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A PRELIMINARY REPORT ON THE PALYNOLOGICAL INVESTIGATION OF THE MIDDLE OLIGOCENE (HENIS CLAY AND SANDS AND MARLS OF OUDE BIEZEN) IN THE TONGEREN-VALKENBURG AREA, BELGIUM AND THE NETHERLANDS.

by

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A preliminary investigation on the pollencontent of Oligocene deposits of the Tongeren-Valkenburg area (Belgium and The Netherlands) demonstrates that the lower part of the Henis Clay is barren, whereas the Oude Biezen complex and the higher part of the Henis Clay generally contain more or less well-preserved palynological material. The results do not contradict the assumption of Henis Clay and Oude Biezen complex belonging to the same sedimentary cycle.

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Contents:

INTRODUCTION

During the last three years the "Werkgroep voor Tertiaire en Kwartaire Geologie" examined the stratigraphy of the Oligocene in the Tongeren region, Belgium. Many conclusions have been drawn already from sedimentological investigations and from study of the macrofossils, especially molluscs. Some problems could not be solved by those methods alone. Therefore during the last two years special samples were taken for palynological examination. Most of this material proved to be excellent for analysis. At the Rijksmuseum van Geologie en Mineralogie (RGM), Leiden, The Netherlands, the palynological subdepartment has taken up this project which is now under study. In due course the results of this investigation will be published. A preliminary report, however, may be of interest to those, studying the stratigraphy of the region. Some observations support conclusions, already drawn by other disciplines, whereas other results are new.

LOCALITIES (see Fig. 1 - 3)

Samples from the localities mentioned below have been studied for this paper. The stratigraphy is briefly mentioned in the first column of the tables. These data were adopted from unpublished reports in the RGM files.

Tongeren, exposure and auger drilling on the Bilzer Steenweg, opposite nr. 126, approximately 750 m N and 50 m W of Tongeren basilica, province of Limburg, Belgium, 1974-1975. Field number T1 and T1B, Locality number of the Geological Service of Belgium 107W-116(1e vervolg)(IVa).

Stratigraphy:			
0.00 -	0.75 m	Quaternary deposits
0.75 -	1.55 m	Oligocene, Berg Sands
1.55 -	5.10 m	Oligocene, Sands and Marls of Oude Biezen
5.10 -	12.85 m	Oligocene, Henis Clay
12.85 -	12.95 m	Oligocene, Neerrepen Sands

Samples (see Tab. 1) from 1.64 to 3.36 m were taken from indisturbed cores, the samples from 4.10 to 12.75 m were taken from the auger boring. Boring T1B (see Tab. 2) is a duplicate boring of the T1 auger boring in which an undisturbed core could be collected from the part of 5.35 to 6.50 m of the T1 boring.

Tongeren, clay-pit of the Francart brickworks, approximately 1225 m N and 475 m E of Tongeren basilica, province of Limburg, Belgium, 1973. Locality number: Francart, Tongeren, section 3 (see Fig. 2). Locality number of the Geological Service of Belgium: 107W-195(1e vervolg).

Stratigraphy:			
0.00 -	3.35 m	Oligocene, Sands and Marls of Oude Biezen
3.35 -	8.22 m	Oligocene, Henis Clay
8.22 -	?	Oligocene, Neerrepen Sands

Samples (see Tab. 3) were taken from undisturbed cores, collected in an oblique position ($\pm$ 50°) on the steep front of the clay-pit, therefor the measurement does not represent the vertical height of the section. The boundary between the Henis Clay and the Sands and Marls of Oude Biezen is indicated in the first column of Tab. 3.

