

## 14. REMARKS ON THE OLIGOCENE CALCAREOUS NANNOPLANKTON BIOGEOGRAPHY OF THE NORWEGIAN SEA (DSDP LEG 38)

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### INTRODUCTION

During Deep Sea Drilling Project Leg 38, four sites drilled in the Norwegian Sea (336, 338, 349, and 352) yielded calcareous nannoplankton of early Cenozoic ordered corrensites could not be detected. The expanding chlorite could have been derived from the underlying calcareous sediments, and their study is critical to the delineation of calcareous plankton biogeography. The purpose of this note is to extend the knowledge of the early Cenozoic calcareous nannoplankton biogeography into these northern high latitudes and to compare the results with those of low to mid and southern high latitudes of the Atlantic Ocean (see Haq and Lohmann, 1976; Haq et al., in press).

All cores reported to contain early Cenozoic nanoliths (Müller this volume) were examined. Site 336, Cores 36 to 29 and Core 15 contained very rare and extremely poorly preserved coccoliths. Only Core 15, Section 1 contains recognizable specimens, but many species are fragmentary and there is evidence of contaminants of late Cenozoic age.

Site 338, Core 33 has been assigned an early Eocene age (*Tribraehiatus orthostylus* Zone) by Müller (this volume). Preservation, however, is too poor and coccoliths so rare that it is not possible to obtain a meaningful census of the nannoplankton from this level. Cores 25, 23 and 22 contain moderately well preserved coccoliths of early Oligocene age. Cores 24 and 21 through 19 contain poorly preserved nanoflora.

Sites 349 (late Eocene) and 352A (Oligocene) contain very rare and poorly preserved coccoliths and also could not be used in this study.

Thus, of all the samples examined, only three levels at Site 338 (Cores 25, 23, and 22) contained moderately well preserved coccoliths among which delicate species could be recognized. This site is at 67°47.11'N, and is the highest northern latitude site where well-preserved early Cenozoic calcareous nannoplankton were recovered. One sample from each of the above cores was selected for reconstructing the early Oligocene biogeography of the Norwegian Sea.

### AGE OF THE OLIGOCENE ASSEMBLAGES

The nanoflora of Site 338 contains many characteristic elements of the Oligocene. However, as in other high latitude areas, the zone-diagnostic tropical/subtropical species are absent. In Cores 23 and 22 rare specimens of the early Oligocene marker *Cyclococcolithus formosus* were seen. The benthonic foraminiferal assemblages recorded at these levels and a few rare planktonic specimens (see van Hinte, this volume) are similar to the Rupelian of northwest

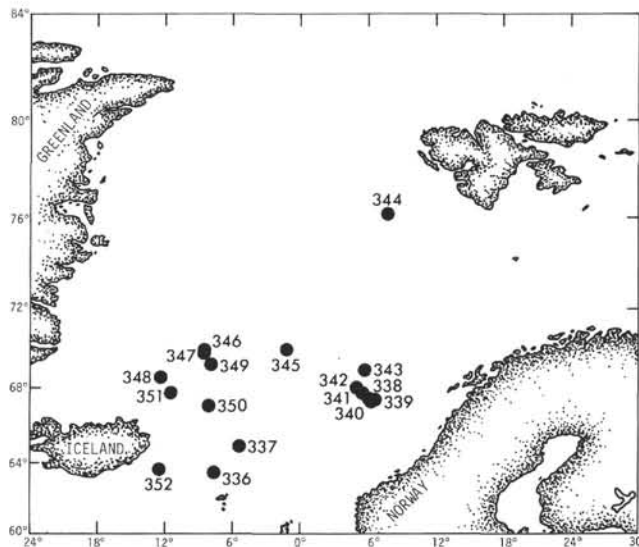


Figure 1. Drill sites of DSDP Leg 38 and location of Site 338.

Europe. From these considerations a broad 35 to 30 m.y.B.P. age (equivalent to *Sphenolithus predistentus* Zone of the low-mid latitudes) is assigned to this interval.

### OLIGOCENE ASSEMBLAGES AND PALEOBIOGEOGRAPHY

Census data for the three early Oligocene levels is presented in Table 1.

