DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 1997/103

Microfaunal and nannofloral analysis of the Lower Cretaceous of the Valdemar-2 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

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Contents

1. Introduction

The microfaunal and nannofossils study of part of the Lower Cretaceous section of Valdemar-2 well was undertaken as part of the EFP-93 Cretaceous Stratigraphy Project. This well was chosen as it had a good coverage of core material for the subject interval. The data from this well and that from North Jens-1 well have been combined to produce a zonation scheme which is illustrated in Figure1 and described in an accompanying report in this project. The close spacing of samples in the cored sections has allowed a highly detailed zonation to be erected.

1.1 Materials and methods

Sampling from Valdemar-2 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 (see Summary Sheets 1-3).

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: 63

Nannofossils: 63

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: Valdemar-2

INTERVAL AGE	MICROZONE	DEPTH	NANNOZONE	DEPTH	COMBINED ZONE
Upper Aptian (top not seen)	?M1	7474.25'	b1	7474.25'	SL2
			b2	7480.75'	SL3
	M2-M3a	7487.75'	?b2	7487.75'	
basal Upper- Lower Aptian			c-d	7388.25	SL4-5
Lower Aptian			e-h	7500'	SL6-9
	M3b	7510'	i	7510'	SL10
	M4	7530'		7530'	
			j	7540'	
Middle to Lower Barremian	M5	7560'		7560'	SL10-11
			k	7576.03'	TX1-5
	M6a	7583.00'	k-o	7583.00'	
	M6b	7620'			
			o	7630'	TX5
			p	7640.08'	TX6
	M7	7646.00'			
			q	7653.13'	TX7
	M8a	7657.00'			
	M8b-c	7659.66'			

INTERVAL AGE	MICROZONE	DEPTH	NANNOZONE	DEPTH	COMBINED ZONE
			r	7675.00'	TX8
			s	7677.33'	TX9
Middle to Lower Barremian			t-u	7677.83'	TX10-11
	M9		u	7681.50'	TX11-12
	M10	7691.17'	?u-v		TX12
			v-w	7694.50'	TX13-14
	M11	7697.50'			
			w	7708.00'	TX14
Upper Hauterivian	M12	7723.00'			TX15
			x	7730'	
	M13-14	7740'	y1-2	7740'	
			y3	7750'	VH1

Last sample examined at 7760'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 more significant micro and nannofossils are shown in Summary Sheets 1-3

Valdemar-2 well: Microfauna

7474.25' - 7500': Upper Aptian (top not seen)

The presence of *Blefuscuiana infracretacea* s.l. at 7474.25' together with the minor influx (and first downhole occurrence) of *Valvulineria gracillima* at 7480.75' is indicative of Upper Aptian age. At 7483.30', the first downhole occurrence of *Lenticulina* sp. var.4 was recorded which is supportive of this age. In general, microfaunas were poor in diversity and abundance in this interval.

7500' - 7560': Lower Aptian

The incoming of the planktic foraminifera *Blefuscuiana infracretacea* s.l. (abundant) following the barren, organic debris rich interval associated with the Fischschiefer is suggestive of Lower Aptian age. This age is confirmed by an influx of *Blefuscuiana aptiana* s.l. (Banner et al., 1993). From 7510' to 7560', microfaunal recovery was poor and this can be related to the sample type which over this interval were ditch cuttings rather than core samples. However, the overall view was that the benthic foraminiferal component of these sample increased downhole, especially agglutinated benthic foraminifera.

7560' - 7723': Middle to Lower Barremian

The first downhole occurrence of an assemblage including the calcareous benthic foraminifera *Gavelinella barremiana* and *Gavelinella* cf. *barremiana* together with the agglutinated benthic foraminifera *Falsogaudryinella moesiana* indicates that the age of the top of the interval is of Middle Barremian age. This age is supported by the occurrence of *Falsogaudryinella* sp.X (of King *et al.* 1989) at 7583.00'

7723' - 7760': Upper Hauterivian

Evidence for Upper Hauterivian age is poorly defined in this interval. However, at 7723' the incoming of a relatively diverse microfauna including calcareous benthic foraminifera, especially nodosarids, and smooth ostracods, (*Bairdia* spp., *Krithe* spp.) suggests Upper Hauterivian age as this combination is often seen as an intra Upper Hauterivian marker from neighbouring areas in the North Sea (unpublished data).

