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12. PLANKTONIC FORAMINIFER BIOSTRATIGRAPHY AND PALEOENVIRONMENTAL IMPLICATIONS OF LEG 152 SITES (EAST GREENLAND MARGIN)[1]

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ABSTRACT

Five sites and eight holes drilled on the East Greenland Margin during Ocean Drilling Program Leg 152 recovered Quaternary to middle Eocene sediments. Planktonic foraminiferal assemblages display generally low diversity; abundance and preservation varies from layer to layer. Several intervals devoid of planktonic foraminifers were identified in middle Miocene through Pliocene, lower upper Oligocene, and Eocene sediments. The more complete sedimentary sequence recovered at Site 918 spans the interval from the Quaternary to the middle Eocene. However, a major hiatus is recorded in the interval that spans the upper Eocene and the lower Oligocene. Two minor hiatuses occur in the lowermost Miocene and probably in the upper part of the middle Miocene, respectively.

Paleoclimatic interpretations based on species diversity, changes in assemblages, and comparison with the stable isotope record indicate that several alternating glacial-interglacial episodes occurred during the Pliocene and the Quaternary. These two intervals are, however, separated by a warmer episode in the early Pliocene. Cool conditions and glacial episodes also prevailed in the late Miocene, whereas a slight warming probably occurred in the middle Miocene. This period was, however, cooler than the late Oligocene, the early Miocene, and the middle Eocene. These latter intervals were characterized by a warmer climate as indicated by the presence of several warmer water taxa. The first occurrence of *Neogloboquadrina pachyderma* and the changes in coiling direction of *Neogloboquadrina atlantica* are also climatically controlled.

Comparison with previously drilled sites in the same area indicates that the short early Miocene hiatus and part of the hiatus spanning the late middle Eocene and the early Oligocene identified in Hole 918D may have interregional extensions in the North Atlantic Ocean.

INTRODUCTION

In this paper I study the biostratigraphy and the paleoenvironmental implications of Quaternary through middle Eocene planktonic foraminifers recovered from five sites and eight holes (914–916, 918, and 919) drilled in the North Atlantic Ocean during Ocean Drilling Program (ODP) Leg 152 (East Greenland Margin). Sites were drilled on the East Greenland shelf along an ideal north-northwest to south-southeast transect from the inner shelf (Sites 914–917) to the continental rise (Sites 918–919). Figure 1 shows the location of the sites drilled during Leg 152 and some of the sites previously drilled in the North Atlantic. Table 1 shows geographic coordinates, water depth, and penetration at each hole.

A Quaternary–Pliocene sequence was recovered from Hole 918A and at Site 919, whereas middle Miocene to upper Oligocene sediments were recovered in Hole 918D. Upper Eocene sediments were recovered in Holes 915A and 916A. The oldest sediments, based on planktonic foraminifers, are considered as early middle Eocene in age (Hole 918D).

In the northern Atlantic, extended sedimentary sequences were previously recovered during Deep Sea Drilling Project (DSDP) Legs 12, 48, 49, 81, and 94 and ODP Legs 104 (Norwegian Sea) and 105 (Baffin Bay and Labrador Sea). Berggren (1972), Poore (1979), Murray (1979), Krasheninnikov (1979), Spiegler and Jansen (1989), and Aksu and Kaminski (1989) described the planktonic foraminifers from these legs. Only Holes 407 and 408 (Leg 49) are close to the Leg 152 sites. A summary of the biostratigraphic data obtained and a correlation with some of the more representative sites drilled in the North Atlantic are reported below.

METHODS

The present study is based on 1–3 samples per section for each core. Only a few representative core catchers were included. Sample volume was about 10 cm^3. In case some specimens would prove suitable for isotope analyses, all samples were soaked in distilled water, washed through >40 µm sieve, and dried at room temperature. Samples were then dry-sieved through >40 µm, 40–150 µm, and >250 µm sieves to obtain three size fractions. They were then studied under a binocular microscope. The three size fractions were obtained to facilitate comparison with previous paleoclimatological studies (Haq et al., 1977; Premoli Silva and Boersma, 1989; Spezzaferri, 1994a). Abundances of single species, groups of species, and other components over total faunal content were estimated in each sample (see Appendix). These include biogenic remains (radiolarians, diatoms, sponge spicules, benthic foraminifers, ostracodes, mollusk and echinoid fragments, and fish remains) as well as inorganic components (red clay, quartz, glauconite, oxides, pyrite, tephra, and dropstones). Seven categories are distinguished and plotted in the range charts. They are VR: very rare (1–3 specimens per sample), R: rare (<10 specimens), C: common (10–30 specimens), A: abundant (30–50 specimens), VA: very abundant (about 50–70 specimens), D: dominant (more than 70 specimens), X: simple occurrence. Planktonic foraminiferal preservation was graded with the following scale: VP: very poor preservation, P: poor preservation, M: moderate preservation, and G: good preservation (Larsen, Saunders, Clift, et al., 1994). Species diversity was estimated counting the number of species present in each sample.

The range charts report only samples containing planktonic foraminiferal faunas. However, a large number of the studied samples

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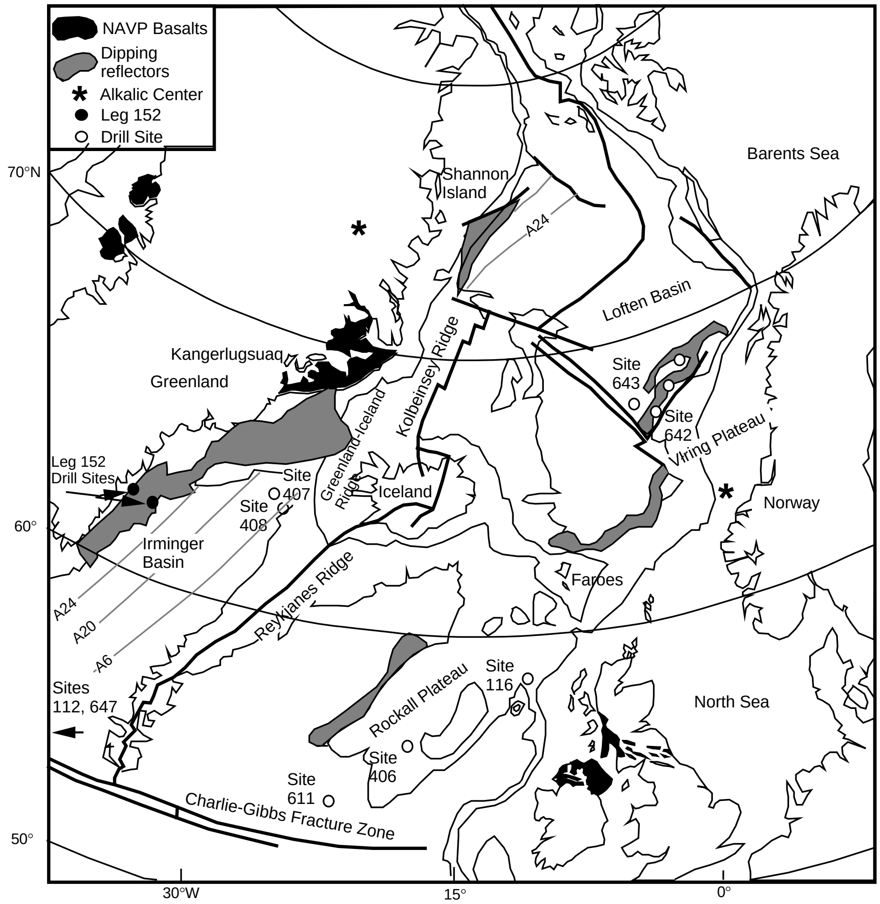

Figure 1. Location map of Leg 152 East Greenland Margin sites and of Sites 407 and 408 (East Greenland), 112 and 647 (Labrador Sea), 642 and 643 (Vøring Plateau), 116 and 406 (Rockall Plateau), and 611 (Rockall Trough).

Table 1. Geographic coordinates, water depth, and depth penetration of holes drilled during Leg 152.

Hole	Latitude	Longitude	Water depth (m)	Penetration (m)
914A	63°27.738′N	39°43.489′W	533.2	18.6
914B	63°27.737′N	39°43.482′W	533.2	245.0
915A	63°28.285′W	39°46.909′W	533.1	209.4
916A	63°29.137′N	39°48.400′W	513.7	101.7
918A	63°5.569′N	38°38.336′W	1868.5	332.7
918D	63°5.572′N	38°38.334′W	1868.2	1310.1
919A	62°40.20′N	37°27.611′W	2088.2	93.5
919B	62°40.201′N	37°27.618′W	2086.0	147.9

were devoid of planktonic faunas. All the studied samples, including those barren of planktonic faunas and the other organic and inorganic components, are listed in the Appendix.

PLANKTONIC FORAMINIFER BIOSTRATIGRAPHY

Preliminary investigations were conducted on board; data for each hole are included in Larsen, Saunders, Clift, et al. (1994). This chapter mainly deals with the major characteristics of planktonic foraminiferal assemblages, stratigraphic distribution, intensity of dissolution and/or displacement at each site, and paleoenvironmental implications in the North Atlantic.

The detailed study of planktonic foraminiferal faunas revealed that the Quaternary–Pliocene sediments were sometimes redeposited and planktonic faunas were affected by reworking (Holes 918A, 919A, and 919B). The assemblages generally show low diversity, as is expected at high latitudes. Preservation and degree of recrystallization vary from good to very poor.

Miocene faunas are apparently less affected by reworking (Hole 918D). They are generally richer and more diversified and reflect warmer water conditions. Their preservation, however, is poor to very poor. Most of the specimens are deformed, and wall textures do not retain the original pattern.

Upper Oligocene planktonic foraminifers are very rare, very poorly preserved, and often they cannot be identified (Hole 918D). Eocene planktonic faunas fluctuate in abundance and preservation from layer to layer. The assemblages are richer and well diversified in sediments with high red clay content, whereas planktonic foraminifers are totally absent in sediments rich in glauconite and/or quartz (Holes 915A, 916A, and 918D).

The zonation of Spiegler and Jansen (1989) is applied to the high latitude Quaternary–Pliocene assemblages. The zonations of Blow (1969, 1979) and Spezzaferri (1994b) are applied to the Miocene and Eocene, and Oligocene and early Miocene faunas, respectively. However, since most of the Oligocene and Miocene markers are missing, zonal attribution is often based on the entire assemblage and/or second order events, rather than on the first and last occurrence and/or presence of markers. Figures 2 and 3 show the main bioevents identified in this study, together with those of Spiegler and Jansen (1989) and some of the standard bioevents used to mark zonal boundaries at low and middle latitudes (Blow, 1979, with modification from Spezzaferri, 1994b; and Premoli Silva, pers. comm., 1995). They are plotted vs. the Geomagnetic Polarity Time Scale of Cande and Kent (1992) modified according to Cande and Kent (1995).

The events used for identifying the Oligocene and Miocene zonal boundaries or zones are (from oldest to youngest):

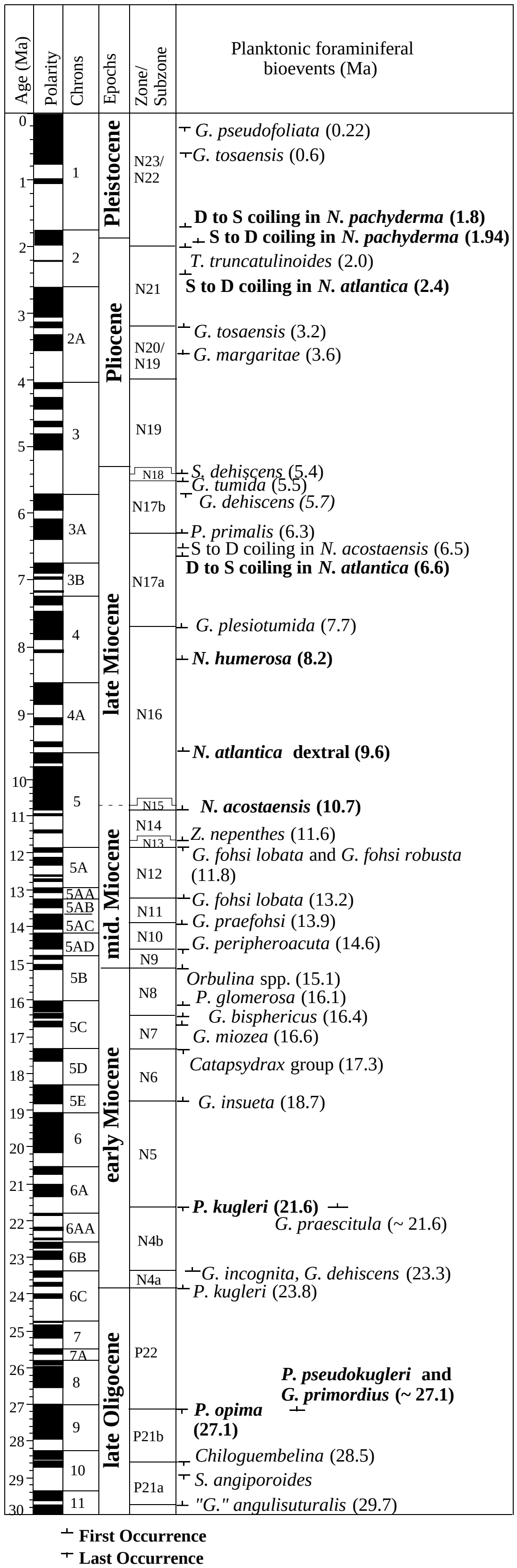

Figure 2. Summary of the Neogene bioevents identified in this study (in bold) plotted vs. some of the standard bioevents used at low and middle latitudes (from Larsen et al., 1994, modified by Spezzaferri, 1994b, and Premoli Silva, pers. comm., 1995). Geomagnetic Polarity Time Scale from Cande and Kent (1992) modified according to Cande and Kent (1995).

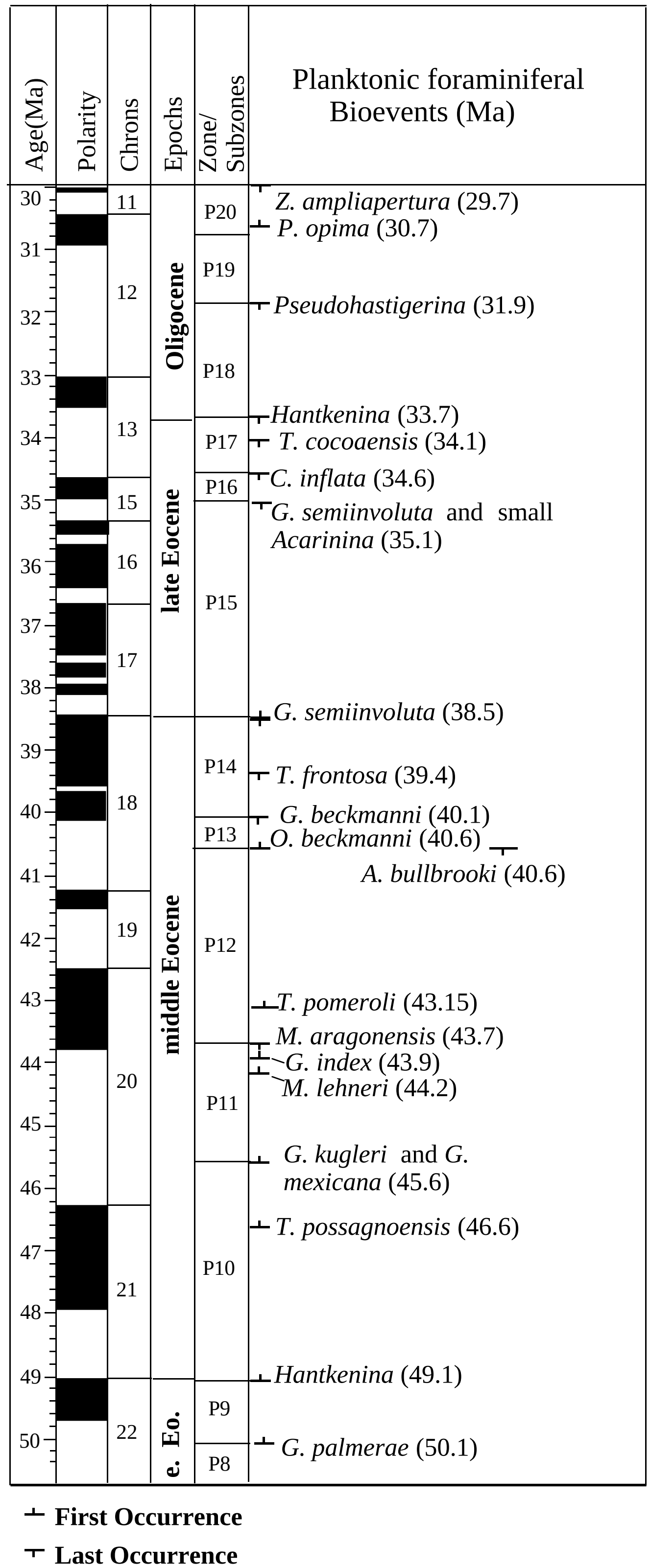

Figure 3. Summary of the Paleogene standard bioevents used at low and middle latitudes. In this study zonal attribution is based on the entire assemblage and/or second order events, rather than on the first and last occurrence and/or presence of markers.

1. The occurrence of *Chiloguembelina cubensis* and *Paragloborotalia opima* allows the identification of Zone P21, late Oligocene; however, the two Subzones P21a and P21b cannot be separated due to the scarcity of the specimens.
2. The occurrence of *Paragloborotalia pseudokugleri* is equated to Zone P22, late Oligocene.
3. The co-occurrence of *Paragloborotalia kugleri, Globigerinoides* spp., and *Globoquadrina dehiscens* allows identification of Subzone N4b, early Miocene.
4. The LO (last occurrence) of *P. kugleri* marks the top of Biozone N4b, early Miocene.
5. The occurrence of *Catapsydrax dissimilis* in the absence of *P. kugleri* is here used to identify the interval including Zones N5–N6, early Miocene. The two zones, however, cannot be separated.
6. The LO of *Catapsydrax dissimilis* and the FO (first occurrence) of *Globigerinoides bisphericus* and *Praeorbulina transitoria* mark the base and the top of Zone N7, respectively, early Miocene.
7. The presence of *Globorotalia scitula* allows the tentative identification of Zone N9, middle Miocene.
8. The LO of *Praeorbulina glomerosa* indicates the upper boundary of Zone N9, middle Miocene.
9. The occurrence of *Globorotalia* cf. *suterae,* sensu Poore (1979), indicates the interval from Zone N9 through N14, middle Miocene. Single biozones cannot be identified.
10. The presence of *Neogloboquadrina acostaensis* is here used to identify Zone N16 (Blow, 1979) = *N. acostaensis* Zone (Spiegler and Jansen, 1989). However, the lower and upper boundaries of this interval were not observed.

SITE DESCRIPTIONS

Site 914

Site 914 is located on the East Greenland Shelf, approximately 60 km from the coast. Three holes were drilled at this site, with recovery from the first two holes only. The advanced piston corer (APC) was used at Hole 914A. Two cores were recovered with a core recovery of 63.9%. Hole 914B was drilled down to 93.8 meters below seafloor (mbsf) and then cored by rotary core barrel (RCB) to 245 mbsf. Seventeen cores were retrieved from this hole with an average core recovery of 11.8%.

Sediments at Site 914 consist of Quaternary glaciogenic deposits overlying lower Oligocene–upper Eocene mixed volcaniclastic and siliciclastic shelf deposits.

Planktonic foraminifers are generally present in Hole 914A. The assemblages are diverse, abundant, and well preserved in the first 35 cm, then diversity, abundance, and preservation diminish to very rare and poor, respectively. The list of the identified species is reported in Table 2. Cores 152-914A-1H and 2H and 152-914B-7R are attributed to the *Neogloboquadrina pachyderma* sinistral Zone (Pleistocene). In some intervals this species occurs together with *N. pachyderma* dextral, *Neogloboquadrina dutertrei, N. acostaensis, Globigerina bulloides, G. scitula,* and *G. inflata.* Together, these species are interpreted as a warmer assemblage, typical of some interglacial stages (Aksu et al., 1989). This assemblage is hereafter referred to as a "warmer assemblage."

Zonal attribution is not possible from Samples 152-914A-15R-1, 50–52 cm, through 17R-5, 89–91 cm, which are devoid of planktonic foraminifers. Only a few specimens of *Neogloboquadrina pachyderma* sinistral were found in Hole 914B (see Appendix Table 1).

Site 915

Site 915 is located on the East Greenland Shelf approximately 58 km from the coast. A single hole was drilled at this site. The RCB was used throughout 209.4 mbsf, and 26 cores were retrieved with an average core recovery of 15.7%. The sedimentary sequence at this site consists of Pleistocene to Holocene glaciomarine mud and sand with dropstones overlying middle and upper Eocene volcaniclastic silty sandstone and silty siltstone with interbeds of calcareous mudstone and sandstone.

Planktonic foraminiferal assemblages are abundant to rare with moderate preservation in the Pleistocene to Holocene sediments, and very rare and poorly preserved in the Eocene (Table 3).

Samples 152-915A-1R-1, 0–2 cm, and 1R-1, 61–63 cm, contain *N. pachyderma* sinistral plus the "warmer assemblage" and are attributed to the *N. pachyderma* sinistral Zone (Pleistocene). In the sequence below, only Samples 152-915A-15R-CC and 16R-1, 123–125 cm, contain planktonic foraminifers. The occurrence of *Chiloguembelina cubensis* and *"Globoquadrina" tapuriensis* in the

Table 2. Stratigraphic ranges of selected Pleistocene planktonic foraminifers in Hole 914A.

152-914A Core, section, interval (cm)	Pl. foram. assembl.	*N. pachyderma* sinistr.	*N. pachyderma* dextr.	*Tenuitellinata* sp.	*T. quinqueloba*	*G. juvenilis*	*G. bulloides*	*N. dutertrei*	*G. vivans*	*T. anfracta*	*H. riedeli*	*G. glutinata*	*N. acostaensis*	*G. uvula*	*G. conglomerata*	*G. inflata*	Zones	Age
1H-1, 0-2	W	A	C	R	C	C	C	C	-	-	-	C	-	R	R	R	*N. pachyderma* sinistral	**Pleistocene**
1H-1, 33-35	W	A	R	R	C/R	C	C	C/R	VR	VR	VR	R/C	R	VR				
1H-1, 95-97		X	-	X	-	X												
1H-2, 83-85		X	-	-	-													
1H-2, 96-98		X	-	X	-													
1H-2, 135-137		X	-	-	-													
1H-3, 95-97		X	-	-	-													
2H-1, 26-28		X	-	X	-													
2H-1, 32-35		X	VR	-	-													
2H-3, 134-136		X	-	-	-													
2H-4, 34-36		X	-	X	-													
2H-5, 62-64		X	-	-	-													
2H-6, 13-15		X	VR	X	cf													

Notes: W = warm assemblage, VW = very warm assemblage. VR = very rare (1–3 specimens), R = rare (< 10 specimens), C = common (10–30 specimens), A = abundant (30–50 specimens), VA = very abundant (about 50–70 specimens), D = dominant (more than 70 specimens), X = simple occurrence, dash = not present.

Table 3. Stratigraphic ranges of selected Pleistocene and upper Eocene planktonic foraminifers in Hole 915A.

152-915A Core, section, interval (cm)	Barren Samples	Pl. foram. assembl.	*Z. ampliapertura*	*"G." venezuelana*	*C. martini*	*C. unicavus*	*G. variabilis*	*"G." tapuriensis*	*Chiloguembelina* sp.	*Globorotaloides* sp. 1	*N. pachyderma* sinistr.	*N. pachyderma* dextr.	*Tenuitellinata* sp.	*N. acostaensis*	*G. bulloides*	*T. quinqueloba*	*G. juvenilis*	*N. humerosa*	*G. scitula*	*N. dutertrei*	*G. glutinata*	*G. uvula*	*T. minutissima*	*G. inflata*	*G. conglomerata*	Zones	Age
1R-1, 0-2		W									X	X	-	-	X	X	X	-	-	X	X	-	-	X	X	*N. pachy.* sinistral	**Pleist.**
1R-1, 61-63		W	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X				
15R-CC			-	-	-	-	-	X	X	X																upper Zone P17	**late Eoc.**
16R-1, 9-11	1		-	-	-	-	-																				
16R-1, 123-125			X	X	X	X	X																				
18R-1, 96-98 to 22R-3, 22-24	12																										**?**

Note: Abbreviations defined in Table 2.

former allows its assignment to the upper part of Zone P17 (upper Eocene).

Site 916

Site 916 is located on the East Greenland Shelf, approximately 50 km from the coast. Only one hole was drilled at this site with the RCB system, down to 102 mbsf. Fifteen cores were recovered with an average core recovery of 16.6%. The sedimentary sequence consists of Quaternary glaciomarine sediments and diamicton overlying volcaniclastic sandy silt with interbeds of silty sand. Abundance and preservation of planktonic foraminifers decrease from rare and moderate in the Pleistocene to very rare and poor in the Eocene (Table 4).

Sample 152-916A-5R-1, 61–63 cm, is assigned to the *N. pachyderma* sinistral Zone. The occurrence of *Subbotina linaperta* in Sample 152-916A-13R-3, 49–50 cm, allows identification of the interval spanning Zone P15 to lower P17 (late Eocene).

Table 4. Stratigraphic ranges of selected Pleistocene and upper Eocene planktonic foraminifers in Hole 916A.

152-916A Core, section, interval (cm)	Barren Samples	*Globorotaloides* sp. 1	*S. eocaena*	*C. unicavus*	*S. linaperta*	*"G." venezuelana*	*G. variabilis*	*G. glutinata*	*Tenuitellinata* sp.	*N. pachyderma* dextr.	*N. pachyderma* sinistr.	Zones	Age
5R-1, 61-63		-	-	-	-	-	-	X	X	X	X	*N. pachy.* sin.	**Pleist.**
13R-1, 68-69	B	-	-	-	-	-	-	-	-	-	-	— —?— —	**—?—**
13R-2, 54-55		-	-	-	-	VR	VR					P15- lower P17	**late Eoc.**
13R-3, 49-50		VR	VR	VR	VR								

Note: Abbreviations defined in Table 2.

Site 918

Site 918 is located near the center of the seaward-dipping reflector sequence (SDRS) on the upper continental rise of the southeast Greenland Margin, approximately 130 km from the coast. Four holes were drilled at this site. Holes 918B and 918C were abandoned, however, because of drilling problems.

Thirty-eight cores were recovered in Hole 918A with an average core recovery of 78.2%. The APC was used to 171.3 mbsf. The extended core barrel (XCB) was used down to 332.7 mbsf. The sedimentary sequence spanning the interval from Pliocene to Holocene consists of glaciomarine, dark gray silt with volcaniclastic and continental derived components.

Pliocene to Holocene sediments yield generally abundant, rich, and well preserved planktonic foraminiferal assemblages. Abundance, however, fluctuate from level to level and decrease from the top to the bottom of the sequence. Planktonic faunas are rarer and often absent from Core 152-918A-16R to the bottom of the hole. Although several intervals with turbidites were observed, foraminiferal assemblages do not show clear evidence of reworking at this site. The main planktonic foraminiferal bioevents are reported in the range chart and the biostratigraphic log together with the occurrence of the "warmer assemblage" and species diversity trends (Fig. 4; Table 5).

