Holocene vegetation evolution in the Kleine Nete Valley in Herentals Bruggenbeemd (Antwerp, BE)

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1. Introduction

Palynological analyses, combined with radiocarbon dates, provide great opportunities for understanding the changes in the living environment of prehistoric communities. However, organic sediment records that are suitable for palynological analysis are very limited in Northern Belgium: besides the Middle and Late Holocene coastal peat bogs, long organic sequences of Holocene age can only be found in river valleys. In the western part of the Scheldt Basin (Scheldt and Durme Valley), quite some pollen records are available and have led to the construction of biostratigraphic schemes. Verbruggen *et al.* (1996) proposed a regional pollen biozonation for Sandy Flanders, with zones named after the chronozones of Mangerud *et al.* (1974) (Oldest Dryas to Subatlantic). Storme *et al.* (2017) defined an updated biozonation with better time-control for the Scheldt Basin, including zones SB1 to SB7.

For the eastern part of the Scheldt Basin on the other hand, long and well-dated Holocene pollen records are scarcer and there exists no regional pollen biozonation for that region. In this paper, a new pollen record from Herentals, in the Kleine Nete Valley, will be compared with data from the western part of the Scheldt Basin. The goal is to assess whether the regional vegetation and the local alluvial environment in the Kleine Nete Valley develop in the same way and at the same pace as in the valleys of the Scheldt and the Durme. This may be a first step in determining whether the regional biozonation for the Scheldt Basin is also valid for the smaller valleys in the eastern part of the Basin.

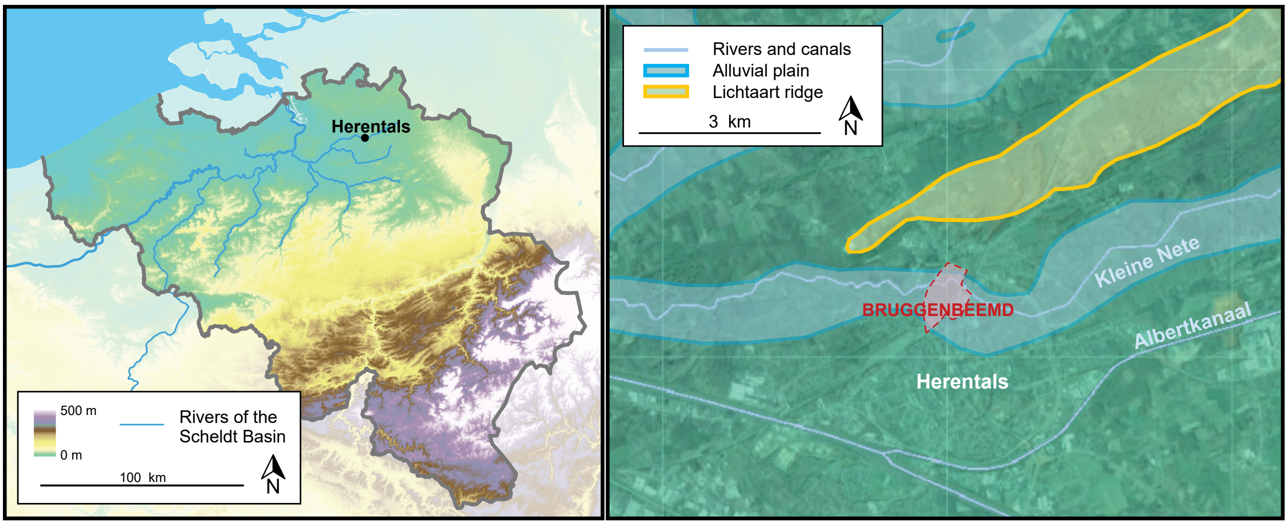


Fig. 1 – Location of study area Bruggenbeemd in the Kleine Nete Valley in Herentals. Left: DEM based on SRTM data (NASA *et al.*, 2002); Right: detailed map based on Quaternary geological map (1/200 000) from geopunt.be.

To this end, a Holocene peat sequence from a palaeochannel of the Kleine Nete at Herentals Bruggenbeemd (Fig. 1) is analysed palynologically and radiocarbon dated. These analyses allow to study especially the Early Holocene in detail.

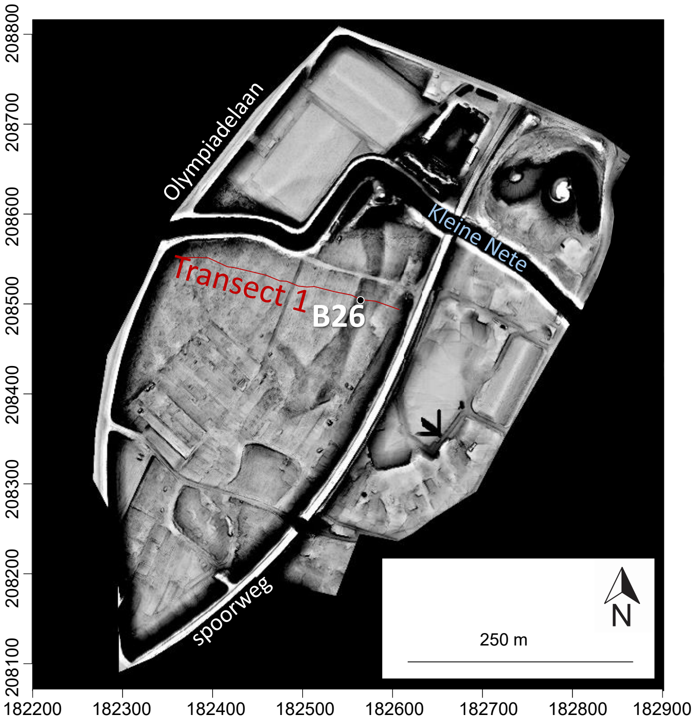


Fig. 2 – Elevation map (Rozek et *al*., 2020) with location of transect 1 and core B26. Location: x = 182 570 m; y = 208 500 m; z = 11.6 m TAW.

2. Material

In July 2020, during a palaeolandscape survey in Herentals Bruggenbeemd (Fig. 1, Fig. 2), six lithostratigraphic profiles were constructed based on hand augering transects. The longest of these transects (transect 1) revealed a palaeochannel (Fig. 3) that is also recognizable as a depression in the DEM (Fig. 2).

