

STATOIL

WELL 34/10-12
(1,600m-2,800m T.D.)

NORWEGIAN OFFSHORE

PALEONTOLOGICAL/
STRATIGRAPHICAL FINAL REPORT

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KODE Well 34/10-12 nr

Returneres etter bruk





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ENCLOSURES

1. Stratigraphic Log 1,600m-2,800m (Scale 1:500)



1. INTRODUCTION

This report presents the results of the stratigraphical and paleontological study of samples from Well 34/10-12 drilled by Statoil in the North Sea (Norwegian offshore) during 1981.

The information presented is based on analyses as recommended in our telex dated 31.7.81. and accepted by Max Eien of Statoil in a telex dated 21.8.81. (No. 13412/81-F). The last samples for analysis were received by Paleoservices Ltd on 3.12.81. Conventional microfauanal and lithological analyses were carried out on ditch cuttings at an average interval of 3m from 1,600m to 2,800m (total 259) and 20 on sidewall cores between 1,977m and 2,794.8m. A total of 100 samples, (16 sidewall cores between 1,977m and 2,794.8m, 82 ditch cuttings between 1,996m and 2,800m, and two cores samples at 2,038.4m and 2,039.75m) have been examined for palynology from the interval 1,977m to 2,800m.

Petrophysical logs were provided by Statoil but in all cases boundaries are based solely on the samples provided.

The Stratigraphical Log (scale 1:500) is presented with this report and a Sedimentary History diagram (Fig.1) is included in the report.



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2. CONCLUSIONS

1. The first sample included in this study, at 1,600m, is a claystone of Eocene age.
2. The Eocene section studied (1,600m-1,633m), comprises mainly claystone with agglutinating foraminiferids, deposited in a marine, outer sublittoral to bathyal, environment.
3. The interval 1,633m-1,687m comprises tuffaceous claystone and is the North Sea 'Ash Marker' which is Early Eocene-Late Paleocene age.
4. Late - ?Middle Paleocene claystones and sands (1,687m-1,807m) contain common agglutinating foraminiferids typical of a marine, outer sublittoral to bathyal, environment.
5. The Late - ?Middle Paleocene sediments rest unconformably on those of Late Cretaceous (Maastrichtian) age at 1,807m. There is no paleontological evidence for the presence of definite Middle or Early Paleocene sediments in this sequence.
6. Only the upper part of the Late Cretaceous is present in this well and this comprises claystones of Maastrichtian to Campanian age. Deposition was in a marine, outer sublittoral to bathyal environment; the faunas recorded suggest an environment influenced by oceanic circulation in the upper part of the section; a more restricted environment lower in the sequence is indicated by the sparser fauna.



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7. Late Cretaceous (Campanian) sediments unconformably overlie those of Middle Jurassic (Bathonian - Bajocian) age at 2,014m.
8. The Brent Formation (2,014m-2,250m) in this well includes the Ness, Etive, Rannoch and Broom units and is dated as Bathonian - Bajocian. The samples in this interval are dominated by drilling mud additives resulting in an apparent absence of age diagnostic floras. The Ness unit comprises claystone and sandstone deposited in a transitional, probably fluvial, deltaic environment. The sands below contain a restricted microflora with common terrestrially-derived organic matter and are regionally considered to be mainly nearshore marine deposits.
9. The Dunlin Formation (2,250m-2,690m) in this well includes the Drake, Cook, Burton and Amundsen members and is dated by the fossils as Middle Jurassic, Early Bajocian (= Aalenian) to Early Jurassic, possibly Sinemurian. There are a number of faunal and floral markers throughout this interval which can be used in regional correlations. The Dunlin Formation was deposited in a marine, mainly inner sublittoral, environment.
10. Only the top of the Statfjord Formation (2,690m-2,800m) was penetrated in this well and was dated as Sinemurian. It comprises mainly sands deposited in a nearshore marine environment, with a sideritic claystone at the base indicating a non-marine, transitional, environment.