Samples 152-918A-1H-1, 45–47 cm, through 9H-7, 48–50 cm (from the surface down to 77.02 mbsf), are attributed to the *N. pachyderma* sinistral Zone (Pleistocene). Several and sometimes relatively extended intervals with the "warmer assemblage" are identified in this zone.

The upper *Neogloboquadrina atlantica* dextral Zone (Pliocene) is identified only in this hole, from 79.02 to 81.68 mbsf (Samples 152-918A-10H-1, 122–124 cm, through 10H-3, 88–90 cm). The *Neogloboquadrina atlantica* sinistral Zone (Pliocene) is identified from 81.68 to 320.55 mbsf (Samples 152-918A-10H-4, 87–98 cm, to 37H-6, 10–12 cm). Several intervals with the "warmer assemblage" are identified and are often associated with *N. atlantica* dextral.

Hole 918D was drilled from the seafloor to 253.2 mbsf, and from 279.9 to 324 mbsf. A total of 113 RCB cores was recovered in this hole with an average core recovery of 25.1%. One of the more complete sedimentary records of the North Atlantic was recovered in this hole (Fig. 5). However, a major unconformity truncated the sequence in the middle Eocene (Zone P12) at the top of Core 152-918D-88R, which is overlain by upper Oligocene sediments belonging to Zone P21.

Minor hiatuses probably span the interval from the upper part of Zone P22 (late Oligocene) to the lower part of Subzone N4b (early Miocene) as well as the upper part of the middle Miocene.

Species diversity is commonly very low throughout the Pliocene and upper and middle Miocene sequences. It markedly increases in the lower Miocene and in part of the Oligocene interval (Tables 6–8). Assemblages are rich and well diversified in the middle Eocene sediments containing high abundance of red clay.

Generally scarce and moderately to poorly preserved Pliocene assemblages belonging to the *N. atlantica* sinistral Zone were identified from Samples 152-918D-11R-1, 81–83 cm, through 24R-2, 68–70 cm (386.91–505.38 mbsf). At the beginning of its range, *N. atlantica* sinistral is associated with relatively abundant and large specimens of *O. universa* (Fig. 5).

Sample 152-918D-24R-2, 120–122 cm, is difficult to assign to the biozones above and below because both *N. atlantica* sinistral and dextral are absent. However, based on the *Bolboforma* biostratigraphy, it may belong to the late Miocene *N. atlantica* dextral Zone (Spezzaferri and Spiegler, this volume). This late Miocene zone is identified from Sample 152-918D-24R-3, 26–28 cm, through 36R-3, 123–126 cm (506.27–621.63 mbsf).

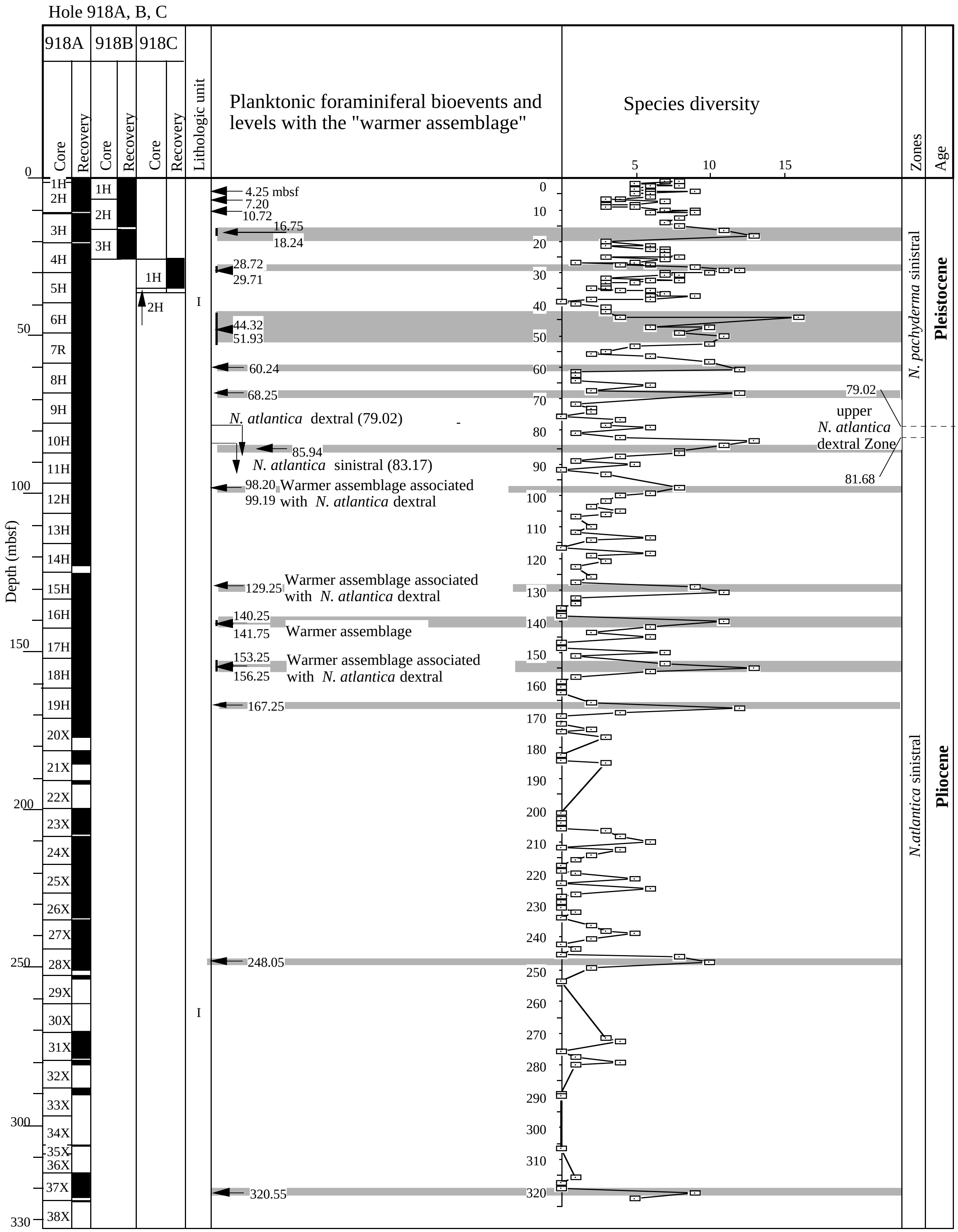

Figure 4. Main planktonic foraminifer bioevents in Holes 918A, 918B, and 918C, plotted vs. biozone assignments and species diversity trends. Arrows, horizontal bands, and/or vertical bold lines indicate the intervals of occurrence of the relatively warmer assemblages consisting of *N. dutertrei, N. acostaensis, N. humerosa, G. juvenilis, G. glutinata, G. bulloides, T. quinqueloba, G. scitula,* and *G. inflata*

Table 5. Stratigraphic ranges of selected Pleistocene and Pliocene planktonic foraminifers in Hole 918A.

152-918A Core, section, interval (cm)	Barren Samples	Pl. foram. assembl.	*G. bulloides*	*N. atlantica* sin.	*G. juvenilis*	*T. quinqueloba*	*G. glutinata*	*"G." venezuelana*	*G. scitula*	*N. pachyderma*	*Neogloboquadrina* spp.	*N. acostaensis*	*N. humerosa*	*Tenuitellinata*	*G. obesa*	*Tenuitella* sp.	*G. uvula*	*N. dutertrei*	*G. inflata*	*G. falconensis*	*N. atlantica* dex.	*Globigerina* sp. A	*G. rubescens*	*S. globigerum*	*N. pachyderma*	*T. minutissima*	*G. conglomerata*	*N. praehumerosa*	*G. tehyeri*	*G. ruber*	*T. iota*	Zones	Age
1H-1, 45-47			X	-	-	X	X	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	X		
1H-2, 19-21			X	-	-	X	X	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-1, 11-13			X	-	-	X	X	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-1, 46-48		?	X	-	-	A	X	-	-	X	-	-	X	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-1, 95-97			-	-	-	X	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-2, 10-12			-	-	-	X	-	-	-	X	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-		
2H-2, 44-46			-	-	-	X	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-2, 95-97		W	-	-	-	X	-	-	-	X	-	X	X	X	-	-	-	X	R	-	-	-	-	-	X	X	-	-	-	-	-		
2H-3, 10-12			-	-	-	X	-	-	-	X	-	-	X	R	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-3, 45-47			-	-	-	X	-	-	-	X	-	-	X	X	-	-	-	R	-	-	-	-	-	-	R	-	-	-	-	-	-		
2H-3, 95-97			X	-	-	-	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-4, 16-18		W?	-	-	-	-	-	-	-	X	-	VR	-	-	-	-	-	X	VR	-	-	-	-	-	-	-	-	-	-	-	-		
2H-4, 45-47			-	-	V	-	-	-	-	VR	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-4, 95-97		W	-	-	R	X	-	-	-	X	-	X	-	R	cf	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	-		
2H-5, 17-19			-	-	-	-	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-5, 45-47			-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	V	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-5, 96-98			-	-	-	X	-	-	-	X	-	-	X	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-6, 19-21			-	-	X	X	-	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-6, 41-43			X	-	X	X	-	-	-	X	-	X	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-6, 96-98			X	-	X	X	X	-	-	X	-	-	X	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-7, 19-21			X	-	-	-	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-	R	-	-	X	-	-	-		
2H-7, 42-44			X	-	X	X	-	-	X	A	-	-	X	X	-	-	-	X	-	-	-	-	R	-	-	-	-	-	-	-	-		
3H-2, 30-32			X	-	-	-	-	-	-	X	-	X	X	X	R	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-		
3H-3, 28-30			X	-	-	X	-	-	-	X	-	-	X	VR	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	-		
3H-4, 30-32			X	-	-	X	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-		
3H-5, 30-32		W	X	-	X	X	X	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	R	VR	-	-	-	-	-		
3H-6, 29-31		W	X	-	X	X	VR	-	VR	X	-	X	X	X	-	-	X	X	-	-	-	-	-	-	VR	X	-	-	-	-	-		
3H-7, 29-31			-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	-	-		
4H-1, 42-44			-	-	-	X	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
4H-1, 95-97			-	-	V	-	-	-	-	C	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-		
4H-1, 141-143			-	-	R	-	-	-	-	X	-	X	-	X	X	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-		
4H-2, 42-44			-	-	-	X	-	-	-	X	-	R	X	C/A	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	-		
4H-2, 95-97			-	-	-	X	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	-		
4H-2, 141-143			X	-	X	X	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-		
4H-3, 42-44			-	-	-	-	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	R	X	-	-	-	-	-		
4H-3, 95-97			X	-	-	-	X	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-		
4H-3, 140-142			-	-	-	-	-	-	-	X	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-		
4H-4, 42-44			-	-	-	-	-	-	-	X	-	X	X	X	cf	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-		
4H-4, 95-97			-	-	-	X	-	-	-	X	-	-	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
4H-4, 140-142			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
4H-5, 42-44			-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-		
4H-5, 96-98			-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	-		
4H-5, 140-142		W?	-	-	X	X	-	-	-	X	-	X	X	-	X	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-		
4H-6, 42-44		W	X	-	X	X	-	-	X	A	-	X	X	X	X	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	*N. pachyderma* sinistral	**Pleistocene**
4H-6, 96-98		W?	X	-	-	X	-	-	-	X	-	X	X	X	X	-	X	X	-	-	-	-	-	-	-	X	-	X	-	-	-		
4H-6, 141-143		W	X	-	-	X	X	-	X	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-		
4H-7, 41-43			-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-		
5H-1, 14-16			X	-	-	X	-	-	-	X	-	X	X	X	VR	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
5H-1, 69-61		W?	X	-	X	X	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-		
5H-1, 120-122			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	-		
5H-2, 14-16		W?	X	-	-	X	-	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-		
5H-2, 69-71			-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	R	X	-	-	-	-	cf		
5H-2, 120-122			X	-	-	R	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-			
5H-3, 14-16			-	-	-	-	-	-	-	X	-	R	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-			
5H-3, 69-71			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-			
5H-3, 120-122			VR	-	-	VR	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
5H-4, 14-16			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-			
5H-4, 69-71			-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	X	-	-			
5H-4, 120-122			-	-	X	-	-	-	-	X	-	X	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-			
5H-5, 14-16			-	-	-	X	-	-	-	C	-	X	-	-	-	-	-	X	-	-	-	-	-	-	R	X	-	X	-	-			
5H-5, 69-71		W?	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	R	-	-	R	-	-			
5H-5, 120-122		W?	R	-	X	-	-	-	-	X	-	R	R	X	-	-	-	X	-	-	-	-	-	-	R	X	-	-	-	-			
5H-6, 14-16			-	-	X	VR	X	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-			
5H-6, 69-71			-	-	-	VR	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
5H-6, 120-122	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
5H-7, 14-16			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
6H-1, 54-56			-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-			
6H-2, 118-120			-	-	-	X	-	-	-	C	-	-	-	-	-	-	-	C	-	-	-	-	-	-	-	-	-	-	-	-			
6H-3, 109-111			-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-			
6H-4, 2-5		W	X	-	X	X	X	-	X	X	-	X	X	-	X	-	X	X	X	-	-	-	-	-	C	X	cf	-	-	X			
6H-5, 145-147		W	X	-	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	X	-	-	-				
6H-6, 21-23		W	X	-	-	X	-	-	cf	X	-	X	X	-	-	-	-	X	R	-	-	-	-	-	-	X	-	X	-				
6H-7, 34-36		W	VR	-	X	X	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	R	X	-	-	-				
7H-1, 48-50		W	X	-	X	X	-	-	-	X	X	X	-	-	-	-	X	X	X	-	-	-	-	-	-	X	-	X	-				
7H-2, 113-115		W?	R	-	-	X	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	X	X	X	X	-				
7H-3, 79-81			-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	R	X	-	-	-				
7H-4, 106-108			-	-	-	-	-	-	-	C	-	-	-	-	-	-	-	-	-	-	-	-	-	X	R	-	-	-	-				
7H-5, 59-61			-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
7H-6, 126-128			-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	R	X	-	-	-				
7H-7, 12-14			-	-	X	X	X	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	VR	R	X	-	X	-				
8H-1, 144-146		W?	-	-	X	X	X	-	-	X	-	X	-	X	R	-	X	X	-	-	-	-	-	-	X	X	-	X	-				
8H-2, 82-84			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
8H-3, 4-6			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
8H-4, 40-42			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
8H-5, 111-113			-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	VR	X	-	X	-				
8H-6, 47-49			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-				
8H-7, 45-47		W	X	-	X	X	-	-	X	X	-	X	X	-	-	-	X	X	-	-	-	-	-	-	VR	X	-	-	V				
9H-2, 133-135			-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R				
9H-3, 141-143			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-					
9H-4, 59-61			-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
9H-5, 121-123	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
9H-6, 72-74			-	-	V	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-					
9H-7, 48-50			-	-	R	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-					
10H-1, 122-124		W?	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	X				*N. atlantica* dex.	
10H-2, 133-135			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-					
10H-3, 88-90			-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	R	-	-	X					
10H-4, 87-89			-	X	X	X	-	-	-	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	X	X	-	X				*N. atlantica* sin.	**Pliocene**
10H-5, 54-56		?	-	X	X	X	X	-	-	X	-	X	X	X	-	-	-	X	-	-	-	-	-	-	-	X	X						
10H-6, 64-65		W	-	X	X	-	-	-	X	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	X	X							
10H-7, 14-16			X	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	VR							

Table 5 (continued).

152-918A Core, section, interval (cm)	Barren Samples	Pl. foram. assembl.	*G. bulloides*	*N. atlantica* sin.	*G. juvenilis*	*T. quinqueloba*	*G. glutinata*	*"G." venezuelana*	*G. scitula*	*N. pachyderma* sin.	*Neogloboquadrina* spp.	*N. acostaensis*	*N. humerosa*	*Tenuitellinata* sp.	*G. obesa*	*Tenuitella* sp.	*G. uvula*	*N. dutertrei*	*G. inflata*	*G. falconensis*	*N. atlantica* dex.	*Globigerina* sp. A	*G. rubescens*	*S. globigerum*	*N. pachyderma* dex.	*T. minutissima*	Zones	Age
11H-1, 41-43			-	cf	-	-	-	-	-	X	-	-	-	-	cf	-	-	-	-	-	-	-	-	-	-	X	*N. atlantica* sinistral	**Pliocene**
11H-2, 81-83			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11H-3, 39-41			-	R	-	cf	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-		
11H-4, 40-42	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11H-5, 40-42			-	-	-	cf	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-		
12H-1, 140-142		W	-	cf	X	X	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	X	X	X		
12H-2, 89-91		W?	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	R	X		
12H-3, 68-70			-	-	-	-	-	-	R	X	-	-	-	-	-	-	-	-	-	-	-	-	R	-	R	-		
12H-4, 85-87			-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-		
12H-5, 86-88			-	-	-	-	-	-	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-		
12H-6, 80-82			-	-	-	-	-	-	-	R	-	-	-	X	-	-	-	-	-	-	-	-	-	-	R	X		
12H-7, 46-48			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	X		
13H-1, 96-98			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13H-3, 95-97			-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13H-4, 94-96			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13H-5, 95-97			-	X	-	-	-	-	-	X	-	X	X	-	-	-	X	-	-	-	-	-	-	-	VR	-		
13H-6, 95-97			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-		
14H-1, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14H-2, 95-97			-	X	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	X	-		
14H-3, 78-80			-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14H-4, 95-97			-	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14H-5, 95-97			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
15H-1, 95-97			-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
15H-2, 95-97			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
15H-3, 95-97		W	-	-	X	X	-	-	X	X	-	X	-	-	-	-	X	cf	-	-	VR	-	-	-	VR	-		
15H-4, 95-97			-	X	X	X	X	-	-	X	-	X	-	X	X	-	X	-	-	-	-	-	-	-	X	X		
15H-5, 95-97			-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
16H-1, 95-97			-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
16H-2, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
16H-3, 95-97			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
16H-4, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
16H-5, 95-97		W	VR	X	X	X	-	-	-	X	X	X	cf	X	-	-	X	-	-	-	-	-	-	-	X			
16H-6, 95-97		W	-	cf	X	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R			
17H-1, 95-97			-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR			
17H-2, 95-97			-	X	-	X	-	-	-	A	-	-	-	X	VR	-	-	-	-	-	-	-	-	-	X			
17H-3, 96-98 to 17R-4, 96-98	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
17H-5, 95-97			-	X	X	X	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X				
17H-6, 95-97			-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
18H-1, 95-97		W	-	X	X	X	-	-	X	X	-	-	-	-	-	-	X	-	-	-	X	-	-					
18H-2, 95-97		W	-	X	X	X	X	-	-	X	X	X	X	X	-	X	-	X	-	-	-	X	cf					
18H-3, 95-97			-	X	X	X	-	-	-	X	-	X	-	-	-	-	-	-	-	-	X							
18H-4, 95-97			-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
18H-5, 95-97 to 19R-1, 95-97	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
19H-3, 95-97			-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-								
19H-4, 95-97		W?	X	X	X	X	X	-	-	X	X	X	-	X	-	X	C	X	-	-								
19H-5, 95-97			-	-	-	X	-	-	-	-	X	-	-	-	-	X	-	-	-	-								
19H-6, 95-97 to 20H-1, 95-97	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
20H-1, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
20H-2, 105-107			-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	cf	-								
20H-3, 94-96	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
20H-4, 93-95			-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-								
21H-1, 97-99 to 21H-2, 114-116	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
21H-3, 46-48			-	-	X	X	-	-	-	VR	-	-	-	-	-	-	-	-	-	-								
23H-1, 94-96 to 23H-4, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
23H-5, 94-96		W?	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	cf	-								
23H-6, 95-97			-	-	X	X	-	-	-	-	-	-	-	-	-	X	X	-	-	-								
24H-1, 96-98		W	-	-	X	X	-	-	X	-	X	-	-	-	-	X	-	-	X	-								
24H-2, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
24H-3, 93-95			X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-								
24H-4, 94-96			-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
24H-5, 92-94			-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
24H-6, 95-97 to 25H-1, 96-98	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
25H-2, 94-96			-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
25H-3, 94-96		W?	-	-	X	X	-	-	-	VR	-	-	-	-	-	-	-	-	cf	X								
25H-4, 94-96	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
25H-5, 94-96		W	X	-	X	X	-	-	-	X	-	-	-	-	-	-	X	-	X									
25H-6, 94-96			-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-										
26H-1, 95-97 to 26H-3, 96-97	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
26H-4, 95-97			-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-										
26H-5, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
27H-1, 105-107			-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-										
27H-2, 95-97		W?	-	-	X	X	-	-	-	-	-	-	-	-	-	X	-	-										
27H-3, 95-97			-	X	-	X	-	-	-	X	X	X	-	-	-	-	-	-										
27H-4, 95-97			-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-										
27H-5, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
27H-6, 94-96			-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-										
28H-1, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
28H-2, 96-98			-	X	-	X	X	-	-	X	X	X	X	X	-	-	-	-										
28H-3, 95-97		W?	-	X	X	X	X	-	-	X	-	X	X	-	X	-	X	X										
28H-4, 97-99			-	-	X	-	-	-	-	-	-	X	-	-	-	-												
29H-1, 97-99	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-												
31H-1, 95-97			-	-	-	X	-	-	-	-	-	-	-	X	-	X												
31H-2, 95-97			-	-	-	X	-	-	-	X	-	-	-	X	X													
31H-4, 95-97	1		-	-	-	-	-	-	-	-	-	-	-															
31H-5, 95-97			-	-	-	-	-	-	-	-	-	-	-															
31H-6, 95-97			-	-	-	-	-	-	-	X	X	X	X															
32H-1, 96-98			-	-	X	-	-	-	-	-	-																	
33H-1, 94-96 to 35H-1, 31-33	3		-	-	-	-	-	-	-	-	-																	
37H-1, 95-97			-	X	-	-	-	-	-	-	-																	
37H-2, 89-91 to 37H-3, 95-97	2		-	-	-	-	-	-	-	-	-																	
37H-4, 95-97		W	X	X	X	X	X	X	X	X	X																	
37H-6, 10-12			X	X	X	X	X																					

Note: Abbreviations defined in Table 2.

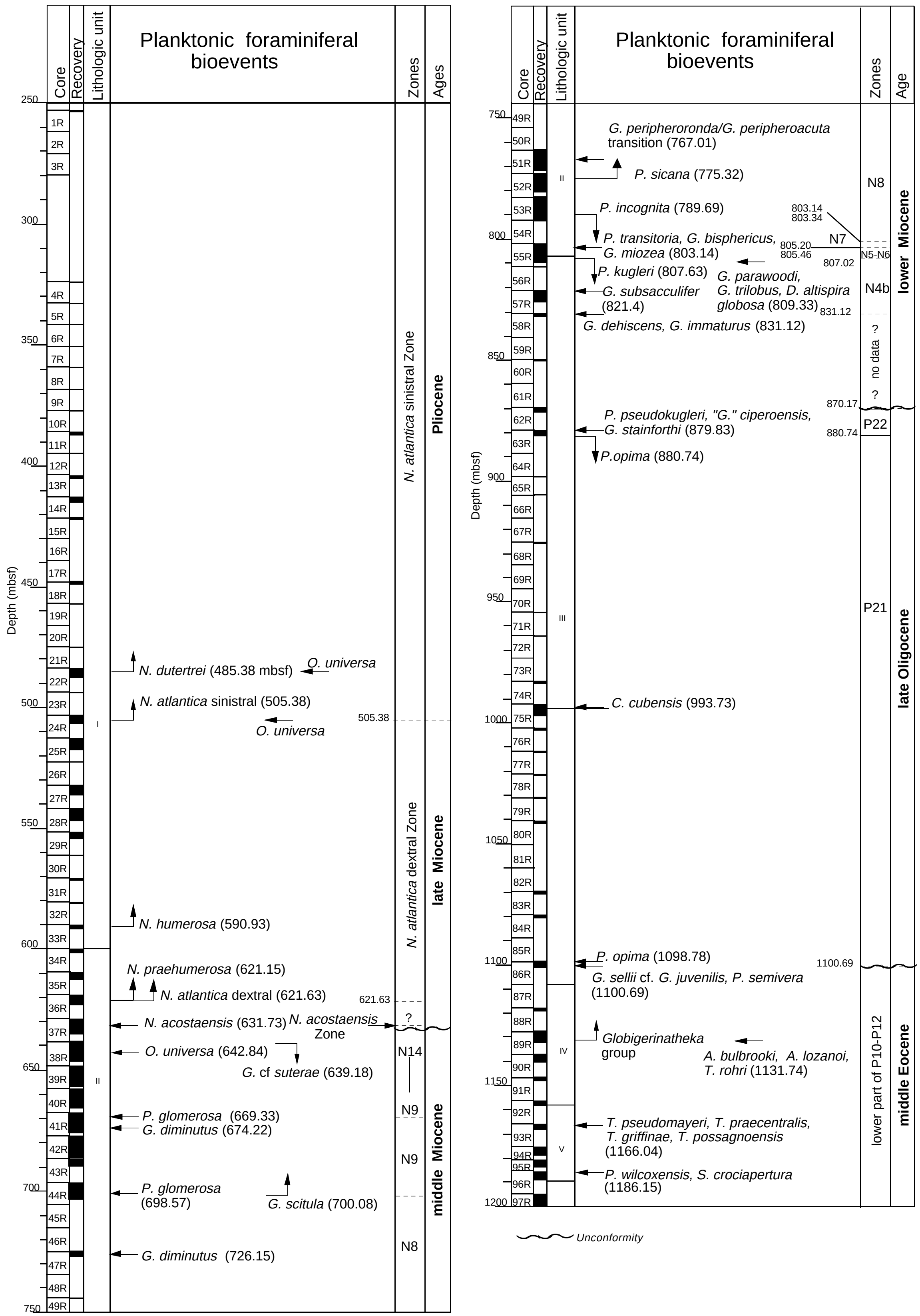

Figure 5. Main planktonic foraminifer bioevents in Hole 918D, plotted vs. biozone assignments.

Table 6. Stratigraphic ranges of selected Pliocene planktonic foraminifers in Hole 918D.

