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THE MICROPALAEONTOLOGY, PALYNOLOGY AND

STRATIGRAPHY OF THE MOBIL 33/12-2

NORWEGIAN NORTH SEA WELL

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I

SUMMARY

Triassic rocks are the oldest encountered in this well. They form a very thick sequence of continental and fluvio-lacustrine deposits which from palynological evidence are suggested to range from Ladinian to ?Rhaetian. Initially they are fine sandstones with minor red shales and these pass up firstly into a red and grey shale sequence and then into interbedded red shales and sandstones with sporadic grey shales. Towards the top of the Triassic, limestone bands and then coarse, white sands probably of fluvial or littoral origin are encountered. Deposits of this type extend up into the Lower Jurassic as far as the Sinemurian.

Overlying the Lower Jurassic sands are marine sediments comprising grey shales with subordinate sands and ironstones. The microfossils and palynomorphs recovered suggest they range from Upper Sinemurian to Toarcian in age. Middle Jurassic sands and interbedded shales of probable deltaic origin overlie the Lower Jurassic deposits and pass up into a very thin section of black, Kimmeridgian shales.

An unconformity cuts out the Lower Cretaceous and part of the Upper Cretaceous and rocks ranging in age from Santonian to Maastrichtian overlie the Kimmeridgian. They are fairly deep water marine deposits which are initially interbedded siltstones, fine sandstones and shales but in the middle of the Campanian they pass up into a dominantly shale sequence. In the

Maastrichtian some interbedded limestone and chalk also occur and a rich assemblage of planktonic foraminifera indicate strong open marine influences at this time.

The Danian appears to be missing thus the Palaeocene rests unconformably on the Maastrichtian. Volcanic activity is in evidence in the Palaeocene as indicated by the presence of tuffs and tuffaceous shales.

Outer sublittoral - bathyal water depths existed throughout the Palaeocene, Palaeocene - Lower Eocene, Eocene, ?Eocene and up to 3580' in the Oligocene. Open marine connections did occur as shown by the presence of radiolaria in the Palaeocene and Lower Eocene - Palaeocene and the occurrence of planktonic foraminifera towards the top of the Palaeocene.

In the upper part of the Oligocene the seas shallowed to outer sublittoral depths, this environment being maintained throughout the Lower and Middle Miocene. The occurrence of planktonic foraminifera in the Lower and Middle Miocene indicates that open marine conditions existed.

Further shallowing to outer sublittoral - inner sublittoral depths occurred in the Upper Miocene.

II

INTRODUCTION

This report summarises the results of the micropalaeontological, palynological and stratigraphical analyses which have been carried out on material received from the interval 1660' - 14280' from the Mobil 33/12-2 Norwegian North Sea Well under Project No. IIA/745/1138.

Under this project a total of 993 ditch cuttings and 14 core samples was analysed utilising standard micropalaeontological techniques. In addition 109 ditch cuttings, core and sidewall core samples covering the interval 8140' - 14280' were treated palynologically.

A summary of the determinations obtained by these analyses has already been communicated by telex and telephone and forms the framework of factual information on which this report is based. A summary of the sequence penetrated in this well can be seen in Table 1.

The terminology adopted for the environmental conclusions follows that of Hedgpeth (1957) from which Table 2 of this report is taken.

The prepared samples and recorded information are now filed and curated in the confidential records section of these laboratories.

We wish to acknowledge the continued co-operation and assistance received from the various members of Mobil Exploration Norway Inc., with whom we have been associated during the course of this work.

III

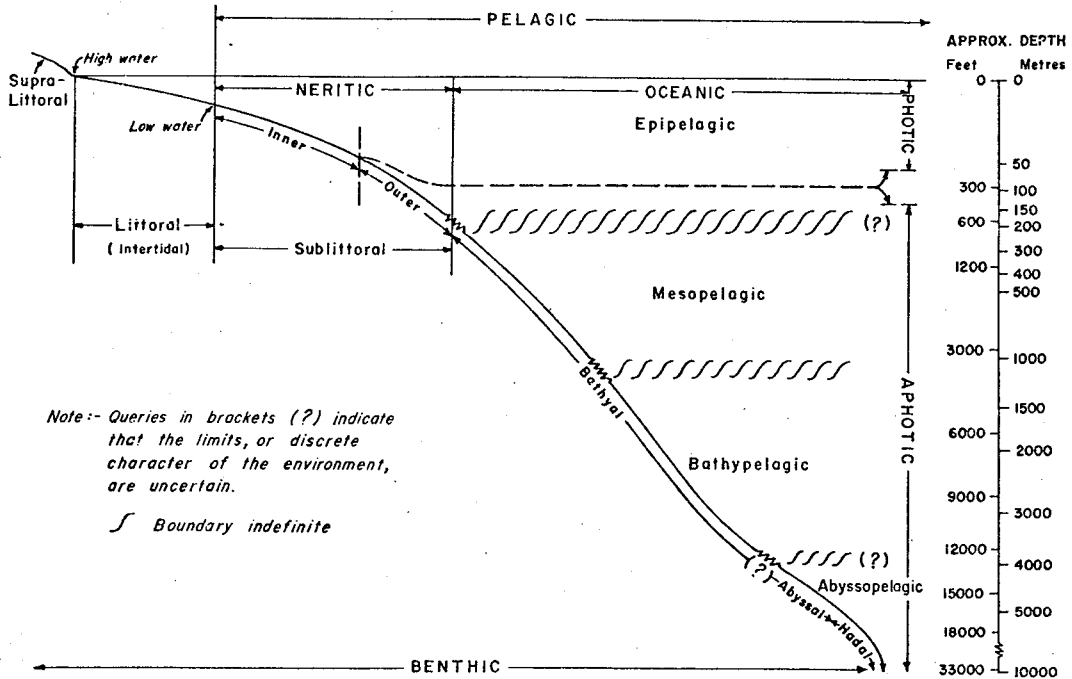
SUCCESSION

TABLE 1

<u>Interval</u>	<u>Thickness</u>	<u>Stage</u>	<u>System/Subsystem</u>
1660' - 1760'	+ 100'	-	Upper Miocene
1780' - 2480'	+ 700'	-	Middle Miocene
2500' - 2920'	+ 420'	-	Lower Miocene
2940' - 4120'	+ 1180'	-	Oligocene
4140' - 4380'	+ 240'	-	? Eocene
4400' - 4500'	+ 100'	-	Eocene
4520' - 5420'	+ 900'	-	Lower Eocene - Palaeocene
5440' - 6100'	+ 660'	-	Palaeocene
6120' - 6380'	+ 260'	Maastrichtian)
6400' - 6620'	+ 220'	Lower Maastrichtian)
6640' - 7940'	+ 1300'	Campanian) Upper Cretaceous
7960' - 8140'	+ 180'	Santonian)
8160'	-	Kimmeridgian)
8160' - 8200'	+ 40'	-	Middle Jurassic
8250' - 8330'	+ 80'	Toarcian)
8350' - 8630'	+ 280'	Domerian)
8650' - 8810'	+ 160'	Carixian - Upper Sinemurian) Lower Jurassic
8830' - 9100'	+ 270'	Sinemurian)
9120' - 9380'	+ 260'	? Hettangian)
9390' - 11810'	+ 2420'	? Rhaetian - ? Carnian	Upper Triassic
11820' - 14280'	+ 2460'	Carnian - ? Ladinian	Upper - ? Middle Triassic

TABLE 2

CLASSIFICATION OF MARINE ENVIRONMENTS



The classification of marine environments used in this report is presented in diagrammatic form above. Pelagic (water) and Benthic (bottom) environments are recognised.

PELAGIC

- Neritic
- Oceanic
 - Epipelagic
 - Mesopelagic
 - Bathypelagic
 - Abyssopelagic

BENTHIC

- Supralittoral
- Littoral (Intertidal)
- Sublittoral
 - Inner
 - Outer
- Bathyal
- Abyssal
- Hadal

The classification is after Hedgpeth (1957) and results from several years discussion by a Committee of the Division of Earth Sciences, National Research Council, National Academy of Sciences, Washington D. C.

IV

TERTIARY

INTERVAL 1660' - 1760'; Upper Miocene

General Lithology

Sandy, silty clay is predominant. Coarse to very coarse sand, rock fragments and shell fragments also occur but may be caved. The samples are contaminated with cement.

Micropalaeontology and Stratigraphy

The foraminiferal assemblage within this topmost interval, which contains Cibicides cf. pseudoungerianus, is indicative of an Upper Miocene age.

Environment

A general sublittoral environment of deposition is postulated for this interval on account of the combination of shallow water forms, e.g. Elphidium spp., Quinqueloculina seminulum and Rotalia beccarii together with deeper water forms, e.g. Cassidulina spp.

INTERVAL 1780' - 2480'; Middle Miocene

General Lithology

Light grey clay occurs throughout this interval along with very fine to fine, clear sand and silt. Caved rock and shell fragments are present in the samples.

Micropalaeontology and Stratigraphy

This interval contains a diversified but generally very poor microfauna.

The overall assemblage consists dominantly of calcareous benthonic foraminifera with a few agglutinating and planktonic foraminifera. The appearance of Pullenia sphaeroides at the top followed, in order of appearance, by Spiroplectammina deperdita, Epistomina elegans, Sigmoilina celata, Loxostomum sinuosum, Bolivina dilitata, Bolivina beyrichi and Uvigerina hosiusi indicate that these deposits are of Middle Miocene age.

Environment

An open marine, outer sublittoral environment of deposition is suggested for this interval on account of the diverse foraminiferal assemblage containing a number of planktonic species.

INTERVAL 2500' - 2920'; Lower Miocene

General Lithology

The lithology down to 2640' is like that present in the overlying interval but at around 2660' - 2680' there is an increase in sand. This is very fine to coarse with the coarser grains often being well rounded. Shell fragments also occur at 2660' while at 2680' (and also in the 80' below) the sand is iron-stained and associated with small ironstone nodules. Light grey-brown, slightly sandy clay is present in the lower part of the section.

Micropalaeontology and Stratigraphy

Lower Miocene deposits are seen to have been penetrated with the

appearance in the top sample of Orbulina universa followed lower in the interval by Globorotalia scitula and Globorotalia barisanensis.

The microfaunas fluctuate in abundance and are dominated by calcareous benthonic foraminifera with a few agglutinating foraminifera. Planktonic foraminifera occur more commonly.

Environment

A similar environment of deposition to that of the overlying interval is postulated on account of the diversity of calcareous benthonic foraminifera. Open marine connections are suggested by the abundant occurrence of planktonic species.

INTERVAL 2940' - 4120'; Oligocene

General Lithology

Clay and shale are the dominant lithotypes with subordinate sandy beds.

Sandy, slightly pyritic clay is present above 3040' but from 3060' to about 3340' there is an increase in sand (which is predominantly very fine to fine-grained) together with notable amounts of dark green glauconite. The clay and shale which occurs over this section is buff and brown, sandy and glauconitic. Sponge spicules are also noted at 3300'.

Light brown, soft, slightly silty shale and clay are dominant from 3380' to 3600' but at 3620' there is a marked increase in clear sand which includes coarse, rounded grains. The amount of sand falls off below 3720' and

light to dark brown shale and clay become the main lithotypes. Some iron-staining occurs at 3980' while just below there is some creamy white shale/clay. The bottom 100' of the interval contains medium to dark grey-brown shale and clay with very fine to fine white sand.

Micropalaeontology and Stratigraphy

The deposits in this interval are either barren or very poorly fossiliferous. Calcareous benthonic foraminifera are dominant down to 3500' whilst below 3560' deep water agglutinating foraminifera appear in small numbers.

An Oligocene age is attributed to this interval on account of the appearance of Globigerina prasaepis in the topmost sample. Further evidence for an Oligocene age is shown by the subsequent appearance of Virgulina schreibersiana, Globigerina ouachitaensis, Turrilina alsatica, Nonion sp. 1, Elphidium subnodosum and Sigmoilina schlumbergeri. A flood of sponge spicules occurs below 3200'.

Environment

An outer sublittoral environment of deposition is suggested for this interval down to 3560' whilst below this depth the appearance of deep water agglutinating foraminifera including Bathysiphon sp., Cyclammina placenta and Glomospira charoides indicates that outer sublittoral - bathyal depths occurred during deposition of the basal section.

INTERVAL 4140' - 4380'; ?Eocene

General Lithology

Grey-brown clay is present in the upper part of this interval but at around 4200' to 4260' there is also some very finely granular siderite, dolomite, light creamy brown limestone and grey-green shale. Clay and soft shale with a little fine sand make up the bottom 100'.

Micropalaeontology and Stratigraphy

This short, mostly poorly fossiliferous interval, which is exclusively composed of agglutinating foraminifera, is assigned a questionable Eocene age on account of the appearance of Cyclammina cf. challinori.

Environment

The same environment (outer sublittoral to bathyal) to that of the lower part of the Oligocene is postulated for this interval on account of the similarity of the microfaunas.

INTERVAL 4400' - 4500'; Eocene

General Lithology

Soft shale and clay are again dominant, but in this interval they contain soft pellets of chamosite and subordinate siderite. There is, in addition, a small amount of iron-stained, light grey limestone.

Micropalaeontology and Stratigraphy

A definite Eocene age is assigned to this interval with the appearance at the top of Cyclammina challinori.

Environment

The presence of an exclusively deep water agglutinating foraminiferal assemblage suggests an outer sublittoral - bathyal environment of deposition for this interval.

INTERVAL 4520' - 5420'; Lower Eocene - Palaeocene

General Lithology

Clay and soft shale remain dominant throughout this interval. They are usually greyish brown or greyish green in colour, occasionally bright green while between 4880' and about 5000' are often yellowish green. In the uppermost 200' these are associated with pyrite and siderite of which the latter may be in the form of sphaerosiderite.

Micropalaeontology and Stratigraphy

This richly fossiliferous interval, which is again dominated by agglutinating foraminifera, is assigned a Lower Eocene - Palaeocene age on account of the appearance at the top of large flattened radiolaria. The subsequent occurrence of Cyclammina sp. 1, Spiroplectammina spectabilis and Verneuilina subeocaena substantiates this age. Eocene forms, which appear for the first time in this interval, include Cibicides proprius, Globigerina linaperta, Anomalina grosserugosa and Angulogerina abbreviata. Radiolaria occur in flood abundance at 5140'.