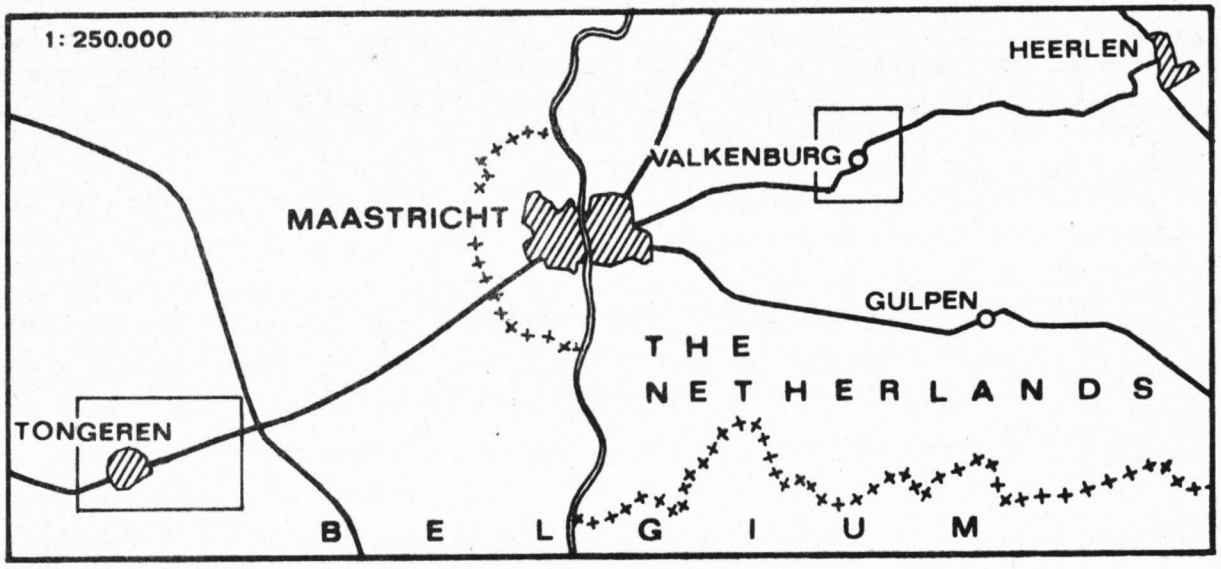

fig. 1

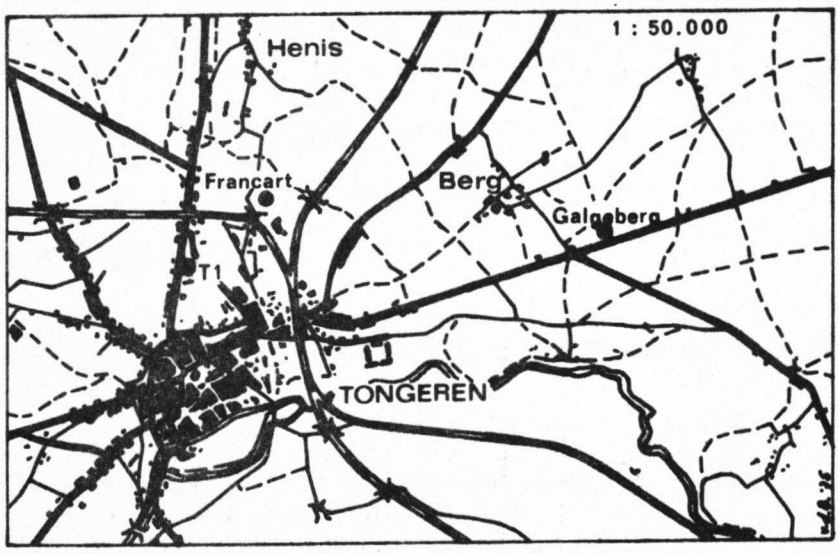

fig. 2

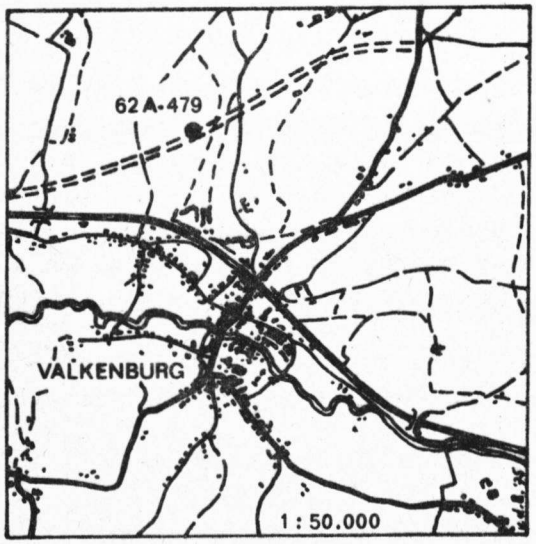

fig. 3

Explanation

Fig. 1. General area map

Fig. 2. Map of the Tongeren region with the localities T1 (and T1B at the same place), Francart and Galgeberg

