THE MICROPALAEONTOLOGY AND STRATIGRAPHY OF THE PHILLIPS (NORWAY) 7/11-1X NORTH SEA WELL

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ROBERTSON RESEARCH COMPANY LIMITED

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THE MICROPALAEONTOLOGY AND STRATIGRAPHY OF THE PHILLIPS (NORWAY) 7/11-1X NORTH SEA WELL

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C O N T E N T S

E N C L O S U R E S

Micropalaeontological Analysis Charts Nos. 1 - 12.

Biostratigraphic Chart showing the distribution of the Diagnostic Caenozoic and Mesozoic Foraminifera and Ostracoda in the Phillips (Norway) 7/11-1X North Sea Well.

I

INTRODUCTION

This report summarises the results of the micropalaeontological, palynological and stratigraphical analyses which have been carried out under Project No. ARP 689/19 on material received from the interval 1590' - 13000' of the Phillips (Norway) 7/11 - 1X North Sea Well.

This exploration well was the first drilled in block 7/11 of the Norwegian North Sea Concession Area.

The stratigraphic interval dealt with in the current report ranges from Pleistocene, through a thick and relatively complete Tertiary sequence into the Upper Cretaceous Chalk. This overlies deposits of Cretaceous - Jurassic age. The well finally bottomed in rock salt of Zechstein age.

We wish to acknowledge the co-operation and assistance received from the various members of Phillips Petroleum Company Limited with whom we have been associated during the course of this work.

A summary of the sequence penetrated in this well can be seen overleaf in Table 1.

II

SUCCESSION

TABLE I

Unit	Interval	Thickness	Stage	System/Subsystem
A	1590' - 1650'	+ 60'	-	Pleistocene
B	1680' - 2010'	± 330'	Scaldisian	Upper Pliocene
C	2090' - 2450'	± 360'	Upper Diestian	Lower Pliocene
D	2500' - 2650'	± 150'	Lower Diestian	Upper Miocene
E	2700' - 5100'	± 2400'	-	Middle Miocene
F	5120' - 5820'	± 700'	Burdigalian	Lower Miocene
G	5840' - 6500'	± 660'	Aquitanian	Lower Miocene
H	6560' - 8720'	± 2160'	-	Oligocene
I	8740' - 9220'	± 480'	-	?Upper - ?Middle Eocene
J	9240' - 9380'	± 140'	-	?Lower Eocene - ?Palaeocene
K	9400' - 10060'	± 660'	-	Palaeocene
L	10070' - 10388'	± 318'	Danian	Lower Palaeocene
M	10390' - 11360'	± 970'	Maestrichtian	Upper Cretaceous
	11370' - 11390'	± 20'	Lower Maestrichtian	
	11400' - 11460'	± 60'	Campanian	
	11470'	-	Coniacian - Turonian	
	11480' - 12266'	± 786'	Turonian - Cenomanian - ?Albian	
N	12270' - 12460'	± 190'	-	Cretaceous - Jurassic
O	12480' - 13000'	+ 520'	Zechstein	Upper Permian

III

MATERIALS AND METHODS

Under Project No. ARP 689/19 a total of 595 ditch cuttings, 16 side wall cores and 4 core pieces were analysed utilising standard micropalaeontological and, where necessary, palynological techniques.

A summary of the information obtained from the samples was forwarded in a series of letters. These contain the framework of factual information on which this report is based. The prepared samples and recorded information are now filed and curated in the confidential records section of these laboratories.

The samples received were treated utilising standard techniques and all the microfossils obtained were examined. Use was made not only of the planktonic foraminifera present but also of the benthonic forms, ostracods and where necessary miospores.

In assessing the age of the samples, reference was made to published work on this portion of the stratigraphic column from all the countries surrounding the North Sea. The age, in the cases where no diagnostic planktonic foraminifera are present, was assigned on the basis of similarity of faunal association present in appropriate sequences in the above mentioned countries. The latter method has the disadvantage that many of these faunal associations are controlled by facies changes, but the assemblages in question would still appear to provide a sound correlation between the deposits encountered in this well and those found in equivalent horizons in Northern Europe.

2 Samples from the Tertiary, 19 from the Cretaceous and Cretaceous - Jurassic sections and 14 from the Permian section were analysed palynologically.

IV

QUATERNARY

UNIT A, INTERVAL 1590' - 1650'; Pleistocene

General Lithology

Quite a varied lithology is present in this unit. The dominant lithotypes appear to be fine-grained sands and conglomerates interbedded with clays.

The sands comprise white to colourless, fine to very fine-grained, subangular to subrounded quartz grains, and are associated with small pebble fragments of greenish sandstone and basic to ultrabasic igneous rocks. The clays are greyish brown in colour, and increase in amount slightly towards the base of the unit. Bleached, reworked shell fragments are common throughout consisting mostly of lamellibranchs with occasional echinoids.

Micropalaeontology and Stratigraphical Conclusions

Poor microfaunas were encountered in the samples received from this upper section. However, the presence of Elphidiella arctica in association with Elphidium incertum and Elphidium cf. hughesi would indicate that the unit is of Pleistocene age.

V

TERTIARY

(a) Pliocene

UNIT B, INTERVAL 1680'-- 2010'; Scaldisian, Upper Pliocene

General Lithology

The washed residues throughout this unit are very small, and examination of the unwashed samples indicates that the dominant lithotypes are grey and greyish brown clays. Pyrite is present in most samples, increasing in amount slightly towards the base where it is joined by minor quantities of brownish limonite. Quartz grains are present in most samples, but may have caved from the overlying unit.

Micropalaeontology and Stratigraphical Conclusions

The incoming at the top of this unit of Cibicides lobatulus var. grossa and Cassidulina laevigata pliocarinata would signify that the Upper Pliocene (Scaldisian) has been encountered. This is further confirmed by the occurrence of Cibicides scaldisiensis and Polymorphina charlottensis at 1770'.

Apart from the upper sample the remainder of the interval contains a moderately rich microfauna. The major genera present include Nonion, Cassidulina and Elphidium.

The forms recorded from this interval are similar to those noted in the Coralline Crag deposits of East Anglia, England and the Scaldisian deposits of the Netherlands.

UNIT C, INTERVAL 2090' - 2450'; Upper Diestian, Lower Pliocene

General Lithology

This unit is entirely composed of dark grey clays, which are only very slightly pyritic.

Micropalaeontology and Stratigraphical Conclusions

Impoverished microfaunas are recorded from the upper part of this interval. However, below 2300' they become moderately rich. The faunal association present is essentially a Cassidulina - Elphidium assemblage.

The majority of the forms noted within this interval are similar to those from the overlying Scaldisian. However, the presence of Uvigerina cf. cookei, Bulimina elongata, Elphidium inflatum and Elphidium antoninum in association with the aforementioned faunal assemblage may indicate that the Upper Diestian (Lower Pliocene) is present.

(b) Miocene

UNIT D, INTERVAL 2500' - 2650'; Lower Diestian; Upper Miocene

General Lithology

Dark grey clays are again the dominant lithotype but there is a noticeable increase in pyrite. Traces of brownish, silty ironstone are present in the sample from 2600'.

Micropalaeontology and Stratigraphical Conclusions

The incoming of Bolivina subspinescens, Pyrgo bulloides and Uvigerina canariensis at the top of this interval together with the subsequent appearance of Cibicides **peelensis** and Cibicides aknerianus would indicate that Miocene deposits have been encountered, these probably being of Lower Diestian age i.e. Upper Miocene.

Moderate faunas are recorded here belonging essentially to a Cibicides - Cassidulina assemblage. Subsidiary numbers of Uvigerina spp. also occur. These sediments differ from the Upper Miocene deposits of many parts of Northern Europe in having a moderately rich fauna. Usually deposits of this age are only sparsely fossiliferous.

UNIT E, INTERVAL 2700' - 5100'; Middle Miocene

General Lithology

Grey clays are the dominant lithotype in the higher parts of this unit, down to 3610'. They are usually strongly pyritic with occasional bands of reddish and reddish brown ironstone. Rare, thin layers of light greenish, greyish and buff to brown claystone occur below 3000', and light grey, argillaceous limestone is noted at 3300' and 3610'. Subordinate amounts of shell fragments are present in one or two samples.

Below 3650' light to medium grey shales are commonly present in the samples, and become quite abundant between 3880' and 4020'. Reddish-coloured shales and siltstones are present below 3880', often associated with reddish and reddish brown ironstones. Pyrite is observed in many samples, and grey, microcrystalline, often sucrosic, dolomite is present between 4920' - 5100'.

Micropalaeontology and Stratigraphical Conclusions

A great variation in the microfaunal assemblages occurs in the samples comprising this interval. Several horizons are extremely rich in species whereas others are almost barren. Basically this interval can be subdivided into 3 sections which are outlined below.

2700' - 3350'

The fauna in this case is very similar to that recorded from the overlying Upper Miocene except that rare specimens of Uvigerina hosiusi are noted, the first appearing at 2700'. This foraminifera is usually taken to be indicative of the Middle Miocene. Other new forms noted here include the following species:

Karreriella cf. siphonella

Asterigerina staeschei

Nodosaria pyrula

Textularia gramen

Echinocythereis scabra

This association of forms would substantiate the Middle Miocene determination.

3400' - 4860'

The most important feature of this interval is the occurrence throughout of many horizons with fairly numerous specimens of Uvigerina hosiusi. Other typical Middle Miocene forms noted include:

Bolivina floridana imporcata

Virgulina pertusa

Listerella communis

Cytheropteron cf. steinmanni

"Cythere" latimarginata

4880' - 5100'

The top of this sub-unit is marked by the incoming of Radiolaria together with several small species of Globigerina including G. bradyi, G. juvenilis and G. foliata. Other forms present are similar to those already mentioned above.

UNIT F, INTERVAL 5120' - 5820'; Burdigalian, Lower Miocene

General Lithology

Greyish clays and shales are again the dominant lithotypes throughout this unit with occasional thin layers of buff to brownish shales. Hard, dense, light grey, sucrosic dolomite is common in the highest part of the interval, from 5120' - 5280'. Prepared samples are generally very small in volume due to the abundance of soft clays.

