

9. MIDDLE EOCENE TO MIOCENE PLANKTONIC FORAMINIFERS FROM DEEP SEA DRILLING PROJECT SITES 608 AND 610, NORTHEASTERN ATLANTIC¹

D. Graham Jenkins, Department of Earth Sciences, Open University, Milton Keynes, United Kingdom²

ABSTRACT

Thirty-one core-catcher samples from the middle Eocene to middle Miocene at Site 608 and 13 core-catcher samples from the lower to middle Miocene of Site 610 have been examined for planktonic foraminifers. Stratigraphic ranges have been established at both sites and the sequence divided into zones. Zonal markers and other datum events are correlated with the most recent time scale.

INTRODUCTION

This chapter is a shore-laboratory report on the planktonic foraminifers extracted from cores taken at Sites 608 and 610 on Leg 94 during July and August 1983. Both sites (Fig. 1) are located in the modern planktonic foraminiferal Transitional Faunal Province (Bé, 1977); their coordinates are given in the following table:

Site	Latitude	Longitude	Water depth (m)
608	42°50.21' N	23°05.25' W	3526
610	53°13.30' N	18°53.21' W	2417

PROCEDURES

Core-catcher sediment samples from the two sites were examined and the planktonic foraminifers identified. Semiquantitative assessments of each species were plotted on stratigraphic range charts (Tables 1, 2) and the zones and epoch boundaries assigned (Figs. 2, 3).

Previous relevant work on the North Atlantic includes DSDP Leg 12 (Berggren, 1972; Poore and Berggren, 1974, 1975a, 1975b); DSDP Leg 49 (Poore, 1979); and DSDP Leg 81 (Huddlestun, 1985).

EPOCH BOUNDARY MARKERS

The Eocene/Oligocene boundary at Site 608 is marked by the extinctions of *Globigerinatheka index*, *Globigerina linaperta*, and *Globorotalia cerroazulensis*. An unconformity, with the lower Oligocene missing, appears to be at or near the boundary, as indicated by the planktonic foraminifers studied at a resolution of one sample per core. Uppermost Eocene Sample 608-49, CC contains an overlap of *G. cerroazulensis* and *Globigerina ampliapertura*; the latter occurs in the upper part of the *G. cerroazulensis* Zone (Toumarkine and Luterbacher, 1985).

The Oligocene/Miocene boundary is always difficult to identify because it is ill-defined. It has been placed at

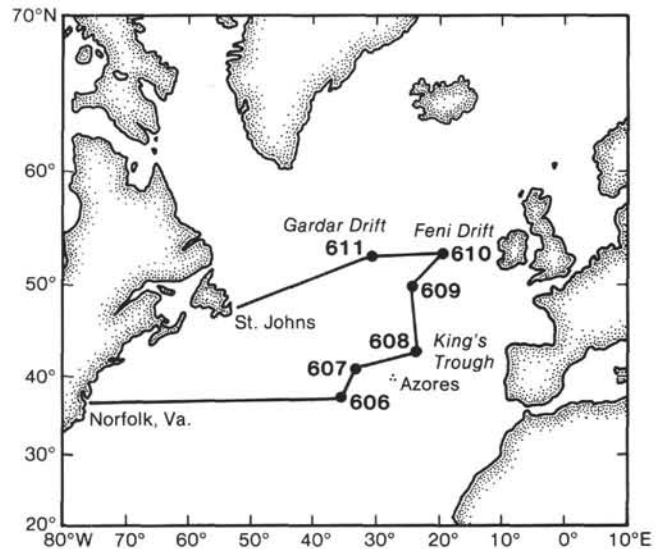


Figure 1. Map showing locations drilled on Leg 94.

Site 608 at the first appearance of *Globoquadrina dehiscentes*, within the stratigraphic ranges of *Globorotalia kugleri* and *Globigerinoides primordius*.

ZONAL SCHEMES

Three different attempts have previously been made to subdivide the North Atlantic Eocene–Pleistocene (Berggren, 1972; Poore, 1979; and Huddlestun, 1985). Berggren (1972) established some zones for the Cenozoic of the North Atlantic on DSDP Leg 12. These were rather ill-defined, and instead of using these zones, Poore (1979), on DSDP Leg 49, attempted to assign “P” and “N” zones that Blow (1969) had established for the Tropical-Subtropical Faunal Province. Huddlestun (1985) devised 13 numbered biostratigraphic intervals from the lower Eocene to the Holocene on DSDP Leg 81.

