

Distribution of Chlorophyll-*a* Contents in the Surface Water along the Course of the FUJI to and from Antarctica in 1972-1973

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「ふじ」航路(1972-1973)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: 1972年11月25日から1973年4月16日まで、第14次南極地域観測隊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色素を蛍光法によって測定した。クロロフィル-*a*量は日本沿岸、マカッサル海峡、亜南極域、南極収束線以南の東経82°~104°付近、東経15度線の63°~67°S付近、アフリカ南岸付近、マラッカ海峡で高かった。各水域のクロロフィル-*a*量およびクロロフィル-*a*とフェオフィチンの和に対するクロロフィル-*a*の百分率の平均値を比較すると、南極域と亜南極域でクロロフィル-*a*量は最も高く、同時にクロロフィル-*a*の百分率も高かった。マラッカ海峡、セレベス海、マカッサル海峡ではクロロフィル-*a*量は高く、沿岸水の特徴を示していた。インド洋、北西太平洋、南シナ海のクロロフィル-*a*量は低く、また、クロロフィル-*a*の百分率も低かった。

Abstract: Measurements of chlorophyll-*a* and phaeophytin at the surface were carried out by fluorometric methods on board the FUJI from November 1972 to April 1973.

The chlorophyll-*a* contents were relatively high in the coastal region of Japan, the Makassar Strait, the Subantarctic region, the area from 82° to 104°E south of the Antarctic Convergence, the area from 63° to 67°S on the meridian of 15°E, the area off the southern coast of Africa and the Malacca Strait. The distributional patterns of chlorophyll-*a* obtained by the present investigation were generally similar to those of the previous investigations.

The mean values of chlorophyll-*a* and percentages of chlorophyll-*a* to the sum of chlorophyll-*a* and phaeophytin were extremely low in the Indian Ocean, the western North Pacific Ocean, and the South China Sea. On the other hand, in the Subantarctic and the Antarctic regions, they were high, and in the Malacca Strait, the Celebes Sea and the Makassar Strait the concentrations of chlorophyll-*a* were almost equal to those in the Subantarctic and the Antarctic regions.

1. Introduction

ICHIMURA and FUKUSHIMA (1963) studied chlorophyll-*a* distribution during the

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voyage of the research vessel SÔYA in 1960–1961 and SAIJO and KAWASHIMA (1964) studied the primary production during the cruise of the UMITAKA-MARU in 1961–1962. Since 1965 chlorophyll-*a* determination has been carried out as part of the routine works in the marine biological program of the Japanese Antarctic Research Expedition (JARE).

The present report deals with the geographical distribution of chlorophyll-*a* by fluorometric methods in the surface water along the course of the icebreaker FUJI during the JARE-14 cruise from November 1972 to April 1973.

2. Materials and Methods

Sea water samples of 250 ml were taken at the surface by a plastic bucket twice or three times a day. At each station, water temperature, salinity and other chemical elements were observed simultaneously with the pigments (SUGITA and IWANAGA, 1974). Chlorophyll-*a* and phaeophytin data were taken at 139 stations during the cruise of the icebreaker FUJI from November 25, 1972 to April 14, 1973 (Appendix 1).

After added with 5 mg of magnesium carbonate, 250 ml of sea water was filtered through a 24-mm diameter glass fiber filter (Reeve Angle 984-H Ultra Filter). The filters were stored in a desiccator in refrigerator for a few days before analysis. The filters were ground in a glass mortar with 2 ml of 90% acetone and poured into a centrifuge tube after adding 8 ml of 90% acetone. The tube was centrifuged at 3,000 rpm for 3 minutes, and the supernatant fluid (exactly 10 ml) was carefully poured into a fluorescence cuvette. The fluorescence (F_0) of the acetone extract was determined with Hitachi model FPL-2 fluorometer that had been adjusted using a standard solution. For preparing the standard solution, 1 mg of fluorescein sodium salt was dissolved in 1 l of distilled water. Two drops of 0.5 N hydrochloric acid were added directly to the extract in the cuvette for conversion of chlorophyll to phaeophytin and after 3 minutes the fluorescence value (F_a) was read.

