



Continental Shelf Institute

Institutt for kontinentalsokkelundersøkelser

REPORT TITLE	
BIOSTRATIGRAPHY OF STATOIL 15/9-1 NORWEGIAN NORTH SEA WELL	
PE	
CONTRACTOR	
CONTRACTORS REF.:	JOB. NO.:
	0-62/1/77

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		RESPONSIBLE SCIENTIST	Løfaldli		

SUMMARY

Biostratigraphical analyses have been carried out on sample material from the interval 200m - 3734m in the Statoil 15/9-1 well. The stratigraphy is based largely on analyses of wet cuttings, but also some core-material and side wall cores have been examined. The results of these analyses based on foraminifera, nannofossils and palynomorphs are presented in this report, together with the environmental conclusion for each of the biozones. These investigations have revealed several hiatuses. A summary of the stratigraphical sequence in this well follows on page 1.

KEY WORDS

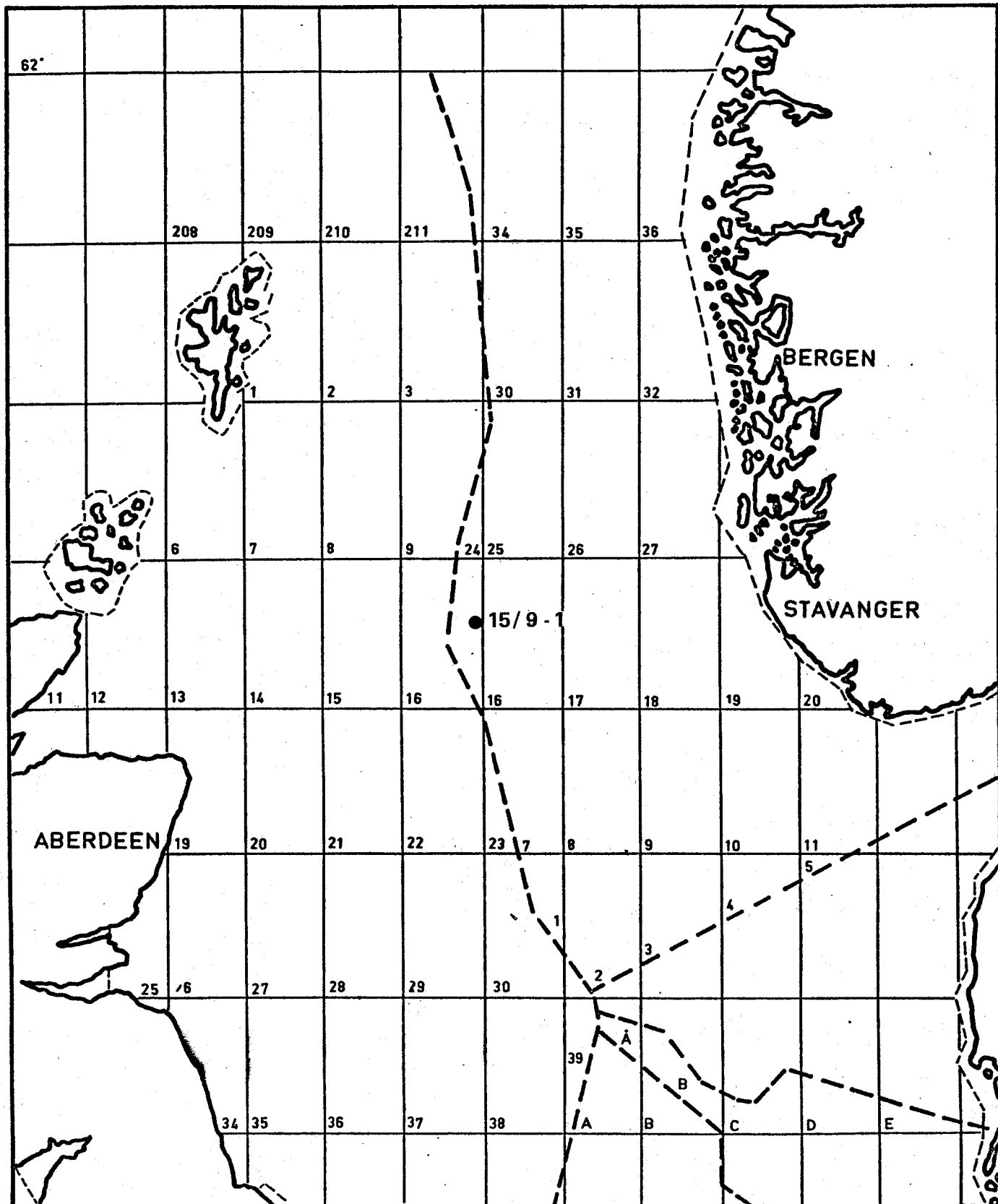
Biostratigraphy

North Sea

SUMMARY REPORT

INTERVAL (m)	THICKNESS (m)	STAGE/ZONE	SYSTEM
200-500	300+	Early Pleistocene	Quaternary
550-820	270±100	Pliocene	Tertiary
870-1110	240±80	Early Pliocene- Late Miocene	Tertiary
1140-1390	250±60	Miocene	Tertiary
1420-1810	390±40	Oligocene	Tertiary
1820-2020	200±60	Oligocene-Eocene	Tertiary
2070-2521	451±68	Eocene	Tertiary
2539-2785	246±21	Paleocene	Tertiary
2788-2980	192±11	Maastrichtian	Cretaceous
2988-3304	316±8	Post-Albian/Camp. probably Senonian	Cretaceous
3304-3350	46±	Early Albian	Cretaceous
3350-3385	35±3	Late Aptian	Cretaceous
✓ 3388-3522	134±11	Calloviaian	Jurassic
3530-3729	199±8	Bathonian/Bajocian	Jurassic
3729-3734	5+		?Triassic

LOCALITY MAP



STATOIL WELL 15/9-1

Introduction

The biostratigraphic zonation of Statoil well 15/9-1 is based on foraminifera, coccoliths, dinoflagellates, pollen and spores. Zonation of the Tertiary is based on foraminifera and to some extent coccoliths, whereas zonation of the Cretaceous is based on coccoliths and palynomorphs, with exception of the uppermost part where foraminifera are used. Zonation of the Jurassic is based exclusively on palynomorphs.

