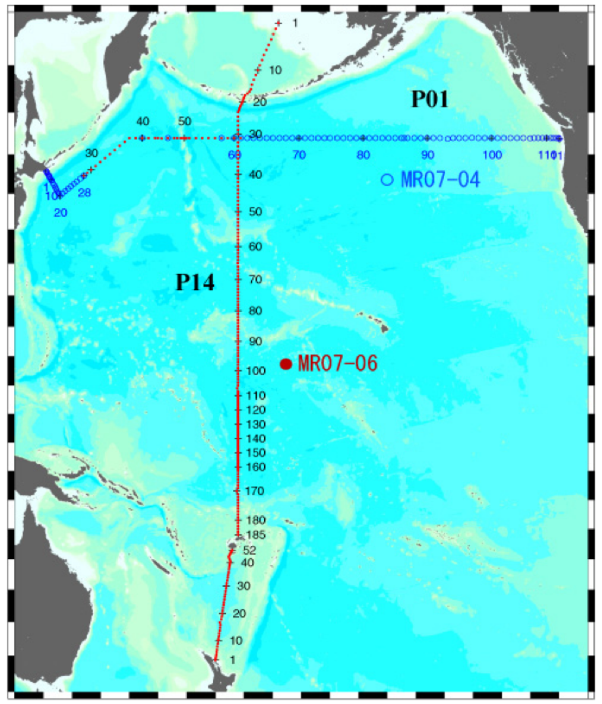
CRUISE REPORT P01, P14

(Updated Sept 2025)



HIGHLIGHTS

CRUISE SUMMARY INFORMATION

Section designation	P01	P14 Leg 1	P14 Leg 2
Expedition designation	**49NZ20070724**	**49NZ20071008**	**49NZ20071122**
Chief Scientists	**Takeshi Kawano / JAMSTEC**	**Takeshi Kawano / JAMSTEC**	**Akihiko Murata / JAMSTEC**
Dates	24 JUL 2007 - 20 NOV 2009	08 OCT 2007 - 20 NOV 2007	22 NOV 2007 - 26 DEC 2007
Ship	*R/V MIRAI*		
Ports of call	Hachinohe, Japan - Dutch Harbor, U.S.A.	Hachinohe, Japan - Majuro, Marshall Islands - Auckland, New Zealand	
Geographic boundaries	47° 01.87' N 145° 27.26' E 124° 58.91' W 39° 41.32' N	59° 00.11' N 175° 2.04' E 173° 59.8' W 35° 38.06' S	
Stations	88	272	
Floats and drifters	5 floats deployed	14 floats deployed	
Moorings	0	0	

Takeshi Kawano • kawnaot@jamstec.go.jp / **Akihiko Murata** • akihiko.murata@jamstec.go.jp
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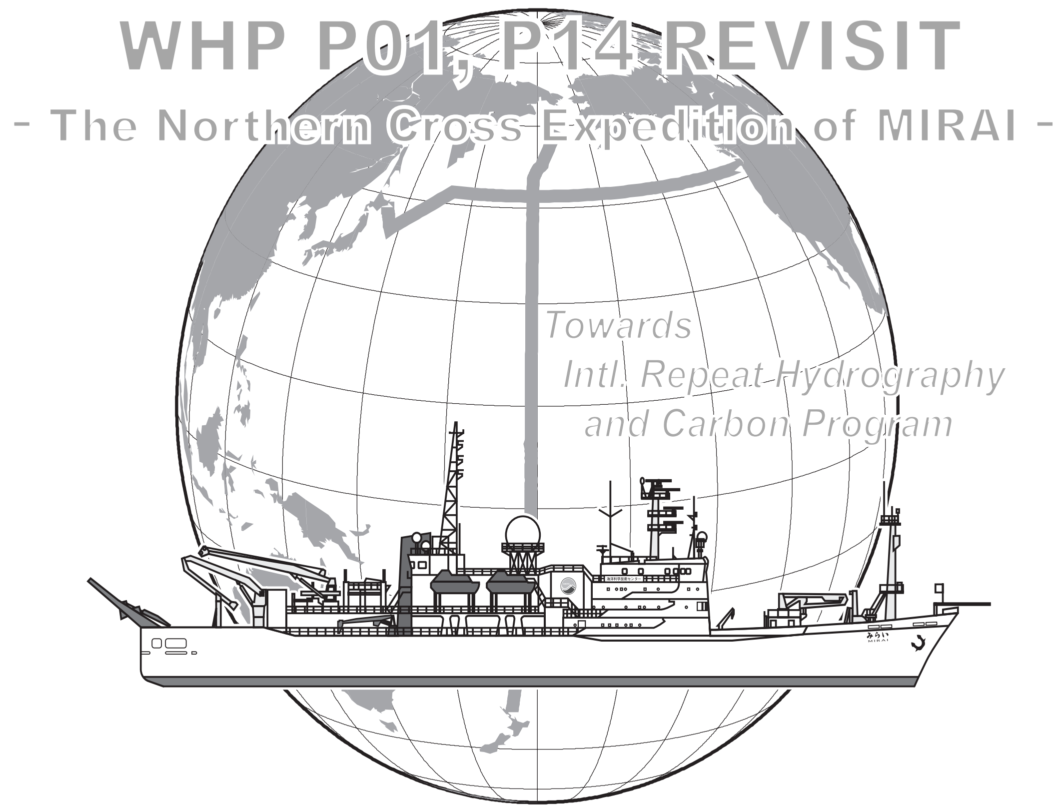
LINKS TO TEXT LOCATIONS

Shaded sections are not relevant to this cruise or were not available when this report was compiled

Updated CTD oxygen notes are appended to the end of this document

WHP P01, P14 REVISIT DATA BOOK

Edited by
Takeshi Kawano (JAMSTEC),
Hiroshi Uchida (JAMSTEC)
Toshimasa Doi (JAMSTEC)



WHP P01, P14 REVISIT DATA BOOK

March,1, 2009 Published
Edited by Takeshi Kawano (JAMSTEC), Hiroshi Uchida (JAMSTEC) and Toshimasa Doi (JAMSTEC)

Published by © JAMSTEC, Yokosuka, Kanagawa, 2009
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Printed by Ryoin Co., Ltd.
12, Nishikichou, Naka-ward, Yokohama, 231-8715, Japan

Contents

Preface

We, Ocean General Circulation Observational Research Program of IORGC (Institute of Observational Research for Global Change), published four data books after WHP (World Ocean Circulation Experiment Hydrographic Program) revisits along P17N, P6, A10, I3/I4, P3, P10, so far. It is our great pleasure that quite a few scientists in the world accepted our activities not only as references for their scientific works but also even as text books for education.

In 2007, we carried out two cruises on R/V Mirai of JAMSTEC (Japan Agency for Marine Earth Science and Technology) as "The Northen Cross Expedition of Mirai" in order to complete our interim research plan for the period from 2004 through 2008. Target of the cruises was to re-occupy WHP-P1 and WHP-P14 lines.

WHP-P1 is the line occupied in 1985 by United States (Chief Scientist was Dr. Talley) and is the first WHP line that the quality of provided data almost the WOCE standard from the re-occupation by Japan in 1999. Through the re-occupation of WHP-P1, the warming of bottom waters in the North Pacific Sub-arctic was detected and a new view point of changes in the meridonal overturn was introduced. This re-occupation of WHP-P1 succeeded in demonstrating the fact that a re-occupation of a WHP line with as high data quality as WOCE standard was so powerful to promote studies on climatic changes in the ocean especially in the deeper layer.

The third time re-occupation of WHP-P1, which is highlighted in this book, has objectives not only for confirming the bottom water warming. It is to detect Bio-Geochemical changes in the North Pacific Sub-arctic gyre because as far as carbon items concern, this cruise can be regarded as the second time re-occupation. Bio-Geochemical time series stations of K1(Japan) and P(Canada) are located in the western and the eastern ends of WHP-P1, respectively. Of these stations, K1 was established after the second time re-occupation of WHP-P1. Amount of new knowledge are expected to be brought through a comprehensive analysis of data from the WHP re-occupation and from time series stations.

WHP-P14 is the line along the meridian of 175°E. This line was occupied during 1992 though 1996 by three cruises of P14C, P14N and P14S (Chief Scientists were Drs. Roden, Roemmich and Bullister, respectively). This line was selected to be re-occupied as the last long hydrographic ocean observation of the interim research plan of Ocean General Circulation Observational Research Program of IORGC because of two main reasons. The first one is to prepare new data sets of carbon items and of Freons in the center of the Pacific together with other data sets to bound the eastern extension of the bottom water warming. The second one is on rather long history. Japan Meteorological Agency has been declared to re-occupy WHP-P13 along 165°E since 2002 with the same data quality as of WOCE standard. The re-occupation of WHP-P13 was expected but it did not come true yet. On the other hand, the needs for hydrographic high quality data sets have become larger for the ocean climate research in the center of the Pacific. So, we decided to re-occupy WHP-P14, which is located close to WHP-P13, without interrupting the plan of Japan Meteorological Agency, though possible re-occupation of any zonal WHP line was more appropriate for us to estimate the meridonal heat, sea water and material transports.

Finally, we would like to express our gratitude to all participants and crews of the R/V Mirai of the Japan Agency for Marine-earth Science and Technology, for their assistance in carrying out these cruises. The research system of JAMSTEC will be reformed largely in the fiscal year of 2009, however, we would like to continue our effort to re-occupy WHP lines with a vision of realizing a reliable prediction of global climate change. Data from those observations will be disseminated through our data book and web-sites of IORGC (http://www.jamstec.go.jp/iorgc/ocorp/data/post-wace.html), JAMSTEC(http://www.jamstec.go.jp/mirai/index_eng.html),IRHCP(International Repeat Hydrography and Carbon Project; http://cchdo.ucsd.edu/index.html), and CDIAC (Carbon Dioxide Information Analysis Center; http://cdiac.ornl.gov/oceans/RpeatSections/repeat_map.html). No permission is required to reproduce our data books and CDs. We only would like to ask a favor of all scientists to refer our data book of repeat hydrography as often as possible because such references prove that our efforts help the science not only of ourselves but also of all oceanographers and can make our activities for repeat hydrography sustainable.

On International Day of Disabled Parsons at Yokosuka

Masao Fukasawa
Director-General, IORGC/JAMSTEC
Program Director, Ocean General Circulation Observational Research Program of IORGC/JAMSTEC

1 Cruise Narrative

1.1 Highlight

Cruise Code :	MR07-04 and MR07-06	
GHPO Section designation:	P01 and P14	
Chief Scientist:	Takeshi Kawano (MR07-04 and MR07-06 Leg.1)	
	kawnaot@jamstec.go.jp	
	Akihiko Murata (MR07-06 Leg,2)	
	akihiko.murata@jamstec.go.jp	

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Ship:	R/V MIRAI	
Ports of Call:	MR07-04	Sekinehama – Hachinohe – Dutch Harbor
	MR07-06 Leg.1	Sekinehama – Hachinohe – Majuro
	MR07-06 Leg.2	Majuro – Auckland
Cruise Date:	MR07-04	July 24, 2007 – September 3, 2007
	MR07-06 Leg.1	October 8, 2007 – November 20, 2007
	MR07-06 Leg.2	November 22, 2007 – December 26, 2007
Number of Stations:	MR07-04	88 stations
	MR07-06 Leg.1	143 stations
	MR07-06 Leg.2	129 stations
Geographic boundaries:	MR07-04	145°27.26’ E – 124°58.91’ W
		47°01.87’ N – 39°41.32’ N
	MR07-06	152°05.43’ E –173°59.67’W
		59°00.11’N – 35°38.06’S
Floats and drifters deployed:		
	MR07-04	5 floats
	MR07-06	14 floats
Mooring deployed or recovered mooring:		NONE

1.2 Cruise Summary

(1) Station occupied

MR07-04

A total of 88 stations was occupied using a Sea Bird Electronics 36 position carousel equipped with 12 liter Niskin X water sample bottles, a SBE911plus equipped with SBE35 deep ocean standards thermometer, SBE43 oxygen sensor, AANDERAA “optode” oxgen sensor and Benthos Inc. Altimeter and RDI Monitor ADCP. XCTDs were deployed at 18 stations. Cruise track and station location are shown in Figure 1.2.1(a).

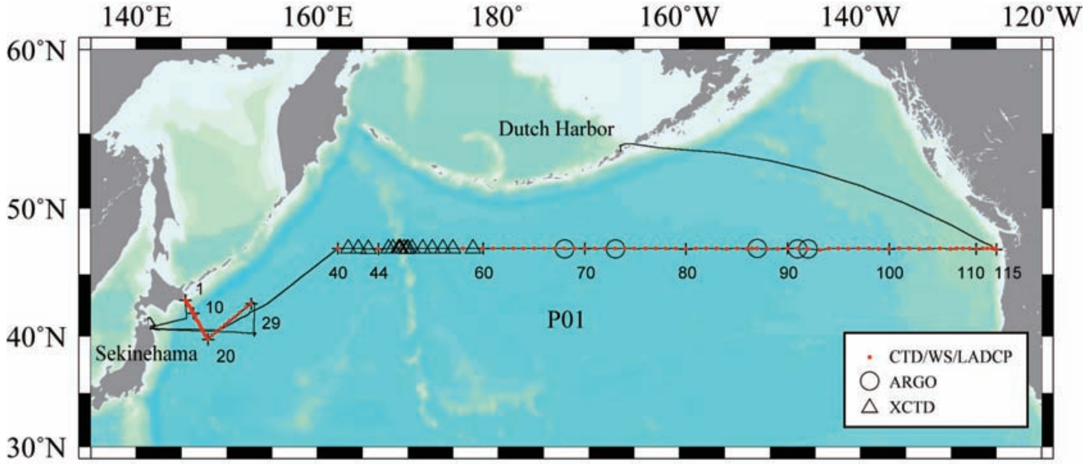

Fig.1.2.1 (a) Cruise Track and hydrographic stations. Solid circle (●) and Triangle (△) represents CTD station and XCTD station, respectively. Open circle (○) shows a position where ARGO floats were deployed.

MR07-06

A total of 272 stations (143 for Leg.1 and 129 for Leg.2) was occupied using a Sea Bird Electronics 36 position carousel equipped with 12 liter Niskin X water sample bottles, a SBE911plus equipped with SBE35 deep ocean standards thermometer, SBE43 oxygen sensor, AANDERAA "optode" oxgen sensor and Benthos Inc. Altimeter and RDI Monitor ADCP. Cruise track and station location are shown in Figure 1.2.1(b).

(2) Sampling and measurements

Water samples were analyzed for salinity, oxygen, nutrients, CFC-11, -12, -113, total alkalinity, DIC, and pH. The sampling layers are coordinated as so-called staggered mesh. Samples for POM, ^{14}C, ^{13}C, ^{137}Cs, N_2O, CH_4 and DMS in MR07-04 and samples for POC, ^{14}C, ^{13}C, ^{137}Cs, Pu, Noble gases, stable isotopes of O_2 and a biological study in MR07-06 were also collected at the selected stations. The bottle depth diagram is shown in Figure 1.2.2. Underway measurements of pCO_2, temperature, salinity, oxygen, surface current, bathymetry and meteorological parameters were conducted along the cruise track.

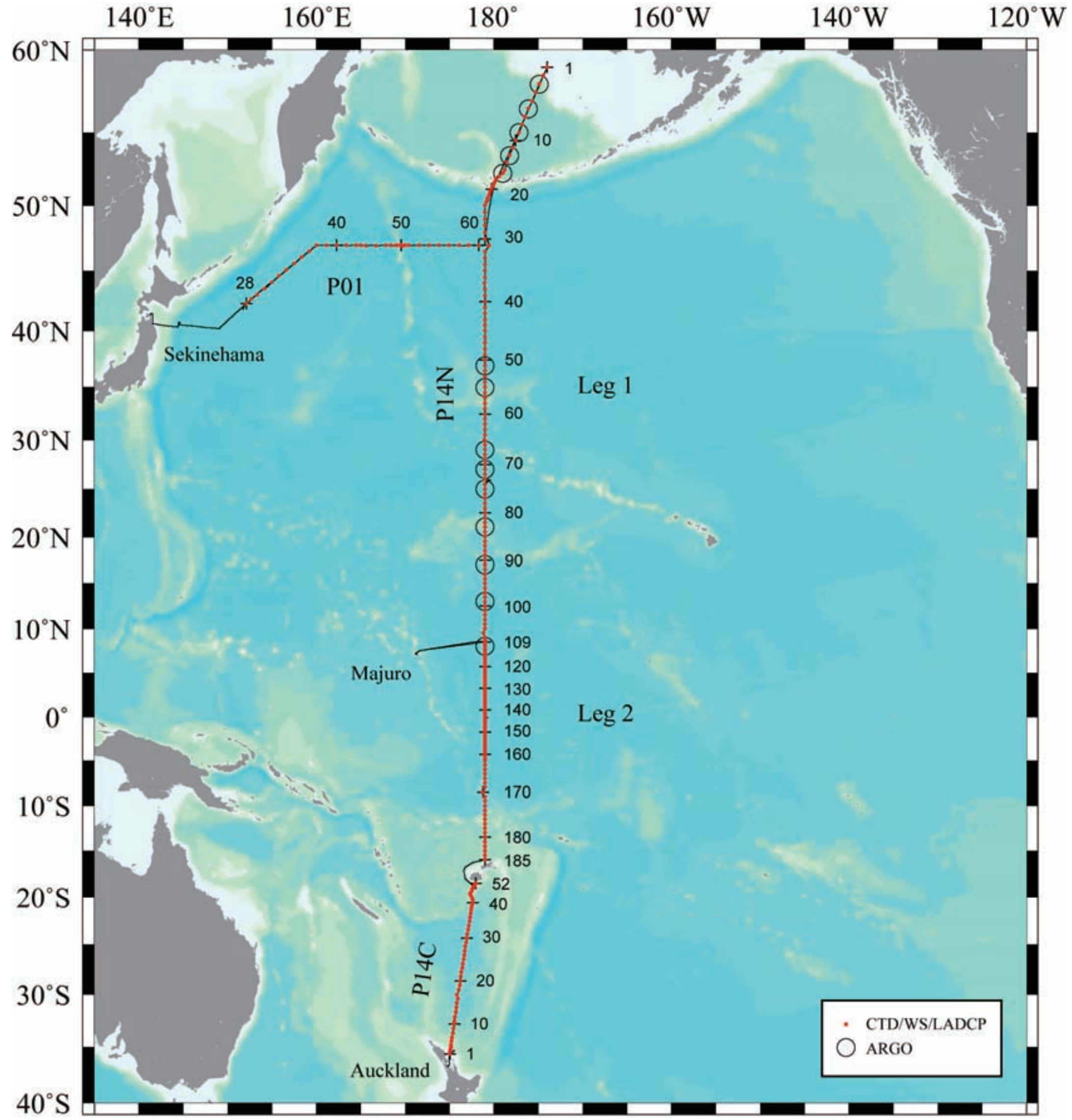

Fig.1.2.1 (b) Cruise Track and hydrographic stations. Solid circle (●) represents CTD station. Open circle (○) shows a position where ARGO floats were deployed.

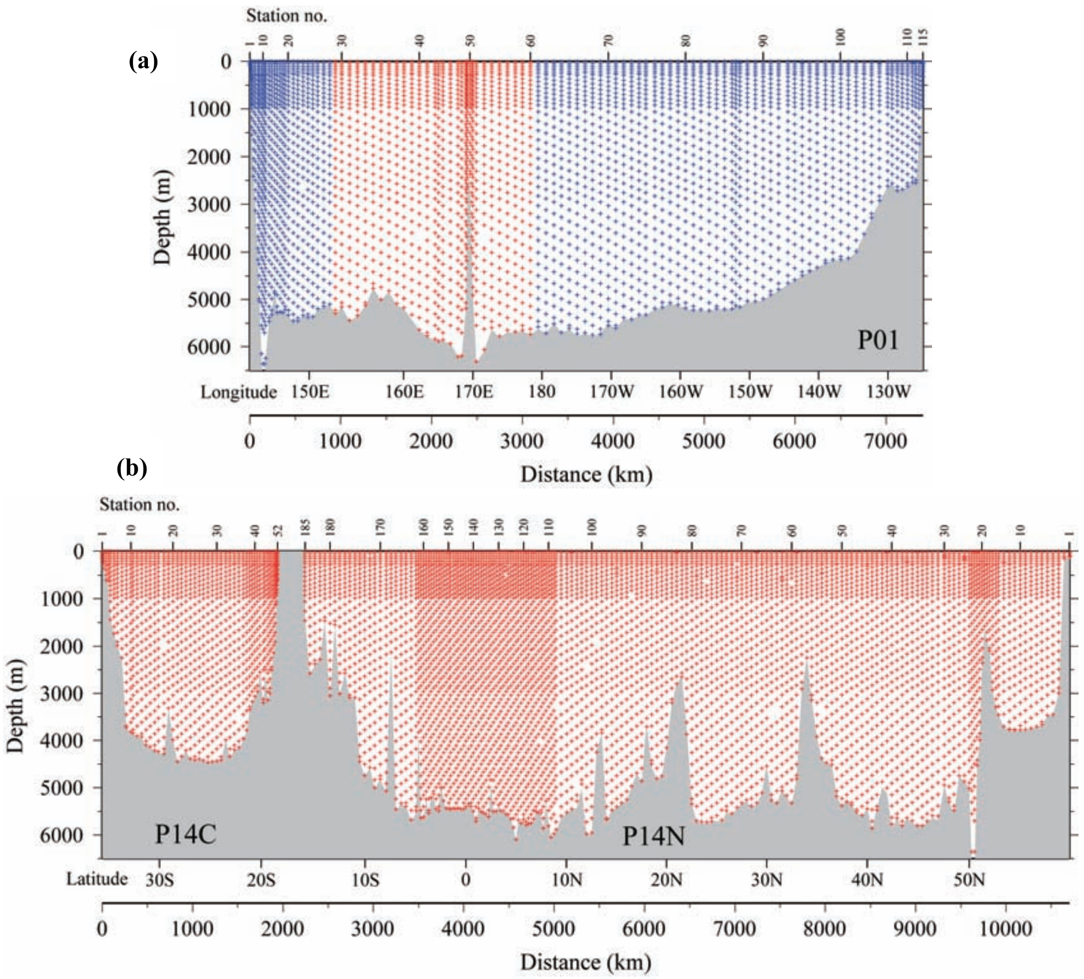

Fig. 1.2.2 The bottle depth diagram for (a) WHP-P1 and (b) WHP-P14. Brue cross (+) represents points where seawater was sampled in MR07-04 and res cross (+) represent points in MR07-06.

(4) Floats and Drifters deployed

ARGO floats were launched along the cruise track. The launched positions of the ARGO floats are listed in Table 1.2.1(a) and (b) for MR07-04 and MR07-06, respectively.

Table 1.2.1(a). Launched positions of the ARGO float in MR07-04.

Float S/N	ARGOS PTT ID	Date and Time of Reset (UTC)	Date and Time of Launch (UTC)	Location of Launch	St. No.
2811	66102	2007/8/16 23:53	2007/8/17 00:58	46-59.46 [N] 172-41.04[W]	P01-068
2804	66095	2007/8/18 09:48	2007/8/18 12:12	46-59.34 [N] 167-04.38[W]	P01-073
2352	60118	2007/8/22 23:55	2007/8/23 01:32	46-59.69 [N] 151-24.37[W]	P01-087
3050	70495	2007/8/24 01:49	2007/8/24 03:51	46-59.35 [N] 146-55.35[W]	P01-091
3049	70494	2007/8/24 08:13	2007/8/24 10:17	46-58.81 [N] 145-47.72[W]	P01-092

Table 1.2.1(b). Launched positions of the ARGO float in MR07-06

Float S/N	ARGOS PTT ID	Date and Time of Reset (UTC)	Date and Time of Launch (UTC)	Location of Launch	St. No.
3268	33318	2007/10/24 03:18	2007/10/24 04:34	52-16.13 [N] 178-58.20[W]	P14N-015
3264	33314	2007/10/24 17:44	2007/10/24 18:55	53-29.83 [N] 178-14.01[W]	P14N-012
3265	33315	2007/10/25 08:44	2007/10/25 10:18	54-59.59 [N] 177-09.45[W]	P14N-009
3260	33306	2007/10/26 00:41	2007/10/26 01:55	56-29.22 [N] 176-05.71[W]	P14N-006
3261	33307	2007/10/27 06:31	2007/10/27 08:01	57-59.70 [N] 174-53.87[W]	P14N-003
3331	75743	2007/11/04 07:05	2007/11/04 08:33	36-58.62 [N] 179-01.88[E]	P14N-051
3330	75742	2007/11/05 04:13	2007/11/05 05:56	34-59.89 [N] 178-59.80[E]	P14N-055
3329	75741	2007/11/07 21:25	2007/11/07 23:52	28-58.83 [N] 179-01.25[E]	P14N-067
3328	75740	2007/11/08 21:30	2007/11/09 00:21	26-59.79 [N] 179-01.77[E]	P14N-071
3341	75753	2007/11/11 04:43	2007/11/11 05:54	25-00.27 [N] 179-01.59[E]	P14N-075
3333	75745	2007/11/13 01:18	2007/11/13 02:28	21-00.66[N] 178-59.88[E]	P14N-083
3332	75744	2007/11/14 18:44	2007/11/14 21:36	17-01.42[N] 178-59.25[E]	P14N-091
3343	75755	2007/11/16 21:04	2007/11/16 21:59	13-00.39[N] 178-59.33[E]	P14N-099
3327	75739	2007/11/24 08:22	2007/11/24 10:05	08-00.17[N] 179-01.21[E]	P14N-111

(5) Moorings deployed or recovered

No mooring was deployed nor recovered during the cruise.

1.3 List of Principal Investigators and Persons in Charge on the Ship

The principal investigator (PI) and the person in charge responsible for major parameters measured on the cruise are listed in Table 1.3.1.

Table 1.3.1(a) List of principal investigators and persons in charge on the ship for MR07-04

Item	Principal Investigator	Person in Charge on the Ship
Underway		
ADCP	Shinya Kouketsu (JAMSTEC)	Satoshi Okumura (GODI)
	skouketsu@jamstec.go.jp	
Bathymetry	Takeshi Matsumoto (Univ. Ryukyus)	Satoshi Okumura (GODI)
	tak@sci.u-ryukyu.ac.jp	
Meteorology	Kunio Yoneyama (JAMSTEC)	Satoshi Okumura (GODI)
	yoneyamak@jamstec.go.jp	
T-S	Yuichiro Kumamoto (JAMSTEC)	Keisuke Wataki (MWJ)
	kumamoto@jamstec.go.jp	
pCO_2	Akihiko Murata (JAMSTEC)	Yoshiko Ishikawa, Yasuhiro Arii (MWJ)
	akihiko.murata@jamstec.go.jp	
Hydrography		
CTD/O_2	Hiroshi Uchida (JAMSTEC)	Satoshi Ozawa (MWJ)
	huchida@jamstec.go.jp	
LADCP	Shinya Kouketsu (JAMSTEC)	Shinya Kouketsu (JAMSTEC)
	skouketsu@jamstec.go.jp	
Salinity	Takeshi Kawano (JAMSTEC)	Naoko Takahashi (MWJ)
	kawanot@jamstec.go.jp	
Oxygen	Yuichiro Kumamoto (JAMSTEC)	Kimiko Nishijima (MWJ)
	kumamoto@jamstec.go.jp	
Nutrients	Michio Aoyama (MRI)	Ayumi Takeuchi (MWJ)
	maoyama@mri-jma.go.jp	
DIC	Akihiko Murata (JAMSTEC)	Yoshiko Ishikawa, Yasuhiro Arii (MWJ)
	akihiko.murata@jamstec.go.jp	
Alkalinity	Akihiko Murata (JAMSTEC)	Fuyuki Shibata, Minoru Kamata (MWJ)
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pH	Akihiko Murata (JAMSTEC)	Fuyuki Shibata, Minoru Kamata (MWJ)
	akihiko.murata@jamstec.go.jp	
CFCs	Kenichi Sasaki (JAMSTEC)	Kenichi Sasaki (JAMSTEC)
	ksasaki@jamstec.go.jp	
$\Delta^{14}C$	Yuichiro Kumamoto (JAMSTEC)	Yuichiro Kumamoto (JAMSTEC)
	kumamoto@jamstec.go.jp	
Radionuclides	Michio Aoyama (MRI)	Junji Matsushita (MWJ)
	maoyama@mri-jma.go.jp	
N_2O & CH_4	Naohiro Yoshida (TITECH)	Osamu Yoshida (Rakuno Gakuen Univ.)
	naoyoshi@depe.titech.ac.jp	
XCTD	Hiroshi Uchida (JAMSTEC)	Satoshi Okumura (GODI)
	huchida@jamstec.go.jp	
DMS	Ippei Nagao (Nagoya Univ.)	Ippei Nagao (Nagiya Univ.)
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PIM	Mitsuo Uematsu (ORI) uematsu@ori.u-tokyo.ac.jp	Yoko Iwamoto (ORI)
DOC	Masao Uchida (NIES) uchidama@nies.go.jp	Yukiko Kuroki (Univ. Tsukuba)
Floats, Drifters		
Argo float	Toshio Suga (JAMSTEC) sugat@jamstec.go.jp	Tomoyuki Takamori (MWJ)

GODI: Global Ocean Development Inc.

JAMSTEC: Japan Agency for Marine-Earth Science and Technology

MRI: Meteorological Research Institute, Japan Meteorological Agency

MWJ: Marine Works Japan, Ltd.

Nagoya Univ.: Nagoya University

NIES: National Institute for Environmental Studies

ORI: Ocean Research Institute, The University of Tokyo

Rakuno Gakuen Univ.: Rakuno Gakuen University

TITECH: Tokyo Institute of Technology

Univ. Tsuluba : University of Tsukuba

Univ. Ryukyus: University of the Ryukyus

Table 1.3.1(b) List of princip al investigator and pers on in char ge on the ship for MR07-06 Leg.1

Item	Principal Investigator	Person in Charge on the Ship
Underway		
ADCP	Shinya Kouketsu (JAMSTEC) skouketsu@jamstec.go.jp	Soichiro Sueyoshi (GODI)
Bathymetry	Takeshi Matsumoto (Univ. Ryukyus) tak@sci.u-ryukyu.ac.jp	Soichiro Sueyoshi (GODI)
Meteorology	Kunio Yoneyama (JAMSTEC) yoneyamak@jamstec.go.jp	Soichiro Sueyoshi (GODI)
T-S	Yuichiro Kumamoto(JAMSTEC) kumamoto@jamstec.go.jp	Masanori Enoki (MWJ)
pCO_2	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Yoshiko Ishikawa (MWJ)
Hydrography		
CTD/O_2	Hiroshi Uchida (JAMSTEC) huchida@jamstec.go.jp	Kenichi Katayama (MWJ)
LADCP	Shinya Kouketsu (JAMSTEC) skouketsu@jamstec.go.jp	Hiroshi Uchida (JAMSTEC)
Salinity	Takeshi Kawano (JAMSTEC) kawanot@jamstec.go.jp	Naoko Takahashi (MWJ)
Oxygen	Yuichiro Kumamoto (JAMSTEC) kumamoto@jamstec.go.jp	Kimiko Nishijima (MWJ)
Nutrients	Michio Aoyama (MRI) maoyama@mri-jma.go.jp	Ayumi Takeuchi (MWJ)
DIC	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Yoshiko Ishikawa (MWJ)

Alkalinity	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Ayaka Hatsuyama (MWJ)
pH	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Ayaka Hatsuyama (MWJ)
CFCs	Kenichi Sasaki (JAMSTEC) ksasaki@jamstec.go.jp	Kenichi Sasaki (JAMSTEC)
$\Delta^{14}C$	Yuichiro Kumamoto (JAMSTEC) kumamoto@jamstec.go.jp	Yuichiro Kumamoto(JAMSTEC)
Radionuclides	Michio Aoyama (MRI) maoyama@mri-jma.go.jp	Hideki Yamamoto (MWJ)
Noble Gasses & $^{17}O/^{18}O$	Toshiro Saino (Nagoya Univ.) tsaino@ihas.nagoya-u.ac.jp i	Charles Stump (Univ. Washington)
Biology	Ken Furuya (Univ. Tokyo) furuya@fs.a.u-tokyo.ac.jp	Takuhei Shiozaki (Univ. Tokyo)
DOC	Masao Uchida (NIES) uchidama@nies.go.jp	Chie Sato (Univ. Tsukuba)
Floats, Drifters		
Argo float	Toshio Suga (JAMSTEC) sugat@jamstec.go.jp	Shinsuke Toyoda (MWJ)

GODI: Global Ocean Development Inc.

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MRI: Meteorological Research Institute, Japan Meteorological Agency

MWJ: Marine Works Japan, Ltd.

Nagoya Univ.: Nagoya University

NIES: National Institute for Environmental Studies

Univ. Tokyo: The University of Tokyo

Univ. Tsuluba : University of Tsukuba

Univ. Ryukyus: University of the Ryukyus

Univ, Washington: University of Washington

Table 1.3.1(c) List of princip al investigator and pers on in char ge on the ship for MR07-06 Leg.2

Item	Principal Investigator	Person in Charge on the Ship
Underway		
ADCP	Shinya Kouketsu (JAMSTEC) skouketsu@jamstec.go.jp	Shinya Okumura (GODI)
Bathymetry	Takeshi Matsumoto (Univ. Ryukyus) tak@sci.u-ryukyu.ac.jp	Shinya Okumura (GODI)
Meteorology	Kunio Yoneyama (JAMSTEC) yoneyamak@jamstec.go.jp	Shinya Okumura (GODI)
T-S	Yuichiro Kumamoto (JAMSTEC) kumamoto@jamstec.go.jp	Masanori Enoki (MWJ)
pCO_2	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Yoshiko Ishikawa (MWJ)
Hydrography		
CTD/O_2	Hiroshi Uchida (JAMSTEC) huchida@jamstec.go.jp	Tomoyuki Takamori (MWJ)
LADCP	Shinya Kouketsu (JAMSTEC) skouketsu@jamstec.go.jp	Hiroshi Uchida (JAMSTEC)
Salinity	Takeshi Kawano (JAMSTEC) kawanot@jamstec.go.jp	Naoko Takahashi (MWJ)
Oxygen	Yuichiro Kumamoto(JAMSTEC) kumamoto@jamstec.go.jp	Kimiko Nishijima (MWJ)
Nutrients	Michio Aoyama (MRI) maoyama@mri-jma.go.jp	Kenichiro Sato (MWJ)
DIC	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Yoshiko Ishikawa (MWJ)
Alkalinity	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Minoru Kamata (MWJ)
pH	Akihiko Murata (JAMSTEC) akihiko.murata@jamstec.go.jp	Minoru Kamata (MWJ)
CFCs	Kenichi Sasaki (JAMSTEC) ksasaki@jamstec.go.jp	Kenichi Sasaki (JAMSTEC)
$\Delta^{14}C$	Yuichiro Kumamoto (JAMSTEC) kumamoto@jamstec.go.jp	Akihiko Murata (JAMSTEC)
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Biology	Ken Furuya (Univ. Tokyo) furuya@fs.a.u-tokyo.ac.jp	Takuhei Shiozaki (Univ. Tokyo)
DOC	Masao Uchida (NIES) uchidama@nies.go.jp	Yukiko Kuroki (Univ. Tsukuba)
Floats, Drifters		
Argo float	Toshio Suga (JAMSTEC) sugat@jamstec.go.jp	Tomoyuki Takamori (MWJ)

GODI: Global Ocean Development Inc.
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MWJ: Marine Works Japan, Ltd.
NIES: National Institute for Environmental Studies
Univ. Tokyo: The University of Tokyo
Univ. Tsuluba : University of Tsukuba
Univ. Ryukyus: University of the Ryukyus

1.4 Scientific Program and Methods

(1) Nature and objectives of MR07-K04 and MR07-K06 cruise project

It is well known that the oceans play a central role in determining global climate. However heat and material transports in the ocean and their temporal changes have not yet been sufficiently quantified. Therefore, global climate change is not understood satisfactorily. The purposes of this research are to evaluate heat and material transports such as carbon, nutrients, etc. in the North Pacific and to detect their long term changes and basin-scale biogeochemical changes since the 1990s. The MR07-04 cruise is a reoccupation of the eastern part of the hydrographic section called 'WHP-P1', which was observed by an ocean science group of USA in 1985 as a part of WOCE (World Ocean Circulation Experiment) and by a joint group of Canada and Japan in 1999. MR07-06 is a reoccupation of the eastern part of WHP-P1 and the hydrographic section called 'WHP-P14', which was observed by an ocean science group of USA (United States of America) in 1993 also as a part of WOCE (World Ocean Circulation Experiment). The WOCE datasets are included in the data base of CLIVAR (Climate Variability and Predictability) and Carbon Hydrographic Data Office (http://whpo.ucsd.edu/). We will compare physical and chemical properties along section WHP-P1 and P14 with WOCE datasets to detect and evaluate long term changes of the marine environment in the Pacific Ocean.

Reoccupations of the WOCE hydrographic sections are now in progress by international cooperation in ocean science community, within the framework of CLIVAR, which is as part of World Climate Research Programme (WCRP) and IOCCP (International Ocean Carbon Coordination Project). Our research is planned as a contribution to these international projects supported by WMO, ICSU/SCOR and UNESCO/IOC, and its results and data will be published by 2009 for worldwide use.

The other purposes of this cruise are as follows:

1) to observe surface meteorological and hydrological parameters as a basic data of meteorology and oceanography such as studies on flux exchange, air-sea interaction and so on,
2) to observe sea bottom topography, gravity and magnetic fields along the cruise track to understand the dynamics of ocean plate and accompanying geophysical activities,
3) to observe bio-geochemical parameters to study carbon cycle in the ocean,
4) to observe green house gasses in the atmosphere and the ocean to study their cycle from bio-geochemical aspect.

(2) Cruise overview

MR07-04 was carried out during the period from July 24 to September 3, 2007. The cruise started from the coast near Hokkaido Japan, and sailed towards east along approximately 47°N. This line was called WHP-P1 and observed by an ocean science group of USA in 1985 as a part of WOCE (World Ocean Circulation Experiment) and by a joint group of Canada and Japan in 1999. The cruise had been designed as a re-occupation of the WHP-P1 stations; however, we could observe only the eastern half of the stations due to an accident. A number of observed stations was 88. MR07-06 cruise was carried out during the period from October 8, 2007 to December 26, 2007. The cruise started also from the coast near Hokkaido. The cruise was designed to observe the rest of WHP-P1 stations (the western part) and WHP-P14N and P14C. A number of stations was 272.At each station, full-depth CTD profile and up to 36 water samples were taken and analyzed. Water samples were obtained from surface to approximately 10 dbar above the bottom with 12-liter Niskin bottles attached to 36-position SBE carousel water sampler. Sampling layer is designed as so-called staggered mesh. The scientists of JAMSTEC and Meteorological Research Institute and the technicians of Marine Works Japan Ltd. (MWJ) were responsible for analyzing water sample for salinity, dissolved oxygen, nutrients, CFCs, total carbon contents, alkalinity, and pH. They also contributed to sampling for total organic carbon, radiocarbon and so on. The technicians of Global Ocean Development Inc. (GODI) had responsibility for a part of underway measurements such as current velocity by Acoustic Doppler Current Profiler (ADCP) geological parameters (topography, geo-magnetic field and gravity), and meteorological parameters. ARGO floats prepared by JAMSTEC and Institute of Ocean Sceinces (Canada) were launched by MWJ technicians and the ship crew. The scientists of Tokyo Institute of Technology joined the cruise for their research on chemical oceanography. A scientist from University of the Ryukyus was a principal investigator for geological parameters (topography, geo-magnetic field and gravity). The scientist from Ocean Research Institute, the university of Tokyo University, Nagoya University, Tsukuba University and University of Washington are also joined the cruise.

(3) Cruise narrative

MR07-04

R/V Mirai departed Hachinohe (Japan) on July 24, 2007. The hydrographic cast of CTD was started at the first station on July 26. All watchstanders were drilled in the method of sample drawing before the first station. Both propellers got entangled in a fishing net at the station 29 on August 2 (local time). Therefore we were forced to return to the port, Hachinohe, to cut and remove the fishing net. We spent 10 days for the trouble and it made us giving up our observation in the western part of the P1 line, from station 29 to station 60. We restarted the WHP revisit observation at the dateline, station P61. On the way from Hachinohe to station P61, we made a CTD cast specially designed for DMS, Nitrous oxide (N_2O), Methane (CH_4), Carbonyl sulfide (COS), and related substances at stations 40, 45, 58 and 60,. From stations 41 to 59 (except 45 and 58), we deploy XCTD (1,000m) instead of CTD cast. R/V Mirai arrived at Dutch Harbor (U.S.A.) on September 3, 2007.

MR07-06

R/V Mirai departed Hachinohe (Japan) on October 8, 2007. The hydrographic cast of CTD was started at the first station, station 28 of WHP-P1 on October 10. After observing the stations until P01-61, she turned to north to observe the stations of WHP-P14N. She called for Majuro (Republic of the Marshall Islands) on November 20, 2007 (Leg.1). She left Majuro on November 22, 2007 for Auckland (New Zealand) and arrived on December 26, 2007 (Leg.2). We observed 272 stations of a part of WHP-P01 line (47N), WHP-P14N and WHP-P14C.

1.5 Major Problems and Goals not Achieved

MR07-04

(1) Stations not occupied

Both propellers got entangled in a fishing net at the station 29. Therefore we were forced to return to the port, Hachinohe, to cut remove the fishing net. We spent 10 days for the trouble and it made us giving up our observation in the western part of the P1 line, from station 29 to station 60. We restarted the observation at the dateline, station P61.

At stations 40, 45, 58 and 60, we made a CTD cast specially designed for DMS, Nitrous oxide (N_2O), Methane (CH_4), Carbonyl sulfide (COS), and related substances.

From stations 41 to 59 (except 45 and 58), we deploy XCTD (1,000m) instead of CTD cast.

(2) Misfiring and mistrip

The carousel water sampler misfired at station 23 (bottle #15).

(3) CTD sensor replacement

We encountered to several problems (drift, shift, noise) of CTD sensors and replaced them after the following stations:

Sta. 10: primary conductivity sensor

Sta. 29: secondary temperature sensor

Sta. 44: primary temperature sensor

MR07-06

(1) Mistrip

The carousel water sampler mistripped at following stations;

Stn. P01-040 (Niskin Bottle #10)

Stn. P01-054 (Niskin Bottle #10)

Stn. P01-077 (Niskin Bottle #27)

Stn. P14N-054 (Niskin Bottle #11)

Stn. P14N-060 (Niskin Bottle #26)

Stn. P14N-063 (Niskin Bottle #11)

Stn. P14N-064 (Niskin Bottle #11)

Stn. P14N-071 (Niskin Bottle #31)

Stn. P14N-092 (Niskin Bottle #24)

Stn. P14N-099 (Niskin Bottle #18)

Stn. P14N-101 (Niskin Bottle #16)

Stn. P14N-103 (Niskin Bottle #5)

Stn. P14N-107 (Niskin Bottle #3 and #12)

Stn. P14N-126(Niskin Bottle＃30)

Stn.P14N-127(Niskin Bottle＃28)

Stn. P14C-007(Niskin Bottle #22)

(2) CTD sensor replacement

We encountered to several problems (crack, drift, shift, noise) of CTD sensors and replaced them after the following stations:

Sta. P01_46: secondary cnductivity sensor

Sta. P14N_4: primary and secondary temperature sensors

Sta. P14N_33: secondary temperature sensor

Sta. P14N_51: secondary conductivity sensor

Sta. P14N_74 cast 1: primary and secondary conductivity, and secondary temperature sensors*

Sta. P14N_99: primary conductivity sensor

Sta. P14N_108: primary conductivity sensor**

Sta. P14N_171: secondary conductivity sensor

* without secondary temperature and conductivity sensors for Sta. P14N_74 cast 2, and secondary conductivity sensor for Stas. from P14N_75 to P14N_79.

** the broken primary conductivity sensor was replaced after the station P14N_109 cast 1.

(3)Thermosalinograph

Salinity data from 2007/10/30 3:36 to 2007/11/6 4:34 was lost due to stuffed antifouling devices.

1.6 List of Participants

The cruise participants of the cruises are listed in Table 1.3.2

Table 1.3.2(a) List of cruise participants for MR07-04

Name	Responsibility	Affiliation
Yasuhiro Arii	Carbon Items	MWJ
Miyo Ikeda	Dissolved Oxygen / Water Sampling	MWJ
Yoshiko Ishikawa	Carbon Items	MWJ
Yoko Iwamoto	Aerosol and Fog water	ORI
Minoru Kamata	Carbon Items	MWJ
Kenichi Katayama	CTD / Water Sampling	MWJ
Kaori Kawana	Aerosol and Fog water	ORI
Kohei Kawano	CH_4 and N_2O / Water Sampling	Tokyo Inst. Tech.
Takeshi Kawano	Chief Scientist / Salinity	IORGC/JAMSTEC
Kei Kojima	Water Sampling	MWJ
Chihiro Komatsu	Water Sampling	MWJ
Shinya Kouketsu	LADCP/ADCP / Water Sampling	IORGC/JAMSTEC
Yuichiro Kumamoto	DO / Thermosalinograph / Δ14C	IORGC/JAMSTEC

Yukiko Kuroki	Organic and Inorganic Carbon	University of Tsukuba
Takashi Makino	Water Sampling	MWJ
Junji Matsushita	Radionuclides / Water Sampling	MWJ
Shunsuke Miyabe	Nutrients	MWJ
Tomohiro Miyabukuro	CH4 and N2O / Water Sampling	Tokyo Inst. Tech.
Dai Motomura	Water Sampling	MWJ
Maki Mukai	Water Sampling	MWJ
Akihiko Murata	Carbon Items/ Water sampling	IORGC/JAMSTEC
Ippei Nagao	DMS	Nagoya University
Kimiko Nishijima	Dissolved Oxygen / Water Sampling	MWJ
Satoshi Okumura	Meteorology / Geophysics	GODI
Shinya Okumura	Meteorology / Geophysics	GODI
Ryo Oyama	Meteorology / Geophysics	GODI
Satoshi Ozawa	Chief Technologist /CTD / Water Sampling	MWJ
Katsunori Sagishima	CFCs	MWJ
Kenichi Sasaki	CFCs	MIO/JAMSTEC
Takayoshi Seike	Nutrients	MWJ
Fuyuki Shibata	Carbon Items	MWJ
Yuichi Sonoyama	CFCs	MWJ
Kazuto Suzuki	Water Sampling	MWJ
Naoko Takahashi	Salinity / Water Sampling	MWJ
Tomoyuki Takamori	CTD / Water Sampling	MWJ
Ayumi Takeuchi	Nutrients	MWJ
Tatsuya Tanaka	Salinity / Water Sampling	MWJ
Shigeki Tasaka	Radon	Gifu University
Shoko Tatamisashi	CFCs	MWJ
Hiroshi Uchida	CTD / LADCP / Warter Sampling	IORGC/JAMSTEC
Hirokatsu Uno	CTD / Water Sampling	MWJ
Keisuke Wataki	Dissolved Oxygen / Water Sampling	MWJ
Osamu Yoshida	CH_4 and N_2O / Water Sampling	Rakuno Gakuen University

GODI	Global Ocean Development Inc.
IORGC	Institute of Observational Research for Global Change
JAMSTEC	Japan Agency for Marine-earth Sceinece and Technology
MIO	Mutsu Institute of Oceanography
MWJ	Marine Works Japan Ltd.
ORI	Ocean Research Institute, The University of Tokyo
Tokyo Inst. Tech.	Tokyo Institute of Technology

Table 1.3.2(b) List of cruise participants for MR07-06 Leg.1

Name	Responsibility	Affiliation
Yasuhiro Arii	Carbon	MWJ
Masanori Enoki	Dissolved Oxygen/Thermosalinograph	MWJ
Hironobu Furuya	Biology	The University of Tokyo
Ayaka Hatsuyama	Carbon	MWJ
Mana Hikami	Water Sampling	MWJ
Miyo Ikeda	Dissolved Oxygen/Water Sampling	MWJ
Yoichi Imai	Water Sampling	JMA
Yoshiko Ishikawa	Carbon	MWJ
Kenichi Katayama	CTD	MWJ
Yoshimi Kawai	LADCP/Water Sampling	IORGC/JAMSTEC
Takeshi Kawano	Chief Scientist/Salinity/Water Sampling	IORGC/JAMSTEC
Fujio Kobayashi	Salinity	MWJ
Taketoshi Kodama	Biology	The University of Tokyo
Fumiyoshi Kondo	Air-Sea Turbulent CO2 Flux	Okayama University
Yuichiro Kumamoto	Dissolved Oxygen/Water Sampling/^{14}C	IORGC/JAMSTEC
Nagi Masuda	Water Sampling	MWJ
Junji Matsushita	Nutrients	MWJ
Hiroshi Matsunaga	CTD	MWJ
Kohei Miura	Nutrients	MWJ
Takumi Miyahara	Water Sampling	MWJ
Dai Motomura	Water Sampling	MWJ
Nguyen Van Nguyen	Biology	The University of Tokyo
Kimiko Nishijima	Dissolved Oxygen/Water Sampling	MWJ
Satoshi Okumura	Meteorology / Geophysics	GODI
Harumi Ota	Meteorology / Geophysics	GODI
Kentaro Oyama	CTD	MWJ
Katsunori Sagishima	CFCs	MWJ
Kenichi Sasaki	CFCs	MIO/JAMSTEC
Chie Sato	POC and Bacteria	University of Tsukuba
Fuyuki Shibata	Chief Technologist/Carbon	MWJ
Takuhei Shiozaki	Biology	The University of Tokyo
Charles Stump	Noble Gasses & $^{17}O/^{18}O$	University of Washington
Soichiro Sueyoshi	Meteorology / Geophysics	GODI
Takeshi Suzuki	Water Sampling	MWJ
Naoko Takahashi	Salinity	MWJ
Ayumi Takeuchi	Nutrients	MWJ
Shoko Tatamisashi	CFCs	MWJ
Shinsuke Toyoda	CTD/ARGO	MWJ
Hiroshi Uchida	CTD/LADCP/Water Sampling	IORGC/JAMSTEC
Masahide Wakita	CFCs	MIO/JAMSTEC
Koshi Yamaguchi	Water Sampling	MWJ
Hideki Yamamoto	Radionuclides/Water Sampling	MWJ
Kazuo Yamamoto	Water Sampling	MWJ

GODI	Global Ocean Development Inc.
IORGC	Institute of Observational Research for Global Change
JAMSTEC	Japan Agency for Marine-earth Sceinece and Technology
JMA	Japan Meteorological Agency
MIO	Mutsu Institute of Oceanography
MWJ	Marine Works Japan Ltd.

Table 1.3.2(b) List of cruise participants for MR07-06 Leg.2

Name	Responsibility	Affiliation
Toshimasa Doi	LADCP/Water Sampling	IORGC/JAMSTEC
Masanori Enoki	Dissolved Oxygen/Thermosalinograph	MWJ
Tsutomu Fujii	CTD	MWJ
Hironobu Furuya	Biology	The University of Tokyo
Ayaka Hatsuyama	Carbon	MWJ
Yukiko Hayakawa	Dissolved Oxygen/Water Sampling	MWJ
Yoichi Imai	Water Sampling	JMA
Yoshiko Ishikawa	Carbon	MWJ
Ryota Ito	Water Sampling	MWJ
Minoru Kamata	Carbon	MWJ
Katsuro Katsumata	LADCP/Water Sampling	IORGC/JAMSTEC
Mikio Kitada	Carbon	MWJ
Taketoshi Kodama	Biology	The University of Tokyo
Misato Koide	Water Sampling	MWJ
Atsushi Kubo	Water Sampling	MWJ
Yukiko Kuroki	POC	University of Tsukuba
Junji Matsushita	Radionuclides/Water Sampling	MWJ
Kohei Miura	Nutrients	MWJ
Akihiko Murata	Chief Scientist/Carbon/Water Sampling	IORGC/JAMSTEC
Nguyen Van Nguyen	Biology	The University of Tokyo
Kimiko Nishijima	Dissolved Oxygen/Thermosalinograph	MWJ
Haruka Nishimura	Water Sampling	MWJ
Ayumi Nomura	Water Sampling	MWJ
Takanori Ojima	Water Sampling	MWJ
Shinya Okumura	Meteorology / Geophysics	GODI
Ryo Oyama	Meteorology / Geophysics	GODI
Satoshi Ozawa	Chief Technologist/CTD	MWJ
Katsunori Sagishima	CFCs	MWJ
Kenichi Sasaki	CFCs	MIO/JAMSTEC
Kenichiro Sato	Nutrients	MWJ
Takayoshi Seike	Nutrients	MWJ
Takuhei Shiozaki	Biology	The University of Tokyo
Yuichi Sonoyama	CFCs	MWJ
Naoko Takahashi	Salinity	MWJ
Shoko Tatamisashi	CFCs	MWJ
Tomoyuki Takamori	CTD/ARGO	MWJ
Tatsuya Tanaka	Salinity	MWJ
Hiroshi Uchida	CTD/LADCP/Water Sampling	IORGC/JAMSTEC
Hirokatsu Uno	CTD	MWJ
Kazuho Yoshida	Meteorology / Geophysics	GODI

GODI	Global Ocean Development Inc.
IORGC	Institute of Observational Research for Global Change
JAMSTEC	Japan Agency for Marine-earth Sceinece and Technology
JMA	Japan Meteorological Agency
MIO	Mutsu Institute of Oceanography
MWJ	Marine Works Japan Ltd.

2. Underway Measurement

2.1 Navigation and Batymetry

2.1.1 Navigation

(1) Personnel

Souichiro Sueyoshi	(GODI)
Satoshi Okumura	(GODI)
Shinya Okumura	(GODI)
Kazuho Yoshida	(GODI)
Har umi Ota	(GODI)
Ryo Ohyama	(GODI)

(2) Overview of the equipment

Ship's position, speed and course were provided by Radio Navigation System on R/V MIRAI. The system integrates GPS position, Log speed, Gyro heading and other basic data on workstation. Ship's course and speed over ground are calculated from GPS position. The workstation clock is synchronized to reference clock by using NTP (Network Time Protocol). Navigation data, called as "SOJ data", is distributed to client computer every second, and recorded every 60 seconds.

Navigation devices are listed below.

1. GPS receiver (2sets): Trimble DS-4000 9-channel receiver, these antennas are located on Navigation deck, port and starboard side. GPS position from each receiver is converted to the position of radar mast.
2. Doppler log: Furuno DS-30, which use three acoustic beam for current measurement
3. Gyrocompass: Tokimec TG-6000, sperry mechanical gyrocompass
4. Reference clock: Symmetricom TymServ2100, GPS time server
5. Workstation Hewlett-Packard ZX2000 running HP-UX ver.11.22

(3) Data period

MR07-04:07:00, 24 July 2007 to 17:30, 3 September 2007 (UTC)

MR07-06 Leg1: 21:30, 7 October 2007 to 21:10, 20 November 2007 (UTC)

MR07-06 Leg2: 22:00, 21 November 2007 to 19:10, 25 December 2007 (UTC)

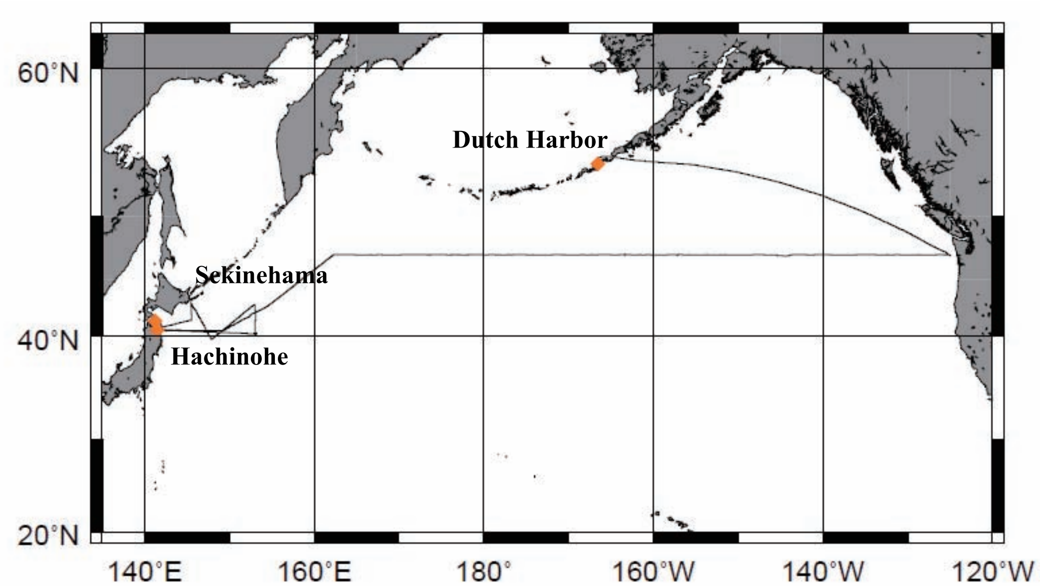

Figure 2.2.1-1 Cruise Track of MR07-04

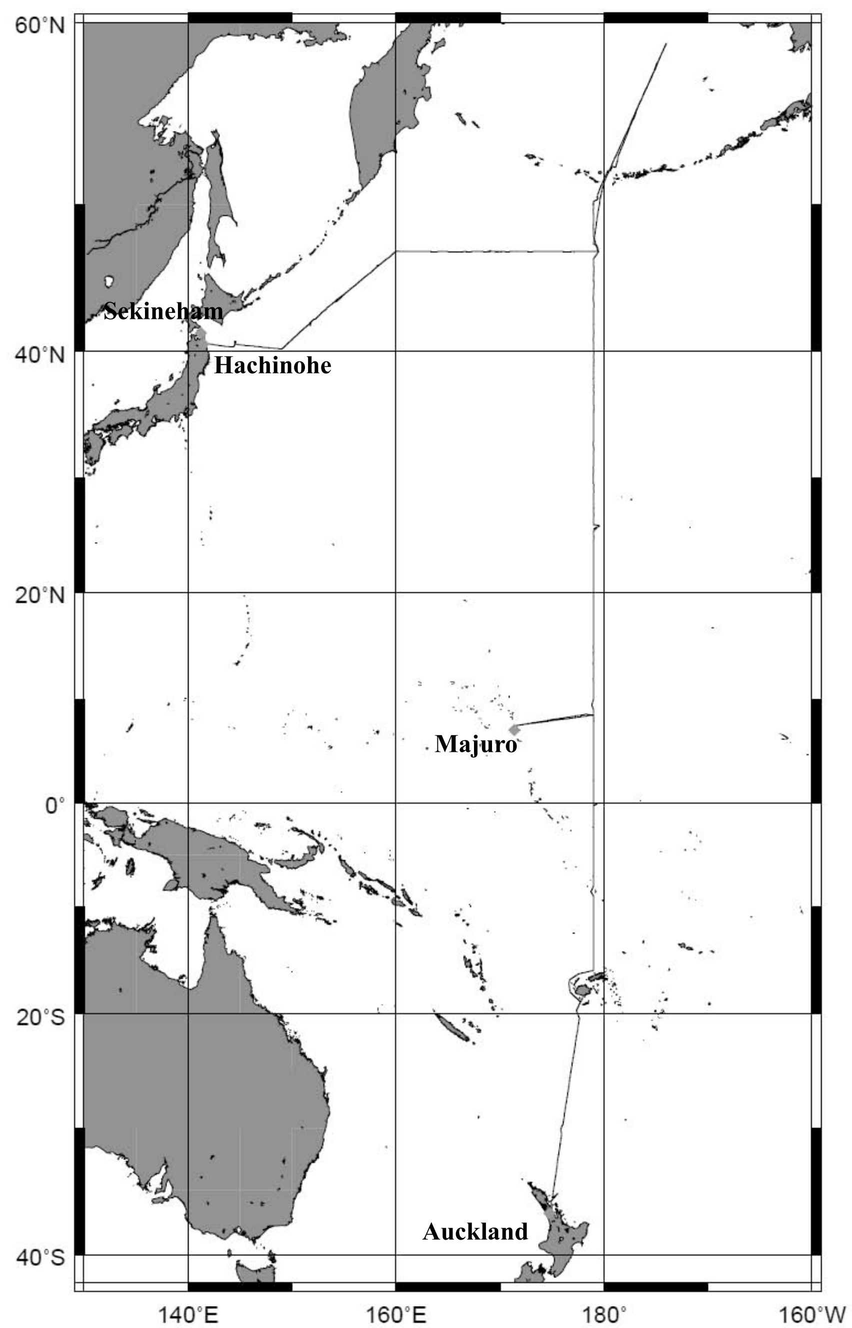

Figure 2.2.1-2 Cruise Track of MR07-06

2.1.2 Bathymetry

(1) Personnel

Takeshi Matsumoto (University of the Ryukyus)
Principal Investigator / Not on-board:
Souichiro Sueyoshi (GODI)
Satoshi Okumura (GODI)
Shinya Okumura (GODI)
Kazuho Yoshida (GODI)
Harumi Ota (GODI)
Ryo Ohyama (GODI)

(2) Overview of the equipments

R/V MIRAI equipped a Multi Beam Echo Sounding system (MBES), SEABEAM 2112.004 (SeaBeam Instruments Inc.) The main objective of MBES survey is collecting continuous bathymetry data along ship's track to make a contribution to geological and geophysical investigations and global datasets. Data interval along ship's track was max 17 seconds at 6,000 m. To get accurate sound velocity of water column for ray-path correction of acoustic multibeam, we used Surface Sound Velocimeter (SSV) data measured at the surface (6.2m depth), and the others depth sound velocity was calculated using temperature and salinity profiles from the nearest CTD data by the equation in Mackenzie (1981).

System configuration and performance of SEABEAM 2112.004,

Frequency:	12 kHz
Transmit beam width:	2 degree
Transmit power:	20 kW
Transmit pulse length:	3 to 20 msec.
Depth range:	100 to 11,000 m

Beam spacing:	1 degree athwart ship
Swath width:	150 degree (max)
	120 degree to 4,500 m
	100 degree to 6,000 m
	90 degree to 11,000 m
Depth accuracy:	Within < 0.5% of depth or +/-1m, whichever is greater, over the entire swath.

(Nadir beam has greater accuracy; typically within < 0.2% of depth or +/-1m, whichever is greater)

(3) Data Period

Bathymetric survey was carried out the CTD observation line during the cruise

MR07-04:	P01-001 on 26 July 2007 to P01-115 on 29 August. 2007
MR07-06 Leg1:	P01-028 on 10 October 2007 to P01-61 on 20 October 2007,
	P14N-001 on 27 October 2007 to P14N-108 on 19 November 2007
MR07-06 Leg2:	P14N-109 on 23 November 2007 to P14N-185 on 12 December 2007
	P14C-048 on 13 December 2007 to P14C-001 on 22 December 2007

(4) Data processing

(4.1) Sound velocity correction

The continuous bathymetry data are split into small areas around each CTD station. For each small area, the bathymetry data are corrected using a sound velocity profile calculated from the CTD data in the area. The equation of Mackenzie (1981) is used for calculating sound velocity. The data processing is carried out using "mbbath" command of MBsystem.

(4.2) Editing and Gridding

Gridding for the bathymetry data are carried out using the HIPS software version 5.4 (CARIS, Canada). Firstly, the bathymetry data during a turn is basically removed before "base surface" is made. A spike noise of each swath data is also removed using "swath editor" and "subset editor". Then the bathymetry data are gridded by "Interpolate" function of the software with following parameters.

BASE surface resolution : 50m x 50m

Interpolate matrix size: 5 x 5

Minimum number of neighbors for interpolate: 16

Finally, interpolated data is exported as ASCII data, and converted to 250m grid data using "xyz2grd" utility of GMT (Generic Mapping Tool) software

.

(5) Data Archive

Bathymetry data obtained during this cruise was submitted to the JAMSTEC Data Management Division, and archived there.

Reference

Mackenzie, K.V. (1981): Nine-term equation for the sound speed in the oceans, J. Acoust. Soc. Am., 70 (3), pp 807-812.

2.1.3 Sea surface gravity

(1) Personnel

Takeshi Matsumoto (University of the Ryukyus)

Principal Investigator / Not on-board:

Souichiro Sueyoshi (GODI)

Satoshi Okumura (GODI)

Shinya Okumura (GODI)

Kazuho Yoshid (GODI)

Harumi Ota (GODI)

Ryo Ohyama (GODI)

(2) Introduction

The difference of local gravity is an important parameter in geophysics. We collected gravity data at the sea surface during MR07-04 cruise from 23 Jul. 2007 to 2 Sep. 2007, MR07-06 Leg1 cruise from 7 Oct. 2007 to 19 Nov. 2007, Leg2 cruise from 23 Nov. 2007 to 23 Dec. 2007.

(3) Parameters

Relative Gravity [mGal]

(4) Data Acquisition

We have measured relative gravity using LaCoste and Romberg air-sea gravity system II (Micro-G LaCoste, Inc.) during this cruise. To convert the relative gravity to absolute one, we measured gravity, using portable gravity meter (Scintrex gravity meter CG-3M), at Sekinehama and Nakagusuku as reference points.

(5) Preliminary Results

Absolute gravity is shown in Table 2.2.3-1

Table 2.2.3-1 Absolute gravity table MR07-04 and MR07-06 cruise

No.	Date	UTC	Port	Absolute Gravity (mGal)	Sea Level (cm)	Draft (cm)	Gravity at Sensor*1 (mGal)	L&R*2 (mGal)
1	23/Jul/2007	06:16	Sekinehama	980371.94	261	615	980372.78	12642.60
2*3	02/Oct/2007	07:03	Sekinehama	980371.94	215	603	980372.64	12642.29
3	07/Oct/2007	00:29	Sekinehama	980371.93	281	628	980372.84	12644.04
4*4	25/Jan/2008	03:53	Nakagusuku	979114.70	285	628	979115.62	11386.68

*1: Gravity at Sensor= Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.0431

*2: LaCoste and Romberg air-sea gravity system II

*3: MR07-05 cruise

*4: MR07-07 Leg1 cruise

(6) Data Archive

Gravity data obtained during this cruise was submitted to the JAMSTEC Data Management Division, and archived there.

2.1.4 On-board geomagnetic measurement

(1) Personnel

Takeshi Matsumoto (University of the Ryukyus)
Principal Investigator / Not on-board:
Souichiro Sueyoshi (GODI)
Satoshi Okumura (GODI)
Shinya Okumura (GODI)
Kazuho Yoshida (GODI)
Harumi Ota (GODI)
Ryo Ohyama (GODI)

(2) Introduction

Measurements of magnetic force on the sea are required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. We measured geomagnetic field using a three-component magnetometer during MR07-04 cruise from 23 Jul. 2007 to 2 Sep. 2007, MR07-06 Leg1 cruise from 7 Oct. 2007 to 19 Nov. 2007, Leg2 cruise from 23 Nov. 2007 to 23 Dec. 2007.

(3) Method

A shipboard three-component magnetometer system (Tierra Tecnica SFG1214) is equipped on-board R/V Mirai. Three-axis flux-gate sensors with ring-cored coils are fixed on the fore mast. Outputs of the sensors are digitized by a 20-bit A/D converter (1 nT/LSB), and sampled at 8 times per second. Ship's heading, pitch and roll are measured utilizing a Fiber-Optic Gyro installed for Doppler radar system. Ship's position (GPS) and speed data are taken from Navigation data via LAN every second.

(4) Data Archive

Magnetic force data obtained during this cruise was submitted to the JAMSTEC Data Management Division, and archived there.

(5) Remarks

For calibration of the ship’s magnetic effect, we made a “figure-eight” turn (a pair of clockwise and anti-clockwise rotation). This calibration was carried out as below.

MR07-04 cruise: 22 Aug 2007, 06:49 to 07:17 about at 46-59N, 152-31W
MR07-06 cruise: 03 Dec. 2007, 02:03 to 02:24 about at 00-03S, 179-20E

2.2 Surface Meteorological Observation

(1) Personnel

Kunio Yoneyama (JAMSTEC)
Satoshi Okumura (GODI)
Souichiro Sueyoshi (GODI)
Shinya Okumura (GODI)
Kazuho Yoshida (GODI)
Ryo Ohyama (GODI)
Harumi Ota (GODI)

(2) Objective

As a basic dataset that describes weather conditions during the cruise, surface meteorological observation was continuously conducted.

(3) Methods

There are two different surface meteorological measurement systems on board the R/V MIRAI. One is the MIRAI surface meteorological observation system (SMET), and the other is the Shipboard Oceanographic and Atmospheric Radiation measurement system (SOAR).

Instruments of SMET are listed in Table 2.2.1. All SMET data were collected and processed by KOAC-7800 weather data processor made by Koshin Denki, Japan. Note that although SMET contains rain gauge, anemometer and radiometers in their system, we adopted those data from not SMET but SOAR due to the following reasons; 1) Since SMET rain gauge is located near the base of the mast, there is a possibility that its capture rate might be affected, 2) SOAR's anemometer has better starting threshold wind speed (1 m s^{-1}) comparing to SMET's anemometer (2 m s^{-1}), and 3) SMET's radiometers record data with 10 W/m^2 resolution, while SOAR takes high resolution data of 1 W/m^2.

SOAR system was designed and constructed by the Brookhaven National Laboratory (BNL), USA, for an accurate measurement of solar radiation on the ship. Details of SOAR can be found at http://www.gim.bnl.gov/soar/. SOAR consists of 1) Portable Radiation Package (PRP) that measures short and long wave downwelling radiation, 2) Zeno meteorological system that measures pressure, air temperature, relative humidity, wind speed/direction, and rainfall, and 3) Scientific Computer System (SCS) developed by the National Oceanic and Atmospheric Administration (NOAA), USA, for data collection, management, real-time monitoring, and so on. Information on sensors used here is listed in Table 2.2.2.

Table 2.2.1. Instruments and locations of SMET.

Sensor	Parameter	Manufacturer / type	Location / height from sea level
Thermometer*1	air temperature	Vaisala, Finland / HMP45A	compass deck*2 / 21 m
	relative humidity		
Thermometer	sea temperature	Sea-Bird Electoronics, Inc./SBE3S*3	4th deck / -5 m
Barometer	pressure	Setra Systems Inc., USA / 370	captain deck / 13 m

*1 Gill aspirated radiation shield 43408 made by R. M. Young, USA is attached.
*2 There are two thermometers at starboard and port sides.
*3 Sea surface temperature data were taken from EPCS surface water monitoring system.

Table 2.2.2. Instruments and locations of SOAR.

Sensor	Parameter	Manufacturer / type	Location / height from sea level
Anemometer	wind speed/direction	R. M. Young, USA / 05106	foremast / 25 m
Rain gauge	rainfall accumulation	R. M. Young, USA / 50202	foremast / 24 m
Radiometer	short wave radiation	Eppley, USA / PSP	foremast / 24 m
	long wave radiation	Eppley, USA / PIR	foremast / 24 m

(4) Data processing and data format

All raw data were recorded every 6 seconds. Datasets produced here are 1-minute mean values (time stamp at the end of the average). They are simple mean of 8 samples (10 samples minus maximum/minimum values) to exclude singular values. Liner interpolation onto missing values was applied only when their interval is less than 5 minutes.

Since the thermometers are equipped on both starboard/port sides on the deck, we used air temperature/relative humidity data taken at upwind side. Dew point temperature was produced from relative humidity and air temperature data.

No adjustment to sea level values is applied except pressure data.

Data are stored as ASCII format and contains following parameters.

Time in UTC expressed as YYYYMMDDHHMM, time in Julian day (1.0000 = January 1, 0000Z), longitude (°E), latitude (°N), pressure (hPa), air temperature (°C), dew point temperature (°C), relative humidity (%), sea surface temperature (°C), zonal wind component (m/sec), meridional wind component (m/sec), precipitation (mm/hr), downwelling shortwave radiation (W/m^2), and downwelling longwave radiation (W/m^2).

Missing values are expressed as "9999".

(5) Data Quality

To ensure the data quality, each sensor was calibrated as follows. Since there is a possibility for fine time resolution data sets to have some noises caused (generated) by turbulence, it is recommended to filter them out (ex. hourly mean) from this 1-minute mean data sets depending on the scientific purpose.

T/RH sensor:

Temperature and humidity probes were calibrated before/after the cruise by the manufacturer. Certificated accuracy of T/RH sensors are better than ± 0.2 °C and ± 2 %, respectively.

We also checked T/RH values using another calibrated portable T/RH sensor (Vaisala, HMP45A) before and after the cruise. The results are,

Temperature (°C)

Mean difference between T (SMET) and T (portable) is

-0.23±0.22 (°C) at port side, -0.06±0.16 (°C) at starboard side.

Relative Humidity (%)

Mean difference between RH (SMET) and RH (portable) is

2.6±1.3 (%) at port side, 1.7±1.5 (%) at starboard side.

Sea surface temperature sensor:

Temperature sensor was calibrated before the cruise at the manufacturer. Certificated accuracy is better than 0.0002°C for MR07-04 cruise and 0.00003°C for MR07-06 cruise, respectively.

Pressure sensor:

Using calibrated portable barometer (Vaisala, Finland / PTB220, certificated accuracy is better than ± 0.1 hPa), pressure sensor was checked before/after the cruise. Mean difference of SMET pressure sensor and portable sensor is 0.04±0.05 hPa.

Precipitation:

Before the cruise, we put water into the rain gauge to check their linearity between the indicated values and water amount input. Expected accuracy is better than ± 1 mm corresponding to the sensor's specification. The results are as follows, and data were corrected using this relationship.

	MR07-04	MR07-06 Leg-1	Leg-2
minimum input water volume (cc)	0.0	0.0	0.0
minimum measured value (mm)	1.0	1.1	1.1
maximum input water volume (cc)	512.5	512.3	510.0
maximum measured value (mm)	51.8	51.9	51.9

Radiation sensors:

Short wave and long wave radiometers were calibrated by the manufacturer, Remote Measurement and Research Company, USA, prior to the cruise (April 2008).

(6) Data periods

MR07-04 0700 UTC, July 24, 2007 - 0000 UTC, September 2, 2007

MR07-06 Leg-1 2130 UTC, October 7, 2007 - 2110 UTC, November 20, 2007

MR07-06 Leg-2 0100 UTC, November 23, 2007 - 0130 UTC, December 23, 2007

(7) Point of contact

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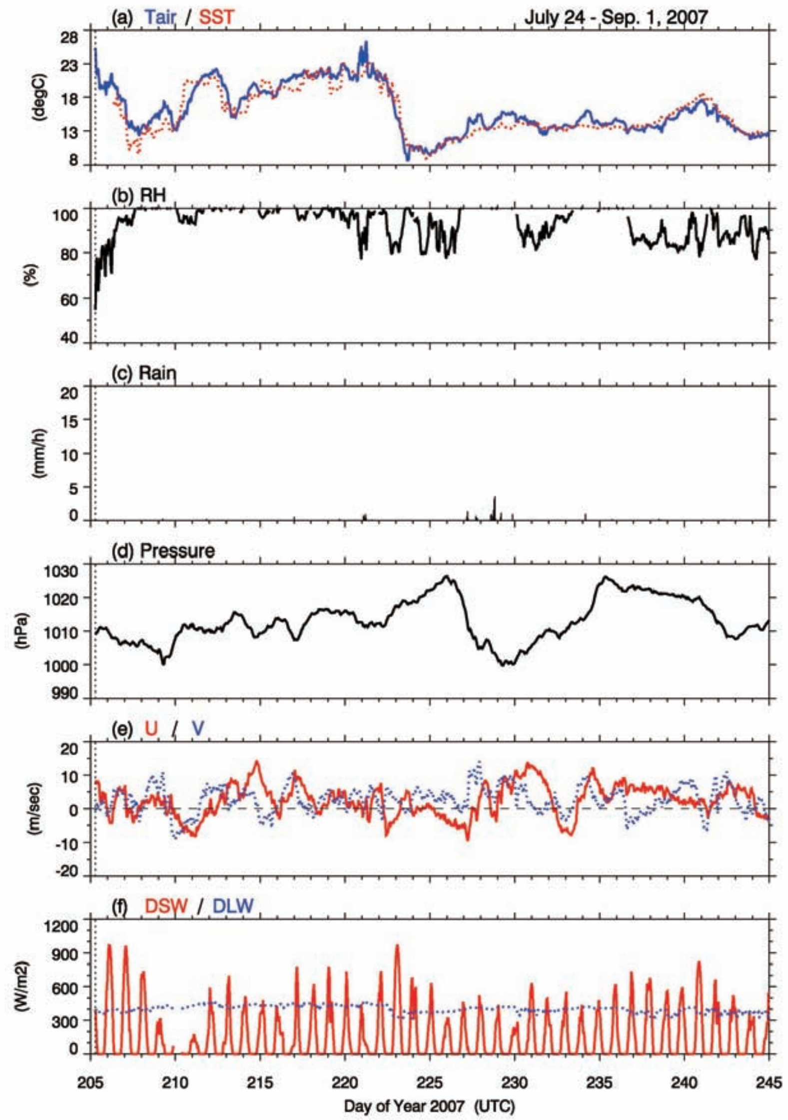

Figure 2.2.1. Time series of (a) air and sea surface temperature, (b) relative humidity, (c) precipitation, (d) pressure, (e) zonal and meridional wind components, and (e) short and long wave radiation for MR07-04 cruise data. Day 205 corresponds to July 24, 2007.

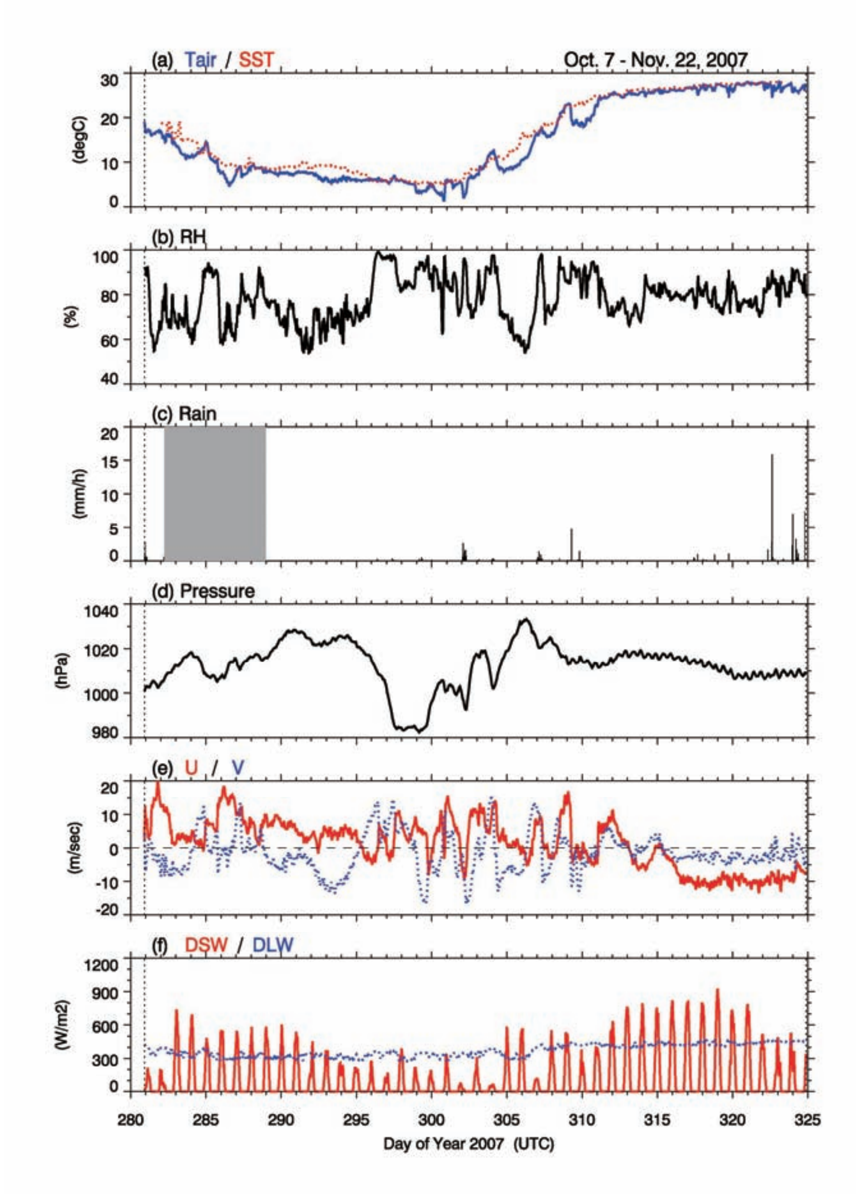

Figure 2.2.2. Same as Figure 2.2.1, but for MR07-06 leg 1 cruise. Day 280 corresponds to October 7, 2007. Shading in (c) indicates no data is available during this period.

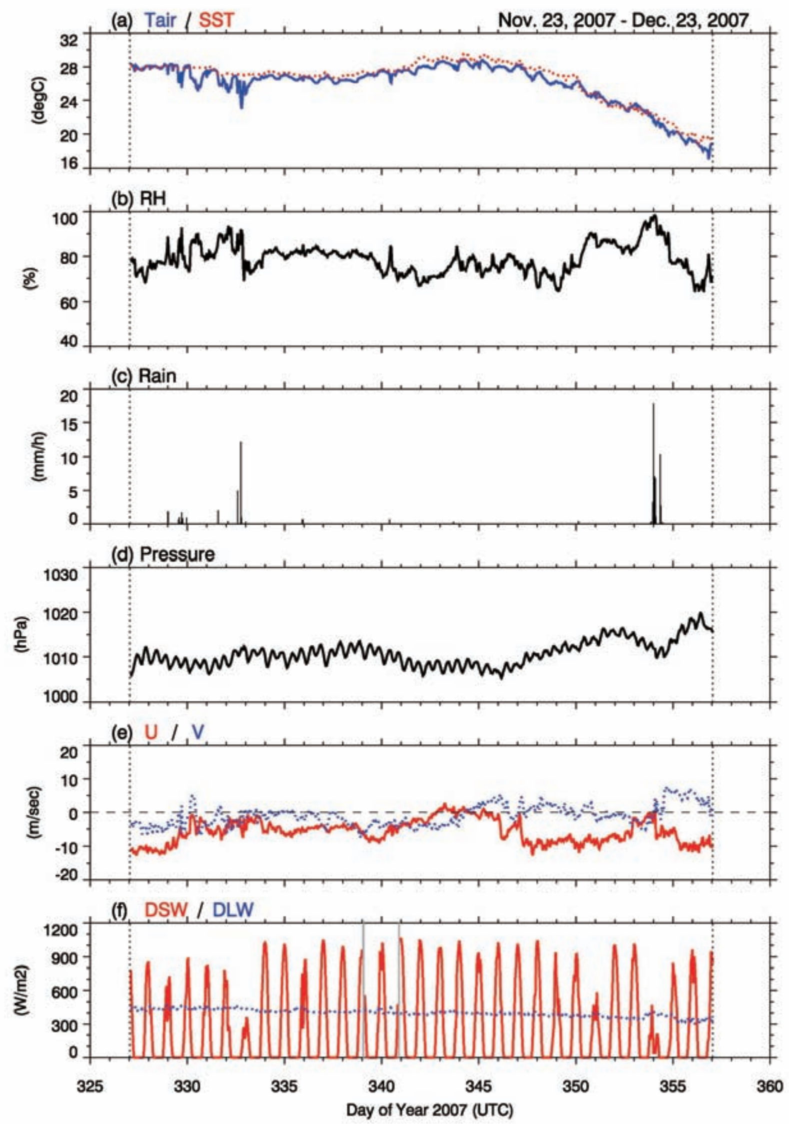

Figure 2.2.3. Same as Figure 2.2.1, but for MR07-06 leg 2 cruise. Day 325 corresponds to November 21, 2007.

2.3 Thermosalinograph and related measurements

9 September 2008

(1) Personnel

Yuichiro Kumamoto (JAMSTEC)

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(2) Objective

Our purpose is to measure salinity, temperature, dissolved oxygen, and fluorescence in near-sea surface water during MR07-04 and MR07-06 cruises.

(3) Methods

The Continuous Sea Surface Water Monitoring System (Nippon Kaiyo Co. Ltd.), including the thermo-salinograph, has five sensors and automatically measures salinity, temperature, dissolved oxygen, and fluorescence in near-sea surface water every one minute. This system is located in the sea surface monitoring laboratory on R/V MIRAI and connected to shipboard LAN system. Measured data, time, and location of the ship were displayed on a monitor and then stored in a data management PC (IBM NetVista 6826-CBJ). The near-surface water was continuously pumped up to the laboratory from about 4 m water depth and flowed into the system through a vinyl-chloride pipe. The flow rate of the surface seawater was controlled by several valves and adjusted to be 12 L/min except for a fluorometer (about 0.5 L/min). The flow rate was measured by two flow meters. Specifications of the each sensor in this system are listed below.

a) Temperature and salinity sensors

SEACAT THERMOSALINOGRAPH

Model:	SBE-21, SEA-BIRD ELECTRONICS, INC.	
Serial number:	MR07-04 [25 ~ 31 July]: 2641 (Cal. Date: 9 Feb. 2007)	
	MR07-04 [31 July ~ 1 Sep]: 3126 (Cal. Date: 1 Sep. 2006)	
	MR07-06: 2641 (Cal. Date: 9 Feb. 2007)	
Measurement range:	Temperature −5 to +35°C,	Salinity 0 to 6.5 S m^{-1}
Accuracy:	Temperature 0.01°C 6$month^{-1}$,	Salinity 0.001 S m^{-1} $month^{-1}$
Resolution:	Temperatures 0.001°C,	Salinity0.0001 S m^{-1}

b) Bottom of ship thermometer

Model:	SBE 3S, SEA-BIRD ELECTRONICS, INC.
Serial number:	MR07-04: 2175 (Cal. Date: 15 Feb. 2007)
	MR07-06: 2607 (Cal. Date: 10 Aug. 2007)
Measurement range:	−5 to +35°C
Resolution:	±0.001°C
Stability:	0.002°C $year^{-1}$

c) Dissolved oxygen sensor

Model:	2127A, HACH ULTRA ANALYTICS JAPAN, INC.
Serial number:	47477
Measurement range:	0 to 14 ppm
Accuracy:	±1% at 5°C of correction range
Stability:	1% $month^{-1}$

d) Fluorometer

Model:	10-AU-005, TURNER DESIGNS
Serial number:	5562 FRXX
Detection limit:	5 ppt or less for chlorophyll-a
Stability:	0.5% $month^{-1}$ of full scale

e) Flow meter

Model:	EMARG2W, Aichi Watch Electronics LTD.
Serial number:	8672

Measurement range: 0 to 30 l min^{-1}
Accuracy: ±1%
Stability: ±1% day^{-1}

(4) Measurements

Periods of measurement, maintenance, and problems during MR07-04 and MR07-06 are listed in Table 2.3.1. During MR07-04, SEB-21 was exchanged from S/N 2641 to S/N 3126 on July 31. During MR07-06, an antifoulant (antibiotic) device to prevent growth of aquatic organisms was detached from the SBE-21 sensors due to a problem on November 7. Due to this problem salinity data were lost between October 30 and November 7.

(5) Calibrations

(5.1) Comparison with bottle data

We collected the surface seawater samples for salinity sensor calibration (Table 2.3.2 and 2.3.3). The seawaters were collected approximately twice a day using a 250ml brown grass bottle. The samples were stored in the sea surface monitoring laboratory and then measured using the Guildline 8400B at the end of the legs after all the measurements of the hydrocast bottle samples (see section 3.2).

(5.2) Sensor calibrations

The sensors for temperature and salinity were calibrated before the cruise. After the cruise the sensors will be calibrated again in order to evaluate drifts of measurements during the cruise. The results of the calibrations are available via our web page, http://www.jamstec.go.jp/cruisedata/mirai/e/index.html.

(6) Date archive

Quality controlled data and meta-data are available via our web page, http://www.jamstec.go.jp/cruisedata/mirai/e/index.html.

Table 2.3.1 Events list of the thermo-salinograph during MR07-04 and MR07-06

Cruise	Date [UTC]	Time [UTC]	Event	Remarks
MR07-04	25-July-07	10:07	All the measurements started.	Departure Hachinohe
	31-July-07	20:49	All the measurements stopped. Checked SBE21(S/N2641)	
	31-July-07	22:19	All the measurements started. Exchanged SBE21(S/N2641 –> S/N3126)	
	02-Aug.-07	23:15~23:16	Failure of data storage for location.	Unknown problem
	08-Aug.-07	01:01	All the measurements stopped.	Arrival Hachinohe
	10-Aug.-07	00:46	All the measurements started.	Departure Hachinohe
	01-Sep.-07	17:55	All the measurements stopped.	Arrival Dutch Harbor
MR07-06	9-Oct.-07	02:17	All the measurements started.	Departure Hachinohe (Leg-1 start)
	05-Nov.-07	14:31~14:35	Lost of all the data.	Due to a tripping of a circuit breaker
	30-Oct.-07	03:36	Lost of salinity data.	Due to a problem of the antibiotic device
	07-Nov.-07	04:08		
	07-Nov.-07	04:09~05:04	Lost of all the data.	Reboot of the data management PC
	18-Nov.-07	04:35	Failure of RMT temperature data archive.	Due to a noise in the data
	19-Nov.-07	07:36	All the measurements stopped.	Arrival Majuro (Leg-1 end)
	23-Nov.-07	02:00	All the measurements started.	Departure Majuro (Leg-2 start)
	23-Dec.-07	01:28	All the measurements stopped.	Arrival Auckland (Leg-2 end)

Table 2.3.2 Comparison of the sensor salinity with the bottle salinity during MR07-04.

Date [UTC]	Time [UTC]	Latitude	Longitude	Sensor salinity [PSS-78]	Bottle salinity [PSS-78]	Difference [Sen. - Bot.]
2007/7/25	11:45	40-59.56800N	143-01.10930E	33.5532	33.5435	0.0097
2007/7/25	22:50	41-25.73860N	145-33.00760E	33.1134	33.1092	0.0042
2007/7/26	7:50	42-48.17710N	145-27.19090E	33.0332	32.9148	0.1184
2007/7/26	18:35	42-39.75580N	145-41.41540E	32.8070	32.7676	0.0394
2007/7/27	6:57	42-10.79830N	146-05.03190E	32.7934	32.7528	0.0406
2007/7/27	18:26	41-52.48810N	146-18.41610E	32.6836	32.6956	-0.0120
2007/7/28	6:25	41-42.78640N	146-26.08430E	32.7105	32.7144	-0.0039
2007/7/28	17:42	41-21.42700N	146-41.11320E	32.7118	32.7226	-0.0108
2007/7/29	6:17	40-50.82040N	147-04.04230E	32.7539	32.8174	-0.0635
2007/7/29	18:17	40-07.44810N	147-33.93700E	34.3895	34.3785	0.0110
2007/7/30	6:15	39-41.50140N	147-55.39620E	34.3704	34.3733	-0.0029
2007/7/30	18:49	40-19.26800N	148-52.31960E	34.4994	34.4946	0.0048
2007/7/31	6:58	40-55.49780N	149-51.04410E	34.4920	34.4889	0.0031
2007/7/31	19:15	41-33.67610N	150-52.33380E	33.0052	32.9972	0.0080
2007/8/1	7:01	42-20.17860N	152-05.04200E	33.2326	33.2204	0.0122
2007/8/1	17:05	42-40.53890N	152-42.26540E	33.0865	33.0802	0.0063
2007/8/2	3:43	42-46.24720N	152-52.61200E	33.0909	33.086	0.0049
2007/8/2	14:40	42-16.33730N	153-02.98470E	33.7921	33.7798	0.0123
2007/8/3	11:06	41-09.40780N	153-00.48910E	34.5137	34.5066	0.0071
2007/8/3	21:09	40-32.21620N	153-00.60930E	33.7968	33.8032	-0.0064
2007/8/4	8:43	40-00.34550N	153-01.61040E	34.1606	34.1553	0.0053
2007/8/4	23:16	40-11.85680N	153-09.64890E	33.8481	33.844	0.0041
2007/8/5	7:25	40-12.99160N	152-33.21310E	33.9156	33.9139	0.0017
2007/8/5	22:56	40-18.83730N	150-22.60930E	33.5227	33.5537	-0.0310
2007/8/6	8:29	40-21.15240N	148-57.04860E	33.7495	33.712	0.0375
2007/8/6	22:49	40-24.15980N	147-13.70230E	34.4521	34.4463	0.0058
2007/8/7	8:34	40-26.14660N	146-01.54310E	33.6041	33.5854	0.0187
2007/8/10	3:29	40-30.47580N	148-30.41270E	32.6756	32.6924	-0.0168
2007/8/10	15:38	41-45.96810N	152-21.06700E	33.0687	33.0622	0.0065
2007/8/11	2:43	43-18.92240N	155-37.71560E	33.9769	33.9437	0.0332
2007/8/11	7:34	44-05.47490N	156-59.82140E	32.8430	32.8564	-0.0134
2007/8/11	21:08	46-15.85980N	160-54.30660E	32.9301	32.9136	0.0165
2007/8/12	10:23	47-00.16990N	163-58.87420E	32.7841	32.8029	-0.0188
2007/8/12	20:49	46-59.16850N	166-44.32290E	32.8503	32.8436	0.0067
2007/8/13	10:17	47-00.34900N	171-07.85130E	32.7411	32.7608	-0.0197
2007/8/13	22:10	47-00.12300N	175-35.01600E	32.8015	32.8139	-0.0124
2007/8/14	12:08	46-59.93210N	178-18.23620E	32.7989	32.7947	0.0042
2007/8/14	21:53	47-00.83360N	179-26.98080E	32.7283	32.7244	0.0039
2007/8/15	9:26	46-59.51960N	178-18.91400W	32.6862	32.6819	0.0043
2007/8/15	21:48	47-00.07570N	176-37.54620W	32.5401	32.5288	0.0113
2007/8/16	9:45	47-00.04090N	174-56.44210W	32.6165	32.6103	0.0062
2007/8/16	21:05	46-59.78510N	172-42.64610W	32.7305	32.7317	-0.0012
2007/8/17	8:58	47-00.42840N	171-15.40150W	32.6261	32.6201	0.0060
2007/8/17	20:13	46-59.66060N	169-20.49430W	32.5481	32.5443	0.0038
2007/8/18	8:55	47-00.45780N	167-05.29050W	32.6200	32.6132	0.0068
2007/8/18	21:57	47-01.17270N	164-59.92870W	32.7182	32.7068	0.0114
2007/8/19	7:47	47-00.44260N	163-43.31850W	32.6417	32.6403	0.0014
2007/8/19	20:06	47-00.56460N	161-29.41830W	32.6488	32.6454	0.0034
2007/8/20	8:42	46-59.45290N	159-40.89610W	32.8259	32.7851	0.0408
2007/8/20	19:06	47-00.21960N	158-08.58960W	32.6516	32.6507	0.0009
2007/8/21	8:05	46-59.50660N	155-51.80530W	32.6803	32.6594	0.0209
2007/8/21	20:49	47-00.05950N	153-38.13320W	32.6733	32.6492	0.0241
2007/8/22	8:51	46-57.98700N	152-03.39390W	32.5771	32.5925	-0.0154
2007/8/22	21:01	46-59.89670N	151-37.39790W	32.5729	32.5669	0.0060
2007/8/23	7:05	46-59.11440N	150-17.59340W	32.5377	32.5289	0.0088
2007/8/23	19:37	47-00.48950N	148-02.17190W	32.4434	32.4448	-0.0014
2007/8/24	7:13	46-59.97990N	145-48.73560W	32.4713	32.3907	0.0806
2007/8/24	19:29	46-59.56400N	143-40.41810W	32.3720	32.3577	0.0143
2007/8/25	6:47	46-59.96520N	141-54.50520W	32.3190	32.3614	-0.0424

2007/8/25	21:10	47-00.04030N	139-04.06470W	32.4736	32.4163	0.0573
2007/8/26	7:39	46-59.23350N	137-29.04750W	32.4100	32.4496	-0.0396
2007/8/26	17:20	46-59.98240N	135-43.90950W	32.4774	32.4267	0.0507
2007/8/27	5:59	46-59.30070N	133-27.95720W	32.4447	32.4419	0.0028
2007/8/27	17:02	47-00.38230N	131-13.71710W	32.3672	32.3549	0.0123
2007/8/28	6:43	47-00.11040N	128-38.31500W	32.3364	32.2963	0.0401
2007/8/28	18:37	47-00.30230N	126-28.19600W	32.0321	32.1002	-0.0681*
2007/8/29	6:10	46-55.65720N	124-58.92520W	31.8860	31.581	0.3050*
2007/8/29	16:56	48-01.70010N	127-57.81150W	31.8923	32.3276	-0.4353*
2007/8/30	7:34	49-37.43780N	132-44.53330W	32.2969	32.0908	0.2061*

* Difference between the sensor and the bottle salinity is large.

Table 2.3.3 Comparison of the sensor salinity with the bottle salinity during MR07-06

Date [UTC]	Time [UTC]	Latitude	Longitude	Sensor salinity [PSS-78]	Bottle salinity [PSS-78]	Difference [Sen. - Bot.]
2007/10/9	5:25	40-32.06180N	144-33.13440E	33.8540	33.8458	0.0082
2007/10/9	14:12	40-22.40990N	146-42.40840E	33.6539	33.7204	-0.0665*
2007/10/10	2:55	41-05.85970N	150-18.13910E	33.0454	33.0327	0.0127
2007/10/10	17:23	42-20.76330N	152-09.03380E	33.0246	33.0196	0.0050
2007/10/11	6:36	43-04.88550N	153-19.58350E	32.8880	32.8815	0.0065
2007/10/11	18:27	44-04.74300N	154-59.84680E	32.6292	32.6202	0.0090
2007/10/12	6:42	44-20.23280N	155-24.25840E	32.6718	32.6882	-0.0164
2007/10/12	18:48	45-04.93350N	156-38.62630E	32.6208	32.6191	0.0017
2007/10/13	6:20	46-05.23470N	158-20.15860E	32.6245	32.6095	0.0150
2007/10/13	17:47	46-30.35720N	159-06.53620E	32.6256	32.6067	0.0189
2007/10/14	6:03	47-01.02970N	160-08.89530E	32.6805	32.6503	0.0302
2007/10/14	17:40	46-59.52310N	162-15.61480E	32.6576	32.6517	0.0059
2007/10/15	5:48	47-00.14140N	164-21.29860E	32.7218	32.7181	0.0037
2007/10/15	18:09	46-59.07380N	165-37.89780E	32.7204	32.7177	0.0027
2007/10/16	5:45	46-57.67950N	166-43.18590E	32.7198	32.7006	0.0192
2007/10/16	17:21	46-59.41470N	168-22.56610E	32.6269	32.6230	0.0039
2007/10/17	4:43	47-00.57730N	169-05.85870E	32.6415	32.6348	0.0067
2007/10/17	16:50	46-58.65870N	169-48.59680E	32.6433	32.6435	-0.0002
2007/10/18	4:37	46-59.83390N	170-28.31700E	32.6664	32.6637	0.0027
2007/10/18	17:37	47-00.36100N	172-11.21260E	32.6925	32.6908	0.0017
2007/10/19	4:00	47-00.24210N	173-49.77000E	32.6660	32.6612	0.0048
2007/10/19	17:22	46-59.80860N	176-05.82360E	32.6682	32.6711	-0.0029
2007/10/20	4:52	46-59.40840N	177-23.84440E	32.7044	32.6961	0.0083
2007/10/20	17:22	47-00.00850N	179-26.22310E	32.7052	32.6981	0.0071
2007/10/21	4:47	47-59.94950N	178-58.96240E	32.7126	32.7113	0.0013
2007/10/21	16:29	48-59.35410N	178-58.98940E	32.7462	32.7458	0.0004
2007/10/22	5:27	50-00.83360N	178-58.88290E	32.7591	32.7558	0.0033

2007/10/22	16:31	50-28.96300N	179-17.18900E	32.7410	32.7375	0.0035
2007/10/23	4:21	50-56.90210N	179-34.72020E	32.7865	32.7856	0.0009
2007/10/23	17:34	51-49.39240N	179-48.31570W	33.1172	33.0838	0.0334
2007/10/24	4:31	52-16.13690N	178-58.41500W	33.0384	33.0340	0.0044
2007/10/24	16:44	53-29.70310N	178-14.46000W	33.0212	32.9384	0.0828*
2007/10/25	4:14	54-29.63280N	177-33.24850W	32.9897	33.0030	-0.0133
2007/10/25	16:43	55-46.93320N	176-39.18100W	32.9090	32.8842	0.0248
2007/10/26	5:22	56-58.85310N	175-40.15170W	32.6355	32.6284	0.0071
2007/10/26	18:01	57-59.76550N	174-49.90480W	32.5895	32.5258	0.0637*
2007/10/27	4:57	58-08.08730N	174-44.48860W	32.5030	32.3429	0.1601*
2007/10/27	17:19	56-30.05810N	176-03.67350W	32.5951	32.7054	-0.1103*
2007/10/28	4:39	54-08.81850N	177-54.30220W	32.9045	32.9649	-0.0604*
2007/10/28	13:05	52-32.19380N	179-08.82310W	33.0417	33.0057	0.0360
2007/10/29	4:01	50-14.37020N	179-37.14930E	32.7248	32.7183	0.0065
2007/10/29	14:42	47-41.52110N	179-02.67540E	32.7274	32.6862	0.0412
2007/10/30	3:41	46-53.64970N	179-22.82010E	-	32.6969	-
2007/10/30	15:14	45-59.16150N	179-01.56400E	-	32.6628	-
2007/10/31	3:35	45-00.74700N	178-57.16110E	-	32.8870	-
2007/10/31	15:15	44-25.17970N	178-59.33940E	-	32.9982	-
2007/11/1	3:39	43-25.96290N	179-02.30580E	-	33.0939	-
2007/11/1	15:26	42-28.59190N	178-59.11440E	-	33.4875	-
2007/11/2	3:12	41-23.64650N	179-01.51310E	-	33.8685	-
2007/11/2	15:27	40-20.81390N	178-59.78120E	-	33.9810	-
2007/11/3	3:24	39-26.10410N	179-02.86940E	-	33.9847	-
2007/11/3	15:45	38-23.33390N	178-58.98450E	-	34.2733	-
2007/11/4	3:31	37-18.29470N	179-01.24320E	-	34.1793	-
2007/11/4	16:00	35-59.85240N	179-00.06330E	-	34.3576	-
2007/11/5	3:58	35-00.12920N	179-00.07790E	-	34.3425	-
2007/11/5	15:55	33-44.35400N	178-59.55440E	-	34.3342	-
2007/11/6	3:11	32-29.25280N	178-59.81090E	-	34.4613	-
2007/11/6	15:20	31-30.00990N	179-01.02830E	-	34.9858	-
2007/11/7	3:58	30-29.46880N	178-58.82510E	-	34.8471	-

2007/11/7	15:23	29-29.82960N	178-59.54800E	35.0656	35.0616	0.0040
2007/11/8	3:31	28-29.09130N	178-59.81260E	35.1072	35.1020	0.0052
2007/11/8	15:09	27-29.82050N	179-00.43770E	35.1408	35.1350	0.0058
2007/11/9	3:38	26-29.73090N	179-00.05290E	35.1328	35.1256	0.0072
2007/11/9	15:02	26-01.48300N	179-09.89370E	35.2352	35.2285	0.0067
2007/11/10	3:35	25-55.53690N	179-35.36160E	35.1871	35.1823	0.0048
2007/11/10	14:53	25-37.38100N	179-08.77730E	35.1945	35.1835	0.0110
2007/11/11	3:32	25-00.00200N	179-00.87020E	35.1259	35.1160	0.0099
2007/11/11	15:07	24-00.25110N	178-59.54920E	35.1751	35.1667	0.0084
2007/11/12	3:25	23-00.17370N	178-59.73550E	35.1788	35.1675	0.0113
2007/11/12	15:29	22-00.68720N	178-59.79810E	35.2859	35.2776	0.0083
2007/11/13	3:54	20-40.66570N	178-59.76420E	35.2590	35.2487	0.0103
2007/11/13	15:15	19-30.66360N	179-00.02710E	34.9384	34.9276	0.0108
2007/11/14	3:29	18-30.92670N	179-00.39380E	34.9828	34.9705	0.0123
2007/11/14	15:43	17-31.50610N	178-59.80200E	34.7915	34.7802	0.0113
2007/11/15	4:07	16-24.89740N	178-59.54480E	34.6641	34.6546	0.0095
2007/11/15	15:30	15-30.91970N	178-59.09970E	34.7727	34.7595	0.0132
2007/11/16	3:36	14-30.31750N	178-58.52030E	34.7215	34.7105	0.0110
2007/11/16	15:14	13-30.46350N	178-59.04190E	34.6934	34.6809	0.0125
2007/11/17	3:25	12-31.37000N	178-59.21560E	34.5697	34.5586	0.0111
2007/11/17	15:21	11-31.21370N	178-59.68420E	34.3699	34.3584	0.0115
2007/11/18	4:03	10-30.99360N	178-59.81610E	34.3508	34.3394	0.0114
2007/11/18	15:29	09-29.79300N	178-49.30000E	34.2541	34.2427	0.0114
2007/11/19	4:12	08-45.75560N	178-59.25940E	34.0907	34.0779	0.0128
2007/11/19	7:34	08-30.49010N	178-59.17670E	34.0624	34.0496	0.0128
2007/11/23	6:21	08-28.64970N	177-35.78940E	34.3121	34.2969	0.0152
2007/11/23	20:57	08-30.58210N	178-59.31190E	34.2402	34.2239	0.0163
2007/11/24	4:35	08-15.65310N	178-59.95810E	34.2931	34.2779	0.0152
2007/11/24	15:11	07-44.86660N	179-00.67490E	34.3735	34.3571	0.0164
2007/11/25	5:25	06-59.91330N	179-00.06250E	34.9224	34.9055	0.0169
2007/11/25	15:03	06-43.39460N	179-01.10810E	34.9023	34.8856	0.0167
2007/11/26	9:02	05-48.04660N	179-00.02110E	34.6940	34.6773	0.0167

2007/11/26	19:05	05-26.90940N	178-59.91100E	34.8380	34.8221	0.0159
2007/11/27	3:34	04-59.55490N	178-59.60990E	34.9097	34.8895	0.0202
2007/11/27	15:19	04-28.97130N	179-00.63150E	35.1440	35.1281	0.0159
2007/11/28	3:45	03-59.53280N	179-00.29860E	35.1021	35.0869	0.0152
2007/11/28	15:44	03-30.23710N	179-00.16020E	35.1012	35.0856	0.0156
2007/11/29	3:36	03-00.21240N	179-00.13510E	35.1367	35.1212	0.0155
2007/11/29	16:01	02-18.22210N	179-00.16430E	35.1347	35.1212	0.0135
2007/11/30	3:55	01-46.88070N	178-59.98650E	35.1377	35.1235	0.0142
2007/11/30	15:31	01-15.66770N	179-00.43110E	35.1435	35.1276	0.0159
2007/12/1	3:46	00-44.30730N	178-59.59540E	35.1914	35.1760	0.0154
2007/12/1	15:37	00-14.79480N	178-59.80660E	35.2090	35.1943	0.0147
2007/12/2	4:15	00-14.67970S	178-59.64810E	35.2218	35.2073	0.0145
2007/12/2	12:41	00-10.57770S	179-06.94120E	35.2325	35.2174	0.0151
2007/12/3	4:52	00-12.28510S	179-04.73820E	35.2249	35.2099	0.0150
2007/12/3	14:57	00-44.44420S	179-00.38430E	35.2623	35.2469	0.0154
2007/12/4	3:20	01-14.79930S	178-59.80360E	35.3369	35.3212	0.0157
2007/12/4	15:34	01-44.20500S	178-59.90450E	35.4360	35.4201	0.0159
2007/12/5	3:22	02-17.59460S	178-59.93920E	35.6036	35.5869	0.0167
2007/12/5	15:24	02-53.72300S	178-59.76740E	35.6056	35.5887	0.0169
2007/12/6	3:06	03-27.43530S	179-00.16390E	35.7017	35.6843	0.0174
2007/12/6	15:36	04-00.42580S	179-00.22410E	35.6937	35.6779	0.0158
2007/12/7	3:32	04-30.49320S	179-00.53770E	35.7250	35.7082	0.0168
2007/12/7	15:32	04-59.93530S	179-00.01310E	35.5754	35.5597	0.0157
2007/12/8	3:45	06-00.49190S	179-00.46560E	35.3242	35.3077	0.0165
2007/12/8	14:36	06-53.23310S	178-59.79630E	34.9645	34.9512	0.0133
2007/12/9	4:03	08-00.07870S	178-59.79360E	34.9440	34.9289	0.0151
2007/12/9	15:36	09-00.39210S	178-59.93910E	34.8335	34.8182	0.0153
2007/12/10	3:40	10-00.45970S	178-59.86400E	34.9014	34.8881	0.0133
2007/12/10	15:18	11-13.93150S	178-59.74590E	34.7253	34.7089	0.0164
2007/12/11	3:33	12-30.37470S	178-59.91460E	34.6997	34.7019	-0.0022
2007/12/11	15:51	13-46.37280S	179-00.26670E	34.7411	34.7252	0.0159
2007/12/12	4:00	15-22.73890S	178-59.73240E	34.5721	34.5526	0.0195

2007/12/12	15:19	16-12.74140S	177-54.43780E	34.4854	34.4725	0.0129
2007/12/13	4:35	18-00.97310S	176-45.86950E	34.5336	34.5170	0.0166
2007/12/13	14:24	18-50.60070S	177-46.34680E	34.6658	34.6499	0.0159
2007/12/14	3:17	18-55.97910S	177-42.97910E	34.6754	34.6600	0.0154
2007/12/14	15:33	19-28.61270S	177-27.00180E	34.6839	34.6687	0.0152
2007/12/15	3:23	20-07.58350S	177-31.91270E	34.8697	34.8541	0.0156
2007/12/15	14:34	20-49.63040S	177-33.64870E	34.7734	34.7594	0.0140
2007/12/16	3:13	21-27.06220S	177-28.28690E	34.7654	34.7500	0.0154
2007/12/16	14:27	22-35.48470S	177-15.81440E	35.1803	35.1668	0.0135
2007/12/17	3:34	23-28.79280S	177-06.59720E	35.2719	35.2571	0.0148
2007/12/17	15:22	24-33.84780S	176-55.51780E	35.3974	35.3832	0.0142
2007/12/18	3:14	25-40.20740S	176-44.22250E	35.3818	35.3685	0.0133
2007/12/18	15:32	26-32.00690S	176-35.73230E	35.5411	35.5272	0.0139
2007/12/19	3:17	27-42.58850S	176-23.83980E	35.3077	35.2935	0.0142
2007/12/19	14:58	28-42.40730S	176-13.37440E	35.4757	35.4621	0.0136
2007/12/20	3:33	29-47.61200S	175-58.31910E	35.5968	35.5770	0.0198
2007/12/20	15:37	30-52.84490S	175-51.55180E	35.6651	35.6505	0.0146
2007/12/21	3:21	31-44.20450S	175-43.19030E	35.6629	35.6484	0.0145
2007/12/21	15:40	32-49.34980S	175-32.03160E	35.7132	35.6991	0.0141
2007/12/22	3:07	33-42.10310S	175-23.62260E	35.6878	35.6729	0.0149
2007/12/22	15:06	35-01.27420S	175-09.08010E	35.7422	35.7286	0.0136
2007/12/23	1:20	35-33.05740S	175-08.87520E	35.6953	35.6812	0.0141

* Difference between the sensor and the bottle salinity is large.

2.4 Underway pCO_2

9 November 2008

(1) Personnel

Akihiko Murata (IORGC, JAMSTEC)

Yoshiko Ishikawa (MWJ)

Yasuhiro Arii (MWJ)

Mikio Kitada (MWJ)

(2) Objectives

Concentrations of CO_2 in the atmosphere are now increasing at a rate of 1.5 ppmv y^{-1} due to human activities such as burning of fossil fuels, deforestation, cement production, etc. It is an urgent task to estimate as accurately as possible the absorption capacity of the ocean against the increased atmospheric CO_2, and to clarify the mechanism of the CO_2 absorption, because the magnitude of the predicted global warming depends on the levels of CO_2 in the atmosphere, and because the ocean currently absorbs 1/3 of the 6 Gt of carbon emitted into the atmosphere each year by human activities.

In the P1 and P14 revist cruises, we were aimed at quantifying how much anthropogenic CO_2 is absorbed in the surface ocean in the Pacific. For the purpose, we measured pCO_2 (partial pressures of CO_2) in the atmosphere and in the surface seawater.

(3) Apparatus and shipboard measurement

Continuous underway measurements of atmospheric and surface seawater pCO_2 were made with the CO_2 measuring system (Nippon ANS, Ltd) installed in the R/V *Mirai* of JAMSTEC. The system comprises of a non-dispersive infrared gas analyzer (NDIR; BINOS® model 4.1, Fisher-Rosemount), an air-circulation module and a showerhead-type equilibrator. To measure concentrations (mole fraction) of CO_2 in dry air (xCO_2a), air sampled from the bow of the ship (approx. 30 m above the sea level) was introduced into the NDIR through a dehydrating route with an electric dehumidifier (kept at ~2 °C), a Perma Pure dryer (GL Sciences Inc.), and a chemical desiccant ($Mg(ClO_4)_2$). The flow rate of the air was 500 ml min^{-1}. To measure surface seawater concentrations of CO_2 in dry air (xCO_2s), the air equilibrated with seawater within the equilibrator was introduced into the NDIR through the same flow route as the dehydrated air used in measuring xCO_2a. The flow rate of the equilibrated air was 600 – 800 ml min^{-1}. The seawater was taken by a pump from the intake placed at the approx. 4.5 m below the sea surface. The flow rate of seawater in the equilibrator was 500 – 800 ml min^{-1}.

The CO_2 measuring system was set to repeat the measurement cycle such as 4 kinds of CO_2 standard gases (Table 2.4.1), xCO_2a (twice), xCO_2s (7 times). This measuring system was run automatically throughout the cruise by a PC control.

(4) Quality control

Concentrations of CO_2 of the standard gases are listed in Table 2.4.1, which were calibrated by the JAMSTEC primary standard gases. The CO_2 concentrations of the primary standard gases were calibrated by C.D. Keeling of the Scripps Institution of Oceanography, La Jolla, CA, USA.

Since differences of concentrations of the standard gases between before and after the cruise were allowable (< 0.1 ppmv), the averaged concentrations (Table 2.4.1) were adopted for the subsequent calculations.

In actual shipboard observations, the signals of NDIR usually reveal a trend. The trends were adjusted linearly using the signals of the standard gases analyzed before and after the sample measurements.

Effects of water temperature increased between the inlet of surface seawater and the equilibrator on xCO_2s were adjusted based on Gordon and Jones (1973), although the temperature increases were slight, being ~ 0.3 °C.

We checked values of xCO_2a and xCO_2s by examining signals of the NDIR on recorder charts, and by plotting the xCO_2a and xCO_2s as a function of sequential day, longitude, sea surface temperature and sea surface salinity.

Reference

Gordon, L. I. and L. B. Jones (1973) The effect of temperature on carbon dioxide partial pressure in seawater. Mar. Chem., 1, 317-322.

Table 2.4.1. Concentrations of CO_2 standard gases used in (a) P1 and (b) P14 revisit cruises

(a)

Cylinder no.	Concentrations (ppmv)
CQB09356	289.77
CQB15439	349.02
CQB15432	394.23
CQB09375	439.75

(b)

Cylinder no.	Concentrations (ppmv)
CQB06555	270.02
CQB19242	330.40
CQB15437	369.28
CQB09327	419.68

2.5 Acoustic Doppler Current Profiler

5 November 2008

(1) Personnel

Shinya Kouketsu (JAMSTEC)

Hiroshi Uchida (JAMSTEC)

Satoshi Okumura (GODI)

Shinya Okumura (GODI)

Ryo Oyama (GODI)

Kazuho Yoshida (GODI)

(2) Instruments and method

The instrument used was an RDI 76.8 kHz unit, hull-mounted on the centerline and approximately 23 m aft of the bow at the water line. The firmware version was 5.59 and the data acquisition software was the RDI VMDAS Version. 1.4. The Operation was made from the first CTD station to the last CTD station in each leg. It was continued to the Auckland port in the third leg. The instrument was used in the water-tracking mode during the most of operations, recording each ping raw data in 8 m x 100 bins from about 23 m to 735 m in deep. Typical sampling interval was 3.5 seconds. Bottom track mode was added in the easternmost shallow water region. GPS gave the navigation data. Two kinds of compass data were recorded. One was the ship's gyrocompass which is connected the ADCP system directory, were stored with the ADCP data. Current field based on the gyrocompass was used to check the operation and the performance on board. Another compass used was the Inertial Navigation Unit (INU), DRU-H, Honeywell Inc. Its accuracy is 1.0 mile (about 0.056 degree) and had already set on zero bias before the beginning of the cruise. The INU compass data were stored independently, and were combined with the ADCP data after the cruise.

(3) Performance of the ADCP data

The performance of the ADCP instrument was almost good: on streaming, profiles usually reached to about 600 m. Profiles were rather bad on CTD station. The profiles were sometimes obtained from 200 m to 500 m. In these cases the ADCP signal was weak typically at about 350 m in deep. It is probably due to the babbles from the bow-thruster. Echo intensities for each legs changed due to environment of sea (Fig. 2.5.1), although the intensities were not different by each beams. During MR07-04 in which we observed in the subarctic region, enough echo intensities for good observation (over 60 counts) were obtained up to bin number of 50.

(4) Data processing

We processed ADCP data as described below. ADCP-coordinate velocities were converted to the earth-coordinate velocities using the ship heading from the INU. The earth-coordinate currents were obtained by subtracting ship velocities from the earth-coordinate velocities. Corrections of the misalignment and scale factors were made using the bottom track data for each legs. The misalignment angle calculated was 0.5, 1, and 1 degree and the scale factor was 0.975 for MR07-04, MR07-06 leg1 and MR07-06 leg2, respectively.

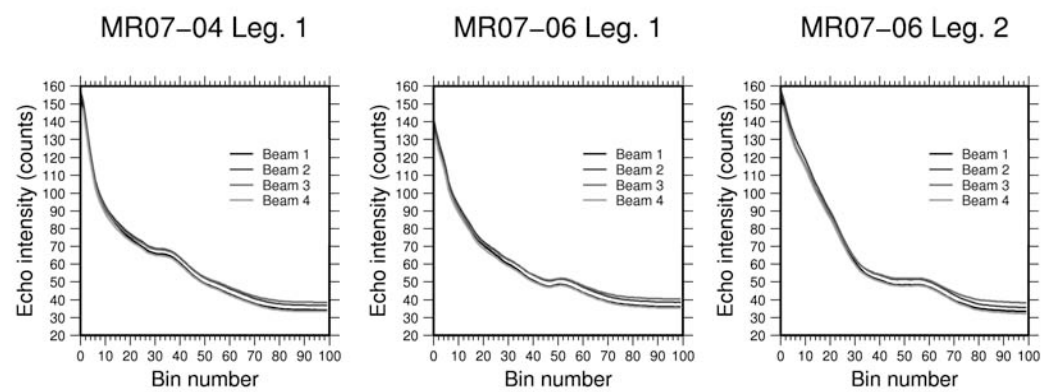

Fig. 2.5.1. Cruise-averaged echo intensities for each beams by bins.

2.6 XCTD

4 November 2008

(1) Personnel

Hiroshi Uchida (JAMSTEC)

Satoshi Okumura (GODI)

Shinya Okumura (GODI)

Ryo Ohyama (GODI)

(2) Objectives

Expendable Conductivity, Temperature and Depth profiler (XCTD) measurements were carried out to obtain upper ocean temperature and salinity data at CTD stations skipped over in the cruise MR07-04.

(3) Instrument and Method

The XCTD used was XCTD-1 (Tsurumi-Seiki Co., Ltd., Yokohama, Kanagawa, Japan) with a MK-100 deck unit (Tsurumi-Seiki Co., Ltd.). Ship's speed was slowed down to 12 knot during the XCTD measurement. In the cruise MR07-04, 17 XCTD-1 probes were deployed by using 8-loading automatic launcher (Tsurumi-Seiki Co., Ltd.), except for stations P01_42, 51, 53, 54, 55, 56, and 57 at which the XCTD probes were deployed by using hand launcher from the stern of the upper deck due to communication error.

(4) Data Processing and Quality Control

The XCTD data were processed and quality controlled based on a method by Uchida and Imawaki (2008) with slight modification. The followings are the data processing sequence used in the reduction of the XCTD data.

1. Raw temperature and conductivity data from the first nine scans of the XCTD data were deleted and data considerably deeper than depth range of the manufacturer's specifications and spikes were manually removed.
2. Missing data by the above editing was linearly interpolated when the data gap was within 15 scans (about 2 m).
3. Temperature and conductivity data were low-pass filtered (running mean with a window of 15 scans).
4. The conductivity data was advanced for 1.5 scans (about 0.2 m), instead of 2 scans described in Uchida and Imawaki (2008), relative to the temperature data to correct mismatch of response time of the sensors.
5. Pressure was estimated from depth and location (latitude) by calculating backward from a pressure to depth conversion equation (Saunders and Fofonoff, 1976), and salinity was calculated from the pressure, temperature and conductivity data by using the reference conductivity of 42.896 mS cm^{-1} at salinity of 35, temperature of 15 °C (IPTS-68) and pressure of 0 dbar. The reference conductivity value is used in the manufacturer's data processing software.
6. The data were sampled at 1-dbar interval.
7. Salinity biases of the XCTD data were estimated by using tight relationship between temperature and salinity in the deep ocean. At in situ temperature of 2.75 °C, mean salinity was 34.399 (SD, 0.006) and mean pressure was 993 dbar (SD, 53 dbar) for the CTD data obtained at four stations (P01_40, 44, 58, and 60). Difference between XCTD salinity and the mean CTD salinity at temperature of 2.75 °C was considered to be salinity bias of the XCTD data (Table 2.6.1). For the XCTD data of the station P01_51, salinity bias could not be estimated because the maximum depth was too shallow to estimate the salinity bias.

(5) Results

Vertical sections of potential temperature and salinity are shown in Fig. 2.6.1 combining with CTD data obtained at four stations (P01_40, 44, 58, and 60). Relationship between potential temperature and salinity is also shown in Fig. 2.6.2.

Table 2.6.1 Salinity offset correction value to the XCTD salinity data. Ship intake temperature (SST) and salinity (SSS), and maximum pressure for the XCTD data are also shown.

Station	Serial number	SST [°C]	SSS [PSU]	Max. pressure [dbar]	Salinity offset [PSU]
P01_41	03022140	10.725	32.974	1045	0.009
P01_42	02121625	10.580	32.857	1044	0.015
P01_43	02121627	10.048	32.835	1044	0.028
P01_45	03022141	9.656	32.801	1045	0.033
P01_46	03022142	9.676	32.858	1044	0.010
P01_47	03022176	9.892	32.858	1044	0.010
P01_48	03022171	9.988	32.840	1044	0.024
P01_49	03022174	10.116	32.794	1043	0.027
P01_50	03022172	10.074	32.782	1044	0.005
P01_51	03022170	10.000	32.798	484	-
P01_52	03022149	10.100	32.739	1045	0.015
P01_53	03022148	10.293	32.755	1045	0.031
P01_54	03022146	10.774	32.756	1045	0.024
P01_55	03022152	10.788	32.719	1045	0.026
P01_56	03022147	10.858	32.735	1045	0.025
P01_57	03022151	11.579	32.797	1045	0.010
P01_59	03022144	11.560	32.770	1044	0.014

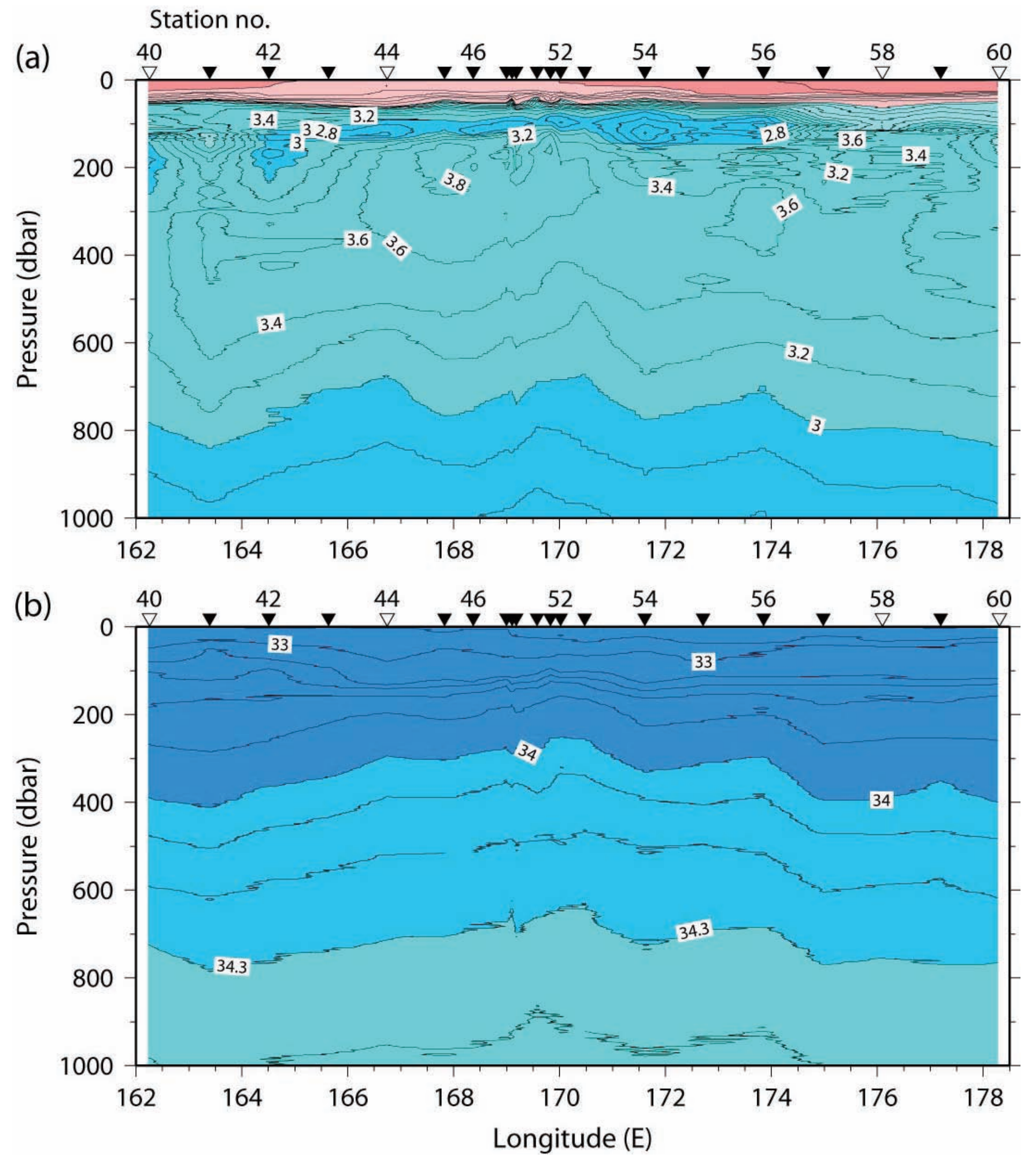

Fig. 2.6.1 Vertical section of (a) potential temperature and (b) salinity. Filled triangles (open triangles) show station locations for the XCTD (CTD) measurements.

