

# **Microfaunal and nannofloral analysis of the Lower cretaceous of the Iris-1 well**

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

David J. Jutson, Emma Sheldon and  
Jan Audun Rasmussen

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# 1. Introduction

As part of the EFP-93 Cretaceous Stratigraphy Project, microfaunal and nannofossil analyses of ditch cutting, sidewall core and conventional core samples covering the interval of the Valhall to Farsund Formations (Hauterivian to Volgian) well were undertaken. A stratigraphic subdivision has been produced and is presented in this report.

The chronostratigraphic subdivision of the Valhall Formation that has been established for this project and which has been used in the interpretation of the results of the Iris-1 material is based on research together with published and confidential proprietary schemes from the North Sea and adjacent areas (Fig. 1).

## 1.1 Materials and methods

All samples were collected using normal techniques appropriate to the discipline involved. In the case of nannofossils, this required stringent precautions to avoid contamination from sample to sample. Implements used to take samples were cleaned with mild acid before a new sample was taken.

Preparation techniques for microfaunas were as follows. The samples were cleaned in water and then crushed by use of a hammer. The resultant material was soaked in hydrogen peroxide for a period not less than 12 hours. They were then heated to just below boiling point and left to cool. The peroxide which had soaked into the sample material caused the sediment particles to disaggregate due to the release of oxygen in the form of small bubbles. The residues of this were separated through a 63 $\mu$  sieve and the remaining material was dried under infra-red lamp and bagged for future analysis.

The nannofossil samples were prepared by smear technique. That is, the samples were crushed and put into solution with distilled water in a test tube. This was physically agitated and left to stand for ten seconds to allow the larger fragments to fall out of suspension. A small amount of the dissolved material was removed from the top 1 cm of solution by use of a dropper pipette. The sediment solution was then spread on a cover slip and left to dry. When it had dried, the cover slip was set onto a standard thickness microscope slide with an epoxy resin (Norland Optical Adhesive) and set under ultra violet light. At all stages, precautions to avoid contamination were taken. Nannofossils are small enough to be



## 2. Biostratigraphic summary

All depths quoted are in feet and inches and are measured depth from rotary table (MDRT). The stratigraphic distribution of micro and nannofossils are summarised in Summary Charts 1- 4.

### 2.1 Compiled biostratigraphy: Iris-1 well

INTERVAL AGE	MICROZONE	DEPTH	NANNOZONE	DEPTH	COMBINED ZONE
Lower Hauterivian (top not seen)	M18	11370'	$\alpha$	11370'	VH4
	M19	11440'	$\alpha$		VH5
			$\beta$ 1	11500'	
Upper Valanginian	M20	11510'	$\beta$ 1		VH6a
			$\beta$ 2	11680'	VH6b
----- stratigraphic break -----					
Lower Valanginian	M21	11740'	$\gamma$ 1	11740'	VH7a
			$\gamma$ 2- $\gamma$ 3	12280'	VH7b-c
Upper Ryazanian			$\delta$	12400'	VH8
	M22	12430'	$\epsilon$	12800'	
Lower Ryazanian	M23	13010'		<i>poor recovery</i>	F1
Upper Volgian (Jurassic)	<i>No zonation</i>	13080'		<i>poor recovery</i>	

Last sample examined at 13230'

## 2.2 Biostratigraphic description

### Iris-1 well: Microfauna

#### 11370' (first sample examined) - 11510': Lower Hauterivian

The occurrence at 11370' of the radiolarian *Praeconocaryomma* sp.1 (in-house) together with ostracods including *Pontocyprilla superba* and *Pontocyprilla* sp.2 (in-house) suggest a Lower Hauterivian age for the interval. The ostracods recorded from this interval were in general, smooth forms. The majority of these smooth forms have not been formally described as they do not appear in coeval sections in adjacent areas where most of the research into this group has been undertaken (Germany, England). At 11380', a small fragment of the agglutinated foraminifera *Haplophragmoides inconstans gracile* supports Lower Hauterivian age (Bartenstein & Brandt, 1951). Microfaunal assemblages were moderately diverse but contained significant caving mainly from the Barremian.

An influx of the radiolarian cyrtid sp.4 (in-house) together with common actinomid radiolaria at 11440' is additional evidence of Lower Hauterivian age. At 11490', an agglutinated foraminiferal influx including *Triplasia emslandensis* and *Reophax minutissima* indicates proximity to the base of the Lower Hauterivian interval.

