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The main phases of settlement development in the north fragment of the Sandomierz Upland and their sedimentological and palynological record in the sediments of the bottom of the Obręczówka river valley

Główne fazy rozwoju osadnictwa północnego fragmentu Wyżyny Sandomierskiej i ich sedymentologiczny i palinologiczny zapis w osadach dna doliny Obręczówki

Keywords: the Sandomierz Upland, Obręczówka river valley, loess cover evolution, radiocarbon dating, climate changes

Słowa kluczowe: Wyżyna Sandomierska, dolina rzeki Obręczówki, ewolucja pokrywy lessowej, datowanie radiowęglowe, zmiany klimatyczne

INTRODUCTION

The Obręczówka and the Przepaść river valleys located in the north fragment of the Sandomierz Upland (Kondracki 2001) belong to those areas where numerous archeological excavations have been carried out for a long time (Podkowińska 1961; Żaki 1972; Bąbel 1975; Kowalski 1975; Uzarowiczowa 1975; Uzarowicz -Chmielewska 1979; Bąbel 1998; Balcer 2002; Orzechowski 2007; Jedynak, Kaptur 2008; Kaptur 2010; Przeździecki et al. 2011; Orzechowski 2013; Kaptur 2014) (Fig. 1). The settlement development within the border between the Sandomierz Upland and the Iłża Foreland, lasting, with breaks, from the Paleolithic period, resulted in the cultural diversification of archeological sites. Within the above-mentioned river catchment areas, settlement development was connected mainly with easy access to water, fertile soils derived from loess (in the case of the Przepaść river – chernozems), geology of the region (flint outcrops) and configuration of the land (defensive function of sites).

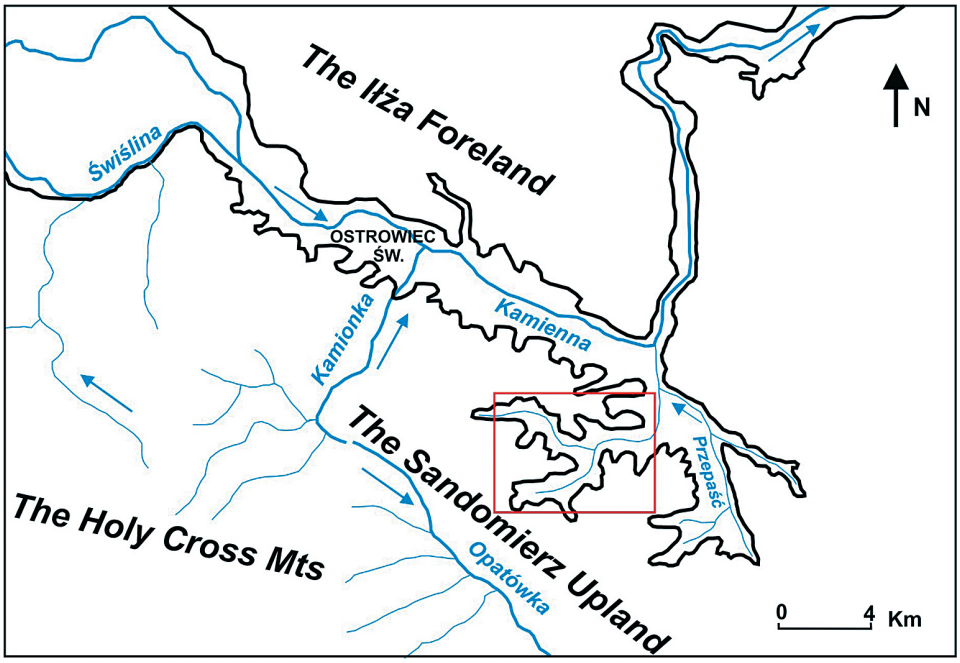

Fig. 1. Location and extent of the Obręczówka river valley (autor's, compilation)
Ryc. 1. Lokalizacja i zasięg doliny rzeki Obręczówki (opracowanie własne)

The connection between the phases of settlement over loess uplands with the reconstruction of natural environment allows for the insight into paleogeographical evolution of the river valleys used agriculturally (Jersak, Śnieszko 1983; Śnieszko 1995; Klimek et al. 2006; Szwarczewski 2007; Bałaga et al. 2008; Zygmunt 2009; Reder et al. 2010; Wójcicki 2010). Within the investigated area of the Sandomierz Upland, in the bottom of the old, Pleistocene loess valleys, locally, fragments of lowland bogs remain preserved and are represented by sedge bogs, whose condition partially enabled paleogeographic reconstruction of the loess upland areas. Peats indicate stability of the landscape, whereas mineral-organic sediments indicate intensification of slope processes (Klimek et al. 2006). In the Obręczówka valley, as well as in the Przepaść and Gierczanka valleys, radiocarbon datings and palynological analyses of peat horizons have not been carried out yet although Samsonowicz indicates peat existence (1934). Peat seams occur below 1.5 m of silty-clayey deluvial layer, lining the bottom of the Obręczówka river valley. They occupy the whole width thereof, thus, forming distinct horizon within its bottom.

