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24. LATE MIOCENE TO PLEISTOCENE PLANKTONIC FORAMINIFERS FROM OCEAN DRILLING PROGRAM SITE 677, PANAMA BASIN¹

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ABSTRACT

Forty-three core-catcher samples from the upper Miocene to uppermost Pleistocene of ODP Site 677 were examined for planktonic foraminifers. Range charts were compiled for Holes 677A and 677B, and zonal markers and datum planes are correlated with the most recently published time scale. The absence of key species such as *Globorotalia truncatulinoides*, *Globorotalia tosaensis*, *Globorotalia miocenica*, and *Globorotalia margaritae* prohibits the use of any of the standard tropical zonal schemes. The zonal scheme used here was devised for this area on DSDP Leg 9.

INTRODUCTION

This chapter is a shorebased laboratory report on the planktonic foraminifers extracted from core-catcher samples taken from Holes 677A and 677B on Ocean Drilling Program Leg 111 during August to October 1988. The sites (Fig. 1) are located in the modern planktonic foraminiferal tropical province (Bé, 1977), and this warm-water influence is reflected in the late Miocene-Pleistocene faunas. Site 677 is at 1°12.14'N, 83°44.22'W, in a water depth of 3461 m. Previous relevant work in the Panama Basin from Deep Sea Drilling Project (DSDP) Leg 9 includes Jenkins and Orr (1971, 1972) and Orr and Jenkins (1980).

PROCEDURES

Core-catcher samples from the two sites were examined, planktonic foraminifers identified, and semiquantitative assessments of each species and subspecies (VR = very rare, <5%; R = rare, 5%–10%; C = common, 10%–20%; A = abundant, >20%) were plotted on stratigraphic range charts (Tables 1 and 2). Zones and epoch boundaries used in this study are shown in Figure 2.

ZONAL SCHEME

One of the major problems in the Panama Basin is the lack of some key species in the upper Neogene of Holes 677A and 677B (e.g., *Globorotalia truncatulinoides*, *Globorotalia tosaensis*, *Globorotalia margaritae*, and *Globorotalia miocenica*). It was therefore not possible to use the zonal schemes of Bolli (1957), Blow (1969), and Bolli and Saunders (1985). The zonal scheme used for Holes 677A and 677B is that devised by Jenkins and Orr (1972) for the eastern equatorial Pacific and for DSDP Sites 83 and 84 in the Panama Basin north of the Galapagos Rift Zone.

EPOCH BOUNDARY MARKERS

The Miocene/Pliocene boundary is estimated as 5.4 Ma (Berggren et al., 1985), and the initial appearance of *Globorotalia tumida* has been estimated as 5.2 Ma by Berggren et al. (1985). The Pliocene/Pleistocene boundary is now estimated as 1.6 Ma, and the extinction of *Globigerinoides fistulosus* has been given as 1.6 Ma by Berggren et al. (1985). *Globorotalia unguolata*, identified in Samples 111-677A-1H-CC and 111-677A-

2H-CC, has been identified as a Holocene marker (Bolli and Saunders, 1985); therefore, the first two cores of Hole 677A are probably Holocene in age.

DATUM PLANES

Important datum planes identified in Hole 677A are shown in Figure 3. According to Berggren et al. (1985) *Sphaeroidinella dehiscens* appears at 5.1 Ma, but it is obvious that in Hole 677A it made a much later appearance at about 3.8 Ma in Sample 111-677A-17X-CC, corresponding to a major coiling change in *Pulleniatina* (Fig. 3). This event is therefore unreliable for correlations within the Panama Basin.

A number of the datum planes were originally described by Hays et al. (1969) from piston cores and were documented by Orr and Jenkins (1980) in Leg 9 material. The major coiling changes in species of *Pulleniatina* shown in Figure 3 correspond to those recorded by Orr and Jenkins (1980).

CONCLUSIONS

The excellent upper Miocene to Holocene material afforded by Site 677 recovery should prove to be useful for high resolution (10^4 – 10^5 yr) faunal studies. The design of such a program will be improved by oxygen isotope studies (Shackleton and Hall, this volume).

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Table 1. Range chart for planktonic foraminifers from Hole 677A core-catcher samples.