The concentrations of chlorophyll-*a* and phaeophytin were calculated from the equations:

$$\text{Chlorophyll-}a \text{ (mg/m}^3\text{)} = \frac{1}{11.3} (F_0 - F_a) \times \frac{\text{Vol. ext. (ml)}}{\text{Vol. fil. (ml)}}$$

$$\text{Phaeophytin (mg/m}^3\text{)} = \frac{1}{11.3} (5.2 F_a - F_0) \times \frac{\text{Vol. ext. (ml)}}{\text{Vol. fil. (ml)}}$$

F_0 : the fluorescence before acidification

F_a : the fluorescence after acidification

Vol. ext.: the volume of acetone extract

Vol. fil.: the volume of sea water sample

3. Results and Discussion

3.1. Western North Pacific Ocean (St. 1–12, St. 136–139)

The chlorophyll-*a* content at St. 1 located in the coastal water near Japan was considerably high, 1.01 mg/m^3 (Fig. 1). Such large concentration of it was also

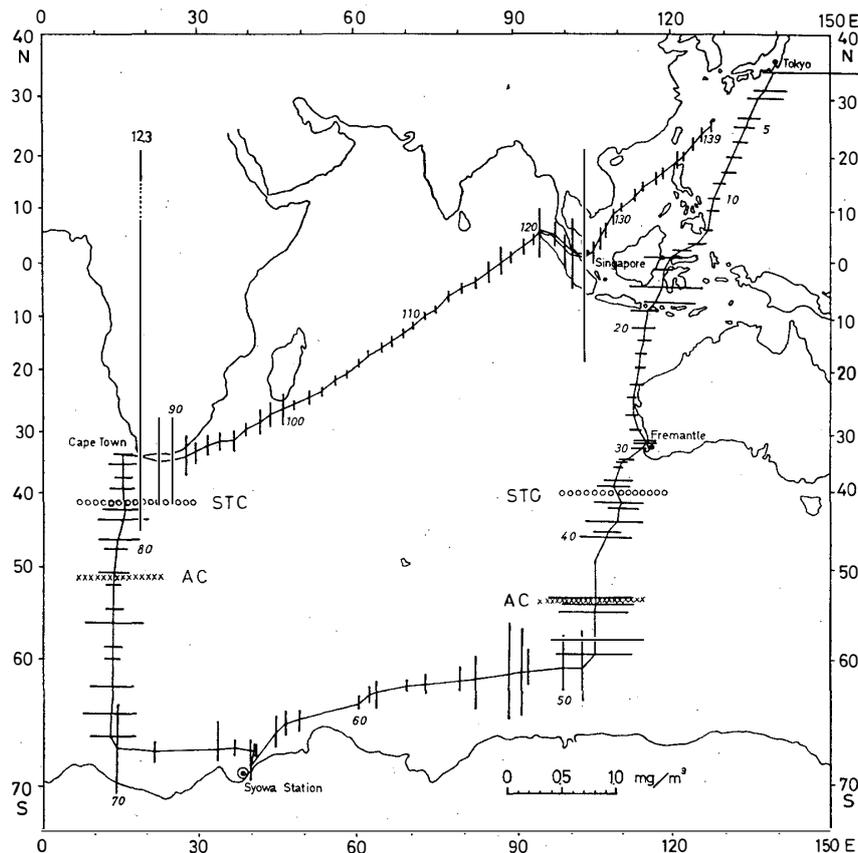


Fig. 1. Distribution of chlorophyll-*a* along the route of the FUJI. Numerals show serial station numbers (STC: Subtropical Convergence, AC: Antarctic Convergence).

observed in 1966, 1974 and 1976 (HOSHIAI, 1968; HOSHINO, 1974; OHNO, 1976). In the present sampling region, which corresponds to the waters of the Kuroshio, the Kuroshio Countercurrent and the North Pacific Equatorial Current, the chlorophyll-*a* contents were small, being in the range of 0.08 to 0.33 mg/m^3 (mean value: 0.16 mg/m^3) in November and 0.08 to 0.13 mg/m^3 (mean value: 0.11 mg/m^3) in April (Fig. 1).

The distributional pattern of chlorophyll-*a* obtained in the present investigation agreed well with that in the same area observed from January to February on 1969 (KAWARADA and SANO, 1969). These results reveals oligotrophic nature of the western North Pacific Central Water well.

3.2. Celebes Sea and Makassar Strait (St. 13–18)

The chlorophyll-*a* contents were from 0.17 to 0.67 mg/m^3 (mean value: 0.33 mg/

m³). Great values more than 0.50 mg/m³ were found in the Makassar Strait (Fig. 1). The similar distributional pattern of chlorophyll-*a* was found by the previous workers without exceptions in these areas. As a reason of the high standing crop of phytoplankton, it may be supposed that the area is composed of coastal water rich in nutrient salts.

