

Surface Water Chlorophyll-a Contents Observed During the Cruise of the FUJI to Antarctica, November 1973–April 1974*

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「ふじ」の航路に沿う表面海水中のクロロフィル a 量 (1973年11月–1974年4月)*

星 野 孝 治**

要旨: 1973年11月27日から1974年4月18日まで、第15次南極観測行動中の「ふじ」の航路に沿って、192地点で表面海水中のクロロフィル a 量を測定した。

クロロフィル a 量は南極海で一番多く、次いで南東大西洋、セレベス海、マカッサル海峡が多く、インド洋、西太平洋、南シナ海では少なかった。また、マラジョージナヤソ連基地沖のクロロフィル a 量は、南極海の中でもずばぬけて多かった。

クロロフィル a 量の水平分布は細部では異なる点もあるが、過去4回の観測結果とだいたい一致している。

As part of the routine work in the marine biological program of the 15th Japanese Antarctic Research Expedition (1973–1974), surface water chlorophyll-a contents were measured on board at intervals during the cruise of the research vessel FUJI.

Surface water was sampled three times a day in the Antarctic Sea as well as in other areas along the course from Fremantle to Cape Town, twice daily from Tokyo to Fremantle and from Cape Town to Singapore, and once a day between Singapore and Tokyo.

Surface water was sampled by a plastic bucket and was filtered through a Millipore filter HA (47 mm). Chlorophyll was extracted with 90% acetone for 24 hours in a dark refrigerator. After centrifuging the extract at 3000 rpm for 10 minutes, the amount of chlorophyll-a was determined with a spectrophotometer (Hitachi 101). The chlorophyll-a concentration was calculated according to the following formula:

$$\text{Chlorophyll-a (mg/m}^3\text{)} = (11.64E_{663} - 2.16E_{645} - 0.10E_{680}) \times F$$

$$F = \frac{\text{Volume of acetone (ml)}}{\text{Volume of filtered water (l)}}.$$

Chlorophyll-a concentrations and water temperatures are shown in Table 1 and the horizontal distribution of chlorophyll-a in Figs. 1 and 2.

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Table 1. Chlorophyll-a contents along the route of the FUJI.

| Station | Date | Time (Local) | Latitude | Longitude | Chlorophyll-a (mg/m ³) | Water temp. (°C) |
|---------|---------|-----------------|-----------|-----------|---------------------------------------|---------------------|
| | 1973 | | | | | |
| 1 | Nov. 27 | 0800 | 30-59' N | 133-51.2E | 0.17 | 23.1 |
| 2 | | 2000 | 29-09 | 132-08.5 | 0.10 | 24.0 |
| 3 | 28 | 0800 | 26-23 | 131-49 | 0.09 | 24.0 |
| 4 | | 2000 | 23-42 | 131-04 | 0.11 | 24.3 |
| 5 | 29 | 0800 | 20-59.2 | 130-16.8 | 0.09 | 25.0 |
| 6 | | 2000 | 18-17 | 129-33.5 | 0.07 | 28.3 |
| 7 | 30 | 0700 | 15-43 | 128-37 | 0.06 | 28.7 |
| 8 | | 1900 | 13-03.8 | 127-58.7 | 0.05 | 28.5 |
| 9 | Dec. 1 | 0700 | 10-24 | 127-12.7 | 0.05 | 29.0 |
| 10 | | 1900 | 7-39 | 126-51.5 | 0.04 | 28.7 |
| 11 | 2 | 0700 | 5-02 | 125-30 | 0.03 | 28.7 |
| 12 | | 1900 | 3-28.5 | 123-22.9 | 0.16 | 29.1 |
| 13 | 3 | 0700 | 1-56.2 | 121-22.8 | 0.27 | 29.0 |
| 14 | | 1900 | 0-16 | 119-33 | 0.17 | 29.5 |
| 15 | 4 | 0700 | 2-18.5S | 118-40.5 | 0.16 | 29.0 |
| 16 | | 1900 | 4-58 | 118-15 | 0.12 | 29.2 |
| 17 | 5 | 0700 | 7-13 | 116-53.2 | 0.08 | 28.8 |
| 18 | | 1900 | 9-03.2 | 115-37.2 | 0.04 | 29.5 |
| 19 | 6 | 0700 | 11-25.2 | 115-05 | 0.05 | 28.8 |
| 20 | | 1900 | 13-05 | 114-27.5 | 0.07 | 30.1 |
| 21 | 7 | 0700 | 15-59.7 | 114-09 | 0.03 | 28.5 |
| 22 | | 1900 | 18-28 | 113-47 | 0.03 | 28.2 |
| 23 | 8 | 0700 | 20-51.3 | 113-16 | 0.05 | 26.5 |
| 24 | | 1900 | 23-17 | 112-47.4 | 0.05 | 24.4 |
| 25 | 9 | 0700 | 25-41.2 | 112-22.5 | 0.09 | 22.7 |
| 26 | | 1900 | 28-08.2 | 113-02.8 | 0.07 | 22.2 |
| 27 | 10 | 0700 | 30-19.4 | 114-13.5 | 0.05 | 21.5 |
| | | | Fremantle | | | |
| 28 | 16 | 1300 | 31-55.5 | 115-26.6 | 0.28 | 21.5 |
| 29 | | 1800 | 32-26.5 | 114-27 | 0.05 | 20.6 |
| 30 | 17 | 0700 | 33-54 | 111-46 | 0.09 | 19.8 |
| 31 | | 1300 | 34-27.7 | 111-13 | 0.09 | 19.2 |
| 32 | | 1800 | 35-22 | 110-46.5 | 0.06 | 18.8 |
| 33 | 18 | 0700 | 38-10.8 | 110-06.6 | 0.07 | 14.9 |
| 34 | | 1300 | 39-08.9 | 109-56 | 0.23 | 15.2 |
| 35 | | 1800 | 40-09 | 109-53.9 | 0.14 | 14.0 |
| 36 | 19 | 0700 | 42-47 | 109-49.5 | 0.16 | 11.9 |
| 37 | | 1300 | 43-11 | 109-58 | 0.18 | 11.8 |
| 38 | | 1800 | 43-59 | 109-47 | 0.37 | 11.0 |

