Chlorophyll *a* concentration of phytoplankton during a cruise of the 51st Japanese Antarctic Research Expedition in 2009–2010

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Abstract

Measurements of phytoplankton chlorophyll *a* concentration in seawater at depths less than 200 m were made in the Indian sector of the Southern Ocean during the 51st Japanese Antarctic Research Expedition (JARE) in the austral summer of 2009–2010. This expedition was the first cruise of the new icebreaker *Shirase*.

1. Introduction

This report documents the phytoplankton chlorophyll *a* concentration measured during a cruise by the icebreaker *Shirase* during the 51st Japanese Antarctic Research Expedition (JARE-51) in the austral summer of 2009–2010. The chlorophyll *a* concentration was measured in two series: (1) spatial variations in chlorophyll *a* within the surface water along the cruise track, and (2) a vertical profile of chlorophyll *a* in the Indian sector of the Southern Ocean.

2. Materials and methods

Surface seawater was collected manually two or three times per day during the cruise, from water that was continuously pumped up through the hull of the vessel. Vertical water samples were obtained along north–south transects (40°S–64°S) at 110°E (December 2009), Lützow-Holm Bay (February 2010), and 150°E (March 2010) (Fig. 1 and Tables 1 and 2). At stations where vertical water sampling was performed, surface seawater was collected in a plastic bucket. Vertical water samples were collected with a Niskin bottle attached to a multi-sampler on a CTD (Conductivity-Temperature- Depth) (SBE 55 ECO, Sea-Bird

Electronics, Bellevue, Washington, USA). Seawater samples (200 ml) were filtered onto a glass fiber filter (Whatman, GF/F). The filter was immediately soaked in N, N-dimethylformamide (Suzuki and Ishimaru, 1990), and pigments were extracted. The concentration of chlorophyll *a* was determined fluorometrically (Parsons *et al*., 1984) with a fluorometer (10-AU, Turner Design, Sunnyvale, California, USA). Until JARE-49, concentrations of chlorophyll *a* had been measured by the Holm-Hansen method (Holm-Hansen *et al*., 1965); however, the acidification technique employed in this method involved errors in the case that algal chlorophyll *b* was present (Welshmeyer, 1994). Thus, the Welshmeyer method was employed from JARE-50 onward. The fluorometer was calibrated against a chlorophyll *a* standard (Wako Chemical Co.) using a spectrophotometer, prior to the start of the JARE-51 cruise. The value of the specific absorption coefficient was taken from Porra *et al*. (1989).

3. Data

Figure 1 shows a map of the sampling stations for the JARE-51 cruise. Table 1 lists the sampling locations and chlorophyll *a* concentrations at the sea surface and in subsurface water. The data presented in this report are available on digital media.

4. Data policy

Permission to use the data for publication or presentation should be obtained in writing. Inquiries should be addressed to:

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6. References

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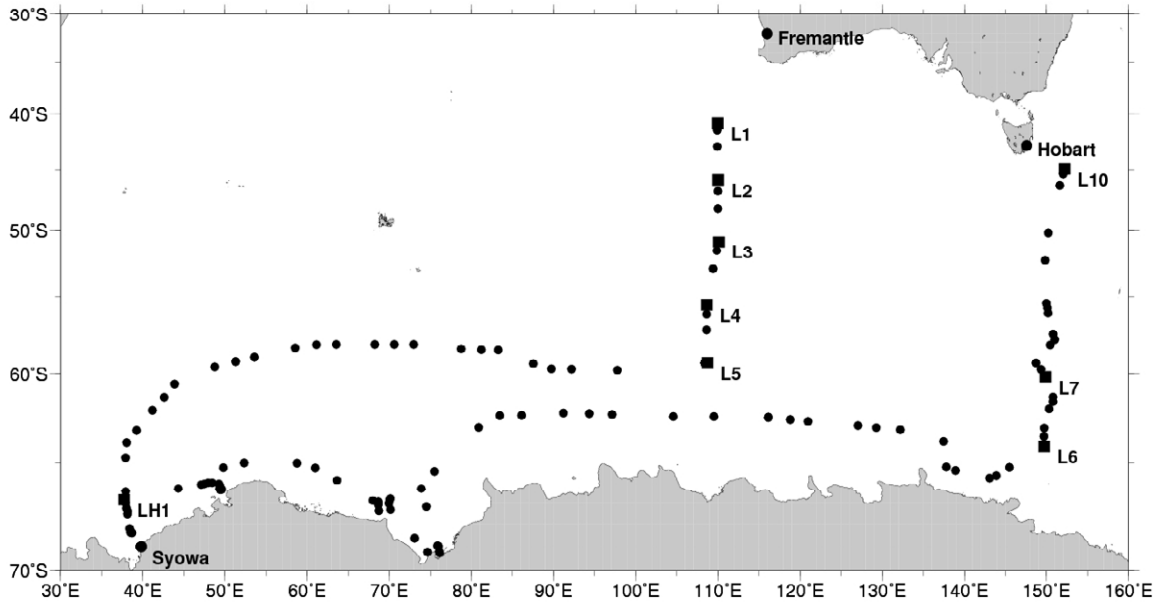

Fig. 1. Locations of sampling stations during JARE-51 (2009–2010) in the Southern Ocean. Solid circles indicate surface water sampled by pumping. Solid squares are stations at which vertical water samples were collected.

Table 1. Sampling date, time, position and chl *a* concentration for Stations L1–L10 and LH1.

Station	Unit	L1		L2		L3		L4		L5	
Date	UTC	2009/12/1		2009/12/2		2009/12/3		2009/12/4		2009/12/5	
Latitude	deg S	40°50.5′		45°52.3′		50°54.3′		55°33.2′		59°20.5′	
Longitude	deg E	109°59.0′		110°01.4′		110°07.1′		108°39.4′		108°44.0′	
		Depth (dbar)	Chl *a* (μ g l^{-1})	Depth (dbar)	Chl *a* (μ g l^{-1})	Depth (dbar)	Chl *a* (μ g l^{-1})	Depth (dbar)	Chl *a* (μ g l^{-1})	Depth (dbar)	Chl *a* (μ g l^{-1})
		0	0.27	0	0.52	0	0.32	0	0.59	0	0.44
		20	0.23	20	0.53	20	0.32	20	0.59	20	0.44
		50	0.24	50	0.53	50	0.38	50	0.53	50	0.50
		75	0.45	75	0.52	75	0.41	75	0.53	75	0.47
		100	0.40	100	0.37	100	0.41	100	0.48	100	0.19
		200	0.02	200	0.02	200	0.05	200	0.03	200	0.03
		500	0.00	500	0.01	500	0.01	500	0.02	500	—

Station	Unit	L6		L7		L10		LH1	
Date	UTC	2010/3/6		2010/3/8		2010/3/13		2010/2/14	
Latitude	deg S	64°07.2′		60°12.0′		44°55.1′		66°51.2′	
Longitude	deg E	149°43.1′		149°52.3′		152°12.1′		37°42.7′	
		Depth (dbar)	Chl *a* (μ g l^{-1})	Depth (dbar)	Chl *a* (μ g l^{-1})	Depth (dbar)	Chl *a* (μ g l^{-1})	Depth (dbar)	Chl *a* (μ g l^{-1})
		0	2.98	0	0.57	0	0.72	0	0.61
		20	3.07	20	0.58	20	0.72	20	0.69
		50	0.21	50	0.62	50	0.72	50	0.03
		75	0.09	75	0.96	75	0.29	75	0.72
		100	0.06	100	0.09	100	0.09	100	0.51
		200	0.01	200	0.06	200	0.01	200	0.02
		500	0.03	500	0.02	500	0.01		

Table 2. Sampling date, time, position and chl *a* concentration of the surface seawater.

