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9. Campanian to Miocene Planktonic Foraminifers from the Iberia Abyssal Plain[1]

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ABSTRACT

Planktonic foraminifers recovered from five sites drilled off western Portugal during Ocean Drilling Program Leg 173 are documented. Hole 1065A yielded planktonic foraminifers from Miocene sediments in Sections 173-1065A-1R-1 through 6R-2. Hole 1067A penetrated middle Eocene sediments containing planktonic foraminifers in Section 173-1067A-1R-1 through Lower Eocene planktonic foraminiferal horizons to Section 12R-CC. Hole 1068A yielded planktonic foraminiferal assemblages from middle Eocene sediments at Section 173-1068A-1R-1 to Maastrichtian sediments at Section 173-1068A-15R-3, whereas Hole 1069A contained middle Eocene taxa in Section 173-1069A-1R-1 through Campanian/Maastrichtian forms in Section 173-1069A-15R-2. All of the planktonic foraminifers recovered from these sites are of poor to moderately good preservation and are variable in abundance. Hole 1070A yielded only six planktonic foraminifers, with the assemblages being dominated by benthic foraminifers and fish teeth. The co-occurrence of other microfossil groups, including benthic foraminifers, are only briefly discussed here. The lower Miocene biosiliceous facies recorded in Hole 1065A is considered to be coeval with a similar facies found in onshore sections farther to the east, in southern Spain.

INTRODUCTION

Sediment core samples from five sites drilled by the Ocean Drilling Program Leg 173 in the Atlantic Iberia Abyssal Plain off the shore of

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Portugal have been analyzed for planktonic foraminifers. The fossiliferous sediments containing these taxa range from Campanian to early Miocene. The Miocene faunas are abundant and generally well preserved, whereas the older sediments yield much less abundant and diverse assemblages that are usually poorly preserved. The pre-Neogene sequences are punctuated by turbiditic deposits and deposition below the carbonate compensation depth (CCD). These depositional environments are not ideal for recovery of well-preserved calcareous foraminiferal plankton of biostratigraphically useful size (i.e., >125 µm in diameter); consequently, many indeterminate forms, too poorly preserved to be positively identified, are present in the samples. In addition to the in situ foraminifers there are assemblages of abundant benthic and planktonic calcareous foraminifers containing very small individuals that are interpreted to have been deposited below the CCD and protected by rapid burial. Similar assemblages were recorded in Leg 149 sediments; Kuhnt et al. (1996) suggested that they had been redeposited from shallower depths.

METHODS

The samples were washed in water (with no other chemical agents) and then sieved through a 63-µm sieve mesh before drying in an oven. The dried residues were sieved into four size fractions before examination: 63–125, 126–250, 251–500, and >500 µm. The residue below 125 µm was examined, but no biostratigraphically useful forms have been recorded from this fraction, with the exception of the Paleocene intervals, where the occurrence of small species such as *Parvularugoglobigerina eugubina* has been noted. Preservation of the assemblages is described by assessment of the general appearance of the assemblage and classified as good (G), moderately good (M), or poor (P). The relative abundance of planktonic foraminifers in any one sample is classified as abundant (A; >20 specimens), common (C; 5–20 specimens), few (F; 2–4 specimens), rare (R; 1 specimen), or barren (B). The presence of reworking is recorded as Rw on the charts and contamination as Cn. Approximately 10 cm^3 (if available) of sediment was processed for each sample.

BIOSTRATIGRAPHY

The timescale of Berggren et al. (1995) was used to provide age estimates for the Cenozoic time interval and that of Gradstein et al. (1995) for the Cretaceous time interval. The zonation scheme of Berggren et al. (1995) has been used for planktonic foraminifers recovered from the Miocene interval with modifications from Blow (1969). The zonation scheme of Berggren and Miller (1988) with modifications from Blow (1969) has been applied to the Paleocene and Eocene planktonic foraminifers recorded. Cenozoic taxonomic concepts follow Kennett and Srinivasan (1983) and Blow (1969) for the Miocene and Tourmarkine and Luterbacher (1985) and Blow (1969) for the Paleocene and Eocene. Genus-species combinations generally follow those used by Blow (1979) and Berggren et al. (1995). Cretaceous taxonomic concepts are based on Robaszynski et al. (1984) and Caron (1985).

