DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 1997/102

Microfaunal and nannofloral analysis of the Lower Cretaceous of the North Jens-1 well

- a contribution to the EFP-93 project: Lower and Upper Cretaceous stratigraphy in the Central Trough

David J. Jutson

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
MINISTRY OF ENVIRONMENT AND ENERGY

G E U S

DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 1997/102

Microfaunal and nannofloral analysis of the Lower Cretaceous of the North Jens-1 well

- a contribution to the EFP-93 project: Lower and Upper Cretaceous stratigraphy in the Central Trough

David J. Jutson

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
MINISTRY OF ENVIRONMENT AND ENERGY

GEUS

Contents

1. Introduction **3**
1.1 Materials and methods 3

2. Biostratigraphic summary **5**
2.1 Compiled biostratigraphy: North Jens-1 5
2.2 Biostratigraphic description 7

3. References **11**

Enclosures: Fig. 1 and Summary Sheet 1-3

Appendix 1

1. Introduction

As part of the EFP-93 Cretaceous Stratigraphy Project, microfaunal and nannofossil analyses of the cored intervals and intervening sections with only ditch cutting sample coverage from the Lower Cretaceous interval of the North Jens-1 well were undertaken. A stratigraphic subdivision has been produced and is presented in this report.

The chronostratigraphic subdivision of the Lower Cretaceous that has been established from the North Jens-1 material is based on both published and confidential proprietary schemes from the North Sea and adjacent areas and is included in chart form in this report (Figure 1) and as a fully described scheme in a separate section of the EFP93 report.

1.1 Materials and methods

Sampling from North Jens-1 well was undertaken at intervals of between 1.5ft and 10ft. Microfaunal samples were prepared using conventional extraction techniques with a 63µ sieve. Samples were split into fractions that contained sufficient microfossil recovery to be statistically significant (>300 specimens) and were quantitatively and qualitatively analysed.

Nannofossils preparations were made by conventional smear sample technique and mounted using Norland Optical Adhesive. The slides were analysed under polarised light . In the samples from core chips, total counts of specimens from 6 fields of view per slide were made. This generally exceeded the 300 specimen statistical minimum. In smear slides from ditch cutting samples, the count was often below the minimum and the specimens were poorly concentrated therefore counts of two long slide cover axes were made.

The majority of samples in this study were chips taken from conventional cores but where there were gaps between cores, ditch cutting samples were used. In general, the microfossil recovery, both nannofossil and microfaunal was significantly worse from the ditch cutting samples. As a result of this, several intervals in both wells have limited data.

In the text, reference to abundance levels has been made. These are defined as follows:

Rare	=	1-5 specimens
Common	=	6-20 ..

Very Common	=	21-50 ..
Abundant	=	>50

Number of samples analysed:

Microfauna: 34

Nannofossils: 100

A full sample list is given in Appendix 1. Faunal slides of microfaunas recovered were made from all samples to obtain reference material. Nannofossil slides have been kept and are stored at GEUS.

2. Biostratigraphic summary

All depths given to 2 decimal places refer to conventional core samples. Integers refer to cuttings samples. Log depths are indicated by (log). These results are also plotted graphically in Summary Sheets 1-3. The zonation scheme is illustrated in Figure 1.

2.1 Compiled biostratigraphy: North Jens-1

INTERVAL AGE	MICROZONE	DEPTH	NANNOZONE	DEPTH	COMBINED ZONE
Upper Aptian (top not seen)		7350.50'	a	7350.50'	SL1
	M1	7362.66'	b1	7362.66'	SL2
	M2	7376.00'	b2	7376.00'	SL3
basal Upper -Lower Aptian			c	7388.00'	SL4
Lower Aptian			d	7392.75	SL5
	M3a	7395.75'	e	7395.75'	SL6
			f	7400.75'	SL7
	M3b	7403.58'	g	7403.58'	SL8
			h	7405.25'	SL9
			i	7408.50'	SL10
	M4	7410'			
Middle - Lower Barremian	M5	7440'			
			j	7446.50'	
				7455.50'	SL11
			k	7461.17'	
	M6a	7467.35'		7467.35'	TX1
-			l	7473.25'	TX2
			m	7483.00'	TX3
	M6b	7485.00'			
			n	7489.50'	TX4

