

Benthic Foraminifera from the Continental Margin off Queen Maud Land, Antarctica

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ABSTRACT

The foraminiferal fauna of the sediments of the continental margin of Queen Maud Land (except the continental shelf) is dominated by planktic foraminifera (more than 90%) while in the benthic foraminifera the calcareous outnumber the arenaceous. The richness of the benthic foraminifera (812 to less than 100 per gm) and diversity (44 to 5 pieces) decreases from the shelf to the slope. Altogether 59 species of benthic foraminifera along with 14 indetermined species were recorded. The dominant species among the calcareous benthic foraminifera is *Ehrenbergina glabra* and among the arenaceous the *Cyclammina cancellata*. The presence of some shallow water foraminifera such as *Legena* and *Oolina* in the deep water has been explained due to ice rafting. The absence of *Uvigerina* a common genera of the Sub-Antarctic regions indicates lack of faunal mixing from the southern Indian Ocean to the Antarctic Continental Margins.

INTRODUCTION

As a part of the First Indian Expedition to the Antarctica, a number of sediment, rock, water and ice samples were collected from the continental margin and adjacent seas off the Princess Astrid Coast, Queen Maud Land for laboratory studies (Fig. 1).

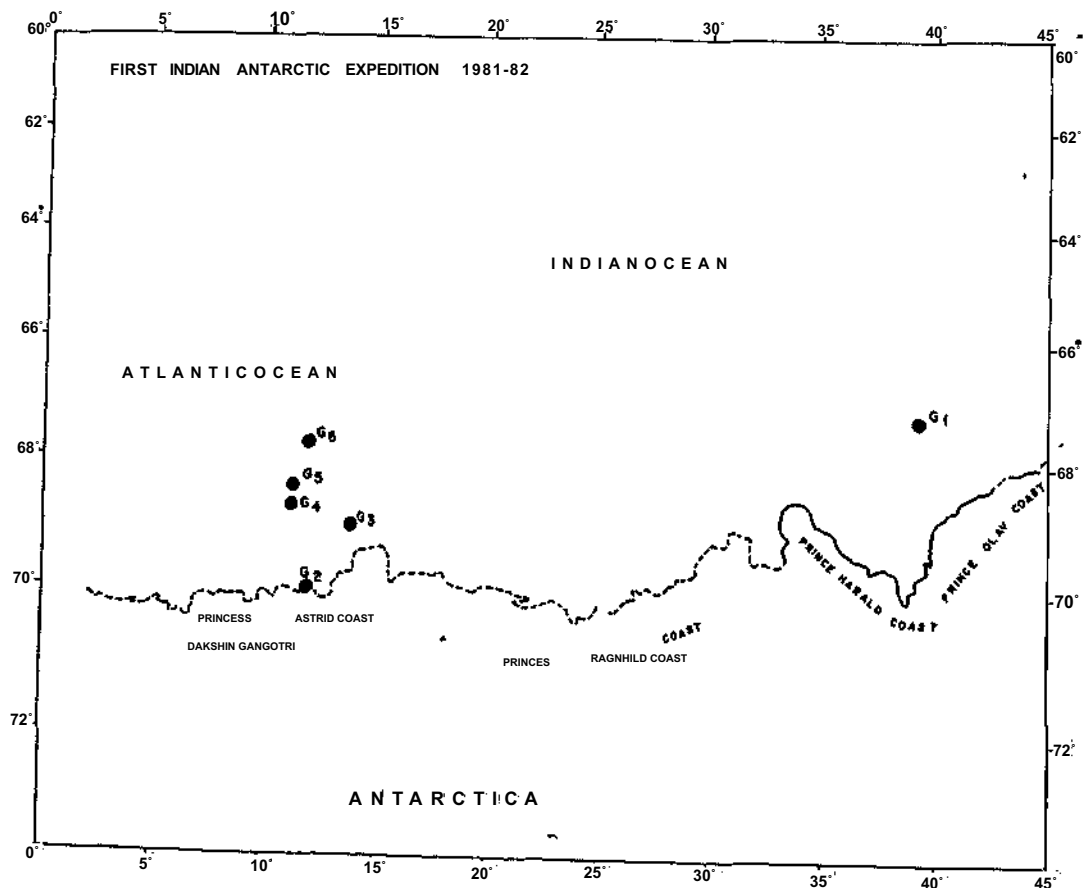


Fig 1 : Map showing the locations of samples

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PREVIOUS WORK

