GEOLOGIJA. 2011. Vol. 53. No. 1(73). P. 27–35

Succession of the Mazovian Interglacial near Łuków (E. Poland): palynostratigraphic and palaeogeographic approach

Irena Agnieszka Pidek,

Sławomir Terpiłowski,

Marzena Małek

Pidek I. A., Terpiłowski Sl., Małek M. Succession of the Mazovian Interglacial near Łuków (E. Poland): palynostratigrapic and palaeogeographic approach. *Geologija*. Vilnius. 2011. Vol. 53. No. 1(73). P. 27–35. ISSN 1392-110X.

The geomorphological and palynological situation of the Mazovian Interglacial deposits of the Domaszki profile in the Łuków Plain (E. Poland) – one of the three Mazovian successions documented in the Samica River valley (Fig. 1) – is presented. Interglacial deposits occur under the cover of glaciofluvial deposits of the valley outwash from the Wartanian Glaciation or, as in the Domaszki site, alluvial-biogenic deposits from the Vistulian Glaciation and the Holocene (Fig. 1C). The pollen spectra of lithologically varied Mazovian Interglacial deposits documented (Table, Fig. 2) several phases – the phase of boreal birch and pine-birch forests at the beginning of the interglacial warming, the phase of communities dominated by spruce and alder and then by yew in the first period of the interglacial optimum, the phase of an optimum with fir and hornbeam communities and the presence of exotic taxa (among others *Pterocarya*, *Buxus*), followed by a cooling represented by pine forests with numerous open areas.

The geomorphological evidences and pollen spectra suggest that the contemporary Samica River valley is of an old origin (from the Sanian-2 Glaciation = Elster-2 = Berezinian), and the stratigraphic hiatus including a sequence of younger Pleistocene deposits may be a result of subglacial water erosion during glaciations and / or a strong river erosion during the anaglacial and kataglacial phases.

Key words: Mazovian Interglacial, pollen analysis, Łuków Plain, Poland

Received 06 April 2009, accepted 05 June 2009

Irena Agnieszka Pidek, Sławomir Terpiłowski. Institute of Earth Sciences, Maria Curie-Skłodowska University, Kraśnicka 2 c/d, 20-718 Lublin, Poland. **Marzena Małek.** POLGEOL S.A., Lublin Office, Budowlana 26, 20-469 Lublin, Poland. E-mail of the corresponding author: i.pidek@poczta.umcs.lublin.pl

INTRODUCTION

The Quaternary deposits at the Domaszki site were studied in the western part of the Łuków Plain which, according to Kondracki (2000), belongs to the South Podlasie Lowland (Fig. 1A, B). The region under investigation is located in the eastern part of the Central European Lowlands. The deposits at Domaszki were drilled through for the first time during the geological survey for the Detailed Geological Map of Poland 1 : 50 000, Łuków sheet (602) (Małek, Buczek, 2006). Organogenic deposits were drilled at that time in numerous profiles with the use of mechanical WH drilling equipment. The occurrence of lake sediments from the Mazovian Interglacial period (= Holsteinian = Aleksandrian *vide* Lindner et al., 2004a) was evidenced by means of pollen analysis in 15 sites (Małek, Pidek, 2007). The surface of the examined area consists of a strongly denuded morainic plateau (Fig. 1C) built of tills of the Odranian and Sanian-2 glaciations.

