

## MERIDIONAL HYDROGRAPHIC SECTIONS AND PLANKTONIC FORAMINIFERAL ASSEMBLAGES IN THE WEST PACIFIC OCEAN IN 1991

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### 1 Introduction

Oceanographic observations were carried out on the way to Papua New Guinea and again on the way back to Japan, in November/December 1991. Oceanographic data were taken with CTD and XBT. Samples of planktonic foraminiferal assemblage were also collected by vertical towing. In this report we discuss the CTD and XBT data and planktonic foraminifera samples, and make a comparison with the results of a study of the same region in 1989 (HATTA *et al.*, 1990).

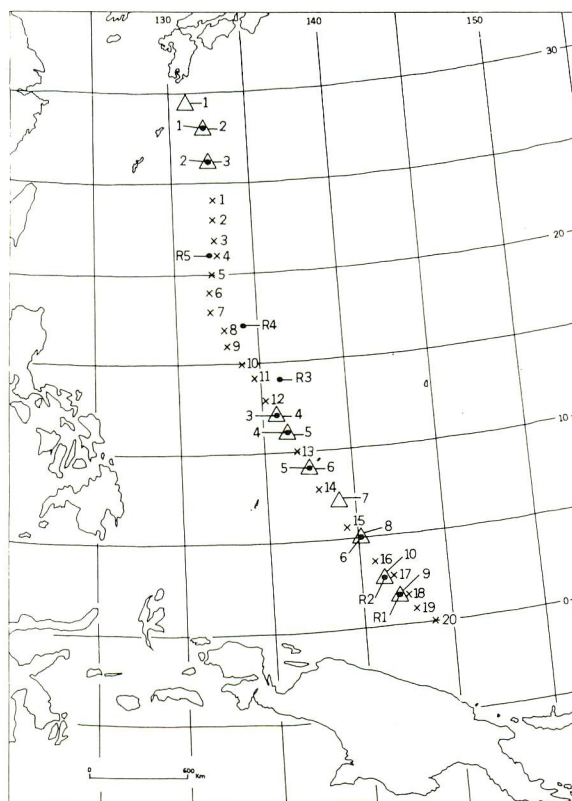


Fig. 1. Map showing observation stations and sampling stations of planktonic foraminifera.

Symbols;  $\triangle$  : CTD observation ;  $\times$  : XBT observation ;  
 $\bullet$  : planktonic foraminifera (Original St. No.)

## 2 CTD and XBT observation stations and planktonic foraminifera sampling stations.

Figure 1 shows the observation and sampling stations. The XBT was launched at 20 stations from lat.  $24^{\circ}-00'.0$  N, long.  $132^{\circ}-46'.4$  E, lat.  $00^{\circ}-00'.0$  N, long.  $143^{\circ}-59'.9$  E, these stations are shown by the symbol X in figure 1. All XBT data were taken on the way out to Papua New Guinea. The CTD was lowered at 10 stations from lat.  $29^{\circ}-33'.9$  N, long.  $131^{\circ}-08'.7$  E, to lat.  $03^{\circ}-00'.0$  N, long.  $141^{\circ}-24'.6$  E; these data are shown by the symbol  $\triangle$  in figure 1. The first eight CTD data were taken on the way out to Papua New Guinea and the last two were taken on the way back to Japan.

Samples of planktonic foraminifera were taken at 11 stations from lat.  $27^{\circ}-59'.6$  N, long.  $131^{\circ}-55'.8$  E, to lat.  $02^{\circ}-00'.3$  N, long.  $142^{\circ}-03'.0$  E; these stations are shown by the symbol  $\bullet$  in figure 1. Samples from No.1 to No.6 were taken on the way out to Papua New Guinea and No.R.1 to No.R.5 were taken on the way back to Japan.