The zonal schemes used for the Eocene to middle Miocene at Site 608 and lower to middle Miocene at Site 610 are shown in Figures 2 and 3. In Figure 4, datum planes are correlated with the most recent time scale (Berggren et al., 1985).

¹ Ruddiman, W. F., Kidd, R. B., Thomas, E., et al., *Init. Repts. DSDP, 94*: Washington (U.S. Govt. Printing Office).

² Address: Department of Earth Sciences, Open University, Milton Keynes, MK7 6AA, Buckinghamshire, United Kingdom.

Table 1. Range chart with diversity data for core-catcher samples from Hole 608.

P and N zone correlatives	Chronostratigraphic unit	Zone	Core	<i>Globigerina corpulenta</i>	<i>Globigerinatheka mexicana</i>	<i>Globigerina linaperta</i>	<i>Globorotalia cerroazulensis</i>	<i>Globigerina turritulina</i>	<i>Globigerinatheka index</i>	<i>Globigerinatheka subconglobatus</i>	<i>Truncorotaloides pseudotopilensis</i>	<i>Truncorotaloides topilensis</i>	<i>Globigerinatheka pomeroli</i>	<i>Globigerina euapertura</i>	<i>Globigerina ansiporoides</i>	<i>Morozovella lehneri</i>	<i>Truncorotaloides collactea</i>	<i>Chiloguembelina cubensis</i>		
N9-N14	middle	<i>G. mayeri</i>	27																	
			28																	
			29																	
			30																	
			31																	
			32																	
			33																	
N8	Miocene	<i>P. glomerata curva</i>	34																	
N7			35																	
N5-N6			lower	<i>G. trilobus</i>	36															
					37															
			38																	
			39																	
N4	upper Oligo.	<i>G. kugleri</i>	40																	
			41																	
			42																	
			43																	
			44																	
			45																	
N3			46																	
			48																	
P17	Eocene	upper	<i>G. cerroazulensis</i>	49	VR	C	cf. R	C	VR					C	VR			C		
				50	cf. C	C	C	C	C											
				51	C	C	R		C											
				52	R	R	R		A											
			53	A	C	cf. R		A					R	C		R				
P14	middle	<i>T. rohri</i>	54	A		R	R	?VR	cf. R	R	C	R	C	?VR	R	R	C	C		
			57	cf. R	R	cf. C														

Note: VR = very rare, R = rare, C = common, A = abundant, X = reworked, cf. = compare. Diversity = number of species per sample.

CONCLUSION

A more detailed analysis of North Atlantic Cenozoic planktonic foraminifers is being undertaken to develop a more acceptable set of zonal schemes for the area.

ACKNOWLEDGMENTS

J. M. Jenkins helped in checking the manuscript, which was typed by C. Whale; J. Taylor drafted the tables.

REFERENCES

Bé, A. W. H., 1977. An ecological, zoogeographical and taxonomic review of Recent planktonic foraminifera. In Ramsey, A. T. S. (Ed.), *Oceanic Micropaleontology* (Vol. 1): London (Academic Press), 1-88.

Berggren, W. A., 1972. Cenozoic biostratigraphy and paleobiology of the North Atlantic. In Laughton, A. S., Berggren, W. A., et al., *Init. Repts. DSDP*, 12: Washington (U.S. Govt. Printing Office), 965-999.

Berggren, W. A., Kent, D. V., and Van Couvering, J., 1985. Neogene geochronology and chronostratigraphy. In Snelling, N. J. (Ed.), *Geochronology and the Geologic Time Scale*. Spec. Pap. Geol. Soc. London, 10:211-260.

Blow, W. H., 1969. Late middle Eocene to Recent planktonic foraminiferal biostratigraphy. In Brönnimann, P., and Renz, H. H. (Eds.), *Proc. First Planktonic Conf.*: Leiden (E. J. Brill), pp. 199-422.

Huddleston, P. F., 1985. Planktonic foraminiferal biostratigraphy, Deep Sea Drilling Project Leg 81. In Roberts, D. G., Schnitker, D., et al., *Init. Repts. DSDP*, 81: Washington (U.S. Govt. Printing Office), 429-438.