The main objective of the study is a connection of sequence of alluvial, deluvial and organic deposits with archeologically proved phases of settlement in the neighbourhood of the Obręczówka valley next to Krzczonowice. Radiocarbon

dating and palynological analyses of peat constitute additional supplement to the research carried out by Jersak and Śnieszko (1983), connected with geographical environment changes within the Opatów-Sandomierz loess patch in the late Vistulian and the Holocene.

REGIONAL SETTINGS

The investigated area of the Sandomierz Upland, situated among Ostrowiec Świętokrzyski, Ćmielów and Opatów, is dissected by the old Pleistocene valleys filled with the Holocene deluvial-aluvial deposits. These valleys, together with vast, undulating rural plains filled with closed depressions, as well as dry valleys and young Holocene gullies occurring in source sections of the side confluences, are the main elements of the contemporary loess relief. The thickness of the Vistulian loess cover within the investigated area is between ten and twenty meters (Jersak 1965; Makowski 1976). The bedrock is represented mainly by the Liassic (Zagaje, Gromadzice, Zarzecze and Ostrowiec levels) deposits, represented within the investigated area mostly by fine, medium and coarse grained sandstones (Kosmowska-Suffczyńska 1966), covered with glacial and fluvioglacial deposits of the Middle Polish Glaciation and, varying in age, loess, divided by interglacial and interstadial fossil soils (Jersak 1965; Lindner et al. 1999). Soil cover mainly consists of secondary, typical brown soils, acid and leached, on weakly developed, strongly eroded slopes. The Holocene model profiles of grey-brown podzolic soils occur only in forested areas and are witnesses of pedological, geomorphological and landscape changes triggered by the human activity (Gałka, Dębicki 2014).

In the vicinity of Krzczonowice, Obręczówka connects with its side tributaries flowing from Przeuszyn and Bogusławice. The change of its course from longitudinal to parallel occurs in the so-called "Zaolzie" – the meadow areas of the Krzczonowice village (Photo 1). Within this section, in 1965, water meadows were reclaimed because of difficulties connected with haying. The channel of Obręczówka had its own natural, winding course then.Currently, only one section has preserved its natural character, i.e. the one between Glinka and Buszkowice, because of protection of riverside stand. Local boggy character of valley also results from the presence of alluvial fans, having been formed during erosional processes within dry, side loess valleys.

THE SETTLEMENT OF THE PALEOLITH, THE NEOLITH AND THE EARLY BRONZE AGE

The Paleolithic and the Mesolithic settlement within the north-eastern margin of the Holy Cross Mountains started along the Kamienna river valley on account of convenient environmental factors. This is proved mainly by the Upper, Middle

Photo 1. "Zaolzie" – the investigated fragment of the Obręczówka river valley located close to Krzczonowice (photo by Elżbieta Gałka)

Fot. 1. „Zaolzie" – badany fragment doliny rzeki Obręczówki zlokalizowany blisko Krzczonowic (fot. Elżbieta Gałka)

and Late Paleolithic sites located, among others, in Krzemionki (in the Lipnik quarry). The sites of the Magdalenian culture in Podgrodzie, Jankowice, Janik and „Mały Gawroniec" hill in Ćmielów have been discovered recently (Przeździecki et al. 2011). The first human groups, having lived off from gathering and hunting, did not cause any bigger changes to the natural geographical environment (Żaki 1972). Small remnants of settlement can be traced in the Holy Cross Mountains, dating back to the Younger Stone Age (the Neolith 4200–1800 BC), and a strong development of the Neolithic settlement has been recorded throughout the entire Holy Cross region. In the Suchedniów and Pakosław profiles, the first traces of the Neolithic crop growing were recorded in the immediate neighbourhood of the Holly Cross Mountains, dating back to 4000 years BC (Szczepanek 1961).

Another, very important factor, which contributed to the intensification of prehistoric settlement in the Neolith period within the Sandomierz Upland was exploitation and marketing of stripped flint material (the Lower Astartian) (Balcer 2002). The most important Neolithic sites within the investigated area are Ćmielów (Gawroniec), Broniszowice and Stryczowice. A new method of agricultural production in this period was connected with slash-and-burn cultivation as a basic and regular agrotechnological means (Kruk 1993). Forests were destroyed to a large extent and first traces of gully erosion coming from this period have also been noticed. Erosion was, however, restricted during the low settlement or population movement periods, when forest vegetation encroached on the farmland.

On the Gawroniec-Pałyga hill in Ćmielów next to numerous flint workshops connected with flint mines, traces of cultivation and breeding were found (Podkowińska 1961). Thanks to the possibility of radiocarbon dating of hollows found in Ćmielów and Stryczowice, we can determine the precise period of their

existence. Apart from the Lengyel Culture, these dates fall, almost completely, into the time interval of extensive slash and burn cultivation lasting from 3200 BC to the close of the Neolith 2200 BC (Bakker et al. 1969; Uzarowicz-Chmielewska 1979). The existence of carts and a road network has been proved by cart's ornament carved into the earthenware of the Funnel Baker Culture found in Ostrowiec Świętokrzyski. The period of existence of this settlement was estimated at around 2700–2500 BC (Uzarowiczowa 1975).

