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THE YPRESIAN IN THE BELGIAN BASIN

by E. STEURBAUT (*)

INTRODUCTION

This field trip is the first of a series of trips to stratotypes of Belgian Palaeogene Stages. It is organised by the "Contactgroep Geologie van de Tertiaire Afzettingen in België - Groupe de Contact Géologie des Sédiments Tertiaires Belges", on the very special occasion of the celebration of the centenary of the "Belgische Vereniging voor Geologie - Société belge de Géologie".

As the Ypresian is one of the most impressive and best represented stages of the Belgian Tertiary with various, thick and well-exposed sequences, it was not easy to decide upon the exposures to be presented. It seemed evident that the two predominantly occurring lithofacies, which were already mentioned by DUMONT in 1849 in its original definition, had to be shown. On the other hand it was thought necessary to include various aspects of Ypresian sedimentation and tectonics, and to present some of the characteristic, high-diversity shell-beds, which are rare in the Belgian Ypresian. Before going into the details of the excursion programme, it seemed also advisable to comment briefly on previous investigations, and to consider some general aspects of the Ypresian deposits.

Finally, it must be emphasized that this excursion could not have taken place without the permission and collaboration of the various claypit owners, for which they are gratefully acknowledged. Dr. S. GEETS is thanked for providing the diagrams with the grain-size distribution of boreholes and exposures, Prof. Dr. G. DE MOOR for providing the description of the Marke borehole and Dr. J. DE CONINCK for information regarding the dinoflagellates. Mr D. BAVAY is thanked for help in drafting the figures, Mr. T. TEMMERMAN for photographic work and Mrs. N. REYNAERT for typing the manuscript.

THE YPRESIAN IN THE BELGIAN BASIN

GENERAL COMMENTS

The Ypresian is one of the best represented, best studied and internationally accepted stages of the Belgian Tertiary. It was defined by DUMONT in 1849 to specify the marine deposits between the previously introduced Landenian and Brusselian Stages (DUMONT, 1839), including a lower thick clayey and an uppermost sandy unit. Shortly afterwards in 1851 DUMONT established the Paniselian Stage for the clayey-sandy deposits between his formerly defined Ypresian and Brusselian Stages. Since then, two different interpretations of the Ypresian Stage concept have been currently in use :

- the Ypresian *sensu stricto*, when referring to the two major lithologic units defined by DUMONT in 1849. In this opinion the Paniselian Stage is considered to be valid ;
- the Ypresian *sensu lato*, when referring to boundaries mentioned in DUMONT's original definition. Here, the Ypresian is considered to include all deposits between the top of the Landenian and the base of the Brusselian. Consequently, the Paniselian is rejected, falling within the Ypresian.

It is the second version with an "extended" Ypresian that has been adopted in recent compilation works on Palaeogene stratigraphy (e.g. BERGGREN *et al.*, 1985 and CAVELIER & POMEROL, 1986). It is considered by STEURBAUT & NOLF (1986, fig. 10) as the time-interval during which all the deposits between the base of the Ieper Clay auct. and the top of the Aalterbrugge Lignitic Horizon (*sensu* HACQUAERT, 1939), were deposited (see also fig. 2). The deposition of this sequence is supposed to have taken place within 6 M.Y., and between 51 and 45 million years ago according to CURRY & ODIN (1982). BERGGREN *et al.* (1985) give somewhat "older" ages , between 58 and 52 M.Y. respectively, also based on radio-

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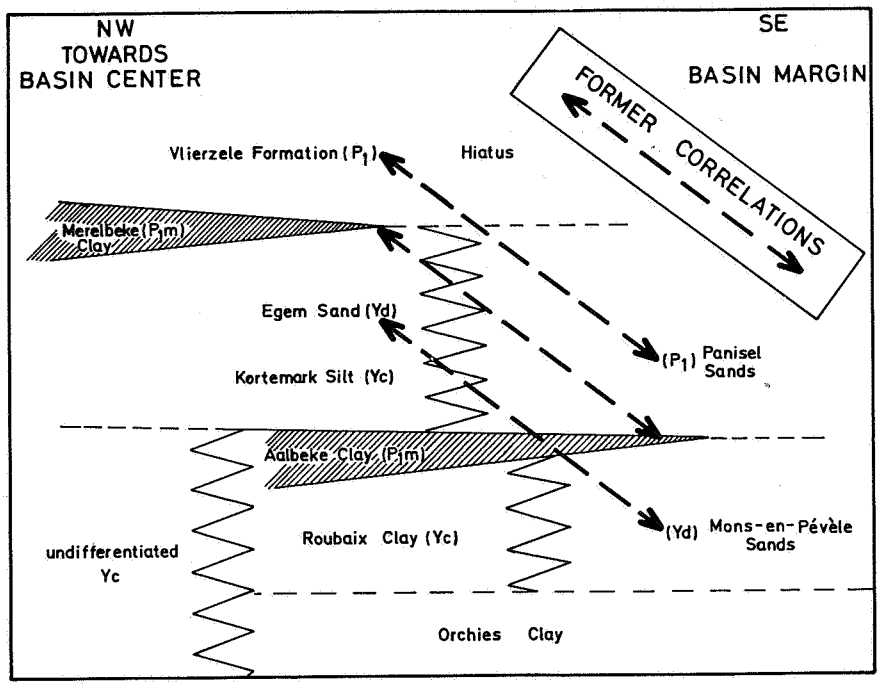

Figure 1. Simplified correlation scheme for the Belgian Ypresian deposits, compared to the correlations used for the establishment of the Belgian geological map (after STEURBAUT & NOLF, 1986).

metric datings on glauconite.

The Ypresian deposits have been recognised for centuries due to their extensive geographic distribution and considerable economic value. Even today the clays are used for brick and tile manufacture, and the sands for road construction. The Ypresian deposits underlie the whole northern half of the Belgian territory ; if the thin Quaternary cover is disregarded they crop out in nearly the entire southern and western sectors of this region (see fig. 3). They generally rest on Palaeocene deposits that are lagoonal in the northwest and continental in the northeast and the southwest (DE GEYTER, 1981). In the centre of the basin, in the triangle Geraardsbergen-Mons-Genappe southwest of Brussels, they rest directly on Palaeozoic deposits (LEGRAND, 1968, map II). The thickness of the Ypresian deposits increases northward, from a few metres in the extreme South and Southeast to about 150 m in the northern part of the basin, with a maximum recorded thickness in the extreme northwest (Knokke : 182 m). The strata dip gently to the North, but the dip is greater than the inclination of the post-Tertiary erosion surface. Therefore, they are covered by subsequent deposits that become progressively younger northward (see fig. 3).