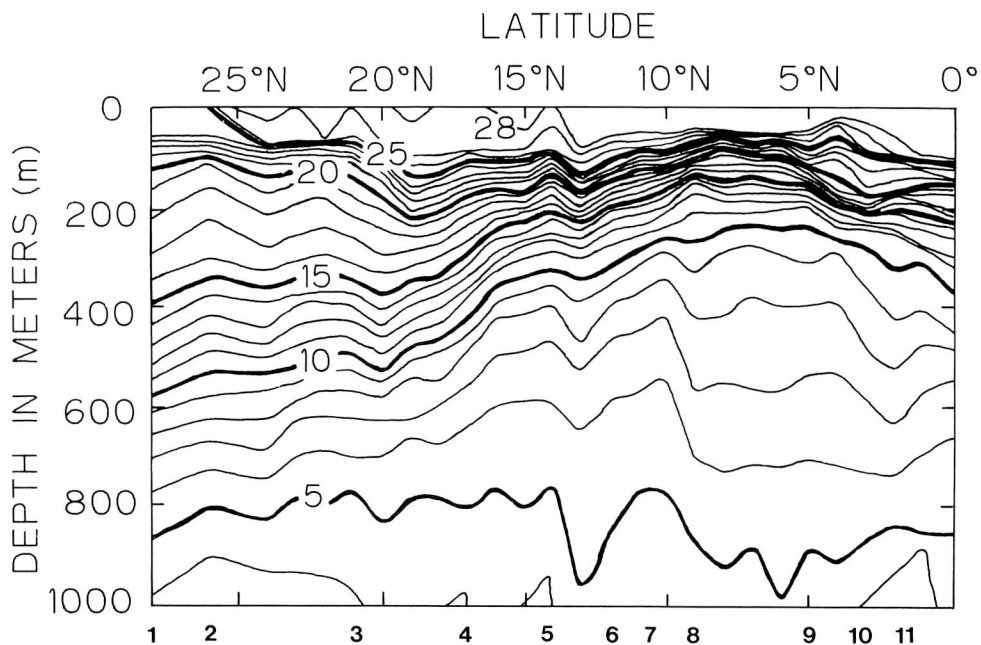


Fig. 2. Vertical distribution of water temperature ( $^{\circ}$ C) between  $29^{\circ}$  N and Equator. (Number 1-11 : Planktonic sampling station)

## 3 Temperature

A vertical section of water temperature in the region between lat.  $29^{\circ}-33'.9$  N, long.  $131^{\circ}-08'.7$  E and the Equator, long.  $143^{\circ}-59'.9$  E is shown in Fig. 2. Surface water of  $25-29^{\circ}$  C was found in the surface mixed layer. The surface mixed layer was about 75m thick over the whole section. Surface thermal fronts were found at about lat.  $26^{\circ}$  N and  $14^{\circ}$  N. A sharp thermocline of  $20^{\circ}$  C was found between the Equator and lat.  $15^{\circ}$  N at  $100-300$  m depths. The thermocline sloped up from the Equator to lat.  $08^{\circ}$  N, and sloped down again from lat.

08°N to the north. The ridge of the thermocline at about 08°N was thought to indicate the boundary between the North Equatorial Current and the North Equatorial Countercurrent. At about lat. 15°N, the thermocline began to separate into upper and lower thermoclines. The lower thermocline centered around 10 - 12 °C in the subtropical region. Between these thermoclines, a homogeneous layer was found at 100 ~ 400 m depths. Isotherms with 5 - 8 °C at depths between 600 and 800 m in the North Pacific Intermediate Water sloped up approximately from lat. 26°N to lat. 10°N.

#### 4 Sampling methods and data of planktonic foraminifera

The Number of sampling stations of planktonic foraminifera was 11, extending from about 28°N, 132°E to 02°N, 142°E (Table 3). At each station we collected 4 horizon samples by vertical towing from the water between 0 and 50m, 50 and 100m, 100 and 150m, 150 and 200m in depth. It took about one hour to collect 4 horizon samples in 11 stations. All 44 samples contained fresh planktonic foraminifera. Table 4 is a list of planktonic foraminifera. *Globigerinoides sacculifer* (BRADY) and *G. ruber* (D'ORBIGNY) were found at every stations. *Globigerina rubescens* HOFKER was found in samples between 17°N and 05°. *Candeina nitida* D'ORBIGNY was found only in samples at 14°N and 12°N. *Globorotalia menardii* (PARKER, JONES and BRADY) was contained only in the sample situated south of 05°N, and *G. tumida* was limited to the samples at 03°N and 02°N. These result are similar to those of HATTA *et al.* (1990).

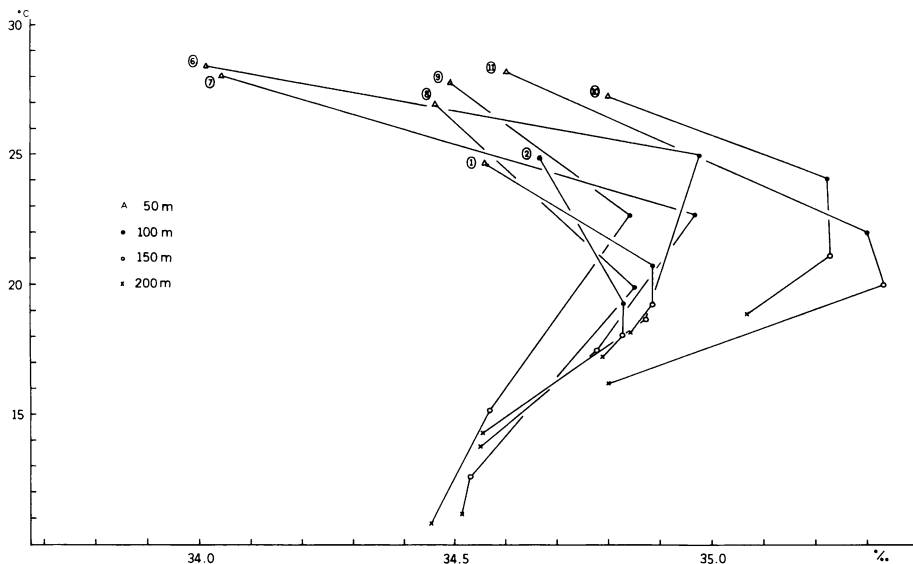


Fig. 3. Temperature-salinity diagram of sampling stations of planktonic foraminifera (Station Number, 1, 2, 6-11).

Station Number	1	2	6	7	8	9	10	11
Original St. No.	1	2	3	4	5	6	R 2	R 1

## 5 Relationship between planktonic foraminifera and sea water

Two distinct differences were found in planktonic foraminiferal assemblages between the northern region of station No.3 (R5) and the southern region of No.4 (R4), and between No.9 (original No.6) and No.10 (R2).