Poore, R. Z., 1979. Oligocene through Quaternary planktonic foraminiferal biostratigraphy of the North Atlantic: DSDP Leg 49. In Luyendyk, B. P., Cann, J. R., et al., *Init. Repts. DSDP*, 49: Washington (U.S. Govt. Printing Office), 447-517.

Poore, R. Z., and Berggren, W. A., 1974. Pliocene biostratigraphy of the Labrador Sea: Calcareous plankton. *J. Foram. Res.*, 4:91-108.

_____, 1975a. Late Cenozoic planktonic foraminiferal biostratigraphy and paleoclimatology of Hatton-Rockall Basin: DSDP Site 116. *J. Foram. Res.*, 5:270-293.

_____, 1975b. The morphology and classification of *Neoglobobulimina atlantica* (Berggren). *J. Foram. Res.*, 5:77-84.

Toumarkine, M., and Luterbacher, H., 1985. Paleocene and Eocene planktonic foraminifera. In Bolli, H. M., Saunders, J., and Perch-Nielsen, K. (Eds.), *Plankton Stratigraphy*: Cambridge (Cambridge University Press), pp. 87-154.

Date of Initial Receipt: 5 November 1984
Date of Acceptance: 19 April 1985

Table 1 (continued).

P and N zone correlatives	Chronostratigraphic unit	Zone	Core	<i>Catapsydrax glutinata</i>	<i>Globoquadrina dehiscens</i>	<i>Globigerina bulloides</i>	<i>Globorotalia minutissima</i>	<i>Globigerina connecta</i>	<i>Globorotalia obesa</i>	<i>Globorotalia peripheroronda</i>	<i>Globigerina bradyi</i>	<i>Globorotalia bella</i>	<i>Catapsydrax stainforthi</i>	<i>Globigerinoides trilobus</i>	<i>Globorotalia incognita</i>	<i>Globoquadrina globosa</i>	<i>Globorotalia praescitula</i>	<i>Globorotalia zealandica</i>
N9-N14	middle	<i>G. mayeri</i>	27	C	C	C					R			R				
			28	C	C	R				R					C			
			29	R	R	cf. R								C				
			30	R	A									C				
			31	C	A									R				
			32	R	A	R			R	R	R			A				
			33	R	C					cf. C				R				
N8	Miocene	<i>P. glomerosa curva</i>	34	C	C	C								R			C	
N7				35	R	A	VR				VR				C			C
N5-N6	lower	<i>G. trilobus</i>	36	C	A				R	R		R		C		C	C	
			37	R		R			cf. VR	cf. VR			R		C		C	C
			38	C			C				R		cf. R	cf. VR	cf. VR	cf. VR	C	cf. VR
			39	C	A	R	R				R		cf. R	cf. VR	cf. VR	cf. VR	C	cf. VR
N4		<i>G. kugleri</i>	40	R	A	cf. R	cf. VR				cf. VR							
			41	R	A	R					R							
			42	C	C		R		cf. VR	VR								
			43	C	C	R	cf. R	VR										
			44	C	cf. VR	R												
			45	R														
N3	upper Oligo.	<i>G. angulisurensis</i>	46															
			48															
P17	Eocene	upper	<i>G. cerroazulensis</i>	49														
				<i>G. linaperta</i>	50													
				51														
			52															
			53															
P14	middle	<i>T. rohri</i>	54															
			57															

Table 1 (continued).