#### 11510' - 11740': Upper Valanginian

An additional agglutinated foraminiferal influx which included *Bigenerina clavellata* and *Ammobaculites eocretaceus* indicates the top of the Upper Valanginian interval. The calcareous benthic foraminifera, *Epistomina tenuicostata* was also recorded at this depth. Supporting this age determination at 11630' was the first downhole occurrence of *Palaeomiliolina lanceolata*. and the occurrence of *Epistomina caracolla anterior* at 11690'. Microfaunal recovery was not good in this interval. Diversity and abundance both declined downhole.

#### *11740'- 12430': Lower Valanginian*

The first downhole occurrence of *Falsoguttulina wolburgi* and the occurrence of *Fron-diculina concinna* are evidence that the Lower Valanginian has been reached. This is confirmed by the incoming of *Buliminella loeblichii* at 11750'. At the same depth, the agglutinated foraminifera, *Ammovertella cellensis* was present. This species ranges into the Lower Hauterivian but has a minor acme in the Late Valanginian of onshore England. The top in this well may be equivalent to the acme in adjacent areas and that the caving may have obscured the full acme. Microfaunal recovery was poor in this interval.

#### *12430' - 13010': Upper Ryazanian*

The consistent occurrence of *B. loeblichii* from the sidewall core at 12426.00' suggests that the Late Ryazanian has been reached. It is also coincident with the base occurrence of common radiolaria and agglutinated foraminifera (mainly *Glomospira* spp.). Additional stratigraphically significant species include *Trocholina infragranulata* s.l. at 12510', *Trocholina* sp.2 (in-house) at 12570' and *Lenticulina nodosa* at 12600'. The top of this interval is lower than the corresponding nannofossil top. This may be accounted for by the masking of the true increase of *B. loeblichii* by caving in the ditch cutting sample at 12400'.

#### *13010' - 13080': Lower Ryazanian*

## **Iris-1 well: Calcareous Nannofossils**

### *11370' (first sample examined) - 11500': Lower Hauterivian*

Evidence for Lower Hauterivian age in this interval was poor. The nannofloras were typical of the “*Watznaueria* deserts” recorded in the Lower Cretaceous of the North Sea. That is, low diversity nannofloras dominated by *Watznaueria bamesae* and/or *Watznaueria communis*. At 11380', the occurrence of *Tegalulithus septentrionalis* is indicative of Hauterivian age, as is *Cruciellipsis cuvillien* at 11490'

### *11500' - 11740': Upper Valanginian*

The first possible stratigraphic markers for Upper Valanginian age were recorded at 11500' which was 10' above a more reliable microfaunal marker. This was the incoming of common *Diazomatolithus lehmanii* together with *Sollasites lowei*. This is a stratigraphic top that can be employed locally in the Danish Sector of the North Sea. A more reliable and widely used markers were recorded at 11620' with the top occurrence of *Rucinolithus wisei* and at 11630' with the top occurrence of *Triquetrorhabdulus(?) shetlandensis*. *Nannoconus steinmanni minor*, an Upper Valanginian species was recorded at 11680'. Accompanying this species was *Micrantholithus speetonensis* which has previously been recorded from the Lower Valanginian. Taylor (1982) also recorded this species from the Upper Valanginian of Speeton in England. Subsequent studies of the Valanginian have been almost all on sections with little or no Upper Valanginian and the occurrence in Iris-1 is probably the first confirmation of Taylor's observations.

### *11680' - 11740': Lower Valanginian*

The top of the Lower Valanginian is marked by an increase in the abundance of *Corolithion achylosum* at 11740'. At 11750', *Tranolithus gabalus* becomes very common which may also be significant but has not been recorded in other sections in the neighbouring onshore areas. The first occurrence of very common *T. gabalus* at this depth which is just below a possible unconformity, suggests that the basal part of the Upper Valanginian is missing. Additional evidence of this is the absence of both *Nannoconus dolomiticus* and

*Diadorhombus rectus*, which are markers for the VH6c subzone at the base of the Upper Valanginian. At 11870' *M. speetonensis* becomes consistently common and is associated with *Micrantholithus brevis* and the top of very common *Crucibiscutum salebrosus*. Intra Lower Valanginian markers were recorded at 12280' and 12340' with the top occurrences of *Kokia borealis* and *K. borealis 'minor'* respectively.