All taxa found of value to biostratigraphic and environmental interpretation are mentioned in faunal and floral lists, though only stratigraphical important taxa are mentioned on the stratigraphic chart.

A brief bibliography of the most important references used is given.

BIOSTRATIGRAPHY

QUATERNARY

Interval 200m - 500m. EARLY PLEISTOCENE

Foraminifera:

A calcareous, benthonic fauna is obtained from this interval. The fauna has a shallow-water character, and is dominated by Elphidium clavatum. Other foraminifera recorded in this unit are:

Elphidium incertum

Elphidium ustulatum

Cassidulina laevigata

Cassidulina crassa

Quinqueloculina seminulum

Oolina melo

Buccella frigida

Elphidium spp.

Protelphidium spp.

Trifarina spp.

TERTIARY

Interval 550m - 820m. PLIOCENE (270 m)

Foraminifera:

A quite rich fauna of calcareous, benthonic forms is obtained from this unit. The fauna has a shallow-water character and indicates an inner neritic condition. A Pliocene age is suggested by the occurrence of the benthonic species Cassidulina laevigata, Elphidium antonium, Nonion affine and Cibicides lobatulus, var. grossa. Other foraminifera found include:

Cassidulina subglobosa

Elphidium clavatum

Quinqueloculina seminulum

Elphidium incertum

Biloculinella globula

Miliolinella cf. enoplostoma

Trifarina spp.

Uvigerina spp.

Protelphidium spp.

Interval 870m - 1110m. EARLY PLIOCENE - LATE MIOCENE (240m)

Foraminifera:

A quite rich fauna of calcareous, benthonic forms have been found in this unit. The species Cassidulina laevigata, Ammonia batavus, Nonion affine, Elphidium antonium, Nonion boueanum and Cibicides lobatulus, var. grossa are quite common. The fauna suggests an inner neritic condition for this interval. Other foraminifera present include:

Dentalina vertebralis

Quinqueloculina seminulum

Pseudopolymorphina doanei

Dimorphina tuberosa

Listerella communis
Elphidium clavatum
Lenticulina vortex
Elphidium inflatum
Globulina gibba
Lenticulina calcar
Lenticulina peregrina
Marginulina costata
Marginulina filicostata
Bulimina elongata
Sigmoilina schlumbergeri

