

**Biogeochemical properties of seawater measured from the icebreaker *Shirase*
during the 54th Japanese Antarctic Research Expedition
in the austral summer, 2012–2013**

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1. Introduction

Biogeochemical properties of seawater have been routinely measured between Japan and the Japanese Antarctic Station Syowa (69°00'S, 39°35'E) as part of the monitoring program of the Japanese Antarctic Research Expedition (JARE), which is conducted each austral summer season (December–March) along regular routes across the Indian Ocean sector of the Southern Ocean. During JARE cruises, data have been collected both in the open ocean, and, since the 52nd JARE (2010–2011), in areas of sea ice off Syowa Station, Lützow-Holm Bay.

This report presents biogeochemical data acquired from the JARE-54 cruise (2012–2013). The dataset is composed of two series of data: (1) vertical profile data sampled at routine monitoring stations along a meridional transect at 110°E, 150°E, and data collected in Lützow-Holm Bay; and (2) surface water samples obtained along cruise tracks to confirm spatial variations in biogeochemical properties.

2. Sampling

Biogeochemical data presented in this report include temperature and salinity (measured by a sensor probe) and inorganic nutrients and chlorophyll *a* concentrations (measured by water analysis). All seawater samples and auxiliary data were taken from the icebreaker *Shirase* during the JARE-54 cruise. The sampling stations are shown in [Figure 1](#).

2.1. Vertical profile sampling

Seawater samples and auxiliary data for vertical profiles were taken at monitoring stations along 110°E (L1–L5), 150°E (L6–L10), and in Lützow-Holm Bay (A–BP) in December 2012, March 2013, and February 2013, respectively. Sampling at station L7 (60°S, 150°E) was canceled because of rough seas, and sampling at station D (planned in the pack ice zone) was canceled due to an extremely narrow pack ice zone. At the time of sampling, station A was located in the multi-year fast-ice zone, and station B was located in the first-year fast-ice zone. Station C was located in the open ocean zone, although it was adjacent to the pack ice zone ([Fig. 1](#)). Details of sampling in the sea-ice area are given in Takahashi *et al.* (2012, 2014).

Vertical temperature and salinity profiles were measured to a depth of 500 m using a conductivity–temperature–depth (CTD) memory probe (SBE 19 plus; Sea-Bird Electronics, Inc.) attached to a water sampler (SBE 55 ECO; Sea-Bird Electronics, Inc.). The data were downloaded from the CTD to a laptop computer immediately after each cast. The CTD sensor was calibrated by the manufacturer prior to the cruise. Note that the salinity data in this report were not corrected by the bottle salinity data measured by the salinometer.

Seawater was sampled to a depth of 400 m or to the bottom depth (whichever was less) during the down cast using a standard 4 L Niskin bottle (Sea-Bird Electronics, Inc.). Sampling was conducted at depths of 20, 50, 75, 100, 200, and 400 m at stations L1–L10 and C–BP, at 20, 50, 75, 100, 200, and 240 m at station A, and at 5, 20, 50, 75, 100, and 200 m at station B. Seawater at 0 m was collected from the deck using a 5 L polyethylene bucket. Seawater samples at 400 m at station L1 and at 200 m at station L2 were unavailable because of sampling difficulties. Seawater samples

other than 0 and 75 m at station A were also unavailable because of Niskin bottle sample difficulties caused by seawater temperatures which were near the freezing point.

Seawater was subsampled into 10 mL polyethylene screw-cap vials and 250 mL high density polyethylene (HDPE) screw-cap light blocking bottles to analyze concentrations of inorganic nutrients and chlorophyll *a*, respectively. After subsampling, seawater samples for nutrient analysis were immediately placed and stored in an ultra-low temperature freezer (-85°C) until analysis on land. Phytoplankton chlorophyll *a* was extracted by N, N-Dimethylformamide (Suzuki and Ishimaru, 1990) just after filtering the seawater using a glass fiber filter (Whatman, GF/F), and the samples were stored in a freezer (-18°C) until analysis on board.

2.2. Underway sampling

Underway surface water sampling was conducted during the cruise. Seawater was continuously pumped from 10 m below sea level to an on-board laboratory, and the inlet seawater temperature and salinity were quasi-continuously measured by sensor probes (SBE 38 for temperature and SBE45 for salinity; Sea-Bird Electronics, Inc.). Inorganic nutrients and chlorophyll *a* were analyzed from samples collected manually 2–3 times per day from the outlet of the laboratory; samples were treated in the same manner as those of the bottle samples collected in the vertical profiles.

3. Analysis

Concentrations of chlorophyll *a* were determined fluorometrically (Parsons *et al.*, 1984) using an on-board fluorometer (10-AU; Turner Design, Sunnyvale). The fluorometer was calibrated against a chlorophyll *a* standard (Wako Chemical Co.) at a laboratory on land prior to the cruise, using a spectrophotometer and the specific absorption coefficient (Porra *et al.*, 1989).

The samples for the nutrient concentration analyses were frozen and transported to a laboratory at Hokkaido University, Japan, via the National Institute of Polar Research, Japan. The frozen samples were thawed to room temperature starting the day before the analyses. Concentrations of the nutrients $\text{NO}_3 + \text{NO}_2$, PO_4 , SiO_2 , NH_4 , and NO_2 were determined using an autoanalyzer

(QuAAtro2-HR; BL-TEC K. K.), according to the Joint Global Ocean Flux Study colorimetric analysis method (JGOFS, 1994). The nutrient concentrations were calibrated against KANSO reference materials (BT, BF, BG, BS, and AZ; KANSO Technos Co., Ltd.) except for NH_4 , which was calibrated using an ammonium nitrogen standard solution for water analysis (Wako Pure Chemical Industries, Ltd.).

4. Results

All information about sampling at the routine monitoring stations is listed in [Table 1](#). Vertical profiles of temperature and salinity at each monitoring station are shown in [Figure 2](#), and bottle analysis data, along with CTD data at defined depths, are listed in [Table 2](#). Underway water sampling analysis data and sampling information are shown in [Table 3](#).

