastern part of the valley forming a deep depression (palaeochannel dated at 10,940±50 BP). In the Early Holocene the Ondava River cut off during lateral migration the upper part of palaeochannel fill, and as a result clay balls (9,940±50 BP) became included in the younger channel alluvia. At the beginning of the Neolithic the level of the floodplain was lower by about 3 m comparing to the present-day bottom of the valley. This plain was probably already exploited by humans in that period, judged on the basis of several archaeological sites linked to the early Eastern Linear Pottery Culture. Direct confirmations of human presence are provided by ceramics found *in situ* in the lower part of fossil soil dated at 6,130±40 BP. During the Neolithic we note a slow process of aggradation (1.2 m of sediment) since soil-forming "kept up" with the sedimentation. A change in the rhythm of overbank deposition occurred after 5,830±40 BP, which led to the fossilization of the soil by over 1 m thick layer of silts. It is difficult to determine whether it is related to human activity, but it is worth noting that the above date sets roughly the beginning of the Eneolithic.

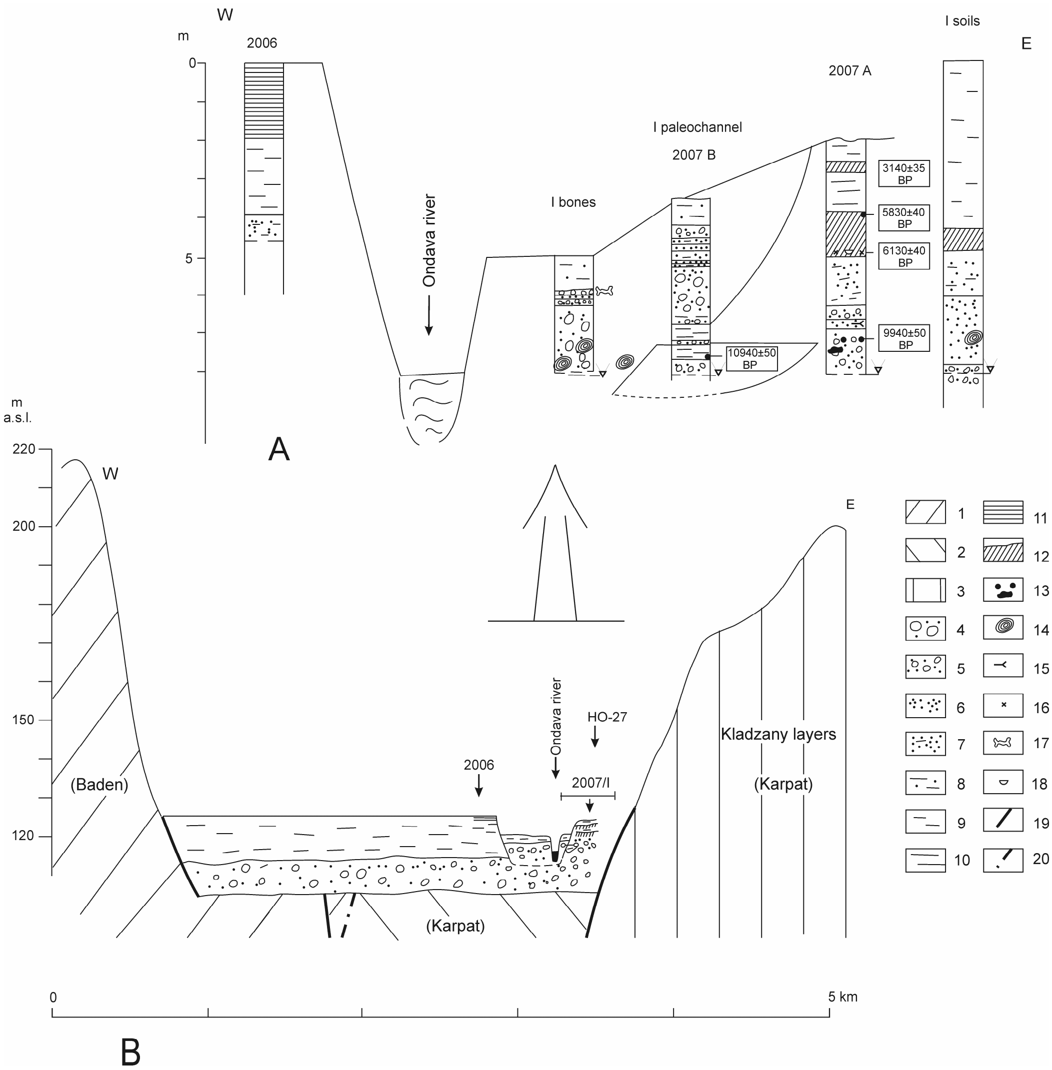

Fig. 2. General section across the Ondava river valley near Kladzany (A) and schematic section of floodplain with studied profiles (B) (T. Kalicki)
1 – bedrock (Badenian), 2 - bedrock (Karpatian), 3 - bedrock – Kladzany formation (Karpatian), 4 – coarse gravels with sands, 5 – gravels with sands, 6 – sands, 7 – silty sands, 8 – sandy silts, 9 – silts, 10 – clayey silts, 11 – silts with horizontal beding, 12 – buried soils, 13 – clay balls, 14 – subfossil trees, 15 – detritus, 16 – charcoals, 17 – bones, 18 – pottery, 19 – faults, 20 – supposed faults

In the Eastern Slovakian Lowland, in contrast to other regions of eastern Slovakia, this period (represented by Tiszapolgár, Bodrogkeresztúr, and especially Baden Culture) is not associated with demonstrable decrease of human settlement. However, a distinct intensification of human presence is visible only in the Bronze Age. What is more important, the location of profiles in Kladzany basically records the situation in areas north of the Eastern Slovakian Lowland where archaeological remains of Eneolithic settlement are scanty (till the period covered by Eastern Slovakian Barrows culture, i.e. the very end of the Eneolithic, ca. 2300 BC).

The next phase of stabilization dated to the later Subboreal period is documented by the upper soil that was fossilized during the phase of floods (3,140±35 BP), well recorded in numerous valleys of Central Europe (Kalicki 2006). In the Late Holocene a series of alluvia building a lower morphological terrace appeared. The type of the sediments, dominated by channel and overbank facies confirm a greater flow within the river channel, which has been narrowed and stabilized by resistant to side erosion fine clastic series.

The charcoal analyses carried out at Moravany (Lityńska-Zając *et al*. 2008) demonstrate that among Neolithic charcoals, the dominance of oak (*Quercus* sp.), ash (*Fraxinus excelsior*) and elm (*Ulmus* sp.) is outstanding. The other taxa were represented by single specimens. The dominance of oak may suggest the presence of deciduous oak forest which could have predominated in rich soils present in neighboring area. On the other hand, high frequency of ash and elm indicate that also riverine forest was present in the vicinity. The list of tree taxa may imply rather broken canopy of local forests. This assumption might be based on the presence of taxa that usually do not regenerate well in closed forest such as oak, ash and hazel.

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VOLCANISM AND PREHISTORIC SETTLEMENT IN RIO COLCA BASIN SOUTHERN PERU

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As volcanoes are part of the natural environment, there have been always interactions between humans and volcanoes. Volcanic landscapes were attractive factors for ancient cultures. Rio Colca river system, which drains western slopes of Andes in southern Peru, is one of the example of these interactions. The important implication is abundance of volcanic resources. One of the most important is obsidian, used for producing tools in Pre-Colombian America. Its quarries have been discovered in Rio Colca valley near Cerro Hornillo. Obsidian together with turquoise, serpentine, gold and silver were traded to distant regions as Altiplano in Andes. Thick layers of fine volcanic sediments deposited during explosive events, upon a variety of environmental factors, created fertile soils. This allowed to develop intensive agriculture, which played substantial role in economy of past societies. The remains of these human activity are monumental agricultural terraces in Rio Colca valley. Volcanoes influenced not only material sphere of human activities but also symbolic culture and religious beliefs. Their impressive cones dominating in the landscape were often worshipped. In Peru dormant the Tertiary volcano Hualca Hualca was considered to be a *pacarina*, place of mythical origin of a tribe, for Cabanas, who lived in upper part of Rio Colca valley.

Area of detail study area is located in the lowest section of the Volcanoes Valley near Ayo. The valley is filled by young volcanic rocks mainly lava flows and cinder cones, referred to as the Andahua formation, rest upon older Pleistocene alluvial deposits and sandstones from the Yura Group of Jurassic age (Fig. 1).

Fluvial complex of Rio Ayo and volcanic complex of Mamachocha occur in the valley bottom. Alluvia of torrential fan on the right sight of the valley are cut by gully of the Rio Ayo depth up to some teens metres. Mamacocha complex consist some generation of Andahua lava. The oldest flow is the axis of the valley and get younger towards the left slope of the valley. These lavas were squeezed out in the valley bottom parallel to its axis. Due to our observations (volcanic bombs, volcanic glass and piroclastic deposits) Laguna Mamacocha considered previously as a dammed lake is rather a lake filled depression in eruption center. Besides lake the depression is filled with youger series of volcanic flows with very distinct levee.

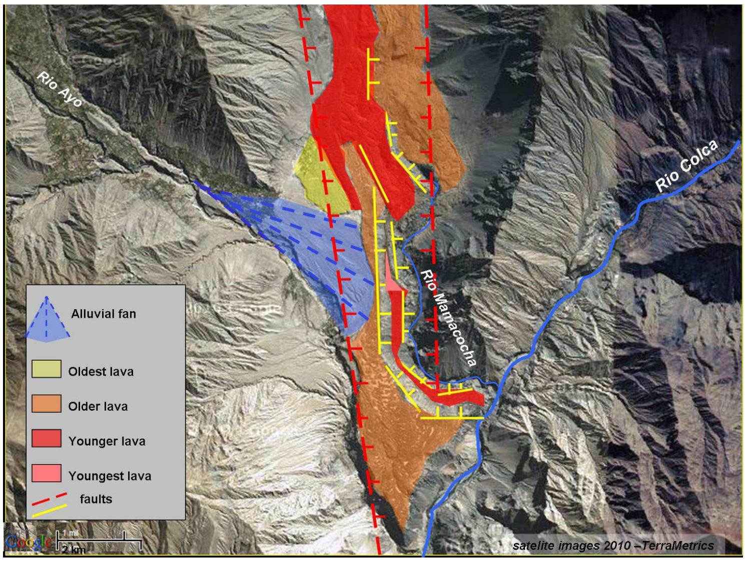

Fig. 1. Sequences of volcanic lavas filling the Volcanoes Valley

Volcanic rocks blocked the Rio Mamacocha in the section between Laguna Chachas and Laguna Mamacocha, some teens kilometers long. Water flows underground in this section in volcanic tubes. The river starts again from Laguna Mamacocha and flows between volcanic complex Mamacocha and left slope of the valley consists of folded sedimentary rocks. A littlebit upstream of mouth to the Rio Colca the river has epigenetic gorge. Limnic sediments of old dammed lakes occur also in this section.

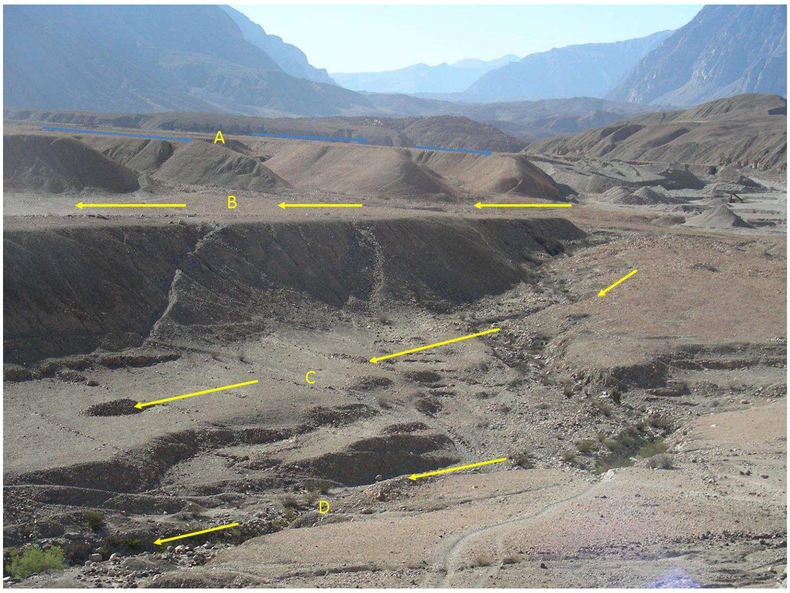

Fig. 2 Changes of hydrological pattern coused by volcanic activity in the valley

A numbers of agriculture terraces occur on the slope along the Volcanoes Valley. Ceramic Chuquibamba (from 950-1000 AD to 1532 AD) and Collagua (from 1050 to 1532 AD) style conduct that these terraces were built before the youngest volcanic activity period. Volcanic eruptions caused changes in morphology and hydrological pattern in the valley and finaly trigerred changes of setlement pattern and a decrease human activity and colapse of agriculture (Fig.2).

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FROM THE GEOARCHAEOLOGY OF RIVER VALLEYS IN CENTRAL POLAND - RESEARCH POTENTIAL AND PROBLEMS

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Most of settlements dated to the Prehistory and to the Early Middle Ages have been located in Central Poland at weakly inclined (not more than 3 degrees) slopes built of sands or silty sands of alluvial and partly deluvial origin of river terraces. Sandy aggradational river terraces have been recognized as a most suitable landscape component for location of prehistoric and early historic settlements in Central Poland (Kittel 2012a) and in other old glaciated areas. The last ice cover was present in the area under the study during the Saalian Glaciations, i.e. during Wartanian Cold Stage. Very intensive formation processes of river valley took place there during the Weichselian Cold Stage and it was resulted in formation of river terraces (Turkowska 1988, 2006).

The paper presents selected results of multidisciplinary research from the scope of environmental archaeology undertaken in Łódź Region (after Turkowska 2006), mainly in the Ner River catchment. Undertaken in the project analysis include: stratygraphy and sedimentology analysis of deposits, geochechemical analysis, palaeobotanical (i.e. pollen, plant macrofossils fossil wood and charcoals) and palaeozoological analysis. Samples of organic materials have been dated by radiocarbon method and clastic sediments - by TL method. Deposits have been dated by archaeological methods as well. The detailed geomorphological and palaeogeographical research has been continued in the surroundings of sites under the study.

The geoarchaeological research has been focused above all to Neo-Holocene slope and alluvial deposits uncovered at a few archaeological sites (ex. Wierzbowa, Bechcice, Bechcice Kolonia, Lutomiersk-Koziówki, Szynkielew - see: Kittel and Twardy 2003; Kittel et al. 2011; Kittel 2012a, b, c, d) in the course of archaeological excavations. Investigations have been continued at the sites represented by remains of prehistoric settlements intensively occupied since the Bronze Age until the Roman Period or until the Middle Ages.

Surfaces usually occupied by the prehistoric and by the Early Middle Ages settlements (i.e. weakly inclined sandy slopes) are special appropriate for slope wash processes. Discovered at most of the investigated sites slope deposits cover moderately or even low inclined surfaces, which limited sites and previous settlements and in some cases culmination part of site areas.

Researched slope sediments are represented above all by deluvia and earthworks origin deposits and they covered and contained in some cases buried sub-fossil soils. Aeolian deposits exist at archaeological sites and partly within slope covers as well. At few sites, the chronologically appropriate to the settlement activity period alluvial sediments have been detailed recognized. Alluvia under the study are represented by overbank deposits and by organic deposits of pallaeochannels fills. Analyzed slope and alluvial deposits contain artefacts and ecofacts, which documents human impact to the environmental changes. Within discussed deposits are often documented as artefacts as: pottery, flints tools, stone tools, stones and ecofacts as above all: charcoals, seeds and corns.

Both eco- and artefacts document the spatial and chronological range of morphologic processes at sites areas. The occurrence of artefacts and ecofacts is very important among others for reconstructions of strict chronology of sediments deposition processes. The chronology of deposits and processes might be determined by standard methods used in Quaternary research - radiocarbon or dendrochronological dating of identified ecofacts must be undertaken, but simultaneously archaeological method is most important. The chronology of individual layers can be based upon chronology of archaeological artefacts and 14C dates of ecofacts. The features of artefacts uncovered within deposits are very important for recognition of conditions and period of the accumulation of sediments. Macrofossils, above all charcoals, within particular layers are a very important source of knowledge about the range and intensity of human activity and about the vegetation evolution as well. Artefacts included within deposits play a very important part in the correctly recognise of the chronology of covers and ecofacts - in the reconstructions of natural environment evolution.

River system, as well as slope system, are very sensitive to impact connected with climate changes (mainly with cooling of climate) on the one hand, and with intensive settlement and economical activity of human societies on the second hand. Those factors cause reactions of discussed systems and effects of this reaction are often preserved in character of appropriate sediment and/or erosive structures. Transformations of morphology and geology of slope sides and valley elements is caused by systems reactions. Distinction of climatic or anthropogenic factor due to the alluvial or slope system activity is not always clear to recognize. Effects of both factors might be chronological correlated as well.

Very distinctive human activity relicts (as archaeological objects and cultural layers) and the human societies activity periods recognized at sites under the study could be correlated with the periods of morphological processes activity and of accumulation of appropriate deposits. In such cases, the anthropogenic factor has been indicated as an initiator of environmental changes resulted in sediment deposition processes as the effect of slope erosion and river activity. The processes have been indirectly initiated by distinct human impact on environmental components, what was resulted in the deposition of sediment covers containing artefacts and ecofacts. The oldest slope covers with traces of human impact have been dated in Łódź Region to the Middle Ages and alluvial deposits resulted from human activity should be dated mainly to the Roman Period, the Middle Ages and the Modern Times (Twardy 2008, 2011).

The human factor is responsible for environmental changes resulting in creation of conditions suitable for initiation and development of geomorphologic processes. The human must be defined as an indirect processes factor and reaction of river system and slope system is often preserved in character of appropriate deposits and erosive structures. The strict identification of the correlation of human factors with environmental reactions is suitable for recognize within complex multidisciplinary research including both archaeology and geoarchaeology and other environmental archaeology disciplines research. Only the comprehensive multidisciplinary research applying methods of archaeology and environmental archaeology supplies the certain arguments to recognize anthropogenic deposits and traces of human impact recorded in natural environment components. The recognised anthropogenic deposits are the source for recognition of: (1) phases and intensity of development of settlement or hiatuses and (2) intensity, directions and range of land-use in the past.

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**BIERAWKA – ODRA CONFLUENCE:
A RECORD OF SANDY-BED RIVER TRANSFORMATION
UNDER HUMAN IMPACT**

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The Bierawka river is a right-hand tributary of the upper Odra river, southern Poland (Fig. 1). Its catchment covers about 370 km^2 and drains the western margin of the Silesia Upland (260-280km a.s.l.) and sandy Koźle Plain (180-230m a.s.l.). The Bierawka catchment is covered with Quaternary glacigenic sediment, related to Scandinavian ice-sheet advancing during Odra/Saale glaciation to the Moravian Gate. In its lower course there are mostly sandy deposits. The fine alluvia infill the valley floor. During the last Scandinavian glaciation the Bierawka catchment was situated within periglacial zone. As a result, the elevation was "smoothed" by denudation processes when the sandy plains were transformed by Aeolian processes.