Date (UTC)	Time (UTC)	Latitude (deg S)	Longitude (Deg E)	Chl *a* (μg l^{-1})
2009/12/1	5:30	41°29′	109°55′	0.25
2009/12/1	12:00	42°58′	109°56′	0.53
2009/12/2	6:00	46°49′	110°00′	0.65
2009/12/2	12:00	48°16′	110°00′	0.53
2009/12/3	6:00	51°37′	109°52′	0.56
2009/12/3	12:04	53°00′	109°25′	0.73
2009/12/4	6:00	56°12′	108°38′	0.32
2009/12/4	12:04	57°14′	108°37′	0.52
2009/12/5	5:48	59°20′	108°24′	0.60
2009/12/5	12:00	59°20′	108°24′	0.68
2009/12/6	0:00	59°20′	108°24′	0.63
2009/12/6	6:11	59°20′	108°24′	0.73
2009/12/6	12:13	59°47′	97°46′	0.73
2009/12/7		59°43′	92°11′	0.82
2009/12/7	5:40	59°42′	89°44′	0.94
2009/12/7	12:00	59°23′	87°32′	0.49
2009/12/8	1:00	58°32′	83°16′	1.89
2009/12/8		58°31′	81°12′	0.85
2009/12/8		58°28′	78°45′	1.87
2009/12/9	2:25	58°11′	72°58′	0.67
2009/12/9	8:13	58°11′	70°36′	0.38
2009/12/9	14:08	58°11′	68°14′	0.29
2009/12/10	2:00	58°11′	63°33′	0.27
2009/12/10	8:00	58°12′	61°08′	0.31
2009/12/10	14:12	58°24′	58°33′	0.24
2009/12/11	3:20	58°59′	53°35′	0.15
2009/12/11	9:00	59°15′	51°18′	0.10
2009/12/11	14:57	59°35′	48°45′	0.10
2009/12/12	4:00	60°37′	43°52′	0.11
2009/12/12	10:01	61°24′	42°36′	0.46
2009/12/12	16:19	62°09′	41°10′	0.33
2009/12/13	4:10	63°16′	39°15′	0.21
2009/12/13	10:20	63°55′	38°02′	0.22
2009/12/13	16:00	64°43′	37°54′	0.26
2009/12/14	4:14	66°26′	37°55′	0.18
2009/12/14	10:07	67°00′	37°52′	0.26
2009/12/14*	16:41	67°25′	38°10′	0.21
2009/12/15*	5:06	68°12′	38°24′	0.37
2009/12/15*	8:00	68°23′	38°40′	0.43
2009/12/15*	16:20	68°24′	38°41′	0.38
2010/1/27*	16:05	69°00′	39°37′	0.90
2010/1/30*	11:20	69°00′	39°37′	0.83
2010/2/14*	6:00	68°59′	38°36′	0.90
2010/2/14*	6:20	68°23′	38°31′	0.84
2010/2/14	9:31	67°32′	38°08′	0.58
2010/2/14	10:31	67°16′	38°01′	0.66
2010/2/15	12:00	66°18′	44°19′	0.20
2010/2/15	15:10	66°05′	47°06′	0.19
2010/2/15	16:05	66°03′	47°30′	0.45
2010/2/15	17:01	66°00′	47°57′	0.32
2010/2/15	18:04	66°00′	48°27′	0.36
2010/2/16	1:57	66°19′	49°33′	1.15
2010/2/16*	2:31	66°21′	49°37′	1.28
2010/2/16*	15:10	66°20′	49°36′	1.55
2010/2/16*	15:41	66°19′	49°31′	1.23
2010/2/16	16:00	66°16′	49°29′	0.90
2010/2/16	17:03	66°08′	49°22′	0.34
2010/2/16	18:06	66°03′	49°16′	0.25
2010/2/17*	9:00	66°21′	49°30′	1.01
2010/2/18*	7:30	66°22′	49°27′	1.03
2010/2/18*	17:26	66°22′	49°26′	1.07
2010/2/19*	5:36	66°18′	49°20′	1.14
