

Denne rapport  
tilhører



L&U DOK. SENTER

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KODE *well 3410-7 nr11*

Returneres etter bruk



**PALEOSERVICES**



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ENCLOSURES

1. STRATIGRAPHICAL LOG  
(Scale 1:500)  
1500-2250m T.D.



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1. INTRODUCTION.

This report presents the results of the stratigraphical and palaeontological study of samples from Well 34/10-7 drilled by Statoil in the North Sea (Norwegian offshore) during 1980.

The information presented is based on the analysis of ditch samples collected at 5m intervals between 1500m and 1575m and 3m intervals between 1575m and 2250m T.D. Eighty seven sidewall cores were analysed between 1715m and 2245m; seven other sidewall cores received were unlabelled and so unusable. Twenty four core samples were received and analysed.

A total of sixty three samples (thirty seven sidewall cores, fourteen ditch samples and twelve core samples) have been examined for palynology from the interval 1806m - 2250m.

Interval tops are taken from sample depths, although petrophysical logs were provided by Statoil.

A stratigraphical/palaeontological log (Scale 1:500) is presented with this report.



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2. CONCLUSIONS.

1. The highest sample included in this study (1500m) is of Early Eocene age.
2. Claystone and tuffaceous claystone (1510-1560m) characterise the North Sea 'Ash Marker' which is of basal Eocene-Late Paleocene age. Deposition of these sediments was in a marine, outer sublittoral to bathyal environment with contemporaneous vulcanicity.
3. The Paleocene section (1560-1666m) comprises claystone and sandy claystone deposited in a restricted marine, outer sublittoral to bathyal environment.
4. The absence of Middle & Early Paleocene fossils indicates that rocks of this age are missing and that the Late Paleocene rests unconformably on top-most Cretaceous (Late Maastrichtian) at 1666m.
5. Richly fossiliferous claystone and occasional limestone (1666m-1806m) characterise the Late Cretaceous section, which in this well, include beds of Maastrichtian and possibly Campanian age. Deposition was in a marine, outer sublittoral to bathyal environment.
6. The Late Cretaceous (Maastrichtian - ?Campanian) section rests unconformably on the Early Jurassic (Early Toarcian - Late Pliensbachian) at Ca.1806m.
7. The youngest Jurassic rocks are represented by the Cook Member of the Dunlin Formation and are dated as Early Toarcian-Late Pliensbachian. The Dunlin section (1806-2053m) in this well includes beds of Early Toarcian-Early Pliensbachian age and comprises sandstone, siltstone, claystone and limestone with a prominent level with oolites at 1954m.



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8. Palynological evidence suggests that the upper part of the Statfjord Formation (Ca.2053-2062m) is not older than Sinemurian in age; however biostratigraphical evidence for the age of the section below 2062m is very limited.



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3. STRATIGRAPHICAL SUMMARY.

<u>Interval</u>	<u>Age</u>	<u>Thickness</u>
1500m - 1510m F.S.E.	Early Eocene	10m
1510m - 1560m	Early Eocene - Paleocene	50m
1560m - 1666m	Paleocene	106m
--- ? --- ? --- ? ---	Unconformity --- ? --- ? --- ?	-----
1666m - 1693m	Late Cretaceous, Late Maastrichtian	27m
1693m - 1806m	" " Maastrichtian - ?Campanian	113m
-----	Unconformity -----	-----
1806m - 1837m	Early Jurassic, Early Toarcian - Late Pliensbachian	31m
1837m - 2023m	" " Late Pliensbachian	186m
2023m -Ca.2053m	" " Early Pliensbachian	30m
--- ? --- ? --- ? ---	Unconformity --- ? --- ? --- ?	-----
Ca.2053m-2250m T.D.	Early Jurassic - ?Late Triassic ?Sinemurian-Hettangian-?Rhaetian.	197m



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4. STRATIGRAPHY.

This discussion supplements the information presented on the stratigraphical log (Enclosure 1). The lithology and biota are described and the age and depositional environment interpreted.

4.1 1500m-1510m EARLY EOCENE.

Lithology:

Claystone, green, occasionally brown; some brown limestone.

Biostratigraphy:

The planktic foraminiferid *Globigerina* gr. *triloculinoides* is present in this interval and marks a regional event of Early Eocene age.

Environment:

Marine, outer sublittoral to bathyal.

4.2 1510m-1560m EARLY EOCENE - LATE PALEOCENE.

Lithology:

1510m-1530m As above, occasionally tuffaceous and sideritic.

1530m-1560m Claystone, tuffaceous and sideritic, green and occasionally brown, often sandy.

Biostratigraphy:

Fossils are rare, but the appearance of *Coscinodiscus* sp.1 in association with tuffaceous claystones indicates the North Sea "Ash Marker" which is of Early Eocene - Late Paleocene age.