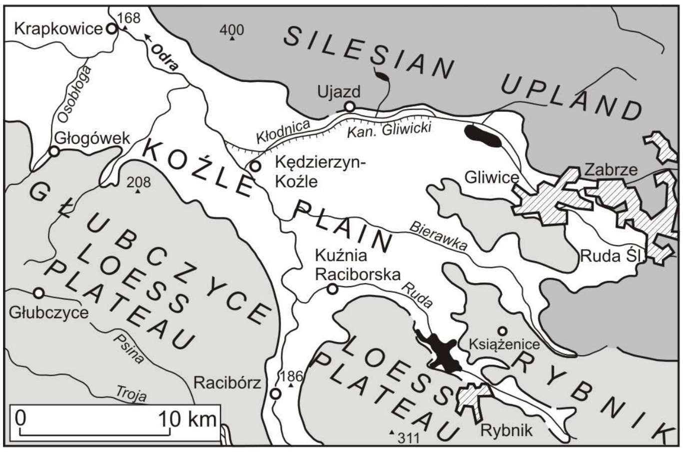

Fig. 1. Bierawka-Odra confluence in the Koźle Plain.

Since the Early Medieval times the upper Odra drainage basin was under the Czech or Polish political influences. Since 1348 it belonged to the Czech Kingdom and later to the Habsburg Monarchy. The political and economic stability during four and a half centuries favoured new settlements location. As a result of Silesian Wars (1740-1763) whole Odra drainage basin was incorporated within the Kingdom of Prussia.

It was a strong impulse to use the Odra river as a waterway linking provinces of the Kingdom of Prussia located downstream. Later the coal mining in Upper Silesia and its export to Wrocław and further downstream the river stimulated adaptation of the Odra channel to aquatic navigation. This resulted in cutting of the meander loops and an increase in longitudinal slope of the river.

Along the Odra valley, its floor is bordered by the paleomeanders undercutting the Pleistocene sandy plain/terrace (Fig.2.1). In the vicinity of the Bierawka mouth, there occur paleomeanders with different radius of curvature; the older ones, with the radius to 1km, were cut off a few thousand years ago (Wójcicki 2012). The younger generation of paleomeanders is usually more shallow and their edges reach less than 3m. During the first period of adaptation of the Odra river to shipping/barge traffic the artificially cut meanders were created. As a result, between Odra–Olza confluence (near Bohumin) and Odra-Nysa Kłodzka confluence (upstream of Brzeg) the shortening of Odra river channel reaches 18% (http://www.zegluga.wroclaw.pl/articles.php?article_id=429). It was an essential impulse to vertical channel erosion which was slowly limited during few centuries. The comparison of the topographic maps 1:25 000 from interval of about 50 years (1939-1987) indicates that the level of Bierawka river mouth to the Odra river was lowered by about 3m, which means the average of more than 6 cm/year.

The eastern part of Bierawka catchment is elevated 80-100m above Odra valley floor (Fig.1). Here, relatively long vegetation period with mild temperatures and precipitation favoured the development of agriculture. Therefore, since Early Medieval times the agricultural settlements were developed here. Until the end of 13th century there were about 10 settlements (Panic 1992). In the middle of 14th century the population density reached 7-10 inhabitants/km^2 and by the end of 18th century as much as 30-50 inhabitans/km^2 (Ładogórski 1955). As a result, the area of cultivated fields expanded. During medieval times low crop productivity caused one farmer family to use one feud of farm land (up to 25ha). In that situation even a small settlement, a dozen or so farms, used a few km^2 of farm land. This caused a more rapid overland rainfall or snow-melting water and finally rapid increase of Bierawka discharge, especially after rainstorms which occur here more than 140 times/year (Bielec-Bąkowska 2002). About 1.5km upstream the confluence of the Odra river there is a distinct trace of former bifurcation of Bierawka river (Fig.2). Bifurcation of river can be caused by large woody jam as a result of forested riverbank undercuts. Also about 120 years long (1583-1700) long period with cold winter months (February-March) was recorded in the neighbouring Opole Plain (Opała 2012). It was partly related to Maunder Minimum of solar activity (1645-1715). During the past century the minimal winter temperatures dropped here to -29^{0}C. This can stimulate the river icing and ice-jams formation, also in the above mentioned period.

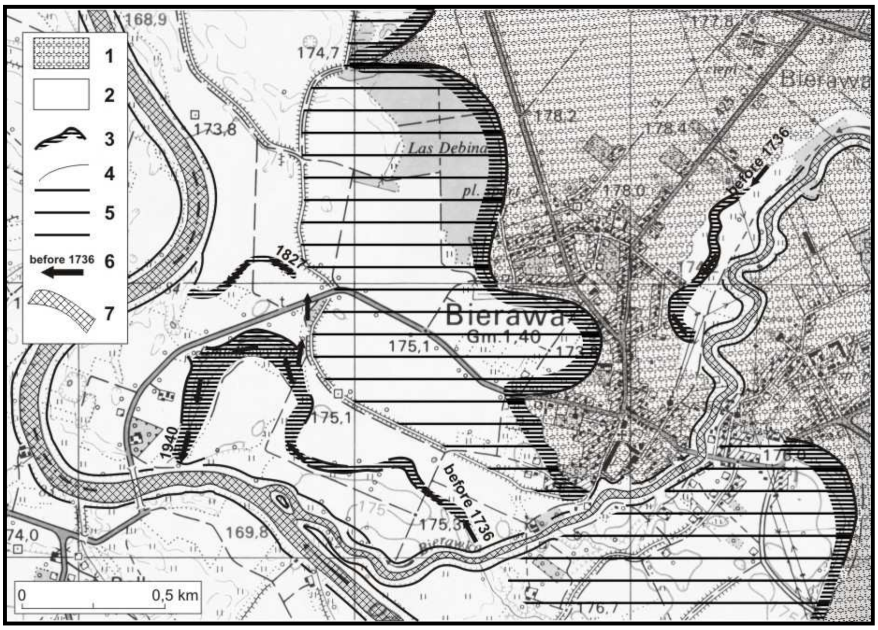

Fig. 2. Topography of the Bierawka-Odra confluence area.
1 - Pleistocene sandy plain, 2 - Holocene valley floor, 3 - river undercuts with palaeochannels mostly organic infill, 4 - river channel sides, 5 - extend of ponds since 1736, later swamps, actually farmland or forests, 6 - former river course, 7 - present-day river channels

The oldest map of this part of Odra river course dating back to 1736 (Wieland & Schubert) informs that in the zone of aforementioned Bierawka channel divergence there existed ironworks ("*Messing und Eisenhammer"*) and in its lower course of the left branch there were also two watermills . Within the older generation of the paleomeanders depression, upstream and downstream of the Bierawka river mouth, there existed also two large ponds, up to 0.7 to 1km long (Fig. 2.3). This indicates a stable high ground water level related to the Odra channel, which was higher than the present mean water level. In modern times the former pond bottoms are forested or used as farmlands, their floors lying more than 5m above mean water level in Odra river.

After 90 years of Wieland & Schubert map publication there occurred highly visible changes in the area of Odra Bierawka confluence. This indicates the Prussian *Urmeßtischbladt* 1:25 000 edited in 1827. It confirms the occurrence of Bierawka channel divergence. The right/northern channel branch probably carried water to a former ponds already with a swampy bottom or small lakes. The left branch diverged downstream of Bierawa village. A part of Bierawka river waters running to a water mill-*Wald Mülle.* This topography informs about successive deepening of the Odra river channel. The break of 18/19 century was also the period of local industry development on the basis of local or imported iron ores, local charcoal production and local energy of running water. Even the small stream was dammed to store the water for a few hours to use it in water-wheels. The aforementioned map (*Urmeßtischblad 1827)* indicates that at the beginning of 19th century even the small tributaries of upper part in the Bierawka catchment have been partitioned with a set of dykes and pond cascades. These constructions essentially limited the floods waves downstream of Bierawka channel.

After a century (98 years) and two centuries later than Wielland & Schubert map, the *Topographise Karte 1941* 1:25 000 indicates further environmental changes near the Odra-Bierawka confluence. Downstream of the former bifurcation point there were remains of a dry channel, well preserved to this day, with bow-like undercuts up to 2m high. Today, in the lowermost Bierawka course, there is only one active channel. The bottoms of paleochannels, 200 years ago used as a ponds, were forested or used as meadows (Fig. 2). This type of land use has been preserved to the present days. It enabled the former ponds bottom to be used for at least 280 years as a present cropland.

The lowering of mean water level in Odra river was a result of a long-lasting impact to deepening of the river channel. Consequently, the Bierawka longitudinal slope in its lowermost 1.5km-long course increased the longitudinal slope from 1.5m/km at the point of former divergence to the 10m/km before to the Odra mouth. To protect the vertical erosion, a set of concrete steps has been constructed.

Current mean yearly discharge of Bierawka river reaches 3m^3/sec. During the last century the water supply from coal mines existing since the mid of 19th century in upper part of catchment has impacted water discharge of Bierawka river. However, the frontal rainstorms or fast melting of snow cover can increase river discharge even ten times. During longer frontal rains in July 1997, when neighbouring gauge station in Krapkowice recorded 212mm of precipitation during four days, the Bierawka river drastically increased water discharge to 104 m^3/sec. During the same flood Odra river discharge reached 3120m^3/sec at Koźle gauge station located few km downstream Bierawka mouth. Maximal recorded Bierawka river discharge reached 162 m^3/sec in July 1972 (Dubicki ed., 1999.

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THE GEOMORPHIC AND SEDIMENTOLOGICAL RECORD OF LOCAL HISTORIC HUMAN IMPACT: A CASE STUDY FROM VALLEYS OF EASTER SUDETES LOESS FORELAND

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The Eastern Sudetes Mts slopes and its NE foreland is located in a temperate climatic zone of Central Europe, between 50^{o}00’- 50 ^{o}30’Nφ and 17^{o} 00’- 18 ^{o} 20’E λ (Fig1). During the Pleistocene cool periods the Scandinavian ice sheet reached the mountain foothills twice. During the last Pleistocene glaciation – Vistulian – the mountain slopes were covered by periglacial regoliths while its foreland was covered by a few-metre thick mantel of loess. During the Holocene climate amelioration the forest communities succeeded the loess upland and the mountain slopes. On the loess plateau there sprouted mostly deciduous forests while on the higher mountain ridges sprouted the coniferous ones. Oceanic or continental air masses create here a seasonal rainstorms or dry seasons. On the nearest mountains foreland the loess plateau receives yearly 600-750 mm of precipitation. There are 120-140 days with the temperature more than 10^{0}C, and 140-160 frosty days. In July mean temperatures reach 15-16^{0}C, and in January -3 to -4^{0}C. In some years during the winter months the minimal temperatures fall down to-20^{0} C (Qitt 1971).

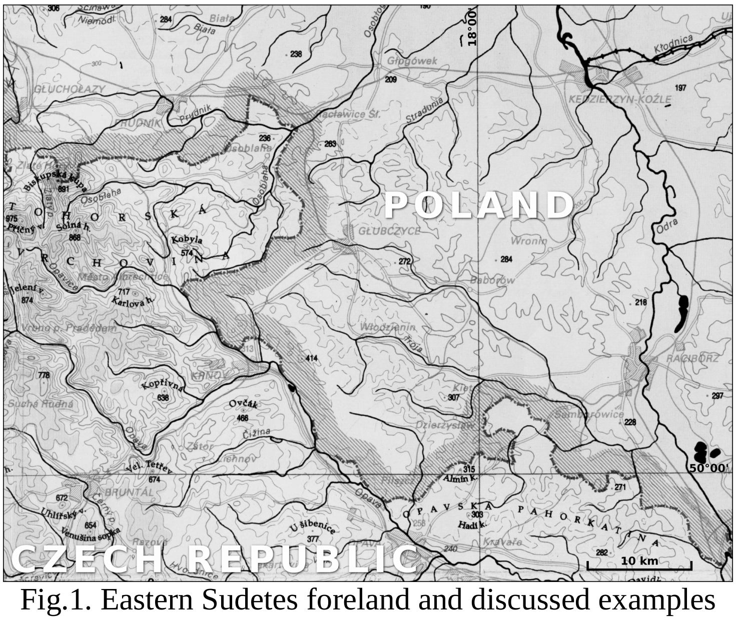

Fig.1. Eastern Sudetes foreland and discussed examples

The Odra river and its transit tributaries cross the mountain slope and loess plateau area. Here occurs a dense pattern of valleys filled with alluvia. The present day relief of loess plateau indicates a dense pattern of small dry valleys, mostly infilled with colluvia. This indicates, that under the previous complete forest cover there existed permanent small streams. During the summer rainstorms and especially during the snow melting periods, the episodic small streams occurred here. During the spring or mid-winter snow thawing the melting waters cannot percolate through frozen ground/soil. As a result, the overland flow waters yield in suspension a lot of eroded soil, which is partly deposited in these small dry valleys.

The climatic changes during the middle Holocene caused the migration of the Neolithic communities from Southern Europe to the north. Between 7-5 millennium BC the farmers and breeders of Linear Pottery Culture migrated from Pannonian Basin northwards, crossed the mountain passes and started to settle the northern forelands of Carpathians and Sudetes foreland. One of the important trails of this migration follows the Moravian Gate – downstream the upper Odra valley. The loess plateaus occurring here offered semi-permanent water streams, fertile soils, and intensive biomass production especially during longer summer days.

According to the archaeological investigations (vide Kulczycka-Leciejowiczowa, 1993) in the discussed part of the loess plateau the Neolithic settlements occurred from the period of the Linear Band Ceramic Culture, since about 6500 years BP. There were small settlements with 40-80 inhabitants in a few family groups, located mostly on the sun-exposed valley sides, near water sources (Fig.2).

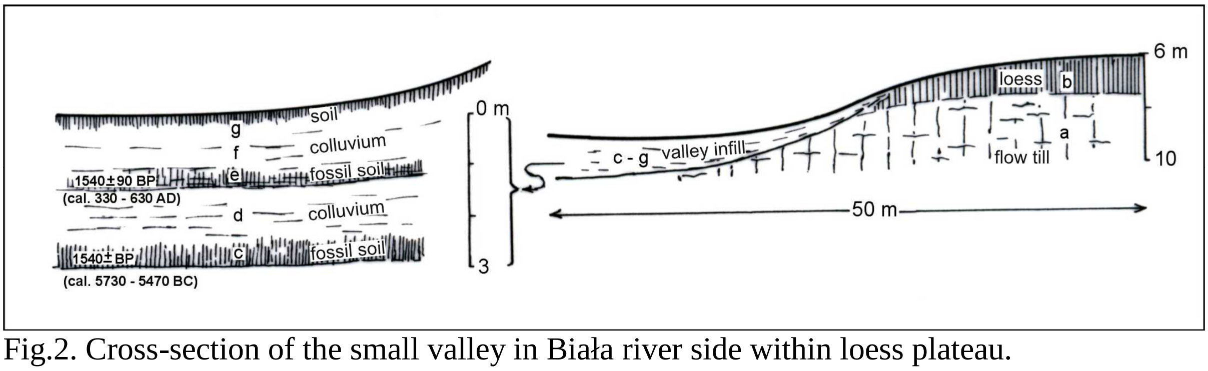

Fig.2. Cross-section of the small valley in Biała river side within loess plateau.

The Biała river has a source area within the loess plateau, about 6km from the mountain foothill. On its left side, about 15m above the valley floor, a small dry valley was crossed by a 80-meter long exposure (Fig.2). The dry valley is cut into a flow till (a) covered by loess (b) and infilled with older colluvium (c-g). Here upon a chernozem fossil soil (c) about 0.5m thick, two younger units of yellow colluvium occur (d & f), inter-bedded with a fossil chernozem soil horizon (e). The youngest soil horizon (g) was developed in the present ground surface. The lower chernozem fossil soil dated for 6650±50 BP (cal. 57210-5470 BC) represents the Holocene soil previously infilling this small valley floor. The lower layer of yellow colluvium (d) about 0.9m thick represents the oldest phase of soil erosion recorded in the loess plateau. The beginning of its deposition started probably during the first Neolithic clearance in this part of the southern-oriented Biała valley side, and probably was continued until the Bronze Age. The overlaying 0.4m thick chernozem soil (e), dated for 1540±90 (cal. 330-630 AD) indicates the re-afforestation of the valley side. This may be related to depopulation of the loess plateau during the Migration Period.

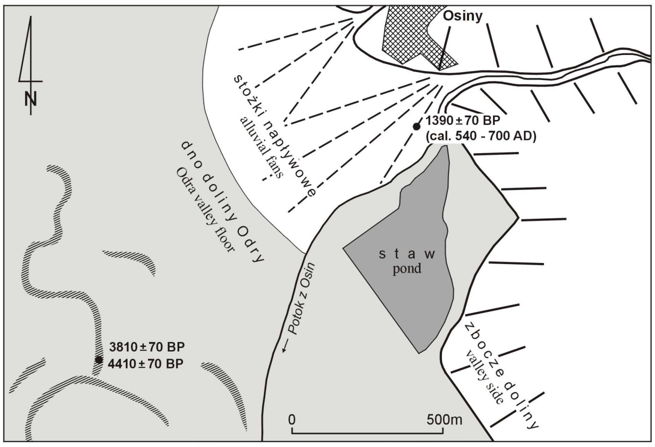

Fig.3. Alluvial fans prograding to the Odra valley floor.

Settling of the loess plateau by the Slavic tribes occurred during the 6-7 AD (Foltyn 2002). This initiated again the processes of clearance and soil erosion. The basic problem of the new settlement erection was a source of water in the neighbourhood. After settling of the sites more favourable to developing agriculture, the new generation of Slav tribes migrated also to the right side of the Odra valley, where the permanent streams occur. As a result of clearance and cultivation of steep valley sides, the soil erosion started. The prograding alluvial fans covered the Odra valley floor with paleomeanders undercutting the valley sides and infilled with organic matter. A few fans deposits covered these organic infills of a similar ^{14}C age, between 1430±70 BP and 1390±70 BP (cal. 530-700AD) (Fig.3). These events indicate than in the situation of a lack of archeological sources, the geomorphic or sedimentological records can be a good indicator of human impact in some catchments.

This paleogeographic supposition confirms that the remains of a probably older stronghold, situated in a neighbouring of these small catchment. This stronghold, located in a neighbouring catchment, about 4km from the dated alluvial fan, was dated according to archaeological sources between 7th and 9th centuries AD, and was destroyed in 9th century by Great Moravian invasion.

In the direct mountains foreland the natural environment is more different than in the loess plateau. This differentiated the sources of alluvia and a rate of its sedimentation. This is reflected in differentiation of vertical sequences of these deposits. In the lower course of the Prudnik creek, the tributary of the Osoblaha river, the longitudinal valley floor slope varies from 2.0 to 1.6 m/km. The undercuts of the river banks near Slezske Pavlovice, about 2.5m high, show a record of historic river activity during the last two millennia (Fig.4)

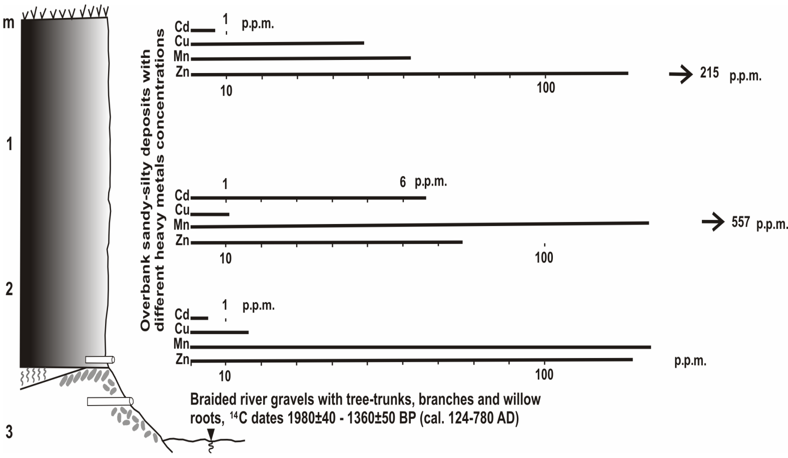

Fig 4. Vertical sequence of alluvia in the Prudnik stream undercut:
Note the cadmium concentration in overbank deposits.