Valdemar-2 well: Calcareous Nannofossils

7474.25' - 7500': Upper Aptian (top not seen)

The presence of *Eprolithus varolii* s at 7474.25' together with *Micrantholithus hoschulzii*, abundant *W. barnesae* and *Rhagodiscus asper* indicate that the age of this interval is Upper Aptian. Jakubowski (1987) used the co- occurrences of *M. hoschulzii, E. varolii* and abundant *R. asper* to define his NLK 7 (Upper Aptian) zone but noted that *M. hoschulzii* had been used by Sissingh (1977) to define his 7a subzone which was Lower Aptian in age. However, there is a plexus running from *M. hoschulzii* s.s. and a similar species, *M. obtusus* (Lower Aptian - Valanginian) which could have caused the difference. Alternatively, as the Sissingh (1977) zonation was based on Tethyan sections and it may be that the extinction of *M. hoschulzii* is diachronous northwards.

Nannofloras in this interval became poorer in diversity and abundance downhole and in general terms were dominated by *W. barnesae* and *R. asper*. At 7488.25', the nannoflora was accompanied by organic debris and it was notable that the nannoflora contained approximately 50% dwarf forms.

7500' - 7560': Lower Aptian

The incoming of *Micrantholithus obtusus* s.s. together with rare nannoconids allows an age assignation of Lower Aptian to be given to this interval. The nannoconids were observed as top views and therefore no specific identification could be made. This interval was analysed using ditch cutting samples and the quality of data was not as high as from the core samples used in other parts of the study.

7560' - 7723.00': Middle to Lower Barremian

The nannofossil assemblage at 7560' includes an increase in both abundance and diversity in comparison to the last sample from the overlying interval. Most importantly, the increase in the numbers of *Nannoconus* spp. including *N. rectangularis*. Although numbers were high, the individual species could only rarely be identified by comparison with standard references and therefore informal names have been erected to accommodate this deficiency. These names or names related to these forms will be confirmed in a publication in preparation and are indicated in the text with inverted commas. These include "*N. albrechtseni*" and "*N. tirsgaardii*", both recorded at 7560'. The increase in abundance and diversity of nannoconids is a stratigraphically significant marker for the top of the Barremian (Erba, 1994; Jakubowski, 1987)

At 7577.00', another undescribed but stratigraphically useful species, "*Phanulithus valdemarensis*" was recorded. This species was also noted in the North Jens-1 well. In this well it's first downhole occurrence was associated with an influx of *Nannoconus abundans*.

This interval was characterised by multiple influxes of nannoconids and micrantholithids. Notable species in this interval were *Microstaurus chiastius* (7600'), *Zygodiscus sisyphus* (7577.00'), *Nannoconus borealis* (7590'), and *Percivalia fenestrata* (7649.00').

7730' - 7760': Upper Hauterivian

The occurrence of *Bukrylithus ambiguus* at 7730' indicates that the Upper Hauterivian has been penetrated. This is confirmed at 7740' by the incoming of *Tegulalithus septentrionalis*. Nannofloras were low in diversity but high in abundance and were dominated by *Watznaueria barnesae* and *Rhagodiscus asper.*