The earlier studies on the distribution and ecology of the recent foraminifera in the Circum-Antarctic have been carried out by Heron-Allen and Earland (1922), Wiesner (1931), Uchio (1960), McNight (1962), Bandy and Echolos (1964), Herb (1971) and more recently Kato and Tai (1979).

PRESENT STUDY AND METHODS

The present study is based on seven sediment samples collected by grab between 227-3580 m depth from the 12°E Ridge. The sediments near the coast are sandy silt which grades seaward into clayey silt and silty clay (Table 1). About five grammes of the sediment was dispersed with sodium hexametaphosphate, kept overnight and sieved through an ASTM 230 mesh sieve (63 microns) to separate the sand fraction from silt and clay. The sand fraction was dried in an oven at 60°C, and scanned under a stereobinocular microscope for foraminiferal content. The percentages of planktic, calcareous and arenaceous foraminifera from sand fraction (> 63 microns) were estimated for one gramme of sediment for each station (Fig. 2A). The calcareous and arenaceous foraminiferal percentages of the coarse fractions were taken for quantitative study of benthic foraminifera (Fig. 2 B, Table 2).

TABLE 1

Station depths, sediment texture and distribution of coarse fraction and calcium carbonate in sediments.

Station No.	Depth (m)	Coarse fraction (%)	Calcium Carbonate (%)	Texture
G-1	3580	1.78	11.5	Clayey silt
G-2	227	25.39	27.5	Sandy silt
G-3	2337	0.99	6.7	Clayey silt
G-4	1661	4.7	15.0	Clayey silt
G-5	2070	5.83	20.7	Clayey silt
G-6	1990	3.03	4.9	Silty clay

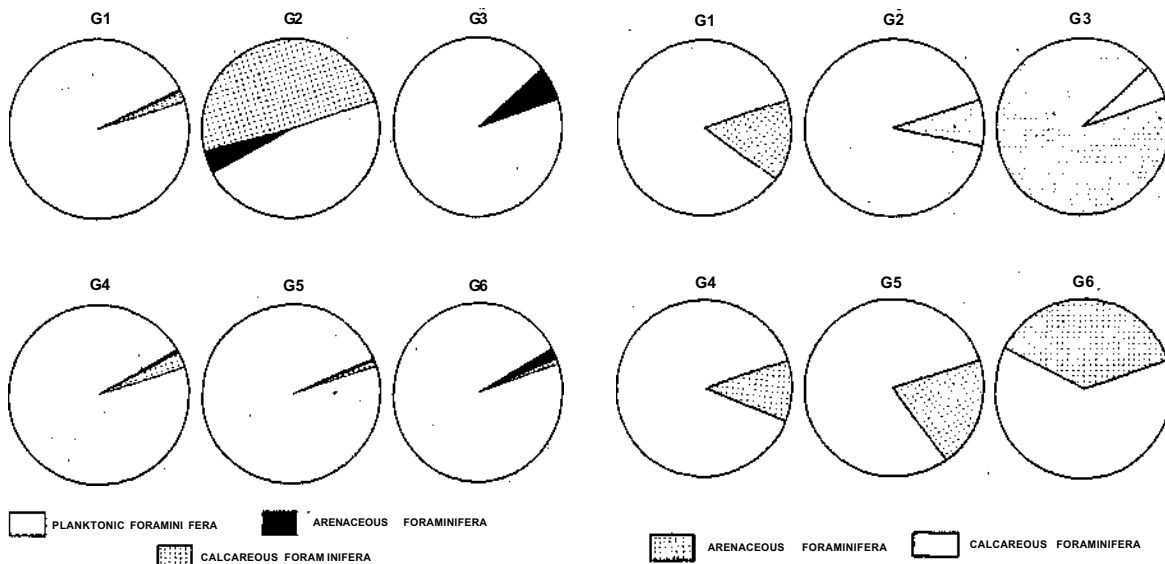


Fig. 2A : Circular diagram showing the distribution of planktic, benthic arenaceous and calcareous foraminifera.

