

Report EP-49436

MICROPALAEONTOLOGICAL SUMMARY OF
NORSKE SHELL 17/11-2

by

J. Stolk

SIPM EP/12

May 1978

for A/S Norske Shell



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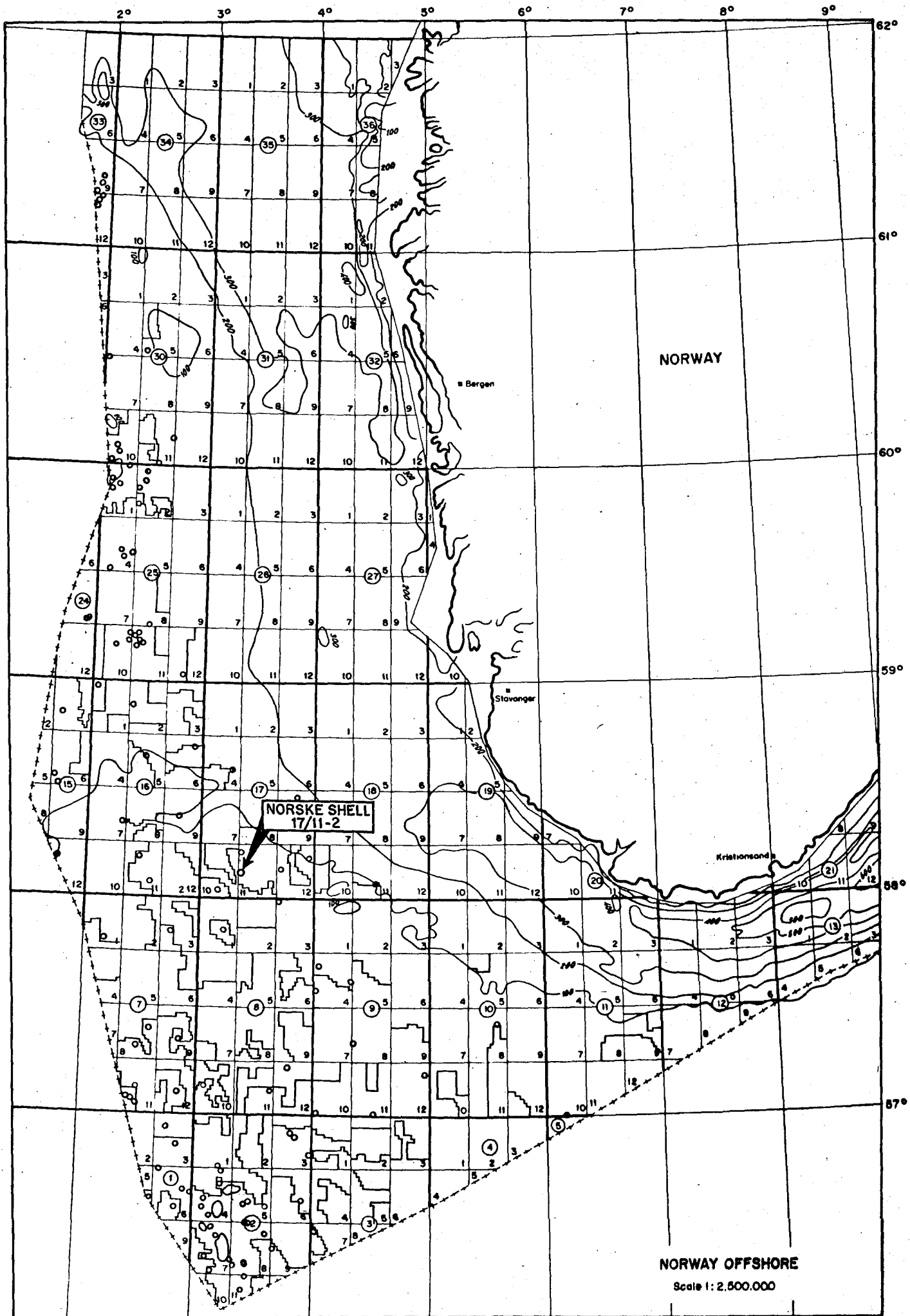
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TEXT FIGURE 1

CONTENTS

	page
SUMMARY	III
I. Introduction	1
II. STRATIGRAPHY	1
1. Quaternary	1
1.01 Pleistocene	1
2. Tertiary	2
2.01 Pliocene	2
2.02 Miocene	3
2.03 Oligocene	4
2.04 Eocene	5
2.05 Paleocene	7
3. Upper Cretaceous	8
3.01 Maastrichtian	8
3.02 Campanian	9
3.03 Santonian	9
4. Lower Cretaceous	10
4.01 Albian	10
4.02 Aptian	11
4.03 Barremian	12
4.04 Hauterivian	13
4.05 Valanginian	14
4.06 Berriasian	15
5. Upper Jurassic	15
5.01 Portlandian	15
5.02 Kimmeridgian	16
6. Inconclusive	17
III. DEPOSITIONAL ENVIRONMENTS	17
REFERENCES	

Appendices

1. Summary list of sidewall samples taken from the interval 1325 - 2630 m and samples of core nr. 1: 2533 - 2542 m (8310 - 8340 ft) in Norske Shell well 17/11-2 (2 pages)

Enclosures

1. Palaeo-log of Norske Shell 17/11-2, interval 210 - 2644 m
scale 1 : 5000; drw. nr. G-62284/1

Text figures

1. Key map Norway offshore licence area, scale 1 : 2,500,000;
drw. nr. G-62284/2 (inside front cover)

SUMMARY

Time-stratigraphical and environmental interpretation of the sedimentary sequence penetrated in this well is made possible by the results of a microfaunal investigation of cutting-, core- and sidewall samples from the interval 210 - 2644 m, the nannofloral examination of the sidewall samples between 1325 and 1740 m and a palynological study of palynomorphs in some sidewall samples of the interval 2325 - 2630 m and core nr. 1. The following time-stratigraphic subdivision can accordingly be presented,

Pleistocene	210	-	270 (430)	m
Pliocene	290 (450)	-	540	m
Miocene	550	-	600	m
Oligocene	610	-	1030	m
Eocene	1050	-	1250	m
Paleocene	1260	-	1340	m
Maastrichtian	1350	-	1430	m
Campanian	1450	-	1680	m
Santonian	1692	-	1767	m
Albian	1767	-	1920	m
Aptian	1930	-	1960	m
Barremian	1970	-	2010	m
Hauterivian	2020	-	2270	m
Valanginian	2275	-	2410	m
Berriasian	2415	-	2470	m
Portlandian	2475	-	2495	m
Kimmeridgian	2495	-	2517 (2521)	m
?Triassic and ?M - U. Jurassic	2521	-	2644 (TD)	m

Several unconformable contacts are clearly indicated by incomplete microfaunal sequences or total lack of certain biostratigraphic units. The environment of deposition of the more open marine sediments met with at this locality appears to have been continuously shallower than in the centralmost part of the North Sea Basin.

KEYWORDS

Norway offshore; Central North Sea area; Egersund Basin; Biostratigraphy; Microfauna; Foraminifera; arenaceous -, calcareous benthonic -, planktonic -; Diatoms; Ostracoda; Nannoflora: calcareous nannoplankton; Palynology: palynomorphs; Time-stratigraphy; Quaternary; Tertiary; Cretaceous; Jurassic; ?Triassic; Lithology; Depositional environment.

MICROPALAEONTOLOGICAL SUMMARY OF NORSKE SHELL 17/11-2

I. Introduction

The well is situated close to the western boundary of block 17/11 in the central North Sea area (see text fig. 1). It was drilled to evaluate Middle Jurassic and Triassic prospects in the faulted western flank of a large monoclinial structure associated with a seismically defined, NE - SW striking, ridge shaped salt piercement, which forms one of the local uplifts in the Egersund Basin.