Hole 1065A

Planktonic foraminifer taxa are generally abundant and well preserved in Cores 173-1065A-1R through 6R and are of early Miocene age (Aquitanian to Burdigalian; Subzones M1b–M4a of Berggren et al. [1995] and Zones N4–N7 of Blow [1969]) (Table T1). In the uppermost sample examined (173-1065A-1R-1, 5–6 cm) the presence of *Catapsydrax dissimilis* suggests an age no younger than Subzone M4a of Berggren et al. (1995). This age assignment is supported by the co-occurrence of *Globigerinoides trilobus*, *Globoquadrina venezuelana,* and *Globoquadrina dehiscens,* all of which are characteristic of uppermost lower Miocene sediments. The absence of species commonly present in younger middle Miocene Zones M5 (Berggren et al., 1995) and N8 (Blow, 1969), such as *Praeorbulina glomerosa curva* and *Praeorbulina transitoria,* also suggests that the sediments at the top of this cored interval can be dated as late early Miocene.

T1. Planktonic foraminifer taxa, Hole 1065A, p. 8.

Hole 1067A

Cores 173-1067A-1R through 13R range in age from early Paleocene to middle Eocene, based on calcareous nannofossil Subzone CP1b through Zones CP3 to Subzone CP13c (Bukry, 1973, 1975) (Table T2). These zones correspond to planktonic foraminiferal Subzones P1b to base P3b to Zone P11 (Berggren and Miller, 1988). The planktonic foraminiferal assemblages recovered from these cores are sparse, and specimens are generally very poorly preserved. The uppermost sample analyzed for planktonic foraminifers is 173-1067A-1R–1, 88–90 cm, which yielded rare specimens of *Truncorotaloides rohri*, *Morozovella aragonensis,* and *Acarinina broedermanni.* These species are consistent with an age assignment of middle Eocene Zone P12 but are slightly younger than the initial calcareous nannofossil assignment of Subzone CP13c. The occurrence of rare *Acarinina pentacamerata* in Sample 173-1067A-1R-2, 82–86 cm, suggests that sediments of the older zone, middle Eocene Zone P11, were penetrated at this depth.

In samples between 173-1067A-1R-2, 82–86 cm, (middle Eocene Zone P11) and 9R-4, 80–84 cm (middle Eocene Zone P10), no age diagnostic planktonic foraminifers have been recovered, and the Zone P11/P10 boundary is based on calcareous nannofossil evidence. In Sample 173-1067A-9R-5, 79–83 cm, the occurrence of *Morozovella quetra* indicates the presence of lower Eocene sediments of Zone P9. This age assignment is supported by the occurrence of *Acarinina soldadoensis* in Sample 173-1067A-10R-1, 83–86 cm. The Zone P9/P8 boundary is based on calcareous nannofossils. Penetration of sediments of Zones P7 and P6 is also based on calcareous nannofossil zones, although the species of planktonic foraminifers are consistent with these age determinations and include sparse assemblages with characteristic early Eocene taxa.

T2. Planktonic foraminifer taxa, Hole 1067A, p. 9.

Hole 1068A

Core 173-1068A-1R through Section 15R-3 yielded planktonic foraminifers of varied preservation and abundance (Table T3). In Sample 173-1068A-1R-1, 83–86 cm, the co-occurrence of *Subbotina eocaena* and *Morozovella aragonensis* suggests an age of middle Eocene (Zone P11) at this depth. The rare occurrence of *Acarinina soldadoensis* in Sample 173-1068A-2R-3, 78–82 cm, indicates penetration of lower Eocene sediments. Zone P10 could not be defined by planktonic foraminifers re-

T3. Planktonic foraminifer taxa, Hole 1068A, p. 10.

covered from this interval. Sample 173-1068A-10R-CC yielded a rich and diverse assemblage of moderately well preserved forms, including *Igorina convexa*, *Morozovella aequa, Planorotalites pseudomenardii*, and *Pseudohastigerina wilcoxensis*, which is consistent with a late Paleocene age (Zone P4/P5?). Further subdividing the early Paleocene using planktonic foraminifers was not possible. In Samples 173-1068A-13R-4, 133–136 cm, to 15R-3, 14–18 cm, abundant reworking of early Paleocene and latest Cretaceous age taxa is evident. The boundary between Paleocene and Cretaceous age sediments is based on calcareous nannofossils. Common Cretaceous planktonic foraminifers have been recovered and are considered to be in situ below 173-1068A-14R-4, 17–21 cm.