Fig. 2B : Circular diagram showing the distribution of arenaceous and calcareous foraminifera.

TABLE 2

Distribution of benthic foraminifera, calcareous and arenaceous foraminifera in sediments.

Station No.	Number of benthic foraminifera (per gram)	Calcareous foraminifera (%)	Arenaceous foraminifera (%).
G-1	7	85.7	14.3
G-2	812	92.1	7.9
G-3	15	—	100.0
G-4	72	88.9	11.1
G-5	80	80.0	20.0
G-6	64	37.5	62.5

The identification of foraminifera was based on the studies by Herb (1971) and Corliss (1979). For studies of benthic foraminifera the coarse fractions (> 149 micron) were split with a microsplitter to yield about 100-150 specimens and the percentage of each species of foraminifera was computed. In some cases where the sediment did not yield the required number of specimens and the sample quantity was insufficient the percentage is based on counts of less than 100 specimens.

Representative specimens of foraminifera from all the stations were picked and mounted on specimen stubs and coated with gold-palladium for scanning electron microscopy and photographed (Plate 1 and 2) on a Cambridge Stereoscan Electron Microscope.

RESULTS AND DISCUSSION

The planktic foraminifera constitute more than 90 per cent of the foraminiferal assemblage in the 63 micron fractions of all the samples except station G-2 on the shelf. The high percentage of planktic foraminifera is characteristic of an open oceanic environment. The benthic foraminifera are rich (812 per gm) in the shelf region (sample G-2) and decrease on the slope to less than 100 per gm. Altogether 59 species of benthic foraminifera along with 14 indetermined species were recorded in the samples (Table 3). The diversity of benthic foraminifera decreases seaward, from 44 species on the shelf to 5 species on the slope. The benthic foraminiferal fauna in the > 63 micron fraction of all samples mainly comprises calcareous foraminifera except G-3 in which arenaceous foraminifera dominate (Fig. 2B).

Calcareous foraminifera are particularly well represented at station G-2 on the continental shelf off the Princess Astrid Coast and constitute over 90 per cent of the total foraminifera.

The coarse fraction (> 149 microns) of the sediments on the shelf (G-2) beside foraminifera also contains bryozoa (particularly abundant in the +35 and +60 mesh fractions), bivalves and ostracoda. Out of the 44 species of benthic foraminifera recorded, calcareous forms constitute 34, the remaining being arenaceous. Among these *Ehrenbergina glabra* is the dominant species (37%) and other common species are: *Angulogerina angulosa*, *Cassidulina subglobosa*, *Buliminella elegantissima*, *Oolina squamosa*, *Cibicides lobatulus*, *Cyclogyra involvens*, *Pyrgo depressa*, *Quinqueloculina seminulum*, *Fissurina marginata*, *Trochammina globulosa*, *T. nana*, *Reophax guttifer*, *Patellina corrugata* and *Saccamina* sp.

On the slope in this area (1661 to 2070m) the coarse fraction is mainly composed of *Globigerina* ooze which seaward grades into sands devoid of fauna and flora except a few benthic foraminifera. The following species are common on the slope *Bulimina aculeate*, *A. angulosa*, *Epistominella exigua*, *Cyclammina cancellata*, *Fissurina marginata*, *Planulina wuellerstrofi* and *Eggrella bradyi*. The discoloured tests of *E. bradyi* and some ostracoda and bryozoa suggest reworking and transport by ice rafting. The sediments from station G-6 on the slope (1990 m) are devoid of fossils except for a few common