LITHOSTRATIGRAPHY

The Ypresian deposits occur in the main part of Belgium, North of the river Maas (or Meuse), and in northern France as far as the Calais area. In the Northwest (towards the North Sea Basin centre), the lithological succession consists of a lower clayey sequence (100 to 140 m ; symbol Yc of the Belgian geological map) overlain by very fine sands (10 to 20 m ; symbol Yd of the geological map). The top of the Ypresian in that area consists of rather coarse, more or less clayey glauconitic sands with sandstone bands (maximum thickness of about 30 m ; symbol P1 or "Lower Paniselian" of the Belgian geological map). The limit between the Yd and P1 deposits is marked by a thin (5 to 10 m) heavy clay, the Merelbeke Clay (= P1m of the Belgian geological map), which is an excellent marker in the North of the area, but is absent to the South.

Toward the margin of the basin, in northern France and in southern Belgium, a more or less similar lithological succession was recognized by ORTLIEB & CHELLONNEIX already in 1870, and by GOSSELET in 1874, before the completion of the legend of the Belgian geological map (1892). In this area, the clayey part (Yc) of the Ypresian consists of a lower heavy clay, the Orchies Clay, and a very silty and fossiliferous upper part, the Roubaix Clay. More to the East, the Orchies Clay is covered by sandy deposits, the Mons-en-Pévèle Sands, which were considered by GOSSELET (1874), to represent at least in part, the lateral equivalent of the Roubaix Clay. Both the Roubaix Clay (in the West) and the Mons-en-Pévèle Sands (in the East) are overlain by a 10 m thick heavy Aalbeke Clay, which in turn is covered by "Lower Paniselian" (P1) sands.

On the basis of similarity in the lithological succession (clay/sand or silty clay/heavy clay/glauconitic sand with sandstones) in both the North and the South of the basin, the correlations, shown by arrows in fig. 1 were established, resulting in the outline of a legend for the Belgian geological map (1892). These correlations, however, were refuted by STEURBAUT & NOLF (1986). Through detailed lithostratigraphic analysis and calcareous nannoplankton investigation it was proved that the nummulitic sands from the southern part of the basin (= Mons-en-Pévèle Sand Member, e.g. at Mons-en-Pévèle, Forest, Ronse, Mont Panisel, ...) and the overlying heavy clay (= Aalbeke Clay Member, e.g. at Aalbeke, Ronse, Marke, ...) and clayey sand (= Panisel Sand Member, e.g. at Mont Panisel (topmost beds), Moeskroen, Schepdaal, ...) are older and unconnected with their supposed equivalents from northern Belgium (successively the nummulitic sand at Egem and around Ghent (= Egem Sand Member) ; the heavy clay at Merelbeke (= Merelbeke Clay Member) and the sandy clay to clayey sand at Pittem and Vlierzele (= Vierzele Formation) (see figs. 1 and 2).

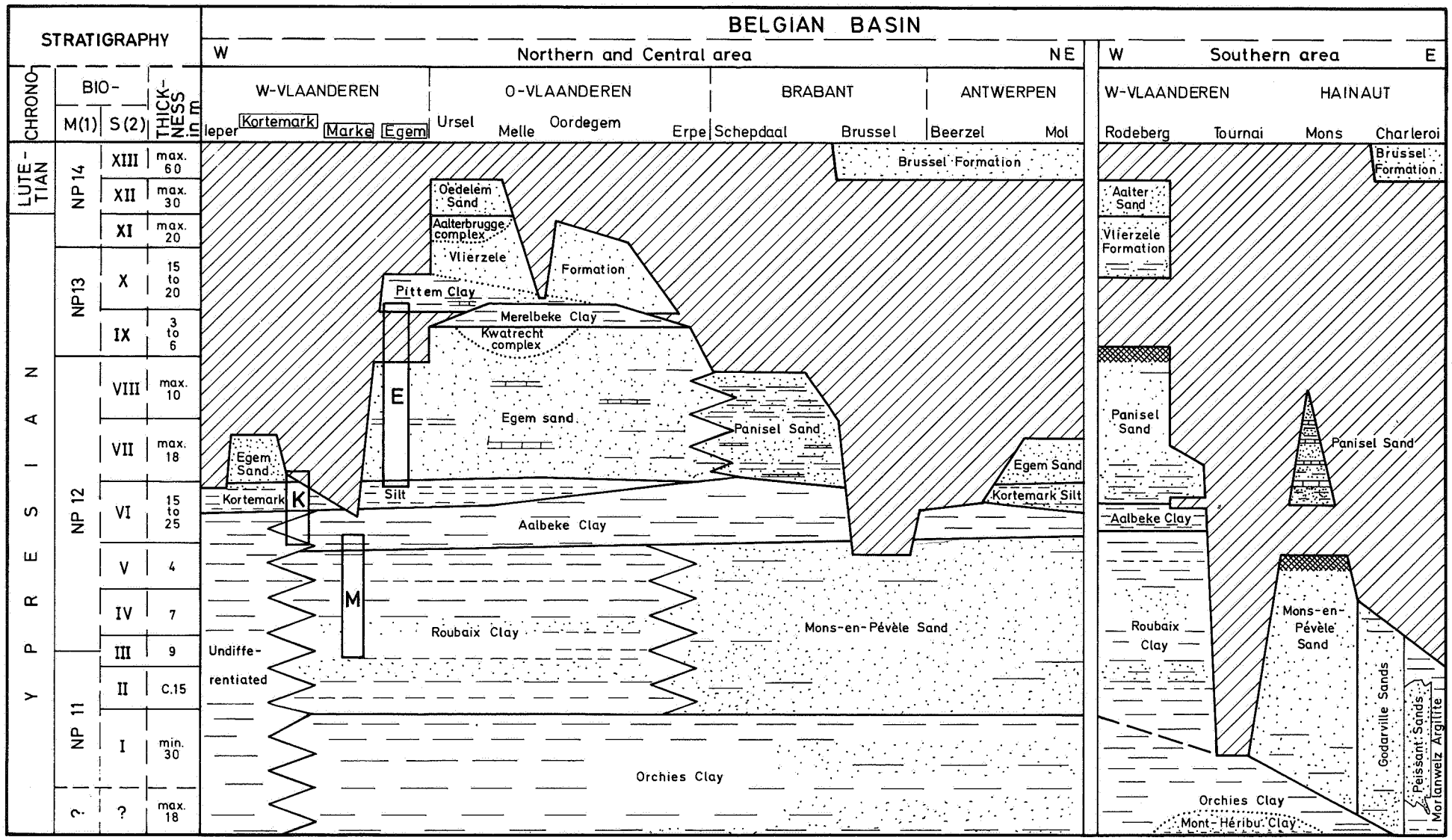

Figure 2. Corretaion of the litho- and biostratigraphic subdivisions of the Ypresian (1=MARTINI, 1971 ; 2=STEURBAUT, 1986) (after STEURBAUT & NOLF, 1986).