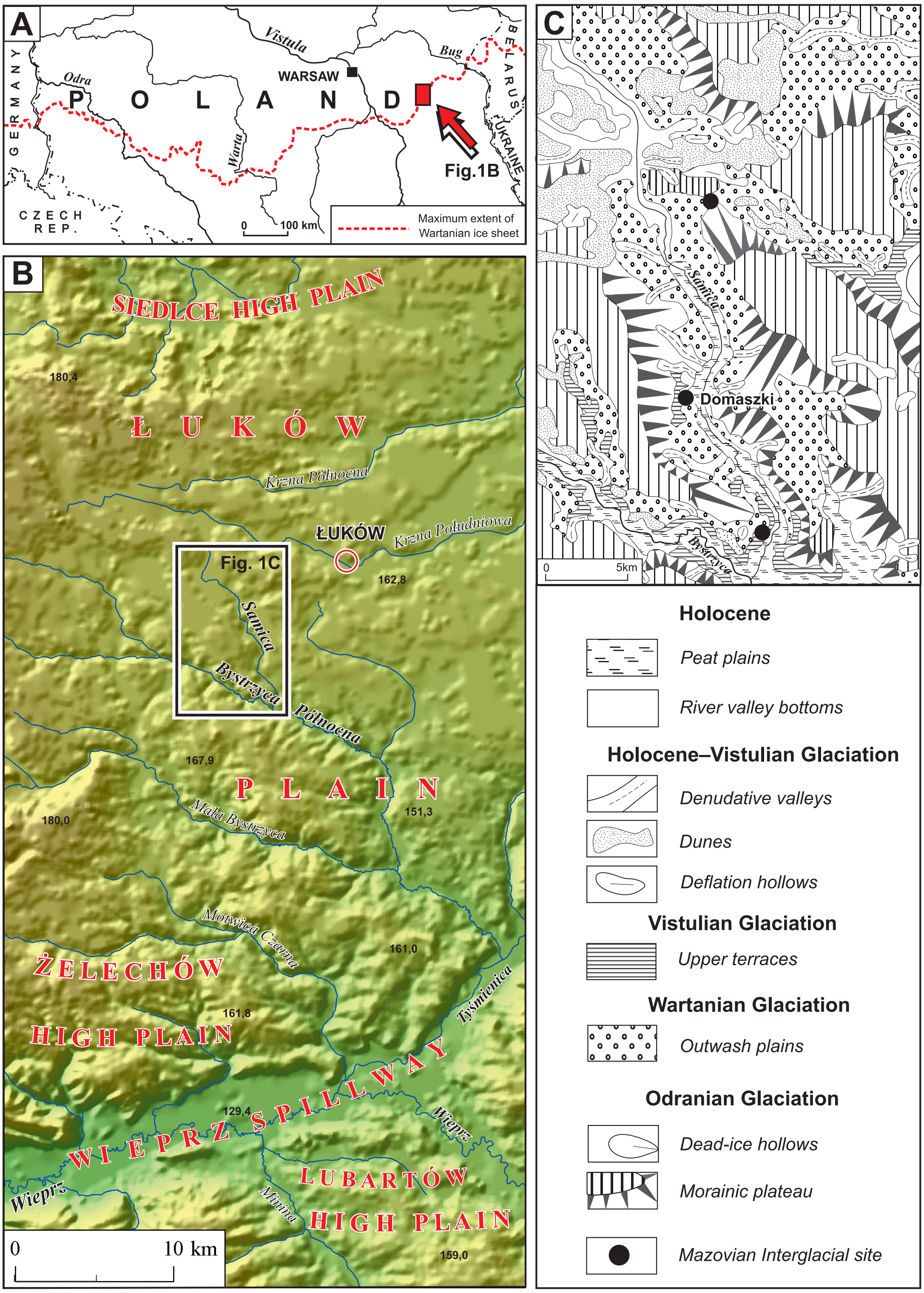

Fig. 1. Site location map (*A*) showing part of the South Podlasie Lowland (*B*) with the Mazovian Interglacial sites and the geomorphological situation of the exposure at Domaszki (*C*) examined in detail

1 pav. Situacinis žemėlapis (*A*): Pietų Podlesės žemumos fragmentas (*B*), Mazovijos tarpledynmečio vietos ir geomorfologinė Domaškių vietovės padėtis (*C*)

Three of the Mazovian sites are located in the Samica River valley (Fig. 1 B, C). Compared with them, the Domaszki site stands out with its large thickness of lake deposit succession reaching at least, as then was thought, to a depth of 11.5 m. As it was impossible to take samples from the whole lake succession, only three samples of deposits from a depth of 3.3–4.5 m were palynologically analysed. The preliminary analysis revealed that the mentioned deposits had been formed during the optimum of the Mazovian Interglacial period (Małek, Pidek, 2007). In order to precisely identify the geological situation, thicknesses and palinostratigraphy of Mazovian Interglacial deposits, a new drilling with WH drilling equipment was made in 2008. The bottom of organogenic deposits was shown to occur at a depth of 13.3 m and the top at 2.8 m. Deposits of such a considerable thickness may represent various interglacial / glacial periods of the Quaternary, especially that in the examined area of the Łuków Plain there are fossil lake basins of various age neighbouring directly with each other. The oldest of them developed in the Ferdynandovian Interglacial period, like in the Łuków site – a stratotype profile for this region (Rühle, 1969; Sobolewska, 1969 – with a later reinterpretation by Mojski, 1982; Terpiłowski, 2001). Many of fossil basins developed in the Mazovian and Eemian Interglacials (Żarski et al., 2005). A complete palaeogeographical and palynological recognition of the lake succession at Domaszki, which may contribute to specifying the stratigraphy of the examined area, was the aim of the present study.

THE GEOLOGICAL–GEOMORPHOLOGICAL SETTING OF THE STUDY SITE

The drilling was located in the Samica River valley floor (Fig. 1B). It is a left-bank tributary of the Bystrzyca Północna River flowing into the Tyśmienica River. The valleys of this river system are thought to refer to valleys of water outflow during the Wartanian ice-sheet front stabilization in the Siedlce and Żelechów High Plains adjacent to the Łuków Plain (Zaborski, 1927; Mojski, 1972; Harasimiuk et al., 2004). The Bystrzyca and Samica river valleys use the proglacial water outflow line, whereas the Tyśmienica River valley follows the pro- and extraglacial water outflow line (= Wieprz spillway) (Fig. 1 A, B). The proglacial water outflow in the Samica River valley is documented by glaciofluvial deposits occurring close to its slope and inserted in a morainic plateau from the Odranian Glaciation (Fig. 1C). The Mazovian Interglacial deposits occur under a cover of glaciofluvial deposits or alluvial deposits from the Vistulian Glaciation and mineral-organic ones from the Holocene. The drilling is located in the Holocene floor of the Samica River valley.