The deepest point of the palaeochannel encountered during this survey was found in core B26 in transect 1 (Fig. 2, Fig. 3). The channel infill was subsequently sampled at this location by means of a gouge auger. The sampled sequence consists of two core sections with an 8 cm hiatus between them. Above the basal Weichselian coarse sand deposits, the infill starts at 8.95 m TAW with a 5 cm thick layer of brown, stratified, silty fine sand, followed by a return of glauconitic coarse to medium sand (Fig. 4). From 9.03 m TAW, the infill continues with one metre of peat. The lower part of the peat layer is black, clearly stratified and with recognizable fine plant remains. The upper part consists of more brownish wood peat. Above 10.10 m TAW, the natural sequence is topped off with recent anthropogenic deposits.

The brown fine sand layer and the peat layer were subsampled from the gouge core (Fig. 4). Palynological subsamples (ca. 1 ml) were taken at 23 levels. Samples for radiocarbon dating consist of 2 to 3 cm thick slices of the core at seven different levels.

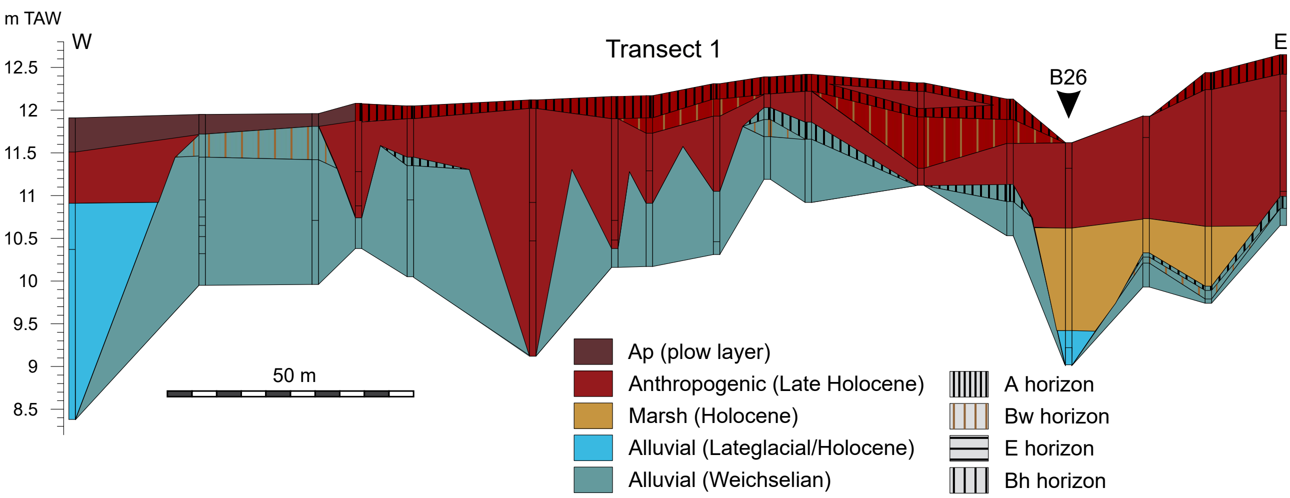
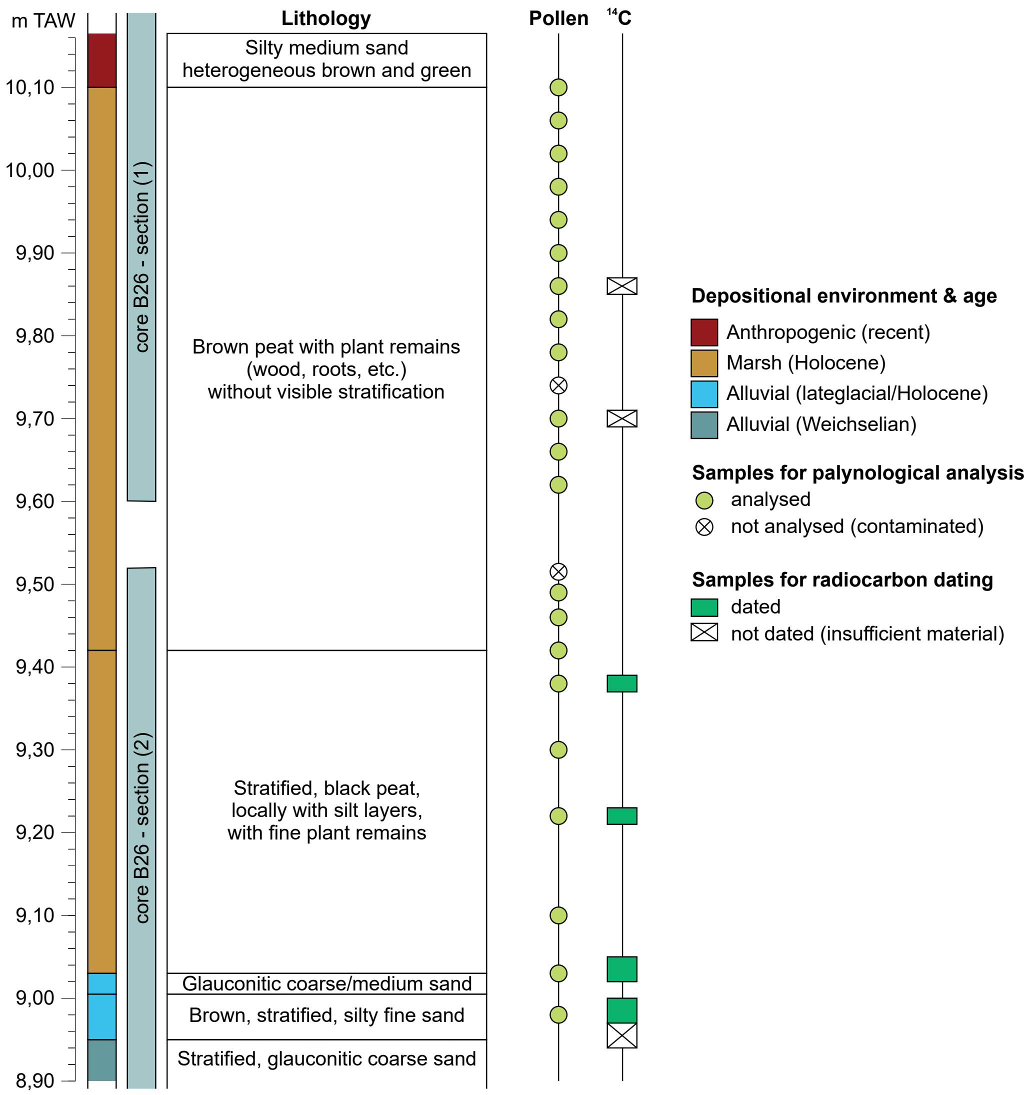


Fig. 3 – Transect 1 (location in Fig. 2) showing the sampled peat-filled channel.