In the lowermost section of these undercuts there occur coarse gravels. Their structure and micro-topography indicate that there are braided river deposits. The remnants of vertical stems and roots of riparian vegetation as well as the horizontally situated tree stumps, dated using ^{14}C method indicated the age of their deposition between 1980± 40 and 1360±50 BP (cal. 124-780 AD). This was the period of the decline of the Roman Empire. The mountain streams with longitudinal gradient of 25-35 m/km, dissecting the Zlatohorska ridge slope, were a main supplier of coarse sediment to the Prudnik river. The dendrochronologically dated fragment of a youngest tree trunk, wedged in a fine silty-sandy alluvia, indicated 623 year AD. This was the beginning of an intensive soil erosion caused by loess upland clearance by Slavic tribes.

A pilot study of some heavy metals concentration in these fine overbank deposits (Zn, Pb, Cu, Cd, Mn) sampled just above gravel channel deposits reflect a typical geochemical background of this region. About 1m above the dated tree trunks the cadmium concentration is one order of magnitude higher than in the lower vertical section of alluvia. This phenomenon can be correlated with gallery construction for gold and other ore mining in the source area of Zlaty potok (Večeřa), the tributary of Prudnik stream, at the beginning of the break of 15/16th centuries. The washing down of the non-forested mining waste heaps in the Zlaty potok sources, 30-33km upstream of the discussed alluvia undercuts, is responsible for higher content of other heavy metals in the upper section of the Prudnik river bank undercuts.

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HORSE STABLE IN MEDIEVAL CENTRAL EUROPE; RECONSTRUCTION OF MEDIEVAL MAINTENANCE PRACTICES

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Maintenance practices of horse stables are not often recorded in historical or archaeological sources. In the case of Medieval bailey in Veselí nad Moravou Czech Republic, we can apply sedimenthological and micromorphological approach to determine the sediment composition and to track possible maintenance practices which were used. The background is composed of easily erodible sediements with a potential of high water level, the organic staining in calcareous rich lenses of organic waste was preserved below the horse stabling, which is also probably connected with the permeable geological background and the position within the alluvial zone of the Morava river.

Most of references concerning the study of object infillings are concerned with the fact if the infilling originated naturally or anthropogenically (Parma et al., 2010, Novák et al, 2011). In the case of Veselí nad Moravou stable, from the sedimenthological and micromorphological view it is evident that the infilling originated antropogenically as a way of remediation. Such examples are known for example from Halstatt sunken houses (Jarosova et al., 2010) or for example from Viking houses (Millek xx). Maintenance of Viking sunken houses in Island can be suprisingly used as an analogue. The remediation layers are a type of cleaning and parallel way of aggradation easilly erodible surface. The erosion in Island is due to the volcanic background (Millek 2012 a, b), in Veselí nad Moravou due to the sandy erodible background and the fact that during the removal of stabling the background is repeatedly removed because of sticking on the stabling. Due to such maintenance practices were preserved minimally 10 aggradation layers composed of waste from ovens and also common domestic waste as visible from the appearance of animal bones which were not burnt. On the other hand such waste has remediation effect and protects against the inflamation of hoofs.

Preserved stabling was according to the lack of ruderal species quite fresh, i. e. waiting to be removed. Its pollen composittion shows that the organic part of the stable itself comes from the end of summer. But from the etnographical source it is known that horses were used to be stabled after 16th of October (St. Havel). Until that time hourses were pastured and stayed outside 24 hours.

RECOGNITION OF AGRICULTURAL PRACTICES IN NILE SLAG WATER DEPOSITS; THE CASE STUDY FROM JEBEL SABALOKA, 6TH NILE CATARACT, NORTHERN SUDAN

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Alluvial deposits within the Sabaloka Gorge and the Sixth Cataract, the Nile River, Sudan, represent a set of deposits with a high lithological variability. This is due to the geomorphology and short-time and intensive flood events resulting in aggradation and erosion of the alluvial zone. Also a human maintenance of the alluvial zone plays a role. The fine fraction of alluvial sediments, usually composed of silt and clay, occurs mostly in the form of thin intervals (max. 10 cm) of darker material. This material is the product of suspended-load sedimentation which occurs at the end of flooding event, and its provenance from the area of Blue Nile sources can be expected. This suspended load is material derived from the fields, as can be recently observed. Three main facies types were distinguished in this type of fine-grained material. The first corresponds to the primary deposited suspended load. Once this material is exposed to oxygen and heat, it starts to dry and shrink. These post-depositional processes lead to the formation of platy microstructure with prevailing void plates. The high amount of partly decomposed organic matter and humus expressed by a high amount of TOC occurs as a natural part of material deposited from the source areas. Magnetic susceptibility of such material is usually quite low, while the frequency-dependent susceptibility shows a visible enhancement.

When the fluvial erosion influences once deposited suspended load, flakes of the dried mud will be deposited further downstream. The depositional energy must be higher now because the material becomes much coarser. The erosion of once dried and shrunk mud is higher when agriculturally maintained or destructed, for example, by trampling. This material represents the second type of facies. Erosion and depositional processes lead to the origin of granular to inter-grain microaggregate microstructure with single packing and compound packing voids. Such material is usually rich in charcoal because redeposition usually takes place sometime after the primary deposition, and because of the human presence. Magnetic susceptibility as well as frequency-dependent magnetic susceptibility of such a material are usually moderate or slightly enhanced due to the mixing with coarser diamagnetic material during redeposition.

Once the first or second facial types are anthropogenically influenced, the internal microstructure changes into an inter-grain microaggregate and subangular blocky microstructure with compound packing voids and vesicles and with porphyritic-like distribution. The material is bioturbated and rich in partly decomposed or decomposed organic matter, charcoal or microcharcoal. It is also rich in carbonate due to fertility maintenance and plant growing. Magnetic susceptibility of such material is moderate and the frequency-dependent magnetic susceptibility is enhanced due to the fertility maintenance (burning of organic matter) and bacterial processes during the pedogenesis.

SETTLEMENT OF WIELBARK CULTURE FROM ROMAN PERIOD ON DRAWA RIVER VALLEY IN NORTHERN POLAND. ENVIRONMENTAL AND ECONOMICAL CONSIDERATIONS

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Abstract not subbmited

TRACES OF HUMAN IMPACT ON SELECTED MIRES IN THE GRABIA RIVER VALLEY, ŁÓDŹ REGION

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The Grabia river is a natural, mostly unregulated, medium-sized (ca. 81 km long) lowland river in Central Poland, inflowing to the Widawka River (in the basin of the Oder). The Grabia River catchment covers 819.5 km^2 of agricultural and forested land (Maksymiuk, 1970; Siciński, Tończyk, 2005). The Wartanian Cold Stage of the Odranian Glaciation during the Saalian Glaciations (Lindner 2005, Marks 2011, Lindner and Marks 2012) was the last to cover the Łódź region. The so-called Widawka Lobe developed during this glaciation (Klatkowa, 1972; Turkowska, 2006). Numerous oxbows occur within the valley, some of them including a complex of transitional mires, fens, and swamps. Most mires in the valley are peat-filled floodplain basins or oxbows (Klatkowa, 1985; Turkowska 1988). Most peat packages are approximately 2 m thick, though in palaeomeanders, they reach up to 3 m. Some mires (Świerczyna site) are located in marginal parts of the valley floor, within Late Weichselian fossil oxbows. Other sites (such as the Ldzań site) exist in cut-off palaeochannel close to the present Grabia River channel. Most of the palaeochannels have a meandering shape, and are from the Late Weichselian and Holocene.

The present investigation focuses mainly on the usefulness of valley mires in reconstructing and dating humidity changes—flood records in particular. The Grabia River valley is relatively well archaeologically recognized (mainly in the vicinity of Ldzań), and our study thus also determines the human impact on the valley environment (landscape), and particularly on the mires. Anthropogenic influence has periodically played a significant role in humidity changes.

The oldest traces of human settlement in the Grabia River valley are correlated with the Funnel Beaker Culture and the Pit and Comb Pottery Cultures (Pelisiak, 2004; Pelisiak, Kaminski 2004). Our studies indicate occasional penetration into this part of the valley by humans in the Neolithic. Apart from individual grains of pollen of *Plantago lanceolata*, *Artemisia*, and *Urtica*, there are no other indicators of human activity in the oldest part of the profile. A distinct stage of human activity (with pollen grains of *Secale*, *Rumex* and *Plantago* *lanceolata*) is recognized for the Subatlantic period. The palaeontological data (Cladocera) also confirm a lack of significant human activity on the mire. In the current phase of the study, we also attempt to determine whether the record of human impact coincides with periods of intense flooding.

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PALEOECOLOGICAL RECORD OF EARLY HOLOCENE AND NEOLITHIC IMPACT IN TRAVERTINE VALLEY ENVIRONMENT, SANTOVKA SITE, WESTERN SLOVAKIA

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Site Santovka is located on the western Slovakia near Levice. The research is focused on organic infill of narrow valley in Pleistocene travertine mound (Kovanda 1971). Lateglacial is captured in a layer of silty wash sediment with travertine fragments based on the profile. According mollusk record they were open until steppe landscape. Beginning of the Holocene is reflected in the accumulation of calcareous fens. The pollen spectrum is predominant hazel (Corylus) and oak (Quercus). Less frequent are the elm (Ulmus), beech (Fagus), spruce (Picea) and pine (Pinus). Due to the morphology of narrow Valley is also captured local wetland species also macrofossil record of forest vegetation. Malacozoological evidence shows forest elements, but also species such as xerothermic Cepeae vindobonensis. Together with palynological records of heliophilous trees (e.g., Cotinus coggygria and Staphylea pinnata) can reconstruct the vegetation as a mosaic of forest and open habitats.

Around 8500 BP begins sedimentation of calcareous clay. Environment had the character of a small shallow lake. The valley was probably dammed by travertine, because in calcareous clay appear travertine desks. The younger sediments (upper 8000 BP) contain first Neolithic shards. The palynological record human presence does not occur, however, in the sediment due to erosion commencing slightly increasing the proportion of clastic quartz. Then is formed a thin layer of decomposed organic material with a large amount of carbonate and charcoals. Beyond this horizon strongly increasing amount of ceramics and appear chronologically younger ceramic artifacts. The entire profile is covered with a layer of sandy loam with pieces of travertine and rich archaeological finds, mainly from the Bronze Age. This layer is dated around 6000 BP. Sedimentation after this date can be interpret as a rising proportion of influx from the surrounding eroded loess slopes. Due to modern travertine quarry we cannot reconstruct locality development in later periods.

Lithologically varied profile in the travertine valley provides a unique record of early Holocene environment. The presence of the first farmers appeared ceramic artifacts in the sediment, before there is a significant impact on the surrounding landscape.

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LATE PALAEOLITHIC SETTLEMENT ON THE BACKGROUND OF PALAEOGEOGRAPHY OF THE WARTA RIVER VALLEY IN THE KOŁO BASIN

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Well known discoveries from the Koźmin Las site, in the Warta river valley in the Koło Basin (Forysiak 2005) represent tree trunks and *in situ* stumps surrounded by organic material all dated to the Alleröd/Younger Dryas age (Dzieduszyńska, Petera-Zganiacz 2012; Petera 2007; Petera-Zganiacz, Dzieduszyńska 2007; Kittel et al. 2012). Due to radiocarbon dating, the forest was probably destroyed during Younger Dryas (Dzieduszyńska et al. 2011). This project is the first study which link a dendrological approach to Late Weichselian palaeoenvironmental reconstructions in central Poland with research into the economic adaptation of the Late Palaeolithic hunters to changes in the local environment.

Precise study of the geology and relief of that area was given by Petera (2002), Forysiak (2005), Dzieduszyńska and Petera-Zganiacz (2012). In the Late Weichselian the Warta river was considered as a multichannel river. In the Younger Dryas and Early Holocene some channels were filled in and were changed into peat bogs and some of them remained dry (Forysiak 2005). Archaeology of that area shows quite intensive settlement (Fig. 1) during the Late Weichselian (Chmielewska 1978; Kabaciński, Sobkowiak-Tabaka 2009).

The closest Late Palaeolithic site is located 2 km southward from Koźmin Las on the left bank of Struga Janiszewska river at Kuźnica Janiszewska (Fig. 1:1). At the site, known from the Polish Archaeological Record as to be an Iron Age settlement, dozens of flint artefacts, made from local erratic flint, have been discovered during projects field works. One of the most characteristic pieces is a large burin made on narrow blade which was detached from classical Swiderian double platform core (Fig. 2). Burins at that time were mostly used as multifunction tools for engraving, cutting and scraping (Winiarska-Kabacińska 2009). Those kinds of artefact have to be linked with the Late Palaeolithic Swiderian Culture, which developed in western and central Poland during the Alleröd and Younger Dryas (Schild 1975; Niesiołowska et al. 2011; Sobkowiak-Tabaka 2011).

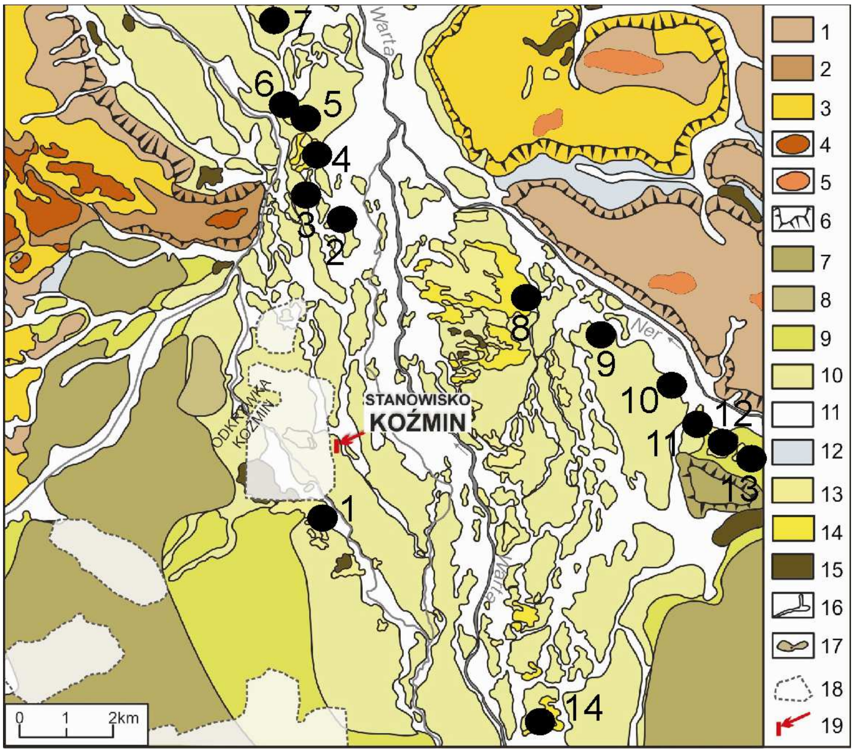

Fig. 1. Location of the investigated area in relation to gemorphological situation (after Forysiak, 2005)
1 – morainic plain, 2 – hummocky morainic plain, 3 – fluvioglacial plain, 4 – end-morainic hillocks, 5 – kames, 6 – slopes, 7 – lower terrace of marginal valley, 8 – erosional terrace, 9 – high river terrace, 10 – low river terrace, 11 – valley floors, 12 – lacustrine plain, 13 – aeolian sands, 14 – dunes, 15 – peat bogs, 16 – valleys of various origin, 17 - closed depressions of various origin, 18 - post-exploatation areas and outcrops of the Adamów Lignite Mine, 19 – location of Koźmin site.
Palaeolithic sites: 1 – Kuźnica Janiszewska 17; 2 – Janów 22 (aut 427); 3 – Janów 21 (aut 425); 4 – Dobrów; 5 – Ruszków 4 i Zawadki; 6 – Ruszków II; 7 – Koło; 8 – Rzuchów 24 (aut 433); 9 – Chełmno 4 (aut 434); 10 – Sobótka 4 (aut 436); 11 – Cichmiana 5 (aut 439); 12 – Cichmiana 1 (aut 440); 13 – Cichmiana 2 (aut 441); 14 – Kuczki 1. (after Chmielewska 1978; Kabaciński, Sobkowiak-Tabaka 2009; Sobkowiak-Tabaka 2011)

Fig. 2. Burin from Kuźnica Janiszewska site 17.

First scientific study in Koło Basin were conducted by J. Sawicka and L. Sawicki in 1925 and after that by W. Chmielewska, M. Chmielewski and J. Trzeciakowski in 1951 (Chmielewska 1978). These scientists were studying materials and stratigraphy mostly from two dunes south from Koło on the left bank of the Warta river, where they verify sites Rumin IV, V, VIII and localities in Dobrów (Fig. 3) and Ruszków (Fig. 1: 4-6;). They also did research in the Ner river valley in that area where they discovered stone age sites at Cichmiana (Chmielewska 1978). Second archaeological campaign was conducted by Poznań Archaeology Rescue Team from Institute of Archaeology and Ethnology Polish Academy of Science. They were digging several sites on the large scale Motorway A2 rescue project. The Late Palaeolithic finds were discovered at eight localities (Fig.1: 2-3, 8-13) from which the most important are Cichmiana 2, Janów 21 and Rzuchów 24, where flint tools typical for the Late Palaeolithic Swiderian Culture were registered. Those are double platform cores, blades and flakes from exploitation of that kind of cores and tools like endscrapers, burins and leaf point (Fig. 4). The remains of large scale the Palaeolithic campsites were found at those sites (Kabaciński, Sobkowia-Tabaka 2009).

