20. NEOGENE BENTHIC FORAMINIFERS FROM DSDP SITES 360 AND 362, SOUTH EASTERN ATLANTIC

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Miocene to Quaternary benthic foraminifers have been examined from the South Atlantic Sites 360 and 362 (Figure 1). Site 360 is situated midway down the continental rise off Southwest Africa, at latitude 35°51'S, longitude 18°05'E, in a water depth of 2977 meters. Site 362 is situated on the Abutment Plateau of the Frio Ridge segment of the Walvis Ridge, at latitude 19°45'S, longitude 10°32'E, in a water depth of 1325 meters.

The portions examined are: Site 360, Cores 1-25 (lower Pliocene-lower Miocene); Site 362, Cores 1-38 (Pleistocene-lower Miocene).

Most of the material examined consists of foraminifer- or diatom-rich nannofossil ooze and chalks. The benthic foraminifers are sparse, and in many instances only 1-2 specimens were found for each species present (Tables 1 and 2).

The benthics appear as a very small portion of the total foraminifer fauna, in most cases less than 1% of the sample provided.

The benthic faunas are dominated by long-ranging, moderate to deep-water species, not particularly suitable for biostratigraphic subdivision. Miliolids, mainly *Quinqueloculina*, and *Biloculina* are persistent throughout Sites 360 and 362.

Arenaceous forms were found with six species present at Site 360, and nine at Site 362. From the range charts (Tables 1 and 2) it can be seen that the dominant and persistent forms are: *Pullenia bulloides, Pullenia quinqueloba, Oridorsalis umbonatus, Oridorsalis tenera, Cassidulina subglobosa, Cassidulina laevigata, Alabumina tenuimarginata, Sphaeroidina bulloides, Martinottiella communis, Cibicides ihungia, Cibicides molestus, Bulimina truncanella, Angulogerina esuriens, Gyroidina prominula* and *Gyroidinoides zelandicus*. Less common, though still present, are: *Hopkinsina mioindex, Euuvigerina notohispida, Bolivina finlayi, Laticarinina halophora* and various species of *Stilostomella*.

The following species observed are known from the New Zealand sequence: *Cibicides molestus, Cibicides ihungia, Bulimina marginata, Cassidulina laevigata,* and *Pullenia bulloides*. Vella (1962a, b, c, 1963) inferred the following depth ranges for Miocene and Pliocene forms from the east coast of the North Island, New Zealand:
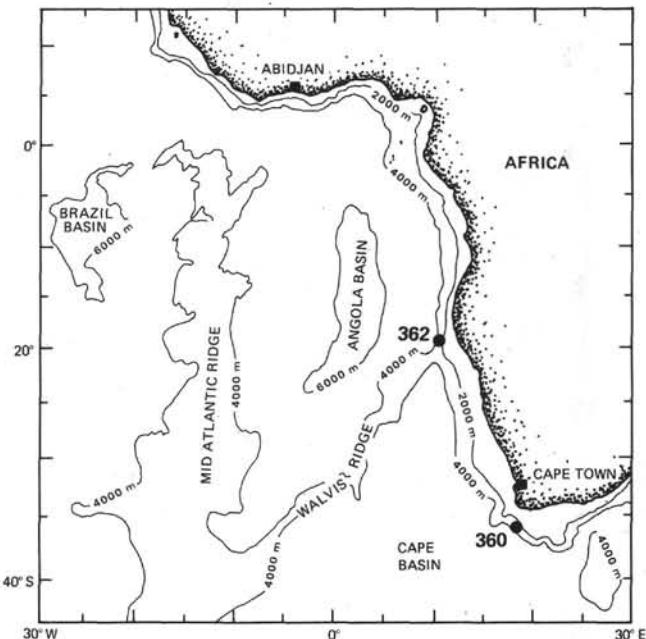
Figure 1. *Location of Sites 360 and 362.*

Pullenia bulloides	1000-4000 feet
Pullenia quinqueloba	400-1000 feet
Cibicides molestus	200-2000 feet
Cibicides ihungia	20-4000 feet
Cassidulina laevigata	20-1000 feet
Bulimina marginata	20-1000 feet

REFERENCES

Vella, P.P., 1962a. Biostratigraphy and paleoecology of Mauriceville District, New Zealand: Trans. Roy. Soc. New Zealand Geol., v. 1, p. 183-199.