Temperature-salinity diagram from CTD data is given in figure 3. It can be seen that the T-S diagram is divided into four types (Nos.1 and 2, Nos.6 and 7, Nos.8 and 9, and Nos.10 and 11).

Planktonic foraminiferal assemblage consisted of 4 groups, Nos.1-3, Nos.4-8, Nos.9, and Nos.10-11. We consider that No.4 (R4) to No.8 correspond to the North Equatorial Current, and that Nos.10 and 11 correspond to the North Equatorial Countercurrent. We also thought that No.9 is perhaps an intermediate assemblage, and that Nos.1-3 are influenced by the Kuroshio Counter Current.

## 6 Paleontological significance

When we study the geological age and palaeoecology of strata containing planktonic foraminifera, it is necessary to make a comparative study of fresh specimens of recent planktonic foraminifera.

D'ORBIGNY (1839) described planktonic foraminifera from the beach sands of Cuba. Since these planktonic foraminifera were studied over a century ago, this has been used for biostratigraphic analysis.

BRADY (1884) reported planktonic foraminifera in the scientific report of the Voyage of H. M. S. Challenger during the years 1873-76, and since then living planktonic foraminifera have been studied by many researchers.

BÉ (1977) studied the ecology, zoogeography and taxonomy of recent foraminifera on the basis of the studies of various authors, and he mapped out the faunal provinces. According to BÉ (1977), subtropical species are *Globigerinoides ruber* (D'ORBIGNY), *Globorotalia hirusuta* (D'ORBIGNY), *Globigerinella aequilateralis* (BRADY), *Orbulina universa* D'ORBIGNY and *Globigerinoides conglobatus* (BRADY), and tropical species are *Globigerinoides sacculifer* (BRADY), *Globorotalia menardii* (D'ORBIGNY), *Globoquadrina dutertrei* (D'ORBIGNY) and *Pulleniatina obliquiloculata* (PARKER and JONES).

Our data of from the West Pacific Ocean is generally in agreement with the above mentioned faunal provinces. As the data used by BÉ (1977) did not contain much information on the West Pacific Ocean, our data is more detailed and may provide important information on planktonic foraminifera in this province.

## References

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Table 1. XBT observation data ; Station Number, Date, Time of start of sampling, Position and Temperature of each depth.

XBT No.	1	2	3	4	5	6	7	8	9	10
Date	1991.11. 3	1991.11. 3	1991.11. 4	1991.11. 4	1991.11. 4	1991.11. 4	1991.11. 5	1991.11. 5	1991.11. 5	1991.11. 5
Stn.	XBT 1 18:43	XBT 2 23:30	XBT 3 04:02	XBT 4 08:39	XBT 5 13:36	XBT 6 18:50	XBT 7 00:13	XBT 8 06:08	XBT 9 11:52	XBT 10 17:28
Lat.	24-00'00N	23-00'00N	22-00'00N	21-00'00N	20-00'00N	19-00'00N	18-00'00N	17-00'00N	16-00'00N	15-00'00N
Long	132-46'41E	132-47'33E	132-45'58E	132-39'08E	132-15'00E	132-06'61E	132-25'83E	133-01'45E	133-36'69E	134-11'12E
	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)
0	26.95	26.93	27.17	26.97	27.43	28.11	27.83	27.90	28.06	28.24
10	26.97	26.94	27.19	26.94	27.42	28.11	27.81	27.90	27.99	28.25
20	26.97	26.97	27.21	26.97	27.33	28.08	27.81	27.90	27.97	28.13
30	26.99	26.99	27.21	26.97	27.28	28.11	27.81	27.92	27.97	28.13
50	27.08	26.97	27.24	26.57	27.26	27.60	27.67	27.87	27.94	28.04
75	26.41	24.48	24.38	24.54	26.58	27.53	27.30	27.62	27.63	27.54
100	22.05	21.80	21.75	21.85	24.75	26.69	26.24	25.50	25.72	25.32
150	19.80	19.07	18.89	19.47	20.90	24.47	23.56	21.89	20.87	21.00
200	18.47	17.89	17.64	18.49	19.27	21.44	20.48	18.64	17.42	17.01
250	17.51	17.10	16.86	17.18	17.73	18.56	18.04	16.61	14.39	14.02
300	16.71	16.19	15.84	16.22	16.94	16.49	16.06	14.72	12.43	11.14
400	13.85	12.89	12.74	12.97	14.13	12.84	12.17	10.59	8.56	8.25
500	11.23	10.61	9.82	9.91	10.83	9.40	8.91	7.94	6.99	6.93
600	8.61	7.67	7.36	7.49	7.62	7.32	7.01	6.58	6.02	5.93
700	6.73	5.98	5.68	6.06	6.00	5.55	5.83	5.59	5.37	5.47
800	5.34	4.82	4.98	4.77	5.05	4.91	4.90	5.03	4.78	5.00
850	4.84	4.52	4.64	4.54	4.86	4.60	4.49	4.73	4.56	4.75
900						4.42	4.34		4.47	