3.3. South China Sea (St. 126–135)

Chlorophyll-*a* contents fluctuated from 0.08 to 0.20 mg/m³ (mean value: 0.13 mg/m³) (Fig. 1). It is to be noted that the area was as low as the Indian Ocean and the western North Pacific Ocean in chlorophyll-*a* content. These results resembled those along the similar course obtained by the previous workers.

3.4. Indian Ocean (St. 19–35, St. 84–125)

The contents of chlorophyll-*a* were 0.21 to 0.63 mg/m³ (mean value: 0.40 mg/m³) in the Malacca Strait (St. 120–125) (Fig. 1). Such high chlorophyll-*a* concentrations were also observed by the previous workers, especially NISHIWAKI (1972), HOSHINO (1974), OHNO (1976), OHYAMA and MAYAMA (1976), and FUKUCHI (1977). At St. 125 outside the Singapore Harbor, a great value of chlorophyll-*a* (1.95 mg/m³) was obtained. Furthermore, the maximum value of chlorophyll-*a* (12.3 mg/m³) in the present observation was found at St. 88 outside the Cape Town Harbor (Fig. 1). These two values may reflect embayment nature of water.

In the eastern Indian Ocean (St. 19–35), the contents of chlorophyll-*a* were low, being in the range of 0.08 to 0.30 mg/m³ (mean value: 0.16 mg/m³) in December. NISHIWAKI (1972) and FUKUCHI (1977) observed the high chlorophyll-*a* concentrations (0.20–0.27 mg/m³, 0.37 mg/m³) in the area off the western coast of Australia in December of 1970 and 1976, but no high values were found in the present and previous observations. In the central Indian Ocean (St. 100–120), the contents of chlorophyll-*a* in March were the lowest in the present investigation, being in the range of 0.06 to 0.25 mg/m³ (mean value: 0.10 mg/m³).

In the Agulhas Current region (St. 84–99), the chlorophyll-*a* contents were rich, being in the range of 0.12 to 0.80 mg/m³ (mean value: 0.27 mg/m³) in March (Fig. 1). Especially, they were extremely high in the coastal water off the southern coast of Africa. Such high concentrations of chlorophyll-*a* were also recorded by TAKAHASHI (1969), TOMINAGA (1971), NISHIWAKI (1974), HOSHINO (1974), and OHNO (1976).

3.5. Southern Ocean (St. 36–83)

On route to Antarctica, the Subtropical Convergence was located at around 40°S, and the Antarctic Convergence was at around 53°S. On the return cruise, the Antarctic Convergence was situated at 50°40'S and the Subtropical Convergence was 41°20'S (Fig. 1). These convergences were recognized by the sudden change of

surface water temperature. Especially, a notable change of water temperature (6.7°C per about 13 nautical miles) was found at the Subtropical Convergence in the western part of the Indian sector.

In the Subantarctic region (St. 36–44, 79–83), the chlorophyll-*a* contents were high, being from 0.25 to 0.76 mg/m³ (mean value: 0.46 mg/m³) in the eastern part of the Indian sector and from 0.21 to 0.46 mg/m³ (mean value: 0.34 mg/m³) in the western part. It is supposed that the considerable differences of chlorophyll-*a* contents in the difference region may be related with the blooming period of phytoplankton, especially diatoms.

In the Antarctic region (St. 45–78), the chlorophyll-*a* contents were also high, being from 0.11 to 0.87 mg/m³ (mean value: 0.43 mg/m³) in the eastern part of the Indian sector, and from 0.10 to 0.81 mg/m³ (mean value: 0.29 mg/m³) in the western part (Fig. 1). The values of chlorophyll-*a* in the region tended to fluctuate greatly with area. The higher chlorophyll-*a* values were distributed in the two areas from 82° to 104°E south of the Antarctic Convergence in the eastern part of Indian sector and between 63° and 67°S in the meridian of 15°E. The high chlorophyll-*a* concentrations in the former area were also observed in the previous investigations (HOSHIAI, 1968; TAKAHASHI, 1969; TOMINAGA, 1971; NISHIWAKI, 1972; HOSHINO, 1974; OHNO, 1976; OHYAMA and MAYAMA, 1976; FUKUCHI, 1977).

