15. CALCAREOUS NANNOFOSSILS, DEEP SEA DRILLING PROJECT HOLES 417D, 418A, AND 418B

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Fossiliferous Mid-Cretaceous calcareous sediments were recovered from Holes 417D (Leg 51B), 418A (Leg 52), and 418B (Leg 53). Core recovery in this section was incomplete at all three holes. Nevertheless, a detailed biostratigraphic study was undertaken in order to glean whatever useful information might be obtained about the mid-Cretaceous history of the North Atlantic. Checklists of calcareous nannofossils for the three holes are given in Figures 1 to 3 with certain species illustrated on Plate 1. On the basis of the first appearance in the stratigraphic record of *Lithastrinus floralis*, a distinctive nannofossil species, the oldest sediment above basement in each hole is the same age. According to Thierstein (1973), this species first appears near mid-Aptian and is common to abundant in upper Aptian and younger sediments. No similar predecessor species is known. In all three of the above holes *Lithastrinus floralis* appears a short distance above the sediment-basement contact. Following the time scale of van Hinte (1976), the age of basement in this area is estimated to be not less than 112 m.y.

In the holes only one fossiliferous interval was encountered below the lowest occurrence of *Lithastrinus floralis* and in two of them, Samples 417D-2-3, 111-112 cm and 418A-15-1, 7-9 cm, common specimens of *Corollithion acutum* were recorded. Although Roth and Thierstein (1972) reported this species to range from Aptian to Campanian, in this study it was not encountered in any sample other than the above two. At Hole 418B, *Corollithion acutum* was not found but the only fossiliferous sample from below the lowest occurrence of *Lithastrinus floralis* (Sample 418B-34-1, 3-4 cm), yielded a poorly preserved residual assemblage, and the absence of *Corollithion acutum* may be the result of dissolution.

Aside from the same age in the lowest part of the sections, the nannofossil succession at the two sites is different; how much of this is attributable to incomplete core recovery is not at all clear. In Hole 417D an early Albian to late Aptian age is represented in Cores 20 and 21. The middle Albian, characterized by the partial range of *Prediscosphaera cretacea* below the lowest occurrence of *Eiffellithus turriseiffeli*, is represented by a barren interval. The fossiliferous interval above this is in Section 17-1, which contains abundant *Eiffellithus turriseiffeli* and, therefore, represents an age not older than late Albian, although it may be as young as Cenomanian.

In Hole 418A, the entire fossiliferous interval, excepting the lowermost sample (15-1, 7-9 cm), is early Albian to late Aptian in age. The interval in question extends from the top of Sample 10-1, 52-54 cm to Sample 14, CC, 4-6 cm, and is bracketed between the lowest occurrence of *Prediscosphaera cretacea* (early Albian) which datum was not encountered, and the lowest occurrence of *Lithastrinus floralis* (middle Aptian) which was recorded. No part of the approximately 100 cm of Cenomanian to upper Albian sediment represented in Section 17-1 at Hole 417D was recovered at Hole 418A. This may be the result of poor core recovery, but it is equally possible that a thin fossiliferous upper Albian-Cenomanian section was penetrated within the uncored 22.5 meters between Cores 9 and 10.

The most complete mid-Cretaceous section was recovered in Hole 418B. The mid-Cretaceous biostratigraphy of Manivit et al. (1977) is quite useful in dating this section. The upper Aptian to lower Albian is represented by Cores 29 through 33, bracketed by the lowest occurrence of *Lithastrinus floralis* in Sample 33-1, 134-135 cm and the lowest occurrence of *Prediscosphaera cretacea* in Sample 28-3, 50-51 cm. Middle Albian is represented by Section 28-2, and is bracketed at the base by the lowest occurrence of *Prediscosphaera cretacea* and at the top by the lowest occurrence of *Eiffellithus turriseiffeli* in Sample 28-2, 13-14 cm. Upper Albian is represented in Sections 28-1 and 28-2 having, at the base, the lowest occurrence of *Eiffellithus turriseiffeli* and, at the top, the lowest occurrence of *Lithraphidites alatus* in Sample 28-1, 21-22 cm. The latter datum is not always totally reliable but is well developed in this section. The Cenomanian is represented in Cores 26, 27, and 28, marked at the base by *Lithraphidites alatus* and at the top by transition to an unfossiliferous interval. The top of the fossiliferous interval, Sample 26-1, 35-36 cm, is late Cenomanian in age, based on the highest occurrence of *Cruciellipsis chiastia* immediately below it in Sample 26-1, 50-51 cm.