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3. STRATIGRAPHICAL SUMMARY

<u>Interval</u>	<u>Age</u>	<u>Thickness</u>
1,600m - 1,633m (F.S.E.)	Eocene	33m
1,633m - 1,687m	Early Eocene - Late Paleocene	54m
1,687m - 1,807m	Late - ?Middle Paleocene	120m
-----UNCONFORMITY-----		
1,807m - 1,840m	Late Cretaceous, Late Maastrichtian	33m
1,840m - 2,014m	Late Cretaceous, Late Maastrichtian - Campanian	174m
-----UNCONFORMITY-----		
2,014m - 2,235m	Middle Jurassic, Bathonian - Bajocian	221m
2,235m - 2,325m	Middle - Early Jurassic, Early Bajocian (=Aalenian) - Toarcian	90m
2,325m - 2,350m	Early Jurassic, Early Toarcian	25m
2,350m - 2,420m	Early Jurassic, Early Toarcian - Late Pliensbachian	70m
2,420m - 2,600m	Early Jurassic, Late Pliensbachian	180m
2,600m - 2,690m	Early Jurassic, Early Pliensbachian-?Late Sinemurian	90m
2,690m - 2,765m	Early Jurassic, Sinemurian	75m
2,765m - 2,800m (T.D.)	Early Jurassic, Early Sinemurian	35m



4. STRATIGRAPHY

This discussion supplements the information presented on the Stratigraphical Log (Encl. 1). The lithostratigraphy and biostratigraphy are described and age and depositional environments interpreted.

4.1 1,600m (F.S.E.) - 1,807m TERTIARY (Eocene - Paleocene).

Lithostratigraphy:

1,600m-1,633m Claystone, pale grey and green; rare tuffaceous debris.

1,633m-Ca.1,699m Claystone and tuffaceous claystone, grey.

Ca.1,699m-1,777m Claystone, grey and green-grey with some sand, fine and occasionally coarse grained, angular and subrounded. Occasional tuffaceous claystone present through much of this interval but it is probably caved from the overlying unit.

1,777m-1,807m Claystone, as above, with more sand, fine to coarse grained, angular to rounded.

Biostratigraphy:

1,600m-1,633m Eocene

This interval contains a diverse assemblage of foraminiferids including both "in-place" and caved taxa. The dominant fauna comprises agglutinating foraminiferids, including *Haplophragmoides eggeri*, *H. walteri*, *Bolivinosia spectabilis*, *Cyclamina placenta* and *Rhabdammina discreta*; this association is typical of the lower part of the Eocene in the northern North Sea. Radiolaria are common, especially below 1,606m.



1,633m-1,687m Early Eocene - Late Paleocene

Common silicified and pyritised diatoms, including *Coscinodiscus* sp.1 and *C.* sp.2, characterise this interval, which is referred to the North Sea 'Ash Marker' and is of Early Eocene to Late Paleocene age.

1,687m-1,807m Late - ?Middle Paleocene

The top of this interval is recognised by the re-appearance downhole of common agglutinating foraminiferids, including many of the taxa which were present in the Eocene, together with *Rzehakina* sp., *Recurvoides* sp., *Pelosina complanata*, *Trochammina* sp. and common *Bolivinosia spectabilis*.

No fossils of definite Middle and Early Paleocene age are present.

Environment:

1,600m-1,633m Marine, outer sublittoral to bathyal. The fauna of agglutinating foraminiferids is typical of a 'deepwater' environment with restricted circulation near the sea bed. The presence of radiolaria suggest 'open-marine' circulation in the upper part of the water column.

1,633m-1,687m Marine, sublittoral to bathyal, with contemporaneous volcanic activity.

1,687m-1,807m Marine, outer sublittoral to bathyal. The fauna of agglutinating foraminiferids is typical of a 'deepwater' environment with restricted circulation near the sea bed. The sands in this interval were probably introduced by turbidity currents.



Remarks:

The Late - ?Middle Paleocene probably rests unconformably on the Late Cretaceous (Late Maastrichtian) at 1,807m.