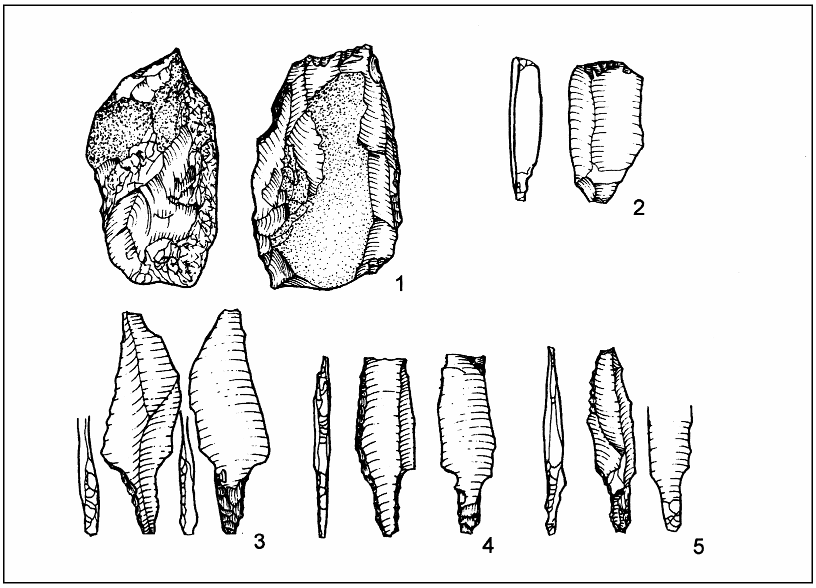

Fig. 3. Tools from Dobrów site (after Sobkowiak 2011)

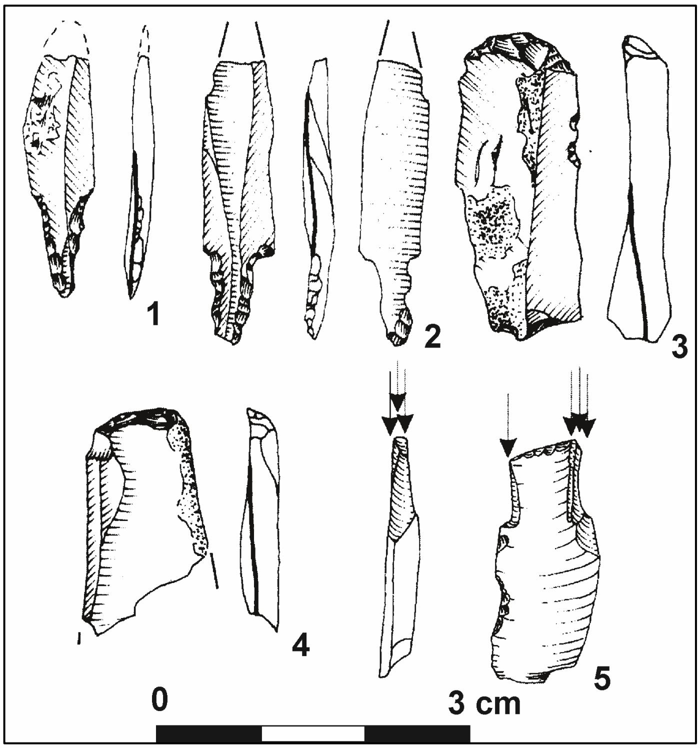

Fig. 4. Tools from Cichmiana site 2. 1-2: leaf point; 3-4: endscrapaers; 5: burin (after Kabaciński, Sobkowiak-Tabaka 2009)

Intensive use of chocolate flint at those sites and obsidian at Cichmiana 2 (Kabaciński, Sobkowiak 2009) suggests that people who were living in that region had highly mobile way of life. They were probably hunting for big game like reindeer, elk or deer and explore the surroundings of bog and forest at Koźmin. Chmielewska (1978, 220) suggests that in some "*favorable conditions some of Swidry groups could also confined themselves to hunting locally, without moving far, and the forest reindeer could have played a significant role*". It is possible that geological and archaeological results from discussed project could support that hypothesis. There is possibility that during the Younger Dryas and perhaps the Preboreal period in Koło Basin landscape were optimal for hunters because of high geodiversity of the natural environment and probably existence of isolated islands of pine dominated forests (Kittel et al. 2012) and they decided to stay here for longer time and explore the vicinity of that area.

The most important archaeological fact for discussed project is discovery of the Palaeolithic artefacts at Kuźnica Janiszewska 17 which is until now the closest locality for the bog and subfossil forest at Koźmin. This find confirm that Swiderian hunters were exploring close surroundings of the site and had advanced settlement strategy in the Late Alleröd, Younger Dryas and perhaps the Preboreal period. Results of interdisciplinary palaeoecological research from Koźmin project could help with study of the Late Palaeolithic hunters behavior, chronology and impact of dynamic environment to the Palaeolithic man.

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ANTHROPOGENIC CHANGES OF KAMIONKA VALLEY BASED ON CARTOGRAPHIC AND HISTORICAL SOURCES

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Kamionka have seventeen kilometers length in Skarżysko-Kamienna district, been in northern part of Świętokrzyskie voivodeship. Kamionka flows through the Suchedniów Plateau, which is located in the macroregion Kielce Upland in subprovince Małopolska Upland (Kondracki 2002). Its source is in the foothills of Jamno and Ciosowa hill, near Łączna village. Earlier Kamionka river was also called Łączna. The catchment area is 107.26 km^2 and river slope is 5‰. Small size and large height difference makes it drain is not uniform and gives it a mountain river character.

Suchedniów plateau is built mainly of the Lower Triasic sandstone belonging to the Mesozoic fringe of the Góry Świętokrzyskie (Holy Cross Mountains). Kamionka cut into the base Triassic, mainly red sandstones, which are popular excavated materialin the area. River especially in the Suchedniów flows through glacial deposits and fluvioglacial sands and gravels. Last glaciation, which reached the area, occurred 300-230 thousands years ago (Mid-Polish glaciations - Oder). Limit of the Oder maximum ice sheet, ran around the surrounding area and is also probably affected the same river Kamionka, which at that time could have flowed through the valley Żarnówki located westward of Suchedniów. For almost the entire stretch of the valley, also are embedded fluvial sands and gravels, sands of river terraces, and all deposits accumulate during the Holocene.

The main methods of data collection were old topographic maps analysis and cadastral maps of Suchedniów area (even from 1860). Much of the information on anthropogenic changes in the Kamionka valley were also a number of notes, lists and descriptions of the area. To compare the changes in this area over the years have allowed old photo taken mainly in the first half of the twentieth century (S. Piasta personal information) Thanks to the community interview with some persons who got knowledge of the area and performed field observations, it was determined the remains of the old infrastructure. This allowed a comparison of current information with materials from the first half of the last century.

The aim of research is to capture the significant anthropogenic changes in the Kamionka river valley. Presentation materials showing the development of the valley, and to compare them with the current state. The largest anthropogenic changes within the Kamionka valley reported in Suchedniów and Rejów. The upper part of the river was relatively most natural, while the middle (Suchedniów) and lower (Rejów), showed large changes in anthropogenic. At the moment, the major anthropogenic changes on Suchedniów and Rejów sections are two artificial lakes, built to retention and tourism. Over the years, there have in these areas to the various changes made by man. In the twentieth century, there were few functioning water mills, which were built with artificial lakes and pounds (Ciemny Staw on Berezów with the impressive dam). In place of today's park in Suchedniów, was previously a smaller lake, after which it was only a fragment of the old discount and situational references on maps of the city in 1860. Anthropogenic changes on a large scale in the Suchedniów can find even in earlier years. This area was one of the Old Polish Industrial Region and the Central Industrial District. During the development of the Old Polish Industrial Region, in this area was responsible Stanisław Staszic. Due to the nature of the village, where iron was mined and there were many forges, most likely for the activity of one of them, piled embankment across the valley between the hill on which the church stands a hill where the cemetery is now located. The shaft is surrounded by a park on the north side, today it is routed on the road that was already marked on maps from 1860, suggesting early origin of the object. It had probably change the direction of the river towards the west (now from here the river forms a visible arc around the church and going back to the paleochannel) to drive the hammer at a nearby forge. After many of these facilities are only residual residue.

In terms of anthropogenic changes, Kamionka river is very diverse. There are parts of the river, where human intervention was minimal, and where a man completely changed the course of the river. The rich history of the region, and its position relative to the industrialized area of Poland, Kamionka river was the source of energy for iron industry in Suchedniów, fueling the then forges. Numerous mills built on the relatively small river, resulted in the creation at different times, different size water tanks, after which only withstood the shafts. Proximity to key tourist region Góry Świętokrzyskie and surroundings picturesque terrain, made at the beginning of the twentieth century, the area became a popular place for recreation. Tourist element highly influenced the development of the valley which can be seen today.

HOLOCENE PALAEODYNAMIC OF THE RHONE RIVER AND LAND USE IN THE BASSES TERRES FLOODPLAIN (FRANCE)

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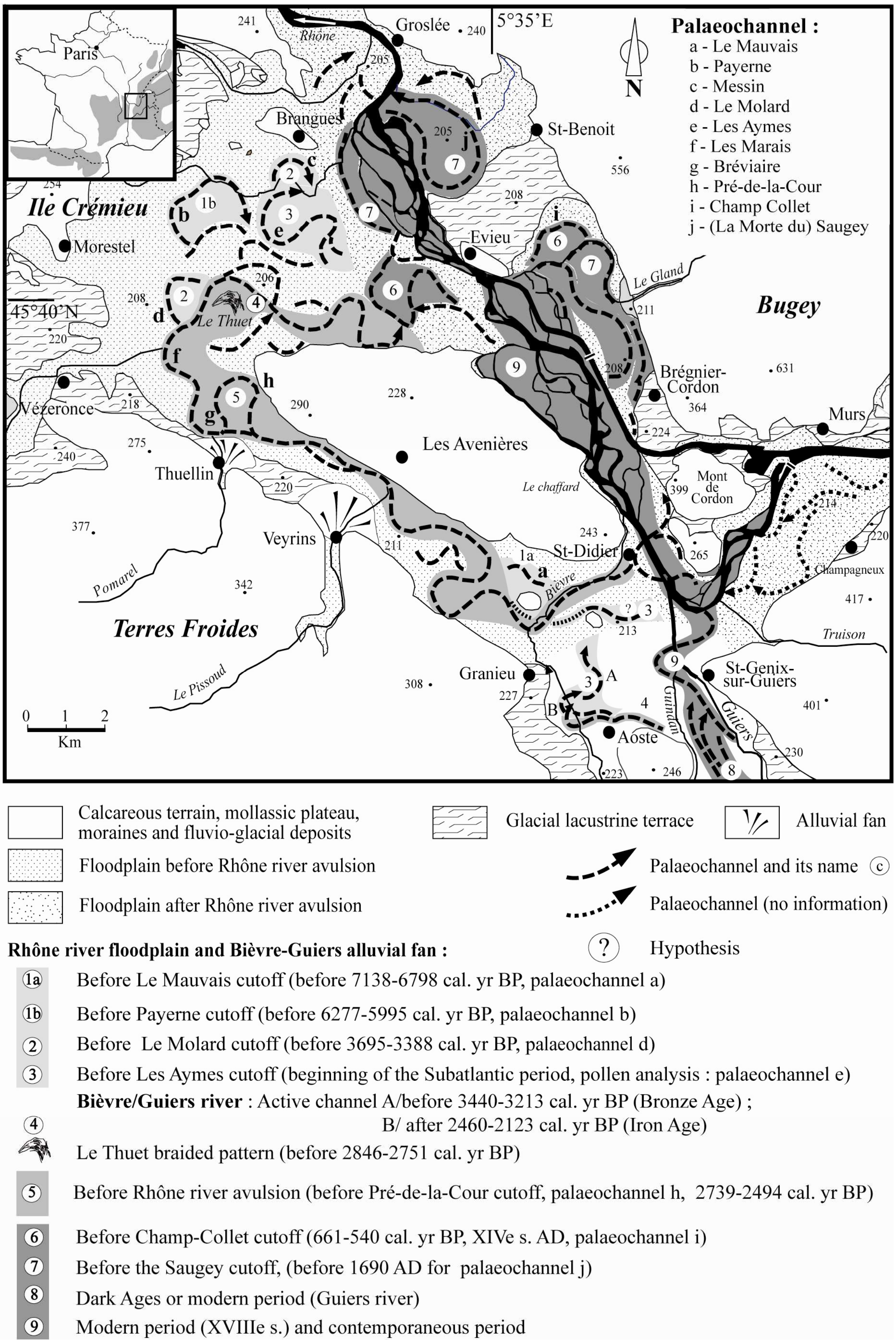
Palaeoenvironmental and geoarchaeological investigations have been carried out over the last decade in an area located in the floodplain of the Rhone river, 70 km northeast of the city of Lyon.The study was done in the framework of the program *Peuplement et milieu en Bas Dauphiné (Isle Crémieu) de l'apparition de l'agriculture à l'époquemoderne* directed by J.-F. Berger (UMR 5600-CNRS) and founded by the French Ministry of Culture and the *PYGMALION* program*PaléohYdroloGy and huMAn–cLimate-envIronmentinteractiONs in the Alps* directed by F. Arnaud (UMR 5204-CNRS) and funded by the Agence Nationale de la Recherche.

The river occupies the upper part of a glacial basin at the junction of the southern calcareous Jura mountains (Bugey, Crémieu plateau) and the mollassic hills of the Dauphiné piemont (Terres Froides)(Fig. 1). This basin was undercutduring the Quaternary formations and filled by glaciolacustrine clay and coarse materials from local streams (up to 197 to 202 m a.s.l.). These glaciolacustrine formations are covered with sandy-gravel alluvium of the Rhone river, about 10 m thick (the top is located at a height of 205 to 208 m). The alluvial plain of the Rhône river (Basses Terres floodplain) spreads on all sides of the Avenières mollassic outcrop. Today, the stream follows the northern branch (Brégnier-Cordon floodplain) and its main tributary is the Guiers river which built a large alluvial fan. The valley of the Avenières corresponds to a former branch of the Rhône river (Salvador et al, 2009). The avulsion process isolated and protected this plain from fluvial erosion and the trace of a set of former wandering meanders has been preserved on its surface.

Firstly, the study aims to reconstruct the spatio-temporal fluctuations of the Rhône river and to identify their origin by studying these palaeochannels. The plan organization and the sedimentary filling of these former channels give information on local fluvial dynamics. The chronological setting is provided by a set of hundred radiocarbon datings. Phases of channels avulsion, fluvial pattern change and major occurrences of strong hydrosedimentary inputs are identified from the ancient Atlantic period until the Subatlantic period (Modern Times).



Secondly, the research studies the interactions between ancient societies and the fluvial environment from Neolithic to modern period (Gaucher 2012). The goal is to understand the rhythms and the processes of evolution of this fluvial anthroposystem on the long term, what means how social and fluvial systems fit and adjust each other.The results allowed us to discuss the intricacies of climate and human causalities on the evolution of the fluvial environment. They also allowed us to estimate the influence of hydrosystem changes on land-use patterns (human settlements, agrarian systems etc.). It was question of the fluvial risk management by pre-protohistoric and historic societies.

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REMOTE SENSING AND GEOPHYSICAL STUDIES FOR DISCOVERING AND INTERPRETING ANTHROPOGENIC AND NATURAL STRUCTURES: A CASE STUDY FROM MICHAŁOWICE (NIDA BASIN, ŚWIĘTOKRZYSKIE VOIVODESHIP, POLAND)

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Since geophysical and remote sensing techniques have been incorporated alongside archaeological excavations in the Michałowice research project, they have strongly changed and enlarged the knowledge of the studied archaeological site. With the use of high resolution magnetic prospecting - which has great potential in the non-magnetic loess soils of the area - new archaeological features such as square burials and single urn graves have been discovered, vastly enhancing our knowledge of this site.

Though globally non-destructive archaeology is well established by now, with thousands of publications and case studies, this approach is only now making large in-roads into the contemporary Polish archaeological paradigm. A shift is visible from analysing and describing single finds, to trying to reconstruct past landscapes and human activity within these spaces. A problem of interpretation arises as many archaeological features native only to Polish archaeology have a yet undiscovered “geophysical signal”. Hence, whilst viewing and interpreting geophysical data, many features may be misunderstood or omitted during analysis.

Such was the case in Michałowice (cf. Fig.1 and 2), where heavily magnetised round magnetic features discovered in 2011 and subsequently excavated in 2012 were thought to remnants of an Iron Age round barrow. Whilst excavating, the function of the features still remained a mystery until consultations with geomorphologists/soil scientists who classified it as possible paleopedological remnant underneath a former “wymok”. Despite of this, the excavations continued as there were archaeological features and findings from within the wymok.

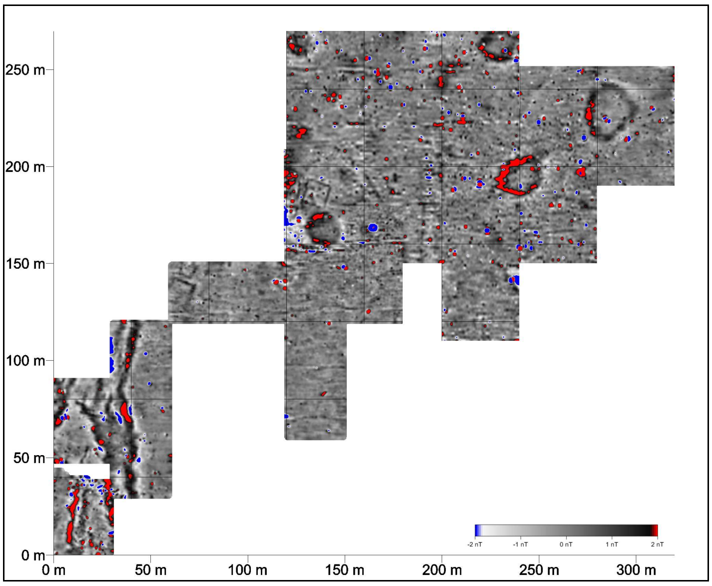

Fig.1: Magnetic prospection of the Michalowice archaeological site in the years 2010-2012

From a purely archaeological point of view - such geological features, though they possess much important (geo-)archaeological data - are mostly evaded. However the misinterpretation of the round magnetic feature and subsequent excavation also revealed that within this wymok there are many Iron Age features, dug into the wymok itself.

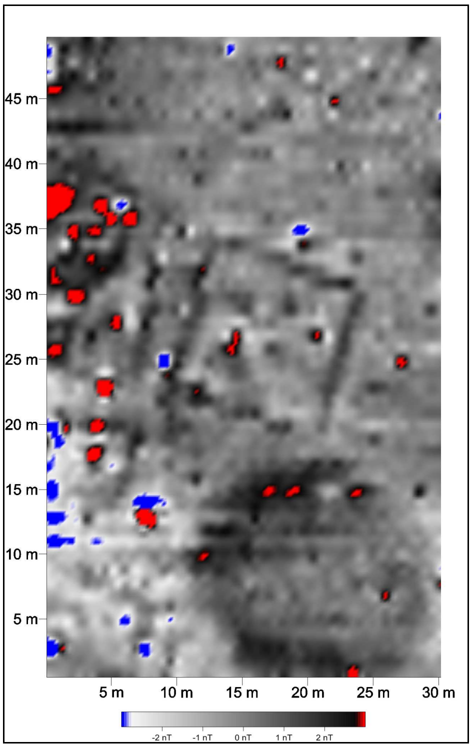

Fig. 2: Area encompassing square and circular anomalies excavated in 2012

The case study of Michałowice shows that there is still a need for interdisciplinary teams to analyse and interpret all kinds of archaeological sources, acquired both from remote sensing and excavation. To the archaeologists it is an important cautionary tale that even though some features appear to be purely natural, the boundary between “archaeological/anthropogenic” and “geological/natural” is very inscrutable as it was rarely the subject of a simultaneous precise study by both archaeologists and geomorphologists.

ENVIRONMENTAL CONDITIONING LOCATION OF THE LUSATIAN CULTURE SETTLEMENT AT BIAŁA (SITE 9)

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The purpose of article is to present the environmental conditioning of the settlement location of the Lusatian culture at site 9 in Biała (Prudnik county, Opole voivodeship). The town is located in the southwest territory of Poland, on the Głubczyce Plateau. It's a moraine upland (235-260 meters, up to 315 meters on the Czech side), covered with loess, located in the confines of Przedgórze Sudeckie (Kondracki 2011). Fertile soils, the abundance of local flows and a climate conducive to farming led to this area being settled by Neolithic communities from 7000 BP (Klimek 2010).