| Station | Date | Time (Local) | Latitude | Longitude | Chlorophyll-a (mg/m ³) | Water temp. (°C) |
|---------|---------|-----------------|--------------------|-----------|---------------------------------------|---------------------|
| 39 | Dec. 20 | 0700 | 46-12.5S | 109-06.1E | 0.28 | 9.5 |
| 40 | | 1300 | 47-07.2 | 108-49 | 0.26 | 8.2 |
| 41 | | 1800 | 48-04 | 108-32 | 0.10 | 7.2 |
| 42 | 21 | 0700 | 50-21.1 | 108-28 | 0.11 | 4.8 |
| 43 | | 1300 | 51-26.4 | 108-37.2 | 0.13 | 4.5 |
| 44 | | 1800 | 52-16.8 | 108-49 | 0.78 | 3.6 |
| 45 | 22 | 0700 | 54-25 | 109-55.1 | 0.57 | 1.8 |
| 46 | | 1300 | 55-23.2 | 110-32 | 0.75 | 2.2 |
| 47 | | 1800 | 56-09.9 | 111-01.5 | 0.67 | 1.2 |
| 48 | 23 | 0700 | 57-45 | 108-33 | 0.32 | 0.5 |
| 49 | | 1300 | 58-00.7 | 108-02 | 0.39 | 0.7 |
| 50 | | 1800 | 58-26.5 | 106-40 | 0.25 | 0.0 |
| 51 | 24 | 0700 | 60-08.8 | 103-35.6 | 0.39 | -0.3 |
| 52 | | 1300 | 60-33 | 101-46 | 0.44 | 0.0 |
| 53 | | 1800 | 60-52.3 | 99-52 | 0.13 | 0.3 |
| 54 | 25 | 0700 | 61-27.6 | 94-10.1 | 0.62 | -0.3 |
| 55 | | 1300 | 61-37 | 92-01 | 0.60 | -0.3 |
| 56 | | 1800 | 61-49.2 | 89-52 | 0.76 | -0.3 |
| 57 | 26 | 0700 | 62-24.4 | 84-12.5 | 1.10 | -0.1 |
| 58 | | 1300 | 62-51 | 81-56 | 0.89 | -0.5 |
| 59 | | 1800 | 63-23.3 | 79-52.5 | 1.08 | -0.4 |
| 60 | 27 | 0700 | 63-58.1 | 73-37 | 0.77 | -0.6 |
| 61 | | 1300 | 64-08.4 | 71-10 | 0.20 | -0.7 |
| 62 | | 1800 | 64-20 | 68-45 | 0.25 | -1.0 |
| 63 | 28 | 0700 | 64-51 | 61-58.8 | 0.19 | -1.2 |
| 64 | | 1300 | 64-51 | 59-15 | 0.35 | -0.8 |
| 65 | | 1800 | 64-55 | 57-05 | 0.53 | -0.7 |
| 66 | 29 | 0700 | 64-48.4 | 52-07 | 0.34 | -1.7 |
| 67 | | 1300 | 65-00 | 50-19.5 | 0.43 | -1.6 |
| 68 | | 1800 | 64-55.3 | 49-17 | 0.40 | -1.7 |
| 69 | 30 | 0700 | 65-23.1 | 45-06 | 0.29 | -1.2 |
| 70 | | 1300 | 65-50 | 43-39 | 0.23 | -0.7 |
| 71 | | 1800 | 66-29.5 | 42-11 | 0.15 | -0.7 |
| 72 | 31 | 0700 | 68-01 | 38-40 | 0.85 | -1.9 |
| 73 | | 1300 | 68-21.7 | 38-20.1 | 0.83 | -1.5 |
| | | | Fast-ice edge | | | |
| | 1974 | | | | | |
| 74 | Jan. 1 | 0800 | 68-39.5 | 38-47 | 0.22 | -1.7 |
| | Feb. 5 | | Left fast-ice edge | | | |
| 75 | 10 | 1300 | 67-16 | 43-37 | 1.58 | -1.5 |
| 76 | 11 | 1900 | 67-19.1 | 44-13.7 | 3.01 | -1.5 |

