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Data report: late Neogene planktonic foraminiferal biostratigraphy of the Nankai Trough, IODP Expedition 315[1]

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Chapter contents

Abstract

Planktonic foraminifers from Site C0001, drilled during Integrated Ocean Drilling Program Expedition 315 off the Kumano region in the northwestern Pacific Ocean, were examined to establish a reference biostratigraphy of the Nankai Trough Seismogenic Zone. Planktonic foraminifers are present throughout the cores at this site, with the exception of several barren intervals in the lower part of the section. Seventeen biohorizons are recognized at this site. Among these, 15 biohorizons were refined and 2 biohorizons were detected after the onboard study. The studied sequence correlates with Zones N.17b–N.22, ranging in age from late Miocene to Holocene. A new age-depth plot for the site is proposed based the foraminiferal data from this study combined with nannofossil biohorizons determined on board during the expedition.

Introduction

Integrated Ocean Drilling Program Expedition 315 was conducted to investigate detailed physical properties and stratigraphy at two pilot sites for future riser drilling in the Nankai Trough Seismogenic Zone off the Kumano region, Kii Peninsula, southwest Honshu, Japan (see the **"Expedition 315 summary"** chapter [Ashi et al., 2009]). During the expedition, the R/V *Chikyu* drilled seven holes at Site C0001 and two holes at Site C0002. Site C0001 is located at the slope basin on the Nankai accretionary prism (33°14′N, 136°42′E; 2198 m water depth) (Fig. **F1**). At Site C0001, ocean bottom sediments to 458 m coring depth below seafloor (CSF) were obtained using the hydraulic piston coring system, extended shoe coring system, and rotary core barrel system. With respect to onboard visual description of the obtained cores, the lithology is divided into two units: Unit I is Quaternary slope apron deposits, and Unit II is Miocene to Quaternary accretionary prism sediments. These sediments are mainly composed of hemipelagic silty clay to clayey silt with many intercalating ash and sand layers. The boundary between the units is unconformable and marked by a basal sand layer.

To reconstruct the detailed deformation history of the NankaiTrough Seismogenic Zone, we need a combined stratigraphic approach including biostratigraphic methods. In previous drilling of the Nankai area at the Ashizuri and Muroto

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transects, ~200–250 km westward of the present site (Fig. F1), the stratigraphic framework of the accretionary prism was mainly established by calcareous nannofossil biostratigraphy (Deep Sea Drilling Project Legs 31 and 87 and Ocean Drilling Program Legs 131 and 190) (Karig, Ingle, et al., 1975; Kagami, Karig, Coulbourn, et al., 1986; Hill, Taira, Firth, et al., 1993; Moore et al., 2005). However, because of dissolution processes beneath the calcium carbonate depth (CCD), planktonic foraminifers are poorly preserved and sparse at these sites (Ujiié, 1975; Lagoe, 1986).

According to onboard study during Expedition 315, sediments from Site C0001 bear calcareous microfossils including planktonic foraminifers (see the **"Expedition 315 summary"** chapter [Ashi et al., 2009]). Therefore, this site is suitable for establishing a standard biostratigraphy for the Nankai Trough Seismogenic Zone. In addition, continuous foraminiferal data from the present site have a great potential for aiding paleoceanographic reconstruction of the Western Boundary Current of the northwestern Pacific Ocean (the Kuroshio Current; Fig. F1). The purpose of this study is to construct a detailed planktonic foraminiferal biostratigraphy of Site C0001 as a reference biostratigraphy for the Nankai Trough Seismogenic Experiment (NanTroSEIZE) project.

Methods and materials

Samples used for this research were collected from Holes C0001E, C0001F, and C0001H at an interval of 1 to 2 samples per section. We treated 266 samples, ranging in age from Holocene to late Miocene. The stratigraphy of the present site is divided into two units. Unit I (0–198.98 m logging depth below seafloor [LSF] in Hole C0001D) is slope apron deposits mainly composed of hemipelagic clayey silt to silty clay. Unit II (198.98 m LSF to bottom of hole) is the accretionary prism consisting of siltstone with many minor faults.

Soft-sediment samples from Unit I (20 cm^3) were treated with a hydrogen peroxide solution. Firm rock samples from Unit II were disaggregated using the sodium tetraphenylborate method (Hanken, 1979). After samples became macerated, each sample was wet-sieved through a 63 µm screen. Planktonic foraminiferal specimens >125 µm were observed under a binocular microscope. Semiquantitative estimates were made of species relative abundance (abundant: >16%, common: 8%–16%, rare: 4%–8%, present: <4%) for each sample that contained >100 individuals. Species from samples yielding <100 individuals were recorded as "+" in occurrence tables. Scanning electron microphotographs of selected index species were taken using a JCM-5000 (JEOL Co. Ltd., Japan).

At Site C0001, most of the marker species for Berggren et al.'s (1995) zonation are very rare or absent. Therefore, we use the planktonic foraminiferal zonation of Blow (1969). Biohorizons were quoted from Thompson et al. (1979) (biohorizon 1 of table 1), Oda (1977) (biohorizon 5), Berggren et al. (1995) (biohorizons 3, 9, and 17), Motoyama et al. (2004) (biohorizons 6 and 8), and Gradstein et al. (2004) (biohorizons 2, 4, 7, and 10–16) and converted in numerical age to the standard GTS2004 timescale (Gradstein et al., 2004).

Results

Planktonic foraminiferal fossils occur throughout Site C0001, with the exception of several barren intervals in Unit II. Fossil abundance and preservation are generally excellent in Unit I. In contrast, sediments from Unit II have rare occurrences of planktonic foraminifers, with moderate to poor preservation or barren intervals. These barren samples include only thick-walled benthic foraminifers with surfaces disfigured by dissolution. Therefore, the rare occurrences and barren intervals in Unit II might be the result of some dissolution processes.

Stratigraphic distributions of selected planktonic foraminiferal species are given in Tables **T1, T2,** and **T3.** Scanning electron microphotographs of important age-diagnostic species are shown in Plates **P1, P2, P3,** and **P4.** The planktonic foraminiferal assemblage is characterized by dominant occurrences of such temperate to cosmopolitan taxa as *Neogloboquadrina* and *Globigerina*. Tropical to subtropical taxa such as *Globigerinoides, Globorotalia,* and *Pulleniatina* continuously occur in Unit I. Presently, the Kumano region lies beneath mixed waters caused by coastal upwelling between the warm Kuroshio Current and the Kii Peninsula (Fig. F1). Hence, the foraminiferal composition of Unit I is consistent with present-day conditions. The assemblage of Unit II includes more cool-water taxa, such as *Neogloboquadrina pachyderma* (sinistral), than Unit I. The most noteworthy feature of the Unit II assemblage is cyclic changes in the dominant coiling direction of *N. pachyderma* (Fig. F2; Table T4). At least 18 changes with 10 dextral and 9 sinistral intervals are observed in the studied section from

~3–5 Ma. The frequency of the coiling change generally corresponds to the perturbation of orbital eccentricity.