Interval 1140m - 1390m, MIOCENE (250m)

Foraminifera:

The fauna consists mainly of calcareous forms. The presence of the benthonic species Asterigerina staeschi, Bulimina elongata, Elphidium inflatum and Virgulina schreibersiana indicates a Miocene age of this unit. Other benthonic species include:

Nonion affine
Høglundina elegans
Cibicides lobatulus
Globobulimina cf. auriculata
Nonion boueanum
Gyroidina soldanii
✓ Sigmoilina cf. tenuis
Cassidulina crassa
✓ Ceratobulimina contraria
Pullenia bulloides
Cibicides akneriana
Lenticulina calcar
Lenticulina peregrina
Guttulina communis
Dentalina aciculata
Bolivina antiqua

Planktonic foraminifera present in this unit include Globigerina bulloides, Globoquadrina altispira, Globoquadrina

dehiscens and Globigerinoides trilobus.

The fauna mentioned above indicates a neritic environment for this interval.

Interval 1420m - 1810m. OLIGOCENE (390m)

Foraminifera:

A quite rich fauna of agglutinated and calcareous forms is obtained from this interval. This fauna infers an environment with open marine conditions, probably on the shelf. An Upper Oligocene age is suggested by the occurrence of Cibicides telegdi at 1440 m. The section below 1500 m is probably of Middle to Early Oligocene age since Rotaliatina bulimoides is present here. Other foraminifera recorded in this unit include:

Turrilina alsatica
Stilostomella adolphina
Høglundina elegans
Nonion affine
Ceratobulimina contraria
Pullenia bulloides
Asterigerina staeschi
Asterigerina gürichi
Gyroidina soldanii
Cibicides aknerianus
Eponides schreibersi
Alabamina tangentialis
Sphaeroidina bulloides
Sigmoilina cf. tenuis
Globorotalia siakensis
Globigerina bulloides

The upper limit of this interval is uncertain due to down-fallen Late Tertiary planktonic foraminifera.

Interval 1820m - 2020m. OLIGOCENE - EOCENE (200m)

Foraminifera:

The fauna consists mainly of agglutinated, long-ranging species and minor elements of calcareous forms. Species of the genera Cyclamina, Ammodiscus, Glomospira, Haplophragmoides, Bathysiphon, Saccamina and Psammosphaera occur together with some specimens of the calcareous forms Høglundina elegans and Asterigerina staeschi. A few specimens of the planktonic species Globigerina bulloides are also found.

Interval 2070m - 2521m. EOCENE (451m)

Foraminifera:

The poor fauna consists mainly of agglutinated long-ranging species of the genera Ammodiscus, Bathysiphon, Cyclamina, Glomospira and Haplophragmoides. In addition to these species, a few planktonic forms are found. The presence of Globigerina linaperta, Bathysiphon eocenicus and Cyclamina amplexans suggests an Eocene age for this interval. This fauna indicates a bathyal environment of deposition.

Nannofossils:

At 2521m, a characteristic early Eocene nannoflora was found with:

Discolithina plana
Sphenolithus radians
Neococcolithus dubius
Neococcolithus concinnus
Zygrhablithus bijugatus

Interval 2539m - 2785m. PALEOCENE (246m)

Foraminifera:

The poor fauna generally consists of agglutinated foraminifera of little stratigraphic value. Species of the genera Ammodiscus, Glomospira, Cyclamina, Trochamminoides, Recurvoides, Haplophragmoides, Bathysiphon and Dendrophrya are found.

Planktonic foraminifera are present in the lowermost part of the unit. The presence of Globorotalia pseudobulloides at 2785m, suggests that this part of the section is of Early or Middle Paleocene age. Planktonic forms restricted to the Danian are not recorded, suggesting that the Danian may be absent. Species of the benthonic genera Lenticulina and Gavelinella are represented in the lowermost part of the sequence. Reworked Late Cretaceous foraminifera also occur in the lower part of the unit. The fauna present indicates an open marine environment, probably a bathyal condition in the upper part.

Nannofossils:

From 2692 to 2770m, both Cretaceous and Paleocene nannoplankton were found. Cretaceous forms are restricted to a few very common and relatively resistant species, suggesting that they are reworked into Paleocene sediments. These forms are: Neococcolithus protenus, Crucilacolithus tenuis and Rhomboaster cuspis.

