

1731

NORSK HYDRO WELL 30/7-2

BIOSTRATIGRAPHY FROM 1725 - 2475 m

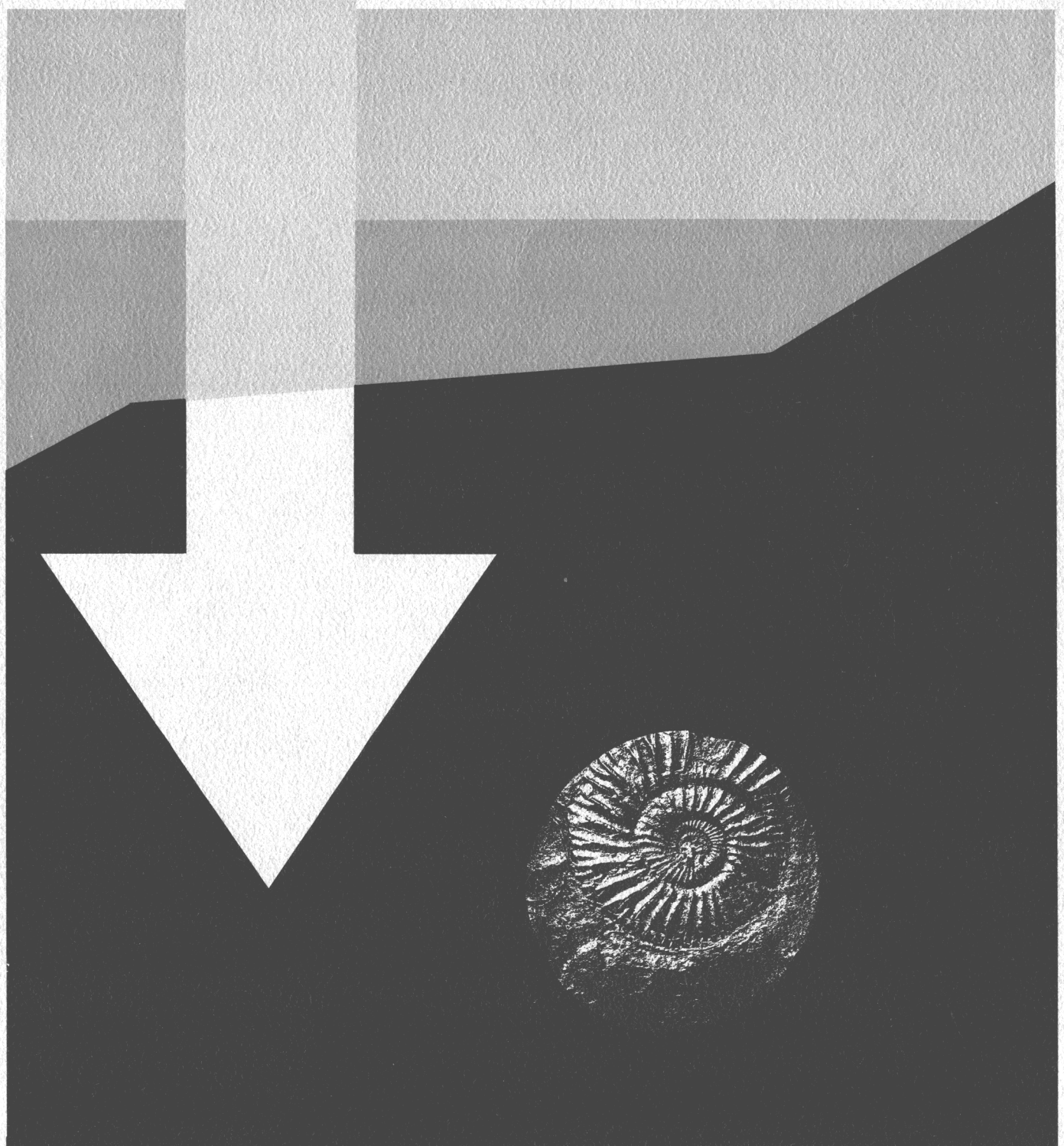
ORIGINAL



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NTNF'S

KONTINENTALSOKKELKONTOR



Norsk Hydro 30/7-2: Biostratigraphy from 1725 - 2475 m.

To: Norsk Hydro A/S, Attn. A. Sæbøe

Your ref.: 30/7-2, 1725-2475 m.