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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				
APTIAN	UPPER	SOLA FM.			a		SL1
APTIAN	UPPER	SOLA FM.	M1		b	1	SL2
APTIAN	UPPER	SOLA FM.	M2		b	2	SL3
APTIAN	LOWER	SOLA FM. (FISCH SCHIE)	M2		c		SL4
APTIAN	LOWER	SOLA FM.	M2		d		SL5
APTIAN	LOWER	SOLA FM.	M2		e		SL6
APTIAN	LOWER	SOLA FM.	M2		f		SL7
APTIAN	LOWER	SOLA FM.	M3	a	g		SL8
APTIAN	LOWER	SOLA FM.	M3	a	h		SL9
APTIAN	LOWER	SOLA FM.	M3 / M4	b	i		SL10
BARREMIAN	LOWER - MIDDLE	SOLA FM.	M5	a	j		SL11
BARREMIAN	LOWER - MIDDLE	SOLA FM.	M5	b	k		SL11
BARREMIAN	LOWER - MIDDLE	TUXEN FM.	M6	a	k		TX1
BARREMIAN	LOWER - MIDDLE	TUXEN FM.	M6	a	l		TX2
BARREMIAN	LOWER - MIDDLE	TUXEN FM.	M6	a / b	m		TX3
BARREMIAN	LOWER - MIDDLE	TUXEN FM.	M6	b	n		TX4
BARREMIAN	LOWER - MIDDLE	TUXEN FM.	M6	b	o		TX5
BARREMIAN	LOWER - MIDDLE	TUXEN FM.	M6	b	p		TX6
BARREMIAN	?...	TUXEN FM.	M7 / M8	a-b	q		TX7
BARREMIAN	LOWER	TUXEN FM. (MUNK MARL)	M8	c	r		TX8
BARREMIAN	LOWER	TUXEN FM.	M8	c	s		TX9
BARREMIAN	LOWER	TUXEN FM.	M8	c	t		TX10
BARREMIAN	LOWER	TUXEN FM.	M8	c	u	1	TX11
BARREMIAN	LOWER	TUXEN FM.	M9		u	2	TX12
BARREMIAN	LOWER	TUXEN FM.	M10		v		TX13
BARREMIAN	LOWER	TUXEN FM.	M11		w		TX14
HAUTERIVIAN	UPPER	TUXEN FM.	M12		x		TX15
HAUTERIVIAN	UPPER	TUXEN FM.	M12		y	1	TX15
HAUTERIVIAN	UPPER	TUXEN FM.	M13		y	2	TX15
HAUTERIVIAN	UPPER	VALHALL FM	M14	a / b	y	3	VH1
HAUTERIVIAN	UPPER	VALHALL FM	M15		z (part)		VH1

MICROFAUNAL EVENTS

- V.gracillima grp.
- abundant B.infracretacea (1)
- influx of B.aptiana
- common & consistent B.infracretacea
- impoverished microfaunas
- G.barremiana, Falsogaudryinella sp.X
- G.barremiana (common)
- common H.planispira
- Falsogaudryinella sp.X (common)
- reappearance of B.infracretacea
- A.neocomianus
- abundant B.infracretacea (2)
- pyritised radiolaria
- ?Inoceramus spp. debris
- Marssonella spp.
- influx agglutinated foraminifera
- V.reideli
- ostracods
- L.ouachensis wisselmanni
- increase in diversity and abundance
- M.robusta grp.
- V. humilis præcursor

NANNOFOSSIL EVENTS

- high abundance of W.barnesae
- influx of E.varolii
- abnt. Nannoconids (1), incl. N.abundans
- R.pseudoangustus, N.kamptneri
- L.subquadratus "minor"
- abnt. organic debris (1)
- Z.sisyphus (large 1)
- v.comm. Micrantholithus spp.fragments (1)
- L.carniolensis
- abnt. Nannoconids (2)
- abnt. organic debris (2)
- abnt. Corolithion spp.
- reduction in diversity and abundance
- abnt. Nannoconids (3)
- influx of B.ellipticum
- "Phanulithus valdemarensis"
- P.embergeri (1), N."vermiformis"
- N.borealis. abnt "P.valdemarensis"
- base of "P.valdemarensis"
- abnt. Nannoconids (4)
- Z.sisyphus (large 2)
- super abnt. Z.sisyphus
- v.comm. Micrantholithid fragments (2)
- comm. "N.vermiformis"
- P.embergeri (2), C.rothii
- thin nannoconids, C.mexicana
- abnt. Nannoconids (5) incl. N."ananas"
- v.comm. Micrantholithid fragments (3)
- reduction in diversity and abundance
- D & A as in VC18a
- abnt. organic debris (3)
- low diversity with comm. L.carniolensis
- minor influx of thin nannoconids
- comm. A.infracretacea/Micrantholithid (4)
- R.laffittei (large)
- increase of A.infracretacea
- v.comm. Micrantholithid fragments (5)
- influx of A.infracretacea
- increase in M.chiastius
- abnt. Nannoconids (6)
- comm./v.comm. L.carniolensis
- comm. B.ambiguus
- influx of T.septentrionalis
- abnt. Nannoconids (7)
- increase in A.infracretacea

