Veget Hist Archaeobot (2011) 20:199–206
DOI 10.1007/s00334-011-0284-4

ORIGINAL ARTICLE

Vegetation changes during the Slavic period, shown by a high resolution pollen diagram from the Maujahn peat bog near Dannenberg, Hanover Wendland, Germany

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Received: 22 November 2010 / Accepted: 1 February 2011 / Published online: 17 February 2011

Abstract In the Maujahn peat bog the Slavic period is recorded with a high-resolution pollen diagram in 150 cm of the peat profile. In the upper part of the pollen diagram the time resolution is 3.2 years in the middle and lower part 5.2 years. The Slavic period can be divided into four stages according to different kind of land use and intensity of human influence. The main crop was *Secale*; less important was the cultivation of *Triticum*, *Panicum*, *Hordeum*, *Avena* and *Pisum*. The Slavic period lasted from about A.D. 800–1200. The pollen diagram also displays a final part of the Migration period.

Keywords Palaeoecology · Slavic period · Germany · Lower saxony

Introduction

In several palynological studies so far published from Northern Germany, the Slavic period is represented in less than 30 cm of the sediment column and consequently it is difficult to produce a high-resolution pollen diagram for that period. This is true for sites investigated so far in the neighborhood of the Maujahn peat bog, in other parts of the Hanover Wendland and in the westernmost part of Brandenburg just opposite to the Hanover Wendland east of the river Elbe as well as for Lake Arend (Fig. 1) situated in Sachsen-Anhalt south of the Hanover Wendland (Christiansen 2008) and for the Löddigsee in Southern Mecklenburg (Jahns 2007). Only in Lake Rudow (Fig. 1) is the Slavic period represented in somewhat more of the sediment column (Jahns and Christiansen, personal communication). Furthermore, there is almost no information about a subdivision of the Slavic period by means of vegetation changes in the area concerned. Only Lange (1971, 1976, 1980) and Jeschke and Lange (1987) gave some information for East German lowland sites about changes in the amount of cereal pollen grains during the Slavic period. Lange proposed the division of the Slavic period into three stages according the archaeological record.

A well-dated and high-resolution pollen diagram has been published from Lake Belau in East Schleswig–Holstein, where the Slavic period is developed in more than one metre of the sediment column (Wiethold 1998). Likewise, Lake Plön in Eastern Schleswig–Holstein may be mentioned (Averdieck 1974, 1978), but the distance between Eastern Schleswig–Holstein and the Hanover Wendland is too large for a comparison especially through the lack of data from the area between these regions.

Study area

The Hanover Wendland is a part of Lower Saxony situated west of the lower middle course of the river Elbe (Fig. 1). The area under study belongs to the westernmost area settled by Slavic tribes during the 7th–12th century A.D. The Maujahn peat bog (33 m a.s.l., 53°05′36.53″ N, 11°02′41.11″ E) is situated about 3 km west of Dannenberg in a deep sinkhole caused by salt tectonic processes which started during the Subboreal period. Originally the Maujahn peat bog was a deep lake about 150 m in diameter. Today, the lake surface is totally covered by *Sphagnum* mats which

Communicated by F. Bittmann.