4.2 1,807m-2,014m LATE CRETACEOUS (Maastrichtian - Campanian)

Lithostratigraphy:

Shetland Group

Claystone, grey, calcareous in the upper part, occasional glauconite and pyrite. Thin beds of limestone, brown, below Ca. 1,960m.

Biostratigraphy:

1,807m-1,840m Late Maastrichtian

The interval contains an abundant and diverse fauna of planktic and benthic foraminiferids. The planktics include *Pseudotextularia elegans*, *Racemiguembelina fructicosa*, *Globotruncana contusa*, *Globotruncanella havanensis* and *Abathomphalus mayaroensis* and indicates a Late Maastrichtian age. Benthic taxa include occasional agglutinating species and calcareous species including *Stensioeina pommerana*, *Bolivina incrassata* and *Eponides beisseli*.

1,840m-2,014m Late Maastrichtian - Campanian

Microfauna: The top of this interval is taken at the first downhole occurrence of *Reussella szajnochae*, a regionally consistent marker in the lower part of the Late Maastrichtian.

There is a large sample gap between 1,849m and 1,870m, but below 1,876m calcareous foraminiferids become scarcer and agglutinating species more common. The fauna is sparse in the lowest part of the interval and there is no evidence of any of the regional faunal markers below the Campanian.



Microflora: A rich and diverse assemblage of dinoflagellate cysts and spores/pollen, associated with common humic kerogen, is present in the sidewall core samples examined at 1,977m and 2,012.5m respectively. The presence of the dinoflagellate cysts *Odontochitina operculata*, *Palaeohystrichophora infusorioides* and *Diconodinium firmum*, in association with the pollen *Aquilapollenites* spp. indicates the penetration of sediments of Campanian age.

Environment:

Marine, outer sublittoral to bathyal. The association of calcareous planktic foraminiferids with calcareous and agglutinating benthic foraminiferids above 1,876m is typical of the influence of open sea currents in the upper part of the water column and well oxygenated bottom conditions. The lower part of the interval with its sparsity of calcareous taxa and relative abundance of agglutinating taxa suggests more restricted conditions at the sea bed, presumably reflecting a change in the carbonate compensation depth.

Remarks:

Late Cretaceous (Maastrichtian - Campanian) sediments rest unconformably on the Middle Jurassic (Bathonian - Bajocian) Brent Formation.

4.3 2,014m-2,250m MIDDLE JURASSIC (Bathonian - Bajocian)

Lithostratigraphy:

Brent Formation

The cuttings samples through this formation are extremely poor and are in most cases dominated by drilling mud additive obscuring the "in-place" lithologies.



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Ness Unit

2,014m-Ca.2,054m Sand, fine-medium grained, angular to subangular.

Ca.2,054m-2,095m Sand, fine-medium grained, angular to subangular, and claystone, black to dark grey, often with black plant debris.

2,095m-2,145m Sand and claystone, as above, together with sandstone, fine grained, calcareous and micaceous. Between 2,105m-2,115m drilling mud additive only..

2,145m-2,180m Sand, fine to medium and occasionally coarse grained, angular to subrounded, and claystone, dark grey, with plant remains.

Two core chips have been received from CORE 1 (see Appendix : Core Descriptions).

Etive/Rannoch Unit

2,180m-2,200m Sand, fine to coarse grained, occasional gravel, angular to subrounded.

2,200m-2,235m Sand, as above, together with sand, fine grained, angular, micaceous.

2,235m-2,240m As above, together with calcite cemented fine grained angular sandstone.

Broom Unit

2,240m-2,250m Sand, fine - coarse grained and gravel, angular to subrounded, some brown ?dolomitic cement.

Biostratigraphy:

2,014m-2,235m Bathonian - Bajocian

Microfauna: Rare foraminiferids occur through this interval but are all presumed to be caved from the overlying Cretaceous and Tertiary sequences.