Micropalaeontology and Stratigraphical Conclusions

Poor to very poor microfaunas are encountered within this interval and much of the sequence may be barren, the forms noted in the samples probably being present as a result of caving.

The occurrence, at the top of this interval of Globorotalia fohsi barisanensis, Uvigerina tenuipustulata and Angulogerina var. tenuistriata would indicate that the Burdigalian stage of the Lower Miocene has been penetrated. Very little change is noted in the faunal content of the sample through the remainder of the interval and, therefore, all the section has been placed in the Burdigalian.

UNIT G, INTERVAL 5840' - 6500'; Aquitanian, Lower Miocene

General Lithology

This interval is entirely composed of soft grey clays with occasional thin bands of light to dark grey and bluish grey shales. Traces of brown dolomite are noted in one or two samples.

Micropalaeontology and Stratigraphical Conclusions

Again within this interval the faunas recorded from the samples are poor to very poor, and arenaceous foraminifera are noted at many horizons.

The incoming of Globorotalia scitula praescitula and Globigerinoides bisphericus at 5840' together with their continued appearance at several horizons within the interval would indicate that the Aquitanian stage of the Lower Miocene is present here. This is partially confirmed by the absence of any forms restricted to the Oligocene.

(c) Oligocene

UNIT H, INTERVAL 6560' - 8720'; Oligocene

General Lithology

Dark grey and black clays with frequent interbedded medium to dark grey and black shales are dominant in the highest interval, down to 7600'. The shales often become silty and are locally strongly-micaceous. Brown dolomitic and sideritic mudstones and siltstones form occasional bands, particularly above 7060'. Thin, brown silty dolomites occur between 7580' - 7600'. Trace amounts of very fine, white to colourless, angular quartz grains are noted in the samples from 7000', 7100' and 7320'.

There is an increase in shales at 7620' and the interval 7620' - 7880' consists of interbedded light and dark greyish brown shales. The dark grey variety is absent below 7880', where light grey shales predominate to the base of the unit. The whole interval is essentially a uniform shale sequence, with clays above 7080' and rare thin brown limestone bands throughout. The sidewall cores received from 8154' and 8288' consist of greyish brown shales.

Micropalaeontology and Stratigraphical Conclusions

Moderate to poor assemblages are encountered within this interval with arenaceous foraminifera being the dominant forms present throughout. At the top there is a marked change in the faunal content and in addition to the arenaceous foraminifera the following diagnostic benthonic and planktonic forms are recorded:

Asterigerina gürichi

Siphonodosaria hirsuta

Globigerina praebulloides leroyi

Catapsydrax unicavus

Globigerinita martini scandretti

This faunal association would indicate that the top of this interval is of Oligocene age. The arenaceous forms present would also appear to confirm this determination.

Other indications of an Oligocene age for this interval are the occurrences of Cibicides tenellus below 7040'; Rotaliatina buliminoides below 8260' and the common specimens of Gyroidina girandana below 8280'.

A thicker and less fossiliferous development of Oligocene deposits is encountered in this well compared to those recorded from the Northern European localities.

(d) Eocene

UNIT I, INTERVAL 8740' - 9220'; ?Upper - ?Middle Eocene

General Lithology

This interval is essentially composed of interbedded light and medium grey shales. Traces of green shale are present at 8740' and 9080', and considerable amounts of a greenish grey variety occur in the sample from 9020'. Light grey to brownish, translucent, fibrous calcite occurs in many samples below 8920', probably resulting from lamellibranch shell fragments.

Brown, slightly dolomitic limestone is present at 8800' and also forms thin bands in the interval 9060' - 9120'.

Micropalaeontology and Stratigraphical Conclusions

Poor faunas are again noted within this section and arenaceous foraminifera predominate. The following new forms are noted at the top of the interval the bulk of which are green stained:

Globorotalia cf. cerro-azuelensis

Globorotalia cf. centralis

Globigerina barbosa

Trochammina globigeriniformis var. altiformis

Globigerina cf. linaperta linaperta

Bathysiphon eocenicus

This faunal association would suggest that the Eocene has been encountered, possibly the Middle - Upper Eocene. However, none of the typical calcareous benthonics of Upper - Middle Eocene age, as are found in the European deposits, are noted in this well.

(e) ?Eocene - ?Palaeocene

UNIT J, INTERVAL 9240' - 9380'; ?Lower Eocene - ?Palaeocene

General Lithology

Shales are again the dominant lithotype in this unit. They are mostly light grey and greenish grey in colour, and generally associated with some purple shales, which become particularly common at 9280'. Trace amounts of brownish, silty limestone occur at 9300'.

Micropalaeontology and Stratigraphical Conclusions

The incoming of purplish shale and sideritic nodules at the top of this unit may signify a break in the sequence. The faunas as a whole are poor across this boundary but the presence of Globigerina triangularis at 9240' could be indicative of a ?Lower Eocene - ?Palaeocene age. The incoming of the following arenaceous foraminifera are noted at 9320'.

Haplophragmoides cf. obliquecameratus

Cyclammina challinori

Cyclammina incisa

Trochammina pentagona

These are forms recorded by Haynes from the Palaeocene deposits of England and may indicate that the top of the Palaeocene occurs at this depth.

(f) Palaeocene

UNIT K, INTERVAL 9400' - 10,060'; Palaeocene

General Lithology

Shales are the dominant lithotype in the highest part of the unit, down to 9520'. They are light grey to greenish grey in colour, with subordinate amounts of purplish shale in a few samples which may possibly have caved. Cream to white limestone is noted at 9400' - 9430' and probably forms rare, very thin bands. Minor quantities of very fine, angular quartz grains are present at 9460'.

Sandstones appear at 9540' and are interbedded with light to medium greenish grey and grey shales. The sandstones are generally greyish to brown in colour, fine to very fine-grained and slightly calcareous.

In the lowest interval, between 9820' - 10,060', sandstones become dominant. They are again fine to very fine-grained with occasional medium, subrounded grains. Shales are still present in this interval, probably forming thin layers interbedded with the sandstones. Towards the base, below 10,000', the sandstone locally becomes greyish, and contains black, carbonized plant fragments.

A number of sidewall cores were examined from this unit. Grey shale occurs at 9457', greyish brown sandstone at 9670', greyish green shale with a trace of sandstone at 9727', and greyish brown shale at 9923'.

Three core samples were also received. Fine, medium grey, very argillaceous, slightly silty sandstone occurs at 9594', associated with some grey, micaceous siltstone. Siltstone is the dominant lithotype at 9640', together with considerable amounts of buff and light brown, very fine-grained sandstone. The core sample from 9696' is entirely composed of dark grey and greenish grey, occasionally waxy shale.

Micropalaeontology and Stratigraphical Conclusions

Poor faunas are noted down to 9480' but below this depth moderately rich faunal assemblages are recorded. At 9400' several specimens of Globigerina triloculinoides which are indicative of the Palaeocene are found to occur. Further diagnostic Palaeocene forms found within this section include the following :

Globigerina inaequispira

Globigerina spiralis

Involutina pyrotecnica

Glomospirella woodi

?Rzehakina sp.

Spiroplectammina spectabilis

An indication that the lower part of the Palaeocene is present can be seen with the incoming of Globigerina pseudobulloides at 10050'. Cores 9594' and 9640' were analysed palynologically but the microspores extracted from these rocks, especially from 9594' are poor. The fact that Cicatricosisporites dorogensis is present indicates that these samples are of Paleogene age (Older Tertiary). It is difficult to give a more accurate dating, on the palynological evidence available, but the general microflora and the fact that Cicatricosisporites dorogensis is relatively common suggests that these cores are of ?Lower Eocene - ?Palaeocene age.

UNIT L, INTERVAL 10,070' - 10,388'; Danian

General Lithology

The highest division of this unit, between 10,070' - 10,100', comprises white chalk (often having a pink stain), interbedded with light grey shales and white to light grey sandstones. Chalk is relatively subordinate in amount below 10,090', where the shales are the dominant lithotype. Brown transluscent flint occurs at 10,080'.

Chalk is absent from the interval 10,110' - 10,150'. Slightly pyritic grey shales are abundant above 10,120', together with fine to very fine-grained silty sandstones. These sandstones are the dominant lithotype between 10,130' - 10,150'. They are white to light grey in colour, calcareous, and composed of subangular to subrounded quartz grains.

The interval 10,160' - 10,260' is marked by the re-appearance of chalk, which is the dominant lithotype. It is associated with fine-grained sandstones, as in the higher interval, and subordinate amounts of medium grey shales. Below 10,240' the chalk is light grey in colour, and locally becomes arenaceous, containing fine, white to grey, angular quartz grains. Traces of white flint occur in the sample at 10,250'.

Sandstones become dominant in the interval 10,270' - 10,340', together with white chalk and subordinate amounts of light grey shales. The sandstones are fine to very fine-grained, as in the higher parts of the unit, though locally they contain some medium, angular quartz grains. Light grey, hard, dense, brittle limestone occurs in the sample from 10,330'.

The lowest part of this unit, between 10,350' - 10,388', comprises abundant sandstones with thin bands of grey, hard, dense, brittle limestone. This limestone is the dominant lithotype at 10,390', where it is medium to dark grey in colour. A sidewall core at 10,385' comprises whitish grey sandstone, and one from 10,388' is composed of dark grey, brittle, dense, argillaceous limestone.

Micropalaeontology and Stratigraphical Conclusions

Chalk is first encountered at 10070' and this is found to contain the following diagnostic foraminifera:

Globorotalia compressa

Globigerina pseudobulloides

Osangularia lens

This faunal assemblage occurring in association with the chalk lithology would suggest that the Danian has been encountered and thus this interval is probably the equivalent of the Danskekalk of Denmark.

Reworked Upper Cretaceous foraminifera are also noted in the sample at 10,070' and these may well be derived from the base of the Palaeocene clay sequence.

