Distribution of the Surface Chlorophyll *a* along the Course of the FUJI to and from Antarctica in 1979–1980

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「ふじ」航路 (1979–1980) における表面海水中のクロロフィル *a* 量の分布

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要旨: 1979 年 11 月から 1980 年 4 月の間，第 21 次南極地域観測隊の海洋生物定常観測の一環として「ふじ」航路に沿って，表面海水中のクロロフィル *a* 量の測定を行った．調査地点は，216 点である．

クロロフィル *a* 量の高い値は，セレベス海，マカッサル海峡，マラッカ海峡の陸地に近い海域および南極海域で見い出された．南極海域のクロロフィル *a* 量は，0.06～2.89 mg/m^3 と大きな変動を示し，とりわけ，収束線域および大陸沿いの浮氷域で顕著であった．

今回，フリーマントル出航後，東経 110 度線に沿って南緯 60 度まで 2 時間おきの表面観測を行い，クロロフィル *a* 量の変動状態を従来より明確に知ることができた．しかし，クロロフィル *a* 量と海洋環境の関わりについては必ずしも明らかではなく，今後さらに密な観測を行うことが望まれる．

Abstract: The measurements of chlorophyll *a* concentration in the surface sea water were carried out at 216 stations along the route of the icebreaker FUJI from November 1979 to April 1980. This observation was conducted as a part of the routine works of marine biological program of the Japanese Antarctic Research Expedition (JARE).

The geographical distribution of chlorophyll *a* resembled the results obtained by the previous JARE investigators. High chlorophyll *a* concentrations were observed in the Southern Ocean and also in the areas adjacent to the landmass. In the Southern Ocean, the chlorophyll *a* concentration fluctuated from 0.06 mg/m^3 to 2.89 mg/m^3. The chlorophyll *a* was high and fluctuated particularly near the Subtropical Convergence, the Australasian Subantarctic Front, the Antarctic Convergence and in the pack-ice region along the Antarctic coast.

To study the distribution of chlorophyll *a* and its correlation to the oceanographical conditions, a two-hour interval observation was carried out from 34°S and 60°S along 110°E on the southward leg. The more detailed information on chlorophyll *a* distribution was obtained, although the data are still insufficient to explain clearly the relation between them.

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1. Introduction

The investigation of chlorophyll *a* distribution in the surface water along the cruise track of the icebreaker FUJI has been carried out as a part of the routine works of the marine biological program of the Japanese Antarctic Research Expedition (JARE).

The present author made the determination of the concentration of surface chlorophyll *a* during November 1979 to April 1980 (JARE–21). FUKUCHI (1980) discussed the regional distribution of surface chlorophyll *a* along the route of the FUJI based on the data acquired by the JARE biologists between 1965 and 1976. In his report, however, he gave the averaged figures of chlorophyll *a* concentration with the large standard deviation in the regions covering both Subtropical and Antarctic Convergences. Therefore, to obtain more detailed information on the chlorophyll *a* distribution the present author undertook a close interval observation of chlorophyll *a* in this region.

2. Materials and Methods

The water sampling was ordinarily made two or three times a day. However, the sampling was carried out at two-hour intervals between Fremantle and 60°S along 110°E. A total of 216 stations were dealt with throughout the present work.

The surface water was sampled with a plastic bucket and was filtered through a Whatman GF/C glass fiber filter (ϕ 47 mm) under reduced pressure. The chlorophyll *a* concentration was determined by the colorimetric method of UNESCO (1966) using a HITACHI model 101 spectrophotometer on board. The values of chlorophyll *a* and basic information on the sampling sites are listed in Appendix 1. Physical and chemical oceanographic data cited in the present report were obtained by Messrs. M. MINE and K. MATSUMOTO, who were the oceanographers of JARE–21.

3. Results and Discussion

The observation was started on 23 November 1979 in the western part of the North Pacific and discontinued on 14 April 1980 near the Okinawa Islands (Fig. 1). As the FUJI called at Cape Town on her return voyage, the present cruise track was rather similar to those of JARE 7–16 than JARE 17–20.

Though the present results were obtained by the observations extending over a period of five months from start to end, it is assumed that they represent regional chlorophyll *a* values along the cruise track.