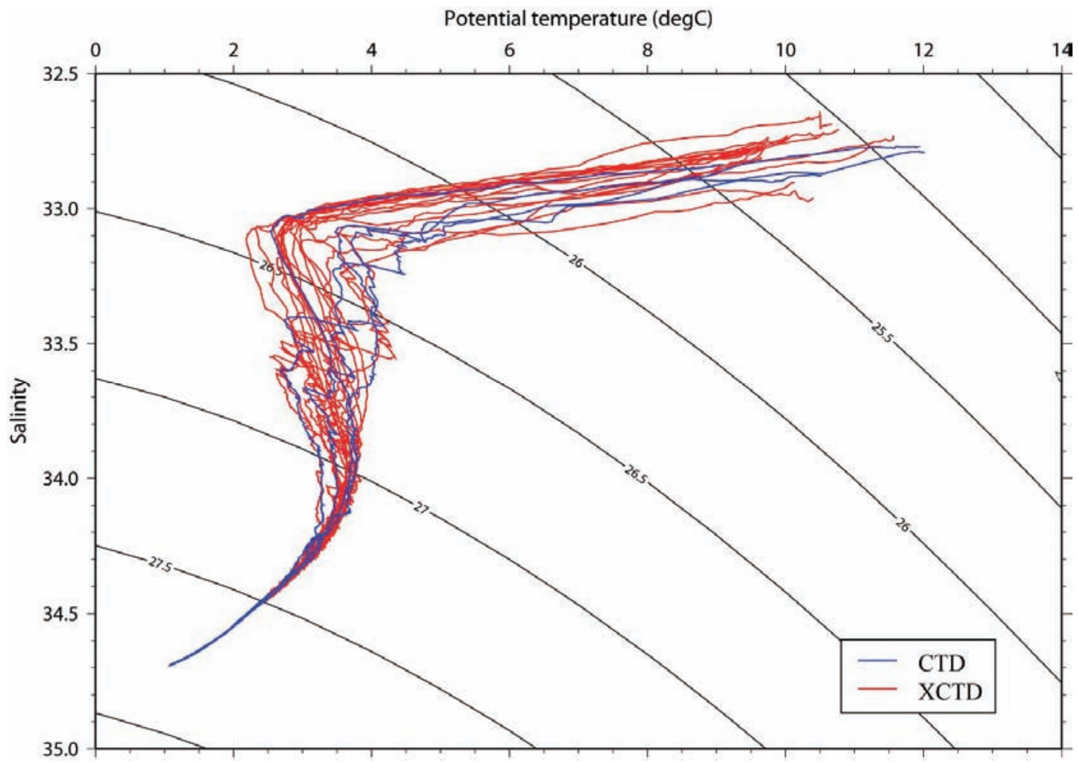

Fig. 2.6.2 Potential temperature plotted against salinity for the XCTD (red curves) and CTD (blue curves) data obtained from station P01_40 to 60.

(6) Data format

Data format for the XCTD data is basically based on WOCE Exchange Format for the CTD data. Quality flags were set to "1" for the XCTD data except for the offset corrected salinity data for which quality flags were set to "2". Temperature and salinity profiles near the sea surface were filled with the shallowest values and the quality flags were set to "7".

References

Saunders, P. M. and N. P. Fofonoff (1976): Conversion of pressure to depth in the ocean. *Deep-Sea Res.*, 23, 109-111.

Uchida, H. and S. Imawaki (2008): Estimation of the sea level trend south of Japan by combining satellite altimeter data with in situ hydrographic data. *J. Geophys. Res.*, 113, C09035, doi:10.1029/2008JC004796.

3.1 CTD/O_2 Measurements

11 December 2008

(1) Personnel

Hiroshi Uchida (JAMSTEC)

Satoshi Ozawa (MWJ) (MR07-04_1 and MR07-06_2)

Hirokatsu Uno (MWJ) (MR07-04_1 and MR07-06_2)

Tomoyuki Takamori (MWJ) (MR07-04_1 and MR07-06_2)

Kenichi Katayama (MWJ) (MR07-04_1 and MR07-06_1)

Hiroshi Matsunaga (MWJ) (MR07-06_1)

Kentaro Ohyama (MWJ) (MR07-06_1)

Shinsuke Toyoda (MWJ) (MR07-06_1)

Tsutomu Fujii (MWJ) (MR07-06_2)

(2) Winch arrangements

The CTD package was deployed by using 4.5 Ton Traction Winch System (Dynacon, Inc., Bryan, Texas, USA), which was installed on the R/V Mirai in April 2001 (Fukasawa et al., 2004). Primary system components include a complete CTD Traction Winch System with up to 8000 m of 9.53 mm armored cable (Ocean Cable and Communications Co., Yokohama, Kanagawa, Japan).

(3) Overview of the equipment

The CTD system was SBE 911plus system (Sea-Bird Electronics, Inc., Bellevue, Washington, USA). The SBE 911plus system controls 36-position SBE 32 Carousel Water Sampler. The Carousel accepts 12-litre Niskin-X water sample bottles (General Oceanics, Inc., Miami, Florida, USA). The SBE 9plus was mounted horizontally in a 36-position carousel frame. SBE's temperature (SBE 3) and conductivity (SBE 4) sensor modules were used with the SBE 9plus underwater unit. The pressure sensor is mounted in the main housing of the underwater unit and is ported to outside through the oil-filled plastic capillary tube. A modular unit of underwater housing pump (SBE 5T) flushes water through sensor tubing at a constant rate independent of the CTD's motion, and pumping rate (3000 rpm) remain nearly constant over the entire input voltage range of 12-18 volts DC. Flow speed of pumped water in standard TC duct is about 2.4 m/s. Two sets of temperature and conductivity modules were used. An SBE's dissolved oxygen sensor (SBE 43) was placed between the primary conductivity sensor and the pump module. Auxiliary sensors, a Deep Ocean Standards Thermometer (SBE 35), an altimeter (PSA-916T; Teledyne Benthos, Inc., North Falmous, Massachusetts, USA), an oxygen optode (Oxygen Optode 3830; Aanderaa Data Instruments AS, Bergen, Norway), and a fluorometer (Seapoint sensors, Inc., Kingston, New Hampshire, USA) were also used with the SBE 9plus underwater unit. In addition, two prototypes of oxygen optode (RINKO; Alec Electronics Co. Ltd., Kobe, Hyogo, Japan) were also used. To minimize motion of the CTD package, a heavy stainless frame (total weight of the CTD package without sea water in the bottles is about 1000 kg) was used with an aluminum plate (54 × 90 cm: see Fig. 3.1.1 in Kawano and Uchida, 2007).

Summary of the system used in the cruises MR07-04 and MR07-06

Deck unit:

SBE 11plus, S/N 0272

Under water unit:

SBE 9plus, S/N 79492 (Pressure sensor: S/N 0575)

Temperature sensor:

Primary

SBE 3plus, S/N 4216 (stations from P01_1_1 to P01_44_1)

SBE 3plus, S/N 4188 (stations from P01_58_1 to P01_115_1)

(stations from P01_28_2 to P14N_4_1)

SBE 3, S/N 1525 (stations from P14N_30_1 to P14C_1_1)

Secondary

SBE 3, S/N 1464 (stations from P01_1_1 to P01_29_1)

SBE 3, S/N 1525 (stations from P01_40_1 to P01_115_1)

(stations from P01_28_2 to P14N_4_1)

SBE 3plus, S/N 4421 (stations from P14N_30_1 to P14N_33_1)

SBE 3plus, S/N 4188 (stations from P14N_34_1 to P14N_73_1)

SBE 3plus, S/N 4216 (stations from P14N_75_1 to P14C_1_1)

* without secondary temperature sensor for station P14N_74_2

Conductivity sensor:

Primary

SBE 4, S/N 1203 (stations from P01_1_1 to P01_10_1)

SBE 4, S/N 3064 (stations from P01_11_1 to P01_115_1)

(stations from P01_28_2 to P14N_74_1)

SBE 4, S/N 1206 (stations from P14N_74_2 to P14N_99_1)

SBE 4, S/N 3116 (stations from P14N_100_1 to P14N_109_1)

SBE 4, S/N 3124 (stations from P14N_109_2 to P14C_1_1)

Secondary

SBE 4, S/N 2854 (stations from P01_1_1 to P01_115_1)

SBE 4, S/N 2240 (stations from P01_28_2 to P01_46_1)

SBE 4, S/N 3036 (stations from P01_47_1 to P14N_51_1)

SBE 4, S/N 2854 (stations from P14N_52_1 to P14N_74_1)

SBE 4, S/N 2435 (stations from P14N_80_1 to P14N_171_1)

SBE 4, S/N 1172 (stations from P14N_172_1 to P14C_1_1)

* without secondary conductivity sensor for stations from P14N_74_2 to P14N_79_1

Oxygen sensor:

SBE 43, S/N 0949 (stations from P01_1_1 to P01_115_1)

SBE 43, S/N 0394 (stations from P01_28_2 to P14C_1_1)

AANDERAA Oxygen Optode 3830, S/N 612

ALEC Oxygen Optode (RINKO, prototype I) (stations from P01_1_1 to P01_115_1)

(stations from P01_28_2 to P14N_182_1)

ALEC Oxygen Optode (RINKO, prototype II) (stations from P14N_109_2 to P14C_1_1)

Pump:

Primary

SBE 5T, S/N 4598 (stations P01_1_1 to P01_58_2)

SBE 5T, S/N 4595 (stations P01_60_1 to P01_115_1)

(stations P01_28_2 to P14C_1_1)

Secondary

SBE 5T, S/N 4595 (stations P01_1_1 to P01_58_2)

SBE 5T, S/N 4598 (stations P01_60_1 to P01_115_1)

(stations P01_28_2 to P14C_1_1)

Altimeter:

PSA-916T, S/N 1157

Deep Ocean Standards Thermometer:

SBE 35, S/N 0045

Fluorometer:

Seapoint Sensors, Inc., S/N 2579

* without fluorometer for the following stations,

because the maximum pressure was beyond the pressure-proof

stations from P01_9_1 to P01_12_1,

from P01_44_2 to P01_46_1,

from P01_53_1 to P01_54_1,

from P14N_24_1 to P14N_23_1,

from P14N_100_1 to P14N_101_1,

from P14N_107_1 to P14N_109_2,

and P14N_123_1

Carousel Water Sampler:

SBE 32, S/N 0391

Water sample bottle:

12-litre Niskin-X (no TEFLON coating)

(4) Pre-cruise calibration

i. Pressure

The Paroscientific series 4000 Digiquartz high pressure transducer (Model 415K-187: Paroscientific, Inc., Redmond, Washington, USA) uses a quartz crystal resonator whose frequency of oscillation varies with pressure induced stress with 0.01 per million of resolution over the absolute pressure range of 0 to 15000 psia (0 to 10332 dbar). Also, a quartz crystal temperature signal is used to compensate for a wide range of temperature changes at the time of an observation. The pressure sensor has a nominal accuracy of 0.015% FS (1.5 dbar), typical stability of 0.0015% FS/month (0.15 dbar/month), and resolution of 0.001% FS (0.1 dbar). Since the pressure sensor measures the absolute value, it inherently includes atmospheric pressure (about 14.7 psi). SEASOFT subtracts 14.7 psi from computed pressure automatically.

Pre-cruise sensor calibrations for linearization were performed at SBE, Inc.

S/N 0575, 27 October 1999

The time drift of the pressure sensor is adjusted by periodic recertification corrections against a dead-weight piston gauge (Model 480DA, S/N 23906; Bundenberg Gauge Co. Ltd., Irlam, Manchester, UK). The corrections are performed at JAMSTEC, Yokosuka, Kanagawa, Japan by Marine Works Japan Ltd. (MWJ), Yokohama, Kanagawa, Japan, usually once in a year in order to monitor sensor time drift and linearity.

S/N 0575, 5 July 2007

slope = 0.99980507

offset = 2.33363

Result of the pre-cruise pressure sensor calibration against the dead-weight piston gauge is shown in Fig. 3.1.1.

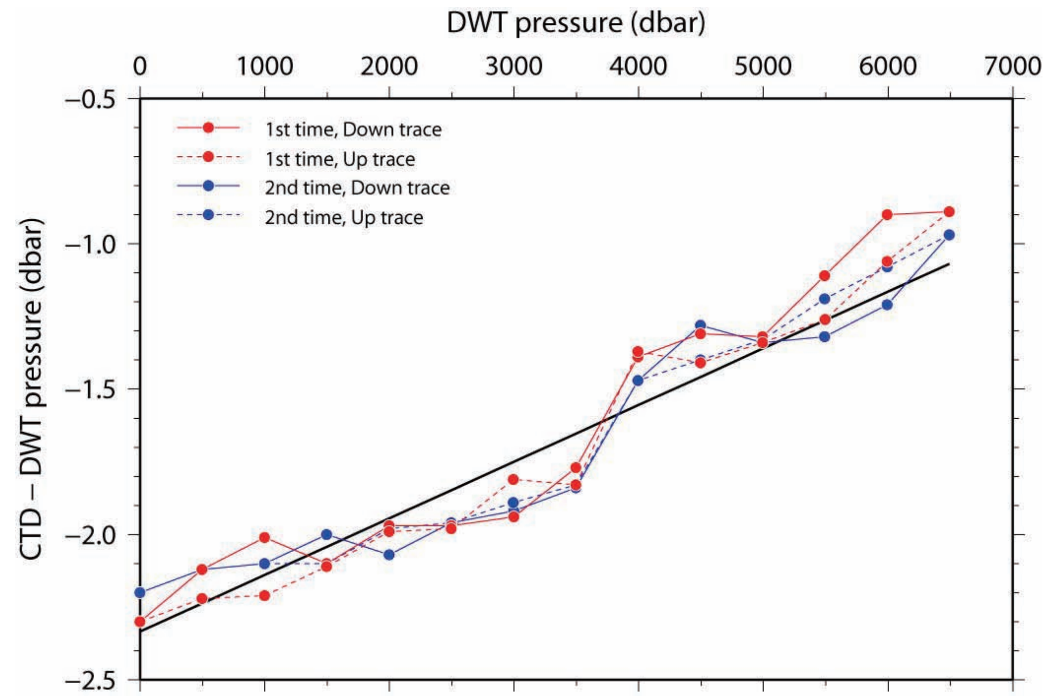

Figure 3.1.1 Difference between the dead-weight piston gauge and the CTD pressure. The calibration line (black line) is also shown.

ii. Temperature (SBE 3)

The temperature sensing element is a glass-coated thermistor bead in a stainless steel tube, providing a pressure-free measurement at depths up to 10500 (6800) m by titanium (aluminum) housing. The SBE 3 thermometer has a nominal accuracy of 1 mK, typical stability of 0.2 mK/month, and resolution of 0.2 mK at 24 samples per second. The premium temperature sensor, SBE 3plus, is a more rigorously tested and calibrated version of standard temperature sensor (SBE 3).

Pre-cruise sensor calibrations were performed at SBE, Inc.

S/N 4188, 16 May 2007

S/N 4216, 16 May 2007

S/N 1464, 28 June 2007

S/N 1525, 14 June 2007

S/N 4421, 14 June 2007

Pressure sensitivity of SBE 3 was corrected in accordance with a method by Uchida et al. (2007), for the following sensor.

S/N 4188, –2.946675e–7 [°C/dbar]

Time drift of the SBE 3 temperature sensors based on the laboratory calibrations is shown in Fig. 3.1.2.

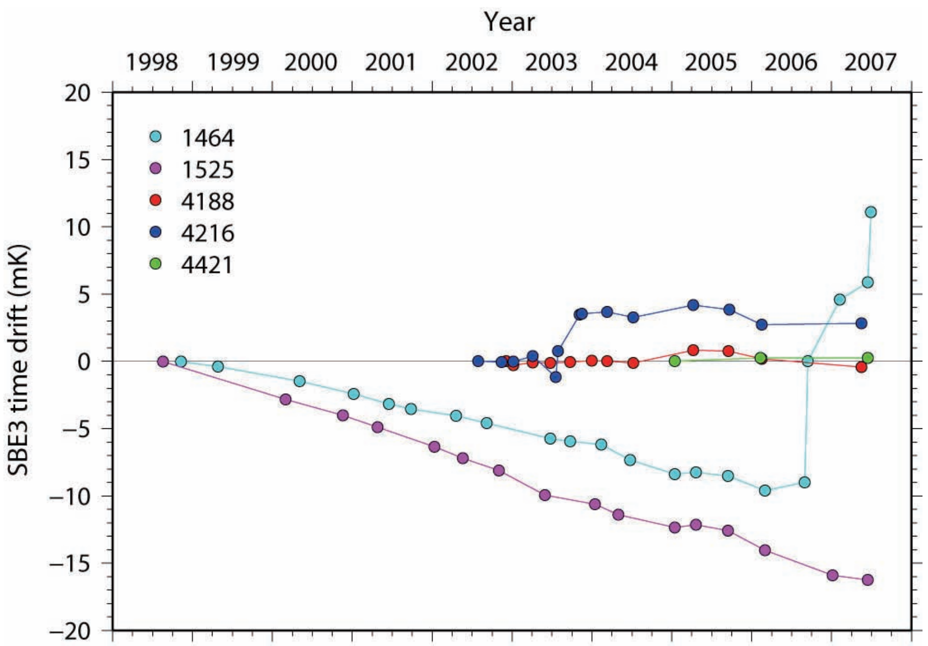

Figure 3.1.2 Time drift of SBE 3 temperature sensors based on laboratory calibrations.

iii. Conductivity (SBE 4)

The flow-through conductivity sensing element is a glass tube (cell) with three platinum electrodes to provide in-situ measurements at depths up to 10500 (6800) m by titanium (aluminum) housing. The SBE 4 has a nominal accuracy of 0.0003 S/m, typical stability of 0.0003 S/m/month, and resolution of 0.00004 S/m at 24 samples per second.

Pre-cruise sensor calibrations were performed at SBE, Inc.

S/N 1203, 14 June 2007

S/N 3064, 14 June 2007

S/N 1088, 14 June 2007

S/N 2240, 10 August 2007

S/N 3036, 10 May 2007

S/N 2854, 10 August 2007

S/N 1206, 10 May 2007

S/N 2435, 10 August 2007

S/N 3116, 16 May 2007

S/N 3124, 16 May 2007

S/N 1172, 14 June 2007

The value of conductivity at salinity of 35, temperature of 15 °C (IPTS-68) and pressure of 0 dbar is 4.2914 S/m.

iv. Oxygen (SBE 43)

The SBE 43 oxygen sensor uses a Clark polarographic element to provide in-situ measurements at depths up to 7000 m. The range for dissolved oxygen is 120% of surface saturation in all natural waters, nominal accuracy is 2% of saturation, and typical stability is 2% per 1000 hours.

Pre-cruise sensor calibrations were performed at SBE, Inc.

S/N 0949, 1 June 2007

S/N 0394, 23 June 2007

v. Deep Ocean Standards Thermometer

Deep Ocean Standards Thermometer (SBE 35) is an accurate, ocean-range temperature sensor that can be standardized against Triple Point of Water and Gallium Melt Point cells and is also capable of measuring temperature in the ocean to depths of 6800 m. The SBE 35 was used to calibrate the SBE 3 temperature sensors in situ (Uchida et al., 2007).

Pre-cruise sensor linearization was performed at SBE, Inc.

S/N 0045, 27 October 2002

Then the SBE 35 is certified by measurements in thermodynamic fixed-point cells of the TPW (0.0100 °C) and GaMP (29.7646 °C). The slow time drift of the SBE 35 is adjusted by periodic recertification corrections. Pre-cruise sensor calibration was performed at SBE, Inc.

S/N 0045, 29 May 2007 (slope and offset correction)

The time required per sample = 1.1 × NCYCLES + 2.7 seconds. The 1.1 seconds is total time per an acquisition cycle. NCYCLES is the number of acquisition cycles per sample and was set to 4. The 2.7 seconds is required for converting the measured values to temperature and storing average in EEPROM.

When using the SBE 911 system with SBE 35, the deck unit receives incorrect signal from the under water unit for confirmation of firing bottle #16. In order to correct the signal, a module (Yoshi Ver. 1; EMS Co. Ltd., Kobe, Hyogo, Japan) was used between the under water unit and the deck unit.

Time drift of the SBE 35 based on the fixed point calibrations is shown in Fig. 3.1.3.

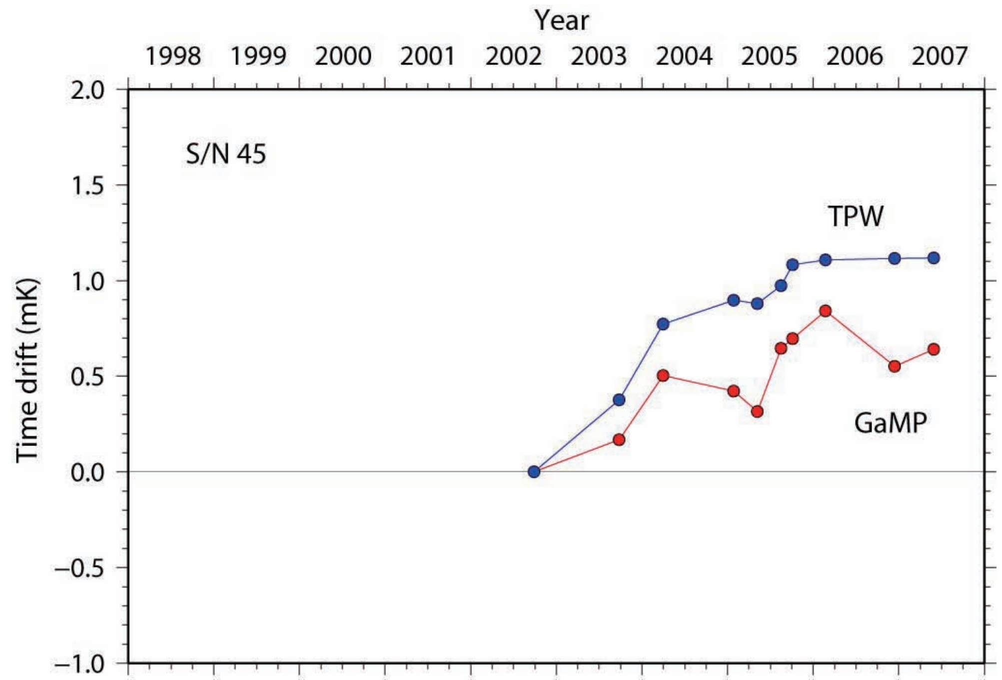

Figure 3.1.3 SBE35 time drift based on laboratory fixed point calibrations (triple point of water, TPW and gallium melt point, GaMP) performed by SBE, Inc.

vi. Altimeter

Benthos PSA-916T Sonar Altimeter (Teledyne Benthos, Inc.) determines the distance of the target from the unit by generating a narrow beam acoustic pulse and measuring the travel time for the pulse to bounce back from the target surface. It is rated for operation in water depths up to 10000 m. The PSA-916T uses the nominal speed of sound of 1500 m/s.

vii. Oxygen Optode

Oxygen Optode 3830 (Aanderaa Instruments AS) is based on the ability of selected substances to act as dynamic fluorescence quenchers. In order to use with the SBE 911plus CTD system, an analog adaptor (3966) is connected to the oxygen optode (3830). The analog adaptor is packed into titanium housing made by Alec Electronics Co. Ltd., Kobe, Hyogo, Japan. The sensor is designed to operate down to 6000 m. The range for dissolved oxygen is 120% of surface saturation in all natural waters, nominal accuracy is less than 5% of saturation, and setting time (68%) is shorter than 25 seconds.

Outputs from the sensor are the raw phase shift and temperature. The optode oxygen can be calibrated in accordance with a method by Uchida et al. (2008) by using oxygen data obtained from discrete water samples.

viii. Fluorometer

The Seapoint Chlorophyll Fluorometer (Seapoint Sensors, Inc., Kingston, New Hampshire, USA) provides in-situ measurements of chlorophyll-a at depths up to 6000 m. The instrument uses modulated blue LED lamps and a blue excitation filter to excite chlorophyll-a. The fluorescent light emitted by the chlorophyll-a passes through a red emission filter and is detected by a silicon photodiode. The low level signal is then processed using synchronous demodulation circuitry, which generates an output voltage proportional to chlorophyll-a concentration.

ix. Prototype of oxygen optode

The prototype of oxygen optodes (RINKO prototype I and II: Alec Electronics Co. Ltd.) provides the raw phase shift and temperature at depths up to 7000 m. Pre-cruise calibration was not performed for the prototype sensors. The RINKO can also be calibrated in accordance with a method by Uchida et al. (2008) by using oxygen data obtained from discrete water samples.

(5) Data collection and processing

i. Data collection

CTD system was powered on at least 20 minutes in advance of the data acquisition and was powered off at least two minutes after the operation in order to acquire pressure data on the ship's deck.

The package was lowered into the water from the starboard side and held 10 m beneath the surface for about one minute in order to activate the pump. After the pump was activated, the package was lifted to the surface and lowered at a rate of 1.0 m/s to 200 m (or 300 m when significant wave height is high) then the package was stopped to operate the heave compensator of the crane. The package was lowered again at a rate of 1.2 m/s to the bottom. For the up cast, the package was lifted at a rate of 1.1 m/s except for bottle firing stops. At each bottle firing stops, the bottle was fired after waiting from the stop for 30 seconds and the package was stayed at least 5 seconds for measurement of the SBE 35. At 200 m (or 300 m) from the surface, the package was stopped to stop the heave compensator of the crane.

Water samples were collected using a 36-bottle SBE 32 Carousel Water Sampler with 12-litre Niskin-X bottles. Before a cast taken water for CFCs, the 36-bottle frame and Niskin-X bottles were wiped with acetone.

Data acquisition software

SEASAVE-Win32, version 5.27b

ii. Data collection problems

Temperature sensor

Scattering of difference between the primary temperature sensor S/N 4216 and the SBE 35 was slightly greater than that between the secondary temperature sensor S/N 1464 and the SBE 35. Therefore the temperature sensor S/N 4188 was used as primary temperature sensor after the station P01_44_1.

Scattering of difference between the primary temperature sensor S/N 4188 and the SBE 35 was slightly greater than that between the secondary temperature sensor S/N 1525 and the SBE 35. Therefore the temperature sensor S/N 1525 was used as primary temperature sensor and the temperature sensor S/N 4421 was used as secondary temperature sensor after the station P14N_4_1. The secondary temperature sensor S/N 4421, however, showed large discrepancy (about 0.5 mK) between the down-cast and up-cast. Therefore the secondary temperature sensor was replaced with the temperature sensor S/N 4188 after the station P14N_33_1.

Scattering of difference between the secondary temperature sensor S/N 4188 and the SBE 35 was gradually became large. Therefore the secondary temperature sensor S/N 4188 was replaced with the temperature sensor S/N 4216 after the station P14N_73_1.

At the stations from P14N_75_1 to P14N_79_1, the secondary temperature sensor was used without the secondary conductivity sensor. The temperature sensor was directly connected with the pump by a tube. Consequently, the temperature sensor reading was about 1 mK higher than usual for the stations from P14N_75_1 to P14N_79_1.

Conductivity sensor

The conductivity sensor reading from the primary conductivity sensor was shifted during the down cast of station P01_7_1, P01_8_1, P01_9_1, and P01_10_1. Therefore the conductivity sensor was replaced after the station P01_10_1.

The secondary conductivity sensor S/N 2240 was broken near the bottom of the station P01_45_1. Therefore the secondary conductivity sensor was replaced with the conductivity sensor S/N 3036 after the station P01_46_1. The secondary conductivity sensor S/N 3036 was broken near the bottom of the station P14N_51_1. Therefore the secondary conductivity sensor was replaced with the conductivity sensor S/N 2854 after the station. The primary and secondary conductivity sensors S/N 3064 and S/N 2854 were broken near the bottom of the station P14N_74_1. Therefore the primary conductivity sensor was replaced with the conductivity sensor S/N 1206 and the secondary temperature and conductivity sensors were removed from the CTD system after the station, and at the station P14N_80_1, the secondary conductivity sensor S/N 2435 was attached to the CTD system. The primary conductivity sensor S/N 3116 was broken near the bottom of the station P14N_108_1. Because the secondary conductivity sensor was in normal condition and the remaining station was only one station for the cruise MR07-06_1, the broken conductivity sensor was left for the station P14N_109_1. At the beginning of the cruise MR07-06_2, the primary conductivity was replaced with the conductivity sensor S/N 3124. The secondary conductivity sensor S/N 2435 was broken near the bottom of the station P14N_171_1. Therefore the secondary conductivity sensor was replaced with the conductivity sensor S/N 1172 after the station.

Because the conductivity sensor reading from the primary conductivity sensor S/N 1206 was slightly shifted during a long stop due to the winch trouble during the station P14N_98_1, the primary conductivity sensor was replaced with the conductivity sensor S/N 3116 after the station P14N_99_1.

Prototype of oxygen optode

At the station P14N_181_1, the sensor reading from RINKO prototype I was unstable during the down-cast, although the sensor reading was normal during the up-cast. At the station P14N_182_1, RINKO prototype I did not work during the cast due to leakage. Therefore the sensor was removed after the cast.

Winch troubles

At the station P01_34_1, a sensor in the hydraulic actuator of the crane broke at about 864 dbar of the up-cast. Therefore CTD was operated without heave motion of the crane at the station P01_35_1.

At the station P14N_98_1, a chain rotating the cable drum broke at about 713 dbar of the down-cast and the CTD package was stopped at the depth for about 110 minutes during repair.

At the station P14N_178_1, the CTD package rapidly approached the bottom before firing the bottle #1, and the neatly arranged cable on the winch drum broke down in disorder because the CTD package was quickly upped near the bottom. Therefore the cast was quitted. The station location was changed about one mile from the original location and the second cast was carried out.

Miss trip and miss fire

Niskin bottles did not trip correctly at the following stations.

Miss trip	Miss fire
P01_23_1, #15	P14N_60_1, #26
P01_40_2, #10	P14N_71_1, #31

P01_54_1, #10 P14C_35_1, #11

P14N_54_1, #11

P14N_63_1, #11

P14N_64_1, #11

P14N_77 _1, #27

P14N_92_1, #24

P14N_99_1, #18

P14N_101_1, #16

P14N_103_1, #5

P14N_107_1, #3 and #12

P14N_110_1, #2

P14N_126_1, #30

P14N_127_1, #28

P14C_50_1, #24

P14C_7_1, #22

Other incidents of note

At station P01_29_1, a longline for fishery was caught in a propeller at about 5000 dbar of the down cast. Therefore the cast was quitted and no water was sampled.

At station P01_58_1, primary temperature signal was lost at 2400 dbar of the down cast. Therefore the cast was quitted and the connection cable was replaced.

At stations P01_81_1, P01_105_1 and P01_111_1, Jellyfish was in secondary T-C duct, and data quality from the secondary temperature and conductivity sensors was bad. The secondary T-C duct was cleaned with Triton-X after the casts.

At station P01_115_1, a fishing boat existed near the planned location. Therefore the station location was changed a little to the north.

At the station P01_47_1, the secondary temperature and conductivity data were noisy.

At the station P14N_55_1, the SBE 35 data of bottle #8 was lost, because the next bottle firing command was sent before storing the SBE 35 data in the internal memory.

At the station P14N_140_1, the secondary salinity data did not change from zero. Therefore the cast was quitted. The secondary sensors were flushed with water and the second cast was carried out.

iii. Data processing

SEASOFT consists of modular menu driven routines for acquisition, display, processing, and archiving of oceanographic data acquired with SBE equipment. Raw data are acquired from instruments and are stored as unmodified data. The conversion module DATCNV uses instrument configuration and calibration coefficients to create a converted engineering unit data file that is operated on by all SEASOFT post processing modules. The following are the SEASOFT and original software data processing module sequence and specifications used in the reduction of CTD data in this cruise.

Data processing software

SEASOFT-Win32, version 5.27b

DATCNV converted the raw data to engineering unit data. DATCNV also extracted bottle information where scans were marked with the bottle confirm bit during acquisition. The duration was set to 4.4 seconds, and the offset was set to 0.0 second.

TCORP (original module, version 1.0) corrected the pressure sensitivity of the SBE 3 for both profile and bottle information data. One SBE 3 (S/N 4188) was corrected because it had relatively large pressure sensitivity (about +1.8 mK per 6000 dbar).

ROSSUM created a summary of the bottle data. The data were averaged over 4.4 seconds.

ALIGNCTD converted the time-sequence of sensor outputs into the pressure sequence to ensure that all calculations were made using measurements from the same parcel of water. For a SBE 9plus CTD with the ducted temperature and conductivity sensors and a 3000-rpm pump, the typical net advance of the conductivity relative to the temperature is 0.073 seconds. So, the SBE 11plus deck unit was set to advance the primary and the secondary conductivity for 1.73 scans (1.75/24 = 0.073 seconds). Oxygen data are also systematically delayed with respect to depth mainly because of the long time constant of the oxygen sensor and of an additional delay from the transit time of water in the pumped plumbing line. This delay was compensated by 6 seconds advancing oxygen sensor output (oxygen voltage) relative to the temperature data. Data from the RINKO prototype I and II were also delayed 2 seconds relative to the temperature data.

ALIGNOPT (original module, version 0.1) also compensated the delay of the AANDERAA optode sensor by advancing relative to the CTD temperature data as a function of temperature (t).

align (sec) = 25 × exp(–0.13 × t) (for $0 \leq t \leq 16.3$ °C)

= 25 (for $t < 0$ °C)

= 3 (for $t > 16.3$ °C)

WILDEDIT marked extreme outliers in the data files. The first pass of WILDEDIT obtained an accurate estimate of the true standard deviation of the data. The data were read in blocks of 1000 scans. Data greater than 10 standard deviations were flagged. The second pass computed a standard deviation over the same 1000 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to all variables.

CELLTM used a recursive filter to remove conductivity cell thermal mass effects from the measured conductivity. Typical values used were thermal anomaly amplitude alpha = 0.03 and the time constant 1/beta = 7.0.

FILTER performed a low pass filter on pressure with a time constant of 0.15 seconds. In order to produce zero phase lag (no time shift) the filter runs forward first then backwards.

WFILTER performed as a median filter to remove spikes in fluorometer data. A median value was determined by 49 scans of the window.

SECTION (or original module of SECTIONU, version 1.0) selected a time span of data based on scan number in order to reduce a file size. The minimum number was set to be the start time when the CTD package was beneath the sea-surface after activation of the pump. The maximum number was set to be the end time when the package came up from the surface. Data for estimation of the CTD pressure drift were prepared before SECTION.

LOOPEDIT marked scans where the CTD was moving less than the minimum velocity of 0.0 m/s (traveling backwards due to ship roll).

DESPIKE (original module, version 1.0) removed spikes of the data. A median and mean absolute deviation was calculated in 1-dbar pressure bins for both down- and up-cast, excluding the flagged values. Values greater than 4 mean absolute deviations from the median were marked bad for each bin. This process was performed 2 times for temperature, conductivity, oxygen voltage (SBE 43) and optode oxygen (AANDERAA) data.

DERIVE was used to compute oxygen (SBE 43).

BINAVG averaged the data into 1-dbar pressure bins. The center value of the first bin was set equal to the bin size. The bin minimum and maximum values are the center value plus and minus half the bin size. Scans with pressures greater than the minimum and less than or equal to the maximum were averaged. Scans were interpolated so that a data record exist every dbar.

DERIVE was re-used to compute salinity, potential temperature, and density (σ_θ).

SPLIT was used to split data into the down cast and the up cast.

The shift of the primary conductivity data at stations P01_7_1, P01_8_1, P01_9_1, and P01_10_1 were corrected by using original module SHIFTCORR. The conductivity sensor gradually shifted from 1000 dbar to the following depth of the down cast. Magnitude of the shift at the following depth was estimated and the conductivity data between 1000 dbar and the following depth was linearly corrected.

Station	Maximum depth of the shift	Magnitude of the shift at the maximum depth
P01_7_1	4170 dbar	–0.00003 S/m
P01_8_1	3774 dbar	–0.00001 S/m
P01_9_1	5850 dbar	–0.00002 S/m
P01_10_1	5820 dbar	–0.00004 S/m

For the station P14N_36_1, bad quality data of the primary temperature and conductivity between 37 and 78 dbar of the down-cast were corrected by using original module SWAP. The bad quality data were replaced with the secondary temperature and conductivity data for the depths. Offsets of the secondary temperature and conductivity data relative to the primary temperature and conductivity data at the depths were estimated from the upper and lower data and were subtracted from the secondary data.

For the station P14N_36_1, bad quality data of the SBE43 between the surface and 70 dbar of the down-cast were replaced by the up-cast data of the SBE43.

Remaining spikes in temperature and salinity data were manually eliminated from the 1-dbar-averaged data. The following data gaps over 1-dbar were linearly interpolated with a quality flag of 6.

Station	Pressure (dbar)	Parameters
P01_2_1	348	Salinity
P01_4_1	70	Salinity
P01_5_1	413, 435-440, 456, 475, 485, 485, 503-504	Salinity
P01_12_1	173	Salinity
P01_21_1	826	Salinity
P01_25_1	108, 416	Salinity
P01_70_1	202, 207	Salinity
P01_72_1	384	Salinity
P01_X15_1	480	Salinity
P01_79_1	141	Salinity
P01_82_1	1776-1780	Salinity
P01_84_1	26	Temperature, Salinity
P01_114_1	284-290	Salinity
P01_115_1	20	Salinity
P01_28_2	99	Salinity
P01_33_1	480	Salinity
P01_57_1	73	Salinity
P14N_110_1	300	Temperature
P14N_111_1	139, 199	Temperature
P14N_154_1	201	Temperature
P14N_164_1	627	Salinity
P14N_170_1	1387	Salinity
P14C_10_1	50	Temperature
P14C_10_1	49-50	Salinity
P14C_6_1	1520	Salinity

(6) Post-cruise calibration

i. Pressure

The CTD pressure sensor offset in the period of the cruise was estimated from the pressure readings on the ship deck. For best results the Paroscientific sensor was powered on for at least 20 minutes before the operation. In order to get the calibration data for the pre- and post-cast pressure sensor drift, the CTD deck pressure was averaged over first and last one minute, respectively. Then the atmospheric pressure deviation from a standard atmospheric pressure (14.7 psi) was subtracted from the CTD deck pressure. The atmospheric pressure was measured at the captain deck (20 m high from the base line) and sub-sampled one-minute interval as a meteorological data. Time series of the CTD deck pressure is shown in Fig. 3.1.4.

The CTD pressure sensor offset was estimated from the deck pressure obtained above. Mean of the pre- and the post-casts data over the whole period gave an estimation of the pressure sensor offset from the pre-cruise calibration. Mean residual pressure between the dead-weight piston gauge and the calibrated CTD data at 0 dbar of the pre-cruise calibration was subtracted from the mean deck pressure.

Estimated mean offset of the pressure data is listed in Table 3.1.1. The post-cruise correction of the pressure data is not deemed necessary for the pressure sensor.

Table 3.1.1 Offset of the pressure data. Mean and standard deviation are calculated from time series of the average of the pre- and the post-cast deck pressures.

Cruise	Mean deck pressure	Standard deviation	Residual pressure	Estimated offset
MR07-04_1	0.12 dbar	0.09 dbar	0.06 dbar	0.06 dbar
MR07-06_1	0.11 dbar	0.09 dbar	0.06 dbar	0.05 dbar
MR07-06_2	0.16 dbar	0.17 dbar	0.06 dbar	0.10 dbar

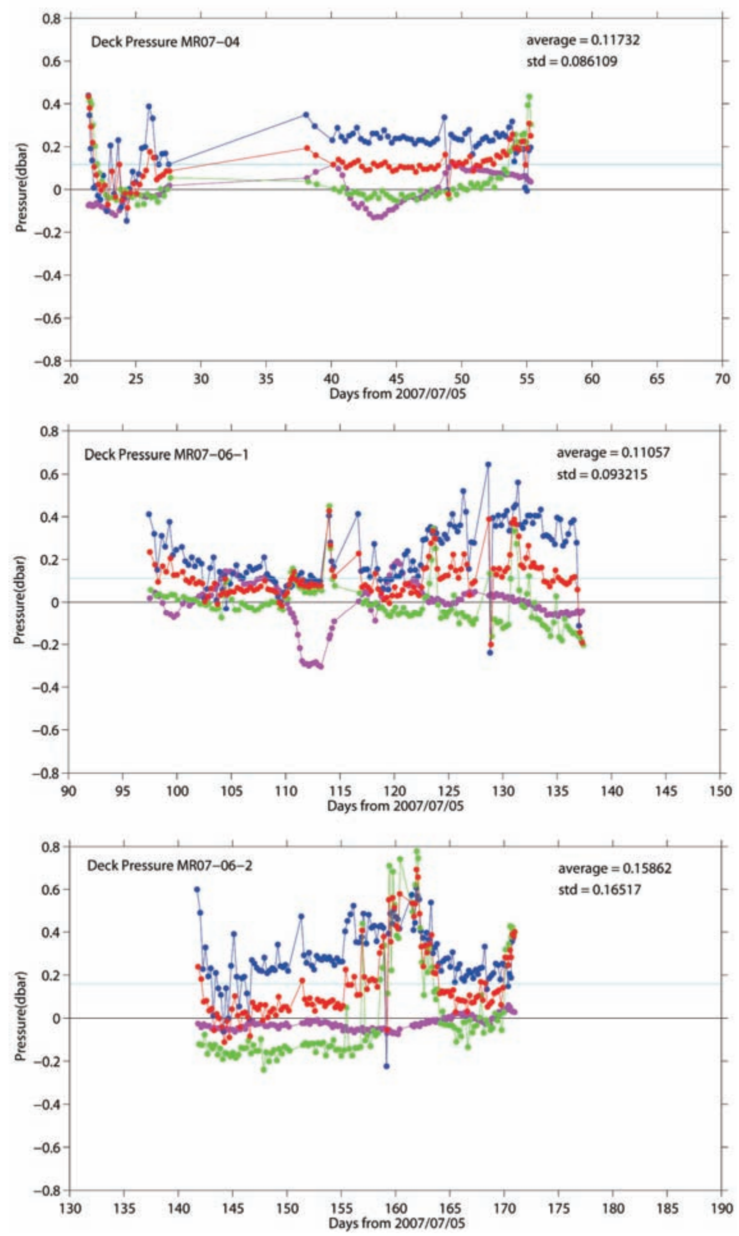

Figure 3.1.4 Time series of the CTD deck pressure. Pink dot indicates atmospheric pressure anomaly. Blue and green dots indicate pre- and post-cast deck pressures, respectively. Red dot indicates an average of the pre- and the post-cast deck pressures.

ii. Temperature

The CTD temperature sensors (SBE 3) were calibrated with the SBE 35 under the assumption that discrepancies between SBE 3 and SBE 35 data were due to pressure sensitivity, the viscous heating effect, and time drift of the SBE 3, in accordance with a method by Uchida et al. (2007).

Post-cruise sensor calibration for the SBE 35 was performed at SBE, Inc.

S/N 0045, 8 February 2008 (2nd step: fixed point calibration)

Slope = 1.000014

Offset = –0.001127

Offset of the SBE 35 data from the pre-cruise calibration was estimated to be smaller than 0.2 mK for temperature smaller than 4.5 °C. So the post-cruise correction of the SBE 35 temperature data was not deemed necessary for the SBE 35.

The CTD temperature was calibrated as

$$\text{Calibrated temperature} = T - (c_0 \times P + c_1 \times t + c_2)$$

where T is CTD temperature in °C, P is pressure in dbar, t is time in days from pre-cruise calibration date of CTD temperature and c_0, c_1, and c_2 are calibration coefficients. The coefficients were determined using the data for the depths deeper than 1950 dbar.

The primary temperature data were basically used for the post-cruise calibration. The secondary temperature sensor was also calibrated and used instead of the primary temperature data, because the primary conductivity data was not able to be used for the stations P14N_108_1 and P14N_109_1. The number of data used for the calibration and the mean absolute deviation from the SBE 35 are listed in Table 3.1.2 and the calibration coefficients are listed in Table 3.1.3. The results of the post-cruise calibration for the CTD temperature are summarized in Table 3.1.4 and shown in Figs. 3.1.5 ~ 3.1.7.

Table 3.1.2 Number of data used for the calibration (pressure ≥ 1950 dbar) and mean absolute deviation between the CTD temperature and the SBE 35. Serial number 4216 for the cruise MR07-06_1 was secondary temperature sensor.

Cruise	Serial number	Number	Mean absolute deviation	Note
MR07-04_1	4216	382	0.1 mK	Stns. from P01_1_1 to P01_44_1
	4188	760	0.1 mK	Stns. from P01_58_1 to P01_115_1
MR07-06_1	4188	825	0.1 mK	Stns. from P01_28_2 to P14N_4_1
	1525	1210	0.1 mK	Stns. from P14N_30_1 to P14N_109_1
	4216	421	0.1 mK	Stns. from P14N_80_1 to P14N_109_1
MR07-06_2	1525	1528	0.1 mK	

Table 3.1.3 Calibration coefficients for the CTD temperature sensors.

Cruise	Serial number	c_0 (°C/dbar)	c_1 (°C/day)	c_2 (°C)
MR07-04_ 1	4216	2.02667e–8	–2.25241e–5	0.0027
	4188	4.44381e–8	2.69275e–5	–0.0016
MR07-06_ 1	4188	3.85600e–8	1.54264e–5	–0.0013
	1525	–6.56477e–9	1.76679e–5	–0.0018
	4216	4.66846e–8	–6.65040e–5	–0.0129
MR07-06_2	1525	8.24860e–9	–1.23300e–5	0.0028

Table 3.1.4 Difference between the CTD temperature and the SBE 35 after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 1950 dbar. Number of data used is also shown.

	Pressure ≥ 1950 dbar			Pressure < 1950 dbar		
Cruise	Number	Mean (mK)	Sdev (mK)	Number	Mean (mK)	Sdev (mK)
MR07-04_1	1142	0.00	0.1	1589	0.35	12.7
MR07-06_1	1570	0.00	0.2	2962	0.01	6.9
MR07-06_2	2121	0.00	0.1	3007	–0.15	8.4

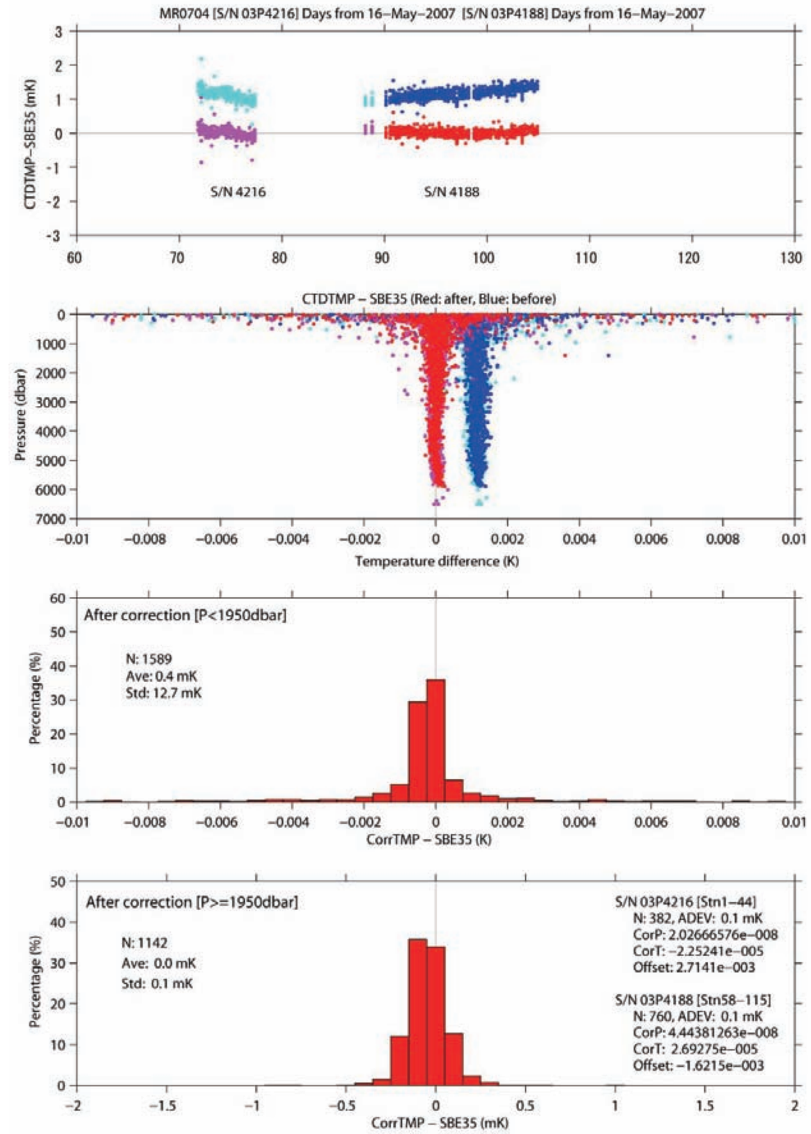

Figure 3.1.5 Difference between the CTD temperature and the SBE 35 for the cruise MR07-04_1. Blue/cyan and red/magenta dots indicate before and after the post-cruise calibration using the SBE 35 data, respectively. Top panel shows for P ≥ 1950 dbar. Lower two panels show histogram of the difference after the calibration.

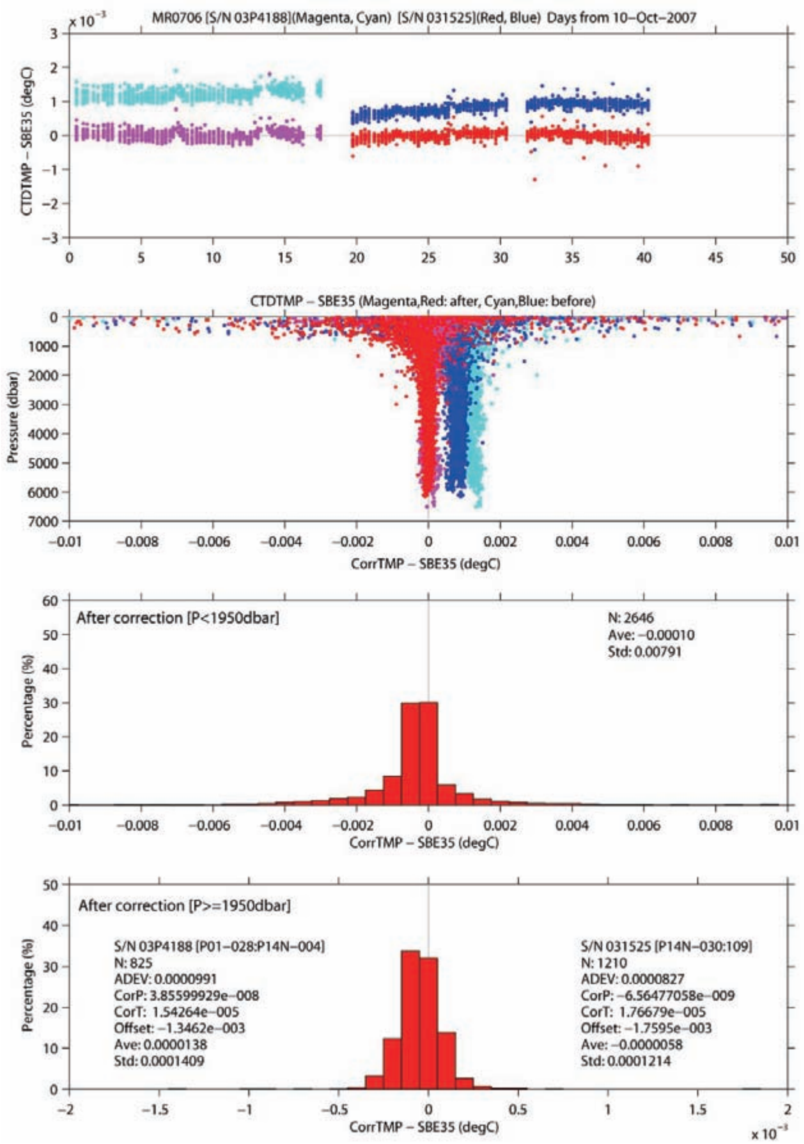

Figure 3.1.6 Same as Fig. 3.1.5, but for the cruise MR07-06_1.

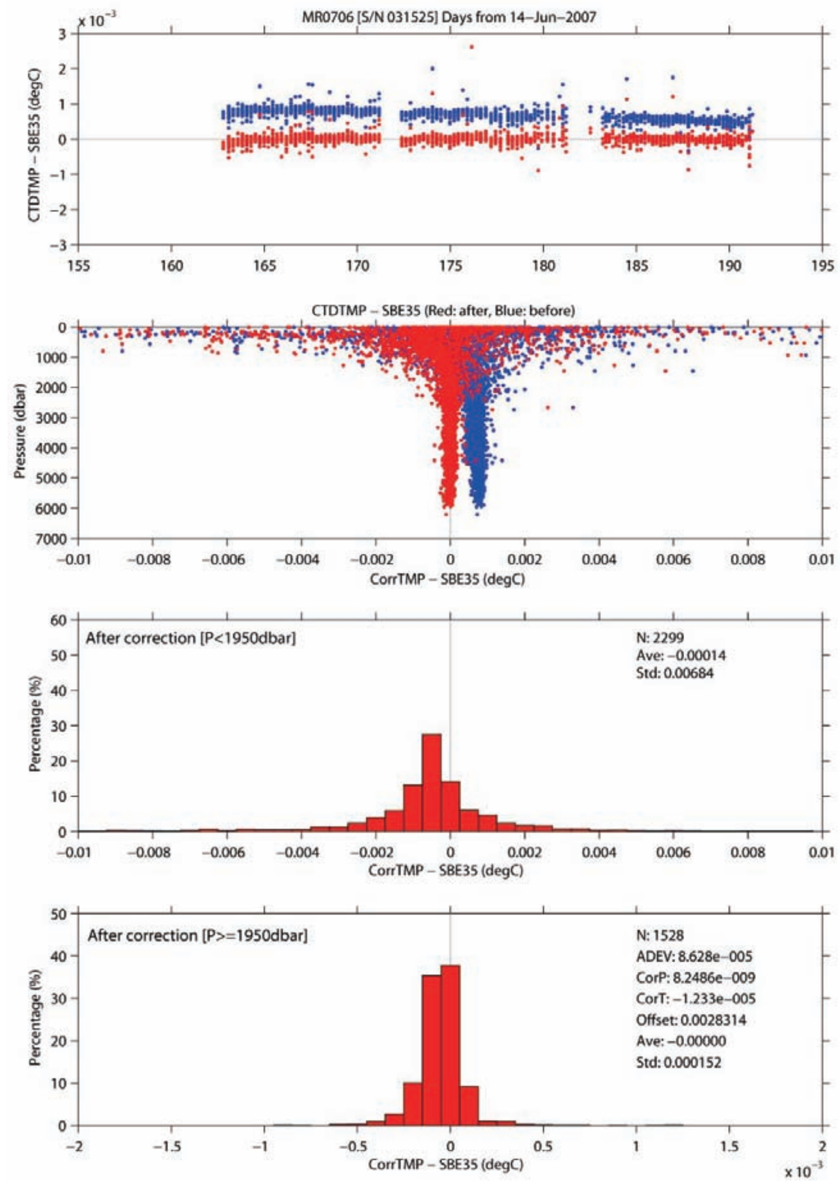

Figure 3.1.7 Same as Fig. 3.1.5, but for the cruise MR07-06_2.

iii. Salinity

The discrepancy between the CTD salinity and the bottle salinity is considered to be a function of conductivity and pressure. The CTD salinity was calibrated as

$$\text{Calibrated salinity} = S - (c_0 \times P + c_1 \times C + c_2 \times C \times P + c_3)$$

where S is CTD salinity, P is pressure in dbar, C is conductivity in S/m and c_0, c_1, c_2 and c_3 are calibration coefficients. The best fit sets of coefficients were determined by minimizing the sum of absolute deviation with a weight from the bottle salinity data. The MATLAB® function FMINSEARCH was used to determine the sets. The weight was given as a function of vertical salinity gradient and pressure as

$$\text{Weight} = \min[4, \exp\{\log(4) \times Gr / Grad\}] \times \min[4, \exp\{\log(4) \times P^2 / PR^2\}]$$

where Grad is vertical salinity gradient in PSU $dbar^{-1}$, and P is pressure in dbar. Gr and PR are threshold of the salinity gradient (0.5 mPSU $dbar^{-1}$) and pressure (1000 dbar), respectively. When salinity gradient is small (large) and pressure is large (small), the weight is large (small) at maximum (minimum) value of 16 (1). The salinity gradient was calculated using up cast CTD salinity data. The up cast CTD salinity data was low-pass filtered with a 3-point (weights are 1/4, 1/2, 1/4) triangle filter before the calculation.

The primary conductivity data created by the software module ROSSUM were basically used after the post-cruise calibration for the temperature data. For the stations P14N_108_1 and P14N_109_1, the secondary conductivity data was used, because the primary conductivity data was not able to be used for the stations. The coefficients were determined for some groups of the CTD stations. The results of the post-cruise calibration for the CTD salinity are summarized in Table 3.1.5 and shown in Figs. 3.1.8 and 3.1.9. And the calibration coefficients and number of data used for the calibration are listed in Table 3.1.6.

Table 3.1.5 Difference between the CTD salinity and the bottle salinity after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 950 dbar. Number of data used is also shown.

	Pressure ≥ 950 dbar			Pressure < 950 dbar		
Cruise	Number	Mean	Sdev	Number	Mean	Sdev
MR07-04_1	1494	0.0	0.4	1105	–5.7	19.1
MR07-06_1	2672	0.0	0.4	1870	0.0	4.3
MR07-06_2	2067	–0.1	0.5	1647	1.1	8.8

Table 3.1.6 Calibration coefficients for the CTD salinity. Number of data used is also listed.

Station	Number	c_0	c_1	c_2	c_3
MR07-04_1					
P01_1-28	824	1.0331764015e–5	1.6322214271e–3	–3.1041705576e–6	–5.21792e–3
P01_40-82	845	5.5743728228e–6	–7.5153334807e–3	–1.5802276835e–6	2.33384e–2
P01_83-92	357	–2.6365673251e–6	–1.7948408615e–2	9.9643702860e–7	5.64183e–2
P01_X17-115	568	–6.8043279569e–7	–1.1413741305e–2	3.6019288465e–7	3.54391e–2
MR07-06_1					
P01_28	33	1.2366877766e–5	–3.1864710265e-3	–3.7410180073e-6	8.30924e-3
P01_29	34	1.4429501944e–5	–1.7179786902e–3	–4.3563216655e–6	3.81095e–3
P01_30	33	8.0524469712e–6	–4.6347655243e–3	–2.3595978265e–6	1.29389e–2

P01_32-33	101	1.1753176804e–5	–2.5920297513e–3	–3.5208528038e–6	6.03307e–3
P01_34-41	261	5.2675994458e–6	–4.3909897182e–3	–1.5450824887e–6	1.17190e–2
P01_42-46	216	7.0309692113e–6	–4.3031061185e–3	–2.0723214458e–6	1.08889e–2
P01_47-57	341	1.1092775540e–5	–2.3272648509e–3	–3.3053060435e–6	3.57009e–3
P01_58-59	71	3.2310197116e–6	–4.4057460257e–3	–9.2624113598e–7	1.08304e–2
P01_60-4	826	6.7400531759e–6	–2.7670250955e–3	–1.9631840097e–6	4.12712e–3
P14N_30-39	356	6.2991911918e–6	–1.7666229796e–3	–1.8995982920e–6	1.75626e–3
P14N_40-53	477	5.0547425123e–6	–7.9209509292e–4	–1.5177307189e–6	–1.96119e–3
P14N_54-73	633	3.1759512104e–6	–1.0157437278e–3	–9.4764638711e–7	–1.42327e–3
P14N_74-77	34	2.4469862353e–6	6.4594035205e–4	–7.2598062391e–7	–8.86545e–4
P14N_78-81	133	4.7865965493e–6	1.6054792872e–4	–1.4517360658e–6	–1.54977e–4
P14N_82-99	545	4.3956514692e–7	1.0331301338e–4	–1.1130619565e–7	1.08226e–4
P14N_100-107	271	4.2884569782e–6	–1.7427574735e–3	–1.2594920500e–6	8.51481e–3
P14N_108-109	70	6.0865582513e–6	–4.5049125413e–4	–1.7802113940e–6	2.18567e–3
MR07-06_2					
P14N_109-115	232	2.3777541759e–6	–1.3933958135e–3	–6.6273977628e–7	8.17648e–3
P14N_116-127	417	3.5670485696e–6	–1.1006125106e–3	–1.0346847842e–6	6.86221e–3
P14N_128-138	377	1.3987382078e–6	–1.4065398654e–3	–3.4347529939e–7	7.53518e–3
P14N_139-144	205	2.8354655464e–6	–1.2215836660e–3	–7.9541774815e–7	6.53515e–3
P14N_145-149	170	3.1542072660e–6	–2.0613822363e–3	–8.9077088694e–7	8.87180e–3
P14N_150-158	301	4.8230368910e–6	–1.2147005582e–3	–1.4092637192e–6	5.57979e–3
P14N_159-174	505	1.6174979975e–6	–1.1887433192e–3	–3.8999095831e–7	4.42873e–3
P14N_175-P14C_1	1484	–1.2626975255e–6	–1.0905094466e–3	5.9573995339e–7	2.43615e–3

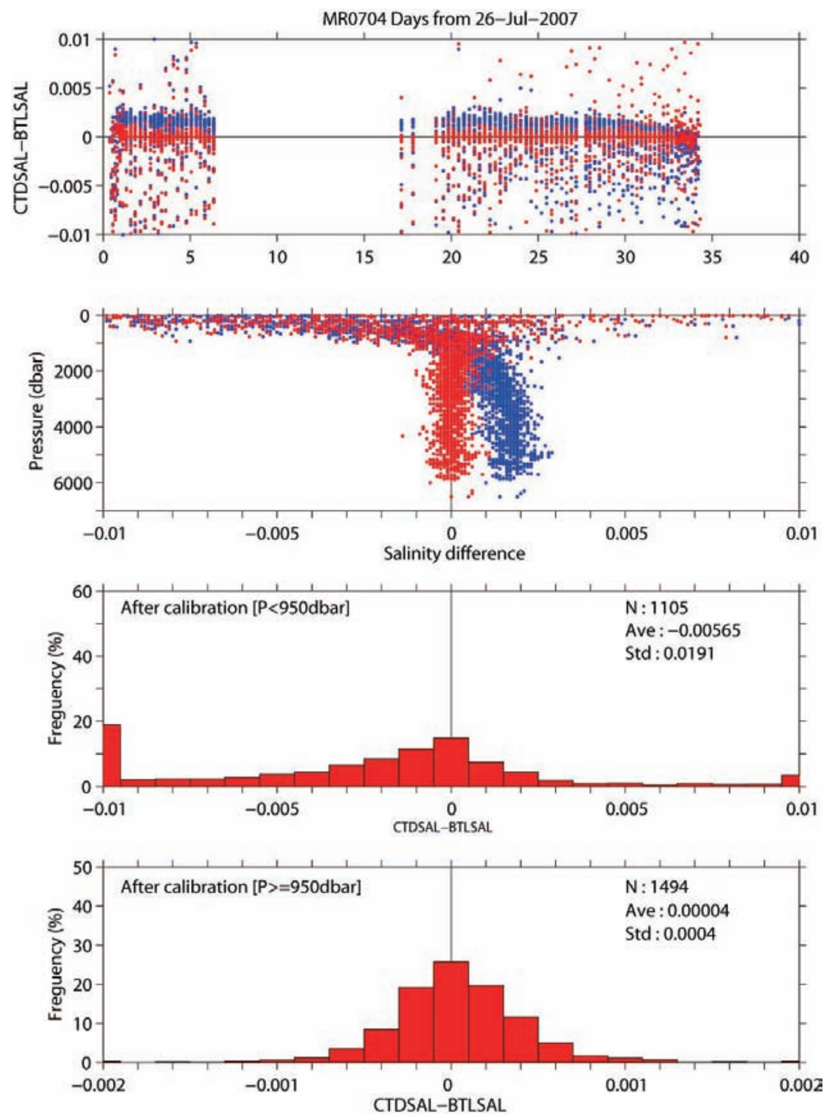

Figure 3.1.8 Difference between the CTD salinity and the bottle salinity for the cruise MR07-04_1. Blue and red dots indicate before and after the post-cruise calibration using the bottle salinity data, respectively. Top panel shows for P ≥ 950 dbar. Lower two panels show histogram of the difference after the calibration.

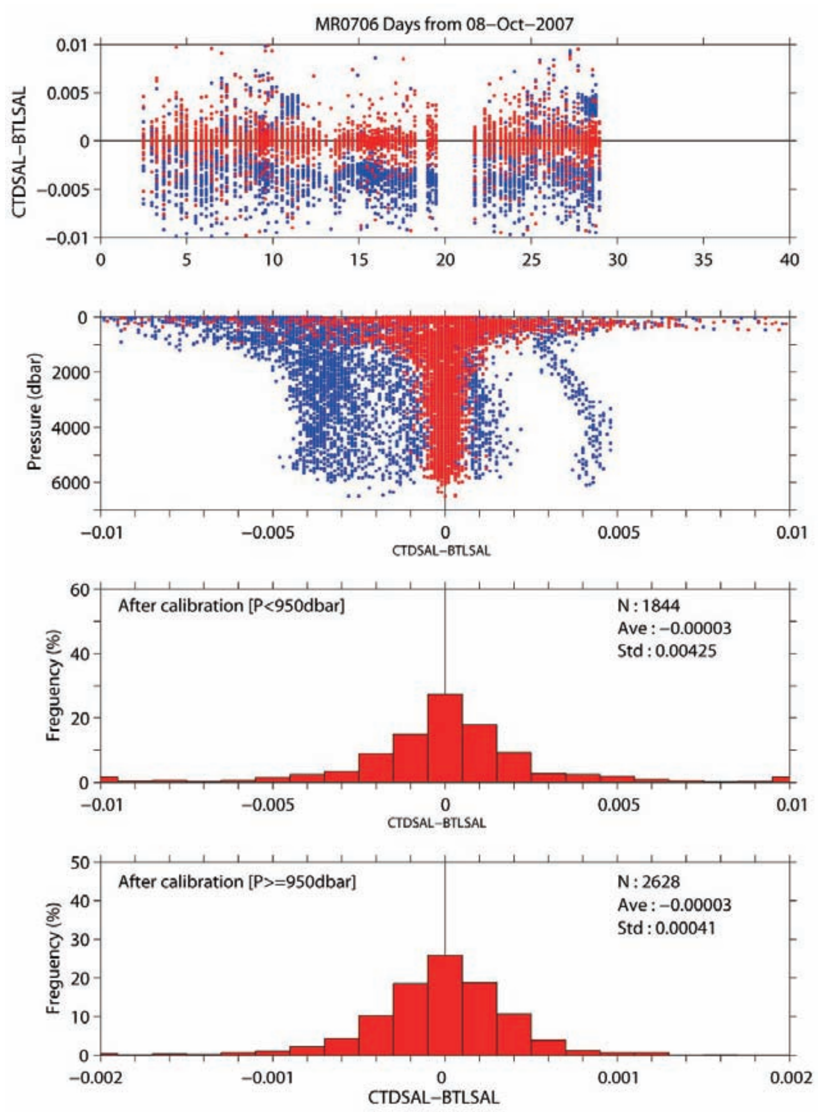

Figure 3.1.9 Same as Fig. 3.1.8, but for the cruise MR07-06_1.

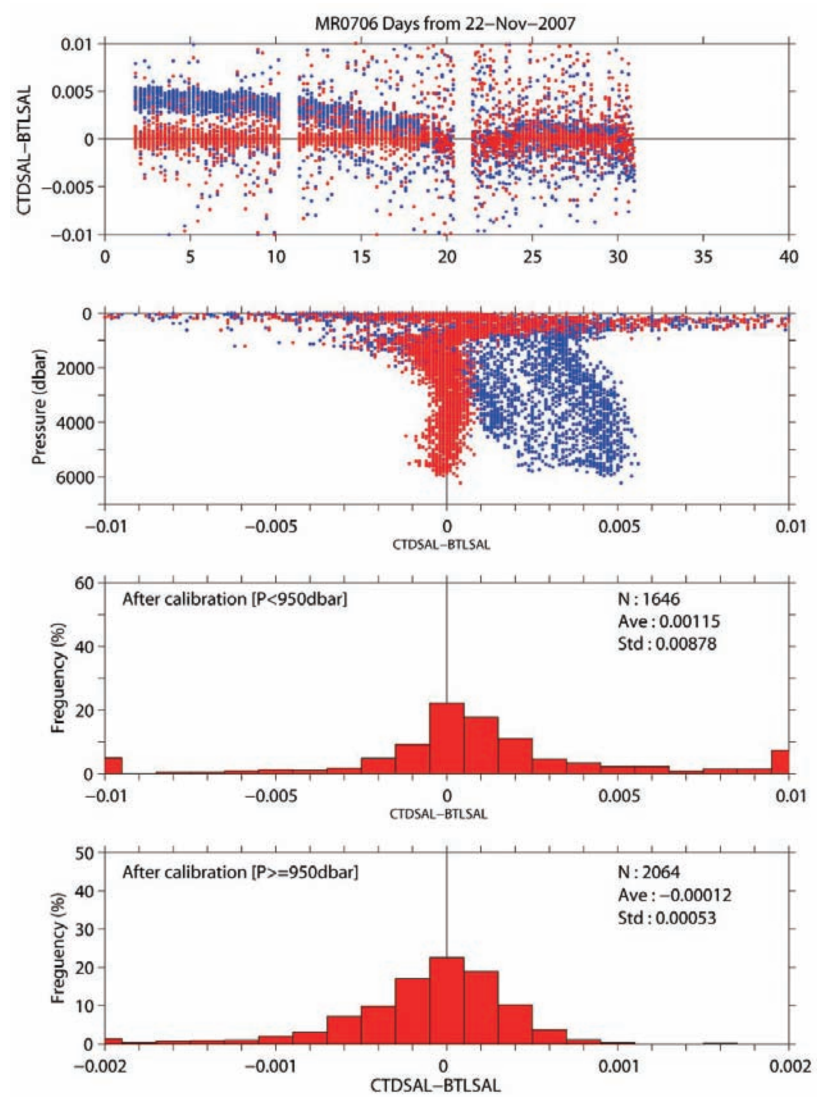

Figure 3.1.10 Same as Fig. 3.1.8, but for the cruise MR07-06_2.

iv. Oxygen (MR07-04)

The AANDERAA and ALEC oxygen optodes were calibrated for the cruise MR07-04.

AANDERAA oxygen optode

The AANDERAA oxygen optode was calibrated by the Stern-Volmer equation, according to a method by Uchida et al. (2008):

$$O_2\ (\mu mol/l) = (P_0 / P - 1) / K_{sv}$$

where P is the phase shift, P_0 is the phase shift in the absence of oxygen and K_{sv} is Stern-Volmer constant. The P_0 and the K_{sv} are assumed to be functions of temperature as follows.

$$K_{sv} = C_{11} + C_{12} \times t + C_{13} \times t^2$$

$$P_0 = C_{21} + C_{22} \times t$$

$$P = C_{31} + C_{32} \times P_b$$

where t is CTD temperature (°C) and P_b is raw phase measurement (deg). The oxygen concentration was calculated using temperature data from the first responding CTD temperature sensor instead of temperature data from slow responding optode temperature sensor.

The calibration was performed for the up cast phase data created by the software module ROSSUM after the post-cruise calibration for the CTD temperature and salinity. The calibration coefficients (C_{11}, C_{12}, C_{13}, C_{21}, C_{22}, C_{31} and C_{32}) were determined for all CTD stations. The offset (C_{31}) for the phase shift was slightly changed for the 6 groups of CTD casts. The results of the post-cruise calibration for the optode oxygen are summarized in Table 3.1.7 and shown in Fig. 3.1.8. And the calibration coefficients and number of data used for the calibration are listed in Table 3.1.8.

Although the up cast optode data was well calibrated in situ (Fig. 3.1.8), difference between the up and down cast was quite large in the surface layer (~150 dbar) (Fig. 3.1.9). Similar discrepancy was seen in the data obtained in the North Pacific subarctic region (MR06-03_2), and was not seen in the data obtained in the North Pacific subtropical region (MR05-05) (Uchida et al., 2008). Data quality of the in-situ calibrated down cast optode data was bad in the surface layer.

The optode oxygen data from the down cast was about 1 μmol/kg smaller than that from the up cast at depths between 1000 and 3000 dbar (Uchida et al., 2008). Although more work needs to be done on understanding the sensor's response under various situations at ambient temperature and in a vertical gradient of oxygen for more accurate compensation for the profile data, the down cast profile data were empirically corrected by using following equation.

$$O_{2c} = O_2 + 20 \times dO_2 / dp$$

where O_2 is the optode oxygen (μmol/kg) and p is pressure (dbar). For the calculation of the derivative, the oxygen profile was low-pass filtered by using a box-car filter with a window of 5 dbar before the calculation. The results of the correction is shown in Fig. 3.1.10.

Table 3.1.7 Difference between the optode oxygen and the bottle oxygen after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 950 dbar. Number of data used is also shown.

Pressure ≥ 950 dbar			Pressure < 950 dbar		
Number	Mean (μmol/kg)	Sdev (μmol/kg)	Number	Mean (μmol/kg)	Sdev (μmol/kg)
1510	0.01	0.31	1118	0.10	2.00

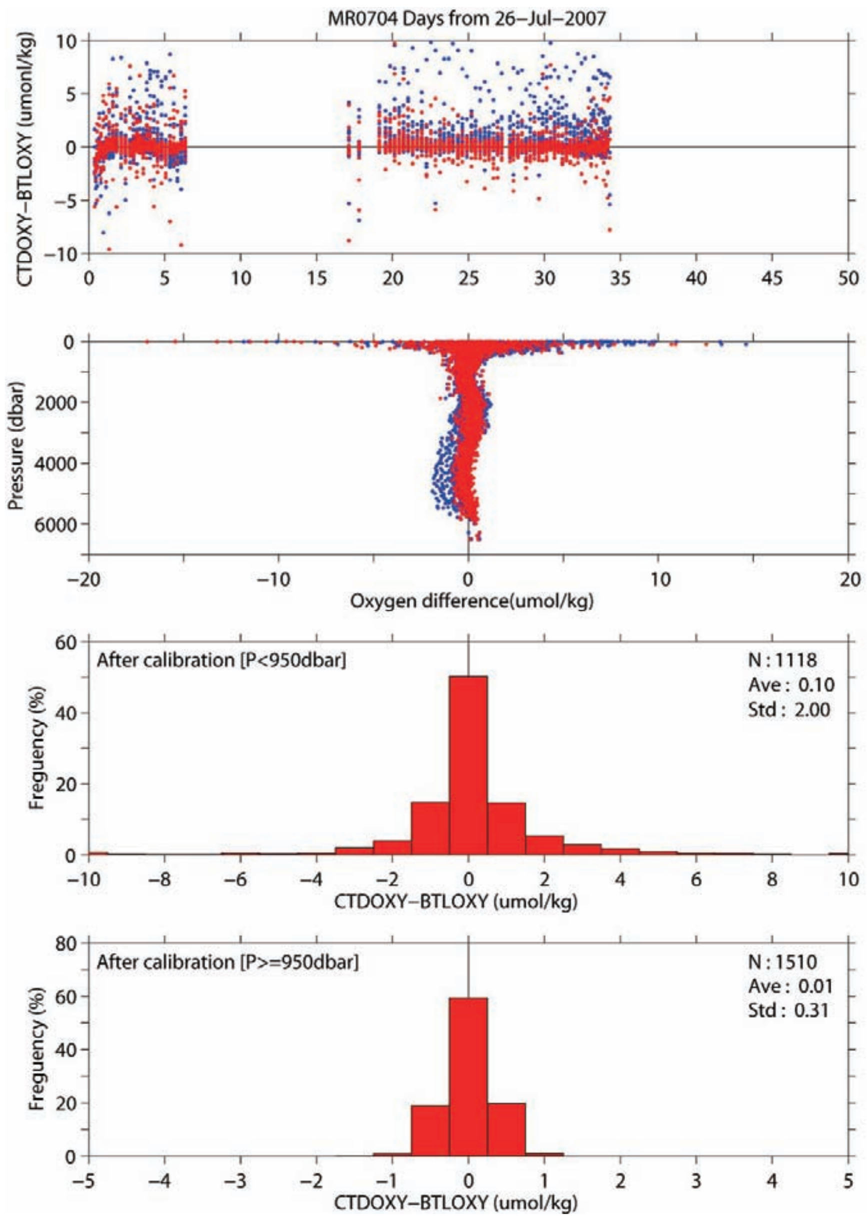

Fig. 3.1.8 Difference between the optode oxygen and the bottle oxygen. Blue and red dots indicate before and after the post-cruise calibration using the bottle salinity data, respectively. Lower two panels show histogram of the difference after the calibration.

Table 3.1.8 Calibration coefficients for the optode oxygen. Number of data used is also listed.

Number	Mean absolute deviation	Coefficients	Group of CTD casts
2627	0.60 μmol/kg	C_{11} = 2.635256348237611e–03	
		C_{12} = 1.225025719497667e–04	
		C_{13} = 1.761916331924197e–06	
		C_{21} = 60.17218865923306	
		C_{22} = 8.903986993195000e–02	
		C_{31} = –6.060184746615353	1_1 – 9_1
		= –6.004547679479678	10_1 – 17_1
		= –6.053733067496423	18_1 – 23_1
		= –6.105901740541861	24_1 – 28_1
		= –6.018089856760813	40_1 – 103_1
		= –6.069381437495752	104_1 – 115_1
		C_{32} = 1.090377252560871	

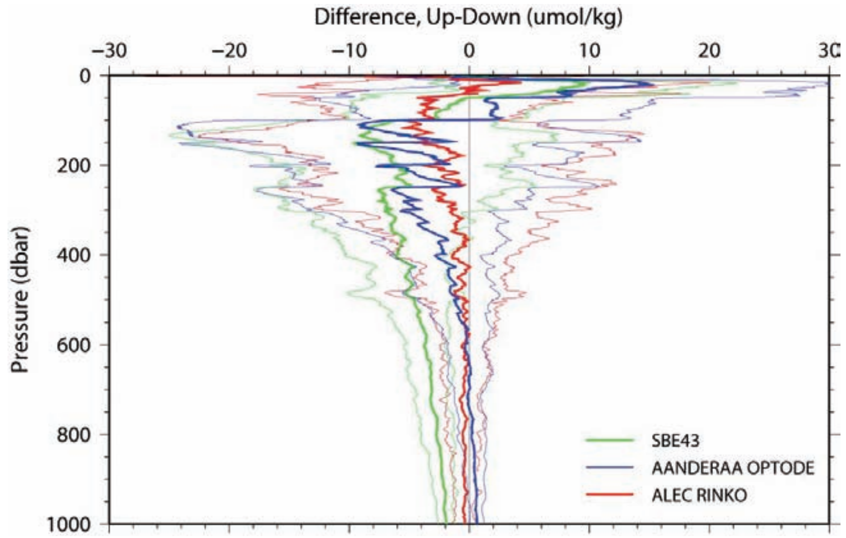

Fig. 3.1.9 Mean oxygen difference between the down and up casts (up-down) for the SBE 43 (green line), the oxygen optode (blue line) and the prototype oxygen optode (red line) obtained from the cruise MR07-04. Thin lines represent 1 standard deviation from the mean profile.

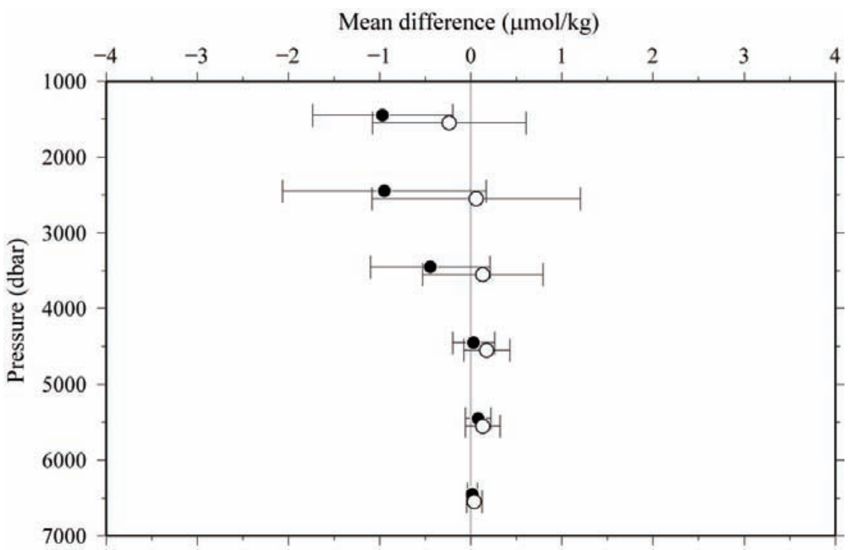

Fig. 3.1.10 Mean oxygen difference between the down and up casts (down-up) for the oxygen optode before (closed circles) and after (open circles) the correction (see text for detail).

ALEC prototype oxygen optode (RINKO)

The prototype of ALEC oxygen optode was calibrated by the Stern-Volmer equation, according to a method by Uchida et al. (2008):

$$O_2\ (\mu mol/l) = (P_0 / P - 1) / K_{sv}$$

where P is the phase shift, P_0 is the phase shift in the absence of oxygen and K_{sv} is Stern-Volmer constant. The P_0 and the K_{sv} are assumed to be functions of temperature as follows.

$$K_{sv} = C_{11} + C_{12} \times t + C_{13} \times t^2$$

$$P_0 = C_{21} + C_{22} \times t$$

$$P = C_{31} + C_{32} \times V$$

where t is CTD temperature (°C) and V is raw sensor output (voltage). The response of the sensing foil of the prototype optode decreases with increasing ambient pressure, and this pressure effect was estimated to decrease the response by 2.8 % per 1000 dbar. The oxygen concentration was calculated using temperature data from the first responding CTD temperature sensor instead of temperature data from slow responding optode temperature sensor.

The calibration was performed for the up cast data created by the software module ROSSUM after the post-cruise calibration for the CTD temperature and salinity. The calibration coefficients (C_{11}, C_{12}, C_{13}, C_{21}, C_{22}, C_{31} and C_{32}) were determined for some groups of the CTD stations. The offset (C_{31}) for the phase shift was slightly changed for each CTD cast. The calibration coefficients and number of data used for the calibration are listed in Table 3.1.9. The results of the post-cruise calibration are summarized in Table 3.1.10 and shown in Fig. 3.1.11. In the post-cruise calibration, data depths deeper than 2000 dbar were not used for the first 2 groups (Stns. 1~15 and 16~28) because the calibration coefficients were not well determined when the data were included. Therefore the quality flag of the calibrated oxygen data depths deeper than 2000 dbar were set to 3 for stations from 1 to 28.

Although the up cast optode data was well calibrated in situ (Fig. 3.1.11) and performance in the surface layer was quite well (Fig. 3.1.9), difference between the up and down cast was quite large in the deep layer (depths deeper than 1500 dbar).

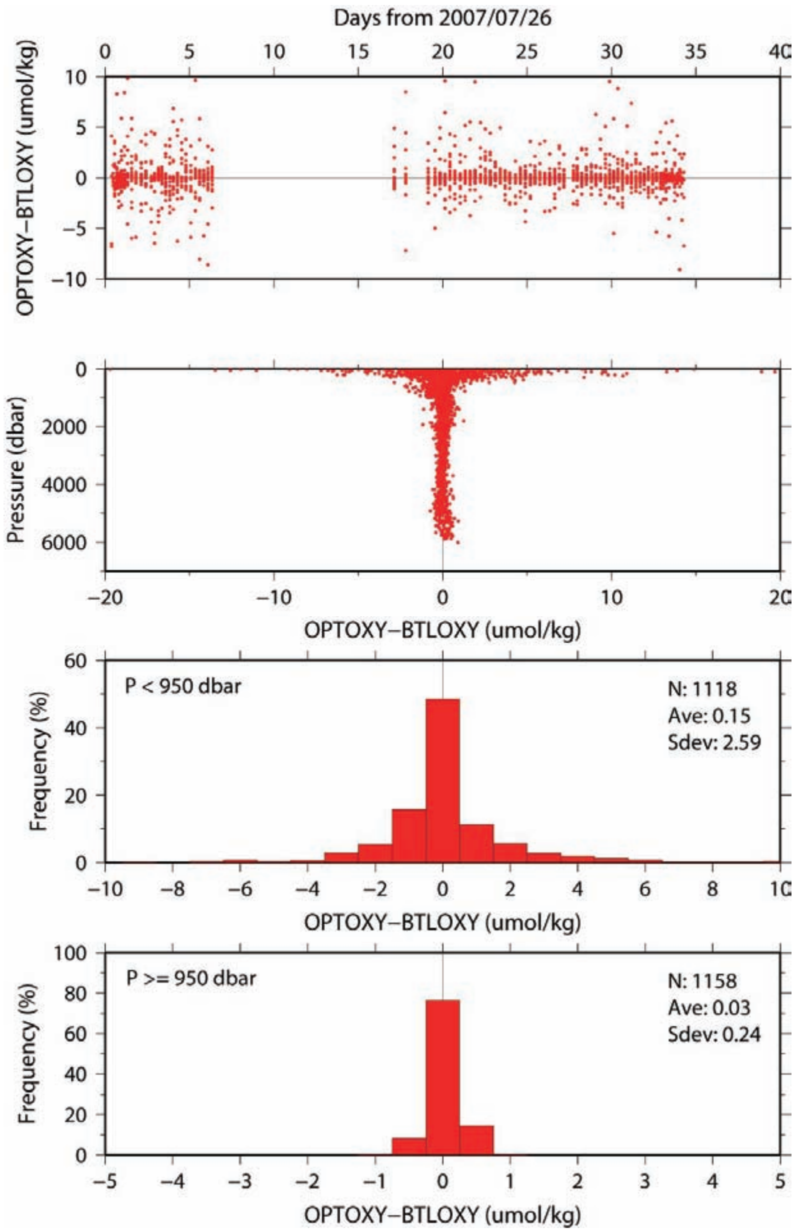

Fig. 3.1.11 Difference between the prototype optode oxygen and the bottle oxygen for after the post-cruise calibration. Top panel shows for P ≥ 950 dbar. Lower two panels show histogram of the difference.

Table 3.1.9 Calibration coefficients for the prototype of oxygen optode. Number of data (Num) used and mean absolute deviation (Adev) are also listed.

Stn	Num	Adev	C11	C12	C13	C21	C22	C32
1-15	246	1.19	5.8789102e-3	1.3202160e-4	-1.4972252e-6	6.7651313	-8.4590827e-2	1.6812784
16-28	239	1.47	6.0506919e-3	6.2425650e-5	-4.7143030e-7	8.1756988	-1.3633868e-1	2.0311299
40-68	375	0.70	5.3269802e-3	3.1786415e-4	-3.9858532e-6	6.0288515	-2.5233800e-2	1.6248560
69-78	343	0.41	5.1852402e-3	2.5808996e-4	6.0745581e-7	5.7606052	-1.3581176e-2	1.5629738
79-87	336	0.36	5.1906670e-3	2.6273419e-4	5.0734085e-7	5.6164948	-1.1385041e-2	1.5362879
88-97	317	0.54	5.1486342e-3	2.3234328e-4	2.6910529e-7	6.3327141	-2.0598345e-2	1.7236231
98-104	198	0.43	5.2445225e-3	1.9401424e-4	1.4324301e-6	6.0844733	-2.9092447e-2	1.6510633
105-115	221	1.05	5.1940610e-3	2.2635952e-4	1.0836666e-6	7.3620419	-1.6032098e-2	2.0102865

Stn	C31	Stn	C31	Stn	C31	Stn	C31
1	-1.4663410	16	-1.8044790	40	-1.5211045	69	-1.4133193
2	-1.5028371	17	-1.8013574	44	-1.5283612	70	-1.4127655
3	-1.4959721	18	-1.7933317	58	-1.5244686	71	-1.4092531
4	-1.4995386	19	-1.7848185	60	-1.5257361	72	-1.4092409
5	-1.4968510	20	-1.7851197	61	-1.5231930	73	-1.4070984
6	-1.5046124	21	-1.7818728	62	-1.5239379	74	-1.4079670
7	-1.4828724	22	-1.7922501	63	-1.5199569	X15	-1.4055382
8	-1.4845656	23	-1.7746797	64	-1.5214495	76	-1.4020200
9	-1.4752667	24	-1.7617735	65	-1.5190013	77	-1.4060858
10	-1.4907149	25	-1.7543922	66	-1.5220141	78	-1.4020048
11	-1.4728418	26	-1.7486554	67	-1.5200137		
12	-1.4852094	27	-1.7497571	68	-1.5197691		
13	-1.4586884	28	-1.7557400				
14	-1.4565111						
15	-1.4541353						

Stn	C31	Stn	C31	Stn	C31	Stn	C31
79	-1.4005308	88	-1.5249214	98	-1.4498959	105	-1.7497139
80	-1.4002417	89	-1.5217801	99	-1.4473812	106	-1.7474551
81	-1.3991096	90	-1.5212776	100	-1.4476825	107	-1.7506227
82	-1.3983053	91	-1.5184959	101	-1.4488230	108	-1.7414919
83	-1.3970340	92	-1.5172182	102	-1.4451071	109	-1.7450724
84	-1.3965286	X17	-1.5150712	103	-1.4435156	110	-1.7421465
85	-1.3945384	94	-1.5141203	104	-1.4391912	111	-1.7338304
86	-1.3943334	95	-1.5103182			112	-1.7424335
X16	-1.3928051	96	-1.5127131			113	-1.7349491
87	-1.3923077	97	-1.5110558			114	-1.7298328
						115	-1.7540911

Table 3.1.10 Difference between the prototype optode oxygen and the bottle oxygen after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 950 dbar. Number of data used is also shown.

Pressure ≥ 950 dbar			Pressure < 950 dbar		
Number	Mean (μmol/kg)	Sdev (μmol/kg)	Number	Mean (μmol/kg)	Sdev (μmol/kg)
1158	0.03	0.24	1118	0.15	2.59

Table 3.1.11 Difference between the combined optode oxygen and the bottle oxygen after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 950 dbar. Number of data used is also shown.

Pressure ≥ 950 dbar			Pressure < 950 dbar		
Number	Mean (μmol/kg)	Sdev (μmol/kg)	Number	Mean (μmol/kg)	Sdev (μmol/kg)
1510	0.01	0.31	1118	0.15	2.59

Combined use of the two optode oxygen data

Final CTD oxygen data were produced by combining the two optode oxygen data, because the data quality of the down cast data for the AANDERAA oxygen optode was bad in the surface layer and for the ALEC prototype oxygen optode was bad in the deep layer. The combined oxygen O in μmol/kg was calculated as follows:

$O = O_1$ (for $P \leq 800$ dbar)

$= O_2$ (for $P \geq 1000$ dbar)

$= W_1 \times O_1 + W_2 \times O_2$ (for 800 dbar $< P <$ 1000 dbar)

$W_1 = (1000 - P) / (1000 - 800)$

$W_2 = 1 - W_1$

where O_1 is the ALEC prototype optode oxygen in μmol/kg, O_2 is the AANDERAA optode oxygen in μmol/kg, and P is pressure. The comparisons between the combined optode oxygen and the bottle oxygen are summarized in Table 3.1.11.

v. Oxygen (MR07-06)

The SBE 43 oxygen sensor was calibrated for the cruise MR07-06 as follows.

$$O_2\ [\mathrm{ml/l}] = Soc \times \{v+offset\} \times \exp\{(TCor) \times t + (PCor) \times p\} \times Oxsat(t, s)$$

where p is pressure in dbar, t is temperature in °C and s is salinity in psu. Oxsat is oxygen saturation value minus the volume of oxygen gas (STP) absorbed from humidity-saturated air. Soc, offset, TCor and PCor are the calibration coefficients. The best fit sets of coefficients are determined by minimizing the sum of absolute deviation with a weight from the bottle oxygen data.

The down-cast CTD data sampled at same density of the up-cast CTD data created by the software module ROSSUM are used after the post-cruise calibration for the CTD temperature and salinity.

The coefficients were determined for some groups of the CTD stations. The calibration coefficients and number of the data used for the calibration are listed in Table 3.1.12. The results of the post-cruise calibration for the CTD oxygen are summarized in Table 3.1.13 and shown in from Figures 3.1.12 and 3.1.13.

Table 3.1.12 Calibration coefficients for the CTD oxygen. Number of data used is also listed.

Station	Number	Soc	Offset	TCor	PCor
P01_28_2–P01_36_1	299	0.4617342	–0.5212380	2.2118097e–3	1.3725459e–4
P01_37_1–P01_44_2	313	0.4654003	–0.5219757	2.0347435e–3	1.3653978e–4
P01_45_1–P01_52_1	239	0.4712498	–0.5226352	1.3921095e–3	1.3539851e–4
P01_53_1–P01_56_1	142	0.4746477	–0.5203241	8.6392465e–4	1.3356417e–4
P01_57_1–P01_59_1	107	0.4747909	–0.5253515	1.2616959e–3	1.3577596e–4
P01_60_2–P14N_29_1	105	0.4771914	–0.5168202	1.0539244e–4	1.3202413e–4
P14N_28_1–P14N_21_1	267	0.4763509	–0.5223087	6.2960998e–4	1.3445401e–4
P14N_20_1–P14N_4_1	459	0.4688899	–0.5227800	2.8376767e–3	1.3873165e–4
P14N_30_1–P14N_35_1	212	0.4731548	–0.5194302	1.4379132e–3	1.3444478e–4
P14N_36_1–P14N_38_1	35	0.4893230	–0.5237080	–9.4980732e–4	1.3213583e–4
P14N_39_1–P14N_54_1	543	0.4774736	–0.5235095	1.8334515e–3	1.3497810e–4
P14N_55_1–P14N_73_1	604	0.4696442	–0.5195310	2.2965664e–3	1.3703207e–4
P14N_74_2–P14N_109_1	1174	0.4747268	–0.5257560	1.7272031e–3	1.3737072e–4
P14N_109_2–P14N_125_1	584	0.4759044	–0.5260304	1.8433363e–3	1.3730910e–4
P14N_126_1–P14N_155_1	1028	0.4821183	–0.5331461	1.7173733e–3	1.3781520e–4
P14N_156_1–P14N_171_1	525	0.4786612	–0.5326933	2.1517595e–3	1.3916129e–4
P14N_172_1–P14N_185_1	328	0.4577516	–0.5081243	3.2346432e–3	1.4062034e–4
P14C_48_1–P14C_36_1	376	0.4586324	–0.5078367	3.1528881e–3	1.3845760e–4
P14C_35_1–P14C_19_1	501	0.4590327	–0.5006313	2.9939197e–3	1.3471839e–4
P14C_18_1–P14C_1_1	395	0.4587594	–0.5018013	3.1010637e–3	1.3465825e–4

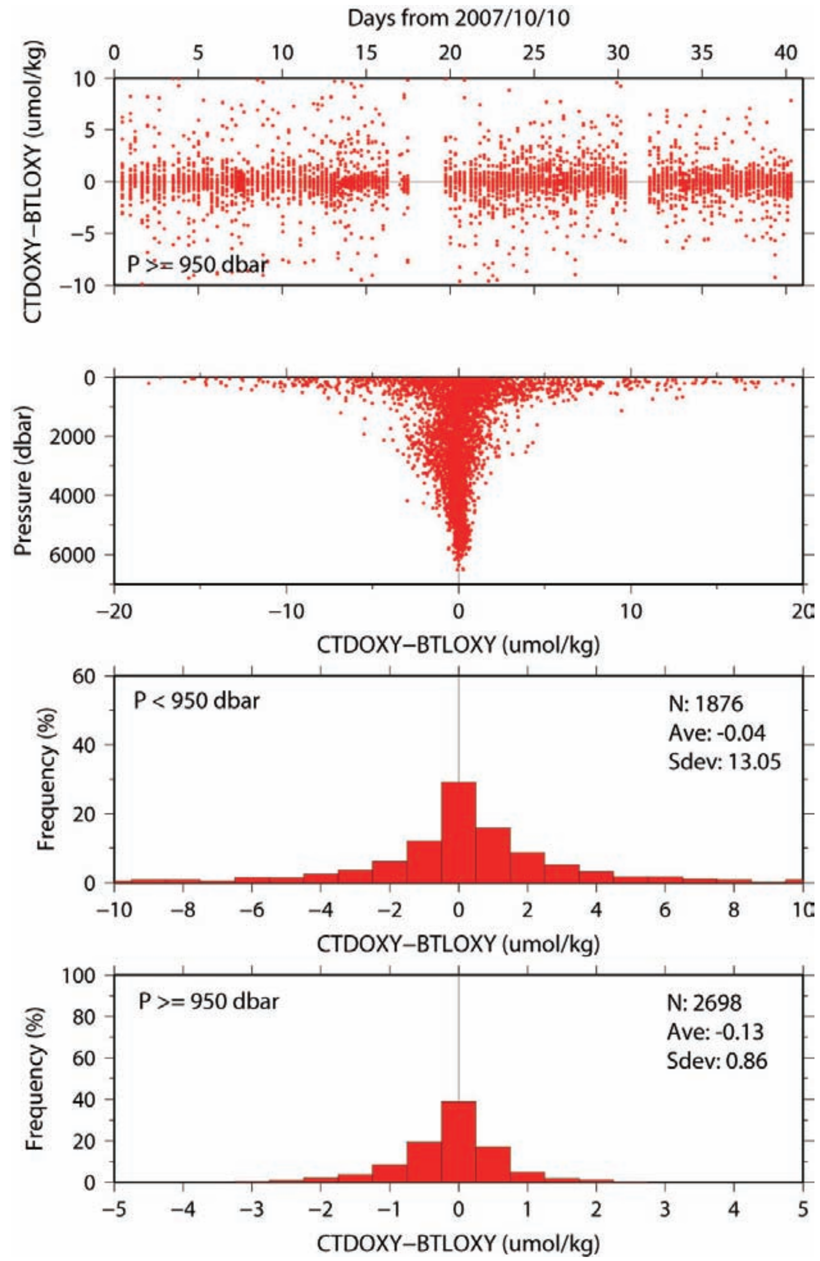

Figure 3.1.12 Difference between the CTD oxygen and the bottle oxygen for after the post-cruise calibration for leg 1. Lower two panels show histogram of the difference.

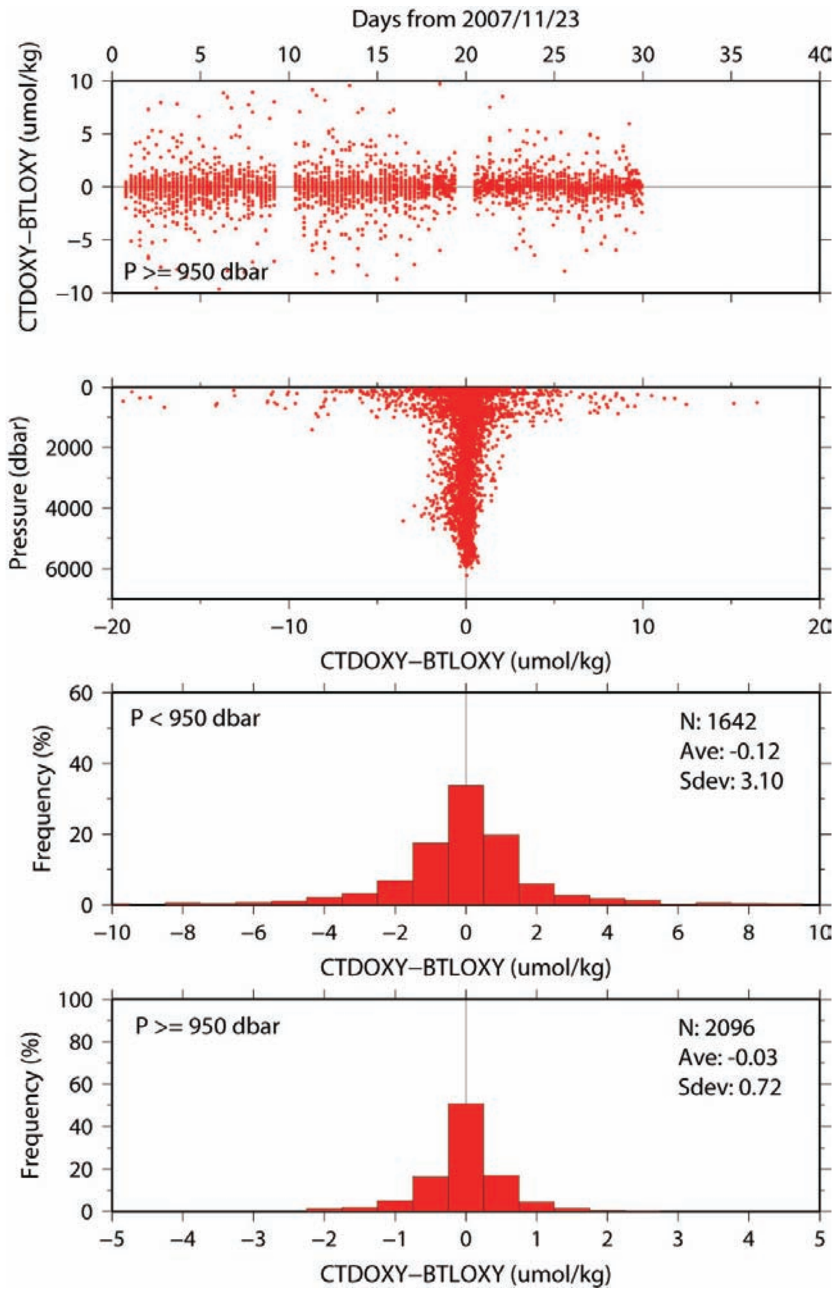

Figure 3.1.13 Difference between the optode oxygen and the bottle oxygen for after the post-cruise calibration for leg 2. Lower two panels show histogram of the difference.

Table 3.1.13 Difference between the CTD oxygen and the bottle oxygen after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 950 dbar. Number of data used is also shown.

	Pressure ≥ 950 dbar			Pressure < 950 dbar	
Number	Mean (μmol/kg)	Sdev (μmol/kg)	Number	Mean (μmol/kg)	Sdev (μmol/kg)
Leg 1					
2698	–0.13	0.86	1876	–0.04	13.05
Leg 2					
2096	–0.03	0.72	1642	–0.12	3.10

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Update of CTD oxygen data for the cruises MR07-04 and MR07-06

September 24, 2009

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1. Introduction

The CTD oxygen data were updated after the data book was published by Kawano et al. (2009). In the data book, data from two oxygen optode sensors (Oxygen Optode 3830; Aanderaa Data Instruments AS, Bergen, Norway, and RINKO; JFE Alec Co. Ltd., Kobe, Japan) were combined and used because data quality of the SBE 43 oxygen sensor was relatively bad (Kawano et al., 2009) for the cruise MR07-04. Data from the two oxygen optode sensors were combined because the Optode 3830 had a slow time response without pressure hysteresis and the RINKO had a fast time response with pressure hysteresis. The time-dependent, pressure-induced effect (pressure hysteresis) on the sensing foil of the RINKO was similarly observed in the SBE 43 data. Recently, a correction method of the pressure hysteresis was developed for the SBE 43 (Sea-Bird Electronics, 2009), and the correction method was successfully applied to the RINKO (Murata, 2009). Therefore, the RINKO data were reprocessed, calibrated, and used as the CTD oxygen data for the cruises MR07-04 and MR07-06.

2. Data processing

The RINKO data were reprocessed from the raw data. The time-dependent, pressure-induced effect (pressure hysteresis) of the RINKO was corrected for both profile and bottle data by using RINKOCOR (original module, version 1.0) and RINKOCORROS (original module, version 1.0) after the module TCORP. The calibration coefficients, H1 (amplitude of hysteresis correction), H2 (curvature function for hysteresis), and H3 (time constant for hysteresis) were determined empirically as:

H1 = 0.0065 for the RINKO prototype I with the foil A or C
H1 = 0.0055 for the RINKO prototype I with the foil B or prototype II with the foil D
H1 = 0.0060 for the RINKO prototype II with the foil C
H2 = 5000 dbar
H3 = 2000 seconds.

Type of the prototype and foil is listed in Table 1. Data from the RINKO sensors are systematically delayed with respect to depth because of the slow response time compared with the CTD sensors. This delay was compensated by 1 second advancing sensor output (voltage) relative to the CTD temperature data by using the SEASOFT module ALIGNCTD. To remove spikes of the data, the process of the DESPIKE was also performed for the RINKO data. The rest of the data processing was not changed from the data book (Kawano et al., 2009).

Table 1. Type of the prototype and foil used in the cruises.

Cruise	RINKO	Foil	Note
MR07-04	Prototype I (UV LED)	A	
MR07-06_1	Prototype I	B	
MR07-06_2	Prototype I	C	Stations from P14N_109_2 to P14N_175_1
	Prototype II (Green LED)	D	Stations from P14N_176_1 to P14N_185_1
	Prototype II	C	Stations from P14C_48_1 to P14C_1_1

3. Post-cruise calibration

The pressure-hysteresis corrected RINKO data was calibrated by the Stern-Volmer equation, basically according to a method by Uchida et al. (2008) with slight modification:

$$[O_2]\ (\mu mol/l) = (V_0 / V - 1) / K_{sv}$$

and

$$K_{sv} = C_0 + C_1 \times T + C_2 \times T^2$$
$$V_0 = 1 + C_3 \times T$$
$$V = C_4 + C_5 \times V_b + C_6 \times t + C_7 \times t \times V_b$$

where V_b is the RINKO output (voltage), V_0 is voltage in the absence of oxygen, T is temperature (°C), and t is time (days). The V_0 and V are normalized by the phase shift in the absence of oxygen at 0°C, and the time drift of the RINKO output was corrected. The oxygen concentration is calculated by using the in situ calibrated CTD temperature data. The pressure-compensated oxygen concentration $[O_{2c}]$ can be calculated as follows.

$$[O_{2c}] = O_2\ (1 + C_p p / 1000)$$

or

$$[O_{2c}] = O_2\ (1 + C_p p / 1000)^{1/3}$$

where p is CTD pressure (dbar) and C_p is the compensation coefficient. Since the sensing foil of the optode is permeable only to gas and not to water, the optode oxygen must be corrected for salinity. The salinity-compensated oxygen can be calculated by multiplying the factor of the effect of salt on the oxygen solubility (García and Gordon, 1992). García and Gordon (1992) have recommended the use of the solubility coefficients derived from the data of Benson and Krause.

The pressure-compensation coefficient (C_p) and the coefficient for the V_0 (C_3) were empirically estimated in advance except for the C_p for the cruise MR07-06 leg 1 (Table 2). The C_p for the cruise MR07-06 leg 1 was determined simultaneously with the remaining coefficients. The remaining seven coefficients (C_0, C_1, C_2, C_4, C_5, C_6, and C_7) were determined by minimizing the sum of absolute deviation with a weight from the bottle oxygen data. The revised quasi-Newton method (the FORTRAN subroutine DMINF1 from the Scientific Subroutine Library II, Fujitsu Ltd., Kanagawa, Japan) was used to determine the sets. The weight was given as a function of pressure as:

$$\text{Weight} = \min[10, \exp\{\log(10) \times P / PR\}]$$

where PR is threshold of the pressure (950 dbar).

The post-cruise calibrated temperature and salinity data were used for the calibration. The coefficients were determined for some groups of the CTD stations. The calibration coefficients are listed in Table 3. The results of the post-cruise calibration for the RINKO oxygen are summarized in Table 4 and shown in Figs. 1, 2, and 3.

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Table 2. Calibration coefficients for the V_0 (C_3) and for the pressure-compensation equation (C_p). The pressure-compensation equation is also shown.

Groups	C_3	C_p	Pressure-compensation equation
01–06	–0.0022	0.109	$O_2 (1 + C_p p / 1000)^{1/3}$
07	–0.0028	0.055	$O_2 (1 + C_p p / 1000)$
08	–0.0028	0.056	$O_2 (1 + C_p p / 1000)$
09	–0.0028	0.057	$O_2 (1 + C_p p / 1000)$
10–11	–0.0028	0.055	$O_2 (1 + C_p p / 1000)$
12	–0.0028	0.054	$O_2 (1 + C_p p / 1000)$
13	–0.0028	0.053	$O_2 (1 + C_p p / 1000)$
14–15	–0.0028	0.054	$O_2 (1 + C_p p / 1000)$
16	–0.0028	0.053	$O_2 (1 + C_p p / 1000)$
17	–0.0028	0.051	$O_2 (1 + C_p p / 1000)$
18	–0.0028	0.056	$O_2 (1 + C_p p / 1000)$
19	–0.0028	0.055	$O_2 (1 + C_p p / 1000)$
20	–0.0028	0.057	$O_2 (1 + C_p p / 1000)$
21	–0.0028	0.056	$O_2 (1 + C_p p / 1000)$
22	–0.0028	0.058	$O_2 (1 + C_p p / 1000)$
23–41	–0.0021	0.100	$O_2 (1 + C_p p / 1000)^{1/3}$
42	–0.0024	0.066	$O_2 (1 + C_p p / 1000)$
43–45	–0.0021	0.100	$O_2 (1 + C_p p / 1000)^{1/3}$

Group of CTD stations 01: P01_1_1–P01_18_1, 02: P01_19_1–P01_21_1, 03: P01_22_1–P01_26_1, 04: P01_27_1–P01_29_1, 05: P01_40_1–P01_44_1, 06: P01_58_2–P01_115_1, 07: P01_28_2, 08: P01_29_2–P01_30_1, 09: P01_32_1–P01_31_1, 10: P01_33_1–P01_35_1, 11: P01_36_1–P01_37_1, 12: P01_38_1–P01_43_1, 13: P01_44_2–P01_46_1, 14: P01_47_1–P01_55_1, 15: P01_56_1–P01_61_2, 16: P14N_29_1–P14N_16_1, 17: P14N_15_1–P14N_5_1, 18: P14N_1_1–P14N_4_1, 19: P14N_30_1–P14N_49_1, 20: P14N_50_1–P14N_63_1, 21: P14N_64_1–P14N_73_1, 22: P14N_74_1–P14N_109_1, 23: P14N_109_2–P14N_110_1, 24: P14N_111_1–P14N_112_1, 25: P14N_113_1–P14N_115_1, 26: P14N_116_1–P14N_118_1, 27: P14N_119_1–P14N_120_1, 28: P14N_121_1–P14N_122_1, 29: P14N_123_1–P14N_124_1, 30: P14N_125_1–P14N_126_1, 31: P14N_127_1–P14N_130_1, 32: P14N_131_1–P14N_135_1, 33: P14N_136_1–P14N_141_1, 34: P14N_142_1–P14N_144_1, 35: P14N_145_1–P14N_147_1, 36: P14N_148_1–P14N_149_1, 37: P14N_150_1–P14N_154_1, 38: P14N_155_1–P14N_160_1, 39: P14N_161_1–P14N_164_1, 40: P14N_165_1–P14N_170_1, 41: P14N_171_1–P14N_175_1, 42: P14N_176_1–P14N_185_1, 43: P14C_48_1–P14C_49_1, 44: P14C_52_1–P14C_19_1, 45: P14C_18_1–P14C_1_1

Table 3. Calibration coefficients for the RINKO oxygen sensors. The group of the CTD stations is same as that shown in Table 2.

Group	C_0	C_1	C_2	C_4	C_5	C_6	C_7
MR07-04							
01	5.78769e–3	1.88171e–4	5.21610e–6	–0.229888	0.254955	–2.43960e–3	1.74806e–3
02	5.76112e–3	2.05112e–4	4.20869e–6	–0.247620	0.261781	2.66538e–3	–1.91261e–4
03	5.58601e–3	1.94710e–4	3.60579e–6	–0.212837	0.254295	–2.82424e–3	1.37946e–3
04	5.52573e–3	2.53171e–4	–9.45815e–7	–0.171401	0.242433	–8.92725e–3	3.03414e–3
05	5.50404e–3	1.54503e–4	6.20130e–6	–0.151539	0.241621	–4.59826e–3	1.44984e–3
06	5.33007e–3	1.84105e–4	3.53496e–6	–0.211406	0.257880	–9.26535e–4	5.21621e–4
MR07-06 leg 1							
07	6.55224e–3	2.12959e–4	7.32523e–6	–0.408829	0.281951	0.00000	0.00000
08	6.45822e–3	2.14475e–4	6.35186e–6	–0.417754	0.283925	1.81734e–2	–2.32210e–3
09	6.30664e–3	1.19267e–4	1.02338e–5	–0.374523	0.274294	–1.66424e–3	3.47136e–3
10	6.29642e–3	1.30131e–4	1.20613e–5	–0.402078	0.283497	7.75298e–3	–8.98322e–5
11	6.40532e–3	–6.71557e–6	2.64522e–5	–0.367286	0.275724	-4.93850e–3	2.98357e–3
12	6.05874e–3	9.93107e–5	1.32774e–5	–0.372592	0.278740	2.17949e–3	1.09013e–3
13	6.03637e–3	8.01334e–5	1.58469e–5	–0.380144	0.285135	3.33545e–3	9.87750e–5
14	5.94341e–3	8.92774e–5	1.27029e–5	–0.354093	0.276789	6.36922e–4	1.12659e–3
15	6.01971e–3	1.30065e–4	1.09592e–5	–0.344272	0.277559	–1.21930e–3	1.10575e–3
16	5.85814e–3	1.51238e–4	8.52212e–6	–0.360336	0.280217	9.57900e–4	7.46866e–4
17	5.76211e–3	2.02794e–4	7.38395e–6	–0.366150	0.286581	5.09066e–4	5.41219e–4
18	5.87643e–3	1.30110e–4	1.47536e–5	–0.237946	0.233457	–6.75607e–3	3.56108e–3
19	5.71949e–3	1.68597e–4	5.73708e–6	–0.347475	0.284820	3.14416e–4	4.89874e–4
20	5.70894e–3	1.87827e–4	4.02373e–6	–0.366959	0.293059	1.27735e–3	1.13690e–4
21	5.80033e–3	1.95761e–4	4.35824e–6	–0.375413	0.302121	1.28422e–3	–1.60368e–4
22	5.76787e–3	1.80175e–4	4.38162e–6	–0.352233	0.298371	7.66105e–4	–8.16506e–5
MR07-06 leg 2							
23	5.44937e–3	1.65251e–4	2.76961e–6	–0.199505	0.239278	3.09346e–3	4.15719e–3
24	5.54177e–3	1.61531e–4	3.18336e–6	–0.228340	0.249132	1.83265e–2	–2.15387e–3
25	5.42048e–3	1.83287e–4	2.07555e–6	–0.192462	0.241038	–4.07720e–4	2.49626e–3
26	5.45889e–3	1.64536e–4	2.88640e–6	–0.192265	0.243283	–1.88936e–3	2.06094e–3
27	5.35393e–3	1.60876e–4	2.80193e–6	–0.138462	0.225840	–1.67471e–2	7.32406e–3
28	5.38960e–3	1.85479e–4	2.07045e–6	–0.213034	0.253068	4.39692e–3	–6.93024e–4
29	4.91234e–3	1.69346e–4	1.34107e–6	–0.138257	0.236248	–7.47363e–3	3.11840e–3
30	5.29710e–3	1.86796e–4	1.85766e–6	–0.190758	0.248364	–7.30369e–4	7.20446e–4
31	5.29129e–3	1.84807e–4	2.06747e–6	–0.197598	0.249238	–1.06270e–4	8.01728e–4
32	5.35606e–3	1.85394e–4	2.29483e–6	–0.188360	0.247306	–2.34961e–3	1.19205e–3
33	5.23672e–3	1.76559e–4	2.52414e–6	–0.195684	0.252713	–1.02750e–3	5.84364e–4
34	5.36437e–3	1.71687e–4	3.34220e–6	–0.287883	0.282532	7.97539e–3	–2.50022e–3
35	5.07284e–3	1.80971e–4	2.12433e–6	–0.238973	0.284333	3.72564e–3	–2.43784e–3
36	5.16377e–3	1.77869e–4	2.70794e–6	–0.209220	0.246022	1.93576e–4	1.20839e–3
37	5.18307e–3	1.78043e–4	2.97573e–6	–0.238163	0.274864	2.18383e–3	–1.17744e–3

38	5.18550e–3	1.72648e–4	3.33928e–6	–0.224989	0.271406	6.54311e–4	–6.88668e–4
39	4.73947e–3	1.70534e–4	2.09447e–6	–0.237428	0.284716	3.34250e–3	–1.69718e–3
40	4.53781e–3	1.65093e–4	1.75764e–6	–0.113741	0.233677	–4.24469e–3	1.73284e–3
41	4.60581e–3	1.62495e–4	2.23853e–6	–0.179177	0.254948	–5.72044e–4	4.97947e–4
42	3.51665e–3	1.16255e–4	2.37582e–6	–0.413749	0.300233	–3.24861e–3	1.34826e–3
43	4.24252e–3	1.22672e–4	3.09423e–6	0.122545	0.051831	–3.05446e–2	1.20623e–2
44	3.77773e–3	1.20741e–4	2.44550e–6	–0.507127	0.309672	4.31407e–4	–1.68904e–4
45	3.40682e–3	1.16962e–4	1.79879e–6	–0.529886	0.325479	1.74046e–3	–6.22456e–4

Table 4. Difference between the RINKO oxygen and the bottle oxygen after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 950 dbar. Number of data used is also shown.

Cruise	Pressure ≥ 950 dbar			Pressure < 950 dbar		
	Number	Mean (μmol/kg)	Sdev (μmol/kg)	Number	Mean (μmol/kg)	Sdev (μmol/kg)
MR07-04	1510	–0.01	0.22	1118	0.25	2.70
MR07-06_1	2698	–0.01	0.18	1876	–0.07	1.31
MR07-06_2	2095	–0.00	0.24	1642	–0.01	1.03

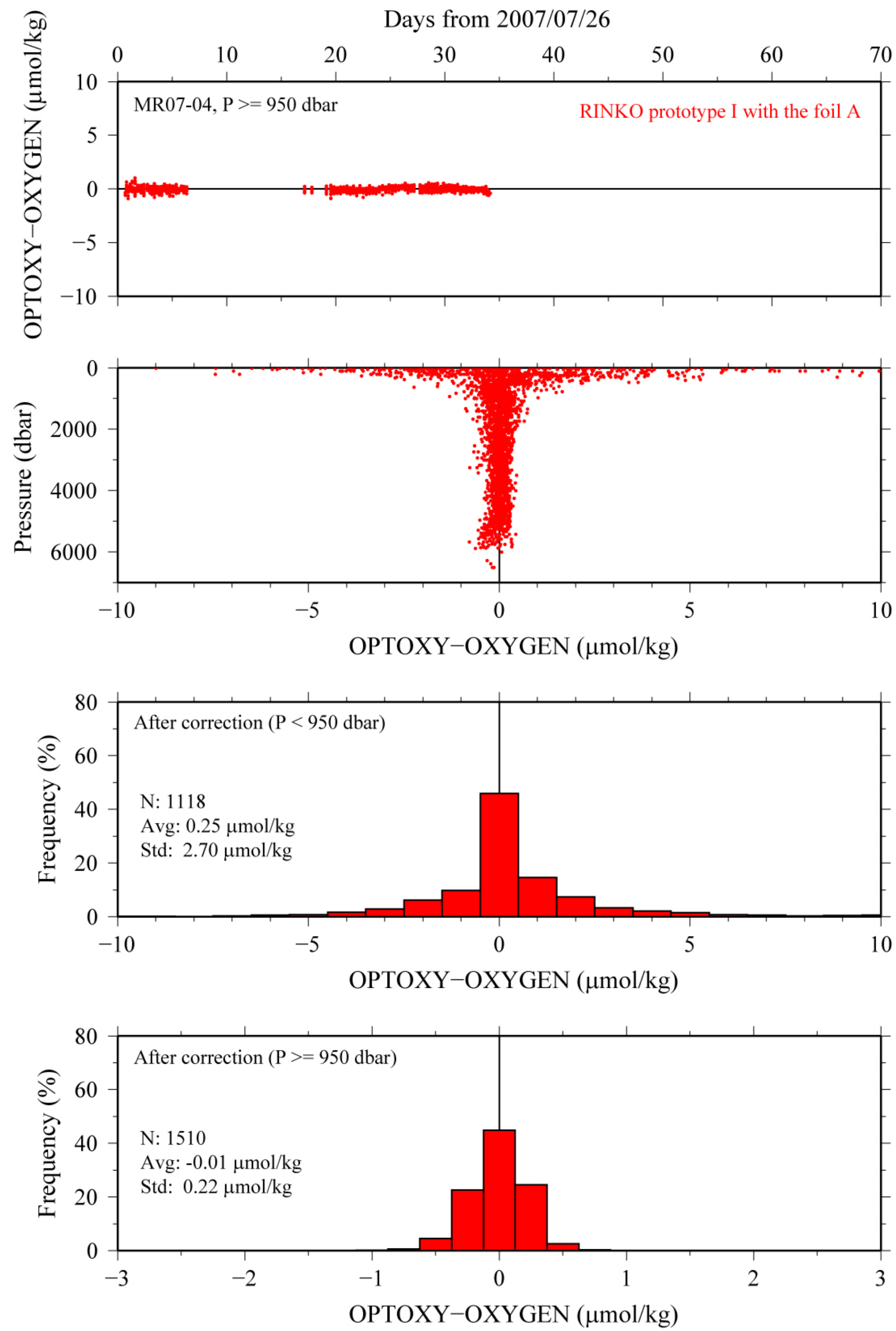

Figure 1. Difference between the RINKO oxygen and the bottle oxygen after the post-cruise calibration for the cruise MR07-04. Lower two panels show histogram of the difference.

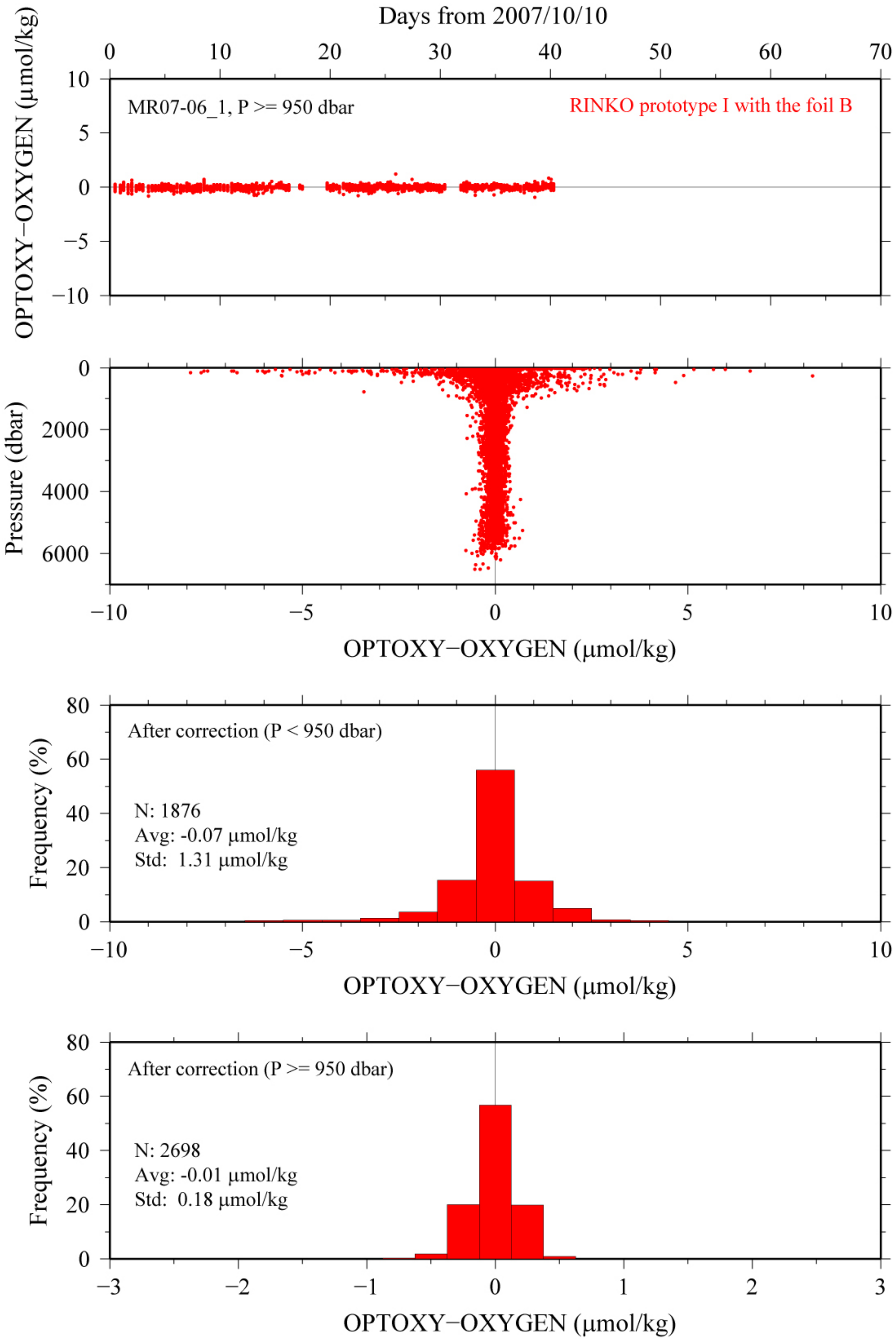

Figure 2. Same as Fig. 1, except for the cruise MR07-06 leg 1.