Fig. 3. Map of the Valkenburg region with the locality 62A.479

Tongeren, Berg, exposure and boring on the Galgeberg, approximately 975 m N and 2825 m E of Tongeren basilica, province of Limburg, Belgium, 1973. Locality number: Galgeberg section. Locality number of the Geological Servige of Belgium: 107W-92(1e en 2e vervolg), locality map see Fig. 2.

Stratigraphy:

0.00 -	0.30 m	Quaternary deposits
0.30 -	0.75 m	Oligocene, Berg Sands
0.75 -	2.90 m	Oligocene, Sands and Marls of Oude Biezen
2.90 -	9.25 m	Oligocene, Henis Clay
9.25 -	10.10 m	Oligocene, Neerrepen Sands

Samples (see Tab. 4) from 0.75 to 2.15 m were taken from undisturbed cores collected in the exposure. Samples from 3.53 to 3.80 m were taken from a Dachnowsky boring and samples from 3.85 to 8.70 m were collected with an auger.

Valkenburg, temporary exposure in road-cut for the Maastricht - Heerlen highway, province of Limburg, the Netherlands, 1975. Locality number of the Geological Service of the Netherlands: 62A.479. For further details about this locality see Cadée & Vaessen (1975: 51).
In this exposure the upper part of the Henis Clay was sampled for this investigation by means of undisturbed cores. As a result of the strong lateral variation of the deposits the depths of these cores can not be correlated with the description of Cadée & Vaessen. Roughly can be assumed that the palynological samples (see Tab. 5) from 0.02 to 1.82 m agree with the part of 1.10 - 3.00 m of the description of Cadée & Vaessen. The upper 0.19 m of this section have been investigated intensively, as the dark coloured heavy clay appears to be very promising.

MATERIAL

Most samples, chosen for palynological use, consisted of clay or sandy clay, enabling preparation techniques to be standarised. The frequently occurring sandy parts, especially from the Sands and Marls of Oude Biezen have not been studied. From rich samples 5 - 10 cm^3 material proved to be sufficient. For the poorer parts of the sections 30 - 50 cm^3 yielded enough sporomorphs.

PREPARATION TECHNIQUES

A gentle KOH treatment was given to remove humates (gently heating during some minutes in a 10% solution). A HF treatment during some hours (no heating) proved to be necessary, after which a heavy liquid separation (bromoform/alcohol mixture, sp. gr. 2.0) completed the processing. From pure glycerin, in which the residues are kept, glycerin-jelly mounts were made. All kinds of organic remnants, such as wood fragments and other plant tissues and even small insects are thus preserved for examination. A sieve was used only when too coarse plant remains were present.

ANALYSIS

In order to analyse the material reference collections are needed, in which single grain slides of palynomorphs (pollen grains, spores and dinoflagellates = hystrichospheres) are available. These three groups of microfossils seem to play an equal important role in this study. A reference collection of recent pollen was present in the subdepartment palynology of the RGM. A reference collection of Tertiary pollen, spores and dinoflagellates, mainly from northwestern Europe, in which the Tongeren material is well represented, was initiated some time ago. Nearly all of these types have been photographed (Leitz Orthoplan-Orthomat) and the photographs have been arranged in photobooks for easy comparison. Descriptions and illustrations of published Tertiary palynomorphs have been photocopied and arranged in a similar way, forming a provisional key for identification. This preliminary work is nearly completed and the analysis of the sections may now proceed.

SCANNING

As a first approach the material has been scanned: a rapid glance at some slides of each sample revealed their contents. They may be rich, moderately rich or even barren (see Tab. 1-5, columns "occurrence"). The state of preservation of the grains is indicative for depositional conditions, either favourable for good fossilisation, deterioriation or even destruction of the grains (see Tab. 1-5, columns "preservation"). As it may be assumed that during the whole Oligocene pollen supply must have been contineous, the presence of a long sequence of barren samples is indicative for very bad conditions of preservation during that period.