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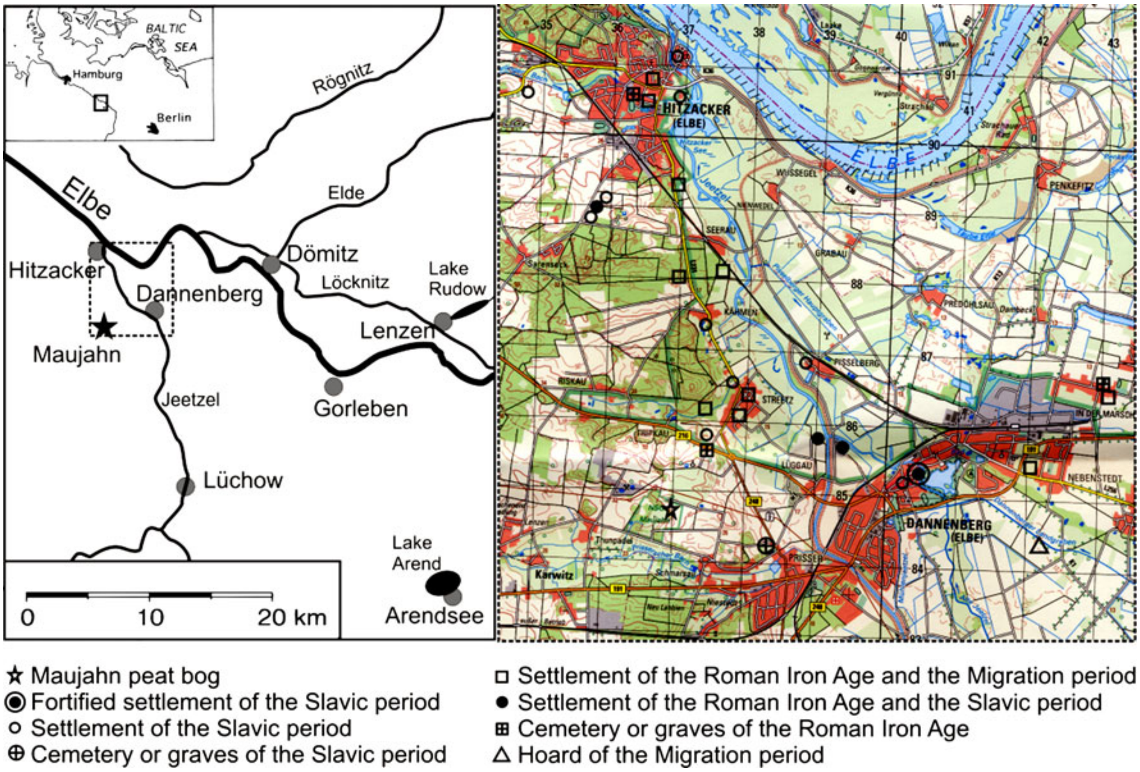

Fig. 1 Map of the study area with location of archaeological sites (after Nüsse 2008 and Saile 2007). Printed by permission (Landesvermessung und Geobasisinformation Niedersachsen—D 17470); grid 1 × 1 km

are up to 3.5 m thick near to the eastern margin of the peat bog where the cores were obtained.

Materials and methods

In 2006 a peat profile of the uppermost 3 m at the eastern part of the Maujahn peat bog was cored with a Russian corer in order to check the suitability of the peat layer for a high resolution palynological study of the Slavic period. The choice of the site followed the study of Lesemann (1969). The result of the check study showed that the Slavic period seemed to be well represented in that part of the peat profile. Consequently in 2007 two more cores were taken, one for palynological studies and the other one for radiocarbon dating. The cores consist throughout of poorly decomposed *Sphagnum* peat without any changes, therefore no stratigraphic column is given in the pollen diagram (Fig. 2).

The palynological work was focussed on the depth between 46 and 248 cm. From 46 to 84 cm, samples were counted every cm. Below 84 cm the sample distance is 2 cm. Names used for the different pollen types are in accordance with Beug (2004). For all pollen samples 1,000 arboreal pollen grains (AP sum) were counted excluding *Betula*, *Alnus* and *Corylus*. The number of all pollen types is calculated in percentages of the AP sum. For the laboratory technique see Beug (2004).

The pollen diagram can be divided into six local pollen zones (LPZ). Radiocarbon data are given for all LPZ boundaries (Table 1).

Archaeological setting

The Maujahn peat bog is situated near the river Jeetzel which flows from south to north and finally into the river Elbe near the town of Hitzacker. In this region, dry areas of somewhat higher elevation nearby the rivers and brooks have been intensively settled and used agriculturally since the last century B.C. In the west of the Drawehn hills there are only very few archaeological sites. Several settlements from the Roman Iron Age have been found together with their cemeteries around Hitzacker as well as around Dannenberg (Nüsse 2008; Fig. 1). During the 4th century A.D. the density of settlements decreased markedly as happened likewise in other parts of the Hanover Wendland. Only a few settlements existed until the middle of the 5th century. All archaeological sources point to this drastic decrease of the population or even to an absence of settlements in many parts of the area concerned during the Migration period. There is only the hoard from Nebensted dated to the 6th century which indicates that the area was not totally abandoned during that time.