The population of the Linear Band Pottery communities (7 sites) preferred areas located low, close to water (lower fragments of slopes adjacent to the valley). In flood periods, when temporary water was rising, they could have been periodically flooded. Another group of people from that period preferred areas located on the escarpment of upland and the slope of the valley, around 15–25 meters above bottom (Kowalski 1975). Similar location was typical of the Lengyel Culture (3 sites). Both above-mentioned cultures represented the oldest, primitive garden-type stage of socio-economic development in the Neolith within loess uplands (4800–3200 BC) (Kruk 1993).

The Funnel Beaker Culture has 10 sites by the Obręczówka river. All sites occupy areas situated high in comparison with the valley bottom (average 20 m), in place where slope transforms into the upland area. These sites are dry, sunny, enabling a simultaneous observation of the valley and plain areas. The location of the Neolithic and the Early Bronze Age cultures in the neighbouring catchment area of the Kamionka river (125 archaeological sites) is similar (Bąbel 1975).

In the Obręczówka valley, next to Funnel Beaker Culture, there are 14 permanent sites of the Globular Amphora Culture with the same settlement preferences as the previous one (Kowalski 1975). One of them was investigated next to Krzczonowice village, where apart from the Globular Amphora Culture site, the Tarnobrzeg Group of the Lusatian Culture (TGLC), the Pomeranian Culture and the Przeworsk Culture of early Roman Age sites were found (Jedynak, Kaptur, 2008; Barga-Więcławska, Jedynak 2014). The natural environment of the hill in Krzczonowice surroundings, in the period of several hundreds of years of the second half of the 3rd millennium BC, can be described as a xerothermic grassland of steppe type belonging to the *Festuco-Brometea* class. It was confirmed by numerous finds of these species in the hearths of the Globular Amphora Culture pits and their radiocarbon dating. Later habitats on hills were overgrown by shrubs (Barga-Więcławska, Jedynak 2014). Apart from the Obręczówka valley, this culture occurs in the Gierczanka valley, in Stodoły, Mierzanowice and Ostrowiec Świętokrzyski. At the close of the Neolith (2200–1800 BC), permanent agricultural settlement slowly disappeared and was replaced by nomadic groups whose farming was based on pasturing (Kruk 1993). The relics of that period are, among others, numerous mounds and ground embankments distributed on hills culminations in the basement area of the Kamienna river, located

205–282 m a.s.l. (Bąbel 1998) (Photo 2). The people of Chłopice-Vesele group, harbinger of changes which started in the Bronze Age period, did not build large settlements. Their nomadic lifestyle entailed characteristic distribution of burial mounds along the rivers. The Samborzec culture is represented by much bigger cemeteries, i.e. in Mierzanowice, and has a permanent character.

Photo 2. Prehistoric mound in Wola Grójecka ("Swedish Mound") (photo by Elżbieta Gałka)
Fot. 2. Prehistoryczny kurhan w Woli Grójeckiej („Szwedzka Mogiła") (fot. Elżbieta Gałka)

THE SETTLEMENT OF THE BRONZE AND THE IRON AGE

In the Bronze Age, this area was settled by the Lusatian culture and the Lusatian-Pomeranian-Cloche culture complex. This settlement was characterized by a big concentration of sites and their even distribution forming small ecumens. First groups sites of the Pomeranian-Cloche complex were located in the middle part of the Pokrzywianka and Kamionka river catchments. The main centre was along the Przepaść valley, which in the south is connected with sites in the middle of the Opatówka river valley. Within its limits, several local centres existed in the region of Opatów, Wojnowice and Ćmielów. The presence of these groups was linked with first serious deforestation which started slope processes (Orzechowski 2007).

Similarly, the settlement of the Lusatian culture tribes was responsible for deforestation, which caused changes to the natural landscape of the Sandomierz Upland (soil erosion, slope run-off) (Żaki 1972).

The late phase of the La Téne, together with the Roman period (IV–V CE), triggered economic activity within the investigated area, which was reflected in archaeological and paleobotanical material (Szczepanek 1961). The vast settlement complex of the Przeworsk culture, existing on the Sandomierz Upland, was a settlement base for the metallurgy production in the Holy Cross Mountains. This region, through the upper section of the Opatówka river valley, was connected with the ancient metallurgy centre on the north-eastern forelands of the Holy Cross Mountains. The main reason for such situation were fertile soils developed from loess. Thanks to them, settlers could make food supplies for people working in the neighbouring centre.

Within the area of 800 km^2, a huge productive complex was registered. According to investigations, it consisted of 8,000 smelting workshops with groups of several dozens (60–70) settlements of different size, divided, in turn, into micro regions consisting of 5–6 settlements (Orzechowski 2007). Apart from primitive smelting furnaces, vertical mineshafts and mining excavations were discovered in a deep mine in Rudki. Other traces of settlement include cremation cemeteries, numerous in the eastern part of the region, treasures and single archaeological finds of the Roman coins found, among others, within the Obręczówka river basin in Krzczonowice surroundings (Kaptur 2010).