Environment:

Marine, outer sublittoral to bathyal with contemporaneous volcanic activity.





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4.3 1560m-1666m PALEOCENE.

Lithology:

1560m-1591m Claystone, dark green; rare beds of brown limestone.

1591m-1666m Claystone, dark green, often sandy; beds of sand, fine-medium grained, angular, with limestone, grey and dolomite, brown.

Biostratigraphy:

This interval is recognised regionally by the highest occurrence of a diverse fauna of agglutinating foraminiferids which consistently includes *Bolivinopsis spectabilis*.

The absence of Middle and Early Paleocene fossil markers indicates that rocks of these ages are missing.

Environment:

Marine, outer sublittoral to bathyal; possibly restricted.

4.4 1666m-Ca.1806m LATE CRETACEOUS (Maastrichtian-?Campanian).

Lithostratigraphy:

Shetland Group:

1666m-1699m Limestone, chalky, white and very light brown and claystone, grey with occasional pyrite and glauconite.

1699m-1789m Sample quality extremely poor due to the presence of cement and drilling mud additives. Claystone and occasional siltstone, grey; thin beds of light grey limestone; pyrite and occasional glauconite.



1789m-1806m As above together with sideritic claystone below 1798m and a white microcrystalline limestone at 1801m. The sidewall core at 1804m was taken in a claystone, light green, sandy, pyritic and micaceous.

Biostratigraphy:

1666m-1693m Late Maastrichtian.

The interval contains a diverse and abundant assemblage of foraminiferids which characterise the upper part of the Late Maastrichtian and include *Pseudotextularia elegans*, *Abathomphalus mayaroensis*, *Globotruncanella havanensis*, *Globotruncana contusa*, *Globigerinelloides messinae*, and *Rugoglobigerina rugosa*.

1693m-1806m Maastrichtian-?Campanian.

The top of this interval is recognised by the first downhole appearance of *Reussella szajnochae* which regionally occurs within the lower part of the Late Maastrichtian.

Age diagnostic foraminiferids become less common downhole but the presence of *Rugoglobigerina rugosa* and *Globigerinelloides messinae* in the lowest samples suggests that the interval is not older than Campanian. The highest occurrence of *Abathomphalus intermedius* (at 1774m) suggests an age at that depth of Late - "mid" Maastrichtian. As the latter is so close to the base of this interval this may suggest that the whole interval is not older than Maastrichtian.

Environment:

Marine, outer sublittoral to bathyal. Abundant planktic foraminiferids in the upper part indicate the influence of open sea currents while the increasing numbers of agglutinating foraminiferids downhole are typical of more restricted conditions.



4.5 Ca.1806m-Ca. 2053m EARLY JURASSIC (Early Toarcian-  
Early Pliensbachian).

Lithostratigraphy:

Dunlin Formation/Unit.

1806m-1900m Laminated sandstone, fine and fine - medium grained, angular to subangular; claystone and siltstone, grey, with fine lignitic debris, pyrite and mica.

1900m-1936m Lithologies as above together with brown limestone and more grey claystone.

1936m-1954m Claystone, grey, sandy, fine-medium grained and very fine grained, angular to subangular.

1954m-1990m Claystone, grey interbedded with limestone, brown; with ?chamositic/phosphatic oolites in the upper part.

1990m-2020m Dominantly cement with some grey claystone and brown limestone.

2020m-2053m Claystone, grey, occasional silty claystone and sandstone, very fine grained, micaceous.

Biostratigraphy:

1806m-1837m Early Toarcian - Late Pliensbachian.

Microflora:

Eight samples (three SWCs and five core) have been examined and contained rich assemblages of palynomorphs. The dinoflagellate cyst *Nannoceratopsis gracilis* is present throughout together with acanthomorph acritarchs.

The dinoflagellate cyst *Mancodinium semitabulatum* is also present.



The spore/pollen assemblages are dominated by Chasmatosporites spp., Classopollis spp., bisaccate pollen and Cereboropollenites mesozoicus.

Between 1,806 and 1,818m small, (<30 u) Inaperturopollenites/Spheripollenites spp. are abundant. These represent a palynoevent seen in previous wells in the area, and which according to Morbey (1978) is characteristic of the Early Toarcian.

Microfauna:

Barren.

Macrofauna:

Bivalve fragments were collected from the cores by Statoil geologists but they are too poorly preserved to be identified.

1,837m-2,023m Late Pliensbachian.

Microflora:

Seven core, thirteen SWCs and one ditch sample have been examined. Rich and diverse assemblages of palynomorphs are present throughout dominated by spores/pollen, but dinoflagellate cysts and acritarchs are consistently present.