As no more than the preliminary work for identification of palynomorphs has been finished, only a rough inventarisation of the palynological contents could be made. The occurrence of pollen of the "main groups" (see Tab. 1-5) has little scientific meaning. It just gives an indication which parts of the sections are promising and should be properly analysed and which parts may be neglected, being of little practical use. The columns headed "vesiculate". "3-cp" etc. stand for morphological pollen types and have no taxonomical meaning.

Generally the occurrence of a fair amount of dinoflagellates may be seen as an indication of marine conditions. The rare occurrence of dinoflagellates probably will be the result of transportation by wind or water and may be even due tc reworking.As a matter of fact some reworked Eocene and Paleocene dinoflagellates are present in slides of Galgeberg material, according to a personal communication by a specialist on the subject, Dr G. L. Eaton, England, during the Flankton Symposium 1974 in Kiel, Western Germany.

Scanning is but a very limited approach. In due course proper analysis of the material will reveal facts about vegetation and climate, as yet unknown. In the meantime these preliminary results may be of some help in studying the stratigraphy of the Henis/Oude Biezen complex, keeping in mind that these results are only provisional.

CONCLUSIONS

1) All material from the Tongeren-Valkenburg area shows the same pattern: the uppermost part of the Henis Clay and the clayey parts of the Oude Biezen complex are rich in palynomorphs, which for the greater part have been very well preserved. The underlying part of the Henis Clay is barren. The boundary is always sharp (see columns "occurrence" in the Tables). The lack of pollen in the basal parts of the heavy Henis Clay in the Tongeren area has been explained by Buurman & Langeraar (1975: 69) by supposing this clay to have been deposited in an oxidatory supratidal environment, in which conditions for fossilisation were bad. A quick transgression would then make conditions for fossilizing of palynomorphs favourable, which would account for the sudden occurrence of well preserved pollen in the overlying sediments.

There is only one exception in the above mentioned pattern: in the Francart clay-pit (see Tab. 3) all samples, Henis and Oude Biezen alike, were barren throughout the section. In all slides abundant minute charcoal particles together with some small wood fragments are present. As these slides closely resemble those from the barren parts of the Henis Clay at other sites (Galgeberg, TI and Valkenburg) it might be suggested that the uppermost part of the Henis Clay could have been removed before the sedimentation of the Oude Biezen sequence in the Francart clay-pit took place. The upper part of the Francart section shows at several places erosional features (gullies), supporting this hypothesis. One single dark lignitic sample, taken just for reasons of curiosity and situated laterally of the investigated section of the Francart clay-pit, appeared to contain the same Oligocene pollen types, found by E. Roche, Belgium, in Francart material some years ago (personal communication during his visit to the RGM in 1975). Apparently strata, rich in pollen, are still present at this locality and should be sampled again for further investigation as soon as possible.

2) In the paper of van Hinsbergh, Janssen & Vaessen (1973: 21) the Henis Clay is taken together with the overlying Sands and Marls of Oude Biezen to represent a single sedimentation cycle. Scanning of the palynological material revealed no sharp boundary between the two members. Thorough palynological analysis of the samples may give an affirmative answer, but up to now no facts have been revealed to contradict the above mentioned hypothesis.

Explanation of symbols used in the tables

x : grains of this main group are present.
+, ±, - : rich, moderately rich and barren respectively (see Tables 1-5, columns "occurrence")
+, - : well preserved and badly preserved respectively (see Tables 1-5, columns "preservation"
& : well preserved grains occur together with (badly) deteriorated ones (see Tab. 1-5, columns "preservation".