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_____, 1962c. Late Tertiary Nonionid foraminifera from Wairarapa, New Zealand: Trans. Roy. Soc. New Zealand Geol., v. 1, p. 285-296.

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TABLE 1
Distribution of Lower Pliocene to Lower Miocene Benthic Foraminifers in Site 360

DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)
79,5 – 89	1	1	90–92
	1		CC
89 – 98,5	2	1	87–89
98,5 – 108	3	3	88–90
	3		CC
108 – 117,5	4	3	89–91
117,5 – 127	5	3	107–109
	5		CC
127,5 – 136,5	6	3	88–90
136,5 – 146	7	3	109–111
	7		CC
146 – 155,5	8	3	108–110
155,5 – 165	9	3	86–88
	9		CC
165 – 174,5	10	3	106–108
174,5 – 184	11	3	59–60
184 – 193,5	12	3	84–86
	12		CC
193,5 – 203	13	3	88–90
	13		CC
203 – 212,5	14	3	87–89
212,5 – 222	15	1	81–83
	15		CC
222 – 231,5	16	2	61–63
	16		CC
231,5 – 241	17	1	123–125
	17		CC
241 – 250,5	18	1	127–129
	18		CC
260 – 269,5	19	4	107–109
	19		CC
279 – 288,5	20	1	102–104
298 – 307,5	21	3	82–84
	21		CC
317 – 326,5	22	5	61–63
336 – 345,5	23	3	93–95
	23		CC
355 – 364,5	24	2	12–14
	24		CC
374 – 383,5	25	1	86–88
	25		CC

Species columns (left to right): Cibicides sp., Martinottiella communis, Gyroidina zelandicus, Bulimina miolaevis, Cassidulina subglobosa, Brizalina sp., Pullenia bulloides, Anomalinoides fasciatus, Oridorsalis umbonatus, Stilostomella basicarinata, Angulogerina esuriens, Fursenkoina schreibersiana, Astrononion impressum, Karreriella/Siphotextularia, Sphaeroidina bulloides, Euuvigerina notohispida, Rosalina sp., Stilostomella stachei, Stilostomella 'bortonica', Gyroidina prominula, Cibicides (with umbonal plug), Bolivina sp., Cibicides (flanged), Pullenia quinqueloba, Cassidulina laevigata, Discopulvinulina bertheloti, Globobulimina sp., Quinqueloculina sp., Alabamina tenuimarginata, Karrerulina aegra, Cibicides novozealandica, Laticarinina halophora, Nodosaria longiscata, Nodosaria sp., Anomalina aotea, Textularia sp., Bulimina truncanella, Masilina tenuis

TABLE 2 – *Continued*

Species columns (vertical headers, left to right):
Nuttalides truempyi · Bulimina marginata · Bolivinopsis cubensis · Melonis zeobesus · Nodosaria obliquecostata · Bilocolina sp. · Cibicides robertsonianus · Sigmoilopsis schlumbergeri · Stilostomella verneuilli · Stilostomella pomuligera · Quinqueloculina sp. · Nodosarella subnodos · Lagenonodosaria hirstua · Nodosaria delicatula · Nodosaria striata · Uvigerina sp. · Vaginulina vagina · Uvigerina plejeba · Vulvulina sp. · Uvigerina striata · Bulimina pupula · Proxifrons sp. · Ehrenbergina sp.

