

Chrono-stratigraphy Age/Stage Ma	Geomagnetic Polarity	Sub-Boreal ammonite Zones	Dinocyst Zonation		Offshore Norway Zonation (Gradstein et al., 1999 and this study)	
			Selected last occurrences of dinocysts		NCF Zones	Foraminifera Zones
66	C29	Un-Named Interval				
67	C30	Pachydiscus gollevillensis	DCZ 11	d <i>Palynodinium gallator</i> , <i>Alisogymnium euclaense</i> , <i>Dinogymnium</i> spp.	NCF 19	Pseudotextularia elegans
69	C31	Pachydiscus neubergicus / Acanthoscaphites tridens?		c <i>Xenascus ceratoides</i>	NCF 18	Globigerinelloides volutus
70				b <i>Apteodinium deflandrei</i>		Reussella szajnochae
72	C32	Nostoceras hyatti		a <i>Odontochitina costata</i>	NCF 17	Tritaxia dubia
73		Didymoceras donezianum	DCZ 10	c <i>Trichodinium castanea</i> <i>Senoniasphaera rotundata</i>		
74		Bostrychoceras polyplacum		b <i>Raetiaedinium truncigerum</i>		
76	C33	Neancyloceras phaleratum		a <i>Chatangiella manumii</i>	NCF 16	Fenestrella bellii
77		Trachyscaphites spiniger Scaphites hippocrepis III	DCZ 9	d <i>Callaiosphaeridium asymmetricum</i> <i>Dinogymnium denticulatum</i>		
79		Placentoceras bidorsatum		c <i>Coronifera oceanica</i>	NCF 15	Inoceramus LCO
80		Marsupites testudinarius (stemless crinoid)		a <i>Scriniodinium campanula</i>		
81		Uintacrinus socialis (stemless crinoid)		d <i>Psaligonyaulax deflandrei</i>		
82		Placentoceras polyopsis		c		

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84	C34	Marsupites testudinarius		a	NCF 15	Inoceramus LCO
85		Uintacrinus socialis (stemless crinoid)		d <i>Scriniodinium campanula</i>		
86		Placentoceras polyopsis		c <i>Psaligonyaulax deflandrei</i>	NCF 14	Stensioeina granulata polonica
87		Texanites gallicus	DCZ 8		NCF 13	Marginotruncana
88		Paratexanites serratomarginatus		b <i>Cyclonephelium filoreticulatum</i>		
89		Gauthiericeras margae Peroniceras tridorsatum Forresteria petroceniensis		a <i>Senoniasphaera rotundata alveolata</i>		
90		Subprionocyclus neptuni		a <i>Stephodinium coronatum</i>	NCF 12	Dicarinella
91		Collignonoceras woolgari	DCZ 7	b		
92		Mammites nodosoides		a <i>Codonella campanulata</i>	NCF 11	Whiteinella brittonensis
93		Watinoceras devonense / Wat. coloradoense		d <i>Carpodinium obliquicostatum</i>		
94		Nigericeras scotti		c <i>Epelidosphaeridia spinosa</i>		
95		Neocardioceras juddii		b <i>Ovoidinium verrucosum</i>	NCF 10	Hedbergella delrioensis
96		Burroceras clydense Metoicoceras geslinianum Calycoceras guerangeri Acanthoceras jukesbrownei Acanthoceras rhotomagense Cunningtonoceras inerne	DCZ 6	a <i>Protoellipsodinium spinocristatum</i>	NCF 9	Sigmoilina antiqua
97		Mantelliceras dixonii		d <i>Cauca parva</i> , <i>Ovoidinium scabrosum</i>		
98		Mantelliceras mantelli		c <i>Lithodinium arundum</i> , <i>Carpodinium granulatum</i>	NCF 8	Osangularia schloenbachi
99		Arrhaphoceras briacensis Mortoniceras perinflatum Mortoniceras rostratum	DCZ 5			
100		Mortoniceras fallax				
101		Mortoniceras inflatum				
102		Mortoniceras pricei	DCZ 5		NCF 8	Osangularia schloenbachi
103		Diploceras cristatum		d <i>Lithodinium arundum</i> , <i>Carpodinium granulatum</i>	NCF 7	hiatus
104		Euhoplites lautus		c <i>Kleithriasphaeridium eoinodes</i>		
105		Euhoplites loratus		b <i>Discorsia nanna</i> , <i>Occiscyusta tentoria</i>	NCF 6	Recurvoides spp.
106		Hoplites dentatus		a <i>Dingodinium cerviculum</i> , <i>Gardodinium trabeculosum</i>	NCF 5	Verneuilinoides chapmani
107		Douvilleiceras mammillatum Leymeriella tardefurcata		d <i>Muderongia sagena</i>		
108		Leymeriella schrammeni		c <i>Trichodinium ciliatum</i> , <i>Callaiosphaeridium trycherium</i>	NCF 4	hiatus
109		Hypacanthoplites jacobi	DCZ 4			
110		Parahoplites nutfieldensis		a <i>Phoberocysta neocomica</i> , <i>Heslertonia heslertonensis</i> , <i>Cassiculosphaeridium magna</i>		
111		Epicheloniceras martinoides				
112		Tropaeum bowerbanki				
113		Deshayesites deshayesi				
114		Deshayesites forbesi				
115		Prodeshayesites fissicostatus	DCZ 4			