152-918D Core, section, interval (cm)	Barren samples	Pl. foram. sssembl.	Species diversity	*N. pachyderma* sinistr.	*N. acostaensis*	*N. atlantica* dextr.	*G. juvenilis*	*G. glutinata*	*T. neoclemenciae*	*T. quinqueloba*	*G. uvula*	*N. praehumerosa*	*G. bulloides*	*"G." venezuelana*	*G. quadrilobatus*	*G. immaturus*	*S. seminulina*	*G. menardii*	*G. obesa*	*Tenuitellinata* sp.	*Z. woodi*	*G. scitula*	*N. humerosa*	*G. lenguaensis*	*G. bulbosa*	*P. continuosa*	*Neogloboquadrina* sp.	*O. universa*	*G. falconensis*	*N. atlantica* sinistr.	*D. larmeui*	*N. dutertrei*	Zones	Age
11R-1, 81-83	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*N. atlantica* sinistral	**Pliocene**
13R-1, 52-54			1	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14R-1, 6-8			1	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14R-1, 95-97	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14R-2, 95-97			3	-	-	-	-	-	-	-	-	-	X	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-		
18R-1, 28-30	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
22R-1, 134-136		W	11	-	X	-	X	X	-	X	X	-	-	-	-	-	X	-	cf	-	cf	-	-	-	-	-	X	-	-	X	-	X		
22R-2, 8-10		W	8	X	-	-	X	-	-	-	-	X	X	X	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	X	-	X		
22R-3, 8-10		W	9	-	-	-	X	-	-	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-	-	-	X	-	-	X	X			
24R-1, 97-99			2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	VR				
24R-2, 68-70		W	12	X	-	-	X	X	-	X	-	-	X	X	-	-	-	-	-	-	X	X	-	-	-	-	X	X	X	X				
24R-2, 120-122			1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X						?	?
24R-3, 26-28			2	-	VR	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-							*N. atlantica* dextral	**late Miocene**
25R-1, 45-48			1	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
25R-2, 14-16			2	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-								
25R-3, 44-46			1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	-	-	-	-								
25R-4, 72-74			8	VR	X	-	X	-	-	X	-	-	X	cf	-	-	-	-	-	-	-	-	-	-	X	cf								
25R-5, 3-4			3	-	-	-	-	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-										
27R-1, 44-46 to 28R-4, 7-9	7		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
29R-1, 95-97			6	-	X	X	-	-	-	-	X	-	-	X	-	-	-	-	-	-	cf	X	-	-										
29R-2, 95-97			5	-	X	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	X	-	-										
31R-1, 73-75	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
32R-1, 95-97			7	-	X	X	X	X	-	X	-	-	-	-	-	-	-	-	X	-	-	X	-	cf										
33R-1, 93-95			7	-	X	X	X	X	-	-	-	-	X	-	-	-	-	-	-	-	-	X	X	VR										
34R-1, 121-122			7	-	X	-	X	-	-	-	X	-	X	X	-	X	-	-	-	-	X													
35R-1, 68-69	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-														
35R-2, 66-68			2	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	VR														
36R-1, 130-132			8	-	X	X	X	X	X	-	-	X	-	X	-		-	-	-	X														
36R-2, 75-78		W	14	X	X	X	X	X	X	-	-	X	X	X	X	X	X	X	X															
36R-2, 123-126			8	X	X	X	X	X	X	X	cf	-																						

Note: Abbreviations defined in Table 2.

Sample 152-918D-37R-3, 13−16 cm (at 631.73 mbsf), yields common to rare and moderately preserved planktonic foraminifers attributable to Zone N16 = *N. acostaensis Zone* (late Miocene). This zonal assignment is based on the presence of *N. acostaensis.* However, the lower and upper boundaries of this zone were not observed.

The middle and lower Miocene assemblages are more problematic. The entire sequence is characterized by very monotonous and similar assemblages with minor faunal variations perhaps (but not necessarily) corresponding to cooler episodes with stronger dissolution (Table 7). Assemblages are generally poorly preserved, and specimens are often corroded and deformed.

Samples 152-918D-38R-1, 98−100 cm, to 44R-3, 98−100 cm, yield generally rare and poorly preserved middle Miocene foraminiferal faunas. A few samples are devoid of planktonic foraminifers; however, their abundance and preservation slightly increase from the top to the bottom of the sequence. The interval from Sample 152-918D-38R-1, 98−100 cm, through 41R-1, 76−78 cm (639.18–667.96 mbsf), is attributed to an undifferentiated interval belonging to Zones N9 through N14 based on the presence of *Globorotalia* cf. *suterae,* sensu Poore (1979). Samples 152-918D-41R-2, 63−65 cm, through 44R-3, 98−101 cm (669.33–701.53 mbsf), are tentatively assigned to Zone N9, based on the presence of *Globorotalia scitula* together with *Praeorbulina glomerosa.* According to Blow (1969), *G. scitula* first occurs at the middle of Zone N9; therefore, the lower part of this zone may not be present. *Neogloboquadrina pachyderma* sinistral is first observed in Sample 152-918D-47R-2, 95−97 cm, close to the Zone N8−N9 transition.

Samples 152-918D-44R-4, 97−110 cm, through 55R-1, 134−136 cm (703.34–803.14 mbsf), contain planktonic foraminiferal assemblages attributable to Zone N8 based on the presence of rare specimens of *Praeorbulina transitoria, P. glomerosa,* and *P. sicana.* Its lower boundary is based on the FO of *Globigerinoides bisphericus.* Species diversity markedly increases within this zone. The genus *Globigerinoides,* represented by *G. immaturus* and *G. bisphericus* and *Dentoglobigerina altispira globosa,* which are interpreted as warm water species (Spezzaferri and Premoli Silva, 1991; Spezzaferri, 1994a), is more consistently present and more abundant throughout.

The FO of *G. bisphericus* and the LO of *Catapsydrax dissimilis* mark the upper and the lower boundary of Zone N7, respectively (Samples 152-918D-55R-2, 4−6 cm, through 55R-3, 40−42 cm, 803.34–804.20 mbsf). The assemblage in this zone includes *Zeaglobigerina woodi, Globorotalia birnageae, Globigerinoides trilobus,* and *Praeorbulina transitoria.*

Only two of the studied samples belong to the undifferentiated interval from Zone N6 through N5 (Samples 152-918D-55R-3, 66−68 cm, through 55R-4, 72−74 cm, 805.46–807.02 mbsf). The upper and the lower boundary are based on the LO of *Catapsydrax dissimilis* and *Paragloborotalia kugleri,* respectively. The accompanying assemblages include *G. praescitula, Catapsydrax unicavus, Dentoglobigerina langhiana, Paragloborotalia semivera, Globorotalia zealandica,* and *Zeaglobigerina woodi.*

Subzone N4b is identified from Sample 152-918D-55R-5, 11−13 cm, through 58R-1, 42−44 cm (807.63–831.12 mbsf). The zonal marker *P. kugleri* is present in the upper three samples attributable to this zone only. The presence of *Globoquadrina dehiscens, Globigerinoides immaturus,* and *Globigerinoides trilobus* since Core 152-918D-58R, however, allows assignment of the entire interval to Subzone N4b (Spezzaferri, 1994a, 1994b). Subzone N4a is not identified in the studied samples.

The late Oligocene Zone P22 is identified from Sample 152-918D-62R-1, 87−90 cm, through 63R-1, 93−96 cm (880.74–879.83 mbsf). Faunal assemblages are generally rich and well diversified. Zonal assignment is based on the presence of *Paragloborotalia pseudokugleri.* The accompanying assemblage includes *Z. woodi, Zeaglobigerina connecta, Globorotaloides stainforthi, Globorotalia birnageae, Globoquadrina praedehiscens,* and *Dentoglobigerina altispira globosa* (Table 8).

Planktonic foraminiferal assemblages are very scarce and very poorly preserved in the late Oligocene Zone P21 (Samples 152-

Table 7. Stratigraphic ranges of selected Miocene planktonic foraminifers in Hole 918D.

152-918D Core, section, interval (cm)	Barren samples	Species diversity	Pl. foram. assembl.	"G." venezuelana	G. suteri	G. rohri	G. variabilis	G. dehiscens	G. immaturus	G. glutinata	C. unicavus	G. larmeui	D. praedehiscens	Tenuitellinata sp.	T. praestainforthi	P. nana	T. neoclemenciae	P. continuosa	G. stainforthi	C. dissimilis	Z. connecta	D. langhiana	G. praeapis	P. siakensis	G. trilobus	G. uvula	G. juvenilis	T. quinqueloba	P. semivera	G. praebulloides	G. birnageae	G. woodi	G. obesa	G. tripartita	G. subsacculifer	D. altispira globosa	G. parawoodi	S. disjuncta	P. pseudokugleri	P. kugleri	Z. brazieri	G. labiacrassata	G. subquadratus	"G." ciperoensis	G. falconensis	G. incognita	C. chipolensis	T. munitissima	G. praescitula	G. zealandica	G. peripheroronda	P. acrostoma	P. mayeri	G. quadrilobatus	P. transitoria	G. bisphericus	G. miozea	"G." pseudociperoensis	P. peripheroronda/P. peripheroacuta	G. cf suterae	G. siphonifera	Guembelitria sp.	Z. decoraperta	P. sicana	Z. druryi	G. bulbosa	G. diminutus	N. pachyderma sinistr.	P. scitula	P. glomerosa	Globigerina sp. A	D. baroemoenensis	G. ruber	O. universa	N. acostaensis	Zones	Age
37R-2, 14-16	B	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-?-	l.M.
37R-3, 13-16		7		-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	X	-	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X		
37R-3, 58-60 to 37R-5, 20-22	3	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
38R-1, 98-100		11	W	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	X	X	-	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-		middle Miocene
38R-2, 114-116		15	W	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
38R-3, 60-62		16	W	X	-	-	-	-	X	X	-	X	-	-	X	-	X	-	-	-	-	-	-	-	X	-	X	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	N14 (N. acostaensis)	
38R-4, 14-16		2	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-		
38R-4, 52-54		8	W	X	-	-	-	-	X	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	X	-	X	-	-	X	-	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
38R-5, 13-15		3		X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
38R-5, 113-115 to 39R-1,135-137	4	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
39R-2, 16-18		1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
39R-2, 93-95 to 39R-4, 16-18	4	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
39R-4, 95-97		7		-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
39R-5, 16-18		2		-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
39R-6, 0-2		5		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
39R-6, 73-75		9		-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-	-	X	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40R-1, 41-43 to 40R-2, 39-41	3	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40R-2, 125-127		4		-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40R-3, 34-36		3		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-		
40R-3, 116-118		4		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-		
40R-4, 64-66 to 40R-4, 120-122	2	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40R-5, 11-13		5		-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40R-5, 64-66		4		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40R-6, 23-25	B	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40R-6, 48-50		1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N9	
41R-1, 34-36		2		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
41R-1, 76-78		1		-	-	-	-	-	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—?—	
41R-2, 63-65		5	W	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	X	-	-	-	-		
41R-2, 117-119		3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
41R-3, 32-34	B	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
41R-3, 121-123		2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
41R-4, 34-36		3	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	-	-	-	-		
41R-4, 118-120		4		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
41R-5, 102-104		1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-		
41R-6, 16-18		6	W	X	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	-	-	-	-	-	-	X	-	X	-	-	X	-	-	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-		
41R-6, 78-80	B	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
42R-1, 79-81		4	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	cf	-							
42R-2, 109-111		2		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
42R-3, 132-134		1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
42R-4, 127-129		2		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
42R-5, 99-101		1		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
42R-6, 95-97		4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	VR	-	-	-	VR	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
43R-1, 24-27		3		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
43R-1, 103-107	B	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N9	
43R-2, 48-52		4		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	cf	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
43R-2, 145-148		1		-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
44R-1, 96-98		4	W	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-		
44R-2, 97-100		21	W	X	-	-	-	-	-	X	-	X	-	X	X	-	X	-	-	-	X	-	-	X	X	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-	X	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	cf	-	-	-	-	-	-	X	-	X	X	X	-	-	-	-		
44R-3, 98-101		4	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-		
44R-4, 97-100		2	W	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
44R-5, 124-127	B	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
47R-2, 95-97		9	W	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	cf	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X									
51R-1, 93-95		12	W	X	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	X	-	-	-	X	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	R	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-									
51R-2, 111-113		3	W	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
51R-3, 81-83		10	W	X	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-									
51R-4, 132-134		10	W	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	X	-	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-									
51R-5, 28-30		13	W	X	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	X	X	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	X	-	X	-	X	-	-	-	-	-	-	-									
51R-5, 80-82	B	0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
51R-6, 42-44		6	W	-	-	-	VR	-	-	-	-	VR	-	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-									
52R-1, 41-44		17	W	X	-	-	-	-	X	X	-	-	-	-	X	X	X	-	-	-	X	-	-	-	X	-	X	-	-	-	cf	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	X											
52R-1, 106-109		21	W	X	-	-	-	-	X	-	-	-	-	-	-	X	X	-	-	-	X	-	-	-	X	-	X	X	-	X	-	X	X	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	X	X	-	X	-	-	-	X	cf	X	-	X	-	-	-	X												
52R-2, 34-36		12	W	-	-	-	-	-	X	-	-	-	-	-	X	-	X	-	-	-	X	-	-	-	-	-	X	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-												
52R-2, 92-94		13	W	-	-	-	-	-	X	X	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	cf	X	-	X	-	-	-	cf												
52R-3, 15-18		13	W	X	-	-	-	-	X	-	-	-	-	X	X	-	X	-	-	-	-	-	-	-	X	-	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-													
52R-3, 121-124		11	W	X	-	-	-	-	-	X	-	X	-	-	X	-	X	-	-	-	-	-	-	-	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-													
52R-4, 37-40		12	W	X	-	-	-	-	-	X	-	-	-	X	-	X	X	-	-	-	X	-	-	-	-	-	X	X	-	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-													
52R-4, 124-126		25	W	X	-	-	-	X	X	X	-	X	-	X	X	-	X	-	-	-	-	-	-	-	X	-	X	X	X	X	cf	X	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	C	-	X	-	-	X	X	X	X	-	X	-	-	-													
52R-5, 52-55		19	W	X	-	-	-	-	X	X	-	X	-	-	X	X	X	-	-	-	X	-	-	X	X	-	X	X	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-	-	X	-	-	-	-	-	-	-													
52R-5, 83-85		17	W	X	-	-	-	X	X	X	-	X	-	-	X	X	X	-	-	-	-	-	-	-	X	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	X	-	-	X	X	-	-	-	-	-	-	-													
53R-1, 30-31		12		-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	X	-	X	-	-	-													
53R-1, 121-123		16	W	-	-	-	-	-	-	X	-	-	-	-	X	-	X	-	-	-	-	-	-	X	X	-	X	X	X	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-													
53R-2, 10-12		12	W	X	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X	-	X	-	-	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	cf													
53R-2, 93-95		6	W	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-	X	-	-	-	-	-											N8	
53R-3, 47-49		8	W	VR	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	X	-	-	-	-	-	-	-	-	X	-	X	-	-	-												
53R-3, 124-126		11	W	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	cf	-	-	-	-	-	-	-	X	-	X	-	-	-												
53R-4, 38-40		6	W	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-												
53R-4, 105-107		4	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
53R-5, 26-27		7	W	X	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-												
53R-5, 119-121		12	W	X	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X	VR	-	cf	-	-	X	-	-	X	-	-	-	-	-	-	-	-												
53R-6, 29-31		15	W	X	-	-	-	-	-	X	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	VR	-	-	-	-	X	-	-	-	-	-	X	-	X	X	X	-												
53R-6, 119-121		7		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	cf	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-												
53R-CC		16	W	-	-	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	X	-	X	X	-	X	VR	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	X	-	X	-	-	-	-	-	X	X																
55R-1, 64-66		17	W	X	-	VR	-	X	X	X	-	X	-	-	-	-	X	-	-	-	-	-	-	-	X	-	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	cf	X	-	X	-	X	cf	-	-	-																		
55R-1, 134-136		24	W	X	-	-	-	X	X	X	-	X	-	-	X	-	X	-	-	-	-	X	-	X	X	-	X	X	-	-	-	X	-	-	X	-	-	X	-	-	-	-	X	-	-	X	VR	-	X	X	-	X	-	-	cf	X	X	-																		
55R-2, 4-6		18	W	X	-	-	X	X	X	X	-	X	-	-	X	X	-	-	-	-	X	-	-	-	X	-	X	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	X	-	X	-	-	-	-																		
55R-2, 88-90		22	W	X	-	-	X	X	-	X	-	R	-	X	X	X	-	X	-	-	X	X	-	-	-	-	X	VR	-	X	X	X	X	-	-	-	-	cf	-	-	X	-	-	-	-	X	-	-	-	-	cf	A	-																							N7	early Miocene
55R-3, 40-42		19	W	X	-	-	-	X	-	X	-	-	-	-	X	X	X	-	-	-	X	X	-	X	X	-	X	-	X	-	X	X	X	-	-	X	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	X																								
55R-3, 66-68		20	W	X	-	cf	-	X	-	X	-	-	-	-	X	X	X	-	-	X	X	X	-	-	-	-	X	-	X	-	X	X	-	-	-	-	-	-	-	-	-	R	-	-	-	X	-	-	cf	X	cf	X	-																								
55R-4, 72-74		23	W	X	X	X	X	VR	-	X	-	X	-	-	X	-	X	-	cf	-	X	-	-	X	-	-	X	X	-	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-	cf	X	X	X																											N5-N6	
55R-5, 11-13		18	W	X	-	X	X	-	X	X	-	X	X	X	-	-	X	-	-	X	-	-	-	-	X	-	X	-	VR	-	-	R	X	-	-	-	-	-	-	X	-	-	X	cf																																
55R-5, 107-109		18	W	X	-	-	-	-	-	X	-	X	-	X	-	-	X	-	cf	X	A/C	-	-	-	X	-	X	-	X	X	-	A	-	-	-	-	-	cf	X	X	X	X	-																																	
55R-6, 31-33		20	W	X	-	-	-	-	cf	X	-	-	-	-	X	X	X	-	-	X	X	-	-	X	X	-	X	-	X	X	-	X	X	-	-	X	X	cf	X	X	-	-	-																																	
57R-1, 43-45		10	W	-	-	X	-	-	VR	X	-	X	-	-	-	X	X	-	-	X	-	-	-	-	-	-	X	-	X	-	-	-	-	-	X	-	-	-																																							
57R-1, 118-120		9	W	X	-	-	-	-	X	X	-	-	X	X	-	-	X	-	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	X	-	-	-	-																																								N4b	
57R-2, 50-52		7	W	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	X	-	-	-	-	X	X	-	-	-	-	-																																									
57R-2, 116-118		12	W	X	-	-	X	-	-	X	-	X	X	-	-	X	-	-	-	X	-	-	-	-	X	-	X	-	X	X	X	-	-	-	-	-	-	-																																									
57R-3, 2-4		9	W	X	-	-	X	-	-	X	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-																																									
57R-3, 147-149		20	W	X	X	-	X	X	X	X	X	X	X	-	-	-	X	-	X	X	X	X	X	X	VR	X	X	VR																																																		
58R-1, 42-44		15	W	X	X	X	X	cf	X	X	X	X	X	X	X	X	X	X																																																												

Note: Abbreviations defined in Table 2.

918D-63R-2, 34–37 cm, through 86R-2, 69–71 cm, 880.74–1100.69 mbsf). Identification of this zone is based on the presence of *Paragloborotalia opima* together with *Globoquadrina sellii*, *Globigerinita juvenilis, Paragloborotalia semivera,* and very rare and random specimens of *C. cubensis.*

An undifferentiated interval spanning the lower part of Zone P10 through Zone P12 (early middle Eocene) is identified from Sample 152-918D-88R-1, 70–72 cm, down to the bottom of the sequence (1118.50–1188.16 mbsf). Planktonic faunas are generally scarce and poorly preserved or absent, with the exception of the red clay-rich interval from Sample 152-918A-89R-3, 28–30 cm, through 88R-1, 70–72 cm, where faunal assemblages are richer, well diversified, and typical of warmer water (Plates 1, 2). The presence of *Turborotalia possagnoensis, T. praecentralis, T. pseudomayeri, T. boweri, Acarinina bullbrooki, A. matthewsae,* and globigerinathekids indicates that this assemblage cannot be older than the early middle Eocene (Premoli Silva and Boersma, 1988; Premoli Silva, pers. comm., 1995). The accompanying assemblage also includes abundant *A. pentacamerata, Subbotina utilisindex, S. angiporoides, S. hornibrooki,* the *Catapsydrax* group, *Globorotaloides,* and pseudohastigerinids, and rarer *Acarinina acceleratoria, A. soldadoensis angulosa, A. lozanoi, A. densa, A. intermedia,* and *Subbotina linaperta.*

Table 8. Stratigraphic ranges of selected middle Eocene and upper Oligocene planktonic foraminifers in Hole 918D.

152-918D Core, section, interval (cm)	Barren samples	Pl. foram. assembl.	Species diversity	*P. wilcoxensis*	*P. micra*	*S. crociapertura*	*T. pseudomayeri*	*T. praecentralis*	*T. griffinae*	*T. possagnoensis*	*G. suteri*	*Guembelitria* spp.	*"G." venezuelana*	*T. clemenciae*	*S. eocaenica*	*T. boweri*	*S. utilisindex*	*S. angiporoides minima*	*T. gemma*	*S. eocaena*	*S. hornibrooki*	*A. rugosoaculeata*	*A. rotundimarginata*	*G. permicus*	*A. intermedia*	*Globorotalodes* sp. 1	*A. interposita*	*G. micra*	*A. cuneicamerata*	*A. densa*	*A. bulbrooki*	*A. pentacamerata*	*A. primitiva*	*S. inaequispira*	*A. lozanoi*	*A. lybiaensis*	*A. rohri*	*M. broedermanni*	*T. pseudotopilensis*	*P. danvillensis*	*A. medizzai*	*C. unicavus*	*A. matthewsae*	*"G." senni*	*Catapsydrax* sp.	*C. taroubaensis*	*T. reissi*	*C. cubensis*	*Globigerinatheka* sp.	*G. carcoselleensis*	*P. pseudoscitulus*	*P. planoconicus*	*A. soldadoensis angulosa*	*A. acceleratoria*	*S. praeturritilina*	*D. galavisi*	*G. sellii*	*P. siakensis*	*G. praebulloides*	*P. semivera*	*S. angiporoides angip.*	*G. juvenilis*	*P. opima*	*P. nana*	*G. officinalis*	*T. munda*	*P. pseudocontinuosa*	*Z. woodi*	*G. tripartita*	*G. variabilis*	*Z. connecta*	*P. pseudokugleri*	*"G." ciperoensis*	*G. birnageae*	*G. glutinata*	*G. stainforthi*	*T. angustiumbilicata*	*D. baroemoenensis*	*D. larmeui*	*D. altispira globosa*	*G. rohri*	*G. obesa*	*G. praedehiscens*	*T. praestainforthi*	*"G." angulioffcinalis*	Zones	Age
62R-1, 87-90		W	26	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-	X	X	X	-	cf	X	X	X	X	VR	-	A	X	X	-	-	X	X	X	VR	X	X	P22	late Oligocene
62R-2, 77-81		W	20	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	-	X	X	X	X	X	X	-	-	-	X	X	-	X	X	X							
63R-1, 93-96		W	19	-	-	-	-	-	-	-	X	-	cf	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	-	X	-	X	X	X	X	X	X	X	X	cf	X										
63R-2, 34-37		W	7	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	X	X	-	-	-	-	-	-															P21	
68R-1, 45-47	B		0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																
72R-1, 25-27		W	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-																
75R-1, 53-55		W	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-																
75R-1, 133-135		W	14	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	R	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	-	-	-	X	X	X																
75R-2, 26-28		W	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-																		
75R-2, 108-110		W	9	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	VR	-	-	-	-	-	-	-	-	-	-	cf	-	-	X	X	X	-	X	X																		
75R-3, 5-8		W	6	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	X																			
76R-1, 28-30		W	9	-	-	-	-	-	-	-	X	-	-	R	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	X	X	X																				
76R-1, 97-100 to 78R-1, 25-27	2		0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																				
84R-1, 59-61		W	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	-	-	X	-	-																				
86R-1, 28-30		W	8	-	-	-	-	-	-	-	X	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	cf	X	X	X																				
86R-2, 69-71		W	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cf	X	X	X	VR	X																					
88R-1, 70-72		W	31	X	X	X	R	X	-	-	cf	X	-	-	X	-	C	X	-	-	X	X	X	-	-	-	X	X	-	-	-	X	-	X	X	X	-	X	-	X	-	-	-	cf	-	X	cf	X	X	-	cf	X	-	X	-	R																													lower part of Zone P10 -P12	middle Eocene
88R-CC, 3-5		W	23	X	X	X	-	-	-	-	cf	R	-	-	X	-	X	X	-	-	X	X	-	-	cf	X	X	X	-	-	-	X	-	X	-	X	-	-	-	-	-	-	-	cf	-	X	-	-	X	-	X	-	-	X	cf	-																														
89R-1, 37-38		W	14	X	X	-	-	-	-	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-	-	X	VR	-	-	-	X	X	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-																														
89R-1, 106-108		W	18	-	X	-	-	X	-	-	-	-	-	-	-	X	X	-	X	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X	-	-	X	-	-	X	-	X	X	-	X	-	-	X	-	-																														
89R-2, 13-15		W	30	X	X	X	-	X	cf	X	-	X	-	-	X	R	X	X	-	X	X	X	X	-	-	X	X	-	X	-	X	X	-	X	VR	-	-	-	X	X	-	-	-	-	X	-	-	X	-	-	X	-	cf	X	-	cf																													
89R-2, 97-99		W	23	X	X	cf	-	cf	X	-	-	R	-	-	-	X	-	X	-	X	-	X	-	-	-	X	X	-	-	-	-	X	X	-	-	-	X	-	X	-	cf	-	-	-	-	-	-	X	X	-	-	cf	cf	X	cf																														
89R-3, 28-30			26	X	X	-	-	cf	-	-	cf	X	-	-	X	cf	-	-	X	X	X	X	-	X	-	-	-	-	-	-	X	X	X	X	-	-	-	-	X	X	-	-	X	-	-	X	X	X	-	X	X	VR	X																																	
89R-3, 63-65		W	16	X	X	-	-	X	-	-	-	-	-	-	cf	X	-	-	-	-	X	X	X	-	-	-	X	X	-	-	-	X	X	X	-	-	cf	-	X	-	-	-	-	-	-	-	-	-	X																																				
89R-3, 98-99		W	24	X	-	-	-	-	-	-	cf	X	-	-	X	-	-	-	cf	-	-	X	X	-	-	-	-	X	X	-	X	X	X	-	-	X	cf	-	X	X	X	X	X	cf	X	X	cf	X																																					
89R-4, 34-36		W	25	X	cf	-	-	-	-	-	cf	-	-	-	X	-	X	X	-	X	-	X	X	-	X	-	X	X	X	X	R	X	X	cf	R	X	cf	X	X	X	X																																												
90R-2, 16-18		W	11	X	-	X	-	-	-	-	-	-	-	-	cf	-	-	X	X	X	X	X	-	X	cf	X																																																												
90R-2, 113-115		W	9	X	-	-	-	-	-	-	cf	-	-	-	cf	-	-	X	-	X	X	X	X	X																																																														
90R-3, 31-33	B	W	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X																																																																						
90R-3, 89-91		W	7	X	-	-	-	-	X	-	-	-	-	-	X	X	cf	X	X																																																																						
91R-1, 14-16		W	3	X	-	-	-	-	-	-	-	-	cf	X																																																																												
91R-1, 105-107		W	2	-	-	-	-	-	-	-	cf	X																																																																														
92R-1, 17-19 to 92R-2, 41-43	3		0	-	-	-	-	-	-	-																																																																															
93R-1, 24-26		W	4	-	-	-	X	X	X	X																																																																															
93R-1, 38-40 to 95R-1, 21-23	3	W	0	-	-	-																																																																																					
96R-2, 43-45		W	3	X	cf	X																																																																																						
96R-2, 97-99 to 96R-3, 94-96	3		0																																																																																								

Note: Abbreviations defined in Table 2.

Site 919

Site 919 is located on the continental rise of southeastern Greenland, within the western part of the Irminger Basin. Three holes were drilled, with recovery from Holes 919A and 919B only. The sedimentary sequence at this site is composed predominantly of silty clay, clayey silt, and clay with silt. It is characterized by numerous levels with fining-upward grain sizes and very sharp basal contacts, typical of transportation by, and deposition from, turbidity currents.