The dinoflagellate *Nannoceratopsis gracilis* is consistently present in abundance down to and including 1,935m; below this it has only been observed at 1,986m, where it occurs commonly. *Mancodinium semitabulatum*, is present down to 1,890m. Acanthomorph acritarchs and *Crassosphaera* spp. occur throughout.

The presence of *N. gracilis* down to 1,986m, is consistent with a Late Pliensbachian age for this interval.



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The spore/pollen assemblages are similar to those from the overlying interval and are dominated by Chasmatosporites spp., bisaccate pollen and Osmundacidites/Baculatisporites spp. Cerebropollenites cf. thiergartii is consistently present and abundant below 1,925m. Other taxa present include Lycopodiacidites rugulatus (below 1,935m) and Kraeuselisporites reissingeri (1,857.25 and below).

Reworking of Carboniferous and Late Triassic sediments is indicated by the presence in small numbers of Lycospora spp., Densosporites spp., Limbosporites lundbladii and striate bisaccate pollen.

Microfauna:

The highest occurrence of the ostracod genus Ogmoconchella has consistently been used in Paleoservices Ltd., reports in this area as indicating a Late Pliensbachian age although the genus has occasionally been found on land in the earliest Toarcian.

The following are regionally persistent faunal markers within the Late Pliensbachian which occur in this well.

- 1,837m Top Ogmoconchella spp.
- 1,909m Top Ogmoconchella aequalis (large form) with gastropods.
- 1,939m Top Ogmoconcha amalthei amalthei
- 1,954m Top Ogmoconchella transversa and consistent Dentalina matutina.
- 1,984m Top Wicherella semiora (probably within the lower part of the A.margaritatus ammonite zone).



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Macrofauna:

Bivalve fragments from the upper part of this section were collected from cores by Statoil geologists but are too poorly preserved for identification.

Interval 2,023m-Ca.2,053m Early Pliensbachian.

Microflora:

The palynofloras obtained from the five SWCs examined are dominated by spores/pollen, with microplankton (acanthomorph acritarchs) present in small numbers. The spore/pollen assemblages comprise long ranging forms and are dominated by *Classopollis* spp., bisaccate pollen and *Osmundacidites/Baculatisporites* spp. *Cerebropollenites* cf. *thiergartii* is common to abundant.

Rare specimens of *Zebrasporites interscriptus* are present at 2,021.5 and 2,031m.

No age-restricted taxa are present, but the absence of *Nannoceratopsis gracilis* is consistent with an Early Pliensbachian age.

Microfauna:

The first downhole occurrence of *Gammacythere ubiquita* at 2,023m indicates the penetration of the Early Pliensbachian. It may occur higher as poor samples, composed mainly of cement, are present between 1,990m and 2,023m.

Sample quality is also extremely poor in the lower part of this interval. Two regional markers, top *Kinkelinella* spp. and *Ogmoconcha* spp. (inc. *O. danica*, *O. contractula* and *O. amalthei*) are absent. This may be due to the poor samples or the absence of this section.

Environment:

Marine, sublittoral, mainly inner, sublittoral.



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- 4.6 Ca.2,053m-2,250m T.D. EARLY JURASSIC-?LATE TRIASSIC.  
(?Sinemurian-Hettangian-?Rhaetian).

Lithostratigraphy:

Statfjord - Cormorant Formations.

2,053m-2,167m Sand/sandstone, medium to coarse and occasionally gravelly, dominantly angular; occasional beds of claystone, brown, often lignitic and sideritic below Ca.2,116m occasionally varicoloured.

2,167m-2,250m Sand/sandstone as above and often pink, together with claystone and siltstone, red occasionally varicoloured grey, green, brown and red.

Biostratigraphy:

Interval Ca.2,053m-2,250m T.D. ?Sinemurian-Hettangian-  
?Rhaetian.

Microflora:

Fifteen SWCs and thirteen ditch samples have been examined from this interval. The palynological evidence for the age of this interval is extremely limited, but comparable intervals in other wells in the area have been dated as being of Sinemurian to Rhaetian age.

Palynomorphs have only been recorded from seven of the SWCs, and with the exception of the SWC at 2,062m, are present only in very small numbers and in these cases the possibility that the palynomorphs are the result of drilling mud contamination cannot be ruled out. The low palynomorph productivity of these samples is a result of their lithology.



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The SWC at 2,062m contains a rich microflora, of limited diversity comprising spores and pollen dominated by long ranging taxa i.e. *Cyathidites* spp., bisaccate pollen and *Araucariacites* spp. Rare specimens of *Cerebropollenites mesozoicus* are also present and suggest an age not older than Sinemurian at this level. Very rare palynomorphs are present in the SWC at 2,083m and include a form very tentatively identified as *Ovalipollis ovalis*, which suggests penetration of strata not younger than Hettangian in age.