Site 9 in Biała is located at an altitude of 230 meters above sea level, at the top of a hill sloping to the north-west, towards to the valley of Biała river. The distance from the bottom of the valley to the farthest excavated area on the site does not exceed 550 meters.

Archeological supervision and rescue excavations at the site were conducted in the summer and autumn of the year 2011. Altogether, field works covered the area of around 26,9 ares. Relatively thick culture layer, 398 archeological objects and over 40000 artefacts of various types have been discovered at the site. Special attention was paid to the large amount of finds conserved in the culture layer of the terrain marked off for research. In the northern part of the site, and particularly the north-west part, the effects of erosion that took place on the slope were taken note of. These erosions could possibly be gully erosions. The excavated materials has been dated to the bronze age and early iron age (from Bronze III into the Hallstatt C period). The location of the settlement and its chronology coincides with other Lusatian culture sites of the same period on the Głubczyce Plateau (Gedl 1983, Gedl 1997, van den Boom H. 1997).

Based on the range carried out excavations, the area of the site is estimated to be at least 3 acres, and on the basis of cartographic analysis up to 8 acres. Aerial prospection using LIDAR, additional test excavations, geophysical prospection and palaeogeographic studies seems to be necessary to achieve a fuller picture of the site at the microregional scale.

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ZUBRZYCE SITES "U" AND "W" – NEWLY DISCOVERED FUNNEL BEAKER CULTURE SETTLEMENTS AT THE GŁUBCZYCE PLATEAU

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The Głubczyce Plateau is a moraine upland located (235-260 meters, up to 315 meters on the Czech side) in the confines of Przedgórze Sudeckie, through which the Osobloga river flows. It is covered with loess, on which chernozems were mainly formed during the Holocene period, indicating the fertile agricultural health of the land (Abłamowicz 2004, Kondracki 2011,). Zubrzyce is found in a location, where the source section of the river Troja, which is powered by smaller rivers of water that flow into it. Thanks to this, the terrains agricultural development remains a very positive characteristic of the settlement. During the

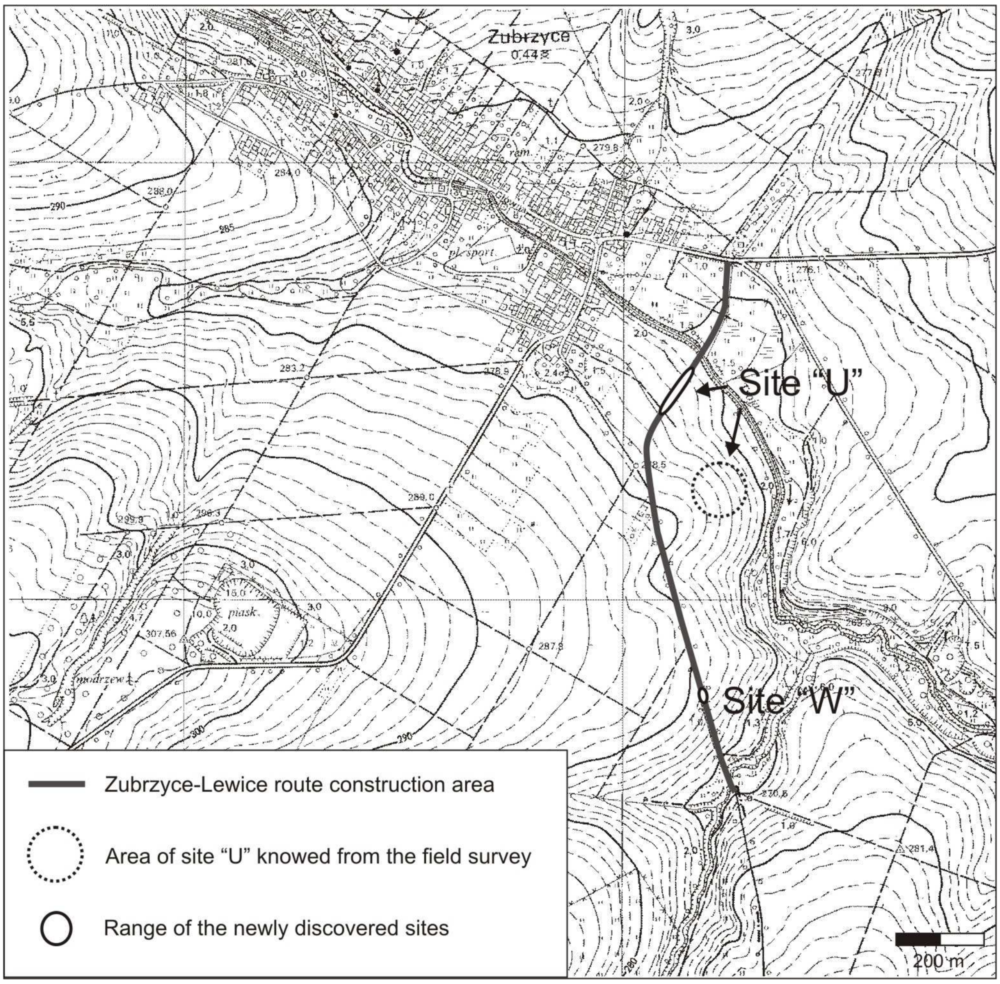

Fig. 1. Location of the sites and the route construction area

Atlantic and Subboreal periods, the land was overgrown with both deciduous and mixed forests (Kulczycka-Leciejewiczowa 2004). At the same time, it was an area of an intense and close-knit settlement, which also encompassed the terrain near the Odra, from the Racibórz Basin, going northwest (Abłamowicz 2004).

Archeological supervision and rescue excavations at the site was carried out at sites “U” and “W”, in the village Zubrzyce (located within the Głubczyce gmina, or the municipality, of the Opole voivodeship) from November 2011 to October 2012. These excavations were conducted in accordance with the investment called “the pavement of the municipal road in Lewice-Zubrzyce”. This included the road construction that was taking place then, as well – from the east part of Zubrzyce to the border of the Głubczyce gmina at Wierzbiec. The first step of the earthwork related to the investments included exposing the a strip of land measuring about 13 meters wide and 550 meters long, which created a possibility of recording the occurrence of anthropogenic layers located at the site of the excavation. The next segment, with the length of about 715 meters encompassed a part of the area along the valley of Wierzbiec, as well as the slope. The research was limited to executing excavations up to the extension of the existing metalled road that followed along a trench.

Over the duration of the period in which the excavations took place, two previously unknown Funnel Beaker Culture settlements were discovered. The first of the two was linked with the known surface nearest it, site “U”, in grounds of the variety of the objects found at the excavation site. The second, new site was called site “W”, because even though it was located between sites “L” and “T”, it was in no way associated with them.

Site U is located from about 269 to 271 meters above sea level on a mild slope on an incline which leads towards the valley. The excavated area was located in the first segment of terrain, with the first humus layer already removed. As a part of the execution of the investor excavation, two different concentrations of archeological artifacts were distinguished. The smaller of the two was located about 60 meters from the Troja riverbed (5 features); the second and larger localization (21 features) extended to a distance of about 125-155 meters from the riverbed. Of the investigated features, 11 of them contains finds: 925 pottery fragments, 44 flints, 884 burnt clay fragments, three spindle whorls, and one miniature stone hatchet. Furthermore, 13 bone fragments were found and samples taken for archaeobotanic testing.

The second site is located at an altitude of about 276-278 meters above sea level, along the ridge of the Wierzbiec valley, at a distance of about 210 meters from the riverbed, in the second localization aforementioned. Four archeological features have been discovered here. In the fill, three of the found items were movable artifacts: 266 ceramic fragments, 5 flints, 45 burnt clay fragments.

Funnel Beaker Culture developed in an area interesting for us, during the second quarter of the IV millennium BC (Nowak 2009). The previous researches showed that the environment of the unit is a universal one and does not have any kind of preferences as far as area of settlement is concerned (Nowak 2009). On account of this, the two sites being in essentially different physiographic locations is not surprising to us.

Over the course of the excavation, the existence of a culture layer was not recorded, and the upper layers of soil only contained sporadic evidence of finds. In the ceiling layer, any objects exposed to tillage damage occurred less so than in the bottom layers. This situation may be interpreted in two ways:

1. most of the artifacts found in the marked off territory were found *in situ*, and the culture layer never formed, since the area itself was rarely ever put to use,
2. the culture layer eroded completely, along with its artifacts, and not many of the artifacts found in the ceiling layer survived the tillage damage done to them during the process of recording what was found at the surface.

Regardless of the interpretation, what is significant is that both of the sites had very little chance of even being discovered during the excavations, and if it hadn't been for the archeological surveillance, they would have most likely never been discovered. The problem, thus, goes deeper than that. As a result of intense agriculture, what interests us is the large scale of erosion that has occurred at the slopes of the valley. What may follow the erosion is covering of the sites located on the valley floor by colluvia (deluvia), which would make it even harder to fulfill the task of traditional prospection. Although the question has been raised many times throughout literature (Rydlewski, Valde-Nowak 1981, among others) solutions allowing for the completion of an Archaeological Map of Poland (AZP) group for new research tools, as well as a new system for the protection of undiscovered sites have not yet been met with.

The description above leads us to conclude, that in order to attain a fuller picture of the excavated terrain interdisciplinary research must take place, with geophysical prospection and complex palaeoecological research included. If able to conduct such work, we might be able to say what exactly it was that was characteristic of settlements such as these. Are we dealing with exploitation of certain terrain, by a relatively small groups of peoples (evidence at sites that follow shows us that settlers lead a nomadic lifestyle), or are we dealing with an intense and relatively short-lived reign over the land by most of the society? In the case of research conducted on Funnel Beaker Culture settlements, this question is essential due to the fact that we are unable to precisely date the site or materials found and as well as the large number of existing sites concerning this culture. This problem has been touched upon many times in literature concerning the subject (most recently Nowak 2009), yet it has not been met with much possibility to solve it.

The results of the research lead us to the conclusion that archeological surveillance of the area is necessary, as well as the verification of material on the subject of Funnel Beaker Culture settlements on the basis of up-to-date research, including Archaeological Map of Poland, since the data in the last monograph which concerns this question (Kulczycka-Leciejewiczowa 1993) is now out of date.

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RIVER TERRACES: PROCESSES OF DEVELOPMENT, SEDIMENTARY CHARACTERISTICS, RESPONSE TO CLIMATIC FORCING AND PREFERRED SITES FOR HUMAN OCCUPATION

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Although river terrace development and triggering seem to be simply understood, there are a number of pertinent questions that disturb this simplicity and require further consideration. This contribution aims at deriving some answers to those questions by assessing evidence from published archives. For instance:

- How is the terrace-forming erosion process running? Is there a typical sedimentary succession below terraces? Different kinds of terraces and their sedimentary successions may originate either from aggradation, incision or lateral migration.
- What is the genetic origin of each sedimentary layer? Different floodplain environments (active channel belt, fluvial lakes, overbank zone) are characterized by specific sedimentary facies.
- What are the relative ages of those layers and erosion phases within a climate driven erosion-aggradation cycle? The variability in staircase preservation in relation to climatic cyclicity is analysed in three scenarios.

Finally, a preliminary inventory is presented of most favourite sites for human occupation in fluvial valleys as derived from a random selection of archaeological findings. Generally, human occupation in that morphological position seems to be linked with, at least temporarily, dry conditions. Climatic conditions do not seem to play the major role. The termination of a settlement may have been due to increased risks of flooding, apart from other than fluvio-environmental reasons.

RIVER, MAN AND MAMMOTHS – THE UPPER PALAEOLITHIC SETTLEMENTS IN THE UPPER VISTULA BASIN

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The results of recent studies of two Gravettian sites: Jaksice II and Kraków Spadzista are presented. Both localities, are of similar age (24,000-20,000 BP) but differ in site location and the stone inventory.

The newly discovered site – Jaksice II, is located on the first terrace of Vistula river, about 40 km NE from Kraków-Spadzista. It is situated opposite to the Raba river mouth to Vistula (Fig. 1). The area of 24 m^2 were excavated during regular fieldworks conducted in 2011 and 2012. The fieldworks resulted in numerous stone artefacts and mammal remains. A piece of mammoth tooth provided an uncalibrated date about 23 000 rcyBP, falling into chronological framework of the Kraków Spadzista settlement (Wilczyński, Wojtal 2011).

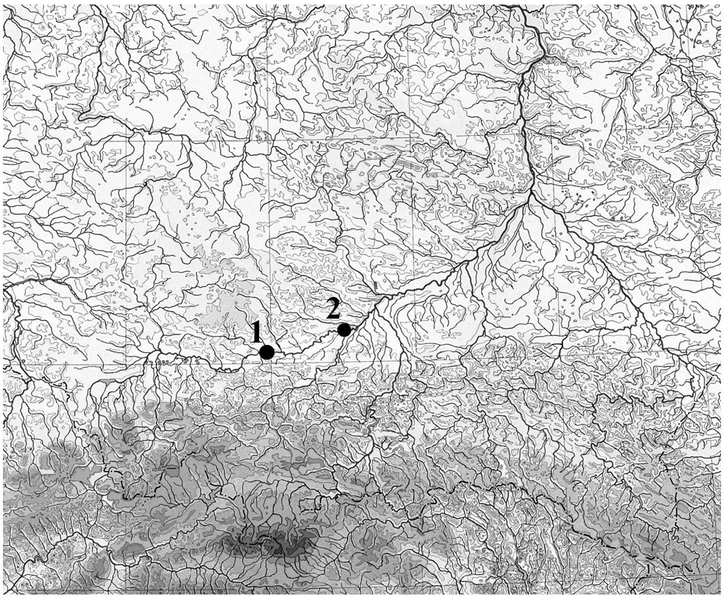

Fig. 1. Location of the Kraków Spadzista (1) and Jaksice II site (2).

The Kraków-Spadzista site is located in the eastern part of the Tenczyński Horst on the northern slope of the Saint Bronis1awa Hill. It lies close to the XIX century Austrian earth rampart, on a rocky promontory. The site is located on a triangular plateau of about 2 ha large, and is set apart on the north by a rocky cliff and on the east and west by Pleistocene gorges (Kozłowski et al., 1974; Sobczyk 1995). The character of the settlement, the spatial and horizontal distribution of the materials, and the radiocarbon dating have revealed the nature of the Kraków-Spadzista site. It is very likely that the few cultural levels created during repeated visits by hunter-gatherers were mixed together by post depositional processes (e.g., solifluction) in one cultural level (layer 6) and form a so called local palimpsest (Wilczyński et al., 2012). In 2011 and 2012 two trenches, located in different areas of the site, were excavated. They yielded large number stone artefacts, mammals remains and isolated bone ornaments.

During field works at both sites whole sediment from the cultural layer (Gravettian) were wet-sieved. It should be noted that among the numerous small fragments (sometimes of length below 5 mm) of mammal remains (e.g. bones and teeth of rodents and polar foxes) no fish nor birds remains were found. It could suggest that at this site the base of Gravettian hunters-gatherers economy were hunting of mammoths. At both sites wet-sieving provide also huge number of burned bone fragments (probably belonging to mammoths) which were used as a fuel in camp fires.

It is possible that large rivers (possibly also wetlands and river crossings used by the animals) facilitated the hunting of big game mammals (mammoth, horses, reindeer) - especially in the case of the Jaksice II site. Opposite to Jaksice at Kraków Spadzista site, where dry and free of any sources of water, the plateau raised about 50 m above the bed of the Rudawa River, could determine location of the site as a natural trap using by the Gravettian hunters. By the Jaksice II site example we could state that Gravettian settlement occupied not only relatively high altitude hills but also the rivers terraces. These two contrasting locations (on the hill and on the river terrace/bank) are of large significance as they provide information about Gravettian occupation in Poland.

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FLOODPLAINS OF LARGE RIVER SYSTEMS - HOMOGENOUS OR HETEROGENEOUS DEPOSITION ENVIRONMENTS? LESSONS LEARNED FROM HIGH-RESOLUTION XS^{210}PB ANALYSES

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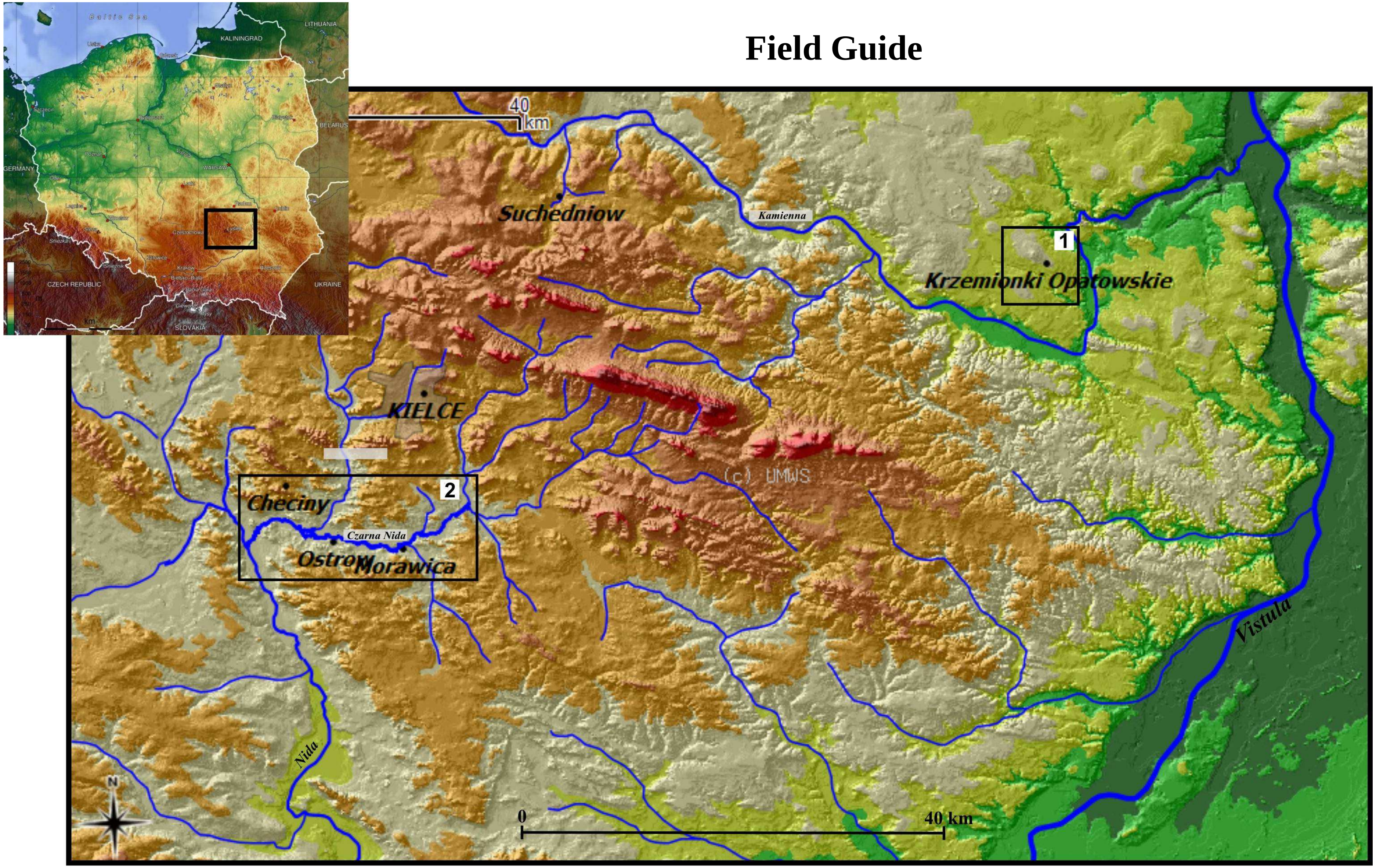
One of the questions in fluvial geomorphology of large river basins is the question of how sediment is distributed on floodplains. For large rivers different processes and conveyors like floodplain channels, crevasse splays and avulsions play a role in sediment delivery to the floodplains. But how efficient and homogenous is sediment transport to floodplains in large river systems? How dependent is overbank sedimentation on external factors like climate and land cover change? How stable are sediments in distal parts of the floodplain after deposition? And, have short-term processes implications on the use of floodplain profiles as long-term records?