Fig. 4 – Lithological description of core B26 and stratigraphic position of the subsamples for palynological analysis and radiocarbon dating.



3. *Method*

3.1. Palynological analysis

The selected palynological subsamples were treated in the Palaeontology lab of Ghent University according to the standard procedure for pollen preparation (Moore *et al.*, 1991), including acetolysis and dissolution in hydrogen fluoride. A known amount of Lycopodium spores was added to each sample during preparation in order to estimate the pollen concentration for each analysed level.

The prepared residues were studied with a light microscope at 400x magnification. Pollen, spores and non-pollen palynomorphs were identified (Beug, 2004; Moore *et al.*, 1991; Shumilovskikh, 2022) until at least 400 pollen grains were counted. All taxa (pollen, spores, non-pollen palynomorphs) are expressed as a percentage of the pollen sum, which includes all pollen grains of terrestrial plants (AP: arboreal pollen & NAP: non-arboreal pollen). Furthermore, the concentration of pollen and microcharcoal fragments (> 10 µm) was calculated, based on the number of Lycopodium spores counted. The preservation quality was evaluated by scoring a number of pollen grains from 1 (very poor) to 5 (excellent) and calculating the average. These data (percentages, concentrations, preservation) are presented in a pollen diagram using TILIA software (Grimm, 2015). Based on shifts in pollen assemblages, the sequence is divided in biozones.

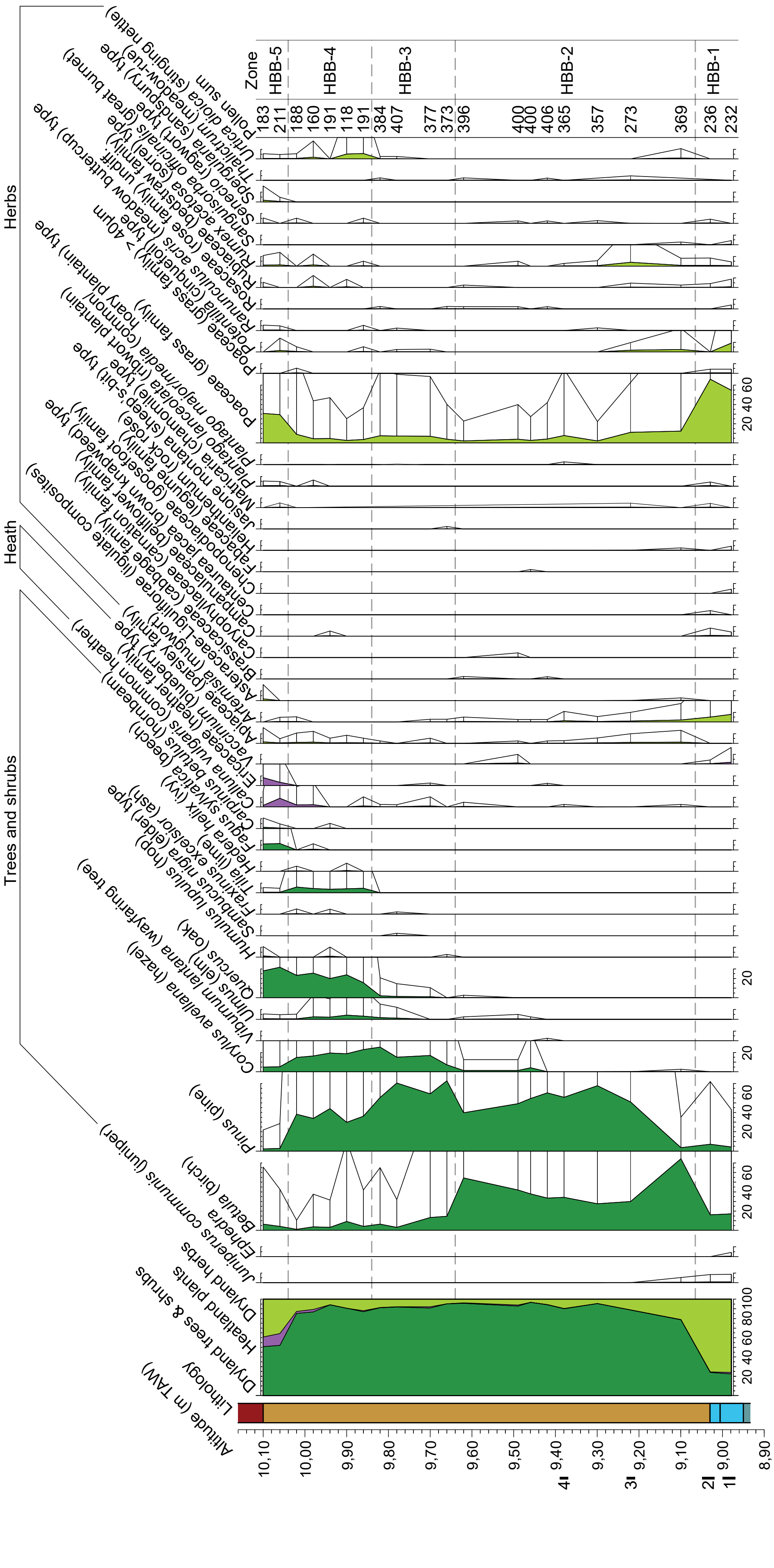


Fig. 5-1 – Percentage diagram. Part 1: pollen from upland plants (included in pollen sum).