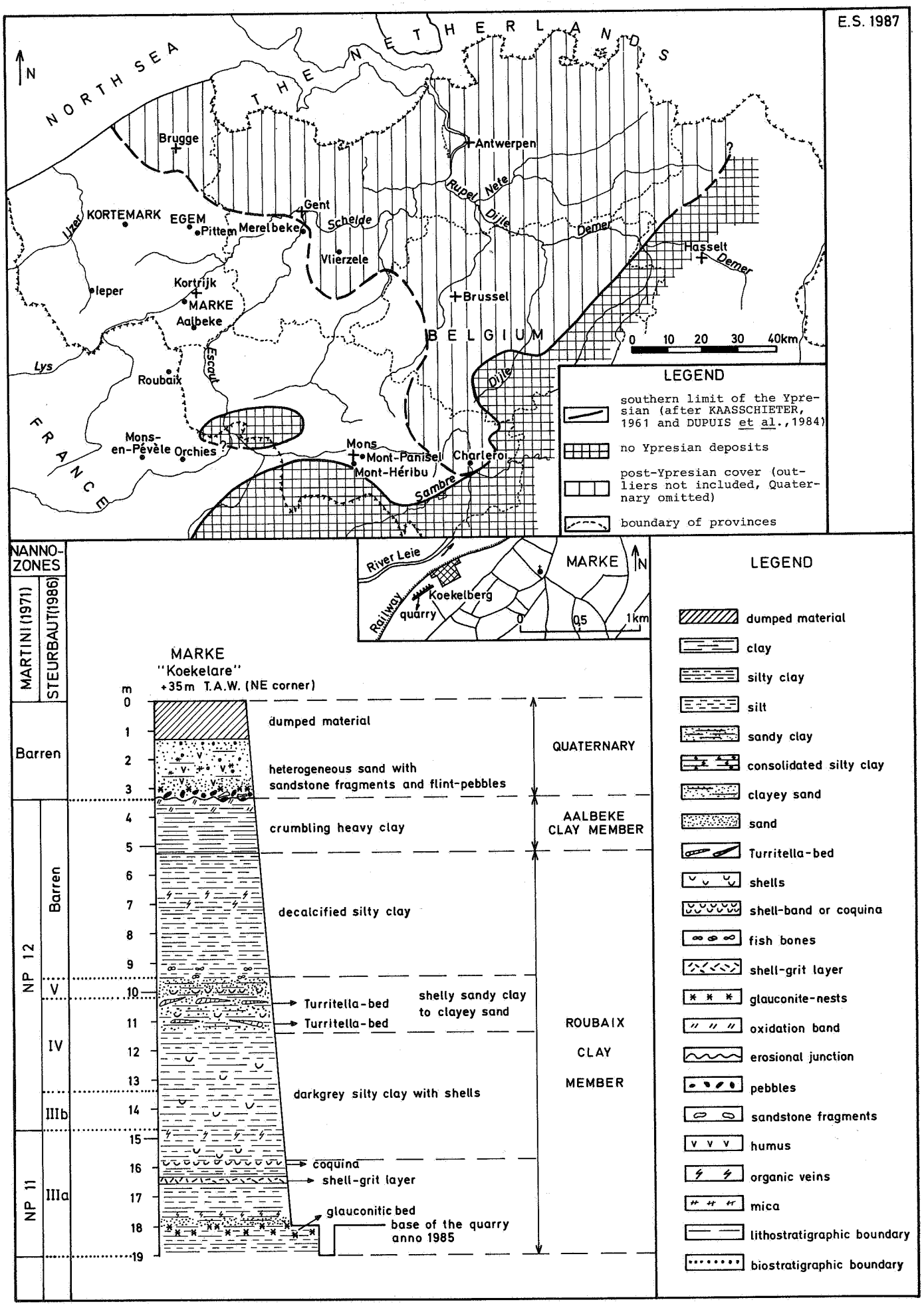

Figure 3. Distribution of Ypresian deposits in the Belgian Basin and its stratigraphy in the Marke clay quarry.

Two formations were distinguished by STEURBAUT & NOLF (1986) : a lower Ieper Formation and an upper Vlierzele Formation. The Ieper Formation includes a lower clayey sequence (Orchies Clay, Roubaix Clay and Aalbeke Clay Members) ; a middle silty to sandy part (Kortemark Silt and Egem Sand Members) and an upper heavy clay (Merelbeke Clay Member). More to the East, the Roubaix Clay Member is represented by its sandy equivalent, the Mons-en-Pévèle Sand Member, whereas the silty to sandy middle part (Kortemark Silt and Egem Sand Members) is replaced by a heterogeneous sand-clay unit with numerous sandstone bands, the Panisel Sand Member.

The Vlierzele Formation consists of a locally developed clayey to silty part, the Pittem Clay Member, and of yellowishgreen glauconitic fine sand with sandstone bands.

During the last meetings of the "Contactgroep Geologie van de Tertiaire Afzettingen in België" it appeared that there is a general agreement on the lithostratigraphic subdivision of the Ypresian, at least concerning the identification, correlation and naming of the different members. The proposals of STEURBAUT & NOLF (1986) are accepted, although the grouping of the members into formations is still a point of discussion.

BIOSTRATIGRAPHY

The study of the calcareous nannofossils by STEURBAUT (*in* STEURBAUT & NOLF, 1986) has led to a major advance in the knowledge of the Belgian Ypresian stratigraphy. Through closely spaced sampling and investigation a very detailed calcareous nannofossil zonation was established and correlated with MARTINI'S standard calcareous nannofossil zonation. Eleven units were recognized : units I, II and IIIa assignable to zone NP11, units IIIb, IV, V, VII and VIII to zone NP12, units IX and X to NP13 and unit XI to NP14 (see fig. 2). In a subsequent paper (STEURBAUT, 1987) it was demonstrated that most of STEURBAUT'S nannoplankton-events are recognizable in middle to high latitudes of the northern hemisphere, allowing a very high resolution biostratigraphy.

The Ypresian deposits of the Belgian Basin have also been the subject of other important biostratigraphic investigations. For a general discussion on these investigations the reader should consult WILLEMS, BIGNOT & MOORKENS (1981) and WILLEMS (1982). The literature on the Ypresian fauna and flora was also listed by STEURBAUT & NOLF (1986, p. 119).

DESCRIPTION OF THE EXPOSURES

Three sections are presented which slightly overlap one another, and form a c. 70 m continuous succession in the middle part of the Ypresian (see fig. 2).

1. MARKE, clay pit Koekelberg (fig. 3)

General remarks - The clay pit is located 1 km west of the Marke village centre, some 4 km southwest of Kortrijk (map-sheet 29/5 ; coordinates : x = 69.000, y = 166.800). Leave motorway E17 Gent-Lille at exit 2 "Kortrijk zuid" ; take ringroad, and leave at exit 12 ; take road to Aalbeke, at c. 1 km turn right to Marke centre.

Details of section - Exposed is a 19 m thick sequence, including a 3.3 m thick Quaternary cover and a 15.7 m thick clayey sequence, representing the middle part of the Ieper Formation. The Quaternary cover consists of a 1.30 m thick band of dumped reddish brick debris and a 2 m heterogeneous sand with sandstone fragments and flint-pebbles. The Ypresian consists of an uppermost 2 m thick crumbling heavy clay of the Aalbeke Clay Member and a lower 13.7 m thick, more heterogenous Roubaix Clay Member : a silty clay to clayey silt with sandy intercalations, *Turritella*-beds, shell-grit layers and at the base a substantial glauconitic-bed (see fig. 3). The base of the Marke quarry lies some 65 m above the base of the Ieper Formation.