| Station | Date | Time (Local) | Latitude | Longitude | Chlorophyll-a (mg/m ³) | Water temp. (°C) |
|---------|---------|-----------------|----------|-----------|---------------------------------------|---------------------|
| 77 | Feb. 12 | 1700 | 67-37 S | 45-26.8E | 1.59 | -1.4 |
| 78 | 13 | 1300 | 67-28 | 44-45 | 2.48 | -1.6 |
| 79 | | 1900 | 67-28 | 44-45 | 2.87 | -1.6 |
| 80 | 14 | 2000 | 67-12.8 | 43-53 | 2.03 | -1.6 |
| 81 | 15 | 0700 | 66-48.8 | 43-26 | 2.62 | -1.7 |
| 82 | | 1300 | 66-53.2 | 43-47.3 | 1.76 | -1.4 |
| 83 | | 1800 | 66-53.2 | 43-47.3 | 1.24 | -1.6 |
| 84 | 16 | 0700 | 66-30.7 | 43-00 | 1.32 | -1.0 |
| 85 | | 1300 | 66-04 | 42-56 | 0.32 | -1.1 |
| 86 | | 1800 | 64-59.4 | 42-55 | 0.30 | 1.1 |
| 87 | 17 | 0700 | 62-49.4 | 43-13 | 0.09 | 0.5 |
| 88 | | 1300 | 62-21.3 | 43-24.5 | 0.16 | 0.7 |
| 89 | | 1800 | 61-28.7 | 43-30.5 | 0.23 | 0.9 |
| 90 | 18 | 0700 | 59-34 | 43-35 | 0.47 | 1.0 |
| 91 | | 1300 | 59-14.6 | 43-29 | 0.23 | 1.1 |
| 92 | | 1800 | 58-25 | 43-28.4 | 0.18 | 1.0 |
| 93 | 19 | 0700 | 57-00.9 | 40-46 | 0.19 | 1.2 |
| 94 | | 1300 | 56-54.7 | 40-01 | 0.27 | 1.0 |
| 95 | | 1800 | 56-54 | 38-28 | 0.21 | 1.2 |
| 96 | 20 | 0700 | 56-59 | 34-14.8 | 0.26 | 1.6 |
| 97 | | 1300 | 57-10.5 | 34-01 | 0.18 | 1.8 |
| 98 | | 1800 | 58-00.6 | 34-05 | 0.12 | 1.2 |
| 99 | 21 | 0700 | 60-07.4 | 34-17 | 0.10 | 1.6 |
| 100 | | 1300 | 60-31.6 | 34-20.3 | 0.05 | 1.2 |
| 101 | | 1800 | 61-21.7 | 34-28 | 0.09 | 1.1 |
| 102 | 22 | 0700 | 63-36.3 | 34-13 | 0.09 | 1.1 |
| 103 | | 1300 | 63-58 | 34-18 | 0.05 | 1.2 |
| 104 | | 1800 | 64-44.3 | 34-31 | 2.40 | 1.2 |
| 105 | 23 | 0700 | 66-22.3 | 33-34 | 0.81 | 1.0 |
| 106 | | 1300 | 66-30.6 | 31-55 | 0.33 | 1.3 |
| 107 | | 1800 | 66-50 | 30-27 | 0.54 | 1.2 |
| 108 | 24 | 0700 | 66-53.2 | 26-09.5 | 0.55 | 1.5 |
| 109 | | 1300 | 66-42.6 | 25-20 | 0.24 | 1.7 |
| 110 | | 1800 | 66-33.6 | 23-38.5 | 0.14 | 1.4 |
| 111 | 25 | 0700 | 66-43.2 | 19-00 | 0.14 | 1.8 |
| 112 | | 1300 | 66-35 | 16-51.7 | 0.22 | 1.8 |
| 113 | | 1800 | 66-29.5 | 15-02 | 0.35 | 1.9 |
| 114 | 26 | 0700 | 66-42.5 | 10-23 | 0.23 | 1.3 |
| 115 | | 1300 | 66-42.5 | 8-07.6 | 0.75 | 1.8 |
| 116 | | 1800 | 66-42.7 | 6-15 | 1.23 | 1.2 |
| 117 | 27 | 0700 | 66-32.3 | 1-31 | 0.56 | 0.8 |