Environment

On account of the presence of a deep water agglutinating foraminiferal

assemblage and abundant radiolaria an open marine, outer sublittoral environment is postulated for this interval. Slight shallowing may possibly have occurred near the base as indicated by the appearance of a number of calcareous benthonic foraminifera.

INTERVAL 5440' - 6100'; Palaeocene

General Lithology

Initially soft shale is the main lithotype. This is green, blue-grey, dark brown or rarely red-brown. It tends to become increasingly mottled down the section and grades into tuffaceous shales and tuffs until between about 5600' and 5760' tuffaceous and volcanic rocks become relatively common. Besides tuffaceous shales, there are speckled black and white, highly calcareous tuffs and fine agglomerates and a few fragments of possible altered basalt. Hard, dark grey-brown limestone and pyrite are associated with the tuffaceous deposits.

In the bottom section below about 5860' the sediments become arenaceous with the occurrence of fine to coarse, angular to subrounded sand.

Micropalaeontology and Stratigraphy

This interval may be subdivided into 3 units using the microfaunas present.

The upper unit, from the top down to 5640', contains a very poor foraminiferal assemblage but includes the Palaeocene marker fossils,

Globigerina triloculinoides, Coscinodiscus sp. 1 and Coscinodiscus sp. 2.

The middle unit, 5660' - 5980', is composed of a rich, agglutinating foraminiferal assemblage which includes Cyclammina sp. A and Trochammina sp. A, with green-staining being noted at the top of this unit.

The lower unit, 6000' to the base, contains an agglutinating foraminiferal assemblage with a solitary reworked Upper Cretaceous foraminifera.

Tuffs and tuffaceous shales occur within this interval and are further evidence for a Palaeocene age.

The Danian is assumed to be missing since neither chalk nor Danian planktonic foraminifera are found.

Environment

On account of the predominance of deep water agglutinating foraminifera an outer sublittoral - bathyal environment is suggested for this interval. Good oceanic connections are postulated for the upper unit where radiolaria, and planktonic foraminifera occur. The proximity of this area to volcanic activity is indicated by the occurrence of tuffs and tuffaceous shales.

CRETACEOUSINTERVAL 6120' - 6380'; Maastrichtian, Upper CretaceousGeneral Lithology

Soft, light grey shale is present throughout most of this interval. In the top sample small amounts of milky coloured calcite also occur while just below this there are traces of light grey limestone some of which contain abundant microfossils. In the bottom 100' white to light grey chalk is also present in small amounts and pyrite becomes relatively common. Throughout the interval there is considerable caving.

Micropalaeontology and Stratigraphy

The top of the Cretaceous is marked by a significant influx of planktonic foraminifera which includes such diagnostic species as Pseudotextularia elegans elegans, P. elegans fructicosa and Globotruncana contusa. These taxa indicate that sediments of Late Maastrichtian age are present. The Maastrichtian determination is supported by the appearance of Bolivina incrassata gigantea and Rugoglobigerina spp. at 6160' as well as the subsequent occurrence of Globotruncana arca, G. stuarti, Osangularia lens, Abathomphalus mayaroensis and Reussella szajnochae elongata.

Environment

The high percentage of planktonic foraminifera in the good to moderate

microfaunas recovered from these deposits indicates that deposition occurred in an outer sublittoral to bathyal environment with strong open marine influence.

INTERVAL 6400' - 6620'; Lower Maastrichtian, Upper Cretaceous

General Lithology

Soft, light grey shale occurs almost exclusively here. The only exception is a little light grey, calcareous siltstone at 6440'.

Micropalaeontology and Stratigraphy

The general microfauna of this interval is similar to that of the Maastrichtian. There is, however, an increase in the numbers and size of the specimens of Rugoglobigerina spp. which suggest a Lower Maastrichtian age.

The assemblages recovered from this unit are initially good to moderate in numbers but there is a general reduction towards the base although an increase in the percentage of agglutinating forms. At 6580' there is an influx of small planktonic species such as Globigerinelloides asper and Heterohelix spp.

Environment

An outer sublittoral to bathyal environment is again indicated by the high percentage of planktonic foraminifera present. The increase in agglutinating foraminifera towards the base suggests that conditions were slightly more restricted in the earlier part of the unit.

INTERVAL 6640' - 7940'; Campanian, Upper Cretaceous

General Lithology

From the top of this interval to 7380' the rocks present are mainly soft, light grey and greenish grey shales. At 7000', however, there are traces of red-brown shales accompanied by some buff to brown, finely crystalline, granular or silty, dolomite and siderite which also occurs sporadically below this depth. It probably occurs as nodules or thin beds within the dominantly shale sequence.

From 7400' to the base of the interval the deposits are notably arenaceous. Light grey, friable siltstones which are sometimes calcareous and slightly glauconitic are relatively abundant but fine, clear sand also occurs. Light grey shales continue through this section and probably form an interbedded sequence with the siltstones. It must be noted, however, that many of the samples in this lower section are poor making it difficult to draw positive conclusions from the lithology.

Micropalaeontology and Stratigraphy

Poor to very poor microfaunas consisting essentially of long-ranging agglutinating foraminifera or caved Tertiary species characterise this interval. Very few diagnostic forms occur in these deposits and it is only on the occurrence of a solitary specimen of Globotruncana sp. 1 that a Campanian age has been assigned to it. It has not been possible, as in other wells, to subdivide this unit although the appearance of brown-stained agglutinating forms at 6920' or of minor amounts of red shale at 7000' may mark the Upper - Lower Campanian boundary.

Environment

The predominance of deep water agglutinating foraminifera indicates that restricted outer sublittoral to bathyal conditions prevailed throughout this section.

INTERVAL 7960' - 8140'; Santonian, Upper Cretaceous

General Lithology

Grey shale and siltstone, like that occurring in the interval above, is present here but, in this interval other lithotypes are developed. Most notable is the presence of fine to coarse, clear sand which occurs at 8020' and below. Small amounts of yellowish brown and green shale are also present at, and below, 8060'. At 8100' there is a thin bed of light grey, moderately hard, micritic limestone while at the base of the interval, at 8140', there is an occurrence of a similar but lighter coloured limestone.

Micropalaeontology and Stratigraphy

The assemblages recovered from this interval are essentially similar to those of the Campanian. The incoming of presumed in situ radiolaria, which become green-stained at 8060', and of Globotruncana marginata and G. linneiana tricarinata suggests that Santonian sediments are present. No evidence to suggest the presence of older Upper Cretaceous or Lower Cretaceous sediments has been found and the Santonian therefore rests unconformably on rocks of Kimmeridgian age.

Environment

The similarity of the microfauna to that of the Campanian indicates a similar outer sublittoral to bathyal environment. The presence of radiolaria and planktonic foraminifera suggests some oceanic influence.

VI

JURASSIC

INTERVAL 8160'; Kimmeridgian, Upper Jurassic

General Lithology

In the one sample representing this interval, the in situ lithology is considered to be very dark brown shale with lignite and bone fragments.

Micropalaeontology, Palynology and Stratigraphy

No in situ Upper Jurassic foraminifera have been recovered from this unit. The occurrence as presumed caved forms of Haplophragmoides cf. canui and H. aff. infracalloviensis does suggest the presence of Upper Jurassic sediments and this is supported by the black shale lithology.

A single specimen of Sirmiodinium grossi was recorded from this interval. If in situ, this species suggests that sediments no older than late Kimmeridgian in age have been encountered.

Environment

An inner sublittoral environment is suggested for this interval.

INTERVAL 8160' - 8200'; Middle Jurassic

General Lithology

This interval is characterised by a relative abundance of sand with soft shale. The sand is poorly sorted, fine to coarse, colourless, subangular to subrounded and at 8200' is associated with pyrite.

Micropalaeontology, Palynology and Stratigraphy

No in situ microfossils have been recorded from these deposits.

The palynofloras recorded from this interval include Pareodinia ceratophora, Chytroeisphaeridia spp., Lycopodiumsporites semimurus and common Cerebropollenites mesozoicus. This association is consistent with an undifferentiated Middle Jurassic age determination.

Environment

From the lithology and regional considerations a probable deltaic environment is suggested for this interval.

INTERVAL 8250' - 8330'; Toarcian, Lower Jurassic

General Lithology

Soft, medium to light grey shale with subordinate very fine sand and silt occurs in the section above 8300'. At 8310' there is a marked increase in sand ranging from very fine to very coarse with some granules of which the latter are sometimes rounded. This is associated with abundant ironstone in the form of siderite and chamosite oolites. There is a fall off of sand and ironstone at 8330' and a consequent increase in soft grey shale.

Micropalaeontology, Palynology and Stratigraphy

The occurrence of Toarcian sediments is indicated by the influx of small agglutinating foraminifera at 8250' which include such species as Verneuilinoides mauritii and Trochammina cf. gryci. The assemblages are moderate in numbers at the top of the interval but at the base, below 8310' they become impoverished.

Nannoceratopsis gracilis occurs in abundance in this interval, where its association with Concentrisporites pseudosulcatus is consistent with a Toarcian age determination. The occurrence of Callialasporites dampieri at 8270' is indicative of an age not older than late Toarcian at that depth.

Environment

The presence of a microfauna dominated by small agglutinating foraminifera suggests that deposition occurred in an inner sublittoral environment. The occurrence of ironstone also suggests that a fairly shallow marine environment prevailed.

INTERVAL 8350' - 8630'; ^{Pliensbb.} Domerian, Lower Jurassic

General Lithology

Soft, medium to dark grey shale with minor sand and silt occurs at the top of this interval but soon passes down into a more sandy section in which very fine to fine, loose sand and silt occurs with moderately hard, light grey, calcareous sandstone and some pyrite. Soft, grey shale becomes dominant at 8440' and remains so to the base of the interval although fine sand and silt is still present. In addition, the bottom 80' is notably pyritic.

Micropalaeontology, Palynology and Stratigraphy

The record of the microplankton Mancodinium semitabulatum at 8350' is considered to mark the top of the Domerian. The associated palynoflora, which includes Corrugatisporites anagrammensis, Cerebropollenites thiergartii, Chasmatosporites apertus and C. hians is consistent with this determination.

The microfaunas recovered from this unit are poor to very poor. Initially only agglutinating forms occur but from 8390' rare calcareous benthonic foraminifera and ostracodes appear. The appearance of such ostracodes as Hungarella cf. amalthei, H. etaulensis and H. contractula supports the Domerian (Upper Pliensbachian) age assigned on the basis of the microflora.

Environment

The poor to very poor microfaunas are again dominated by agglutinating foraminifera and in conjunction with the lithology would suggest an inner sublittoral environment. The occurrence of some calcareous benthonic forms suggests that more open marine conditions than in the Toarcian prevailed.

INTERVAL 8650' - 8810'; Carixian - Upper Sinemurian, Lower Jurassic

General Lithology

From the ditch cuttings at 8650', the top of this interval includes a sand body composed of fine to very coarse, poorly sorted, predominantly subrounded sand. Chamosite and calcareous oolites also occur. In the core, which is just below this (from 8653' to 8694') moderately hard, dark grey, micaceous shale passes into a thin oolitic limestone and then back into micaceous shale. In the section below the core dark grey shale remains dominant but subordinate fine sand, silt and dolomite also occur.

Micropalaeontology, Palynology and Stratigraphy

At 8650' and in the succeeding core samples calcareous benthonic

foraminifera and ostracodes occur more commonly. The presence of common specimens of Lenticulina varians and the appearance of Dentalina matutina, Planularia ornata and Nodosaria cf. hortensis in association with the ostracodes Krausella lanceolata and Healdia mouhersensis indicates that sediments of Carixian (Lower Pliensbachian) - Upper Sinemurian age have been penetrated. The occurrence of abundant grey, calcareous ooliths in the samples gives support to this determination. The appearance of ?Otocythere cf. lepidus, however, may suggest that Sinemurian rocks occur since this form has only previously been recorded from the Sinemurian.

Palynomorph assemblages of Carixian - Sinemurian age are recorded from the core interval 8653' - 8694'. The age of the strata is determined largely by the absence of key Rhaetian - Hettangian and Domerian (Upper Pliensbachian) index species. The ditch cuttings samples examined from directly beneath the core interval have produced somewhat diluted palynomorph assemblage of Carixian - Sinemurian age intermixed with abundances of caved Tertiary dinoflagellates.

In addition to the stratigraphically long-ranging miospores of Jurassic aspect, acanthomorph, netromorph, herkomorph, and polygonomorph acritarchs are recorded from the core interval in association with rare Dinophyceae (Dinoflagellata), Chlorophyceae and Botryococcus type algae. Some reworking of Permo-Triassic palynosediments is inferred from the presence of specimens assignable to the species Weylandites sp. and Protosacculina macrosacca.

The occurrence of the dinoflagellates Horolonginella sp. (cf. Plankton 1 SCHULZ & MAI in Döring et al. 1966) and Polysphaeridium ?langi and the miospore Taeniaesporites cf. rhaeticus at and below 8678.5' may suggest a Sinemurian age for the lower part of the core interval.

Environment

The influx of calcareous benthonic forms and ostracodes in this interval suggests that conditions were somewhat deeper than in the overlying Lower Jurassic section and so general sublittoral conditions of deposition are indicated.

INTERVAL 8830' - 9100'; Sinemurian, Lower Jurassic

Stf. 8856'

General Lithology

This interval is characterised by an abundance of coarse sand. Soft shale with minor sand appears to be present at the top of the interval but from 8870' to 9040' sand is dominant. This ranges in size from very fine sand to granules although sand of coarse-grained size and above is most common. It is white and angular and sometimes kaolinitic. Light to medium brown and grey-green shales are common in some of the samples suggesting that there is some interbedding of shales. It is likely, however, that many of them are caved. Shales do appear to increase substantially between 9050' and 9080', however, where some ironstaining and the occurrence of sphaerosiderite is noted.

Micropalaeontology, Palynology and Stratigraphy

Only presumed caved microfossils occur in this unit and the incoming of coarse sands is taken as the top of the interval.

Diluted palynomorph assemblages of Carixian - Sinemurian age are recorded over this interval. The base of the Sinemurian stage is provisionally placed below the final appearance of Cerebropollenites mesozoicus in abundance in the samples. (Somewhat poorly preserved single specimens questionably assigned to C. mesozoicus are recorded at the lower horizons 9120' and 9250'-9360').

Environment

Generally the lithology suggests a very shallow water, marginal marine or fluviatile type of environment.