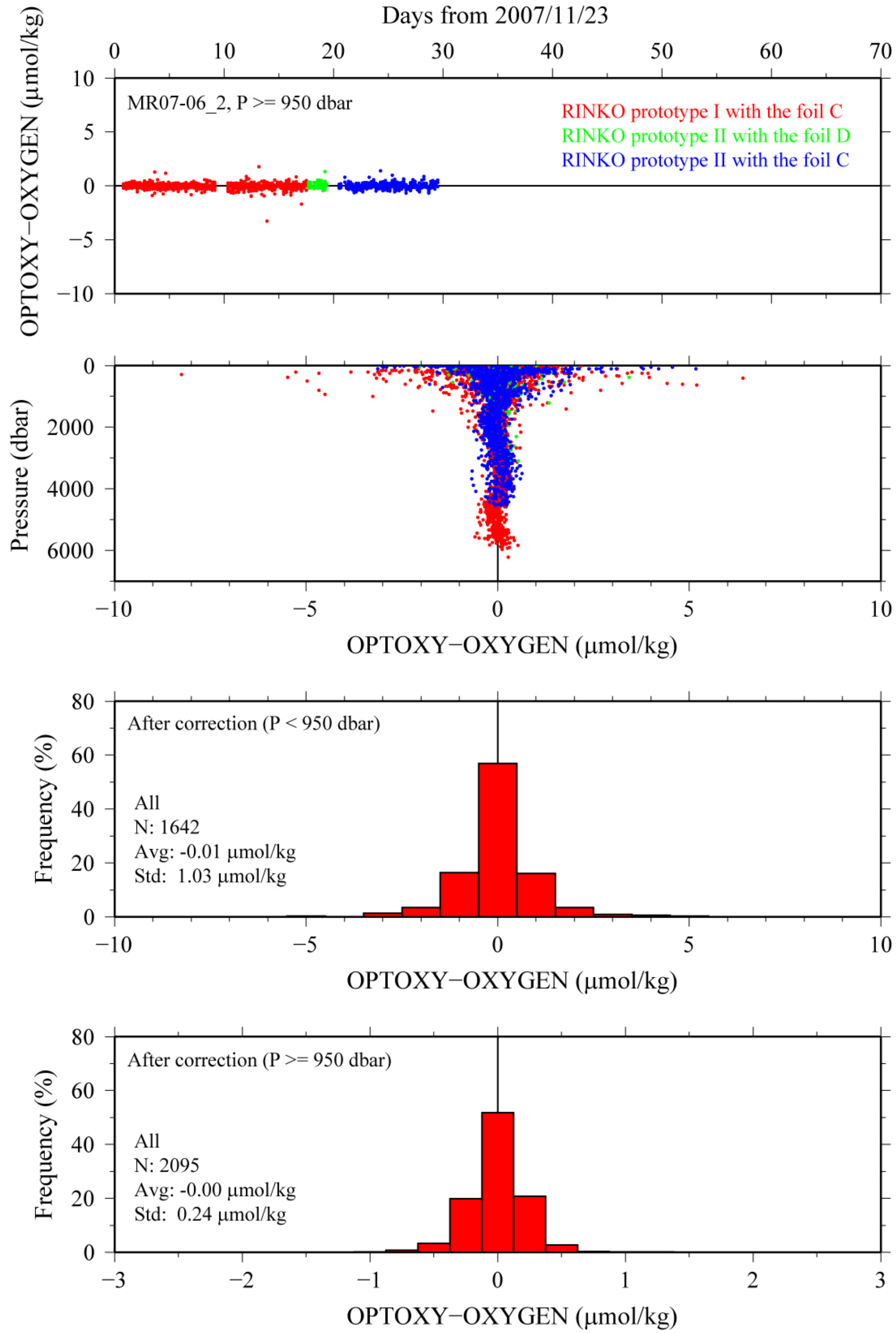

Figure 3. Same as Fig. 1, except for the cruise MR07-06 leg 2.

3.2 Salinity

31 October 2008

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(2) Objectives

Bottle salinities were measured to compare with CTD salinities for calibrating CTD salinities and for identifying leaking bottles

(3) Instrument and Method

(3.1) Salinity Sample Collection

Samples for salinity measurement were collected and stored in 250-ml brown borosilicate glass bottleswith GL32 screw caps with PTFE liners. Each bottle was rinsed three times with sample water, and then the water was allowed to overflow the bottle for few seconds. Excess water was poured out until the water was level with the shoulder of the bottle. The caps were also thoroughly rinsed and then tightly screwed onto the bottles. The sealed bottles were rinsed with fresh water (cap side up) and dried on a towel. The bottles were stored upside down in a carrying case and brought to the laboratory for temperature equilibration. Samples were stored more than 12 hours in the laboratory where the salinity was to be measured.

(3.2) Instruments and Method

The measurements were conducted with two Guildline Autosal laboratory salinometers (Model 8400B S/N 62556 and S/N 62827), which were modified by the addition of a peristaltic-type sample intake pumps (provided by OSIL). Two digital platinum resistance thermometers (Model 9540) were used to measure temperature: one placed in the bath of the Autosal to measure the bath temperature, and the other placed beside the Autosal to measure the ambient temperature. The measurement system was almost same as Aoyama et al (2003). The Autosal and thermometers were connected to a laptop computer through Binary Coded Decimal output and GP-IB interfaces, respectively. When the function dial was turned to the 'read' setting, 31 readings of the double conductivity ratio were acquired after a pause of 5 seconds. Acquisition of the 31 readings took about 10 seconds. The double conductivity ratio of a sample was taken to be the median of the 31 readings. The temperature was taken to be the average of the values measured before and after readings of the double conductivity ratio.

The salinometer was operated in the air-conditioned ship's laboratory at a bath temperature of 24 °C. An ambient temperature varied from approximately 20 °C to 24 °C, while a bath temperature is very stable and varied within +/- 0.002 °C on rare occasion. The double conductivity ratio (along with temperature) was sampled for the sixth and seventh fillings of the conductivity cell. If the difference between the double conductivity ratios obtained for these two fillings was smaller than 0.00002, the average of the two double conductivity ratios was used to calculate the salinity. If the difference was greater than or equal to 0.00003, we measured an additional filling of the cell. If the double conductivity ratio obtained for the additional filling did not satisfy the criterion specified above, we measured two additional fillings of the cell, and the median of the double conductivity ratios for the five fillings was used to calculate the salinity. Algorithm for practical salinity scale, 1978 (UNESCO, 1981) was employed to convert the conductivity ratios to salinities

The measurements were typically conducted for 16 hours a day and the cell was rinsed by pure water every day and cleaned by ethanol or soap or both after the daily measurement.

(3.3) Preliminary Result

(i) MR07-04

Standard Seawater

Standardization control was set to 452 and all the measurements were done by this setting. STNBY was 5398 +/- 0001 and ZERO was 0.00001 +/- 0.00001. We used IAPSO Standard Seawater batch P148 whose conductivity ratio was 0.99982 (double conductivity ratio is 1.99964) as the standard for salinity. We measured 37 bottles of P148 during routine measurement from Stn.1 to Stn.28 and 78 bottles from Stn.40 to Stn.115.

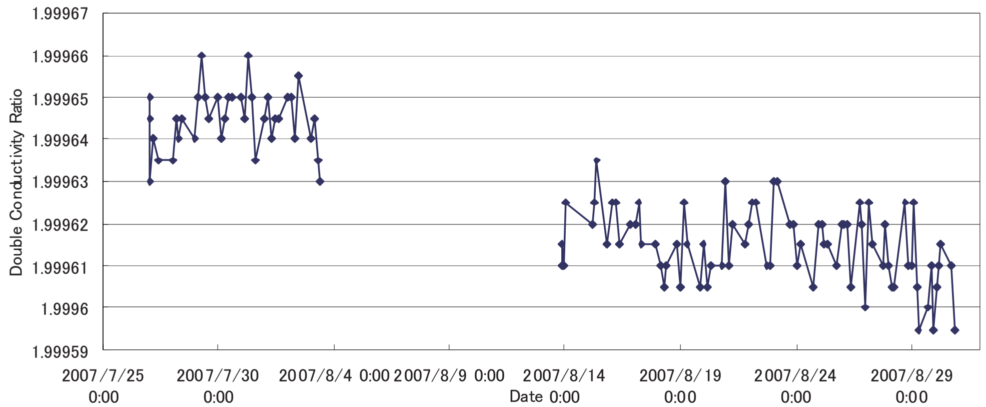

Fig.3.2.1 History of Double conductivity ratio of P148 during Leg.1. X and Y axes represents date and double conductivity ratio, respectively.

Fig.3.2.1 shows the history of double conductivity ratio of the Standard Seawater batch P148. During the period from 27, July to 4, August, the average of double conductivity ratio was 1.99985 and no drifts was calculated. Therefore we subtract 0.00001 from double conductivity ratio of samples measured during this period. Because of the trouble described in Section.1, measurement was interrupted for about 10 days. During the period from 13 August, double conductivity ratio of SSW was around 1.99862, however, after 28 August, it became smaller, probably due to cooling of room temperature. Therefore, we added 0.00002 to double conductivity ratio of samples measured from 13 August to 28 August, and 0.00003 to it measured after 28 August. Correction for the history of double conductivity ration after this correction was shown in Fig.3.2.2. After correction, the average of double conductivity ratio of 115 bottles of SSW became 1.999636 and the standard deviation was 0.00008, which is equivalent to 0.0002 in salinity.

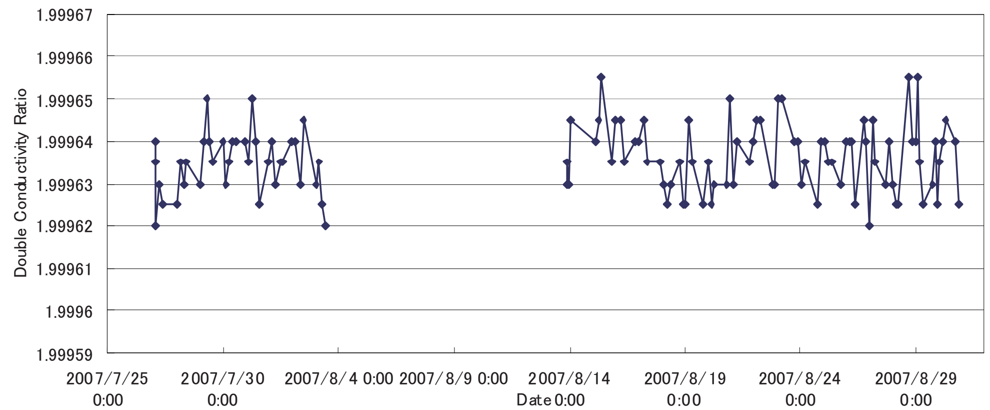

Fig.3.2.2 History of Double conductivity ratio of P148. X and Y axes represent time Date and double conductivity ratio, respectively. (after correction)

Sub-Standard Seawater

We also measured sub-standard seawater periodically to monitor the conditions of the Autosal. Approximately 20 L of seawater collected from a deep layer and gravity filtered through a membrane filter (Millipore HA, pore size 0.45 μm) was used as sub-standard seawater. The sub-standard seawater was stored in an aged cubitainer with no headspace and stirred for at least 24 hours before use. Sub-standard seawater was measured every six samples in case of a sudden drift in the Autosal. During the whole measurements, there was no detectable sudden drift of the salinometer.

Replicates

We took 491 pairs of replicates. Fig.3.2.3 shows the histogram of the absolute difference between replicate samples. There were 4 bad measurements and 5 questionable measurements of replicate samples. Excluding these bad and questionable measurements, the average and standard deviation of the absolute deference of 482 pairs of replicate samples was 0.0018 and 0.00019 in salinity, respectively.

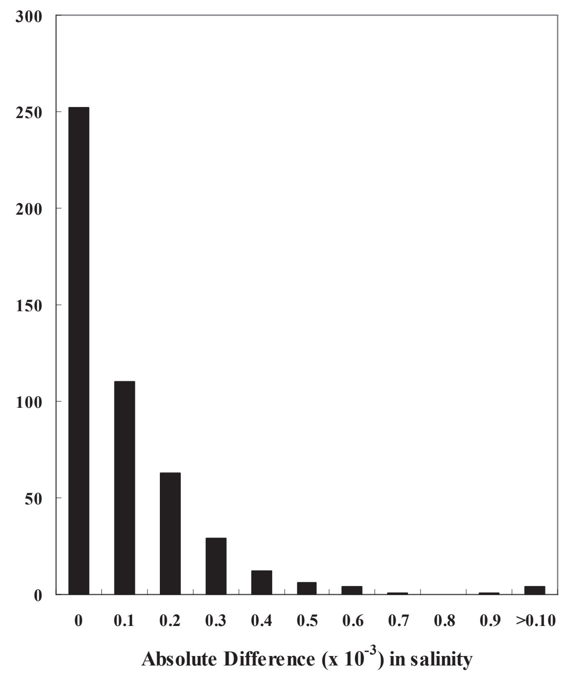

Fig.3.2.3 The histogram of the absolute difference between replicate samples.

(ii) MR07-06 Leg.1

Standard Seawater

Leg.1

Standardization control was set to 460 and all measurements were done by this setting. STNBY was 5402 +/- 0001 and ZERO was 0.00001 +/- 0.00001. We used IAPSO Standard Seawater batch P148 whose conductivity ratio was 0.99982 (double conductivity ratio is 1.99964) as the standard for salinity. We measured 146 bottles of P148 during routine measurement.

Fig.3.2.4 shows the history of double conductivity ratio of the Standard Seawater batch P148.

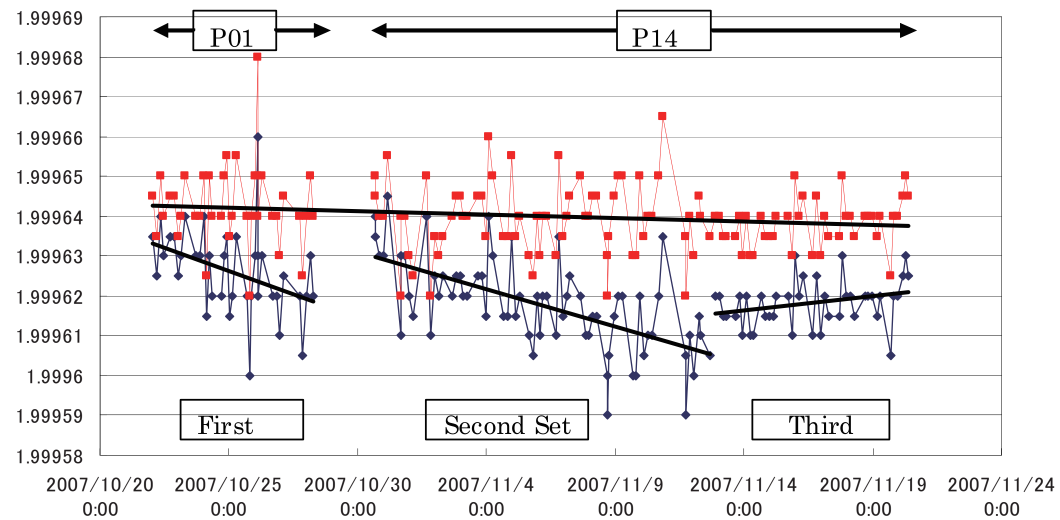

Figure 3.2.4. The history of double conductivity ratio of the Standard Seawater batch P142.

Drifts were calculated by fitting data from P148 to the equation obtained by the least square method (solid lines). Correction for the double conductivity ratio of the sample was made to compensate for the drift. After the drift correction, we add 0.00001 for the first and second set and 0.00002 for the third set to make the average to 1.99964. After these corrections, the standard deviation of 146 bottles becomes 0.000009, which is equivalent to 0.0002 in saliniy.

Sub-Standard Seawater

We also measured sub-standard seawater periodically to monitor the conditions of the Autosal. Approximately 20 L of seawater collected from a deep layer and gravity filtered through a membrane filter (Millipore HA, pore size 0.45 µm) was used as sub-standard seawater. The sub-standard seawater was stored in an aged cubitainer with no headspace and stirred for at least 24 hours before use. Sub-standard seawater was measured every six samples in case of a sudden drift in the Autosal. During the whole measurements, there was no detectable sudden drift of the salinometer.

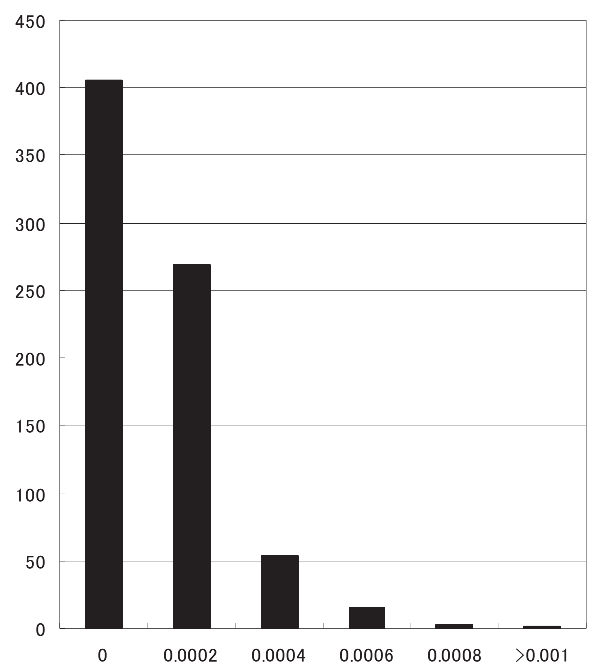

Figure 3.2.5 . The histogram of the absolute difference between each pair of replicate samples in Leg.1. X axis is absolute difference in salinity and Y axis is frequency..

Replicates

We took 840 pairs of replicate. Fig.3.2.5 shows the histogram of the absolute difference between each pair of the replicate samples. There were 6 bad measurements in the replicate samples. Excluding these bad measurements, the standard deviation of the absolute difference in 834 pairs of the replicate samples was 0.00017 in salinity.

(iii)MR07-06 Leg.2

Standard Seawater

Standardization control was set to 464 and all measurements were done by this setting. STNBY was 5402 +/- 0001 and ZERO was 0.00001 +/- 0.00001.We used IAPSO Standard Seawater batch P148 as the standard for salinity. We measured 160 bottles of P148 during routine measurement. There were 2 bad bottles whose conductivities were extremely high. Data of these 2 bottles are not taken into consideration hereafter.

Fig.3.2.6 shows the history of double conductivity ratio of the Standard Seawater batch P148. Drifts were calculated by fitting data from P148 to the equation obtained by the least square method (solid lines). Correction for the double conductivity ratio of the sample was made to compensate for the drift. After correction, the average of double conductivity ratio became 1.999625 and the standard deviation was 0.00008, which is equivalent to 0.0002 in salinity. We added 0.000015 to make an average to 1.99964.

Sub-Standard Seawater

We also measured sub-standard seawater periodically to monitor the conditions of the Autosal. Approximately 20 L of seawater collected from a deep layer and gravity filtered through a membrane filter (Millipore HA, pore size 0.45 µm) was used as sub-standard seawater. The sub-standard seawater was stored in an aged cubitainer with no headspace and stirred for at least 24 hours before use. Sub-standard seawater was measured every six samples in case of a sudden drift in the Autosal.

During the whole measurements, there was no detectable sudden drift of the salinometer.

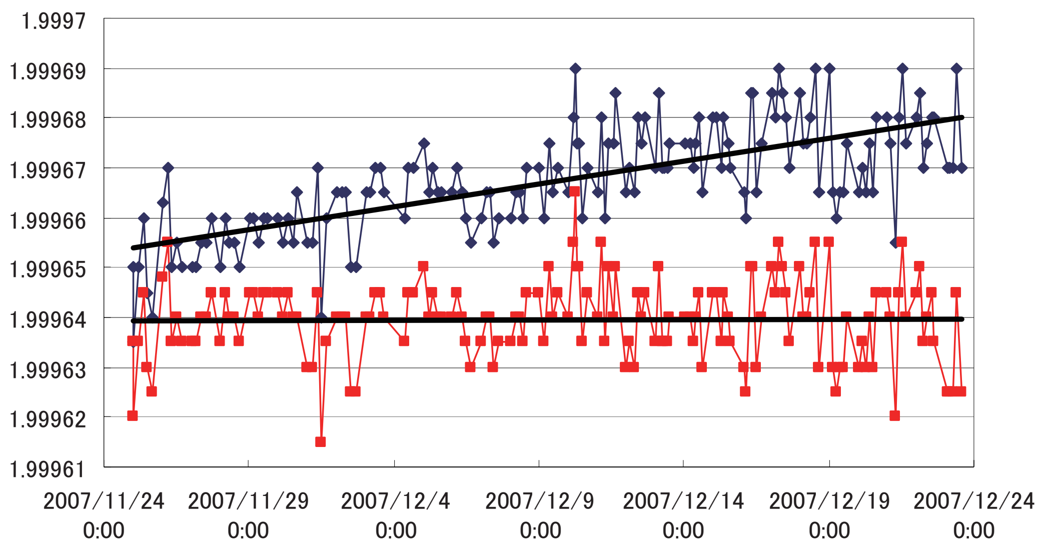

Fig.3.2.6 History of Double conductivity ratio of P148 during Leg.2. X and Y axes represents date and double conductivity ratio, respectively..

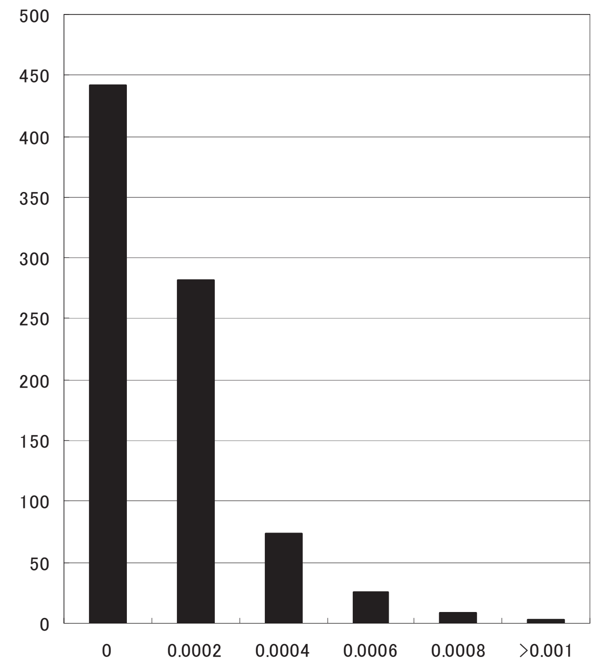

Figure 3.2.7 The histogram of the absolute difference between each pair of replicate samples in Leg.2. X axis is absolute difference in salinity and Y axis is frequency.

Replicates

We took 749 pairs of replicate samples. Fig.3.2.7 shows the histogram of the absolute difference between each pair of the replicate samples. There were 4 questionable measurements in the replicate samples. Excluding these questionable measurements, the standard deviation of the absolute difference in 745 pairs of the replicate samples was 0.00016 in salinity.

References

Aoyama, M., T. Joyce, T. Kawano and Y. Takatsuki: Standard seawater comparison up to P129. Deep-Sea Research, I, Vol. 49, 1103～1114, 2002

UNESCO: Tenth report of the Joint Panel on Oceanographic Tables and Standards. UNESCO Tech. Papers in Mar. Sci., 36, 25 pp., 1981

3.3 Oxygen

9 November 2008

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(2) Objectives

Dissolved oxygen is one of good tracers for the ocean circulation. Recent studies in the North Pacific indicated that dissolved oxygen concentration in intermediate layers decreased in basin-wide scale during the past decades. The causes of the decrease, however, are still unclear. During cruises of MR07-04 conducted from 24-Jul-07 to 03-Sep-07 and MR07-06 from 08-Oct-07 to 25-Dec-07, we measured dissolved oxygen concentration from surface to bottom layers at all the hydrocast stations along around 47°N in the subarctic North Pacific and along 179°E in the central Pacific. These stations reoccupied the WHP-P01 (1985), WHP-P14N (1993), and WHP-P14C (1992) stations. Our purpose is to evaluate temporal changes in dissolved oxygen in the Pacific Ocean between the 1980/90s and 2007.

(3) Reagents

Pickling Reagent I: Manganous chloride solution (3M)

Pickling Reagent II: Sodium hydroxide (8M) / sodium iodide solution (4M)

Sulfuric acid solution (5M)

Sodium thiosulfate (0.025M)

Potassium iodate (0.001667M)

CSK standard of potassium iodate: Lot EWL3818, Wako Pure Chemical Industries Ltd., 0.0100N

(4) Instruments

Burette for sodium thiosulfate and potassium iodate: APB-510 manufactured by Kyoto Electronic Co. Ltd. / 10 cm^3 of titration vessel

Detector: Automatic photometric titrator, DOT-01 manufactured by Kimoto Electronic Co. Ltd.

(5) Seawater sampling

Following procedure is based on a determination method in the WHP Operations Manual (Dickson, 1996). Seawater samples were collected from 12-liters Niskin sampler bottles attached to the CTD-system. Seawater for bottle oxygen measurement was transferred from the Niskin sampler bottle to a volume calibrated glass flask (ca. 100 cm^3). Three times volume of the flask of seawater was overflowed. Sample temperature was measured by a thermometer during the overflowing. Then two reagent solutions (Reagent I, II) of 0.5 cm^3 each were added immediately into the sample flask and the stopper was inserted carefully into the flask. The sample flask was then shaken vigorously to mix the contents and to disperse the precipitate finely throughout. After the precipitate has settled at least halfway down the flask, the flask was shaken again to disperse the precipitate. The sample flasks containing pickled samples were stored in a laboratory until they were titrated.

(6) Sample measurement

At least two hours after the re-shaking, the pickled samples were measured on board. A magnetic stirrer bar and 1 cm^3 sulfuric acid solution were added into the sample flask and stirring began. Samples were titrated by sodium thiosulfate solution whose molarity was determined by potassium iodate solution. Temperature of sodium thiosulfate during titration was recorded by a thermometer. We measured dissolved oxygen concentration using two sets of the titration apparatus, named DOT-1 and DOT-3. Dissolved oxygen concentration (μmol kg^{-1}) was calculated by the sample temperature during the sampling, CTD salinity, flask volume, and titrated volume of the sodium thiosulfate solution.

(7) Standardization

Concentration of sodium thiosulfate titrant (ca. 0.025M) was determined by potassium iodate solution. Pure potassium iodate was dried in an oven at 130°C. 1.7835 g potassium iodate weighed out accurately was dissolved in deionized water and diluted to final volume of 5 dm^3 in a calibrated volumetric flask (0.001667M). 10 cm^3 of the standard potassium iodate solution was added to a flask using a volume-calibrated dispenser. Then 90 cm^3 of deionized water, 1 cm^3 of sulfuric acid solution, and 0.5 cm^3 of pickling reagent solution II and I were added into the flask in order. Amount of titrated volume of sodium thiosulfate (usually 5 times measurements average) gave the molarity of the sodium thiosulfate titrant. Table 3.3.1 and 3.3.2 show result of the standardization during the two cruises. Error (C.V.) of the standardization was 0.02 ± 0.01 %, c.a. 0.05 μmol kg^{-1}.

(8) Determination of the blank

The oxygen in the pickling reagents I (0.5 cm^3) and II (0.5 cm^3) was assumed to be 3.8 x 10^{-8} mol (Murray *et al.*, 1968). The blank from the presence of redox species apart from oxygen in the reagents (the pickling reagents I, II, and the sulfuric acid solution) was determined as follows. 1 and 2 cm^3 of the standard potassium iodate solution were added to two flasks respectively. Then 100 cm^3 of deionized water, 1 cm^3 of sulfuric acid solution, and 0.5 cm^3 of pickling reagent solution II and I each were added into the two flasks in order. The blank was determined by difference between the two times of the first (1 cm^3 of KIO_3) titrated volume of the sodium thiosulfate and the second (2 cm^3 of KIO_3) one. The results of three-time blank determinations were averaged and listed in Table 3.3.1 (MR07-04) and Table 3.3.2 (MR07-06). During MR07-04 cruise, the averaged blank of DOT-3 was –0.010 ± 0.001 (S.D., n=17) cm^3. That of DOT-1 decreased from –0.003 ± 0.001 (S.D., n=4) to –0.009 ± 0.002 (S.D., n=12) cm^3 on July 31 because the pickling reagents for DOT-1 were replaced. During MR07-06 cruise, The averaged blank values for DOT-1 and DOT-3 before December 20 were – 0.007 ± 0.001 (S.D., n=30) and –0.007 ± 0.001 (S.D., n=29) cm^3, respectively. After the day, the values of the blank increased by about 0.005 cm^3 in the sample measurements for P14C-001～-009 because we replaced the pickling reagents II solution. We also confirmed that there was no systematic bias in the blank determination between the DOT-1 and DOT-3 measurements on the both cruises.

Table 3.3.1 Results of the standardization and the blank determinations during MR07-04.

Date	KIO_3		DOT-1 (cm^3)			DOT-3 (cm^3)			Samples
(UTC)	#	ID No.	$Na_2S_2O_3$	E.P.	blank	$Na_2S_2O_3$	E.P.	blank	(Stations)
2007/07/26	1	20070619-05-02	20070613-01-03	3.960	-0.002	20070613-01-04	3.952	-0.011	P01-001,002,003,004,005,006,007
2007/07/27		20070619-05-03	20070613-02-03	3.959	-0.003	20070613-02-04	3.950	-0.012	P01-008,009,010,011,012
2007/07/28		20070619-05-04	20070413-03-01	3.968	-0.003	20070413-03-02	3.962	-0.011	P01-013,014,015,016,017,018
2007/07/30		20070619-05-05	20070413-03-01	3.968	-0.003	20070413-03-02	3.960	-0.010	P01-019,020,021,022,023,024 (DOT-01)
2007/07/30		20070619-05-06	–	–	–	20070413-03-02	3.961	-0.011	P01-019,020,021,022,023,024 (DOT-03)
2007/07/31		20070619-05-07	20070613-03-03	3.961	-0.011	20070613-03-04	3.959	-0.011	P01-025,026,027,028

2007/08/12	2	20070619-06-01	20070413-03-03	3.960	-0.009	20070413-03-04	3.962	-0.011	P01-040,044
2007/08/14		20070619-06-02	20070413-04-01	3.960	-0.010	20070413-04-02	3.960	-0.011	P01-058,060,061,062,063
2007/08/15		20070619-06-03	20070413-04-01	3.962	-0.009	20070413-04-02	3.961	-0.010	P01-064,065,066,067,068
2007/08/17		20070619-06-04	20070413-04-03	3.960	-0.012	20070413-04-04	3.962	-0.011	P01-069,070,071,072,073,074
2007/08/19		20070619-06-05	20070413-04-03	3.962	-0.006	20070413-04-04	3.962	-0.010	P01-X15,076,077,078,079,080
2007/08/21		20070619-06-06	20070413-05-01	3.961	-0.009	20070413-05-02	3.959	-0.010	P01-081,082,083,084,085,086
2007/08/23		20070619-06-07	20070413-05-01	3.961	-0.008	20070413-05-02	3.959	-0.009	P01-X16,087,088,089
2007/08/24		20070619-06-08	20070413-05-03	3.959	-0.009	20070413-05-04	3.961	-0.010	P01-090,092,X17,094,095
2007/08/25	3	20070619-07-01	20070413-05-03	3.959	-0.008	20070413-05-04	3.960	-0.011	P01-096,097,098,099,100,101
2007/08/27		20070619-07-02	20070413-06-01	3.957	-0.010	20070413-06-02	3.958	-0.011	P01-102,103,104,105,106,107
2007/08/28		20070619-07-03	20070413-06-01	3.958	-0.012	20070413-06-02	3.960	-0.008	P01-108,109,110,111,112,113,114,115

Batch number of the KIO_3 standard solution

Table 3.3.2 Results of the standardization and the blank determinations during MR07-06.

Date	KIO_3		DOT-1 (cm^3)			DOT-3 (cm^3)			Samples
(UTC)	#	ID No.	$Na_2S_2O_3$	E.P.	blank	$Na_2S_2O_3$	E.P.	blank	(Stations)
2007/10/09	4	20070619-09-02	20070613-03	3.951	-0.008	20070613-03	3.952	-0.007	P01-028,029,030,032
2007/10/12		20070619-09-03	20070613-03	3.951	-0.007	20070613-03	3.952	-0.007	P01-031,033,034,035,036,037
2007/10/14		20070619-09-04	20070613-05-01	3.953	-0.006	20070613-05-02	3.952	-0.005	P01-038,039,040,041,042,X13,043
2007/10/16		20070619-09-05	20070613-05-01	3.953	-0.006	20070613-05-02	3.954	-0.007	P01-044,045,046,047
2007/10/17		20070619-09-06	20070613-05-03	3.953	-0.006	20070613-05-04	3.951	-0.008	P01-048,049,050,051,052,053,054
2007/10/18		20070619-09-07	20070613-05-03	3.952	-0.007	20070613-05-04	3.952	-0.008	P01-055,056,057,058,059,060
2007/10/20		20070619-09-08	20070613-06-01	3.956	-0.009	20070613-06-02	3.956	-0.009	P01-061,P14N-029,028,027,026,025,024
2007/10/22	5	20070619-10-01	20070613-06-01	3.957	-0.005	20070613-06-02	3.957	-0.007	P14N-023,022,021,020,019
2007/10/23		20070619-10-02	20070613-06-03	3.957	-0.006	20070613-06-04	3.956	-0.006	P14N-018,017,016,015,014,013,012,011,010,009,008,007,006,005,004,003,002,001

2007/10/29	5	20070619-10-04	20070613-07-01	3.957	-0.007	20070613-07-02	3.957	-0.008	P14N-030,X01,032,033,034,035,036,037,038,039,040
2007/11/01		20070619-10-06	20070613-07-03	3.957	-0.007	20070613-07-04	3.957	-0.007	P14N-041,042,043,044,045,046,047,048,049,051,052
2007/11/04		20070619-10-08	20070613-08-01	3.955	-0.007	20070613-08-02	3.956	-0.008	P14N-053,054,055,056,057,058,059,060,061
2007/11/06	6	20070911-11-01	20070613-08-01	3.959	-0.006	20070613-08-02	3.960	-0.006	P14N-062,063,064,X02
2007/11/07		20070911-11-02	20070613-08-03	3.957	-0.004	20070613-08-04	3.957	-0.008	P14N-066,067,068,069,070,071,072,073
2007/11/11		20070911-11-03	20070613-08-03	3.959	-0.004	20070613-08-04	3.959	-0.008	P14N-074,075,076,077
2007/11/12		20070911-11-04	20070613-09-01	3.955	-0.009	20070613-09-02	3.958	-0.007	P14N-078,079,080,081,082,083,084,085,086,087,089,090
2007/11/14		20070911-11-06	20070613-09-03	3.955	-0.008	20070613-09-04	3.957	-0.008	P14N-091,092,093,094,095,096,097,098,099,100,101,102
2007/11/18		20070911-11-08	20070613-10-01	3.956	-0.010	20070613-10-02	3.958	-0.008	P14N-103,104,105,X04,107,108,109

2007/11/23	7	20070911-12-02	20070613-10-03	3.960	-0.007	20070613-10-04	3.959	-0.010	P14N-109(2),110,111,112,113,114,115,116,117
2007/11/26		20070911-12-04	20070613-11-01	3.956	-0.007	20070613-11-02	3.955	-0.009	P14N-118,119,120,121,122,123,124,125,126,127,128,129
2007/11/28		20070911-12-06	20070613-11-03	3.956	-0.007	20070613-11-04	3.957	-0.006	P14N-130,131,132,133,134,135,136,137,138,139,140,141
2007/12/01		20070911-12-08	20070613-12-03	3.953	-0.006	20070613-12-01	3.956	-0.005	P14N-142,143,144
2007/12/03	8	20070911-13-02	20070613-12-03	3.954	-0.007	20070613-12-01	3.956	-0.006	P14N-145,146,147,148,149,150
2007/12/04		20070911-13-03	20070613-12-02	3.953	-0.006	20070613-12-04	3.956	-0.005	P14N-151,152,153,154,155,156,157,158,159,160,161,162,163
2007/12/08		20070911-13-06	20070613-13-01	3.949	-0.006	20070613-13-02	3.952	-0.007	P14N-164,165,166,167,168,169,170,171,172,173,174,175,176
2007/12/11		20070911-13-08	20070613-13-03	3.951	-0.004	20070613-13-04	3.952	-0.008	P14N-177,178,179,180,181,182,183,184,185
2007/12/12	9	20070911-14-01	20070613-13-03	3.944	-0.006	–	–	–	P14N-184,185

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2007/12/13	9	20070911-14-02	20070613-13-03	3.950	-0.007	20070613-13-04	3.950	-0.008	P14C-049,048,052,051,050,047,046,045,044
2007/12/14	9	20070911-14-03	20070613-14-01	3.956	-0.006	20070613-14-02	3.958	-0.007	P14C-043,042,041,040,039,038,037,036
2007/12/17	9	20070911-14-05	20070613-14-03	3.955	-0.008	20070613-14-04	3.956	-0.009	P14C-032,031,030,029,028,027,026,025,024, 023,022,021,020,019
2007/12/22	10	20070911-15-01	20070613-15-01	3.966	0.002	20070613-15-02	3.967	0.004	P14C-009,008,007
2007/12/22	10	20070911-15-02	20070613-15-03	3.967	0.001	20070613-15-04	3.965	-0.001	P14C-006,005,004,003,002,001

Batch number of the KIO_3 standard solution

(9) Replicate sample measurement

Replicate samples were taken from every CTD cast. The replicate sample pairs of good measurement (flagged 2) during MR07-04 and MR07-06 cruises were 236 and 739, respectively. The total number of the replicate pairs, 975 was about 9 % of the total sample measurements. The standard deviations of the replicate measurements during MR07-04 and MR07-06 cruises were 0.10 and 0.08 μmol kg^{-1}, respectively, which was calculated by a procedure (SOP23) in DOE (1994). In addition, there was no significant difference between the DOT-1 and DOT-3 measurements on the both cruises. Although there are several outlying data, relationship between the difference in the replicate sample pairs and sampling depth was not clear (Fig. 3.3.1). The difference also did not depend on measurement date (Fig. 3.3.2). In the hydrographic data sheet, the results of the replicate sample pairs were averaged and flagged "2" (see section 11).

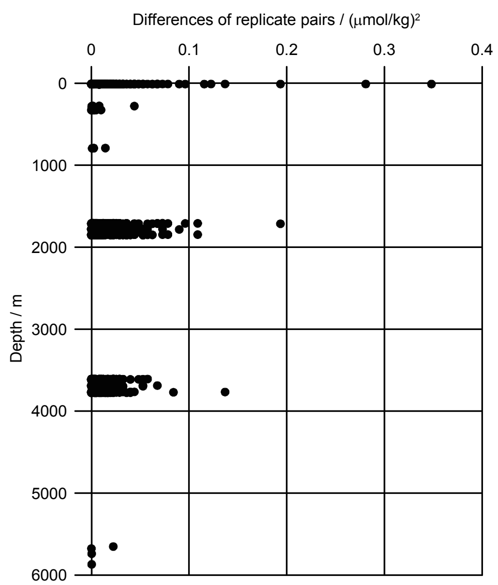

Figure 3.3.1 Differences of replicate sample pairs against sampling depth.

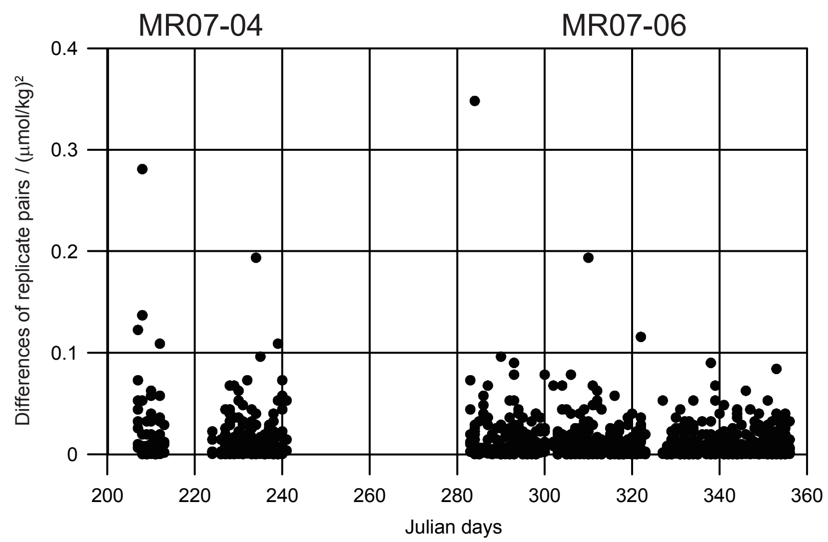

Figure 3.3.2 Differences of replicate sample pairs against measurement date (Julian days).

(10) CSK standard measurements

The CSK standard is a commercial potassium iodate solution (0.0100 N) for analysis of dissolved oxygen. During MR07-04 and MR07-06 cruises, we measured six bottles of the CSK standard solutions (Lot EWL3818) against our KIO_3 standards as samples (Table 3.3.3). A good agreement among them confirms that there was no systematic shift in our oxygen measurements during the two cruises. These values also agree with those measured in our previous cruises, MR07-03, suggesting comparability in the oxygen measurements among the three cruises.

Table 3.3.3 Results of the CSK standard (Lot EWL3818) measurements on board.

Date (UTC)	KIO_3 ID No.	DOT-1		DOT-3		Remarks
		Conc. (N)	error (N)	Conc. (N)	error (N)	
2007/10/07	20070619-08-05	0.010009	0.000002	−	−	MR07-06
2007/11/19	20070911-12-01	0.010003	0.000001	0.010000	0.000001	
2007/11/23	20070911-12-02	0.010000	0.000001	0.010003	0.000002	
2007/12/23	20070911-15-09	0.010006	0.000002	0.010007	0.000001	
2007/07/23	20070619-05-01	0.009999	0.000001	0.010002	0.000002	MR07-04
2007/08/29	20070619-07-04	0.010004	0.000001	0.010006	0.000003	
2007/06/10	20070424-01-08	−	−	0.010006	0.000002	MR07-03
2007/07/24	20070425-01-06	0.010006	0.000003	0.010005	0.000002	

(11) Quality control flag assignment

Quality flag values were assigned to oxygen measurements using the code defined in Table 0.2 of WHP Office Report WHPO 91-1 Rev.2 section 4.5.2 (Joyce *et al*., 1994). Measurement flags of 2 (good), 3 (questionable), 4 (bad), and 5 (missing) have been assigned (Tables 3.3.4). The replicate data were averaged and flagged 2 if both of them were flagged 2. If either of them was flagged 3 or 4, a datum with "younger" flag was selected. Thus we did not use flag of 6 (replicate measurements). For the choice between 2, 3, or 4, we basically followed a flagging procedure as listed below:

a. Bottle oxygen concentration and difference between bottle oxygen and CTD oxygen at the sampling layer were plotted against CTD pressure. Any points not lying on a generally smooth trend were noted.

b. Dissolved oxygen was then plotted against sigma-theta. If a datum deviated from a group of plots, it was flagged 3.

c. Vertical sections against pressure and potential density were drawn. If a datum was anomalous on the section plots, datum flag was degraded from 2 to 3, or from 3 to 4.

d. If the bottle flag was 4 (did not trip correctly), a datum was flagged 4 (bad). In case of the bottle flag 3 (leaking) or 5 (unknown problem), a datum was flagged based on the procedure shown above.

Table 3.3.4 Summary of assigned quality control flags.

Flag	Definition	MR07-04	MR07-06	Total
2	Good	2,628	8,312	10,940
3	Questionable	1	19	20
4	Bad	0	17	17
5	Not report (missing)	1	2	3
	Total	2,630	8,350	10,980

(12) Preliminary Results

(12.1) Comparison with Winkler oxygen measurements by University of Washington on board

At station MR07-06_P01-035, we conducted an inter-comparison of Winkler oxygen measurements between University of Washington (UW) and JAMSTEC on board. Seawater sample for UW was collected just after the oxygen sampling for JAMSTEC. The bottle oxygen concentrations in the samples from 15 Niskin bottles were

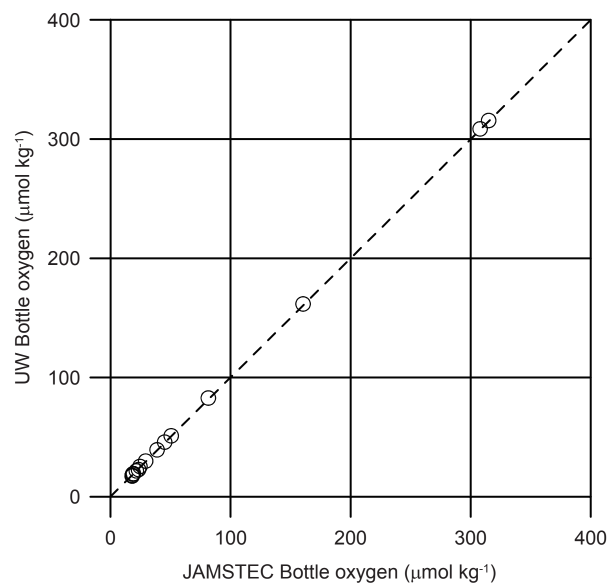

Figure 3.3.3 Comparison of bottle oxygen measurement between UW and JAMSTEC. A broken line shows a linear regression line whose correlation coefficient (r^2) and standard error are 0.99997 and 0.567 μmol kg^{-1}, respectively.

analyzed separately by UW and JAMSTEC and compared each other. We got a very good agreement between UW and JAMSTEC results (Fig. 3.3.3).

(12.2) Comparison of oxygen measurements at a cross point

During MR07-06 cruise, we compared two profiles of bottle oxygen at a cross point, 47.0°N/179.5°E. The first and second casts were conducted on 20-Oct.-2007 (MR07-06_P01-061) and 30-Oct.-2007 (MR07-06_P14N-X01), respectively. Below 1200 dbar, we got a good agreement between the first and second measurements (Fig. 3.3.4). We had also measured bottle oxygen concentration at the cross point during our previous cruise, MR07-04 (P01-061, 14-Aug.-2007). The oxygen profile in deep waters at the cross point of MR07-04 well agreed with those of MR07-06 (Fig. 3.3.4).

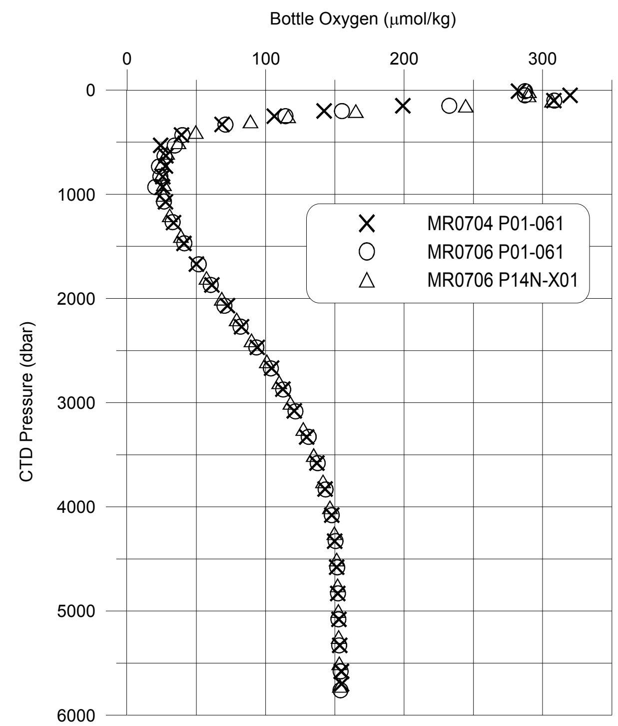

Figure 3.3.4 Vertical profiles of bottle oxygen concentration at a cross point (47.0°N/179.5°E) during MR07-06 and MR07-04 cruises.

(12.3) Decadal changes in dissolved oxygen along WHP-P01

Figure 3.3.5 shows zonal transects of dissolved oxygen along WHP-P01 in 2007. From 152°E (P01-028) to 179°E (P01-061), we re-occupied during MR07-06 in the October of 2007. The rest of the WHP-P01 stations were revisited during MR07-04 in the July and August of 2007. Difference in dissolved oxygen distribution between the eastern and western North Pacific can be distinguished. The boundary between the east and west is likely to be lying around 160°W. Dissolved oxygen concentrations in bottom waters in the west are higher than those in the east. The minimum concentration around 1000 m depth in the east was lower than that in the west.

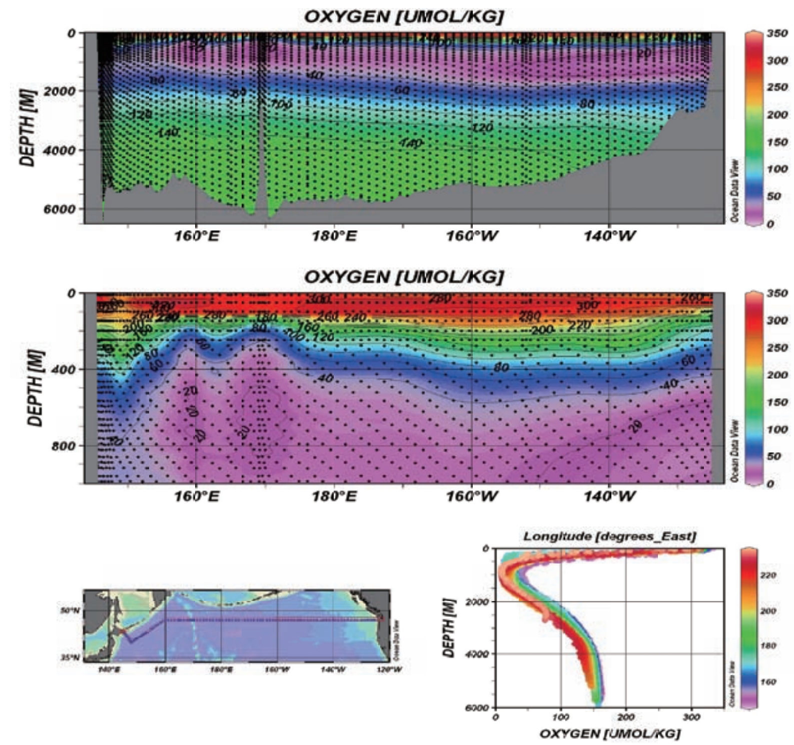

Figure 3.3.5 Zonal transects of dissolved oxygen along WHP-P01 in 2007 (Schlitzer, 2008).

We compared dissolved oxygen in deep waters below 4000 m depth in 2007 with those in 1985 and 1999 along WHP-P01. The oxygen concentration in 2007 were slightly lower than those in 1985 and 1999 by 1.9 ± 0.8 (n=641) and 1.1 ± 1.2 (n=628) µmol kg^{-1}, respectively. Despite of these small offsets in the deep layers, dissolved oxygen concentrations in the thermocline in 2007 were significantly higher than those in 1999. Distribution of differences in Apparent Oxygen Utilization (AOU) against water density between 1999 and 2007 (Fig. 3.3.6b) indicates that AOU (dissolved oxygen) decreased (increased) in waters just below seasonal mixing layer from 1999 to 2007. The maximum AOU decrease (about −50 µmol kg^{-1}) was found in 26.6 σ_θ layer between 180° and 140°W approximately. This AOU change between 1999 and 2007 is opposite to that between 1985 and 1999 (Fig. 3.3.6a).

(12.4) Decadal changes in dissolved oxygen along WHP-P14N/C

Figure 3.3.7 shows meridional transects of dissolved oxygen along WHP-P14N/C in 2007. WHP-P14N and P14C lines are lying from the Bering Sea to the Fiji Island and from the Fiji Islands to New Zealand (the South Fuji Basin), respectively. The transect of WHP-P14N is characterized by an oxygen minimum in mid-layers from the Bering Sea to the equator. In the Central Pacific Basin from 20°N to 10°S, dissolved oxygen concentration in bottom water (Circumpolar Deep Water) is slightly high. In the South Fiji Basin, dissolved oxygen maximum was found in mid-layers around 600 − 800 m depth.

We compared dissolved oxygen in deep waters below 4000 m depth in 2007 with those in 1992/93 along WHP-P14N/C. The oxygen data in 2007 were slightly lower than those in 1992/93 by 1.3 ± 2.0 (n=1106). Figure 3.3.8 shows distribution of differences in AOU against water density between 1992/93 and 2007. Except in the Bering Sea there was not large change in dissolved oxygen or AOU.

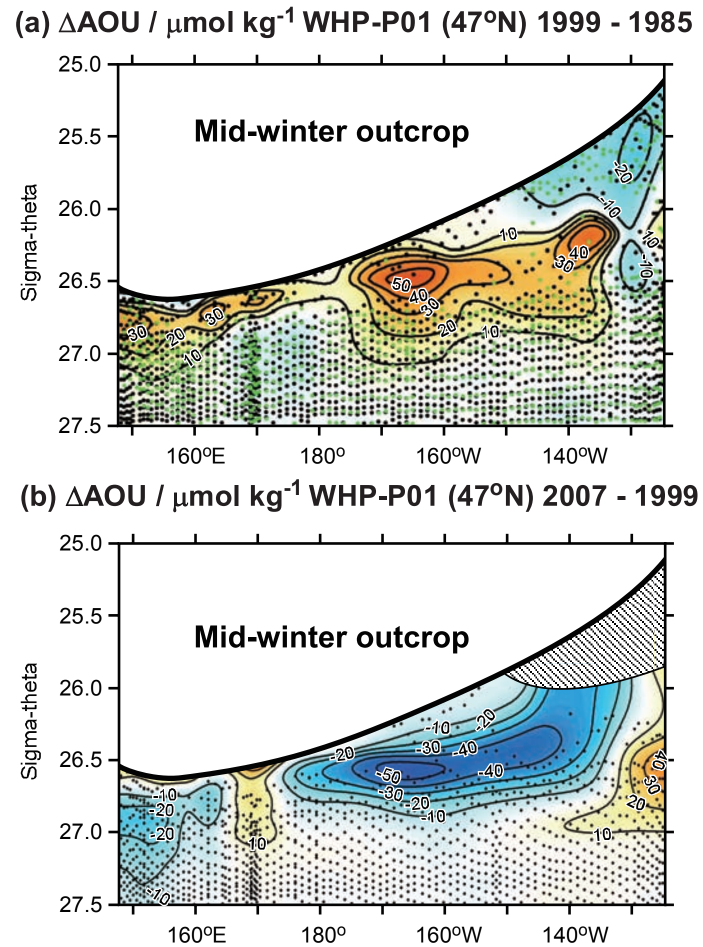

Figure 3.3.6 Distributions of differences of Apparent Oxygen Utilization, AOU (µmol kg^{-1}) against density (σ_0) between 1985 and 1999 (a) and between 1999 and 2007 (b). Contour intervals are 10 µmol kg^{-1}. Small dots indicate sampling layers for bottle oxygen. Sparse data hinder the comparison between 1999 and 2007 in shallow layers in the area to the east of 150°W (shaded area).

The maximum AOU increase (about 40 µmol kg^{-1}) was found in 26.6 σ_θ layer in the Bering Sea. Small temporal changes in the tropical region between 20°N and 20°S may be caused by transition of mesoscale eddies. At a cross point between MR07-04 and MR07-06 cruises (47°N/179°E), the intermediate AOU decreased by about 30 µmol kg^{-1} from 1999 to 2007 (see Fig. 3.3.6b). On the other hand, that decreased by about 10 µmol kg^{-1} from 1993 to 2007 (Fig. 3.3.8) These results imply that the intermediate AOU increased by about 20 µmol kg^{-1} from 1993 to 1999, which is consistent with the AOU increase between 1985 and 1999 at the cross point (see Fig. 3.3.6a).

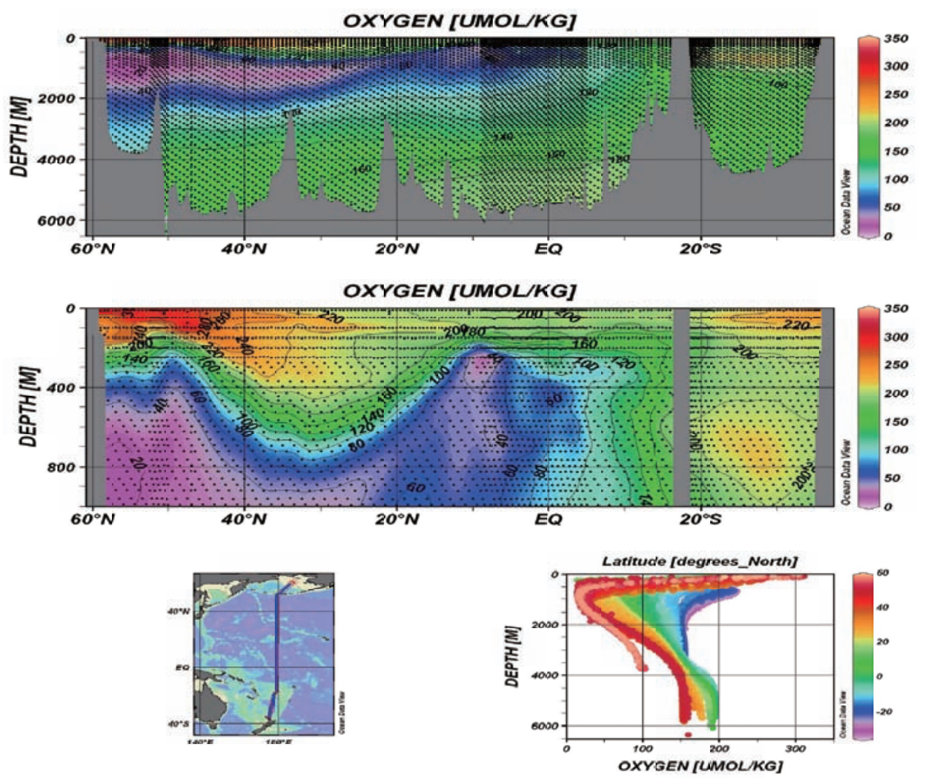

Figure 3.3.7 Meridional transects of dissolved oxygen along WHP-P14N/C in 2007 (Schlitzer, 2008).

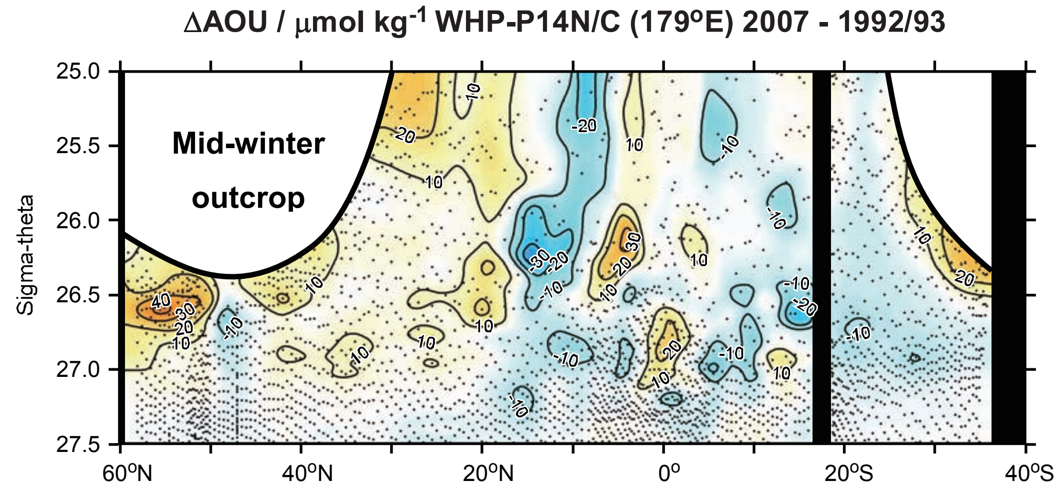

Figure 3.3.8 Distributions of differences of AOU (μmol kg^{-1}) against density (σ_θ) between 1992/93 and 2007. Contour intervals are 10 μmol kg^{-1}. Small dots indicate sampling layers of dissolved oxygen in 2007.

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3.4 Nutrients

27 October 2008

(1) Personnel

MR0704 cruise

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(2) Objectives

The objectives of nutrients analyses during the R/V MiraiMR0704 and MR0706 cruises, WOCE P1 and P14 revisited cruise in 2007, in the North Pacific are as follows;

- Describe the present status of nutrients concentration with excellent comparability.
- The determinants are nitrate, nitrite, phosphate and silicate.
- Study the temporal and spatial variation of nutrients concentration based on the previous high quality experiments data of WOCE previous P1 cruises in 1985 and 1999, P14N/C cruises in 1992, GOESECS, IGY and so on.
- Study of temporal and spatial variation of nitrate: phosphate ratio, so called Redfield ratio.
- Obtain more accurate estimation of total amount of nitrate, phosphate and silicate in the interested area.
- Provide more accurate nutrients data for physical oceanographers to use as tracers of water mass movement.

(3) Summary of nutrients analysis

We made 85 and 266 TRAACS800 runs for the samples at 88 in MR0704 and 273 stations in MR0706, respectively. The total amount of layers of the seawater sample reached up to 263 and 8319 for MR0704 and MR0706, respectively. We made duplicate measurement at all layers.

(4) Instrument and Method

(4.1) Analytical detail using TRAACS 800 systems (BRAN+LUEBBE)

The phosphate analysis is a modification of the procedure of Murphy and Riley (1962). Molybdic acid is added to the seawater sample to form phosphomolybdic acid which is in turn reduced to phosphomolybdous acid using L-ascorbic acid as the reductant.

Nitrate + nitrite and nitrite are analyzed according to the modification method of Grasshoff (1970). The sample nitrate is reduced to nitrite in a cadmium tube inside of which is coated with metallic copper. The sample stream with its equivalent nitrite is treated with an acidic, sulfanilamide reagent and the nitrite forms nitrous acid which reacts with the sulfanilamide to produce a diazonium ion. N-1-Naphthylethylene-diamine added to the sample stream then couples with the diazonium ion to produce a red, azo dye. With reduction of the nitrate to nitrite, both nitrate and nitrite react and are measured; without reduction, only nitrite reacts. Thus, for the nitrite analysis, no reduction is performed and the alkaline buffer is not necessary. Nitrate is computed by difference.

The silicate method is analogous to that described for phosphate. The method used is essentially that of Grasshoff et al. (1983), wherein silicomolybdic acid is first formed from the silicate in the sample and added molybdic acid; then the silicomolybdic acid is reduced to silicomolybdous acid, or "molybdenum blue," using ascorbic acid as the reductant. The analytical methods of the nutrients during this cruise are similar with previous cruises (Uchida and Fukasawa, 2005).

The flow diagrams and reagents for each parameter are shown in Figures 3.4.1-3.4.4.

(4.2) Nitrate Reagents

Imidazole (buffer), 0.06 M (0.4 % w/v)

Dissolve 4 g imidazole, $C_3H_4N_2$, in ca. 1000 ml DIW; add 2 ml concentrated HCl. After mixing, 1 ml Triton(R)X-100 (50 % solution in ethanol) is added.

Sulfanilamide, 0.06 M (1 % w/v) in 1.2M HCl

Dissolve 10 g sulfanilamide, 4-$NH_2C_6H_4SO_3H$, in 900 ml of DIW, add 100 ml concentrated HCl. After mixing, 2 ml Triton(R)X-100 (50 %f solution in ethanol) is added.

N-1-Napthylethylene-diamine dihydrochloride, 0.004 M (0.1 %f w/v)

Dissolve 1 g NEDA, $C_{10}H_7NHCH_2CH_2NH_2 \cdot 2HCl$, in 1000 ml of DIW and add 10 ml concentrated HCl. Stored in a dark bottle.

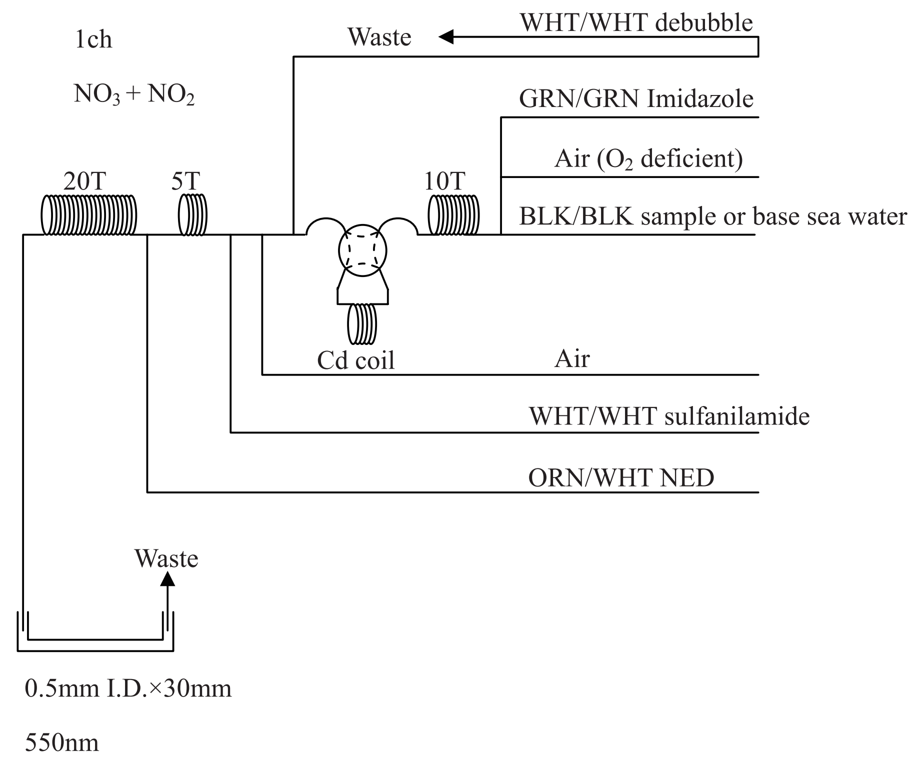

Figure3.4.1: 1ch. (NO_3+NO_2) Flow diagram.

(4.3) Nitrite Reagents

Sulfanilamide, 0.06 M (1 % w/v) in 1.2 M HCl

Dissolve 10g sulfanilamide, 4-$NH_2C_6H_4SO_3H$, in 900 ml of DIW, add 100 ml concentrated HCl. After mixing, 2 ml Triton(R)X-100 (50 % solution in ethanol) is added.

N-1-Napthylethylene-diamine dihydrochloride, 0.004 M (0.1 % w/v)

Dissolve 1 g NEDA, $C_{10}H_7NHCH_2CH_2NH_2 \cdot 2HCl$, in 1000 ml of DIW and add 10 ml concentrated HCl. Stored in a dark bottle.

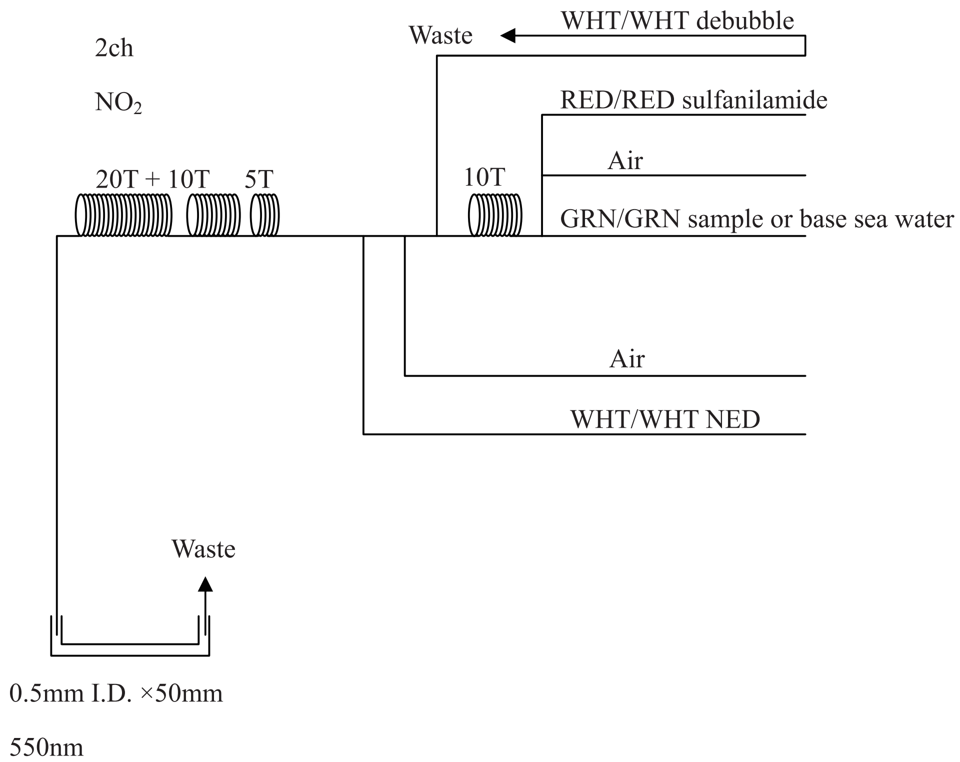

Figure3.4.2: 2ch. (NO_2) Flow diagram.

(4.4) Silicate Reagents

Molybdic acid, 0.06 M (2 % w/v)

Dissolve 15 g Disodium Molybdate(VI) Dihydrate, $Na_2MoO_4 \cdot 2H_2O$, in 980 ml DIW, add 8 ml concentrated H_2SO_4. After mixing, 20 ml sodium dodecyl sulphate (15 % solution in water) is added.

Oxalic acid, 0.6 M (5 % w/v)

Dissolve 50g Oxalic Acid Anhydrous, HOOC: COOH, in 950 ml of DIW.

Ascorbic acid, 0.01M (3 % w/v)

Dissolve 2.5g L (+)-Ascorbic Acid, $C_6H_8O_6$, in 100 ml of DIW. Stored in a dark bottle and freshly repared before every measurement.

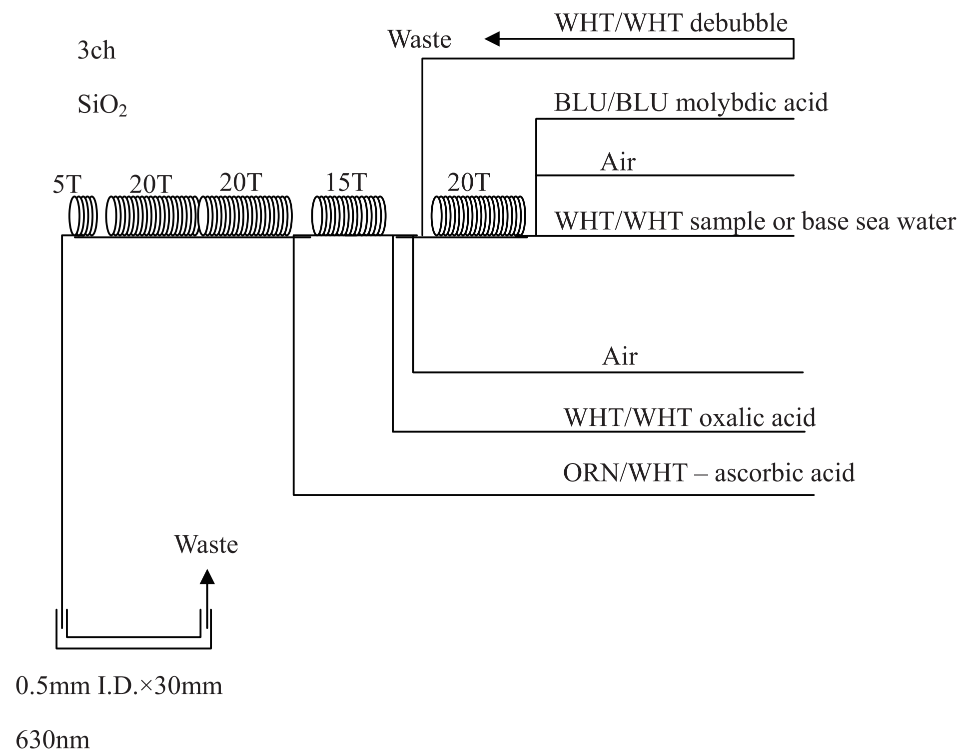

Figure3.4.3: 3ch. (SiO_2) Flow diagram.

(4.5) Phosphate Reagents

Stock molybdate solution, 0.03M (0.8 % w/v)

Dissolve 8 g Disodium Molybdate(VI) Dihydrate, $Na_2MoO_4 \cdot 2H_2O$, and 0.17 g Antimony Potassium Tartrate, $C_8H_4K_2O_{12}Sb_2 \cdot 3H_2O$, in 950 ml of DIW and add 50 ml concentrated H_2SO_4.

Mixed Reagent

Dissolve 0.8 g L (+)-Ascorbic Acid, $C_6H_8O_6$, in 100 ml of stock molybdate solution. After mixing, 2 ml sodium dodecyl sulphate (15 % solution in water) is added. Stored in a dark bottle and freshly prepared before every measurement.

Reagent for sample dilution

Dissolve Sodium Hydrate, NaCl, 10 g in ca. 950 ml of DIW, add 50 ml Acetone and 4 ml concentrated H_2SO_4. After mixing, 5 ml sodium dodecyl sulphate (15 % solution in water) is added.

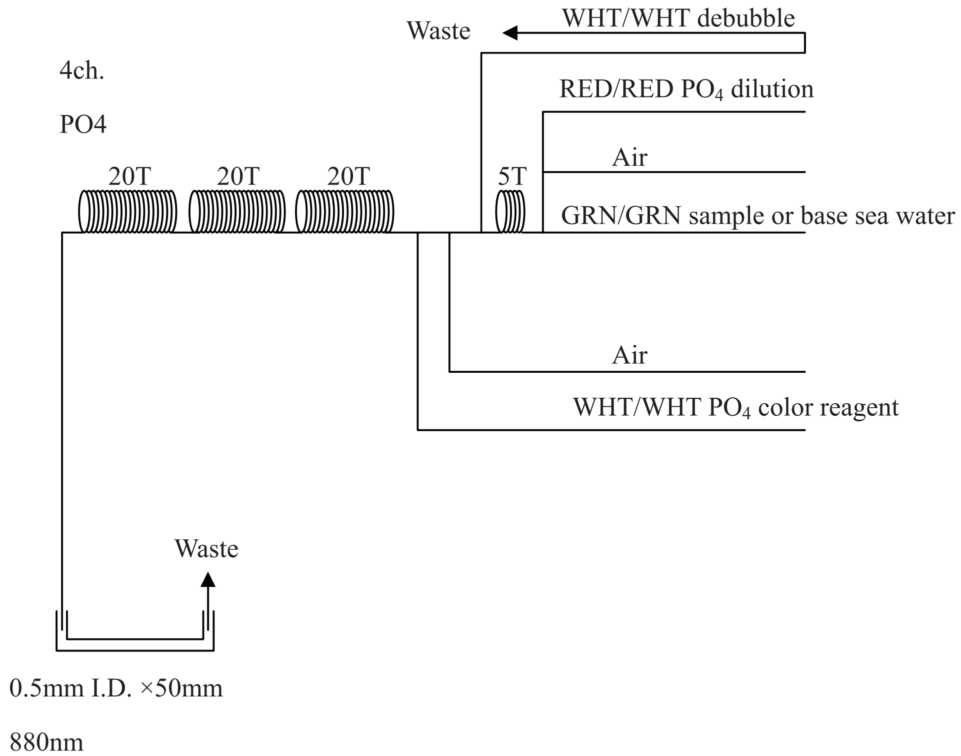

Figure3.4.4: 4ch. (PO_4) Flow diagram.

(4.6) Sampling procedures

Sampling of nutrients followed that oxygen, trace gases and salinity. Samples were drawn into two of virgin 10 ml polyacrylates vials without sample drawing tubes. These were rinsed three times before filling and vials were capped immediately after the drawing. The vials are put into water bath at 24 ± 1deg. C in 10 minutes before use to stabilize the temperature of samples in both MR0704 and MR0706.

No transfer was made and the vials were set an auto sampler tray directly. Samples were analyzed after collection basically within 20 hours in MR0704 and 14 hours in MR0706.

(4.7) Data processing

Raw data from TRAACS800 were treated as follows;

- Check baseline shift.
- Check the shape of each peak and positions of peak values taken, and then change the positions of peak values taken if necessary.
- Carry-over correction and baseline drift correction were applied to peak heights of each samples followed by sensitivity correction.
- Baseline correction and sensitivity correction were done basically using liner regression.
- Load pressure and salinity from CTD data to calculate density of seawater.
- Calibration curves to get nutrients concentration were assumed second order equations.

(5) Nutrients standards

(5.1) Volumetric Laboratory Ware of in-house standards

All volumetric glass- and polymethylpentene (PMP)-ware used were gravimetrically calibrated. Plastic volumetric flasks were gravimetrically calibrated at the temperature of use within 2-3 K.

Volumetric flasks

Volumetric flasks of Class quality (Class A) are used because their nominal tolerances are 0.05 % or less over the size ranges likely to be used in this work. Class A flasks are made of borosilicate glass, and the standard solutions were transferred to plastic bottles as quickly as possible after they are made up to volume and well mixed in order to prevent excessive dissolution of silicate from the glass.

High quality plastic (polymethylpentene, PMP, or polypropylene) volumetric flasks were gravimetrically calibrated and used only within 3-4 K of the calibration temperature.

The computation of volume contained by glass flasks at various temperatures other than the calibration temperatures were done by using the coefficient of linear expansion of borosilicate crown glass.

Because of their larger temperature coefficients of cubical expansion and lack of tables constructed for these materials, the plastic volumetric flasks were gravimetrically calibrated over the temperature range of intended use and used at the temperature of calibration within 3-4 K. The weights obtained in the calibration weightings were corrected for the density of water and air buoyancy.

Pipettes and pipettors

All pipettes have nominal calibration tolerances of 0.1 % or better. These were gravimetrically calibrated in order to verify and improve upon this nominal tolerance.

(5.2) Reagents, general considerations

Specifications

For nitrate standard, "potassium nitrate 99.995 suprapur" provided by Merck, CAS No. : 7757-91-1, was used.

For phosphate standard, "potassium dihydrogen phosphate anhydrous 99.995 suprapur" provided by Merck, CAS No. : 7778-77-0, was sued.

For nitrite standard, "sodium nitrate" provided by Wako, CAS No. : 7632-00-0, was used. And assay of nitrite was determined according JIS K8019 and assays of nitrite salts were 99.1 %. We use that value to adjust the weights taken.

For the silicate standard, we use "Silicon standard solution SiO2 in NaOH 0.5 mol/l CertiPUR" provided by Merck, CAS No. : 1310-73-2, of which lot number is HC623465 is used. The silicate concentration is certified by NIST-SRM3150 with the uncertainty of 0.5 %.

Ultra pure water

Ultra pure water (MilliQ water) freshly drawn was used for preparation of reagents, higher concentration standards and for measurement of reagent and system blanks.

Low-Nutrient Seawater (LNSW)

Surface water having low nutrient concentration was taken and filtered using 0.45 μm pore size membrane filter. This water is stored in 20 liter cubitainer with paper box. The concentrations of nutrient of this water were measured carefully in May 2007.

(5.3) Concentrations of nutrients for A, B and C standards

Concentrations of nutrients for A, B and C standards are set as shown in Table 3.4.1. The C standard is prepared according recipes as shown in Table 3.4.2. All volumetric laboratory tools were calibrated prior the cruise as stated in chapter (i). Then the actual concentration of nutrients in each fresh standard was calculated based on the ambient, solution temperature and determined factors of volumetric lab. wares.

Table 3.4.1 Nominal concentrations of nutrients for A, B and C standards.

	A	B	C-1	C-2	C-3	C-4	C-5	C-6	C-7
NO_3(μM)	45000	900	BA	AY	AX	AV	BF	55	BG
NO_2(μM)	4000	20	BA	AY	AX	AV	BF	1.2	BG
SiO_2(μM)	36000	2880	BA	AY	AX	AV	BF	170	BG
PO_4(μM)	3000	60	BA	AY	AX	AV	BF	3.6	BG

Table 3.4.2 Working calibration standard recipes.

C Std.	B-1 Std.	B-2 Std.
C-6	30 ml	30 ml

B-1 Std.: Mixture of nitrate, silicate and phosphate

B-2 Std.: Nitrite

(5.4) Renewal of in-house standard solutions.

In-house standard solutions as stated in (iii) were renewed as shown in Table 3.4.3.

Table 3.4.3 Timing of renewal of in-house standards.

NO_3, NO_2, SiO_2, PO_4	Renewal
A-1 Std. (NO_3)	maximum 1 month
A-2 Std. (NO_2)	maximum 1 month
A-3 Std. (SiO_2)	commercial prepared solution
A-4 Std. (PO_4)	maximum 1 month
B-1 Std. (mixture of NO_3, SiO_2, PO_4)	8 days
B-2 Std. (NO_2)	8 days

C Std.	Renewal
C-6 Std. (mixture of B-1 and B-2 Std.)	24 hours

Reduction estimation	Renewal
D-1 Std. (7200μM NO_3)	when A-1 Std. renewed
43μM NO_3	when C Std. renewed
47μM NO_2	when C Std. renewed

(6) Reference material of nutrients in seawater

To get the more accurate and high quality nutrients data to achieve the objectives stated above, huge numbers of the bottles of the reference material of nutrients in seawater (hereafter RMNS) are prepared (Aoyama et al., 2007). In the previous world wide expeditions, such as WOCE cruises, the higher reproducibility and precision of nutrients measurements were required (Joyce and Corry, 1994). Since no standards were available for the measurement of nutrients in seawater at that time, the requirements were described in term of reproducibility. The required reproducibility was 1 %, 1-2 %, 1-3 % for nitrate, phosphate and silicate, respectively. Although nutrient data from the WOCE one-time survey was of unprecedented quality and coverage due to much care in sampling and measurements, the differences of nutrients concentration at crossover points are still found among the expeditions (Aoyama and Joyce, 1996, Mordy et al., 2000, Gouretski and Jancke, 2001). For instance, the mean offset of nitrate concentration at deep waters was 0.5 μmol kg^{-1} for 345 crossovers at world oceans, though the maximum was 1.7 μmol kg^{-1} (Gouretski and Jancke, 2001). At the 31 crossover points in the Pacific WHP one-time lines, the WOCE standard of reproducibility for nitrate of 1 % was fulfilled at about half of the crossover points and the maximum difference was 7 % at deeper layers below 1.6 deg. C in potential temperature (Aoyama and Joyce, 1996).

(6.1) RMNSs for this cruise

RMNS lots BA, AY, AX, AV and BF, which cover full range of nutrients concentrations in the western North Pacific Ocean are prepared. 40 sets of BA, AY, AX, AV and BF are prepared.

Since silicate concentration along P1 section was expected to be very high, we also prepared RMNS lot BG, of which silicate concentration is 255 μmol kg^{-1}. When silicate concentration expected to exceed 170 μmol kg^{-1}, we add RMNS lot BG as an additional standard as C-7. These RMNSs were renewed daily and analyzed every 2 runs on the same day.

Eighty-five and 266 bottles of RMNS lot BC are prepared for MR0704 and MR0706, respectively, to use every analysis at every hydrographic station. These RMNS assignment were completely done based on random number. The RMNS bottles were stored at a room in the ship, REAGENT STORE, where the temperature was maintained around 24-26 deg. C.

(6.2) Assigned concentration for RMNSs

We assigned nutrients concentrations for RMNS lots BA, AY, AX, AV, BF, BC and BG as shown in Table 3.4.4.

Table 3.4.4 Assigned concentration of RMNSs.

unit: μmol kg^{-1}

	Nitrate	Phosphate	Silicate	Nitrite
AH	**35.31**	**2.114**	**132.20**	**(0.02)***
BA	**0.07**	**0.068**	**1.60**	**0.02**
AY	**5.60**	**0.516**	**29.42**	**0.62**
AX	**21.42**	**1.619**	**58.06**	**0.35**
AV	**33.36**	**2.516**	**154.14**	**0.10**
BF	**41.39**	**2.809**	**150.61**	**0.02**
BC	**40.71**	**2.782**	**156.13**	**0.02**
BG	**36.85**	**2.570**	**254.42**	**0.06**

* Concentration of nitrite for lot. AH did not assign. The value in the table is result of measurement on 7 Oct. 2007.

(6.3) The homogeneity of RMNSs

The homogeneity of lot BC and analytical precisions are shown in Table 3.4.5. These are for the assessment of the magnitude of homogeneity of the RMNS bottles those are used during the cruise. As shown in Table 3.4.5 and Table 3.4.6 the homogeneity of RMNS lot BC for nitrate and silicate are the same magnitude of analytical precision derived from fresh raw seawater in May 2005. The homogeneity for phosphate, however, exceeded the analytical precision at some extent. In May 2007, analytical precisions become better less than 0.1 % and the homogeneity at lot BF and BG for nitrate, phosphate and silicate were 0.11-0.14 %, 0.17-0.21 %, 0.08-0.10 %, respectively.

Table 3.4.5 Homogeneity of lot BC and previous lots derived from simultaneous 30 samples measurements and analytical precision onboard R/V Mirai in May 2005.

	Nitrate	Phosphate	Silicate
	CV %	**CV %**	**CV %**
BC	**0.22**	**0.32**	**0.19**
(AH)	**(0.39)**	**(0.83)**	**(0.13)**
(K)	**(0.3)**	**(1.0)**	**(0.2)**
Precision	**0.22**	**0.22**	**0.12**

Note: N=30 × 2

Table 3.4.6 Homogeneity of lot BF and BG derived from simultaneous 7 samples measurements and analytical precision onboard R/V Mirai in May 2007.

	Nitrate	Phosphate	Silicate
	CV %	**CV %**	**CV %**
BF	**0.11**	**0.21**	**0.10**
BG	**0.14**	**0.17**	**0.08**
Precision	**0.05**	**0.07**	**0.06**

Note: N=7 × 4

(6.4) Comparability of RMNSs during the periods from 2003 to 2007

Cruise-to-cruise comparability has examined based on the results of the previous results of RMNSs measurements obtained among cruises, and RMNS international comparison experiments in 2003 and 2006. The uncertainties for each value were obtained similar method described in 7.1 in this chapter at the measurement before each cruise and inter-comparison study, shown as precruise and intercomparison, and mean of uncertainties during each cruise, only shown cruise code, respectively. As shown in Table 3.4.7, the nutrients concentrations of RMNSs were in good agreement among the measurements during the period from 2003 to 2007. For the silicate measurements, we show lot numbers and chemical company names of each cruise/measurement in the footnote. As shown in Table 3.4.7, there shows less comparability among the measurements due to less comparability among the standard solutions provided by chemical companies in the silicate measurements.

Table 3.4.7 (a) Comparability for nitrate.

unit: μmol kg^{-1}

Cruise/Lab	RM Lots													
	AH	unc.	BA	unc.	AY	unc.	AX	unc.	AV	unc.	BF	unc.	BC	unc.
							Nitrate							
2003														
2003intercomparison	35.23													
2005														
MR05-01	35.54	0.08	0.05	0.03			21.49	0.09	33.38	0.08				
MR05-02			0.07	0.02	5.61	0.02	21.45	0.07	33.35	0.06			40.70	0.06
MR05-05_1precruise	35.65	0.05	0.07	0.00	5.57	0.00	21.41	0.01	33.41	0.02			40.76	0.03
MR05-05_1			0.07	0.01	5.62	0.02	21.43	0.05	33.36	0.05			40.73	0.85
MR05-05_2 precruise			0.08	0.00	5.58	0.00	21.39	0.02	33.36	0.03			40.72	0.03
MR05-05_2			0.07	0.01	5.62	0.02	21.44	0.05	33.36	0.05			40.73	0.06
MR05-05_3 precruise			0.06	0.00	5.62	0.00	21.49	0.01	33.39	0.01			40.79	0.01
MR05-05_3			0.07	0.01	5.61	0.02	21.44	0.04	33.37	0.05			40.75	0.05
2006														
MR06-02_precruise					5.62	0.00			33.36	0.01				
MR06-03 precruise					5.59	0.00			33.42	0.02				
MR06-03_2precruise					5.62	0.00			33.24	0.02				
MR06-04_1precruise					5.60	0.01			33.33	0.04				
MR06-04_2precruise					5.58	0.01			33.12	0.04				
MR06-05_1precruise			0.07	0.00	5.61	0.00	21.42	0.01	33.28	0.01			40.63	0.02
2006intercomparison			0.04	0.00	5.58	0.01	21.40	0.02	33.32	0.03			40.63	0.04
2003intercomp_revisit	35.4	0.03												
2007														
MR07-01_precruise			0.04	0.00	5.59	0.01	21.38	0.04	33.31	0.06			40.60	0.07
MR07-02_precruise			0.04	0.00	5.62	0.01	21.44	0.02	33.40	0.03	41.36	0.04		
MR07-04_precruise_1	35.74	0.03	0.07	0.00	5.67	0.00	21.59	0.02	33.49	0.03	41.47	0.03	40.83	0.03
MR07-04_precruise_2	35.80	0.01	0.08	0.00	5.65	0.00	21.60	0.01	33.47	0.01	41.55	0.02	40.92	0.02
MR07-04			0.08	0.01	5.61	0.02	21.41	0.06	33.38	0.05	41.36	0.06	40.77	0.05
MR07-05_precruise			0.08	0.00	5.65	0.01	21.43	0.02	33.44	0.04	41.46	0.05	40.87	0.04
MR07-06_1precruise	35.61	0.02	0.07	0.00	5.61	0.00	21.44	0.01	33.43	0.02	41.44	0.02	40.79	0.02
MR07-06_1			0.08	0.01	5.62	0.04	21.44	0.03	33.41	0.05	41.36	0.04	40.81	0.04
MR07-06_2precruise	35.61	0.04	0.06	0.00	5.62	0.01	21.43	0.02	33.54	0.04	41.42	0.05	40.79	0.05
MR07-06_2			0.08	0.01	5.61	0.02	21.44	0.03	33.39	0.06	41.36	0.05	40.81	0.04

Table 3.4.7 (b) Comparability for phosphate.

unit: μmol kg^{-1}

Cruise/Lab	RM Lots													
	AH	unc.	BA	unc.	AY	unc.	AX	unc.	AV	unc.	BF	unc.	BC	unc.
			Phosphate											
2003														
2003intercomp	2.1													
2005														
MR05-01	2.133	0.023	0.065	0.006			1.622	0.008	2.52	0.007				
MR05-02			0.061	0.010	0.515	0.009	1.614	0.008	2.515	0.008			2.778	0.010
MR05-05_1precruise	2.148	0.006	0.045	0.000	0.508	0.000	1.620	0.001	2.517	0.002			2.781	0.002
MR05-05_1			0.063	0.007	0.515	0.007	1.615	0.006	2.515	0.007			2.778	0.033
MR05-05_2 precruise			0.066	0.000	0.519	0.000	1.608	0.001	2.510	0.001			2.784	0.002
MR05-05_2			0.064	0.005	0.517	0.005	1.614	0.004	2.515	0.005			2.782	0.006
MR05-05_3 precruise			0.060	0.000	0.519	0.000	1.620	0.001	2.517	0.002			2.788	0.002
MR05-05_3			0.061	0.004	0.514	0.003	1.618	0.005	2.515	0.004			2.779	0.008
2006														
MR06-02_precruise					0.516	0.000			2.515	0.002				
MR06-03 precruise					0.496	0.001			2.499	0.003				
MR06-03_2precruise					0.504	0.001			2.515	0.003				
MR06-04_1precruise					0.502	0.000			2.501	0.002				
MR06-04_2precruise					0.508	0.000			2.507	0.002				
MR06-05_1precruise			0.071	0.000	0.527	0.000	1.629	0.000	2.523	0.001			2.788	0.001
2006intercomparison			0.071	0.000	0.524	0.000	1.623	0.001	2.515	0.002			2.791	0.002
2003intercomp_revisit	2.141	0.001												
2007														
MR07-01_precruise			0.073	0.000	0.524	0.001	1.620	0.002	2.521	0.003			2.784	0.003
MR07-02_precruise			0.080	0.000	0.593	0.000	1.646	0.001	2.553	0.002	2.832	0.002		
MR07-04_precruise_1	2.140	0.002	0.062	0.000	0.518	0.000	1.620	0.001	2.512	0.002	2.811	0.002	2.782	0.002
MR07-04_precruise_2	2.146	0.002	0.056	0.000	0.514	0.000	1.620	0.001	2.517	0.002	2.811	0.002	2.788	0.002
MR07-04			0.066	0.004	0.521	0.005	1.617	0.005	2.513	0.004	2.805	0.006	2.781	0.007
MR07-05_precruise			0.052	0.000	0.506	0.001	1.618	0.002	2.508	0.003	2.804	0.003	2.794	0.003
MR07-06_1precruise	2.144	0.001	0.066	0.000	0.520	0.000	1.617	0.001	2.517	0.001	2.806	0.001	2.790	0.001
MR07-06_1			0.064	0.004	0.519	0.005	1.620	0.003	2.515	0.003	2.808	0.003	2.783	0.005
MR07-06_2precruise	2.146	0.002	0.067	0.000	0.520	0.000	1.620	0.001	2.517	0.002	2.808	0.002	2.789	0.002
MR07-06_2			0.066	0.004	0.521	0.005	1.619	0.005	2.515	0.003	2.807	0.004	2.785	0.006

Table 3.4.7 (c) Comparability for silicate.

unit: μmol kg^{-1}

Cruise/Lab	RM Lots													
	AH	unc.	BA	unc.	AY	unc.	AX	unc.	AV	unc.	BF	unc.	BC	unc.
			Silicate											
2003														
2003intercomparison**	133.97													
2005														
MR05-01#	135.42	0.20	1.58	0.06			59.42	0.07	157.71	0.19				
MR05-02#			1.65	0.05	30.15	0.08	59.53	0.11	157.87	0.19			159.93	0.19
MR05-05_1precruise##	135.89	0.13	1.55	0.00	30.13	0.02	59.55	0.03	157.92	0.09			160.05	0.09
MR05-05_1##			1.63	0.07	30.11	0.08	59.50	0.12	157.96	0.26			160.08	0.36
MR05-05_2 precruise##			1.62	0.00	30.12	0.02	59.46	0.04	158.02	0.09			160.22	0.10
MR05-05_2##			1.63	0.06	30.11	0.07	59.49	0.09	158.00	0.16			160.14	0.15
MR05-05_3 precruise##			1.61	0.00	30.13	0.03	59.54	0.05	158.02	0.14			160.12	0.14
MR05-05_3##			1.64	0.05	30.12	0.05	59.47	0.09	157.93	0.18			160.08	0.13
2006														
MR06-02_precruise##					30.21	0.02			158.14	0.12				
MR06-03 precruise†					29.39	0.02			154.47	0.10				
MR06-03_2precruise†					29.56	0.01			154.52	0.08				
MR06-04_1precruise†					29.50	0.00			154.31	0.02				
MR06-04_2precruise†					29.44	0.01			153.98	0.03				
MR06-05_1precruise***			1.67	0.00	29,62	0.02	58.32	0.04	154.15	0.11			156.10	0.11
2006intercomparison†			1.64	0.00	29.50	0.01	58.18	0.03	154.33	0.08			156.31	0.08
2003intercomp_revisit†	132.55	0.07												
2007														
MR07-01_precruise†			1.59	0.00	29.37	0.03	57.99	0.06	154.21	0.15			156.06	0.16
MR07-02_precruise†			1.65	0.00	29.60	0.02	58.37	0.04	154.55	0.09	150.57	0.09		
MR07-04_precruise_1 $	133.38	0.06	1.61	0.00	29.57	0.01	58.46	0.03	154.82	0.07	151.03	0.07	156.98	0.07
MR07-04_precruise_2 $	133.15	0.12	1.69	0.00	29.61	0.03	58.44	0.05	154.87	0.14	151.04	0.14	156.86	0.14
MR07-04 $			1.62	0.07	29.42	0.07	58.11	0.11	154.45	0.21	150.59	0.16	156.62	0.48
MR07-05_precruise $			1.70	0.00	29.43	0.02	58.08	0.04	154.05	0.11	150.48	0.11	156.31	0.11
MR07-06_1precruise $	133.02	0.09	1.64	0.00	29.72	0.02	58.50	0.04	155.06	0.11	150.31	0.11	156.33	0.11
MR07-06_1 $			1.61	0.04	29.43	0.07	58.13	0.08	154.48	0.13	150.53	0.11	156.64	0.08
MR07-06_2precruise $	132.70	0.07	1.56	0.00	29.48	0.01	58.25	0.03	154.39	0.08	150.56	0.08	156.57	0.08
MR07-06_2 $			1.58	0.07	29.35	0.08	58.04	0.10	154.38	0.16	150.49	0.13	156.61	0.13

List of lot numbers: *: Kanto 306F9235; **: Kanto 402F9041; #: Kanto 502F9205; ##: Kanto 609F9157; †: Merck OC551722; ***: Merck HC694149; $: Merck HC623465

(7) Quality control

(7.1) Precision of nutrients analyses during the cruise

MR0704

Precision of nutrients analyses during the cruise was evaluated based on the 11 measurements, which are measured every 12 samples, during a run at the concentration of C-6 std. We also evaluated the reproducibility based on the replicate analyses of five samples in each run. Summary of precisions are shown in Table 3.4.8. As shown in Table 3.4.8 and Figures 3.4.5-3.4.7, the precisions for each parameter are generally good considering the analytical precisions estimated from the simultaneous analyses of 12 samples in May 2007. Analytical precisions previously evaluated were 0.05 % for nitrate, 0.07 % for phosphate and 0.06 % for silicate, respectively. During this cruise, analytical precisions were 0.06 % for nitrate, 0.10 % for phosphate and 0.07 % for silicate in terms of median of precision, respectively. Then we can conclude that the analytical precisions for nitrate, phosphate and silicate were maintained throughout this cruise. The time series of precision are shown in Figures 3.4.5-3.4.7.

Table 3.4.8 Summary of precision based on the replicate analyses of 11 samples in each run through out cruise.

	Nitrate CV %	Phosphate CV %	Silicate CV %
Median	**0.06**	**0.10**	**0.07**
Mean	**0.06**	**0.10**	**0.07**
Maximum	**0.12**	**0.19**	**0.12**
Minimum	**0.02**	**0.03**	**0.01**
N	**85**	**85**	**85**

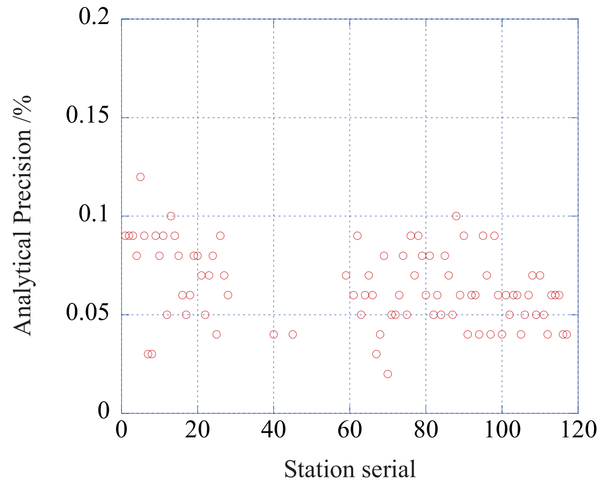

Figure 3.4.5 Time series of precision of nitrate for MR0704.

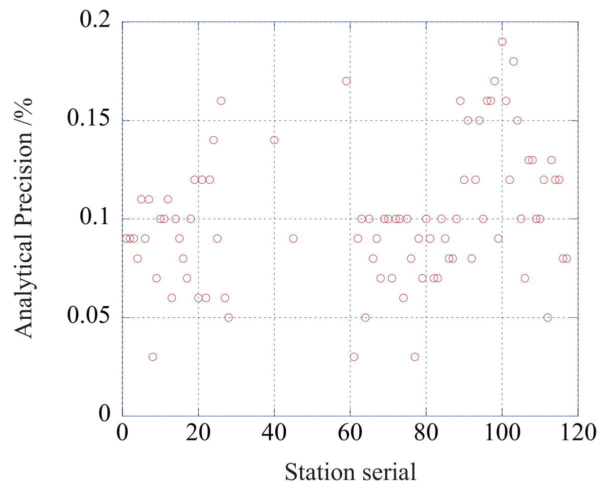

Figure 3.4.6 Time series of precision of phosphate for MR0704.

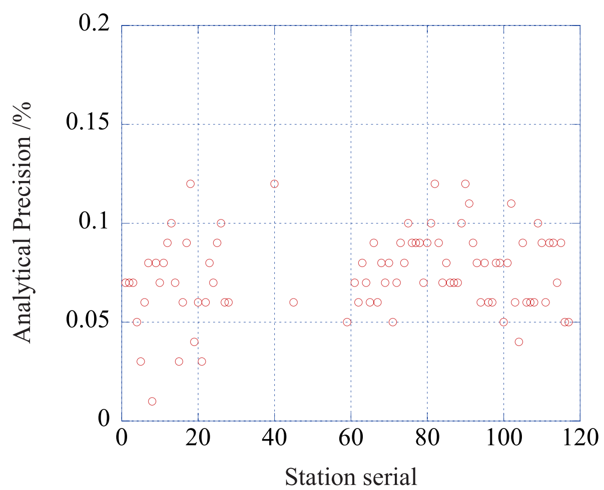

Figure 3.4.7 Time series of precision of silicate for MR0704.

MR0706

Precision of nutrients analyses during the cruise was evaluated based on the 11 measurements, which are measured every 12 samples, during a run at the concentration of C-6 std. We also evaluated the reproducibility based on the replicate analyses of five samples in each run. Summary of precisions are shown in Table 3.4.9. As shown in Table 3.4.9 and Figures 3.4.8-3.4.10, the precisions for each parameter are generally good considering the analytical precisions estimated from the simultaneous analyses of 12 samples in May 2007. Analytical precisions previously evaluated were 0.05 % for nitrate, 0.07 % for phosphate and 0.06 % for silicate, respectively. During this cruise, analytical precisions were 0.07 % for nitrate, 0.09 % for phosphate and 0.07 % for silicate in terms of median of precision, respectively. Then we can conclude that the analytical precisions for nitrate, phosphate and silicate were maintained throughout this cruise. The time series of precision are shown in Figures 3.4.8-3.4.10.

Table 3.4.9 Summary of precision based on the replicate analyses of 11 samples in each run through out cruise.

	Nitrate CV %	Phosphate CV %	Silicate CV %
Median	**0.07**	**0.09**	**0.07**
Mean	**0.07**	**0.10**	**0.07**
Maximum	**0.15**	**0.20**	**0.16**
Minimum	**0.02**	**0.03**	**0.02**
N	**266**	**266**	**266**

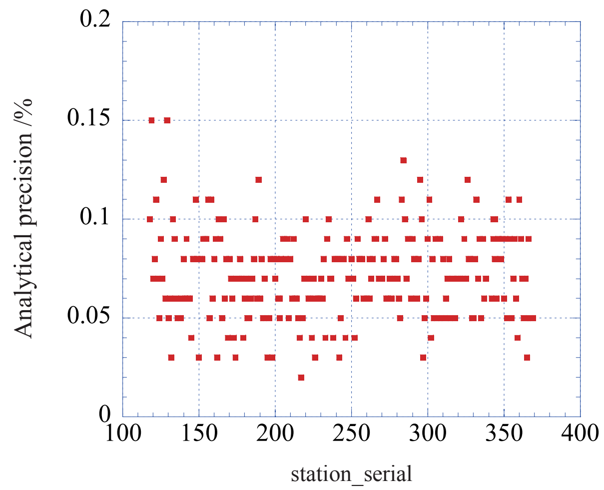

Figure 3.4.8 Time series of precision of nitrate for MR0706.

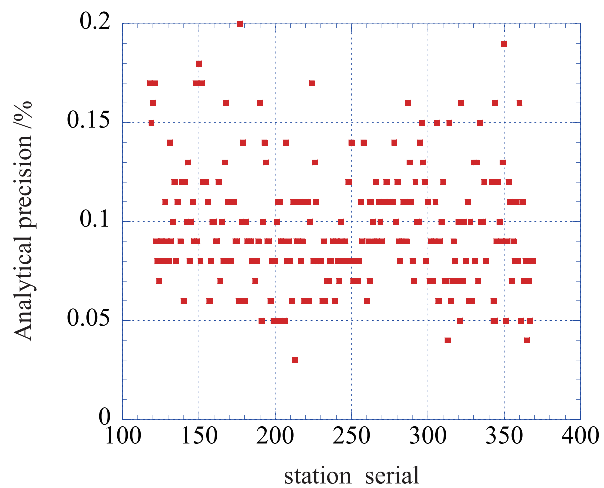

Figure 3.4.9 Time series of precision of phosphate for MR0706.

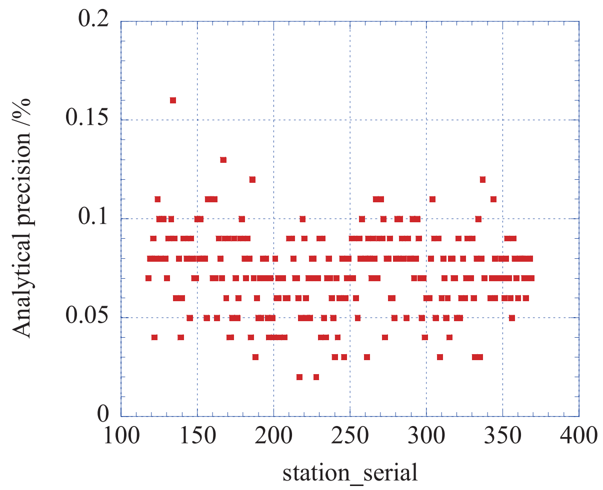

Figure 3.4.10 Time series of precision of silicate for MR0706.

(7.2) Carry over

We can also summarize the magnitudes of carry over throughout the cruise. These are small enough within acceptable levels as shown in Table 3.4.10.

Table 3.4.10 (a) Summary of carry over through out MR0704 cruise.

	Nitrate CV %	Phosphate CV %	Silicate CV %
Median	**0.16**	**0.11**	**0.20**
Mean	**0.16**	**0.13**	**0.20**
Maximum	**0.28**	**0.44**	**0.36**
Minimum	**0.02**	**0.00**	**0.07**
N	**85**	**85**	**85**

Table 3.4.10(b) Summary of carry over through out MR0706 cruise.

	Nitrate CV %	Phosphate CV %	Silicate CV %
Median	**0.14**	**0.14**	**0.12**
Mean	**0.14**	**0.14**	**0.13**
Maximum	**0.33**	**0.40**	**0.29**
Minimum	**0.00**	**0.00**	**0.01**
N	**266**	**266**	**266**

(8) Problems/improvements occurred and solutions.

MR0704

During the analysis for the samples between station 8 and station 27 of WHP-P1, we got a problem on phosphate measurements.17 samples from 8 stations showed large difference on duplicate measurements exceeding uncertainty of 0.02 µmol kg^{-1}.

Especially 12 samples showed 0.05 to 0.97 µmol kg^{-1} higher values. We had judged that these higher values are contamination during the sampling from Niskin bottle or test tube itself. Therefore, we had checked probable source of this contamination including air-conditioners in the water sampling room and the laboratory. For the air-conditioners, we had cleaned up them. For the test tubes, we had made blank test for 440 tubes.

We did not see any contaminations on test tubes. Since higher phosphate concentration did not occur after we clean up the air-conditioners, we had concluded that the source of the contamination of phosphate might be one of air-conditioners in the Lab.

MR0706

No problem occurred during this cruise.

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3.5. Dissolved inorganic carbon (C_T)

9 November 2008

(1) Personnel

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Yoshiko Ishikawa (MWJ)

Yasuhiro Arii (MWJ)

Mikio Kitada (MWJ)

(2) Objectives

Concentrations of CO_2 in the atmosphere are now increasing at a rate of 1.5 ppmv y^{-1} due to human activities such as burning of fossil fuels, deforestation, cement production, etc. It is an urgent task to estimate as accurately as possible the absorption capacity of the oceans against the increased atmospheric CO_2, and to clarify the mechanism of the CO_2 absorption, because the magnitude of the predicted global warming depends on the levels of CO_2 in the atmosphere, and because the ocean currently absorbs 1/3 of the 6 Gt of carbon emitted into the atmosphere each year by human activities.

In the cruises (MR07-04 and MR07-06, revisit of WOCE P1 and P14 lines) using the R/V Mirai, we were aimed at quantifying how much anthropogenic CO_2 is absorbed in the Pacific Ocean. For the purpose, we measured CO_2-system properties such as dissolved inorganic carbon (C_T), total alkalinity (A_T), pH and underway pCO_2.

In this section, we describe data on C_T obtained in the cruise in detail.

(3) Apparatus

Measurements of C_T were made with two total CO_2 measuring systems (systems-A and -C; Nippon ANS, Inc.), which are slightly different from each other. The systems comprise of a seawater dispensing system, a CO_2 extraction system and a coulometer (Model 5012, UIC Inc.).

The seawater dispensing system has an auto-sampler (6 ports), which takes seawater from a 300 ml borosilicate glass bottle and dispenses the seawater to a pipette of nominal 20 or 26 ml volume by a PC control. The pipette is kept at 20 °C by a water jacket, where water from a water bath set at 20 °C is circulated.

CO_2 dissolved in a seawater sample is extracted in a stripping chamber of a CO_2 extraction system by adding phosphoric acid (10% v/v). The stripping chamber is approx. 25 cm long and has a fine frit at the bottom. The acid is added to the stripping chamber from the bottom of the chamber by pressurizing an acid bottle for a given time to push out a right amount of acid. The pressurizing is made with nitrogen gas (99.9999 %). After the acid is transferred to the stripping chamber, a seawater sample kept in a pipette is introduced to the stripping chamber by the same method as in adding an acid. The seawater reacted with phosphoric acid is stripped of CO_2 by bubbling the nitrogen gas through a fine frit at the bottom of the stripping chamber. The CO_2 stripped in the stripping chamber is carried by the nitrogen gas (140 ml min^{-1} for the systems-A and -C) to the coulometer through a dehydrating module. For the system-A, the module consists of two electric dehumidifiers (kept at 1 - 2 °C) and a chemical desiccant ($Mg(ClO_4)_2$). For the system-C, it consists of three electric dehumidifiers with a chemical desiccant.

(4) Shipboard measurement

(4.1) Sampling

All seawater samples were collected from depth with 12 liter Niskin bottles basically at every other stations. The seawater samples for C_T were taken with a plastic drawing tube (PFA tubing connected to silicone rubber tubing) into a 300 ml borosilicate glass bottle. The glass bottle was filled with seawater smoothly from the bottom following a rinse with a seawater of 2 full, bottle volumes. The glass bottle was closed by a stopper, which was fitted to the bottle mouth gravimetrically without additional force.

At a chemical laboratory on the ship, a headspace of approx. 1 % of the bottle volume was made by removing seawater with a plastic pipette. A saturated mercuric chloride of 100 μl was added to poison seawater samples. The glass bottles were sealed with a greased (Apiezon M, M&I Materials Ltd) ground glass stopper and the clips were secured. The seawater samples were kept at 4 °C in a refrigerator until analysis. A few hours just before analysis, the seawater samples were kept at 20 °C in a water bath.

(4.2) Analysis

At the start of each leg, we calibrated the measuring systems by blank and 5 kinds of Na_2CO_3 solutions (nominally 500, 1000 1500, 2000, 2500 μmol/L). As it was empirically known that coulometers do not show a stable signal (low repeatability) with fresh (low absorption of carbon) coulometer solutions. Therefore we measured 2% CO_2 gas repeatedly until the measurements became stable. Then we started the calibration.

The measurement sequence such as system blank (phosphoric acid blank), 2 % CO_2 gas in a nitrogen base, and seawater samples (6) was programmed to repeat. The measurement of 2 % CO_2 gas was made to monitor response of coulometer solutions (from UIC, Inc.). For every renewal of coulometer solutions, certified reference materials (CRMs, batch 80 and a small number of batch 75) provided by Prof. A. G. Dickson of Scripps Institution of Oceanography were analyzed. In addition, in-house reference materials (RM) (batch: QRM Q15, Q16 and Q17) were measured at the initial, intermediate and end times of a coulometer solution's lifetime.

The preliminary values were reported in a data sheet on the ship. Repeatability and vertical profiles of C_T based on raw data for each station helped us check performances of the measuring systems.

In the cruise, we finished all the analyses for C_T on board the ship. As we used two systems, we had not encountered such a situation as we had to abandon the measurement due to time limitation.

(5) Quality control

We conducted quality control of the data after return to a laboratory on land. With calibration factors, which had been determined on board a ship based on blank and 5 kinds of Na_2CO_3 solutions, we calculated C_T of CRM (batches 80 and 75), and plotted the values as a function of sequential day, separating legs and the systems used. There were no statistically-significant trends of CRM measurements.

Based on the averages of C_T of CRM, we re-calculated the calibration factors so that measurements of seawater samples become traceable to the certified value of batch 80. We did not use the measured results of batch 75 because of a small number of measurements.

Temporal variations of RM measurements for one coulomer solution are shown in Fig. 3.5.1. From this figure, it is evident that RM measurements had a linear trend of ~3 to ~7 μmol kg^{-1}, implying that measurements of seawater samples also have the trend. The trend was also found in temporal changes of 2 % CO_2 gas measurements. The trend seems to be due to "cell age" change (Johnson *et al.*, 1998) of a coulometer solution.

Considering the trends, we adjusted measurements of seawater samples so as to be traceable to the certified value (2006.50 μmol kg^{-1}) of batch 80.

Finally we surveyed vertical profiles of C_T. In particular, we examined whether systematic differences between measurements of the systems-A and -C existed or not. Then taking other information of analyses into account, we determined a flag of each value of C_T.

The average and standard deviation of absolute values of differences of C_T analyzed consecutively were 1.1 and 1.0 μmol kg^{-1} (n=162), 1.2 and 1.1 μmol kg^{-1} (n = 440) for MR07-04 and MR07-06, respectively.

To evaluate accuracy of measured C_T, we compared vertical profiles of C_T measured in MR07-04 and MR07-06 with those measured at a station of other WOCE lines crossing the P1 and P14 lines. Results are shown in Fig. 3.5.2. From these figures, it is found that C_T measured in the cruises is sufficiently accurate. Together with other comparisons, we estimated the accuracy to be ~ ± 2.0 μmol kg^{-1}.

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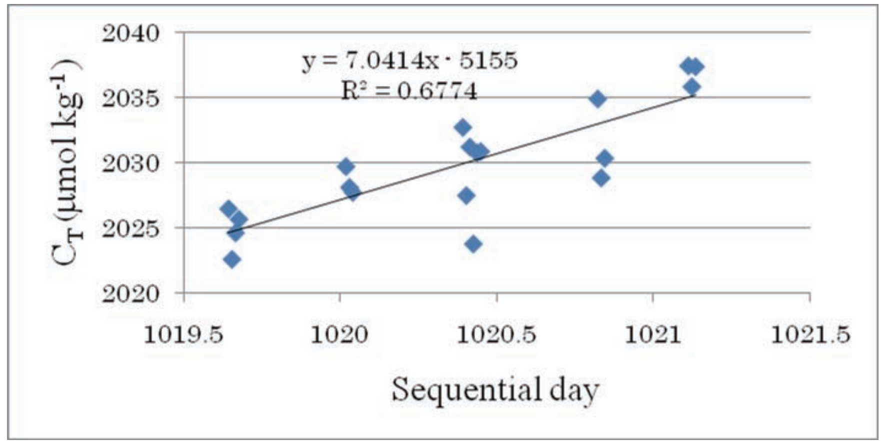
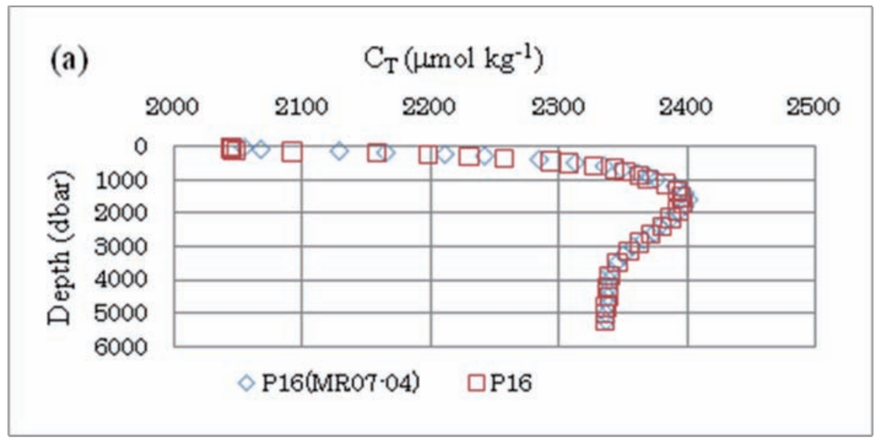
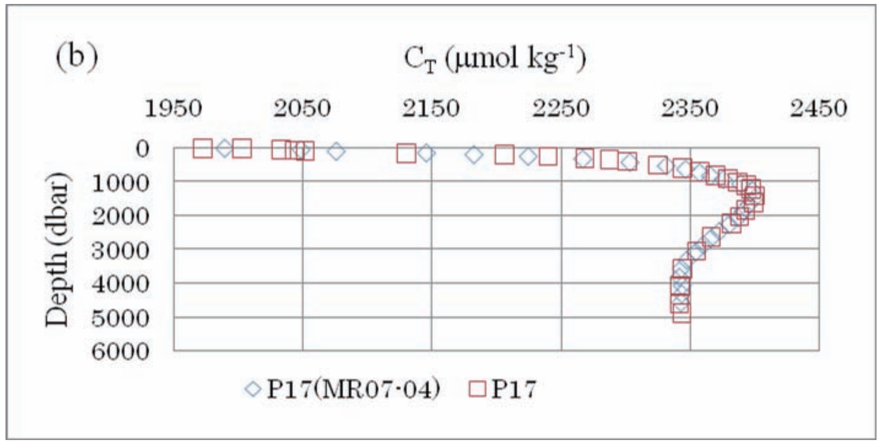


Fig. 3.5.1. Distributions of RM measurements as a function of seaquential day for Stns. 044 and 046 during MR07-06.





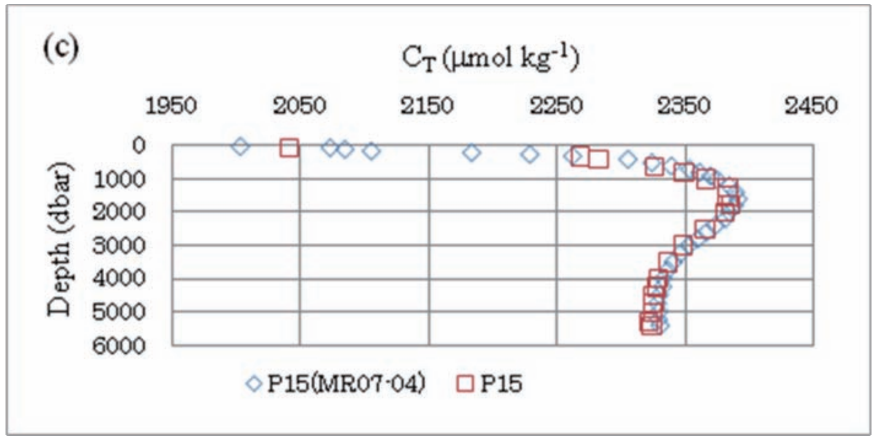


Fig. 3.5.2. Comparison of vertical profiles of C_T measured in MR07-04 with those measured previously at the cross points with (a) P16, (b) P17 and (c) P15 lines of WOCE.

3.6. Total alkalinity (A_T)

9 November 2008

(1) Personnel

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(2) Objectives

Concentrations of CO_2 in the atmosphere are now increasing at a rate of 1.5 ppmv y^{-1} due to human activities such as burning of fossil fuels, deforestation, cement production, etc. It is an urgent task to estimate as accurately as possible the absorption capacity of the oceans against the increased atmospheric CO_2, and to clarify the mechanism of the CO_2 absorption, because the magnitude of the predicted global warming depends on the levels of CO_2 in the atmosphere, and because the ocean currently absorbs 1/3 of the 6 Gt of carbon emitted into the atmosphere each year by human activities.

In the cruises (MR07-04 and MR07-06, revisit of WOCE P1 and P14 lines) using the R/V Mirai, we were aimed at quantifying how much anthropogenic CO_2 is absorbed in the Pacific Ocean. For the purpose, we measured CO_2-system properties such as dissolved inorganic carbon (C_T), total alkalinity (A_T), pH and underway pCO_2.

In this section, we describe data on A_T obtained in the cruise in detail.

(3) Apparatus

Measurement of A_T was made based on spectrophotometry using a custom-made system (Nippon ANS, Inc.). The system comprises of a water dispensing unit, an auto-burette (765 Dosimat, Metrohm), and a spectrophotometer (Carry 50 Bio, Varian), which are automatically controlled by a PC. The water dispensing unit has a water-jacketed pipette and a water-jacketed titration cell. The spectrophotometer has a water-jacketed quartz cell, length and volume of which are 8 cm and 13 ml, respectively. To circulate sample seawater between the titration and the qaurtz cells, PFA tubes are connected to the cells.

A seawater of approx. 40 ml is transferred from a sample bottle (brosilicate glass bottle; 130 ml) into the water-jacketed (25 ºC) pipette by pressurizing the sample bottle (nitrogen gas), and is introduced into the water-jacketed (25 ºC) titration cell. The seawater is circulated between the titration and the quartz cells by a peristaric pump to rinse the route. Then, Milli-Q water is introduced into the titration cell, and is circulated in the same route twice to rinse the route. Next, a seawater of approx. 40 ml is weighted again by the pipette, and is transferred into the titration cell. The weighted seawater is introduced into the quartz cell. Then, for seawater blank, absorbances are measured at three wavelengts (750, 616 and 444 nm). After the measurement, an acid titrant, which is a mixture of approx. 0.05 M HCl in 0.65 M NaCl and bromocresol green (BCG) is added (approx. 2.1 ml) into the titration cell. The seawater + acid titrant solution is circulated for 6 minutes between the titration and the quartz cells, with stirring by a stirring tip and bubbling by wet nitrogen gas in the titration cell. Then, absorbances at the three wavelengths are measured again.

Calculation of A_T was made by the following equation:

$$A_T = (-[H^+]_T V_{SA} + M_A V_A) / V_S,$$

where M_A is the molarity of the acid titrant added to the seawater sample, $[H^+]_T$ is the total excess hydrogen ion concentration in the seawater, and V_S, V_A and V_{SA} are the initial seawater volume, the added acid titrant volume, and the combined seawater plus acid titrant volume, respectively. $[H^+]_T$ is calculated from the measured absorbances based on the following equation (Yao and Byrne, 1998):

$$pH_T = -\log[H^+]_T = 4.2699 + 0.002578(35 - S) + \log((R - 0.00131)/(2.3148 - 0.1299R)) - \log(1 - 0.001005S),$$

where S is the sample salinity, and R is the absorbance ratio calculated as:

$$R = (A_{616} - A_{750})/(A_{444} - A_{750}),$$

where A_i is the absorbance at wavelength *i* nm.

The HCl in the acid titrant was standardized (0.049977 M) on land. The concentrations of BCG were estimated to be approx. 0.04×10^{-3} M, and 2.0×10^{-6} M in the acid titrant and in the sample seawater, respectively.

(4) Shipboard measurement

(4.1) Sampling

All seawater samples were collected from depth using 12 liter Niskin bottles basically at every other stations. The seawater samples for A_T were taken with a plastic drawing tube (PFA tubing connected to silicone rubber tubing) into borosilicate glass bottles of 130 ml. The glass bottle was filled with seawater smoothly from the bottom after rinsing it with a seawater of half a or a full bottle volume. A few hours before analysis, the seawater samples were kept at 25 °C in a water bath.

(4.2) Analysis

We analyzed reference materials (RM; Batch: QRM 15, 16 and 17), which were produced for C_T measurement by JAMSTEC, but were efficient also for the monitor of A_T measurement. In addition, certified reference materials (CRM, batches 80 and 75, certified value = 2214.49 and 2210.09 µmol kg^{-1}, respectively) were also analyzed periodically to monitor systematic differences of measured A_T. The reported values of A_T were set to be traceable to the certified value (2214.49µmol kg^{-1}) of the batch 80.

The preliminary values were reported in a data sheet on the ship. Repeatability calculated from replicate samples and vertical profiles of A_T based on raw data for each station helped us check performance of the measuring system.

In the cruise, we finished all the analyses for A_T on board the ship. We did not encounter so serious problems as we had to give up the analyses.

(5) Quality control

Temporal changes of A_T were monitored by measuring A_T of CRM. We found no abnormal measurements during the cruises.

After making the measured values of A_T comparable to CRM, we examined vertical profiles of A_T. Then taking other information of analyses into account, we determined a flag of each value of A_T.

The average and standard deviation of absolute values of differences of A_T analyzed consecutively were 0.4 and 0.4 µmol kg^{-1} (n = 152), and 0.5 and 0.5 µmol kg^{-1} (n = 407) for MR07-04 and MR07-06, respectively.

To evaluate accuracy of measured A_T, we compared vertical profiles of A_T measured in MR07-04 and MR07-06 with those measured at a station of other WOCE lines crossing the P1 and P14 lines. Results are shown in Fig. 3.6.1. From these figures, it is found that A_T measured in the cruises are more accurate than those obtained in other WOCE lines, which were measured based on potentionmetry. Together with other comparison, we estimated that the reported values were systematically 2.0 - 3.0 µmol kg^{-1} higher than the previously reported values.