The remainder of this interval differs from the typical Danian of Denmark in that here it is composed of interbedded shales, sandstones and chalk, while in Denmark it is entirely composed of chalk.

Further diagnostic Danian forms recorded from this interval include the following foraminifera

Globigerina daubjergensis

Globigerina cf. arabica

Globorotalia quadrata

Karreria fallax

Although a similar thickness of Danian deposits are encountered here they are on the whole much less fossiliferous than those from the type section in Denmark.

VI

CRETACEOUS

UNIT M, INTERVAL 10,390' - 12,266'; Maestrichtian - ?Albian

General Lithology

Very hard, light greyish limestone is the predominant lithotype between 10,390' - 10,420', and is associated with subordinate amounts of hard, dense, white chalk.

The interval 10,430' - 10,860' is essentially a uniform sequence of very hard, brittle, dense chalk, and chalky limestone, which locally become light greyish in colour. Light to medium grey, hard, brittle limestone becomes increasingly common below 10,870', and appears to be interbedded with the chalky limestone down to 11,180'.

Chalk and chalky limestone are rarely present in the interval 11,190' - 11,410', where the dominant rock is a light to medium grey argillaceous limestone. An interesting feature is the occurrence of fine-grained, light greyish, sucrosic dolomite between 11,260' - 11,270', and at 11,340'. The sample from 11,410' contains traces of light green limestone.

The interval 11,420' - 11,810' comprises a series of interbedded white chalky limestones and light grey, hard, dense limestones. A similar sequence occurs between 11,820' - 12,030', but the grey limestones are slightly granular. They are again hard and brittle, and vary in texture from microcrystalline to finely-crystalline. These rocks are occasionally very slightly glauconitic.

The section from 12,040' - 12,266' is composed mainly of light grey to white, brittle, dense limestones. White, light blue and brown flint is a minor constituent of the samples 12,040' - 12,060'. Light to dark grey calcareous shales occur rarely throughout this interval,

often as thin laminae in the limestones. Clear, colourless to white, fine to medium-sized gypsum crystals occur in some samples, particularly at 12,170' and 12,260'. This gypsum appears to represent vein, and possibly small vug, infillings.

Three sidewall cores were examined from this unit. Hard, dense, brittle white limestone occurs at 12,258', whilst the sample from 12,259' is composed of medium to dark grey, hard, brittle, argillaceous limestone. The sidewall core from 12,266' is composed mainly of medium to dark grey, calcareous shale, which locally grades into grey, very argillaceous micrite.

Micropalaeontology, Palynology and Stratigraphical Conclusions

Great difficulty was encountered in attempting to subdivide the Chalk. The extremely poor microfaunas in the upper part and at the base and the rather unusual aspect of the more abundant foraminifera in the intervening section both added to the normal problems of establishing a subdivision of the Chalk.

No evidence for the Santonian stage was found and the Coniacian rocks appear to be extremely thin.

Several thin sections were made from the upper and lower intervals of the Chalk in case these yielded any further evidence.

INTERVAL 10,390' - 11,360'; Maestrichtian

The presence of ?Globotruncana contusa at 10,390' has been used to define the top of the Cretaceous Chalk. It should be pointed out that this is a solitary, poor specimen, and it could conceivably have caved from the overlying interval (10,070') which contains reworked Upper Cretaceous foraminifera. It is at this point, however, that chalk and chalky limestone dominate the samples.

In the remainder of the interval the microfaunas are extremely sparse and poorly preserved. The only forms occurring are either of little stratigraphical value or are questionable specimens. Although the evidence is tenuous we have assigned this interval to the Maestrichtian.

INTERVAL 11,370' - 11,390'; Lower Maestrichtian.

At 11,370' there is a significant increase in the microfauna with Rugoglobigerina rugosa cf. rotundata and Rugoglobigerina rugosa rugosa being particularly common. These forms often occur in the North Sea, in abundance, in the lower part of the Maestrichtian and because of this we have placed this interval in the Lower Maestrichtian.

INTERVAL 11,400' - 11,460'; Campanian

The incoming of Globotruncana cf. marginata and the subsequent occurrence of ?Globorotalites micheliniana suggests that this section is of Campanian age.

INTERVAL 11,470'; Coniacian - Turonian

From 11,470' the microfaunas consist of rather unusual varieties of Coniacian - Turonian species which are normally found in the North Sea.

In sample 11,470' the presence of Globotruncana cf. imbricata suggests that rocks of Coniacian age are present whilst the incoming of Praeglobotruncana cf. hagni and Praeglobotruncana stephani signify that Turonian rocks also occur in this sample.

It may be that only the lower part of the Coniacian is present. No Santonian forms have been recorded and from this it would appear that there is a hiatus in the Chalk section.

INTERVAL 11,480' - 12,266'; Turonian - Cenomanian - ?Albian

No significant change in the microfauna occurs in this interval but Praeglobotruncana cf. hagni and Praeglobotruncana stephani occur more commonly than in the overlying section and for this reason we have assigned this interval to the Turonian and Cenomanian stages. No definite evidence of Cenomanian beds has been found and hence no boundary can be drawn to

divide these two stages from one another.

The basal boundary of this section could not be drawn on micropalaeontological criteria due to the very poor microfaunas but it has been tentatively placed directly below side wall core 12266' on palynological evidence.

The presence of ?Baltisphaeridium hirsutum, Hystrichosphaera ramosa and Hystrichosphaeridium cf. siphoniferum indicates that this core is of mid Cretaceous age (Cenomanian - Albian). The microplankton are similar to those occurring in the overlying samples and hence it may be that this core is of Cenomanian rather than Albian age.

We, therefore, consider this interval to be basically of Turonian - Cenomanian age but the possibility of Albian rocks being present cannot be entirely excluded.

VII

CRETACEOUS - JURASSIC

UNIT N, INTERVAL 12,270' - 12,460';

General Lithology

Light to medium grey, occasionally white, hard, dense, argillaceous limestones constitute the dominant lithotype. Black carbonaceous and argillaceous streaks and laminae exist in the limestone in one or two samples. Black shales are commonly interbedded with the limestones.

Gypsum/anhydrite attains an important role in this unit, occurring as an abundance of fine to very fine, colourless crystals which are often aggregated together forming small lumps. The significance of these deposits is not clear because they resemble neither typical evaporitic anhydrites nor typical vein material. They may in fact represent vug infillings in the limestones, but the possibility that they are bedded cannot be ruled out.

Examination of sidewall cores sheds some light on this problem. Two, from 12,274' and 12,276', comprise hard, black, slightly carbonaceous shales, containing considerable amounts of gypsum/anhydrite crystals. Thus it is possible that the gypsum/anhydrite occurs here as discrete crystals, or aggregates, within the shales. This mode of occurrence may be comparable with the presence of selenite gypsum crystals in the London and Oxford Clays of England.

Evidence that some of the gypsum/anhydrite may be bedded and evaporitic comes from the examination of sidewall cores at 12,282' and 12,283' which are composed entirely of massive, light grey, friable, microcrystalline gypsum/anhydrite.

The sidewall core from 12,278' comprises medium grey, very argillaceous limestone.

Palynology and Stratigraphical Conclusions

A definite change in the microflora is apparent between side wall cores 12,266' and 12,274'. The microflora from side wall core 12,274' has more poorly preserved forms and has miospores present as well as microplankton. The microplankton consists basically of Pterospermopsis sp., and ?Pterospermopsis sp. but some forms of Gonyaulacysta sp. are also present. No definite age can be assigned to this microflora and for this reason we merely allot this interval to the Cretaceous - Jurassic. No lithological break could be found to correspond with the palynological break except that gypsum/anhydrite becomes more common in this section. The base of this interval has been drawn immediately above the incoming of the first Zechstein miospores and so this section could conceivably contain rocks which are in part older than the Jurassic.

VIII

PERMIAN

UNIT 0, INTERVAL 12,480' - 13,000'; Zechstein

General Lithology

The highest part of the unit, down to 12,500', is very similar in lithology to the overlying interval, and consists of interbedded and interlaminated grey, argillaceous limestones and black shales, with some gypsum/anhydrite.

Colourless to white salt appears at 12,510' and is associated with varying amounts of grey limestones, down to 12,610'. The limestones have probably largely caved, but some may be in situ. Gypsum/anhydrite is very subordinate in amount in this interval. Traces of pink and red shales occur in the samples between 12,540' - 12,600'.

Salt is the only lithotype present below 12,620'. It is white to colourless, and occasionally pink in the upper part, but entirely pink below 12,930'.

Palynology and Stratigraphical Conclusions

The only definite Zechstein miospores recovered from this well occur in composite sample 12,460' - 12,500'. This sample contains one specimen of Leuckisporites virkkiae and two of Protohaploxypinus sp. as well as a few less definite forms. In order to establish where these forms first appear the three samples, which made up the composite one, were examined individually. No characteristic miospores were obtained from these samples but bisaccate grains of similar preservation were obtained from 12,480' and a single specimen of ?Leuckisporites virkkiae occurred at 12,500'. We have, therefore, placed the top of the Zechstein at 12,480' and in this we have ignored any possibility that these forms could be reworked. The first salt, and hence any supporting lithological evidence for the Zechstein, appears at 12,510'.