The close proximity of the sites to one another, and the nearly identical depth to basement, leads to the expectation that their early history was similar, yet their paleontological record is similar only in that the oldest sediments above basement have the same age. Although the imperfect core recovery reduces interpretation to the level of speculation, the marked discrepancy in the degree of development of calcareous sediments of post early Aptian age is puzzling. If the sites did indeed have histories of sedimentation as different as might be inferred from the paleontological record of the calcareous nannofossils, then the history of euxinic sediments in the North Atlantic may be more complex than heretofore suspected.

REFERENCES

Manivit, H., Perch-Nielsen, K., Prins, B., and Verbeek, J.W., 1977. Mid Cretaceous calcareous nannofossil biostratigraphy, *Kon. Nederl. Akad. Weten.*, ser. B, v. 80, p. 169-181.

Roth, P.H. and Thierstein, H., 1972. Calcareous nannoplankton: Leg 14 of the Deep Sea Drilling Project. *In* Hayes, D.E., Pimm, A.C., et al., *Initial Reports of the Deep Sea Drilling Project*, v. 14: Washington (U.S. Government Printing Office), p. 421-485.

AGE	LEG 51B HOLE 417D Core, Section Depth (cm)	*Biscutum constans*	*Watznaueria barnesae*	*Watznaueria britannica*	*Markalus circumradiatus*	*Flabellites biforaminis*	*Manivitella pemmatoidea*	*Cyclagelosphaera margerelli*	*Cretarhabdus angustiforatus*	*Cretarhabdus conicus*	*Cretarhabdus surirellus*	*Cretarhabdus coronadventis*	*Cretarhabdus loriei*	*Podorhabdus dietzmannii*	*Prediscosphaera cretacea*	*Cruciellipsis chiastia*	*Parhabdolithus angustus*	*Parhabdolithus asper*	*Parhabdolithus embergeri*	*Eiffellithus turriseiffeli*	*Zygodiscus diplogrammus*	*Chiastozygus litterarius*	*Vekshinella matalosa*	*Reinhardtites fenestratus*	*Mitosia infinitae*	*Corollithion signum*	*Corollithion acutum*	*Stephanolithion laffittei*	*Lithastrinus floralis*	*Hayesites albiensis*	*Rucinolithus irregularis*	*Assipetra infracretacea*	*Lithraphidites carniolensis*	*Rhabdolekiskus aquitanicus*	*Tetrapodorhabdus decorus*	IMPORTANT NANNOFOSSIL DATUM LEVELS
CENOMANIAN TO LATE ALBIAN	17-1, 16-18	c	a		f	f	c				a	f		r	f	f		a	c	a	a	c						r	c				f			
	17-1, 69-70		a			r	a				c	r				c		c	a	a	c	c							r				r	r		
	17-1, 103-104	r	a			r	c		r		c				r	r		a	f	a	a	c				r		r	f				c		f	
	17-1, 110-111	r	a	r		r	c		r		c		r		r	c	r	a	f	a	c	f	r					r	c	r			a		r	L.O. *Eiffellithus turriseiffeli*
	BARREN INTERVAL																																			
EARLY ALBIAN TO LATE APTIAN	20-1, 23-25	r	a	f		f	r				f			r		c		a	c			r	c					f	c		c		a			
	20-2, 19-20		a											r		c			f										r		r		f			
	21-2, 56-57		a																c													c				
	21-3, 7-8		a	c	r	r	r			c	f			f		a		a	c			r	c	r	r			c	c			c	a			
	21-3, 20-21		a	f	f	r	c			c	c					c		a	c				c	f	f			c	c			a	c			L.O. *Lithastrinus floralis*
EARLY APTIAN	21-3, 111-112		a	f	r	f	c	r	f	c	f		f	f		c	r	a	c		f		c	c	f		c	a			c	c	c			*Corollothion acutum*

Figure 1. *Nannofossil species checklist and abundance estimates for Hole 417D. a = abundant, c = common; f = few; r = rare.*