| Station | Date | Time (Local) | Latitude | Longitude | Chlorophyll-a (mg/m ³) | Water temp. (°C) |
|---------|---------|-----------------|-----------|-----------|---------------------------------------|---------------------|
| 118 | Feb. 27 | 1300 | 66-12.2S | 1-11 E | 0.59 | 0.8 |
| 119 | | 1800 | 65-24.8 | 0-19 | 0.29 | 1.0 |
| 120 | 28 | 0700 | 62-50.4 | 1-18 | 0.44 | 1.0 |
| 121 | | 1300 | 62-10.7 | 1-14.2 | 0.35 | 1.2 |
| 122 | | 1800 | 61-12.0 | 1-20 | 0.14 | 1.1 |
| 123 | March 1 | 0700 | 58-54 | 3-13 | 0.08 | 0.8 |
| 124 | | 1300 | 58-32 | 3-31 | 0.06 | 0.8 |
| 125 | | 1900 | 57-22 | 4-08.3 | 0.07 | 1.6 |
| 126 | 2 | 0800 | 55-09.6 | 5-38.2 | 0.28 | 1.0 |
| 127 | | 1300 | 54-08.9 | 6-11 | 0.51 | 1.1 |
| 128 | | 1800 | 53-12.5 | 6-56 | 0.46 | 1.3 |
| 129 | 3 | 0800 | 50-22.4 | 8-25.4 | 0.25 | 3.3 |
| 130 | | 1400 | 49-56 | 8-55 | 0.28 | 3.7 |
| 131 | | 1800 | 49-14.2 | 9-23.4 | 0.25 | 4.8 |
| 132 | 4 | 0700 | 47-04.4 | 10-51 | 0.22 | 7.0 |
| 133 | | 1300 | 46-42 | 11-20 | 0.41 | 7.3 |
| 134 | | 1800 | 45-45.8 | 11-50.6 | 0.31 | 7.3 |
| 135 | 5 | 0700 | 43-21 | 13-07.4 | 0.18 | 9.3 |
| 136 | | 1300 | 42-44.6 | 13-29 | 0.16 | 11.8 |
| 137 | | 1800 | 41-52.8 | 13-57.6 | 0.61 | 15.8 |
| 138 | 6 | 0700 | 39-55.6 | 14-56 | 0.23 | 20.0 |
| 139 | | 1300 | 39-57.4 | 15-05.5 | 0.27 | 20.3 |
| 140 | | 1800 | 39-11.7 | 15-24.4 | 0.23 | 20.8 |
| 141 | 7 | 0700 | 37-15.5 | 16-12.4 | 0.22 | 18.8 |
| 142 | | 1400 | 36-21 | 16-43.7 | 0.11 | 20.5 |
| 143 | | 1800 | 35-50 | 17-10 | 0.15 | 21.0 |
| 144 | 8 | 1800 | 33-52.2 | 18-16.2 | 7.84 | 15.8 |
| | | | Cape Town | | | |
| 145 | 15 | 1900 | 34-57.8 | 19-30.8 | 0.46 | 17.6 |
| 146 | 16 | 0700 | 34-45.8 | 22-41 | 0.53 | 18.2 |
| 147 | | 1900 | 34-22.7 | 25-48.5 | 0.56 | 20.5 |
| 148 | 17 | 0700 | 33-18.4 | 28-03.5 | 0.06 | 25.0 |
| 149 | | 1900 | 32-23 | 30-36.3 | 0.11 | 26.8 |
| 150 | 18 | 0700 | 31-11 | 33-14.2 | 0.08 | 25.5 |
| 151 | | 1900 | 30-00.3 | 35-48 | 0.08 | 26.6 |
| 152 | 19 | 0700 | 28-49.3 | 38-22 | 0.05 | 26.4 |
| 153 | | 1900 | 27-51.5 | 40-55.3 | 0.04 | 26.5 |
| 154 | 20 | 0700 | 27-05.5 | 43-18 | 0.18 | 26.8 |
| 155 | | 1900 | 26-12.3 | 45-45.7 | 0.14 | 26.0 |
| 156 | 21 | 0700 | 25-18.3 | 48-03.8 | 0.05 | 27.3 |
| 157 | | 1900 | 24-17.2 | 50-19.2 | 0.05 | 26.6 |

