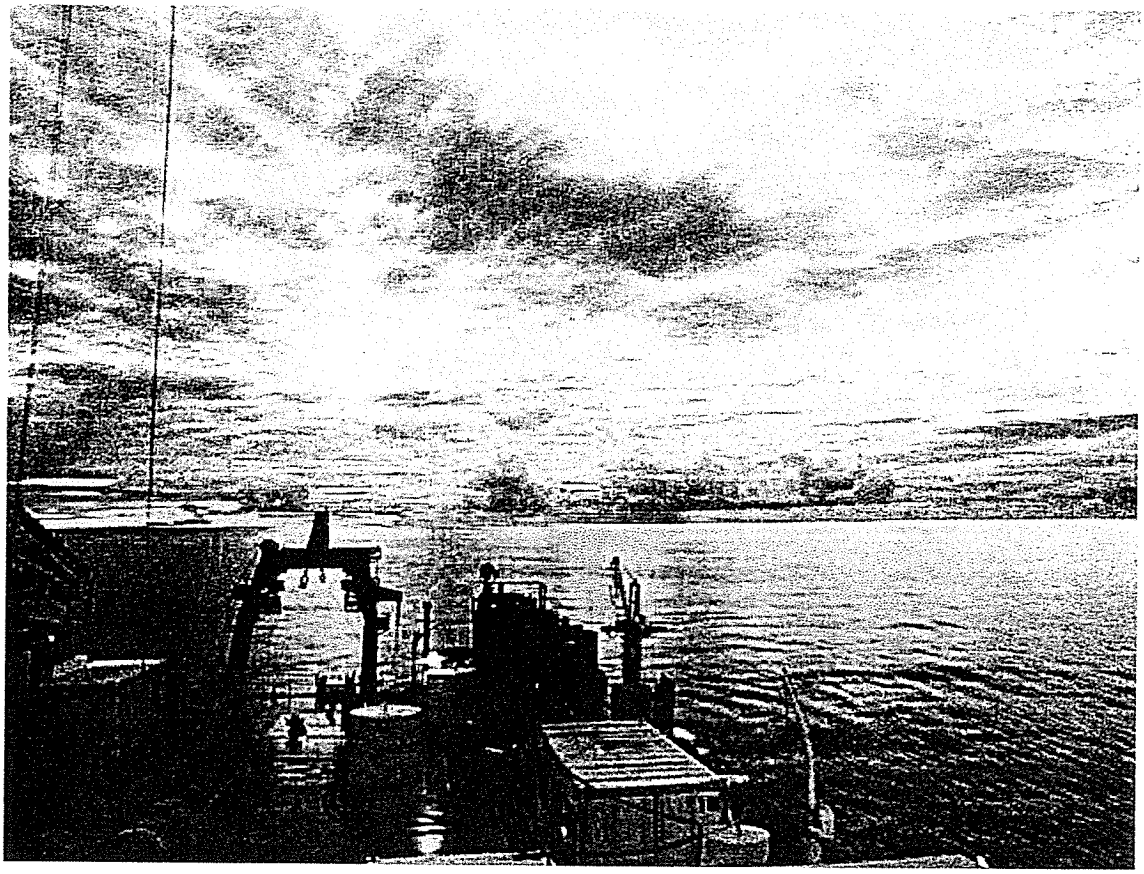
doi : 10.17596/0003713

Cruise Report

TOCS KY99-09



Sunset at the Mindanao sea

20.Oct.'99 ~ 23.Nov.'99

JAMSTEC

TOCS KY99-09 Cruise Report

1. Cruise Summary

1. Cruise Summary

Ship	: R/V KAIYO
Chief Investigator	: Yuji Kashino (JAMSTEC)
Co-Chief Investigator	: Rahadian (BPPT)
Cruise Code	: KY99-09
Project Title	: Tropical Ocean Climate Study
Period	: October 20, 1999 – November 23, 1999
Ports of call	: Koror (Republic of Palau)
	Kavieng (Papua New Guinea)
Institute	: JAMSTEC (Japan Marine Science and Technology Center)
	BPPT (Badan Pengkajian dan Penerapan Teknologi)
	University of Hawaii
	PMEL (Pacific Marine Environmental Laboratory)
	University of Philippines
	MWJ (Marine Work Japan Co. LTD)
	NME (Nippon Marine Enterprise Co. LTD)
	KEEC (Kansai Environmental Engineering Center Co.LTD)

Purpose: The purpose of this cruise is to observe currents, temperature, salinity etc., in the western equatorial Pacific to understand the ENSO (El Nino/Southern Oscillation) phenomena. Because El Nino is occurred with migration of the warm water pool in the western equatorial Pacific, variability of the warm water pool is focused in this study. Additionally, a sea water flow from the Pacific to the Indian Ocean in the Indonesian Seas, i.e., the Indonesian Throughflow is also focused because this flow might be related to the warm water pool variability.

Observation Summery :

(Leg 1)

A current meter buoy, which was deployed during KY99-01 cruise, was recovered at 5-07N, 125-40E (Philippines EEZ).

An ADCP buoy was deployed at 6-48N, 126-42E (Philippines EEZ).

72 CTD casts using SBE 911 plus CTD and Sontek Lowered ADCP were performed to measure vertical profiles of temperature, salinity and current until 2000m depth

Sea water at 2000m depth were sampled by Niskin bottles at 36 CTD casts to check

CTD salinity.

7 XCTDs were deployed at CTD casts to check XCTD performance.

Current along the cruise track was measured by a shipboard ADCP.

CO2 concentration in air and sea water was measured along the cruise track by KEEC.

These observations were conducted in the open sea, Palau EEZ, Philippines EEZ, and Indonesian EEZ.

(Leg 2)

Following buoy work were performed:

ADCP buoys: Recovery and deployment at 0N,138E, 2-30S,142E and 0N,147E

One current meter provided by Ocean Research Institute (ORI, Tokyo Univ.) was installed in these moorings at 700m depth at these sites.

One current meter of ORI was recovered at 0N, 138E and 0N, 147E.

Four current meters of Kiel University were recovered at 2-30S, 142E.

ATLAS buoys: Recovery at 2.4N, 137.5E, 0N, 147E and 5N, 147E

5 CTD and 50 XCTD casts were performed until 1000m depth. At all CTD casts, Niskin bottles were used to get water sample for salinity measurement.

13 XCTDs were successively deployed during CTD cast at 2.4N, 137.5E for XCTD performance test.

Current along the cruise track was measured by a shipboard ADCP.

CO2 concentration in air and sea water was measured along the cruise track by KEEC.

These observation were conducted in the open sea, Papua New Guinea EEZ, Micronesia EEZ, Indonesian EEZ and Palau EEZ.

Preliminary Results

During this cruise, La Nina seems continuing although it was week comparing during last Kaiyo cruise (KY99-01, February 1999). Sea surface temperature in the Philippine Sea is over 30°C and strong westward current (South Equatorial Current) with speed of ~1.5 knot was observed along the equator. In contrast, sea surface

salinity was low west of 135E (~33.5PSU). It might be due to large precipitation associating with this high SST.

During Leg 1 cruise, since weather was very good and sea state was also very quiet, we can successfully conduct observation along 7N, where we gave up observation during KY99-01. Regarding mooring work, we recovered the current meter mooring at the axis of the Mindanao Current (south of Mindanao). And also we deployed the ADCP mooring east of Mindanao, where is steep topography. Lowered ADCP, which did not work during KY99-01, work well until the end of this leg. Because we could conduct observation smoothly and ship time expected to be remained, we conducted bottom topography survey at 2N and 5N, 130E, where TRITON Buoys will be deployed. Furthermore, XCTD casts after Station #60 were changed to CTD casts. Thus, Leg 1 cruise was conducted perfectly and R/V Kaiyo arrived at Palau one day earlier than plan.

Only a problem during Leg 1 was CTD winch trouble. Because the shifter of the winch seems not good, wire could not be rolled regularly at the edge of reel. But this problem was not serious because the winch operators mastered its operation without stopping winch until the end of this leg. This problem was not fixed during Leg 2.

On the other hand, we met some troubles concerning Leg 2 cruise. Since we had a plan of entering Papua New Guinea EEZ, we submitted our cruise plan to Papua New Guinea. Although we received the clearance from Papua New Guinea on September 28, this clearance notification says that two scientists from Papua New Guinea will participate in this cruise. However, we had never received any information regarding the participants from Papua New Guinea just until the end of Leg 1. (If we had not received it until Leg 2 cruise, Kaiyo cannot departure from Palau !!) We strongly hope quick response from the countries issuing clearance such as Papua New Guinea.

Weather was not good at the beginning of the Leg 2 cruise (135E line), but it was not serious because we conducted only XCTD observation during that period. After this line, weather became good.

Next, connector of CTD (SBE 16) used for measurement of sea surface temperature and salinity which is needed for CO2 analysis was broken on Nov.9. Replace for it, we used another SBE 16 which is spare for ADCP moorings.

Leg 2 is basically buoy maintenance cruise: we replaced three ADCP buoys and recovered three ATLAS buoys. We also met problems during these buoy works. Most serious one is lost of an acoustic releaser at 0N, 138E. We use two acoustic releasers for ADCP buoys in vertical series. At 0N, 138E, lower one (Benthos, S/N 665) did not respond to enable and release commands from Kaiyo. We tried to send commands to

this releaser many times changing ship location, transducer and on board unit, however, it failed. Therefore, we released this mooring at the upper one and gave up recovering the lower one. We do not still know why this releaser did not work.

We found that the wind sensor of the ATLAS buoy at 2N, 137E was lost and its tower was a little broken. Fisherman boat was probably moored at this buoy.

In order to measure temperature and salinity profile, we mainly used TSK – XCTD during Leg 2. However, XCTD's wire was cut 8 times. (Totally, we deployed 70 XCTDs.) Furthermore, strange profiles were acquired two times. We asked XCTD maker (Tsurumi Seiki Co Ltd.) to check this matter.

In spite of above troubles, R/V Kaiyo arrived at Kavieng one day earlier than plan because they are not serious problem. In particular, mooring works except for lost of the releaser did very well. We successfully got data from all of moored instruments.

Although we do not analysis data during cruise, some interesting results are obtained. For example, current and pressure time series from current meters deployed south of Mindanao shows large tidal signal with period of 15 days. Averaged velocity at 160m depth is about 80 cm/sec. Because no time series observation at the Mindanao Current, these information are probably very important for understanding of the Mindanao Current and Indonesian Throughflow.

Direct current measurement by shipboard and Lowered ADCPs also gives interesting results. In particular, complicate current pattern in the Philippine Sea becomes clear not only at surface/subsurface layer but also intermediate layer.

Thus, we can say that TOCS KY99-09 cruise finished successfully.

Acknowledgments:

We would like to express special thanks to Captain O. Yukawa and crew of R/V Kaiyo. During the cruise, technicians of Marine Work Japan Co. Ltd. and Nihon Marine Enterprise Co. Ltd., participated in this cruise and helpfully supported us.

This cruise was a joint cruise by Japan Marine Science and Technology Center (JAMSTEC), Japan, and Badan Pengkajian Dan Penerapan Teknologi (BPPT), Indonesia, under the Tropical Ocean Climate Study (TOCS) project. We thank our colleagues in JAMSTEC and BPPT for their efforts in conducting this cruise.

To get the clearances from Indonesia, Micronesia, Papua New Guinea, Philippines and Republic of Palau, many persons in these countries and of Japanese Government worked. We would also like to say thanks for their works.

2. List of Instruments

2.List of Instruments

(1) CTD (Conductivity-Temperature-Depth profiler)

SBE9-11 plus system, Sea-Bird Electronics,Inc.,USA

CTD Fish for 10,500m	S/N 09P8010-0319
C-Sensor	S/N 041045 (Primary)
	S/N 041174 (Secondary)
T-Sensor	S/N 031462 (Primary)
	S/N 031465 (Secondary)
P-Sensor	S/N 41223

(2) Shipboard ADCP (Acoustic Doppler Current Profiler)

VM-75,RD Instruments,USA

(75kHz,16m bin length,Normal range 560m starting 30m depth)

(3) LADCP (Lowered Acoustic Doppler Current Profiler)

Sontek dual ADP-250 LADP System

S/N C117,C118

(4) Salinity

Guildline Autosal Model 8400B

(5) pCO2

The MRI CO2 Measuring System

3. Participants List

3. Participants List

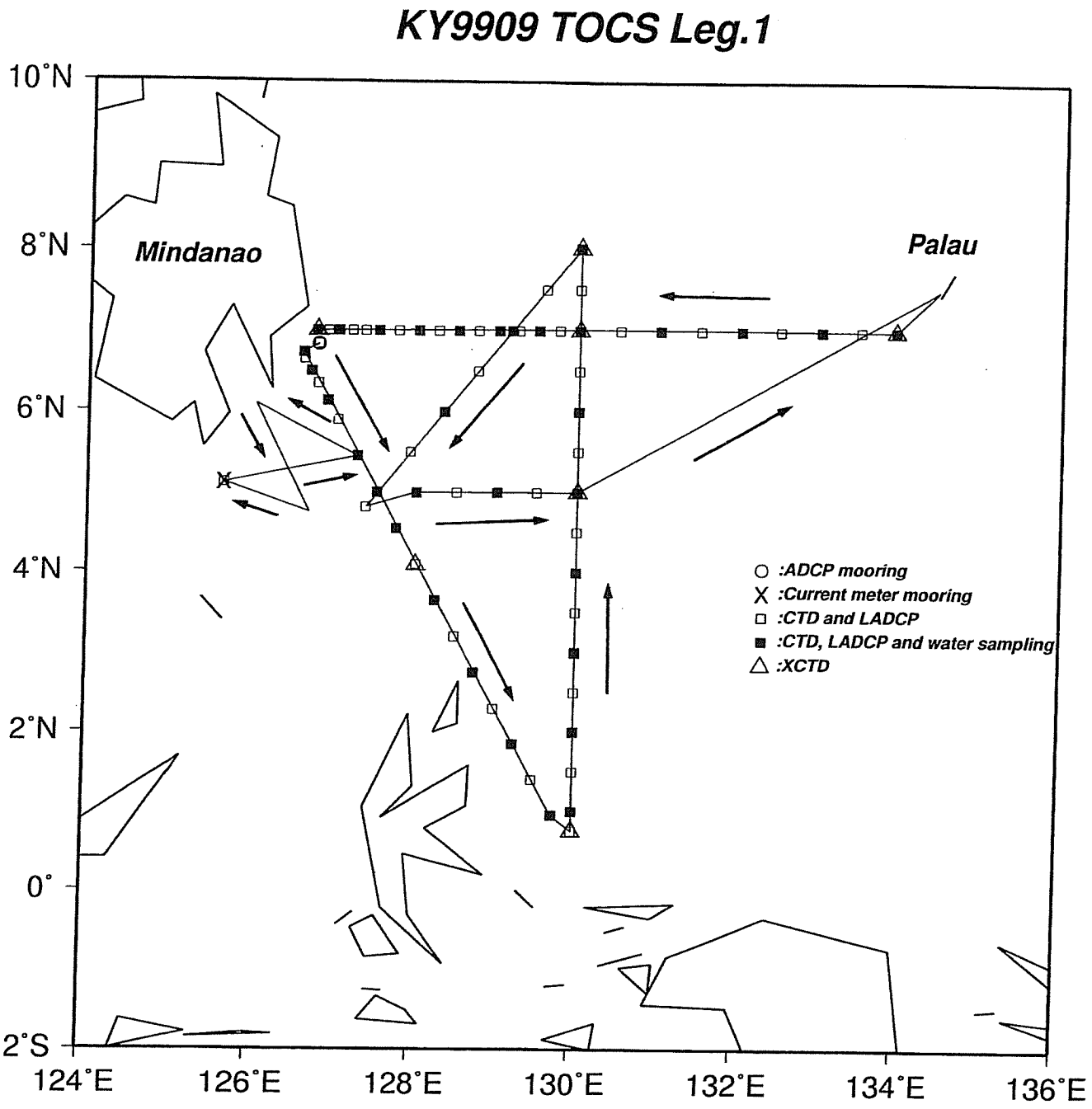
Yuji Kashino	Japan Marine Science and Technology Center (JAMSTEC) 2-15, Natsushima, Yokosuka, Kanagawa, 237 Japan Phone : +81-468-66-3811
Hideaki Hase	JAMSTEC
Satoru Kanda	Nippon Marine Enterprises, Ltd. (NME) 14-1, Ogawa-cho, Yokosuka, Kanagawa, 238 Japan Phone : +81-468-24-4611
Atuo Ito	Marine Works Japan Ltd. (MWJ) Live Pier Kanazawahakkei 3F 1-1-7, Mutsuura, Kanazawa-ku, yokohama, Kanagawa, 236 Japan Phone : +81-45-787-0041
Shinichiro Yokogawa	MWJ
Fuyuki Shibata	MWJ
Mikio Kitada	MWJ
Akira So	MWJ
Toru Idai	MWJ
Takashi Kitao	Kansai Environmental Engineering Center Co.,Ltd. 1-3-5,Azuchimachi,Chuo-Ku,Osaka,541-0052,Japan Phone : +81-6-6263-7314
Rahadian	Agency for the Assessment and Application of Technology Badan Pengkajian dan Penerapan Teknologi (BPPT) Baruna Jaya Technical Services Unit Building I, 18th Floor JI M.H.Thamrin N0.8 Jakarta 10340 Indonesia Phone : +62-21-316-8820

Antoni Wibowo	Agency for the Assessment and Application of Technology Badan Pengkajian dan Penerapan Teknologi (BPPT) Directorate of Technology for Natural Resources Inventory New Building, 19th Floor JI M.H.Thamrin N0.8 Jakarta 10340 Indonesia Phone : +62-21-316-9731
Sunar Widiyanto	Indonesia Navy / Hydrography JI.Pantai Kuta V/1 Jakarta Indonesia Phone : +62-21-684810 ext.3926
Mark P.Ablondi	Pacific Marine Enviromental Laboratry (PMEL) 7600 Sand Point Way Northeast Seatle, WA98115, U.S.A Phone : +1-206-526-6403
Eric Firing	Dept.of Oceanography Univ.of Hawaii 1000 Pope Road. Honolulu 96822, U.S.A Phone : +1-808-956-7894
Jaybee B.Udarbe	Marine Science Institute Univ. of the Philippines Diliman ,Quezon City 1101,Philippines Phone : +632-922-3959

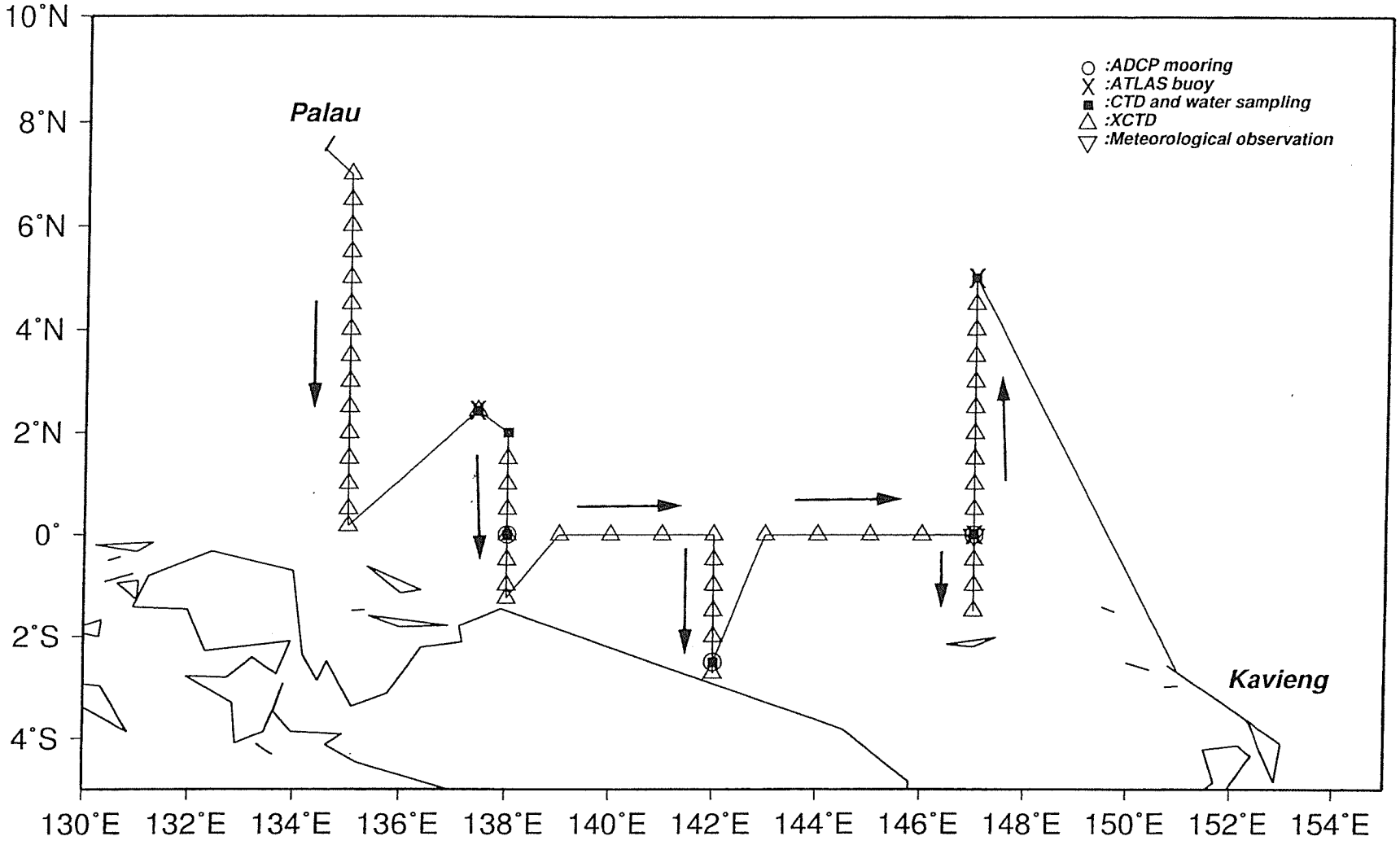
R / V KAIYO Crew Menbers

Captain	Osamu Yukawa
Cheif Officer	Toshinobu Miyata
Second Officer	Isao Maeda
	Takafumi Aoki
Third Officer	Shigeo Masuda
Cheif Engineer	Tatsuo Jidozono
First Engineer	Kimio Matsukawa
Second Engineer	Kazunori Noguchi / Kazuhiko Kaneda
Third Engineer	Masaya Sumida
Cheif Radio Officer	Masahiro Aimono
Second Radio Officer	Hidehiro Ito
Boatswain	Munemasa Konishi
Able Seaman	Tamotsu Otani
Able Seaman	Shoichi Abe
Able Seaman	Masatsugu Hamaoka
Able Seaman	Keiji Shikama
Able Seaman	Kazumi Ogasawara / Shuuji Takuno
Able Seaman	Yukito Fujimura / Tetsuji Mesuda
No.1 Oiler	Masaru Murao
Oiler	Masanori Shiino
Oiler	Tsuneo Harimoto
Oiler	Kazuo Abe
Oiler	Tomokazu Sasaki
Cheif Steward	Kaoru Takashima
Steward	Hidetoshi Kamata
Steward	Sueto Sasaki
Steward	Kazunori Nagano
Steward	Satoshi Kawata

4. Hydrographic Measurements


KY9909 TOCS Leg.1
10°N
8°N
6°N
4°N
2°N
0°
2°S
124°E
126°E
128°E
130°E
132°E
134°E
136°E
Mindanao
Palau
:ADCP mooring
:Current meter mooring
:CTD and LADCP
:CTD, LADCP and water sampling
:XCTD

KY9909 TOCS Leg.2



4.2 Casts Table

4.2.1 CTD

St.	Date	Time(GMT)	Latitude	Longitude
C01	20 Oct.'99	06:25	07° 00.098'N	133° 56.018'E
C02	20 Oct.'99	10:26	06° 59.915'N	133° 30.127'E
C03	20 Oct.'99	14:32	06° 59.840'N	132° 59.848'E
C04	20 Oct.'99	19:53	06° 59.771'N	132° 30.057'E
C05	20 Oct.'99	23:57	07° 00.021'N	131° 59.994'E
C06	21 Oct.'99	04:18	07° 00.119'N	131° 30.195'E
C07	21 Oct.'99	08:34	07° 00.164'N	131° 00.165'E
C08	21 Oct.'99	13:03	07° 00.034'N	130° 30.146'E
C09	21 Oct.'99	17:16	07° 00.048'N	130° 00.101'E
C10	21 Oct.'99	20:04	07° 00.109'N	129° 45.121'E
C11	21 Oct.'99	22:52	07° 00.017'N	129° 30.135'E
C12	22 Oct.'99	01:52	07° 00.125'N	129° 15.082'E
C13	22 Oct.'99	04:30	07° 00.044'N	129° 00.127'E
C14	22 Oct.'99	07:11	06° 59.976'N	128° 45.051'E
C15	22 Oct.'99	09:49	06° 59.976'N	128° 30.086'E
C16	22 Oct.'99	12:28	06° 59.886'N	128° 15.106'E
C17	22 Oct.'99	15:02	07° 00.866'N	128° 00.119'E
C18	22 Oct.'99	17:32	07° 00.934'N	127° 45.140'E
C19	22 Oct.'99	19:51	07° 00.017'N	127° 30.104'E
C20	22 Oct.'99	21:55	06° 59.940'N	127° 20.152'E
C21	22 Oct.'99	23:44	06° 59.978'N	127° 10.022'E
C22	22 Oct.'99	01:53	06° 59.614'N	126° 59.748'E
C23	23 Oct.'99	03:55	07° 00.191'N	126° 52.081'E
C24	23 Oct.'99	05:54	07° 00.516'N	126° 44.176'E
C25	24 Oct.'99	00:46	06° 48.385'N	126° 42.100'E
C26	24 Oct.'99	02:35	06° 48.878'N	126° 34.227'E
C27	24 Oct.'99	04:24	06° 39.565'N	126° 35.102'E
C28	24 Oct.'99	06:18	06° 30.490'N	126° 40.211'E
C29	24 Oct.'99	08:16	06° 21.479'N	126° 45.052'E
C30	24 Oct.'99	10:41	06° 08.528'N	126° 52.015'E
C31	24 Oct.'99	13:28	05° 54.682'N	127° 00.140'E
C32	24 Oct.'99	17:34	05° 27.073'N	127° 15.130'E
C33	26 Oct.'99	00:28	05° 07.320'N	125° 40.700'E
C34	26 Oct.'99	10:32	05° 26.966'N	127° 15.033'E
C35	26 Oct.'99	14:53	05° 00.105'N	127° 29.956'E
C36	26 Oct.'99	19:01	04° 33.108'N	127° 44.958'E
C37	26 Oct.'99	23:20	04° 05.963'N	128° 00.016'E
C38	27 Oct.'99	03:25	03° 38.986'N	128° 15.015'E
C39	27 Oct.'99	06:43	03° 12.054'N	128° 29.987'E
C40	27 Oct.'99	10:35	02° 44.992'N	128° 44.984'E
C41	27 Oct.'99	15:07	02° 18.074'N	129° 00.066'E
C42	27 Oct.'99	19:32	01° 51.174'N	129° 14.887'E
C43	27 Oct.'99	23:39	01° 24.004'N	129° 29.951'E

St.	Date	Time(GMT)	Latitude	Longitude
C44	28 Oct.'99	03:23	00° 56.911'N	129° 45.035'E
C45	28 Oct.'99	06:11	00° 44.904'N	129° 59.947'E
C46	28 Oct.'99	08:55	01° 00.044'N	129° 59.953'E
C47	28 Oct.'99	13:02	01° 29.978'N	130° 00.078'E
C48	28 Oct.'99	17:08	01° 59.849'N	129° 59.974'E
C49	29 Oct.'99	05:10	02° 29.981'N	130° 00.011'E
C50	29 Oct.'99	09:17	03° 00.054'N	130° 00.037'E
C51	29 Oct.'99	13:12	03° 29.904'N	129° 59.970'E
C52	29 Oct.'99	17:14	04° 00.011'N	130° 00.072'E
C53	29 Oct.'99	21:22	04° 29.954'N	130° 00.060'E
C54	30 Oct.'99	01:16	05° 00.073'N	129° 59.957'E
C55	30 Oct.'99	11:41	05° 29.947'N	130° 00.079'E
C56	30 Oct.'99	15:42	06° 00.041'N	130° 00.108'E
C57	30 Oct.'99	19:51	06° 29.914'N	130° 00.028'E
C58	31 Oct.'99	00:00	06° 59.995'N	129° 59.963'E
C59	31 Oct.'99	04:07	07° 30.032'N	129° 59.949'E
C60	31 Oct.'99	07:59	08° 00.110'N	129° 59.944'E
C61	31 Oct.'99	12:54	07° 30.107'N	129° 35.094'E
C62	31 Oct.'99	17:38	07° 00.041'N	129° 10.134'E
C63	31 Oct.'99	22:50	06° 30.034'N	128° 45.005'E
C64	1 Nov.'99	03:52	06° 00.029'N	128° 20.038'E
C65	1 Nov.'99	08:55	05° 29.947'N	127° 54.904'E
C66	1 Nov.'99	22:31	04° 59.915'N	127° 29.969'E
C67	1 Nov.'99	20:03	04° 49.042'N	127° 22.045'E
C68	2 Nov.'99	02:48	05° 00.051'N	128° 00.151'E
C69	2 Nov.'99	06:42	04° 59.947'N	128° 29.694'E
C70	2 Nov.'99	10:34	04° 59.894'N	129° 00.023'E
C71	2 Nov.'99	14:33	05° 00.005'N	129° 29.963'E
C72	2 Nov.'99	18:30	04° 59.948'N	129° 59.952'E
C88	11 Nov.'99	01:14	02° 24.423'N	137° 28.758'E
C89	11 Nov.'99	06:48	02° 04.419'N	138° 03.143'E
C93	12 Nov.'99	06:00	00° 01.415'N	138° 02.136'E
C106	15 Nov.'99	02:14	02° 28.469'N	141° 59.165'E
C115	18 Nov.'99	01:17	00° 01.076'N	147° 00.890'E
C125	20 Nov.'99	00:54	05° 00.661'N	146° 58.902'E

98-154

4.2.2 XCTD

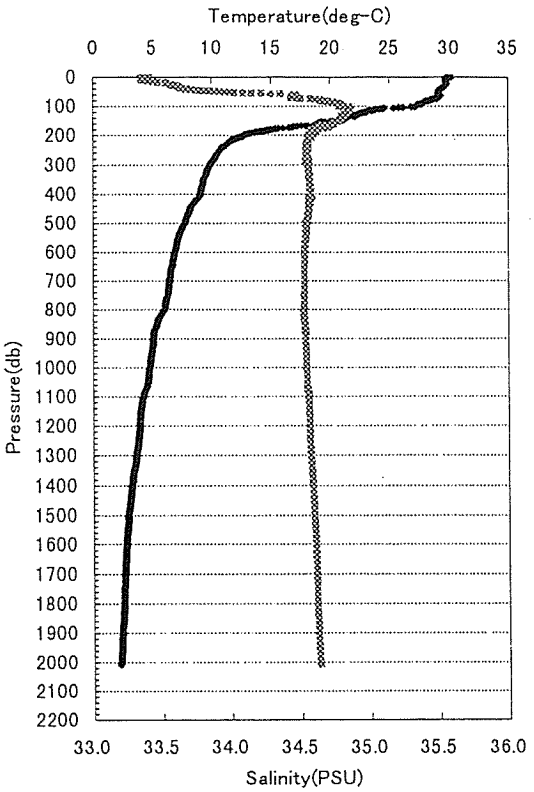
St.	Date	Time(GMT)	Latitude	Longitude
X01	20 Oct.'99	07:33	06° 59.631'N	133° 55.647'E
X10	21 Oct.'99	21:11	07° 00.035'N	129° 44.718'E
X24	23 Oct.'99	07:11	06° 58.471'N	126° 44.699'E
X37	27 Oct.'99	00:10	04° 05.463'N	128° 00.140'E
X45	28 Oct.'99	06:48	00° 44.941'N	129° 59.884'E
X54	30 Oct.'99	02:18	05° 00.018'N	130° 00.236'E
X60	31 Oct.'99	09:08	07° 59.668'N	129° 59.698'E
X73	08 Nov.'99	10:47	06° 59.660'N	135° 00.006'E
X74	08 Nov.'99	14:18	06° 30.013'N	134° 59.777'E
X75	08 Nov.'99	17:50	05° 59.990'N	135° 00.007'E
X76	08 Nov.'99	21:13	05° 29.978'N	135° 00.056'E
X77	09 Nov.'99	00:03	04° 59.869'N	135° 00.549'E
X78	09 Nov.'99	02:47	04° 29.988'N	135° 00.173'E
X79	09 Nov.'99	05:32	03° 59.988'N	134° 59.991'E
X80	09 Nov.'99	08:19	03° 29.277'N	135° 00.109'E
X81	09 Nov.'99	10:53	03° 00.725'N	134° 59.716'E
X82	09 Nov.'99	13:23	02° 31.305'N	134° 59.652'E
X83	09 Nov.'99	16:07	02° 00.068'N	135° 00.068'E
X84	09 Nov.'99	03:42	01° 29.954'N	135° 00.009'E
X85	09 Nov.'99	21:18	01° 00.320'N	134° 59.987'E
X86	10 Nov.'99	00:24	00° 29.987'N	134° 59.816'E
X87	10 Nov.'99	02:22	00° 10.553'N	134° 59.885'E
X90	11 Nov.'99	11:25	01° 29.976'N	137° 59.992'E
X91	11 Nov.'99	14:07	00° 59.994'N	137° 59.972'E
X92	11 Nov.'99	16:55	00° 29.988'N	137° 59.899'E
X93	12 Nov.'99	06:48	00° 01.175'N	138° 02.045'E
X94	12 Nov.'99	09:39	00° 30.020'S	138° 00.006'E
X95	12 Nov.'99	12:20	01° 00.010'S	138° 00.039'E
X96	12 Nov.'99	14:08	01° 15.231'S	138° 00.110'E
X97	12 Nov.'99	23:54	00° 00.224'S	138° 59.801'E
X98	13 Nov.'99	06:20	00° 00.012'S	139° 59.999'E
X99	13 Nov.'99	15:15	00° 00.002'S	141° 00.006'E
X100	14 Nov.'99	00:37	00° 00.117'N	141° 59.413'E
X101	14 Nov.'99	04:24	00° 30.116'S	142° 00.215'E
X102	14 Nov.'99	07:46	00° 59.030'S	141° 59.589'E
X103	14 Nov.'99	10:56	01° 29.598'S	141° 59.995'E
X104	14 Nov.'99	14:06	01° 59.847'S	142° 00.008'E
X105	14 Nov.'99	19:28	02° 42.562'S	142° 00.086'E
X107	15 Nov.'99	20:10	00° 01.339'S	142° 59.423'E
X108	16 Nov.'99	02:17	00° 00.278'S	144° 00.094'E
X109	16 Nov.'99	07:49	00° 00.009'S	145° 00.011'E

St.	Date	Time(GMT)	Latitude	Longitude
X110	16 Nov.'99	13:25	00° 00.194'N	145° 59.942'E
X112	17 Nov.'99	04:36	00° 29.924'S	146° 59.943'E
X113	17 Nov.'99	07:29	00° 59.873'S	146° 59.991'E
X114	17 Nov.'99	10:19	01° 29.302'S	146° 59.841'E
X116	18 Nov.'99	05:34	00° 30.059'N	147° 00.007'E
X117	18 Nov.'99	10:15	00° 59.976'N	146° 59.984'E
X118	18 Nov.'99	13:19	01° 29.573'N	146° 59.734'E
X119	18 Nov.'99	17:32	02° 00.065'N	147° 00.000'E
X120	18 Nov.'99	21:34	02° 29.914'N	147° 00.062'E
X121	19 Nov.'99	01:38	03° 00.033'N	147° 00.005'E
X122	19 Nov.'99	05:48	03° 29.866'N	146° 59.989'E
X123	19 Nov.'99	10:14	03° 59.912'N	146° 59.996'E
X124	19 Nov.'99	14:35	04° 29.918'N	146° 59.994'E

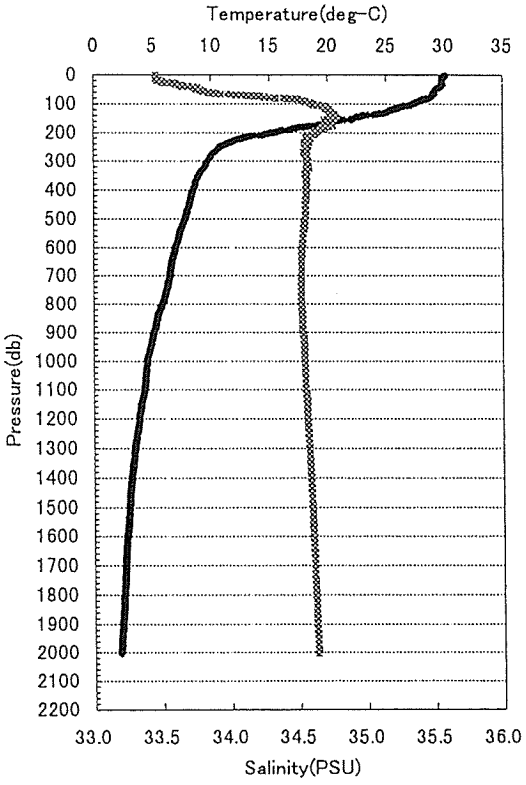
4.3 Profiles

4.3.1 CTD Profiles

St.C01(07N 134E)

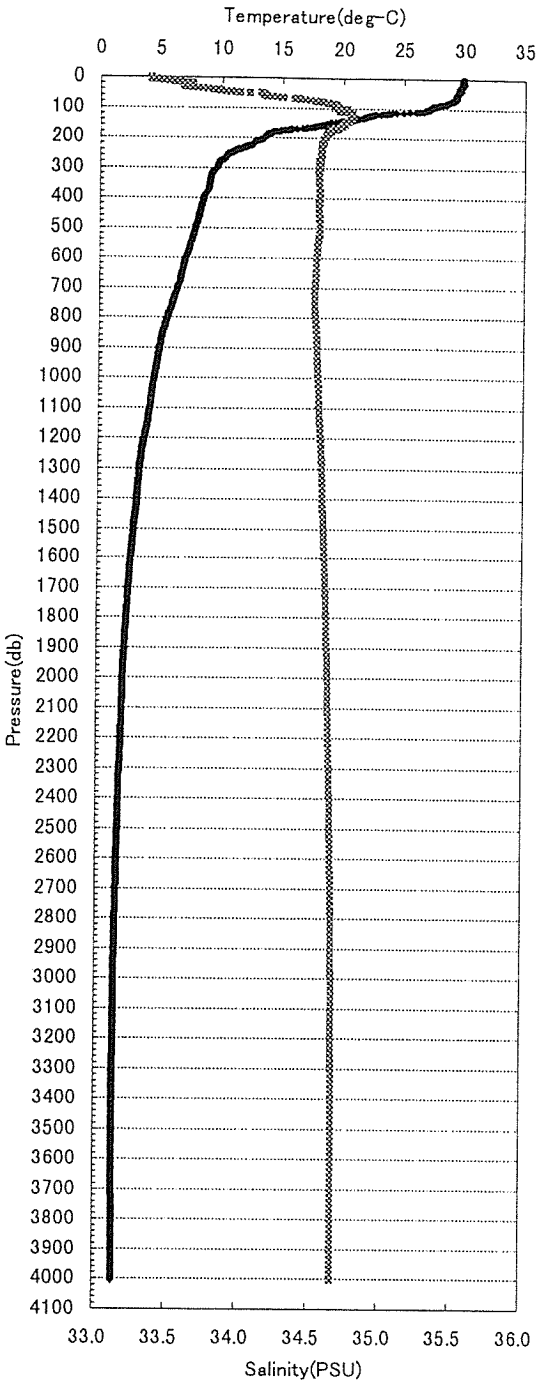


St.C02(07N,133-30E)

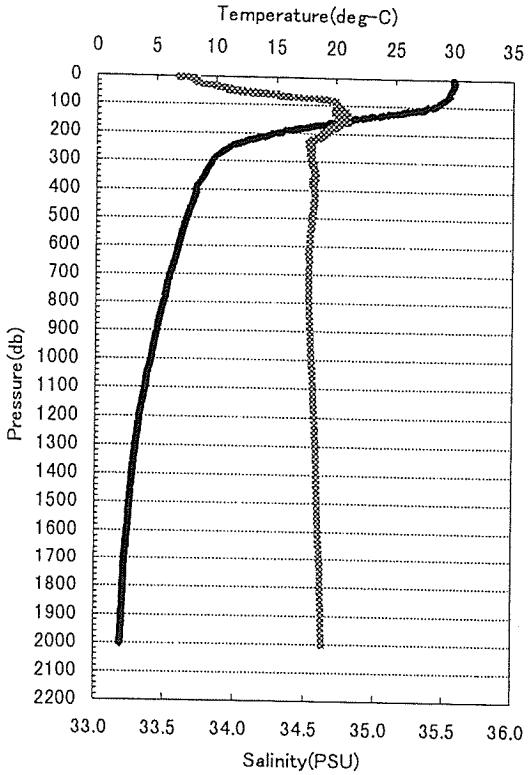


Salinity Temperature

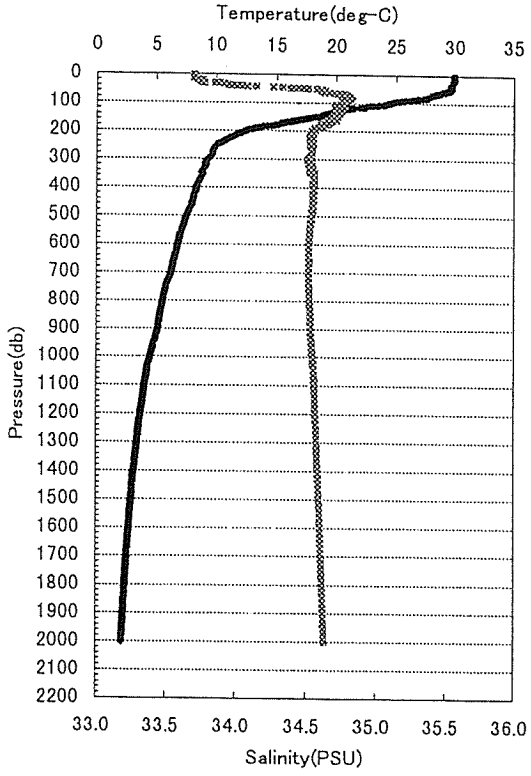
St.C03(07N,133E)



St.C04(07N,132-30E)

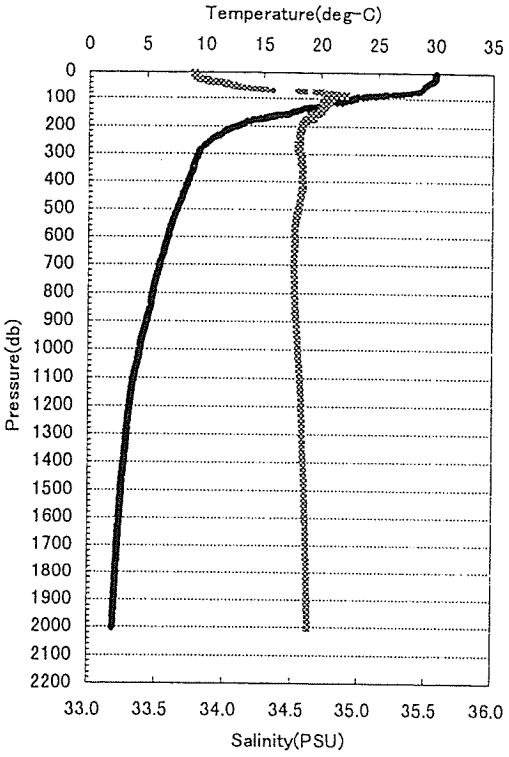


St.C05(7N,132E)

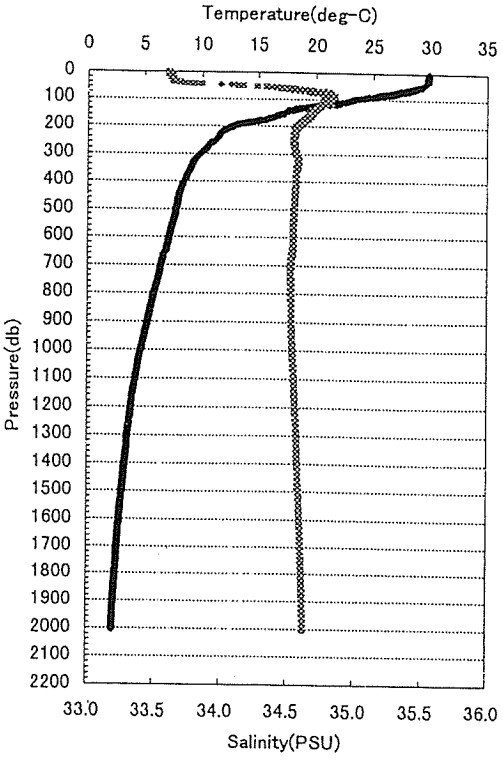


Salinity ——— Temperature

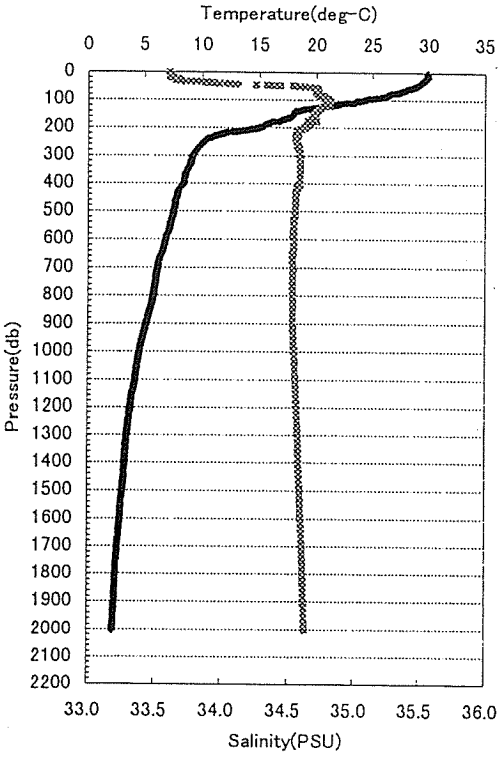
St.C06(7N,131-30E)



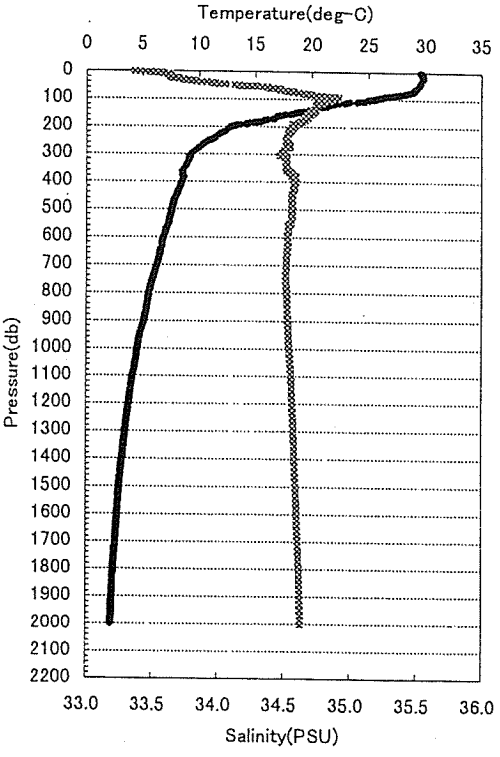
St.C07(7N,131E)



St.C08(7N,130-30E)

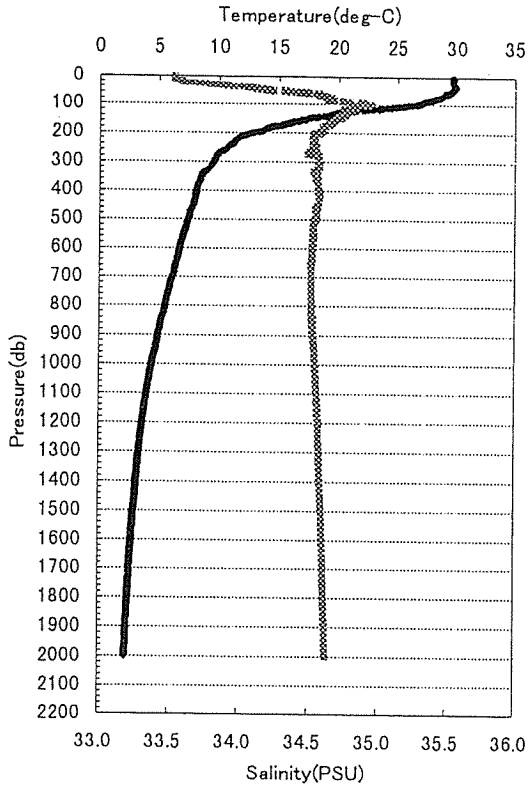


St.C09(7N,130E)

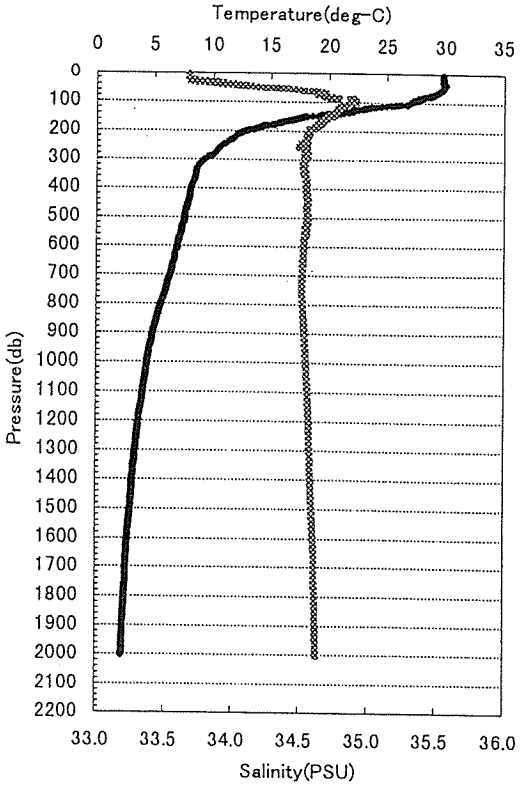


Salinity ——— Temperature

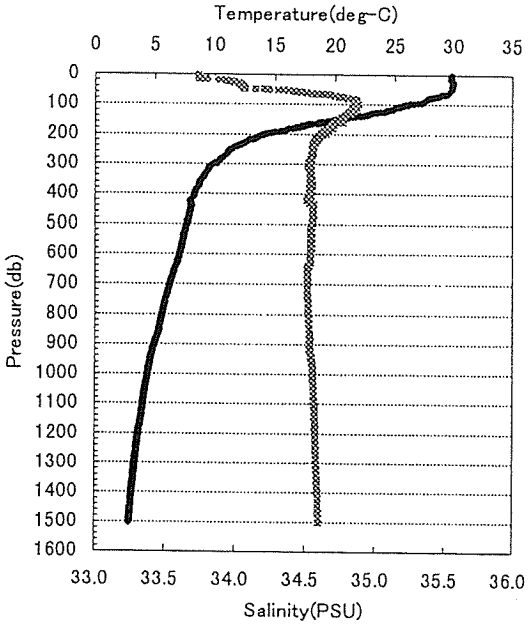
St.C10(7N,129-45E)



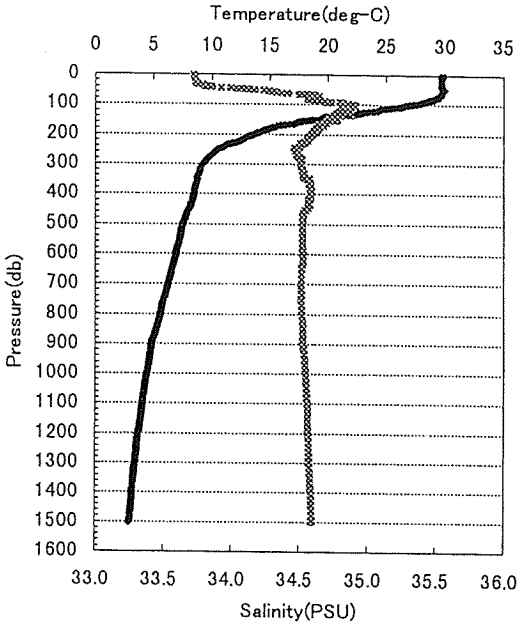
St.C11(7N,129-30E)



St.C12(7N,129-15E)

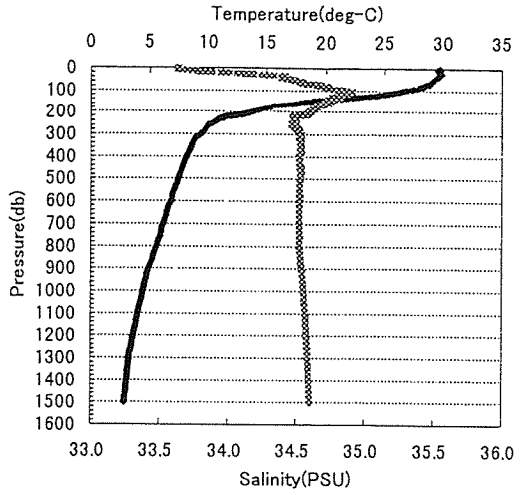


St.C13(7N,129E)

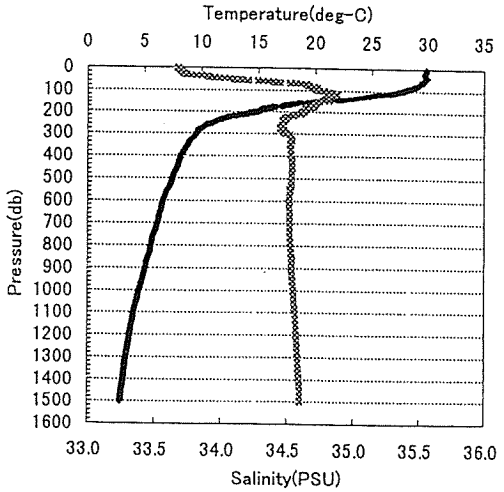


Salinity ——— Temperature

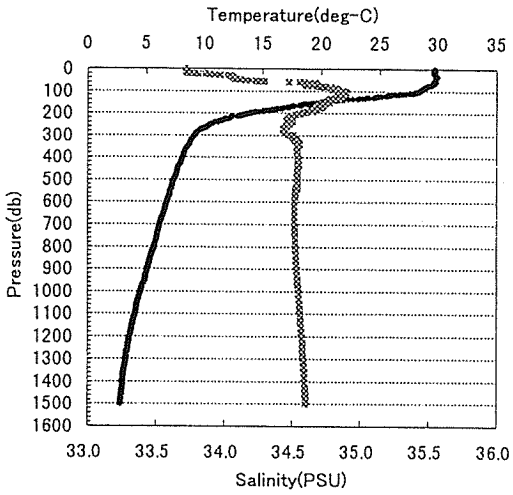
St.C14(7N,128-45E)



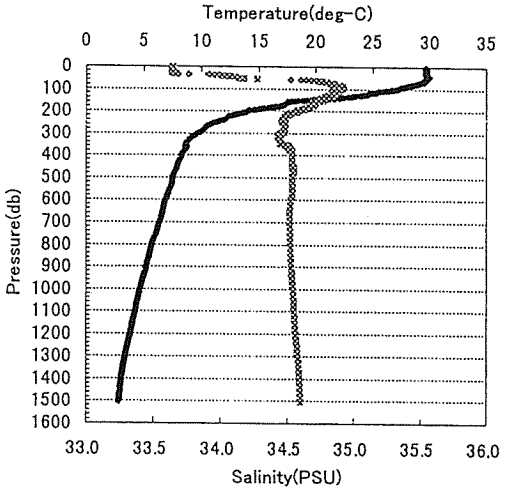
St.C15(7N,128-30E)



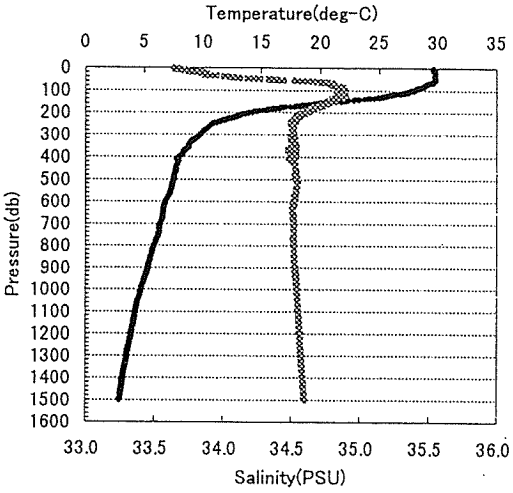
St.C16(7N,128-15E)



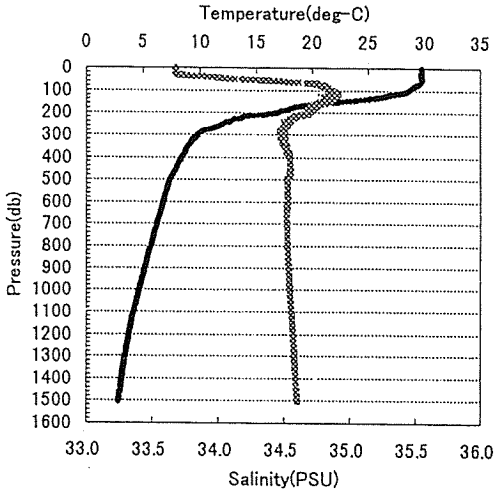
St.17(7N,128E)



St.C18(7N,127-45E)

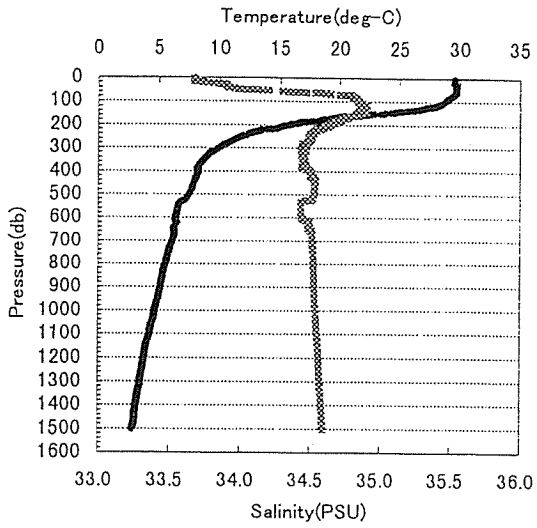


St.C19(7N,127-30E)

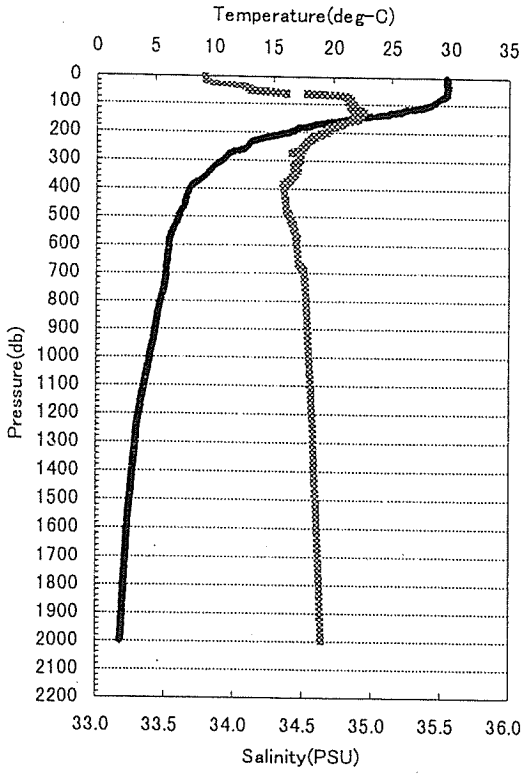


Salinity　Temperature

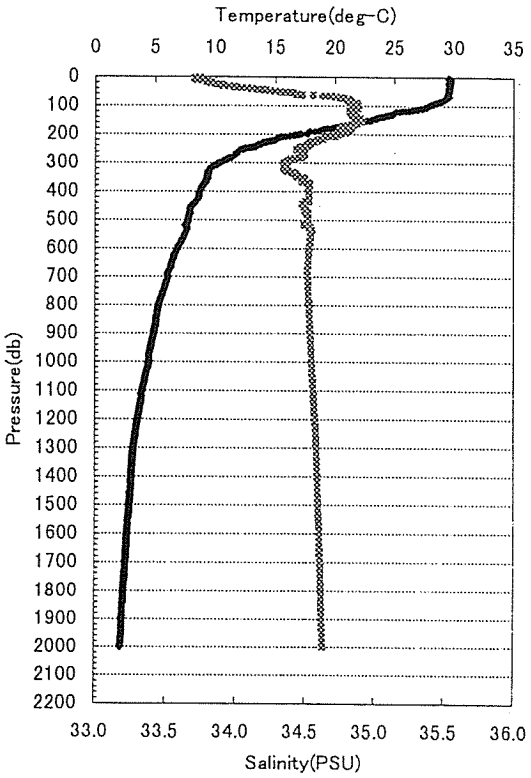
St.C20(7N,127-20E)



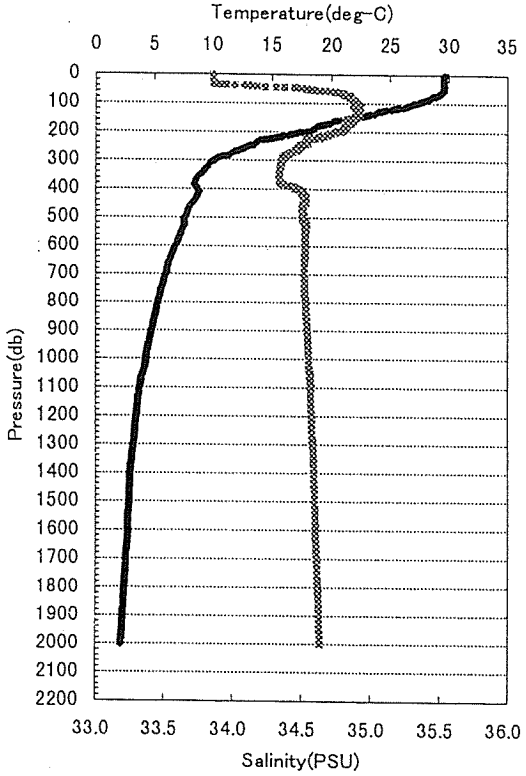
St.C21(7N,127-10E)



St.C22(7N,127E)

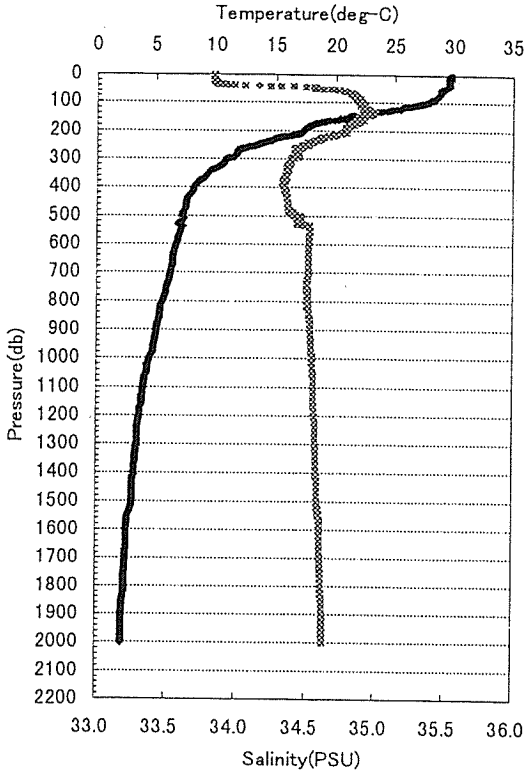


St.C23(7N,126-52E)

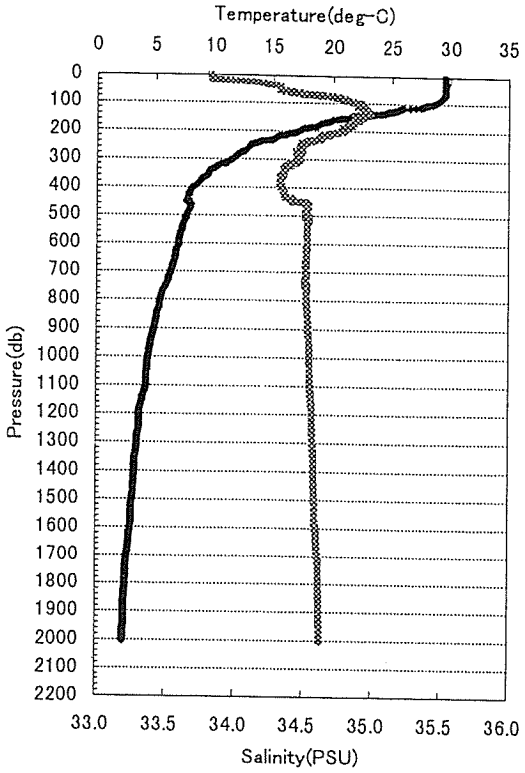


Salinity ——— Temperature

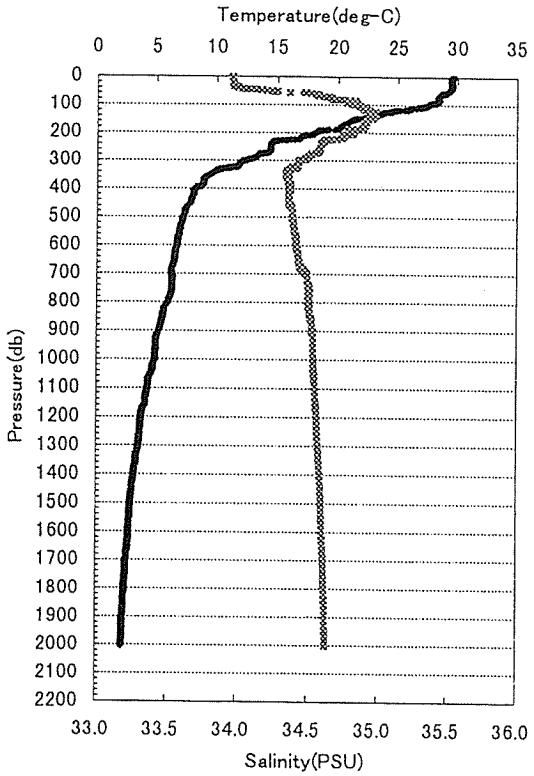
St.C24(6-50N,126-45E)



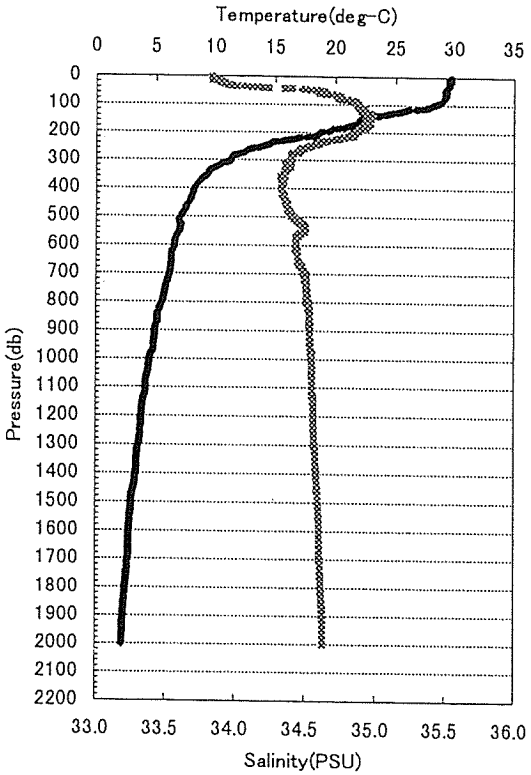
St.C25(6-48N,126-30E)



St.C26(6-48N,126-30E)

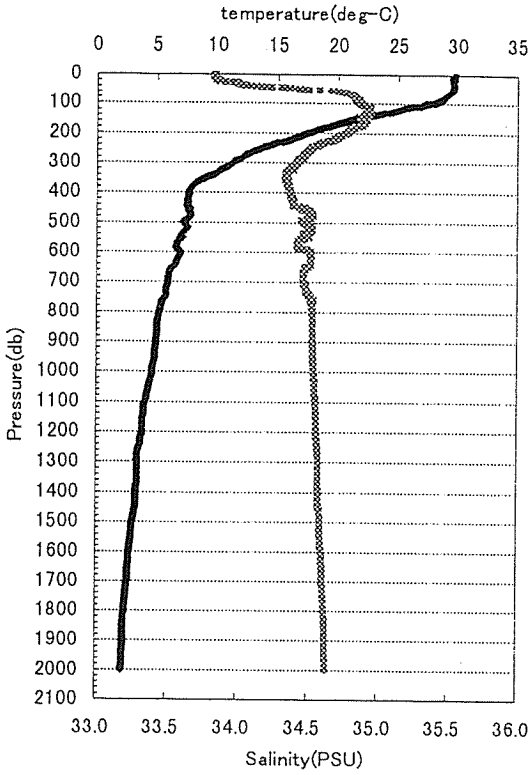


St.C27(6-39N,126-35E)

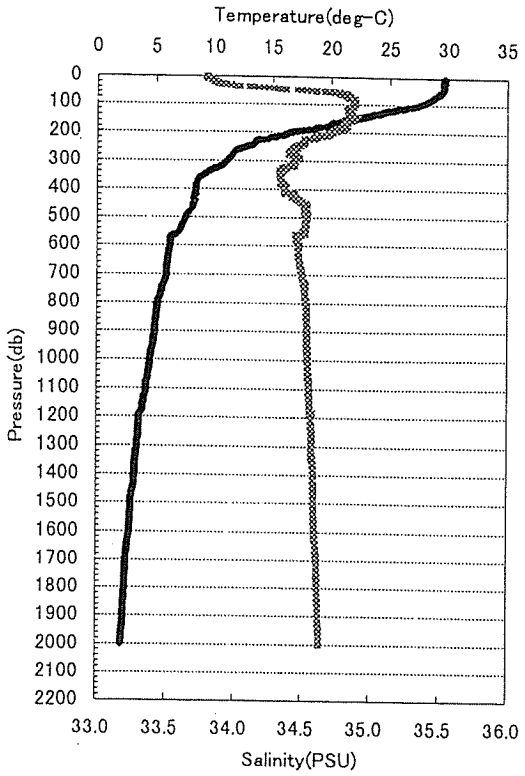


Salinity ——— Temperature

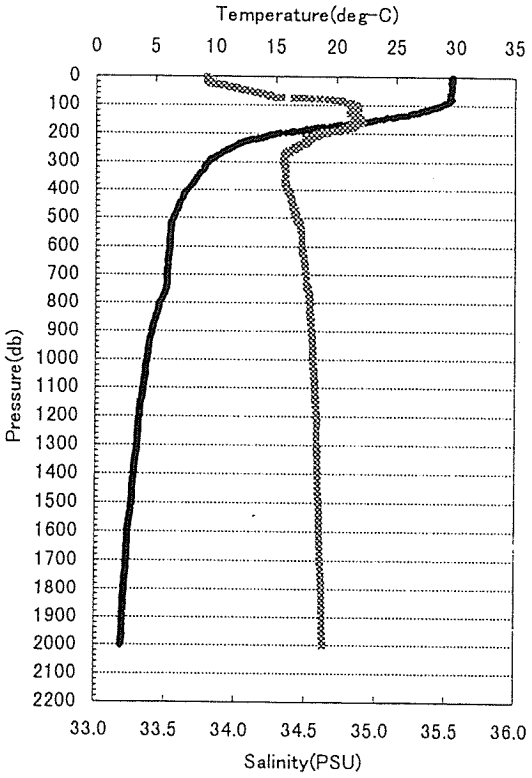
St.C28(6-30N,126-40E)



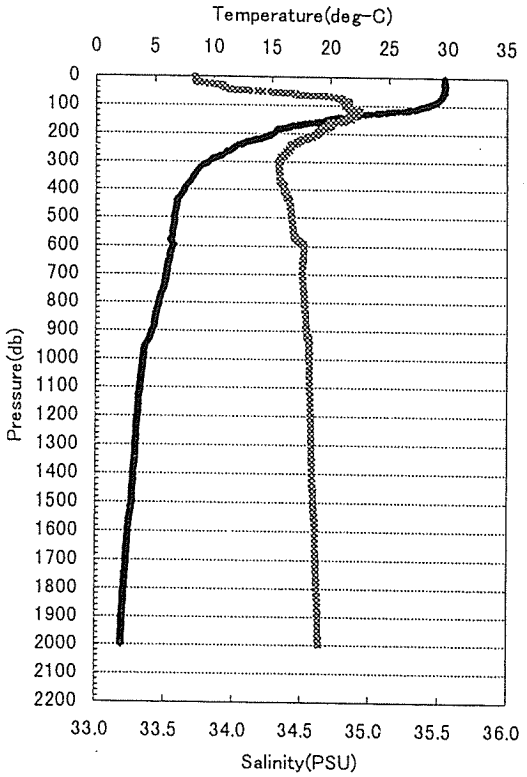
St.C29(6-21N,126-45E)



St.C30(6-08N,126-52E)

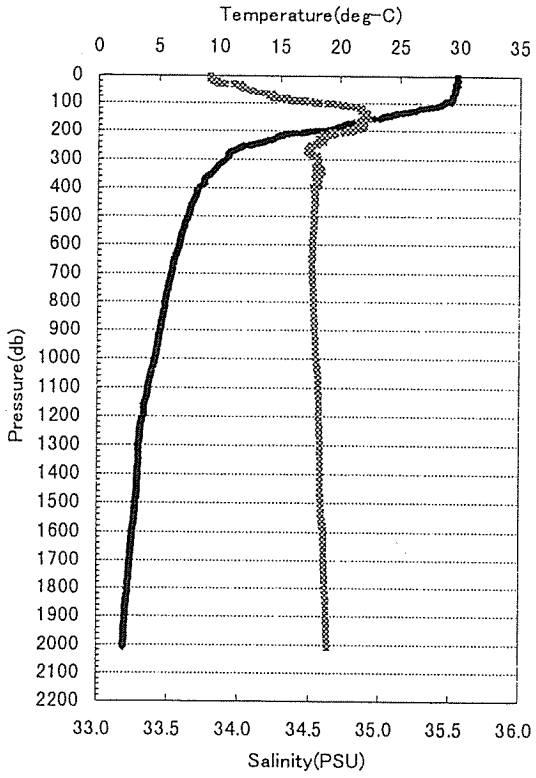


St.C31(5-54N,127E)

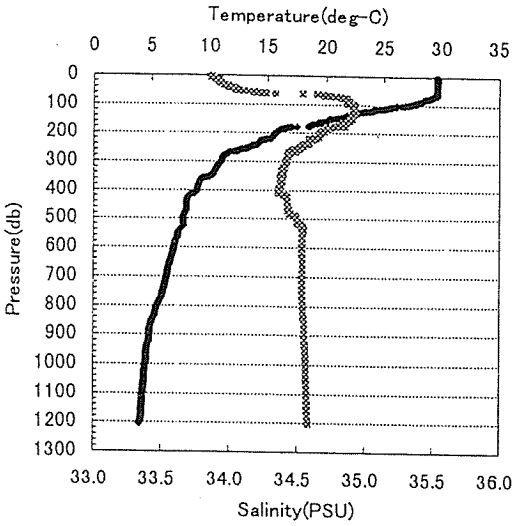


Salinity ——— Temperature

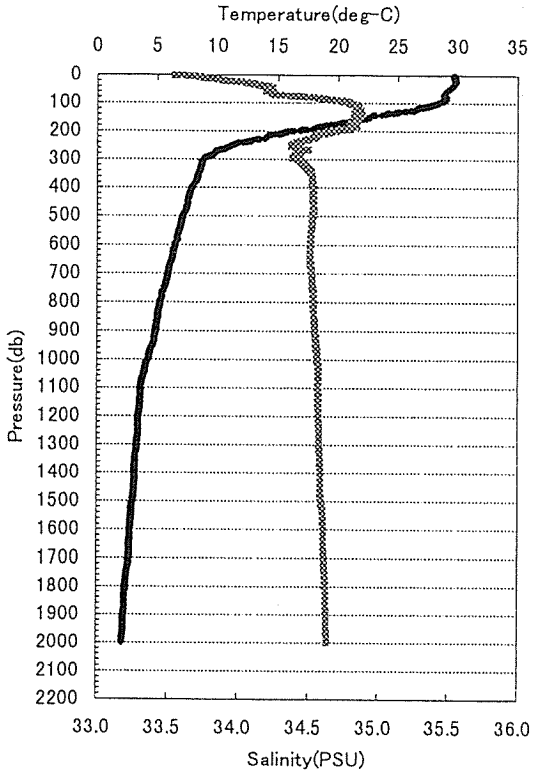
St.C32(5-27N,127-15E)



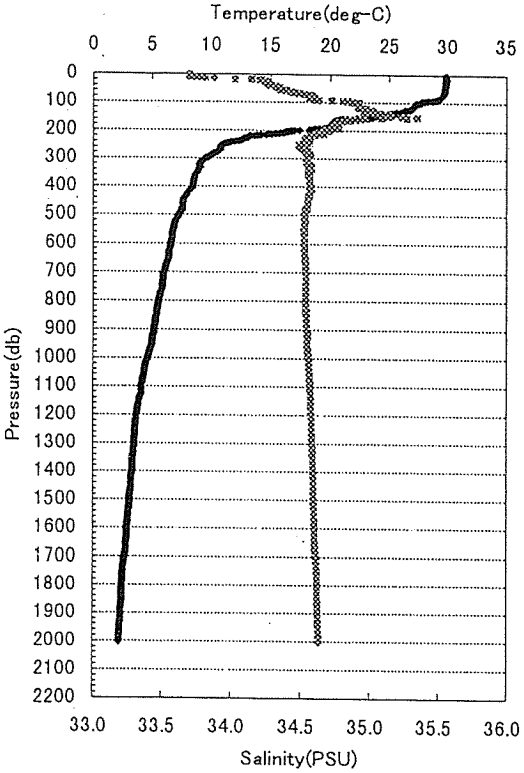
St.C33(5-07N,125-38E)



St.C34(5-27N,127-15E)

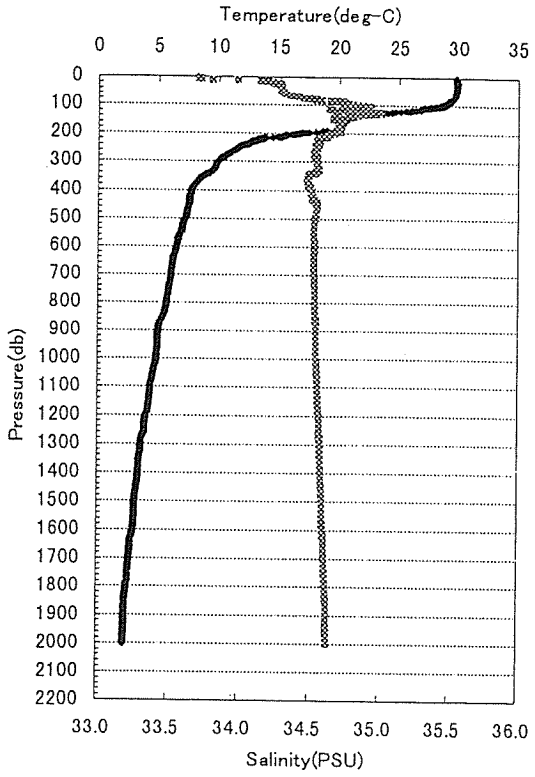


St.C35(5N,127-30E)

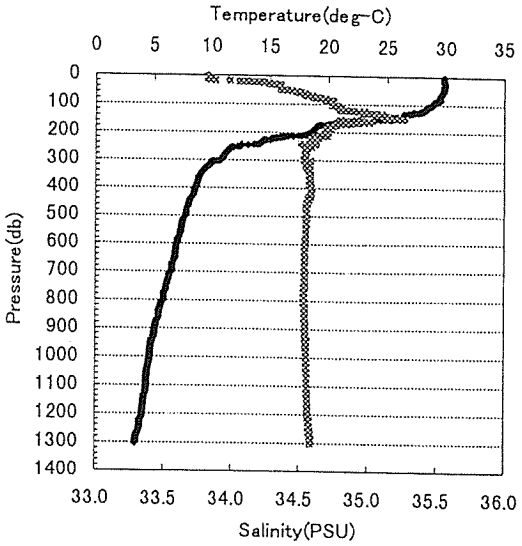


Salinity ——— Temperature

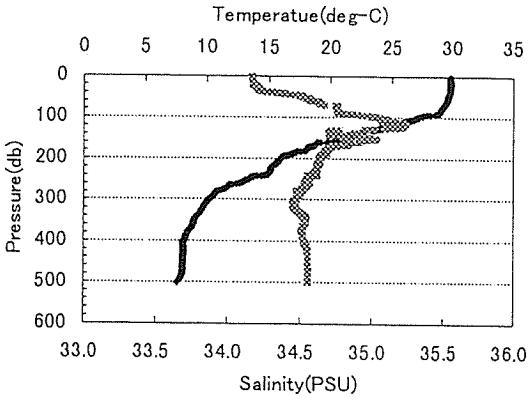
St.C36(4-33N,127-45E)



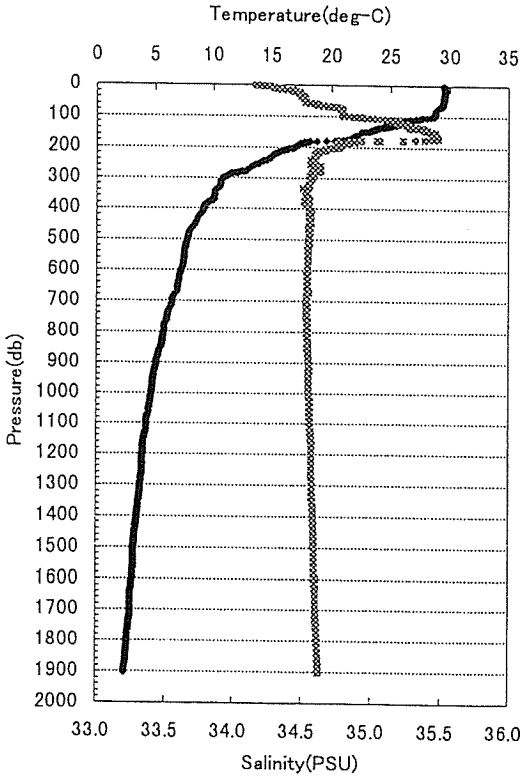
St.C37(4-06N,128E)



St.C38(3-39N,128-15E)