Hole 1069A

We analyzed middle lower Eocene sediments from Sample 173-1069A-1R-1, 12–15 cm, through Upper Cretaceous sediments in Sample 15R-4, 1–3 cm, for planktonic foraminifers (Table T4). Specimens recovered are generally rare and only moderately well preserved or, more often, very poorly preserved. Although the ages of the assemblages are consistent with and the assemblages are characteristic of the age assignments for these cored sediments, the boundaries are based largely on calcareous nannofossil analyses. In the middle to early Eocene interval in Cores 173-1069A–1R and 2R (Zones P9–P10) the foraminiferal taxa include species such as *Morozovella aragonensis*, *Acarinina broedermanni,* and *Globigerinatheka senni*. In Sample 173-1069A-3R-1, 68–72 cm, the co-occurrence of *Acarinina bullbrooki* and *Acarinina soldadoensis* confirms that the sediments recorded at this level are no younger than latest early Eocene (Zone P9). Assemblages recovered in the core below this, down to Sample 173-1069A-5R-CC, 7–11 cm, are very similar in planktonic foraminiferal content and preservation. Sample 173-1069A-5R-CC contains abundant but poorly to moderately preserved specimens, and the only determinable species are *Acarinina bullbrooki* and *Morozovella aragonensis*. Below this horizon, in Samples 173-1069A-6R-1, 128–131 cm, through 9R-4, 101–105 cm, planktonic foraminifers are either absent or very poorly preserved. In Sample 173-1069A-9R-CC, planktonic foraminifers are abundant although poorly preserved. Below Sample 173-1069A-12R-1, 55–60 cm, the remainder of the early Paleocene assemblages are heavily reworked with Cretaceous forms and a mixture of pink and white specimens. At the base of Core 13R, Cretaceous planktonic foraminifers are common together with rare Paleocene taxa. Below Section 15R-2 only very rare indeterminate Cretaceous planktonic foraminifers have been recovered.

T4. Planktonic foraminifer taxa, Hole 1069A, p. 12.

Hole 1070A

The recovery of planktonic foraminifers from these cores was extremely poor, although we examined 35 samples from 173-1070A-1R-1, 43–48 cm, through 7R-CC. In Sample 173-1070A-1R-4, 22–25 cm, a fragment of *Globoquadrina* spp. was recovered, which suggests an age of Zone P21 (Oligocene or younger). Sample 173-1070A-1R-CC yielded two planktonic foraminiferal specimens of *Catapsydrax unicavus*, a long-ranging species with a stratigraphic distribution from late Eocene Zone P14 to early Miocene Zone N6 and one specimen of *Globigerinatheka* spp. that is characteristic of a late Eocene to early Oligocene assemblage. In Sample 173-1070A-3R-1, 64–69 cm, two very poorly preserved

specimens of Paleogene appearance were recovered. One of these specimens is very tentatively identified as *Acarinina bullbrooki;* if identified correctly, this would suggest an age for the sample within the range of late early Eocene (Zone P9) to middle Eocene (Zone P14). The remainder of the samples analyzed from Hole 1070A are barren of planktonic foraminifers.

DISCUSSION

Miocene faunas recorded only from Hole 1065A are usually abundant and generally show good preservation. Eocene and Paleocene faunas from Holes 1067A, 1068A, and 1069A are mostly sparse and very poorly preserved. Late Cretaceous taxa from Holes 1067A, 1068A, and 1069A are very rare and poorly preserved. Hole 1070A yielded only six specimens of planktonic foraminifers, all of which are very poorly preserved.

In comparison to planktonic foraminiferal assemblages recovered during Leg 149, the faunas documented here are similar in composition and preservation although the age intervals recovered from each leg differ slightly. Sediments recovered from Holes 1067A, 1068A, and 1069A yielded very rare Late Cretaceous planktonic foraminiferal taxa, whereas Hole 1070A has only agglutinated benthic taxa through the Mesozoic interval. A complete K/T boundary section is not represented in either Hole 1068A or Hole 1069A, although continuous cores of Paleocene to Cretaceous sediments were recovered at both sites. Although specimens of *Parvularugoglobigerina eugubina* have been recovered, they are considered to have been reworked. Both intervals in Holes 1068A and 1069A show bioturbation and evidence of reworking, and the original sediment sequence deposited during Zone P0 and Subzones Pa and P1a of Berggren et al. (1995) are considered to have been redeposited.