2779.7
INTERVAL 9120' - 9380'; ?Hettangian, Lower Jurassic

General Lithology

Sand like that occurring in the interval above is present here with the addition of some light grey, fine sandstone and siltstone in the uppermost part and also some red sand grains and pink feldspars. Interbedded shales and sandy shales are also present. These are grey, light green and rarely red.

Micropalaeontology, Palynology and Stratigraphy

The ditch cuttings samples examined beneath the core interval to a depth of 9590' are heavily contaminated with Tertiary dinoflagellate cyst taxa.

The base of the Hettangian is defined on lithological rather than palynological criteria. In situ palynomorphs are poorly represented over this interval. The extent of the Hettangian is tentatively determined by the absence of specimens clearly assignable to the miospore species Cerebropollenites mesozoicus.

No in situ microfossils have been recorded from these sediments.

Environment

Deposition of the Hettangian in a non-marine environment is suggested by the absence of in situ microplankton. Supra-littoral, near-shore, fluviolacustrine conditions may have prevailed and influenced the deposition of these sediments.

VII

TRIASSIC

2862

INTERVAL 9390' - 11810'; ?Rhaetian - ?Carnian, Upper Triassic

General Lithology

This interval consists mainly of soft red shales with interbeds of fine sandstones and siltstones and subordinate coarse sand and limestone.

Initially the lithology is similar to that occurring in the ?Hettangian with poorly sorted, white, occasionally kaolinitic sands being interbedded with variable green, red and brown shales all of which are often silty and sandy. The difference between this section and the ?Hettangian section is that more red shales are present and these tend to increase downwards as the sands decrease.

Just below the casing point from 9600' to about 9800' there is an interbedded sequence of shales, sands and limestones. At 9630' the limestone is white and chalky or occasionally pink, at 9670' it is harder, grey-brown and crystalline, while at around 9710' - 9730' it is yellow-brown. All are interbedded with red, grey, light green, yellow sometimes silty, micaceous and sandy shales and very fine sands.

From 9800' to about 10360' soft, red shales become dominant but there are interbeds of other shales, particularly light green shales and also very fine to fine, white and orange sand and silt.

At 10380' and just below, some sand occurs in a soft, white, calcareous clay matrix. Light grey shale and white limestone also occur in trace amounts.

Red shale and interbedded sands remain dominant. If the sidewall cores are typical then the sands in the ditch cuttings are derived from light grey very friable, very silty sandstones.

³⁴
At 11240' and just below, medium to dark grey shale is fairly common while between about 11360' and 11540' soft, white calcareous clay is often present and is possibly derived from the matrix of sandstones. Some of the sandstones over this section are often coarser grained, poorly sorted and feldspathic.

The bottom 250' consists of red, silty shales, siltstones and light green shales with very fine, white and orange sand.

Palynology and Stratigraphy

Palyniferous samples are not recorded over this interval. The samples examined are either barren or contain caved Tertiary dinoflagellates or winnowed black wood fragments (inertinite). The marked absence of any in situ Hettangian - Rhaetian index species over the interval 9120' - 11810' is somewhat striking. A caved Hettangian - late Rhaetian microflora containing the index species Cingulizonates rhaeticus and Kraeuselisporites reissingeri is recorded from black shale lithologies examined over the underlying interval ³⁷⁸⁵ 12420' - 12710'.

Environment

The existence of caved Hettangian - late Rhaetian black shales does suggest that more fluviatile, possibly restricted marine conditions may have prevailed within or above a sequence of early Jurassic - late Triassic strata of predominantly continental aspect.

3602
INTERVAL 11820' - 14280'; Carnian - ?Ladinian, Upper - ?Middle Triassic

General Lithology

A number of lithological sections can be distinguished in this interval. The uppermost, from 11880' to 12240', consists mainly of fairly soft, red shale and silty shale with subordinate light green shale, fine sand and siltstone. White, calcareous shale also occurs and may be a cementing material to the sand.

Between 12250' and about 12500', although red shales still appear to be dominant medium to dark grey shales also become common. In addition, white and light grey, very fine sandstones, calcareous siltstones and grey limestones are also locally abundant with minor intercalations of yellow shale.

Grey shales tend to be more common in the section from 12500' to 12800' but are lighter coloured than in the section above. Traces of carbonaceous, grey siltstone were noted and between 12700' and 12750' there are small amounts of pink and white, finely crystalline limestone.

Between 12800' and about 13060' red shales are again dominant but interbedding of grey shales, fine sandstones and siltstones still occurs.

From 13060' to 13500' there is an increase in arenaceous deposits. Red-brown, white and light to medium grey, very fine silty sandstones and siltstones become common. These are frequently calcareous and are associated with some grey limestone.

Between 13500' and 14000' light red and orange, very fine sand and silt

become very abundant. Interbeds of red shale and silty shale are still common however.

In the section below 14000' the sand and silt continues to be dominant but is often more strongly cemented with a calcareous cement. The red shale which is also present tends to be calcareous too and often has white, anhydrite streaks.

Palynology and Stratigraphy

In situ microplankton are noticeably absent from samples of this interval. The miospore assemblages recorded suggests a Carnian - ?Ladinian age for the strata. A gradual transition from a dominantly Carnian to a Ladinian microflora is recognised.

The interval ³⁶⁰³ 11820' - ⁴¹⁴⁸ 13610' is characterised mainly by a Carnian microflora represented by the appearance and association of Ovalipollis ovalis, O. grebeae, O. notabilis, ?Vallasporites ignacii, Paracirculina scurrilis, "Lueckisporites" cf. junior, Patinasporites cf. densus and Enzonasporites obliquus.

⁴¹⁴⁸
Below 13610' the Carnian microflora is recorded in association with a more typically Ladinian microflora represented by the appearance and association of Protodiploxypinus sittleri, Triadispora crassa, ?Praecirculina granifer, Schizosaccus keuperi, Foveolatitriletes potonie and Nevesisporites limatulus.

Environment

The presence of terrestrial and the absence of marine palynosediments within this interval suggests that supra-littoral, fluvio-lacustrine environments

existed for at least part of the time, probably mainly during the deposition of grey shales in the middle of the interval. The predominance of red shales and sands, however, suggests that continental conditions prevailed for most of the interval.

VIII

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- | | | |
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APPENDIX

Sidewall core and Core descriptions

<u>Depth</u>	<u>Sidewall Core No.</u>	<u>Description</u>
10903'	51	<u>SANDSTONE</u> . Very friable, light grey, very fine-grained, silty and micaceous. Moderate porosity.
11054'	50	<u>SILTY SANDSTONE</u> . As SWC 51 but siltier.
11069'	49	<u>SHALE</u> . Soft, dark brownish red, fairly silty and micaceous.
11079'	48	<u>SILTY SANDSTONE</u> . Friable, light greyish green, very fine-grained and very silty, moderately micaceous. Moderate porosity.
11099'	46	<u>SILTY SANDSTONE</u> . As SWC 48.
11166'	45	<u>CALCAREOUS, SANDY SILTSTONE</u> . Friable, cream, composed of silt with very fine sand, soft, white, calcareous matrix, slightly micaceous, moderate to poor porosity.
11190'	44	<u>SILTY, ARGILLACEOUS, CALCAREOUS SANDSTONE</u> . Soft and friable, brownish red, composed of silt to very fine sand with mica in a calcareous, argillaceous matrix. Poor porosity.
11196'	30	<u>CALCAREOUS SHALE</u> . Moderately soft, medium brownish red, moderately calcareous, slightly silty and micaceous.
11276'	43	<u>SANDSTONE</u> . Friable, light brownish grey, very fine-grained and silty. Moderate porosity.
11280'	42	<u>SILTY SANDSTONE</u> . Friable, light grey, very fine-grained and very silty, micaceous. Moderate porosity.
11282'	29	<u>SANDSTONE</u> . Friable, medium brown-grey, very fine-grained, slightly micaceous. Good porosity.

<u>Depth</u>	<u>Sidewall Core No.</u>	<u>Description</u>
11451'	13	<u>SHALE</u> . Moderately soft, dark red with yellow mottling, slightly silty and sandy.
11690'	34	<u>SILTSTONE</u> . Moderately friable, light grey, moderate porosity.
11848'	33	<u>CALCAREOUS SILTSTONE</u> . Moderately friable, light grey to white, moderately calcareous, poor to moderate porosity.
11890'	32	<u>ARGILLACEOUS SILTSTONE</u> . Moderately friable, dark brown-red, slightly micaceous, very argillaceous, slightly calcareous. Poor porosity.
11985'	31	<u>SHALE</u> . Moderately soft, brownish red, slightly calcareous, slightly micaceous.
12343'	22	<u>CALCAREOUS SHALE AND SILTSTONE</u> . Soft and friable, light grey, micaceous, moderately calcareous shale and siltstone.
12378'	21	<u>SILTY LIMESTONE/CALCAREOUS SILTSTONE</u> . Moderately hard, light to medium grey, composed of silt with abundant calcareous cement.
12489'	20	<u>ARGILLACEOUS SILTSTONE</u> . Very soft and friable, dark red-brown, composed of silt with very fine sand, mica and abundant argillaceous material.
13292'	8	<u>SILTY SANDSTONE</u> . Very friable, dark red-brown, moderately sorted, very fine-grained, moderately silty and slightly argillaceous. Moderate porosity.
13300'	6	<u>SILTY SANDSTONE</u> . As SWC 8 but lighter in colour.
13304'	5	<u>SILTY SANDSTONE</u> . As SWC 6 but siltier.
13308'	4	<u>SILTY SANDSTONE</u> . As SWC 8.
13382'	3	<u>SANDSTONE</u> . Very friable, brownish red, very fine to fine-grained, slightly silty, moderate porosity.

<u>Depth</u>	<u>Sidewall Core No.</u>	<u>Description</u>
11286'	41	<u>CALCAREOUS SANDY SILTSTONE</u> . Very friable, light grey, composed of silt and very fine sand with abundant parallel orientated mica in soft, calcareous matrix. Moderate porosity.
11290'	28	<u>SHALE</u> . Moderately soft, brown-red, slightly silty and micaceous.
11294'	40	<u>SILTY SANDSTONE</u> . Friable, medium reddish grey, very fine-grained, silty and fairly micaceous. Poor to moderate porosity.
11416'	39	<u>CALCAREOUS SHALE</u> . Moderately soft, dark red, slightly calcareous, slightly silty and micaceous.
11425'	38	<u>SANDSTONE</u> . Friable, creamy buff, composed of very fine to medium, angular to subrounded, mainly colourless but also green and orange quartz and feldspar with silt and mica. Poor to moderate porosity.
11432'	14	<u>SANDSTONE</u> . Moderately friable, speckled cream, green and orange, poorly sorted, very fine to coarse, angular to subrounded, colourless, green and orange quartz and feldspar with some silt. Moderate porosity.
11434'	37	<u>SANDSTONE</u> . As SWC 38 but light greenish in colour.
11443'	36	<u>SANDSTONE</u> . As SWC 14 but with some very coarse sand and granules.
11447'	12	<u>SANDSTONE</u> . Friable, green, quite poorly sorted, very fine to medium sand and silt, moderate porosity.
11447'	26	<u>SANDSTONE</u> . Friable, light greenish cream, composed of poorly sorted, very fine to very coarse, quartz and feldspar with abundant silt. Moderate porosity.
11451'	25	<u>SANDSTONE</u> . As SWC 26.

Core Depth

Description

8653' - 8659'

Moderately hard, dark grey, fairly micaceous shale becoming waxy towards the bottom.

8659' - 8660'

Shale as above but with scattered poorly sorted, angular sand, pyrite, shells and shell fragments.

8660 - 8662 $\frac{1}{2}$ '

Laminated dark grey to black, waxy shale and medium to dark grey, oolitic limestone grading into hard, massive, fairly coarsely crystalline, oolitic limestone.

8662 $\frac{1}{2}$ ' - 8690'

Hard, dark grey, micaceous shale with some shell fragments.

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BIOSTRATIGRAPHICAL ANALYSIS CHART

DATE 25. 9. 74. CHART No. 14 LOCATION Norwegian North Sea 33 '12 2 Well
 FOR Mobil Exploration Norway Inc. ANALYST CGL. SJM.

- | | | | |
|--|---|---|----------------------|
| <input type="checkbox"/> LIMESTONE | <input type="checkbox"/> SANDSTONE | <input type="checkbox"/> COAL / LIGNITE | |
| <input type="checkbox"/> DOLOMITE | <input type="checkbox"/> COARSE SAND | <input type="checkbox"/> Silty/Sandy red shale | DIAGNOSTIC SPECIES * |
| <input type="checkbox"/> WHITE CHALK | <input type="checkbox"/> CONGLOMERATE | <input type="checkbox"/> Calcareous sandstone/
Sandy limestone | |
| <input type="checkbox"/> MARL | <input type="checkbox"/> GYPSUM/ANHYDRITE | <input type="checkbox"/> | |
| <input type="checkbox"/> CLAY | <input type="checkbox"/> SALT | <input type="checkbox"/> | |
| <input type="checkbox"/> SHALE | <input type="checkbox"/> CHERT | <input type="checkbox"/> | |
| <input type="checkbox"/> SILTY/SANDY SHALE | <input type="checkbox"/> PYRITE | <input type="checkbox"/> | |
| <input type="checkbox"/> SILTSTONE | <input type="checkbox"/> GLAUCONITE | <input type="checkbox"/> | |

- | ENVIRONMENT | | | |
|---|----------|-------------------|------------------------------|
| CONTINENTAL
BRACKISH / DELTAIC /
LAGOONAL | LITTORAL | INNER SUBLITTORAL | OUTER SUBLITTORAL
BATHYAL |

- | | |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | AGGLUTINATING
FORAMINIFERA |
| <input type="checkbox"/> | CALCAREOUS
BENTHONIC
FORAMINIFERA |
| <input type="checkbox"/> | PLANKTONIC
FORAMINIFERA |

INTERPRETED LITHOLOGY	DEPTH IN FEET	SYSTEM	STAGE
Shale	0 - 100	MIDDLE - UPPER TRIASSIC	? LADINIAN - CARNIAN
Shale	100 - 200		
Shale	200 - 300		
Shale	300 - 400		
Shale	400 - 500		
Shale	500 - 600		
Shale	600 - 700		
Shale	700 - 800		
Shale	800 - 900		
Shale	900 - 1000		

MICROFOSSILS	%	
	AGGLUTINATING FORAMINIFERA	PLANKTONIC FORAMINIFERA
Ovalipollis ovalis	X	
Ovalipollis grebeae	X	
Ovalipollis notabilis	X	
Labiipollis mesozoicus	X	
Granuloperulipollis rudis	X	
Corollina meyeriana	X	
Sulcatiporites kraeuseli	X	
Enzonasporites tenuis	X	
? Carnisporites telephorus	X	
Duplicisporites cf. maneus	X	
Pracireulina granifer	X	
? Granuloperulipollis rudis	X	
Carnisporites cf. hercynicus	X	
Paracireulina securilis	X	
? Ellipsosvelatiporites sp.	X	
Protodiploxyphus sp.	X	
Lycopodioidites sp.	X	
Valliasporites cf. ignacii	X	
Tridispora crassa	X	
Paracireulina cf. maljackinae	X	
Enzonasporites obliquus	X	
Foveolatriletes pottoni	X	
Nevesisporites limatus	X	
Schizosaccus keuperi	X	
Vitrisporites pallidus	X	

Miospores

ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART

DATE: 25. 9. 74. CHART No. 13 LOCATION: Norwegian North Sea 33 12 2 Well
 FOR: Mobil Exploration Norway Inc. ANALYST: CGL. SJM.