Ten cores were retrieved with the APC at Hole 919A with an average core recovery of 100%. Pleistocene planktonic foraminifers are generally abundant and well preserved throughout the sequence.

Eight cores were recovered with the APC at Hole 919B. The core recovery was 100%.

Pleistocene planktonic foraminiferal faunas are generally abundant and well preserved; however, both abundance and preservation diminish toward the bottom of the sequence. The main planktonic foraminiferal bioevents at Site 919 are reported in the range charts and the biostratigraphic log together with the occurrence of the "warmer assemblage" and species diversity trends (Fig. 6; Tables 9, 10).

DISCUSSION

Pliocene-Pleistocene Transition

The transition from the late Pliocene to the early Pleistocene deserves comment. Spiegler and Jansen (1989) described the upper *Neogloboquadrina atlantica* dextral and *Neogloboquadrina pachyderma* dextral Zones in the uppermost Pliocene sediments of the Vøring Plateau (Leg 104). In those sites, the two zones were characterized by the presence of small specimens of the marker species only (D. Spiegler, pers. comm., 1995) or more rarely were associated with *Globigerina bulloides* and *Turborotalita quinqueloba* (Spiegler and Jansen, 1989).

The upper *N. atlantica* dextral and *N. pachyderma* dextral Zones are not present at the Leg 152 sites. The only exception is a very short upper *N. atlantica* dextral Zone in Hole 918A, where the marker species is associated with *N. pachyderma* dextral. In the Leg 152 holes, these two species generally occur together with the temperate transitional species *Globorotalia scitula* and *Globorotalia inflata* (Ruddiman and McIntyre, 1976; Aksu et al., 1989) in well diversified assemblages. Therefore, they may be considered as relatively warmer species. This interpretation is also supported by the co-occurrence of a change in coiling direction from dextral to sinistral in *N. atlantica* together with a significant increase in planktonic foraminifer $\delta^{18}O$ values in the Labrador Sea (Aksu and Hillaire-Marcel, 1989).

Based on these data the presence of *N. atlantica* dextral and *N. pachyderma* dextral as the only components of the assemblages and the diachroneity of the change in coiling direction (Aksu and Kaminski, 1989) may be related to warming episodes. This warming on the Vøring Plateau was, however, probably not enough to produce the proliferation of the richer and relatively more diversified assemblages observed in the Irminger Basin at Site 918. On the other hand, the warmer North Atlantic Current and the persistence of the Gulf Stream off the eastern Canadian Margin and the southern Labrador Sea may have had a more marked influence on the surface water along the East Greenland coasts (Berggren and Schnitker, 1983; Eldholm et al., 1989).

First Occurrence of *N. pachyderma* and *N. acostaensis*

The first occurrences of the species *Neogloboquadrina pachyderma* and *N. acostaensis* also deserve comment. In the East Greenland sites, *Neogloboquadrina pachyderma* sinistral first occurs in the uppermost part of Zone N8 in the upper lower Miocene, very close to

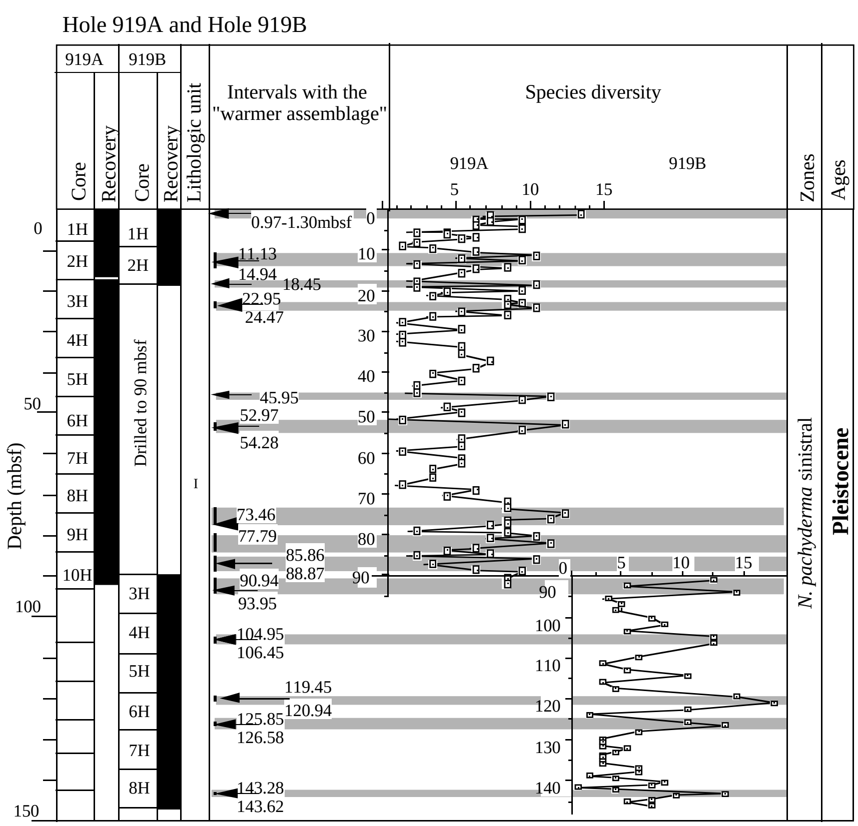

Figure 6. Main planktonic foraminifer bioevents in Holes 919A and 919B, plotted vs. biozone assignments and species diversity trend.

Table 9. Stratigraphic ranges of selected Pleistocene planktonic foraminifers in Hole 919A.

152-919A Core, section, interval (cm)	Pl. foram. assembl.	*N. pachyderma* sin.	*T. humilis*	*G. bulloides*	*N. acostaensis*	*N. dutertrei*	*Tenuitellinata* sp.	*T. quinqueloba*	*G. juvenilis*	*S. globigerum*	*N. pachyderma* dex.	*G. scitula*	*G. inflata*	*G. glutinata*	*Z. decoraperta*	*N. humerosa*	*N. atlantica* sin.	*T. minutissima*	*G. uvula*	*O. universa*	*G. obesa*	Zones	Age
1H-1, 130-132	W	X	-	X	X	X	X	X	X	X	R	-	-	VR	-	X	-	X	VR	-	-	*N. pachyderma* sinistral	**Pleistocene**
1H-2, 20-22	W	X	-	X	X	X	X	A	-	-	-	-	-	-	-	X	-	-	-	-	-		
1H-2, 96-98		X	-	-	X	X	X	X	-	-	-	-	-	-	-	X	-	-	-	-	-		
1H-2, 130-132		X	-	X	X	X	X	X	-	R	-	-	-	-	-	X	-	-	X	-	-		
1H-3, 20-22		X	-	-	-	X	X	X	X	-	VR	-	-	-	-	-	-	-	X	-	-		
1H-3, 96-98		X	-	-	-	X	X	X	-	-	-	-	-	-	-	X	-	X	-	-	-		
1H-3, 130-132		X	-	X	-	X	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-		
1H-4, 20-22		X	-	R	X	R	R	X	VR	-	-	-	-	-	-	R	-	-	X	-	-		
1H-4, 96-98		X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
1H-4, 130-132		X	-	-	-	X	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-		
1H-5, 20-22		C	-	-	-	-	R	X	-	-	R	-	-	-	-	-	-	-	-	-	-		
1H-5, 97-99		X	-	-	X	X	VR	VR	-	-	-	-	-	-	-	X	-	-	-	-	-		
1H-5, 130-132		X	-	-	X	X	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-		
2H-1, 15-17		X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-1, 96-98		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-2, 14-16		X	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-2, 95-97		X	-	X	X	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-		
2H-3, 13-15	W	X	-	C	R	X	VR	X	X	-	-	X	-	-	-	-	-	X	X	-	-		
2H-3, 95-97		X	-	-	-	VR	X	X	-	-	R	-	-	-	-	-	-	-	-	-	-		
2H-4, 14-16	W	X	-	X	X	X	X	X	X	-	VR	-	-	-	-	X	-	-	-	-	-		
2H-4, 101-103		X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2H-5, 13-15	W	X	-	X	-	X	X	X	X	-	R	-	-	-	-	X	-	-	-	-	-		
2H-5, 94-96		X	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-		
2H-6, 13-15		X	-	X	X	cf	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3H-1, 8-10		X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3H-1, 95-97	W	X	-	X	-	X	X	X	X	-	VR	VR	-	X	-	-	-	X	-	-	-		
3H-2, 8-10		X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3H-2, 95-97		X	-	-	X	X	X	X	X	-	R	-	-	-	-	X	-	-	VR	-	-		
3H-3, 8-10		X	-	-	X	-	X	-	-	-	VR	-	-	-	-	-	-	-	-	-	-		
3H-3, 96-98		X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3H-4, 8-10		X	-	X	X	X	X	X	-	-	R	-	-	-	-	-	-	X	-	-	-		
3H-4, 96-98	W	X	-	-	X	-	X	X	-	-	X	R	-	-	-	X	-	X	-	-	X		
3H-5, 8-10		X	-	X	X	X	X	X	-	-	R	-	-	-	-	-	-	X	-	-			
3H-5, 97-99	W	X	-	X	X	X	X	X	X	-	VR	VR	-	-	-	-	-	X	-	-			
3H-6, 7-9		X	-	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-			
3H-6, 95-97		X	-	X	-	X	X	X	X	-	R	-	-	-	-	-	-	-	X	-			
3H-7, 8-10		X	-	-	-	cf	X	-	-	-	-	-	-	-	-	-	-	-	-	-			
4H-1, 95-97		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
4H-2, 95-97		X	-	-	X	X	X	-	-	-	-	VR	-	-	-	-	-	-	-	-			
4H-3, 95-97		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
4H-4, 95-97		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
4H-5, 95-97		X	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-			
4H-6, 95-97		X	-	X	R	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-			
5H-1, 95-97		X	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-			
5H-2, 95-97		X	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-			
5H-3, 93-95		X	-	-	-	cf	X	-	-	-	-	-	-	-	-	-	-	-	-	-			
5H-4, 97-99		X	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-			
5H-5, 95-97		X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-			
5H-6, 95-97		X	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	-	-	-			
5H-7, 45-47	W	X	-	X	-	X	X	X	X	-	R	C	C	X	-	X	-	-	-	-			
6H-1, 97-99		A	-	-	-	VR	R	X	X	-	VR	-	-	X	-	X	-	-	X	-			
6H-2, 97-99		X	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-			
6H-3, 97-99		X	-	-	X	R	X	X	-	-	-	-	-	-	-	-	-	-	-	-			
6H-4, 96-98		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
6H-5, 97-99	VW	A	X	X	-	X	X	X	X	-	R	C	X	X	-	-	-	-	-	VR			
6H-6, 78-80	W	X	-	X	X	X	X	X	-	-	R	-	R	R	-	-	-	-	-				
7H-1, 95-97		X	-	-	-	X	X	-	-	X	R	-	-	-	-	-	-	-	-				
7H-2, 95-97		X	-	-	-	X	X	X	-	-	R	-	-	-	-	-	-	-	-				
7H-3, 90-92		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
7H-4, 95-97		X	-	-	-	X	R	X	X	-	-	-	-	-	-	-	-	-	-				
7H-5, 95-97		X	-	-	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-				
7H-6, 94-96		X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-				
8H-1, 79-81		X	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-				
8H-2, 96-98		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
8H-3, 96-98		X	-	X	-	-	X	-	X	-	-	-	-	X	-	-	-	-	X				
8H-4, 96-98		X	-	-	-	cf	R	X	-	-	-	-	-	-	-	-	-	-	-				
8H-5, 96-98		X	-	C	-	X	X	X	X	-	-	-	-	X	-	-	*	-	X				
8H-6, 96-98	W	X	-	X	-	X	X	C	X	-	-	X	-	X	-	-	-	-	-				
9H-1, 30-32	W	A	X	X	-	X	X	C	C	-	C/R	-	X	X	-	-	-	X	X				
9H-1, 130-132	W	X	-	X	-	X	X	X	X	-	C	X	X	X	-	-	-	X	-				
9H-2, 29-31		X	-	X	-	X	X	X	X	-	-	-	-	X	-	-	-	X	-				
9H-2, 130-132	W	X	-	-	-	cf	X	X	X	-	-	-	X	X	-	-	-	X	-				
9H-3, 29-31	W	X	-	X	R	-	R	X	X	-	-	-	X	-	-	-	-	-	-				
9H-3, 130-132		X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	*	-	-				
9H-4, 29-31	W	X	R	R	-	-	X	X	X	-	-	-	R	X	-	-	*	-	-				
9H-4, 130-132	W	X	X	VR	-	X	X	X	X	-	VR	-	-	-	-	X	*	X	-				
9H-5, 30-32	W	X	X	-	-	X	X	X	X	-	-	-	-	-	-	-	-	X	-				
9H-5, 129-131		X	X	X	X	X	X	C	X	-	-	-	-	X	-	-	-	X	X				
9H-6, 29-31		X	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-						
9H-7, 29-31		A	-	-	X	cf	-	X	-	-	-	-	-	-	-	-	-						
10H-1, 46-48		X	-	X	X	X	X	X	-	-	-	-	-	-	-	X	*						
10H-1, 118-120		X	-	-	-	-	-	X	-	-	-	-	-	-	-								
10H-2, 36-38	W	X	-	X	-	X	X	A	X	-	VR	X	-	X	X								
10H-3, 35-37		X	-	-	-	-	-	X	-	-	-	-	-	X									
10H-3, 141-143		C	-	-	X	X	X	X	X	-	-	-	-	-									
10H-4, 37-39	W	C	-	X	-	X	X	X	X	-	-	X	X	X									
10H-5, 70-72		C	-	-	X	X	X	X	X	X	VR												
10H-6, 41-43		C	VR	X	X	X	X	X	X	-	-												

Notes: * = the presence of specimens of *N. atlantica* sinistral that are probably reworked. Abbreviations defined in Table 2.

Table 10. Stratigraphic ranges of selected Pleistocene planktonic foraminifers in Hole 919B.

152-919B Core, section, interval (cm)	Pl. foram. assembl.	Barren Samples	*N. pachyderma*	*N. pachyderma*	*N. atlantica* sin.	*G. juvenilis*	*Tenuitellinata* sp.	*G. glutinata*	*T. quinqueloba*	*G. bulloides*	*N. dutertrei*	*T. minutissima*	*N. atlantica* dex.	*G. scitula*	*N. acostaensis*	*S. globigerum*	*G. inflata*	*G. uvula*	*N. humerosa*	Zones	Age
3H-1, 94-96	W		C	R	-	X	X	-	X	X	X	-	-	R	X	R	VR	-	-	*N. pachyderma* sinistral	**Pleistocene**
3H-2, 100-102			X	-	-	-	X	-	X	-	-	-	-	-	-	VR	-	-	-		
3H-3, 95-97	W		X	R	*	X	X	X	X	C	X	X	-	R	-	-	C/R	VR	-		
3H-4, 96-98			C	VR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3H-5, 95-97			C	-	-	-	X	-	-	-	-	-	-	-	VR	-	-	-	-		
3H-6, 96-98			C	R/C	-	-	-	-	VR	-	-	-	-	-	-	-	-	-	-		
4H-1, 95-97			C	VR	-	-	X	-	X	-	X	-	-	-	X	-	-	-	-		
4H-2, 95-97			C	-	-	-	X	-	X	-	X	X	-	-	X	-	-	X	-		
4H-3, 95-97			C	-	-	-	X	-	X	-	-	-	-	-	-	-	-	X	-		
4H-4, 95-97	W		X	R	-	X	X	X	X	-	X	X	-	X	X	-	X	-	-		
4H-5, 95-97	W		X	VR	-	X	X	X	X	-	X	-	-	X	cf	-	X	VR	-		
5H-1, 95-97			C	-	-	-	X	-	X	-	-	VR	-	-	R	-	-	-	-		
5H-2, 95-97			X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-		
5H-3, 95-97			X	-	*	-	-	-	-	-	cf	-	-	-	X	-	-	-	-		
5H-4, 94-96			C	R	-	X	X	-	X	-	X	X	-	-	X	-	-	X	-		
5H-5, 97-99			X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-		
5H-6, 97-99			C	-	*	-	X	-	-	-	-	-	-	-	-	-	-	-	-		
6H-1, 95-97	W		X	R	*	X	C	X	X	-	X	-	-	C	X	-	R	X	-		
6H-2, 94-96	W		X	R	*	X	X	X	X	X	X	X	*	X	X	-	C	X	-		
6H-3, 96-98			C	R	*	-	X	-	-	-	X	X	*	-	X	-	-	-	X		
6H-4, 95-97			X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
6H-5, 135-137	W		X	-	*	X	X	X	X	-	-	-	-	X	X	-	-	X			
6H-6, 58-60	W		C	R	*	X	X	X	X	X	X	X	-	X	-	-	X				
7H-1, 21-23			C	VR	*	-	-	-	X	-	-	-	-	X	-	-					
7H-2, 35-37			C	VR	-	-	-	-	-	-	-	-	-	-	-	-					
7H-2, 112-114			X	-	-	-	-	-	X	-	-	-	-	-	-	-					
7H-3, 59-61			X	VR	-	-	-	-	-	-	-	-	-	-	-	-					
7H-3, 112-114			X	-	*	-	-	-	X	-	-	-	-	-	-	VR					
7H-4, 30-32			X	-	-	X	-	-	-	-	VR	-	-	-	-	-					
7H-4, 125-127			X	-	*	-	-	-	-	-	-	-	-	-	-	-					
7H-5, 35-37			X	X	-	-	-	-	-	-	-	-	-	-	-	-					
7H-5, 125-127			X	VR	-	-	-	-	-	-	-	-	-	-	-	-					
7H-6, 19-21			X	X	-	-	-	-	-	-	-	-	-	-	-	-					
7H-6, 143-145			C	R	*	-	X	-	-	-	cf	-	-	-	-	-					
8H-1, 56-58			C	R	*	-	X	-	-	-	cf	-	-	-	-	-					
8H-1, 120-122			X	-	-	-	-	-	-	-	-	-	-	-	-	-					
8H-2, 29-31			X	-	-	-	-	-	-	-	cf	-	-	-	X	-					
8H-2, 138-140			X	VR	*	X	X	-	C	-	X	-	-	-	-	-					
8H-3, 67-69			X	R	-	-	R	-	-	X	-	X	-	-	-	-					
8H-3, 119-121		B	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
8H-4, 9-11			C	-	*	-	-	-	-	-	-	-	-	-	-	-					
8H-4, 128-130	W		X	R	*	X	X	R	X	-	X	X	-	VR	cf	C					
8H-5, 12-14	W		C	VR	*	-	VR	-	X	VR	-	X	*								
8H-5, 108-110			X	-	*	X	X	-	-	-	X	X									
8H-6, 12-14			X	-	*	-	X	-	-	X											
8H-6, 109-111			X	-	*	X	X	X	X												

Notes: * = the presence of specimens of *N. atlantica* sinistral and dextral that are probably reworked. Abbreviations defined in Table 2.

the Zone N8–N9 transition. Therefore, it occurs much earlier than at other middle and high latitude sites in the North Atlantic where it commonly occurs in the *N. pachyderma* sinistral Zone, at about 1.8 Ma (Hooper and Weaver, 1987; Raymo et al., 1987). However, Aksu and Kaminski (1989) and Spiegler and Jansen (1989) first observed this species within the *N. atlantica* dextral Zone in the upper Miocene, in the Labrador Sea and the Norwegian Sea, respectively. Premoli Silva et al. (1993) found this species within Zones N16–N17 in the upper Miocene in the Northwestern Pacific. Based on these previous data and in accordance with Spiegler and Jansen (1989) and Spiegler (pers. comm., 1995), this event may not be an isochronous stratigraphic marker over large distances at high northern latitudes.

The FO of *Neogloboquadrina acostaensis* was used by Spiegler and Jansen (1989) to indicate the middle/late Miocene boundary. In a later revision of the biostratigraphy of the Vøring Plateau, Spiegler and Müller (1992) and Müller and Spiegler (1993) equated the middle/late Miocene boundary to the boundary between calcareous nannofossil Zones NN8 and NN9 of Martini (1971) and Zones CN6 and CN7 of Okada and Bukry (1980). It also corresponds to the boundary between the *Bolboforma laevis* and *B. subfragoris* Zones (see also Spezzaferri and Spiegler, this volume). Based on this revision, the FO of *Neogloboquadrina acostaensis* in the North Atlantic lies in the upper middle Miocene.

In Leg 152 sediments the first finding of *N. acostaensis* is preceded by an extended interval devoid of planktonic foraminifers. Therefore, these sites may not record its FO. Sample 152-918D-37R-3, 13–16 cm, is only tentatively placed in the late Miocene. Its assignment to the middle Miocene, however, cannot be ruled out.

Comparison With Other Sites in the North Atlantic

Figure 7 summarizes age assignments for middle Eocene through Holocene sediments recovered in Hole 918D and 915A relative to some of the more representative sites previously drilled in nearby areas in the North Atlantic. This summary is compiled using, and in some cases reinterpreting, the previous biostratigraphic data of Berggren (1972), Poore (1979), Krasheninnikov (1979), Weaver (1987), Spiegler and Jansen (1989), Aksu and Kaminski (1989), and Firth (1989) as well as the lithostratigraphic data in Laughton, Berggren, et al. (1972); Montadert, Roberts, et al. (1979); Eldholm, Thiede, Taylor, et al. (1989); and Srivastava, Arthur, Clement, et al. (1989). Included are Sites 407 and 408 (East Greenland Margin), Holes 112, 112A, and 647A (Labrador Sea), Holes 642B and 643A (Vøring Plateau), Sites 406 and 116 (Rockall Plateau), and Hole 611C (Rockall Trough).

Eocene sediments were recovered from the Leg 152 sites, plus Sites 112, 116, 406, 408, 647, and Hole 643A. As at Hole 918D, Sites 112, 406, 408, and 643 recovered a red clayey middle Eocene interval. An important hiatus spans the interval from the upper middle Eocene to the entire lower Oligocene in Hole 918D. A similar hiatus

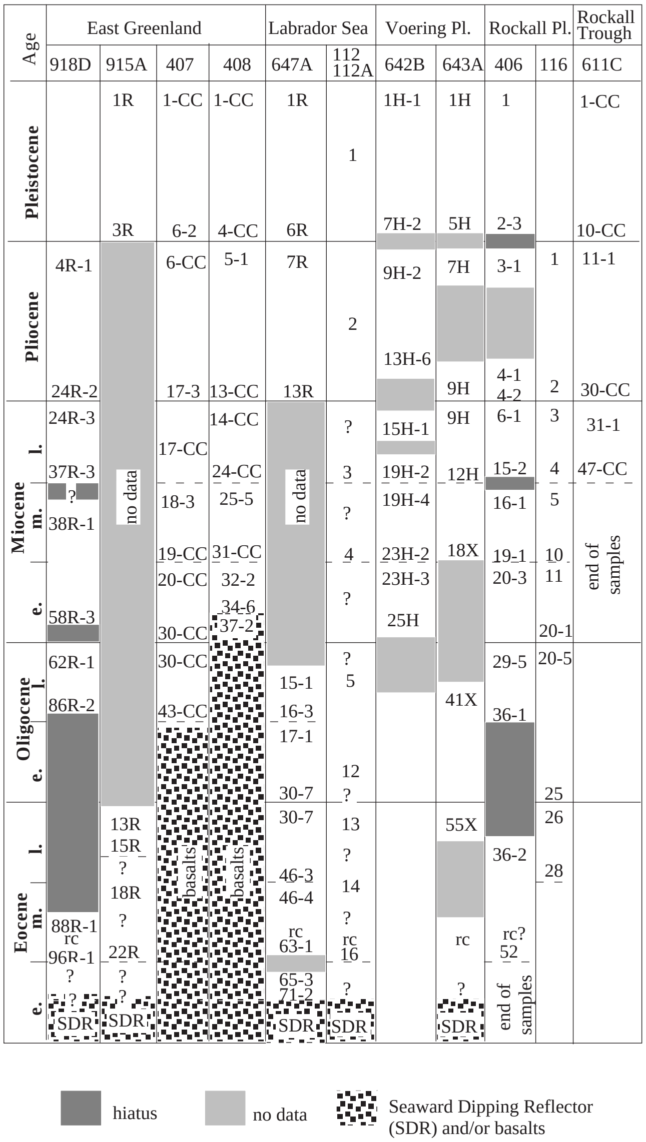

Figure 7. Summary of the planktonic foraminifer biostratigraphy for the sediments from Leg 152 Holes 918D and 915A and from DSDP Legs 12, 48, 49, 94, and ODP Legs 104 and 105 (partially modified according to the present paper). For holes the following values are represented: core number, core type (when available), and section number (when available).

is observed at Site 406. The only other event that has a less local significance is a hiatus probably eliminating the uppermost part of the middle Miocene in Holes 918D and Site 406.

Previous studies on deep sea circulation provide a compilation of the main hiatuses in the North Atlantic (Miller and Tucholke, 1983; Pearson and Jenkins, 1986). Pearson and Jenkins (1986) suggested the presence of interregional hiatuses during the late Pliocene, early Miocene, early Oligocene, and late middle Eocene in the North Atlantic. These data indicate that the short early Miocene hiatus and part of the hiatus spanning the late middle Eocene and the early Oligocene identified in East Greenland may have interregional extension.

Seven of the holes considered in Figure 7 encounter basement and/or the seaward dipping reflector. However, the boundary between the basement and the sedimentary sequence cannot be identified based on planktonic foraminifers in Holes 918D and 915A. This boundary reasonably occurs within the lower Eocene in the Labrador Sea. Sites 407 and 408 encountered basalt at the beginning of the upper Oligocene and in the lower Miocene, respectively. Intercalation of lower Miocene, calcareous nannofossil-rich sediments within the basalt (Steinmetz, 1979) indicates that local volcanic activity persisted on the Reykjanes Ridge during this period.

Paleoenvironmental Remarks

Decreases in temperature are often accompanied by declines in species diversity (Bé, 1977; Hemleben et al., 1989; Jenkins, 1993). Therefore, it is reasonable to assume that fossil species diversity would also follow changes in paleotemperature (Jenkins, 1993). Kennett and Shackleton (1976) also demonstrated that there is some correlation between the fall in diversity and the isotope record from planktonic foraminifers. In the absence of quantitative data, a preliminary and tentative paleoenvironmental interpretation based on planktonic foraminiferal assemblages from Leg 152 sediments may be based on species diversity and changes (Spezzaferri, 1994a).

Aksu et al. (1989) observed that, in the Labrador Sea, Pleistocene glacial intervals were characterized by low species diversity wherein the fauna was dominated by *N. pachyderma* sinistral, with varying percentages of *G. bulloides, G, quinqueloba*, and *N. pachyderma* dextral. Interglacial stages were characterized by higher species diversity wherein the faunas included *N. pachyderma* dextral, *N. quinqueloba, G. inflata*, with rarer *N. dutertrei, G. tumida, G. scitula, G. hirsuta, G. crassaformis, G. menardii*, and *T. truncatulinoides.*

Comparing the curves of species diversity obtained for Pleistocene assemblages from Hole 919A and 919B (Fig. 6) with the oxygen isotope record (Flower, this volume), it is evident that some intervals with relatively higher species diversity correlate with interglacial isotopic Stages 1, 5, 7, 9, 11, 13, 15, and 17.

