



Vegetation patterns under climate changes in the Eemian and Early Weichselian in Central Europe inferred from a palynological sequence from Ustków (central Poland)

Piotr Kołaczek^{a,*}, Monika Karpińska-Kołaczek^b, Joanna Petera-Zganiacz^c

^a Department of Biogeography and Palaeoecology, Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, ul. Dziegielowa 27, 61-680 Poznań, Poland

^b Department of Palaeobotany and Palaeoherbarium, Faculty of Biology and Earth Sciences, Jagiellonian University, Lubicz 46, 31-512 Kraków, Poland

^c Department of Quaternary Research, Faculty of Geographical Sciences, University of Łódź, ul. Kopcińskiego 31, 90-142 Łódź, Poland

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ABSTRACT

This paper presents a fresh examination of a pollen profile from Ustków (central Poland), which after preliminary results was thought to span a period between the Early Eemian (MIS 5e) and the upper Pleni-Weichselian (MIS 3). The newly obtained results confirmed the age assessment of the bottom series, but revealed a much older age for the uppermost part of the profile as far back as the Rederstatt stadial (MIS 5b). Palynological research showed slightly different patterns of vegetation in comparison to other sites located in Central Europe. Among them were an early *Ulmus* maximum coinciding with the *Betula* optimum in the Early Eemian, a relatively late optimum of *Taxus baccata* during the decline of the Middle Eemian, and a distinct division of the older part of the Late Eemian into phases of *Abies-Picea* and *Picea-Pinus* forest domination. The Hering stadial (MIS 5d) falls into a typical bipartition reflected by heathland domination during its older part and the prevalence of *Juniperus* thickets and *Artemisia-Poaceae* steppe during its younger part, which makes this succession similar to those from northern Germany. The pollen spectra reflecting the Brørup interstadial (MIS 5c) distinctly revealed an intra-Brørup cold oscillation rarely detected in profiles from Central Europe and a period of *Larix* dominated forests during the latest part of the interstadial (extraordinarily high percentages exceeding 15% of the total pollen sum). Local pollen taxa, together with the lithological composition of deposits, revealed that there was a water body in the area during the periods of the Late Saalian/Early Eemian transition–Middle Eemian (the decline of the *Tilia* phase), the Hering stadial (MIS 5d), the early Brørup interstadial (MIS 5c), and the Rederstatt stadial (MIS 5b). Between these time-intervals a poor and/or rich fen and/or bog functioned.

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1. Introduction

Research carried out on profiles with series which span periods of the Interglacial–Glacial cycle is crucial to understand patterns in the palaeoclimate, palaeohydrology and palaeoecology of that period, and they are important for building predictive climate models (Reille et al., 1998; Müller and Sánchez-Góñi, 2007). There is nothing new in the statement that such sites are unique to the area of Central and Western Europe, as a result of several damaging mechanical processes these sites were subjected to during the Weichselian and subsequent Holocene. Of about 300 pollen profiles spanning the Eemian interglacial (MIS 5e) examined from the area

of Poland (Kupryjanowicz et al., 2011), only the profile from Horoski Duże in eastern Poland (Granoszewski, 2003) reached the stadial after the Denekamp interstadial (MIS 3). This fact prompted reexamination of the palynological analysis of the profile from Ustków (central Poland) which, after preliminary pollen analysis and radiocarbon dating, was thought to span the period between the Saalian/Eemian transition and the decline of the Pleni-Weichselian (Klatkova and Załoba, 1991) i.e. the lengthiest organic sequence from the Eemian–Weichselian period. Due to the relative uniformity of the Eemian and Early Weichselian patterns of vegetation in Central Europe (comp. Turner, 2002; Velichko et al., 2007), a detailed pollen analysis of the Ustków profile would be the best tool for verifying its age. Moreover, fewer than a dozen sites from the area of Poland spanning the Eemian–Early Weichselian period have been incorporated into synthetic reconstructions of more regional and/or global climate–vegetation relationships

* Corresponding author.

E-mail address: pkolacz@amu.edu.pl (P. Kołaczek).