XBT No.	11	12	13	14	15	16	17	18	19	20
Date	1991.11. 5	1991.11. 6	1991.11. 7	1991.11. 7	1991.11. 8	1991.11. 8	1991.11. 8	1991.11. 9	1991.11. 9	1991.11. 9
Stn.	XBT 11 22:53	XBT 12 03:59	XBT 13 00:44	XBT 14 13:31	XBT 15 02:21	XBT 16 14:56	XBT 17 20:20	XBT 18 01:46	XBT 19 07:09	XBT 20 13:13
Lat.	14-00'00N	13-00'00N	10-00'00N	08-00'00N	06-00'00N	04-00'00N	03-00'00N	02-00'00N	01-00'00N	00-00'00N
Long	134-46'38E	135-18'86E	138-59'87E	138-12'54E	139-38'07E	141-05'57E	141-49'92E	142-34'86E	143-17'39E	143-59'94E
	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)	Temp. (°C)
0	27.61	28.38	28.63	28.70	28.84	28.90	28.54	28.67	28.61	29.16
10	27.60	28.39	28.66	28.63	28.80	28.85	28.54	28.66	28.61	29.00
20	27.51	28.39	28.63	28.51	28.83	27.59	28.54	28.66	28.57	28.95
30	27.24	28.42	28.66	28.51	28.83	26.61	27.75	28.27	28.61	28.92
50	26.59	28.42	28.11	25.88	28.32	25.22	27.12	28.06	28.61	28.90
75	26.29	28.42	25.63	20.24	21.73	22.98	26.43	27.74	28.51	28.82
100	22.88	26.91	22.18	17.74	18.63	21.34	23.76	24.44	27.68	28.27
150	18.74	23.11	16.22	14.95	15.15	20.38	21.45	20.95	20.34	19.87
200	15.23	18.32	12.80	11.43	11.50	14.16	17.28	15.14	15.71	17.68
250	12.98	13.92	10.44	9.89	9.78	10.68	10.92	11.08	12.83	13.65
300	10.56	11.58	8.62	8.94	8.96	8.77	9.90	10.18	10.59	12.00
400	7.93	8.91	7.28	8.20	8.02	7.83	8.74	9.25	9.05	9.66
500	6.63	7.58	6.22	7.42	7.40	7.20	7.85	8.20	7.50	7.91
600	5.97	6.44	5.72	6.77	6.81	6.55	6.98	7.24	6.70	6.73
700	5.39	5.82	5.19	6.21	6.13	6.11	6.46	6.33	5.96	5.92
800	4.73	5.32	4.85	5.63	5.54	5.49	5.47	5.57	5.36	5.17
850	4.46	5.17	4.64	5.30	5.31	5.17	5.09	5.40	5.05	
900		5.10	4.54	5.10	5.20					

Table 2. CDT observation data ; Station Number, Date, Time of start of sampling, Position and Temperature of each depth.

CTD No	1		2		3		4		5	
Date	1991.11. 2		1991.11. 2		1991.11. 2		1991.11. 6		1991.11. 6	
Stn.	CTD 1 00:06		CTD 2 09:38		CTD 3 22:42		CTD 4 10:10		CTD 5 17:18	
Lat.	29 -33'86N		28 -00'00N		26 -00'00N		11 -55'30N		10 -59'98N	
Long	131 -08'72E		131 -55'87E		132 -18'61E		135 -55'18E		136 -25'85E	
	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)
0	24.93	33.835	24.71	34.562	25.07	34.310	28.59	33.970	28.67	33.872
10	24.77	34.568	24.71	34.560	24.90	34.670	28.52	33.993	28.67	33.880
20	24.77	34.568	24.71	34.561	24.91	34.670	28.50	33.993	28.49	33.995
30	24.78	34.571	24.71	34.560	24.90	34.670	28.46	34.078	28.40	34.075
50	24.77	34.568	24.71	34.560	24.90	34.671	28.36	34.153	28.08	34.451
75	24.76	34.571	22.27	34.844	22.35	34.747	26.61	34.858	26.47	34.849
100	24.64	34.541	20.74	34.885	19.31	34.829	24.99	34.972	22.68	34.968
150	22.79	34.699	19.30	34.871	18.08	34.833	18.70	34.872	17.52	34.778
200	19.08	34.772	18.29	34.846	17.25	34.790	14.32	34.564	13.74	34.552
250	17.58	34.739	17.59	34.813	16.61	34.755	11.52	34.441	11.22	34.433
300	16.22	34.671	16.92	34.779	15.93	34.702	10.37	34.416	9.23	34.392
400	12.57	34.477	14.86	34.628	13.46	34.518	7.77	34.461	7.58	34.454
500	8.40	34.315	12.53	34.451	10.57	34.332	6.52	34.463	6.40	34.477
600	5.44	34.303	9.25	34.250	8.52	34.241	5.91	34.501	5.85	34.500
700	3.95	34.373	6.95	34.186	6.35	34.224	5.49	34.525	5.34	34.523
800	3.30	34.427	5.63	34.204	5.03	34.260	5.18	34.535	4.84	34.541
900	3.04	34.463	4.62	34.284	4.01	34.346	4.69	34.542	4.26	34.556
1000	2.81	34.494	3.85	34.386	3.35	34.424	4.17	34.563	3.87	34.568
1100	2.69	34.512	3.31	34.441	3.09	34.437	3.87	34.576	3.60	34.582