#### 12400' - 12850': Upper Ryazanian

The consistent occurrence of *Sollasites arcuatus* at 12400' is considered to indicate to top of the Upper Ryazanian. This is a marker that has been used by both Crux (1989) and Perch Nielsen (pers. comm.). It is 30' above the recognised microfaunal top for this age. The occurrence of *Kokia curvata* at 12500' is possibly low in this section as it's top is normally associated with the Lower Valanginian. The base of *S. arcuatus* at 12800' marks the rapid decline of both nannofossil diversity and abundance as the lithology changes from a calcareous claystone to a claystone proper, probably formed under near anoxic conditions (Farsund Formation).

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# Enclosures

Fig. 1 and Summary Sheets 1-4



# EFP 93

## HAUTERIVIAN TO RYAZANIAN BIOSTRATIGRAPHIC ZONATION

MAY 1997

AGE/LITHOSTR.		ZONATIONS			MICROFAUNAL EVENTS	NANNOFOSSIL EVENTS					
		microfauna	nannofossil	combined							
	HAUTERIVIAN	UPPER	TUX.	M12	X	TX15	<ul style="list-style-type: none"> <li>☐ <i>L.ouachensis wisselmanni</i></li> </ul>	<ul style="list-style-type: none"> <li>☐ influx of <i>T.septentrionalis</i></li> <li>☐ abnt. Nannoconids (?)</li> </ul>			
				M13	y				1		
				M14					2		
		VALANGIAN	UPPER	VALHALL FM.	M15	z	VH1	<ul style="list-style-type: none"> <li>☐ <i>M.robusta</i> grp.</li> <li>☐ <i>V. humilis praecursor</i></li> </ul>	<ul style="list-style-type: none"> <li>☐ incr. in A. infracretacea</li> <li>☐ <i>C.cuvillieri</i>, <i>S.colligata</i></li> </ul>		
					M16					α	VH2
					M17						
	LOWER		M18	α	VH4	<ul style="list-style-type: none"> <li>☐ <i>L.nodosa</i>, <i>P.superba</i>, incr. <i>P.mandelstami</i> abundant, <i>T.beitenstædti</i></li> </ul>	☐ <i>T.(?) shetlandensis</i>				
			M19		VH5	<ul style="list-style-type: none"> <li>☐ influx of radiolaria</li> </ul>	☐ <i>C.silvaradion</i> , comm. <i>C.margarelli</i>				
			UPPER		VALHALL FM.	M20	β	1	a	<ul style="list-style-type: none"> <li>☐ <i>G.neocomiensis</i> (sensu Sliter), <i>H.inconstans gracile</i>, influx <i>G.hannoverana</i></li> </ul>	☐ <i>A.cellensis</i>
	LOWER	M21		γ		2	b	<ul style="list-style-type: none"> <li>☐ agglit. influx: <i>Glomospira</i> spp., <i>B.clavellata</i></li> <li>☐ <i>E.tenuicostata</i>, <i>A.eocretaceus</i></li> </ul>	☐ v comm. <i>D.lehmanni</i> & <i>C.achylosum</i>		
						3	c	<ul style="list-style-type: none"> <li>☐ <i>B.loeblichii</i>, <i>M.valdensis</i>, <i>C.valdensis</i></li> <li>☐ <i>F.wolburgi</i></li> </ul>	☐ <i>R.wisel</i> , <i>N.steinmanni</i> minor		
	UPPER	VALHALL FM.	M22	δ	VH7	1	a	<ul style="list-style-type: none"> <li>☐ <i>K.borealis</i></li> <li>☐ <i>K.borealis</i> (small)</li> </ul>	☐ abnt <i>C.achylosum</i> , <i>N.steinmanni</i> minor		
						2	b	<ul style="list-style-type: none"> <li>☐ <i>K.curvata</i>, <i>N.concavus</i></li> </ul>	☐ <i>N.dolomiticus</i> , <i>D.rectus</i>		
						3	c	<ul style="list-style-type: none"> <li>☐ incr. <i>B.loeblichii</i>, <i>Trocholina</i> spp.</li> </ul>	☐ abnt <i>C.salebrosus</i> , comm. <i>Sollasites</i> spp.		
	RYAZANIAN	LOWER	FARSUND FM.	M23	ε	F1	<ul style="list-style-type: none"> <li>☐ <i>Tricolocapsa</i> sp.1 &amp; sp.2, <i>P.jonesi</i></li> <li>☐ <i>H.calloviensis</i></li> </ul>	☐ <i>K.curvata</i> , <i>N.concavus</i>			
							<ul style="list-style-type: none"> <li>☐ <i>S.arcuratus</i> ☐ <i>T.(?) shetlandensis</i></li> <li>☐ <i>S.arcuratus</i>, abnt <i>R.asper</i></li> </ul>				
	VOLG.	UPPER					<ul style="list-style-type: none"> <li>☐ <i>Præconocoryomma</i>(?) sp.2 (Dyer &amp; Copestake) comm. <i>S.devorata</i></li> </ul>				