A total of 17 biohorizons are recognized in Holes C0001E, C0001F, and C0001H (Table T4). Among them, 15 biohorizons (1–3, 5–11, and 13–17) were reported on board using core catcher samples (see the "Expedition 315 Site C0001" chapter [Expedition 315 Scientists, 2009]) and refined by examination of section samples in the present study. Two biohorizons (4 and 12; see Table T4) were detected in the present study. *Globigerinoides ruber* (pink) continuously occurs between Samples 315-C0001E-1H-3, 5–10 cm, and 2H-5, 14–18 cm. The last occurrence (LO) of this morphotype (0.12 Ma) is recognized between Samples 315-C0001E-1H-2, 36–40 cm (0.40 m LSF), and 1H-3, 81–83 cm (1.44 m LSF). In Hole C0001B, this biohorizon is located above Sample 314-C0001B-1H-CC, 0–5 cm (2.11 m LSF), which is in good accordance with the results of Hole C0001E. *Truncorotalia tosaensis* occurs from the lower to middle part of Hole C0001E, and the LO (0.61 Ma) is recognized between Samples 315-C0001E-3H-1, 40–42 cm (13.33 m LSF), and 3H-CC, 23–28 cm (13.59 m LSF). The first occurrence (FO) of *Truncorotalia crassaformis hessi* is placed between Samples 315-C0001E-9H-8, 72–73 cm (78.55 m LSF), and 9H-CC, 29–34 cm (79.28 m LSF). The LO of *Globoturborotalita obliquus* lies between Samples 315-C0001F-4H-8, 55–60 cm (139.19 m LSF), and 4H-CC, 12.5–17.5 cm (139.60 m LSF). The coiling direction change from sinistral to dextral of *Pulleniatina* spp., mainly composed of *Pulleniatina obliquiloculata* and *Pulleniatina primalis,* is recorded twice: the lower (SD1: 4.08 Ma) is between Samples 315-C0001F-14H-CC, 0–5 cm (206.66 m LSF), and 315-C0001H-1R-CC, 26–31 cm (232.52 m LSF), and the upper (SD2: 1.7–1.8 Ma) lies between Samples 315-C0001F-6H-CC, 21–26 cm (157.67 m LSF), and 7H-2, 12–16 cm (159.45 m LSF). The FO of *Truncorotalia truncatulinoides* (1.93 Ma) is detected between Samples 315-C0001F-9H-6, 32–36 cm (180.75 m LSF), and 9H-CC, 27.5–32.5 cm (184.65 m LSF), and defines the base of Zone N.22. *Neogloboquadrina asanoi* occurs abundantly in Samples 315-C0001F-10H-11, 52–54 cm (189.49 m LSF), and 10H-CC, 37–42 cm (191.31 m LSF). The LO of this species (1.8 Ma) is clearly observed between Samples 315-C0001F-10H-9, 114–119 cm (188.70 m LSF), and 10H-11, 52–54 cm. The FO of *T. tosaensis* (3.35 Ma) is placed between Samples 315-C0001F-11H-CC, 13–18 cm (194.93 m LSF), and 12H-CC, 18–23 cm (195.96 m LSF), and determines the lower boundary of Zone N.21. Three biohorizons of different ages are found in the same interval, namely, the FO of *Globoconella inflata* modern form (2.3–2.5 Ma) and the LOs of *Sphaeroidinellopsis seminulina* s.l. (*S. seminulina* and *Sphaeroidinellopsis subdehiscens*) (3.59 Ma) and *Dentoglobigerina altispira altispira* (3.47 Ma), between Samples 315-C0001F-13H-CC, 20–25 cm (199.29 m LSF), and 14H-1, 125–129 cm (200.98 m LSF). This interval corresponds to the lithostratigraphic boundary between Units I and II. With respect to the foraminiferal ages, the sedimentation gap between Units I and II should be at least 1.09 m.y. The LO of *Hirsutella margaritae* (3.85 Ma) could be placed below Sample 315-C0001C-5R-1, 25–27 cm (267.69 m LSF). However, the precise position of the LO cannot be determined because the species occurs only sporadically. The FO of *Truncorotalia crassaformis* (4.31 Ma) is placed between Samples 315-C0001F-18H-CC, 0–1 cm (216.85 m LSF), and 20X-4, 65–67 cm (224.14 m LSF). The LO of *Globoturborotalita nepenthes* occurs between Samples 315-C0001H-2R-1, 110–112 cm (237.83 m LSF), and 2R-3, 127–129 cm (240.91 m LSF). The zonal maker species *Globorotalia tumida* appears sporadically, and its deepest occurrence is in Sample 315-C0001H-24R-1, 99–101 cm (439.47 m LSF). It therefore indicates a maximum age of 5.57 Ma for this sample. This biohorizon also defines the lower boundary of Zone N.18. In addition, the lowermost sample of Hole C0001H, namely, 315-C0001H-26H-CC, 15–20 cm (456.67 m LSF), contains *P. primalis*. Therefore, the sample is younger than the FO age of *P. primalis* (6.4 Ma: the lower boundary of Subzone N.17b).

The FOs of *T. crassaformis hessi, T. truncatulinoides,* and *T. tosaensis* are slightly discordant with other biohorizons. Previous workers have mentioned that these events are occasionally delayed in mid-latitude regions; for example, the FO of *T. truncatulinoides* is about 2.4 Ma in the southwestern part of the Pacific Ocean (Dowsett, 1988) and 1.1–1.2 Ma off southern Australia (Brunner et al., 2002). This implies that the discordance could be explained by ecological diachroneities of the three biohorizons.

In addition to the key species above, two important index species, namely *Globoturborotalita extremus* and *Pulleniatina finalis,* are recognized in the middle to lower part of the section. The LO of *G. extremus* is 1.98 Ma (Gradstein et al., 2004), and the FO of *P. finalis* is 2.04 Ma (Berggren et al., 1995; recalibrated to the standard timescale of Gradstein et al., 2004). However, it is hard to identify the two biohorizons at the present site because of their discontinuous occurrences.

Figure F2 represents the refined age-depth plot of Site C0001 using biohorizons of calcareous nannofossils (see the "Expedition 315 Site C0001" chapter [Expedition 315 Scientists, 2009]) and planktonic foraminifers (the present study). The plot indicates that foraminiferal biohorizons of the present study generally are consistent with the calcareous nannofossil data. Furthermore, the planktonic foraminiferal data provide detailed constraints around the boundary between Units I and II rather than the nannofossil data. Sedimentation rates of the upper slope apron deposits (Unit I) can be divided into three intervals: the uppermost part (~0–50 m LSF) is 50–60 mm/k.y., the middle part (~50–130 m LSF) is 200–250 mm/k.y., and the lower part (~130 m LSF to the base of Unit I) is 80–90 mm/k.y. No evidence of significant stratigraphic repeat is observed in Unit II, even though the unit is composed of accretionary prism deposits. The sedimentation rates of Unit II range from 200 to 220 mm/k.y.

The Pliocene/Pleistocene boundary is constrained between Samples 315-C0001F-13H-CC, 20–25 cm (199.29 m LSF), and 14H-1, 125–129 cm (200.98 m LSF), on the basis of two planktonic foraminiferal biohorizons, namely the FO of *G. inflata* modern form and the LO of *D. altispira altispira*. This boundary corresponds to the unconformity between lithologic Units I and II. The Miocene/Pliocene boundary is suggested just above the FO of *G. tumida*. This biohorizon lies below Sample 315-C0001H-24R-1, 99–101 cm (439.47 m LSF). However, calcareous nannofossil results indicate that the Miocene/Pliocene boundary is located between Samples 315-C0001H-24R-CC, 0–5 cm (441.82 m LSF), and 26R-CC, 15–20 cm (456.67 m CSF) (see the "Expedition 315 Site C0001" chapter [Expedition 315 Scientists, 2009]). The precise determination of the boundary requires further studies.

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Globigerina falconensis Blow, 1959, p. 177, pl. 9, figs. 40a–40c, 41.

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Globigerinella siphonifera (d'Orbigny), 1839b, p. 83, pl. 4, figs. 15–18; Banner and Blow, 1960, pp. 22–23, figs. 2a–2c.

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Globigerinita iota Parker, 1962, p. 250, pl. 10, figs. 26–30.

Globigerinita uvula (Ehrenberg), 1861, pl. 2, figs. 24–25.

Globigerinoides bollii Blow, 1959, p. 189, pl. 10, figs. 65a–65c.

Globigerinoides conglobatus (Brady), 1879, p. 28; Brady, 1884, pl. 80, figs. 1–5.

Globigerinoides ruber (d'Orbigny), 1839b, p. 82, pl. 4, figs. 12–14.

Note: *G. ruber* is divided into two morphotypes (white and pink). Gradstein et al. (2004, table A2.3) call the pink-type morphotype *G. ruber rosa*.

Globigerinoides sacculifer (Brady), 1877, p. 535; Brady, 1884, pl. 80, figs. 11–17.

Globoconella conoidea (Walters), 1965, p. 124, figs. 8i–8m.

Globoconella conomiozea (Kennett), 1966, p. 235, figs. 10a–10c.

Globoconella inflata (d'Orbigny), 1839c, p. 134, pl. 12, figs. 7–9.

Note: The evolutional trend of *G. inflata* is characterized by a reduction in the number of chambers in the uppermost whorl (e.g., Malmgren and Kennett, 1981). We distinguished *G. inflata* into two morphotypes, namely transitional and modern forms, by the number of chambers (Hayashi et al., 2003). The modern form differs from the transitional form in having three chambers in its last whorl, in contrast to the four chambers of the transitional form.

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Figure F1. Map showing the Site C0001 with previous ODP and DSDP sites in and around the Nankai Trough, northwestern Pacific Ocean. Topographic data are distributed from the Hydrographic and Oceanographic Department, Japan Coast Guard. Blue oval marks the area of coastal upwelling around Site C0001.

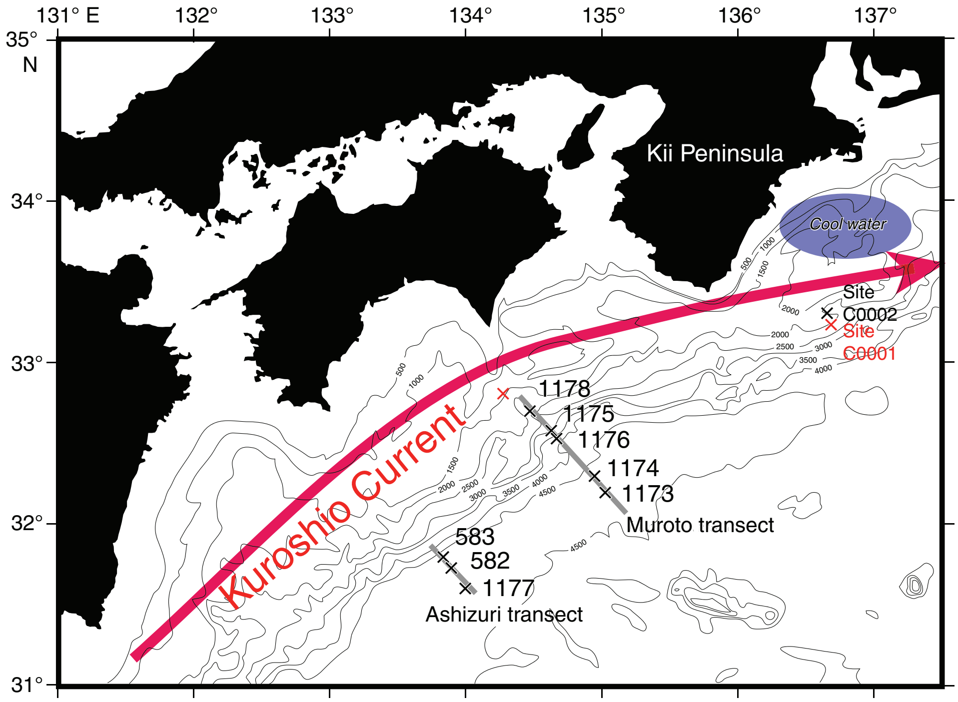

Figure F2. Age-depth plot for Site C0001. Nannofossil zones are from Martini (1971) and planktonic foraminifer zones are from Blow (1969). See the "Expedition 315 summary" chapter (Ashi et al., 2009) for discussion about lithologic units. For coiling ratio column, *Neogloboquadrina pachyderma* s.l. is *Neogloboquadrina pachyderma* and *Neogloboquadrina incompta*. Biohorizon numbers are defined in Table T4.