Sediments of Quaternary, Tertiary, Cretaceous and Jurassic age were penetrated before the top of the objective interval was reached at 2521 m; the well then passed through predominantly arenaceous and entirely non - fossiliferous rock to the final depth of 2644 m.

Within the interval 210 - 2644 m, microfaunal observation was carried out in 137 cutting samples, examined at general interspacings of 20 metres but in certain parts of the well considerably closer; in addition, thirty two sidewall samples, taken between 1770 and 2517 m, and several levels of the conventional core nr. 1, cut from 2533 to 2542 m, were microfaunally investigated. The fifteen sidewall samples, received from equidistant levels between 1325 and 1740 m in the chalk interval, were examined on nannoplankton content only whereas a palynological study of palynomorphs was extended to fourteen sidewall samples from the interval 2325 - 2630 m and to several samples taken from core nr. 1. Appendix 1 lists a summary of the sidewall and core samples with indication of the various types of examination performed and some time-stratigraphic results.

The more important biostratigraphic details of the microfaunal study are, together with interpretation towards time-stratigraphy and depositional environment, recorded in a palaeo-log (encl. 1).

Micropalaeontological and electric log criteria disclose a remarkably precise correlation of the penetrated sequence in the present well with the interval from approximately 7700 ft upwards in Norske Shell 17/11-1, located about 11 kms to the north in the east flank of the same structure.

All depth figures mentioned in this report are in metres and comply in general with the drilling log as measured from the derrickfloor, which stands at an elevation of 112 m above the sea bed with a water depth of 79 m from mean sea level; the depths of the sidewall samples and markers of the electric log are related to the Schlumberger survey.

Microfaunal details of the several time-stratigraphic units recognized in the well, as well as some notes on the environments of deposition, are given in the following chapters.

II. STRATIGRAPHY

1. Quaternary

1.01 Pleistocene: 210 - 270 (430)* m

* - alternative limits

The foraminiferal yield of the cutting samples consisted of very small quantities of calcareous benthonic specimens only, belonging to

Cassidulina 3 - C.pliocarinata van Voorthuijzen
and Elphidium 4 - E.selseyense (Heron Allen & Earland)

The regular presence of Upper Cretaceous microfaunal elements points to conditions of reworking. The alternative lower limit of this interval, at 430 m, is discussed in the next subchapter.

2. Tertiary

2.01 Pliocene: 290 (450)* - 540 m

Microfaunal observations within this interval did not contribute towards establishing a definite boundary between sediments of Pliocene and Pleistocene age. The highest occurrence of the Pliocene marker

Cibicides 3 - C.grossa ten Dam & Reinhold
was observed in cutting sample 290 m. Its rare occurrence disappears however below 330 m to be followed by an interval with common presence of
Elphidium 2 - E.hannai (Cushman & Grant)

It reappears with common numbers at cutting sample 450 m to continue regularly downwards with increasing quantity as part of a foraminiferal assemblage with typical Pliocene aspect. It is therefore possible that the higher, poor occurrences of Cibicides 3 are to be ascribed to reworking in a zone of conglomeratic lithology.

Apart from the details mentioned above, the upper half of the interval, down to 430 m, yielded foraminiferal microfaunas made up mainly by the following calcareous benthonic species

Cassidulina 3 - C.pliocarinata van Voorthuijzen
Elphidium 4 - E.selseyense (Heron Allen & Earland)
Elphidium 10
Eponides 3 - B.frigida (Cushman)
Nonion 4
Nonion 7 - N.affine (Reuss)
Nonion 9 - N.compressum DiNapoli
Nonion 10 - N.depressulum (Walker & Jacob)
Quinqueloculina 2 - Q.carinata d'Orb
Quinqueloculina 3
and Quinqueloculina 4 - Q.seminula (Linnaeus)

in quantity varying greatly from one sample to the other. Additional to the above, specimens of reworked Upper Cretaceous Foraminifera occur regularly and more in particular representatives of the genera Globotruncana, Rugoglobigerina and Stensioina. Cutting sample 390 m yielded a fair amount of pyritized megaspores whereas fragments of lamellibranchs, gastropods and echinoderms form a regular background to the microfaunal assemblage.

The lower half (450 - 540 m) of the interval yielded moderately rich to abundant microfaunas of definite Pliocene age. Characteristic in the assemblage of predominantly calcareous benthonic - and minor amounts of arenaceous Foraminifera are, apart from Cibicides 3, the following species

Bulimina 2 - B.subulata Cushman & Parker

* - alternative limits

Bulimina 27	- B.marginata d'Orb
Bulimina 29	
Cibicides 2	- C.limbatosuturalis van Voorthuijzen
Cibicides 6	- C.pseudoungerianus (Cushman)
Cibicides 12	- C.lobatulus (Walker & Jacob)
Elphidium 3	- E.excavatum (Terquem)
Rotalia 1	- S.pseudotepidus van Voorthuijzen
Sigmoilina 6	- S.celata Costa
and Textularia 3	- T.sculpturata Cushman & ten Dam

Some of them display distinct top-occurrences (see encl.1) thus pointing to a gradual reduction of the microfaunal diversity in ascending order. The foraminiferal yield of the cutting samples includes furthermore nearly all species observed in the overlying part of the interval; such occurrences could of course be the result of contamination but the relatively greater abundance of, amongst others, Nonion 7 might at least be interpreted towards autochthony.

2.02 Miocene: 550 - 600 m

The upper limit of this very short interval is readily recognized by the top-occurrence of

Ehrenbergina 2	
Elphidium 11	
and Epistomina 1	- E.elegans (d'Orb.)

in cutting sample 550 m followed by that of

Asterigerina 1	- A.staeschei ten Dam & Reinhold
----------------	----------------------------------

in cutting sample 560 m. The autochthonous foraminiferal content appears in these two cutting samples to be far less diverse than in the remaining part of the interval.

Generally abundant microfaunal yields were obtained from cutting sample 570 m onwards and, apart from the above mentioned species, characterized by the following,

Alabamina 3	- A.tangentialis (Clodius)
Bigenerina 1	- B.nodosaria d'Orb.
Bulimina 8	- B.elongata d'Orb.
Ceratobulimina 1	- C.contraria (Reuss)
Cristellaria 7	- M.akneriana Neugeboren
Ehrenbergina 1	- E.serrata healyi Spiegler
Ehrenbergina 3	- E.variabilis praepupa Spiegler
Elphidium 1	- E.inflatum (Reuss)
Globigerina 22	- G.apertura Cushman
Globigerina 23	- G.?concinna Reuss
Globigerinoides 1	- G.trilobus (Reuss)
Globorotalia 6	- G.praescitula Blow
Globorotalia 9	- G.scitula (Brady)
Marginulina 1	- M.dingdeni ten Dam & Reinhold
Martinottiella 2	- M.communis (d'Orb.)
Siphonina 1	- S.reticulata (Czjzek)
Textularia 23	- S.deperdita (d'Orb.)
and Uvigerina 2	- U.tenuipustulata van Voorthuijzen

The two lowermost examined samples, at 590 and 600 m, contained furthermore specimens of Asterigerina 1 transitional to A.gürichi (Franke).

Accessory microfaunal components regularly observed with fair quantity are small, pyritized Diatoms referable to Coscinodiscus and few fish remains. As observed in the residues of the washed cutting samples, the sediment incorporates, from 560 m downwards, a high amount of glauconite, partly coprolithic.