METHODS

Material for pollen analysis was obtained by the hydrofluoric acid method. Samples were first treated with 10% HCl in order to carbonate the removal. Next they were boiled with 3.5% KOH. The mineral fraction was removed in HF 40%. The organic fraction was subjected to Erdtman's acetolysis. The obtained sporomorphs were stained with acid fuchsine and sluiced with pure glycerine. Pollen spectra were counted on at least two slides. Usually, 600–700 and sometimes 1 000 pollen grains of trees and shrubs (AP) were counted in the samples with a good and very good frequency of sporomorphs. The samples with a very low frequency of sporomorphs came mainly from silty deposits. An attempt was made to count at least 300 grains of AP + NAP in these samples. The identification of pollen and spores was done using mainly the keys inserted in Beug (2004) and Faegri et al. (1989).

The results of pollen analysis of 52 samples taken from a depth of 0.3–13.00 m (the lowermost part of lacustrine deposits at a depth of 13.0–13.30 m was disturbed) are presented in the form of a percentage diagram (Fig. 2) based on the POLPAL software (Walanus, Nalepka, 1999; Nalepka, Walanus, 2003). The calculations of pollen and spore percentage were based on the sum of pollen grains of trees and shrubs (AP) and of terrestrial herbs and dwarf shrubs (NAP). The percentage of aquatic and lakeshore vegetation pollen, of Pteridophyta and Bryophyta spores, and of redeposited and non-determined taxa was calculated in relation to the sum including the AP + NAP + given taxon.

POLLEN ZONATION

The pollen succession (Fig. 2) is divided into eight local pollen assemblage zones (LPAZs) signed with the D abbreviation and numbered 1–8 from the bottom. There appears a hiatus between the last two zones (D-7 and D-8 LPAZs). When distinguishing the local pollen assemblage zones, the criteria published by West (1970) and Janczyk-Kopikowa (1987, 1988) were applied. The names of the zones are derived from the taxa that are predominant in or typical of a particular zone.

D-1 *Betula–Juniperus* LPAZ (5 samples; 13.00–12.50 m)
AP 86–89%. The zone is characterized by high *Betula* undiff. values (up to 82%). *Juniperus* (up to 6%) and Poaceae (up to 4%) appear most frequently. Apiaceae, *Thalictrum*, *Comarum* t. *Salix* undiff. and *Betula nana* t. are present, among other pollen types. The occurrence of *Hippophae rhamnoides* is worth noting. Among trees, the values of *Pinus* rise up to 21% in the sample 12.70 m and then fall to 14% in subsequent samples. Spores of Musci excl. *Sphagnum* as well as pollen of *Myriophyllum spicatum* and *Ceratophyllum* hairs are numerous. A single redeposited pre-Quaternary pollen grain of *Nyssa* was found.

D-2 *Pinus–Alnus–Picea* L PAZ (9 samples; 12.20–10.10 m)
AP 88–95%. *Pinus* and *Alnus* are dominant among AP, and their values are up to 35% and 25%, respectively. *Betula* undiff. slightly decreases and ranges from 25 to 63%. The continuous low-value pollen curves of *Larix*, *Picea*, *Fraxinus, Ulmus, Quercus* and *Taxus*, as well as single pollen grains of *Tilia, Populus* and *Corylus* are observed. The presence of single pollen grains of *Celtis* is worth mentioning. The values of *Juniperus* and *Betula nana* t. decreased in the upper part of the zone. Among NAP, the presence of *Humulus* is worth noting. The variety of NAP taxa is great. *Helianthemum* occurs among others. The percentages of Musci spores are still high (up to 34%), and coenobia of *Pediastrum* appear regularly.