Microflora: This interval is characterised by an assemblage of predominantly spores/pollen associated with common humic kerogen and exinite/cutinite. Although there are no age - diagnostic palynomorphs present in this interval, comparison with nearby wells shows that this assemblage is typical of Middle Jurassic, Bathonian - Bajocian age. The lower part of this interval is dated by its relationship to the better - dated underlying interval.

The samples examined from this interval contain common/abundant *Cyathidites* spp., common bisaccate pollen and generally common/abundant *Perinopollenites elatoides*. Other taxa present include *Cerebropollenites mesozoicus*, *Osmundacidites/Baculatisporites* spp., *Callialasporites dampieri* (from 2,038.4m) and *Chasmatosporites hians/apertus* (from 2,140m). The freshwater/brackish alga *Botryococcus* sp. is recorded at 2,215m.

Remarks:

Regionally, the first downhole appearance of *Nannoceratopsis gracilis* is in the middle part of the Ness Unit and indicates an age no younger than basal Bathonian. However, in this well either due to the lack of brackish - marine influences or because of poorly fossiliferous samples, this palynomorph has not been recorded until 2,235m and therefore only a general Bathonian - Bajocian age is assigned to these Brent sediments.



2,235m-2,250m Early Bajocian (=Aalenian)

Microfauna: No in-situ fauna observed.

Microflora: The first and consistent downhole appearance of *Nannoceratopsis gracilis* at 2,235m indicates the penetration of sediments of Early Bajocian (=Aalenian) age. The assemblage is characterised by common/abundant long-ranging spores/pollen associated with common humic kerogen. The freshwater/brackish alga *Botryococcus* sp. is recorded at 2,235m.

Remarks:

Regionally, the first downhole appearance of consistent (and normally common/abundant) *Nannoceratopsis gracilis* occurs at the top of the Broom unit. This palynological event has been recorded here but in this case the relative abundance of *N. gracilis* is much reduced when compared with previous wells in the area. Here, this event also represents the first downhole occurrence of *N. gracilis* (see above).

Environment:

2,014m-Ca.2,180m Transitional (continental-marine), "deltaic". The palynological assemblages indicate a strong terrestrial influence close to the depositional basin.

Ca.2,180m-2,250m "Near shore" marine, regressive. Strong terrestrial input with slight brackish-marine influences below 2,235m.



4.4 2,250m-2,690m MIDDLE JURASSIC-EARLY JURASSIC, (Early Bajocian (=Aalenian)-Pliensbachian/?Sinemurian

Lithostratigraphy:

Dunlin Formation

Most of the samples through this interval are small and contain drilling mud additives and common caved lithologies.

Drake Unit

2,250m-2,350m Claystone, and occasional siltstone, grey. Sand in the uppermost samples is probably caved.

Cook-Burton-Amundsen Units

2,350m-2,370m Sand, fine and occasionally medium grained, angular to subangular, rare interbeds of claystone, grey.

2,370m-2,380m Sand, as above, together with sandstone, calcite cemented.

2,380m-2,410m Sand, fine-coarse grained, angular to subrounded, common woody debris and pyrite coated sand grains, with occasional interbedded sandstone, fine grained, angular, calcareous and claystone, grey.

2,410m-2,470m Interbedded sand, fine grained, angular, sandstone, calcareous, and claystone, grey.

2,470m-2,520m Marl/limestone, brown; claystone, and siltstone, grey and sand, fine and fine to medium grained, angular.

2,520m-2,550m Claystone, grey; sand, loose, fine and occasionally medium grained, with round calcareous pellets.

2,550m-2,690m Interbedded claystone/siltstone, grey; limestone, brown and sand, fine to medium grained, angular to subrounded.



More precise boundaries between these units are tentatively made in the Sedimentary History Diagram based on analyses of cuttings.

Biostratigraphy:

2,250m-2,325m Early Bajocian (=Aalenian)-Toarcian

Microfauna: A diagnostic ostracod and foraminiferid fauna occurs in the upper part of this interval which is Aalenian to Late Toarcian in age. The diagnostic taxa are the ostracods *Camptocythere foveolata* gr., *C. parvula* and *C. toarciana* and the foraminiferid *Nodosaria regularis*.