At present, due to a rather long period of inactivity, the Marke section presents a slightly wheatered surface with various nicely developed sedimentological and tectonic structures, which, at the time of our field-work campaign (1984 to 1986) were not visible. In the middle of the Roubaix Clay Member is an alternation of dark grey green (fine sand) and much paler, greyish bands (much finer sediments ; silty clay to clayey silts). These bands are cut by two substantial faults with a throw of a few metres.

Some 20 years ago a 40 m deep borehole was drilled about 2 km southeast of the clay pit on behalf of Prof. Dr. G. DE MOOR. A short description of this borehole is added in addendum. The grain-size distribution is given in fig. 4.

Macrofossils - The Marke sequence is rather poor in macrofossils. A few *Turritella*-beds with abundant *Nummulites planulatus*, some pectinids and fish-otoliths are recorded from the Roubaix Clay Member, at the middle part of the section. However, most of the molluscs are flattened by early diagenetic compression.

Microfossils - Up to now only calcareous nannofossils have been investigated. The uppermost part of the section is completely decalcified and yields no nannofossils. The lowermost 9 m present low-diversity, poorly preserved assemblages except for the basal 20 cm which contains 30 nannofossil species. The lowermost 4 m contain *Rhabdosphaera sola* and *Rhabdosphaera truncata* (see Plate I, figs. 2 and 3), while *Discoaster lodoensis* is absent, and are therefore assignable to STEURBAUT'S unit IIIa, which corresponds to the uppermost part of MARTINI'S NP11. The overlying 5 m are attributable to units IIIb, IV and V indicating the lower part of zone NP12 (see fig. 3).

Environment - The sedimentological structures, flora and fauna suggest a rather shallow marine, upper shelf facies. The

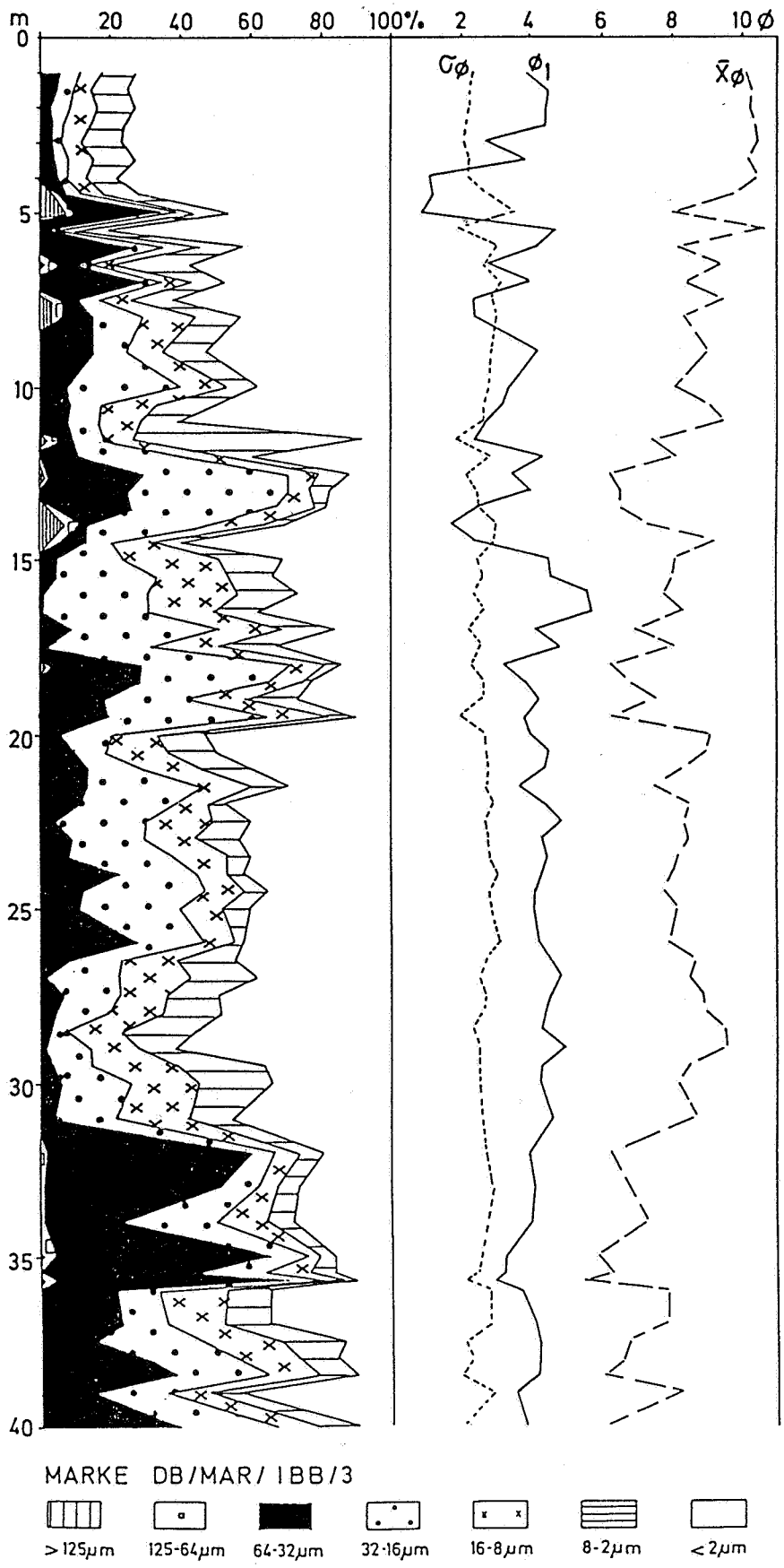

Figure 4. Grain-size distribution of the sediments in the Marke borehole by S. GEETS.