The recolonization of the Hanover Wendland started in early medieval times and mainly coincided with the first appearance of Slavic tribes in the area (Saile 2007). For a long time the beginning of the Slavic settlement was dated to the 7th century (Wachter 1998). The present knowledge, however, suggests a date in the 8th century or at the end of the 7th century (Willroth 1999). There are a few early Slavonic settlements that are situated in places of the late Roman Iron Age and the early Migration period. However there is no proof of settlement continuity; the reason must be a concordance of places suitable for settlements. After an early recolonization period the settlement intensity increased from the 9th and 10th century. Not later than in the 9th century fortified settlements were established in Hitzacker and Dannenberg. Archaeological finds from near both places indicate concentrations of rural settlements. Both fortifications were centres within their surroundings. So far, only the two fortifications have been studied archaeologically, and it must be said that there is a significant lack of research on rural settlements within the surroundings of these two sites.

In the middle part of the 12th century the rather extensive independence of the Slavic settler came to an end during the German eastward expansion. Under the government of the German earls of Lüchow and Dannenberg and influenced by *Heinrich der Löwe*, Duke of Saxony, a large number of new settlements were founded and agriculture was intensified.

Results

Main characteristics of the local pollen zones LPZ 1–6

LPZ 1 (248–203 cm). *Fagus* decreases from 70 to 20%, *Quercus* increases from 20 to 40%. Low values of *Pinus*. NAP 10–20%. *Secale* 1–2%, small values of the *Triticum* and *Hordeum* type. All secondary anthropogenic indicators display low values. Poaceae 5–15%, *Pteridium* 1–2%.

LPZ 2 (203–138 cm). *Fagus* 20–30%, *Quercus* 30–50%, *Pinus* increases at the LPK 1/2 transition to 15–20%, and NAP to 40–60%. High *Betula* values. *Secale* 5–10%, *Triticum* and *Hordeum* type values are very low. Scattered finds of cf. *Panicum* and of *Avena* type. First pollen grain of *Fagopyrum*. Sum of the anthropogenic indicators 10–20%. Scattered finds of *Centaurea cyanus* and *Scleranthus*, one pollen grain of *Agrostemma*. Poaceae p.p. 10–25%, *Pteridium* up to 15%.

LPZ 3 (138–112 cm). *Carpinus* decreases from 20 to 6%, *Quercus* increases to 60%. *Pinus* and *Betula* decrease. *Pteridium* decreases to 2%. First pollen grain of *Castanea*. The average percentage of *Secale* is 5.8%.

LPZ 4 (112–82 cm). Tree pollen curves without major changes. Slight decrease of the *Secale* curve (average value 3.9%). One pollen grain of *Linum usitatissimum* and two pollen grains of *Pisum sativum*.

LPZ 5 (82–53 cm). Increase of *Calluna*, *Secale* (average value 6.7%) and especially at the end of the LPZ of NAP and anthropogenic indicators. One pollen grain each of cf. *Arnoseris minima* and *Glaucium*.

LPZ 6 (53–46 cm). *Fagus* and *Carpinus* decrease to minimal values. Considerable increase of *Pinus*, *Calluna*, NAP, Poaceae p.p. and *Secale*. *Triticum* type and *Hordeum* type remain almost constant. Among the other anthropogenic indicators there is an increase especially of *Rumex acetosa* type, Brassicaceae and Chenopodiaceae. First pollen grains of *Xanthium spinosum* type and one grain of *Malva neglecta*. Continuous curve of *Fagopyrum*.

Time resolution of the pollen diagram and duration of the local pollen zones

In the pollen diagram the time resolution is 3.2 years in the period LPZ 5 and 5.2 years for the period LPZ 2–4 based on mean values calculated from the radiocarbon data. For the duration of the local pollen zones LPZ 1–6 mean values of the 2σ interval with the highest probability are used (Table 1). For the LPZ boundary 1–2 the mean value of the data above and below the zone boundary is used in spite of the possibility of a small hiatus at that part of the peat column.

LPZ 2	184 years
LPZ 3	17 years
LPZ 4	116 years
LPZ 5	93 years

For the duration of the Slavic period (LPZ 2–5) about 400 years can be calculated.

