

PALEONTOLOGICAL STUDY OF THE STATOIL 34/10-4

OFFSHORE NORWAY WELL

By

M.E. Millioud, J.P. Colin and M. Pons

EPR-E.WA10.80

JUNE 1980

INTRODUCTION

Paleontological studies were carried out on the Statoil 34/10-4 well from 1698m to 2600m with the purpose of verifying and eventually polishing up Paleoservices stratigraphic interpretation.

For the palynological studies, we used mainly slides borrowed from Paleoservices, although some samples were also processed at EPR-E. Nannofossil, foraminifer, and ostracode studies are based in samples prepared at EPR-E. The list of the samples studied at EPR-E is given in the appendix.

Our studies support the following stratigraphic interpretation:

<u>TOP (m)</u>	<u>AGE</u>
1698	Late Maastrichtian
1770	Early Maastrichtian - Late Campanian
1816	Early Bathonian to Bajocian
1902.7	Early Bajocian (Aalenian)
1938	Early Bajocian (Aalenian) to Late Toarcian
2005	Early Toarcian
2062	Late Pliensbachian
2221	Lowermost Late Pliensbachian
2251	Early Pliensbachian
2370	(?)Early Jurassic (undifferentiated)

STRATIGRAPHY

CRETACEOUS 1698m - 1815m

LATE MAASTRICHTIAN: 1698m - 1770m

Nannofossils:

The presence at 1698m of *Nephrolithus frequens* together with *Arkhangelskiella cymbiformis*, gives a Late Maastrichtian age. *Cribrosphaerella ehrenbergi*, *Micula staurophora*, *Eiffellithus turriseiffeli*, *Kamptnerius magnificus* are the most important species present in this unit.

Foraminifera:

Pseudotextularia elegans, *Heterohelix globulosa*, *H. striata*, *Globotruncana arca*, *Rugoglobigerina* ex. gr. *rugosa*, *Globigerinelloides asper*, *G. multispina* are observed at 1698m.

At 1704m, *Globotruncana stuartiformis* is present and at 1728m, *Stensioeina pommerana* and *Globotruncana contusa* are observed.

EARLY MAASTRICHTIAN - LATE CAMPANIAN: 1770m - 1815m

Nannofossils:

The association of *Arkhangelskiella cymbiformis* and *Reinhardtites anthophorus* at 1770m indicates an Early Maastrichtian to Late Campanian age. At 1776m, *Reinhardtites levis* is observed.

Foraminifera:

Rugoglobigerina ex. gr. *rugosa*, *Globigerinelloides asper* and *G. multispina* are the most important species in this interval.

Globotruncana havanensis is observed at 1776m.

JURASSIC 1816m - 2579m

EARLY BATHONIAN TO BAJOCIAN: 1816m - 1901.6m

The sidewall core at 1816m contains rare specimens of *Nannoceratopsis gracilis* associated with the pollen *Quadraeculina anellaeformis*. Both forms have their top occurrence in the Early Bathonian. A single specimen of *Nannoceratopsis senex* was identified at 1822m. Unfortunately, all core samples between 1833.10m and 1896m were found to be practically barren. The core sample at 1901.6m contains very rare specimens of *Nannoceratopsis gracilis* and a rather abundant terrestrial microflora.

EARLY BAJOCIAN (AALENIAN): 1902.7m - 1918m

Between 1902.7m and 1912m, the 7 core and sidewall core samples examined are characterized by a microplankton assemblage in which *Nannoceratopsis gracilis* is dominant (constituting more than 90% of the marine microplankton).

An Early Bajocian (Aalenian) age is therefore very likely. *Nannoceratopsis gracilis* is less abundant, but still common at 1918m. *Nannoceratopsis ambonis* has been observed at 1912m, while *Fromea elongata* has its top occurrence at 1918m.

EARLY BAJOCIAN (AALENIAN) TO LATE TOARCICAN: 1938m - 2003m

Moesiodinium raileanui and the form illustrated by THUSU as dinoflagellate type 2 have their top occurrence in the sidewall core at 1938m. These two forms have been found in sediments attributed to the Toarcian but their complete stratigraphic range still needs to be precised. In the 34/10-4 well, *Moesiodinium raileanui* occurs in all sidewall samples between 1938m and 1973m. *Nannoceratopsis gracilis* and *Nannoceratopsis senex* are present in many samples, but a dominance of *N. senex* over *N. gracilis* has not been observed. *Nannoceratopsis triceras* has been observed at 1973m.

