Upper Miocene Planktonic Foraminifera From Bali

(with 7 plates and 3 figures)

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Abstract

Samples of Tertiary sediments discovered recently on the island of Bali by members of the Indonesian Geological Survey were studied. Among them three contain smaller foraminifera, which are particularly significant to the understanding of the geological setting of this island. Thirty three species and subspecies of planktonic foraminifera belonging to eight genera were identified. Globigerina nepenthes, Globigerina rubescens, Sphaeroidinella seminulina, Sphaeroidinella dehiscens, Globigerinoides obliguus extremus, Globigerinoides ruber, Globorotalia cf acostaensis, Globorotalia margaritae, Globorotalia tumida, Globorotalia tumida flexuosa, Globorotalia crassaformis, Globorotalia cultrata, Pulleniatina primalis, Pulleniatina obliguiloculata obliguiloculata, Pulleniatina obliguiloculata praecursor, and Hastigerina aequilateralis are the most important species among them. Assuming that the range of these species from Bali is similar to the range of the same species in the well known section at Bodjonegoro, East Java, the three Bali assemblages are assignable to the upper Miocene Globigerinoides obliguus extremus, Globorotalia margaritae, and Globorotalia crassaformis zones.

Introduction

Little is known about the paleontology of the island of Bali. The only article is by HARTONO (1964), which deals with the percentage of coiling direction of *Pulleniatina obliquiloculata* (PARKER & JONES) and *Globorotalia menardii* (D'ORBIGNY). Knowledge of the geology of this island is also very scanty. Except for the southern peninsula and Prapat Agung to the west, almost all tertiary sedimentary rocks are covered by volcanic products (SANDBERG, 1909, unpublished).

New exposures of Tertiary sediments were discovered by members of the Geological Survey of Indonesia during recent geological mapping and a number of samples were sent to the writer for age identification. Three of these contain smaller foraminifera of great importance for understanding of the geological setting of this island.

The purpose of this paper is to present the results of a study of the planktonic foraminifera of these three samples, in which thirty three species and subspecies belonging to eight genera were identified. All species are systematically described and illustrated. The planktonic foraminiferal assemblage is similar to that of well no. 1, Bodjonegoro, in the petroleumbearing area of East Java (BOLLI, 1966), and thus a similar upper Miocene for the Bali rocks is indicated.

Sample localities

Two of the rock samples come from the banks of the rivers Taman and Mentjatu, near the villages of Padjahan and Galiukir, about 5 kilometers west of the main road between Tabanan and Singaradja (fig. 1; localities number LP 241 and LP 251). The sampled layers are tuffaceous marls, that dip south-eastward, respectively 16° and 20°. Sample number LP 251 contains a small amount of subangular quartz grains. The third sample, JDE III, is calcareous sandstone from the southern flank of Luwur hill near Padang Bay.



Fig 1 Map chowing cample localities

Foraminifera assemblages

As far as the fossil content is concerned, the foraminifera specimens of sample LP 251 are best preserved. The fauna has been identified by comparison with descriptions of faunas of the Miocene Cipero and Lengua formations of Trinidad (BOLLI, 1957), Miocene and Pliocene beds from Papua and New Guinea (BELDFORD, 1962) and from localities in Java. Thirty-three species and subspecies of planktonic foraminifera belonging to eight genera have been identified. All of them are listed in the distribution chart in figure 2.

Sample LP 241 contains ten characteristic species: Globigerina nepenthes, Globigerinoides obliquus extremus, Sphaeroidinella seminulina, Hastigerina aequilateralis, Pulleniatina primalis, Globigerina venezuelana, Globorotalia cultrata, Globorotalia menardii, Globorotalia tumida and Globorotalia cf acostaensis. Sphaeroidinella seminulina is most abundant. Younger species such as Globorotalia margaritae and Globorotalia crassaformis are not represented. Except for Globorotalia cf acostaensis, Globorotalia cultrata and Globigerina venezuelana, all typical species of sample LP 241 are also found in sample LP 251 together with characteristic species such as Globorotalia margaritae, Globorotalia tumida flexuosa, Sphaeroidinella dehiscens, Globoquadrina altispira altispira, Globoquadrina altispira globosa and Globoquadrina dutertrei. Sample JDE III contains important species such as Pulleniatina obliquiloculata obliquiloculata, Pulleniatina