Trying to answer some of these questions several landscape units along the Sacramento River floodplain between River Mile (RM) 175 and RM 195 have been analysed for infilling rates and processes using OSL and high-resolution XS^{210}Pb profile analyses and dating. The landscape structure of this particular reach of the Sacramento River with large ephemeral floodplain channel systems, natural, large scale annual inundation of the floodplain and a high level of preservation of pristine fluvial environments is highly suited to answer the question of how different topographic units influence sediment deposition on a floodplain. Using high-resolution XS^{210}Pb analyses it is possible not only to calculate infilling rates but also to identify different styles of infilling and erosion processes and their distribution over the floodplain of a large river system during the last century. Thus shedding light on the complexity of large river floodplains as sediment sinks. Using OSL and ^{14}C dating as additional dating tools, this combined approach also enabled the comparison of last centuries' processes and rates with all-Holocene records testing how well modern sedimentation rates fit site specific long term evolution.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ARCHEOLOGICAL MUSEUM AND RESERVE "KRZEMIONKI" NEAR OSTROWIEC ŚWIĘTOKRZYSKI

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.

Photo A. Jedynak

Photo A. Jedynak

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 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.

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 metres 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 metres 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 (chamber-pillar 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 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.

Underground exhibition gallery ca.0,5 km long passing through Neolithic mining units was opened for tourists 1 july 2004.

The reserve is situated 8 km north - east of Ostrowiec, near the road to Lipsko. Transport from Ostrowiec by bus (lines No 10 & 11), coach or using own means of communication.

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

Andrzej Przychodni

Research of A. Przychodni and S. Orzechowski(2002) and A. 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 K. 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).

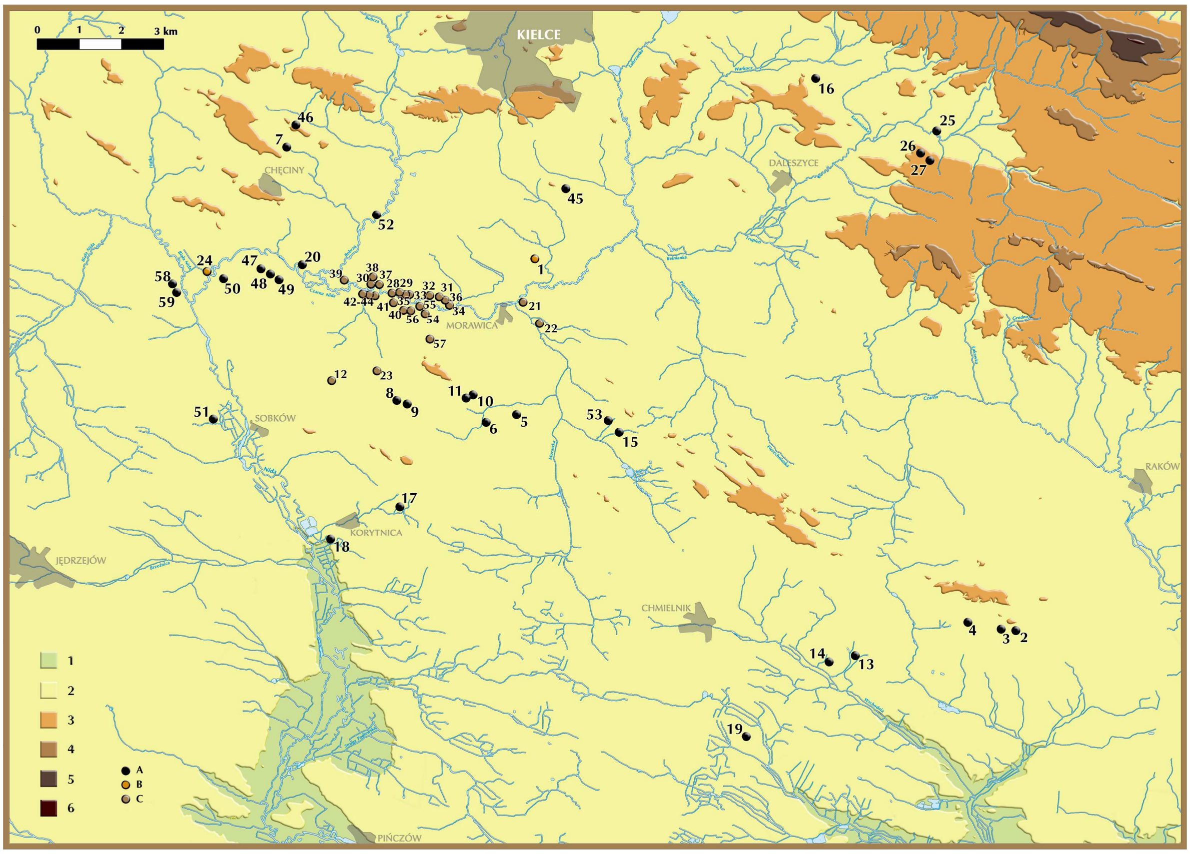

Fig. 1. Bloomery sites in the tributary of the Upper and Middle Nida, the Wschodnia, the Kakonianka and the Warkocz. 1 – 100-200 m a.s.l., 2 – 200-300 m a.s.l., 3 – 300-400 m a.s.l., 4 – 400-500 m a.s.l., 5 – 500-600 m a.s.l.. A – sites know from surface research, B – excaveted sites, C – sites discovered 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. (K. Godłowski 1985, P. Kaczanowski, R. Madyda-Legutko 1986, T. Bochniak, A. 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 iron-processing centre on the Nida, confirmed by burials containing smith's tools in Korytnica, Sobkow dis. and Szaniec, Busko-Zdroj dis. (S. Skurczyński 1947, Skurczyński 1956, Wielowiejski 1960, A. Kokowski 1981, L. 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. (K. Belenin 1992). It needs mentioning, that using clay tuyere blocks for building the furnaces is a feature sporadically noticed outside the Świetokrzyskie Mountians centre.

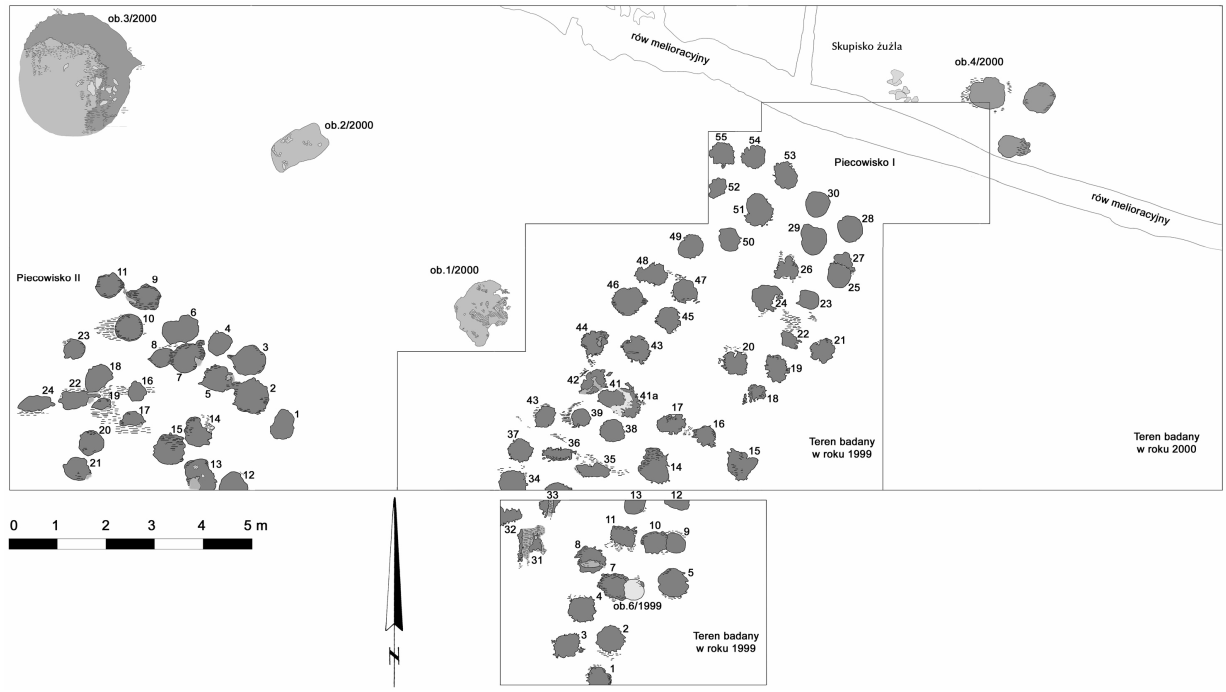

Fig. 2. Bilcza-Zastawie, site 8/45. Plan structures discovered during 1999-2000.

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GEOMORPHOLOGY AND GEOARCHEOLOGY OF CZARNA NIDA VALLEY

Joanna Krupa

Introduction

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).

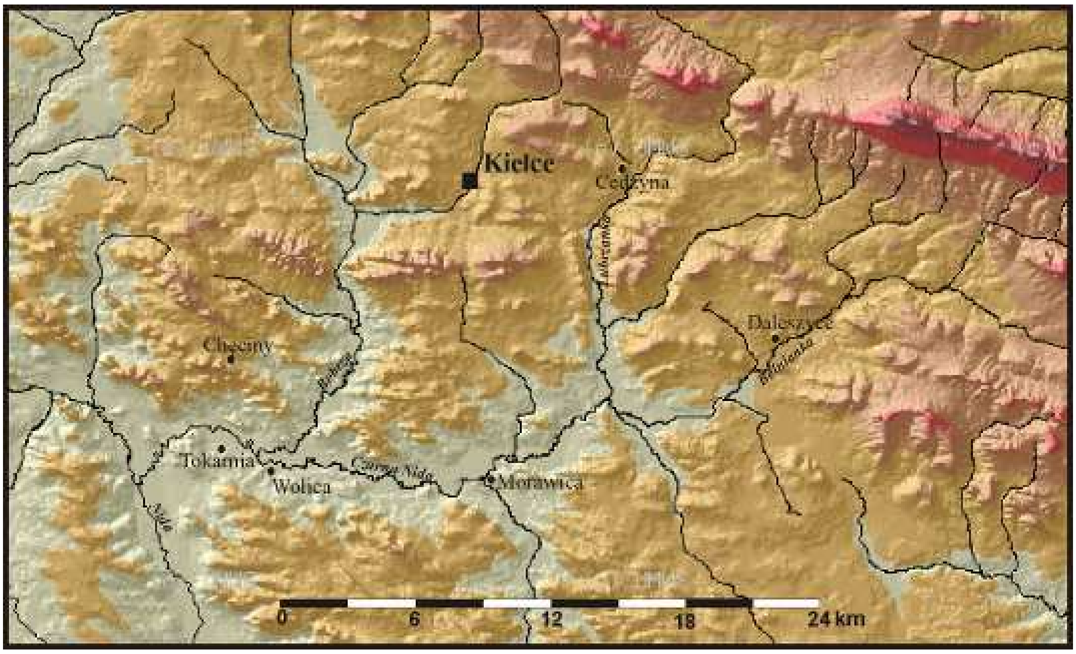


Fig. 1. Location of the study area

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.

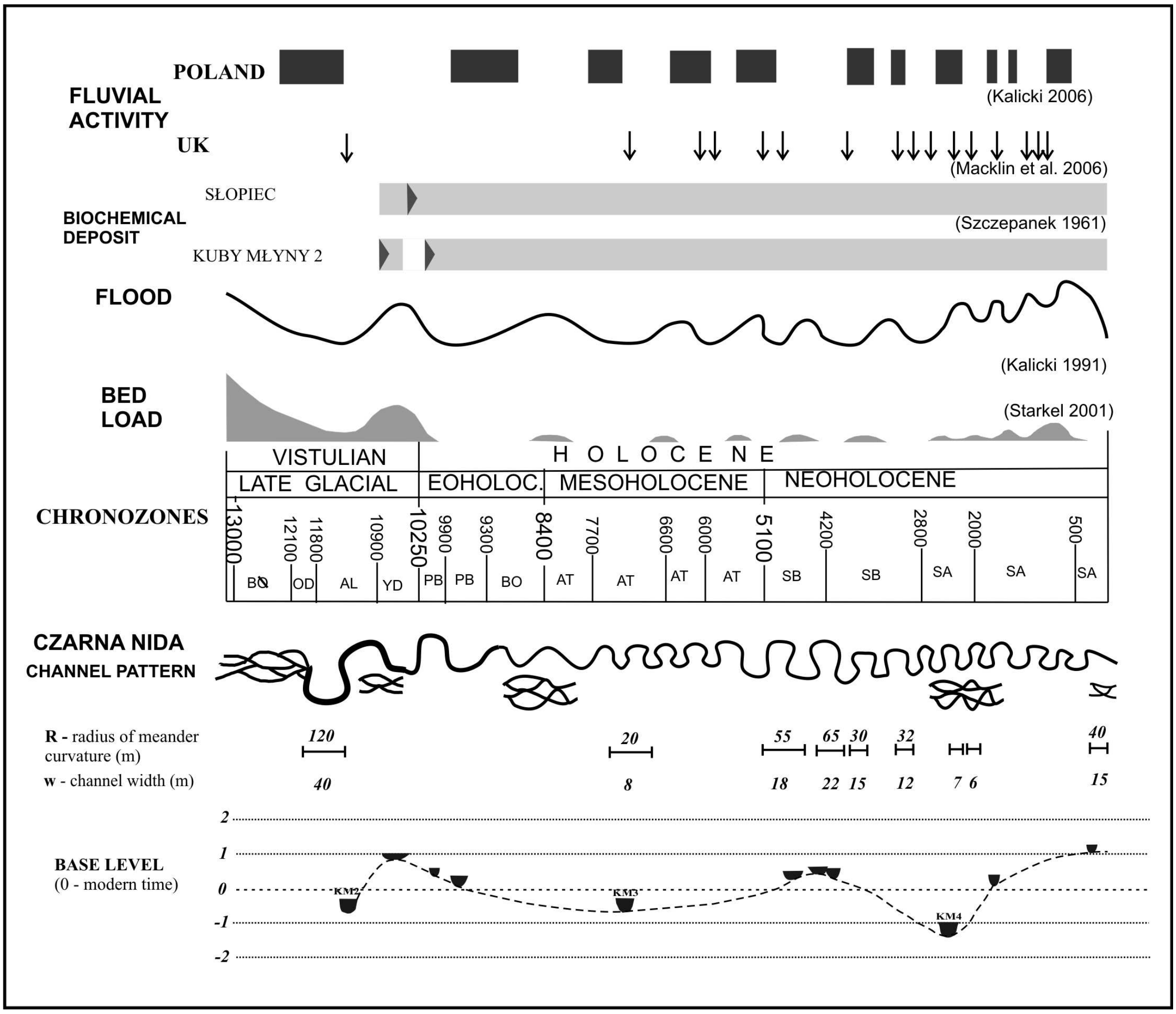
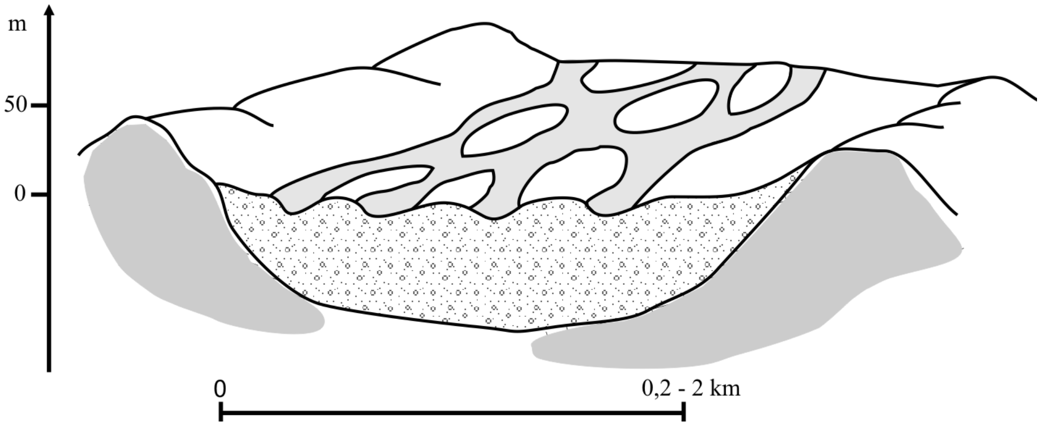
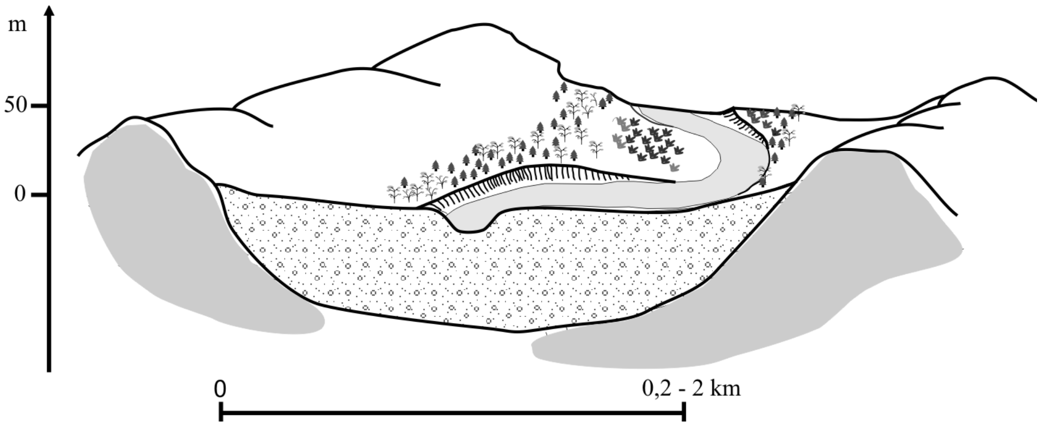


Fig. 2. Fluvial activity of Czarna Nida and corresponding paleogaographical factors (according to different authors): fluvial activity in Poland (Kalicki 2006); fluvial activity in the UK (Macklin i in. 2006); biochemical deposit – Słopiec (Szczepanek 1961); flood frequency (Kalicki 1991); suspensed-material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