An open pace does not mean the same as "-", which has a definite negative meaning !

stratigraphy	depth	sediment	plant-remains	wood	charcoal	pollen - spores: occurrence	pollen - spores: preservation	pollen - spores: fragments	dinoflagellates: occurrence	dinoflagellates: preservation	dinoflagellates: fragments	main groups of sporomorphs: vesiculate	3 cp	3 p	1 p	tetrades	div.	trilete spores	monolete spores
OUDE BIEZEN COMPLEX	1.64-1.66	clay, beige	-	-	+	+|-	&		+		-	x	x	x	x				
	1.78-1.80	clay, beige	-	-	+	+	&	+	+	+	-	x	x	x	x				
	2.00-2.04	clay, beige	+	+|-	+	+	&		+|-		+	x	x	x		x		x	
	2.09-2.11	clay, beige	+	+|-	+	+|-	&		+|-		-	x	x	x				x	
	2.24-2.26	clay, beige	+	+|-	+	+	&	+	-		-	x	x	x	x	x		x	
	2.33-2.35	clay, grey-beige	-	-	+	+|-	+		-		-	x	x	x				x	
	3.13-3.15	clay, beige	-	-	+	+++	+		+|-		-	xxx	xx	x	x	x			
	3.33-3.36	clay, beige	-	-	+	+|-	+		-		-	x	x	x		x		x	
	4.10-4.15	clay, green (rust)	-	-	+	++	+		-		-	xx	xx	x	x	x			
H E N I S C L A Y	5.15-5.25	clay, green	-	-	+	+	+		-		-	x	xx	x	x	x		x	
	5.75-5.85	clay, green	-	+|-	+	++	&	+	+|-		-	xx	xx	x	xx	x		x	
	6.14-6.25	clay, brown-black	+	-	+	+|-	&	+	+|-		-	x	x	x	x			x	
	6.25-6.35	clay, brown-black	+	-	-	+|-	&	+	-		-	x	x						
	6.55-6.65	clay, grey-green	+	+	+|-	+|-	-	+	+|-		-	x	x	x	x				
	6.65-6.75	clay, grey-green	-	+|-	+	-		-	-		-	x						x')	

Table 1, continued at next page

stratigraphy	depth	sediment	plant-remains	wood	charcoal	pollen - spores: occurrence	pollen - spores: preservation	pollen - spores: fragments	dinoflagellates: occurrence	dinoflagellates: preservation	dinoflagellates: fragments	main groups of sporomorphs: vesiculate	3 cp	3 p	1 p	tetrades	div.	trilete spores	monolete spores
H E N I S C L A Y	6.75-6.85	clay, dark	-	+	+	-			-		-	x						x')	
	6.85-6.95	clay, grey-green	-	±	+	-		-	+')		-							x')	
	6.95-7.05	clay, grey-green	-	±	±	-	-	±	-		-								
	7.15-7.25	sandy clay, drk grey green	-	±	±	-	-	±	-		-								
	9.15-9.25	clay, dark grey	-	+	+	-		-	-		-								
	12.65-12.75	clay, green	-	±	±	-		-	-		-								

Table 1. Tongeren, loc. T1 (see Fig. 2)

From the Henis Clay (5.10 - 12.85 m) only the upper 1.55 m (5.10 - 6.65 m) is rich in pollen. There is a sharp boundary with the barren lower part of the Henis Clay.

') = only 1-3 grains

stratigraphy	depth	sediment	charcoal	wood	plant-remains	pollen - spores: fragments	pollen - spores: preservation	pollen - spores: occurrence	dinoflagellates: fragments	dinoflagellates: preservation	dinoflagellates: occurrence	main groups of sporomorphs: monolete spores	trilete spores	div.	tetrades	1 p	3 p	3 cp	vesiculate
OUDE BIEZEN	1.63-1.64	clay, beige	+	-	-		+	+	+	+	+|		×	×	×	×	×	×	×
	1.73-1.74	clay, beige	+	+	+		+	+		+	+|		×	×		×	×	×	×
	1.84-1.85	clay, beige	+	-	-		+	++		+	++		×	×	×	×	×	××	×
	1.92-1.93	clay, beige	+	-	-		+	++		+	+		×	×		×	×	××	×
	2.05-2.06	clay, beige	+	+	-		+	++		+	+|		×	×		×	×	××	×
	2.14-2.14	clay, beige	+	+	-		+	++		+	+|		×	×			×	×	×
	2.22-2.23	clay, brown-black	+	+	+	+	&	+	-	-	-		×	×			×	×	×
	2.28-2.29	clay, brown (rust)	+	+	-	+	&	+	-	-	-		×	×	×	×	×	×	×
HENIS CLAY	5.35-5.40	clay	+	+	-	+	&	+		&	+|		×	×			×	×	×
	5.40-5.45	clay	+	-	+		&	+	+|		-		×	×			×	×	×
	5.45-5.50	clay	+	-	+	+	&	+	-		-					×	×	×	×
	5.50-5.55	clay	+	-	-		+	+	+|		-			×	×	×	××	×	×
	5.55-5.60	clay	+	-	-	+	&	+	+	-	-				×	×	×	×	×	×
	5.60-5.65	clay	+	+|	-		+	+	+	-	-	+|		×	×	×	××	×	×
	5.65-5.70	clay	+	-	-	+	-	+	+|	+	+			×	×	×	×	×	×
	5.70-5.75	clay	+	-	-			+	+|	+	+						×	×	×
	5.75-5.80	sandy clay, light grey	+	+	-		+	++	+|	+	+			×	×	×	×	××	×
	5.86-5.88	clay, dark	+	+	-		+	+	-	-	-		×	×		×	×	×	×