Though the relation of the oceanic Convergences to the chlorophyll-*a* distribution was discussed by some previous workers (HOSHIAI, 1968; TAKAHASHI, 1969; TOMINAGA, 1971; OHNO, 1976; FUKUCHI, 1977), there were not enough data about chlorophyll-*a* near the Convergences to compare with the structure of the Convergences in the present investigation. Therefore, special investigations should be planned to obtain some useful information in the frontal zones and pack ice regions, where the productivity of phytoplankton may be high in the Southern Ocean.

In the pack ice region, a high chlorophyll-*a* content, 0.37 mg/m³, was found at St. 64 (Fig. 1). TAKAHASHI (1969), TOMINAGA (1971), HOSHINO (1974), OHNO (1976), OHYAMA and MAYAMA (1976), and FUKUCHI (1977) observed such high values of chlorophyll-*a*. Especially, OHNO (1976) made many measurements in this region and reported this region to be productive.

According to EL-SAYED (1970), the chlorophyll-*a* concentrations were in the range of 0.01 to 5.80 mg/m³ (mean value: 0.26 mg/m³) in the Pacific sector of the Antarctic and Subantarctic, and in the range of 0.01 to 110.35 mg/m³ (mean value: 0.89 mg/m³) in the Atlantic sector. Generally speaking, the mean chlorophyll-*a* concentrations in the Indian sector in the present study may be intermediated between the mean values of the Atlantic and Pacific sectors.

3.6. Comparison of chlorophyll-*a* contents and pigment ratio in each region

The pigment ratio (percentage of chlorophyll-*a* to the sum of chlorophyll-*a* and phaeophytin) may be one of the indices of the activity of phytoplankton. So, the mean values of chlorophyll-*a* and the pigment ratio were compared in each region and month (Fig. 2). The lowest (53%) was obtained in November in the western North Pacific Ocean. And, the pigment ratio was low and in the same level in the western North Pacific Ocean (53–69%), the South China Sea (68%), the Indian Ocean (63–67%), the Malacca Strait (66%) and the Agulhas Current region (66%). It may be suggested that phytoplankton was inactive in these regions. On the other hand, the highest pigment ratio (91%) was observed in December in the Antarctic region. And, the almost same pigment ratio was found in the Antarctic region (83–91%), the Celebes Sea and Makassar Strait (80%) and the pack ice region (80%). This may indicate that phytoplankton was blooming in these regions. The pigment ratio in the Subantarctic region was from 67 to 78%, and lower than that in the Antarctic region, contrary to the high contents of chlorophyll-*a*. Also, in the Antarctic and Subantarctic regions, the chlorophyll-*a* contents were higher in December than those in March. This fact may indicate that December is in the blooming period of phytoplankton and March the decaying period.

In the Malacca Strait, the Celebes Sea and the Makassar Strait, the contents of chlorophyll-*a* were almost equal to those in the Subantarctic and the Antarctic regions. It shows that these regions may be characterized by coastal water rich in nutrient salts. Summalizing the above data, the chlorophyll-*a* contents in the Southern Ocean were three or four times as much as those in the Indian Ocean, the western North Pacific Ocean and the South China Sea.

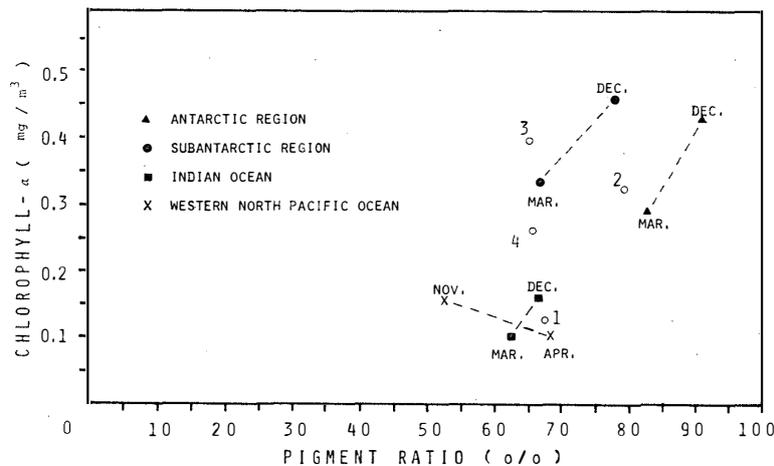


Fig. 2. Relationship between mean chlorophyll-*a* content and pigment ratio (1: South China Sea, 2: Celebes and Makassar Strait, 3: Malacca Strait, 4: Agulhas Current region).