| Station | Date | Time (Local) | Latitude | Longitude | Chlorophyll-a (mg/m ³) | Water temp. (°C) |
|---------|----------|-----------------|-----------|-----------|---------------------------------------|---------------------|
| 158 | March 22 | 0700 | 23-22.2S | 52-24 E | 0.06 | 26.3 |
| 159 | | 1900 | 22-25.5 | 54-36 | 0.04 | 27.3 |
| 160 | 23 | 0700 | 21-23 | 56-48.8 | 0.06 | 26.8 |
| 161 | | 1900 | 19-55 | 58-52 | 0.03 | 26.8 |
| 162 | 24 | 0700 | 18-30.5 | 60-50.5 | 0.02 | 26.5 |
| 163 | | 1900 | 16-50 | 63-05 | 0.04 | 27.1 |
| 164 | 25 | 0700 | 15-14 | 64-56 | 0.14 | 27.1 |
| 165 | | 1900 | 13-50.2 | 67-00.1 | 0.03 | 27.3 |
| 166 | 26 | 0700 | 12-26.8 | 68-53.1 | 0.03 | 27.5 |
| 167 | | 1900 | 11-00 | 70-49 | 0.08 | 27.5 |
| 168 | 27 | 0700 | 9-32.7 | 72-52.5 | 0.10 | 27.5 |
| 169 | | 1900 | 7-50 | 75-24.2 | 0.11 | 28.5 |
| 170 | 28 | 0700 | 6-18.8 | 77-42.5 | 0.16 | 28.6 |
| 171 | | 1900 | 4-48.3 | 80-01.7 | 0.11 | 29.3 |
| 172 | 29 | 0700 | 3-19 | 82-18.5 | 0.10 | 29.1 |
| 173 | | 1900 | 1-39 | 84-22 | 0.06 | 29.0 |
| 174 | 30 | 0700 | 0-08.5 | 86-15 | 0.04 | 29.0 |
| 175 | | 1900 | 1-37.3N | 88-26.7 | 0.05 | 29.0 |
| 176 | 31 | 0700 | 3-25.3 | 90-43 | 0.07 | 29.1 |
| 177 | | 1900 | 5-05.7 | 93-11 | 0.10 | 29.3 |
| 178 | April 1 | 0700 | 6-04.2 | 95-26.2 | 0.12 | 28.9 |
| 179 | | 1900 | 5-17 | 97-52.7 | 0.12 | 29.3 |
| 180 | 2 | 0700 | 3-59.3 | 99-48.7 | 0.64 | 29.2 |
| 181 | | 1900 | 2-26.7 | 101-37 | 0.26 | 29.0 |
| 182 | 3 | 0700 | 1-14.6 | 103-25.9 | 0.88 | 28.3 |
| | | | Singapore | | | |
| 183 | 9 | 1900 | 2-04.8 | 104-59.5 | 0.09 | 28.5 |
| 184 | 10 | 1900 | 6-19 | 107-30.8 | 0.10 | 27.6 |
| 185 | 11 | 1900 | 10-15 | 110-47.5 | 0.05 | 27.8 |
| 186 | 12 | 1900 | 13-49.5 | 114-38 | 0.06 | 27.8 |
| 187 | 13 | 1900 | 17-16.5 | 118-41 | 0.05 | 28.2 |
| 188 | 14 | 1900 | 20-46.8 | 122-40.9 | 0.05 | 26.8 |
| 189 | 15 | 1900 | 24-05.9 | 126-14.8 | 0.08 | 24.4 |
| 190 | 16 | 1900 | 27-32.9 | 129-48 | 0.08 | 22.7 |
| 191 | 17 | 1900 | 31-30 | 133-05 | 0.11 | 22.0 |
| 192 | 18 | 1900 | 33-54.8 | 137-55.2 | 1.06 | 16.0 |