The microfaunal content of the interval, consisting of predominantly calcareous benthonic -, somewhat lesser planktonic - and a relatively minor ratio of arenaceous Foraminifera, compares, except for that of the uppermost two samples, closely with the foraminiferal assemblage observed in the lower part of the Miocene interval of the Albuskjell area, where the vertically most extensive and presumably complete sequence of the Tertiary North Sea Basin was found (ref. 9).

With reference to a recent biostratigraphic study of Miocene sediments in northwest Germany (ref. 3), the interval would, at least below 570 m, correlate with the early Miocene "tenuipustulata" zone which is restricted to the upper part of the Hemmoor Formation. Hence, the upper limit of the interval represents obviously an unconformable contact with the overlying Pliocene in this well.

2.03 Oligocene: 610-1030 m

The top of this interval is based on the uppermost presence of

Coscinodiscus 5

in cutting sample 610 m. This conspicuous Diatom species with four to six distinct peripheral horns on one side of its disc-shaped, pyritized body has a widespread distribution in the central and northern North Sea area. With regard to its stratigraphic range in the vertically far more extensive Tertiary sequence of the Albuskjell area (ref. 9), an incomplete transition during late Oligocene should be considered a possibility in this well.

Severe contamination from cavings prohibits unfortunately a true assessment of the microfaunal assemblage in the upper part of the interval. Nevertheless, the first appearance in cutting sample 670 m and subsequent regular downward occurrences of

Elphidium 9 - E.hiltermanni Hagn

Discorbis 18

Nonion 5 - N.roemeri Cushman

and Rotalia 7 - R.canui Cushman

are obviously autochthonous and diagnostic for Oligocene age. Fair amounts of Asterigerina 1 transitional to A.gürichi (Franke) occur regularly in this part of the interval whereas the first appearance (top-occurrence) of definite

Asterigerina 2 - A.gürichi (Franke)

was observed in cutting sample 730 m. The top-occurrences of

Coscinodiscus 3 and Bolivina 18

were observed simultaneously at 750 m. The former, a conspicuous pyritized Diatom having slightly outwards arched sides in a basically square peripheral outline of the biconvex body, is adorned on one side with one horn in each corner. It occurs here in the same stratigraphical relationship to Coscinodiscus 5 as in the Oligocene deposits of the Albuskjell area (ref. 9). The stratigraphic position of Bolivina 18 in this part of the microfaunal sequence provides furthermore a good correlation between our wells in the 17/10 and 17/11 blocks.

A distinct qualitative change in the foraminiferal assemblage takes place at 810 m. From this depth downwards, all cutting samples yielded abundant

foraminiferal microfaunas, in general referable to a "Cristellaria - Dentalina - Nodosaria" assemblage but also incorporating a fairly high ratio of arenaceous specimens belonging to only a few genera. Characteristic in this assemblage of distinctly yellowish brown coloured microfossils are, amongst others, the following species

Alabamina 1	- A.wolterstorffi (Franke)
Alabamina 3	- A.tangentialis (Clodius)
Asterigerina 2	- A.gürichi (Franke)
Cassidulina 6	- C.carapitana Hedberg
Ceratobulimina 1	- C.contraria (Reuss)
Cibicides 1	- C.praecinctus (Karrer)
Cibicides 5	- C.ungerianus (d'Orb.)
Cristellaria 8	- C.convergens Bornemann
Dentalina 13	- D.vertebralis (Reuss)
Dentalina 15	- D.obliquestriata Reuss
Dentalina 18	- N.ludwigi Reuss
Egerella 5	- K.mexicana (Nuttall)
Epistomina 1	- E.elegans (d'Orb.)
Gyroidina 1	- G.girardana (Reuss)
Gyroidina 3	- G.soldanii d'Orb.
Haplophragmium 5	- A.humboldti (Reuss)
Karrerella 1	- K.siphonella (Reuss)
Nodosaria 2	- N.longiscata d'Orb.
Nodosaria 6	- N.multilineata (Bornemann)
Nodosaria 33	- N.ewaldi Reuss
Nodosaria 34	- N.pauperata (d'Orb.)
Quinqueloculina 5	- Q.impressa Reuss
Rotaliatina 1	- R.bulimoides (Reuss)
Sigmoidella 1	- P.humboldti Reuss
and Spiroloculina 1	- S.canaliculata d'Orb.

with considerable variation of quantity and regularity of occurrence between each species; some of them display distinct extinction levels within the interval (see encl. 1). The presence of Rotaliatina 1 is held diagnostic for Middle Oligocene age. The assemblage as a whole has a widespread geographical distribution in northwestern Europe as it is known from the Boom Clay of Belgium, the Septaria Clay of Germany and the Viborg Formation of Denmark.

Fragments of Bryozoa, Gastropods and Serpulids were observed from 910 m downwards. From 990 m onwards, the lowermost samples yielded furthermore fair amounts of spherical Radiolaria and bone-shaped objects both in pyritized preservation. Significant also is the observation at this depth of the last vestiges, in ascending sense, of a rapidly impoverishing assemblage of white arenaceous Foraminifera which occur more abundantly in the upper part of the preceding Eocene interval. This may be indicative for a gradual transition in the sequence at the Eocene - Oligocene boundary.

Observations in the washed cutting samples point to a high pyritic and glauconitic content in the predominantly clayey lithology of the interval; fragments of dark brown limestone were seen from 890 m onwards.

2.04 Eocene: 1050 - 1250 m

The upper limit of this interval is indicated by the sudden appearance of brightly white coloured microfaunas representing an association of

calcareous benthonic, planktonic and arenaceous Foraminifera in approximately equal ratios; the latter show a tendency towards quantitative increase in descending order. Characteristic in this assemblage, which appears to be restricted to the approximate upper half of the interval, are the following calcareous species

Anomalina 1	- A.grosserugosa (Gümbel)
Eponides 18	- P.cancellata Cushman & Bermudez
Globigerapsis 1	- G.index (Finlay)
Globigerina 13	- G.yeguaensis Weinzierl & Applin
Guttulina 5	- G.spicaeformis Roemer
Uvigerina 12	
and Vaginulina 2	- L.decorata (Reuss)

whereas the bulk of the arenaceous part is made up of

Ammodiscus spp.	
Bathysiphon 1	
Cyclammina 1	- C.placenta (Reuss)/cancellata Brady
Glomospira 2	- G.charoides (Jones & Parker)
Haplophragmoides 2	- R.obsoletum (Goës)
Haplophragmoides spp.	
Karrerella 5	
Martinottiella 1	

with occasional addition of

Dorothia 8	- D.eocenica (Cushman)
Karrerella 6	
and Textularia 22	- T.plummerae Lalicker

The agglutinate test of most arenaceous specimens is, except for Ammodiscus and Glomospira, composed of medium sized grains rather loosely packed, thus rendering a sugary appearance. The foraminiferal yield of the cutting samples is, from 1170 m downwards, interpreted to consist of arenaceous specimens only in an assemblage which is essentially similar to the one discussed above. A qualitative change is indicated however by the presence of

Cyclammina 3	- C.amplectens Grzybowski
Spiroplectammina 3	- S.spectabilis (Grzybowski)
Valvulina 2	

and the regular occurrence of more distinct specimens of

Dorothia 8	- D.eocenica (Cushman)
------------	------------------------

diagnostic for the Lower Eocene PT22/24 zone. The microfossil assemblage includes furthermore Radiolaria in great abundance. Within this part of the interval, a change is noticeable from medium to fine granular composition in the agglutinate test of the arenaceous Foraminifera.

Just above the base of the interval, the presence of the Diatom species

Coscinodiscus 1 large var.

and Coscinodiscus 2

in the cutting samples 1230 and 1250 m is diagnostic for the earliest Eocene PT 21 zone. Noteworthy of these usually pyritized Diatoms is that a considerable number of them are here preserved in a clear siliceous state.