The biosiliceous facies from the lower Miocene discussed by Gervais (1996) and recorded from Leg 149 (Gervais, 1996) and Leg 47B (Iaccarino and Salvatorini, 1979; Iaccarino and Premoli Silva, 1979) are also present in Hole 1065A from Leg 173. These facies are similar in age and characteristics to those found in onshore sections in Andalucia, southern Spain (Alvira and Hovasse, 1975), and support the suggestion (Gervais, 1996) of a relatively widespread change in water-mass currents and fluctuation in the CCD, reflecting periodic changes in climate.

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SPECIES LIST

Acarinina bullbrooki (Bolli)
Acarinina pentacamerata (Subbotina)
Acarinina primitiva (Finlay)
Acarinina soldadoensis (Brönnimann)

Acarinina soldadoensis angulosa (Bolli)
Acarinina subsphaerica (Subbotina)
Catapsydrax dissimilis (Cushman and Bermúdez)
Catapsydrax stainforthi Bolli, Loeblich and Tappan
Catapsydrax unicavus Bolli, Loeblich and Tappan
Eoglobigerina eobulloides (Morozova)
Globigerina ampliapertura Bolli
Globigerina angustiumbilicata (Bolli)
Globigerina bulloides d'Orbigny
Globigerina cryptomphala Glaessner
Globigerina falconensis Blow
Globigerina praebulloides Blow
Globigerina sellii (Borsetti)
Globigerinatheka kugleri (Bolli, Loeblich and Tappan)
Globigerinatheka senni (Beckmann)
Globigerinita naparimaensis Brönnimann
Globigerinoides altiaperturus Bolli
Globigerinoides immaturus Leroy
Globigerinoides primordius Blow and Banner
Globigerinoides subquadratus Brönnimann
Globigerinoides trilobus (Reuss)
Globoconusa daubjergensis (Brönnimann)
Globoquadrina baroemoenensis (Leroy)
Globoquadrina dehiscens dehiscens (Chapman, Parr and Collins)
Globoquadrina praedehiscens Blow & Banner
Globoquadrina venezuelana (Hedberg)
Globorotalia kugleri Bolli
Globorotalia obesa Bolli
Globorotalia peripheroronda Blow and Banner
Globorotalia siakensis (LeRoy)
Globotruncana ventricosa White
Igorina broedermanni (Cushman and Bermudez)
Igorina convexa (Subbotina)
Jenkinsella mayeri (Cushman and Ellisor)
Morozovella aequa (Cushman and Renz)
Morozovella aragonensis (Nutall)
Morozovella caucasica (Glaessner)
Morozovella conicotruncata (Subbotina)
Morozovella quetra (Bolli)
Paragloborotalia opima nana (Bolli)
Parvularugoglobigerina eugubina (Luterbacher and Premoli Silva)
Planorotalites pseudomenardii (Bolli)
Pseudohastigerina wilcoxensis (Cushman and Ponton)
Subbotina eocaena (Terquem)
Subbotina frontosa (Subbotina)
Subbotina linaperta (Finlay)
Truncorotaloides rohri Brönnimann and Bermúdez
Turborotalia cerroazulensis possagnoensis (Tourmarkine and Bolli)
Zeaglobigerina woodi (Jenkins)

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Table T1. Stratigraphic distribution of planktonic foraminifer taxa, Hole 1065A.