5. Data archive

The data presented in this report are archived and available as csv file from web site (<http://biows.nipr.ac.jp/JARE/>). Permission to use these data for publication or presentation should be obtained in writing. Inquiries about details of the data record should be addressed to:

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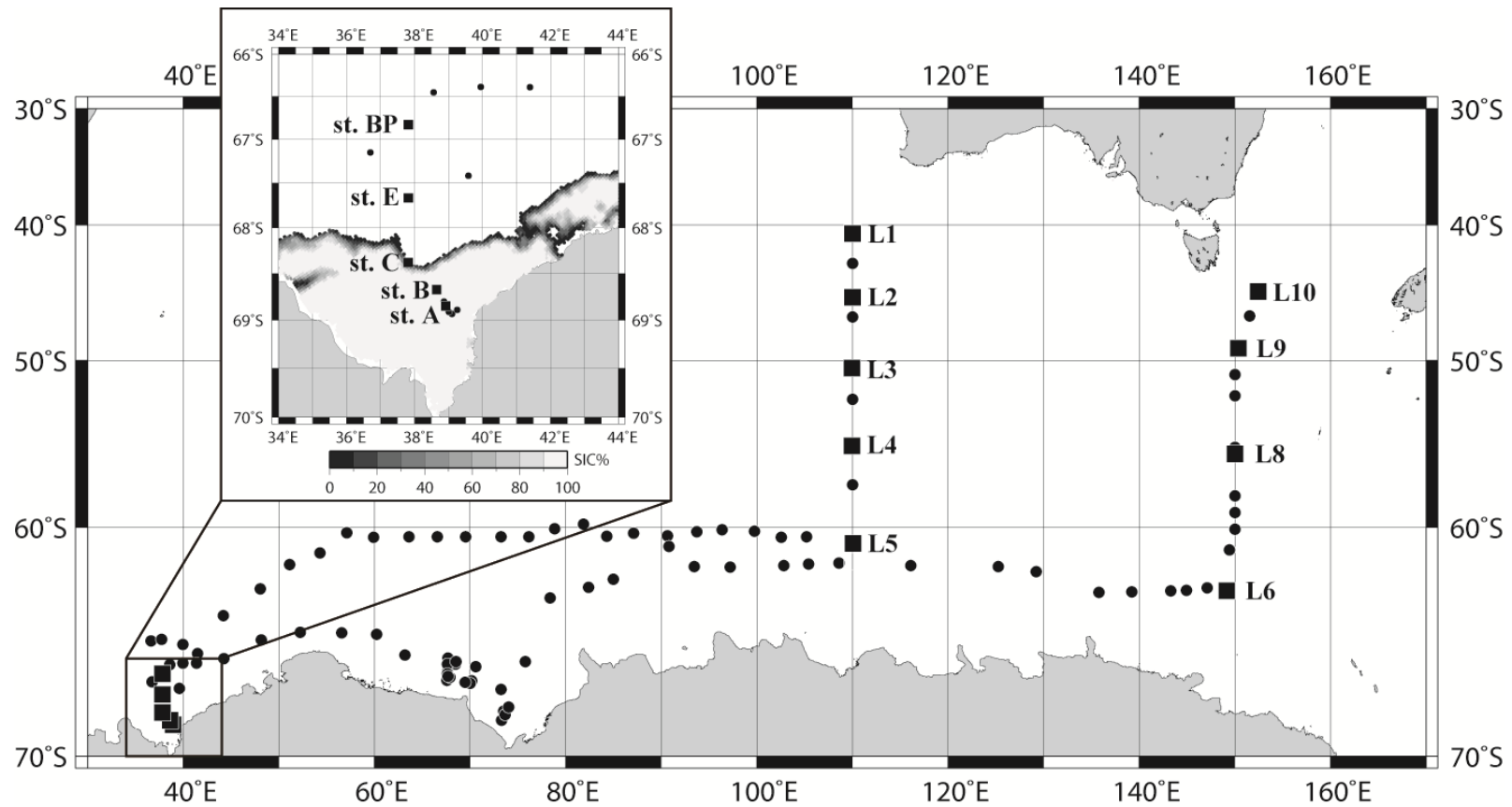


Fig. 1. Locations of sampling stations during the JARE-54 cruise. Solid circles indicate underway surface water sampling points. Solid squares indicate vertical sampling stations. SIC indicates the sea ice concentration (%) on 17 February 2013. The SIC data were obtained from Daily AMSR2 sea ice maps (<http://www.iup.uni-bremen.de:8084/amr2/>).