Microflora: The first downhole appearance of the small dinocysts Plankton Type 2 Schulz and Mai, *Parvocysta nasuta* and Dinoflagellate Type 3 Thusu at 2,262m indicates the penetration of sediments of Early Bajocian (=Aalenian) to Toarcian age.

This assemblage is also characterised by common/abundant *Perinopollenites elatoides*, common bisaccate pollen and *Osmundacidites/Baculatisporites* spp, *Classopollis torosus* and the dinocyst *Nannoceratopsis gracilis*. Humic kerogen is the dominant type throughout this interval.

2,325m-2,350m Early Toarcian

Microfauna: This interval is recognised by the first downhole occurrence of the ostracod *Kinkelinella intrepida* at 2,325m, a taxon found in the Early Toarcian in England.

Microflora: No age-diagnostic palynomorphs have been recorded from this interval. The sample at 2,325m contains a rich flora characterised by abundant bisaccate pollen and *Nannoceratopsis gracilis*, with common *Osmundacidites/Baculatisporites* spp., *Perino-*



pollenites elatoides and Cerebropollenites mesozoicus. The samples examined below 2,330m contain a much reduced microflora. Accessory taxa include Plankton Type 2 Schulz and Mai (at 2,325m and 2,345m) and Parvocysta nasuta (2,325m-2,350m) but these are likely to be caved from the overlying interval.

Remarks:

Regionally, the occurrence of abundant Spheripollenites spp./ sphaeromorph clusters is in the lower part of the Drake unit and indicates the penetration of sediments of Early Toarcian age. However, in this well, the event is not positively recorded until 2,369m, i.e. in the Cook unit (see below).

2,350m-2,420m Early Toarcian-Late Pliensbachian

Microfauna: Only rare and non age-diagnostic fossils occur through this interval. It can be dated as Early Toarcian to Late Pliensbachian because of its stratigraphic position between dated intervals.

Microflora: The occurrence of abundant Spheripollenites spp./sphaeromorph clusters in the sidewall core sample at 2,369m indicates the presence of sediments of Early Toarcian age at this level. Other common elements of this assemblage include abundant Cerebropollenites mesozoicus and common bisaccate pollen, Classopollis torosus and Chasmatosporites hians/apertus. Incoming taxa include Cerebropollenites thiergartii and Krauselisporites sp. (at 2,405m). Both humic and sapropelic kerogen are recorded from this interval.



2,420m-2,600m Late Pliensbachian

Microfauna: The top of this interval is taken at a consistent regional marker, the first downhole occurrence of the ostracod genus *Ogmoconchella*. This genus rarely occurs in the basal Toarcian of onshore successions but is consistently used as conventional top for the Late Pliensbachian.

The downhole occurrences of *Ogmoconchella aequalis* (large form) with gastropods, at 2,470m, *Ogmoconcha amalthei* gr. at 2,500m and *Ogmoconchella transversa* at 2,520m are regionally consistent markers.

Microflora: No age-diagnostic palynomorphs have been recorded from this interval. The microfloral assemblage is characterised by long-ranging spores/pollen associated with generally common humic and rare sapropelic kerogen. Taxa present include common/abundant bisaccate pollen and *Classopollis torosus* with common *Cyathidites* spp., *Cerebropollenites mesozoicus*, *Chasmatosporites hians/apertus* (from 2,475m) and *Cerebropollenites thiergartii* (from 2,486m). The freshwater/brackish alga *Botryococcus* sp. is present at 2,525m and from 2,565m-2,600m.

The dinocyst *Nannoceratopsis gracilis* is not recorded in the sidewall core below 2,486m. This palynomorph does not normally occur in sediments older than Late Pliensbachian age in this region.