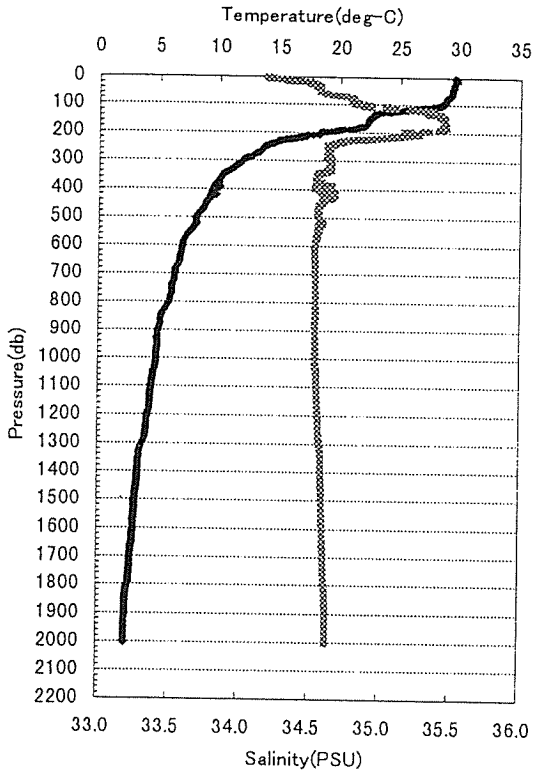


St.C39(3-12N,128-30E)

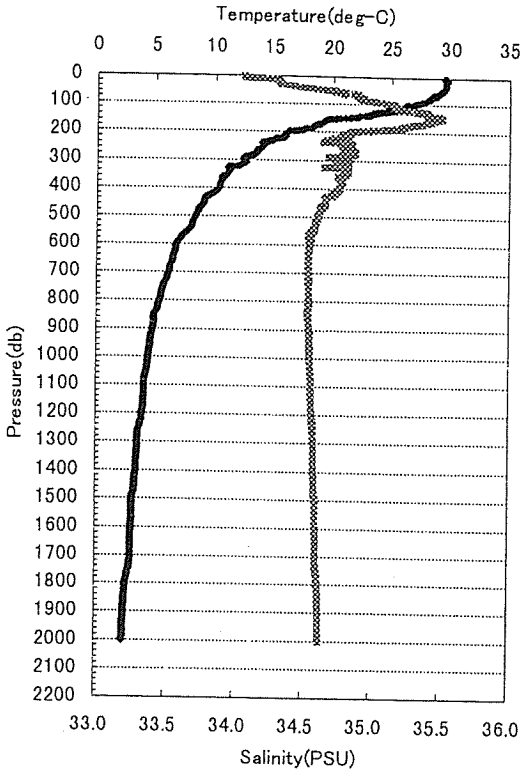


Salinity Temperature

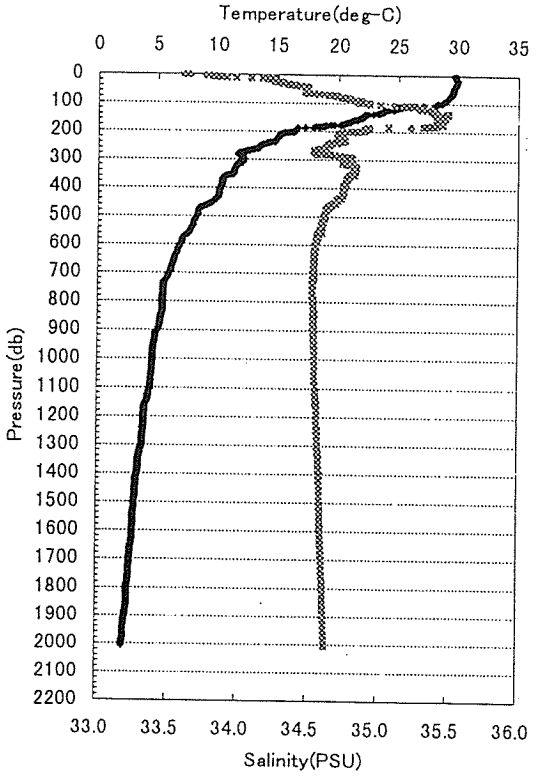
St.C40(2-45N,128-45E)



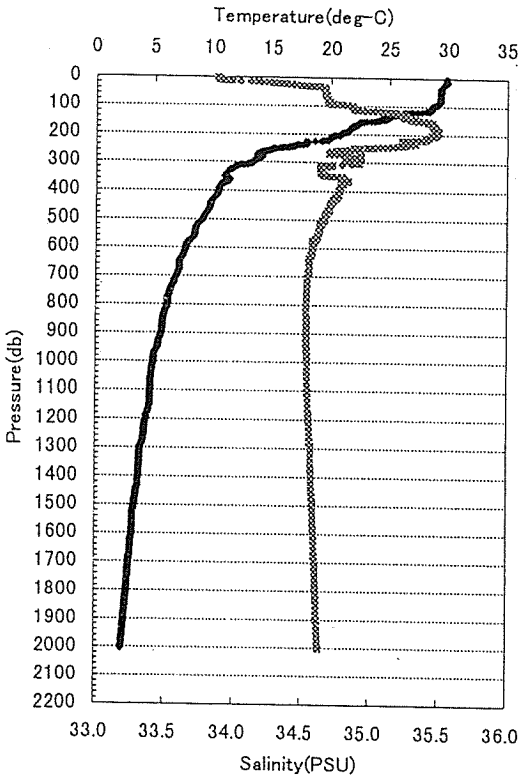
St.C41(2-18N,129E)



St.C42(1-51N,129-15E)

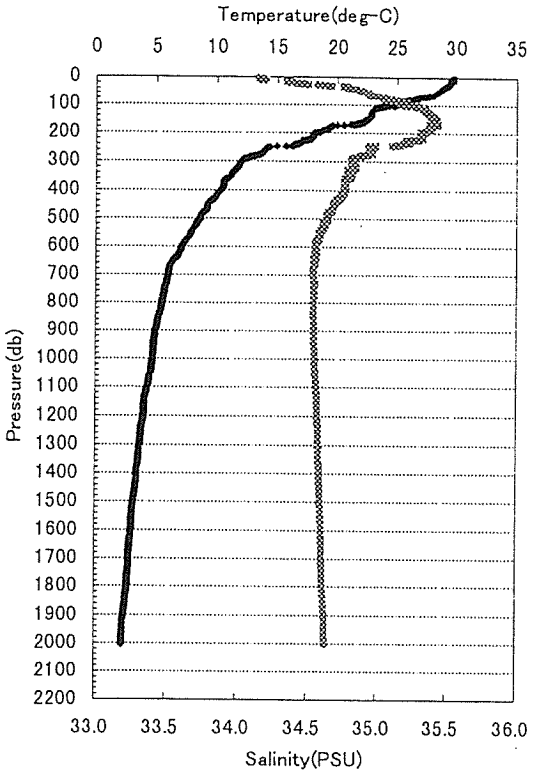


St.C43(1-24N,129-30E)

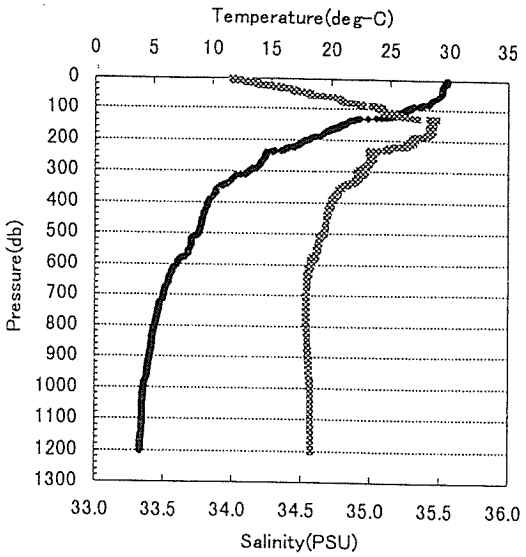


Salinity ——— Temperature

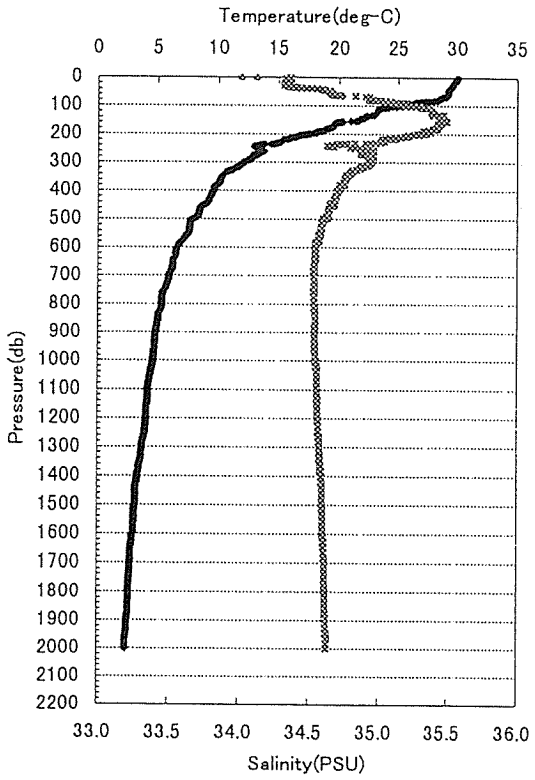
St.C44(0-57N,129-45E)



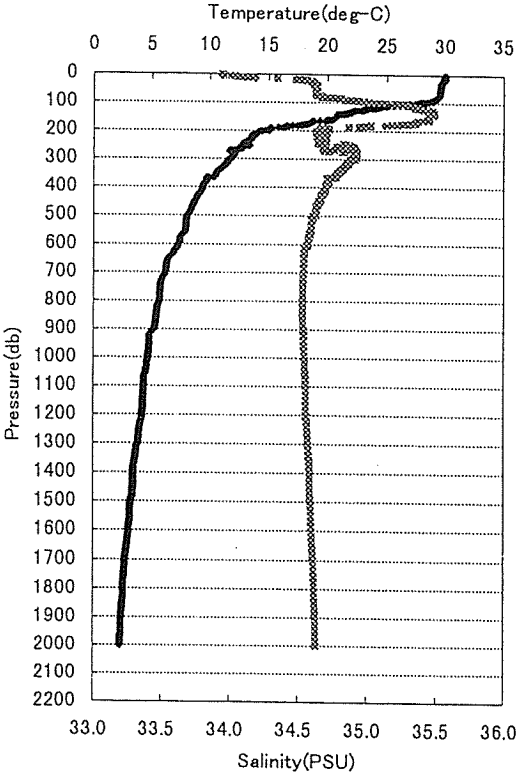
St.C45(0-30N,130E)



St.C46(1N,130E)

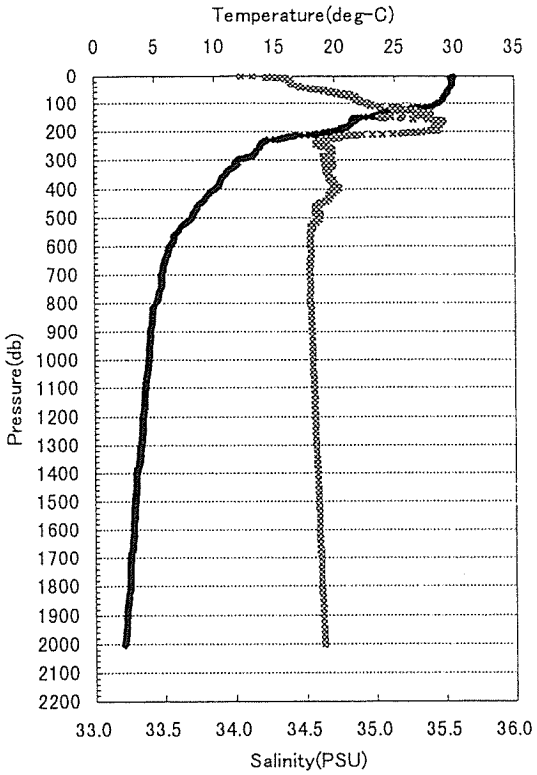


St.C47(1-30N,130E)

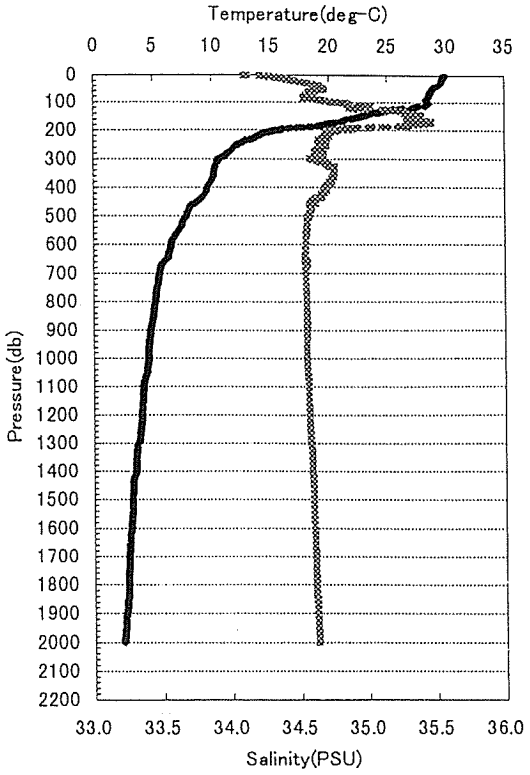


Salinity ——— Temperature

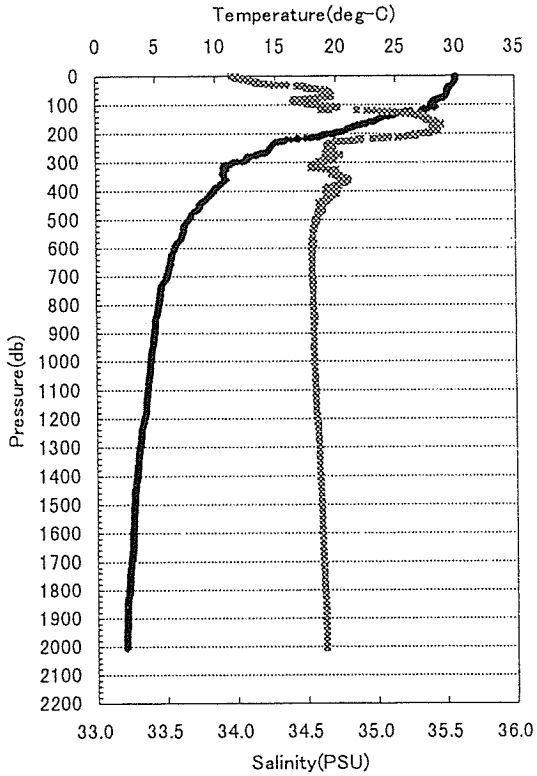
St.C48(2N,130E)



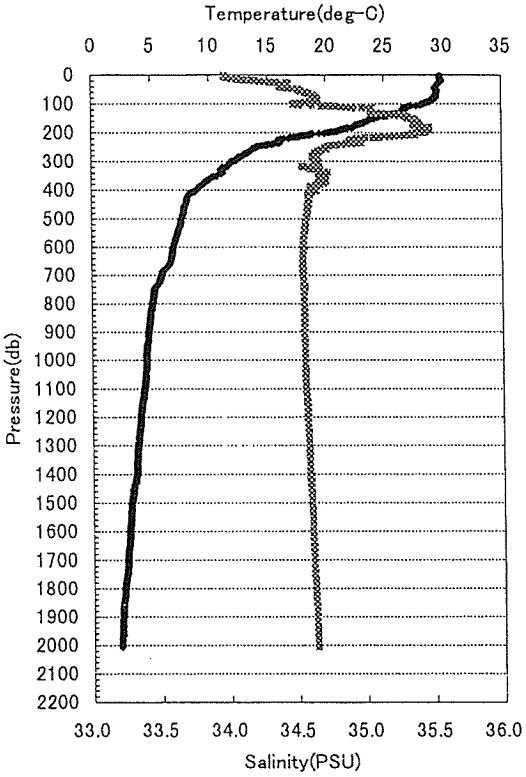
St.C49(2-30N,130E)



St.C50(3N,130E)

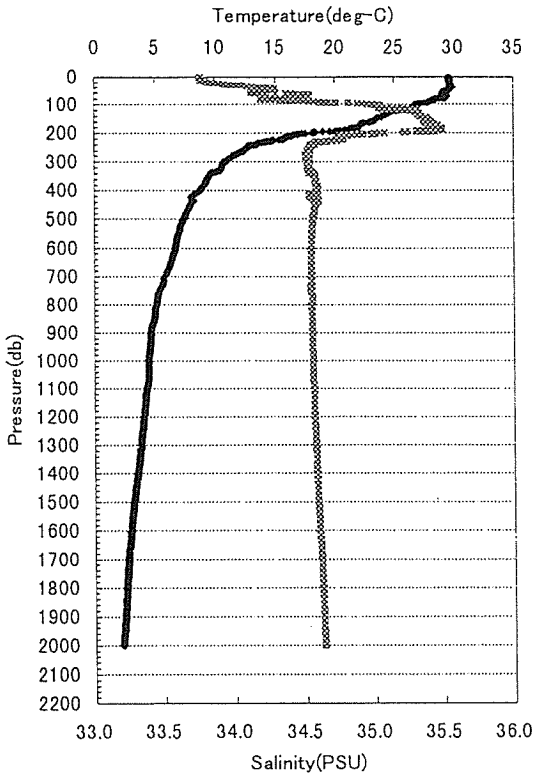


St.C51(3-30N,130E)

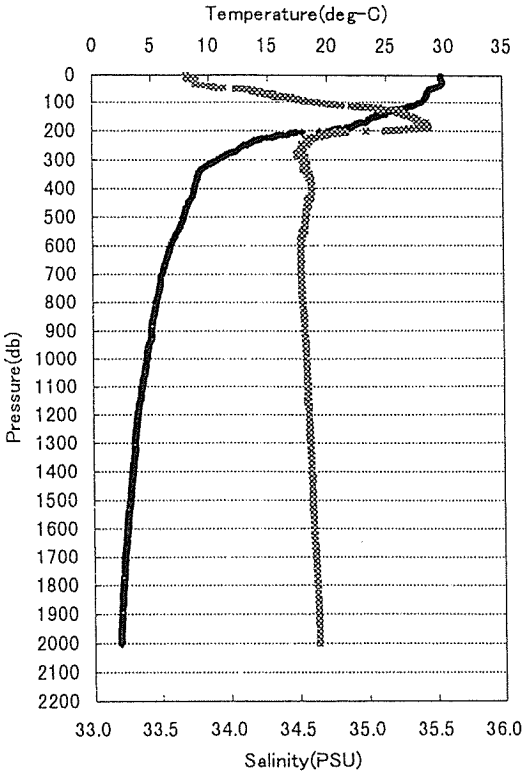


Salinity ——— Temperature

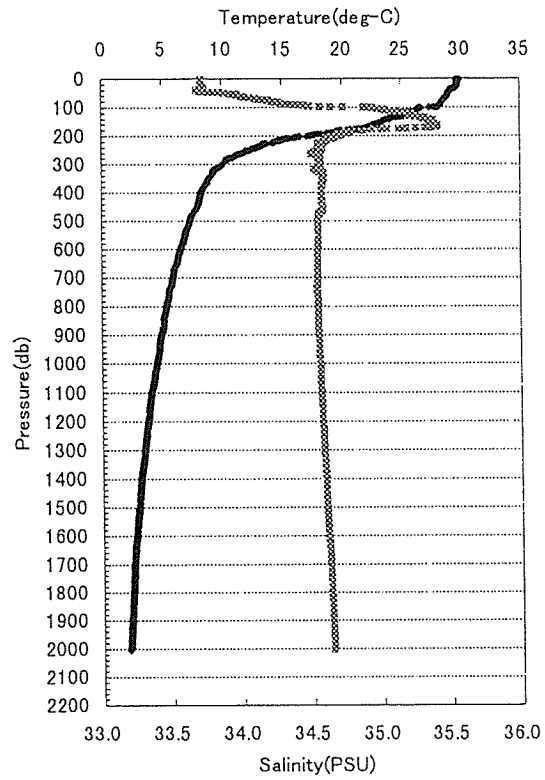
St.C52(4N,130E)



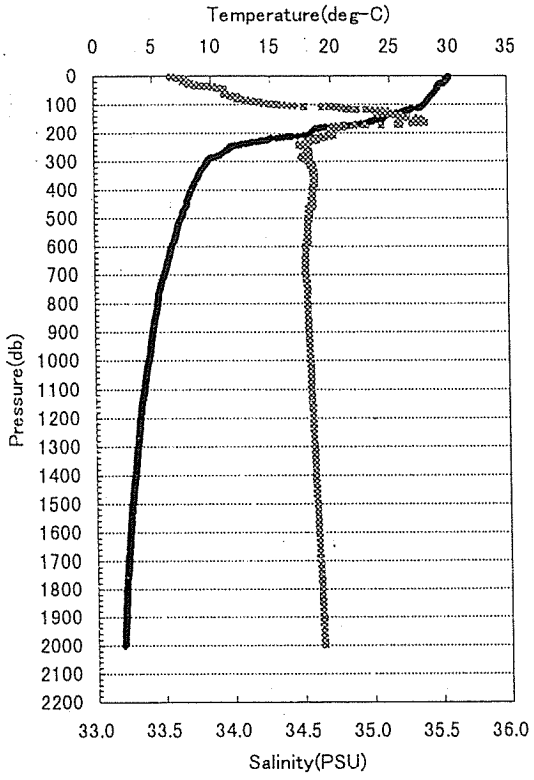
St.C53(4-30N,130E)



St.C54(5N,130E)

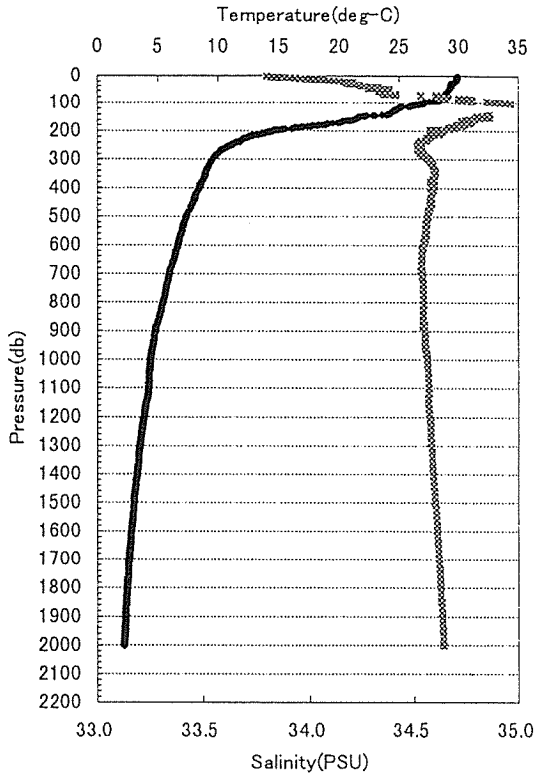


St.C55(5-30N,130E)

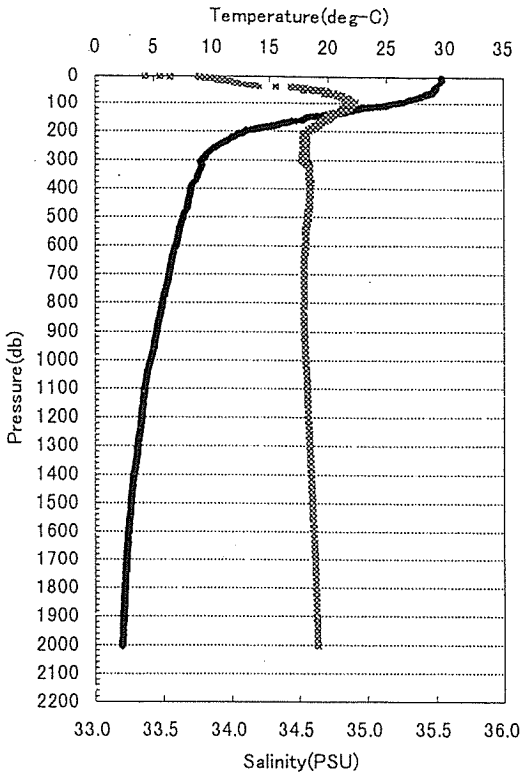


Salinity Temperature

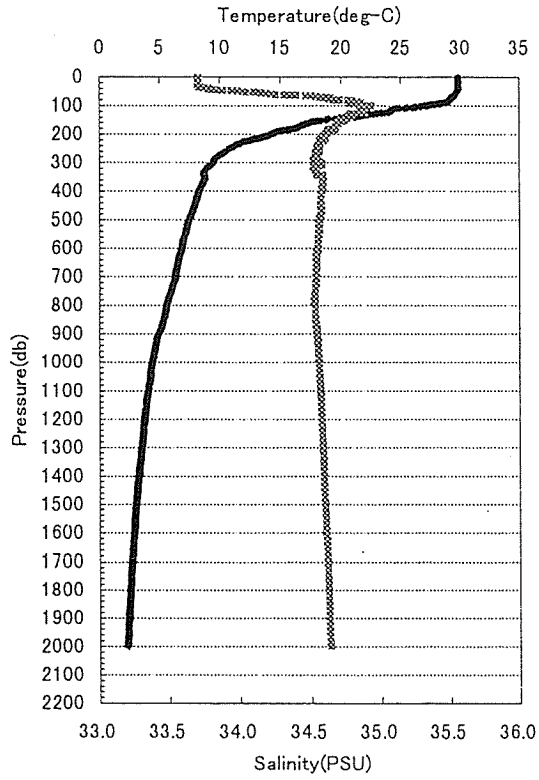
St.C56(6N,130E)



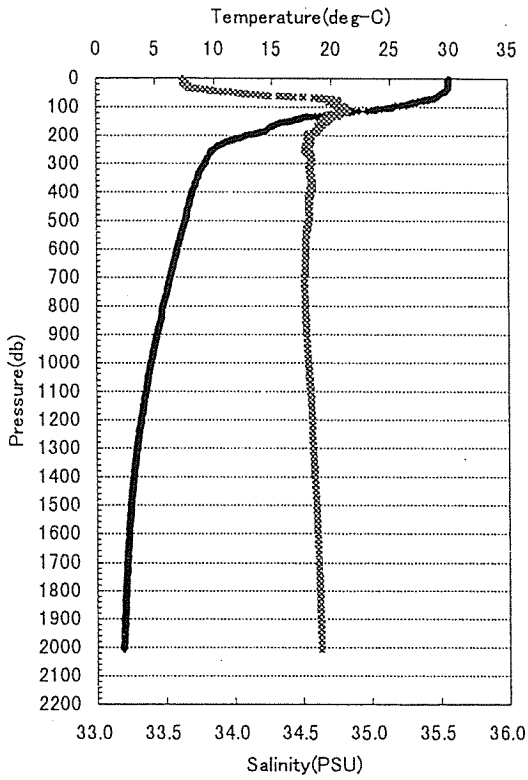
St.C57(6-30N,130E)



St.C58(7N,130E)

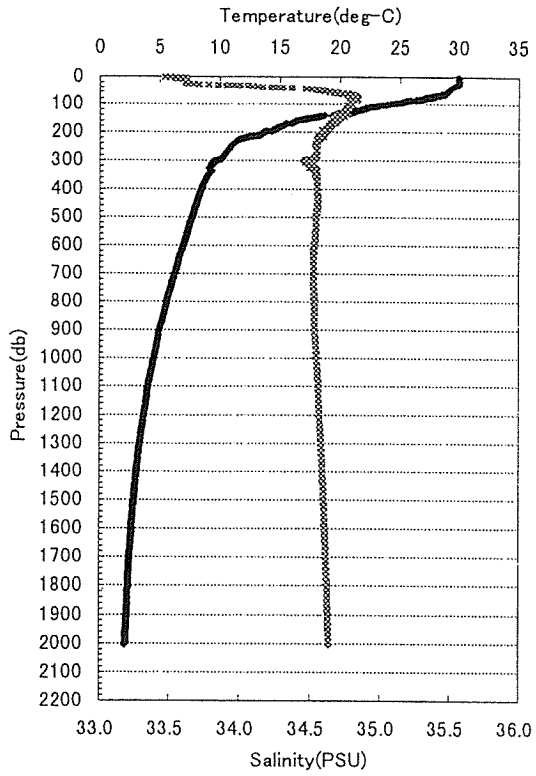


St.C59(7-30N,130E)

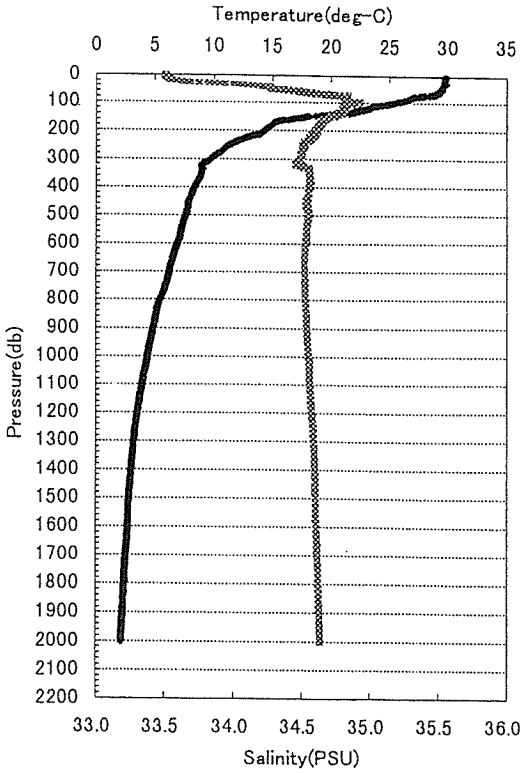


Salinity ——— Temperature

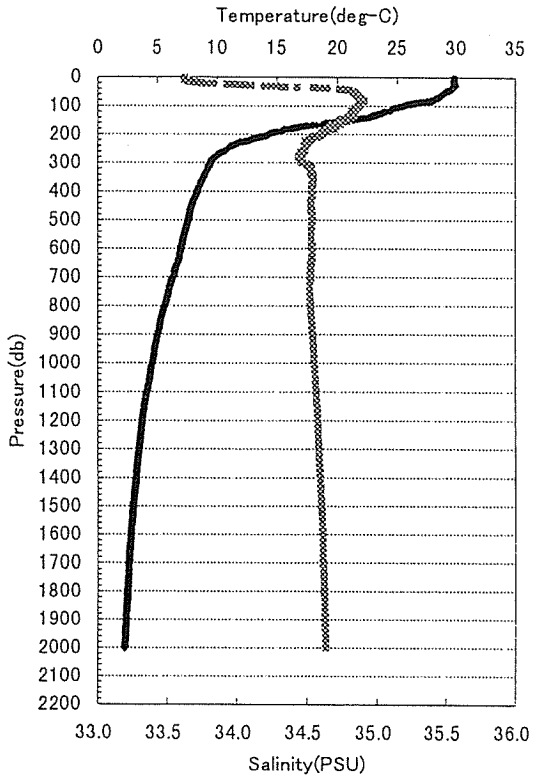
St.C60(8N,130E)



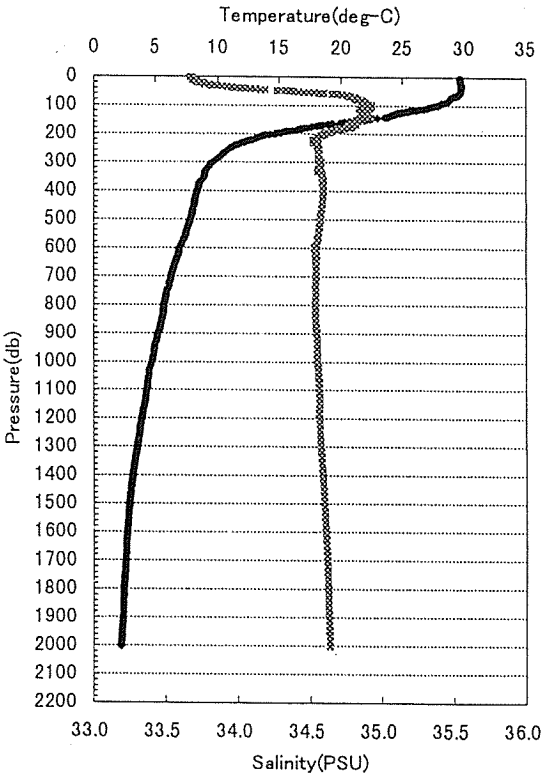
St.C61(7-30N,129-35E)



St.C62(7N,129-10E)

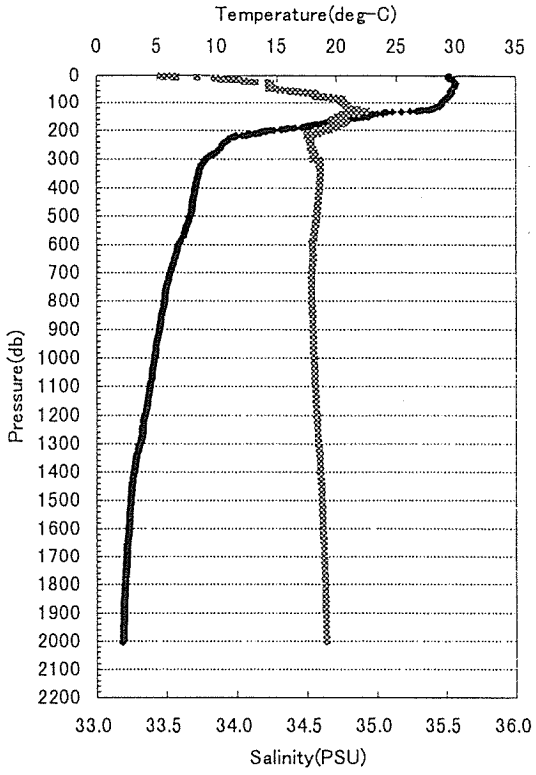


St.C63(6-30N,128-45E)

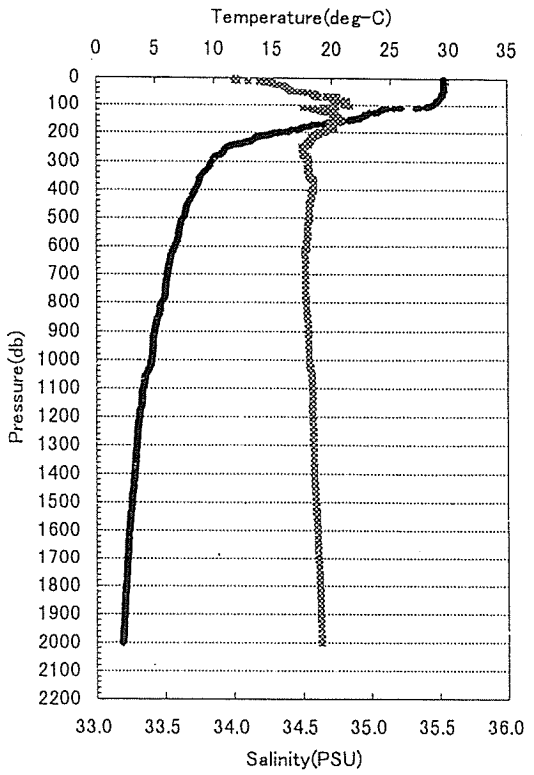


Salinity ——— Temperature

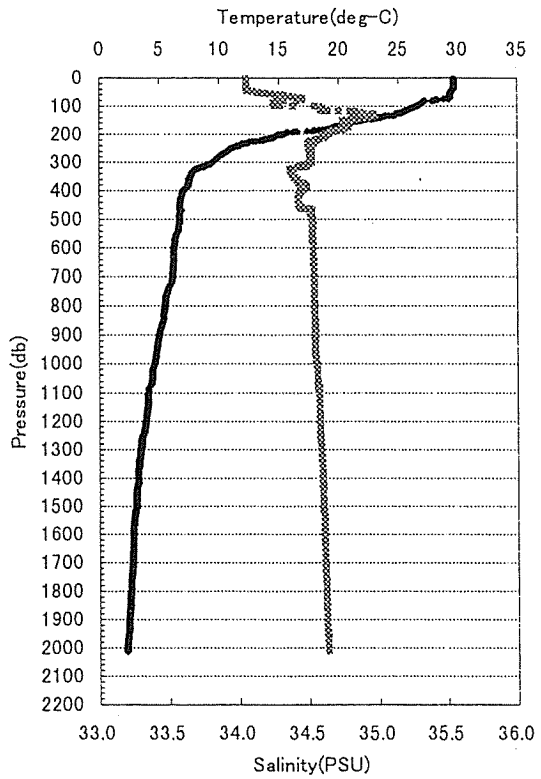
St.C64(6N,128-20E)



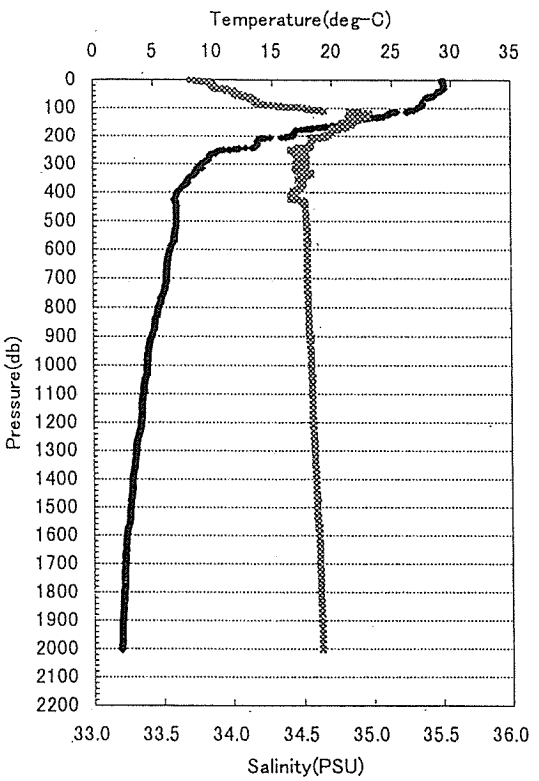
St.C65(5-30N,127-55E)



St.C66(5N,127-30E)

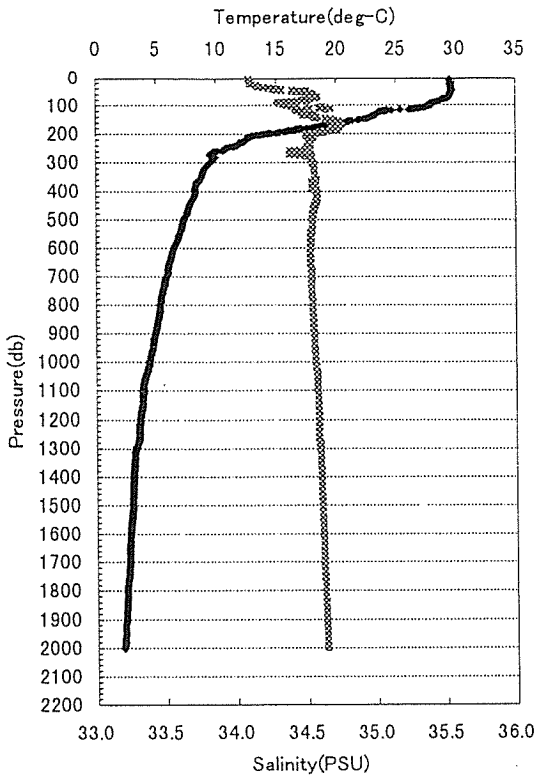


St.C67(5N,128E)

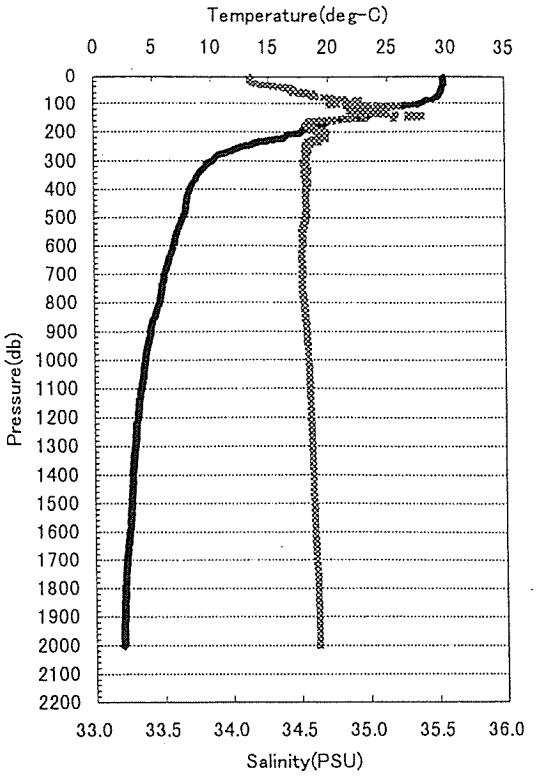


Salinity Temperature

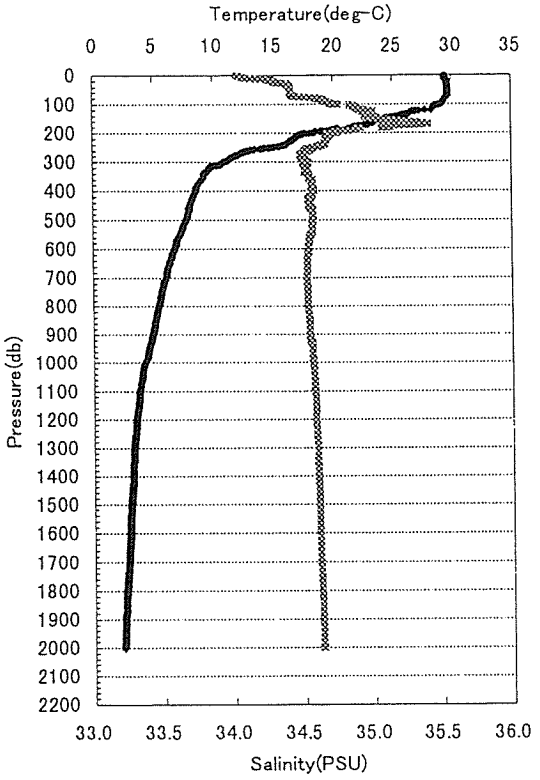
St.C68(5N,128E)



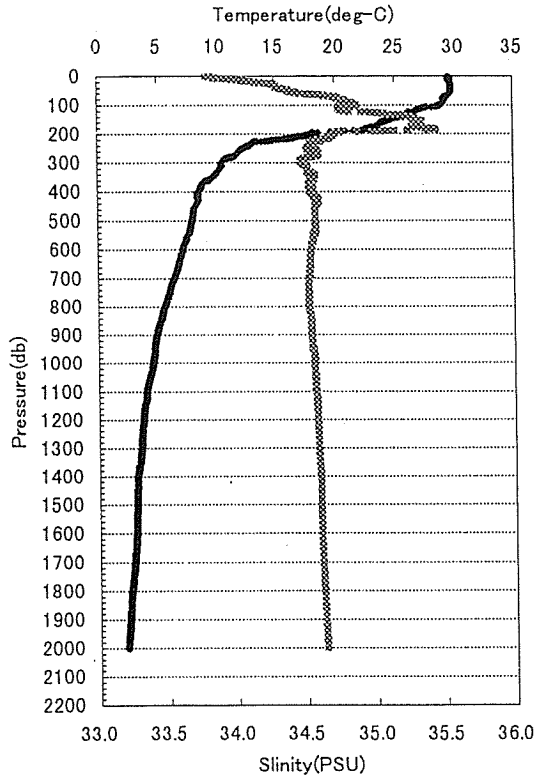
St.C69(5N,128-30E)



St.C70(5N,129E)

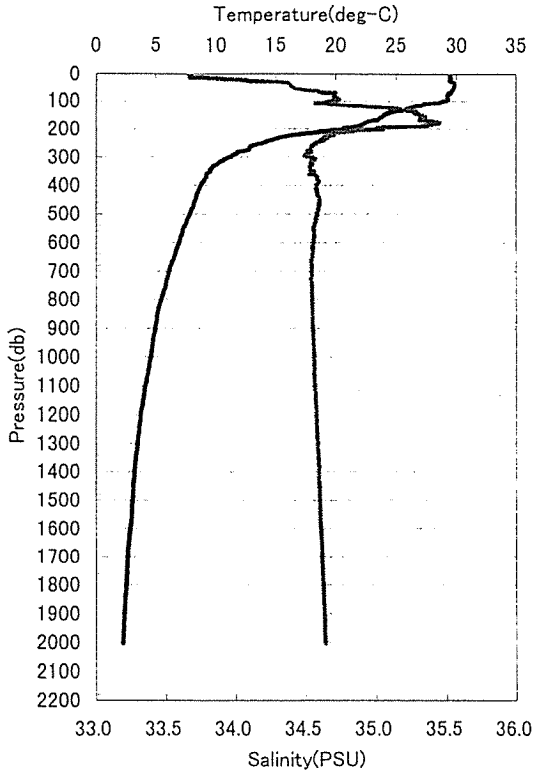


St.C71(5N,129-30E)

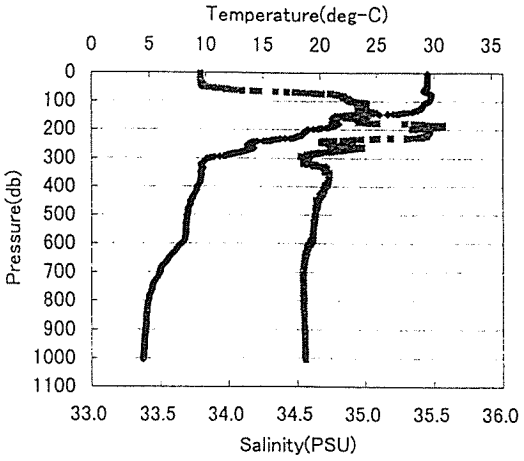


Salinity Temperature

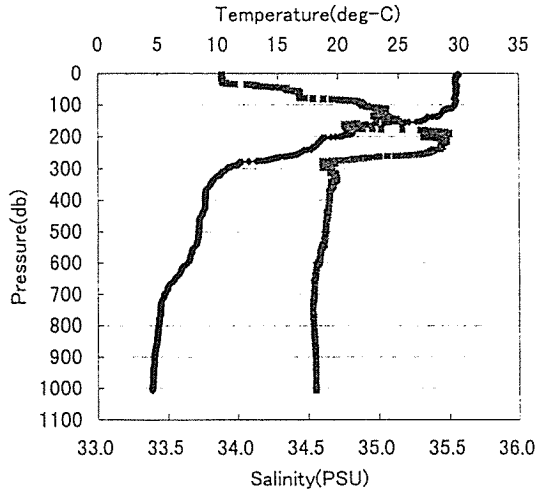
St.C72(5N,130E)



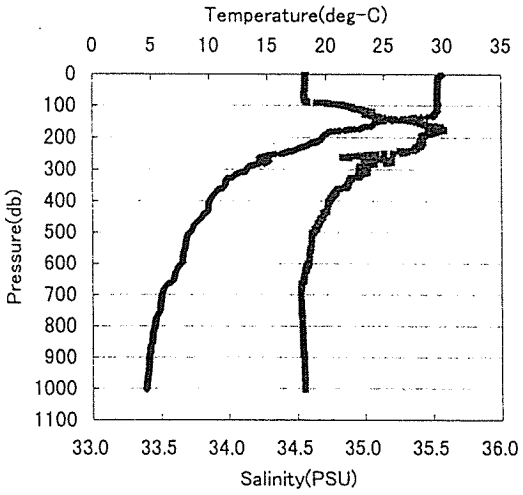
St.C88(2-26N,137-25E)



St.C89(2N,138E)

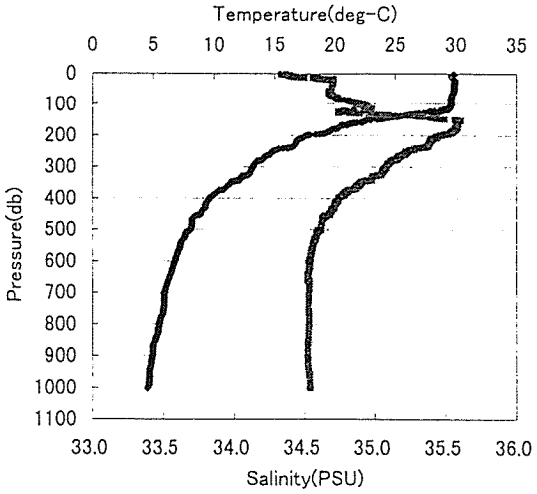


St.C93(0N,138E)

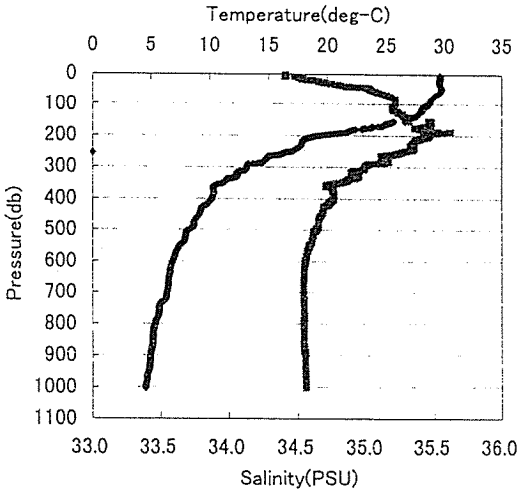


Salinity Temperature

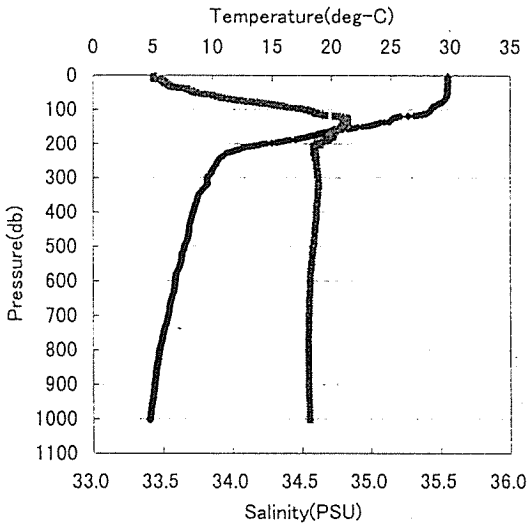
St.C106(2-30N,147E)



St.C115(0N,147E)



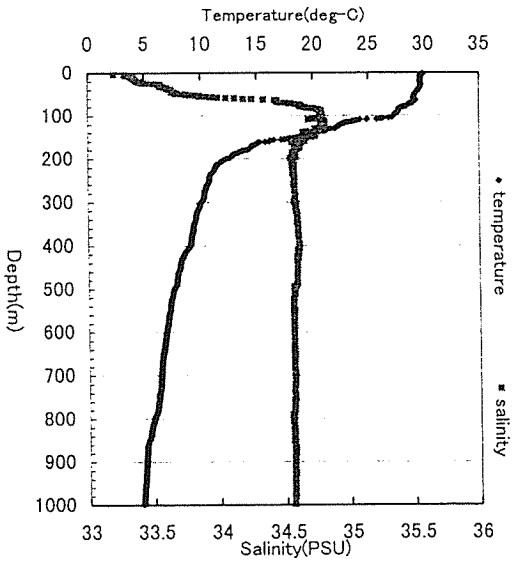
St.C125(5N,147E)



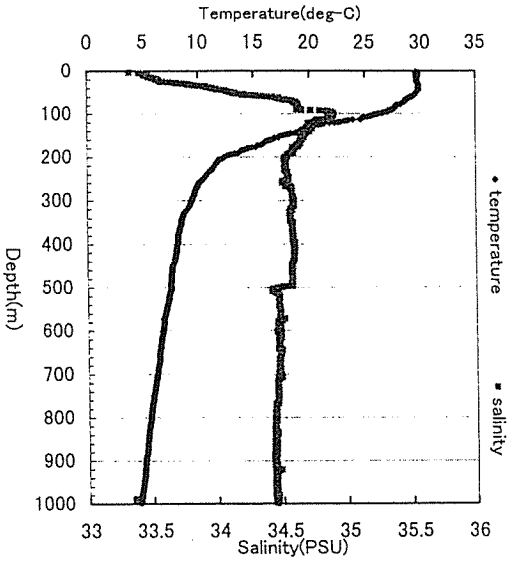
Salinity　　Temperature

4.3.2 XCTD Profiles

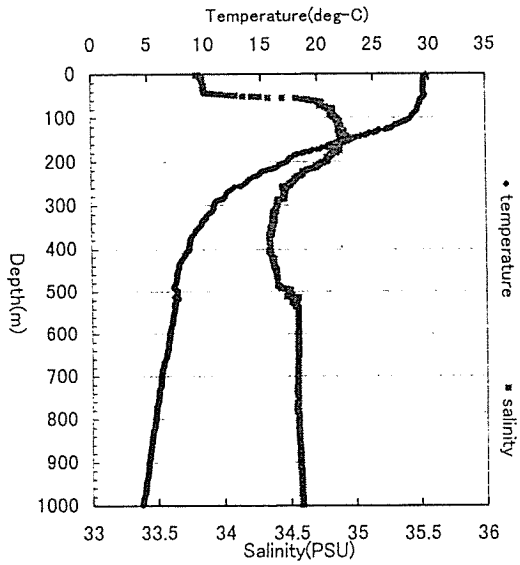
St.X01(07-00N,133-56E)



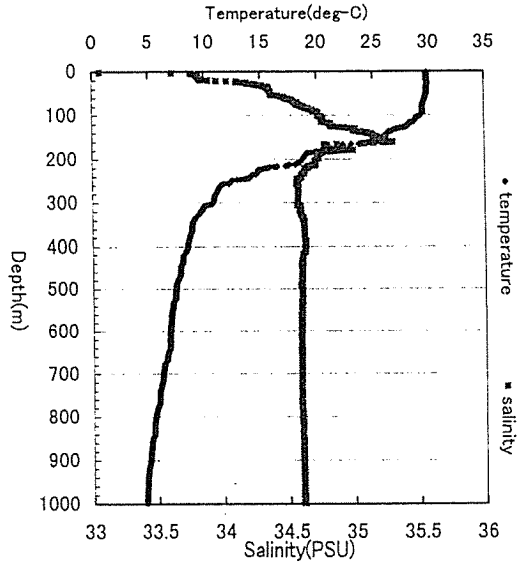
St.X10(07-00N,129-45E)



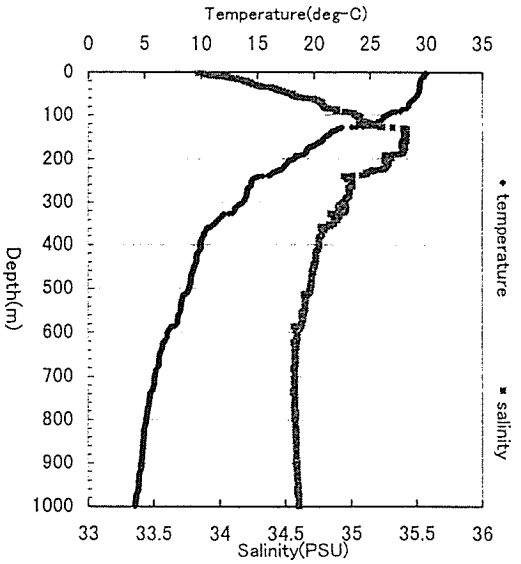
St.X24(07-00N,126-44E)



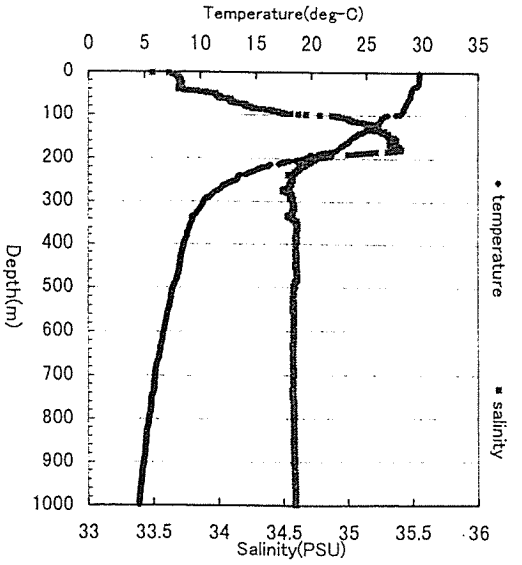
St.X37(04-06N,128-00E)



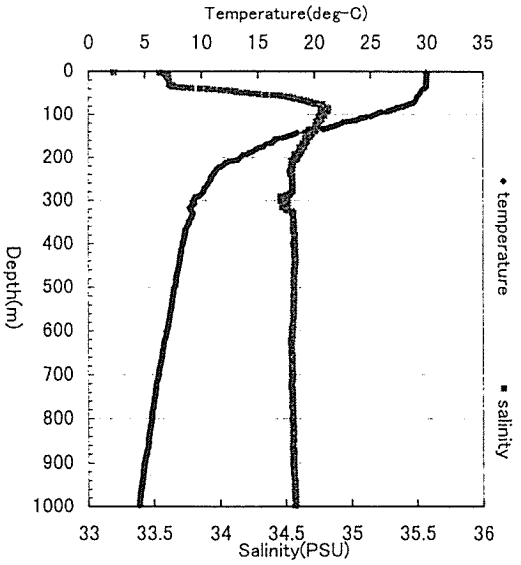
St.X45(00-45N,130-00E)



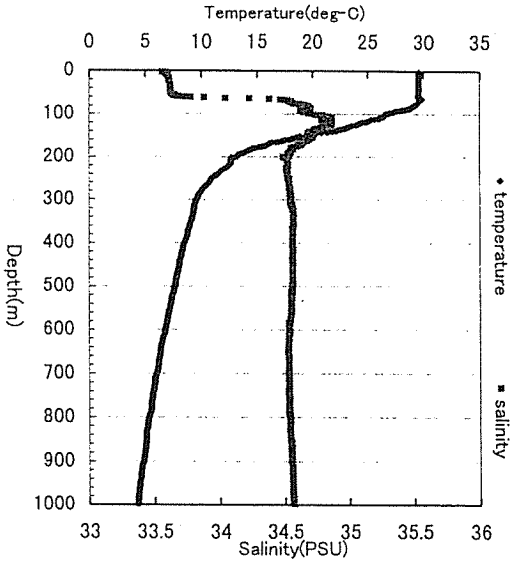
St.x54(05-00N,130-00E)



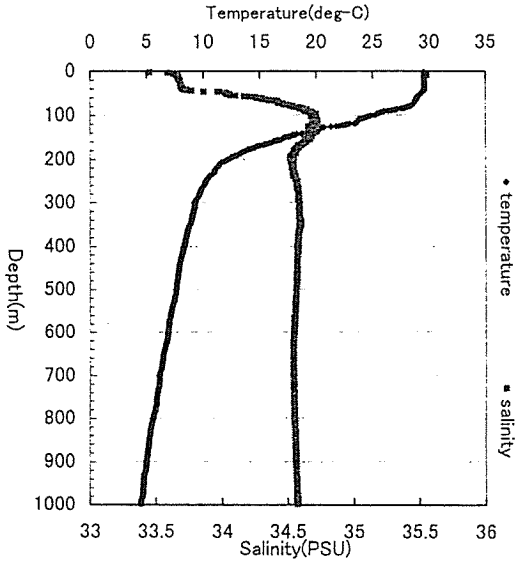
St.X60(08-00N,130-00E)



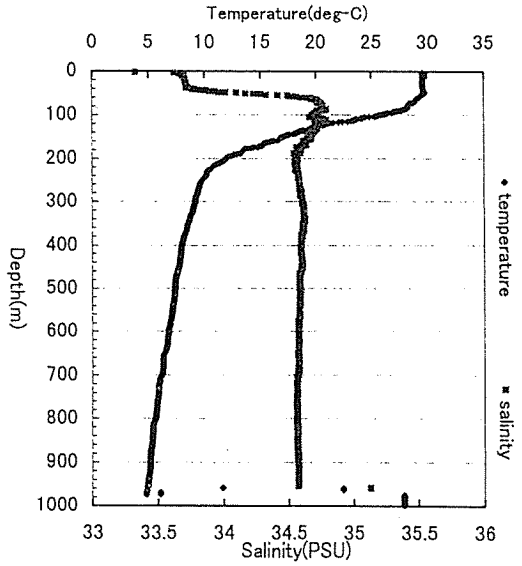
St.X73(07-00N,135-00E)



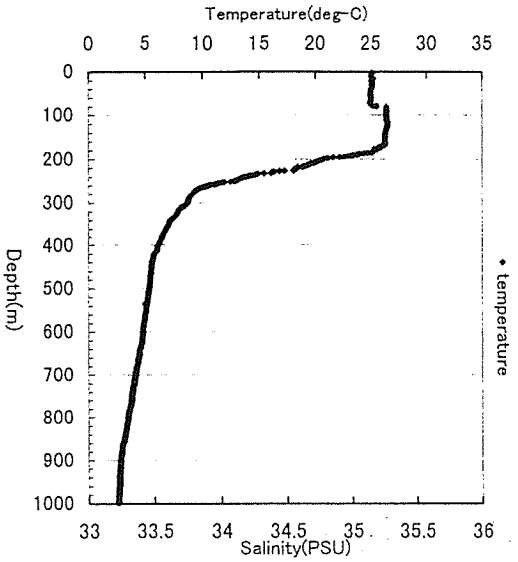
St.X74(06-30N,135-00E)



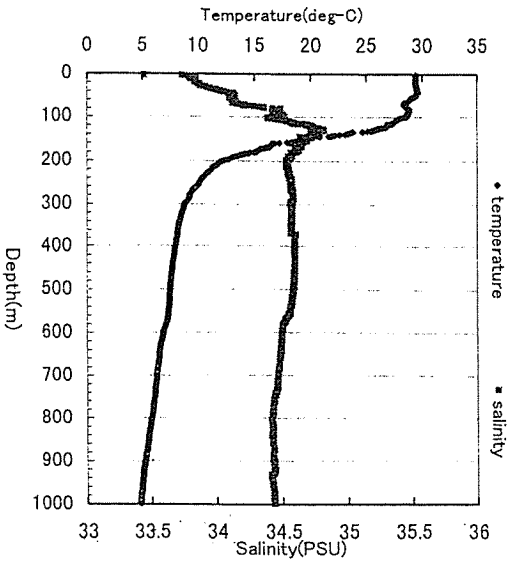
St.X75(06-00N,135-00E)



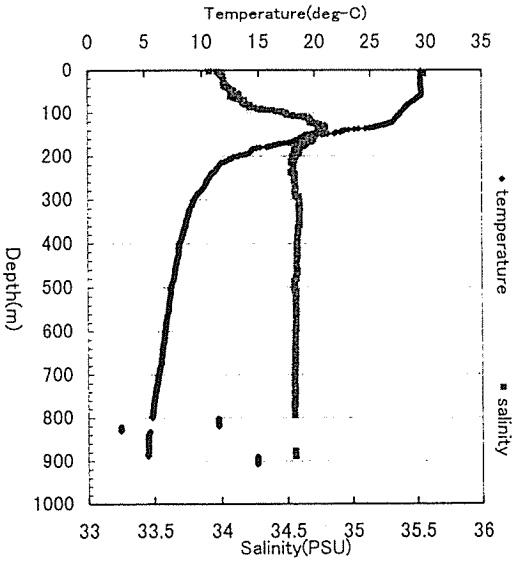
St.X76(05-30N,135-00E)



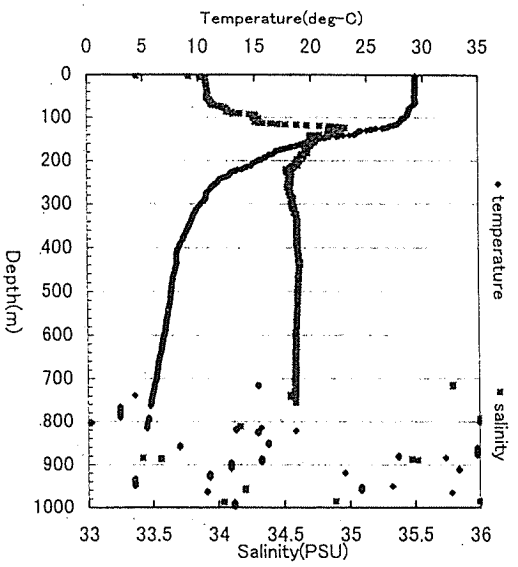
St.X77(05-00N,135-00E)



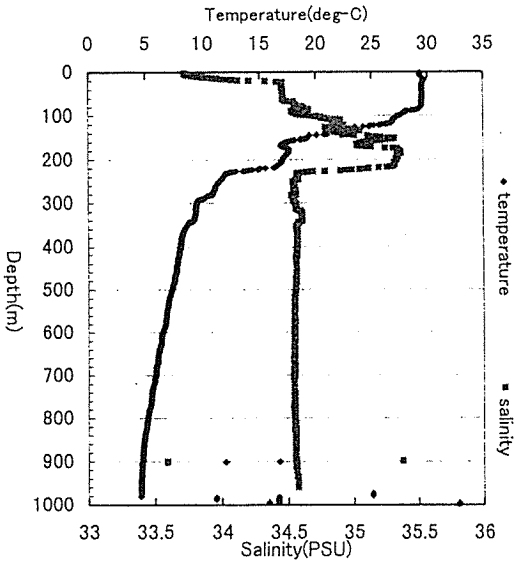
St.X78(04-30N,135-00E)



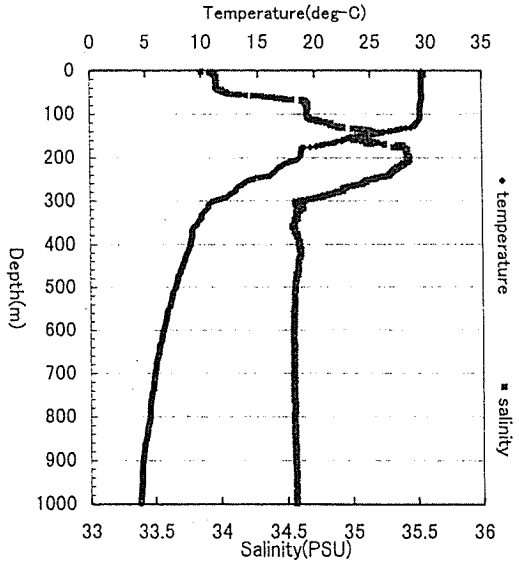
St.X79(04-00N,135-00E)



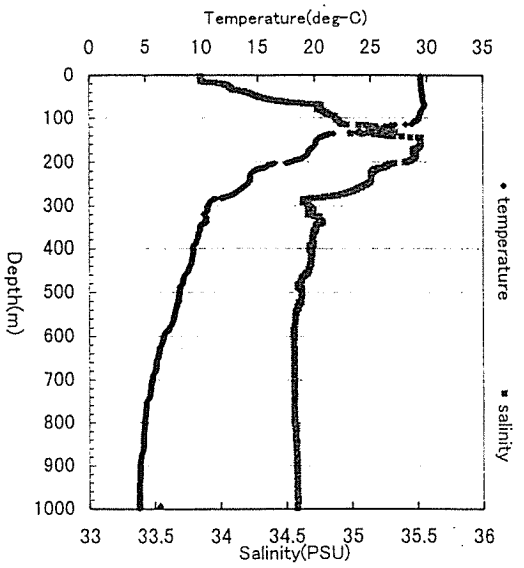
St.X80(03-30N,135-00E)



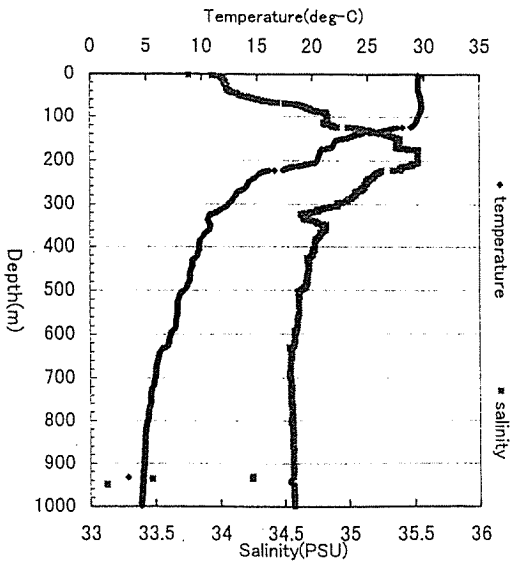
St.X81(03-00N,135-00E)



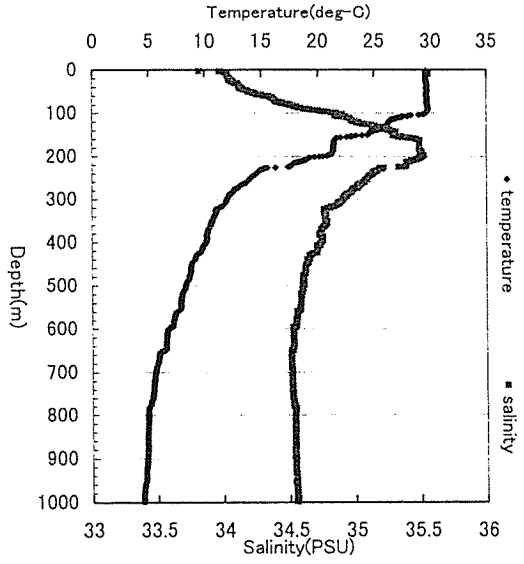
St.X82(02-30N,135-00E)



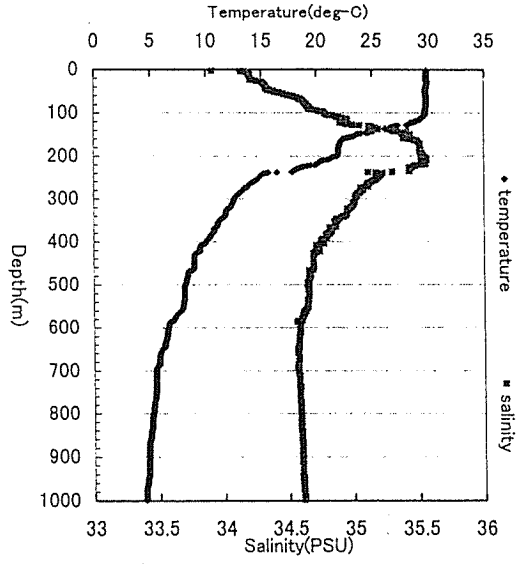
St.X83(02-00N,135-00E)



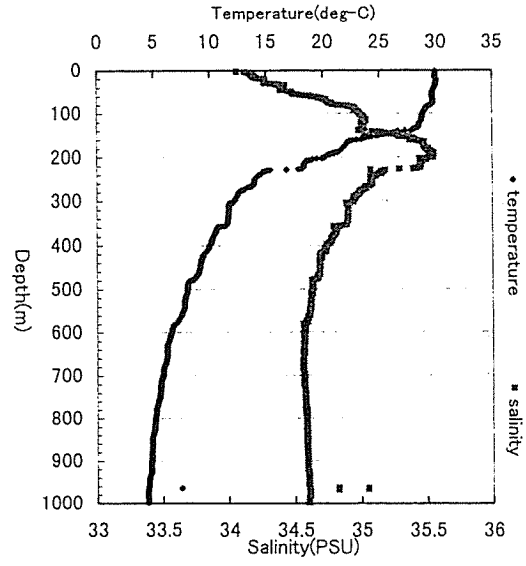
St.X84(01-30N,135-00E)



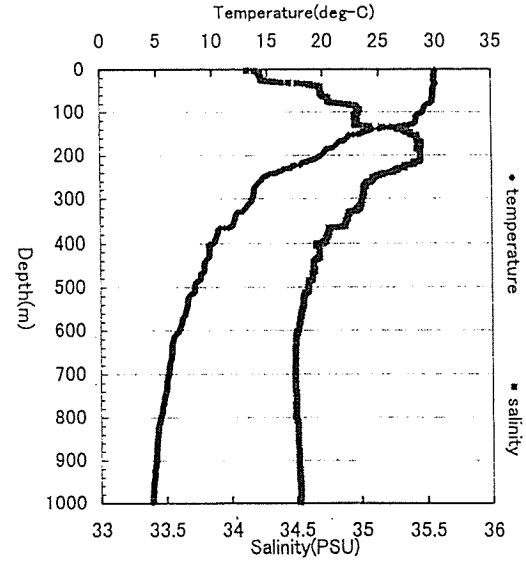
St.X85(01-00N,135-00E)



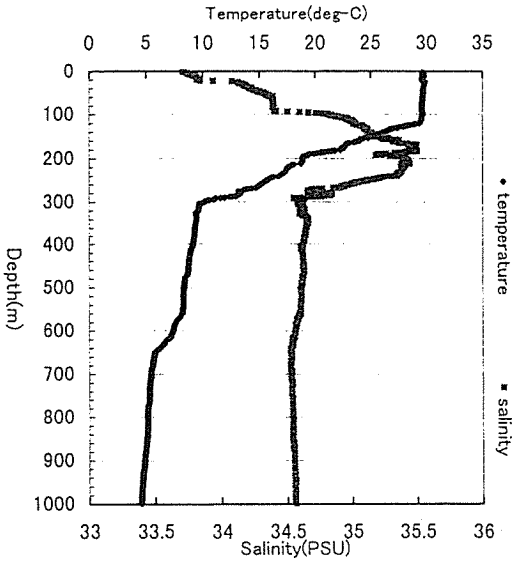
St.X86(00-30N,135-00E)



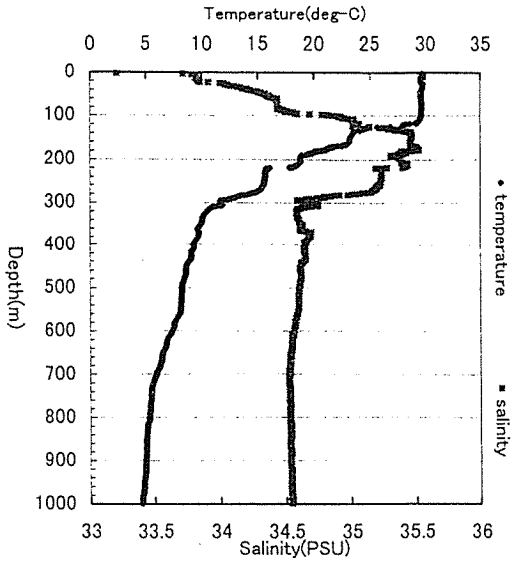
St.X87(00-10N,135-00E)



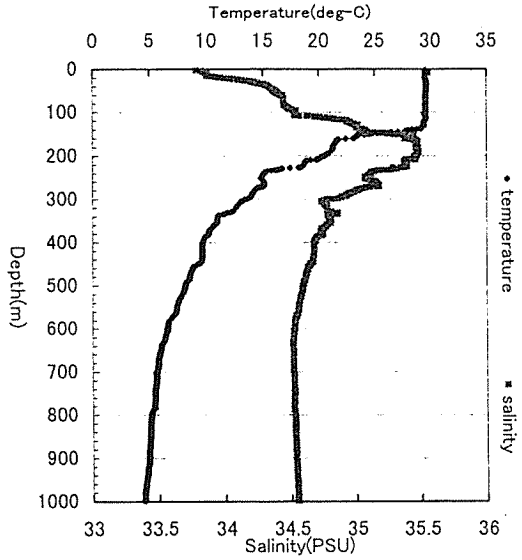
St.X90(01-30N,138-00E)



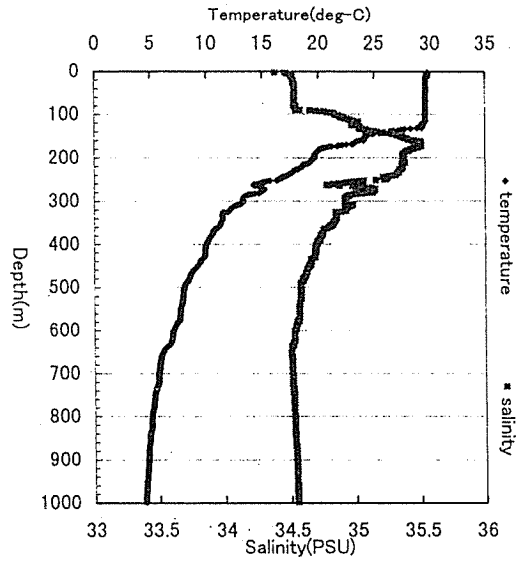
St.X91(01-00N,138-00E)



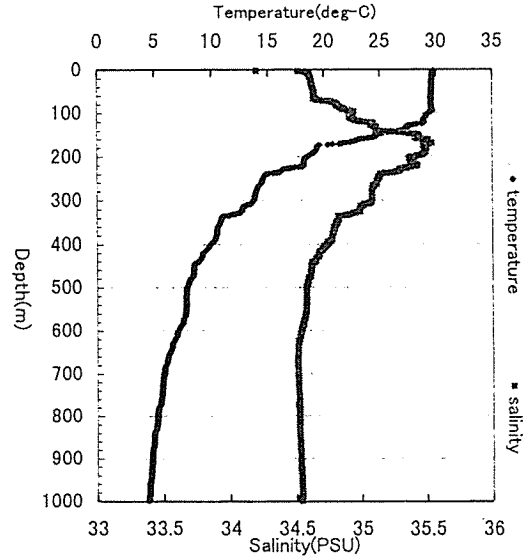
St.X92(00-30N,138-00E)



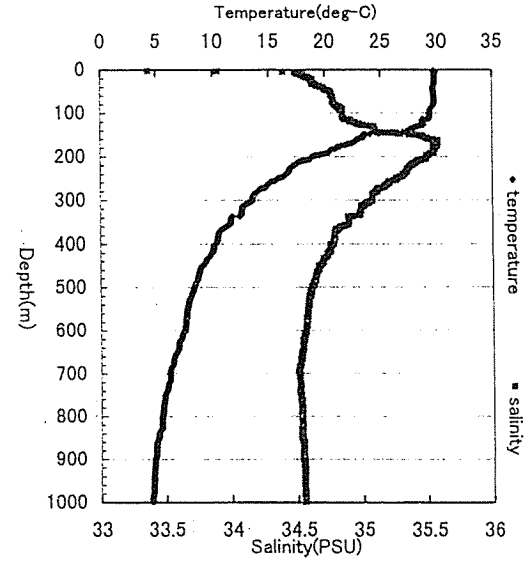
St.X93(00-00N,138-00E)



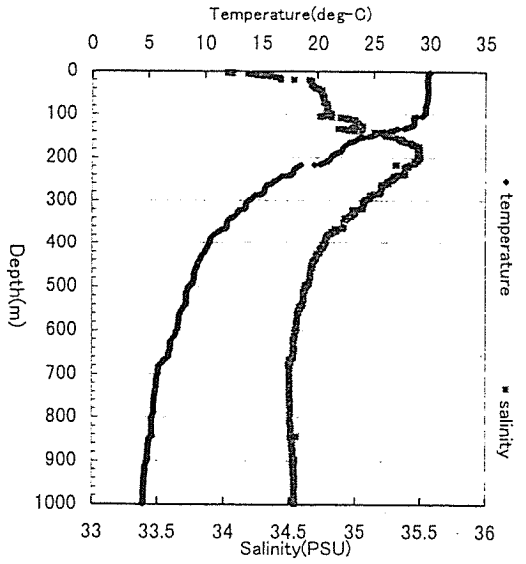
St.X94(00-30S,138-00E)



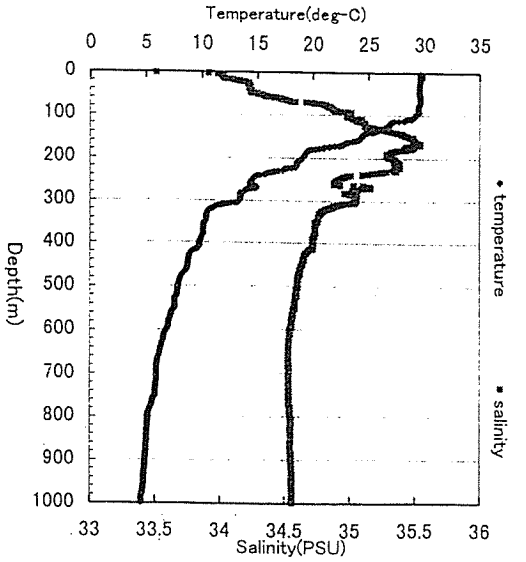
St.X95(01-00S,138-00E)



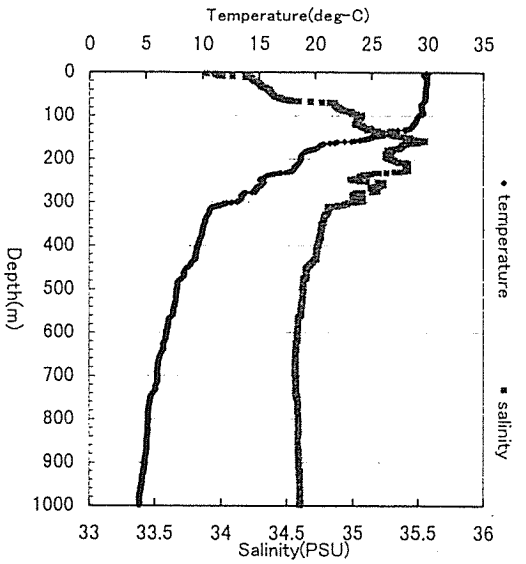
St.X96(01-15S,138-00E)



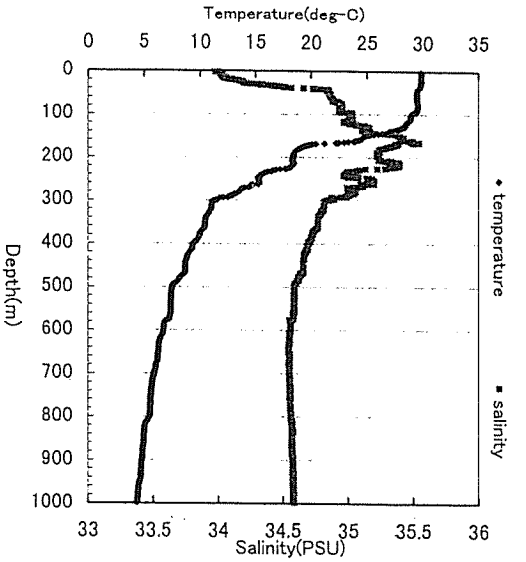
St.X97(00-00N,139-00E)



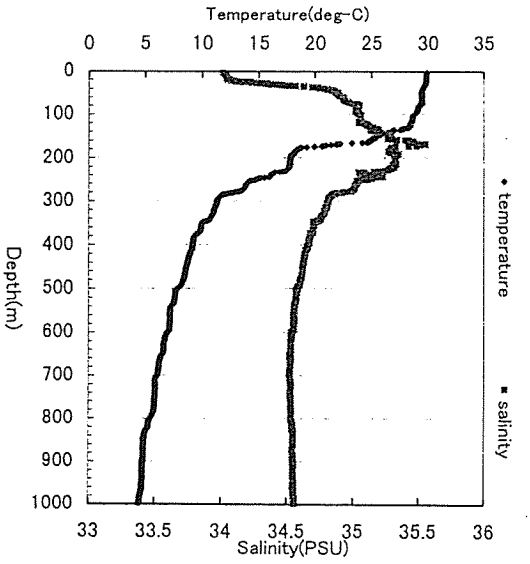
St.X98(00-00N,140-00E)