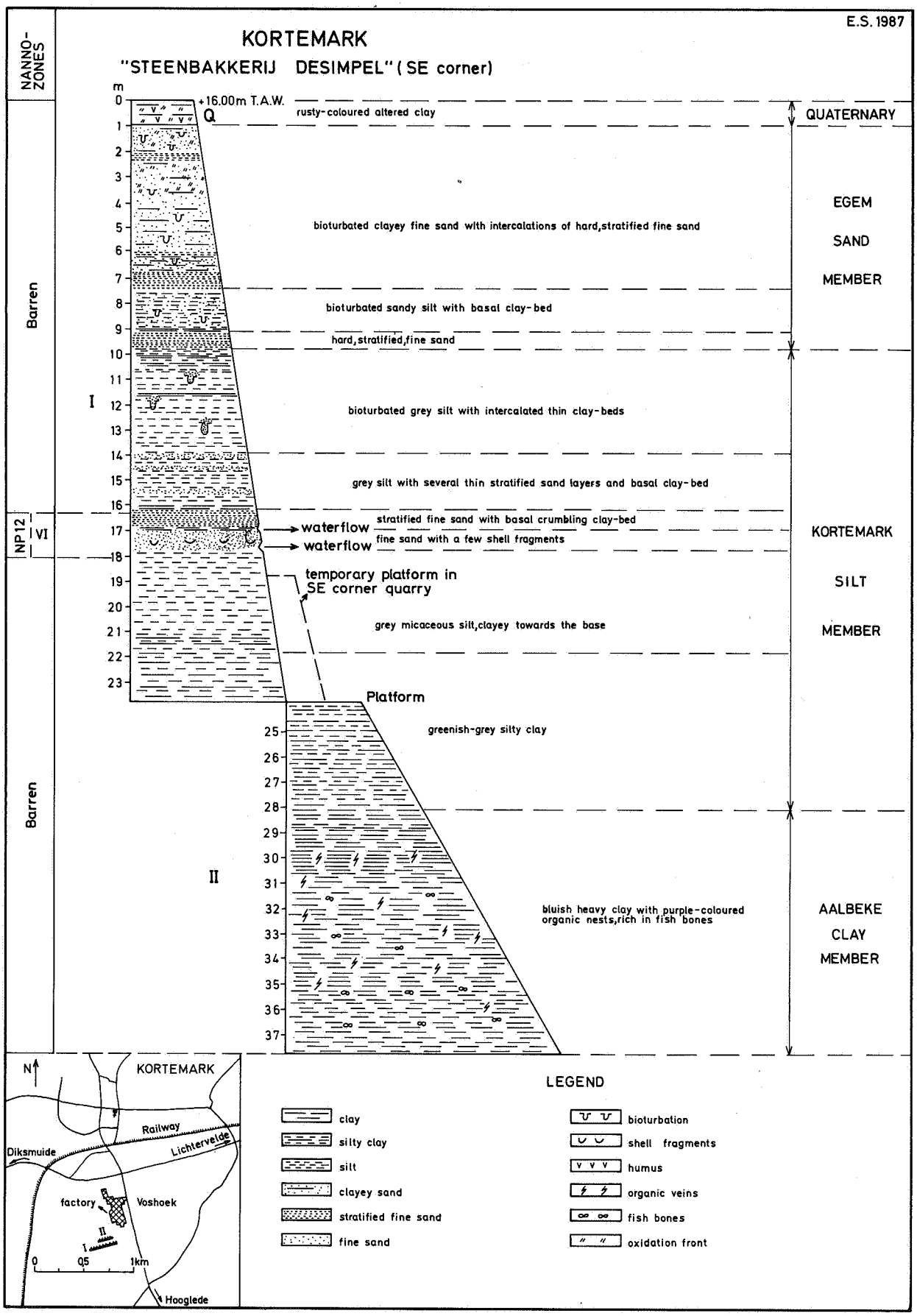

Figure 5. Stratigraphy of the Ypresian deposits in the Kortemark clay quarry.

presence of shell-grit layers refers to high-energy conditions and may be the result of storm surges. The coarse-grained glauconite band at the base of the quarry indicates reduced sedimentation, probably due to tectonic phenomena.

2. KORTEMARK, clay pit Desimpel (fig. 5)

General remarks - The clay quarry is situated 1 km south of the Kortemark village centre, immediately west of the road from Kortemark to Hooglede (map-sheet 20/3-4 ; coordinates : x = 57.050, y = 190.400). It is chosen as type-locality of the Kortemark Silt Member, and appears to be an adequate substitute for the stratotype of the Ypresian.

Details of section - The Ieper Formation is mined in two pits c. 100 m apart (see fig. 5). Pit I exposes, under a thin Quaternary cover, clayey sands with intercalations of hard stratified sands, slightly altered on top (= Egem Sand Member), resting on a heterogeneous complex of grey silt with sandy intercalations, becoming more clayey towards the base (= Kortemark Silt Member). Pit II shows a fairly homogeneous clayey sequence, including an uppermost 4 m thick silty clay (= basal part of the Kortemark Silt Member), resting on a bluish heavy clay with purple-coloured organic nests, rich in fish bones, and which is considered to represent the upper part of the Aalbeke Clay Member. Some small erosive channels and faults are encountered in the uppermost part of pit I, in the Egem Sand and Kortemark Silt Members. However, these structures are not easily visible due to an almost permanent excavation, obliterating all superficial features. The Kortemark sequence is also almost completely decalcified. Calcareous fossils have only been found in the lower part of pit I, some 2 m above the base of the temporary platform in the SE corner of the quarry. The grain-size distribution in the uppermost pit is given in fig. 6.

Macrofossils - The Kortemark sequence is very scarce in macrofossils, because of almost complete decalcification. Some shell-fragments occur in pit I, in a 1 m thick band at 17 m below surface.

Microfossils - Low-diversity, poorly preserved calcareous nannofossils and foraminiferid assemblages are recorded from the non-decalcified band. The nannofossil assemblage contains seven species, among which *Discoaster lodoensis*, *Tribrachiatus orthostylus* and *Chiasmolithus* aff. *expansus*, indicating STEURBAUT'S nanno-unit VI, which corresponds to the middle part of MARTINI'S NP12. Two samples from the Kortemark Silt Member were investigated for dinoflagellates by DE CONINCK (1976). Both samples, taken at respectively 10 and 17.50 m below surface contain high-diversity assemblages, assignable to DE CONINCK'S dinoflagellate-zone 7 (DE CONINCK, in press). Some of the dinoflagellate marker species are illustrated in Plate I.

Environment - The presence of erosive channels indicate high-energy conditions in a shallow marine, upper shelf environment.

3. EGEM, sandpit Ampe (fig. 7)

General remarks - The sand pit Ampe is located 2 km northwest of the Egem village centre, immediately west of road N50 from Kortrijk to Brugge, near a conspicuous 100 m high antenna. Excavation started in the beginning of the seventies, and has been continued up to now. At present the pit is about 30 m deep and covers an area of about 0.5 km2. It is chosen as type-locality of the Egem Sand Member.

Details of section - This is only locality in the Belgian Basin where the upper part of the Ieper Formation is almost entirely exposed. The Kortemark Silt Member has been only recently exposed by new commercial excavations. It consists of (ascending) : a micaceous silt (bed V of fig. 7), the top of which has channel structures filled with a laminated fine sand containing concentrations of worm tubes, shark teeth and fish otoliths (bed IV) ; a thin clay (bed III) ; a thin sand bank (bed II) ; and a 4 m thick silty clay (bed I). The Egem Sand Member, which is almost entirely exposed here, consists of 20 m thick greenish, glauconitic, shelly, fine sand with a few thin intercalations of clay (21 distinct beds can be identified, see fig. 7). The Pittem Clay Member is represented by a basal 40 cm thick shelly sandstone and 3 m thick heterogeneous sandy clay with thin sand- or siltstone banks. In this exposure, and further to the South, the Merelbeke Clay Member is absent between the Egem Sand and the Pittem Clay Members, indicating a major hiatus. The grain-size distribution of some intervals in the Egem sand pit is given in fig. 8. Figure 8 (1) covers the uppermost 8 m, fig. 8 (2) corresponds to the interval from 15 to 19 m below surface, whereas fig. 8 (3) covers the lowermost part of the quarry.