LITHOLOGY

LIMESTONE SANDSTONE COAL/LIGNITE
 DOLOMITE COARSE SAND Silty/Sandy red shale
 WHITE CHALK CONGLOMERATE Calcareous sandstone
 RED MARL OR SHALE GYPSUM/ANHYDRITE Sandy limestone
 CLAY SALT
 SHALE CHERT
 SILTY/SANDY SHALE PYRITE
 SILTSTONE GLAUCONITE

DIAGNOSTIC SPECIES

AGGLUTINATING FORAMINIFERA
 CALCAREOUS BENTHONIC FORAMINIFERA
 PLANKTONIC FORAMINIFERA

INTERPRETED LITHOLOGY	DEPTH IN FEET	SYSTEM	STAGE	ENVIRONMENT				% FORAMINIFERAL ASSEMBLAGES	
				CONTINENTAL	BRACKISH / DELTAIC / LAGOONAL	LITTORAL	BATHYAL		
Shale	0 - 100	MIDDLE - UPPER TRIASSIC	? LADINIEN - CARNIAN						
Shale	100 - 200								
Shale	200 - 300								
Shale	300 - 400								
Shale	400 - 500								
Shale	500 - 600								
Shale	600 - 700								
Shale	700 - 800								
Shale	800 - 900								
Shale	900 - 1000								

Miospores

MICROFOSSILS	0-100	100-200	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000
<i>O. rufus ovalis</i>	X	X	X	X	X	X	X	X	X	X
<i>Ovalipollis grebenei</i>	X	X	X	X	X	X	X	X	X	X
? <i>Granuloperculatipollis rudis</i>	X	X	X	X	X	X	X	X	X	X
<i>Deltoidospora</i> sp.	X	X	X	X	X	X	X	X	X	X
<i>Corollina meyeriana</i>	X	X	X	X	X	X	X	X	X	X
<i>Discosporites</i> sp.	X	X	X	X	X	X	X	X	X	X
<i>Vesicaspora</i> sp.	X	X	X	X	X	X	X	X	X	X
<i>Vitrosporites pallidus</i>	X	X	X	X	X	X	X	X	X	X
<i>Paracirculina securialis</i>	X	X	X	X	X	X	X	X	X	X
<i>Ovalipollis notabilis</i>	X	X	X	X	X	X	X	X	X	X
<i>Granuloperculatipollis rudis</i>	X	X	X	X	X	X	X	X	X	X
? <i>Laccisporites</i> cf. <i>junior</i>	X	X	X	X	X	X	X	X	X	X
? <i>Osmundacidites alpinus</i>	X	X	X	X	X	X	X	X	X	X
<i>Labiipollis granulatus</i>	X	X	X	X	X	X	X	X	X	X
<i>Patinasporites cf. densus</i>	X	X	X	X	X	X	X	X	X	X
? <i>Pseudozonatasporites summus</i>	X	X	X	X	X	X	X	X	X	X
? <i>Camerosporites secatus</i>	X	X	X	X	X	X	X	X	X	X
<i>Fenzlaspores obliquus</i>	X	X	X	X	X	X	X	X	X	X
? <i>Chasmatosporites</i> sp.	X	X	X	X	X	X	X	X	X	X
<i>Cyclotriletes microgranifer</i>	X	X	X	X	X	X	X	X	X	X
<i>Protodiploxyphius suttleri</i>	X	X	X	X	X	X	X	X	X	X
<i>Triadispora crassa</i>	X	X	X	X	X	X	X	X	X	X
<i>Pardisporites</i> sp.	X	X	X	X	X	X	X	X	X	X
? <i>Pracirculina granifer</i>	X	X	X	X	X	X	X	X	X	X
<i>Duplicisporites ipancus</i>	X	X	X	X	X	X	X	X	X	X
? <i>Triadispora bolcheji</i>	X	X	X	X	X	X	X	X	X	X

REGISTRERT
 5 NOV. 1974

ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART
 DATE: 20. 9. 74. CHART No. 11 LOCATION: Norwegian North Sea 33/12 - 2 Well
 FOR: Mobil Exploration Norway Inc. ANALYST: CGL. SJM.

LITHOLOGY

- LIMESTONE
- SANDSTONE
- COAL / LIGNITE
- DOLOMITE
- COARSE SAND
- Silty/Sandy red shale
- WHITE CHALK
- CONGLOMERATE
- Calcareous shale/clay
- RED MARL OR SHALE
- GYPSUM/ANHYDRITE
- Sandy limestone/Calcareous sandstone
- CLAY
- SALT
- SHALE
- CHERT
- SILTY/SANDY SHALE
- PYRITE
- SILTSTONE
- GLAUCONITE

DIAGNOSTIC SPECIES

-
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-
-

ENVIRONMENT

- CONTINENTAL BRACKISH / DELTAIC / LAGOONAL
- LITTORAL
- INNER SUBLITTORAL
- OUTER SUBLITTORAL
- BATHYAL

% FORAMINIFERAL ASSEMBLAGES

- AGGLUTINATING FORAMINIFERA
- CALCAREOUS BENTHONIC FORAMINIFERA
- PLANKTONIC FORAMINIFERA

INTERPRETED LITHOLOGY	DEPTH IN FEET	SYSTEM	STAGE	CONTINENTAL BRACKISH / DELTAIC / LAGOONAL	LITTORAL	INNER SUBLITTORAL	OUTER SUBLITTORAL	BATHYAL	% FORAMINIFERAL ASSEMBLAGES	
SWC 11054'	1054	UPPER TRIASSIC	?CARNIAN - ?RUETAN							
SWC 11069'	1069									
SWC 11075'	1075									
SWC 11080'	1080									
SWC 11166'	1166									
SWC 11190'	1190									
SWC 11192'	1192									
SWC 11193'	1193									
SWC 11194'	1194									
SWC 11195'	1195									
SWC 11493'	1493	UPPER - MIDDLE TRIASSIC	CARNIAN - ?LADINIAN							
SWC 11416'	1416									
SWC 11425'	1425									
SWC 11434'	1434									
SWC 11441'	1441									
SWC 11447'	1447									
SWC 11451'	1451									
SWC 11690'	1690									
SWC 11848'	1848									
SWC 11890'	1890									
SWC 11985'	1985									

Miospores

MICROFOSSILS

- Osmundacidites sp.
- Spore type cf. Triancoraesporites
- Stereisporites (Stereigranisporsis) sp.
- Deltoidispora sp.
- Corollina meyeriana
- ?Granuloperculatipollis rudis
- Ovalipollis ovalis
- Stereisporites sp.
- ? Vallasporites ignacii

REGISTRERT 5 NOV. 1974

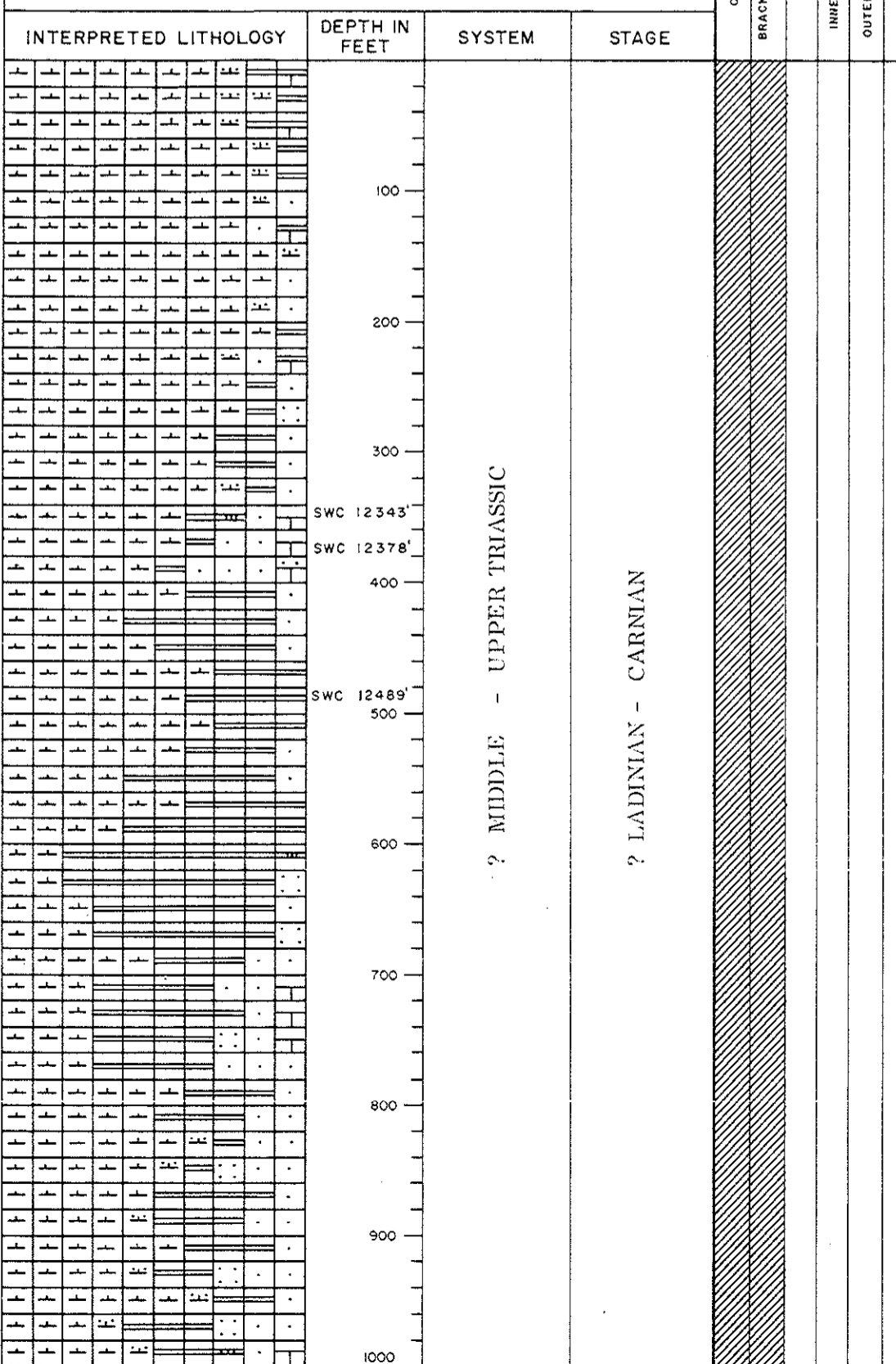
ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART

DATE: 23. 9. 74. CHART No. 12: 12000' - 13000' LOCATION: Norwegian North Sea 33/12-2 Well

FOR: Mobil Exploration Norway Inc. ANALYST: CGL, SJM, MJF.

LIMESTONE SANDSTONE COAL/LIGNITE
 DOLOMITE COARSE SAND Silty/Sandy red shale
 WHITE CHALK CONGLOMERATE Calcareous shale/Argillaceous limestone
 RED MARL OR SHALE GYPSUM/ANHYDRITE Calcareous sandstone/Sandy limestone
 CLAY S SALT
 SHALE C CHERT
 SILTY/SANDY SHALE P PYRITE
 SILTSTONE G GLAUCONITE