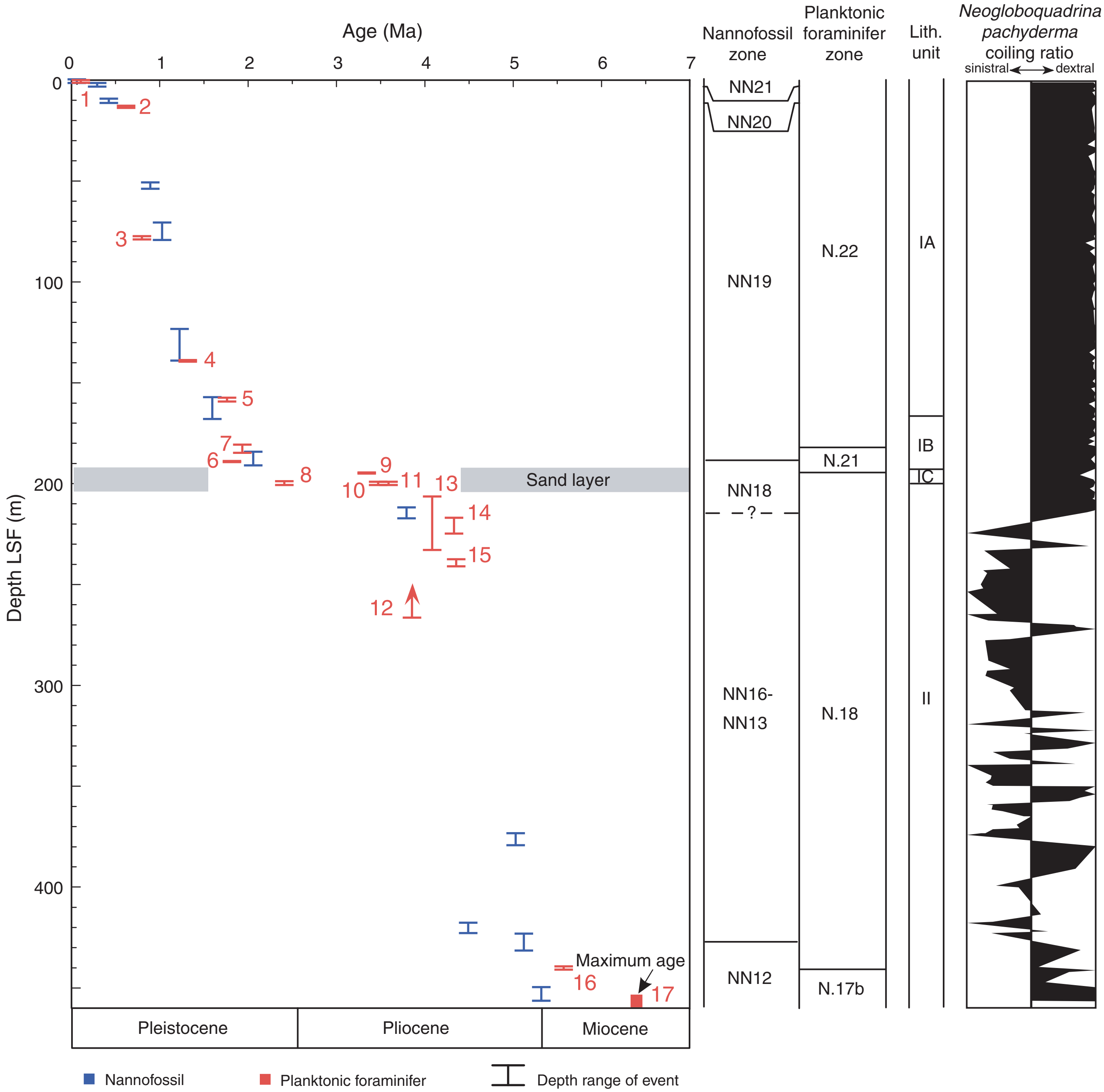

Table T1. Stratigraphic distribution of selected planktonic foraminiferal species, Hole C0001E. (Continued on next page.)

Core, section, interval (cm)	Depth CCSF (m)	Depth LSF in Hole C0001D (m)	Abundance	Preservation	*Globigerina bulloides*	*Globigerina falconensis*	*Globigerina umbilicata*	*Globigerinella calida*	*Globigerinella siphonifera*	*Globigerinita glutinata*	*Globigerinita iota*	*Globigerinita uvula*	*Globigerinoides conglobatus*	*Globigerinoides ruber* (white)	*Globigerinoides ruber* (pink)	*Globigerinoides sacculifer*	*Globoconella inflata* modern form	*Globoconella inflata* transitional form	*Globoconella puncticulata*	*Globorotalia tumida*	*Globorotaloides variabilis*	*Globoturborotalita rubescens*	*Globoturborotalita tenella*	*Hastigerina pelagica*	*Hirsutella hirsuta*	*Hirsutella scitula*	*Menardella menardii*	*Neogloboquadrina dutertrei*	*Neogloboquadrina humerosa*	*Neogloboquadrina incompta*	*Neogloboquadrina inglei*	*Neogloboquadrina* cf. *inglei*	*Neogloboquadrina kagaensis*	*Neogloboquadrina pachyderma* (dextral)	*Neogloboquadrina pachyderma* (sinistral)	*Orbulina suturalis*	*Orbulina universa*	*Pulleniatina obliquiloculata* (dextral)	*Pulleniatina obliquiloculata* (sinistral)	*Sphaeroidinella dehiscens*	*Truncorotalia crassaformis*	*Truncorotalia crassaformis hessi*	*Truncorotalia crassaformis viola*	*Truncorotalia tosaensis*	*Truncorotalia truncatulinoides*	*Turborotalita quinqueloba*
315-C0001E-																																														
1H-1, 7.0–9.0	0.07	0.07	A	M	C				+	R			+	R		+	C	C		+						+	+	R		A							+	R			+				+	+
1H-2, 36.0–40.0	0.42	0.40	A	G	R	+				R	+	+		+		+	R	C		+		+	+			+	+	C		A		+		C	+		+	+			+				+	+
1H-3, 5.0–10.0	1.52	1.44	A	G	R	+			+	+			+	+	+	R	C	R		+		+				+		C		A				R			+	R			+				+	
1H-3, 79.0–83.0	2.19	2.08	C	G	A	R			+	A	+	+	+	+	+	+	+	R		+	+	+				+	+	R	+	C				+			+	R			+				+	+
1H-5, 39.0–43.0	3.21	3.05	A	G	C	R			+	C	R		+	R	+	+	+	+		+	+	+	+			+	+	R		A				C	+		+	+		+	+				+	+
1H-CC, 20.0–25.0	4.08	3.87	A	G	A					+			+	C	+	+	A	+		+							+	C		A							+	A			+				+	
2H-1, 11.0–15.0	4.22	4.01	A	G	C	C				R	+	+		+	+	+	C	R				+	+				+	C		A				C				R			+				+	+
2H-2, 12.0–16.0	5.62	5.34	A	G	C	R			+	R	+	+	+	R	+	+	+	+		+	+	+	+			+	+	R		A				A	+		+	R			+				+	
2H-3, 12.0–16.0	7.03	6.67	A	G	C	C			+	A	R	+	+	+	+	+	+	+		+	+	R	+		+	+	+	R	+	R				+			+	+	+	+	+				+	R
2H-5, 14.0–18.0	8.66	8.22	A	G	R	+				A	+		+	+	+		R	R		+	+	+	+			+	+	+		A				C			+	+			+					+
2H-5, 81.0–86.0	9.29	8.82	A	G		+				R			+	+		+	A	C		+	+					+		C		A				+				+			+					+
2H-6, 17.0–21.0	10.10	9.59	A	G	C	+		+	+	C	+	+	+	R		+	R	R		+	+	+	+			+	+	+	+	A				R			+	+		+	+					+
2H-7, 17.0–21.0	11.51	10.92	A	G	R	+		+		A	+			R		+	R	R			+	+	+			+		C		A				+			+	+	+		+				+	+
2H-8, 17.0–21.0	12.91	12.27	A	G	C	R				C	+	+		R		+	+	+			+	+	+			+		C		A				C	+			+							+	+
2H-CC, 46.0–51.0	13.58	12.91	A	G	+				+	+			+	R		+	A										+	A		A							+	C			+				+	
3H-1, 40.0–42.0	14.01	13.33	A	G	C	+		+		C	+			R		+	+	R		+		+	+			+		R	+	A	+			C	+			+			+					+
3H-CC, 23.0–28.0	14.28	13.59	A	G	R	R		+	+	C	+	+	+	R		+	+	+		+		+				+		C		A	R			C	+		+	+			+			+		C
4H-1, 50.0–53.0	23.59	22.56	A	G	+	+				C	+			R		+	C	C		+	+		+			+		R	+	A				R	+		+	+			+			+		+
4H-2, 94.0–98.0	25.42	24.33	A	G	C	+				C		+		+		+	+	+		+	+	+	+	+		+		R	+	A				C	+		+	+	+							A
4H-3, 104.0–108.0	26.94	25.80	A	G	C	+	+			C	+			+		+	R	+		+	+	+	+				+	R	+	A				R			+	R			+					R
4H-5, 69.0–75.0	28.04	26.86	A	G	A	C	+		+	C				R		+	+	+		+	+	+	+			+		R	+	C				+				R			+					R
4H-6, 88.0–92.0	29.65	28.41	A	G	A	C				C	+	+		R		+	R	C			+		+			+			+	C	+			R				+			+					R
4H-7, 36.0–40.0	30.59	29.32	A	G	A	+				C	R	+		+			R	C		+		+	+			+		+	R	C				+			+									R
4H-8, 66.0–68.0	32.28	30.95	A	G	C	C		+		A	+	+		+		+	R	+			+	+				+		+	+	C				+	+						+					+
4H-CC, 23.5–28.5	32.58	31.24	A	G	C	+			R	+				R		+	A	R		+						+	+	R		A					+		+	+			+			+		+
5H-1, 104.0–108.0	33.57	32.19	A	G	C	R				C	R			+			A	C				+	+	+		+		+						A		+		+		+	+					+
5H-3, 27.0–30.0	35.62	34.20	A	G	R	R	+			C	+			C		+	C	R			+	+	+			+		+	R	C				+				+	+	+	R				+	+
5H-5, 21.0–25.0	36.94	35.50	A	G	R	+				R	+	+		R		+	+	R			+	+	+			+		+	+	A				A	+			+		+	+					+
5H-6, 55.0–58.0	38.70	37.23	A	G	R	R				A	+	+		R			C	C		+	+	+	+			+		+	+	R	+			C	+		+	+			R					R
5H-8, 37.0–40.0	41.37	39.86	A	G	C	R				A	+	+	+	+		+	R	R			+					+		+	+	C				A	+						+					R
5H-CC, 42.0–47.0	42.08	40.56	C	G	R	A			+	+			+	C		+	A	R		+						+		+		R							+	+			+			+		
6H-2, 33.0–36.0	43.73	42.18	A	G	R	+		+		C	+	+		R			R	R			+								R	A				A	+			+			+					+
6H-3, 49.0–51.0	45.18	43.62	A	G	+	+				C	+	+		+			+	R		+	+	+	+			+		+	+	A				A	+			+	+					+		+
6H-5, 32.0–35.0	46.34	44.76	A	G	R	+				A	+			R			+	+			R	+							R	A	+			A							+					R
6H-7, 33.0–36.0	49.00	47.38	A	G	R	R				C		+		R		+	+	R		+	+	+				+			+	A				A	+		+				+			+	+	R
6H-CC, 32.5–37.5	51.58	49.92	A	G	+	R			+	+			+	+		+	C	+	+	+						+	+	+		A							+				+	+	+	+		+
7H-1, 51.0–54.0	52.06	50.40	A	G	A	R				A		+		R			R	R		+		+	+			+		+	+	R				+			+				R	+			+	R
7H-2, 63.0–67.0	53.40	51.71	A	G	R	+				A		+		+			R	C				+				+				A				A	+			+			+	+				