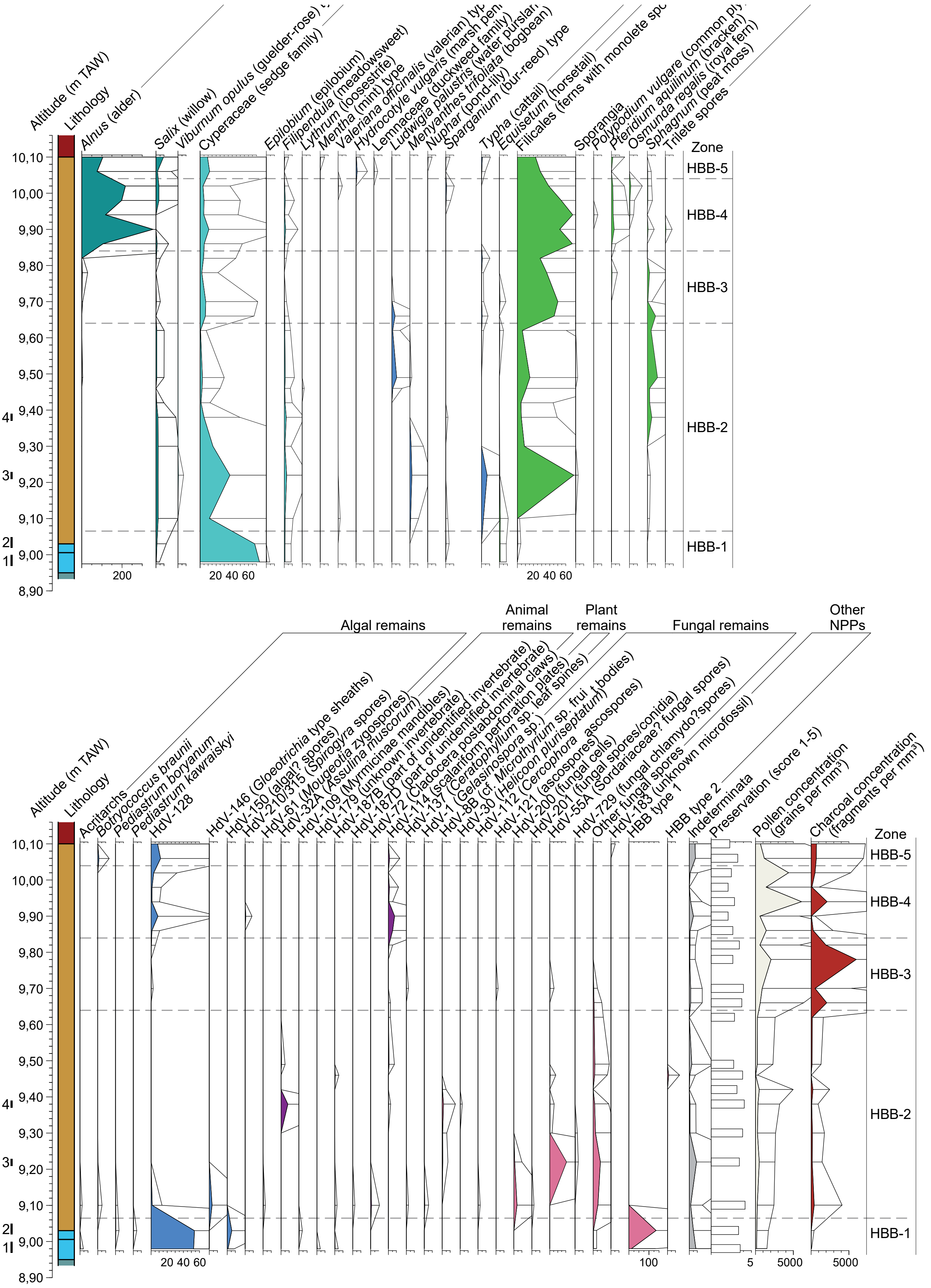


Fig. 5-2 – Percentage diagram. Part 2: pollen from wetland and aquatic plants & plant spores.
Part 3: Non-pollen palynomorphs.

3.2. Radiocarbon dating

Samples for radiocarbon dating were sieved on 2 mm and 0.5 mm meshes. From the sieve residues, above-ground parts of terrestrial plants (seeds, fruits, leaves) were selected. The samples were AMS-dated at KIK (Royal Institute for Cultural Heritage). The resulting dates were calibrated with OxCal 4.4 (Bronk Ramsey, 2009), using the IntCal20 calibration curve (Reimer *et al.*, 2020).

4. Results

4.1. Palynological analysis: regional component

The sample from the top centimetre of section 2 (at 9.52 m TAW) and a sample from section 1 (at 9.74 m TAW) contained atypical pollen compared to neighbouring pollen spectra, e.g. early occurrences of *Alnus*, *Tilia, Fagus* and *Carpinus*. These samples are considered to be contaminated during coring or sampling and are left out of the diagram.

The pollen spectra can be grouped in five biozones (Fig. 5) based on changes in the composition of the regional component. The characteristics of each biozone are presented below, along with the resulting interpretation of the regional vegetation and correlation with biostratigraphical zonations from the Scheldt Basin (Storme *et al.*, 2017) and Sandy Flanders (Verbruggen *et al.*, 1996).

4.1.1. Zone HBB-1

The first biozone corresponds to the sandy layer in the base. The pollen spectra show a dominance of herbs, with considerable percentages of Poaceae, *Artemisia* and *Potentilla*. Several other herb taxa, mostly indicative of grassland, are occasionally present. Arboreal taxa are represented by *Betula* (*ca.* 17 %), *Juniperus* and *Ephedra*. The *Betula* pollen may either be from a tree form of birch or dwarf birch. The low amounts of *Pinus* pollen are assumed to originate from long distance transport. These spectra point to a regional vegetation consisting of grasslands with sparse bushes of birch, juniper and ephedra. This corresponds to the typical vegetation of the colder periods of the lateglacial. In combination with the radiocarbon dates (*cf. infra*), we propose a correlation with biozone SB-1 / Younger Dryas (Storme *et al.*, 2017; Verbruggen *et al.*, 1996).

4.1.2. Zone HBB-2

The second zone comprises the lower 60 cm of the peat layer. It is characterised by high values of *Betula* (> 30 %). In addition, *Pinus* exceeds 50 %, except in the base of the zone. Herbs occur in small numbers, with among others Poaceae, *Artemisia*, Apiaceae and *Rumex acetosa* type. These spectra point to rather dense birch-pine forests as is typical for biozone SB-2 and -3 / Preboreal (Storme *et al.*, 2017; Verbruggen *et al.*, 1996), although in this location *Pinus* seems to appear much earlier than in the western Scheldt Basin or Sandy Flanders.

4.1.3. Zone HBB-3

The transition from zone HBB-2 to -3 is characterised by a sharp drop of *Betula* values, accompanied by a rise of *Pinus* (up to *ca.* 70 %) and *Corylus* (up to *ca.* 25 %). *Ulmus* and *Quercus* are present in low numbers. NAP variety and abundance is low, with mainly Poaceae (4-8 %). Part of the Filicales spores might be from ferns in the understorey of the dryland forests. During the deposition of this zone, a dense mixed forest developed, which is typical of biozone SB-4 / Boreal (Storme *et al.*, 2017; Verbruggen *et al.*, 1996).