The base of the Lower Eocene tuffaceous deposits is indicated by the electric log marker LT 20 at 1246 m.

2.05 Paleocene: 1260 - 1340 m

The autochthonous microfaunal content of the two uppermost examined cutting samples, at 1260 and 1270 m, was found to be strongly masked by contamination from cavings. Nevertheless, the very scarce presence of

Bulimina 23 - *B.aff.aculeata* d'Orb. sensu ten Dam
Cymbalopora 2 - *T.ruthven-murrayi* Cushman & Renz
and Saccamina 2 - *S.rhumbleri* (Franke)

would indicate that sediments of Paleocene age had been reached at these depths. From 1290 m onwards, the fossiliferous yield shows a gradual increase of autochthonous specimens, belonging mainly to calcareous benthonic and arenaceous Foraminifera. The assemblage includes, amongst others,

Allomorphina 2 - *A.halli* Jennings
Anomalina 4 - *R.parvula* ten Dam
Anomalina 6 - *A.danica* (Brotzen)
Bulimina 1 - *B.trigonalis* ten Dam
Bulimina 26 - *B.denticulata* Cushman & Parker
Cibicides 32
Cystamina 1 - *C.pauciloculata* (Brady)
Dorothia 10 - *G.bentonensis* (Carman)
Parrella 1 - *O.lens* Brotzen
Spiroplectamina 3 - *S.spectabilis* (Grzybowski)
Textulariella 3 - *T.varians* Glaessner

and a fair amount of specimens belonging to

Anomalinoidea nobilis Brotzen

and *Clavulinoidea aspera* (Cushman)

The assemblage can therefore be referred to the Middle Paleocene PT 13/15 zone.

The uppermost presence of carbonate sediment: pale greyish white, hard marl and chalk was observed in cutting sample 1320 m. The fossiliferous content is instantly marked by abundant fragments of Bryozoa, Enchinoderms, Pelecypods and somewhat lesser amounts of sponge remains (needles and rhaxes). Amongst the foraminiferal yield was noticed, in addition to some of the species mentioned above, the presence of the following,

Alabamina 2 - *A.obtusa* (Burrows & Holland)
Anomalina 31
Bolivinoidea 7 - *B.paleocenicus* (Brotzen)
Bulimina 13 - *B.ovata* d'Orb.
Bulimina 32 - *B.plena* Brotzen
Cibicides 55 - *C.ekblomi* Brotzen
Discorbis 16 - *D.binkhorsti* (Reuss)
Globigerina 18 - *G.triloculinoides* Plummer
Globigerina 26 - *G.daubjergensis* Bronnimann
Globorotalia 7 - *G.pseudobulloides* Plummer
Reussella 4 - *B.curvisuturata* Brotzen
Siphonina 2 - *P.eklundii* Brotzen
Spirillina sp.A - *S.subornata* Brotzen
Zeauvigerina sp.A - *Z.aegyptica* Said & Kenawy

as well as

Bolivinita selmensis Cushman
Cibicides succedens Brotzen
Coleites reticulosus Plummer

and a fair amount of arenaceous specimens belonging predominantly to the genera Arenobulimina, Gaudryina, Marssonella, Spiroplectamina and Textularia. This assemblage is characteristic for the early Paleocene PT 11 zone which extends to the base of the interval at cutting sample 1340 m.

Two sidewall samples, taken at 1325 and 1340 m, were investigated only on calcareous nannoplankton content which resulted in an upper danian - subzone np 4a dating (see Appendix 1).

3. Upper Cretaceous

Microfaunal examination within the chalk interval was carried out on cutting samples only since the recoveries of the thirteen sidewall samples, taken between 1370 and 1740 m, proved to consist of substandard amounts of sediment, insufficient to warrant a representative microfaunal yield. The latter were therefore reserved entirely for nannofloral investigation of which the time-stratigraphic results are summarized in Appendix 1.

Certain discrepancies of age interpretation are evident between the nannofloral and microfaunal systems and are probably caused by the fact that the calcareous nannoplankton subdivision has yet not been sufficiently tested on northwest European material of the Upper Cretaceous.

Moderately rich to abundant microfaunas were extracted from the cutting samples which shows that the carbonate deposits at this locality are soft enough to release its microfaunal content upon treatment by means of the standard washing procedure. Some difficulties were experienced however with the specific determination of specimens belonging to Bolivinoidea and Stensioina as their delicate ornamental features were often masked by attached sediment.

3.01 Maastrichtian: 1350 - 1430 m

The upper limit of this interval is clearly marked by the highest occurrence of

Globotruncana 10	- G.contusa (Cushman)
Pseudotextularia 1	- P.elegans (Rzehak)
Pseudotextularia 2	- R.fructicosa (Egger)
Stensioina 1	- S.pommerana Brotzen

observed in cutting sample 1350 m.

Furthermore occurring amongst the fairly abundant foraminiferal content of the interval, are the following calcareous benthonic species

Anomalina 11	
Anomalina 19	- A.velascoensis Cushman
Anomalina 28	- G.pertusa (Marsson)
Anomalina 34	
Bolivina 2	- B.incrassata Reuss
Bolivinoidea 1	- B.draco (Marsson)
Bolivinoidea 2	- B.miliaris Hilterman & Koch
Cibicides 8	- C.excavata Brotzen
Cibicides 11	- C.voltziana (d'Orb.)
and Stensioina 7	- S.excolata (Cushman)

with considerable variation in quantity between each.

Planktonic Foraminifera are represented predominantly by
Rugoglobigerina spp.

and infrequently by some specimens of
Globigerinelloides spp.

Globotruncana 4 - *G.arca* (Cushman)
Globotruncana 11 - *G.mayaroensis* (Bolli)
and *Praeglobotruncana* 2 - *P.citae* (Bolli)

Appreciable amount of fragments of Bryozoa, Echinoderms and Inoceramus form a regular background to the microfaunal assemblage.

3.02 Campanian: 1450 - 1680 m

The top of this interval is determined by the uppermost presence of
Bolivinoidea 5 - *B.decorata* (Jones)
in cutting sample 1450 m.

Below this level, several diagnostic species display successively first appearances (see encl. 1). They are

Anomalina 3 - *G.clementiana* (d'Orb.)
Anomalina 20 - *A.gracilis* (Marsson)
Anomalina 32
Anomalina 36
Bulimina 5 - *B.triangularis* Cushman & Parker
Bulimina 18 - *B.parvula* Brotzen
Globotruncana 13 - *G.cretacea* (d'Orb.)
Gyroidina 7 - *G.globosa* (Hagenow)
Planulina 14
Pyramidina 1 - *P.szajnochae* (Grzybowski)
and *Reussella* 1 - *R.cushmani* Brotzen

providing in combination ample evidence for the Campanian age of the interval.

The presence of

Stensioina 2 - *S.exculpta gracilis* Brotzen
Stensioina 6
Stensioina 9

and a fair amount of specimens probably referable to

Stensioina granulata incondita Koch (ref. 5)
in the two lowermost examined cutting samples at 1650 and 1671 m would point to early Campanian age at these levels.

The lower limit of the interval is placed at sidewall sample 1680 m which provided, amongst the nannoflorally examined sidewall samples, the lowermost evidence for Campanian age (see Appendix 1).

3.03 Santonian: 1692 - 1767 m

The main diagnostic species for this interval is

Stensioina 3 - *S.granulata polonica* Witwicka (ref.5)
which displays a distinct top-occurrence in cutting sample 1692 m. With respect to the stratigraphic range of this species in northwest Germany (ref. 5), absence of late Santonian sediments should be considered a possibility in this well. Furthermore, the presence of

Stensioina 4 - *S.granulata granulata* (Olbertz)
observed in the lowermost examined cutting samples at 1731 and 1752 m would lend support to an early Santonian (Lower to early Middle) interpretation for the entire interval.