AUSTRAL-NEW ZEALAND PLANKTONIC FORAMINIFERAL ZONES (Jenkins 1966, 1967, 1975)	TROPICAL PLANKTONIC FORAMINIFERAL ZONES (Bolli 1957, 1966, 1973)		AGE
Globorotalia puncticulata	Globorotalia margaritae	L	PLIOCENE
Globorotalia conomiozea	Neogloboquadrina dutertrei	U	MIOCENE
	Globorotalia acostaensis		
Globorotalia miotumida			
	Globorotalia menardii		
Globorotalia mayeri mayeri	Globorotalia mayeri / Globigerinoides ruber / Globorotalia fohsi robusta / Globorotalia fohsi lobata / Globorotalia fohsi fohsi	M	
Orbulina suturalis	Globorotalia fohsi peripheroronda		
Praeorbulina glomerosa curva	Praeorbulina glomerosa		
Globigerinoides trilobus trilobus	Globigerinatella insueta / Globigerinita stainforthi / Globigerinita dissimilis	L	
Globigerina woodi connecta			

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TABLE 2
Distribution of Pleistocene to Lower Miocene Benthic Foraminifers at Site 362

LEG 40
SITE 362

Species columns (left to right):
Oridorsalis umbonatus · Rectuvigerina sp. · Sphaeroidina bulloides · Stilostomella stachei · Stilostomella pomuligera · Astrononion pusillum · Anomalinoides faciatus · Cassidulina subglobosa · Bulimina marginata · Vaginulina vagina · Gyroidina prominula · Pullenia bulloides · Bolivina sp. · Bulimina mioleavis? · Cassidulina laevigata · Siphotextularia / Karreriela · Cibicides ihungia · Gyroidina zelandicus · Cibicides sp. · Quinqueloculina sp. · Stilostomella 'bortonica' · Nodosaria striata · Fursenkoina schreibersiana · Nuttalides truempyi · Pullenia quinqueloba · Spiroloculina canaliculata · Vulvulina sp. · Alabamina tenuimarginata · Bolivinopsis cubensis · Anomalina aotea · Martinottiella communis · Cibicides (flanged) · Euvigerina notohispida · Textularia sp. · Discopulvinulina berthelati · Loticarinina halophora · Bulimina truncanella · Biloculina sp. · Stilostomella basicarinata · Massilina tenuis · Anomalina sp. · Oridorsalis cf. tenera · Sigmoilopsis schlumbergeri · Nodosaria obliquecostata · Cibicides molestus · Nodosaria longiscata · Cibicides vortex

DEPTH BELOW SEA FLOOR IN METERS	CORE	SECTION	INTERVAL (cm)
36 – 45,5	1	1	58–60
45,5– 55	2	3	58–60
55 – 64	3	3	58–60
64,5– 74	4	3	58–60
			CC
74 – 83	5		CC
83,5– 93	6	3	58–60
93 – 102,5	7		CC
102,5– 112	8		CC
112 – 121,5	9	3	58–60
121,5– 131	10	3	58–60
131 – 140,5	11	1	58–60
			CC
140,5– 150	12		CC
150 – 159,5	13	3	58–60
			CC
159,5– 169	14		CC
197,5– 207	16	4	58–60
216,5– 226	17	4	58–60
235,5– 245	18	3	58–60
254,5– 264	19	3	58–60
			CC
273,5– 283	20		CC
292,5– 302	21	3	58–60
311,5– 321	22		CC
330,5– 340	23	3	58–60
349,5– 359	24	3	58–60
368,5– 378	25	3	58–60
387,5– 397	26	3	58–60
406,5– 416	27	3	58–60
425,5– 435	28	3	58–60
444,5– 454	29	3	58–60
			CC
463,5– 473	30	3	58–60
			CC
482,5– 492	31	1	58–60
		3	58–60
			CC
501,5– 511	32	3	58–60
			CC
520,5– 530	33	4	58–60
		5	58–60
		6	58–60
549 – 559,5	34		CC
577,5– 587	35	3	58–60
		5	58–60
			CC
596,5– 606	36	1	87–89
		3	58–60
615,5– 625	37	2	58–60
		4	58–60
644 – 653,5	38	1	58–60

TABLE 2 — *Continued*

The left portion of the table lists the following benthic foraminiferal species (column headers, read vertically), with occurrence bars plotted against the zonation rows:

Siliostomella verneuilli · Angulogerina esuriens · Globobulimina (arenaceous) · Dentalina subcostata · Proxifrons sp. · Ellipsoglandulina subconica · Vaginulinopsis sp. · Uvigerina 'bartotara' · Bolivina anastomosa · Cerobertina sp. · Nodosaria hispida · Noviuva plebeja · Astrononion impressum · Buliminella sp. · Textularia (square) · Nodosaria pyrula · Bulimina pupula · Textularia sp. · Hofkeruva zeacuminata · Hoeglundina elegans · Loxostomum sp. · Cibicides novozelandicus · Concris sp. · Uvigerina sp. · Cerobertina (long, thin) · Rosalina sp. · Quadrimorphina sp. · Astrononion charlottensis