CRETACEOUS

Interval 2788m - 2980m. MAASTRICHTIAN (192m)

Foraminifera and nannofossils indicate a Maastrichtian age for this interval. Environment, open marine.

Foraminifera:

Important stratigraphic markers within this unit include Heterohelix globulosa, Pseudotextularia elegans, Globotruncana contusa, Pseudoguembelina excolata and Stensioina pommerana. Other foraminifera present include species of the genera Gavelinella, Gyroidinoides, Pullenia, Lenticulina, Haplophragmoides and Ammodiscus.

Nannofossils:

The presence of Nephrolithus frequens at 2801m indicates a Late Maastrichtian age. Other nannofossils present in this unit:

Archangelskiella cymbiformis
Eiffellithus turriseiffelli
Prediscosphaera cretacea
Micula staurophora
Lucianorhabdus cailleuxi
Eiffellithus anceps
Cretarhabdus surirellus
Zeugrhabdotus diplogrammus
Microrhabdulus decoratus
Tetralithus obscurus
Cretarhabdus crenulatus
Reinhardtites levis

Interval 2988m - 3304m. POST-ALBIAN/CAMPANIAN, probably
SENONIAN (316m).

This interval yielded only poor and undiagnostic nannofossils, dinoflagellates and pollen. Samples at 2998 and 3028m indicate a Campanian age. Palynofloras at 3286 - 3291m and 3301 - 3304m indicate a general Late Cretaceous (post-Albian) age. We consider the interval as probably Senonian. Environment: Open marine.

Nannofossils:

A Campanian age is indicated at 2998m with the arrival of Cribrosphaera ehrenbergi. This age is supported by the constant presence of Watznaueria spp. from 3028 downward. As a whole, the nannoflora of this interval is poor.

A pre-Maastrichtian, Late Cretaceous age is all that can be said with certainty. The data are insufficient to indicate stratigraphical hiatuses.

Nannofossils found include:

Archangelskiella cymbiformis
Eiffellithus turriseiffelli
Prediscosphaera cretacea
Micula staurophora
Cretarhabdus surirellus
Tetralithus obscurus
Cretarhabdus crenulatus

Cribrosphaera ehrenbergi

Cretarhabdus conicus

Watznaueria spp.

Palynology

Palynological analyses were carried out only on the lower part of this interval. At 3301 - 3304m considerable amounts of wood fragments and coaly matter were recorded. This indicates a transgressive phase and a probable stratigraphic hiatus. Assemblages at this level and above contain very few palynomorphs of value in biostratigraphy. However, triporate pollen and the dinoflagellate cyst Palaeohystrichophora infusorioides sensu stricto were recovered at 3286 - 3291m. Although these forms are known from the late Vraconian (latest, Late Albian) they are uncommon before the Cenomanian and later Senonian deposits. This, together with the absence of other typical Late Albian species, indicates a post-Albian age at this level.

The magnitude of the stratigraphic hiatus, which may be quite considerable, can not be estimated on the basis of the palaeontological evidence available. The latest known occurrence of P. infusorioides is in the Middle/Late Campanian.

This interval is tentatively referred to the Senonian.

Interval 3304m - 3350m. EARLY ALBIAN (46m)

Nannofossils indicate an Albian age for this interval, whilst dinoflagellates indicate a general Late Aptian/Early Albian age. Nannofossils found include:

Parhabdolithus splendens

Nannoconus 108

Tetralithus gothicus

Ahmueллерella octoradiata

Diazomatolithus lehmani

Parhabdolithus asper

Dinoflagellates:

The following species were recorded from this interval:

Apteodinium grande
Palaeoperidinium cretaceum
Cyclonephelium compactum
C. distinctum
Cassiculosphaeridia reticulata
Dictyopyxidia imperfecta
Exochosphaeridium striolatum
Gonyaulacysta cassidata
G. confossa
Cribroperidinium edwardsi
Hystriochodinium pulchrum
Hystriochosphaeridium tubiferum
Odontochitina operculata
O. costata
Oligosphaeridium complex
Prolixosphaeridium granulatum
Scriniodinium campanula
S. rostratum
Litosphaeridium sp.?
Cauca parva
Hystriochodinium voighti
?Microdinium crinitum

The consistent presence of C. parva and P. cretaceum in this assemblage is indicative of a Late Aptian to Early Albian age for this interval.