Fig.1



**BIOSTRATIGRAPHIC SUMMARY SHEET**

1

Well: IRIS-1  
 Operator: BRIT OIL  
 Country: OFFSHORE DENMARK  
 Analyst(s): D. JUTSON

**EFP  
93**

Date: JUNE 1996

LITHOSTRAT.	AGE	ZONE/SUBZONE	LITH.	FEET	S	BIOSTRATIGRAPHIC EVENTS
VALHALL FM.	LOWER HAUTERIVIAN	M18	VH4	11350		
				11360		
				11370	◇	Præconocaryomma sp.1
				11380	◇	T.septentrionalis
				11390		
		11400				
		11410				
		11420				
		11430				
		11440	◇	common actinommid radiolaria, Cyrtid sp.4		
	11450					
	11460					
	11470					
	11480					
	11490	◇	T.emslandensis, infl. R.minutissima: C.cuvillieri			
	11500	◇	comm. D.lehmannii, S.loweii			
	11510	◇	B.clavellata, E.tenuicostata, A.æocretaceus: C.oblongata			
	11520					
	11530					
	11540	◇				
	11550					
11560	◇					
11570	◇					
11580						
11590						
11600	◇					
11610						
11620	◇	comm. E.antiquus, R.wisei				
11630	◇	P.lanceolata, T.(?) shetlandensis				
11640						
11650						
11660	◇					
11670						
11680	◇	N.steinmannii minor, M.speetonensis				
11690	◇	E.caracolla anterior				
11700						
11710						
11720	◇					
11730						
11740	◇	F.wolburgi, F.concinna: abnt. C.achylosum				
11750	◇	B.loeblichii, A.cellensis: v.comm. T.gabalus				
11760						
11770						
11780	◇					
11790						
11800						
UPPER VALANGINIAN	M19	VH5	11440			
			11450			
			11460			
			11470			
			11480			
	M20	β1	VH6a	11580		
				11590		
				11600		
				11610		
				11620		
LOWER VALANGINIAN	M21	γ1	VH7a	11680		
				11690		
				11700		
				11710		
				11720		



**BIOSTRATIGRAPHIC SUMMARY SHEET**

2

Well: IRIS-1  
 Operator: BRITOIL  
 Country: OFFSHORE DENMARK  
 Analyst(s): D. JUTSON

**EFP  
93**

Date: JUNE 1996

LITHOSTRAT.	AGE	ZONE/SUBZONE	LITH.	FEET	S	BIOSTRATIGRAPHIC EVENTS
VALHALL FM.	LOWER VALANGINIAN	M21 γ1	VH7a	11790		
				11800	◇	
				11810	◇	
				11820		
				11830		
				11840	◇	
				11850		
				11860	◇	
				11870	◇	▼ T.v. comm. C.salebrosus, M.brevis, comm. M.speetonensis
				11880		
				11890		
				11900	◇	▼ T.abnt T.gabalus
				11910		
				11920	◇	
				11930	◇	▼ T.comm. R.laffitei
				11940		
				11950		
				11960		
				11970		
				11980	◇	
				11990		
				12000		
				12010	◇	▼ radiolaria and agglutinated foraminifera
				12020		
				12030		
12040	◇					
12050						
12060						
12070						
12080						
12090						
12100	◇	▼ comm. M.speetonensis				
12110						
12120						
12130						
12140						
12150						
12160	◇					
12170						
12180						
12190						
12200						
12210						
12220	◇					
12230						
12240						



**BIOSTRATIGRAPHIC SUMMARY SHEET**

3

Well: IRIS-1  
 Operator: BRITOIL  
 Country: OFFSHORE DENMARK  
 Analyst(s): D. JUTSON