Our ref.: NTNFK 75-235/NTNFK 75-275

Materials: sidewalls from 1725-2475m

Analysts: Bell, Edwards, Løfaldli

Thusu.

Data synthesized by: Waddams

Data: 14.11.1975

Enquiries: J. Kleppe tel. Oslo

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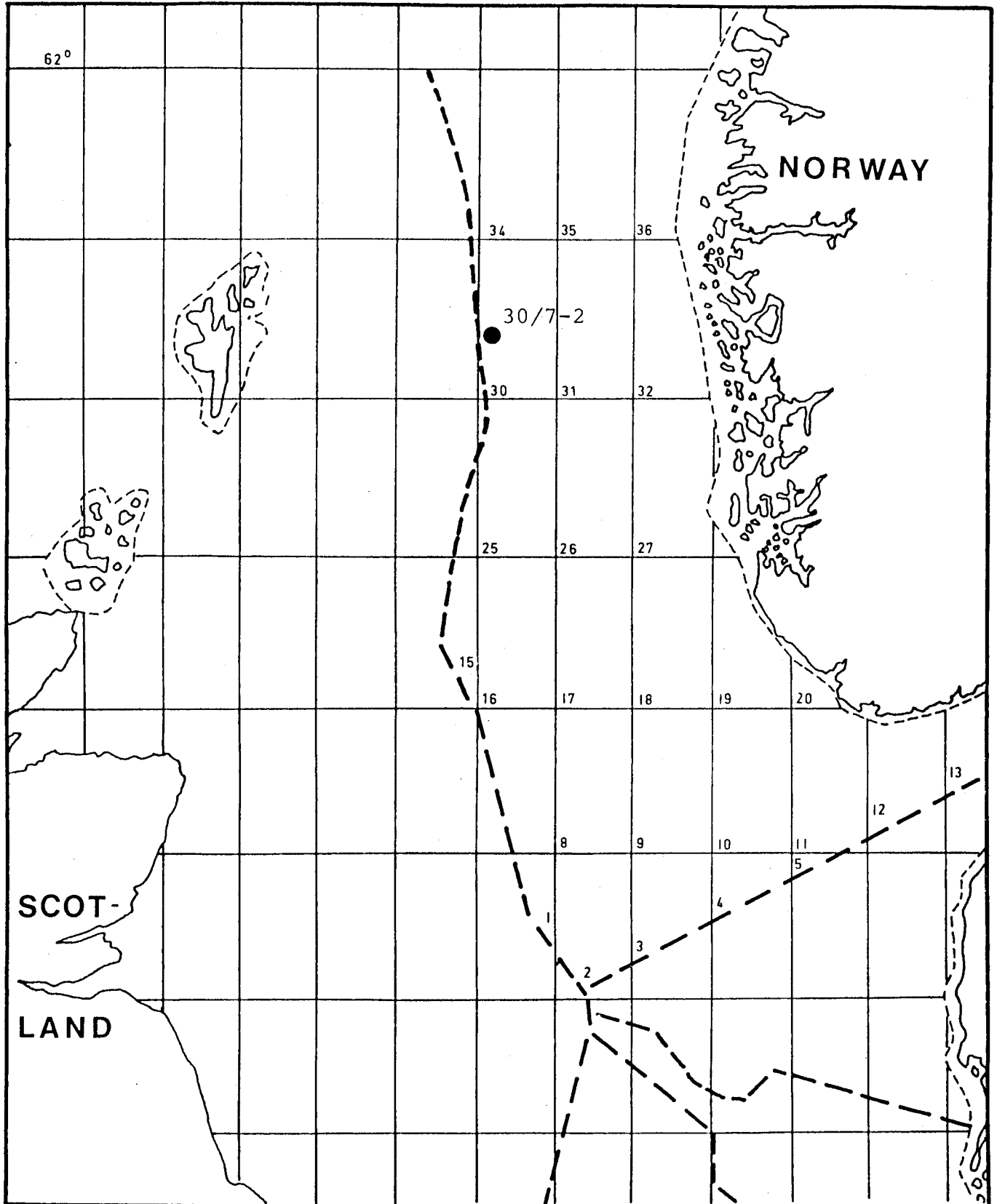
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## SUMMARY REPORT