No isotope record is available for Hole 918A; however, several intervals characterized by higher planktonic foraminiferal species diversity, here interpreted as interglacial stages, are identified throughout the sequence (Fig. 4). Species diversity is markedly lower in the Pliocene than in the Pleistocene. However, the FO of *N. atlantica* sinistral at the base of the Pliocene in Hole 918D is associated with relatively abundant and large-sized *O. universa.* This latter species is generally abundant at low latitudes and in warm water. Therefore, the early Pliocene in the North Atlantic may have been characterized by warmer climate. This interpretation is also supported by Funder et al. (1985), who identified the presence of an early Pliocene boreal forest in northeastern Greenland.

Planktonic foraminifers are generally scarce, sometimes absent, and low in diversity in the upper Miocene. This may reflect the general cooling trend in the North Atlantic within the early late Miocene at about 10–11 Ma and the initiation of glaciations in East Greenland at about 7–8 Ma (Larsen et al., 1994).

A relatively milder middle Miocene interval is indicated by the presence of a few specimens of *Globigerinoides* spp. However, the high dissolution affecting planktonic foraminiferal assemblages, the low species diversity, and the higher abundance of radiolarians (see Appendix) may reflect cooler and/or stronger upwelling conditions during this period than in the early Miocene (Berggren and Schnitker, 1983).

During the early Miocene–late Oligocene, a broad tropical-subtropical bioprovince with gradational boundaries reflected the extension of warm-water masses to unusually high latitudes (Thunell and Belyea, 1982; Berggren and Schnitker, 1983; Kennett et al., 1985). This warming is documented in East Greenland by highly diversified planktonic foraminiferal assemblages, which also include a high abundance of warm-water taxa such as the *"Globigerina" ciperoensis* group, *Globigerinoides* spp., dentoglobigerinids and globoquadrinids (Spezzaferri, 1994a).

No data are available for paleoclimatic interpretation based on planktonic foraminifers from early late Oligocene to middle Eocene times, when turbiditic sandy sedimentation, probably originated on the continental shelf (Thiede et al., 1986), and a hiatus prevented the preservation and/or deposition of calcareous sediments.

Very high diversity assemblages, together with abundant acarininids and turborotaliids in the middle Eocene sediments, indicate that warmer conditions prevailed during this interval (Boersma et al., 1987; Premoli Silva and Boersma, 1989; Boersma and Premoli Silva, 1991).

SUMMARY AND CONCLUSIONS

Leg 152 on the East Greenland Margin provided an extended sedimentary sequence at Site 918. However, a major hiatus spans the upper Eocene and the lower Oligocene. Two minor hiatuses occurred in the lowest Miocene and probably in the upper part of the middle Miocene. According to previous studies, the hiatus spanning the upper middle Eocene and the lower Oligocene, and the hiatus spanning the lowest Miocene may have regional extension; moreover, the middle Eocene red clay-rich interval seems to be a common feature in the North Atlantic.

Paleoclimatic interpretation based on planktonic foraminifers suggests that several glacial-interglacial episodes occurred during the Pleistocene and Pliocene. The early Pliocene was characterized by a warm climate. Cool conditions prevailed during the late Miocene when glaciation was initiated in southern Greenland. A relatively milder middle Miocene was preceded by the warm Oligocene and Eocene.

Recognition of climatically controlled first occurrences of *N. pachyderma* and changes in the coiling direction of *N. atlantica* is supported in this study and by data in the literature.

SPECIES LIST AND TAXONOMIC NOTES

This list of species is particularly rich for high latitudes. This signifies that unusually abundant and highly diverse planktonic foraminifer faunas (mainly belonging to the Paleogene and Miocene) were encountered in the sediments recovered in the North Atlantic during Leg 152. Species are listed in alphabetical order by genus.

The generic and specific concepts and the species groups used by Boersma and Premoli Silva (1983), Boersma et al. (1987), Premoli Silva and Boersma (1988, 1989), and by Spezzaferri (1994b) are retained herein, whenever possible.

The species illustrated in the plates in this paper are those rarely given elsewhere or those of stratigraphic interest.

Acarinina bullbrooki (Bolli, 1957) (= *Globorotalia bullbrooki* Bolli)
Acarinina densa (Cushman, 1925) (= *Pulvinulina crassata* var. *densa* Cushman)
Acarinina cuneicamerata (Blow, 1979) (= *Globorotalia (Acarinina) cuneicamerata* Blow)
Acarinina intermedia Subbotina, 1953
Acarinina interposita Subbotina, 1953
Acarinina libyaensis (El Khoudary, 1977) (= *Truncorotaloides libyaensis* El Khoudary)
Acarinina lozanoi (Colom, 1954) (= *Globigerina lozanoi* Colom)
Acarinina matthewsae (Blow, 1979) (= *Globorotalia (Acarinina) matthewsae* Blow)
Acarinina medizzai (Toumarkine and Bolli, 1975) (= *Globigerina medizzai* Toumarkine and Bolli). This form seems closely related to *Acarinina rugosoaculeata.*
Acarinina acceleratoria Khalilov, 1956
Acarinina pentacamerata Subbotina, 1953
Acarinina primitiva (Finlay, 1939) (= *Globoquadrina primitiva* Finlay)
A*carinina pseudotopilensis* Subbotina 1953
Acarinina rohri (Brönnimann and Bermudez, 1953) (= *Truncorotaloides rohri* Brönnimann and Bermudez)
Acarinina rotundimarginata Subbotina, 1953
Acarinina rugosoaculeata Subbotina, 1953
Acarinina soldadoensis angulosa (Bolli, 1957) (= *Globigerina soldadoensis* Brönnimann subsp. *angulosa* Bolli)
Cassigerinella chipolensis (Cushman and Ponton, 1932) (= *Cassidulina chipolensis* Cushman and Ponton)
Catapsydrax dissimilis (Cushman and Bermudez, 1937) (= *Globigerina dissimilis* Cushman and Bermudez)
Catapsydrax taroubaensis (Brönnimann, 1952) (= *Globigerina taroubaensis* Brönnimann)
Catapsydrax unicavus Bolli, Loeblich, and Tappan, 1957
Chiloguembelina cubensis (Palmer, 1934) (= *Guembelina cubensis* Palmer).
Dentoglobigerina altispira globosa (Bolli, 1957) (= *Globoquadrina altispira globosa* Bolli)
Dentoglobigerina baroemoenensis (Le Roy, 1939) (= *Globigerina baroemoenensis* Le Roy)
Dentoglobigerina galavisi (Bermudez, 1961) (= *Globigerina galavisi* Bermudez)
Dentoglobigerina langhiana (Cita and Gelati, 1960) (= *Globoquadrina langhiana* Cita and Gelati)
Dentoglobigerina larmeui (Akers 1955) (= *Globoquadrina larmeui* Akers)
Gallitellia vivans (Cushman, 1934) (= *Guembelitria vivans* Cushman)
Globigerina sp. A Very rare specimens of this informal species described by Poore (1979) were found in Pliocene sediments from the East Greenland Margin (Sample 152-918A-18H-2, 95–97 cm, only). They possess four to six chambers in the last whorl, an open and wide umbilicus, and an umbilical-extraumbilical aperture sometimes bordered by a thin but distinct lip. Wall texture is smooth and microperforate.
*“Globigerina” angulio*f*ficinalis* Blow, 1969
Globigerina bulbosa Le Roy, 1944
Globigerina bulloides d’Orbigny, 1926
“Globigerina” ciperoensis Bolli, 1957
Globigerina falconensis Blow, 1959
Globigerina officinalis Subbotina, 1953
Globigerina praebulloides Blow, 1959
“Globigerina” prasaepis Blow, 1969
“Globigerina” pseudociperoensis Blow, 1969 (= *Globigerina praebulloides pseudociperoensis* Blow)
“Globigerina” venezuelana Hedberg, 1937
Globigerinatheka index (Finlay, 1939) (= *Globigerinoides index* Finlay)
“Globigerinatheka” senni (Beckmann, 1953) (= *Sphaeroidinella senni* Beckmann)
Globigerinatheka micra (Shutskaya, 1958) (= *Globigerinoides subconglobatus* var. *micra* Shutskaya)
Globigerinella obesa Bolli, 1957
Globigerinella siphonifera (d’Orbigny, 1839) (= *Globigerina siphonifera* d’Orbigny)
Globigerinita glutinata (Egger, 1893) (= *Globigerina glutinata* Egger)
Globigerinita juvenilis (Bolli, 1957) (= *Globigerina juvenilis* Bolli)
Globigerinita uvula (Ehrenberg, 1861) (= *Pylodexia uvula* Ehrenberg)
Globigerinoides bisphericus Todd, 1954
Globigerinoides diminutus Bolli, 1957
Globigerinoides immaturus Le Roy, 1939
Globigerinoides parawoodi Keller, 1961
Globigerinoides quadrilobatus (d’Orbigny, 1839) (= *Globigerina quadrilobata* d’Orbigny)
Globigerinoides ruber (d’Orbigny, 1839) (= *Globigerina rubra* d’Orbigny)
Globigerinoides subquadratus Brönniman, 1954
Globigerinoides subsacculifer Cita, Premoli Silva and Rossi, 1965
Globigerinoides trilobus (Reuss, 1850) (= *Globigerina triloba* Reuss)
Globoquadrina dehiscens (Chapman, Parr, and Collins, 1934) (= *Globorotalia dehiscens* Chapman, Parr and Collins)
Globoquadrina praedehiscens Blow and Banner, 1962
Globoquadrina rohri (Bolli, 1957) (= *Globigerina rohri* Bolli)
Globoquadrina sellii Borsetti, 1959
“Globoquadrina” tapuriensis (Blow and Banner, 1962) (= *Globigerina tripartita tapuriensis* Blow and Banner)
Globoquadrina tripartita (Koch, 1926) (= *Globigerina bulloides* var. *tripartita* Koch)
Globorotalia birnageae Blow, 1959
Globorotalia cf. *suterae* Catalano and Sprovieri, 1971. In the studied samples were found only specimens resembling those illustrated by Poore (1979) as *Globorotalia* cf. *suterae.* Typical specimens belonging to this species are probably absent in the North Atlantic.
Globorotalia inflata (d’Orbigny, 1839) (= *Globigerina inflata* d’Orbigny)
Globorotalia lenguaensis Bolli, 1957
Globorotalia miozea Finlay, 1939

Globorotalia peripheroronda Blow and Banner, 1966 (= *Globorotalia (Turborotalia) peripheroronda* Blow and Banner)
Globorotalia praescitula Blow, 1959
Globorotalia scitula (Brady, 1882) (= *Pulvinulina scitula* Brady)
Globorotalia theyeri Fleisher, 1974
Globorotalia zealandica Hornibrook 1958
Globorotaloides carcosellensis Toumarkine and Bolli, 1975
Globorotaloides permicrus (Blow and Banner, 1962) (= *Globorotalia (Turborotalia) permicra* Blow and Banner)
Globorotaloides sp. 1. This informal species was first identified in the subantarctic region and is recurrent in all the Atlantic Ocean (Premoli Silva and Spezzaferri, 1990; Nocchi et al., 1991). However, in the Irminger Basin it is usually rare.
Globorotaloides stainforthi (Bolli, Loeblich, and Tappan, 1957) (= *Catapsydrax stainforthi* Bolli, Loeblich, and Tappan)
Globorotaloides suteri Bolli, 1957
Globorotaloides variabilis Bolli, 1957
Globoturborotalita rubescens (Hofker, 1956) (= *Globigerina rubescens* Hofker)
Hastigerinopsis riedeli (Rögl and Bolli, 1973) (*Hastigerinella riedeli* Rögl and Bolli)
Morozovella broedermanni (Cushman and Bermudez, 1949) (= *Globorotalia (Truncorotalia) broedermanni* Cushman and Bermudez)
Neogloboquadrina acostaensis (Blow, 1959) (= *Globorotalia acostaensis* Blow)
Neogloboquadrina atlantica (Berggren, 1979) (= *Globigerina atlantica* Berggren)
Neogloboquadrina conglomerata (Schwager, 1866) (= *Globigerina conglomerata* Schwager)
Neogloboquadrina dutertrei (d'Orbigny, 1830) (= *Globigerina dutertrei* d'Orbigny)
Neogloboquadrina humerosa (Takayanagi and Saito, 1962) (= *Globorotalia humerosa* Takayanagi and Saito)
Neogloboquadrina pachyderma (Ehrenberg, 1861) (= *Aristospira pachyderma* Ehrenberg)
Neogloboquadrina praehumerosa (Natori, 1976) (= *Globorotalia (Turborotalia) humerosa praehumerosa* Natori)
Orbulina universa d'Orbigny, 1839
Paragloborotalia acrostoma (Wezel, 1966) (= *Globorotalia acrostoma* Wezel)
Paragloborotalia continuosa (Blow, 1959) (= *Globorotalia opima* subsp. *continuosa* Blow)
Paragloborotalia incognita (Walters, 1965) (= *Globorotalia zealandica incognita* Walters)
Paragloborotalia kugleri (Bolli, 1957) (= *Globorotalia kugleri* Bolli)
Paragloborotalia mayeri (Cushman and Ellisor, 1939) (= *Globorotalia mayeri* Cushman and Ellisor)
Paragloborotalia nana (Bolli, 1957) (= *Globorotalia opima nana,* Bolli)
Paragloborotalia opima (Bolli, 1957) (= *Globorotalia opima opima* Bolli)
Paragloborotalia pseudocontinuosa (Jenkins, 1967) (= *Globorotalia pseudocontinuosa* Jenkins)
Paragloborotalia pseudokugleri (Blow, 1969) (= *Globorotalia pseudokugleri* Blow)
Paragloborotalia semivera (Hornibrook, 1961) (= *Globigerina semivera* Hornibrook)
Paragloborotalia siakensis (Le Roy, 1938) (= *Globigerina siakensis* Le Roy)
Planorotalites planoconicus (Subbotina, 1953) (= *Globorotalia planoconica* Subbotina)
Planorotalites pseudoscitulus (Glaessner, 1937) (= *Globorotalia pseudoscitula* Glaessner)
Praeorbulina glomerosa (Blow, 1956) (= *Globigerinoides glomerosa glomerosa* Blow)
Praeorbulina sicana (de Stefani, 1952) (= *Globigerinoides sicana* de Stefani)
Praeorbulina transitoria (Blow, 1956) (= *Globigerinoides transitoria* Blow)
Pseudohastigerina danvillensis (Howe and Wallace, 1932) (= *Nonion danvillensis* Howe and Wallace)
Pseudohastigerina micra (Cole, 1927) (= *Nonion micrus* Cole)
Pseudohastigerina wilcoxensis (Cushman and Ponton, 1932) (= *Nonion wilcoxensis* Cushman and Ponton)
Sphaeroidinellopsis disjuncta Finlay, 1940
Sphaeroidinellopsis seminulina (Schwager, 1966) (= *Globigerina seminulina* Schwager)
Streptochilus globigerum (Schwager, 1866) (= *Textilaria globigera* Schwager)
Subbotina angiporoides angiporoides (Hornibrook, 1965) (= *Globigerina angiporoides* Hornibrook)
Subbotina angiporoides minima (Jenkins, 1966) (= *Globigerina angiporoides* Hornibrook subsp. *minima* Jenkins)
Subbotina crociapertura Blow, 1979
Subbotina eocaena (Guembel, 1868) (= *Globigerina eocaena* Guembel). This species is very rare in Greenland.
Subbotina eocaenica (Terquem, 1882) (= *Globigerina eocaenica* Terquem)
Subbotina hornibrooki (Brönniman, 1952) (= *Globigerina hornibrooki*, Brönniman)
Subbotina inaequispira (Subbotina, 1953) (= *Globigerina inaequispira* Subbotina)
Subbotina linaperta (Finlay, 1939) (= *Globigerina linaperta* Finlay)
Subbotina utilisindex (Jenkins and Orr, 1973) (= *Globigerina utilisindex* Jenkins and Orr)
Tenuitella anfracta (Parker, 1967) (= G*loborotalia anfracta* Parker)
Tenuitella clemenciae (Bermudez, 1961) (= *Turborotalia clemenciae* Bermudez)
Tenuitella gemma (Jenkins, 1971) (= *Globorotalia (Turborotalia) gemma* Jenkins)
Tenuitella iota (Parker, 1962) (= *Globigerinita iota* Parker)
Tenuitella minutissima (Bolli, 1957) (= *Globorotalia minutissima*)
Tenuitella munda (Jenkins, 1966) (= *Globorotalia munda* Jenkins)
Tenuitella neoclemenciae Li, 1987
Tenuitella reissi (Loeblich and Tappan, 1957) (= *Globorotalia reissi* Loeblich and Tappan)
Tenuitellinata angustiumbilicata (Bolli, 1957) (= *Globigerina ciperoensis angustiumbilicata* Bolli)
Tenuitellinata praestainforthi (Blow, 1979) (= *Globigerinita praestainforthi praestainforthi* Blow)
Tenuitellinata sp. This informal species is generally abundant in Pleistocene sediments recovered on the East Greenland Margin. However, it rarely occurs in Pliocene assemblages. It possesses low trochospiral test consisting of two and a half to three whorls, five chambers in the last whorl gradually increasing in size. An umbilicus is generally present but varies considerably in size. Profile circular and petaloid. Peripheral margin rounded. Umbilical-extraumbilical aperture sometimes strongly tending to the peripheral margin, and bordered by a lip. Wall texture smooth and microperforate.
Turborotalia boweri (Bolli, 1957) (= *Globorotalia boweri* Bolli)
Turborotalia griffinae Blow, 1979
Turborotalia possagnoensis (Toumarkine and Bolli, 1970) (= *Globorotalia cerroazulensis possagnoensis Toumarkine and Bolli)*
Turborotalia praecentralis Blow, 1979
Turborotalia pseudomayeri (Bolli, 1959) (= *Globigerina pseudomayeri* Bolli)
Turborotalita quinqueloba (Natland, 1938) (= *Globigerina quinqueloba* Natland)
Zeaglobigerina ampliapertura (Bolli, 1957) (= *Globigerina ampliapertura* Bolli)
Zeaglobigerina brazieri (Jenkins, 1966) (= *Globigerina brazieri* Jenkins)
Zeaglobigerina connecta (Jenkins, 1964) (= *Globigerina woodi connecta* Jenkins)
Zeaglobigerina decoraperta (Takayanagi and Saito, 1962) (= *Globigerina decoraperta* Takayanagi and Saito)
Zeaglobigerina druryi (Akers, 1955) (= *Globigerina druryi* Akers)
Zeaglobigerina labiacrassata (Jenkins, 1966) (= *Globigerina labiacrassata* Jenkins)
Zeaglobigerina woodi Jenkins, 1960

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APPENDIX

This appendix comprises a complete list of the studied samples, including those devoid of planktonic foraminifers, plotted vs. residue abundance and preservation, presence of contaminants and reworked specimens, benthic foraminifers, radiolarians, sponge spicules, diatoms, echinoids and mollusk fragments, ostracodes, fish remains, quartz, glauconite, oxides, tephra, dropstones, and red clay.

Appendix Table 1. Holes 914A and 914B.

152-914A Core, section, interval (cm)	Abundance of pl. forams >250	150	40	Preservation >250	150	40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids fragments	Mollusks	Ostracodes	Quartz	Glauconite	Tephra	Dropstones	Age
1H-1, 0-2	A	A	A	G	G	G	-	-	C	CR	VA	-	VR	R	R	A	-	-	AC	**Pleistocene**
1H-1, 33-35	A	A	A	G	G	G	-	-	C	-	VR	-	-	-	R	A	R	C	C	
1H-1, 95-97	CR	VR	-	M	M	-	-	-	CR	R	CR	CR	-	-	-	A	-	-	-	
1H-2, 83-85	R	VR	-	M	M	-	-	-	R	-	VR	-	-	-	-	VA	-	R	VA	
1H-2, 96-98	R	VR	-	M	MP	-	-	-	R	-	VR	-	-	-	-	D	-	VR	A	
1H-2, 135-137	VR	VR	-	M	M	-	-	-	-	-	VR	-	-	-	-	A	R	-	A	
1H-3, 95-97	R	-	-	M	-	-	-	-	R	-	VR	-	-	-	-	A	-	-	A	
2H-1, 26-28	VR	-	-	MP	-	-	-	-	R	VR	-	-	-	-	-	A	-	-	A	
1H-1, 32-35	VR	VR	-	P	P	-	-	-	R	-	VR	-	-	-	-	A	-	-	A	
2H-3, 134-136	VR	-	-	MP	-	-	-	-	R	-	VR	-	-	-	-	A	-	-	A	
2H-4, 34-36	R	R	VR	M	M	-	-	-	R	-	VR	-	-	-	-	VA	-	-	A	
2H-5, 62-64	VR	VR	-	P	MP	-	-	-	R	-	-	-	-	-	-	VA	-	-	A	
2H-6, 13-15	VR	VR	-	MP	MP	-	-	-	R	-	-	-	-	-	-	D	-	-	A	

152-914B Core, section, interval (cm)	Barren Samples	*N. pachyderma* sinistr.	Abundance of pl. forams >250	150	40	Preservation >250	150	40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids fragments	Mollusks	Ostracodes	Quartz	Glauconite	Oxides	Tephra	Red Clay	Dropstones	Age
7R CC, 23-25		X	VR	-	-	M	-	-	-	-	-	VR	-	-	-	-	-	A	-	-	-	-	A	**Pleist.**
15R-1, 50-52	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AC	R	R	R	VR	-	**?**
15R-1, 90-92	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	CR	-	CR	-	-	
15R-2, 27-29	B	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	A	R	-	R	-	-	
16R-1, 46-47	B	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	A	R	VR	R	-	-	
16R-2, 90-93	B	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	AC	CR	-	R	R	-	
16R-3, 92-93	B	-	-	-	-	-	-	-	-	-	VR	R	-	-	-	-	-	A	C	-	-	-	-	
16R-4, 76-78	B	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	AC	VR	R	R	VR	-	
17R-1, 82-84	B	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	A	R	VR	VR	-	-	
17R-2, 82-85	B	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	A	R	-	R	VR	-	
17R-3, 73-75	B	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	AC	CR	-	R	VR	-	
17R-4, 76-79	B	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	AC	VR	-	R	-	-	
17R-5, 89-91	B	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	A	R	-	-	VR	-	

Notes: B = barren, VR = very rare (1–3 specimens), R = rare (< 10 specimens), C = common (10–30 specimens), A = abundant (30–50 specimens), VA = very abundant (about 50–70 specimens), D = dominant (more than 70 specimens), VP = very poor preservation, P = poor preservation, M = moderate preservation, G = good preservation, dash = not present.

Appendix Table 2. Holes 915A and 916A.

152-915A Core, section, interval (cm)	Barren Samples	>250 Abundance	150 of	40 pl. forams	>250	150 Preservation	40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids fragments	Mollusks	Ostracods	Quartz	Glauconite	Oxides	Tephra	Red Clay	Dropstones	Age
1R-1, 0-2		CR	R	R	M	M	M	-	-	AC	-	R	-	R	C	-	D	VR	-	-	-	-	**Pleist.**
1R-1, 61-63		AC	AC	C	M	M	M	-	-	AC	CR	C	-	R	-	-	D	-	-		-	A	
15R-CC		VR	-	-	VP	-	-	-	-	C	-	-	-	-	-	-	AC	R	-	-	-	-	**late Eoc.**
16R-1, 9-11	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	R	-	-	-	-	
16R-1, 123-125		VR	VR	VR	P	VP	P	-	-	-	-	-	-	-	-	-	AC	VR	R	-	-	-	
18R-1, 96-98	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AC	R	C	-	VR	-	**?**
18R-2, 96-98	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	R	R	-	VR	-	
18R-3, 84-86	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	R	-	-	-	-	
19R-1, 83-85	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	R	-	-	-	-	
19R-2, 83-85	B	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	R	R	-	-	C	-	
19R-3, 97-99	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	R	-	-	R	-	
20R-1, 95-97	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	R	-	-	R	-	
21R-1, 46-48	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AC	C	-	-	-	-	
21R-2, 1-4	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AC	C	R	-	-	-	
21R-5, 15-17	B	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	C	CR	R	-	-	-	
22R-2, 30-32	B	-	-	-	-	-	-	-	-	VR	VR	-	-	-	-	-	A	CR	R	-	-	-	
22R-3, 22-24	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	R	R	-	-	-	

152-916A Core, section, interval (cm)	Barren Samples	>250 Abundance	150 of	40 pl. forams	>250	150 Preservation	40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids fragments	Mollusks	Ostracods	Quartz	Glauconite	Oxides	Tephra	Wood fragments	Red Clay	Dropstones	Age
5R-1, 61-63		R	R	-	M	M	-	-	-	C	R	-	-	VR	R	-	A	-	-	-		-	AC	**Pleist.**
13R-1, 68-69	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	R	-	-	CR	-		**late Eoc.**
13R-2, 54-55		VR	-	VR	P	-	P	CR	-	-	-	-	-	-	-	-	A	R	-	-		-		
13R-3, 49-50		VR	VR	-	P	P	-	VR	-	-	-	R	-	-	-	-	C	R	-	-		-		

Note: Abbreviations defined in Appendix Table 1.

Appendix Table 3. Hole 918A.