3.1. The sea areas other than Indian and Antarctic Oceans (Stns. 2–17 and 197–216)

The chlorophyll *a* concentrations were in a range of 0.02–0.27 mg/m^3 in the western North Pacific and 0.06–0.22 mg/m^3 in the South China Sea. High chlorophyll *a* con-

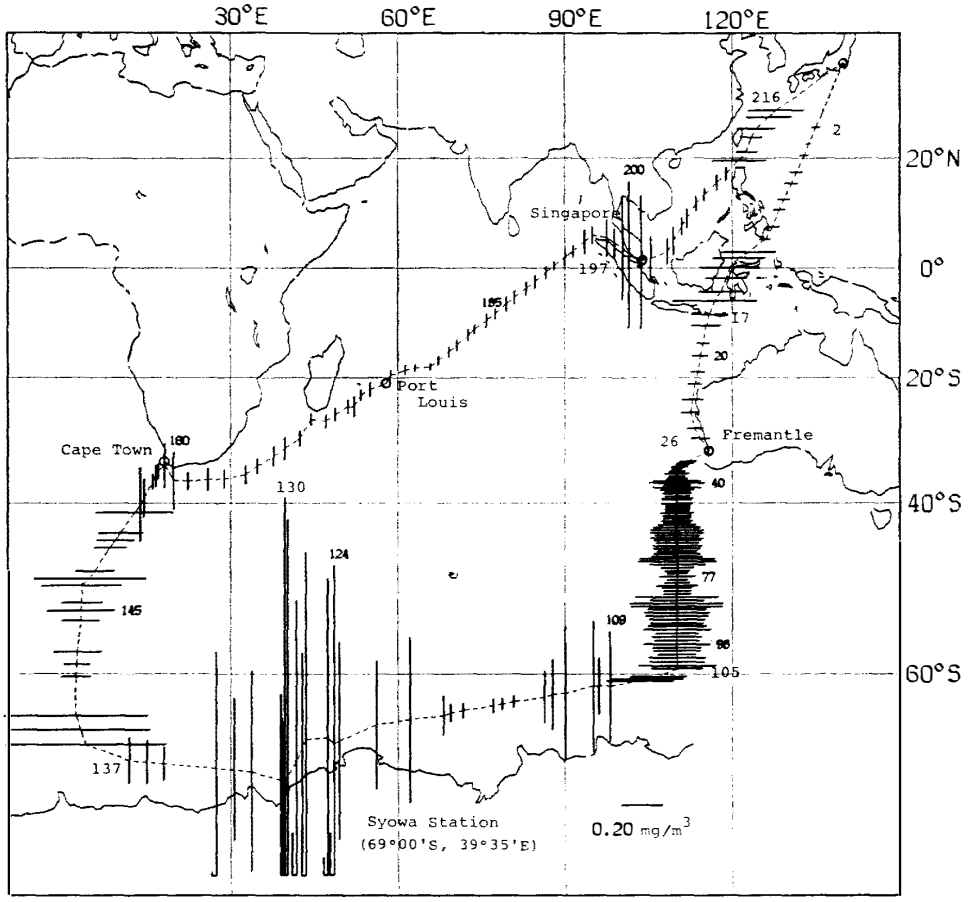

Fig. 1. The distribution of chlorophyll a along the cruise track of the FUJI in 1979–1980. Concentration of chlorophyll a is shown by a solid line. Numerals indicate serial numbers of sampling stations.

centrations were observed in the Celebes Sea (0.17–0.41 mg/m^3) and the Malacca Strait (0.14–0.76 mg/m^3). The high value of 0.76 mg/m^3 was observed at Stn. 200 in the Malacca Strait on the homeward route. The distribution pattern of chlorophyll *a* observed in the areas agreed with those reported by previous JARE investigators.

3.2. Eastern part of Indian Ocean (Stns. 18–26)

Chlorophyll *a* concentrations of the present work were 0.06 to 0.17 mg/m^3. In general, chlorophyll *a* concentrations seem to be less than 0.20 mg/m^3 in this area, as reported by HUMPHREY (1966) and the previous JARE investigators, except only two results of 0.43 mg/m^3 by OHYAMA and MAYAMA (1976) and 0.37 mg/m^3 by FUKUCHI (1977).

3.3. From Fremantle to 60°S along 110°E (Stns. 27–105)

The distributions of the surface chlorophyll *a*, water temperature and salinity

between 34°S and 60°S along 110°E are shown in Fig. 2. The Subtropical Convergence (STC) zone was located between 37°00′S and 38°30′S (from Stns. 40 to 44) and the Antarctic Convergence (AC) was situated at about 51°40′S near Stn. 83. The Australasian Subantarctic Front (ASF) (GORDON, 1972) was recognized near Stn. 73, 48°S between the STC and the AC, where the surface water temperature and salinity changed abruptly (Fig. 2).