Age	Zone	Sample	<i>Candeiina nitida</i>	<i>Chilouembelina</i> sp.	<i>Globigerina apertura</i>	<i>Globigerina bulloides</i>	<i>Globigerina decoraperta</i>	<i>Globigerina juvenilis</i>	<i>Globigerinella aequilateralis</i>	<i>Globigerinoides conglobatus</i>	<i>Globigerinoides extremus</i>	<i>Globigerinoides fragilis</i>	<i>Globigerinoides obliquus</i>	<i>Globigerinoides fistulosus</i>	<i>Globigerinoides ruber</i>	<i>Globigerinoides sacculifer</i>	<i>Globigerinoides trilobus</i>	<i>Globigerinita glutinata</i>	<i>Globoquadrina altispira</i>	<i>Globoquadrina dehiscens</i>	<i>Globoquadrina globosa</i>	<i>Globoquadrina venezuelana</i>	<i>Globorotalia crassaformis</i>		
Pleistocene	<i>Pulleniatina obliquiloculata</i>	1H-CC						VR																	
		2H-CC							VR																
Pleistocene	<i>Pulleniatina obliquiloculata</i>	3H-CC		VR		VR		VR																	
		4H-CC																							
		5H-CC																							
		6H-CC																							
		7H-CC		VR																					
		8H-CC																							
		9H-CC																							
late Pliocene	<i>Globigerinoides fistulosus</i>	10H-CC			R																				
		11H-CC																							
		12H-CC				R																			
		13H-CC																							
		14H-CC																							
early Pliocene	<i>Globorotalia tumida</i>	15H-CC																							
		16X-CC																							
		17X-CC																							
		18X-CC																							
late Miocene	<i>Globorotalia plesiotumida</i>	19X-CC																							
		20X-CC																							
		21X-CC																							
		22X-CC																							
		23X-CC																							
		24X-CC																							
		25X-CC																							
		26X-CC																							
		27X-CC																							
		28X-CC																							
29X-CC																									
30X-CC																									
31X-CC																									
32X-CC																									
33X-CC																									

Note: VR = very rare; R = rare; C = common; A = abundant.

Table 1 (continued).

<i>Globorotalia explicationis</i>															
<i>Globorotalia fimbriata</i>															
<i>Globorotalia juanai</i>															
<i>Globorotalia menardii</i>															
<i>Globorotalia merotumida</i>															
<i>Globorotalia obesa</i>															
<i>Globorotalia plesiotumida</i>															
<i>Globorotalia plesiotumida-Globorotalia tumida</i>															
<i>Globorotalia scitula</i>															
<i>Globorotalia tumida</i>															
<i>Globorotalia tumida flexuosa</i>															
<i>Globorotalia unguolata</i>															
<i>Globorotaloides hexagona</i>															
<i>Globorotaloides variabilis</i>															
<i>Neogloboquadrina acostaensis</i>															
<i>Neogloboquadrina continuosa</i>															
<i>Neogloboquadrina duterrei</i>															
<i>Neogloboquadrina humerosa</i>															
<i>Neogloboquadrina pachyderma</i>															
<i>Orbulina bilobata</i>															
<i>Orbulina universon</i>															
<i>Pulleniatina obliquiloculata</i>															
<i>Pulleniatina primaris</i>															
<i>Pulleniatina primaris-Neogloboquadrina acostaensis</i>															
<i>Sphaeroidinella disjuncta</i>															
<i>Sphaeroidinella dehiscens</i>															
<i>Sphaeroidinella seminulina</i>															
<i>Globorotalia explicationis</i>	VR	C C A R			R VR R R										
<i>Globorotalia fimbriata</i>															
<i>Globorotalia juanai</i>															
<i>Globorotalia menardii</i>															
<i>Globorotalia merotumida</i>															
<i>Globorotalia obesa</i>															
<i>Globorotalia plesiotumida</i>															
<i>Globorotalia plesiotumida-Globorotalia tumida</i>															
<i>Globorotalia scitula</i>															
<i>Globorotalia tumida</i>															
<i>Globorotalia tumida flexuosa</i>															
<i>Globorotalia unguolata</i>															
<i>Globorotaloides hexagona</i>															
<i>Globorotaloides variabilis</i>															
<i>Neogloboquadrina acostaensis</i>															
<i>Neogloboquadrina continuosa</i>															
<i>Neogloboquadrina duterrei</i>															
<i>Neogloboquadrina humerosa</i>															
<i>Neogloboquadrina pachyderma</i>															
<i>Orbulina bilobata</i>															
<i>Orbulina universon</i>															
<i>Pulleniatina obliquiloculata</i>															
<i>Pulleniatina primaris</i>															
<i>Pulleniatina primaris-Neogloboquadrina acostaensis</i>															
<i>Sphaeroidinella disjuncta</i>															
<i>Sphaeroidinella dehiscens</i>															
<i>Sphaeroidinella seminulina</i>															
<i>Globorotalia explicationis</i>															
<i>Globorotalia fimbriata</i>															
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<i>Globorotalia menardii</i>															
<i>Globorotalia merotumida</i>															
<i>Globorotalia obesa</i>															
<i>Globorotalia plesiotumida</i>															
<i>Globorotalia plesiotumida-Globorotalia tumida</i>															
<i>Globorotalia scitula</i>															
<i>Globorotalia tumida</i>															
<i>Globorotalia tumida flexuosa</i>															
<i>Globorotalia unguolata</i>															
<i>Globorotaloides hexagona</i>															
<i>Globorotaloides variabilis</i>															
<i>Neogloboquadrina acostaensis</i>															
<i>Neogloboquadrina continuosa</i>															
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<i>Pulleniatina obliquiloculata</i>															
<i>Pulleniatina primaris</i>															
<i>Pulleniatina primaris-Neogloboquadrina acostaensis</i>															
<i>Sphaeroidinella disjuncta</i>															
<i>Sphaeroidinella dehiscens</i>															
<i>Sphaeroidinella seminulina</i>															
<i>Globorotalia explicationis</i>															
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<i>Globorotalia juanai</i>															
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<i>Globorotalia plesiotumida</i>															
<i>Globorotalia plesiotumida-Globorotalia tumida</i>															
<i>Globorotalia scitula</i>															
<i>Globorotalia tumida</i>															
<i>Globorotalia tumida flexuosa</i>															
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<i>Pulleniatina primaris-Neogloboquadrina acostaensis</i>															
<i>Sphaeroidinella disjuncta</i>															
<i>Sphaeroidinella dehiscens</i>															
<i>Sphaeroidinella seminulina</i>															