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Sample interval (m)	NTNFK no.	Lithology	Age
1725.0	75-235	mudstone	Middle Eocene
1736.5	75-236	mudstone	
1746.5	75-237	mudstone	
1825.0	75-238	sand	Early Eocene
1859.0	75-239	sand	
1893.0	75-240	sand	
1909.5	75-241	sand	
1922.0	75-242	sand	
1934.0	75-243	sand	
1944.5	75-244	sand	
1957.5	75-245	sand	
1963.5	75-246	sand	Late Paleocene
1977.0	75-247	sand	
1982.0	75-248	sand	
1985.0	75-249	sand	
2010.0	75-250	mudstone	
2020.0	75-251	mudstone	
2034.0	75-252	mudstone	
2038.5	75-253	mudstone	
2062.5	75-254	sand	
2083.0	75-255	sand	
2085.0	75-256	sand	
2100.0	75-257	mudstone	
2127.0	75-258	mudstone	
2152.0	75-259	mudstone	Middle Paleocene
2176.0	75-260	mudstone	
2200.0	75-261	mudstone	
2215.0	75-262	mudstone	
2228.5	75-263	mudstone	
2254.0	75-264	mudstone	
2275.0	75-265	mudstone	Danian (Early Paleocene)
2300.0	75-266	mudstone	
2324.5	75-267	mudstone	
2341.0	75-268	mudstone	
2352.0	75-269	mudstone	
2360.0	75-270	mudstone	
2386.0	75-271	marl	Maastrichtian
2394.5	75-272	marl	
2436.0	75-273	chalk	
2456.0	75-274	marl	
2475.0	75-275	marl	

LOCALITY MAP



## INTRODUCTION

The biostratigraphic zonation of Norsk Hydro 30/7-2 is based almost exclusively on dinoflagellates and foraminifera (two characteristic pollen taxa are recorded). The faunal and floral lists provided are not exhaustive though all important and stratigraphically significant taxa, on which the biostratigraphic analysis is based are included. Lithological notes are incorporated into the biostratigraphic part of the report whilst comments on thermal indices, environment of deposition and log interpretation are presented after the biostratigraphy.

## BIOSTRATIGRAPHY

### INTERVAL 1725 to 1746.5 M. MIDDLE EOCENE

#### Lithology

This interval is composed of clayey mudstone. The upper cores have a faint but distinctive bluish-green grey colour while the lower core is dark grey.

#### Micropalaeontology and palynology.

A rich microflora consisting of c. 50% pollen and spores and 50% microplankton was recovered from all cores. The uppermost core yielded a quite rich foraminiferal fauna. Other cores yielded only a sparse fauna of arenaceous benthonic foraminifera.

#### Faunal and flora list.

##### Dinoflagellates:

Areoligera cf. tauloma

Areosphaeridium arcuatum

A. diktyoplokus

A. multicornutum

Cordosphaeridium sp. B.

C. aff. funiculatum

Leptodinium sp. B.

Lingulodinium sp. A.

Pentadinium laticinctum

Spiniferites ramosus

Tanyosphaeridium ellipticum  
Wetzeliella articulata subsp. A.

Foraminifera

Cyclammina amplectens - common  
Haplophragmoides walteri  
Trochamminoides trifolius  
Ammodiscus spp.  
Glomospira spp.  
Haplophragmoides spp.

INTERVAL 1825 to 1893 M. LATE EARLY EOCENE

Lithology

Light grey very friable muddy sands

Micropalaeontology and Palynology

Rich microfloral assemblages consisting of c. 80% pollen and spores and c. 20% microplankton were recovered. Only a sparse foraminiferal assemblage was recorded.

Faunal and floral list.

Dinoflagellates:

Achileodinium excellens  
Achomosphaera alcicornu  
Areoligera cornuta  
Areosphaeridium diktyoplokus  
Cyclonephelum pastielsi  
Deflandrea phosphoritica  
Homotryblium pallidum  
H. tenuispinosum  
Lingulodinium sp. A  
Oligosphaeridium complex  
Samlandia cf. reticulifera  
Spiniferites ramosus  
S. ramosus subsp. A.  
Thalassiphora pelagica

Wetzeliella articulata subsp. articulata

W. coleothrypta

W. aff. lunaris

W. pachyderma

Foraminifera:

Cyclammina amplectens

Hyperammina spp.