Three species of ostracodes have been observed within this interval: *Camptocythere* gr. *media* at 1947m, *C. parvula* and *Camptocythere pusilla* at 1971m. These three species are considered as indicating an Early Bajocian (Aalenian) age. The simultaneous occurrence of these ostracodes and of the dinoflagellates *Moesiodinium raileanui* and dinoflagellate type 2 in THUSU is somewhat contradictory. In all likelihood, the ranges of at least some of these fossils should be extended: either the above mentioned dinoflagellates go into the Early Bajocian, or the listed species of *Camptocythere* occur already in the Late Toarcian. The data available so far do not permit to decide which hypothesis is more likely.

Within the interval 1938m - 2003m, marine microplankton constitutes from 19% to 46% of the palynological assemblages. Spore/pollen assemblages are characterized by abundant *Alisporites* spp., *Classopollis* spp. and *Deltoidospora* spp. *Cerebropollenites mesozoicus*, *Osmundacidites wellmanii* and *Lycopodiumsporites* spp. are common, while *Quadraeculina anellaeformis* is present in most samples. *Clavatisporites hughesii* is common between 1960m and 1973m. Reworked specimens of *Kraeuselisporites reissingeri*, *Lueckisporites* sp. and *Taeniaesporites triassicus* have been observed at 1944m.

From 1923m to 2005m, there is a dominance of arenaceous foraminifera: *Haplophragmoides* spp., *Trochammina* spp., *Ammodiscus asper*.

EARLY TOARCIAN: 2005m - 2038m

The top of the Early Toarcian has been placed at 2005m, where the Early Toarcian ostracode *Ektyphocythere intrepida* has been observed.

Foraminifera are rare below 2005m.

Dinoflagellates are not very abundant. *Nannoceratopsis gracilis* and *N. senex* have been observed at 2020m. Dinoflagellate N-102, which has been observed in many samples from 1816m, has its deepest occurrence at 2020m.

Among the terrestrial palynomorphs, *Lycopodiumsporites* spp. and *Osmundacidites wellmanii* are less numerous. Small sphaeromorphs (*Inaperturopollenites* spp.) are dominant at 2030m. Similar abundances of *Inaperturopollenites* are known to occur in the Early Toarcian.

LATE PLIENSBACHIAN: 2062m - 2185m

The top of the Late Pliensbachian has been placed at 2062m where *Luehndea* cf. *spinosa* has its top occurrence. In the same sample, *Mancodinium semitabulatum*, rarely observed above, is relatively common. Numerous specimens of *Nannoceratopsis* cf. *spiculata* have been observed at 2185m. Acritarchs are common throughout the interval. Among the terrestrial palynomorphs, *Chasmatosporites* spp. becomes more abundant. Marine microplankton versus terrestrial palynomorphs ratios decrease below 2130m.

The first downhole occurrence of the characteristic Pliensbachian ostracode *Ogmoconchella* gr. *adenticulata* has been recorded at 2074m. Foraminifera are rare in this interval.

LOWERMOST LATE PLIENSBACHIAN: 2221m

The ostracode marker species *Whicherella semiora*, which is known to be restricted to the lowermost part of the Late Pliensbachian (lower part of the *A. margaritatus* zone), occurs at 2221m, where another ostracode species, *Ogmoconchella transversa* has its first occurrence.

EARLY PLIENSBACHIAN: 2251m - 2356m

The Early Pliensbachian age proposed for this interval is based on the top occurrence of the ostracode marker *Gamacythere ubiquita* at 2251m and confirmed by the occurrence of the ostracodes *Ogmoconchella* cf. *danica* and *Klinglerella elongata* at 2296m. The base of this unit is based on the deepest common occurrence of large specimens of *Quadraeculina anellaeformis*. An undescribed tabulate dinoflagellate, dinoflagellate N-106, is relatively common at 2356m. In all likelihood, it is the form recorded as dinoflagellate type 7 by Paleoservices.

(?)EARLY JURASSIC: 2370m - 2579m

No ostracodes or foraminifera have been observed in this interval, and palynological associations are poor and far between. The sample at 2370m contains quite a few terrestrial palynomorphs but is heavily contaminated: most of the forms are Tertiary pollen grains. At 2391m, only non-diagnostic forms have been observed. In the deepest palynological slide examined, at 2579m, the dinoflagellate *Nannoceratopsis senex* and terrestrial palynomorphs *Cerebropollenites mesozoicus* have been identified. *Nannoceratopsis senex* does not occur below the Late Pliensbachian, while *Cerebropollenites mesozoicus* is not found below the Sinemurian. Mud contamination, however, is very likely, since Tertiary pollen grains are also abundant. Despite a careful microscopical examination, it has not been possible to find any pre-Pliensbachian or Rhaetian forms.