TABLE 3
Distribution of benthic foraminifera

Station No.	G-2	G-4	G-6	G-5	G-3	G-1
Depth (m)	227	1661	1990	2070	2337	3580
Species						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Adercotryma glomerosa</i>		12				3.4
<i>Alveolophragmium sp.</i>						1.1
<i>Ammobaculites agglutinans</i>					6.3	
<i>Ammobaculites Sp.</i>					3.1	
<i>Angulogerina angulosa</i>	6.5	7.2			3.1	
<i>Astrorhiza crassatina</i>						3.3
<i>Bulimina aculeata</i>		50.6		2.7		
<i>Buliminella elegantissima</i>	4.6				3.1	
<i>Cassidulina crassa</i>	X					
<i>C. subglobosa</i>	6.5					
<i>Cibicides fletcheri</i>		12				
<i>C. lobatulus</i>	8.3	2.4				
<i>Cibicides Sp.</i>	2.1			2.7		1.1
<i>Cribrosomoides contorta</i>	3.5					
<i>C. crassimargo</i>					6.3	
<i>C. subglobulus</i>	X		40.0			
<i>Cyclammina cancellata</i>	X			5.5	15.6	38.2
<i>C. orbicularis</i>		12	15.0		6.1	5.6
<i>C. pusilla</i>		12				
<i>Cyclogyra foliaceae</i>	X					
<i>C. involvens</i>	3.3					
<i>Dentalina communis</i>	X				6.3	
<i>Discorbis sp.</i>	1.1					
<i>Eggerella bradyi</i>		15.7	10.0	5.5	6.3	
<i>Epistominella exigua</i>		7.2	25.0	38.8	3.1	10.1
<i>E. umbonifera</i>						6.7
<i>Eponides sp.</i>				2.7		
<i>Eponides weddellensis</i>		12		2.7		1.1
<i>Ehrenbergina glabra</i>	36.9				9.5	
<i>Fissurina fimbriata</i>	X					
<i>F. marginata</i>	14	3.6	10.0	11.1		1.1
<i>Fissurina sp.</i>	1.0			2.7	9.4	
<i>Gyroidina soldanii</i>	X					
<i>Haplophragmoides bradyi</i>	X			5.5	3.1	
<i>Hoeglundina elegans</i>						2.2
<i>Hormosina globularis</i>					3.1	
<i>Hyperammina cylindrica</i>					6.3	
<i>Lagena gracilllis</i>		12				
<i>L. hispida</i>					2.7	2.2
<i>L. leavis</i>	X					
<i>L. sulcata</i>	X			2.7		1.1
<i>Laticarina pauperata</i>	X					
<i>Lenticulina sp.</i>	X	12				
<i>Melonis pompiloides</i>						3.4
<i>Milliammina sp.</i>	X					

Benthic Foraminifera From...

TABLE 3 (Contd.)

Station No	G-2	TABLE 3 (Contd.)		G-5	G-3	G-1
Depth(m)	227	G-4	G-6	2070	2337	3580
species		1661	1990	(5)	(6)	(7)
(1)	(2)	(3)	(4)			
<i>Miliolinella subrotunda</i>	X					
<i>Nonion sp.</i>		1.2				1.1
<i>Oolina globosa</i>	X					1.1
<i>O.squamosa</i>	4.0					3.4
<i>Oridorsalis tener</i>						
<i>Patellina corrugata</i>	2.2					
<i>Planulina wuellerstrofi</i>		1.2		5.5		
<i>Psammosphaera fusca</i>	X				3.1	
<i>Psammosphaera sp.</i>	X					1.1
<i>Pullenia bulloides</i>						
<i>Pyrgo bulloides</i>	2.7					
<i>Pyrgo depressa</i>	1.6			2.7		
<i>P. murrhina</i>				2.7		
<i>Quinqueloculina seminulum</i>	1.6					
<i>Quinqueloculina sp.</i>	2.1					
<i>Reophax cylindricus</i>						3.4
<i>R. dentaliformis</i>						
<i>R. guttifer</i>	1.1					
<i>R. modulifer</i>	X					2.2
<i>R. pilulifer</i>	X				6.3	
<i>Reophax sp.</i>	X	12				
<i>Saccamina sp.</i>	2.3					
<i>Spirillina sp.</i>	3.0					
<i>S. vivipam</i>	1.1					
<i>Triloculina tricarinata</i>	X					
<i>Triloculina sp.</i>	X					
<i>Trichammina globulosa</i>	1.1					
<i>T. nana</i>	1.1					