152-918A Core, section, interval (cm)	Barren Samples	Abundance of pl. forams			Preservation			Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids frag.	Mollusks	Ostracods	Quartz	Glauconite	Oxides	Tephra	Dropstones	Age
		>250	150	40	>250	150	40															
1H-1, 45-47		C	VR	R	G	G	M	-	-	R	-	VR	-	-	-	-	D	C	-	R	C	
1H-2, 19-21		A/M	C	R	G	G	G	-	-	C/R	-	-	-	-	-	-	D	R	-	C/R	A/C	
2H-1, 11-13		C	R	VR	G	G	G	-	-	C	VR	VR	-	-	-	-	D	R	-	R	C	
2H-1, 46-48		A	R	VR	G	G	G	-	-	C/R	VR	R	-	-	-	-	A	R	-	R	A	
2H-1, 95-97		C	VR	VR	G/M	M	M	-	-	C	VR	R	-	-	-	-	D	VR	-	-	A/C	
2H-2, 10-12		VR	VR	VR	G	G	G	-	-	R	-	VR	-	-	-	-	D	C/R	-	-	C	
2H-2, 44-46		A	R	VR	G	G/M	M	-	-	R	VR	-	-	-	-	-	D	VR	-	-	A	
2H-2, 95-97		A	R	VR	G	G/M	M	-	-	C/R	VR	VR	-	-	-	-	D	C/R	-	A	C/R	
2H-3, 10-12		A	R	-	G	M	-	-	-	R	VR	C/R	-	-	-	-	D	C/R	-	C	R	
2H-3, 45-47		C	VR	-	G	M	-	-	-	C/R	VR	VR	-	-	-	-	D	C/R	-	R	R	
2H-3, 95-97		A	-	-	G	-	-	-	-	C/R	-	R	-	-	-	-	D	R	-	R	A/C	
2H-4, 16-18		M	VR	-	G/M	M	-	-	-	R	-	-	-	-	-	-	D	R	-	R	A	
2H-4, 45-47		VR	VR	VR	M	M	M	-	-	R	VR	R	-	-	-	-	D	R	-	R	R	
2H-4, 95-97		A	VR	VR	G	M	M	-	-	C/R	VR	VR	-	-	-	-	D	R	R	AC	A/C	
2H-5, 17-19		A/C	VR	VR	G	G	M	-	-	C	-	R	-	-	-	-	D	R	-	R	C	
2H-5, 45-47		R	R	VR	G/M	G	M	-	-	R	-	VR	-	-	-	-	D	R	-	C/R	C	
2H-5, 96-98		C	R	-	G	G/M	-	-	-	R	-	VR	-	-	-	-	D	R	-	R	C/R	
2H-6, 19-21		A	R	-	G	M	-	-	-	R	-	R	-	-	-	-	D	-	-	R	R	
2H-6, 41-43		A/C	VR	-	G	G	-	-	-	R	VR	R	R	-	-	-	D	VR	-	-	R	
2H-6, 97-99		C	VR	VR	M	G/M	M	-	R	C	R	R	-	-	R	-	D	R	-	-	-	
2H-7, 19-21		A	C/R	VR	G	G/M	M	-	-	R	VR	VR	-	-	-	-	A	R	-	-	C/R	
2H-7, 42-44		A	M	-	G	G/M	-	-	-	R	VR	VR	-	-	-	-	D	R	-	A	R	
3H-2, 30-32		A/C	M	VR	G	G/M	G/M	-	-	R	-	R	-	-	-	-	D	R	-	C	A/C	
3H-3, 28-30		A	M	VR	G	G	G	-	-	R	-	R	-	-	-	-	D	VR	-	R	R	
3H-4, 30-32		A	R	-	G	G	-	-	-	C	R	R	-	-	-	-	A	R	-	R	A	
3H-5, 30-32		A	C/R	VR	G	G	G	-	-	A/C	-	VR	R	-	-	-	A/C	R	-	R	A	
3H-6, 29-31		A	C/R	VR	G	G	G	-	-	C	-	R	-	-	-	-	D	VR	-	R	A/C	
3H-7, 29-31		C	R	-	G/M	M	-	-	-	R	R	R	-	-	-	-	D	VR	-	A/C	A	
4H-1, 42-44		A	R	-	G/M	M/P	-	-	-	R	-	R	-	-	-	-	D	VR	-	-	A/C	
4H-1, 95-97		A/C	R	VR	G	G	M/P	R	-	R	-	R	-	-	-	-	D	R	-	-	C	
4H-1, 141-143		A	C/R	R	G/M	M	M	-	-	R	-	-	-	-	-	-	A	-	-	C	C/R	
4H-2, 42-44		A	C/R	VR	G	G	G/M	-	-	C	-	R	-	-	-	-	A	R	-	-	A	
4H-2, 95-97		C	R	VR	G	G/M	M/P	-	-	C	-	VR	-	-	-	-	D	R	-	-	C	
4H-2, 141-143		R	VR	VR	M/P	M	M	-	-	R	-	R	-	-	-	-	D	VR	-	-	R	
4H-3, 42-44		C	R	R	G	G/M	P	-	-	R	-	-	-	-	-	-	D	-	-	-	C	
4H-3, 95-97		C	R	VR	G	M	M	-	-	R	-	-	-	-	-	-	A	-	-	-	C	
4H-3, 140-142		C/R	VR	-	G	M	-	-	-	VR	-	VR	-	-	-	-	D	VR	-	-	R	
4H-4, 42-44		C	VR	VR	G/M	M	M/P	-	-	R	-	R	-	-	-	-	D	VR	-	-	C/R	
4H-4, 95-97		A	VR	-	G/M	M	-	-	-	C/R	-	R	-	-	-	-	D	VR	-	-	-	
4H-4, 140-142		VR	-	-	M	-	-	-	-	VR	-	-	-	-	-	-	D	-	-	-	A	
4H-5, 42-44		C	C/R	VR	G	M	P	-	-	R	-	-	-	-	-	-	D	-	-	R	A/C	**Pleistocene**
4H-5, 96-98		R	R	-	G	M	-	-	-	VR	-	-	-	-	-	-	D	R	-	R	A	
4H-5, 140-142		A	C/R	VR	M	M	M	-	-	C/R	-	R	-	-	-	R	A	VR	-	A	C	
4H-6, 42-44		A	C	R	G	G/M	G/M	-	-	C	-	C	-	-	-	R	D	R	-	A	C	
4H-6, 96-98		VA	C	VR	G	G/M	M	-	-	C	VR	R	-	-	-	-	A/C	R	-	C	C	
4H-6, 141-143		A/C	C	VR	G	G	M	-	-	R	VR	VR	-	-	-	-	D	-	-	R	C/R	
4H-7, 41-43		A	C	VR	G	G/M	M	-	-	C	R	C/R	-	R	-	-	D	R	-	A/C	-	
5H-1, 14-16		A	C	VR	G	G/M	G/M	-	-	C/R	R	R	-	R	-	-	D	R	-	R	C	
5H-1, 69-61		A/C	R	-	G/M	G/M	-	-	-	C	-	C/R	-	-	-	-	D	-	-	VR	R	
5H-1, 120-122		R	R	-	G	G/M	-	-	-	C	-	VR	-	-	-	-	D	-	R	C	C/R	
5H-2, 14-16		C	R	-	G	M	-	-	-	R	VR	R	-	VR	-	-	D	-	-	C/R	C/R	
5H-2, 69-71		R	VR	-	G	G/M	-	-	-	R	VR	R	-	-	-	-	D	-	R	VR	A/C	
5H-2, 120-122		A/C	C/R	VR	G	G	M	-	-	R	-	VR	-	-	-	-	D	-	-	-	R	
5H-3, 14-16		C/R	R	-	G/M	M	-	-	-	VR	-	-	-	-	-	-	D	VR	-	-	A/C	
5H-3, 69-71		C	VR	VR	G	M	P	-	-	R	R	-	-	-	-	-	A	-	-	VR	-	
5H-3, 120-122		R	VR	-	M	P	-	-	-	R	VR	R	-	-	-	-	D	VR	-	R	-	
5H-4, 14-16		C	-	-	G	-	-	-	-	R	-	R	-	-	-	-	D	-	-	-	-	
5H-4, 69-71		C	VR	-	G	M	-	-	-	VR	-	VR	-	-	-	-	D	VR	-	R	R	
5H-4, 120-122		C	VR	-	G/M	VP	-	-	-	R	R	R	-	-	-	-	D	-	-	R	-	
5H-5, 14-16		A	C/R	VR	G	G	M	-	-	R	VR	R	-	-	-	-	D	VR	R	C/R	R	
5H-5, 69-71		A/C	C/R	-	G/M	M	-	-	-	C/R	R	VR	-	-	-	-	A	VR	-	C	A	
5H-5, 120-122		VA	C	VR	G	G/M	M	-	-	C/R	-	VR	-	VR	-	-	A/C	VR	-	R	C	
5H-6, 14-16		A	C	VR	G	M	M	-	-	R	-	R	-	-	-	-	D	R	R	-	R	
5H-6, 69-71		R	VR	VR	G	G/M	P	-	R	R	CR	C	-	VR	-	-	D	-	-	-	A/C	
5H-6, 120-122	B	-	-	-	-	-	-	-	-	-	R	VR	-	-	-	-	D	R	-	-	A/C	
5H-7, 14-16		VR	VR	-	M	M	-	-	-	R	-	VR	-	-	-	-	A	VR	-	-	A	
6H-1, 54-56		A/C	C	VR	G/M	G/M	M	-	-	R	VR	VR	-	-	-	-	D	VR	-	-	A/C	
6H-2, 118-120		VR	-	-	G	-	-	-	-	VR	-	R	-	-	-	-	D	-	R	-	C	
6H-3, 109-111		A	R	VR	G	G/M	M	-	-	R	C	C	-	VR	-	-	A	R	-	C/R	C	
6H-4, 2-5		VR	-	-	M	-	-	-	-	A/C	C/R	R	-	-	-	-	A	R	-	-	A	
6H-5, 145-147		R	-	-	G/M	-	-	-	-	C/R	R	R	-	-	-	-	A	-	R	-	VA	
6H-6, 21-23		VR	-	-	G/M	-	-	-	-	C/R	R	C/R	-	-	-	-	D	VR	-	-	A	
6H-7, 34-36		A	C/R	VR	G	G/M	M	-	-	C	R	C/R	-	-	-	-	D	-	R	-	C	
7H-1, 48-50		A	C	VR	G	G	M	-	-	C/R	R	R	-	-	-	VR	D	VR	-	C	C	
7H-2, 113-115		A/M	C	VR	G/M	G/M	M	-	-	R	R	C/R	-	VR	-	R	D	-	-	-	A	
7H-3, 79-81		VR	-	VR	M	-	G/M	-	-	C	R	-	-	-	-	-	A	R	-	-	A	
7H-4, 106-108		R	R	VR	G/M	M	P	-	-	R	C	R	-	-	-	-	D	VR	-	C/R	R	
7H-5, 59-61		C	C/R	VR	G	M	M	-	-	R	R	R	-	-	-	-	A	VR	-	R	C/R	
7H-6, 126-128		A	C	VR	G	G	G/M	-	-	C	R	R	-	-	-	-	A	R	-	C	-	
7H-7, 12-14		A	C	VR	G/M	M	M	-	-	C	R	C	-	-	-	-	A	-	-	C	C	
8H-1, 144-146		A	C	VR	G	G/M	M/P	-	-	C/R	R	R	-	-	-	-	A	VR	-	R	R	
8H-2, 82-84		A	A/C	VR	G	G	M	-	-	-	-	VR	-	-	-	-	A	-	R	VR	C	
8H-3, 4-6		M	C/R	R	M	M	M/P	-	-	R	-	R	-	-	-	-	A	R	C/R	R	C	
8H-4, 40-42		VA	A	C	G	G	G/M	-	-	-	-	-	-	-	-	-	A	VR	-	-	C/R	
8H-5, 111-113		C	R	-	G/M	M	-	-	-	VR	R	VR	-	-	-	-	A	-	-	A	C	
8H-6, 47-49		R	R	-	G	M	-	-	-	R	VR	R	-	-	-	-	A	VR	C	-	C	
8H-7, 45-47		C/R	R	-	G	G/M	-	-	-	R	R	C/R	-	-	-	VR	D	VR	-	C/R	C/R	
9H-2, 133-135		-	VR	-	-	M	-	-	-	-	R	VR	-	-	-	-	D	-	-	-	A/C	
9H-3, 141-143		C	VR	-	G	G/M	-	-	-	R	R	VR	-	-	-	-	D	-	-	-	A	
9H-4, 59-61		C	R	VR	G	M	M	-	-	VR	R	R	-	-	-	-	C	-	-	-	-	
9H-5, 121-123	B	-	-	-	-	-	-	-	-	-	R	VR	-	-	-	-	VA	-	-	-	C/R	
9H-6, 72-74		C	C/R	VR	G	G/M	M/P	-	-	-	R	VR	-	-	-	-	D	VR	-	-	-	
9H-7, 48-50		C/R	R	VR	G	G	M	-	-	R	C/R	R	-	-	-	-	VA	-	-	R	R	
10H-1, 122-124		AC	VR	-	G	G/M	-	-	-	CR	R	A/C	-	-	-	-	A	VR	-	C	VR	
10H-2, 133-135		-	VR	-	-	M	-	-	-	VR	R	C	-	-	-	-	A	R	C	-	C/R	
10H-3, 88-90		VR	R	-	G	G/M	-	-	-	R	C/R	C/R	-	-	-	-	A	VR	R	A	C	
10H-4, 87-89		A	C	VR	G	G	G	-	-	R	R	A/C	-	-	-	-	A	VR	-	C	R	**Pliocene**
10H-5, 54-56		M	A/C	R	G/M	G	G	-	-	C	R	VA	-	VR	-	-	A	-	-	C	C/R	
10H-6, 64-65		M	C/R	R	G/M	G	G	-	-	C	R	C	-	VR	-	-	A	VR	-	A	C	
10H-7, 14-16		C	A/C	VR	G	G	M	-	-	R	R	C/R	-	-	-	-	C	-	-	A	C	

Note: Abbreviations defined in Appendix Table 1.

Appendix Table 3 (continued).

152-918A Core, section, interval (cm)	Barren Samples	Abundance of pl. forams >250	150	40	Preservation >250	150	40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids frag.	Mollusks	Ostracods	Quartz	Glauconite	Oxides	Tephra	Dropstones	Age
11H-1, 41-43		C	C/R	VR	G	G	G	-	-	C	R	A/C	-	-	-	-	C	-	R	A	-	
11H-2, 81-83		VR	-	-	M	-	-	-	-	-	R	R	-	-	-	-	C	VR	A	C/R	-	
11H-3, 39-41		R	VR	VR	G	G/M	G/M	-	-	C/R	R	R	-	-	-	-	C	R	-	A/C	A	
11H-4, 40-42	B	-	-	-	-	-	-	-	-	-	C/R	VA	-	-	-	-	C	VR	-	A	C/R	
11H-5, 40-42		R	VR	VR	G	G/M	G/M	-	-	R	R	A	-	-	-	-	C	-	R	C	C	
12H-1, 140-142		A/C	R	VR	G	G	G/M	-	-	C/R	R	C/R	-	-	-	-	D	-	-	C/R	C	
12H-2, 89-91		C	C	VR	G	G	M	-	-	C/R	VR	R	-	-	-	-	D	-	-	VR	R	
12H-3, 68-70		R	VR	-	G	R	-	-	-	R	-	-	-	-	-	-	D	-	-	-	R	
12H-4, 85-87		VR	VR	VR	G/M	G/M	G/M	-	-	R	-	R	-	-	-	-	D	VR	C	R	C	
12H-5, 86-88		R	VR	-	G/M	M	-	-	-	R	-	R	-	-	-	-	D	-	-	VR	C	
12H-6, 80-82		VR	R	VR	M	G	M	-	-	VR	-	-	-	-	-	-	D	VR	-	-	C	
12H-7, 46-48		VR	VR	VR	M	M	M	-	-	VR	-	-	-	-	-	-	D	VR	-	-	-	
13H-1, 96-98		VR	-	VR	M	-	P	-	-	-	-	-	-	-	-	-	VA	-	-	-	-	
13H-3, 95-97		VR	VR	-	G	M	-	-	-	R	-	VR	-	-	-	-	A	-	-	VR	-	
13H-4, 94-96		VR	VR	VR	M/P	M	M	-	-	A	-	R	-	-	-	-	A	-	-	VR	R	
13H-5, 95-97		C	VR	VR	G	G	G/M	-	-	C	R	VA	-	-	-	-	A	-	-	C	R	
13H-6, 95-97		VR	VR	-	G	M	-	-	-	-	R	C	-	-	-	-	A	VR	R	C	C/R	
14H-1, 95-97	B	-	-	-	-	-	-	-	-	VR	R	R	-	-	-	-	A	-	R	C/R	C	
14H-2, 95-97		C	VR	VR	G	G/M	M	-	-	VR	R	C	-	-	-	-	D	-	R	C	C	
14H-3, 78-80		VR	VR	-	M	M	-	-	-	R	VR	VR	-	-	-	-	D	VR	VR	VR	R	
14H-4, 95-97		VR	R	VR	M	G/M	M	-	-	VR	-	VR	-	-	-	-	D	VR	-	-	-	
14H-5, 95-97		R	VR	VR	G	G	G	-	-	-	VR	-	-	-	-	-	D	VR	-	-	-	
15H-1, 95-97		VR	VR	-	G/M	M	-	-	-	VR	VR	R	-	-	-	-	D	VR	R	R	C	
15H-2, 95-97		VR	VR	-	G	G/M	-	-	-	R	C	C	-	-	-	-	A	-	A/C	C/R	C/R	
15H-3, 95-97		A	C	VR	M	M	M/P	-	-	A/C	R	C	-	-	-	-	A	-	C/R	A/C	-	
15H-4, 95-97		C	C	VR	G/M	M	P	-	-	R	R	C	-	-	-	-	A	-	R	C	C/R	
15H-5, 95-97		VR	VR	-	G	G	-	-	-	VR	R	R	-	-	-	-	D	-	R	R	C/R	
16H-1, 95-97		-	VR	-	-	M	-	-	-	VR	VR	VR	-	-	-	-	VA	-	-	-	R	
16H-2, 95-97	B	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	A	-	-	-	-	
16H-3, 95-97		-	VR	-	-	G	-	-	-	-	R	-	-	-	-	-	VA	-	-	C/R	-	
16H-4, 95-97	B	-	-	-	-	-	-	-	-	-	R	C/R	-	-	-	-	VA	-	R	C	-	
16H-5, 95-97		A/C	C	VR	G/M	M/P	G/M	-	-	C	R	VA	-	R	-	-	A	R	C/R	A	-	
16H-6, 95-97		C	R	VR	G/M	G/M	G	-	-	C	C/R	A/C	-	-	-	-	VA	VR	C	R	C/R	
17H-1, 95-97		VR	VR	-	G	G	-	-	-	C	R	R	-	-	-	-	A	VR	C	A	-	
17H-2, 95-97		C	C/R	R	G	G	G/M	-	R	C	C	A	-	-	-	-	A	-	A	C	C	
17H-3, 95-97	B	-	-	-	-	-	-	-	-	-	C/R	A	-	-	-	-	VA	-	-	R	A/C	
17H-4, 96-98	B	-	-	-	-	-	-	-	R	VR	VR	C	-	-	-	-	A	R	C	C	C	
17H-5, 95-97		C	C/R	VR	M/P	M/P	P	-	-	C	VR	C	-	-	-	-	A	R	R	A/C	R	
17H-6, 95-97		-	VR	-	-	M	-	-	-	C	VR	C	-	-	-	-	A/C	R	R	C	R	
18H-1, 95-97		C/R	C/R	R	G/M	G/M	G	-	-	C	VR	C/A	-	VR	-	-	A	R	A/C	A	VR	
18H-2, 95-97		C	C/R	VR	P	P	P	-	-	C	R	C/R	-	VR	-	-	A	-	-	A	-	
18H-3, 95-97		VR	VR	-	G/M	M	-	-	R	C	R	R	-	-	-	-	A	R	-	R	-	
18H-4, 95-97		VR	-	-	G	-	-	-	-	VR	R	C	-	-	-	-	D	-	C/R	R	-	
18H-5, 95-97	B	-	-	-	-	-	-	-	-	VR	R	R	-	-	-	-	D	-	R	C/R	-	
18H-6, 95-97	B	-	-	-	-	-	-	-	-	VR	R	C	-	-	-	-	D	VR	C	R	-	
19H-1, 95-97	B	-	-	-	-	-	-	-	-	R	C	A/C	-	-	-	-	A	VR	R	A	-	**Pliocene**
19H-3, 95-97		R	-	-	M	-	-	-	-	-	C	VA	-	-	-	-	A/C	R	-	A/C	-	
19H-4, 95-97		A/C	C	CR	P	P	P	-	-	C	R	C	-	-	-	-	A	-	C	C	-	
19H-5, 95-97		VR	-	VR	P	-	VP	-	-	R	R	R	-	-	-	-	D	VR	-	VR	A/C	
19H-6, 95-97	B	-	-	-	-	-	-	-	-	-	R	C	-	-	-	-	D	-	-	A/C	A/C	
20H-1, 95-97	B	-	-	-	-	-	-	-	-	-	R	C	-	-	-	-	A	-	R	A/C	VR	
20H-2, 105-107		-	VR	-	-	M	-	-	-	R	R	R	-	-	-	-	D	-	R	C	-	
20H-3, 94-96	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	-	-	VR	-	
20H-4, 93-95		VR	VR	-	M	M	-	-	-	C	VR	R	-	-	-	-	D	VR	R	C/R	-	
21H-1, 97-99	B	-	-	-	-	-	-	-	-	VR	-	C/R	-	-	-	-	D	-	-	C	R	
21H-2, 114-116	B	-	-	-	-	-	-	-	-	VR	R	C	-	-	-	-	D	-	-	C	R	
21H-3, 46-48		VR	VR	-	VP	P	-	-	-	R	C/R	C/R	-	-	-	-	D	VR	R	C	C/R	
23H-1, 94-96	B	-	-	-	-	-	-	-	-	-	R	A	-	-	-	-	C	VR	R	A	VR	
23H-2, 95-97	B	-	-	-	-	-	-	-	-	-	C/R	C/R	-	-	-	-	R	-	A	C	C	
23H-3, 95-97	B	-	-	-	-	-	-	-	-	-	C	A	-	-	-	-	C	-	C/R	VA	C	
23H-4, 95-97	B	-	-	-	-	-	-	-	-	-	C	D	-	-	-	-	C	-	-	VA	-	
23H-5, 94-96		R	VR	-	G	M/P	-	-	-	C	R	A	-	-	-	-	A/C	VR	R	A	-	
23H-6, 95-97		VR	VR	VR	M	M	M	-	-	VR	R	A	-	-	-	-	A	-	C/R	C	-	
24H-1, 96-98		VR	VR	VR	M	G	M	-	-	C/R	R	C	-	-	-	-	D	-	A	C	R	
24H-2, 95-97	B	-	-	-	-	-	-	-	-	-	R	C	-	-	-	-	D	-	C	C/R	R	
24H-3, 93-95		R	VR	-	G	G/M	-	-	-	R	R	C	-	-	-	-	D	-	A/C	C	C	
24H-4, 94-96		-	VR	VR	-	P	P	-	-	R	-	R	-	-	-	-	A	-	R	C/R	R	
24H-5, 92-94		-	VR	-	-	M	-	-	-	R	VR	C/R	-	-	-	-	A	VR	C	C	R	
24H-6, 95-97	B	-	-	-	-	-	-	-	-	-	VR	R	-	-	-	-	A	VR	VR	A/C	VR	
25H-1, 96-98	B	-	-	-	-	-	-	-	-	-	-	C/R	-	-	-	-	C	R	R	C	-	
25H-2, 94-96		-	VR	-	-	M	-	-	-	R	VR	R	-	-	-	-	A	-	R	C	R	
25H-3, 94-96		VR	VR	-	VP	VP	-	-	-	R	-	C/R	-	-	-	-	A	-	R	A	-	
25H-4, 94-96	B	-	-	-	-	-	-	-	-	-	R	C/R	-	-	-	-	A	-	C/R	C	-	
25H-5, 94-96		R	C/R	R	VP	VP	VP	-	-	C	R	C	-	-	-	-	A	VR	-	A	-	
25H-6, 94-96		-	VR	-	-	P	-	-	-	R	R	C/A	-	-	-	-	A	-	C	A	C/R	
26H-1, 95-97	B	-	-	-	-	-	-	-	-	VR	R	A	-	-	-	-	C	VR	C	A	R	
26H-2, 95-97	B	-	-	-	-	-	-	-	-	-	R	C	R	-	-	-	C	-	-	A	C/R	
26H-3, 95-97	B	-	-	-	-	-	-	-	-	R	VR	C/R	-	-	-	-	C	-	-	A	-	
26H-4, 95-97		-	VR	-	-	P	-	-	-	R	R	A	-	-	-	-	A	-	R	A	-	
26H-5, 95-97	B	-	-	-	-	-	-	-	-	VR	R	C	-	-	-	-	C	-	-	A	-	
27H-1, 105-107		VR	R	-	M	P	-	-	-	-	VR	C	-	-	-	-	A	-	R	R	-	
27H-2, 95-97		R	R	R	G/M	M	M	-	-	-	R	C	-	-	-	-	A	-	R	C	R	
27H-3, 95-97		C	C	R	M/P	P	P	-	-	C	C	A	-	-	-	-	A	-	R	A/C	C	
27H-4, 95-97		-	VR	VR	-	VP	VP	-	-	VR	C/R	C	-	-	-	-	A	VR	AC	R	R	
27H-5, 95-97	B	-	-	-	-	-	-	-	-	-	VR	R	-	-	-	-	A	VR	C	R	C	
27H-6, 94-96		-	VR	-	-	P	-	-	-	C	R	R	-	-	-	-	VA	-	-	C	R	
28H-1, 95-97	B	-	-	-	-	-	-	-	-	-	-	VR	-	-	-	-	VA	-	-	R	-	
28H-2, 96-98		C/R	VR	-	M	M	-	-	-	R	C	VA	-	-	-	-	A	VR	-	C	-	
28H-3, 95-97		C/R	R	VR	M/P	M	M	-	-	-	C/R	C	-	-	-	-	D	R	VR	R	A	
28H-4, 97-99		VR	VR	-	P	P	-	-	-	C/R	VR	R	-	-	-	-	D	R	-	VR	A/C	
29H-1, 97-99	B	-	-	-	-	-	-	-	-	R	VR	R	-	-	-	-	D	-	R	R	AC	
31H-1, 95-97		-	VR	VR	-	M	M	-	-	C/R	R	C/R	-	-	-	-	A	VR	VR	VA	R	
31H-2, 95-97		VR	R	-	M	M	-	-	-	C/R	R	C	-	-	-	-	A	-	R	C	-	
31H-4, 95-97	B	-	-	-	-	-	-	-	-	-	R	R	-	-	-	-	D	VR	R	C	R	
31H-5, 95-97		-	VR	-	-	P	-	-	-	-	-	VR	-	-	-	-	D	-	R	VR	VR	
31H-6, 95-97		VR	-	-	M	-	-	-	-	R	A	D	-	R	-	-	A	-	R	C/R	C	
32H-1, 96-98		-	VR	-	-	M	-	-	-	R	R	C	-	-	-	-	A	R	VR	C	R	
33H-1, 94-96	B	-	-	-	-	-	-	-	-	-	VR	A	-	-	-	-	A	-	R	C	-	
33H-2, 3-5	B	-	-	-	-	-	-	-	-	-	R	C	-	-	-	-	R	-	R	D	R	
35H-1, 31-33	B	-	-	-	-	-	-	-	-	-	R	R	-	-	-	-	A/C	-	R	VA	-	
37H-1, 95-97		VR	-	-	M	-	-	-	R	-	C/R	A/C	VR	-	-	-	A	-	A/C	C/R	C	
37H-2, 89-91	B	-	-	-	-	-	-	-	-	-	R	C/R	-	-	-	-	A/C	-	C	R	-	
37H-3, 95-97	B	-	-	-	-	-	-	-	-	VR	VR	C/R	-	-	-	-	D	-	A/C	-	R	
37H-4, 95-97		C	VR	VR	M	M	M	-	-	R	VR	R	-	-	-	-	D	R	C	C	-	
37H-6, 10-12		R	VR	-	M	M	-	-	-	C/R	R	R	-	-	-	-	D	R	C	R	R	

Appendix Table 4. Hole 918D.