The chlorophyll *a* concentration was less than 0.12 mg/m³ between Stns. 27 and 38. It increased to 0.25 and 0.27 mg/m³ at Stns. 39 and 40 of the north edge of the STC zone. But it decreased to 0.13 mg/m³ at Stn. 41 in the middle of the STC zone, followed by an increase to 0.24 mg/m³ at Stn. 42. At the south edge of the STC zone, Stn. 44, it decreased again to 0.12 mg/m³. Though the increase of chlorophyll *a* in the northern part of the STC zone had been shown by previous JARE data, it was difficult to clarify the relation of the surface chlorophyll *a* distribution to the oceanographical conditions

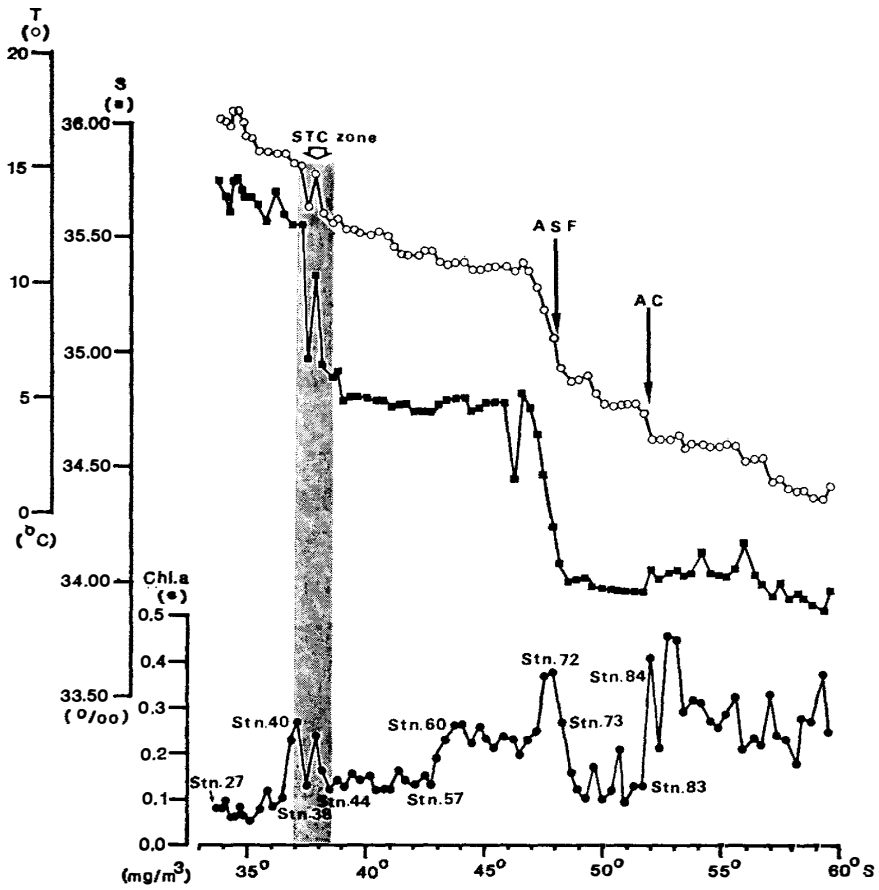

Fig. 2. The distributions of the surface chlorophyll a, water temperature and salinity between 34°S and 60°S along 110°E (STC zone: Subtropical Convergence zone, ASF: Australasian Subantarctic Front, AC: Antarctic Convergence, Chl. a (●): Chlorophyll a, T (○): Water temperature, S (■): Salinity).

due to the scarcity of data on their vertical distributions and also the distant intervals of surface observation stations as mentioned by KURODA (1978). The chlorophyll *a* distribution around the STC obtained by the present two-hour interval observation agreed with the results reported by PLANCKE (1977) based on the one-hour interval observation in the sea around the Kerguelen Islands.

The chlorophyll *a* concentration was in the range of 0.12 to 0.16 mg/m^3 from Stns. 45 to 57. After a marked increase of chlorophyll *a* between Stns. 57 and 60, it maintained the high values between 0.22 and 0.26 mg/m^3 till Stn. 70. The water temperature decreased gradually from Stns. 45 to 70. Although remarkable decreases of salinity were found at Stns. 45 and 67, the salinity was stable at other stations between Stns. 45 and 70. However, the correlation between the chlorophyll *a* distribution and the water temperature and also the salinity in this region was not detected.

The water temperature and the salinity decreased markedly from Stns. 70 to 83, where the ASF is. The chlorophyll *a* fluctuated remarkably around the ASF. Namely, it was 0.25 mg/m^3 at Stn. 70 and it reached 0.37 and 0.38 mg/m^3 at Stns. 71 and 72 and decreased again to 0.27 mg/m^3 at Stn. 73.

Between the ASF and AC (Stns. 74 to 83), the chlorophyll *a* concentration was low and fluctuated slightly in the range of 0.10 to 0.20 mg/m^3. The water temperature continued to decrease but the salinity was stable in this region. The correlation of the chlorophyll *a* to the water temperature and the salinity was not also clear.

