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Chlorophyll *a* in the Bransfield Strait and the southern part of Drake Passage during BIOMASS-SIBEX (December 1983-January 1984)*

ABSTRACT: The chlorophyll *a* content was measured at 62 oceanographic stations. At each station samples were collected from eight standard depths between the water surface and 150 m. Integrated values (chlorophyll *a* mg/m^2) are used in the presentation of the results and discussion. The recorded quantities of chlorophyll *a* were rather high, amounting to as much as 634 mg/m^2. The areas with high chlorophyll *a content* (>200 mg/m^2) were located in the region of the Anvers Island and Brabant Island, on the shelf around Joinville Island and opposite the Antarctic Sound, close to Clarence Island and beyond the regions recommended in the BIOMASS-SIBEX programme to the east and south of the South Orkney Islands. In the acetonic extracts of photosynthetizing pigments large quantities of phytoxanthin were found using the TLC method, what precludes the use of the Lorenzen method for determination of chlorophyll *a* and its degradation products.

Key words: chlorophyll *a*, BIOMASS-SIBEX

1. Introduction

Determinations of chlorophyll *a* were obligatory in the SIBEX programme, so they were carried out at all main oceanographic stations investigated during the r/v "Profesor Siedlecki" cruise. All the hitherto studies on chlorophyll carried out earlier in the same research area (Burkholder and Sieburth 1961, El-Sayed, Mandelli and Sugimura 1964, El-Sayed

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1968) were conducted during the austral summer season (January-March). In some regions very high chlorophyll concentrations were recorded at the water surface, even as high as 26 mg/m^3, in the greater part of the remaining regions chlorophyll content was very low (in the range of 0.3—0.5 mg/m^3). The network of the oceanographic stations was sparse at the time, thus it is difficult to define precisely the range of the areas with high or low chlorophyll concentrations. Moreover, the above-mentioned authors did not look for the connection of this parameter with hydrological situation prevailing in the region under investigations. At present, there is a tendency towards relating quantities of chlorophyll with the distinguished water masses of characteristic T and S values and also with the dynamics of the oceanic waters. This approach to the problem was assumed for the critical analysis of the results of the BIOMASS-FIBEX programme (cf. Lipski 1982).

The distribution of the water masses worked out on the basis of the German data was presented by Stein (1982) and were published in the BIOMASS Report, Series 30 and 31. The data and results of Chilean expedition were published by Sievers (1982). Using the polish data Grelowski and Tokarczyk (1985) distinguished the water masses in SIBEX area.

Descriptions of the dynamics of water in the Bransfield Strait region, from the early days of Clowes (1934) up to the latest findings of SIBEX, present invariably this region as an area of the confluence of the water masses from the Bellingshausen Sea and Weddell Sea. Only against the background of this hydrological situation one can try to explain why large quantities of chlorophyll were found in some particular areas whereas other regions are extremaly poor in phytoplankton.

2. Material and methods

Geographical coordinates of the oceanographic stations are given in the paper of Rakusa-Suszczewski and Lipski (1985). Analyses were carried out at 62 oceanographic stations. Of that number 9 stations were located beyond the recommended SIBEX research area (the South Orkneys region). Moreover, additional determinations of chlorophyll content in nannoplankton (phytoplankton of cells <20 μm) were made at 6 stations.

Water samples were collected by means of a 6-litre Van Dorn-type bathometer or a 5-litre "Hydrobios" bathometer from eight standard depths: 0, 10, 20, 30, 50, 75, 100 and 150 m. Usually the whole content of the bathometer was filtered through a GF/C Whatman Glass-Fiber filter, In the cases of great abundance of phytoplankton only 2—3 liters of the water sample were filtered. For determination of chlorophyll *a* the procedure of Evans and O'Reilly (1980) was used with a slight modification: acetone extract was not centrifuged but filtered through GF/C filter. For

Table I.