The settlement of the Przeworsk culture was dispersed and occurred in the form of islands. Bigger centres of the Przeworsk culture within the investigated area occur in the middle and lower section of the Opatówka river course and catchment areas of the Przepaść and Kamionka, Świślina and Pokrzywianka rivers. Within the investigated areas, objects of up to 1 ha (64%) prevail. Settlements of up to 5 ha constitute 29% (most of them 2–3 ha settlements), settlements of up to 15 ha – 7% (average size of settlements is 10–12 ha). The smallest settlements were inhabited seasonally, where 2–3 ha settlements coexisted with and supported ancient workshops (Orzechowski 2007). In the early Roman period, location of settlements within valleys was preferred, but in the late Roman period the number of settlement sites located within floodplain terraces and edge zone of the plain increased. Recesses of the floodplain terraces were preferred as a place of permanent settlement. On northern slopes, above 45% of sites were found (Orzechowski 2007). At the close of the Bronze Age and during the Iron period, because of smelting and settlement/rural activity of the settlers, the landscape of the Sandomierz Upland underwent serious modification. Dense forest areas changed into communities with park character (Szczepanek 1961).

Development of ancient metallurgy centre coincided with the Subatlantic period. The analyses carried out on charcoal taken from forge hearths of the primitive smelting furnaces occurring in the Holy Cross Mountains, correlate well with the results of paleobotanical analyses (Orzechowski 2007, 2013). According to Szczepanek (1961), in pollen diagrams we can see a decrease in beech, hornbeam and fir, simultaneously with pine, cereals and weeds increase. Human activity was reflected in the form of fire traces, all species of cereals were known, as well as *Fagopyrum Tataricum* grown.

THE SETTLEMENT OF THE MIDDLE AGES PERIOD AND HISTORICAL TIMES

In the Migration Period, within the investigated area, we can observe a sudden decrease in settlement (Żaki 1972). Other traces of metallurgy, less significant than in the Roman period, appeared in the 9th–10th century. Thanks to fertile soils occurring in the area, first settlements in Stradów, Stawy, Szczaworyż and Radom were built. At the turn of the 12th and 13th centuries, settlements in Sandomierz, Wiślica, Połaniec, Zawichost, Sieciechów and Żarnów changed into towns, also the Benedictine monastery on Holy Cross was built. In its neighbourhood, efficient farming, horticulture and fruit farming (for example vine) were introduced by Cistercian monasteries in Wąchock (1179) and Koprzywnica (1185). From 10th century onwards, anecumenas became smaller and forms of farming underwent diversification (Żaki 1972). Better conditions for early medieval settlement and agriculture existed in river valleys, but in the full Middle Ages floodplain and plain areas were preferred (Gieysztor 1967).

In the 13th–15th century, the Holy Cross region underwent a sudden process of parish network development of the Catholic Church (Olszewski 2001). During Holocene, in the 15th century, very fast and abundant loess diluvium accumulation connected with agriculture development began on the bottoms of stabilized valleys within the Sandomierz Upland. In 1611–1615, 20 manors existed here (Muszyńska 1977). During the manorial system development, in the second half of the 15th century, interference in the rural, Opatów landscape was very strong and caused serious changes to soil cover, relief and flora. At the same time, the road net between the settlements of the Sandomierz Upland developed and the density of new roads leading to fields also increased (Wąsowicz 1967). In the 16th and 17th century, erosional processes were the strongest. The quality of the cultivated soils decreased, also serious typological changes of the soil cover were observed. The relief of the investigated area underwent strong and permanent transformation – the main evidence are loess gullies formed in historical times (Makowski 1976; Czarnecki 1996). Next to surface erosion, piping occurred

(Strzemski 1957, 1961). Further transformations of the Obręczówka river valley surroundings in the Middle Ages period, in the 18th and 19th century, and in the period of the Old Polish Industrial Region, were connected with iron mining and metallurgy development (Piwek 1999; Kaptur 2014). Current vast gullies originate mainly from that period. Taking into consideration natural factors, an increase in the intensity of morphogenetic processes from the 15th to the turn of the 18th and 19th centuries was connected mainly with climate moistening and cooling in the Little Ice Age period (1400–1857) (Starkel 1994; Klimek et al. 2006).