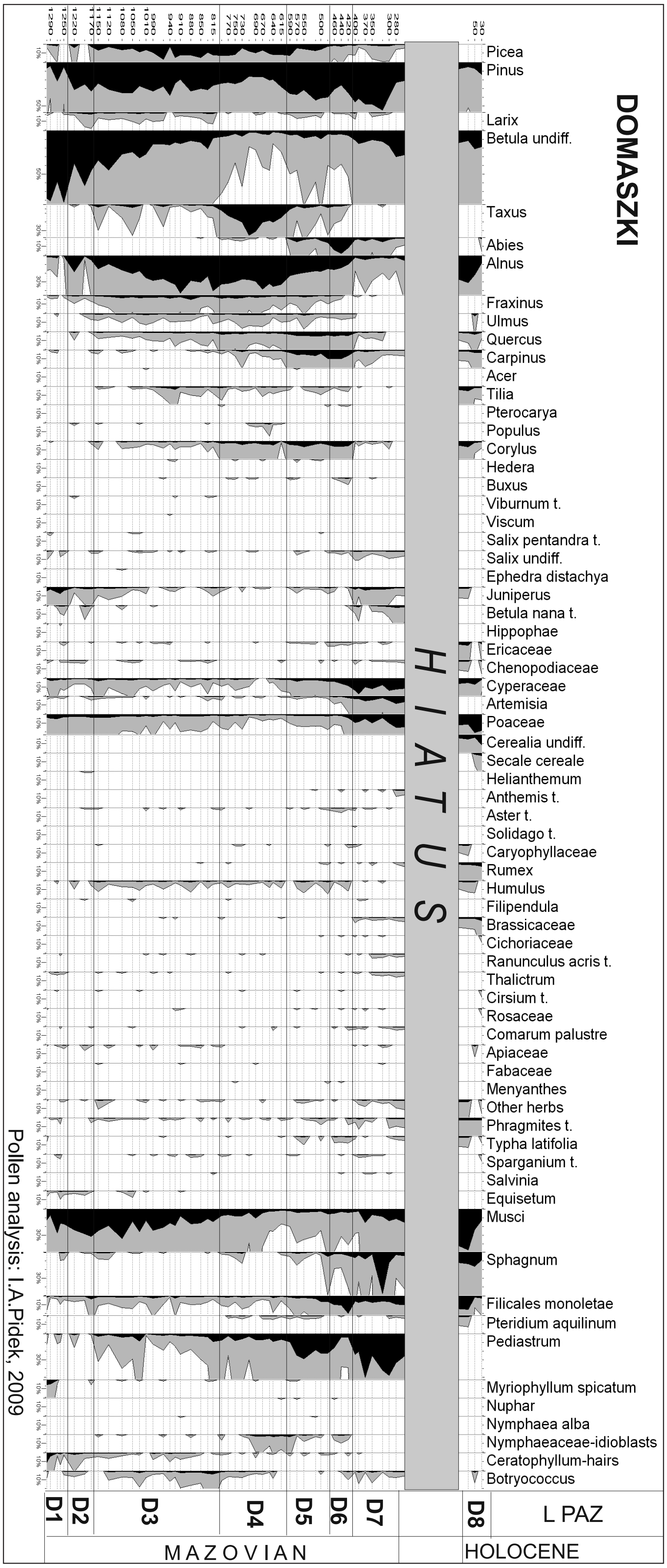

Fig. 2. Percentage pollen diagram of the organogenic deposits from Domaszki

2 pav. Procentinė žiedadulkių iš Domaškių vietovės diagrama

D-3 *Alnus–Picea–Fraxinus-/Tilia* / LPAZ (9 samples; 9.90–8.15 m)

AP 92–96%. The pollen values of *Pinus* range from 20 to 38%, and the percentage of *Alnus* and *Picea* gradually rises, reaching the maxima of 41% and 18%, respectively. *Tilia* and *Fraxinus* reach their absolute maximum (i. e. 3.3% and 5.1%, respectively) in the older part of the zone; the curves of *Taxus, Ulmus, Quercus* and *Corylus* are continuous, with the values around 0.5–1.5%. The continuous curve of *Carpinus* starts in the younger part of the zone. Single pollen grains of *Hedera, Viscum, Buxus, Viburnum* and *Euonymus* are found. NAP values are very low (4–8%).

D-4 *Taxus–Alnus–Picea* LPAZ (10 samples; 7.90–6.15 m)

AP 95–98%. The high values of *Taxus* with the maximum of 36% distinguish this zone from all the other ones. Those of *Betula* undiff. fall to 6%. The percentage of *Alnus* (up to 39%) and *Picea* (up to 13%) is still high. The curves of *Ulmus, Fraxinus, Quercus, Carpinus, Tilia* and *Corylus* are continuous, their values ranging from 0.4 to 0.9%. *Abies* pollen occurs sporadically, and *Populus* appears in the younger part of the zone. Sporadic pollen grains of *Tsuga* are worth mentioning. *Hedera*, *Buxus*, *Sambucus* and *Frangula* are present. Nymphaeaceae idioblasts are recorded among non-pollen microfossils.

D-5 *Pinus–Carpinus–Quercus* LPAZ (4 samples; 5.90–5.15 m)

AP 91–96%. This zone is characterized by the high pollen values of *Pinus* that reach over 43%, and of increasing values of *Carpinus*, *Quercus*, *Abies*. The values of *Taxus* are lower and range between 5% (in the lower part of the zone) and 3% (in the upper one). The percentages of *Picea* are still high (up to 7%), and pollen grains of *Populus* disappear. The low but continuous curves of *Juniperus* and *Pteridium aquilinum* are worth noting. Pollen of Ericaceae is more frequent than in the preceding zone. Tetrads of *Typha latifolia* pollen are also more frequent as well as coenobia of *Pediastrum*. *Sphagnum* and Filicales monolete spores reach higher values. The NAP values are higher than in the previous zone due to increased values of Cyperaceae.