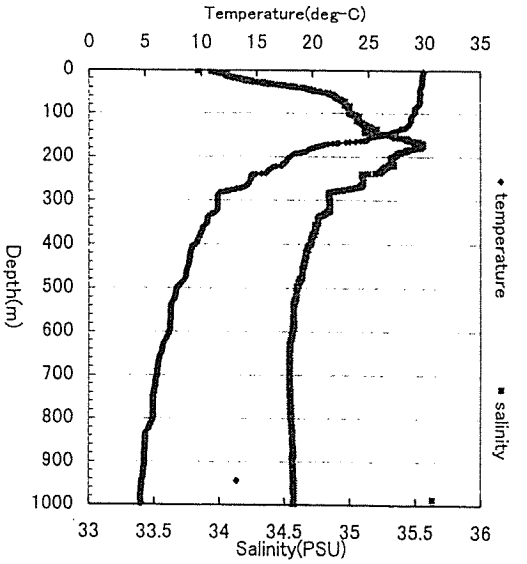
St.X99(00-00N,141-00E)



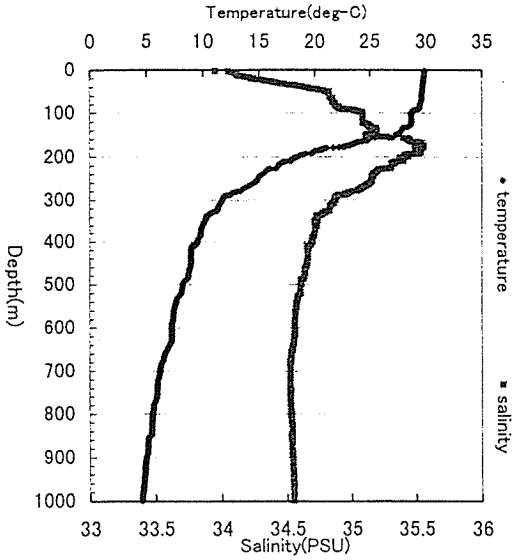
St.X100(00-00N,142-00E)



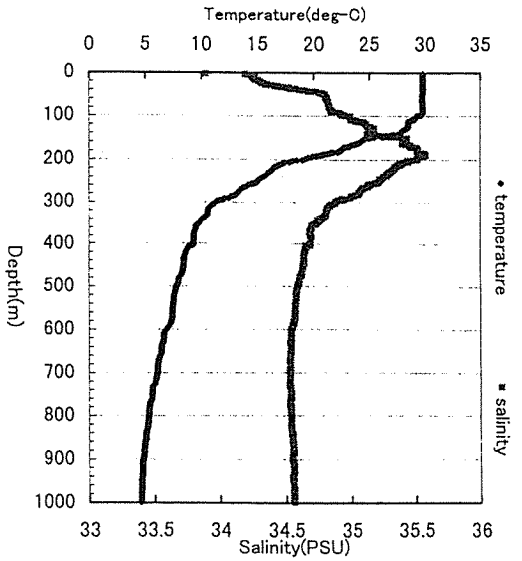
St.X101(00-30S,142-00E)



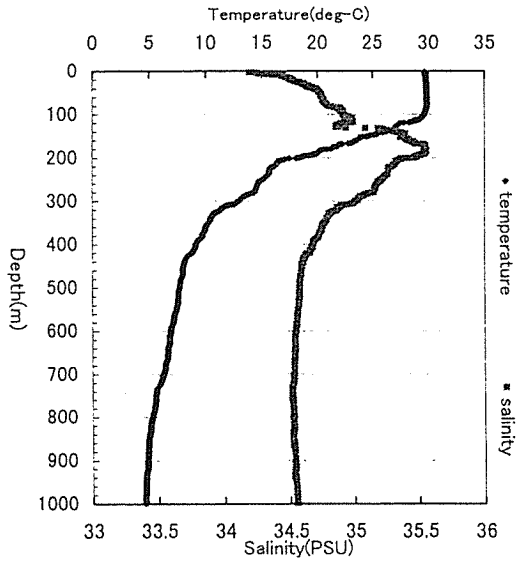
St.X102(01-00S,142-00E)



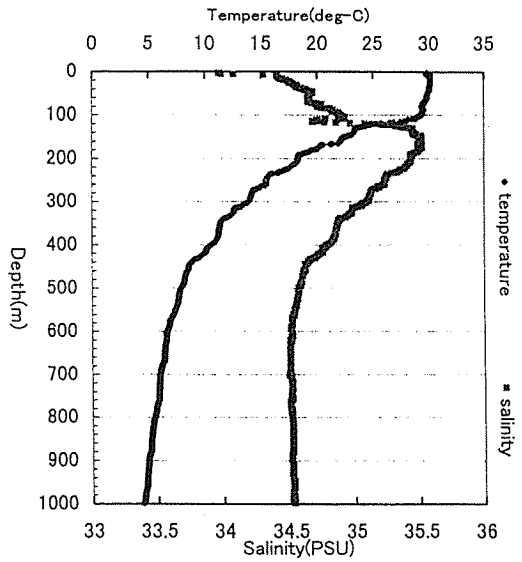
St.X103(01-30S,142-00E)



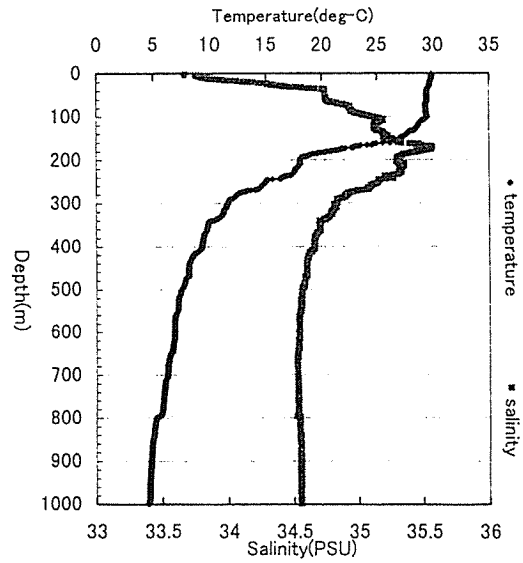
St.X104(02-00S,142-00E)



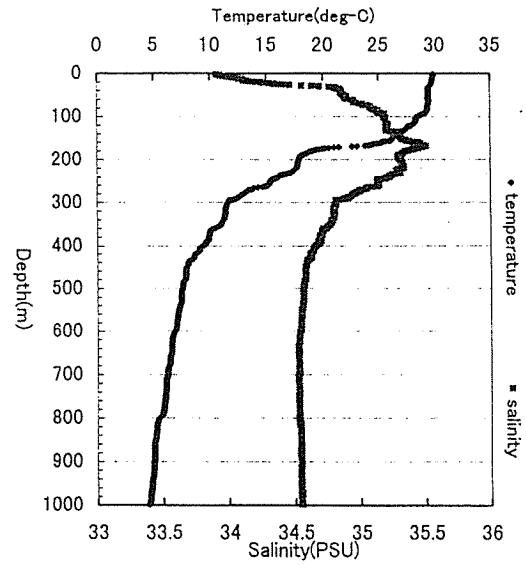
St.X105(02-43S,142-00E)



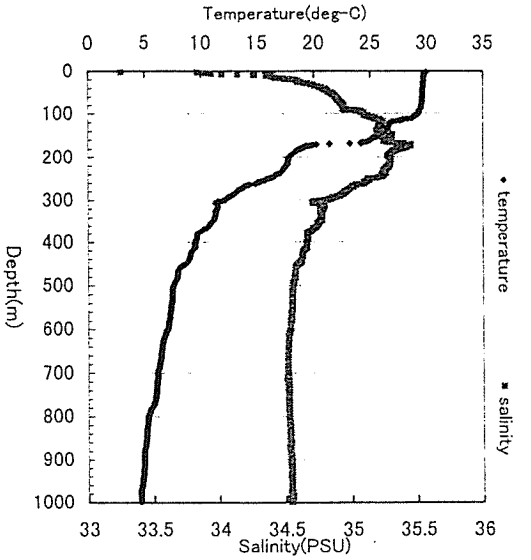
St.X107(00-00N,143-00E)



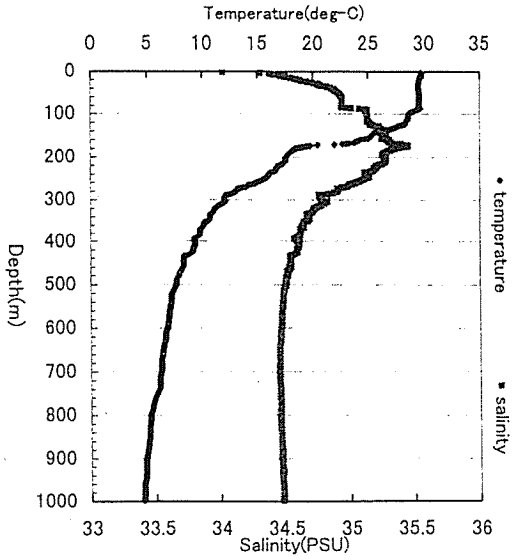
St.X108(00-00N,144-00E)



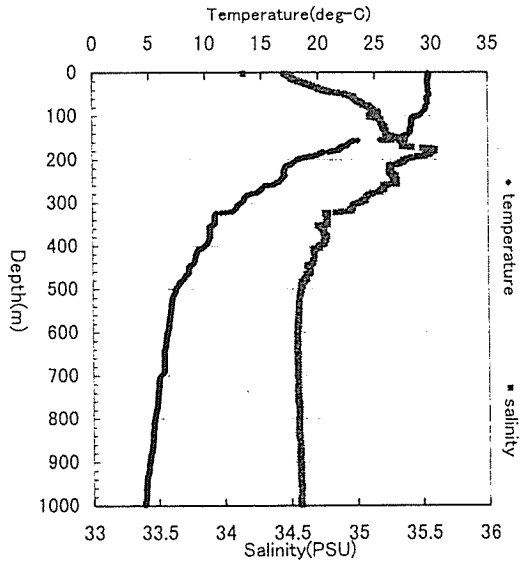
St.X109(00-00N,145-00E)



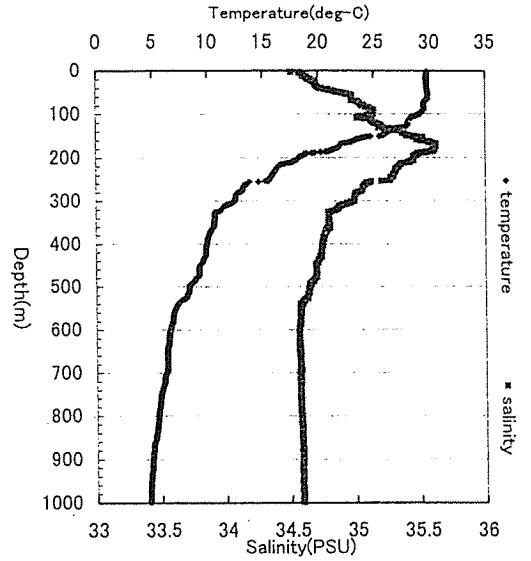
St.X110(00-00N,146-00E)



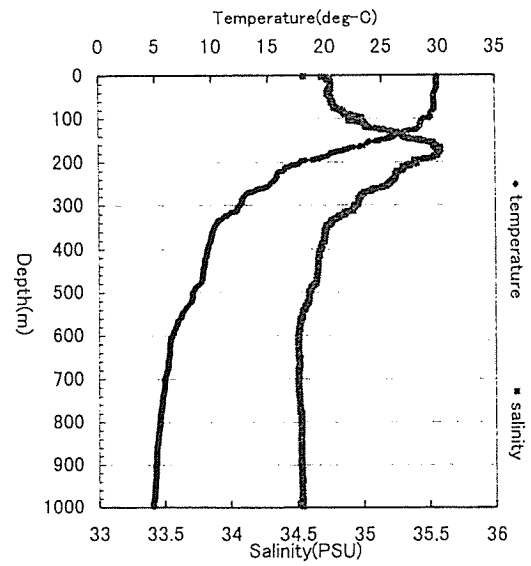
St.X112(00-30S,147-00E)



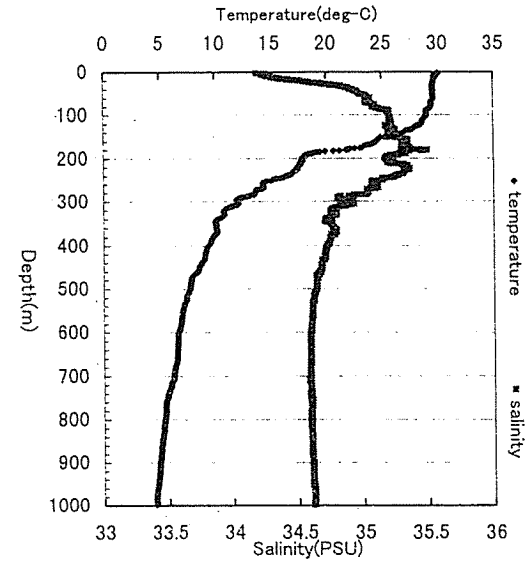
St.X113(01-00S,147-00E)



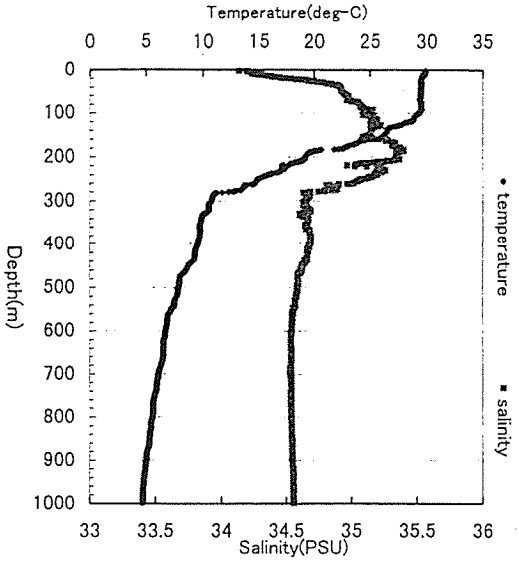
St.X114(01-30S,147-00E)



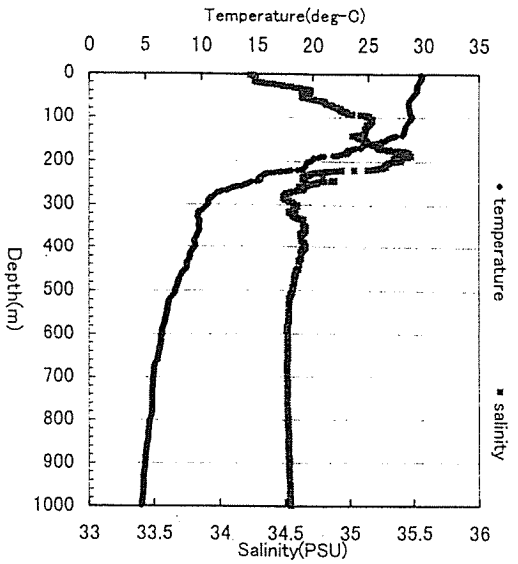
St.X116(00-30N,147-00E)



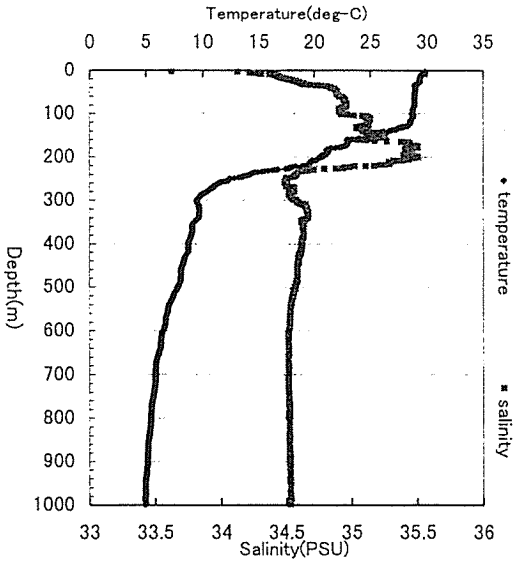
St.X117(01-00N,147-00E)



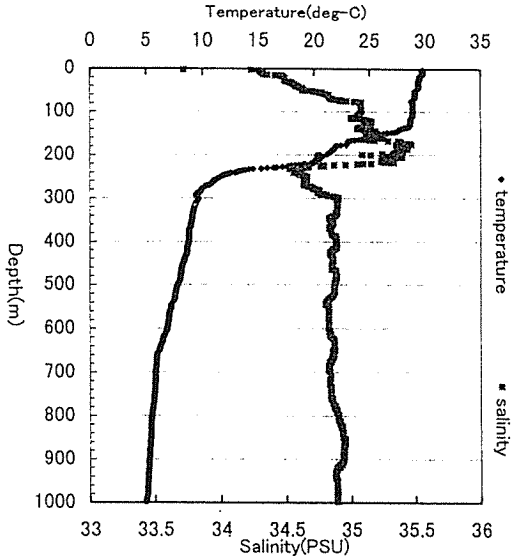
St.X118(01-30N,147-00E)



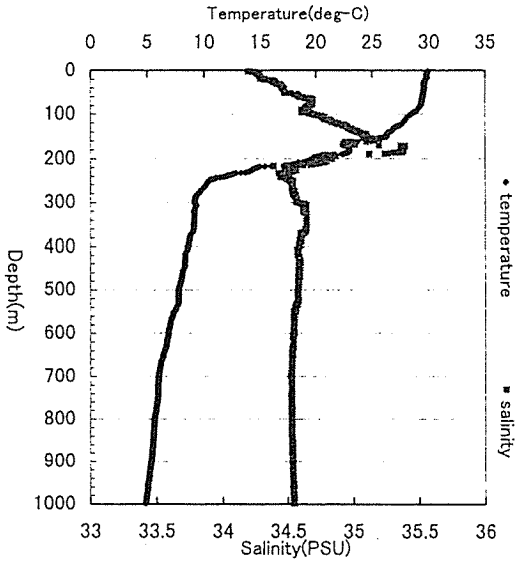
St.X119(02-00N,147-00E)



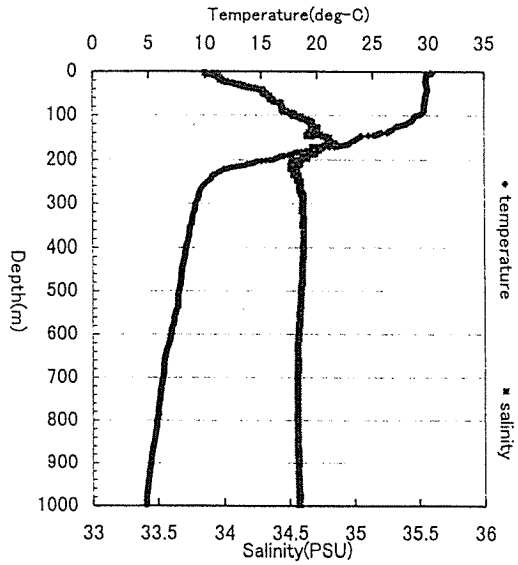
St.X120(02-30N,147-00E)



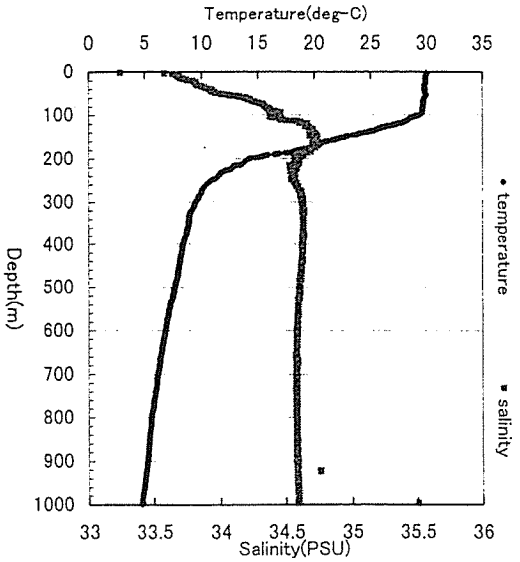
St.X121(03-00N,147-00E)



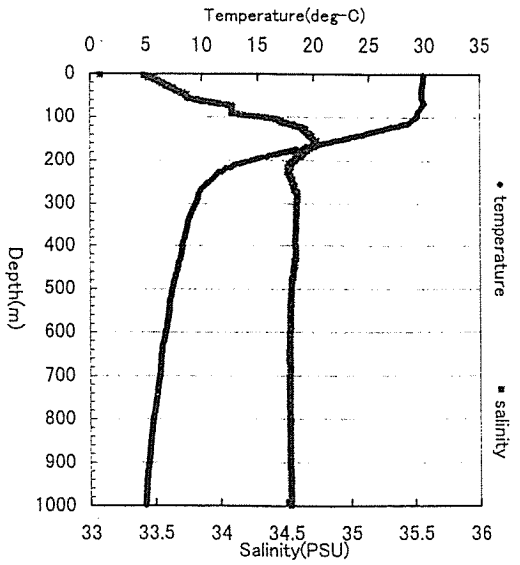
St.X122(03-30N,147-00E)



St.X123(04-00N,147-00E)



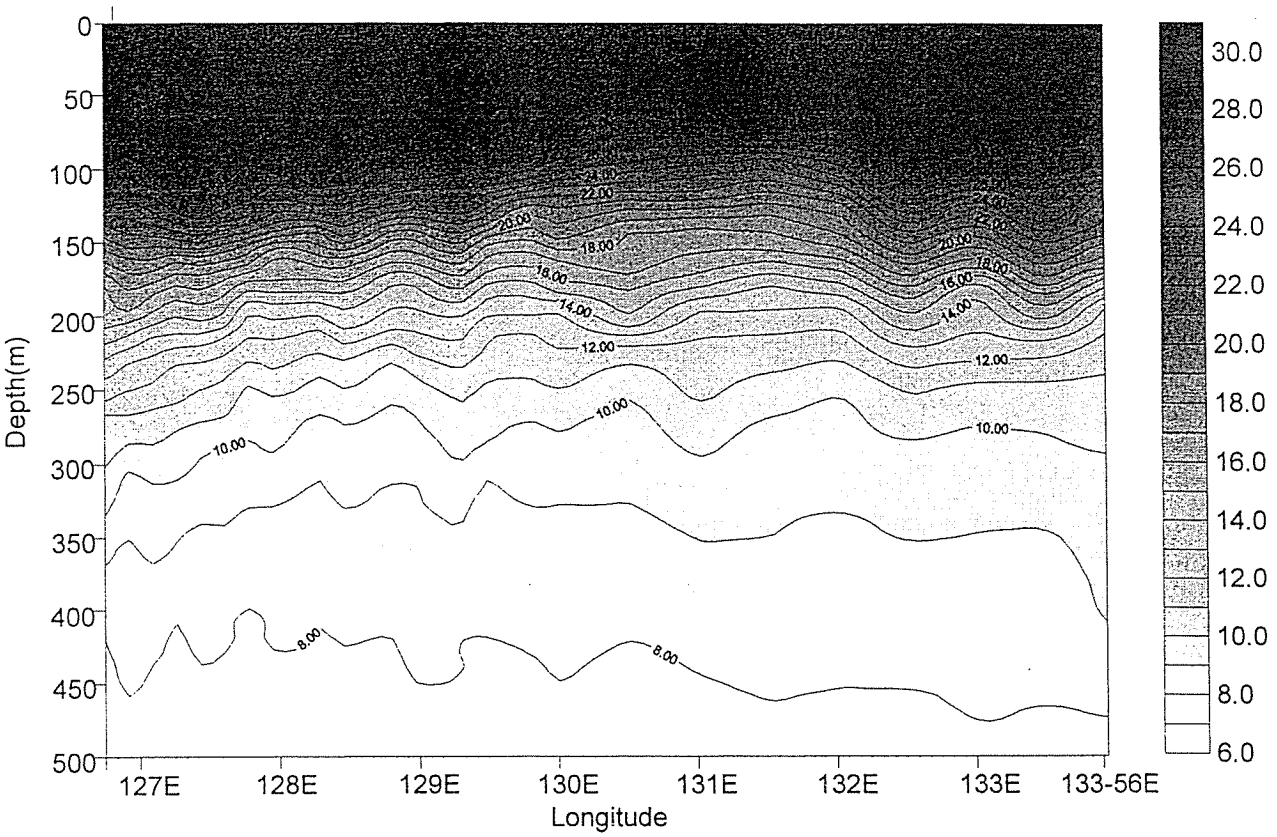
St.X124(04-30N,147-00E)



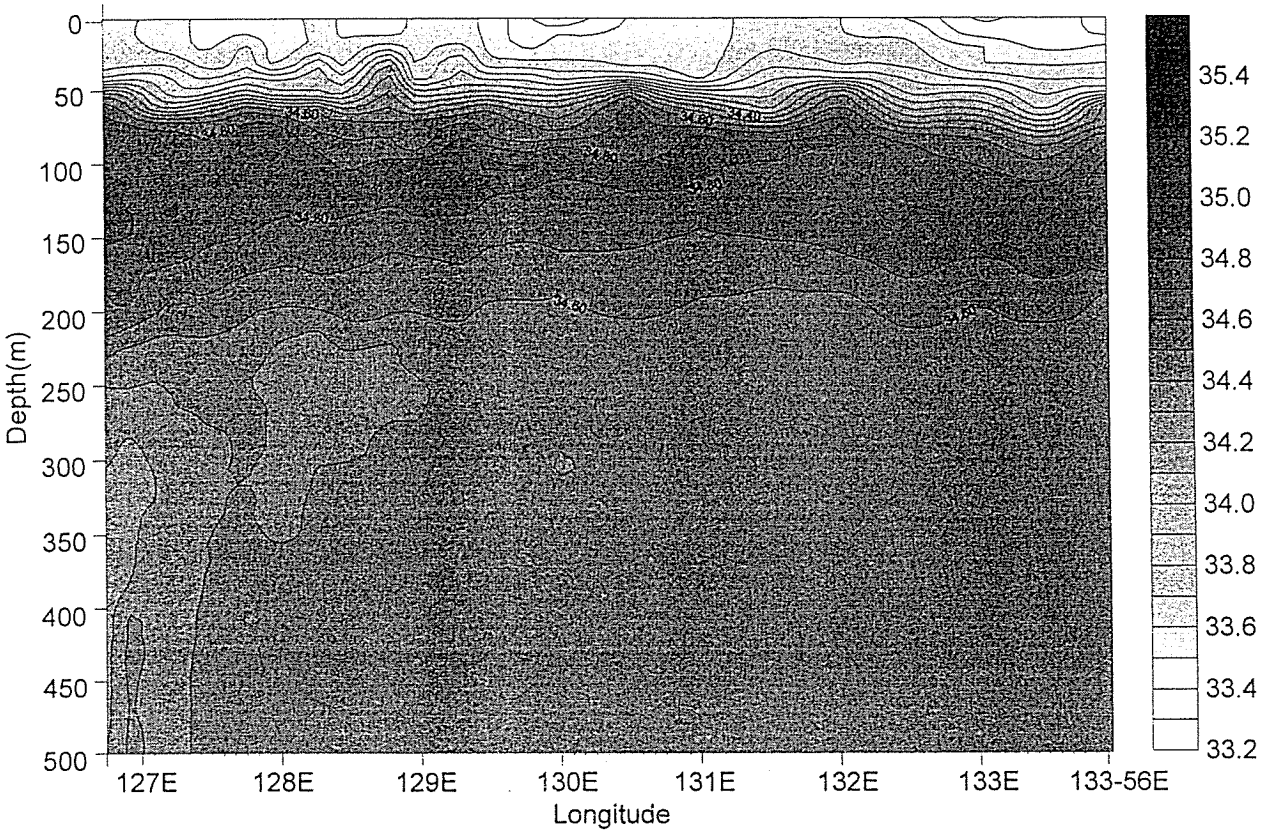
4.4 Sectios

4.4.1 Temperature and Salinity

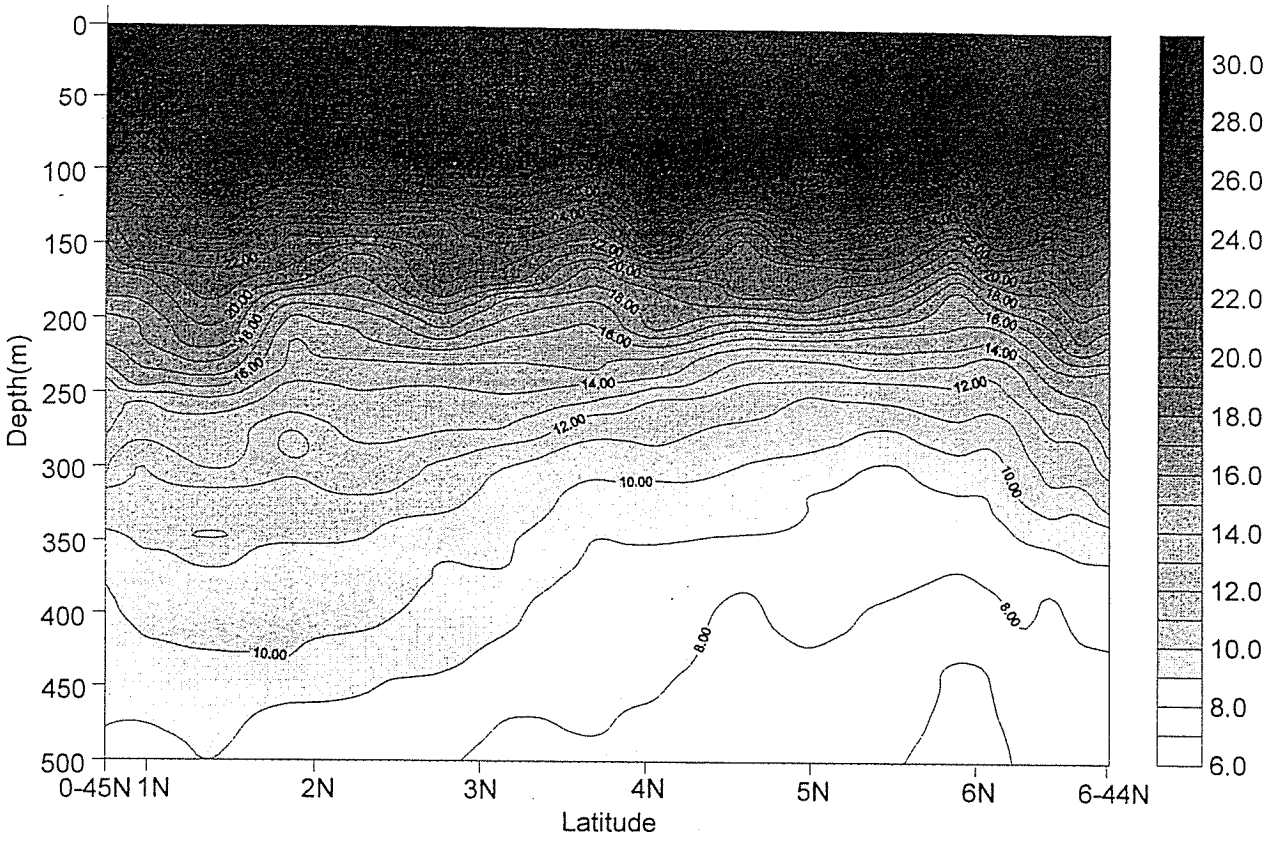
Temperature of CTD data KY99-09 C01-C24



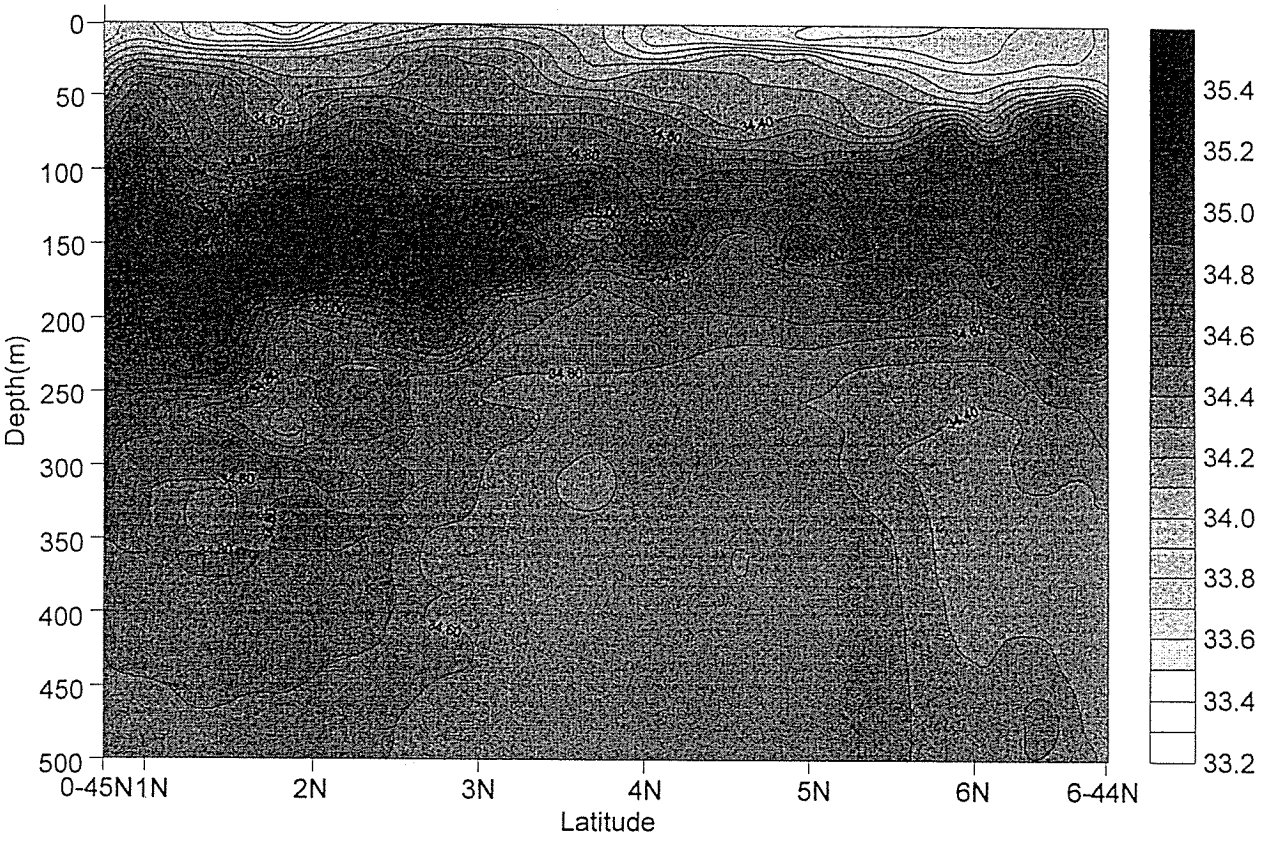
Salinity of CTD data KY99-09 C01-C24



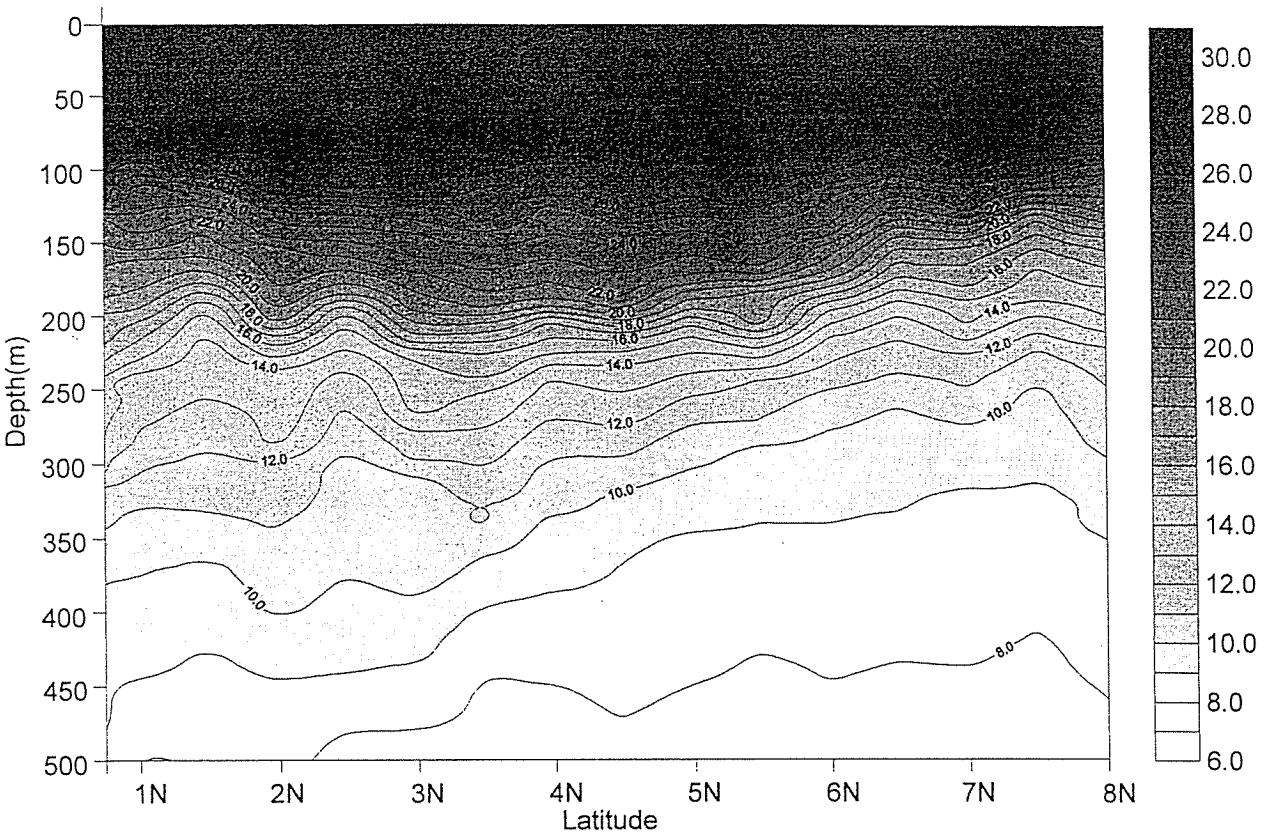
Temperature of CTD data KY99-09 C26-C45



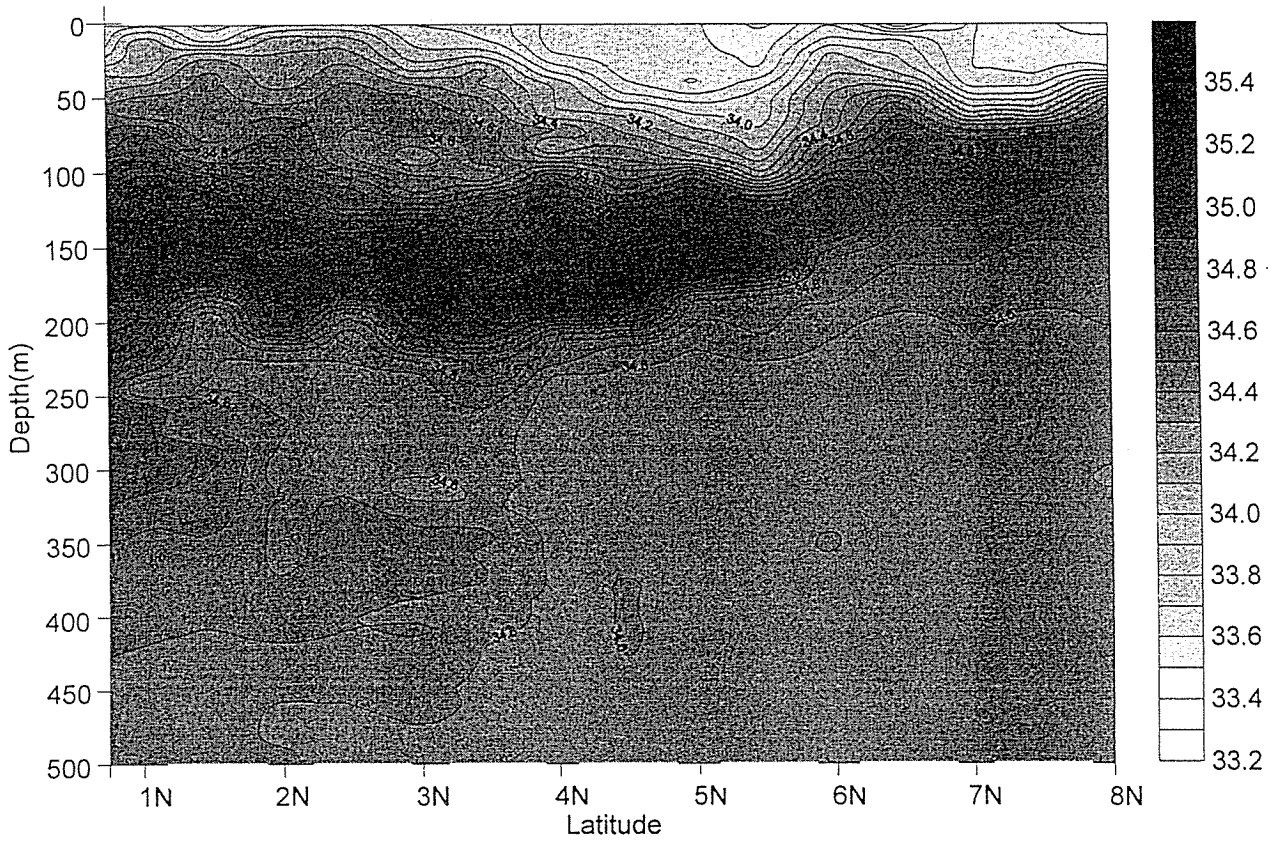
Salinity of CTD data KY99-09 C26-C45



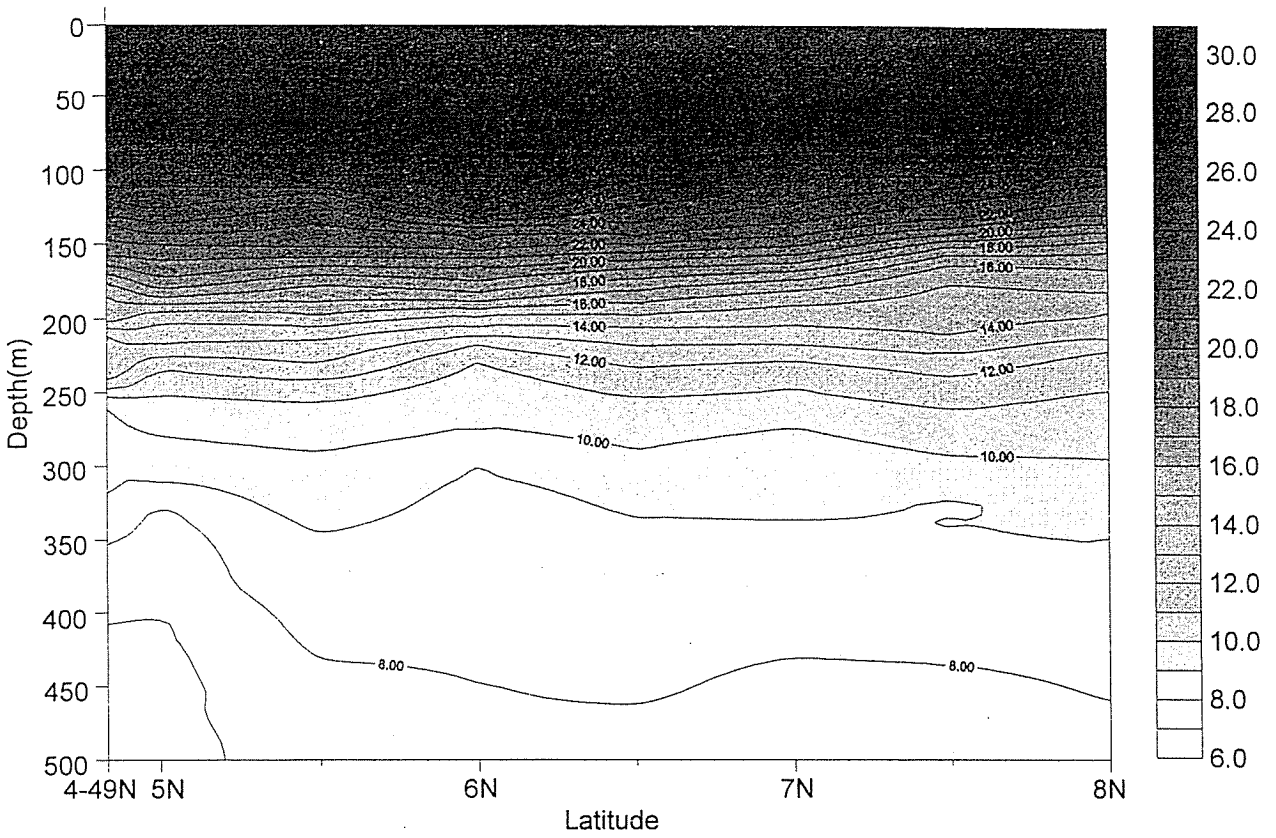
Temperature of CTD data KY99-09 C45-60



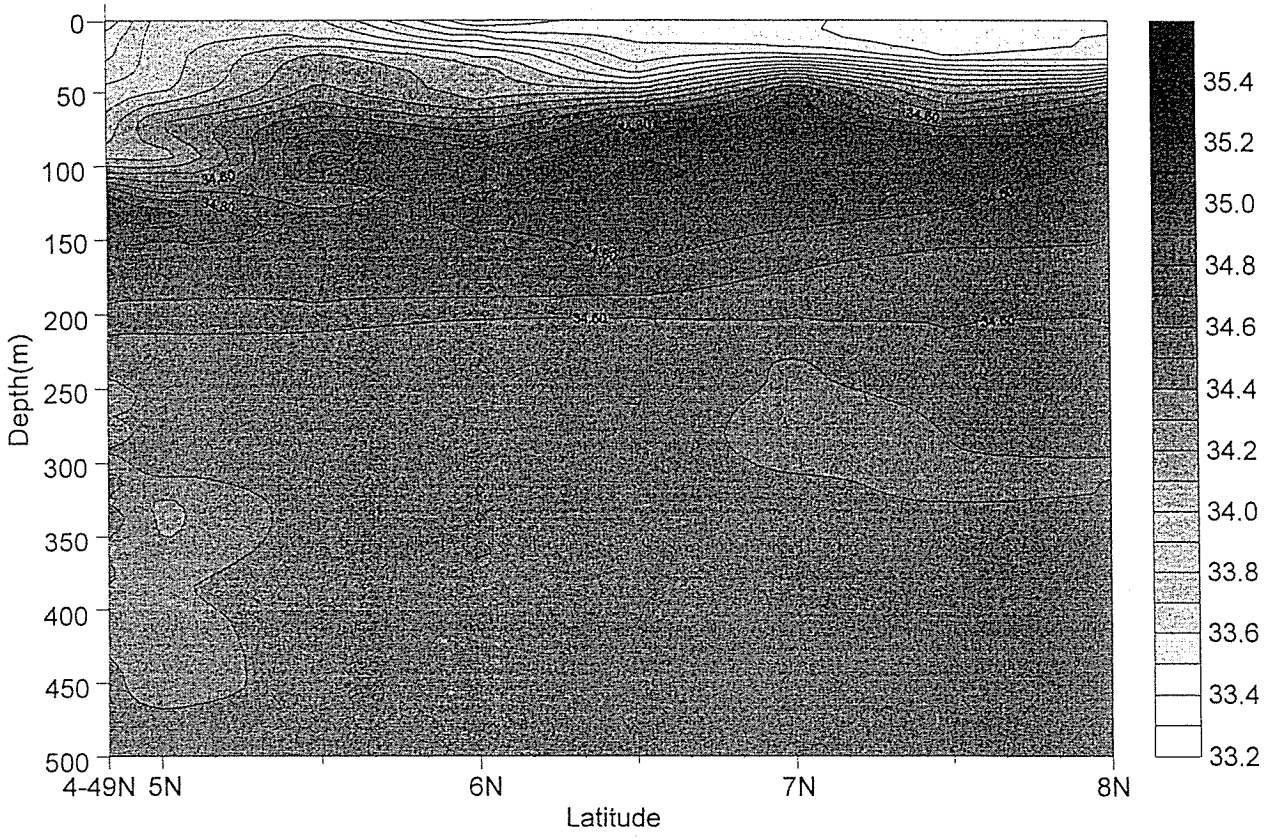
Salinity of CTD data KY99-09 C45-60



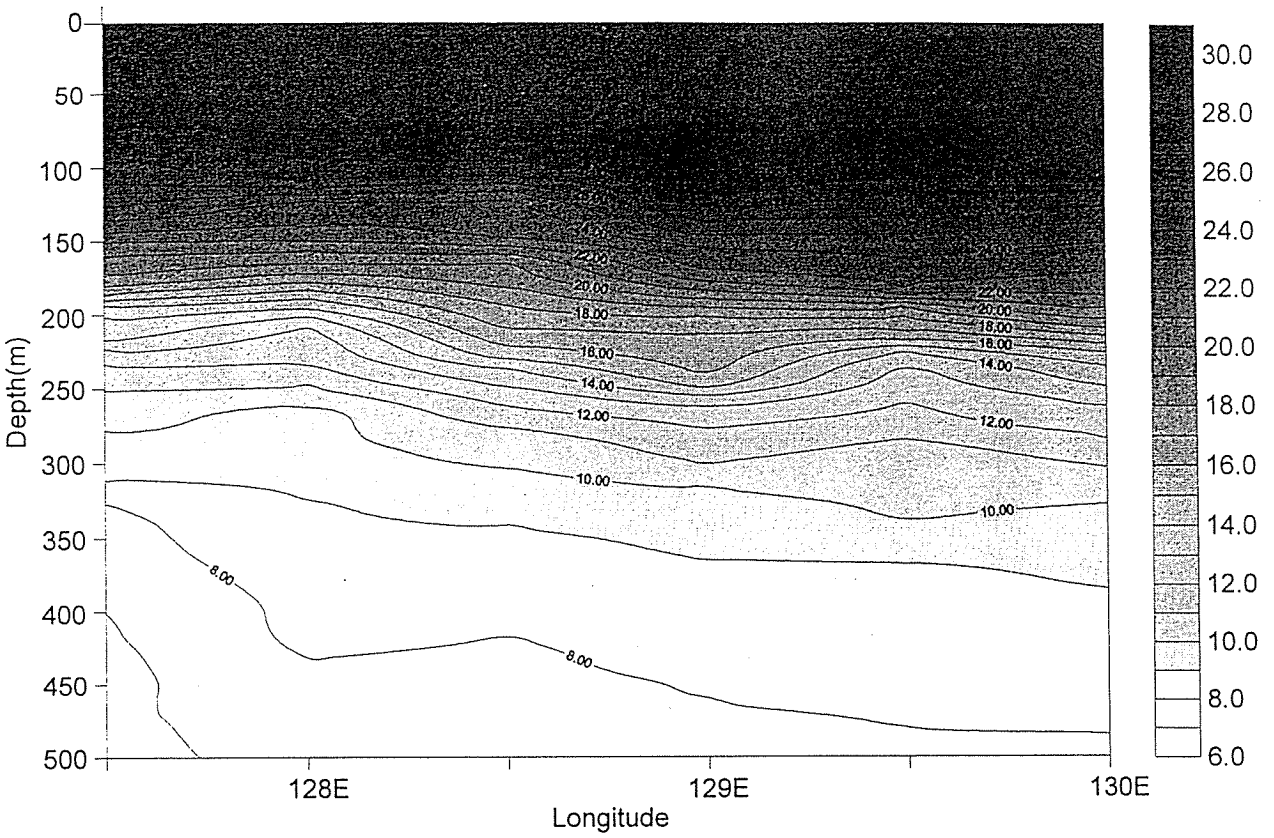
Temperature of CTD data KY99-09 C60-C67



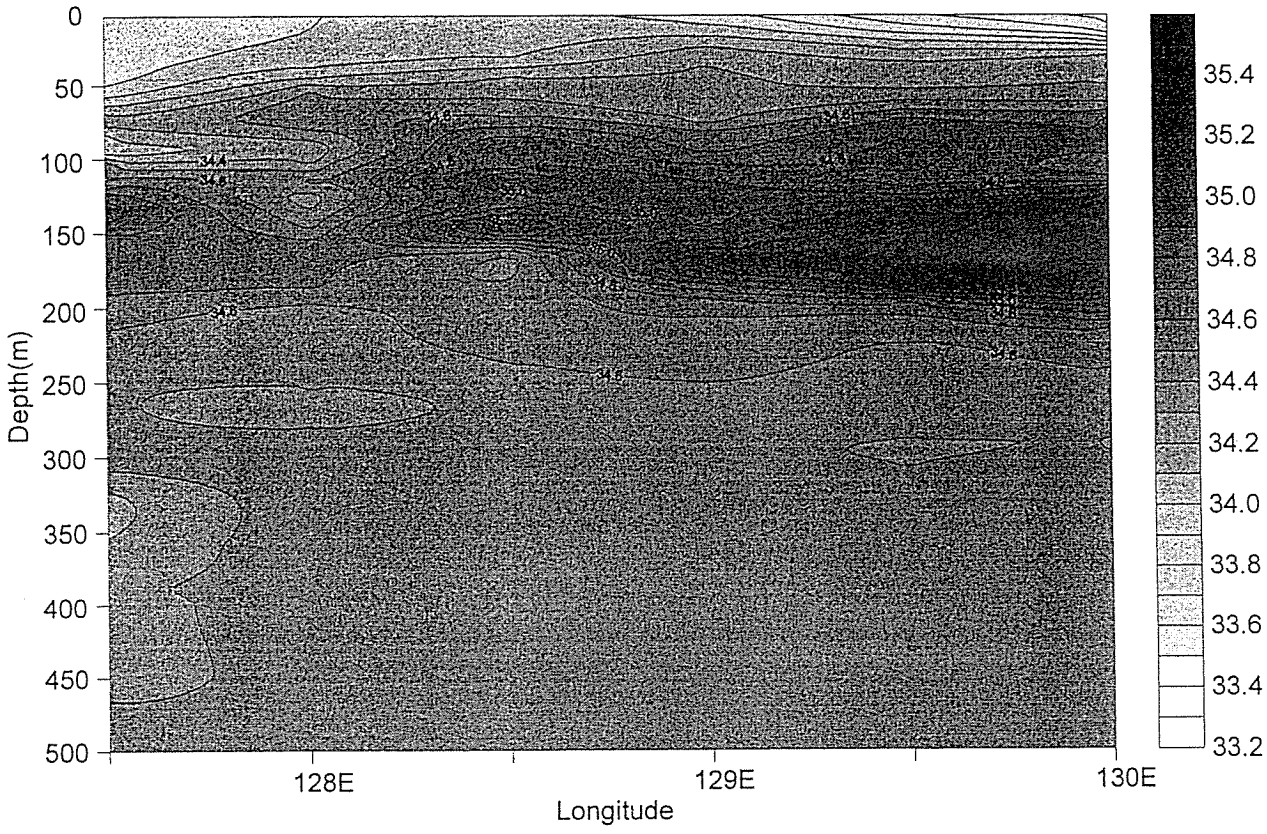
Salinity of CTD data KY99-09 C60-C67



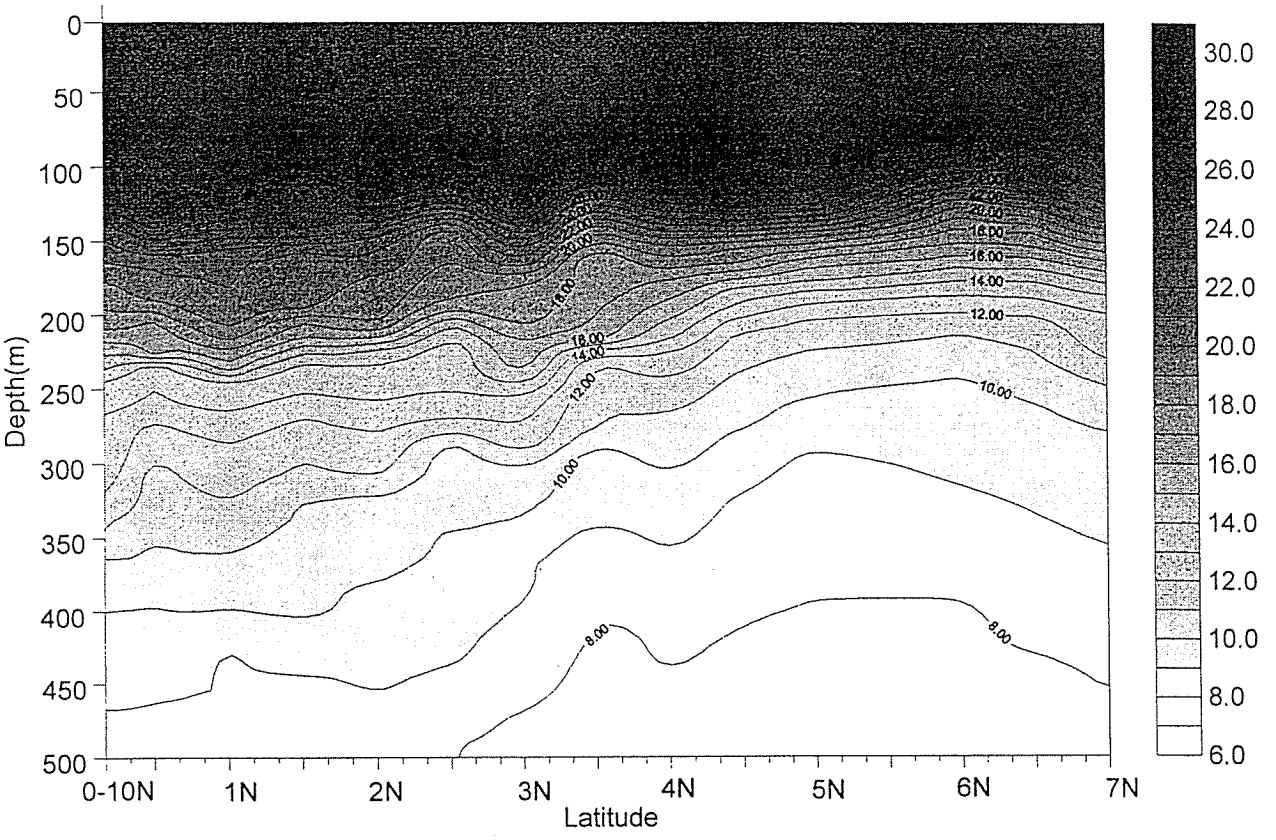
Temperature of CTD data KY99-09 C66-C72



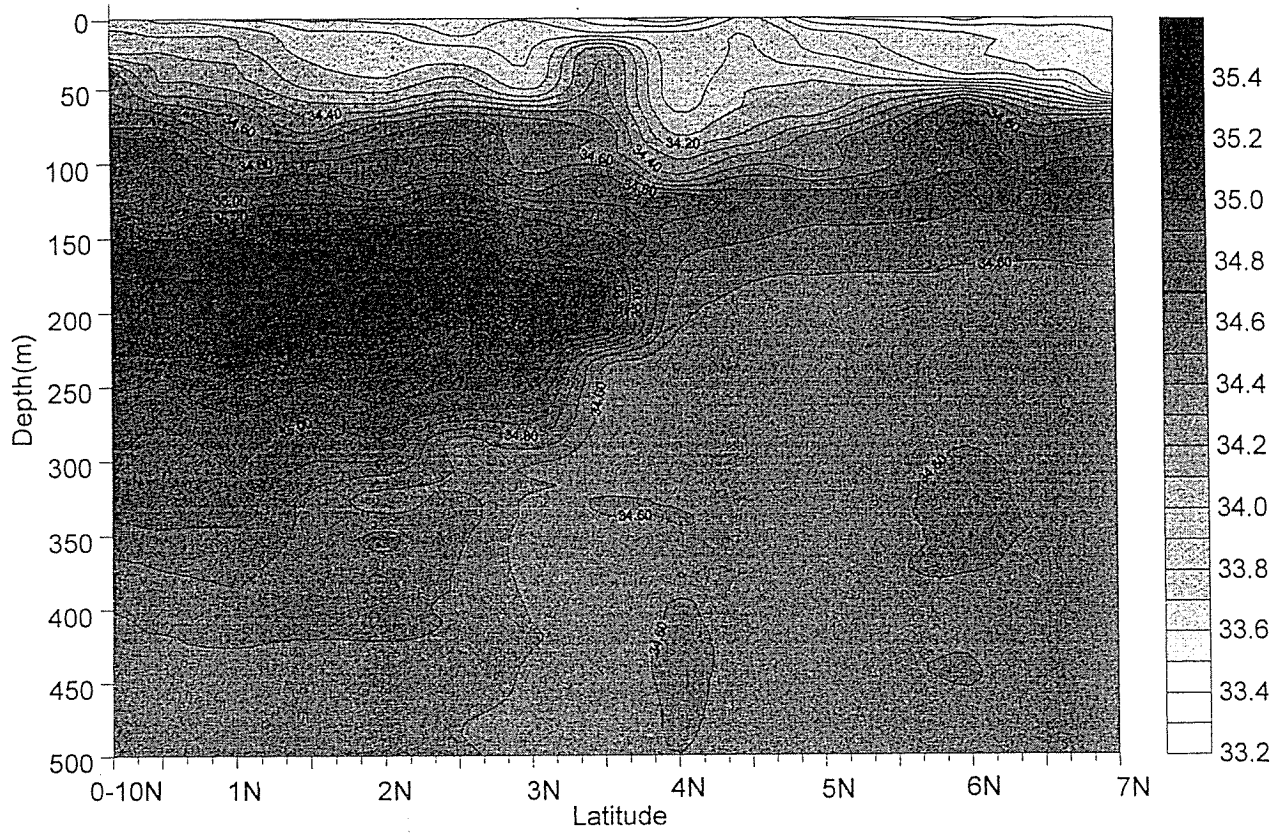
Salinity of CTD data KY99-09 C66-C72



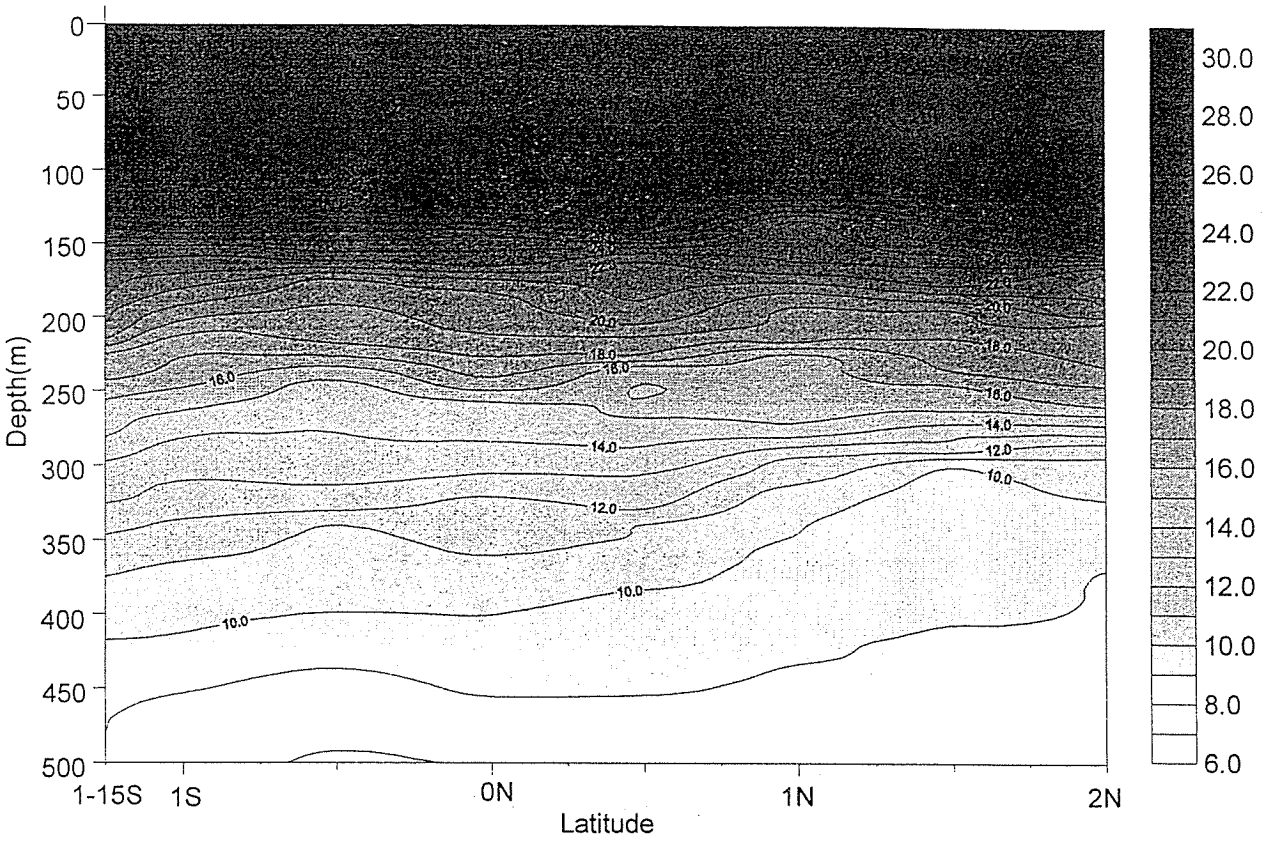
Temperature of XCTD data KY99-09 X73-X87



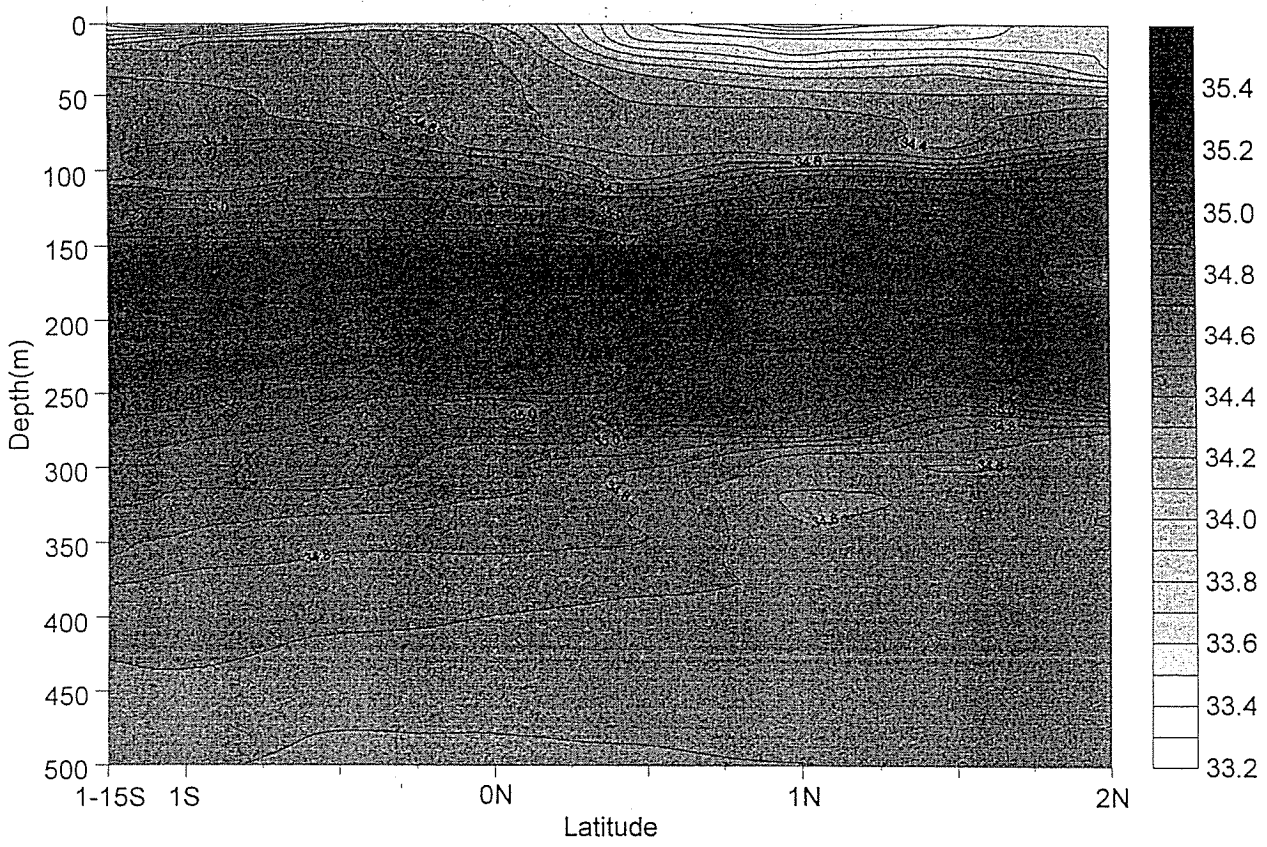
Salinity of XCTD data KY99-09 X73-X87



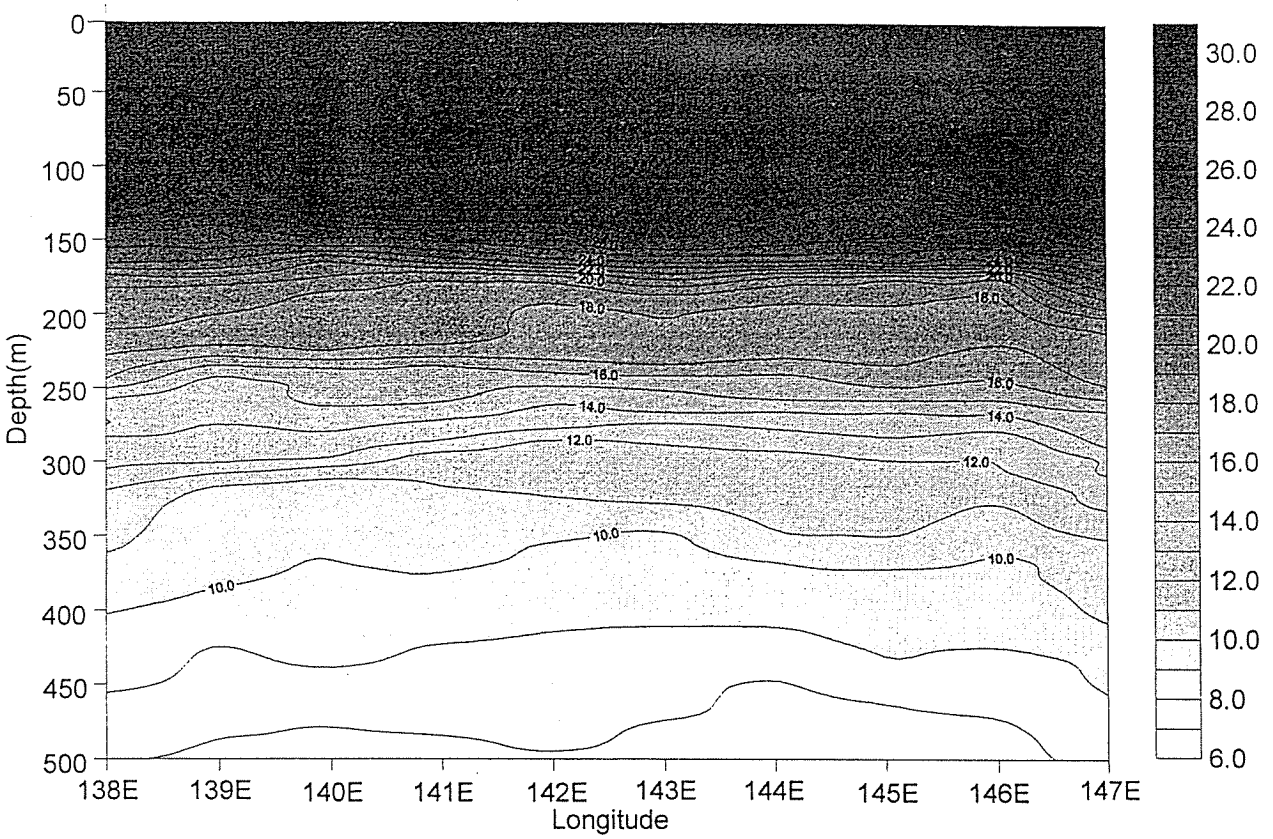
Temperature of XCTD data KY99-09 X90-X96



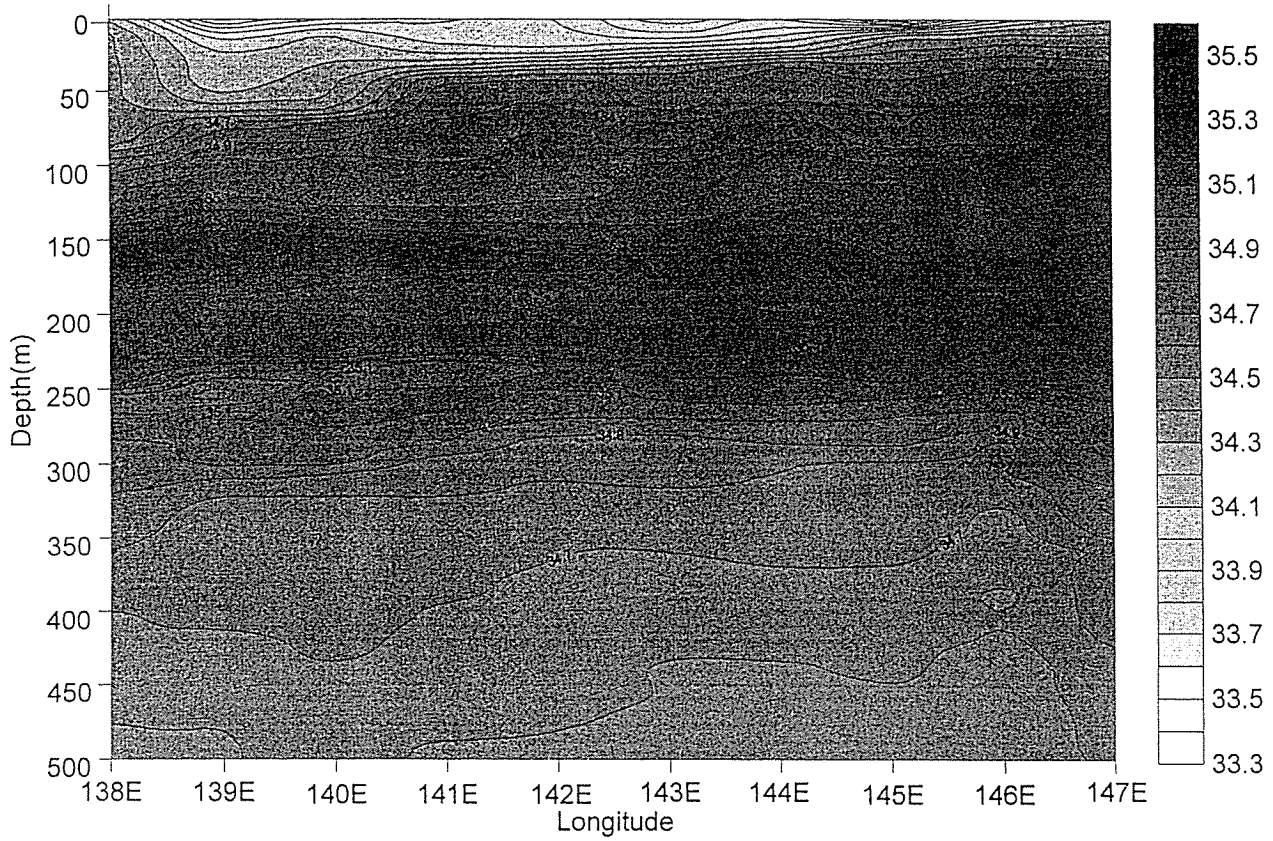
Salinity of XCTD data KY99-09 X90-X96



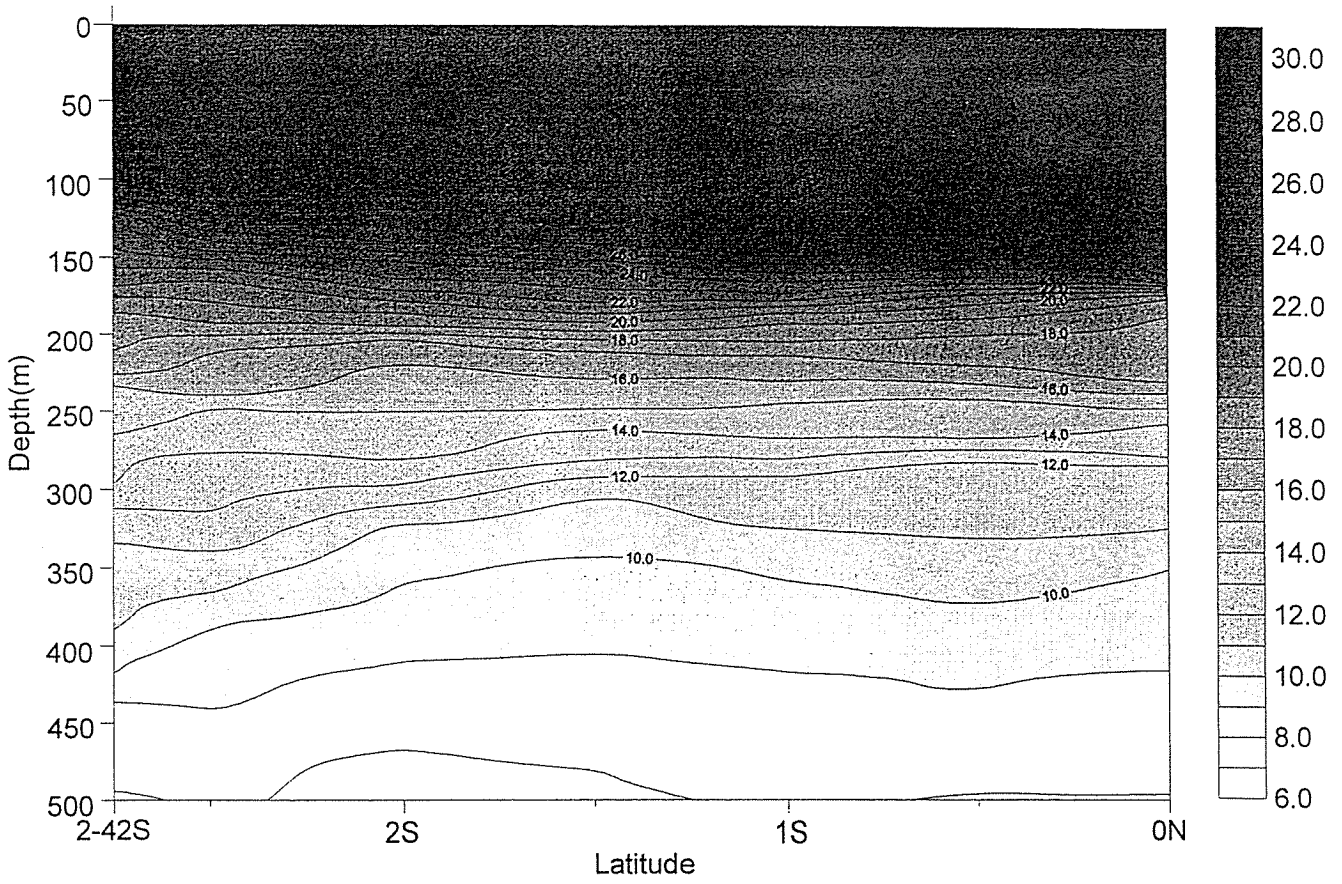
Temperature of XCTD data KY99-09 X093-X115



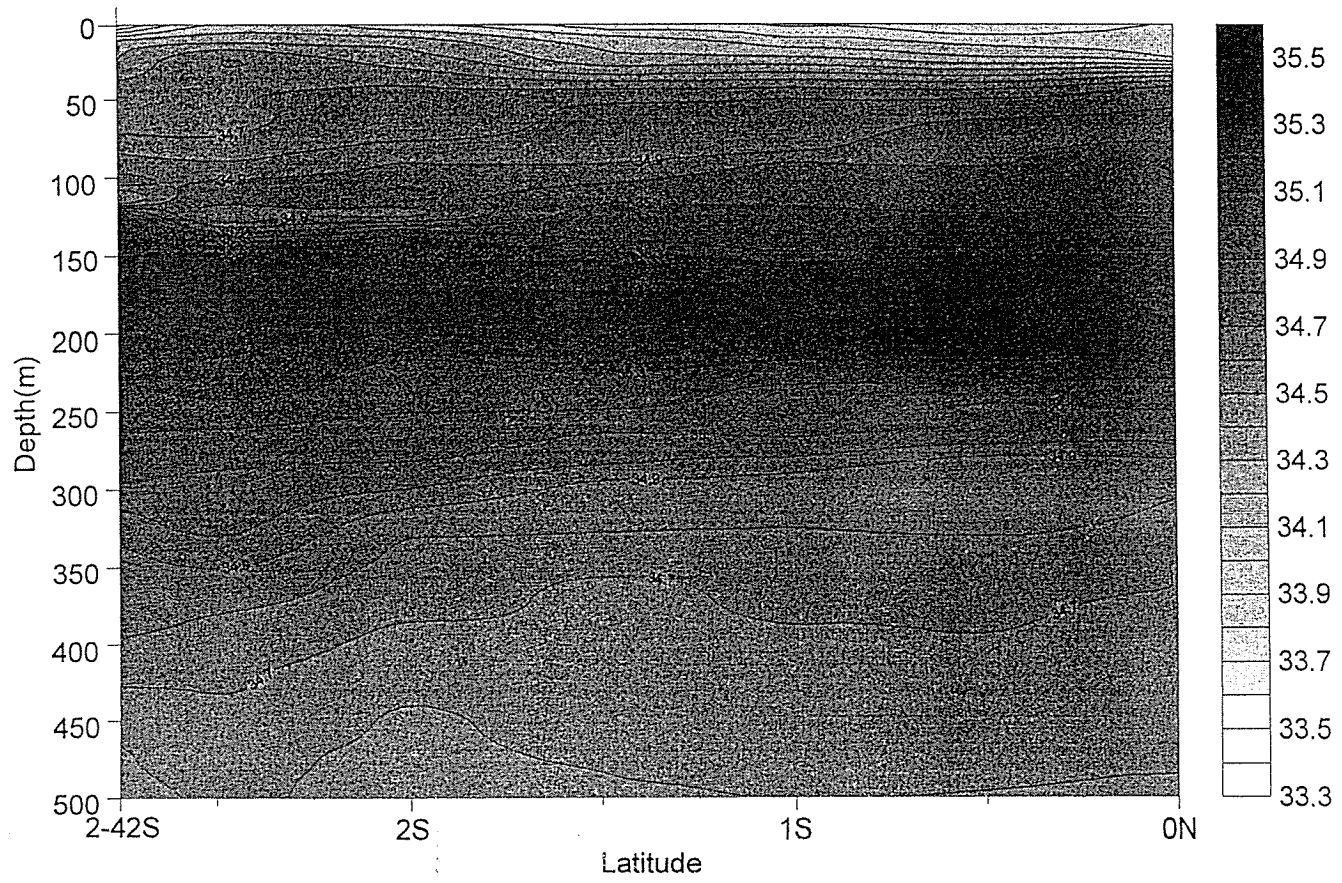
Salinity of XCTD data KY99-09 X93-X115



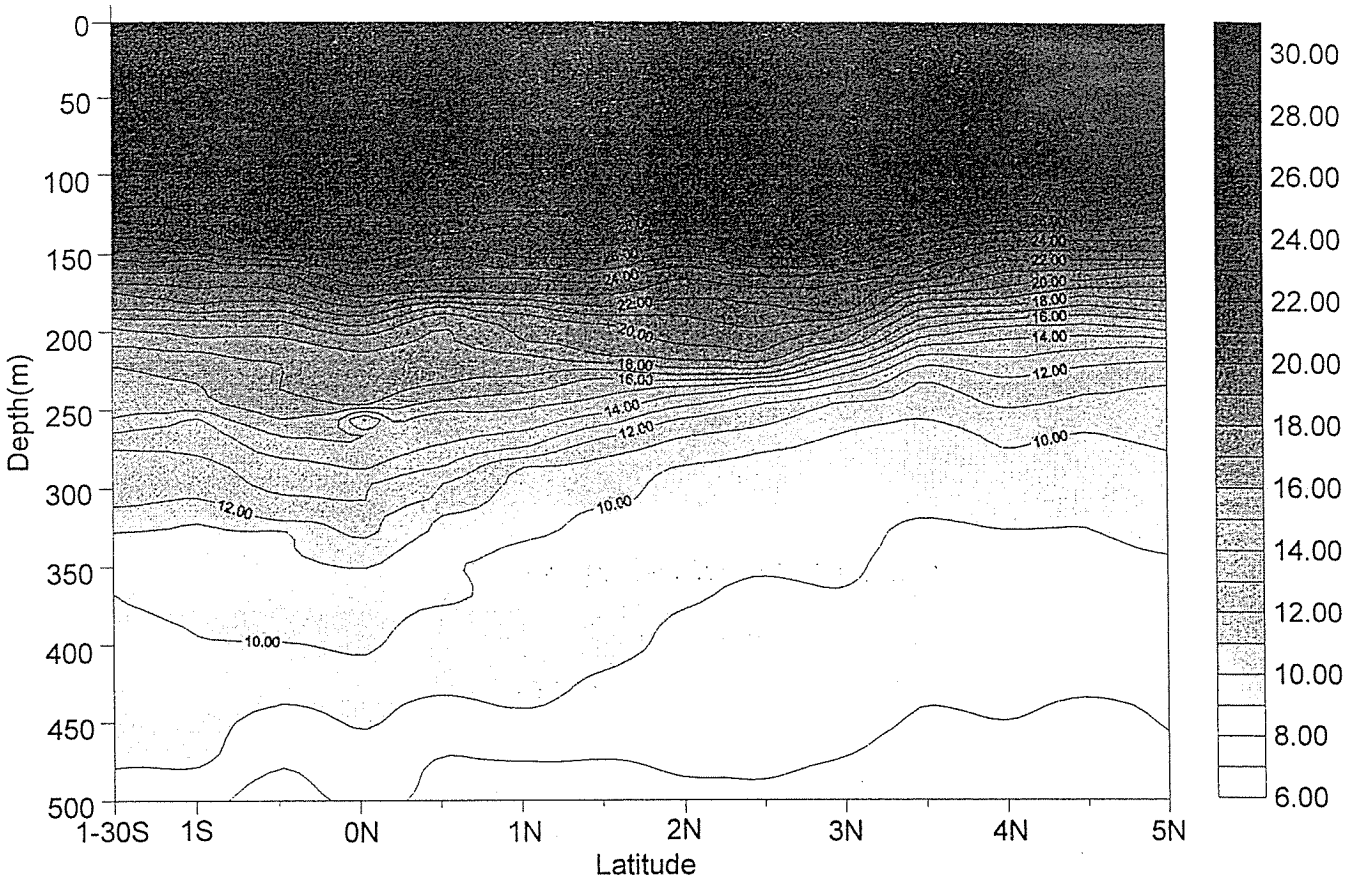
Temperature of XCTD data KY99-09 X100-X105