152-918D Core, section, interval (cm)	Barren	>250	150	40	>250	150	40	Contamination	Reworking	Benthic	Radiolarians	Sponge	Diatoms	Echinoids	Fish	Mollusks	Quartz	Glauconite	Oxides	Red	Tephra	Dropstones	Age
11R-1, 81-83	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	R	R	-	-	A	Pliocene
13R-1, 52-54		VR	-	-	P	-	-	-	-	-	-	-	-	-	-	-	VA	VR	R	-	-	A	
14R-1, 6-8		VR	-	-	VP	-	-	-	-	VR	VR	-	-	-	-	-	C	R	R	-	-	A	
14R-1, 95-97	B	-	-	-	-	-	-	-	-	VR	R	C/R	-	-	-	-	VA	VR	R	-	R	A	
14R-2, 95-97		VR	-	-	P	-	-	-	R	-	-	VR	-	R	-	-	C	R/C	R	VR	-	C	
18R-1, 28-30	B	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	D	R/C	R	-	-	A/C	
22R-1, 134-136		C	CR	VR	G/M	M/P	M/P	-	-	C	-	-	-	R	-	-	D	R/C	R	-	-	C/R	
22R-2, 8-10		A/C	VR	VR	M	M	P	-	-	A/C	-	-	-	R	-	-	VA	C	-	-	R	C	
22R-3, 8-10		C	VR	VR	G/M	M	M	-	-	C/R	-	-	-	R	-	-	VA	R	R	-	VR	C	
24R-1, 97-99		-	VR	-	-	VP	-	-	-	VR	-	-	-	-	-	-	A	VR	R/C	-	-	R	
24R-2, 68-70		C	VR	VR	G/M	M	M	-	-	R	-	-	-	-	-	-	A	R	-	-	-	-	
24R-2, 120-122		VR	-	-	VP	-	-	-	-	VR	-	-	-	-	-	-	A	VR	C	-	-	C	?
24R-3, 26-28		-	VR	-	-	VP	-	-	-	C	VR	-	-	R	-	-	D	R	A	-	-	-	late Miocene
25R-1, 45-48		VR	VR	-	P	M/P	-	-	-	VR	-	-	-	-	-	-	A	VR	A	-	-	-	
25R-2, 14-16		-	VR	-	-	VP	-	-	-	VR	-	-	-	-	-	-	A	R	R	-	-	-	
25R-3, 44-46		-	VR	-	-	P	-	-	-	VR	-	-	-	-	-	-	D	R	C	-	-	C	
25R-4, 72-74		VR	VR	VR	M	P	M	-	R	C	-	-	-	-	-	-	VA	VR	C/R	VR	-	-	
25R-5, 3-4		VR	VR	VR	M	M	M/P	-	-	C/R	-	-	-	-	-	-	A	R	C/R	-	-	-	
27R-1, 44-46	B	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	A	VR	R	-	-	R	
27R-2, 14-16	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	VR	R	-	-	C	
27R-3, 95-97	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	R	R	-	-	-	
28R-1, 94-96	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	-	-	-	-	-	
28R-2, 94-96	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	R	-	-	-	-	
28R-3, 115-117	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	VR	R	-	-	-	
28R-4, 7-9	B	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	A	-	R	-	-	-	
29R-1, 95-97		VR	VR	-	M	M	-	-	-	R	-	-	-	-	-	-	VA	R	R	-	-	-	
29R-2, 95-97		R	-	-	M	-	-	-	-	C	-	-	-	-	-	-	VA	R	R	-	-	-	
31R-1, 73-75	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	R	R	-	-	-	
32R-1, 95-97		VR	VR	-	P	P	-	-	-	R	-	-	-	-	-	-	A	C/R	R	-	-	-	
33R-1, 93-95		VR	R	-	M/P	P	-	-	-	R	-	-	-	-	-	-	A	R	-	-	-	-	
34R-1, 121-122		C/R	VR	VR	P	P	-	-	-	C/R	R	-	-	R	-	-	VA	R	R	-	-	-	
35R-1, 68-69	B	-	-	-	-	-	-	-	-	VR	-	-	-	R	R	-	VA	C/R	R	-	-	-	
35R-2, 66-68		-	VR	-	-	M/P	-	-	-	R	-	-	-	-	-	-	VA	R	R	-	-	-	
36R-1, 130-132		C	C	R	G/M	G/M	P	-	-	R	-	-	-	-	-	-	A	-	C/R	-	-	-	
36R-2, 75-78		A	C	R	M/P	M/P	P	-	R	C	-	-	-	-	-	-	VA	C/R	-	-	-	-	
36R-2, 123-126		C	C	R	M	M/P	P	-	-	R	-	-	-	-	-	-	A	-	R	-	-	-	
37R-2, 14-16	B	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	A	C	R	-	-	-	
37R-3, 13-16		C/R	R	VR	M	M	P	-	-	C	-	-	-	-	-	-	VA	R	R	-	-	-	
37R-3, 58-60	B	-	-	-	-	-	-	-	-	VR	-	-	-	-	R	-	A	A	R	-	-	-	middle Miocene
37R-4, 8-10	B	-	-	-	-	-	-	-	-	C/R	-	-	-	R	-	-	A	C	C	-	-	-	
37R-5, 20-22	B	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	A	R	R	-	-	-	
38R-1, 98-100		C/R	C/R	VR	P	P	VP	-	-	C	-	-	-	R	-	-	VA	R	-	-	-	-	
38R-2, 114-116		VR	VR	VR	P	VP	VP	-	-	R	R	-	-	-	-	-	R	R	R	-	-	-	
38R-3, 60-62		C	R	VR	P	VP	P	-	-	R	R	-	-	-	-	-	A	R	R	-	-	-	
38R-4, 14-16		VR	-	-	P	-	-	-	-	R	VR	-	-	R	-	-	C	R	C	-	-	-	
38R-4, 52-54		R	R	R	VP	VP	P	-	-	C	R	-	-	R	R	-	A	R	C	-	-	-	
38R-5, 13-15		-	VR	VR	-	VP	VP	-	-	C/R	R	R	-	-	-	-	R	R	C/R	-	R	-	
38R-5, 113-115	B	-	-	-	-	-		-	-	R	-	R	-	-	-	-	C	R	R	-	-	-	
38R-6, 23-25	B	-	-	-	-	-		-	-	R	R	C/R	-	-	-	-	C	R	R	-	-	-	
39R-1, 76-78	B	-	-	-	-	-	-	-	-	VR	R/C	A/C	-	-	-	-	A	R	C	-	R	-	
39R-1, 135-137	B	-	-	-	-	-	-	-	-	R	R/C	C	-	-	-	-	A/C	R	-	-	-	-	
39R-2, 16-18		VR	-	-	VP	-	-	-	R	VR	C	A/C	-	-	-	-	A/C	C	-	-	C	-	
39R-2, 93-95	B	-	-	-	-	-	-	-	-	R	R	C/R	-	-	-	-	C	R	R	-	R	-	
39R-3, 53-55	B	-	-	-	-	-	-	-	-	VR	VR	R	-	-	-	-	A/C	R	R	-	VR	-	
39R-3, 94-96	B	-	-	-	-	-	-	-	-	R	C/R	C/R	-	-	-	-	C	C/R	R	-	-	-	
39R-4, 16-18	B	-	-	-	-	-	-	-	-	R	C/R	C/R	VR	-	-	-	C	R	C/R	-	C/R	-	
39R-4, 95-97		VR	VR	VR	P	P	VP	-	R	R	R	C/R	-	-	-	-	C	R	R	-	-	-	
39R-5, 16-18		VR	-	VR	VP	-	VP	-	-	R	R	C/R	VR	-	-	-	A/C	R	R	-	-	-	
39R-6, 0-2		VR	VR	VR	VP	VP	VP	-	-	R	R	A/C	-	-	R	-	C	R	C/R	-	A	-	
39R-6, 73-75		VR	VR	VR	P	P	P	-	-	A/C	R	R	-	-	-	-	C	-	C/R	-	-	-	
40R-1, 41-43	B	-	-	-	-	-	-	-	-	VR	R	R	-	-	-	-	C	R	-	-	R	-	
40R-1, 79-81	B	-	-	-	-	-	-	-	-	C/R	VR	R	-	-	-	-	R	R	R	-	C/R	-	
40R-2, 39-41	B	-	-	-	-	-	-	-	-	-	R	C	-	-	-	-	A	C/R	R	-	-	-	
40R-2, 125-127		VR	VR	VR	P	VP	VP	-	-	R	-	C/R	VR	-	R	-	R	-	R	-	-	-	
40R-3, 34-36		VR	VR	VR	VP	VP	M/P	-	-	R	R	R	-	-	-	-	C	R	R	-	R	-	
40R-3, 116-118		R	VR	VR	P	M/P	VP	-	-	R	R	C	R	-	-	-	A/C	R	R	-	R	-	
40R-4, 64-66	B	-	-	-	-	-	-	-	-	R	R	C	R	-	-	-	R	C/R	R	-	-	-	
40R-4, 120-122	B	-	-	-	-	-	-	-	-	R	C/R	C	R	-	-	-	C	C/R	R	-	-	-	
40R-5, 11-13		VR	VR	VR	P	P	M/P	-	-	C	R	C/R	R	-	-	-	CR	VR	-	-	-	-	
40R-5, 64-66		VR	VR	VR	VP	P	VP	-	-	R	R	R	VR	-	-	-	C	R	-	-	-	-	
40R-6, 23-25	B	-	-	-	-	-	-	-	-	R	C	C	VR	-	-	-	A	VR	R	-	R	-	
40R-6, 48-50		-	VR	-	-	VP	-	-	-	R	R	C	VR	-	-	-	A/C	R	R	-	R	-	
41R-1, 34-36		VR	-	VR	VP	-	P	-	-	R	R	C	-	-	-	-	A/C	R	R	-	R	-	
41R-1, 76-78		VR	-	-	VP	-	-	-	-	R	R	A	VR	-	-	-	C	-	-	-	-	-	
41R-2, 63-65		-	-	-	-	-	-	-	-	C/R	R	C	VR	-	-	-	C	VR	C/R	-	C/R	-	
41R-2, 117-119		VR	VR	-	VP	VP	-	-	-	C/R	R	C	VR	-	-	-	A/C	VR	-	-	VR	-	
41R-3, 32-34	B	-	-	-	-	-	-	-	-	R	R	A	R	R	-	-	A/C	R	-	-	R	-	
41R-3, 121-123		R	VR	-	M	VP	-	-	-	C	C/R	A	-	-	-	-	A/C	C	C/R	-	-	-	
41R-4, 34-36		VR	VR	-	VP	VP	-	-	-	R	R	C	-	-	-	-	C	R	-	-	-	-	
41R-4, 118-120		VR	-	VR	VP	-	P	-	-	VR	R	C/R	R	-	-	-	C/R	R	R	-	-	-	
41R-5, 102-104		VR	-	-	P	-	-	-	-	-	R	C	-	-	-	-	A/C	R	-	-	-	-	
41R-6, 16-18		VR	VR	VR	VP	P	P	-	-	-	R	R	-	-	-	-	C	R	C	-	-	-	
41R-6, 78-80	B	-	-	-	-	-	-	-	-	R	C	A/C	-	-	-	-	A/C	R	A/C	-	-	-	
42R-1, 79-81		VR	VR	VR	M/P	P	VP	-	-	R	R	C	R	-	-	-	C	R	-	-	-	-	
42R-2, 109-111		VR	-	VR	P	-	P	-	-	C/R	C/R	R	-	-	-	-	C	VR	-	-	C	-	
42R-3, 132-134		VR	VR	VR	M	M/P	P	-	-	R	R	R	VR	-	-	-	C/R	R	-	-	-	-	
42R-4, 127-129		VR	VR	VR	VP	VP	VP	-	-	C/R	R	R	-	-	-	-	C	R	-	-	-	-	
42R-5, 99-101		-	-	VR	-	-	P	-	-	R	R	A/C	-	-	-	-	A/C	R	-	-	-	-	
42R-6, 95-97		VR	VR	-	M	G/M	-	-	-	C	R	C	-	-	-	-	A/C	R	-	-	-	-	
43R-1, 24-27		VR	VR	VR	VP	M	M	-	-	C/R	R	R	VR	-	-	-	A/C	VR	-	-	-	-	
43R-1, 103-107	B	-	-	-	-	-	-	-	-	R	R	A/C	-	-	-	-	A/C	-	-	-	-	-	
43R-2, 48-52		-	VR	VR	VP	M	M	-	-	R	R	A/C	-	-	-	-	R	-	-	-	-	-	
43R-2, 145-148		VR	-	VR	-	-	P	-	-	CR	R	C	-	-	-	-	A/C	-	-	-	-	-	

Note: Abbreviations defined in Appendix Table 1.

Appendix Table 4 (continued).

152-918D Core, section, interval (cm)	Barren Samples	>250 Abundance	150	40 pl.	>250 Preservation	150	40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids	Fish remains	Mollusks	Quartz	Glauconite	Oxides	Red clay	Tephra	Dropstones	Age
44R-1, 96-98		-	-	-	-	-	-	-	-	C	R	C/R	-	R	R	-	R	R	R	-	-	-	**mid. Mioc.**
44R-2, 97-100		R	VR	R	P/M	M	M	-	-	R	R	C	-	R	-	-	C	R	R	-	-	-	
44R-3, 98-101		-	VR	VR	-	VP	VP	-	-	R	VR	C	VR	-	-	-	A	C	-	-	-	-	
44R-4, 97-100		-	VR	VR	-	VP	VP	-	R	R	VR	C	-	R	-	-	C	R	-	-	-	-	**early Miocene**
44R-5, 124-127	B	-	-	-	-	-	-	-	-	-	VR	C	-	-	-	-	A	R	-	-	-	-	
47R-2, 95-97		VR	VR	VR	VP	VP	VP	-	-	R	R	C	-	-	R	-	A	C	-	-	-	-	
51R-1, 93-95		C	R	VR	VP	P	VP	-	-	R	C	R	-	-	-	-	C	R	C	-	-	-	
51R-2, 111-113		VR	VR	VR	VP	VP	P	-	-	R	C	R	-	-	-	-	C	-	C/R	-	-	-	
51R-3, 81-83		C	R	VR	VP	VP	VP	-	-	C/R	C	VR	-	VR	-	-	R	C/R	C	-	-	-	
51R-4, 132-134		VR	VR	VR	VP	VP	VP	-	-	R	C	R	-	R	-	-	C	R	R	-	-	-	
51R-5, 28-30		R	VR	R	VP	VP	P	-	-	R	C	R	-	-	-	-	C	R	R	-	-	-	
51R-5, 80-82	B	-	-	-	-	-	-	-	-	-	A	R	R	-	-	-	C	VR	A	-	-	-	
51R-6, 42-44		R	VR	-	P	VP	-	-	-	VR	A	R	-	R	-	-	A	C/R	A	-	-	-	
52R-1, 41-44		VR	R	VR	VP	VP	VP	-	-	R	C/R	R	-	-	-	-	C	R	R	-	-	-	
52R-1, 106-109		C	R	R	P	P	P	-	-	R	R	VR	-	-	-	-	R	VR	R	-	-	-	
52R-2, 34-36		VR	VR	VR	VP	VP	P	-	-	VR	R	R	-	-	R	-	R	VR	R	-	-	-	
52R-2, 92-94		R	R	VR	VP	P	VP	-	-	R	R	VR	-	R	-	-	C/R	VR	C/R	-	-	-	
52R-3, 15-18		R	R	R	VP	P	P	-	-	R	C	-	-	-	-	-	C	R	R	-	-	-	
52R-3, 121-124		C	C/R	R	M/P	P	VP	-	-	R	A/C	R	R	-	-	-	C	R	C/A	-	-	-	
52R-4, 37-40		A/C	A/C	A/C	M/P	P	M/P	-	-	C/R	C	-	-	-	-	-	C/R	R	C	-	-	-	
52R-4, 124-126		A	R	C/R	P	VP	P	-	-	C	A	-	-	R	-	-	C	-	C	-	-	-	
52R-5, 52-55		VR	VR	VR	VP	VP	VP	-	-	R	C	-	-	-	-	-	C	R	C	-	-	-	
52R-5, 83-85		A	R	VR	M/P	P	VP	-	-	R	C	-	-	-	-	-	C	R	C/R	-	-	-	
53R-1, 30-31		C	R	R	P	P	P	-	-	C	A	-	R	R	R	-	-	R	C/R	-	-	-	
53R-1, 121-123		R	VR	VR	VP	VP	VP	-	-	C/R	A	R	-	R	-	-	C	R	C/R	-	-	-	
53R-2, 10-12		C	VR	VR	VP	P	VP	-	-	R	C	R	-	R	R	-	R	C/R	A/C	-	-	-	
53R-2, 93-95		VR	VR	VR	VP	VP	VP	-	-	VR	C	-	-	R	-	-	R	-	C	-	-	-	
53R-3, 47-49		VR	VR	VR	VP	VP	VP	-	-	R	A	-	-	-	-	-	A	R	C	-	-	-	
53R-3, 124-126		R	R	VR	P	VP	P	-	-	R	A	-	-	-	-	-	C	R	R	-	-	-	
53R-4, 38-40		VR	VR	VR	VP	VP	VP	-	-	R	A	-	-	-	-	-	A	C	C	-	-	-	
53R-4, 105-107		VR	VR	VR	VP	VP	VP	-	-	R	A	VR	-	-	R	-	A	R	C	-	-	-	
53R-5, 26-27		VR	VR	VR	VP	VP	VP	-	-	C/R	A	-	-	-	-	-	A	A	A/C	-	-	-	
53R-5, 119-121		R	R	R	P	P	P	-	-	R	C/R	-	-	-	-	-	A/C	R	A	-	-	-	
53R-6, 29-31		VR	VR	VR	VP	VP	VP	-	-	C	A	-	-	-	-	-	C	R	A	-	-	-	
53R-6, 119-121		R	R	VR	P	VP	VP	-	-	C	A	-	-	-	-	-	A	R	R	-	-	-	
53R-CC		R	R	R	VP	VP	VP	-	-	C	A	-	-	-	-	-	C	R	A/C	-	-	-	
55R-1, 64-66		C	C	C/R	M	M	M	-	-	A/C	C	-	-	-	-	-	A/C	R	R	-	-	-	
55R-1, 134-136		A	R	R	M/P	P	P	-	-	R	C	-	VR	R	-	-	A/C	C	-	-	-	-	
55R-2, 4-6		C	C/R	R	M	P	P	-	-	C	C	-	-	-	-	-	A/C	A	-	-	-	-	
55R-2, 88-90		A	C	R	M	VP	P	-	-	C	C	-	-	-	-	-	A	C/R	-	-	-	-	
55R-3, 40-42		A	C/R	R	M/P	P	P	-	-	C/R	C	-	R	-	R	-	R	R	-	-	-	-	
55R-3, 66-68		C	C	C	M	M/P	M	-	-	C	C	-	-	-	-	-	C	C/R	R	-	-	-	
55R-4, 72-74		C	C	C	M	M	M	-	-	-	C/R	-	-	-	-	-	A	C/R	-	-	-	-	
55R-5, 11-13		C	C	C/R	VP	VP	P	-	-	R	C	-	-	R	-	-	C	R	R	-	-	-	
55R-5, 107-109		A	A	A/C	M	M/P	M	-	-	C	C	-	-	-	R	-	A	C	C	-	-	-	
55R-6, 31-33		A	A/C	C	M	MP	M	-	-	C	C	-	-	-	-	-	C	R	R	-	-	-	
57R-1, 43-45		VR	VR	VR	VP	VP	VP	-	-	C/R	C	-	-	-	-	-	C	C	C/R	-	-	-	
57R-1, 118-120		VR	VR	VR	VP	VP	VP	-	-	R	C	-	-	-	-	-	A	-	R	-	-	-	
57R-2, 50-52		VR	C/R	R	VP	VP	VP	-	-	C	A/C	-	-	-	-	-	C	-	C	-	-	-	
57R-2, 116-118		C/R	C/R	VR	VP	P	P	-	-	A/C	A	-	-	-	-	-	C	R	-	-	-	-	
57R-3, 2-4		R	VR	VR	VP	P	P	-	-	A	A	-	-	R	-	-	A	C/R	R	-	-	-	
57R-3, 147-149		R	R	R	VP	P	VP	-	-	C	C	-	-	-	-	-	A/C	C/R	-	-	-	-	
58R-1, 42-44		R	VR	C	VP	P	P	-	-	R	R	VR	-	R	-	-	C	C	-	-	-	-	
62R-1, 87-90		C	C	C	M/P	M/P	M/P	-	-	R	R	-	-	-	-	-	C	C	-	-	-	-	**late Oligocene**
62R-2, 77-81		A/C	A/C	A	P	P	P	-	-	C	-	-	-	-	R	-	C	C/R	-	-	-	-	
63R-1, 93-96		R	C/R	R	P	P	P	-	-	R	-	-	-	-	R	-	C	C/R	-	-	-	-	
63R-2, 34-37		VR	R	VR	P	P	P	-	-	R	-	-	-	-	-	-	A/C	C/R	-	-	-	-	
68R-1, 45-47	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
72R-1, 25-27		R	-	-	P	-	-	-	-	-	-	-	-	-	R	-	A	A/C	-	-	-	-	
75R-1, 53-55		VR	VR	-	P	P	-	-	-	R	-	-	-	-	-	-	A	C	-	-	-	-	
75R-1, 133-135		R	R	R	P	P	P	-	-	C/R	-	-	-	-	-	-	D	C	-	-	-	-	
75R-2, 26-28		-	VR	VR	-	P	P	-	-	R	-	VR	-	-	-	-	C	C/R	-	-	-	-	
75R-2, 108-110		R	R	R	P	P	P	-	-	R	-	-	-	-	R	-	D	A	-	-	-	-	
75R-3, 5-8		R	R	R	P	P	P	-	-	R	-	-	-	-	-	-	D	C/R	-	-	-	-	
76R-1, 28-30		R	R	R	P	P	P	-	-	R	-	-	-	-	-	-	D	C/R	-	-	-	-	
76R-1, 97-100	B	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	D	C/R	-	R	-	-	
78R-1, 25-27		-	VR	-	-	P	-	-	-	-	-	-	-	-	-	-	D	C	-	-	-	-	
84R-1, 59-61	B	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	D	C/R	-	-	-	-	
86R-1, 28-30		R	R	R	P	P	P	-	-	R	R	VR	-	R	-	-	VA	R	-	R	-	-	
86R-2, 69-71		-	R	R	-	P	P	-	-	R	R	-	-	-	-	-	VA	R	R	R	-	-	
88R-1, 70-72		A	A	A/C	M/P	M/P	P	-	-	R	-	-	-	-	-	-	D	VA	-	C	-	-	**middle Eocene**
88R-CC, 3-5		A	A	A	P	P	P	-	-	C	-	-	-	R	R	-	D	A	-	C	-	-	
89R-1, 37-38		A	A/C	A	P	P	P	-	-	C	-	-	-	-	-	-	C/R	C	-	R	-	-	
89R-1, 106-108		C	A	A	M/P	P	P	-	-	R	-	-	-	-	R	-	C	A	R	R	-	-	
89R-2, 13-15		A	A	A	M/P	M/P	M/P	-	-	C/R	-	-	-	R	R	-	R	AC	-	R	-	-	
89R-2, 97-99		A	A	R	M	P	P	-	-	C/R	-	-	-	-	R	-	C/R	A	-	A	-	-	
89R-3, 28-30		R	C	C/R	VP	P	VP	-	-	C/R	-	-	-	R	R	-	A/C	A	-	C	R	-	
89R-3, 63-65		C	C	C	VP	VP	VP	-	-	R	-	VR	-	-	R	-	C	VA	-	-	-	-	
89R-3, 98-99		A/C	C	C/R	VP	VP	VP	-	-	R	-	-	-	-	R	-	C/R	A/C	R	-	-	-	
89R-4, 34-36		A	A	A	G/M	G/M	G/M	-	-	R	-	-	-	-	R	-	C/R	A/C	R	-	-	-	
90R-2, 16-18		R	R	R	P	P	P	-	-	C	-	-	-	R	R	-	VR	A	-	-	-	-	
90R-2, 113-115		R	R	R	P	P	P	-	-	A	-	-	-	R	R	-	R	C	-	-	-	-	
90R-3, 31-33	B	-	-	-	-	-	-	-	-	C	-	-	-	-	-	-	-	A	-	-	-	-	
90R-3, 89-91		R	R	R	P	P	P	-	-	C	R	-	-	-	-	-	R	-	-	-	-	-	
91R-1, 14-16		R	VR	VR	P	P	P	R	-	C	-	-	-	-	-	-	R	A	-	-	-	-	
91R-1, 105-107		-	R	R	-	-	P	-	-	C/R	VR	-	-	-	-	-	A	VR	-	-	-	-	
92R-1, 17-19	B	-	-	-	-	-	-	-	-	-	-	-	-	R	R	-	A	VA	-	-	-	-	
92R-1, 136-138	B	-	-	-	-	-	-	-	-	A/C	VR	-	-	R	R	R	-	VA	-	-	-	-	
92R-2, 41-43	B	-	-	-	-	-	-	-	-	R	-	-	-	R	R	-	C/R	C	-	-	-	-	
93R-1, 24-26		R	R	-	P	P	-	-	-	R	R	-	-	-	R	-	R	R	-	-	-	-	
93R-1, 38-40	B	-	-	-	-	-	-	-	-	R	C/R	-	-	-	R	-	-	VR	-	-	-	-	
93R-2, 7-9	B	-	-	-	-	-	-	-	-	C	C	-	-	-	R	-	-	A	-	-	-	-	
95R-1, 21-23	B	-	-	-	-	-	-	-	-	C	A/C	-	-	-	-	-	-	R	-	-	-	-	
96R-2, 43-45		R	R	-	P	P	-	-	-	R	R	-	-	-	R	-	C	A/C	-	-	-	-	
96R-2, 97-99	B	-	-	-	-	-	-	-	-	R	R	-	-	-	-	-	C	A	-	-	-	-	
96R-3, 71-73	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	C/R	-	-	-	-	
96R-3, 94-96	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	D	-	-	-	-	

Appendix Table 5. Hole 919A.