The assemblages at all three levels within the early Oligocene are dominated by small to medium-sized reticulofenestrads (see Plate 1). Reticulofenestrads occur in similar quantities in Cores 25, Section 2 and 23, Section 6, but in Core 22, Section 6 they increase twofold. *Reticulofenestra bisecta* shows the opposite trend (from 25% in 25-2 to 2%-4% in higher samples). *Coccolithus pelagicus* (*s. ampl.*) is dominant in Sample 23-6 (45% of the total flora), prominent in 25-2 (12%), but reduces to 4% in the top sample (22-6). All other taxa occur only in minor quantities. In general, the whole interval is dominated by reticulofenestrads and *C. pelagicus*.

This assemblage comprises the same elements described at other northern high latitude sites (e.g., DSDP Sites 112, 116, 119 and the Viborg Formation of Denmark—see Haq and Lohmann, 1976, Appendix Table IIC), but differs with respect to dominant taxa. Other high latitude sites contain a similarly high percentage of reticulofenestrads (including *R. bisecta*), but *Dictyococites hesslandii* and *Cyclococcolithus neogammation* are also prominent. These taxa occur in only minor amounts in the Norwegian Sea. *Coccolithus pelagicus* dominates at Site 117.

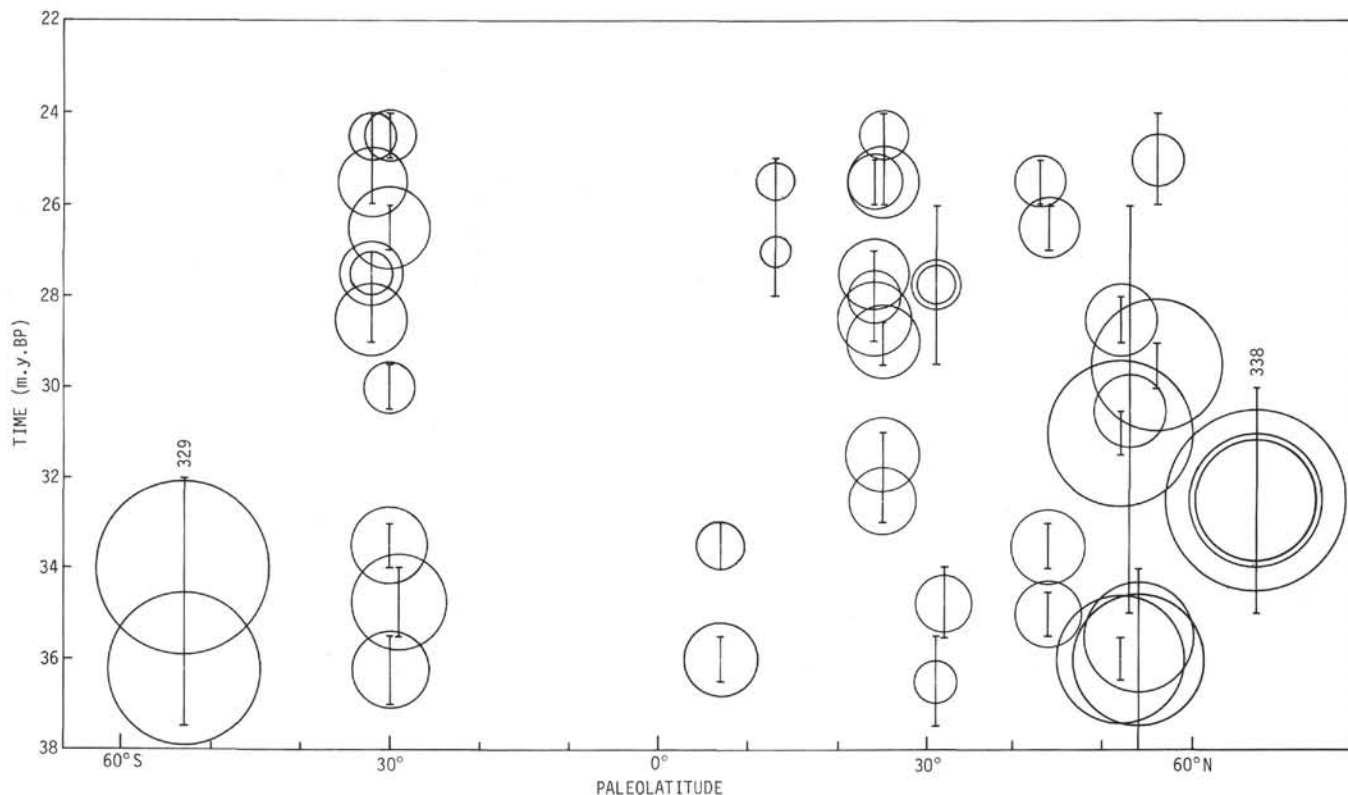


Figure 2. Time and paleolatitudinal distribution of the nannofloral assemblage represented by a sample of early Oligocene age from DSDP Site 338, Core 23, Section 6, 101-102 cm. Line segments indicate positions of samples with which Sample 338-23-6, 101-102 cm is compared, and lengths of the line segments reflect uncertainties in the samples' estimated ages. A list and description of all samples, except those from Site 338, are given in Haq and Lohmann (1976) and Haq et al. (in press). The plotted circles are drawn to be proportional to a measure of similarity ( $\cosine \theta$ ) between each of the samples and Sample 338-23-6, 101-102 cm. Thus, the sizes and locations of these circles reflect the distribution of the nannofloral assemblage described from Sample 338-23-6. As one might expect, this plot shows that the assemblage from high-latitude Site 338 predominates in high latitudes. This assemblage seems to be distinctly more abundant above 50° latitude, both north and south. Note, however, that this pattern of predominance in high latitudes does not continue beyond 29 or 30 m.y.B.P.