**EFP  
93**

Date: JUNE 1996

LITHOSTRAT.	AGE	ZONE/SUBZONE	LITH.	FEET	s	BIOSTRATIGRAPHIC EVENTS
VALHALL FM.	LOWER VALANGINIAN	M21	γ1 VH7a γ2 -3 VH7 b-c	12230		
				12240		
				12250		
				12260		
				12270		
				12280	◇	☞ K.borealis
				12290		
				12300		
				12310		
				12320		
				12330		
				12340	◇	☞ K.borealis 'minor'
				12350		
				12360		
				12370		
				12380		
				12390		
				12400	◇	☞ consistent S.arcuatus
				12410		
				12420		
				12430	+	☞ (SWC) consistent B.ioeblichii
				12440		
				12450		
				12460	◇	
				12470		
				12480		
				12490		
				12500	◇	☞ K.curvata
				12510	◇	☞ T.infraganulata s.l.
				12520	◇	
				12530		
				12540	◇	☞ consistent P.lanceolata
				12550		
				12560		
				12570	◇	☞ Trocholina sp.2
				12580	◇	
				12590		
				12600	◇	☞ L.nodosa
				12610		
				12620		
				12630		
				12640	◇	
				12650		
				12660		
				12670		
				12680		



# BIOSTRATIGRAPHIC SUMMARY SHEET

4

Well: IRIS-1  
 Operator: BRITOIL  
 Country: OFFSHORE DENMARK  
 Analyst(s): D. JUTSON

Date: JUNE 1996

# EFP 93

LITHOSTRAT.	AGE	ZONE/SUBZONE	LITH.	FEET	S	BIOSTRATIGRAPHIC EVENTS
VALHALL FM.  LEEK MBR.	UPPER RYAZANIAN	M22	δ VH8	12670		
				12680		
				12690		
				12700	◇	
				12710		
				12720		
				12730		
				12740		
				12750		
				12760	◇	
12770						
12780						
12790						
12800	◇		abnt T.infracretacea s.l., comm R.perforata ▲ S.arcuatus			
12810						
12820	◇					
12830						
12840						
12850	◇		decrease in nannofossil diversity and abundance			
12860						
12870						
12880						
12890	+		(SWC) infl. organic material			
12900						
12910						
12920						
12930						
12940						
12950						
12960	+		(SWC) abnt Trocholina spp, B.loeblich, F.wolburgi			
12970	‡					
12980						
12990						
13000						
13010	+		(CORE) Tricolocapsa sp.1			
13020	+		(CORE) H.infracaloviensis			
13030						
13040						
13050	+		(SWC) v comm. Tricolocapsa sp.1, P.hexagona Præconocaryomma sp.2 (Dyer & Copestake), S.devorata			
13060						
13070						
13080	◇		comm. Præconocaryomma sp.2 (D&C), comm. S.devorata v.comm P.hexagona			
13090						
13100						
13110	◇					
13120						
FARSUND FM.	LOWER RYAZANIAN	M23	ε VH8 -F1	12960		
				12970		
				12980		
				12990		
				13000		
				13010		
				13020		
				13030		
				13040		
				13050		
13060						
13070						
13080						
13090						
13100						
13110						
13120						
UPPER VOLG. (JURAS.)				12960		
				12970		
				12980		
				12990		
				13000		
				13010		
				13020		
				13030		
				13040		
				13050		
13060						
13070						
13080						
13090						
13100						
13110						
13120						

# Appendix 1

## Samples Analysed for Micro/nannopaleontology

### Iris-1

#### Microfossils & Nannofossils

11370'  
11380'  
11440'  
11490'  
11500'  
11510'  
11540'  
11560'  
11570'  
11600'  
11620'  
11630'  
11660'  
11680'  
11690'  
11720'  
11740'  
11750'  
11780'  
11800'  
11810'  
11840'  
11860'  
11870'  
11900'  
11920'  
11930'  
11980'  
12010'  
12040'  
12100'  
12160'  
12220'  
12280'  
- 12340'  
12400'  
12426'  
12460'  
12500'  
12510'  
12520'  
12540'

12580'  
12600'  
12640'  
12700'  
12760'  
12800'  
12820'  
12850'  
12890'  
12961'  
12968'  
12970'  
12967'  
13006'  
13018'  
13050'  
13080'  
13110'  
13140'  
13170'  
13200'  
13230'      64 samples

Total number of samples:	Microfaunas	64
	Nannofossils	64

N.B. all samples are ditch cutting samples unless marked