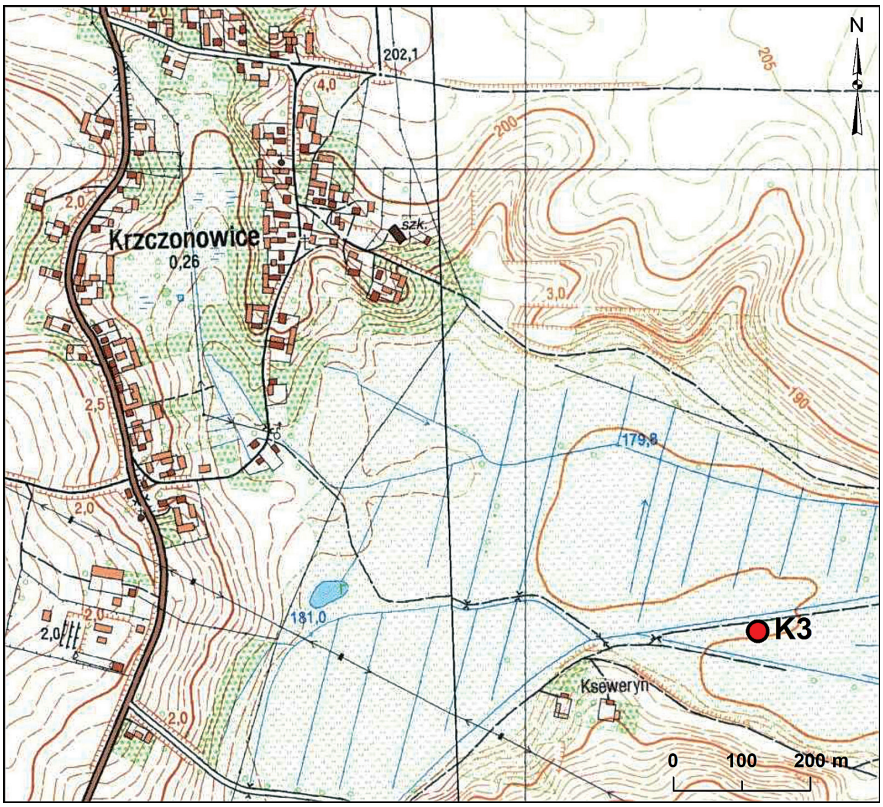

Fig. 2. Location of the Krzczonowice core (K3) in the Obręczówka river valley on the topographic map

Source: Topographic map in 1 : 10 000, sheets M-34-43-B-d-4 Krzczonowice (1999), M-34-44-A-c-3 Buszkowice (2003), GUGiK

Ryc. 2. Lokalizacja rdzenia Krzczonowice (K3) w dolinie rzeki Obręczówki na mapie topograficznej

Źródło: Mapa topograficzna w skali 1 : 10 000, arkusze M-34-43-B-d-4 Krzczonowice (1999), M-34-44-A-c-3 Buszkowice (2003), GUGiK

METHODS

Radiocarbon dates were obtained in Gliwice Radiocarbon Laboratory in the Department of Radioisotopes, in the Institute of Physics of the Silesian University of Technology. Material for analyses was taken by Instorf probe close to the Krzczonowice village, from the single core located in the axial fragment of the Obręczówka valley, in "Zaolzie" (50˚51'29 N, 21˚30'23 E) (Fig. 2).

Plant remains taken from the selected layers of peat deposited at the depth ranging from 1.55 to 2.40 m (4 samples) and 2.85 to 2.90 m (1 sample) were subject to radiocarbon analysis. The samples were initially chemically prepared for testing, and their age was determined by means of liquid scintillation counting of beta radiation spectrometry (LSC). For the calculations, the calibration curve IntCal04 (Reimer et al. 2004) and the program OxCal v4.0.5 (Bronk Ramsey 2007) were used.

Samples taken from the selected mineral and organic, and organic levels were subject to pollen analysis. The material for the microscopic analysis was prepared using Erdtman acetolysis (Wasylikowa 1973). Initially, in order to remove silica, the samples were treated with hydrofluoric acid. Under the microscope, the whole surface of the cover glass was examined.

RESULTS

Together with the redeposited loess sediments, the thickness of Holocene sediments proved for this core is about 3.4 m. Radiocarbon dates (from 2215 ± 80 BP to 360 ± 80 BP) comprise and confirm the Middle and the Younger Neoholocene stage of anthropogenic denudation of the loess Sandomierz Upland (Tab. 1, Fig. 3, 4).

According to sedimentological record of the bottom of the Obręczówka river valley, the bottom most sediment (3.20–3.40 m) is organic silt, locally slightly sandy, in the roof with malacofauna. Above, at the depth of 2.90–3.20, olive-grey, slightly sandy organic-mineral silt with numerous malacofauna occurs. Dated on 2215 ± 80 BP peat horizon occurring at the depth of 2.85–2.90 m. Above peat layer, at the depth of 2.60–2.85 m, detritus gyttja with scarce malacofauna, slightly sandy occurs covered with 20 cm layer of slightly sandy silt in the floor. At the depth of 1.55–2.40 m sedge peat, moderately decomposed occurs. Selected layers of peat were dated on 1720 ± 75 BP, 1360 ± 70 BP, 970 ± 80 BP and 360 ± 80 BP. Peat is covered by mineral-organic silt, grey-brown, clayey in the roof at the depth of 1.40 m. Silty-clayey, the top most alluvial - deluvial layer, with thickness of 1.40 m was not investigated.