AGE	LEG 52 HOLE 418A Core, Section Depth (cm)	*Watznaueria barnesae*	*Watznaueria britannica*	*Markalus circumradiatus*	*Flabellites biforaminis*	*Manivitella pemmatoidea*	*Cretarhabdus angustiforatus*	*Cretarhabdus conicus*	*Cretarhabdus surirellus*	*Cretarhabdus coronadventis*	*Cretarhabdus loriei*	*Podorhabdus dietzmannii*	*Cruciellipsis chiastia*	*Parhabdolithus angustus*	*Parhabdolithus asper*	*Parhabdolithus embergeri*	*Zygodiscus diplogrammus*	*Chiastozygus litterarius*	*Vekshinella matalosa*	*Reinhardites fenestratus*	*Mitosia infinitae*	*Corolithion acutum*	*Stephanolithion laffittei*	*Lithastrinus floralis*	*Rucinolithus irregularis*	*Assipetra infracretacea*	*Lithraphidites carniolensis*	*Watznaueria biporta*	cf. *Assipetra infracretacea*	cf. *Rucinolithus wisei*	*Watznaueria deflandrei*	IMPORTANT NANNOFOSSIL DATUM LEVELS
EARLY ALBIAN TO LATE APTIAN	10-1, 52-54	a			r	c			f	r			r		c	f	f	f						f			r	r				
	BARREN INTERVAL																																
	12-1, 51-53	a	r		f	a		r	f				f		f	a		f	r					c	r		c		f			
	12-1, 97-99	a	r	f	c	c		r					f		c	c	r	f	c					c	r	r	a	r				
	12-1, 146-148	a	r	r	f	f		f	f	r			f		f	c	r	r	f		f			c	c		a	r		f		
	12-2, 20-23	a			f								f			c								r	r							
	12-2, 25-27	a			r	c		f	f				f		c	c			c					c	f		a					
	12-2, 31-33	a	r		f	f			r				f		r	a		r						f	f		a		c			
	13-1, 39-41	a			r	c		r	f				f		f	c		r						c	f		a	r			r	
	BARREN INTERVAL																																
	13, CC, 12-14	a																															
	14, CC, 4-6	a	r		r			r	r				r		r	r			r	r			r		r	f	c		c			L.O. *Lithastrinus floralis*
EARLY APTIAN	15-1, 7-9	a	r	r	r	r	r		f		f	f	r		c	r	f		f	f	r	c	f		r	f	c					*Corollithion acutum*

Figure 2. *Nannofossil species checklist and abundance estimates for Hole 418A. a = abundant, c = common; f = few; r = rare.*

AGE	LEG 53 HOLE 418B Core, Section Depth (cm)	*Biscutum constans*	*Watznaueria barnesae*	*Watznaueria biporta*	*Watznaueria britannica*	*Markalius circumradiatus*	*Flabellites biforaminis*	*Manivitella pemmatoidea*	*Cretarhabdus angustiforatus*	*Cretarhabdus conicus*	*Cretarhabdus loriei*	*Cretarhabdus surirellus*	*Cretarhabdus coronadventis*	*Tetrapodorhabdus decorus*	*Podorhabdus dietzmannii*	*Podorhabdus albianus*	*Prediscosphaera cretacea*	*Cruciellipsis chiastia*	*Broinsonia enormis*	*Parhabdolithus angustus*	*Parhabdolithus asper*	*Parhabdolithus embergeri*	*Chiastozygus litterarius*	*Eiffellithus turriseiffeli*	*Mitosia infinitae*	*Reinhardtites fenestratus*	*Vekshinella matalosa*	*Vekshinella* sp.	*Tranolithus orionatus*	*Zygodiscus diplogrammus*	*Corollithion achylosum*	*Stephanolithion laffittei*	*Hayesites albianus*	*Rucinolithus irregularis*	*Lithastrinus floralis*	*Assipetra infracretacea*	*Lithraphidites alatus*	*Lithraphidites carniolensis*	IMPORTANT NANNOFOSSIL DATUM LEVELS
	26-1, 35-36	a	a			c	c	a	c		f	a		c			a			c	a	f	a	a						a					c		f	a	
94	26-1, 50-51	a	a	r	f		c	a			f	c	r	f	f		c	r		c	c	f	c	a							c					c		c	c	H.O. *Cruciellipsis chiastia*
CENOMANIAN	26-1, 88-89	a	a				f	a				a		f			a	f		c	c	c	c	a				r		a					c		f	a	
	26-1, 121-122	a	a				r	a				c	r	r		r	a		c	c	c	f	c	a				r	r	a		r			f		c	a	
	27-1, 51	c	a	r	r		f	f			r	c	f	f			a			f	c	f	f	a				r	r	f					f		r		
	28-1, 11-12	a	a				r	c			r	f	r				c	r		c	c	c	f	a						c					f		r		
	28-1, 21-22		a	r	r		f	c			r	c	c	f		f	c	f		f			c	a						c	f	f			f		f	c	L.O. *Lithraphidites alatus*
100	28-1, 92-93	a	a	r	r	r	f				r	c	f				f	f			c	c	f	a						a					r			c	
LATE ALBIAN	28-1, 133	c	a			r	f	f				c	r					f			f	r								f			r		f				H.O. *Hayesites albiensis*
	28-2, 13-14	a	a			r	f	c		r		a	r				f	c		f	c	c	c	a				r		c		c	r		f			c	L.O. *Eiffellithus turriseffeli*
104	28-2, 81-82	c	a		r		r	c		f	r	c	c			r				f	a	f	c				f	r		a		f			c			c	
MIDDLE ALBIAN	28-2, 109-110		a	f	f		c			r	f	c	f				f	f		f	c	f	f					r		a		f	c		f			c	
	28-2, 129-130	c	a	r			r	c			r	f	f			r	f	c		c	c		c							f		f	c		f				
106	28-3, 50-51	c	a	r			f	c		f	f	c	f				f	f		f	c	f	c				f	r		c					f			c	L.O. *Prediscosphaera*
	29-1, 31-32		a	r		r	f	c										f				c								f			f		c				
	31, CC		a			r						r										f													·r				
EARLY ALBIAN TO LATE APTIAN	32-1, 5-6		a	f	c	f	f	c		f		c	r					f			a	r	c				a				a			f	c			a	
	32-1, 73-74		a	r	f	r	f			r		f						r			c						c			c				r	r	c			c	
	32-1, 125-126		a		r		f	r				r						f			f	f												f	f			c	
	33-1, 39-40		a	f		f	r			r												f												f					
	33-1, 104-105		a		c			r		c		c									c	f				f								f	c	f			
	33-1, 134-135		a		c	f				c					r			c			f	c			f		c					c		f	r			c	L.O. *Lithastrinus floralis*
112																																								
EARLY APTIAN	34-1, 3-4		a		f	f	r	r										r			r	f											r		f		r		