Table T1 (continued).

Core, section, interval (cm)	Depth CCSF (m)	Depth LSF in Hole C0001D (m)	Abundance	Preservation	*Globigerina bulloides*	*Globigerina falconensis*	*Globigerina umbilicata*	*Globigerinella calida*	*Globigerinella siphonifera*	*Globigerinita glutinata*	*Globigerinita iota*	*Globigerinita uvula*	*Globigerinoides conglobatus*	*Globigerinoides ruber* (white)	*Globigerinoides ruber* (pink)	*Globigerinoides sacculifer*	*Globoconella inflata* modern form	*Globoconella inflata* transitional form	*Globoconella puncticulata*	*Globorotalia tumida*	*Globorotaloides variabilis*	*Globoturborotalita rubescens*	*Globoturborotalita tenella*	*Hastigerina pelagica*	*Hirsutella hirsuta*	*Hirsutella scitula*	*Menardella menardii*	*Neogloboquadrina dutertrei*	*Neogloboquadrina humerosa*	*Neogloboquadrina incompta*	*Neogloboquadrina inglei*	*Neogloboquadrina* cf. *inglei*	*Neogloboquadrina kagaensis*	*Neogloboquadrina pachyderma* (dextral)	*Neogloboquadrina pachyderma* (sinistral)	*Orbulina suturalis*	*Orbulina universa*	*Pulleniatina obliquiloculata* (dextral)	*Pulleniatina obliquiloculata* (sinistral)	*Sphaeroidinella dehiscens*	*Truncorotalia crassaformis*	*Truncorotalia crassaformis hessi*	*Truncorotalia crassaformis viola*	*Truncorotalia tosaensis*	*Truncorotalia truncatulinoides*	*Turborotalita quinqueloba*
7H-3, 56.0–60.0	54.63	53.01	A	G	+	+		+		R	+			+		+	+	R				+				+		R	R	A				A	+		+	+			+					+
7H-5, 52.0–53.0	55.86	54.36	A	G	C	R				A	+	+		R			R	+			+	+				+		+	+	C				C	+						+					+
7H-6, 28.0–31.0	56.74	55.33	A	G	R	R				A				+		+	+	+			+	+	+			+		+	R	A				A	+			+			+					+
7H-7, 41.0–42.0	57.19	55.83	A	G	C	R		+		C	+	+		+		+	+	C		+	+	+	+		+	+			+	A				A	+									+		+
7H-9, 83.0–87.0	59.03	57.85	A	G	C	C			+	C	+	+	+	+		+	C	C		+	+	+					+	+	+	A	+			C	+			+		+	+			+		
7H-CC, 29.5–34.5	61.07	60.11	A	G	R					+				+		+	C	A	R	+							+	+		A							+	R		+	R			+	+	
8H-1, 53.0–54.0	61.57	60.66	A	G	R	R		+		C				R		+	C	C			+								+	A				R	+			+		+	R	+		+		R
8H-2, 61.0–62.0	62.90	62.12	A	G	C	R		+		C	+		+	+		+	R	+		+		+	+					+	R	A				C			+	+			+			+	+	+
8H-6, 52.0–53.0	65.48	64.97	A	G	C	R				C	+	+	+	+			+	C		+	+		+			+			+	A				R	+			+		+	+					+
8H-7, 59.0–60.0	66.77	66.39	A	G	R	R			+	C	+	+		+		+	R	C	+		+	+	+			+			+	A				C	+						+			+		+
8H-8, 26.0–27.0	67.82	67.55	A	G	R	R				A	+	+		+		+	+	C			+	+							+	A				R	+						+	+				R
8H-CC, 45.5–50.5	70.58	70.59	A	G	+	+			+				+	+		+	C	A	+	+							+	+		A							+	R		+	+					
9H-1, 62.0–63.0	71.17	71.24	A	G	C	R		+		A	+		+	C		+	C	C		+	+	+	+						R	+				+				+			R			+		+
9H-2, 67.0–68.0	72.49	72.70	A	G	C	+		+		A	+	+		+		+	+	C			+	+	+					+	+	A				R				+			+	+				R
9H-3, 88.0–89.0	73.96	74.32	A	G	A	+	+			R	+	+		+			C	C		+	+	+				+			+	A				R				+			+			+		+
9H-5, 85.0–86.0	75.37	75.50	A	G	C	C		+		A	+	+		R		+	+	+			+	R	+			+			+	A	+			+			+				+					+
9H-6, 84.0–85.0	76.64	76.52	A	G	C	R				A		+		+			R	A		+	+	+							+	A				+	+			+			+			+		+
9H-8, 72.0–73.0	79.16	78.55	A	G	C	C		+		C		+		R		+	C	C		+	+	+							R	+				+			+	+			R	+		+	+	+
9H-CC, 29.0–34.0	80.07	79.28	A	M	R	+			+	C				+		+	A	C	+	+								+		A							+	+		+	+			+		
10H-1, 119.0–120.0	81.18	80.17	A	G	R	R				C	+	+	+	C		+	+	C			+	R	+			+			+	A	+			R	+				+		+			+	+	+
10H-3, 86.0–87.0	83.54	82.06	A	G	C	R				A	+	+		R			R	C			+	+	+						+	C				R			+									+
10H-6, 94.0–95.0	86.26	84.25	A	G	C	C		+		A	+	+		+			C	C				+				+				C				+	+						+					+
10H-9, 105.0–106.0	88.92	86.79	A	G	C	R				A	+	+		+			+	R				R				+			+	C				R				+			+					R
10H-CC, 23.5–28.5	89.58	87.42	A	G	+	+			+	+				R		+	A	A	+	+						+	+	R		C							+	+			+			+		
11H-2, 70.0–71.0	91.56	89.32	A	G	C	+				C		+	+	C		+	+	C		+	+	C	+						+	A	+			C			+		+		+					+
11H-5, 48.0–49.0	93.96	91.63	A	G	C	+		+		A		+		+		+	+	R			+	+		+		+			R	C	+			A	+						+					+
11H-7, 101.0–103.0	97.10	94.70	A	G	C	+	+			A		+		+		+	+	A		+	+	+				+			+	A				+	+			+			+				+	+
11H-CC, 26.5–31.5	99.08	96.70	C	M	R	+				C			+	+		+	A	A	+	+									+	+				+			+	+			+			+	+	
12H-1, 51.0–53.0	99.58	97.20	A	G	A	R		+		C			+	C			+	C			R	+						+	+	C				C				+			+					R
12H-2, 47.0–49.0	100.77	98.40	A	G	A	R				A	+	+		R		+	C	C			+	+							+	C				+			+	+			+			+		
12H-3, 108.5–110.5	102.69	100.33	A	G	R					R				+				+					+						+	A				+	+									+		+
12H-6, 60.5–62.5	104.84	102.50	A	G	A	R	+			A		+		+		+	+	A		+		+	+						+	C				+			+	+			+			+		+
12H-7, 92.0–94.0	106.53	104.20	A	G	A	+	+			+		+		+		+	+	R			+								R	A	+			C	+									+		+
12H-CC, 21.0–26.0	108.58	106.26	A	G	C	+				+			+	R		+	C	A	+	+						+	+	+	+	A			+		+		+		+	+	+			+	+	+
13H-6, 40.0–42.0	114.21	111.91	A	G	C	+		+		C	+			C		+	+	C		+	+	R	+				+		R	C				R	+				+		+			+	+	C
13H-7, 59.0–61.0	115.70	113.40	A	G	C	+				C		+		C			+	R			+	+	+						R	A				R	+		+				+			+		C
13H-CC, 25.0–30.0	118.07	115.77	A	G	R	R				+			+	C		+	C	R	+	+								+	R	A			+		+		+	+		+	+			+	+	R