Tab. 1. Results of radiocarbon dating of peat samples taken from the core in Krzczonowice
Tab. 1. Wyniki datowań radiowęglowych próbek torfu pobranych ze rdzenia w Krzczonowicach

No	Sample name/ depth (m)	No Lab.	Age ^{14}C (BP)	Calibrated age range 68%	Calibrated age range 95%
1	Krzczonowice 3/1.55-1.60	GdS-622	360 ± 80	1450 (33.4%) 1530 calAD 1555 (34.8%) 1635 calAD	1415 (94.1%) 1670 calAD 1780 (1.3%) 1800 calAD
2	Krzczonowice 3/1.92-2.00	GdS-623	970 ± 80	990 (68.2%) 1160 calAD	890 (3.7%) 930 calAD 935 (91.7%) 1225 calAD
3	Krzczonowice 3/2.25-2.30	GdS-624	1360 ± 70	605 (58.6%) 715 calAD 745 (9.6%) 770 calAD	545 (94.3%) 820 calAD 840 (1.1%) 860 calAD
4	Krzczonowice 3/2.35-2.40	GdS-625	1720 ± 75	235 (68.2%) 410 calAD	125 (90.8%) 445 calAD 450 (0.5%) 465 calAD 480 (4.1%) 535 calAD
5	Krzczonowice 3/2.85-2.90	GdS-626	2215 ± 80	385 (68.2%) 200 calBC	405 (95.4%) 50 calBC

Source: Autor's compilation
Źródło: Opracowanie własne

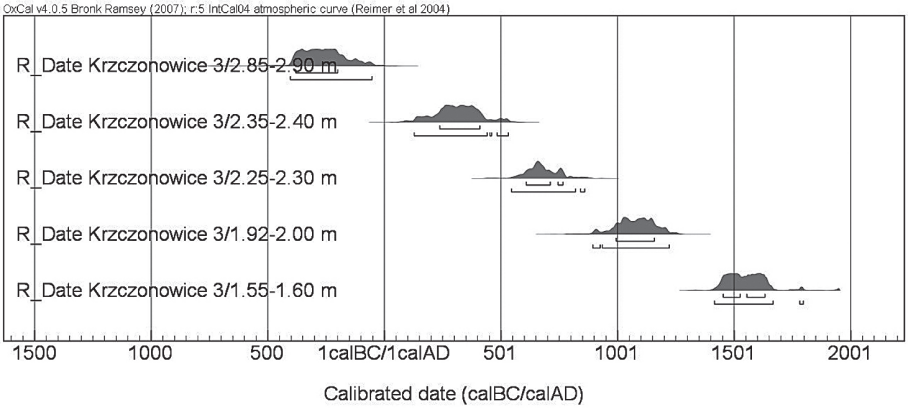

Fig. 3. Comprehensive list of time intervals of calibrated radiocarbon dates
Source: Calibrated curve IntCal04 (Reimer et al. 2004). Programme used for calculations: OxCal v4.0.5 (Bronk Ramsey 2007)
Ryc. 3. Sumaryczne zestawienie przedziałów czasowych skalibrowanych dat radiowęglowych
Źródło: Krzywa kalibracyjna IntCal04 (Reimer i in. 2004). Program wykorzystany do obliczeń: OxCal v4.0.5 (Bronk Ramsey 2007)

According to the palynological analyses carried out in the investigated core, most of samples were characterized by a very low frequency of pollen – several grains in a slide, where the most frequent taxons were: *Pinus*, *Cyperaceae* and *Polypodiaceae*. Only samples taken from the depth 140–145 cm and 155–160 cm (360 ± 80 BP) as well as 210–220 cm and 225–230 cm (1360 ± 70 BP) have high-

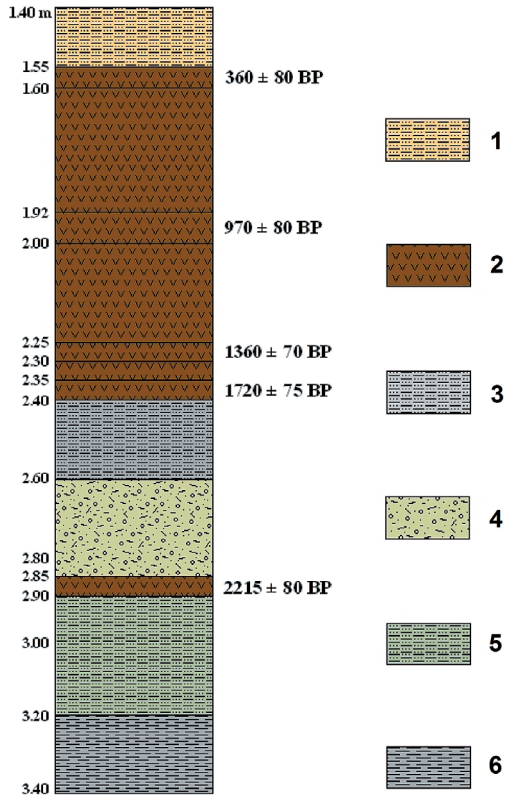

Fig. 4. Lithology of radiocarbon dated core (K3) in Krzczonowice (own elaboration)

Legend: 1 – mineral-organic silt, 2 – sedge peat, 3 – sandy silt, 4 – detritus gyttja with scarce malacofauna, 5 – mineral-organic silt, 6 – organic silt

Ryc. 4. Litologia datowanego radiowęglowo rdzenia (K3) w Krzczonowicach (opracowanie własne)

Legenda: 1 – namuł mineralno-organiczny, 2 – torf turzycowy, 3 – ił piaszczysty, 4 – gytia grubodetrytusowa z nieliczną malakofauną, 5 – namuł organiczno-mineralny, 6 – ił organiczny

er pollen frequency, which allows to apply the statistic method. Those samples (depth 210–230 cm) are characterized by the presence of pollen *Carpinus*, *Fagus* and *Abies* taxons, which migrate and spread throughout Poland in the Youngest Holocene (Ralska-Jasiewiczowa 2004). The presence of the *Abies* pollen may indicate that the above mentioned layer was accumulated in the Subatlantic period. In spectra, *Pinus* pollen dominate whereas the pollen of *Ulmus* and *Tilia*, the taxons disappearing in the Young Holocene period, are scarce.