The high concentration of microcharcoal fragments indicates the occurrence of forest fires.

4.1.4. Zone HBB-4

AP values remain high in this zone (*ca.* 90 %). *Pinus* and *Corylus* remain abundant, but are now accompanied by more important amounts of *Quercus* (*ca.* 20 %), *Tilia* (*ca.* 5 %) and *Ulmus* (*ca.* 3 %) and a number of occasionally present trees and climbers. The NAP is generally low, with herbs such as Poaceae (*ca.* 4 %), *Pteridium aquilinum* (*ca.* 2 %) and a peak of *Urtica dioica* type. The dryland forest is now dominated by oak and other deciduous trees with an understorey of bracken. The presence of stinging nettle may well be a local phenomenon. Forest fires occurred at least at one occasion (*cf.* charcoal peak at 9.94 m TAW). This zone is interpreted as the equivalent of biozone SB-5 / Atlantic, possibly including the transition to zone SB-6 / Subboreal (Storme *et al.*, 2017; Verbruggen *et al.*, 1996).

4.1.5. Zone HBB-5

In the upper zone, the AP drops to *ca.* 50 %, while heathland shrubs and herbs increase to respectively *ca.* 10 % and *ca.* 40 %. Most tree taxa decrease compared to the previous zone. However, *Quercus* (*ca.* 30 %) and *Fagus* (*ca.* 6 %) increase. Heathland shrubs include *Calluna vulgaris*, but many pollen grains could not be further identified than family level (Ericaceae). The NAP mainly consists Poaceae (*ca.* 30 %). The landscape was partly deforested, although important portions of beech-oak forest remained. There is no direct evidence of agricultural activities, although the presence of heathland and grassland may indicate livestock breeding. Based on *Fagus* pollen exceeding 1 %, this zone corresponds to the Subatlantic biozone (Verbruggen *et al.*, 1996).

4.2. Palynological analysis: local component

Although the local component was not taken into consideration when defining the five biozones, the zone boundaries also coincide with some important changes in local elements.

4.2.1. Zone HBB-1

The high values of Cyperaceae indicate that the local vegetation was dominated by sedges, probably at the edge of a channel. The algae, including HdV-128, -150 and some *Pediastrum* colonies, testify to open water or at least temporary influx of water. An unknown microfossil, here referred to as 'HBB type 1', is abundant in this zone and probably originates from a similar environment as the before mentioned algae. HBB type 1 is a pale, smooth, spherical microfossil with a slit-shaped aperture and a diameter of 20-25 µm (Fig. 6).

4.2.2. Zone HBB-2

Some algal types are still present in the base, but soon disappear. Wetland taxa such as *Salix*, Cyperaceae, *Filipendula* and Filicales are present throughout the zone, but more abundant in the lower half. Thanks to the good preservation, it is possible to confirm that most of the monolete spores (*cf.* Filicales) are from *Thelypteris palustris*. Various types of fungal spores are also mainly present in the lower half. The aquatics *Typha* and *Menyanthes* are limited to the base, while *Ludwigia palustris* and *Sphagnum* show a peak in the top. *Assulina muscorum* tests and *Microthyrium* fruit bodies are also indicative of *Sphagnum* peat. These spectra reflect a fen with sparse willow bushes and with some small open-water zones. Dominance of sedges and marsh ferns grades into a greater importance of peat moss.