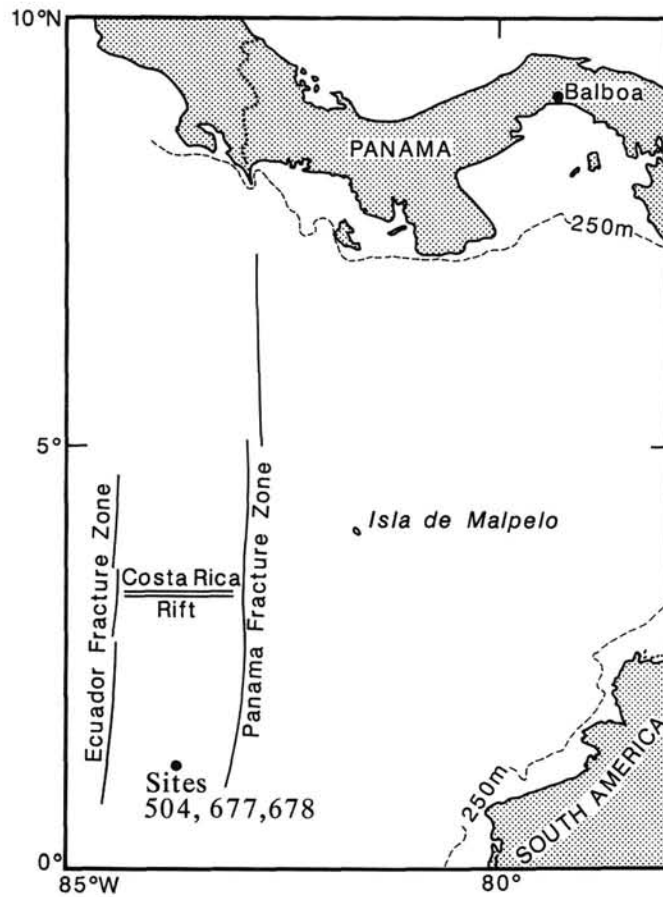


Figure 1. Sites drilled on ODP Leg 111.

Table 2. Range chart for planktonic foraminifers from Hole 677B core-catcher samples.