benthic foraminifera like: *Cribrostomoides subglobulus*, *Epistominella exigua*, *Cyclammina obricularis*, *Fissurina marginata* and *Eggrella bradyi*. Similarly the foraminiferal fauna at a depth of 2337 m on the slope is very poor. Out of the 18 species recorded *Cyclammina cancellata* and *Ammobaculites agglutinans* are common. The reasons for the very poor organic activity in this part of the slope are not clear.

The coarse fraction of the sample from the slope (3580 m) off the Princess Olav Coast largely comprises radiolarian and terrigenous material including pebbles with minor benthic and planktic foraminifera, sponge spicules. Possibly the slope in the region is in the calcium carbonate compensation depth (CCD) and the sediment grades into quartz, radiolarian diatom ooze. The planktic foraminifera are negligible but benthic foraminifera are represented by 23 species largely arenaceous and some calcareous forms indicate a good diversity. The presence of some shallow water foraminifera such as *Lagena*, *Oolina* and pebbles may be due to ice rafting. *Cyclammina cancellata* (38 per cent) is the only abundant arenaceous species followed by *Epistominella exigua* (10 per cent), *E. umbonifera* (7 per cent) and *C. orbicularis* (6 per cent).

The samples though limited, provide additional data on the distribution of foraminifera in the Antarctic waters but do not permit drawing conclusion on the ecology and bathymetric zonation. The