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Appendix 1. Chlorophyll-*a* and phaeophytin contents, pigment ratio, water temperature and salinity along the route of the FUJI to Syowa Station, Antarctica, in 1972-1973.

Station No.	Date	Time (LMT)	Location		Chl.- <i>a</i> (mg/m ³)	Phaeop. (mg/m ³)	Pigment ratio (%)	W.T. (°C)	Salinity (‰)
			Lat.	Long.					
	1972		Leave Tokyo						
	Nov. 25								
1	25	1600	34-55N	139-25E	1.01	0.58	64	18.4	34.35
2	26	0800	32-03	137-50	0.30	0.27	53	22.7	34.62
3	26	1800	30-03	136-29	0.33	0.27	55	23.3	34.58
4	27	0800	27-15	135-03	0.18	0.19	48	23.8	34.73
5	27	1800	25-13	134-05	0.18	0.13	59	24.5	34.63
6	28	0800	22-24	132-43	0.13	0.11	53	26.4	34.75
7	28	1800	20-23	131-50	0.13	0.11	54	26.4	34.78
8	29	0800	17-31	130-25	0.13	0.11	55	27.6	34.70
9	29	1800	15-32	129-27	0.11	0.09	54	28.0	34.81
10	30	0800	12-45	128-09	0.11	0.08	59	28.0	32.72
11	30	1900	10-13	127-25	0.11	0.09	55	28.3	34.58
12	Dec. 1	0900	6-27	126-33	0.08	0.06	58	28.2	34.60
13	1	1800	4-41	125-00	0.17	0.08	67	28.2	34.47
14	2	0800	2-36	122-06	0.17	0.09	64	28.6	34.14
15	2	1800	1-12	120-15	0.34	0.08	81	29.3	34.44
16	3	0800	1-36S	118-54	0.18	0.07	73	29.5	33.45
17	3	1800	4-00	118-35	0.67	0.07	91	29.3	34.00
18	4	0800	6-59	117-08	0.47	0.11	81	30.0	34.18
19	4	1800	8-49	115-42	0.25	0.07	78	29.7	34.47
20	5	0700	11-47	115-02	0.21	0.12	62	29.0	34.55
21	5	1800	14-05	114-38	0.13	0.07	65	29.2	34.62
22	6	0700	16-41	114-00	0.10	0.06	60	26.5	34.82
23	6	1800	18-57	113-36	0.08	0.06	60	26.3	34.88
24	7	0700	21-40	113-10	0.12	0.06	66	24.8	35.02
25	7	1800	23-59	112-43	0.08	0.05	65	24.0	35.22
26	8	0700	26-40	112-36	0.10	0.06	61	22.6	35.26
27	8	1800	29-04	113-25	0.11	0.05	70	23.0	35.52
28	9	0700	31-33	115-05	0.22	0.10	69	20.9	35.67
29	10	0745	31-57	115-38	0.23	0.11	68	22.3	35.72
	10	1000	Arrive in Fremantle						
	16	1100	Leave Fremantle						
30	16	1800	32-31	114-24	0.14	0.08	65	21.0	35.75
31	17	0800	34-18	111-19	0.14	0.16	46	19.7	35.79
32	17	1300	34-47	110-26	0.10	0.06	64	19.5	35.71
33	17	1800	35-36	110-02	0.08	0.05	63	18.4	35.77
34	18	0830	38-02	109-05	0.26	0.12	69	16.3	35.18
35	18	1800	38-42	108-52	0.30	0.11	73	15.2	35.00
36	19	0800	41-14	110-08	0.47	0.18	72	12.2	34.77
37	19	1300	41-53	109-51	0.28	0.13	69	12.7	34.54
38	19	1800	43-46	109-11	0.52	0.19	73	11.6	34.71
39	20	0800	45-03	107-25	0.25	0.12	67	10.2	34.53
40	20	1300	45-38	107-00	0.48	0.13	79	9.0	34.33
41	20	1800	45-30	106-36	—	—	—	8.6	34.30
42	21	0800	48-51	104-47	—	—	—	5.5	33.94
43	21	1800	50-14	104-49	—	—	—	5.1	33.95
44	22	0900	52-56	104-51	0.76	0.05	94	2.8	33.96
45	22	1300	53-37	104-52	0.66	0.05	93	3.6	33.97
46	22	1800	54-33	104-41	0.64	0.00	100	2.1	33.95
47	23	0930	57-29	104-38	0.85	0.00	100	1.2	33.93
48	23	1800	59-08	104-41	0.69	0.00	100	0.1	33.84