Table 2 (continued at next page

stratigraphy	depth	sediment	plant-remains	wood	charcoal	pollen - spores			dinofla-gellates			main groups of sporomorphs							
						occurrence	preservation	fragments	occurrence	preservation	fragments	vesiculate	3 cp	3 p	1 p	tetrades	div.	trilete spores	monolete spores
HENIS CLAY	5.88-5.90	clay, dark	-	+	+	+	+		-		-	x	x	x	x	x		x	
	5.90-5.92	clay, dark	-	+	+	+	+		-		-	x	x		x				
	5.92-5.94	clay, dark	-	-	+	+	+		-		-	x	x	x	x	x		x	
	5.94-5.96	clay, grey	-	-	+	+	+		-		+/-	x	x	x	x	x		x	
	5.96-5.98	clay, grey	-	-	+	+	+		+/-	+	-	x	xx	x	x	x		x	
	5.98-6.00	clay, grey	-	-	+	+	+		+/- ')		-	x	xx	x	x	x	x		
	6.00-6.02	clay, grey	-	-	+	+	+		-		-	x	xx	x	x	x		x	

Table 2. Tongeren, loc. T1B (see Fig. 2).

From the Henis Clay (5.10 - 12.85 m the upper part is rich in pollen. The lower part has not been investigated yet.

') = ? reworked

stratigraphy	depth	sediment	plant-remains	wood	charcoal	pollen - spores: occurrence	pollen - spores: preservation	pollen - spores: fragments	dinoflagellates: occurrence	dinoflagellates: preservation	dinoflagellates: fragments	main groups of sporomorphs: vesiculate	3 cp	3 p	1 p	tetrades	div.	trilete spores	monolete spores
OUDE BIEZEN	0.00	clay	-	+	+	-		-	-		-								
	0.10	clay	-	+	+	-		-	-		-								
	0.20	clay	-	+	+	-		-	-		-								
	0.30	clay	-	+	+	-		-	-		-		x						x')
	0.40	clay	-	+	+	-		-	-		-	x		x					x')
	0.50	clay	-	+	+/+	-		-	-		-	x							x')
	0.60	clay	-	+	+	-		-	-		-								
	1.10	clay	-	+	+	-		-	-		-								
	2.75	clay	-	+	+	-		-	-		-								x')
HENIS CLAY	4.00	clay	-	+/+	+	-		-	-		-								
	4.17	clay	-	+	+	-		-	-		-								
	4.38	clay	-	+/+	+	-		-	-		-								
	4.60	clay	-	+/+	+	-		-	-		-								
	4.80	clay	-	+/+	+	-		-	-		-								
	5.00	clay	-	+/+	+	-		-	-		-								
	5.20	clay	-	+/+	+	-		-	-		-								
	5.40	clay	-	+	+	-		-	-		-								
	5.60	clay	-	+/+	+	-		-	-		-								
	5.80	clay	-	+/+	+	-		-	-		-								
	6.00	clay	-	+/+	+	-		-	-		-								
	6.20	clay	-	+	+	-		-	-		-								
	6.40	clay	-	+	+	-		-	-		-								
	6.60	clay	-	+/+	+	-		-	-		-								
	7.00	clay	-	+/+	-	-		-	-		-								
	7.70	clay	-	+/+	+/+	-		-	-		-								
	7.80	clay	-	+/+	+/+	-		-	-		-								
	7.90	clay	-	+/+	+/+	-		-	-		-								