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ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE	ANALYST	LOCATION
12.6.68.	CWH. RJG.	Norwegian North Sea Well 7/11-1X

FOR	CHART NO.
Phillips Petroleum Limited, Norway.	1590' - 2000'

LIMESTONE
DOLOMITE
OOLITIC LIMESTONE
CLAY
SHALE
SILTY/SANDY SHALE
SILTSTONE
SANDSTONE
CONGLOMERATE
GYPSUM
VOLCANICS
INTRUSIVES
S SALT
COAL
C CHERT
F Shell fragments

FORAMINIFERA AND OSTRACODA

MICROFOSSILS

- Elphidium incertum
- Nonion granosum
- Elphidiella arctica
- Globulina gibba
- Cassidulina laevigata
- Elphidium cf. hughesi
- Elphidiella hannai
- Triloculina oblonga
- Bulimina elongata var. subulata
- Angulogerina angulosa
- Cibicides lobatulus var. grossa
- Cassidulina laevigata pliocarinata
- Cassidulina oblonga
- Discorbis milletti
- Elphidium antoninum
- Elphidium macellum
- Nonion soldanii
- Lenticulina sp.
- Cibicides scaldisiensis
- Quinqueloculina seminulum
- Polymorphina charlottensis
LITHOLOGY	DEPTH IN FEET	SYSTEM	STAGE	ZONE
	100	PLEISTOCENE		
	200			
	300			
	400			
	500			
— — — · · O F F F F	600			
— — — · · O F F F F				
— — — — · · O F F F				
— — — — — — — — — F	700			
— — — — — — — — —		UPPER PLIOCENE	SCALDISIAN	
— — — — — — — — —	800			
— — — — — — — — —				
— — — — — — — — —	900			
— — — — — — — — —				
— — — — — — —	1000			

- Trachyleberis aff. dunelmensis
- Bulimina aculeata
- "Cythere" latimarginata
- Cassidulina crassa
- Elphidium inflatum

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE: 12.6.68. | ANALYST: CWH. RJG. | LOCATION: Norwegian North Sea Well 7/11-1X

FOR: Phillips Petroleum Limited, Norway. | CHART NO. 2: 2000' - 3000'

LITHOLOGY: LIMESTONE, DOLOMITE, OOLITIC LIMESTONE, CLAY, SHALE, SILTY/SANDY SHALE, SILTSTONE, SANDSTONE, CONGLOMERATE, GYPSUM, VOLCANICS, INTRUSIVES, SALT, COAL, CHERT

DEPTH IN FEET: 1000, 900, 800, 700, 600, 500, 400, 300, 200, 100

SYSTEM	STAGE	ZONE
MIDDLE MIOCENE	UPPER PLIOCENE ? —— ?	
UPPER MIOCENE		
? LOWER PLIOCENE		
LOWER DIESTIAN	SCALDISIAN ? —— ?	
?UPPER DIESTIAN		

MICROFOSSILS

FORAMINIFERA AND OSTRACODA

+	Elphidium incertum
+	Elphidium inflatum
+	Elphidium antoninum
+	Cassidulina laevigata pliocarinata
+	Cassidulina laevigata
+	Cassidulina oblonga
+	Globigerina bulloides
+	Nonion granosum
+	Cibicides scaldisiensis
+	Discorbis milletti
+	Quinqueloculina seminulum
+	Guttulina lactea
	Cibicides lobatulus var. grossa
	Cassidulina crassa
	Cibicides ungerianus
	Nonion soldanii
	Bulimina elongata
	Uvigerina cf. cookei
	Globulina gibba
	Quinqueloculina undosa
	Aurila convexa
	Bolivina subspinescens
	Pyrgo bulloides
	Sigmoilina celata
	Eponides repandus
	Uvigerina canariensis
	Uvigerina asperula
	Cibicides peelensis
	Quinqueloculina buchiana
	Fissurina laevigata
	Pullenia quinqueloba
	Cibicides aknerianus
	Uvigerina hosiusi
	Nonion affine
	Bulimina elongata var. subulata
	Pyrulina fusiformis
	Rotalia beccarii var.
	Lenticulina gibba
	Asterigerina staeschei
	Textularia gramen
	Echinocythereis scabra
	Globorotaloides variabilis
	Nodosaria pyrula
	Karreriella cf. siphonella

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE	ANALYST	LOCATION
12.6.68.	CWH. RJG.	Norwegian North Sea Well 7/11-1X

FOR: Phillips Petroleum Limited, Norway.

CHART NO. 3

3000' - 1000'

LIMESTONE · DOLOMITE · OOLITIC LIMESTONE · CLAY · SHALE · SILTY/SANDY SHALE · SILTSTONE · SANDSTONE · CONGLOMERATE · GYPSUM · VOLCANICS · INTRUSIVES · SALT · COAL · CHERT

FORAMINIFERA AND OSTRACODA

MICROFOSSILS

- Cibicides lobatulus var. grossa
- Cibicides akneriana
- Cibicides angerranus
- Cibicides pelensis
- Cassidulina laevigata
- Elphidium antoninum
- Elphidium inflatum
- Acrbergerina stuescheri
- Nonion soldanii
- Nonion affine
- Bolivina beyrichi var. tenera
- Bolivina elongata var. subulata
- Pyrgo bulloides
- Uvigerina canariensis
- Uvigerina asperula
- Globigerina bulloides
- Quinqueloculina buchiana
- Sigmoilina celata
- Triloculina broidyi
- Bulimina subspinescens
- Virgulina pauperata
- Nodosaria pyrula
- Amphicoryna scalaris
- Fissurina laevigata
- Uvigerina hostusi
- Cassidulina subglobosa
- Pseudopolymorphina subnodosa
- Glandulina laevigata
- Cibicides lobatulus
- Loxostomum sinuosum
- Lagena semistriata
- Globulina gibba
- Echinocythereis scabra
- Nonion boreanum
- Palliolina aequiloba
- Globorotaloides variabilis
- Globoquadrina venezuelana
- Bolivina beyrichi
- Virgulina pertusa
- Lenticulina globosa
- Nodosaria hispida
- Cancris auriculus
- Bolivina floridana imperata
- Bolivina dilatata
- Lagena sulcata
- Laxostomum teretum
- Orbulina universa
- Cythere? lactimarginata
- Spirolectina complectata
- Lenticulina arcuata
- Lenticulina cf. haueriana
- Marginulina akjerana
- Dentalina divergens
- Lenticulina sp.
- Listerella communis
- Sphaeroidina bulloides
- Lagena tenuis
- ?Textularia cf. gramen
- Quadrocythere macropora
- Siphocythereis labiata

LITHOLOGY · DEPTH IN FEET · SYSTEM · STAGE · ZONE

100 · 200 · 300 · 400 · 500 · 600 · 700 · 800 · 900 · 1000

MIDDLE MIOCENE

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE	ANALYST	LOCATION	
12.6.68.	CWH. RJG.	Norwegian North Sea Well 7/11-1X	
FOR			CHART NO. 4
Phillips Petroleum Limited. Norway.			1000' - 5000'

▦	LIMESTONE	⁘	SILTSTONE	S	SALT
▥	DOLOMITE	·	SANDSTONE	●	COAL
▦	OOLITIC LIMESTONE	O	CONGLOMERATE	C	CHERT
─	CLAY	/	GYPSUM	☐	
▥	SHALE	V	VOLCANICS	☐	
▥	SILTY / SANDY SHALE	X	INTRUSIVES	☐	

LITHOLOGY

DEPTH IN FEET

SYSTEM

STAGE

ZONE

MICROFOSSILS

FORAMINIFERA AND OSTRACODA

- Cytheridea mulleri
- "Cythere" latimarginata
- Echinocythereis scabra
- Nonion boueanum
- Nonion affine
- Nonion soldanii
- Nonion granosum
- Cibicides ungerianus
- Cibicides peelensis
- Cibicides aknerianus
- Cibicides lobatulus
- Uvigerina hosiusi
- Uvigerina canariensis
- Sigmoilina celata
- Quinqueloculina buchiana
- Quinqueloculina seminulum
- Cassidulina laevigata
- Cassidulina subglobosa
- Elphidium inflatum
- Pyrgo bulloides
- Globigerina bulloides
- Globoquadrina venezuelana
- Loxostomum sinuosum
- Bulimina elongata var. tenera
- Bulimina elongata var. subulata
- Asterigerina staeschei
- Rotalia beccarii var.
- Glandulina laevigata
- Pullenia sphaeroides
- Lagena tenuis
- Marginulina akneriana
- Bolivina beyrichi
- Siphotextularia labiata
- Textularia cf. gramen
- Fissurina laevigata
- Globigerina angustiumbilicata
- Lagena striata
- Sphaeroidina bulloides
- Quadracythere macropora
- Listerella communis
- Trifarina bradyi
- Pullenia quinqueloba
- Krithe cf. papillosa
- Cyamocytheridea punctillata
- Bosquetina aff. pectinata.
- Nodosaria soluta
- Cytherella beyrichi
- Frondicularia nysti
- Guttulina problema
- Cytheropteron cf. steinmanni
- Nodosaria konincki
- Globigerina praebulloides praebulloides
- Glomospira charoides
- Lenticulina grandis
- Karreriella siphonella
- Nodosaria pyrula
- Orbulina universa
- Globigerina concinna
- Bolivina floridana imporcata
- Pterygocythereis jurinei
- Cyclammina placenta
- Ammodiscus incertus
- Haplophragmoides latidorsatus
- Lagena hexagona
- Cuneocythere? cribosa
- Glandulina aequalis
- Globigerina foliata
- Globigerina bradyi
- Globigerina juvenilis
- Cornuspira involens
- Cyclammina sp.
- Globorotaloides suteri
- Lagena gracillima
- Globorotalia scitula scitula
- Angulogerina gracilis var. tenuistriata
- Carinocythereis aff. carinata

OTHER FOSSILS

- Radiolaria

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE	ANALYST	LOCATION
12.6.68.	CWil. RJG.	Norwegian North Sea Well 7/11-1X

FOR	CHART NO.
Phillips Petroleum Limited, Norway.	5
	5900' - 6000'

LIMESTONE
DOLOMITE
OOLITIC LIMESTONE
CLAY
SHALE
SILTY/SANDY SHALE
SILTSTONE
SANDSTONE
CONGLOMERATE
GYPSUM
VOLCANICS
INTRUSIVES
SALT
COAL
CHERT