2,600m-2,690m Early Pliensbachian-?Late Sinemurian

Microfauna: The age-diagnostic Early Pliensbachian ostracod *Gammacythere ubiquita* occurs in the upper part of the interval. This is a consistent marker regionally as is the abundance level of *Ogmoconcha amalthei* gr. at 2,620m.



Microflora: Only long-ranging spores/pollen and rare acritarchs associated with both humic and sapropelic kerogen have been recorded from this interval. The assemblage is dominated by typically abundant bisaccate pollen with frequently common *Classopollis torosus* (abundant at 2,663m), *Chasmatosporites hians/apertus* and *Cerebropollenites thiergartii*. Accessory taxa include *Micrhystridium/Veryhachium* spp. and *Tasmanites* sp. (at 2,645m).

Environment:

2,250m-2,350m Marine, sublittoral. Strong terrestrial input with significant brackish-marine influences.

2,350m-2,690m Marine, ?littoral to sublittoral. These sediments mainly deposited in a shallow marine environment. The interbedded sands at the base of the Amundsen highlight the transgressive nature of this sequence, while the fossils in the Cook sands indicate a regressive episode in the Dunlin.

4.5 2,690m-2,800m (T.D.) EARLY JURASSIC (Sinemurian)

Lithostratigraphy:

Statfjord Formation

Sand, fine to coarse grained, angular to subangular, poorly sorted, occasional sandstone, fine grained, angular at 2,755m; below 2,780m some claystone, purple, with siderite below 2,795m.

Microfauna: Occasional foraminiferids and ostracods occur throughout this interval but they are all presumed to be caved.

Microflora: The samples examined from this interval contain an assemblage of long-ranging spores/pollen, the majority of which are contained in the overlying



interval. Both humic and sapropelic kerogen are present. Incoming forms include rare specimens of *Krauselisporites reissingeri* and *Conbaculatisporites mesozoicus* (at 2,745m), *Nevesisporites limatulus* (at 2,765m) and *Trachysporites asper* (at 2,775m).

Nevesisporites limatulus has not been previously recorded in sediments younger than Early Sinemurian, whilst both *Conbaculatisporites mesozoicus* and *Trachysporites asper* are characteristic of sediments of Sinemurian and older age (Lund, 1977). The long-ranging pollen *Cerebropollenites mesozoicus* is present in the sidewall core sample at 2,794.8m. This palynomorph is not normally recorded in sediments older than Sinemurian in this region, and thus indicates an age not older than Sinemurian at this level. No taxa which indicate an age older than Sinemurian have been recorded.

Environment:

Marine, 'nearshore', littoral to inner sublittoral with a transitional, "non-marine" claystone at the base.



5. REFERENCES

LUND, J.L. 1977. Rhaetic to Lower Liassic palynology of the onshore south-eastern North Sea Basin. Geological Survey of Denmark. II. Series No. 109. 128.pp.



APPENDIXa) Sidewall Core Descriptions

- | | | |
|----------|------|--|
| 1,977m | (29) | <u>Claystone</u> ; medium-dark grey, non-calcareous, micromicaceous, accessory pyrite. |
| 1,994.5m | (28) | <u>Claystone</u> ; dark grey, small block of chalk and silt, slightly calcareous, micromicaceous, accessory pyrite. |
| 2,007m | (27) | <u>Claystone</u> ; dark grey, occasional silty laminae, slightly calcareous, micromicaceous, accessory pyrite. |
| 2,012.5m | (26) | <u>Claystone</u> ; dark grey, occasional silty laminae (orangy-brown), non-calcareous, micromicaceous, accessory pyrite. |
| 2,152m | (24) | <u>Claystone</u> ; dark grey, irregular laminae of fine white sand, hard pellet of degraded chert in core, slightly calcareous, micromicaceous, accessory pyrite. |
| 2,200m | (23) | <u>Sandstone</u> ; white-light brown, fine grained, grains angular-subangular moderately well sorted, loosely cemented, non-calcareous matrix, faint laminae, micromicaceous, accessory pyrite and chlorite. |
| 2,225m | (22) | <u>Sandstone</u> ; light brown, fine grained, grains angular; sub-angular, well sorted, loosely cemented, non-calcareous matrix, micromicaceous, accessory pyrite and chlorite. |
| 2,262m | (20) | <u>Claystone</u> ; dark grey, silty, slightly calcareous, micromicaceous, accessory pyrite. |