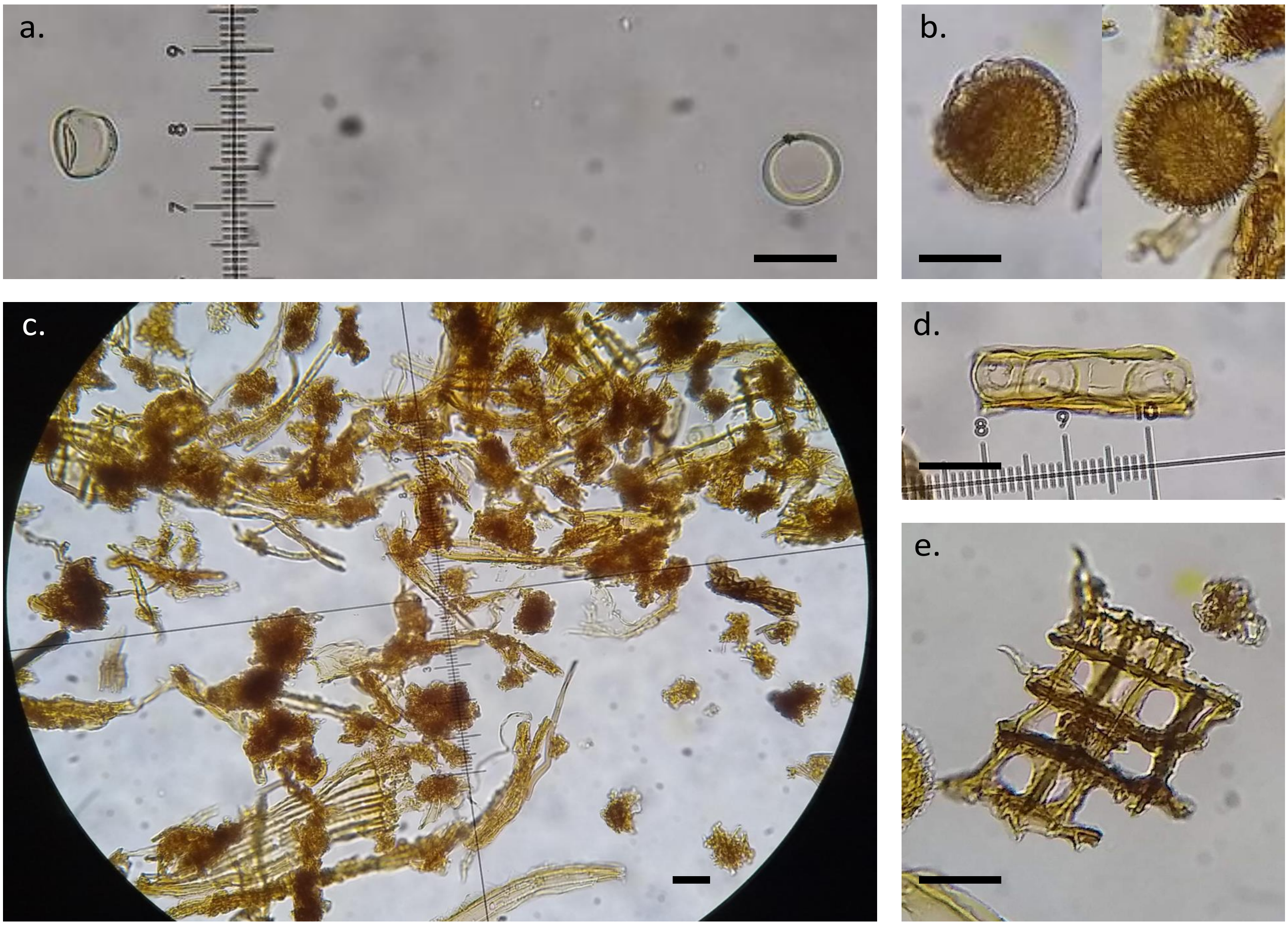


Fig. 6 – Microscopic images of some non-pollen palynomorphs in core B26. Scale bar = 25 µm.
a. unknown type 'HBB type 1'; b. unknown type 'HBB type 2'; c. matrix of the pollen residue in the sample at 9.46 m TAW, including degraded remains, probably mainly of pine wood; d. tracheid pits of conifer wood (HdV-218); e. cross-fields with fenestriform pits, characteristic of *Pinus sylvestris* wood (Schoch *et al.*, 2004).

Birch and pine may also have occurred locally, in the wetter parts of the landscape. The local presence of pine is certain at 9.46 m TAW, where remains of pine wood (Fig. 6:c-e) are abundant. They demonstrate that pine was growing in or at the edge of the valley.

4.2.3. Zone HBB-3

The percentage of *Sphagnum* and *Ludwigia palustris* decreases in the base of zone HBB-3, while Filicales (probably *Thelypteris palustris*, up to 50 %) and to a lesser extent Cyperaceae (up to 7 %) regained more importance. Low amounts of *Typha* are present and NPPs are practically absent. This composition indicates a fen environment dominated by marsh ferns and sedges. This resembles the environment from the base of zone HBB-2, although in zone HBB-3 the nutrient richness may have been somewhat higher.

4.2.4. Zone HBB-4

Alnus arrives in this zone with values over 100 % of the pollen sum and up to 350 %. Wood vessel plates (HdV-114) are probably from alder wood. Filicales show a peak (70 %) in the base, while *Salix* increases in the top (4 %). In addition, Cyperaceae and Filipendula are continuously present. Zone HBB-4 brings along a major change in the local environment with the advent of alder, forming alder carr forests with an understorey of marsh ferns, sedges and meadowsweet. By the top of the zone, willow starts to take up a more important portion of the carr, which may indicate more variable water levels.

4.2.5. Zone HBB-5

The upper zone shows a drop of *Alnus* and increase of *Salix*. Alder carr gives way to willow-dominated wetland forest. Since willow tolerates more frequent changes in water level, this probably means that the local environment was too wet or unstable for alder. Such transition me be caused by increased frequencies of flooding events. In addition, several aquatic plant taxa and algal types occur, pointing to open water. Here, we interpret this component as material that was imported from the river to the floodplain during floods.

4.3. Radiocarbon dating

No suitable material for radiocarbon dating was recovered in the lower sample from the basal sand layer and in both samples from the brown peat. Four samples from the black peat did result in dates, which after calibration all plot roughly in the 12th millennium cal BP (Tab. 1, Fig. 7). The two deepest samples, one from the top of the brown sand and one from the base of the peat, date around the transition from Weichselian lateglacial to Holocene. This indicates that peat growth started, at least in some parts of the channel, soon after the temperature rose around 11,700 cal BP. The third date, however, is older than the first. This date is considered unreliable, probably due to incorporation of reworked material. The upper date is well in line with the lower two and indicates that peat growth was rather fast in the beginning of the Early Holocene (*ca.* 10 cm per century remaining after compaction).

Core (segment)	*Altitude (m TAW)*	*Composition*	*Selected material*	*Lab number*	*Measured age (BP)*	*2 σ probability range (cal BP)*
B26 (1)	9,87-9,85	Strongly degraded, roots	No suitable material			
	9,71-9,69	Strongly degraded, roots	No suitable material			
B26 (2)	9,39-9,37	Very organic, degraded	*Betula sp. (3 nutlets), Carex sp. (9 nutlets), Pinus (4 needle fragments)*	RICH-29300	9714 ± 41	11240-10870
	9,23-9,21	Very organic, degraded	*Betula sp. (3 scales + 1 nutlet), Carex sp. (1 nutlet), Comarum palustre (9), Menyanthes trifoliata (2)*	RICH-29297	10199 ± 40	12000-11730
	9,05-9,02	Very organic, degraded	*Betula sp. (5 scales + 1 nutlet), Carex sp. (1 nutlet)*	RICH-29298	9991 ± 46	11700-11260
	9,00-8,97	Very organic, degraded	*Betula sp. (scales) (5), Cyperaceae (1), cf. Rumex acetosella*	RICH-29299	10136 ± 34	11950-11500
	8,97-8,94	Barely organic	No suitable material			

Tab. 1 – Selected material for radiocarbon dating and resulting measured and calibrated ages.

5. Interpretation and discussion

5.1. Age and correlation with climate and regional vegetation development

The studied core yields information about the dryland vegetation in the Campine area, starting from the last cold period of the Weichselian lateglacial (GS-1). The open grassland vegetation with sparse shrubs corresponds to the vegetation described for the Scheldt and Durme Valley, with the addition of *Ephedra*. Indeed, in the Netherlands, *Ephedra distachya* is considered to have grown locally during the lateglacial, with a preference for more sandy areas (Hoek, 1997).

In the Bruggenbeemd diagram, the sharp rise of *Betula* at the start of the Holocene is soon followed by a rise of *Pinus*. In the biozonation of the Scheldt basin, this rise corresponds with the base of zone SB3 and is dated around 11,000 cal BP (Storme *et al.*, 2017). However, the radiocarbon dates from Bruggenbeemd suggest that the *Pinus* rise occurred well before 11,000 cal BP (Fig. 7). An early presence of *Pinus* is also found in the Grote Nete Valley (Gelorini *et al.*, 2007). There, the dominance of pine over birch is explained as the result of the proximity of the dry and sandy Campine plateau. The same may apply to the Bruggenbeemd location, where the Kleine Nete Valley borders the Lichtaart Ridge (Fig. 1). However, from 9.46 m TAW upward, *Pinus* is definitely present within the valley, since microscopic remains of pine wood are recovered (Fig. 6:c-e). Further research, including macrobotanical analyses, higher resolution radiocarbon dating and an overview of all Early Holocene palaeo-ecological records from the eastern part of the Scheldt Basin, is needed to understand the extent and age of this early spread of pine.