LITHOLOGY | DEPTH IN FEET | SYSTEM | STAGE | ZONE

MIDDLE MIOCENE
LOWER MIOCENE
BURDIGALIAN
AQUITANIAN

MICROFOSSILS

FORAMINIFERA AND OSTRACODA

Echinocythereis scabra
Krithe cf. papillosa
"Cythere" latimarginata
Notion bonaeanum
Notion affine
Notion gualtieri
Notion praeauricula
Cibicides ungerianus
Cibicides peelensis
Cibicides akneranus
Uvigerina bostusi
Uvigerina camariensis
Sigmoilina celata
Quinqueloculina buchiana
Cassidulina laevigata
Cassidulina subglobosa
Globigerina bulloides
Globigerina praebulloides occlusa
Globigerina angustiumbilicata
Globigerina cf. venezuelana
Bulimina elongata var. tenera
Asterigerina staeschei
Rotalia beccarii var.
Glandulina laevigata
Pullenia sphaeroides
Siphotextularia lobata
Fissurina laevigata
Globigerina angustiumbilicata
Sphaeroidina bulloides
Globigerina cf. praebulloides
Globigerina praebulloides praebulloides
Globigerina ciperoensis
Lenticulina crassa
Globocassidulina subglobosa
Cyclammina placenta
Ammodiscus incertus
Haplophragmoides latidorsatus
Glandulina aequalis
Globigerina bradyi
Globigerina falconensis
Globigerina ouachitaensis
Lagena striata
Globorotalia scitula scitula
Globorotalia cf. mayeri
Globigerinoides trilobus trilobus
Bulimina elongata var. subulata
Pyrgo bulloides
Ophtalmia universa
Bolivina beyrichi
Chrysalogonium longicornis
Angulogerina angulosa var. tenuistriata
Karreriella sphaerella
Pullenia quinqueloba
Uvigerina tenuipustulata
Marginulina akneriana
Elphidium inflatum
Bolivina cookei
Glomospira charoides
Lisserella cf. communis
Cyclammina sp.
Spiroculina limbata
Nodosaria soluta
Bolivina floridana imperata
Gyroidina girardana
Cornuspira involvens
Globorotalia scitula praescitula
Globigerinoides bisphericus
Saccorhiza ramosa
Nodosaria obliqua
Bigenerina nodosaria

OTHER FOSSILS

Radiolaria

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE	ANALYST	LOCATION
12.6.68.	CWH. RJG.	Norwegian North Sea Well - 7/11-1X

FOR	CHART NO. 6
Phillips Petroleum Limited. Norway.	6000' - 7000'

LIMESTONE
DOLOMITE
OOLITIC LIMESTONE
CLAY
SHALE
SILTY/SANDY SHALE
SILTSTONE
SANDSTONE
CONGLOMERATE
GYPSUM
VOLCANICS
INTRUSIVES
SALT
COAL
CHERT

LITHOLOGY

DEPTH IN FEET

SYSTEM

STAGE

ZONE

FORAMINIFERA AND OSTRACODA

MICROFOSSILS

Cyclammina sp.
Globigerina praebulloides praebulloides
Globigerina angustiumbilicata
Haplophragmoides latidorsatus
Eisenackia cf. comunis
Pollenia sphaeroides
Globigerina concinna
Globigerinoides triloba triloba
Globorotalia fohsi barisanensis
Lvigerina temipustulata
Globigerina juvenilis
Asterigerina staeschei
Cornuspira involens
Siphotextularia labiata
Sigmoilina miocenica
Cassidulina crassa crassa praecrassicula
Nodosaria pyrula
Sigmoilina tenuis
Sphaeroidinellopsis seminulum seminulum
Frondicularia nysti
Bulimina elongata var. tenera
Nodosaria spinescens
Ammodiscus incertus
Cyclammina placenta
Glomospira charoides
Bulimina dingdenensis
Sphaeroidina bulloides
Cassidulina sp.
Nonion affine sp.
Anomalinoides grosserugosa var. tenuistriata
Nodosaria ludwigi
Globigerinoides bisphericus
Rhabdammina sp.
Siphonodosaria hirsuta
Asterigerina guerichi
Lagena laevigata
Frondicularia semimuda
Haplophragmoides carinatus
Globigerina praebulloides leroyi
Quinqueloculina akneriana
Lagena sulcata
Lagena oxystoma
Lenticulina lamarcina
Cassidulina minima
Globigerinita martini sendretti
Guttulina problema
Bulimina subulifera
Bolivina plicatella
Gravellina cf. marinensis
Ammodiscus dominicensis
Echinocythereis scabra
Bulimina elongata
Textularia agglutinans
Haplophragmoides sp.1
Haplocytheridea mayeri
Cribrobolia mayeri
Globigerina cf. bulloides
Sigmoilina cf. schlumbergeri
Lenticulina aff. platypleura
Hyperammina sp. 1
Cribrostomoides sp. 1
Globoquadrina venezuelana

SYSTEM: LOWER MIOCENE, OLIGOCENE
STAGE: AQUITANIAN
ZONE:

DEPTH IN FEET: 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE 12.6.68. | ANALYST CWH. RJG. | LOCATION Norwegian North Sea Well 7/11-1X

FOR Phillips Petroleum Limited, Norway. | CHART NO. 7 | 7000' - 8000'

LIMESTONE, DOLOMITE, OOLITIC LIMESTONE, CLAY, SHALE, SILTY/SANDY SHALE, SILTSTONE, SANDSTONE, CONGLOMERATE, GYPSUM, VOLCANICS, INTRUSIVES, SALT, COAL, CHERT

LITHOLOGY | DEPTH IN FEET | SYSTEM | STAGE | ZONE

1000 900 800 700 600 500 400 300 200 100

OLIGOCENE

MICROFOSSILS

FORAMINIFERA AND OSTRACODA

- Haplophragmoides sp. 1
- Cyclammina placenta
- Haplophragmoides latidorsatus
- Haplophragmoides carinatum
- Cyclammina sp.
- Globigerina angustiumbilicata
- Bathysiphon dubia
- Rhabdammina sp.
- Gravellina cf. narivaensis
- Sigmoilina celata
- Globigerina praebulloides praebulloides
- Cribrostomoides sp. 1
- Coscinodiscus sp.
- Ammodiscus incertus
- Guttulina problema
- Hyperammina sp.
- Bulimina elongata
- Globoquadrina venezuelana
- Nodosaria spinescens
- Cibicides tenellus
- Globigerina cf. ampliapertura
- Nonion affine
- Lenticulina hauerina
- Sphaeroidina bulloides
- Ammodisus dominicensis
- Lagena sulcata
- Lagena elongata
- Haplocytheridea curvata
- Catapsydrax unicavus
- Chilostomella cylindroides
- Krithe pernoides
- Frondicularia seminuda
- Loxostumum digitale
- Pullenia sphaeroides
- Globigerina praebulloides leroyi
- Glandulina laevigata
- ?Saccammina sp.
- Hormosina sp.
- Hyppocrepina sp.
- Pelosina sp.
- Glomospira charoides
- Cornuspira involens
- Eponides umbonatus
- Catapsydrax dissimilis
- Echinocythereis scabra

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE: 12.6.68. | ANALYST: CWH. RJG. | LOCATION: Norwegian North Sea Well 7/11-1X

FOR: Phillips Petroleum Limited. Norway. | CHART NO. 8 | 8000' - 9000'

LITHOLOGY: LIMESTONE, DOLOMITE, OOLITIC LIMESTONE, CLAY, SHALE, SILTY/SANDY SHALE, SILTSTONE, SANDSTONE, CONGLOMERATE, GYPSUM, VOLCANICS, INTRUSIVES, SALT, COAL, CHERT

DEPTH IN FEET: 1000, 900, 800, 700, 600, 500, 400, 300, 200, 100

SYSTEM: ?UPPER - ?MIDDLE EOCENE; OLIGOCENE

STAGE

ZONE

MICROFOSSILS

FORAMINIFERA AND OSTRACODA

- Glomospira charoides
- Bathysiphon dubia
- Rhabdammina sp.
- Globigerina angustiumbilicata
- Cyclammina sp.
- Lenticulina grandis
- Cyclammina placenta
- Haplophragmoides latidorsatus
- Cribrostomoides sp. 1
- Pelosina sp.
- Cytheretta sp.
- Hyperammina sp.
- Globoquadrina venezuelana
- Hormosina sp.
- Ammodiscus incertus
- Echinocythereis scabra
- Hyppocrepina sp.
- Catapsydrax unicavus
- Globigerina praebulloides praebulloides
- Haplophragmoides sp. 1
- Gyroidina girandana
- Sigmoilina celata
- Ammodiscus dominicensis
- Pyrgo sp.
- Nonion affine
- Haplophragmoides carinatum
- Spiroloculina canaliculata
- Catapsydrax dissimilis
- Bulimina elongata
- Coscinodiscus sp.
- Glandulina laevigata
- Lagena sulcata
- Lenticulina hauerina
- Guttulina problema
- Cibicides tenellus
- Rotaliatina buliminoides
- Cytherella beyrichi
- Krithe pernoides
- Lagena laevigata
- Triloculina tricarinata
- Gravellina cf. narivaensis
- Haplophragmoides sp.
- Pyrulina cylindroides
- Cancris auriculus
- Xestoleberis muelleriana
- Globigerina cf. ampliapertura
- Globorotalia cf. cerro-azulensis
- Globorotalia cf. centralis
- Cribrostomoides sp. 2
- Bathysiphon eocenicus
- Trochammina globigeriniformis var. altiformis
- Globigerina barbosa
- Globigerina cf. linaperta linaperta
- Trochammina globigeriniformis

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE 12.6.68. | ANALYST JWC CWH. RJG | LOCATION Norwegian North Sea Well 7/11-1X

FOR Phillips Petroleum Limited, Norway. | CHART NO. 9 | 9000' - 10000'

LITHOLOGY: LIMESTONE, DOLOMITE, OOLITIC LIMESTONE, CLAY, SHALE, SILTY/SANDY SHALE, SILTSTONE, SANDSTONE, CONGLOMERATE, GYPSUM, VOLCANICS, INTRUSIVES, SALT, COAL, CHERT