COMPARISONS BETWEEN EPR-E AND PALEOSERVICES

BIOSTRATIGRAPHIC INTERPRETATION ON STATOIL 34/10-4

(See attached paleolog)

CRETACEOUS

We agree with Paleoservices in attributing to the Late Maastrichtian the first sample we examined, at 1698m. They place the upper limit of their Maastrichtian - (?)Campanian unit at 1716m, based on the first downhole occurrence of *Reussella szajnochae* at 1716m. We have not observed this fossil at 1716m, but have identified at 1770m the association of *Arkhangelskiella cymbiformis* and *Reinhardtites anthophorus*, which indicates an Early Maastrichtian to Late Campanian age.

JURASSIC

Both laboratories agree in picking the top of the Jurassic at 1816m and in attributing this horizon to the Early Bathonian - Bajocian. There is also a good agreement on the top of the Early Bajocian (Aalenian) unit, placed by Paleoservices at 1901.6m and by EPR-E at 1902.6m, first sample in which *Nannoceratopsis gracilis* is dominant.

Paleoservices places the top of the Toarcian at 1973m, noting the presence at 1977m of the ostracode *Camptocythere toarciana* which suggests an Early Toarcian age.

However, we prefer to attribute to the Early Bajocian - Late Toarcian the interval 1938m - 2005m. In this interval, the presence of ostracodes *Camptocythere* gr. *media*, *C. parvula*, *C. pusilla* indicates an Early Bajocian age, while the presence of the dinoflagellate *Moesiodinium raileanui* between 1938m and 1973m rather suggests a Toarcian age.

Both laboratories agree in placing at 2005m the top of the well-dated Early Toarcian and at 2062m the top of the Pliensbachian.

There is a slight discrepancy about the upper limit of the Early Pliensbachian. While we place it at 2251m, where we note the first downhole occurrence of Early Pliensbachian ostracodes, Paleoservices places it slightly higher, at 2236m.

At 2332m, Paleoservices notes the presence of a poorly preserved specimen of the ostracode *Cristocythere betzi*, suggesting a Sinemurian age. We have still attributed to the Pliensbachian, however, the sample at 2356m, which still contains large specimens of *Quadraeculina anellaeformis*.

MEM:JPC:MP:cm
June 1980

APPENDIX

LIST OF SAMPLES STUDIED FOR PALYNOLOGY

(E: processed by EPR-E; all other samples: slides loaned by Paleoservices)

	<u>DEPTH (m)</u>		<u>DEPTH (m)</u>		<u>DEPTH (m)</u>	
SWC	1816		SWC	1938	Core	2352
"	1822		"	1944	"	2352.6
Core	1826		"	1951	"	2353.7
"	1833.1	E	"	1955	"	2356
"	1836		"	1960	SWC	2370
"	1839.4	E	"	1963	"	2391
"	1846		"	1968	"	2407.5
"	1857		"	1973	Cutt.	2420-23
"	1867		"	2003	SWC	2440
"	1877		"	2020	Cutt.	2440-43
"	1885.15	E	"	2030	SWC	2452
"	1887		"	2038	"	2480
"	1890.55	E	"	2062	"	2487
"	1896		"	2075	"	2498
"	1901.6		"	2084	Cutt.	2500-03
"	1902.7	E	"	2095	SWC	2502
"	1904.5	E	"	2130	"	2507
"	1904.65		"	2160	"	2518
"	1905.8		"	2172	"	2537
"	1906.5	E	"	2185	"	2547.5
"	1907.2		"	2225	"	2553
SWC	1912		"	2265	Cutt.	2560-63
"	1914		"	2285	SWC	2575
"	1918		"	2315	"	2579
			"	2337	Cutt.	2593-600

LIST OF SAMPLES STUDIED FOR MICROPALAEONTOLOGY

(Processed at EPR-E)

(M: Foraminifer or/and Ostracod C: Coccolith)