Age	Zone	Sample	<i>Globigerinella aequilateralis</i>	<i>Globigerina bulloides</i>	<i>Globigerina bradyi</i>	<i>Globigerina juvenilis</i>	<i>Globigerinoides conglobatus</i>	<i>Globigerinoides fistulosus</i>	<i>Globigerinoides ruber</i>	<i>Globigerinoides sacculifer</i>	<i>Globigerinoides trilobus</i>	<i>Globigerinita glutinata</i>	<i>Globorotalia crassaformis</i>	<i>Globorotalia menardii</i>	<i>Globorotalia obesa</i>	<i>Globorotalia scitula</i>	<i>Globorotalia tumida</i>	<i>Globorotalia tumida flexuosa</i>	<i>Globorotalia unguolata</i>	<i>Globorotaloides variabilis</i>	<i>Neogloboquadrina duertrei</i>	<i>Orbulina bilobata</i>	<i>Orbulina universa</i>	<i>Pulleniatina obliquiloculata</i>	<i>Sphaeroidinella dehiscens</i>	
Pleistocene	<i>Pulleniatina obliquiloculata</i>	1H-CC							R	R	C								C				C			
		2H-CC	R			VR	VR		R	R	C								A					A	R	
		3H-CC					VR		C	C	C			R	C								VR	C	VR	VR
		4H-CC				VR		VR		VR		VR												R	R	
		5H-CC	VR						C	C	C	R	VR											C	C	
		6H-CC	R			VR	R		A	C	C						VR	A	A					C	C	
		7H-CC	R		R	R		C	C	VR	C					VR	A	R				A		C	C	C
		8H-CC					VR		R		R				R		VR	R		A		C		R	R	VR
late Pliocene	<i>Globigerinoides fistulosus</i>	9H-CC				R	VR	R	C	R			VR	R	VR	VR	C				C		R			
		10H-CC		VR			R		C	C	R			VR	C	VR	VR	C		VR	A		C	C	C	

Note: VR = very rare; R = rare; C = common; A = abundant.

Epoch	Zone	Definition of Zonal Boundaries
Pleistocene	<i>P. obliquiloculata</i>	<i>G. fistulosus</i> Extinction I
Late Pliocene	<i>G. fistulosus</i>	<i>G. fistulosus</i> Initial appearance I
	<i>S. dehiscens</i>	<i>S. dehiscens</i> Initial appearance I
Early Pliocene	<i>G. tumida</i>	<i>G. tumida</i> Initial appearance I
Late Miocene	<i>G. pleisio-tumida</i>	

Figure 2. Zones and zonal markers for Holes 677A and 677B.

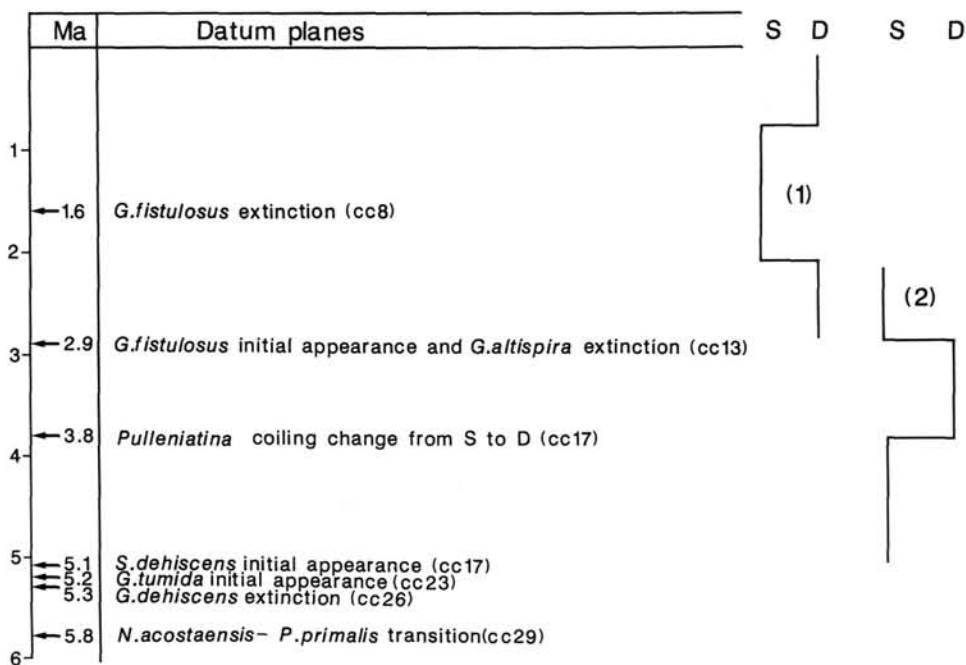


Figure 3. Datum planes identified in core-catcher (cc) samples from Holes 677A and 677B and correlated with the Berggren et al. (1985) time scale. Major sinistral (S) and dextral (D) coiling changes are shown for (1) *Pulleniatina obliquiloculata* and (2) *Pulleniatina primalis*.