Reference

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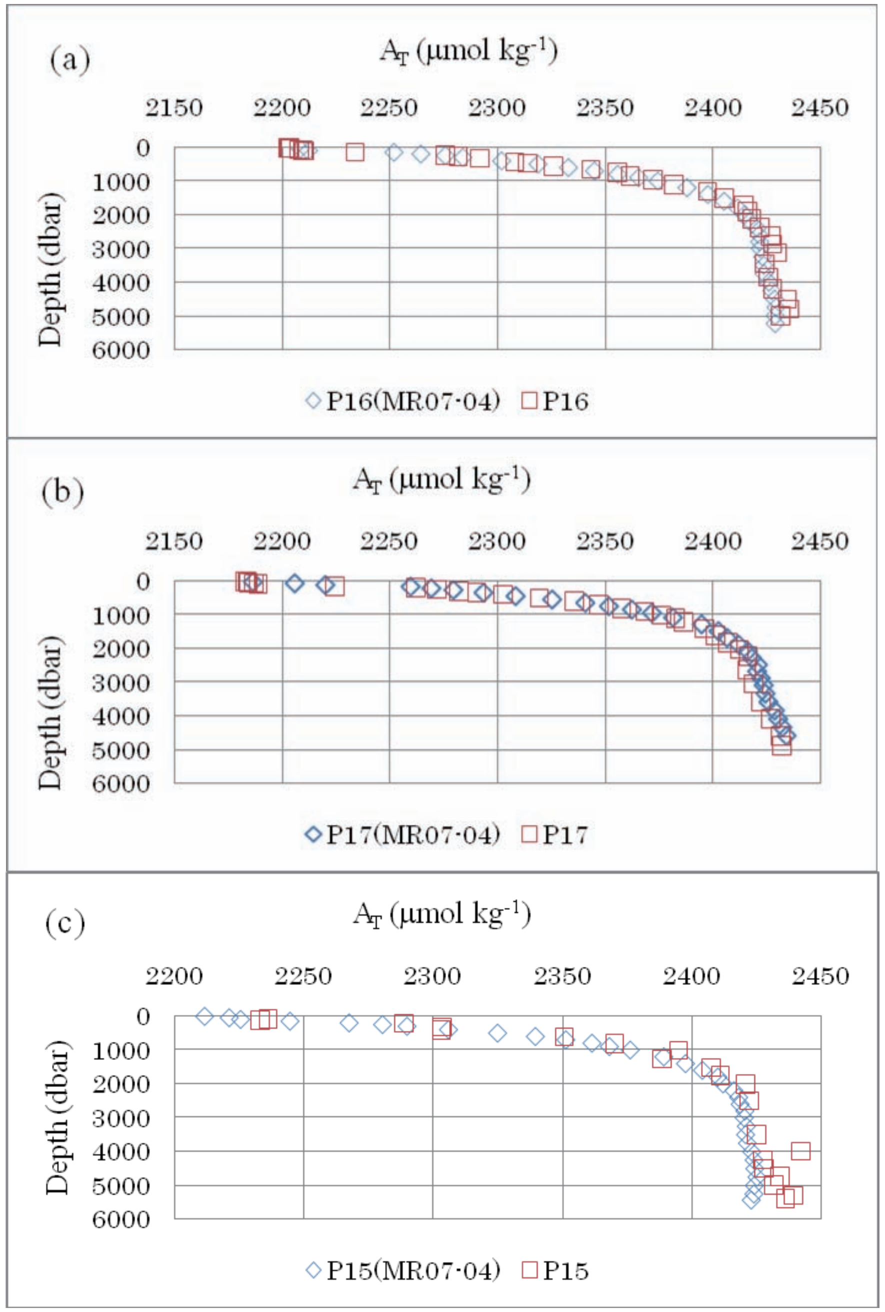

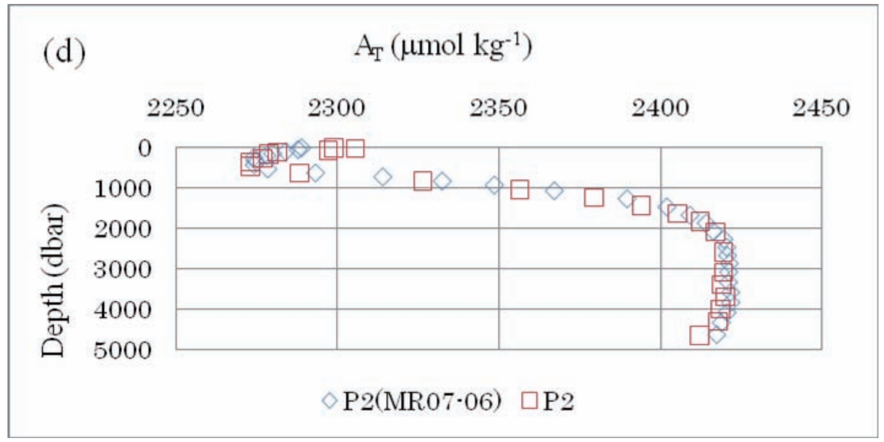

Fig. 3.6.1. Comparison of vertical profiles of A_T measured in MR07-04 and MR07-06 with those measured previously at the cross points with (a) P16, (b) P17 (c) P15, and (d) P2 lines of WOCE.

3.7. pH

9 November 2008

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(2) Objectives

Concentrations of CO_2 in the atmosphere are now increasing at a rate of 1.5 ppmv y^{-1} due to human activities such as burning of fossil fuels, deforestation, cement production, etc. It is an urgent task to estimate as accurately as possible the absorption capacity of the oceans against the increased atmospheric CO_2, and to clarify the mechanism of the CO_2 absorption, because the magnitude of the anticipated global warming depends on the levels of CO_2 in the atmosphere, and because the ocean currently absorbs 1/3 of the 6 Gt of carbon emitted into the atmosphere each year by human activities.

In the cruises (MR07-04 and MR07-06, revisit of WOCE P1 and P14 lines) using the R/V Mirai, we were aimed at quantifying how much anthropogenic CO_2 is absorbed in the Pacific Ocean. For the purpose, we measured CO_2-system properties such as dissolved inorganic carbon (C_T), total alkalinity (A_T), pH and underway pCO_2.

In this section, we describe data on pH obtained in the cruise in detail.

(3) Apparatus

Measurement of pH was made by a pH measuring system (Nippon ANS, Inc.), which adopts spectrophotometry. The system comprises of a water dispensing unit and a spectrophotometer (Carry 50 Scan, Varian).

Seawater is transferred from borosilicate glass bottle (300 ml) to a sample cell in the spectrophotometer. The length and volume of the cell are 8 cm and 13 ml, respectively, and the sample cell was kept at 25.00 ± 0.05 °C in a thermostated compartment. First, absorbances of seawater only are measured at three wavelengths (730, 578 and 434 nm). Then an indicator is injected and circulated for about 4 minutes. to mix the indicator and seawater sufficiently. After the pump is stopped, the absorbances of seawater + indicator are measured at the same wavelengths.

The pH is calculated based on the following equation (Clayton and Byrne, 1993):

$$pH = pK_2 + \log\left(\frac{A_1 / A_2 - 0.00691}{2.2220 - 0.1331(A_1 / A_2)}\right) \quad (1),$$

where A_1 and A_2 indicate absorbances at 578 and 434 nm, respectively, and pK_2 is calculated as a function of water temperature and salinity.

(4) Shipboard measurement

(4.1) Sampling

All seawater samples were collected from depth with 12 liter Niskin bottles basically at every other stations. The seawater samples for pH were taken with a plastic drawing tube (PFA tubing connected to silicone rubber tubing) into a 300 ml borosilicate glass bottle, which was the same as used for C_T sampling. The glass bottle was filled with seawater smoothly from the bottom following a rinse with a sea water of 2 full, bottle volumes. The glass bottle was closed by a stopper, which was fitted to the bottle mouth gravimetrically without additional force.

A few hours just before analysis, the seawater samples were kept at 25 °C in a water bath.

(4.2) Analysis

For an indicator solution, *m*-cresol purple (2 mM) was used. The indicator solution was produced on board a ship, and retained in a 1000 ml DURAN® laboratory bottle. We renewed an indicator solution 3 times when the headspace of the bottle became large, and monitored pH or absorbance ratio of the indicator solution by another spectrophotometer (Carry 50 Scan, Varian) using a cell with a short path length of 0.5 mm. In most indicator solutions, the absorbance ratios of the indicator solution were initially in the range 1.4 – 1.6, and decreased to 1.1.

It is difficult to mix seawater with an indicator solution sufficiently under no headspace condition. However, by circulating the mixed solution with a peristaltic pump, a well-mixed condition came to be attained rather shortly, leading to a rapid stabilization of absorbance. We renewed a TYGON® tube of a peristaltic pump periodically, when a tube deteriorated.

Absorbances of seawater only and seawater + indicator solutions were measured 15 times each, and averages computed from the last five values of absorbance were used for the calculation of pH (Eq. 1).

The preliminary values of pH were reported in a data sheet on the ship. Repeatability calculated from replicate samples and vertical profiles of pH based on raw data for each station helped us check performance of the measuring system.

We finished all the analyses for pH on board the ship. We did not encounter so serious a problem as we had to give up the analyses. However, we sometimes experienced malfunctions of the system during the cruise:

Differences between absorbances of seawater only and those of seawater + indicator solution were infrequently greater than ± 0.001. This implies dirt of the cell. In this case, we cleaned or replaced the cell.

(5) Quality control

It is recommended that correction for pH change resulting from addition of indicator solutions is made (DOE, 1994). To check the perturbation of pH due to the addition, we measured absorbance ratios by doubling the volume of indicator solutions added to a same seawater sample. We corrected absorbance ratios based on an empirical method (DOE, 1994), although the perturbations were small. Figure 3.7.1 illustrates an example of perturbation of absorbance ratios by adding indicator solutions.

We surveyed vertical profiles of pH. In particular, we examined whether systematic differences between before and after the renewal of indicator solutions existed or not. Then taking other information of analyses into account, we determined a flag of each value of pH.

The average and standard deviation of absolute values of differences of pH analyzed consecutively were 0.0008 and 0.0007 pH unit (n = 199), and 0.0005 and 0.0006 pH unit (n = 565) for MR07-04 and MR07-06, respectively.

References

Clayton T.D. & R.H. Byrne (1993) Spectrophotometric seawater pH measurements: total hydrogen ion concentration scale calibration of m-cresol purple and at-sea results. Deep-Sea Research 40, 2115-2129.

DOE (1994) Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water, version 2, A. G. Dickson & C. Goyet, eds. (unpublished manuscript).

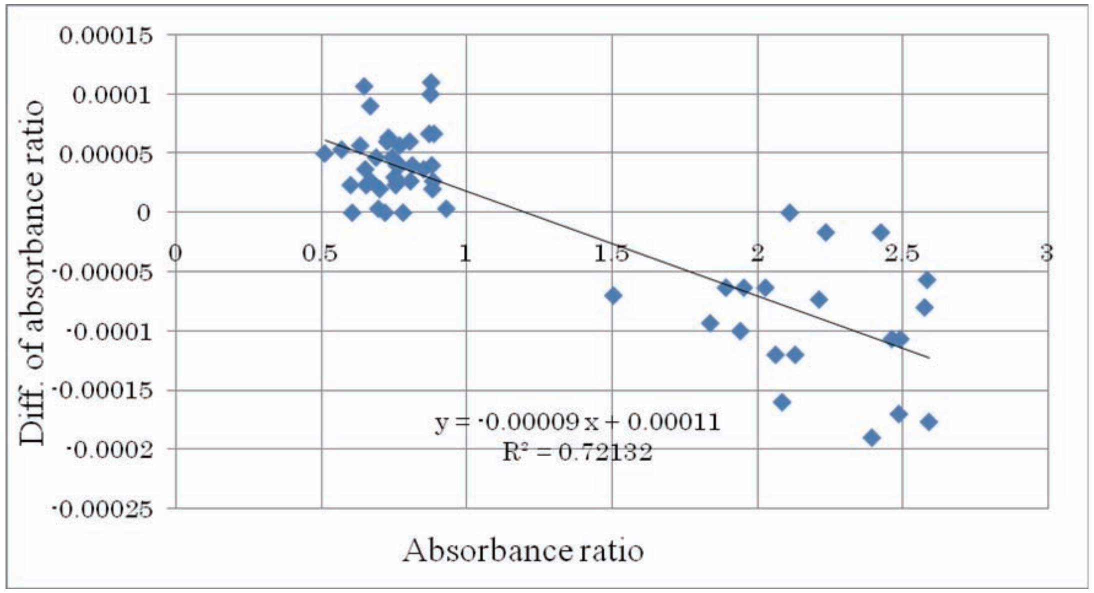

Figure 3.7.1. Perturbation of absorbance ratios by adding indicator solutions. The line (y = -0.00009x + 0.00011, R^2 = 0.72132) was determined by the method of least squares.

3.8 Chlorofluorocarbons (CFCs)

3 November 2008

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(2) Introduction

Chlorofluorocarbons (CFCs) are completely man-made compounds that are chemically and biologically stable gasses in the environment. The CFCs have accumulated in the atmosphere since 1930's (Walker et al., 2000) and the atmospheric CFCs can slightly dissolve in sea surface water. The dissolved CFCs concentrations in sea surface water should have changed year by year and then penetrate into the ocean interior by water circulation. Three chemical species of CFCs, namely CFC-11 (CCl_3F), CFC-12 (CCl_2F_2) and CFC-113 ($C_2Cl_3F_3$), dissolved in seawater are useful transient tracers for the ocean circulation with times scale on the order of decades. In these cruises, we determined concentrations of CFCs dissolved in seawater on board.

Carbon tetrachloride (CCl_4), CFC like compound, have been used as an additional chemical tracer which have longer history than CFCs. This compound was also been analyzed for several stations as qualitative indicator.

(3) Apparatus

Dissolved CFCs and CCl_4 were measured by a typical method modified from the original design of Bullister and Weiss (1988). A custom made purging and trapping system was attached to gas chromatograph (GC-14B: Shimadzu Ltd) having an electron capture detector (ECD-14: Shimadzu Ltd). Cold trap columns were stainless steel tube packed with 80/100 mesh Porapak T in MR07-04 cruise and with 80/100 mesh Porapak N in MR07-06 cruise. A pre-column and a main column on CFCs system were Silica Plot capillary column [i.d.: 0.53mm, length: 8m, film thickness: 6µm] and a complex capillary column (Pola Bond-Q [i.d.: 0.53mm, length: 7m, film thickness: 10µm] followed by Silica Plot [i. d.: 0.53mm, length: 22m, film thickness: 6µm]), respectively. On the CCl_4 system, these were DB-624 capillary column [i.d.: 0.53 mm, length: 30 m, film thickness: 3µm] and longer DB-624 capillary column [length: 100 m], respectively.

(4) Shipboard measurement

(4.1)Sampling

Before casting CTD, the water sampling system was cleaned by diluted acetone to remove any oils which could cause contaminations of CFCs. Seawater sub-samples were collected from 12 litter Niskin bottles into glass bottles. The bottle volumes were 300ml and 150ml for CFCs and CCl_4 analyses, respectively. The bottles had been filled with pure nitrogen gas before the sampling. The two times bottle volumes of seawater sample were overflowed. The bottles filled with seawater were kept in water bathes roughly controlled on the sample temperature. The concentrations were determined as soon as possible (normally within 12 hrs).

(4.2)Analysis

Constant volume of sample water (50ml for CFCs and 30 ml for CCl_4) was taken into the purging & trapping system. Dissolved CFCs and CCl_4 were extracted by nitrogen gas purge. The sample gas were dried by magnesium perchlorate desiccant and concentrated on a trap column cooled to -45 °C. The compounds were desorbed by electrically heating the trap column to 140 °C for CFCs and to 130 °C for CCl_4 within 1.5 minutes, and led into the pre-column. The gasses were roughly separated on the pre-column. When required compounds were eluted, the pre-column was switched onto cleaning line and flushed back by counter flow of pure nitrogen gas. The back flush system prevented to enter any compounds that had higher retention time than CFCs and CCl_4 into main analytical column and permitted short time analysis. The compounds which were sent onto main column were separated further and detected by an electron capture detector (ECD). On the CFCs analytical system, retention time of compounds was around 1.5, 4.4 and 11 minutes for CFC-12, -11 and -113, respectively. On the CCl_4 system, that was 6 min, 8min, 10 min and 15 min for CFC-12, -11, -113, and CCl_4. Temperatures of an analytical column and a detector were 95 and 240 °C for CFC analysis, respectively. These were 50 and 200 °C for CCl_4 analysis, respectively. Pure nitrogen gas (99.99995) was purified by a molecular sieve 13X gas filter and was used for analyses. On the CFCs system, mass flow rates of nitrogen gas were 17, 20, 20 and 200 ml/min for carrier, detector make up, back flush and sample purging gasses, respectively. On the CCl_4 system, these were 13, 27, 20 and 130 ml/min, respectively.

Gas loops whose volumes were around 1, 3 and 10 ml were used for introducing standard gases into the analytical system. The standard gasses had been made by Japan Fine Products co. ltd. Standard gas cylinder numbers used in cruises were listed in Table 3-8-1. Cylinder of CPB30524 was for reference. Precise mixing ratios of the standard gasses were calculated by gravimetric data. The standard gases used in this cruise have not been calibrated to SIO scale standard gases yet because SIO scale standard gasses is hard to obtain due to legal difficulties for CFCs import into Japan. The data will be corrected as soon as possible when we obtain the standard gasses.

Table 3-8-1. Standard gas cylinder list.

Cylinder No.	Concentration determined gravimetric data (pptv).			
	CFC-11	CFC-12	CFC-113	CCl_4
CPB02957	300	159	30.0	249
CPB03033	302	162	30.8	0
CPB03322	301	161	30.6	399
CPB09898	301	161	30.6	400
CPB28489	300	160	30.0	250
CPB30524	300	159	30.2	403

(5) Quality control

(5.1) Main problems on the shipboard analysis

CFC-12

CFC-12 data observed from Station P01-010 and P01-011 (MR07-04) may contain large err. At the analyses, there was trouble of air conditioner of analytical room and room temperature remarkably rose up to 37 °C. Capacity of cooling system of cold trap felled off and a part of CFC-12 was not quantitatively absorbed on the trap. Although the concentrations were corrected by the trapping efficiency estimated from standard gas analyses, we give this data flag “3”.

CFC-113

A large and broad peak was interfered determining CFC-113 peak area for samples collected from surface several hundred meters depth in the latitude band of subtropical and tropical region (MR07-06). Retention time of the interfering peak was around 3 % shorter than that of CFC-113. The peak of a compound interfering CFC-113 determination could not be completely separated from the peak of CFC-113 by our analytical condition. We tried to split these peaks on chromatogram analysis and give flag “4”. In the case of the interfering peak completely covering the CFC-113 peak, we could not determine CFC-113 peak area and give flag “5”.

CCl_4

Several problems were found in CCl_4 analysis as follows, and all CCl_4 data were given flag “4”. One of the problems was in standardization. Mixing ratio of the atmospheric CCl_4 observed in these cruises was notably higher than the annual mean value reported by Dr. J. L. Bullister in web site of Carbon Dioxide Information Analysis Center (CDIAC, http://cdiac.ornl.gov/oceans/new_atmCFC.html). Concentration of CCl_4 in surface water was also higher than predicted value from the solubility (Bullister and Wisegarver, 1998). Concentration of CCl_4 was corrected by using the reported atmospheric CCl_4 mixing ratio and concentration of CCl_4 was corrected but accuracy was doubtful. Additional problem was high blank. The gas line blank was negligible but water line blank was high and varied from 0.04 to 0.07 pmol/kg. These blank values were too high to determine precise concentration of CCl_4 though the blank value was frequently obtained and corrected.

(5.2) Blank of CFC-11 and CFC-12

Some blank water samples which were made by nitrogen purge of seawater in CFCs sample bottle were analyzed and any CFCs were not detected. Significant increase in CFCs concentration during keeping sampling bottle in a water bath was not found for around one week. CFCs concentrations in deep water which was one of oldest water masses in the ocean were low but not zero for CFC-11 and -12. Average concentrations of CFC-11, 12 in the deep water denser than 27.7 σ_θ and warmer than 1°C of potential temperature were 0.012 ± 0.005, 0.006 ± 0.003 pmol kg^{-1}(n > 1500), respectively. These values were assumed as sampling blanks which was contaminations from Niskin bottle and/or during sub-sampling and were subtracted from all data. Significant blank was not found in CFC-113 measurements.

(5.3) Precisions

The analytical precisions were estimated from replicate sample analyses (Table 3-8-2). The replicate samples were basically collected from two sampling depths which is around 150 m and 700 m depths.

Table. 3-8-2. Analytical precisions of CFC concentrations estimated from replicate analyses.

Cruise	CFCs	Precisions*		n
		(pmol kg^{-1})	(%)	
MR07-04				
	CFC-11	0.009	0.4	154
	CFC-12	0.007	0.6	151
	CFC-113	0.008	7	158
MR07-06 Leg 1				
	CFC-11	0.010	0.6	233
	CFC-12	0.008	0.9	234
	CFC-113	0.008	10	217
MR07-06 Leg 2				
	CFC-11	0.007	0.6	206
	CFC-12	0.009	0.8	206
	CFC-113	0.004	5	112

*Precision whichever is greater

(6) References

Walker, S.J., Weiss, R.F. and Salameh, P.K., Reconstructed histories of the annual mean atmospheric mole fractions for the halocarbons CFC-11, CFC-12, CFC-113 and Carbon Tetrachloride, *Journal of Geophysical Research*, **105**, 14,285-14,296, (2000).

Bullister, J.L and Weiss, R.F. Determination of CCl_3F and CCl_2F_2 in seawater and air. *Deep Sea Research*, **35**, 839-853 (1988).

3.9 Lowered Acoustic Doppler Current Profiler

5 November 2008

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(2) Overview of the equipment

An acoustic Doppler current profiler (ADCP) was integrated with the CTD/RMS package. The lowered ADCP (LADCP), Workhorse Monitor WHM300 (Teledyne RD Instruments, San Diego, California, USA), which has 4 downward facing transducers with 20-degree beam angles, rated to 6000 m. The LADCP makes direct current measurements at the depth of the CTD, thus providing a full profile of velocity. The LADCP was powered during the CTD casts by a 50.4 volts rechargeable Ni-Cd battery pack. The LADCP unit was set for recording internally prior to each cast. After each cast the internally stored observed data was uploaded to the computer on-board. By combining the measured velocity of the sea water and bottom with respect to the instrument, and shipboard navigation data during the CTD cast, the absolute velocity profile can be obtained (e.g. Visbeck, 2002).

The instrument used in this cruise was as follows.

Teledyne RD Instruments, WHM300-I-UG27

S/N 8484 (CPU firmware ver. 16.28)

S/N 2553 (CPU firmware ver. 16.28) (with pressure sensor) *

* Serial number 2553 was used at stations from P14C_41 to P14C_32.

(3) Data collection

In this cruise, data were collected with the following configuration.

Bin size: 8.0 m

Number of bins: 14

Pings per ensemble: 1

Ping interval: 1.0 sec

At the following stations, the CTD cast was carried out without the LADCP, because the maximum pressure was beyond the pressure-proof of the LADCP (6000 m).

Stations from P01_11 to P01_12

Stations from P01_44 to P01_46

Stations from P01_53 to P01_54

Stations from P14N_24 to P14N_23

(4) Data collection problems

Echo intensity of a transducer of serial number 8484 was found to become weak gradually, which is shown in the echo intensity means in each cast at the second (Fig. 3.8.1). The peak after station P14N_140 results from enhanced reflections by the equatorial upwelling and that after P14C-52 from the substitution by anther sensor (serial number 2553). A part of data from the substituted sensor was missed by unknown reason at the following stations.

P14C_40: from 2920 m of down-cast to 2870 m of up-cast

P14C_33: from 2440 m of down-cast to 2680 m of up-cast

P14C_32: from 3540 m of down-cast to 3330 m of up-cast

Therefore the original sensor (serial number 8484) was used again after 10 casts from the substitution.

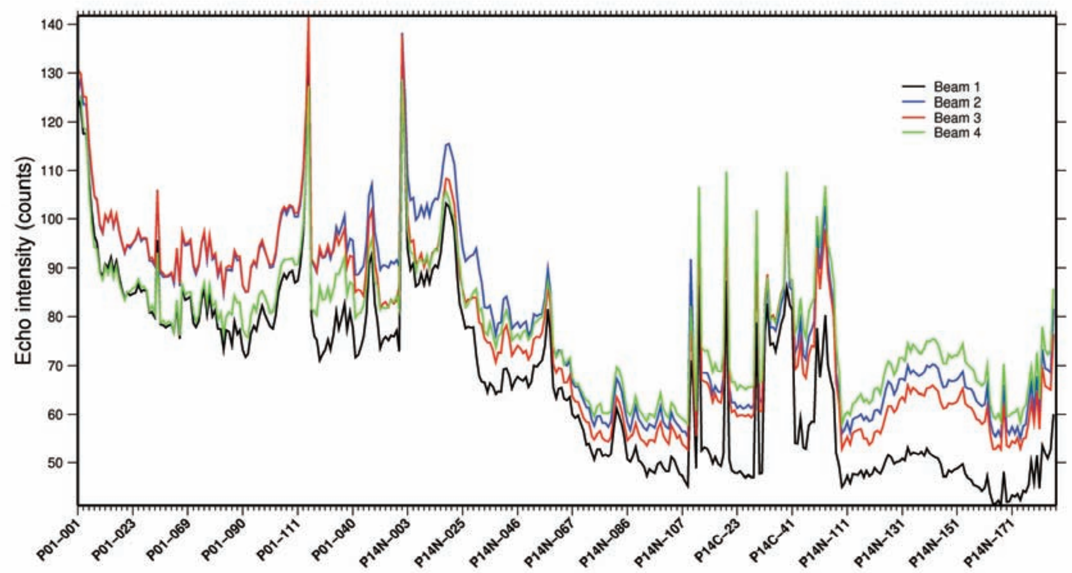

Fig. 3.9.1. Cast-averaged echo intensity at the second bin in each beam of the LADCP for MR07-04 and MR07-06 cruises.

(4) Data process

Vertical profiles of velocity are obtained by the inversion method (Visbeck, 2002). Since the first bin from LADCP is influenced by the turbulence generated by CTD frame, the weight for the inversion is set to small value of 0.1. GPS navigation data are used in the calculation of the reference velocities and the bottom-track data are used for the correction of reference velocities. Shipboard ADCP (SADCP) data averaged for 1 minute are also included in the calculation. The CTD data are used for the sound speed and depth calculation. IGRF (International Geomagnetic Reference Field) 10^{th} generation data are used for calculating magnetic deviation to correct the direction of velocity. In the processing, we use Matlab routines provided from M. Visbeck and G. Krahmann (http://ladcp.ldeo.columbia.edu/ladcp).

Reference

Visbeck, M. (2002): Deep velocity profiling using Lowered Acoustic Doppler Current Profilers: Bottom track and inverse solutions. *J. Atmos. Oceanic Technol.*, 19, 794-807.

3.10 $\delta^{13}C$ and $\Delta^{14}C$ of Dissolved Inorganic Carbon

14 June 2013

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(2) Introduction

Stable and radioactive carbon isotopic ratios ($\delta^{13}C$ and $\Delta^{14}C$) of dissolved inorganic carbon (DIC) are good tracers for the anthropogenic carbon in the ocean. During our MR07-04 and MR07-06 cruises in 2007, named revisit cruises of WHP-P01 (47°N approx.) and WHP-P14NC (179°E approx.) lines, respectively, we collected seawater samples for $\delta^{13}C$ and $\Delta^{14}C$ analyses at stations along the lines in the Pacific. Here we report the final results of $\delta^{13}C$ and $\Delta^{14}C$ of DIC. Our preliminary report of $\delta^{13}C$ and $\Delta^{14}C$ measurements is replaced by this final report. General information and other hydrographic data of the cruises have already published in our data book for WHP-P01 and -P14NC Revisit Cruises (Kawano et al., 2009)

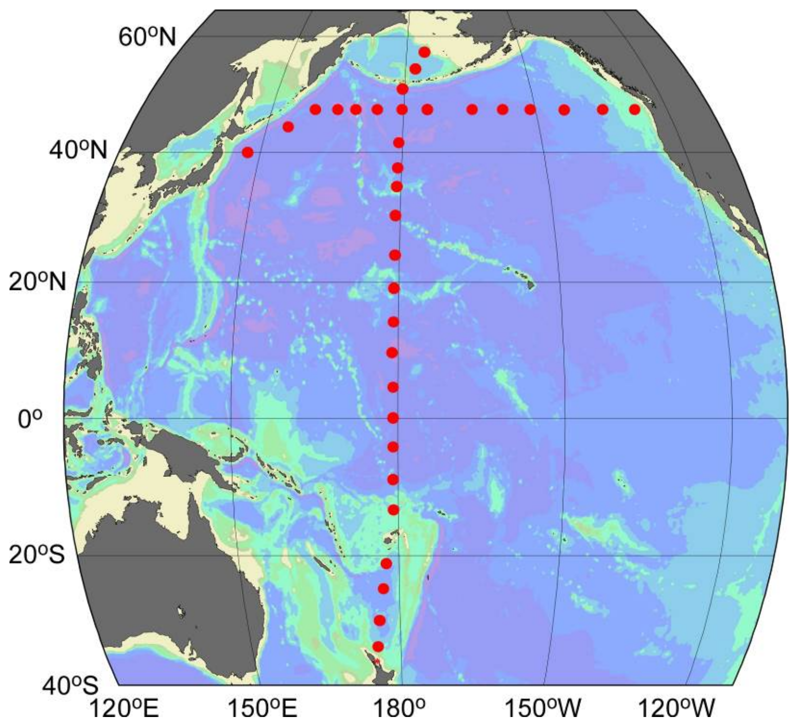

Figure 3.10.1 Sampling stations for $\delta^{13}C$ and $\Delta^{14}C$ of dissolved inorganic carbon during MR07-04 and MR07-06 cruises (July 2007 — December 2007) except stations P01_010, P01_027, P01-060, P01_072, and P01_097.

(3) Sample collection

The sampling stations are summarized in Figure 3.10.1 and Table 3.10.1. A total of 1319 seawater samples, including 74 replicate samples, were collected between surface (about 10 m depth) and near bottom at 39 stations using 12-liter X-Niskin bottles. The seawater in the X-Niskin bottle was siphoned into a 250 cm^3 glass bottle with enough seawater to fill the glass bottle two times. Immediately after sampling, 10 cm^3 of seawater was removed from the bottle and poisoned by 50 μl of saturated $HgCl_2$ solution. Then the bottle was sealed by a glass stopper with Apiezon M grease and stored in a cool and dark space on board. These procedures on board basically follow the methods described in WOCE Operation Manual (McNichol and Jones, 1991).

Table 3.10.1 The sampling stations, number of samples, and maximum sampling pressure for carbon isotopes in DIC during MR07-04 and MR07-06 cruises.

Cruise	Station	No. samples	No. replicate samples	Max. sampling pressure /db
MR07-04	P01-010	36	2	6501
MR07-04	P01-019	34	2	5314
MR07-04	P01-027	34	2	5242
MR07-04	P01-066	36	2	5853
MR07-04	P01-072	34	2	5499
MR07-04	P01-X15	34	2	5430
MR07-04	P01-081	34	2	5324
MR07-04	P01-X16	33	2	5227
MR07-04	P01-X17	31	2	4742
MR07-04	P01-097	30	2	4399
MR07-04	P01-101	29	2	4202
MR07-04	P01-108	23	1	2752
MR07-06	P01-032	34	2	5451
MR07-06	P01-038	33	2	5279
MR07-06	P01-X13	36	2	6008
MR07-06	P01-048	29	2	4255
MR07-06	P01-056	36	2	5904
MR07-06	P01-060	36	2	5737
MR07-06	P14N-005	26	2	3529
MR07-06	P14N-011	28	2	3852
MR07-06	P14N-023	36	2	6500
MR07-06	P14N-X01	35	2	5718

Table 3.10.1 continued.

Cruise	Station	No. samples	No. replicate samples	Max. sampling pressure /db
MR07-06	P14N-042	32	2	4970
MR07-06	P14N-050	34	2	5487
MR07-06	P14N-056	25	1	3194
MR07-06	P14N-X02	30	2	4625
MR07-06	P14N-077	34	2	5838
MR07-06	P14N-087	32	2	4890
MR07-06	P14N-097	36	2	5780
MR07-06	P14N-X04	35	2	5706
MR07-06	P14N-125	35	2	5765
MR07-06	P14N-143	34	2	5497
MR07-06	P14N-160	35	2	5724
MR07-06	P14N-171	33	2	5084
MR07-06	P14N-180	25	1	3087
MR07-06	P14C-037	28	2	3838
MR07-06	P14C-028	31	2	4538
MR07-06	P14C-X06	29	2	4310
MR07-06	P14C-007	20	1	2012
	Total	1245	74	

(4) Sample preparation

In our laboratory, DIC in the seawater samples were stripped cryogenically and split into three aliquots: Accelerator Mass Spectrometry (AMS) ^{14}C measurement (about 200 μmol), ^{13}C measurement (about 100 μmol), and archive (about 200 μmol). Efficiency of the CO_2 stripping from seawater sample was more than 95 % that was calculated from concentration of DIC in the seawater samples. The stripped CO_2 gas for ^{14}C was then converted to graphite catalytically on iron powder with pure hydrogen gas. Yield of graphite powder from CO_2 gas was estimated to be about 80 % in average by weighing of sample graphite powder. Details of these preparation procedures were described by Kumamoto et al. (2011).

(5) Sample measurements

$\delta^{13}C$ of the sample CO_2 gas was measured using Finnigan MAT252 mass spectrometer. The $\delta^{13}C$ value was calculated by a following equation:

$$\delta^{13}C\ (‰) = (R_{sample} / R_{standard} - 1) \times 1000. \quad (1)$$

where R_{sample} and $R_{standard}$ denote ^{13}C / ^{12}C ratios of the sample CO_2 gas and the standard CO_2 gas, respectively. The working standard gas was purchased from Oztech Gas Co. and assigned $\delta^{13}C$ value of -3.67 ‰ (Lot No. SHO-1250C) versus VPDB (Vienna Pee Dee Belemnite) standards. The gas has been calibrated relative to the appropriate internationally accepted IAEA primary standards. $\Delta^{14}C$ in the graphite sample was measured at AMS facilities of Institute of Accelerator Analysis Ltd in Shirakawa (Pelletron 9SDH-2, National Electrostatic Corporation), Paleo Labo Co. Ltd in Kiryu (Compact-AMS, National Electrostatic Corporation), Japan Atomic Energy Agency in Mutsu (Model 4130-AMS, High Voltage Engineering Europa), and National Institute for Environmental Studies in Tsukuba (Pelletron 9SDH-2, National Electrostatic Corporation). The $\Delta^{14}C$ value was calculated by:

$$\delta^{14}C\ (‰) = (R_{sample} / R_{standard} - 1) \times 1000, \quad (2)$$

$$\Delta^{14}C\ (‰) = \delta^{14}C - 2\ (\delta^{13}C + 25)\ (1 + \delta^{14}C / 1000), \quad (3)$$

where R_{sample} and $R_{standard}$ denote, respectively, ^{14}C / ^{12}C ratios of the sample and the international standard (NIST Oxalic Acid SRM4990-C). $R_{standard}$ was corrected for decay since A.D. 1950 (Stuiver and Polach, 1977; Stuiver, 1983). Equation 3 is normalization for isotopic fractionation. When quality of $\delta^{13}C$ value was not "good", $\Delta^{14}C$ was calculated by an interpolated $\delta^{13}C$ value derived from data at just above and below layers. Finally $\Delta^{14}C$ value was corrected for radiocarbon decay between the sampling and the measurement dates. Individual errors of $\delta^{13}C$ were given by standard deviation of repeat measurements. Errors of $\Delta^{14}C$ were derived from larger of the standard deviation of repeat measurements and the counting error. Means of the $\delta^{13}C$ and $\Delta^{14}C$ errors were calculated to be 0.004 ‰ (n = 1,073) and 2.5 ‰ (n = 1,070), respectively, which corresponds to "repeatability" of our $\delta^{13}C$ and $\Delta^{14}C$ measurements.

$\delta^{13}C$ and $\Delta^{14}C$ in the seawater samples from stations P01_010, P01_027, P01-060, P01_072, and P01_097 (170 samples) were not measured due to shortage of research funds.

(6) Replicate measurements

Replicate samples were taken at all the stations. $\delta^{13}C$ and $\Delta^{14}C$ values in "good" quality were obtained from 64 pairs of the replicate samples (Table 3.10.2). The standard deviation of the $\delta^{13}C$ and $\Delta^{14}C$ replicate analyses was calculated to be 0.021 ‰ (n = 58) and 3.6 ‰ (n = 60), respectively. These were larger than the values of repeatability (0.004 and 2.5 ‰, respectively) probably due to errors from the sample preparation, which corresponds to "reproducibility" of our $\delta^{13}C$ and $\Delta^{14}C$ analyses.

(7) Reference seawater measurements

During the sample measurements period from October 2008 to March 2010, we also measured $\delta^{13}C$ and $\Delta^{14}C$ in reference seawaters together with those in the samples. The reference seawater (RS) was prepared from a large volume of surface seawater collected in an open ocean. The surface seawater was filtered, exposed to ultraviolet irradiation, poisoned by $HgCl_2$, dispensed in 250 cm^3 glass bottles, and then has been stored since July 2004. $\delta^{13}C$ and $\Delta^{14}C$ in one of the reference seawaters were measured at every suite of samples from a station (every 40 samples approx.). The results are shown in Table 3.10.3. The standard deviations (n = 32) of $\delta^{13}C$ and $\Delta^{14}C$ were 0.022 ‰ and 6.1 ‰, respectively, which corresponds to "uncertainty" of our $\delta^{13}C$ and $\Delta^{14}C$ analyses including error due to the sample preparation and sample storage.

Table 3.10.2 Summary of replicate analyses.

Station	Btl	$\delta^{13}C$ / ‰				$\Delta^{14}C$ / ‰			
		$\delta^{13}C$	Error[a]	E.W.Mean[b]	Uncertainty[c]	$\Delta^{14}C$	Error[d]	E.W.Mean[b]	Uncertainty[c]
P01-019	32	-	-	-	-	-12.3	1.9	-8.7	5.2
		-	-			-5.0	1.9		
P01-019	12	0.005	0.005	0.010	0.006	-231.2	1.5	-232.8	2.4
		0.014	0.004			-234.6	1.6		
P01-066	32	-	-	-	-	-63.4	1.7	-62.8	1.2
		-	-			-62.3	1.7		
P01-066	12	-0.051	0.003	-0.072	0.030	-228.1	2.1	-225.2	3.2
		-0.093	0.003			-223.6	1.6		
P01-X15	32	0.081	0.003	0.045	0.071	-35.0	1.9	-33.0	3.5
		-0.020	0.004			-30.1	2.3		
P01-X15	12	-0.092	0.003	-0.070	0.059	-227.4	1.7	-227.9	1.2
		-0.009	0.005			-228.4	1.6		
P01-081	32	0.145	0.003	0.134	0.016	-11.8	3.0	-10.8	2.1
		0.122	0.003			-9.9	2.9		
P01-081	12	-0.071	0.004	-0.062	0.007	-241.4	2.6	-233.6	10.4
		-0.061	0.001			-226.8	2.4		
P01-X16	32	0.128	0.009	0.128	0.002	-14.8	1.7	-12.4	3.5
		0.128	0.002			-9.9	1.7		
P01-X16	12	-0.093	0.002	-0.095	0.023	-241.4	1.6	-239.0	3.3
		-0.125	0.007			-236.7	1.6		
P01-X17	32	0.015	0.002	-0.013	0.040	-28.7	2.4	-34.6	7.9
		-0.041	0.002			-39.9	2.3		

Table 3.10.2 continued.

Station	Btl	$\delta^{13}C$ / ‰				$\Delta^{14}C$ / ‰			
		$\delta^{13}C$	Error[a]	E.W.Mean[b]	Uncertainty[c]	$\Delta^{14}C$	Error[d]	E.W.Mean[b]	Uncertainty[c]
P01-X17	12	-0.005	0.004	-0.012	0.010	-237.4	2.0	-236.7	1.4
		-0.019	0.004			-236.1	2.0		
P01-101	32	0.018	0.003	0.024	0.006	-	-	-	-
		0.026	0.002			-	-		
P01-101	12	-	-	-	-	-237.2	1.6	-240.7	4.7
		-	-			-243.8	1.5		
P01-108	32	-0.310	0.005	-0.309	0.003	-9.3	1.9	-9.3	1.3
		-0.308	0.003			-9.3	1.9		
P01-032	32	-0.457	0.004	-0.458	0.003	-98.1	2.9	-98.3	2.1
		-0.460	0.005			-98.5	3.1		
P01-032	12	0.054	0.003	0.057	0.004	-222.3	2.6	-222.5	1.8
		0.059	0.003			-222.8	2.6		
P01-038	32	-0.821	0.006	-0.820	0.002	-110.4	2.9	-112.6	3.0
		-0.820	0.002			-114.7	2.9		
P01-038	12	0.057	0.004	0.062	0.012	-220.0	2.7	-225.6	7.7
		0.074	0.006			-231.0	2.6		
P01-X13	32	-0.560	0.006	-0.559	0.003	-100.6	2.3	-98.7	2.7
		-0.559	0.003			-96.8	2.3		
P01-X13	12	0.042	0.003	0.037	0.005	-224.5	3.5	-223.9	2.5
		0.035	0.002			-223.3	3.6		
P01-048	32	-0.556	0.005	-0.565	0.007	-94.7	2.9	-93.6	2.0
		-0.566	0.002			-92.5	2.8		
P01-048	12	-	-	-	-	-222.4	2.6	-221.1	1.8
		-	-			-219.8	2.6		
P01-056	32	-0.816	0.005	-0.750	0.054	-101.7	2.2	-102.8	1.5
		-0.739	0.002			-103.8	2.1		
P01-056	12	-	-	-	-	-224.5	1.8	-226.3	2.8
		-	-			-228.4	2.0		
P14N-005	32	0.011	0.005	0.015	0.004	-63.9	3.2	-67.3	4.5
		0.016	0.002			-70.2	3.0		

Table 3.10.2 continued.

Station	Btl	$\delta^{13}C$ / ‰				$\Delta^{14}C$ / ‰			
		$\delta^{13}C$	Error[a]	E.W.Mean[b]	Uncertainty[c]	$\Delta^{14}C$	Error[d]	E.W.Mean[b]	Uncertainty[c]
P14N-005	12	-0.232	0.005	-0.271	0.029	-230.5	2.7	-229.6	2.0
		-0.273	0.001			-228.6	2.8		
P14N-011	32	-0.213	0.002	-0.224	0.057	-74.0	3.0	-73.0	2.1
		-0.293	0.005			-72.0	2.9		
P14N-011	12	-0.253	0.004	-0.254	0.003	-234.9	2.6	-227.7	10.7
		-0.256	0.005			-219.7	2.8		
P14N-023	32	-0.728	0.003	-0.719	0.009	-106.1	3.2	-107.0	2.1
		-0.715	0.002			-107.8	2.9		
P14N-023	12	0.038	0.004	0.037	0.002	-219.4	2.7	-219.0	1.9
		0.036	0.003			-218.6	2.7		
P14N-X01	32	-0.211	0.004	-0.206	0.011	-69.7	3.2	-68.5	2.2
		-0.195	0.006			-67.5	2.9		
P14N-X01	12	0.004	0.006	0.009	0.004	-224.2	2.7	-224.9	1.9
		0.010	0.002			-225.6	2.8		
P14N-042	32	0.405	0.004	0.401	0.004	34.2	4.3	33.0	3.3
		0.399	0.003			31.4	5.1		
P14N-042	12	-0.027	0.002	-0.033	0.033	-229.4	3.6	-231.2	2.6
		-0.073	0.005			-233.1	3.7		
P14N-050	32	0.392	0.003	0.397	0.007	38.0	3.8	34.9	4.2
		0.402	0.003			32.0	3.6		
P14N-050	12	0.030	0.002	0.025	0.011	-226.4	2.8	-224.1	3.3
		0.015	0.003			-221.7	2.8		
P14N-056	32	0.427	0.004	0.435	0.011	45.6	3.3	46.7	2.3
		0.442	0.004			47.8	3.1		
P14N-X02	32	0.467	0.007	0.462	0.004	59.7	3.4	59.3	2.4
		0.461	0.003			58.9	3.4		
P14N-X02	12	0.033	0.005	0.058	0.029	-231.4	2.7	-230.7	1.9
		0.074	0.004			-230.1	2.6		
P14N-077	29	0.316	0.002	0.320	0.010	46.0	3.3	47.5	2.3
		0.330	0.003			49.0	3.3		

Table 3.10.2 continued.

Station	Btl	$\delta^{13}C$ / ‰				$\Delta^{14}C$ / ‰			
		$\delta^{13}C$	Error[a]	E.W.Mean[b]	Uncertainty[c]	$\Delta^{14}C$	Error[d]	E.W.Mean[b]	Uncertainty[c]
P14N-077	12	0.087	0.002	0.085	0.008	-231.3	2.9	-227.9	4.6
		0.075	0.005			-224.8	2.7		
P14N-087	32	0.570	0.003	0.535	0.050	72.4	4.3	69.8	3.8
		0.499	0.003			67.0	4.5		
P14N-087	12	0.060	0.002	0.064	0.006	-	-	-	-
		0.068	0.002			-	-		
P14N-097	32	0.658	0.003	0.656	0.007	72.3	6.4	76.4	5.7
		0.648	0.006			80.3	6.3		
P14N-097	12	0.070	0.003	0.059	0.011	-230.6	3.9	-229.4	2.8
		0.054	0.002			-228.2	3.9		
P14N-X04	32	-0.085	0.003	-0.085	0.001	-7.9	2.1	-6.9	1.5
		-0.085	0.001			-5.8	2.2		
P14N-X04	12	0.066	0.002	0.068	0.004	-	-	-	-
		0.072	0.003			-	-		
P14N-125	29	0.403	0.004	0.403	0.003	-70.7	2.2	-65.8	6.9
		0.402	0.004			-60.9	2.2		
P14N-125	12	0.080	0.006	0.092	0.011	-223.5	1.5	-225.1	2.9
		0.095	0.003			-227.6	1.8		
P14N-143	32	0.693	0.005	0.696	0.003	73.0	2.0	70.8	2.8
		0.697	0.003			69.1	1.8		
P14N-143	12	0.125	0.003	0.124	0.003	-225.8	2.1	-222.6	3.8
		0.121	0.004			-220.4	1.8		
P14N-160	32	1.040	0.003	1.032	0.016	62.5	2.3	60.9	2.1
		1.017	0.004			59.5	2.1		
P14N-160	12	0.151	0.002	0.154	0.014	-219.1	1.7	-215.7	4.7
		0.171	0.005			-212.4	1.7		
P14N-171	29	0.634	0.003	0.636	0.002	-18.1	2.1	-17.8	1.4
		0.637	0.003			-17.5	2.0		
P14N-171	12	0.164	0.003	0.184	0.028	-225.0	2.4	-222.0	4.2
		0.203	0.003			-219.0	2.4		

Table 3.10.2 continued.

Station	Btl	δ13C / ‰				Δ14C / ‰			
		$\delta^{13}C$	Error[a]	E.W.Mean[b]	Uncertainty[c]	$\Delta^{14}C$	Error[d]	E.W.Mean[b]	Uncertainty[c]
P14N-180	32	0.978	0.003	0.979	0.002	85.7	3.0	88.1	3.6
		0.980	0.004			90.8	3.2		
P14C-037	32	0.928	0.004	0.935	0.010	-	-	-	-
		0.942	0.004			-	-		
P14C-037	12	0.260	0.003	0.253	0.014	-203.7	1.6	-203.8	1.1
		0.240	0.004			-203.8	1.6		
P14C-028	32	-	-	-	-	89.0	1.8	87.6	2.4
		-	-			85.6	2.1		
P14C-028	12	0.252	0.003	0.248	0.006	-205.6	1.7	-204.7	1.3
		0.244	0.003			-203.7	1.7		
P14C-X06	32	0.951	0.002	0.952	0.004	79.2	2.2	79.8	1.6
		0.956	0.006			80.4	2.2		
P14C-X06	12	0.232	0.004	0.224	0.009	-213.3	2.0	-210.4	3.7
		0.219	0.003			-208.0	1.8		
P14C-007	32	1.011	0.002	1.005	0.014	52.9	2.4	53.6	1.6
		0.991	0.003			54.1	2.2		

a. Standard deviation of repeat measurements.
b. Error weighted mean of the replicate pair.
c. Larger of the standard deviation and the error weighted standard deviation of the replicate pair.
d. Larger of the standard deviation of repeat measurements and the counting errors.

Table 3.10.3 Summary of $\delta^{13}C$ and $\Delta^{14}C$ measurements in the reference seawaters (RS).

No.	RS No.	δ13C / ‰			Δ14C a / ‰		
		Measurement date	$\delta^{13}C$	Error[b]	Measurement date	$\Delta^{14}C$	Error[c]
1	RM0407-162	10-Sep-09	-0.908	0.002	09-Oct-09	38.9	2.0
2	RM0407-165	14-Sep-09	-0.902	0.003	16-Oct-09	43.9	2.0
3	RM0407-160	19-Jan-10	-0.903	0.005	23-Oct-09	38.6	1.9
4	RM0407-115	21-Jan-10	-0.908	0.003	13-Nov-09	39.1	1.9
5	RM0407-33	01-Feb-10	-0.887	0.005	27-Nov-09	26.6	2.3
6	RM0407-136	03-Feb-10	-0.900	0.003	18-Dec-09	22.8	1.8
7	RM0407-145	04-Feb-10	-0.926	0.005	11-Mar-10	37.6	3.2
8	RM0407-60	11-Sep-08	-0.856	0.004	07-Oct-08	31.8	3.3
9	RM0407-173	16-Sep-08	-0.890	0.003	07-Oct-08	31.7	3.2

Table 3.10.3 continued

No.	RS No.	δ13C / ‰			Δ14C a / ‰		
		Measurement date	$\delta^{13}C$	Error[b]	Measurement date	$\Delta^{14}C$	Error[c]
10	RM0407-30	07-Oct-08	-0.876	0.004	31-Oct-08	32.5	3.4
11	RM0407-17	08-Oct-08	-0.881	0.002	31-Oct-08	23.6	3.3
12	RM0407-181	04-Sep-08	-0.924	0.002	08-Oct-08	40.4	4.4
13	RM0407-134	05-Nov-08	-0.891	0.005	15-Dec-08	37.3	3.4
14	RM0407-142	13-Nov-08	-0.891	0.004	15-Dec-08	36.1	3.3
15	RM0407-137	17-Nov-08	-0.888	0.003	15-Dec-08	39.3	3.2
16	RM0407-19	04-Nov-08	-0.897	0.004	11-Nov-08	27.2	3.4
17	RM0407-61	09-Dec-08	-0.866	0.003	01-Apr-09	25.6	4.4
18	RM0407-62	13-Jan-09	-0.883	0.003	07-Apr-09	35.5	6.2
19	RM0407-63	15-Jan-09	-0.873	0.004	14-May-09	45.9	2.1
20	RM0407-34	09-Feb-09	-0.931	0.005	27-May-09	26.2	2.7
21	RM0407-85	12-Feb-09	-0.922	0.002	12-Jun-09	40.0	1.8
22	RM0407-41	16-Mar-09	-0.883	0.005	19-Jun-09	36.2	1.9
23	RM0407-84	18-Mar-09	-0.911	0.006	06-Jul-09	42.2	2.1
24	RM0407-95	19-May-09	-0.892	0.005	05-Aug-09	28.0	3.0
25	RM0407-21	20-May-09	-0.933	0.002	28-Aug-09	31.2	1.9
26	RM0407-108	21-May-09	-0.957	0.004	04-Sep-09	30.9	1.8
27	RM0407-179	23-Jul-09	-0.892	0.006	05-Sep-09	24.9	2.5
28	RM0407-4	16-Jun-09	-0.880	0.002	11-Sep-09	33.4	2.0
29	RM0407-105	18-Jun-09	-0.916	0.003	18-Sep-09	35.3	2.1
30	RM0407-7	21-Jul-09	-0.899	0.002	26-Oct-09	35.3	3.1
31	RM0407-187	22-Jul-09	-0.913	0.006	26-Oct-09	34.7	3.1
32	RM0407-5	08-Feb-10	-0.881	0.004	16-Mar-10	37.4	3.1

a. Decay corrected for 01/July/2004.
b. Standard deviation of repeat measurements.
c. Larger of the standard deviation and the counting error.

(8) Quality control flag assignment

Quality flag values were assigned to all $\delta^{13}C$ and $\Delta^{14}C$ measurements using the code defined in Table 0.2 of WHP Office Report WHPO 91-1 Rev.2 section 4.5.2 (Joyce et al., 1994). Quality flags of 2, 3, 4, 5, and 6 have been assigned (Table 3.10.4). For the choice between 2 (good), 3 (questionable), or 4 (bad), we basically followed a flagging procedure in Key et al. (1996) as listed below:

a. On a station-by-station basis, a datum was plotted against pressure. Any points not lying on a generally smooth trend were noted.

b. $\delta^{13}C$ ($\Delta^{14}C$) was then plotted against dissolved oxygen (alkalinity) concentration and deviant points were noted. If a datum deviated from both the depth and oxygen (alkalinity) plots, it was flagged 3 (questionable).

c. Vertical transections against depth were prepared using the Ocean Data View (Schlitzer, 2012). If a datum was anomalous on the transection plots, datum flag was degraded from 2 to 3, or from 3 to 4.

Quality flags of $\delta^{13}C$ and $\Delta^{14}C$ for all the samples from stations P01_010, P01_027, P01-060, P01_072, and P01_097 (170 samples) were assigned to be 5.

Table 3.10.4 Summary of assigned quality control flags.

Flag	Definition	Number	
		$\delta^{13}C$	$\Delta^{14}C$
2	Good	931	952
3	Questionable	84	58
4	Bad	0	0
5	Not report (missing)	172	175
6	Replicate	58	60
Total		1245	1245

(9) Data Summary

Figure 3.10.2 shows vertical transection of $\delta^{13}C$ against depth. Higher $\delta^{13}C$ values were observed in surface waters. Along the meridional line higher values were found in the southern subtropical region. Minimum of $\delta^{13}C$ was found in deep waters from 500 to 2,000 m depth approximately in the North Pacific and the smallest value was in the deep waters of the subarctic region. From the deep to the bottom waters $\delta^{13}C$ increases gradually. The general distribution of $\delta^{13}C$ well agrees with that presented in a previous study (Kroopnick, 1985) and is mainly governed both by biogeochemical process and ocean circulation.

Figure 3.10.3 shows vertical transection of $\Delta^{14}C$ against depth. Higher $\Delta^{14}C$ values were observed in the thermocline (< about 1,000 m depth) because of the bomb-produced radiocarbon penetration. In the North Pacific relative higher $\Delta^{14}C$ was measured in bottom waters below 4,000 m depth approximately where the high-$\delta^{13}C$ water was observed, which is derived from a northward transport of the Circumpolar Deep Water from the South Pacific. Minimum of $\Delta^{14}C$ was found in deep waters from 1,500 to 4,000 m depth approximately. The general distribution of $\Delta^{14}C$ in deep and bottom waters supports a previous study (Key et al., 2004) and indicates the global pattern of thermohaline circulation.

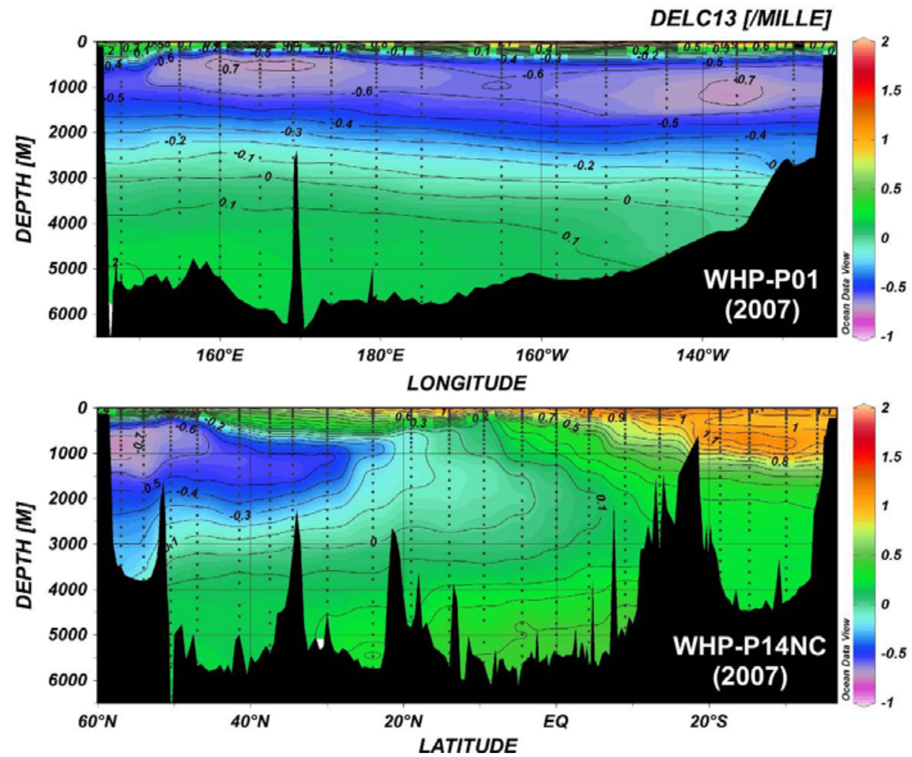

Figure 3.10.2 Vertical transections of $\delta^{13}C$ (‰) against depth along the WHP-P01 (upper, 47°N approx.) and WHP-P14NC (lower, 179°E approx.) lines in 2007.

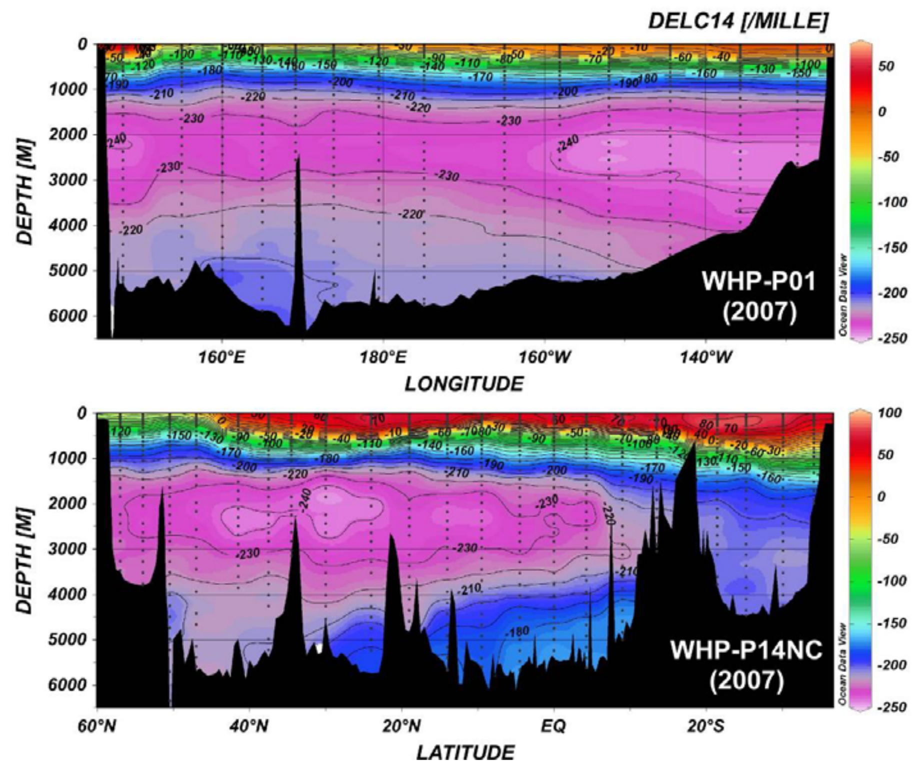

Figure 3.10.3 Same as the Figure 3.10.2 but for $\Delta^{14}C$ (‰).

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49MR0704_1.sum file

P01 REV R/V MIRAI CRUISE MR0704

SHIP/CRS EXPOCODE	WOCE SECT	STNNBR	CASTNO	CAST TYPE	DATE	UTC TIME	EVENT CODE	POSITION LATITUDE	LONGITUDE	NAV	UNC DEPTH	COR DEPTH	HT ABOVE BOTTOM	WIRE OUT	MAX PRESS	NO. OF BOTTLES	PARAMETERS	COMMENTS
49MR0704_1	P01	1	1	ROS	072607	0905	BE	42 58.28 N	145 27.30 E	GPS	101	99						
49MR0704_1	P01	1	1	BUC	072607	0906	UN	42 58.28 N	145 27.29 E	GPS	102	99					1,31,33,34,82	11.3C
49MR0704_1	P01	1	1	ROS	072607	0910	BO	42 58.29 N	145 27.26 E	GPS	102	99	10	85	89	6	1-8,23,24,26,27,31,33,34,37,81,82	#2 CHLOR MAX, SOME SMPLS WERE TAKEN FROM DUPL BTLS
49MR0704_1	P01	1	1	ROS	072607	0918	EN	42 58.30 N	145 27.26 E	GPS	102	99						
49MR0704_1	P01	1	1	UNK	072607	0928	UN	42 58.21 N	145 27.46 E	GPS	103	99						AIR CH4/N2O AND COS SMPL
49MR0704_1	P01	2	1	ROS	072607	1109	BE	42 53.36 N	145 31.20 E	GPS	358	356						
49MR0704_1	P01	2	1	BUC	072607	1112	UN	42 53.35 N	145 31.17 E	GPS	357	355					1	10.8C
49MR0704_1	P01	2	1	ROS	072607	1120	BO	42 53.36 N	145 31.10 E	GPS	357	354	9	350	353	7	1-8,23,24,26,27	
49MR0704_1	P01	2	1	ROS	072607	1137	EN	42 53.35 N	145 30.98 E	GPS	355	353						
49MR0704_1	P01	3	1	ROS	072607	1315	BE	42 51.36 N	145 32.54 E	GPS	958	960						
49MR0704_1	P01	3	1	BUC	072607	1323	UN	42 51.34 N	145 32.50 E	GPS	943	944					1	11.2C
49MR0704_1	P01	3	1	ROS	072607	1336	BO	42 51.31 N	145 32.45 E	GPS	923	926	12	909	916	14	1-8,23,24,26,27	
49MR0704_1	P01	3	1	ROS	072607	1419	EN	42 51.23 N	145 32.21 E	GPS	958	957						
49MR0704_1		401	1	UNK	072607	1444	BE	42 50.94 N	145 32.54 E	GPS	1029	1029						FOG WATER SMPL FOR TRACE ELEMENTS (#21)
49MR0704_1	P01	4	1	ROS	072607	1601	BE	42 48.81 N	145 35.61 E	GPS	1534	1534						THICK FOG
49MR0704_1	P01	4	1	BUC	072607	1608	UN	42 48.80 N	145 35.54 E	GPS	1525	1529					1	11.0C
49MR0704_1	P01	4	1	ROS	072607	1633	BO	42 48.85 N	145 35.38 E	GPS	1536	1534	10	1556	1566	17	1-8,27,37	
49MR0704_1	P01	4	1	ROS	072607	1729	EN	42 48.84 N	145 34.68 E	GPS	1516	1517						
49MR0704_1	P01	5	1	ROS	072607	1848	BE	42 38.88 N	145 41.92 E	GPS	2388	2390						THICK FOG
49MR0704_1	P01	5	1	BUC	072607	1856	UN	42 38.80 N	145 41.87 E	GPS	2409	2408					1	11.4C
49MR0704_1		401	1	UNK	072607	1856	EN	42 38.81 N	145 41.87 E	GPS	2408	2408						
49MR0704_1		402	1	UNK	072607	1856	BE	42 38.81 N	145 41.87 E	GPS	2408	2408						FOG WATER SMPL FOR TRACE ELEMENTS (#22)
49MR0704_1	P01	5	1	ROS	072607	1930	BO	42 38.64 N	145 41.56 E	GPS	2412	2411	14	2442	2441	21	1-8,23,24,26,27	
49MR0704_1	P01	5	1	ROS	072607	2042	EN	42 38.11 N	145 41.13 E	GPS	2354	2358						
49MR0704_1	P01	6	1	ROS	072607	2221	BE	42 29.59 N	145 50.41 E	GPS	3149	3149						THICK FOG
49MR0704_1	P01	6	1	BUC	072607	2229	UN	42 29.56 N	145 50.36 E	GPS	3150	3150					1	11.9C
49MR0704_1	P01	6	1	UNK	072607	2232	UN	42 29.54 N	145 50.36 E	GPS	3148	3148						80L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	6	1	ROS	072607	2315	BO	42 29.37 N	145 50.19 E	GPS	3146	3144	10	3150	3182	33	1-8,22,27	
49MR0704_1		402	1	UNK	072607	2340	EN	42 29.31 N	145 50.12 E	GPS	3146	3146						
49MR0704_1	P01	6	1	ROS	072707	0044	EN	42 29.03 N	145 49.78 E	GPS	3148	3149						
49MR0704_1	P01	7	1	ROS	072707	0218	BE	42 17.11 N	146 3.27 E	GPS	4166	4166						THICK FOG
49MR0704_1	P01	7	1	BUC	072707	0229	UN	42 17.05 N	146 3.23 E	GPS	4171	4171					1	13.4C
49MR0704_1	P01	7	1	ROS	072707	0325	BO	42 17.08 N	146 3.20 E	GPS	4160	4158	13	4171	4228	29	1-8,23,24,26,27	
49MR0704_1	P01	7	1	ROS	072707	0519	EN	42 16.93 N	146 2.97 E	GPS	4169	4166						
49MR0704_1		403	1	UNK	072707	0600	BE	42 14.12 N	146 3.90 E	GPS	4504	4504						FOG WATER SMPL FOR TRACE ELEMENTS (#23)
49MR0704_1	P01	8	1	ROS	072707	0658	BE	42 10.79 N	146 5.03 E	GPS	5055	5050						FOG
49MR0704_1		403	1	UNK	072707	0700	EN	42 10.79 N	146 5.05 E	GPS	5047	5047						
49MR0704_1	P01	8	1	BUC	072707	0705	UN	42 10.79 N	146 5.04 E	GPS	5054	5054					1,31,33	13.7C
49MR0704_1	P01	8	1	ROS	072707	0814	BO	42 10.82 N	146 5.18 E	GPS	5033	5036	11	5060	5134	33	1-8,23,24,26,27,31,33	
49MR0704_1	P01	8	1	ROS	072707	1017	EN	42 10.97 N	146 5.84 E	GPS	5057	5058						
49MR0704_1	P01	9	1	ROS	072707	1230	BE	41 59.11 N	146 13.56 E	GPS	6160	6160						WITHOUT FLUOROMETER, FOG
49MR0704_1	P01	9	1	BUC	072707	1238	UN	41 59.11 N	146 13.64 E	GPS	6162	6162					1	13.4C
49MR0704_1	P01	9	1	ROS	072707	1404	BO	41 58.95 N	146 14.55 E	GPS	6256	6255	11	6240	6282	36	1-8,27,37	
49MR0704_1	P01	9	1	ROS	072707	1659	EN	41 58.56 N	146 16.46 E	GPS	6139	6139						
49MR0704_1		404	1	UNK	072707	1721	BE	41 58.12 N	146 16.38 E	GPS	6177	6177						FOG WATER SMPL FOR TRACE ELEMENTS (#24)

49MR0704_1		404	1	UNK	072707	1815	EN	41 52.70 N	146 18.17 E	GPS	6708	6708						
49MR0704_1	P01	10	1	ROS	072707	1832	BE	41 52.48 N	146 18.52 E	GPS	6735	6736						WITHOUT FLUOROMETER, FOG
49MR0704_1	P01	10	1	BUC	072707	1846	UN	41 52.41 N	146 18.65 E	GPS	6734	6735					1	13.1C
49MR0704_1	P01	10	1	ROS	072707	2008	BO	41 51.99 N	146 18.80 E	GPS	6736	6739	-9	6410	6502	36	1-8,12,13,23,24,26,27,43	
49MR0704_1	P01	10	1	ROS	072707	2257	EN	41 51.16 N	146 19.69 E	GPS	7174	7175						
49MR0704_1		405	1	UNK	072707	2329	BE	41 48.89 N	146 21.36 E	GPS	7212	7213						FOG WATER SMPL FOR TRACE ELEMENTS (#25)
49MR0704_1		405	1	UNK	072807	0031	EN	41 43.98 N	146 24.01 E	GPS	6801	6801						
49MR0704_1		406	1	UNK	072807	0031	BE	41 43.98 N	146 24.01 E	GPS	6801	6801						FOG WATER SMPL FOR TRACE ELEMENTS (#26)
49MR0704_1		406	1	UNK	072807	0116	EN	41 42.80 N	146 24.53 E	GPS	6654	6654						
49MR0704_1	P01	11	1	ROS	072807	0152	BE	41 42.68 N	146 24.68 E	GPS	6553	6554						WITHOUT FLUOROMETER AND LADCP, REPLACED PRI COND SENSOR
49MR0704_1	P01	11	1	BUC	072807	0200	UN	41 42.68 N	146 24.72 E	GPS	6551	6552					1	13.6C
49MR0704_1	P01	11	1	UNK	072807	0205	UN	41 42.68 N	146 24.74 E	GPS	6541	6541						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	11	1	ROS	072807	0329	BO	41 42.62 N	146 24.93 E	GPS	6538	6539	-9	6394	6501	36	1-8,22,27	
49MR0704_1		407	1	UNK	072807	0614	UN	41 42.79 N	146 26.00 E	GPS	6498	6498						RAIN SMPL FOR STABLE ISOTOPE (#1, 0.6MM)
49MR0704_1	P01	11	1	ROS	072807	0632	EN	41 42.78 N	146 26.14 E	GPS	6495	6495						
49MR0704_1	P01	12	1	ROS	072807	0826	BE	41 40.36 N	146 31.80 E	GPS	6262	6262						WITHOUT FLUOROMETER AND LADCP
49MR0704_1	P01	12	1	BUC	072807	0833	UN	41 40.35 N	146 31.82 E	GPS	6257	6257					1,31,33,34,82	15.2C
49MR0704_1	P01	12	1	ROS	072807	1000	BO	41 40.29 N	146 31.99 E	GPS	6251	6251	11	6273	6383	36	1-8,23,24,26,27,31,33,34,82	
49MR0704_1	P01	12	1	ROS	072807	1248	EN	41 39.87 N	146 32.33 E	GPS	6101	6101						
49MR0704_1	P01	12	1	UNK	072807	1300	UN	41 39.39 N	146 32.48 E	GPS	6067	6067						AIR CH4/N2O SMPL
49MR0704_1		408	1	UNK	072807	1313	BE	41 37.76 N	146 33.31 E	GPS	5926	5925						FOG WATER SMPL FOR TRACE ELEMENTS (#27)
49MR0704_1		408	1	UNK	072807	1519	EN	41 24.18 N	146 40.19 E	GPS	5514	5515						
49MR0704_1	P01	13	1	ROS	072807	1558	BE	41 21.67 N	146 41.37 E	GPS	5487	5487						WITH FLUOROMETER AND LADCP
49MR0704_1	P01	13	1	BUC	072807	1606	UN	41 21.62 N	146 41.41 E	GPS	5476	5477					1,83	13.4C
49MR0704_1	P01	13	1	ROS	072807	1723	BO	41 21.44 N	146 41.16 E	GPS	5475	5475	9	5525	5574	36	1-8,27,37,81,83	#2 AT CHLOR MAX
49MR0704_1	P01	13	1	ROS	072807	1947	EN	41 20.73 N	146 40.88 E	GPS	5472	5472						
49MR0704_1	P01	13	1	UNK	072807	2000	UN	41 20.32 N	146 40.94 E	GPS	5478	5478						AIR COS SMPL
49MR0704_1	P01	14	1	ROS	072807	2121	BE	41 7.84 N	146 53.33 E	GPS	5334	5334						
49MR0704_1	P01	14	1	BUC	072807	2129	UN	41 7.85 N	146 53.31 E	GPS	5335	5335					1	14.3C
49MR0704_1	P01	14	1	ROS	072807	2242	BO	41 7.80 N	146 53.29 E	GPS	5335	5334	9	5359	5428	34	1-8,23,24,26,27	
49MR0704_1	P01	14	1	ROS	072907	0052	EN	41 7.69 N	146 52.93 E	GPS	5335	5335						
49MR0704_1	P01	15	1	ROS	072907	0231	BE	40 51.74 N	147 4.41 E	GPS	5034	5035						
49MR0704_1	P01	15	1	BUC	072907	0239	UN	40 51.77 N	147 4.32 E	GPS	4993	4993					1	15.2C
49MR0704_1	P01	15	1	ROS	072907	0354	BO	40 51.90 N	147 3.88 E	GPS	4714	4714	7	4899	4960	33	1-8,27	
49MR0704_1	P01	15	1	ROS	072907	0601	EN	40 51.80 N	147 3.15 E	GPS	4794	4794						
49MR0704_1	P01	16	1	ROS	072907	0726	BE	40 37.51 N	147 13.39 E	GPS	5291	5291						
49MR0704_1	P01	16	1	BUC	072907	0732	UN	40 37.51 N	147 13.34 E	GPS	5292	5292					1,31,33	17.1C
49MR0704_1	P01	16	1	ROS	072907	0846	BO	40 37.60 N	147 12.83 E	GPS	5291	5292	9	5312	5381	34	1-8,23,24,26,27,31,33	
49MR0704_1	P01	16	1	ROS	072907	1054	EN	40 37.97 N	147 11.77 E	GPS	5297	5297						
49MR0704_1	P01	17	1	ROS	072907	1249	BE	40 23.21 N	147 23.65 E	GPS	5272	5276						
49MR0704_1	P01	17	1	BUC	072907	1258	UN	40 23.27 N	147 23.63 E	GPS	5274	5278					1,83	20.6C
49MR0704_1	P01	17	1	ROS	072907	1412	BO	40 23.26 N	147 23.04 E	GPS	5271	5275	9	5292	5363	33	1-8,27,37	
49MR0704_1	P01	17	1	ROS	072907	1629	EN	40 23.32 N	147 22.58 E	GPS	5270	5275						
49MR0704_1	P01	18	1	ROS	072907	1830	BE	40 7.47 N	147 33.97 E	GPS	5284	5288						
49MR0704_1	P01	18	1	BUC	072907	1839	UN	40 7.52 N	147 33.91 E	GPS	5287	5290					1	20.4C
49MR0704_1	P01	18	1	UNK	072907	1841	UN	40 7.54 N	147 33.92 E	GPS	5287	5291						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	18	1	ROS	072907	1953	BO	40 8.01 N	147 33.28 E	GPS	5288	5291	9	5366	5379	36	1-8,22,27	
49MR0704_1	P01	18	1	ROS	072907	2202	EN	40 9.20 N	147 31.93 E	GPS	5283	5287						
49MR0704_1	P01	19	1	ROS	072907	2350	BE	39 56.36 N	147 43.11 E	GPS	5233	5234						
49MR0704_1	P01	19	1	BUC	072907	2358	UN	39 56.45 N	147 43.04 E	GPS	5229	5230					1	20.9C

49MR0704_1	P01	19	1	ROS	073007	0111	BO	39 56.92 N	147 42.81 E	GPS	5237	5238	10	5260	5314	34	1-8,12,13,23,24,26,27	
49MR0704_1	P01	19	1	ROS	073007	0337	EN	39 57.75 N	147 42.56 E	GPS	5239	5240						
49MR0704_1	P01	20	1	ROS	073007	0531	BE	39 41.32 N	147 55.63 E	GPS	5359	5358						
49MR0704_1	P01	20	1	BUC	073007	0539	UN	39 41.36 N	147 55.51 E	GPS	5355	5354					1,83	20.7C
49MR0704_1	P01	20	1	ROS	073007	0655	BO	39 41.67 N	147 55.26 E	GPS	5353	5351	10	5380	5442	34	1-8,27,37	
49MR0704_1	P01	20	1	ROS	073007	0904	EN	39 42.17 N	147 54.54 E	GPS	5346	5345						
49MR0704_1	P01	21	1	ROS	073007	1124	BE	40 1.06 N	148 24.64 E	GPS	5475	5476						
49MR0704_1	P01	21	1	BUC	073007	1131	UN	40 1.06 N	148 24.50 E	GPS	5467	5468					1,31,33,34,82	21.1C
49MR0704_1	P01	21	1	ROS	073007	1249	BO	40 1.31 N	148 24.18 E	GPS	5459	5461	10	5484	5559	36	1-8,23,24,26,27,31,33,34,64,81,82	#2 AT CHLOR MAX
49MR0704_1		409	1	UNK	073007	1312	UN	40 1.35 N	148 24.15 E	GPS	5461	5461						RAIN SMPL FOR STABLE ISOTOPE (#2, 0.8MM)
49MR0704_1	P01	21	1	ROS	073007	1510	EN	40 1.56 N	148 23.66 E	GPS	5452	5453						
49MR0704_1	P01	21	1	UNK	073007	1524	UN	40 2.06 N	148 24.50 E	GPS	5461	5459						AIR CH4/N2O SMPL
49MR0704_1		410	1	UNK	073007	1524	BE	40 2.11 N	148 24.60 E	GPS	5458	5459						FOG WATER SMPL FOR TRACE ELEMENTS (#28)
49MR0704_1	P01	22	1	ROS	073007	1732	BE	40 19.23 N	148 52.67 E	GPS	5468	5468						FOG
49MR0704_1	P01	22	1	BUC	073007	1742	UN	40 19.21 N	148 52.62 E	GPS	5468	5468					1	20.5C
49MR0704_1	P01	22	1	UNK	073007	1746	UN	40 19.20 N	148 52.60 E	GPS	5467	5467						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1		410	1	UNK	073007	1820	EN	40 19.18 N	148 52.40 E	GPS	5466	5466						
49MR0704_1	P01	22	1	ROS	073007	1857	BO	40 19.28 N	148 52.30 E	GPS	5465	5465	7	5475	5561	36	1-8,22,27	
49MR0704_1		411	1	UNK	073007	2055	UN	40 19.59 N	148 51.83 E	GPS	5468	5468						RAIN SMPL FOR STABLE ISOTOPE (#3, 0.3MM)
49MR0704_1	P01	22	1	ROS	073007	2109	EN	40 19.62 N	148 51.79 E	GPS	5467	5468						
49MR0704_1	P01	22	2	UNK	073007	2130	UN	40 21.03 N	148 54.26 E	GPS	5489	5489						AIR COS SMPL
49MR0704_1		412	1	UNK	073007	2204	BE	40 24.77 N	149 0.79 E	GPS	5507	5507						FOG WATER SMPL FOR TRACE ELEMENTS (#29)
49MR0704_1		412	1	UNK	073007	2300	EN	40 30.74 N	149 11.08 E	GPS	5269	5267						
49MR0704_1	P01	23	1	ROS	073107	0023	BE	40 37.28 N	149 22.48 E	GPS	5356	5354						
49MR0704_1	P01	23	1	BUC	073107	0030	UN	40 37.33 N	149 22.57 E	GPS	5351	5349					1	21.3C
49MR0704_1	P01	23	1	ROS	073107	0144	BO	40 37.41 N	149 22.77 E	GPS	5351	5349	9	5362	5450	33	1-8,23,24,26,27	#15 MISS FIRE
49MR0704_1	P01	23	1	ROS	073107	0401	EN	40 37.55 N	149 23.21 E	GPS	5348	5346						
49MR0704_1	P01	24	1	ROS	073107	0714	BE	40 55.49 N	149 51.06 E	GPS	5390	5388						
49MR0704_1	P01	24	1	BUC	073107	0721	UN	40 55.55 N	149 51.17 E	GPS	5386	5386					1,83	21.4C
49MR0704_1	P01	24	1	ROS	073107	0836	BO	40 55.67 N	149 51.73 E	GPS	5382	5380	9	5410	5476	35	1-8,27,37	
49MR0704_1	P01	24	1	ROS	073107	1047	EN	40 55.75 N	149 53.14 E	GPS	5370	5369						
49MR0704_1		413	1	UNK	073107	1124	BE	41 1.31 N	150 1.00 E	GPS	5232	5231						FOG WATER SMPL FOR TRACE ELEMENTS (#30)
49MR0704_1		413	1	UNK	073107	1240	EN	41 15.21 N	150 19.63 E	GPS	5356	5353						
49MR0704_1	P01	25	1	ROS	073107	1255	BE	41 15.83 N	150 20.61 E	GPS	5370	5366						
49MR0704_1	P01	25	1	BUC	073107	1303	UN	41 15.90 N	150 20.82 E	GPS	5371	5367					1,31,33	19.6C
49MR0704_1	P01	25	1	ROS	073107	1418	BO	41 15.68 N	150 21.42 E	GPS	5376	5373	9	5381	5468	34	1-8,23,24,26,27,31,33	
49MR0704_1	P01	25	1	ROS	073107	1634	EN	41 15.10 N	150 22.59 E	GPS	5373	5369						
49MR0704_1	P01	26	1	ROS	073107	1853	BE	41 33.70 N	150 52.27 E	GPS	5213	5211						
49MR0704_1	P01	26	1	BUC	073107	1900	UN	41 33.68 N	150 52.30 E	GPS	5212	5211					1	16.6C
49MR0704_1	P01	26	1	UNK	073107	1902	UN	41 33.68 N	150 52.33 E	GPS	5214	5213						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	26	1	ROS	073107	2011	BO	41 33.73 N	150 52.43 E	GPS	5212	5211	8	5219	5303	36	1-8,22,27	
49MR0704_1	P01	26	1	ROS	073107	2215	EN	41 33.76 N	150 52.72 E	GPS	5209	5208						
49MR0704_1	P01	27	1	ROS	080107	0048	BE	41 56.44 N	151 27.78 E	GPS	5152	5154						
49MR0704_1	P01	27	1	BUC	080107	0055	UN	41 56.45 N	151 27.85 E	GPS	5151	5153					1	16.9C
49MR0704_1	P01	27	1	ROS	080107	0208	BO	41 56.41 N	151 28.18 E	GPS	5155	5157	10	5160	5242	34	1-8,12,13,23,24,26,27,43	
49MR0704_1	P01	27	1	ROS	080107	0419	EN	41 55.98 N	151 28.70 E	GPS	5164	5166						
49MR0704_1	P01	28	1	ROS	080107	0659	BE	42 20.19 N	152 5.00 E	GPS	5112	5110						
49MR0704_1	P01	28	1	BUC	080107	0706	UN	42 20.11 N	152 5.15 E	GPS	5108	5107					1,83	16.0C
49MR0704_1	P01	28	1	ROS	080107	0819	BO	42 19.78 N	152 5.43 E	GPS	5123	5121	10	5136	5202	33	1-8,27,37	
49MR0704_1	P01	28	1	ROS	080107	1021	EN	42 19.44 N	152 5.73 E	GPS	5130	5128						
49MR0704_1	P01	29	1	ROS	080107	1257	BE	42 40.99 N	152 40.74 E	GPS	5313	5313						

49MR0704_1	P01	29	1	BUC	080107	1306	UN	42 41.00 N	152 40.91 E	GPS	5315	5314					1,31,33,34,82	16.0C
49MR0704_1	P01	29	1	ROS	080107	1414	BO	42 40.87 N	152 41.63 E	GPS	5303	5309	-9	4997	5027	0		WINCH STOPPED (LONGLINE FOR FISHERY WAS CAUGHT IN A PROPELLER)
49MR0704_1	P01	29	1	ROS	080107	1438	UN	42 40.82 N	152 41.47 E	GPS	5302	5302						QUITED THIS CAST
49MR0704_1	P01	29	1	ROS	080107	1558	EN	42 40.95 N	152 42.03 E	GPS	5293	5293						NO WATER SMPL
49MR0704_1		414	1	UNK	080207	0438	BE	42 46.69 N	152 56.91 E	GPS	5133	5133						FOG WATER SMPL FOR TRACE ELEMENTS (#31)
49MR0704_1		414	1	UNK	080207	0635	EN	42 43.88 N	153 0.77 E	GPS	5144	5144						
49MR0704_1		415	1	UNK	080207	0635	BE	42 43.88 N	153 0.77 E	GPS	5144	5144						FOG WATER SMPL FOR TRACE ELEMENTS (#32)
49MR0704_1		415	1	UNK	080207	0845	EN	42 36.13 N	153 3.16 E	GPS	5169	5169						
49MR0704_1		416	1	UNK	080207	1231	BE	42 23.08 N	153 2.95 E	GPS	5150	5150						FOG WATER SMPL FOR TRACE ELEMENTS (#33)
49MR0704_1		416	1	UNK	080207	1429	EN	42 16.87 N	153 2.98 E	GPS	5260	5260						
49MR0704_1		417	1	UNK	080207	1429	BE	42 16.87 N	153 2.98 E	GPS	5260	5260						FOG WATER SMPL FOR TRACE ELEMENTS (#34)
49MR0704_1		417	1	UNK	080207	1745	EN	42 6.36 N	153 3.85 E	GPS	5299	5299						
49MR0704_1		418	1	UNK	080407	0244	BE	40 10.95 N	153 0.17 E	GPS	5707	5714						FOG WATER SMPL FOR TRACE ELEMENTS (#35)
49MR0704_1		418	1	UNK	080407	0458	EN	40 2.98 N	153 0.97 E	GPS	5691	5698						
49MR0704_1		419	1	UNK	080407	0458	BE	40 2.98 N	153 0.97 E	GPS	5691	5698						FOG WATER SMPL FOR TRACE ELEMENTS (#36)
49MR0704_1		419	1	UNK	080407	0753	EN	39 59.88 N	153 0.96 E	GPS	5673	5680						
49MR0704_1		420	1	UNK	080507	0514	UN	40 13.66 N	152 49.85 E	GPS	5719	5727						RAIN SMPL FOR STABLE ISOTOPE (#4, 4.7MM)
49MR0704_1		421	1	UNK	081007	0155	UN	40 30.65 N	147 57.61 E	GPS	5329	5332						RAIN SMPL FOR STABLE ISOTOPE (#5, 2.1MM)
49MR0704_1		422	1	UNK	081107	1345	BE	45 2.98 N	158 40.69 E	GPS	5267	5267						FOG WATER SMPL FOR TRACE ELEMENTS (#37)
49MR0704_1		422	1	UNK	081107	1558	EN	45 26.38 N	159 24.83 E	GPS	5289	5289						
49MR0704_1		423	1	UNK	081107	1558	BE	45 26.38 N	159 24.83 E	GPS	5289	5289						FOG WATER SMPL FOR TRACE ELEMENTS (#38)
49MR0704_1		423	1	UNK	081107	1828	EN	45 49.70 N	160 6.22 E	GPS	5473	5473						
49MR0704_1	P01	40	1	ROS	081207	0149	BE	46 59.57 N	162 15.17 E	GPS	5640	5640						REPLACED SEC TEMP SENSOR
49MR0704_1	P01	40	1	BUC	081207	0157	UN	46 59.61 N	162 15.15 E	GPS	5647	5646					1,31,33,34,82,83	10.9C
49MR0704_1	P01	40	1	UNK	081207	0200	UN	46 59.63 N	162 15.16 E	GPS	5646	5646						20L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	40	1	ROS	081207	0319	BO	46 59.75 N	162 15.47 E	GPS	5663	5662	9	5645	5776	29	1-6,23,24,26,31,33,34,37,64,81-83	#2,3 AT CHLOR MAX
49MR0704_1	P01	40	1	ROS	081207	0526	EN	47 0.04 N	162 16.10 E	GPS	5670	5670						
49MR0704_1	P01	40	2	UNK	081207	0540	UN	47 0.17 N	162 18.00 E	GPS	5645	5645						AIR N2O/CH4 AND COS SMPL
49MR0704_1	P01	41	1	XCT	081207	0843	DE	47 0.20 N	163 23.62 E	GPS	5778	5779						TSK XCTD-1(MK-100) #03022140
49MR0704_1	P01	42	1	XCT	081207	1146	DE	47 0.20 N	164 30.55 E	GPS	5845	5845						TSK XCTD-1(MK-100) #02121625
49MR0704_1	P01	43	1	XCT	081207	1444	DE	46 59.18 N	165 37.96 E	GPS	5869	5869						TSK XCTD-1(MK-100) #02121627
49MR0704_1	P01	44	1	ROS	081207	1747	BE	47 0.08 N	166 44.71 E	GPS	5951	5952						
49MR0704_1	P01	44	1	BUC	081207	1755	UN	47 0.01 N	166 44.83 E	GPS	5951	5953					1,31,33,83	9.4C
49MR0704_1	P01	44	1	UNK	081207	1759	UN	46 59.97 N	166 44.84 E	GPS	5953	5954						20L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	44	1	ROS	081207	1918	BO	46 59.48 N	166 44.69 E	GPS	5956	5957	-9	5922	6001	29	1-6,23,24,26,28,31,33,34,83	#2,3 AT CHLOR MAX
49MR0704_1	P01	44	1	ROS	081207	2129	EN	46 59.04 N	166 44.18 E	GPS	5958	5959						
49MR0704_1	P01	45	1	XCT	081307	0038	DE	47 0.20 N	167 49.82 E	GPS	6251	6251						TSK XCTD-1(MK-100) #03022141
49MR0704_1	P01	46	1	XCT	081307	0209	DE	46 59.92 N	168 22.31 E	GPS	6261	6260						TSK XCTD-1(MK-100) #03022142
49MR0704_1	P01	47	1	XCT	081307	0353	DE	46 59.82 N	168 59.63 E	GPS	5210	5210						TSK XCTD-1(MK-100) #03022176
49MR0704_1	P01	48	1	XCT	081307	0415	DE	46 59.98 N	169 5.89 E	GPS	4180	4180						TSK XCTD-1(MK-100) #03022171
49MR0704_1	P01	49	1	XCT	081307	0433	DE	47 0.01 N	169 10.84 E	GPS	2718	2718						TSK XCTD-1(MK-100) #03022174
49MR0704_1	P01	50	1	XCT	081307	0543	DE	46 59.38 N	169 34.52 E	GPS	2385	2385						TSK XCTD-1(MK-100) #03022172
49MR0704_1	P01	51	1	XCT	081307	0631	DE	46 58.76 N	169 49.77 E	GPS	4209	4209						TSK XCTD-1(MK-100) #03022170
49MR0704_1	P01	52	1	XCT	081307	0710	DE	46 59.60 N	170 0.99 E	GPS	4999	4999						TSK XCTD-1(MK-100) #03022149
49MR0704_1	P01	53	1	XCT	081307	0829	DE	47 0.27 N	170 28.53 E	GPS	6344	6344						TSK XCTD-1(MK-100) #03022148
49MR0704_1	P01	54	1	XCT	081307	1135	DE	47 0.30 N	171 36.59 E	GPS	6102	6101						TSK XCTD-1(MK-100) #03022146
49MR0704_1	P01	55	1	XCT	081307	1433	DE	47 0.30 N	172 42.65 E	GPS	5608	5608						TSK XCTD-1(MK-100) #03022152
49MR0704_1	P01	56	1	XCT	081307	1729	DE	47 0.43 N	173 50.82 E	GPS	5785	5785						TSK XCTD-1(MK-100) #03022147
49MR0704_1	P01	57	1	XCT	081307	2030	DE	47 0.40 N	174 58.51 E	GPS	5706	5706						TSK XCTD-1(MK-100) #03022151
49MR0704_1	P01	58	1	ROS	081307	2341	BE	46 59.64 N	176 5.68 E	GPS	5698	5698						REPLACED PRI TEMP SENSOR

49MR0704_1	P01	58	1	BUC	081307	2348	UN	46 59.71 N	176 5.67 E	GPS	5696	5696					1,31,33,34,82,83	12.0C
49MR0704_1	P01	58	1	UNK	081307	2350	UN	46 59.72 N	176 5.68 E	GPS	5695	5694						20L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	58	1	ROS	081407	0025	UN	46 59.89 N	176 5.84 E	GPS	5696	5696						LOST PRI TEMP SIGNAL AT 2400M
49MR0704_1	P01	58	1	ROS	081407	0100	EN	47 0.06 N	176 6.01 E	GPS	5695	5695						QUITED THIS CAST
49MR0704_1	P01	58	2	ROS	081407	0153	BE	46 59.48 N	176 5.36 E	GPS	5695	5694						REPLACED PRI TEMP CABLE
49MR0704_1	P01	58	2	ROS	081407	0321	BO	46 59.84 N	176 5.68 E	GPS	5696	5696	11	5711	5801	29	1-6,23,24,26,31,33,34,37,81-83	#2,3 AT CHLOR MAX
49MR0704_1	P01	58	2	ROS	081407	0526	EN	47 0.12 N	176 6.61 E	GPS	5694	5694						
49MR0704_1	P01	58	2	UNK	081407	0550	UN	47 0.15 N	176 12.35 E	GPS	5502	5502						AIR N2O/CH4 AND COS SMPL
49MR0704_1	P01	59	1	XCT	081407	0830	DE	47 0.29 N	177 11.50 E	GPS	5664	5665						TSK XCTD-1(MK-100) #03022144
49MR0704_1	P01	60	1	ROS	081407	1138	BE	46 59.78 N	178 18.24 E	GPS	5756	5756						CHANGED PRI PUMP WITH SEC PUMP
49MR0704_1	P01	60	1	BUC	081407	1146	UN	46 59.85 N	178 18.27 E	GPS	5760	5760					1,31,33,83	12.1C
49MR0704_1	P01	60	1	UNK	081407	1148	UN	46 59.86 N	178 18.26 E	GPS	5757	5757						20L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	60	1	ROS	081407	1309	BO	47 0.17 N	178 18.27 E	GPS	5765	5765	9	5779	5867	28	1-6,23,24,26,31,33,34,37	#2,3 AT CHLOR MAX
49MR0704_1	P01	60	1	ROS	081407	1527	EN	47 0.47 N	178 18.30 E	GPS	5752	5752						
49MR0704_1	P01	61	1	ROS	081407	1851	BE	47 0.43 N	179 26.65 E	GPS	5560	5561						
49MR0704_1	P01	61	1	BUC	081407	1900	UN	47 0.50 N	179 26.56 E	GPS	5555	5555					1,83	12.3C
49MR0704_1	P01	61	1	ROS	081407	2019	BO	47 0.75 N	179 26.90 E	GPS	5629	5630	9	5619	5701	36	1-8,27,37	#3=#23 DUPLICATE SMPL
49MR0704_1	P01	61	1	ROS	081407	2235	EN	47 0.86 N	179 26.92 E	GPS	5640	5640						
49MR0704_1	P01	62	1	ROS	081507	0152	BE	46 59.45 N	179 25.69 W	GPS	5718	5718						
49MR0704_1	P01	62	1	BUC	081507	0200	UN	46 59.49 N	179 25.70 W	GPS	5719	5718					1,31,33,34,82	12.6C
49MR0704_1	P01	62	1	ROS	081507	0322	BO	46 59.68 N	179 25.77 W	GPS	5722	5721	9	5750	5840	36	1-8,23,24,26,27,31,33,34,82	
49MR0704_1		424	1	UNK	081507	0342	BE	46 59.71 N	179 25.77 W	GPS	5724	5723						RAIN SMPL FOR TRACE ELEMENTS (#21)
49MR0704_1		425	1	UNK	081507	0523	UN	47 0.06 N	179 25.88 W	GPS	5652	5652						RAIN SMPL FOR STABLE ISOTOPE (#6, 1.8MM)
49MR0704_1		424	1	UNK	081507	0532	EN	47 0.28 N	179 25.78 W	GPS	5604	5603						
49MR0704_1		426	1	UNK	081507	0532	BE	47 0.28 N	179 25.78 W	GPS	5604	5603						RAIN SMPL FOR TRACE ELEMENTS (#22)
49MR0704_1	P01	62	1	ROS	081507	0544	EN	47 0.26 N	179 25.93 W	GPS	5608	5607						
49MR0704_1	P01	62	1	UNK	081507	0558	UN	47 0.31 N	179 24.02 W	GPS	5618	5617						AIR N2O/CH4 SMPL
49MR0704_1	P01	63	1	ROS	081507	0905	BE	46 59.41 N	178 19.08 W	GPS	5674	5673						
49MR0704_1	P01	63	1	BUC	081507	0912	UN	46 59.47 N	178 19.01 W	GPS	5643	5643					1,83	13.0C
49MR0704_1	P01	63	1	ROS	081507	1031	BO	46 59.81 N	178 18.46 W	GPS	5503	5503	9	5559	5630	36	1-8,23,27,28,34,37,81	#2 AT CHLOR MAX
49MR0704_1		426	1	UNK	081507	1050	EN	46 59.90 N	178 18.33 W	GPS	5502	5502						
49MR0704_1		427	1	UNK	081507	1050	BE	46 59.90 N	178 18.33 W	GPS	5502	5502						RAIN SMPL FOR TRACE ELEMENTS (#23)
49MR0704_1		428	1	UNK	081507	1144	UN	47 0.13 N	178 17.84 W	GPS	5495	5495						RAIN SMPL FOR STABLE ISOTOPE (#7, 5.6MM)
49MR0704_1	P01	63	1	ROS	081507	1255	EN	47 0.28 N	178 17.32 W	GPS	5509	5509						
49MR0704_1		429	1	UNK	081507	1340	BE	47 0.19 N	178 4.79 W	GPS	5642	5642						FOG WATER SMPL FOR TRACE ELEMENTS (#39)
49MR0704_1	P01	64	1	ROS	081507	1605	BE	46 59.67 N	177 13.07 W	GPS	5700	5701						
49MR0704_1	P01	64	1	BUC	081507	1620	UN	46 59.78 N	177 12.96 W	GPS	5706	5706					1	13.7C
49MR0704_1	P01	64	1	ROS	081507	1742	BO	46 59.96 N	177 12.63 W	GPS	5709	5710	8	5732	5823	35	1-8,23,24,26,27	
49MR0704_1		429	1	UNK	081507	1755	EN	46 59.98 N	177 12.60 W	GPS	5710	5711						
49MR0704_1		427	1	UNK	081507	1755	EN	46 59.98 N	177 12.60 W	GPS	5710	5711						
49MR0704_1		430	1	UNK	081507	1755	BE	46 59.98 N	177 12.60 W	GPS	5710	5711						RAIN SMPL FOR TRACE ELEMENTS (#24)
49MR0704_1	P01	64	1	ROS	081507	2002	EN	47 0.36 N	177 11.63 W	GPS	5710	5711						
49MR0704_1		431	1	UNK	081507	2033	UN	47 0.31 N	177 4.46 W	GPS	5625	5626						RAIN SMPL FOR STABLE ISOTOPE (#8, 1.8MM)
49MR0704_1		430	1	UNK	081507	2120	EN	47 0.02 N	176 46.75 W	GPS	5629	5629						
49MR0704_1	P01	65	1	ROS	081507	2333	BE	47 0.76 N	176 3.09 W	GPS	5633	5633						
49MR0704_1	P01	65	1	BUC	081507	2340	UN	47 0.75 N	176 3.08 W	GPS	5636	5636					1	13.9C
49MR0704_1	P01	65	1	UNK	081507	2343	UN	47 0.76 N	176 3.09 W	GPS	5634	5634						100L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	65	1	ROS	081607	0059	BO	47 0.74 N	176 2.68 W	GPS	5637	5637	9	5650	5735	36	1-8,22,27	
49MR0704_1	P01	65	1	ROS	081607	0326	EN	47 0.67 N	176 1.95 W	GPS	5634	5633						
49MR0704_1	P01	66	1	ROS	081607	0633	BE	47 0.45 N	174 57.84 W	GPS	5790	5789						
49MR0704_1	P01	66	1	BUC	081607	0641	UN	47 0.45 N	174 57.74 W	GPS	5788	5788					1,31,33	13.8C

49MR0704_1	P01	66	1	ROS	081607	0802	BO	47 0.31 N	174 57.28 W	GPS	5787	5787	9	5766	5853	36	1-8,12,13,23,24,26,27,31,33	
49MR0704_1	P01	66	1	ROS	081607	1022	EN	46 59.91 N	174 56.07 W	GPS	5794	5794						
49MR0704_1		432	1	UNK	081607	1048	BE	46 59.86 N	174 50.96 W	GPS	5747	5746						FOG WATER SMPL FOR TRACE ELEMENTS (#40)
49MR0704_1		432	1	UNK	081607	1335	EN	46 59.91 N	173 48.11 W	GPS	5706	5706						
49MR0704_1	P01	67	1	ROS	081607	1344	BE	46 59.88 N	173 48.08 W	GPS	5716	5715						
49MR0704_1	P01	67	1	BUC	081607	1352	UN	46 59.92 N	173 48.04 W	GPS	5724	5723					1,83	13.7C
49MR0704_1		433	1	UNK	081607	1427	BE	46 59.91 N	173 47.90 W	GPS	5722	5722						RAIN SMPL FOR TRACE ELEMENTS (#25)
49MR0704_1	P01	67	1	ROS	081607	1513	BO	47 0.05 N	173 47.76 W	GPS	5724	5724	9	5745	5830	35	1-8,27,28,37	
49MR0704_1		434	1	UNK	081607	1622	UN	47 0.00 N	173 47.37 W	GPS	5722	5722						RAIN SMPL FOR STABLE ISOTOPE (#9, 0.6MM)
49MR0704_1	P01	67	1	ROS	081607	1737	EN	46 59.97 N	173 46.96 W	GPS	5719	5719						
49MR0704_1		433	1	UNK	081607	1844	EN	46 59.82 N	173 26.25 W	GPS	5633	5632						
49MR0704_1		435	1	UNK	081607	1844	BE	46 59.82 N	173 26.25 W	GPS	5633	5632						RAIN SMPL FOR TRACE ELEMENTS (#26)
49MR0704_1		435	1	UNK	081607	2030	EN	46 59.78 N	172 42.54 W	GPS	5790	5790						
49MR0704_1	P01	68	1	ROS	081607	2049	BE	46 59.67 N	172 42.89 W	GPS	5795	5794						
49MR0704_1	P01	68	1	BUC	081607	2059	UN	46 59.77 N	172 42.70 W	GPS	5763	5762					1	14.1C
49MR0704_1		436	1	UNK	081607	2059	UN	46 59.78 N	172 42.69 W	GPS	5763	5762						RAIN SMPL FOR STABLE ISOTOPE (#10, 12.6MM)
49MR0704_1	P01	68	1	ROS	081607	2219	BO	46 59.74 N	172 42.36 W	GPS	5793	5792	9	5789	5883	36	1-8,23,24,26,27	
49MR0704_1		437	1	UNK	081607	2345	BE	46 59.68 N	172 41.89 W	GPS	5804	5803						FOG WATER SMPL FOR TRACE ELEMENTS (#41)
49MR0704_1	P01	68	1	ROS	081707	0049	EN	46 59.53 N	172 41.26 W	GPS	5814	5814						
49MR0704_1	P01	68	1	FLT	081707	0058	DE	46 59.46 N	172 41.04 W	GPS	5825	5824						ARGO #2811/ID66102
49MR0704_1		437	1	UNK	081707	0101	EN	46 59.45 N	172 40.82 W	GPS	5828	5827						
49MR0704_1		438	1	UNK	081707	0101	BE	46 59.45 N	172 40.82 W	GPS	5828	5827						FOG WATER SMPL FOR TRACE ELEMENTS (#42)
49MR0704_1		438	1	UNK	081707	0314	EN	47 0.21 N	171 50.05 W	GPS	5765	5766						
49MR0704_1		439	1	UNK	081707	0405	BE	47 0.41 N	171 33.34 W	GPS	5753	5755						RAIN SMPL FOR TRACE ELEMENTS (#27)
49MR0704_1	P01	69	1	ROS	081707	0408	BE	47 0.35 N	171 33.27 W	GPS	5767	5767						
49MR0704_1	P01	69	1	BUC	081707	0417	UN	47 0.31 N	171 33.15 W	GPS	5764	5764					1,83	14.5C
49MR0704_1	P01	69	1	ROS	081707	0540	BO	47 0.49 N	171 33.43 W	GPS	5732	5732	12	5769	5864	36	1-8,27,37,83	
49MR0704_1		440	1	UNK	081707	0638	UN	47 0.69 N	171 33.43 W	GPS	5717	5717						RAIN SMPL FOR STABLE ISOTOPE (#11, 6.4MM)
49MR0704_1	P01	69	1	ROS	081707	0758	EN	47 0.69 N	171 33.32 W	GPS	5731	5731						
49MR0704_1		439	1	UNK	081707	0818	EN	47 0.68 N	171 29.22 W	GPS	5721	5720						
49MR0704_1	P01	70	1	ROS	081707	1124	BE	47 0.11 N	170 26.38 W	GPS	5587	5586						
49MR0704_1	P01	70	1	BUC	081707	1132	UN	47 0.10 N	170 26.37 W	GPS	5593	5592					1,31,33,34,82	13.9C
49MR0704_1	P01	70	1	ROS	081707	1252	BO	46 59.95 N	170 25.77 W	GPS	5520	5520	10	5592	5666	36	1-8,23,24,26,27,31,33,34,81,82	#2 AT CHLOR MAX
49MR0704_1	P01	70	1	ROS	081707	1519	EN	46 59.31 N	170 24.12 W	GPS	5427	5426						
49MR0704_1	P01	70	1	UNK	081707	1530	UN	46 59.28 N	170 23.70 W	GPS	5463	5461						AIR N2O/CH4 SMPL
49MR0704_1		441	1	UNK	081707	1616	UN	46 59.67 N	170 5.54 W	GPS	5293	5294						RAIN SMPL FOR STABLE ISOTOPE (#12, 3.2MM)
49MR0704_1		442	1	UNK	081707	1623	BE	46 59.66 N	170 2.97 W	GPS	5510	5510						FOG WATER SMPL FOR TRACE ELEMENTS (#43)
49MR0704_1	P01	71	1	ROS	081707	1820	BE	46 59.96 N	169 21.11 W	GPS	5608	5608						
49MR0704_1	P01	71	1	BUC	081707	1831	UN	46 59.85 N	169 20.81 W	GPS	5617	5616					1	13.9C
49MR0704_1	P01	71	1	UNK	081707	1833	UN	46 59.85 N	169 20.79 W	GPS	5613	5613						100L THROUGH HULL PUMP FOR R.N.
49MR0704_1		442	1	UNK	081707	1859	EN	46 59.75 N	169 20.68 W	GPS	5618	5618						
49MR0704_1		443	1	UNK	081707	1859	BE	46 59.75 N	169 20.68 W	GPS	5618	5618						FOG WATER SMPL FOR TRACE ELEMENTS (#44)
49MR0704_1		444	1	UNK	081707	1859	BE	46 59.75 N	169 20.68 W	GPS	5618	5618						RAIN SMPL FOR TRACE ELEMENTS (#28)
49MR0704_1	P01	71	1	ROS	081707	1948	BO	46 59.67 N	169 20.55 W	GPS	5617	5617	8	5635	5726	36	1-8,22,27	
49MR0704_1	P01	71	1	ROS	081707	2203	EN	46 59.63 N	169 20.11 W	GPS	5619	5620						
49MR0704_1	P01	72	1	UNK	081707	2220	UN	46 59.60 N	169 17.75 W	GPS	5620	5620						AIR COS SMPL
49MR0704_1		443	1	UNK	081707	2230	EN	46 59.66 N	169 14.54 W	GPS	5569	5569						
49MR0704_1		444	1	UNK	081707	2230	EN	46 59.60 N	169 14.54 W	GPS	5569	5569						
49MR0704_1	P01	72	1	ROS	081807	0131	BE	47 0.21 N	168 13.17 W	GPS	5401	5403						
49MR0704_1	P01	72	1	BUC	081807	0142	UN	47 0.14 N	168 13.06 W	GPS	5395	5398					1	14.8C
49MR0704_1	P01	72	1	ROS	081807	0258	BO	46 59.99 N	168 12.63 W	GPS	5403	5405	9	5431	5499	36	1-8,12,13,23,24,26,27,40,43	

49MR0704_1		445	1	UNK	081807	0341	UN	46 59.90 N	168 12.43 W	GPS	5401	5403						RAIN SMPL FOR STABLE ISOTOPE (#13, 1.0MM)
49MR0704_1	P01	72	1	ROS	081807	0511	EN	46 59.51 N	168 11.73 W	GPS	5389	5391						
49MR0704_1	P01	73	1	ROS	081807	0820	BE	47 0.60 N	167 5.62 W	GPS	5434	5434						
49MR0704_1	P01	73	1	BUC	081807	0831	UN	47 0.54 N	167 5.41 W	GPS	5432	5431					1,83	14.7C
49MR0704_1	P01	73	1	ROS	081807	0947	BO	47 0.13 N	167 4.98 W	GPS	5428	5427	8	5481	5531	34	1-8,27,28,37	
49MR0704_1	P01	73	1	ROS	081807	1202	EN	46 59.25 N	167 4.63 W	GPS	5425	5425						
49MR0704_1	P01	73	1	FLT	081807	1212	DE	46 59.34 N	167 4.38 W	GPS	5422	5421						ARGO #2804/ID66095
49MR0704_1	P01	74	1	ROS	081807	1530	BE	47 1.12 N	165 59.22 W	GPS	5335	5334						
49MR0704_1	P01	74	1	BUC	081807	1540	UN	47 1.03 N	165 59.23 W	GPS	5340	5339					1,31,33	14.7C
49MR0704_1	P01	74	1	ROS	081807	1653	BO	47 0.71 N	165 58.81 W	GPS	5339	5338	8	5371	5434	34	1-8,23,24,26,27,31,33	
49MR0704_1	P01	74	1	ROS	081807	1901	EN	46 59.85 N	165 57.96 W	GPS	5337	5336						
49MR0704_1	P01	X15	1	ROS	081807	2207	BE	47 0.94 N	164 59.72 W	GPS	5336	5335						
49MR0704_1	P01	X15	1	BUC	081807	2220	UN	47 0.80 N	164 59.47 W	GPS	5335	5334					1	14.7C
49MR0704_1	P01	X15	1	ROS	081807	2338	BO	46 59.90 N	164 59.14 W	GPS	5334	5334	9	5497	5431	34	1-8,12,13,23,24,26,27	
49MR0704_1	P01	X15	1	ROS	081907	0203	EN	46 58.63 N	164 59.19 W	GPS	5336	5337						
49MR0704_1	P01	76	1	ROS	081907	0602	BE	47 1.09 N	163 43.46 W	GPS	5201	5202						
49MR0704_1	P01	76	1	BUC	081907	0612	UN	47 1.01 N	163 43.46 W	GPS	5202	5203					1	14.5C
49MR0704_1	P01	76	1	UNK	081907	0620	UN	47 0.96 N	163 43.42 W	GPS	5205	5207						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	76	1	ROS	081907	0726	BO	47 0.56 N	163 43.31 W	GPS	5206	5206	10	5239	5294	36	1-8,22,27	
49MR0704_1	P01	76	1	ROS	081907	0930	EN	46 59.97 N	163 43.15 W	GPS	5202	5206						
49MR0704_1	P01	77	1	ROS	081907	1301	BE	47 0.47 N	162 37.45 W	GPS	5171	5172						
49MR0704_1	P01	77	1	BUC	081907	1313	UN	47 0.41 N	162 37.41 W	GPS	5179	5180					1	13.7C
49MR0704_1	P01	77	1	ROS	081907	1426	BO	47 0.15 N	162 37.21 W	GPS	5176	5176	9	5195	5267	34	1-8,23,24,26,27	
49MR0704_1	P01	77	1	ROS	081907	1635	EN	46 59.38 N	162 37.08 W	GPS	5172	5173						
49MR0704_1	P01	78	1	ROS	081907	2000	BE	47 0.63 N	161 29.45 W	GPS	5075	5076						
49MR0704_1	P01	78	1	BUC	081907	2014	UN	47 0.46 N	161 29.34 W	GPS	5077	5076					1,83	13.8C
49MR0704_1	P01	78	1	ROS	081907	2131	BO	47 0.00 N	161 29.18 W	GPS	5083	5082	9	5111	5171	33	1-8,27,37,83	
49MR0704_1	P01	78	1	ROS	081907	2350	EN	46 59.49 N	161 29.00 W	GPS	5083	5082						
49MR0704_1	P01	79	1	ROS	082007	0321	BE	46 59.77 N	160 22.21 W	GPS	5125	5127						
49MR0704_1	P01	79	1	BUC	082007	0331	UN	46 59.84 N	160 22.13 W	GPS	5125	5127					1,31,33,34,82	13.9C
49MR0704_1	P01	79	1	UNK	082007	0350	UN	46 59.84 N	160 22.04 W	GPS	5122	5124						AIR N2O/CH4 SMPL
49MR0704_1	P01	79	1	ROS	082007	0444	BO	46 59.85 N	160 21.67 W	GPS	5126	5128	10	5149	5215	34	1-8,23,24,26,27,31,33,34,64,81,82	#2 AT CHLOR MAX
49MR0704_1	P01	79	1	ROS	082007	0648	EN	46 59.70 N	160 20.83 W	GPS	5127	5129						
49MR0704_1	P01	80	1	ROS	082007	1001	BE	46 59.52 N	159 15.68 W	GPS	5189	5188						
49MR0704_1	P01	80	1	BUC	082007	1011	UN	46 59.44 N	159 15.62 W	GPS	5188	5187					1,83	13.7C
49MR0704_1	P01	80	1	ROS	082007	1124	BO	46 59.31 N	159 15.50 W	GPS	5189	5189	9	5201	5282	34	1-8,27,28,37	
49MR0704_1	P01	80	1	ROS	082007	1345	EN	46 58.59 N	159 15.06 W	GPS	5186	5185						
49MR0704_1	P01	81	1	ROS	082007	1708	BE	47 0.52 N	158 7.91 W	GPS	5233	5232						
49MR0704_1	P01	81	1	BUC	082007	1716	UN	47 0.47 N	158 7.91 W	GPS	5234	5233					1	13.6C
49MR0704_1	P01	81	1	ROS	082007	1831	BO	47 0.26 N	158 8.35 W	GPS	5232	5231	9	5262	5325	36	1-8,12,13,23,24,26,27,40,43	JELLYFISH IN SEC TC DUCT
49MR0704_1	P01	81	1	ROS	082007	2036	EN	47 0.34 N	158 9.21 W	GPS	5236	5235						
49MR0704_1	P01	82	1	ROS	082107	0006	BE	47 0.13 N	157 1.41 W	GPS	5230	5231						
49MR0704_1	P01	82	1	BUC	082107	0015	UN	47 0.15 N	157 1.60 W	GPS	5233	5234					1	13.8C
49MR0704_1	P01	82	1	UNK	082107	0017	UN	47 0.17 N	157 1.63 W	GPS	5229	5230						100L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	82	1	ROS	082107	0130	BO	47 0.41 N	157 1.56 W	GPS	5227	5228	8	5246	5321	36	1-8,22,27	
49MR0704_1	P01	82	1	ROS	082107	0343	EN	47 0.98 N	157 1.43 W	GPS	5227	5227						
49MR0704_1	P01	83	1	ROS	082107	0711	BE	46 59.19 N	155 51.81 W	GPS	5251	5250						
49MR0704_1	P01	83	1	BUC	082107	0718	UN	46 59.25 N	155 51.82 W	GPS	5253	5252					1,31,33	14.3C
49MR0704_1	P01	83	1	ROS	082107	0833	BO	46 59.66 N	155 51.78 W	GPS	5249	5247	10	5283	5342	34	1-8,23,24,26,27,31,33	
49MR0704_1	P01	83	1	ROS	082107	1040	EN	47 0.13 N	155 51.72 W	GPS	5247	5245						
49MR0704_1	P01	84	1	ROS	082107	1358	BE	46 59.37 N	154 46.28 W	GPS	5205	5207						

49MR0704_1	P01	84	1	BUC	082107	1408	UN	46 59.45 N	154 46.28 W	GPS	5206	5208					1,83	14.1C
49MR0704_1		446	1	UNK	082107	1445	BE	46 59.53 N	154 46.14 W	GPS	5203	5204						FOG WATER SMPL FOR TRACE ELEMENTS (#45)
49MR0704_1	P01	84	1	ROS	082107	1521	BO	46 59.64 N	154 45.92 W	GPS	5205	5206	8	5229	5297	34	1-8,27,28,37	
49MR0704_1		446	1	UNK	082107	1715	EN	46 59.74 N	154 45.15 W	GPS	5207	5209						
49MR0704_1	P01	84	1	ROS	082107	1721	EN	46 59.76 N	154 45.04 W	GPS	5206	5208						
49MR0704_1		447	1	UNK	082107	1834	BE	46 59.64 N	154 19.93 W	GPS	5187	5187						FOG WATER SMPL FOR TRACE ELEMENTS (#46)
49MR0704_1		447	1	UNK	082107	2024	EN	47 0.20 N	153 39.20 W	GPS	5221	5220						
49MR0704_1	P01	85	1	ROS	082107	2033	BE	47 0.08 N	153 38.28 W	GPS	5222	5221						
49MR0704_1	P01	85	1	BUC	082107	2040	UN	47 0.07 N	153 38.19 W	GPS	5224	5222					1	14.3C
49MR0704_1		448	1	UNK	082107	2125	BE	47 0.00 N	153 37.88 W	GPS	5222	5221						FOG WATER SMPL FOR TRACE ELEMENTS (#47)
49MR0704_1	P01	85	1	ROS	082107	2154	BO	47 0.00 N	153 37.66 W	GPS	5223	5222	9	5249	5314	33	1-8,23,24,26,27	
49MR0704_1		448	1	UNK	082107	2348	EN	46 59.93 N	153 37.03 W	GPS	5227	5226						
49MR0704_1	P01	85	1	ROS	082207	0004	EN	46 59.91 N	153 36.93 W	GPS	5227	5225						
49MR0704_1		449	1	UNK	082207	0037	BE	46 59.86 N	153 29.05 W	GPS	5220	5219						FOG WATER SMPL FOR TRACE ELEMENTS (#48)
49MR0704_1		449	1	UNK	082207	0249	EN	46 59.64 N	152 38.20 W	GPS	5237	5238						
49MR0704_1	P01	86	1	ROS	082207	0313	BE	46 59.52 N	152 32.49 W	GPS	5199	5199						
49MR0704_1		450	1	UNK	082207	0315	UN	46 59.53 N	152 32.42 W	GPS	5207	5208						RAIN SMPL FOR STABLE ISOTOPE (#14, 0.6MM)
49MR0704_1	P01	86	1	BUC	082207	0320	UN	46 59.53 N	152 32.38 W	GPS	5208	5210					1	14.3C
49MR0704_1	P01	86	1	UNK	082207	0329	UN	46 59.53 N	152 32.32 W	GPS	5210	5211						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	86	1	ROS	082207	0434	BO	46 59.42 N	152 31.84 W	GPS	5195	5195	10	5241	5301	36	1-8,22,27	
49MR0704_1		451	1	UNK	082207	0544	BE	46 59.20 N	152 31.20 W	GPS	5196	5197						FOG WATER SMPL FOR TRACE ELEMENTS (#49)
49MR0704_1		452	1	UNK	082207	0634	UN	46 59.03 N	152 30.66 W	GPS	5221	5221						RAIN SMPL FOR STABLE ISOTOPE (#15, 1.2MM)
49MR0704_1	P01	86	1	ROS	082207	0638	EN	46 59.01 N	152 30.61 W	GPS	5226	5226						
49MR0704_1		451	1	UNK	082207	0640	EN	46 59.01 N	152 30.61 W	GPS	5222	5222						
49MR0704_1		453	1	UNK	082207	0649	BE	46 58.37 N	152 30.69 W	GPS	5230	5230						3-AXIS MAGNETOMETER CALIBRATION
49MR0704_1		453	1	UNK	082207	0717	EN	46 58.33 N	152 30.38 W	GPS	5249	5250						
49MR0704_1	P01	X16	1	ROS	082207	1630	BE	47 0.35 N	152 0.22 W	GPS	5117	5116						
49MR0704_1	P01	X16	1	BUC	082207	1640	UN	47 0.23 N	152 0.18 W	GPS	5136	5135					1	14.1C
49MR0704_1	P01	X16	1	ROS	082207	1749	BO	46 59.79 N	151 59.86 W	GPS	5132	5131	8	5176	5227	33	1-8,12,13,23,24,26,27	
49MR0704_1	P01	X16	1	ROS	082207	1950	EN	46 59.31 N	151 59.51 W	GPS	5166	5165						
49MR0704_1	P01	87	1	ROS	082207	2148	BE	47 0.44 N	151 25.21 W	GPS	5141	5140						
49MR0704_1	P01	87	1	BUC	082207	2157	UN	47 0.37 N	151 25.18 W	GPS	5139	5138					1,31,33,34,82	13.9C
49MR0704_1	P01	87	1	UNK	082207	2230	UN	47 0.22 N	151 25.04 W	GPS	5153	5151						AIR N2O/CH4 AND COS SMPL
49MR0704_1	P01	87	1	ROS	082207	2310	BO	47 0.11 N	151 24.92 W	GPS	5177	5177	8	5192	5266	34	1-8,23,24,26,27,31,33,34,81,82	#2 AT CHLOR MAX
49MR0704_1	P01	87	1	ROS	082307	0124	EN	46 59.80 N	151 24.48 W	GPS	5149	5148						
49MR0704_1	P01	87	1	FLT	082307	0132	DE	46 59.69 N	151 24.37 W	GPS	5164	5164						ARGO #2352/ID60118
49MR0704_1	P01	88	1	ROS	082307	0442	BE	46 59.64 N	150 18.01 W	GPS	5037	5037						
49MR0704_1	P01	88	1	BUC	082307	0449	UN	46 59.61 N	150 17.90 W	GPS	5043	5043					1,83	14.1C
49MR0704_1	P01	88	1	ROS	082307	0600	BO	46 59.35 N	150 17.70 W	GPS	5052	5043	10	5059	5131	33	1-8,27,37,83	
49MR0704_1	P01	88	1	ROS	082307	0758	EN	46 58.80 N	150 17.20 W	GPS	4993	4994						
49MR0704_1		454	1	UNK	082307	0906	BE	46 59.06 N	149 54.84 W	GPS	5147	5148						FOG WATER SMPL FOR TRACE ELEMENTS (#50)
49MR0704_1		454	1	UNK	082307	1039	EN	46 59.98 N	149 18.78 W	GPS	5073	5074						
49MR0704_1	P01	89	1	ROS	082307	1115	BE	46 59.82 N	149 9.04 W	GPS	5058	5058						FOG
49MR0704_1	P01	89	1	BUC	082307	1125	UN	46 59.77 N	149 8.83 W	GPS	5057	5058					1	13.8C
49MR0704_1		455	1	UNK	082307	1147	BE	46 59.66 N	149 8.75 W	GPS	5055	5055						FOG WATER SMPL FOR TRACE ELEMENTS (#51)
49MR0704_1	P01	89	1	ROS	082307	1236	BO	46 59.50 N	149 8.67 W	GPS	5058	5058	10	5068	5140	33	1-8,23,24,26,27	
49MR0704_1		455	1	UNK	082307	1347	EN	46 59.98 N	149 8.70 W	GPS	5056	5056						
49MR0704_1	P01	89	1	ROS	082307	1442	EN	46 58.82 N	149 8.54 W	GPS	5053	5053						
49MR0704_1		456	1	UNK	082307	1516	BE	46 58.77 N	148 59.21 W	GPS	5029	5028						FOG WATER SMPL FOR TRACE ELEMENTS (#52)
49MR0704_1		456	1	UNK	082307	1735	EN	47 0.59 N	148 7.88 W	GPS	5007	5007						
49MR0704_1	P01	90	1	ROS	082307	1759	BE	47 0.66 N	148 2.67 W	GPS	5004	5003						