Macrofossils - The Egem Sand Member is the most fossiliferous part of the Belgian Ypresian. In the Ampe quarry it is characterized by a rich macrofauna with molluscs (dominance of oysters), *Nummulites planulatus*, shark teeth and fish-otoliths. The most common forms are illustrated in Plate I.

Microfossils - The section was sampled for foraminiferids (GERITS *et al.*, 1981), dinoflagellates (DE CONINCK & NOLF, 1979 and ISLAM, 1982) and calcareous nannofossils (STEURBAUT & NOLF, 1986). Only the lowermost samples of the Kortemark Silt Member yielded nannofossils. They are assigned to unit VI, which corresponds to the middle part of NP12. The samples of the Egem Sand Member contain low-diversity, poorly preserved nanno-assemblages (maximum of 18 species), assignable to the upper part of NP12 (see fig. 7). The uppermost ones, from the upper part of bed 21, contain *Nannoturba robusta* and *Discoaster cruciformis* and should, therefore, be attribued to unit VIII. The underlying ones do not contain the above mentioned species, but show a few *Rhabdosphaera crebra*, *Discoaster elegans* and *Sphenolithus radians*, allowing assignment to unit VII. Unit IX, which is known from the topmost part of the Egem Sand Member in the Kallo borehole seems to be missing here.

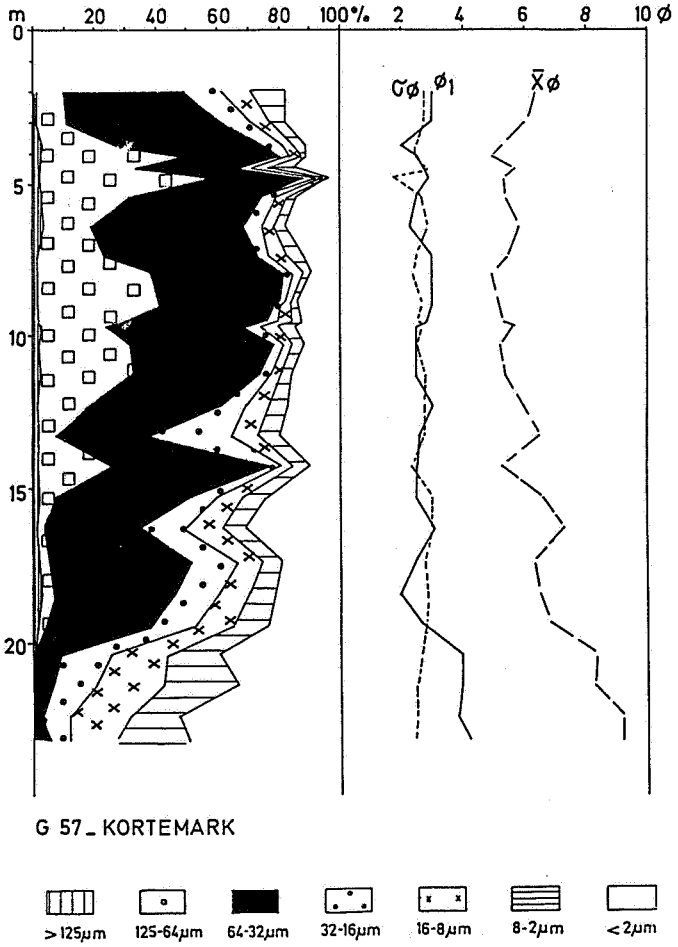

Figure 6. Grain-size distribution of the sediments in pit I of the Kortemark clay quarry by S. GEETS

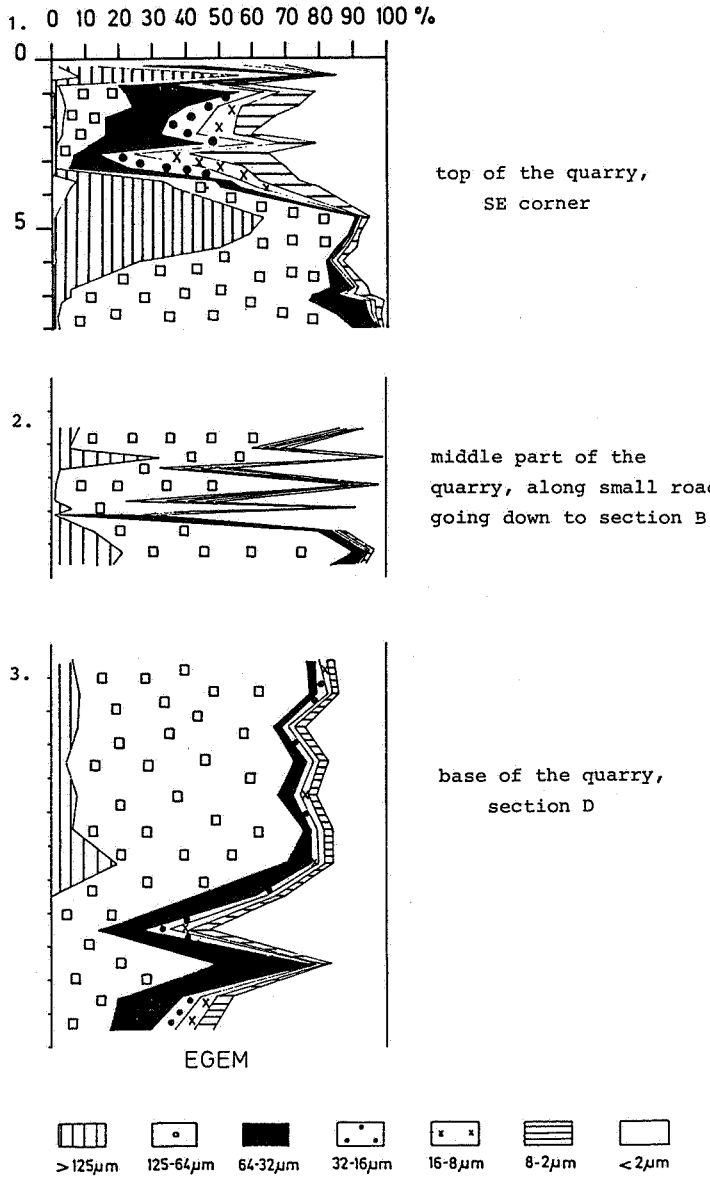

Figure 8. Grain-size distribution of the sediments in the Egem sand quarry by S. GEETS.