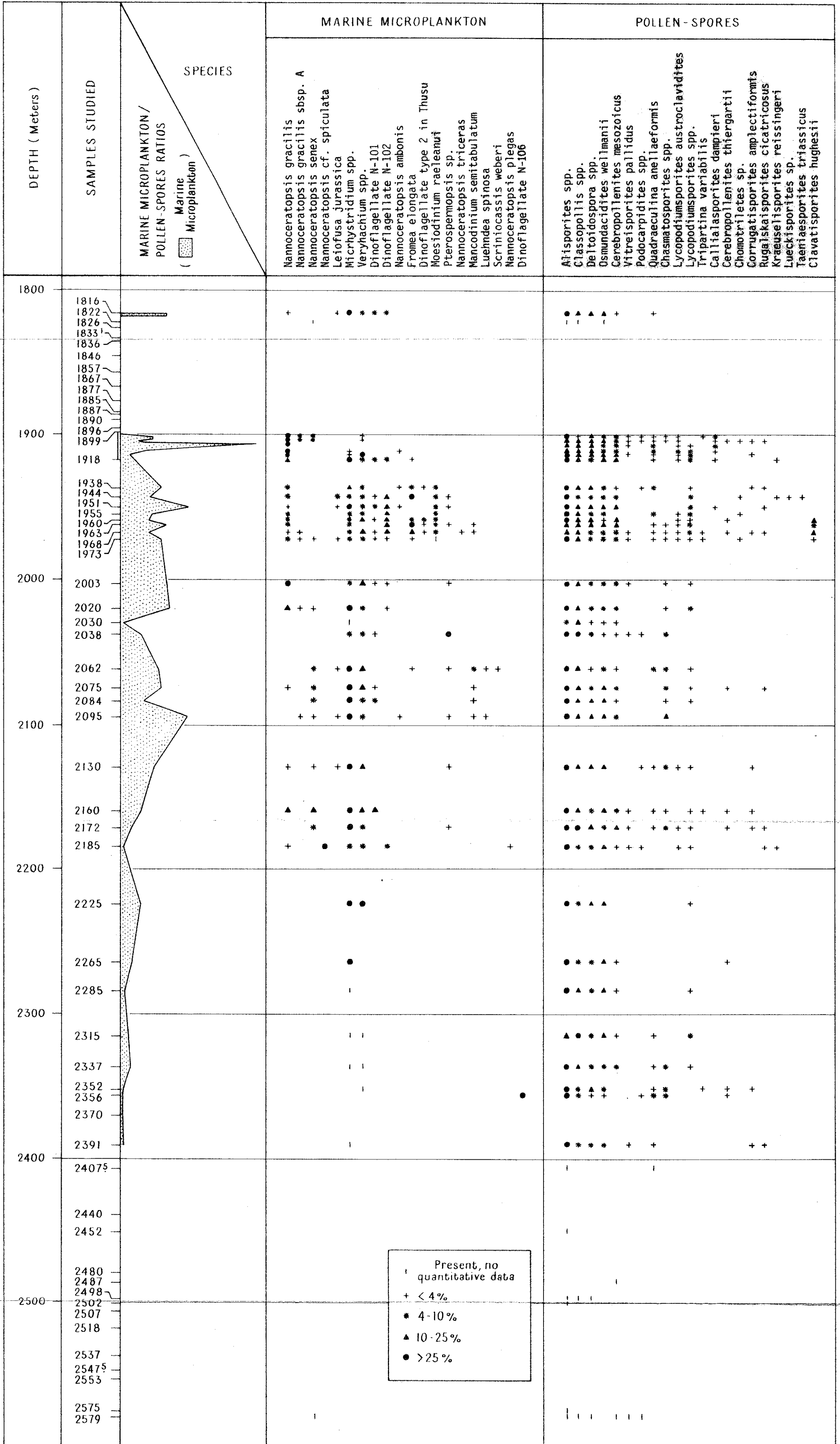
	<u>DEPTH (m)</u>			<u>DEPTH (m)</u>	
Cutt.	1698	M-C	Cutt.	2005	M
"	1704	M-C	"	2014	M
"	1716	C	"	2029	M
"	1722	C	"	2062	M
"	1728	M-C	"	2074	M
"	1734	C	"	2104	M
"	1746	C	"	2113	M
"	1752	M-C	"	2131	M
"	1764	C	"	2161	M
"	1770	C	"	2179	M
"	1776	M-C	"	2191	M
"	1788	C	"	2221	M
"	1800	M-C	"	2224	M
"	1815	C	"	2239	M
"	1821	M-C	"	2251	M
Core	1904.5	M	"	2260	M
Cutt.	1914	M	"	2272	M
"	1923	M	"	2281	M
"	1941	M	"	2296	M
"	1947	M	"	2311	M
"	1971	M	"	2332	M
"	1990	M	"	2341	M