Table. **Description of deposits from Domaszki site**
Lentelė. **Litologinis Domaškių vietovės nuosėdų aprašymas**

Depth, m	Deposit
0.00–0.20	Organogenic embankment, sandy, dark grey (developed presumably during digging of pond)
0.20–0.50	Organic, black mud
0.50–0.70	Sandy, grey-yellow silt with horizontal lamination; HCl^-
0.70–1.70	Fine-grained yellow-grey and grey-beige sand with gravels; HCl^-
1.70–2.50	Clayey, yellow-grey silt with brown stripes; HCl^-
2.50–3.00	Clayey, steely-grey silt; HCl^-
3.00–4.50	Black, strongly humous silt, crumbled in places, with numerous lenses and inserts of black-brown peat (clayey in the top to a depth of 3.4 m) and gyttja; HCl^-/at the depth of 4.4–4.5 m HCl^+
4.50–5.00	Peat and gyttja; HCl^+
5.00–5.70	Grey-beige gyttja; HCl^{+++}
5.70–13.00	Black, humus silt with numerous lenses and mud laminae; lenses of gyttja; at a depth of 5.70–9.40 m HCl^{+++}; at a depth of 9.50–13.00 HCl^+
13.00–13.30	Beige-grey sandy gyttja, saturated with water and disturbed
13.30–15.00	Fine grained, grey-beige sand with gravels, strongly saturated with water

D-6 *Abies–Carpinus–Quercus* LPAZ (5 samples; 5.00–4.20 m)
AP 82–93%. *Abies* and *Carpinus* are typical taxa of this zone. Their pollen values reach the absolute maxima of 19% and 10%, respectively and then rapidly decline at the transition to the next zone. The percentages of *Pinus* and *Alnus* slightly fall and those of *Corylus* remain at the same level as in the previous zone. The frequencies of *Fraxinus* and *Taxus* decrease in the younger part of the zone. Pollen grains of *Pterocarya* and *Buxus* are present. The curve of *Calluna* is low but continuous. Other pollen types of the Ericaceae family occur. The NAP percentages rise to 18% in the uppermost samples of the zone.

D-7 *Pinus*–NAP–*Sphagnum* LPAZ (7 samples; 4.00–2.80 m)
AP 59–79%. This zone is characterized by a considerable rise in the pollen values of *Pinus* (up to max. 42%) and also of NAP (up to 20%) and *Sphagnum* spores (up to 45%). The frequency of *Juniperus*, *Salix* and *Betula nana* t. slightly increases and that of *Alnus, Abies, Ulmus, Quercus, Carpinus* and *Corylus* declines very rapidly. Pollen of *Artemisia*, Chenopodiaceae and *Anthemis* t. is more frequent in the younger part of the zone. The amount of *Pediastrum* coenobia achieves maximum in this zone (ca. 50%), and Nymphaeaceae idioblasts disappear.

D-8 NAP-*Alnus* LPAZ (3 samples; 0.70–0.30 m)
AP 48–62%. *Alnus* and NAP overdominate the pollen spectra. The pollen of *Alnus* reaches 31% in the lower sample and then decreases to 9%. The other tree pollen types occur less frequently. Birch pollen values range from 12 to 21% and those of pine from 5 to 14%. The Poaceae percentage values culminate at 11%. Pollen of *Cerealia* (*Secale cereale* among other types) as well as *Calluna, Rumex acetosa/acetosella, Urtica*, Brassicaceae occur frequently. No pollen of aquatic plants or colonies of algae are found. Abundant Musci are worth noting among spores.

VEGETATION CHANGES

Vegetation history in the areas surrounding the Domaszki site was interpreted basing on the percentage pollen diagram (Fig. 2).

D1 LPAZ. The high values of *Betula* undiff. pollen and the simultaneous fall in the NAP percentage indicate the occurrence of tree-birch forest at the beginning of the interglacial warming. Single pollen grains of *Alnus* and *Fraxinus* in the younger part of the zone evidence that alder and ash probably started to encroach on wet habitats at that time. However, the forest cover was not dense. The rather high pollen values of *Juniperus* and Poaceae indicate that grass communities with abundant juniper occurred at places, probably on dry, poor soils. The sporadic pollen grains of *Hippophae* evidence that this shrub may have persisted on the sunny hills not occupied by forest. The occurrence of *Betula nana* t. and *Salix* undiff. pollen indicates the presence of the shrub tundra communities in the landscape.

D2 LPAZ. The rapid rise in the *Pinus* values and the simultaneous fall in the percentage of *Betula* undiff. provide evidence of an increasing amount of pine in forests at that time. These pine-birch forests were of a boreal nature. Larch was an important component there as its pollen composes a continuous curve. Patches of grass communities with juniper still persisted in open, dry places. Due to the development of forests, patches of tundra communities with *Betula nana* and willow shrubs decreased. The gradual rise in the pollen values of *Picea*, *Alnus*, *Fraxinus, Quercus* and *Ulmus* in the younger part of the zone indicates that the proportion of spruce in forests increased, and alder and elm-ash riverine forests began developing on wetter places. The presence of *Populus* pollen in this zone may indicate that poplar encroached riverine forests. The herbaceous vegetation of riverine communities was probably the source of *Humulus* and *Filipendula* pollen. On the other hand, *Artemisia* and *Helianthemum* pollen can be probably related to the communities of drier meadows.