	LC	LOWER MIDCENE			MIDDLE		MIOCENE		UPPER MIOCENE			PLIO- CENE	12	A SP (
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Fig. 2														Olot Has Sph Glot	Ülobigerina nepenthes Hastigerina aequilateralis Sphaeroidinella seminulina Bloborotalia acostaensis Alchonotalia acostaensis		
														Olo Glo Glo Glo Glo Sph Glo Glo Glo Glo	oprotalia inenardu borotalia margaritae borotalia tumida borotalia tumida fiesuosa borotalia temida fiesuosa borotalia crassatormis binatina doliquiloculata bigerinoides obliquus ostremus bigerinoides obliquus obliquus tigerina rubescens borotalia obesa		
	' 			` <u>-</u>	 			` 						Gla Gla Gla	bbigerinoides ruber var. oborotalia scilula obigerina venezuelana		

Range in Bodjonegoro Suggested extended range in Bali

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obliquiloculata praecursor, Sphaeroidinella dehiscens, Hastigerina aequilateralis, Globigerinoides ruber and Globorotalia crassaformis.

The most typical species of the above three samples occur also in the Miocene layers of well no. 1, Bodjonegoro (BOLLI, 1966). If the range of these species is comparable to the range of the similar assemblage at Bodjonegoro, the three localities on Bali are upper Miocene and correlatives of the Globigerinoides obliquus extremus, Globorotalia margaritae and Globorotalia crassaformis zones (figure 2).

At Bodjonegoro Globigerina nepenthes and Sphaeroidinella seminulina are restricted to the Globorotalia acostaensis zone, whereas in Bali they are found in Globigerinoides obliquus extremus and Globorotalia margaritae also, as represented by samples LP 241 and LP 251.

BANNER & BLOW (1967) consider that these two species range up to the Sphaeroidinella debiscens zone, which is correlated by BOLLI (1966) with the Globorotalia margaritae zone of well no. 1, Bodjonegoro. Globorotalia tumida which appears in Bodjonegoro near the top of the Globorotalia margaritae zone appears somewhat lower in Bali namely in the Globigerinoides obliquus extremus zone.

Description of species

The systematic arrangement of genera follows the classification of BOLLI, 1957.

Family Orbulinidae SCHULTZE, 1854

Genus Globigerina D'ORBIGNY, 1826

Globigerina rubescens HOFKER

(Pl. 2, Fig. 9)

1962 Globigerina rubescens HOFKER - PARKER, Micropaleontology vol. 8, no. 2, p. 226, figs. 17-18.

1964 Globigerina rubescens HOFKER - TODD, U.S. Geol. Surv. Prof. Paper, 260-CC, p. 1080, pl. 29, fig. 1.

Test small, high trochospiral; wall calcareous, perforate, strongly beaded; chambers about 12 to 13 arranged in 3 whorls; the four chambers of the last coil increase gradually in size. Sutures deeply depressed; aperture high arch in the umbilicus.

This species is frequently found in sample LP 251. Maximum diameter of figured species LP 251 = 0.28 mm., height of spiral coiling = 0.30 mm.

Globigerina glutinata (EGGER)

(Pl. 2, Fig. 12)

