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OGÓLNA CHARAKTERYSTYKA STANOWISKA KOŹMIN LAS

ZARYS TREŚCI

Stanowisko Koźmin Las zlokalizowane jest na obszarze dobrze rozpoznanym w trakcie studiów geologicznych i geomorfologicznych prowadzonych przez badaczy z ośrodka łódzkiego od lat 90. ub. wieku w odkrywkach węgla brunatnego Kopalni Węgla Brunatnego „Adamów”. Od 2010 roku realizowane były tutaj wielowskaźnikowe badania nad znaleziskiem kopalnego lasu ze schyłku późnego vistulianu. Pozostałość *in situ* bardzo dobrze zachowanych szczątków drzew z tego okresu jest rzadkością w skali europejskiej. Uzyskane wyniki stały się podstawą wniosków paleośrodowiskowych i paleogeograficznych.

Słowa kluczowe: Kotlina Kolska, dolina środkowej Warty, badania interdyscyplinarne, subfosylny las

CHARACTERISTICS OF THE KOŹMIN LAS SITE

SUMMARY

Abstract. Koźmin Las site is located in the well recognized area during the geological and geomorphological studies conducted since 90s of the last century in the outcrops of the Adamów JSC Lignite Mine in Central Poland. Since 2010 have been undertaken multiproxy investigations on the sediments with relicts of former riparian forest dated back at the Vistulian Lateglacial. Well-preserved tree trunks and *in situ* stamps from this period are rare on a European scale. Obtained results were the basis of palaeoenvironmental and palaeogeographical conclusions.

Key words: Koło Basin, middle Warta River valley, multidisciplinary investigations, subfossil forest

The Koźmin Las site ($\varphi = 52^{\circ} 04' 52''$ N, $\lambda = 18^{\circ} 40' 03''$ E; 97.5 a.s.l.) is situated in Central Poland, in the Koło Basin mezoregion. The last ice sheet cover was present there during the Odranian Glaciation, Warta Stage. The area is located in the middle section of the Warta River valley, within the geological unit, the so-called Uniejów Basin – the area, which is characterized by a tendency to subsidence determining the specificity of the morphological characteristics of the valley, expressed with its extension and the domination of the youngest surface. Monotonous valley surface is varied with river terraces, dry channels cut in the low terrace and Lateglacial and Holocene dunes. The Koźmin site lies on the low terrace (Fig. 1).

Previous studies in the Uniejów Basin were carried out by geomorphologists and geologists from the Łódź University since the 90ties of the XXth century and concerned lithostratigraphy of till horizons, fluvial problems and periglacial environment. Organic unit lying 2-3 m b.g.l., whose age was set at the Alleröd and Younger Dryas, became a subject of interest after finding within it a *in situ* tree trunk (Photo 1).

Assemblages of tree remains, including trunks, stumps, branches and roots were excavated in an open test peat of about 6x20 m (Fig. 2), with use of archaeological approach. The objectives of the studies at the Koźmin Las site were (1) to determine the conditions for the development and functioning of the riparian forest in the Warta valley, with particular emphasis on palaeoclimate, palaeohydrological relations in the valley, and paleoecology of the forest, (2) to identify the causes, conditions and consequences and the rate at which the destruction of the forest formations occurred. Also other problems were studied, such as chronology of sediments, Younger Dryas floods, palaeo-pedological problems, adaptation of the Late Palaeolithic hunters to changing environmental conditions.

The main content of this volume is a presentation of the results achieved on the basis of multidisciplinary studies and their palaeo-geographical interpretation. Although the results contained are not complete, the editors hope to succeed in attempts to demonstrate the contribution of the conducted investigations to the knowledge on the Lateglacial environment at the over-regional scale.