INTERVAL 1909.5 to 1957.5 M. EARLY EOCENE.

Lithology

This interval consist of micaceous, very friable, light grey slightly muddy sands.

Micropalaeontology and palynology.

Rich microfloral assemblages were again recovered whilst foraminifera were uncommon. Pollen and spores make up c. 70% of the microflora and microplankton c. 30%.

Faunal and floral lists.

Achomosphaera alcicornu

Areoligera cornuta

A. senonensis

Comasphaeridium cometes

Cordosphaeridium gracilis

C. pastielsi

C. sp. A.

Deflandrea sp. A.

D. cf. diebelli

D. oebisfeldensis

D. phosphoritica

Diphes collegerum

Homotryblum pallidium

Inaternosphaera cf. axialis

Oligosphaeridium complex

Peresseiasphaeridium cf. pannosum

Spiniferites ramosus



Thalassiphora pelagica  
Wetzeliella aff. lunaris

What is the criteria for the  
 paleocene/ocene boundary in this  
 well?

Foraminifera:

Dendrophrya excelsa  
Haplophragmoides walteri  
H. sp.  
Ammodiscus sp.  
Pullenia sp.

INTERVAL 1963.5 to 2127 M. LATE PALEOCENE

Lithology

The lithology of this interval is more complex, including alternating sand and mudstone units.

From 1963.5 to 1985.0 the dominant lithology is slightly micaceous, muddy, friable, light grey sands. The sand at 1963.5 contains some glauconite grains. The sand at 1985 is calcareous. From 2010 to 2038.5 clayey, dark grey, slightly calcareous mudstones predominate.

From 2062.5 to 2085 the main lithology is micaceous, muddy, friable light grey sands.

From 2100 to 2127 clayey mudstones, dark grey with a trace of mica are present.

Micropalaeontology and palynology

Foraminifera were again uncommon in this interval though a rich microflora consisting of c. 70% pollen and spores and c. 30% dinoflagellates was recovered.

Faunal and floral lists

Pollen:

Extratropopollenites sp.  
Inaperturopollenites sp.

Dinoflagellates:

Areoligera coronata

A. senonensis  
Australiella sp. A.  
Comasphaeridium cometes  
Cordosphaeridium sp. A.  
Cyclonephelium divaricatum  
Deflandrea oebisfeldensis  
D. aff. obliquipes  
D. cf. phosphoritica  
D. speciosa  
D. cf. symmetrica  
Dinogymnium cf. digitus  
Gonyaulacysta sp. A  
Lejeunia hyalina  
Spiniferites ramosus  
Thalassiphora pelagica  
Wetzeliella (Apectodinium) hyperacantha  
W. (A) homomorpha subsp. homomorpha  
W. (A) homomorpha subsp. quinquelata

Foraminifera:

Haplophragmoides walteri  
H. sp.  
Ammodiscus sp.  
Arenobulimina sp.

INTERVAL 2152 to 2254 M. MIDDLE PALEOCENE

Lithology

This interval consists of medium to dark grey, clayey mudstones, with variable sand, silt and mica content.

Micropalaeontology and palynology.

The interval is characterised by a slightly richer assemblage of arenaceous benthonic foraminifera and a rich microfloral assemblage consisting of c. 90% pollen and spores, and c. 10% microplankton.

Faunal and floral lists

Dinoflagellates:

Achomosphaera ramulifera  
A. alcicornu  
Apteodinium sp. A.  
Areoligera coronata  
A. senonensis  
Eisenackia ornata  
Exochosphaeridium sp.  
Oligosphaeridium complex  
Scriniodinium sp. A.  
Spiniferites crassipellis  
S. ramosus

Foraminifera:

Ammodiscus glabratus  
A. spp.  
Bathysiphon spp.  
Dendrophrya robusta  
Glomospira spp.  
Hyperammina spp.  
Kalamopsis grzybowskii  
Trochamminoides trifolius

INTERVAL 2275 to 2360 M. EARLY PALEOCENE (DANIAN)

Lithology

The uppermost part of this unit is composed of very dark grey clayey mudstones, with sand and mica in the topmost core. In the lower part are calcareous silty mudstones.

Micropalaeontology and palynology

The core at 2360 M. yielded a rich fauna of planktonic and some benthonic foraminifera. Other samples were poor in foraminifera. Rich microfloras were recovered from all cores, pollen and spores make up about 50% of the assemblages, microplankton c. 50%.