D3 L PAZ. The changes of *Betula* undiff., *Alnus* and *Picea* pollen values reflect a gradual decrease of birch proportion in forest communities and the progressive domination of alder and spruce in wetter places. The still continuous curve of *Larix* pollen indicates that the admixture of larch in pine–birch forests was considerable. *Quercus* may have appeared on more fertile habitats in pine forests, and the continuous presence of *Corylus* pollen indicates that hazel probably occurred in the margins and open places of forests. Ash–elm riverine forests spread in the river valley as is evidenced by the rising pollen values of *Fraxinus* and by the continuous curve of *Ulmus*. *Alnus*, and probably *Quercus,* may have occurred as an admixture in these forests, too. It is probable that *Celtis* also appeared in riverine communities. Pollen grains of *Carpinus* are more frequent in the upper part of the zone. They indicate the beginning of hornbeam expansion. The upper part of the D3 LPAZ reflects different types of riverine forests (alder-, ash–elm- and alder–ash ones) which occupied extensive areas. This picture can be inferred from the very high pollen values of *Alnus*, the highest percentages of *Fraxinus*, and the continuous curve of *Ulmus*. Lime began to play an important role then. It was probably *Tilia cordata*. Similar communities of rich multispecies mixed forests were found in other sites with the Mazovian successions (Krupiński, 1995; 2000). The increasing pollen values of *Taxus* in the uppermost samples of this zone provide evidence of a gradual encroachment of yew. In this period, *Hedera* and *Humulus* occurred in rich multispecies riverine communities. The presence of these taxa together with *Viscum* evidences warm climate conditions. The reduction of dry and poor grass areas is shown by a considerable decrease in the pollen values of *Juniperus*. The pollen curves of Poaceae and Cyperaceae, the diversity of herb taxa, and the occurrence of sporadic pollen grains of *Betula nana* t. indicate that different open communities still existed, but their role in the landscape was not important. The slightly greater variety of NAP taxa and the pollen grains of herbs that occupied different meadow types provide an evidence of the diversified floral composition of open habitats. Pollen of *Filipendula, Cirsium* t., *Ranunculus acris* t., *Thalictrum* and Apiaceae can be related to the communities of wet meadows.

D4 LPAZ. The rapid rise of *Taxus* pollen values, from the beginning of the zone to the absolute maximum (36%), provides evidence of the dominant role of yew in forest communities. Coniferous and mixed forests also underwent transformation. Pine was less numerous, and birch probably occurred only sporadically. The gradual rise of *Carpinus*, *Quercus* and *Corylus* values in this zone indicates that dry-ground communities started to develop. Tree layer was composed probably of hornbeam and oak with an admixture of lime and spruce. Fir trees could also have entered these communities as can be suggested by the repeated occurrence of *Abies* pollen grains. *Buxus* – an indicator of warm climate, its pollen being recorded more frequently than in the previous zone – could also have found good conditions for its development in the understorey of mixed dry-ground forests. Alder and riverine forests underwent rather small transformations as evidenced by still high pollen values of *Alnus*, *Fraxinus* and by still low curves of *Ulmus* and *Tilia*. Single pollen grains of *Pterocarya* may indicate that this tree probably appeared also in ash–elm riverine forests.

D5 LPAZ. The rapid decrease in *Taxus* pollen values and the fall in the percentage of *Picea*, *Alnus* and *Fraxinus* indicate a considerable reduction of yew stands and areas covered by wetter forests of different types. This was probably caused by a climate change towards much more continental and maybe also colder conditions. This drier and slightly colder climatic oscillation has been recorded in many sites of the Mazovian Interglacial in Poland, among others in Gościęcin (Środoń, 1957), Krępiec (Janczyk-Kopikowa, 1981), Biała Podlaska, Ossówka (Krupiński, 1995; 2000), Woskrzenice and Kaliłów (Bińka, Nitychoruk, 1995; 1996), Konieczki (Nita, 1999) and Brus (Pidek, 2003), always in the same palynostratigraphic position after the *Taxus* curve decline.

The areas covered by elm–ash riverine forests and alder forests were somewhat reduced at that time. The considerable rise in *Pinus* values (up to 43%), occurring just after a rapid fall in the percentages of *Taxus* and trees from wetter habitats, probably provides evidence of pine encroachment on different habitats from which yew, alder and riverine trees retreated. The continuous presence of *Pteridium aquilinum* spores throughout this zone is probably connected with loose pine forests. The rise in the pollen values of *Quercus* probably provides evidence of the development of mixed pine–oak forests. A simultaneous increase in the frequencies of *Carpinus* and *Corylus* indicates the expansion of fertile dry-ground hornbeam–oak forests with hazel. *Tilia* and *Picea* may have occurred as an admixture in these communities. Pollen of *Parrotia* appeared in this zone; this may indicate its presence in shrub understorey of forest communities as suggested by Bińka (Bińka et al., 2003).