Chlorophyll *a* in oceanographic stations during SIBEX (individual values and weighted means in mg/m³; integrated values in mg/m²)

Depth (m) / St. No	4	9	11	13	18	24	30	40	42	53	56	59
0	0.73	1.21	0.90	0.51	3.38	8.12	2.55	0.39	0.38	3.16	0.20	0.34
10	0.69	1.15	0.66	0.53	3.26	7.84	2.84	0.22	0.36	3.15	0.21	0.30
20	0.72	1.18	0.91	0.56	2.46	6.53	2.02	0.35	0.30	3.17	0.20	0.36
30	0.73	0.81	0.63	0.58	4.94	5.47	2.57	0.28	0.36	3.04	0.18	0.22
50	0.73	0.70	0.50	0.88	2.77	5.10	1.96	0.35	0.23	3.01	0.21	0.42
75	0.75	0.70	0.38	0.55	1.77	0.62	0.24	0.33	0.41	2.67	0.24	0.41
100	0.48	0.36	0.21	0.53	1.14	0.64	0.23	0.29	0.21	2.25	0.18	0.27
150	0.33	0.23	0.10	0.22	0.35	0.45	0.30	0.20	0.18	1.34	0.08	0.11
0—100 integrated value	65.1	79.3	53.0	62.3	269.0	399.1	152.9	31.6	32.0	287.2	20.8	34.7
0—100 weighted mean	0.65	0.79	0.53	0.62	2.69	3.99	1.53	0.32	0.32	2.87	0.21	0.35
0—150 integrated value	85.3	94.0	60.8	81.1	306.3	426.4	166.1	43.9	41.7	377.0	27.3	44.2
0—150 weighted mean	0.57	0.63	0.41	0.54	2.04	2.84	1.11	0.29	0.28	2.51	0.18	0.29

Depth (m) / St. No	61	63	65	68	71	74	76	78	80	82	84	87
0	0.20	0.34	1.00	0.66	0.46	0.89	0.35	0.13	0.23	0.27	2.55	0.55
10	0.19	0.29	0.96	0.72	0.45	0.86	0.35	0.12	0.18	0.26	2.68	0.48
20	0.17	0.28	0.97	0.68	0.49	0.85	0.34	0.12	0.18	0.29	2.19	0.47
30	0.17	0.31	0.88	0.60	0.57	0.84	0.34	0.11	0.21	0.26	2.24	0.54
50	0.18	0.32	0.39	0.42	0.49	0.79	0.39	0.12	0.23	0.33	2.15	0.57
75	0.18	0.24	0.17	0.30	0.50	0.78	0.33	0.11	0.22	0.30	1.93	0.56
100	0.18	0.25	0.09	0.29	0.40	0.71	0.26	0.12	0.23	0.24	1.71	0.45
150	0.18	0.23	0.09	0.06	0.31	0.52	0.23	0.10	0.15	0.06	0.50	0.09
0—100 integrated value	18.0	28.4	51.7	46.9	48.8	80.3	34.0	11.7	21.6	28.7	213.1	53.9
0—100 weighted mean	0.18	0.28	0.52	0.47	0.49	0.80	0.34	0.12	0.22	0.29	2.13	0.54
0—150 integrated value	26.2	40.4	56.2	55.6	66.5	111.1	46.3	17.2	31.3	36.2	268.3	66.7
0—150 weighted mean	0.17	0.27	0.37	0.37	0.44	0.74	0.31	0.11	0.21	0.24	1.79	0.44

Depth (m) / St. No	89	92	94	97	100	103	105	108	112	114	117*)
0	0.76	0.39	6.56	6.73	7.68	4.58	4.31	3.84	1.63	1.45	2.57
10	0.75	0.39	7.66	6.83	7.67	4.32	4.16	4.02	1.57	1.37	2.29
20	0.72	0.38	6.99	6.58	8.11	4.55	3.80	3.61	1.56	1.76	2.01
30	0.70	0.39	6.42	6.77	7.95	4.42	4.12	3.63	1.61	1.67	1.62
50	0.78	0.85	7.06	7.02	7.63	3.72	4.83	3.47	1.69	0.87	1.80
75	0.70	0.66	7.13	6.70	1.50	3.39	4.17	3.29	1.42	0.33	1.55
100	0.56	0.47	0.55	0.64	0.56	2.02	2.88	2.82	1.18	0.12	1.30
150	0.43	0.33	0.05	0.26	0.18	1.36	1.90	2.05	0.87	0.09	—
0—100 integrated value	71.1	57.0	619.6	604.8	531.6	371.6	411.9		151.9	92.9	175.7
0—100 weighted mean	0.71	0.57	6.20	6.05	5.32	3.72	4.12	3.46	1.52	0.93	1.76
0—150 integrated value	95.8	77.0	634.6	627.3	550.1	456.1	531.4	467.3	203.1	98.2	—
0—150 weighted mean	0.64	0.51	4.23	4.18	3.67	3.04	3.54	3.12	1.35	0.65	—