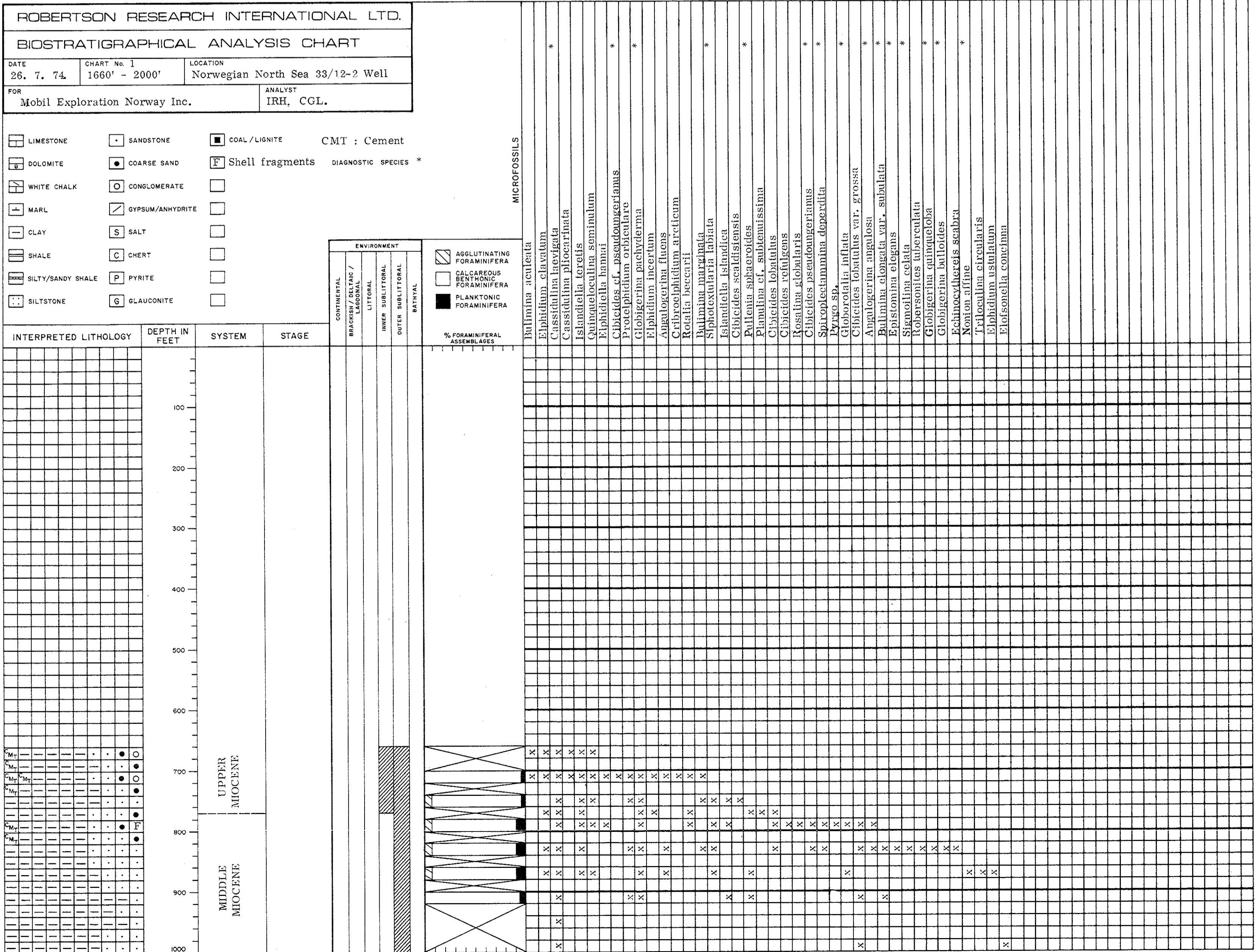
DIAGNOSTIC SPECIES *



ENVIRONMENT	% FORAMINIFERAL ASSEMBLAGES		MICROFOSSILS
	AGGLUTINATING FORAMINIFERA	PLANKTONIC FORAMINIFERA	
CONTINENTAL BRACKISH/DELTAIC/LAGOONAL			* Corollina meyeriana Osmundacitites sp. Deltoidospora sp.
LITTORAL			* ? Classopollis torosus (caved ?) ? Tsugaepollenites sp. (caved ?) Ovalipollis grebene Carnisporites cf. sphuliger Kraeuselisporites reisingeri (caved) ? Granuloperculatipollis rudis Ovalipollis ovalis
INNER SUBLITTORAL			* Carnisporites granulatus Granuloperculatipollis rudis Ovalipollis cf. cultus Vitresporites pallidus Quadraculina anellaformis (caved) Kytomisporeis laevigatus (?caved) Monosulcites rhaetoliasseus (?caved) Vesicaspora fuscus (caved) Cingulizonites rhaeticus (caved) Chasmatosporites sp.
OUTER SUBLITTORAL			* ? Praceirculina granifer ? Schizosaccus keuperi Labiipollis granulatus "Laccisporites" cf. junior Protodiploxyipinus sittleri Protodiploxyipinus sp. Calamospora keuperiana Parilinites cf. callosus Triadispora staplini Brachysaccus neomundanus Comaculatisporites mesozoicus Lunatisporites acutus Distalanulisporites punctus
BATHYAL			

REGISTERED
 19 NOV. 1974

Foraminifera & Ostracoda



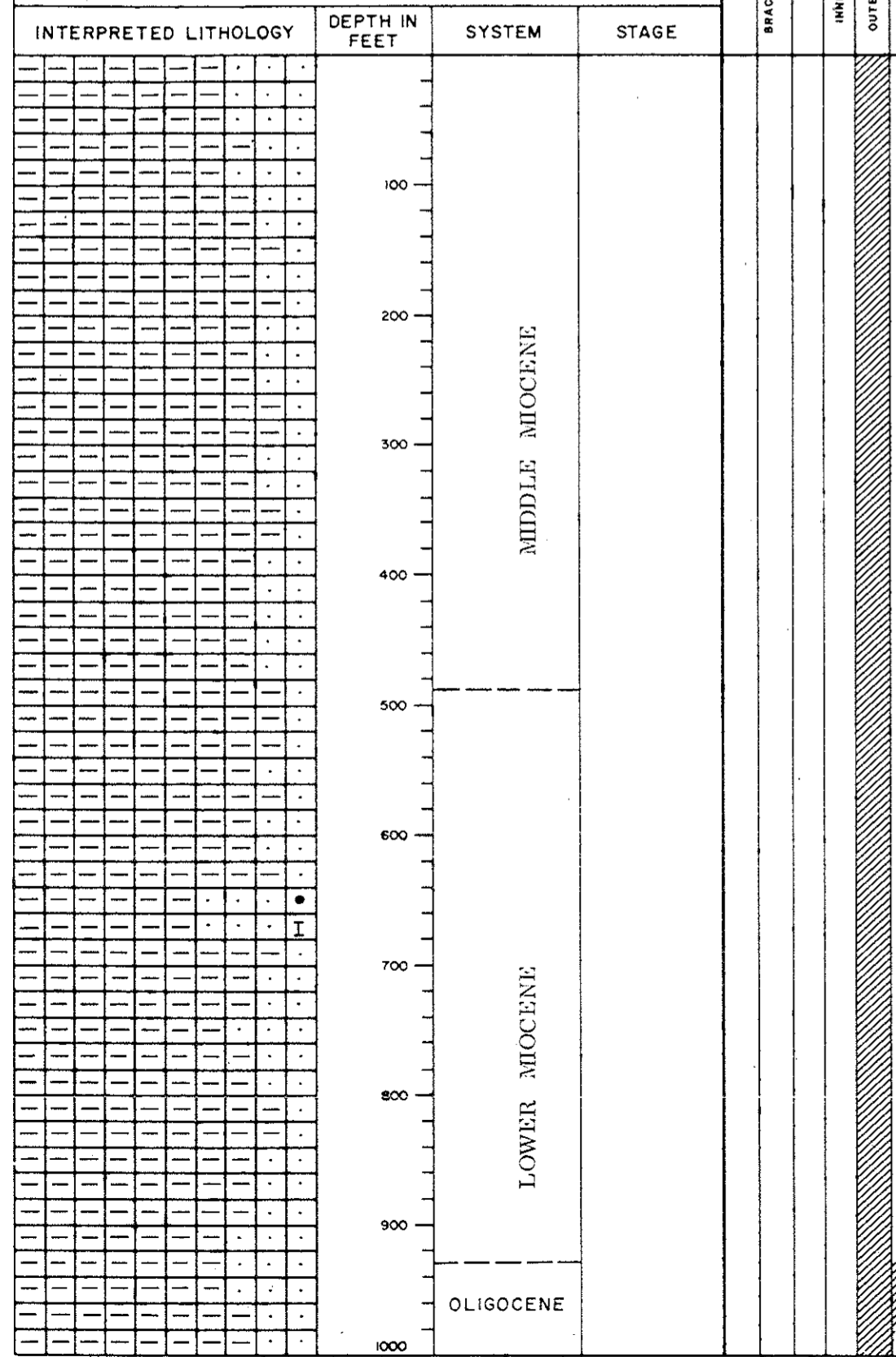
ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART
 DATE: 26.7.74 CHART No 2 LOCATION: Norwegian North Sea 33/12-2 Well
 FOR: Mobil Exploration Norway Inc. ANALYST: IRH, CGL.

- LITHOLOGY LEGEND:
- LIMESTONE
 - SANDSTONE
 - COAL/LIGNITE
 - DOLOMITE
 - COARSE SAND
 - IRONSTONE
 - WHITE CHALK
 - CONGLOMERATE
 - MARL
 - GYPSSUM/ANHYDRITE
 - CLAY
 - SALT
 - SHALE
 - CHERT
 - SILTY/SANDY SHALE
 - PYRITE
 - SILTSTONE
 - GLAUCONITE

DIAGNOSTIC SPECIES *

- ENVIRONMENT:
- CONTINENTAL / MARGINAL
 - LITORAL
 - INNER SUBLITORAL
 - OUTER SUBLITORAL
 - BATHYAL

- % FORAMINIFERAL ASSEMBLIES:
- AGGLUTINATING FORAMINIFERA
 - CALCAREOUS BENTHONIC FORAMINIFERA
 - PLANKTONIC FORAMINIFERA



Foraminifera & Ostracoda

Species	0-100	100-200	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000
<i>Cibicides lobatulus</i> var. <i>grossi</i>	X	X	X	X	X	X	X	X	X	X
<i>Cibicides relictus</i>	X	X	X	X	X	X	X	X	X	X
<i>Quinqueloculina lata</i>	X	X	X	X	X	X	X	X	X	X
<i>Cassidulinia laevigata</i>	X	X	X	X	X	X	X	X	X	X
<i>Balminia marginata</i>	X	X	X	X	X	X	X	X	X	X
<i>Pyrgo</i> sp.	X	X	X	X	X	X	X	X	X	X
<i>Siphonostoma labiata</i>	X	X	X	X	X	X	X	X	X	X
<i>Protelphidium orbiculare</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina pachyderma</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina bulloides</i>	X	X	X	X	X	X	X	X	X	X
<i>Lenticulina</i> spp.	X	X	X	X	X	X	X	X	X	X
<i>Ephedrella hamae</i>	X	X	X	X	X	X	X	X	X	X
<i>Angulogerina angulosa</i>	X	X	X	X	X	X	X	X	X	X
<i>Quinqueloculina seminulum</i>	X	X	X	X	X	X	X	X	X	X
<i>Globorotalia inflata</i>	X	X	X	X	X	X	X	X	X	X
<i>Balminia aculeata</i>	X	X	X	X	X	X	X	X	X	X
<i>Pyrgo bulloides</i>	X	X	X	X	X	X	X	X	X	X
<i>Echinocythereis scabra</i>	X	X	X	X	X	X	X	X	X	X
<i>Cibicides pacificus</i>	X	X	X	X	X	X	X	X	X	X
<i>Aurila convexa</i>	X	X	X	X	X	X	X	X	X	X
<i>Cibicides lobatulus</i>	X	X	X	X	X	X	X	X	X	X
<i>Listrella communis</i>	X	X	X	X	X	X	X	X	X	X
<i>Loxostomum sinuosum</i>	X	X	X	X	X	X	X	X	X	X
<i>Bolivina dilatata</i>	X	X	X	X	X	X	X	X	X	X
<i>Siphonostoma cf. hirsuta</i>	X	X	X	X	X	X	X	X	X	X
<i>Cibicides pseudounguiferinus</i>	X	X	X	X	X	X	X	X	X	X
<i>Nonion affine</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina quinqueloba</i>	X	X	X	X	X	X	X	X	X	X
<i>Gyroldina soldanii</i>	X	X	X	X	X	X	X	X	X	X
<i>Planulina cf. armbucensis</i>	X	X	X	X	X	X	X	X	X	X
<i>Balminia fusiformis</i> var. <i>marginata</i>	X	X	X	X	X	X	X	X	X	X
<i>Bolivina bevrichi</i>	X	X	X	X	X	X	X	X	X	X
<i>Plectodondularia advena</i>	X	X	X	X	X	X	X	X	X	X
<i>Uvigerina hostisi</i>	X	X	X	X	X	X	X	X	X	X
<i>Sigmolina celata</i>	X	X	X	X	X	X	X	X	X	X
<i>Nonion pompilioides</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina praebulloides</i>	X	X	X	X	X	X	X	X	X	X
<i>Bolivina serrato-suturalis</i>	X	X	X	X	X	X	X	X	X	X
<i>Pragelobulimina ovata</i>	X	X	X	X	X	X	X	X	X	X
<i>Orbulina universa</i>	X	X	X	X	X	X	X	X	X	X
<i>Ephedrella antoniium</i>	X	X	X	X	X	X	X	X	X	X
<i>Pallena sphaeroides</i>	X	X	X	X	X	X	X	X	X	X
<i>Cythereella</i> sp.	X	X	X	X	X	X	X	X	X	X
<i>Eoisomina elegans</i>	X	X	X	X	X	X	X	X	X	X
<i>Bolivina subsphaerica</i>	X	X	X	X	X	X	X	X	X	X
<i>Sphaerostaminina deperdita</i>	X	X	X	X	X	X	X	X	X	X
<i>Sphaeroidina bulloides</i>	X	X	X	X	X	X	X	X	X	X
<i>Dentalina</i> spp.	X	X	X	X	X	X	X	X	X	X
<i>Eponides umbonatus</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina amataisumbilicata</i>	X	X	X	X	X	X	X	X	X	X
<i>Yagudina</i> sp.	X	X	X	X	X	X	X	X	X	X
<i>Globigerina concinna</i>	X	X	X	X	X	X	X	X	X	X
<i>Globorotalia scitula</i>	X	X	X	X	X	X	X	X	X	X
<i>Bolivina floridana</i> var. <i>impureata</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina subaenariensis</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina pacifica</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina cf. gortemij</i>	X	X	X	X	X	X	X	X	X	X
<i>Nodosaria subaenariensis</i>	X	X	X	X	X	X	X	X	X	X
<i>Globorotalia obesa</i>	X	X	X	X	X	X	X	X	X	X
<i>Globorotalia brisimansis</i>	X	X	X	X	X	X	X	X	X	X
<i>Globigerina brisimansis</i>	X	X	X	X	X	X	X	X	X	X

Other fossils

- Fish otolith
- Cassidulinis* spp.
- Elphidium* spp.