1962 Globigerina glutinata (EGGER) - PARKER, Micropaleontology, vol. 8, no. 2, p. 246, pl. 9, figs. 1-6.

Nr	S.PECIES	291	LP, 251	JD€ ∰
1	Glabigerinaides trilabus trilabus	ε	a	с
2	Globigerinoides trilobus immaturus		ε	£
3	Globigerinaides sacculiterus	f	С	f
4	Glabigerinaides obliquus obliquus	r	ç	r
5	Globigerinoides obliquus extremus	f	С	
6	Globigerinaides canglabatus	r		•
7	Glabigerinuides ruber	.		F
8	Olobigerino venezvelana	r		
9	Globigerina pachyderma	• '	f	•
10	Globigerina Tuliata		r	
π	Glabigerina nepenthes	c	f	
12	Globigerina glutinata		r	
j3	Globigerina rubescens		f	
14	Drbulina universa	ð	ä,	
15	Orbulina suturalis	f		•
16	Pulleniatina obliquiloculata obliquiloculata	.		r
17	Pulleniatina obliquilaculata praecursor	-		f
18	Pulleniatina primalis	f	F	
79	Hastigerina aequilateraks	r		r
20	Eloboquadrina altispira globosa	.	r	
27	Globuquadrina altispira altispira	•	С	•
22	Globoquadrina dutertrei	.	С	r
23	Sphaeroidinella seminulina	a	С	
24	Sphaeroidinella dehiscens		r	f
25	Globarotalia menardii	а	a	а
26	Glaborotalia margaritae	.	f	
27	Globarotalia scitula	•	r	
28	Glabarotalia tumida	r	a.	Ŧ
29	Globorotalia tumida flexuosa		r	
مد	Glaboratatia crassaformis	•		f
31	Globarotalia ef acostaensis	ε	•	
32	Globorotelia cultrata	Ŧ	•	
33	Globorotalia obesa	r	ε	

Fig.3. Distribution of planktonic foraminifera as abundant c:common fiftequent rispare 1968 Globigerina glutinata (EGGER) - HERB, Eclogae Geologicae Helvetiae, vol. 61/2, p. 478, pl. 3, figs. 4-6.

Test small, trochospiral; wall calcareous, finely perforate, smooth; chambers about 12 to 13 arranged in 3 whorls; four in the last coil. Sutures deeply depressed; umbilicus covered by one bulla; small supplementary apertures are along the border line between bulla and chambers. Maximum diameter of figured species LP 251 = 0.22 mm.

Globigerina foliata BOLLI

(Pl. 2, Fig. 10)

1957 Globigerina foliata BOLLI - U. S. National Mus. Bull. 215, p. 111, pl. 24, fig. 1.

This species is rarely found in sample LP 251. Maximum diameter of figured species LP 251 = 0.28 mm.

Globigerina nepenthes TODD

(Pl. 2, Fig. 11)

1957 Globigerina nepenthes TODD - BOLLI, U. S. Nat. Mus. Bull. 215, p. 111, pl. 24, figs. 3-4.

Test small, trochospiral; wall calcareous, perforate; surface fairly smooth; chambers about 7 to 8 arranged in 2 whorls; the last one chamber sack-like in shape. Sutures depressed; aperture medium arch, bordered above by a thick lip. This species is commonly found in samples LP 241 and LP 251. Maximum diameter of figured species LP 241 = 0.30 mm.

Globigerina pachyderma (EHRENBERG)

(Pl. 2, Fig. 13)

1968 Globigerina pachyderma (Ehrenberg) - Herb, Eclogae Geol. Helv., p. 473, pl. 3, figs. 1–2.

Shape of test trochospiral, periphery rounded; wall calcareous, surface smooth, small pores giving lattice-like appearance. Chambers about 13 arranged in 3 whorls, inflated, increase rapidly in size; sutures deeply depressed. Aperture medium arch, interiomarginal. This species is frequently found in sample LP 251. Maximum diameter of figured species LP = 0.35 mm.

Globigerina venezuelana Hedberg

(Pl. 2, Fig. 14)

1957 Globigerina venezuelana HEDBERG — BOLLI, U. S. Nat. Mus. Bull. 215, p. 110, pl. 23, figs. 6-8.

This species is only found in sample LP 241. Maximum diameter of figured species LP 241 = 0.57 mm.

Genus Pulleniatina Cushman, 1927 Pulleniatina primalis Banner & BLOW

(Pl. 3 and 4, Figs. 20 and 21)

1967 Pulleniatina primalis BANNER & BLOW — Micropal., vol. 13, no. 2, p. 142–143, pl. 1, fig. 2.

Shape of test trochospiral, axial periphery broadly rounded; wall calcareous, perforate; chambers about 12 to 13 arranged in about 3 whorls, the 5 chambers of the last coil increase rapidly in size. Sutures radial, slightly curved, deeply depressed. Aperture interiomarginal arch, extending ventrally along the base of apertural face, starting from umbilicus to the periphery; apertural face is thickened. This species is frequently found in sample LP 241. Two forms are figured. Twenty and five specimens have been picked up respectively from samples LP 241 and LP 251. All of them are sinistrally coiled. Maximum diameter of figured species LP 241 = 0.50 mm., LP 251 = 0.45 mm.