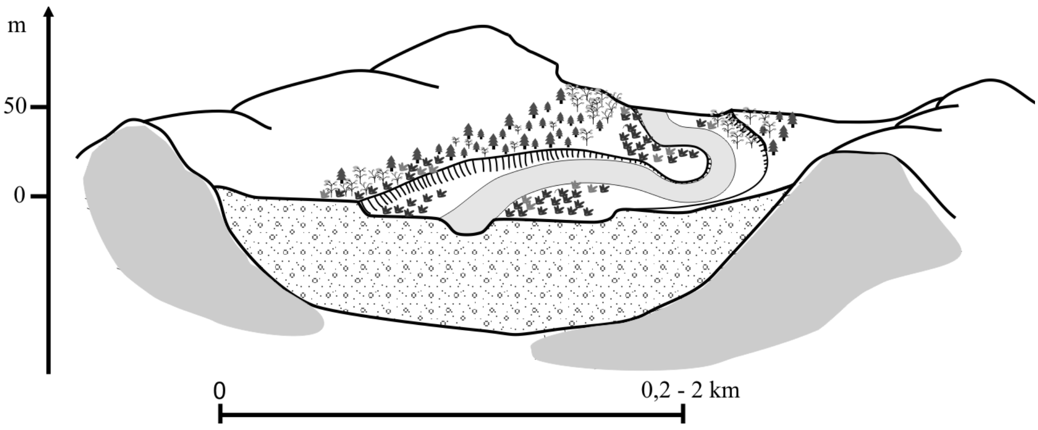
The evidence of the Czarna Nida evolution stages is the distribution of landforms in the valley (Fig. 3)



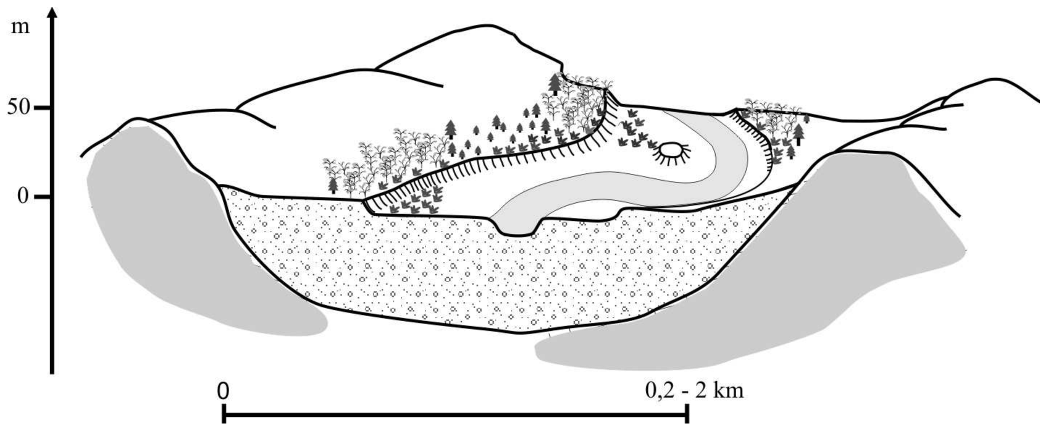
A. Last Glacial Maximum – Younger Pleniglacial (LGM – YPL)



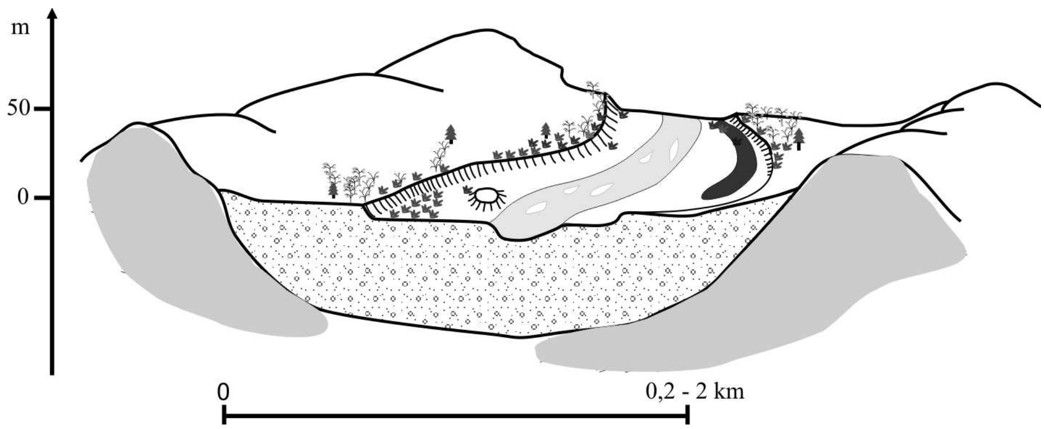
B. Late Glacial (LG)



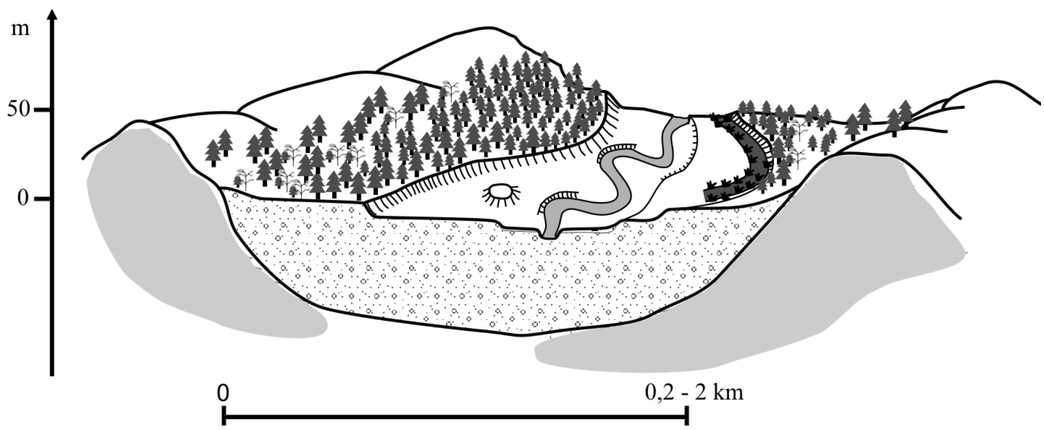
B.1. Late Glacial – Alleröd (AL)



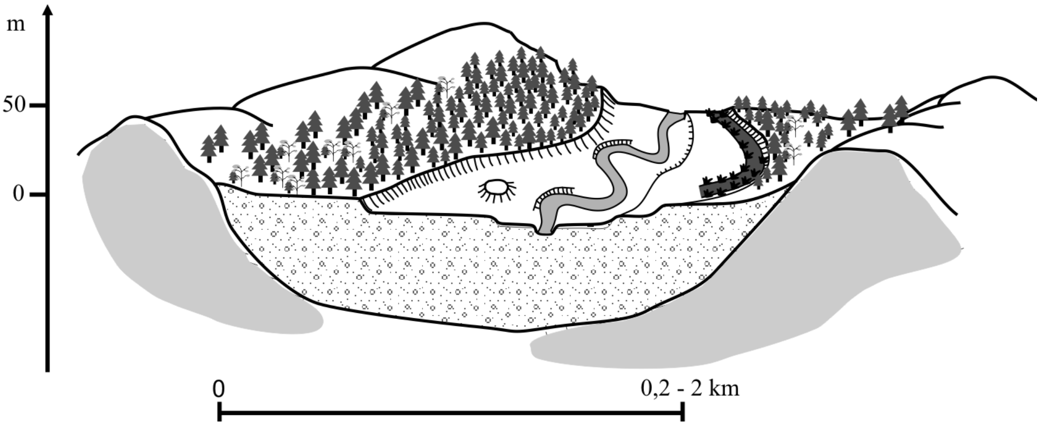
B.2. Late Glacial – Alleröd (AL)



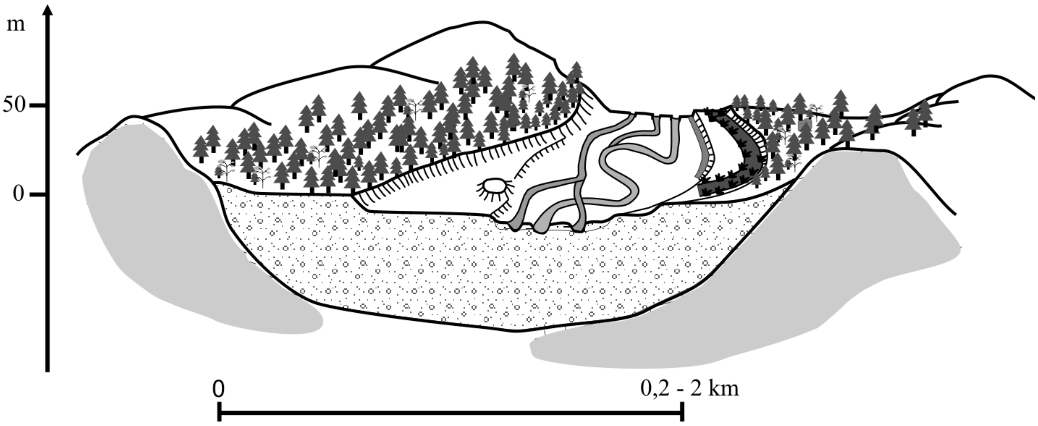
C. Late Glacial – Younger Dryas (YD)



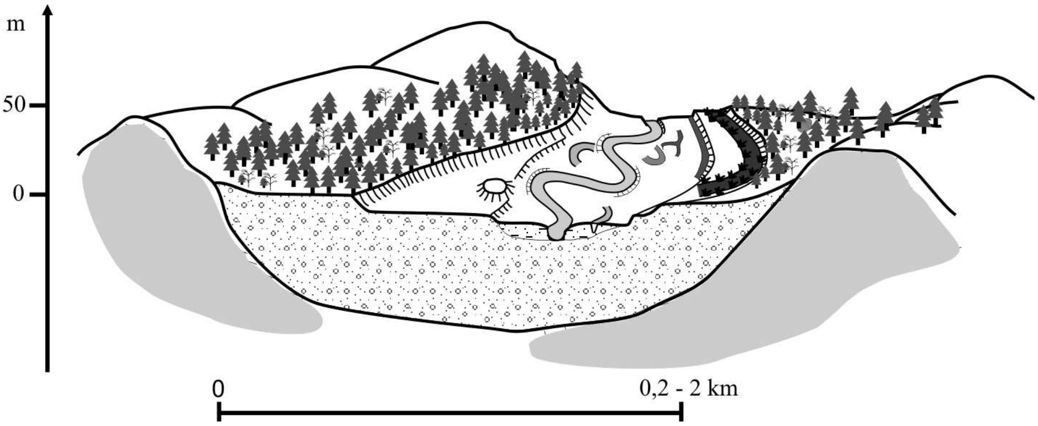
D. Holocene – Preboreal (PB)



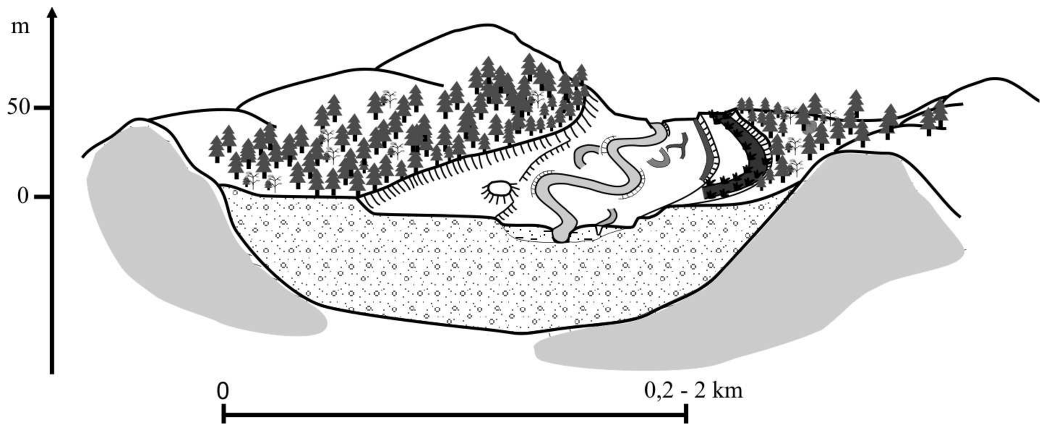
E. Holocene – Boreal (BO)



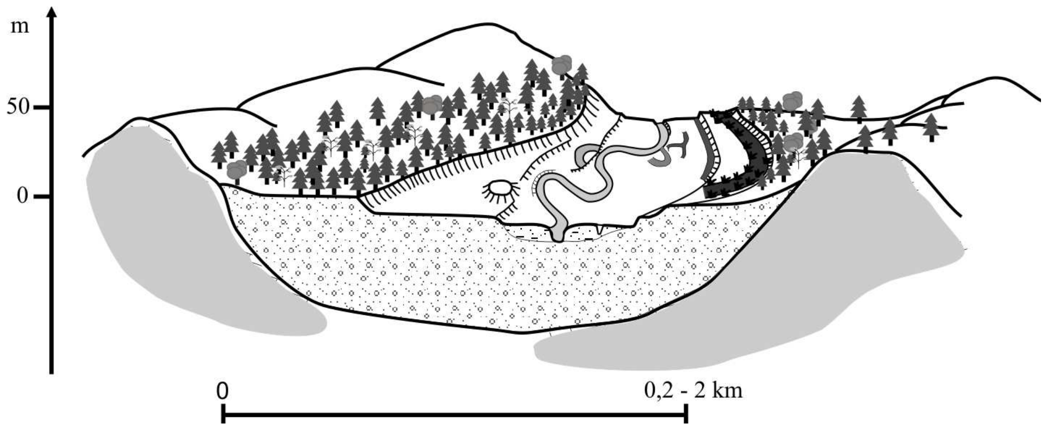
E. Holocene – Boreal (BO)



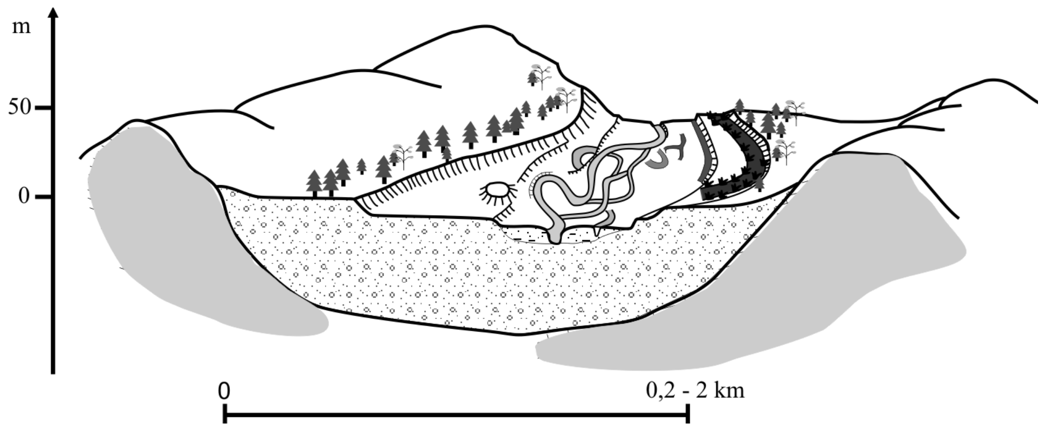
F. Holocene – Atlantic (AT)



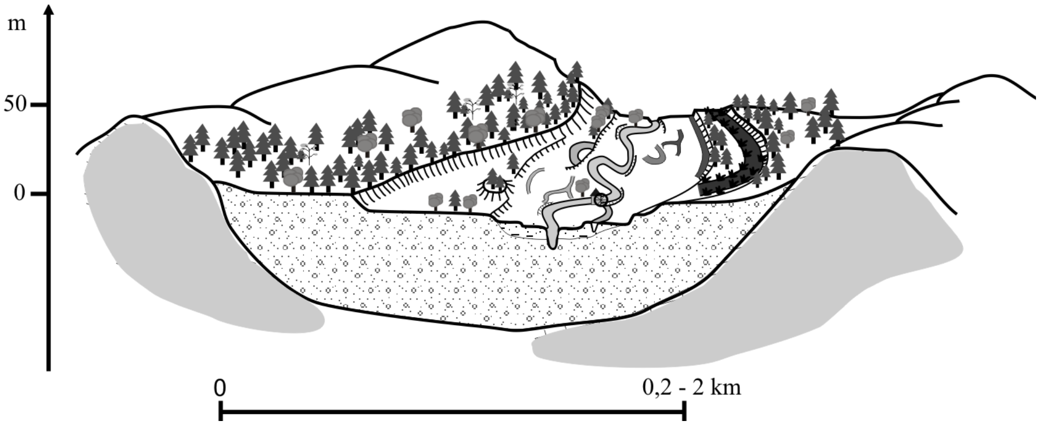
G. Holocene – Subboreal (SB)



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

Sites

1. Ostrów- Łaziska section

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 accumulative-erosional, 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.