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126	M0r	Deshayesites forbesi Prodeshayesites fissicostatus Parancycloceras bidentatum / Parancycloceras scalare Simanocycloceras stollei Ancyloceras inexam / S. pingue	DCZ 4	a <i>Phoberocysta neocomica</i> , <i>Heslertonia heslertonensis</i> , <i>Cassiculosphaeridium magna</i>	NCF 4	hiatus
127	M1	Paracrioceras denckmanni		d <i>Kleithriasphaeridium corrugatum</i>	NCF 3	Falsogaudrynella xenogena
128	M3	Paracrioceras elegans Haplocrioceras fissicostatum Paracrioceras rarocinctum	DCZ 3	c		
129	M5	Simbirskites variabilis Simbirskites marginatus Craspedodiscus gotschei Milanowskia speetonensis Speetonoceras inversum		b <i>Nelchinospis kostromiensis</i>	NCF 2	Falsogaudrynella praemoesiana acme
130	M6	Endemoceras regale		a <i>Canningia cf. reticulata</i>		
131	M7	Endemoceras noricum			NCF 1	Protomarsonella kummi
132	M8	Endemoceras paucinodum		c <i>Lagenorhysis delicatula</i>		
133	M9	Stolcoceras tuberculatum Dichotomites	DCZ 2			
134	M10	Prodichotomites		b <i>Systematophora palmula</i>		
135	M10N	Polyptychites		a <i>Dingodinium spinosum</i>		
136	M11	Paratollia/Platylenticeras		c <i>Daveya boresphaera</i>		
137	M11A	Peregrinoceras albidum		b <i>Systematophora daveyi</i>		
138	M12	Surites stenomphalus		a <i>Egmontodinium expiratum</i>		
139	M13	Surites icenii	DCZ 1			
140	M14	Hectoroceras kochi				
141	M15	Runctonia runctoni				
142	M16	Subcraspedites lamplughii				
143	M17	Subcraspedites preplacomphalus				

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127	M1	Paracrioceras denckmanni		d <i>Kleithriasphaeridium corrugatum</i>	NCF 3	Falsogaudrynella xenogena
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Figures 2.10: Eleven dinoflagellate cyst zones (DCZ) and thirty-nine subzones for Cretaceous marine strata in the North Sea. To increase utility of the operational micropaleontological zonation in Figures 2.7 and 2.8 and the literature dinoflagellate zonation we have placed them side by side in Figures 2.10a-d, using their independent chronostratigraphic calibrations. The chronostratigraphic interpretation of the dinoflagellate cyst events is mainly based on available peer-reviewed palynological publications. It also builds on results of unpublished PhD theses and collected contributions from the manuals of the "Advanced courses in Organic-Walled Dinoflagellate Cysts" organized from 1994 through 2012 in Utrecht, Haarlem, Bremen, Tubingen, Urbino and other locations. Use was made also of in-house (RGD, LPP and TNO) reports from 1980-2015 (e.g. TNO compilation report "Ranges and zonation of Cretaceous dinoflagellates in NW Europe, 2002" (see remarks below and reference list). The international geologic timescale of Gradstein et al. (2012) is used for chronostratigraphic calibration.