Given the considerable thickness of the Early Holocene peat in Bruggenbeemd, this sequence was considered promising for assessing the effects of the 11.4 ka cold event (Rasmussen *et al.*, 2014) on the vegetation. This cold and dry oscillation was recorded as a peak of grasses in pollen records from the Lower Scheldt Valley (Kalkense Meersen, Storme *et al.*, 2017) and the Grote Nete Valley (Hechtel-Eksel, Gelorini *et al.*, 2007). By contrast, no vegetation changes that might be linked to this event were found in Bruggenbeemd. The signal may have been obscured here, by the abundance of *Pinus* pollen.

The Bruggenbeemd pollen diagram shows a late rise of oak (simultaneous with the arrival of *Alnus*, around 8600 cal BP) and low values for lime, while pine remains dominant until the Late Holocene. This is similar in the Grote Nete Valley (Gelorini *et al.*, 2007), but quite different in the Scheldt Valley, where oak replaced pine as the dominant forest tree around 9600 cal BP (Crombé *et al.*, 2019; Storme *et al.*, 2017) and lime became an important addition to these forests after 8600 cal BP. This shows that pine did not only settle earlier, but also remained present for a much longer time in the Campine area than in the western part of the Scheldt Basin.

Another remarkable difference is the presence of anthropogenic indicators in the pollen records. In the Scheldt and Durme Valley, the first signs of deforestation, soil disturbance and cereal cultivation start to appear from *ca.* 5000 cal BP. By contrast, the Bruggenbeemd record shows a very dense forest until far into the Late Holocene and does not contain any evidence of arable farming. This location seems to have been desolate for a long time, probably due to the poor sandy soils.

Finally, the upper part of the pollen diagram shows the disappearance of pine from the area, while oak-beech forests developed and the deforested land was turned over into heath- and grassland, possibly for livestock farming. Percentages of *Fagus* as high as 6 % are not found in pollen studies from alluvial sequences in the western Scheldt Basin (zone SB-7, Storme *et al.*, 2017). However, archaeological features in western Belgium do contain evidence for beech-oak forests, developing after the abandonment of Roman period occupation sites (e.g. Deforce *et al.*, 2020; Storme, 2021). It is not clear how general or patchy this forest type was spread in the Flemish sand region, so for now we don't have enough information to conclude to a correlation with the upper biozone in Bruggenbeemd.

5.2. Local palaeo-environment

The sand in the base of the studied sequence is proof of a rather high-energy stream during GS-1. Our data do not allow to determine in what type of river this deposition took place: it may have been a meandering or braided river. In any case, the flow in this channel dropped almost immediately after the climate warming at the start of the Holocene. A

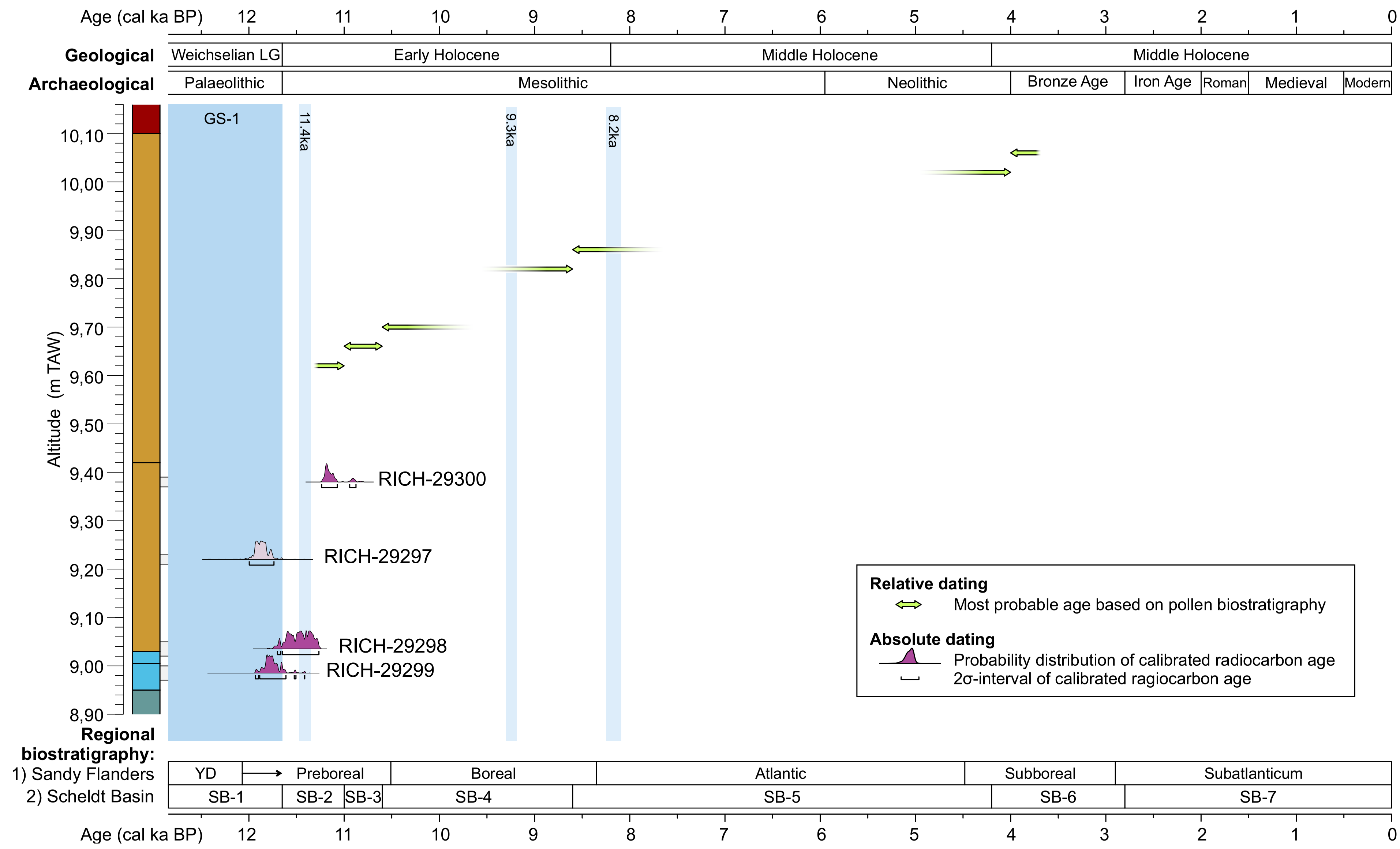


Fig. 7 – Age depth diagram with calibrated radiocarbon dates and relative dates based on correlation of local pollen zones with regional pollen biostratigraphy of Sandy Flanders (Verbruggen et *al.*, 1996) and the Scheldt Basin (Storme et *al.*, 2017). GS-1: Greenland Stadial 1 (Rasmussen et *al.*, 2014).