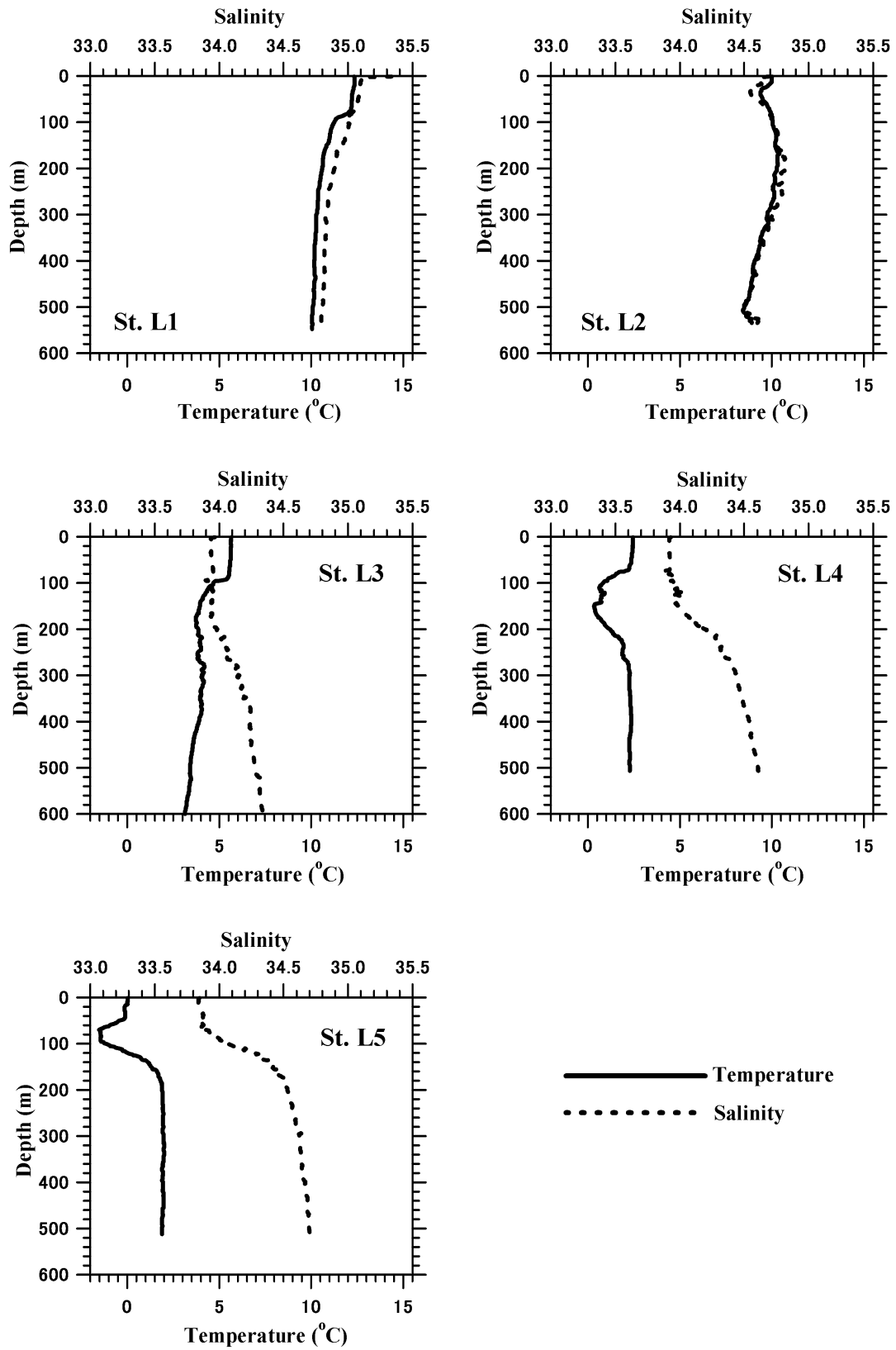


Fig. 2. Vertical profiles of temperature and salinity at each monitoring station.

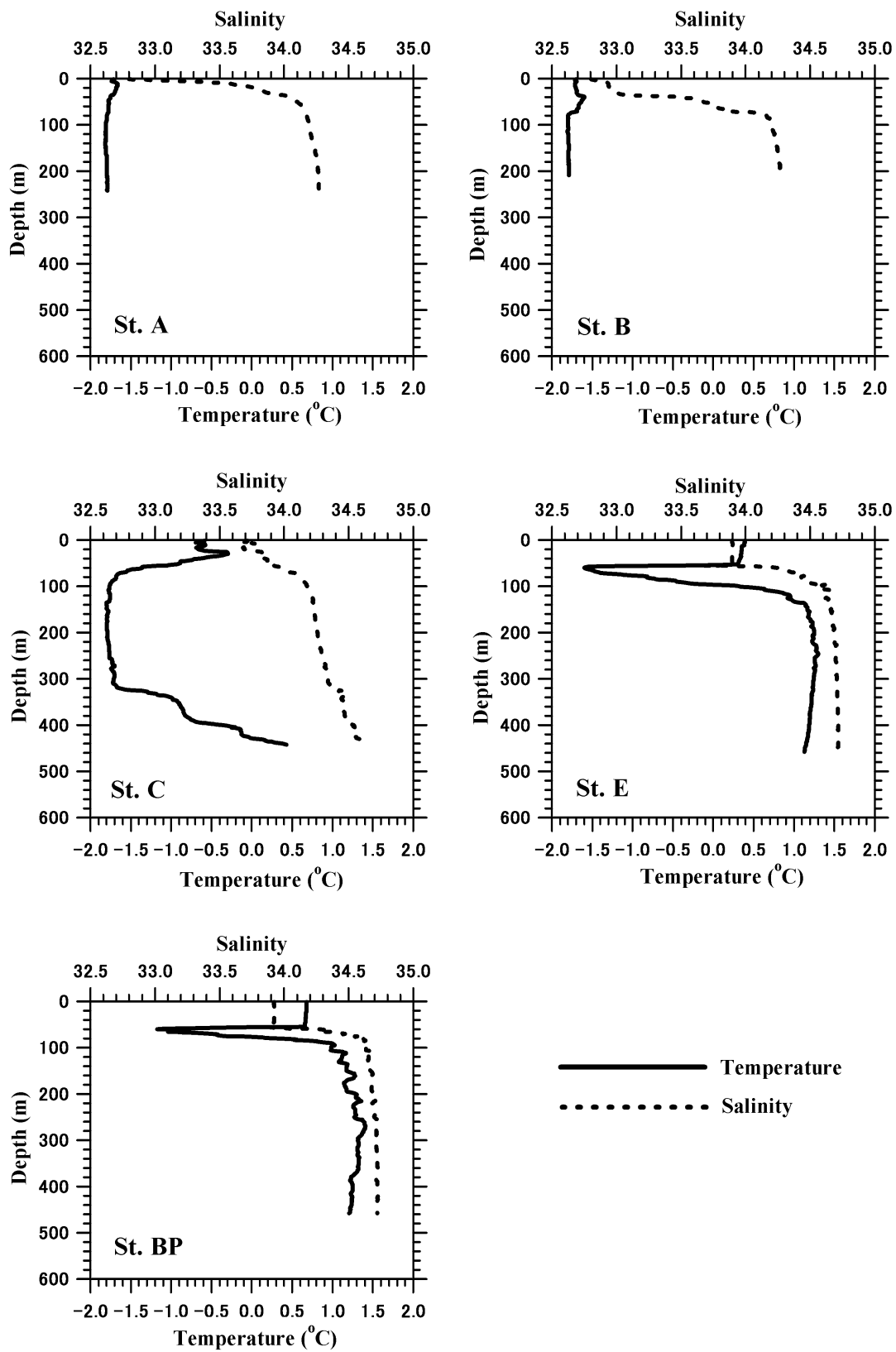


Fig. 2. Continued.