Depth (m) / St. No	120	122	124*)	128	130	132	135	138*)	141	143	146	151
0	1.83	1.94	0.87	3.75	1.40	1.25	0.37	1.18	1.62	1.23	3.58	2.37
10	1.80	1.93	0.71	3.65	1.39	1.11	0.47	1.12	1.61	1.29	3.27	2.34
20	1.81	1.98	0.76	3.63	1.50	1.10	0.45	1.00	1.21	1.20	2.60	1.94
30	1.67	1.24	0.82	3.60	1.32	1.13	0.51	0.56	1.04	1.16	2.46	1.36
50	1.53	1.37	0.78	3.02	0.97	1.04	0.46	0.38	0.97	1.01	1.89	0.60
75	1.30	0.25	0.60	0.36	0.95	0.93	0.50	0.33	0.88	0.93	0.97	0.34
100	1.16	0.15	0.24	0.33	0.86	0.86	0.49	0.29	0.78	0.10	0.66	0.25
150	0.90	0.07	—	0.17	0.11	0.70	0.39	—	0.51	0.06	0.40	0.20
0—100 integrated value	151.7	106.6	66.8	226.6	112.0	102.7	47.7	55.9	106.5	95.7	188.5	100.2
0—100 weighted mean	1.52	1.07	0.67	2.27	1.12	1.03	0.48	0.56	1.06	0.96	1.89	1.0
0—150 integrated value	203.2	112.1	—	239.1	136.3	141.7	69.7	—	137.7	99.7	215.0	111.4
0—150 weighted mean	1.35	0.75	—	1.59	0.91	0.94	0.46	—	0.92	0.66	1.43	0.74

Depth (m) / St. No	153	155	157	160*)	163	166	169	171	174	177	181	209	211	214	218
0	1.51	9.53	5.10	3.65	3.31	5.96	5.44	0.45	1.91	2.16	0.46	0.35	0.35	0.15	0.28
10	1.55	9.94	5.10	3.63	3.12	7.33	5.72	0.42	1.84	3.43	0.44	0.37	0.30	0.13	0.29
20	1.67	11.19	6.03	3.05	3.00	7.18	5.92	0.46	1.12	3.45	0.41	0.37	0.32	0.18	0.29
30	0.57	8.16	5.44	3.46	3.08	7.41	5.77	0.38	1.46	3.83	0.36	0.37	0.36	0.19	0.29
50	0.47	4.18	4.30	2.99	4.02	3.97	2.00	0.46	1.16	3.34	0.35	0.25	0.30	0.20	0.12
75	0.19	1.48	2.96	3.22	2.78	1.17	1.30	0.22	0.43	3.20	0.29	0.14	0.20	0.21	0.19
100	0.09	0.40	2.96	2.86	1.86	0.64	0.75	0.11	0.64	2.34	0.32	0.11	0.21	0.18	0.17
150	0.20	0.20	2.14	—	1.94	0.36	0.57	0.08	0.45	1.38	0.22	0.06		0.09	0.11
0—100 integrated value	64.8	517.4	426.2	325.0	307.2	412.6	317.0	34.0	105.9	321.4	35.5	24.8	27.7	18.7	25.2
0—100 weighted mean	0.65	5.17	4.26	3.25	3.07	4.13	3.17	0.34	1.06	3.21	0.35	0.25	0.28	0.19	0.25
0—150 integrated value	70.3	532.4	553.7	—	402.2	437.6	350.0	38.7	133.2	414.4	49.12	29.0	36.0	25.4	32.2
0—150 weighted mean	0.47	3.55	3.69	—	2.68	2.92	2.33	0.26	0.89	2.76	0.33	0.19	0.24	0.17	0.21