') = 1 - 3 grains only

Table 3. Tongeren, loc. Francart, Tongeren, section 3 (see Fig. 2)

The Henis Clay (3.35 - 8.22 m) is completely barren. In the overlying Sands and Marls of Oude Biezen only a very limited amount of pollen is present.

stratigraphy	depth	sediment	plant-remains	wood	charcoal	pollen - spores: occurrence	pollen - spores: preservation	pollen - spores: fragments	dinoflagellates: occurrence	dinoflagellates: preservation	dinoflagellates: fragments	main groups of sporomorphs: vesiculate	3 cp	3 p	1 p	tetrades	div.	trilete spores	monolete spores
OUDE BIEZEN	0.75–0.77	clay, brown	+	–	–	–	+	–	–		–	x	x	x		x	x	x	
	0.95–0.97	clay, brown	–	+|–	+|–	–		–	–		–	x	x	x		x	x		
	1.48–1.50	clay, brown	–	+|–	+	+|–	+	–	–		–	xx	x	x		x	x	x	
	1.86–1.88	clay, brown	–	–	+	+|–	+	–	–		–	x	x	x		x	x		
	1.98–2.00	clay, brown	–	–	+	+	+	–	–		–	xx	x	x	x	x		x	
	2.13–2.15	clay, brown	–	–	+|–	+	+	–	–		–	xx	xx	x		x	x		
HENIS CLAY	3.53	clay	–	–	+	+	+	–	–		–	xx	xx		x	x	x	x	
	3.60	clay	–	–	+	+	+	–	–		–	xx	xx	x		x	x	x	
	3.70	clay	–	–	+	+	+	–	–		–	xx	xx	xx		x	x		x
	3.80	clay	–	–	+	+	+	–	–		–	x	xx	x		x	x	x	
	3.85–3.95	clay	–	–	+	+	&	–	+|–	+	–	x	x	x	xx	x	x	x	
	3.95–4.05	clay	–	–	+	+	+	–	+|–	+	–	x	x	x			x	x	
	4.00	clay	–	–	+	+	&	+	+|–	&	–	x	xx	x	x	x	x		
	4.05–4.15	clay	+|–	+	+	+	&	+	–		+	x	xx		xx		x	x	
	4.10	clay	+	+|–	+|–	+	&	+	–		–	x	x	x	x	x		x	
	4.15–4.25	clay	–	–	+|–	+|–	&	+	–		–	x	x	x					
	4.25–4.35	clay	+|–	–	+	+	&	+	+		–	x	x	x	x				
	4.30	clay	–	+	+|–	+	–	+	–		–	x	x		x		x	x	
	4.35–4.40	clay	–	–	+	–	–	+	–		–	x	x	x					
	4.45–4.55	clay	–	–	+	–	–	–	–		–	x							

Table 4, continued at next page

stratigraphy	depth	sediment	plant-remains	wood	charcoal	pollen - spores: occurrence	pollen - spores: preservation	pollen - spores: fragments	dinoflagellates: occurrence	dinoflagellates: preservation	dinoflagellates: fragments	main groups of sporomorphs: vesiculate	3 cp	3 p	1 p	tetrades	div.	trilete spores	monolete spores
H E N I S C L A Y	4.55-4.65	clay	-	-	+	-		-	-		-								
	4.75-4.85	clay, brown-green	-	+	+	-		-	-		-								
	4.85-4.95	clay, green	-	+	+	-		-	-		-								
	4,95-5.05	clay	-	+	+	-		-	-		-								
	4.99	clay	-	+	+	-		-	-		-								
	5.05-5.10	clayey sand	-	+	+|+	-		-	-		-	x (1 grain)							
	5.20-5.30	clayey sand	-	+	+|+	-		-	-		-								
	5.30-5.40	clayey sand	-	+	+|+	-		-	-		-								
	5.40-5.50	clayey sand	-	+|+	+|+	-		-	-		-								
	5.60-5.65	clayey sand	-	+|+	+|+	-		-	-		-								
	5.90-6.00	clay, dark green	-	+|+	+|+	-		-	-		-								
	6.20-6.30	clay	-	-	+	-		-	-		-								
	7.55	clay	+	+|	+|+	-		-	-		-								
	7.30-7.40	clay, dark green	-	|-	+|+	-		-	-		-								
	7.80-7.90	clay	-	-	+|+	-		-	-		-	x (1 grain)							
	8.20-8.30	clay, green	-	-	+|+	-		-	-		-								
	8.60-8.70	clay	-	+|	+	-		-	-		-								