LITOLOGICZNA CHARAKTERYSTYKA OSADÓW W STANOWISKU KOŹMIN LAS I ICH INTERPRETACJA PALEOGEOGRAFICZNA

ZARYS TREŚCI

W artykule omówiono cechy osadów odsłoniętych w stanowisku Koźmin Las i w stropie odkrywek kopalnianych KWB Adamów położonych w dolinie Warty w pobliżu centrum Kotliny Kolskiej. Osady podzielono na trzy ogniwa wydzielając w ten sposób: utwory rzeki roztokowej (ogniwo dolne – „a”), organiczne i mineralno-organiczne osady facji pozakorytowej rzeki jednokorytowej, najprawdopodobniej meandrującej (ogniwo środkowe – „b”) oraz aluwia wielokorytowej rzeki *ana-branching* typu 2 (ogniwo górne – „c”). Ponadto omówiono litologiczną charakterystykę utworów poszczególnych ogniw, na którą składała się analiza strukturalna i teksturalna oraz wyniki badań koncentracji węgla organicznego, zawartości CaCO₃, odczynu oraz udziału krzemionki bio- i terygeniczej w materii mineralnej. Osady poszczególnych ogniw przyporządkowano facjom utworów rzecznych. Na podstawie datowań ¹⁴C oraz OSL określono czas ich powstawania. Szczególną uwagę zwrócono na organiczne i mineralno-organiczne osady ogniwa środkowego („c”), zawierające świadectwa funkcjonowania formacji leśnej na dnie doliny Warty w późnym vistulianie. Osady zinterpretowano w kontekście przemian typu rozwinięcia koryta Warty w górnym plenivistulianie i późnym vistulianie po początki holocenu.

Słowa kluczowe: dolina rzeczna, aluwia, osady korytowe, osady pozakorytowe, późny vistulian, Polska Środkowa

LITHOLOGICAL CHARACTERISTICS OF DEPOSITS OF THE SITE KOŹMIN LAS AND THEIR PALAEOGEOGRAPHICAL INTERPRETATION

SUMMARY

Abstract. The article presents the location, history of research and methods used to study the deposits of the Koźmin Las profile from the Warta River valley, Koło Basin. The depositional sequence at the site was grouped into three lithological units, and thus were distinguished: a braided river alluvium (lower unit – „a”), organic and mineral-organic deposits of a meandering river (middle unit – „b”) and alluvia of a multichannel river (upper unit – „c”). Lithological characteristics of the units comprises structural and textural description and geochemical analysis, i.e. organic matter concentration, content of calcium carbonate, content of terrigenous and biogenic silica in the deposit. Deposits forming the individual units have been assigned to different alluvial environments. Chronological framework was established on the basis of radiocarbon and OSL dating. Particular attention was paid to the organic and mineral-organic material of the middle unit („b”), with remains of the trees which evidence the existence of riparian forest in the Late Vistulian. These deposits were interpreted in relations to the changes of the Warta River channel pattern in the Upper Plenivistulian and Late Vistulian time until the Holocene beginning.

Key words: river valley, alluvia, channel deposits, overbank deposits, Late Vistulian, Central Poland

The profile Koźmin Las (Koło Basin, Central Poland) exposes a tripartite sequence of floodplain deposits of the Warta River, accumulated from the Plenivistulian decline, through the Late Vistulian until the beginning of the Holocene. Based on lithological properties, the studied deposits were divided into three lithological units, termed: lower („a”), middle („b”) and upper („c”). They were studied with methods used in the Quaternary geology, such as sedimentological analysis according to Miall (1985) with some modifications by Zieliński (1998), grain-size composition, organic matter concentration, calcium carbonate content, terrigenous and biogenic silica content in the deposit.

Sands of the lower unit („a”) have been attributed to a periglacial environment of a sand-bed braided river system, developed in the Koło Basin in the Plenivistulian and the early Late Vistulian (up to the Alleröd).

Organic and organic-mineral deposits of the middle unit („b”) contain the main assemblage of organic detritus (339 objects of subfossil tree remains registered). These large woody debris are relicts of former dense pine forest which grew in the floodplain of the Warta River in the Late Vistulian (the late Alleröd – early Younger Dryas timespan). Palaeoenvironmental changes at the site was provided from a range of proxy biological indicators. Wood pieces and organic material were radiocarbon-dated. The unit deposits are thought to represent the floodplain zone of a meandering river. The base of the unit could have been deposited in the distal floodplain, where the pine forest developed. Due to climatic, hydrological, hydrogeological changes, and probably a reactivation of insular permafrost (or at least deep seasonal freezing of the ground) in the Younger Dryas, water-logging of the forest ecosystem led to the formation of extensive but shallow water pool. These events contributed to the forest destruction in the very short time. The remains are well preserved in mineral-organic material of the middle unit, deposited in the proximal floodplain of a meandering river.