Age	Zone/ Subzone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Globoquadrina dehiscens*	*Globoquadrina venezuelana*	*Globorotalia foshi peripheroronda*	*Catapsydrax stainforthi*	*Globigerinoides altiaperturus*	*Globorotalia kugleri*	*Globigerinoides trilobus*	*Catapsydrax dissimilis*	*Catapsydrax unicavus*	*Globigerinoides* spp.	*Jenkinsella mayeri*	*Globigerina praebulloides*	*Globigerinoides immaturus*	*Globigerinoides primordius*	*Globigerinita naparimaensis*	*Globigerina angustiumbilicata*	*Globigerina falconensis*	*Globigerina* spp.	*Globigerinoides subquadratus*	*Globorotalia obesa*	*Globorotalia siakensis*	*Zeaglobigerina woodi*	*Globoquadrina baroemoenensis*	*Globoquadrina praedehiscens*	*Golbigerina sellii*	*Globoquadrina* spp.	*Paragloborotalia opima nana*	*Globigerina bulloides*	Indeterminate spp.	Siliceous microfossils
		173-1065A-																																	
early Miocene	M4a	1R-1, 5-6	251.05	A	G	C	C	C				C								F		R	R	C											C
	M2-M3	1R-1, 6-7	251.06	A	G					R										F	R	R		R							R		C	C	C
		1R-1, 80-84	251.80	A	G																		C	R			R				C		R		C
		1R-2, 81-85	253.31	A	G	A	A		R	R		A	F		F			F																R	
	M2	1R-3, 80-84	254.80	R	G							R									R		R												A
		1R-4, 82-84	256.32	R	P	R							R															R						R	A
		1R-CC	257.10	A	G	F	F		R		Rw		F		F	F	F	F																	
		2R-1, 81-83	261.51	R	P																				R						C				C
		2R-2, 79-82	262.99	C	G								R	R			C				R				R	R			R					R	F
		2R-CC	263.27	B																															
	M1b-M2	3R-1, 82-87	271.12	A	G											C	A						C				R	C			C				C
		3R-2, 82-84	272.62	A	G											C	C						C			R		C	R						F
		3R-CC	273.23	A	G	F	F		R				F	R		R																			
		4R-1, 84-88	280.84	A	G								C			R	C				C				R						R				C
		4R-2, 85-90	282.35	A	G				C				R	R		C	R											R							C
		4R-3, 90-93	283.90	A	G				R								C		C		C		R			R									C
		4R-4, 102-105	285.52	A	G									R			R		R												R				C
		4R-CC	286.70	C	M	F	F					F	R				F																	C	C
		5R-1, 84-86	290.44	A	G	C					C				C	C	R		R		C		C				R				C				C
		5R-CC	291.33	A	G		F				R		F						R															R	
		6R-1, 83-86	300.03	A	G				R					R			C				R		C												C
	M1b	6R-2, 81-82	301.51	C	G											R	F													R		Rw			R
		6R-CC	302.63	B																															

Notes: Abundance: A = abundant, C = common, F = few, R = rare, B = barren. Preservation: G = good, M = moderately good, P = poor. Rw = reworked.

Table T2. Stratigraphic distribution of planktonic foraminifer taxa, Hole 1067A.

Age	Zone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Truncorotaloides rohri*	*Acarinina bullbrooki*	*Acarinina pentacamerata*	*Subbotina linaperta*	*Subbotina eocaena*	*Globigerina* spp.	*Morozovella aragonensis*	*Acarinina primitiva*	*Pseudohastigerina wilcoxensis*	*Igorina broedermanni*	*Acarinina soldadoensis*	*Globigerina cryptomphala*	*Morozovella quetra*	*Globigerinatheka senni*	*Turborotalia cerroazulensis possagnoensis*	Indeterminate spp.
middle Eocene	P11	173-1067A-																			
		1R-1, 88-90	648.88	F	P	R						R			R						
		1R-2, 82-86	650.32	F	P			R													
		1R-3, 72-76	651.72	R	P																
		1R-4, 78-82	653.28	F	P				F												R
		1R-CC	653.53	R	P		R	R	R	R							R	R			
		2R-1, 80-82	658.40	R	P															R	
		2R-2, 80-82	659.90	R	P						R										
		2R-CC	661.39	F	P	R	R	R	R		R		R								
		3R-1, 23-25	667.53	F	P															R	
		3R-2, 64-67	669.44	F	P			R	R												
		3R-3, 68-72	670.98	F	P				R												R
		3R-4, 23-26	672.03	F	P				R												R
		3R-CC	672.57	F	P	R	R	R						R					R	R	
		4R-1, 67-71	677.57	B																	
		4R-2, 11-14	678.51	B																	
		4R-2, 90-92	679.30	F	P			R						R							F
		4R-3, 88-91	680.78	B																	
		4R-CC	681.37	F	P	R			R		R			R					R		
		5R-1, 54-57	687.04	R	P															R	
		5R-2, 72-75	688.72	F	P																F
		5R-3, 3-7	689.31	R	P														R		
	P10	5R-CC	690.52	F	P	R	R	R	R	R	R			R	R	R					
		6R-1, 113-115	697.23	R	P																R
		6R-2, 82-85	698.42	R	P				R												
		6R-CC, 3-6	699.11	R	P														R		
		6R-CC	699.26	R	P							R			R	R					R
		7R-1, 100-103	706.80	R	P			R													
		7R-2, 82-83	708.12	R	P								R								
		7R-CC	709.69	B																	
		8R-1, 75-79	716.25	R	P										R						
		8R-2, 85-88	717.85	F	P																F
		8R-3, 79-83	719.29	F	P			R							R						F
		8R-CC	720.73	R	P			R	R			R	R	R							
		9R-1, 78-82	725.98	R	P														R		
		9R-2, 79-82	727.49	F	P		R	R													R
		9R-3, 79-82	728.99	B																	
		9R-4, 80-84	730.50	F	P														R		
		9R-5, 79-83	731.99	R	P			R										R			
early Eocene		9R-CC	732.37	B																	
	P9	10R-1, 83-86	735.63	F	P			R								R					
		10R-2, 83-86	737.13	R	P				R												
		10R-3, 0-4	737.80	F	P																F
		10R-CC	739.57	R	P				R			R	R								
		11R-1, 71-74	740.31	R	P											R					
		11R-2, 58-60	741.68	R	P													R			
	P8	11R-3, 12-14	742.72	R	P							R									
		11R-3, 36-39	742.96	R	P							R									
		11R-4, 8-11	743.68	F	P																F
		11R-4, 28-30	743.88	F	P							F				R					
		11R-CC	744.31	F	P				R		R			R							
	P7	12R-1, 67-70	745.17	B																	
		12R-2, 28-29	745.78	F	P				F				R		R						R
		12R-CC	746.34	F	P				R		R					R					
	P6	13R-1, 55-58	754.75	B																	
		13R-2, 24-28	755.94	B																	
	?	13R-CC	756.55	R	P																R