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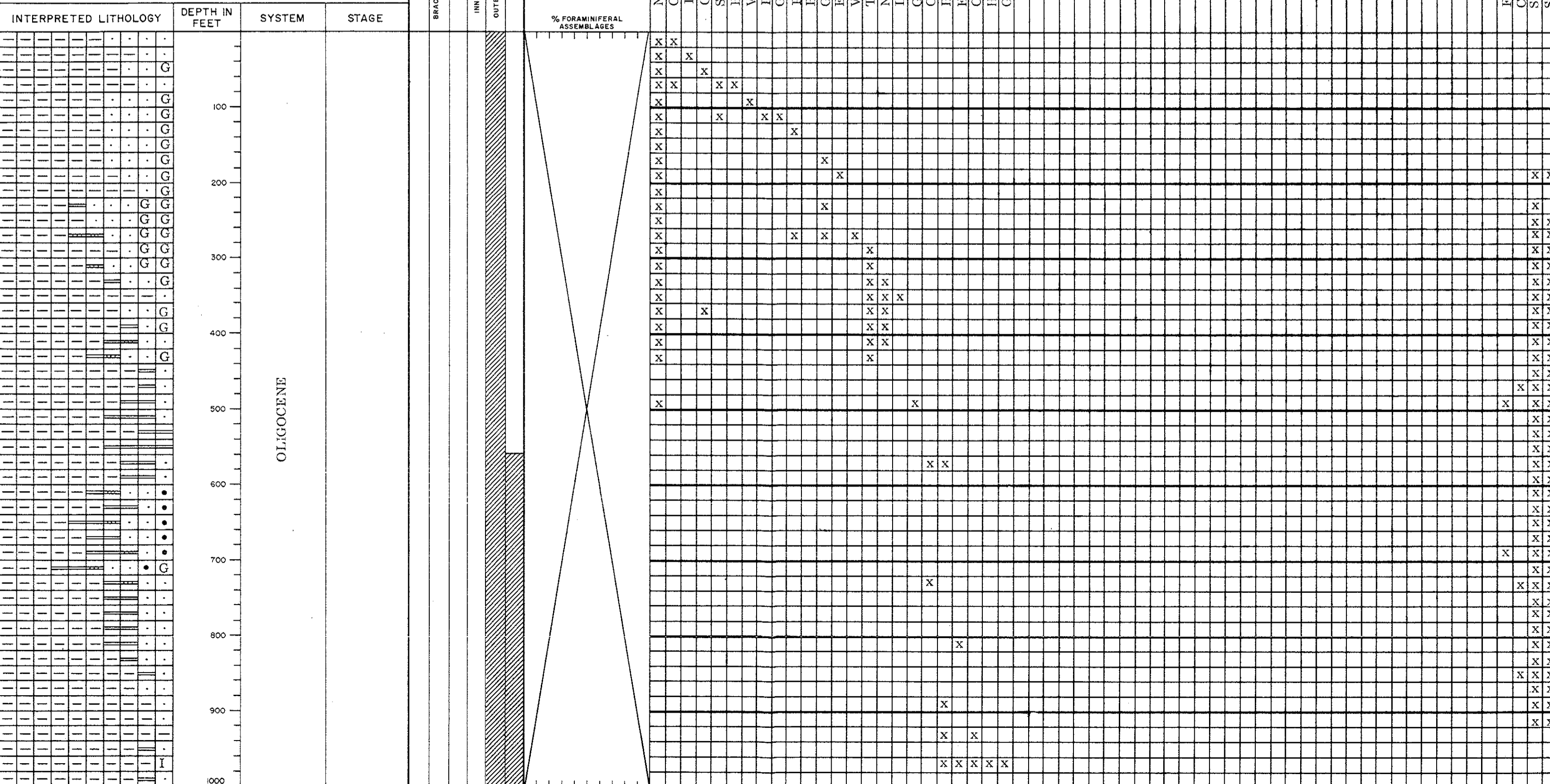
BIOSTRATIGRAPHICAL ANALYSIS CHART

DATE 26.7.74. CHART No. 3 LOCATION Norwegian North Sea 33/12-2 Well
 FOR Mobil Exploration Norway Inc. ANALYST IRH. CGL.

- LIMESTONE
- SANDSTONE
- COAL / LIGNITE
- DOLOMITE
- COARSE SAND
- Ironstone
- WHITE CHALK
- CONGLOMERATE
- MARL
- GYPSUM/ANHYDRITE
- CLAY
- SALT
- SHALE
- CHERT
- SILTY/SANDY SHALE
- PYRITE
- SILTSTONE
- GLAUCONITE

DIAGNOSTIC SPECIES *

- AGGLUTINATING FORAMINIFERA
- CALCAREOUS BENTHONIC FORAMINIFERA
- PLANKTONIC FORAMINIFERA



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5 NOV. 1974

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BIOSTRATIGRAPHICAL ANALYSIS CHART

DATE 6. 8. 74. CHART No. 4 4000' - 5000' LOCATION Norwegian North Sea 33/12-2 Well

FOR Mobil Exploration Norway Inc.

ANALYST IRH, CGL.

- | | | |
|--|---|--|
| <input type="checkbox"/> LIMESTONE | <input type="checkbox"/> SANDSTONE | <input type="checkbox"/> COAL / LIGNITE |
| <input type="checkbox"/> DOLOMITE | <input type="checkbox"/> COARSE SAND | <input type="checkbox"/> Ironstone |
| <input type="checkbox"/> WHITE CHALK | <input type="checkbox"/> CONGLOMERATE | <input type="checkbox"/> Ironstained limestone |
| <input type="checkbox"/> MARL | <input type="checkbox"/> GYPSUM/ANHYDRITE | <input type="checkbox"/> Sphaerosiderite |
| <input type="checkbox"/> CLAY | <input type="checkbox"/> SALT | |
| <input type="checkbox"/> SHALE | <input type="checkbox"/> CHERT | |
| <input type="checkbox"/> SILTY/SANDY SHALE | <input type="checkbox"/> PYRITE | |
| <input type="checkbox"/> SILTSTONE | <input type="checkbox"/> GLAUCONITE | |

- ENVIRONMENT
- | | | | | |
|--|-----------------------------------|--|--|----------------------------------|
| <input type="checkbox"/> CONTINENTAL BRACHYON / DELTAIC / LAGOONAL | <input type="checkbox"/> LITTORAL | <input type="checkbox"/> INNER SUBLITTORAL | <input type="checkbox"/> OUTER SUBLITTORAL | <input type="checkbox"/> BATHYAL |
|--|-----------------------------------|--|--|----------------------------------|
- DIAGNOSTIC SPECIES *
- | | | |
|---|--|--|
| <input type="checkbox"/> AGGLUTINATING FORAMINIFERA | <input type="checkbox"/> CALCAREOUS BENTHONIC FORAMINIFERA | <input type="checkbox"/> PLANKTONIC FORAMINIFERA |
|---|--|--|

INTERPRETED LITHOLOGY

DEPTH IN FEET

SYSTEM

STAGE

% FORAMINIFERAL ASSEMBLAGES

MICROFOSSILS

Foraminifera

Other fossils

DEPTH IN FEET	SYSTEM	STAGE	ENVIRONMENT	% FORAMINIFERAL ASSEMBLAGES	MICROFOSSILS	Other fossils	
0-100	OLIGOCENE				Cribrerosomoides spp. * Bathysiphon sp. * Cyclammina placenta * Eggerella sp. * Nonion affine * Elphidium subnodosum * Sigmolina schlumbergeri * Recurvoides spp. * Cyclammina cf. challinori * Haplophragmoides spp. * Glomospira charoides * Sigmolina tenuis * Glomospira sp. * Verneuilina sp. * Trochammina cf. globigeriniformis * Cyclammina challinori * Reophax sp. * Trochammina cf. globigeriniformis var. altiformis * Ammolagena clavata * Cyclammina sp. 1 * Spiroplectammmina spectabilis * Ammodiscus incertus * Trochammina globigeriniformis * Trochammina sp. * Dorothyia sp. * Verneuilina subocataena *		
100-200	? EOCENE						
200-300							
300-400	EOCENE						
400-500							
500-600	PALAEOCENE - LOWER EOCENE						
600-700							
700-800							
800-900							
900-1000							
							Coscinodiscus sp. * Large flattened radiolaria * Radiolaria * Fish teeth *

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 BIOSTRATIGRAPHICAL ANALYSIS CHART
 DATE 8. 8. 74. CHART No. 5 LOCATION Norwegian North Sea 33/12-2 Well
 FOR Mobil Exploration Norway Inc. ANALYST IRH, CGL.

	LIMESTONE		SANDSTONE		COAL/LIGNITE
	DOLOMITE		COARSE SAND		Volcanics
	WHITE CHALK		CONGLOMERATE		
	MARL		GYPSUM/ANHYDRITE		
	CLAY		SALT		
	SHALE		CHERT		
	SILTY/SANDY SHALE		PYRITE		
	SILTSTONE		GLAUCONITE		

CMT Cement
 DIAGNOSTIC SPECIES *
 REWORKED SPECIES R

INTERPRETED LITHOLOGY	DEPTH IN FEET	SYSTEM	STAGE
	0-100	PALAEOCENE - LOWER EOCENE	
	100-200		
	200-300		
	300-400		
	400-500		
	500-600		
	600-700		
	700-800		
	800-900		
	900-1000	PALAEOCENE	

ENVIRONMENT			
CONTINENTAL BRACKISH / SALINE / LAGOONAL	LITTORAL	INNER SUBLITTORAL	OUTER SUBLITTORAL BATHYAL

% FORAMINIFERAL ASSEMBLAGES		
	AGGLUTINATING FORAMINIFERA	
	CALCAREOUS BENTHONIC FORAMINIFERA	
	PLANKTONIC FORAMINIFERA	

MICROFOSSILS	0-100	100-200	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000
Ammoidiscus incertus	X	X	X	X	X	X	X	X	X	X
Bathysiphon sp.	X	X	X	X	X	X	X	X	X	X
Spiroplectammima spectabilis	X	X	X	X	X	X	X	X	X	X
Haplophragmoides spp.	X	X	X	X	X	X	X	X	X	X
Cyclammima challinori	X	X	X	X	X	X	X	X	X	X
Ammosphaeroidina sp.	X	X	X	X	X	X	X	X	X	X
Recurviroites spp.	X	X	X	X	X	X	X	X	X	X
Ammolagena clavata	X	X	X	X	X	X	X	X	X	X
Glomospira sp.	X	X	X	X	X	X	X	X	X	X
Glomospira charoides	X	X	X	X	X	X	X	X	X	X
Verneuilina subcaena	X	X	X	X	X	X	X	X	X	X
Cyclammima placenta	X	X	X	X	X	X	X	X	X	X
Trochammima globigeriniformis	X	X	X	X	X	X	X	X	X	X
Globigerinelloides asper	X	X	X	X	X	X	X	X	X	X
Saccammima sp.	X	X	X	X	X	X	X	X	X	X
Trochammima cf. globigeriniformis	X	X	X	X	X	X	X	X	X	X
Cyclammima spp.	X	X	X	X	X	X	X	X	X	X
Globigerina spp.	X	X	X	X	X	X	X	X	X	X
Cibicides cf. allenii	X	X	X	X	X	X	X	X	X	X
Lenticulina (Kolbulus) spp.	X	X	X	X	X	X	X	X	X	X
Gyrogonina spp.	X	X	X	X	X	X	X	X	X	X
Caneris sp.	X	X	X	X	X	X	X	X	X	X
Cibicides proprius	X	X	X	X	X	X	X	X	X	X
Cibicides cf. ungerianus	X	X	X	X	X	X	X	X	X	X
Globigerina linaperta	X	X	X	X	X	X	X	X	X	X
Anomalina grosserugosa	X	X	X	X	X	X	X	X	X	X
Stilostomella sp.	X	X	X	X	X	X	X	X	X	X
Angulogerina abbreviata	X	X	X	X	X	X	X	X	X	X
Bulimina cf. midwayensis	X	X	X	X	X	X	X	X	X	X
Anomalina cf. acuta	X	X	X	X	X	X	X	X	X	X
Globigerina cf. yeguaensis	X	X	X	X	X	X	X	X	X	X
Asterigerinoides cf. crassaformis	X	X	X	X	X	X	X	X	X	X
Nuttallides sp.	X	X	X	X	X	X	X	X	X	X
Globigerina psuedococconeana	X	X	X	X	X	X	X	X	X	X
Globigerina triloculinoides	X	X	X	X	X	X	X	X	X	X
Textularia plummerae	X	X	X	X	X	X	X	X	X	X
Coleites cf. danicus	X	X	X	X	X	X	X	X	X	X
Pelosina spp.	X	X	X	X	X	X	X	X	X	X
Chilostomella sp.	X	X	X	X	X	X	X	X	X	X
Cyclammima sp. A	X	X	X	X	X	X	X	X	X	X
Eponides cf. franki	X	X	X	X	X	X	X	X	X	X
Trochammima spp.	X	X	X	X	X	X	X	X	X	X
Saccammima cf. placenta	X	X	X	X	X	X	X	X	X	X
Trochammima cf. sp. A	X	X	X	X	X	X	X	X	X	X
Rzehakina sp.	X	X	X	X	X	X	X	X	X	X
Allomorphina sp.	X	X	X	X	X	X	X	X	X	X
Trochammima sp. A	X	X	X	X	X	X	X	X	X	X
Dentalina sp.	X	X	X	X	X	X	X	X	X	X
Hyperammima sp.	X	X	X	X	X	X	X	X	X	X
Rugoglobigerina rugosa rugosa	X	X	X	X	X	X	X	X	X	X
Coccolithus sp. 1	X	X	X	X	X	X	X	X	X	X
Coccolithus sp. 2	X	X	X	X	X	X	X	X	X	X
Large round radiolaria	X	X	X	X	X	X	X	X	X	X
Fish teeth	X	X	X	X	X	X	X	X	X	X
Large flattened radiolaria	X	X	X	X	X	X	X	X	X	X
Radiolaria	X	X	X	X	X	X	X	X	X	X

REGISTERED
 5 NOV 1974

Foraminifera
 Other fossils

ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART
 DATE 28:7:74 CHART No. 6 LOCATION Norwegian North Sea 33/12-2 Well
 FOR Mobil Exploration Norway Inc. ANALYST JWC, IRH.