INTERVAL AGE	MICROZONE	DEPTH	NANNOZONE	DEPTH	COMBINED ZONE
Middle - Lower Barremian			o	7512.75'	TX5
			p	7524.75'	TX6
	M7		q	7533.17'	TX7
	M8a-b	7536.75'		7536.75'	
	M8c	7555.17'			TX7-8
			r	7557.25'	TX8
			s	7559.00'	TX9
			t	7561.00'	TX10
			u1	7563.75'	TX11
	M9		u2	7576.00'	TX12
	M10	7594.55'	v	7594.55'	TX13
	M11	7606.41'	w	7606.41'	TX14
Upper Hauterivian	M12-13	7616.75'	x	7616.75'	TX15
			y1	7619.75'	
	M14a	7624.30'	y2	7624.30'	
			y3	7627.81'	VH1
	M14b	7636.41'			

Last sample examined at 7638.50'MD

2.2 Biostratigraphic description

All depths quoted are in feet and inches and are measured depth from rotary table (MDRT). The stratigraphic occurrences of important micro and nannofossils are shown in Summary Sheets 1-3.

North Jens-1 well: Microfauna

7350.58' - 7395.75': Upper Aptian (top not seen)

The occurrence at 7350.58' of a microfauna dominated by medium to high spired forms of the planktic foraminifera *Blefuscuiana infracretacea* s.l. suggests an Upper Aptian age for this interval (Banner *et al.*, 1993). The accompanying microfauna consisted almost exclusively of varieties of *B. infracretacea* together with a single recorded calcareous benthic foraminifera, *Lenticulina muensteri*.

Other samples in this interval also contained microfaunas dominated by planktic foraminifera, although the calcareous benthic component was slightly greater but did not stratigraphically diagnostic species. The top of the Upper Aptian was not recorded in this study.

7395.75' - 7440': Lower Aptian

A sharp decline in diversity and abundance to two specimens of *Blefuscuiana aptiana* (pyritised) together with a change in lithology indicates that the Fischschiefer and the Lower Aptian has been reached (Banner *et al.*, 1994). A more representative fauna of this facies was encountered at 7403.58' where an influx (more than 200 specimens) of *B. aptiana* s.l. was recorded. This apparent low occurrence of the 'typical' Fischschiefer microfauna is probably due to environmental control. The Fischschiefer is normally developed as a black claystone but below this conspicuous horizon there are smaller black horizons together with grey intercalations. The occurrence of the fauna below the black horizon is probably due to the environment being marginally hospitable to planktic foraminifera in the grey levels but too hostile in the main black horizon.

The microfaunal assemblages of the interval downhole to the base of the interval is poor but again dominated by planktic foraminifera *(B. infracretacea* s.l., *B. aptiana* s.l.).

7440' - 7616.75': Middle to Lower Barremian

The first downhole occurrence (= local last evolutionary occurrence) of *Gavelinella barremiana* together with *Falsogaudryinella* sp.X (of King 1989). From 7455.5' to the base of the interval, microfaunal assemblages were mainly composed of low diversity and abundance calcareous benthic foraminifera with subsidiary agglutinating benthic foraminifera. One exception to this was at 7545' where there was an influx of planktic foraminifera where *B. infracretacea* s.l. and *Hedbergella planispira* were abundant and common respectively.

7616.75' - 7638.5': Upper Hauterivian

Microfaunally, this boundary was not satisfactorily defined in this well. At 7616.75', in the absence of any distinct microfaunal markers, the top of the consistent occurrence of smooth ostracods (*Macrocypris* spp., *Pontocyprella* spp.) has been used as the defining criterion (unpublished data). These ostracods are well known to exploration company biostratigraphers from this interval in the Central Graben and are considered to be of local importance. Most of the species have not been formally described as they have not been recorded outside the North Sea Basin, even in adjacent onshore sections in Britain or Germany.

North Jens-1 well: Calcareous Nannofossils

7350.5' - 7388': Upper Aptian

Nannofloral assemblages in this interval were dominated by *Watznaueria barnesae. Rhagodiscus asper* occurred in all samples and increased in abundance from common to abundant towards the base of the interval which suggests Upper Aptian age. This is confirmed by the top occurrence of *Micrantholithus obtusus* at 7557.66' and an influx of *Eprolithus varolii* with rare nannoconids at 7362.66' (Jakubowski 1978) . From 7386.58' to

7388' there is a gradual decline in both diversity and abundance with increasing proximity to the Fischschiefer.