- 2,276m (19) Claystone; very dark grey, non-calcareous, micromicaceous, accessory pyrite.
- 2,369m (16) Sandstone; very fine grained, angular-subangular, well sorted, loosely cemented, slightly calcareous matrix, buff colour, micromicaceous, accessory lignite, pyrite and chlorite.
- 2,405m (15) Claystone; dark grey, silty, laminated, irregular fine laminae of fine grained white sand, non-calcareous, accessory lignite and pyrite.
- 2,426m (14) Claystone; dark grey/brown, silty, laminated, irregular laminae of fine grained white sand, slightly calcareous, accessory pyrite.
- 2,525m (12) Claystone; dark grey, laminae of fine grained white sand, calcareous, micromicaceous, accessory pyrite.
- 2,545m (11) Claystone; dark grey, very finely laminated and fine grained white sand, calcareous, micromicaceous, accessory pyrite.
- 2,574m (10) Claystone; dark grey, occasional irregular laminae of fine grained white sand, calcareous, micromicaceous, accessory pyrite.
- 2,663m (5) Sandstone; fine grained, grains angular-subangular, well sorted, loosely cemented, micromicaceous, calcareous matrix, light grey, accessory pyrite and lignite.



- 2,686m (4) Siltstone; grading to clayey siltstone, faintly laminated, light grey/brown, micromicaceous, calcareous, accessory pyrite.
- 2,760m (3) Claystone; dark grey, silty, irregular laminae of fine grained white sand, micromicaceous slightly calcareous, accessory pyrite.
- 2,787m (2) Claystone; dark grey, lignitic, subwaxy texture, micromicaceous, accessory pyrite (core contaminated internally with drilling mud).
- 2,794.8m (1) Claystone; dark grey, lignitic, occasional irregular laminae of fine grained, white/brown sand, micromicaceous, accessory pyrite (core contaminated internally with drilling mud).

b) Core Descriptions

Core 1. (Box 2)

2,038.40-45m Sandstone; fine grained, grains subangular-angular, well sorted, micromicaceous, well cemented, non-calcareous matrix, light grey, accessory pyrite and lignite.

Core 1. (Box 4)

2,039.70-75m Sandstone; fine grained, grains angular-subangular, well sorted, micromicaceous, well cemented, non-calcareous matrix, light grey, accessory pyrite and lignite.



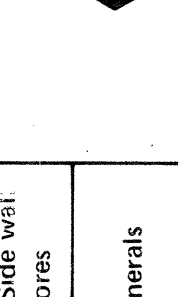
WELL 34/10-12

1600m - 2800m T.D.

NORWEGIAN OFFSHORE

STRATIGRAPHIC LOG

SCALE 1 500 (Metric)

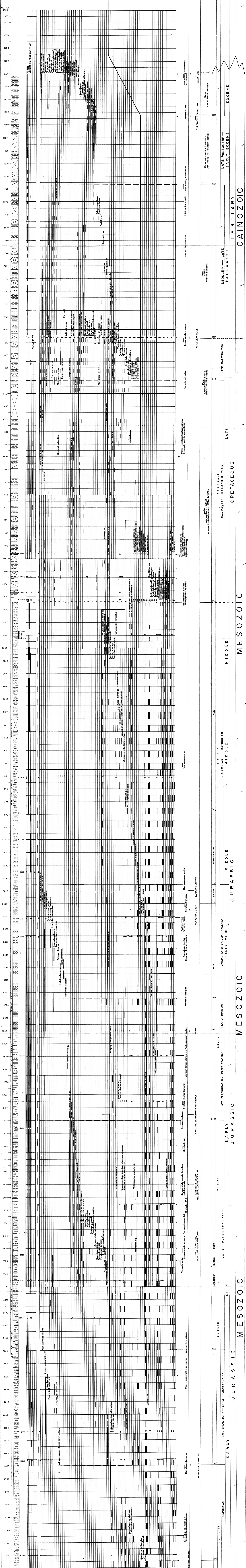


PREPARED BY
PALEOSERVICES
UNIT 15, SANDOWN ROAD, WATFORD WD17 4DB ENGLAND.