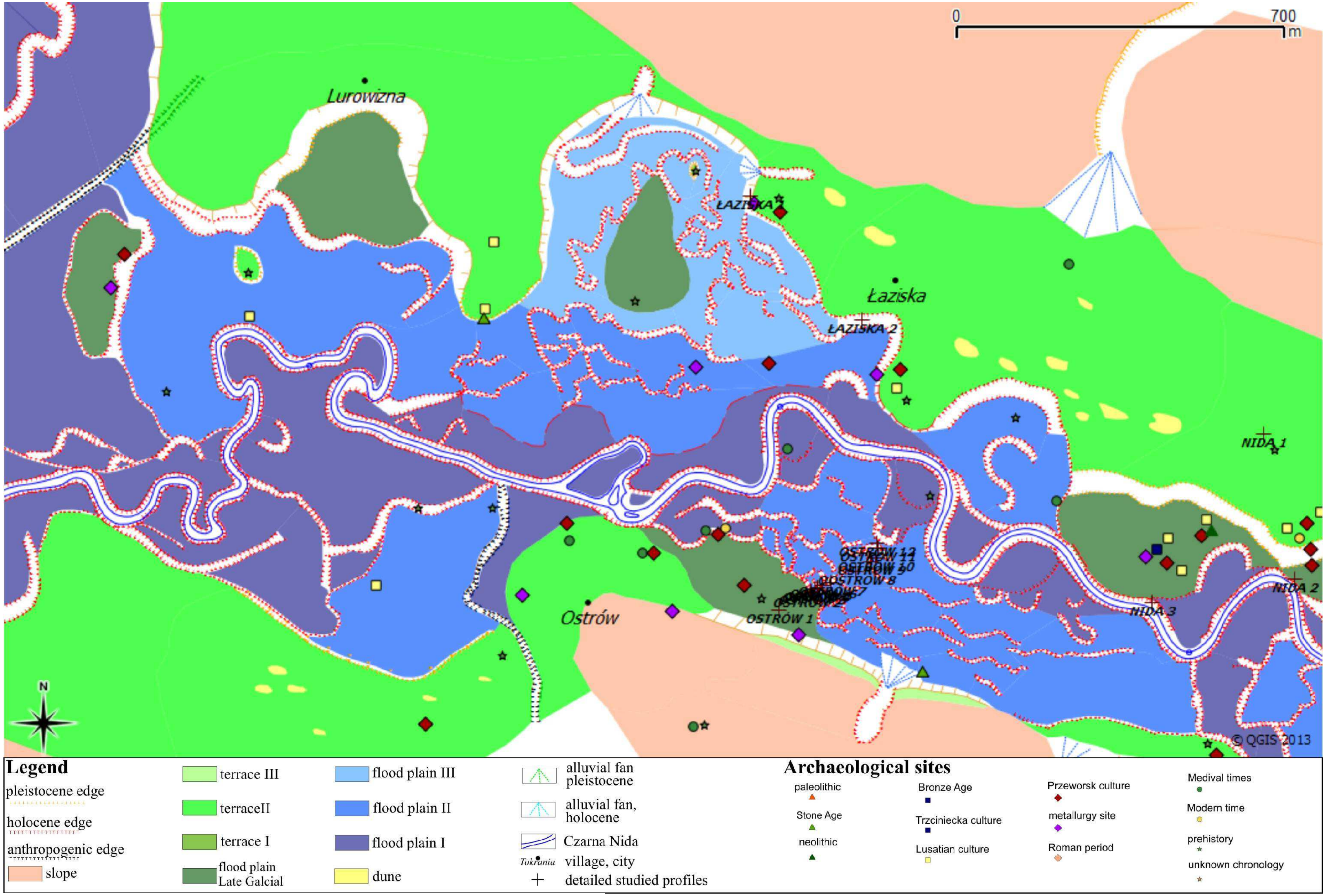


Fig. 4. Geomorphological map of Ostrów Łaziska section

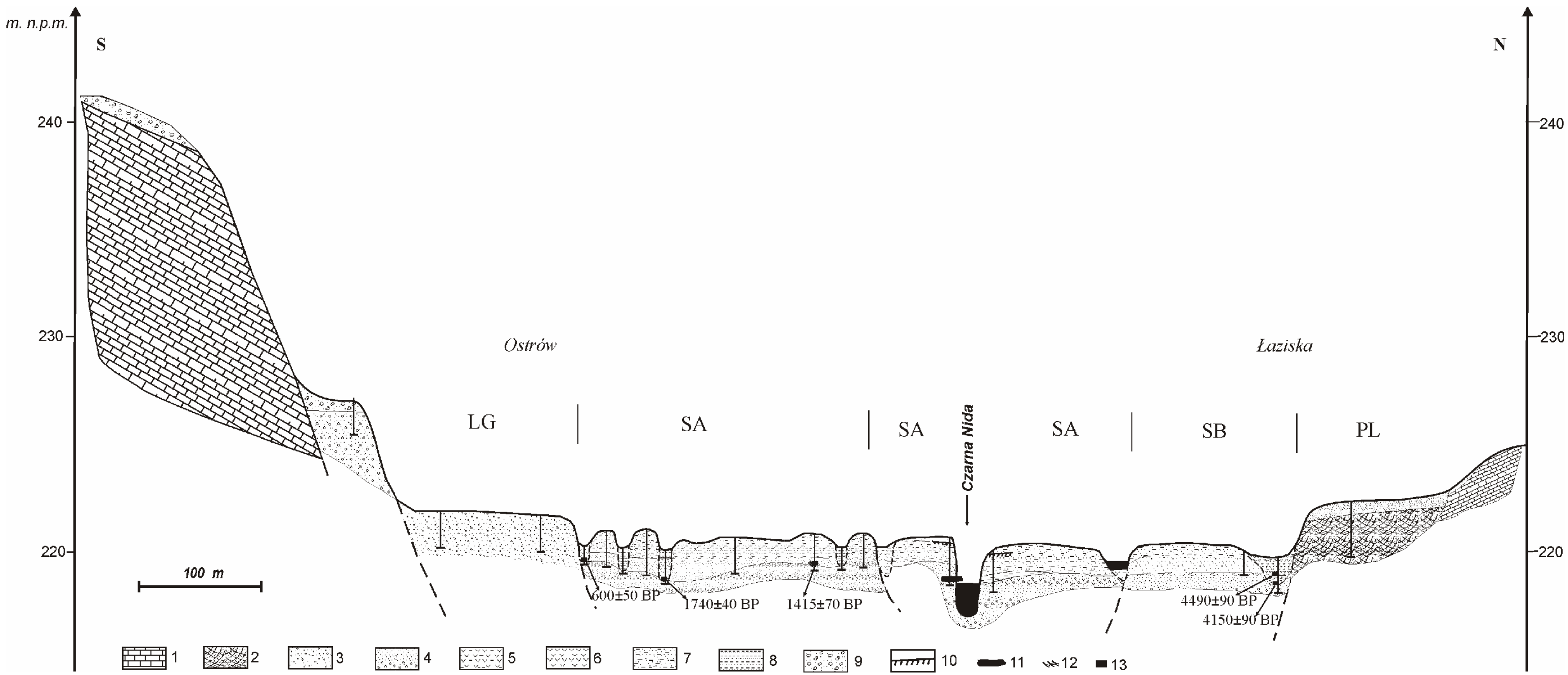


Fig. 5. Schematic section across flood plain in the middle course near Ostrów - Łaziska.
1 – limestone, 2- cross bedded sands, 3 – medium and coarse sands, 4 – gravels with sands, 5 – peaty silts, 6 – peats, 7 – sandy silts, 8 – silts, 9 – slope deposit, 10 – buried soil, 11 – subfossil tree, 12- branches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

2. Vistulian terrace at Łaziska (site 1)

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. 6).

Fig. 6. Vistulian terrace near Łaziska

3. Lateglacial large palaeomeander (macromeander) Łaziska 1

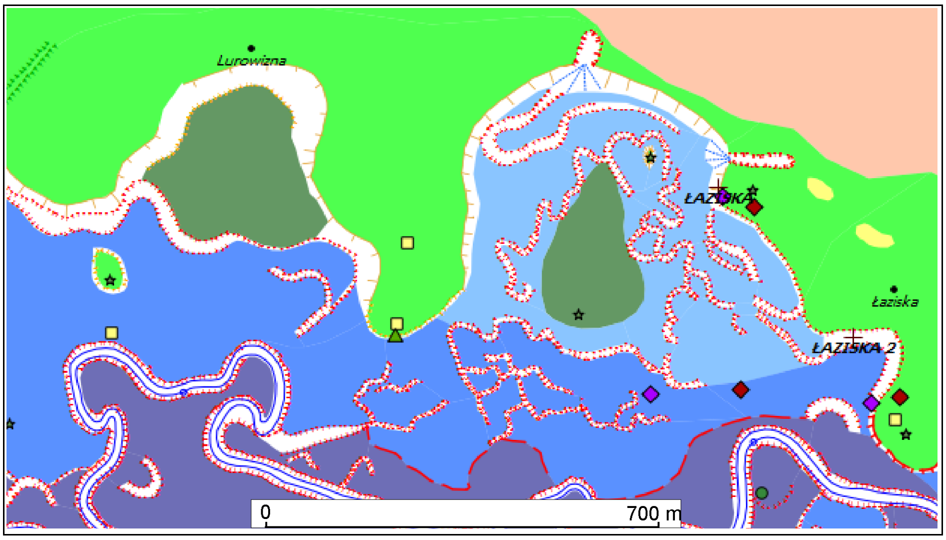


Fig. 7. Geomorphological map (explanations like on Fig.)

Terrace is cut by two large meanders Łaziska 1 and Lurowizna (Fig. 7). 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.

4. Holocene palaeomeander Łaziska 2

Site is located east of large paleomeander (Łaziska 1) (Fig. 8). 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 horizonts, lower – organic, and upper silty sandy 30 cm thick. This indicates a change in the sedimentation type probably during the last few centuries. Subboreal inset is cut by paleochannel of much smaller parameters probably of Subatlantic age, accompany the modern channel.

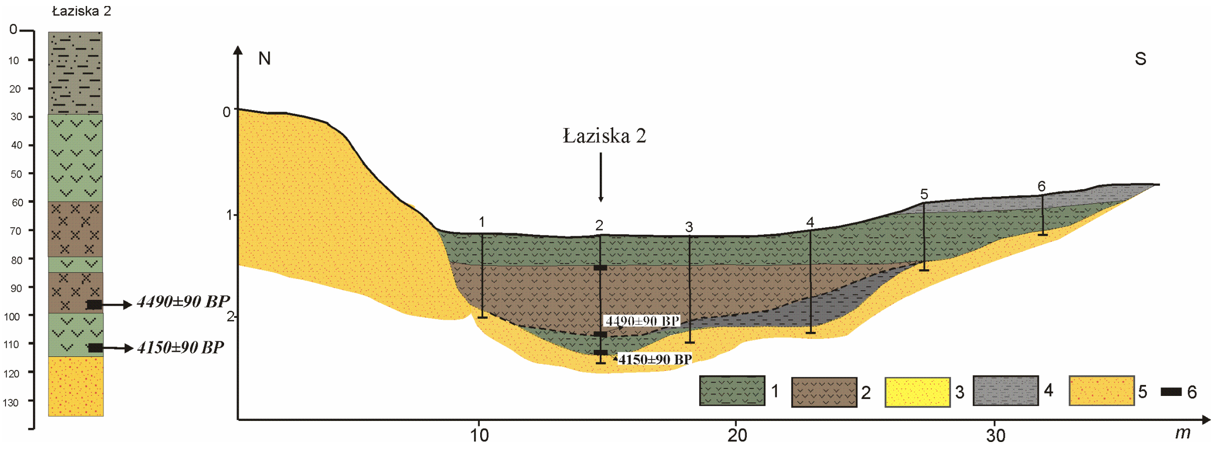


Fig. 8. Section accros paleomeander at Łaziska 2
1 – peaty silts, 2 – peats, 3 – fine sands, 4 – sandy silts, 5 – medium and corase sands, 6 – ^{14}C datings.

5. Pleistocene terrace III at Ostrów (site 3)

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. 9,10).

Fig. 9. Terrace III (10 m) near Ostrów

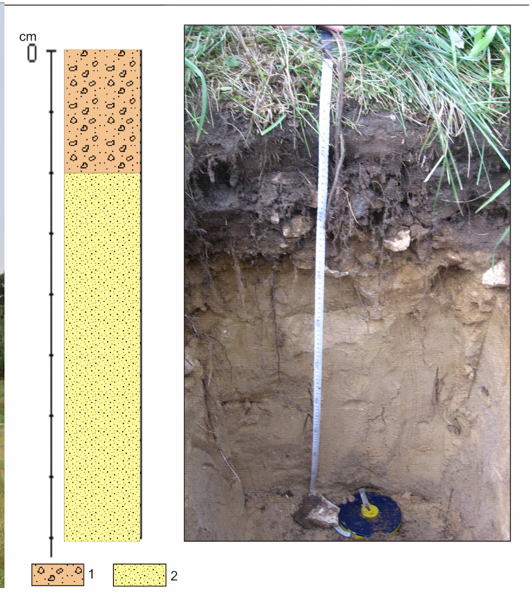


Fig. 10. Profile of 10 m terrace near Ostrów
1- slope deposit, 2 – sands and grave

6. Roman-Medieval multichannel system at Ostrów

Multichannel systems are preserved in some places of the flood plain (Fig. 12). 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. 11).

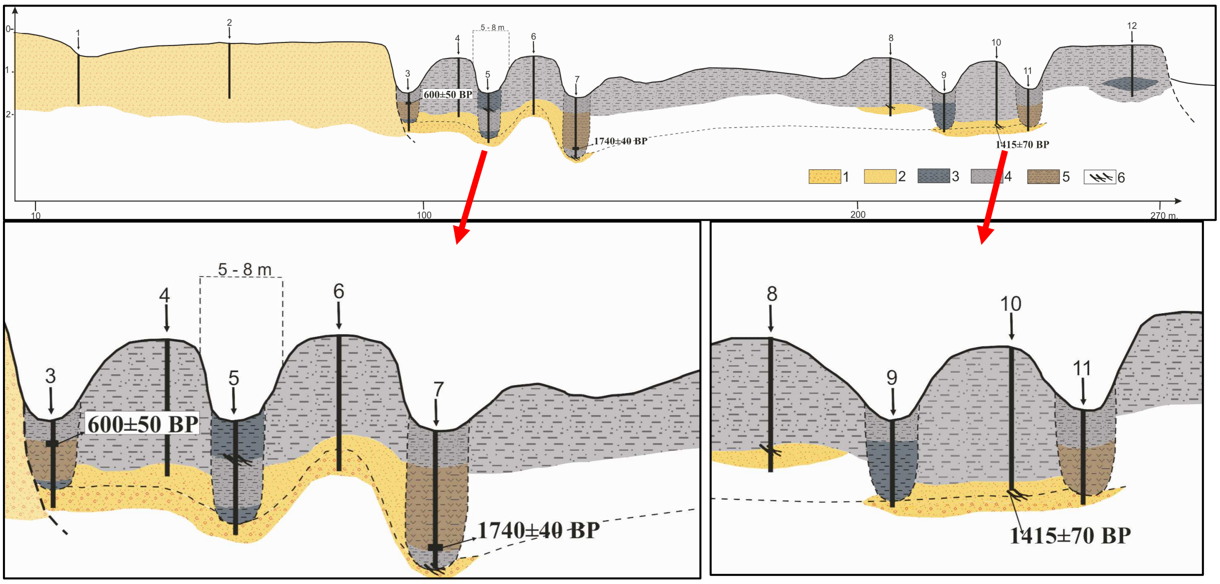


Fig. 11. Cross section across valley bottom with remains of multichannel system.
1 – gravel with sands, 2 – sands, 3 – silts, 4 – sandy silts, 5 - peaty silts and silty peats, 6 - branches and detritus

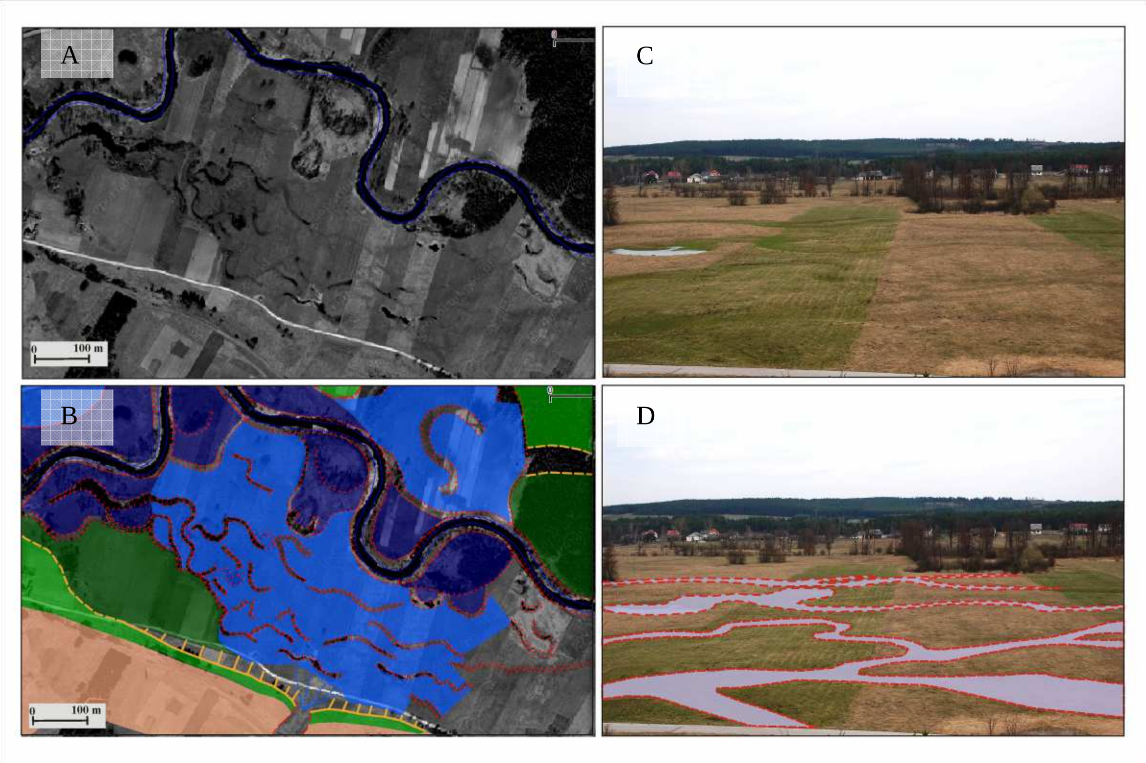


Fig. 12. Multichannel system near Ostrów (areal photographs 1969) (A), geomorphological map (B), view in the field (C), reconstruction (D).

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 δ1 = 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) (Fig. 11).

7. Subatlantic buried soil at Zbrza

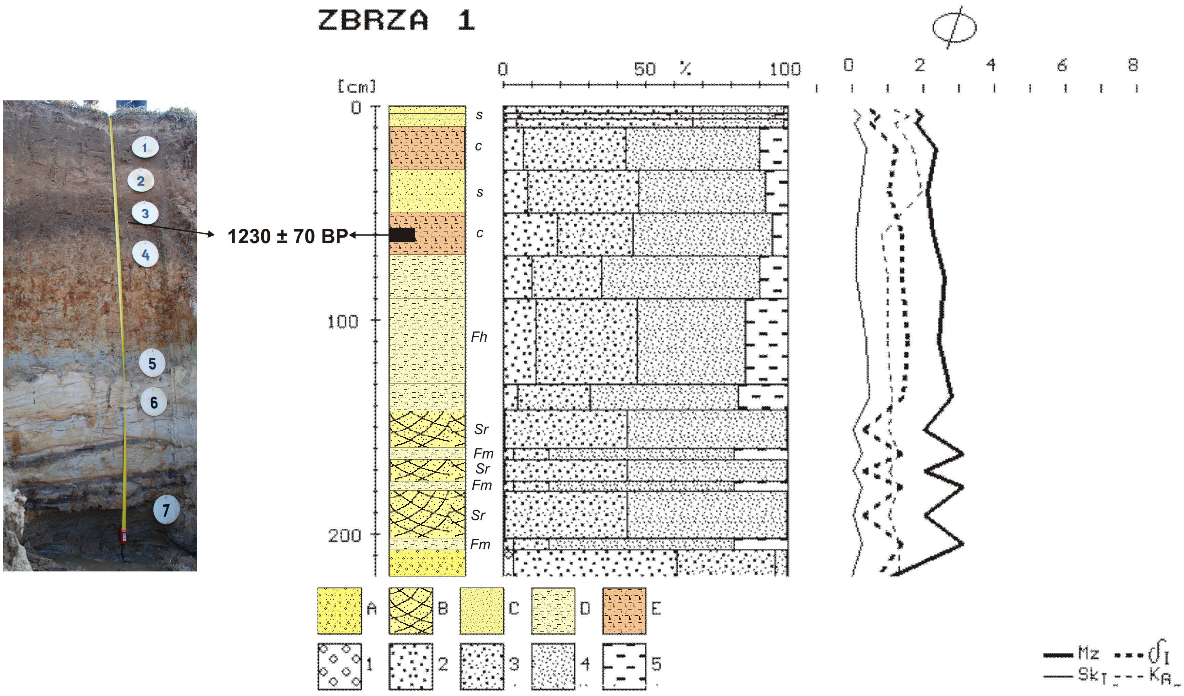


Fig. 13. Profiles of floodplain deposits Zbrza 1
A – medium sands, B- cross bedded sands , C – sands, D – silty sands, E – buried soil. kopalnej, 1 – gravels, 2 –medium sands, 3 – fine grained sands, 5 - silty sands,
Folk-Ward's statistical parametres of grain size: Mz – mean diameter, δ –standard deviation (sorting)

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. 13).

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