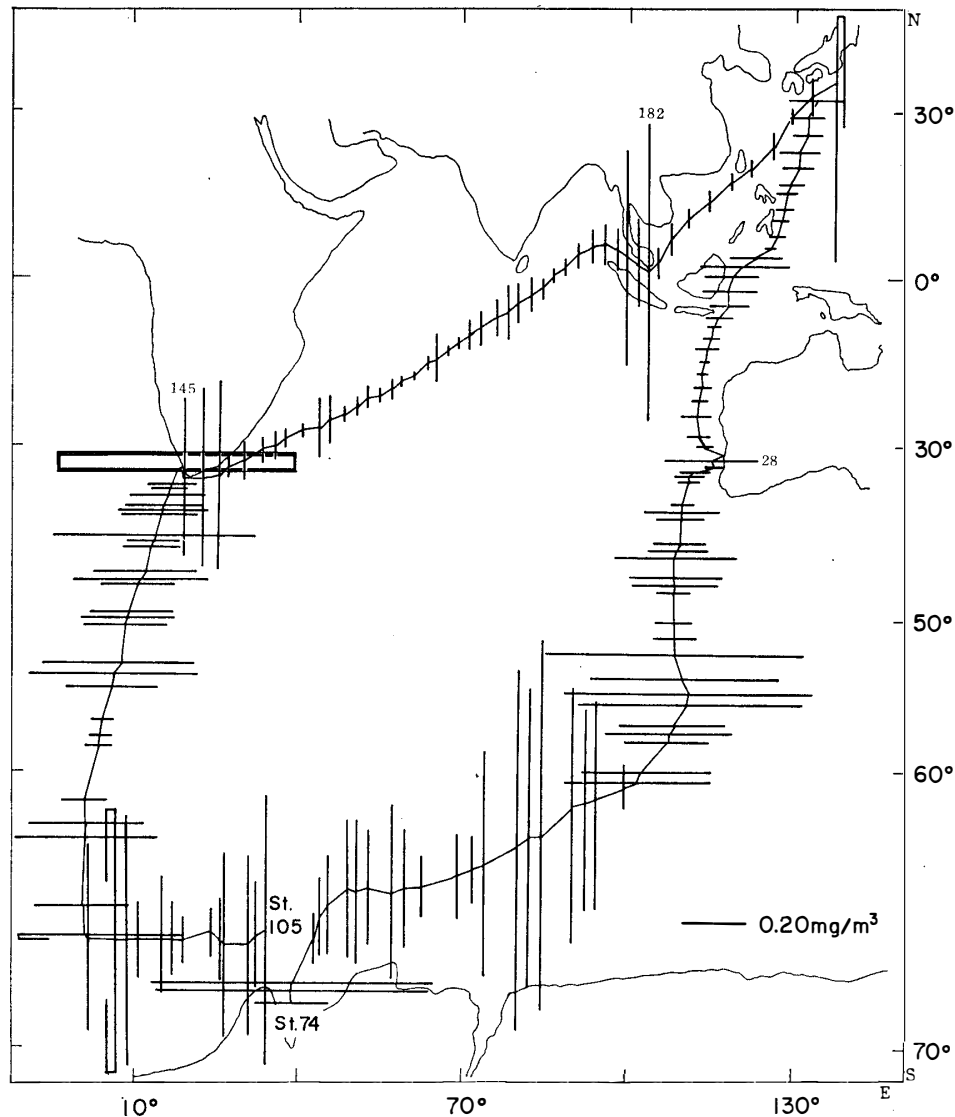


Fig. 1. Horizontal distribution of chlorophyll-a along the route of the FUJI from St. 1 to St. 74 and from St. 105 to St. 192.