In spite of considerable amounts of caved specimens obscuring the autochthonous microfaunal content in the cutting samples, a distinct quantitative increase of Globotruncana spp. with a predominance of

Globotruncana 2 - G.marginata (Reuss)

as well as the presence of abundant Radiolaria are considered "in situ" occurrences.

The lower limit of the interval is accepted at 1767 m where electric log characteristics show a clear break of the chalk with the underlying clastic sediments.

4. Lower Cretaceous

Generally rich and fairly diverse microfaunas were observed to prevail throughout the interval. The foraminiferal assemblages are composed mainly of calcareous benthonic and arenaceous specimens to be joined, in a few parts of the interval, by planktonics. The microfaunal content compares, as a whole, very closely with age-equivalent counterparts of the southern North Sea area and of onshore localities in England (Gault, Speeton), the Netherlands, northwest Germany and France (stratotype Albian).

The availability of sidewall samples, taken throughout the interval between 1770 and 2400 m at regular interspacing of 25 to 30 metres, contributed greatly towards a more reliable recognition of vertical distribution in the microfaunal sequence.

Abnormally short intervals of Aptian and Barremian age were thus established; tectonic movements may be responsible for some incompleteness.

Palynological investigation of some sidewall samples in the lowermost part of the interval was decisive towards exact age assignments.

4.01 Albian: 1767*- 1920 m

The foraminiferal microfaunas, observed in the cuttings and sidewall samples of this interval, consist mainly of white arenaceous specimens. They are poorly represented in the topmost part but, from 1830 m onwards, they gain rapidly in quantity. Relatively minor amounts of calcareous benthonic Foraminifera were observed occasionally from the same depth downwards. The foraminiferal assemblage is more in particular characterized by the presence of

Ammobaculites 4	- A.reophacoides Bartenstein
Ammobaculites 20	- A.parvispira ten Dam
Ammodiscus spp.	
Anomalina 7	- A.berthelini ten Dam
Bathysiphon spp.	
Bigenerina 2	- G.sherlocki Bettenstaedt
Dorothia 5	- V.subfiliformis Bartenstein
Epistomina 2	- E.polypoides (Eichenberg)
Epistomina 13	- E.chapmani ten Dam
Eponides 4	- L.lamplughi (Sherlock)
Glomospira 1	- G.gordialis (Jones & Parker)
Glomospira 2	- G.charoides (Jones & Parker)

*- based on electric log evidence

Guttulina 7	- F.alta (Magniez-Jannin)
Haplophragmoides 10	- H.nonioninoides (Reuss)
Haplophragmoides spp.	
Spiroplectinata 1	- S.annectens (Parker & Jones)
Textularia 20	- T.bettenstaedti Bartenstein & Oertli
Uvigerinamina 1	
and Valvulina 1	

Noteworthy is the regular occurrence, from cutting sample 1790 m downwards, of arenaceous specimens morphologically similar to the triangular, initial part of Gaudryina 7. They exhibit however a distinct granular appearance of the agglutinate test, which is moreover often coated with a dusting of very fine, black material as in Textularia 20. These specimens are undoubtedly conspecific with

Gaudryina aff.dividens Grabert described by Magniez-Jannin (ref. 7) from Lower to Middle Albian sediments (stratotype) of France and confirmed by our observations in sample material of the same localities.

Amongst the rather diverse lot of Haplophragmoides spp., a good deal of specimens could be allocated to

Haplophragmoides chapmani Morozova (ref. 7)

They occur upwards to the top of the interval. A fair amount of

Falsogaudryinella moesiana (Neagu) (ref. 1)

was furthermore observed in the rich microfaunal content of sidewall sample 1860 m.

Microfaunal criteria would thus indicate that the interval comprises a fairly complete sequence of, at least, Lower and Middle Albian shaly deposits. In the uppermost part of the interval, where the sediment becomes increasingly more sandy and glauconitic, the very poor microfaunal content did not provide positive evidence for late Albian age.

The upper limit of the interval represents obviously an unconformable contact with the overlying Santonian chalk.

4.02 Aptian: 1930 - 1960 m

The upper limit of this interval is based on the highest occurrence of Epistomina 14

The microfaunal yield of the cutting samples displays otherwise, possibly due to contamination from cavings, all characteristics of the overlying Albian interval.

The Aptian age is furthermore substantiated by the rich, red coloured microfaunas extracted from the cutting and sidewall sample at 1950 m with, amongst others, appreciable amounts of

Anomalina 8	
Anomalina 27	
Gaudryina 7	- G.dividens Grabert
Cuttulina 7	- F.alta (Magniez-Jannin)
Hedbergella 1	- H.infracretacea (Glaessner)
Hedbergella 8	
Hedbergella 10	
Spirillina 1	
Valvulineria sp.C	- V.loeterlei Tappan var.

and by the influx of

Gyroidina 9 - G.bartensteini Bettenstaedt s.l.
and Hedbergella 9 - H.apertiana Bartenstein
in cutting sample 1960 m. Although these foraminiferal criteria could be interpreted towards a completeness of the interval, the very limited vertical extension of it prohibits at the same time a detailed subdivision.

4.03 Barremian: 1970 - 2010 m

Biostratigraphic recognition of this short interval is afforded in the first instance by the very rich microfaunal content of two sidewall samples, taken at 1980 and 2010 m. Autochthonous parts of the microfaunal yield of the cutting samples, although severely contaminated with caved material, could therefore rather easily be recognized. It would then appear that the foraminiferal assemblage is composed of calcareous benthonic, planktonic and arenaceous specimens in about equal ratio. The more significant species of it are herewith listed as follows

Anomalina 33	- G.barremiana Bettenstaedt
Astacolus 9	- L.crepidularis (Roemer)
Bigenerina 2	- G.sherlocki Bettenstaedt
Cristellaria 5	- D.macfadyeni Bartenstein
Cristellaria 15	
Cristellaria 52	- L.ouachensis Sigal
Dorothia 5	- V.subfiliformis Bartenstein
Epistomina 3	- E.hechti Bartenstein, Bettenstaedt & Bolli
Epistomina 7	- E.ornata (Roemer)
Epistomina 15	- E.spinulifera (Reuss)
Glomospira 3	- M.washitensis Loeblich & Tappan
Guttulina 7	- F.alta (Magniez-Jannin)
Gyroidina 9	- C.bartensteini Bettenstaedt s.l.
Marginulina 11	- M.gracilissima (Reuss)
Marsonella sp.B	- M.kummi Zedler
Spirillina 8	- S.minima Schacko
Textularia 20	- T.bettenstaedti Bartenstein & Oertli

and Valvulineria 10

Amongst the morphologically variable representatives of the genus Falsogaudryinella Bartenstein should be mentioned a rather common and regular presence of specimens with distinct wing-shaped projections which often terminate in spikes; they have been provisionally allocated to

Uvigerinamina sp.B

Also noticeable within the interval is the gradual transition of Guttulina 7 to Guttulina 10 - F.tealbyensis (Bartenstein). Fair amounts of Ostracoda occur regularly from cutting sample 2000 m downwards and amongst them were observed a few specimens of

Cythereis 10	- C.acuticostata Triebel
and Cythereis 34	- C.blanda Kaye

Both sidewall samples yielded a considerable quantity of planktonic Foraminifera referable to Hedbergella and possibly Globigerinelloides.