The combination of nannofossil and dinoflagellate occurrence is taken as conclusive evidence of an Early Albian age for this interval.

Environment: Shallow marine.

Interval 3350m - 3385m. LATE APTIAN (35m)

Aptian nannofossils and Late Aptian/Early Albian dinoflagellates are present in this interval.

Nannofossils:

At 3361m, a characteristic Aptian association is present with Cornusphaera mexicana, Micula infracretacea, Staurolithites matalosus and Nannoconus 84.

Other nannofossils present are:

Watznaueria spp.

Parhabdolithus asper

Micrantholithus hoschulzi

Below 3361m, the paucity of nannofossils prevent a continuous stratigraphic control.

Palynology:

Rich dinocysts assemblage recorded from this interval is characterized by the presence of Cassiculosphaeridia reticulata. C. reticulata range from Aptian to Cenomanian. Most other species recorded are known to range from Aptian to Albian. The assemblage can be confidently dated as Late Aptian to Early Albian, on the presence of the following species:

Apteodinium grande

Palaeoperidinium cretaceum

Cyclonephelium compactum

C. distinctum

Cassiculosphaeridia reticulata

Exochosphaeridium striolatum

Gonyaulacysta cassidata

G. confossa

Cribroperidinium edwardsi

Hexagonifera chalamydata

Hystrichodinium pulchrum

Hystrichosphaeridium tubiferum

Litosphaeridium siphoniphorum (single specimen)

Odontochitina operculata
O. costata
Oligosphaeridium complex
Pareodinia ceratophora
Prolixosphaeridium granulosum
Scriniodinium campanula
S. rostratum
Spiniferites cingulatus

Environment: Open marine.

*Kimmeridgian 2.
3m 2.*

JURASSIC

Interval 3388m - 3522m. CALLOVIAN (134m)

Cores and cuttings yielded a sparse dinocyst microflora. The taxa recorded are not known to be restricted to the Callovian with the exception of Lithodinia deflandrei. Dinoflagellates from the upper part of this interval (3388m - 3409m) suggest a possible Early Oxfordian age. The following taxa are recorded from this interval:

Gonyaulacysta jurassica
Scriniodinium oxfordianum
S. dictyotum
S. crystallinum
Adnatosphaeridium aemulum
Lithodinia deflandrei
Wanaea digitata
Valensiella cf. vermiculata
Chytroeisphaeridia chytroides
Cleistosphaeridium spp.
Tenua rioulti
Pareodinia spp.
Sirmiodinium grossi
Leptodinium cf. subtilum

Environment: Marine, near shore.

Interval 3530m - 3729m. BATHONIAN/BAJOCIAN (199m)

3530m to 3626,80m. BATHONIAN

3643m to 3729m. ?BAJOCIAN/BATHONIAN

At 3530m there is a change in palynofacies suggesting near shore marine conditions above in contrast to the deltaic conditions below: The number of pollen and spores and other remains of landplants increase. At 3568m and 3576m samples contain reworked Late Triassic palynomorphs.

What remains
- these are
reworked?
explanation

At 3591-3594m, and 3618-3621m non-marine samples are poorer in palynomorphs of a clearly higher coalification rank, indicating deposition very close to the shore line.

Dinoflagellates:

Tenua baculata

Spores and pollen:

✓ Cerebropollenites mesozoicus

Diverse bivesiculate coniferous pollen grains

Podocarpidites rousei

Classopollis classoides

Cycadopites nitidus

Exesipollenites

Eucommiidites minor

Eucommiidites troedsonii

Callialasporites spp.

Concentrisporites hallei

Perinopollenites elatoides

Chasmatosporites apertus

Chasmatosporites sp.

Lycopodiumsporites semimurus

Lycopodiumsporites austroclavatoides

Corrugatisporites amplexiformis

Leptolepidites equatibossus

Environment: Inner deltaic.

Interval 3643-46m to 3726-29m contains samples of a lower coalification rank than those recorded in the above lying interval.

} Superior

Dinoflagellates (& Acritarchs): Veryhachium/Micrhystridium.