Remains of the subfossil forest are covered by 2 m thick sandy and sandy-silty deposits of the upper unit („c”). This material has been linked to a overbank deposition of a multichannel river (anabranching type 2) palaeoenvironment. The deposition dates at the Younger Dryas, with possible continuation in the early Preboreal period. This alluvial unit was formed during rapid fast successive floods throughout the area of several tens of square kilometres. Environmental changes in the Warta River valley at the end of the Vistulian late glacial and the Pleistocene – Holocene boundary were very dynamic, and their spatial extent and scale is not repeated during the entire Holocene.

UWARUNKOWANIA ROZPRZESTRZENIENIA I WŁAŚCIWOŚCI SERII ORGANICZNEJ ZAWIERAJĄCEJ SZCZĄTKI LASU Z MŁODSZEGO DRYASU W KOTLINIE KOLSKIEJ

ZARYS TREŚCI

Artykuł dotyczy zasięgu serii organicznej stanowiącej element budowy geologicznej terasy niskiej doliny Warty. Istotną cechą serii organicznej jest obecność szczątków lasu datowanego na młodszy dryas. Celem badań było stwierdzenie czy obserwowana dotychczas znaczna ciągłość i duże rozprzestrzenienie serii w odkrywkach KWB „Adamów” stanowią regułę. Wykazano, że analizowana seria zajmowała pierwotnie obszar o powierzchni przynajmniej 18 km² oraz potwierdzono przyjmowane wcześniej założenie, że teren występowania serii organicznej pokrywa się z wydzieloną morfologicznie terasą niską doliny Warty. Kolejny aspekt badań odnosił się do cech serii organicznej takich jak np. jej miąższość oraz sposób wykształcenia. Określenie parametrów hipsometrycznych stropu serii pozwoliło na obliczenie spadku jej powierzchni oraz porównanie ze spadkami współczesnych elementów morfologicznych doliny Warty. Wskazano przyczyny miejscowej utraty ciągłości serii i powiązano je z funkcjonowaniem systemu wielokorytowego w dolinie Warty u schyłku późnego vistulianu. Przeprowadzone badania pozwalają sądzić, że seria organiczna była rozprzestrzeniona w obrębie niemal całego dna doliny Warty w młodszym dryasie, kiedy to osiągnęła największy zasięg. Holocenijskie procesy erozyjne doprowadziły do uprzątnięcia serii w osi doliny. Istotnym czynnikiem wpływającym na obecny, nieciągły charakter serii w obszarze badań są także prace górnicze.

Słowa kluczowe: osady organiczne, system wielokorytowy, młodszy dryas, dolina Warty

DETERMINANTS OF SPREAD AND PROPERTIES OF THE ORGANIC SERIES CONTAINING REMAINS OF THE YOUNGER DRYAS FOREST

SUMMARY

Abstract. The study concerns the extent of the organic series, which is characteristic element of geology of the Warta valley low terrace. The series contains trees remnants of the Younger Dryas forest. The purpose of the study was to establish if the continuity and significant extent of the series observed previously in the walls of the open pits of the “Adamów” Lignite Mine is the rule. Results of investigations indicate that organic series has covered the area at least of 18 km² and have confirmed the thesis that the occurrence of the series coincides with the low terrace of the Warta valley. The properties of the organic series as thickness and texture were recognized. On the base of the altitude of the top of the series, the gradient of the top was counted and compared with gradients of present morphological elements of the valley. The causes of local breaks in continuity of the series were identified and connected with the functioning of the multichannel system in the Warta River valley at the end of the Late Vistulian. The study results suggest that the organic series was spread almost within the entire valley bottom during the Younger Dryas, when it reached the greatest extent. The erosion during the Holocene led to removal of the series from the axis of the valley. The anthropopressure is an important factor which causes discontinuity of the series in the study area.

Key words: organic deposits, multichannel system, Younger Dryas, Warta River valley

Distinctive element in geology of the low terrace of the Warta River valley within Uniejów Basin is continuity and extension of the organic series. This feature, despite of its small thickness, makes it important in palaeogeography of the valley. The palaeogeographical significance of the series is highlighted by the presence of numerous remains of trees, including stamps *in situ*, originating during the Younger Dryas.