As stated above, the AC was situated between Stns. 83 and 84, where the chlorophyll *a* increased abruptly to 0.41 mg/m^3 (Stn. 84). The water temperature decreased but the salinity increased at the AC. From the AC to 60°S, the water temperature decreased gradually. The chlorophyll *a* concentration was high (0.19 to 0.46 mg/m^3) in this region. The chlorophyll *a* and the salinity fluctuated from place to place.

3.4. Along the Antarctic Continent (Stns. 106–137)

The distributions of chlorophyll *a*, water temperature and salinity along the Antarctic Continent are given in Fig. 3. The chlorophyll *a* varied in a wide range from 0.06 to 2.89 mg/m^3 between Stns. 106 and 137. The water temperature and the salinity also varied widely. Between Stns. 115 and 120 and between Stns. 135 and 137, the chlorophyll *a* concentration was low and did not fluctuate. From Stn. 106 to Stn. 114 and from Stn. 121 to Stn. 134, the chlorophyll *a* concentration was high above 0.26 mg/m^3 and fluctuated remarkably. In particular, it fluctuated extremely within a short distance from Stn. 123 (65°36′S, 49°18′E) to Stn. 131 (68°23′S, 38°51′E), which was a pack-ice region. Extreme fluctuation of the water temperature and the salinity also occurred in the short distance.

High values of phytoplankton biomass in the pack-ice region were mentioned by many investigators. Some of them ascribed the high biomass to the ice algae released

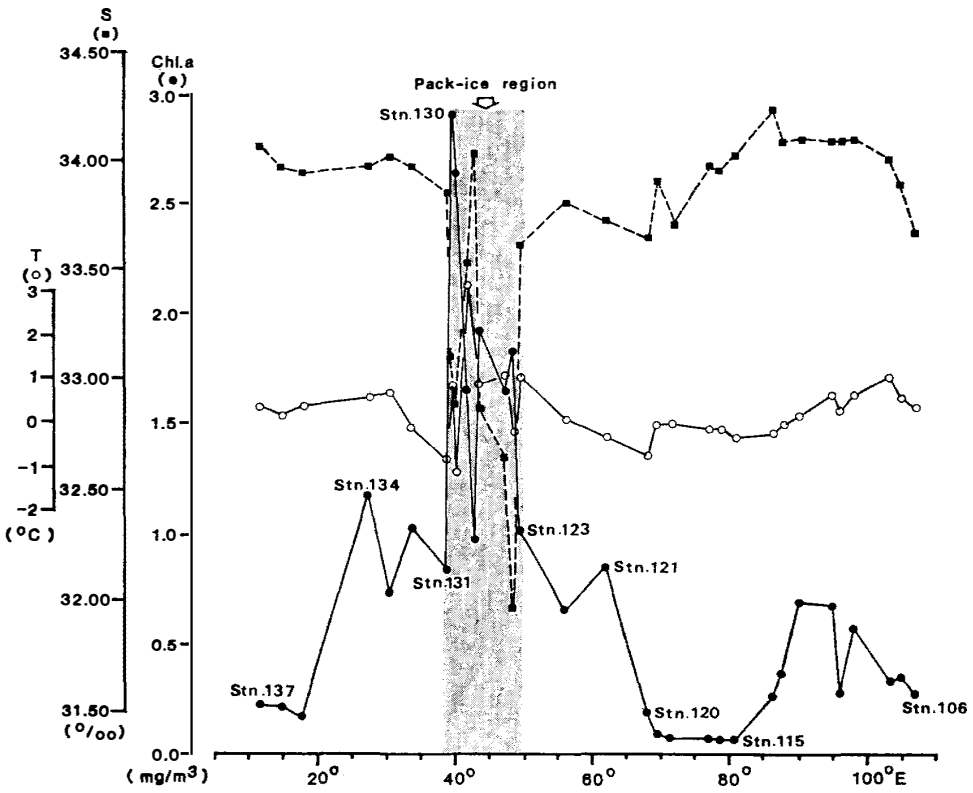

Fig. 3. The distributions of the surface chlorophyll a, water temperature and salinity along the Antarctic Continent (Chl. a (●): Chlorophyll a, T (○): Water temperature, S (■): Salinity).

from ice floes. However, to elucidate the relation between the high chlorophyll *a* concentration and the ice algae, detailed and sequential investigations should be undertaken.

3.5. From Antarctic Ocean to Cape Town (Stns. 138–158)

The distributions of chlorophyll *a*, water temperature and salinity between Stn. 138 (65°50′S, 03°55′E) and Cape Town are shown in Fig. 4. The intervals between sampling stations on the northward leg, three times a day, were not close enough to make a comparison between the data of the southward leg and those of the northward leg. It is difficult to discuss the presence of such discontinuity in surface water as the ASF. However, it is possible to outline the chlorophyll *a* distribution and its relation to the changes in water temperature and salinity. The Antarctic Convergence and the Subtropical Convergence zone were presumably situated at about 50°S and between 41°S and 42°S.