7388' - 7392.75': basal Upper to Lower Aptian

The decline in nannofloral assemblage diversity and abundance recorded in the basal part of the previous interval is continued in this small interval which is characterised by nannofloras which are badly etched and occur together with abundant organic debris. This interval represents the main part of the Fischschiefer and the age definition is wide and is based on the ages of the over and underlying intervals.

7392.75' - 7446': Lower Aptian

A recovery in nannofloral diversity and abundance to the levels recorded in the Upper Aptian interval was noted at 7392.75'. This, with an influx of *Corollithion achylosum* and the incoming of *Bukrylithus ambiguus*, both at 7408.5' suggests that the Lower Aptian has been reached (unpublished data).

7446' - 7616.75': Middle to Lower Barremian

An influx of *Nannoconus* spp. including *N. abundans* and *N. borealis* indicates that the Middle to Lower Barremian has been penetrated (Jakubowski 1978). Nannofloras in this interval were dominated by *W. barnesae* and *R. asper* together with influxes of micrantholithids (*Micrantholithus obtusus* and *M. hoschulzii*) and nannoconnids (*Nannoconus longus, N. bermudezi, N. aquitanicus, N. rectangularis*).

Additional markers of Middle and Early Barremian included *Zygodiscus sisyphus* at 7467.33', *Conusphaera rothii* at 7512.75', *Nannoconus steinmannii* at 7579'.

Previously undescribed nannofossils recorded included "*Phanulithus valdemarensis*" (7451.17') which became abundant and formed a significant marker over the interval 7463.66' to 7472' and "*Zygodiscus priisholmii*" (7495.25').

Several new morphotypes of *Nannoconus* spp. were also noted. These included *"N. tirsgaardii"* (7467.33'), "*N. vermiformis*" (7489.5'), "*N. ananas*" (7528'), "*N. albrechtsenii*" (7536.75') , "*N. microananas*" (7589') and *Nannoconus* sp.X (7616.75'. The names of all the undescribed species are informal and may change when the species are formally described. (*text in preparation*).

7616.75' - 7638.5': Upper Hauterivian

The occurrence of a nannoflora with increased diversity including common *B. ambiguus* suggests an Upper Hauterivian age for this interval. This is confirmed by the influx of *Tegulalithus septentrionalis* at 7619.75' and *Ethmorhabdus hauterivianus* at 7630.41' (Jakubowski 1978, Crux 1989). As in the previous interval nannofloras are dominated by *W. barnesae, R. asper* micrantholithids and nannoconids.

3. References

Banner, F.T., Copestake, P. & White, M.R., 1993: Barremian-Aptian Praehedbergellidae of the North Sea area: a reconnaissance: *Bulletin of the Natural History Museum (Geology)* **49**, 1-30.

Bartenstein, H., 1965: Taxonomische revision und nomenklator zu Franz E. Hecht "Standard-Gliederung der Nordwestdeutschen Unterkreide nach foraminiferen" (1938) Teil 4: A1b, *Senkenbergiana Lethaia* **46**(4/6), 327-366.

Bralower, T.J., Arthur, M.A., Leckie, R.M., Sliter, W.V., Allard, D.J., & Schlanger, S.O., 1994: Timing and Paleoceanography of Oceanic Dysoxia/Anoxia in the Late Barremian to Early Aptian (Early Cretaceous): *Palaios* **9**, 335-369.

Crux, J., 1987: Six new species of calcareous nannofossils from the Lower Cretaceous strata of England and Germany. *International Nannoplankton Association, Newsletter* **9**, 30-34

Crux, J., 1989: Biostratigraphy and paleogeographical applications of Lower Cretaceous nannofossils from north-western Europe: *In* Crux, J., & van Heck, S. (ed.) *Nannofossils and their Applications*: Ellis Horwood, Chichester, 143-211.

Erba, E., 1994: Nannofossils and superplumes: The early Aptian "nannoconid" crisis. *Paleoceanography* **9**, 483-501

Jakubowski, M., 1986: New calcareous nannofossil taxa from the Lower Cretaceous of the North Sea. *International Nannoplankton Association, Newsletter* **8**, 38-42

Jakubowski, M., 1987: A proposed Lower Cretaceous nannofossil zonation scheme for the Moray Firth Area of the North Sea. *Abhandlung der Geologischen Bundesanstalt* **39**, 99-119.