During investigations carried out in open pits of the “Adamów” Lignite Mine since 1995, organic series, which occurs about 2–3 m below surface has been observed (Figs 1, 2). The aim of the studies

was to establish the original extent of the organic series and to complement the information collected in open pits.

More than hundred drillings performed in the left side of the Warta River valley allowed to broaden the knowledge on characteristics of the organic series. In drillings the series was represented by black silt with admixture of organic plant remains or highly decomposed black peat with pieces of wood. The thickness of these deposits ranges from 15 to 50 cm. The base of the series lies on altitude of 93,2 m a.s.l. in the north part of study area and on altitude of 95,8 m a.s.l. on the south. The altitude of the top, ranges respectively, from 94,5 to 96,5 m a.s.l. Calculated gradient of the top of the series (0,37‰) appeared higher than the gradient of the low terrace (0,26‰) and slightly higher than present-day valley floor gradient (0,37‰) (Fig. 7).

In places, the studied series is cut by channels of the anabranching river system (Fig. 3), which developed in the end of the Younger Dryas. Results of investigations allow to claim that organic series has been extended in the entire valley floor during the Younger Dryas (Fig. 6). During the Holocene, in the middle part of the valley, organic series was completely eroded in a wide zone. In the study area an important factor, which influenced on observed present-day discontinuous character of the series, is anthropopressure pronounced by open pit exploitation of lignite. The extent of the series in the south and north is limited by the boundary of the study area, but most probably the series occur in a wider area.

ROZWÓJ ROŚLINNOŚCI W PÓŻNYM VISTULIANIE ORAZ FUNKCJONOWANIE I ZANIK EKOSYSTEMU LEŚNEGO W STANOWISKU KOŹMIN LAS

ZARYS TREŚCI

Artykuł prezentuje wyniki badań palinologicznych i makroszczątków roślin ze stanowiska Koźmin Las, na którym udokumentowano późnovistuliańskie osady, reprezentowane przez torfy i mułki organiczne oraz pozostałości lasu w postaci fragmentów pni w pozycji *in situ*. Badaniami paleobotanicznymi objęto dwa profile osadów – KL 1 i KL 2, przy czym analizę makroszczątków roślin wykonano tylko dla profilu KL 1. Wyróżniono kilka etapów rozwoju zagłębienia. Początkowo, w okresie allerödu deponowane były osady piaszczyste, zawierające pyłek głównie sosny i brzozy. Spadek udziału pyłku brzozy i wzrost krzywych turzycowatych i traw, a co za tym idzie większy udział w krajobrazie zbiorowisk nieleśnych wyznacza granicę z młodszym dryasem. Około $10\ 710 \pm 60$ BP / 12 744 – 12 547 cal BP nastąpił rozwój torfowiska niskiego. W wyniku podniesienia się poziomu wody i dostawy materiału terygenicznego do powstałego rozlewiska, rozwój torfowiska zakończył się. Miało to miejsce około $10\ 430 \pm 80$ BP / 12 566 – 12 067 cal BP.

Słowa kluczowe: późny vistulian, dolina Warty, historia roślinności, zmiany klimatu, palinologia, analiza makroszczątków roślin

VEGETATION DEVELOPMENT IN THE LATE VISTULIAN AND FUNCTIONING AND END OF THE FOREST ECOSYSTEM IN KOŹMIN LAS SITE

SUMMARY

Abstract. The paper presents the results of studies of pollen and plant macroremains from the site of Koźmin Las, in which remnants of a forest, observed as fragmentary *in situ* tree trunks, and Late Vistulian sediments, represented by peats and organic silts, were preserved. Palaeobotanical analyses were performed for two sediment sections, KL 1 and KL 2, however plant macrofossils were examined only in section KL 1. Several stages were distinguished in the development of the depression. Initially, in the Alleröd, the deposited sandy sediments were dominated by pine and birch pollen. Decrease in birch pollen values and the accompanying increase in curves of sedges and grasses, indicating greater proportion of non-forest communities in landscape, evidence the boundary with Younger Dryas, ca. $10\ 710 \pm 60$ BP/ 12 744–12 547 cal BP, being the time of functioning of a low peat bog. Its development ended, due to rising water level and supply of terrigenous material to the overflow area, at ca. $10\ 430 \pm 80$ BP / 12 566–12 067 cal BP.