CTD No	6		7		8		9		10	
Date	1991.11. 7		1991.11. 7		1991.11. 8		1991.11.28		1991.11.28	
Stn.	CTD 6 06:28		CTD 7 19:25		CTD 8 08:11		CTD 9 14:32		CTD 10 23:24	
Lat.	09 -00'01N		07 -00'03N		05 -00'07N		02 -00'00N		03 -00'00N	
Long	137 -36'76E		138 -54'70E		140 -21'41E		142 -00'58E		141 -24'63E	
	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)	Temp. (°C)	Sal. (‰)
0	28.57	33.743	28.63	33.993	28.59	34.006	28.71	34.577	28.37	34.541
10	28.52	33.933	28.63	33.999	28.51	34.004	28.64	34.571	28.34	34.603
20	28.52	33.932	28.60	33.996	28.51	34.005	28.60	34.573	28.34	34.603
30	28.52	33.933	28.50	33.991	28.41	34.065	28.58	34.574	28.31	34.620
50	26.99	34.460	27.93	34.113	27.80	34.494	28.23	34.603	27.30	34.807
75	23.72	34.641	23.70	34.682	25.41	34.678	27.09	34.800	25.04	35.135
100	19.91	34.853	18.50	34.771	22.68	34.843	22.01	35.300	24.11	35.248
150	12.60	34.532	14.11	34.616	15.19	34.572	20.06	35.327	21.15	35.288
200	11.17	34.514	11.35	34.555	10.81	34.454	16.18	34.807	18.93	35.170
250	10.34	34.535	9.35	34.576	9.68	34.585	12.42	34.626	13.47	34.606
300	9.48	34.533	8.62	34.577	9.13	34.609	10.19	34.714	10.07	34.504
400	8.16	34.563	7.85	34.558	7.99	34.594	9.04	34.675	8.36	34.655
500	7.52	34.554	7.35	34.570	7.24	34.577	7.99	34.624	7.50	34.609
600	6.78	34.544	6.81	34.561	6.57	34.560	7.04	34.580	6.83	34.582
700	6.03	34.540	6.10	34.544	6.05	34.552	6.05	34.560	6.51	34.567
800	5.38	34.541	5.61	34.552	5.43	34.553	5.24	34.557	5.82	34.566
900	4.86	34.556	4.85	34.555	4.91	34.561	4.64	34.575	5.01	34.571
1000	4.27	34.568	4.33	34.567	4.44	34.569	4.25	34.580	4.48	34.582
1100	3.81	34.580	3.90	34.578	4.06	34.578	4.04	34.584	3.80	34.597

Table 3. Sampling data of planktonic foraminifera : Station number of Table 4, Original station number, Date, Sampling time (Start, Finish), Sampling position (latitude, longitude).