Pulleniatina obliquiloculata obliquiloculata (PARKER & JONES)

(Pl. 4, Fig. 23)

1967 Pulleniatina obliquiloculata obliquiloculata — BANNNER & BLOW, Micropaleontology, vo. 13, no. 2, p. 137–139, pl. 3, fig. 4.

This species is found only in sample JDE III. Maximum diameter of figured species JDE III = 0.47 mm.

Pulleniatina obliquiloculata praecursor (BANNER & BLOW)

(Pl. 4, Fig. 22)

1967 Pulleniatina obliquiloculata praecursor — BANNER & BLOW, Micropal., vol. 13, no. 2, p. 139—140, pl. 3, fig. 3.

Twenty specimens have been picked up from the sample JDE III, all of them are dextrally coiled. Maximum diameter of figured species JDE III = 0.62 mm.

Genus Sphaeroidinella Cushman, 1927 Sphaeroidinella seminulina (Schwager)

(Pl. 3, Figs. 17 and 18)

- 1957 Sphaeroidinella rutschi Cushman & RENZ BOLLI, U. S. Nat. Mus. Bull. 215, p. 115, pl. 26, figs. 6–7.
- 1964 Sphaeroidinella seminulina seminulina (SCHWAGER) BANDY, Micropal., vol. 10, text-fig. no. 6, fig. 1.

Wall smooth, finely perforate, pores giving an almost lattice-like appearance; three to four chambers are in the last coil, the last one is sack-like in shape. Aperture interiomarginal. Two forms are figured, one without sack-like last chamber. Maximum diameter of figured species LP 251 = 0.60 mm.

Sphaeroidinella dehiscens (PARKER & JONES)

(Pi. 3, Fig. 19)

1957 Sphaeroidinella debiscens (PARKER & JONES) -- BOLLI, LOEBLICH & TAPPAN, U.S. Nat. Mus. Bull. 215, p. 32, pl. 6, figs. 1–5.

1962 Sphaeroidinella dehiscens (PARKER & JONES) — PARKER, Micropal., vol. 8, no. 2, p. 234, pl. 5, figs. 1–2.

This species is frequently found in sample JDE III. Maximum diameter of figured species JDE III = 0.80 mm.

Genus Globoquadrina FINLAY, 1947

Globoquadrina altispira altispira (Cushman & JARVIS)

(Pl. 3, Fig. 16)

- 1957 Globoquadrina altispira altispira (CUSHMAN & JARVIS) BOLLI, U. S. Nat. Mus. Bull. 215, p. 111, pl. 24, figs. 7–8.
- 1960 Globoquadrina altispira (Cushman & Jarvis) -- Cole, Todd & Johnson, Bull. American Pal., vol. 41, no. 186, p. 107, pl. 3, figs. 3-7.

Maximum diameter of figured species LP 251 = 0.50 mm., height of coiling = 0.45 mm.

Globoquadrina altispira globosa Bolli

(Pl. 3, Fig. 15)

- 1957 Globoquadrina altispira globosa BOLLI U. S. Nat. Mus. Bull. 215, p. 111, pl. 24, fig. 9.
- 1964 Globoquadrina altispira (CUSHMAN & JARVIS) TODD, Geol. Surv. Prof. Paper, 260-CC, p. 1081, pl. 291, fig. 4.

Maximum diameter of figured species LP 251 = 0.57 mm., height of coiling = 0.40 mm.

Globoquadrina dutertrei (D'ORBIGNY)

(Pl. 5, Fig. 27)

- 1941 Globigerina aff. cretacea D'ORBIGNY LEROY, Colorado School of Mines Quarterly, vol. 36, no. 1, pt. 1, p. 43, pl. 2, figs. 108—110.
- 1962 Globoquadrina dutertrei (D'ORBIGNY) PARKER, Micropal., vol. 8, no. 2, p. 242 to 244, pl. 7, figs. 10—13.