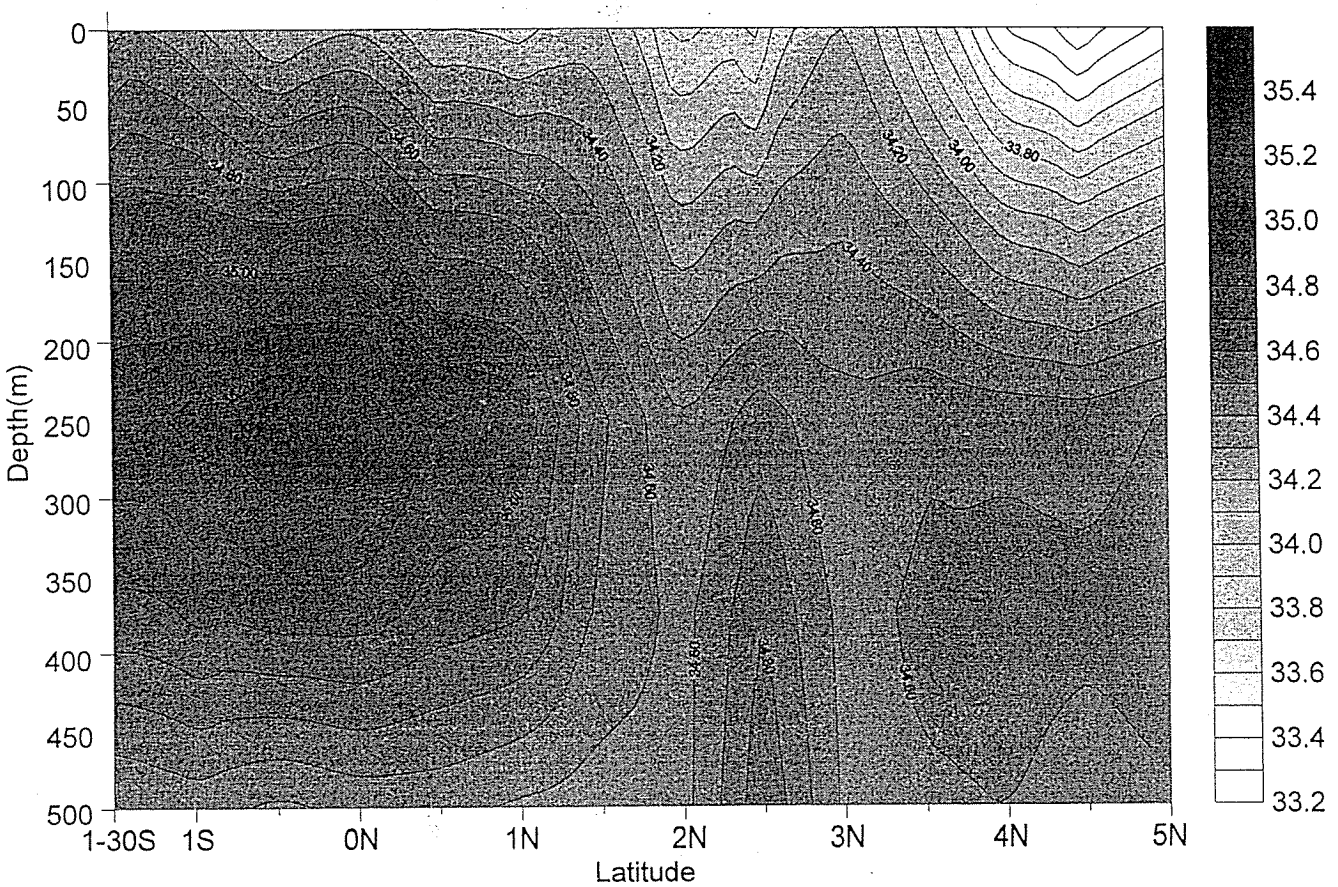
Salinity of XCTD data KY99-09 X100-X105



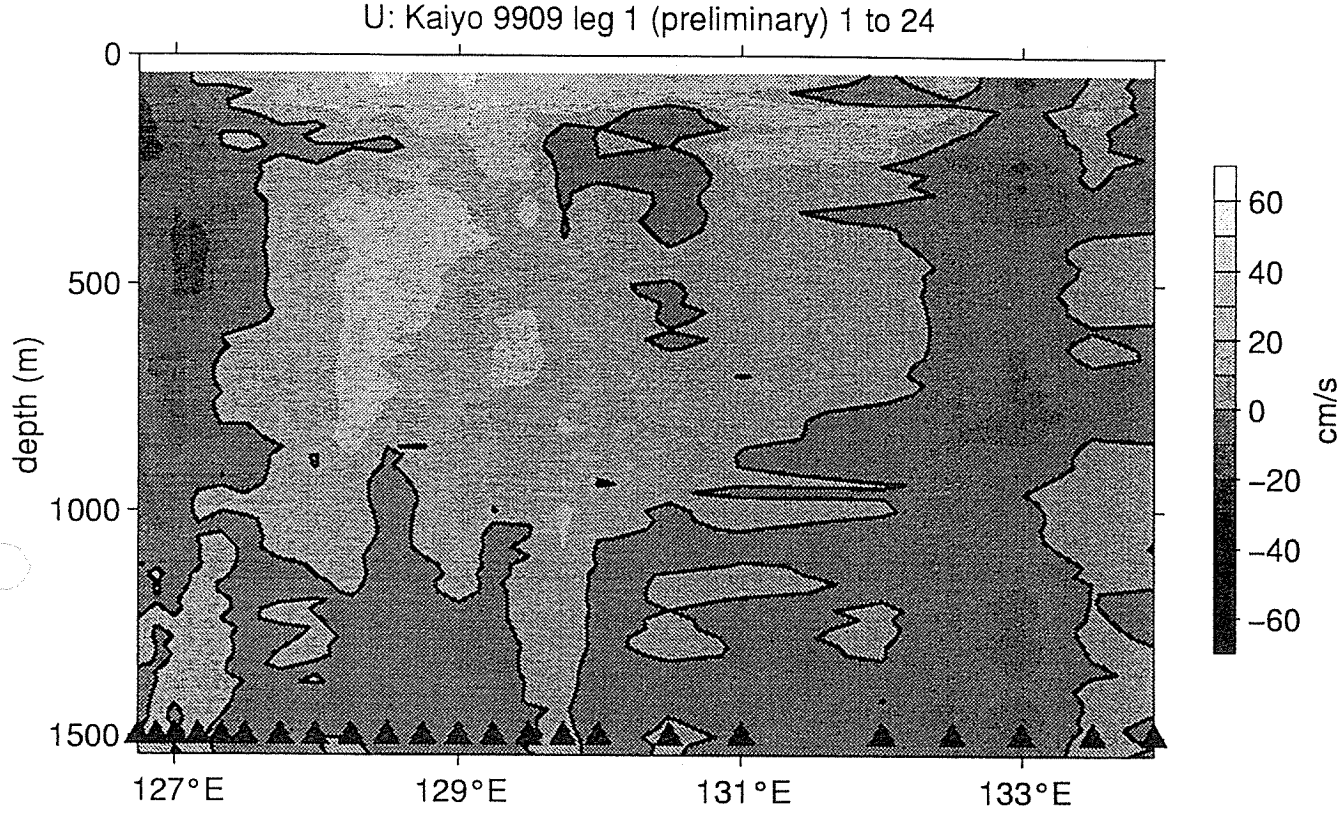
Tempareature of XCTD data KY99-09 X112-C125

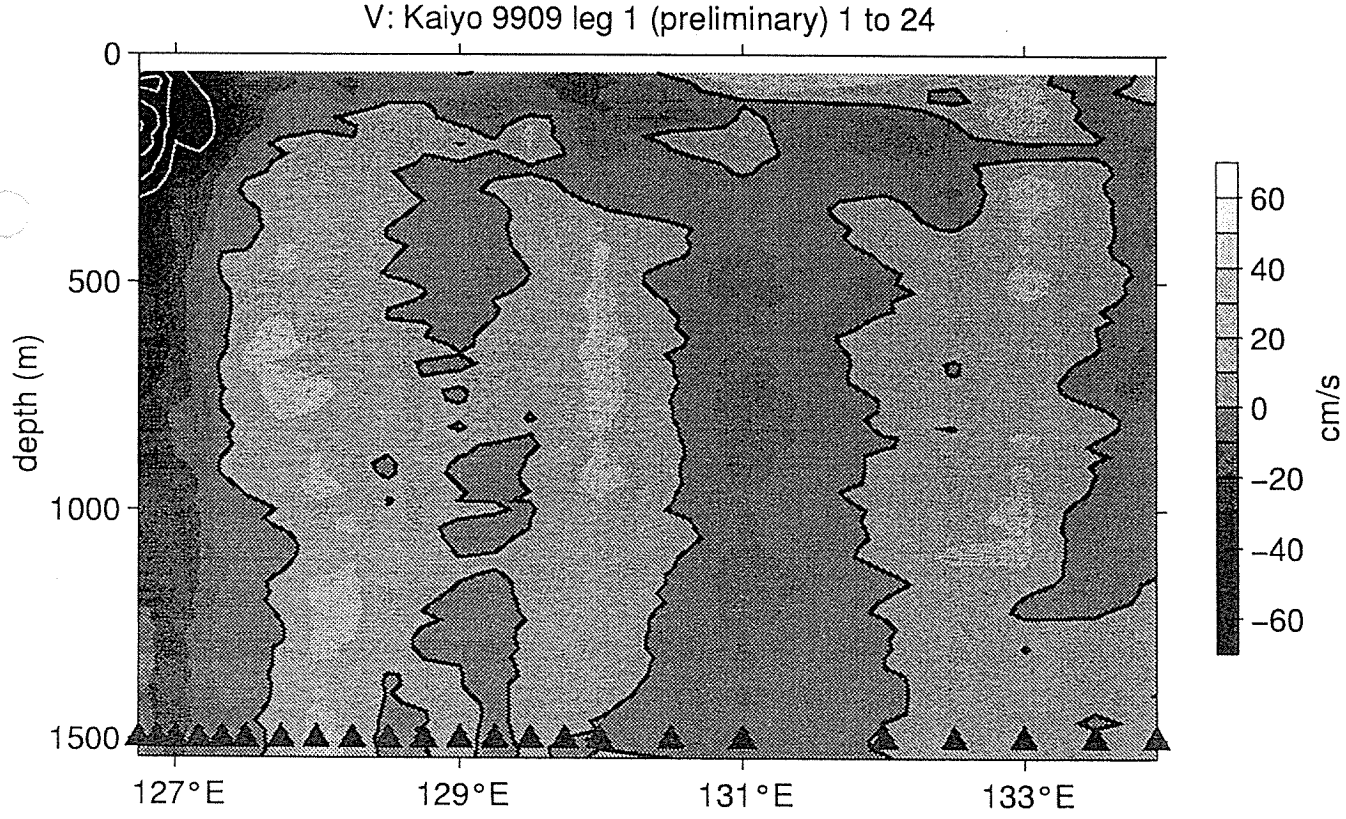


Salinity of XCTD data KY99-09 X112-C125

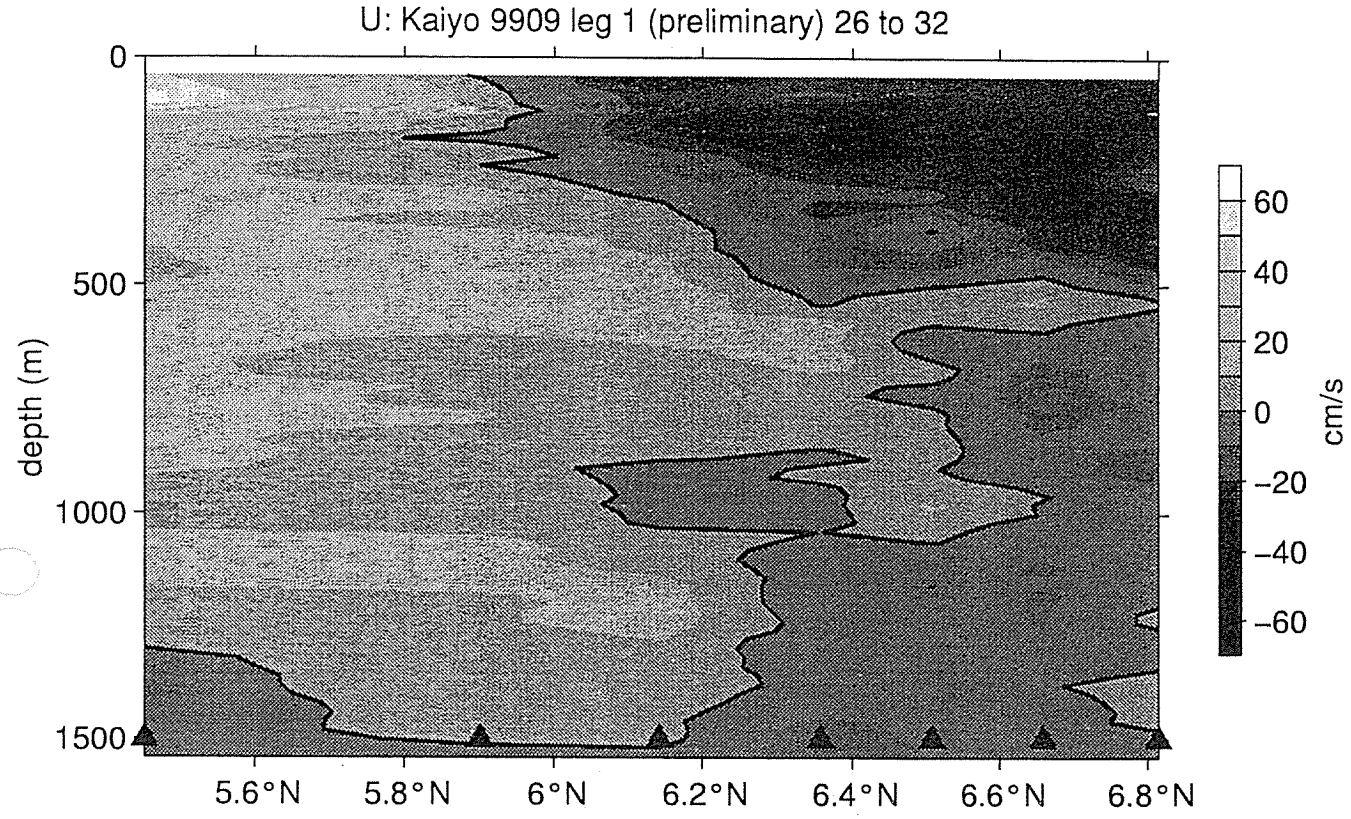


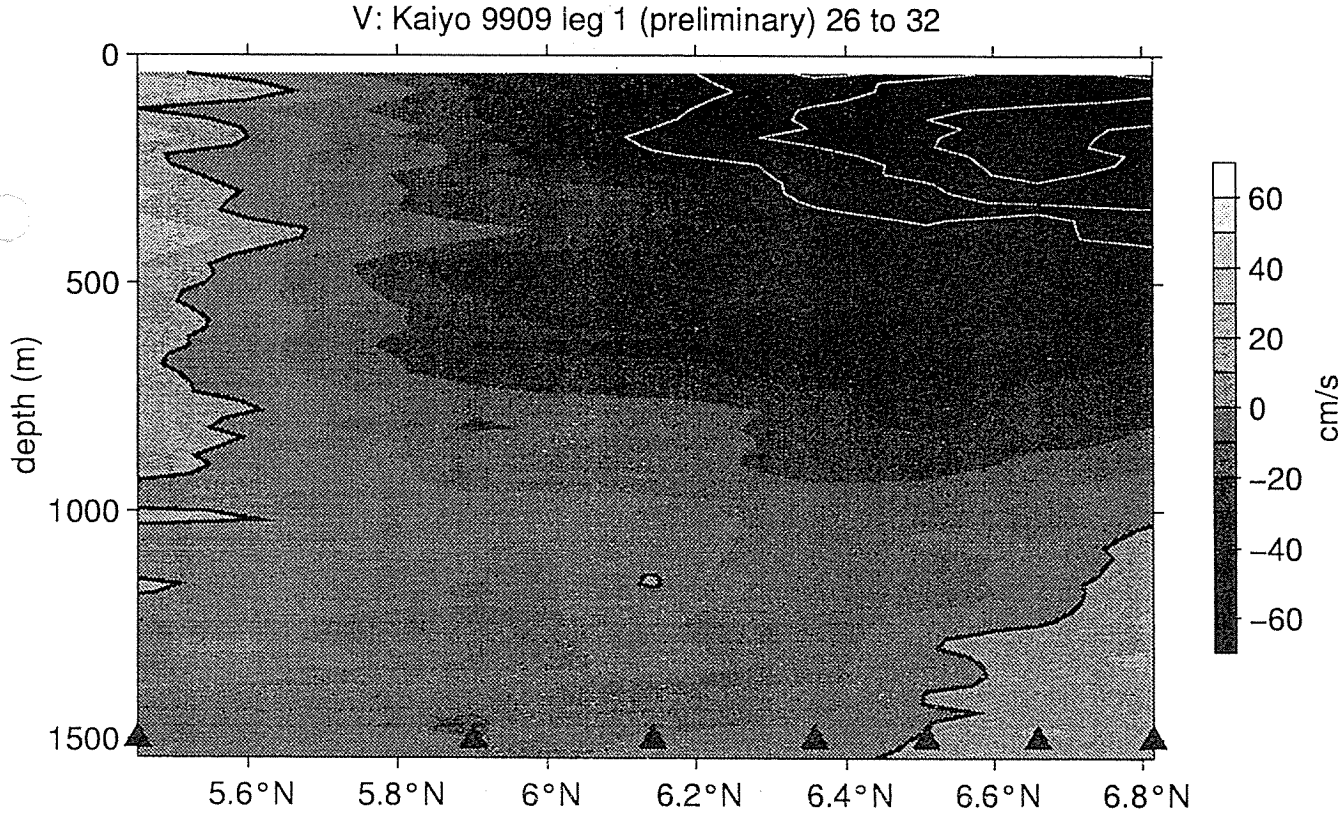
4-4-2. Current



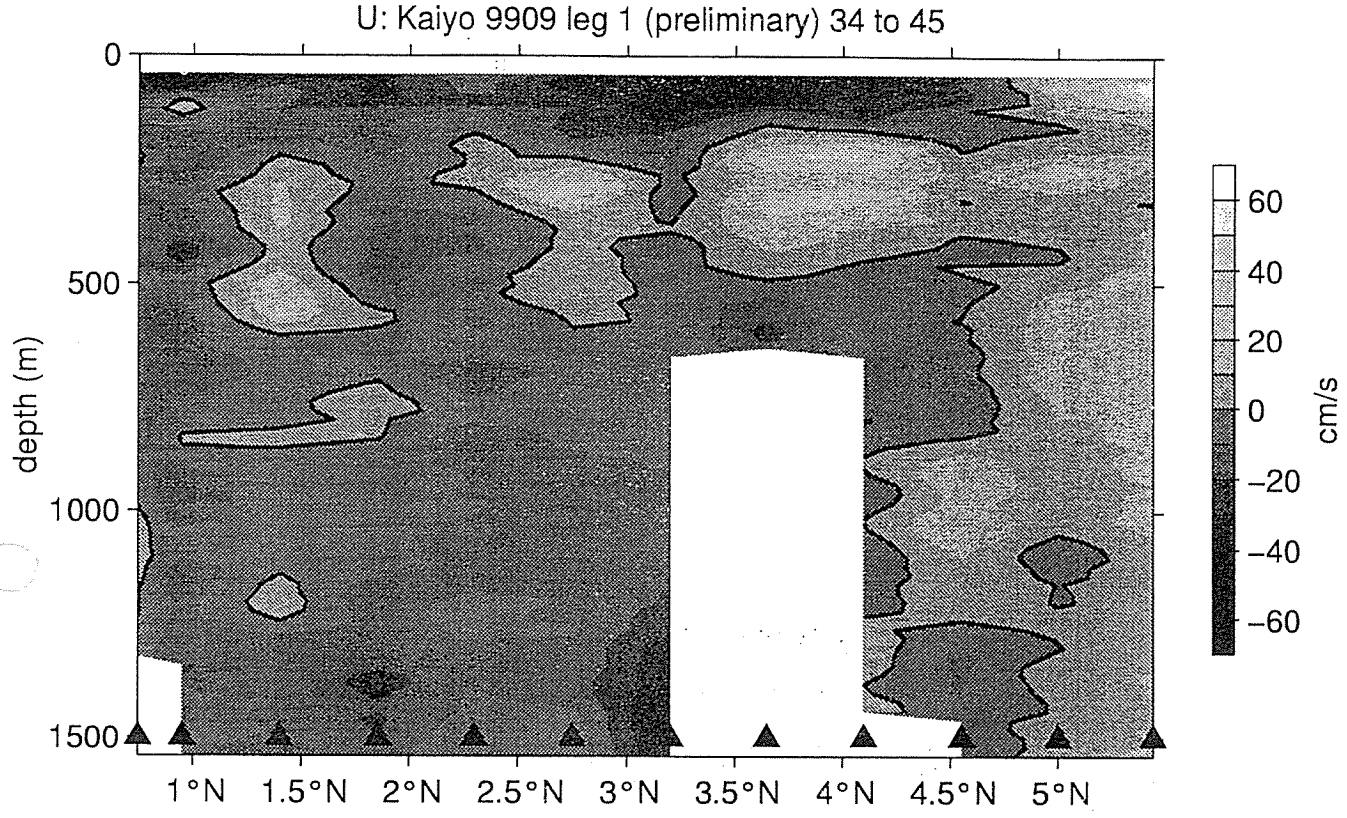


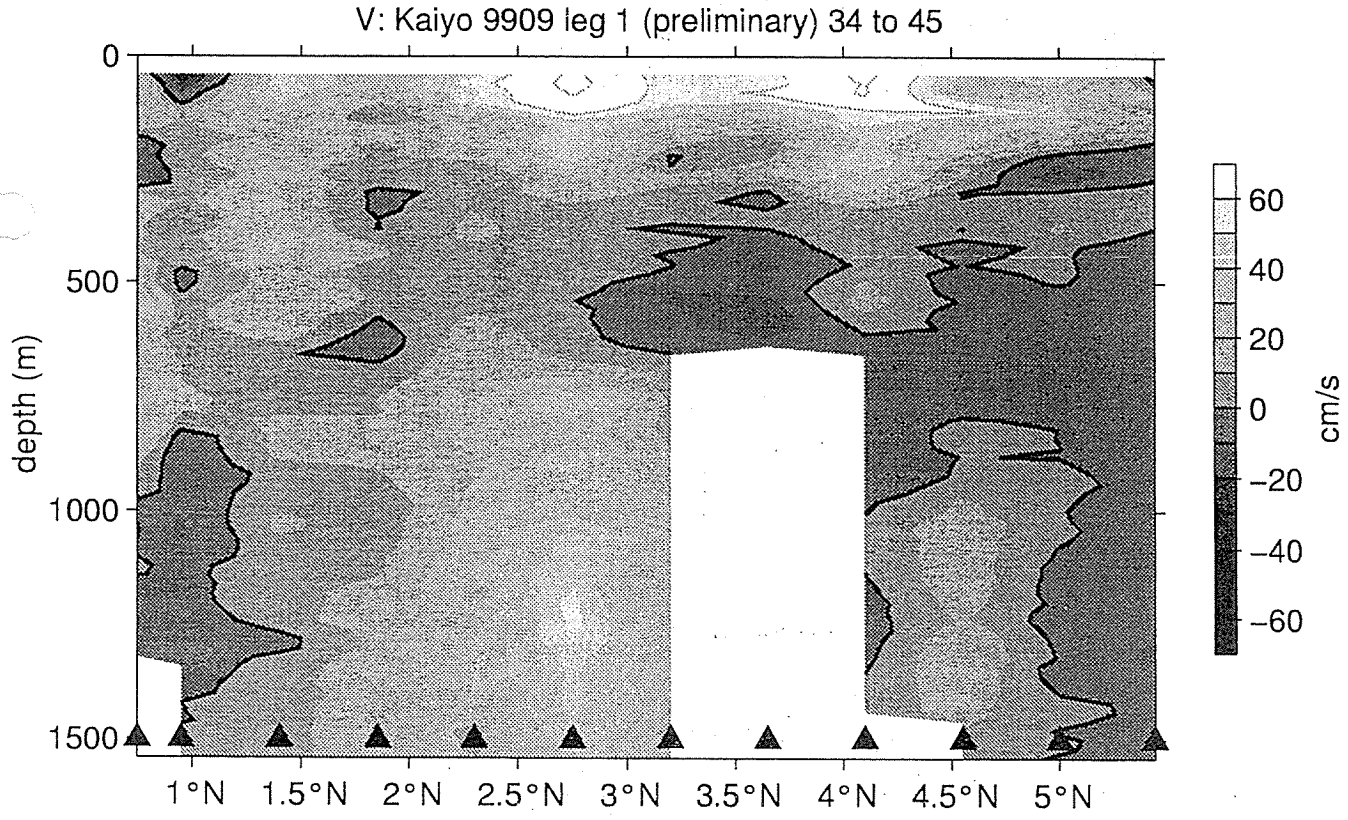
99-11-6 0:22 lcont.m



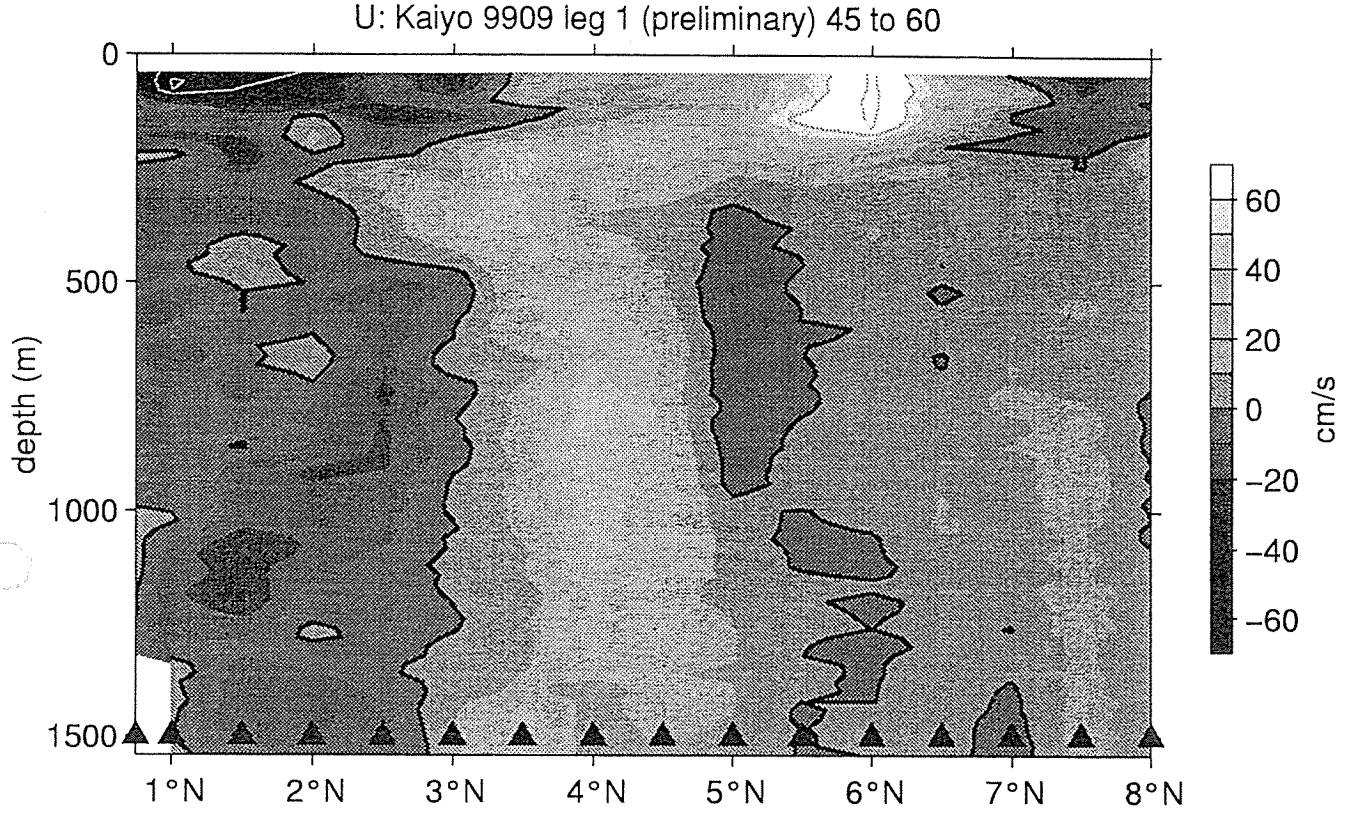


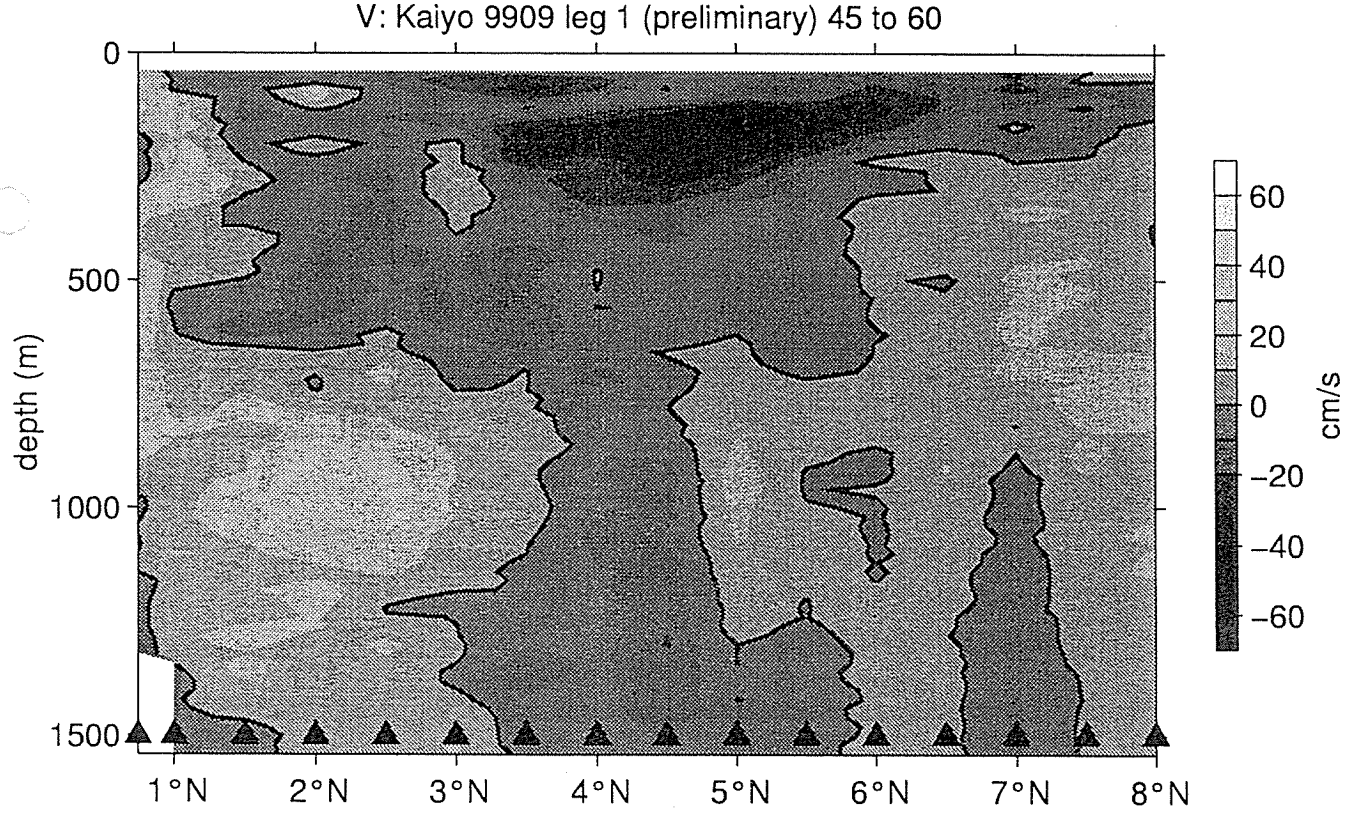
99-11-6 0:22 lcont.m



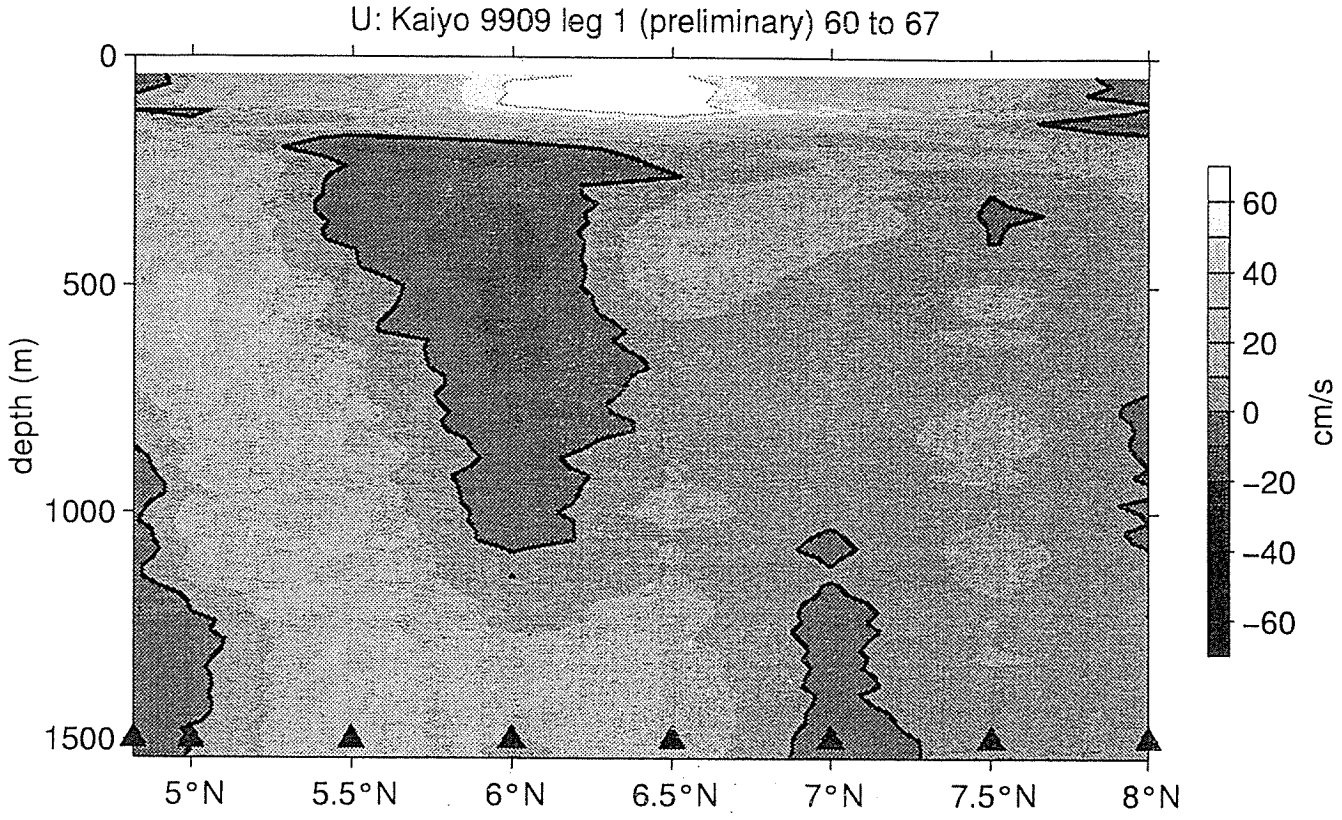


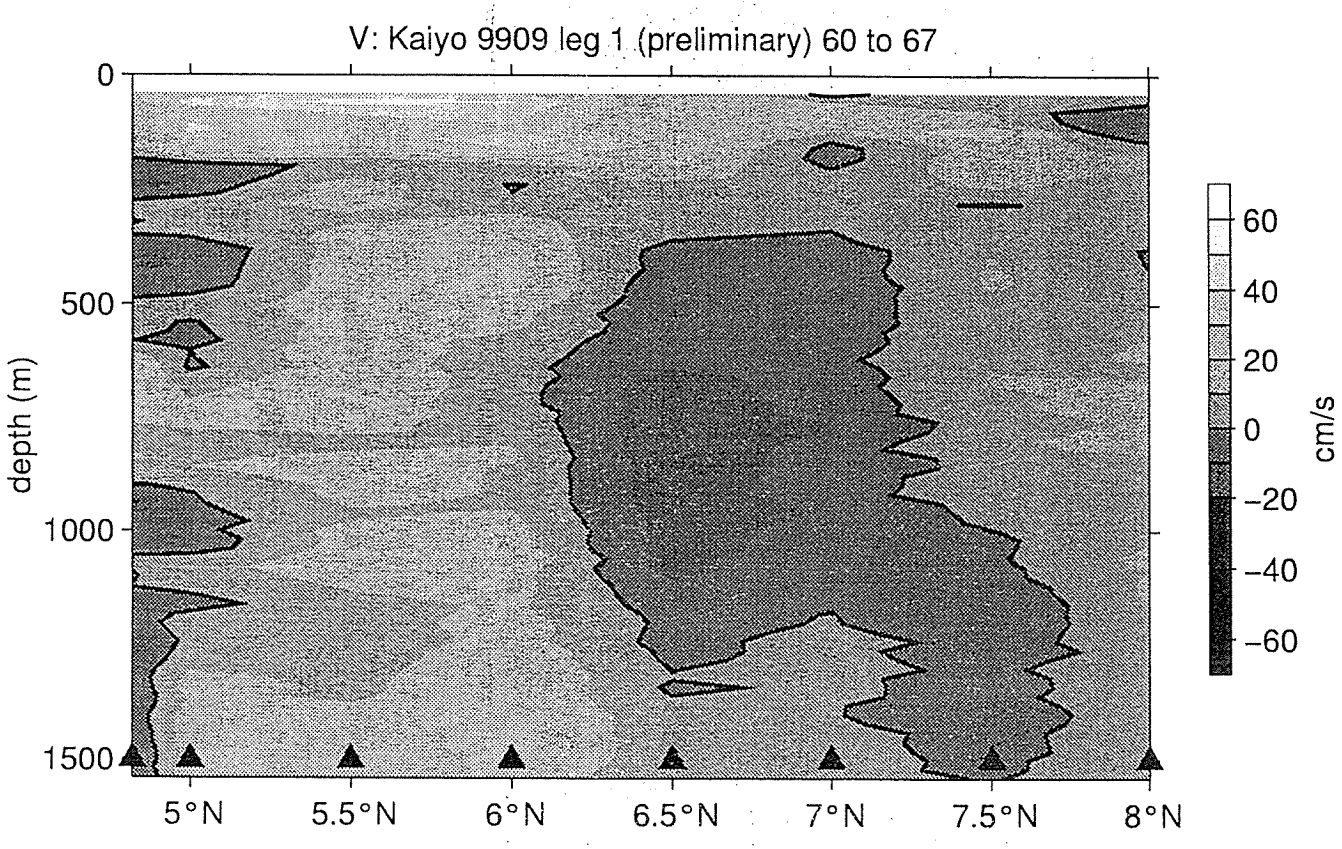
99-11-6 0:22 lcont.m



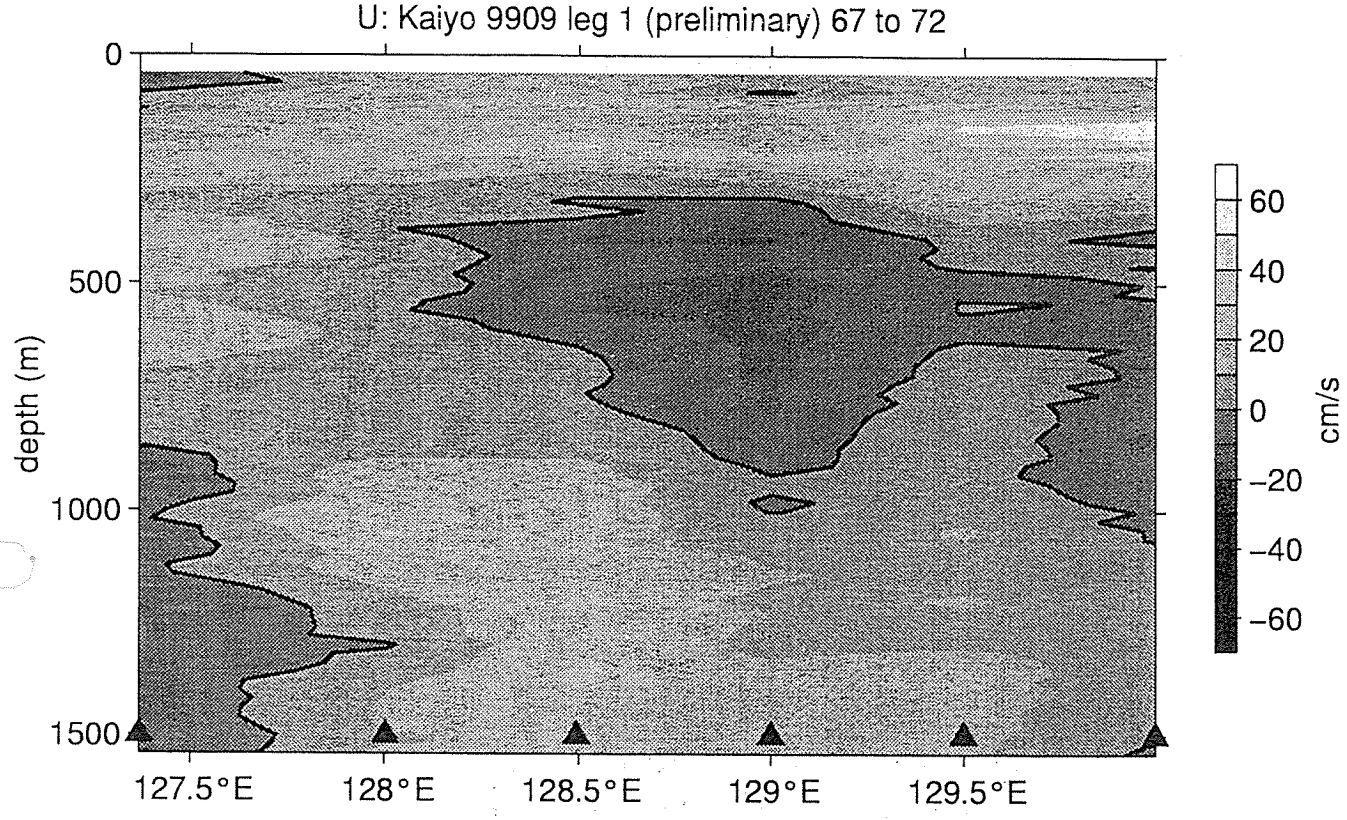


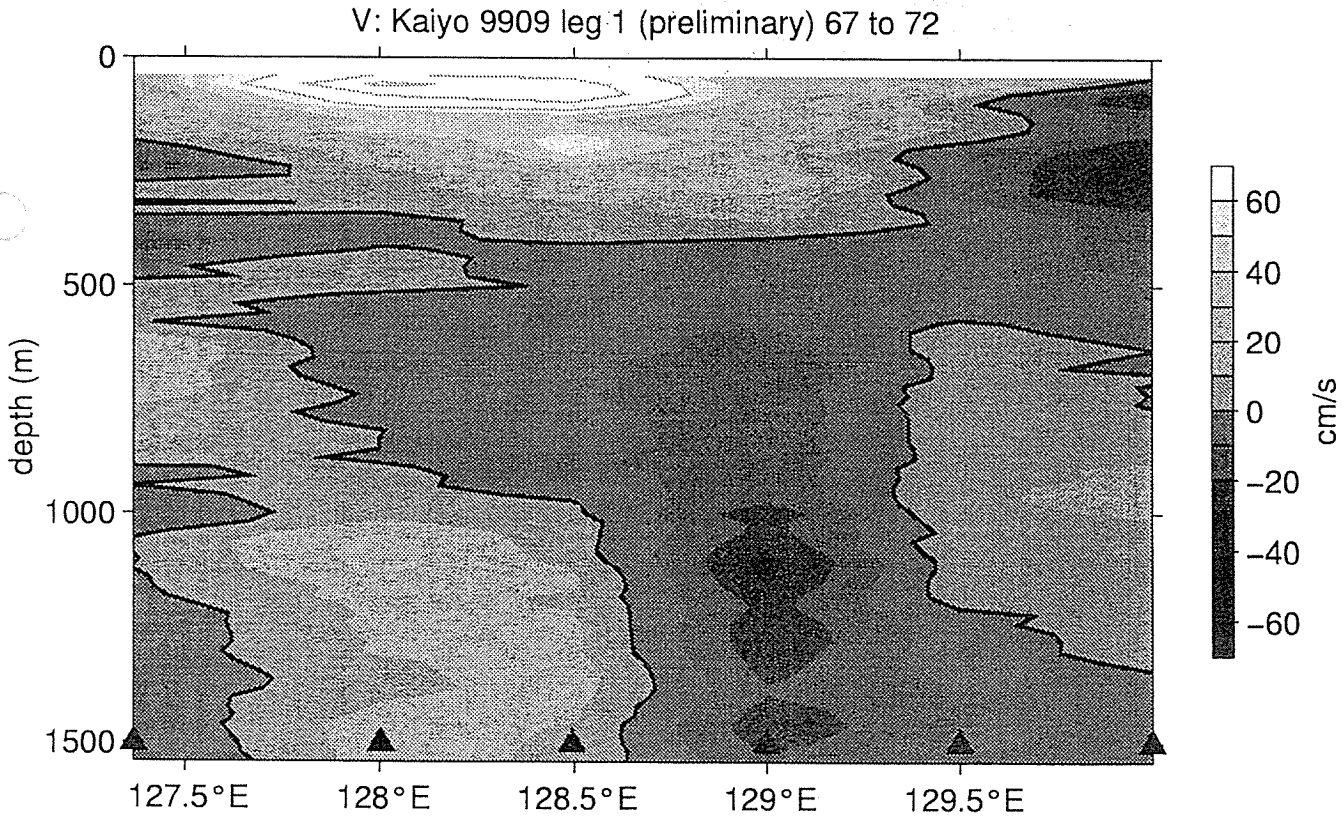
99-11-6 0:23 lcont.m





99-11-6 0:24 lcont.m





99-11-6 0:25 lcont.m

4.5 Bottle Salinity

To confirm the difference the conductivity sensore of CTD from data of salinity measurements by using Guildline Autosal Salinometer model 8400B.

1.Salinity Sample Collection

Seawater samples were collected from the deepest layer,500m to 2000m, of Niskin Sampling Bottle. The bottles in which the salinity samples were collected and stored were 250 ml Phoenix brown glass bottles with screw caps. Each bottles were rinsed three times and filled with sample water. Salinity samples were stored in the same laboratory as the salinity measurement was made.

2.Instruments and Method

The salinity analysis was carried out by a Guildline Autosal Salinometer model 8400B,which was modified by addition of an Ocean Science International peristaltic-type sample intake pump. Data of the salinometer was collected simultaneously by a personal computer. A double conductivity ratio was defined as a median of 31 readings of the salinometer. Data collection was started after 5 seconds and it took about 10 seconds to collect 31 readings by a personal computer.

The salinometer was operated in the airconditioned ship's laboratory at a bath temperature of 24 deg C.

3.Standard Sea Water

Autosal model 8400B was standardized only before sequence of measurements by use of IAPSO Sandard Seawater batch P135 whose conductivity ratio was 0.99992(salinity=34.997psu). After the standard ization,8400B was monitored by 2-3 SSW ampules before and after the measurements for samples.

Leg.1 - 36 samples
Leg.2 - 10 samples

4.Result

The average of difference between CTD and AUTOSAL is 0.0071psu.
The standard deviation is 0.0189.

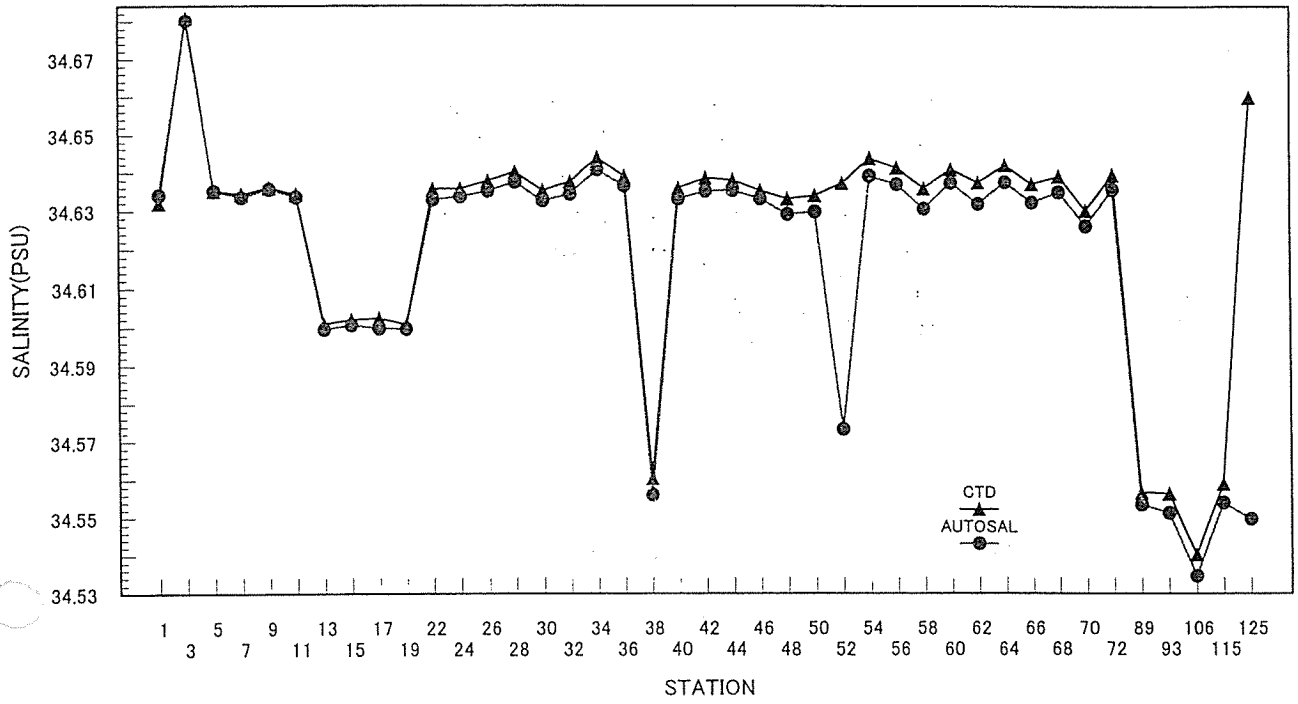
Salinity Data Comparison between CTD and AUTOSAL

St.	CTD (PSU)	AUTOSAL (PSU)	Depth (m)	Bottle No.	Difference (PSU)
1	34.6320	34.6341	2000	121	-0.0021
3	34.6809	34.6802	4000	122	0.0007
5	34.6352	34.6351	2000	123	0.0001
7	34.6344	34.6335	2000	124	0.0009
9	34.6361	34.6357	2000	125	0.0004
11	34.6344	34.6337	2000	126	0.0007
13	34.6010	34.5995	2000	127	0.0015
15	34.6021	34.6007	2000	128	0.0014
17	34.6025	34.5999	2000	129	0.0026
19	34.6009	34.5997	2000	130	0.0012
22	34.6357	34.6329	2000	131	0.0028
24	34.6358	34.6338	2000	132	0.0020
26	34.6379	34.6352	2000	133	0.0027
28	34.6402	34.6375	2000	134	0.0027
30	34.6353	34.6327	2000	135	0.0026
32	34.6376	34.6344	2000	136	0.0032
34	34.6439	34.6408	2000	137	0.0031
36	34.6390	34.6366	2000	138	0.0024
38	34.5605	34.5561	500	139	0.0044
40	34.6360	34.6332	2000	140	0.0028
42	34.6387	34.6352	2000	141	0.0035
44	34.6382	34.6355	2000	142	0.0027
46	34.6354	34.6333	2000	143	0.0021
48	34.6333	34.6292	2000	144	0.0041
50	34.6341	34.6299	2000	145	0.0042
52	34.6373	34.5734	2000	146	0.0639
54	34.6437	34.6392	2000	147	0.0045
56	34.6413	34.6370	2000	148	0.0043
58	34.6359	34.6306	2000	149	0.0053
60	34.6409	34.6373	2000	150	0.0036
62	34.6374	34.6318	2000	151	0.0056
64	34.6419	34.6375	2000	152	0.0044
66	34.6370	34.6322	2000	153	0.0048
68	34.6390	34.6349	2000	154	0.0041
70	34.6301	34.6260	2000	155	0.0041
72	34.6394	34.6356	2000	156	0.0038
89	34.5568	34.5536	1000	157,158	0.0032
93	34.5564	34.5514	1000	159,160	0.0050
106	34.5403	34.5347	1000	161,162	0.0056
115	34.5590	34.5540	1000	163,164	0.0050
125	34.6600	34.5497	1000	165,166	0.1103
				AVG.	0.0071
				S.D.	0.0189

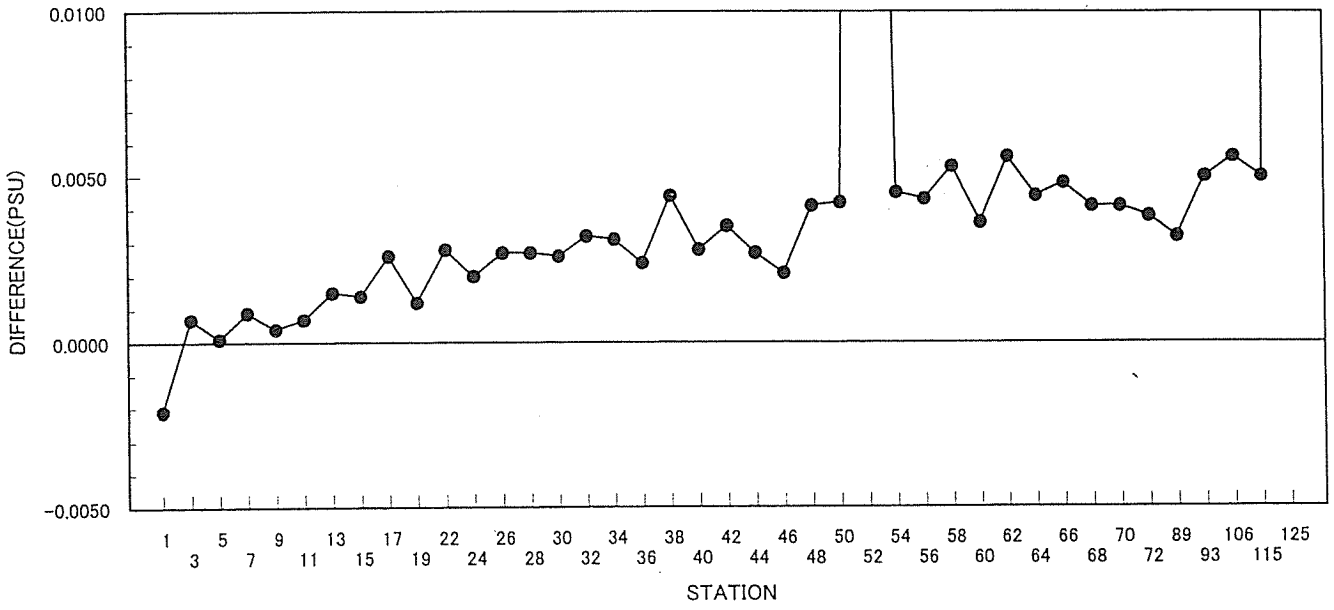
duplicate samples

	salinity	S.D.
157	34.5539	0.0003
158	34.5532	
159	34.5516	0.0002
160	34.5512	
161	34.5347	0.0000
162	34.5347	
163	34.5542	0.0002
164	34.5538	
165	34.5500	0.0004
166	34.5493	
	AVG.	0.0002

Salinity Data Comparison between CTD and AUTOSAL



Difference of Salinity Data between CTD and AUTOSAL



5. Shipboard ADCP

5. Shipboard ADCP

A series of shipboard ADCP measurements were conducted from Oct. 20 to Nov. 4 (Leg. 1; Palau-Mindanao-Palau) and from Nov. 8 to Nov. 23 (Leg.2; Palau-PNG-Kavieng). R/V Kaiyo mounts Narrow Band ADCP instrument (77kHz, 30 degree beam angle) that manufactured by RD Instrument. The configurations were set as follows.

PC (Personal Computer) time: GMT
Depth cell length: 16m
Number of cell: 64
Pings per ensemble: 28pings
Average time: 300sec
Pitch and roll offsets: 0.0

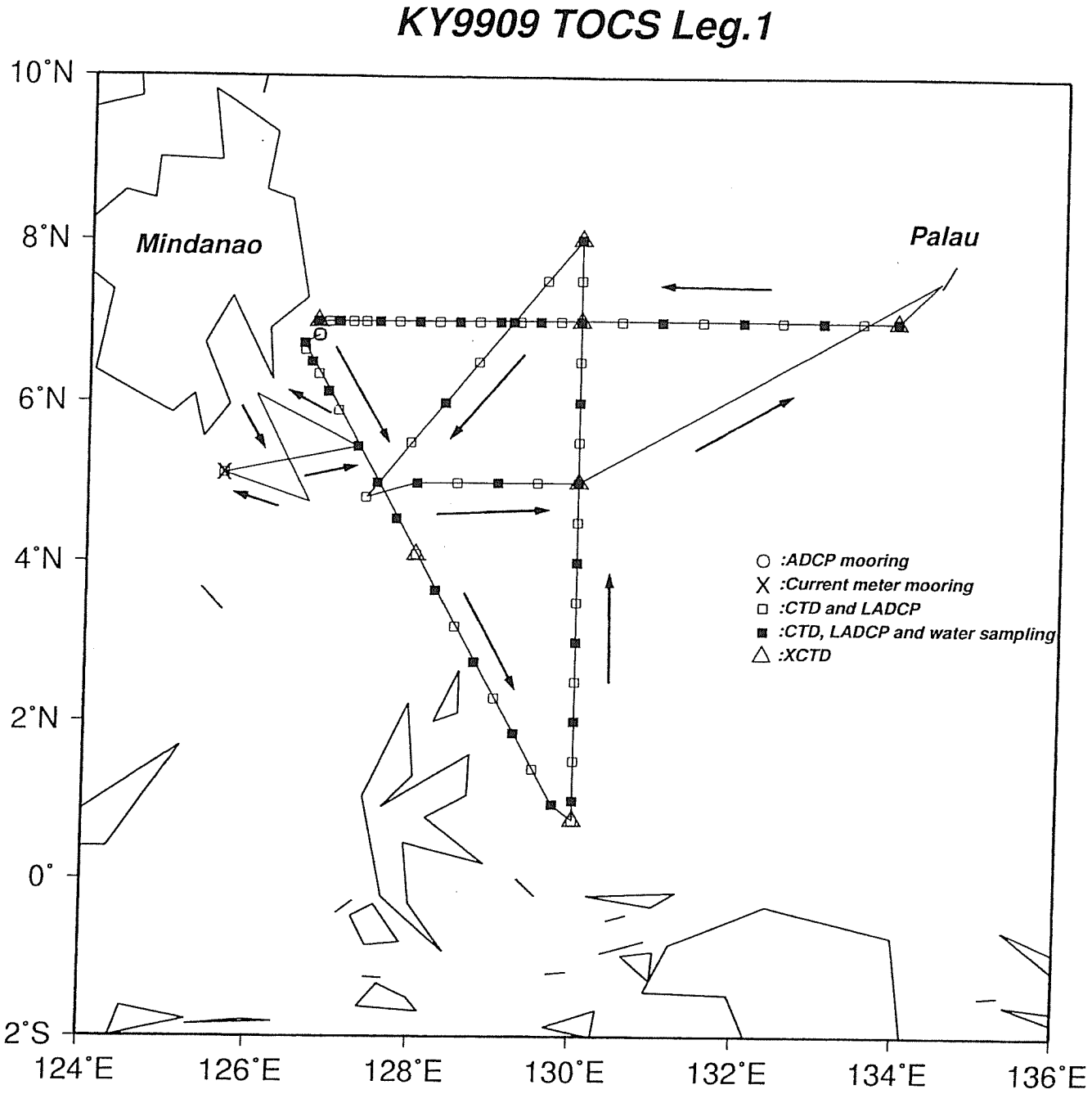
We logged the GPGGS signals as accurate position fixes at the full 1 Hz sampling rate in order to calculate the absolute velocities.

Using CODAS (Common Oceanographic Data Access System) software provided by Univ. of Hawaii, we made the data processing.

Accurate agreement of time between PC and GPS signal is essential to the calculation of the absolute velocities. The discrepancies between PC and GPS time, however, increased during this cruise (PC time 1 sec behind at start of Legl, 18 sec behind at end of Legl, 2 sec behind at start of Leg2 and 18 sec behind at end of Leg2). The CODAS software corrected the discrepancies between the PC and GPS time. The calibrations of misalignment between gyrocompass and transducer were not performed since these errors were small enough during this cruise.

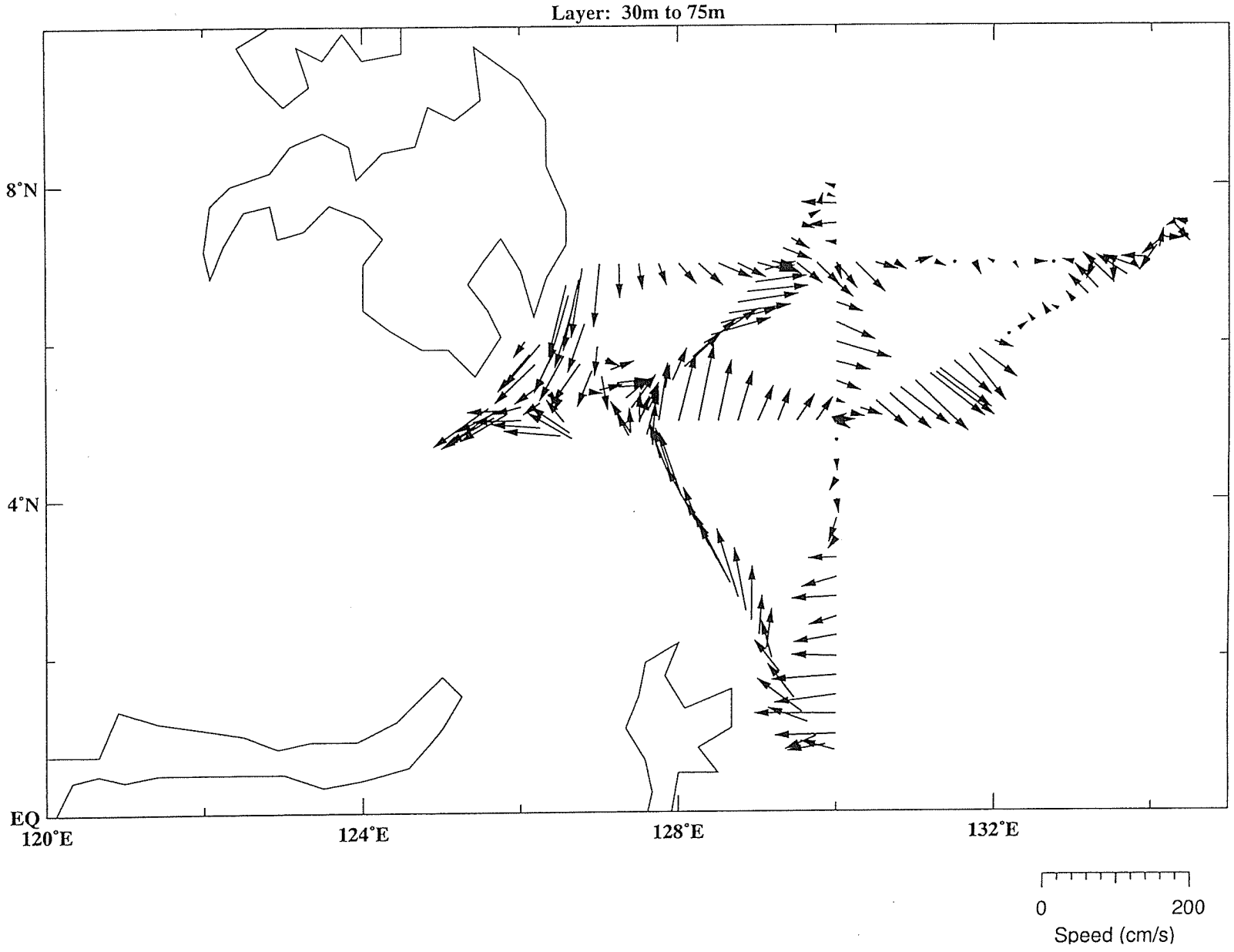
As the results of legl cruise, southwestward strong coastal current was seen southeast of Mindanao Island, indicating the Mindanao Current. The Mindanao Current bifurcated around 7 N, 128 E; one flowed southeastward as the North Equatorial Countercurrent (NECC) and the other flowed into the Celebes Sea. Surface westward current along the latitude of 2 N changed direction to northward north of Halmahera Island and then joined in the NECC. At surface (30 to 75m depth), the center of the Halmahera Eddy was found around 5 N, 130 E.

Leg2 measurement shows that westward current along the equator and eastward NECC were observed at surface. A part of the surface westward current along changed direction and joined in NECC near 3 N, 147E. At subsurface (200m depth), retroflection of the New Guinea Coastal Undercurrent was found around 138E and 142E.


KY9909 TOCS Leg.1
10°N
8°N
6°N
4°N
2°N
0°
2°S
124°E
126°E
128°E
130°E
132°E
134°E
136°E
Mindanao
Palau
:ADCP mooring
:Current meter mooring
:CTD and LADCP
:CTD, LADCP and water sampling
:XCTD