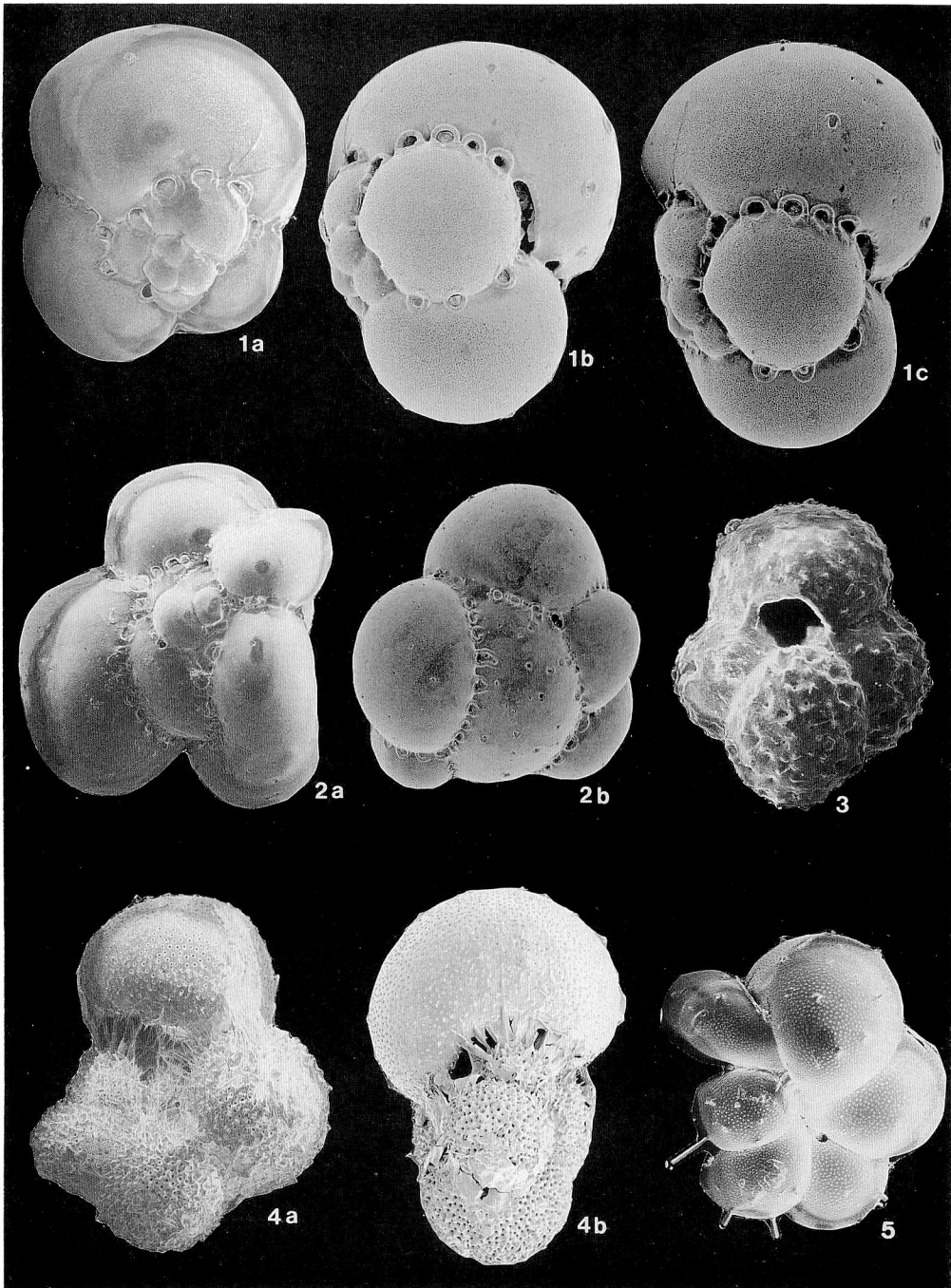
Station Number	Original St. No.	Date	Sampling time Start - Finish	Sampling position. (Latitude, Longitude)
1	No.1	91.11. 2	10:00-10:55	27 -59'6 N, 131 -55'8 E
2	No.2	91.11. 2	23:00-23:45	26 - 0'0 N, 132 -18'5 E
6	No.3	91.11. 6	11:10-11:55	11 -55'3 N, 135 -55'2 E
7	No.4	91.11. 6	18:10-19:05	10 -60'0 N, 136 -26'1 E
8	No.5	91.11. 7	7:30- 8:10	8 -59'9 N, 137 -37'0 E
9	No.6	91.11. 8	8:15- 9:10	5 -00'1 N, 140 -21'5 E
11	R.No.1	91.11.28	15:45-16:50	2 -00'3 N, 142 -03'0 E
10	R.No.2	91.11.29	0:15- 1:35	3 -00'2 N, 141 -29'0 E
5	R.No.3	91.12. 1	17:00-18:00	14 -00'6 N, 136 -14'5 E
4	R.No.4	91.12. 2	12:45-13:30	17 -00'2 N, 134 -13'7 E
3	R.No.5	91.12. 3	12:50-13:40	20 -59'8 N, 132 -14'1 E



Table 4. List of planktonic foraminifera at stations No.1 to No.11.

Station number	No.1 (1)	No.2 (2)	No.3 (R5)	No.4 (R4)	No.5 (R3)	No.6 (3)
	N28 0' E131 55'8	N26 0' E132 18'5	N21 0' E132 14'1	N17 0' E134 13'7	N14 0' E136 14'5	N12 0' E135 55'2
Depth	0-50-100-150-200					
<i>Candeina nitida</i>					2	2
<i>Globigerina rubescens</i>				34 27 17 7	48 22 18 5	11 17 7 6
<i>Globigerina aequilateralis</i>	1		5 2	3 1 2 2	1	2
<i>Globigerina calida</i>	6 5 3	12 7 1 5	7 1 3	17 16 5	22 6 9 2	2 1
<i>Globigerina glutinata</i>				22 13 1 2	36 3 2	2 6 3
<i>Hastigerina pelagica</i>						
<i>Globigerinoides conglobatus</i>				20 15 4 2	7 5 6	
<i>Globigerinoides obliquus</i>	2 3	4 1 1	2	17 15 2 3	16 2 5 1	2 1
<i>Globigerinoides ruber</i>	12 9 2 6	21 11 5	13 5 3 2	14 26 9 15	8 6 5 2	1 3 2 1
<i>Globigerinoides sacculifer</i>	43 37 7 18	61 33 8 17	39 14 14 2	47 28 2 3	36 4 3 2	1 1 2 1
<i>Globigerinoides tenellus</i>						
<i>Globorotalia hirsuta</i>				1		
<i>Globorotalia menardii</i>						
<i>Globorotalia tumida</i>						
<i>Orbulina universa</i>				2 4 4 1	2 1	
<i>Pulleniatina obliquiloculata</i>						
Miscellaneous	35 20 21	45 35 16	28 16 17 3	40 28 13 4	78 7 6 13	15 21 13 17
Total	99 74 9 48	143 87 10 43	92 37 37 11	216 173 59 39	254 57 55 25	30 56 27 27

