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Biogeochemical properties of seawater in Lützow-Holm Bay in February 2011 during the 52nd Japanese Antarctic Research Expedition

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1. Introduction

The powerful ice-breaking capacity of the Japanese icebreaker *Shirase* raises the possibility of marine observations in the first-ice and/or permanent-ice zone. As part of the marine biological monitoring program of the Japanese Antarctic Research Expedition (JARE), ship-based observations of the sea-ice region of Lützow-Holm Bay, off Syowa Station, East Antarctica, began during the 52nd Japanese Antarctic Research Expedition of 2010–2011 (JARE-52). The aim of this program is to investigate biological production and mechanisms in relation to sea ice. This report presents vertical profiles of the biogeochemical properties of seawater collected in Lützow-Holm Bay during February 2011.

2. Sampling

Seawater samples for vertical profiles were collected at several monitoring stations in Lützow-Holm Bay (Stations A, B, C, D, and BP; Fig. 1) in February 2011. At the time of sampling, Stations A and B were in the multi-year fast-ice zone, Station C was in the first-year fast-ice zone,

Station D was in the pack-ice zone, and Station BP was in the open-ocean zone. Details of sampling are given in Takahashi *et al*. (2012).

Seawater was sampled to a depth of 400 m or to the bottom depth (whichever was less) during the down cast in standard 4 L Niskin bottles (Sea-Bird Electronics, Inc., Bellevue, WA, USA). Sampling was conducted at depths of 20, 50, 75, 100, 200, and 400 m at Stations D and BP; at 20 and 50 m at Station A; at 10, 30, 50, 75, 100, and 125 m at Station B; and at 20, 50, 75, 100, 200, and 230 m at Station C. Surface seawater was collected from the deck in a 5 L polyethylene bucket.

Seawater was subsampled into 10 mL polyethylene screw-cap vials and 250 mL high-density polyethylene screw-cap light-blocking bottles to analyze the concentrations of inorganic nutrients and chlorophyll *a*, respectively. After subsampling, seawater samples for nutrient analysis were immediately stored in an ultra-low-temperature freezer (−85°C) until analysis on land. Phytoplankton chlorophyll *a* was extracted with N,N-dimethylformamide (Suzuki and Ishimaru, 1990) from a glass microfiber filter (Grade GF/F; Whatman, St. Louis, MO, USA) just after filtration; the samples were stored in a freezer (−18°C) until analysis on board.

3. Analysis

Vertical temperature and salinity profiles were measured to a depth of 500 m or to the bottom depth with a conductivity–temperature–depth (CTD) memory probe (SBE 19plus; 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 reported here were not corrected by bottle salinity measured by salinometer.

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

The samples for the nutrient concentration analyses were frozen and transported to a laboratory at Hokkaido University, Hokkaido, Japan. The frozen samples were thawed to room temperature starting the day before the analyses. Concentrations of the nutrients $NO_3 + NO_2$, PO_4, SiO_2, and NO_2 were determined using a continuous-flow autoanalyzer (QuAAtro 2-HR; BL-TEC K.K., Osaka, Japan), according to the Joint Global Ocean Flux Study (JGOFS) spectrophotometric method (IOC/UNESCO, 1994). The nutrient concentrations were calibrated against KANSO reference materials (BT and BG; KANSO Technos Co., Ltd., Osaka, Japan).

4. Results

Monitoring station information is listed in Table 1. Vertical profiles of temperature and salinity at each monitoring station are shown in Fig. 2; water analysis data, along with CTD data at defined depths, are listed in Table 2.

5. Data archive

The data presented in this report are archived and available from the online Science Database of the National Institute of Polar Research (http://scidbase.nipr.ac.jp/?ml_lang=en). Permission to use these data for publication or presentation should be obtained in writing. Inquiries about the details of the data record should be addressed to:

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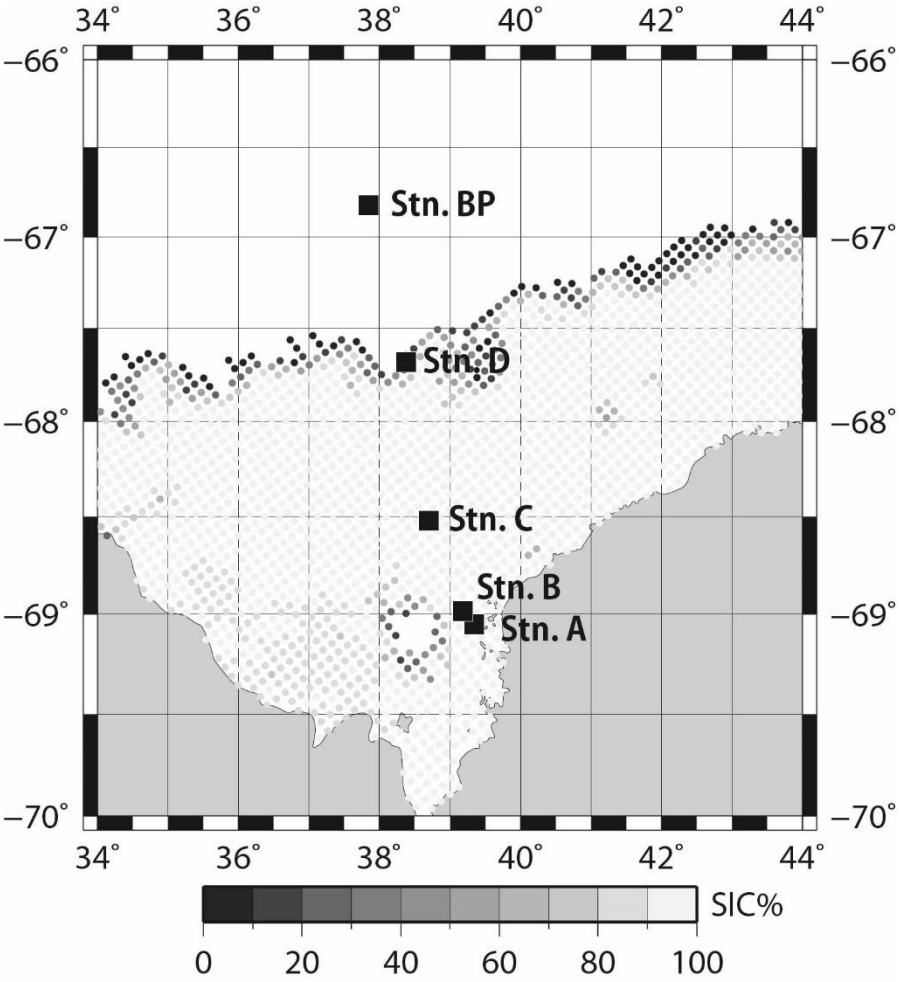

Fig. 1. Locations of sampling stations occupied during the JARE-52 cruise. Solid squares indicate hydrocast stations. SIC% indicates the sea-ice concentration on 23 February 2011. The SIC data were obtained from daily AMSR2 sea-ice maps (http://www.iup.uni-bremen.de:8084/amsr2/).