King, C., Bailey, H.W., Burton, C., & King, A.D., 1989: Cretaceous of the North Sea. *In* D.G. Jenkins & J.W. Murray (ed.) *Stratigraphic Atlas of Fossil Foraminifera*, 2nd edition, Ellis Horwood Ltd., Chichester. 418-489.

Mutterlose, J., 1992: Biostratigraphy and palaeobiology of Early Cretaceous calcareous nannofossils. *Cretaceous Research* **13**,167-189.

Mutterlose, J., & Wise, S.J., 1990: Lower Cretaceous nannofossils biostratigraphy of ODP Leg 113 Holes 692B and 693A, Continental Slope off East Antarctica, Weddell Sea: *Proceedings of the Ocean Drilling Program, Scientific Results* **113**, 325-351.

Perch-Nielsen, K., 1979: Calcareous nannofossils from the Cretaceous between the North Sea and the Mediterranean: *Aspekte der Kreide Europas, IUGS, A*, 223-272.

Perch-Nielsen, K., 1985: Mesozoic calcareous nannofossils: *In* Bolli, H.M., Saunders, J.B., & Perch-Nielsen, K., (ed.), *Plankton Stratigraphy*: Cambridge University Press, New York, 329-426

Sissingh, W., 1977: Biostratigraphy of Cretaceous calcareous nannoplankton. *Geologie en Mijnbouw* **56**, 37-65

Sliter, W., 1980: Mesozoic foraminifers and deep-sea benthic environments from Deep Sea Drilling Project Sites 415 and 426, Eastern North Atlantic. *In* Lancelot, Y. *et al. Initial Reports of the Deep Sea Drilling Project* **50**, 353-427.

Enclosures

Fig. 1 and Summary sheets 1-3

EFP 93

LOWER APTIAN TO HAUTERIVIAN BIOSTRATIGRAPHIC ZONATION

(Based on data from North Jens-1 and Valdemar-2 wells)