*) stations shallower than 150 m

spectrophotometric measurements Beckman 25 spectrophotometer was used; calculations of chlorophyll concentrations ($C_{chlor.}$) were made using a simplified equation after Jeffrey and Humphrey (1975):

$$C_{chlor} = 11.4\ E^{664} \times \frac{v}{V \cdot l}$$

where:

E_{664} — absorbance at 664 nm corrected for turbidity
v — volume of acetone used for extraction
V — volume of filtered water sample
I — sample path length (50.0 mm cuvette was used)

For a few initial determinations a more developed equation was used, as Jeffrey and Humphrey (1975) proposed for samples dominated by diatoms, but it soon turned out these two equations gave identical results when used for determination of small as well as large quantities

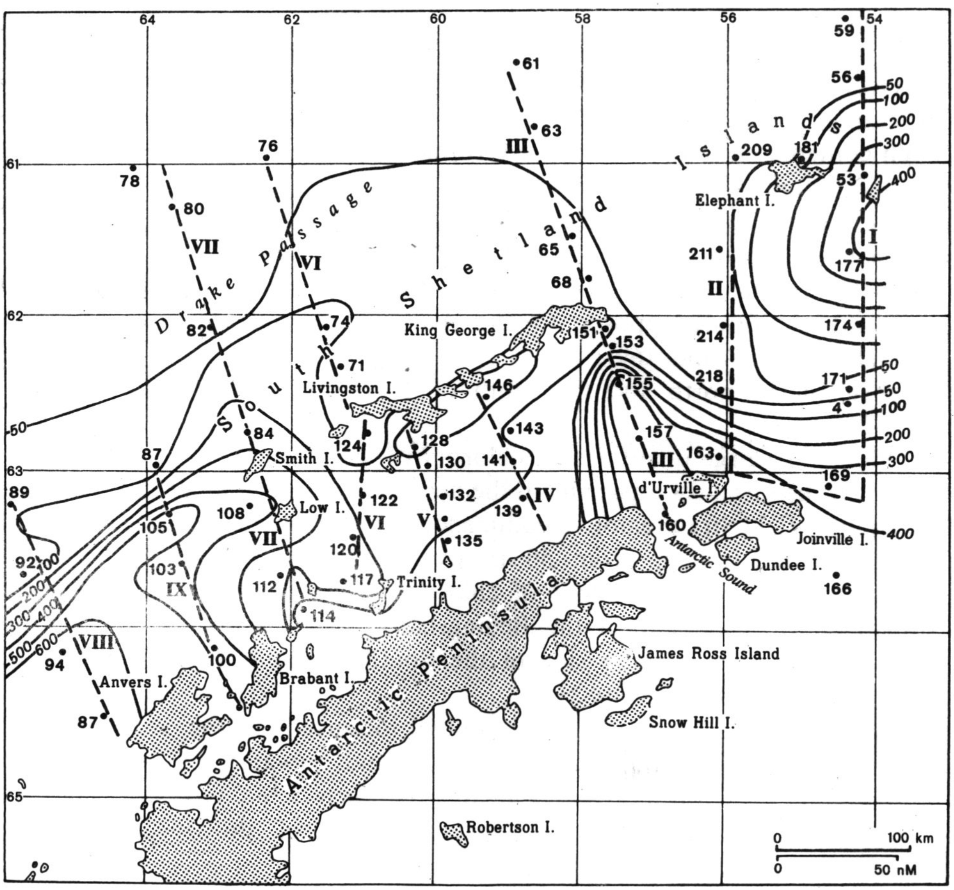

Fig. 1. Chlorophyll *a* — integrated values (mg/m^2). Numbers show oceanographic stations where chlorophyll measurements were made

of chlorophyll. The data from the measurements made at the investigated stations are given in Table I. The integrated values, i.e. the quantities of chlorophyll *a* in the water column under 1 m^2 of the sea surface downwards to the depths of 100 and 150 m and the corresponding weighted means were calculated and are also presented in Table I. Spatial distribution of chlorophyll *a* is shown in Fig. 1.