152-919A Core, section, interval (cm)	Abundance of pl. forams >250	150	40	Preservation >250	150	40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids fragm.	Mollusks	Ostracods	Quartz	Glauconite	Oxides	Tephra	Dropstones	Age
1H-1, 130-132	A/C	C/R	R	G	G	G	-	VR	R	R	VR	R	VR	-	-	A/C	R	R	A/C	-	
1H-2, 20-22	A	A	C	G	G	G	-	VR	C/R	R	VR	-	C	-	-	A/C	R	-	C/R	C	
1H-2, 96-98	A	C	R	G	G	G	-	-	R	-	VR	-	-	-	R	A	R	-	R	R	
1H-2, 130-132	A/C	C/R	R	G	G	G	-	R	R	R	R	-	-	-	R	A	R	-	A	-	
1H-3, 20-22	A	C	R	G	G/M	M	-	-	C	VR	R	R	-	-	R	A	R	-	A	-	
1H-3, 96-98	A	C	R	G	G/M	G	-	VR	C	-	VR	R	-	-	R	A	VR	-	R	C	
1H-3, 130-132	A	C	R	G	G	G	-	VR	C/R	VR	VR	R	-	-	-	A	R	-	A/C	-	
1H-4, 20-22	A	C	R	G	G	G	-	-	R	R	R	VR	-	-	-	A	VR	-	C	R	
1H-4, 96-98	VR	-	VR	M	-	M	-	-	-	R	C	A/C	-	-	-	A	R	-	C	-	
1H-4, 130-132	C/R	VR	-	G/M	G/M	-	-	-	VR	-	VR	C/R	-	-	-	A	VR	-	C	-	
1H-5, 20-22	R	R	VR	G	M	M	-	-	R	VR	VR	R	-	-	-	C	VR	-	R	R	
1H-5, 97-99	A	C	VR	G	G	M	-	-	R	VR	R	VR	VR	-	-	A	R	-	A	C/R	
1H-5, 130-132	A	AC	-	G	G	-	-	-	C/R	R	R	R	VR	-	-	A	R	-	A	R	
2H-1, 15-17	VR	-	-	G/M	-	-	-	-	R	R	R	R	-	-	-	A	VR	-	A	R	
2H-1, 96-98	R	VR	-	G/M	M	-	-	-	C/R	C/R	A	-	-	-	-	A/C	VR	-	A	-	
2H-2, 14-16	C	R	VR	G	G	M	-	-	R	R	C	R	-	-	-	C	-	-	A	-	
2H-2, 95-97	A	C	R	G	P	P	-	R	C	C	C	-	-	-	-	C	-	-	A	R	
2H-3, 13-15	A	C	C/R	G	M	G/M	-	-	C/R	C/R	C	VR	-	-	-	C	-	-	D	R	
2H-3, 95-97	C	R	VR	G	G/M	M	-	-	C	C	C/R	-	-	-	-	A	VR	R	C	R	
2H-4, 14-16	A	A	VR	G	G/M	G/M	-	-	R	R	R	-	R	-	R	A	VR	-	A/C	C	
2H-4, 101-103	C	-	-	G/M	-	-	-	VR	-	-	R	-	-	-	-	C	VR	-	A	R	
2H-5, 13-15	A	A/C	VR	G	G/M	G/M	-	-	R	R	R	-	R	-	-	A	-	-	A	C/R	
2H-5, 94-96	A	R	VR	G	G/M	M	-	-	C/R	C/R	R	-	R	-	-	A	VR	-	C	R	
2H-6, 13-15	A	A/C	A/C	G	G	-	-	-	C	C	C	-	VR	-	VR	A	VR	-	C	R	
3H-1, 8-10	C/R	C	R	G	G	M	-	VR	C	R	A	-	-	-	-	A	-	-	C/R	VR	
3H-1, 95-97	VA	C	R	G	M	M	-	-	C	R	C	-	-	-	-	A	VR	-	C	C	
3H-2, 8-10	A/C	C	-	G/M	P	-	-	-	C/R	R	C/R	-	-	-	-	A	VR	-	C/R	R	
3H-2, 95-97	A	C	VR	G	M	M	-	-	C/R	-	R	-	-	-	R	VA	R	-	R	R	
3H-3, 8-10	A	C	R	G	M/P	M	-	-	C/R	-	-	-	-	-	-	A	R	-	R	C	
3H-3, 96-98	C	C/R	-	G	M	-	-	VR	R	-	-	-	-	-	-	A	R	-	R	R	
3H-4, 8-10	A	C	R	G	G/M	M	-	-	R	-	R	-	-	-	-	A	R	-	C	C	
3H-4, 96-98	A/C	C	R	G	G	M	-	-	R	-	R	-	R	-	R	VA	R	-	C/R	C/R	
3H-5, 8-10	A	C	R	G	G/M	M	-	-	C	-	R	-	R	-	-	A/C	R	-	A/C	R	
3H-5, 97-99	A	A/C	R	G	G	M	-	-	C	R	R	-	-	-	-	C	VR	-	A	R	
3H-6, 7-9	A	C	VR	G	G	M	-	-	C	C	R	-	-	-	R	A	R	-	A	C	
3H-6, 95-97	C	VR	-	G	M	-	-	-	R	R	A/C	R	VR	-	-	A	R	-	A	-	
3H-7, 8-10	R	R	-	G	M	-	-	-	R	C/R	R	-	-	-	-	C	R	-	A	C	
4H-1, 95-97	VR	R	-	G/M	M	-	-	-	C/R	A/C	D	-	-	-	-	D	C/R	R	C	-	
4H-2, 95-97	A/C	C	R	G	G	M	-	-	C/R	C/R	R	-	-	-	-	C	R	-	VA	C	
4H-3, 95-97	-	VR	-	-	M	-	-	-	-	C	D	-	-	-	-	D	VR	-	C	-	
4H-4, 95-97	VR	-	-	M	-	-	-	-	-	-	-	R	-	-	-	C	R	-	VA	VA	
4H-5, 95-97	A	C	R	G	G/M	M	-	-	C	R	R	VR	-	-	-	A	VR	-	C	C	
4H-6, 95-97	A	C/R	-	G	G	-	-	-	C/R	VR	-	-	-	-	-	VA	VR	-	A	C	
5H-1, 95-97	A	C	VR	G	G	M	-	-	C/R	C/R	C/R	-	R	-	-	A	-	-	C	R	
5H-2, 95-97	A	C	R	G	G	M	-	-	C	C/R	C/R	-	-	-	-	A	-	-	C	R	
5H-3, 93-95	A	C	VR	G	M	M	-	-	R	R	-	-	-	-	-	C	R	-	A/C	C	
5H-4, 97-99	VA	C/R	VR	G	M	M	-	-	C	R	R	-	-	-	-	A/C	R	-	A	R	
5H-5, 95-97	VR	-	-	G	-	-	-	-	VR	R	R	-	R	-	-	A	-	R	C	-	
5H-6, 95-97	VR	R	-	G	M	-	-	-	R	C/R	D	-	-	-	-	A	VR	R	R	-	Pleistocene
5H-7, 45-47	VA	C	C/R	G	G	G	-	-	A/C	C	R	-	VR	-	R	A	R	-	A	A/C	
6H-1, 97-99	A	C/R	R	G	M	M	-	R	R	C/R	R	R	-	-	-	A	R	-	A	R	
6H-2, 97-99	A	C/R	VR	G	M	M	-	-	R	-	VR	-	-	-	-	D	R	-	-	C	
6H-3, 97-99	C	C	R	G	G	M	-	-	A/C	C	A	-	-	R	-	C	-	-	VA	-	
6H-4, 96-98	VR	VR	-	G	M	-	-	-	-	C/R	R	-	-	-	-	C	R	-	A	A	
6H-5, 97-99	VA	A	C	G	G	G	-	-	C	C	A/C	-	VR	-	R	A	R	R	C	VR	
6H-6, 78-80	A	A	C/R	G	G	G	-	-	C	C	A	-	-	-	-	A	R	-	C/R	-	
7H-1, 95-97	R	C	VR	G	G	G	-	-	R	R	VR	-	-	-	-	A	CR	-	C	C	
7H-2, 95-97	A	C	R	G	M	G/M	-	-	C/R	R	R	-	R	-	-	D	VR	-	C/R	C	
7H-3, 90-92	VR	VR	-	M	M	-	-	-	R	R	C	-	-	-	-	D	VR	-	R	-	
7H-4, 95-97	A	A/C	C	G	G	G	-	-	C	R	C	-	-	-	-	A	R	C	C	-	
7H-5, 95-97	A	C	-	G	G	-	-	-	R	-	R	-	-	-	-	A	R	-	-	A/C	
7H-6, 94-96	A	A	C	G	G	G	-	-	C	C	A	-	-	-	-	C/R	-	R	-	-	
8H-1, 79-81	A/C	C	R	G	M	M	-	-	R	R	C/R	C/R	-	-	-	A	VR	C	C	-	
8H-2, 96-98	VR	VR	VR	M	M	M	-	-	R	R	VR	-	-	-	-	A	-	-	R	-	
8H-3, 96-98	C	C/R	VR	G/M	M	M	-	-	R	R	R	-	-	-	R	A	-	A	C	-	
8H-4, 96-98	C/R	R	-	M	M	-	-	-	R	R	C	-	R	-	-	A	-	C	C	-	
8H-5, 96-98	C	C	R	G	G	M	-	R	A/C	C/R	C	-	-	-	-	A	-	A	C	-	
8H-6, 96-98	A/C	A/C	R	G	G	G	-	-	C	C/R	C	-	-	-	-	A/C	-	C	A/C	-	
9H-1, 30-32	A	G	C	G	G	G	-	-	A/C	R	A	-	R	-	-	C	R	-	A/C	A/C	
9H-1, 130-132	A	A	A/C	G	G	G	-	-	C	C/R	A/C	R	-	-	R	A	-	R	A	C	
9H-2, 29-31	A	C	R	G	G	G/M	-	-	C	C	A	-	-	-	R	C	-	C/R	R	-	
9H-2, 130-132	C	C/R	R	G	G	G	-	-	R	R	C/R	R	-	-	-	A	R	-	C	R	
9H-3, 29-31	A/C	C/R	C/R	G	G/M	G	-	-	C/R	R	C	-	VR	-	-	VA	R	-	A/C	-	
9H-3, 130-132	R	VR	VR	G	G	G	-	R	R	-	R	R	C/R	-	-	A	C	-	A	-	
9H-4, 29-31	A/C	C	C/R	G	G	G	-	R	A	R	C/R	R	-	-	R	A/C	R	-	C	C	
9H-4, 130-132	A	A/C	R	G	G	G	-	R	A/C	R	A/C	-	-	-	-	A	VR	-	C/R	-	
9H-5, 30-32	A	A/C	C/R	G	G	G	-	-	A/C	R	A	-	-	-	-	C	VR	R	A	-	
9H-5, 129-131	A	A	R	G	G	G	-	-	A	R	A	-	-	-	-	C	-	-	C	-	
9H-6, 29-31	A	C	R	G	G	G	-	-	C	R	C	-	-	-	-	A	R	-	A	C/R	
9H-7, 29-31	A	C	VR	G	G	G	-	-	A/C	R	C	-	R	-	-	A	VR	-	C	R	
10H-1, 46-48	A	A	R	G	G	G/M	-	R	C	R	A/C	-	-	-	R	A	VR	-	C	C	
10H-1, 118-120	C	C/R	-	G	G	-	-	-	R	C	A/C	-	-	-	-	C	VR	-	A	C/R	
10H-2, 36-38	A	A	A/C	G	G	G	-	-	C	R	A	-	R	-	-	A/C	R	-	A/C	-	
10H-3, 35-37	C/R	R	-	G	G	-	-	-	R	A/C	D	-	-	-	-	A	VR	-	C	R	
10H-3, 141-143	A	A	R	G	G	G/M	-	-	C	C	A/C	-	VR	-	R	A	R	-	R	R	
10H-4, 37-39	A	A	R	G	G	G	-	-	C	-	A	-	-	-	VR	D	C/R	-	C/R	C	
10H-5, 70-72	A	A	VR	G	G	M	-	-	C	C	A	-	-	-	-	A	R	-	C	R	
10H-6, 41-43	A	A	R	G	G	G	-	-	C/R	-	VR	-	VR	-	-	C	R	-	C	C/R	

Note: Abbreviations defined in Appendix Table 1.

Appendix Table 6. Hole 919B.

152-919B Core, section, interval (cm)	Barren Samples	Abundance of pl. forams >250	Abundance of pl. forams 150	Abundance of pl. forams 40	Preservation >250	Preservation 150	Preservation 40	Contamination	Reworking	Benthic foram.	Radiolarians	Sponge spicules	Diatoms	Echinoids fragm.	Mollusks	Ostracods	Quartz	Glauconite	Oxides	Tephra	Dropstones	Age
3H-1, 94-96		A	A	C	G	G	G	-	-	C	C	A	-	-	-	-	C	VR	-	A	C	Pleistocene
3H-2, 100-102		A/C	A	R	G	G	G	-	-	C	R	D	-	-	-	-	C	R	-	C	VR	
3H-3, 95-97		A	A	C	G/M	G	G	-	R	R	R	C	-	-	-	-	A	-	-	-	-	
3H-4, 96-98		R	R	VR	G	M	M	-	-	R	R	R	-	-	-	-	A	C	-	-	C	
3H-5, 95-97		A	C	R	G	G	G	-	-	R	R	R	-	-	-	-	A	R	-	A	R	
3H-6, 96-98		C	C/R	-	G/M	G/M	-	-	-	R	R	R	-	-	-	-	A	-	-	VA	R	
4H-1, 95-97		A	C/R	C	G	G	G	-	-	VR	-	-	-	-	-	R	A	R	-	C/R	R	
4H-2, 95-97		A	A	C/R	G	G	M	-	-	C	R	R	-	-	-	-	C	R	-	A	C	
4H-3, 95-97		C	C/R	VR	M	M/P	M	-	-	R	R	A/C	VR	-	-	-	A	R	C	A	R	
4H-4, 95-97		A	A	C/R	G	G	M	-	-	-	R	VA	-	R	-	R	A	-	-	A	VR	
4H-5, 95-97		A	A	R	G	G	M	-	-	C	C/R	A	-	-	-	-	A	-	-	C	R	
5H-1, 95-97		C	R	VR	G	M	P	-	-	R	R	R	-	-	-	-	C	VR	-	VA	-	
5H-2, 95-97		C	C	R	G	G	P	-	-	C	C/R	A	-	R	-	-	A	R	R	R	R	
5H-3, 95-97		C	R	-	G	M	-	-	-	R	C	VA	-	R	-	-	A	-	VR	R	R	
5H-4, 94-96		A	C	R	G	M	M	-	-	R	-	C	-	-	-	-	C	-	C/R	R	R	
5H-5, 97-99		R	VR	-	M	M	-	-	R	VR	R	VR	-	-	-	-	C	-	-	D	R	
5H-6, 97-99		A	C	VR	G	M	M	-	R	R	-	R	-	-	-	-	A	R	VR	A	C/R	
6H-1, 95-97		VA	A	R	G	G	M	-	R	C	R	C	-	-	-	R	A	-	-	A/C	-	
6H-2, 94-96		VA	C	R	G	G	G	-	R	R	-	C	-	-	-	-	A	R	-	C	VR	
6H-3, 96-98		A	C	R	M	M	P	-	R	R	-	-	-	-	-	-	C	R	-	-	C	
6H-4, 95-97		R	VR	-	M	M	-	-	VR	R	R	R	-	-	-	-	A	-	R	C	R	
6H-5, 135-137		VA	C	R	G	M	M/P	-	R	R	R	A/C	-	-	-	-	VA	R	-	C	-	
6H-6, 58-60		VA	A	C	G	G	G	-	R	C	C/R	A	-	-	-	R	A	-	-	C	-	
7H-1, 21-23		C	C/R	VR	M	M/P	P	-	R	C	C/R	VA	-	-	-	-	A	VR	-	R	R	
7H-2, 35-37		C/R	R	-	M	P	-	-	-	R	-	-	-	-	-	-	A	VR	-	-	R	
7H-2, 112-114		R	R	-	G/M	M	-	-	R	-	-	VR	-	-	-	-	A	VR	-	-	C	
7H-3, 59-61		R	VR	-	M	P	-	-	-	R	-	-	-	-	-	-	A	VR	-	-	-	
7H-3, 112-114		VR	R	VR	M	M	M	-	R	R	VR	-	-	-	-	-	A	VR	-	-	R	
7H-4, 30-32		C	C/R	VR	G	M	P	-	-	R	-	-	-	R	-	R	C	-	-	-	C	
7H-4, 125-127		R	VR	-	R	P	-	-	R	-	VR	VR	-	-	-	-	VA	-	A	-	-	
7H-5, 35-37		VR	VR	-	M	P	-	-	-	R	R	-	-	-	-	-	A	-	-	-	C	
7H-5, 125-127		R	VR	-	M	M	-	-	-	R	R	C/R	-	-	-	-	A	-	-	R	R	
7H-6, 19-21		R	R	-	C	P	-	-	-	R	-	C	-	-	-	-	VA	-	R	R	-	
7H-6, 143-145		R	R	VR	M	M	M	-	R	R	-	R	-	-	-	-	A	-	-	R	C	
8H-1, 56-58		A	C	-	G	M	-	-	R	R	R	-	-	-	-	-	C	-	-	A	R	
8H-1, 120-122		R	R	-	M	M	-	-	-	R	R	A	-	-	-	-	A	R	-	C	-	
8H-2, 29-31		C/R	VR	-	G	M	-	-	-	R	R	A	-	-	-	-	A	-	R	R	R	
8H-2, 138-140		A/C	C	R	G	G	M	-	R	R	R	VR	-	-	-	-	A	R	R	R	R	
8H-3, 67-69		C/R	R	VR	G	M	M	-	R	R	-	-	-	R	-	-	A/C	VR	-	-	A	
8H-3, 119-121	1	-	-	-	-	-	-	-	-	VR	-	-	-	-	-	-	A	C/R	-	VR	A/C	
8H-4, 9-11		C	C/R	VR	G	M	M	-	R	R	-	C	-	-	-	-	C	-	-	A/C	-	
8H-4, 128-130		A	A	A	G	G	G	-	R	C	R	C	-	VR	-	-	R	-	-	C	-	
8H-5, 12-14		C	A/C	VR	G	G	M	-	R	R	R	R	-	VR	-	-	A	R	-	C	A	
8H-5, 108-110		C	R	VR	G	M	M	-	R	R	C	VA	-	-	-	-	C	-	-	C	R	
8H-6, 12-14		C	C	VR	G	M	M	-	R	R	-	R	-	-	-	-	A	VR	-	C	C	
8H-6, 109-11		C/R	R	VR	M	M	M	-	R	-	R	R	-	-	-	-	A	-	-	C	A/C	

Note: Abbreviations defined in Appendix Table 1.

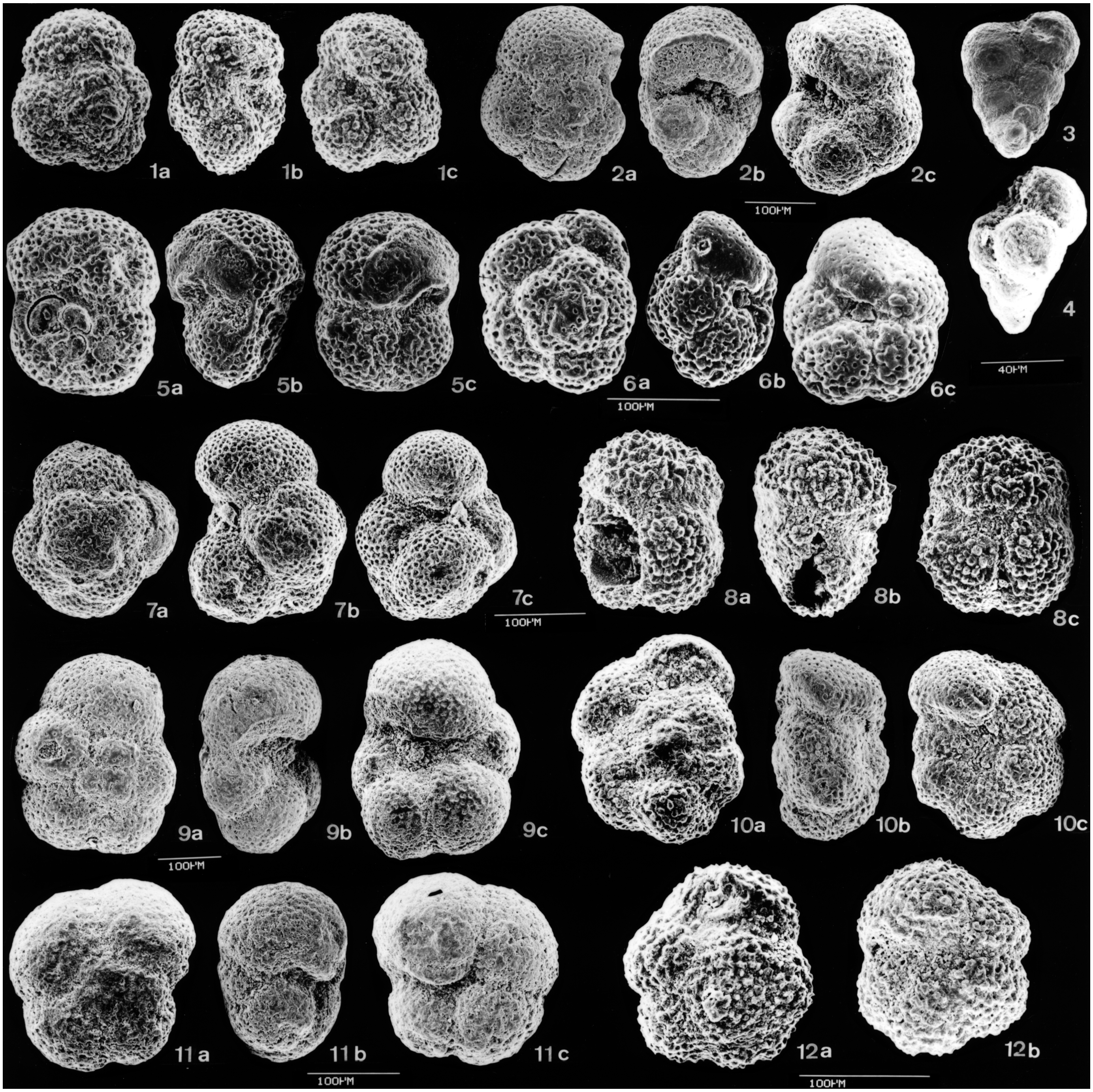

Plate 1. Paleogene planktonic foraminifers from the East Greenland Margin (a, spiral view; b, side view; c, umbilical view; d, detail of the wall texture except when differently specified). **1a–c.** *Acarinina bullbrooki* (Bolli), Sample 152-918D-89R-4, 34–36 cm. **2a–c.** *Turborotalia praecentralis* Blow, Sample 152-918D-93R-1, 24–26 cm. **3.** *Chiloguembelina* cf. *cubensis* (Palmer), Sample 152-918D-88R-1, 70–72 cm, side view. **4.** *Guembelitria* sp., Sample 152-918D-88R-1, 70–72 cm, side view. **5a–c.** *Turborotalia boweri* (Bolli), Sample 152-918D-89R-2, 13–15 cm. **6a–c.** *Acarinina rugosoaculeata,* Sample 152-918D-89R-2, 13–15 cm. **7a–c.** *Acarinina lozanoi* (Colom), Sample 152-918D-89R-4, 34–36 cm. **8a–c.** *Acarinina primitiva* (Finlay), Sample 152-918D-89R-3, 98–99 cm. **9a–c.** *Turborotalia pseudomayeri* (Bolli), Sample 152-918D-93R-1, 24–26 cm. **10a–c.** *Acarinina pentacamerata* Subbotina, Sample 152-918D-89R-4, 34–36 cm. 11a–c. *Turborotalia griffinae* Blow, Sample 152-918D-93R-1, 24–26 cm. **12a–b.** *Acarinina medizzai* (Toumarkine and Bolli), Sample 152-918D-89R-4, 34–36 cm.

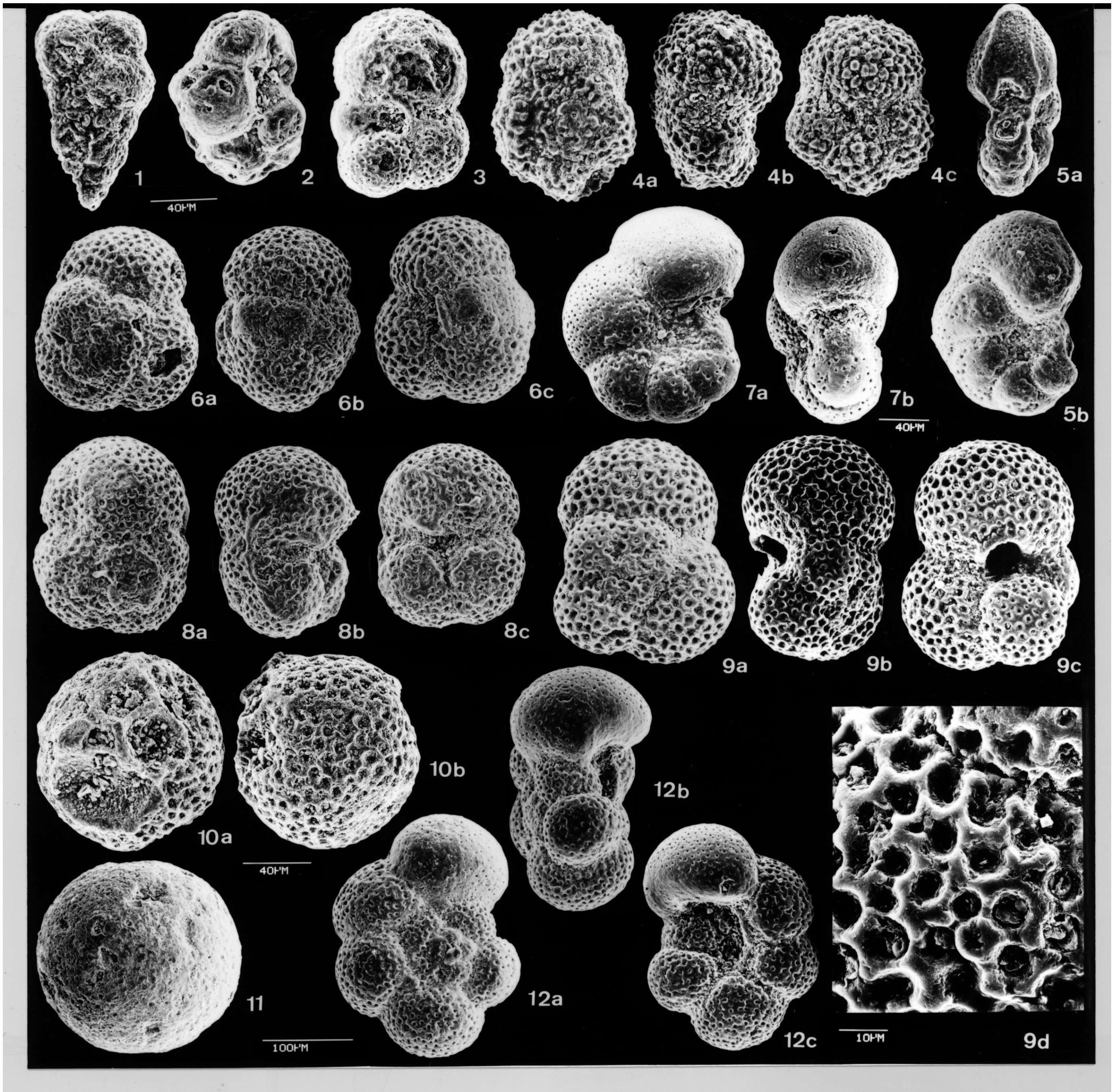

Plate 2. Paleogene planktonic foraminifers from the East Greenland Margin (a, spiral view; b, side view; c, umbilical view, d, detail of the wall texture, except when differently specified). **1.** *Chiloguembelina cubensis* (Palmer), Sample 152-918D-76R-1, 48−30 cm, side view. **2.** *Cassigerinella chipolensis* (Cushman and Ponton), Sample 152-918D-53R-6, 29−31 cm, umbilical view. **3.** *Subbotina crociapertura* Blow, Sample 152-918D-96R-2, 43−45 cm, umbilical view. **4a−c.** *Globorotaloides* sp. 1, Sample 152-918D-90R-2, 16−18 cm. **5a−b.** *Pseudohastigerina danvillensis* (Howe and Wallace), Sample 152-918D-89R-2, 13−15 cm; a, apertural view; b, side view. **6a−c.** *Catapsydrax unicavus* Bolli, Sample 152-918D-88R-1, 70−72 cm. **7a−b.** *Pseudohastigerina wilcoxensis* (Cushman and Ponton), Sample 152-918D-90R-2, 113−115 cm; a, side view; b, apertural view. **8a−c.** *Dentoglobigerina galavisi* (Bermudez), Sample 152-918D-88R-1, 70−72 cm. **9a−d.** *Subbotina hornibrooki* (Brönniman), Sample 152-918D-90R-2, 113−115 cm. **10a−b.** *Globigerinatheka* cf. *index* (Finlay), Sample 152-918D-89R-3, 98−99 cm; a, b, side view. **11.** *Globigerinatheka* sp., Sample 152-918D-89R-4, 34−36 cm. **12a−c.** *Acarinina acceleratoria* Khalilov, Sample 152-918D-88R-1, 70−72 cm.

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