Notes: Abundance: F = few, R = rare, B = barren. Preservation: P = poor.

Table T3. Stratigraphic distribution of planktonic foraminifer taxa, Hole 1068A. (**See table notes.** Continued on next page.)

Age	Zone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Subbotina eocaena*	*Igorina broedermanni*	*Acarinina soldadoensis*	*Morozovella aequa*	*Pseudohastigerina wilcoxensis*	*Morozovella aragonensis*	*Acarinina soldadoensis angulosa*	*Eoglobigerina eobulloides*	*Igorina convexa*	*Planorotalites pseudomenardii*	Indeterminate spp.	Reworked
		173-1068A-															
middle Eocene	P11-P10?	1R-1, 83-86	712.13	R	P	R					R						
		1R-CC	719.55	R	P											R	
early Eocene	P9-P4?	2R-3, 78-82	721.68	R	P			R									
		2R-CC	727.85	A	P	R	R	R		R	R					C	C
		3R-CC	740.43	R	P	R						R					
		4R-1, 21-24	740.51	B													
		4R-3, 11-15	743.41	R	P											R	
		4R-CC	749.23	B													
		5R-1, 81-84	750.71	C	P	C										R	
		5R-3, 82-85	753.72	F	M	F											
		5R-4, 81-84	755.21	R	P											R	
		5R-CC	757.71	A	P					R						C	
		6R-2, 65-68	761.75	F	M	F											
		6R-3, 78-82	763.38	F	M			F									
		6R-4, 30-33	764.40	R	M	R											
		6R-7, 13-16	768.73	B													
		6R-CC	769.47	R	P											R	
		7R-5, 0-3	773.80	C	M												C
		7R-CC	776.41	A	P												A
		8R-2, 148-150	781.88	R	P			R									
		8R-6, 147-150	787.87	R	P				R								
		8R-CC	788.75	B													
		9R-1, 77-80	789.27	C	P											C	
		9R-2, 79-82	790.79	R	M									R			
		9R-3, 80-83	792.30	F	M			F									
		9R-4, 76-79	793.76	C	M									C			
		9R-5, 73-76	795.23	R	P			R									
		9R-6, 61-64	796.61	R	P					R							
		9R-CC	798.10	B													
		10R-1, 79-83	798.89	F	P											F	
		10R-2, 83-87	800.43	R	P			R									
		10R-3, 67-71	801.77	B													
late Paleocene to Senonian	P4-?	10R-CC	802.52	C	M				R	R				R	R	C	
		11R-1, 84-89	808.54	F	P			F									
		11R-2, 94-96	810.14	B													
		11R-3, 85-87	811.55	F	M			R							F		
		11R-4, 79-85	812.99	R	P			R									
		11R-5, 77-82	814.47	C	P			R							C		
		11R-CC	815.41	B													
		12R-1, 26-30	817.56	R	M										R		
		12R-2, 26-30	819.06	R	M			R									
		12R-3, 26-29	820.56	B													
		12R-4, 29-33	822.09	C	P											C	
		12R-5, 26-30	823.56	R	P										R		
		12R-6, 25-28	825.05	R	P											R	
		12R-7, 27-30	826.57	B													
		12R-CC, 5-8	827.06	B													
		12R-CC	827.01	B													
		13R-1, 71-74	827.61	R	P											R	
		13R-2, 25-28	828.65	F	P											F	
		13R-3, 5-8	829.95	R	P											R	
		13R-3, 20-23	830.10	B													
		13R-3, 107-110	830.97	R	P											R	
		13R-4, 20-24	831.60	B													
		13R-4, 133-136	832.73	A	P											A	A
		13R-5, 8-12	832.98	C	P											C	C
		13R-5, 84-88	833.74	C	P											C	
		13R-6, 71-75	835.11	B													

Table T3 (continued).