Key words: Late Vistulian, Warta River valley, history of vegetation, climatic changes, palynology, plant macrofossil analysis

The site of Koźmin Las, including remnants of a forest, preserved as fragmentary *in situ* tree trunks, and Late Vistulian sediments, represented by peats and organic silts, was subjected to palaeobotanical studies. Palynological analysis was carried out for two sediment sections, KL 1 and KL 2, while plant macrofossils were examined only in section KL 1.

Palaeobotanical studies provided basis for identifying subsequent stages in the development of the small Koźmin Las depression. Sandy sediments deposited in the first phase, falling within the Alleröd, comprise mainly pine and birch pollen. However, in the upper part of section, frequency of birch pollen decreases as it is replaced by increasing amounts of sedges and grasses, what is likely to suggest greater proportion of non-forest communities in landscape. Occasionally found pollen grains of aquatic plants evidence periodic flooding in the area. The next stage, covering the time of ca $10\ 710 \pm 60$ BP/ 12 744–12 547 cal BP (95.4%) and the development of peat bog, is typified by rising pollen curves of Cyperaceae and occurrence of macroremains of various sedge species, *Menyanthes trifoliata*, *Co-*

marum palustre and *Viola palustris*. Pine and birch were also found in the peat bog. The subsequent stage is recorded in sandy and sandy-silty sediments including only sparse, most likely rebedded, plant macroremains and pollen grains of trees with higher temperature requirements. At ca 10 430 ± 80 BP / 12 566–12 067 cal BP (95.4%), the peat bog ended its functioning, due to rising water level and supply of terrigenous material to the shallow overflow area, while the local forest community begun to decrease its area. It cannot be excluded that the forest may have been destroyed in a sudden event. The season in which the trees are flooded and duration of time for which water retains at a high level are of key importance. If flood occurs in winter or early spring and water level falls before the trees enter their vegetation period, flooding should not cause much damage. Most species tolerate such conditions for up to 4 months, however beyond their vegetation season. If flood affects the trees during this season, particularly typified by warm weather, weakening or even death of trees is likely to be observed within one or two weeks. The most resistant species may survive for maximally 3–5 months (Kozłowski 1997; Rouvinen 2002; Baughman 2010).

WARUNKI EKOLOGICZNE ROZWOJU PÓŻNOVISTULIAŃSKIEGO ZBIORNIKA KOŹMIN LAS W ŚWIETLE ANALIZY CLADOCERA

ZARYS TREŚCI

Rezultaty analizy subfosylnych szczątków wioślarek (Cladocera) z profilu osadów organicznych stanowiska Koźmin Las (dolina Warty, Polska Środkowa) pozwoliły przedstawić rekonstrukcję rozwoju opisywanego zbiornika i odnieść je do aktywności fluwialnej Warty, szczególnie w okresie młodszego dryasu, pomiędzy 12 900 i 11 600 cal BP. Wyróżniono dwie fazy rozwoju zbiornika. Stwierdzono, że był to płytki zbiornik, o niestabilnych warunkach hydrologicznych. Prawdopodobną przyczyną fluktuacji był zmienny poziom wód gruntowych, powierzchniowych i rzecznych w dolinie Warty. Zmiany we frekwencji Cladocera skorelowano z aktywnością fluwialną rzeki oraz, w szerszym ujęciu, z warunkami klimatycznymi panującymi w młodszym dryasie.

Słowa kluczowe: dolina Warty, subfosylne szczątki Cladocera, młodszy dryas, aktywność fluwialna, powódzie, klimat

ECOLOGICAL CONDITIONS OF THE SMALL LATE VISTULIAN POND OF KOŹMIN LAS SITE IN THE LIGHT OF CLADOCERA ANALYSIS

SUMMARY

Abstract. The sediments from small pond infillings located in the Warta River valley in central Poland was studied by Cladocera analysis in order to examine the response of aquatic ecosystems to environmental changes in the Younger Dryas. Lithological and geochemical records were also used to reconstruct fluvial activity of the Warta River. In the Koźmin Las site development, between ca. 12.900 and 11.600 cal BP, prevailed variable hydrological conditions. Cladocera analysis indicates the presence of shallow pool and partly telmatic conditions. The local processes, such as the influence of the Warta River, habitat modification, macrophyte presence, and eutrophication, were important, but these forces were not only major factors that affect the biota diversity in the Younger Dryas. The observation of changes in the composition and concentration of aquatic communities in the studied pool indicates that the changes also occurred in response to climate changes.