reflect
signature

STATOIL 34/10-4

JURASSIC MICROPLANKTON AND POLLEN-SPORES DISTRIBUTION CHART

Prepared by M. E. MILLIQUOUD, EPR-E (Bordeaux), June 1980



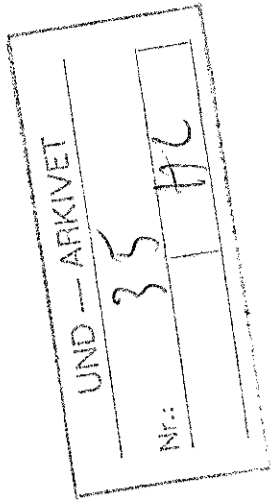
DEPTH (Meters)		SAMPLES STUDIED	SPECIES
1700	1698	1704	1716
1700	1716	1722	1734
1700	1734	1746	1752
1700	1752	1764	1770
1700	1770	1788	1800
1800	1815	1821	
1900	1904.5	1914	1923
1900	1941	1947	
2000	1971	1990	2005
2000	2014	2029	
2100	2062	2074	
2100	2104	2113	
2100	2131		
2200	2161	2179	2191
2200	2221	2224	2239
2200	2251	2260	2272
2200	2281	2296	
2300	2311		
	2332		
	2341		
NANNOFOSSILS			
<ul style="list-style-type: none"> Nephrolithus frequens Arkhangelskiella cymbiformis Cribrosphaerella ehrenbergi Ahmullerella octoradiata Predicosphaera cretacea Glaukolithus compactus Lucianorhabdus cayeuxi Kamptnerius magnificus Micula staurophora Eiffellithus turrisseiffelli Cretarhabdus decorus Cretarhabdus crenulatus Glaukolithus fessus Microrhabdulus stradneri Watznaueria barnesae Microrhabdulus decoratus Chiastozygus litterarius Zygodiscus spiralis Parhabdololithus angustus Gartnerago obliquum Braarudosphaera bigelowi Glaukolithus diplogrammus Reinhardtites anthophorus Zygodiscus acanthus Reinhardtites leviss Lithastrinus floralis 			
FORAMINIFERA			
<ul style="list-style-type: none"> Pseudotextularia elegans Heterohelix globulosa Heterohelix striata Heterohelix glabrans Heterohelix spp. Globorotalites sp. Ammodiscus sp. Globotruncana arca Rugoglobigerina ex. gr. rugosa Globigerinelloides asper Globigerinelloides multispina Stensioeina sp. Bolivina incrassata Globotruncana stuartiformis Globotruncana sp. Globigerinelloides spp. Globotruncana contusa Reussella szajnochae szajnochae Stensioeina pommerana Dorothia sp. Globotruncana havanensis Bathysiphon sp. Recurvoides sp. Haplophragmoides spp. Trochammina spp. Nodosaria corallina Ammodiscus asper Ammodiscus spp. Denticulina spp. Nodosaria spp. Lenticulina varians Dentalina spp. Marginulina spp. Guttulina sp. Lenticulina prima Frondicularia sp. Marginulina prima Mesodentalina matutina Frondicularia bicostata Frondicularia sulcata Lenticulina inaequistriata Lenticulina matutina Rectoglandulina vulgata Marginulina cf. lamellosa Lingulina tenera Nodosaria raphanistriformis Polymorphinids Rectoglandulina multicostata Lenticulina aff. breoni Saracenaria sp. 			
OSTRACODES			
<ul style="list-style-type: none"> Camptocythere gr. media Camptocythere parvula Camptocythere pusilla Camptocythere cf. foveolata Ektyphocythere intrepida Procytherura hastata Ogmoconchella gr. adenticulata Pseudomacrocypris sp. Ogmoconchella aequalis Kinkelinella sp. Ektyphocythere aff. champauae Ogmoconchella cf. pseudospina Paradoxostoma sp. Ogmoconcha amalthei Ogmoconcha contractula Ogmoconchella cf. gruendeli Pseudohealdia truncata Ogmoconchella bispinosa Ogmoconchella transversa Wicherella semiora Polycope cerasia Gramanella aspostolescui Gammacythere ubiquita Ogmoconchella cf. danica Klinglerella elongata Isobythocypris sp. Bairdia molesta Polycope sp. Cytheropteron foveolatum Polycope sp. 			