Age	Zone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Subbotina eocaena*	*Igorina broedermanni*	*Acarinina soldadoensis*	*Morozovella aequa*	*Pseudohastigerina wilcoxensis*	*Morozovella aragonensis*	*Acarinina soldadoensis angulosa*	*Eoglobigerina eobulloides*	*Igorina convexa*	*Planorotalites pseudomenardii*	Indeterminate spp.	Reworked
late Paleocene to Senonian	P4-?	13R-6, 111-115	835.51	B													
		13R-CC, 2-6	835.63	A	G												A
		13R-CC	835.75	A	P								C				A
Senonian (based on calcareous nannofossils)		14R-2, 0-4	838.10	A	G												A
		14R-2, 105-108	839.15	C	M											C	C
		14R-3, 96-100	840.56	F	M											F	
Senonian		14R-4, 17-21	841.27	C	M											C	C
		14R-4, 105-108	842.15	C	M											F	F
		14R-5, 17-19	842.77	C	P											C	
		14R-5, 120-123	843.80	B													
		14R-6, 4-7	844.14	B													
		14R-6, 65-68	844.75	B													
		14R-7, 11-14	845.21	B													
		14R-CC	845.68	C	P											C	
		15R-1, 12-16	846.42	B													
		15R-2, 21-25	848.01	B													
		15R-3, 14-18	849.44	C	P											C	
?	?	15R-4, 41-44	850.71	B													
		15R-5, 11-15	851.53	B													
		15R-CC		B													

Notes: Abundance: A = abundant, C = common, F = few, R = rare, B = barren. Preservation: G = good, M = moderately good, P = poor.

Table T4. Stratigraphic distribution of planktonic foraminifer taxa, Hole 1069A. (**See table notes.** Continued on next page.)

Age	Zone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Acarinina bullbrooki*	*Morozovella caucasica*	*Globigerinatheka senni*	*Subbotina eocaena*	*Igorina broedermanni*	*Subbotina frontosa*	*Morozovella aragonensis*	*Acarinina soldadoensis*	*Acarinina pentacamerata*	*Pseudohastigerina wilcoxensis*	*Morozovella aequa*	*Morozovella conicotruncata*	*Acarinina subsphaerica*	*Parvularugoglobigerina eugubina*	*Eoglobigerina eobulloides*	*Globoconusa daubjergensis*	*Globotruncana ventricosa*	*Heterohelix* spp.	*Rugoglobigerina* spp.	*Globotruncana* spp.	Indeterminate spp.	Reworked
		173-1069A-																								
		1R-1, 12-15	718.92	F	M	F	F																			
		1R-2, 11-15	720.41	R	M	R			R			R													R	
		1R-3, 0-4	721.80	R	M		R		R		R															
		1R-4, 12-15	723.12	B																						
mid to early Eocene	P10-P9	1R-CC	723.62	C	M			F		R		R													C	R
		2R-1, 68-72	729.08	B																						
		2R-2, 93-97	730.21	R	P				R																	
		2R-3, 86-91	731.64	B																						
		2R-CC	731.89	C	M	R	R	R	R	R															R	C
		3R-1, 68-72	738.78	R	P	R							R													
		3R-2, 35-40	739.95	R	M					F			R													
		3R-CC	741.63	R	P	R						R	R													
		4R-1, 7-10	747.77	R	M					R																
		4R-2, 45-48	749.65	F	M					F																
		4R-3, 33-35	751.03	B																						
		4R-CC	751.24	C	M	R						R	R	R												
		5R-1, 15-17	757.55	R	P				R																	
early Eocene	P9-P6	5R-2, 13-15	759.03	C	M	R	R					R														
		5R-CC, 7-11	759.48	R	P							R														
		5R-CC	759.55	A	P	R						R													A	C
		6R-1, 128-131	768.38	A	P				C	R				R												
		6R-2, 113-116	769.73	R	P																				R	
		6R-3, 109-112	777.19	B																						
		6R-4, 10-13	771.70	R	P								R													
		6R-5, 81-84	773.91	R	P							R				R										
		6R-CC	774.22	B																						
		7R-1, 1-4	776.81	B																						
		7R-2, 1-4	778.31	B																						
		7R-3, 11-15	779.91	R	P								R		R											
		7R-4, 7-11	781.37	B																						
		7R-5, 10-14	782.90	B																						
		7R-5, 20-25	783.00	R	P										R										F	
		7R-5, 84-88	783.64	R	P																				R	
		7R-CC	784.58	C	P											R									F	
late Paleocene	P5-P3	8R-1, 87-90	787.27	R	P																				R	
		8R-2, 42-47	788.32	B																						
		8R-3, 114-117	790.54	B																						
		8R-4, 46-50	791.36	R	P											R									F	
		8R-5, 63-66	793.03	B																						
		8R-CC	793.27	B																						
		9R-1, 87-92	796.87	R	P																				F	
		9R-2, 57-62	798.07	B																						
		9R-3, 47-52	799.47	R	P													Rw							R	
		9R-4, 101-105	801.51	R	P										Rw											
		9R-CC	801.88	A	P												R								A	
		10R-2, 3-7	807.13	B																						
		10R-3, 1-5	808.61	F	P																				F	
		10R-4, 1-5	810.11	R	M															R						
		10R-5, 1-7	811.61	B																						
		10R-6, 6-10	812.69	R	P																				R	
early Paleocene	P2-P0	10R-7, 84-88	813.74	F	M															F						
		10R-8, 6-12	814.46	F	P																				F	
		10R-CC	812.63	B																						
		11R-1, 97-101	816.27	R	P																R					
		11R-2, 93-97	817.73	B																						
		11R-3, 95-98	819.25	R	P																				R	
		11R-4, 100-104	820.80	B																						