Key words: Warta River valley, subfossil Cladocera, Younger Dryas, fluvial activity, floods, climate

The development of the Koźmin Las pond, which is located in the Warta River valley, started at the end Alleröd and continued into the beginning of the Holocene. The species composition and frequency of Cladocera were the basis for the reconstruction of the Koźmin Las site development. Two phases of the Cladocera development were distinguished. The dominance of littoral forms, including the taxa associated with macrophytes and sediment, showed on the presence of a shallow pool, or on the littoral zone of the reservoir of stagnant water. The main period of this site development occurred in the Younger Dryas. During this period, apparently influence of local conditions, especially floods, on the development of biota in the pool were marked. Despite the fact, that the floods are not directly shown in the record of Cladocera, temporary presence of pelagic species, and those which prefer more fertile waters, may be associated with an increase in the water level in the pool due to a general increase of groundwater in the Warta valley as a result of flood episodes. These changes are particularly evident ca.12,700–12,550 cal BP and ca. 12,550–12,050 cal BP. It is possible that climate conditions had also a partial impact on an increase of aquatic fauna biodiversity – changes in cladoceran communities occurred in the unstable temperature conditions prevailing in the Younger Dryas.

SKŁAD CHEMICZNY OSADÓW ORGANICZNYCH ZE STANOWISKA KOŹMIN LAS

ZARYS TREŚCI

W oparciu o wyniki składu chemicznego osadów organicznych w stanowisku Koźmin Las, przedstawiono rekonstrukcję warunków środowiskowych doliny Warty pod koniec allerrödu i w młodszym dryasie. Do rekonstrukcji wykorzystano dane dotyczące zawartości materii organicznej, materii mineralnej, węglanu wapnia, odczynu oraz koncentracji makro- (Na, K, Mg, Ca, Fe, Mn) i mikropierwiastków (Cu, Zn i Pb). Do czynników kształtujących skład chemiczny późnovistuliańskich osadów organicznych w dolinie Warty zaliczono sorpcję metali przez materię organiczną i uwodnione tlenki żelaza, zmienność akumulacji minerałów ilastych w środowisku sedymentacyjnym, sposób zasilania ekosystemu oraz właściwości akumulacyjne roślin w stosunku do określonych pierwiastków.

Słowa kluczowe: osady organiczne, dolina rzeczna, geochemia, Polska Środkowa

CHEMICAL COMPOSITION OF ORGANIC SEDIMENTS FROM THE SITE KOŹMIN LAS

SUMMARY

Abstract. The chemical composition of organic deposits from the site Koźmin Las are the basis of reconstruction of environment conditions of the Warta River valley at the end of the Alleröd and in the Younger Dryas. Environmental archives presented in this study, comprise organic matter content, mineral matter content, calcium carbonate content, reaction and macro- (Na, K, Mg, Ca, Fe, Mn) and microelements (Cu, Zn and Pb). The sorption of metals by organic matter and hydrated iron oxides, clay minerals accumulation variability in depositional environment, water relations of the ecosystem and bioaccumulation of some elements are the factors determining the chemical composition of organic sediments in the Warta river valley.

Key words: organic sediments, river valley, geochemistry, central Poland

In order to reconstruct the main stages of sedimentation of organic deposits, taken from the outcrops of the Adamów Lignite Mine, used stratigraphic variability of concentration marked lithochemistry elements (organic matter, mineral matter, bio and terrigenous silica, calcium carbonate, macro- and microelements) and changes in the proportions of the participation of selected elements, i.e., catchment erosion indicator, eutrophication indicator, type and rate of denudation in the catchment indicator and conditions of oxidation-reduction indicator.

As a results of the hierarchical cluster analysis was collected in the study profile of three geochemical level (KL I, KL II, KL III), which differ significantly of chemical composition. The main lithochemistry component of studied sediment is terrigenous silica (60,8-98,5%), which the share of results of surface water supply ecosystem from the turn of Alleröd and Younger Dryas. High values of the coefficient of variation for almost all geochemical features, constitute a record high growth of environment al conditions (mainly hydrological and geomorphological), which prevailing in the initially and finally phase of sedimentation studied organic deposits (geochemical levels: KL I and KL II). Sediments of geochemical level KL I are characterized by dark color, high degree of decomposition of organic matter, high content of mineral matter, slightly acidic, higher rates of mechanical denudation and erosion rate of the catchment. Their sedimentation took place both in stagnant waters, as well as during periodic floods.