Additionally a few analyses of acetonic extracts of pigments were made by means of thin-layer chromatography using Merck plates with cellulose and hexane /acetone/ n-propanol: 90/10/0.45 solvent. Further analyses could not be made for lack of time and over and above that chromatograms were not of the best quality due to the rough sea tossing the ship. The range of the euphotic zone was estimated only on the basis of the measurements of the visibility of the Secchi disc.

3. Results

Owing to the season in which the investigations were conducted — the beginning of austral summer — large quantities of chlorophyll were found. High contents of chlorophyll *a* were recorded in three regions of the SIBEX Area A, namely:

— shelf along Anvers Island and Brabant Island extending as far as Smith Island (Stations 84, 94, 97, 100, 103, 105, 108 and 112);
— shelf around Joinville Island and d'Urville Island and the part of Bransfield Strait opposite to the Antarctic Sound (Stations 155, 157, 160, 163, 166 and 169);
— shelf to the north and the south of Clarence Island (Stations 53 and 177).

Moreover, large quantities of chlorophyll were found on the shelf of the South Orkney Islands, especially in the northern and eastern parts of that area.

In Bransfield Strait region (recommended cross-sections 4, 5 and 6 on Fig. 1) average values ranging from 50 to over 200 mg/m^2 were recorded, but a belt of an increased amount of chlorophyll was distinctly marked in the stream of the waters from the Bellingshausen Sea carried on by a strong current along the southern side of the South Shetland Islands (Stein and Rakusa-Suszczewski 1983).

Waters decidedly poor in chlorophyll occurred in the regions of the northern parts of the cross-sections 1, 3, 6 and 7 (waters of Drake Passage beyond the shelf Fig. 1) and the area between King George Island and Elephant Island (including the closest vicinity of the Elephant Island) extending southeastwards beyond 54°E.

The results of the additional determinations of the chlorophyll *a* content in nannoplankton are presented in Table II. Since the collection of water samples required for this supplementary determinations was made in co-operation

Table II.

Nannoplanktonic chlorophyll *a* and percentage of total chlorophyll content

Depth (m)	Station No 68		94		132		155		171		181	
	chlorophyll mg/m³	%	chlorophyll mg/m³	%	chlorophyll mg/m³	%	chlorophyll mg/m³	%	chlorophyll mg/m³	%	chlorophyll mg/m³	%
0	0.67	100*)	0.38	6	0.93	74	2.29	24	0.48	100*)	0.39	84
25	0.66	100*)	0.38	6	0.71	64	4.04	42	0.44	100*)	0.32	85
50	0.48	100*)	0.39	6	0.71	68	2.07	50	0.44	96	0.28	81
75	0.36	100*)	0.48	7	0.21	23	0.53	36	0.22	100*)	0.24	83
100	0.31	100*)	0.10	18	0.11	13	0.46	100	0.12	100*)	0.26	80
150	0.08	100*)	—**)	—	0.10	14	0.17	85	0.09	100*)	0.18	83

*) within the limits of accurency all chlorophyll is nannoplanktonic chlorophyll
**) very low concentration, lack of reliable dtata

with a team of plankton investigators therefore the samples were taken only from six depths. Nannoplanktonic chlorophyll content for the depth of 25 m was calculated on the basis of the mean value between the depths of 20 and 30 m.

In the vertical distribution of chlorophyll (Table I) the following characteristic features may be noticed:

— at the stations where chlorophyll concentrations were high (over 2 mg/m^3) the maximum quantities occurred almost exclusively at the shallow depths of 0—20 m;
— a similar situation occurs also in the greater part of the stations with middle values of chlorophyll concentrations (1—2 mg/m^3);
— at the stations where small quantities of chlorophyll were noted the maximum concentrations occurred deeper i.e. downwards to the depth of 50 m.

In about one fourth of the total number of the investigated stations a sharp decrease in chlorophyll concentrations was observed below the thermocline.

Visibility of Secchi disc ranged from 4.0 m at the station 155 (station with the highest values of chlorophyll concentration in the surface water layer) to 25 m at the station 61 (station typical for the waters of Drake Passage), which corresponds to the estimated range of the euphotic zone (after Poole and Atkins 1929) 11 and 73 m, respectively.