Geologic position of the Younger Dryas subfossil forest in the Warta River valley, central Poland



DANUTA DZIEDUSZYNSKA AND JOANNA PETERA-ZGANIACZ

*Department of Quaternary Studies, Institute of Earth Science,
University of Lodz, Narutowicza str., 88, 90-139 Lodz, Poland*

Abstract

Numerous tree trunks are present in the Late Weichselian deposits on the low terrace of the Warta river valley, in central Poland. This study concerns the well preserved tree remnants as well as accompanying depositional series and their sedimentary environments in relation to the geological position. The depositional sequence presented covers periods from the Middle Weichselian onwards. The riparian forest dates at the Younger Dryas. Environmental changes connected with rapid cooling were responsible for its destruction.

Keywords (GeoRef Thesaurus, AGI): sediments, organic sediments, trees, subfossils, paleoenvironment, climate change, Weichselian, Younger Dryas, Kozmin, Poland

Corresponding author email: dadziedu@geo.uni.lodz.pl

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1. Introduction

Since 1995, geological and palaeogeographical investigations of the Quaternary deposits in the open pit area of the Miocene lignite exploitation within the ADAMÓW JSC Lignite Mine have been carried out at the Department of Quaternary Studies of University of Lodz. The area is situated in the lowland part of central Poland (coordinates N 52°04'51" and E 18°40'3") (Fig. 1). Geomorphologically, the mine area lies on the low terrace on the western side of the Warta river valley (Fig. 2). It is located in the middle section of the river course, where the river flows northward. The valley signifi-

cantly expands there, attaining up to 8–10 km in width, while its morphological elements, e.g. terraces, are hardly distinguishable.

The extensive exposures connected with the mining activity gave an opportunity to investigate the whole Quaternary complex. Results obtained provided the basis for stratigraphical and palaeogeographical investigations (Klatkova, 1996; Forysiak et al., 1999; Turkowska et al., 2000, 2004; Petera, 2002; Petera & Forysiak, 2004; Forysiak, 2005; Petera-Zganiacz, 2007). In 2007, the main interest was focused on the remnants of forest within the

Badania „kopalnego lasu” ze schyłku vistulianu w dolinie Warty (Kotlina Kolska, środkowa Polska)

Piotr Kittel, Joanna Petera-Zganiacz, Danuta Dzieduszyńska, Juliusz Twardy, Marek Krapiec, Szymon Bijak, Karol Bronisz, Michał Zasada, Dominik Płaza

Abstrakt. W obrębie osadów późnovistuliańskiej terasy niskiej doliny Warty stwierdzono liczne karpy oraz pnie powalonych drzew, stanowiące przynajmniej w części zachowane *in situ* relikty „kopalnego lasu”. Datowania ^{14}C pni dowodzą, że odnalezione drzewa rosły na tym terenie w przedziale 12760-11765 lat temu. W sezonach 2010 i 2011 w wykopie o wymiarach 6 x 20 m, udokumentowano ponad 300 fragmentów drzew, a także drobne gałęzie oraz szyszki. Znaleziony materiał pomierzono i pobrano z niego próbki do określenia składu gatunkowego, wymiarów drzew, ich wieku, a także wzajemnych relacji chronologicznych i tempa zamierania lasu. Udokumentowany został także ogólny kontekst geologiczny i osady, w których znajdowano poszczególne fragmenty drewna. Wstępne wyniki wskazują, że w dolinie Warty co najmniej od końcowej części allerödu funkcjonował niewysoki, dość gęsty las sosnowy, który w młodszym dryasie najprawdopodobniej uległ podtopieniu. Dobre zachowanie drewna dowodzi jego szybkiego pogrzebienia, przez co zaistniała możliwość podjęcia szczegółowych interdyscyplinarnych badań paleoekologicznych, których efektem winno być dokładniejsze poznanie przemian środowiska naturalnego późnego glacjału w środkowej Polsce.