The most important factors that affect the chemical composition of sediments from the site Koźmin Las are: sorption of organic deposits, mechanical denudation processes and passive lithophilic elements supply and oxygenation changes in sedimentary environment, which are mainly due to the flooding of the Warta river valley. Rise of water level in the valley (the indicator oxidation-reduction conditions above 160) was probably one the main causes of Late Weichselan forest destruction.

Z BADAŃ NAD SCHYŁKOWO PALEOLITYCZNYM OSADNICTWEM W KOTLINIE KOLSKIEJ

ZARYS TREŚCI

Badania archeologiczne w Kotlinie Kolskiej mają długą, ponad 90-letnią tradycję. W tym czasie przebadano metodami archeologicznymi kilkanaście stanowisk ze schyłkowego paleolitu. Większość z nich pozostawiła ludność określana mianem kultury świderskiej. Odnotowano też pojedyncze zabytki krzemienne związane ze starszymi społecznościami – z kulturą hamburską oraz z tzw. tylczakami łukowymi. Powiązanie wyników badań archeologicznych z interdyscyplinarnymi studiami środowiskowymi, które są prowadzone od kilkunastu lat w Kotlinie Kolskiej, pozwoliło na bardziej precyzyjne osadzenie zabytków pozostawionych przez człowieka z końca paleolitu w czasie i przestrzeni. Kooperacja geografii i archeologii daje szansę na kolejne odkrycia stanowisk archeologicznych z paleolitu w tym rejonie.

Słowa kluczowe: schyłkowy paleolit, kultura świderska, ostrza trzoneczkowate, stanowisko Koźmin Las

FROM THE RESEARCH ON THE FINAL PALAEOLITHIC SETTLEMENT IN THE KOŁO BASIN

SUMMARY

Abstract. Archaeological research in Koło Basin has a long, over 90 years, history. During that time dozen of late Palaeolithic sites were discovered. Most of them are linked with Tanged point Complex which is also called Sviderian Culture. From other periods of the Late Weichselian there are just signals of possible presence of settlement of Hamburgian Culture and Federmessergruppe or Arch Back Pieces. Combination of interdisciplinary palaeoecological research at the Koźmin Las site and archaeological query helped with more accurate dating and locating of the Palaeolithic camps in the geomorphological landscape. Cooperation of geography and archaeology also gives chance for future discovery of unknown late Palaeolithic sites from that area.

Key words: Final Palaeolithic, Sviderian cCulture, tanged points, Koźmin Las site

Long history of archaeological research of late Palaeolithic communities in the Koło Basin shows that the most intensive character in the studied area has settlement of the Tanged point Complex, which is also called the Sviderian Culture. From other periods of the Late Weichselian there are just signals of possible presence of older late Palaeolithic population of Hamburgian Culture and Federmessergruppe or Arch Back Pieces. The article presents history of archaeological research, intensity of Sviderian Culture settlement on the background of other sites from Central Poland. These proof a highly mobile way of life and significance of human contacts in that period. Environmental information which are known from the studied terrain about Late Alleröd and Younger Dryas was obtained in 2010 and 2011 from an open test pit of the Koźmin Las site (Dzieduszyńska et al. 2011, 2014; Kittel et al. 2012) and from other studies conducted in the research area. The most important archaeological fact which is connected with discovery of Palaeolithic artefacts at Kuźnica Janiszewska 17 which is until now the closest locality for the bog and subfossil forest in Koźmin Las site. This find confirms that Swiderian hunters were exploring close surroundings of the terrain where pine forest grow during Late Alleröd and Younger Dryas. Generally, results of interdisciplinary palaeoecological research from Koźmin Las locality and archaeological query helped to recognize the Late Palaeolithic hunters behaviour, chronology and to determine a scale of impact of dynamic environment to the Palaeolithic man.