49MR0704_1	P01	90	1	BUC	082307	1807	UN	47 0.65 N	148 2.60 W	GPS	5002	5001					1,83	14.0C
49MR0704_1		457	1	UNK	082307	1831	BE	47 0.62 N	148 2.37 W	GPS	5008	5007						FOG WATER SMPL FOR TRACE ELEMENTS (#53)
49MR0704_1	P01	90	1	ROS	082307	1917	BO	47 0.51 N	148 2.21 W	GPS	5007	5006	9	5020	5087	32	1-8,27,28,37,83	
49MR0704_1		458	1	UNK	082307	2033	UN	47 0.35 N	148 1.88 W	GPS	5015	5014						RAIN SMPL FOR STABLE ISOTOPE (#16, 0.2MM)
49MR0704_1		457	1	UNK	082307	2107	EN	47 0.27 N	148 1.74 W	GPS	5012	5012						
49MR0704_1	P01	90	1	ROS	082307	2114	EN	47 0.24 N	148 1.71 W	GPS	5009	5009						
49MR0704_1	P01	91	1	ROS	082407	0026	BE	47 0.22 N	146 55.76 W	GPS	4908	4909						FOG
49MR0704_1	P01	91	1	BUC	082407	0036	UN	47 0.16 N	146 55.59 W	GPS	4912	4914					1,31,33	14.2C
49MR0704_1		459	1	UNK	082407	0105	BE	47 0.46 N	147 4.06 W	GPS	4915	4916						FOG WATER SMPL FOR TRACE ELEMENTS (#54)
49MR0704_1	P01	91	1	ROS	082407	0146	BO	46 59.89 N	146 55.66 W	GPS	4913	4913	9	4930	4991	33	1-8,23,24,26,27,31,33	
49MR0704_1		459	1	UNK	082407	0315	EN	46 59.70 N	146 55.70 W	GPS	4911	4913						
49MR0704_1	P01	91	1	ROS	082407	0344	EN	46 59.52 N	146 55.55 W	GPS	4914	4915						
49MR0704_1	P01	91	1	FLT	082407	0351	DE	46 59.35 N	146 55.35 W	GPS	4918	4918						ARGO #3050/ID70495
49MR0704_1	P01	92	1	ROS	082407	0656	BE	47 0.14 N	145 49.04 W	GPS	4815	4813						
49MR0704_1	P01	92	1	BUC	082407	0703	UN	47 0.07 N	145 48.88 W	GPS	4809	4807					1	13.7C
49MR0704_1	P01	92	1	UNK	082407	0710	UN	47 0.01 N	145 48.77 W	GPS	4807	4806						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1		460	1	UNK	082407	0724	BE	46 59.89 N	145 48.63 W	GPS	4814	4813						FOG WATER SMPL FOR TRACE ELEMENTS (#55)
49MR0704_1	P01	92	1	ROS	082407	0811	BO	46 59.63 N	145 48.40 W	GPS	4810	4808	9	4842	4881	36	1-8,22,27	
49MR0704_1		460	1	UNK	082407	0940	EN	46 59.17 N	145 48.15 W	GPS	4809	4807						
49MR0704_1	P01	92	1	ROS	082407	1007	EN	46 58.98 N	145 47.98 W	GPS	4808	4806						
49MR0704_1	P01	92	1	FLT	082407	1017	DE	46 58.81 N	145 47.72 W	GPS	4808	4807						ARGO #3049/ID70494
49MR0704_1	P01	X17	1	ROS	082407	1412	BE	46 54.09 N	144 25.99 W	GPS	4682	4681						
49MR0704_1	P01	X17	1	BUC	082407	1421	UN	46 54.08 N	144 26.05 W	GPS	4682	4682					1	13.6C
49MR0704_1		461	1	UNK	082407	1434	UN	46 54.05 N	144 26.04 W	GPS	4681	4681						RAIN SMPL FOR STABLE ISOTOPE (#17, 0.2MM)
49MR0704_1	P01	X17	1	ROS	082407	1525	BO	46 54.00 N	144 26.18 W	GPS	4682	4682	8	4680	4742	36	1-8,12,13,23,24,26,27,40,43	
49MR0704_1	P01	X17	1	ROS	082407	1714	EN	46 53.99 N	144 26.07 W	GPS	4678	4678						
49MR0704_1	P01	94	1	ROS	082407	2008	BE	47 1.18 N	143 30.18 W	GPS	4599	4599						
49MR0704_1	P01	94	1	BUC	082407	2015	UN	47 1.10 N	143 30.10 W	GPS	4603	4603					1,83	14.0C
49MR0704_1	P01	94	1	ROS	082407	2119	BO	47 0.91 N	143 29.84 W	GPS	4601	4601	9	4605	4667	31	1-8,27,28,37	
49MR0704_1	P01	94	1	ROS	082407	2313	EN	47 0.50 N	143 29.73 W	GPS	4601	4600						
49MR0704_1	P01	95	1	ROS	082507	0218	BE	47 0.85 N	142 26.39 W	GPS	4502	4502						
49MR0704_1	P01	95	1	BUC	082507	0226	UN	47 0.76 N	142 26.30 W	GPS	4502	4502					1,31,33,34,82	14.0C
49MR0704_1	P01	95	1	UNK	082507	0240	UN	47 0.68 N	142 26.29 W	GPS	4504	4504						AIR N2O/CH4 SMPL
49MR0704_1	P01	95	1	ROS	082507	0327	BO	47 0.49 N	142 26.29 W	GPS	4506	4507	10	4524	4574	32	1-8,23,24,26,27,31,33,34,81,82	#2 AT CHLOR MAX
49MR0704_1	P01	95	1	ROS	082507	0515	EN	47 0.17 N	142 26.26 W	GPS	4509	4509						
49MR0704_1	P01	96	1	ROS	082507	0827	BE	46 59.74 N	141 21.17 W	GPS	4418	4418						
49MR0704_1	P01	96	1	BUC	082507	0834	UN	46 59.63 N	141 21.14 W	GPS	4421	4421					1	14.1C
49MR0704_1	P01	96	1	UNK	082507	0847	UN	46 59.55 N	141 21.18 W	GPS	4419	4420						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	96	1	ROS	082507	0937	BO	46 59.35 N	141 21.18 W	GPS	4420	4419	10	4424	4481	36	1-8,22,27	
49MR0704_1	P01	96	1	ROS	082507	1131	EN	46 58.97 N	141 21.38 W	GPS	4418	4418						
49MR0704_1	P01	97	1	ROS	082507	1455	BE	47 1.87 N	140 13.52 W	GPS	4330	4331						
49MR0704_1	P01	97	1	BUC	082507	1503	UN	47 1.79 N	140 13.49 W	GPS	4331	4332					1	14.3C
49MR0704_1	P01	97	1	ROS	082507	1602	BO	47 1.60 N	140 13.56 W	GPS	4331	4332	9	4346	4400	30	1-8,12,13,23,24,26,27	
49MR0704_1	P01	97	1	ROS	082507	1749	EN	47 0.95 N	140 13.60 W	GPS	4332	4332						
49MR0704_1	P01	98	1	ROS	082507	2116	BE	47 0.03 N	139 4.15 W	GPS	4231	4231						
49MR0704_1	P01	98	1	BUC	082507	2125	UN	46 59.98 N	139 4.11 W	GPS	4227	4227					1,83	14.4C
49MR0704_1	P01	98	1	ROS	082507	2223	BO	46 59.71 N	139 3.94 W	GPS	4230	4229	9	4249	4295	30	1-8,27,37,83	
49MR0704_1	P01	98	1	ROS	082607	0012	EN	46 59.14 N	139 3.94 W	GPS	4232	4231						
49MR0704_1	P01	99	1	ROS	082607	0328	BE	46 59.93 N	137 57.69 W	GPS	4170	4170						
49MR0704_1	P01	99	1	BUC	082607	0336	UN	46 59.87 N	137 57.62 W	GPS	4171	4170					1,31,33	14.6C
49MR0704_1	P01	99	1	ROS	082607	0433	BO	46 59.58 N	137 57.80 W	GPS	4172	4172	10	4199	4235	29	1-8,23,24,26,27,31,33	

49MR0704_1	P01	99	1	ROS	082607	0615	EN	46 59.29 N	137 57.86 W	GPS	4174	4174						
49MR0704_1	P01	100	1	ROS	082607	0928	BE	46 59.86 N	136 51.25 W	GPS	4171	4170						
49MR0704_1	P01	100	1	BUC	082607	0936	UN	46 59.75 N	136 51.21 W	GPS	4169	4169					1	14.9C
49MR0704_1	P01	100	1	UNK	082607	0942	UN	46 59.74 N	136 51.25 W	GPS	4165	4164						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	100	1	ROS	082607	1035	BO	46 59.54 N	136 51.23 W	GPS	4173	4174	9	4177	4228	36	1-8,22,27	
49MR0704_1	P01	100	1	ROS	082607	1225	EN	46 59.03 N	136 51.21 W	GPS	4165	4165						
49MR0704_1	P01	101	1	ROS	082607	1547	BE	47 0.25 N	135 44.39 W	GPS	4147	4147						
49MR0704_1	P01	101	1	BUC	082607	1555	UN	47 0.18 N	135 44.41 W	GPS	4142	4142					1	15.4C
49MR0704_1	P01	101	1	ROS	082607	1651	BO	47 0.00 N	135 44.07 W	GPS	4142	4141	8	4161	4202	36	1-8,12,13,23,24,26,27,40,43	
49MR0704_1		462	1	UNK	082607	1726	UN	46 59.98 N	135 43.88 W	GPS	4146	4146						RAIN SMPL FOR STABLE ISOTOPE (#18, 0.2MM)
49MR0704_1	P01	101	1	ROS	082607	1832	EN	47 0.16 N	135 43.56 W	GPS	4146	4146						
49MR0704_1	P01	102	1	ROS	082607	2152	BE	47 1.52 N	134 37.22 W	GPS	3998	3999						
49MR0704_1	P01	102	1	BUC	082607	2200	UN	47 1.51 N	134 37.15 W	GPS	4001	4001					1,83	15.3C
49MR0704_1	P01	102	1	ROS	082607	2258	BO	47 1.27 N	134 37.03 W	GPS	4000	4000	9	4012	4055	28	1-8,27,28,37	
49MR0704_1	P01	102	1	ROS	082707	0039	EN	47 0.89 N	134 36.80 W	GPS	3998	3998						
49MR0704_1	P01	103	1	ROS	082707	0354	BE	46 59.81 N	133 28.20 W	GPS	3639	3640						
49MR0704_1	P01	103	1	BUC	082707	0401	UN	46 59.75 N	133 28.08 W	GPS	3644	3644					1	16.1C
49MR0704_1	P01	103	1	ROS	082707	0453	BO	46 59.52 N	133 27.99 W	GPS	3642	3642	9	3668	3696	27	1-8,23,24,26,27	
49MR0704_1	P01	103	1	ROS	082707	0625	EN	46 59.15 N	133 27.87 W	GPS	3657	3658						
49MR0704_1	P01	104	1	ROS	082707	0939	BE	47 0.13 N	132 22.16 W	GPS	3301	3301						
49MR0704_1	P01	104	1	BUC	082707	0949	UN	47 0.09 N	132 22.05 W	GPS	3300	3300					1	16.3C
49MR0704_1	P01	104	1	UNK	082707	0951	UN	47 0.08 N	132 22.04 W	GPS	3299	3299						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	104	1	ROS	082707	1036	BO	46 59.82 N	132 21.94 W	GPS	3299	3299	9	3313	3339	36	1-8,22,27	
49MR0704_1	P01	104	1	ROS	082707	1210	EN	46 59.30 N	132 21.61 W	GPS	3304	3305						
49MR0704_1	P01	105	1	ROS	082707	1531	BE	47 0.47 N	131 14.16 W	GPS	2942	2942						
49MR0704_1	P01	105	1	BUC	082707	1539	UN	47 0.45 N	131 14.10 W	GPS	2939	2940					1,31,33,34,82	16.6C
49MR0704_1	P01	105	1	UNK	082707	1600	UN	47 0.41 N	131 14.00 W	GPS	2944	2944						AIR N2O/CH4 AND COS SMPL
49MR0704_1	P01	105	1	ROS	082707	1620	BO	47 0.39 N	131 13.90 W	GPS	2945	2945	8	2942	2969	25	1-8,23,24,26,27,31,33,34,82	
49MR0704_1	P01	105	1	ROS	082707	1736	EN	47 0.37 N	131 13.52 W	GPS	3045	3045						
49MR0704_1	P01	106	1	ROS	082707	2107	BE	46 58.92 N	130 2.12 W	GPS	2635	2635						
49MR0704_1	P01	106	1	BUC	082707	2116	UN	46 58.91 N	130 2.01 W	GPS	2632	2632					1	17.1C
49MR0704_1	P01	106	1	ROS	082707	2153	BO	46 58.81 N	130 1.86 W	GPS	2632	2631	9	2635	2656	23	1-8,23,24,26,27	
49MR0704_1	P01	106	1	ROS	082707	2312	EN	46 58.69 N	130 1.23 W	GPS	2622	2622						
49MR0704_1	P01	107	1	ROS	082807	0108	BE	46 59.90 N	129 23.04 W	GPS	2564	2563						
49MR0704_1	P01	107	1	BUC	082807	0116	UN	46 59.89 N	129 22.96 W	GPS	2563	2563					1,83	17.1C
49MR0704_1	P01	107	1	ROS	082807	0151	BO	46 59.79 N	129 22.78 W	GPS	2578	2576	9	2577	2599	22	1-8,27,37,83	
49MR0704_1	P01	107	1	ROS	082807	0257	EN	46 59.62 N	129 22.27 W	GPS	2573	2572						
49MR0704_1	P01	108	1	ROS	082807	0506	BE	47 0.27 N	128 38.86 W	GPS	2726	2727						
49MR0704_1	P01	108	1	BUC	082807	0514	UN	47 0.24 N	128 38.76 W	GPS	2724	2725					1	17.5C
49MR0704_1	P01	108	1	ROS	082807	0552	BO	47 0.18 N	128 38.60 W	GPS	2724	2725	10	2730	2752	23	1-8,12,13,23,24,26,27	
49MR0704_1	P01	108	1	ROS	082807	0702	EN	47 0.05 N	128 38.11 W	GPS	2726	2727						
49MR0704_1	P01	109	1	ROS	082807	0914	BE	46 59.89 N	127 55.25 W	GPS	2699	2699						
49MR0704_1	P01	109	1	BUC	082807	0923	UN	46 59.85 N	127 55.20 W	GPS	2701	2701					1	17.5C
49MR0704_1	P01	109	1	UNK	082807	0929	UN	46 59.84 N	127 55.17 W	GPS	2698	2697						95L THROUGH HULL PUMP FOR R.N.
49MR0704_1	P01	109	1	ROS	082807	1001	BO	46 59.75 N	127 55.02 W	GPS	2700	2700	9	2702	2724	31	1-8,22,27	
49MR0704_1	P01	109	1	ROS	082807	1118	EN	46 59.52 N	127 54.47 W	GPS	2701	2701						
49MR0704_1	P01	110	1	ROS	082807	1329	BE	46 59.80 N	127 12.16 W	GPS	2633	2633						
49MR0704_1	P01	110	1	BUC	082807	1337	UN	46 59.79 N	127 12.08 W	GPS	2633	2633					1,31,33	18.1C
49MR0704_1	P01	110	1	ROS	082807	1413	BO	46 59.65 N	127 11.94 W	GPS	2632	2632	9	2636	2659	23	1-8,23,24,26,27,31,33	
49MR0704_1	P01	110	1	ROS	082807	1522	EN	46 59.39 N	127 11.57 W	GPS	2634	2634						
49MR0704_1	P01	111	1	ROS	082807	1739	BE	47 0.19 N	126 28.47 W	GPS	2552	2552						

49MR0704_1	P01	111	1	BUC	082807	1745	UN	47 0.21 N	126 28.45 W	GPS	2548	2548					1,83	18.3C
49MR0704_1	P01	111	1	ROS	082807	1821	BO	47 0.30 N	126 28.27 W	GPS	2550	2550	9	2556	2572	24	1-8,27,28,37,83	
49MR0704_1	P01	111	1	ROS	082807	1928	EN	47 0.26 N	126 27.88 W	GPS	2550	2550						
49MR0704_1	P01	112	1	ROS	082807	2101	BE	47 0.19 N	126 0.30 W	GPS	2558	2558						
49MR0704_1	P01	112	1	BUC	082807	2111	UN	47 0.24 N	126 0.30 W	GPS	2558	2557					1	18.6C
49MR0704_1	P01	112	1	ROS	082807	2147	BO	47 0.31 N	126 0.17 W	GPS	2552	2552	9	2562	2581	23	1-8,23,24,26,27,	
49MR0704_1	P01	112	1	ROS	082807	2259	EN	47 0.27 N	125 59.68 W	GPS	2535	2535						
49MR0704_1	P01	113	1	ROS	082907	0037	BE	47 0.35 N	125 30.55 W	GPS	1751	1750						
49MR0704_1	P01	113	1	BUC	082907	0046	UN	47 0.32 N	125 30.56 W	GPS	1750	1750					1	18.7C
49MR0704_1	P01	113	1	ROS	082907	0110	BO	47 0.25 N	125 30.62 W	GPS	1756	1757	9	1744	1756	18	1-8,23,24,26,27	
49MR0704_1	P01	113	1	ROS	082907	0158	EN	47 0.06 N	125 30.67 W	GPS	1749	1749						
49MR0704_1	P01	114	1	ROS	082907	0358	BE	47 0.02 N	125 3.38 W	GPS	906	906						
49MR0704_1	P01	114	1	BUC	082907	0406	UN	46 59.97 N	125 3.41 W	GPS	952	952					1,31,33,34,82,83	18.1C
49MR0704_1	P01	114	1	ROS	082907	0421	BO	46 59.94 N	125 3.48 W	GPS	986	986	22	944	950	16	1-8,23,24,26,27,31,33,34,37,81,82	HAB MEASURED BY LADCP
49MR0704_1	P01	114	1	UNK	082907	0440	UN	46 59.91 N	125 3.57 W	GPS	1031	1031						AIR N2O/CH4 AND COS SMPL
49MR0704_1	P01	114	1	ROS	082907	0459	EN	46 59.87 N	125 3.64 W	GPS	1038	1038						
49MR0704_1	P01	115	1	ROS	082907	0655	BE	46 56.34 N	124 58.91 W	GPS	280	280						
49MR0704_1	P01	115	1	BUC	082907	0657	UN	46 56.32 N	124 58.93 W	GPS	306	306					1	17.8C
49MR0704_1	P01	115	1	ROS	082907	0708	BO	46 56.30 N	124 59.02 W	GPS	287	287	10	318	322	6	1-8,27	
49MR0704_1	P01	115	1	ROS	082907	0721	EN	46 56.28 N	124 59.10 W	GPS	299	299						
49MR0704_1		463	1	UNK	082907	0831	BE	47 3.83 N	125 17.09 W	GPS	1746	1746						FOG WATER SMPL FOR TRACE ELEMENTS (#56)
49MR0704_1		463	1	UNK	082907	1247	EN	47 33.39 N	126 38.78 W	GPS	2381	2381						

Parameter

1=Salinity, 2=Oxygen, 3=Silicate, 4=Nitrate, 5=Nitrite, 6=PHOSPHATE, 7=CFC-11, 8=CFC-12, 12=$\Delta^{14}C$, 13=$\delta^{13}C$, 22=^{137}CS, 23= Total carbon, 24=Alkalinity, 26=PH, 27=CFC-113, 28=Carbon tetrachloride, 31= CH_4, 33=N_2O, 34=Chlorophyll a, 37=Biogenic sulfur compounds, 40=Particulate organic carbon, 42= Abundance of bacteria, 47=Plutonium, 64= Incubation, 81= Particulate organic matter, 82=$^{15}NO_3$, 83=Particulate inorganic matter

49MR0706_1.sum file

P01/P14 REV R/V MIRAI CRUISE MR0706

SHIP/CRS EXPOCODE	WOCE SECT	STNNBR	CASTNO	CAST TYPE	DATE	UTC TIME	EVENT CODE	POSITION LATITUDE	LONGITUDE	NAV	UNC DEPTH	COR DEPTH	HT ABOVE BOTTOM	WIRE OUT	MAX PRESS	NO. OF BOTTLES	PARAMETERS	COMMENTS
49MR0706_1		601	1	UNK	100807	0245	UN	40 34.48 N	141 31.99 E	GPS	-9	-9						RAIN SMPL FOR STABLE ISOTOPE #1
49MR0706_1		602	1	UNK	100907	0208	BE	40 34.29 N	144 33.80 E	GPS	7425	-9						RELEASING EXCESS TWIST OF CTD CABLE
49MR0706_1		602	1	UNK	100907	0703	EN	40 31.70 N	144 32.76 E	GPS	7383	-9						WOUT 7000M, WEIGHT OF 300KG WITH COMPASS/TILT METER
49MR0706_1		603	1	UNK	100907	0855	UN	40 29.45 N	145 3.27 E	GPS	5955	-9						RAIN SMPL FOR STABLE ISOTOPE #2
49MR0706_1	P01	28	2	ROS	101007	1028	BE	42 20.11 N	152 5.48 E	GPS	5120	5113						
49MR0706_1	P01	28	2	BUC	101007	1036	UN	42 20.07 N	152 5.47 E	GPS	5123	5115					1	15.2C
49MR0706_1	P01	28	2	ROS	101007	1149	BO	42 19.82 N	152 5.43 E	GPS	5127	5119	11	5135	5205	33	1-8,27	
49MR0706_1	P01	28	2	ROS	101007	1409	EN	42 19.50 N	152 5.52 E	GPS	5130	5126						
49MR0706_1	P01	29	2	ROS	101007	2204	BE	42 41.09 N	152 41.25 E	GPS	5313	5312						
49MR0706_1	P01	29	2	BUC	101007	2213	UN	42 41.08 N	152 41.28 E	GPS	5311	5310					1	15.1C
49MR0706_1	P01	29	2	ROS	101007	2328	BO	42 40.89 N	152 41.30 E	GPS	5308	5307	11	5328	5400	34	1-8,23,24,26,27	
49MR0706_1	P01	29	2	ROS	101107	0149	EN	42 40.24 N	152 41.14 E	GPS	5311	5310						A SHRIMP IN SEC TC-DUCT
49MR0706_1	P01	30	1	ROS	101107	0447	BE	43 5.50 N	153 19.50 E	GPS	5165	5164						
49MR0706_1	P01	30	1	BUC	101107	0456	UN	43 5.41 N	153 19.48 E	GPS	5163	5161					1	14.9C
49MR0706_1	P01	30	1	ROS	101107	0609	BO	43 4.92 N	153 19.50 E	GPS	5165	5163	11	5212	5261	34	1-8,27,28	
49MR0706_1	P01	30	1	ROS	101107	0825	EN	43 5.45 N	153 20.14 E	GPS	5175	5173						
49MR0706_1	P01	32	1	ROS	101107	1442	BE	44 4.79 N	154 58.18 E	GPS	5357	5356						
49MR0706_1	P01	32	1	BUC	101107	1452	UN	44 4.80 N	154 58.30 E	GPS	5359	5358					1	12.7C
49MR0706_1	P01	32	1	ROS	101107	1606	BO	44 4.83 N	154 58.96 E	GPS	5344	5343	10	5401	5452	34	1-8,12,13,23,24,26,27	
49MR0706_1	P01	32	1	ROS	101107	1828	EN	44 4.73 N	154 59.87 E	GPS	5312	5312						
49MR0706_1		604	1	UNK	101107	2141	UN	43 37.71 N	154 17.07 E	GPS	5553	5555						RAIN SMPL FOR STABLE ISOTOPE #3
49MR0706_1	P01	31	1	ROS	101107	2220	BE	43 33.88 N	154 9.43 E	GPS	5452	5452						
49MR0706_1	P01	31	1	BUC	101107	2228	UN	43 33.90 N	154 9.49 E	GPS	5455	5455					1	14.5C
49MR0706_1	P01	31	1	UNK	101107	2252	UN	43 33.94 N	154 9.81 E	GPS	5450	5451						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P01	31	1	ROS	101107	2344	BO	43 33.88 N	154 10.25 E	GPS	5453	5454	10	5486	5551	36	1-8,22,27	
49MR0706_1	P01	31	1	ROS	101207	0203	EN	43 33.84 N	154 11.73 E	GPS	5474	5475						
49MR0706_1	P01	33	1	ROS	101207	0813	BE	44 34.58 N	155 47.29 E	GPS	5132	5133						
49MR0706_1	P01	33	1	BUC	101207	0822	UN	44 34.58 N	155 47.34 E	GPS	5135	5135					1	12.2C
49MR0706_1	P01	33	1	ROS	101207	0933	BO	44 34.55 N	155 47.75 E	GPS	5138	5138	11	5157	5228	34	1-8,27	
49MR0706_1	P01	33	1	ROS	101207	1150	EN	44 34.42 N	155 48.73 E	GPS	5147	5146						
49MR0706_1	P01	34	1	ROS	101207	1520	BE	45 4.26 N	156 38.00 E	GPS	4778	4778						
49MR0706_1	P01	34	1	BUC	101207	1528	UN	45 4.25 N	156 38.08 E	GPS	4785	4786					1	11.0C
49MR0706_1	P01	34	1	ROS	101207	1636	BO	45 4.38 N	156 38.23 E	GPS	4766	4766	10	4787	4852	32	1-8,23,24,26,27	
49MR0706_1	P01	34	1	ROS	101207	1856	EN	45 4.91 N	156 38.80 E	GPS	4734	4734						
49MR0706_1	P01	35	1	ROS	101207	2233	BE	45 33.85 N	157 28.69 E	GPS	5032	5031						NO HEAVE MOTION OF CRANE
49MR0706_1	P01	35	1	BUC	101207	2240	UN	45 33.86 N	157 28.70 E	GPS	5037	5037					1	10.1C
49MR0706_1	P01	35	1	ROS	101207	2351	BO	45 33.83 N	157 29.10 E	GPS	5022	5022	10	5045	5100	32	1-8,27,28	OXY SMPL FOR U.W.
49MR0706_1	P01	35	1	ROS	101307	0155	EN	45 32.76 N	157 30.02 E	GPS	4995	4995						
49MR0706_1	P01	36	1	ROS	101307	1111	BE	46 4.32 N	158 19.66 E	GPS	4833	4836						
49MR0706_1	P01	36	1	BUC	101307	1132	UN	46 4.24 N	158 19.52 E	GPS	4837	4836					1	9.5C
49MR0706_1	P01	36	1	ROS	101307	1236	BO	46 3.93 N	158 19.56 E	GPS	4835	4835	11	4851	4914	32	1-8,23,24,26,27	
49MR0706_1	P01	36	1	ROS	101307	1445	EN	46 3.41 N	158 20.21 E	GPS	4816	4816						
49MR0706_1	P01	37	1	ROS	101307	1828	BE	46 34.22 N	159 12.98 E	GPS	5120	5121						
49MR0706_1	P01	37	1	BUC	101307	1908	UN	46 34.05 N	159 13.48 E	GPS	5116	5115					1	9.5C
49MR0706_1	P01	37	1	UNK	101307	1928	UN	46 33.90 N	159 13.59 E	GPS	5105	5105						80L THROUGH HULL PUMP FOR R.N.

49MR0706_1	P01	37	1	ROS	101307	2019	BO	46 33.29 N	159 13.63 E	GPS	5121	5123	9	5219	5193	36	1-8,22,27	
49MR0706_1	P01	37	1	ROS	101307	2230	EN	46 32.17 N	159 13.39 E	GPS	5068	5070						
49MR0706_1	P01	38	1	ROS	101407	0153	BE	47 0.90 N	160 0.85 E	GPS	5190	5190						
49MR0706_1	P01	38	1	BUC	101407	0209	UN	47 0.80 N	160 0.88 E	GPS	5190	5190					1	8.4C
49MR0706_1	P01	38	1	ROS	101407	0317	BO	47 0.51 N	160 1.22 E	GPS	5194	5195	10	5205	5279	36	1-8,12,13,23,24,26,27,40,42,43	
49MR0706_1	P01	38	1	ROS	101407	0528	EN	46 59.99 N	160 2.17 E	GPS	5225	5227						
49MR0706_1	P01	39	1	ROS	101407	0911	BE	47 0.70 N	161 8.54 E	GPS	5315	5314						
49MR0706_1	P01	39	1	BUC	101407	0923	UN	47 0.66 N	161 8.66 E	GPS	5356	5356					1	9.6C
49MR0706_1		605	1	UNK	101407	0935	UN	47 0.59 N	161 8.76 E	GPS	5246	5242						RAIN SMPL FOR STABLE ISOTOPE #4
49MR0706_1	P01	39	1	ROS	101407	1039	BO	47 0.07 N	161 9.20 E	GPS	5431	5432	15	5403	5436	34	1-8,27	
49MR0706_1	P01	39	1	ROS	101407	1249	EN	46 59.19 N	161 10.07 E	GPS	5492	5492						
49MR0706_1	P01	40	2	ROS	101407	1605	BE	46 59.66 N	162 15.31 E	GPS	5655	5657						
49MR0706_1	P01	40	2	BUC	101407	1618	UN	46 59.63 N	162 15.37 E	GPS	5651	5653					1	9.9C
49MR0706_1	P01	40	2	ROS	101407	1735	BO	46 59.52 N	162 15.58 E	GPS	5651	5654	10	5677	5767	35	1-8,23,24,26,27	#10 MISS TRIP
49MR0706_1	P01	40	2	ROS	101407	1952	EN	46 59.48 N	162 16.47 E	GPS	5663	5665						
49MR0706_1	P01	41	1	ROS	101407	2307	BE	47 0.14 N	163 22.05 E	GPS	5766	5768						
49MR0706_1	P01	41	1	BUC	101407	2316	UN	47 0.09 N	163 22.19 E	GPS	5776	5777					1	9.9C
49MR0706_1	P01	41	1	UNK	101407	2333	UN	46 59.92 N	163 22.49 E	GPS	5778	5780						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P01	41	1	ROS	101507	0037	BO	46 59.58 N	163 22.61 E	GPS	5774	5774	10	5826	5895	36	1-8,22,27	
49MR0706_1	P01	41	1	ROS	101507	0305	EN	46 58.84 N	163 23.43 E	GPS	5748	5749						
49MR0706_1	P01	42	1	ROS	101507	0621	BE	47 0.35 N	164 30.43 E	GPS	5846	5843						
49MR0706_1	P01	42	1	BUC	101507	0631	UN	47 0.34 N	164 30.48 E	GPS	5848	5847					1	9.1C
49MR0706_1	P01	42	1	ROS	101507	0753	BO	47 0.10 N	164 30.61 E	GPS	5883	5880	11	5871	5970	36	1-8,23,24,26,27	
49MR0706_1	P01	42	1	ROS	101507	1024	EN	46 59.62 N	164 30.45 E	GPS	5940	5938						
49MR0706_1	P01	X13	1	ROS	101507	1201	BE	46 59.82 N	164 59.20 E	GPS	5891	5891						
49MR0706_1	P01	X13	1	BUC	101507	1209	UN	46 59.81 N	164 59.29 E	GPS	5897	5897					1	9.2C
49MR0706_1	P01	X13	1	ROS	101507	1331	BO	46 59.53 N	164 59.71 E	GPS	5892	5892	11	5923	6008	36	1-8,12,13,23,24,26,27	
49MR0706_1	P01	X13	1	ROS	101507	1606	EN	46 59.05 N	165 0.78 E	GPS	5900	5900						
49MR0706_1	P01	43	1	ROS	101507	1808	BE	46 59.07 N	165 37.89 E	GPS	5865	5865						
49MR0706_1	P01	43	1	BUC	101507	1817	UN	46 59.07 N	165 37.97 E	GPS	5867	5867					1	8.9C
49MR0706_1	P01	43	1	ROS	101507	1940	BO	46 58.75 N	165 38.21 E	GPS	5881	5881	10	5912	5983	36	1-8,27	
49MR0706_1		606	1	UNK	101507	2115	UN	46 58.86 N	165 38.28 E	GPS	5879	5879						RAIN SMPL FOR STABLE ISOTOPE #5
49MR0706_1	P01	43	1	ROS	101507	2209	EN	46 58.60 N	165 38.58 E	GPS	5891	5891						
49MR0706_1	P01	44	2	ROS	101607	0128	BE	46 59.88 N	166 44.98 E	GPS	5953	5916						WITHOUT FLUOROMETER/LADCP
49MR0706_1	P01	44	2	BUC	101607	0137	UN	46 59.72 N	166 45.01 E	GPS	5955	5919					1	8.8C
49MR0706_1	P01	44	2	ROS	101607	0300	BO	46 59.05 N	166 44.57 E	GPS	5966	5930	11	6017	6072	36	1-8,15,23,24,26,27,45	
49MR0706_1	P01	44	2	ROS	101607	0547	EN	46 57.67 N	166 43.14 E	GPS	5947	5911						
49MR0706_1	P01	45	1	ROS	101607	0913	BE	47 0.24 N	167 49.74 E	GPS	6211	6209						WITHOUT FLUOROMETER/LADCP
49MR0706_1	P01	45	1	BUC	101607	0921	UN	47 0.23 N	167 49.75 E	GPS	6213	6211					1	8.7C
49MR0706_1	P01	45	1	UNK	101607	1001	UN	47 0.15 N	167 49.94 E	GPS	6210	6207						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P01	45	1	ROS	101607	1049	BO	46 59.99 N	167 49.95 E	GPS	6211	6208	40	6253	6351	36	1-8,15,22,27,45	OXY SMPL FOR U.W.
49MR0706_1	P01	45	1	ROS	101607	1342	EN	46 59.34 N	167 50.28 E	GPS	6211	6209						SEC CND SENSOR BROKE
49MR0706_1	P01	46	1	ROS	101607	1531	BE	46 59.91 N	168 22.49 E	GPS	6206	6207						WITHOUT FLUOROMETER/LADCP
49MR0706_1	P01	46	1	BUC	101607	1541	UN	46 59.85 N	168 22.55 E	GPS	6198	6199					1	9.1C
49MR0706_1	P01	46	1	ROS	101607	1708	BO	46 59.49 N	168 22.57 E	GPS	6205	6205	34	6247	6335	36	1-8,23,24,26,27	
49MR0706_1	P01	46	1	ROS	101607	1953	EN	46 58.41 N	168 22.01 E	GPS	6347	6347						
49MR0706_1	P01	47	1	ROS	101607	2247	BE	46 59.42 N	168 59.51 E	GPS	5192	5224						REPLACED SEC CND SENSOR
49MR0706_1	P01	47	1	BUC	101607	2258	UN	46 59.40 N	168 59.52 E	GPS	5207	5241					1	9.0C
49MR0706_1	P01	47	1	UNK	101607	2313	UN	46 59.34 N	168 59.52 E	GPS	5185	5217						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P01	47	1	ROS	101707	0009	BO	46 59.21 N	168 59.50 E	GPS	5181	5214	10	5217	5292	36	1-8,22,27	
49MR0706_1	P01	47	1	ROS	101707	0224	EN	46 58.48 N	168 59.39 E	GPS	5276	5310						

49MR0706_1	P01	48	1	ROS	101707	0433	BE	47 0.62 N	169 5.87 E	GPS	4230	4230						
49MR0706_1	P01	48	1	BUC	101707	0442	UN	47 0.58 N	169 5.85 E	GPS	4219	4219					1	9.2C
49MR0706_1	P01	48	1	ROS	101707	0542	BO	47 0.33 N	169 5.88 E	GPS	4189	4188	10	4209	4256	36	1-8,12,13,23,24,26,27,40,42,43	
49MR0706_1	P01	48	1	ROS	101707	0727	EN	47 0.22 N	169 5.98 E	GPS	4085	4085						SEC TMP/CND NOISY
49MR0706_1	P01	49	1	ROS	101707	0927	BE	47 0.73 N	169 10.98 E	GPS	2652	2652						
49MR0706_1	P01	49	1	BUC	101707	0935	UN	47 0.67 N	169 11.04 E	GPS	2645	2645					1	9.1C
49MR0706_1	P01	49	1	ROS	101707	1013	BO	47 0.47 N	169 11.08 E	GPS	2649	2648	10	2656	2667	22	1-8,27	
49MR0706_1	P01	49	1	ROS	101707	1131	EN	47 0.06 N	169 11.07 E	GPS	2698	2698						
49MR0706_1	P01	50	1	ROS	101707	1252	BE	46 59.38 N	169 34.41 E	GPS	2389	2388						
49MR0706_1	P01	50	1	BUC	101707	1301	UN	46 59.34 N	169 34.42 E	GPS	2394	2394					1	9.3C
49MR0706_1	P01	50	1	ROS	101707	1336	BO	46 59.15 N	169 34.43 E	GPS	2401	2401	9	2402	2400	22	1-8,23,24,26,27	
49MR0706_1	P01	50	1	ROS	101707	1458	EN	46 58.82 N	169 34.37 E	GPS	2421	2420						
49MR0706_1		607	1	UNK	101707	1509	BE	46 58.96 N	169 33.67 E	GPS	2471	2470						3-AXIS MAGNETOMETER CALIBRATION
49MR0706_1		607	1	UNK	101707	1529	EN	46 58.83 N	169 33.48 E	GPS	2488	2487						
49MR0706_1	P01	51	1	ROS	101707	1633	BE	46 58.81 N	169 48.61 E	GPS	3882	3882						
49MR0706_1	P01	51	1	BUC	101707	1642	UN	46 58.71 N	169 48.59 E	GPS	3882	3882					1	9.3C
49MR0706_1	P01	51	1	ROS	101707	1739	BO	46 58.23 N	169 48.56 E	GPS	4050	4050	78	3972	3990	28	1-8,23,24,26,27	HAB MEASURED BY LADCP
49MR0706_1	P01	51	1	ROS	101707	1920	EN	46 57.52 N	169 48.35 E	GPS	4156	4156						
49MR0706_1	P01	52	1	ROS	101707	2129	BE	46 59.64 N	169 59.69 E	GPS	4964	4964						
49MR0706_1	P01	52	1	BUC	101707	2142	UN	46 59.57 N	169 59.81 E	GPS	4947	4954					1	9.3C
49MR0706_1	P01	52	1	ROS	101707	2249	BO	46 59.13 N	169 59.82 E	GPS	4922	4922	12	4962	5015	32	1-8,23,24,26,27	
49MR0706_1	P01	52	1	ROS	101807	0045	EN	46 58.50 N	169 59.84 E	GPS	4940	4940						
49MR0706_1	P01	53	1	ROS	101807	0330	BE	47 0.25 N	170 28.51 E	GPS	6342	6342						WITHOUT FLUOROMETER/LADCP
49MR0706_1	P01	53	1	BUC	101807	0338	UN	47 0.17 N	170 28.55 E	GPS	6339	6339					1	9.6C
49MR0706_1	P01	53	1	UNK	101807	0351	UN	47 0.06 N	170 28.53 E	GPS	6337	6337						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P01	53	1	ROS	101807	0509	BO	46 59.61 N	170 28.20 E	GPS	6341	6341	11	6405	6464	36	1-8,22,27	
49MR0706_1	P01	53	1	ROS	101807	0807	EN	46 58.56 N	170 27.04 E	GPS	6348	6342						
49MR0706_1	P01	54	1	ROS	101807	1131	BE	47 0.25 N	171 36.62 E	GPS	6099	6100						WITHOUT FLUOROMETER/LADCP
49MR0706_1	P01	54	1	BUC	101807	1140	UN	47 0.19 N	171 36.61 E	GPS	6103	6102					1	10.3C
49MR0706_1	P01	54	1	ROS	101807	1306	BO	47 0.12 N	171 36.64 E	GPS	6079	6080	10	6092	6196	36	1-8,15,23,24,26,27,45	#10 MISS TRIP
49MR0706_1	P01	54	1	ROS	101807	1558	EN	46 59.88 N	171 36.98 E	GPS	5999	6000						
49MR0706_1	P01	55	1	ROS	101807	1904	BE	47 0.45 N	172 42.61 E	GPS	5611	5605						
49MR0706_1	P01	55	1	BUC	101807	1912	UN	47 0.35 N	172 42.69 E	GPS	5610	5608					1	9.0C
49MR0706_1	P01	55	1	UNK	101807	1924	UN	47 0.22 N	172 42.80 E	GPS	5610	5608						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P01	55	1	ROS	101807	2031	BO	46 59.77 N	172 43.01 E	GPS	5641	5639	10	5662	5719	36	1-8,15,22,27,45	
49MR0706_1	P01	55	1	ROS	101807	2249	EN	46 59.02 N	172 43.20 E	GPS	5680	5678						
49MR0706_1	P01	56	1	ROS	101907	0159	BE	47 0.55 N	173 49.78 E	GPS	5796	5799						
49MR0706_1	P01	56	1	BUC	101907	0208	UN	47 0.51 N	173 49.81 E	GPS	5801	5802					1	9.3C
49MR0706_1	P01	56	1	ROS	101907	0330	BO	47 0.31 N	173 49.80 E	GPS	5810	5811	10	5813	5904	36	1-8,12,13,23,24,26,27,42,43	
49MR0706_1	P01	56	1	ROS	101907	0603	EN	46 59.68 N	173 49.48 E	GPS	5824	5825						
49MR0706_1	P01	57	1	ROS	101907	0925	BE	47 0.41 N	174 57.90 E	GPS	5669	5668						
49MR0706_1	P01	57	1	BUC	101907	0933	UN	47 0.35 N	174 57.90 E	GPS	5675	5673					1	9.6C
49MR0706_1	P01	57	1	ROS	101907	1052	BO	47 0.37 N	174 57.54 E	GPS	5696	5695	10	5698	5776	36	1-8,27	#2=#10 DUPLICATE SMPL
49MR0706_1	P01	57	1	ROS	101907	1316	EN	47 0.20 N	174 56.80 E	GPS	5686	5685						
49MR0706_1	P01	58	3	ROS	101907	1641	BE	47 0.03 N	176 5.73 E	GPS	5693	5692						
49MR0706_1	P01	58	3	BUC	101907	1650	UN	46 59.98 N	176 5.75 E	GPS	5691	5691					1	9.4C
49MR0706_1	P01	58	3	ROS	101907	1811	BO	46 59.79 N	176 5.73 E	GPS	5696	5695	10	5714	5804	35	1-8,23,24,26,27	
49MR0706_1	P01	58	3	ROS	101907	2032	EN	46 59.12 N	176 5.54 E	GPS	5707	5705						
49MR0706_1	P01	59	1	ROS	101907	2349	BE	47 0.28 N	177 11.45 E	GPS	5662	5662						
49MR0706_1	P01	59	1	BUC	102007	0000	UN	47 0.17 N	177 11.35 E	GPS	5658	5659					1	9.4C
49MR0706_1	P01	59	1	UNK	102007	0016	UN	47 0.10 N	177 11.31 E	GPS	5670	5671						80L THROUGH HULL PUMP FOR R.N.

49MR0706_1	P01	59	1	ROS	102007	0118	BO	46 59.81 N	177 10.60 E	GPS	5675	5675	10	5751	5776	36	1-8,22,27	
49MR0706_1	P01	59	1	ROS	102007	0357	EN	46 59.26 N	177 9.09 E	GPS	5668	5669						
49MR0706_1	P01	60	2	ROS	102007	0738	BE	47 0.24 N	178 18.28 E	GPS	5763	5762						
49MR0706_1	P01	60	2	BUC	102007	0750	UN	47 0.16 N	178 18.07 E	GPS	5753	5753					1	9.3C
49MR0706_1	P01	60	2	ROS	102007	0909	BO	46 59.94 N	178 17.48 E	GPS	5753	5752	10	5806	5863	36	1-8,12,13,15,23,24,26,27,45	
49MR0706_1	P01	60	2	ROS	102007	1131	EN	46 59.42 N	178 16.20 E	GPS	5726	5726						
49MR0706_1	P01	61	2	ROS	102007	1507	BE	47 0.86 N	179 27.17 E	GPS	5647	5647						
49MR0706_1	P01	61	2	BUC	102007	1520	UN	47 0.83 N	179 27.18 E	GPS	5638	5643					1	9.2C
49MR0706_1	P01	61	2	ROS	102007	1644	BO	47 0.33 N	179 26.57 E	GPS	5594	5594	10	5727	5762	35	1-8,15,27,45	
49MR0706_1	P01	61	2	ROS	102007	1907	EN	46 59.40 N	179 25.55 E	GPS	5642	5641						
49MR0706_1	P14N	29	1	ROS	102107	0049	BE	47 59.67 N	179 0.11 E	GPS	5330	5330						
49MR0706_1	P14N	29	1	BUC	102107	0100	UN	47 59.61 N	178 59.98 E	GPS	5319	5318					1	9.3C
49MR0706_1	P14N	29	1	ROS	102107	0215	BO	47 59.51 N	178 59.56 E	GPS	5312	5312	10	5332	5412	34	1-8,27	
49MR0706_1	P14N	29	1	ROS	102107	0437	EN	47 59.50 N	178 58.99 E	GPS	5346	5345						
49MR0706_1	P14N	28	1	ROS	102107	0726	BE	48 29.85 N	178 59.91 E	GPS	5462	5461						
49MR0706_1	P14N	28	1	BUC	102107	0740	UN	48 29.74 N	178 59.91 E	GPS	5464	5463					1	8.3C
49MR0706_1	P14N	28	1	UNK	102107	0845	UN	48 29.36 N	178 59.52 E	GPS	5532	5532						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	28	1	ROS	102107	0859	BO	48 29.27 N	178 59.39 E	GPS	5536	5536	11	5566	5600	35	1-8,23,24,26,27	
49MR0706_1	P14N	28	1	ROS	102107	1115	EN	48 28.75 N	178 57.95 E	GPS	5518	5517						
49MR0706_1	P14N	27	1	ROS	102107	1356	BE	48 59.68 N	178 59.72 E	GPS	4755	4755						
49MR0706_1	P14N	27	1	BUC	102107	1404	UN	48 59.68 N	178 59.64 E	GPS	4757	4757					1	8.1C
49MR0706_1		608	1	UNK	102107	1422	UN	48 59.62 N	178 59.55 E	GPS	4755	4755						AIR SMPL FOR BVOC #1
49MR0706_1	P14N	27	1	ROS	102107	1512	BO	48 59.60 N	178 59.37 E	GPS	4757	4756	9	4779	4840	32	1-8,15,23,24,26,27,45	
49MR0706_1	P14N	27	1	ROS	102107	1721	EN	48 59.21 N	178 58.99 E	GPS	4563	4563						
49MR0706_1	P14N	26	1	ROS	102107	1950	BE	49 29.94 N	178 59.60 E	GPS	4890	4889						
49MR0706_1	P14N	26	1	BUC	102107	2000	UN	49 29.86 N	178 59.64 E	GPS	4889	4888					1,32,34,84,86,87	8.2C
49MR0706_1	P14N	26	1	ROS	102107	2112	BO	49 29.46 N	178 59.49 E	GPS	4875	4876	9	4928	4966	34	1-8,15,27,32,34,45,84,86,87	
49MR0706_1	P14N	26	1	ROS	102107	2313	EN	49 28.44 N	178 58.47 E	GPS	4918	4918						
49MR0706_1		609	1	UNK	102107	2332	UN	49 30.87 N	178 58.32 E	GPS	4872	4873						RAIN SMPL FOR STABLE ISOTOPE #6
49MR0706_1	P14N	25	1	ROS	102207	0144	BE	50 0.38 N	178 59.98 E	GPS	4999	4999						
49MR0706_1	P14N	25	1	BUC	102207	0152	UN	50 0.34 N	178 59.96 E	GPS	5023	5026					1	8.3C
49MR0706_1	P14N	25	1	ROS	102207	0304	BO	50 0.41 N	178 59.61 E	GPS	4981	4981	10	5055	5119	33	1-8,23,24,26,27	
49MR0706_1	P14N	25	1	ROS	102207	0517	EN	50 0.34 N	178 58.96 E	GPS	4996	4995						
49MR0706_1	P14N	24	1	ROS	102207	0722	BE	50 14.44 N	179 8.01 E	GPS	6808	6807						WITHOUT FLUOROMETER/LADCP
49MR0706_1	P14N	24	1	BUC	102207	0732	UN	50 14.46 N	179 8.08 E	GPS	6823	6831					1	7.6C
49MR0706_1	P14N	24	1	UNK	102207	0745	UN	50 14.45 N	179 8.23 E	GPS	6809	6807						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	24	1	ROS	102207	0859	BO	50 14.66 N	179 9.04 E	GPS	6832	6831	-9	6434	6503	36	1-8,22,27	
49MR0706_1	P14N	24	1	ROS	102207	1148	EN	50 14.81 N	179 11.50 E	GPS	6743	6742						
49MR0706_1	P14N	23	1	ROS	102207	1339	BE	50 28.43 N	179 16.06 E	GPS	7014	7015						WITHOUT FLUOROMETER/LADCP
49MR0706_1	P14N	23	1	BUC	102207	1346	UN	50 28.47 N	179 16.10 E	GPS	7004	7005					1	7.4C
49MR0706_1	P14N	23	1	ROS	102207	1515	BO	50 28.96 N	179 16.53 E	GPS	6967	6967	-9	6426	6500	36	1-8,12,13,23,24,26,27,85	
49MR0706_1	P14N	23	1	ROS	102207	1817	EN	50 29.55 N	179 18.23 E	GPS	6919	6917						
49MR0706_1	P14N	22	1	ROS	102207	2051	BE	50 42.00 N	179 25.09 E	GPS	4549	4550						
49MR0706_1	P14N	22	1	BUC	102207	2101	UN	50 42.04 N	179 25.13 E	GPS	4550	4551					1	6.6C
49MR0706_1	P14N	22	1	ROS	102207	2202	BO	50 42.28 N	179 25.74 E	GPS	4560	4561	9	4601	4619	33	1-8,27,85	
49MR0706_1	P14N	22	1	ROS	102207	2354	EN	50 42.63 N	179 26.16 E	GPS	4567	4568						
49MR0706_1	P14N	21	1	ROS	102307	0158	BE	50 56.06 N	179 34.22 E	GPS	4014	4013						
49MR0706_1	P14N	21	1	BUC	102307	0206	UN	50 56.15 N	179 34.19 E	GPS	4021	4021					1	6.2C
49MR0706_1	P14N	21	1	ROS	102307	0305	BO	50 56.50 N	179 34.15 E	GPS	3997	3997	10	4030	4065	29	1-8,27	
49MR0706_1	P14N	21	1	ROS	102307	0458	EN	50 57.23 N	179 35.02 E	GPS	3956	3957						
49MR0706_1	P14N	20	1	ROS	102307	0655	BE	51 9.87 N	179 44.34 E	GPS	2621	2622						

49MR0706_1	P14N	20	1	BUC	102307	0705	UN	51 10.03 N	179 44.36 E	GPS	2532	2532					1	6.1C
49MR0706_1	P14N	20	1	UNK	102307	0713	UN	51 10.15 N	179 44.37 E	GPS	2436	2437						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	20	1	ROS	102307	0740	BO	51 10.45 N	179 44.67 E	GPS	2339	2340	10	2430	2392	21	1-8,23,24,26,27	
49MR0706_1	P14N	20	1	ROS	102307	0852	EN	51 11.20 N	179 45.30 E	GPS	2230	2231						
49MR0706_1	P14N	19	1	ROS	102307	1048	BE	51 24.02 N	179 53.97 E	GPS	1526	1526						
49MR0706_1	P14N	19	1	BUC	102307	1057	UN	51 24.04 N	179 54.11 E	GPS	1550	1550					1	6.1C
49MR0706_1	P14N	19	1	ROS	102307	1120	BO	51 24.09 N	179 54.51 E	GPS	1615	1616	10	1598	1597	17	1-8,23,24,26,27	
49MR0706_1		610	1	UNK	102307	1201	UN	51 24.09 N	179 55.42 E	GPS	1697	1697						AIR SMPL FOR BVOC #2
49MR0706_1		611	1	UNK	102307	1210	UN	51 24.12 N	179 55.47 E	GPS	1703	1703						RAIN SMPL FOR STABLE ISOTOPE #7
49MR0706_1	P14N	19	1	ROS	102307	1214	EN	51 24.14 N	179 55.52 E	GPS	1703	1703						
49MR0706_1	P14N	18	1	ROS	102307	1413	BE	51 37.68 N	179 56.42 W	GPS	1890	1890						
49MR0706_1	P14N	18	1	BUC	102307	1419	UN	51 37.66 N	179 56.42 W	GPS	1891	1892					1	6.5C
49MR0706_1	P14N	18	1	ROS	102307	1447	BO	51 37.68 N	179 56.29 W	GPS	1890	1890	10	1891	1902	19	1-8,27	
49MR0706_1	P14N	18	1	ROS	102307	1553	EN	51 37.50 N	179 55.82 W	GPS	1895	1895						
49MR0706_1	P14N	17	1	ROS	102307	1758	BE	51 51.50 N	179 47.13 W	GPS	2114	2112						
49MR0706_1	P14N	17	1	BUC	102307	1807	UN	51 51.49 N	179 47.04 W	GPS	2104	2102					1,32,34,84,86,87	6.6C
49MR0706_1	P14N	17	1	ROS	102307	1837	BO	51 51.43 N	179 46.78 W	GPS	2084	2083	9	2123	2126	20	1-8,23,24,26,27,32,34,84,86,87	
49MR0706_1	P14N	17	1	ROS	102307	1943	EN	51 51.09 N	179 46.57 W	GPS	2051	2049						
49MR0706_1	P14N	16	1	ROS	102307	2149	BE	52 4.14 N	179 23.15 W	GPS	2939	2939						
49MR0706_1	P14N	16	1	BUC	102307	2157	UN	52 4.20 N	179 23.10 W	GPS	2933	2932					1	6.3C
49MR0706_1	P14N	16	1	UNK	102307	2208	UN	52 4.19 N	179 23.07 W	GPS	2954	2953						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	16	1	ROS	102307	2239	BO	52 4.14 N	179 22.94 W	GPS	2979	2979	12	2950	2975	24	1-8,27	
49MR0706_1	P14N	16	1	ROS	102307	2353	EN	52 4.15 N	179 22.76 W	GPS	2978	2977						
49MR0706_1	P14N	15	1	ROS	102407	0159	BE	52 15.42 N	178 59.93 W	GPS	3304	3304						
49MR0706_1	P14N	15	1	BUC	102407	0206	UN	52 15.47 N	178 59.90 W	GPS	3304	3304					1	6.6C
49MR0706_1	P14N	15	1	ROS	102407	0254	BO	52 15.68 N	178 59.54 W	GPS	3308	3308	9	3333	3348	26	1-8,23,24,26,27	
49MR0706_1	P14N	15	1	ROS	102407	0426	EN	52 16.14 N	178 58.52 W	GPS	3322	3322						
49MR0706_1	P14N	15	1	FLT	102407	0434	DE	52 16.13 N	178 58.20 W	GPS	3331	3330						ARGO #3268/ID33318
49MR0706_1	P14N	14	1	ROS	102407	0631	BE	52 30.26 N	178 46.11 W	GPS	3472	3470						
49MR0706_1	P14N	14	1	BUC	102407	0640	UN	52 30.33 N	178 45.98 W	GPS	3470	3469					1	6.6C
49MR0706_1	P14N	14	1	ROS	102407	0729	BO	52 30.47 N	178 45.35 W	GPS	3478	3477	10	3521	3515	26	1-8,15,27,45	
49MR0706_1	P14N	14	1	ROS	102407	0856	EN	52 30.77 N	178 44.88 W	GPS	3485	3484						
49MR0706_1	P14N	13	1	ROS	102407	1111	BE	53 0.04 N	178 35.62 W	GPS	3713	3713						
49MR0706_1	P14N	13	1	BUC	102407	1119	UN	53 0.09 N	178 35.45 W	GPS	3715	3715					1	6.8C
49MR0706_1	P14N	13	1	ROS	102407	1211	BO	53 0.21 N	178 34.62 W	GPS	3718	3718	9	3763	3766	28	1-8,15,23,24,26,27,45	
49MR0706_1	P14N	13	1	ROS	102407	1345	EN	53 0.34 N	178 33.18 W	GPS	3718	3719						
49MR0706_1	P14N	12	1	ROS	102407	1606	BE	53 29.87 N	178 15.12 W	GPS	3773	3772						
49MR0706_1	P14N	12	1	BUC	102407	1614	UN	53 29.89 N	178 14.94 W	GPS	3771	3770					1	6.7C
49MR0706_1	P14N	12	1	UNK	102407	1645	UN	53 29.69 N	178 14.43 W	GPS	3771	3770						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	12	1	ROS	102407	1708	BO	53 29.54 N	178 14.25 W	GPS	3769	3767	10	3826	3825	36	1-8,22,27	
49MR0706_1	P14N	12	1	ROS	102407	1846	EN	53 29.26 N	178 13.94 W	GPS	3771	3770						
49MR0706_1	P14N	12	1	FLT	102407	1855	DE	53 29.33 N	178 14.01 W	GPS	3771	3769						ARGO #3264/ID33314
49MR0706_1		612	1	UNK	102407	1938	UN	53 38.00 N	178 8.16 W	GPS	3789	3788						RAIN SMPL FOR STABLE ISOTOPE #8
49MR0706_1	P14N	11	1	ROS	102407	2120	BE	54 0.02 N	177 54.19 W	GPS	3801	3802						
49MR0706_1	P14N	11	1	BUC	102407	2129	UN	54 0.01 N	177 54.01 W	GPS	3800	3800					1	6.5C
49MR0706_1		613	1	UNK	102407	2142	UN	53 59.93 N	177 53.84 W	GPS	3801	3802						AIR SMPL FOR BVOC #3
49MR0706_1	P14N	11	1	ROS	102407	2222	BO	53 59.67 N	177 53.35 W	GPS	3800	3800	9	3876	3852	36	1-8,12,13,23,24,26,27,40,43	
49MR0706_1	P14N	11	1	ROS	102407	2355	EN	53 59.55 N	177 52.97 W	GPS	3802	3801						
49MR0706_1	P14N	10	1	ROS	102507	0225	BE	54 29.65 N	177 33.67 W	GPS	3792	3791						
49MR0706_1	P14N	10	1	BUC	102507	0232	UN	54 29.61 N	177 33.59 W	GPS	3792	3791					1	6.1C
49MR0706_1	P14N	10	1	ROS	102507	0326	BO	54 29.59 N	177 33.34 W	GPS	3792	3791	10	3797	3842	28	1-8,27	

49MR0706_1	P14N	10	1	ROS	102507	0507	EN	54 29.78 N	177 33.13 W	GPS	3792	3791						
49MR0706_1	P14N	9	1	ROS	102507	0738	BE	54 59.95 N	177 11.93 W	GPS	3776	3775						REPLACED BTL #10
49MR0706_1	P14N	9	1	BUC	102507	0747	UN	54 59.99 N	177 11.76 W	GPS	3777	3775					1	6.0C
49MR0706_1	P14N	9	1	UNK	102507	0756	UN	55 0.00 N	177 11.55 W	GPS	3778	3777						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	9	1	ROS	102507	0840	BO	54 59.85 N	177 10.88 W	GPS	3778	3778	9	3830	3831	28	1-8,23,24,26,27	
49MR0706_1	P14N	9	1	ROS	102507	1009	EN	54 59.63 N	177 9.33 W	GPS	3780	3779						
49MR0706_1	P14N	9	1	FLT	102507	1018	DE	54 59.59 N	177 9.45 W	GPS	3779	3777						ARGO #3265/ID33315
49MR0706_1	P14N	8	1	ROS	102507	1240	BE	55 29.81 N	176 50.52 W	GPS	3753	3752						
49MR0706_1	P14N	8	1	BUC	102507	1249	UN	55 29.80 N	176 50.49 W	GPS	3752	3754					1	6.0C
49MR0706_1	P14N	8	1	ROS	102507	1342	BO	55 29.89 N	176 50.29 W	GPS	3753	3753	10	3763	3806	27	1-8,27	
49MR0706_1	P14N	8	1	ROS	102507	1520	EN	55 30.07 N	176 50.39 W	GPS	3752	3752						
49MR0706_1	P14N	7	1	ROS	102507	1751	BE	56 0.06 N	176 29.91 W	GPS	3716	3716						REPLACED BTL #10
49MR0706_1	P14N	7	1	BUC	102507	1801	UN	56 0.03 N	176 29.74 W	GPS	3718	3717					1,32,34,84,86,87	5.7C
49MR0706_1	P14N	7	1	ROS	102507	1856	BO	55 59.70 N	176 28.94 W	GPS	3716	3716	10	3784	3770	27	1-8,23,24,26,27,32,34,84,86,87	
49MR0706_1	P14N	7	1	ROS	102507	2028	EN	55 58.97 N	176 27.61 W	GPS	3716	3716						
49MR0706_1	P14N	6	1	ROS	102507	2311	BE	56 30.15 N	176 5.68 W	GPS	3674	3673						
49MR0706_1	P14N	6	1	BUC	102507	2322	UN	56 30.07 N	176 5.64 W	GPS	3675	3674					1	5.4C
49MR0706_1		614	1	UNK	102507	2330	UN	56 30.02 N	176 5.65 W	GPS	3674	3674						AIR SMPL FOR BVOC #4
49MR0706_1	P14N	6	1	UNK	102507	2330	UN	56 30.01 N	176 5.65 W	GPS	3674	3674						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	6	1	ROS	102607	0012	BO	56 29.72 N	176 5.64 W	GPS	3675	3676	10	3697	3726	36	1-8,22,27	
49MR0706_1	P14N	6	1	ROS	102607	0146	EN	56 29.05 N	176 5.54 W	GPS	3675	3676						
49MR0706_1	P14N	6	1	FLT	102607	0155	DE	56 29.22 N	176 5.71 W	GPS	3672	3672						ARGO #3260/ID33306
49MR0706_1	P14N	5	1	ROS	102607	0455	BE	56 59.04 N	175 39.80 W	GPS	3481	3479						
49MR0706_1	P14N	5	1	BUC	102607	0510	UN	56 58.90 N	175 39.97 W	GPS	3485	3484					1	5.7C
49MR0706_1		615	1	UNK	102607	0537	UN	56 58.79 N	175 40.31 W	GPS	3484	3483						RAIN SMPL FOR STABLE ISOTOPE #9
49MR0706_1	P14N	5	1	ROS	102607	0559	BO	56 58.74 N	175 40.39 W	GPS	3483	3482	8	3498	3529	26	1-8,12,13,23,24,26,27	
49MR0706_1	P14N	5	1	ROS	102607	0730	EN	56 58.43 N	175 41.12 W	GPS	3481	3480						
49MR0706_1	P14N	1	1	ROS	102707	0006	BE	59 0.11 N	173 59.67 W	GPS	124	123						
49MR0706_1	P14N	1	1	BUC	102707	0007	UN	59 0.11 N	173 59.69 W	GPS	124	123					1	5.7C
49MR0706_1	P14N	1	1	UNK	102707	0007	UN	59 0.12 N	173 59.70 W	GPS	124	123						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	1	1	ROS	102707	0013	BO	59 0.11 N	173 59.74 W	GPS	123	123	-9	110	114	4	1-8,27	ALTIMETER NOT WORK
49MR0706_1	P14N	1	1	ROS	102707	0023	EN	59 0.08 N	173 59.80 W	GPS	125	123						
49MR0706_1		616	1	UNK	102707	0023	UN	59 0.08 N	173 59.80 W	GPS	125	123						AIR SMPL FOR BVOC #5
49MR0706_1		617	1	UNK	102707	0256	UN	58 29.96 N	174 24.91 W	GPS	147	148						RAIN SMPL FOR STABLE ISOTOPE #10
49MR0706_1	P14N	2	1	ROS	102707	0257	BE	58 29.95 N	174 24.94 W	GPS	148	149						
49MR0706_1	P14N	2	1	BUC	102707	0300	UN	58 29.93 N	174 24.98 W	GPS	146	146					1	5.4C
49MR0706_1	P14N	2	1	ROS	102707	0304	BO	58 29.90 N	174 25.03 W	GPS	147	147	-9	134	138	4	1-8,27	ALTIMETER NOT WORK
49MR0706_1	P14N	2	1	ROS	102707	0311	EN	58 29.90 N	174 25.19 W	GPS	146	146						
49MR0706_1	P14N	3	1	ROS	102707	0541	BE	58 0.31 N	174 51.62 W	GPS	3014	3014						
49MR0706_1	P14N	3	1	BUC	102707	0552	UN	58 0.22 N	174 51.80 W	GPS	3012	3012					1	5.8C
49MR0706_1	P14N	3	1	ROS	102707	0633	BO	58 0.02 N	174 52.33 W	GPS	3003	3002	10	3027	3039	25	1-8,23,24,26,27	
49MR0706_1	P14N	3	1	ROS	102707	0752	EN	57 59.68 N	174 53.51 W	GPS	2980	2979						
49MR0706_1	P14N	3	1	FLT	102707	0801	DE	57 59.70 N	174 53.87 W	GPS	2973	2974						ARGO #3261/ID33307
49MR0706_1	P14N	4	1	ROS	102707	1022	BE	57 29.91 N	175 14.83 W	GPS	3460	3460						
49MR0706_1	P14N	4	1	BUC	102707	1030	UN	57 29.85 N	175 14.86 W	GPS	3459	3459					1	5.7C
49MR0706_1	P14N	4	1	UNK	102707	1041	UN	57 29.80 N	175 14.93 W	GPS	3460	3460						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	4	1	ROS	102707	1119	BO	57 29.69 N	175 15.32 W	GPS	3463	3464	9	3462	3510	36	1-8,22,27	
49MR0706_1	P14N	4	1	ROS	102707	1245	EN	57 29.36 N	175 16.11 W	GPS	3468	3468						
49MR0706_1		618	1	UNK	102807	2056	UN	50 40.92 N	179 44.67 E	GPS	4978	4978						RAIN SMPL FOR STABLE ISOTOPE #11
49MR0706_1		619	1	UNK	102807	2223	BE	50 23.74 N	179 37.89 E	GPS	7154	7154						RELEASING EXCESS TWIST OF CTD CABLE AFTER CUTTING OF THE CABLE (400M)

49MR0706_1		619	1	UNK	102907	0310	EN	50 23.30 N	179 38.47 E	GPS	7294	7294						WOUT 7000M, WEIGHT OF 300KG WITH COMPASS/TILT METER
49MR0706_1		620	1	UNK	102907	0352	UN	50 16.37 N	179 37.62 E	GPS	7286	7286						RAIN SMPL FOR STABLE ISOTOPE #12
49MR0706_1		621	1	UNK	102907	0807	UN	49 15.89 N	179 21.89 E	GPS	4826	4826						RAIN SMPL FOR STABLE ISOTOPE #13
49MR0706_1	P14N	30	1	ROS	102907	1607	BE	47 29.66 N	178 59.36 E	GPS	4961	4962						REPLACED PRI AND SEC TMP SENSORS
49MR0706_1	P14N	30	1	BUC	102907	1628	UN	47 29.70 N	178 58.98 E	GPS	4895	4894					1,32,34,84,86,87	8.7C
49MR0706_1	P14N	30	1	ROS	102907	1735	BO	47 29.78 N	178 59.41 E	GPS	4973	4972	9	4984	5042	35	1-8,15,27,32,34,45,84,86,87	
49MR0706_1	P14N	30	1	ROS	102907	1941	EN	47 29.26 N	179 0.45 E	GPS	4972	4970						
49MR0706_1	P14N	X01	1	ROS	102907	2252	BE	47 0.57 N	179 27.09 E	GPS	5634	5636						
49MR0706_1	P14N	X01	1	BUC	102907	2314	UN	47 0.27 N	179 27.27 E	GPS	5680	5680					1	8.7C
49MR0706_1	P14N	X01	1	ROS	103007	0041	BO	46 58.99 N	179 27.20 E	GPS	5677	5679	11	5858	5718	36	1-8,12,13,15,23,24,26,27,40,42,43,45	
49MR0706_1	P14N	X01	1	ROS	103007	0311	EN	46 57.35 N	179 26.29 E	GPS	5447	5450						
49MR0706_1	P14N	32	1	ROS	103007	0554	BE	46 29.88 N	179 0.31 E	GPS	5638	5640						
49MR0706_1	P14N	32	1	BUC	103007	0610	UN	46 29.72 N	179 0.27 E	GPS	5598	5598					1	9.1C
49MR0706_1		622	1	UNK	103007	0613	UN	46 29.70 N	179 0.28 E	GPS	5647	5645						AIR SMPL FOR BVOC #6
49MR0706_1	P14N	32	1	UNK	103007	0626	UN	46 29.60 N	179 0.25 E	GPS	5621	5621						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	32	1	ROS	103007	0725	BO	46 29.30 N	179 0.36 E	GPS	5637	5636	9	5636	5709	36	1-8,22,27	
49MR0706_1	P14N	32	1	ROS	103007	0941	EN	46 29.57 N	179 0.88 E	GPS	5608	-9						UNC DEPTH QUESTIONABLE
49MR0706_1	P14N	33	1	ROS	103007	1223	BE	45 59.86 N	179 0.36 E	GPS	5739	5742						
49MR0706_1	P14N	33	1	BUC	103007	1239	UN	45 59.89 N	179 0.53 E	GPS	5719	5719					1	9.6C
49MR0706_1	P14N	33	1	ROS	103007	1358	BO	45 59.53 N	179 1.09 E	GPS	5721	5723	10	5760	5835	36	1-8,27	
49MR0706_1	P14N	33	1	ROS	103007	1627	EN	45 58.79 N	179 2.09 E	GPS	5733	5733						
49MR0706_1	P14N	34	1	ROS	103007	1851	BE	45 30.08 N	179 0.45 E	GPS	5811	5812						REPLACED SEC TMP SENSOR
49MR0706_1	P14N	34	1	BUC	103007	1906	UN	45 29.96 N	179 0.81 E	GPS	5810	5811					1	11.3C
49MR0706_1	P14N	34	1	ROS	103007	2029	BO	45 29.83 N	179 1.68 E	GPS	5794	5796	9	5866	5928	36	1-8,23,24,26,27,85	
49MR0706_1	P14N	34	1	ROS	103007	2249	EN	45 29.55 N	179 2.44 E	GPS	5764	5767						
49MR0706_1	P14N	35	1	ROS	103107	0410	BE	45 0.73 N	179 0.27 E	GPS	5773	5773						
49MR0706_1	P14N	35	1	BUC	103107	0425	UN	45 0.78 N	179 0.42 E	GPS	5792	5794					1	11.3C
49MR0706_1	P14N	35	1	ROS	103107	0546	BO	45 0.64 N	179 0.85 E	GPS	5776	5775	11	5844	5929	36	1-8,27,85	
49MR0706_1	P14N	35	1	ROS	103107	0808	EN	45 0.39 N	179 1.84 E	GPS	5768	5768						
49MR0706_1		623	1	UNK	103107	0917	UN	44 47.66 N	179 1.85 E	GPS	5658	5657						RAIN SMPL FOR STABLE ISOTOPE #14
49MR0706_1	P14N	36	1	ROS	103107	1043	BE	44 30.03 N	179 0.96 E	GPS	5678	5677						
49MR0706_1	P14N	36	1	BUC	103107	1059	UN	44 29.86 N	179 1.06 E	GPS	5688	5685					1	11.6C
49MR0706_1	P14N	36	1	UNK	103107	1112	UN	44 29.78 N	179 0.95 E	GPS	5702	5699						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	36	1	ROS	103107	1220	BO	44 29.59 N	179 0.55 E	GPS	5749	5747	10	5763	5819	36	1-8,22,27	
49MR0706_1	P14N	36	1	ROS	103107	1447	EN	44 29.21 N	178 59.48 E	GPS	5751	5749						
49MR0706_1	P14N	37	1	ROS	103107	1707	BE	43 59.80 N	178 59.59 E	GPS	5639	5638						
49MR0706_1	P14N	37	1	BUC	103107	1719	UN	43 59.68 N	178 59.40 E	GPS	5654	5653					1,32,34,84,86,87	11.0C
49MR0706_1		624	1	UNK	103107	1733	UN	43 59.66 N	178 59.30 E	GPS	5653	5652						AIR SMPL FOR BVOC #7
49MR0706_1	P14N	37	1	ROS	103107	1836	BO	43 59.73 N	178 58.60 E	GPS	5651	5650	10	5716	5755	36	1-8,15,23,24,26,27,32,34,45,84,86,87	
49MR0706_1	P14N	37	1	ROS	103107	2052	EN	43 59.36 N	178 57.39 E	GPS	5679	5679						
49MR0706_1	P14N	38	1	ROS	103107	2319	BE	43 30.03 N	179 0.07 E	GPS	5815	5817						
49MR0706_1	P14N	38	1	BUC	103107	2327	UN	43 30.09 N	179 0.09 E	GPS	5814	5815					1	11.6C
49MR0706_1	P14N	38	1	ROS	110107	0051	BO	43 29.94 N	179 0.76 E	GPS	5810	5811	11	5864	5923	36	1-8,15,27,45	
49MR0706_1	P14N	38	1	ROS	110107	0318	EN	43 29.17 N	179 2.21 E	GPS	5747	5747						
49MR0706_1	P14N	39	1	ROS	110107	0537	BE	42 58.70 N	179 0.12 E	GPS	5636	5637						
49MR0706_1	P14N	39	1	BUC	110107	0546	UN	42 58.60 N	179 0.23 E	GPS	5649	5651					1	13.1C
49MR0706_1	P14N	39	1	UNK	110107	0554	UN	42 58.56 N	179 0.30 E	GPS	5645	5646						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	39	1	ROS	110107	0706	BO	42 57.96 N	179 0.08 E	GPS	5655	5656	10	5746	5761	36	1-8,23,24,26,27	
49MR0706_1	P14N	39	1	ROS	110107	0927	EN	42 57.26 N	178 59.11 E	GPS	5686	5689						
49MR0706_1	P14N	40	1	ROS	110107	1132	BE	42 28.89 N	179 0.58 E	GPS	5809	5809						

49MR0706_1	P14N	40	1	BUC	110107	1141	UN	42 28.80 N	179 0.58 E	GPS	5800	5800					1	13.5C
49MR0706_1	P14N	40	1	ROS	110107	1301	BO	42 28.74 N	179 0.18 E	GPS	5851	5851	10	5826	5896	36	1-8,27,28	
49MR0706_1	P14N	40	1	ROS	110107	1528	EN	42 28.58 N	178 59.10 E	GPS	5860	5860						
49MR0706_1	P14N	41	1	ROS	110107	1741	BE	41 58.80 N	179 0.34 E	GPS	4973	4974						
49MR0706_1	P14N	41	1	BUC	110107	1749	UN	41 58.79 N	179 0.28 E	GPS	4990	4991					1	14.4C
49MR0706_1	P14N	41	1	ROS	110107	1902	BO	41 58.76 N	178 59.62 E	GPS	5112	5113	11	5065	5104	34	1-8,27,85	
49MR0706_1	P14N	41	1	ROS	110107	2102	EN	41 58.62 N	178 59.19 E	GPS	5189	5190						
49MR0706_1	P14N	42	1	ROS	110107	2325	BE	41 29.49 N	178 59.68 E	GPS	4939	4939						
49MR0706_1	P14N	42	1	BUC	110107	2335	UN	41 29.51 N	178 59.66 E	GPS	4946	4946					1	16.6C
49MR0706_1		625	1	UNK	110107	2343	UN	41 29.54 N	178 59.68 E	GPS	4934	4934						AIR SMPL FOR BVOC #8
49MR0706_1	P14N	42	1	ROS	110207	0044	BO	41 29.30 N	179 0.02 E	GPS	4989	4988	10	4941	4970	32	1-8,12,13,23,24,26,27,85	
49MR0706_1	P14N	42	1	ROS	110207	0245	EN	41 28.27 N	179 1.34 E	GPS	5352	5352						
49MR0706_1	P14N	43	1	ROS	110207	0453	BE	40 59.28 N	179 0.36 E	GPS	5612	5612						
49MR0706_1	P14N	43	1	BUC	110207	0501	UN	40 59.16 N	179 0.38 E	GPS	5534	5532					1	15.8C
49MR0706_1	P14N	43	1	UNK	110207	0514	UN	40 59.03 N	179 0.31 E	GPS	5514	5514						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	43	1	ROS	110207	0620	BO	40 58.39 N	178 59.84 E	GPS	5436	5435	9	5614	5583	36	1-8,22,27	
49MR0706_1	P14N	43	1	ROS	110207	0836	EN	40 57.74 N	178 58.47 E	GPS	5721	5721						
49MR0706_1	P14N	44	1	ROS	110207	1040	BE	40 29.93 N	179 0.00 E	GPS	5868	5868						
49MR0706_1	P14N	44	1	BUC	110207	1048	UN	40 29.92 N	179 0.00 E	GPS	5869	5868					1	16.3C
49MR0706_1	P14N	44	1	ROS	110207	1211	BO	40 30.16 N	178 59.70 E	GPS	5882	5882	11	5908	5981	36	1-8,23,24,26,27	
49MR0706_1	P14N	44	1	ROS	110207	1438	EN	40 30.80 N	178 59.83 E	GPS	5880	5879						
49MR0706_1	P14N	45	1	ROS	110207	1701	BE	40 0.11 N	179 0.06 E	GPS	5481	5482						
49MR0706_1	P14N	45	1	BUC	110207	1710	UN	40 0.16 N	179 0.08 E	GPS	5479	5479					1	17.1C
49MR0706_1	P14N	45	2	BUC	110207	1757	UN	40 0.25 N	179 0.44 E	GPS	5457	5457					32,34,84,86,87	
49MR0706_1	P14N	45	1	ROS	110207	1828	BO	40 0.38 N	179 0.72 E	GPS	5446	5446	9	5516	5561	36	1-8,15,27,32,34,45,84,86,87	
49MR0706_1	P14N	45	1	ROS	110207	2038	EN	40 0.83 N	179 2.10 E	GPS	5319	5319						
49MR0706_1	P14N	46	1	ROS	110207	2317	BE	39 29.00 N	179 0.30 E	GPS	5601	5601						
49MR0706_1	P14N	46	1	BUC	110207	2326	UN	39 29.01 N	179 0.44 E	GPS	5602	5602					1	17.5C
49MR0706_1	P14N	46	1	ROS	110307	0045	BO	39 28.75 N	179 1.09 E	GPS	5603	5603	10	5646	5700	35	1-8,15,27,45	
49MR0706_1	P14N	46	1	ROS	110307	0301	EN	39 27.80 N	179 2.75 E	GPS	5594	5594						
49MR0706_1		626	1	UNK	110307	0335	UN	39 23.89 N	179 2.65 E	GPS	5580	5580						RAIN SMPL FOR STABLE ISOTOPE #15
49MR0706_1	P14N	47	1	ROS	110307	0539	BE	38 59.50 N	179 0.20 E	GPS	5531	5532						
49MR0706_1	P14N	47	1	BUC	110307	0548	UN	38 59.41 N	179 0.35 E	GPS	5532	5533					1	18.3C
49MR0706_1	P14N	47	1	UNK	110307	0550	UN	38 59.38 N	179 0.38 E	GPS	5529	5529						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	47	1	ROS	110307	0716	BO	38 58.23 N	179 1.52 E	GPS	5528	5529	14	5843	5624	35	1-8,23,24,26,27	
49MR0706_1		627	1	UNK	110307	0750	UN	38 57.86 N	179 1.63 E	GPS	5529	5531						AIR SMPL FOR BVOC #9
49MR0706_1	P14N	47	1	ROS	110307	0936	EN	38 57.09 N	179 1.20 E	GPS	5531	5532						
49MR0706_1	P14N	48	1	ROS	110307	1139	BE	38 28.89 N	179 0.52 E	GPS	5380	5381						
49MR0706_1	P14N	48	1	BUC	110307	1147	UN	38 28.73 N	179 0.50 E	GPS	5383	5382					1	19.0C
49MR0706_1		628	1	UNK	110307	1230	UN	38 28.48 N	179 0.17 E	GPS	5378	5378						RAIN SMPL FOR STABLE ISOTOPE #16
49MR0706_1	P14N	48	1	ROS	110307	1304	BO	38 28.43 N	178 59.94 E	GPS	5361	5360	9	5418	5474	35	1-8,27	
49MR0706_1	P14N	48	1	ROS	110307	1516	EN	38 27.88 N	178 58.95 E	GPS	5310	5309						
49MR0706_1	P14N	49	1	ROS	110307	1725	BE	37 59.74 N	179 0.67 E	GPS	5329	5331						
49MR0706_1	P14N	49	1	BUC	110307	1733	UN	37 59.70 N	179 0.62 E	GPS	5331	5333					1	18.9C
49MR0706_1	P14N	49	1	ROS	110307	1851	BO	37 59.20 N	178 59.89 E	GPS	5238	5239	10	5413	5402	34	1-8,27,28	
49MR0706_1	P14N	49	1	ROS	110307	2054	EN	37 58.90 N	178 59.16 E	GPS	5218	5219						
49MR0706_1	P14N	50	1	ROS	110307	2307	BE	37 29.54 N	178 59.92 E	GPS	5386	5386						
49MR0706_1	P14N	50	1	BUC	110307	2316	UN	37 29.52 N	179 0.04 E	GPS	5388	5389					1	19.0C
49MR0706_1	P14N	50	1	ROS	110407	0033	BO	37 29.04 N	179 0.49 E	GPS	5385	5385	9	5449	5487	36	1-8,12,13,23,24,26,27,40,42,43	
49MR0706_1	P14N	50	1	ROS	110407	0244	EN	37 27.86 N	179 1.71 E	GPS	5247	5247						
49MR0706_1	P14N	51	1	ROS	110407	0452	BE	36 59.41 N	178 59.80 E	GPS	5216	5216						

49MR0706_1	P14N	51	1	BUC	110407	0500	UN	36 59.44 N	178 59.90 E	GPS	5217	5217					1	19.3C
49MR0706_1	P14N	51	1	UNK	110407	0512	UN	36 59.40 N	179 0.01 E	GPS	5208	5209						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	51	1	ROS	110407	0615	BO	36 59.38 N	179 0.64 E	GPS	5179	5179	10	5243	5286	36	1-8,22,27	
49MR0706_1	P14N	51	1	ROS	110407	0825	EN	36 58.95 N	179 1.81 E	GPS	5193	5193						SEC CND SENSOR BROKE
49MR0706_1	P14N	51	1	FLT	110407	0833	DE	36 58.62 N	179 1.88 E	GPS	5192	5193						ARGO #3331/ID75743
49MR0706_1	P14N	52	1	ROS	110407	1036	BE	36 30.10 N	178 59.92 E	GPS	4534	4534						REPLACED SEC CND SENSOR
49MR0706_1	P14N	52	1	BUC	110407	1044	UN	36 30.06 N	179 0.04 E	GPS	4532	4532					1	20.2C
49MR0706_1		629	1	UNK	110407	1053	UN	36 30.03 N	179 0.15 E	GPS	4529	4530						AIR SMPL FOR BVOC #10
49MR0706_1	P14N	52	1	ROS	110407	1148	BO	36 29.81 N	179 0.54 E	GPS	4522	4522	9	4568	4596	31	1-8,23,24,26,27	
49MR0706_1	P14N	52	1	ROS	110407	1341	EN	36 29.09 N	179 1.05 E	GPS	4489	4489						
49MR0706_1		630	1	UNK	110407	1450	UN	36 13.74 N	179 0.56 E	GPS	3971	3970						RAIN SMPL FOR STABLE ISOTOPE #17
49MR0706_1	P14N	53	1	ROS	110407	1612	BE	35 59.61 N	179 0.09 E	GPS	4483	4484						
49MR0706_1	P14N	53	1	BUC	110407	1620	UN	35 59.54 N	179 0.12 E	GPS	4482	4482					1	21.5C
49MR0706_1	P14N	53	1	ROS	110407	1726	BO	35 59.03 N	179 0.60 E	GPS	4482	4482	10	4556	4552	30	1-8,15,27,32,34,45,84,86,87	
49MR0706_1	P14N	53	2	BUC	110407	1756	UN	35 58.74 N	179 0.85 E	GPS	4482	4482					32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	53	1	ROS	110407	1917	EN	35 57.95 N	179 1.53 E	GPS	4487	4487						
49MR0706_1	P14N	54	1	ROS	110407	2140	BE	35 30.24 N	179 1.12 E	GPS	4395	4395						
49MR0706_1	P14N	54	1	BUC	110407	2149	UN	35 30.17 N	179 1.08 E	GPS	4396	4396					1	23.0C
49MR0706_1	P14N	54	1	ROS	110407	2251	BO	35 29.91 N	179 1.11 E	GPS	4393	4392	10	4414	4457	31	1-8,15,23,24,26,27,45	#11 MISS TRIP
49MR0706_1	P14N	54	1	ROS	110507	0039	EN	35 29.54 N	179 1.30 E	GPS	4389	4389						
49MR0706_1	P14N	55	1	ROS	110507	0305	BE	35 0.24 N	179 0.02 E	GPS	3948	3949						
49MR0706_1	P14N	55	1	BUC	110507	0315	UN	35 0.22 N	179 0.06 E	GPS	3956	3956					1	23.1C
49MR0706_1	P14N	55	1	UNK	110507	0327	UN	35 0.21 N	179 0.13 E	GPS	3932	3930						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	55	1	ROS	110507	0409	BO	35 0.09 N	179 0.04 E	GPS	3948	3947	9	3941	3985	36	1-8,22,27	
49MR0706_1	P14N	55	1	ROS	110507	0549	EN	34 59.92 N	178 59.94 E	GPS	3985	3985						
49MR0706_1	P14N	55	1	FLT	110507	0556	DE	34 59.89 N	178 59.80 E	GPS	4001	4000						ARGO #3330/ID75742
49MR0706_1	P14N	56	1	ROS	110507	0819	BE	34 29.75 N	178 59.77 E	GPS	3166	3166						
49MR0706_1	P14N	56	1	BUC	110507	0827	UN	34 29.78 N	178 59.77 E	GPS	3166	3166					1	23.0C
49MR0706_1	P14N	56	1	ROS	110507	0912	BO	34 29.54 N	178 59.54 E	GPS	3152	3152	9	3189	3194	36	1-8,12,13,23,24,26,27,40,42,43	
49MR0706_1		631	1	UNK	110507	0933	UN	34 29.55 N	178 59.31 E	GPS	3136	3136						RAIN SMPL FOR STABLE ISOTOPE #18
49MR0706_1	P14N	56	1	ROS	110507	1034	EN	34 29.46 N	178 59.07 E	GPS	3117	3116						
49MR0706_1	P14N	57	1	ROS	110507	1302	BE	33 59.51 N	178 59.85 E	GPS	2261	2259						
49MR0706_1	P14N	57	1	BUC	110507	1309	UN	33 59.47 N	178 59.88 E	GPS	2259	2258					1	23.1C
49MR0706_1		632	1	UNK	110507	1320	UN	33 59.45 N	178 59.86 E	GPS	2257	2256						AIR SMPL FOR BVOC #11
49MR0706_1	P14N	57	1	ROS	110507	1342	BO	33 59.33 N	178 59.77 E	GPS	2250	2249	9	2260	2272	21	1-8,23,24,26,27	
49MR0706_1	P14N	57	1	ROS	110507	1448	EN	33 59.14 N	178 59.63 E	GPS	2240	2238						
49MR0706_1	P14N	58	1	ROS	110507	1711	BE	33 28.95 N	178 59.42 E	GPS	2935	2935						
49MR0706_1	P14N	58	1	BUC	110507	1719	UN	33 29.00 N	178 59.44 E	GPS	2939	2939					1,32,34,84,86,87	23.4C
49MR0706_1	P14N	58	1	UNK	110507	1729	UN	33 28.97 N	178 59.48 E	GPS	2929	2929						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	58	1	ROS	110507	1802	BO	33 28.84 N	178 59.38 E	GPS	2938	2938	11	2934	2950	24	1-8,23,24,26,27,85	
49MR0706_1	P14N	58	1	ROS	110507	1920	EN	33 28.74 N	178 59.35 E	GPS	2944	2943						
49MR0706_1	P14N	59	1	ROS	110507	2146	BE	32 58.69 N	178 59.33 E	GPS	4826	4827						
49MR0706_1		633	1	UNK	110507	2149	UN	32 58.71 N	178 59.30 E	GPS	4825	4827						RAIN SMPL FOR STABLE ISOTOPE #19
49MR0706_1	P14N	59	1	BUC	110507	2154	UN	32 58.72 N	178 59.27 E	GPS	4829	4830					1	23.9C
49MR0706_1	P14N	59	1	ROS	110507	2301	BO	32 58.75 N	178 58.99 E	GPS	4817	4818	10	4842	4897	34	1-8,27,85	
49MR0706_1	P14N	59	1	ROS	110607	0057	EN	32 58.77 N	178 58.02 E	GPS	4827	4828						
49MR0706_1	P14N	60	1	ROS	110607	0319	BE	32 29.10 N	178 59.75 E	GPS	5337	5339						
49MR0706_1	P14N	60	1	BUC	110607	0326	UN	32 29.09 N	178 59.89 E	GPS	5339	5341					1	23.9C
49MR0706_1	P14N	60	1	ROS	110607	0442	BO	32 29.09 N	179 0.50 E	GPS	5344	5346	10	5375	5426	33	1-8,23,24,26-28	#26 MISS FIRE
49MR0706_1	P14N	60	1	ROS	110607	0653	EN	32 28.97 N	179 1.78 E	GPS	5355	5357						
49MR0706_1		634	1	UNK	110607	0752	UN	32 16.60 N	179 0.88 E	GPS	5234	5236						RAIN SMPL FOR STABLE ISOTOPE #20

49MR0706_1	P14N	61	1	ROS	110607	0924	BE	31 59.66 N	178 59.55 E	GPS	5173	5175					
49MR0706_1	P14N	61	1	BUC	110607	0933	UN	31 59.65 N	178 59.46 E	GPS	5175	5177				1	24.0C
49MR0706_1	P14N	61	1	UNK	110607	0943	UN	31 59.66 N	178 59.39 E	GPS	5181	5184					80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	61	1	ROS	110607	1043	BO	31 59.73 N	178 59.03 E	GPS	5181	5184	8	5217	5264	36 1-8,22,27	
49MR0706_1	P14N	61	1	ROS	110607	1244	EN	31 59.85 N	178 58.69 E	GPS	5190	5191					
49MR0706_1	P14N	62	1	ROS	110607	1511	BE	31 29.95 N	179 1.03 E	GPS	5077	5076					
49MR0706_1	P14N	62	1	BUC	110607	1520	UN	31 30.01 N	179 1.02 E	GPS	5072	5071				1	25.2C
49MR0706_1		635	1	UNK	110607	1531	UN	31 30.05 N	179 1.00 E	GPS	5081	5079					AIR SMPL FOR BVOC #12
49MR0706_1	P14N	62	1	ROS	110607	1633	BO	31 30.24 N	179 0.85 E	GPS	5049	5049	10	5099	5162	35 1-8,15,27,32,34,45,84,86,87	
49MR0706_1	P14N	62	2	BUC	110607	1754	UN	31 30.36 N	179 0.77 E	GPS	5005	5001				32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	62	1	ROS	110607	1837	EN	31 30.25 N	179 0.58 E	GPS	5114	5113					
49MR0706_1	P14N	63	1	ROS	110607	2101	BE	30 59.57 N	178 59.71 E	GPS	5334	5333					
49MR0706_1	P14N	63	1	BUC	110607	2110	UN	30 59.59 N	178 59.66 E	GPS	5328	5327				1	25.5C
49MR0706_1	P14N	63	1	ROS	110607	2225	BO	30 59.55 N	178 59.39 E	GPS	5319	5317	9	5352	5427	34 1-8,15,23,24,26,27,45	#11 MISS TRIP
49MR0706_1	P14N	63	1	ROS	110707	0029	EN	30 59.57 N	178 58.30 E	GPS	5333	5333					
49MR0706_1	P14N	64	1	ROS	110707	0305	BE	30 29.68 N	178 58.96 E	GPS	5281	5279					
49MR0706_1	P14N	64	1	BUC	110707	0312	UN	30 29.63 N	178 58.91 E	GPS	5280	5279				1	25.2C
49MR0706_1	P14N	64	1	UNK	110707	0321	UN	30 29.59 N	178 58.89 E	GPS	5282	5279					80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	64	1	ROS	110707	0427	BO	30 29.39 N	178 58.82 E	GPS	5275	5274	10	5296	5366	36 1-8,22,27	#11 MISS TRIP
49MR0706_1	P14N	64	1	ROS	110707	0633	EN	30 29.36 N	178 58.92 E	GPS	5285	5284					
49MR0706_1	P14N	X02	1	ROS	110707	0900	BE	29 59.82 N	178 56.37 E	GPS	4591	4590					
49MR0706_1	P14N	X02	1	BUC	110707	0909	UN	29 59.81 N	178 56.47 E	GPS	4572	4572				1	25.3C
49MR0706_1	P14N	X02	1	ROS	110707	1013	BO	29 59.63 N	178 56.74 E	GPS	4524	4523	8	4573	4625	35 1-8,12,13,23,24,26,27,40,43	#11 NOT USED
49MR0706_1	P14N	X02	1	ROS	110707	1158	EN	29 59.65 N	178 57.09 E	GPS	4552	4552					
49MR0706_1	P14N	66	1	ROS	110707	1424	BE	29 29.68 N	178 59.12 E	GPS	5149	5149					
49MR0706_1	P14N	66	1	BUC	110707	1432	UN	29 29.74 N	178 59.18 E	GPS	5142	5142				1	25.5C
49MR0706_1	P14N	66	1	ROS	110707	1545	BO	29 29.83 N	178 59.77 E	GPS	5132	5133	10	5186	5208	33 1-8,27,85	
49MR0706_1	P14N	66	2	BUC	110707	1657	UN	29 29.83 N	179 0.65 E	GPS	5118	5118				32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	66	1	ROS	110707	1752	EN	29 29.70 N	179 1.54 E	GPS	5074	5074					
49MR0706_1	P14N	67	1	ROS	110707	2015	BE	28 59.64 N	178 59.99 E	GPS	5326	5326					
49MR0706_1	P14N	67	1	BUC	110707	2024	UN	28 59.64 N	179 0.04 E	GPS	5325	5326				1	25.9C
49MR0706_1		636	1	UNK	110707	2038	UN	28 59.66 N	179 0.13 E	GPS	5332	5333					AIR SMPL FOR BVOC #13
49MR0706_1	P14N	67	1	ROS	110707	2138	BO	28 59.47 N	179 0.32 E	GPS	5358	5358	9	5360	5429	36 1-8,23,24,26,27,85	
49MR0706_1	P14N	67	1	ROS	110707	2344	EN	28 58.94 N	179 1.31 E	GPS	5348	5348					
49MR0706_1	P14N	67	1	FLT	110707	2352	DE	28 58.83 N	179 1.25 E	GPS	5348	5348					ARGO #3329/ID75741
49MR0706_1	P14N	68	1	ROS	110807	0202	BE	28 29.72 N	178 59.79 E	GPS	5397	5396					
49MR0706_1	P14N	68	1	BUC	110807	0210	UN	28 29.65 N	178 59.86 E	GPS	5403	5404				1	25.6C
49MR0706_1	P14N	68	1	UNK	110807	0221	UN	28 29.52 N	178 59.83 E	GPS	5398	5398					80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	68	1	ROS	110807	0328	BO	28 29.10 N	178 59.81 E	GPS	5400	5401	10	5430	5486	36 1-8,22,27	
49MR0706_1	P14N	68	1	ROS	110807	0535	EN	28 28.05 N	179 0.01 E	GPS	5400	5400					
49MR0706_1	P14N	69	1	ROS	110807	0841	BE	27 59.80 N	179 0.04 E	GPS	5284	5283					
49MR0706_1	P14N	69	1	BUC	110807	0849	UN	27 59.71 N	179 0.03 E	GPS	5284	5284				1	25.7C
49MR0706_1	P14N	69	1	ROS	110807	1002	BO	27 59.45 N	178 59.92 E	GPS	5287	5287	9	5296	5364	34 1-8,27,28	
49MR0706_1	P14N	69	1	ROS	110807	1206	EN	27 58.85 N	178 59.82 E	GPS	5270	5270					
49MR0706_1	P14N	70	1	ROS	110807	1459	BE	27 29.87 N	179 0.40 E	GPS	5343	5344					
49MR0706_1	P14N	70	1	BUC	110807	1507	UN	27 29.82 N	179 0.43 E	GPS	5349	5350				1	25.7C
49MR0706_1	P14N	70	1	ROS	110807	1624	BO	27 29.31 N	179 0.69 E	GPS	5339	5340	10	5396	5427	34 1-8,15,23,24,26,27,32,34,45,84,86,87	
49MR0706_1	P14N	70	2	BUC	110807	1755	UN	27 28.72 N	179 1.03 E	GPS	5335	5335				32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	70	1	ROS	110807	1832	EN	27 28.42 N	179 1.24 E	GPS	5328	5328					
49MR0706_1	P14N	71	1	ROS	110807	2040	BE	27 0.41 N	179 0.04 E	GPS	5429	5428					
49MR0706_1	P14N	71	1	BUC	110807	2048	UN	27 0.39 N	179 0.11 E	GPS	5433	5432				1	26.6C

49MR0706_1	P14N	71	1	ROS	110807	2205	BO	27 0.28 N	179 0.67 E	GPS	5436	5436	8	5474	5519	34	1-8,15,27,45	#31 MISS FIRE
49MR0706_1	P14N	71	1	ROS	110907	0014	EN	26 59.97 N	179 1.72 E	GPS	5451	5450						
49MR0706_1	P14N	71	1	FLT	110907	0021	DE	26 59.79 N	179 1.77 E	GPS	5448	5448						ARGO #3328/ID75740
49MR0706_1	P14N	72	1	ROS	110907	0229	BE	26 29.96 N	179 0.00 E	GPS	5555	5556						
49MR0706_1	P14N	72	1	BUC	110907	0238	UN	26 29.92 N	179 0.00 E	GPS	5554	5553					1	26.6C
49MR0706_1	P14N	72	1	UNK	110907	0245	UN	26 29.90 N	179 0.01 E	GPS	5558	5558						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1		637	1	UNK	110907	0251	UN	26 29.88 N	179 0.01 E	GPS	5555	5555						AIR SMPL FOR BVOC #14
49MR0706_1	P14N	72	1	ROS	110907	0356	BO	26 29.73 N	179 0.11 E	GPS	5567	5567	9	5571	5651	36	1-8,22,27	
49MR0706_1	P14N	72	1	ROS	110907	0609	EN	26 29.64 N	179 0.19 E	GPS	5567	5567						
49MR0706_1	P14N	73	1	ROS	110907	0824	BE	25 59.87 N	179 0.22 E	GPS	5500	5499						
49MR0706_1	P14N	73	1	BUC	110907	0831	UN	25 59.87 N	179 0.17 E	GPS	5509	5508					1	26.6C
49MR0706_1	P14N	73	1	ROS	110907	0947	BO	25 59.63 N	178 59.85 E	GPS	5526	5525	10	5528	5591	35	1-8,23,24,26,27	
49MR0706_1	P14N	73	1	ROS	110907	1156	EN	25 59.38 N	178 59.31 E	GPS	5546	5546						
49MR0706_1		638	1	UNK	110907	1206	BE	25 59.83 N	178 59.21 E	GPS	5548	5547						3-AXIS MAGNETOMETER CALIBRATION
49MR0706_1		638	1	UNK	110907	1224	EN	26 0.41 N	178 59.29 E	GPS	5524	5524						
49MR0706_1	P14N	74	1	ROS	111007	1605	BE	25 29.64 N	179 0.29 E	GPS	5701	5701						REPLACED SEC TMP SENSOR
49MR0706_1	P14N	74	1	BUC	111007	1613	UN	25 29.66 N	179 0.27 E	GPS	5707	5707					1,32,34,84,86,87	26.7C, PLANKTON NET
49MR0706_1	P14N	74	1	ROS	111007	1733	BO	25 29.81 N	179 0.24 E	GPS	5704	5703	-9	5536				PRI AND SEC CND SENSORS BROKE
49MR0706_1	P14N	74	1	ROS	111007	1859	EN	25 29.82 N	179 0.17 E	GPS	5704	5703						QUITED THIS CAST
49MR0706_1	P14N	74	2	ROS	111007	2002	BE	25 29.72 N	179 0.38 E	GPS	5700	5700						REPLACED PRI CND SENSOR, REMOVED SEC TMP AND CND SENSORS
49MR0706_1	P14N	74	2	ROS	111007	2130	BO	25 30.06 N	179 0.33 E	GPS	5722	5720	10	5726	5799	35	1-8,27	
49MR0706_1	P14N	74	2	ROS	111007	2345	EN	25 30.53 N	179 0.13 E	GPS	5717	5717						
49MR0706_1	P14N	75	1	ROS	111107	0207	BE	24 59.70 N	179 0.21 E	GPS	5579	5579						ATTACHED SEC TMP SENSOR
49MR0706_1	P14N	75	1	BUC	111107	0215	UN	24 59.77 N	179 0.20 E	GPS	5571	5571					1	27.0C
49MR0706_1	P14N	75	1	ROS	111107	0336	BO	24 59.99 N	179 0.89 E	GPS	5701	5701	10	5689	5700	35	1-8,23,24,26,27	
49MR0706_1	P14N	75	1	ROS	111107	0547	EN	25 0.33 N	179 1.57 E	GPS	5710	5710						
49MR0706_1	P14N	75	1	FLT	111107	0554	DE	25 0.27 N	179 1.59 E	GPS	5715	5715						ARGO #3341/ID75753
49MR0706_1	P14N	76	1	ROS	111107	0811	BE	24 30.00 N	179 0.02 E	GPS	5722	5724						
49MR0706_1	P14N	76	1	BUC	111107	0819	UN	24 29.99 N	179 0.06 E	GPS	5723	5724					1	27.1C
49MR0706_1	P14N	76	1	UNK	111107	0827	UN	24 30.05 N	179 0.08 E	GPS	5722	5723						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	76	1	ROS	111107	0939	BO	24 29.97 N	179 0.07 E	GPS	5721	5722	10	5734	5822	36	1-8,22,27	
49MR0706_1	P14N	76	1	ROS	111107	1154	EN	24 30.05 N	178 59.99 E	GPS	5726	5729						
49MR0706_1	P14N	77	1	ROS	111107	1412	BE	24 0.05 N	178 59.85 E	GPS	5739	5739						
49MR0706_1	P14N	77	1	BUC	111107	1421	UN	24 0.07 N	178 59.79 E	GPS	5741	5740					1	27.0C
49MR0706_1		639	1	UNK	111107	1435	UN	24 0.06 N	178 59.68 E	GPS	5741	5741						AIR SMPL FOR BVOC #15
49MR0706_1	P14N	77	1	ROS	111107	1544	BO	24 0.47 N	178 59.53 E	GPS	5744	5743	10	5791	5838	36	1-8,12,13,23,24,26,27,32,34,40,42,43,84,86,87	#27 MISS TRIP
49MR0706_1	P14N	77	2	BUC	111107	1717	UN	24 1.01 N	178 59.36 E	GPS	5741	5741					32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	77	1	ROS	111107	1800	EN	24 1.30 N	178 59.22 E	GPS	5743	5742						
49MR0706_1	P14N	78	1	ROS	111107	2030	BE	23 30.10 N	178 59.87 E	GPS	5737	5737						
49MR0706_1	P14N	78	1	BUC	111107	2039	UN	23 30.11 N	178 59.79 E	GPS	5732	5732					1	27.1C
49MR0706_1	P14N	78	1	ROS	111107	2159	BO	23 30.32 N	178 59.50 E	GPS	5738	5738	9	5754	5831	36	1-8,15,27,45	
49MR0706_1	P14N	78	1	ROS	111207	0015	EN	23 30.51 N	178 59.21 E	GPS	5742	5741						
49MR0706_1	P14N	79	1	ROS	111207	0239	BE	23 0.19 N	178 59.86 E	GPS	5706	5707						
49MR0706_1	P14N	79	1	BUC	111207	0247	UN	23 0.21 N	178 59.82 E	GPS	5710	5710					1	27.3C
49MR0706_1	P14N	79	1	UNK	111207	0254	UN	23 0.20 N	178 59.78 E	GPS	5711	5711						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	79	1	ROS	111207	0408	BO	23 0.16 N	178 59.64 E	GPS	5724	5723	9	5723	5810	36	1-8,15,23,24,26,27,45	
49MR0706_1	P14N	79	1	ROS	111207	0623	EN	23 0.05 N	178 59.04 E	GPS	5718	5719						
49MR0706_1	P14N	80	1	ROS	111207	0848	BE	22 30.56 N	179 0.21 E	GPS	5360	5360						ATTACHED SEC CND SENSOR
49MR0706_1	P14N	80	1	BUC	111207	0857	UN	22 30.59 N	179 0.14 E	GPS	5363	5363					1	27.1C
49MR0706_1	P14N	80	1	ROS	111207	1013	BO	22 31.00 N	178 59.78 E	GPS	5356	5356	9	5415	5445	34	1-8,27,28	

49MR0706_1	P14N	80	1	ROS	111207	1220	EN	22 31.63 N	178 59.43 E	GPS	5336	5336						
49MR0706_1	P14N	81	1	ROS	111207	1444	BE	22 0.40 N	179 0.00 E	GPS	3838	3837						
49MR0706_1	P14N	81	1	BUC	111207	1452	UN	22 0.43 N	178 59.94 E	GPS	3847	3847					1	26.9C
49MR0706_1	P14N	81	1	UNK	111207	1458	UN	22 0.47 N	178 59.93 E	GPS	3884	3883						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	81	1	ROS	111207	1552	BO	22 0.85 N	178 59.72 E	GPS	3749	3749	12	3919	3926	36	1-8,22,27	
49MR0706_1	P14N	81	2	BUC	111207	1557	UN	22 0.89 N	178 59.69 E	GPS	3741	3740					32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	81	1	ROS	111207	1726	EN	22 1.56 N	178 59.18 E	GPS	3609	3608						
49MR0706_1	P14N	82	1	ROS	111207	1949	BE	21 30.06 N	178 59.61 E	GPS	2687	2685						
49MR0706_1	P14N	82	1	BUC	111207	1959	UN	21 30.12 N	178 59.48 E	GPS	2683	2682					1	27.1C
49MR0706_1		640	1	UNK	111207	2011	UN	21 30.18 N	178 59.42 E	GPS	2664	2664						AIR SMPL FOR BVOC #16
49MR0706_1	P14N	82	1	ROS	111207	2037	BO	21 30.32 N	178 59.24 E	GPS	2640	2641	9	2673	2680	23	1-8,23,24,26,27,85	
49MR0706_1	P14N	82	1	ROS	111207	2146	EN	21 30.81 N	178 58.80 E	GPS	2475	2474						
49MR0706_1	P14N	83	1	ROS	111307	0015	BE	21 0.13 N	178 59.85 E	GPS	2811	2812						
49MR0706_1	P14N	83	1	BUC	111307	0024	UN	21 0.18 N	178 59.84 E	GPS	2807	2807					1	27.1C
49MR0706_1	P14N	83	1	ROS	111307	0105	BO	21 0.28 N	178 59.80 E	GPS	2796	2796	8	2811	2832	25	1-8,27,85	
49MR0706_1	P14N	83	1	ROS	111307	0220	EN	21 0.58 N	178 59.71 E	GPS	2773	2773						
49MR0706_1	P14N	83	1	FLT	111307	0228	DE	21 0.66 N	178 59.88 E	GPS	2744	2744						ARGO #3333/ID75745
49MR0706_1	P14N	84	1	ROS	111307	0448	BE	20 30.30 N	179 0.05 E	GPS	3359	3359						
49MR0706_1	P14N	84	1	BUC	111307	0455	UN	20 30.34 N	178 59.99 E	GPS	3329	3328					1	27.2C
49MR0706_1	P14N	84	1	UNK	111307	0503	UN	20 30.37 N	178 59.93 E	GPS	3271	3272						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	84	1	ROS	111307	0539	BO	20 30.44 N	178 59.88 E	GPS	3225	3226	10	3213	3240	26	1-8,27	
49MR0706_1	P14N	84	1	ROS	111307	0659	EN	20 30.93 N	178 59.56 E	GPS	3351	3351						
49MR0706_1	P14N	85	1	ROS	111307	0938	BE	20 0.04 N	179 0.03 E	GPS	4129	4128						
49MR0706_1	P14N	85	1	BUC	111307	0946	UN	20 0.07 N	179 0.00 E	GPS	4143	4142					1	27.3C
49MR0706_1	P14N	85	1	ROS	111307	1044	BO	20 0.34 N	178 59.98 E	GPS	4149	4149	9	4185	4221	29	1-8,23,24,26,27	
49MR0706_1	P14N	85	1	ROS	111307	1224	EN	20 0.87 N	178 59.67 E	GPS	4250	4249						
49MR0706_1	P14N	86	1	ROS	111307	1446	BE	19 30.47 N	179 0.13 E	GPS	4771	4770						
49MR0706_1	P14N	86	1	BUC	111307	1455	UN	19 30.51 N	179 0.07 E	GPS	4775	4774					1	27.5C
49MR0706_1	P14N	86	1	UNK	111307	1501	UN	19 30.56 N	179 0.07 E	GPS	4770	4769						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	86	1	ROS	111307	1603	BO	19 30.99 N	178 59.92 E	GPS	4771	4771	11	4811	4836	36	1-8,22,27,32,34,84,86,87	
49MR0706_1		641	1	UNK	111307	1635	UN	19 31.10 N	178 59.98 E	GPS	4769	4768						RAIN SMPL FOR STABLE ISOTOPE #21
49MR0706_1	P14N	86	2	BUC	111307	1715	UN	19 31.36 N	178 59.84 E	GPS	4776	4775					32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	86	1	ROS	111307	1755	EN	19 31.72 N	178 59.64 E	GPS	4770	4769						
49MR0706_1	P14N	87	1	ROS	111307	2022	BE	19 0.22 N	178 59.90 E	GPS	4821	4821						
49MR0706_1	P14N	87	1	BUC	111307	2031	UN	19 0.30 N	178 59.80 E	GPS	4821	4821					1	27.7C
49MR0706_1		642	1	UNK	111307	2040	UN	19 0.35 N	178 59.72 E	GPS	4820	4819						AIR SMPL FOR BVOC #17
49MR0706_1	P14N	87	1	ROS	111307	2139	BO	19 0.86 N	178 59.39 E	GPS	4825	4825	10	4887	4890	33	1-8,12,13,15,23,24,26,27,45	
49MR0706_1	P14N	87	1	ROS	111307	2330	EN	19 1.91 N	178 58.96 E	GPS	4814	4814						
49MR0706_1	P14N	88	1	ROS	111407	0203	BE	18 30.18 N	179 0.30 E	GPS	4500	4499						
49MR0706_1	P14N	88	1	BUC	111407	0211	UN	18 30.32 N	179 0.33 E	GPS	4500	4499					1	27.8C
49MR0706_1	P14N	88	1	ROS	111407	0316	BO	18 30.85 N	179 0.37 E	GPS	4570	4569	10	4557	4568	31	1-8,15,27,45	
49MR0706_1	P14N	88	1	ROS	111407	0504	EN	18 31.61 N	179 0.11 E	GPS	4751	4752						
49MR0706_1	P14N	89	1	ROS	111407	0732	BE	18 0.04 N	178 59.69 E	GPS	3746	3748						
49MR0706_1	P14N	89	1	BUC	111407	0740	UN	18 0.09 N	178 59.66 E	GPS	3746	3746					1	27.7C
49MR0706_1	P14N	89	1	UNK	111407	0748	UN	18 0.15 N	178 59.62 E	GPS	3739	3739						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	89	1	ROS	111407	0836	BO	18 0.47 N	178 59.56 E	GPS	3645	3646	9	3740	3761	27	1-8,27,28	
49MR0706_1	P14N	89	1	ROS	111407	1004	EN	18 1.07 N	178 59.29 E	GPS	3520	3520						
49MR0706_1	P14N	90	1	ROS	111407	1230	BE	17 30.26 N	179 0.15 E	GPS	4877	4877						
49MR0706_1	P14N	90	1	BUC	111407	1241	UN	17 30.35 N	179 0.16 E	GPS	4883	4883					1	27.7C
49MR0706_1	P14N	90	1	ROS	111407	1348	BO	17 30.76 N	179 0.03 E	GPS	4870	4869	10	4902	4945	32	1-8,23,24,26,27	
49MR0706_1	P14N	90	1	ROS	111407	1548	EN	17 31.55 N	178 59.80 E	GPS	4864	4864						

49MR0706_1	P14N	91	1	ROS	111407	1822	BE	16 59.70 N	178 59.83 E	GPS	4710	4710						
49MR0706_1	P14N	91	1	BUC	111407	1832	UN	16 59.81 N	178 59.79 E	GPS	4698	4698					1,32,34,84,86,87	27.9C, PLANKTON NET
49MR0706_1	P14N	91	1	UNK	111407	1851	UN	17 0.01 N	178 59.73 E	GPS	4698	4698						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	91	1	ROS	111407	1938	BO	17 0.44 N	178 59.64 E	GPS	4711	4711	9	4765	4770	36	1-8,22,27	
49MR0706_1		643	1	UNK	111407	1957	UN	17 0.66 N	178 59.53 E	GPS	4739	4739						RAIN SMPL FOR STABLE ISOTOPE #22
49MR0706_1	P14N	91	1	ROS	111407	2127	EN	17 1.40 N	178 59.10 E	GPS	4791	4791						
49MR0706_1	P14N	91	1	FLT	111407	2136	DE	17 1.42 N	178 59.25 E	GPS	4782	4782						ARGO #3332/ID75744
49MR0706_1	P14N	92	1	ROS	111507	0006	BE	16 29.86 N	178 59.68 E	GPS	4977	4978						
49MR0706_1	P14N	92	1	BUC	111507	0016	UN	16 29.97 N	178 59.69 E	GPS	4980	4980					1	28.2C
49MR0706_1		644	1	UNK	111507	0030	UN	16 30.13 N	178 59.70 E	GPS	4985	4983						AIR SMPL FOR BVOC #18
49MR0706_1	P14N	92	1	ROS	111507	0127	BO	16 30.77 N	178 59.64 E	GPS	4977	4978	8	5078	5053	32	1-8,23,24,26,27	#24 MISS TRIP
49MR0706_1	P14N	92	1	ROS	111507	0327	EN	16 31.87 N	178 59.34 E	GPS	4974	4974						
49MR0706_1	P14N	93	1	ROS	111507	0600	BE	16 0.07 N	178 59.95 E	GPS	5231	5232						
49MR0706_1	P14N	93	1	BUC	111507	0610	UN	16 0.17 N	178 59.92 E	GPS	5245	5245					1	28.0C
49MR0706_1	P14N	93	1	UNK	111507	0616	UN	16 0.22 N	178 59.87 E	GPS	5255	5255						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	93	1	ROS	111507	0722	BO	16 0.72 N	178 59.71 E	GPS	5273	5274	10	5313	5343	34	1-8,27	
49MR0706_1	P14N	93	1	ROS	111507	0927	EN	16 1.40 N	178 59.62 E	GPS	5265	5265						
49MR0706_1	P14N	94	1	ROS	111507	1150	BE	15 30.29 N	178 59.93 E	GPS	5334	5334						
49MR0706_1	P14N	94	1	BUC	111507	1159	UN	15 30.31 N	178 59.89 E	GPS	5339	5338					1	27.9C
49MR0706_1	P14N	94	1	ROS	111507	1315	BO	15 30.55 N	178 59.61 E	GPS	5326	5327	9	5354	5419	34	1-8,15,23,24,26,27,45	
49MR0706_1	P14N	94	1	ROS	111507	1524	EN	15 30.91 N	178 59.04 E	GPS	5162	5161						
49MR0706_1	P14N	95	1	ROS	111507	1746	BE	15 0.55 N	178 59.88 E	GPS	5415	5414						
49MR0706_1	P14N	95	1	BUC	111507	1756	UN	15 0.57 N	178 59.87 E	GPS	5412	5412					1,32,34,84,86,87	27.9C, PLANKTON NET
49MR0706_1	P14N	95	1	ROS	111507	1911	BO	15 0.68 N	178 59.49 E	GPS	5416	5415	10	5433	5500	36	1-8,15,27,32,34,45,84,86,87	
49MR0706_1		645	1	UNK	111507	1920	UN	15 0.68 N	178 59.44 E	GPS	5418	5417						RAIN SMPL FOR STABLE ISOTOPE #23
49MR0706_1	P14N	95	1	ROS	111507	2119	EN	15 1.11 N	178 58.66 E	GPS	5418	5417						
49MR0706_1	P14N	96	1	ROS	111507	2343	BE	14 30.16 N	178 59.53 E	GPS	5486	5485						
49MR0706_1	P14N	96	1	BUC	111507	2351	UN	14 30.16 N	178 59.48 E	GPS	5484	5482					1	28.0C
49MR0706_1	P14N	96	1	UNK	111607	0000	UN	14 30.15 N	178 59.42 E	GPS	5486	5485						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	96	1	ROS	111607	0109	BO	14 30.53 N	178 59.01 E	GPS	5476	5476	10	5547	5571	36	1-8,22,27	
49MR0706_1	P14N	96	1	ROS	111607	0324	EN	14 31.26 N	178 58.45 E	GPS	5465	5464						
49MR0706_1	P14N	97	1	ROS	111607	0545	BE	14 0.28 N	178 59.86 E	GPS	5700	5699						
49MR0706_1	P14N	97	1	BUC	111607	0555	UN	14 0.28 N	178 59.78 E	GPS	5673	5674					1	28.0C
49MR0706_1		646	1	UNK	111607	0606	UN	14 0.31 N	178 59.70 E	GPS	5689	5688						AIR SMPL FOR BVOC #19
49MR0706_1	P14N	97	1	ROS	111607	0715	BO	14 0.33 N	178 59.60 E	GPS	5701	5701	9	5695	5779	36	1-8,12,13,23,24,26,27,42,43	
49MR0706_1	P14N	97	1	ROS	111607	0930	EN	14 0.37 N	178 59.64 E	GPS	5664	5664						
49MR0706_1	P14N	98	1	ROS	111607	1149	BE	13 30.00 N	178 59.61 E	GPS	3537	3536						STOPPED 2HR AT 710M ON DOWN CAST DUE TO WINCH TROUBLE
49MR0706_1	P14N	98	1	BUC	111607	1158	UN	13 30.02 N	178 59.61 E	GPS	3559	3559					1	28.0C
49MR0706_1	P14N	98	1	ROS	111607	1501	BO	13 30.44 N	178 59.06 E	GPS	3862	3862	10	3853	3892	28	1-8,23,24,26,27	
49MR0706_1	P14N	98	1	ROS	111607	1639	EN	13 30.56 N	178 58.66 E	GPS	4137	4137						
49MR0706_1	P14N	99	1	ROS	111607	1859	BE	13 0.06 N	178 59.75 E	GPS	4337	4337						
49MR0706_1	P14N	99	1	BUC	111607	1908	UN	13 0.10 N	178 59.67 E	GPS	4299	4298					1,32,34,84,86,87	28.2C, PLANKTON NET
49MR0706_1	P14N	99	1	ROS	111607	2008	BO	13 0.24 N	178 59.49 E	GPS	4214	4213	8	4272	4317	30	1-8,15,27,45	#18 MISS TRIP
49MR0706_1	P14N	99	1	ROS	111607	2151	EN	13 0.50 N	178 59.21 E	GPS	4099	4099						
49MR0706_1	P14N	99	1	FLT	111607	2159	DE	13 0.39 N	178 59.33 E	GPS	4148	4147						ARGO #3343/ID75755
49MR0706_1	P14N	100	1	ROS	111707	0015	BE	12 30.06 N	179 0.17 E	GPS	5974	5972						WITHOUT FLUOROMETER, REPLACED PRI CND SENSOR
49MR0706_1	P14N	100	1	BUC	111707	0025	UN	12 30.10 N	179 0.03 E	GPS	5973	5973					1	28.2C
49MR0706_1	P14N	100	1	UNK	111707	0028	UN	12 30.12 N	179 0.02 E	GPS	5975	5974						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	100	1	ROS	111707	0151	BO	12 30.62 N	178 59.62 E	GPS	5973	5972	11	6031	6074	36	1-8,15,23,24,26,27,45	

49MR0706_1	P14N	100	1	ROS	111707	0417	EN	12 31.69 N	178 58.98 E	GPS	5974	5973						
49MR0706_1	P14N	101	1	ROS	111707	0645	BE	11 59.94 N	178 59.86 E	GPS	5996	5996						WITHOUT FLUOROMETER
49MR0706_1	P14N	101	1	BUC	111707	0656	UN	11 59.97 N	178 59.73 E	GPS	6009	6006					1	28.2C
49MR0706_1	P14N	101	1	ROS	111707	0820	BO	12 0.51 N	178 59.19 E	GPS	5983	5983	9	6076	6096	36	1-8,27,28	#16 MISS TRIP
49MR0706_1	P14N	101	1	ROS	111707	1045	EN	12 1.48 N	178 58.60 E	GPS	5979	5978						
49MR0706_1	P14N	102	1	ROS	111707	1310	BE	11 30.45 N	179 0.05 E	GPS	5053	5052						
49MR0706_1	P14N	102	1	BUC	111707	1318	UN	11 30.48 N	179 0.00 E	GPS	5016	5015					1	28.2C
49MR0706_1		647	1	UNK	111707	1331	UN	11 30.57 N	178 59.95 E	GPS	4991	4990						AIR SMPL FOR BVOC #20
49MR0706_1	P14N	102	1	ROS	111707	1428	BO	11 30.89 N	178 59.80 E	GPS	5026	5025	12	4957	5005	33	1-8,23,24,26,27,32,34,84,86,87	
49MR0706_1	P14N	102	2	BUC	111707	1554	UN	11 31.40 N	178 59.59 E	GPS	5219	5219					32,34,84,86,87	PLANKTON NET
49MR0706_1	P14N	102	1	ROS	111707	1631	EN	11 31.58 N	178 59.42 E	GPS	5353	5352						
49MR0706_1	P14N	103	1	ROS	111707	1854	BE	11 0.17 N	178 59.90 E	GPS	5259	5260						
49MR0706_1	P14N	103	1	BUC	111707	1905	UN	11 0.18 N	178 59.81 E	GPS	5246	5246					1	28.1C
49MR0706_1	P14N	103	1	ROS	111707	2019	BO	11 0.85 N	178 59.45 E	GPS	5426	5425	11	5378	5376	34	1-8,27,85	#5 MISS TRIP
49MR0706_1	P14N	103	1	ROS	111707	2221	EN	11 1.36 N	178 59.01 E	GPS	5582	5581						
49MR0706_1	P14N	104	1	ROS	111807	0045	BE	10 30.34 N	179 0.22 E	GPS	5476	5474						
49MR0706_1	P14N	104	1	BUC	111807	0056	UN	10 30.42 N	179 0.17 E	GPS	5467	5465					1	28.3C
49MR0706_1	P14N	104	1	UNK	111807	0059	UN	10 30.42 N	179 0.14 E	GPS	5472	5472						20L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	104	1	ROS	111807	0214	BO	10 30.77 N	179 0.08 E	GPS	5472	5471	11	5478	5545	36	1-8,23,24,26,27,85	
49MR0706_1	P14N	104	1	ROS	111807	0426	EN	10 31.03 N	178 59.78 E	GPS	5612	5611						
49MR0706_1	P14N	105	1	ROS	111807	0648	BE	10 0.19 N	178 59.91 E	GPS	5554	5553						
49MR0706_1	P14N	105	1	BUC	111807	0656	UN	10 0.25 N	178 59.83 E	GPS	5555	5553					1	28.3C
49MR0706_1	P14N	105	1	ROS	111807	0814	BO	10 0.55 N	178 59.68 E	GPS	5521	5521	9	5556	5620	35	1-8,27	
49MR0706_1	P14N	105	1	ROS	111807	1022	EN	10 1.08 N	178 59.27 E	GPS	5574	5574						
49MR0706_1	P14N	X04	1	ROS	111807	1250	BE	09 29.56 N	178 49.66 E	GPS	5577	5578						
49MR0706_1	P14N	X04	1	BUC	111807	1258	UN	09 29.57 N	178 49.65 E	GPS	5579	5580					1	28.4C
49MR0706_1	P14N	X04	1	ROS	111807	1419	BO	09 29.74 N	178 49.40 E	GPS	5640	5640	10	5640	5706	36	1-8,12,13,23,24,26,27,40,42,43	
49MR0706_1	P14N	X04	1	ROS	111807	1635	EN	09 29.93 N	178 49.04 E	GPS	5639	5638						
49MR0706_1		648	1	UNK	111807	1817	UN	09 8.32 N	178 57.10 E	GPS	5834	5833						RAIN SMPL FOR STABLE ISOTOPE #24
49MR0706_1	P14N	107	1	ROS	111807	1858	BE	09 0.30 N	178 59.88 E	GPS	5907	5906						WITHOUT FLUOROMETER
49MR0706_1	P14N	107	1	BUC	111807	1907	UN	09 0.29 N	178 59.87 E	GPS	5908	5907					1	28.4C
49MR0706_1	P14N	107	1	UNK	111807	1917	UN	09 0.32 N	178 59.83 E	GPS	5909	5909						80L THROUGH HULL PUMP FOR R.N.
49MR0706_1	P14N	107	1	ROS	111807	2028	BO	09 0.33 N	178 59.77 E	GPS	5905	5904	9	5916	6004	36	1-8,15,22,27,45	#3,12 MISS TRIP
49MR0706_1		649	1	UNK	111807	2037	UN	09 0.34 N	178 59.78 E	GPS	5905	5904						AIR SMPL FOR BVOC #21
49MR0706_1	P14N	107	1	ROS	111807	2247	EN	09 0.72 N	178 59.58 E	GPS	5850	5850						
49MR0706_1		650	1	UNK	111807	2257	UN	09 0.01 N	178 59.64 E	GPS	5893	5892						RAIN SMPL FOR STABLE ISOTOPE #25
49MR0706_1	P14N	108	1	ROS	111907	0012	BE	08 45.27 N	179 0.12 E	GPS	6000	6000						WITHOUT FLUOROMETER
49MR0706_1	P14N	108	1	BUC	111907	0021	UN	08 45.31 N	179 0.06 E	GPS	5990	5991					1	28.5C
49MR0706_1	P14N	108	1	ROS	111907	0145	BO	08 45.47 N	178 59.91 E	GPS	6025	6025	10	6006	6096	36	1-8,15,27,45	PRI CND SENSOR BROKE
49MR0706_1	P14N	108	1	ROS	111907	0412	EN	08 45.75 N	178 59.24 E	GPS	5970	5970						
49MR0706_1	P14N	109	1	ROS	111907	0535	BE	08 29.75 N	178 59.56 E	GPS	6093	6093						WITHOUT FLUOROMETER, LEFT BROKEN PRI CND SENSOR
49MR0706_1	P14N	109	1	BUC	111907	0543	UN	08 29.78 N	178 59.53 E	GPS	6099	6098					1	28.3C
49MR0706_1	P14N	109	1	ROS	111907	0708	BO	08 30.24 N	178 59.22 E	GPS	6071	6069	9	6107	6161	36	1-8,23,24,26,27	
49MR0706_1	P14N	109	1	ROS	111907	0937	EN	08 31.21 N	178 58.87 E	GPS	6026	6025						
49MR0706_1		651	1	UNK	111907	1002	UN	08 30.46 N	178 55.38 E	GPS	-9	-9						RAIN SMPL FOR STABLE ISOTOPE #26

Parameter

1=Salinity, 2=Oxygen, 3=Silicate, 4=Nitrate, 5=Nitrite, 6=PHOSPHATE, 7=CFC-11, 8=CFC-12, 12=$\Delta^{14}C$, 13=$\delta^{13}C$, 22=^{137}CS, 23= Total carbon, 24=Alkalinity, 26=PH, 27=CFC-113, 28=Carbon tetrachloride, 31= CH_4, 33=N_2O, 34=Chlorophyll a, 37=Biogenic sulfur compounds, 40=Particulate organic carbon, 42= Abundance of bacteria, 47=Plutonium, 64= Incubation, 81= Particulate organic matter, 82=$^{15}NO_3$, 83=Particulate inorganic matter