AGE (m.y.)*

*after van Hinte, 1976

Figure 3. *Nannofossil species checklist and abundance estimates for Hole 418B. a = abundant; c = common; f = few; r = rare.*

Thierstein, H.R., 1973. Lower Cretaceous calcareous nannoplankton biostratigraphy, *Abh. Geol. Bundesanst.*, Wien, v. 29, p. 1-52.

van Hinte, J.E., 1976. A Cretaceous time scale, *Am. Assoc. Petrol. Geol. Bull.*, v. 60, p. 498-516.

PLATE 1
All Photographs ×2500

Figures 1a, b — *Broinsonia enormis* (Shumenko). Sample 53-418B-26-1, 121-122 cm.
1a. Phase contrast, plain polarized light.
1b. Cross-polarized light.

Figures 2a, b — *Corollithion acutum* Thierstein. Sample 51B-417D-21-3, 111-112 cm.
2a. Interference contrast.
2b. Cross-polarized light.

Figures 3a, b — *Tetrapodorhabdus decorus* (Deflandre). Sample 53-418B-27-1, 51 cm.
3a. Phase contrast.
3b. Cross-polarized light.

Figures 4a, b — *Vekshinella* sp. Sample 53-418B-26-1, 88-89 cm.
4a. Interference contrast.
4b. Cross-polarized light.

Figures 5a, b — *Cretarhabdus coronadventis* (Reinhardt) n. comb. Sample 53-418B-27, 51 cm.
5a. Phase contrast.
5b. Cross-polarized light.

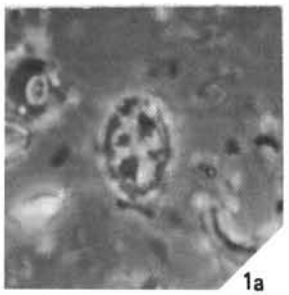
Figures 6a, b — *Podorhabdus albianus* (Black). Sample 53-418B-26-1, 88-89 cm.
6a. Interference contrast.
6b. Cross-polarized light.

Figures 7a, b — *Hayesites albianus* Manivit. Sample 53-418B-28-1, 108-109 cm.
7a. Interference contrast.
7b. Cross-polarized light.

Figures 8a, b — *Rucinolithus irregularis* Thierstein.
8a. Interference contrast.
8b. Cross-polarized light.

Figures 9a, b — *Lithraphidites alatus* Thierstein. Sample 53-418B-26-1, 35-36 cm.
9a. Interference contrast.
9b. Cross-polarized light.