Abundance: A = abundant (>16%), C = common (8%–16%), R = rare (4%–8%), + = present. Preservation: G = good, M = moderate, P = poor, B = barren.

Table T2. Stratigraphic distribution of selected planktonic foraminiferal species, Hole C0001F. This table is available in an **oversized format.**

Table T3. Stratigraphic distribution of selected planktonic foraminiferal species, Hole C0001H. (Continued on next two pages.)

Core, section, interval (cm)	Depth CCSF (m)	Depth LSF in Hole C0001D (m)	Abundance	Preservation	*Candeina nitida*	*Dentoglobigerina altispira altispira*	*Globigerina bulloides*	*Globigerina falconensis*	*Globigerinella obesa*	*Globigerinella siphonifera*	*Globigerinita glutinata*	*Globigerinita uvula*	*Globigerinoides bollii*	*Globigerinoides conglobatus*	*Globigerinoides ruber*	*Globigerinoides sacculifer*	*Globoconella conoidea*	*Globoconella conomiozea*	*Globoconella sphericomiozea*	*Globoquadrina baroemoenensis*	*Globorotalia lenguaensis*	*Globorotalia plesiotumida*	*Globorotalia tumida*	*Globoturborotalita decoraperta*	*Globoturborotalita extremus*	*Globoturborotalita nepenthes*	*Globoturborotalita obliquus*	*Globoturborotalita woodi*	*Hirsutella margaritae*	*Hirsutella scitula*	*Menardella menardii*	*Menardella multicamerata*	*Menardella praemenardii*	*Menardella pseudomiocenica*	*Neogloboquadrina acostaensis* (dextral)	*Neogloboquadrina acostaensis* (sinistral)	*Neogloboquadrina conglomerata*	*Neogloboquadrina humerosa*	*Neogloboquadrina pachyderma* (dextral)	*Neogloboquadrina pachyderma* (sinistral)	*Neogloboquadrina praehumerosa*	*Orbulina suturalis*	*Orbulina universa*	*Pulleniatina primalis* (sinistral)	*Sphaeroidinellopsis seminulina*	*Sphaeroidinellopsis subdehiscens*	*Turborotalita quinqueloba*
315-C0001H-																																															
1R-1, 19.0–21.0	230.20	229.20	B	B																																											
1R-2, 48.0–50.0	231.93	230.65	R	P		+	R	+			+						+	C						+			+	R											A	+							
1R-CC, 26.0–31.0	234.24	232.52	C	G			R	+		+	C					+				+		+		R			R				C			+					R	A	R		+	+	+	+	
2R-1, 110.0–112.0	240.61	237.83	R	P			+	+			+																+			+									+	+							+
2R-3, 127.0–129.0	243.60	240.91	R	P			A	R			A						+	R						+		+	+	R		+									C	A	+				+	+	C
2R-5, 35.0–37.0	245.51	243.06	R	M			R				A		+			R	R													+	+				+				R	A				+		+	
2R-CC, 0.0–5.0	246.34	244.01	C	G			+	R		+	C			+	+	+		+	+				+			+	+			+	+						+		C	A	R		+	+	+	+	+
3R-1, 65.0–67.0	249.66	247.78	R	P							+						+																							+							
3R-2, 97.0–99.0	251.39	249.73	R	M		+	C	R		+	A		+			+	+							+			C	+						+					+	A	C			+			+
3R-3, 86.0–88.0	252.69	251.21	C	M			R	+		+	A		+			+	R	+						R	+		+			+						+			R	A				+			
3R-5, 67.0–69.0	253.91	252.60	R	P				+																																							
3R-CC, 0.0–5.0	254.41	253.17	R	M			+	+			+					+								+	+	+	+				+									+	+		+		+		
4R-1, 118.0–120.0	259.69	259.16	B	B																																											
4R-3, 56.0–58.0	261.90	261.67	R	P																			+	+		+																			+		
4R-5, 110.0–112.0	263.87	263.56	R	P			R	R			A		+			+	+									+	+	+			+					+			R	A	+					+	C
4R-6, 101.0–103.0	265.20	264.81	R	P			+	+			+					+	+							+			+												+	+							
4R-CC, 21.0–26.0	265.54	265.13	R	M		+	+	+								+	+	+					cf	+	+		+			+	+									+	+		+			+	
5R-1, 25.0–27.0	268.26	267.69	R	P			R	+			A		+			+	R									+	+		+	+				+					R	A	R		+				+
5R-2, 79.0–81.0	270.22	269.53	R	M			C	C			C		R			+	C							+		+	A	R		+									C	+			+				
5R-4, 91.0–93.0	271.77	270.98	C	M		+	R	C			C		+		+	+	+						+	+	+	+	R	+		+	+			+				+	A	R		+	+				+
5R-CC, 0.0–5.0	272.00	271.20	R	M		+	+	+									+										+				+								+								
6R-1, 42.0–45.0	277.94	276.78	R	M																																			+	+							
6R-2, 21.0–25.0	278.72	277.51	C	M			R	C			A		+				+				cf			+		+		+						+					R	A	+				+		
6R-CC, 35.0–40.0	280.32	279.01	R	P											+												+																		+	+	
7R-1, 91.0–95.0	287.93	286.16	B	B																																											
7R-2, 114.0–118.0	289.57	287.81	C	M		+	C	R	+		R		+		+	+	r					+	+	+			R	+	+				+	+					R	A	+		+			+	+
7R-3, 44.0–48.0	290.31	288.57	B	B																																											
7R-5, 33.0–37.0	291.63	289.93	B	B																																											
7R-6, 92.0–96.0	293.63	292.00	R	P		+					+					+	+	+						+			+			+									+	+							
7R-7, 29.0–33.0	294.40	292.79	R	M			C	R			C					R	+					+		R		+	R		+		+								R	A	R						
7R-CC, 35.0–40.0	296.47	294.92	R	M		+	+	+	+		+					+	+	+								+	+				+			+				+	+	+	+		+	+		+	
8R-CC, 16.0–21.0	302.48	301.10	R	M			+				+					+											+												+	+	+						
9R-CC, 0.0–5.0	304.30	302.97	R	P				+			+						+												+										+	+	+				+		
10R-1, 127.0–131.0	313.29	312.20	R	M			+	+			+						+					+	+	+		+	+												+	+	+						+
10R-2, 123.0–126.0	314.66	313.60	C	M		+	C	+			A				+	+	+					+		+		+	+				+				+				A	+	+						+
10R-4, 122.0–125.0	317.09	316.10	R	P												+											+												+	+							
10R-5, 126.0–129.0	317.55	316.56	R	G			A	C			C		+			+	+					+	+	R		+	R		+	+				+		+			C	C	R	+				R	+
10R-CC, 26.5–31.5	319.95	319.03	R	M		+	+	+			+					+	+	+						+	+	+	+				+									+	+				+		

Table T3 (continued). (Continued on next page.)