GEUS

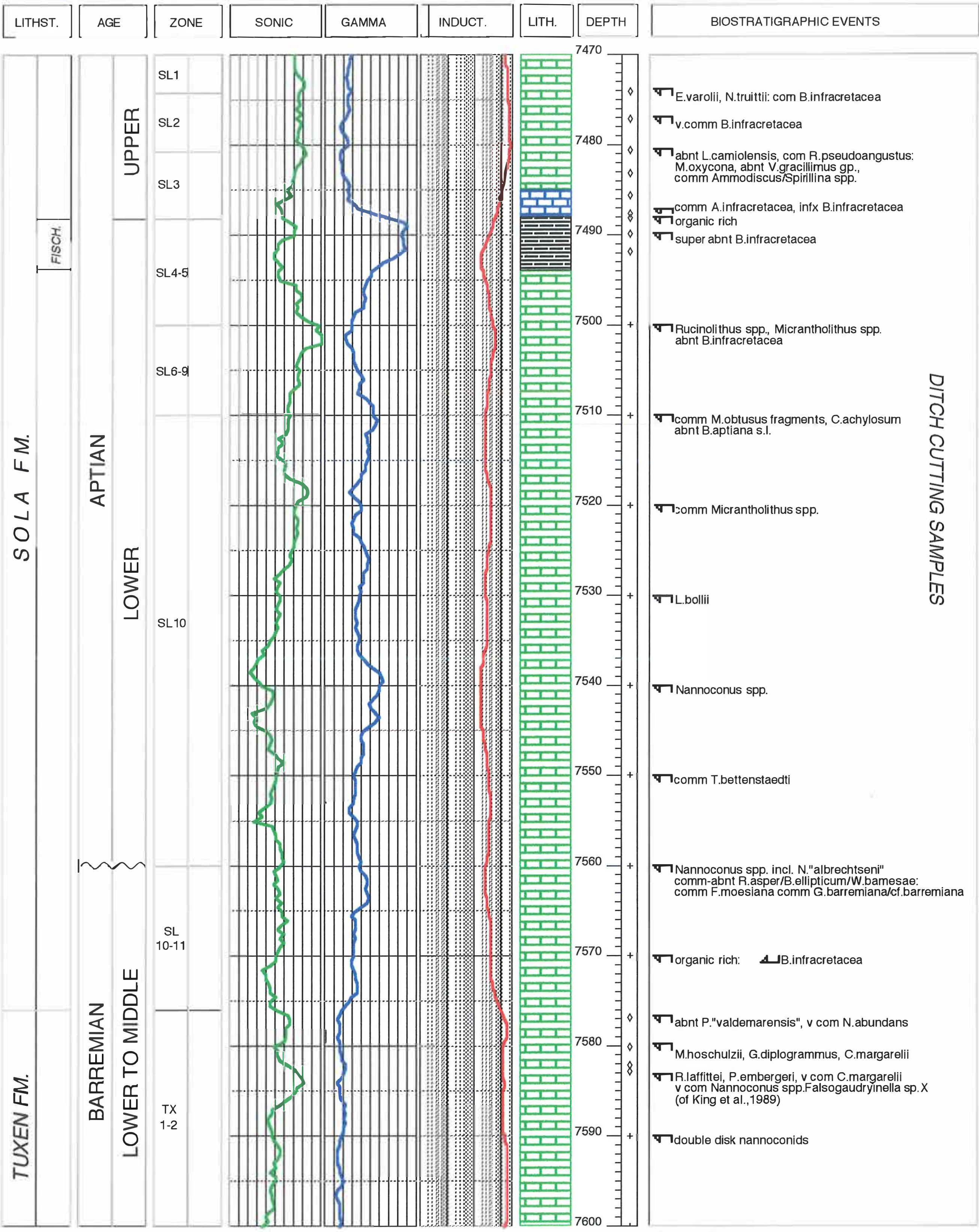
BIOSTRATIGRAPHIC SUMMARY SHEET

1

Well: VALDEMAR-2 WELL
Operator: MÆRSK OLIE OG GAS A/S
Country: DENMARK
Analyst(s): D. Jutson
Date: July 1996

MDRT(FT)

EFP 93



◊ = CORE SAMPLE
+ = DITCH CUTTING SAMPLE

GEUS

BIOSTRATIGRAPHIC SUMMARY SHEET

2

EFP 93

MDRT(FT)