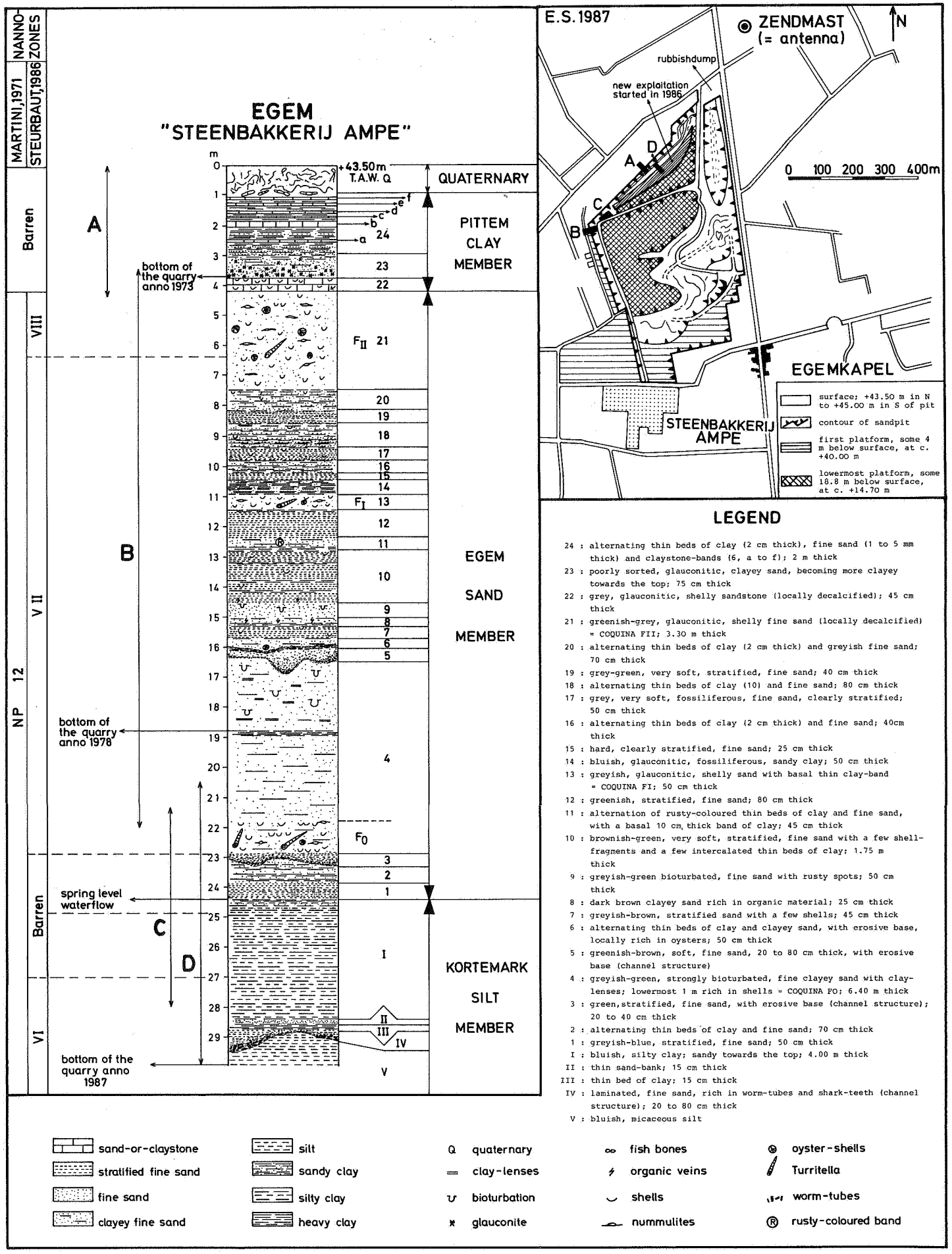

Figure 7. Stratigraphy of the Ypresian deposits in the Egem sand quarry

Environment - The sedimentological structures as well as the flora and fauna indicate shallow marine environment in subtropical region (depths of about 15 m). The presence of erosive channels on the one hand, and of nicely stratified fine sands on the other hand reflect rapidly changing deposition conditions. The Egem quarry sequence was laid down during a fairly long time-span, as the result of continuous erosion and redeposition, with intervals of non-sedimentation and strong bioturbation.

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ADDENDUM

Marke, borehole along motorway E17, drilled by a team of the "Geologisch Instituut, Gent" on behalf of Prof. Dr. G. DE MOOR. The borehole was described by Prof. Dr. G. DE MOOR (unpublished). Its grain-size distribution by Dr. S. GEETS is given in fig. 4.

Short description :

0	- 0,5	m	: light-brown, clayey loam ;
0,5	- 4,5	m	: light - browngrey to - bluegrey, micaceous, very - fine - silty clay, with gypsum cristals at the base ;
4,5	- 11	m	: blue-grey, (clayey) coarse to fine silt, with black humic spots, small pyritic veins, fossil fragments ; some fine laminations ;
11	- 20	m	: dark blue-grey, (clayey) medium to very fine silt, micaceous, finely laminated ; disperse fossil fragments, sometimes concentrated in layers (many *Turritella)* ;
20	- 31	m	: blue-grey, clayey very fine silt, upwards passing into clayey, coarse to medium silt, rich in fossil fragments, sometimes concentrated in layers ; pyritic veins ;
31	- 41	m	: darke blue-grey, (clayey) coarse to medium silt, micaceous, with fossil fragments, coarse glauconite grains and pyritic spots.

Stratigraphic and environmental interpretation :

0,0	- 0,5	m	: Quaternary
0,5	- 4,5	m	: Aalbeke Clay Member ; upper mud-shelf facies
4,5	- 40	m	: Roubaix Clay Member ; upper shelf facies.

PLATE 1

MARKE (Koekelare) CLAY QUARRY

Calcareous nannofossils from the Roubaix Clay Member, at 18.70 m below the top of the quarry ; STEURBAUT'S nannozone IIIa, top of MARTINI'S NP 11.
Scanning electron micrographs ; negatives Archief R.U.G., St-Pietersnieuwstraat, Gent, Belgium.

Fig. 1 *Pontosphaera fimbriata* (BRAMLETTE & SULLIVAN, 1961) (neg. 6943/87)
Fig. 2 *Rhabdosphaera truncata* BRAMLETTE & SULLIVAN, 1961 (neg. 6944/87)
Fig. 3 *Rhabdosphaera sola* PERCH-NIELSEN, 1971 (neg. 6946/87)
Fig. 4 *Tribrachiatus orthostylus* SHAMRAI, 1963 (neg. 6945/87)

KORTEMARK (Desimpel) CLAY QUARRY

Organic-walled phytoplankton from the Kortemark Silt Member ; DE CONINCK'S dinoflagellate-zone 7. Figs. 5 and 7 = dinoflagellates from 17.50 m below top of pit I ; fig. 6 = Prasinophyceae from 10 m below top of pit I. Negatives Archief R.U.G., Laboratorium voor Paletontologie, Krijgslaan 281, Gent, Belgium.