The chlorophyll *a* concentration was high above 0.69 mg/m^3 between Stns. 138 and 140 but it decreased at Stns. 141 and 142 (0.14 and 0.12 mg/m^3) and then increased

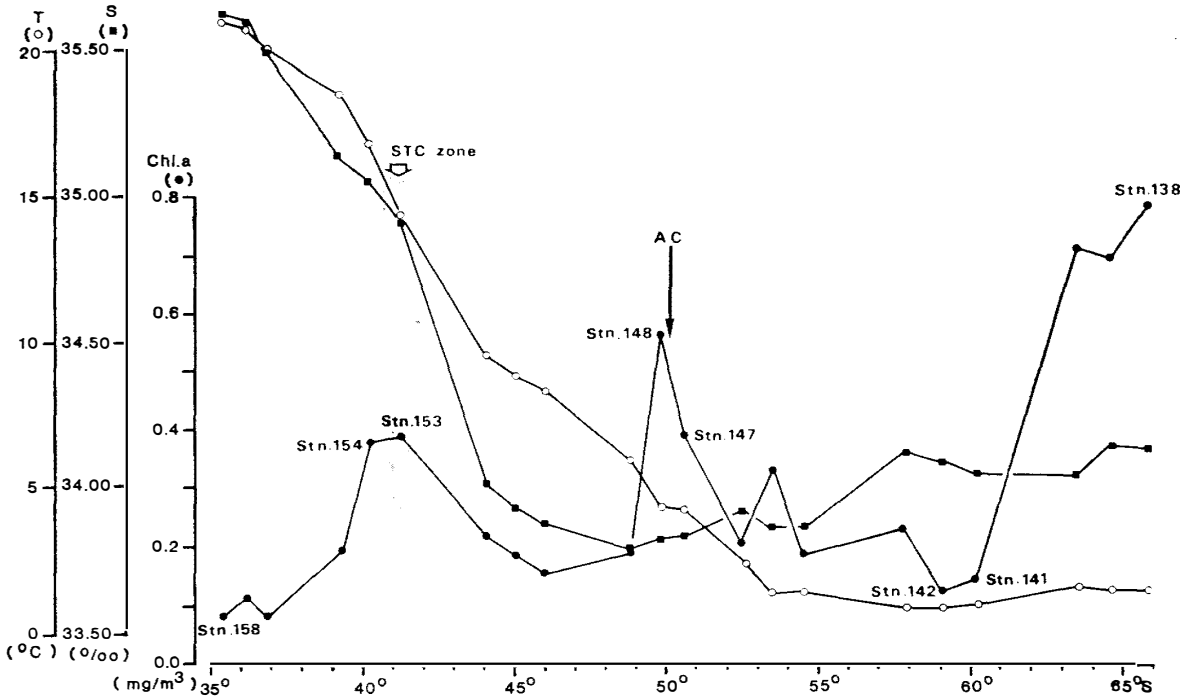

Fig. 4. The distributions of the surface chlorophyll a, water temperature and salinity in a transect between Antarctic Ocean and Cape Town (STC zone: Subtropical Convergence zone, AC: Antarctic Convergence, Chl. a (●): Chlorophyll a, T (○): Water temperature, S (■): Salinity).

toward the AC, where it was 0.55 mg/m³. Between the AC and the STC, the chlorophyll *a* concentration was in the range of 0.15 to 0.21 mg/m³. In the northern part of the STC zone, it became high (0.38 mg/m³ at Stn. 153) again. Toward north from the STC, it decreased gradually.

In general, the chlorophyll *a* concentration of the northward leg was lower than the southward leg.

3.6. Western and northern parts of Indian Ocean (Stns. 159–195)

The chlorophyll *a* concentrations were low (0.03–0.12 mg/m³) in the regions. The high concentration of chlorophyll *a* was found in the restricted part of the coastal water such as the vicinity of Cape Town. The present result coincided with those of the previous JARE investigators.

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References

FUKUCHI, M. (1977): Chlorophyll-*a* content in the surface water along the course of the FUJI to and from Antarctica in 1976–1977. Nankyoku Shiryô (Antarct. Rec.), **60**, 57–69.

FUKUCHI, M. (1980): Phytoplankton chlorophyll stocks in the Antarctic Ocean. J. Oceanogr. Soc. Japan, **36**, 73–84.

GORDON, A. L. (1972): Introduction: Physical oceanography of the southeast Indian Ocean. Antarctic Oceanology II, ed. by D. E. HAYES, Washington, D. C., Am. Geophys. Union, 3–9 (Antarct. Res. Ser. **19**).