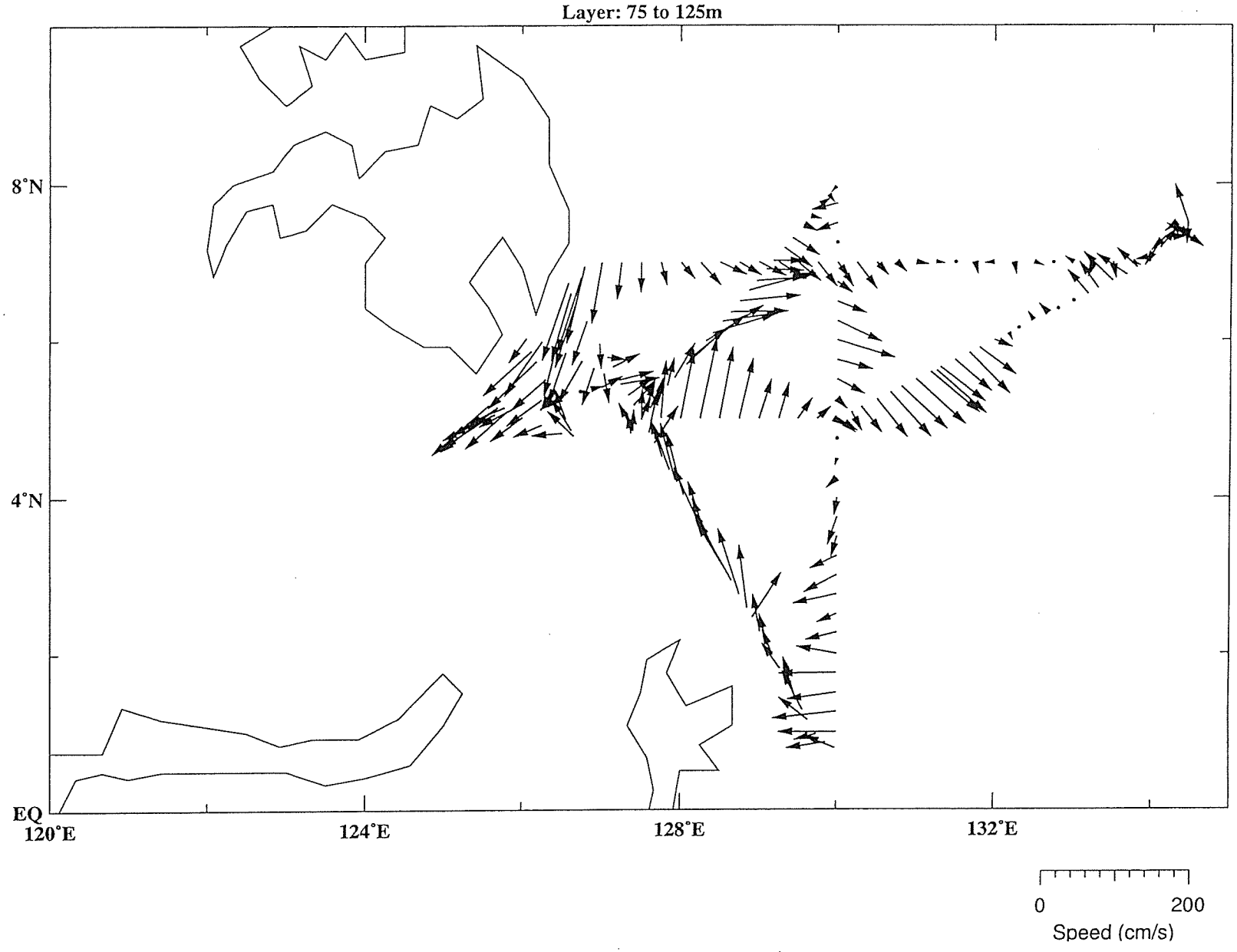
KY9909 Leg.1

Oct 20 to Nov 6, 1999



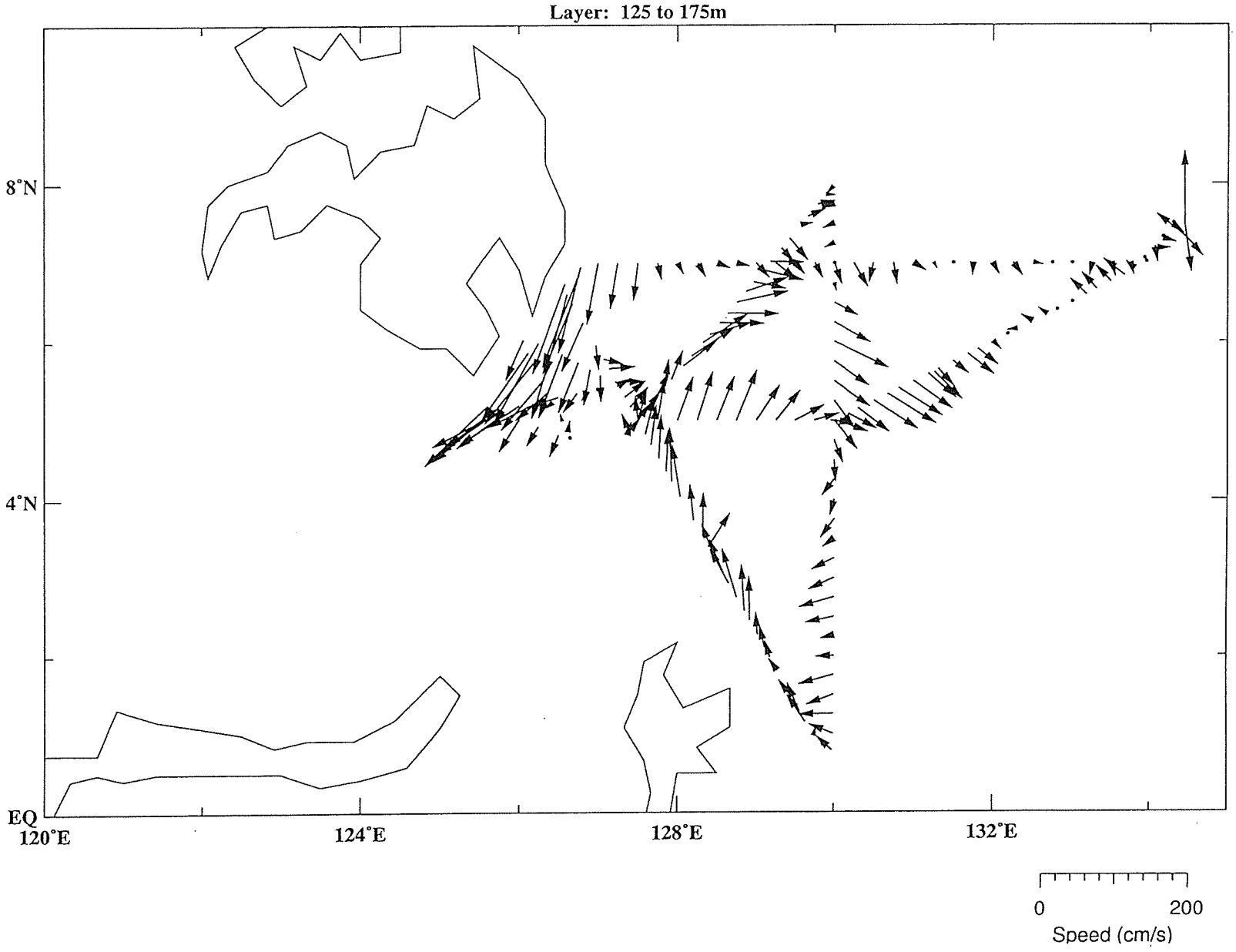
KY9909 Leg.1

Oct 20 to Nov 6, 1999



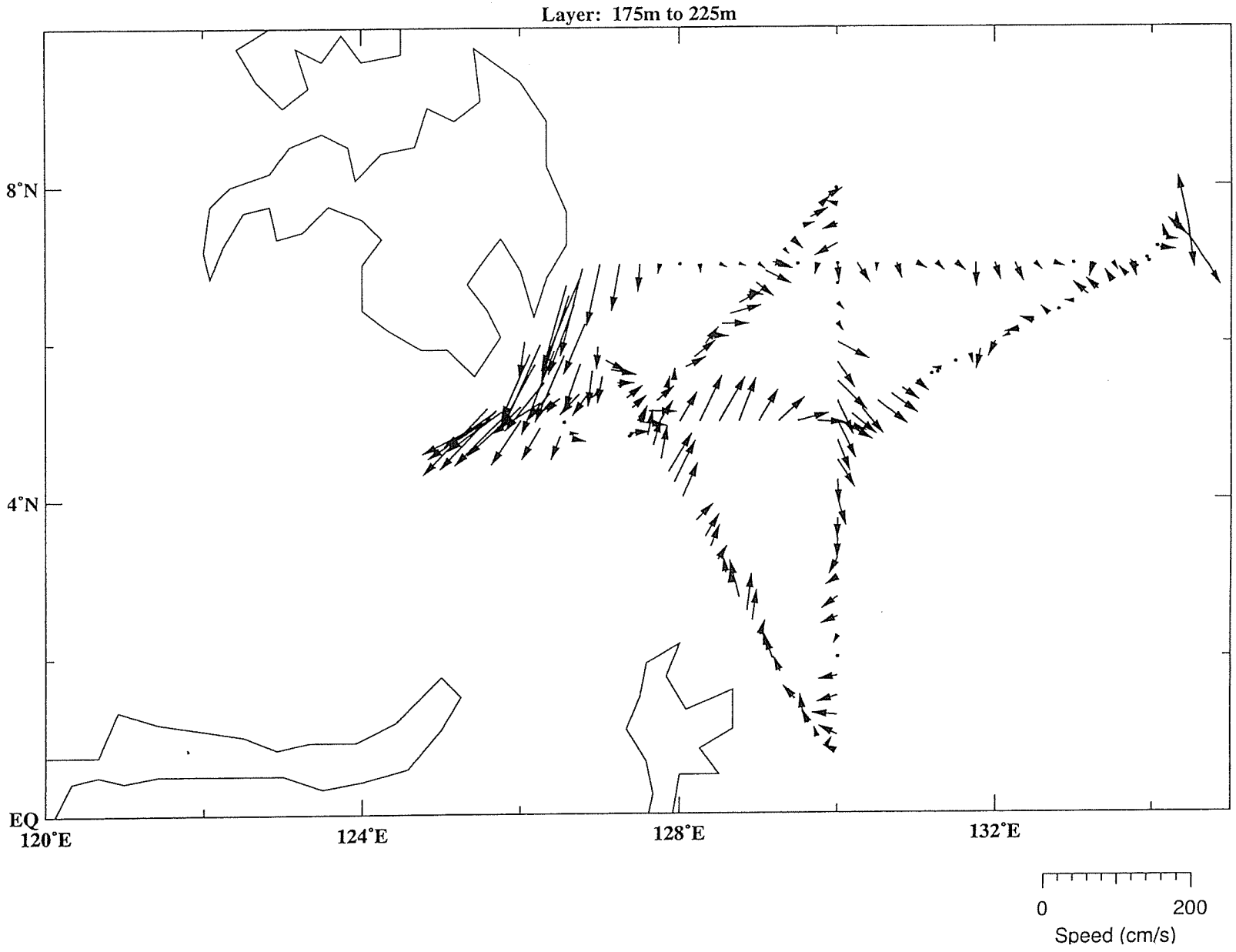
KY9909 Leg.1

Oct 20 to Nov 6, 1999



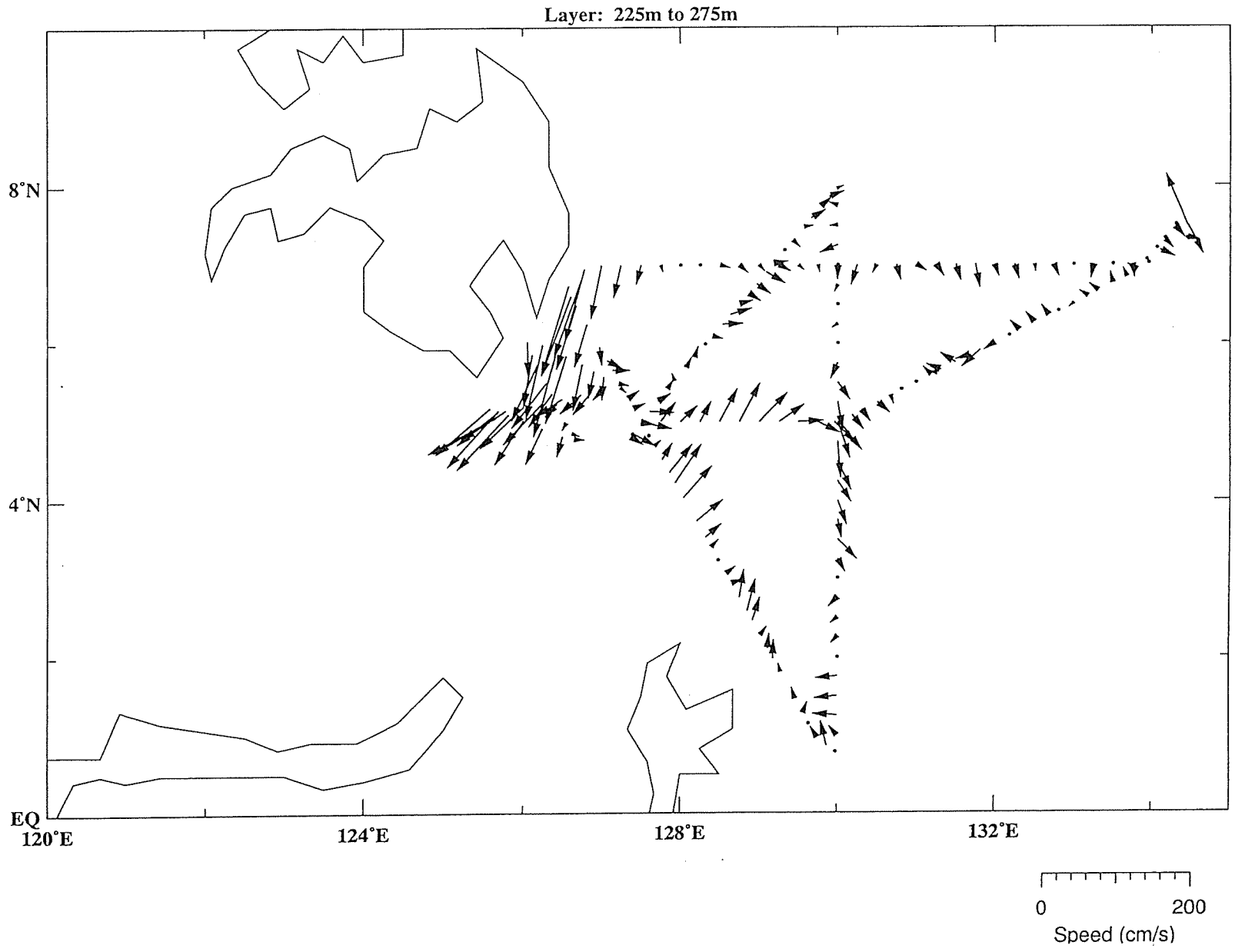
KY9909 Leg.1

Oct 20 to Nov 6, 1999



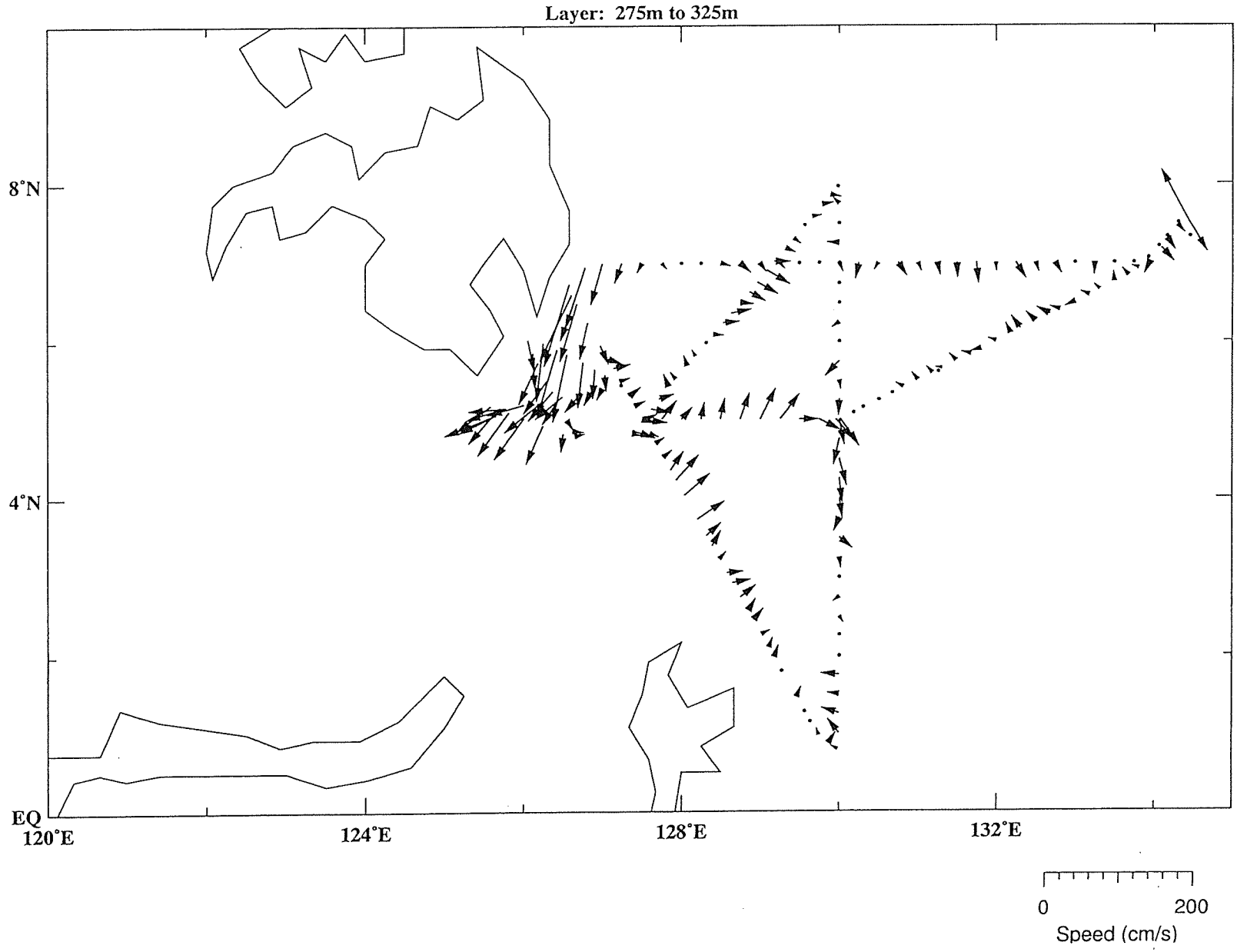
KY9909 Leg.1

Oct 20 to Nov 6, 1999



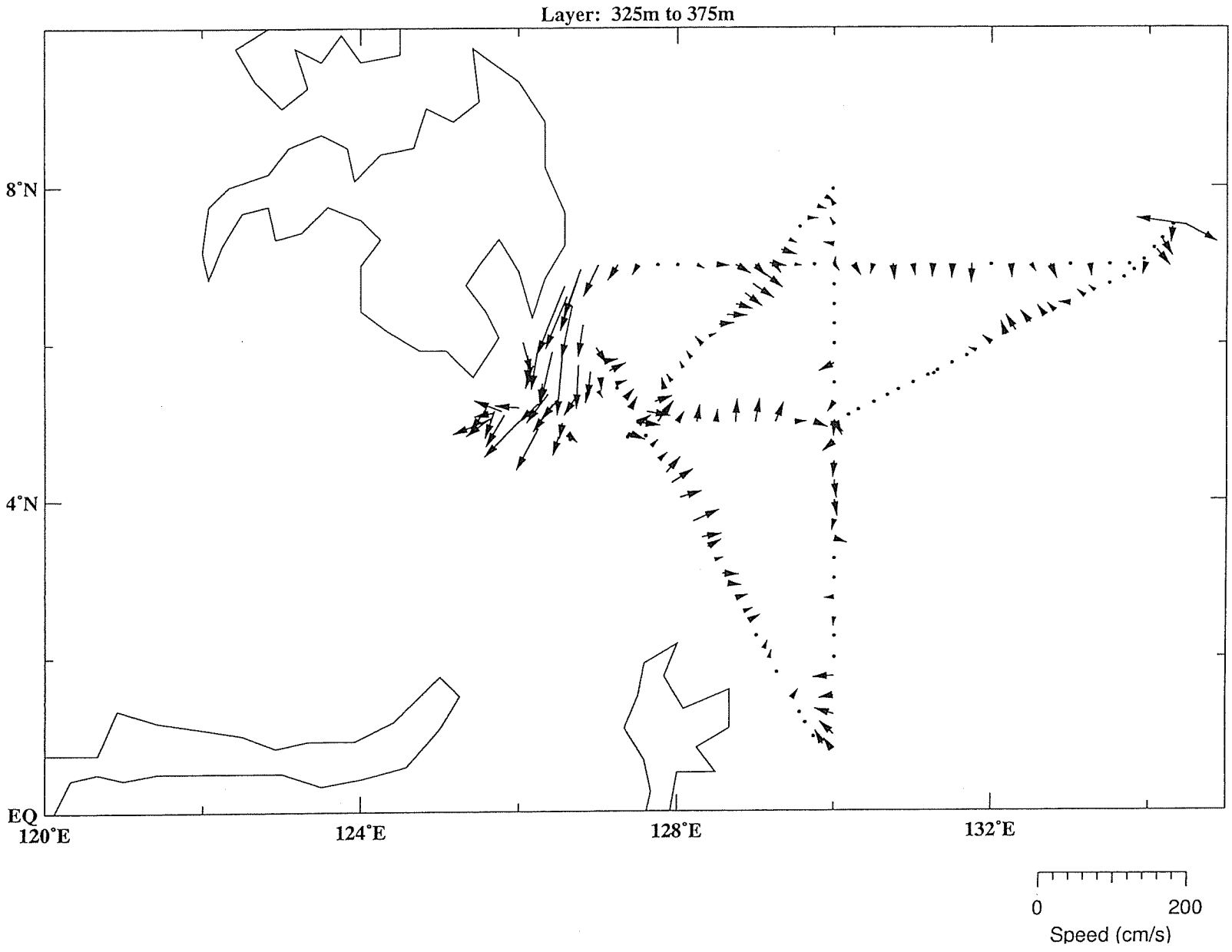
KY9909 Leg.1

Oct 20 to Nov 6, 1999



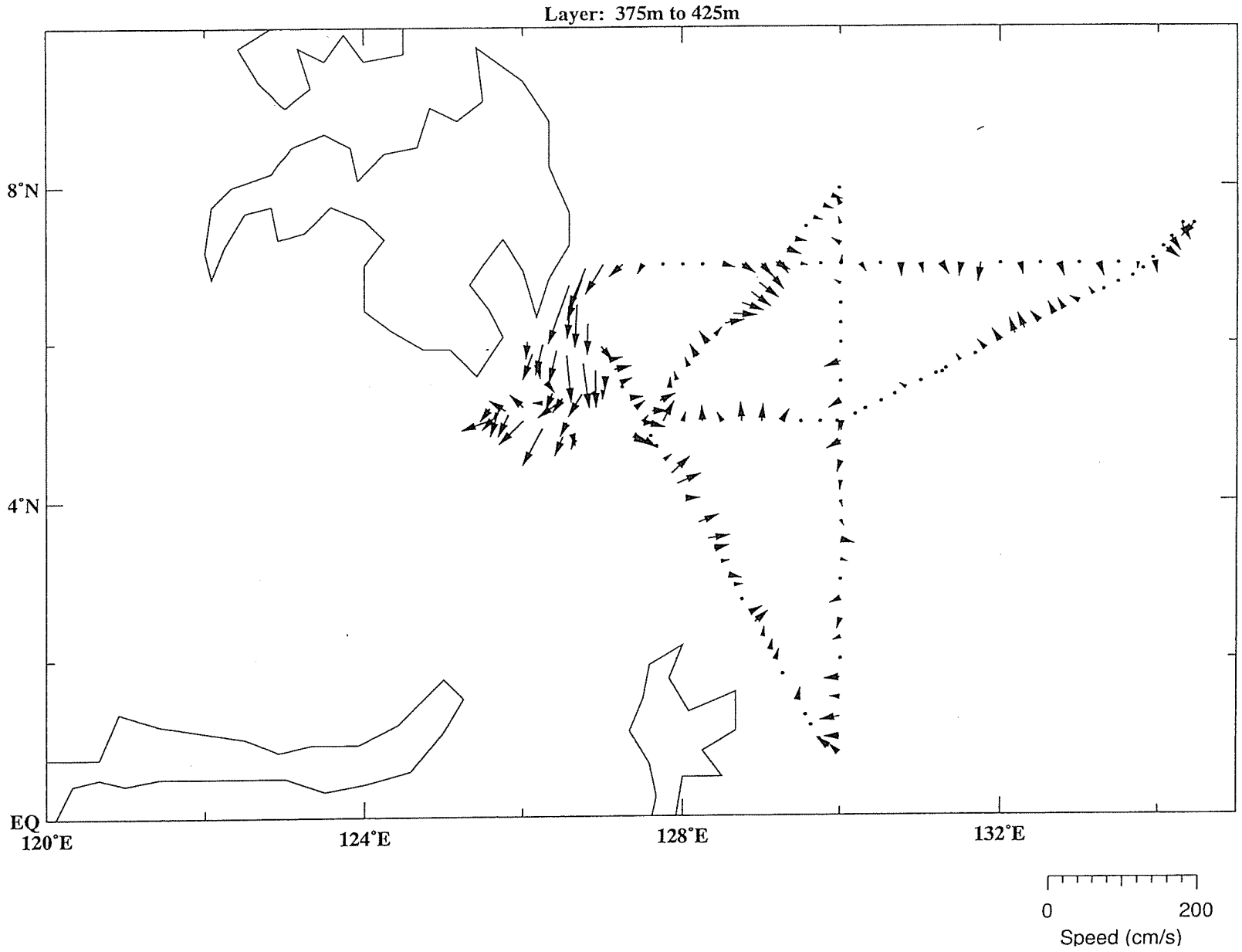
KY9909 Leg.1

Oct 20 to Nov 6, 1999



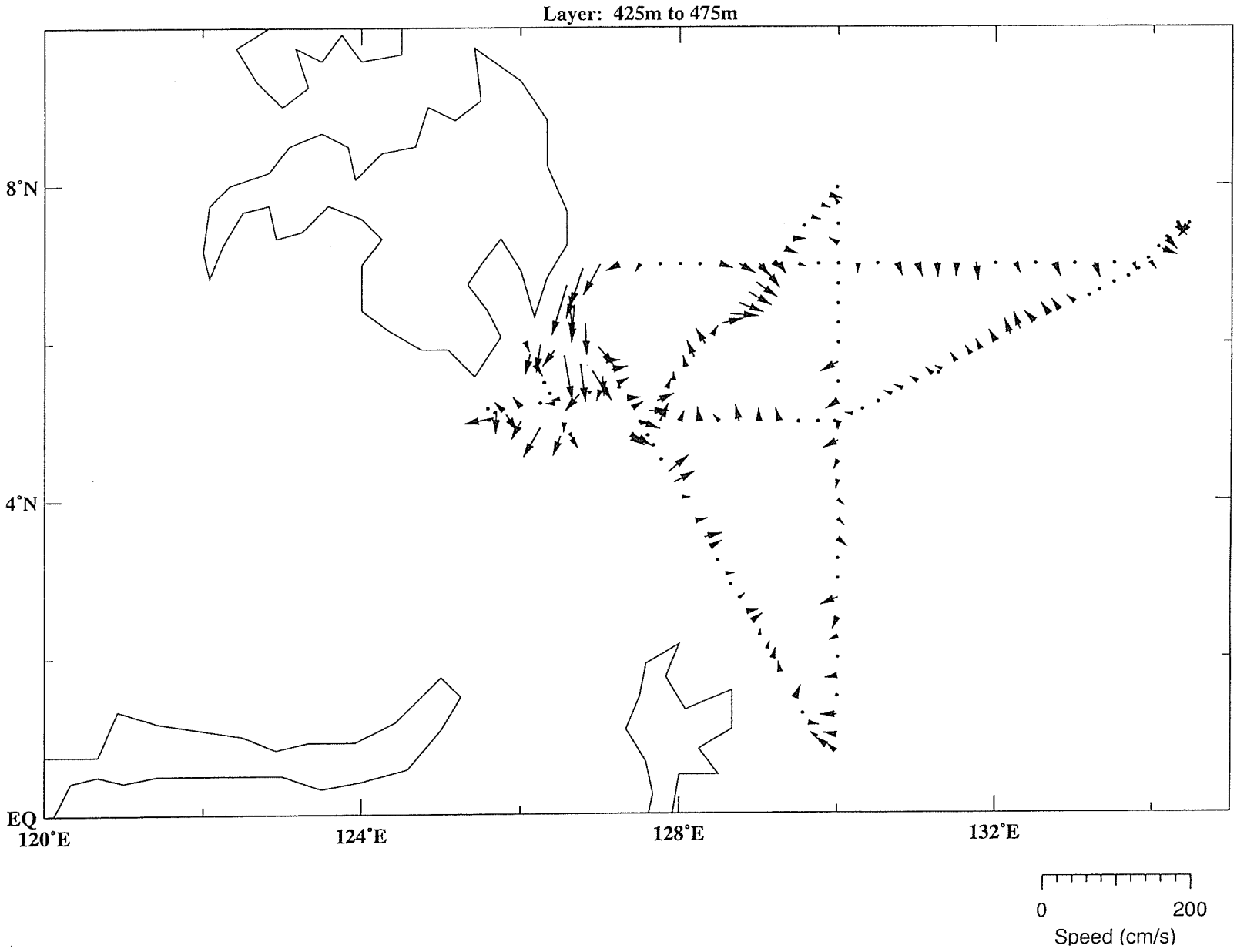
KY9909 Leg.1

Oct 20 to Nov 6, 1999



KY9909 Leg.1

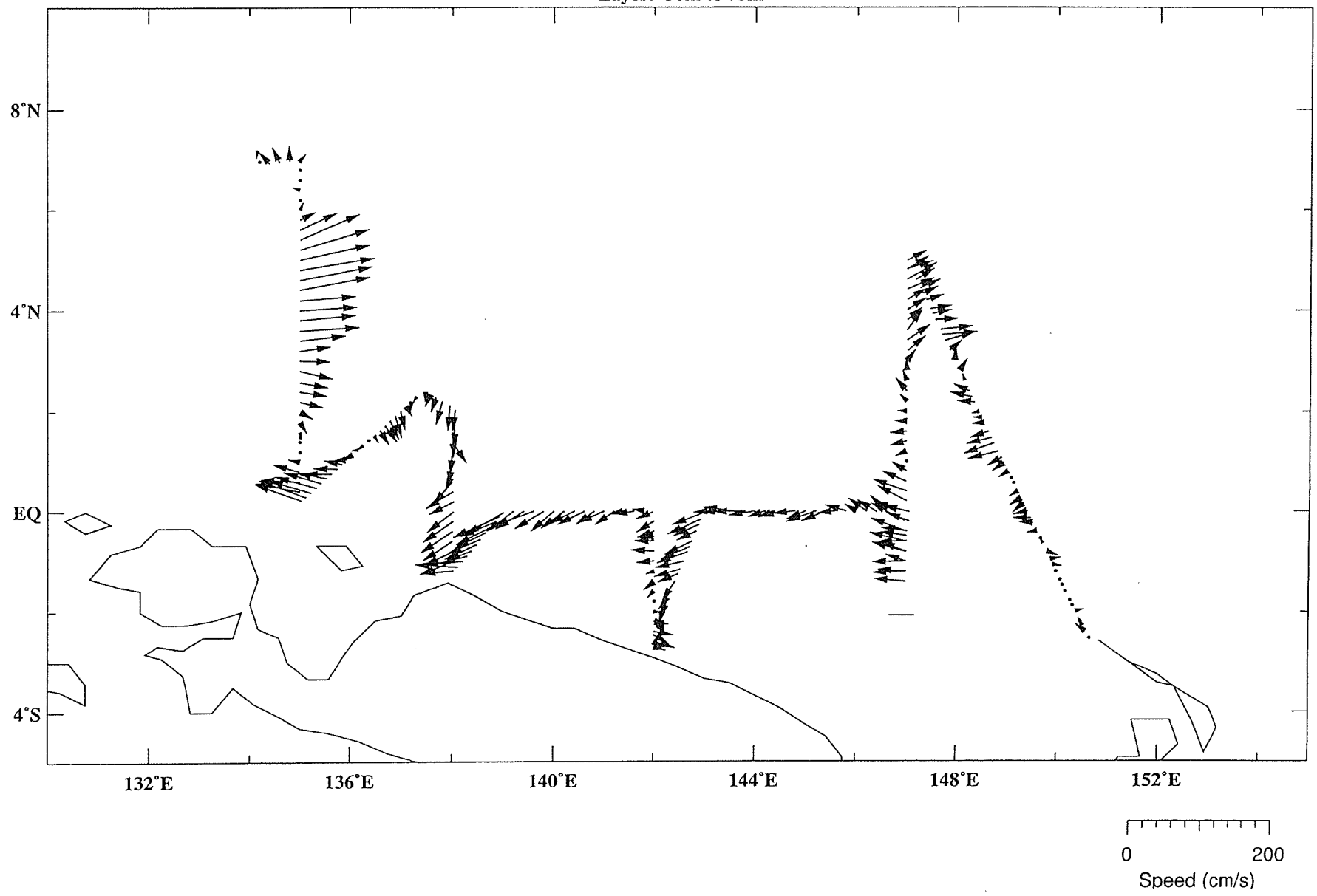
Oct 20 to Nov 6, 1999



KY9909 Leg.2

Nov 8 to Nov 23, 1999

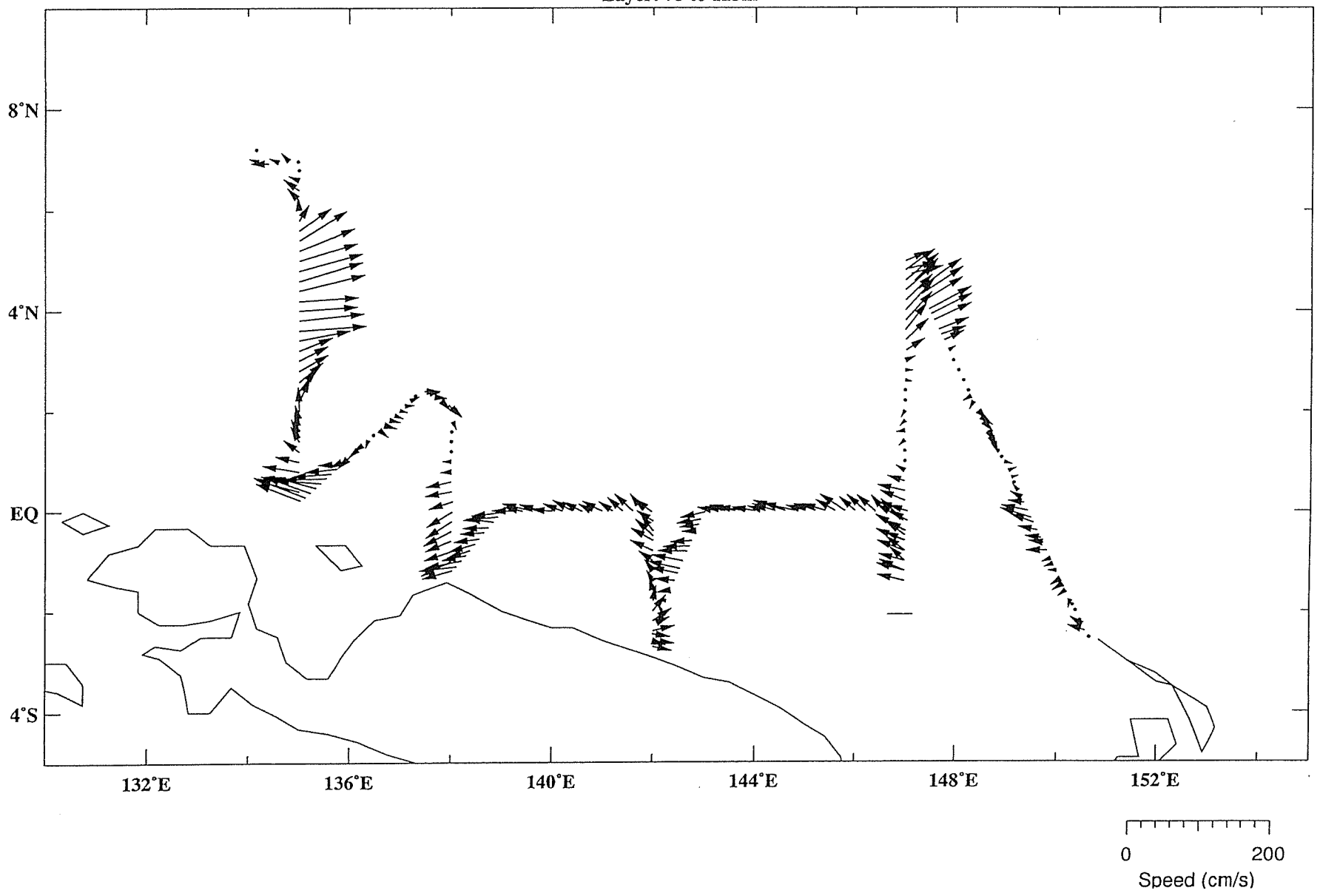
Layer: 30m to 75m



KY9909 Leg.2

Nov 8 to Nov 23, 1999

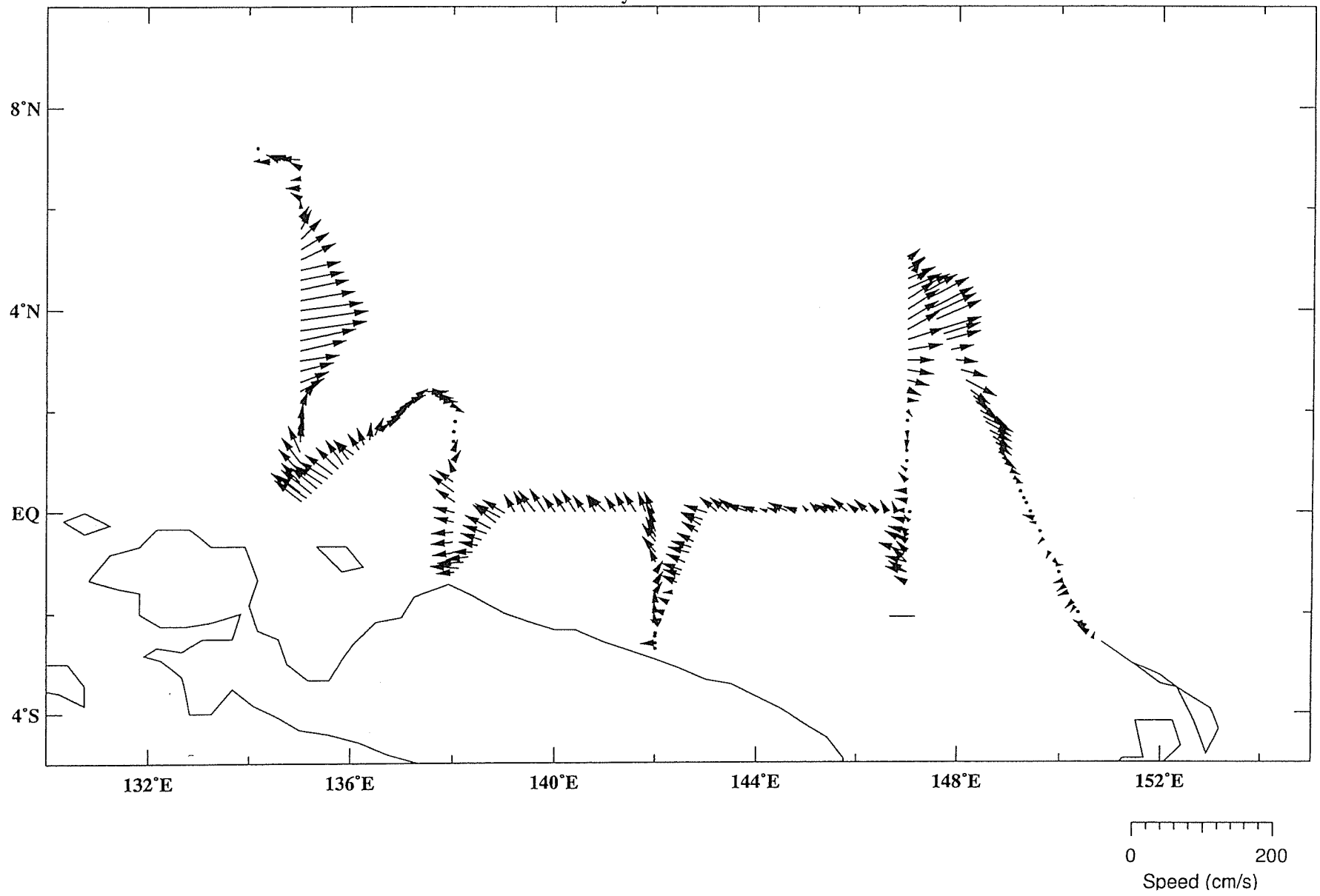
Layer: 75 to 125m



KY9909 Leg.2

Nov 8 to Nov 23, 1999

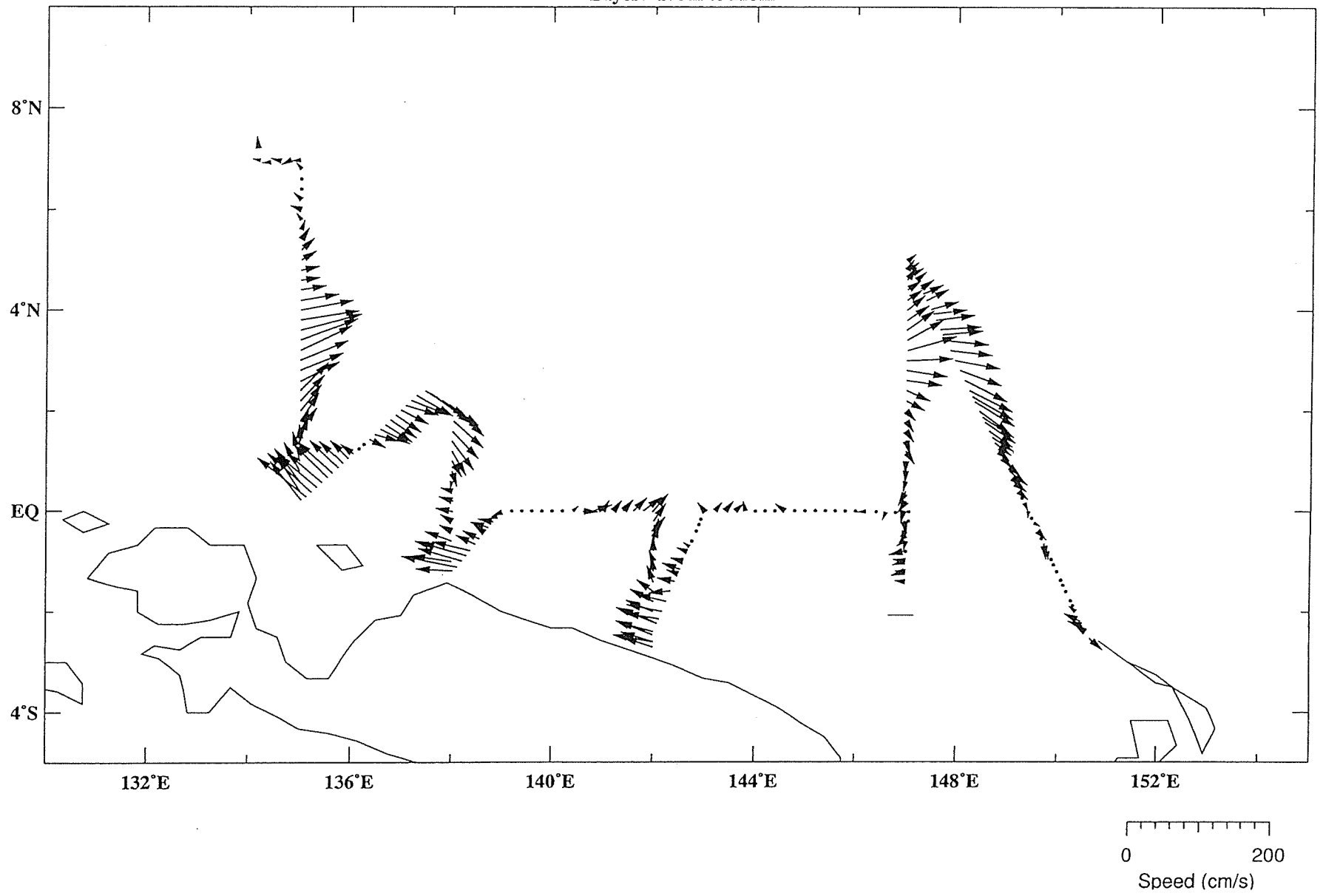
Layer: 125 to 175m



KY9909 Leg.2

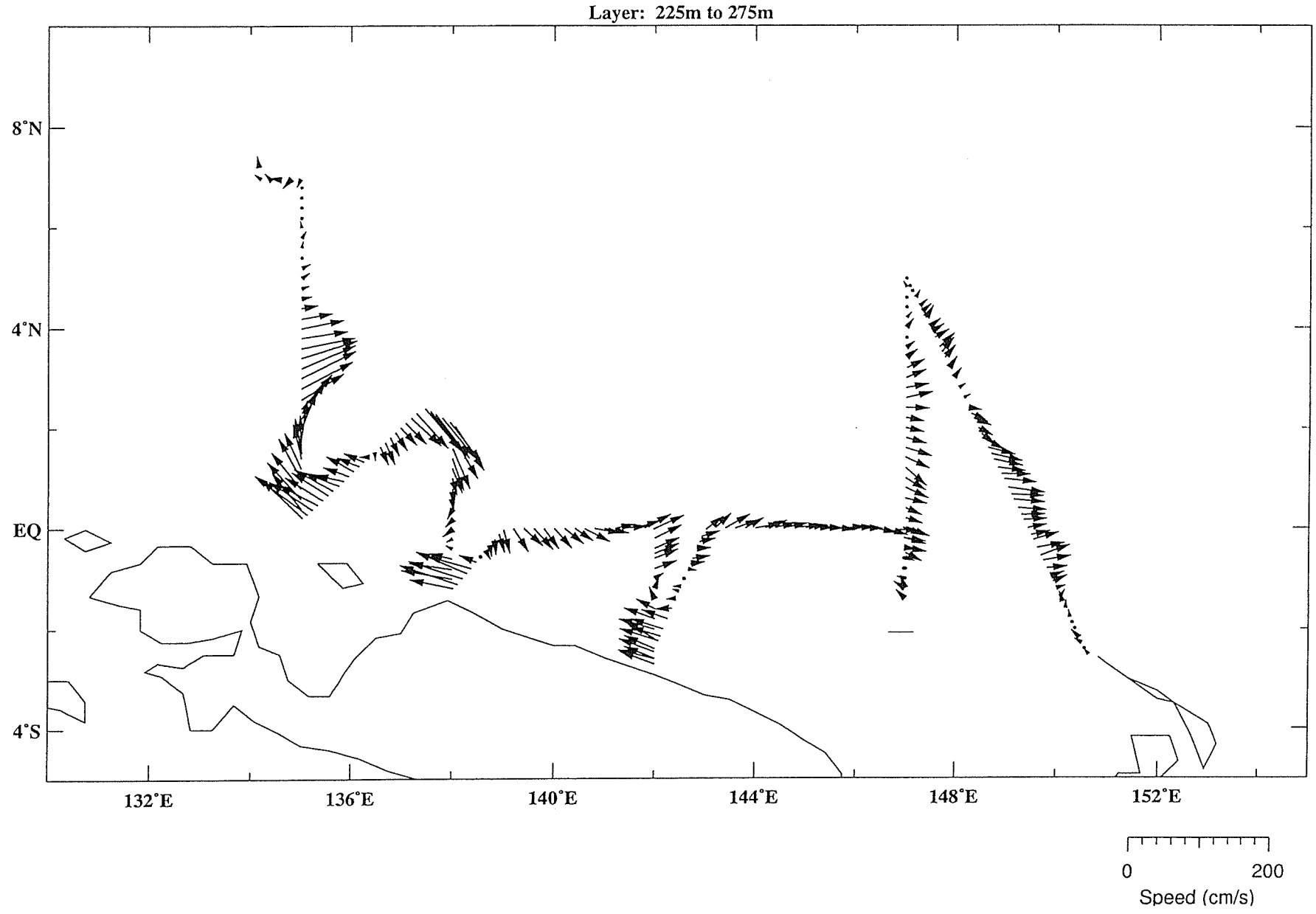
Nov 8 to Nov 23, 1999

Layer: 175m to 225m



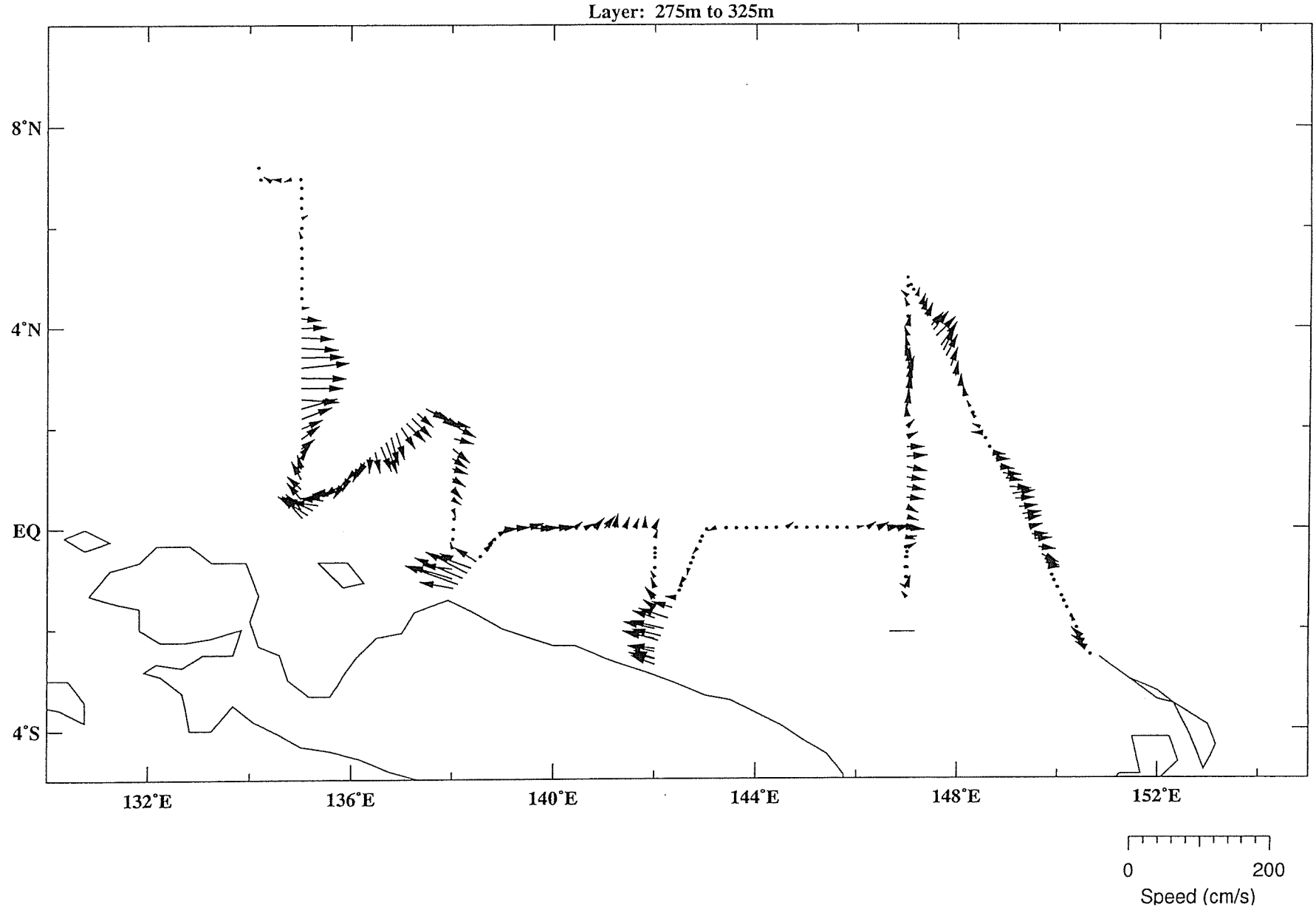
KY9909 Leg.2

Nov 8 to Nov 23, 1999



KY9909 Leg.2

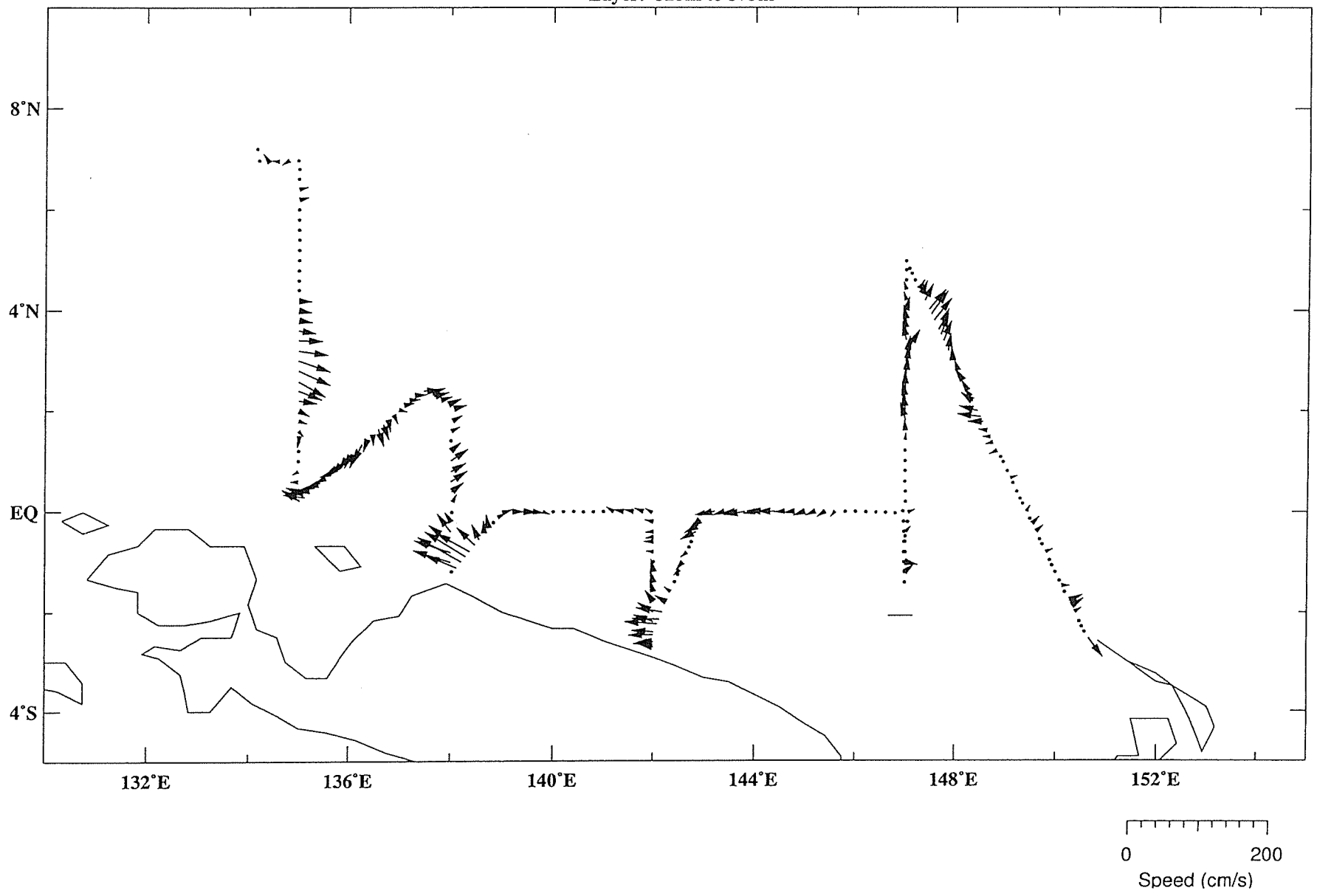
Nov 8 to Nov 23, 1999



KY9909 Leg.2

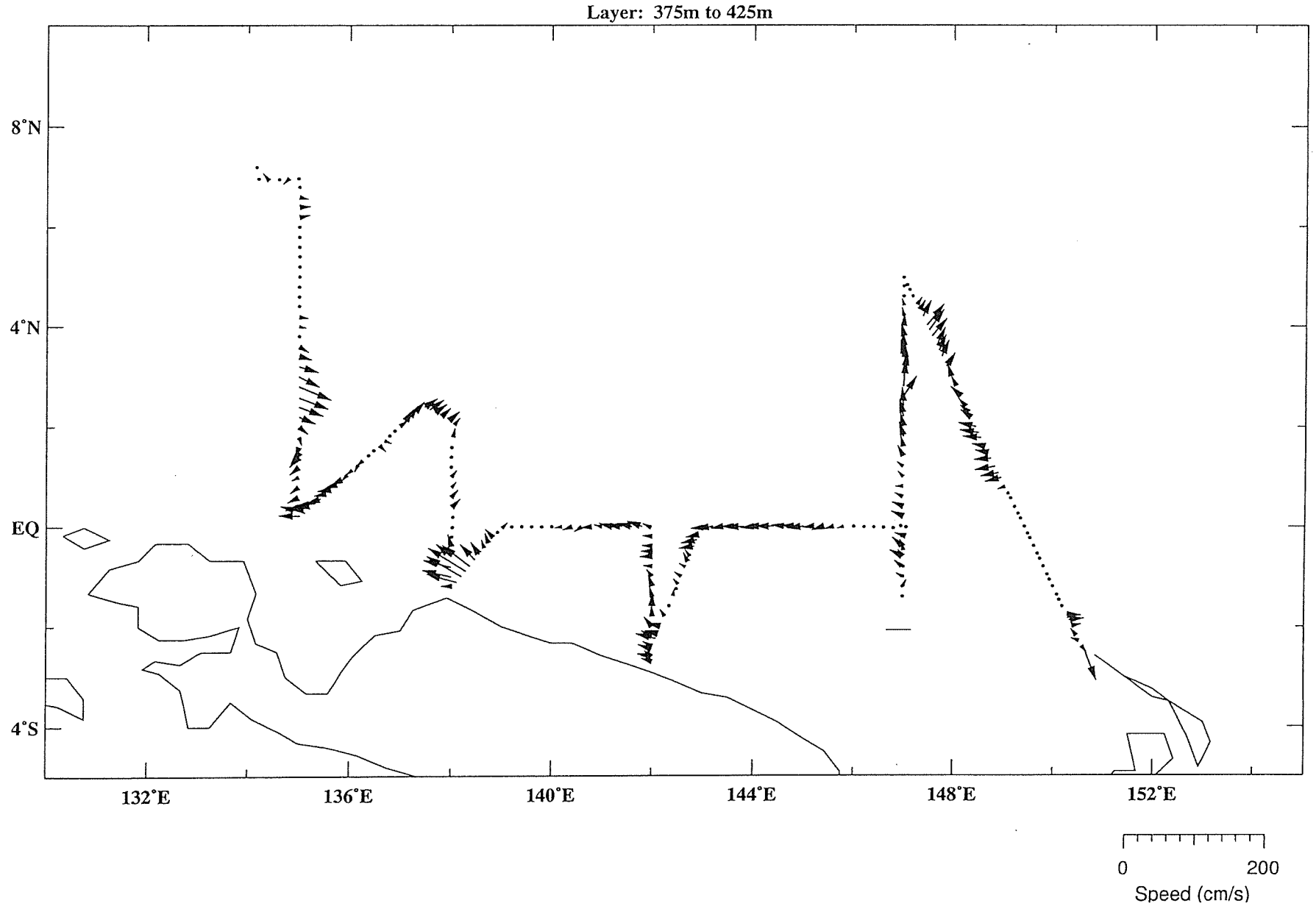
Nov 8 to Nov 23, 1999

Layer: 325m to 375m



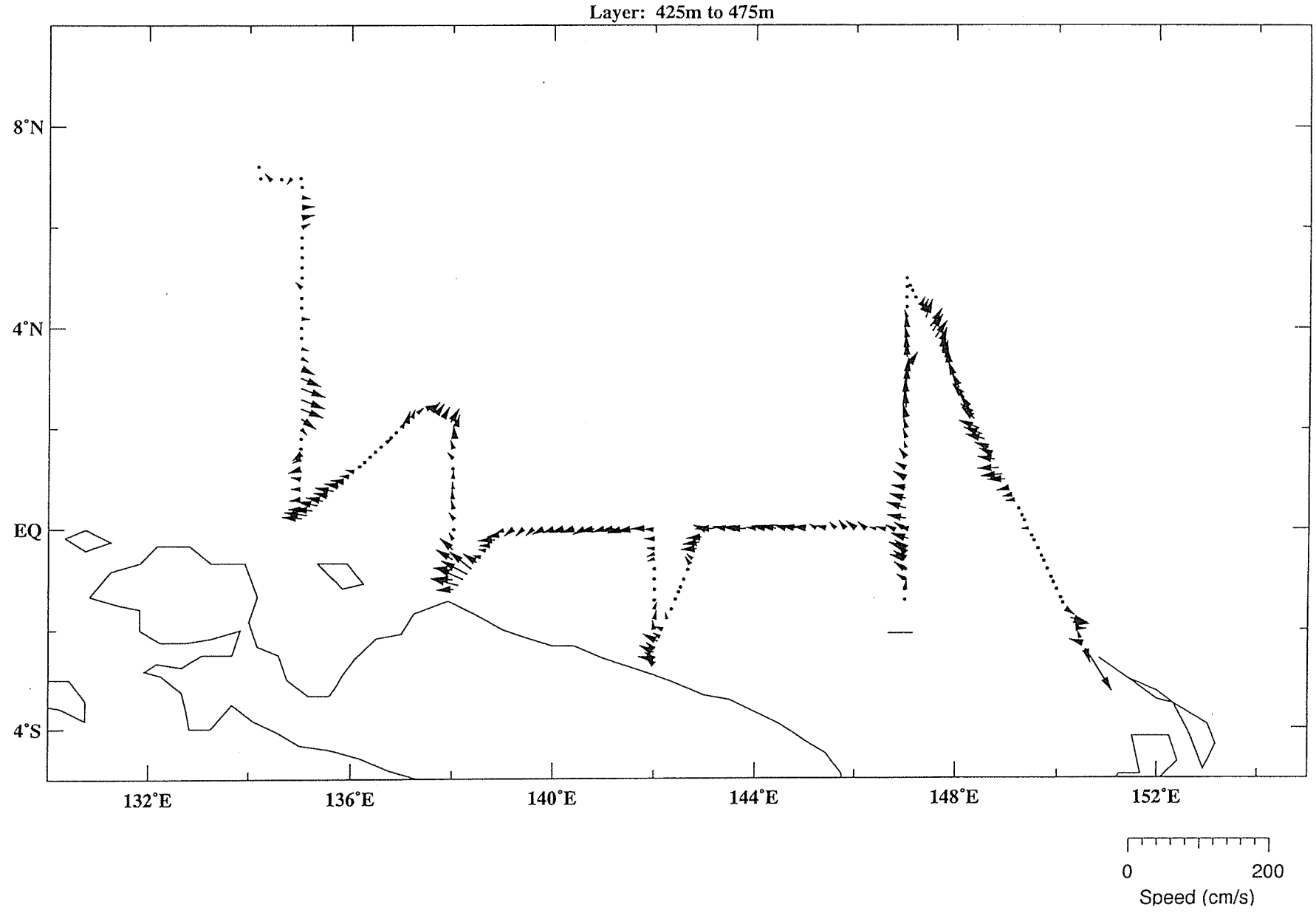
KY9909 Leg.2

Nov 8 to Nov 23, 1999



KY9909 Leg.2

Nov 8 to Nov 23, 1999



6. LADCP

6. Lowered ADCP

Instrumentation and methods

A Sontek dual ADP-250 lowered acoustic Doppler profiler system was mounted on the rosette for all stations. The underwater part of the system consists of a rechargeable battery pack, two Doppler profilers (ADP in Sontek terminology, more widely known as ADCPs), and cables connecting each ADP to the battery. A third short cable is connected to the battery unit; the other end is connected to a longer deck cable providing charging power and communications when the instrument is on deck, and covered with a dummy plug when the instrument is deployed. Data is recorded internally in the 80-Mbyte recorder in each ADP. The underwater system is rated for use to 6000 m depth.

The two ADPs (serial numbers C117 and C118) transmit at 250 kHz, with four beams at 30-degree angles from the vertical, and at 90-degree intervals of azimuth. The instruments are identical except for the orientation of the compass and tilt sensor. One ADP was mounted at the top of the rosette frame, looking up. Its transducer elements were completely above the top ring of the frame. The other instrument was mounted above and inside the bottom ring of the frame, next to the CTD, looking down. It was initially oriented with its vertical axis approximately aligned with the axis of the rosette frame, but this caused two of the beams to partly intersect the bottom ring of the frame. The mounting bracket was then modified so that the instrument could be tilted to swing the transducer inward, away from the frame. The change was made after station 6; for the remainder of the cruise, the instrument was tilted about 10 degrees inward, in which position the beams appear to clear the frame. Prior to the change, beams 2 and 3 were closest to the ring; afterward, beams 1 and 2 were closest. The up-looking ADP was mounted with beams 3 and 4 on the outside. Looking down from the top, the up-looking unit was mounted about 120 degrees clockwise from the down-looker. The battery pack was mounted vertically at mid-level, attached to a vertical frame member just inside the rings, roughly another 120 degrees azimuth from the ADPs. This arrangement gave reasonably good balance.

The Sontek ADPs use incoherent (narrow bandwidth) signal processing and feature shaded transducers for reduced sidelobes in their beam patterns. They are designed to ping at nearly the maximum possible rate as limited by the travel time to the last depth cell. Lowered ADP cabling and circuitry allow the two instruments to ping synchronously; this is essential to prevent interference between them.

The calculation of absolute velocity profiles requires accurate position fixes at the start and end of each cast. These were provided by the Kaiyo's differential GPS (DGPS) system. NMEA GGA messages were logged continuously at 5-s intervals throughout the cruise (excluding the transit back to Palau) via a serial line to the LADCP processing PC. The logging process (running under Linux) writes the fixes to files with a uniform naming convention, and with one file per day; this facilitates automated processing of the LADCP profiles.

Although each Sontek ADP includes a good pressure sensor, it is advantageous to use the depth estimate from the CTD for the final LADCP profile. For this purpose, 1-second time-averaged CTD profiles were used. The CTD and LADCP time series are synchronized in the LADCP software by matching their respective vertical velocity estimates.

The ADP system was prepared for each station by sending a set of commands using the Sontek program sonterm, unplugging the charger, disconnecting the deck cable, anddummying and securing the end of the short underwater cable that remains connected to the battery pack. The entire process takes about 5 minutes. A script was used to modify the command files for each station; only the deployment name needed to be changed. At the end of each station, the system was reconnected, charging commenced, and the data were dumped from each ADP in turn, using the Sontek program sonrec. Serial communications was viaRS-485, with data downloading at 115,200 baud. Typical raw data file size from each 2000-m cast was 6 MB for each instrument.

The instrument setup was identical for all stations, and the only difference between the two instruments was that the up-looker was designated the master and the down-looker the slave. Commands were sent first to the slave (instrument number 1) and then to the master (number 2), at which point both began to ping. Setup parameters include 8-m blanking interval, 8-m cell size, 16-m ping length, 20 depth cells, and maximum ping rate, which was just under 3 pings per second. Data were recorded in beam coordinates.

Data processing was done using software developed at the University of Hawaii and available via anonymous ftp or web browser (see http://currents.soest.hawaii.edu). Thegeneral method is described by Fischer and Visbeck (1993). The UH implementation includes routines written in C, Perl, and Matlab, and runs under Windows or Unix. It is designed for automated processing of many profiles at a time, and for flexibility with respect to editing and other processing parameters. The system handles data from RDI as well as Sontek profilers. At present it treats data from the up-looker and the down-looker as completely independent profiles. Ways of blending them are under investigation.

Results

Profiles were obtained from the up-looker on all stations, and from the down-looker on all but station 6; that one was lost due to a setup error. On two occasions the data download process hung up and had to be restarted, but nothing was lost. The cause of this problem is not known; it was too rare for troubleshooting. One suspect was the power management system in the laptop PC, which was not completely disabled until after the second hangup.

Acoustic scattering is extremely weak below about 1000 m in the region of this cruise. It appears to be better closer to the equator than in and north of the NECC, although this has not yet been quantified. Conditions are marginal for lowered ADCP profiling, and data below about 1500 m are particularly suspect. Nevertheless, it appears that we have useful information on most stations.

Analysis of the technical aspects of the data is highly preliminary as of this writing, and we expect that the accuracy of the final LADCP profiles will be improved considerably. There are indications of bias in the up-looker, possibly caused by acoustic scattering from the wire in sidelobes of the beams, and of subtle but important discrepancies in the tilt and/or heading estimates that reduce agreement between the up-looker and the down-looker. When these problems are better understood, it may be possible to correct the data for them. At present, comparison between lowered and shipboard profiles within their overlapping depth range (considering only the vertical average of the velocity difference) shows cruise-mean differences under 1 cm/s in each component, with standard deviations of about 4 cm/s in each component. These statistics are similar for the up- and down-looker. For the purposes of this report, we will show plots only from the down-looker.

Maps and Sections

The preliminary LADCP currents from the down-looking unit are displayed here in two ways: as vector maps of currents in 250-m layers starting at 500–750 m and ending with 1500–1750 m, and as contoured sections of zonal and meridional components. Several interesting features and patterns are evident. Most obvious are the deep extensions of the Mindanao Current and the Halmahera Eddy.

The Mindanao Current sections show deep southward flow beneath the MC throughout the water column. The vectors rotate counterclockwise slightly with depth, and the deep extension of the MC is more pronounced on the 8N section than on the diagonal section. The core of the deep extension is seen slightly further offshore with increasing depth. Offshore, near 128E, flow on the 8N section is northward; it appears that the deep extension of the MC is the western limb of a cyclonic recirculation, the southern edge of which is near 5N. Stations 32 and 34, both at 5-27N, 127-15E, were occupied less than 2 days apart, but show some differences in current direction. Possible contributors to the difference include measurement error, tides, and lower frequency variability.

On the southeastward diagonal section, north of Halmahera and Morotai near 3N, there is a strong flow northwestward along the topography; it is particularly strong below 700 m, and reaches a peak in V of 50 cm/s near 1300 m. It is not clear from the vector maps whether all this water is also crossing the 130E section near 2S, where flow is the right direction (northwestward), but much slower in the 1250–1500-m layer; if so, it may be that at 3S it has been concentrated by the topography into a very narrow jet, the center of which we happened to have sampled. The maps suggest that the flow to the northwest at these depths retroflects between 4N and 6N and flows eastward across the 130E section near 4N. It is not clear whether the southward current across the 5N section at 129E is coming entirely from the retroflection. Overall, this anticyclonic circulation appears to be a deep expression of the Halmahera Eddy, the shallow portion of which is much larger in diameter and extends further north than the deep part.

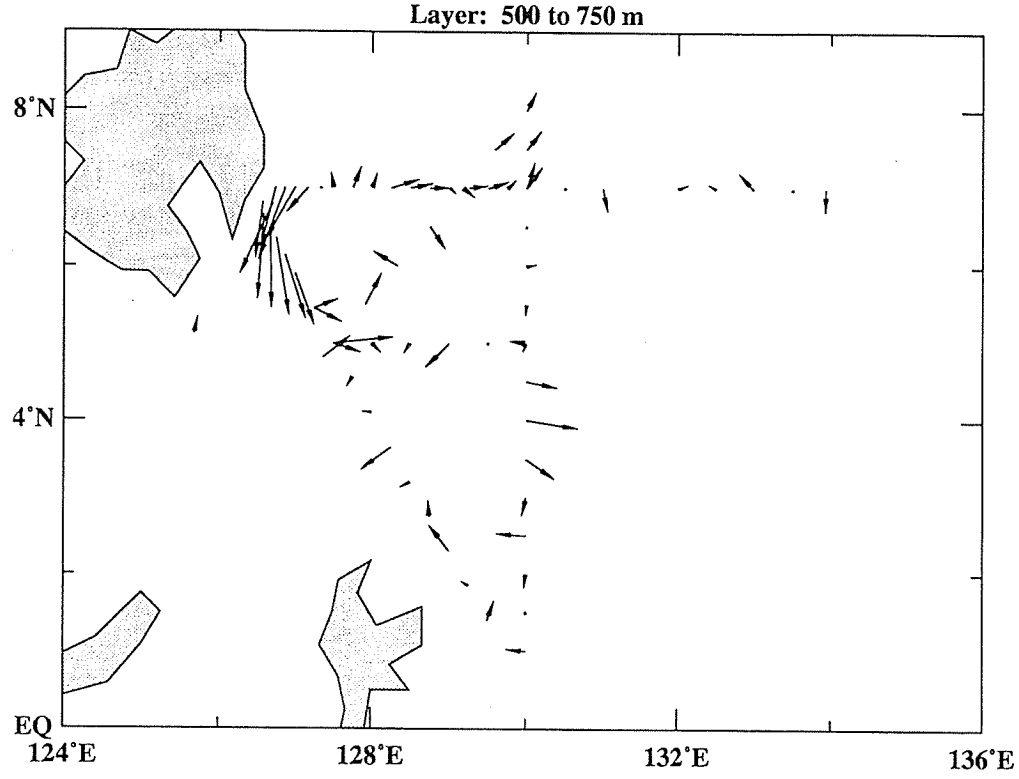
References

Fischer, J., and M. Visbeck, 1993. Deep velocity profiling with self-contained ADCPs. J. Atmos. Oceanic Technol., 10, 764-773.

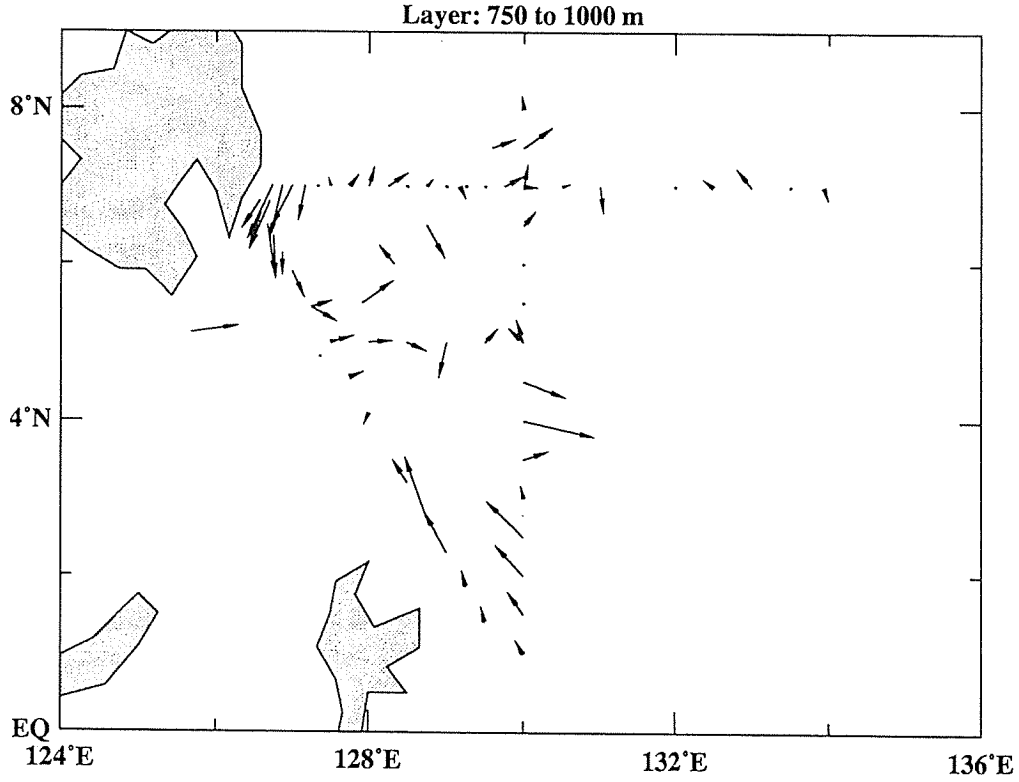
Kaiyo 9909 Leg 1

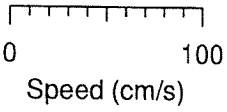
Preliminary LADCP (down-looking)

Layer: 500 to 750 m



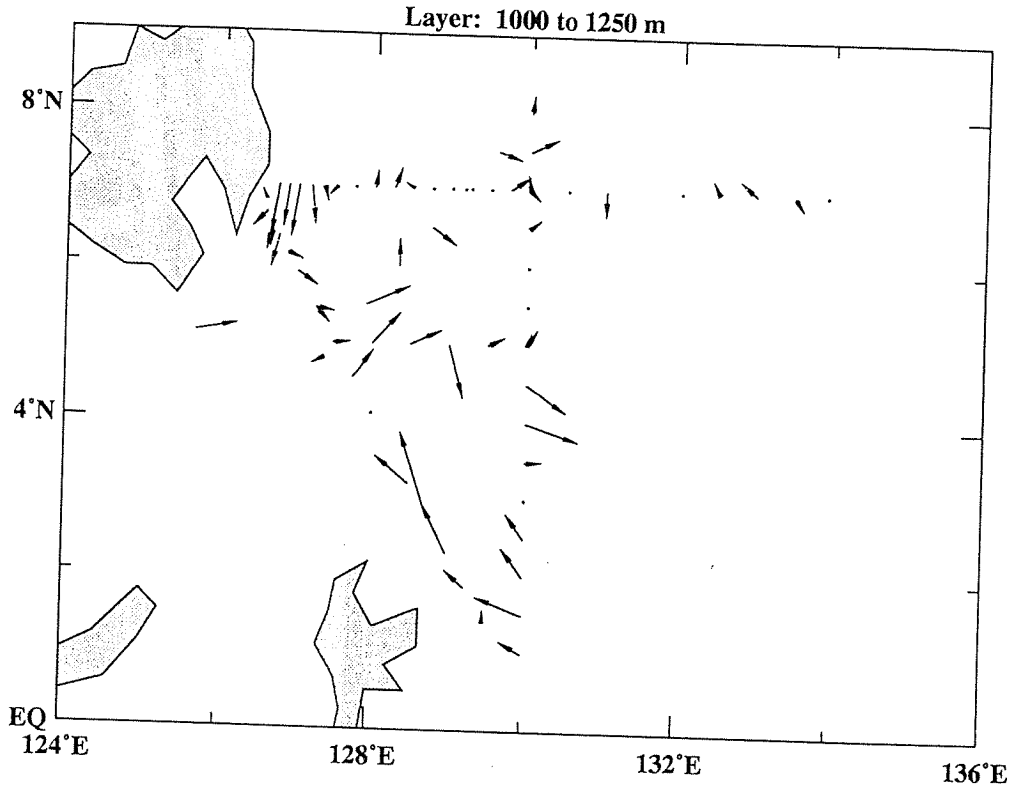
Layer: 750 to 1000 m

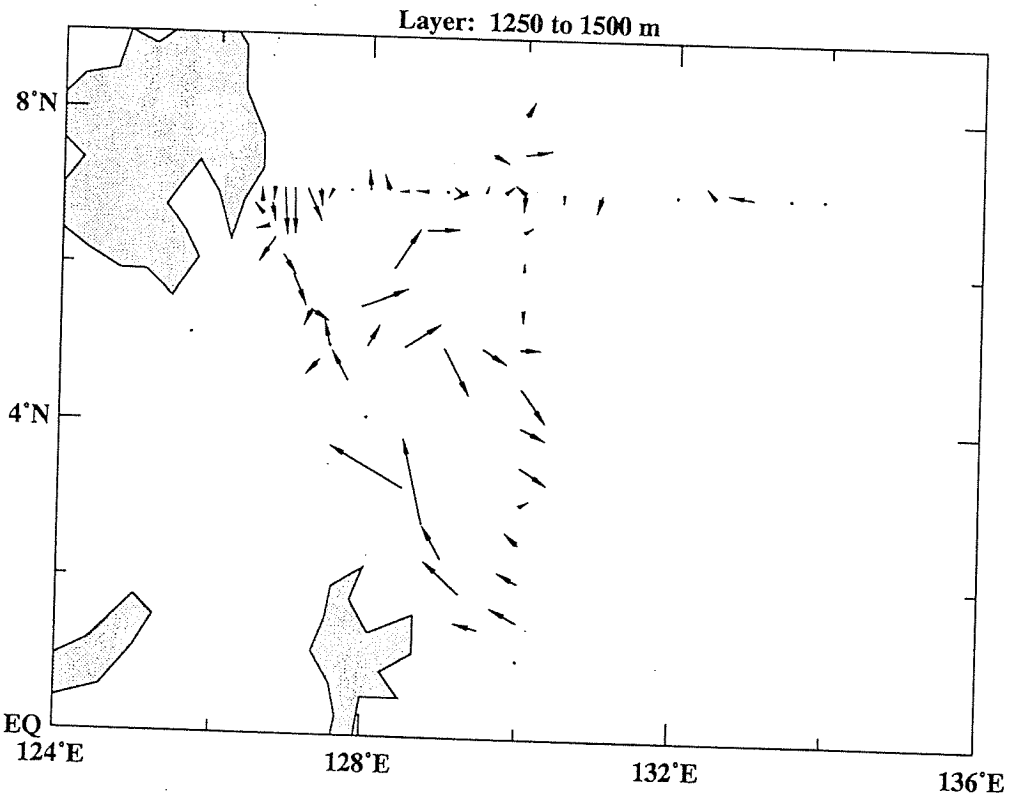


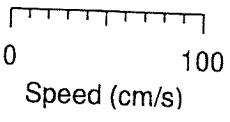


Kaiyo 9909 Leg 1

Preliminary LADCP (down-looking)

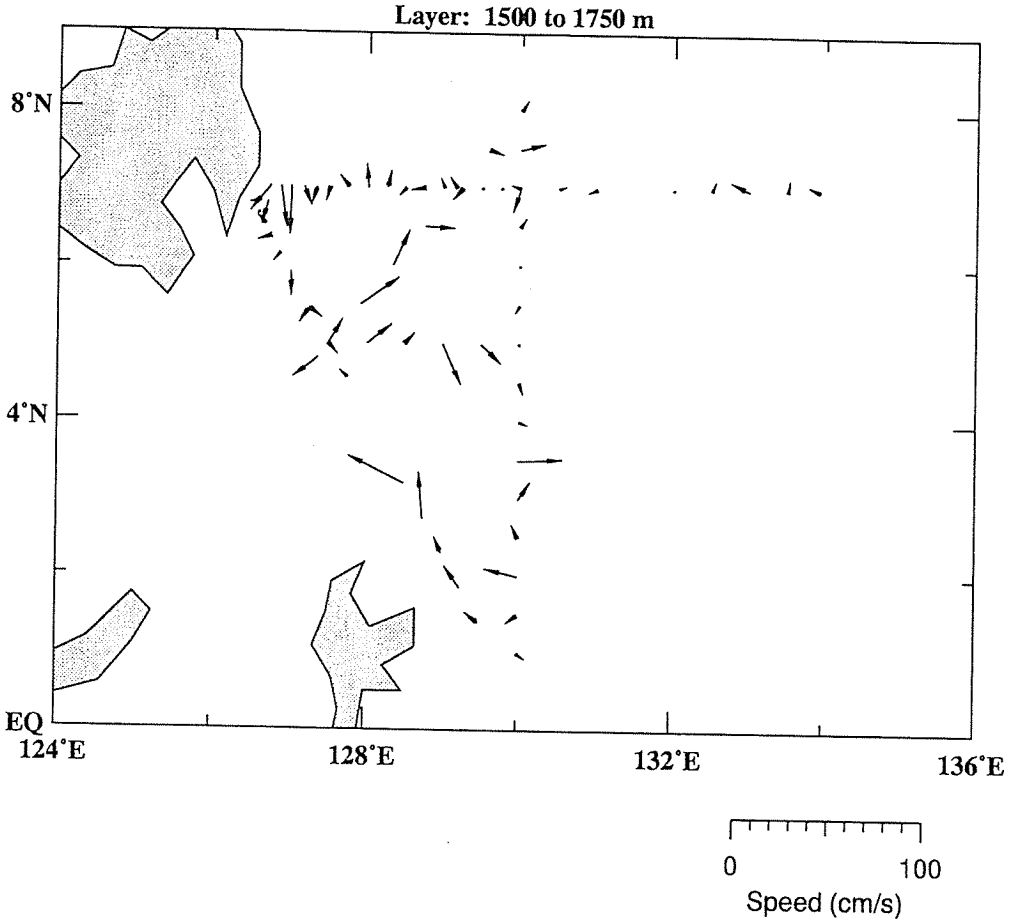






Kaiyo 9909 Leg 1

Preliminary LADCP (down-looking)



7. JAMSTEC Moorings

7. JAMSTEC MOORING

To get the knowledge of physical process in the western equatorial pacific. In this cruise (KY 99-09), we recovered four subsurface moorings at(Mindanao 5N-125E),(00-138E),(2.5S-142E),and (0 0-147E),and deployedfour ADCP mooring at the same place.

Instrument:

1) ADCP

Distance to first bin : 8m

Pings per ensemble : 16

Time per ping : 2.00s

Bin length : 8.00m

Sampling Interval : 3600s

Recovered ADCP

- Serial Number : 1155 (Mooring No.990204-00138E)
- Serial Number : 1151 (Mooring No.980906-25S142E)
- Serial Number : 1222 (Mooring No.990221-00147E)

Deployed ADCP

- Serial Number : 1221 (Mooring No.991024-7N127E)
- Serial Number : 1225 (Mooring No.991112-00138E)
- Serial Number : 1224 (Mooring No.991115-25S142E)
- Serial Number : 1152 (Mooring No.991116-00147E)

2) CTD

SBE-16

Sampling Interval : 1800s

Recovered CTD

- Serial Number : 1288 (Mooring No.990217-5N125E)
- Serial Number : 1282 (Mooring No.990204-00138E)
- Serial Number : 1276 (Mooring No.980906-25S142E)
- Serial Number : 1280 (Mooring No.990221-00147E)

Deployed CTD

- Serial Number : 1281 (Mooring No.991024-7N127E)
- Serial Number : 1275 (Mooring No.991112-00138E)
- Serial Number : 2611 (Mooring No.991115-25S142E)
- Serial Number : 1286 (Mooring No.991116-00147E)

3) Current Meter

Recovered AANDERAA RCM-8

- Serial Number : 10331 (160m) (Mooring No.990217-5N125E)
- Serial Number : 10338 (300m) (Mooring No.990217-5N125E)

・Serial Number : 9760 (500m) (Mooring No.990217-5N125E)
・Serial Number : 10337 (700m) (Mooring No.990217-5N125E)
・Serial Number : 11670 (1000m) (Mooring No.990217-5N125E)
・Serial Number : 10662 (500m) (Mooring No.980906-25S142E)
・Serial Number : 9728 (700m) (Mooring No.980906-25S142E)
・Serial Number : 10622 (850m) (Mooring No.980906-25S142E)
・Serial Number : 94 (1000m) (Mooring No.980906-25S142E)

Recovered Current Meter

・Serial Number : 4080U (700m) (Mooring No.990204-00138E)
・Serial Number : 4011 (700m) (Mooring No.990221-00147E)

Deployed AANDERAA RCM-9

・Serial Number : 355 (400m) (Mooring No.991024-7N127E)
・Serial Number : 357 (700m) (Mooring No.991024-7N127E)

Deployed Current Meter

・Serial Number :SECM0035 (700m) (Mooring No.991112-00138E)
・Serial Number :SDCM0036 (700m) (Mooring No.991115-25S142E)
・Serial Number :SDCM0034 (700m) (Mooring No.991116-00147E)

Deployment :

Four ADCP mooring were deployed at (7N-127E), (00-138E), (2.5S- 142E),and (00-147E) . The moorings were planed to make the ADCP buoy placed at about 270m.

After we dropped the anchor, we monitored depth of the acoustic releaser (Fig.7-1 ～ 7-4). The descending rate was about 2.7m/sec.

Each position of the mooring were showed below.

Results of calibration

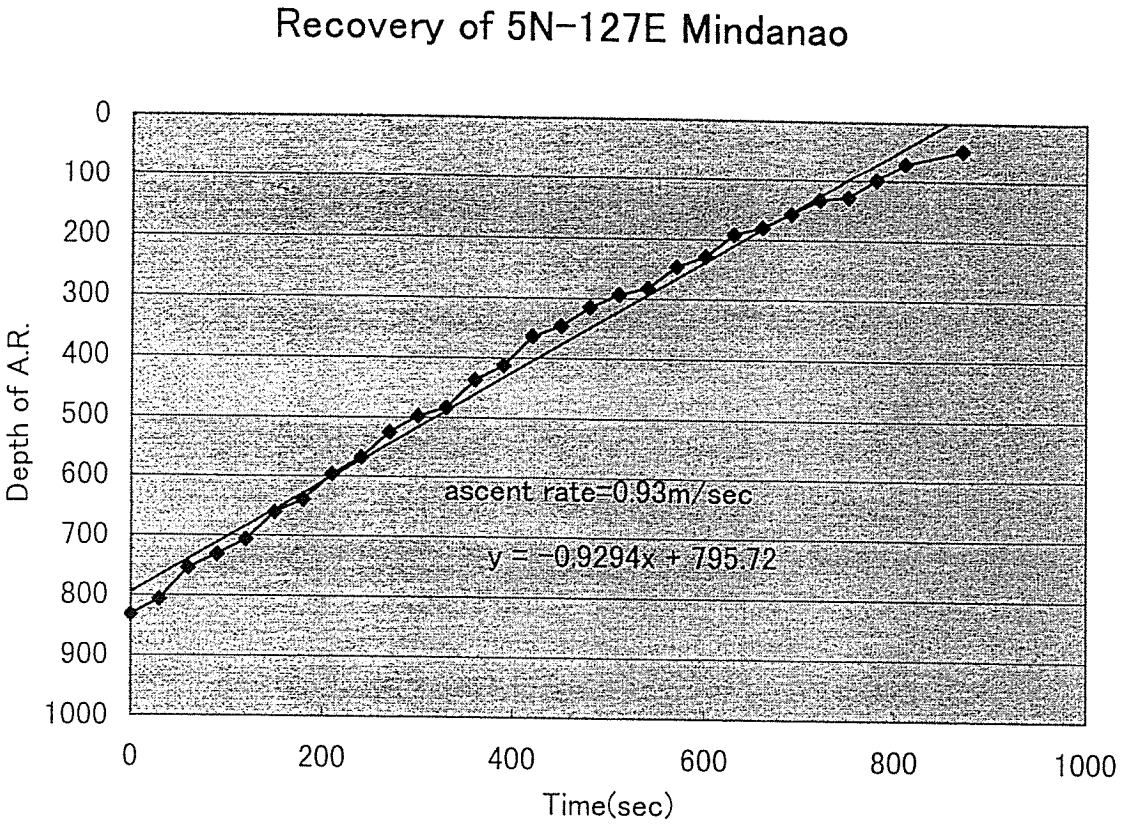
・Mooring No.991024-7N127E(Mindanao)
Lat: 06 ° 49.596N Long: 126 ° 42.723E
・Mooring No.991112-00138E
Lat: 00 ° 00.972S Long: 138 ° 01.801E
・Mooring No.991115-25S142E
Lat: 02 ° 28.110S Long: 141 ° 58.572E
・Mooring No.991116-00147E
Lat: 00 ° 00.050S Long: 147 ° 05.292E

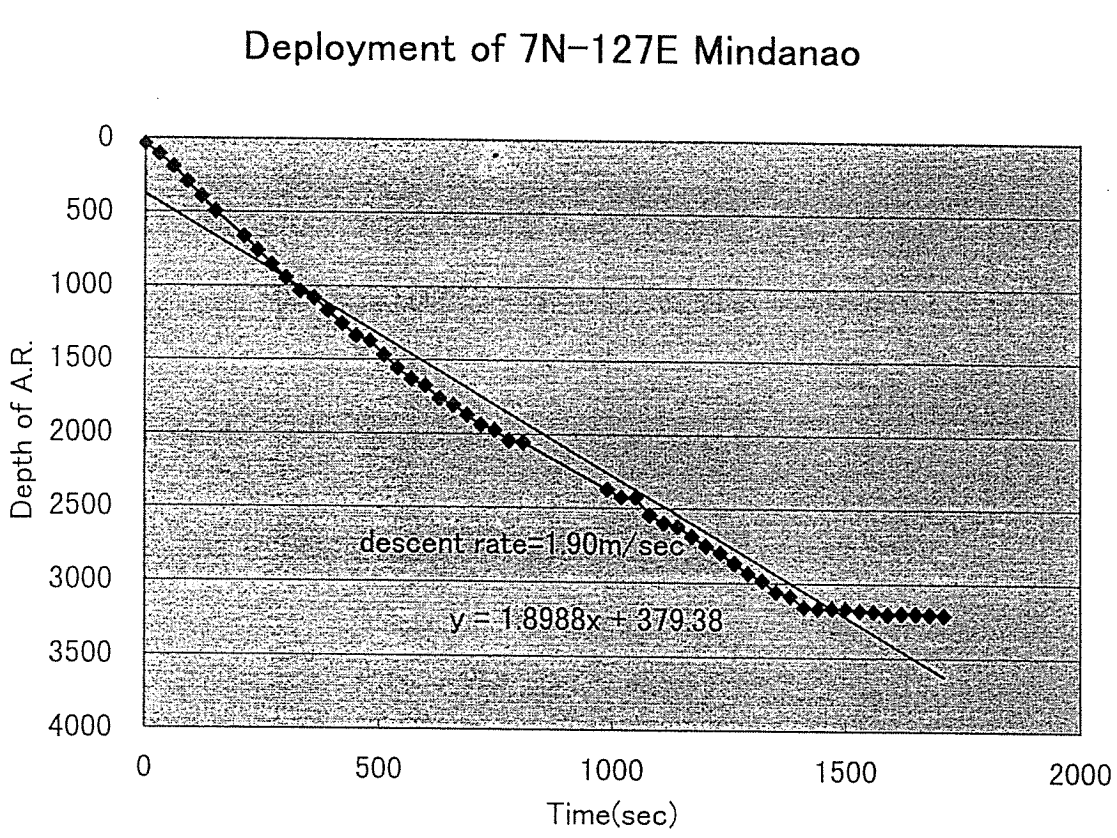
Recovery

We recovered three ADCP moorings and one current meter mooring which were deployed on Oct.-Nov.1999 (K99-09).

We monitored depth of acoustic releaser after we released the anchor(Fig.7-1 ～ 7-4).