The rather limited vertical extent of the interval prohibits a detailed biostratigraphic subdivision. Microfaunal criteria would point to a Middle Barremian age assignment for the larger part but the presence, with few specimens, of

Astacolus 15 - L.neopachynota Bartenstein & Kaever
Cristellaria 51 - L.heiermanni Bettenstaedt
Marginulina 20 - L.schreiteri (Eichenberg)
Saracenaria 4 - S.bronni (Roemer)
and Trocholina 1 - V.carpathica Neagu & Popescu
in the lowermost part of the interval could be indicative for a normal transition upwards from the underlying Hauterivian.

4.04 Hauterivian: 2020 -2270 m

Generally rich microfaunas were obtained from the cuttings and nine sidewall samples, the latter received from fairly equidistant levels between 2040 and 2250 m (see Appendix 1). Discounting the sizable amounts of obviously caved specimens in the cutting samples, the foraminiferal assemblage of the interval appears to be composed exclusively of calcareous benthonic and arenaceous species with intermittent extremes of the latter.

The upper limit of the interval could be clearly established on the top-occurrence of

Anomalina 16 - G.sigmoicosta (ten Dam)
at cutting sample 2020 m. The lowermost, reliable occurrence of this species was observed in sidewall sample 2040 m which would therefore classify the uppermost part of the interval as definite late Hauterivian.

The foraminiferal assemblage is furthermore characterized by the following calcareous benthonic species,

Astacolus 9 - L.crepidularis (Roemer)
Astacolus 15 - L.neopachynota Bartenstein & Kaever
Astacolus 16 - L.bettenstaedti Bartenstein & Brand
Cristellaria 45 - L.guttata (ten Dam)
Cristellaria 51 - L.heiermanni Bettenstaedt
Cristellaria 52 - L.ouachensis Sigal
Epistomina 8 - E.caracolla (Roemer)
Lagena 2 - L.hauteriviana Bartenstein & Brand
Marginulina 11 - M.gracilissima (Reuss)
Marginulina 18 - L.breyeri Zedler
Marginulina 20 - L.schreiteri (Eichenberg)
Nodosaria 38 - N.loeblichae ten Dam
Quinqueloculina 7 - H.antiqua (Reuss)
Saracenaria 4 - S.bronni (Roemer)
Spirillina 8 - S.minima Schacko
Trocholina 1 - V.carpathica Neagu & Popescu
and the arenaceous species,
Ammobaculites 3 - A.subcretaceus Cushman & Alexander
Bigenerina 2 - G.sherlocki Bettenstaedt
Bigenerina 3 - G.hannoverana Bartenstein & Brand
Glomospira 3 - M.washitensis Loeblich & Tappan
Guttulina 10 - F.tealbyensis (Bartenstein)
Marssonella sp.B - M.kummi Zedler
and Textularia 20 - T.bettenstaedti Bartenstein & Oertli
with considerable variations in frequency of occurrence and quantity from one species to the other. A noticeable change is indicated by a distinct quantitative reduction, from cutting sample 2090 m downwards, of the calcareous microfauna and by the first appearance, in sidewall sample

2100 m, of rather coarse grained arenaceous Foraminifera, forming the dominant portion of the microfaunal assemblage in the remaining part of the interval. A return to abundance of calcareous benthonic specimens was observed however near the base of the interval in sidewall sample 2250 m which yielded, amongst others, a fairly large amount of

Epistomina 7 - E.ornata (Roemer)

Amongst the Ostracoda were observed some rare and spasmodically distributed occurrences of

Protocythere 3 - P.triplicata (Roemer)

and Protocythere 4 - P.hechti Triebel

Noteworthy of the generally rich occurrences of Dorothia 5 is the gradual increase of specimens identical with V.neocomiensis (Mjatliuk). Although diagnostic indices for Lower Hauterivian were not observed, possibly owing to the strongly arenaceous nature of the foraminiferal assemblage in the approximate lower half, the interval is nevertheless considered to represent a complete sequence or largely so.

4.05 Valanginian: 2275 - 2410 m

Nine sidewall samples, taken at equidistant levels between 2275 and 2400 m, provided the more essential microfaunal information of this interval since the cutting samples were observed to be strongly contaminated. Thus, the upper limit of the interval is determined by the presence of poorly preserved specimens of

Epistomina 9 - E.anterior Bartenstein & Brand

in sidewall sample 2275 m. The microfaunal content of this sample displays, moreover, qualitative characteristics which are distinctly different from that of the next higher sidewall sample at 2250 m.

The foraminiferal assemblage is, as a whole, largely composed of arenaceous specimens whose agglutinate tests are in general rather coarsely grained, frequently including conspicuous amounts of pyrite. General occurrences amongst the arenaceous Foraminifera are those of

Ammobaculites 3 - A.subcretaceus Cushman & Alexander

Bigenerina 3 - G.hannoverana Bartenstein & Brand

Dorothia 5 - V.neocomiensis (Mjatliuk)

Glomospira 1 - G.gordialis (Jones & Parker)

Marssonella 3 - M.cf.kummi Zedler

Reophax 1 - R.minutus Tappan

Reophax 3 - R.scorpiurus Montfort

and Textularia 20 - T.bettenstaedti Bartenstein & Oertli

in quantity varying considerably from one species to the other.

In addition to the above, large amounts of extremely diverse specimens belonging to

Haplophragmoides and Trochammina

feature with regular and common presence throughout the interval.

Although distorted preservation makes these fossils in general specifically indistinct, the latter genus was observed to include fair numbers of T.inflata (Montague).

The more significant is however the presence of

Trochammina sp.E - V.meentzeni Klingler

observed from sidewall sample 2325 m downwards and that of

Haplophragmium 7 - H.subaequale Mjatliuk

with top-occurrence in cutting sample 2330 m. A few small sized and therefore somewhat doubtful specimens of

Ammovertella 1 - *A. cellensis* Bartenstein & Brand
were seen occasionally in haphazard vertical distribution.

Subordinate amounts of generally small sized calcareous benthonic Foraminifera, varying strongly in total quantity from one sample to the next, were observed throughout the interval. They comprise mainly non-diagnostic specimens of the genera Dentalina, Lagena, Lenticulina, Marginulina, Nodosaria and Saracenaria. A quantitative increase of these fossils was observed in the lowermost part of the interval from cutting sample 2390 m downwards. The age-assignment of the interval is furthermore confirmed by the palynological investigation of four sidewall samples between 2325 and 2400 m (see Appendix 1).

Correlation with the neighbouring Norske Shell 17/11-1 leads to an obvious biostratigraphic match with the interval 6197 - 6790 ft in that well, notwithstanding that part of it (6485 - 6790 ft) received earlier a different age interpretation based on then insufficiently known criteria (ref. 8).

4.06 Berriasian: 2415 - 2470 m

This interval is in the cutting - as well as in the sidewall samples microfaunally characterized by vast amounts of distorted arenaceous Foraminifera belonging exclusively to

Haplophragmoides 20

and Haplophragmoides 21

together with equally large quantities of small, pyritized Radiolaria including a substantial number of specimens referable to

Radiolaria 2 - Lithostrobus sp.

Fair amounts of fish remains as well as shell fragments, including Inoceramus, were regularly observed.

This microfaunal assemblage, although locally within the North Sea area most characteristic for the concerned part of the stratigraphic sequence, can not be interpreted towards a precise age-assignment. Palynological investigation of the sidewall samples 2415, 2425 and 2450 m resulted on the other hand in a firm Berriasian dating (see Appendix 1). The foraminiferal yield of the uppermost sidewall sample 2415 m displays a transitional character in containing also a generous amount of small Haplophragmoides and Trochammina specimens reminiscent of those occurring in the overlying Valanginian interval.