In the layer from 140–160 cm, especially in a sample taken from 150–160 cm depth, apart from the above-mentioned taxons, quite a large number of cereal pollen grains occur (wheat and rye), which clearly indicates a period of intensive agriculture. These results correlate well with the radiocarbon date achieved for the investigated horizon.

Lack of eo-mesoholocene sediments in the examined core in spite of archeologically proved Neolithic and pre-Neolithic phases of settlement in the neighbourhood of the Obręczówka river valley next to Krzczonowice village prevents complete paleogeographic interpretation of the investigated terrain in the Early Holocene.

DISCUSSION

In the case of the Obręczówka river valley, the sedimentary record, achieved radiocarbon dates of peat, palinological analysis as well as archeological excavations (Podkowińska 1961; Żaki 1972; Bąbel 1975; Kowalski 1975; Uzarowiczowa 1975; Uzarowicz-Chmielewska 1979; Bąbel 1998; Balcer 2002; Orzechowski 2007; Jedynak, Kaptur 2008; Kaptur 2010; Przeździecki et al. 2011; Orzechowski 2013; Kaptur 2014), confirm the above-mentioned thesis and indicate the importance of human activity in the rural landscape and soil cover evolution of the Sandomierz Upland.

Date GdS-626 2215 ± 80 BP represents the La Téne period. The occurrence of slightly sandy organic-mineral silt with numerous malacofauna below the dated peat horizon indicates the temporal restarting of erosional processes in the investigated valley in the La Téne period. The settlement of the Lusatian culture tribes was responsible for deforestation, which caused changes to the natural landscape of the Sandomierz Upland (soil erosion, slope run-off) (Żaki 1972). The late phase of the La Téne, together with the Roman period (IV–V CE), triggered economic activity within the investigated area, which was reflected in archaeological and paleobotanical material (Szczepanek 1961). Date GdS-625 1720 ± 75 BP indicates the Przeworsk culture period. Between these two dated peat horizons, above thick detritus gyttja with scarce malacofauna, 20 cm insert of slightly sandy silt occurs, which means, that after relative stabilization of the loess landscape, as a result of intensive deforestation of the investigated area by the Przeworsk culture in the Roman period, strong (intensive) denudation processes occurred, which caused delivery of mineral material to the bottom of the valleys.

The third radiocarbon date obtained for the core in Krzczonowice is GdS-624 1360 ± 70 BP. Lack of mineral horizons during permanent peat deposition from the Roman period indicates the stabilization of the rural landscape in the Migration and in the early Piast's periods. In the bigger valleys of the Holy Cross region, as an effect of forests clearing started in the 6th–7th century, the areas located close to the valleys were cultivated, which accelerated the accumulation of sandy–alluvial floodplain terraces sediments during flood periods (Lindner 1977).

Apart from that, in the Early Middle Ages, serious changes of the loess landscape in the Krzczonowice core were not recorded. Date GdS-623 970 ± 80 BP confirms the continuity of deposition of biogenic sediments in the Obręczówka river valley in the Medieval Climatic Optimum. From the 10th century onwards, anecumenas became smaller and forms of farming underwent diversification (Żaki 1972). At this time agricultural activity was resumed within the upland loess areas. Krzczonowice (Cristonovici) founded in 1191 belongs to the oldest settlements of the Sandomierz Upland.