marsh developed in the former channel. Contrary to the deeper palaeochannels of the Scheldt and Durme valleys (Cruz *et al.*, 2021; Storme *et al.*, 2017), the infill in the Kleine Nete Valley at the studied location at Bruggenbeemd does not show a phase of gyttja deposition in a lake environment prior to the first peat growth.

In the Early Holocene, the peatland in the Kleine Nete Valley was mostly grown with herbs, such as sedges, marsh ferns and meadowsweet. Cattail and bogbean testify to depressions with open water within the marsh. In the Scheldt and Durme valleys, these fens graded into swamps, dominated by willows. By contrast, in the Kleine Nete valley, such willow swamps never really developed. It is however possible that birch took the place of willow in forming a tree layer in the swamps, but the distinction between wet and dry position of birch is impossible to make based on pollen alone.

Wood remains of *Pinus sylvestris* prove that pine was locally present from *ca.* 11,000 cal BP. We generally consider pine as a tree from dryer conditions, but less commonly, it can also inhabit swamps (Hennekens *et al.*, 2010; Luthardt *et al.*, 2015). During that same period, the Bruggenbeemd sequence shows the presence of peat moss and water purslane. We envision the vegetation in the valley as a bog forest, probably with birch in the wettest parts and pine on the somewhat drier edges, and with zones with peat moss blankets. This vegetation differs greatly from contemporaneous wetland vegetations from the western Scheldt Basin (Storme *et al.*, 2017). Our hypothesis is that those differences may be attributed to the less nutrient-rich soils in the Campine area.

As soon as alder arrived in the area (*ca.* 8600 cal BP), the wetland vegetation in the valley of the Kleine Nete turned into an alder carr, just like in any other valley in the wide region at that time. The increase of willow in the wetland forests during the Late Holocene and the presence of pollen from aquatic taxa in the top of the peat is also similar to other valleys in the Scheldt Basin. They are the result of variable water levels and increasing flood frequencies when the rivers of the Scheldt Basin turn back into single channel meandering systems (Meylemans *et al.*, 2013; Storme *et al.*, 2017).

6. Conclusions

Comparison of a new palynological record from the Kleine Nete Valley, at Herentals Bruggenbeemd, with the regional biozonation for the western Scheldt Basin, reveals some differences in vegetation evolution. The main difference is the early appearance (before 11,000 cal BP) and prolonged dominance (until the Late Holocene) of pine in the region of the Kleine Nete Valley. Furthermore, indicators of prehistoric arable farming are absent at Bruggenbeemd and an oak-beech forest developed, probably in historic times.

The local wetland vegetation also shows some differences: the Early Holocene fen vegetation at Bruggenbeemd graded into a swamp with birch, pine and zones with peat moss, whereas willow never dominated as it did in the western Scheldt Basin. This diversion in local vegetation development lasted until alder carr took over in the entire Scheldt Basin (*ca.* 8600 cal BP).

The aforementioned differences in dryland and wetland vegetation are observed in just one core. Some similar patterns are found in the Grote Nete Valley (Gelorini *et al.*, 2007). However, an extensive review of palynological data from the eastern Scheldt Basin is needed to assess whether the observed patterns are valid for a broader region. This should allow to assess the hypothesis that at least some of the observed differences are related to the soil type in the region.

Acknowledgements

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Abstract

Palynological analysis and radiocarbon dating of a peat sequence from the Kleine Nete Valley at Herentals Bruggenbeemd produced a pollen diagram covering most of the Holocene, with a particularly thick Early Holocene layer. Comparison of this new record with data from the western Scheldt Basin revealed some differences in the regional and local vegetation development. Most remarkable are, on one hand, the long-lasting dominance of pine in the dryland forests, from before 11,000 cal BP until the Late Holocene, and on the other hand, the phase of birch and pine swamp with peat moss in the Early Holocene Kleine Nete Valley.

Keywords: Palynology, Kleine Nete, Herentals Bruggenbeemd (BE), Holocene.

Samenvatting

Palynologische analyse en radiokoolstofdatering van een veensequentie uit de Kleine Nete-vallei bij Herentals Bruggenbeemd leverde een pollendiagram op dat het grootste deel van het Holoceen beslaat, met een bijzonder dikke laag uit het Vroeg-Holoceen. Vergelijking van dit nieuwe diagram met gegevens uit het westelijke Scheldebekken bracht enkele verschillen in de regionale en lokale vegetatieontwikkeling aan het licht. Het meest opmerkelijk zijn enderzijds de langdurige dominantie van dennen in de bossen op droge grond, van vóór 11.000 cal BP tot het Laat-Holoceen, en anderzijds de fase van moerasbos met berken, dennen en veenmos in de Vroeg-Holocene Kleine Nete-vallei.

Trefwoorden: Palynologie, Kleine Nete, Herentals Bruggenbeemd (BE), Holoceen.

Résumé

L'analyse palynologique et la datation au radiocarbone d'une séquence de tourbe de la vallée de la Petite Nèthe à Herentals Bruggenbeemd ont produit un diagramme pollinique couvrant la majeure partie de l'Holocène, avec une couche particulièrement épaisse de l'Holocène inférieur. La comparaison de ce nouveau diagramme avec les données du bassin occidental de l'Escaut a révélé certaines différences dans le développement régional et local de la végétation. Les plus remarquables sont, d'une part, la dominance de longue durée du pin dans les forêts sur terrain sec, qui s'opère avant 11 000 cal BP et s'étend jusqu'à l'Holocène supérieur et, d'autre part, la phase de marécages de bouleaux et de pins avec des sphaignes dans la vallée de la Petite Nèthe à l'Holocène inférieur.

Mots clés : Palynologie, Petite Nèthe, Herentals Bruggenbeemd (BE), Holocène.

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