Discussion and conclusions

The pollen sequence can roughly be divided into three parts: an early period with little human influence before A.D. 800

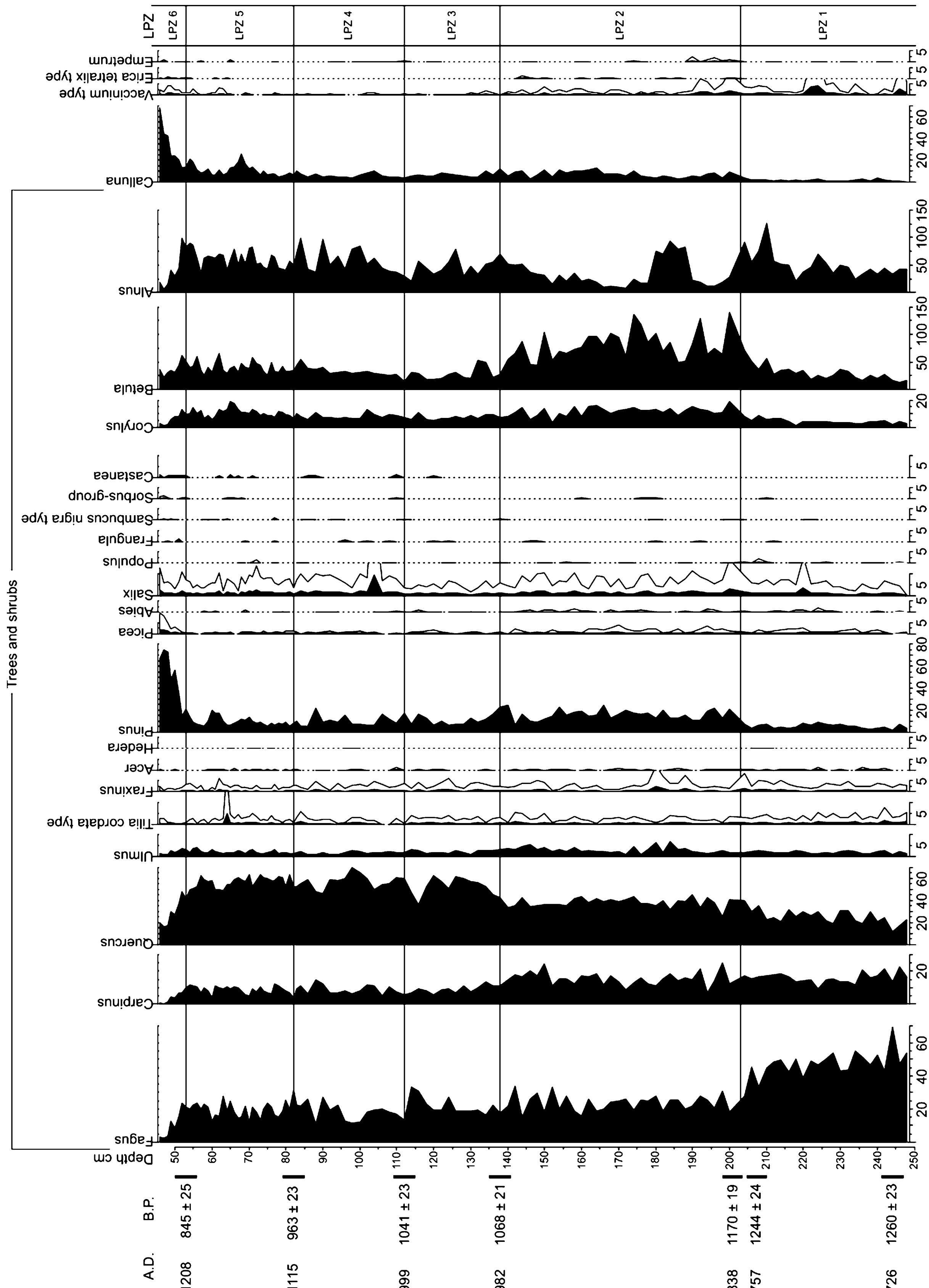

Fig. 2 Maujahn pollen diagram with curves of selected taxa. For the B.P. dates and calibration data see Table 1