ZMIANY ŚRODOWISKA U SCHYŁKU VISTULIANU W POLSCE ŚRODKOWEJ W ŚWIETLE BADAŃ W STANOWISKU KOŹMIN LAS

ZARYS TREŚCI

Wielokierunkowe wyniki badań w stanowisku Koźmin Las przeanalizowano w aspekcie rozpoznania szybkich naturalnych zmian w geosystemach podczas późnego glacjału. Krótkie zdarzenia, zrekonstruowane na rozległym płaskim dnie doliny dużej nizinnej rzeki w staroglacjalnym obszarze Polski Środkowej, odniesiono do zjawisk o charakterze globalnym. Podkreślono cechy zgodne ze schematem wypracowanym na podstawie rdzeni grenlandzkich i stanowisk stratotypowych lądowego środowiska Polski Środkowej oraz specyfikę wynikającą z uwarunkowań lokalnych. Wskazano cechy osadów, których rozpoznanie poszerzyło wiedzę o ewolucji środowiska regionu łódzkiego i przyczyniło się do wzrostu znaczenia stanowiska.

Słowa kluczowe: alleröd / młodszy dryas, geoarchiwum, paleogeografia, subfossylny las, dolina Warty, region łódzki

ENVIRONMENTAL CHANGES AT THE VISTULIAN DECLINE IN CENTRAL POLAND AS SEEN FROM THE KOŹMIN LAS SITE

SUMMARY

Abstract. Multidisciplinary investigations carried out at Koźmin Las have been analysed in the aspect of recognition of fast natural climate changes in geosystems during the Vistulian Late Glacial. A series of short events, reconstructed for the extensive valley of a large lowland river in the old morainic area of Central Poland, has been related to global changes. Features in accordance with the scheme for Greenland ice core records and with the stratotypes of terrestrial palaeoenvironment of Central Poland have been highlighted. Properties of deposits which contributed to the knowledge of evolution of the Łódź Region have been pointed out.

Key words: Alleröd / Younger Dryas, geoarchive, palaeogeography, subfossil forest, Warta River valley, Łódź Region. A profile collected from the Koźmin Las reveals significant changes of the river valley environment during the Late Glacial decline. Geoarchive of past environmental changes consists in the site of rich-organic series with remains of in situ forest and overlying alluvial series. Organic material is devoid of advantages of precisely dated annually laminated sediments, however can be used to palaeoenvironmental and palaeoclimatological reconstructions, including spatial correlations with stratotypes from Greenland ice cores. Time resolution is here obtained by means of sampling compaction.

The objective of this paper is to discuss the significance of multiproxy investigations on the sediments in the context of the Late Glacial dynamic climatic events and to highlight the cognitive value of the conducted studies for palaeogeographical conclusions in the old morainic area of Central Poland.

The chronology of the reconstructed events is based on the radiocarbon dates, of both scintillation and AMS technique, obtained from the organic silts, macrofossils and wood pieces. According to results, the time frame covers the period from $10\,940 \pm 50$ BP to $9\,780 \pm 150$ BP (13 048 to 10 603 cal BP), thus the end of the Alleröd and the Younger Dryas. Alluvial series was dated by OSL. The results yielded for samples range from $12\,730 \pm 620$ BP to $14\,280 \pm 740$ BP and are overestimated in relations to the formation of the organic-rich series, which is probably a result of rapidity of events during the deposition and incomplete bleaching of the previously accumulated dose.

Based on the obtained data, the thesis about rapid environmental changes at the onset of the Younger Dryas cooling has been confirmed. As inferred from the results of the multiproxy investiga-

tions, a few stages of the development of the local depositional basin in the floodplain in the Warta River valley have been recognized. Until ca. 12 700–12 600 cal BP the deposition occurred in a very shallow periodic flow basin, which afterwards dried and was followed by the development of the soil horizon. At that time, between 12 800–12 600 cal BP, the floodplain was forested. The forest was destroyed by an increase in water level and probably was felled by strong winds in a very short time. Between 12 700 / 12 600 and 12 400 / 12 100 the floodplain was occupied by shallow water pool and first geological record of floods were registered. Since 12 100 cal BP onwards, increase of flooding took place, reflected in the lithological transition from the rich-organic series to sandy-silty material.

The original data obtained from the Koźmin Las profile are coherent with the high resolution record available from Lake Gościąż in Central Poland. The clear geological context at the site provides great potential for further discussion on palaeogeography of Central Poland during the Vistulian Late Glacial.