Station No.	Date	Time (LMT)	Location		Chl.- <i>a</i> (mg/m ³)	Phaeop. (mg/m ³)	Pigment ratio (%)	W.T. (°C)	Salinity (‰)
			Lat.	Long.					
49	Dec. 24	0845	60-26S	101-57E	0.64	0.02	97	0.4	33.84
50	24	1800	60-33	98-10	0.50	0.01	98	0.3	33.36
51	25	0800	60-50	91-48	0.32	0.04	89	0.9	33.89
52	25	1230	60-54	90-37	0.79	0.00	100	1.4	33.88
53	25	1800	61-01	88-22	0.87	0.03	96	1.0	33.90
54	26	0915	61-25	81-51	0.48	0.06	89	1.1	33.80
55	26	1800	61-30	78-58	0.22	0.06	80	0.5	33.81
56	27	0800	61-55	72-26	0.18	0.06	74	0.2	33.74
57	27	1800	62-09	68-58	0.11	0.05	66	-0.3	33.25
58	28	0850	62-31	63-29	0.25	0.10	71	0.0	33.52
59	28	1300	62-41	62-12	0.15	0.05	79	-0.1	33.88
60	28	1800	63-24	60-10	0.12	0.05	70	-0.2	33.75
61	30	0800	64-48	48-22	0.19	0.10	65	-1.1	33.88
62	30	1300	65-12	45-59	0.22	0.04	84	-1.3	33.68
63	30	1800	65-50	44-08	0.28	0.05	85	-1.4	33.40
64*	1973 Jan. 1	1100	68-22	39-07	0.37	0.09	80	-1.6	33.64
	1		Arrive the fast ice in Lützow-Holm Bay						
	Feb. 23		Leave the ice field						
65	23	0900	67-20	41-05	0.11	0.08	60	-0.5	—
66	24	2330	67-20	40-32	0.10	0.05	66	-0.5	33.80
67	25	0830	67-07	36-36	0.14	0.04	78	-0.6	33.68
68	25	1800	67-09	33-00	0.36	0.11	77	-0.6	33.74
69	26	1800	67-13	20-10	0.18	0.03	86	-0.2	34.08
70	27	0930	67-05	13-43	0.81	0.14	86	-0.9	34.12
71	27	1930	66-05	12-25	0.41	0.00	99	0.5	—
72	28	0935	63-21	12-37	0.48	0.08	86	1.0	34.09
73	28	1800	62-15	12-50	0.40	0.03	92	1.0	34.01
74	Mar. 1	0900	59-55	12-53	0.14	0.05	72	1.5	33.95
75	1	1800	58-29	12-57	0.15	0.03	83	1.4	34.17
76	2	0905	55-49	13-07	0.53	0.09	85	1.7	34.10
77	2	1800	54-24	13-25	0.15	0.03	85	2.0	34.13
78	3	0855	51-46	13-29	0.14	0.08	64	2.2	33.79
79	3	1900	50-19	13-35	0.28	0.04	87	4.1	33.83
80	4	0900	47-37	13-43	0.21	0.06	77	6.8	33.84
81	4	1900	46-14	14-16	0.37	0.10	79	8.0	33.86
82	5	0855	43-34	15-14	0.46	0.40	53	11.9	34.44
83	5	1700	42-08	15-19	0.37	0.23	61	11.9	34.38
84	6	0850	39-13	15-24	0.22	0.16	58	21.9	35.43
85	6	1900	37-22	15-22	0.16	0.08	67	21.8	35.54
86	7	0855	35-10	15-14	0.24	0.11	69	21.4	35.60
87	7	1900	33-49	15-18	0.18	0.06	73	21.7	35.62
88**	8	1430	33-51	18-26	12.31	2.51	83	16.9	34.80
	9	1000	Arrive in Cape Town						
	15	1000	Leave Cape Town						
89	16	0800	34-54	22-17	0.74	0.54	58	18.7	35.33
90	16	1900	34-32	25-01	0.80	0.15	84	19.5	35.38
91	17	0800	33-48	27-30	0.37	0.25	60	24.8	35.52
92	17	1900	33-05	29-23	0.19	0.09	68	22.9	35.59
93	18	0800	34-14	31-38	0.18	0.10	65	24.1	35.56
94	18	1900	31-26	34-04	0.16	0.09	64	26.3	35.42
95	19	0800	30-14	36-41	0.18	0.07	72	24.6	35.52
96	19	1900	29-09	39-04	0.12	0.05	72	25.8	35.49
97	20	0800	28-02	41-45	0.22	0.09	70	25.7	35.24
98	20	1900	26-56	43-34	0.22	0.11	67	25.7	35.23
99	21	0800	25-52	45-58	0.28	0.18	62	24.9	34.87