HUMPHREY, G. F. (1966): The concentration of chlorophylls *a* and *c* in the south-east Indian Ocean. Aust. J. Mar. Freshwater Res., **17**, 135–145.

KURODA, K. (1978): Distribution of chlorophyll-*a* contents in the surface water along the course of the FUJI to and from Antarctica in 1972–1973. Nankyoku Shiryô (Antarct. Rec.), **61**, 65–74.

OHYAMA, Y. and MAYAMA, T. (1976): Chlorophyll-*a* contents in the surface water observed during the relief voyage of FUJI to Syowa Station, Antarctica, in 1975–1976. Nankyoku Shiryô (Antarct. Rec.), **57**, 115–122.

PLANCKE, J. (1977): Phytoplankton biomass and productivity in the Subtropical Convergence area and shelves of the western Indian subantarctic islands. Adaptation within Antarctic Ecosystems, ed. by G. A. LLANO, Washington, D. C., Smithonian Inst., 51–73.

UNESCO (1966): Determination of Photosynthetic Pigments in Sea Water. Paris, UNESCO, 69 p (Monographic Methodology, **1**).

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Appendix 1. Chlorophyll a contents and water temperatures obtained during the relief voyage of the FUJI to Syowa Station, Antarctica, in 1979–1980.

STATION NO.	DATE	TIME	LATITUDE	LONGITUDE	CHLOROPHYLL-A	WATER TEMP.
1	1979 NOV. 23	0800	27 23 N	135 53 E	*****	24.6
2		1800	25 18	134 55	0.04	25.3
3	24	0800	22 29	133 35	0.02	26.5
4		1800	20 28	132 46	0.04	27.3
5	25	0800	17 33	131 29	0.05	27.9
6		1800	15 39	130 29	0.06	28.0
7	26	0800	12 43	129 14	0.05	28.1
8		1700	10 48	128 22	0.05	28.5
9	27	0800	7 35	127 8	0.06	28.0
10		1800	5 22	125 46	0.05	28.9
11	28	0800	2 60	122 46	0.27	29.5
12		1800	1 55	121 7	0.25	29.2
13	29	0800	0 3	119 28	0.23	28.7
14		1800	1 53 S	118 49	0.20	29.5
15	30	0800	4 26	117 48	0.21	29.6
16		1800	6 10	116 47	0.41	29.6
17	DEC. 1	0800	8 42	115 43	0.17	29.1
18		1800	10 45	115 15	0.14	29.3
19	2	0800	13 47	114 41	0.06	28.5
20		1800	15 59	114 10	0.07	28.5
21	3	0800	18 56	113 42	0.07	27.1
22		1800	21 2	113 17	0.06	26.3
23	4	0800	23 45	112 45	0.10	23.6
24		1800	25 55	112 24	0.09	23.3
25	5	0800	28 36	113 11	0.08	21.8
26		1800	30 13	114 14	0.09	21.5
FREMANTLE						
27	13	0800	33 51	112 3	0.08	17.1
28		1000	33 57	111 50	0.08	17.0
29		1200	34 8	111 29	0.09	16.8
30		1400	34 18	111 10	0.06	17.5
31		1600	34 29	110 49	0.06	17.5
32		1800	34 41	110 29	0.08	17.1
33		2000	34 49	110 17	0.06	16.4
34		2200	35 3	110 0	0.05	16.3
35	14	0000	35 24	109 60	0.08	16.3
36		0200	35 46	109 59	0.12	15.7
37		0400	36 8	109 59	0.08	16.1
38		0600	36 30	109 60	0.10	15.6
39		0800	36 51	110 0	0.23	15.2
40		1000	37 8	109 58	0.27	15.1

Appendix 1 (continued).

STATION NO.	DATE	TIME	LATITUDE	LONGITUDE	CHLOROPHYLL-A	WATER TEMP.
41	DEC. 14	1200	37 29 S	109 59 E	0.13	13.3
42		1400	37 49	110 0	0.24	14.7
43		1600	38 10	110 0	0.16	13.1
44		1800	38 28	110 1	0.12	12.6
45		2000	38 41	110 0	0.14	12.8
46		2200	39 2	109 59	0.12	12.3
47	15	0000	39 24	109 59	0.15	12.3
48		0200	39 35	109 58	0.14	12.2
49		0400	40 6	109 59	0.15	12.1
50		0600	40 27	110 0	0.12	12.2
51		0800	40 48	110 1	0.12	12.0
52		1000	41 2	110 0	0.12	11.6
53		1200	41 23	110 1	0.16	11.3
54		1400	41 44	110 1	0.14	11.2
55		1600	42 6	110 0	0.13	11.2
56		1800	42 26	109 60	0.15	11.4
57		2000	42 39	110 2	0.13	11.3
58		2200	42 60	110 3	0.18	10.9
59	16	0000	43 21	110 0	0.23	10.8
60		0200	43 42	109 59	0.26	10.9
61		0400	44 3	109 58	0.26	10.9
62		0600	44 25	109 59	0.22	10.6
63		0800	44 47	109 58	0.26	10.6
64		1000	45 4	109 59	0.23	10.7
65		1200	45 26	110 0	0.21	10.7
66		1400	45 49	110 0	0.24	10.7
67		1600	46 11	109 60	0.23	10.5
68		1800	46 31	110 3	0.20	10.9
69		2000	46 49	110 1	0.23	10.5
70		2200	47 9	110 4	0.25	9.8
71	17	0000	47 28	110 5	0.37	8.8
72		0200	47 49	110 5	0.38	7.6
73		0400	48 10	110 4	0.27	6.2
74		0600	48 33	110 4	0.16	5.7
75		0800	48 55	110 4	0.12	5.8
76		1000	49 14	110 4	0.10	6.0
77		1200	49 37	110 3	0.17	5.2
78		1400	49 58	110 1	0.10	4.8
79		1600	50 21	109 59	0.12	4.7
80		1800	50 42	109 58	0.20	4.8