D6 LPAZ. The rapidly rising pollen values of *Abies* and *Carpinus* and also a decrease of *Picea* and *Pinus* percentage evidence a regression of spruce and, to a lesser extent, of pine and the more and more important role of fir and hornbeam in mixed forests. Fir communities began expanding on wetter soils, but dry-ground oak–hornbeam forests also could have spread in places, with a higher proportion of *Carpinus* than in the previous zone, and with *Buxus* in the understorey. The role of pine forests was not so important as in the prevoius zone. They may have survived in poor habitats unfavourable for other trees. The high percentages of *Filicales monolete* spores, with the maximum of 20% in the upper part of the D6 LPAZ, may reflect the presence of wet alder or fir communities close to the lake. Pollen of *Pterocarya* can be related to the survived patches of elm–ash riverine forests.

D7 LPAZ. The degradation of both riverine and dry-ground forests, and probably also of forests of the alder carr type in this zone is evidenced by a fall in the pollen values of *Carpinus*, *Quercus*, *Tilia, Alnus* and *Ulmus*, a decrease in *Corylus* percentages, a simultaneous rapid increase in *Pinus* and a small increase in the values of *Betula* undiff. This next expansion of pine may have started simultaneously in different types of forest communities due to the climate cooling. The rise in the values of *Salix* undiff. and NAP, as well as the variety of herb taxa appearing from the beginning of this zone, indicate that forests became less dense and different types of open communities spread. The more frequent presence of *Juniperus* pollen and the occurrence of Ericaceae pollen can be related to clearings in pine forests. The habitats of dry grasses delivered probably pollen of *Artemisia* and Chenopodiaceae. The considerable increase in the NAP values in the uppermost two samples of this zone is conditioned by the pollen percentages of Cyperaceae, Poaceae and *Artemisia* and indicates that the role of open communities became important. The continuous curve of *Betula nana* t. pollen and the rise in the spore percentage of *Sphagnum* and other mosses (Musci excl. *Sphagnum*) indicates that mires spread with patches of tundra-like communities of dwarf birch.

The mentioned two samples of this zone (i. e. 2.80–3.00 m), with a higher proportion of NAP, can be related to a transitional zone between the Mazovian Interglacial and the early glacial of the subsequent glaciation (i. e. Liviecian).

The deposits from the depth of 2.70–0.80 did not contain any sporomorphs. However, three samples (0.3–0.7 m) taken from deposits of the uppermost layer showed characteristic features of the late Holocene Subatlantic pollen spectra. They were included in the D8 LPAZ.

D 8 LPAZ. In spite of the low frequency of pollen grains in the deposits of this zone, the rise in the NAP values (over 40%), conditioned mainly by the percentage of Poaceae, Cerealia, *Rumex,* Brassicaceae and Ericaceae, can be interpreted as an evidence of vast areas cleared by man for crop cultivation. The pollen spectra of the lowermost two samples (0.5–0.7 m) contain abundant pollen of *Alnus*. This may indicate the presence of alder communities in the landscape, which disappeared because of the subsequent human activities in favour of anthropogenic vegetation. Pollen of Cerealia, among which *Secale cereale* appears in the uppermost sample, indicates that the age of this series of deposits cannot be older than the last 1 000 years.

DISCUSSION

In the light of new palaeobotanical data, the pollen succession from Domaszki, in comparison with the preliminary results published by Małek and Pidek (2007), represents a much larger stratigraphic range of the Mazovian Interglacial (= Holsteinian = Alexandrian).

A detailed pollen analysis of 52 samples has shown that the discussed succession covers not only the Mazovian optimum, but also the whole Interglacial. It begins with the phase of boreal birch forests (D1 LPAZ), followed by pine-birch and alder-spruce forests (D2 and D3 LPAZs) and the well-represented phase of a wide distribution of yew-dominated communities (D4 LPAZ) in the first period of the Interglacial optimum. The following intra-Interglacial episode of drier (and maybe cooler?) climate conditions is represented by the D5 LPAZ which reflects a renewed expansion of pine trees in forest communities. The second period of the Mazovian Interglacial optimum, covering the phase of fir and hornbeam communities development (D6 LPAZ), is represented in the Domaszki profile by a rather thin section of silt-peat deposits, and the pollen values of *Abies* (max 19%) and *Carpinus* (max 10%) are lower than in other Mazovian sites from Poland (*vide* Krupiński, 1995, 2000; Pidek, 2003), which can suggest that the development record of forest communities is not complete and does not contain the uppermost part of the climatic optimum. The interglacial succession is closed by the pine pollen zone (D 7 LPAZ), in which the high values of Poaceae, Cyperaceae and *Artemisia* as well as the presence of numerous and variable herb taxa indicate the existence of vast patches of open communities. The uppermost two samples of the D7 LPAZ may be related to a transitional pollen zone between the Interglacial and the Early Glacial of the Liviecian Glaciation.