Core, section, interval (cm)	Depth CCSF (m)	Depth LSF in Hole C0001D (m)	Abundance	Preservation	*Candeina nitida*	*Dentoglobigerina altispira altispira*	*Globigerina bulloides*	*Globigerina falconensis*	*Globigerinella obesa*	*Globigerinella siphonifera*	*Globigerinita glutinata*	*Globigerinita uvula*	*Globigerinoides bollii*	*Globigerinoides conglobatus*	*Globigerinoides ruber*	*Globigerinoides sacculifer*	*Globoconella conoidea*	*Globoconella conomiozea*	*Globoconella sphericomiozea*	*Globoquadrina baroemoenensis*	*Globorotalia lenguaensis*	*Globorotalia plesiotumida*	*Globorotalia tumida*	*Globoturborotalita decoraperta*	*Globoturborotalita extremus*	*Globoturborotalita nepenthes*	*Globoturborotalita obliquus*	*Globoturborotalita woodi*	*Hirsutella margaritae*	*Hirsutella scitula*	*Menardella menardii*	*Menardella multicamerata*	*Menardella praemenardii*	*Menardella pseudomiocenica*	*Neogloboquadrina acostaensis* (dextral)	*Neogloboquadrina acostaensis* (sinistral)	*Neogloboquadrina conglomerata*	*Neogloboquadrina humerosa*	*Neogloboquadrina pachyderma* (dextral)	*Neogloboquadrina pachyderma* (sinistral)	*Neogloboquadrina praehumerosa*	*Orbulina suturalis*	*Orbulina universa*	*Pulleniatina primalis* (sinistral)	*Sphaeroidinellopsis seminulina*	*Sphaeroidinellopsis subdehiscens*	*Turborotalita quinqueloba*
11R-1, 137.0–139.0	322.88	322.04	R	M			+	+			+		+			+	+	+						+			+				+								+								+
11R-2, 135.0–137.0	324.28	323.48	C	M		+	R	R			A		+		+		+							+			R	R	+					+					A	A	+						+
11R-3, 2.0–4.0	324.36	323.56	R	P																																			+	+							
11R-6, 127.0–129.0	328.56	327.87	R	M			+	C			C	+				R							+	R	+	+	R	+			+				+				A		+		+		+		+
11R-CC, 0.0–5.0	329.42	328.75	R	M			+	+			+					+	+									+	+				+								+				+		+		
12R-1, 68.0–70.0	331.69	331.10	R	M			C	A	+		C						C	+						+		+				+									C	+		+			+		
12R-2, 70.0–72.0	333.12	332.80	R	M		R	C	R			C					+	+					+		+			C	+		+	R		+						R	A					+		R
12R-5, 66.0–68.0	335.94	336.49	R	M				+			+						+									+	+	+											+	+				+			
12R-6, 89.0–91.0	337.59	338.99	R	P			R	R			A	+				+		+					+	+		+	R	+											C	A	+						
12R-CC, 0.0–5.0	338.52	339.67	R	M			+	+	+		+					+	+										+				+				+	+				+	+					+	
13R-2, 110.0–140.0	343.16	343.22	B	B																																											
13R-3, 106.0–110.0	344.41	344.59	C	G		+	+	R			A		+			+	C	+					+	+		+	+	+		+	+			+	+				R	A	R	+	+	+	+		+
13R-4, 85.0–89.0	345.61	345.91	C	G			+	C	+		C		+		+	+	R							+	+	+	R			+									C	A	+		+				+
13R-6, 132.0–136.0	347.50	347.97	R	G		+	C	C			C		R			+	+	R					+	+	+	+	R			+	+			+					R	A			+	+		+	
13R-7, 124.0–129.0	348.83	349.43	R	P		+					+		+			+	+	+				+		+			+												+	+							
13R-CC, 0.0–5.0	349.06	349.68	R	M		+	+	+			+					+	+	+				+				+	+				+				cf										+		
14R-1, 116.0–120.0	351.18	352.01	C	M		+	R	R			C		+			R	R	R	+			+		+		+	R	+	+		+		+	+					A	+	+	+			+		+
14R-2, 126.0–132.0	352.70	353.67	R	M			+	+			+					+	+									+	+		+	+				+					+					+			
14R-3, 95.0–99.0	353.80	355.13	R	P			R	R		+	C		R			+	+	+								+	R		+	+		+							A	R			+	+	+		+
14R-5, 94.0–98.0	355.22	357.15	R	M		+	R	C			C		+			+	R					+		+			R	+		+	+								C	+			+				
14R-CC, 23.0–28.0	357.22	358.85	R	M			+	+			+					+	+												+	+									+	+			+	+			
15R-1, 70.0–73.0	360.22	361.26	C	M		+	+	+			A		+			+	+	R						+	+	+	C			+	+			+					R	A			+	+	+	+	+
15R-2, 63.0–68.0	361.57	362.35	R	M			+	R	+		A		+			+	+	+					cf	R		+	R			+									C	A			+		+	+	+
15R-3, 80.0–84.0	363.25	363.70	R	M														+									+												+		+						
15R-5, 76.0–78.0	364.61	364.79	C	G		R	R	C			C					+	+	+					+	R	+	+	A			+	+			+					C	C	+	+	+		+	+	
15R-CC, 22.0–27.0	365.07	365.16	R	M		+	C	R			C				+	R	C	+						+	+	R	A				+								+	+	+		+	+			
16R-1, 101.0–105.0	370.03	369.14	R	P		+	C	C			C					R		R						R		+	C	+	+					+					R	C			+		+		
16R-2, 100.0–104.0	371.44	370.27	R	M			+	+			C		R			+	R							C		R	+			+									A	A	+				+		+
16R-3, 64.0–68.0	372.49	371.16	R	M		+	+	+			+					+	+									+	+			+									+	+	+						
16R-5, 118.0–122.0	374.46	373.19	R	G			+				C		+			R	C	+	+		+			R		R	+		+		+								+	C	+					+	
16R-6, 4.0–8.0	374.73	373.47	R	M			+	+			+		+			+	+					+		+			+			+	+								+	+					+		
16R-CC, 17.5–22.5	375.10	373.85	R	P		+					+					+	+	+				+					+				+						+			+			+		+	+	
17R-CC, 0.0–5.0	380.80	379.73	R	P		+	+	+			A					C	+			+		+	+	+			C		R		+								+								
18R-1, 127.0–131.0	389.29	388.47	R	M		+	+	+								+								+		+	+		+										+						+	+	
18R-CC, 0.0–5.0	391.74	390.99	C	M	+	+	R	R	+		A				+	+	+	+	+	+			cf	+	+	+	C		+	+	+			+	+			+	A	R	+		+	+	+	+	+
19R-2, 44.0–45.0	399.36	398.84	R	P							+		+																										+	+							
19R-CC, 0.0–5.0	400.89	400.42	R	M		+	+	+			+					+	+	+							+	+	+			+	+						+		+	+			+	+	+	+	
20R-1, 36.0–37.0	407.37	407.08	R	P							+		+				+	+								+				+										+							
20R-CC, 0.0–5.0	407.50	407.22	R	P			+	+			+					+	+							+		+	+				+								+	+					+		
21R-1, 71.0–72.0	413.22	413.11	R	G			+	+			+		+			+		+									+			+									+	+				+	+		
21R-4, 127.0–128.0	416.63	416.53	R	M			+	+			+													+							+								+	+							

Table T3 (continued).

Core, section, interval (cm)	Depth CCSF (m)	Depth LSF in Hole C0001D (m)	Abundance	Preservation	*Candeina nitida*	*Dentoglobigerina altispira altispira*	*Globigerina bulloides*	*Globigerina falconensis*	*Globigerinella obesa*	*Globigerinella siphonifera*	*Globigerinita glutinata*	*Globigerinita uvula*	*Globigerinoides bollii*	*Globigerinoides conglobatus*	*Globigerinoides ruber*	*Globigerinoides sacculifer*	*Globoconella conoidea*	*Globoconella conomiozea*	*Globoconella sphericomiozea*	*Globoquadrina baroemoenensis*	*Globorotalia lenguaensis*	*Globorotalia plesiotumida*	*Globorotalia tumida*	*Globoturborotalita decoraperta*
21R-5, 75.0–76.0	417.55	417.46	R	M												+								
21R-CC, 0.0–5.0	417.85	417.76	R	M		+	+		+	+	+				+	+	+	+					+	+
22R-1, 66.0–68.0	420.17	420.09	C	G		+	+	R			C		+		+	R	C	+	+			R	+	+
22R-2, 137.0–139.0	422.30	422.22	C	M			+	R			C		+			+	+							R
22R-CC, 0.0–5.0	422.69	422.61	R	P		+	+	+			+				+	+	+							
23R-1, 138.0–140.0	430.39	430.34	R	P							+		+			+								
23R-CC, 29.0–34.0	431.56	431.50	R	M			+				+					+								
24R-1, 99.0–101.0	439.50	439.47	R	M			R	C			A		+			R							+	C
24R-3, 90.5–92.5	441.26	441.24	R	M			+	+																
24R-CC, 0.0–5.0	441.84	441.82	R	M		+	+	+		+						+								
25R-1, 4.0–9.0	447.27	447.26	C	M		+	+	+			C		+			R	R	+						R
25R-2, 20.0–23.0	448.83	448.82	R	M			+	+			+		+											+
25R-CC, 30.5–35.5	449.81	449.81	R	P			+	+			+					+								
26R-CC, 15.0–20.0	456.67	456.67	R	M		+	+	+			+					+								

Core, section, interval (cm)	*Globoturborotalita extremus*	*Globoturborotalita nepenthes*	*Globoturborotalita obliquus*	*Globoturborotalita woodi*	*Hirsutella margaritae*	*Hirsutella scitula*	*Menardella menardii*	*Menardella multicamerata*	*Menardella praemenardii*	*Menardella pseudomiocenica*	*Neogloboquadrina acostaensis* (dextral)	*Neogloboquadrina acostaensis* (sinistral)	*Neogloboquadrina conglomerata*	*Neogloboquadrina humerosa*	*Neogloboquadrina pachyderma* (dextral)	*Neogloboquadrina pachyderma* (sinistral)	*Neogloboquadrina praehumerosa*	*Orbulina suturalis*	*Orbulina universa*	*Pulleniatina primalis* (sinistral)	*Sphaeroidinellopsis seminulina*	*Sphaeroidinellopsis subdehiscens*	*Turborotalita quinqueloba*
21R-5, 75.0–76.0																							
21R-CC, 0.0–5.0		+	+		+	+	+									+			+		+		
22R-1, 66.0–68.0	+	+	R		+	+	+		+	+					C	C			+	+	+	+	+
22R-2, 137.0–139.0		+	+	+		+									A	A	+		+				+
22R-CC, 0.0–5.0		+	+			+	+								+	+	+		+		+		
23R-1, 138.0–140.0															+	+							
23R-CC, 29.0–34.0			+				+								+	+				+	+		
24R-1, 99.0–101.0	+	+	+	+					+						A	C	+		+	+	+		+
24R-3, 90.5–92.5			+												+		+		+				+
24R-CC, 0.0–5.0		+	+				+				+				+	+	+		+	+		+	
25R-1, 4.0–9.0	+	R	R	+		+	+				+				A	C	+	+	+		+		
25R-2, 20.0–23.0			+	+		+									+					+			
25R-CC, 30.5–35.5			+												+						+	+	
26R-CC, 15.0–20.0			+				+				+				+		+		+	+	+	+	

Abundance: A = abundant (>16%), C = common (8%–6%), R = rare (4%–8%), B = barren. Preservation: G = good, M = moderate, P = poor, B = barren. + = present, cf = confer.