Table 4. Tongeren, Galgeberg section (see Fig. 2).

From the Henis Clay (2.90 - 9.25 m) only the upper 1.45 m (2.90 - 4.05 m) are rich in pollen. There is a sharp boundary with the barren lower part.

') = reworked (see text)

		2–3	3–4	6–6,5	7–7,5	8–8,5	9–9,5	10–10,5	11–11,5	12–12,5	12,5–13	13–14	14–15	15–16	16–17	17–18
main groups of sporomorphs	monolete spores															
	trilete spores						x		x	x	x	x	x	x	x	x
	div.								x							
	tetrades															
	1 p						x					x	x			
	3 p						x			x		x	x	x	x	x
	3 cp			x')				x')	x	x	x	x	x	x	x	x
	vesiculate							x')	x		x	x	x	x	x	x
dinoflagellates	fragments	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı		
	preservation															
	occurrence	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı	ı	+ı	+ı
pollen - spores	fragments	ı	ı	+	ı		+	ı		+	+	+	+	+	ı	+
	preservation			ı		+	&	+	+	&	&	&	&	&	+	&
	occurrence	ı	ı	ı	ı	+ı')	+ı	ı	+ı	+ı	+ı	+	+	+	+	+ı
charcoal		+ı	+ı	+	+	+	+	+	+ı	+	+ı	+	+	+	+	+
wood		ı	ı	+	+	+	+	+	+ı	+	+ı	ı	ı	ı	ı	ı
plant-remains		ı	ı	+	+	ı	ı	ı	ı	+	ı	ı	ı	ı	ı	ı
sediment		sandy clay	sandy clay	sandy clay	clay, black humic	clay, black, humic	clay, black, humic	clayey, black, humic	clayey, black, humic	clay, dark	clay, dark	clay, dark with green	clay, green some dark	clay, green some dark	clay, green	clay, green
depth in cm		2–3	3–4	6–6,5	7–7,5	8–8,5	9–9,5	10–10,5	11–11,5	12–12,5	12,5–13	13–14	14–15	15–16	16–17	17–18
stratigraphy		H E N I S C L A Y														

Table 5, continued at next page

stratigraphy	depth in cm	sediment	plant-remains	wood	charcoal	pollen - spores: occurrence	pollen - spores: preservation	pollen - spores: fragments	dinoflagellates: occurrence	dinoflagellates: preservation	dinoflagellates: fragments	main groups of sporomorphs: vesiculate	3 cp	3 p	1 p	tetrades	div.	trilete spores	monolete spores
HENIS CLAY	18-19	clay, green	-	-	+	-	&	+	-		+	x	x						
	75-78	clay, green	-	±	-	-		-	-		-								
	83-86	clay, green	-	+	+	-		-	-		-								
				±	±														
	105,5-107	clay, green with dark spot	+	+	+	±	&	+	±	&	+	x	x	x		x			
	113,5-116	clay, green with dark band	+	+	+	±	&	+	+	&	+	x	x	x	x			x	
	140-143	clay, green	±	+	++	-		-	-		-			x')			insects		
	143-146	clay, green	-	±	+	-		-	-		-								
	179-182	clay, green	+	+	+	-		-	-		-	x')							

Table 5. Valkenburg, loc. nr. 62A. 479 (see Fig. 3).

The uppermost part of the Henis Clay consists of a black, humic layer in which preservation conditions seem to have been unfavourable. The underlying dark heavy clay is rich in pollen. A boundary with barren lower Henis Clay is present, but not as distinct as in the Tongeren area.

') = 1 - 2 grains only

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