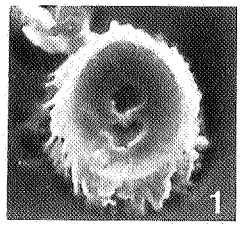
Fig. 5 *Wetzeliella articulata* (WETZEL) EISENACK, 1938
Fig. 6 *Crassosphaera* aff. *concinna* COOKSON & MANUM, 1960
Fig. 7 *Ochetodinium romanum* DAMASSA, 1979

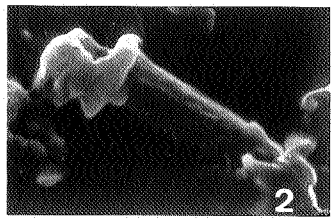
EGEM (Ampe) SAND QUARRY

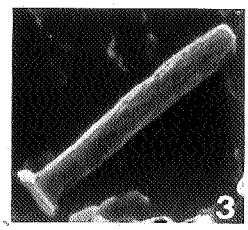
Macrofossils from bed 13(FI) of the Egem Sand Member, at c. 11 m below the top of the quarry.
Numbers refer to the collections of the "Koninklijk Belgisch Instituut voor Natuurwetenschappen", Brussel, Belgium.

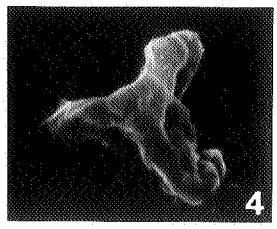
Fig. 8 *Ditrupa* sp. ; worm-tube (IST 5978)
Fig. 9-10 *Venericardia sulcata aizyensis* (DESHAYES, 1858) (IST 5979) (IST 5980)
Fig. 11-12 *Cubitostrea multicostata* (DESHAYES, 1832) (IST 5981) (IST 5982)
Fig. 13 *Nummulites planulatus* (BRUGUIERE, 1792) (IST 5983 - IST 6004)
Fig. 14 *Paraconger papointi* (PRIEM, 1906) ; fish otolith (P 5052)
Fig. 15 "genus Neobythitinorum" *subregularis* (SCHUBERT, 1916) ; fish-otolith (P. 5053)
Fig. 16 *Myliobatis* sp. ; ray tooth (P. 5054)
Fig. 17 *Odontaspis winkleri* LERICHE, 1905 ; shark-tooth (P. 5055)
Fig. 18 *Turbinolia paniselensis* GLIBERT, 1974 ; coral (IST 6005)

MARKE (Koekelberg) QUARRY





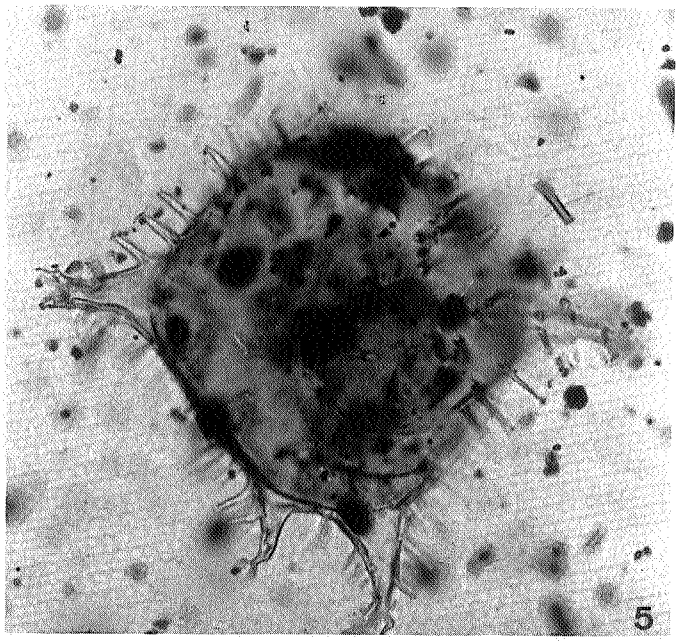


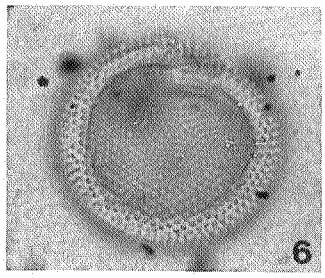


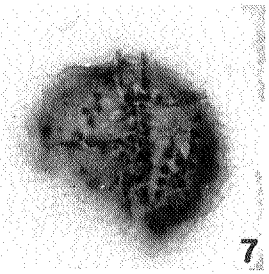
10µm

10µm

KORTEMARK (Desimpel) QUARRY

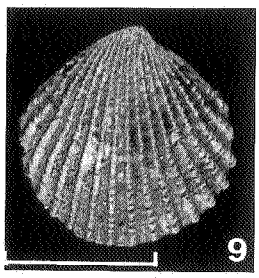


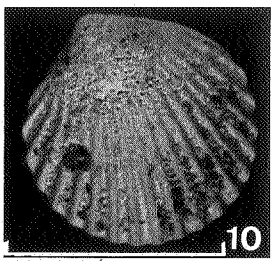


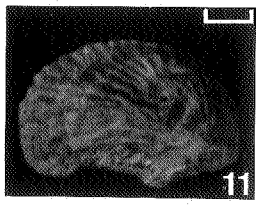


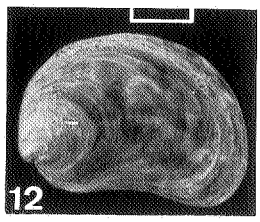
50µm

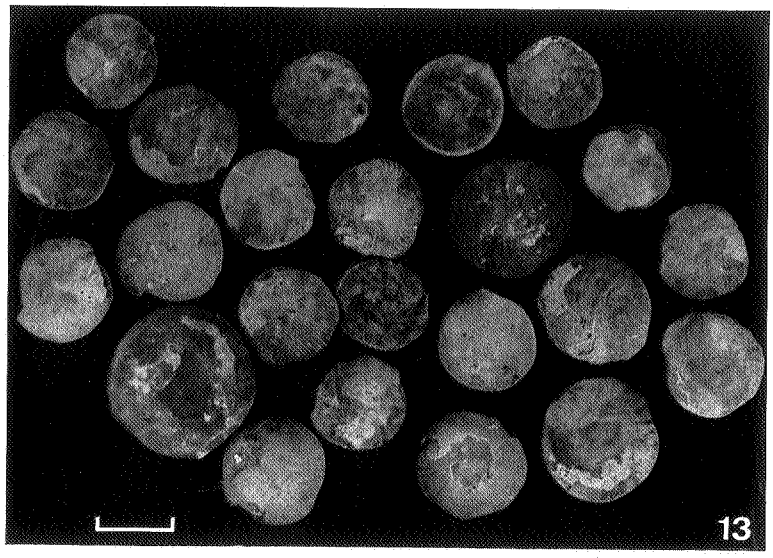
EGEM (Ampe) QUARRY

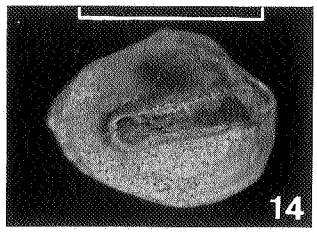


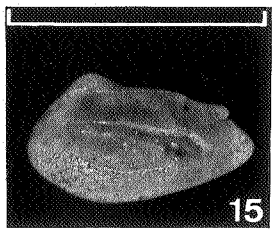


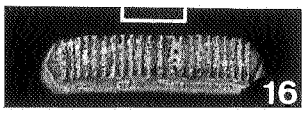












= 5mm