Table T4 (continued).

Age	Zone	Core, section, interval (cm)	Depth (mbsf)	Abundance	Preservation	*Acarinina bullbrooki*	*Morozovella caucasica*	*Globigerinatheka senni*	*Subbotina eocaena*	*Igorina broedermanni*	*Subbotina frontosa*	*Morozovella aragonensis*	*Acarinina soldadoensis*	*Acarinina pentacamerata*	*Pseudohastigerina wilcoxensis*	*Morozovella aequa*	*Morozovella conicotruncata*	*Acarinina subsphaerica*	*Parvularugoglobigerina eugubina*	*Eoglobigerina eobulloides*	*Globoconusa daubjergensis*	*Globotruncana ventricosa*	*Heterohelix* spp.	*Rugoglobigerina* spp.	*Globotruncana* spp.	Indeterminate spp.	Reworked
early Paleocene	P2-P0	11R-CC, 11-14	821.06	R	P														R							R	R
		11R-CC	821.21	A	P																					A	A
		12R-1, 55-60	825.55	C	P																					R	C
		12R-2, 81-86	827.31	R	P																						R
		12R-3, 73-76	828.73	B																							
		12R-4, 128-132	830.78	B																							
		12R-5, 96-102	831.96	B																							
		12R-6, 52-56	833.02	B																							
		12R-CC	833.29	R	M												Cn	Cn		R							R
		13R-1, 42-46	835.12	A	M																						A
		13R-2, 92-96	837.12	A	M														F	F	F						A
		13R-3, 105-109	838.75	C	P																						C
		13R-4, 89-94	840.09	A	M																						A
		13R-5, 73-77	841.43	A	M														F								A
?	?	13R-CC	841.52	A	P																F						A
		14R-1, 4-8	844.44	B																							
Maastrichtian-Campanian		14R-2, 2-6	845.92	A	M																		C	C	R		
		14R-3, 1-4	847.41	B																							
		14R-4, 1-4	848.91	B																							
		14R-5, 1-5	850.41	B																							
		14R-6, 7-11	851.47	B																							
		14R-CC, 1-5	851.96	B																							
		14R-CC	852.09	R	P																	R					
		15R-1, 3-6	854.03	C	P																					C	
		15R-2, 11-15	855.61	B																							
		15R-3, 12-15	857.12	B																							
		15R-4, 1-3	858.51	R																		R				R	
		15R-CC	859.22	B																						R	

Notes: Abundance: A = abundant, C = common, F = few, R = rare, B = barren. Preservation: M = moderately good, P = poor. Rw = reworked. Cn = contamination.