Fig. 2 - DISTRIBUTION CHART OF CALCAREOUS MICROFOSSILS IN 34/10-4

STATOIL 34/10-4

LOG I

SCALE: 1/2000



PREPARED BY J.P. COLIN, M. MILLIoud, M. PONS

EPR-E (BORDEAUX) JUNE 1980

EPR-E PROPRIETARY

METERS	EPR-E	PALEOSERVICES	REMARKS
1700	1698	1692 LATE MAASTRICHTIAN	1698 <i>Nephrolitus frequens</i> , <i>Arkhangelskiella cymbiformis</i> , <i>Pseudotextularia elegans</i> , <i>Globotruncana arca</i> , <i>Heterohelix globulosa</i>
	LATE MAASTRICHTIAN	MAASTRICHTIAN	
	1770	? CAMPANIAN	1770 Association of <i>Arkhangelskiella cymbiformis</i> and <i>Reinhardtites anthophorus</i>
1800	EARLY MAASTRICHTIAN LATE CAMPANIAN		
	1816	1816	1816 <i>Quadraeculina anellaeformis</i> <i>Nannoceratopsis gracilis</i>
	EARLY BATHONIAN BAJOCIAN	EARLIEST BATHONIAN EARLY BAJOCIAN (AALENIAN)	
1900	1902.7	1901.6 EARLY BAJOCIAN (AALENIAN)	1902.7 <i>Nannoceratopsis gracilis</i> (dominant) 1912 <i>Nannoceratopsis gracilis</i> (very abundant)
	EARLY BAJOCIAN (AALENIAN)	1917 1923 <i>Camptocythere</i> sp. CP	1917 <i>Nodosagria spindana</i> 1923 <i>Camptocythere</i> sp. CP
	1938	EARLY BAJOCIAN (AALENIAN) LATE TOARCIAN	1938 <i>Moesiodinium raileanui</i> Toarc 1947 <i>Camptocythere gr. media</i> Baj.
	EARLY BAJOCIAN (AALENIAN) LATE TOARCIAN	1973	1971 <i>Camptocythere parvula</i> + <i>C. pusilla</i> Baj. 1973 Top <i>Nannoceratopsis tricerias</i>
2000	2005	2005 EARLY TOARCIAN	2005 <i>Ektypocythere intrepida</i>
	EARLY TOARCIAN	2020 EARLY TOARCIAN - LATE PLEINSBACHIAN	
	2062	2044 ? LATE PLEINSBACHIAN 2062	<i>duchendea cf. spindana</i> 2062 <i>Mancodinium semitabulatum</i> (common) 2074 <i>Ogmoconchella gr. adenticulata</i>
2100	LATE PLEINSBACHIAN	LATE PLEINSBACHIAN	2131 <i>Kinkelinaella sp.</i> , <i>Ogmoconchella aequalis</i>
			2179 <i>Ogmoconchella amalthei</i>
2200	2221	<i>Ogmoconchella transversa</i> Ea. La. Pleinsb.	2197
	Lowermost LATE PLEINSBACHIAN	2236	2221 <i>Wicherella semiora</i> , <i>Ogmoconchella transversa</i> <i>Gammacythere ubiquita</i>
	2251	EARLY PLEINSBACHIAN	2251 <i>Gammacythere ubiquita</i> , <i>Grammanella apostolescui</i>
2300	EARLY PLEINSBACHIAN	2296 EARLY PLEINSBACHIAN SINEMURIAN	2296 <i>Klinglerella elongata</i> , <i>Ogmoconchella cf. danica</i> <i>Kinkelinaella</i> spp
		2338 SINEMURIAN	2338 ? ? ?
	2370	2356	2356 base common large <i>Quadraeculina anellaeformis</i>
2400	EARLY JURASSIC	EARLY JURASSIC LATE TRIASSIC	
2500			
2600		2579 LATE TRIASSIC	2600 T.D.



ESSO EXPLORATION AND PRODUCTION NORWAY INC.

[UTENLANDSK AKSJESELSKAP]

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U-kopi		

August 1, 1980

STATOIL
P.O.Box 300
4001 STAVANGER

Attn: Svein Nedland

Dear Svein,

Please find enclosed five corrected copies of the "Jurassic microplankton and pollen-spores distribution chart" prepared by M.E. Millioud for the Statoil 34/10-4 well.

The corrections concern the listing of the marine microplankton where the names Moesodinium raeleanui and Pterospermopsis sp. have been inverted.

Please do not hesitate to contact us if you need any additional information on this report.

Very truly yours,

Jean Barrier
Jean Barrier
Chief Geologist

Enclosure

JB/ab

1 kopi er lagt inn i rapporteks. nr. 1

KLF