Appendix 1 (continued).

STATION NO.	DATE	TIME	LATITUDE	LONGITUDE	CHLOROPHYLL-A	WATER TEMP.
81	DEC. 17	2000	50 55 S	110 0 E	0.14	4.8
82		2200	51 18	110 0	0.13	4.8
83	18	0000	51 39	110 1	0.13	4.4
84		0200	52 1	110 2	0.41	3.2
85		0400	52 22	110 2	0.26	3.2
86		0600	52 43	109 59	0.46	3.2
87		0800	53 4	109 58	0.45	3.6
88		1000	53 22	110 0	0.29	2.8
89		1200	53 44	110 1	0.32	3.0
90		1400	54 5	110 0	0.31	3.0
91		1600	54 28	109 60	0.27	2.9
92		1800	54 50	109 60	0.26	2.9
93		2000	55 7	110 0	0.29	3.0
94		2200	55 30	110 0	0.33	2.9
95	19	0000	55 54	110 0	0.21	2.3
96		0200	56 17	110 0	0.24	2.4
97		0400	56 40	109 59	0.22	2.4
98		0600	57 3	109 58	0.33	1.4
99		0800	57 24	109 57	0.24	1.6
100		1000	57 44	109 56	0.23	1.1
101		1200	58 6	109 59	0.19	1.5
102		1400	58 27	110 0	0.28	1.0
103		1600	58 50	109 60	0.27	0.8
104		1800	59 13	109 59	0.38	0.7
105		2000	59 29	109 59	0.25	1.3
106	20	0800	60 14	106 40	0.27	0.4
107		1400	60 28	104 39	0.35	0.6
108		1800	60 37	103 16	0.33	1.1
109	21	0800	61 3	98 1	0.57	0.7
110		1400	61 5	95 54	0.28	0.3
111		1800	61 4	94 55	0.67	0.7
112	22	0800	61 42	89 54	0.69	0.2
113		1400	61 50	87 37	0.35	0.0
114		1800	62 2	86 8	0.26	-0.2
115	23	0800	62 25	80 40	0.06	-0.3
116		1400	62 37	78 38	0.06	-0.1
117		1800	62 44	77 4	0.07	-0.1
118	24	0800	63 11	71 33	0.07	0.0
119		1400	63 21	69 22	0.09	0.0
120		1800	63 36	68 2	0.19	-0.7

Appendix 1 (continued).

STATION NO.	DATE	TIME	LATITUDE	LONGITUDE	CHLOROPHYLL-A	WATER TEMP.
121	DEC. 25	0753	63 54 S	61 60 E	0.84	-0.3
122	26	0740	64 20	55 60	0.65	0.1
123	27	0800	65 36	49 18	1.01	1.1
124		1200	65 48	48 22	1.83	-0.3
125	28	1800	65 20	47 17	1.64	1.1
126	29	0800	65 27	43 21	1.92	0.9
127		1200	66 5	42 40	0.98	2.4
128		1800	67 6	41 38	1.65	3.1
129	30	0800	68 10	40 1	2.64	-1.1
130		1200	68 20	39 35	2.89	0.9
ICE EDGE OFF SYOWA STATION						
131	1980 FEB. 11	2240	68 23	38 51	0.34	-0.3
132	12	0800	67 49	33 35	1.03	0.1
133		1300	67 40	30 27	0.73	0.7
134		1800	67 33	27 16	1.18	0.6
135	13	0800	67 13	17 52	0.17	0.4
136		1300	67 6	14 52	0.22	0.4
137		1800	67 0	11 45	0.23	0.2
138	14	0800	65 50	3 55	0.79	0.4
139		1300	64 42	2 58	0.69	0.9
140		1800	63 34	2 6	0.71	1.5
141	15	0800	60 14	2 4	0.14	1.0
142		1300	59 2	2 18	0.12	0.9
143		1800	57 50	2 28	0.23	0.9
144	16	0800	54 33	3 10	0.18	1.2
145		1300	53 30	3 13	0.33	1.4
146		1800	52 36	3 16	0.20	2.4
147	17	0800	50 36	3 8	0.39	4.2
148		1300	49 49	4 33	0.55	4.3
149		1800	48 52	5 36	0.18	5.9
150	18	0800	46 1	8 19	0.15	8.3
151		1300	45 3	9 14	0.18	8.8
152		1800	44 4	10 13	0.21	9.5
153	19	0800	41 15	12 46	0.38	14.4
154		1300	40 13	13 40	0.37	16.8
155		1800	39 18	14 25	0.19	18.5
156	20	0800	36 55	16 3	0.08	20.1
157		1300	36 8	16 36	0.11	20.8
158		1800	35 24	17 2	0.08	21.0
CAPE TOWN						
159	29	1800	34 30	18 12	0.23	20.9
160	MAR. 1	0800	36 44	19 46	0.29	19.7