5. Upper Jurassic

5.01 Portlandian: 2475 - 2495 m

This very short interval is covered by two sidewall samples, taken at 2475 and 2495 m, whilst only one cutting sample was examined at 2490 m.

The microfaunal assemblage bears essentially the same characteristics as in the overlying Berriasian interval, albeit with a considerable impoverishment of the foraminiferal portion. Hence, the microfaunal content consists predominantly of small, pyritized Radiolaria including

Radiolaria 2 - Lithostrobus sp.

and common to abundant quantities of fish remains.

Palynological examination of the sidewall samples has been decisive for the particular age-assignment (see Appendix 1).

5.02 Kimmeridgian: 2495 - 2517 (2521)*m

The more pertinent microfaunal evidence was in this interval derived again mainly from the sidewall samples, taken at 2505, 2512 and 2517 m. They yielded predominantly arenaceous Foraminifera with a high percentage of small sized, fine fraction specimens, mostly light greyish brown coloured and also partly in pyritized preservation. The higher two samples contained furthermore subordinate amounts of ill-preserved calcareous benthonic specimens as well as abundant fish remains. Significant species observed in this assemblage are

Reophax hounstoutensis Lloyd
Spiroplectamina biformis (Parker & Jones)

and

Ammobaculites UK-DO.8 - A.deceptorius (Haeusler)
Astacolus UK-DO.15
Astacolus UK-DO.18 - A.radiata (Terquem)
Marginulinopsis UK-DO.57
Textularia UK-DO.86 - T.jurassica (Gümbel)
Trochammina sp.D (Uk-DO.98)- T.cf.nitida Brady

The UK-DO annotation refers to a foraminiferal type collection related with microfaunal investigations of Upper Jurassic deposits at and near the Kimmeridge type locality in Dorset, southern England; the arenaceous Foraminifera have furthermore been discussed extensively by Lloyd in a publication of the same locality (ref. 6).

The foraminiferal content of the lowermost sidewall sample 2517 m is distinguished by its exclusively arenaceous character with a good deal of specimens larger than the average small sized ones occurring in the higher samples.

The microfaunal yield of the cuttings, examined from 2495 m onwards at interspacings of 5 metres, proved to consist mainly and abundantly of specimens belonging to the Haplophragmoides 20/21 assemblage of the Berriasian interval. This should, in view of the results obtained from the sidewall samples, be earmarked entirely as contamination. Small sized arenaceous specimens, as observed in the sidewall samples and more in particular those referable to Trochammina cf.nitida Brady, were seen only rarely in the cuttings.

The Kimmeridgian age is confirmed by palynological dating of the two lower sidewall samples (see Appendix 1).

Conspicuous breaks in the electric log curves at 2495, 2509 and 2521 m divide the interval twofold into a higher part with very high gamma ray response ("hot shales") and a lower one with gradual lessening radioactivity. In lithological respect, the whole interval consists of dark brown to black, carbonaceous shale. Based on these characteristics, the interval can obviously be referred to the lowermost part of the Børglum Member of the Bream Formation in terms of recent lithostratigraphic nomenclature (ref. 4).

* - based on electric log evidence

6. Inconclusive (microfaunally/florally barren): 2521 - 2644 m (TD)

The regular examination of cutting samples was terminated when the drill entered at 2521 m a continuous sequence of predominantly arenaceous deposits; occasional spot-checks revealed the absence of autochthonous microfauna. On account of their unpromising lithological aspect, none of the sidewall samples, taken at thirteen successive levels between 2522,5 and 2630 m, was examined microfaunally; only three of them were made subject of palynological investigation as they contained some small amounts of argillaceous sediment.

Except for the very scarce presence of Kimmeridgian palynomorphs in sample 2594,5 m which could with fair certainty be ascribed to contamination, all samples were observed to be microflorally barren otherwise. A conventional core was cut from 2533 to 2542 m (8310 - 8340 ft) and sampled at several more argillaceous levels for microfaunal and microfloral investigation; all samples thus examined proved to be non-fossiliferous (see Appendix 1).

Adequate lithological descriptions of the sidewall samples and core nr. 1 are incorporated with the well resume, wherein also some suggestions are given for the possible age and structural interpretation of the interval. The upper part consists to at least 2570 m predominantly of light greenish grey coloured, fine grained sandstone and, occasionally, some very minor argillaceous intercalations. This sediment shows in core nr. 1 frequent features of cross-bedding and slumping. With particular reference to details described and shown in a recently published standard lithostratigraphic nomenclature for the central and northern North Sea areas (ref. 4), the concerned part of the interval would most likely be identifiable with the Middle to Upper Jurassic Haldager Formation. Dark colours: dark grey green, black and reddish brown are conspicuous in some argillaceous sediment of the sidewall samples from 2582 m downwards. Furthermore, the presence of large, frosted quartz grains in the cutting samples and a somewhat higher gamma ray response simultaneous with lower velocity of the electric log, appear to qualify the lower part of the interval distinct from the overlying. Based on these characteristics, it would most likely be of Triassic age (see also fig. 25 of ref. 4)

III. DEPOSITIONAL ENVIRONMENTS

The sequence starts in the lowermost part of the well with an entirely non-fossiliferous interval from 2521 to 2544 m. Lithological criteria (see under subchapter II.6) may be indicative for a terrestrial environment of the presumably Triassic sediments in the lower part (\pm 2570 - 2644 m), whereas the upper part (2521 - \pm 2570 m) would, on similar grounds, most likely represent a series of deltaic deposits, laid down during possible Middle to Upper Jurassic time.

Marine conditions prevailed in the succeeding interval (2415 - 2521 m) as indicated by its microfaunal content. The prevalence of fairly diverse but small sized arenaceous Foraminifera in the microfaunal assemblage of the Kimmeridgian shales giving way to a pronounced monotony of the exclusively arenaceous Haplophragmoides 20/21 assemblage in the Portlandian and Berriasian part of the interval would, taking also into account the high carbonaceous and pyritic content of the shales throughout, be indicative for deposition in fairly shallow, static waters (embayment ?) with bottom circulation gradually lessening during the course of time; paralic to inner neritic appears the more likely environmental interpretation for this interval.

The appearance of fairly common calcareous Foraminifera in the microfaunal assemblage with the onset of Valanginian time should be indicative for a definite turn to more open marine conditions and although a pronounced coarseness of grain in the arenaceous Foraminifera throughout the Valanginian would be suggestive for still relatively shallow conditions, proximity to a middle neritic environment becomes gradually more evident. The same applies to the larger part of the overlying Hauterivian interval up to 2100 m but subsequent sedimentation in the Lower Cretaceous took place in an open marine, middle neritic environment as witnessed by the generally rich microfaunal content, regularly composed of calcareous benthonic and arenaceous Foraminifera in about equal ratio. The influx of additional planktonic Foraminifera during Barremian and Aptian time points to increased circulation of the surface water. A qualitative reduction in the microfaunal assemblage leading to the presence of exclusively arenaceous Foraminifera in the uppermost part of the Albian interval, showing simultaneously a gradual quantitative decrease in ascending order, could be ascribed to shallowing conditions towards the close of Lower Cretaceous time followed by a non-depositional and/or erosional phase in the early Upper Cretaceous.

The microfaunal content of the Upper Cretaceous carbonate sediments points to a generally middle neritic environment of deposition. The increased presence of planktonic Foraminifera in the Santonian part would be indicative again for somewhat less sheltered conditions. The same applies for the uppermost part of the chalk laid down during early Paleocene time.