Table T4. Planktonic foraminiferal biohorizons, Site C0001.

Zone	Age (Ma)	Event	Top: Hole, core, section, interval (cm)	Top: Depth LSF (m)	Bottom: Hole, core, section, interval (cm)	Bottom: Depth LSF (m)	Mean depth LSF (m)	Range (±m)	Lith. unit
			315-		315-				
	0.12	1 LO *Globigerinoides ruber* (pink)	C0001E-1H-2, 36.0–40.0	0.40	C0001E-1H-3, 5.0–10.0	1.44	0.92	0.52	
	0.61	2 LO *Truncorotalia tosaensis*	C0001E-3H-1, 40.0–42.0	13.33	C0001E-3H-CC, 23.0–28.0	13.59	13.46	0.13	
	0.80	3 FO *Truncorotalia crassaformis hessi*	C0001E-9H-8, 72.0–73.0	78.55	C0001E-9H-CC, 29.0–34.0	79.28	78.92	0.37	
N22	1.30	4 LO *Globoturborotalita obliquus*	C0001F-4H-8, 55.0–60.0	139.19	C0001F-4H-CC, 12.5–17.5	139.60	139.40	0.21	I
	1.7–1.8	5 SD2 *Pulleniatina* spp.	C0001F-6H-CC, 21.0–26.0	157.67	C0001F-7H-2, 12.0–16.0	159.45	158.56	0.89	
	1.8	6 LO *Neogloboquadrina asanoi*	C0001F-10H-9, 114.0–119.0	188.70	C0001F-10H-11, 52.0–54.0	189.49	189.10	0.40	
	1.93	7 FO *Truncorotalia truncatulinoides*	C0001F-9H-6, 32.0–36.0	180.75	C0001F-9H-CC, 27.5–32.5	184.65	182.70	1.95	
N21	2.3–2.5	8 FO *Globoconella inflata* modern form	C0001F-13H-CC, 20.0–25.0	199.29	C0001F-14H-1, 125.0–129.0	200.98	200.14	0.84	
	3.35	9 FO *Truncorotalia tosaensis*	C0001F-11H-CC, 13.0–18.0	194.93	C0001F-12H-CC, 18.0–23.0	195.96	195.45	0.52	
	3.47	10 LO *Dentoglobigerina altispira altispira*	C0001F-13H-CC, 20.0–25.0	199.29	C0001F-14H-1, 125.0–129.0	200.98	200.14	0.84	
	3.59	11 LO *Sphaeroidinellopsis seminulina* s.l.	C0001F-13H-CC, 20.0–25.0	199.29	C0001F-14H-1, 125.0–129.0	200.98	200.14	0.84	
	3.85	12 LO *Hirsutella margaritae*	—	—	C0001H-5R-1, 25.0–27.0	267.69	267.69	0.00	
N18	4.08	13 SD1 *Pulleniatina* spp.	C0001F-14H-CC, 0.0–5.0	206.66	C0001H-1R-CC, 26.0–31.0	232.52	219.59	12.93	
	4.31	14 FO *Truncorotalia crassaformis*	C0001F-18H-CC, 0.0–1.0	216.85	C0001F-20X-4, 65.0–67.0	224.14	220.50	3.64	II
	4.37	15 LO *Globoturborotalita nepenthes*	C0001H-2R-1, 110.0–112.0	237.83	C0001H-2R-3, 127.0–129.0	240.91	239.37	1.54	
	5.57	16 FO *Globorotalia tumida*	C0001H-24R-1, 99.0–101.0	439.47	C0001H-24R-3, 90.5–92.5	441.24	440.36	0.88	
<N17b	6.60	17 FO *Pulleniatina primalis*	C0001H-26R-CC, 15.0–20.0	456.67	—	—	—	—	

Depth is in Hole C0001D. FO = first occurrence, LO = last occurrence, SD = dominant coiling direction change from sinistral to dextral. — = no data.

Plate P1. **1a–1c.** *Dentoglobigerina altispira altispira* (Cushman and Jarvis) (Sample 315-C0001F-12H-CC, 18–23 cm). **2a–2c.** *Globoconella inflata* (d'Orbigny) modern form (Sample 315-C0001F-5H-9, 79–81 cm). **3a–3c.** *Globoconella inflata* (d'Orbigny) transitional form (Sample 315-C0001F-5H-9, 79–81 cm). **4a–4c.** *Hirsutella margaritae* (Bolli and Bermudez) (Sample 315-C0001H-5R-1, 25–27 cm). Scale bars = 100 µm.

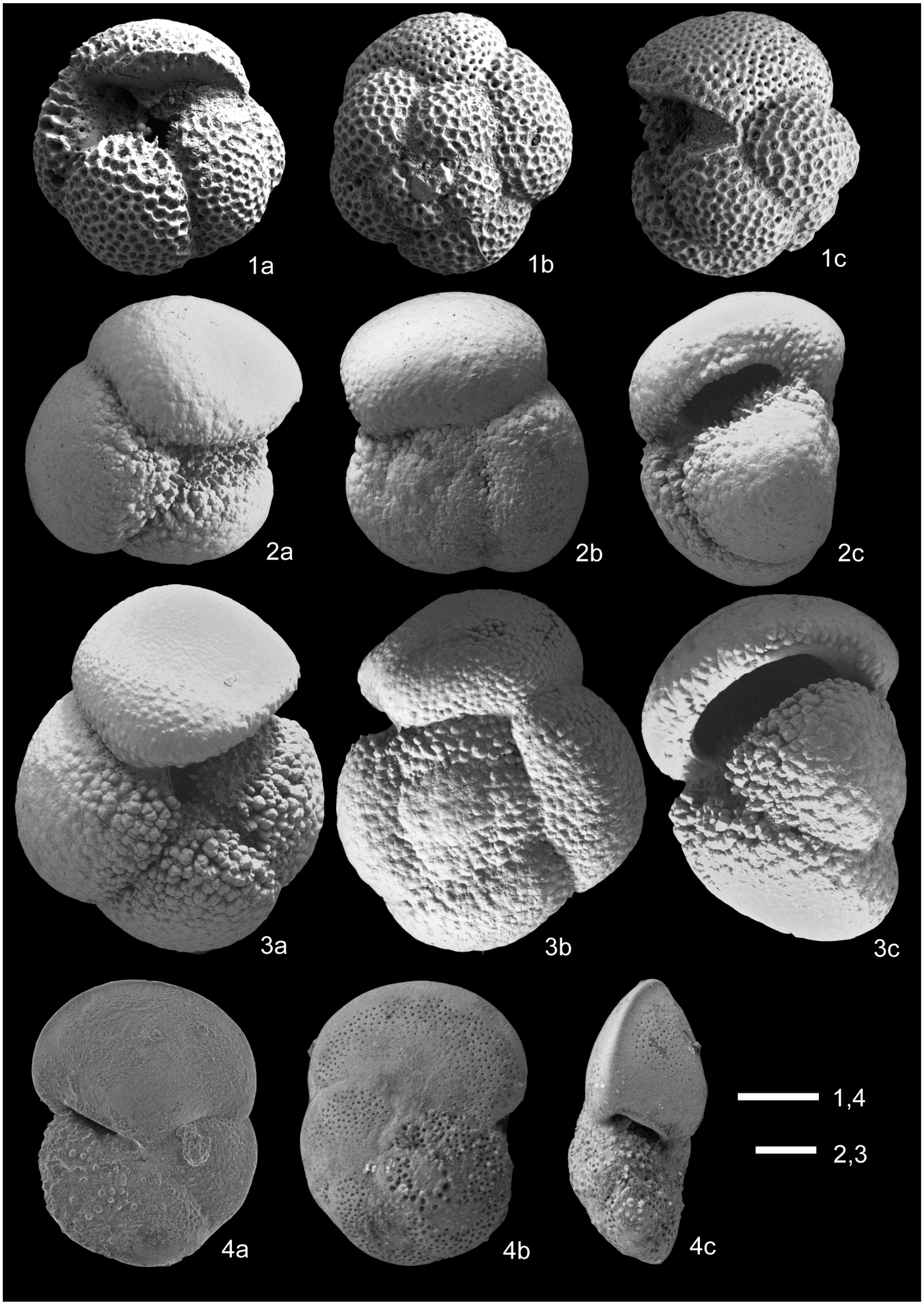

Plate P2. 1a–1b. *Globorotalia tumida* (Brady) (Sample 315-C0001H-21R-CC, 0–5 cm). **2a–2c.** *Globoturborotalita extremus* (Bolli and Bermudez) (Sample 315-C0001H-10R-CC, 26.5–31.5 cm). **3a–3c.** *Globoturborotalita nepenthes* (Todd) (Sample 315-C0001H-14R-1, 116–120 cm). **4a–4c.** *Globoturborotalita obliquus* (Bolli) (Sample 315-C0001E-13H-CC, 25–30 cm). Scale bars = 100 µm.