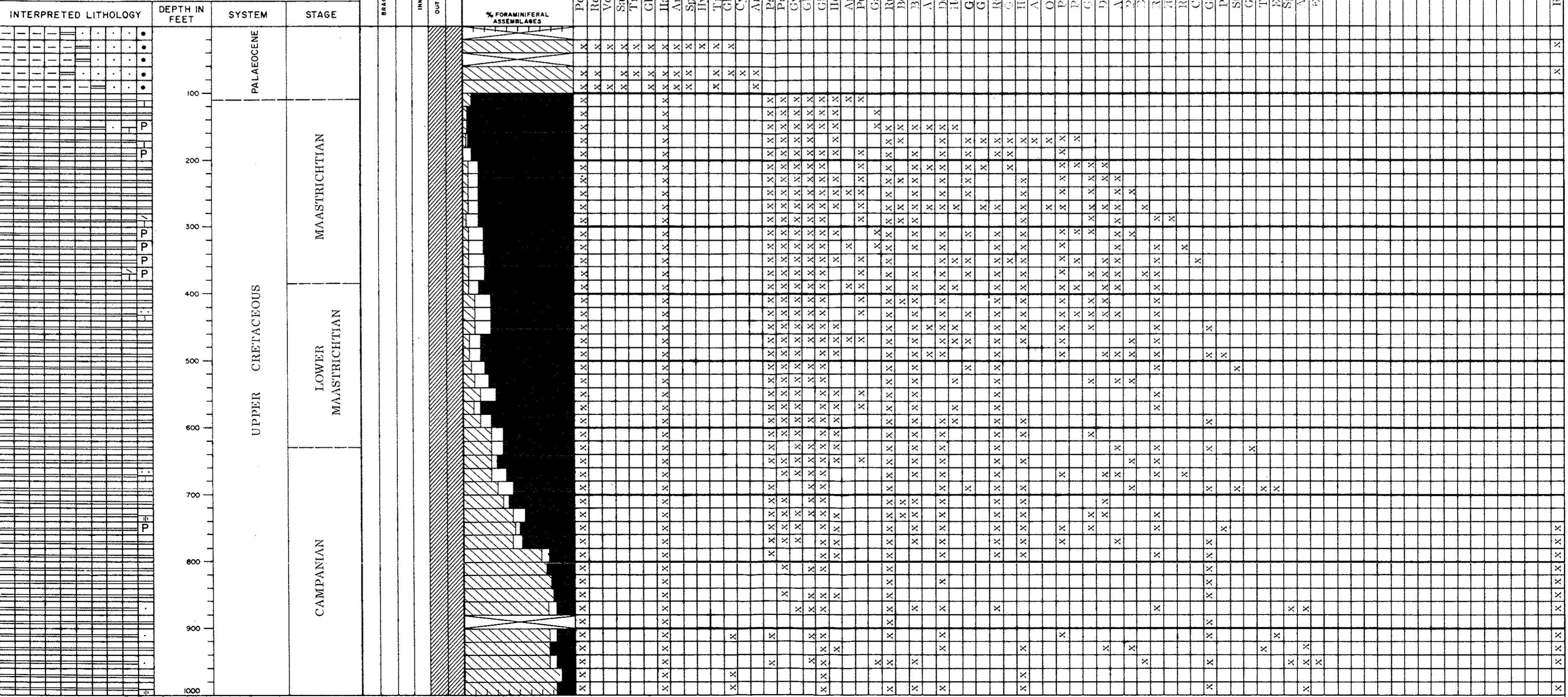
- | | | |
|---------------------|--------------------|----------------------------------|
| LIMESTONE | SANDSTONE | COAL / LIGNITE |
| DOLOMITE | COARSE SAND | CALCAREOUS SANDSTONE / SILTSTONE |
| WHITE CHALK | CONGLOMERATE | DIAGNOSTIC SPECIES * |
| MARL | GYPSUM / ANHYDRITE | |
| CLAY | SALT | |
| SHALE | CHERT | |
| SILTY / SANDY SHALE | PYRITE | |
| SILTSTONE | GLAUCONITE | |

- | |
|-----------------------------------|
| AGGLUTINATING FORAMINIFERA |
| CALCAREOUS BENTHONIC FORAMINIFERA |
| PLANKTONIC FORAMINIFERA |

- | |
|---|
| CONTINENTAL BRACKISH / DELTAIC / LAGOONAL |
| LITTORAL |
| INNER SUBLITTORAL |
| OUTER SUBLITTORAL |
| BATHYAL |

MICROFOSSILS

- Pelosina spp.
- Recurvoides spp.
- Vorneuilina subeocena *
- Saccamina cf. placenta *
- Trochammina sp. A *
- Glonospira charoides
- Haplomarginoides spp.
- Ammodiscus incertus *
- Spiroplectammima spectabilis
- Hyperammima spp.
- Trochammina sp.
- Glonospira sp. A
- Cyclammima sp. A
- Ammosphaeroidina sp.
- Pseudotextularia elegans elegans *
- Pseudotextularia elegans fructicosa *
- Cyroidinoides spp.
- Globotruncana contusa
- Globigerinelloides asper *
- Heterohelix globatosa *
- Anomalinoidea hyphalutis
- Pullenia sp.
- Cavelinonion nobilis
- Rugoglobigerina rugosa rugosa *
- Pollina incrassata gigantea *
- Boglobigerinella multispina *
- Altomorpha sp.
- Dorobbia sp.
- Heterohelix pulchra *
- Globotruncana arca *
- Globotruncana stuarti *
- Rugoglobigerina rugosa rotundata *
- Globotruncana cf. talsostuardi *
- Haplomarginoides coronatus *
- Anomalinoidea rubiginosa *
- Osagularia lens
- Polymorphinids
- Pseudoglandulina spp.
- Cavelinella vombensis
- Dentalina sp.
- Abathomphalus mayaroensis *
- Pseudoglobotruncana citre *
- Dulicella cf. arkadelpitana *
- Reussella szajnochae elongata *
- Heterohelix costulata *
- Reussella szajnochae szajnochae *
- Cibicides beuumontianus
- Gaudryina bentonensis
- Pracubimmina ventricosa
- Stensioina pommerana *
- Globotruncana sp. 1
- Textularia cf. foeda
- Eponides beisseli
- Spiroplectammima sp.
- Ammodiscus sp.
- Eponides sp.



REGISTRERT
 5 NOV. 1974

Other fossils

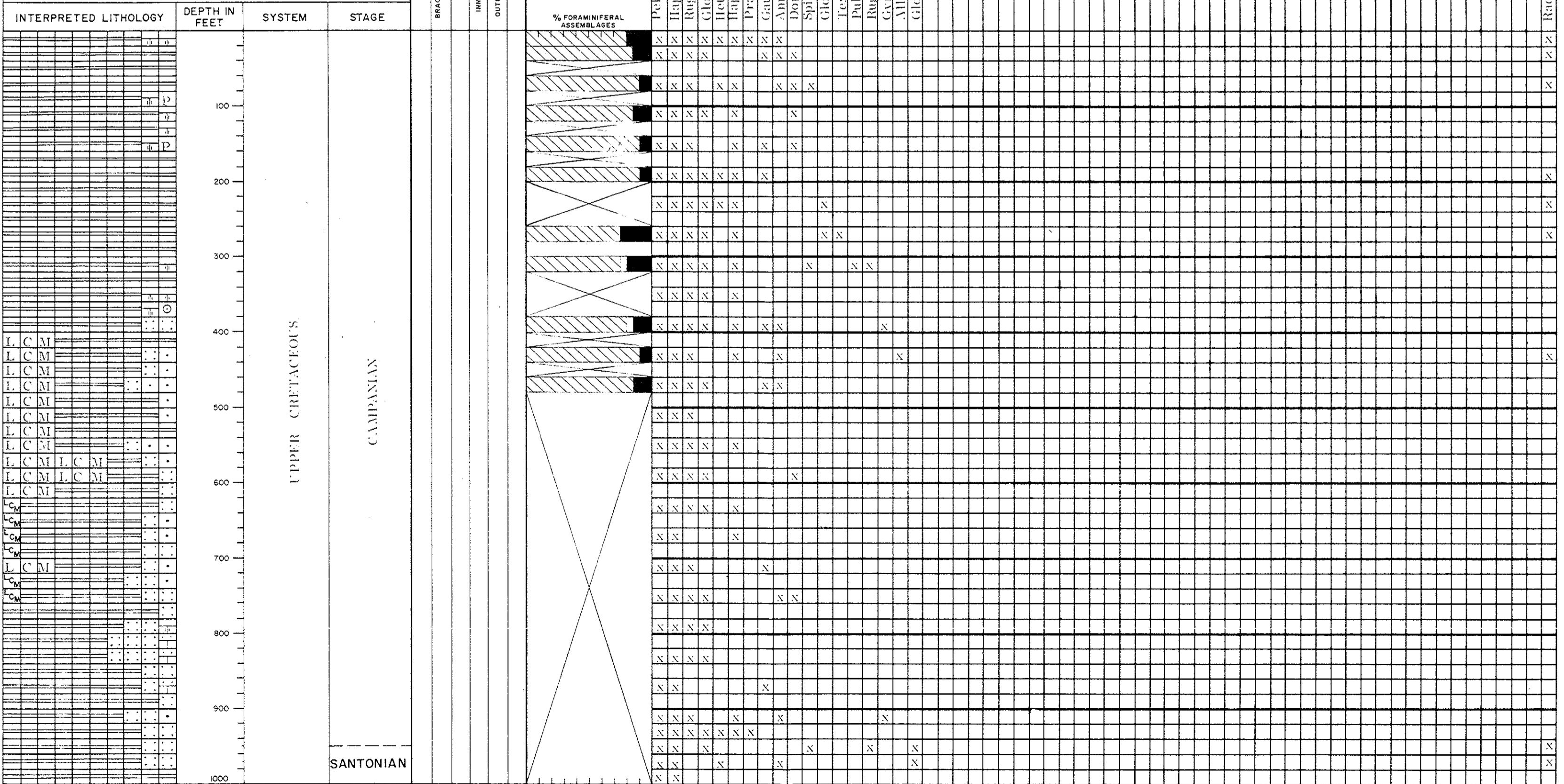
Radiolaria

ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART
 DATE 3. 9. 74. CHART No. 7 LOCATION Norwegian North Sea 33. 12-2 Well
 FOR Mobil Exploration Norway Inc. ANALYST CGL. JWC.

- LIMESTONE SANDSTONE COAL / LIGNITE LCM Lost circulation material
 DOLOMITE COARSE SAND Sphaerosiderite DIAGNOSTIC SPECIES *
 WHITE CHALK CONGLOMERATE Calcareous sandstone/
 MARL GYPSUM/ANHYDRITE siltstone
 CLAY S SALT
 SHALE C CHERT
 SILTY/SANDY SHALE P PYRITE
 SILTSTONE G GLAUCONITE

- ENVIRONMENT
 CONTINENTAL BRACKISH / BALTIC / LAGONAL LITTORAL INNER SUBLITTORAL OUTER SUBLITTORAL BATHYAL

- AGGLUTINATING FORAMINIFERA
 CALCAREOUS BENTHONIC FORAMINIFERA
 PLANKTONIC FORAMINIFERA



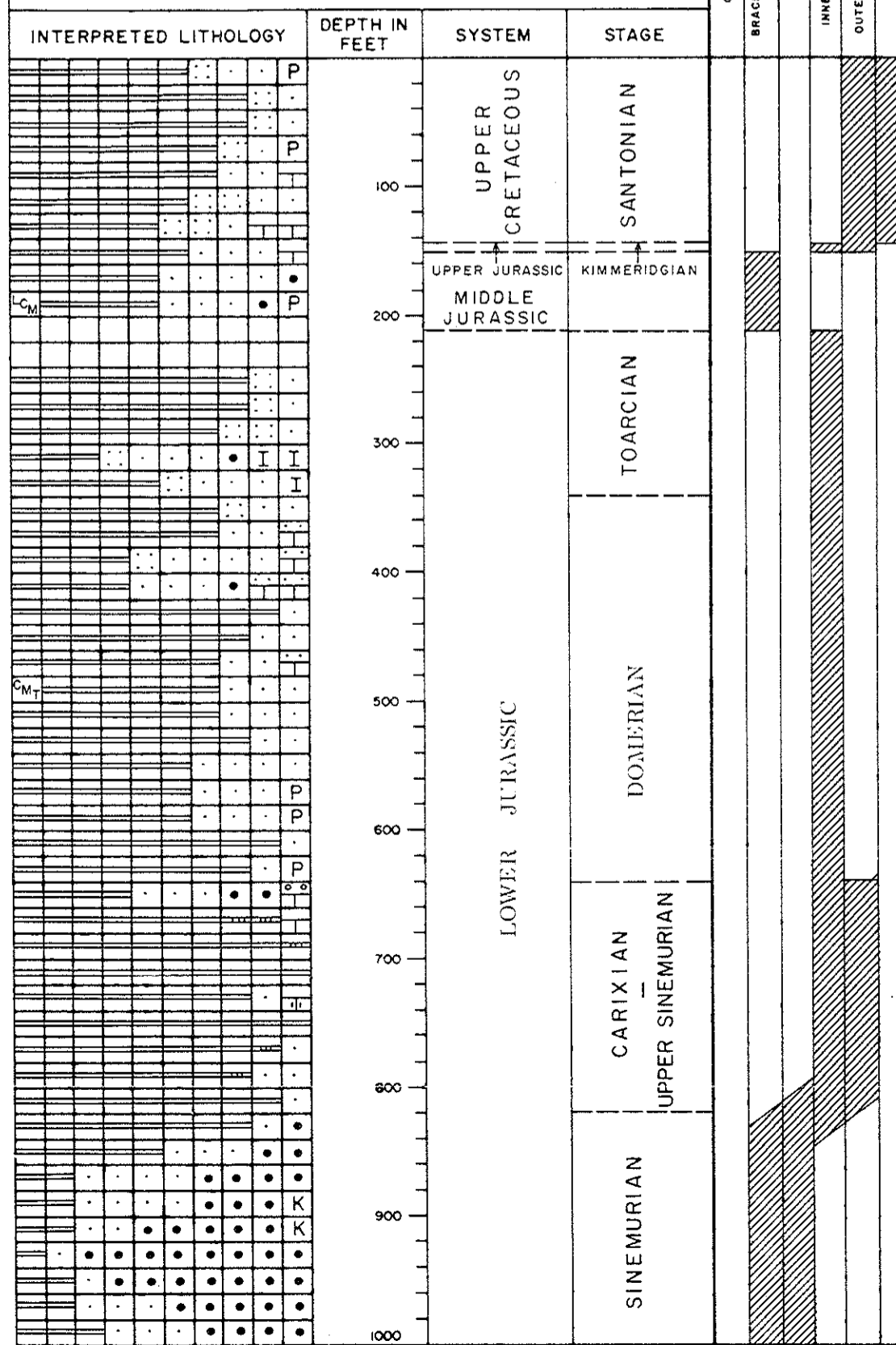
REGISTRERT

5 NOV. 1974

Other fossils

ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART
 DATE: 8-9-74 CHART No. B LOCATION: Norwegian North Sea 33/12-2 Well
 FOR: Mobil Exploration Norway Inc. ANALYST: CGL, JM, MJF, JWC.