The ensuing succession of predominantly clastic sediments in the Tertiary interval proves, on its microfaunal content, to have been deposited almost entirely in a middle neritic environment, interrupted only during the Lower Eocene (interval 1170 - 1250 m) by deeper conditions, bathyal to outer neritic, as indicated by the occurrence of abundant Radiolaria and exclusively arenaceous Foraminifera, reflecting a pronounced similarity to the deep water Rhabdammina faunas known from the centralmost part of the Tertiary North Sea Basin (ref. 9). The additional presence of planktonic Foraminifera in the higher part of the Eocene interval is considered a signal for the return to an outer/middle neritic environment. The same applies to the larger part of the Miocene which, bounded by unconformities, obviously represents a transgressive phase.

The uppermost part of the penetrated sequence, interval 210 - 430 m, yielded a low diversity assemblage of only calcareous benthonic Foraminifera which is thought to reflect an inner neritic environment; the progressive reduction of species in ascending order within this interval can be interpreted towards a gradual shallowing of the environment.

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APPENDIX 1 (page 1)

Summary list of sidewall samples taken from the interval 1325 - 2630 m and samples of core nr. 1: 2533 - 2542 m (8310 - 8340 ft) in Norske Shell well 17/11-2.

F - microfaunally examined
NP - nannoflorally examined
P - palynologically examined

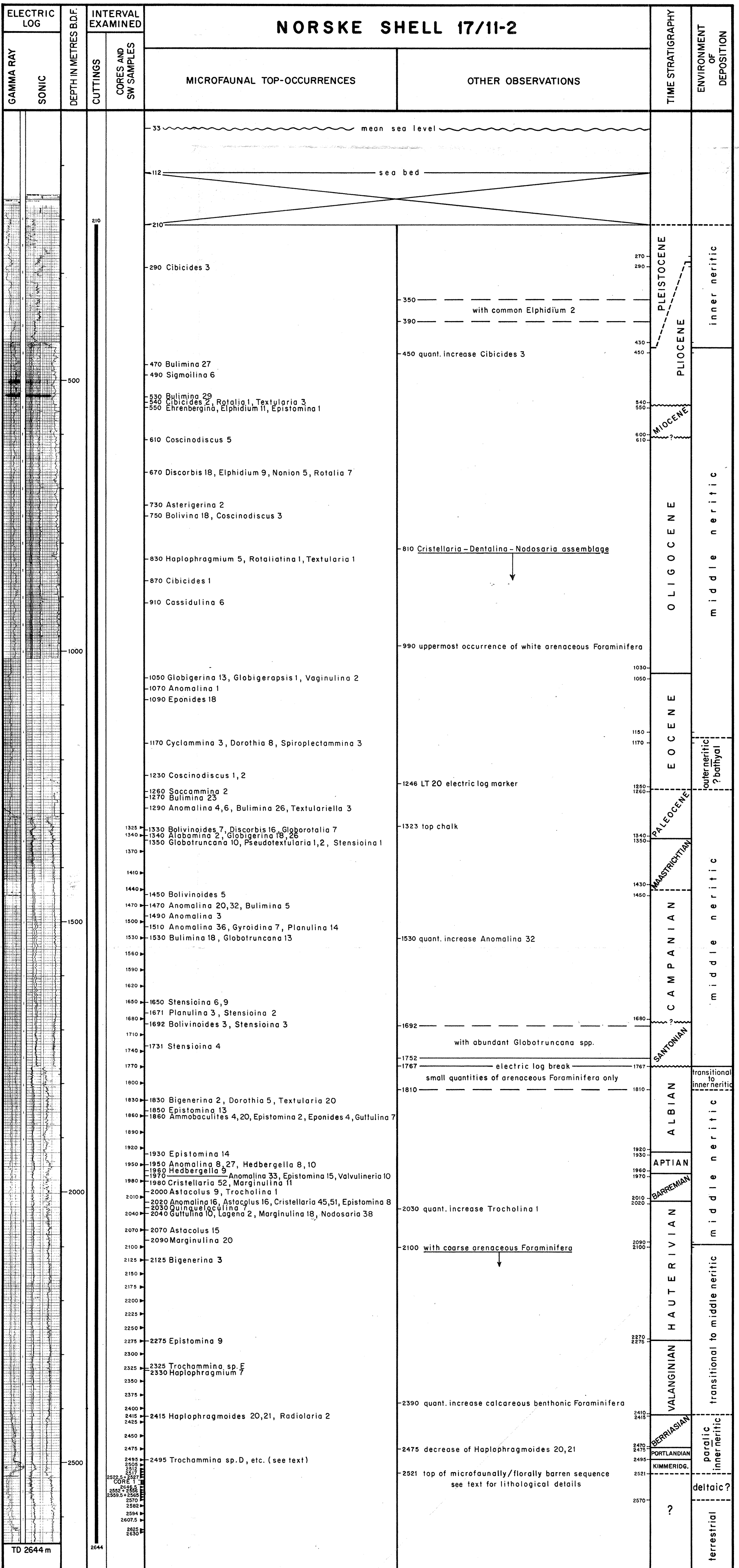
* - contaminated with drillingmud

depth
in metres

1325	NP	Upper Danian - zone np 4
1340	NP	Upper Danian - zone np 4
1370	NP	Upper Maastrichtian - zone ma 3
1410	NP	Upper Maastrichtian - zone ma 3
1440	NP	Upper Maastrichtian - zone ma 3
1470	NP	Upper Maastrichtian - zone ma 3
1500	NP	Lower Maastrichtian - zones ma 1/2
1530	NP	Lower Maastrichtian - zones ma 1/2
1560	NP	Upper Campanian/Lower Maastrichtian - zones ca 6/ma 1
1590	NP	Upper Campanian - zones ca 5/6
1620	NP	Campanian - zones ca 1/5
1650	NP	Campanian - zones ca 1/5
1680	NP	Campanian - zones ca 1/5
1710	NP	Upper Santonian
1740	NP	Upper Santonian
1770	F	
1800	F	
1830	F	
1860	F	
1890	F	
1920	F	
1950	F	
1980	F	
2010	F	
2040	F	
2070	F	
2100	F	
2125	F	
2150	F	
2175	F	
2200	F	
2225	F	
2250	F	
2275	F	
2300*	F	

APPENDIX 1 (page 2)

2325	F P	Valanginian/Hauterivian		
2350	F P	Valanginian		
2375	F P	Valanginian		
2400	F P	Valanginian		
2415	F P	Berriasian		
2425	F P	Berriasian		
2450	F P	Berriasian		
2475	F P	Portlandian		
2495	F P	Portlandian		
2505	F			
2512	F P	Kimmeridgian		
2517	F P	Kimmeridgian		
2522,5				
2527				
2533,9	P	inconclusive, barren	core nr. 1 at	8313 ft
2534,8	P	" "	"	8316 ft
2537,7	F P	" "	"	8325 ft 6 in
2538	F P	" "	"	8326 ft 4 in
2538,5	F P	" "	"	8328 ft
2540	F P	" "	"	8333 ft
2546,5				
2552				
2556				
2559,5				
2565				
2570				
2582*				
2594,5	P	inconclusive (with contamination of Kimmeridgian palynomorphs)		
2607,5				
2625	P	inconclusive, barren		
2630	P	inconclusive, barren		



CASING :

30" at 189 m
 20" at 427 m
 13 3/8" at 1306 m

SHELL INTERNATIONALE PETROLEUM MAATSCHAPPIJ B.V.		
THE HAGUE	EXPLORATION & PRODUCTION	
NORWAY OFFSHORE PALAEO - LOG NORSKE SHELL 17/11-2 INTERVAL 210m - 2644 m vertical scale 1:5000		
Author: J. Stolk	Encl.: 1	Date: May 1978
Report No.: EP 49436		Draw. No.: G.62284/1