DEPTH IN FEET: 1000, 900, 800, 700, 600, 500, 400, 300, 200, 100

SYSTEM: PALAEOCENE | ?LOWER EOCENE - ?PALAEOCENE | ?UPPER - ? MIDDLE EOCENE

STAGE

ZONE

MICROFOSSILS

FORAMINIFERA AND OSTRACODA

- Samples analysed palynologically
- Bathysiphon eocenicus
- Cyclammina placenta
- Glomospira charoides
- Rhabdammina sp.
- Hyperammina sp.
- Trochammina globigeriniformis
- Trochammina globigeriniformis var. altiformis
- Haplophragmoides sp.
- Haplophragmoides carinatum
- Haplophragmoides latidorsatus
- Hormosina sp.
- Cyclammina sp.
- Ammodiscus incertus
- Cribrostomoides sp.
- Globigerina barbosa
- Coscinodiscus sp.
- Pelosina sp.
- Hyppocrepina sp.
- Globigerina cf. linaperta linaperta
- Krithe cf. rutoti
- Globigerina triangularis
- Haplophragmoides cf. obliquicameratus
- Cyclammina challinori
- Cyclammina incisa
- Trochammina pentagona
- Globigerina triloculinoides
- Involutina pyrotecnica
- Glomospirella woodi
- ?Rzehakina sp.
- Spiroplectammina spectabilis
- Pullenia quaternaria
- Globigerina inaequispira
- Globigerina spiralis

MIOSPORES

- Cicatricosisporites sp.
- cf. Polyadopollenites sp.
- Cicatricosisporites dorogensis
- Cingulatisporites marxheimensis
- Toroispora sp.
- Triatrisporites myricoides
- Laevigatosporites haardti

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE 12.6.68. | ANALYST CWH. JWC. RJG | LOCATION Norwegian North Sea Well 7/11-1X

FOR Phillips Petroleum Limited, Norway. | CHART NO. 10 10000' - 11000'

LIMESTONE, SILTSTONE, SALT
DOLOMITE, SANDSTONE, COAL
OOLITIC LIMESTONE, CONGLOMERATE, CHERT and flint
CLAY, GYPSUM, White chalk and chalky limestone
SHALE, VOLCANICS
SILTY/SANDY SHALE, INTRUSIVES

* Reworked Upper Cretaceous forms.

LITHOLOGY | DEPTH IN FEET | SYSTEM | STAGE | ZONE

1000 900 800 700 600 500 400 300 200 100

UPPER CRETACEOUS | PALAEOCENE

MAESTRICHTIAN | DANIAN

MICROFOSSILS

FORAMINIFERA

Bathysiphon eocenicus	
Rhabdammina sp.	
Hyperammina sp.	
Trochammina globigeriniformis	
Trochammina globigeriniformis var. altiformis	
Haplophragmoides carinatum	
Cyclammina sp.	
Coscinodiscus sp.	
Haplophragmoides cf. obliquicameratus	
Cyclammina challinori	
Cyclammina incisa	
Trochammina pentagona	
Globigerina triloculinoides	
Involutina pyrotecnica	
Glomospirella woodi	
?Rzehakina sp.	
Spiroplectammina spectabilis	
Hormosina sp.	
Globigerina pseudobulloides	
Cibicides proprius	
Pullenia quaternaria	
Globigerina spiralis	
Allomorphina subtriangularis	
Bulimina midwayensis	
Gavelinopsis acuta	
Pseudotextularia elegans	*
Biglobigerinelloides sp.	*
?Rugoglobigerina sp.	*
Osangularia lens	
Globorotalia compressa	
Globigerina aff. daubjergensis	
Nodosaria cf. limbata	
Glandulina laevigata	
Allomorphina halli	
Lagena vulgaris	
Lagena gracillicosta	
Globorotalia quadrata	
Globigerina daubjergensis	
Guttulina hantkeni	
Dorothia bulletta	
Pyrulina cylindroides	
Karreria fallax	
Globigerina cf. arabica	
?Globotruncana contusa	
Heterohelix sp.	
?Stensioina sp.	
?Globigerinelloides sp.	
?Rugoglobigerina sp.	
Gavelinella sp.	
Praebulimina sp.	
Pullenia sp.	
Heterohelix cf. punctulata	
Lenticulina cf. pseudovalis	
Polymorphina sp.	
Pullenia cf. cretacea	
Lenticulina sp.	
Gavelinopsis sp.	

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE	ANALYST	LOCATION
12.6.68.	MCC. JWC. RJG.	Norwegian North Sea Well 7/11-1X

FOR	CHART NO.
Phillips Petroleum Limited, Norway.	11000' - 12000'

LIMESTONE
DOLOMITE
OOLITIC LIMESTONE
CLAY
SHALE
SILTY/SANDY SHALE
SILTSTONE
SANDSTONE
CONGLOMERATE
GYPSUM
VOLCANICS
INTRUSIVES
SALT
COAL
CHERT
White chalk and chalky limestone

LITHOLOGY | DEPTH IN FEET | SYSTEM | STAGE | ZONE

100 200 300 400 500 600 700 800 900 1000

UPPER CRETACEOUS

MAESTRICHTIAN.

LOWER MAESTRICHTIAN

CAMPANIAN

CONIACIAN-TURONIAN

?ALBIAN - CENOMANIAN - TURONIAN

FORAMINIFERA

MICROFOSSILS

?Rugoglobigerina sp.
Gavelinella sp.
Lenticulina sp.
Polymorphina sp.
Striate Heterohelix sp.
Eoguttulina sp.
Rugoglobigerina rugosa cf. rugosa
Rugoglobigerina rugosa cf. rotundata
Pullenia cretacea
Globotruncana cf. marginata
Tritaxilina laevigata
Gyroidinoides nitida
Globotruncana cf. mariei
Globigerinelloides aspera
Heterohelix cf. globulosa
Gaudryina sp.
?Globorotalites michelliniana
Globotruncana arca
Globotruncana cf. imbricata
Praeglobotruncana stephani
Praeglobotruncana cf. hagni
Globotruncana linneiana cf. tricarinata
Reussella cf. szajnochae
Globotruncana linneiana cf. bulloides
Heterohelix sp.
Globotruncana linneiana linneiana
Praeglobotruncana sp.
Biglobigerinelloides sp.

ROBERTSON RESEARCH COMPANY LIMITED

MICROPALAEONTOLOGICAL ANALYSIS CHART

DATE 12.6.68. | ANALYST JWC. BJG. | LOCATION Norwegian North Sea Well 7/11-1X | CHART NO. 12

FOR Phillips Petroleum Limited, Norway. | 12000' - 13000'

LITHOLOGY: LIMESTONE, SILTSTONE, SALT; DOLOMITE, SANDSTONE, COAL; OOLITIC LIMESTONE, CONGLOMERATE, CHERT and flint; CLAY, GYPSUM/anhydrite, White chalky limestone; SHALE, VOLCANICS; SILTY/SANDY SHALE, INTRUSIVES

DEPTH IN FEET: 1000, 900, 800, 700, 600, 500, 400, 300, 200, 100

SYSTEM	STAGE	ZONE
UPPER PERMIAN	ZECHSTEIN	
JURASSIC - CRETACEOUS		
UPPER CRETACEOUS	TURONIAN - CENOMANIAN - ? ALBIAN	

MICROFOSSILS

FORAMINIFERA

- Samples analysed palynologically
- Gyroidinoides nitida
- Praeglobotruncana stephani
- Globotruncana linneiana cf. bulloides
- Gavelinella sp.
- ?Rugoglobigerina sp.
- Praeglobotruncana cf. hagni
- Globotruncana cf. marginata
- Biglobigerinelloides sp.
- Praeglobotruncana sp.
- Globotruncana arca
- Lenticulina sp.
- Anomalina sp.

MICROPLANKTON

- Odontochitina cf. operculata
- Hystrichosphaera ramosa ramosa
- Odontochitina sp.
- ?Cannosphaeropsis densa
- Deflandrea bakeri
- Deflandrea rectangularis
- Hystrichosphaera cf. siphoniferum
- Hystrichosphaeridium cf. recurvatum
- ?Baltisphaeridium hirsutum
- ?Gonyaulacysta sp.
- Oligosphaeridium complex
- Gonyaulacysta sp.
- Pterospermopsis sp.
- ?Pterospermopsis sp.
- Cannosphaeropsis cf. filamentosa

MIOSPORES

- ?Gleicheniidites sp.
- ?Classopollis sp.
- ?Bisaccates
- ?Tsugaepollenites sp.
- Bisaccates
- ?Leuckisporites virkkiae
- Protohaploxypinus sp.
- Leuckisporites virkkiae

BIOSTRATIGRAPHIC CHART SHOWING THE DISTRIBUTION OF THE DIAGNOSTIC, CAENOZOIC AND MESOZOIC FORAMINIFERA AND OSTRACODA IN THE PHILLIPS (NORWAY) 7/11-IX NORTH SEA WELL

SHEET 1 OF 3

by
ROBERTSON RESEARCH COMPANY LIMITED,
Llanddulas, Abergele, Denbighshire.