PLATE 1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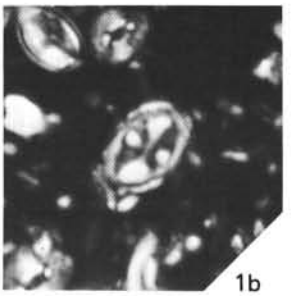
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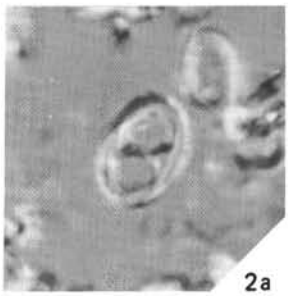
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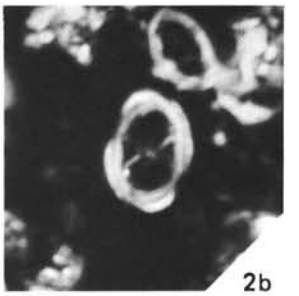
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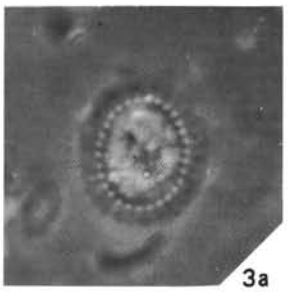
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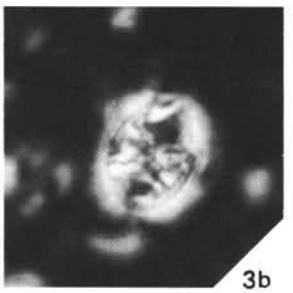
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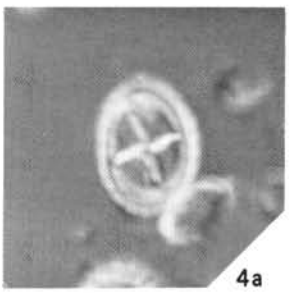
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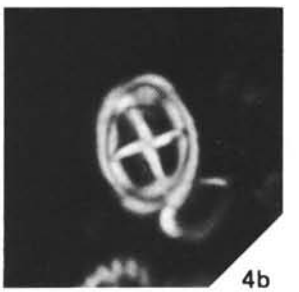
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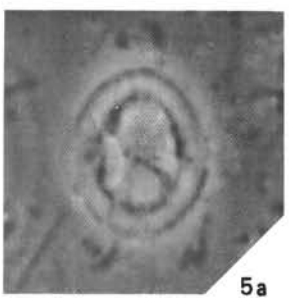
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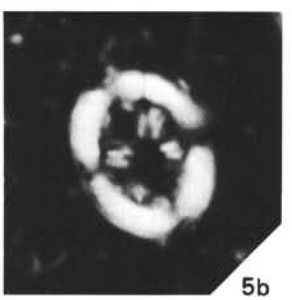
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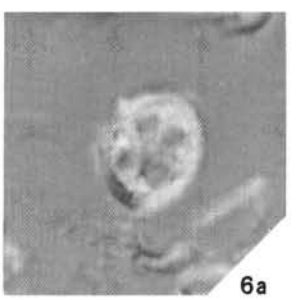
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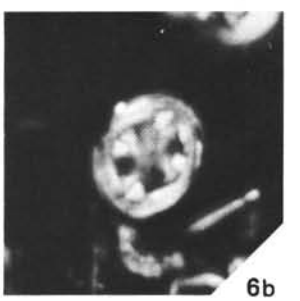
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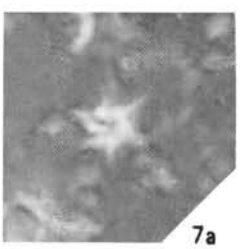
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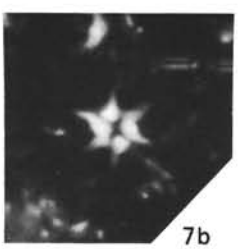
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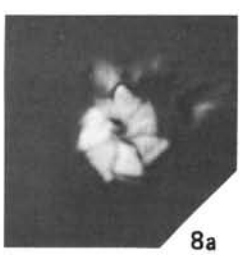
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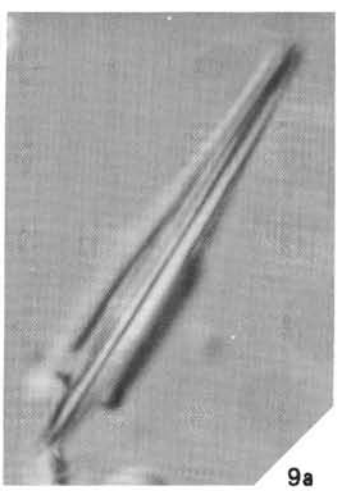
8b


9a


9b