<i>Globoquadrina altispira</i>																			
<i>Globigerinoides ruber</i>	R																		
<i>Globorotalia archaemenardii</i>	R																		
<i>Globorotalia miozea</i>	R																		
<i>Sphaeroidinella disjuncta</i>	R																		
<i>Globigerina falconensis</i>	R																		
<i>Globigerina angustiumbilicata</i>	C																		
<i>Præorbulina glomerosa curva</i>																			
<i>Præorbulina sicanus</i>																			
<i>Globorotalia praemenardii</i>																			
<i>Orbulina suturalis</i>																			
<i>Globigerina decoraperta</i>																			
<i>Globorotalia mayeri</i>	R																		
<i>Globorotalia continuosa</i>	R																		
<i>Globigerinoides sacculifer</i>	A																		
<i>Globorotalia miotumida</i>	R																		
<i>Globorotalia menardii</i>	R																		
<i>Globorotalia nympha</i>	C																		
<i>Orbulina universa</i>	C																		
<i>Globorotalia fohsi</i>	cf. R																		
<i>Globorotalia scitula</i>	R																		
<i>Globorotalia merotumida</i>	cf. R																		
<i>Globorotalia plesiotumida</i>	R																		
Diversity	15																		
	15																		
	12																		
	12																		
	13																		
	13																		
	13																		
	6																		
	13																		
	13																		
	13																		
	13																		
	13																		
	12																		
	11																		
	13																		
	15																		
	9																		
	11																		
	10																		
	8																		
	12																		
	11																		
	11																		
	8																		
	10																		
	14																		
	3																		

Table 2. Range chart with diversity data for core-catcher samples from Hole 610.

Chrono-stratigraphic unit	Zone	Core	<i>Globigerina venezuelana</i>	<i>Catapsydrax dissimilis</i>	<i>Globigerina angustumbilicata</i>	<i>Globorotalia semivera</i>	<i>Globigerina bulloides</i>	<i>Globigerinita glutinata</i>	<i>Globigerina woodi</i>	<i>Globoquadrina dehiscentis</i>	<i>Globorotalia pseudocontiniosa</i>	<i>Globorotalia cf. bella</i>	<i>Globorotalia?</i> (v. small)	<i>Globorotalia nana</i>	<i>Globigerina juvenilis</i>	<i>Globigerinoides trilobus</i>	<i>Globoquadrina ellispira</i>	<i>Globorotalia obesa</i>	<i>Globigerinoides succulifer</i>	<i>Globorotalia zealandica</i>	<i>Catapsydrax unicus</i>	<i>Globorotalia praescitula</i>	<i>Globigerinoides cf. hispanicus</i>	<i>Globorotalia miozea</i>
u. Mio.	<i>N. humerosa</i>	15					A	R		R					C		R							
m. Mio.	<i>G. mayeri</i>	16					C	R		R						R		VR						
lower Miocene	<i>G. glomerosa curva</i>	17			C		C			R						A	R	VR	VR			VR		
	<i>G. trilobus</i>	18							R	A						R	R						C	R
		19							C	C	A						R	C					C	VR
		20								C	A						R	R					C	VR
		21								C	R						R	R					C	VR
22			A							R						R	R					C	VR	
23			R		R	C		VR	R	R				C	R	R	cf. R	cf. R	C	A		VR	R	
<i>C. dissimilis</i>	24			R		R	C	VR	VR	C	C			R		C								
	25		C	R		R	C	VR	VR	C	C			R		C								
	26		C	C		R	C	VR	R	A	C			R		C								
	27		A	C	VR	VR	C	R	VR	A	VR	VR	VR	R	R									

Note: VR = very rare, R = rare, C = common, A = abundant, cf. = compare. Diversity = number of species per sample.

Table 2 (continued).

Chrono-stratigraphic unit	Zone	Core	<i>Globorotalia cf. praemenardii</i>	<i>Sphaeroidinella disjuncta</i>	<i>Globigerinoides? mitra</i>	<i>Præorbulina glomerosa curva</i>	<i>Præorbulina sicanus</i>	<i>Globorotalia miotumida</i>	<i>Globorotalia menardii</i>	<i>Orbulina suturalis</i>	<i>Globorotalia mayeri</i>	<i>Globorotalia continuosa</i>	<i>Globigerina falconensis</i>	<i>Globigerinoides ruber</i>	<i>Globigerina decoraperta</i>	<i>Globorotalia peripherononda</i>	<i>Globorotalia suterae</i>	<i>Turborotalia quinqueloba</i>	<i>Globigerina bradyi</i>	<i>Neogloboquadrina humerosa</i>	<i>Globorotalia scitula</i>	<i>Neogloboquadrina acostensis</i>	<i>Globorotalia merotumida</i>	Diversity	
u. Mio.	<i>N. humerosa</i>	15			VR					R					R			R	R	A	C	A	C	14	
m. Mio.	<i>G. mayeri</i>	16						C	R	R	A	R	VR	VR	VR	cf. VR	C	C	C					17	
lower Miocene	<i>G. glomerosa curva</i>	17				R	VR																	10	
	<i>G. trilobus</i>	18																							8
		19		VR	C	R																			8
		20																							7
		21																							8
22																								7	
23																							12		
<i>C. dissimilis</i>	24																							7	
	25																							8	
	26																							10	
	27																							11	