Another human activity within the loess patch was observed at the turn of the 13th and 14th centuries (Jersak, Śnieszko 1983). In the 13th–15th century, the Holy Cross region underwent a sudden process of parish network development of the Catholic Church (Olszewski 2001). During Holocene, in the 15th century, very fast and abundant loess diluvium accumulation connected with agriculture development began on the bottoms of stabilized valleys within the Sandomierz Upland. The roof of the peats filling up the bottom of the Obręczówka valley in the Krzczonowice surroundings was dated GdS-622 360 ± 80 BP. Above the peat roof mineral-organic silt occurs, grey-brown, clayey in the roof, gradually changing into the youngest Holocene silty-clayey deluvial deposits. This date precisely indicates the beginning of incessant intensive denudation of the soil cover of the Sandomierz Upland, reflected in the form of 1.5 m layer of deluvial deposits filling up the bottom of the Obręczówka valley and its tributaries. Radiocarbon dates of peat confirm palynological analyses. In the radiocarbon dated layer, especially from the depth of 150–160 cm, numerous pollens of cereals occur (wheat and rye), which indicates the period connected with intensive farming. Within the Sandomierz Upland area, on the bottom of the stabilized valleys, very fast and abundant accumulation of loess diluvium connected with farming development started during Holocene in the 15th century (also proved by Kosmowska-Suffczyńska [1983]). Also in the Świślina valley, at the depth of 5 m from the roof of floodplain terrace, slag and pieces of iron occur, which Klatka (1958) connects with medieval metallurgy. It means, that at least 5 m layer of sediments was created over a few hundred years. According to Klatka, favourable period for formation of this sediments was the time interval between the 14th and 17th century, and the estimated rate of accumulation of flood sediments is 1 m per one hundred years. According to Śnieszko (1995), the rate is very probable because geomorphological conditions in the Świślina river catchment favour loess denudation. In the Świślina river valley, above sediments connected with ancient metallurgy, there is a 5 m series of silts accumulated in the 19th century, connected with non-existing water dam in Nietulisko Fabryczne (Klatka 1958), which indicates strong denudation processes during that period. As it was mentioned before, the increase in the intensity of morphogenetic processes from the 15th to the turn of the 18th and 19th centuries was connected mainly with climate moistening and cooling in the Little Ice Age period (1400–1857) (Starkel 1994; Klimek et al. 2006).

Due to the significant hiatus in the examined core, in spite of the presence, in the Obręczówka valley and the adjacent terrain, of numerous documented archaeological sites chronologically including the period from the Paleolithic to historical times, the impact of pre-Neolithic and Neolithic settlement on the loess cover was not proved.

Similarly to the case of the Obręczówka river valley, also in the bottom of the Opatówka river valley in Wilczyce, situated about 18 km in a straight line

from Krzczonowice, silty and silty-clayey alluvium was substantiated, lying on moderate and non-decomposed peat and silty peat. The alluvium is intersected by thin layers of fine-grained sand, gradually changing into silt sediments. In the bottom of the valley a series of alternating sands and silt layers occurs (Bałaga et al. 2008). Radiocarbon dates (from 2445 ± 95 BP to 230 ± 85 BP) and pollen spectra indicate the late-Holocene age of these sediments. According to the authors, in the Early Holocene, strong erosion occurred, which caused the removal of almost all late Vistulian alluvium/sediments. On account of close neighbourhood of Opatówka and Obęczówka river valleys and good agreement of achieved dates, erosion must have comprised also the investigated area resulted in lack of Neolithic and pre-Neolithic/ eo-mesoholocene sediments. According to Żurek (2002), this sedimentological break in eo- and mezoholocene is not clear and requires further investigations. Szczepanek (2001) connects sedimentological gap in sedimentation, lasting from the beginning of Holocene to the youngest part of the Subboreal, with climate and hydrological changes occurring in this period within the Holy Cross region, at the same time taking into consideration the need for further research.

CONCLUSIONS

1. Received radiocarbon dates (from 2215 ± 80 BP to 360 ± 80 BP) are comprised within and confirm the Middle and the Younger Neoholocene stage of anthropogenic denudation of the loess cover of the Sandomierz Upland.
2. It was stated, that the settlement of the Przeworsk Culture, as well as that of historical times, were, to a large extent, responsible for changes of the natural geographical environment of the investigated fragment of the loess patch.
3. On account of considerable hiatus existing in the investigated core in the Krzczonowice surroundings, the influence of the Neolithic and earliest settlement on the loess cover evolution was not proved. It shows the necessity of further paleogeographic research preceded by terrain reconnaissance.

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STRESZCZENIE

Doliny rzek Obręczówki i Przepaści wchodzące w skład zlewni rzeki Kamiennej od dawna są obiektami licznych, długotrwałych wykopalisk archeologicznych. Rozwój osadnictwa w obrębie badanego terenu, trwający z przerwami od paleolitu, wpłynął na występowanie licznych, zróżnicowanych kulturowo, stanowisk archeologicznych. Stały się one podstawą, obok analizy mineralno-organicznego wypełnienia dna doliny Obręczówki, rekonstrukcji faz osadniczych północnego skłonu opatowskiego płata lessowego. Analizie palinologicznej i datowaniom radiowęglowym poddano próbki torfu pobrane z rdzenia Krzczonowice (K3) zlokalizowanego na tzw. Zaolziu. Zapis litologiczny oraz uzyskane daty radiowęglowe (od 2215 ± 80 BP do 360 ± 80 BP) obejmują oraz dokumentują środkowy i młodszy neoholoceński etap denudacji antropogenicznej opatowskiej wyżyny lessowej. Stwierdzono, iż rozwijające się w okresie rzymskim osadnictwo kultury przeworskiej oraz osadnictwo w czasach historycznych w największym stopniu przyczyniły się do pedologiczno-geomorfologicznych oraz krajobrazowych przemian obszarów lessowych tego terenu. Intensywnej działalności człowieka towarzyszyły fluktuacje klimatyczne intensyfikujące tempo denudacji pokrywy lessowej. Ze względu na znaczny hiatus istniejący w badanym rdzeniu wpływ osadnictwa przedneolitycznego oraz neolitycznego na pokrywę lessową nie został udokumentowany.

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