Shape of test trochospiral, exial periphery broadly rounded; wall calcareous, perforate, surface coarsely pitted; chambers about 10 to 12 arranged in 2 to 3 whorls; the five chambers of the last coil increase fairly rapidly in size. Sutures radial, strongly depressed; aperture high arch, bordered above by thin lip. This species is rarely found in samples from Bali. Maximum diameter of figured species LP 241 = 0.42 mm.

Jahrb, Geol. B.-A., 1972, Sonderband 19

Genus Orbulina d'Orbigny, 1839

Orbulina suturalis Brönnimann

(Pl. 4, Fig. 25)

1957 Orbulina universa d'Orbigny --- Bolli, U.S. Nat. Mus. Bull. 215, p. 115, pl. 27, fig. 4.

This species is frequently found in sample LP 241. Matimum diameter of figured species LP 241 = 0.65 mm.

Orbulina universa D'ORBIGNY

(Pl. 4, Fig. 24)

1957 Orbulina universa D'ORBIGNY — BOLLI, U. S. Nat. Mus. Bull. 215, p. 115, pl. 27, fig. 5.

This species is found in samples LP 241 and LP 251. Maximum diameter of figured species LP 241 = 0.65 mm.

> Genus Globigerinoides Cushman, 1927 Globigerinoides trilobus trilobus (REUSS)

(Pl. 1, Fig. 1)

1956 Globigerinoides triloba (REUSS) - BLOW, Micropal., vol. 2, no. 1, p. 62, fig. 1.

1960 Globigerinoides triloba triloba (REUSS) — JENKINS, Micropal., vol. 6, no. 4, p. 353, pl. 2, fig. 5.

This species is fairly abundant in samples LP 241 and LP 251. Maximum diameter of figured species LP 241 = 0.35 mm.

Globigerinoides trilobus immaturus LEROY

(Pl. 1, Fig. 2)

- 1957 Globigerinoides triloba immatura LEROY U. S. Nat. Mus. Bull. 215, p. 113, pl. 25, figs. 5-6.
- 1962 Globigerinoides quadrilobatus immatura BELDFORD, Bull. 62-1-N, Guinea Foram, p. 5, pl. 3, figs. 1—4.

This species is found commonly in sample LP 251. Maximum diameter of figured species LP 251 = 0.45 mm.

Globigerinoides sacculiferus (BRADY)

(Pl. 1, Fig. 3)

- 1957 Globigerinoides triloba sacculifera (BRADY) BOLLI, U.S. Nat. Mus. Bull. 215, p. 113, pl. 25, figs. 5—6.
- 1962 Globigerinoides quadrilobatus sacculifer BELDFORD, Bull. 62-1-N Guinea Foram, p. 5, pl. 4, figs. 1—6.

This species is fairly common in samples from Bali. Maximum diameter of figured species LP 251 = 0.50 mm.

Globigerinoides ruber D'ORBIGNY

(Pl. 2, Fig. 8)

1960 Globigerinoides rubra (D'ORBIGNY) — JENKINS, Micropal., vol. 6, no. 4, p. 354, pl. 2, figs. 8-9.

This species is frequently found in sample JDE III. Maximum diameter of figured species JDE III = 0.37 mm.

Globigerinoides obliquus obliquus BOLLI

(Pl. 1, Fig. 4)

1966 Globigerinoides obliquus obliquus Bolli — Eclogae Geol. Helv., vol. 59, no. 1, pl. 1, figs. 18-19.

Maximum diameter of figured species LP 251 = 0.42 mm.

Globigerinoides obliquus extremus Bolli & BERMUDEZ

(Pl. 1, Fig. 5)

1966 Globigerinoides obliquus extremus BOLLI & BERMUDEZ — Eclogae Geol. Helv. vol. 59, no. 1, pl. 1, figs. 17–21.

This subspecies is frequently found in samples LP 241 and LP 251. Maximum diameter of figured species LP 251 = 0.35 mm.