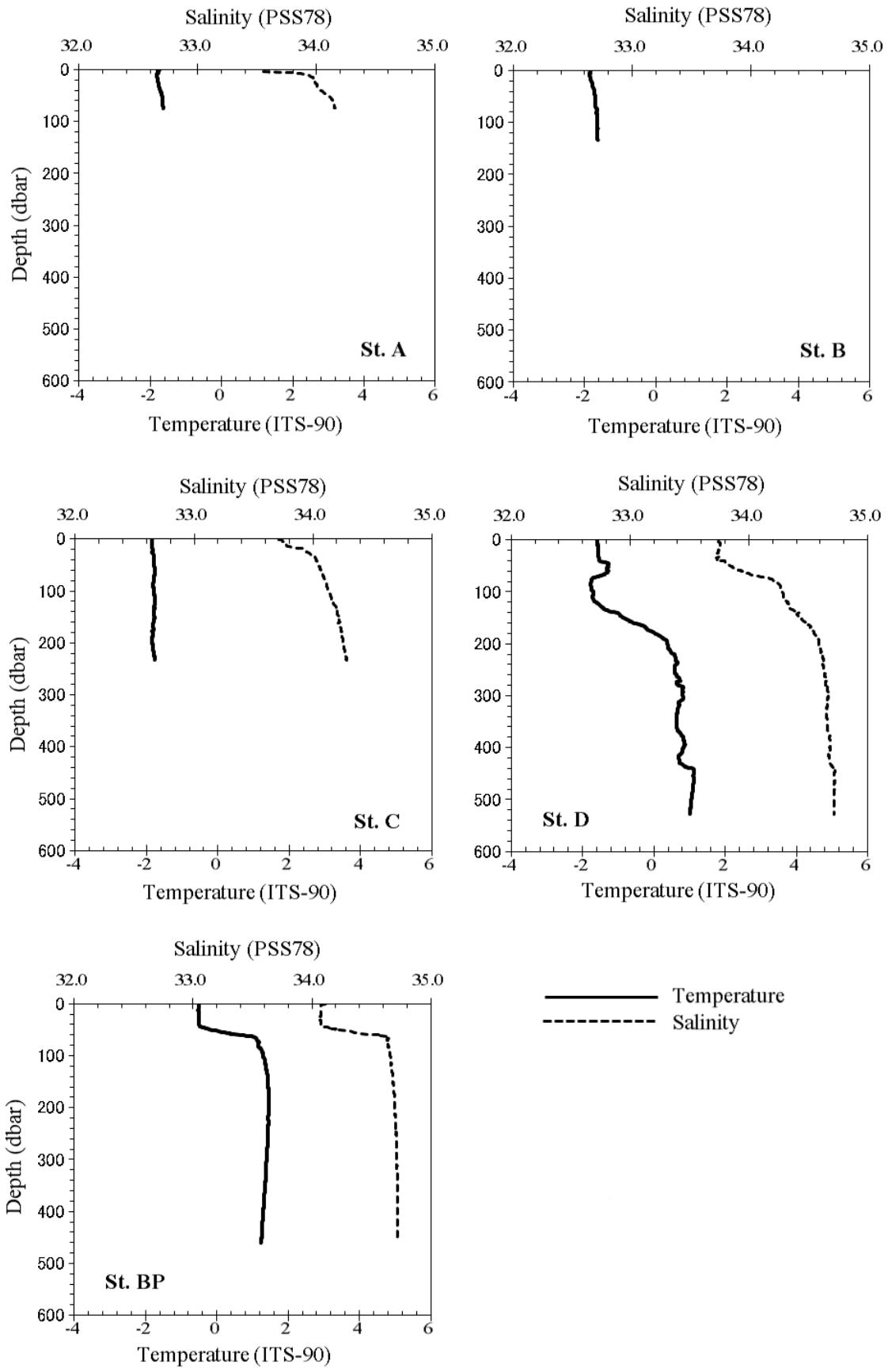

Fig. 2. Vertical profiles of temperature and salinity at the monitoring stations.

Table 1. Monitoring station information

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)
A	2011/2/9	13:12	69-03.03	39-20.55	77	–2.5	–0.8	0.7	990.2
B	2011/2/12	13:03	68-59.04	39-11.02	138	–7.0	–1.9	1.7	991.4
C	2011/2/18	05:07	68-31.31	38-42.12	233	–0.6	–1.8	1.3	996.2
D	2011/2/23	17:17	67-41.10	38-22.15	3806	–4.3	–1.6	7.6	966.1
BP	2011/2/24	04:45	66-49.43	37-50.61	4494	0.7	–0.5	6.1	970.6

Table 2. CTD and water analysis data at the monitoring stations

Stn	Depth	CTD data		Water analysis data				
		Temperature	Salinity	Nitrate	Nitrite	Phosphate	Silicate	Chl *a*
	(dbar)	(°C)		(μmol/L)	(μmol/L)	(μmol/L)	(μmol/L)	(μg/L)
A	0 (Bucket)	-	-	18.1	0.0	1.3	39.0	2.47
	20	–1.7936	33.9786	34.1	0.0	2.4	84.1	0.21
	50	–1.6674	34.1000	30.8	0.0	2.2	72.9	0.08
B	0 (Bucket)	-	-	35.5	0.0	2.5	83.6	0.03
	10	–1.8613	ND	35.3	0.0	2.6	84.5	0.02
	30	–1.7742	ND	30.5	0.0	2.2	70.0	0.01
	49	–1.7065	ND	31.6	0.0	2.3	73.5	0.01
	74	–1.6591	ND	29.7	0.0	2.1	68.0	0.00
	99	–1.6467	ND	34.1	0.0	2.5	79.5	0.00
	123	–1.6377	ND	35.0	0.0	2.6	81.9	0.01
C	0 (Bucket)	-	-	30.1	0.1	2.1	64.8	0.36
	20	–1.8205	33.9314	29.4	0.1	2.1	64.3	0.08
	50	–1.7997	34.0441	34.6	0.0	2.6	78.0	0.07
	74	–1.7851	34.0931	30.3	0.1	2.2	67.2	0.05
	99	–1.7917	34.1288	33.8	0.1	2.5	78.0	0.04
	199	–1.8374	34.2555	29.7	0.0	2.1	63.6	0.03
	229	–1.7678	34.2838	29.8	0.0	2.1	64.7	-
D	0 (Bucket)	-	-	29.7	0.2	2.1	69.9	0.25
	20	–1.5548	33.7460	ND	ND	ND	ND	ND
	50	–1.2956	33.8348	30.0	0.2	2.2	72.0	0.27
	75	–1.7225	34.1731	30.7	0.1	2.2	72.1	0.21
	100	–1.7035	34.2795	32.3	0.0	2.3	74.7	0.11
	200	0.3838	34.5931	33.5	0.0	2.4	89.1	0.02
	400	0.8606	34.6846	31.7	0.0	2.3	90.2	-
BP	0 (Bucket)	-	-	28.6	0.1	2.0	67.9	0.77
	20	–0.5162	34.0737	27.8	0.1	2.0	65.5	0.77
	49	–0.2568	34.2096	31.1	0.1	2.3	76.7	1.01
	75	1.1796	34.6372	34.7	0.1	2.5	90.3	0.56
	98	1.2977	34.6585	35.9	0.0	2.6	94.7	0.18
	199	1.4514	34.6989	34.7	0.0	2.5	95.2	0.01
	396	1.3078	34.7222	34.2	0.0	2.5	97.0	-

ND: no data.