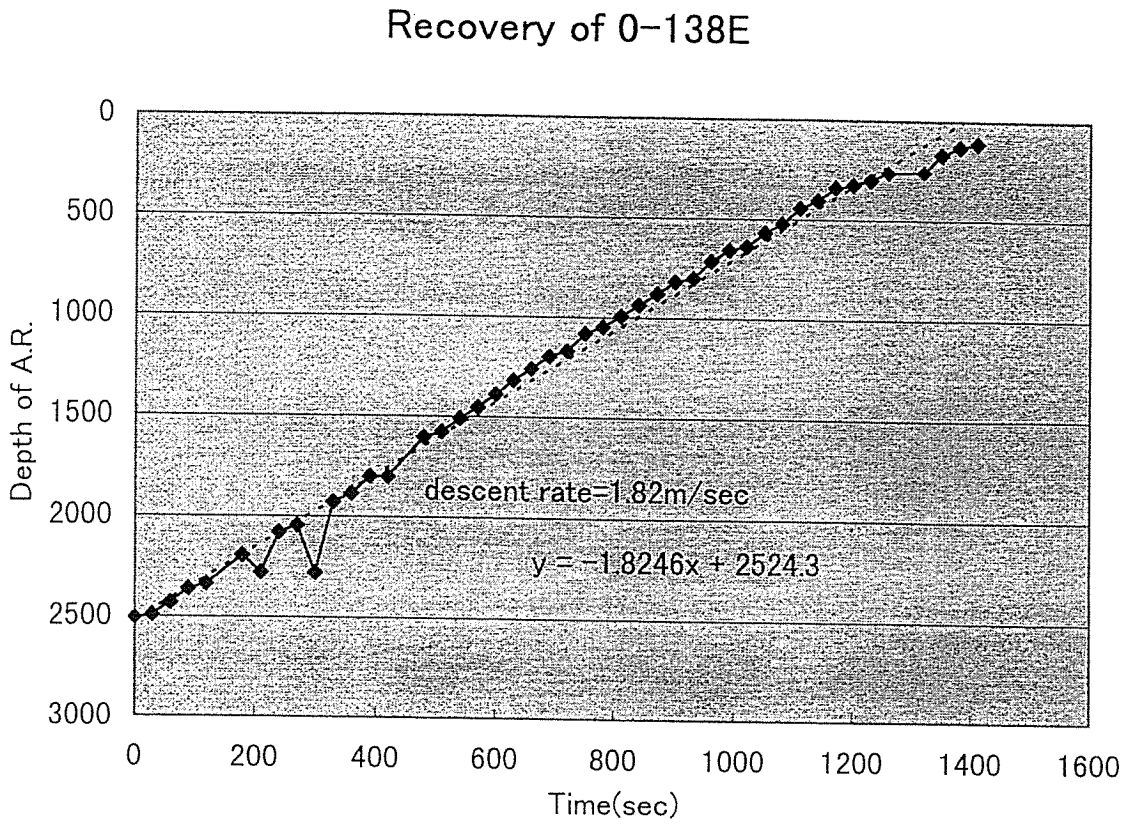
After the recovery, we uploaded ADCP and CTD data into a computer,then raw data were converted into ASCII code. Results were shown in the figures on following pages. Fig.7-5 ～ 7-8 shows CTD depth, temperatureand salinity data . Fig.7-9 ～ 7-17 shows the velocity data (eastward and northward component) at 50m(29bins for 2.5S-142E ADCP,21bins for 00-147E, 25bins for 00-138E), 100m(23bins for 2.5S-142E ADCP,15bins for 00-147E, 19bins for 00-138E) and 150m(16bins for 2.5S-142E ADCP,9bins for 00-147E, 12bins for 00-138E) depth.

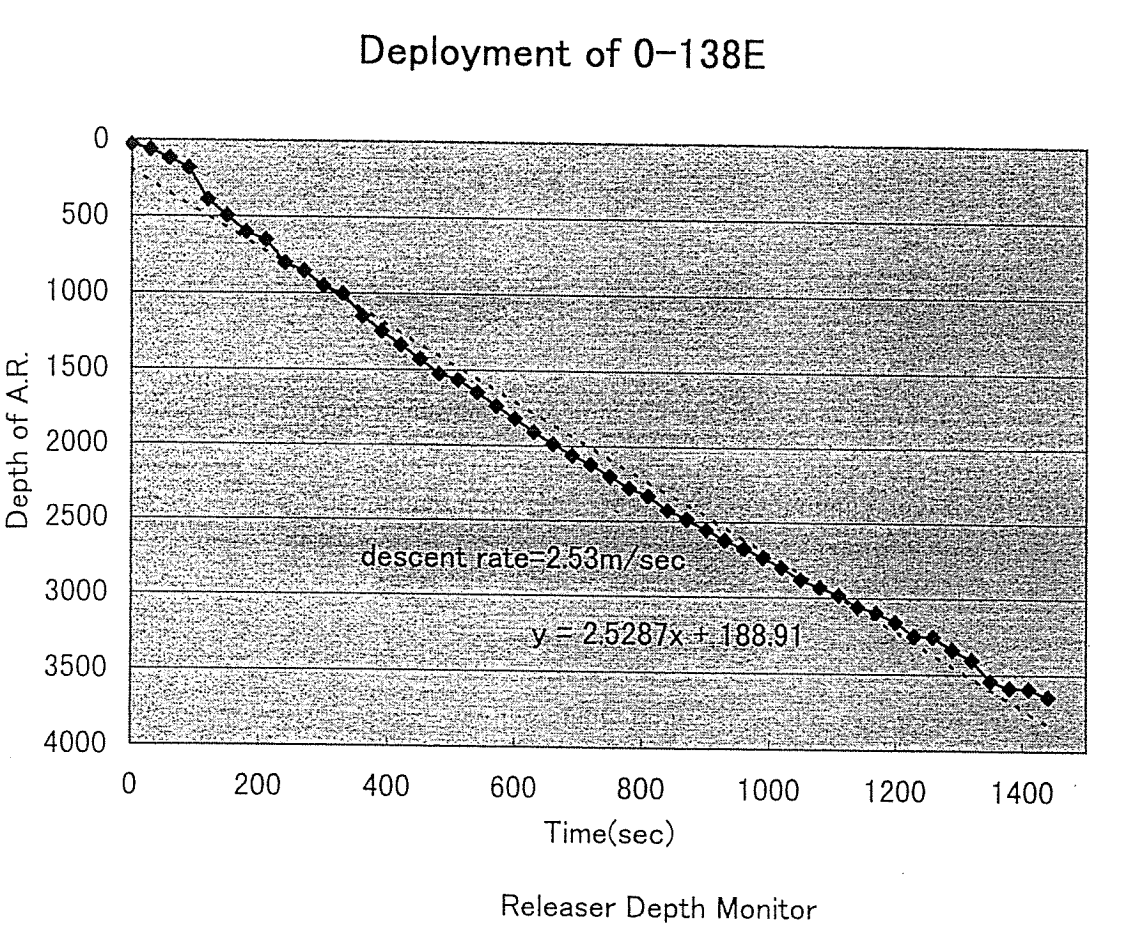




Releaser Depth Monitor

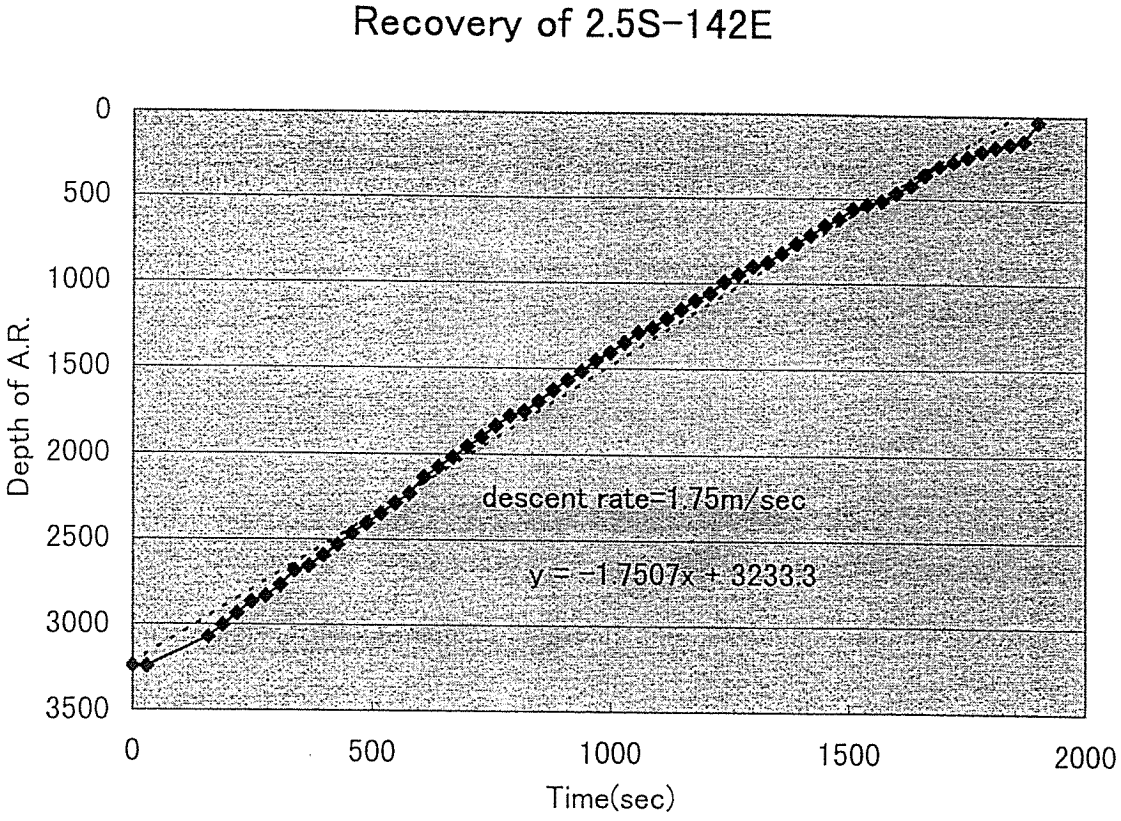
Fig. 7-01

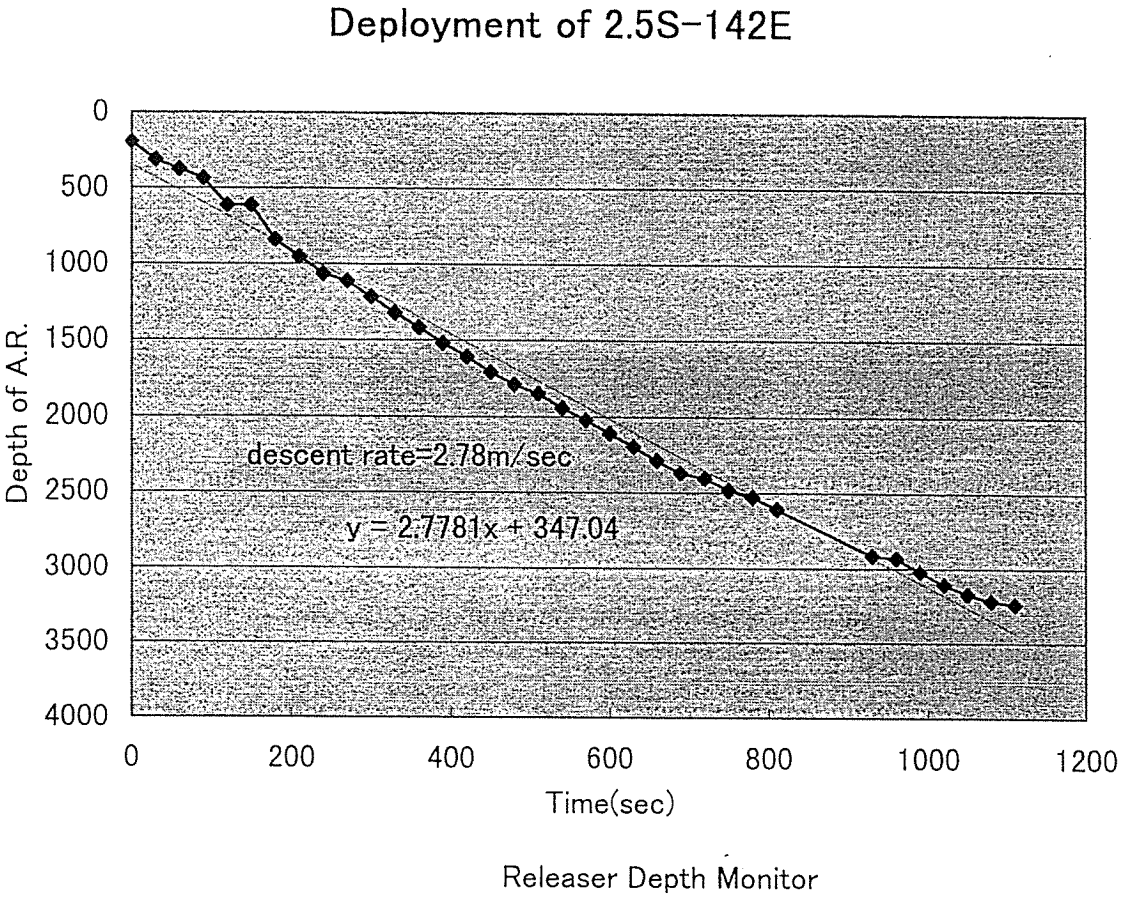




Releaser Depth Monitor

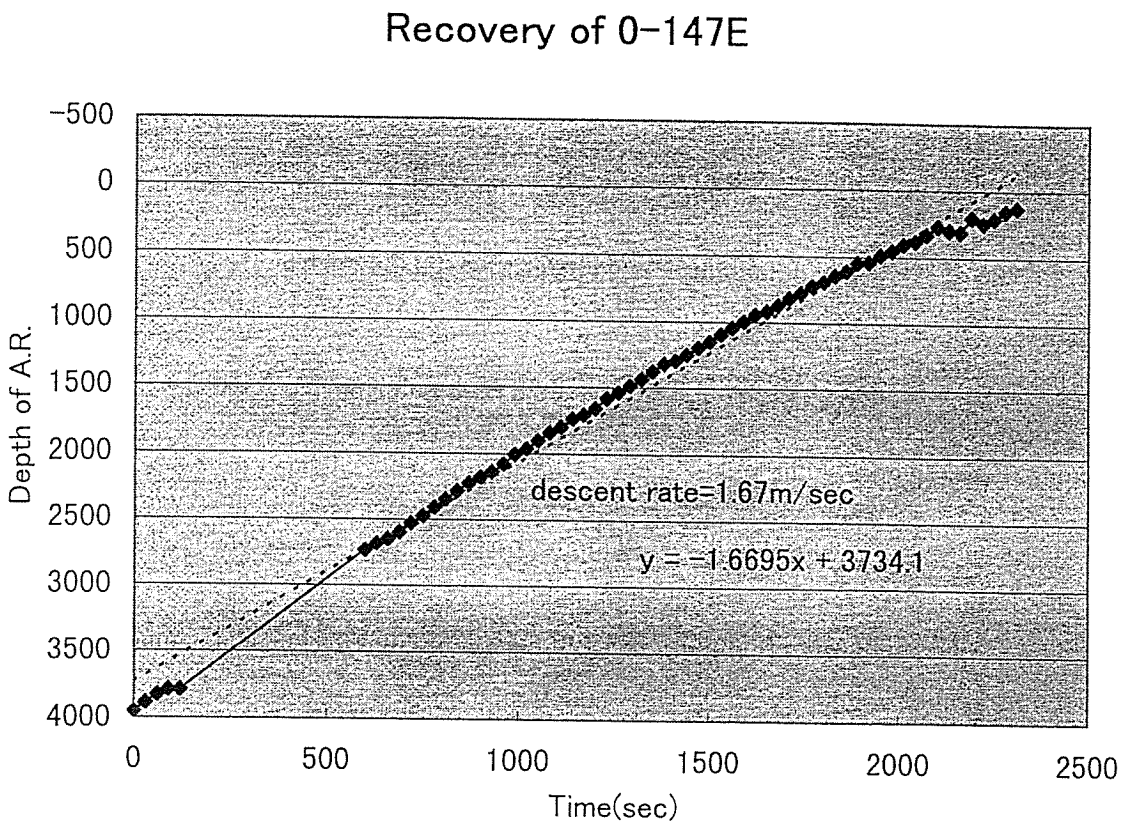
Fig. 7-02

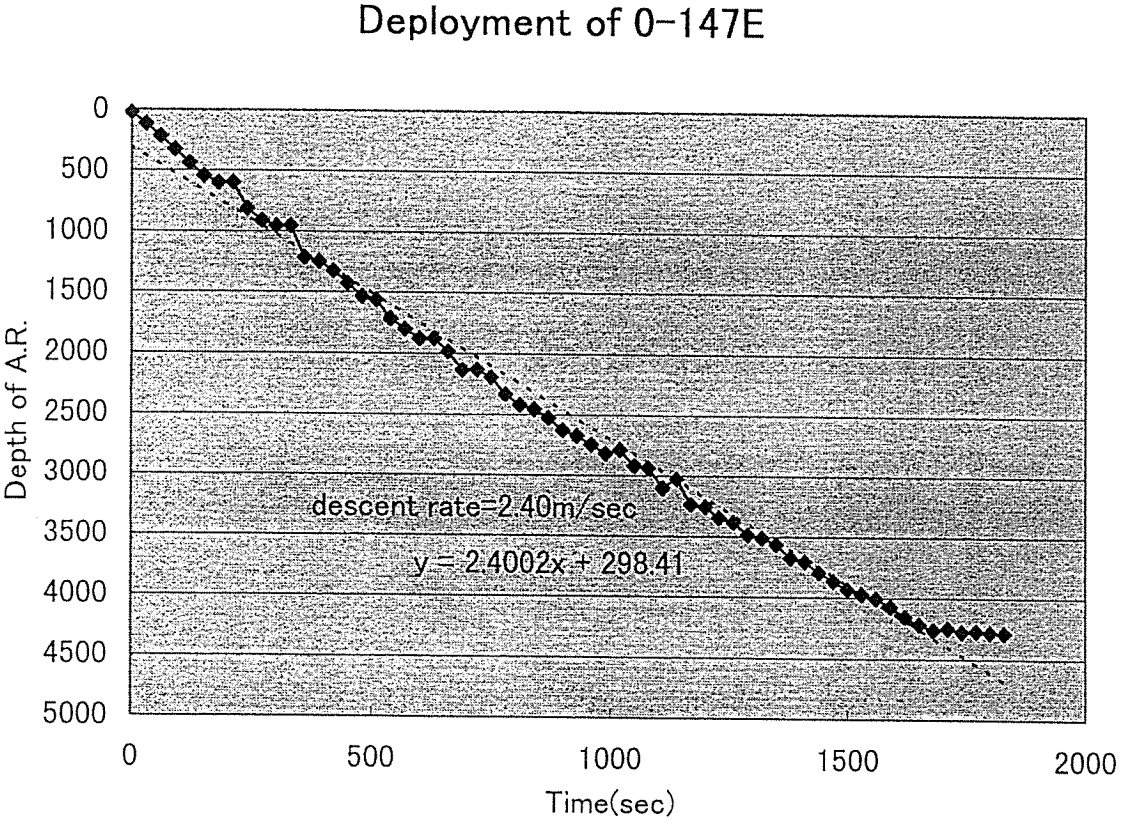




Releaser Depth Monitor

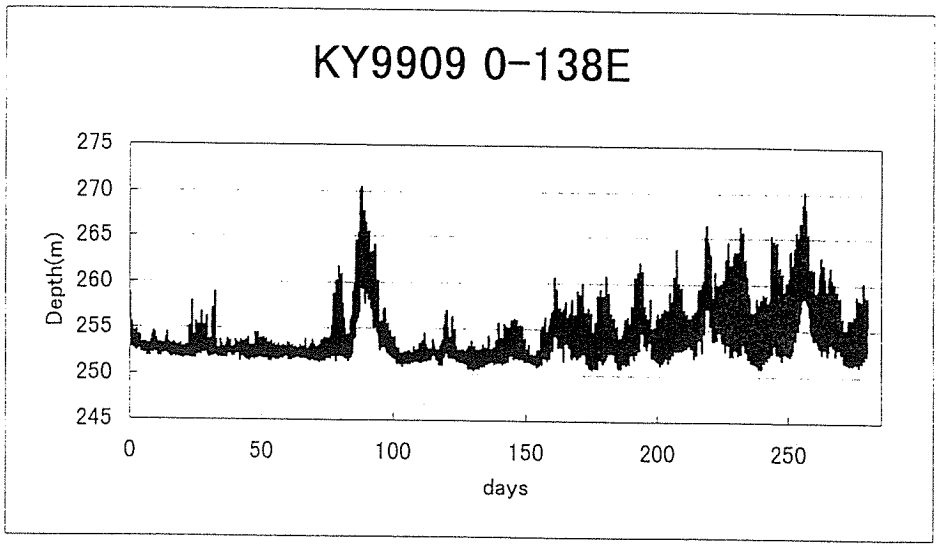
Fig. 7-03

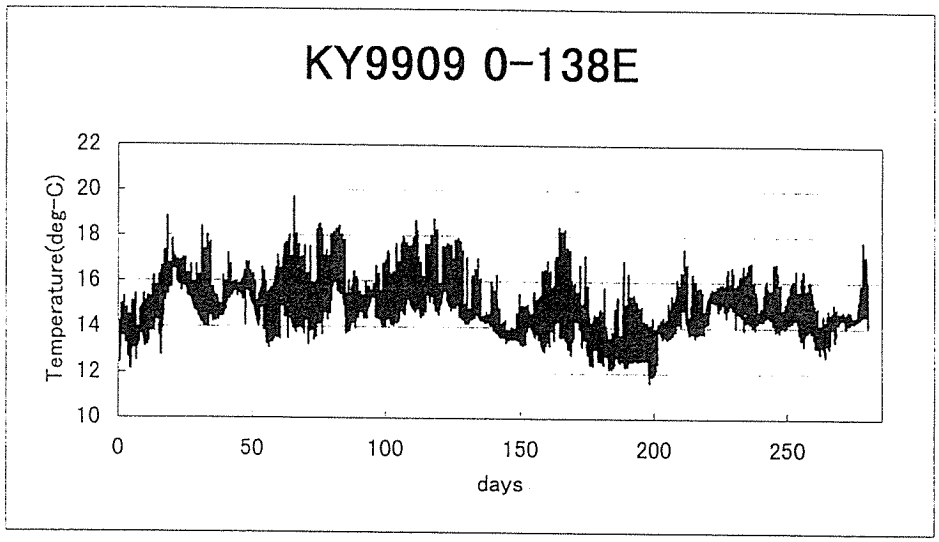




Releaser Depth Monitor

Fig. 7-04


KY9909 0-138E
Depth(m)
275
270
265
260
255
250
245
0
50
100
150
200
250
days


KY9909 0-138E
Temperature(deg-C)
22
20
18
16
14
12
10
0
50
100
150
200
250
days

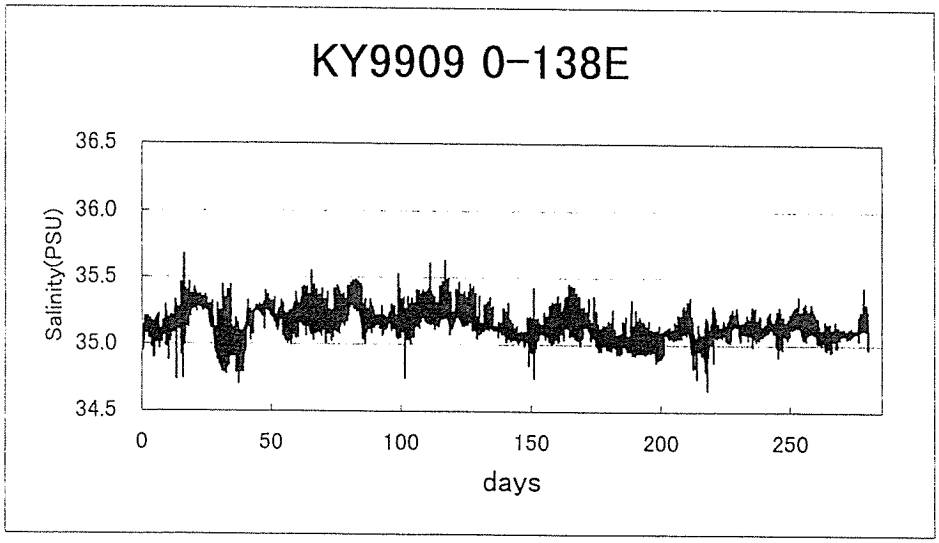
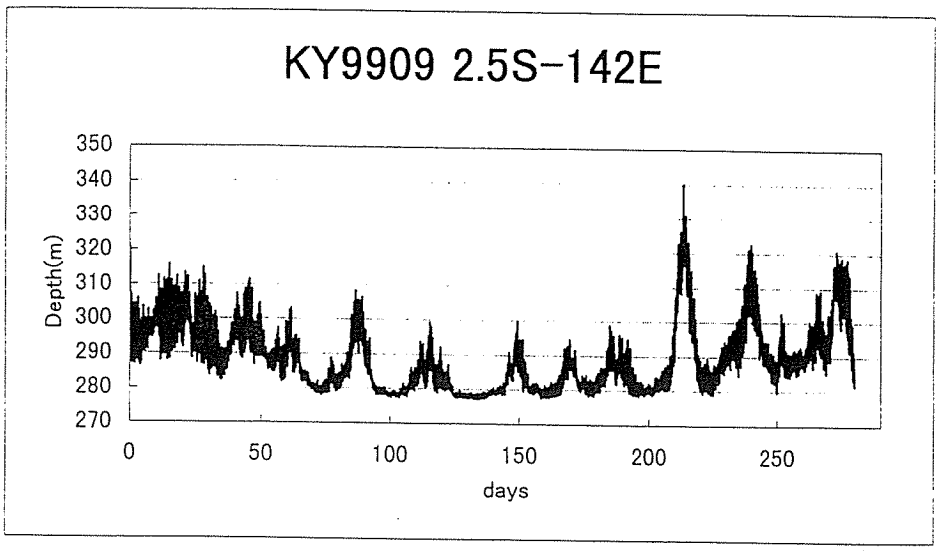
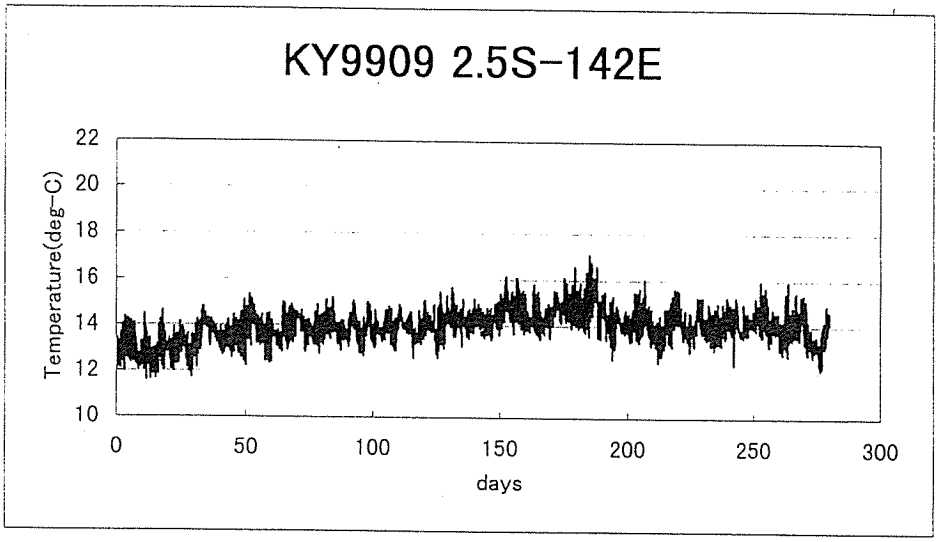

KY9909 0-138E
Salinity(PSU)
36.5
36.0
35.5
35.0
34.5
0
50
100
150
200
250
days

Fig. 7-05


KY9909 2.5S-142E
Depth(m)
350
340
330
320
310
300
290
280
270
0
50
100
150
200
250
days


KY9909 2.5S-142E
Temperature(deg-C)
22
20
18
16
14
12
10
0
50
100
150
200
250
300
days

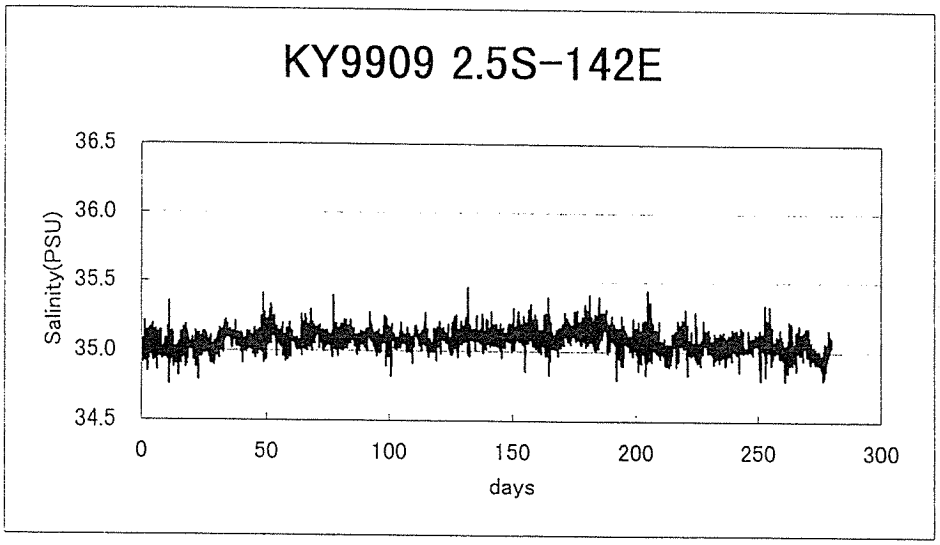
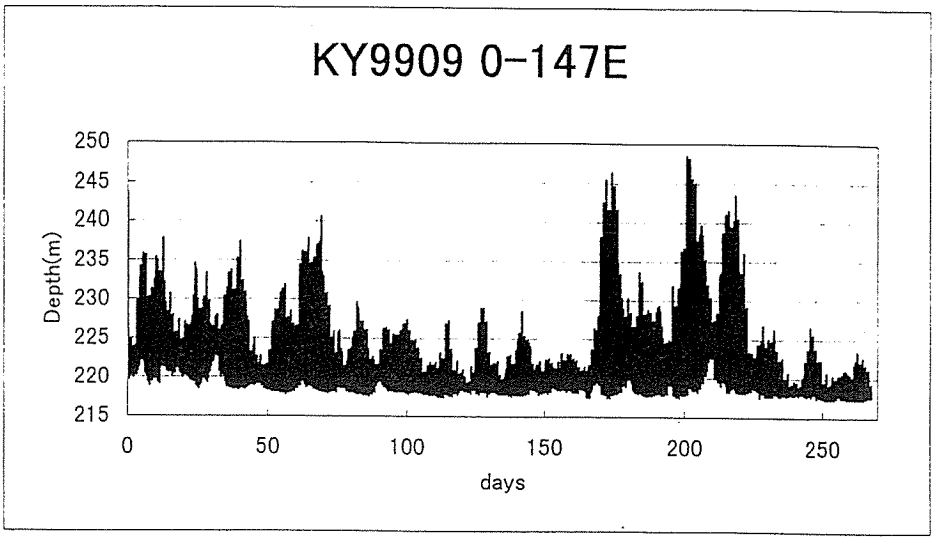
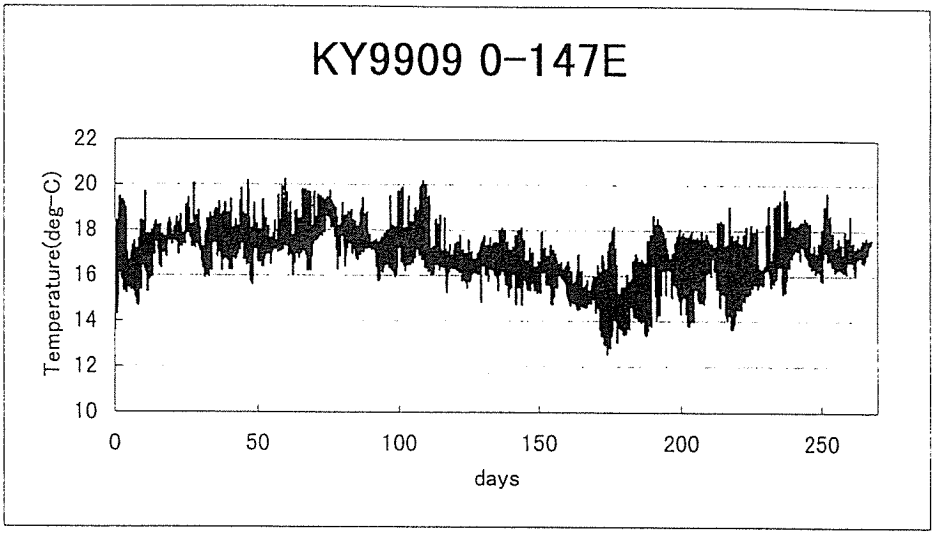

KY9909 2.5S-142E
Salinity(PSU)
36.5
36.0
35.5
35.0
34.5
0
50
100
150
200
250
300
days

Fig. 7-06


KY9909 0-147E
Depth(m)
250
245
240
235
230
225
220
215
0
50
100
150
200
250
days


KY9909 0-147E
Temperature(deg-C)
22
20
18
16
14
12
10
0
50
100
150
200
250
days

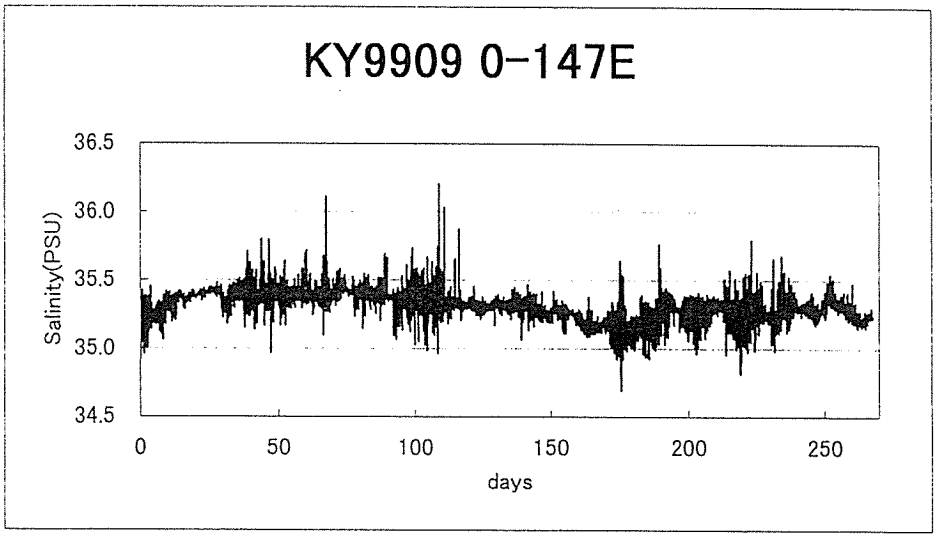
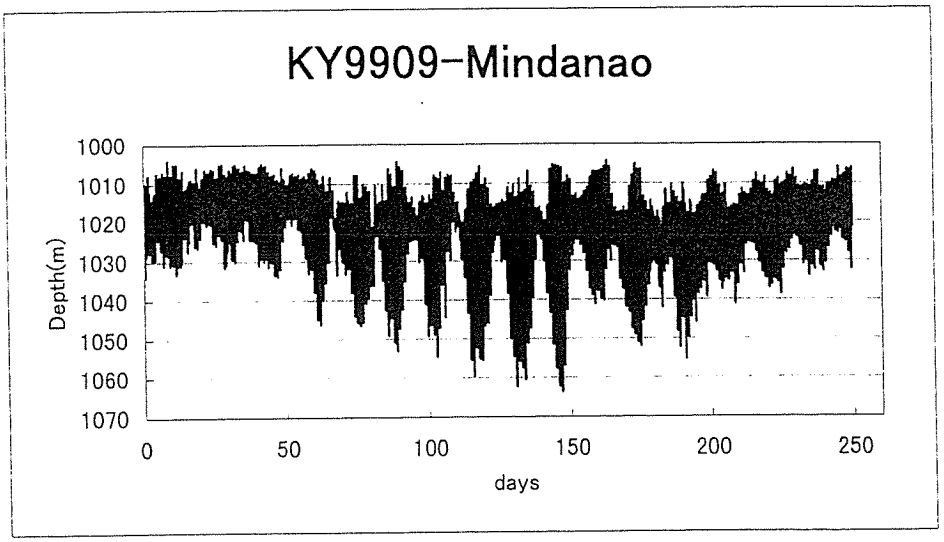
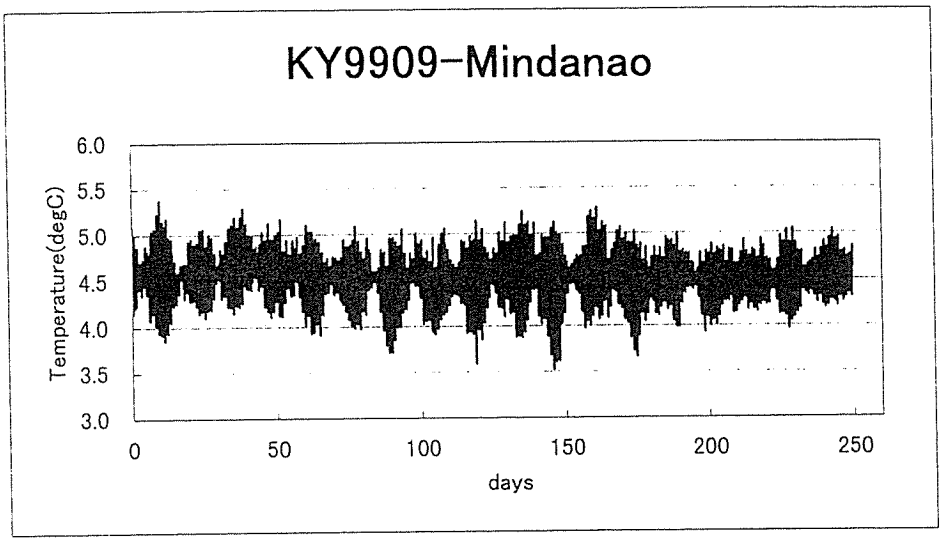

KY9909 0-147E
Salinity(PSU)
36.5
36.0
35.5
35.0
34.5
0
50
100
150
200
250
days

Fig. 7-07


KY9909-Mindanao
Depth(m)
1000
1010
1020
1030
1040
1050
1060
1070
0
50
100
150
200
250
days


KY9909-Mindanao
Temperature(degC)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
0
50
100
150
200
250
days

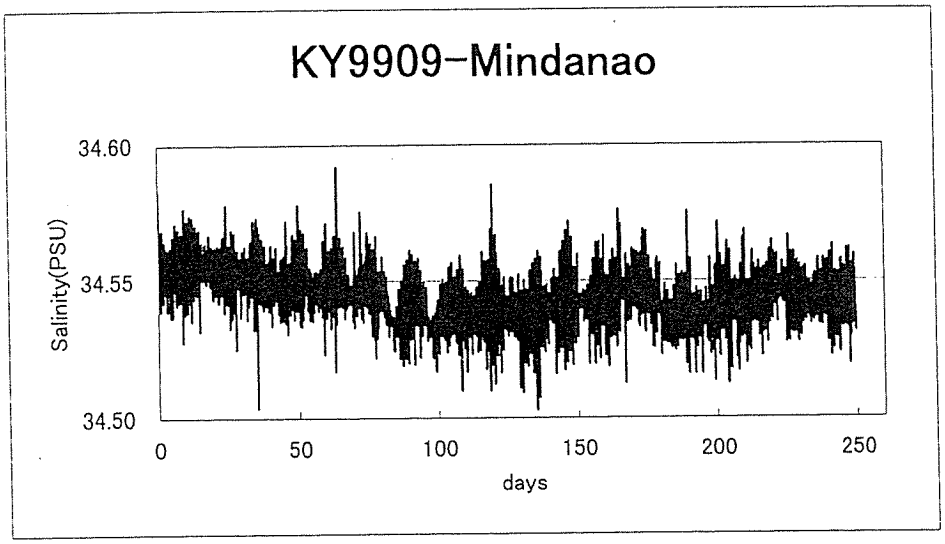
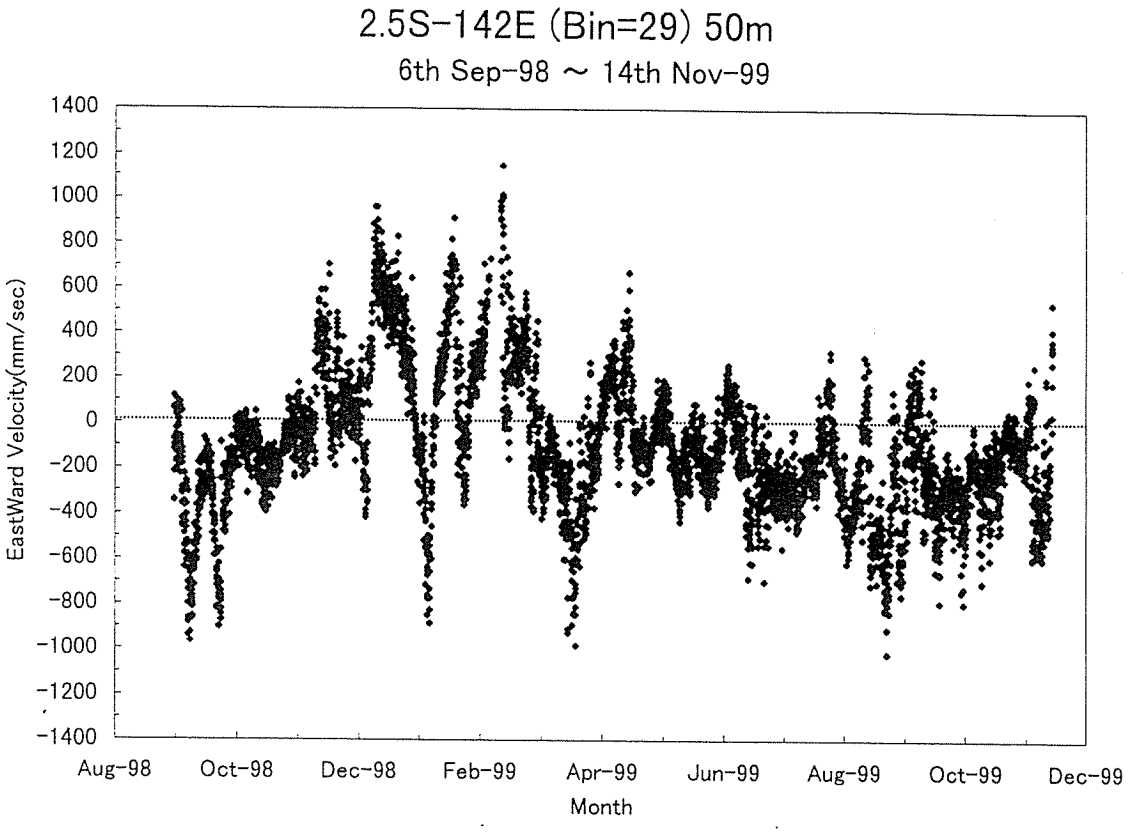

KY9909-Mindanao
Salinity(PSU)
34.60
34.55
34.50
0
50
100
150
200
250
days

Fig. 7-08



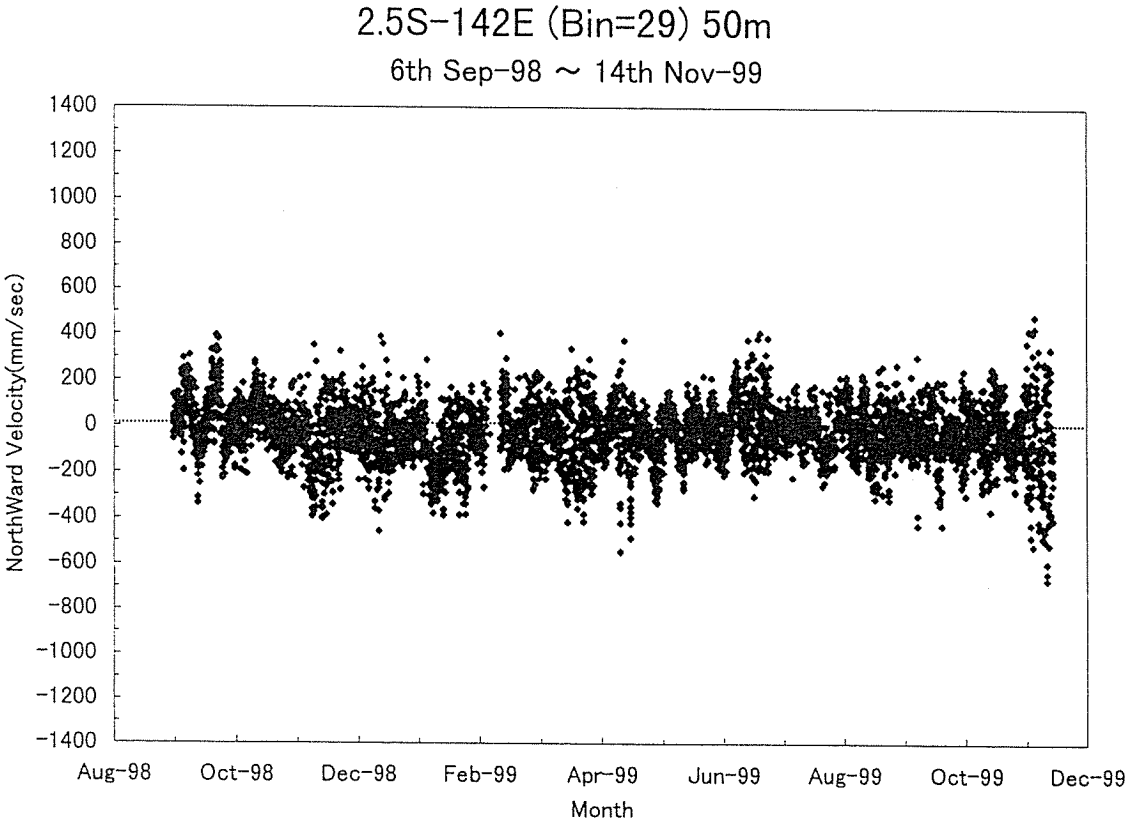
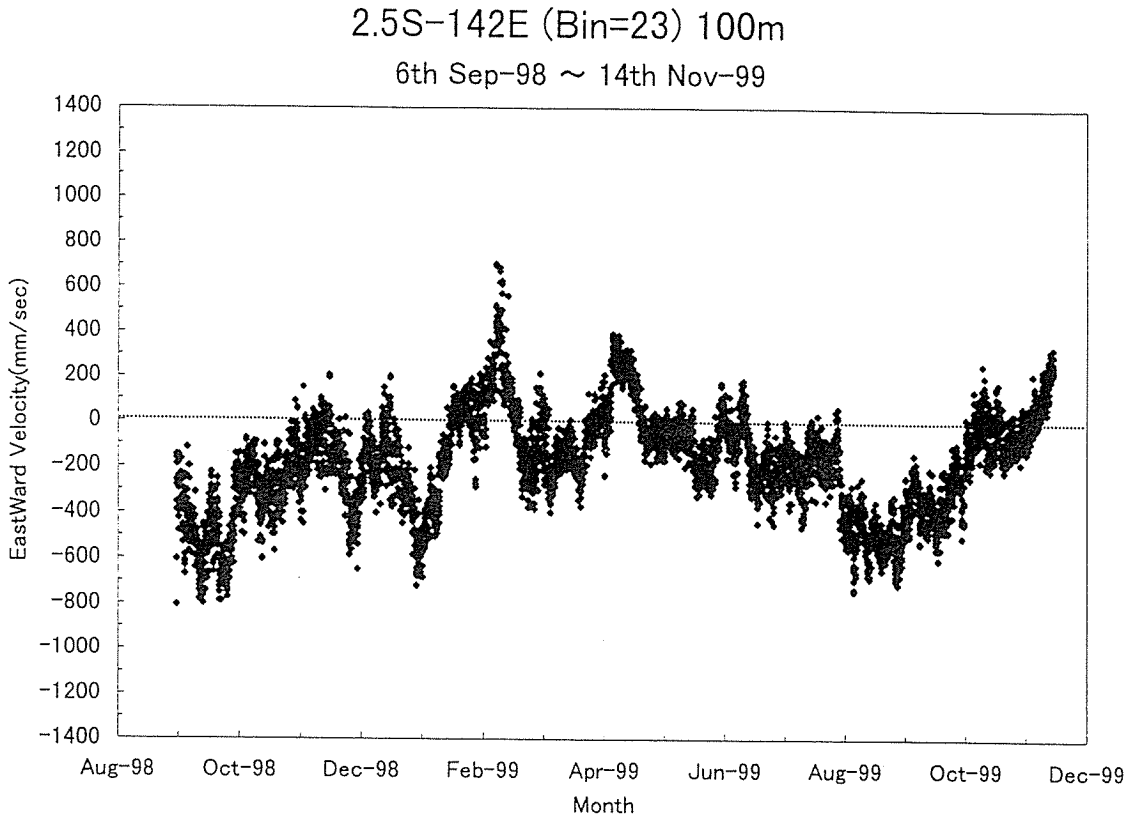


Fig. 7-09 Time series of velocity



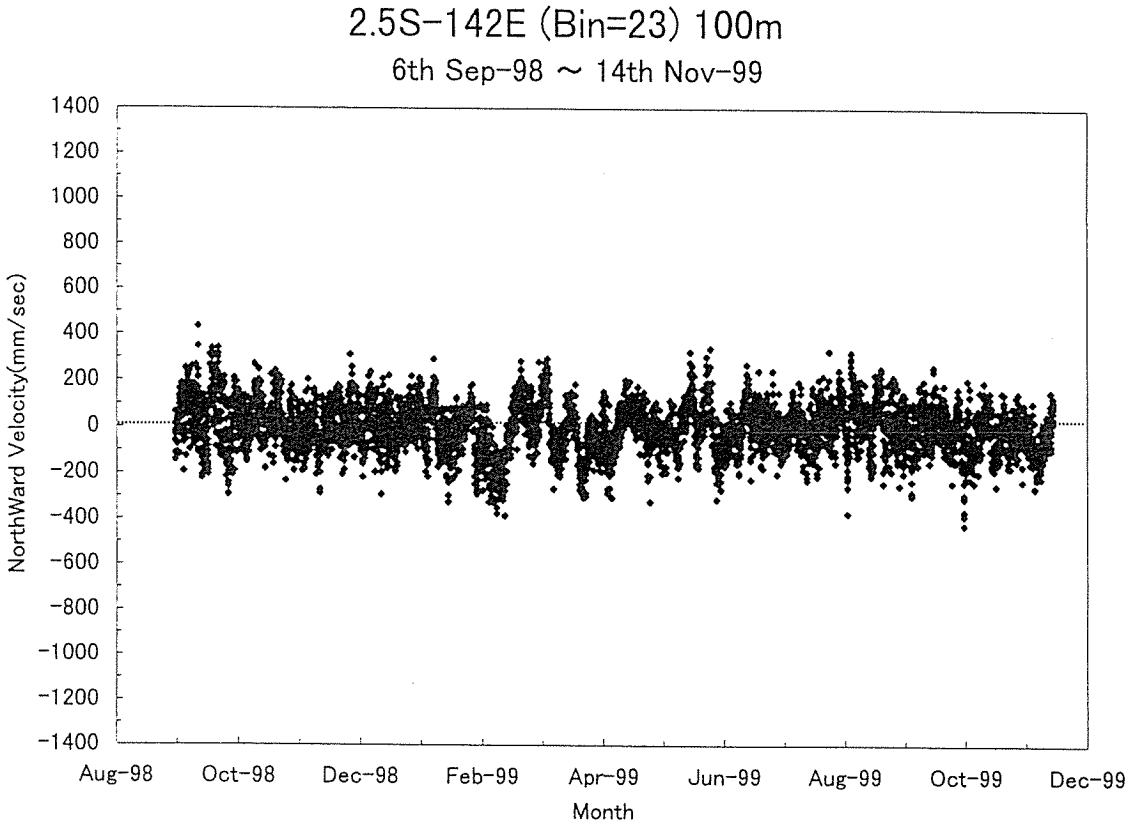
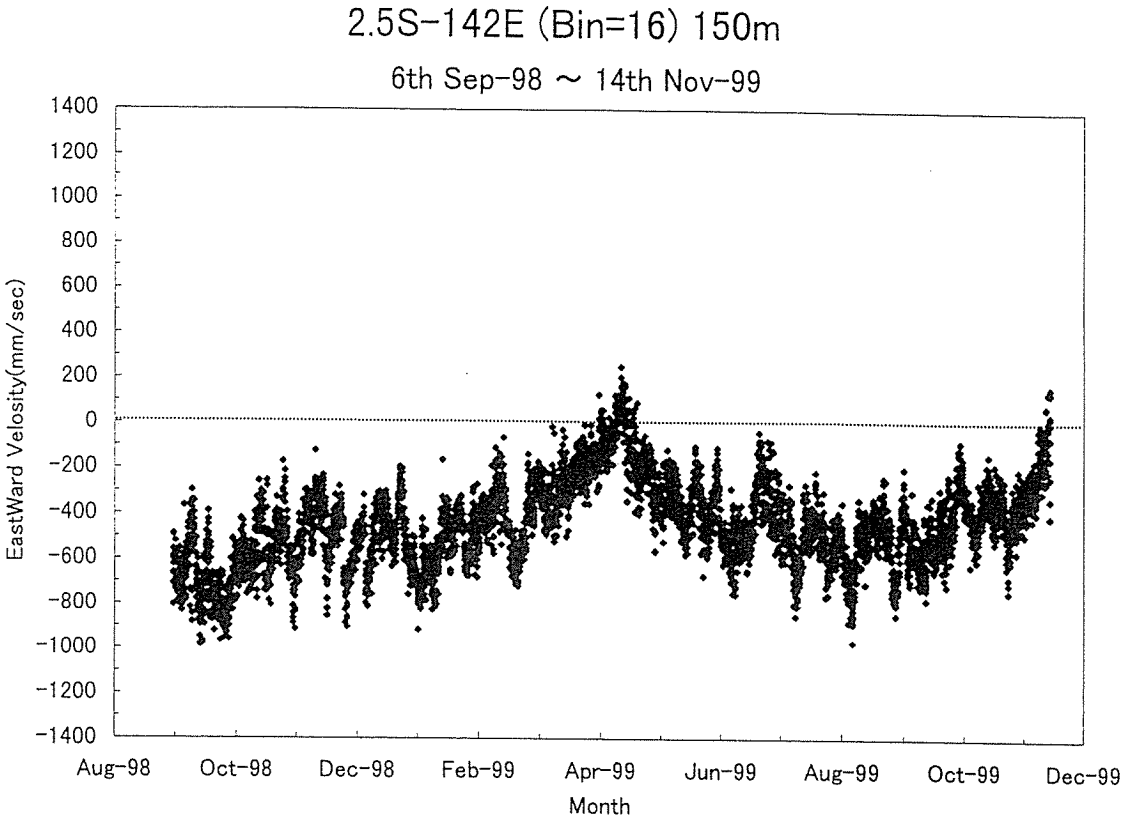


Fig. 7-10 Time series of velocity



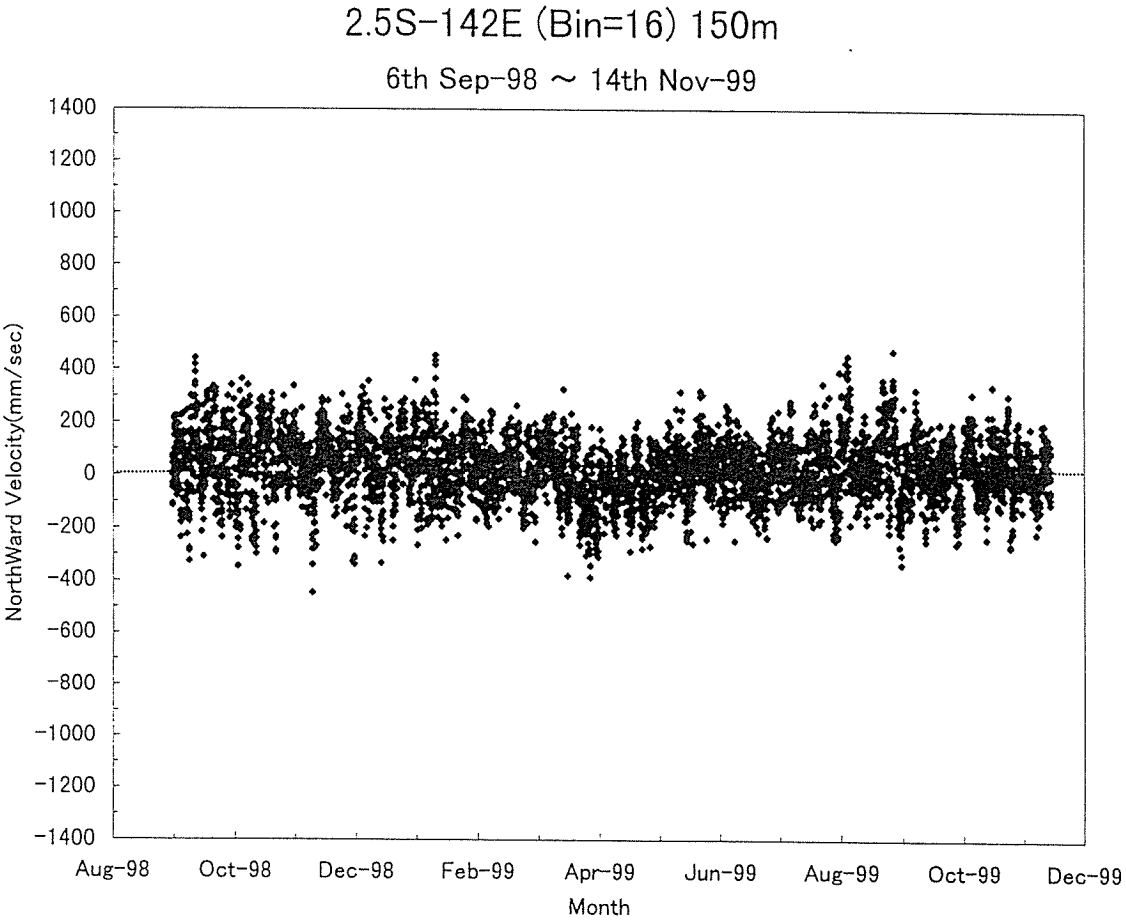
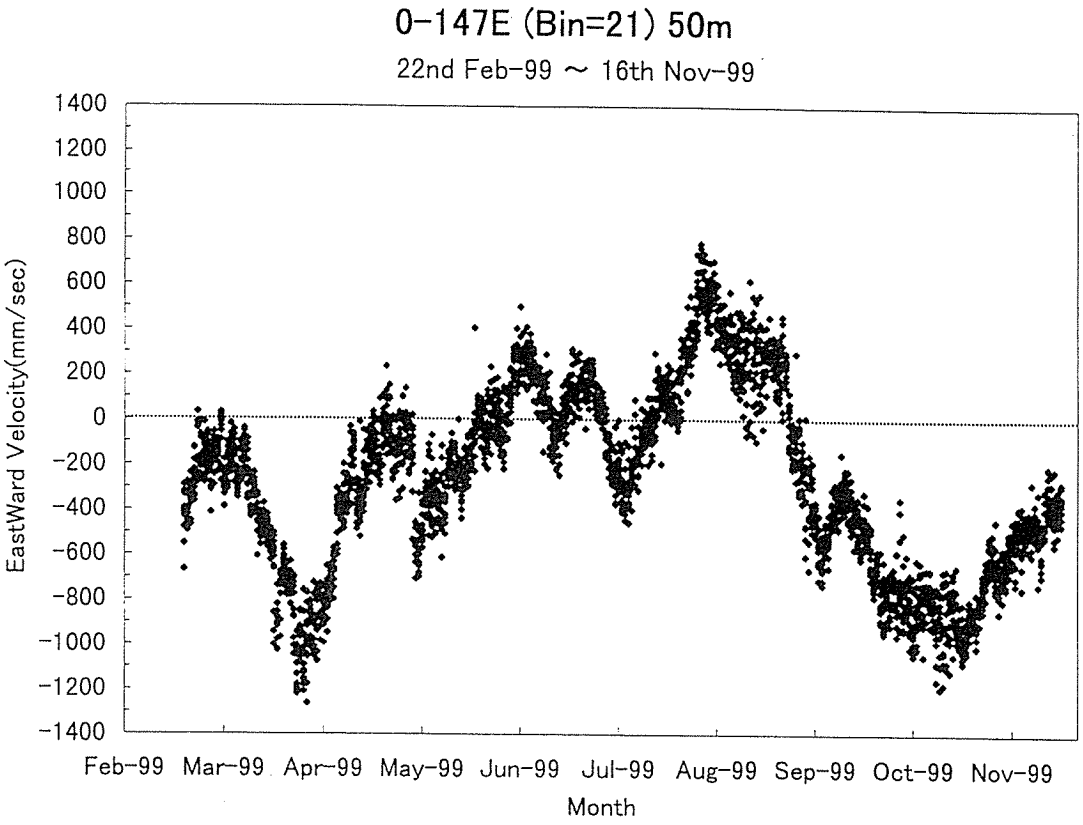


Fig. 7-11 Time series of velocity



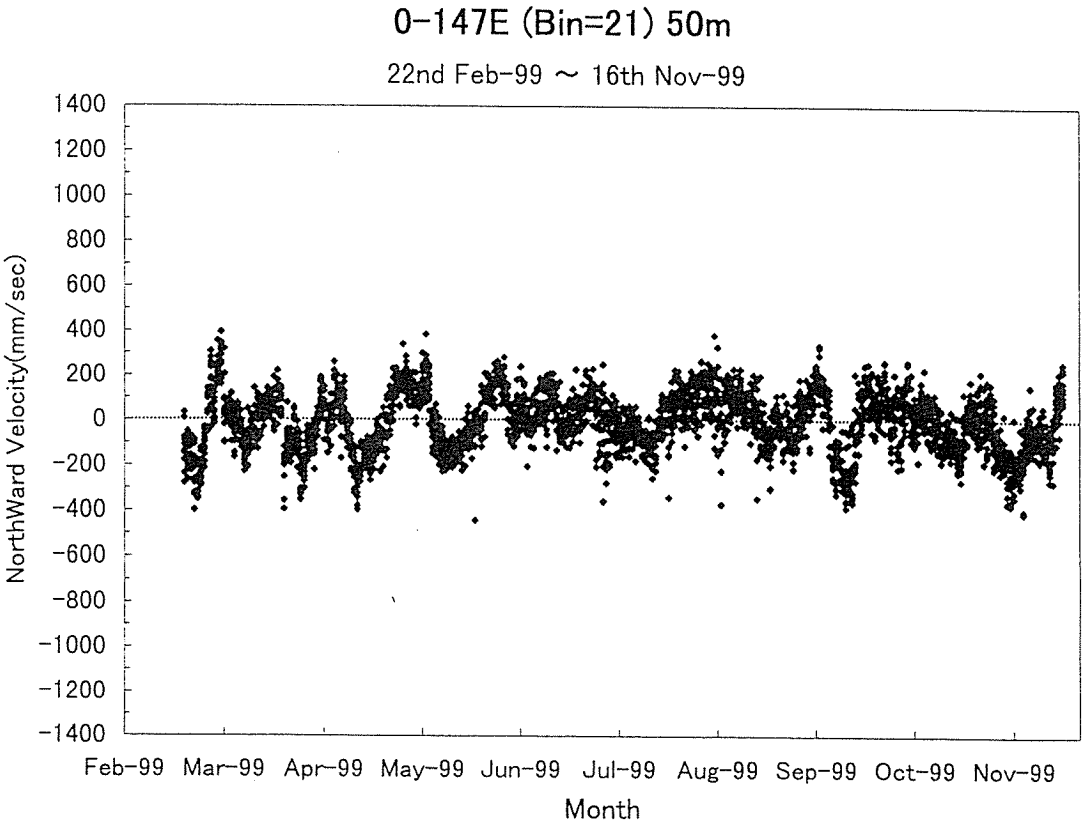
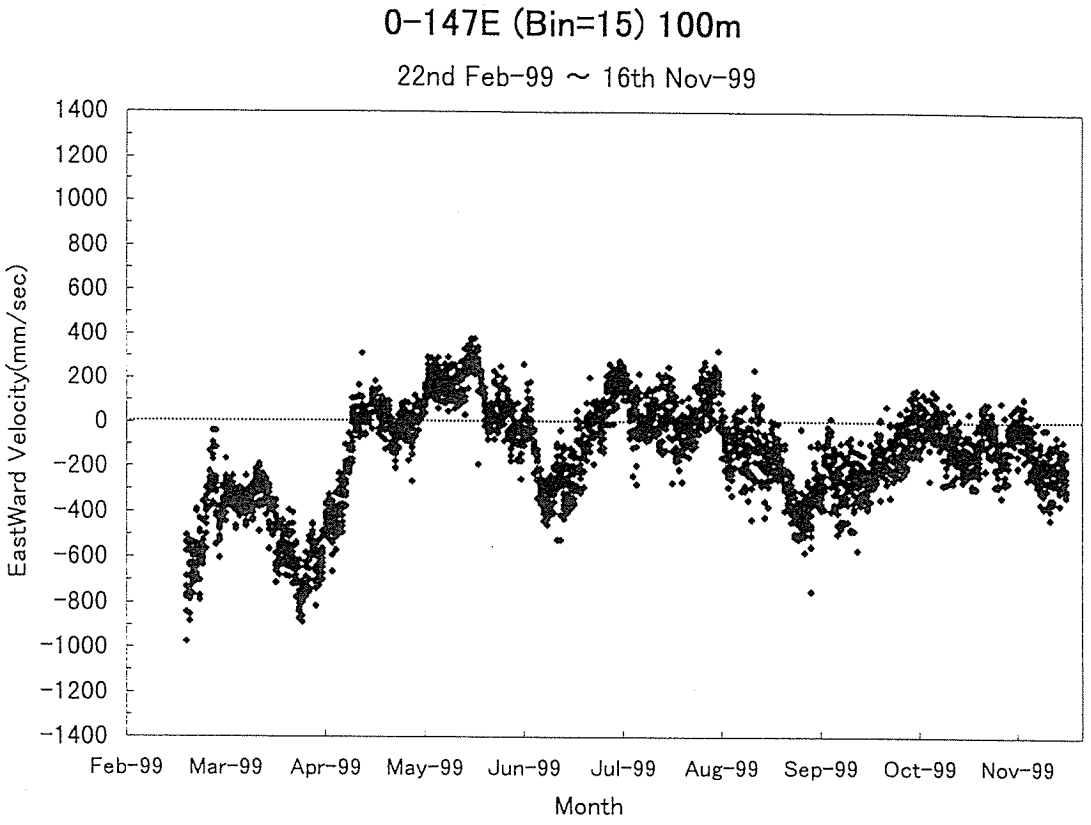


Fig. 7-12 Time series of velocity



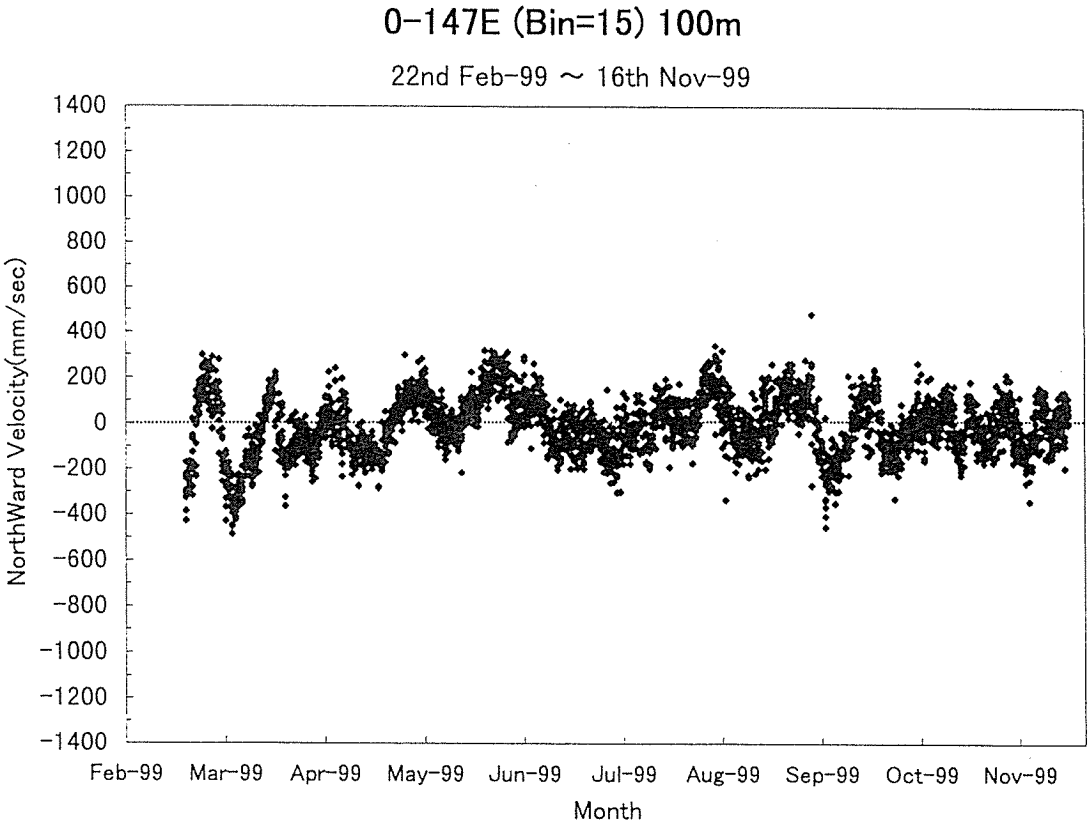
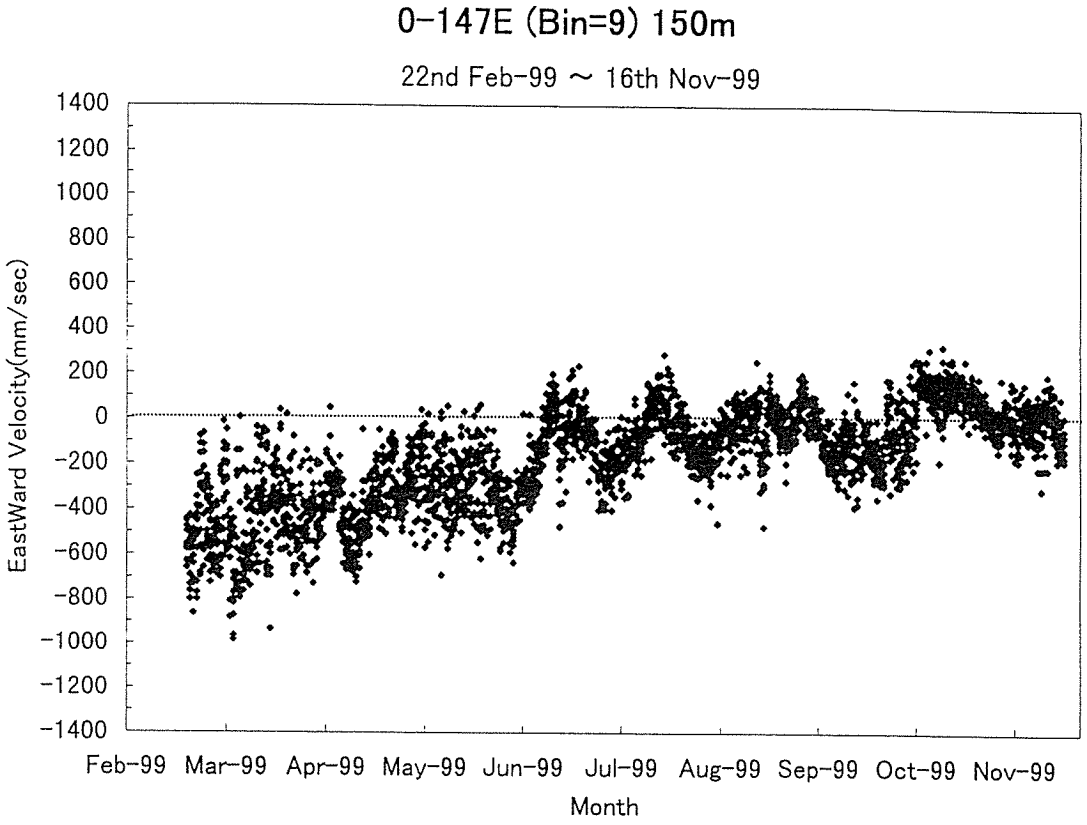


Fig. 7-13 Time series of velocity



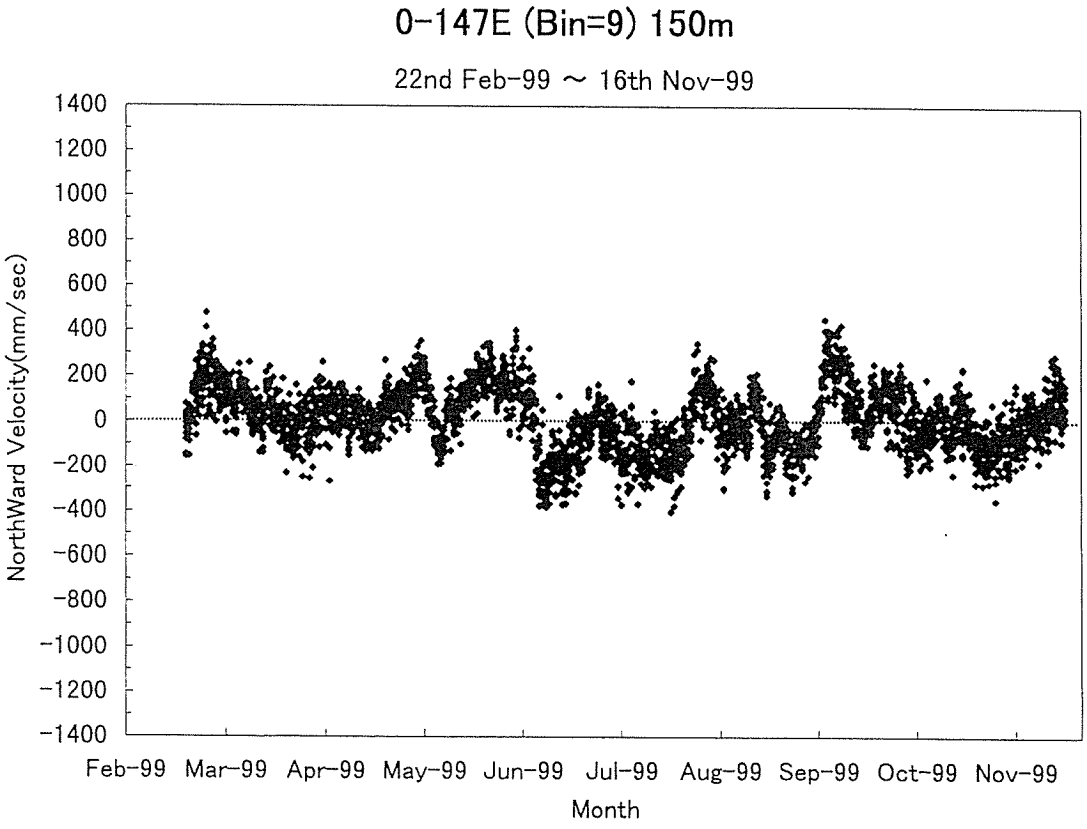
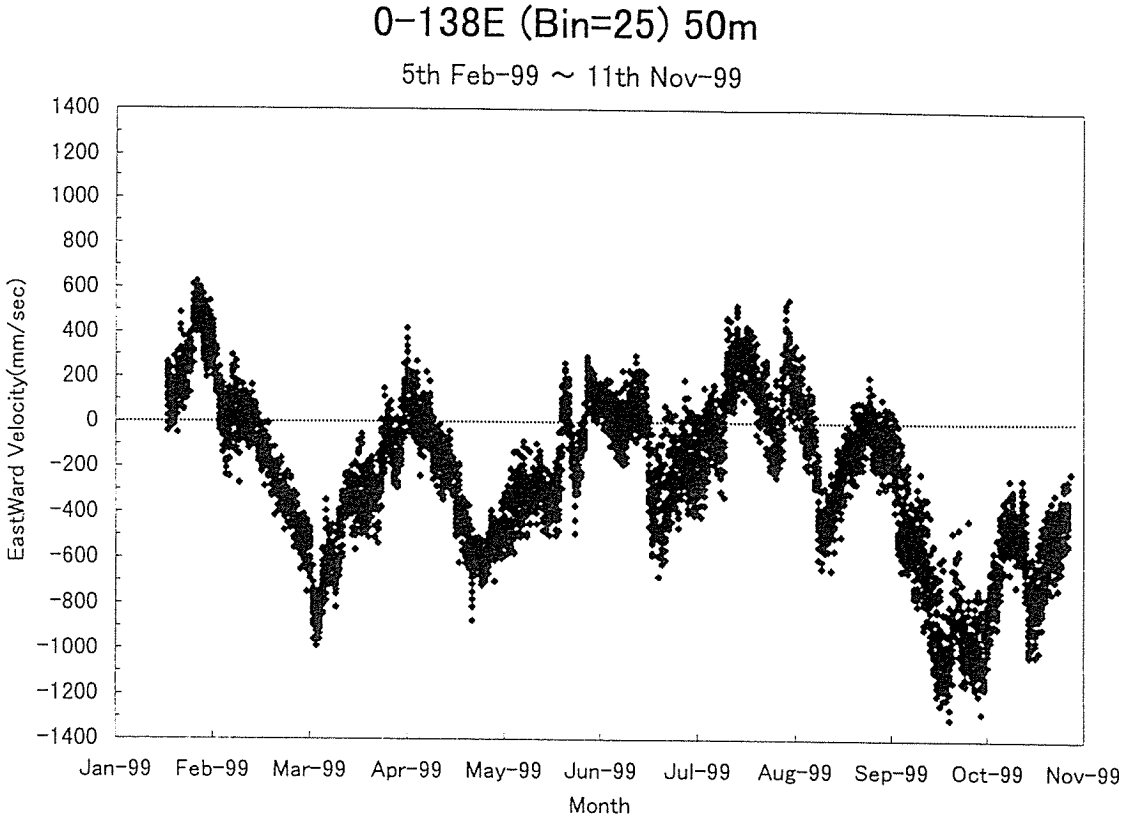


Fig. 7-14 Time series of velocity



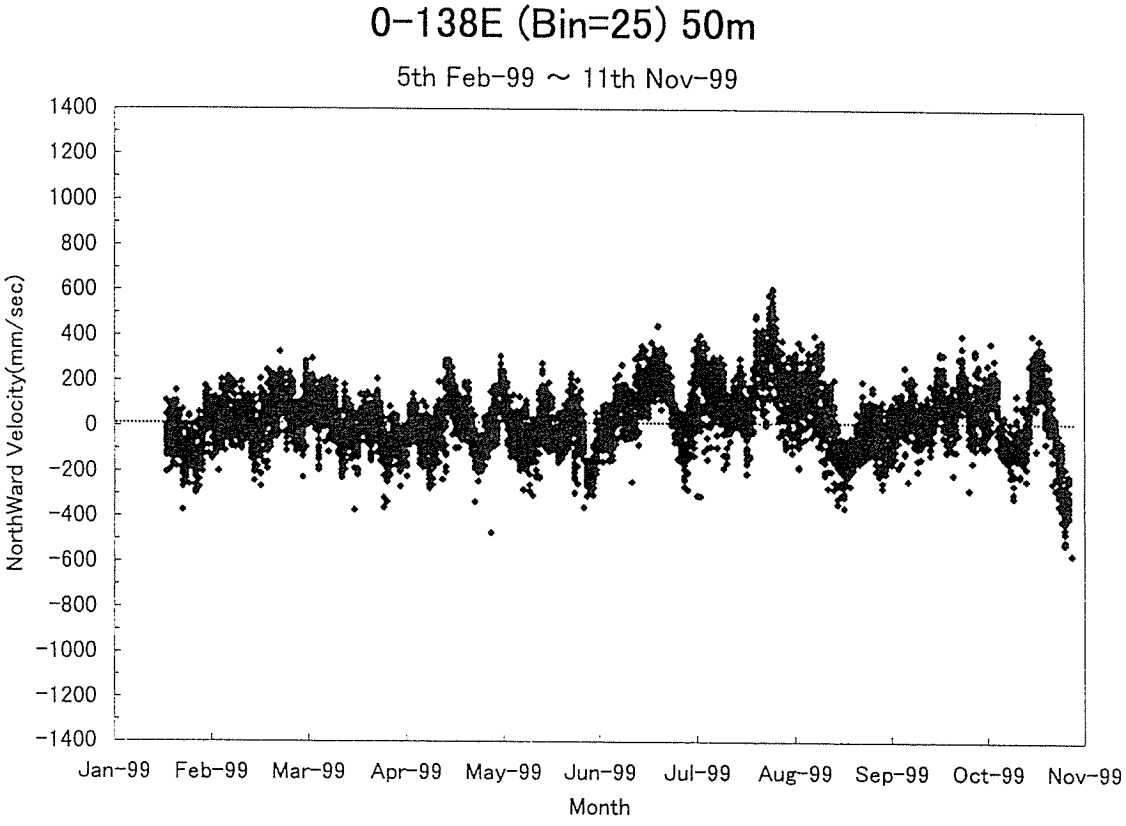
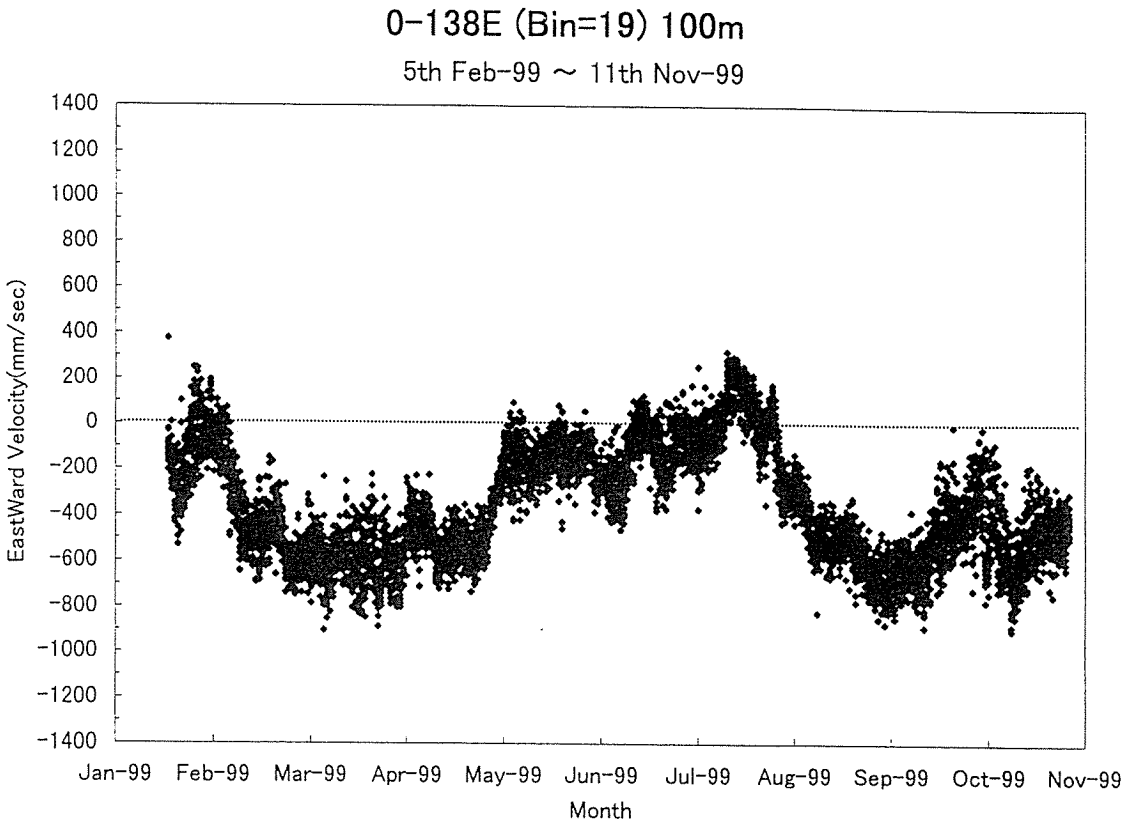