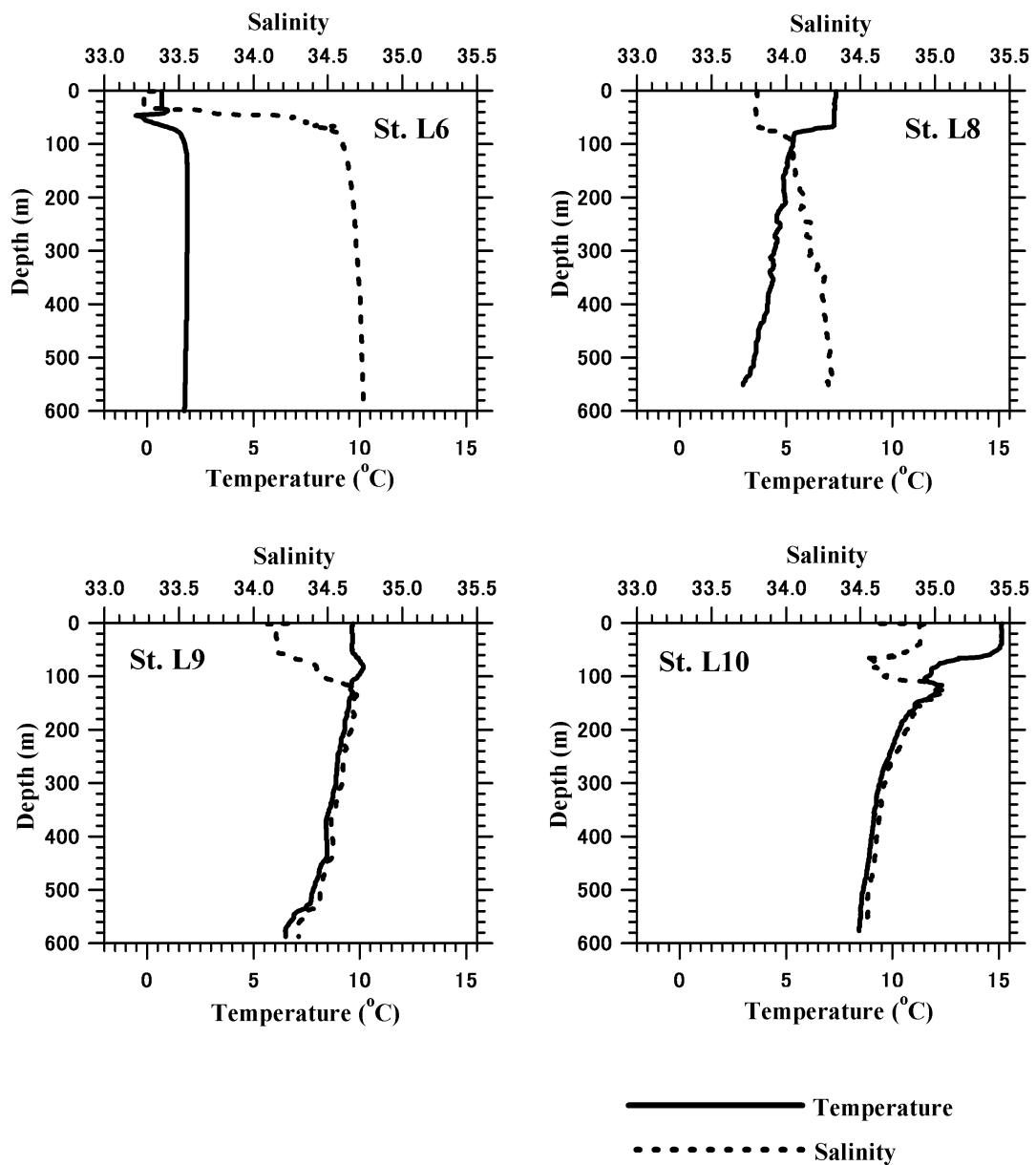


Fig. 2. Continued.

Table 1. Sampling date, time, position, bottom depth, air temperature, wind speed, and atmospheric pressure at each station.

Station	Date (UTC)	Time (UTC)	Latitude (°S)	Longitude (°E)	Bottom depth (m)	Air temperature (°C)	Sea surface temperature (°C)	Wind speed (m/s)	Atmospheric pressure (hPa)
L1	2012/12/ 2	1:10	40-39.84	110-00.98	4487	12.2	12.4	7.7	1021.5
L2	2012/12/ 3	1:10	45-32.85	110-00.56	4066	11.2	10.7	9.8	1021.5
L3	2012/12/ 4	1:17	50-31.85	109-58.83	3333	7.9	5.8	13.9	993.8
L4	2012/12/ 5	1:11	55-26.96	109-58.27	3833	3.2	2.6	8.2	975.4
L5	2012/12/ 6	1:09	60-50.05	110-03.30	4293	0.4	0.3	5.7	73.2
A	2013/ 2/10	18:45	68-50.94	38-55.29	268	-0.7	-1.7	ND	988.5
B	2013/ 2/16	8:02	68-40.38	38-38.70	243	0.9	-1.8	5.1	969.9
C	2013/ 2/17	7:40	68-22.80	37-48.81	1655	-0.2	-1.2	3.1	976.5
E	2013/ 2/17	12:55	67-40.04	37-48.97	3496	1	-0.8	3.1	975.6
BP	2013/ 2/18	6:04	66-49.94	37-49.02	4496	ND	ND	2.1	ND
L6	2013/ 3/ 9	22:03	63-10.32	149-10.81	3808	2.9	0.8	11.3	991.5
L8	2013/ 3/12	5:05	55-55.55	149-59.95	3696	ND	ND	ND	ND
L9	2013/ 3/13	22:05	49-12.44	150-24.13	1654	12.0	9.7	14.4	994.8
L10	2013/ 3/14	22:03	45-09.39	152-26.29	4692	16.8	15.2	9.8	1012

ND: No Data

Table 2. Conductivity–temperature–depth (CTD) and water analysis data of at monitoring stations.