SYSTEM	MIOCENE			PLIOCENE		PLEISTOCENE
SUB-SYSTEM	MIDDLE MIOCENE		UPPER MIOCENE	? LOWER PLIOCENE	UPPER PLIOCENE	
STAGE			LOWER DIESTIAN	? UPPER DIESTIAN	SCALDISIAN	
ZONE						

OSTRACODA

5000 4800 4600 4400 4200 4000 3800 3600 3400 3200 3000 2800 2600 2400 2200 2000 1800 1600 1400 1200 1000

FORAMINIFERA

- *Trachyleberis aff. dunalmensis*
- *"Cythere" latimarginata*
- *Aurila convexa*
- *Echinocythereis scabra*
- *Quadracythera macropora*
- *Cytheridea mülleri*
- *Krithe cf. papillosa*
- *Cyammocythereidea punctillata*
- *Bosquetina aff. pectinata*
- *Cytherella beyrichi*
- *Cytheropteron cf. steinmanni*
- *Pterygocythereis jurinei*
- *Carinocythereis aff. carinata*

- *Elphidium incertum*
- *Elphidiella arctica*
- *Cassidulina laevigata*
- *Elphidium cf. hughesi*
- *Elphidiella hannai*
- *Bulimina elongata var. subulata*
- *Angulogerina angulosa*
- *Cibicides lobatulus var. grossa*
- *Cassidulina laevigata plocarinata*
- *Discorbis milletti*
- *Elphidium antoninum*
- *Elphidium macellum*
- *Nonion scaldisiensis*
- *Cibicides scaldisiensis*
- *Polymorphina charlottensis*
- *Bulimina aculeata*
- *Elphidium inflatum*
- *Globigerina bulloides*
- *Cibicides ungerianus*
- *Bulimina elongata*
- *Uvigerina cf. cookei*
- *Bolivina subspinescens*
- *Pyrgo bulloides*
- *Sigmoilina celata*
- *Eponides repandus*
- *Uvigerina canariensis*
- *Uvigerina asperula*
- *Cibicides peelensis*
- *Quinqueloculina buchiana*
- *Cibicides akneranus*
- *Uvigerina hosiusi*
- *Nonion affine*
- *Pyrulina fusiformis*
- *Rotalia beccarii var.*
- ***Asterigerina staeschei***
- *Textularia gramen*
- *Globorotaloides variabilis*
- *Nodosaria pyrula*
- *Karreriella cf. siphonella*
- *Bulimina elongata var. tenera*
- *Trifarina bradyi*
- *Pseudopolymorphina subnodosa*
- *Loxostomum sinuosum*
- *Frondicularia nysti*
- *Nonion boueanum*
- *Globoquadrina venezuelana*
- *Bolivina beyrichi*
- *Virgulina pertusa*
- *Nodosaria ludwigi*
- *Caneris auriculus*
- *Bolivina floridana imperata*
- *Bolivina dilatata*
- *Loxostomum teretum*
- *Orbulina universa*
- *Spiroloculina canaliculata*
- *Karreriella siphonella*
- *Marginulina akneriana*
- *Dentalina divergens*
- *Listerella communis*
- *Lagena tenuis*
- *Siphotextularia labiata*
- *Globigerina angustiumbilicata*
- *Sphaeroidina bulloides*
- *Nodosaria soluta*
- *Nodosaria konincki*
- *Globigerina praebulloides praebulloides*
- *Glomospira charoides*
- *Lenticulina grandis*
- *Globigerina concinna*
- *Cyclammina placenta*
- *Ammodiscus incertus*
- *Haplophragmoides latidorsatus*
- *Glandulina aequalis*
- *Globigerina foliata*
- *Globigerina bradyi*
- *Globigerina juvenalis*
- *Cornuspira involens*
- *Globorotaloides suteri*
- *Globorotalia scitula scitula*
- *Angulogerina gracilis var. tenuistriata*

BIOSTRATIGRAPHIC CHART SHOWING THE DISTRIBUTION OF THE DIAGNOSTIC, CAENOZOIC AND MESOZOIC FORAMINIFERA AND OSTRACODA IN THE PHILLIPS (NORWAY) 7/11-IX NORTH SEA WELL

SHEET 2 OF 3

by
ROBERTSON RESEARCH COMPANY LIMITED,
Llandudno, Abergele, Denbighshire.

SYSTEM	EOCENE	OLIGOCENE	MIOCENE		SYSTEM
SUB-SYSTEM	?UPPER - ?MIDDLE EOCENE		LOWER MIOCENE	MIDDLE MIOCENE	SUB-SYSTEM
STAGE			AQUITANIAN / BURDIGALIAN		STAGE
ZONE					ZONE

OSTRACODA	9500	8800	8600	8400	8200	8000	7800	7600	7400	7200	7000	6800	6600	6400	6200	6000	5800	5600	5400	5200	5000	FORAMINIFERA
Echinocythereis scabra																						Cassidulina laevigata
Krithe cf. papillosa																						Bulimina elongata var. subulata
"Cythere" latimarginata																						Nonion soldanii
Cytherella beyrichi																						Elphidium inflatum
Haplocytheridea curvata																						Globigerina bulloides
Krithe perneides																						Cibicides ungerianus
Cytheretta sp.																						Bulimina elongata
Xestoleberis muelleriana																						Pyrgo bulloides
																						Sigmoilina celata
																						Uvigerina canariensis
																						Cibicides pseudoungerianus
																						Quinqueloculina buchiana
																						Cibicides aknerianus
																						Uvigerina hosiusi
																						Nonion affine
																						Ratalia beccarii var.
																						Asterigerina staeschei
																						Nodosaria pyrula
																						Bulimina elongata var. tenera
																						Loxostomum sinuosum
																						Frondicularia mysti
																						Nonion bauanum
																						Globoquadrina venezuelana
																						Bolivina beyrichi
																						Nodosaria ludwigi
																						Cancris auriculus
																						Bolivina floridana imporcata
																						Orbulina universa
																						Spiroloculina canaliculata
																						Karreriella siphonella
																						Marginulina akneriana
																						Listerella communis
																						Siphotextularia labiata
																						Globigerina angustiumbilicata
																						Sphaeroidina bulloides
																						Nodosaria soluta
																						Globigerina praebulloides praebulloides
																						Glomospira charoides
																						Lenticulina grandis
																						Globigerina concinna
																						Cyclammina placenta
																						Ammodiscus incertus
																						Haplophragmoides latidorsatus
																						Glandulina aequalis
																						Globigerina foliata
																						Globigerina bradyi
																						Globigerina juvenilis
																						Cornuspira involens
																						Globoratalia scitula scitula
																						Angulogerina gracilis var. tenuistriata
																						Globoratalia cf. mayeri
																						Globigerinoides trilobo trilobo
																						Ehrenbergina serrata
																						Globoratalia fohsi barisanensis
																						Uvigerina tenuipustulata
																						Bolivina cookei
																						Sphaeroidinellopsis seminula seminula
																						Sigmoilina miocenica
																						Gyroidina girardana
																						Globoratalia scitula praescitula
																						Globigerinoides bisphericus
																						Spiroplectammina carinata
																						Nodosaria amaciata var. multilineata
																						Sigmoilina tenuis
																						Nodosaria spinescens
																						Rhabdammina sp.
																						Siphonodosaria hirsuta
																						Astarigerina gürichi
																						Frondicularia seminuda
																						Haplophragmoides carinatum
																						Globigerina praebulloides leroyi
																						Catapsydrax unicavus
																						Globigerinita martini scandretti
																						Dentalina globulifera
																						Bathysiphon dubia
																						Gravellina cf. narivaensis
																						Ammodiscus dominicensis
																						Textularia agglutinans
																						Haplophragmoides sp. 1
																						Globoratalia mayeri
																						Globigerina cf. ampliapertura
																						Sigmoilina cf. schlumbergeri
																						Cribrostomoides sp. 1
																						Cibicides tenellus
																						Chilostomella cylindroides
																						Loxostomum digitale
																						Hormosina sp.
																						Hyperammina sp.
																						Pelosina sp.
																						Eponides umbonatus
																						Catapsydrax dissimilis
																						Rotaliatina bulimoides
																						Triloculina tricarinata
																						Haplophragmoides sp. 2
																						Pyrulina cylindroides
																						Globoratalia cf. cerro-azulensis
																						Globoratalia cf. centralis
																						Cribrostomoides sp. 2
																						Bathysiphon eocenicus
																						Trochammina globigeriniformis var. altiformis
																						Globigerina barbosa
																						Globigerina cf. linaperta linaperta
																						Trochammina globigeriniformis

BIOSTRATIGRAPHIC CHART SHOWING THE DISTRIBUTION OF THE DIAGNOSTIC, CAENOZOIC AND MESOZOIC FORAMINIFERA AND OSTRACODA IN THE PHILLIPS (NORWAY) 7/11-IX NORTH SEA WELL

SHEET 3 OF 3

by
ROBERTSON RESEARCH COMPANY LIMITED,
Llanddulas, Abergele, Denbighshire.

SYSTEM	PERMIAN	JURASSIC-CRETACEOUS	CRETACEOUS			PALAEOCENE		?PALAEOCENE - EOCENE	EOCENE	SYSTEM
SUB-SYSTEM	UPPER PERMIAN		UPPER CRETACEOUS			LOWER PALAEOCENE	UPPER - MIDDLE PALAEOCENE	?L. EOCENE - ?U. PALAEOCENE	? UPPER-?MIDDLE EOCENE	SUB-SYSTEM
STAGE	ZECHSTEIN		? ALBIAN - CENOMANIAN - TURONIAN	SANTONIAN - CAMPANIAN	MAASTRICHTIAN	DANIAN				STAGE
ZONE										ZONE

OSTRACODA

Kritha cf. rutori

FORAMINIFERA

Glomospira charoides
Cyclammina placenta
Ammodiscus incertus
Haplophragmoidas latidorsatus
Rhabdammina sp.
Haplophragmoides carinatum
Harmosina sp.
Hyppocrepina sp.
Pelosina sp.
Haplophragmoides sp. 2
Pyrulina cylindroides
Cribrostomoides sp. 2
Bathysiphon eocenicus
Trochammina globigeriniformis var. altiformis
Globigerina barbosa
Globigerina cf. linaperta linaperta
Trochammina globigeriniformis
Globigerina triangularis
Haplophragmoides cf. obliquicameratus
Cyclammina challinori
Cyclammina incisa
Trochammina pentagona
Globigerina triloculinoides
Involutina pyrotecnica
Glomospirella woodi
?Rzehakina sp.
Spiroplectammina spectabilis
Pullenia quaternaria
Globigerina inaequispira
Globigerina spiralis
Globigerina pseudobulloides
Cibicides proprius
Allomorphina subtriangularis
Bulimina midwayensis
Gavelinopsis acuta
Osangularia lens
Globorotalia compressa
Globigerina aff. daubjergensis
Nodosaria cf. limbata
Allomorphina halli
Globorotalia quadrata
Globigerina daubjergensis
Guttulina honikeni
Dorothia bulletta
Karreria fallax
Globigerina cf. arabica
?Globotruncana contusa
Heterohelix sp.
?Stensioina sp.
?Globigerinelloides sp.
?Rugoglobigerina sp.
Heterohelix cf. punctulata
Rugoglobigerina rugosa cf. rugosa
Rugoglobigerina rugosa cf. rotundata
Pullenia cretacea
Globotruncana cf. marginata
Globotruncana cf. mariei
Globigerinelloides aspera
Heterohelix cf. globulosa
?Globorotalites michelinianna
Globotruncana area
Globotruncana cf. imbricata
Praeglobotruncana stephani
Praeglobotruncana cf. hagni
Globotruncana linneiana cf. tricarinata
Reussella cf. szajnochae
Globotruncana linneiana cf. bulloides
Globotruncana linneiana linneiana
Praeglobotruncana sp.
Biglobigerinelloides sp.