Fig.1

AGE/LITHOSTR.				ZONATIONS			MICROFAUNAL EVENTS	NANNOFOSSIL EVENTS
APTIAN	UPPER	SOLA FM.			a	SL1		high abundance of W.barnesae
APTIAN	UPPER	SOLA FM.		M1	b 1	SL2	V.gracillima grp.	influx of E.varolii abnt. Nannoconids (1), incl. N.abundans
APTIAN	UPPER	SOLA FM.		M2	b 2	SL3	abundant B.infracretacea (1)	R.pseudoangustus, N.kamptneri L.subquadratus "minor"
APTIAN	LOWER	SOLA FM.	FISCH SCHIE	M2	c	SL4		abnt. organic debris (1)
APTIAN	LOWER	SOLA FM.		M2	d	SL5		Z.sisyphus (large 1)
APTIAN	LOWER	SOLA FM.		M2	e	SL6		v.comm. Micrantholithus spp.fragments (1)
APTIAN	LOWER	SOLA FM.		M2	f	SL7		L.camiolensis
APTIAN	LOWER	SOLA FM.		M3 a	g	SL8	influx of B.aptiana	abnt. Nannoconids (2)
APTIAN	LOWER	SOLA FM.		M3 a	h	SL9		abnt. organic debris (2)
APTIAN	LOWER	SOLA FM.		M3 b / M4	i	SL10	common & consistent B.Infracretacea impoverished microfaunas G.barremiana, Falsogaudryinella sp.X	abnt. Corolithion spp. reduction in diversity and abundance abnt. Nannoconids (3)
BARREMIAN	LOWER - MIDDLE	SOLA FM.		M5 a / M5 b	j / k	SL11	G.barremiana (common) common H.planispira	Influx of B.ellipticum "Phanulithus valdemarensis"
BARREMIAN	LOWER - MIDDLE	TUXEN FM.		M6 a	k	TX1	Falsogaudryinella sp.X (common)	P.embergeri (1), N."vermiformis" abnt "P.valdemarensis" N.borealis.
BARREMIAN	LOWER - MIDDLE	TUXEN FM.		M6 a	l	TX2		base of "P.valdemarensis"
BARREMIAN	LOWER - MIDDLE	TUXEN FM.		M6 a / M6 b	m	TX3	reappearance of B.infracretacea	abnt. Nannoconids (4)
BARREMIAN	LOWER - MIDDLE	TUXEN FM.		M6 b	n	TX4		Z.sisyphus (large 2) super abnt. Z.sisyphus v.comm. Micrantholithid fragments (2) comm. "N.vermiformis" P.embergeri (2), C.rothii
BARREMIAN	LOWER - MIDDLE	TUXEN FM.		M6 b	o	TX5		thin nannoconids, C.mexicana
BARREMIAN	LOWER - MIDDLE	TUXEN FM.		M6 b	p	TX6		abnt. Nannoconids (5) incl. N."ananas"
BARREMIAN	LOWER - MIDDLE / ?	TUXEN FM.		M7 / M8 a-b	q	TX7	A.neocomianus abundant B.infracretacea (2) pyritised radiolaria	v.comm. Micrantholithid fragments (3) reduction in diversity and abundance D & A as in VC18a
BARREMIAN	LOWER	TUXEN FM.	MUNK MARL	M8 c	r	TX8	?Inoceramus spp. debris	abnt. organic debris (3)
BARREMIAN	LOWER	TUXEN FM.		M8 c	s	TX9		low diversity with comm. L.camiolensis
BARREMIAN	LOWER	TUXEN FM.		M8 c	t	TX10		minor influx of thin nannoconids
BARREMIAN	LOWER	TUXEN FM.		M8 c	u 1	TX11		comm. A.infracretacea/Micrantholithid (4) R.laffittei (large)
BARREMIAN	LOWER	TUXEN FM.		M9	u 2	TX12	Marssonella spp.	increase of A.infracretacea v.comm. Micrantholithid fragments (5)
BARREMIAN	LOWER	TUXEN FM.		M10	v	TX13	influx agglutinated foraminifera	influx of A.infracretacea increase in M.chiastius
BARREMIAN	LOWER	TUXEN FM.		M11	w	TX14	V.reideli	abnt. Nannoconids (6) comm./v.comm. L.camiolensis
HAUTERIVIAN	UPPER	TUXEN FM.		M12 / M13	x / y 1 / y 2	TX15	ostracods L.ouachensis wisselmanni	comm. B.ambiguus influx of T.septentrionalis abnt. Nannoconids (7)
HAUTERIVIAN	UPPER	VALHALL FM		M14 a / M14 b / M15	y 3 / z (part)	VH1	increase in diversity and abundance M.robusta grp. V. humilis præcursor	increase in A.infracretacea