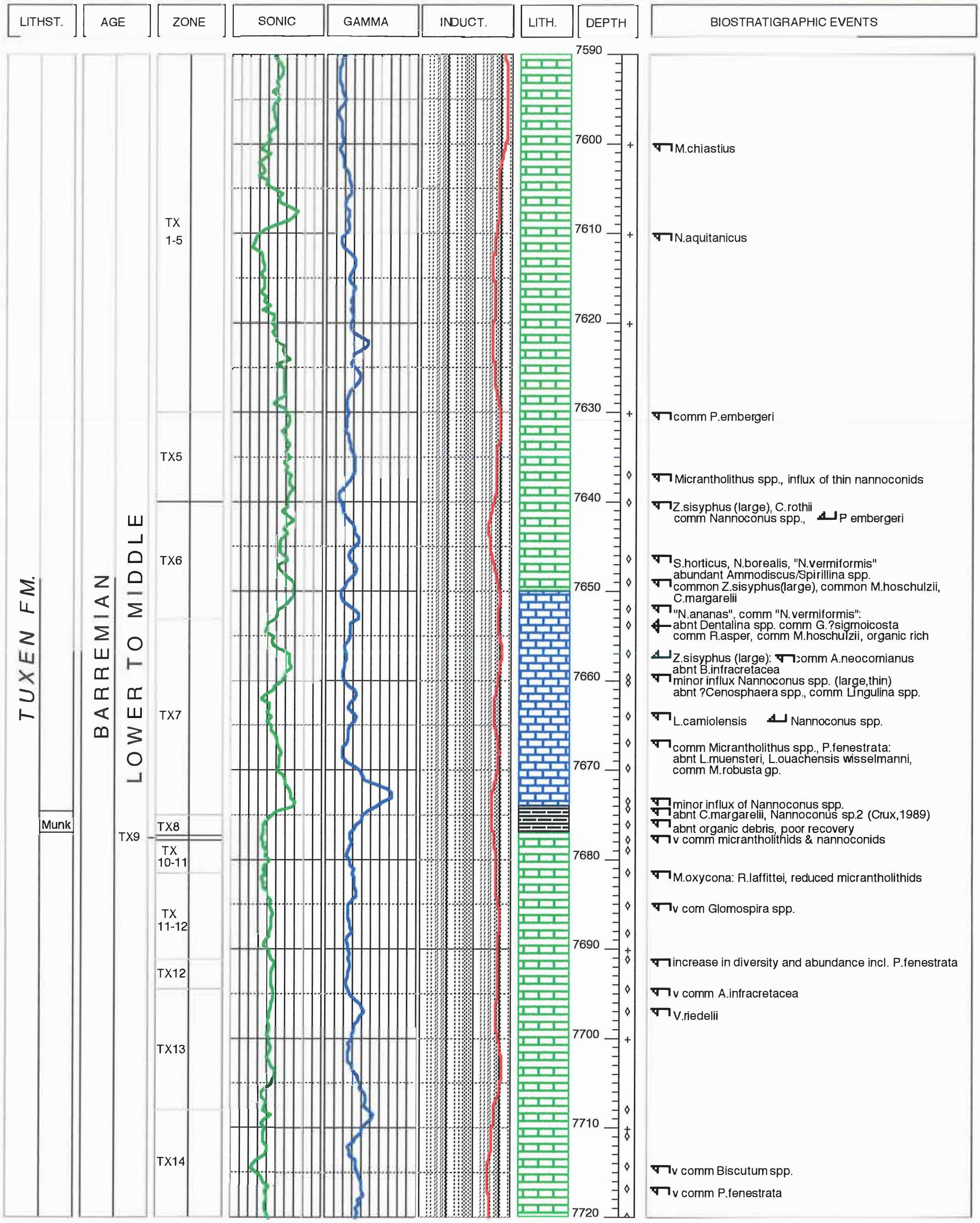
Well: *VALDEMAR-2 WELL*

Operator: *MÆRSK OLIE OG GAS A/S*

Country: *DENMARK*

Analyst(s): *D. Jutson*

Date: *July 1996*



◊ = CORE SAMPLE
+ = DITCH CUTTING SAMPLE

GEUS

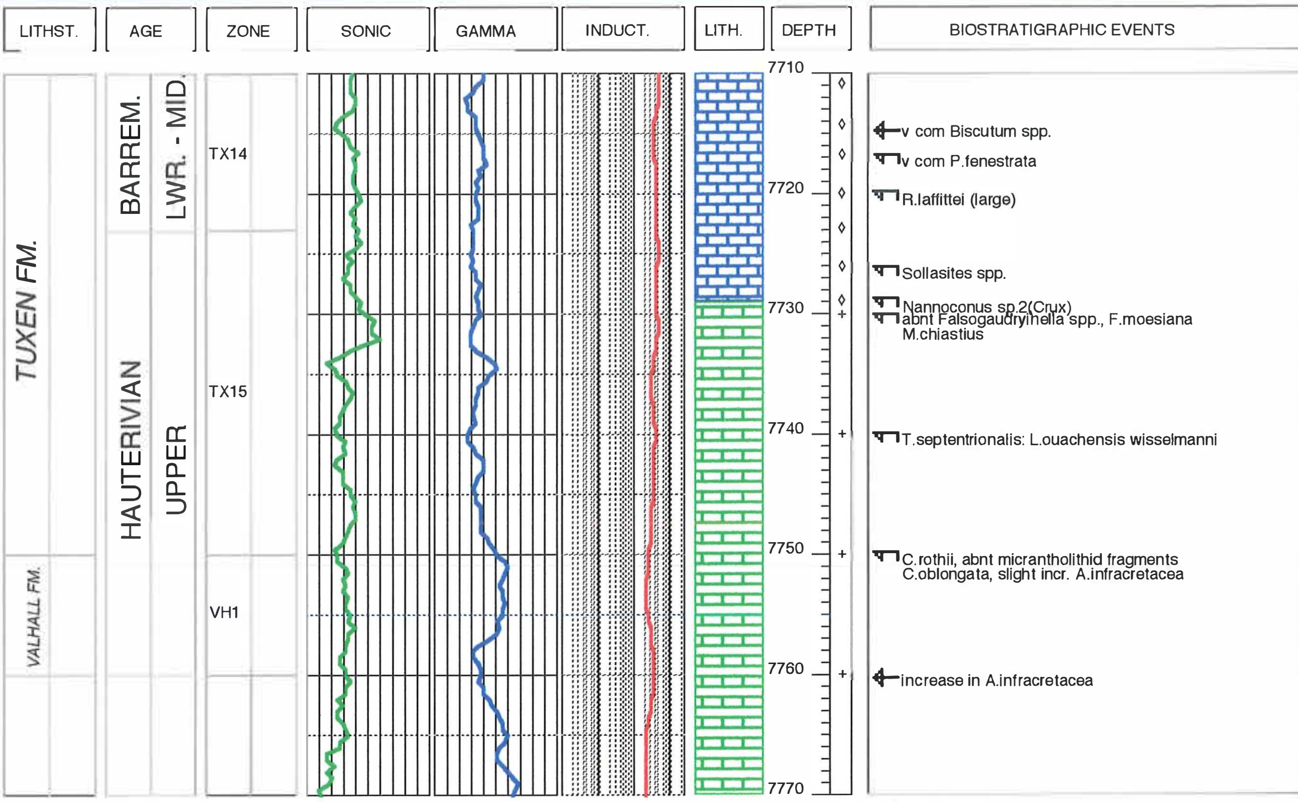
BIOSTRATIGRAPHIC SUMMARY SHEET

3

MDRT(FT)

EFP 93

Well: *VALDEMAR-2 WELL*
Operator: *MÆRSK OLIE OG GAS A/S*
Country: *DENMARK*
Analyst(s): *D. Jutson*
Date: *July 1996*



LAST SAMPLE EXAMINED AT 7760' MDRT

◊ = CORE SAMPLE
+ = DITCH CUTTING SAMPLE

Appendix 1

Samples analysed for Micro/nannopaleontology

Valdemar-2

Microfauna/Nannofossils

7474.25’	7664.00’
7477.25’	7667.00’
7480.75’	7669.83’
7483.30’	7674.33’
7485.75’	7675.50’
7487.75’	7676.00’
7488.25’	7677.33’
7490’	7677.83’
7492’	7679.00’
7500’	7681.50’
7510’	7685.17’
7520’	7688.25’
7530’	7690’
7540’	7691.17’
7560’	7694.50’
7570’	7700’
7577’	7708.00’
7580’	7710’
7580.25’	7711.00
7583.00’	7714.33’
7590’	7716.83’
7600’	7720.08’
7610’	7723.00’
7620’	7726.17’
7630’	7729.00’
7637.00’	7730’
7640.08’	7740’
7646.41’	7750’
7649.00’	7760’
7652.00’	
7653.00’	Total number of samples: Microfaunas & nannofossils each 63
7659.66’	
7657.00’	
7660.25’	

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