The horizontal distribution of chlorophyll-a in 1973-1974 closely resembled that found by previous workers (*e.g.*, HOSHIAI, 1968; NISHIWAKI, 1972). The highest concentrations were found in the Antarctic Sea; the next highest were those found in the Cerebes Sea, the Makassal Strait, and the Atlantic Ocean; somewhat lower values were obtained for the Western Pacific Ocean, the Indian Ocean, and the South China Sea.

The outline of chlorophyll-a distribution was as follows:

Tokyo to Fremantle (St. 1 - St. 27)

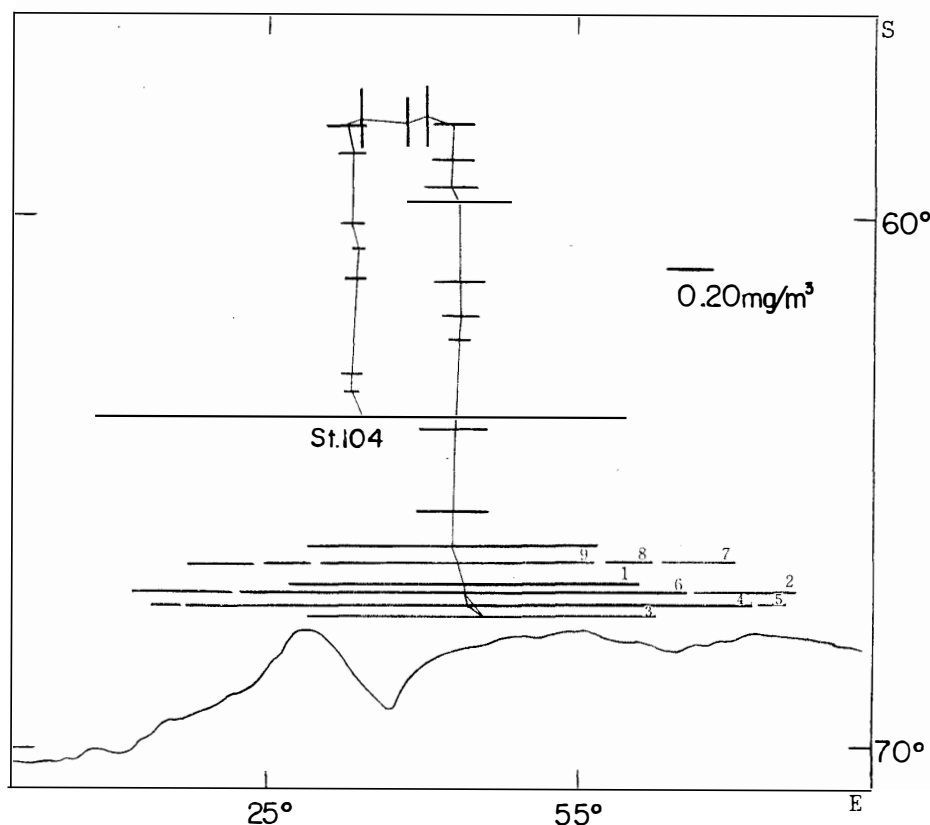


Fig. 2. Horizontal distribution of chlorophyll-a along the route of the *FUJI* between St. 75 and St. 104. Numbers 1-9 indicate stations 75 to 83 in order.

In the sea area adjacent to Japan a high chlorophyll-a concentration (0.17 mg/m^3) was observed but that of the Western Pacific was low ($0.03\text{--}0.11 \text{ mg/m}^3$). In the Cerebes Sea and the Makassal Strait the concentration becomes two to three times ($0.04\text{--}0.27 \text{ mg/m}^3$) that in the Western Pacific Ocean but again falls off in the northern part of the Indian Ocean to values ($0.03\text{--}0.09 \text{ mg/m}^3$) similar to those found in the Western Pacific.