LEGEND

- | | | |
|------------------------|--------------------------------|---------------------------|
| CLAY/LAYSTONE | SANDSTONE | LIMESTONE |
| SHALE | CONGLOMERATE | CHALK |
| MARL, CALCAREOUS SHALE | VOLCANICS LAVA/TUFFS | DOLOMITE |
| SILTSTONE/SILT | UNDIFFERENTIATED BASEMENT | SALT |
| SAND | NO SAMPLES | ANHYDRITE/GYPSUM |
| MEGAFOSSILS | G | MICA |
| CHERT | S | CORALS |
| PYRITE | GLAUCONITE | SIDEWALL CORES |
| | LIGNITE/COAL | ROCK SAMPLES |
| | POSSILS AND ACCESSORY MINERALS | |
| | As/dont | |
| | Common | |
| | Rare | |
| | Abundant | FOSSILS IN SIDEWALL CORES |
| | | Rare |
| | | Common |
| | | PETROGRAPHICAL ANALYSIS |

- Boundary
--- Uncertainty
--- T.D. (Total depth)
--- Perturb. or interrupted sequence
F.S.R. First sample received
L.S.R. Last sample received



DEPTH (m)	PERIOD	LITHOLOGY	FASSILS
2800	EARLY SINEURIAN	SILTSTONE	<i>Meriania linearis</i>
2700	SINEURIAN	SAND, POORLY SORTED	<i>Opisthocoeles</i>
2600	EARLY SINEURIAN - EARLY PLENSBACHIAN	CLAYSTONE	<i>Opisthocoeles</i>
2500	LATE PLENSBACHIAN	SAND, LIMESTONE, BROWN	<i>Opisthocoeles</i>
2400	EARLY JURASSIC	SAND AND SILTSTONE CALCAREOUS	<i>Opisthocoeles</i>
2300	EARLY TORCIN	SAND	<i>Opisthocoeles</i>
2200	EARLY - MIDDLE TORCIN (JURASSIC)	CLAYSTONE, GREY	<i>Opisthocoeles</i>
2100	MIDDLE TORCIN (JURASSIC)	CLAYSTONE	<i>Opisthocoeles</i>
2000	MIDDLE TORCIN (JURASSIC)	CLAYSTONE	<i>Opisthocoeles</i>
1900	MIDDLE TORCIN (JURASSIC)	CLAYSTONE	<i>Opisthocoeles</i>
1800	LATE MASTRICHTIAN (JURASSIC)	CLAYSTONE	<i>Opisthocoeles</i>
1700	MIDDLE? - LATE PALEOCENE	CLAYSTONE	<i>Opisthocoeles</i>
1600	EARLY EOCENE - LATE PALEOCENE	TUFFACEOUS CLAYSTONE	<i>Opisthocoeles</i>
1550	EOCENE	CLAYSTONE	<i>Opisthocoeles</i>

SEDIMENTARY HISTORY®

CLIENT: **STATOIL**

WELL NO: **34/10-12**

FIGURE: **1** DATE: **DEC. 1981**

PROJECT NO: **888** ANALYST: **R.W.M., C.B., G.C.W.**

- KEY:
- Missing section
 - Open marine circulation
 - Restricted circulation
 - Mainly coarse clastics (sand)
 - Mainly fine clastics (silt, clay)
 - Carbonates
 - Evaporites
 - Volcanics
 - Regressive sequence
 - Transgressive sequence
- Vail et al. 1980



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