4. Discussion

The above-mentioned regions with high chlorophyll content lie within the range of the water masses of very diversified characteristics. In the areas around Anvers Island, Brabant Island and Smith Island there was found the waters of the Bellingshausen Sea origin (Grelowski and Tokarczyk 1985), though at the stations 100, 103 and 112 the primary T/S structure of these waters was greatly changed by local conditions. On the shelf around Joinville Island and d'Urville Island and in the vicinity of station 157 there were waters of the Weddell Sea. The neighbouring station 155, where very high abundance of phytoplankton was observed, showed sharp change in temperature and salinity at the depth of about 20 m, while from the depth of 100 m downwards this parameters of the water were very close to the values typical for the waters of the Weddell Sea. This two mentioned above regions differs in surface layer (0—20 m) water temperature of about 1°C, what is a great difference in Antarctic seas. A similarly great difference in water temperatures occurs between the remaining two regions of large quantities of chlorophyll — viz. the vicinity of Clarence Island and the shelf around the South Orkneys. Thus, the statement that in the Antarctic regions temperature and salinity do not determine the occurrence of the mass-blooming of the phytoplankton is confirmed once more.

The water masses dynamic in the regions of high chlorophyll concentrations is also strongly differentiated though it should be noted that all these regions are in general located over a shelf, i.e. in the waters not exceeding the depths of 500 m.

A comparison of the SIBEX data with those from the earlier experiment FIBEX (Lipski 1982) shows that the quantities of chlorophyll recorded during SIBEX expedition are twice as high as well in the integrated values under 1 m^2 of the sea surface as in concentrationvalues per 1 m^3:

FIBEX $C_{max}=4.4$ mg/m^3; $Z_{max}(0-150 \text{ m})=332$ mg/m^2;

SIBEX $C_{max}=11.2$ mg/m^3; $Z_{max}(0-150 \text{ m})=635$ mg/m^2.

Spatial distribution of the areas with high or low concentrations of chlorophyll is similar in many details. During the time of both experiments the highst quantities of chlorophyll were found to the west of Anvers Island, the middle values in the narrow strip of water along the northern part of the South Shetlands and whereas the lowest values occurred throughout nearly the whole area of the Bransfield Strait and in the northwestern part of the investigated area in the waters typical for Drake Passage. The only important difference was observed in the occurrence of large quantities of chlorophyll in the waters of the Weddell Sea origin in the vicinity of d'Urville Island, Joinville Island and Antarctic Sound.

Even the preliminary determinations of net-phytoplankton (Kopczyńska and Ligowski 1985) show that its species composition is not uniform for the given area of high concentrations of phytoplankton. For instance the region around Anvers Island and Brabant Island icludes stations with high abundance of large-size *Corethron criophilum* cells (Sta. 94 and 97) and stations 84, 100, 103, 105 and 108, where small-size species *Chaetoceros neglectus* and *Chaetoceros tortissimum* are predominant. A similar situation occurs in the region of high phytoplankton concentrations near Joinville Island and Antarctic Sound.

Frequent measurements of the chlorophyll content supplemented by only sporadic determinations of phytoplankton species therefore lead to false conclusions with regard to the expansion of various species.

An interesting regularity may be observed in the results of the determination of chlorophyll in the nannoplankton fractions (Table II). In all the stations (Nos. 68, 171 and 181), where the analysis of the total content of chlorophyll gave the values to about 50 mg/m^2 in the 0—150 m water layer the percentage of the nannoplankton fraction was very high, ranging from 80- to 100%.

However, when the total chlorophyll content was of medium values the percentage of nannoplankton may be very variable. Moreover, this correlation is also strongly differentiated in vertical distribution.

These findings should be treated with great caution since they are not confirmed as yet by the results of quantitative samples of bottle-collected phytoplankton. Also the method of fractionization of phytoplankton as well as the inaccuracy of chlorophyll determinations at very low concentrations may lead to serious errors.