Fig. 7-15 Time series of velocity



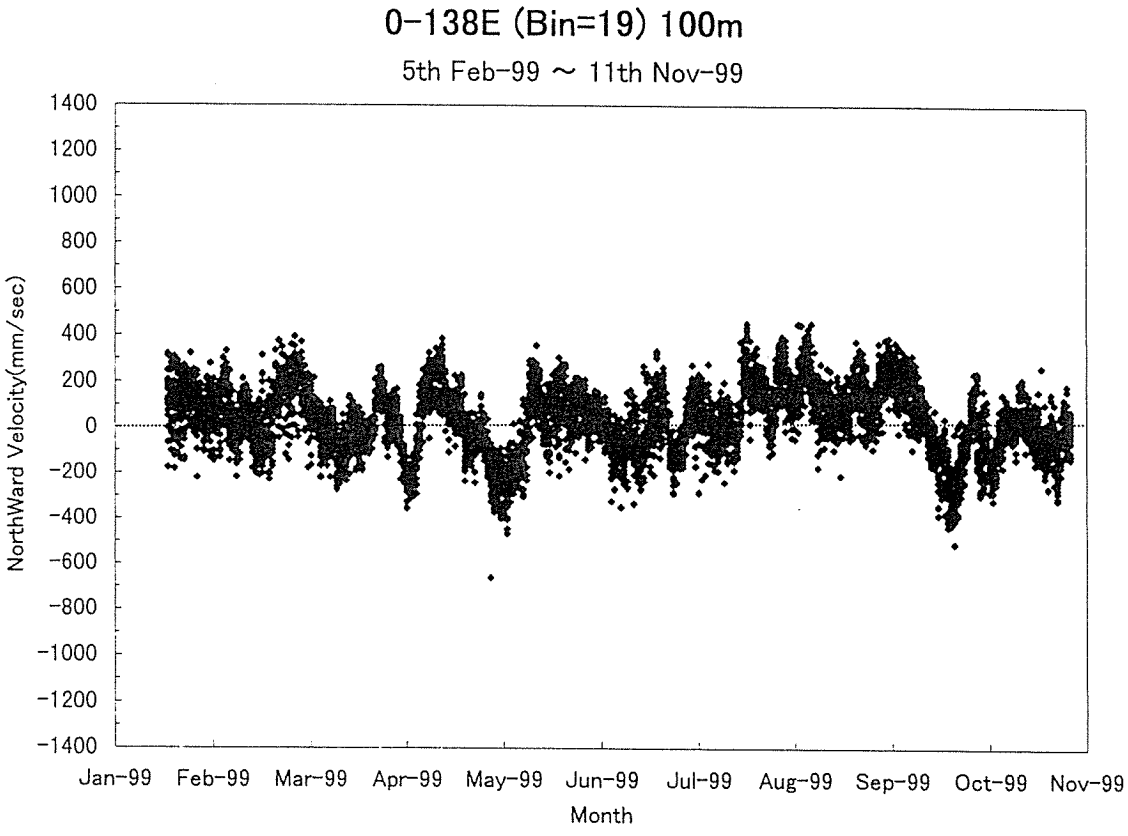
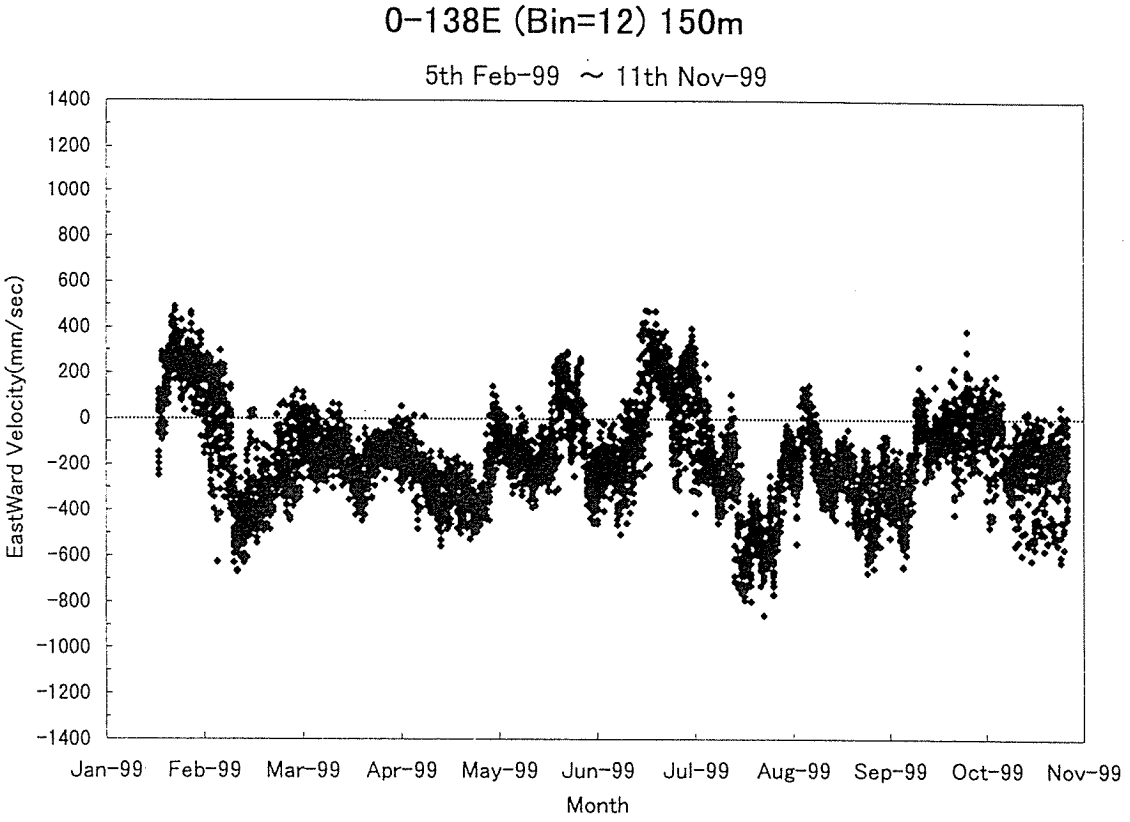


Fig. 7-16 Time series of velocity



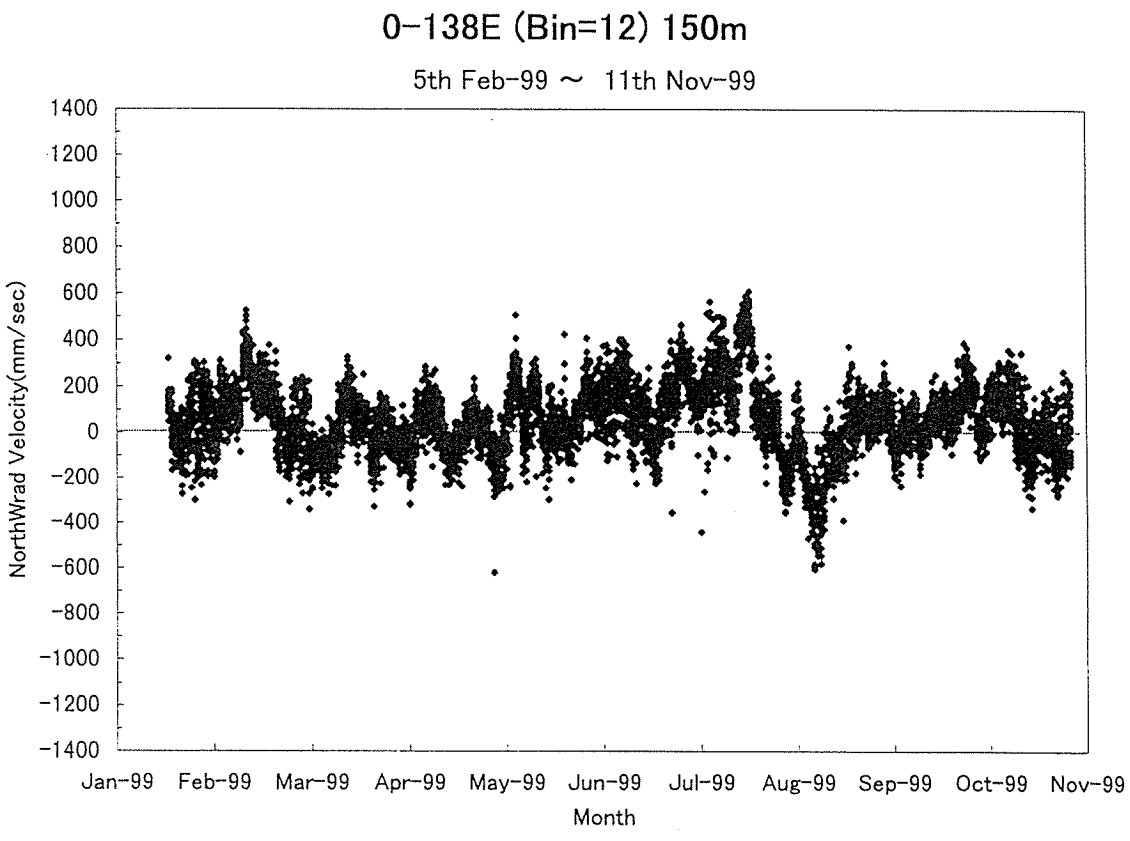


Fig. 7-17 Time series of velocity

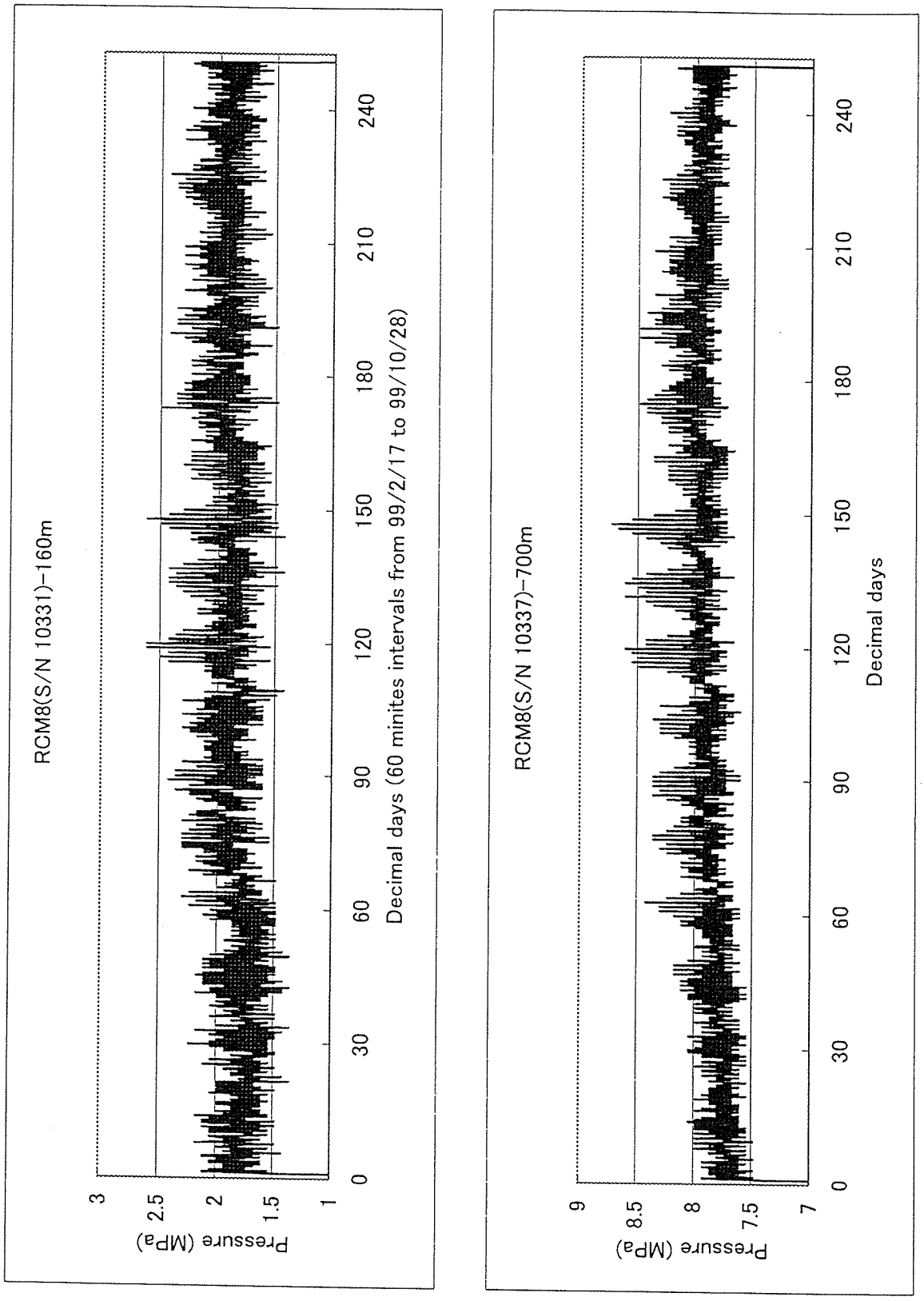


Fig. 7-18 Time series of velocity

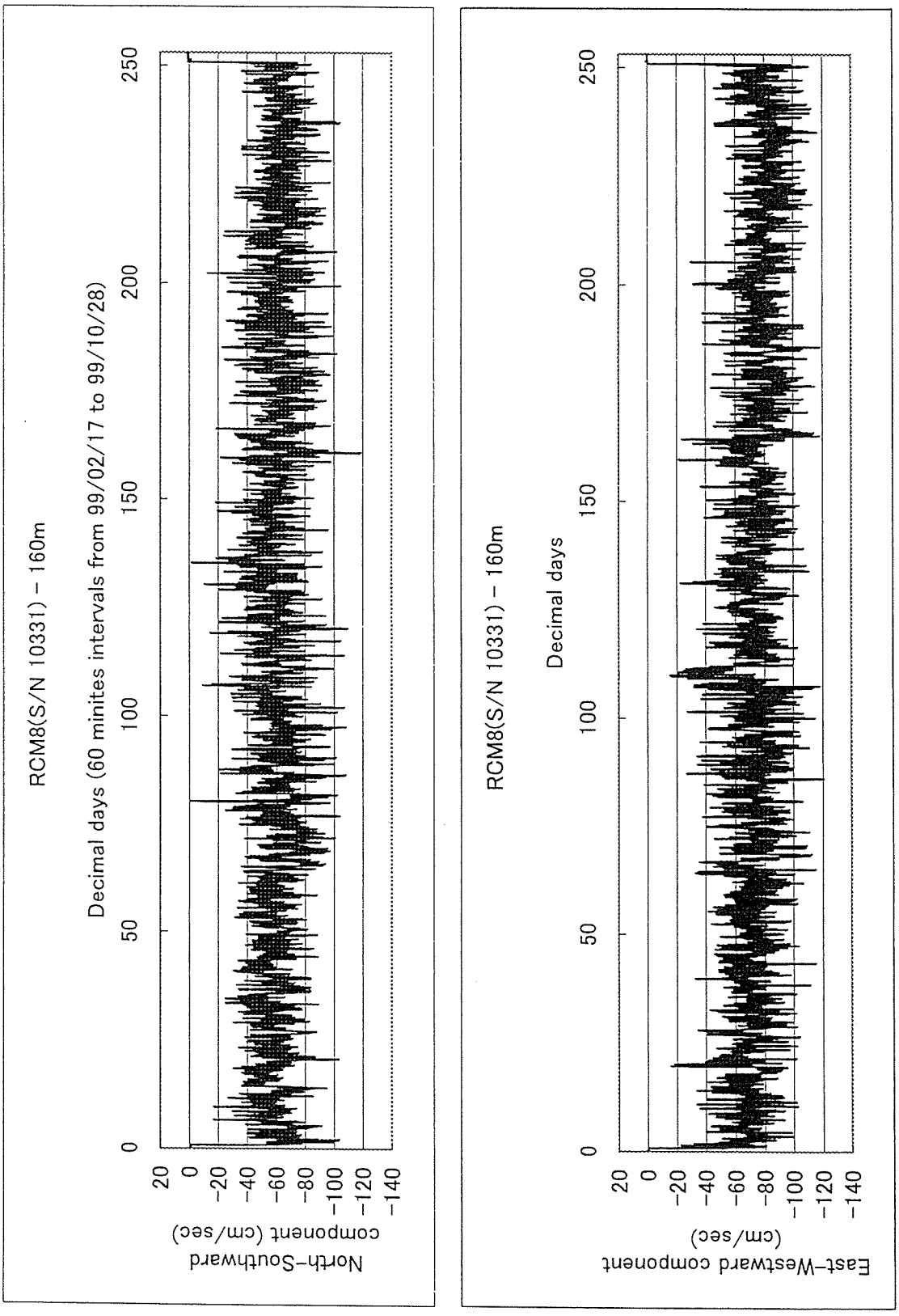


Fig 7-19 Time series of velocity

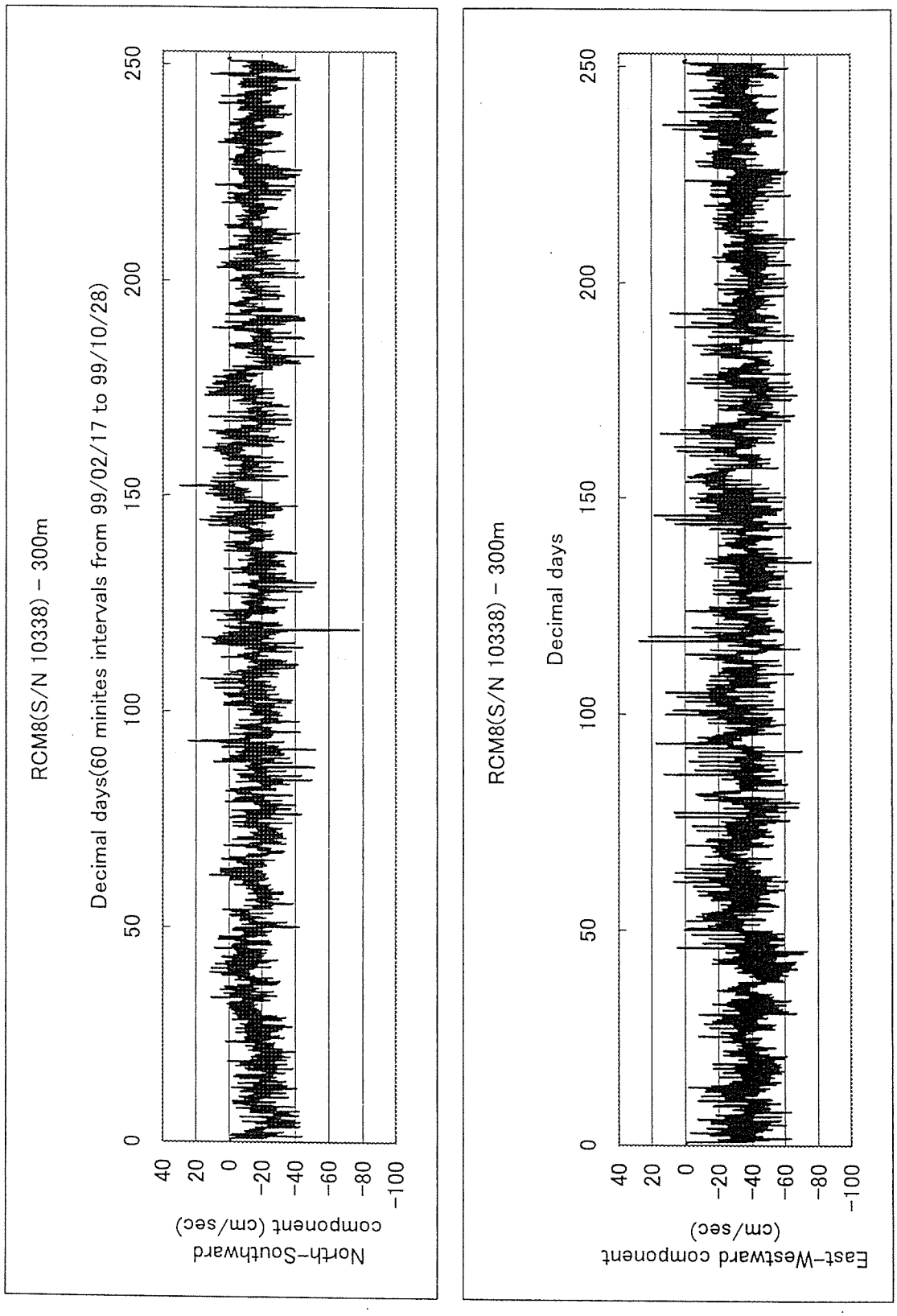


Fig 7-20 Time series of velocity

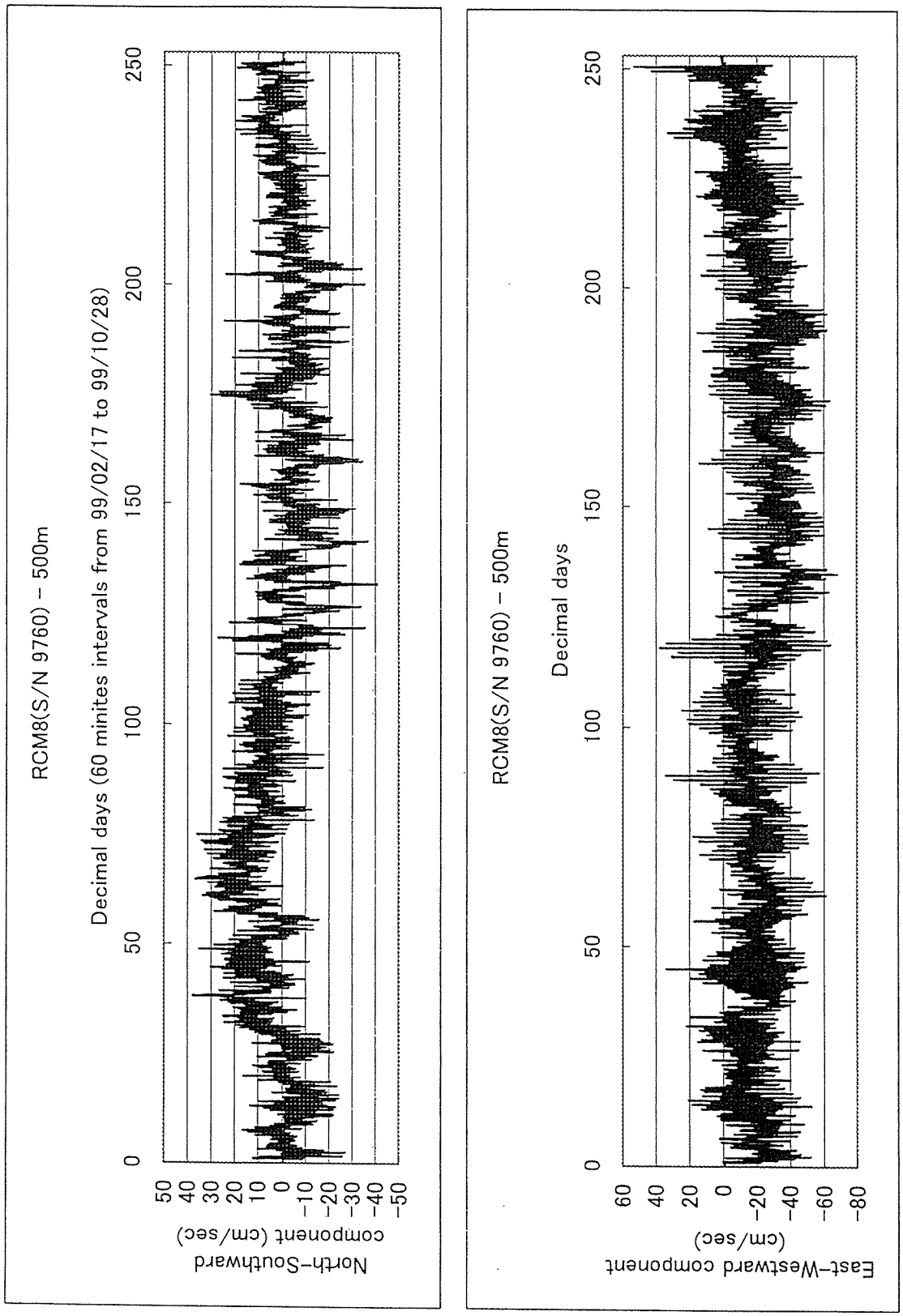


Fig 7-21 Time series of velocity

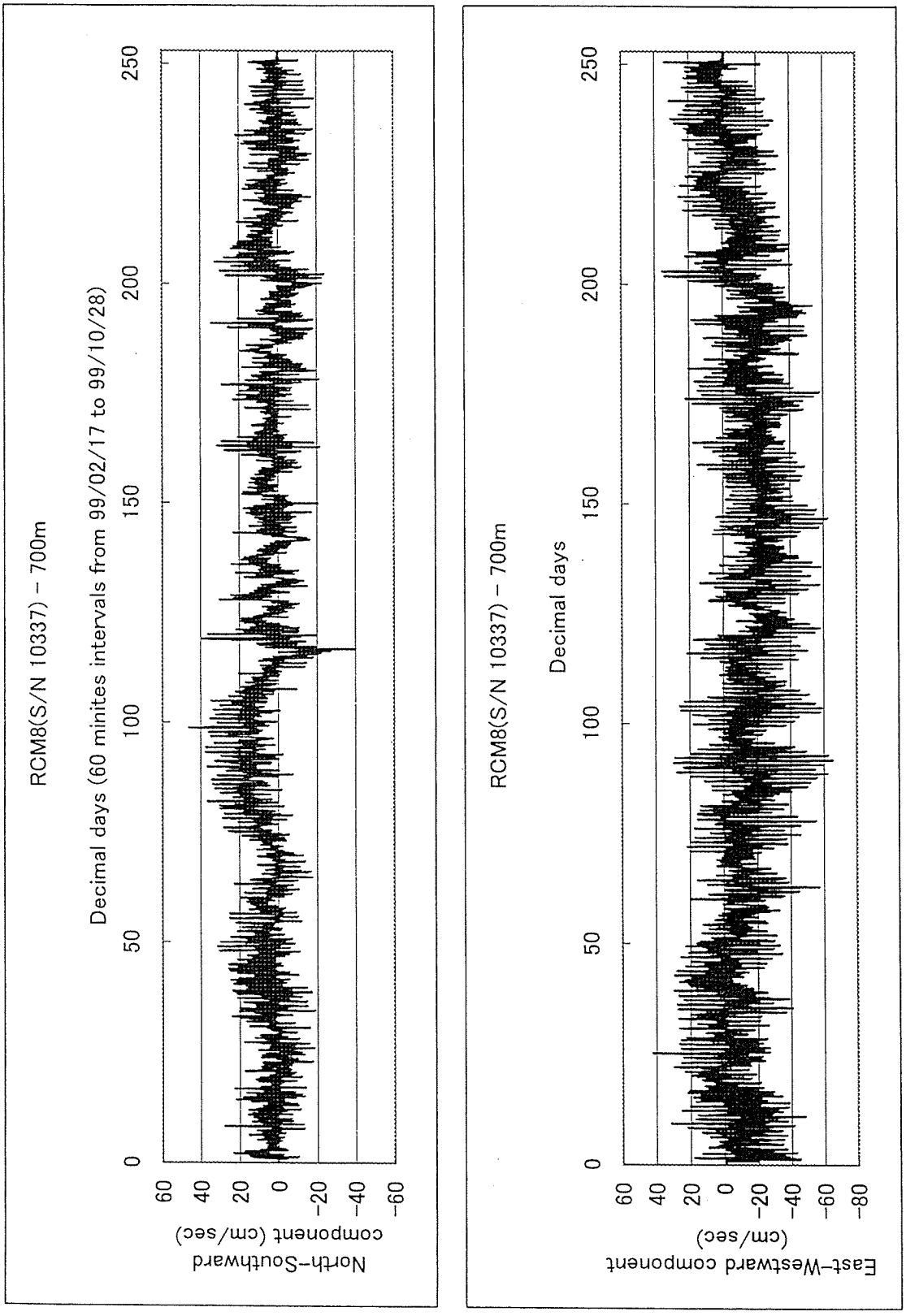


Fig 7-22 Time series of velocity

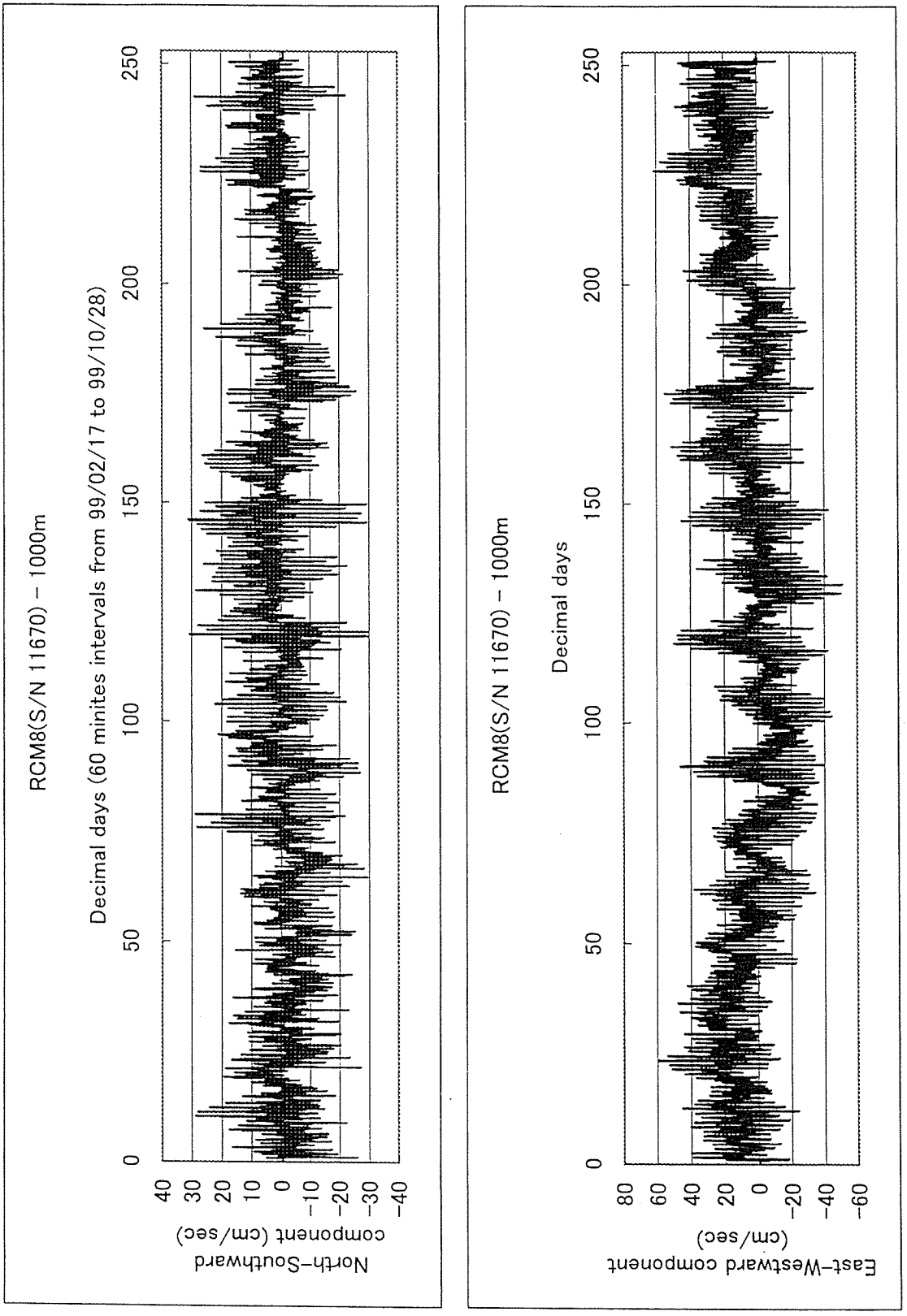
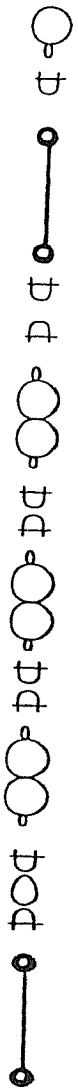
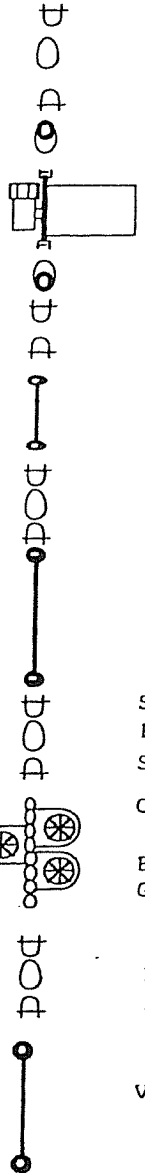


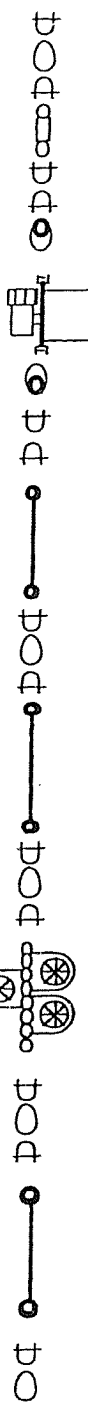
Fig 7-23 Time series of velocity



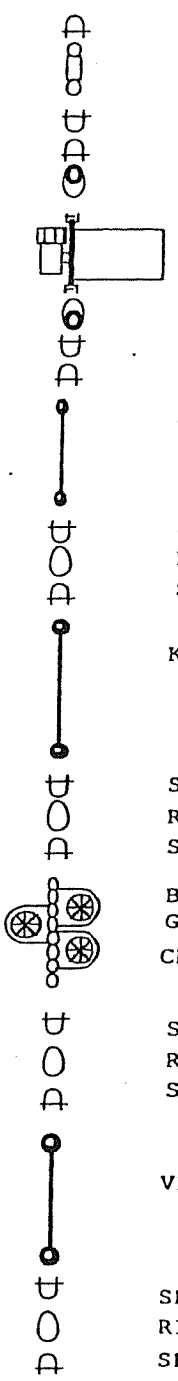
BUOY(150m)
SHACKLE 5/8
PP
16mm x 10m
SHACKLE 5/8
SHACKLE 7/8
ABS BUOY CT608B
SHACKLE 7/8
SHACKLE 7/8
ABS BUOY CT608B
SHACKLE 7/8
SHACKLE 7/8
ABS BUOY CT608B
SHACKLE 7/8
RING 19mm
SHACKLE 5/8
VECTLAN
12mm x 1.5m



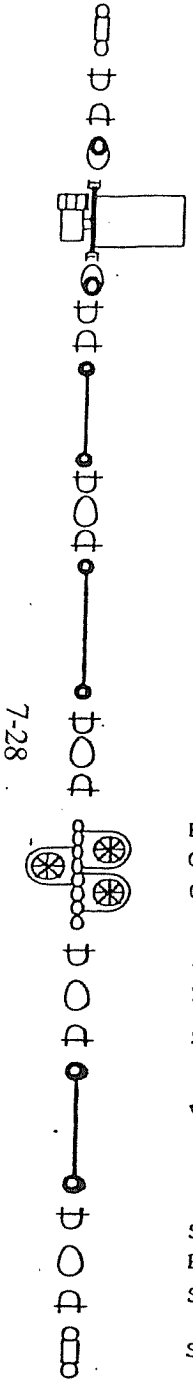
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
RING(SUS) 19mm
AANDERA(RCM)
(160m)s/n 10331
RING(SUS) 19mm
SHACKLE 5/8
SHACKLE 5/8
VECTLAN
12mm x 1.5m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(09-K1-01)
9mm x 134m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 3.0m
BENTHOS
GLASS BALL 3ps.
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
VECTOLAN
12mm x 10.0m



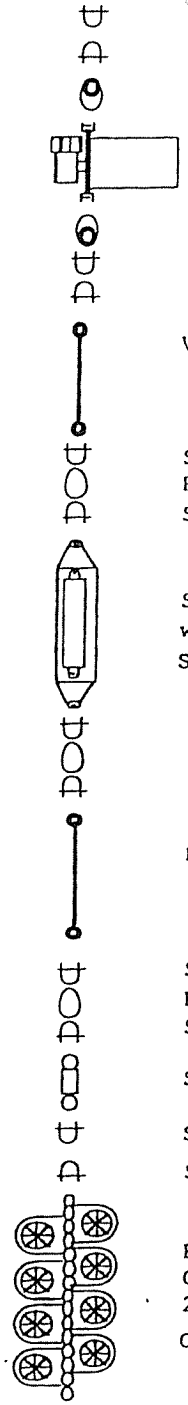
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm
AANDERAA(RCM)
(300m)s/n 10338
RING(SUS) 19mm
SHACKLE 5/8
SHACKLE 5/8
VECTLAN
12mm x 1.5m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(09-K2-01)
9mm x 185m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
BENTHOS
GLASS BALL 3ps.
CHAIN
13mm x 3.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
VECTOLAN
12mm x 10.0m
SHACKLE 5/8
RING 19mm



SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm
AANDERAA(RCM)
(500m)s/n 9760
RING(SUS) 19mm
SHACKLE 5/8
SHACKLE 5/8
VECTLAN
12mm x 1.5m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(09-K2-02)
9mm x 185m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
BENTHOS
GLASS BALL 3ps.
CHAIN
13mm x 3.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
VECTOLAN
12mm x 10.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

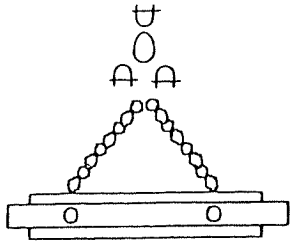


SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm
AANDERAA(RCM)
(700m) s/n 10337
RING(SUS) 19mm
SHACKLE 5/8
SHACKLE 5/8
VECTLAN
12mm x 1.5m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(09-K3-01)
9mm x 286m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
BENTHOS
GLASS BALL 3ps.
CHAIN
13mm x 3.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
VECTOLAN
12mm x 10.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102



SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm
AANDERAA(RCM)
(1,000m)s/n 11670
RING(SUS) 19mm
SHACKLE 5/8
SHACKLE 5/8
VECTLAN
12mm x 1.5m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SBE-16
with SS-Cage
S/N 1288
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(09-K1-02)
9mm x 100.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
BENTHOS
GLASS BALL
2040-17V x 8ps.
CHAIN
13mm x 8.0m

SHACKLE 5/8
SHACKLE 5/8
SWIVEL BS103
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
BENTHOS A.R.
S/N 667 E.C.=G
14.5kHz R.C.=F
SHACKLE 5/8
CHAIN
13mm x 5.0m
SHACKLE 5/8
BENTHOS A.R.
S/N 664 E.C.=D
14.0kHz R.C.=C
SHACKLE 5/8
CHAIN
13mm x 2.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
NYLON
16mm x 200m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
16mm x 5.0m



SHACKLE 5/8
RING 19mm
SHACKLE 5/8 x 2
CHAIN
13mm x 2.5m x
SHACKLE 5/8 x 2
RAIL ANCHOR 1.8t

Mindanao '99 Spring
5N125E
Depth=1372m

18-Feb-'99(Deployed)

	KEVLER (NO.)	Length
1	09-K1-01	134m
2	09-K2-01	185m
3	09-K2-02	185m
4	09-K3-01	286m
5	09-K1-02	100m

Depth	Nylon Length
D=1,250m	100m
D=1,300m	140m
D=1,350m	190m

DEPLOYMENT & RECOVERY

MOORING No. 990217-05N125E

PROJECT	TOCS	TIME	UTC
AREA	MINDANAO SOUTH	RECORDER (D)	ITO/A
POSITION	5°N 125°E	(R)	
DEPTH			
PERIOD	1999. 2. 17~	NAVIGATION SYSTEM :	WGS 84
No.of DAYS			
LENGTH :	m	DEPTH of BUOY : m	BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	BENTHOS (Upper)		TYPE	BENTHOS (BOTTOM)	
S/N	667		S/N	664	
RECEIVE F.	13.0	kHz	RECEIVE F.	13.0	kHz
TRANSMIT F.	14.5	kHz	TRANSMIT F.	14.0	kHz
ENABLE C.	G		ENABLE C.	D	
RELEASE C.	F		RELEASE C.	C	
BATTERY	2year		BATTERY	2year	
TEST on DECK	OK		TEST on DECK	OK	

DEPLOYMENT

DATE	1999. 2. 18	SHIP	KAIYO	CRUISE No.	KY9901
WEATHER	bc	CONDITIONS	Smooth	DIR. of WIND	36
VEL. of WIND	1.8 kt				
DEPTH	1386 m	DEPTH of A.R.	1113 m	DESCEND. RATE	m/s
BUOY	:				
POS. of STRT	05°07.394N	125°40.315E	HOR.RANGE	m	
POS. of DEP.	05°07.389N	125°40.233E	SINKER	1:37	DISAPPEAR. 1:42
POS. of MOORING	05°07.328N	125°40.200E			LANDING 1:46

NOTE アンテナ - 5台 04:00 スタート 99/2/17

SSBL	TIME	S / R	DEPTH

RECOVERY

DATE	1999. 10. ~~26~~ 25	SHIP	KAIYO	CRUISE No.	KY9909
WEATHER	bc	CONDITIONS	Smooth	DIR. of WIND	SE
VEL. of WIND	2 m/s				
START of RELEASE	22 : 19	FINISH of RELEASE	22 : 24		
POS. of DISCOVERY	°	°	ASCENDING RATE	m/s	
DIRECTION	°	DISTANCE	m		

NOTE

SSBL	TIME	S / R	DEPTH

TIME RECORD

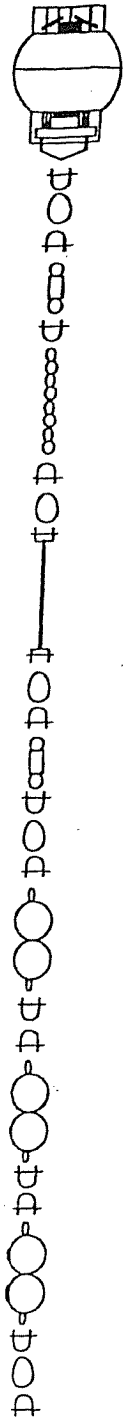
MOORING NO. 990217-05N125E

		DEPLOYMENT 990218		RECOVERY (Date: 991025)	
		START : 0:47 FINISH : 1:37		START : 22:45 FINISH : 23:33	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ABS BUOY	2 x 3	0:49		22:48	
AANDERAA	10331	0:50		22:50	
KEVLER	09-K1-01 134m	0:50 ~ 0:53		22:54 ~ 22:56	
GLASS BALL	3	0:57		22:57	
AANDERAA	10338	0:58		22:59	
KEVLER	09-K2-01 185m	0:58 ~ 1:00		23:02 ~ 23:05	最後にヨリが入る
GLASS BALL	3	1:03		23:05	
AANDERAA	9760	1:04		23:07	
KEVLER	09-K2-02 185m	1:04 ~ 1:07		23:11 ~ 23:14	
GLASS BALL	3	1:09		23:14	
AANDERAA	10337	1:10		23:16	
KEVLER	09-K3-01 286m	1:10 ~ 1:14		23:19 ~ 23:24	
GLASS BALL	3	1:16		23:25	
AANDERAA	11670	1:17		23:27	
CTD SBE16	1288	1:17		23:27	
KEVLER	09-K1-02 100m	1:17 ~ 1:20		23:29 ~ 23:32	
GLASS BALL	8	1:23		23:33	
A.R.	667	1:24		23:33	
A.R.	664	1:24		23:33	
NYLON	200m	1:24 ~ 1:27			
ANCHOR	1.8t	1:37			

アンデラー 5台 99/2/17 04:00 スイッチオン

作業テイ 22:30
ブイにロープ取付 22:40
ABSと~~アンデラー~~の間を20mに
マヨナイ する次回から

00-138(spring)'99



FLOAT(F-12)
ADCP S/N 1155
CTD SBE16 S/N 1282

SHACKLE 7/8
RING 19mm
SHACKLE 22mm
SWIVEL AB103(USED)
SHACKLE 22mm

CHAIN
13mm x 3.0m

SHACKLE 5/8
RING 19mm

WIRE
10mm x 50m

RING 19mm
SHACKLE 5/8
SWIVEL AB102(USED)
SHACKLE 5/8
RING 19mm
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

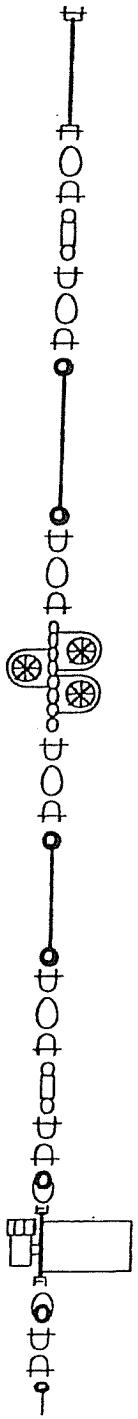
SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
RING 19mm
SHACKLE 5/8



WIRE
10mm x 200m

RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

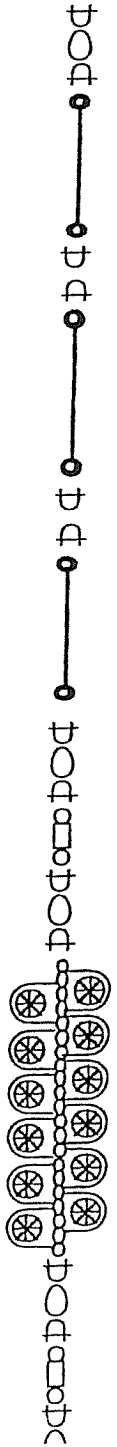
KEVLER(K2-10)
12mm x 188m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 3.0m
BENTHOS
GLASS BALL 3ps.
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm
Ru-1
S/N 4080U
(700m)
RING(SUS) 19mm
SHACKLE 5/8
SHACKLE 5/8

VECTOLAN



SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K10-23)
12mm x 976m

SHACKLE 5/8
SHACKLE 5/8

KEVLER(K10-24)
12mm x 976m

SHACKLE 5/8
SHACKLE 5/8

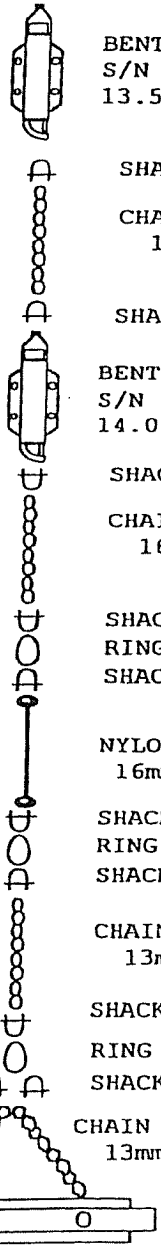
KEVLER(K10-08)
12mm x 988m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS
GLASS BALL
2040-17V x 12ps.

CHAIN
13mm x 8.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL BS103
SHACKLE 5/8
RING 19mm



BENTHOS A.R.
S/N 689 E.C.=B
13.5kHz R.C.=A

SHACKLE 5/8

CHAIN
13mm x 5.0m

SHACKLE 5/8

BENTHOS A.R.
S/N 665 E.C.=F
14.0kHz R.C.=D

SHACKLE 5/8

CHAIN
16mm x 2.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

NYLON
16mm x 150m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

CHAIN
13mm x 5.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8 x 2

CHAIN
13mm x 2.5m x 2

SHACKLE 5/8 x 2
RAIL ANCHOR 1.8t

0°N, 138°E
水深:3,907m
索長:3584.6m

DEPLOYMENT & RECOVERY

MOORING No. 990204-00138E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	A. ITO
POSITION	0° 138°E	(R)	
DEPTH	3909 m		
PERIOD	1999.2.4～1999.11.11	NAVIGATION SYSTEM :	WGS 84
No.of DAYS	270 days		

LENGTH : m DEPTH of BUOY : m BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	BENTHOS (Upper)	TYPE	BENTHOS (Lower)
S/N	689	S/N	665
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	13.5 kHz	TRANSMIT F.	14.0 kHz
ENABLE C.	B	ENABLE C.	F
RELEASE C.	A	RELEASE C.	D
BATTERY	2 years	BATTERY	2 years
TEST on DECK	OK	TEST on DECK	OK

DEPLOYMENT

DATE 4 Feb. 99 SHIP KAIYO CRUISE No. KY9901

WEATHER bc CONDITIONS Smoth DIR. of WIND 280 VEL. of WIND 5.8m/s

DEPTH 3903 m DEPTH of A.R. 3740 m DESCEND. RATE m/s BUOY :

POS. of STRT 00°01.860S 138°03.432E HOR.RANGE m

POS. of DEP. 00°01.122S 138°01.728E SINKER 1:22 DISAPPEAR. :

POS. of MOORING 00 01.088S 138 01.680E LANDING 1:46

NOTE

RECOVERY

SSBL	TIME	S / R	DEPTH

RECOVERY

DATE 11. Nov. 99 SHIP KAYO CRUISE No. KY9909

WEATHER bc CONDITIONS smooth DIR. of WIND VEL. of WIND 5m/s

START of RELEASE 21:54 FINISH of RELEASE 00:03

POS. of DISCOVERY 0°01.354S 138°01.223E ASCENDING RATE m/s

DIRECTION ° DISTANCE m

NOTE
22:00 [illegible]離し → 起きない
船を移動 22:25 [illegible]切り離し → 起きない
デッキユニット交換 → ENABLE 送信 22:39、22:41、22:42、22:43
22:44、22:45、22:46 起きない → リリース 22:47、22:48～22:54 計10回
22:55 トランスデューサー交換。23:01 ENABLE、23:02～23:20 リリース計20回
リリース 23:42～23:59 計25回
リリース(上側) ENABLEを送信 00:00 OK

SSBL	TIME	S / R	DEPTH

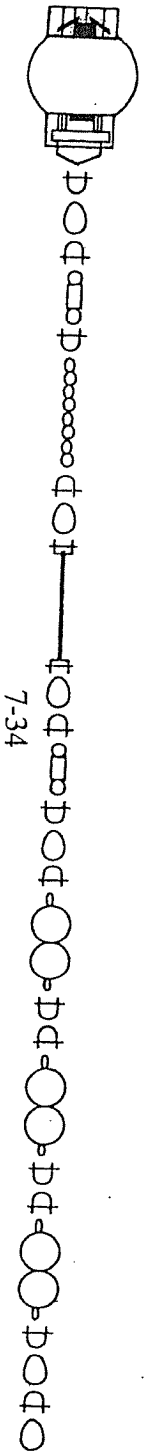
TIME RECORD

MOORING NO. 990204-00138E

		DEPLOYMENT		RECOVERY (Date: 99/11/12)	
		START : 0:25 FINISH : 01:22		START : 00:28 FINISH : 01:41	
ITEM	S/N etc.	TIME	MEMO	TIME (ON DECK)	MEMO
ADCP	S/N 1155 S/N 1282	0:28		0:36	
WIRE	50 m	0:25 ~ 0:26		0:38 ~ 0:41	
ABS BOUY	2 × 3	0:30		0:42	
WIRE	200 m	0:30 ~ 0:34		0:43 ~ 0:48	
KEVLER	188 m	0:37 ~ 0:40	K2-10	0:48 ~ 0:50	
GLASS BALL	3	0:43		0:51	
AANDERAA	4080 U	0:44	VECTOLAN 10m & 1.5m	0:54	
KEVLER	976 m	0:44 ~ 0:53	K10-23	0:56 ~ 1:11	
〃	976 m	0:54 ~ 1:01	K10-24	1:12 ~ 1:25	
〃	988 m	1:02 ~ 1:09	K10-08	1:26 ~ 1:39	
GLASS BALL	12	1:12		1:40	
BENTHOS A.R.	689	1:13	135 B/A	1:40	
〃	665	1:13	140 F/D	先先	
NYLON	160 m	1:13 ~ 1:16			
RAIL ANCHOR	1.8t	1:22			

アニデラ PU-1 S/N 4080 U スイチオン 05:43 99/02/04
着水が 00:44

作業艇 00:12 (99/11/12)
アニデラ水を切った時間
0:50



FLOAT (F-09)
ADCP S/N 1151
CTD SBE16 S/N 1276

SHACKLE 20mm
RING 19mm
SHACKLE 5/8

SWIVEL AB102
SHACKLE 5/8

CHAIN
13mm x 3.0m

SHACKLE 16mm
RING 19mm

WIRE
10mm x 50m

RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 26mm (7/8)

ABS BUOY CT608B
NYLON 2.2m

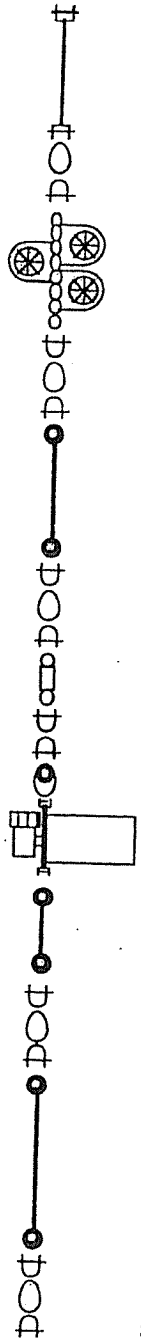
SHACKLE 26mm (7/8)
SHACKLE 26mm (7/8)

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 26mm (7/8)
SHACKLE 26mm (7/8)

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 26mm (7/8)
RING 19mm
SHACKLE 5/8
RING 19mm



WIRE
10mm x 160m

RING 19mm
SHACKLE 5/8

BENTHOS
GLASS BALL 3ps. (BLUE)
CHAIN 13mm x 3.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

VECTOLAN
12mm x 10m

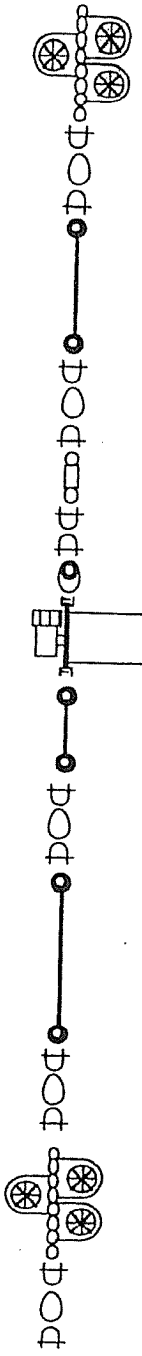
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING (SUS) 19mm
AANDERAA (RCM-08)
S/N 10662
(500m)

WIRE 1m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER (K2-11)
12mm x 200m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8



BENTHOS
GLASS BALL 3ps.
CHAIN 13mm x 3.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING (SUS) 19mm
AANDERAA (RCM-08)
S/N 9728
(700m)

WIRE 1m

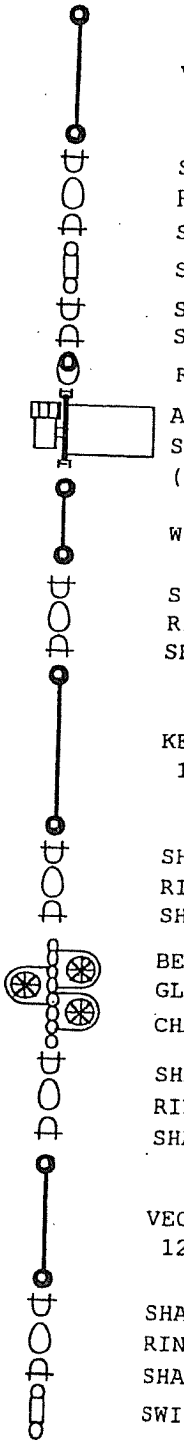
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER (K1.5-01)
12mm x 150m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS
GLASS BALL 3ps.
CHAIN 13mm x 3.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8



VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING (SUS) 19mm
AANDERAA (RCM-08)
S/N 11622
(850m)

WIRE 1m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER (K1.5-02)
12mm x 150m

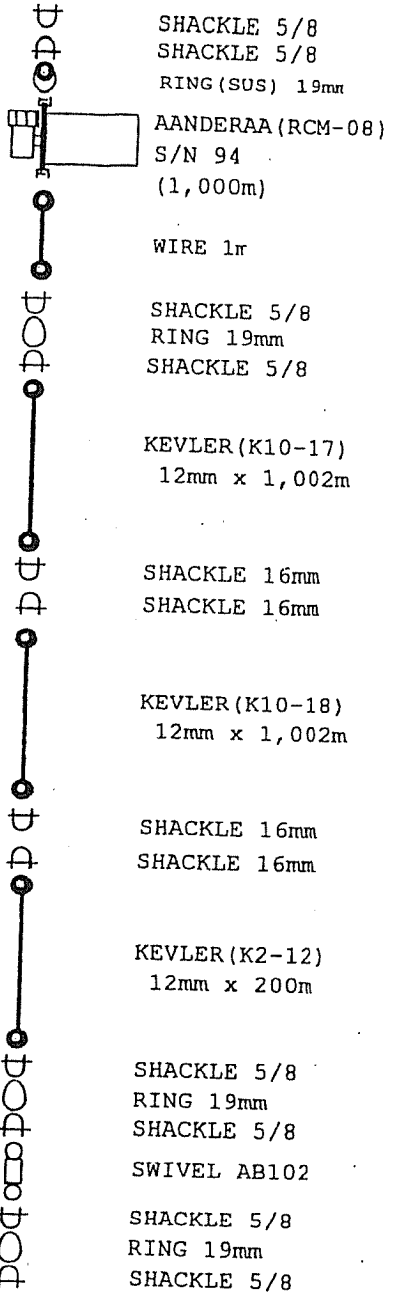
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

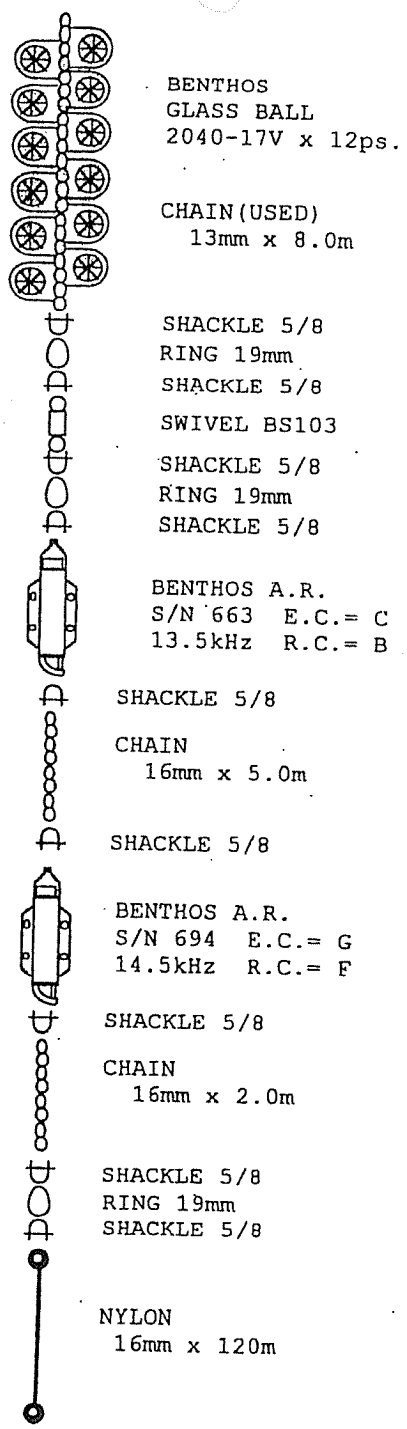
BENTHOS
GLASS BALL 3ps. (PINK)
CHAIN 13mm x 3.0m

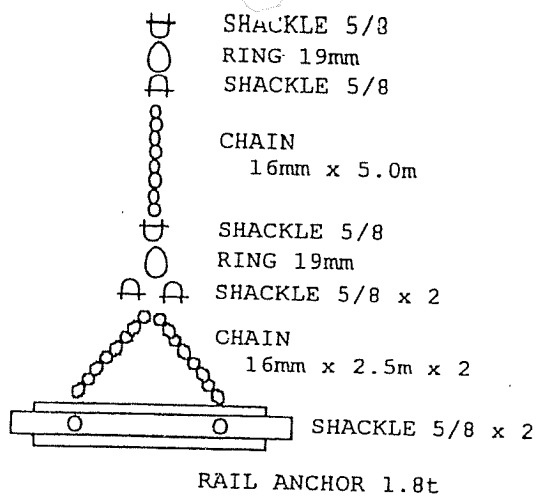
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102







2.5° S, 142° E
水深:3,441m
索長:3,118.1m

DEPLOYMENT & RECOVERY

MOORING No. 980906 -2S142E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	T. Shimbiki
POSITION	02°-30S 142°E	(R)	
DEPTH			
PERIOD	6 Sep. 98 ~ 11. Nov. 99	NAVIGATION SYSTEM :	WGS84
No.of DAYS			
LENGTH :	m	DEPTH of BUOY : m	BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	Benthos (Upper)	TYPE	Benthos (Lower)
S/N	663	S/N	694
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	13.5 kHz	TRANSMIT F.	14.5 kHz
ENABLE C.	C	ENABLE C.	G
RELEASE C.	B	RELEASE C.	F
BATTERY	2 years	BATTERY	2 years.
TEST on DECK		TEST on DECK	

DEPLOYMENT

DATE 6 Sep. 98 SHIP KAIYO CRUISE No. KY98-10

WEATHER bc CONDITIONS 0.3m, 4 m/sec DIR. of WIND 085° VEL. of WIND 5 m/sec

DEPTH 3453 m DEPTH of A.R. 3271 m DESCEND. RATE 2.1 m/s

POS. of STRT 02°26'784S 141°56'950E HOR.RANGE m

POS. of DEP. 02°28'067S 141°58'757E SINKER 04 : 53 DISAPPEAR. 05: 07

POS. of MOORING 02°28'065S 141°58'683E LANDING 05: 15

NOTE

アンデラーは、1 Sep 98 320 (UTC) SWオン (2時間後 ガントcheck)
上より S/N 10662, 9728, 11622, 94
3ps グラスボール 青-黄-黄-ピンク
アンカー上 Nylon 138 → 120 m 変更
ブイ全没 0508
着底 0516
Depth 3453m

SSBL

TIME	S / R	DEPTH
1349 (JST)		43.2
1354 (JST)		191.0
1357 (JST)		768.3
14:02 (JST)		1765.9
14:11 (JST)		2962.2
14:15 (JST)		3267.4

2.1 m/s

RECOVERY

DATE 14. Nov. 1999 SHIP KAIYO CRUISE No. KY99-09

WEATHER bc CONDITIONS Smooth DIR. of WIND VEL. of WIND

START of RELEASE 21:49 FINISH of RELEASE 21:54

POS. of DISCOVERY ° ° (Time 21:56)

DIRECTION 90° DISTANCE m ASCENDING RATE m/s

NOTE

リリースコマンド 21:53 エネイブルは一度で決まる
リリースも一発でOK

SSBL

TIME	S / R	DEPTH

TIME RECORD

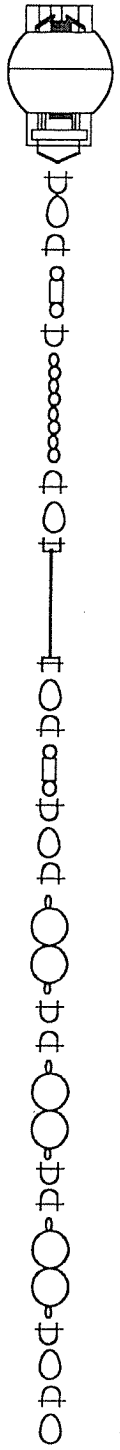
MOORING NO. [illegible]

		DEPLOYMENT Shiribiki START : 0349 (UTC) FINISH : 0455 (UTC)		RECOVERY (Date: 99/[illegible]/[illegible]4) START : 22:36 FINISH : 23:51	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
[illegible]	[illegible] CTD 1276	0352 (UTC)		22: 41	
WIRE	30 m	0350〜0351	WIREから 脱落	22:45〜22:47	
[illegible]	2	0355		22: 48	
〃	2	0355		〃	
〃	2	0355		〃	
WIRE	160 m	0355〜0400		22:48〜22:52	
GLASS BALL	3 ps	0401	(青色) 2コ	22: 53	
AANDERAA [illegible]	S/N 10662 [illegible]	0402	03:20 1.Sep98 UTC カウント 24	22: 56	22:51 *面
KEVLER	200 m	0402〜0408	K2-11	22:57〜23:02	
GLASS BALL	3 ps	0409	3コ見える	23: 02	
#2 AANDERAA (RCM)	S/N 9728 700 m	0410	03:20 1Sep98 UTC カウント 24	23: 03	23: 00
KEVLER	150 m	0410〜0415		23:04〜23:07	K1-5-01
GLASS BALL	3ps	0415	3コ見える	23: 07	
#3 AANDERAA (RCM)	S/N 11622 850 m	0415	03:20 1Sep98 UTC カウント 32	23: 10	23: 07
KEVLER	150 m	0415〜0419		23:11〜23:14	K1.5-02
GLASS BALL	3ps	0419	(ピンク) 3コ見える	23: 14	
#4 AANDERAA (RCM)	S/N 94 1000 m	0420	03:20 1Sep98 UTC カウント 24	23: 16	23: 14
KEVLER	1002 m	0421〜0430		23:17〜23:31	
KEVLER	1002 m	0430〜0440		23:32〜23:44	
KEVLER	200 m	0440〜0445		23:45〜23:48	
GLASS BALL	12 ps	0445		23: 49	
BENTOS A.R.	663	0445	13.5 kHz C-B	23: 49	
〃	694	0446	14.5 kHz G-F	23: 49	
NYLON	138 m	0446〜0452	120m変更		
RAIL ANCHOR	1.7t	0453			

アンデラー S.W オン 1 Sep.98 03:20 (UTC) すべてスタート
Cレンジ 120分ごと 05:20 (UTC) +6 を確認
係留前確認 O.K.
CTD、寿. O.K.
ガラスブイが (3ps) が海面で何コ見えるか記入
0447 リリース 音響確認

ADCPにロープ取付 22:30

ブイ全没 0508 着底 0516 水深 ~~3456~~ m
3453 m (0529) UTC



FLOAT(F-01)
ADCP S/N 1222
CTD SBE16 S/N 1280

SHACKLE 7/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8

CHAIN
13mm x 3.0m

SHACKLE 5/8
RING 19mm

WIRE
10mm x 50m

RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

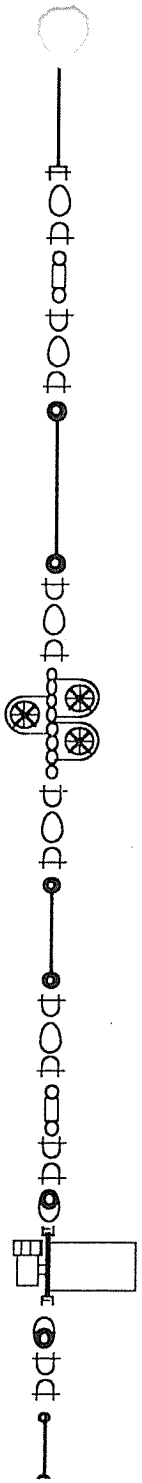
SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
RING 19mm
SHACKLE 5/8
RING 19mm



WIRE
10mm x 200m

RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

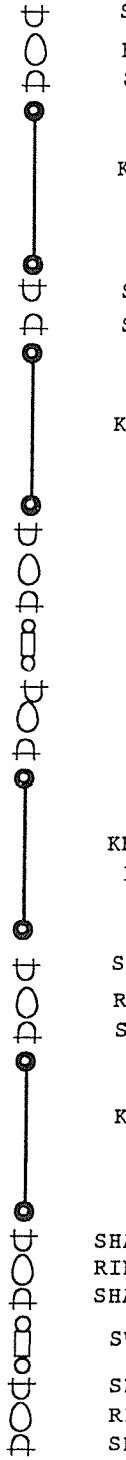
KEVLER(K2-04)
12mm x 187m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 3.0m
BENTHOS
GLASS BALL 3ps.
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm
Ru-1
S/N
(700m)

VECTOLAN
12mm x 1.5m



SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K10-02)
12mm x 975m

SHACKLE 5/8
SHACKLE 5/8

KEVLER(K10-03)
12mm x 975m

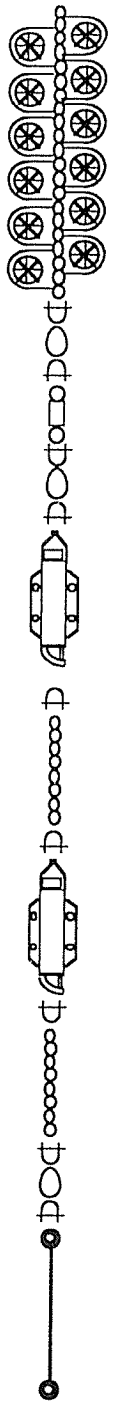
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K10-04)
12mm x 975m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K5-06)
12mm x 488m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8



BENTHOS
GLASS BALL
2040-17V x 12ps.

CHAIN
13mm x 8.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL BS103
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS A.R.
S/N 691 E.C.=D
14.0kHz R.C.=C

SHACKLE 5/8

CHAIN
13mm x 5.0m

SHACKLE 5/8

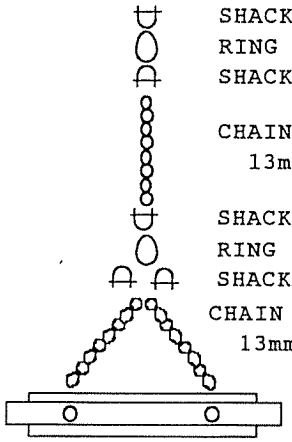
BENTHOS A.R.
S/N 630 E.C.= B
13.5kHz R.C.= A

SHACKLE 5/8

CHAIN
13mm x 2.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

NYLON
16mm x 200m



SHACKLE 5/8
RING 19mm
SHACKLE 5/8

CHAIN
13mm x 5.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8 x 2

CHAIN
13mm x 2.5m x 2

SHACKLE 5/8 x 2

RAIL ANCHOR 1.8t

0°N, 147°E
水深:4,412m
索長:4096.6 m

DEPLOYMENT & RECOVERY

99 0-147E かいよう秋回収、

MOORING No. 990221-00N147E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	K. Nishijima
POSITION	0°-147°E	(R)	
DEPTH	4505		

PERIOD

No.of DAYS

NAVIGATION SYSTEM : WGS 84

LENGTH : 4169.6 m DEPTH of BUOY : m BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	BENTHOS (Upper)	TYPE	BENTHOS (Lower)
S/N	691	S/N	630
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	14.0 kHz	TRANSMIT F.	13.5 kHz
ENABLE C.	D	ENABLE C.	B
RELEASE C.	C	RELEASE C.	A
BATTERY	1 year 16 HRS	BATTERY	1 year 16 HRS
TEST on DECK	水深500mまで下ろしてtest. O.K.	TEST on DECK	水深500mまで下ろしてtest. O.K.

DEPLOYMENT

DATE 21 Feb '99 SHIP MIRAI CRUISE No. MR99-K01

WEATHER c CONDITIONS 1.5m DIR. of WIND 316 VEL. of WIND 08.1

DEPTH 4505 m DEPTH of A.R. 4104 m DESCEND. RATE m/s BUOY 2/21 22:35

POS. of STRT 00°00.85S 147°03.94E HOR.RANGE m

POS. of DEP. 00°-00.09N 147°-05.45E SINKER 2/21 23:55 DISAPPEAR. :

POS. of MOORING 00°-00.00N 147°05.38E LANDING 2/22 0:24

NOTE

2/21 09:00

Ru-1 ON

SSBL	TIME	S/R	DEPTH
S	0:00	13.5KHz	488
S	0:05	↓	1395
B	0:10	↓	2217
L	0:15	↓	2951
	0:20	↓	3567
	0:24	↓	4104

RECOVERY

DATE 16 NOV. 1999 SHIP KAIYO CRUISE No. KY9909

WEATHER bC CONDITIONS Smooth DIR. of WIND VEL. of WIND

START of RELEASE 20:48 FINISH of RELEASE 20:55

POS. of DISCOVERY 65°

DIRECTION 65° ASCENDING RATE m/s

DISTANCE 1020 m H.R.

NOTE

エネイブル 20:49 OK SSBLを確認 → OK

リリース 20:52 NO 20:53 OK

浮上 20:55

開始 00°00.228S 147°04.965E

終了 00°00.599S 147°04.164E

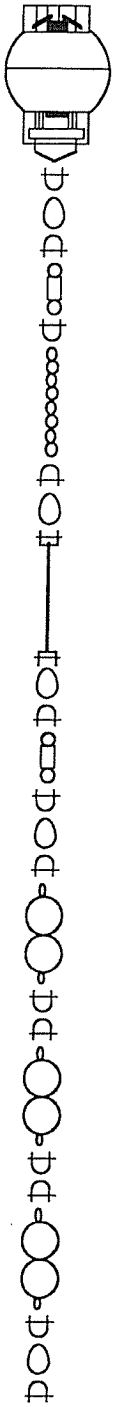
SSBL	TIME	S/R	DEPTH
S			
S			
B			
L			

TIME RECORD

No. 990221-00N147E

BUOY No.:			DEPLOYMENT		RECOVERY	
PTT:			DATE	21 Feb '99	DATE	16 Nov. 99
			START	22:32	START	21:40
			FINISH	23:55	FINISH	23:00
ITEM	S/N	etc	TIME	MEMO		TIME
ADCP & CTD	ADCP 1222 CTD 1280		22:35		21:49	21:49
WIRE	10mm x 50m		22:35~22:39			21:52~21:53
ABS BUOY	2コ		22:39			21:54
ABS BUOY	2コ		22:39			21:54
ABS BUOY	2コ		22:39			21:54
WIRE	10mm x 200m		22:39~22:44			21:56~21:59
KEVLER	(K2-04)	12mm x 187m	22:44~22:50			22:02~22:02
GLASS BALL	3コ		22:50			22:03
Rui-1 (700m)	4011		22:50			22:06
KEVLER	(K10-02)	12mm x 975m	22:50~23:01			22:09~22:22
KEVLER	(K10-03)	12mm x 975m	23:01~23:12			22:23~22:35
KEVLER	(K10-04)	12mm x 975m	23:12~23:24			22:36~22:49
KEVLER	(K5-06)	12mm x 488m	23:24~23:39			22:50~22:58
GLASS BALL	12コ		23:39			23:00
A.R. (Upper)	691		23:39			23:00
A.R. (Lower)	630		23:40			22:59
NYLON	16mm x 200m	② ←順番変更	23:41~23:55			
NYLON	16mm x 73m	①	23:40~23:41			
ANCHOR	1.8t		23:55			

作業始 21:23
ADCPロープ取付 21:34
水面 22:02



FLOAT(F-6)
ADCP S/N 1221
CTD SBE16 S/N 1281

SHACKLE 7/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8

CHAIN
13mm x 3.0m

SHACKLE 5/8
RING 19mm

WIRE
10mm x 50m

RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm

ABS BUOY CT608B
NYLON 2.2m

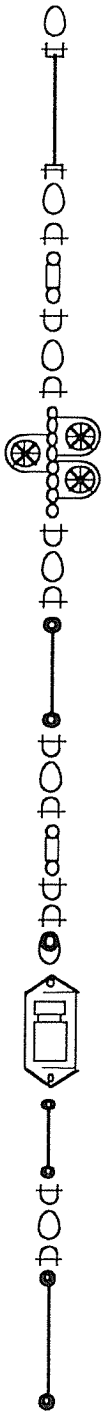
SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
RING 19mm
SHACKLE 5/8



RING 19mm

WIRE
10mm x 50m

RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 3.0m
BENTHOS
GLASS BALL 3ps.
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

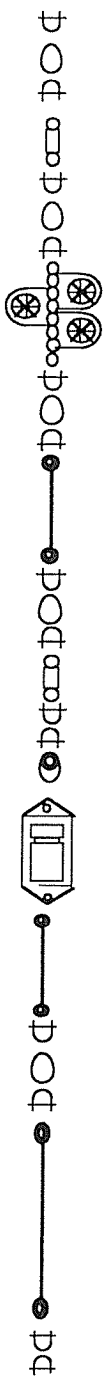
VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm

RCM-9 (400m)
S/N 355

VECTOLAN
12mm x 1.5m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(09-K3-02)
9mm x 300m



SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 3.0m
BENTHOS
GLASS BALL 3ps.
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm

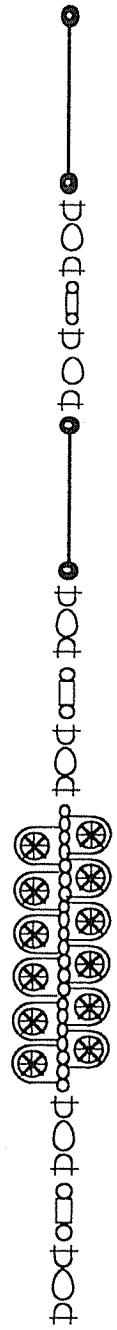
RCM-9 (700m)
S/N 357

VECTOLAN
12mm x 1.5m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(09-K10-06)
9mm x 1010m

SHACKLE 5/8
SHACKLE 5/8



KEVLER(09-K10-07)
9mm x 1010m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

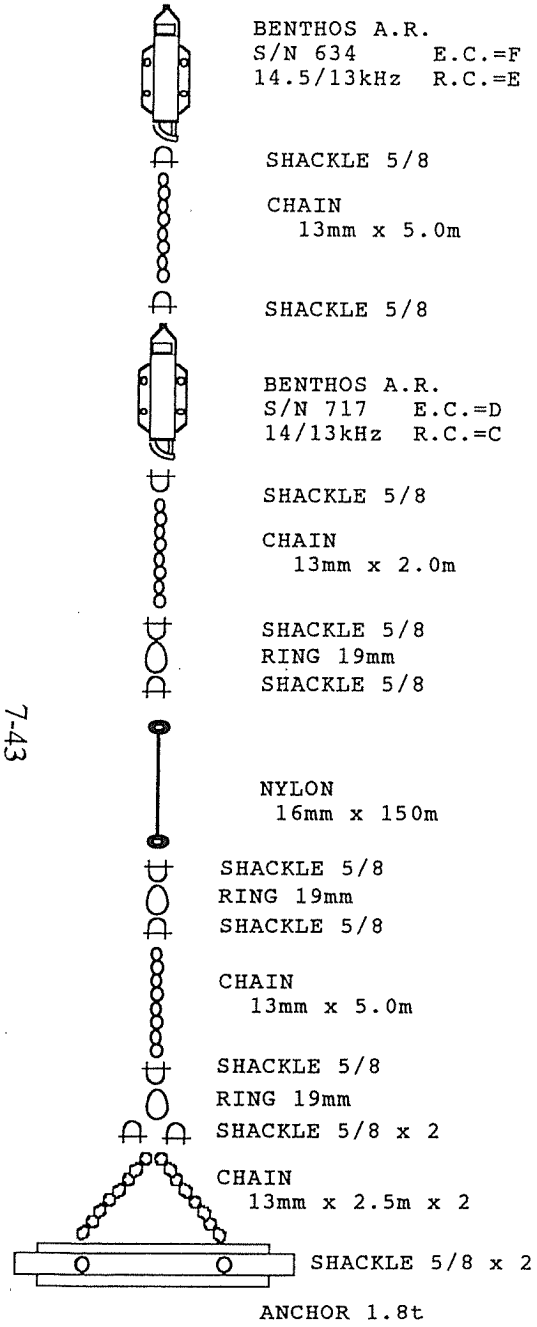
KEVLER(09-K5-01)
9mm x 500m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE
5/8

BENTHOS
GLASS BALL
2040-17V x 12ps.