Globigerinoides conglobatus (BRADY)

(Pl. 1, Figs. 6 and 7)

1962 Globigerinoides conglobatus (BRADY) — BELDFORD, Bull. 62-1-N. Guinea Foram., p. 18, pl. 4, figs. 15–20.

Two different forms are illustrated. One with bulla covering the umbilicus. This species is found only in sample LP 241. Maximum diameter of figured species LP 241 = 0.55 mm and 0.55 mm.

Family Hantkeninidae Cushman, 1927

Genus Hastigerina THOMPSON, 1876

Hastigerina aequilateralis (BRADY)

(Pl. 4, Figs. 26)

- 1957 Hastigerina aequilateralis (BRADY) BOLLI, U. S. Nat. Mus. Bull. 215, p. 108, pl. 22, figs. 1-2.
- 1962 Hastigerina acquilateralis (BRADY) BELDFORD, Bull. 62-1-N, Guinea Foram., p. 21, pl. 5, figs. 15-18.

This species is rarely found in samples of Bali. Maximum diameter of figured species LP 241 = 0.37 mm.

Family Globorotaliidae Cushman, 1927

Genus Globorotalia Cushman, 1927

Globorotalia margaritae BOLLI & BERMUDEZ

(Pl. 7, Fig. 39)

1965 Globorotalia margaritae BOLLI & BERMUDEZ — Boletin Informativo Asociacion Venezolana De Geología Minería y petroleo, vol. 8, no. 5, p. 139, pl. 1, figs. 16—18.

Shape of test low trochospiral, spiral side very convex, umbilical side less convex; axial periphery acute with thin distinct keel. Wall calcareous, finely perforate, surface smooth finely pitted; chambers about 10 to 12 arranged in 2 to $2\frac{1}{2}$ whorls; the five chambers of the last coil increase fairly rapidly in size. Sutures on spiral side strongly curved, slightly depressed; on umbilical side radial and slightly curved. Aperture a slit bordered above by a small thin lip. In Bali this species is frequently found in sample LP 251. Eight specimens were selected, all of them are sinistrically coiled. Maximum diameter of figured species LP 251 = 0.35 mm.

Globorotalia crassaformis (GALLOWAY & WISSLER)

(Pl. 7, Fig. 38)

- 1949 Globorotalia crassula Cushman & Stewart Boomgart, Doctoral thesis Univ. Utrecht Netherland, p. 143, pl. 13, fig. 16.
- 1962 Globorotalia crassaformis (GALLOWAY & WISSLER) PARKER, Micropal., vol. 8, no. 2, p. 253, figs. 17–18.

Shape of test trochospiral, umbilical side highly convex, spiral side nearly flat; axial periphery rounded. Wall calcareous, coarsely beaded; the four chambers of the last whorl increase gradually in size; sutures distinct, slightly curved on spiral side. Aperture a slit situated at the base of a flat apertural face.

This species is frequently found in sample JDE III. Five specimens were picked up, three of them are sinistrally coiled. Maximum diameter of figured species JDE III = 0.55 mm.

Globorotalia cultrata (D'ORBIGNY)

(Pl. 7, Fig. 40)

1962 Globorotalia cultrata (D'ORBIGNY) — PARKER, Micropal., vol. 8, no. 2, p. 235, pl. 5, figs. 3-5.

Shape of test low trochospiral, spiral side slightly convex, umbilical side fairly concave; wall calcareous, surface smooth, beaded on thick keel; chambers about 12 arranged in $2\frac{1}{2}$ whorls, 6 in the last coil, inflated, the last two compressed. Sutures deeply incised, slightly curved on the umbilical side, strongly curved and limbate dorsally. Aperture is not clear. This species is found only in sample LP 241. Twenty specimens were picked up; all of them are dextrally coiled. Maximum diameter of figured species LP 241 = 0.67 mm.