Słowa kluczowe: subfosylne drzewa, okres przejściowy vistulian-holocen, Warta, Polska środkowa

Abstract. Within the deposits of the Late Weichselian lower terrace of the Warta River Valley, numerous stumps and collapsed trunks constituting the relict of subfossil forest in the *in situ* position have been found. ^{14}C dating point to an age range between 12760-11765 cal BP. In 2010 and 2011 in the open pit of 6 x 20 m over 300 tree remnants, branches and cones have been documented. The wood relicts have been measured and sampled in order to describe the species and the tree dimensions, relative chronology and period of decline of trees as well. Besides, the geologic position and lithological characteristics of the units within which the tree remnants were found have been documented. Preliminary results point to the existence of a quite dense though small forest in the Warta River valley from the end of Alleröd at least, which probably in Younger Dryas became water-logged. Good preservation of the wood points to a quick burial and offers an opportunity to carry out interdisciplinary palaeoecological analyses in order to provide the more exact reconstruction of the Late Weichselian environment in central Poland.

Key words: subfossil trees, transition Weichselian-Holocene, Warta River, central Poland

Wstęp

Stanowisko Koźmin zlokalizowane jest w południkowym odcinku doliny Warty, w mezoregionie Kotlina Kolska (Kondracki 2002). W tym obszarze dolina Warty znacznie się rozszerza osiągając

PERIGLACIAL PHENOMENA IN THE EDGE-ZONE OF ŁÓDŹ PLATEAU AND ITS
PALAEOGEOGRAPHICAL SIGNIFICANCE (CENTRAL POLAND)

Joanna Petera-Zganiacz

*Department of Quaternary Studies, Institute of Earth Science, University of Łódź, ul. Kopcińskiego
31, 90-142 Łódź, Poland; e-mail: jap@geo.uni.lodz.pl*

Thermal-contraction cracks are the most important evidence of permafrost occurrence (e.g. Dylík 1966, Romanovskij 1973). These structures have been reported all over Europe in extraglacial area of glacial periods in Pleistocene. Nowadays it is possible to observe modified structures due to thawing of permafrost as ice-wedge pseudomorph, composite-wedge pseudomorph or sand-wedge cast (relict sand wedges) (e.g. Goździk 1973). The most common are ice-wedge pseudomorph, which occur in different types of sediments and geomorphological situations. The sand-wedges appear rarely, usually in the uplands and they are associated with the stone pavement which is regarded as level of stratigraphical significance (e.g. Klatkova 1965). A lot of authors claim that the most favourable conditions for cracking and stone pavement formation occurred during the coldest period of Weichselian, and that phenomena was synchronous. Results of investigation shows that in places the cracks and pavement are separated by vary-grained sediment of several centimeters or more what suggests that the issue is more complex.

The study area is located in central Poland, about 15 km north of Łódź. The terrain was last time covered by the ice sheet during the Wartanian Stage. The Weichselian Glaciations was an ice-free period there. During Wartanian the edge-zone of the so-called Łódź Plateau definitively developed as system of steplike levels between plateau and Warsaw-Berlin ice-marginal streamway. The edge-zone is build from glaciogenic deposits, usually strongly deformed due to glaciotectonic. Moreover, characteristic feature of the area is occurrence of numerous dry valleys which cut the slopes of the levels and dunes developed in the surfaces of the levels. The Rosanów site is situated in the third level – the Katarzynów level, on altitude 154 m a.s.l.

In the investigated site, on the depth of 1-1,5 m the glacial loamy sand was documented. The glacial deposits in places are covered by about 0,5 m vary grained sediment probably developed due to solifluction. On the depth of several centimetres, continuous pavement occur, which consist of gravels including large clasts (0,3 m diameter), on the surface of some grains effects of wind-abrasion are visible. In the top part of the profile aeolian sand was documented. The aeolian unit is continuous and about 1 metre thick, but thickness raise north from the site, where dune developed.

In the glacial deposits of the lower unit a large wedge-shaped structures occur with following features: very clear, not deformed outline, V-shaped and visible vertical lamination of infilling sand (Fig. 1B). This characteristic suggests that structures originated as wedges with primary sand infilling (Goździk 1973, Kolstrup 1986, Murton 1996). The upper parts of structures are usually covered by vary grained, deformed deposits, which separate the cracks and stone pavement.