Appendix 1 (continued).

STATION NO.	DATE	TIME	LATITUDE	LONGITUDE	CHLOROPHYLL-A	WATER TEMP.
161	MAR. 1	1800	36 51 S	22 16 E	0.09	24.3
162	2	0800	36 39	25 50	0.11	23.5
163		1800	36 32	28 48	0.09	23.5
164	3	0800	35 56	32 39	0.09	23.7
165		1800	34 41	34 45	0.08	25.5
166	4	0800	33 4	37 38	0.10	25.5
167		1800	31 51	39 39	0.11	25.5
168	5	0800	30 17	42 20	0.07	25.2
169		1800	27 4	44 18	0.06	26.2
170	6	0800	27 24	46 56	0.07	26.5
171		1800	26 21	48 38	0.07	26.2
172	7	0800	24 59	50 56	0.06	26.7
173		1800	24 50	52 6	0.10	26.9
174	8	0800	22 59	53 20	0.05	26.6
175		1800	22 1	54 59	0.07	27.1
PORT LOUIS						
176	17	1800	19 35	58 36	0.04	29.0
177	18	0800	18 40	61 8	0.04	27.6
178		1800	18 16	62 57	0.03	27.5
179	19	0800	18 7	65 42	0.03	27.4
180		1800	16 51	67 11	0.04	28.2
181	20	0800	15 17	69 8	0.06	28.7
182		1800	14 2	70 35	0.05	28.9
183	21	0800	12 23	72 40	0.05	28.4
184		1800	11 24	73 47	0.04	29.3
185	22	0800	9 47	75 52	0.07	28.4
186		1800	8 31	77 22	0.05	29.0
187	23	0800	6 43	79 28	0.08	29.1
188		1800	5 29	80 57	0.07	29.5
189	24	0800	3 47	83 2	0.07	29.4
190		1800	2 33	84 35	0.07	29.6
191	25	0800	0 51	86 32	0.06	29.2
192		1800	0 24 N	88 2	0.04	32.1
193	26	0800	2 0	89 56	0.09	29.6
194		1800	3 12	91 20	0.05	30.0
195	27	0800	4 55	93 24	0.12	29.7
196		1800	6 9	94 53	0.09	29.9
197	28	0800	5 35	97 27	0.19	29.7
198		1800	4 42	98 48	0.14	29.6
199	29	0800	3 42	100 20	0.53	29.6
200	30	1800	2 33	101 28	0.76	29.6

Appendix 1 (continued).

STATION NO.	DATE	TIME	LATITUDE	LONGITUDE	CHLOROPHYLL-A	WATER TEMP.
201	MAR. 31	0800	1 7 N	103 33 E	0.68	29.7
SINGAPORE						
202	APR. 7	1800	1 48	105 22	0.22	29.6
203	8	0800	3 8	108 19	0.13	28.2
204		1800	5 3	109 25	0.14	28.3
205	9	0800	7 47	110 56	0.09	28.1
206		1800	9 14	111 52	0.10	28.8
207	10	0800	11 56	113 31	0.07	28.0
208		1800	13 38	114 58	0.07	28.4
209	11	0800	15 47	117 14	0.08	28.2
210		1800	17 18	118 52	0.06	30.3
211	12	0800	19 36	121 7	0.26	27.3
212		1800	21 3	122 26	0.10	27.3
213	13	0800	23 39	123 21	0.11	25.9
214		1800	25 8	124 13	0.18	25.3
215	14	0800	26 58	126 28	0.22	25.5
216		1800	28 10	127 49	0.27	23.3