49MR0706_2.sum file

P01/P14 REV R/V MIRAI CRUISE MR0706 LEG2

SHIP/CRS EXPOCODE	WOCE SECT	STNNBR	CASTNO	CAST TYPE	DATE	UTC TIME	EVENT CODE	POSITION LATITUDE	LONGITUDE	NAV	UNC DEPTH	COR DEPTH	HT ABOVE BOTTOM	WIRE OUT	MAX PRESS	NO. OF BOTTLES	PARAMETERS	COMMENTS
49MR0706_2	P14N	109	2	UNK	112307	0934	BE	08 35.39 N	178 12.28 E	GPS	6362	6361						RELEASING EXCESS TWIST OF CTD CABLE
																		AFTER CUTTING OF THE CABLE (400M)
49MR0706_2	P14N	109	2	UNK	112307	1326	EN	08 36.44 N	178 11.92 E	GPS	6416	6416						WOUT 6250M, WEIGHT OF 300KG WITH
																		COMPASS/TILT METER
49MR0706_2	P14N	109	2	ROS	112307	1740	BE	08 29.79 N	178 59.45 E	GPS	6095	6095						
49MR0706_2	P14N	109	2	BUC	112307	1752	UN	08 29.91 N	178 59.49 E	GPS	6084	6085					1,34,86,87	28.3C,PLANKTON NET
49MR0706_2	P14N	109	2	ROS	112307	1912	BO	08 30.29 N	178 59.49 E	GPS	6098	6098	10	6074	6156	36	1-8,23,24,26,27	A NEW OPTODE ADDED, WITHOUT FLUOROMETER
49MR0706_2	P14N	109	2	ROS	112307	2140	EN	08 30.75 N	178 59.26 E	GPS	6090	6089						
49MR0706_2	P14N	110	1	ROS	112407	0038	BE	08 15.48 N	179 0.33 E	GPS	5814	5815						
49MR0706_2	P14N	110	1	BUC	112407	0049	UN	08 15.54 N	179 0.33 E	GPS	5796	5796					1	28.2C
49MR0706_2	P14N	110	1	ROS	112407	0213	BO	08 15.62 N	179 0.17 E	GPS	5737	5736	11	5836	5921	35	1-8,27	#2 MISS TRIP, #33 LEAK AT LOWER CAP
49MR0706_2	P14N	110	1	ROS	112407	0435	EN	08 15.65 N	178 59.95 E	GPS	5721	5720						
49MR0706_2	P14N	111	1	ROS	112407	0630	BE	08 0.00 N	178 59.83 E	GPS	5310	5311						
49MR0706_2	P14N	111	1	BUC	112407	0644	UN	08 0.03 N	178 59.96 E	GPS	5315	5313					1	28.4C
49MR0706_2	P14N	111	1	ROS	112407	0755	BO	08 0.11 N	179 0.30 E	GPS	5307	5307	10	5313	5375	34	1-8,23,24,26,27	#2,#3 FOR TC TECHNICAL STUDY
49MR0706_2	P14N	111	1	ROS	112407	0959	EN	08 0.24 N	179 0.99 E	GPS	5418	5418						
49MR0706_2	P14N	111	1	FLT	112407	1005	DE	08 0.17 N	179 1.21 E	GPS	5403	5404						ARGO #3327/ID75739
49MR0706_2	P14N	112	1	ROS	112407	1216	BE	07 45.03 N	179 0.44 E	GPS	5864	5865						
49MR0706_2	P14N	112	1	BUC	112407	1227	UN	07 44.99 N	179 0.56 E	GPS	5866	5865					1	28.3C
49MR0706_2	P14N	112	1	UNK	112407	1236	UN	07 45.02 N	179 0.62 E	GPS	5864	5865						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	112	1	ROS	112407	1349	BO	07 44.92 N	179 0.69 E	GPS	5868	5867	10	5878	5966	36	1-8,27	
49MR0706_2	P14N	112	1	ROS	112407	1621	EN	07 44.74 N	179 0.59 E	GPS	5869	5869						
49MR0706_2	P14N	113	1	ROS	112407	1819	BE	07 29.92 N	178 59.50 E	GPS	5547	5547						
49MR0706_2	P14N	113	1	BUC	112407	1833	UN	07 29.86 N	178 59.62 E	GPS	5536	5536					1,34,86,87	28.4C,PLANKTON NET
49MR0706_2	P14N	113	1	ROS	112407	1949	BO	07 29.63 N	178 59.66 E	GPS	5542	5543	11	5557	5629	35	1-8,23,24,26,27	
49MR0706_2	P14N	113	1	ROS	112407	2200	EN	07 29.51 N	178 59.76 E	GPS	5537	5537						
49MR0706_2	P14N	114	1	ROS	112507	0002	BE	07 14.47 N	179 0.21 E	GPS	5555	5555						
49MR0706_2	P14N	114	1	BUC	112507	0010	UN	07 14.44 N	179 0.28 E	GPS	5544	5545					1	28.5C
49MR0706_2	P14N	114	1	ROS	112507	0128	BO	07 14.23 N	179 0.26 E	GPS	5541	5540	9	5554	5631	35	1-8,27	
49MR0706_2		652	1	UNK	112507	0140	UN	07 14.19 N	179 0.23 E	GPS	5542	5541						RAIN SMPL FOR STABLE ISOTOPE #27
49MR0706_2	P14N	114	1	ROS	112507	0345	EN	07 14.01 N	179 0.05 E	GPS	5549	5549						
49MR0706_2	P14N	115	1	ROS	112507	0523	BE	06 59.92 N	179 0.03 E	GPS	5516	5516						
49MR0706_2	P14N	115	1	BUC	112507	0536	UN	06 59.89 N	179 0.12 E	GPS	5515	5515					1	28.4C
49MR0706_2	P14N	115	1	ROS	112507	0651	BO	06 59.78 N	179 0.32 E	GPS	5516	5518	9	5530	5605	35	1-8,23,24,26,27	
49MR0706_2	P14N	115	1	ROS	112507	0900	EN	06 59.48 N	179 0.49 E	GPS	5511	5512						
49MR0706_2	P14N	116	1	ROS	112507	1056	BE	06 44.75 N	179 0.11 E	GPS	5670	5671						
49MR0706_2	P14N	116	1	BUC	112507	1106	UN	06 44.73 N	179 0.25 E	GPS	5671	5672					1	28.3C
49MR0706_2	P14N	116	1	UNK	112507	1111	UN	06 44.70 N	179 0.26 E	GPS	5673	5673						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	116	1	ROS	112507	1225	BO	06 44.54 N	179 0.49 E	GPS	5678	5679	10	5696	5769	36	1-8,22,27	#2 EXTRA FOR R.N.
49MR0706_2	P14N	116	1	ROS	112507	1451	EN	06 44.07 N	179 0.84 E	GPS	5690	5690						
49MR0706_2	P14N	117	1	ROS	112507	1642	BE	06 29.81 N	178 59.78 E	GPS	5762	5762						
49MR0706_2	P14N	117	1	BUC	112507	1652	UN	06 29.76 N	178 59.80 E	GPS	5763	5763					1	28.2C
49MR0706_2	P14N	117	1	ROS	112507	1812	BO	06 29.63 N	178 59.77 E	GPS	5760	5760	9	5781	5860	36	1-8,23,24,26,27	
49MR0706_2		653	1	UNK	112507	1923	UN	06 29.58 N	178 59.92 E	GPS	5769	5770						AIR SMPL FOR BVOC #22
49MR0706_2		654	1	UNK	112507	2015	UN	06 29.52 N	178 59.80 E	GPS	5765	5766						RAIN SMPL FOR STABLE ISOTOPE #28
49MR0706_2	P14N	117	1	ROS	112507	2029	EN	06 29.49 N	178 59.82 E	GPS	5773	5773						

49MR0706_2	P14N	118	1	ROS	112507	2220	BE	06 14.48 N	178 59.79 E	GPS	5782	5782					
49MR0706_2	P14N	118	1	BUC	112507	2228	UN	06 14.48 N	178 59.80 E	GPS	5780	5779					1	28.3C
49MR0706_2	P14N	118	1	ROS	112507	2349	BO	06 14.36 N	178 59.88 E	GPS	5791	5793	9	5790	5872	36	1-8,27	
49MR0706_2		655	1	UNK	112607	0032	UN	06 14.39 N	178 59.94 E	GPS	5774	5773						RAIN SMPL FOR STABLE ISOTOPE #29
49MR0706_2	P14N	118	1	ROS	112607	0219	EN	06 14.39 N	179 0.33 E	GPS	5791	5792						
49MR0706_2	P14N	119	1	ROS	112607	0347	BE	06 0.08 N	178 59.64 E	GPS	5798	5796						
49MR0706_2	P14N	119	1	BUC	112607	0355	UN	06 0.11 N	178 59.62 E	GPS	5797	5798					1	28.3C
49MR0706_2	P14N	119	1	UNK	112607	0434	UN	06 0.33 N	178 59.77 E	GPS	5797	5796						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	119	1	ROS	112607	0516	BO	06 0.41 N	178 59.76 E	GPS	5799	5799	10	5819	5893	36	1-8,23,24,26,27	
49MR0706_2	P14N	119	1	ROS	112607	0736	EN	06 0.90 N	178 59.71 E	GPS	5791	5790						
49MR0706_2	P14N	120	1	ROS	112607	0928	BE	05 44.94 N	178 59.95 E	GPS	5683	5684						
49MR0706_2	P14N	120	1	BUC	112607	0936	UN	05 45.02 N	178 59.99 E	GPS	5687	5688					1	28.3C
49MR0706_2	P14N	120	1	ROS	112607	1055	BO	05 45.18 N	179 0.19 E	GPS	5671	5671	8	5690	5770	36	1-8,27	
49MR0706_2	P14N	120	1	ROS	112607	1316	EN	05 45.24 N	179 0.36 E	GPS	5661	5661						
49MR0706_2	P14N	121	1	ROS	112607	1450	BE	05 29.58 N	179 0.02 E	GPS	5764	5764						
49MR0706_2	P14N	121	1	BUC	112607	1458	UN	05 29.58 N	179 0.03 E	GPS	5758	5757					1	28.2C
49MR0706_2	P14N	121	1	ROS	112607	1619	BO	05 29.49 N	178 59.93 E	GPS	5742	5742	7	5779	5859	36	1-8,23,24,26,27	#2 EXTRA FOR CFC
49MR0706_2	P14N	121	2	BUC	112607	1725	UN	05 29.37 N	178 59.93 E	GPS	5739	5739					34,86,87	PLANKTON NET
49MR0706_2	P14N	121	1	ROS	112607	1841	EN	05 29.41 N	178 59.74 E	GPS	5731	5731						
49MR0706_2	P14N	122	1	ROS	112607	2048	BE	05 14.48 N	178 59.78 E	GPS	5692	5694						
49MR0706_2	P14N	122	1	BUC	112607	2057	UN	05 14.48 N	178 59.71 E	GPS	5692	5693					1	28.3C
49MR0706_2	P14N	122	1	ROS	112607	2215	BO	05 14.79 N	178 59.63 E	GPS	5704	5705	9	5721	5791	36	1-8,27,28	#2 EXTRA FOR CFC
49MR0706_2	P14N	122	1	ROS	112707	0031	EN	05 15.25 N	178 59.47 E	GPS	5729	5729						
49MR0706_2	P14N	123	1	ROS	112707	0300	BE	04 59.48 N	178 59.72 E	GPS	6098	6097						
49MR0706_2	P14N	123	1	BUC	112707	0308	UN	04 59.49 N	178 59.66 E	GPS	6117	6117					1	28.4C
49MR0706_2	P14N	123	1	ROS	112707	0434	BO	04 59.79 N	178 59.68 E	GPS	6128	6127	9	6133	6213	36	1-8,23,24,26,27	WITHOUT FLUOROMETER
49MR0706_2	P14N	123	1	ROS	112707	0704	EN	04 59.86 N	178 59.34 E	GPS	6122	6120						
49MR0706_2	P14N	124	1	ROS	112707	0907	BE	04 44.67 N	179 0.00 E	GPS	5854	5854						
49MR0706_2	P14N	124	1	BUC	112707	0916	UN	04 44.68 N	178 59.99 E	GPS	5852	5852					1	27.9C
49MR0706_2	P14N	124	1	UNK	112707	0921	UN	04 44.70 N	178 59.99 E	GPS	5856	5856						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	124	1	ROS	112707	1036	BO	04 44.92 N	179 0.08 E	GPS	5857	5857	9	5873	5952	36	1-8,22,27	
49MR0706_2	P14N	124	1	ROS	112707	1300	EN	04 45.27 N	179 0.27 E	GPS	5881	5880						
49MR0706_2	P14N	125	1	ROS	112707	1440	BE	04 29.13 N	179 0.50 E	GPS	5670	5670						
49MR0706_2	P14N	125	1	BUC	112707	1449	UN	04 29.10 N	179 0.60 E	GPS	5670	5670					1	27.4C
49MR0706_2	P14N	125	1	ROS	112707	1609	BO	04 28.87 N	179 0.61 E	GPS	5674	5673	10	5689	5764	35	1-8,12,13,23,24,26,27,32,34,43,84,86,87	
49MR0706_2	P14N	125	2	BUC	112707	1727	UN	04 28.88 N	179 0.59 E	GPS	5674	5675					34,86,87	PLANKTON NET
49MR0706_2	P14N	125	1	ROS	112707	1826	EN	04 28.66 N	179 0.50 E	GPS	5672	5673						
49MR0706_2	P14N	126	1	ROS	112707	2031	BE	04 14.43 N	179 0.48 E	GPS	5581	5581						
49MR0706_2	P14N	126	1	BUC	112707	2039	UN	04 14.45 N	179 0.47 E	GPS	5580	5581					1	27.5C
49MR0706_2	P14N	126	1	ROS	112707	2158	BO	04 14.46 N	179 0.47 E	GPS	5581	5581	9	5594	5670	35	1-8,27	
49MR0706_2	P14N	126	1	ROS	112807	0007	EN	04 14.56 N	179 0.27 E	GPS	5576	5575						
49MR0706_2	P14N	127	1	ROS	112807	0203	BE	03 59.51 N	179 0.36 E	GPS	5564	5563						
49MR0706_2	P14N	127	1	BUC	112807	0210	UN	03 59.55 N	179 0.34 E	GPS	5573	5572					1	27.5C
49MR0706_2		656	1	UNK	112807	0220	UN	03 59.58 N	179 0.34 E	GPS	5573	5572						AIR SMPL FOR BVOC #23
49MR0706_2	P14N	127	1	ROS	112807	0330	BO	03 59.54 N	179 0.40 E	GPS	5570	5569	10	5584	5659	35	1-8,23,24,26,27	
49MR0706_2		657	1	UNK	112807	0529	UN	03 59.63 N	178 59.63 E	GPS	5570	5570						RAIN SMPL FOR STABLE ISOTOPE #30
49MR0706_2	P14N	127	1	ROS	112807	0542	EN	03 59.63 N	178 59.55 E	GPS	5592	5591						
49MR0706_2	P14N	128	1	ROS	112807	0733	BE	03 44.48 N	179 0.13 E	GPS	5505	5504						
49MR0706_2	P14N	128	1	BUC	112807	0741	UN	03 44.49 N	179 0.07 E	GPS	5505	5504					1	27.5C
49MR0706_2	P14N	128	1	ROS	112807	0857	BO	03 44.60 N	179 0.02 E	GPS	5504	5504	8	5514	5587	34	1-8,27	
49MR0706_2	P14N	128	1	ROS	112807	1100	EN	03 44.91 N	178 59.93 E	GPS	5520	5520						

49MR0706_2	P14N	129	1	ROS	112807	1235	BE	03 29.81 N	179 0.32 E	GPS	5505	5506						
49MR0706_2	P14N	129	1	BUC	112807	1244	UN	03 29.83 N	179 0.28 E	GPS	5506	5506					1	27.5C
49MR0706_2	P14N	129	1	UNK	112807	1248	UN	03 29.83 N	179 0.24 E	GPS	5507	5507						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	129	1	ROS	112807	1402	BO	03 30.08 N	179 0.14 E	GPS	5493	5493	10	5525	5591	35	1-8,23,24,26,27	
49MR0706_2		658	1	UNK	112807	1618	UN	03 30.30 N	179 0.01 E	GPS	5493	5493						RAIN SMPL FOR STABLE ISOTOPE #31
49MR0706_2	P14N	129	1	ROS	112807	1619	EN	03 30.29 N	179 0.01 E	GPS	5493	5494						
49MR0706_2	P14N	130	1	ROS	112807	1830	BE	03 14.83 N	179 0.05 E	GPS	5385	5385						
49MR0706_2	P14N	130	1	BUC	112807	1839	UN	03 14.84 N	178 59.97 E	GPS	5380	5380					1	27.4C
49MR0706_2		659	1	UNK	112807	1928	UN	03 14.92 N	178 59.78 E	GPS	5377	5377						RAIN SMPL FOR STABLE ISOTOPE #32
49MR0706_2	P14N	130	1	ROS	112807	1954	BO	03 15.08 N	178 59.57 E	GPS	5350	5350	9	5420	5456	34	1-8,27	
49MR0706_2	P14N	130	1	ROS	112807	2159	EN	03 15.51 N	178 58.86 E	GPS	5371	5371						
49MR0706_2	P14N	131	1	ROS	112907	0000	BE	02 59.97 N	179 0.87 E	GPS	5513	5514						
49MR0706_2	P14N	131	1	BUC	112907	0009	UN	02 59.97 N	179 0.81 E	GPS	5514	5514					1	27.4C
49MR0706_2		660	1	UNK	112907	0121	UN	02 59.89 N	179 0.54 E	GPS	5521	5522						RAIN SMPL FOR STABLE ISOTOPE #33
49MR0706_2	P14N	131	1	ROS	112907	0128	BO	02 59.89 N	179 0.53 E	GPS	5515	5514	11	5535	5600	34	1-8,23,24,26,27	
49MR0706_2	P14N	131	1	ROS	112907	0340	EN	03 0.20 N	179 0.09 E	GPS	5519	5519						
49MR0706_2	P14N	132	1	ROS	112907	0543	BE	02 44.87 N	179 0.64 E	GPS	5497	5497						
49MR0706_2	P14N	132	1	BUC	112907	0550	UN	02 44.86 N	179 0.49 E	GPS	5507	5506					1	27.5C
49MR0706_2	P14N	132	1	ROS	112907	0707	BO	02 44.81 N	178 59.94 E	GPS	5526	5525	10	5578	5608	35	1-8,27,28	
49MR0706_2	P14N	132	1	ROS	112907	0917	EN	02 44.69 N	178 59.25 E	GPS	5529	5527						
49MR0706_2	P14N	133	1	ROS	112907	1119	BE	02 29.81 N	179 0.45 E	GPS	4810	4811						
49MR0706_2	P14N	133	1	BUC	112907	1126	UN	02 29.78 N	179 0.32 E	GPS	4817	4818					1	27.4C
49MR0706_2	P14N	133	1	ROS	112907	1235	BO	02 29.82 N	179 0.10 E	GPS	4875	4876	10	4863	4913	32	1-8,23,24,26,27	
49MR0706_2	P14N	133	1	ROS	112907	1432	EN	02 29.76 N	178 59.87 E	GPS	4958	4958						
49MR0706_2	P14N	134	1	ROS	112907	1637	BE	02 14.77 N	179 0.42 E	GPS	5610	5610						
49MR0706_2	P14N	134	1	BUC	112907	1645	UN	02 14.70 N	179 0.25 E	GPS	5618	5618					1	27.5C
49MR0706_2	P14N	134	1	UNK	112907	1650	UN	02 14.70 N	179 0.18 E	GPS	5619	5618						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	134	1	ROS	112907	1804	BO	02 14.79 N	178 59.67 E	GPS	5619	5619	10	5680	5719	36	1-8,22,27	#2 EXTRA FOR R.N.
49MR0706_2	P14N	134	1	ROS	112907	2021	EN	02 15.23 N	178 58.63 E	GPS	5646	5645						
49MR0706_2	P14N	135	1	ROS	112907	2232	BE	01 59.83 N	178 59.99 E	GPS	5587	5586						
49MR0706_2	P14N	135	1	BUC	112907	2241	UN	01 59.78 N	178 59.82 E	GPS	5579	5579					1	27.6C
49MR0706_2	P14N	135	1	ROS	112907	2359	BO	01 59.88 N	178 59.47 E	GPS	5570	5571	9	5597	5663	35	1-8,23,24,26,27	
49MR0706_2	P14N	135	1	ROS	113007	0212	EN	01 59.98 N	178 58.91 E	GPS	5580	5580						
49MR0706_2	P14N	136	1	ROS	113007	0413	BE	01 45.38 N	179 0.11 E	GPS	5540	5540						
49MR0706_2	P14N	136	1	BUC	113007	0420	UN	01 45.31 N	178 59.93 E	GPS	5546	5545					1	27.8C
49MR0706_2	P14N	136	1	ROS	113007	0537	BO	01 45.10 N	178 59.66 E	GPS	5546	5546	9	5568	5626	35	1-8,27	
49MR0706_2	P14N	136	1	ROS	113007	0759	EN	01 44.90 N	178 59.10 E	GPS	5554	5555						
49MR0706_2	P14N	137	1	ROS	113007	0959	BE	01 30.08 N	179 0.19 E	GPS	5519	5517						
49MR0706_2	P14N	137	1	BUC	113007	1007	UN	01 30.08 N	179 0.09 E	GPS	5520	5519					1	27.8C
49MR0706_2		661	1	UNK	113007	1011	UN	01 30.09 N	179 0.06 E	GPS	5519	5519						AIR SMPL FOR BVOC #24
49MR0706_2	P14N	137	1	ROS	113007	1124	BO	01 30.30 N	178 59.90 E	GPS	5523	5522	11	5541	5606	34	1-8,23,24,26,27	
49MR0706_2	P14N	137	1	ROS	113007	1339	EN	01 30.53 N	178 59.65 E	GPS	5524	5525						
49MR0706_2	P14N	138	1	ROS	113007	1544	BE	01 15.08 N	179 0.43 E	GPS	5467	5467						
49MR0706_2	P14N	138	1	BUC	113007	1553	UN	01 15.05 N	179 0.31 E	GPS	5445	5446					1	27.5C
49MR0706_2	P14N	138	1	ROS	113007	1710	BO	01 15.00 N	179 0.14 E	GPS	5428	5429	9	5480	5541	35	1-8,27,32,34,84,86,87	
49MR0706_2	P14N	138	2	BUC	113007	1728	UN	01 14.98 N	179 0.10 E	GPS	5429	5430					34,86,87	PLANKTON NET
49MR0706_2	P14N	138	1	ROS	113007	1927	EN	01 14.92 N	178 59.58 E	GPS	5399	5400						
49MR0706_2	P14N	139	1	ROS	113007	2131	BE	01 0.16 N	179 0.01 E	GPS	5717	5718						
49MR0706_2	P14N	139	1	BUC	113007	2140	UN	01 0.14 N	178 59.86 E	GPS	5724	5724					1	27.7C
49MR0706_2	P14N	139	1	ROS	113007	2259	BO	01 0.32 N	178 59.75 E	GPS	5727	5728	9	5744	5815	36	1-8,23,24,26,27	
49MR0706_2	P14N	139	1	ROS	120107	0127	EN	01 0.94 N	178 59.70 E	GPS	5740	5740						

49MR0706_2	P14N	140	2	ROS	120107	0347	BE	00 44.30 N	178 59.56 E	GPS	5514	5511						
49MR0706_2	P14N	140	2	BUC	120107	0355	UN	00 44.31 N	178 59.45 E	GPS	5511	5509					1	27.9C
49MR0706_2	P14N	140	2	ROS	120107	0513	BO	00 44.57 N	178 59.27 E	GPS	5521	5520	10	5534	5599	34	1-8,27	CAST 1 CANCELLED DUE TO SENSOR TROUBLE DETECTED AT SURFACE
49MR0706_2	P14N	140	2	ROS	120107	0725	EN	00 44.70 N	178 59.03 E	GPS	5519	5516						
49MR0706_2	P14N	141	1	ROS	120107	0928	BE	00 29.90 N	178 59.99 E	GPS	5409	5409						
49MR0706_2	P14N	141	1	BUC	120107	0939	UN	00 29.88 N	178 59.89 E	GPS	5406	5406					1	27.6C
49MR0706_2	P14N	141	1	ROS	120107	1054	BO	00 30.03 N	179 0.01 E	GPS	5410	5410	9	5424	5494	35	1-8,23,24,26,27	
49MR0706_2	P14N	141	1	ROS	120107	1310	EN	00 30.12 N	178 59.91 E	GPS	5407	5408						
49MR0706_2	P14N	142	1	ROS	120107	1514	BE	00 14.80 N	178 59.86 E	GPS	5354	5353						
49MR0706_2	P14N	142	1	BUC	120107	1522	UN	00 14.76 N	178 59.77 E	GPS	5353	5352					1	27.3C
49MR0706_2	P14N	142	1	ROS	120107	1638	BO	00 15.03 N	178 59.83 E	GPS	5348	5347	9	5368	5431	34	1-8,27	
49MR0706_2	P14N	142	1	ROS	120107	1846	EN	00 15.57 N	178 59.68 E	GPS	5351	5350						
49MR0706_2	P14N	143	1	ROS	120107	2051	BE	00 0.00 N	178 59.95 E	GPS	5414	5414						
49MR0706_2	P14N	143	1	BUC	120107	2059	UN	00 0.02 N	178 59.84 E	GPS	5413	5413					1	27.2C
49MR0706_2	P14N	143	1	ROS	120107	2214	BO	00 0.10 N	179 0.07 E	GPS	5408	5408	9	5428	5457	36	1-8,12,13,23,24,26,27,40,43	#2, #3 EXTRA FOR PO14C
49MR0706_2		662	1	UNK	120107	2359	UN	00 0.10 N	179 0.09 E	GPS	5409	5409						RAIN SMPL FOR STABLE ISOTOPE #34
49MR0706_2	P14N	143	1	ROS	120207	0024	EN	00 0.07 N	179 0.08 E	GPS	5410	5410						
49MR0706_2	P14N	144	1	ROS	120207	0228	BE	00 14.88 S	178 59.52 E	GPS	5462	5460						
49MR0706_2	P14N	144	1	BUC	120207	0237	UN	00 14.90 S	178 59.48 E	GPS	5463	5462					1	27.3C
49MR0706_2	P14N	144	1	UNK	120207	0242	UN	00 14.90 S	178 59.50 E	GPS	5462	5460						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	144	1	ROS	120207	0354	BO	00 14.72 S	178 59.60 E	GPS	5442	5441	9	5475	5545	36	1-8,22,27	#2 EXTRA FOR R.N.
49MR0706_2	P14N	144	1	ROS	120207	0607	EN	00 14.46 S	178 59.59 E	GPS	5368	5366						
49MR0706_2	P14N	145	1	ROS	120307	0756	BE	00 29.87 S	178 59.89 E	GPS	5457	5457						
49MR0706_2	P14N	145	1	BUC	120307	0803	UN	00 29.89 S	178 59.85 E	GPS	5458	5459					1	27.3C
49MR0706_2	P14N	145	1	ROS	120307	0919	BO	00 29.57 S	178 59.98 E	GPS	5457	5457	10	5482	5545	34	1-8,23,24,26,27	
49MR0706_2	P14N	145	1	ROS	120307	1126	EN	00 29.11 S	178 59.95 E	GPS	5455	5456						
49MR0706_2	P14N	146	1	ROS	120307	1328	BE	00 44.76 S	179 0.25 E	GPS	5445	5444						
49MR0706_2	P14N	146	1	BUC	120307	1336	UN	00 44.78 S	179 0.21 E	GPS	5440	5440					1	27.1C
49MR0706_2	P14N	146	1	ROS	120307	1454	BO	00 44.45 S	179 0.38 E	GPS	5479	5478	11	5475	5533	34	1-8,27	
49MR0706_2	P14N	146	1	ROS	120307	1709	EN	00 44.03 S	179 0.49 E	GPS	5485	5483						
49MR0706_2	P14N	147	1	ROS	120307	1909	BE	01 0.03 S	179 0.08 E	GPS	5463	5464						
49MR0706_2	P14N	147	1	BUC	120307	1917	UN	01 0.02 S	179 0.04 E	GPS	5459	5462					1	27.0C
49MR0706_2		663	1	UNK	120307	1958	UN	00 59.81 S	179 0.07 E	GPS	5468	5469						AIR SMPL FOR BVOC #25
49MR0706_2	P14N	147	1	ROS	120307	2034	BO	00 59.65 S	179 0.04 E	GPS	5474	5476	9	5492	5549	35	1-8,23,24,26,27	
49MR0706_2	P14N	147	1	ROS	120307	2245	EN	00 59.30 S	179 0.18 E	GPS	5487	5488						
49MR0706_2	P14N	148	1	ROS	120407	0051	BE	01 14.87 S	178 59.92 E	GPS	5447	5447						
49MR0706_2	P14N	148	1	BUC	120407	0059	UN	01 14.91 S	178 59.88 E	GPS	5444	5443					1	27.3C
49MR0706_2	P14N	148	1	ROS	120407	0217	BO	01 14.84 S	178 59.93 E	GPS	5445	5444	9	5457	5529	34	1-8,27	
49MR0706_2	P14N	148	1	ROS	120407	0431	EN	01 14.60 S	178 59.87 E	GPS	5449	5447						
49MR0706_2	P14N	149	1	ROS	120407	0627	BE	01 33.29 S	179 0.06 E	GPS	5464	5462						
49MR0706_2	P14N	149	1	BUC	120407	0635	UN	01 33.28 S	179 0.04 E	GPS	5463	5462					1	27.4C
49MR0706_2	P14N	149	1	ROS	120407	0752	BO	01 32.87 S	179 0.14 E	GPS	5457	5455	10	5490	5544	34	1-8,23,24,26,27	
49MR0706_2	P14N	149	1	ROS	120407	1000	EN	01 32.50 S	178 59.84 E	GPS	5457	5455						
49MR0706_2	P14N	150	1	ROS	120407	1156	BE	01 44.75 S	178 59.86 E	GPS	5452	5452						
49MR0706_2	P14N	150	1	BUC	120407	1205	UN	01 44.74 S	178 59.86 E	GPS	5452	5453					1	27.4C
49MR0706_2	P14N	150	1	ROS	120407	1323	BO	01 44.45 S	178 59.86 E	GPS	5450	5451	10	5477	5538	35	1-8,27	
49MR0706_2	P14N	150	1	ROS	120407	1540	EN	01 44.23 S	178 59.89 E	GPS	5456	5456						
49MR0706_2	P14N	151	1	ROS	120407	1744	BE	01 59.95 S	179 0.08 E	GPS	5443	5442						
49MR0706_2	P14N	151	1	BUC	120407	1752	UN	01 59.98 S	179 0.04 E	GPS	5445	5444					1,34,86,87	27.6C, PLANKTON NET
49MR0706_2	P14N	151	1	ROS	120407	1909	BO	01 59.88 S	179 0.20 E	GPS	5443	5442	10	5462	5528	34	1-8,23,24,26,27,32,34,84,86,87	

49MR0706_2	P14N	151	1	ROS	120407	2120	EN	01 59.71 S	178 59.97 E	GPS	5437	5437						
49MR0706_2	P14N	152	1	ROS	120407	2325	BE	02 15.12 S	179 0.05 E	GPS	5308	5307						
49MR0706_2	P14N	152	1	BUC	120407	2333	UN	02 15.12 S	179 0.01 E	GPS	5307	5307					1	27.8C
49MR0706_2	P14N	152	1	ROS	120507	0047	BO	02 15.07 S	178 59.94 E	GPS	5300	5299	10	5303	5374	33	1-8,27	
49MR0706_2	P14N	152	1	ROS	120507	0257	EN	02 14.99 S	178 59.85 E	GPS	5306	5305						
49MR0706_2	P14N	153	1	ROS	120507	0457	BE	02 30.09 S	179 0.09 E	GPS	4953	4953						
49MR0706_2	P14N	153	1	BUC	120507	0505	UN	02 30.10 S	179 0.10 E	GPS	4997	4997					1	27.8C
49MR0706_2	P14N	153	1	UNK	120507	0513	UN	02 30.08 S	179 0.12 E	GPS	4935	4935						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	153	1	ROS	120507	0619	BO	02 29.77 S	178 59.95 E	GPS	4860	4859	11	5044	4994	33	1-8,27	
49MR0706_2	P14N	153	1	ROS	120507	0820	EN	02 29.33 S	178 59.56 E	GPS	4781	4781						
49MR0706_2	P14N	154	1	ROS	120507	1025	BE	02 44.98 S	179 0.14 E	GPS	5499	5499						
49MR0706_2	P14N	154	1	BUC	120507	1033	UN	02 44.98 S	179 0.11 E	GPS	5503	5503					1	27.5C
49MR0706_2	P14N	154	1	ROS	120507	1150	BO	02 44.76 S	178 59.92 E	GPS	5499	5500	10	5524	5590	35	1-8,23,24,26,27	
49MR0706_2	P14N	154	1	ROS	120507	1411	EN	02 44.39 S	178 59.53 E	GPS	5501	5501						
49MR0706_2	P14N	155	1	ROS	120507	1616	BE	02 59.75 S	179 0.16 E	GPS	5461	5462						
49MR0706_2	P14N	155	1	BUC	120507	1624	UN	02 59.73 S	179 0.10 E	GPS	5471	5472					1	27.8C
49MR0706_2	P14N	155	1	ROS	120507	1742	BO	02 59.10 S	178 59.76 E	GPS	5476	5477	9	5559	5549	34	1-8,27	
49MR0706_2	P14N	155	1	ROS	120507	1955	EN	02 58.33 S	178 59.38 E	GPS	5478	5478						
49MR0706_2	P14N	156	1	ROS	120507	2159	BE	03 14.69 S	179 0.19 E	GPS	5131	5130						
49MR0706_2	P14N	156	1	BUC	120507	2208	UN	03 14.68 S	179 0.11 E	GPS	5120	5118					1	28.1C
49MR0706_2	P14N	156	1	ROS	120507	2319	BO	03 14.44 S	178 59.77 E	GPS	5165	5163	10	5176	5223	34	1-8,27	
49MR0706_2	P14N	156	1	ROS	120607	0129	EN	03 13.74 S	178 58.90 E	GPS	5266	5265						
49MR0706_2	P14N	157	1	ROS	120607	0328	BE	03 29.80 S	179 0.39 E	GPS	5221	5221						
49MR0706_2	P14N	157	1	BUC	120607	0336	UN	03 29.83 S	179 0.32 E	GPS	5220	5220					1	28.0C
49MR0706_2		664	1	UNK	120607	0400	UN	03 29.82 S	179 0.23 E	GPS	5220	5220						AIR SMPL FOR BVOC #26
49MR0706_2	P14N	157	1	ROS	120607	0450	BO	03 29.73 S	179 0.19 E	GPS	5220	5220	10	5237	5299	33	1-8,23,24,26,27	
49MR0706_2	P14N	157	1	ROS	120607	0653	EN	03 29.87 S	178 59.62 E	GPS	5230	5231						
49MR0706_2	P14N	158	1	ROS	120607	0853	BE	03 45.00 S	179 0.24 E	GPS	5550	5550						
49MR0706_2	P14N	158	1	BUC	120607	0902	UN	03 45.05 S	179 0.17 E	GPS	5550	5550					1	27.9C
49MR0706_2	P14N	158	1	ROS	120607	1019	BO	03 44.90 S	178 59.87 E	GPS	5545	5545	11	5575	5636	35	1-8,27	
49MR0706_2	P14N	158	1	ROS	120607	1235	EN	03 44.76 S	178 59.44 E	GPS	5535	5535						
49MR0706_2	P14N	159	1	ROS	120607	1440	BE	04 0.41 S	179 0.35 E	GPS	5243	5243						
49MR0706_2		665	1	UNK	120607	1442	UN	04 0.44 S	179 0.33 E	GPS	5246	5244						RAIN SMPL FOR STABLE ISOTOPE #35
49MR0706_2	P14N	159	1	BUC	120607	1450	UN	04 0.48 S	179 0.28 E	GPS	5256	5255					1	27.9C
49MR0706_2	P14N	159	1	ROS	120607	1603	BO	04 0.42 S	179 0.19 E	GPS	5256	5255	9	5266	5333	34	1-8,27,28	
49MR0706_2	P14N	159	1	ROS	120607	1822	EN	04 0.26 S	179 0.01 E	GPS	5246	5246						
49MR0706_2	P14N	160	1	ROS	120607	2026	BE	04 15.47 S	178 59.99 E	GPS	5637	5637						
49MR0706_2	P14N	160	1	BUC	120607	2035	UN	04 15.48 S	178 59.90 E	GPS	5636	5637					1	28.0C
49MR0706_2	P14N	160	1	ROS	120607	2153	BO	04 15.49 S	178 59.66 E	GPS	5631	5631	9	5648	5722	36	1-8,12,13,23,24,26,27,40,43	#2 EXTRA FOR PO14C
49MR0706_2	P14N	160	1	ROS	120707	0015	EN	04 15.92 S	178 59.55 E	GPS	5636	5636						
49MR0706_2	P14N	161	1	ROS	120707	0218	BE	04 30.40 S	179 0.51 E	GPS	5636	5635						
49MR0706_2	P14N	161	1	UNK	120707	0225	UN	04 30.46 S	179 0.53 E	GPS	5644	5642						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	161	1	BUC	120707	0226	UN	04 30.43 S	179 0.52 E	GPS	5633	5632					1	28.4C
49MR0706_2	P14N	161	1	ROS	120707	0346	BO	04 30.47 S	179 0.53 E	GPS	5638	5638	10	5664	5742	36	1-8,22,27	#2 EXTRA FOR R.N.
49MR0706_2	P14N	161	1	ROS	120707	0603	EN	04 30.45 S	179 0.44 E	GPS	5621	5620						
49MR0706_2	P14N	162	1	ROS	120707	0831	BE	04 45.44 S	179 0.28 E	GPS	3805	3805						
49MR0706_2	P14N	162	1	BUC	120707	0839	UN	04 45.46 S	179 0.29 E	GPS	3819	3818					1	28.2C
49MR0706_2	P14N	162	1	ROS	120707	0934	BO	04 45.31 S	179 0.31 E	GPS	3826	3826	8	3847	3882	28	1-8,23,24,26,27	
49MR0706_2	P14N	162	1	ROS	120707	1109	EN	04 45.22 S	179 0.19 E	GPS	3735	3735						
49MR0706_2	P14N	163	1	ROS	120707	1342	BE	05 0.09 S	179 0.12 E	GPS	5485	5486						
49MR0706_2	P14N	163	1	BUC	120707	1350	UN	05 0.01 S	179 0.10 E	GPS	5472	5473					1	28.7C

49MR0706_2	P14N	163	1	ROS	120707	1509	BO	04 59.91 S	179 0.06 E	GPS	5546	5546	9	5513	5584	35	1-8,27,32,34,84,86,87	#2 EXTRA AT 100DBAR
49MR0706_2	P14N	163	2	BUC	120707	1559	UN	04 59.90 S	178 59.89 E	GPS	5553	5553					34,86,87	PLANKTON NET
49MR0706_2	P14N	163	1	ROS	120707	1724	EN	04 59.45 S	178 59.60 E	GPS	5551	5552						
49MR0706_2	P14N	164	1	ROS	120707	2023	BE	05 29.93 S	179 0.31 E	GPS	5687	5687						
49MR0706_2	P14N	164	1	BUC	120707	2031	UN	05 29.87 S	179 0.27 E	GPS	5691	5691					1	29.4C
49MR0706_2	P14N	164	1	ROS	120707	2149	BO	05 29.61 S	178 59.97 E	GPS	5704	5704	9	5716	5786	35	1-8,23,24,26,27	
49MR0706_2	P14N	164	1	ROS	120807	0008	EN	05 29.11 S	178 59.37 E	GPS	5702	5702						
49MR0706_2	P14N	165	1	ROS	120807	0308	BE	06 0.47 S	179 0.45 E	GPS	5426	5425						
49MR0706_2	P14N	165	1	BUC	120807	0317	UN	06 0.48 S	179 0.48 E	GPS	5407	5405					1	29.4C
49MR0706_2		666	1	UNK	120807	0333	UN	06 0.48 S	179 0.47 E	GPS	5407	5406						AIR SMPL FOR BVOC #27
49MR0706_2	P14N	165	1	ROS	120807	0432	BO	06 0.53 S	179 0.42 E	GPS	5404	5403	9	5418	5491	35	1-8,27	
49MR0706_2	P14N	165	1	ROS	120807	0645	EN	06 0.32 S	179 0.91 E	GPS	5430	5429						
49MR0706_2	P14N	166	1	ROS	120807	0908	BE	06 29.86 S	178 59.84 E	GPS	5355	5355						
49MR0706_2	P14N	166	1	BUC	120807	0917	UN	06 29.77 S	178 59.90 E	GPS	5348	5346					1	29.1C
49MR0706_2	P14N	166	1	ROS	120807	1031	BO	06 29.75 S	178 59.83 E	GPS	5353	5352	10	5363	5427	34	1-8,23,24,26,27	
49MR0706_2	P14N	166	1	ROS	120807	1247	EN	06 29.58 S	178 59.64 E	GPS	5347	5347						
49MR0706_2	P14N	167	1	ROS	120807	1511	BE	06 59.95 S	179 0.08 E	GPS	5485	5486						
49MR0706_2	P14N	167	1	BUC	120807	1520	UN	06 59.97 S	179 0.06 E	GPS	5484	5485					1	28.5C
49MR0706_2	P14N	167	1	UNK	120807	1522	UN	06 59.96 S	179 0.06 E	GPS	5479	5480						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	167	1	ROS	120807	1636	BO	07 0.05 S	178 59.64 E	GPS	5466	5467	10	5502	5554	34	1-8,27,28	
49MR0706_2	P14N	167	1	ROS	120807	1853	EN	06 59.87 S	178 58.55 E	GPS	5508	5510						
49MR0706_2	P14N	168	1	ROS	120807	2112	BE	07 29.95 S	178 59.89 E	GPS	2103	2103						
49MR0706_2	P14N	168	1	BUC	120807	2121	UN	07 29.99 S	178 59.86 E	GPS	2127	2126					1	29.4C
49MR0706_2	P14N	168	1	ROS	120807	2154	BO	07 30.00 S	178 59.76 E	GPS	2156	2156	10	2144	2154	20	1-8,23,24,26,27	
49MR0706_2	P14N	168	1	ROS	120807	2254	EN	07 29.94 S	178 59.61 E	GPS	2159	2158						
49MR0706_2	P14N	169	1	ROS	120907	0114	BE	07 59.87 S	179 0.27 E	GPS	5082	5081						
49MR0706_2	P14N	169	1	BUC	120907	0122	UN	07 59.90 S	179 0.24 E	GPS	5082	5082					1	29.4C
49MR0706_2	P14N	169	1	ROS	120907	0234	BO	07 59.80 S	179 0.07 E	GPS	5082	5082	10	5096	5156	33	1-8,23,24,26,27	
49MR0706_2	P14N	169	1	ROS	120907	0439	EN	08 0.20 S	178 59.53 E	GPS	5084	5085						
49MR0706_2	P14N	170	1	ROS	120907	0705	BE	08 29.95 S	178 44.94 E	GPS	4839	4839						
49MR0706_2	P14N	170	1	BUC	120907	0713	UN	08 29.99 S	178 44.93 E	GPS	4839	4838					1	29.5C
49MR0706_2		667	1	UNK	120907	0738	UN	08 30.11 S	178 44.93 E	GPS	4839	4838						AIR SMPL FOR BVOC #28
49MR0706_2	P14N	170	1	ROS	120907	0822	BO	08 30.23 S	178 44.90 E	GPS	4838	4837	10	4849	4902	32	1-8,23,24,26,27	
49MR0706_2	P14N	170	1	ROS	120907	1022	EN	08 30.33 S	178 44.52 E	GPS	4837	4836						
49MR0706_2	P14N	171	1	ROS	120907	1257	BE	09 0.01 S	178 59.88 E	GPS	5014	5013						
49MR0706_2	P14N	171	1	BUC	120907	1305	UN	09 0.03 S	178 59.90 E	GPS	5013	5013					1	29.2C
49MR0706_2	P14N	171	1	ROS	120907	1415	BO	09 0.19 S	178 59.92 E	GPS	5013	5013	10	5026	5083	36	1-8,12,13,23,24,26,27,32,34,40,43,84,86,87	#2, #3, #4 EXTRA FOR PO14C
49MR0706_2	P14N	171	2	BUC	120907	1550	UN	09 0.43 S	178 59.94 E	GPS	5019	5018					34,86,87	PLANKTON NET
49MR0706_2	P14N	171	1	ROS	120907	1625	EN	09 0.54 S	179 0.03 E	GPS	5017	5017						SEC CND SENSOR BROKE
49MR0706_2		668	1	UNK	120907	1825	UN	09 26.28 S	178 59.86 E	GPS	3895	3895						RAIN SMPL FOR STABLE ISOTOPE #36
49MR0706_2	P14N	172	1	ROS	120907	1911	BE	09 29.85 S	178 59.95 E	GPS	4602	4603						REPLACED SEC CND SENSOR
49MR0706_2	P14N	172	1	BUC	120907	1919	UN	09 29.86 S	178 59.95 E	GPS	4600	4600					1	29.3C
49MR0706_2	P14N	172	1	UNK	120907	1921	UN	09 29.86 S	178 59.95 E	GPS	4587	4587						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	172	1	ROS	120907	2024	BO	09 30.03 S	178 59.90 E	GPS	4589	4589	8	4599	4648	36	1-8,22,27	#2-#6 EXTRA FOR R.N.
49MR0706_2	P14N	172	1	ROS	120907	2221	EN	09 30.07 S	178 59.53 E	GPS	4658	4659						
49MR0706_2	P14N	173	1	ROS	121007	0045	BE	10 0.09 S	178 59.90 E	GPS	4755	4754						
49MR0706_2	P14N	173	1	BUC	121007	0054	UN	10 0.13 S	178 59.90 E	GPS	4753	4753					1	29.2C
49MR0706_2	P14N	173	1	ROS	121007	0201	BO	10 0.35 S	178 59.85 E	GPS	4756	4755	10	4775	4819	31	1-8,23,24,26,27	
49MR0706_2	P14N	173	1	ROS	121007	0402	EN	10 0.53 S	178 59.89 E	GPS	4756	4756						
49MR0706_2	P14N	174	1	ROS	121007	0620	BE	10 30.31 S	178 59.91 E	GPS	4411	4409						
49MR0706_2	P14N	174	1	BUC	121007	0628	UN	10 30.34 S	178 59.91 E	GPS	4418	4417					1	29.5C

49MR0706_2	P14N	174	1	ROS	121007	0733	BO	10 30.52 S	178 59.81 E	GPS	4455	4454	9	4474	4518	31	1-8,27	
49MR0706_2	P14N	174	1	ROS	121007	0925	EN	10 30.71 S	178 59.72 E	GPS	4515	4514						
49MR0706_2	P14N	175	1	ROS	121007	1150	BE	11 0.27 S	178 59.95 E	GPS	3097	3096						
49MR0706_2	P14N	175	1	BUC	121007	1158	UN	11 0.28 S	178 59.95 E	GPS	3094	3094					1	29.3C
49MR0706_2		669	1	UNK	121007	1221	UN	11 0.28 S	179 0.02 E	GPS	3094	3093						AIR SMPL FOR BVOC #29
49MR0706_2	P14N	175	1	ROS	121007	1245	BO	11 0.21 S	178 59.96 E	GPS	3116	3116	11	3113	3132	25	1-8,23,24,26,27	
49MR0706_2	P14N	175	1	ROS	121007	1412	EN	11 0.01 S	178 59.78 E	GPS	3149	3149						
49MR0706_2	P14N	176	1	ROS	121007	1632	BE	11 30.44 S	178 59.74 E	GPS	3105	3103						
49MR0706_2	P14N	176	1	UNK	121007	1635	UN	11 30.54 S	178 59.74 E	GPS	3103	3102						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	176	1	BUC	121007	1641	UN	11 30.50 S	178 59.73 E	GPS	3104	3103					1	29.2C
49MR0706_2	P14N	176	2	BUC	121007	1656	UN	11 30.52 S	178 59.71 E	GPS	3104	3103					34,86,87	PLANKTON NET
49MR0706_2	P14N	176	1	ROS	121007	1725	BO	11 30.66 S	178 59.75 E	GPS	3104	3102	9	3109	3131	25	1-8,27,28	
49MR0706_2	P14N	176	1	ROS	121007	1848	EN	11 30.90 S	178 59.80 E	GPS	3102	3100						
49MR0706_2	P14N	177	1	ROS	121007	2104	BE	12 0.20 S	179 0.54 E	GPS	2588	2588						
49MR0706_2	P14N	177	1	BUC	121007	2112	UN	12 0.21 S	179 0.52 E	GPS	2583	2583					1	28.9C
49MR0706_2	P14N	177	1	ROS	121007	2148	BO	12 0.26 S	179 0.51 E	GPS	2573	2572	8	2580	2598	23	1-8,23,24,26,27	
49MR0706_2	P14N	177	1	ROS	121007	2259	EN	12 0.37 S	179 0.39 E	GPS	2556	2555						
49MR0706_2	P14N	178	1	ROS	121107	0117	BE	12 30.34 S	179 0.29 E	GPS	2789	2789						
49MR0706_2	P14N	178	1	UNK	121107	0123	UN	12 30.35 S	179 0.25 E	GPS	2815	2816						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	178	1	BUC	121107	0125	UN	12 30.36 S	179 0.21 E	GPS	2835	2836					1	29.4C
49MR0706_2	P14N	178	1	ROS	121107	0205	BO	12 30.11 S	178 59.99 E	GPS	2624	2625	7	2766	-9	0		WINCH TROUBLE NEAR BOTTOM, CAST CANCELLED
49MR0706_2	P14N	178	1	ROS	121107	0324	EN	12 30.32 S	178 59.55 E	GPS	2558	2558						
49MR0706_2	P14N	178	2	ROS	121107	0401	BE	12 30.95 S	179 1.04 E	GPS	3007	3009						
49MR0706_2	P14N	178	2	BUC	121107	0409	UN	12 30.92 S	179 1.05 E	GPS	3024	3026					1	30.2C
49MR0706_2	P14N	178	2	UNK	121107	0414	UN	12 30.91 S	179 1.06 E	GPS	3025	3025						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	178	2	ROS	121107	0508	BO	12 30.73 S	179 0.96 E	GPS	3031	3032	16	3025	3046	32	1-8,22,27	#2-#5,#7-#10 EXTRA FOR R.N.
49MR0706_2	P14N	178	2	ROS	121107	0631	EN	12 30.56 S	179 0.61 E	GPS	2963	2964						
49MR0706_2	P14N	179	1	ROS	121107	0844	BE	13 0.01 S	178 59.66 E	GPS	1556	1556						
49MR0706_2	P14N	179	1	BUC	121107	0852	UN	13 0.00 S	178 59.61 E	GPS	1556	1555					1	29.2C
49MR0706_2	P14N	179	1	ROS	121107	0913	BO	12 59.94 S	178 59.55 E	GPS	1557	1556	9	1556	1561	17	1-8,23,24,26,27	
49MR0706_2	P14N	179	1	ROS	121107	0959	EN	12 59.81 S	178 59.49 E	GPS	1539	1538						
49MR0706_2	P14N	180	1	ROS	121107	1215	BE	13 29.79 S	179 0.14 E	GPS	3057	3057						
49MR0706_2	P14N	180	1	BUC	121107	1223	UN	13 29.76 S	179 0.13 E	GPS	3058	3059					1	29.3C
49MR0706_2		670	1	UNK	121107	1239	UN	13 29.67 S	179 0.09 E	GPS	3059	3060						AIR SMPL FOR BVOC #30
49MR0706_2	P14N	180	1	ROS	121107	1308	BO	13 29.60 S	179 0.27 E	GPS	3147	3148	11	3073	3088	25	1-8,12,13,23,24,26,27	
49MR0706_2	P14N	180	1	ROS	121107	1433	EN	13 29.23 S	179 0.63 E	GPS	3173	3173						
49MR0706_2	P14N	181	1	ROS	121107	1652	BE	13 59.91 S	179 0.02 E	GPS	1469	1468						
49MR0706_2	P14N	181	1	BUC	121107	1700	UN	13 59.88 S	179 0.01 E	GPS	1472	1472					1,34,86,87	29.0C
49MR0706_2	P14N	181	1	ROS	121107	1722	BO	13 59.87 S	179 0.12 E	GPS	1477	1476	11	1470	1471	18	1-8,23,24,26,27,32,34,84,86,87	#14 EXTRA FOR 32,34,84,86,87
49MR0706_2	P14N	181	1	ROS	121107	1808	EN	13 59.76 S	179 0.21 E	GPS	1481	1479						
49MR0706_2	P14N	182	1	ROS	121107	2026	BE	14 30.05 S	178 59.78 E	GPS	2263	2261						
49MR0706_2	P14N	182	1	BUC	121107	2033	UN	14 30.02 S	178 59.78 E	GPS	2261	2261					1	28.9C
49MR0706_2	P14N	182	1	ROS	121107	2108	BO	14 30.00 S	178 59.81 E	GPS	2246	2245	14	2290	2303	20	1-8,27,28	
49MR0706_2	P14N	182	1	ROS	121107	2207	EN	14 29.90 S	179 0.06 E	GPS	2247	2245						OPTODE PROTOTYPE #1 BROKE
49MR0706_2	P14N	183	1	ROS	121207	0023	BE	14 59.88 S	178 59.54 E	GPS	2356	2355						
49MR0706_2	P14N	183	1	UNK	121207	0029	UN	14 59.85 S	178 59.53 E	GPS	2354	2354						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14N	183	1	BUC	121207	0031	UN	14 59.84 S	178 59.53 E	GPS	2348	2347					1	29.3C
49MR0706_2	P14N	183	1	ROS	121207	0107	BO	14 59.62 S	178 59.49 E	GPS	2409	2409	14	2391	2397	30	1-8,22,27	#2-#5,#7-#10 EXTRA FOR R.N.
49MR0706_2	P14N	183	1	ROS	121207	0220	EN	14 59.49 S	178 59.52 E	GPS	2383	2383						
49MR0706_2	P14N	184	1	ROS	121207	0436	BE	15 29.83 S	178 59.93 E	GPS	2605	2606						

49MR0706_2	P14N	184	1	BUC	121207	0444	UN	15 29.79 S	178 59.84 E	GPS	2600	2601					1	29.2C
49MR0706_2	P14N	184	1	ROS	121207	0521	BO	15 29.68 S	178 59.65 E	GPS	2579	2580	11	2589	2606	22	1-8,23,24,26,27	
49MR0706_2	P14N	184	1	ROS	121207	0634	EN	15 29.65 S	178 59.54 E	GPS	2572	2573						
49MR0706_2	P14N	185	1	ROS	121207	0844	BE	15 58.67 S	178 59.91 E	GPS	1471	1470						
49MR0706_2	P14N	185	1	BUC	121207	0851	UN	15 58.64 S	178 59.89 E	GPS	1472	1472					1	28.8C
49MR0706_2		671	1	UNK	121207	0902	UN	15 58.57 S	178 59.85 E	GPS	1474	1473						AIR SMPL FOR BVOC #31
49MR0706_2	P14N	185	1	ROS	121207	0911	BO	15 58.51 S	178 59.86 E	GPS	1474	1474	10	1471	1474	16	1-8,23,24,26,27	
49MR0706_2	P14N	185	1	ROS	121207	0954	EN	15 58.30 S	178 59.76 E	GPS	1481	1481						
49MR0706_2	P14C	48	1	ROS	121307	1200	BE	18 52.97 S	177 45.05 E	GPS	2125	2124						REPLACED A FOIL OF OPTODE PROTOTYPE #2
49MR0706_2	P14C	48	1	BUC	121307	1208	UN	18 53.00 S	177 45.07 E	GPS	2126	2126					1	28.3C
49MR0706_2	P14C	48	1	ROS	121307	1241	BO	18 53.06 S	177 44.97 E	GPS	2146	2146	12	2160	2171	20	1-8,23,24,26,27	
49MR0706_2	P14C	48	1	ROS	121307	1343	EN	18 53.14 S	177 44.70 E	GPS	2217	2218						
49MR0706_2	P14C	49	1	ROS	121307	1545	BE	18 45.02 S	177 49.78 E	GPS	1934	1933						
49MR0706_2	P14C	49	1	BUC	121307	1554	UN	18 45.03 S	177 49.74 E	GPS	1930	1930					1	28.3C
49MR0706_2	P14C	49	1	ROS	121307	1622	BO	18 45.06 S	177 49.65 E	GPS	1919	1918	9	1918	1926	19	1-8,27	
49MR0706_2	P14C	49	1	ROS	121307	1721	EN	18 44.98 S	177 49.40 E	GPS	1917	1916						
49MR0706_2	P14C	52	1	ROS	121307	1915	BE	18 32.27 S	177 55.71 E	GPS	645	644						
49MR0706_2	P14C	52	1	BUC	121307	1918	UN	18 32.25 S	177 55.73 E	GPS	616	615					1	28.2C
49MR0706_2		672	1	UNK	121307	1927	UN	18 32.21 S	177 55.71 E	GPS	608	608						AIR SMPL FOR BVOC #32
49MR0706_2	P14C	52	1	ROS	121307	1931	BO	18 32.19 S	177 55.71 E	GPS	601	601	15	616	621	11	1-8,23,24,26,27	
49MR0706_2	P14C	52	1	ROS	121307	1955	EN	18 32.12 S	177 55.68 E	GPS	594	595						
49MR0706_2	P14C	51	1	ROS	121307	2159	BE	18 35.88 S	177 56.05 E	GPS	895	896						
49MR0706_2	P14C	51	1	BUC	121307	2207	UN	18 35.90 S	177 55.99 E	GPS	884	884					1	28.1C
49MR0706_2	P14C	51	1	ROS	121307	2219	BO	18 35.86 S	177 55.98 E	GPS	891	892	10	872	876	13	1-8,27	
49MR0706_2	P14C	51	1	ROS	121307	2251	EN	18 35.68 S	177 55.87 E	GPS	854	855						
49MR0706_2	P14C	50	1	ROS	121407	0051	BE	18 39.67 S	177 52.56 E	GPS	1128	1128						
49MR0706_2	P14C	50	1	UNK	121407	0055	UN	18 39.68 S	177 52.53 E	GPS	1128	1127						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	50	1	BUC	121407	0059	UN	18 39.68 S	177 52.48 E	GPS	1127	1127					1	28.1C
49MR0706_2	P14C	50	1	ROS	121407	0117	BO	18 39.69 S	177 52.43 E	GPS	1127	1126	10	1122	1126	16	1-8,23,24,26,27	#24 LIKELY MISS TRIP (ABNORMALLY WARM)
49MR0706_2	P14C	50	1	ROS	121407	0156	EN	18 39.72 S	177 52.36 E	GPS	1129	1130						
49MR0706_2	P14C	47	1	ROS	121407	0401	BE	19 3.01 S	177 38.50 E	GPS	2543	2543						
49MR0706_2	P14C	47	1	BUC	121407	0409	UN	19 2.99 S	177 38.49 E	GPS	2537	2536					1	28.3C
49MR0706_2	P14C	47	1	ROS	121407	0444	BO	19 2.85 S	177 38.46 E	GPS	2518	2518	10	2519	2537	22	1-8,27,28	
49MR0706_2	P14C	47	1	ROS	121407	0556	EN	19 2.85 S	177 38.39 E	GPS	2492	2492						
49MR0706_2	P14C	46	1	ROS	121407	0757	BE	19 12.89 S	177 34.78 E	GPS	3011	3011						
49MR0706_2	P14C	46	1	BUC	121407	0805	UN	19 12.86 S	177 34.74 E	GPS	3013	3013					1	28.0C
49MR0706_2	P14C	46	1	UNK	121407	0813	UN	19 12.83 S	177 34.70 E	GPS	3013	3013						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	46	1	ROS	121407	0847	BO	19 12.69 S	177 34.65 E	GPS	3011	3011	9	3020	3038	33	1-8,22,27	#2-#5,#7-#10 EXTRA FOR R.N.
49MR0706_2	P14C	46	1	ROS	121407	1010	EN	19 12.50 S	177 34.53 E	GPS	3009	3010						
49MR0706_2	P14C	45	1	ROS	121407	1216	BE	19 23.93 S	177 29.30 E	GPS	3162	3162						
49MR0706_2	P14C	45	1	BUC	121407	1224	UN	19 23.91 S	177 29.29 E	GPS	3163	3161					1	27.9C
49MR0706_2	P14C	45	1	ROS	121407	1310	BO	19 23.78 S	177 29.34 E	GPS	3157	3157	9	3163	3188	25	1-8,23,24,26,27	
49MR0706_2	P14C	45	1	ROS	121407	1445	EN	19 23.50 S	177 29.47 E	GPS	3159	3158						
49MR0706_2	P14C	44	1	ROS	121407	1649	BE	19 38.01 S	177 22.00 E	GPS	2535	2536						
49MR0706_2	P14C	44	1	BUC	121407	1659	UN	19 38.01 S	177 22.00 E	GPS	2524	2526					1,34,86,87	27.5C, PLANKTON NET
49MR0706_2	P14C	44	1	ROS	121407	1735	BO	19 38.04 S	177 21.85 E	GPS	2544	2545	18	2518	2528	22	1-8,23,24,26,27,32,34,84,86,87	
49MR0706_2	P14C	44	1	ROS	121407	1846	EN	19 38.08 S	177 21.77 E	GPS	2575	2576						
49MR0706_2	P14C	43	1	ROS	121407	2049	BE	19 49.06 S	177 24.09 E	GPS	3200	3200						
49MR0706_2	P14C	43	1	BUC	121407	2057	UN	19 49.02 S	177 24.07 E	GPS	3212	3212					1	27.5C
49MR0706_2	P14C	43	1	ROS	121407	2143	BO	19 48.95 S	177 24.03 E	GPS	3247	3246	13	3213	3239	26	1-8,23,24,26,27	
49MR0706_2	P14C	43	1	ROS	121407	2306	EN	19 48.54 S	177 24.15 E	GPS	3193	3192						

49MR0706_2	P14C	42	1	ROS	121507	0112	BE	20 7.81 S	177 32.18 E	GPS	2560	2560						
49MR0706_2	P14C	42	1	BUC	121507	0122	UN	20 7.82 S	177 32.15 E	GPS	2560	2559					1	27.5C
49MR0706_2	P14C	42	1	ROS	121507	0157	BO	20 7.79 S	177 32.20 E	GPS	2570	2570	11	2565	2582	22	1-8,27	
49MR0706_2	P14C	42	1	ROS	121507	0308	EN	20 7.58 S	177 32.07 E	GPS	-9	-9						
49MR0706_2	P14C	41	1	ROS	121507	0633	BE	20 22.31 S	177 38.07 E	GPS	3012	3011						
49MR0706_2	P14C	41	1	BUC	121507	0641	UN	20 22.35 S	177 38.09 E	GPS	2980	2979					1	27.3C
49MR0706_2	P14C	41	1	ROS	121507	0723	BO	20 22.34 S	177 38.20 E	GPS	2976	2975	9	2980	3001	24	1-8,23,24,26,27	
49MR0706_2	P14C	41	1	ROS	121507	0846	EN	20 22.37 S	177 38.19 E	GPS	2955	2954						
49MR0706_2	P14C	40	1	ROS	121507	1045	BE	20 37.77 S	177 35.61 E	GPS	3081	3081						LADCP REPLACED FROM S/N 8484 TO S/N 2553
49MR0706_2	P14C	40	1	BUC	121507	1052	UN	20 37.80 S	177 35.58 E	GPS	3079	3079					1	26.8C
49MR0706_2	P14C	40	1	UNK	121507	1054	UN	20 37.80 S	177 35.58 E	GPS	3081	3081						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	40	1	ROS	121507	1135	BO	20 37.72 S	177 35.54 E	GPS	3084	3084	10	3086	3109	25	1-8,27	
49MR0706_2	P14C	40	1	ROS	121507	1303	EN	20 37.60 S	177 35.61 E	GPS	3090	3090						
49MR0706_2	P14C	39	1	ROS	121507	1500	BE	20 52.09 S	177 33.32 E	GPS	3192	3191						
49MR0706_2	P14C	39	1	BUC	121507	1509	UN	20 52.04 S	177 33.32 E	GPS	3189	3189					1	27.3C
49MR0706_2	P14C	39	1	ROS	121507	1559	BO	20 51.90 S	177 33.23 E	GPS	3188	3188	9	3195	3220	25	1-8,23,24,26,27	
49MR0706_2	P14C	39	2	BUC	121507	1643	UN	20 51.78 S	177 33.20 E	GPS	3145	3145					34,86,87	PLANKTON NET
49MR0706_2	P14C	39	1	ROS	121507	1732	EN	20 51.58 S	177 33.17 E	GPS	3144	3143						
49MR0706_2	P14C	38	1	ROS	121507	1941	BE	21 7.01 S	177 30.87 E	GPS	3354	3354						
49MR0706_2	P14C	38	1	BUC	121507	1950	UN	21 6.99 S	177 30.89 E	GPS	3357	3357					1	27.4C
49MR0706_2		673	1	UNK	121507	2005	UN	21 7.01 S	177 30.87 E	GPS	3354	3353						AIR SMPL FOR BVOC #33
49MR0706_2	P14C	38	1	ROS	121507	2037	BO	21 7.09 S	177 30.79 E	GPS	3355	3355	10	3361	3388	26	1-8,27,28	
49MR0706_2	P14C	38	1	ROS	121507	2208	EN	21 7.31 S	177 30.53 E	GPS	3367	3366						
49MR0706_2	P14C	37	1	ROS	121607	0000	BE	21 25.35 S	177 27.91 E	GPS	3800	3800						
49MR0706_2	P14C	37	1	BUC	121607	0009	UN	21 25.36 S	177 27.94 E	GPS	3799	3799					1	27.1C
49MR0706_2	P14C	37	1	ROS	121607	0103	BO	21 25.45 S	177 27.95 E	GPS	3802	3800	13	3800	3838	28	1-8,12,13,23,24,26,27	
49MR0706_2	P14C	37	1	ROS	121607	0255	EN	21 25.56 S	177 28.16 E	GPS	3803	3802						
49MR0706_2		674	1	UNK	121607	0257	UN	21 25.56 S	177 28.21 E	GPS	3803	3802						RAIN SMPL FOR STABLE ISOTOPE #37
49MR0706_2	P14C	36	1	ROS	121607	0451	BE	21 46.11 S	177 24.17 E	GPS	3985	3983						
49MR0706_2	P14C	36	1	BUC	121607	0501	UN	21 46.06 S	177 24.12 E	GPS	3984	3983					1	25.7C
49MR0706_2	P14C	36	1	UNK	121607	0513	UN	21 46.03 S	177 24.11 E	GPS	3983	3982						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	36	1	ROS	121607	0556	BO	21 46.09 S	177 24.04 E	GPS	3984	3983	11	3984	4027	36	1-8,22,27	#2-#9 EXTRA FOR R.N.
49MR0706_2	P14C	36	1	ROS	121607	0739	EN	21 46.13 S	177 24.39 E	GPS	3984	3983						
49MR0706_2	P14C	35	1	ROS	121607	0943	BE	22 12.07 S	177 19.73 E	GPS	4169	4169						
49MR0706_2	P14C	35	1	BUC	121607	0951	UN	22 12.04 S	177 19.67 E	GPS	4167	4166					1	25.2C
49MR0706_2	P14C	35	1	ROS	121607	1049	BO	22 11.96 S	177 19.67 E	GPS	4170	4170	9	4175	4219	28	1-8,23,24,26,27	#11 MISS FIRE
49MR0706_2	P14C	35	1	ROS	121607	1237	EN	22 11.76 S	177 19.57 E	GPS	4167	4167						
49MR0706_2	P14C	34	1	ROS	121607	1447	BE	22 38.01 S	177 15.44 E	GPS	4203	4203						
49MR0706_2	P14C	34	1	BUC	121607	1455	UN	22 37.95 S	177 15.40 E	GPS	4211	4211					1	25.2C
49MR0706_2	P14C	34	1	ROS	121607	1555	BO	22 37.56 S	177 15.51 E	GPS	4216	4216	10	4238	4266	30	1-8,27,32,34,84,86,87	
49MR0706_2	P14C	34	2	BUC	121607	1648	UN	22 37.36 S	177 15.58 E	GPS	4216	4216					34,86,87	PLANKTON NET
49MR0706_2	P14C	34	1	ROS	121607	1744	EN	22 37.18 S	177 15.65 E	GPS	4213	4214						
49MR0706_2	P14C	33	1	ROS	121607	1953	BE	23 3.92 S	177 11.05 E	GPS	4357	4357						
49MR0706_2	P14C	33	1	BUC	121607	2001	UN	23 3.90 S	177 11.08 E	GPS	4355	4355					1	25.1C
49MR0706_2	P14C	33	1	ROS	121607	2102	BO	23 3.90 S	177 10.94 E	GPS	4358	4359	8	4372	4414	30	1-8,23,24,26,27	
49MR0706_2	P14C	33	1	ROS	121607	2249	EN	23 3.70 S	177 10.92 E	GPS	4346	4346						
49MR0706_2	P14C	32	1	ROS	121707	0053	BE	23 29.25 S	177 6.87 E	GPS	4067	4066						
49MR0706_2	P14C	32	1	BUC	121707	0102	UN	23 29.21 S	177 6.83 E	GPS	4070	4069					1	25.1C
49MR0706_2	P14C	32	1	UNK	121707	0106	UN	23 29.20 S	177 6.82 E	GPS	4059	4059						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2		675	1	UNK	121707	0117	UN	23 29.17 S	177 6.82 E	GPS	4037	4034						AIR SMPL FOR BVOC #34
49MR0706_2	P14C	32	1	ROS	121707	0201	BO	23 29.05 S	177 6.69 E	GPS	3997	3996	13	4014	4052	28	1-8,27	

49MR0706_2	P14C	32	1	ROS	121707	0351	EN	23 28.70 S	177 6.52 E	GPS	4218	4217						
49MR0706_2	P14C	31	1	ROS	121707	0607	BE	23 57.65 S	177 1.79 E	GPS	4435	4435						LADCP REPLACED BACK TO S/N 8484
49MR0706_2	P14C	31	1	BUC	121707	0616	UN	23 57.65 S	177 1.77 E	GPS	4435	4434					1	24.4C
49MR0706_2	P14C	31	1	ROS	121707	0719	BO	23 57.50 S	177 1.93 E	GPS	4436	4436	9	4448	4496	31	1-8,27	
49MR0706_2	P14C	31	1	ROS	121707	0910	EN	23 57.30 S	177 2.01 E	GPS	4434	4434						
49MR0706_2	P14C	30	1	ROS	121707	1108	BE	24 21.92 S	176 57.34 E	GPS	4453	4451						
49MR0706_2	P14C	30	1	BUC	121707	1116	UN	24 21.93 S	176 57.30 E	GPS	4451	4450					1	24.3C
49MR0706_2	P14C	30	1	ROS	121707	1219	BO	24 21.78 S	176 57.28 E	GPS	4449	4448	10	4463	4511	30	1-8,23,24,26,27	
49MR0706_2	P14C	30	1	ROS	121707	1424	EN	24 21.65 S	176 57.21 E	GPS	4448	4447						
49MR0706_2	P14C	29	1	ROS	121707	1629	BE	24 48.18 S	176 53.24 E	GPS	4463	4462						
49MR0706_2	P14C	29	1	BUC	121707	1639	UN	24 48.10 S	176 53.21 E	GPS	4465	4465					1	23.6C
49MR0706_2	P14C	29	1	UNK	121707	1643	UN	24 48.09 S	176 53.17 E	GPS	4463	4464						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	29	2	BUC	121707	1656	UN	24 47.98 S	176 53.21 E	GPS	4464	4465					34,86,87	PLANKTON NET
49MR0706_2	P14C	29	1	ROS	121707	1742	BO	24 47.69 S	176 53.08 E	GPS	4444	4444	11	4497	4524	36	1-8,22,27	#2-#7 EXTRA FOR R.N.
49MR0706_2	P14C	29	1	ROS	121707	1934	EN	24 47.28 S	176 52.72 E	GPS	4423	4423						
49MR0706_2	P14C	28	1	ROS	121707	2142	BE	25 14.21 S	176 48.66 E	GPS	4476	4477						
49MR0706_2	P14C	28	1	BUC	121707	2150	UN	25 14.20 S	176 48.61 E	GPS	4476	4477					1	23.7C
49MR0706_2	P14C	28	1	ROS	121707	2252	BO	25 14.08 S	176 48.44 E	GPS	4477	4477	9	4492	4538	36	1-8,12,13,23,24,26,27,40,43	#2-#6 EXTRA FOR PO14C
49MR0706_2	P14C	28	1	ROS	121807	0048	EN	25 13.60 S	176 48.10 E	GPS	4476	4476						
49MR0706_2	P14C	27	1	ROS	121807	0250	BE	25 40.27 S	176 44.42 E	GPS	4439	4439						
49MR0706_2	P14C	27	1	BUC	121807	0258	UN	25 40.27 S	176 44.35 E	GPS	4440	4441					1	23.8C
49MR0706_2	P14C	27	1	ROS	121807	0400	BO	25 40.06 S	176 44.04 E	GPS	4439	4440	11	4460	4499	30	1-8,27,28	
49MR0706_2	P14C	27	1	ROS	121807	0548	EN	25 40.32 S	176 43.67 E	GPS	4434	4435						
49MR0706_2	P14C	26	1	ROS	121807	0746	BE	26 6.28 S	176 39.96 E	GPS	4408	4409						
49MR0706_2	P14C	26	1	BUC	121807	0755	UN	26 6.29 S	176 39.95 E	GPS	4409	4410					1	23.7C
49MR0706_2		676	1	UNK	121807	0810	UN	26 6.29 S	176 39.94 E	GPS	4410	4411						AIR SMPL FOR BVOC #35
49MR0706_2	P14C	26	1	ROS	121807	0857	BO	26 6.25 S	176 39.82 E	GPS	4408	4409	9	4422	4471	30	1-8,27	
49MR0706_2	P14C	26	1	ROS	121807	1041	EN	26 6.12 S	176 39.70 E	GPS	4411	4413						
49MR0706_2	P14C	25	1	ROS	121807	1243	BE	26 32.57 S	176 35.78 E	GPS	4424	4423						
49MR0706_2	P14C	25	1	BUC	121807	1251	UN	26 32.58 S	176 35.80 E	GPS	4425	4425					1	23.3C
49MR0706_2	P14C	25	1	UNK	121807	1259	UN	26 32.56 S	176 35.85 E	GPS	4427	4426						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	25	1	ROS	121807	1355	BO	26 32.50 S	176 35.78 E	GPS	4427	4427	9	4441	4486	31	1-8,23,24,26,27,32,34,84,86,87	
49MR0706_2	P14C	25	2	BUC	121807	1517	UN	26 32.09 S	176 35.71 E	GPS	4429	4428					34,86,87	PLANKTON NET
49MR0706_2	P14C	25	1	ROS	121807	1555	EN	26 31.98 S	176 35.75 E	GPS	4431	4430						
49MR0706_2	P14C	24	1	ROS	121807	1801	BE	26 58.49 S	176 31.52 E	GPS	4397	4396						
49MR0706_2	P14C	24	1	BUC	121807	1810	UN	26 58.53 S	176 31.58 E	GPS	4399	4399					1	24.1C
49MR0706_2	P14C	24	1	ROS	121807	1912	BO	26 58.75 S	176 31.61 E	GPS	4400	4399	10	4410	4459	30	1-8,27	
49MR0706_2	P14C	24	1	ROS	121807	2058	EN	26 58.93 S	176 31.60 E	GPS	4397	4396						
49MR0706_2	P14C	23	1	ROS	121807	2257	BE	27 24.47 S	176 26.67 E	GPS	4238	4236						
49MR0706_2	P14C	23	1	BUC	121807	2306	UN	27 24.52 S	176 26.69 E	GPS	4233	4231					1	23.2C
49MR0706_2	P14C	23	1	ROS	121907	0005	BO	27 24.85 S	176 26.83 E	GPS	4228	4226	9	4245	4284	29	1-8,23,24,26,27	
49MR0706_2	P14C	23	1	ROS	121907	0156	EN	27 24.76 S	176 27.07 E	GPS	4236	4235						
49MR0706_2	P14C	22	1	ROS	121907	0356	BE	27 50.51 S	176 22.28 E	GPS	4358	4358						
49MR0706_2	P14C	22	1	BUC	121907	0404	UN	27 50.47 S	176 22.27 E	GPS	4360	4360					1	22.9C
49MR0706_2	P14C	22	1	UNK	121907	0412	UN	27 50.41 S	176 22.22 E	GPS	4356	4355						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	22	1	ROS	121907	0505	BO	27 50.20 S	176 21.91 E	GPS	4349	4349	8	4390	4413	36	1-8,22,27	#2-#7 EXTRA FOR R.N.
49MR0706_2	P14C	22	1	ROS	121907	0654	EN	27 49.79 S	176 21.33 E	GPS	4338	4338						
49MR0706_2	P14C	21	1	ROS	121907	0859	BE	28 16.59 S	176 18.04 E	GPS	4460	4462						
49MR0706_2	P14C	21	1	BUC	121907	0908	UN	28 16.58 S	176 17.97 E	GPS	4458	4459					1	23.1C
49MR0706_2		677	1	UNK	121907	0935	UN	28 16.52 S	176 17.85 E	GPS	4460	4462						AIR SMPL FOR BVOC #36
49MR0706_2	P14C	21	1	ROS	121907	1010	BO	28 16.35 S	176 17.81 E	GPS	4458	4460	10	4484	4525	30	1-8,23,24,26,27	

49MR0706_2	P14C	21	1	ROS	121907	1155	EN	28 16.10 S	176 17.42 E	GPS	4460	4462						
49MR0706_2	P14C	20	1	ROS	121907	1358	BE	28 42.55 S	176 13.54 E	GPS	4087	4089						
49MR0706_2	P14C	20	1	BUC	121907	1406	UN	28 42.55 S	176 13.52 E	GPS	4062	4063					1	23.1C
49MR0706_2	P14C	20	1	ROS	121907	1504	BO	28 42.39 S	176 13.34 E	GPS	3974	3974	14	4024	4059	28	1-8,27,28	
49MR0706_2	P14C	20	1	ROS	121907	1647	EN	28 41.92 S	176 12.85 E	GPS	3903	3904						
49MR0706_2	P14C	19	1	ROS	121907	1903	BE	29 9.16 S	176 9.04 E	GPS	3334	3333						
49MR0706_2	P14C	19	1	BUC	121907	1911	UN	29 9.19 S	176 9.06 E	GPS	3331	3331					1,34,86,87	23.0C,PLANKTON NET
49MR0706_2	P14C	19	1	ROS	121907	1959	BO	29 9.16 S	176 9.03 E	GPS	3333	3333	10	3336	3365	26	1-8,23,24,26,27	
49MR0706_2	P14C	19	1	ROS	121907	2124	EN	29 9.21 S	176 9.08 E	GPS	3331	3331						
49MR0706_2		678	1	UNK	121907	2212	UN	29 19.53 S	176 7.41 E	GPS	4286	4287						RAIN SMPL FOR STABLE ISOTOPE #38
49MR0706_2	P14C	18	1	ROS	121907	2323	BE	29 34.38 S	176 4.88 E	GPS	4304	4302						
49MR0706_2	P14C	18	1	BUC	121907	2333	UN	29 34.43 S	176 4.90 E	GPS	4308	4306					1	22.8C UNDER HEAVY RAIN
49MR0706_2	P14C	18	1	ROS	122007	0032	BO	29 34.40 S	176 4.95 E	GPS	4301	4300	10	4311	4359	30	1-8,27	
49MR0706_2		679	1	UNK	122007	0153	UN	29 34.40 S	176 4.97 E	GPS	4306	4305						RAIN SMPL FOR STABLE ISOTOPE #39
49MR0706_2	P14C	18	1	ROS	122007	0227	EN	29 34.38 S	176 4.97 E	GPS	4305	4303						
49MR0706_2	P14C	X06	1	ROS	122007	0456	BE	30 4.93 S	175 50.07 E	GPS	4257	4257						
49MR0706_2	P14C	X06	1	BUC	122007	0504	UN	30 4.91 S	175 50.00 E	GPS	4255	4255					1	22.1C
49MR0706_2		680	1	UNK	122007	0527	UN	30 4.86 S	175 50.04 E	GPS	4255	4254						RAIN SMPL FOR STABLE ISOTOPE #40
49MR0706_2	P14C	X06	1	ROS	122007	0603	BO	30 4.80 S	175 50.08 E	GPS	4257	4256	10	4266	4310	36	1-8,12,13,23,24,26,27,40,43	#2-#8 EXTRA FOR PO14C
49MR0706_2	P14C	X06	1	ROS	122007	0747	EN	30 4.65 S	175 50.17 E	GPS	4256	4256						
49MR0706_2	P14C	16	1	ROS	122007	0947	BE	30 26.92 S	175 56.03 E	GPS	4226	4226						
49MR0706_2		681	1	UNK	122007	0950	UN	30 26.92 S	175 56.01 E	GPS	4227	4226						RAIN SMPL FOR STABLE ISOTOPE #41
49MR0706_2	P14C	16	1	BUC	122007	0955	UN	30 26.93 S	175 55.98 E	GPS	4225	4225					1	22.1C
49MR0706_2	P14C	16	1	UNK	122007	1003	UN	30 26.93 S	175 56.02 E	GPS	4227	4227						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	16	1	ROS	122007	1054	BO	30 26.81 S	175 56.06 E	GPS	4228	4228	9	4238	4284	36	1-8,22,27	#2-#7 EXTRA FOR R.N.
49MR0706_2	P14C	16	1	ROS	122007	1243	EN	30 26.84 S	175 55.83 E	GPS	4230	4230						
49MR0706_2	P14C	15	1	ROS	122007	1444	BE	30 52.92 S	175 51.48 E	GPS	4153	4152						
49MR0706_2	P14C	15	1	BUC	122007	1452	UN	30 52.93 S	175 51.49 E	GPS	4150	4150					1	21.9C
49MR0706_2		682	1	UNK	122007	1544	UN	30 52.83 S	175 51.54 E	GPS	4155	4155						AIR SMPL FOR BVOC #37
49MR0706_2	P14C	15	1	ROS	122007	1552	BO	30 52.77 S	175 51.48 E	GPS	4156	4154	10	4165	4206	29	1-8,23,24,26,27,32,34,84,86,87	
49MR0706_2	P14C	15	2	BUC	122007	1657	UN	30 52.58 S	175 51.27 E	GPS	4156	4157					34,86,87	PLANKTON NET
49MR0706_2	P14C	15	1	ROS	122007	1737	EN	30 52.47 S	175 51.32 E	GPS	4155	4155						
49MR0706_2	P14C	14	1	ROS	122007	1941	BE	31 18.74 S	175 47.11 E	GPS	4107	4106						
49MR0706_2	P14C	14	1	BUC	122007	1950	UN	31 18.71 S	175 47.14 E	GPS	4105	4107					1	21.6C
49MR0706_2		683	1	UNK	122007	1950	UN	31 18.71 S	175 47.15 E	GPS	4105	4107						RAIN SMPL FOR STABLE ISOTOPE #42
49MR0706_2	P14C	14	1	ROS	122007	2047	BO	31 18.39 S	175 47.35 E	GPS	4103	4104	9	4134	4159	29	1-8,27,28	
49MR0706_2	P14C	14	1	ROS	122007	2230	EN	31 18.00 S	175 47.75 E	GPS	4106	4107						
49MR0706_2	P14C	13	1	ROS	122107	0035	BE	31 44.79 S	175 42.81 E	GPS	3965	3965						
49MR0706_2	P14C	13	1	BUC	122107	0043	UN	31 44.74 S	175 42.82 E	GPS	3935	3935					1	21.5C
49MR0706_2	P14C	13	1	ROS	122107	0140	BO	31 44.61 S	175 42.98 E	GPS	3952	3951	13	3943	3983	29	1-8,23,24,26,27	
49MR0706_2	P14C	13	1	ROS	122107	0323	EN	31 44.17 S	175 43.18 E	GPS	3817	3816						
49MR0706_2	P14C	12	1	ROS	122107	0538	BE	32 10.77 S	175 38.29 E	GPS	3921	3921						
49MR0706_2	P14C	12	1	BUC	122107	0546	UN	32 10.68 S	175 38.28 E	GPS	3921	3920					1	20.7C
49MR0706_2	P14C	12	1	UNK	122107	0550	UN	32 10.63 S	175 38.27 E	GPS	3921	3921						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	12	1	ROS	122107	0641	BO	32 10.17 S	175 38.19 E	GPS	3925	3925	12	3959	3967	36	1-8,22,27	#2-#9 EXTRA FOR R.N.
49MR0706_2	P14C	12	1	ROS	122107	0826	EN	32 9.25 S	175 38.39 E	GPS	3931	3931						
49MR0706_2	P14C	11	1	ROS	122107	1042	BE	32 36.72 S	175 33.15 E	GPS	3857	3858						
49MR0706_2	P14C	11	1	BUC	122107	1051	UN	32 36.63 S	175 33.08 E	GPS	3857	3858					1	20.5C
49MR0706_2	P14C	11	1	ROS	122107	1145	BO	32 36.16 S	175 33.22 E	GPS	3858	3859	9	3924	3905	28	1-8,23,24,26,27	
49MR0706_2	P14C	11	1	ROS	122107	1326	EN	32 35.71 S	175 33.21 E	GPS	3859	3859						
49MR0706_2	P14C	10	1	ROS	122107	1530	BE	32 49.44 S	175 32.11 E	GPS	3824	3824						

49MR0706_2	P14C	10	1	BUC	122107	1538	UN	32 49.35 S	175 32.04 E	GPS	3833	3834					1	20.1C
49MR0706_2	P14C	10	2	BUC	122107	1627	UN	32 49.03 S	175 31.70 E	GPS	3831	3831					34,86,87	PLANKTON NET
49MR0706_2	P14C	10	1	ROS	122107	1633	BO	32 49.01 S	175 31.67 E	GPS	3834	3835	12	3874	3875	28	1-8,27,32,34,84,86,87	
49MR0706_2	P14C	10	1	ROS	122107	1818	EN	32 48.12 S	175 31.24 E	GPS	3835	3836						
49MR0706_2	P14C	9	1	ROS	122107	2039	BE	33 15.67 S	175 27.29 E	GPS	3730	3730						
49MR0706_2	P14C	9	1	BUC	122107	2048	UN	33 15.59 S	175 27.34 E	GPS	3733	3733					1	20.3C
49MR0706_2	P14C	9	1	ROS	122107	2141	BO	33 15.44 S	175 27.47 E	GPS	3737	3737	10	3746	3781	28	1-8,23,24,26,27	
49MR0706_2	P14C	9	1	ROS	122107	2312	EN	33 15.23 S	175 27.53 E	GPS	3743	3744						
49MR0706_2	P14C	8	1	ROS	122207	0130	BE	33 42.15 S	175 22.96 E	GPS	2343	2339						
49MR0706_2	P14C	8	1	UNK	122207	0139	UN	33 42.16 S	175 23.03 E	GPS	2338	2335						80L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	8	1	BUC	122207	0140	UN	33 42.15 S	175 23.05 E	GPS	2335	2331					1	20.4C
49MR0706_2		684	1	UNK	122207	0152	UN	33 42.22 S	175 23.19 E	GPS	2269	2265						AIR SMPL FOR BVOC #38
49MR0706_2	P14C	8	1	ROS	122207	0211	BO	33 42.17 S	175 23.29 E	GPS	2294	2291	14	2265	2276	28	1-8,22,27	#2-#5,#7-#10 EXTRA FOR R.N.
49MR0706_2	P14C	8	1	ROS	122207	0313	EN	33 42.13 S	175 23.75 E	GPS	2185	2182						
49MR0706_2	P14C	7	1	ROS	122207	0523	BE	34 8.06 S	175 18.18 E	GPS	1998	1996						
49MR0706_2	P14C	7	1	BUC	122207	0531	UN	34 8.01 S	175 18.12 E	GPS	1998	1996					1	19.7C
49MR0706_2	P14C	7	1	ROS	122207	0559	BO	34 7.94 S	175 18.04 E	GPS	2002	1999	11	2002	2012	21	1-8,12,13,23,24,26,27	#22 MISS TRIP, SAMPLES WERE TAKEN FROM #4
49MR0706_2	P14C	7	1	ROS	122207	0700	EN	34 8.05 S	175 18.26 E	GPS	1994	1991						
49MR0706_2	P14C	6	1	ROS	122207	0840	BE	34 27.96 S	175 14.67 E	GPS	1806	1806						
49MR0706_2	P14C	6	1	BUC	122207	0850	UN	34 27.99 S	175 14.65 E	GPS	1764	1764					1	19.3C
49MR0706_2	P14C	6	1	ROS	122207	0915	BO	34 27.95 S	175 14.59 E	GPS	1752	1752	11	1746	1755	18	1-8,27,28	
49MR0706_2	P14C	6	1	ROS	122207	1008	EN	34 27.99 S	175 14.54 E	GPS	1735	1735						
49MR0706_2	P14C	5	1	ROS	122207	1200	BE	34 49.59 S	175 11.11 E	GPS	1441	1441						
49MR0706_2	P14C	5	1	BUC	122207	1207	UN	34 49.64 S	175 11.09 E	GPS	1447	1447					1	19.9C
49MR0706_2	P14C	5	1	ROS	122207	1230	BO	34 49.57 S	175 11.09 E	GPS	1440	1440	10	1444	1449	16	1-8,23,24,26,27	
49MR0706_2	P14C	5	1	ROS	122207	1313	EN	34 49.50 S	175 11.19 E	GPS	1426	1426						
49MR0706_2	P14C	4	1	ROS	122207	1503	BE	35 1.27 S	175 9.09 E	GPS	617	618						
49MR0706_2	P14C	4	1	BUC	122207	1510	UN	35 1.26 S	175 9.03 E	GPS	617	618					1	20.0C
49MR0706_2	P14C	4	1	UNK	122207	1515	UN	35 1.25 S	175 8.97 E	GPS	617	618						20L THROUGH HULL PUMP FOR R.N.
49MR0706_2	P14C	4	1	ROS	122207	1520	BO	35 1.23 S	175 8.91 E	GPS	617	617	10	611	613	11	1-8,27	
49MR0706_2	P14C	4	1	ROS	122207	1545	EN	35 1.21 S	175 8.88 E	GPS	618	619						
49MR0706_2	P14C	3	1	ROS	122207	1740	BE	35 13.84 S	175 6.54 E	GPS	620	619						
49MR0706_2	P14C	3	1	BUC	122207	1748	UN	35 13.83 S	175 6.49 E	GPS	616	616					1	19.9C
49MR0706_2	P14C	3	1	ROS	122207	1757	BO	35 13.83 S	175 6.48 E	GPS	617	617	9	604	610	10	1-8,23,24,26,27	
49MR0706_2	P14C	3	1	ROS	122207	1824	EN	35 13.77 S	175 6.39 E	GPS	613	611						
49MR0706_2	P14C	2	1	ROS	122207	2022	BE	35 27.25 S	175 4.17 E	GPS	367	366						
49MR0706_2	P14C	2	1	BUC	122207	2027	UN	35 27.24 S	175 4.18 E	GPS	367	366					1	20.1C
49MR0706_2	P14C	2	1	ROS	122207	2036	BO	35 27.23 S	175 4.24 E	GPS	368	367	-9	352	358	7	1-8,27	HABTM 26-34 M BY LADCP
49MR0706_2	P14C	2	1	ROS	122207	2052	EN	35 27.21 S	175 4.20 E	GPS	370	369						
49MR0706_2		685	1	UNK	122207	2220	UN	35 36.21 S	175 2.38 E	GPS	256	256						AIR SMPL FOR BVOC #39
49MR0706_2	P14C	1	1	ROS	122207	2241	BE	35 38.03 S	175 2.16 E	GPS	226	226						
49MR0706_2	P14C	1	1	BUC	122207	2245	UN	35 38.04 S	175 2.13 E	GPS	225	225					1	19.6C
49MR0706_2	P14C	1	1	ROS	122207	2253	BO	35 38.06 S	175 2.07 E	GPS	224	224	13	216	222	5	1-8,27	
49MR0706_2	P14C	1	1	ROS	122207	2304	EN	35 38.06 S	175 2.04 E	GPS	223	222						

Parameter

1=Salinity, 2=Oxygen, 3=Silicate, 4=Nitrate, 5=Nitrite, 6=PHOSPHATE, 7=CFC-11, 8=CFC-12, 12=$\Delta^{14}C$, 13=$\delta^{13}C$, 22=^{137}CS, 23= Total carbon, 24=Alkalinity, 26=PH, 27=CFC-113, 28=Carbon tetrachloride, 31= CH_4, 33=N_2O, 34=Chlorophyll a, 37=Biogenic sulfur compounds, 40=Particulate organic carbon, 42= Abundance of bacteria, 47=Plutonium, 64= Incubation, 81= Particulate organic matter, 82=$^{15}NO_3$, 83=Particulate inorganic matter

Figure captions

Figure 1(a) Station locations for WHP-P01 cruise with bottom topography based on Smith and Sandwell (1997).

Figure 1(b) Station locations for WHP-P14 cruise with bottom topography based on Smith and Sandwell (1997).

Figure 2(a) Bathymetry measured by Multi Narrow Beam Echo Sounding system for WHP P01. Cross mark indicates CTD location.

Figure 2(b) Bathymetry measured by Multi Narrow Beam Echo Sounding system for WHP P14. Cross mark indicates CTD location.

Figure 3 Surface wind measured at 25 m above sea level. Wind data is averaged over 1-hour and plotted every 0.5 degree in latitude.
(a) WHP-P01 (b) WHP-P14

Figure 4 Sea surface temperature (SST). Temperature data is averaged over 1-hour.
(a) WHP-P01 (b) WHP-P14

Figure 5 Sea surface salinity (SSS). Salinity data is averaged over 1-hour.
(a) WHP-P01 (b) WHP-P14

Figure 6 Difference in the partial pressure of CO_2 between the ocean and the atmosphere, ΔpCO_2.
(a) WHP-P01 (b) WHP-P14

Figure 7 Surface current at 100 m depth measured by ship board acoustic Doppler current prof iler (ADCP).
(a) WHP-P01 (b) WHP-P14

Figure 8 Potential temperature (°C) cross section calculated by using CTD temperature and salinity data calibrated by bottle salinity measurements. Vertical exaggeration of the 0-6,500 m section is 1000:1. Expanded section of the upper 1000 m is made with a vertical exaggeration of 2500:1.
(a) WHP-P01 (b) WHP-P14

Figure 9 CTD salinity (psu) cross section calibrated by bottle salinity measurements. Vertical exaggeration is same as Figure 8.
(a) WHP-P01 (b) WHP-P14

Figure 10 Same as Figure 9 but with SSW batch correction[1].
(a) WHP-P01 (b) WHP-P14

Figure 11 Density (σ_0) (kg/m^3) cross section calculated using CTD temperature and calibrated salinity data with SSW batch correction. Vertical exaggeration is same as Figure 8.
(a) WHP-P01 (b) WHP-P14

Figure 12 Same as Figure 11 but for σ_4 (kg/m^3).
(a) WHP-P01 (b) WHP-P14

Figure 13 Neutral density (γ^n) (kg/m^3) cross section calculated using CTD temperature and calibrated salinity data with SSW batch correction. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 14 Cross section of bottle sampled dissolved oxygen (μmol/kg). Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8.
(a) WHP-P01 (b) WHP-P14

Figure 15 Silicate (μmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 16 Nitrate (μmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration of the upper 1000 m section is same as Figure 8.
(a) WHP-P01 (b) WHP-P14

Figure 17 Nitrite (μmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 18 Phosphate (μmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 19 Dissolved inorganic carbon (μmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 20 Total alkalinity (μmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 21 pH cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 22 CFC-11 (pmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 23 CFC-12 (pmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 24 CFC-113 (pmol/kg) cross section. Data with quality flags of 2 were plotted. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 25 Cross section of current velocity (cm/s) normal to the cruise track measured by LADCP (northward is positive). (a) WHP-P01 (b) WHP-P14

Figure 26 Difference in potential temperature (°C) between results from WOCE (from Oct. to Nov., 1993) and the revisit cruise (from May to Jul., 2005). Red and blue areas show the areas where potential temperature increased and decreased in the revisit cruise, respectively. On white areas differences in temperature do not exceed the detection limit of 0.002 ^{o}C. Vertical exaggeration is same as Figure 8.
(a) WHP-P01 (b) WHP-P14

Figure 27 Difference in salinity (psu) between results from WOCE and the revisit cruise. Red and blue areas show the areas where salinity increased and decreased in the revisit cruise, respectively. CTD salinity data with SSW batch correction[1] are used. On white areas differences in salinity do not exceed the detection limit of 0.002 psu. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Figure 28 Difference in dissolved oxygen (μmol/kg) between results from WOCE and the revisit cruise. Red and blue areas show the areas where salinity increased and decreased in the revisit cruise, respectively. Bottle oxygen data are used. On white areas differences in salinity do not exceed the detection limit of 2 μmol/kg. Vertical exaggeration is same as Figure 8. (a) WHP-P01 (b) WHP-P14

Note

1. As for the traceability of SSW to Mantyla's value, the offset for the batches P120 (P14C), P122 (P14N), P133 (P01E and P01W), P134 (P01C, a part of P01E and P01H) and P148 (Revisit) is -0.0022, -0.0009, -0.0010, -0.0011 and -0.0011, respectively (The newest values, Kawano et al., in preparation).

References

Jackett, D. R. and R. J. McDougall (1997): A neutral density variable for the world's oceans, Journal of Physical Oceanography, 27, 237-263.

Smith, W. H. F. and D. T. Sandwell (1997): Global seafloor topography from satellite altimetry and ship depth soundings, Science, 277, 1956-1962.

Figure 1(a)
Station locations for WHP-P01 cruise

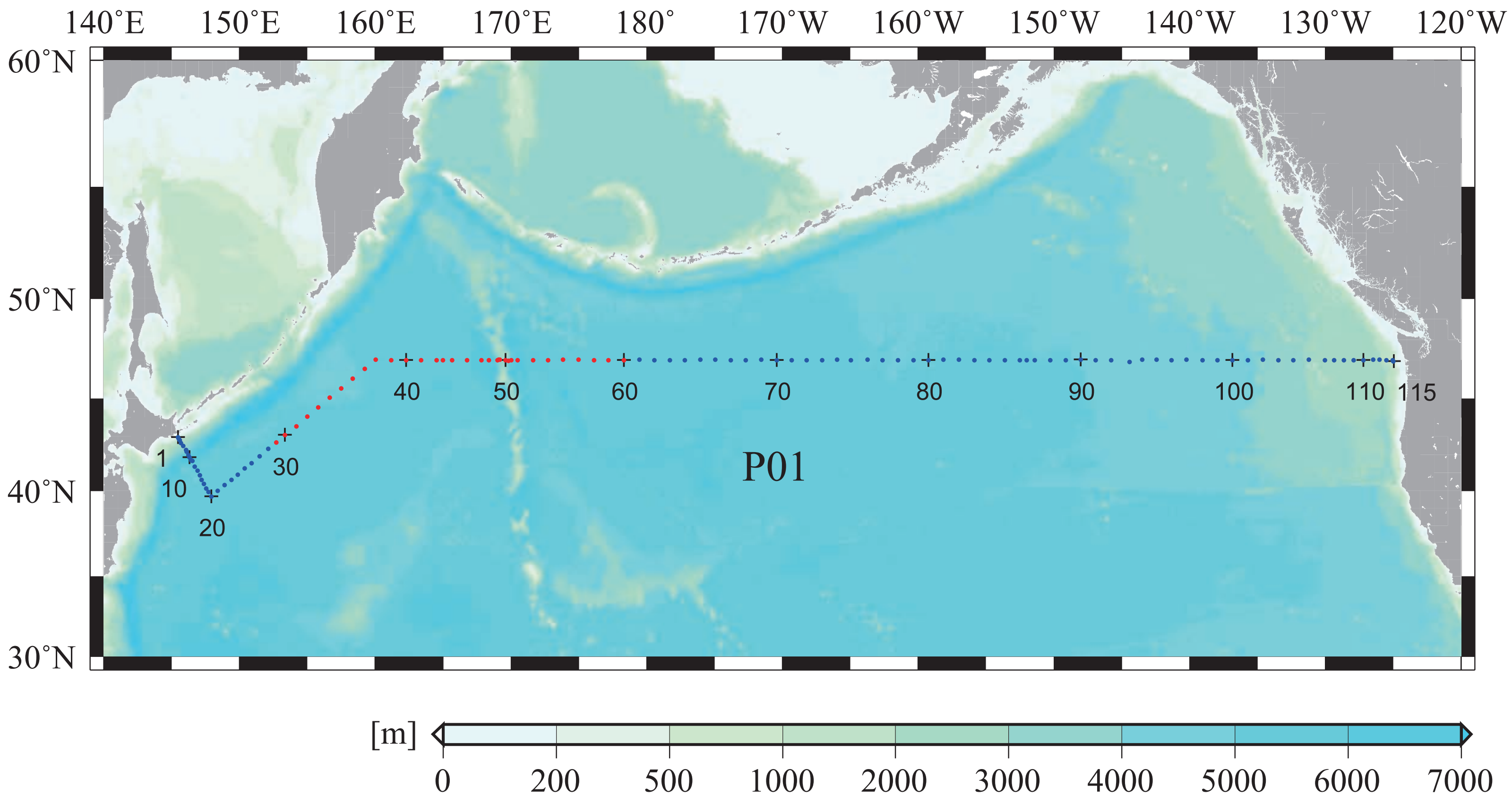

Figure 1(b)
Station locations
for WHP-P14 cruise

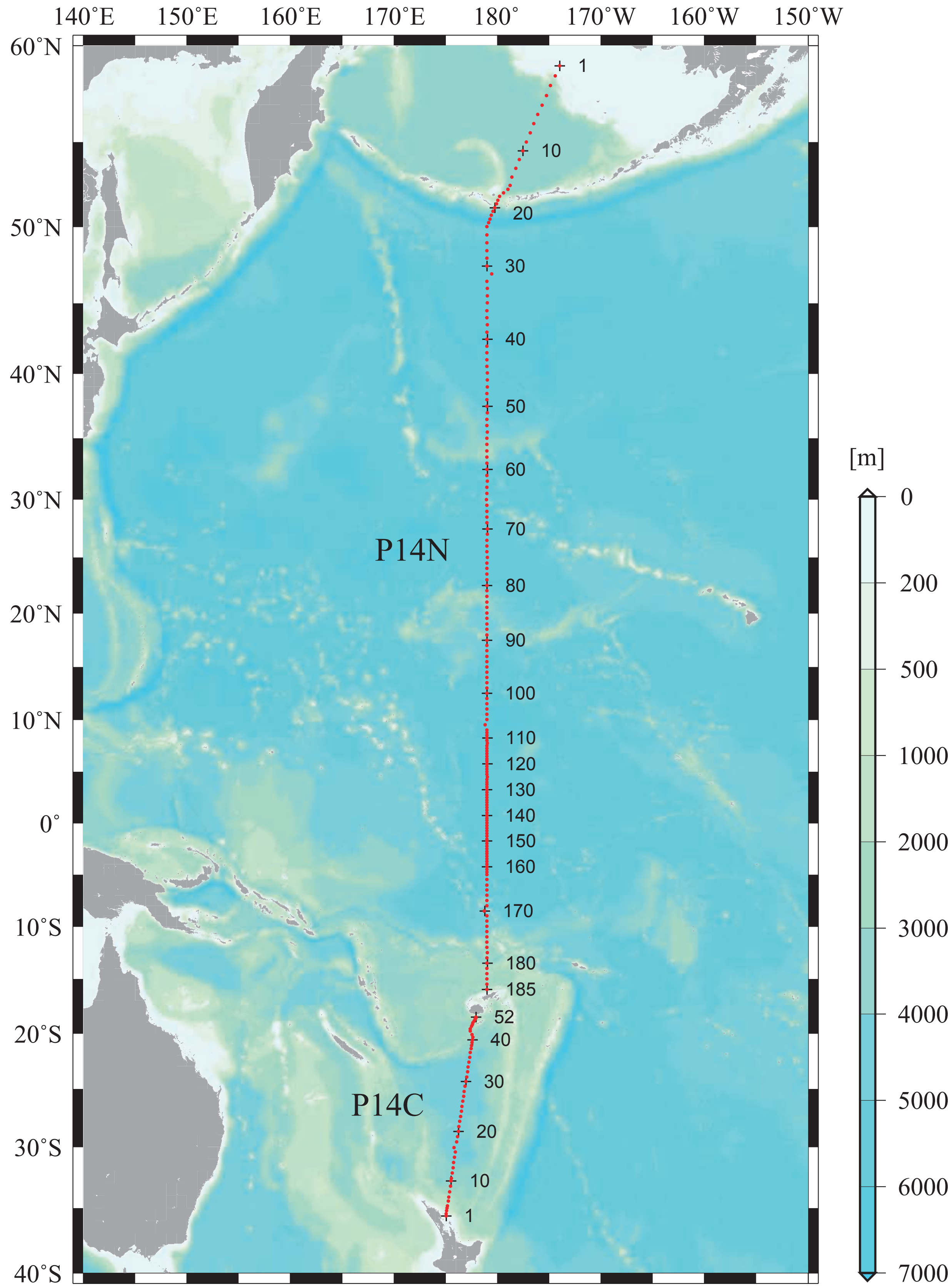

Figure 2(a)
Bathymetry measured by Multi Narrow Beam Echo Sounding system for WHP-P01

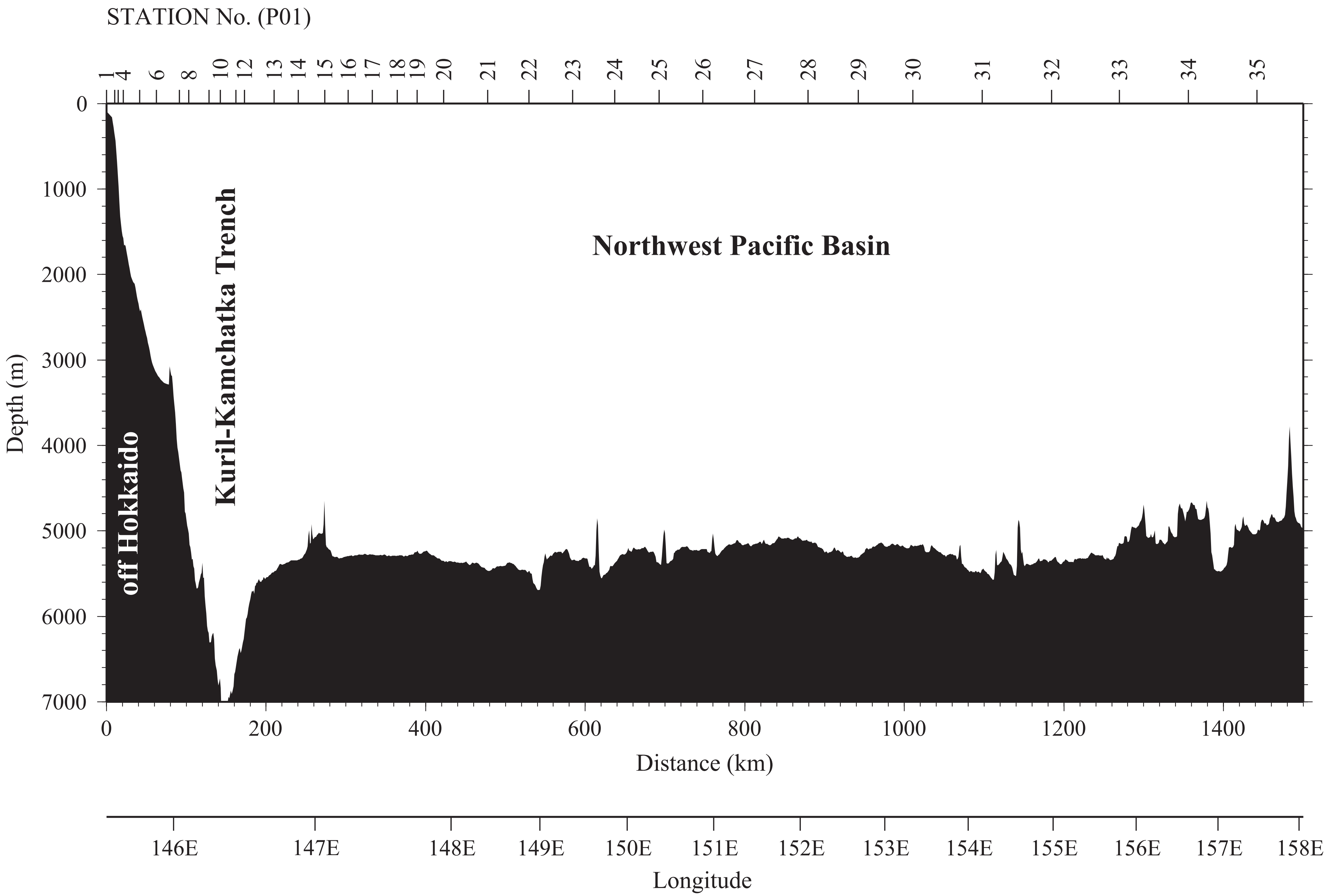

Figure 2(a)
Continued

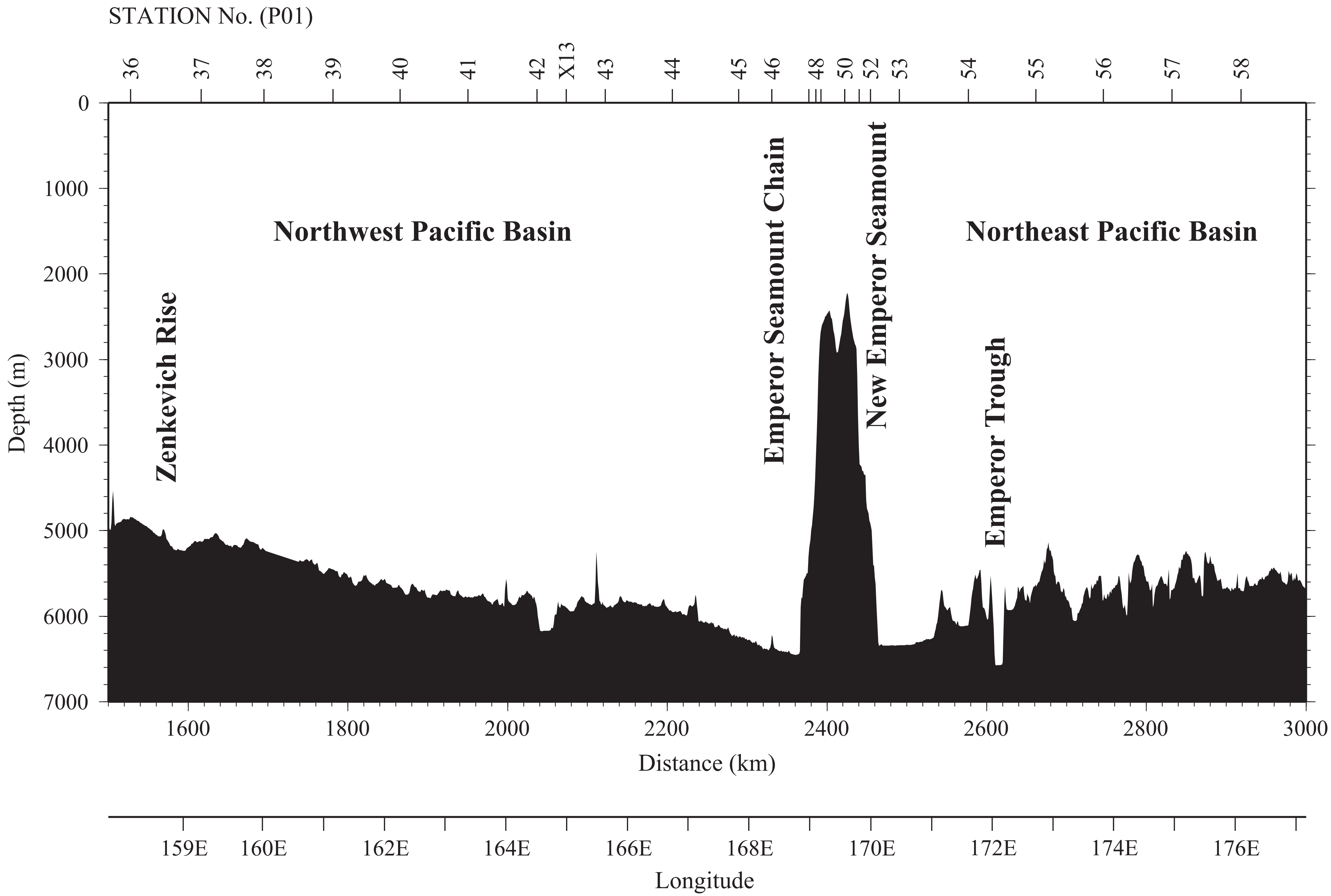

Figure 2(a)
Continued

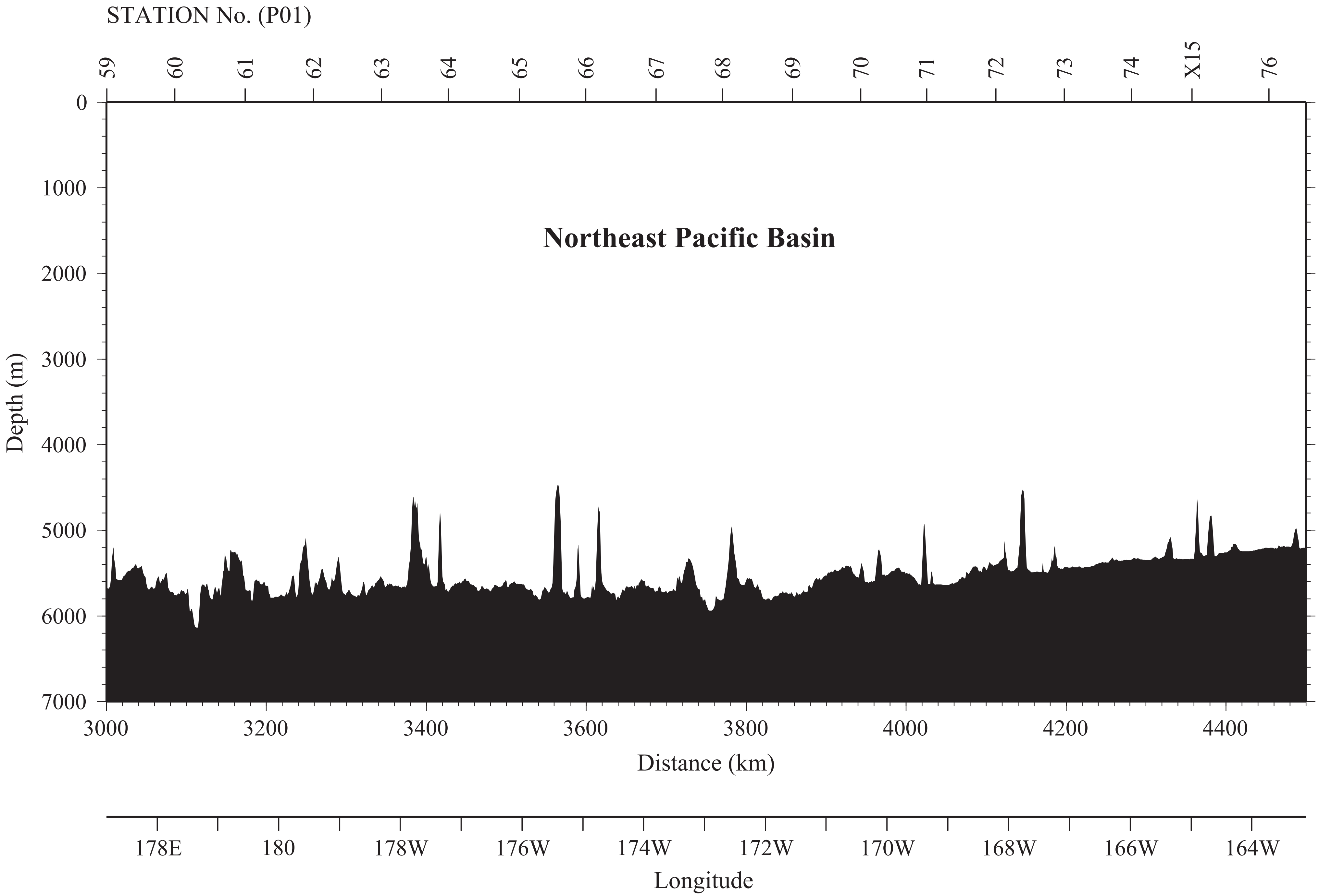

Figure 2(a)
Continued

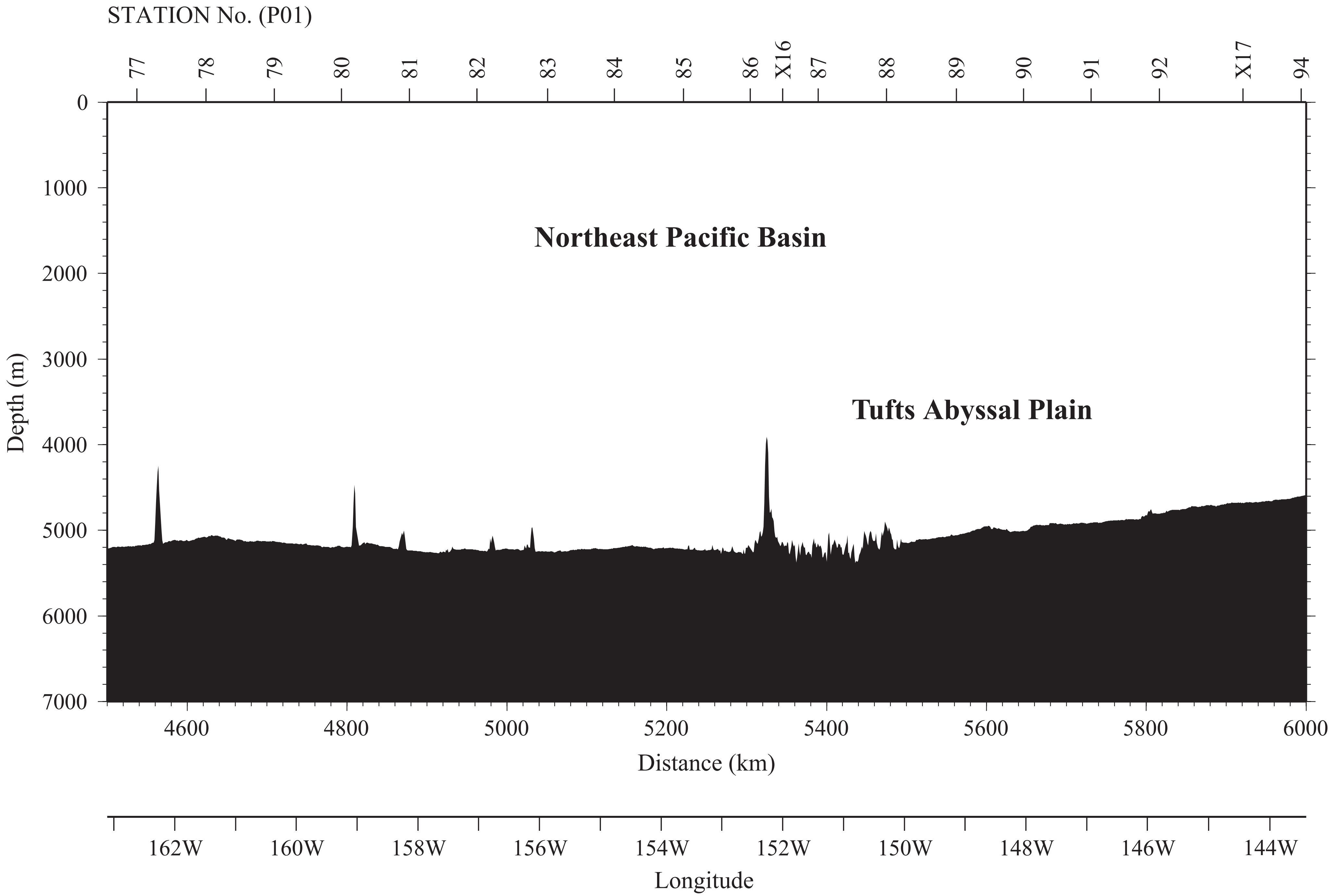

Figure 2(a)
Continued

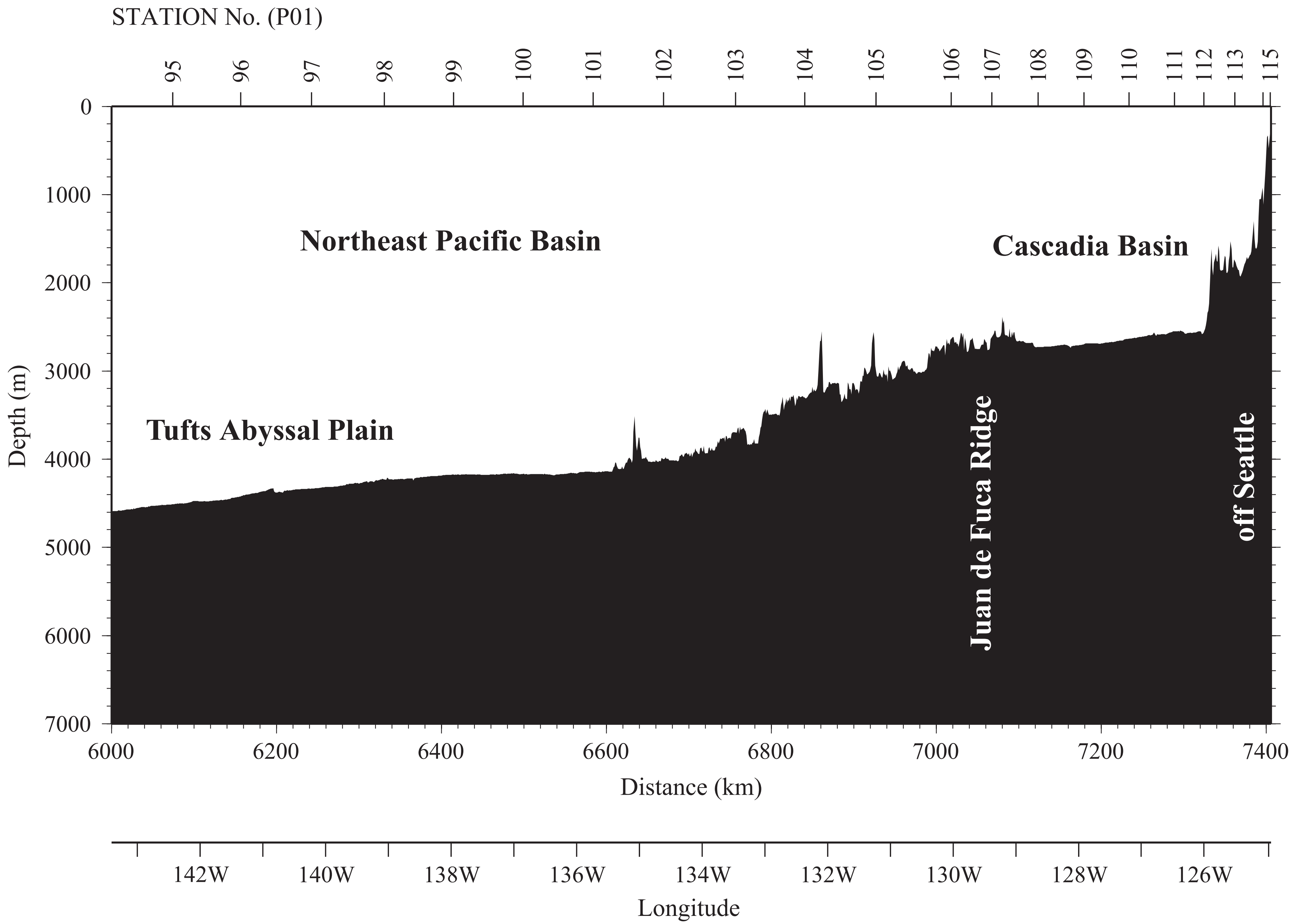

Figure 2(b)
Bathymetry measured by Multi Narrow Beam Echo Sounding System for WHP-P14

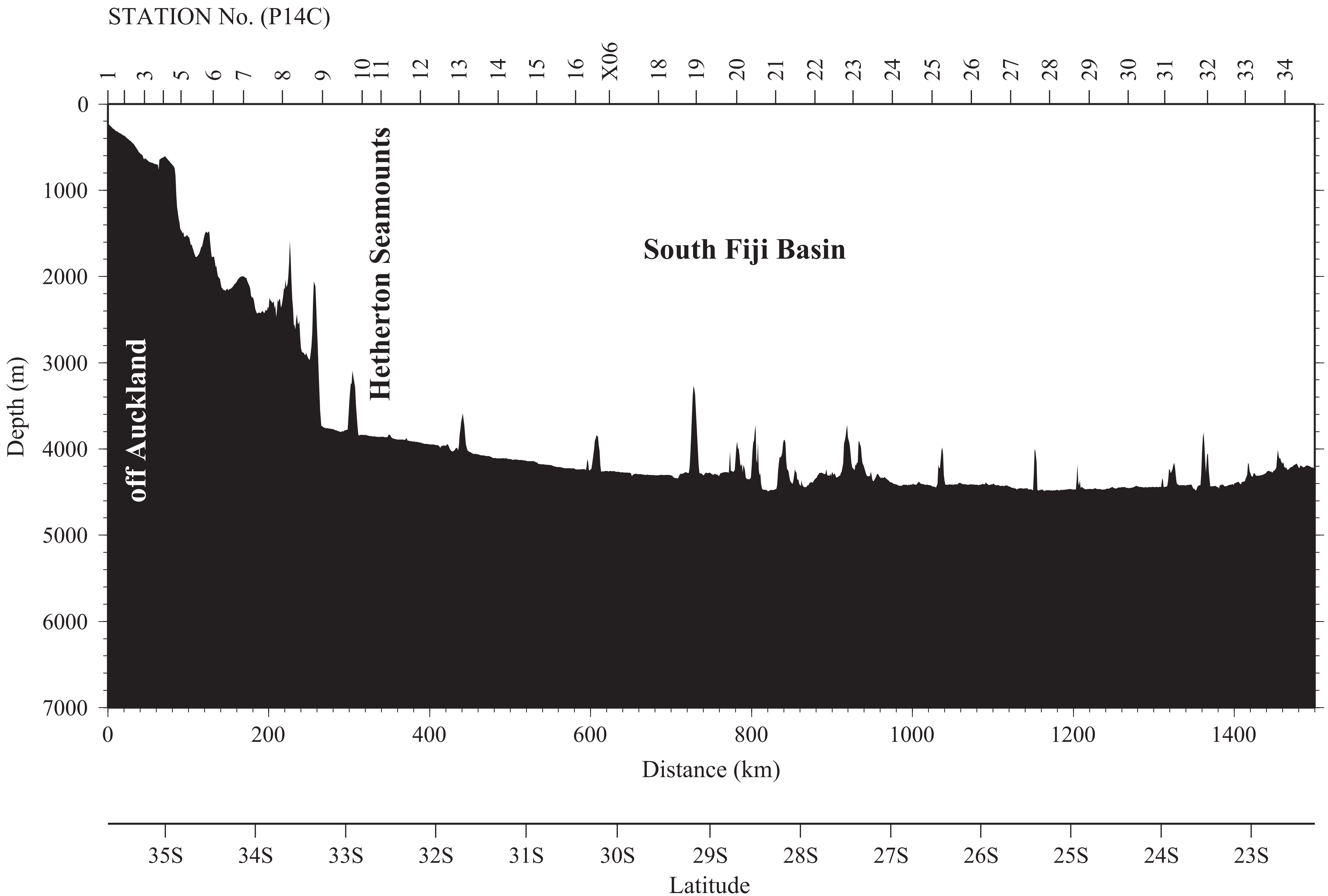

Figure 2(b)
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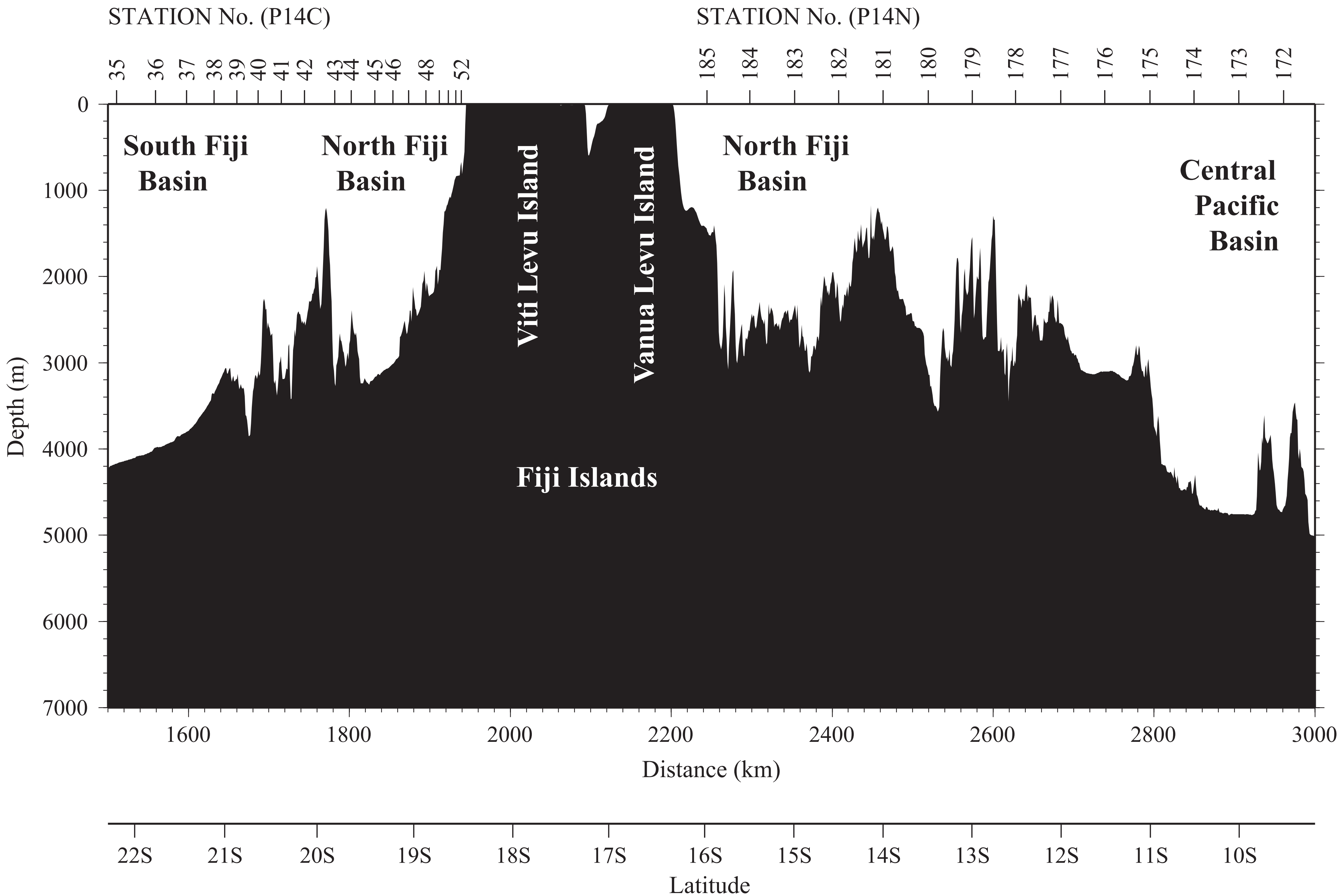