Station number	No.7 (4)	No.8 (5)	No.9 (6)	No.10 (R2)	No.11 (R1)
	N11 0' E136 26'1	N9 0' E137 37'0	N5 0' E140 21'5	N3 0' E141 29'0	N2 0' E142 23'8
Depth	0-50-100-150-200				
<i>Candeina nitida</i>					
<i>Globigerina rubescens</i>	11 14 7 6	3 1	3		
<i>Globigerina aequilateralis</i>		1			
<i>Globigerina calida</i>	3 5 2 2				
<i>Globigerina glutinata</i>	7 5 3	5 4 3 2	8 14 11 7	13 15 7 14	19 17 9 11
<i>Hastigerina pelagica</i>	1				
<i>Globigerinoides conglobatus</i>					
<i>Globigerinoides obliquus</i>	2 3 1	2 3 1	1		
<i>Globigerinoides ruber</i>	13 11 5 2	7 5 5 3	28 34 22 17	36 23 20 27	33 27 11 19
<i>Globigerinoides sacculifer</i>	7 5 3	9 7 7 5	13 23 10 5	41 35 19 33	18 22 6 15
<i>Globigerinoides tenellus</i>			3	2 1	1
<i>Globorotalia hirsuta</i>				2 1 1	
<i>Globorotalia menardii</i>			3 2 1	11 13 7 7	28 31 16 23
<i>Globorotalia tumida</i>				2 3 1 1	1 3 1
<i>Orbulina universa</i>					
<i>Pulleniatina obliquiloculata</i>					2 1
Miscellaneous	9 13 11 4	12 18 5 4	41 68 36 17	71 78 41 67	77 63 22 43
Total	53 56 32 14	39 38 21 14	90 148 81 48	178 168 97 149	177 165 65 112



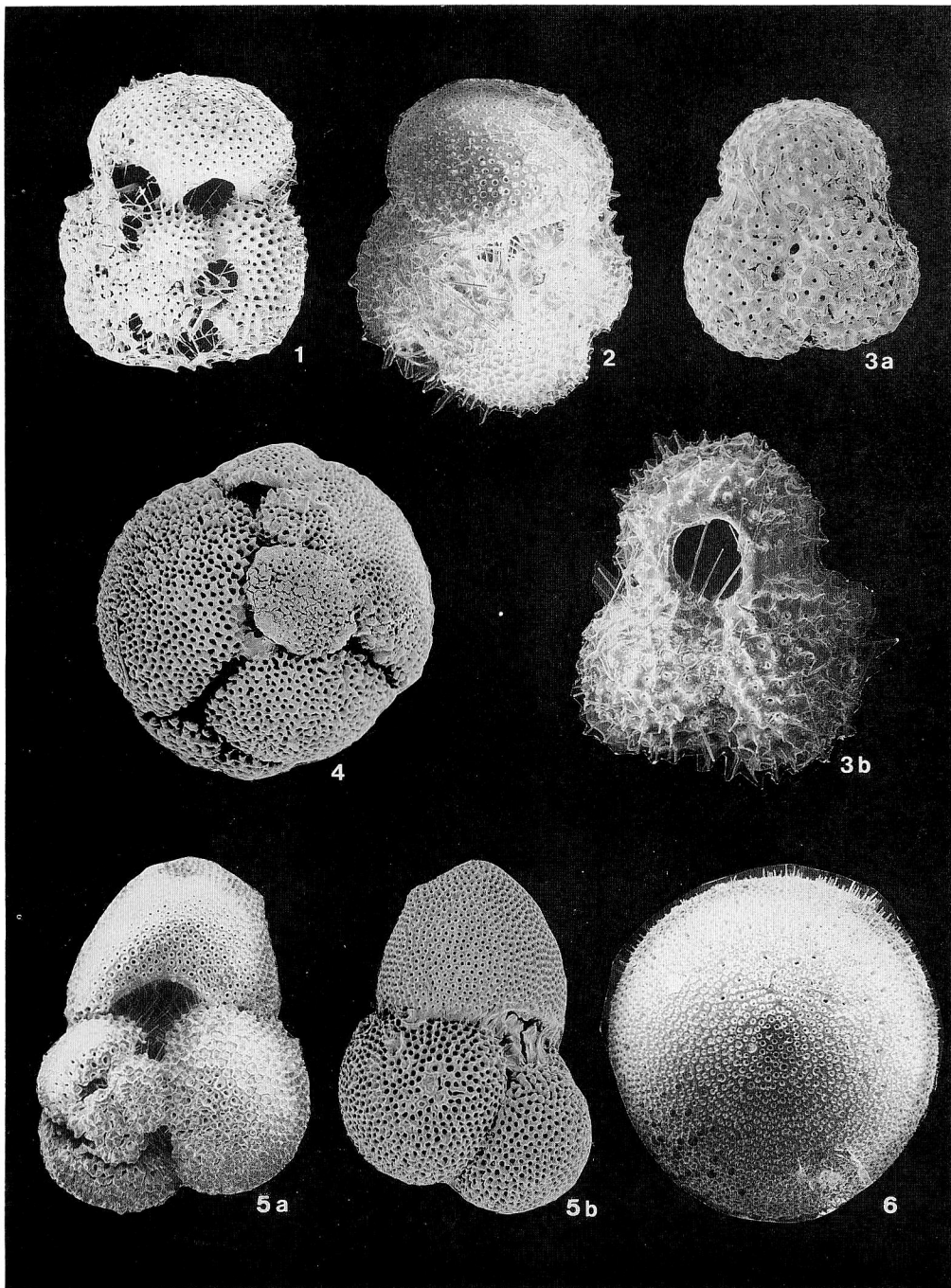
Figs. 1a-2b. *Candeina nitida* D'ORBIGNY, 1a-1c, x200. 2a, x150. 2b, x100.