Spores and pollen:

The same assemblage as for the interval 3530m to 3618m.

Environment:

Inner deltaic conditions for most of this interval though acritarchs and rare dinoflagellates indicate episodes of restricted marine (brackish) conditions.

(barren)

Interval 3729m - 3734m and downwards. TRIASSIC (tentative)

There is a marked lithological change from the above lying interval: A light grey/white sandstone. This sandstone yielded no palynomorphs except cuticle fragments of Mesozoic leaves.

Other palynomorphs recorded from routine preparation of the cuttings yield assemblages similar to the above interval (3530m to 3726m).

There is no evidence of Liassic deposits, we suggest a hiatus between the Middle Jurassic and the barren sandstone, which is probably of Triassic age.

Environment: ?

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Nannofossil references

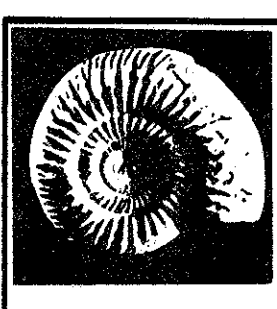
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STRATIGRAPHIC ANALYSIS

CHART NO. 2

COMPANY: STATOIL	JOB No.: 0 - 7762	LITHOLOGY: OSTRACODS:	COCCOLITHS:
WELL No.: 15 / 9 - 1	DATE: 24 / 6 - 77	FORAMS: PALYNOLOGY:	SYNTHESIS:

<p>SANDSTONE </p> <p>SILTY SST </p> <p>SILTSTONE </p> <p>SHALE </p>	<p>CONG/BRECCIA </p> <p>LIMESTONE </p> <p>DOLomite </p> <p>MARL </p>	<p>SAMPLES</p> <p>○ Cuttings</p> <p>□ Core</p> <p>▽ Sidewall Core</p>	<p>PALEO. EVIDENCE OF CAVING</p> <p>▼ Paleo. evidence of caving</p> <p>C Carbonaceous debris</p> <p>G Glauconite</p> <p>M Mica</p>	<p>CONFIDENCE</p> <p>— High</p> <p>- - - Medium</p> <p>..... Low</p>
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DEPTH IN METERS	LITHOLOGY	SAMPLE	REMARKS SCALE: 1:2500	STRATIGRAPHICALLY IMPORTANT SPECIES			PALEOECOLOGICAL SYNTHESIS & REMARKS	CONFIDENCE	AGE	
				NANNOFOSSILS	DINOFLAGELLATES	SPORES/POLLEN			SUBSTAGE / ZONE	PERIOD
2100										
2125										
2150										
2185										
2200										
2230										
2250										
2280										
2300			POOR							
2330										
2350										
2380			FORAMINIFERA							
2400										
2432										
2450										
2485			FAUNA							
2500										
2521										
2540										
2550										
2600										
2615										
2645										
2650										
2695										
2700										
2720										
2750										
2770										
2785			HIATUS							
2795										
2810										
2820										
2835										
2850										
2880										
2900										
2932										
2950										
2977										
2980										
2989										
2998										
3000										
3028										
3050										
3052										
3064										
3100			POOR							
3103										
3115										
3148			PALYNO - AND							
3193										
3200										
3226			NANNOFLORAS							
3250										
3286			Transgressive facies							
3301			HIATUS							
3331										
3343										
3352			Late Cret. downfall							
3361										
3370			HIATUS							
3388										
3400										
3450			RICH IN AMORPHOUS ORGANIC DEBRIS							
3460										
3481										
3493										
3526										
3530										
3550										
3568										
3576										
3600										
3618			CALLOVIAN							
3626,8										
3643,4										
3650			Transgressive facies							
3666			DOWNFALL							
3693										
3708										
3726										
3729			HIATUS							
3732										
3732										
3750										

BATHYAL EOCENE

OPEN MARINE MAASTRICHTIAN

SHALLOW MARINE ELY-M. POST-ALB TO CAMPANIAN (? SENONIAN) EARLY CRETACEOUS

RESTRICTED MARINE CALLOVIAN LATE CRETACEOUS

DELTAIC DELTAIC / BATHONIAN MIDDLE JURASSIC

DELTAIC (INNER) BAJOCIAN / BATHONIAN MIDDLE JURASSIC

NON - MARINE ? TRIASSIC