The pollen succession from Domaszki (D1-D6 LPAZs) corresponds palynologically to the stratotype succession from the Brus site in SE Poland and other sites in the southern Podlasie, and also in the other regions of Poland (Krupiński, 2000; Mamakowa, 2003). According to Janczyk-Kopikowa (1991), Krupiński (1995, 2000) and Mamakowa (2003), the Mazovian pollen succession has strong guiding features enabling its vast correlation. These are the order of encroachment of alder–spruce and hornbeam–fir communities, as well as the presence of a well-marked yew zone, among other things. An additional evidence of the Mazovian age of the deposits from Domaszki is the presence of *Pterocarya* and *Parrotia* pollen. These taxa do not occur in younger than Mazovian deposits and are considered important diagnostic taxa of this interglacial (Krupiński, 1995; Bińka et al., 2003). Regularly, in the optimum phase, *Buxus* pollen appears (Krupiński, 1995), which is present also in Eemian deposits, but less regularly and not in such numerous pollen grains (*vide* Granoszewski, 2003).

According to the latest stratigraphic scheme by Ber et al. (2007) and a detailed correlation with the profiles from Western Europe and Belarus by Lindner et al. (2004a), the Mazovian succession is situated between the Sanian-2 Glaciation (= Elster-2) and Liviecian Glaciation (= Fuhne) and is unequivocally related to the oxygen isotope stage 11. Referring to the geomorphological situation of the Mazovian Interglacial deposits in the Samica River valley, we think that the stratigraphic hiatus would include deposits correlated with oxygen isotope stages from 10 to 5, i. e. from the Liviecian Glaciation (= Fuhne = cooling between Alexandrian and Smolenskian), the Zbójnian Interglacial (= Reinsdorf = Smolenskian), the Krznanian glaciation (not having related units in West and

East European stratigraphic schemes), the Lubavian Interglacial (= Schöningen = Shklovian), the Odranian Glaciation (= Drenthe = Dnieperian) and the Eemian Interglacial. This situation is similar to that in numerous Mazovian Interglacial sites from the eastern part of the Łuków Plain (Krupiński, 1995). The lack of a glacial cover on the Mazovian Interglacial deposits in these sites is explained by proglacial and extraglacial water erosion (Lindner et al., 2004b). In our opinion, another possibility of explaining this problem can be considered for the Domaszki and other sites in the Samica River valley. The situation of the Mazovian Interglacial succession in the river valley and near the morainic plateau from the Odranian Glaciation can indicate that the deposits corresponding to the stratigraphic hiatus were eroded by water. It could take place in periods of ice sheet cover occurrence (in subglacial conditions of channel drainage – according to the model proposed by Boulton and Dobbie, 1993) and / or in anaglacial and kataglacial phases (Jahn, 1956; Liedtke, 1993). Such palaeogeographic significance of the Mazovian Interglacial succession at Domaszki indicates a considerably older genesis of the Samica River valley (than it was supposed), i. e. most likely from the Sanian-2 Glaciation but not the Wartanian Glaciation period. The explanation of reasons for its functioning for such a long time is still open.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Prof. Józef Wojtanowicz and anonymous Reviewer for critical comments to the earlier version of the manuscript. Part of this work was financially supported by the Polish Ministry of Science and Higher Education (project NN 306 198739 : years 2010–2013).

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Irena Agnieszka Pidek, Sławomir Terpiłowski, Marzena Małek

MAZOVIJOS TARPLEDYNMEČIO NUOGULOS LUKOVO RAJONE (RYTŲ LENKIJA): PALINOSTRATIGRAFINIAI IR PALEOGEOGRAFINIAI BRUOŽAI

Santrauka

Straipsnyje aprašyta Domaškų profilio, esančio Lukovo (Rytų Lenkija) lygumoje, tarpledynmečio nuogulų geomorfologinė padėtis ir pateikti palinologiniai tyrimų duomenys. Tai vienas iš trijų profilių, tirtų *Samica* upės slėnyje. Tarpledynmečio nuosėdos slūgso po Vartos ledynmečio fliuvioglacialinėmis nuogulomis arba, kaip nustatyta Domaškų vietovėje, po aliuvinėmis-biogeninėmis Vyslos ir holoceno laikotarpio nuosėdomis. Įvairios litologinės sudėties Mazovijos tarpledynmečio nuosėdų žiedadulkių spektras atskleidė kelias fazes. Borealinių beržų bei pušų ir beržų miškų fazė vyravo atšilimo metu tarpledynmečio pradžioje. Eglės, alksnio ir kukmedžio fazė žymi pirmąją tarpledynmečio optimumo pusę. Po kėnio ir skroblo optimalaus paplitimo fazės, kuriai buvo būdinga egzotinių augalų (tarp jų *Pterocarya*, *Buxus*) priemaiša, išplito pušų miškai bei atvirų vietų augalai, liudijantys atšalimą. Geomorfologiniais ir palinologiniais tyrimų duomenimis, dabartinės *Samica* upės slėnio kilmė yra sena (pradedant ledynmečiu San = Elster2 = Berezian), o stratigrafinė pertrauka, apimanti ankstyvojo pleistoceno nuogulas, susidarė dėl vandens erozijos ledynmečių metu ir / arba dėl stiprios upės srovės erozijos anaglacialinės ir kataglacialinės fazių metu.

Raktažodžiai: Mazovijos tarpledynmetis, palinologiniai tyrimai, Lukovo lyguma