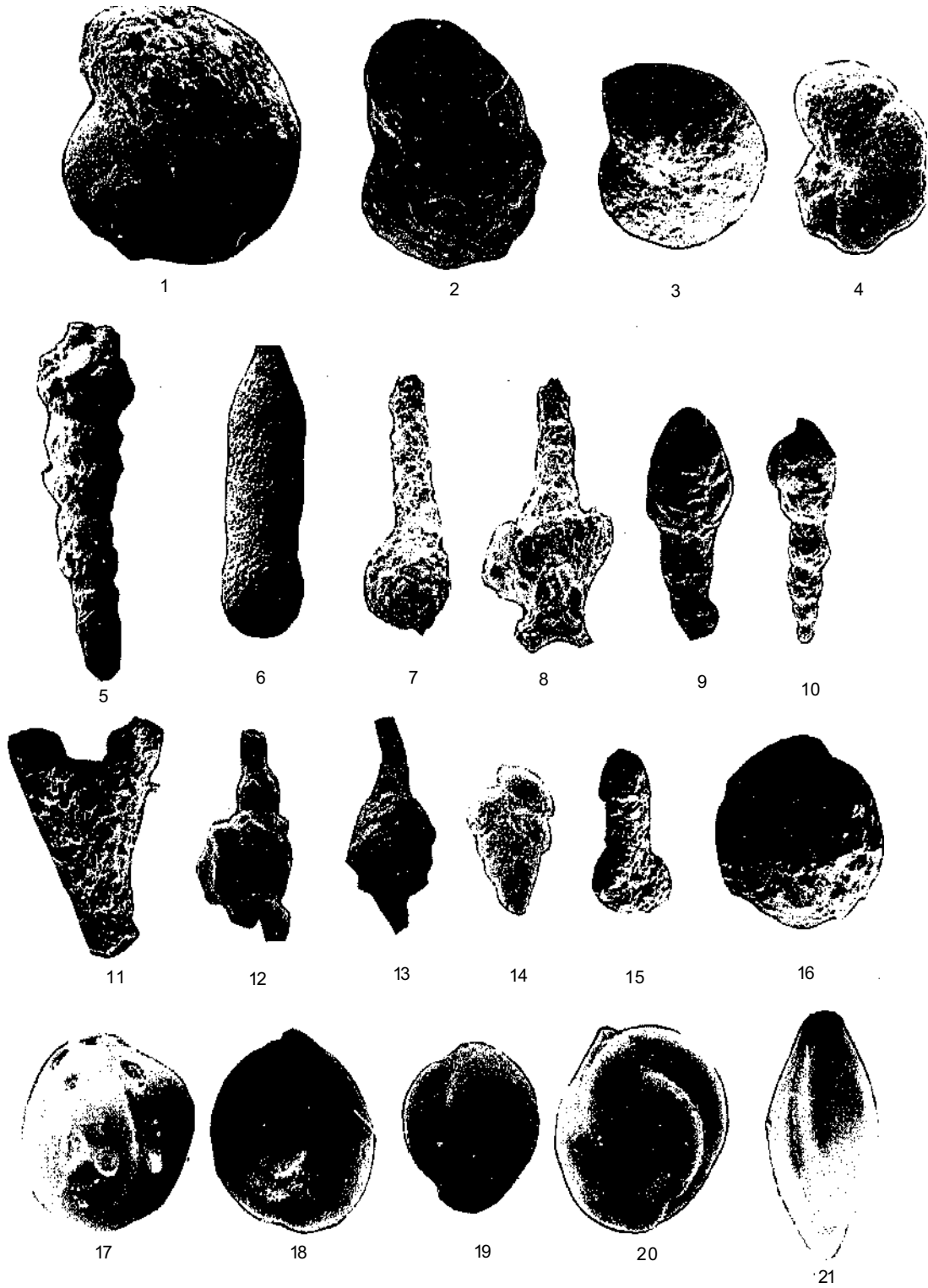


PLATE 1

Scanning electron microphotograph of representative species of foraminifera.