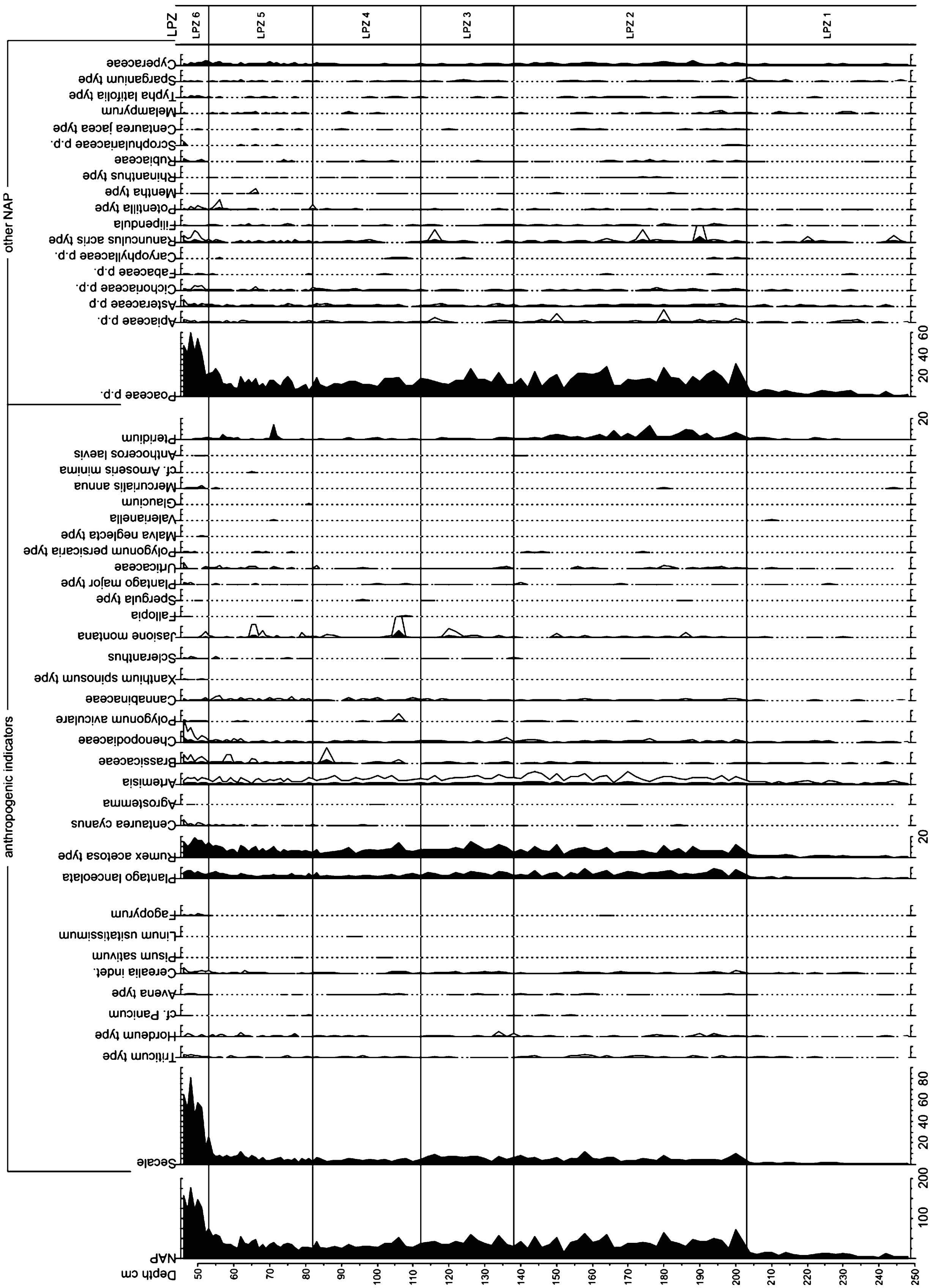

Fig. 2 continued

Table 1 ^{14}C data for the Maujahn peat bog. Calibration is based on the IntCal04 calibration data set (Reimer et al. 2004) using the program CALIB rev.5.0.1; shown are the mean and the 1- and 2σ-ranges (*) of the highest probability

Depth (cm)	Lab-code	^{14}C age (B.P.)	Cal age (A.D.)	δ^{13}C (‰)	Remarks
50–56	KIA 36623	845 ± 25	1197 (1172–1221) 1208 (1160–1256)*	−24.77	LPZ 5/6
79–85	KIA 36624	963 ± 23	1106 (1091–1121) 1115 (1076–1154)*	−21.49	LPZ 4/5
109–115	KIA 36625	1041 ± 23	1004 (990–1018) 999 (971–1026)*	−21.7	LPZ 3/4
135–141	KIA 36626	1068 ± 21	994 (972–1015) 982 (945–1019)*	−25.75	LPZ 2/3
198–204	KIA 36627	1170 ± 19	875 (857–892) 838 (778–897)*	−23.54	Above LPZ 1/2
204–210	KIA 36628	1244 ± 24	720 (691–749) 757 (684–829)*	−25.26	Below LPZ 1/2
241–247	KIA 26629	1260 ± 23	721 (693–749) 726 (671–782)*	−24.99	Base of pollen diagram

(LPZ 1), a middle period with distinct human impact from about A.D. 800–1200 (LPZ 2–5), and a late period with strong human influence after A.D. 1200 (LPZ 6).