Fig. 3. *Globigerina rubescens* HOFKER, x500.

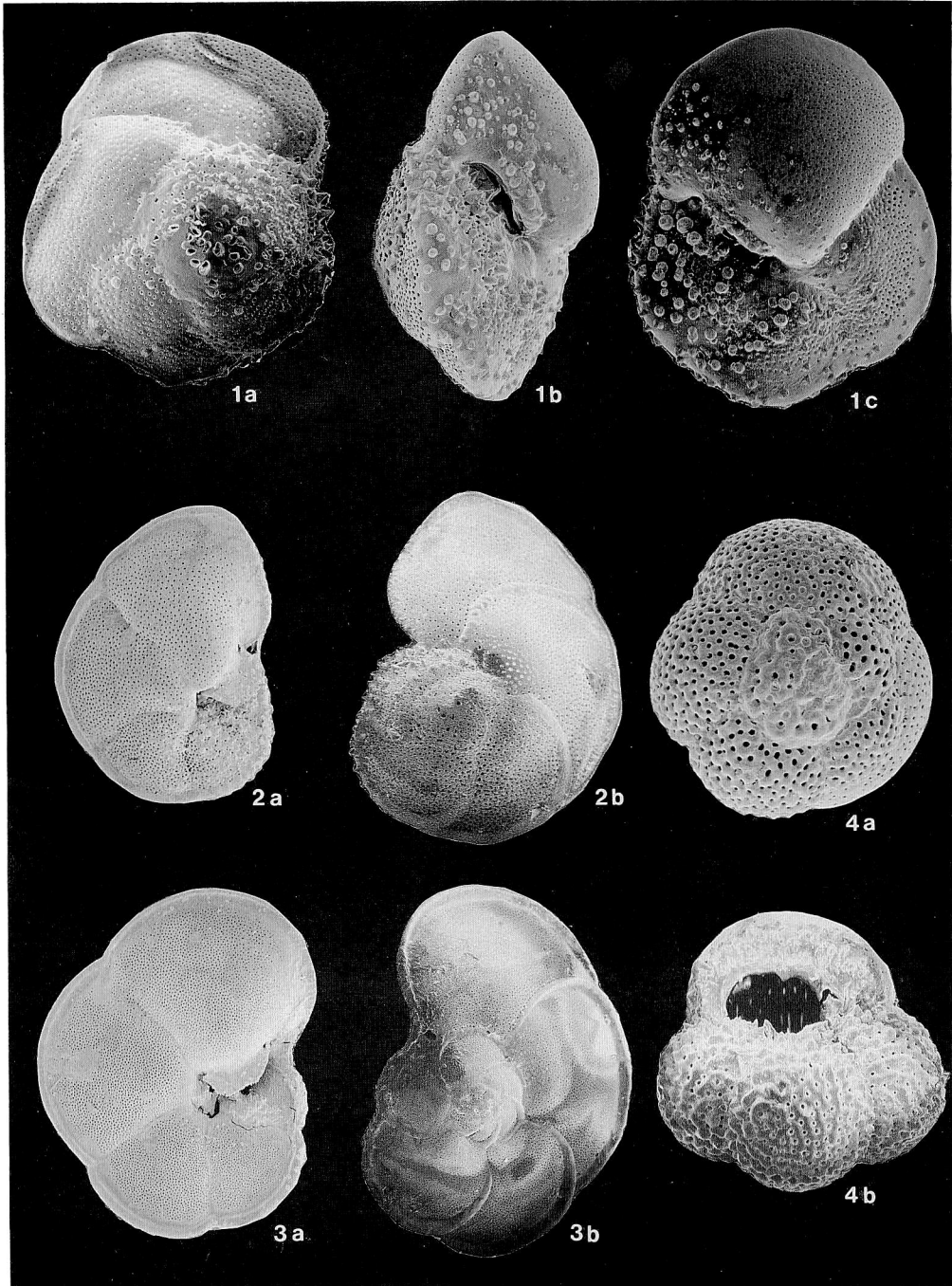
Figs. 4a, b. *Globigerinella aequilateralis* (BRADY), 4a, x150. 4b, x125.

Fig. 5. *Hastigerina pelagica* (D'ORBIGNY), x100.

## Plate 2



Figs. 1, 2. *Globigerinoides obliquus* BOLLI, 1, x120. 2, x150.  
 Figs. 3a, b. *Globigerinoides ruber* (D'ORBIGNY), 3a, x200. 3b, x300.  
 Fig. 4. *Globigerinoides conglobatus* (BRADY), x90.  
 Figs. 5a, b. *Globigerinoides sacculifer* (BRADY), 5a, x100, 5b, x80.  
 Fig. 6. *Orbulina universa* (D'ORBIGNY), x100.



Figs. 1a-c. *Globorotalia hirsuta* (D'ORBIGNY), 1a, x259. b, c, x200.

Figs. 2a, b. *Globorotalia tumida* (BRADY), 2a, x100. 2b, x150.

Figs. 3a, b. *Globorotalia menardii* (PARKER, JONES and BRADY), 1a, x80. 1b, x100.

Figs. 4a, b. *Pulleniatina obliquiloculata* (PARKER and JONES), 4a, x200. 4b, x250.