Station	Pressure (dbar)	CTD data		Water analysis data					
		Temperature (°C)	Salinity	Nitrate ($\mu\text{mol/L}$)	Nitrite ($\mu\text{mol/L}$)	Phosphate ($\mu\text{mol/L}$)	Silicate ($\mu\text{mol/L}$)	Ammonium ($\mu\text{mol/L}$)	Chl <i>a</i> ($\mu\text{g/L}$)
L1	0(Bucket)	-	-	7.4	0.2	0.6	0	0.1	0.26
	20	12.3461	35.0917	6.8	0.1	0.6	0	0.1	0.28
	50	12.2097	35.0792	7.5	0.2	0.6	0	0.1	0.37
	73	12.166	35.0617	7.4	0.2	0.6	0	0	0.28
	98	11.2762	35.0091	10.4	0	0.8	0	0	0.03
	200	10.6045	34.8959	12.0	0	0.8	0	0	0.01
	399	10.1717	34.8128	ND	ND	ND	ND	ND	-
L2	0(Bucket)	-	-	13.7	0.2	1	0	0	0.62
	20	9.8438	34.5998	13.7	0.2	1	0	0	0.65
	49	9.4933	34.5878	14.5	0.2	1	0	0.1	0.61
	74	9.8781	34.6761	13.4	0.2	1	0	0	0.67
	99	10.0339	34.7111	13.9	0	1	0	0	0.04
	199	10.2711	34.8105	ND	ND	ND	ND	ND	ND
	398	9.0971	34.5941	17.6	0	1.2	0	0	-
L3	0(Bucket)	-	-	25.8	0.3	1.6	1.5	0.1	0.41
	20	5.6402	33.9366	24.8	0.2	1.6	1.5	0	0.38
	49	5.6108	33.9492	24.4	0.2	1.6	0.7	0	0.49
	74	5.5535	33.9538	24.2	0.2	1.6	0.8	0.2	0.5
	98	4.7119	33.9454	26.5	0.3	1.7	4.3	0.4	0.25
	198	3.8451	33.9774	31.2	0	2	12.8	0	0.02
	398	3.9152	34.2408	35.1	0	2.3	28.3	0	-
L4	0(Bucket)	-	-	29.2	0.3	1.7	2.7	0	1.13
	20	2.4418	33.9175	28.4	0.3	1.8	2.6	0	1.5
	49	2.3722	33.9225	29.1	0.3	1.7	3.9	0.1	1.47
	74	1.964	33.8976	33.8	0.2	2.2	32.6	0.3	0.18
	99	0.8696	33.9473	40.1	0	2.6	64.3	0	0.03
	197	1.075	34.1958	39.7	0	2.5	61.8	0	0.03
	396	2.3579	34.5351	39.8	0	2.6	79	0	-
L5	0(Bucket)	-	-	30.5	0.3	1.8	26.7	0.2	0.92
	20	-0.1234	33.8429	37.4	0.1	2.4	57.6	0	0.16
	49	-0.2961	33.8116	39.9	0	2.6	85.8	0	0.04
	74	-1.4565	33.9193	41.5	0	2.6	78.8	0	0.04
	99	-1.228	34.0798	38.1	0	2.5	92.4	0	0.01
	198	1.9035	34.5301	39.7	0	2.6	86.5	0	0.01
	397	1.9047	34.6661	38.0	0	2.5	92.6	0	-

ND: No Data

Table 2. Continued.

Station	Pressure (dbar)	CTD data		Water analysis data					
		Temperature (°C)	Salinity	Nitrate ($\mu\text{mol/L}$)	Nitrite ($\mu\text{mol/L}$)	Phosphate ($\mu\text{mol/L}$)	Silicate ($\mu\text{mol/L}$)	Ammonium ($\mu\text{mol/L}$)	Chl <i>a</i> ($\mu\text{g/L}$)
A	0(Bucket)	-	-	19.4	0.5	1.4	42.8	3.5	0.97
	20	-1.6778	33.7791	ND	ND	ND	ND	ND	ND
	49	-1.7736	34.094	ND	ND	ND	ND	ND	ND
	74	-1.7843	34.159	34.7	0.1	2.2	68.8	0.1	0.06
	99	-1.8111	34.2002	ND	ND	ND	ND	ND	ND
	198	-1.7969	34.2623	ND	ND	ND	ND	ND	ND
	240	-1.7928	34.269	ND	ND	ND	ND	ND	ND
B	0(Bucket)	-	-	27.6	0.2	1.8	54.7	1.6	0.55
	5	-1.7109	32.8674	27.7	0.2	1.8	54.5	1.5	0.44
	20	-1.708	32.9461	28.2	0.2	1.9	55.8	1.5	0.43
	49	-1.6332	33.6669	35.8	0	2.3	68.6	0	0.02
	74	-1.7718	34.1247	41.5	0.1	2.7	76.6	0.1	0.05
	99	-1.8012	34.1872	35.2	0.1	2.3	66.4	0.2	0.03
	199	-1.7883	34.2682	35.2	0	2.3	66.8	0	0.02
C	0(Bucket)	-	-	30.0	0.2	2	58	0.7	0.3
	20	-0.6589	33.6775	35.9	0	2.3	69.5	0	0.03
	50	-0.8889	33.8932	31.6	0.1	2.1	61.4	0.6	0.45
	74	-1.6651	34.1042	35.1	0	2.3	66	0	0.07
	98	-1.7615	34.1742	34.8	0.1	2.2	65	0	0.08
	198	-1.7927	34.2574	35.5	0	2.3	66.2	0	0.05
	399	-0.4293	34.5135	37.3	0	2.4	86.3	0	0.02
E	0(Bucket)	-	-	30.8	0.2	2	57.2	0.5	0.18
	20	0.3557	33.8971	36.6	0.2	2.4	78.7	0.2	0.25
	49	0.3108	33.8971	29.9	0.2	2	56.4	0.5	0.23
	74	-1.1913	34.4301	36.1	0.2	2.4	78	0.2	0.28
	98	0.1689	34.6341	38.7	0.1	2.5	93.6	0	0.15
	197	1.252	34.6842	39.1	0	2.5	101.8	0	0.02
	395	1.1908	34.7146	37.2	0	2.4	109.5	0	-
BP	0(Bucket)	-	-	30.6	0.2	2	54.6	0.3	0.2
	20	0.6746	33.921	35.1	0.1	2.3	73.2	0.4	0.29
	50	0.6606	33.9212	30.5	0.2	2	54.5	0.3	0.21
	74	-0.3848	34.4791	38.6	0.2	2.5	95.5	0.1	0.43
	99	0.9852	34.6316	39.1	0.1	2.5	98.7	0	0.22
	198	1.2567	34.7021	38.2	0	2.5	104.9	0	0.02
	397	1.2508	34.7229	37.4	0	2.4	111	0	-

ND: No Data

Table 2. Continued.