AUSTRAL–NEW ZEALAND PLANKTONIC FORAMINIFERAL ZONES (Jenkins 1966, 1967, 1975)	TROPICAL PLANKTONIC FORAMINIFERAL ZONES (Bolli 1957, 1966, 1973)		AGE
Globorotalia truncatulinoides	Globorotalia trunc. truncatulinoides		PLEISTOCENE
Globorotalia inflata	Globorotalia truncatulinoides truncatulinoides or Globorotalia truncatulinoides cf – tosaensis		PLEISTOCENE or UPPER PLIOCENE
	Globorotalia miocenica	M	
Globorotalia puncticulata	Globorotalia margaritae	L	PLIOCENE
Globorotalia conomiozea	Neogloboquadrina dutertrei		
	Globorotalia acostaensis	U	
Globorotalia miotumida			
	Globorotalia menardii		MIOCENE
Globorotalia mayeri mayeri	Globorotalia mayeri – Globorotalia fohsi robusta	M	
	Globorotalia fohsi lobata		
Orbulina suturalis	Globorotalia fohsi fohsi / Globorotalia fohsi peripheroronda		
Praeorbulina glomerosa curva	Praeorbulina glomerosa curva		
	Globigerinatella insueta	L	
Globigerinoides trilobus trilobus	Globigerinita stainforthi – Globigerinita dissimilis		

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PLATE 1

Figure 1   *Bolivinopsis cubensis* (Cushman and Bermudez). ×41.
                Sample 362-19, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figure 2   *Massilina tenuis* (Czjzek). ×47.
                Sample 362-19, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figure 3   *Vaginulina vagina* (Stache). ×23.
                Sample 362-19, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figure 4   *Vaginulinopsis spinulosa* (Stache). ×16.
                Sample 360-23, CC. *Globigerinoides trilobus trilobus* Zone; lower Pliocene.

Figures 5, 6   *Plectofrondicularia whaingaroica* (Stache). ×29.
                Sample 362-11, CC. *Globorotalia puncticulata* Zone; lower Pliocene.

Figure 7   *Stilostomella basicarinata* Hornibrook. ×29.
                Sample 362-14, CC. *Globorotalia puncticulata* Zone; lower Pliocene.

Figure 8   *Stilostomella pomuligera* (Stache). ×29.
                Sample 362-8, CC. *Globorotalia inflata* Zone; middle Pliocene.

Figure 9   *Stilostomella stachei* (Chapman). ×29.
                Sample 362-20, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figure 10   *Bulimina truncanella* Finlay. ×70.
                Sample 362-20, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figure 11   *Angulogerina esuriens* Hornibrook. ×99.
                Sample 362-17-4, 58-60 cm. *Globorotalia puncticulata* Zone; upper Miocene.

Figure 12   *Cassidulina subglobosa* Brady. ×68.
                Sample 362-20, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figures 13, 14 *Pullenia bulloides* (d'Orbigny). ×59.
                Sample 362-8, CC. *Globorotalia inflata* Zone; middle Pliocene.

Figures 15, 16 *Pullenia quinqueloba* (Reuss). ×59.
                Sample 362-4, CC. *Globorotalia inflata* Zone; Pleistocene to upper Pliocene.

Figure 17   *Alabamina tenuimarginata* (Chapman, Parr and Collins). ×29.
                Sample 362-20, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figures 18-20   *Gyroidina zelandicus* (Finlay). ×29.
                Sample 362-19, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figures 21-23   *Anomalina aotea* Finlay. ×50.
                Sample 362-20, CC. *Globorotalia conomiozea* Zone; upper Miocene.

Figures 24, 25 *Anomalinoides fasciatus* (Stache). ×47.
                Sample 362-8, CC. *Globorotalia inflata* Zone; middle Pliocene.

PLATE 1