Faunal and flora lists

Dinoflagellates:

Areoligera senonensis  
A. sp. A.  
Australiella sp. A.  
Deflandrea diebelli  
D. speciosa  
Eisenackia circumtabulata  
Exochosphaeridium tubiferum  
Leptodinium sp. A.  
Oligosphaeridium complex  
Palaeoperidinium basilicum  
Spiniferites ramosus

Foraminifera:

Globorotalia pseudobulloides  
Subbotina triloculinoides  
Globigerina spp.  
Dendrophrya excelsa  
Spiroplectammina spectabilis  
Trochamminoides trifolius  
Dendrophrya robusta  
Gavellinella umbilicata  
Pullenia coryelli  
Hyperammina spp.  
Polymorphinidae

INTERVAL 2386 to 2475 M. MAASTRICHTIAN (LATE CRETACEOUS)

Lithology

The two uppermost cores consist of grey marls with a lower silt content. The middle core, 2436, consists of white chalk. The two lower cores are medium grey, calcareous and slightly silty mudstones

This interval was not examined for palynomorphs.

Micropalaeontology.

A rich fauna of planktonic and benthonic foraminifera was recovered. Planktonic forms dominate.

Faunal list.

## Planktonic forms:

Pseudotextularia elegans  
Pseudoguembelina excolata  
Heterohelix spp. (common)  
Globotruncana spp.  
Globigerinelloides spp.  
Hedbergella spp.

## Arenaceous benthonic forms:

Dendrophrya excelsa  
Dendrophrya discreta  
Thalmanamina recurvoidiformis  
Hormosina placenta  
Trochamminoides irregularis  
Bathysiphon spp.  
Hyperamina spp.  
Ammodiscus spp.

## Calcareous benthonic forms:

Osangularia cordieriana  
Anomalinoides nobilis  
Heterolepa sparksi  
Gavellinella spp.  
Lagena spp.  
Globorotalites spp.

THERMAL INDEX

The thermal index (maturation) of palynomorphs and organic debris is 2,3: thermally unaltered wet gas facies.

## DISCUSSION

Paleontological evidence combined with observations on the sediment cores and the logs provide general guidelines determining the approximate sedimentary environments of deposition, and the geological history of the Maastrichtian to Middle Eocene sequence.

### Maastrichtian

The rich foraminiferal assemblages in which planktonic forms predominate suggest deep marine conditions, outer shelf, slope or abyssal.

The Maastrichtian - Danian boundary appears on the logs, as an abrupt increase in travel time at 2372-4 m, with a corresponding change in the character of the gamma log.

### Lowermost Early Paleocene

The rich foraminifera assemblage at 2360 m also indicates deep marine conditions. Planktonic forms prevail over benthonic forms. Carbonate content is lower than in the Maastrichtian.

### Early Paleocene to Middle Eocene

The general absence or rarity of foraminifera in this interval, and the dominance of spores and pollen over dinoflagellates indicate shallow marine to deltaic conditions near a land area bearing a Taxodiaceous flora, and possibly having a low relief.

The widespread occurrence of mica and glauconite in this sands in this interval strengthen this preliminary interpretation.

Examination of the logs allow this interval to be divided into three main parts:

1. 2347 - 2254. Predominantly mudstones. Corresponds closely to the Early Paleocene.
2. 2254 - 2093. Alternating units of mudstone and muddy sand. Corresponds closely to the Middle Paleocene.
3. 2093 - 1725. Predominantly sand, with occasional mixed sand-mudstone levels, especially in the lower part. Corresponds to the Late Paleocene - Middle Eocene.

Together, these three units represent a general regressive trend which began in the Early Paleocene and persisted until the Middle Eocene. Early Paleocene mudstones have a lower sand content and were possibly laid down in the prodelta region of a large deltaic complex, or outer shelf, in quiet water.

The Middle Paleocene alternating fine and coarse units are an intermediate deposit suggestive of outer delta front environments, the sands representing periodic influxes from the shallower distributary or coastal areas. Alternatively, an inner shelf, marine-dominated regime may be indicated.