TABLE 1  
Census Data for the Three Early Oligocene Levels

Early Oligocene (35-30 m.y.B.P.)	Species		
	338-25-2, 101-102 cm	338-23-6, 101-102 cm	338-22-6, 11-12 cm
Species	%	%	%
<i>Dictyococcites hesslandii</i>	2	1	2
<i>Cyclococcolithus neogammation</i>	5	1	2
<i>Reticulofenestra</i> spp.	42	38	84
<i>Coccolithus pelagicus</i>	12	45	4
<i>Reticulofenestra bisecta</i>	25	2	4
<i>Coccolithus eopelagicus</i>	1	3	0
<i>Cyclococcolithus formosus</i>	0	1	1
<i>Chiasmolithus altus</i>	0	1	0
<i>Reticulofenestra abisecta</i>	0	0	1
Other unrecognizable specimens	13	8	2

As one moves from low to high latitudes, a systematic nannofloral differentiation is seen in the early Oligocene Atlantic Ocean. This is evidenced by the

distinct changes in the relative abundance of taxa. The low to mid latitudes are dominated by the cosmopolitan taxa, *Dictyococcites hesslandii* and *Cyclococcolithus neogammation* (with prominent presence of tropical taxa such as sphenoliths). Towards high latitudes, the reticulofenestrads become equally important, so that assemblages in the North Atlantic (Site 119) are composed of almost equal amounts of these three taxa (mixed assemblage). Still further north (Sites 112, 117) *Coccolithus pelagicus* achieves prominence, but reticulofenestrads still remain important. Finally, in the Norwegian Sea (Site 338) *Dictyococcites hesslandii* and *Cyclococcolithus neogammation* are reduced to rare numbers, reticulofenestrads and *Coccolithus pelagicus* comprising up to 88% of the total nannoflora.

In the southern high latitudes a nannoflora of equivalent age from Site 329 (see Haq et al., in press) is dominated by chiasmoliths (*C. altus*, up to 27% of total flora) and prominent amounts of *Coccolithus pelagicus* and reticulofenestrads (20% and 19%, respectively).

The similarity of the nannoflora recorded from Site 338 to that at other Atlantic sites is shown in Figure 2. The early Oligocene biogeography of the Atlantic is shown in Figure 3.