Station	Pressure (dbar)	CTD data		Water analysis data					
		Temperature (°C)	Salinity	Nitrate ($\mu\text{mol/L}$)	Nitrite ($\mu\text{mol/L}$)	Phosphate ($\mu\text{mol/L}$)	Silicate ($\mu\text{mol/L}$)	Ammonium ($\mu\text{mol/L}$)	Chl <i>a</i> ($\mu\text{g/L}$)
L6	0(Bucket)	-	-	31.1	0.3	1.9	36.1	0.8	0.27
	20	0.6985	33.266	31.5	0.3	1.9	35.4	0.2	0.76
	49	-0.3262	34.3071	35.9	0.1	2.3	59.4	0	1.46
	73	1.287	34.588	39.6	0.2	2.6	85.5	0.2	0.75
	97	1.7512	34.5972	40.0	0.3	2.6	90	0	0.28
	197	1.9071	34.6634	38.9	0	2.5	94.9	0	0.02
	398	1.863	34.7176	37.5	0	2.4	96.5	0	-
L8	0(Bucket)	-	-	25.0	0.3	1.6	0	0.2	0.37
	20	7.2979	33.801	25.2	0.2	1.6	0	0.2	0.32
	50	7.2555	33.7988	25.1	0.2	1.6	0	0.1	0.32
	73	6.2742	33.8326	25.1	0.3	1.7	0	0.4	0.42
	96	5.3312	34.031	26.7	0.1	1.7	3.2	0	0.26
	198	4.9377	34.1166	29.4	0	1.9	8.7	0	0.01
	397	4.1401	34.252	35.5	0	2.3	27.4	0	-
L9	0(Bucket)	-	-	17.0	0.2	1.2	0	0.3	0.7
	19	9.6406	34.1531	17.9	0.2	1.1	0	0.3	0.66
	49	9.6378	34.1528	17.1	0.2	1.1	0	0.2	0.65
	73	10.03	34.3536	14.3	0.2	1	0	0.4	0.5
	97	9.9801	34.4394	14.3	0.2	1	0	0.5	0.19
	198	9.2858	34.6564	16.9	0	1.1	0	0	0.01
	397	8.431	34.53	18.5	0	1.2	0	0	-
L10	0(Bucket)	-	-	2.4	0.1	0.3	0	0.1	0.65
	20	15.1274	34.8976	3.1	0.1	0.3	0	0.1	0.64
	49	14.9904	34.8431	2.6	0.1	0.3	0	0.1	0.63
	74	12.4529	34.5574	7.9	0.2	0.7	0	0.9	0.22
	98	11.7641	34.6498	11.0	0.7	0.8	0	0.2	0.11
	198	10.3487	34.8151	14.7	0	1	0	0	0.01
	398	9.0206	34.6085	18.4	0	1.2	0	0	-

Table 3. Sampling date, time, position, temperature, salinity, nutrient concentrations, and chlorophyll *a* concentrations for underway surface water samplings.

Station	Date (UTC)	Time (UTC)	Latitude (°S)	Longitude (°E)	Temperature (°C)	Salinity	Nitrate ($\mu\text{mol/L}$)	Nitrite ($\mu\text{mol/L}$)	Phosphate ($\mu\text{mol/L}$)	Silicate ($\mu\text{mol/L}$)	Ammonium ($\mu\text{mol/L}$)	Chl <i>a</i> ($\mu\text{g/L}$)
S001	2012/12/ 2	13:23	43-01.74	110-00.68	11.5100	34.7700	9.5	0.2	0.7	0.0	0.1	0.35
S002	2012/12/ 3	8:59	47-00.00	110-00.00	8.2780	34.1695	17.2	0.3	1.1	0.0	0.0	1.34
S003	2012/12/ 4	12:35	52-33.42	110-00.05	3.5564	33.8331	27.3	0.3	1.7	0.0	0.0	0.62
S004	2012/12/ 5	11:52	57-40.72	109-59.97	1.9097	33.8314	30.9	0.3	1.9	16.5	0.2	0.22
S005	2012/12/ 7	0:09	60-29.89	105-12.95	-0.2013	33.8251	30.5	0.2	1.9	38.2	0.1	1.12
S006	2012/12/ 7	7:00	60-30.86	102-33.53	0.3299	33.9450	29.9	0.3	1.8	29.5	0.1	0.88
S007	2012/12/ 7	14:56	60-11.84	99-45.22	0.2951	33.9458	30.2	0.2	1.8	36.0	0.1	1.42
S008	2012/12/ 7	23:48	60-06.54	96-20.91	0.4932	33.8412	29.1	0.3	1.7	22.3	0.1	1.24
S009	2012/12/ 7	7:06	60-12.91	93-43.00	0.4627	33.8286	29.7	0.3	1.8	26.2	0.1	1.23
S010	2012/12/ 8	15:12	60-26.64	90-38.47	0.2647	33.7863	29.3	0.2	1.7	30.4	0.2	1.47
S011	2012/12/ 9	0:48	60-18.41	87-05.20	1.1671	33.9479	29.5	0.2	1.8	15.3	0.1	1.20
S012	2012/12/ 9	8:24	60-27.33	84-17.63	-0.2812	33.8138	34.3	0.2	2.1	59.8	0.0	0.61
S013	2012/12/ 9	16:24	59-49.80	81-50.13	-0.6327	33.9596	34.5	0.2	2.1	60.3	0.1	0.40
S014	2012/12/10	0:51	60-04.24	78-49.38	-0.6081	33.8608	33.2	0.2	2.1	47.0	0.1	0.36
S015	2012/12/10	8:00	60-28.58	76-07.16	-0.7423	33.7995	31.9	0.2	2.0	40.2	0.1	0.84
S016	2012/12/10	15:34	60-30.00	73-14.81	-0.9680	33.6990	31.9	0.2	2.0	35.9	0.1	0.27
S017	2012/12/11	0:32	60-28.78	69-33.15	-0.7730	33.5036	31.4	0.2	2.0	32.6	0.2	0.08
S018	2012/12/11	9:46	60-29.88	66-35.26	-0.4828	33.5868	31.3	0.2	2.0	34.7	0.1	0.07
S019	2012/12/11	17:07	60-29.99	63-37.41	-0.7823	33.6058	31.1	0.2	2.0	33.4	0.1	0.07
S020	2012/12/12	2:47	60-30.07	59-55.04	-0.6404	33.5729	31.1	0.3	2.0	32.4	0.2	0.06
S021	2012/12/10	10:22	60-16.03	57-04.46	-0.8181	33.8070	30.2	0.2	1.9	38.4	0.1	0.72
S022	2012/12/12	17:59	61-18.22	54-16.72	-0.8712	33.7035	30.8	0.2	2.0	41.9	0.1	0.24
S023	2012/12/13	2:31	61-53.41	51-06.32	-0.8175	33.6740	30.4	0.3	1.9	39.8	0.0	0.33
S024	2012/12/13	9:53	63-03.61	48-03.20	-0.9734	33.8634	24.6	0.3	1.8	32.9	0.6	0.17
S025	2012/12/13	18:09	64-18.41	44-10.84	-1.1751	33.8745	32.6	0.2	2.1	59.4	0.2	0.14
S026	2012/12/14	3:57	65-59.28	41-28.82	-1.2551	33.8935	32.6	0.2	2.1	67.7	0.1	0.56

Table 3. Continued.