Globorotalia tumida (BRADY)

(Pl. 7, fig. 37, Pl. 6, Figs. 34 and 35)

- 1957 Globorotalia tumida (BRADY) BOLLI, LOEBLICH & TAPPAN, U. S. Nat. Mus. Bull. 215, p. 41, pl. 10, fig. 2.
- 1964 Globorotalia tumida (BRADY) TODD, U. S. Geol. Survey Prof. Paper, 260-CC, p. 1094, pl. 294, fig. 3.

Three forms of Bali species are illustrated one with slightly folded last chamber. This species is frequently found in samples LP 251 and JDE III, and rarely in sample LP 241. Fifteen specimens were picked up from each sample LP 251 and JDE III; all of them are sinistrally coiled. Matimum diameter of figured species LP 241 = 0.57 mm, LP 251 = 0.70 mm, and JDE III = 0.72 mm.

Globorotalia tumida flexuosa (Koch)

(Pl. 6, Fig. 36)

1964 Globorotalia tumida flexuosa (Koch) — Todd, U. S. Geol. Surv. Prof. Paper, 260-CC, p. 1094, pl. 294, fig. 4.

This subspecies is rarely found in sample LP 251. Maximum diameter of figured species LP 251 = 0.85 m.

Globorotalia menardii (D'ORBIGNY)

(Pl. 6, fig. 32, Pl. 5, Figs. 30 and 31)

- 1957 Globorotalia menardii (D'ORBIGNY) BOLLI, U. S. Nat. Mus. Bull. 215, p. 120, pl. 29, figs. 6—10.
- 1960 Globorotalia menardii (D'ORBIGNY) JENKINS, Micropal., vol. 6, no. 4, p. 362, pl. 4, fig. 8.

This species is fairly abundant in all samples from Bali. Three forms are illustrated. Twenty-two specimens were picked up from sample LP 241 and thirty-one from sample JDE III; all of them are dextrally coiled. Of the 27 specimens picked up from sample LP 251, 24 are sinistrally coiled. Maximum diameter of figured species LP 241 = 0.85 mm., LP 251 = 0.70 mm., JDE III = 0.77 mm.

Globorotalia scitula (BRADY)

(Pl. 6, Fig. 33)

- 1945 Globorotalia canariensis (D'ORBIGNY) CUSHMAN & STAINFORTH, Cush. Lab. Foram. Res., spec. publ., vol. 14, p. 70, pl. 3, fig. 12.
- 1957 Globorotalia scitula (BRADY) BOLLI, U.S. Nat. Mus. Bull. 215, p. 120, pl. 29, figs. 11-12.

Maximum diameter of figured species LP 251 = 0.40 mm.

Globorotalia obesa BOLLI

(Pl. 5, Fig. 29)

1957 Globorotalia obesa BOLLI, n. sp. - U. S. Nat. Mus. Bull. 215, pl. 19, pl. 29, fig. 2.

This species is common in sample LP 251. Maximum diameter of figured species LP 251 = 0.35 mm.

Globorotalia cf. acostaensis BLOW

(Pl. 5, Fig. 28)

1967 Globorotalia (Turborotalia) acostaensis BLOW — BANNER & BLOW, Micropal., vol. 13, no. 2, pl. 1, fig. 1 and pl. 3, fig. 1.

Shape of test trochospiral, axial periphery broadly rounded; umbilicus slightly depressed; wall calcareous, surface beaded; chambers about 8 arranged in two whorls, 5 in the last coil. Sutures radial, slightly curved, deeply depressed; aperture a slit, opens from periphery to umbilicus, bordered above by a lip. This species is found only in sample LP 241. Maximum diameter of figured species LP 241 = 0.32 mm.

Acknowledgment

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plates 1 to 7

PLATE 1.

- Figs. 1 a—c. Globigerinoides trilobus trilobus (Reuss). LP 241; 100 \times .
- Figs. 2 a—c. Globigerinoides trilobus immaturus LEROY. LP 251; 64 ×.
- Figs. 3 a-c. Globigerinoides sacculiferus (BRADY). LP 251; 64 ×.
- Figs. 4 a-c. Globigerinoides obliquus obliquus Bolli. LP 251; 64 ×.
- Figs. 5 a—c. Globigerinoides obliquus extremus Bolli & BERMUDEZ. LP 251; 64 ×.
- Figs. 6 a—c. Globigerinoides conglobatus (BRADY). LP 241; 64 \times .
- Figs. 7 a—c. Globigerinoides conglobatus (BRADY). LP 241; 64 ×.