- LITHOLOGY**
- LIMESTONE
 - DOLOMITE
 - WHITE CHALK
 - MARL
 - CLAY
 - SHALE
 - SILTY/SANDY SHALE
 - SILTSTONE
 - SANDSTONE
 - COARSE SAND
 - CONGLOMERATE
 - GYPHUM/ANHYDRITE
 - SALT
 - CHERT
 - PYRITE
 - GLAUCONITE
 - COAL/LIGNITE
 - IRONSTONE
 - CALCAREOUS SANDSTONE
 - KAOLINITE
 - LOST CIRCULATION MATERIAL
 - CEMENT
- DIAGNOSTIC SPECIES**
- AGGUTINATING FORAMINIFERA
 - CALCAREOUS BENTHONIC FORAMINIFERA
 - PLANKTONIC FORAMINIFERA
- REWORKED SPECIES** R



SPECIES	% FORAMINIFERAL ASSEMBLAGE				
	AGGUTINATING FORAMINIFERA	CALCAREOUS BENTHONIC FORAMINIFERA	PLANKTONIC FORAMINIFERA	REWORKED SPECIES	OTHER
<i>Ammobaculites</i> spp.	X				
<i>Heterohelix globulosa</i>	X				
<i>Lenticulina</i> spp.	X				
<i>Globobulimina asper</i>	X				
<i>Hopliphragmoides</i> spp.	X				
<i>Gyrodinoides</i> spp.	X				
<i>Clavulinoides</i> sp.	X				
<i>Dorothia</i> sp.	X				
<i>Silicoplectambonina</i> sp.	X				
<i>Pelosiina</i> spp.	X				
<i>Globobulimina marginata</i>	X				
<i>Rugoglobobulina rugosa rugosa</i>	X				
<i>Globobulimina limicola tricarinata</i>	X				
<i>Polymorphinoides</i>	X				
<i>Pullenia</i> sp.	X				
<i>Globobulimina cf. multisepta</i>	X				
<i>Globospira</i> sp.	X				
<i>Dentalina</i> spp.	X				
<i>Textularia</i> sp.	X				
<i>Hopliphragmoides</i> cf. <i>canui</i>	X				
<i>Hopliphragmoides</i> aff. <i>influculioyensis</i>	X				
<i>Venutilinoides mauritii</i>	X				
<i>Trochammina</i> cf. <i>gryci</i>	X				
<i>Trochammina</i> cf. <i>nitida</i>	X				
<i>Ammobaculites asper</i>	X				
<i>Trochammina</i> cf. <i>seamata</i>	X				
<i>Ammobaculites</i> sp.	X				
<i>Dentalina</i> cf. <i>torquati</i>	X				
<i>? Mangulina prima</i>	X				
<i>Fogutulina lassica</i>	X				
<i>Lenticulina varians</i>	X				
<i>Margulina prima</i>	X				
<i>Trochammina</i> cf. <i>globocariniformis</i>	X				
<i>? Saracenanina</i> sp.	X				
<i>Geinitzhia tenera tenera</i>	X				
<i>Saracenanina</i> cf. <i>sublaevis</i>	X				
<i>Xobysaria</i> sp.	X				
<i>Pseudobulimina</i> sp.	X				
<i>Dentalina</i> <i>marginata</i>	X				
<i>Leptocyclon</i> <i>sulcata</i>	X				
<i>Planorbina</i> <i>influculiformis</i>	X				
<i>Ammobaculites agulianus</i>	X				
<i>? Indisgen</i>	X				
<i>Scrobaria</i> cf. <i>horrens</i>	X				
<i>? Gaudryina</i> sp.	X				
<i>Geinitzhia tenera praeparata pupoides</i>	X				
<i>Hungarella</i> cf. <i>amulthii</i>	X				
<i>Hungarella</i> sp.	X				
<i>Itardia</i> cf. <i>mothersensis</i>	X				
<i>Hungarella etadensis</i>	X				
<i>Hungarella contractula</i>	X				
<i>Procytheridea</i> sp. E. (APOSTOLESCU)	X				
<i>? Otocythere</i> cf. <i>lapidus</i>	X				
<i>Hungarella</i> sp. B. (APOSTOLESCU)	X				
<i>Kraussella laeocolata</i>	X				
<i>Itardia mothersensis</i>	X				
<i>Bairdia</i> sp.	X				
<i>Procytheridea</i> sp.	X				
<i>Grammelia</i> cf. <i>tatei</i>	X				
<i>Defortospira</i> spp.	X				
<i>Densaspirites peritatus</i>	X				
<i>Baculaspirites comanensis</i>	X				
<i>Bisaccates undiferentiat</i>	X				
<i>Stalispirites telatus</i>	X				
<i>Cerropollenites mesozoicus</i>	X				
<i>Pectinopollenites elatoides</i>	X				
<i>Podocarpidites</i> spp.	X				
<i>Lycopodiumspirites semimurus</i>	X				
<i>Spirites</i> spp.	X				
<i>Physosporites vacuampoi</i>	X				
<i>Calliasporites dampieri</i>	X				
<i>Concentrisporites pseudosulcatus</i>	X				
<i>Physosporites acutus</i>	X				
<i>Physosporites</i> sp.	X				
<i>Physosporites psilatus</i>	X				
<i>Physosporites rotundiformis</i>	X				
<i>Carolina</i> <i>neyeriana</i>	X				
<i>Vireosporites pallidus</i>	X				
<i>Vireosporites anagrammensis</i>	X				
<i>Cerropollenites intergardi</i>	X				
<i>Cerropollenites wellhami</i>	X				
<i>Cerropollenites</i> sp.	X				
<i>Abietinopollenites microclatus</i>	X				
<i>Chasmatosporites apertus</i>	X				
<i>Nitidospirites</i> sp.	X				
<i>Chasmatosporites himis</i>	X				
<i>Acanthites spinosus</i>	X				
<i>Cycloporites</i> spp.	X				
<i>Protocollenus interosus</i>	X				
<i>Psaroniatechus ovalis</i>	X				
<i>Lycopodiumspirites subrotundus</i>	X				
<i>Stylactites</i> <i>indel.</i>	X				
<i>Physosporites ellipticus</i>	X				
<i>Quadraculha anellaeformis</i>	X				
<i>Protolites semicus</i>	X				
<i>Sestrosporites pseudolycolatus</i>	X				
<i>Polychaetospirites triangularis</i>	X				
<i>Tasmanites</i> spp.	X				
<i>Stimulidium grossi</i>	X				
<i>Acanthomorph acirarens</i>	X				
<i>Paracollina ceratophora</i>	X				
<i>Cleistosphaeridium</i> sp.	X				
<i>Chyrosphaeridium</i> sp.	X				
<i>Baryococcus</i> sp.	X				
<i>Nannoceratopsis gracilis</i>	X				
<i>Mancodinium semitalatum</i>	X				
<i>Leiosphaeres</i> <i>indel.</i>	X				
<i>Crassosphaera concinna</i>	X				
<i>Grammidsacus granulatus</i>	X				
<i>Crassosphaera hexagonalis</i>	X				
<i>Radiolalia</i> spp.	X				
<i>Crinoids</i>	X				
<i>Fish teeth</i>	X				
<i>Gastropods</i>	X				
<i>Bivalves</i>	X				
<i>Microforams</i>	X				

REGISTRERT

7-5 NOV. 1974

Foraminifera

Ostracoda

Miospores

Microplankton

Other fossils

Foraminifera

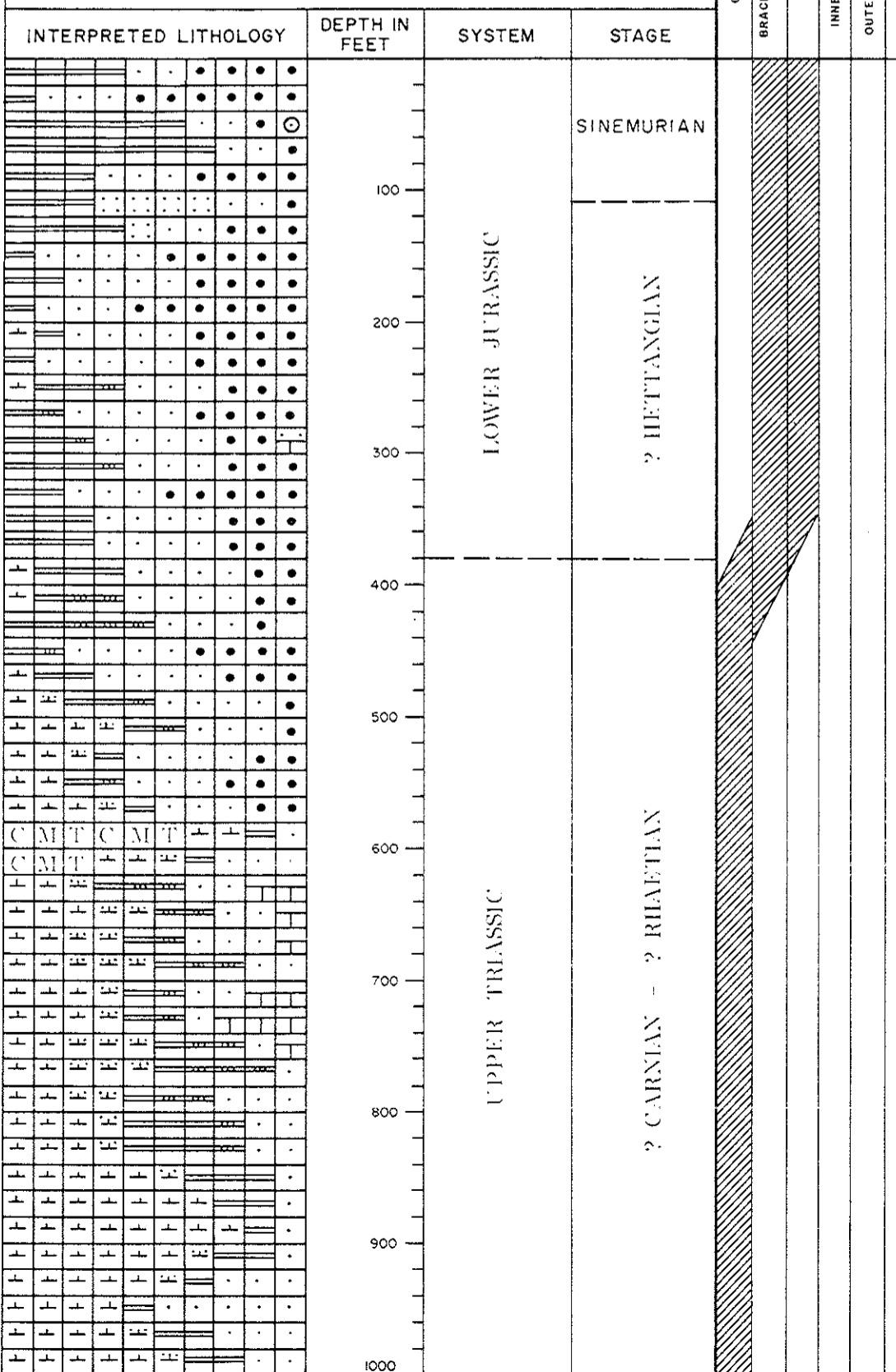
Ostracoda

Miospores

ROBERTSON RESEARCH INTERNATIONAL LTD.
 BIOSTRATIGRAPHICAL ANALYSIS CHART

DATE: 15. 9. 74. CHART No. 9 LOCATION: Norwegian North Sea 33/12-2 Well
 FOR: Mobil Exploration Norway Inc. ANALYST: CGL, JWC, CWH, SJM.

LIMESTONE SANDSTONE COAL/LIGNITE CMT Cement
 DOLOMITE COARSE SAND Sphaerosiderite DIAGNOSTIC SPECIES
 WHITE CHALK CONGLOMERATE Calcareous sandstone/Sandy limestone REWORKED SPECIES R
 RED MARL OR SHALE GYPSUM/ANHYDRITE Kaolinite
 CLAY SALT Silty/Sandy red shale
 SHALE CHERT
 SILTY/SANDY SHALE PYRITE
 SILTSTONE GLAUCONITE



ENVIRONMENT	% FORAMINIFERAL ASSEMBLAGES		MICROFOSSILS
	CONTINENTAL BRACKISH / DELTAIC / LAGOONAL LITTORAL	INNER SUBLITTORAL OUTER SUBLITTORAL BATHYAL	
	X	X	Lenticulina varians
	X	X	Ammodiscus asper
	X	X	Dentalina terquemi
	X	X	? Lingulina aff. Imbecolata
	X	X	Vaginulina sp.
	X	X	Planularia sp.
	X	X	Gemitzinita tenera tenera
	X	X	Pseudoglandulina sp.
	X	X	Dentalina sp.
	X	X	Dentalina aff. tenuistriata
	X	X	Haplophragmoides sp.
	X	X	? Trochammina sp.
	X	X	? Marginulina prima
	X	X	Hungarella sp. A (APOSTOLESCU)
	X	X	Balrdia sp.
	X	X	Classopolis torosus
	X	X	Cerebropollenites mesozoicus
	X	X	Parvisaccites enigmatus
	X	X	Chasmatosporites major
	X	X	Lycopodiumsporites semimuris
	X	X	Osmundacidites wellmanni
	X	X	Stereosporites psilatus
	X	X	Brachysaccus microsaccus
	X	X	Granulatisporites subgranulosus
	X	X	Lycopodiacidites rugulatus
	X	X	Corollina meyeriana
	X	X	? Tsugaepollenites minus
	X	X	Lycopodiuspollenites austroclavauitides
	X	X	Araucariacites australis
	X	X	Araucariacites ovalis
	X	X	Chasmatosporites apertus
	X	X	Pityosporites arcuatus
	X	X	Eucommidites trocissoni
	X	X	? Eucommidites minor
	X	X	Tigrisporites cf. halleinis
	X	X	Foraminisporis cf. jurassicus
	X	X	? Calliasporites turbatus
	X	X	Convolutispora sp.
	X	X	Tachiasporites sp.
	X	X	Spheripollenites cf. psilatus
	X	X	Ptilosporites cf. brevipapillosus
	X	X	? Cerebropollenites mesozoicus

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5 NOV. 1974