Figure 2(b)
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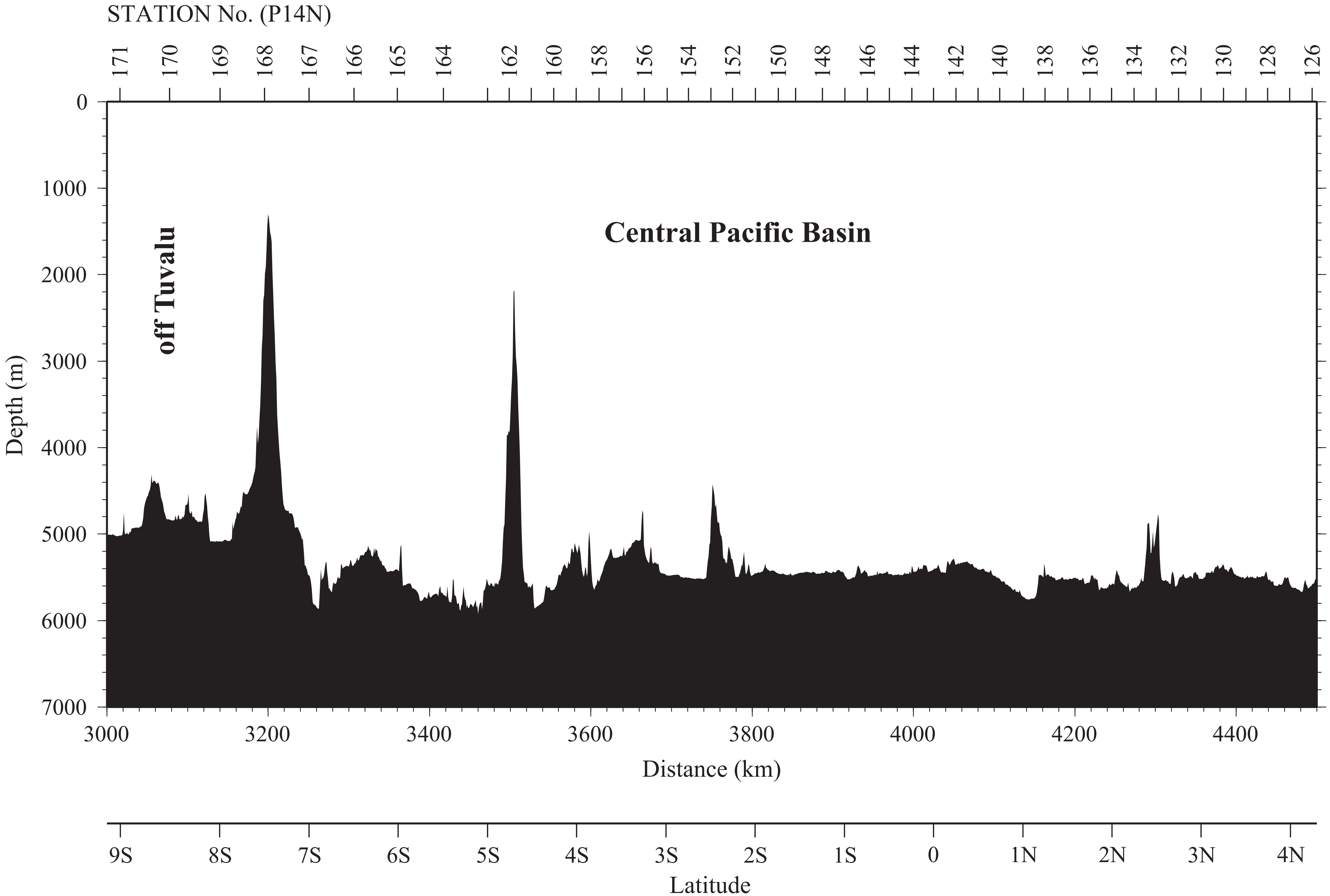

Figure 2(b)
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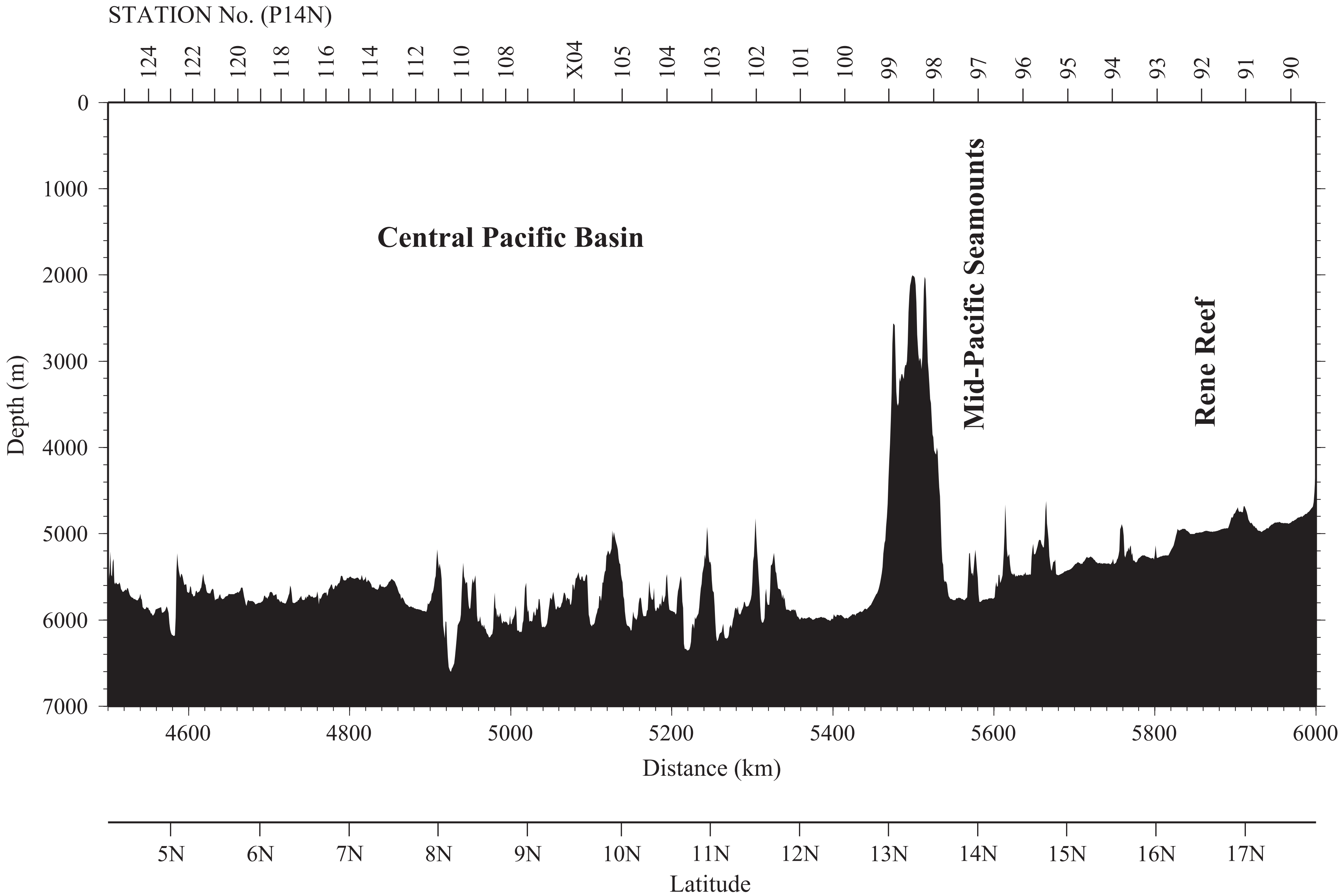

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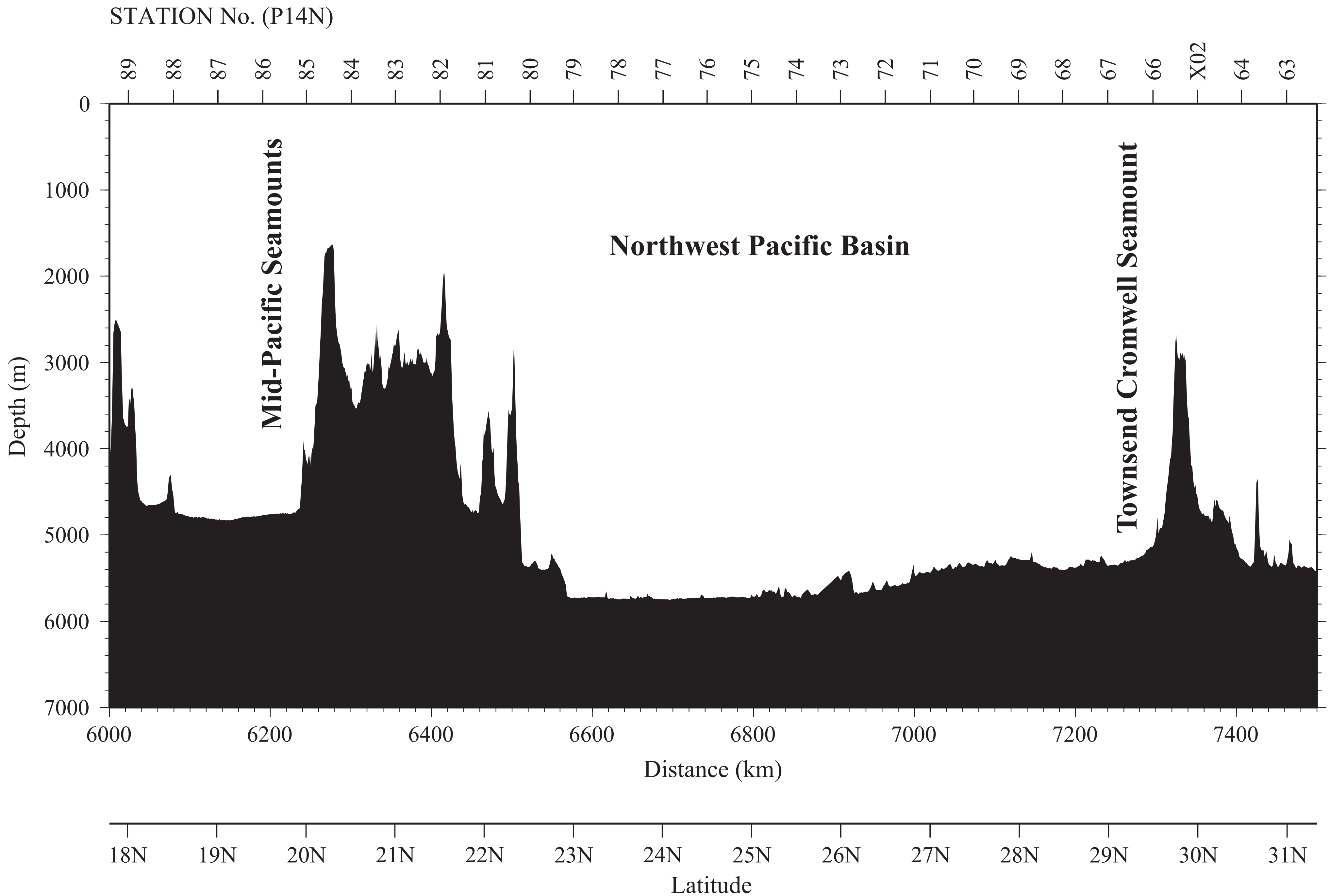

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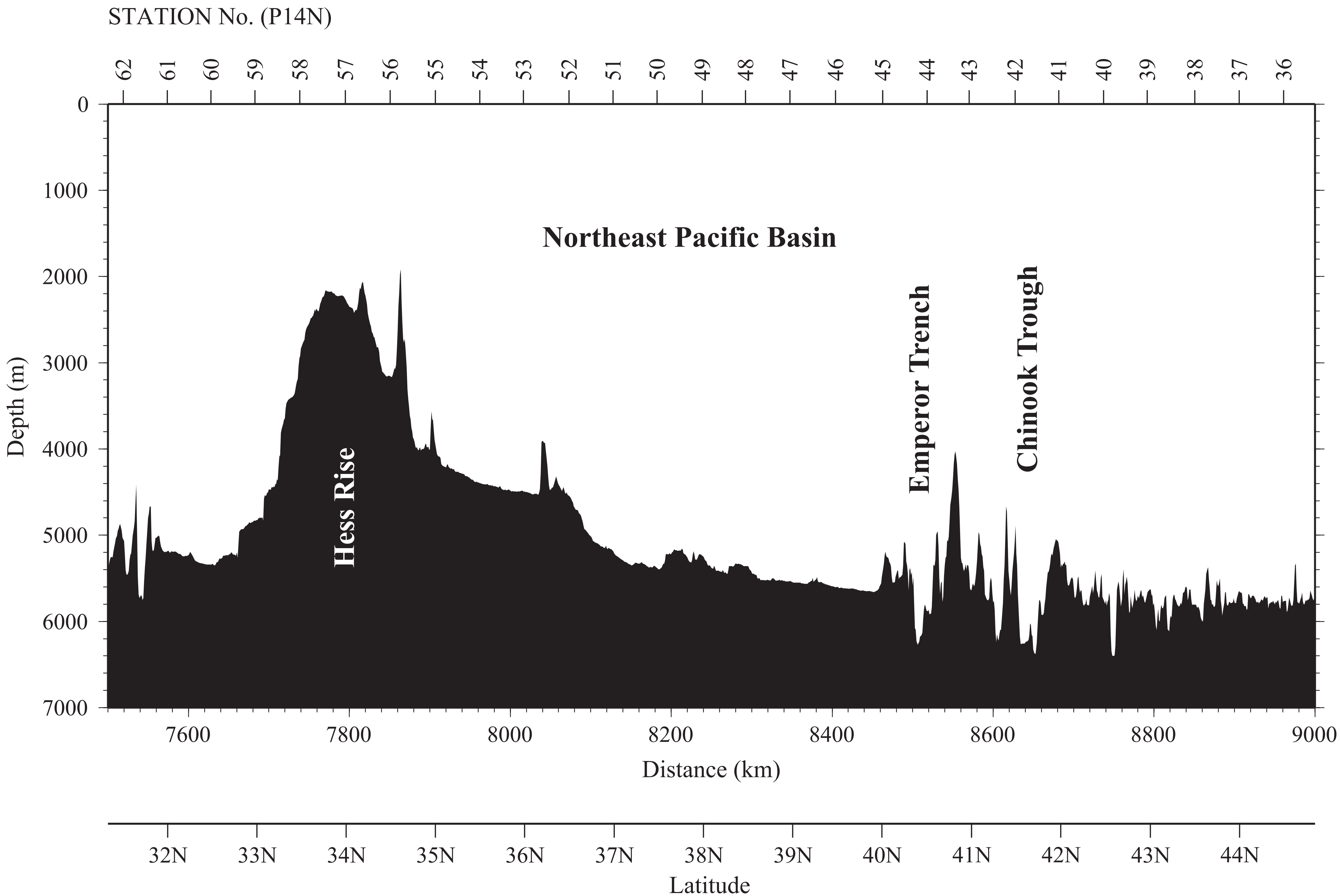

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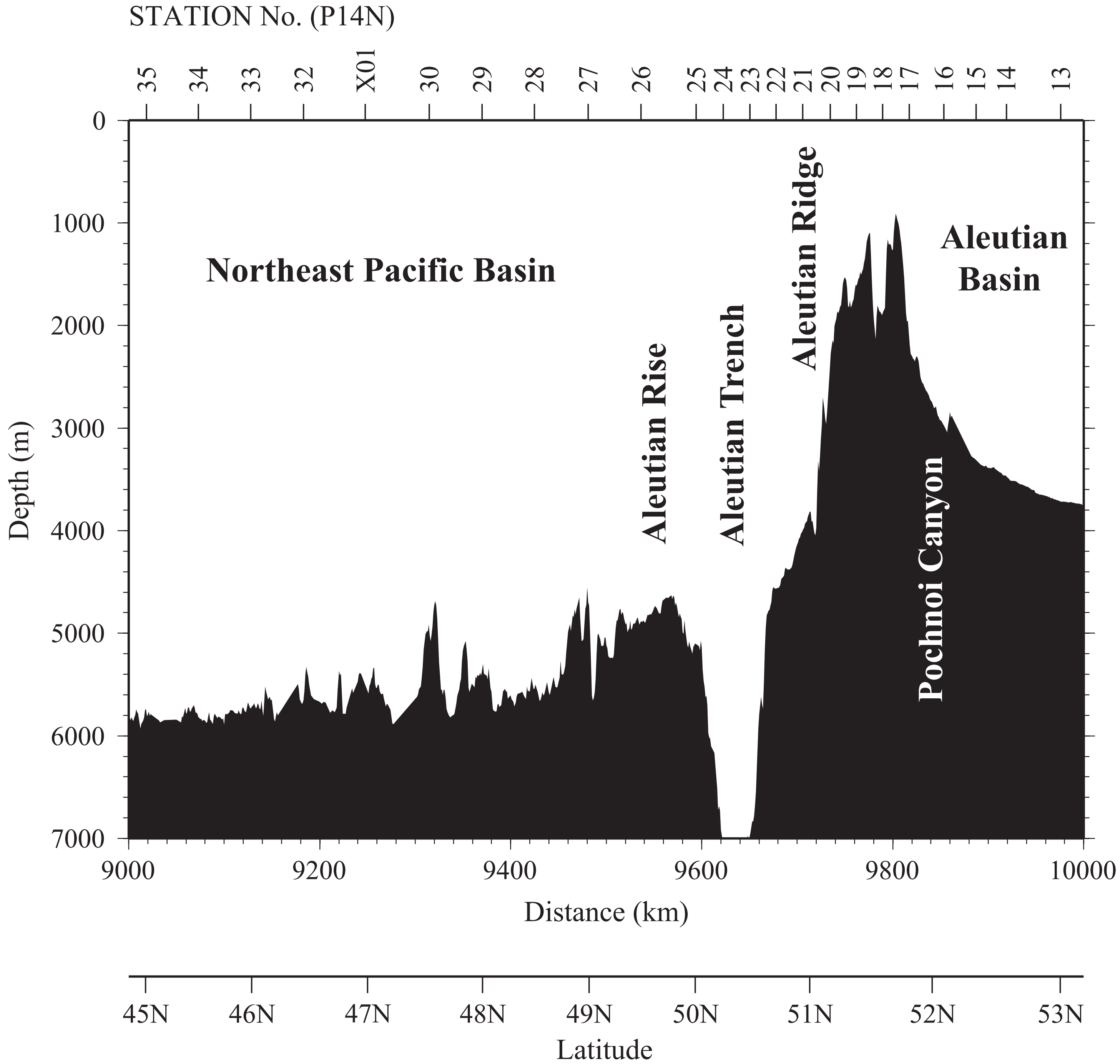

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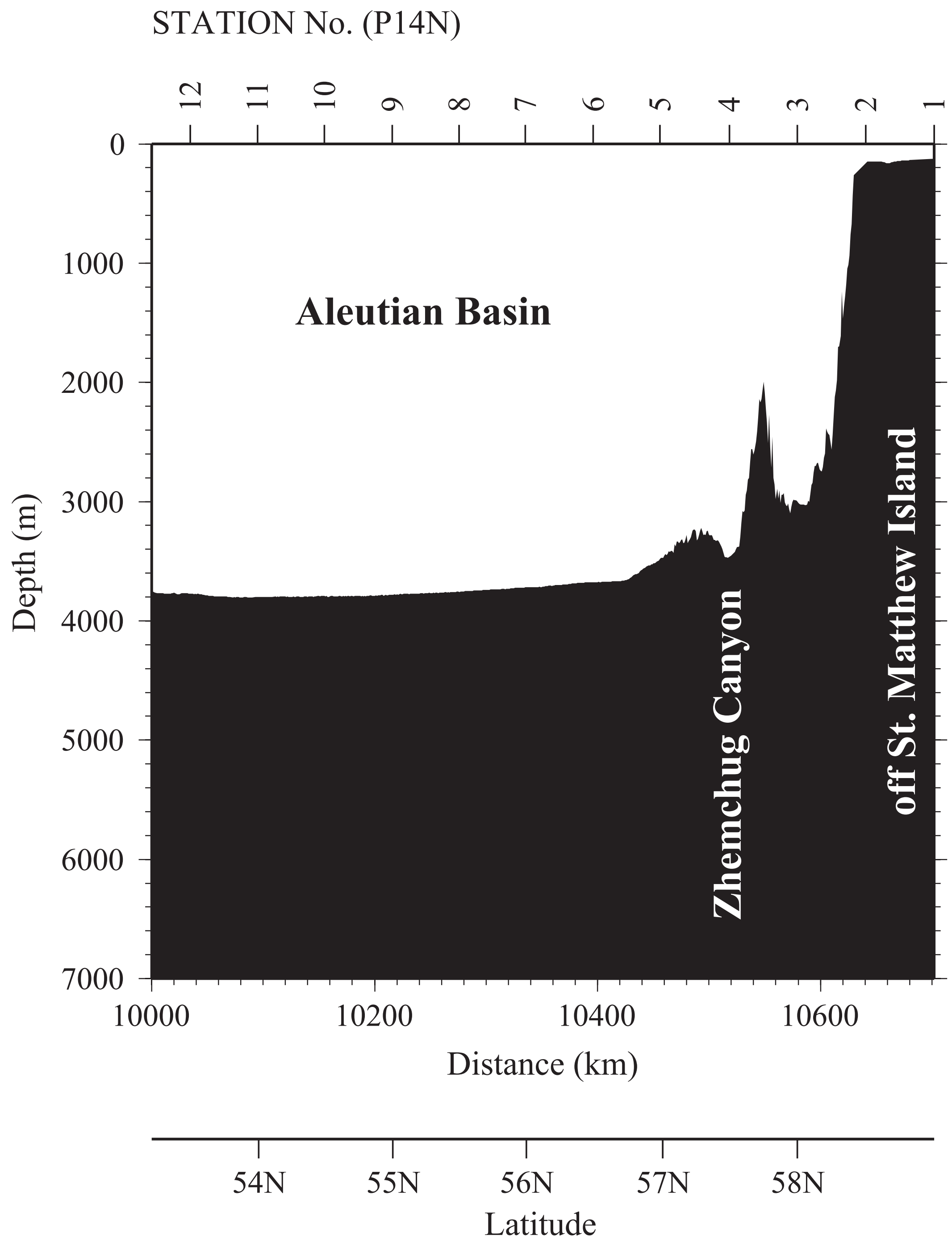
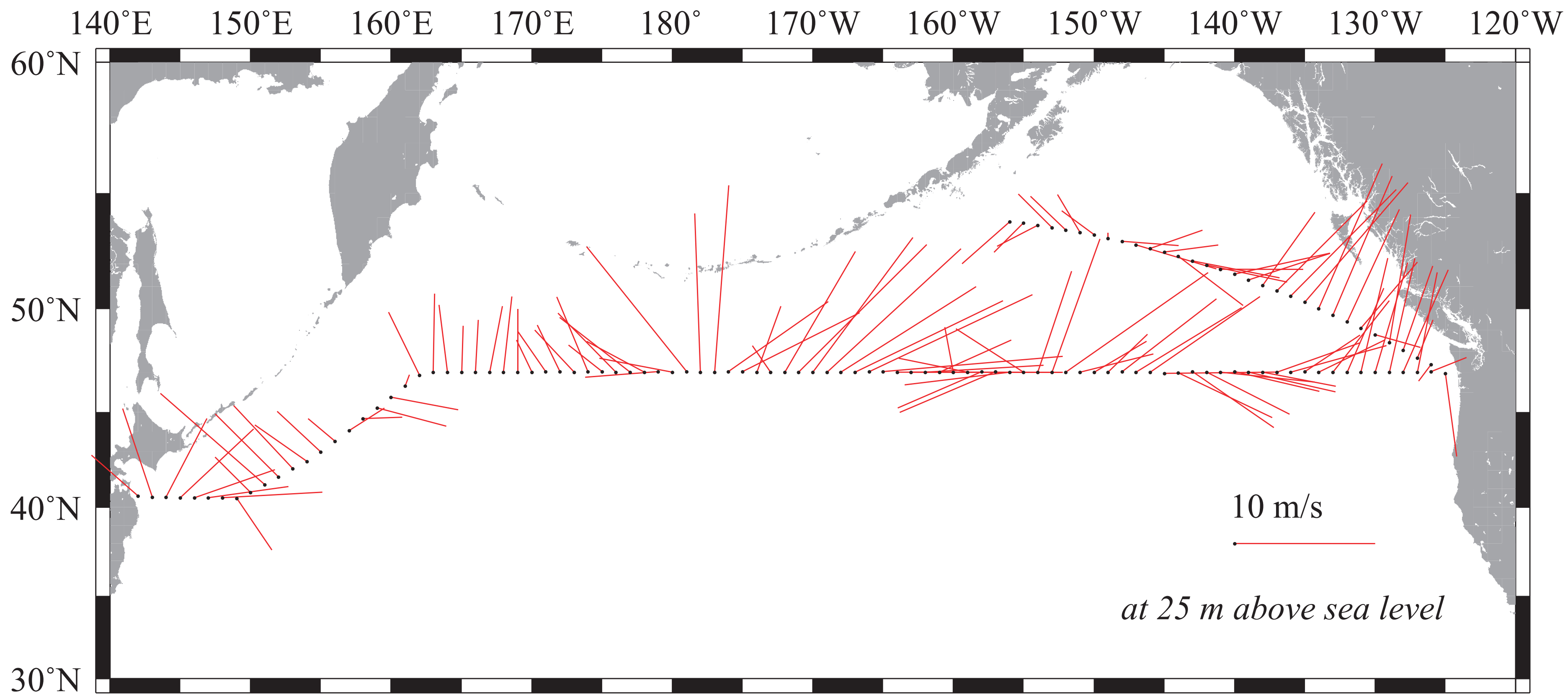


Figure 3
Surface wind measured at 25 m above sea level
(a) WHP-P01



(b) WHP-P14

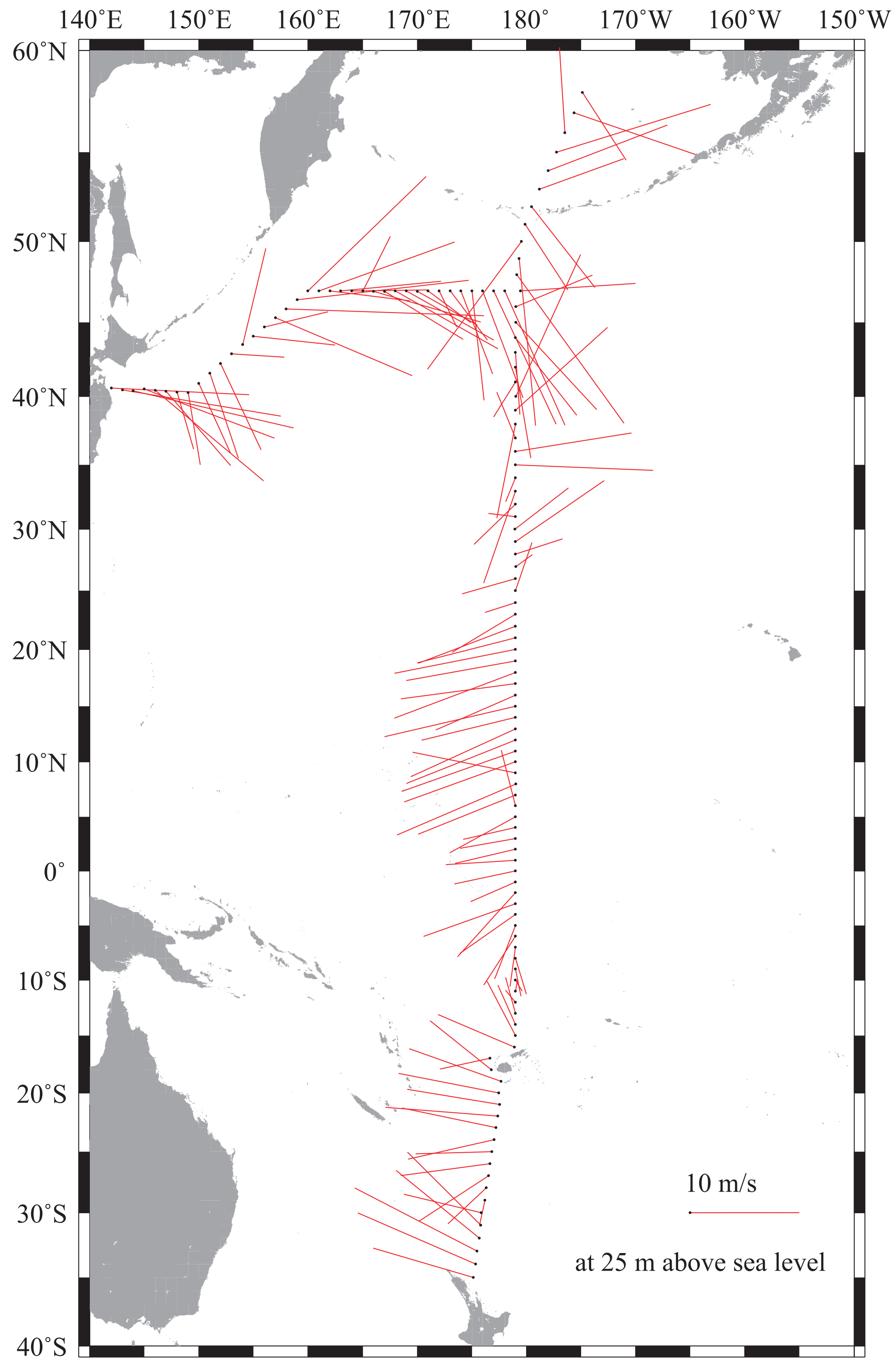
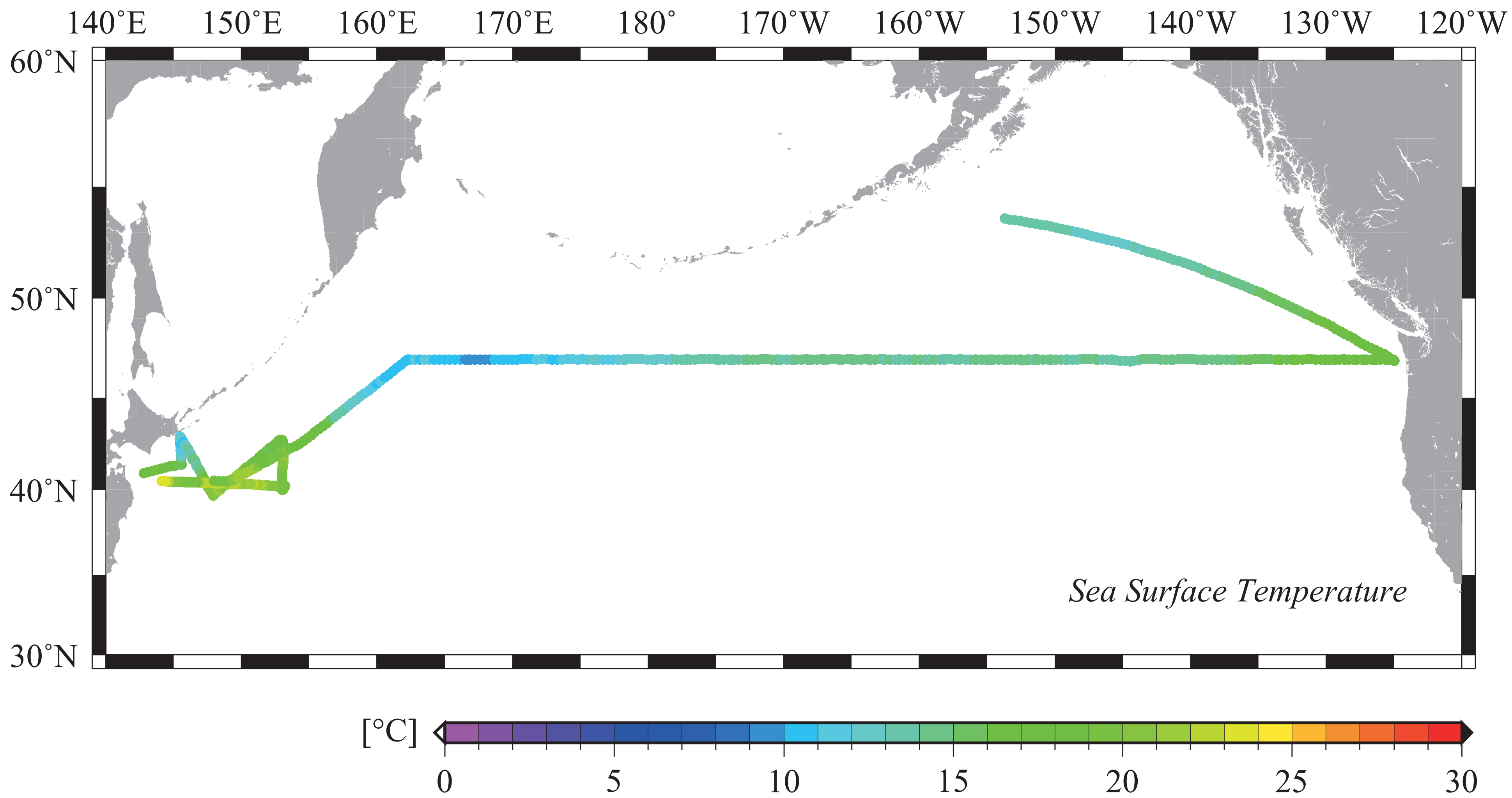
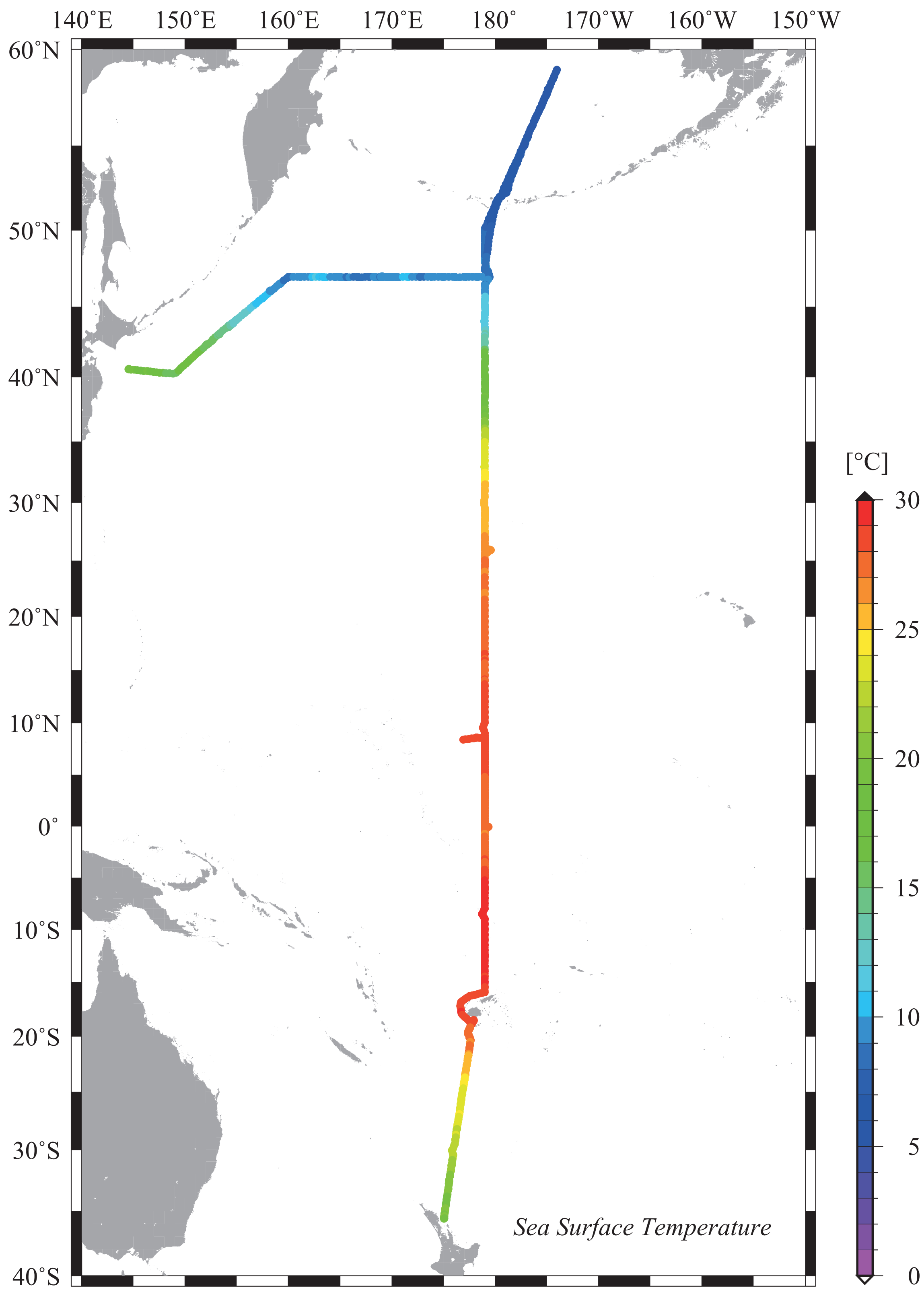

140˚E
150˚E
160˚E
170˚E
180˚
170˚W
160˚W
150˚W
60˚N
50˚N
40˚N
30˚N
20˚N
10˚N
0˚
10˚S
20˚S
30˚S
40˚S
10 m/s
at 25 m above sea level

Figure 4
Sea surface temperature (SST)
(a) WHP-P01

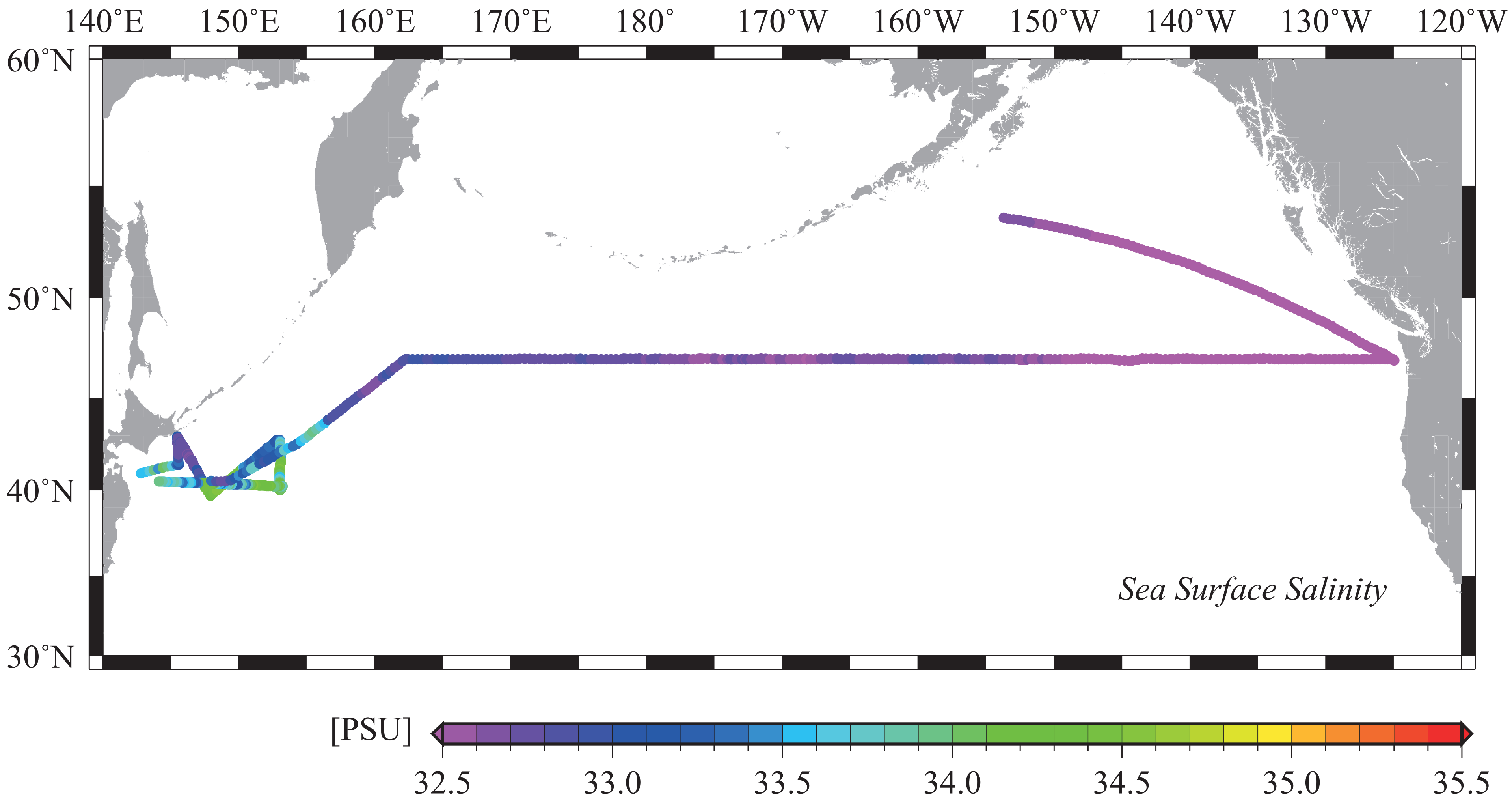


(b) WHP-P14

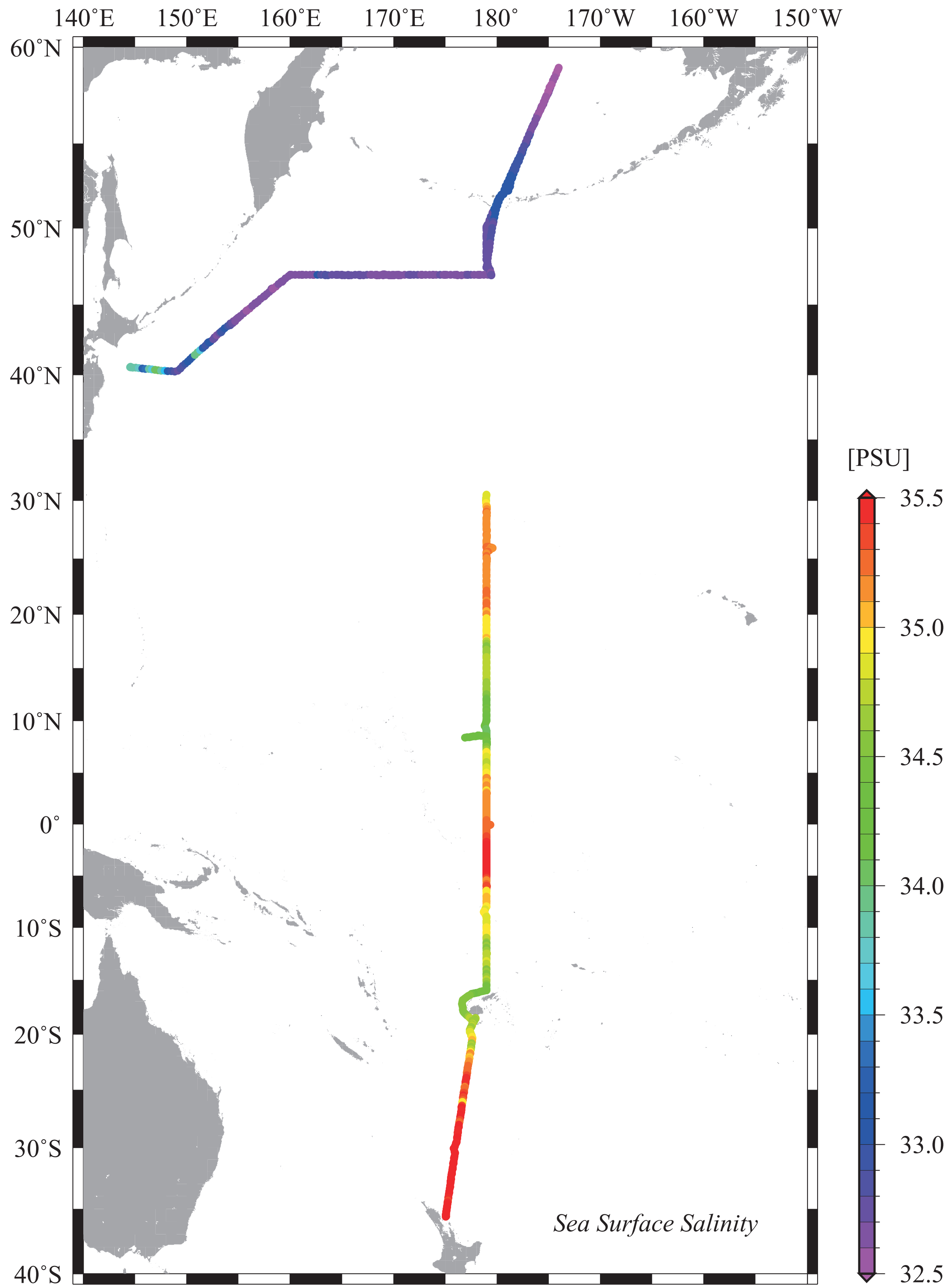


140˚E
150˚E
160˚E
170˚E
180˚
170˚W
160˚W
150˚W
60˚N
50˚N
40˚N
30˚N
20˚N
10˚N
0˚
10˚S
20˚S
30˚S
40˚S
Sea Surface Temperature
[°C]
30
25
20
15
10
5
0

Figure 5
Sea surface salinity (SSS)
(a) WHP-P01

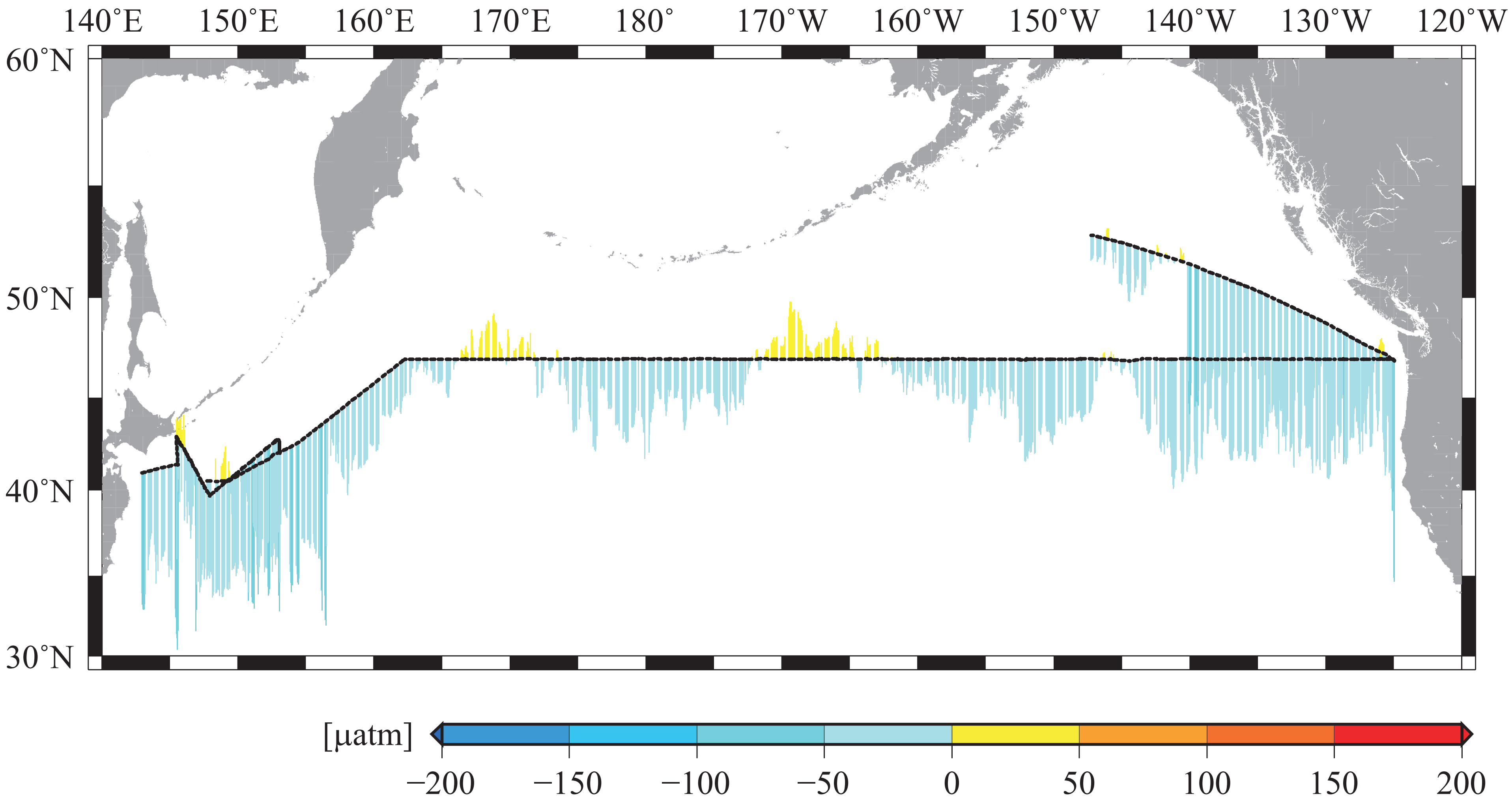


(b) WHP-P14

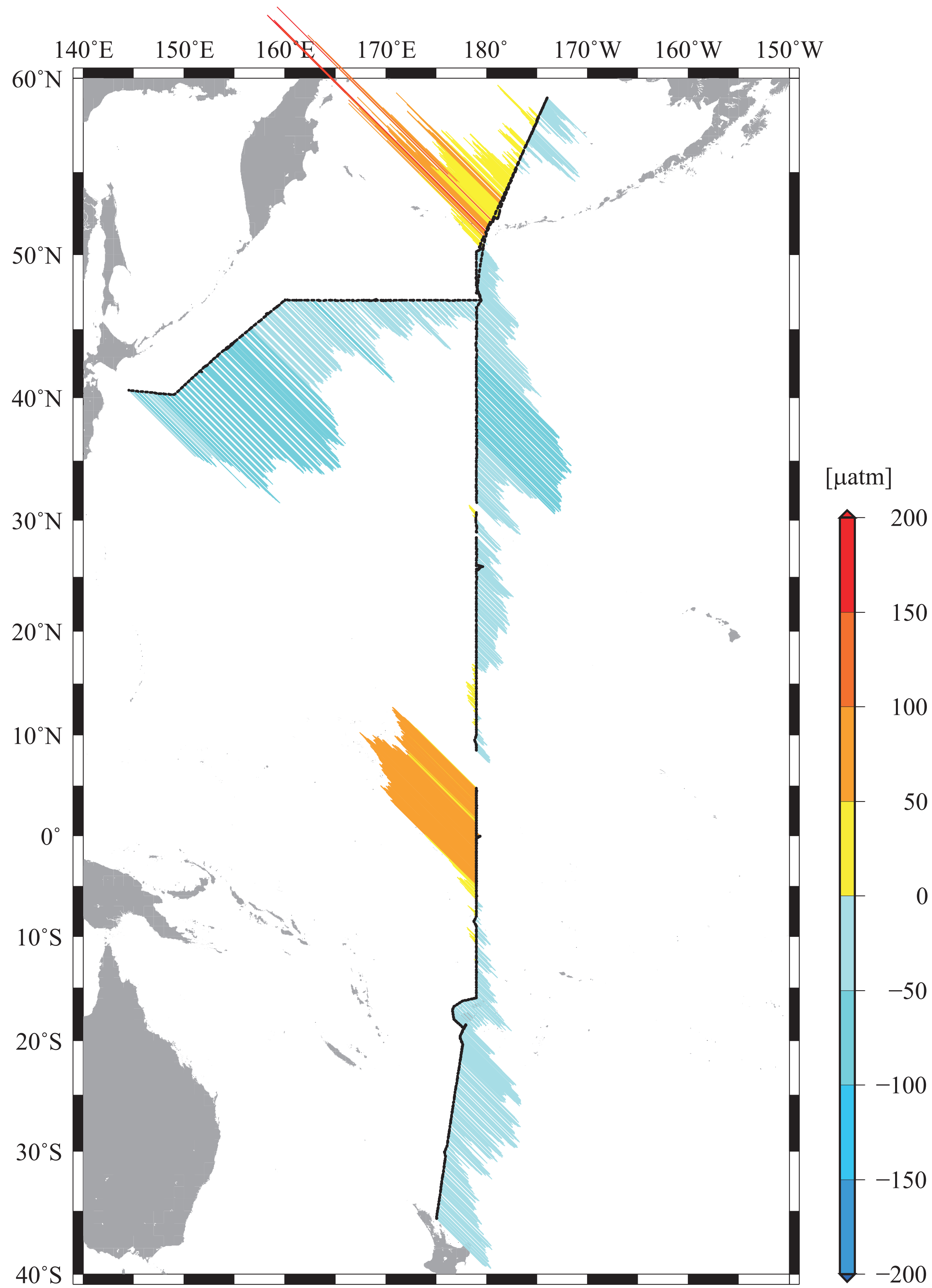


140°E
150°E
160°E
170°E
180°
170°W
160°W
150°W
60°N
50°N
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
[PSU]
35.5
35.0
34.5
34.0
33.5
33.0
32.5
Sea Surface Salinity

Figure 6
ΔpCO_2
(a) WHP-P01

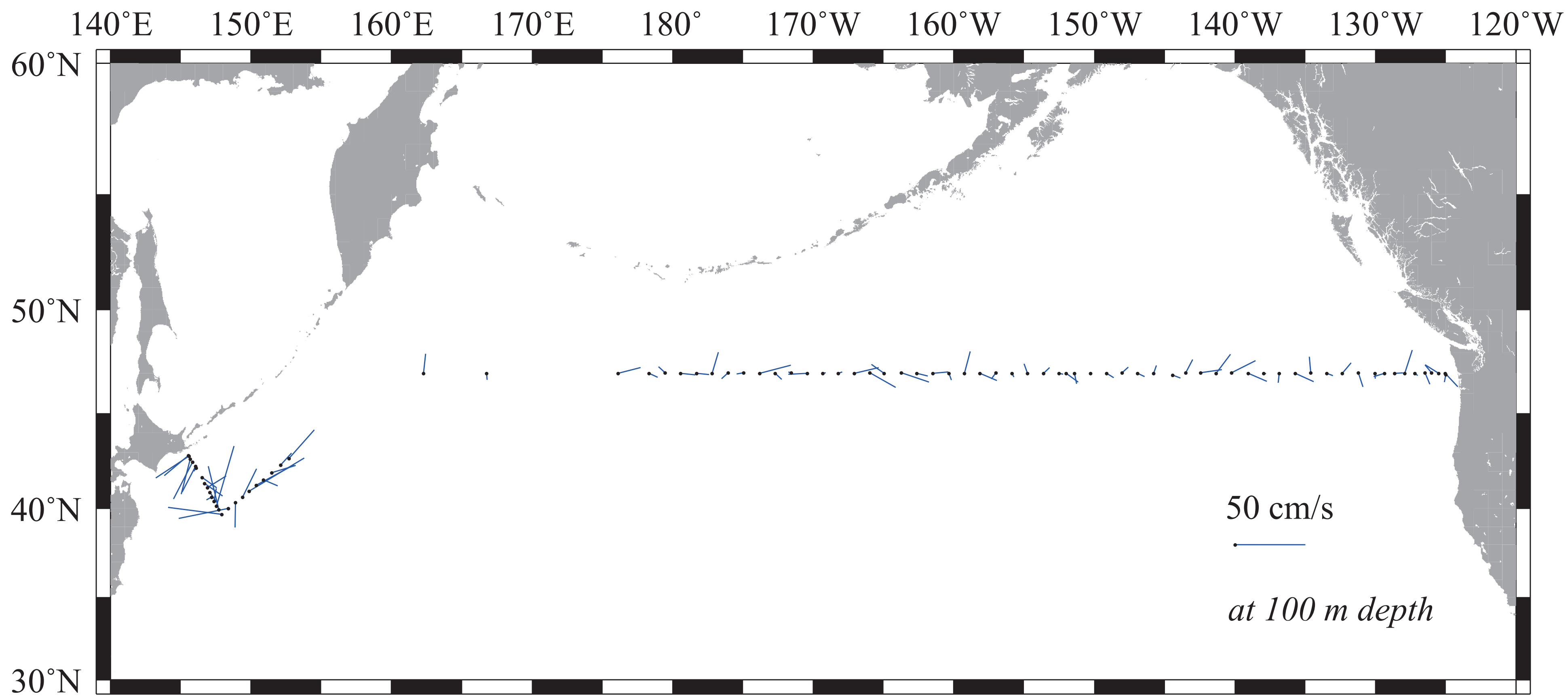


(b) WHP-P14

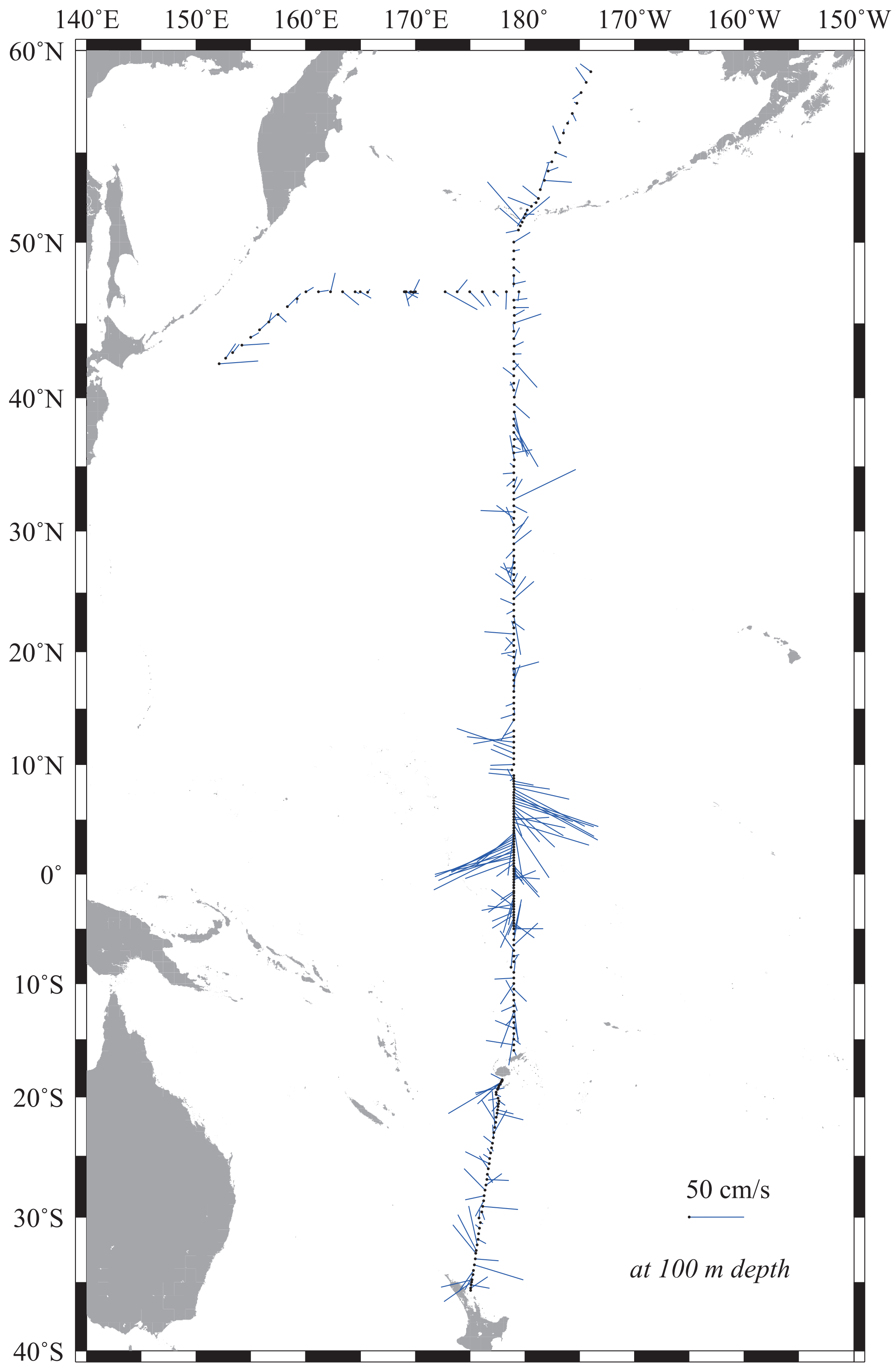


140°E
150°E
160°E
170°E
180°
170°W
160°W
150°W
60°N
50°N
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
[μatm]
200
150
100
50
0
−50
−100
−150
−200

Figure 7
Surface current measured by shipboard ADCP
(a) WHP-P01

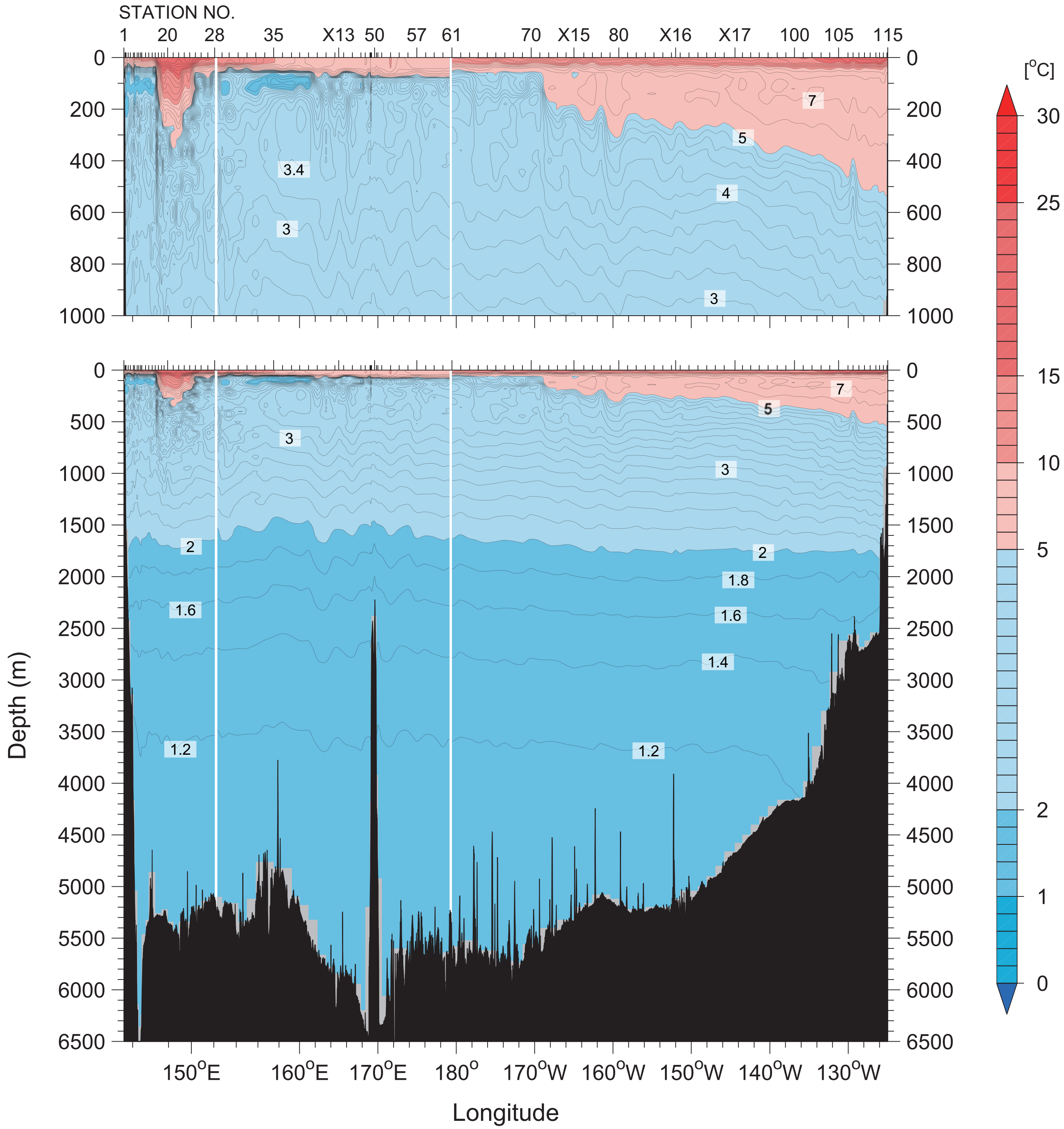


(b) WHP-P14

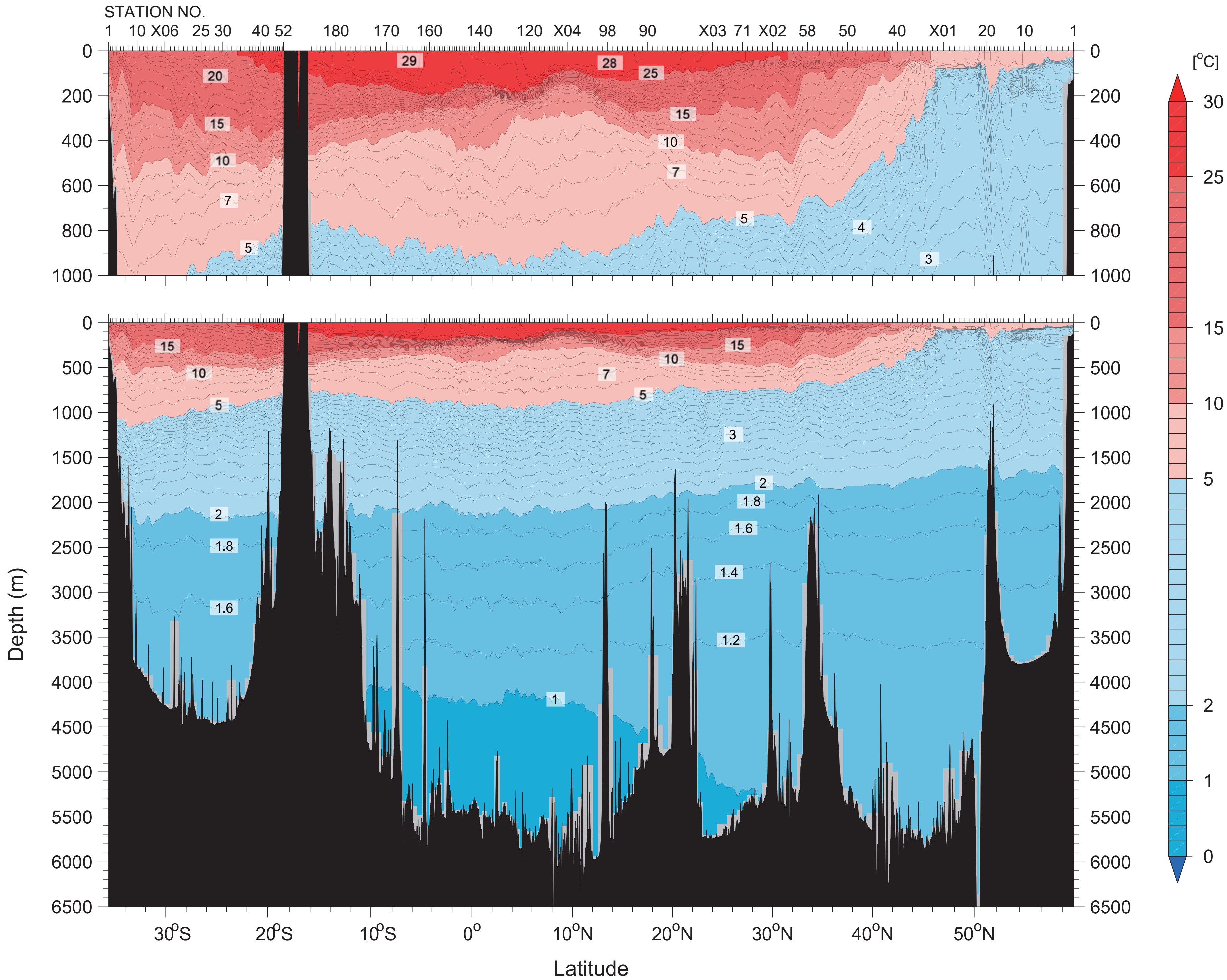


140°E
150°E
160°E
170°E
180°
170°W
160°W
150°W
60°N
50°N
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
50 cm/s
at 100 m depth

Figure 8
Potential temperature (°C)
(a) WHP-P01

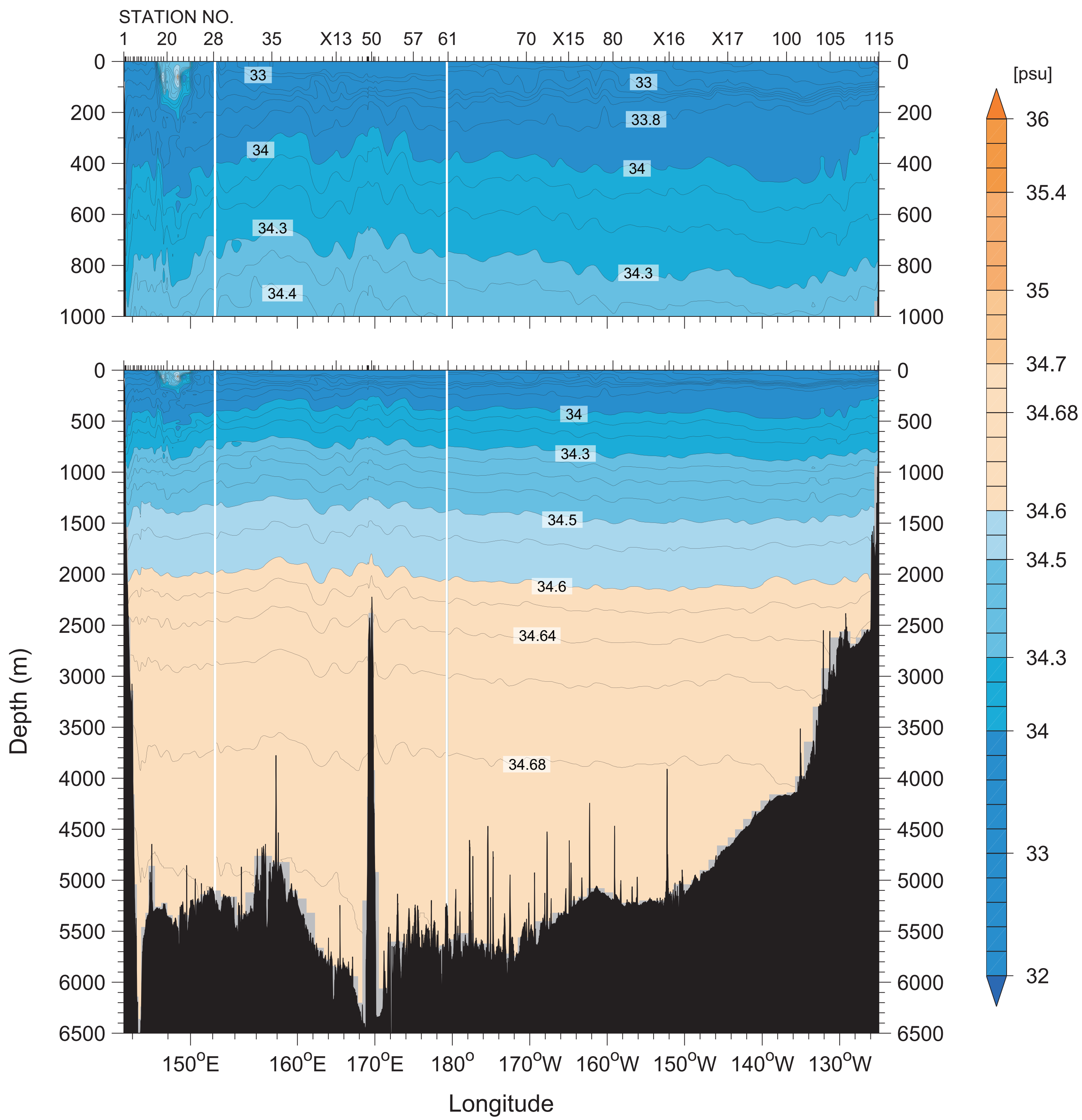


(b) WHP-P14



STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
[°C]

Figure 9
CTD salinity (psu)
(a) WHP-P01



(b) WHP-P14

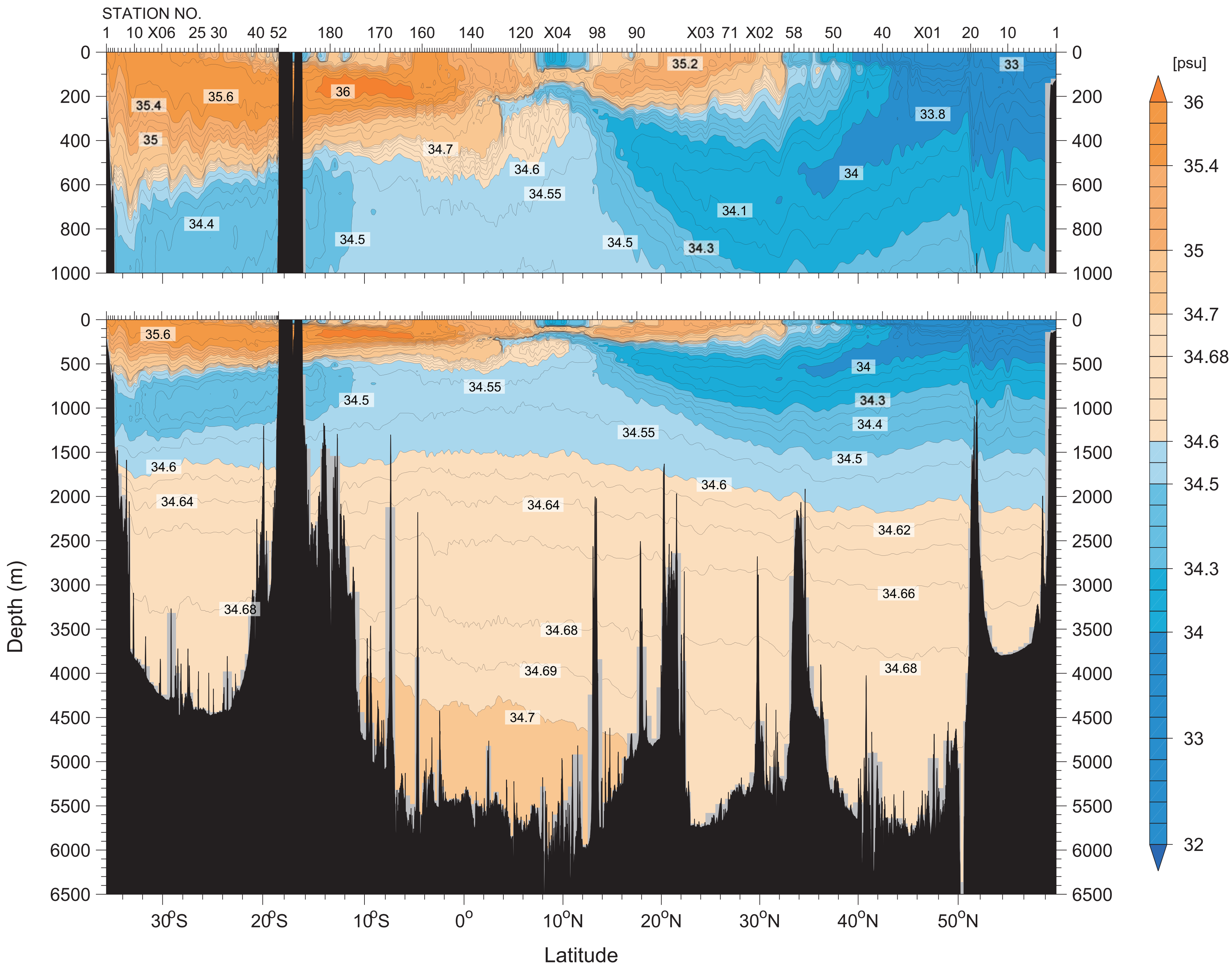
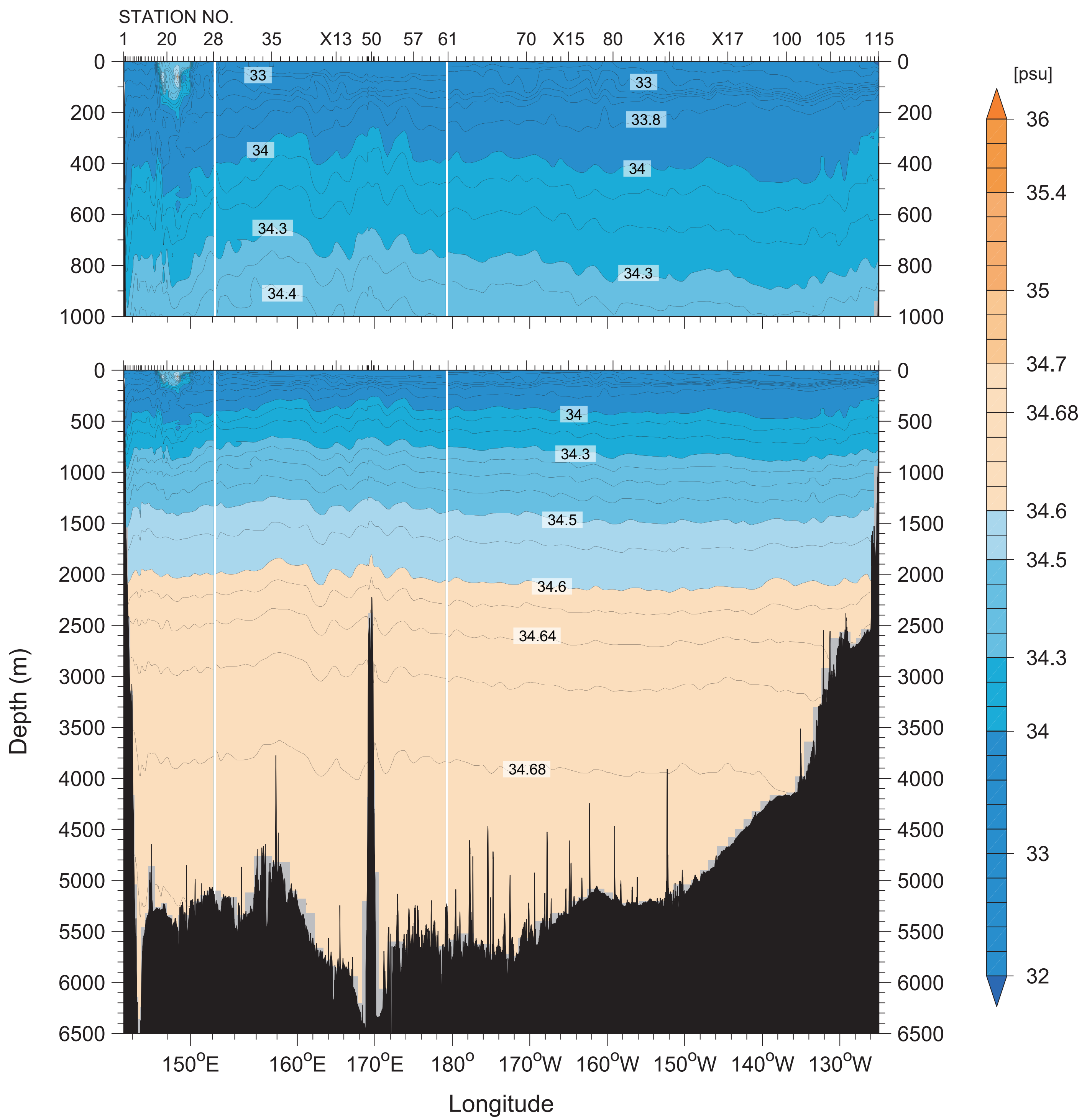

STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
35.4
35.6
35
36
34.7
34.6
34.55
35.2
33
33.8
34
34.1
34.4
34.5
34.3
35.6
34.5
34.55
34.3
34.4
34.55
34.5
34.6
34.64
34.62
34.68
34.66
34.69
34.7
Depth (m)
Latitude
30°S
20°S
10°S
0°
10°N
20°N
30°N
40°N
50°N
[psu]
36
35.4
35
34.7
34.68
34.6
34.5
34.3
34
33
32

Figure 10
CTD salinity (psu) with SSW batch correction
(a) WHP-P01



(b) WHP-P14

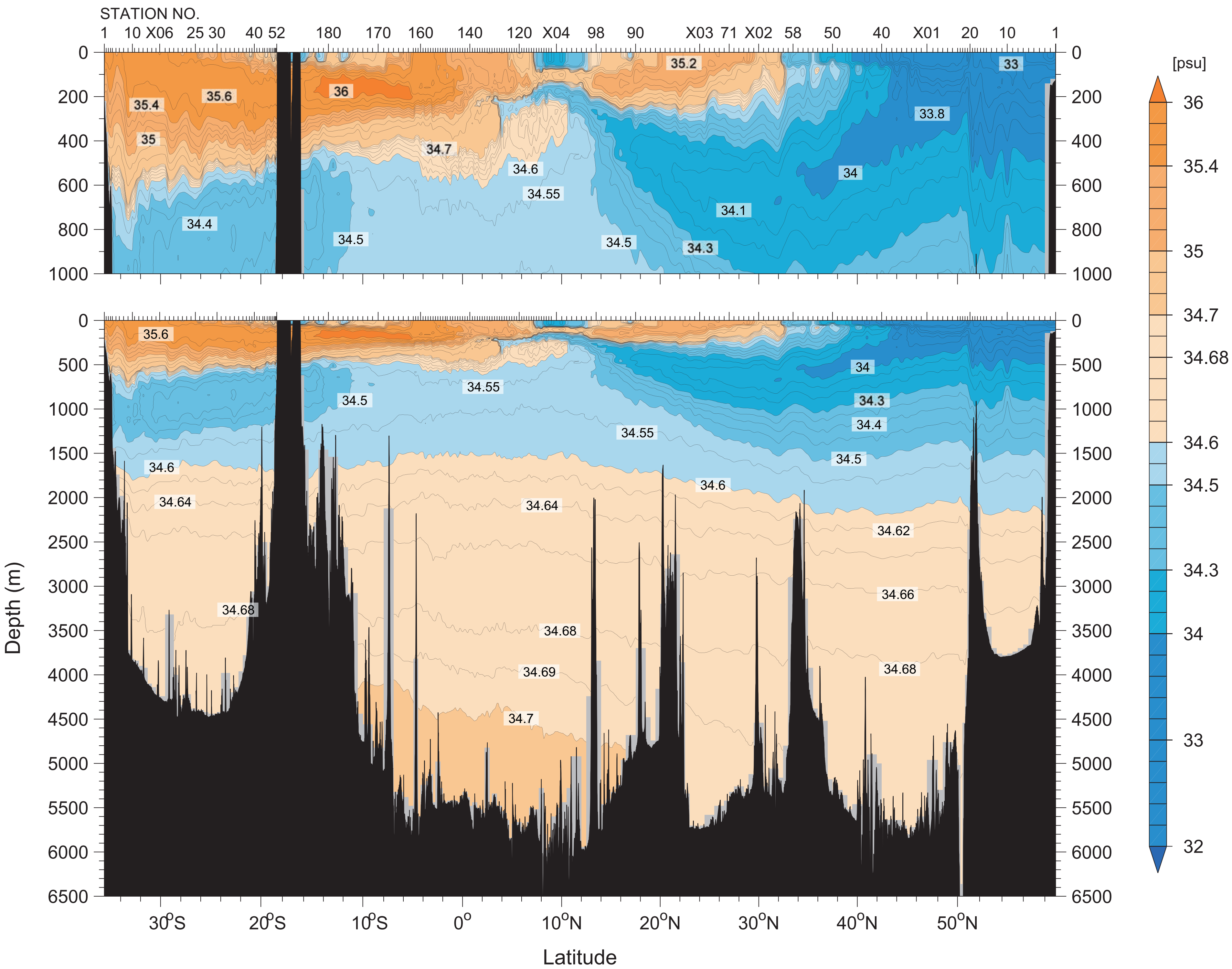
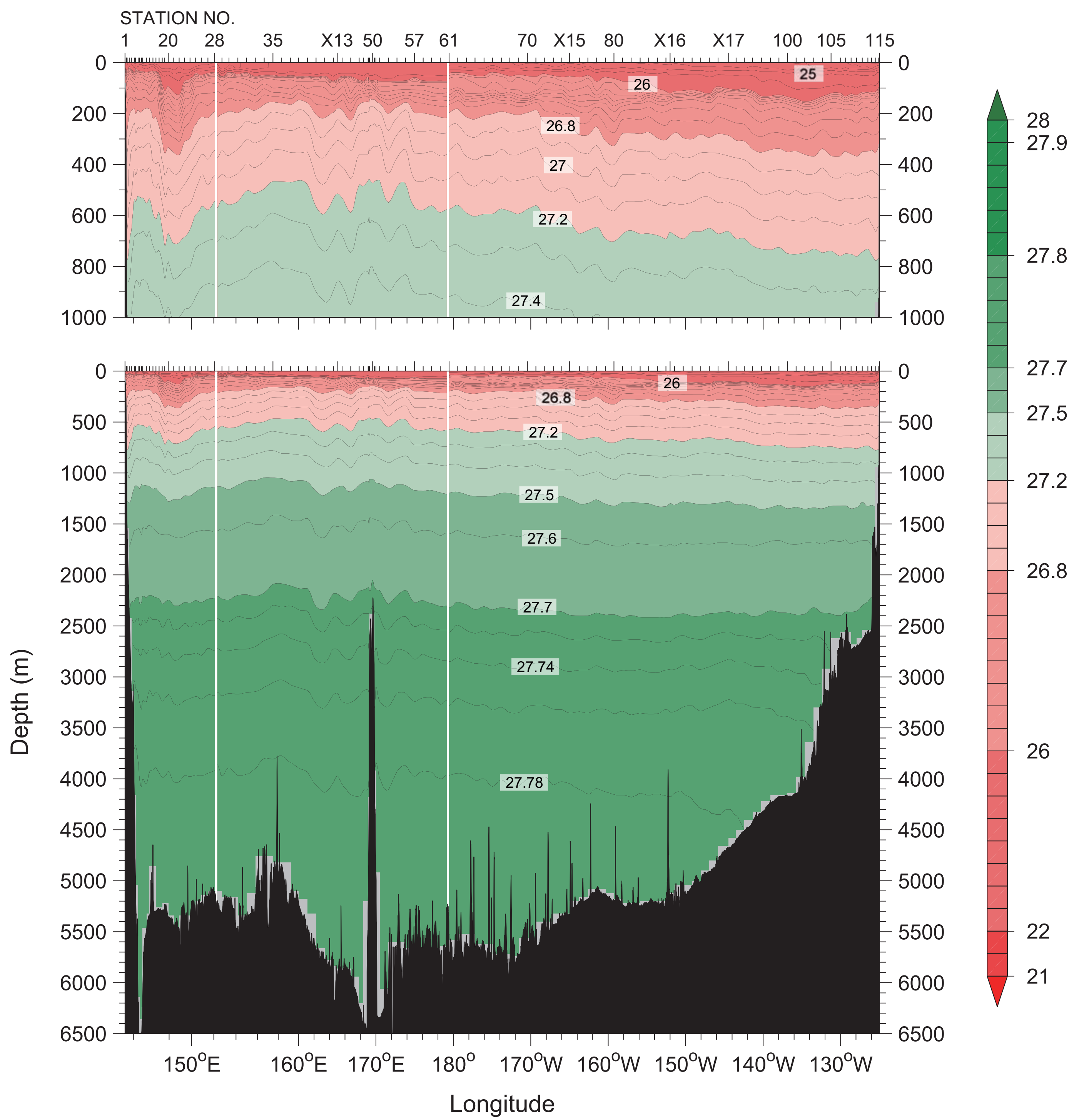
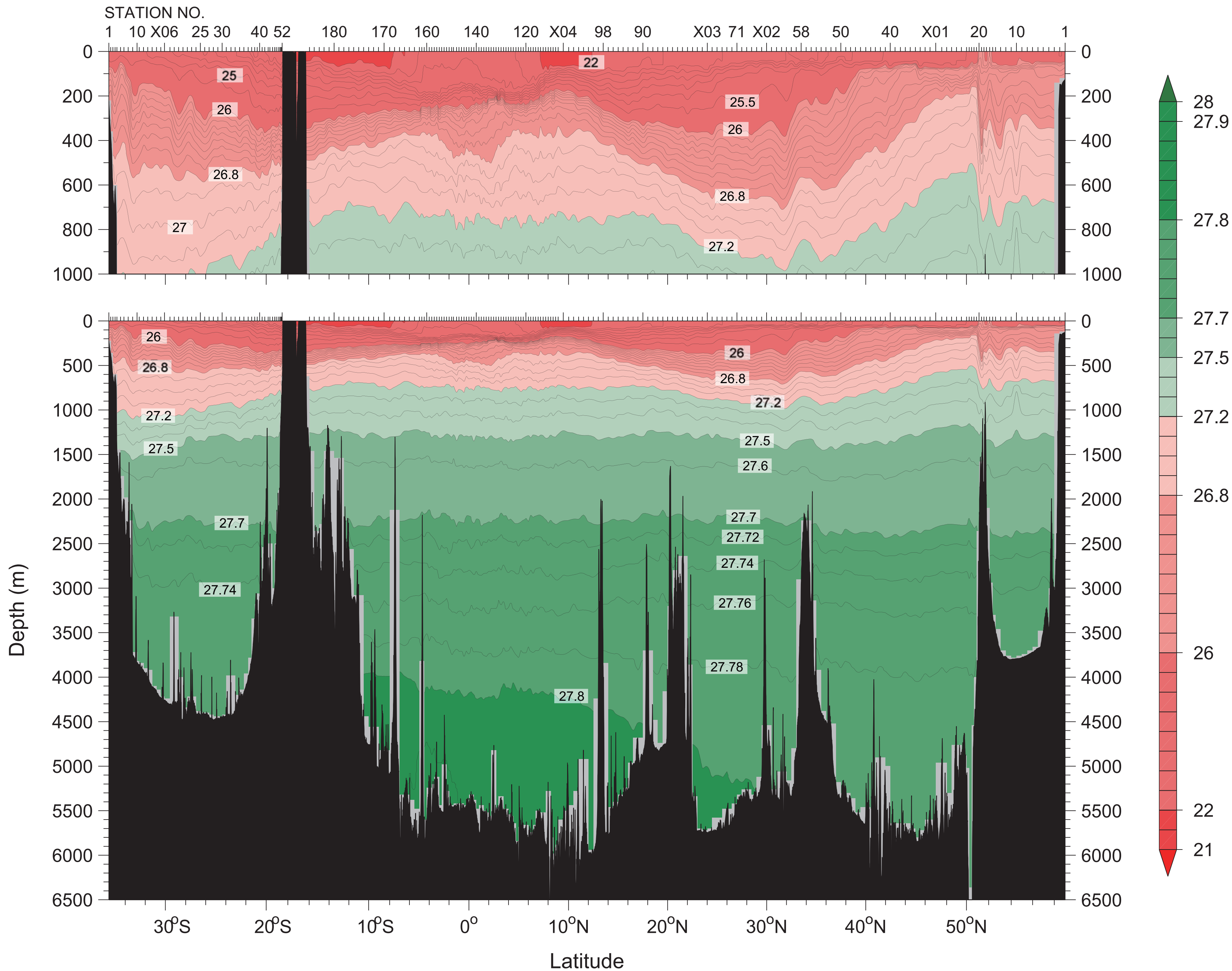

STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
[psu]
36
35.4
35
34.7
34.68
34.6
34.5
34.3
34
33
32
35.4
35.6
35
34.4
36
34.7
34.6
34.55
34.5
35.2
34.5
34.3
34.1
34
33.8
33
34.64
34.68
34.69
34.7
34.62
34.66
Depth (m)
Latitude
30°S
20°S
10°S
0°
10°N
20°N
30°N
40°N
50°N

Figure 11
Density (σ_0) (kg/m^3)
(a) WHP-P01

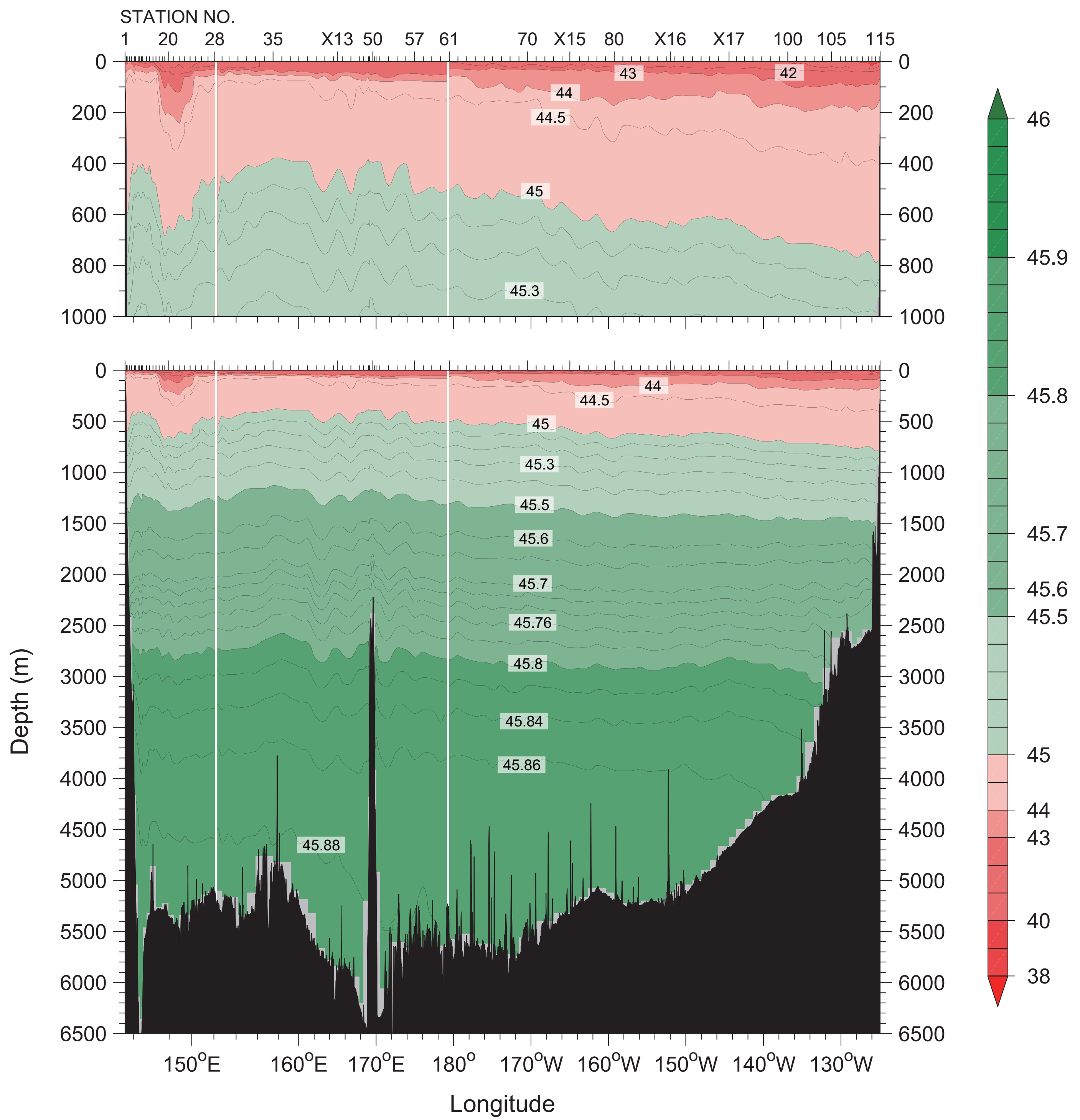


(b) WHP-P14

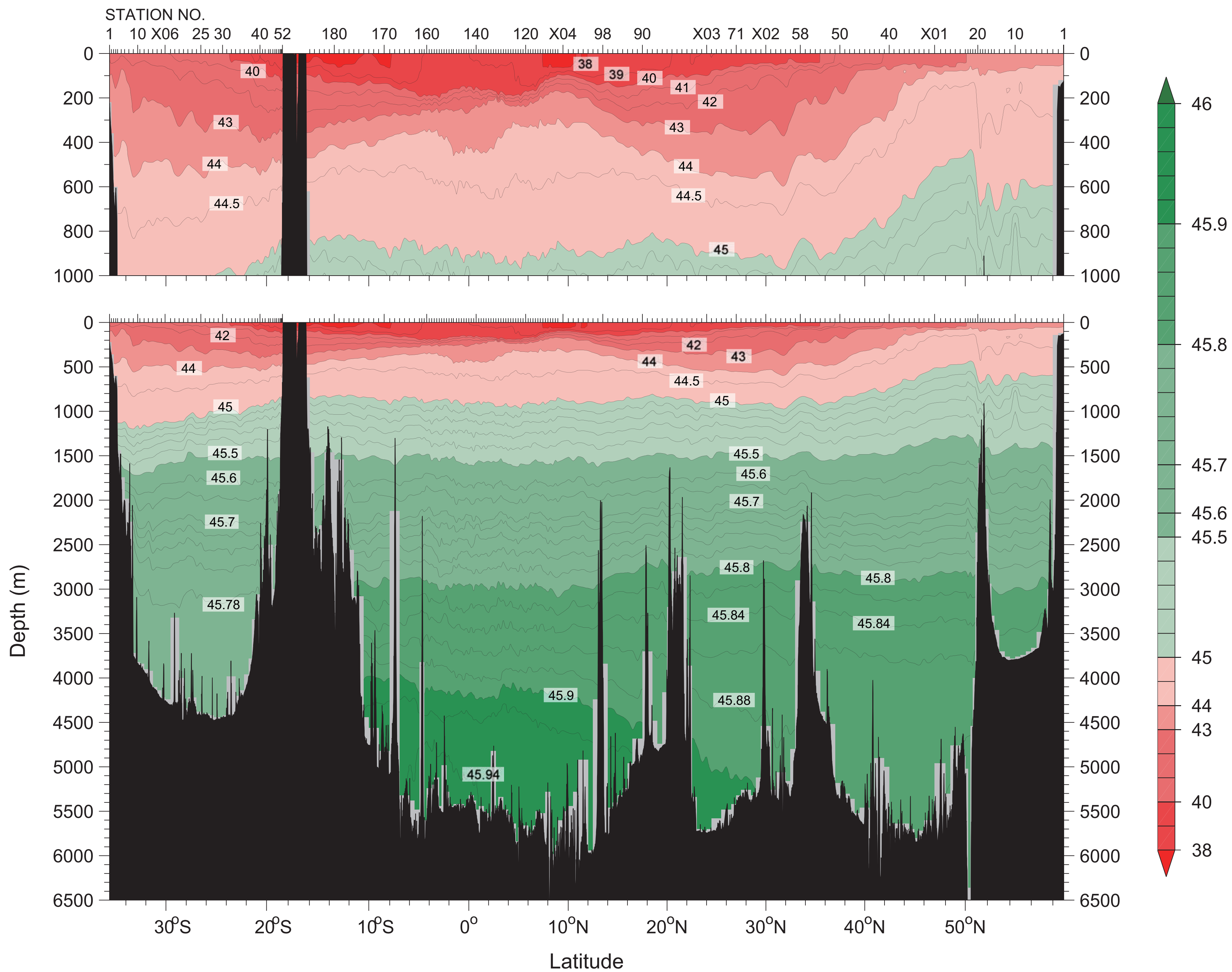


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
25
26
26.8
27
22
25.5
27.2
27.5
27.6
27.7
27.72
27.74
27.76
27.78
27.8
28
27.9
21

Figure 12
Density (σ_4) (kg/m³)
(a) WHP-P01

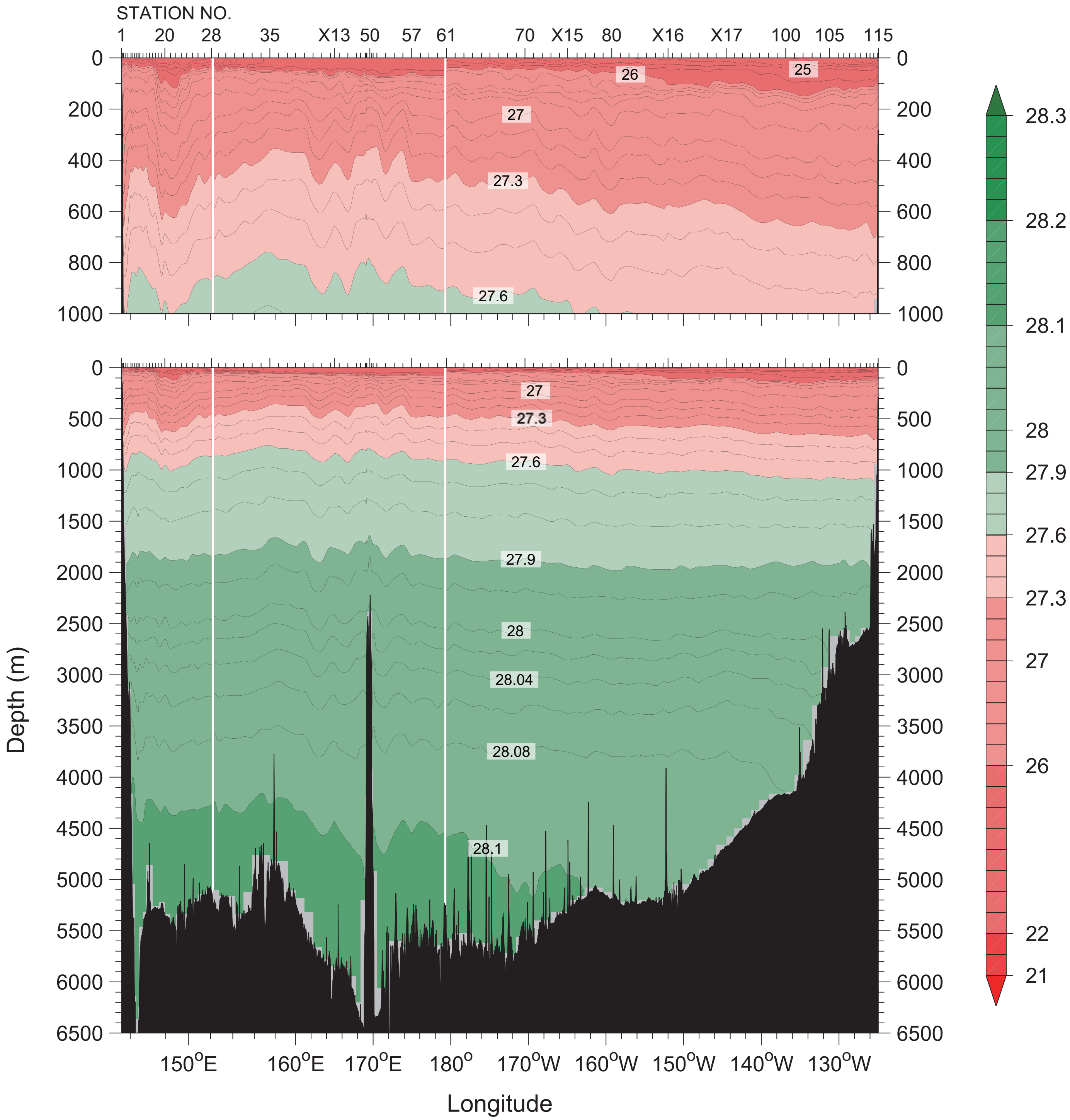


(b) WHP-P14



STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
38 39 40 41 42 43 44 44.5 45 45.5 45.6 45.7 45.78 45.8 45.84 45.88 45.9 45.94
46 45.9 45.8 45.7 45.6 45.5 45 44 43 40 38

Figure 13
Density (γ^n) (kg/m^3)
(a) WHP-P01



(b) WHP-P14

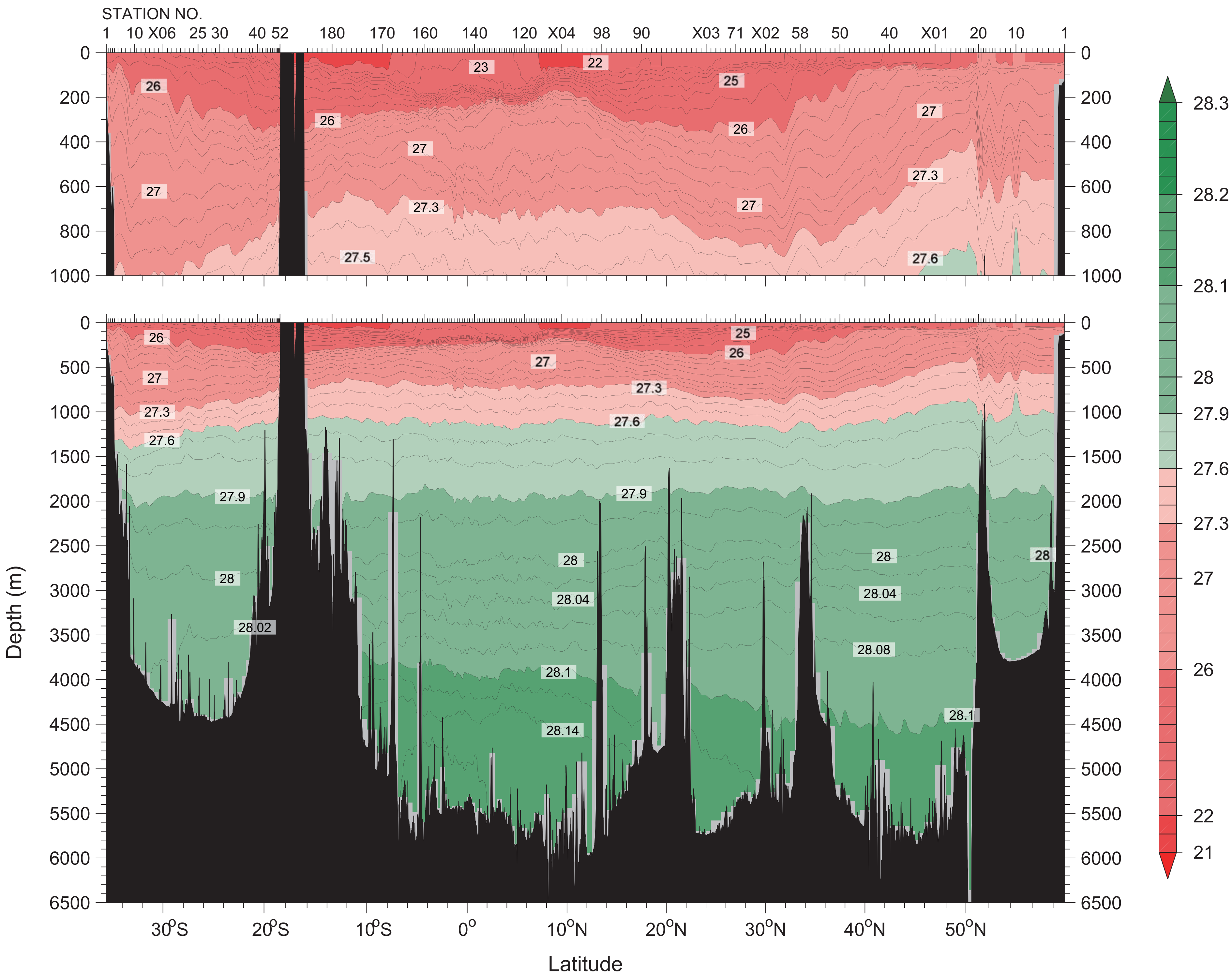
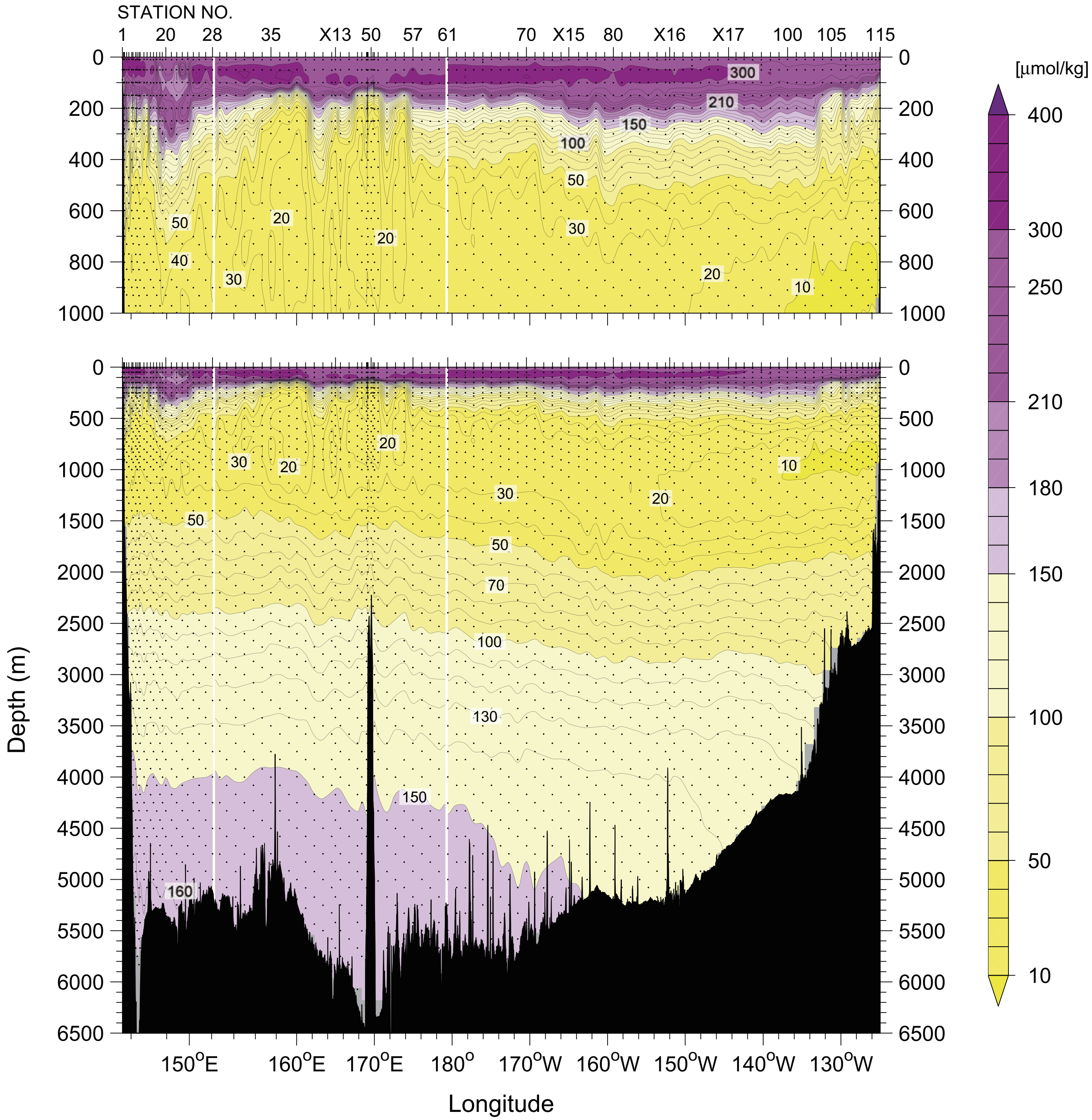
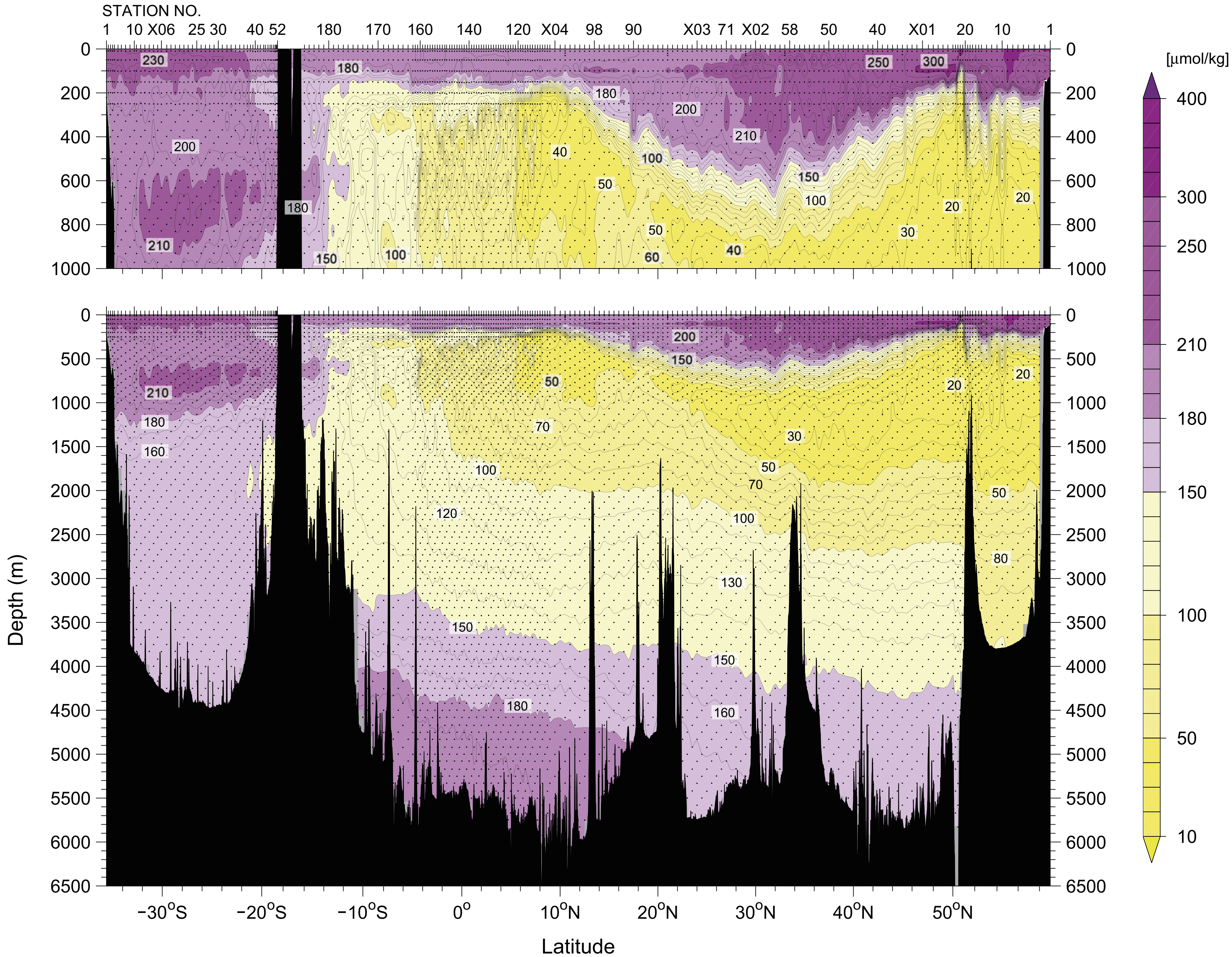

STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
28.3
28.2
28.1
28
27.9
27.6
27.3
27
26
22
21

Figure 14
Bottle sampled dissolved oxygen (µmol/kg)
(a) WHP-P01

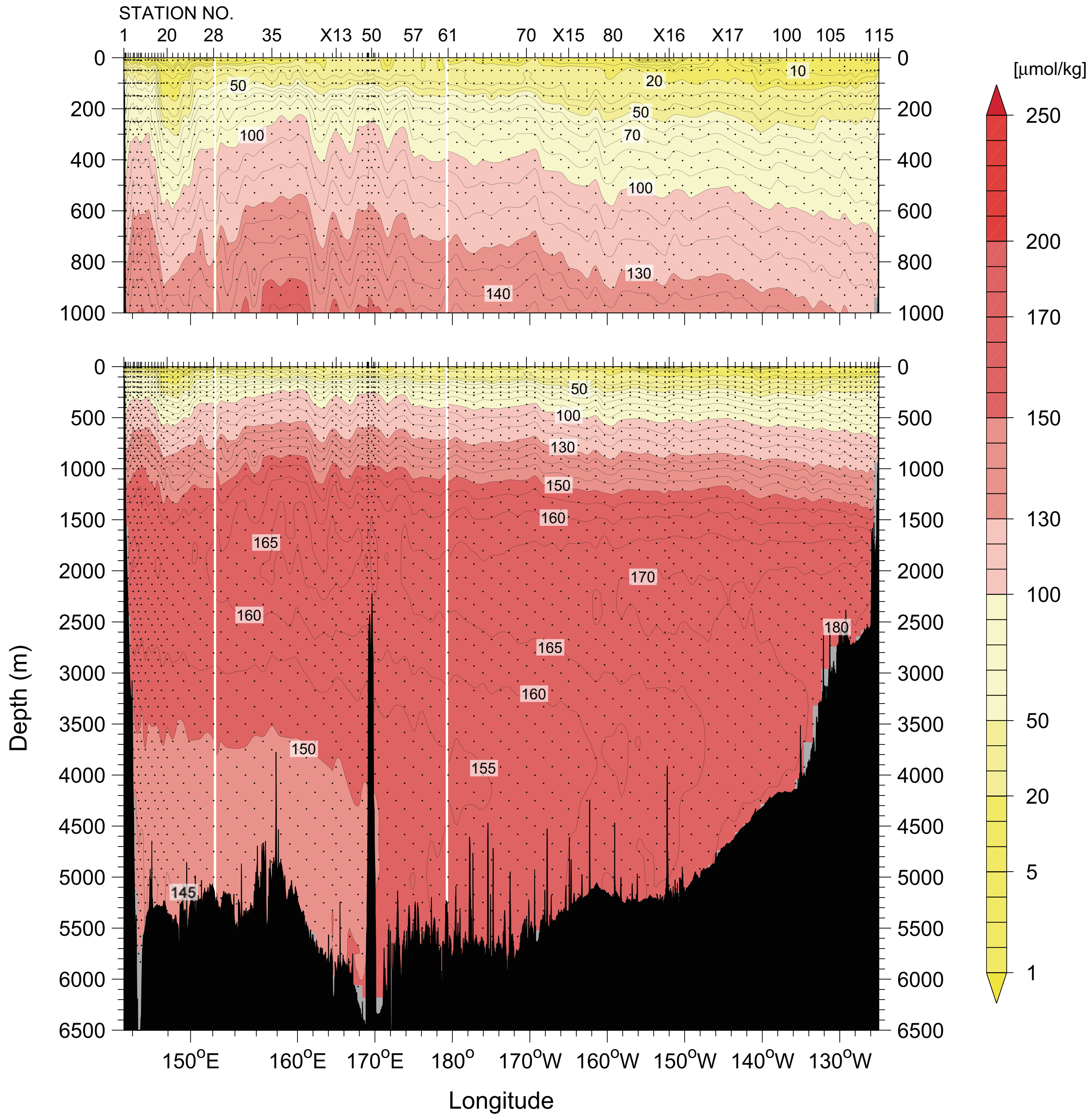


(b) WHP-P14



STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
−30°S −20°S −10°S 0° 10°N 20°N 30°N 40°N 50°N
[µmol/kg]
400 300 250 210 180 150 100 50 10