BIOSTRATIGRAPHIC SUMMARY SHEET

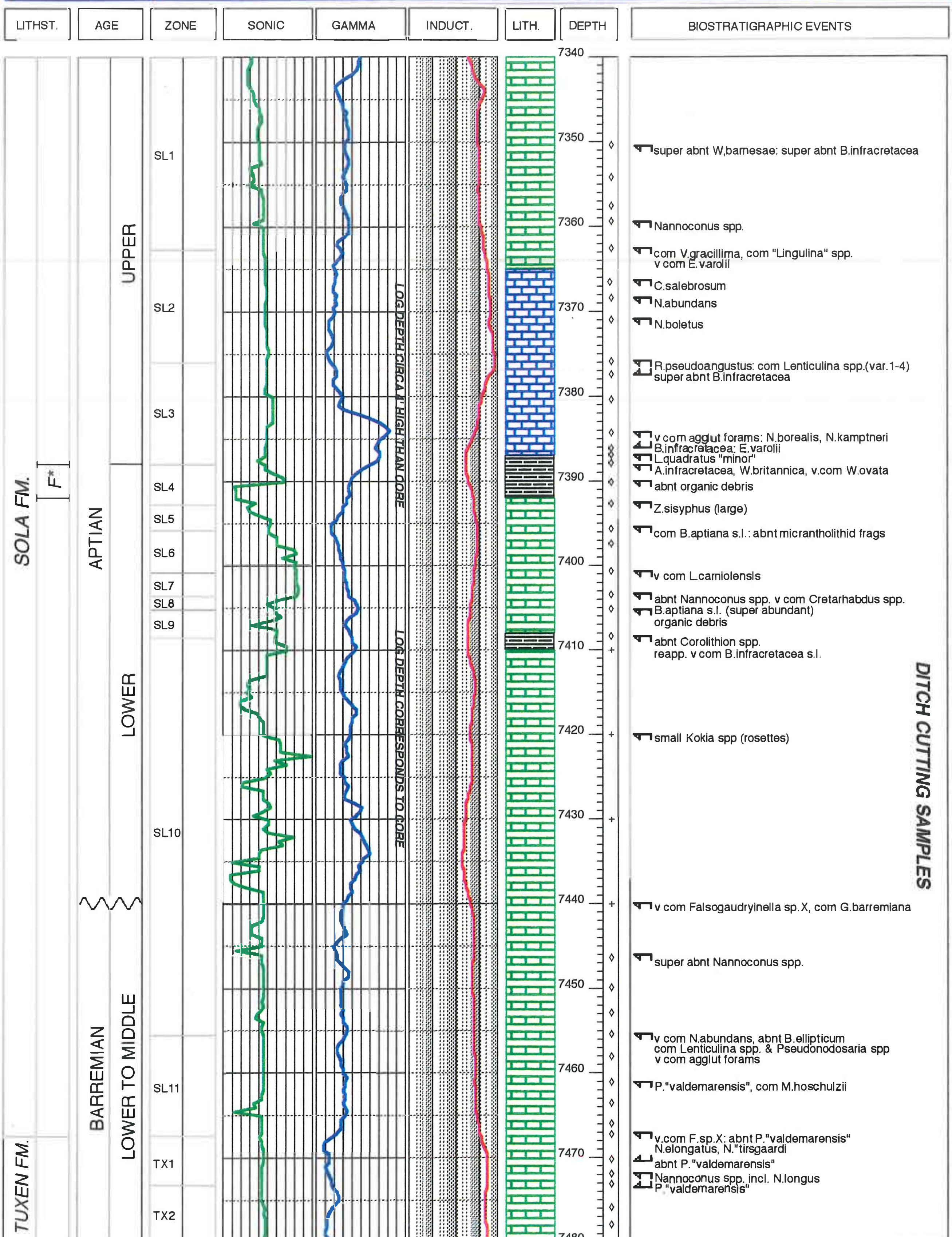
1

GEUS

EFP 93

MDRT(FT)

Well: NORTH JENS-1 WELL
Operator: MÆRSK OLIE OG GAS A/S
Country: DENMARK
Analyst(s): D. Jutson
Date: July 1996



F* = FISCHSCHIEFFER

+ = DITCH CUTTING SAMPLE ◊ = CORE SAMPLE

GEUS

BIOSTRATIGRAPHIC SUMMARY SHEET

2

MDRT(FT)