POSITION DES ECHANTILLONS

DINOFLAGELLES

	Cleistosphaeridium machaerophorum
8606	*Hystrichosphaeridium tubiferum*
	Hystrichosphaera ramosa
8394	*Nematosphaeropsis balcombiana*
	Dinoflagellé (F.492/1-2)
8397	*Hystrichosphaera gr. ramosa*
	Cystodiniopsis sp.
8387	*Baltisphaeridium sp.*
8410	*Hystrichosphaeridium sp.*
8385	*Cannosphaeropsis utinensis*
8466	*Hystrichosphaera ramosa*
	var. membranacea
	Dinoflagellé (F.492/18-19)
	Hystrichosphaera ramosa var.gracilis
	"Hystrichosphère" (F.492/23)
8443	*"Hystrichosphère"*
8417	*Hystrichosphaera sp.*
8413 a	*Hystrichosphaera sp.*
8738 c	*Baltisphaeridium sp.*
8441	*Hystrichosphère*
	cf. ? Dinopterygium
8164	*Hystrichosphaeridium stellatum*
8418	*Hystrichosphaera sp.*
8414	*Hystrichokolpoma sp.*
8449 b	*Dinoflagellé*
8449 a	*Dinoflagellé*
8745	*Gonyaulax ?*
5562	*Tuberculodinium vancampee*
8744 a	*Cordosphaeridium eximulurum*
	Cystodiniopsis sp.
	Dinoflagellé (F.492/18)
8390	*Hystrichosphaera sp.*
8425	*Hystrichokolpoma cf. rigaudae*
8606 b	*Hystrichokolpoma cf. unispinum*
8744 b	*Cordosphaeridium sp.*
	Thalassiphora sp.p.
8738 b+d	*Baltisphaeridium sp.*
8438	*Peridinium*
8392	*Hystrichokolpoma*
8415	*Chiropteridium lobospinosum*
8445 a+b	*? Wetzeliella sp.*
	Chiropteridium aspinetum
	Chiropteridium partispinatum
	Palaeocystodinium golzowense
8443	*Dinoflagellé*
8752	*Deflandrea phosphoritica*
8635	*Wetzeliella symmetrica*
8681 b	*Oligosphaeridium*
8440	*? Chiropteridium sp.*
8437	*Kalypsea cf. aceras*
8439	*Dinoflagellé*
8426	*Deflandrea leptodermadata*
8450	*Hystrichosphaera sp.*
8422	*Adnatosphaeridium sp.*
8424	*Dinoflagellé*
8446	*Dinoflagellé*
8754	*Wetzeliella cf. ovalis*
8427	*Cyclonephelium sp.*
8451	*Paleocystodinium sp.*
8452	*? Pterospermopsis*
8751	*Wetzeliella draco*
8430 a	*Hystrichosphaera crassipellis*
8453	*Hystrichosphaera sp.*
8746 b	*Wetzeliella articulata*
8746 a	*Wetzeliella cf. articulata*
8436	*Achomosphaera sp.*
8455	*Incertæ sedis*
8456	*Cyclonephelium sp.*
8755 b	*cf. Cordosphaeridium capricornum*
8401 a	*Gonyaulacysta sp.*
8457	*Hystrichosphaera sp.*
8681 c	*Polysphaeridium tiara*
8458 b	*Cordosphaeridium sp.*
8458 a	*Cordosphaeridium diktyoplokus*
8755 a	*Cordosphaeridium capricornum*
8459	*Adnatosphaeridium cf. multispinosum*
8448	*Eisenackia sp.*
8399 a	*Wetzeliella reticulata*
8647	*Hystrichosphaera cingulata*
8460	*Deflandrea*
8399 c+b	*Wetzeliella cf. reticulata*
8461	*Hystrichokolpoma eisenacki*
8462	*? Dinoflagellé*
8435	*? Dinoflagellé*
8738 a	*Areoligera*
	Svalbardella sp.
8456	*Cyclonephelium sp.*
8463	*Dinoflagellé*
8738 b	*Areoligera*
8454	*Hystrichosphaera sp.*
8747	*Membranilarnacia reticulata*
8464	*Paleoperidinium sp.*
8416	*Areoligera sp.*
8681 a	*Oligosphaeridium sp.*
8465 a	*Deflandrea sp.*
8738 d	*Areoligera cf. medusettiformis*
8468	*Wetzeliella cf. hyperacantha*
8469 a	*Deflandrea sp.*
8470	*Areoligera cf. senonensis*
8473	*Cannosphaeropsis sp.*
8432	*Diphyes cf. colligerum*
8465 b	*? Deflandrea sp.*
8472	*Deflandrea*
8473	*Gonyaulax*
8474	*Cannosphaeropsis reticulensis*
8465 b	*Peridinium sp.*
8469 b	*Deflandrea sp.*
8475	*"Hystrichosphère ?"*
8750 b	*Wetzeliella edwardsi*
8476	*Wetzeliella sp. (cf. glabra)*
8477	*Wetzeliella condylos*
8478	*Deflandrea sp.*
8396	*Samlandia sp.*
8403	*Deflandrea sp.*
8748	*Peridinium sp.*
8741	*Peridinium basium*
8800	*Cordosphaeridium sp.*
8655	*Hystrichosphaera ramosa*
8794	*Spongodinium deliticnse*
8801	*Gonyaulacysta sp.*
8799	*Hexagonifera sp.*
8795	*Incertæ sedis*
8740	*Deflandrea cf. diebeli (=8667)*
	Deflandrea cf. speciosa (11)
8796	*Deflandrea sp.*
8680	*Triblastula nuda*
	Incertæ sedis (15)
8798	*Triblastula utinensis*
8810	*Hystrichosphaeropsis borussica*
8669	*Hystrichosphaera*
8625 a	*Odontochitina striatoperforata*
8625	*Odontochitina (genre)*
8622	*Cyclonephelium sp.*
	Deflandrea sp.
8761	*Pseudoceratium ceratioides ?*

ZONATION DINOFLAGELLES

POSITION DES ECHANTILLONS

SPORES — POLLENS

	Disaccates
5821	*Sphagnumsporites*
5807	*Lycopodiumsporites*
	CoPo Laricoldites
	Monoletes lisses
	Gleicheniidites
5806	*cf. Osmundacidites*
5838	*Tetrades d'Ericales*
	Inaperturopollenites hiatus
5802+5836	*Tsuga*
5803	*Pr. Ulmus*
5818	*Cicatricosisporites*
	Chenopodiacées
	Triporé (Carpinus ?)
5829 b	*Tricolporé clavé*
	Cameroporites
5823	*Alnus*
5811 b-a	*Triporé, farya*
	Triporé, forylus
5831 a-b	*Tricolporé*
5822	*Triporé*
5805	*Tilia*
5815	*Inaperturé*
5841	*Quercus*
5850	*Tricolporé*
5826	*Tricolporé*
5827	*Tricolporé*
5842	*Multiporé Carpinus*
5849	*Trilète V. Rg*
	Triporé, Betula
5844	*Tricolporé*
5846	*Triporé*
5829 a	*Tricolporé clavé, Ilex*
5851	*Trilète Rg*
5842 a	*Monocolpé*
5804	*Triporé*
5848	*Tricolpé*
5845	*Tricolpé R*
5853	*Cicatricosisporites*
5816	*Tricolporé*
5852	*Cicatricosisporites*
5847 b	*Plicapollis*
5854	*Trilète*
	Kluckisporites
5855	*Pentacolpé*
5850	*Trilète*
5857	*Trilète*
5812 b	*Triporé*
	Cicatricosisporites
5810	*Triporé*

ZONATION SPORES-POLLENS

STRATIGRAPHIE

Mal caractérisé – présence de Odontochitina + ? Pseudoceratium ceratioides

Zone à Deflandrea 8796

Zone à Triblastula nuda 8680 + Tr. utinensis 8798

Zone à Spongodinium delitiense 8794 + Hystrichosphaeridium tiffanyi 8741

Zone à Peridinium 8748

Zone à Membranilarnacia reticulata 8747

Zone à Cordosph. capricornum 8755

Sous-zone à Hyst. eisenacki 8461

Zone à Chiropteridium + Deflandrea phosphoritica + Wetzeliella symmetrica

Zone à Gonyaulax 8745

Zone à Cleistosphaeridium machaerophorum

Sous-zone à ? Nematosphaeropsis balcombiana 8394

ZONATION DINOFLAGELLES

POSITION DES ECHANTILLONS

pas de microflore continentale

Zone à Plicapollis 5847 + Trilete 5854

Zone à Tsuga + Inaperturopollenites hiatus

? Zone à I. hiatus ? + Tricolporé 5831

Zone à Pinus

ZONATION SPORES-POLLENS

non caractérisé

MAESTRICHTIEN

DANIEN

PALEOCENE

PALEOCENE - EOCENE INFERIEUR

EOCENE

OLIGOCENE MOYEN - INFERIEUR

MIOCENE INFERIEUR A OLIGOCENE

MIOCENE

STRATIGRAPHIE

elf NORGE A/S

Secteur: ZONE NORVEGIENNE

Opérateur: elf - NORGE

Etude d'intérêt général sur matériel échantillons

SONDAGE COD - 7/11-1

REPARTITION ET ZONATION DINOFLAGELLES, SPORES ET POLLENS

elf ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES

DIRECTION EXPLORATION

LABORATOIRE

PL 2

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