2010/2/19	11:04	65°14′	49°48′	0.37
2010/2/19	17:30	64°59′	52°20′	0.48
2010/2/20	5:23	65°00′	58°46′	0.34
2010/2/20	10:15	65°15′	60°59′	0.33
2010/2/20	16:22	65°52′	63°38′	0.36
2010/2/21	4:12	66°54′	68°00′	0.32
2010/2/21	9:00	67°23′	68°44′	1.46
2010/2/21	13:55	66°58′	68°40′	0.34
2010/2/22	2:10	67°06′	68°40′	0.34
2010/2/22	15:07	66°46′	68°36′	0.21
2010/2/23	2:27	66°45′	69°54′	0.22
2010/2/23	9:05	67°20′	70°09′	1.47
2010/2/23	14:03	66°48′	70°08′	0.20
2010/2/24	2:38	66°52′	70°03′	0.19
2010/2/24	8:15	67°02′	69°57′	0.68
2010/2/25	3:03	68°38′	73°05′	5.53
2010/2/25	9:20	69°14′	74°39′	5.45
2010/2/25	14:00	68°58′	75°52′	3.39
2010/2/26	3:42	69°13′	76°05′	8.01
2010/2/26	8:49	69°16′	76°08′	6.59
2010/2/26	14:10	68°59′	75°59′	3.98
2010/2/27	4:54	67°11′	74°31′	1.38
2010/2/27	9:23	66°18′	73°54′	0.57
2010/2/27	14:03	65°25′	75°30′	0.55
2010/2/28	3:10	63°06′	80°53′	0.49
2010/2/28	9:13	62°27′	83°27′	0.82
2010/2/28	14:07	62°26′	86°07′	1.86
2010/3/1	2:13	62°18′	91°12′	1.38
2010/3/1	8:03	62°20′	94°21′	0.75
2010/3/1	12:58	62°23′	97°07′	0.61
2010/3/2	2:25	62°30′	104°34′	0.17
2010/3/2	8:06	62°30′	109°31′	0.31
2010/3/2	13:08	62°32′	116°08′	0.29
2010/3/3	1:13	62°33′	116°08′	0.12
2010/3/3	7:30	62°40′	118°49′	0.09
2010/3/3	12:03	62°46′	120°58′	0.85
2010/3/4	0:27	63°00′	127°03′	0.37
2010/3/4	5:02	63°07′	129°17′	0.50
2010/3/4	11:08	63°14′	132°12′	0.71
2010/3/4	23:04	63°51′	137°28′	0.97
2010/3/5	6:12	65°12′	137°48′	0.38
2010/3/5	10:25	65°22′	138°55′	0.46
2010/3/6	0:43	65°45′	143°04′	0.25
2010/3/6	5:11	65°38′	143°53′	0.30
2010/3/6	10:33	65°13′	145°29′	0.41
2010/3/7	5:29	63°35′	149°41′	2.72
2010/3/7	10:05	63°08′	149°43′	2.20
2010/3/8	0:15	62°04′	150°19′	0.86
2010/3/8	4:11	61°39′	150°47′	0.42
2010/3/8	9:10	61°23′	150°47′	0.77
2010/3/9	4:32	59°44′	149°20′	0.38
2010/3/9	9:10	59°20′	148°43′	0.35
2010/3/10	0:00	58°13′	150°27′	0.25
2010/3/10	4:10	57°52′	151°00′	0.29
2010/3/10	8:56	57°30′	150°48′	0.34
2010/3/11	0:28	56°07′	150°11′	0.36
2010/3/11	4:06	55°45′	150°06′	0.32
2010/3/11	9:04	55°27′	149°59′	0.16
2010/3/12	0:06	52°22′	149°50′	0.29
2010/3/12	9:04	50°11′	150°13′	0.46
2010/3/13	0:04	46°21′	151°37′	0.85
2010/3/13	4:13	45°22′	152°02′	0.73

*Sea surface was covered by sea ice.

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