Late Paleocene and Early Eocene section is characterised by a number of minor sands, overlain by thicker sands in the Early or Middle Eocene. Three such sands in the Late Paleocene - Early Eocene interval have lower contacts which are gradational into mudstone, and thus form typical regressive coarsening upward sequences representing shoreline progradation. These sequences are present at 2093 - 2072, 2034 - 2000, and 1934 - 1900 m. Such small scale regressions are typical of the inner delta front area, or innershelf near shore areas. The absence of sharp based sands argues against the presence of distributary sand deposits. Thus the inferred geometry of the present sands is thought to be sheet or gently wedge-shaped, rather than shoestring. The individual sands should correlate for as much as few tens of kilometers. This can be tested with seismic data or information from adjacent wells.

*are there any other bars?*

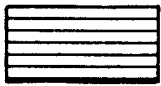
The Middle Eocene mudstones at the top of the section again have foraminifera, here with only benthonic forms suggesting inner shelf conditions. This may mark the onset of transgressive conditions, and gradual decrease of deltaic influence.



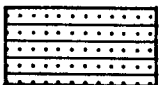
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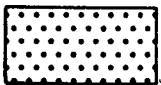
LEGEND



mudstone



interbedded mudstone and sand



sand



marl, chalk



species observed



not recorded in adjacent samples, but presumed present



recorded in adjacent samples

STRATIGRAPHIC ANALYSIS

THE CONTINENTAL SHELF DIVISION OF THE ROYAL NORWEGIAN  
 COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

DEPTH (Metres)	LITHOLOGY (SEE LEGEND)	GAMMA RAY	SYSTEM	AGE INTERPR.	PALEOECOLOGY AND REMARKS	DEPOSITIONAL ENVIRONMENT	
						SHALLOW MARINE / INNER SHELF	INNER DELTA FRONT / INNER SHELF
1725				MIDDLE		SHALLOW MARINE / INNER SHELF	
1750				MIDDLE		SHALLOW MARINE / INNER SHELF	
1775				MIDDLE		SHALLOW MARINE / INNER SHELF	
1800				MIDDLE		SHALLOW MARINE / INNER SHELF	
1825				MIDDLE		SHALLOW MARINE / INNER SHELF	
1850				MIDDLE		SHALLOW MARINE / INNER SHELF	
1875				MIDDLE		SHALLOW MARINE / INNER SHELF	
1900				MIDDLE		SHALLOW MARINE / INNER SHELF	
1925				MIDDLE		SHALLOW MARINE / INNER SHELF	
1950				MIDDLE		SHALLOW MARINE / INNER SHELF	
1975				MIDDLE		SHALLOW MARINE / INNER SHELF	
2000				MIDDLE		SHALLOW MARINE / INNER SHELF	
2025				MIDDLE		SHALLOW MARINE / INNER SHELF	
2050				MIDDLE		SHALLOW MARINE / INNER SHELF	
2075				MIDDLE		SHALLOW MARINE / INNER SHELF	
2100				MIDDLE		SHALLOW MARINE / INNER SHELF	
2125				MIDDLE		SHALLOW MARINE / INNER SHELF	
2150				MIDDLE		SHALLOW MARINE / INNER SHELF	
2175				MIDDLE		SHALLOW MARINE / INNER SHELF	
2200				MIDDLE		SHALLOW MARINE / INNER SHELF	
2225				MIDDLE		SHALLOW MARINE / INNER SHELF	
2250				MIDDLE		SHALLOW MARINE / INNER SHELF	
2275				MIDDLE		SHALLOW MARINE / INNER SHELF	
2300				MIDDLE		SHALLOW MARINE / INNER SHELF	
2325				MIDDLE		SHALLOW MARINE / INNER SHELF	
2350				MIDDLE		SHALLOW MARINE / INNER SHELF	
2375				MIDDLE		SHALLOW MARINE / INNER SHELF	
2400				MIDDLE		SHALLOW MARINE / INNER SHELF	
2425				MIDDLE		SHALLOW MARINE / INNER SHELF	
2450				MIDDLE		SHALLOW MARINE / INNER SHELF	
2475				MIDDLE		SHALLOW MARINE / INNER SHELF	

W (M) COLEOTHRYPATA HIGH  
 W (A) HYPERACANTHA LATE  
 W (A) HYPERACANTHA LATE  
 D. SPECIOSA MIDDLE  
 P. BASILIUM EARLY (DANIAN)  
 DEEP MARINE DEEP MARINE