The first period LPZ 1 can be dated to the end of the Migration period. In the study area *Secale* was cultivated, a crop which was already used in north-western Germany as a cereal since the Roman Iron Age (Behre 1992; Kirleis 2002). As the area was sparsely populated in this period (see 'Archaeological setting' above), human influence on the vegetation cover was limited. The beginning of somewhat stronger human impact at about A.D. 800 can be explained by the first arrival of Slavic settlers. At about A.D. 1200 the end of the Slavic period is shown in the pollen diagram by the onset of a much more extended human impact which is correlated with the late medieval enlargement of land use and population by the German eastward expansion.

The Slavic period lasted about 400 years and can be divided into four stages. With the beginning of the first stage of the period (LPZ 2) Slavic people began rye farming on a larger scale than had been done before during the Migration period. Other cereals were cultivated in lower quantities only. High *Betula* values and an increase of the amount of *Pteridium* spores are typical for this first stage of the Slavic period. Behre (1981) attributes increasing *Pteridium* values to the grazing of cattle in the forests, but the same effect can be caused by fire. However since no charcoal particles were found in the pollen samples, the influence of fire can be excluded. Therefore, grazing of cattle in the woodland by Slavic tribes is indicated in contrast to the habit of the settlers in the Migration period. Grazing cattle and the cutting of trees may have caused open parts in the forests, where *Betula* and *Corylus* expanded. The decrease of *Fagus* and the increase of NAP at the LPZ 1/2 boundary indicate that the new population opened the forests selecting those parts with best soil quality. The simultaneous increase of *Pinus* values can be explained by a higher influence of long distance pollen transport coming from areas with pine forests east of the river Elbe.

In the very short second stage of LPZ 3, the values of *Pteridium* and *Betula* decreased. This may be explained by a certain change in the economy. The decrease of the curve of *Carpinus* indicates an intensified clearance of the forests on more fertile soils during the 10th century.

In the third stage of the Slavic period (LPZ 4) a slight decrease in the amount of human impact can be stated. This can be especially seen by the decrease of the *Secale* curve. Pollen grains of *Pisum sativum* were found here.

The last stage of the Slavic period (LPZ 5) clearly shows a continuous increase in human impact. At the end of LPZ 5 the evidence for human impact is higher than ever before in the course of the Slavic period.

At the transition from LPZ 5 to 6 the curves of *Fagus*, *Carpinus* and *Quercus* decrease to very small values. *Pinus* reaches about 70% and even *Picea*, not native here, shows an increase. This speaks in favour of rapid and heavy clearance of forests through which the long distance pollen influx consequently started to play a more important role in the pollen rain than before.

The presence of *Castanea* pollen grains since about A.D. 1000 (LPZ 4) and its continuous curve in LPK 6 are remarkable. This is unique for the region, where *Castanea* pollen grains are absent or extremely rare as far as pollen diagrams exist in the Hanover Wendland and adjacent areas.

Among the cereals that were cultivated during the Slavic period, rye was the most important. Barley, wheat and oats were of minor significance. It is difficult to estimate the role of *Panicum miliaceum* among the cereals in the study area. *Panicum* appears in the pollen diagram with small values only. The pollen grains are difficult to identify and only a part of them show the size of the cereal type while the remaining part belongs to the wild grass pollen type (Beug 2004). As far as macro remains from excavations of Slavic settlements in the Hanover Wendland have been studied, *Panicum* is often found to be the dominant cereal but the ratio between *Secale* and *Panicum* changes considerably from site to site (Stika, personal communication). Among the other cultivated plants, *Pisum sativum* should be mentioned. Surprisingly, a few pollen grains of *Fagopyrum* were found in pollen spectra of the Slavic period. The continuous *Fagopyrum* curve, however, starts no earlier than at the LPZ 5/6 border at about A.D. 1200. Pollen grains of *Fagopyrum* were also found in sediments of the Slavic period from the Lenzen castle situated east of the river Elbe, opposite to the Hanover Wendland, indicating that the Slavic people were familiar with the use of buckwheat. However no macro remains of buckwheat have so far been found (Stika and Jahns in press). A single pollen grain of *Linum usitatissimum* in LPZ 4 may also be mentioned. It possibly indicates flax cultivation during the Slavic period. Concerning pollen grains of *Pisum* and *Linum usitatissimum* it is difficult to make statements about their significance as cultivated plants because their pollen production is low.