PLATE 2.

- Figs. 8 a—c. Globigerinoides ruber d'Orbigny. IDE III; 100 \times .
- Figs. 9 a—c. Globigerina rubescens HOFKER. LP 251; 100 ×.
- Figs. 10 a—c. Globigerina foliata BOLLI. LP 241; 100 \times .
- Figs. 11 a—c. Globigerina nepenthes TODD. LP 241; 100 \times .
- Figs. 12 a—c. Globigerina glutinata (EGGER). LP 251; 100 ×.
- Figs. 13 a-c. Globigerina pachyderma (Ehrenberg). LP 251; 64 ×.
- Figs. 14 a—c. Globigerina venezuelana Hedberg. LP 241; 64 ×.

PLATE 2













10 c



























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PLATE 3.

- Figs. 15 a—c. Globoquadrina altispira globosa BOLLI. LP 251; 64 ×.
- Figs. 16 a—c. Globoquadrina altispira altispira (Cushman & JARVIS). LP 251; 64 ×.
- Figs. 17 a—c. Sphaeroidinella seminulina (SCHWAGER). LP 251; 64 ×.
- Figs. 18 a—c. Sphaeroidinella seminulina (SCHWAGER). LP 251; 64 ×.
- Figs. 19 a—c. Sphaeroidinella dehiscens (Parker & Jones). JDE III; 50 \times .
- Figs. 20 a-c. Pulleniatina primalis BANNER & BLOW. LP 241; 64 ×.



PLATE 4.

- Figs. 21 a—c. Pulleniatina primalis BANNER & BLOW. LP 251; 64 \times .
- Figs. 22 a—c. Pulleniatina obliquiloculata praecursor (PARKER & JONES) JDE III; 64 ×.

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- Figs. 23 a—c. Pulleniatina obliquiloculata obliquiloculata (PARKER & JONES) JDE III; 64 ×.
- Figs. 24. Orbulina universa D'ORBIGNY. LP 241; 50 ×.
- Figs. 25 a—b. Orbulina suturalis Brönnimann. LP 241; 50 \times .
- Figs. 26 a—c. Hastigerina aequilateralis (BRADY). LP 241; 100 ×.



PLATE 5.

- Figs. 27 a—c. Globoquadrina dutertrei (D'ORBIGNY). LP 241; 100 ×. Figs. 28 a—c. Globorotalia cf. acostaensis BLOW.
- Figs. 28 a—c. Globorotalia ct. acostaensis BLOW. LP 241; 100 \times .
- Figs. 29 a—c. Globorotalia obesa Bolli. LP 251; 100 \times .
- Figs. 30 a-c. Globorotalia menardii (D'ORBIGNY). LP 251; 64 ×.
- Figs. 31 a-c. Globorotalia menardii (D'ORBIGNY). LP 241; 64 ×.

PLATE 5



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PLATE 6.

- Figs. 32 a—c. Globorotalia menardii (D'ORBIGNY). JDE III; 50 ×. Figs. 33 a—c. Globorotalia scitula (BRADY).
- LP 251; 64 \times .
- Figs. 34 a—c. Globorotalia tumida (BRADY). LP 251; 64 \times .
- Figs. 35 a—c. Globorotalia tumida (BRADY). LP 251; 64 ×.
- Figs. 36 a—c. Globorotalia tumida flexuosa (Koch). LP 251; 64 ×.

PLATE 6



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PLATE 7.

- Figs. 37 a—c. Globorotalia tumida (BRADY). LP 241; 64 \times .
- Figs. 38 a—c. Globorotalia crassaformis (GALLOWAY & WISSLER). JDE III; 64 ×.
- Figs. 39 a—c. Globorotalia margaritae BOLLI & BERMUDEZ. LP 251; 100 ×.
- Figs. 40 a—c. Globorotalia cultrata (d'Orbigny). LP 241; 64 \times .

PLATE 7











38 b



38 c















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