EFP 93

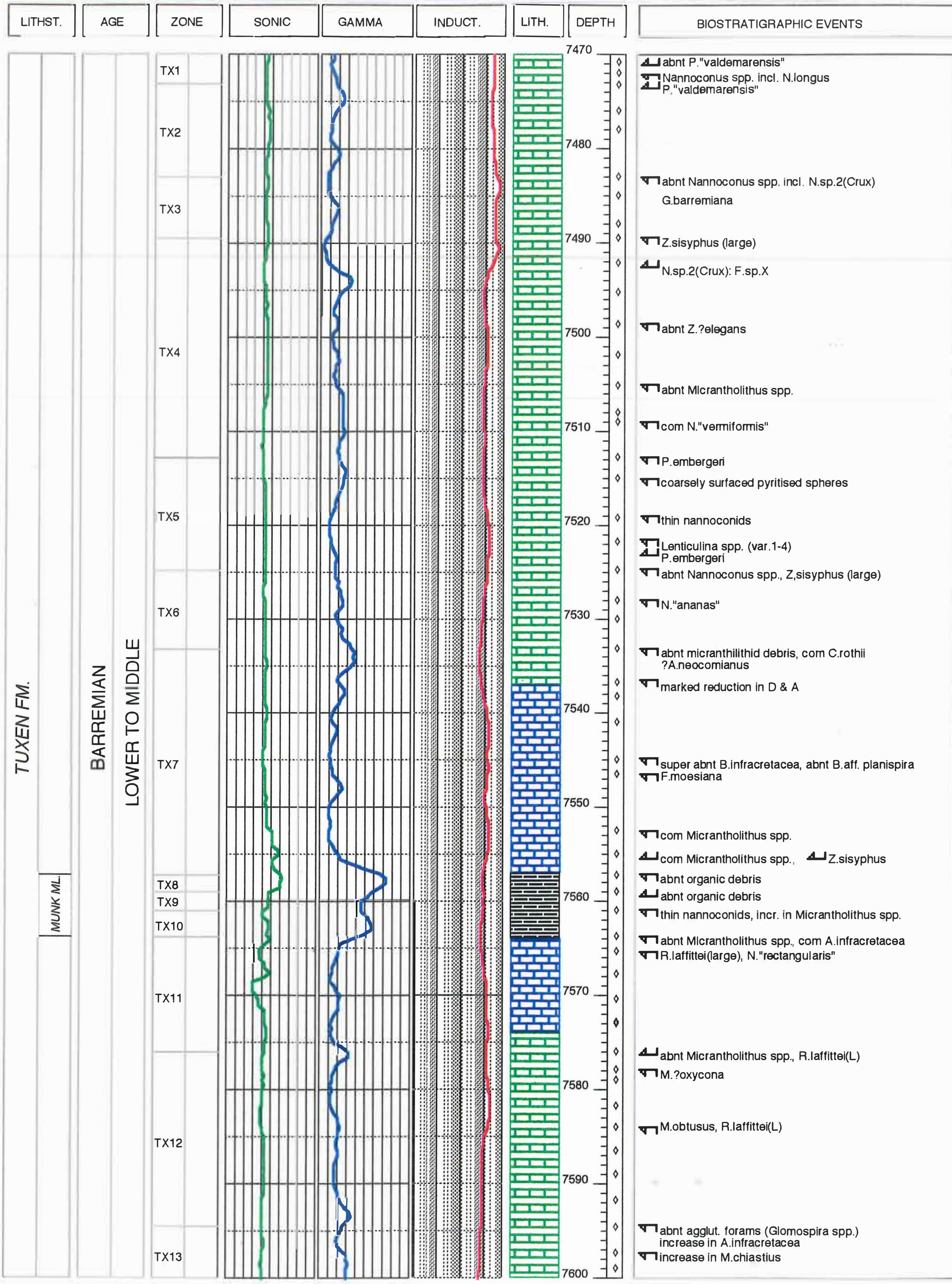
Well: *NORTH JENS-1 WELL*

Operator: *MÆRSK OLIE OG GAS A/S*

Country: *DENMARK*

Analyst(s): *D. Jutson*

Date: *July 1996*



BIOSTRATIGRAPHIC SUMMARY SHEET

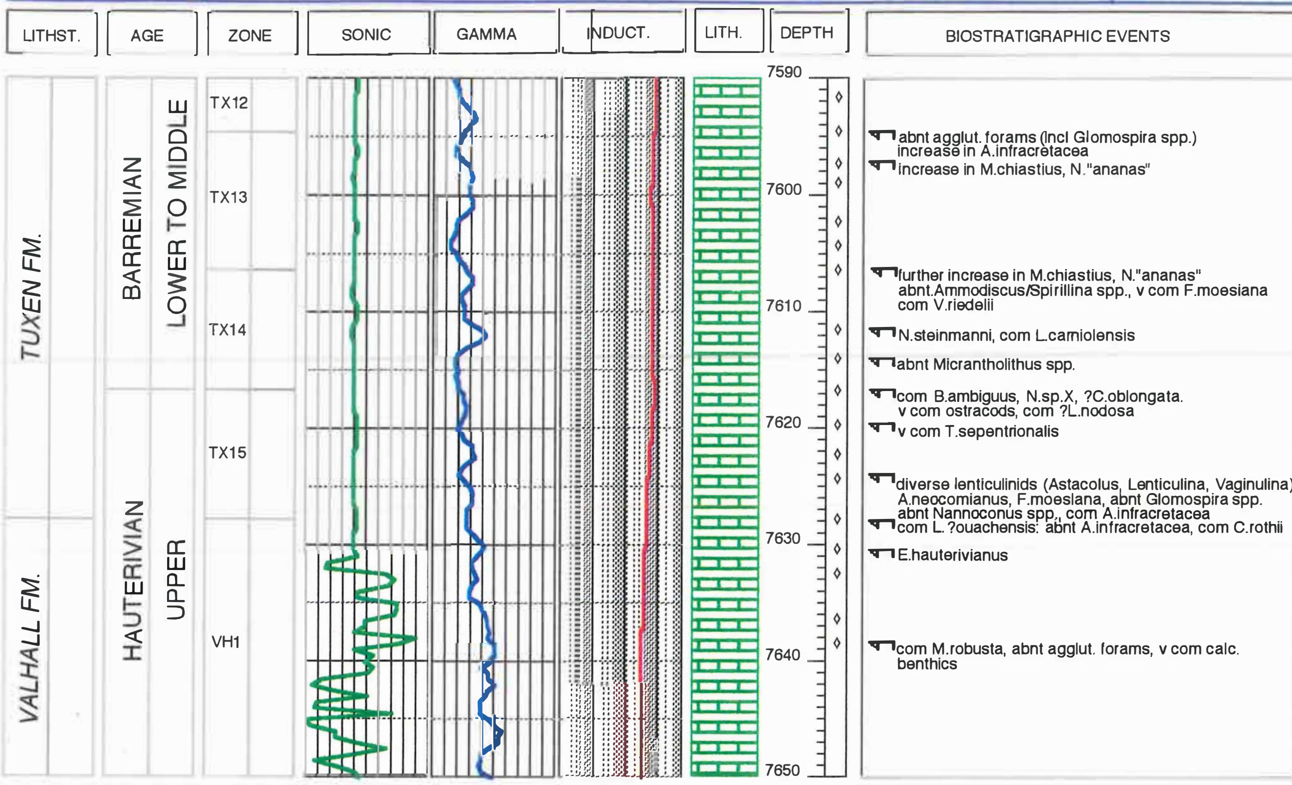
3

MDRT(FT)

GEUS

EFP 93

Well: NORTH JENS-1 WELL
Operator: MÆRSK OLIE OG GAS A/S
Country: DENMARK
Analyst(s): D. Jutson
Date: July 1996



Appendix 1

Samples Analysed for Micro/nannopaleontology

<u>North Jens-1</u>

Microfauna	Nannofossils	
7350.50'	7350.50'	7505.17'
7362.66'	7354.33'	7508.00'
7376.00'	7357.66'	7509.00'
7384.41'	7359.50'	7512.75'
7395.75'	7362.66'	7515.00'
7403.58'	7366.50'	7519.00'
7408.50'	7368.50'	7521.75'
7410'	7371.08'	7524.75'
7420'	7376.00'	7528.00'
7430'	7377.50'	7530.00'
7440'	7380.50'	7533.17'
7446.50'	7384.41'	7536.75'
7455.50'	7386.25'	7538.25'
7461.17'	7386.58'	7541.00'
7467.33'	7387.00'	7545.00'
7476.00'	7388.00'	7546.50'
7485.00'	7390.25'	7552.50'