Station No.	Date	Time (LMT)	Location		Chl.-a (mg/m ³)	Phaeop. (mg/m ³)	Pigment ratio (%)	W.T. (°C)	Salinity (‰)
			Lat.	Long.					
100	Mar. 21	1900	25-05S	48-05E	0.07	0.04	66	27.5	34.90
101	22	0800	24-01	50-49	0.12	0.06	66	27.1	35.03
102	22	1900	23-00	53-28	0.08	0.06	58	27.1	35.12
103	23	0800	21-26	56-04	0.09	0.05	62	28.2	34.92
104	23	1900	20-17	58-21	0.07	0.03	67	27.3	35.14
105	24	0800	18-45	61-02	0.08	0.05	63	28.2	34.96
106	24	1900	17-16	63-09	0.07	0.05	59	28.8	34.60
107	25	0800	15-33	65-13	0.08	0.05	59	28.5	34.66
108	25	1900	14-16	67-09	0.10	0.06	64	28.3	34.45
109	26	0800	12-47	69-16	0.08	0.05	59	28.6	34.46
110	26	1900	11-23	71-01	0.06	0.04	59	30.0	34.33
111	27	0800	9-38	73-15	0.07	0.04	61	29.0	34.31
112	27	1900	7-57	75-20	0.06	0.05	56	30.0	33.83
113	28	0800	6-02	77-52	0.10	0.07	58	28.6	33.89
114	28	1900	4-32	80-13	0.09	0.06	60	29.0	34.20
115	29	0800	2-49	83-06	0.11	0.06	62	29.0	34.13
116	29	1800	1-21	85-15	0.19	0.11	62	29.0	34.19
117	30	0800	0-20N	87-42	0.25	0.18	59	29.4	34.04
118	30	1845	1-45	89-41	0.10	0.07	58	30.2	34.18
119	31	0800	3-28	91-59	0.14	0.08	63	29.4	34.17
120	31	1900	4-56	93-37	0.10	0.07	60	29.6	33.87
121	Apr. 1	0800	6-02	95-44	0.44	0.34	56	29.6	32.92
122	1	1900	5-19	97-52	0.21	0.18	54	29.9	32.29
123	2	0800	3-55	99-55	0.32	0.06	85	29.5	31.20
124	2	1900	2-27	101-37	0.63	0.26	71	29.6	31.32
125***	3	1830	1-16	103-24	1.95	0.25	88	29.5	31.78
	4	1000	Arrive in Singapore						
	9	1000	Leave Singapore						
126	9	1900	2-20	105-03	0.20	0.05	80	30.0	33.24
127	10	0800	4-47	106-20	0.20	0.10	68	29.1	33.57
128	10	1800	6-38	107-32	0.13	0.06	68	30.1	33.64
129	11	0800	9-27	109-11	0.15	0.07	67	28.9	33.63
130	11	1800	11-09	110-42	0.08	0.07	56	28.6	33.73
131	12	0800	13-08	113-11	0.11	0.07	61	28.2	33.64
132	12	1800	14-42	114-57	0.08	0.04	68	28.8	33.69
133	13	0800	16-25	117-22	0.12	0.06	66	27.8	33.94
134	13	1800	17-38	118-49	0.10	0.05	67	28.2	33.90
135	14	0800	18-31	121-02	0.15	0.07	68	27.2	33.87
136	14	1800	20-34	122-30	0.08	0.04	67	26.0	34.93
137	15	0800	22-29	124-29	0.12	0.06	67	26.0	34.94
138	15	1800	23-53	126-06	0.13	0.04	75	24.4	34.76
139	16	0700	25-25	127-35	0.11	0.05	70	23.2	34.73

* In the pack ice region

** Outside the Cape Town Harvor

*** Outside the Singapore Harvor