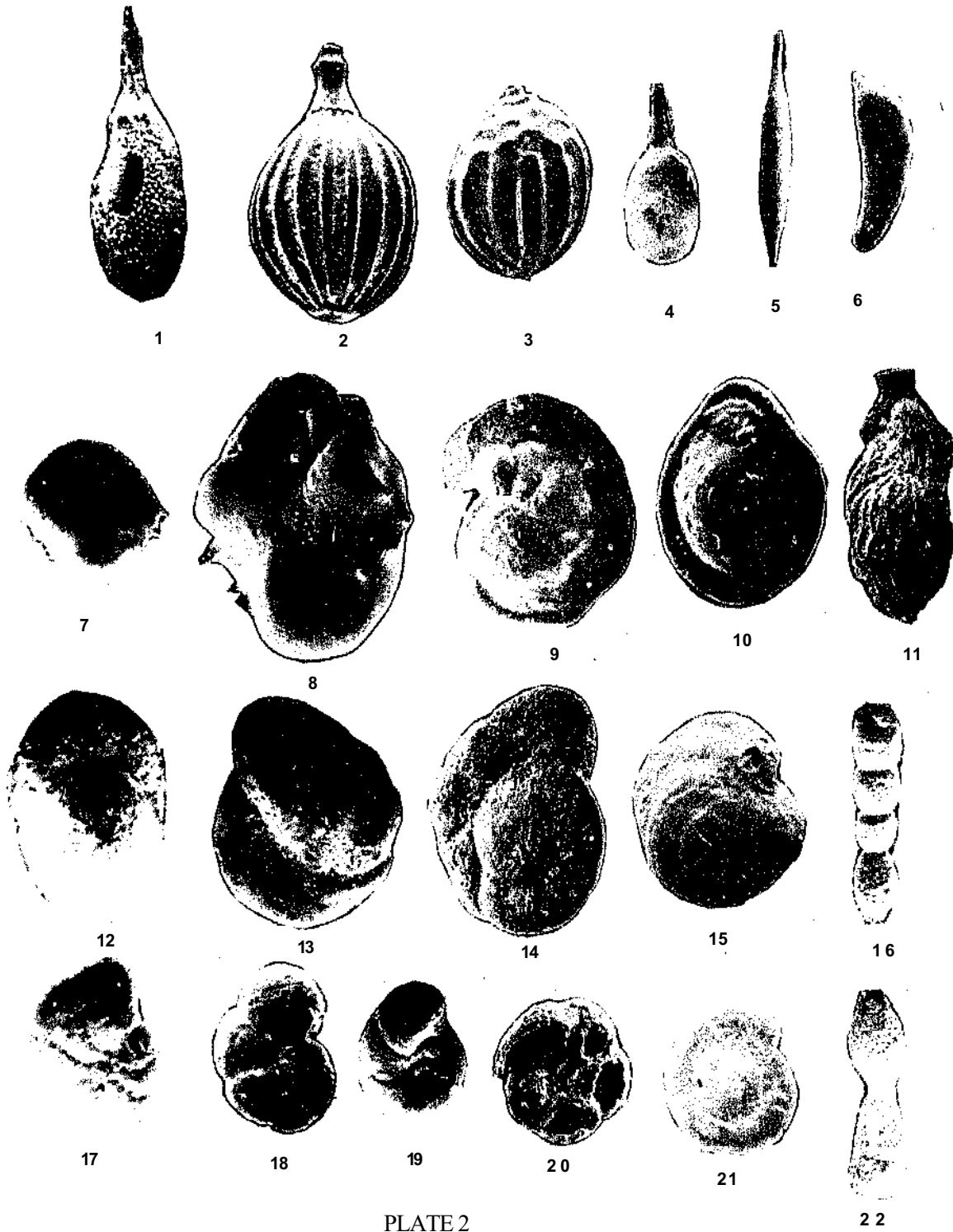


PLATE 2

Scanning electron microphotograph of representative species of foraminifera

deposition of foraminiferal tests is not strictly thanatocoensis, as in the Antarctic region the foraminifera of shallower regions are transported to deeper waters by ice rafting and by turbidity currents.

The samples studied did not contain *Uvigerina* though the genus is reported in sub-antarctic region. The absence may indicate lack of faunal mixing from the Southern Indian Ocean to Antarctic continental margins.

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REFERENCES

- Bandy O.L. and R. S. Echolos 1964
Antarctic foraminiferal zonation. *Biology of the Antarctic Seas* Ed. by M. O. Lee, Washington, *American Geophysical Union* 1., 73-91 (Antarctic Res. Ser. 1).
- Heron-Allen and A. Earland, 1922
Protozoa, Part 2, Foraminifera. British Antarctic ("Terra Nova") Expedition, 1910, *Natural History Report. Zoology*, 6(2), 25-268, Pls. 8.
- Herb R. 1971
Distribution of Recent benthonic foraminifera in the Drake Passage. In: Llano, G.A., and I.E. Wallen, Eds. *Biology of the Antarctic Sea IV. American Geophysical Union. Antarctic Research Series* 17, 251-300.
- Kato M. and Y. Tai 1979
Foraminifera from the Eastern part of Lutzow-Holm Bay, Antarctica. In Proceedings. First symposium on Antarctic Geosciences Ed. Takesi Nagata. *Memoir of National Institute of Polar Research Special Issue* 14, 210-220.
- McNight W. M. Jr. 1962
The distribution of foraminifera of the Antarctic Coast. *Bulletin American Palaeontology* 44., (201), 65-158.
- Uchio T. (1960)
Ecology of living benthonic foraminifera from the San Diego, California area. *Cushman Foundation for Foraminifera Research., Spl. Publ.* 5, 72 pp, 10 pl.
- Wiesner H. 1931
Die foraminiferen der Deutschen Sudpolar Expedition 1901-1903. *Deutsche-Sudpolar Expedition., 20 (Zoologie)* 12, 53-165, Pls. 1-24.