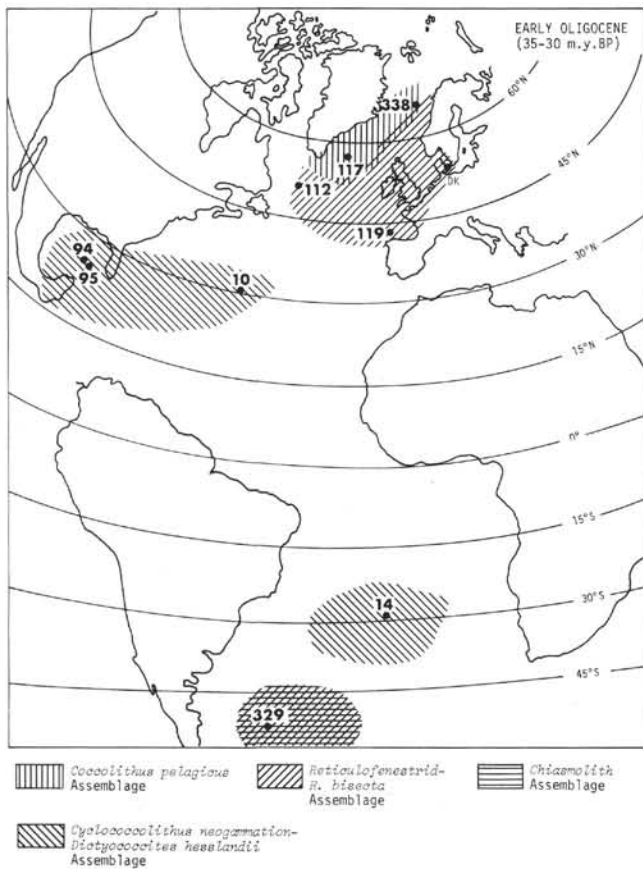


Figure 3. Calcareous nannoplankton biogeography plotted on the Atlantic Basin reconstruction for the early Oligocene (see Haq and Lohmann, 1976). Numbers refer to DSDP Sites (DK = Denmark). The most distinctive assemblages for each latitudinal area are shown around the site in which they are recorded.

As in the northern high latitudes, *Dictyococites hesslandii* and *Cyclococcolithus neogammation* reduce in importance in southern high latitudes (Site 329).

### CONCLUSIONS

1. Haq and Lohmann (1976) recognize a high latitude nannoflora, composed mainly of small to medium-sized reticulofenestrids and *Coccolithus pelagicus*, concentrated between 45° and 60°N from about 37 to 27 m.y.B.P. The predominance of reticulofenestrids and *Coccolithus pelagicus* at high latitude Sites 338 and 329 (Leg 36) is consistent with this interpretation and extends the known range of this high latitude nannoflora to 67°N paleolatitude.

2. The early Oligocene high latitude nannoflora differs between north and south: southern high latitudes are characterized by an abundance of chiasmoliths, a group which is rare in the north. Chiasmoliths are prominent in the south through most of the early Cenozoic (see Haq et al., in press). This preference may indicate a specialized austral nannoplankton province.

### ACKNOWLEDGMENTS

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PLATE 1

(All figures Scanning Electron Micrographs—  
Bar-scales: 1 $\mu$ m)

*Major Components of Early Oligocene  
Assemblage of Norwegian Sea*

- Figure 1 *Reticulofenestra* sp. distal view with central-grille missing. Most common reticulofenestrid at Site 338. Sample 338-23-6, 101-102 cm.
- Figures 2, 3 *Reticulofenestra coenura* (Reinhardt). Proximal views of medium to small-sized specimens. Common. Sample 338-23-6, 101-102 cm.
- Figure 4 Small-sized *Coccolithus* (?) *pelagicus* (Wallich). Distal view. Rare to frequent in present material. Sample 338-23-6, 101-102 cm.
- Figures 5, 6 *Coccolithus pelagicus* (Wallich). Sample 338-25-2, 101-102 cm.  
5. Proximal view.  
6. Distal view.
- Figure 7 Upper: *Reticulofenestra* sp. aff. *R. daviesi* (Haq), distal view. Lower: *Coccolithus pelagicus* (Wallich), distal view. Sample 338-23-6, 101-102 cm.
- Figure 8 *Coccolithus pelagicus* (Wallich). Distal view of a specimen with nearly closed central area and "serrated" outline. Sample 338-23-6, 101-102 cm.

*Minor Components of the Norwegian Sea Assemblage*

- Figure 9 *Chiasmolithus altus* Bukry and Percival. Distal view of a partly corroded specimen. Sample 338-23-6, 101-102 cm.
- Figure 10 *Pontosphaera multipora* (Kamptner). Distal view. Sample 338-22-6, 11-12 cm.

PLATE 1