Among the secondary anthropogenic indicators *Plantago lanceolata*, *Rumex acetosa* type, *Centaurea cyanus*, *Artemisia*, Brassicaceae, Chenopodiaceae, Cannabinaceae (genus identification not possible), *Jasione montana*, *Plantago major* type and *Pteridium* are the more important members of that group. The *Xanthium spinosum* type and *Mercurialis annua* do not appear before LPZ 6. New and rare members within the group of secondary anthropogenic indicators are the *Malva neglecta* type, *Glaucium* and cf. *Arnoseris minima*.

According to Fig. 1 the nearest Slavic settlement so far known is situated at a distance of 1.5 km NE of the Maujahn peat bog. The Slavic fortification of Dannenberg is situated about 3.5 km E of the peat bog. So far as is known the nearest settlements of the Roman Iron Age and Migration period are situated at a distance of 2.0–2.5 km from the peat bog. It is difficult to decide whether the frequent *Secale* pollen, which reach values of 10% during the Slavic period, originates from the known Slavic settlements or from unknown Slavic settlements closer to the Maujahn peat bog, but unknown so far. The onset of Slavic colonization is dated here to about A.D. 800, i.e. somewhat later than pointed out by the present day archaeological information.

Finally it should be emphasised that several pollen curves, especially those of *Fagus*, *Carpinus* and *Quercus*, display far more (minor) fluctuations than could be expected when counting a sum of 1,000 arboreal pollen grains per sample. The explanation is the high time resolution (3 or 5 years from spectrum to spectrum), which makes differences in the annual pollen production visible. For instance *Fagus* produces every 5 years on average many more flowers than in other years.

Acknowledgments This contribution is dedicated to the late Dr. Brunhilt Lesemann who was the first to study the Holocene vegetation history of the Hanover Wendland for her doctoral thesis at the University of Göttingen. Thanks are due to K.-H. Willroth, Göttingen, for the section ‘Archaeological setting’ and to J. Christiansen, Göttingen, for his help in the field and for producing the figures. Thanks are also due to P.M. Grootes, Leibniz Laboratory, University of Kiel, for providing the radiocarbon data and also to the Landkreis Lüchow-Dannenberg for the permission to work in the protected area of the Maujahn peat bog.

Appendix

As a result of the palynological work, a total of 146 different pollen and spore types have been identified. Many of them, especially those which appear in small numbers, are not included in the pollen diagram. They are listed below.

Tree and shrub pollen types

Juglans, *Vitis*, *Ilex*, *Aesculus*, *Juniperus*, *Myrica*, *Rhamnus* type, *Viburnum opulus*, *Taxus* and *Cornus sanguinea*.

NAP pollen and spore types

Oenanthe fistulosa, *Pimpinella saxifraga*, *Hydrocotyle*, *Conium* type, *Gypsophila*, *Minuartia* type, *Cerastium* type, *Silene* type, *Dianthus*, *Melandrium*, *Vicia* type, *Lotus*, *Trifolium repens*, *T. pratense*, *T.* p.p., *Lathyrus* type, *Caltha*, *Thalictrum*, *Sanguisorba minor*, *Solanum dulcamara*, *Lysimachia vulgaris* type, *Ballota* type, *Lamium* album, *Lythrum*, *Erodium*, *Hypericum perforatum* type, *Centaurea scabiosa* type, *Cirsium* type, *Eurumex* type, *Rumex aquaticus* type, *Polygonum bistorta* type, *Valeriana dioica*, *Viola odorata* type, *Mercurialis perennis*, *Gentiana pneumonanthe* type, *Campanula*, cf. *Chrysosplenium*, *Thesium*, *Knautia*, *Succia*, *Scabiosa columbaria* type, *Parnassia*, *Liliaceae*, *Symphytum*, *Drosera rotundifolia*, *Alisma type*, *Utricularia*, *Myriophyllum spicatum*, *Potamogeton natans* type, *Menyanthes*, *Athyrium*, *Dryopteris filix* mas, *Thelypteris palustris*, *Ophioglossum*, *Botrychium*, *Polypodium*, *Lycopodium clavatum* type, *Lycopodium annotinum* type and *Lycopodiella inundata*.

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