The presence of a single specimen of *Quadraeculina anellaeformis* in the SWC at 2,181.4m, if in place and not the result of drilling mud contamination, indicates an age not older than Rhaetian.

The thirteen ditch samples examined yielded microfloras composed of taxa which have all been observed higher in the well; no taxa which definitely indicate an Hettangian or older age have been observed.

Microfauna:

Rare ostracods and foraminiferids are present but are presumed caved.

Environment:

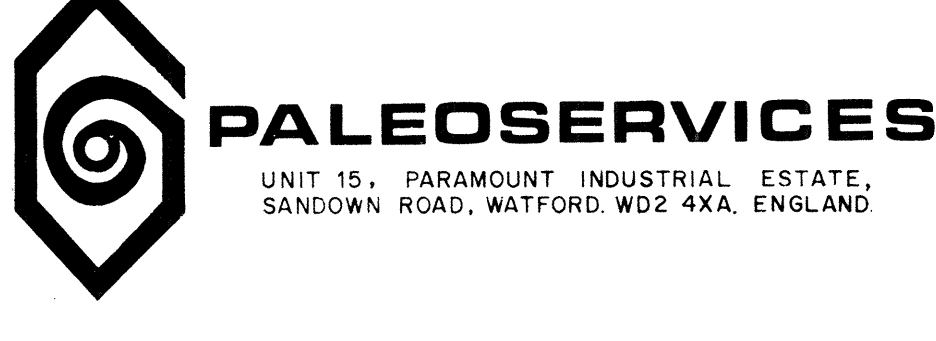
Marine, "nearshore" - paralic, passing downwards to continental, alluvial.





WELL 34/10-7
1500 m. - 2250 m.
NORWEGIAN OFFSHORE
STRATIGRAPHIC LOG

SCALE 1:500



LEGEND

- CLAY/CLAYSTONE, SHALE, MARL - CALCAREOUS SHALE, SILTSTONE/SILT, MEGAFOSSILS, CHERT, PYRITE, SANDSTONE, CONGLOMERATE, VOLCANICS LAVAS/TUFFS, UNDIFFERENTIATED BASEMENT, NO DITCH SAMPLES, LAUCONITIC, SIDERITE, LIGNITE/COAL, LIMESTONE, CHALK, DOLOMITE, CEMENT, AMHYDRITE/GYPSUM, FOSSILS AND ACCESSORY MINERALS (Abundant, Common, Rare, Abundant, Common, Rare, Ditch cuttings, Core, S.W.C.), FOSSILS IN SIDEWALL CORES/CORES, PALYNOLOGICAL ANALYSES

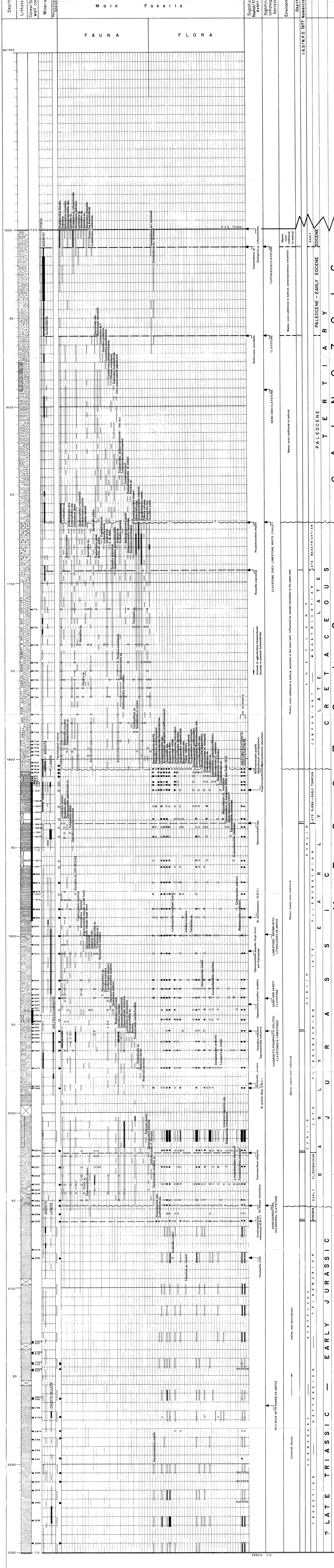


Table with columns: Depth (metres), Lithology, Cores/Side-wall cores, Minerals, Palynology, Main Fossils (Fauna, Flora), Significant lithological horizons, Environment, Depths, Age (Cretaceous, Paleocene, Eocene, Paleogene, Neogene, Quaternary)