For examination of the composition of photosynthezing pigments of the Antarctic phytoplankton the TLC analyses of acetonic extracts were made. These analyses showed great quantities of fucoxanthine and other yellow pigments, whereas the spots characteristic for chlorophyll degradation products nearly did not appear. Since the presence of fucoxanthine has a strong effect on the determination of phaeophytin (Riemann 1978) all the results of spectrophotometric determinations of phaeophytin in the Antarctic waters obtained using equations after Lorenzen (1967) should be brought in question.

There are no available data hitherto as regards the effect of fucoxanthine and other pigments upon the accuracy of fluorometric methods used widely for chlorophyll determinations.

My deep thanks are due to Dr. A. Łukowski for sharing with me the laborious work of chlorophyll determination during the SIBEX expedition on r/v "Profesor Siedlecki".

5. Резюме

Концентрации хлорофилла *a* определялись на 62 станциях согласно программе СИБЭКС. Результаты определений для каждой станции с 8 стандартных глубин от поверхности до 150 м представлены в таблице I. В таблице представлены также интегрированные величины концентрации хлорофилла в толще воды от поверхности до глубины 100 и 150 м, а также соответствующие им взвешенные средние концентрации. Дополнительно на 6 станциях определено содержание хлорофилла в наннопланктоне. Результаты представлены в таблице II. Пространственное распределение хлорофилла на исследуемой акватории, выраженное в интегрированных величинах представляет рис. 1. Найденные концентрации хлорофилла были высокие и достигали 634 мг/м^2. Районы с высокой концентрацией хлорофилла (>200 мг/м^2) находились в окрестности островов Anvers и Brabant, на шельфе вокруг острова Joinville и в проливе Брансфилда напротив Antarctic Sound а также в районе острова Clarence. Вне района исследований БИОМАСС/СИБЭКС большие концентрации хлородилла *a* были найдены на юг и на восток от архипелага южных Оркнейских островов. В остальных районах пролива Брансфилда концентрации хлорофилла были средние и менялись в пределах 50 до 200 мг/м^2. Воды характеризующиеся малыми концентрациями хлородилла находились в проливе Дрейка, вне шельфа, а также в посде между островами Элефант и Кинг Джордж. В ацетонных экстрактах фотосентизирующих пигментов были обнаружены методом TLC большие количества фукоксантины. Это делает невозможным разделить хлорофилл а и продукты его распада по методу Лоренцена.

6. Streszczenie

Zawartości chlorofilu *a* były oznaczone na 62 stacjach oceanograficznych programu SIBEX. Wyniki oznaczeń dla każdej stacji z 8 standardowych głębokości od powierzchni do 150 m przedstawia tabela I. Tabela ta zawiera również zawartości chlorofilu w słupie wody od powierzchni do głębokości 100 i 150 m (tzw. wartości integrowane) oraz odpowiadające im średnie ważone stężeń. Na 6 stacjach wykonano dodatkowo oznaczenia chlorofilu w nannoplanktonie. Rezultaty te pokazuje tabela II. Przestrzenne rozmieszczenie chlorofilu na badanym obszarze przedstawione przy pomocy wartości integrowanych ilustruje rys. 1.

Znalezienie ilości chlorofilu były wysokie i sięgały do 634 mg/m^2. Obszary wysokich zawartości (>200 mg/m^2) znajdowały się w okolicy wysp Anvers i Brabant, na szelfie wokół wyspy Joinville i w Cieśninie Bransfielda naprzeciwko Antractic Sound oraz koło wyspy Clarence. Poza obszarem rekomendowanym przez BIOMASS duże ilości chlorofilu *a* znaleziono na wschód i na południe od archipelagu Orkadów Południowych. Ilości chlorofilu znalezione na pozostałych obszarach Cieśniny Bransfielda miały wartości średnie i wahały się w granicach od 50 do 200 mg/m^2. Wody ubogie w chlorofil występowały na obszarze cieśniny Drake'a poza szelfem oraz w pasie wód między wyspami Króla Jerzego i Elephant. W ekstraktach acetonowych barwników fotosyntetyzujących stwierdzono metodą TLC duże ilości fukoksantyny, co uniemożliwia rozróżnienie chlorofilu *a* i produktów jego rozpadu wg metody Lorenza.

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