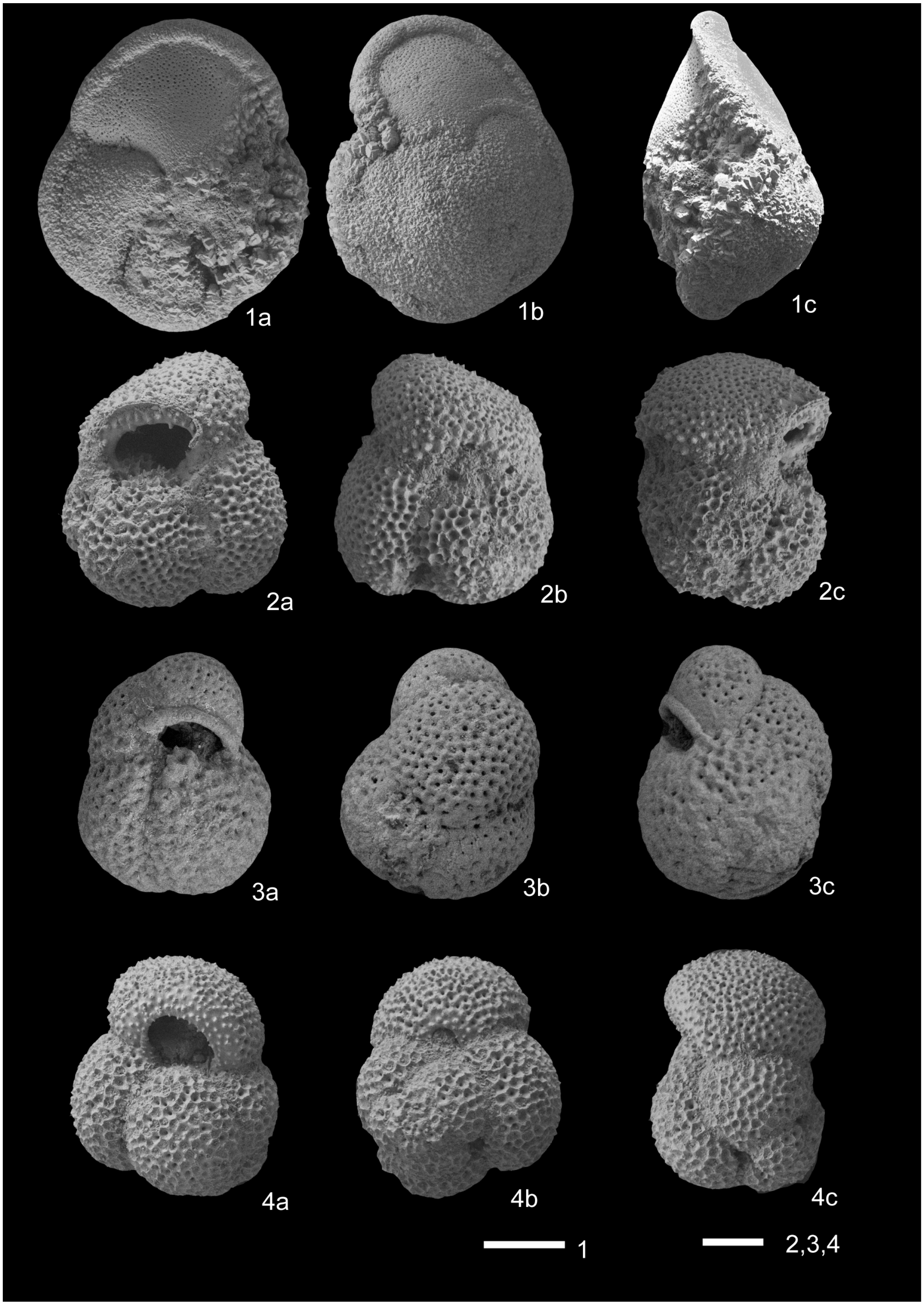

Plate P3. 1a–1c. *Neogloboquadrina asanoi* (Maiya, Saito, and Sato) (Sample 315-C0001H-10H-11, 26–30 cm). **2a–2c.** *Pulleniatina obliquiloculata* (Parker, Jones, and Brady) dextral form (Sample 315-C0001F-8H-CC, 45–50 cm. **3a–3c.** *Pulleniatina obliquiloculata* (Parker, Jones, and Brady) sinistral form (Sample 315-C0001F-8H-CC, 45–50 cm). **4a–4c.** *Pulleniatina primalis* Banner and Blow sinistral form (Sample 315-C0001H-7R-CC, 35–40 cm). Scale bar = 100 µm.

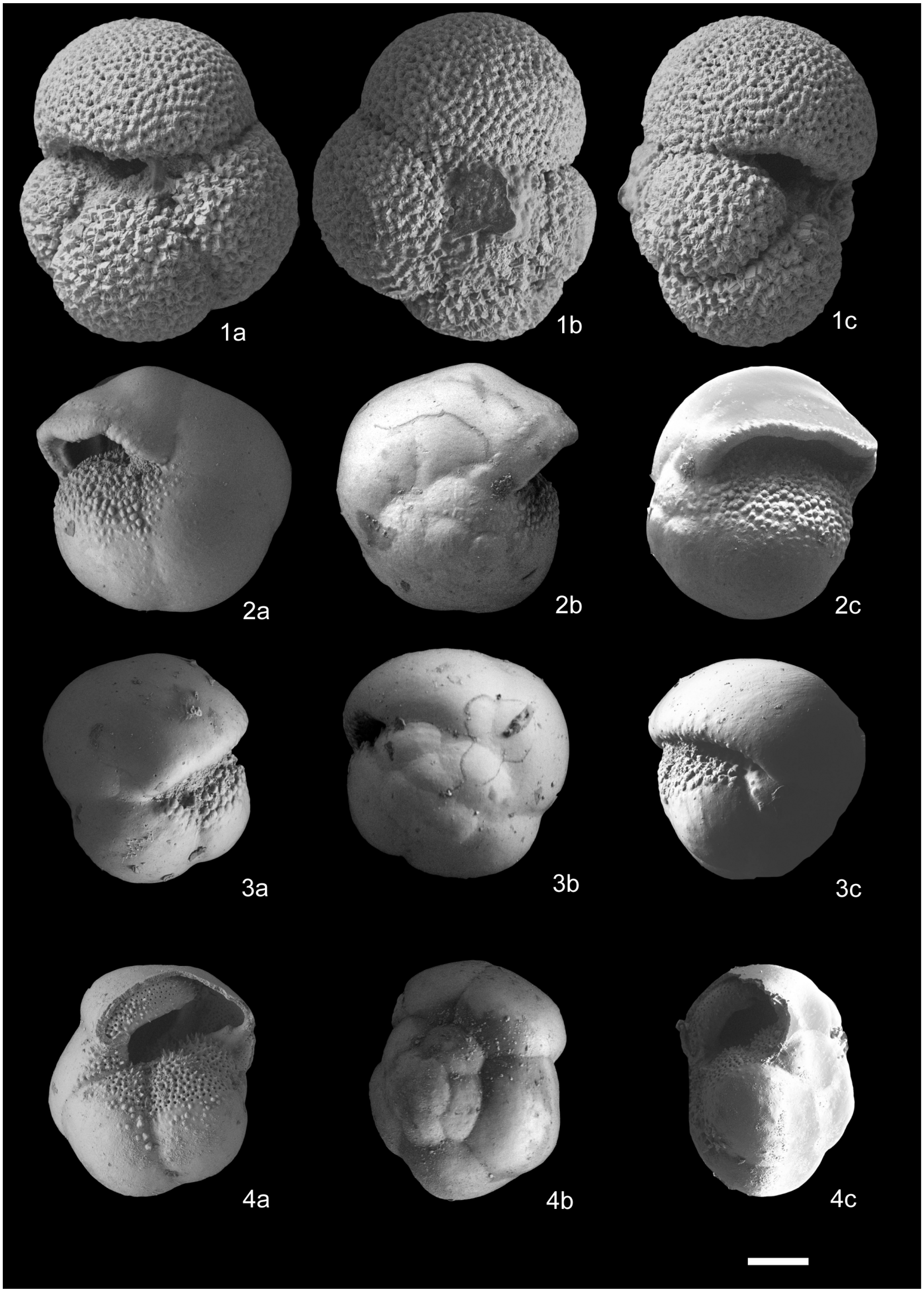

Plate P4. **1a–1c.** *Truncorotalia crassaformis* (Galloway and Wissler) (Sample 315-C0001F-5H-9, 79–81 cm). **2a–2c.** *Truncorotalia tosaensis* (Takayanagi and Saito) (Sample 315-C0001F-7H-13, 13–17 cm). **3a–3c.** *Truncorotalia truncatulinoides* (d'Orbigny) (Sample 315-C0001E-13H-CC, 25–30 cm). **4a–4c.** *Sphaeroidinellopsis seminulina* (Schwager) (Sample 315-C0001H-1R-CC, 26–31 cm). Scale bars = 100 µm.