Chronostratigraphic unit	Zonal scheme at Site 608 (lat. 42°N)	Zonal markers
middle Miocene	<i>G. mayeri</i>	<i>G. mayeri</i> I.A. ↑
	<i>O. suturalis</i>	<i>O. suturalis</i> I.A. ↑
upper Oligocene	<i>P. glomerosa curva</i>	<i>P. glomerosa curva</i> I.A. ↑
	<i>G. trilobus</i>	<i>G. trilobus</i> I.A. ↑
	<i>G. kugleri</i>	<i>G. angulisuturalis</i> Ext. ↓
lower Miocene	<i>G. angulisuturalis</i>	Unconformity
upper Eocene	<i>G. cerroazulensis</i>	<i>G. ampliapertura</i> I.A. ↑
	<i>G. linaperta</i>	<i>T. rohri</i> Ext. ↓
middle Eocene	<i>T. rohri</i>	

Figure 2. Zones and zonal markers at Site 608. I.A. = initial appearance, Ext. = extinction.

Chronostratigraphic unit	Zonal scheme at Site 610 (lat. 53°N)	Zonal markers
middle Miocene	<i>G. mayeri</i>	<i>G. mayeri</i> I.A. ↑
lower Miocene	<i>P. glomerosa curva</i>	<i>P. glomerosa curva</i> I.A. ↑
	<i>G. trilobus</i>	<i>G. trilobus</i> I.A. ↑
	<i>C. dissimilis</i>	

Figure 3. Zones and zonal markers at Site 610. I.A. = initial appearance, Ext. = extinction.

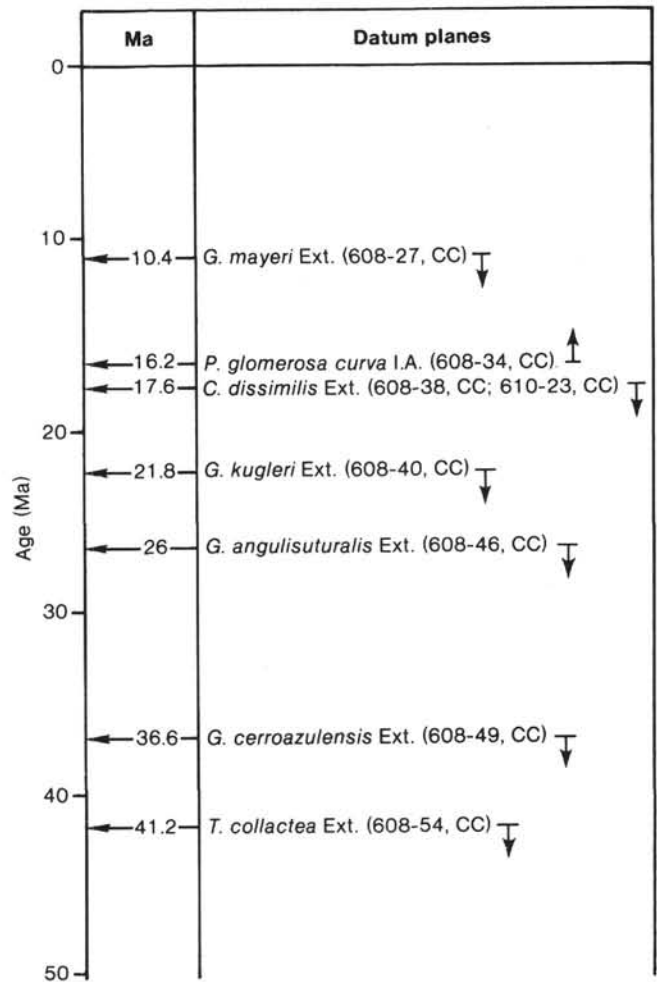


Figure 4. Site data and datum planes correlated with the Berggren et al. (1985) time scale. I.A. = initial appearance, Ext. = extinction.