Station	Date (UTC)	Time (UTC)	Latitude (°S)	Longitude (°E)	Temperature (°C)	Salinity	Nitrate ($\mu\text{mol/L}$)	Nitrite ($\mu\text{mol/L}$)	Phosphate ($\mu\text{mol/L}$)	Silicate ($\mu\text{mol/L}$)	Ammonium ($\mu\text{mol/L}$)	Chl <i>a</i> ($\mu\text{g/L}$)
S027	2012/12/14	11:53	67-25.12	39-35.30	-1.4921	33.9576	33.0	0.2	2.2	65.7	0.2	0.36
S028	2012/12/21	3:58	68-48.07	38-51.99	-1.7507	34.0549	34.9	0.0	2.2	74.5	0.0	0.05
S029*	2012/12/24	8:16	68-51.56	38-55.21	-	-	34.7	0.0	2.2	72.2	0.0	0.05
S030*	2013/ 1/ 5	10:35	68-55.94	39-06.09	-	-	34.9	0.0	2.3	72.1	0.0	0.03
S031	2013/ 2/ 2	15:53	68-53.45	39-15.36	-1.6843	34.0225	34.9	0.1	2.2	76.4	0.0	0.16
S032	2013/ 2/ 3	6:45	68-53.45	39-15.36	-1.6513	33.8487	33.0	0.1	2.1	70.1	0.3	0.34
S033*	2013/ 2/ 9	6:35	68-54.80	39-00.68	-	-	33.6	0.1	2.2	66.7	0.3	0.24
S034*	2013/ 2/10	22:33	68-51.10	38-55.40	-	-	28.5	0.1	1.8	56.8	1.2	0.50
S035	2013/ 2/19	11:20	67-09.25	36-41.98	0.7495	33.8820	30.2	0.2	2.0	54.1	0.3	0.22
S036	2013/ 2/20	3:21	66-27.28	38-33.87	0.7536	33.8882	30.6	0.2	2.0	54.3	0.3	0.17
S037	2013/ 2/20	11:06	65-26.67	36-37.15	1.0034	33.9000	29.8	0.3	1.9	51.4	0.4	0.08
S038	2013/ 2/20	18:33	66-23.40	39-56.90	0.7138	33.9234	30.7	0.2	2.0	55.7	0.4	0.16
S039	2013/ 2/21	3:15	66-23.76	41-24.18	0.7446	33.9448	30.9	0.2	2.0	56.4	0.5	0.15
S040	2013/ 2/21	11:22	65-22.66	37-43.16	0.9498	33.9284	30.3	0.3	2.0	54.6	0.5	0.10
S041	2013/ 2/21	18:38	65-35.23	39-57.59	0.7872	33.8373	30.9	0.2	2.0	54.0	0.3	0.06
S042	2013/ 2/22	3:12	66-11.43	44-15.19	0.2121	33.9089	31.7	0.2	2.0	55.6	0.4	0.24
S043	2013/ 2/22	10:50	65-22.98	48-10.45	-0.0272	33.7930	31.6	0.2	2.0	55.4	0.3	0.29
S044	2013/ 2/22	18:42	65-02.99	52-13.43	0.0253	33.9944	32.9	0.2	2.1	60.2	0.2	0.23
S045	2013/ 2/23	3:21	65-04.99	56-34.63	0.2593	33.7867	31.7	0.2	2.0	53.6	0.2	0.13
S046	2013/ 2/23	11:02	65-09.09	60-14.18	0.8819	33.7655	30.5	0.3	2.0	43.4	0.4	0.17
S047	2013/ 2/23	18:18	66-03.06	63-10.71	-0.3766	33.9544	33.7	0.2	2.2	65.2	0.4	0.25
S048	2013/ 2/24	3:22	67-05.70	67-35.21	-1.1441	34.1481	30.9	0.1	2.0	57.9	1.0	0.49
S049	2013/ 2/24	16:52	66-19.25	68-30.99	-0.6505	34.0136	32.9	0.2	2.1	52.0	0.3	0.39
S050	2013/ 2/25	3:24	67-07.54	70-09.26	-1.1868	34.1433	25.1	0.1	1.7	46.8	2.2	0.61
S050'	2013/ 2/25	5:14	67-12.97	69-59.02	-1.0300	33.8393	22.3	0.1	1.6	43.9	2.4	-
S051	2013/ 2/25	6:14	67-10.85	69-28.10	-1.1823	34.1091	27.2	0.1	1.9	50.4	1.9	0.44

* Samples taken not from pump, but by bucket.

Table 3. Continued.