Fremantle to the fast-ice edge near Syowa Station (St. 28 - St. 74)

Near Fremantle a high chlorophyll-a concentration (0.28 mg/m^3) was observed but then they again decreased to values ($0.05\text{--}0.09 \text{ mg/m}^3$) resembling those of the Northern Indian Ocean. Between 39°S and 52°S the concentration increased ($0.05\text{--}0.37 \text{ mg/m}^3$), especially between 43°S and 47°S ($0.26\text{--}0.37 \text{ mg/m}^3$). In the sea areas south of 52°S , high concentrations ($0.13\text{--}1.08 \text{ mg/m}^3$) were observed and these high concentrations continued along the Antarctic coast to the fast-ice edge near Syowa Station, although previous workers (*e.g.*, HOSHIAI, 1968; TOMINAGA, 1971) reported that along the coast high concentrations were not present.

The offing of Molodezhnaya Station (USSR) (St. 75 - St. 84)

In the offing of Molodezhnaya Station (USSR), about 50 km from the Antarctic Continent, chlorophyll-a concentrations were very much higher (1.32–3.01 mg/m³) than in other areas of the Antarctic Sea.

The offing of Molodezhnaya Station to Cape Town (St. 85 - St. 144)

From the offing of Molodezhnaya Station the FUJI sailed northward along the 43°E meridian, then headed west at 57°S, south at 34°E, again west at 66°30'S, and near 1°E longitude it turned north toward Cape Town. Along this route, it was observed that concentrations were high in the coastal areas but low in other areas. Beyond St. 104 concentrations were low (0.06–0.28 mg/m³) between 60°S and 55°S but otherwise high. Outside of Cape Town harbor an extremely high concentration (7.84 mg/m³) was observed.

Cape Town to Singapore (St. 145 - St. 182)

The concentrations found in the western and central areas of the Indian Ocean (0.02–0.16 mg/m³) did not vary much from those found in the eastern areas, but the Malacca Strait had slightly higher concentrations (0.10–0.88 mg/m³).

Singapore to Tokyo (St. 183 - St. 192)

In the South China Sea and the Western Pacific Ocean the concentrations were low (0.05–0.10 mg/m³) and became high in the coastal area of Japan (1.06 mg/m³).

Chlorophyll-a content with changing latitude in the Southern Ocean (Fig. 3)

As for the relationship between chlorophyll-a content and latitude, zones of decreased concentration were found at 38°S–43°S, 50°S, and 58°S–63°S. The first two zones coincide, respectively, with the Subtropical Convergence and the Antarctic Convergence where surface water temperature changes discontinuously. The last

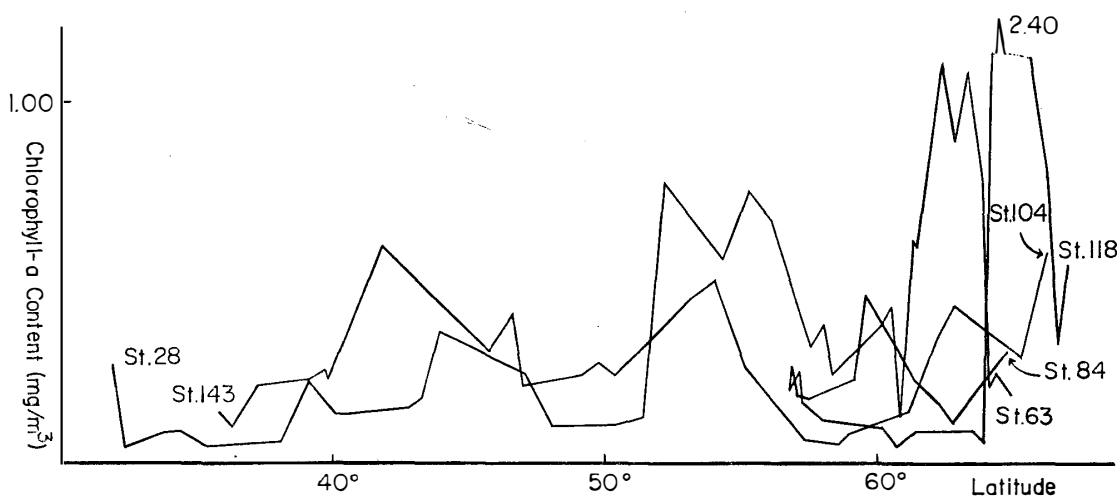


Fig. 3. Relationship between chlorophyll-a content and latitude in the Southern Ocean.

zone of decreased concentration perhaps coincides with the Antarctic Divergence which is produced by opposing surface currents, namely eastbound and westbound currents, off the coast of Antarctica.

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