7492.17'	7392.75'	7555.00'
7505.17'	7397.50'	7557.25
7515.00'	7395.75'	7559.00
7521.75'	7397.50'	7561.00'
7533.17'	7400.75'	7563.75'
7545.00'	7403.58'	7565.33'
7555.17'	7405.25'	7567.75'
7557.25'	7408.50'	7570.41'
7563.75'	7410'	7572.85'
7565.33'	7420'	7576.00'
7576.00'	7430'	7579.00'
7584.17'	7440'	7581.66'
7594.58'	7446.50'	7584.00'
7606.41'	7450.00'	7586.50'
7616.75'	7453.00'	7589.00'
7624.13'	7455.00'	7591.66'
7627.08'	7458.13'	7594.58'
7638.50'	7461.17'	7597.33'
	7463.66'	7599.00'
	7466.08'	7602.25'
	7467.33'	7604.33'
	7470.33'	7606.41
	7472.00'	7611.50'
	7473.25'	7614.00'
	7476.00'	7616.75'

7478.00'	7619.75'
7483.00'	7622.25'
7485.00'	7624.33'
7488.00'	7627.81'
7489.50'	7630.41'
7492.17'	7632.50'
7495.25'	7636.41'
7498.66'	7638.50'
7501.92'	

Total number of samples:	Microfaunas	34
	Nannofossils	100

N.B. all samples are conventional core samples with the exception of those with no decimal places which are ditch cutting samples.