Station	Date (UTC)	Time (UTC)	Latitude (°S)	Longitude (°E)	Temperature (°C)	Salinity	Nitrate ($\mu\text{mol/L}$)	Nitrite ($\mu\text{mol/L}$)	Phosphate ($\mu\text{mol/L}$)	Silicate ($\mu\text{mol/L}$)	Ammonium ($\mu\text{mol/L}$)	Chl <i>a</i> ($\mu\text{g/L}$)
S052	2013/ 2/25	13:00	66-58.06	67-53.94	-1.0215	34.0830	33.3	0.1	2.1	56.8	0.2	0.49
S053	2013/ 2/25	19:13	66-25.22	68-27.13	-0.7518	34.0254	33.2	0.2	2.1	51.9	0.3	0.38
S054	2013/ 2/26	10:20	66-10.30	67-40.25	-0.6882	34.0125	33.8	0.2	2.1	58.5	0.3	0.25
S055	2013/ 2/27	6:05	66-45.15	67-39.00	-1.0506	34.0707	33.5	0.1	2.1	56.9	0.2	0.47
S056	2013/ 2/27	16:09	66-26.00	67-37.74	-0.9510	34.0622	34.1	0.1	2.3	60.8	0.3	0.23
S057	2013/ 2/28	3:30	66-49.49	67-38.43	-1.1232	34.0960	33.4	0.1	2.2	58.1	0.2	0.53
S058	2013/ 2/28	15:17	66-56.51	67-41.08	-1.2208	34.1112	33.3	0.1	2.1	61.2	0.2	0.49
S059	2013/ 3/ 1	5:12	66-19.25	68-30.75	-0.5633	34.0211	33.8	0.2	2.2	59.3	0.3	0.27
S060	2013/ 3/ 1	10:03	66-32.08	70-35.97	-0.4797	33.9547	32.6	0.2	2.1	59.1	0.4	0.30
S061	2013/ 3/ 1	17:35	67-27.98	73-12.97	-0.8607	34.0522	30.7	0.1	2.0	53.1	1.2	0.37
S062	2013/ 3/ 2	1:35	68-19.51	73-30.31	-1.0730	33.9288	25.4	0.1	1.6	47.0	0.8	2.76
S063	2013/ 3/ 2	4:32	68-40.48	73-17.79	-1.2171	33.2625	28.2	0.2	2.0	61.5	4.2	2.45
S064	2013/ 3/ 2	6:00	68-27.37	73-39.68	-1.3793	33.5392	32.0	0.2	2.0	58.9	0.2	4.05
S065	2013/ 3/ 2	7:24	68-10.13	74-02.83	-1.0214	34.1380	38.2	0.2	2.6	60.1	0.4	2.10
S066	2013/ 3/ 2	15:01	66-19.64	75-45.27	-0.2827	33.7772	44.7	0.3	3.2	80.7	3.1	0.25
S067	2013/ 3/ 3	3:17	63-29.87	78-20.39	0.9064	33.5446	39.3	0.3	2.6	51.0	0.0	0.62
S068	2013/ 3/ 3	10:49	62-59.19	82-23.04	0.7789	33.7845	39.4	0.3	2.6	43.2	0.0	1.18
S069	2013/ 3/ 3	15:48	62-36.39	84-59.15	0.7250	33.0077	40.8	0.3	2.6	60.4	0.0	0.69
S070	2013/ 3/ 4	3:06	60-59.26	90-48.76	1.4381	33.8925	40.3	0.4	2.6	42.1	0.0	1.31
S071	2013/ 3/ 4	9:38	62-00.00	93-26.26	1.7933	33.9166	30.8	0.3	1.9	37.8	0.0	0.93
S072	2013/ 3/ 4	15:06	62-00.48	97-13.54	1.6969	33.8376	39.4	0.4	2.4	52.9	0.0	1.15
S073	2013/ 3/ 5	2:54	61-55.90	102-49.35	2.1102	33.7551	35.5	0.4	2.2	11.0	0.4	0.71
S074	2013/ 3/ 5	9:06	61-52.50	105-24.65	2.0604	33.8140	29.6	0.3	1.7	10.2	0.5	0.43
S075	2013/ 3/ 5	17:03	61-48.79	108-34.88	2.0860	33.7122	36.1	0.4	2.3	19.1	0.4	0.90

Table 3. Continued.

Station	Date (UTC)	Time (UTC)	Latitude (°S)	Longitude (°E)	Temperature (°C)	Salinity	Nitrate ($\mu\text{mol/L}$)	Nitrite ($\mu\text{mol/L}$)	Phosphate ($\mu\text{mol/L}$)	Silicate ($\mu\text{mol/L}$)	Ammonium ($\mu\text{mol/L}$)	Chl <i>a</i> ($\mu\text{g/L}$)
S076	2013/ 3/ 6	11:52	61-55.86	116-06.10	1.6756	33.7591	33.4	0.3	2.0	25.3	0.2	2.04
S077	2013/ 3/ 7	5:09	61-59.41	125-16.33	1.4354	33.7841	35.2	0.3	2.3	25.3	0.3	0.65
S078	2013/ 3/ 7	12:40	62-14.12	129-14.11	1.6040	33.8147	34.7	0.3	2.2	19.8	0.2	0.91
S079	2013/ 3/ 8	4:34	63-14.25	135-47.24	1.3230	33.7846	29.4	0.2	1.8	16.1	0.2	0.65
S080	2013/ 3/ 8	12:41	63-12.37	139-13.27	1.4225	33.8046	30.6	0.3	1.9	28.4	0.0	1.15
S081	2013/ 3/ 9	0:24	63-09.68	143-16.91	1.2927	33.7663	32.8	0.3	2.0	28.1	0.2	0.69
S082	2013/ 3/ 9	5:04	63-08.38	144-54.55	1.6260	33.7127	29.0	0.3	1.6	20.5	0.0	1.36
S083	2013/ 3/ 9	12:54	63-00.53	147-05.22	1.7592	33.7127	29.1	0.3	1.7	18.1	0.0	1.08
S084	2013/ 3/10	12:44	61-09.64	149-26.29	1.4809	33.7497	29.8	0.3	1.8	17.0	0.2	0.48
S085	2013/ 3/10	21:39	60-06.06	149-59.65	1.6339	33.7612	30.7	0.3	1.8	25.3	0.0	1.01
S086	2013/ 3/11	4:51	59-12.09	150-00.47	2.0923	33.7850	29.5	0.3	1.7	19.2	0.0	1.01
S087	2013/ 3/11	11:48	58-18.18	150-00.13	3.5102	33.7438	29.1	0.3	1.7	11.1	0.3	0.21
S088	2013/ 3/12	10:27	55-32.06	150-00.37	8.0002	33.8808	23.1	0.2	1.5	0.0	0.1	0.38
S089	2013/ 3/13	2:54	52-21.38	149-59.99	7.7950	33.8553	23.4	0.2	1.5	0.0	0.1	0.41
S090	2013/ 3/13	11:04	50-57.87	149-59.99	10.3301	34.1539	15.0	0.2	1.0	0.0	0.1	0.83
S091	2013/ 3/14	11:58	46-55.17	151-33.17	13.9986	34.6255	4.2	0.1	0.4	0.0	0.1	0.77