Figure 15
Silicate (µmol/kg)
(a) WHP-P01



(b) WHP-P14

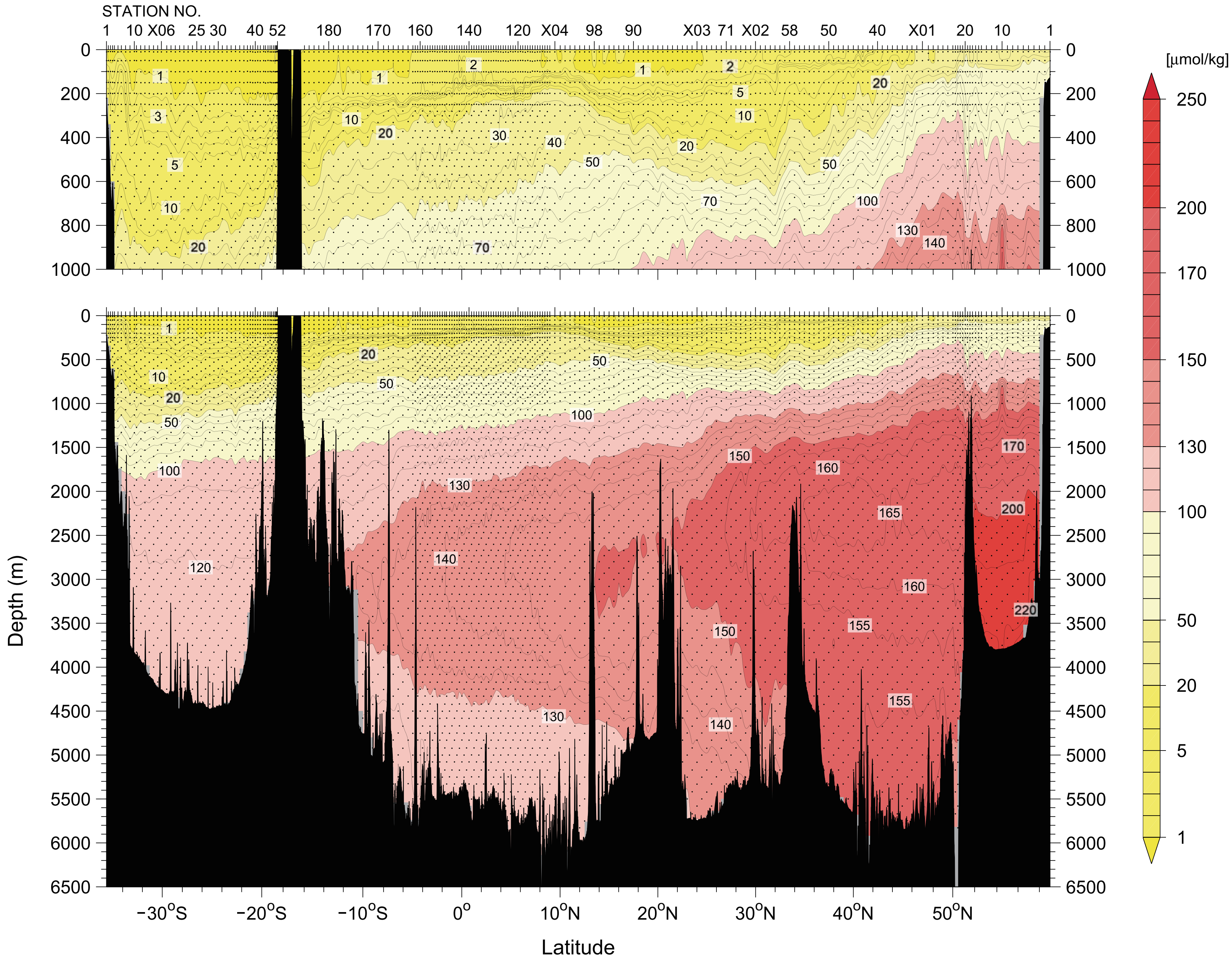
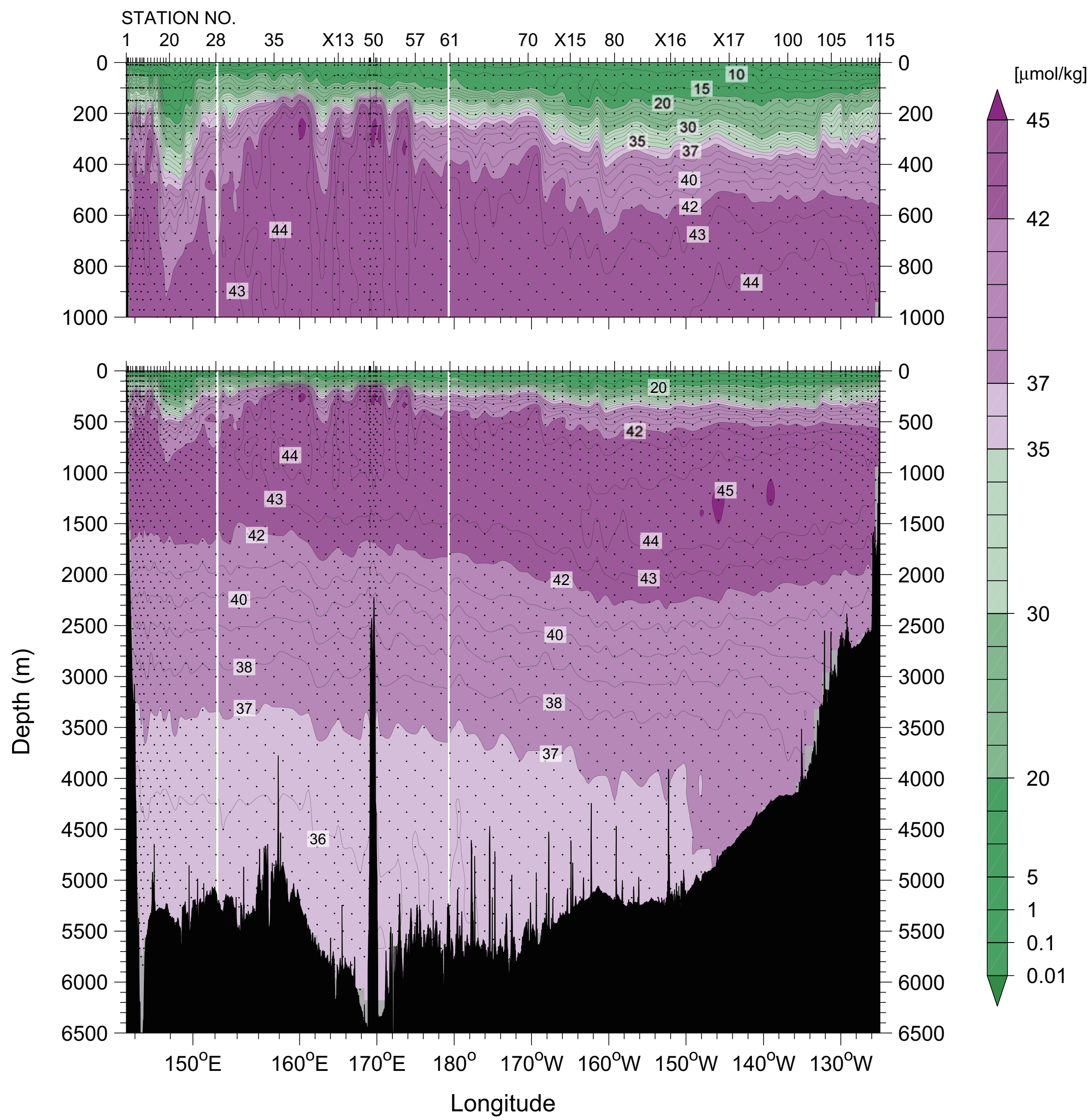
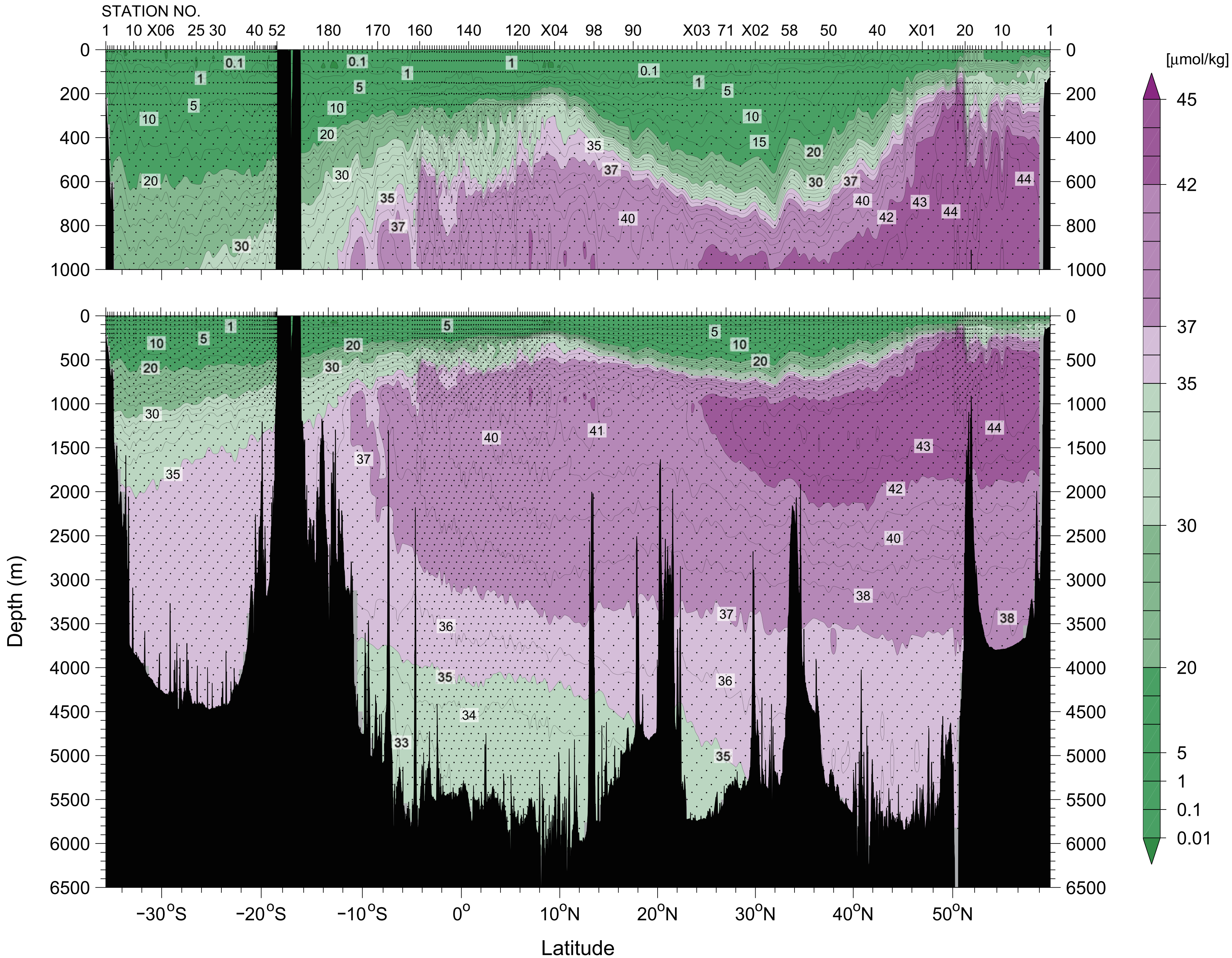

STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
-30°S -20°S -10°S 0° 10°N 20°N 30°N 40°N 50°N
[µmol/kg]
250 200 170 150 130 100 50 20 5 1

Figure 16
Nitrate (µmol/kg)
(a) WHP-P01

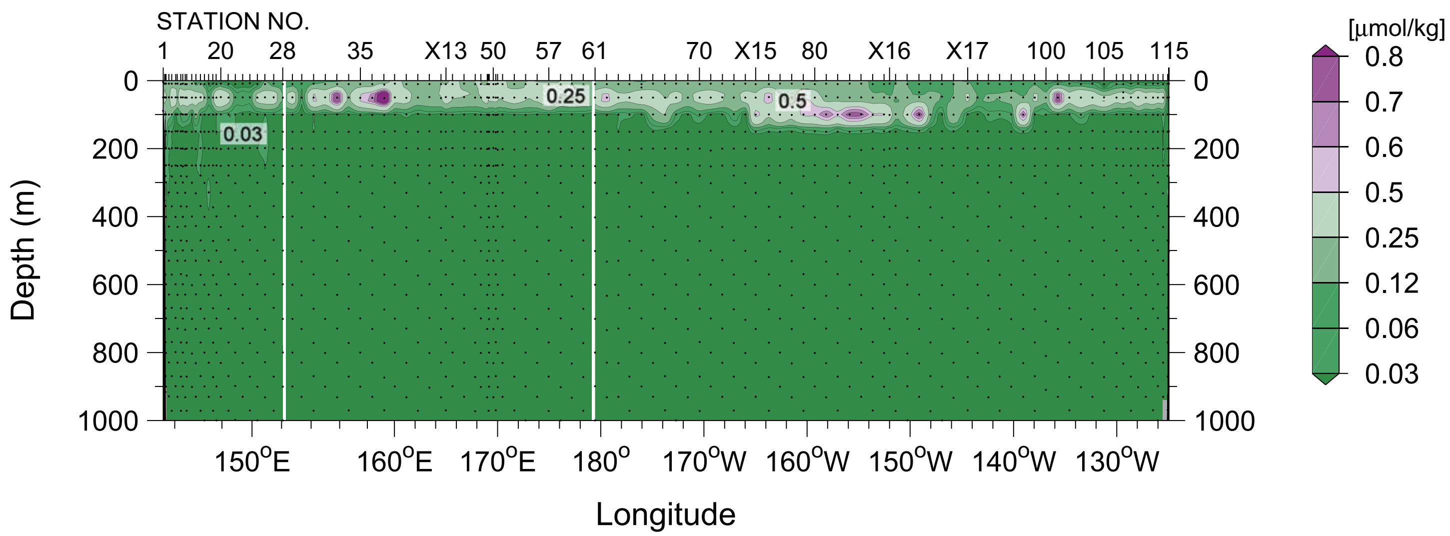


(b) WHP-P14

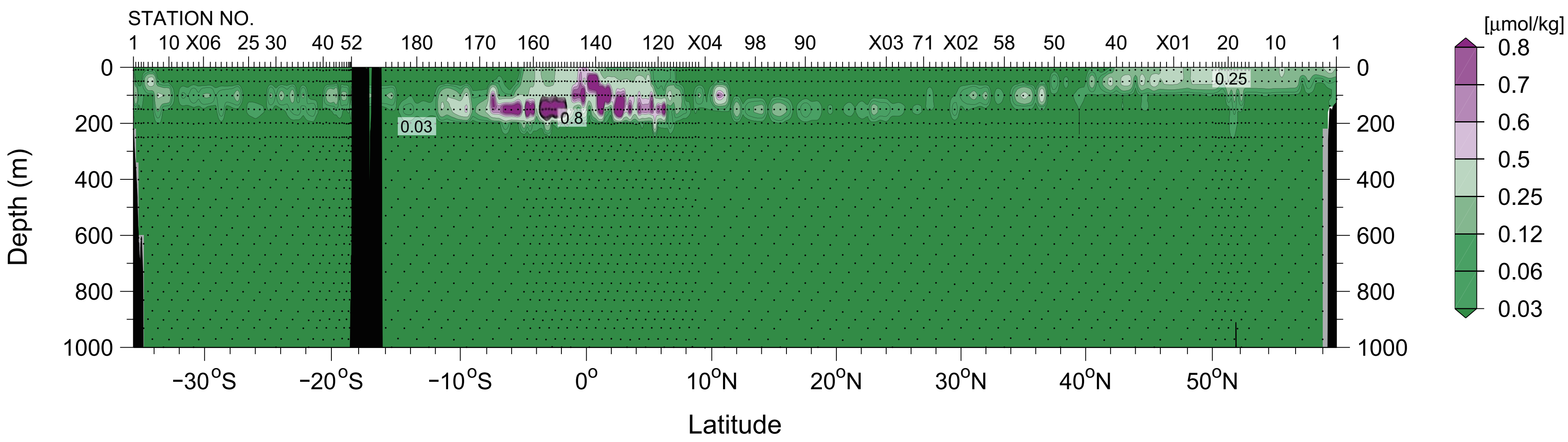


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
-30°S -20°S -10°S 0° 10°N 20°N 30°N 40°N 50°N
[μmol/kg]
45 42 37 35 30 20 5 1 0.1 0.01

Figure 17
Nitrite (µmol/kg)
(a) WHP-P01

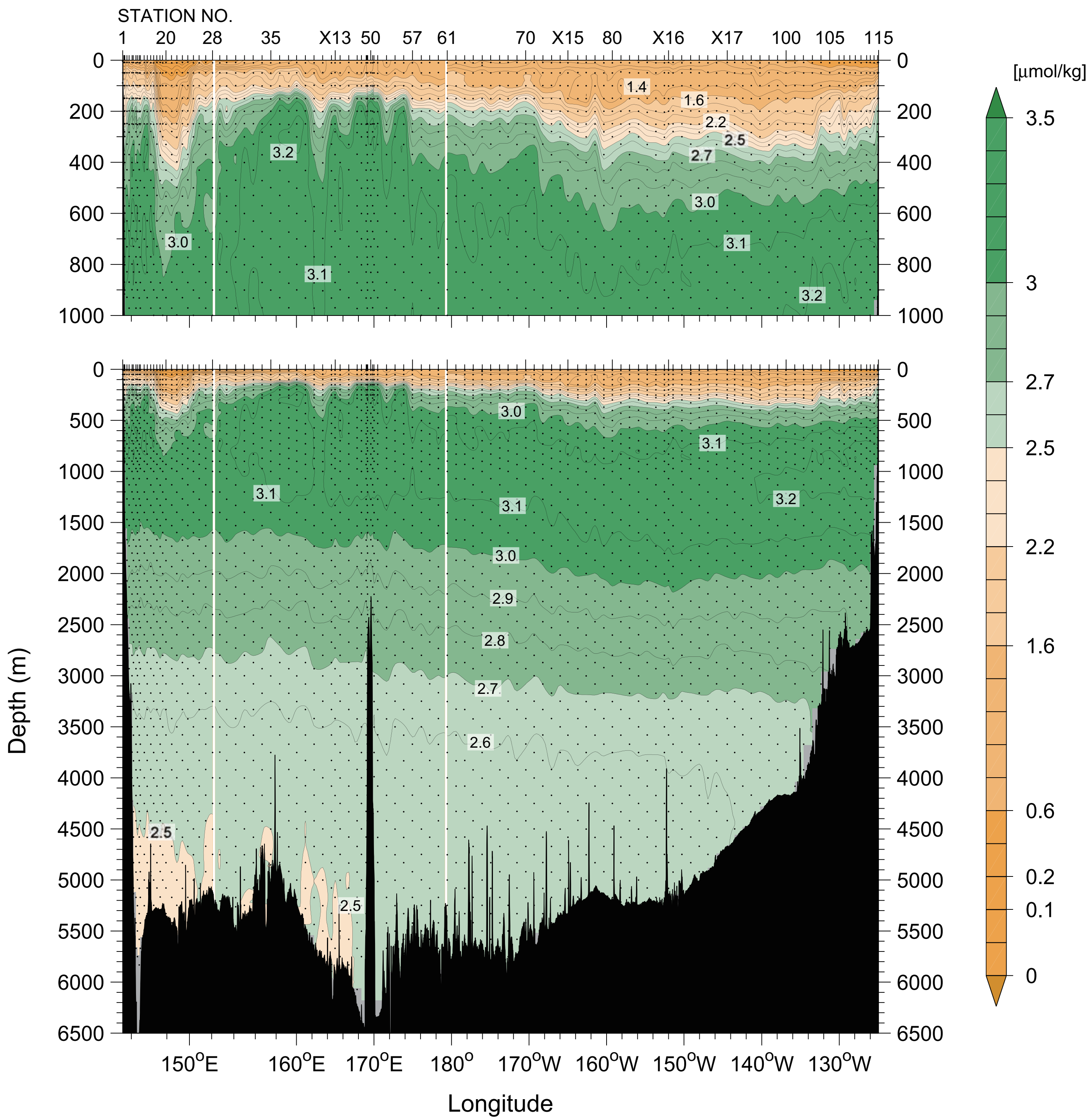


(b) WHP-P14

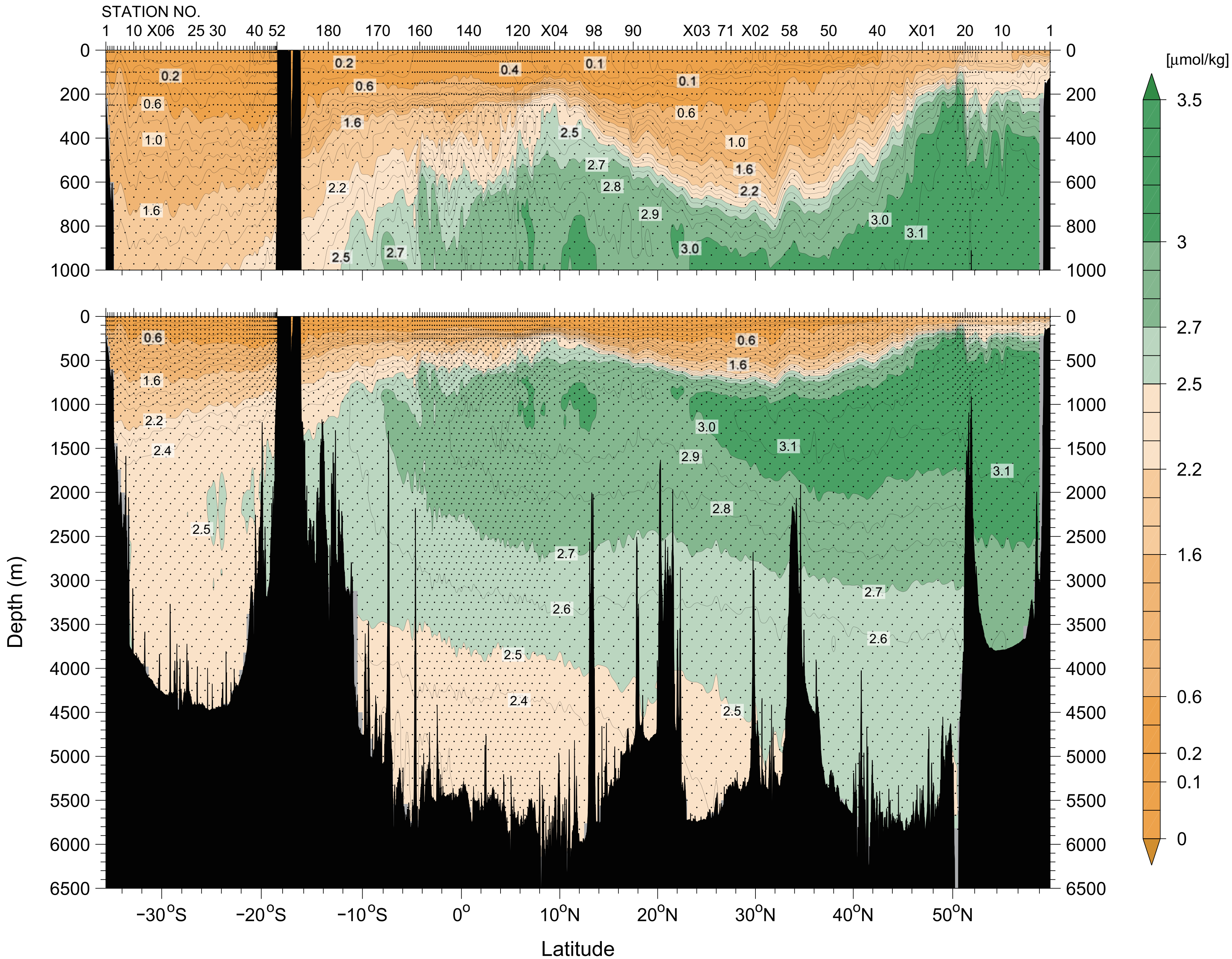


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
[µmol/kg]
0.8
0.7
0.6
0.5
0.25
0.12
0.06
0.03
0.25
0.8
0.03
Depth (m)
0
200
400
600
800
1000
-30°S
-20°S
-10°S
0°
10°N
20°N
30°N
40°N
50°N
Latitude

Figure 18
Phosphate (µmol/kg)
(a) WHP-P01

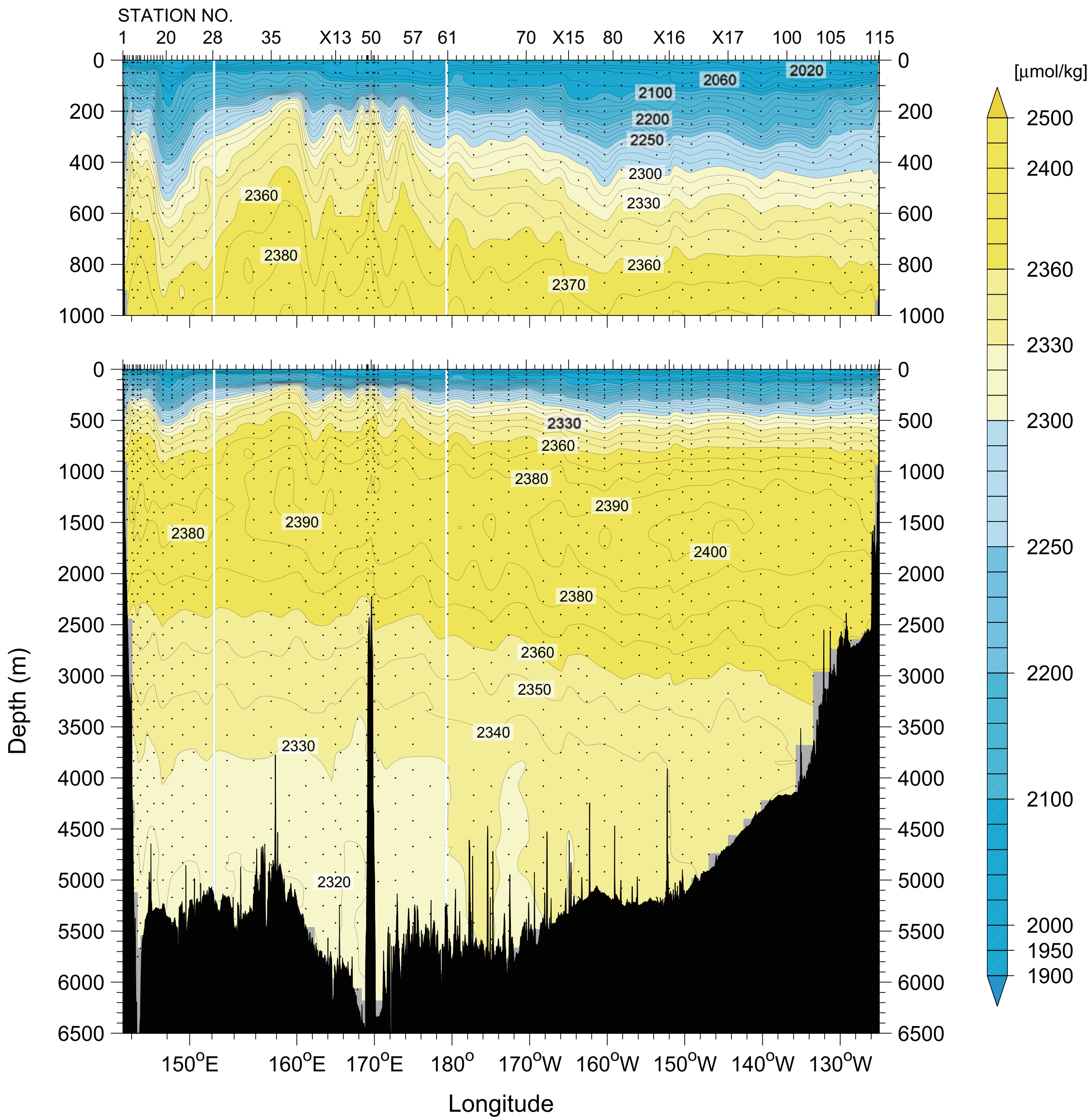


(b) WHP-P14



STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
[μmol/kg]
3.5
3
2.7
2.5
2.2
1.6
0.6
0.2
0.1
0
Depth (m)
-30°S
-20°S
-10°S
0°
10°N
20°N
30°N
40°N
50°N
Latitude

Figure 19
Dissolved inorganic carbon (μmol/kg)
(a) WHP-P01



(b) WHP-P14

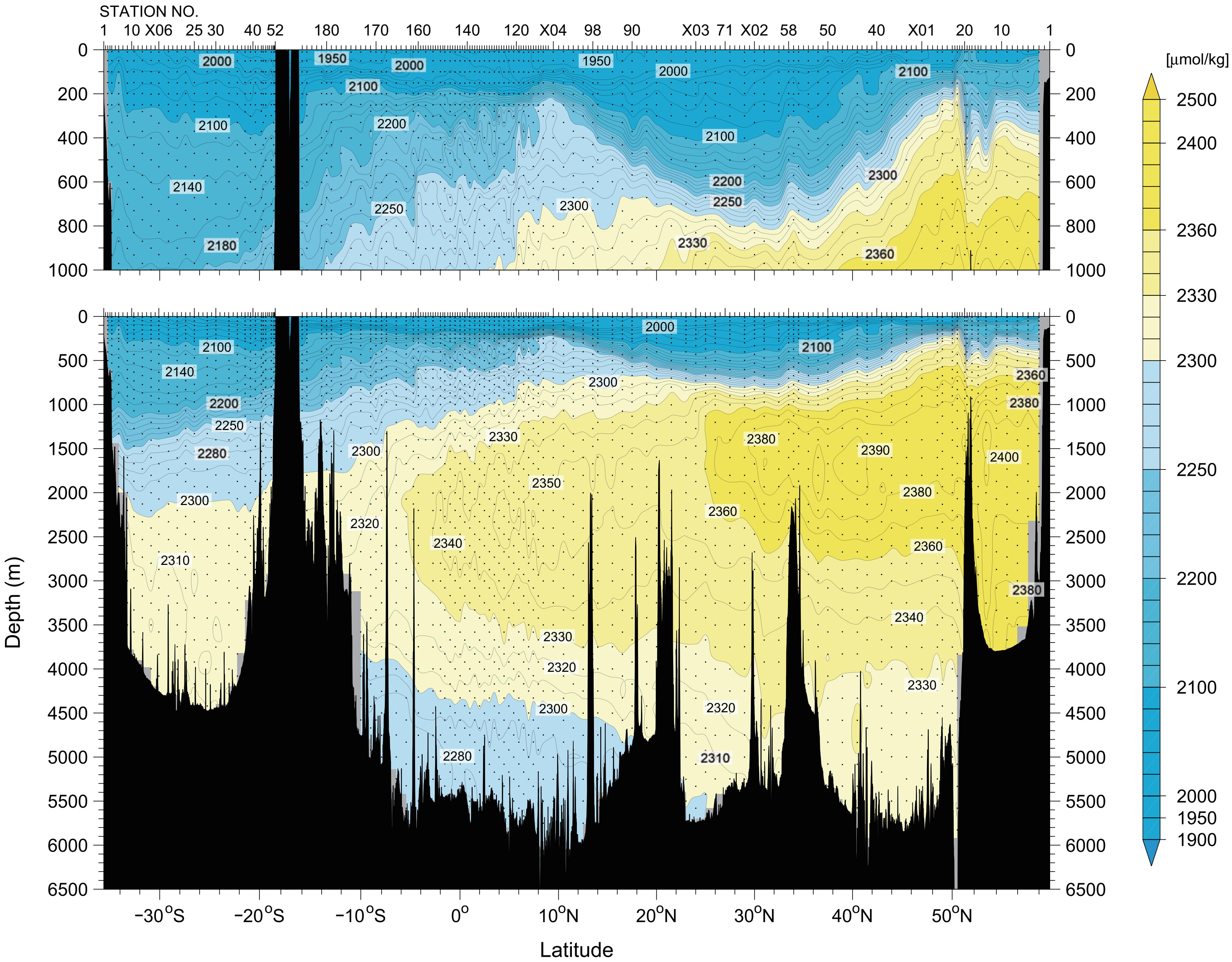
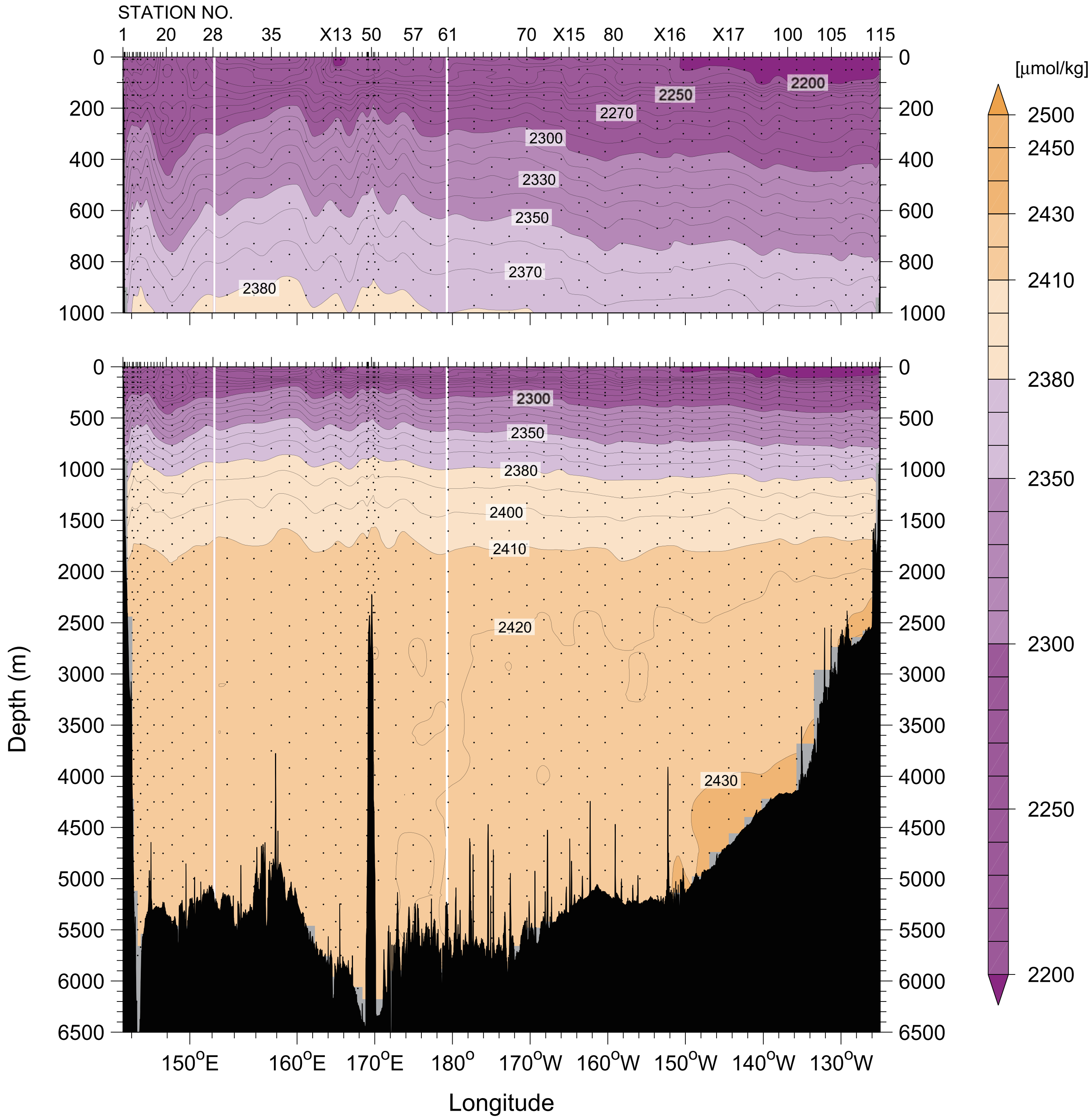
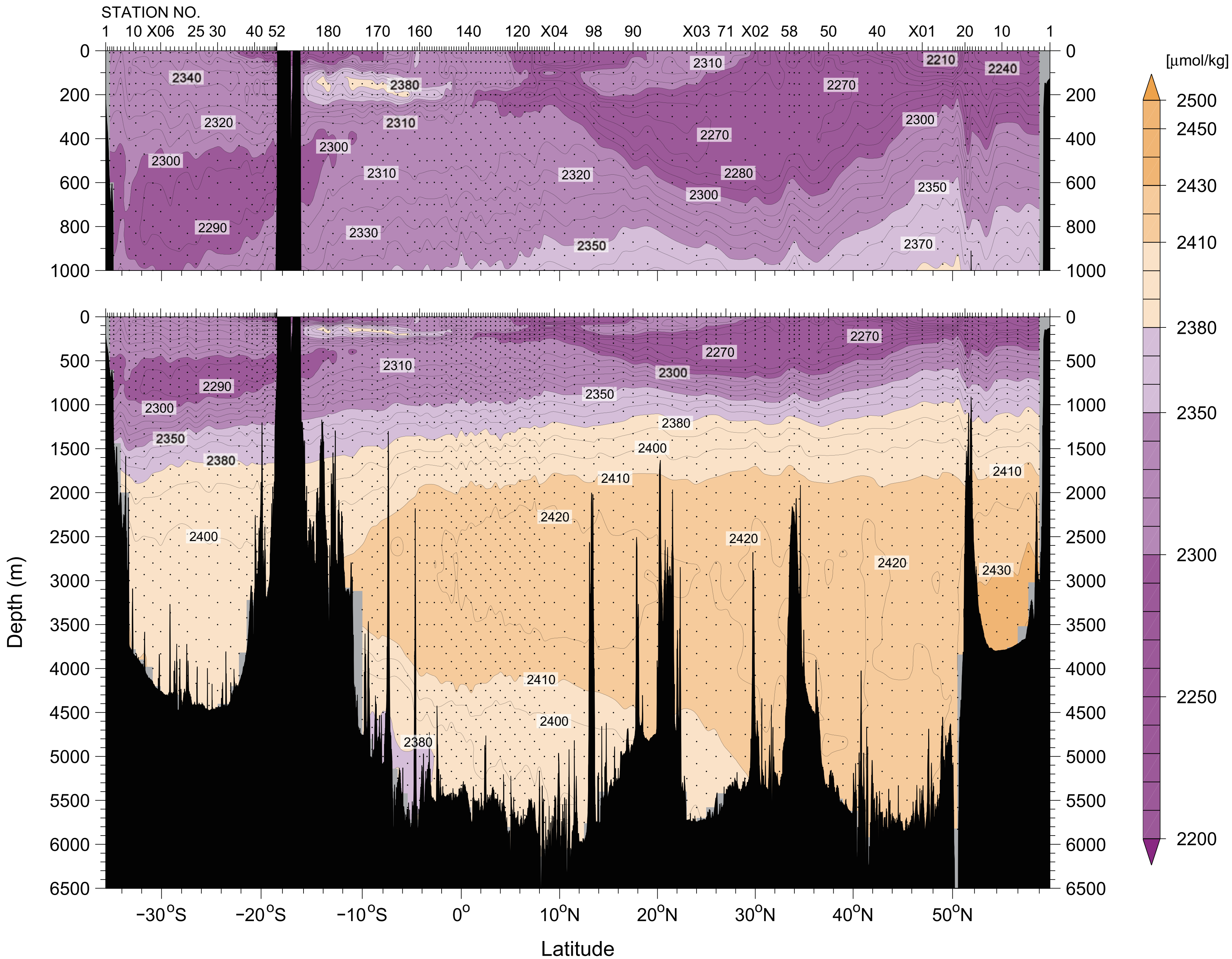

STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
-30°S -20°S -10°S 0° 10°N 20°N 30°N 40°N 50°N
[µmol/kg]
2500 2400 2360 2330 2300 2250 2200 2100 2000 1950 1900

Figure 20
Total alkalinity (µmol/kg)
(a) WHP-P01

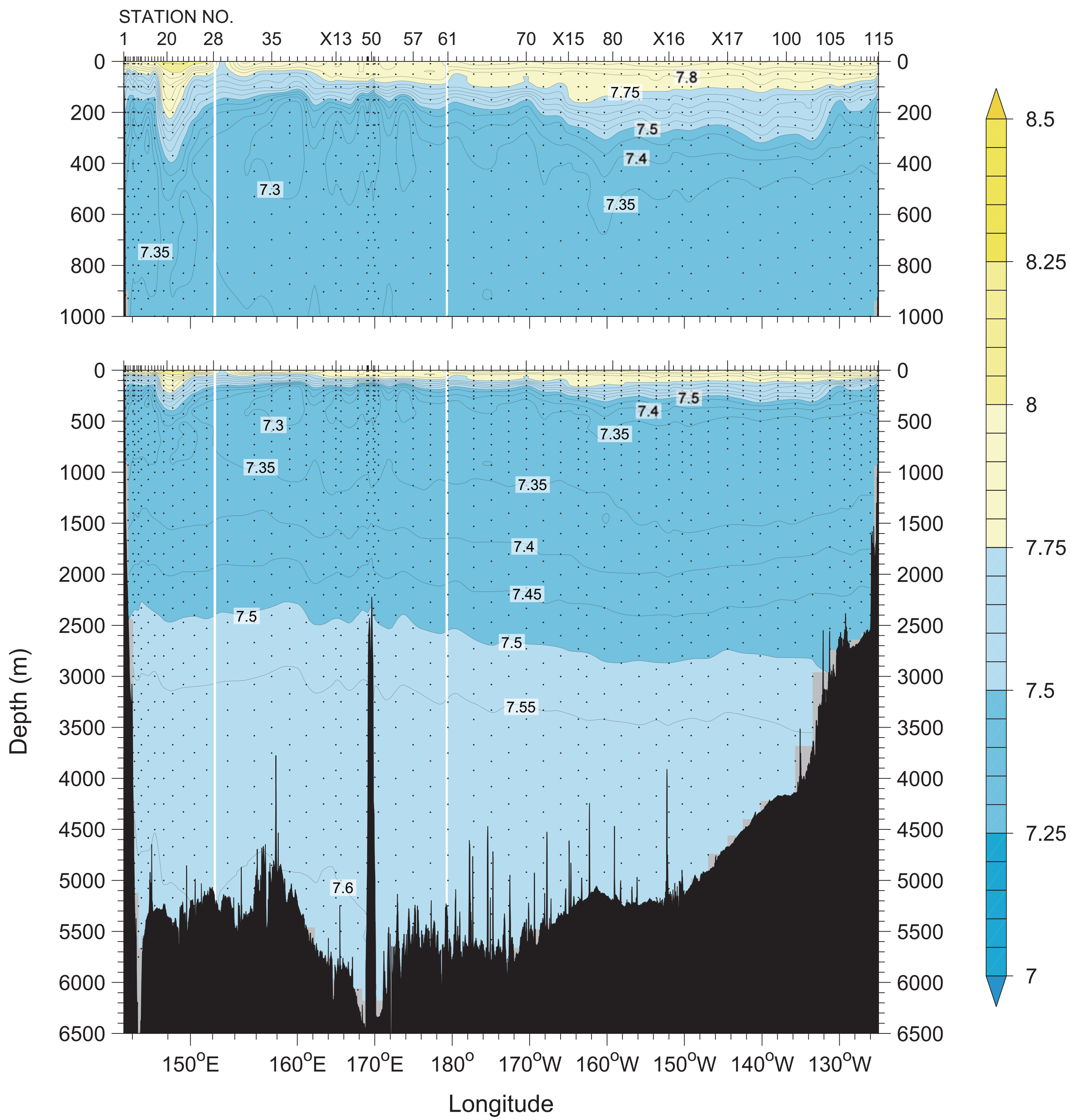


(b) WHP-P14

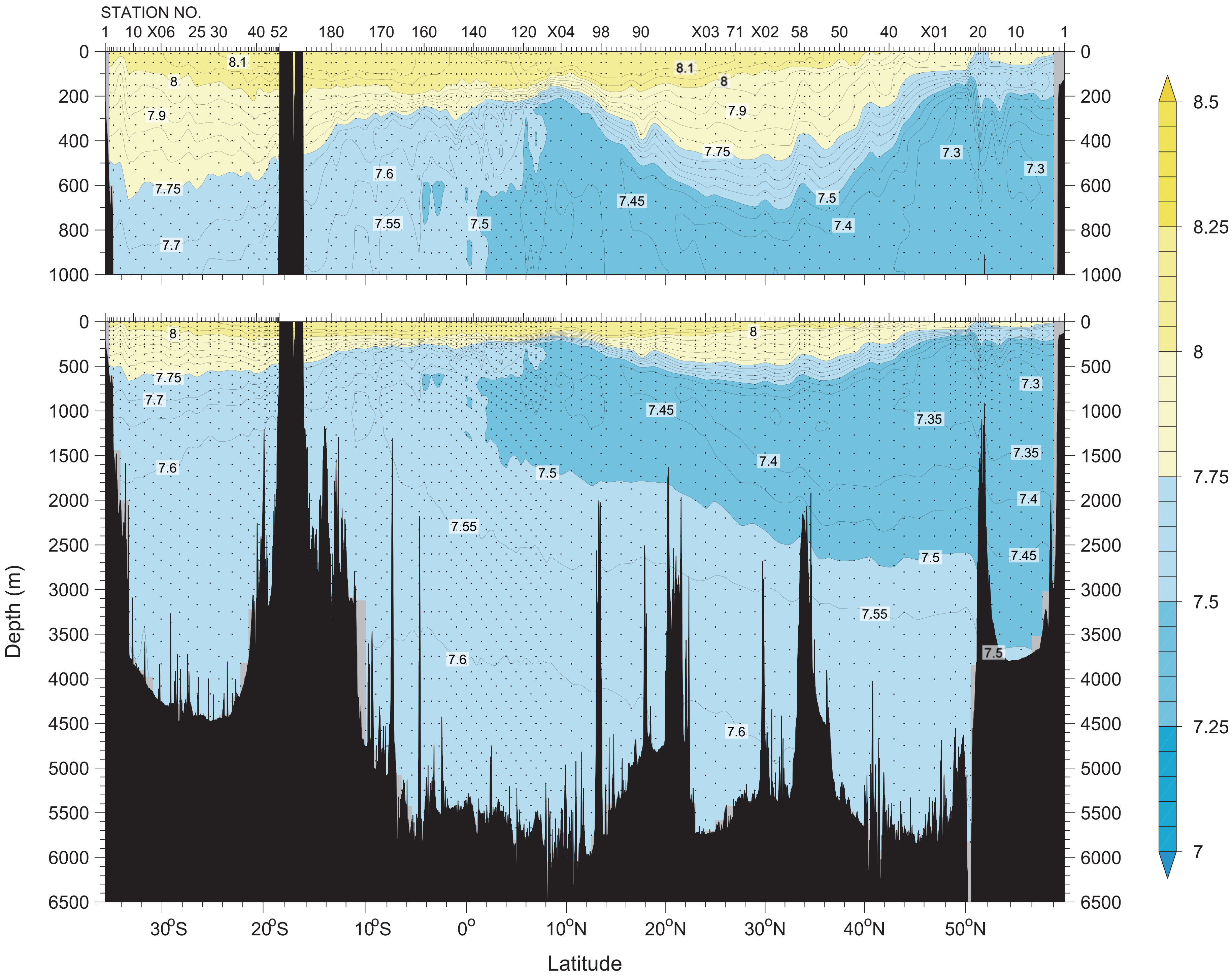


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
-30°S -20°S -10°S 0° 10°N 20°N 30°N 40°N 50°N
[µmol/kg]
2500 2450 2430 2410 2380 2350 2300 2250 2200

Figure 21
pH
(a) WHP-P01

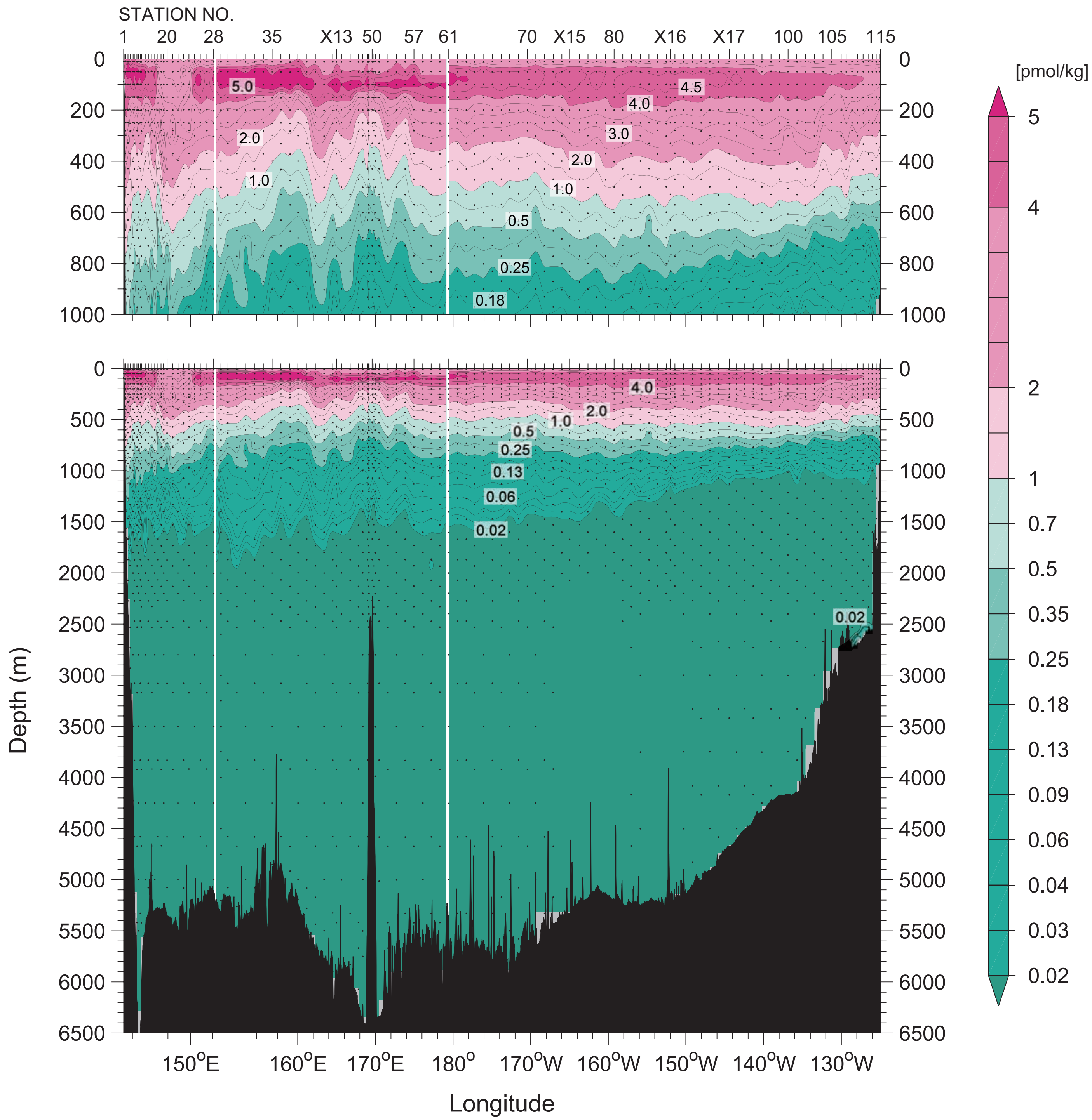


(b) WHP-P14

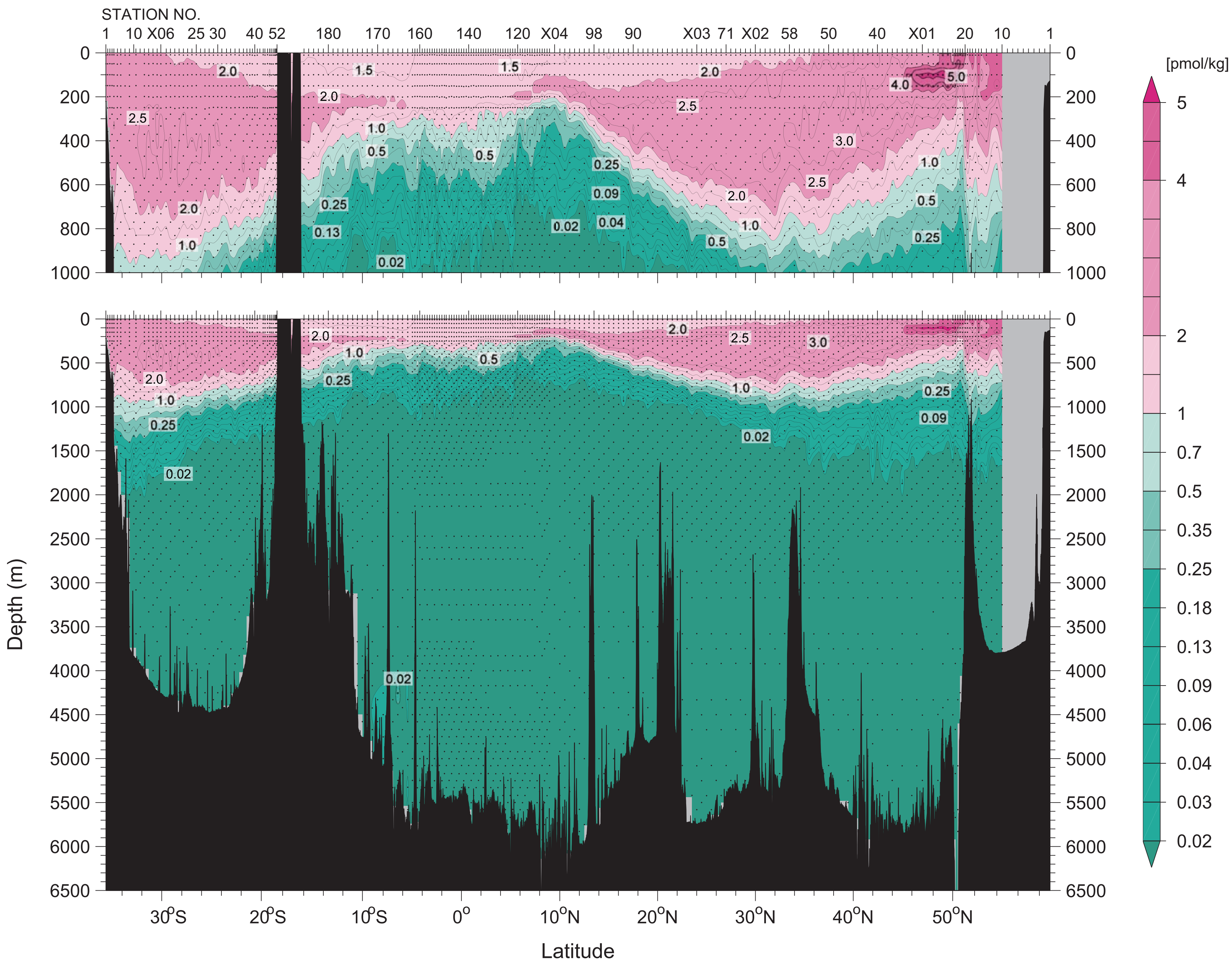


STATION NO.
1
10
X06
25
30
40
52
180
170
160
140
120
X04
98
90
X03
71
X02
58
50
40
X01
20
10
1
Depth (m)
Latitude
30°S
20°S
10°S
0°
10°N
20°N
30°N
40°N
50°N
8.5
8.25
8
7.75
7.5
7.25
7

Figure 22
CFC-11 (pmol/kg)
(a) WHP-P01

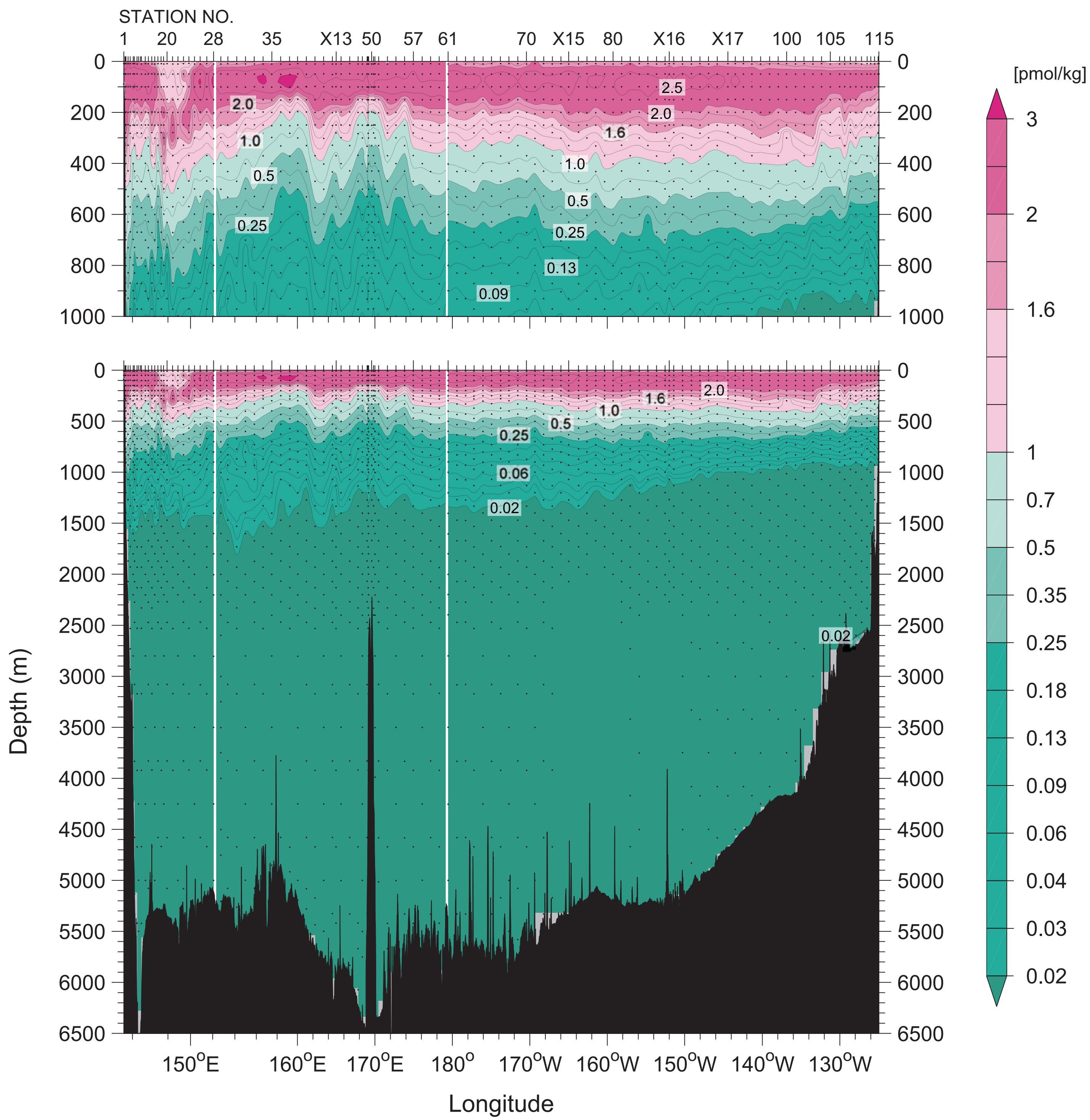


(b) WHP-P14



STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
[pmol/kg]
5
4
2
1
0.7
0.5
0.35
0.25
0.18
0.13
0.09
0.06
0.04
0.03
0.02
Depth (m)
30°S
20°S
10°S
0°
10°N
20°N
30°N
40°N
50°N
Latitude

Figure 23
CFC-12 (pmol/kg)
(a) WHP-P01



(b) WHP-P14

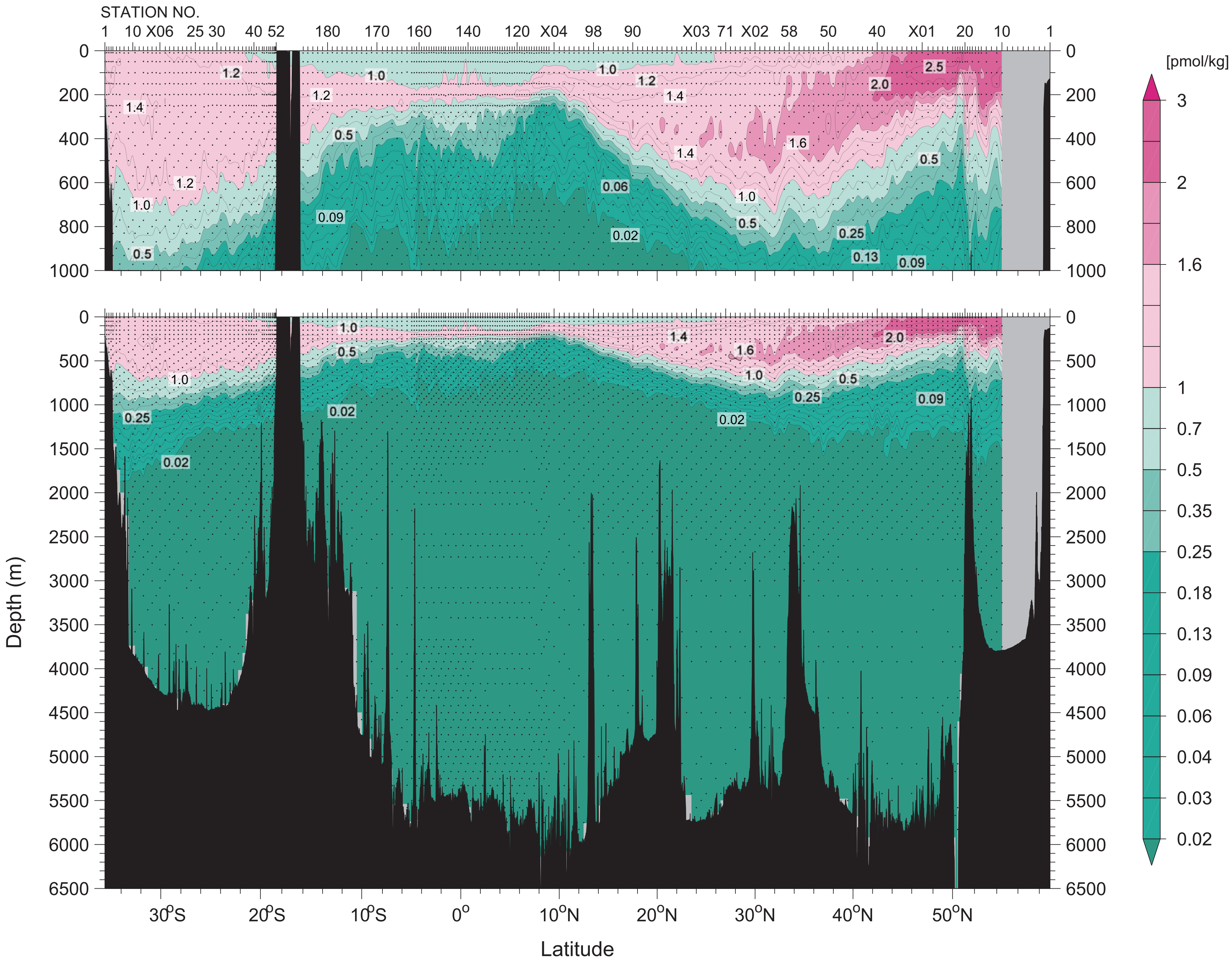
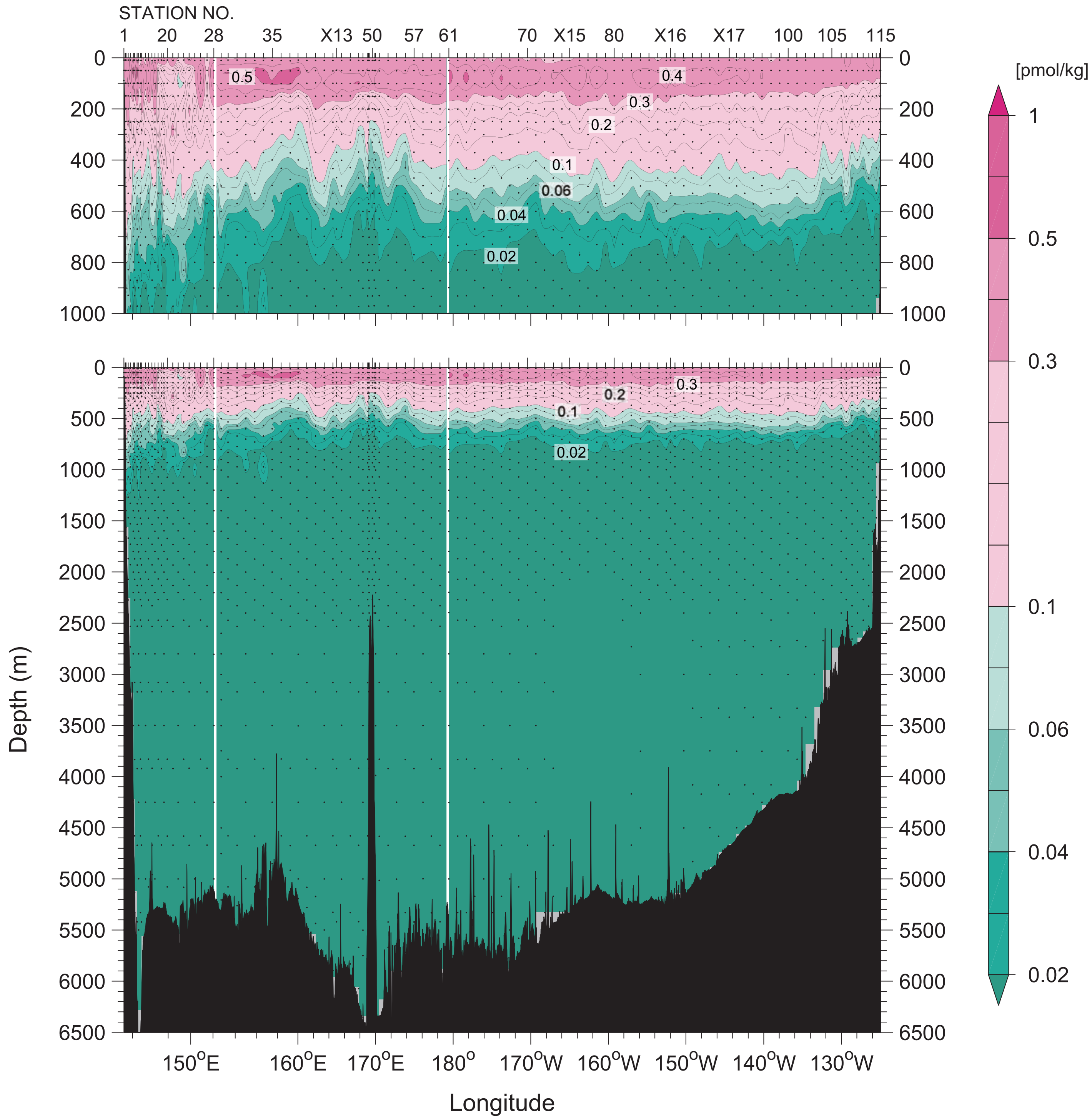
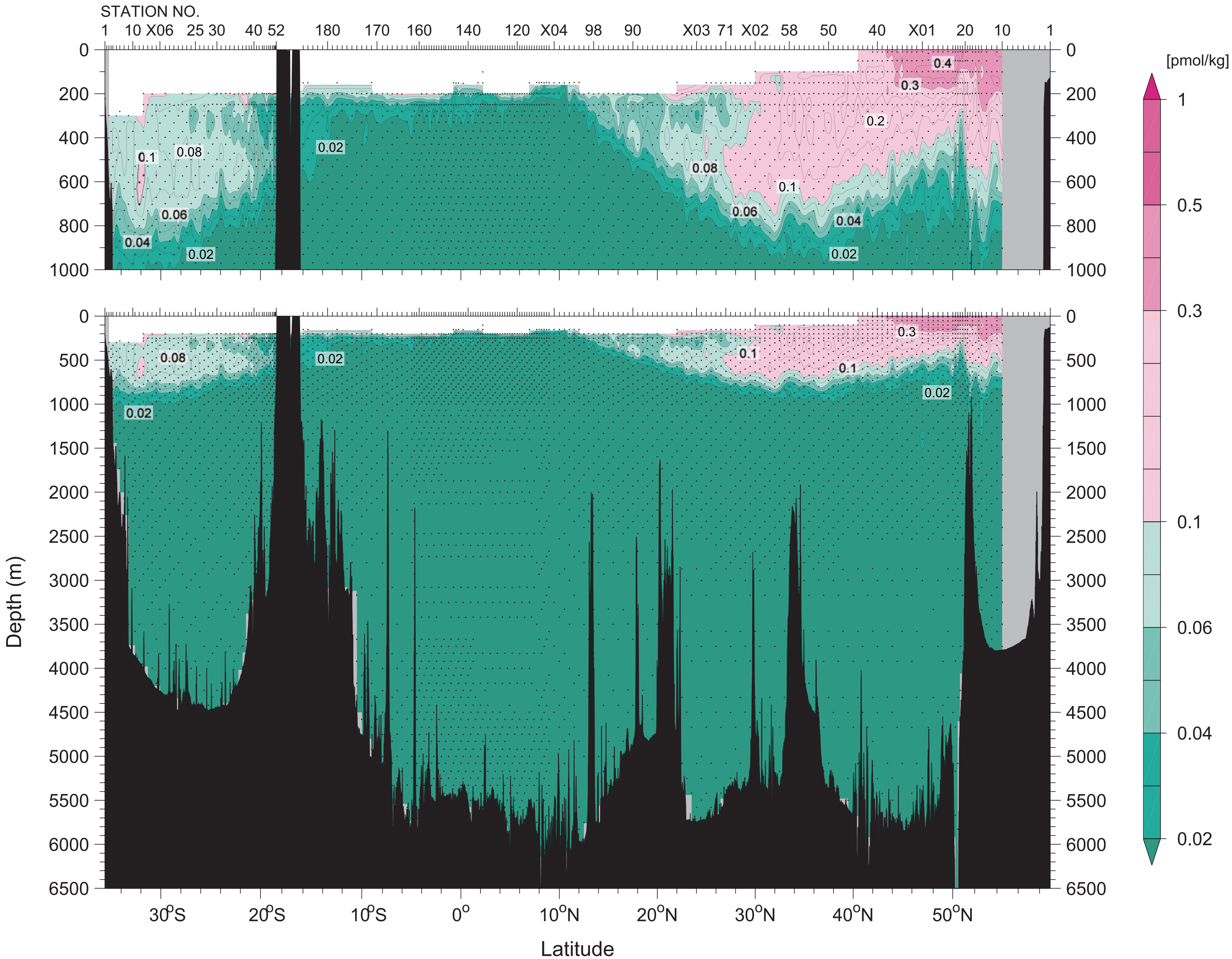

STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
[pmol/kg]
3
2
1.6
1
0.7
0.5
0.35
0.25
0.18
0.13
0.09
0.06
0.04
0.03
0.02
Depth (m)
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
Latitude

Figure 24
CFC-113 (pmol/kg)
(a) WHP-P01

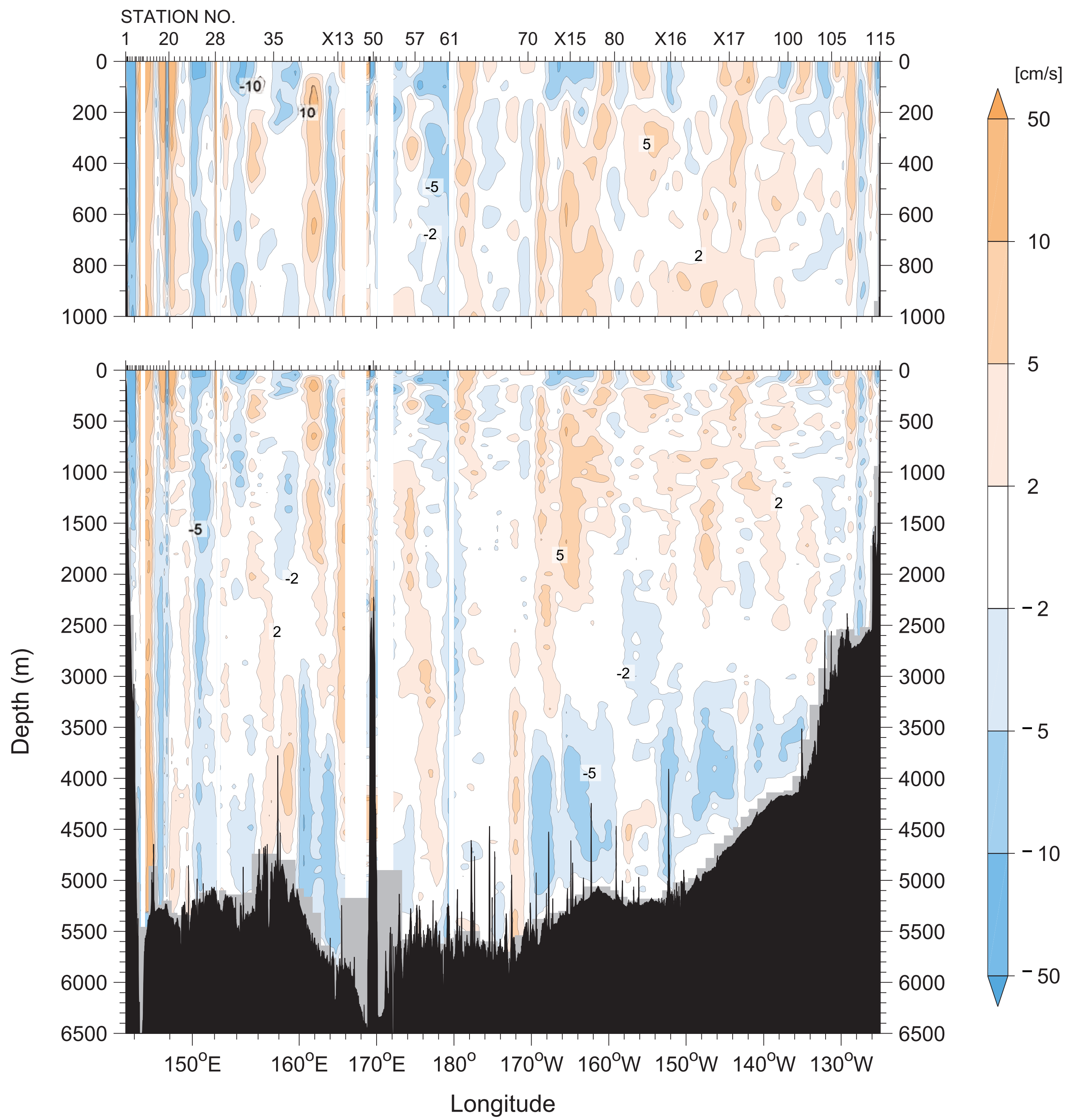


(b) WHP-P14

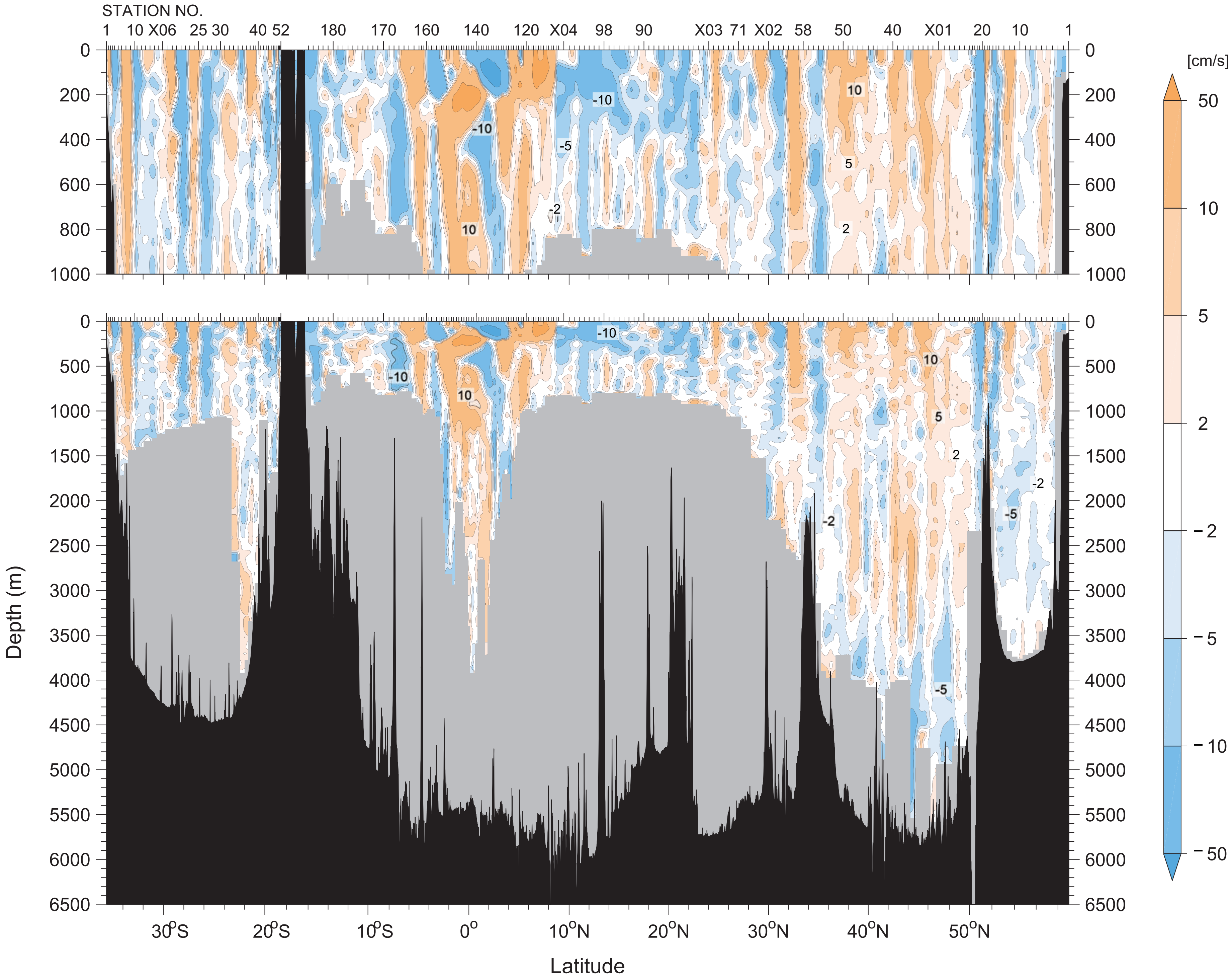


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
[pmol/kg]
1
0.5
0.3
0.1
0.06
0.04
0.02

Figure 25
Current velocity (cm/s) normal to the cruise track measured by LADCP (northward is positive)
(a) WHP-P01

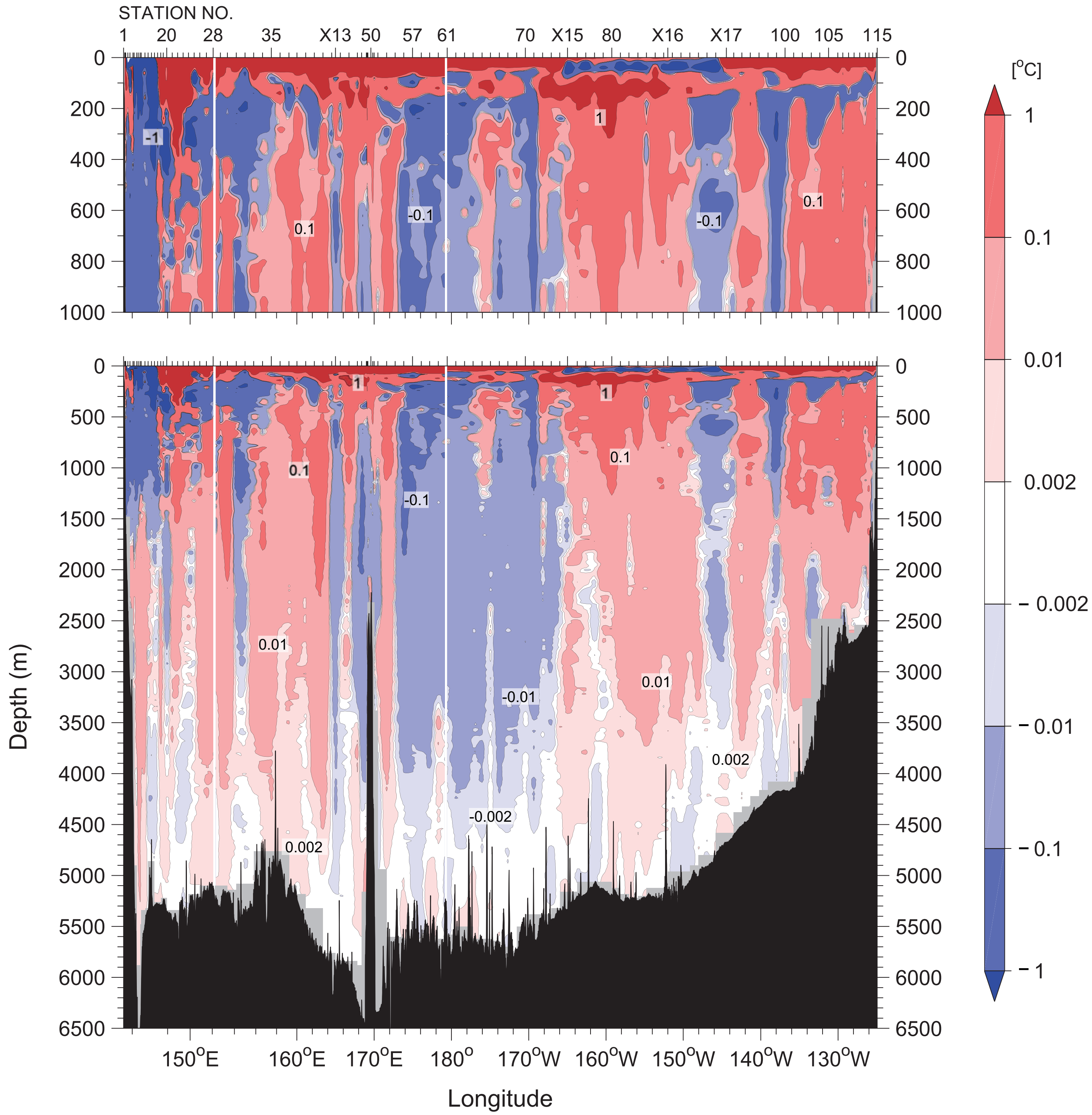


(b) WHP-P14

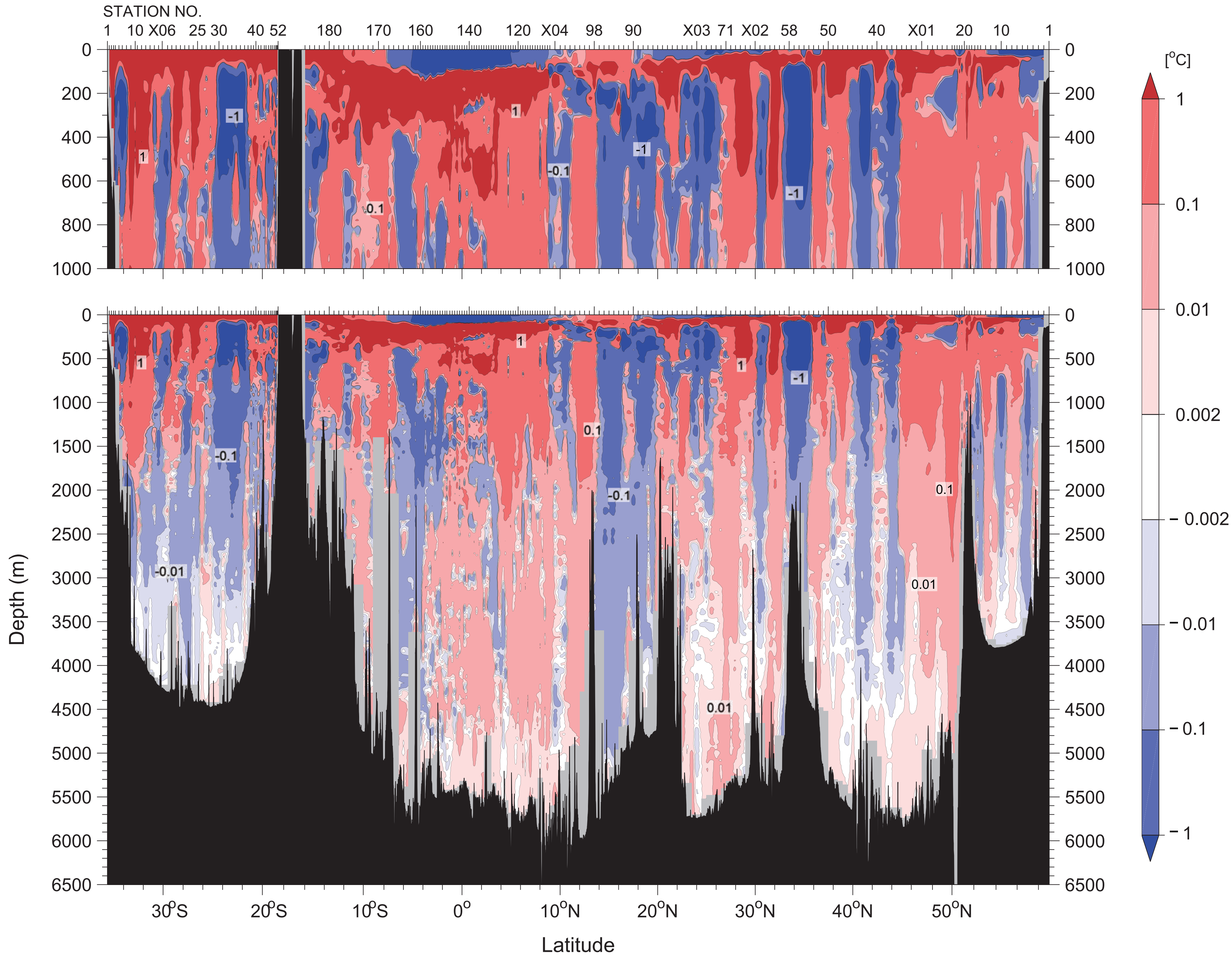


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
[cm/s]
50
10
5
2
−2
−5
−10
−50
Depth (m)
Latitude
30°S
20°S
10°S
0°
10°N
20°N
30°N
40°N
50°N

Figure 26
Difference in potential temperature (°C) between results from WOCE and its revisit cruise the cruise
(a) WHP-P01

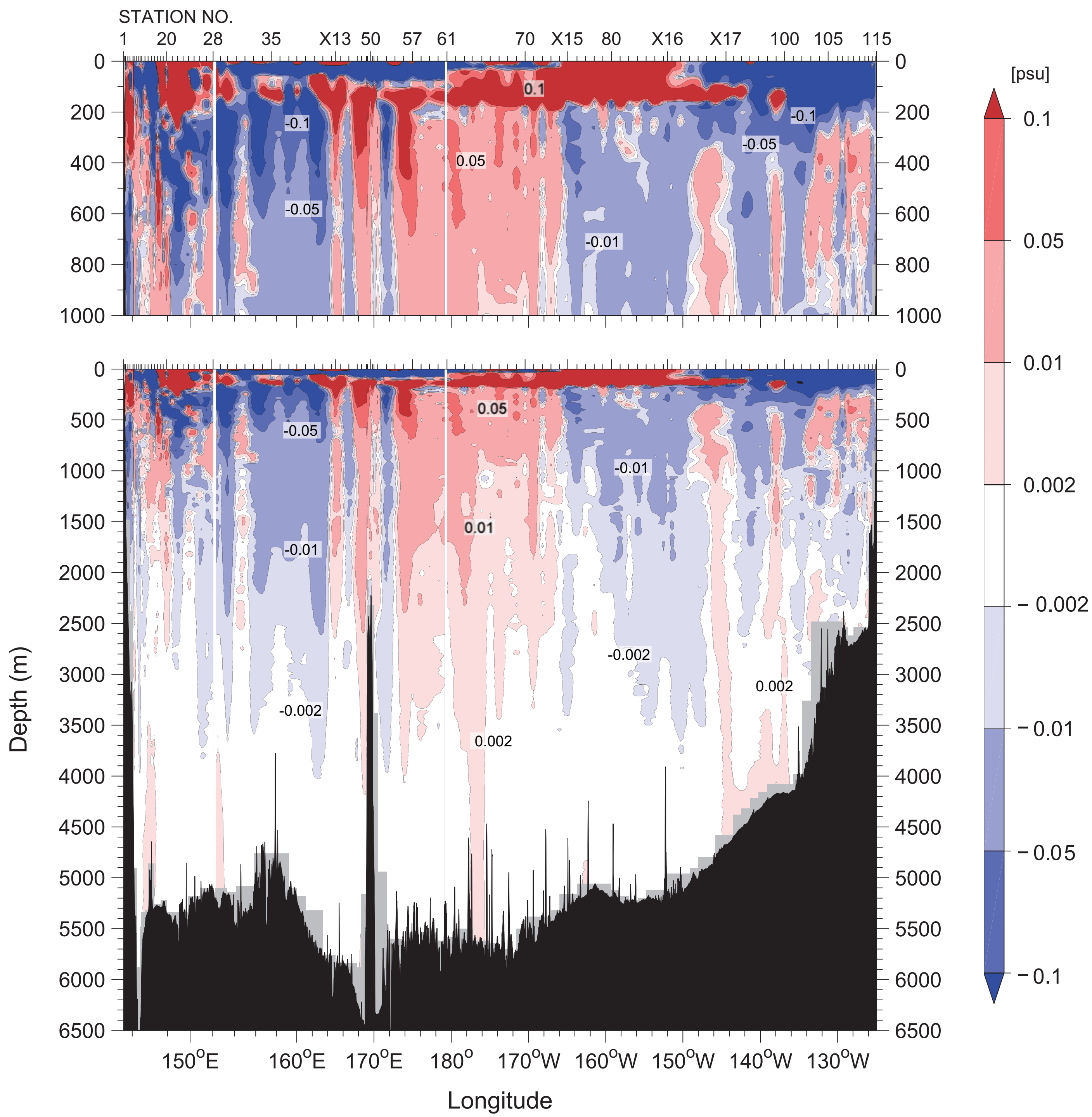


(b) WHP-P14

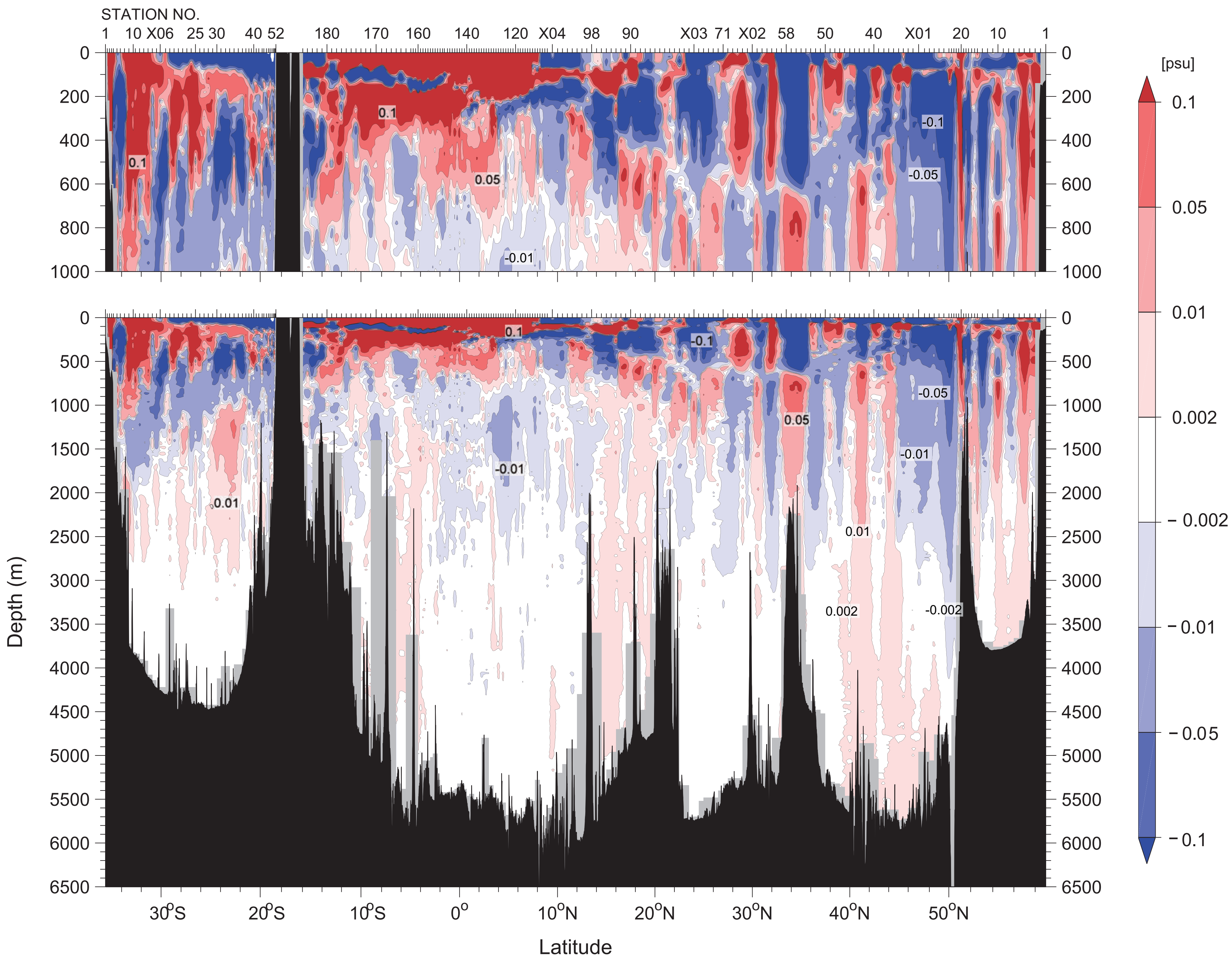


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
[°C]
1
0.1
0.01
0.002
− 0.002
− 0.01
− 0.1
− 1

Figure 27
Difference in salinity (psu) between results from WOCE and its revisit cruise the cruise
(a) WHP-P01

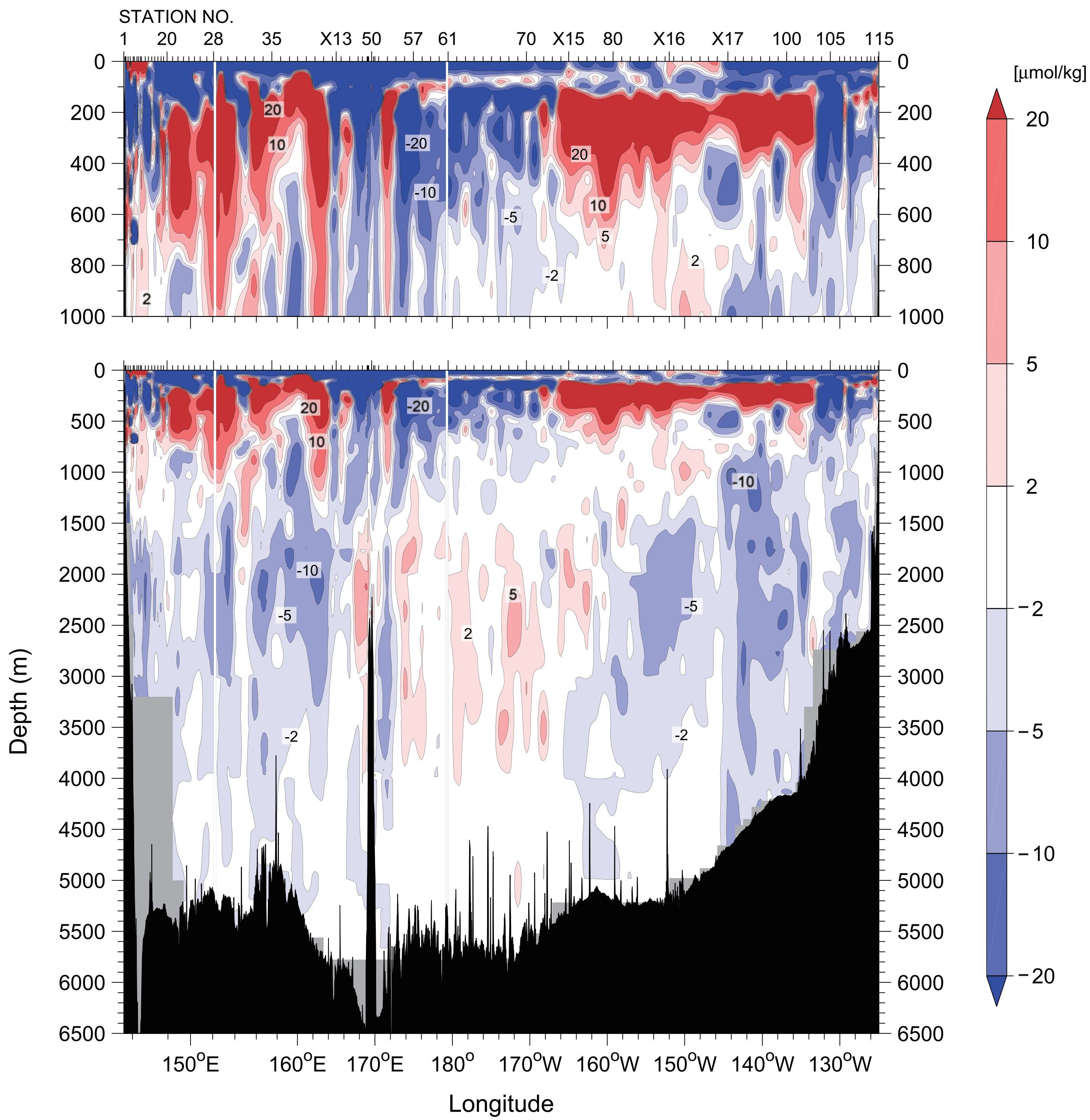


(b) WHP-P14

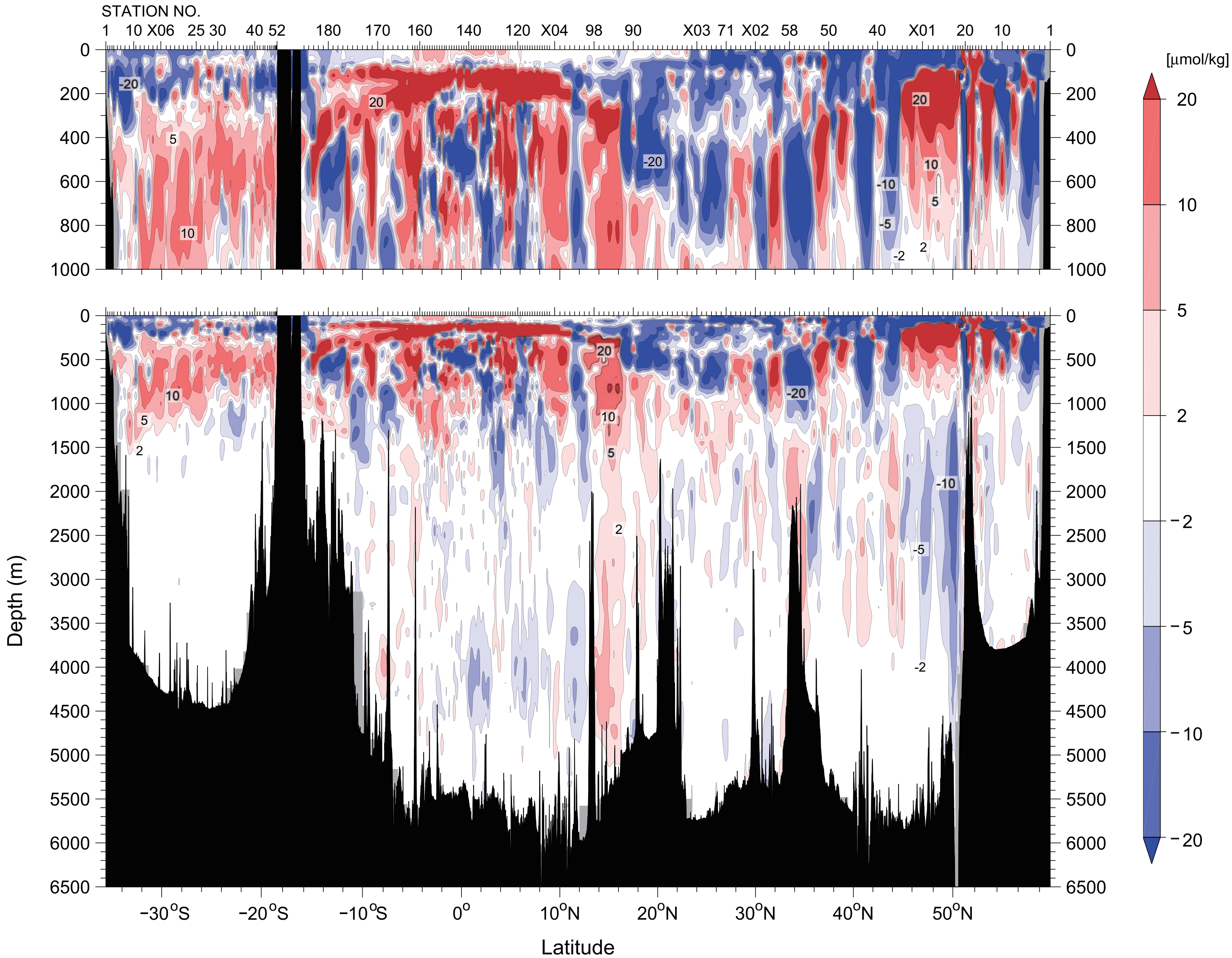


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
Depth (m)
Latitude
30°S 20°S 10°S 0° 10°N 20°N 30°N 40°N 50°N
[psu]
0.1
0.05
0.01
0.002
− 0.002
− 0.01
− 0.05
− 0.1

Figure 28
Difference in dissolved oxygen (µmol/kg) between results from WOCE and its revisit cruise the cruise
(a) WHP-P01



(b) WHP-P14


STATION NO.
1 10 X06 25 30 40 52 180 170 160 140 120 X04 98 90 X03 71 X02 58 50 40 X01 20 10 1
[µmol/kg]
20
10
5
2
-2
-5
-10
-20
Depth (m)
Latitude
-30°S -20°S -10°S 0° 10°N 20°N 30°N 40°N 50°N

Update of CTD oxygen data for the cruises MR07-04 and MR07-06

September 24, 2009

Hiroshi Uchida (JAMSTEC)

1. Introduction

The CTD oxygen data were updated after the data book was published by Kawano et al. (2009). In the data book, data from two oxygen optode sensors (Oxygen Optode 3830; Aanderaa Data Instruments AS, Bergen, Norway, and RINKO; JFE Alec Co. Ltd., Kobe, Japan) were combined and used because data quality of the SBE 43 oxygen sensor was relatively bad (Kawano et al., 2009) for the cruise MR07-04. Data from the two oxygen optode sensors were combined because the Optode 3830 had a slow time response without pressure hysteresis and the RINKO had a fast time response with pressure hysteresis. The time-dependent, pressure-induced effect (pressure hysteresis) on the sensing foil of the RINKO was similarly observed in the SBE 43 data. Recently, a correction method of the pressure hysteresis was developed for the SBE 43 (Sea-Bird Electronics, 2009), and the correction method was successfully applied to the RINKO (Murata, 2009). Therefore, the RINKO data were reprocessed, calibrated, and used as the CTD oxygen data for the cruises MR07-04 and MR07-06.

2. Data processing

The RINKO data were reprocessed from the raw data. The time-dependent, pressure-induced effect (pressure hysteresis) of the RINKO was corrected for both profile and bottle data by using RINKOCOR (original module, version 1.0) and RINKOCORROS (original module, version 1.0) after the module TCORP. The calibration coefficients, H1 (amplitude of hysteresis correction), H2 (curvature function for hysteresis), and H3 (time constant for hysteresis) were determined empirically as:

H1 = 0.0065 for the RINKO prototype I with the foil A or C
H1 = 0.0055 for the RINKO prototype I with the foil B or prototype II with the foil D
H1 = 0.0060 for the RINKO prototype II with the foil C
H2 = 5000 dbar
H3 = 2000 seconds.

Type of the prototype and foil is listed in Table 1. Data from the RINKO sensors are systematically delayed with respect to depth because of the slow response time compared with the CTD sensors. This delay was compensated by 1 second advancing sensor output (voltage) relative to the CTD temperature data by using the SEASOFT module ALIGNCTD. To remove spikes of the data, the process of the DESPIKE was also performed for the RINKO data. The rest of the data processing was not changed from the data book (Kawano et al., 2009).

Table 1. Type of the prototype and foil used in the cruises.

Cruise	RINKO	Foil	Note
MR07-04	Prototype I (UV LED)	A	
MR07-06_1	Prototype I	B	
MR07-06_2	Prototype I	C	Stations from P14N_109_2 to P14N_175_1
	Prototype II (Green LED)	D	Stations from P14N_176_1 to P14N_185_1
	Prototype II	C	Stations from P14C_48_1 to P14C_1_1

3. Post-cruise calibration

The pressure-hysteresis corrected RINKO data was calibrated by the Stern-Volmer equation, basically according to a method by Uchida et al. (2008) with slight modification:

$$[O_2]\ (\mu mol/l) = (V_0 / V - 1) / K_{sv}$$

and

$$K_{sv} = C_0 + C_1 \times T + C_2 \times T^2$$

$$V_0 = 1 + C_3 \times T$$

$$V = C_4 + C_5 \times V_b + C_6 \times t + C_7 \times t \times V_b$$

where V_b is the RINKO output (voltage), V_0 is voltage in the absence of oxygen, T is temperature (°C), and t is time (days). The V_0 and V are normalized by the phase shift in the absence of oxygen at 0°C, and the time drift of the RINKO output was corrected. The oxygen concentration is calculated by using the in situ calibrated CTD temperature data. The pressure-compensated oxygen concentration $[O_{2c}]$ can be calculated as follows.

$$[O_{2c}] = O_2\ (1 + C_p p / 1000)$$

or

$$[O_{2c}] = O_2\ (1 + C_p p / 1000)^{1/3}$$

where p is CTD pressure (dbar) and C_p is the compensation coefficient. Since the sensing foil of the optode is permeable only to gas and not to water, the optode oxygen must be corrected for salinity. The salinity-compensated oxygen can be calculated by multiplying the factor of the effect of salt on the oxygen solubility (García and Gordon, 1992). García and Gordon (1992) have recommended the use of the solubility coefficients derived from the data of Benson and Krause.

The pressure-compensation coefficient (C_p) and the coefficient for the V_0 (C_3) were empirically estimated in advance except for the C_p for the cruise MR07-06 leg 1 (Table 2). The C_p for the cruise MR07-06 leg 1 was determined simultaneously with the remaining coefficients. The remaining seven coefficients (C_0, C_1, C_2, C_4, C_5, C_6, and C_7) were determined by minimizing the sum of absolute deviation with a weight from the bottle oxygen data. The revised quasi-Newton method (the FORTRAN subroutine DMINF1 from the Scientific Subroutine Library II, Fujitsu Ltd., Kanagawa, Japan) was used to determine the sets. The weight was given as a function of pressure as:

$$\text{Weight} = \min[10, \exp\{\log(10) \times P / PR\}]$$

where PR is threshold of the pressure (950 dbar).

The post-cruise calibrated temperature and salinity data were used for the calibration. The coefficients were determined for some groups of the CTD stations. The calibration coefficients are listed in Table 3. The results of the post-cruise calibration for the RINKO oxygen are summarized in Table 4 and shown in Figs. 1, 2, and 3.

References

García, H. E. and L. I. Gordon (1992): Oxygen solubility in seawater: Better fitting equations. *Limnol. Oceanogr.*, 37 (6), 1307–1312.

Kawano, T., H. Uchida and T. Doi (2009): WHP P01, P14 REVISIT DATA BOOK, 212 pp., JAMSTEC, Yokosuka, Japan.

Murata, A. (Ed.) (2009): R/V Mirai Cruise Report, MR09-01, JAMSTEC, Yokosuka, Japan.

Sea-Bird Electronics (2009): SBE 43 dissolved oxygen (DO) sensor – hysteresis corrections, Application note no. 64-3, 7 pp.

Uchida, H., T. Kawano, I. Kaneko, and M. Fukasawa (2008): In situ calibration of optode-based oxygen sensors, *J. Atmos. Oceanic Technol.*, 25, 2271–2281.

Table 2. Calibration coefficients for the V_0 (C_3) and for the pressure-compensation equation (C_p). The pressure-compensation equation is also shown.

Groups	C_3	C_p	Pressure-compensation equation
01–06	–0.0022	0.109	$O_2 (1 + C_p p / 1000)^{1/3}$
07	–0.0028	0.055	$O_2 (1 + C_p p / 1000)$
08	–0.0028	0.056	$O_2 (1 + C_p p / 1000)$
09	–0.0028	0.057	$O_2 (1 + C_p p / 1000)$
10–11	–0.0028	0.055	$O_2 (1 + C_p p / 1000)$
12	–0.0028	0.054	$O_2 (1 + C_p p / 1000)$
13	–0.0028	0.053	$O_2 (1 + C_p p / 1000)$
14–15	–0.0028	0.054	$O_2 (1 + C_p p / 1000)$
16	–0.0028	0.053	$O_2 (1 + C_p p / 1000)$
17	–0.0028	0.051	$O_2 (1 + C_p p / 1000)$
18	–0.0028	0.056	$O_2 (1 + C_p p / 1000)$
19	–0.0028	0.055	$O_2 (1 + C_p p / 1000)$
20	–0.0028	0.057	$O_2 (1 + C_p p / 1000)$
21	–0.0028	0.056	$O_2 (1 + C_p p / 1000)$
22	–0.0028	0.058	$O_2 (1 + C_p p / 1000)$
23–41	–0.0021	0.100	$O_2 (1 + C_p p / 1000)^{1/3}$
42	–0.0024	0.066	$O_2 (1 + C_p p / 1000)$
43–45	–0.0021	0.100	$O_2 (1 + C_p p / 1000)^{1/3}$

Group of CTD stations 01: P01_1_1–P01_18_1, 02: P01_19_1–P01_21_1, 03: P01_22_1–P01_26_1, 04: P01_27_1–P01_29_1, 05: P01_40_1–P01_44_1, 06: P01_58_2–P01_115_1, 07: P01_28_2, 08: P01_29_2–P01_30_1, 09: P01_32_1–P01_31_1, 10: P01_33_1–P01_35_1, 11: P01_36_1–P01_37_1, 12: P01_38_1–P01_43_1, 13: P01_44_2–P01_46_1, 14: P01_47_1–P01_55_1, 15: P01_56_1–P01_61_2, 16: P14N_29_1–P14N_16_1, 17: P14N_15_1–P14N_5_1, 18: P14N_1_1–P14N_4_1, 19: P14N_30_1–P14N_49_1, 20: P14N_50_1–P14N_63_1, 21: P14N_64_1–P14N_73_1, 22: P14N_74_1–P14N_109_1, 23: P14N_109_2–P14N_110_1, 24: P14N_111_1–P14N_112_1, 25: P14N_113_1–P14N_115_1, 26: P14N_116_1–P14N_118_1, 27: P14N_119_1–P14N_120_1, 28: P14N_121_1–P14N_122_1, 29: P14N_123_1–P14N_124_1, 30: P14N_125_1–P14N_126_1, 31: P14N_127_1–P14N_130_1, 32: P14N_131_1–P14N_135_1, 33: P14N_136_1–P14N_141_1, 34: P14N_142_1–P14N_144_1, 35: P14N_145_1–P14N_147_1, 36: P14N_148_1–P14N_149_1, 37: P14N_150_1–P14N_154_1, 38: P14N_155_1–P14N_160_1, 39: P14N_161_1–P14N_164_1, 40: P14N_165_1–P14N_170_1, 41: P14N_171_1–P14N_175_1, 42: P14N_176_1–P14N_185_1, 43: P14C_48_1–P14C_49_1, 44: P14C_52_1–P14C_19_1, 45: P14C_18_1–P14C_1_1

Table 3. Calibration coefficients for the RINKO oxygen sensors. The group of the CTD stations is same as that shown in Table 2.

Group	C_0	C_1	C_2	C_4	C_5	C_6	C_7
MR07-04							
01	5.78769e–3	1.88171e–4	5.21610e–6	–0.229888	0.254955	–2.43960e–3	1.74806e–3
02	5.76112e–3	2.05112e–4	4.20869e–6	–0.247620	0.261781	2.66538e–3	–1.91261e–4
03	5.58601e–3	1.94710e–4	3.60579e–6	–0.212837	0.254295	–2.82424e–3	1.37946e–3
04	5.52573e–3	2.53171e–4	–9.45815e–7	–0.171401	0.242433	–8.92725e–3	3.03414e–3
05	5.50404e–3	1.54503e–4	6.20130e–6	–0.151539	0.241621	–4.59826e–3	1.44984e–3
06	5.33007e–3	1.84105e–4	3.53496e–6	–0.211406	0.257880	–9.26535e–4	5.21621e–4
MR07-06 leg 1							
07	6.55224e–3	2.12959e–4	7.32523e–6	–0.408829	0.281951	0.00000	0.00000
08	6.45822e–3	2.14475e–4	6.35186e–6	–0.417754	0.283925	1.81734e–2	–2.32210e–3
09	6.30664e–3	1.19267e–4	1.02338e–5	–0.374523	0.274294	–1.66424e–3	3.47136e–3
10	6.29642e–3	1.30131e–4	1.20613e–5	–0.402078	0.283497	7.75298e–3	–8.98322e–5
11	6.40532e–3	–6.71557e–6	2.64522e–5	–0.367286	0.275724	-4.93850e–3	2.98357e–3
12	6.05874e–3	9.93107e–5	1.32774e–5	–0.372592	0.278740	2.17949e–3	1.09013e–3
13	6.03637e–3	8.01334e–5	1.58469e–5	–0.380144	0.285135	3.33545e–3	9.87750e–5
14	5.94341e–3	8.92774e–5	1.27029e–5	–0.354093	0.276789	6.36922e–4	1.12659e–3
15	6.01971e–3	1.30065e–4	1.09592e–5	–0.344272	0.277559	–1.21930e–3	1.10575e–3
16	5.85814e–3	1.51238e–4	8.52212e–6	–0.360336	0.280217	9.57900e–4	7.46866e–4
17	5.76211e–3	2.02794e–4	7.38395e–6	–0.366150	0.286581	5.09066e–4	5.41219e–4
18	5.87643e–3	1.30110e–4	1.47536e–5	–0.237946	0.233457	–6.75607e–3	3.56108e–3
19	5.71949e–3	1.68597e–4	5.73708e–6	–0.347475	0.284820	3.14416e–4	4.89874e–4
20	5.70894e–3	1.87827e–4	4.02373e–6	–0.366959	0.293059	1.27735e–3	1.13690e–4
21	5.80033e–3	1.95761e–4	4.35824e–6	–0.375413	0.302121	1.28422e–3	–1.60368e–4
22	5.76787e–3	1.80175e–4	4.38162e–6	–0.352233	0.298371	7.66105e–4	–8.16506e–5
MR07-06 leg 2							
23	5.44937e–3	1.65251e–4	2.76961e–6	–0.199505	0.239278	3.09346e–3	4.15719e–3
24	5.54177e–3	1.61531e–4	3.18336e–6	–0.228340	0.249132	1.83265e–2	–2.15387e–3
25	5.42048e–3	1.83287e–4	2.07555e–6	–0.192462	0.241038	–4.07720e–4	2.49626e–3
26	5.45889e–3	1.64536e–4	2.88640e–6	–0.192265	0.243283	–1.88936e–3	2.06094e–3
27	5.35393e–3	1.60876e–4	2.80193e–6	–0.138462	0.225840	–1.67471e–2	7.32406e–3
28	5.38960e–3	1.85479e–4	2.07045e–6	–0.213034	0.253068	4.39692e–3	–6.93024e–4
29	4.91234e–3	1.69346e–4	1.34107e–6	–0.138257	0.236248	–7.47363e–3	3.11840e–3
30	5.29710e–3	1.86796e–4	1.85766e–6	–0.190758	0.248364	–7.30369e–4	7.20446e–4
31	5.29129e–3	1.84807e–4	2.06747e–6	–0.197598	0.249238	–1.06270e–4	8.01728e–4
32	5.35606e–3	1.85394e–4	2.29483e–6	–0.188360	0.247306	–2.34961e–3	1.19205e–3
33	5.23672e–3	1.76559e–4	2.52414e–6	–0.195684	0.252713	–1.02750e–3	5.84364e–4
34	5.36437e–3	1.71687e–4	3.34220e–6	–0.287883	0.282532	7.97539e–3	–2.50022e–3
35	5.07284e–3	1.80971e–4	2.12433e–6	–0.238973	0.284333	3.72564e–3	–2.43784e–3
36	5.16377e–3	1.77869e–4	2.70794e–6	–0.209220	0.246022	1.93576e–4	1.20839e–3
37	5.18307e–3	1.78043e–4	2.97573e–6	–0.238163	0.274864	2.18383e–3	–1.17744e–3

38	5.18550e–3	1.72648e–4	3.33928e–6	–0.224989	0.271406	6.54311e–4	–6.88668e–4
39	4.73947e–3	1.70534e–4	2.09447e–6	–0.237428	0.284716	3.34250e–3	–1.69718e–3
40	4.53781e–3	1.65093e–4	1.75764e–6	–0.113741	0.233677	–4.24469e–3	1.73284e–3
41	4.60581e–3	1.62495e–4	2.23853e–6	–0.179177	0.254948	–5.72044e–4	4.97947e–4
42	3.51665e–3	1.16255e–4	2.37582e–6	–0.413749	0.300233	–3.24861e–3	1.34826e–3
43	4.24252e–3	1.22672e–4	3.09423e–6	0.122545	0.051831	–3.05446e–2	1.20623e–2
44	3.77773e–3	1.20741e–4	2.44550e–6	–0.507127	0.309672	4.31407e–4	–1.68904e–4
45	3.40682e–3	1.16962e–4	1.79879e–6	–0.529886	0.325479	1.74046e–3	–6.22456e–4

Table 4. Difference between the RINKO oxygen and the bottle oxygen after the post-cruise calibration. Mean and standard deviation (Sdev) are calculated for the data below and above 950 dbar. Number of data used is also shown.

Cruise	Pressure ≥ 950 dbar			Pressure < 950 dbar		
	Number	Mean (μmol/kg)	Sdev (μmol/kg)	Number	Mean (μmol/kg)	Sdev (μmol/kg)
MR07-04	1510	–0.01	0.22	1118	0.25	2.70
MR07-06_1	2698	–0.01	0.18	1876	–0.07	1.31
MR07-06_2	2095	–0.00	0.24	1642	–0.01	1.03

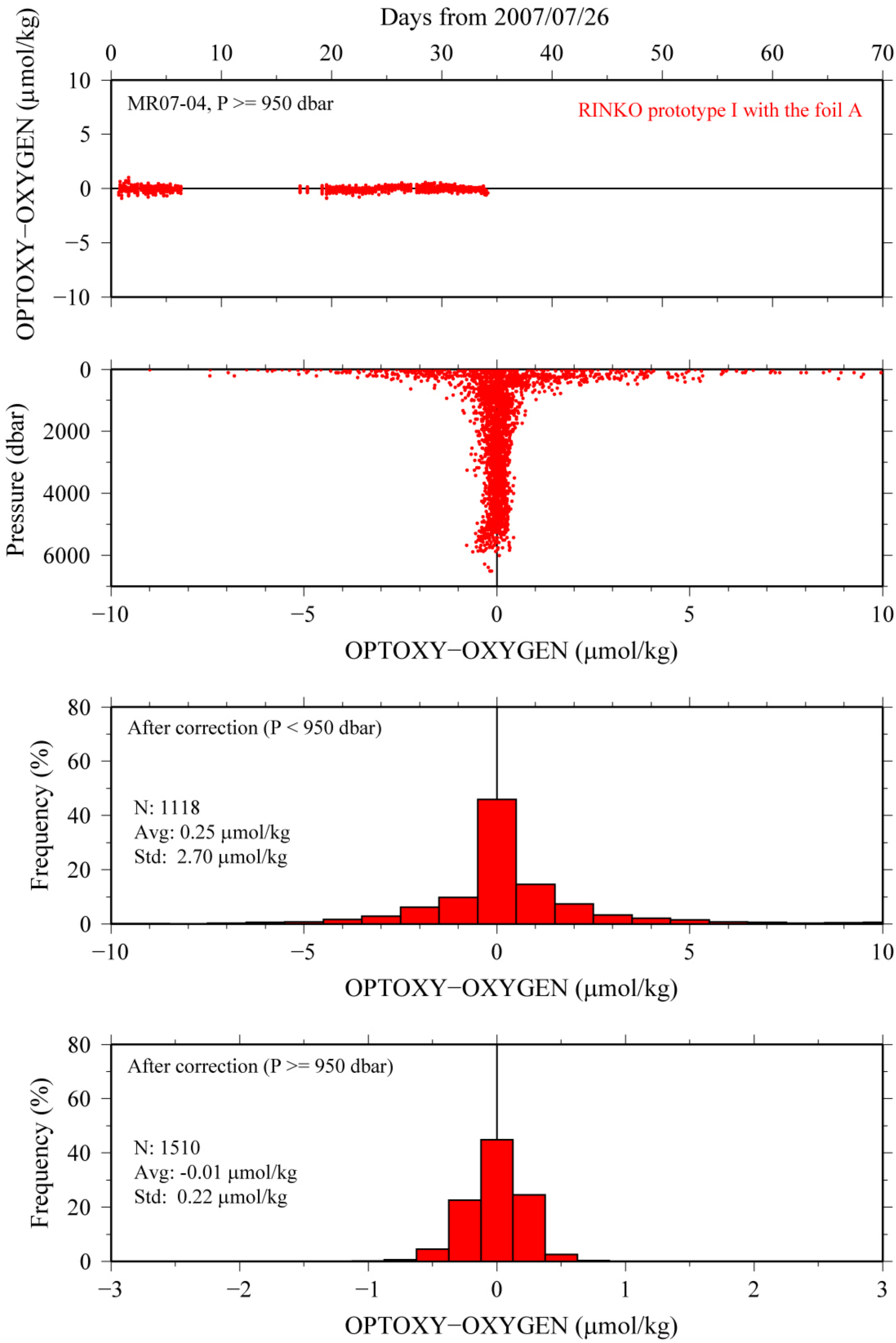


Figure 1. Difference between the RINKO oxygen and the bottle oxygen after the post-cruise calibration for the cruise MR07-04. Lower two panels show histogram of the difference.

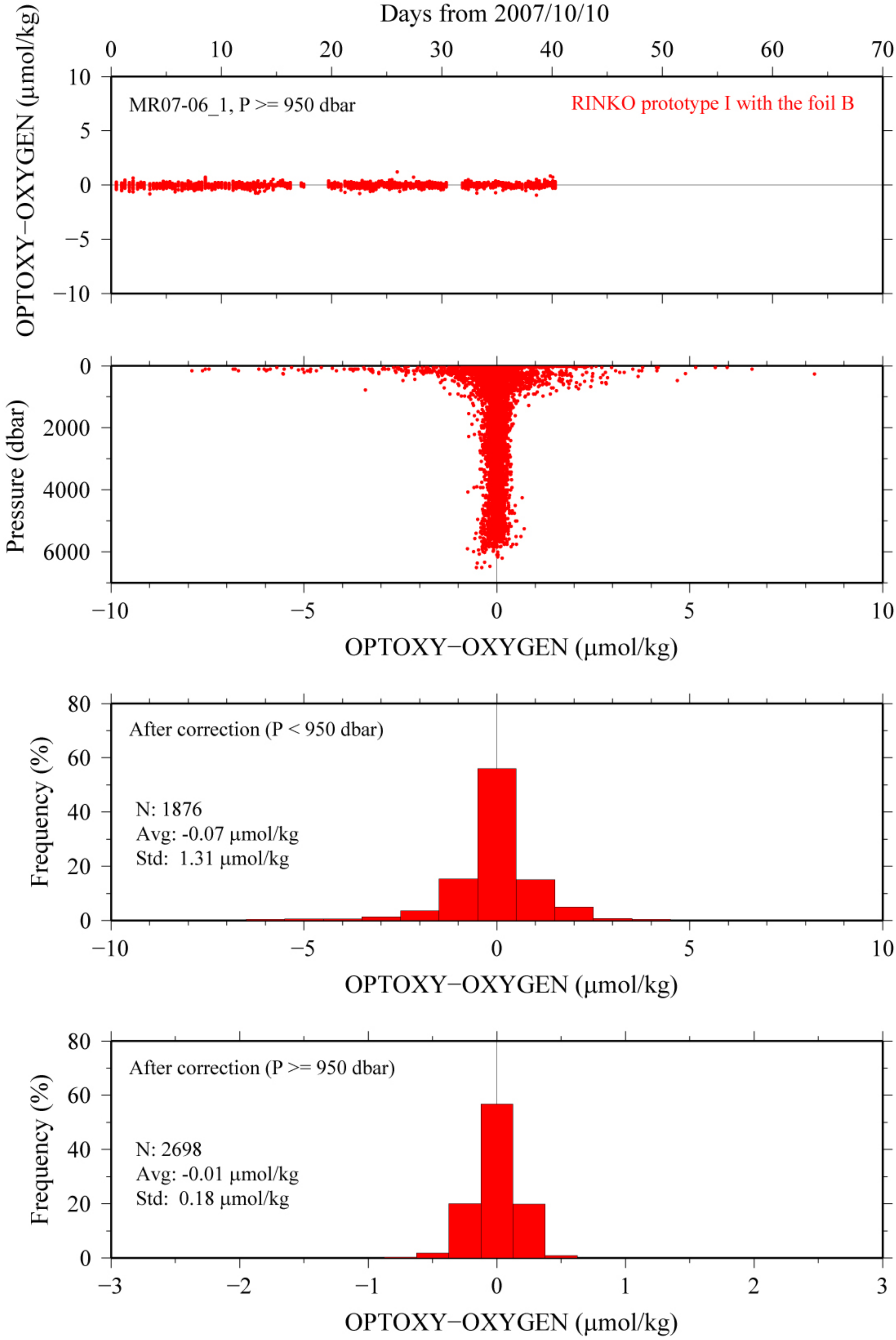


Figure 2. Same as Fig. 1, except for the cruise MR07-06 leg 1.

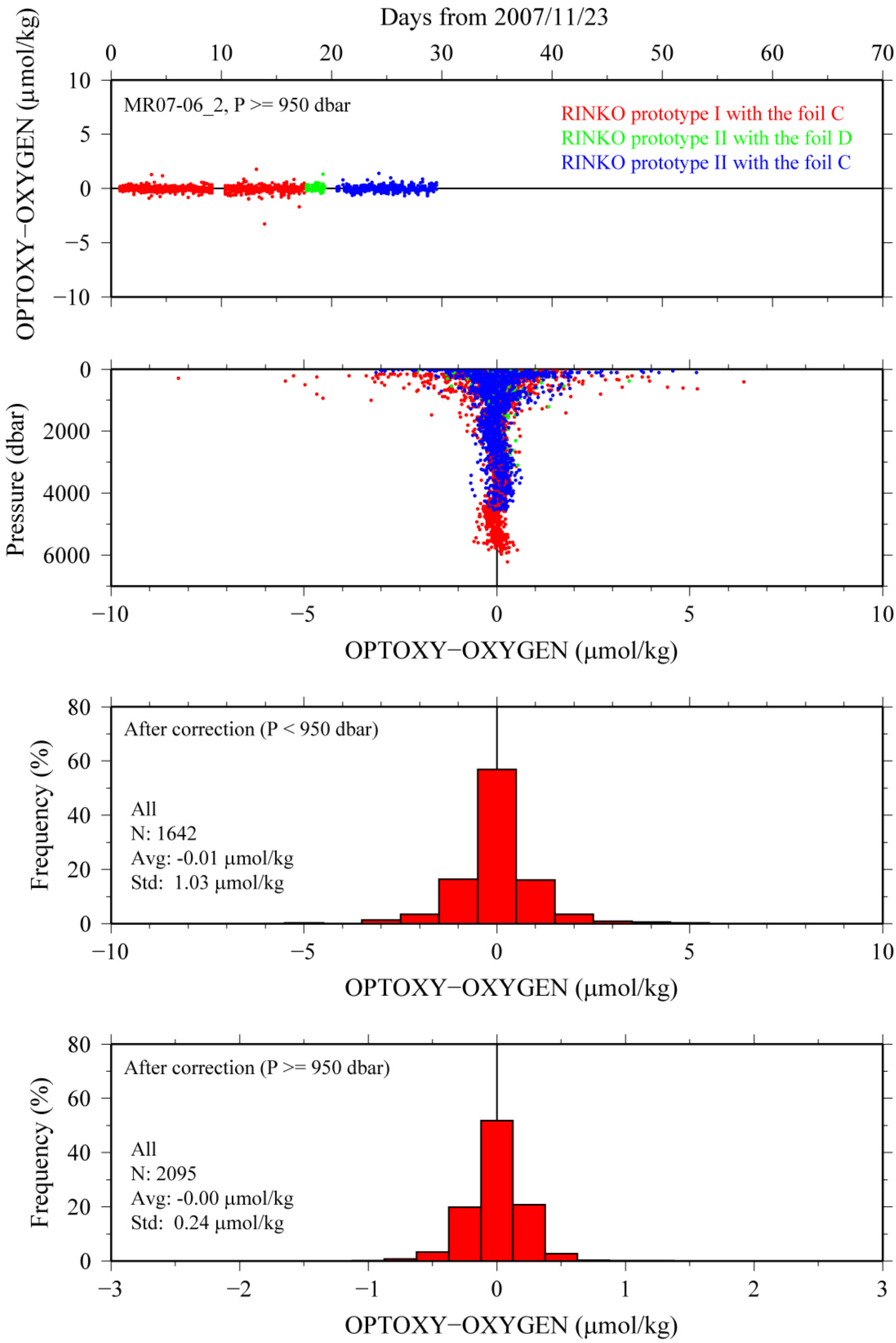


Figure 3. Same as Fig. 1, except for the cruise MR07-06 leg 2.