CHAIN
13mm x 8.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8



Depth(m)	*KEVLER-ID*	*KEVLER Length(m)*	*NYLON(m)*	Depth of ADCP	Depth of AANDRAA	Depth of AANDRAA
3000	09-K1-03	100	120	270.9	393.8	709.1
3100	09-K2-03	200	120	270.3	393.6	708.9
3200	09-K3-03	300	120	270.2	393.0	707.3
3300	09-K4-01	400	120	270.1	392.9	708.2
3400	09-K5-01	500	115	274.9	397.7	714.5
3500	09-K5-01 09-K1-03	500 100	115	275.0	397.8	713.1
3600	09-K5-01 09-K2-03	500 200	115	274.6	397.4	712.7
3700	09-K5-01 09-K3-03	500 300	110	280.4	403.2	718.5
3800	09-K5-01 09-K4-01	500 400	110	280.7	403.5	716.3
3900	09-K10-05	1000	110	279.7	402.5	717.8
4000	09-K10-05 09-K1-03	1000 100	110	280.0	402.8	718.1

7°N, 127°E
水深:3,437m
索長:3,131.1m

DEPLOYMENT & RECOVERY

MOORING No. 991024-7N127E

PROJECT	TDCS	TIME	UTC
AREA	ミンダナオ	RECORDER (D)	ITO
POSITION	7°N 127°E	(R)	
DEPTH	3440m		
PERIOD	1999.10.23 ~	NAVIGATION SYSTEM :	WGS 84
No.of DAYS	360		
LENGTH :	m	DEPTH of BUOY : m	BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	Benthos (Upper)		TYPE	Benthos (bottom)	
S/N	634		S/N	717	
RECEIVE F.	13.0	kHz	RECEIVE F.	13.0	kHz
TRANSMIT F.	14.5	kHz	TRANSMIT F.	14.0	kHz
ENABLE C.	F		ENABLE C.	D	
RELEASE C.	E		RELEASE C.	C	
BATTERY	2 years		BATTERY	2 years	
TEST on DECK	ok		TEST on DECK	ok	

DEPLOYMENT

DATE	1999.10.23		SHIP	KAIYO	CRUISE No. KT99-09
WEATHER	bC	CONDITIONS	DIR. of WIND	N	VEL. of WIND
DEPTH	3437 m	DEPTH of A.R.	3199 m	DESCEND. RATE	m/s BUOY 22:36
POS. of STRT	6°49.48N	126°42.71E	HOR.RANGE		m
POS. of DEP.	6°49.792N	126°42.792E	SINKER	23:56	DISAPPEAR. 00:10
POS. of MOORING	6°49.596N	126°42.723E			LANDING 00:21

NOTE

	TIME	S / R	DEPTH
SSBL			

RECOVERY

DATE		SHIP	CRUISE No.
WEATHER	CONDITIONS	DIR. of WIND	VEL. of WIND
START of RELEASE	:	FINISH of RELEASE	:
POS. of DISCOVERY	°	°	ASCENDING RATE m/s
DIRECTION	°	DISTANCE	m

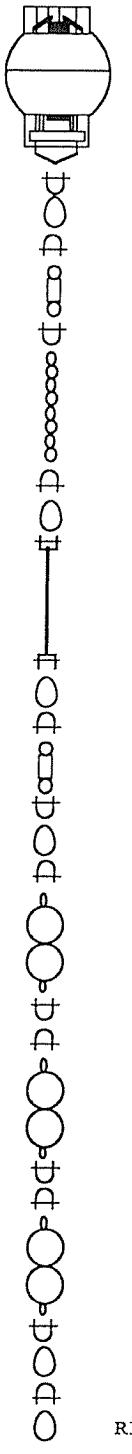
NOTE

	TIME	S / R	DEPTH
SSBL			

TIME RECORD

MOORING NO. 991024 - 7N127E (ミンダナオ)

		DEPLOYMENT		RECOVERY (Date:)	
		START : 22:34 (991023) FINISH :		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP & CTD	ADCP 1221 CTD 1281	22:36			
WIRE	50m	22:36 ~ 22:37			
ABS BUOY	2コ	22:40			
〃	2コ	22:40			
〃	2コ	22:40			
WIRE	50m	22:40 ~ 22:41			
GLASSBALL	3コ	22:42			
AANDERAA RCM-9	S/N 355	22:44			
KEVLER ①	09-K3-02 300m	22:44 ~ 22:49			
GLASS BALL	3コ	22:53			
AANDERAA RCM-9	S/N 357	22:54			
KEVLER ②	09-K10-06 1000m	22:54 ~ 23:05			
〃 ③	09-K10-07 1000m	23:07 ~ 23:18			
〃 ④	09-K5-01 500m	23:20 ~ 23:25			
GLASSBALL	12コ	23:30			
A.R.	S/N 634	23:31			
A.R.	S/N 717	23:31			
NYLON	150m	23:32 ~ 23:34			
ANCHOR	1.8ton	23:56			
23:35 ~ 23:53 航走					



FLOAT(F-10)
ADCP S/N 1225
CTD SBE16 S/N 1275

SHACKLE 7/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8

CHAIN
13mm x 3.0m

SHACKLE 5/8
RING 19mm

WIRE
10mm x 50m

RING 19mm
SHACKLE 5/8
SWIVEL AB102(USED)
SHACKLE 5/8
RING 19mm
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

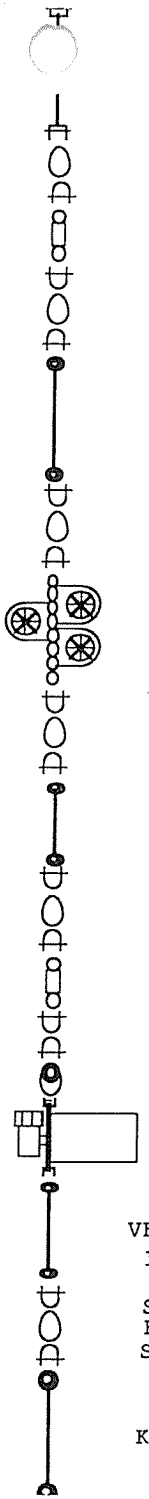
SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
RING 19mm
SHACKLE 5/8
RING 19mm



WIRE
10mm x 200m

RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K2-08)
12mm x 187m

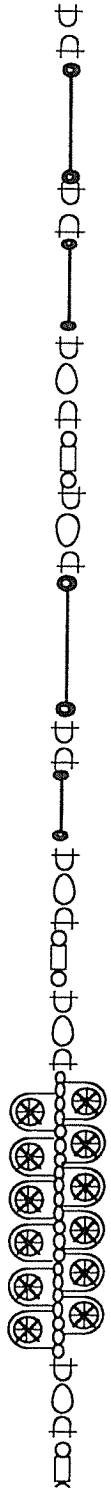
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 3.0m
BENTHOS
GLASS BALL 3ps.
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
VECTOLAN
12mm x 10m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm

S/N SECM0035
SD35(700m)

VECTOLAN
12mm x 1.5m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K10-07)
12mm x 975m



SHACKLE 5/8
SHAC 5/8

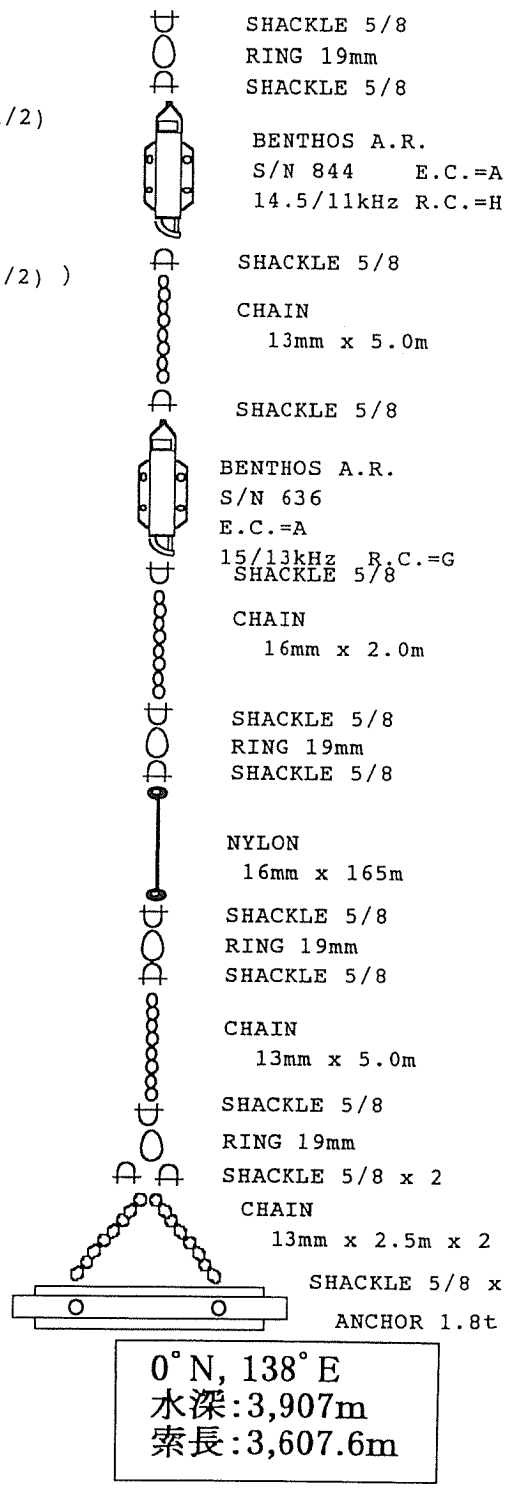
KEVLER(K10- 10 (1/2)
)
12mm x 689m
SHACKLE 5/8
SHACKLE 5/8
KEVLER(K10- 10 (2/2))
12mm x 238m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K10- 20
)
12mm x 960m
SHACKLE 5/8
SHACKLE 5/8
KEVLER(K1-02)
12mm x 87m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS
GLASS BALL
2040-17V x 12ps.

CHAIN
13mm x 8.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL BS103



SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS A.R.
S/N 844 E.C.=A
14.5/11kHz R.C.=H

SHACKLE 5/8

CHAIN
13mm x 5.0m

SHACKLE 5/8

BENTHOS A.R.
S/N 636
E.C.=A
15/13kHz R.C.=G
SHACKLE 5/8

CHAIN
16mm x 2.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

NYLON
16mm x 165m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

CHAIN
13mm x 5.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8 x 2
CHAIN
13mm x 2.5m x 2

SHACKLE 5/8 x
ANCHOR 1.8t

0°N, 138°E
水深:3,907m
索長:3,607.6m

DEPLOYMENT & RECOVERY

MOORING No. 991112-00138E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	A. ITO
POSITION	0° 138°E	(R)	
DEPTH	3909 m		
PERIOD		NAVIGATION SYSTEM :	WGS 84
No.of DAYS			
LENGTH :	m	DEPTH of BUOY : m	BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	Benthos (UPPER)	TYPE	BENTHOS (Lower)
S/N	844	S/N	636
RECEIVE F.	11.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	14.5 kHz	TRANSMIT F.	13.0 kHz
ENABLE C.	A	ENABLE C.	A
RELEASE C.	H	RELEASE C.	9
BATTERY	1 year	BATTERY	2year
TEST on DECK		TEST on DECK	

DEPLOYMENT

DATE	11/12	SHIP KAIYO	CRUISE No. KT99-09
WEATHER	2	CONDITIONS 3.	DIR. of WIND SE VEL. of WIND 4 m/s
DEPTH	3910 m	DEPTH of A.R. m	DESCEND. RATE m/s BUOY 12:36
POS. of STRT	0° 01.558S	138° 00.829E	HOR.RANGE m
POS. of DEP.	0° 00.984S	138° 01.853E	SINKER 13:58 DISAPPEAR. 14:14
POS. of MOORING	0° 00.972S,	138° 01.801 E	LANDING 14:24

NOTE 流向流速計 S/N SECM 0035
(東大海洋研)
スイッチ ON 99.11/11 05:10(UTC)

	TIME	S / R	DEPTH
SSBL			

RECOVERY

DATE		SHIP	CRUISE No.
WEATHER	CONDITIONS	DIR. of WIND	VEL. of WIND
START of RELEASE	:	FINISH of RELEASE	:
POS. of DISCOVERY	°	°	ASCENDING RATE m/s
DIRECTION	°	DISTANCE m	

NOTE

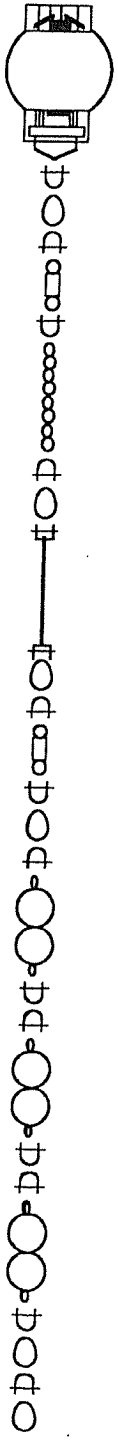
	TIME	S / R	DEPTH
SSBL			

TIME RECORD

MOORING NO. 991112 -00,38E

		DEPLOYMENT		RECOVERY (Date:)	
		START : 3:33 FINISH : 4:59		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	S/N 1225 S/N 1275(UP)	3:36			
WIRE	50m	3:36 ~ 3:38			
ABS BOUY	2×3	3:39			
WIRE	200m	3:39 ~ 3:43			
KEVLER(K2-08)	187m	3:48 ~ 3:51			
GLASS BALL	3	3:55			
Current Meter	S/N SECM0035	3:57			
KEVLER(K10-07)	975m	3:57 ~ 4:09			
KEVLER(K10-10½)	689m	4:10 ~ 4:21			
KEVLER(K10-10½)	238m	4:22 ~ 4:26			
KEVLER(K10-20)	960m	4:27 ~ 4:41			
KEVLER(K1-02)	87m	4:41 ~ 4:43			
GLASS BALL	12	4:48			
BENTHOS A.R.	S/N [illegible]	4:50	11.0 14.5 A . H		
〃	S/N 636	4:50	13.0 15.0 A G		
NYLON	165m	4:50 ~ 4:53			
ANCHOR	1.8t	4:59			

流向流速計(東大海洋研)
S/N SECM0035 (SD35)
ZC.4ON 05:10(UTC)
99/11/11
着水時間 99/11/12 03:57



FLOAT(F-08)
ADCP S/N 1224
CTD SBE16 S/N 2611

SHACKLE 7/8
RING 19mm
SHACKLE 5/8

SWIVEL AB102
SHACKLE 5/8

CHAIN
13mm x 3.0m

SHACKLE 5/8
RING 19mm

WIRE
10mm x 50m

RING 19mm
SHACKLE 5/8

SWIVEL AB102

SHACKLE 5/8
RING 19mm
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

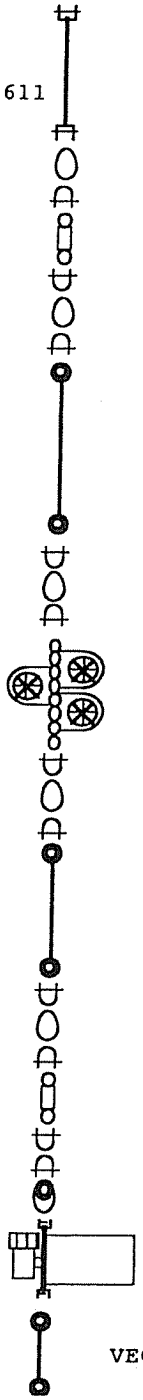
SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
SHACKLE 7/8

ABS BUOY CT608B
NYLON 2.2m

SHACKLE 7/8
RING 19mm
SHACKLE 5/8



WIRE
10mm x 200m

RING 19mm
SHACKLE 5/8

SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K2-07)
12mm x 187m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS
GLASS BALL 3ps.
CHAIN 13mm x 3.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

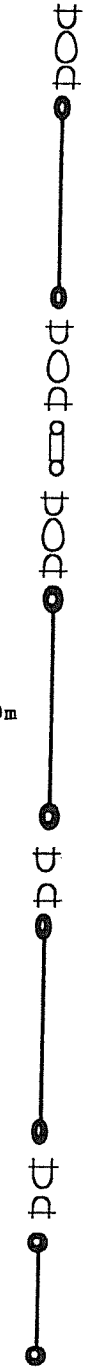
VECTOLAN
12mm x 10m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102

SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm

CURRENT METER
S/N SDCM0036
(700m)

VECTOLAN 1.5m



SHACKLE 5/8
RING 19mm
SHACKLE 5/8

KEVLER(K10-09)
12mm x 985m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8

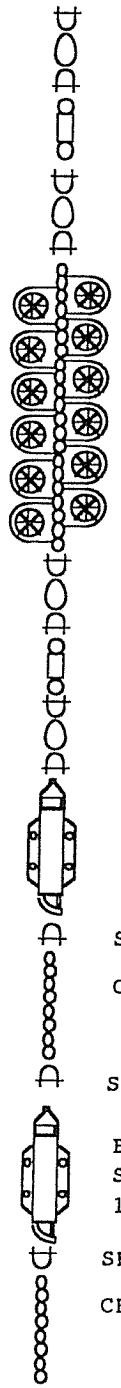
KEVLER(K10-22)
12mm x 960m

SHACKLE 5/8
SHACKLE 5/8

KEVLER(K5-08)
12mm x 488m

SHACKLE 5/8
SHACKLE 5/8

KEVLER(K1-06)
12mm x 100m



SHACKLE 5/8
RING 19mm
SHACKLE 5/8

SWIVEL AB102

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS
GLASS BALL
2040-17V x 12ps.

CHAIN(USED)
13mm x 8.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

SWIVEL BS103

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

BENTHOS A.R.
S/N 719 E.C.= E
14/13kHz R.C.= D

SHACKLE 5/8

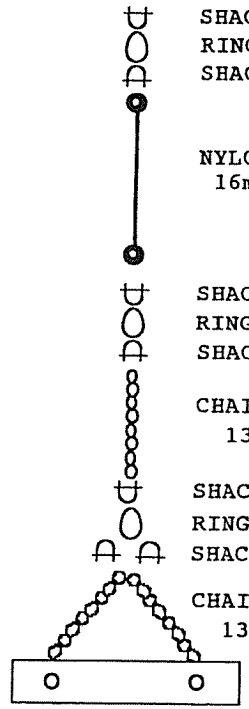
CHAIN
13mm x 5.0m

SHACKLE 5/8

BENTHOS A.R.
S/N 631 E.C.= C
13.5/13kHz R.C.= B

SHACKLE 5/8

CHAIN
13mm x 2.0m



SHACKLE 5/8
RING 19mm
SHACKLE 5/8

NYLON
16mm x 125m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8

CHAIN
13mm x 5.0m

SHACKLE 5/8
RING 19mm
SHACKLE 5/8 x 2

CHAIN
13mm x 2.5m x 2

SHACKLE 5/8 x 2

ANCHOR 1.8t

2.5°S, 142°E
水深:3,441m
索長:3,141.6m

DEPLOYMENT & RECOVERY

MOORING No. 991115-2S142E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	A. ITO
POSITION	02°.30S 142°E	(R)	
DEPTH	3440m		
PERIOD		NAVIGATION SYSTEM :	WGS 84
No.of DAYS			
LENGTH : m	DEPTH of BUOY : m	BUOYANCY :	kg

ACOUSTIC RELEASER

TYPE	Benthos (upper)	TYPE	Benthos (lower)
S/N	719	S/N	631
RECEIVE F.	13 kHz	RECEIVE F.	13 kHz
TRANSMIT F.	14 kHz	TRANSMIT F.	13.5 kHz
ENABLE C.	E	ENABLE C.	C
RELEASE C.	D	RELEASE C.	B
BATTERY	2 years	BATTERY	2 years
TEST on DECK	OK	TEST on DECK	OK

DEPLOYMENT

DATE 15. Nov. 1999 SHIP KAIYO CRUISE No. KY9909

WEATHER 6C CONDITIONS Smooth DIR. of WIND VEL. of WIND

DEPTH 3440 m DEPTH of A.R. 3230 m DESCEND. RATE m/s BUOY 0:30

POS. of STRT 2°28.780S 141°59.820E HOR.RANGE m

POS. of DEP. 2°28.062S 141°58.434S E SINKER 1:44 DISAPPEAR. 1:56

POS. of MOORING 2°28.110S 141°58.572E LANDING 2:03

NOTE アーム ON 13. Nov. 1999 05:00 S/N SDCM0036

SSBL	TIME	S / R	DEPTH

RECOVERY

DATE SHIP CRUISE No.

WEATHER CONDITIONS DIR. of WIND VEL. of WIND

START of RELEASE : FINISH of RELEASE :

POS. of DISCOVERY ° ° ASCENDING RATE m/s

DIRECTION ° DISTANCE m

NOTE

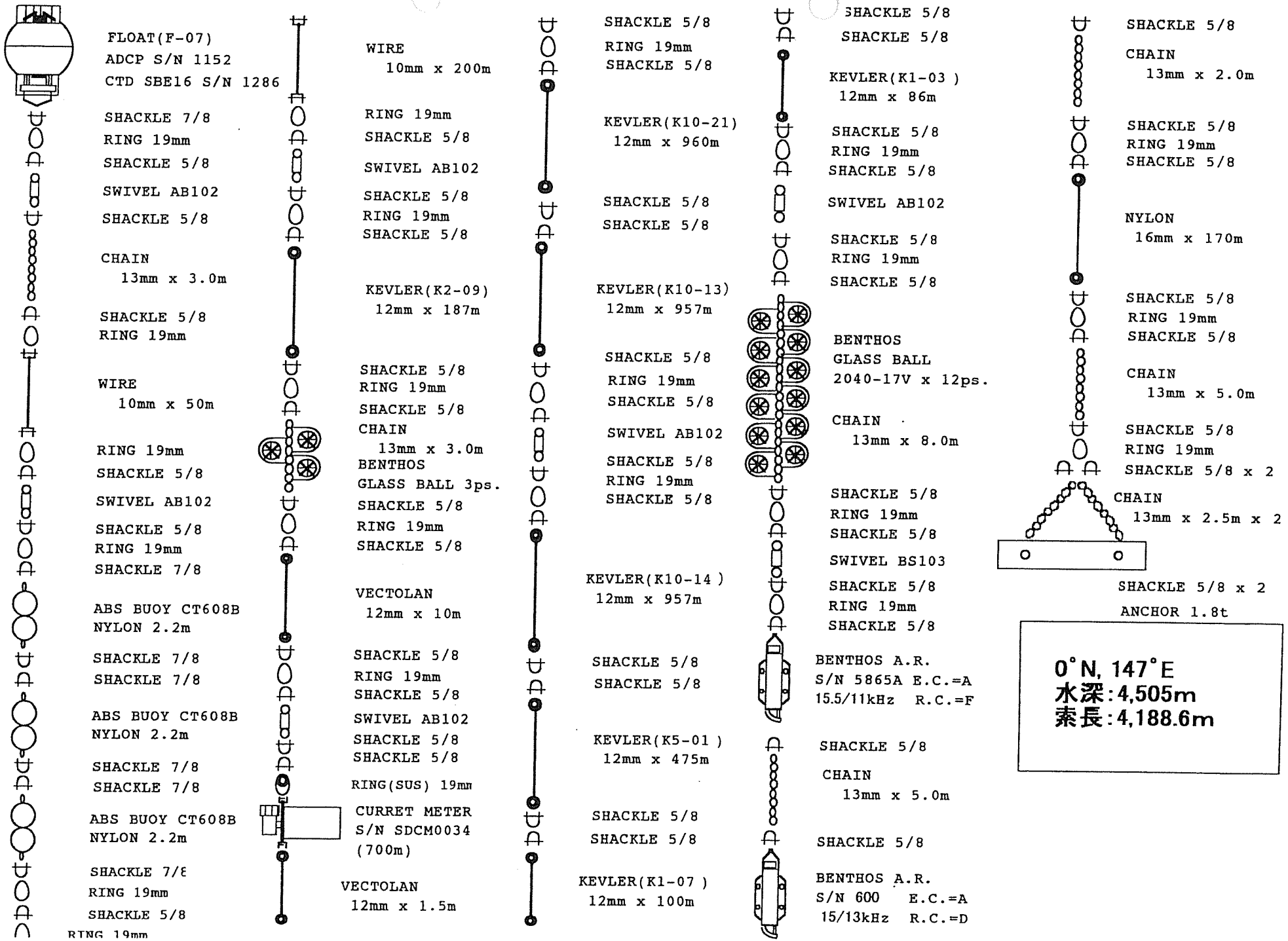
SSBL	TIME	S / R	DEPTH

TIME RECORD

MOORING NO. 991115-25S162E

		DEPLOYMENT		RECOVERY (Date:)	
~		START : 00:28 FINISH : 01:44		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	ADCP 1224 CTD 2611	0:30			
WIRE	50m	0:30 ~ 0:31			
ABS buoy	2×3	0:32			
WIRE	200m	0:32 ~ 0:35			
KEVLER (K2-07)	187m	0:38 ~ 0:42			
GLASS BALL	3ps	0:46			
AANDERAA (RCM)	SDCM0036	0:47			
KEVLER (K10-09)	985m	0:48 ~ 01:04			
KEVLER (K10-22)	960m	01.05 ~ 01:18			
KEVLER (K5-08)	488m	01:19 ~ 01:26			
KEVLER (K1-06)	100m	01:27 ~ 01:29			
GLASS BALL	12ps	01:33			
BENTHOS A.R.	719	01:34			
〃	631	01:35			
NYLON	125m	01:35 ~ 01:38			
ANCHOR	1.8t	01:44			

アンデラ S.W オン 13th Nov. 99 05:00 (U.T.C) S/N SDCM 0036
着水 0:48


FLOAT(F-07)
ADCP S/N 1152
CTD SBE16 S/N 1286
SHACKLE 7/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
CHAIN
13mm x 3.0m
SHACKLE 5/8
RING 19mm
WIRE
10mm x 50m
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 7/8
ABS BUOY CT608B
NYLON 2.2m
SHACKLE 7/8
SHACKLE 7/8
ABS BUOY CT608B
NYLON 2.2m
SHACKLE 7/8
SHACKLE 7/8
ABS BUOY CT608B
NYLON 2.2m
SHACKLE 7/8
RING 19mm
SHACKLE 5/8
RING 19mm
WIRE
10mm x 200m
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(K2-09)
12mm x 187m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 3.0m
BENTHOS
GLASS BALL 3ps.
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
VECTOLAN
12mm x 10m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
SHACKLE 5/8
RING(SUS) 19mm
CURRET METER
S/N SDCM0034
(700m)
VECTOLAN
12mm x 1.5m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(K10-21)
12mm x 960m
SHACKLE 5/8
SHACKLE 5/8
KEVLER(K10-13)
12mm x 957m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
KEVLER(K10-14)
12mm x 957m
SHACKLE 5/8
SHACKLE 5/8
KEVLER(K5-01)
12mm x 475m
SHACKLE 5/8
SHACKLE 5/8
KEVLER(K1-07)
12mm x 100m
SHACKLE 5/8
SHACKLE 5/8
KEVLER(K1-03)
12mm x 86m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL AB102
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
BENTHOS
GLASS BALL
2040-17V x 12ps.
CHAIN
13mm x 8.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
SWIVEL BS103
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
BENTHOS A.R.
S/N 5865A E.C.=A
15.5/11kHz R.C.=F
SHACKLE 5/8
CHAIN
13mm x 5.0m
SHACKLE 5/8
BENTHOS A.R.
S/N 600 E.C.=A
15/13kHz R.C.=D
SHACKLE 5/8
CHAIN
13mm x 2.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
NYLON
16mm x 170m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8
CHAIN
13mm x 5.0m
SHACKLE 5/8
RING 19mm
SHACKLE 5/8 x 2
CHAIN
13mm x 2.5m x 2
SHACKLE 5/8 x 2
ANCHOR 1.8t
0°N, 147°E
水深:4,505m
素長:4,188.6m

DEPLOYMENT & RECOVERY

MOORING No. 99111 -00N147E

PROJECT	TOCS 「みらい」	TIME	UTC
AREA	熱帯赤道域	RECORDER (D)	170/A
POSITION	0°-147°E	(R)	
DEPTH	4500m		
PERIOD	360	NAVIGATION SYSTEM :	WGS 84
No.of DAYS			
LENGTH :	m	DEPTH of BUOY : m	BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	BENTHOS (Upper)	TYPE	BENTHOS (Lower)
S/N	858	S/N	600
RECEIVE F.	11.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	15.5 kHz	TRANSMIT F.	15.0 kHz
ENABLE C.	A	ENABLE C.	A
RELEASE C.	F	RELEASE C.	D
BATTERY	1 year	BATTERY	2 year
TEST on DECK	OK	TEST on DECK	OK

DEPLOYMENT

DATE	16 NOV. 1999	SHIP	KAIYO	CRUISE No.	KY9909
WEATHER	6C	CONDITIONS	DIR. of WIND	VEL. of WIND	
DEPTH	4471 m	DEPTH of A.R.	4287m	DESCEND. RATE m/s	BUOY 23:44
POS. of STRT	00°00.615S	147°03.679E	HOR.RANGE	m	
POS. of DEP.	00°00.0183N	147°05.4022E	SINKER 1:19	DISAPPEAR.	1:37
POS. of MOORING	00°00.05N	147°05.292E		LANDING	1:47

NOTE

SSBL	TIME	S / R	DEPTH

RECOVERY

DATE		SHIP	CRUISE No.
WEATHER	CONDITIONS	DIR. of WIND	VEL. of WIND
START of RELEASE	:	FINISH of RELEASE	:
POS. of DISCOVERY	°	°	ASCENDING RATE m/s
DIRECTION	°	DISTANCE m	

NOTE

SSBL	TIME	S / R	DEPTH

TIME RECORD

MOORING NO. 991116-00N147E

	DEPLOYMENT		RECOVERY (Date:)	
	START : 23:43 FINISH : 01:19		START : FINISH :	

ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	ADCP 1152 CTD 1286	23:44			
WIRE	50 m	23:44~23:45			
ABS buoy	2×3	23:46			
WIRE	200 m	23:47~23:50			
KEVLER (K2-09)	187 m	23:56~23:59			
GLASS BALL	3 ps	0:02			
AANDERAA	SDCM 0034	0:04			
KEVLER (K10-21)	960 m	0:04~0:13			
KEVLER (K10-13)	957 m	0:14~0:24			
KEVLER (K10-14)	957 m	0:26~0:35			
KEVLER (K5-01)	475 m	0:36~0:42			
KEVLER (K1-07)	100 m	0:42~0:44			
KEVLER (K1-)	86 m	0:44~0:46			
GLASS BALL	12 ps	1:03			
BENTHOS A.R.	~~5865A~~	(S/N858) 1:05			
〃	S/N 600	1:05			
NYLON	~~170 m~~ 150/130 m	1:05~1:09			
ANCHOR	1.8 t	1:19			

アンデラ着水 0:04
0:49~0:58 水深が「あさい」と異なったため ナイロンロープを さらに 20m 切った。予定 4505m → 4470m
01:12~01:16 航走

8. TAO Moorings

TAO Mooring Operations

NOAA, Pacific Marine Environmental Laboratory, Seattle, WA, USA

During the TOCS (Tropical Ocean Climate Study) autumn cruise KY-99-09, Leg II aboard *R/V KAIYO*, the last three western Pacific standard ATLAS (Automated Temperature Line Acquistion System) mooring sites of the TAO (Tropical Atmosphere-Ocean) Array were recovered along the 137E and 147E meridians.

This work consisted of three recoveries and no deployments, as these sites are now occupied by JAMSTEC's TRITON moorings as recently deployed by *R/V MIRAI*.

Mooring Description

All sites were surface buoy, taut-line moorings scoped at 98.5% of the associated depth. These standard ATLAS moorings record surface measurements of wind speed, wind direction, air temperature, and relative humidity. Subsurface measurements consists of sea surface temperature and a thermistor chain cable down to 500m depth with ten temperature and two pressure sensors. Data is processed via a tower mounted data logger tube and transmitted via ARGOS satellite.

Descripton of Operations

KAIYO departed Malakal, Belau on 08 November and arrived at 2N/137E on 11 November. The ATLAS mooring was found vandalized with only the data logger tube attached to the damaged buoy tower. The mooring was released from its' anchor and recovered aboard ship without incident. All surface sensors and radar reflector were lost. The integerity of the data logger tube was also jeoparidized and the internal tube electonics were damaged by corrosion beyond field repair.

KAIYO arrived at 0/147E on 18 November and found this mooring also showed signs of foreign visitation with mooring lines attached to the tower and bridle below. Fortunately there was no vandalism and the mooring was released from its' anchor and recovered intact without incident.

KAIYO arrived at 5N/147E on 20 November and found this mooring with no signs of visitation nor vandalism. The mooring was released from its' anchor and recovered intact without incident.

KAIYO arrived in Kavieng, New Ireland, Papua New Guinea on 23 November to end Leg II.

Acknowledgements

A special thank you to Captain Osamu Yukawa, Chief Scientist Yuji Kashino, Chief Officer Toshinobu Miyata, and Bosun Munemasa Konishi for a productive and successful cruise. Mooring operations and ship handling were performed superbly by the expert skills off the Officers, Chiefs, Scientific Technicians, and Crew of *KAIYO*.

TABLE 1 - Summary of TAO Mooring Operations, TOCS KY-99-09

	SITE	DATE	SITE ID	LATITUDE	LONGITUDE	TYPE	OPERATIONS
•	2N/137E	11Nov	ET535	02-24.46N	137-28.36E	STD ATLAS	Recovered
•	EQ/147E	18Nov	ET533	00-01.52N	146-56.13E	STD ATLAS	Recovered
•	5N/147E	20Nov	ET505	04-58.49N	147-00.68E	STD ATLAS	Recovered

9. Carbon dioxide in the ocean

9. Carbon dioxide in the ocean

1. Participants

Hisayuki. Yoshikawa1),Masao Ishii1) ,Takashi Kitao2)
1) Geochemical Research Department, Meteorological Research Institute (MRI),
Nagamine 1-1, Tsukuba, Ibaraki, 305-0052, JAPAN

2) Environmental Chemistry Department Ocean Environmental Survey Team, Kansai
Environmental Engineering Center Co. LTD. (KANSO),
1-3-5, Azuchimachi, Chuo-ku, Osaka, 531-0052, JAPAN

2. Objectives

Carbon dioxide (CO_2), known as a major greenhouse gas, has been increasing in the atmosphere as a result of the anthropogenic emission. Its current global mean concentration is approximately 30% larger than that in the pre-industrial era (280 ppm). In order to predict the atmospheric CO_2 level in the future, it is necessary to understand the processes which are controlling the fluxes among the global carbon reservoirs: the atmosphere, the terrestrial biosphere and the ocean, as well as to estimate the present CO_2 inventory among these reservoirs.

The difference in CO_2 partial pressure (pCO_2) between the sea surface and the marine boundary air (delta pCO_2) is a driving force for the CO_2 exchange between the ocean and the atmosphere, and the temporal and spatial variability of pCO_2 in surface seawater is thought to be playing an important role for the variability of the atmospheric CO_2 growth rate.

The equatorial Pacific is known to act as a source of CO_2 to the atmosphere due primarily to the equatorial upwelling in the central and the eastern areas. Its CO_2 flux has been reported to exhibit a significant interannual variability that is associated with the ENSO event. However, the temporal and spatial variations in delta pCO_2 enough to deduce the interannual variation in CO_2 outflux from the whole equatorial zone has not been well documented.

Partial pressure of CO_2 in seawater is governed by the carbonate system in seawater. It is expected that total inorganic carbon (TCO_2 ; the sum of the concentrations of hydrate carbon dioxide, carbonic acid, bicarbonate, and carbonate) in the upper water column in the equatorial Pacific also exhibits pronounced temporal and spatial variability and affect pCO_2 as a result of the changes in meteorological, oceano-physical, and biological conditions including upwelling, extension of the warm water pool, biological production, and air-sea CO_2 exchange.

In this cruise, we made concurrent measurements of pCO_2 and TCO_2 in order to investigate the air-sea CO_2 flux and the carbonate system in the western equatorial Pacific to clarify the controlling factors which are responsible for their variations.

3. Methods

We made measurements of the CO_2 concentration (mole fraction of CO_2 in dry air ; xCO_2) in marine boundary air (four times every 2 h) and in air equilibrated with

surface seawater (five times every 2 h) using the MRI CO_2 measuring system. Air sample was taken from the top of the bridge into the 2nd laboratory through the 1/4' PFA tubing. Seawater was taken continuously from the seachest and was introduced into the MRI-shower-type equilibrator.

We used non-dispersive infrared (NDIR) gas analyzers (LICOR) and four CO_2 standard gases (299 ppm, 348 ppm, 400 ppm, 449 ppm in air ; Nippon Sanso Co.) to determine the CO_2 concentration. Concentration of CO_2 will be published on the basis of the WMO X85 mole fraction scale after this cruise. Partial pressure of CO_2 will be calculated from xCO_2 by taking the water vapour pressure and sea water temperature rise from the inlet to the equilibrator into account.

We also collected surface seawater taken continuously from the seachest three times a day. We will analyze TCO_2 in these samples after this cruise using the MRI automated CO_2 extraction unit and a coulometer (UIC 5012).

We also measured SST basically three times a day by taking a surface seawater with a backette and the temperature at the seawater intake at seachest every one hour (Fig. 1) in order to compare the in situ temperature and that at the equilibrator for xCO_2 correction.

4. Results

Figure 2 shows distributions of xCO_2 in air and surface seawater from Palau to Palau and from Palau to Kavieng. Only two measurements in a day were tentatively calculated from the preliminary data set for every 2 h. We will calculate the outflux of CO_2 and the whole carbonate system parameters from the data of pCO_2 , TCO_2 , SST, and SSS. we will consider the factors which control the carbonate system in the western equatorial Pacific in more detail.

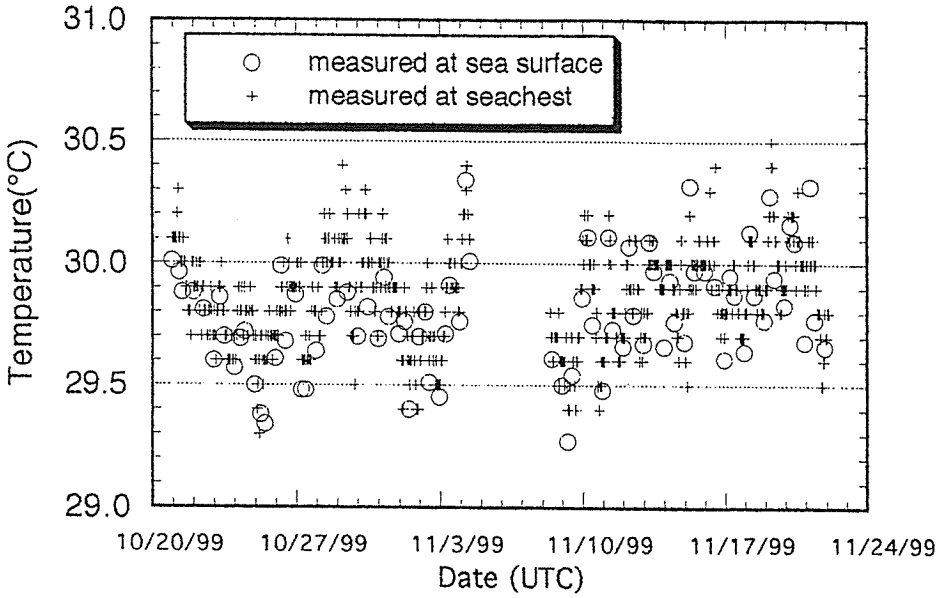


Fig.1 Distributions of seawater temperature.

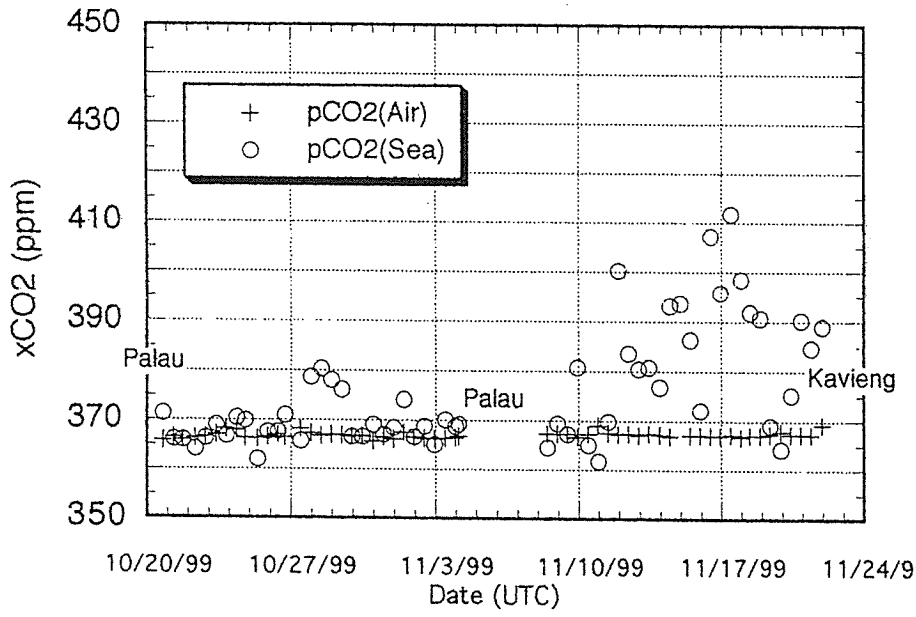


Fig. 2 Distribution of xCO_2 surface seawater and in marine boundary air (selected preliminary data)

Meteo. dataKY9909

UTC	LUT	Lat.	Long.	WD(16)	WF(m/s)	Weather	Atm.P(hPa)	Air T.(.C)	sw TEMP.(.C)	Wet b TEMP.(.C)	Dew p TEMP.(.C)	雲量	...
Palau Departure													LUT=UTC+9h
991020/03	1020/12	07。29.5' N	134。18.5' E	SSW	9.0	bc	1007.6	29.5	30	26.5	25.3	7	
991020/06	1020/15	07。00.0' N	133。56.0' E	S	7.0	bc	1005.6	29.0	30	25.4	24.3	7	
991020/09	1020/18	07。00.1' N	133。42.9' E	WSW	3.0	bc	1007.8	28.4	30	25.4	24.6	6	
991020/12	1020/21	07。00.0' N	133。25.7' E	SSW	4.0	bc	1009.0	28.6	30	25.4	24.4	6	
991020/15	1021/00	06。59.9' N	132。59.9' E	SE	2.0	bc	1009.0	28.0	30	25.0	23.9	6	
991020/18	1021/03	06。59.8' N	132。48.5' E	SSE	4.0	b	1006.2	27.9	30	25.4	24.5	2	
991020/21	1021/06	06。00.0' N	132。29.2' E	SSE	6.0	bc	1007.6	28.4	30	25.4	24.4	7	
991021/00	1021/09	07。00.3' N	131。59.9' E	SSE	6.0	bc	1009.5	29.4	30	25.5	24.1	5	
991021/03	1021/12	07。00.2' N	131。44.3' E	SSE	6.0	bc	1008.5	29.0	30	26.0	25.0	6	
991021/06	1021/15	07。00.2' N	131。24.3' E	SSE	6.0	o	1007.2	29.4	30	25.2	23.4	8	
991021/09	1021/18	07。00.1' N	131。00.2' E	SSE	9.0	bc	1008.0	28.4	30	25.0	23.7	5	
991021/12	1021/21	07。00.2' N	130。38.5' E	SSW	6.0	c	1010.0	28.2	30	26.0	25.3	8	
991021/15	1022/00	07。59.9' N	130。20.5' E	SSW	7.0	bc	1010.0	27.8	30	25.2	24.3	5	
991021/18	1022/03	06。59.8' N	129。59.9' E	S	8.0	c	1008.5	27.5	30	25.3	24.8	8	
991021/21	1022/06	06。00.0' N	129。44.9' E	SSW	8.0	bc	1009.0	27.6	30	25.4	24.8	5	
991022/00	1022/09	06。59.6' N	129。30.1' E	S	5.0	bc	1010.6	29.2	30	25.8	25.0	4	
991022/03	1022/12	07。00.0' N	129。12.8' E	W	5.0	bc	1010.2	29.4	30	25.4	24.3	6	
991022/06	1022/15	07。00.0' N	129。54.8' E	WSW	5.0	bc	1008.0	29.6	30	26.1	24.9	7	
991022/09	1022/18	06。59.9' N	128。34.5' E	W	2.0	c	1009.0	28.8	30	26.0	25.0	8	
991022/12	1022/21	06。59.8' N	128。19.2' E	W	2.0	q	1010.6	27.8	30	25.2	24.1	8	
991022/15	1023/00	06。59.9' N	128。00.1' E	SW	2.0	c	1011.0	28.4	30	25.2	23.9	7	
991022/18	1023/03	07。00.0' N	127。45.0' E	N	2.0	bc	1009.1	28.3	30	25.3	24.2	7	
991022/21	1023/06	07。00.0' N	127。27.9' E	WNW	1.0	bc	1009.2	28.0	30	25.1	23.9	7	
991023/00	1023/09	06。59.9' N	127。10.0' E	WNW	7.0	c	1010.9	28.6	30	25.3	24.3	7	
991023/03	1023/12	06。59.6' N	126。59.8' E	NW	6.0	bc	1009.5	28.5	30	25.2	23.4	7	
991023/06	1023/15	07。00.3' N	126。44.1' E	NNE	7.0	bc	1007.6	28.5	30	25.6	24.4	7	
991023/09	1023/18	06。55.4' N	126。44.8' E	WSW	6.0	bc	1007.6	28.9	30	26.2	25.0	3	
991023/12	1023/21	06。51.8' N	126。40.3' E	NE	9.0	bc	1009.6	28.5	30	26.0	25.1	3	
991023/15	1024/00	06。49.3' N	126。47.5' E	NNE	10.0	bc	1009.6	28.0	30	25.5	24.6	6	
991023/18	1024/03	06。45.8' N	126。46.8' E	NNW	6.0	r	1008.0	27.2	30	25.2	24.3	8	
991023/21	1024/06	06。48.8' N	126。44.0' E	N	8.0	q	1008.2	27.8	30	25.2	24.3	8	
991024/00	1024/09	N/A N/A N	N/A N/A E	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
991024/03	1024/12	06。48.4' N	126。34.1' E	NNE	9.0	bc	1008.3	30.0	30	25.8	24.6	7	
991024/06	1024/15	06。32.5' N	126。39.0' E	NE	7.0	bc	1006.0	30.0	30	25.5	23.9	6	

Meteo. dataKY9909

UTC	LUT	Lat.	Long.	WD(16)	WF(m/s)	Weather	Atm.P(hPa)	Air T.(.C)	sw TEMP.(.C)	Wet b TEMP.(.C)	Dew p TEMP.(.C)	雲量	***
991024/09	1024/18	06。 20.8' N	126。 44.9' E	NNE	8.0	bc	1006.0	28.8	30	25.5	24.3	5	
991024/12	1024/21	06。 07.0' N	126。 52.5' E	NE	6.0	bc	1008.0	28.6	30	26.4	25.8	5	
991024/15	1025/00	05。 50.0' N	127。 02.5' E	NNE	7.0	c	1008.5	28.4	30	26.0	25.1	8	
991024/18	1025/03	05。 26.8' N	127。 15.0' E	ENE	6.0	q	1007.6	27.9	30	25.4	24.5	9	
991024/21	1025/06	05。 37.3' N	126。 56.5' E	N	4.0	q	1007.0	27.9	30	25.0	23.9	10	
991025/00	1025/09	05。 52.3' N	126。 29.0' E	S	6.0	r	1009.5	26.0	30	25.2	24.3	10	
991025/03	1025/12	06。 06.0' N	126。 00.0' E	NNW	5.0	r	1009.6	25.4	30	25.2	25.0	10	
991025/06	1025/15	05。 37.9' N	126。 13.8' E	SSE	4.0	q	1006.6	27.2	30	24.8	24.1	8	
991025/09	1025/18	05。 08.6' N	126。 29.7' E	SSE	4.0	bc	1006.5	27.0	30	24.6	23.5	7	
991025/12	1025/21	04。 46.8' N	126。 35.4' E	SSW	5.0	c	1008.3	27.6	30	26.2	25.5	8	
991025/15	1026/00	04。 59.6' N	126。 04.5' E	W	5.0	c	1009.1	27.5	30	25.6	24.8	8	
991025/18	1026/03	05。 08.5' N	125。 34.7' E	SE	2.0	b	1007.5	27.0	30	24.8	24.3	2	
991025/21	1026/06	05。 07.1' N	125。 40.1' E	SSW	3.0	bc	1008.6	27.5	30	24.8	23.9	3	
991026/00	1026/09	05。 07.3' N	125。 40.5' E	SE	2.0	bc	1009.5	30.0	30	25.4	22.8	3	
991026/03	1026/12	05。 11.0' N	125。 58.4' E	NW	2.0	bc	1009.6	30.2	30	25.6	23.4	3	
991026/06	1026/15	05。 17.3' N	126。 28.2' E	WNW	4.0	bc	1008.4	29.4	30	25.8	25.2	5	
991026/09	1026/18	05。 23.8' N	126。 59.2' E	NE	4.0	r	1008.2	25.2	30	24.2	23.2	10	
991026/12	1026/21	05。 22.5' N	127。 17.6' E	SE	2.0	o	1009.5	27.2	30	24.7	23.6	9	
991026/15	1027/00	05。 00.7' N	127。 30.0' E	ENE	3.0	q	1010.0	27.0	30	25.2	24.3	9	
991026/18	1027/03	04。 41.0' N	127。 40.5' E	NE	1.0	c	1009.6	27.4	30	25.4	24.7	8	
991026/21	1027/06	04。 24.5' N	127。 49.7' E	W	2.0	bc	1008.4	27.3	30	26.6	26.2	4	
991027/00	1027/09	04。 06.0' N	127。 59.8' E	SSE	1.0	b	1009.0	30.0	30	26.0	25.3	3	
991027/03	1027/12	03。 41.9' N	128。 13.3' E	NNW	2.0	q	1009.9	29.0	30	26.2	25.0	10	
991027/06	1027/15	03。 17.5' N	128。 26.8' E	SE	6.0	r	1008.5	25.6	30	24.0	23.4	10	
991027/09	1027/18	02。 59.2' N	128。 37.1' E	SSW	3.0	o	1008.6	26.2	30	24.2	23.4	10	
991027/12	1027/21	02。 42.9' N	128。 46.3' E	W	7.0	o	1010.3	26.9	30	25.0	24.3	10	
991027/15	1028/00	02。 18.6' N	129。 00.0' E	WSW	2.0	q	1011.1	26.0	30	24.0	23.2	10	
991027/18	1028/03	02。 03.2' N	129。 08.2' E	W	3.0	q	1009.0	26.0	30	23.8	23.2	10	
991027/21	1028/06	01。 48.7' N	129。 16.2' E	WSW	4.0	q	1008.6	27.2	30	24.6	23.6	9	
991028/00	1028/09	01。 24.1' N	129。 29.7' E	NW	2.0	c	1009.7	29.2	30	25.0	23.5	9	
991028/03	1028/12	01。 00.3' N	129。 43.2' E	SSW	1.0	c	1009.1	29.8	30	26.0	24.6	8	
991028/06	1028/15	00。 45.8' N	129。 59.2' E	NNE	5.0	r	1007.4	27.0	30	25.3	24.7	9	
991028/09	1028/18	01。 00.0' N	129。 59.8' E	S	2.0	c	1007.5	28.4	30	24.8	23.7	8	
991028/12	1028/21	01。 20.2' N	129。 59.8' E	NW	2.0	bc	1009.0	28.5	30	25.5	24.4	4	
991028/15	1029/00	01。 38.7' N	129。 59.9' E	WNW	2.0	c	1009.5	28.5	30	25.0	23.7	8	

Meteo. dataKY9909

UTC	LUT	Lat.	Long.	WD(16)	WF(m/s)	Weather	Atm.P(hPa)	Air T.(.C)	sw TEMP.(.C)	Wet b TEMP.(.C)	Dew p TEMP.(.C)	雲量	•••
991028/18	1029/03	01。51.8' N	130。00.0' E	SSE	2.0	bc	1008.0	28.2	30	24.6	23.4	7	
991028/21	1029/06	01。58.6' N	130。01.6' E	SSW	2.0	bc	1008.2	28.2	30	24.5	23.2	7	
991029/00	1029/09	02。02.7' N	129。58.1' E	E	3.0	bc	1010.0	29.0	30	25.0	23.5	5	
991029/03	1029/12	02。16.7' N	130。00.8' E	NNE	2.0	bc	1009.0	30.0	30	25.5	23.9	5	
991029/06	1029/15	02。30.0' N	129。59.9' E	NW	3.0	bc	1006.6	31.0	30	25.8	24.3	2	
991029/09	1029/18	02。58.0' N	130。00.0' E	W	5.0	bc	1008.2	27.1	30	24.9	24.2	2	
991029/12	1029/21	03。18.1' N	129。59.9' E	NW	5.0	b	1009.0	28.0	30	25.2	23.9	1	
991029/15	1030/00	03。37.9' N	130。00.0' E	NW	4.0	bc	1009.1	27.5	30	25.0	24.1	5	
991029/18	1030/03	03。59.9' N	130。00.1' E	SSW	4.0	b	1007.2	27.4	30	24.4	23.4	1	
991029/21	1030/06	04。27.4' N	130。00.0' E	WSW	3.0	bc	1007.5	28.0	30	25.0	23.2	4	
991030/00	1030/09	04。45.7' N	130。00.9' E	NNE	2.0	bc	1009.7	29.2	30	25.0	23.5	3	
991030/03	1030/12	04。55.8' N	130。02.7' E	SE	4.0	bc	1009.0	30.5	30	25.3	23.4	4	
991030/06	1030/15	05。00.1' N	130。01.7' E	ENE	3.0	bc	1006.6	29.7	30	25.2	24.3	5	
991030/09	1030/18	05。04.9' N	129。57.3' E	NNE	5.0	r	1008.0	26.2	30	24.8	24.6	10	
991030/12	1030/21	05。29.9' N	130。00.0' E	S	5.0	r	1009.6	26.6	30	25.3	25.0	10	
991030/15	1031/00	05。53.9' N	130。00.0' E	ENE	5.0	bc	1009.2	27.0	30	25.0	24.3	3	
991030/18	1031/03	06。12.4' N	130。00.0' E	ENE	1.0	bc	1007.7	27.5	30	25.0	24.1	7	
991030/21	1031/06	06。31.2' N	130。00.2' E	SE	4.0	bc	1008.3	27.8	30	25.6	24.6	5	
991031/00	1031/09	06。59.9' N	130。00.1' E	E	5.0	bc	1009.8	28.0	30	26.0	25.3	4	
991031/03	1031/12	07。16.1' N	129。59.8' E	NE	6.0	q	1008.8	26.8	30	25.2	24.5	9	
991031/06	1031/15	07。38.6' N	129。59.8' E	NNW	4.0	c	1007.0	28.0	30	25.4	24.6	8	
991031/09	1031/18	08。00.2' N	130。00.1' E	N	2.0	c	1007.6	27.3	30	25.5	N/A	8	
991031/12	1031/21	07。38.0' N	129。41.7' E	WNW	4.0	bc	1009.1	27.8	30	25.6	24.6	3	
991031/15	1101/00	07。29.6' N	129。27.2' E	W	6.0	bc	1009.3	27.0	30	25.0	24.3	2	
991031/18	1101/03	07。00.0' N	129。10.0' E	WNW	8.0	bc	1007.5	28.0	30	25.2	23.9	4	
991031/21	1101/06	06。41.8' N	128。55.2' E	WNW	7.0	q	1007.7	27.8	30	25.2	24.1	8	
991101/00	1101/09	06。29.1' N	128。44.1' E	WNW	7.0	r	1009.6	26.8	30	25.8	25.7	10	
991101/03	1101/12	06。05.9' N	128。24.9' E	NNE	11.0	r	1009.6	24.8	30	24.5	24.4	10	
991101/06	1101/15	05。52.3' N	128。13.7' E	NNW	12.0	r	1006.7	26.3	30	25.3	25.0	10	
991101/09	1101/18	05。30.0' N	127。54.9' E	N	11.0	q	1006.5	26.6	30	25.0	24.5	10	
991101/12	1101/21	05。23.0' N	127。48.2' E	NNW	9.0	q	1009.0	28.0	30	25.4	23.6	10	
991101/15	1102/00	05。09.8' N	127。38.0' E	NNW	3.0	q	1009.0	26.2	30	23.2	21.8	10	
991101/18	1102/03	04。56.9' N	127。27.7' E	NNW	15.0	r	1006.8	25.5	30	24.5	24.1	N/A	
991101/21	1102/06	04。48.5' N	127。22.1' E	N	4.0	r	1007.3	26.5	29	24.9	24.5	10	
991102/00	1102/09	05。00.9' N	127。37.8' E	NNW	7.0	r	1008.5	26.0	30	25.0	24.8	10	

Meteo. dataKY9909

UTC	LUT	Lat.	Long.	WD(16)	WF(m/s)	Weather	Atm.P(hPa)	Air T.(.C)	sw TEMP.(.C)	Wet b TEMP.(.C)	Dew p TEMP.(.C)	雲量	•••
991110/03	1110/12	00。 13.4' N	135。 03.5' E	NE	3.0	c	1009.0	29.5	30	25.5	24.1	7	
991110/06	1110/15	00。 34.4' N	135。 26.2' E	ESE	5.0	c	1007.6	29.5	30	27.7	26.9	9	
991110/09	1110/18	00。 56.0' N	135。 49.6' E	W	9.0	r	1010.0	25.2	30	24.2	23.6	10	
991110/12	1110/21	01。 18.8' N	136。 14.2' E	WNW	7.0	q	1011.0	25.4	30	24.4	24.0	10	
991110/15	1111/00	01。 42.8' N	136。 39.9' E	NW	1.0	q	1010.6	26.0	30	25.0	24.6	10	
991110/18	1111/03	02。 03.3' N	137。 01.5' E	W	2.5	q	1008.0	27.3	30	24.5	23.4	10	
991110/21	1111/06	02。 23.5' N	137。 26.3' E	SSW	7.2	c	1008.2	28.2	30	24.5	23.6	7	
991111/00	1111/09	02。 24.4' N	137。 29.1' E	S	6.0	bc	1009.5	30.0	30	27.0	26.5	5	
991111/03	1111/12	02。 23.7' N	137。 29.4' E	SSW	7.0	bc	1008.5	31.5	30	25.5	23.3	6	
991111/06	1111/15	02。 08.4' N	137。 55.8' E	SSE	5.0	bc	1006.9	30.1	30	28.5	28.1	4	
991111/09	1111/18	01。 57.0' N	138。 03.4' E	S	3.7	bc	1007.5	29.0	30	25.0	22.5	4	
991111/12	1111/21	01。 23.8' N	137。 59.9' E	S	3.3	bc	1009.1	28.0	30	26.0	25.3	4	
991111/15	1112/00	00。 47.9' N	138。 00.1' E	SE	5.1	q	1008.6	27.2	30	26.2	25.6	10	
991111/18	1112/03	00。 22.1' N	138。 00.9' E	ESE	5.0	q	1008.0	28.2	30	25.4	24.6	10	
991111/21	1112/06	00。 04.4' N	138。 02.8' E	ENE	2.7	bc	1008.0	28.2	30	25.2	23.9	5	
991112/00	1112/09	00。 01.4' S	138。 01.4' E	SE	3.0	bc	1010.0	30.0	30	26.0	24.6	7	
991112/03	1112/12	00。 01.5' S	138。 00.8' E	S	5.0	bc	1008.5	30.8	30	26.8	25.5	7	
991112/06	1112/15	00。 01.4' N	138。 02.1' E	ESE	0.2	bc	1007.0	30.5	30	26.5	25.2	6	
991112/09	1112/18	00。 22.7' S	138。 00.2' E	SE	1.2	bc	1007.5	29.0	30	24.8	23.5	5	
991112/12	1112/21	00。 55.9' S	137。 59.9' E	SE	1.6	bc	1009.0	28.2	30	26.2	25.4	5	
991112/15	1113/00	01。 08.2' S	138。 05.3' E	SSE	6.8	c	1009.4	26.0	30	25.0	24.6	8	
991112/18	1113/03	00。 44.9' S	138。 24.2' E	NE	5.2	bc	1007.7	28.3	30	25.4	24.3	4	
991112/21	1113/06	00。 22.3' S	138。 41.6' E	E	7.0	bc	1009.0	28.5	30	25.4	24.3	3	
991113/00	1113/09	00。 00.2' S	138。 59.8' E	E	7.0	bc	1009.8	29.6	30	25.8	24.5	4	
991113/03	1113/12	00。 00.1' N	139。 28.9' E	E	6.5	bc	1009.0	30.5	30	24.4	26.0	3	
991113/06	1113/15	00。 00.0' S	139。 57.1' E	ENE	6.9	bc	1006.7	29.5	30	25.8	24.5	5	
991113/09	1113/18	00。 00.1' N	140。 23.2' E	NE	5.8	bc	1007.9	29.0	30	25.6	24.4	3	
991113/12	1113/21	00。 00.3' N	140。 40.5' E	NE	6.5	bc	1009.1	29.0	30	25.0	23.5	2	
991113/15	1114/00	00。 00.0' N	140。 58.7' E	NE	5.9	bc	1009.1	28.5	30	25.5	24.4	2	
991113/18	1114/03	00。 00.1' N	141。 16.5' E	E	9.1	c	1007.8	26.6	30	25.2	24.7	7	
991113/21	1114/06	00。 00.1' S	141。 34.8' E	N	6.2	q	1009.8	26.0	30	24.5	24.0	9	
991114/00	1114/09	00。 00.0' N	141。 54.9' E	N	9.2	bc	1011.2	27.6	30	25.0	24.1	6	
991114/03	1114/12	00。 18.7' S	141。 59.9' E	N	8.0	bc	1009.6	31.0	30	26.5	25.0	6	
991114/06	1114/15	00。 42.9' S	141。 59.8' E	N	7.0	bc	1007.7	28.5	30	25.3	24.1	6	
991114/09	1114/18	01。 09.1' S	142。 00.0' E	N	4.5	q	1009.4	29.0	30	25.8	24.8	7	

Meteo. dataKY9909

UTC	LUT	Lat.	Long.	WD(16)	WF(m/s)	Weather	Atm.P(hPa)	Air T.(.C)	sw TEMP.(.C)	Wet b TEMP.(.C)	Dew p TEMP.(.C)	雲量	•••
991102/03	1102/12	05。00.0' N	128。00.2' E	NNW	4.0	r	1007.5	26.4	30	25.0	24.5	10	
991102/06	1102/15	05。00.0' N	128。22.8' E	WNW	2.5	q	1005.1	27.8	30	25.2	24.1	8	
991102/09	1102/18	04。59.9' N	128。44.5' E	W	1.0	bc	1006.0	27.3	30	23.8	22.5	3	
991102/12	1102/21	05。00.1' N	129。03.6' E	S	1.5	bc	1007.6	27.2	30	24.0	22.9	3	
991102/15	1103/00	04。59.9' N	129。29.9' E	SSW	6.0	bc	1007.0	27.1	30	24.2	23.1	1	
991102/18	1103/03	05。00.0' N	129。56.7' E	SSW	4.5	bc	1005.2	27.8	30	24.2	22.7	2	
991102/21	1103/06	04。59.7' N	130。00.0' E	SW	5.0	bc	1006.0	28.0	30	25.2	23.9	5	
991103/00	1103/09	05。00.1' N	130。01.0' E	WSW	4.0	bc	1008.3	28.0	30	25.5	24.6	6	
991103/03	1103/12	05。07.5' N	130。15.1' E	WSW	3.0	c	1006.7	29.0	30	26.6	25.7	9	
991103/06	1103/15	05。17.3' N	130。34.6' E	WSW	1.5	c	1005.2	31.0	30	27.2	25.7	8	
991103/09	1103/18	05。28.3' N	130。58.2' E	SSE	5.3	bc	1005.7	29.4	30	25.8	24.6	4	
991103/12	1103/21	05。38.8' N	131。17.6' E	SW	3.6	bc	1008.2	28.2	30	25.2	24.1	4	
991103/15	1104/00	05。49.4' N	131。39.1' E	WNW	1.7	bc	1007.0	28.5	30	25.8	25.3	4	
991103/18	1104/03	06。00.9' N	132。01.7' E	NW	4.0	bc	1005.5	28.4	30	26.0	25.1	4	
991103/21	1104/06	06。11.5' N	132。22.5' E	NW	2.5	bc	1006.0	27.2	30	26.2	25.7	3	
991104/00	1104/09	06。20.1' N	132。40.0' E	NW	4.0	b	1007.6	28.6	30	25.8	25.0	1	
991104/03	1104/12	06。28.1' N	132。56.2' E	NW	3.5	bc	1007.1	29.2	30	25.8	25.8	3	
991104/06	1104/15	06。37.2' N	133。14.4' E	NW	6.3	bc	1005.0	29.0	31	26.0	26.0	3	
991104/09	1104/18	06。47.2' N	133。33.6' E	NW	5.8	bc	1006.5	29.0	31	26.0	26.0	3	
Palau Arrival													
Palau Departure													
991108/09	1108/18	06。58.0' N	134。40.7' E	SSW	13.0	c	1005.0	29.0	30	26.5	25.3	7	
991108/12	1108/21	06。49.9' N	135。00.2' E	SSW	11.5	c	1007.0	28.9	30	26.9	26.3	7	
991108/15	1109/00	06。24.3' N	135。00.0' E	SSW	16.0	bc	1007.2	27.6	30	26.1	25.6	6	
991108/18	1109/03	05。58.8' N	135。00.0' E	SSW	13.0	q	1004.6	28.0	30	25.8	25.5	8	
991108/21	1109/06	05。32.0' N	135。00.0' E	SSW	12.0	q	1006.0	28.8	30	26.6	25.9	8	
991109/00	1109/09	04。58.6' N	135。00.7' E	SSE	12.2	q	1008.2	27.1	30	25.7	25.2	10	
991109/03	1109/12	04。28.4' N	135。00.1' E	W	11.7	q	1007.8	26.4	29	25.3	24.9	10	
991109/06	1109/15	03。55.7' N	134。59.7' E	W	7.5	q	1007.2	27.0	29	26.2	25.9	10	
991109/09	1109/18	03。22.2' N	135。00.0' E	W	10.5	q	1007.7	25.8	30	24.2	23.6	10	
991109/12	1109/21	02。46.8' N	135。00.0' E	WNW	4.0	q	1009.7	27.3	30	24.7	23.8	10	
991109/15	1110/00	02。12.9' N	135。00.3' E	WNW	7.2	c	1010.1	27.0	30	25.1	24.4	8	
991109/18	1110/03	01。38.3' N	134。59.9' E	NE	4.0	c	1008.1	28.1	30	25.5	24.6	10	
991109/21	1110/06	01。03.2' N	134。59.7' E	NE	3.0	bc	1009.6	28.5	30	25.2	23.9	6	
991110/00	1110/09	00。34.1' N	134。59.6' E	S	1.5	bc	1010.5	31.0	30	27.0	25.7	7	

Meteo. dataKY9909

UTC	LUT	Lat.	Long.	WD(16)	WF(m/s)	Weather	Atm.P(hPa)	Air T.(.C)	sw TEMP.(.C)	Wet b TEMP.(.C)	Dew p TEMP.(.C)	雲量	***
991114/12	1114/21	01。38.9' S	141。59.8' E	SW	6.3	bc	1011.3	27.0	30	25.0	24.3	7	
991114/15	1115/00	02。06.9' S	141。59.5' E	W	5.8	bc	1011.6	27.0	30	25.0	24.3	6	
991114/18	1115/03	02。31.2' S	142。00.0' E	WSW	3.2	bc	1009.1	27.2	30	25.1	24.4	4	
991114/21	1115/06	02。28.2' S	141。58.3' E	NW	3.9	c	1010.4	26.8	30	25.6	25.1	8	
991115/00	1115/09	02。28.4' S	141。59.2' E	S	2.5	bc	1010.6	31.2	30	27.0	25.7	6	
991115/03	1115/12	02。27.1' S	141。59.7' E	W	2.5	bc	1009.0	30.0	30	25.8	24.3	6	
991115/06	1115/15	02。02.1' S	142。09.4' E	NW	3.8	c	1007.3	30.6	30	25.7	23.9	8	
991115/09	1115/18	01。35.4' S	142。20.4' E	NNW	4.5	q	1008.4	28.8	30	25.6	24.4	8	
991115/12	1115/21	01。09.3' S	142。31.3' E	N	4.1	bc	1010.2	28.5	30	25.0	23.7	2	
991115/15	1116/00	00。44.1' S	142。41.6' E	N	5.7	bc	1009.7	28.4	30	25.0	23.7	2	
991115/18	1116/03	00。11.1' S	142。55.5' E	N	3.0	bc	1008.8	27.2	30	26.2	25.8	3	
991115/21	1116/06	00。00.2' N	143。10.5' E	NNE	3.0	bc	1009.5	28.1	30	25.1	23.9	4	
991116/00	1116/09	00。00.1' S	143。35.4' E	ENE	4.5	bc	1011.0	29.0	30	25.2	23.5	4	
991116/03	1116/12	00。00.0' S	144。06.0' E	ENE	2.3	bc	1009.5	29.5	30	25.2	23.5	4	
991116/06	1116/15	00。00.1' N	144。40.5' E	ENE	4.7	bc	1011.0	31.5	N/A	26.0	24.4	4	
991116/09	1116/18	00。00.2' N	145。09.4' E	NE	4.0	bc	1008.8	28.7	30	26.4	25.8	3	
991116/12	1116/21	00。00.1' S	145。44.8' E	NNE	6.0	bc	1010.0	29.0	30	25.0	23.2	5	
991116/15	1117/01	00。00.7' S	146。16.2' E	NNE	5.5	bc	1009.5	28.5	30	25.0	23.7	4	LUT=UTC+10h
991116/18	1117/04	00。01.6' N	146。45.8' E	N	7.4	bc	1007.7	28.0	30	25.0	23.9	4	
991116/21	1117/07	00。00.3' S	146。04.5' E	N	8.0	bc	1009.0	28.4	30	24.6	23.0	4	
991117/00	1117/10	00。00.6' S	147。03.6' E	N	5.0	bc	1010.0	30.0	30	25.0	23.2	5	
991117/03	1117/13	00。12.5' S	147。03.0' E	NNE	1.9	bc	1009.6	31.0	30	26.0	24.3	6	
991117/06	1117/16	00。43.8' S	147。00.1' E	NW	2.1	bc	1007.6	30.5	30	26.5	25.2	8	
991117/09	1117/19	01。12.4' S	146。59.9' E	WSW	4.0	bc	1009.6	28.2	30	24.7	23.2	6	
991117/12	1117/22	01。13.9' S	146。59.5' E	WNW	5.0	bc	1010.5	28.5	30	24.5	23.0	5	
991117/15	1118/01	00。43.2' S	146。58.6' E	NW	5.1	b	1008.6	28.0	30	25.0	23.9	2	
991117/18	1118/04	00。12.1' S	146。58.2' E	NNW	3.7	bc	1007.8	28.5	30	25.5	24.4	4	
991117/21	1118/07	00。01.3' N	146。55.7' E	WSW	2.0	bc	1008.6	27.8	30	25.8	25.3	7	
991118/00	1118/10	00。01.1' N	146。55.6' E	WSW	5.0	bc	1009.7	30.0	30	26.0	24.6	4	
991118/03	1118/13	00。09.3' N	147。00.4' E	W	5.1	bc	1007.3	31.0	30	25.0	22.8	4	
991118/06	1118/16	00。34.9' N	146。59.3' E	W	5.3	bc	1005.8	30.0	30	26.0	24.6	5	
991118/09	1118/19	00。57.7' N	147。00.1' E	W	3.5	b	1007.3	26.8	30	24.3	23.6	2	
991118/12	1118/22	01。20.5' N	146。59.6' E	WSW	1.8	b	1008.5	28.5	30	24.8	23.7	2	
991118/15	1119/01	01。41.0' N	147。00.0' E	W	4.5	bc	1008.0	28.2	30	24.8	23.5	3	
991118/18	1119/04	02。03.0' N	146。59.4' E	W	7.0	b	1007.1	28.0	30	25.0	23.9	2	

Meteo. dataKY9909

UTC	LUT	Lat.	Long.	WD(16)	WF(m/s)	Weather	Atm.P(hPa)	Air T.(.C)	sw TEMP.(.C)	Wet b TEMP.(.C)	Dew p TEMP.(.C)	雲量	***
991118/21	1119/07	02。25.9' N	146。59.8' E	NW	7.8	bc	1008.5	27.1	30	24.1	23.0	3	
991119/00	1119/10	02。47.7' N	146。59.8' E	W	5.3	bc	1009.4	28.8	30	25.2	23.6	3	
991119/03	1119/13	03。10.1' N	147。01.0' E	W	4.3	bc	1007.3	31.0	30	25.8	23.9	2	
991119/06	1119/16	03。30.6' N	146。59.5' E	WSW	5.0	bc	1005.7	30.5	30	25.5	23.7	2	
991119/09	1119/19	03。51.5' N	147。00.4' E	WSW	4.1	bc	1007.2	28.6	30	24.7	23.2	2	
991119/12	1119/22	04。11.8' N	147。00.3' E	SW	4.0	bc	1008.8	28.8	30	25.0	23.6	3	
991119/15	1120/01	04。32.2' N	146。59.9' E	SW	6.1	bc	1007.6	28.2	30	24.8	23.5	1	
991119/18	1120/04	04。53.8' N	147。00.3' E	SW	6.0	bc	1006.0	28.0	30	25.0	23.9	1	
991119/21	1120/07	04。58.5' N	147。00.6' E	SW	6.5	bc	1008.1	29.0	30	24.8	23.3	3	
991120/00	1120/10	04。55.1' N	147。00.9' E	SW	6.5	bc	1008.5	30.0	30	25.0	23.2	3	
991120/03	1120/13	05。00.2' N	146。58.5' E	SSW	5.8	bc	1006.7	31.0	30	25.0	22.8	1	
991120/06	1120/16	04。37.2' N	147。10.2' E	SW	7.6	bc	1005.6	30.0	30	25.2	23.5	1	
991120/09	1120/19	04。12.7' N	147。22.1' E	SSW	6.2	bc	1007.6	28.6	30	25.1	23.8	5	
991120/12	1120/22	03。45.9' N	147。34.9' E	S	5.1	bc	1009.2	28.6	30	25.5	24.4	4	
991120/15	1121/01	03。20.9' N	147。47.2' E	SSE	3.0	bc	1007.6	27.8	30	25.3	24.4	1	
991120/18	1121/04	02。57.2' N	147。58.1' E	SSE	4.5	c	1007.0	25.7	30	24.4	23.9	8	
991120/21	1121/07	02。34.8' N	148。09.1' E	SSE	6.9	c	1008.7	26.8	30	25.0	24.4	9	
991121/00	1121/10	02。08.3' N	148。21.7' E	S	1.7	bc	1010.3	29.2	30	25.8	24.7	4	
991121/03	1121/13	01。41.2' N	148。34.9' E	ENE	6.5	r	1008.5	25.8	30	24.6	24.2	9	
991121/06	1121/16	01。16.7' N	148。46.3' E	calm	0.0	c	1006.5	28.0	30	24.2	22.8	8	
991121/09	1121/19	00。59.2' N	148。56.1' E	ESE	1.8	c	1009.1	27.5	30	24.5	23.4	9	
991121/12	1121/22	00。39.8' N	149。05.0' E	W	11.2	q	1010.3	26.4	30	25.4	25.2	10	
991121/15	1122/01	00。20.2' N	149。14.5' E	W	5.5	q	1009.0	26.5	30	25.2	24.6	9	
991121/18	1122/04	00。00.3' S	149。24.8' E	W	6.0	c	1008.0	27.5	30	25.0	24.1	7	
991121/21	1122/07	00。20.6' S	149。34.0' E	NNE	3.2	r	1009.5	25.0	30	24.0	23.6	10	
991122/00	1122/10	00。40.4' S	149。44.2' E	WNW	3.0	q	1011.3	26.9	30	24.9	24.3	10	
991122/03	1122/13	01。02.0' S	149。54.2' E	ENE	3.2	r	1009.5	26.5	30	25.0	24.5	10	

Kavieng Arrival

10. XCTD performance test

10. XCTD performance test

In order to check performance XCTD, we deployed 13 XCTDs (wire of one XCTD was cut during measurement) during CTD cast at 2-24N, 137-29E, where is ATLAS buoy location. This test was conducted just after ATLAS buoy recovery on Nov. 11. Comparing CTD and XCTD parameters at the same time and same depth, its operation was as follows:

1. CTD was lowered until 1000 m and stopped at that depth.
2. A XCTD was deployed.
3. CTD data at 1000m depth was sampled by firing a bottle just XCTD passed 1000m depth.
4. CTD was come up until 800m.
5. Next XCTD was deployed.
6. Same as 3 except at 800m depth.
7. Repeat the processes 4 – 6 at the depth of 700, 600, 500, 400, 300, 250, 200, 150, 100 and 50m depth

Result from above operation is shown Table 1 and Figures 1, 2 and 3. Following results are derived from these table and figures:

1) XCTD temperature is roughly 0.01 degree higher than that of CTD (Figure 10-1-a). Positive temperature offset of 0.01 degree for CTD temperature is seen in XCTD temperature. However, XCTD conductivity is lower (<0.02 mS/cm) than that of CTD except at 1000m. Because contribution for conductivity difference is larger than that for temperature difference, XCTD salinity is lower than that of CTD (<0.02PSU).
2) Standard deviations of XCTD temperature, conductivity and salinity derived from 13 profiles are larger than temperature, conductivity and salinity differences between CTD and XCTD values (Figure 10-2). Therefore, those differences seem to be larger than ocean variability estimated from 13 XCTD profiles during this experiment. This result means that offset of XCTD values for CTD values is not due to ocean variability.
3) Salinity profiles of 13 XCTDs average and CTD show that its peaks (maximum/minimum) of XCTD above 200m are below that of CTD, but not below 200m (Figure 10-3). This might be derived from error of the equation of the XCTD depth.

Table 1.

	CTD			XCTD		
depth (m)	T ITS90	S PSS-78	C mS/cm	T ITS90	S PSS-78	C mS/cm
995.0	4.467	34.559	33.043	4.480	34.563	33.045
799.0	4.872	34.546	33.308	4.886	34.529	33.293
708.0	5.929	34.544	34.216	5.941	34.523	34.191
599.0	7.924	34.597	36.035	7.946	34.545	35.994
495.0	8.321	34.627	36.383	8.334	34.593	36.347
396.0	9.234	34.698	37.256	9.254	34.680	37.234
299.0	11.133	34.544	38.843	10.724	34.478	38.387
244.0	13.878	34.651	41.553	13.912	34.613	41.520
204.0	18.710	35.443	47.228	18.725	35.403	47.163
150.0	21.744	34.797	49.507	21.665	34.729	49.258
101.0	29.590	34.885	57.793	29.598	34.861	57.729
50.0	29.465	33.835	56.095	29.472	33.786	56.001

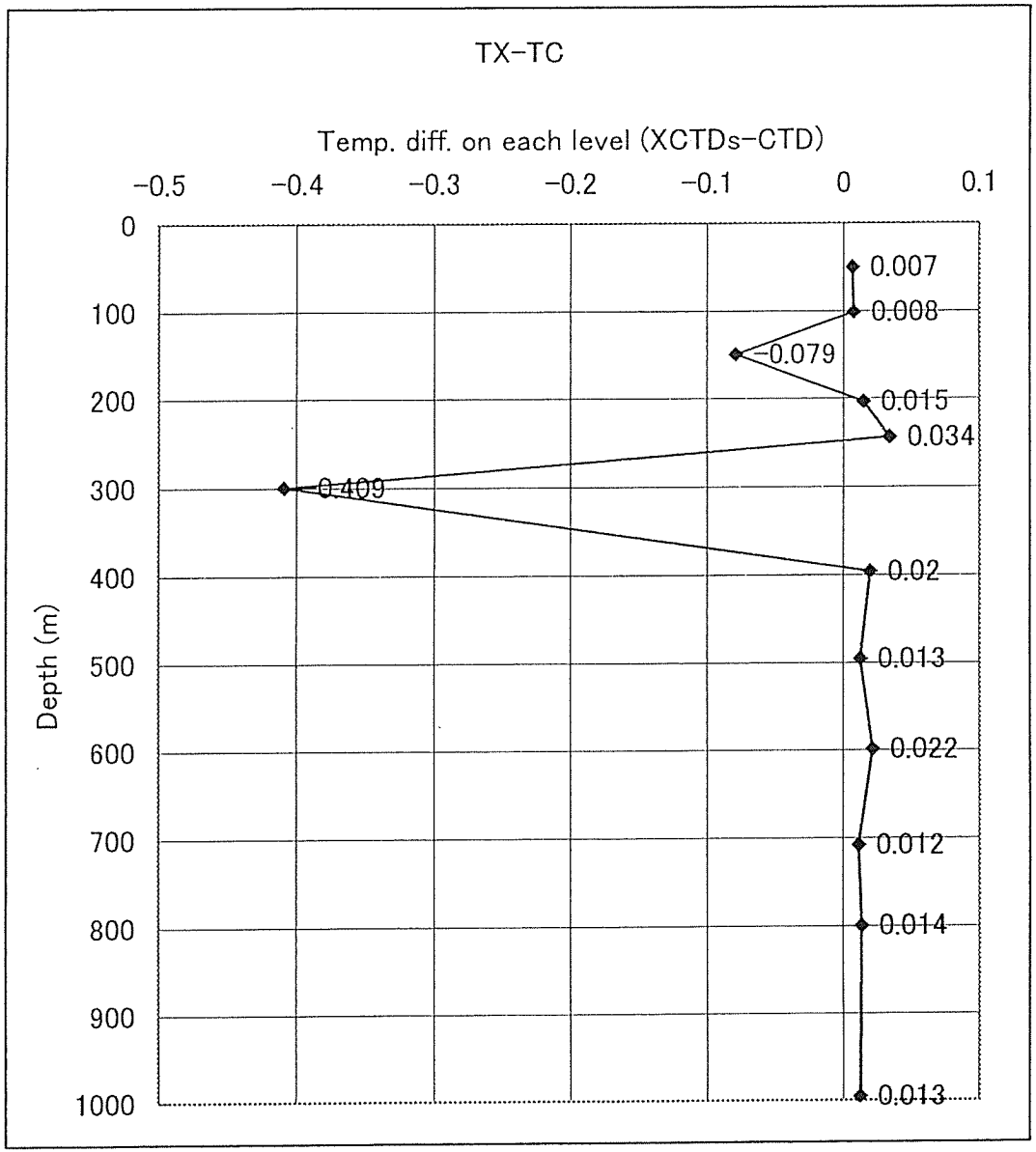

TX-TC
Temp. diff. on each level (XCTDs-CTD)
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000
0.007
0.008
-0.079
0.015
0.034
-0.409
0.02
0.013
0.022
0.012
0.014
0.013

Fig. 10-1-a

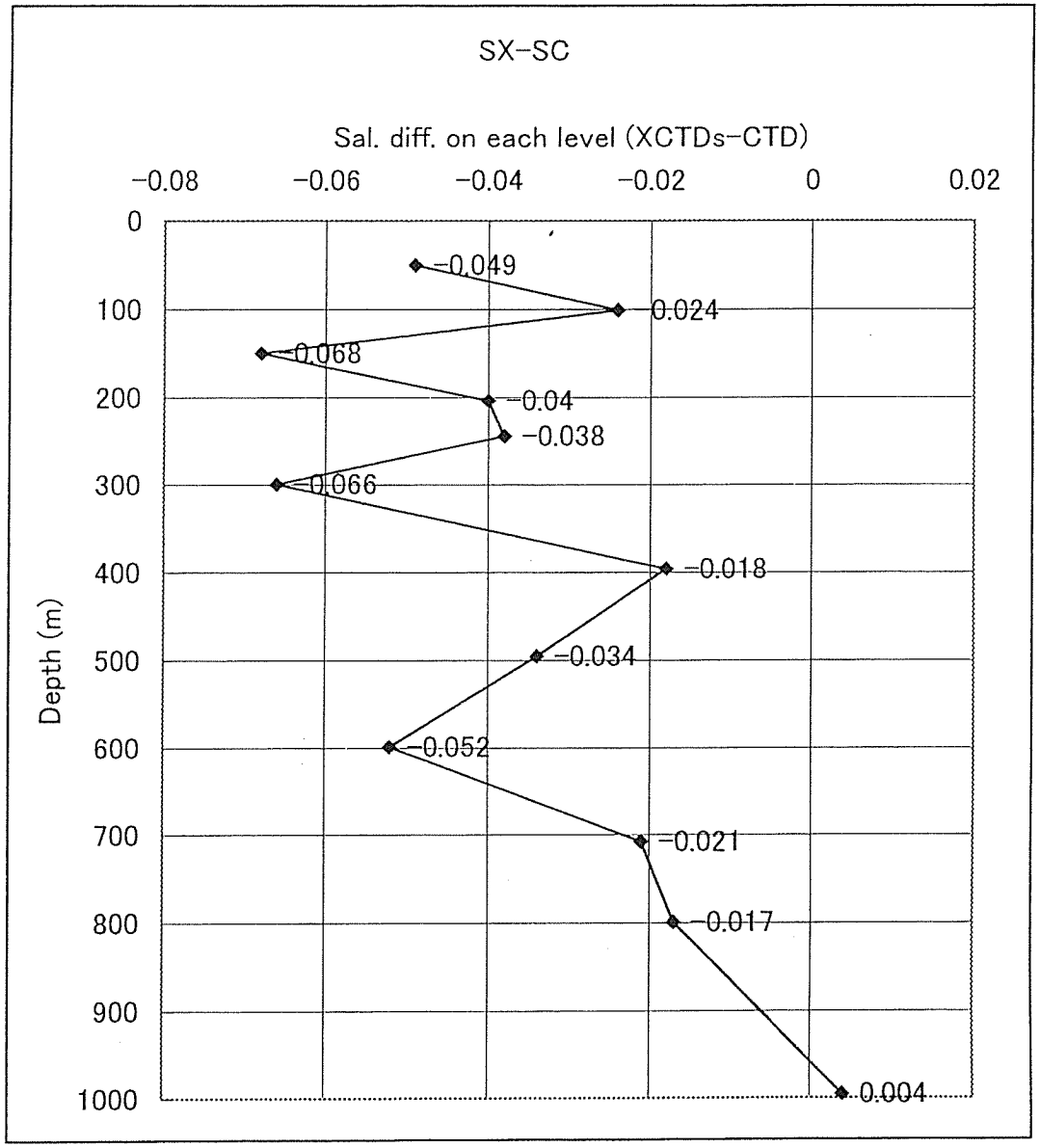

SX-SC
Sal. diff. on each level (XCTDs-CTD)
-0.08
-0.06
-0.04
-0.02
0
0.02
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000
-0.049
0.024
-0.068
-0.04
-0.038
-0.066
-0.018
-0.034
-0.052
-0.021
-0.017
0.004

Fig. 10-1-b

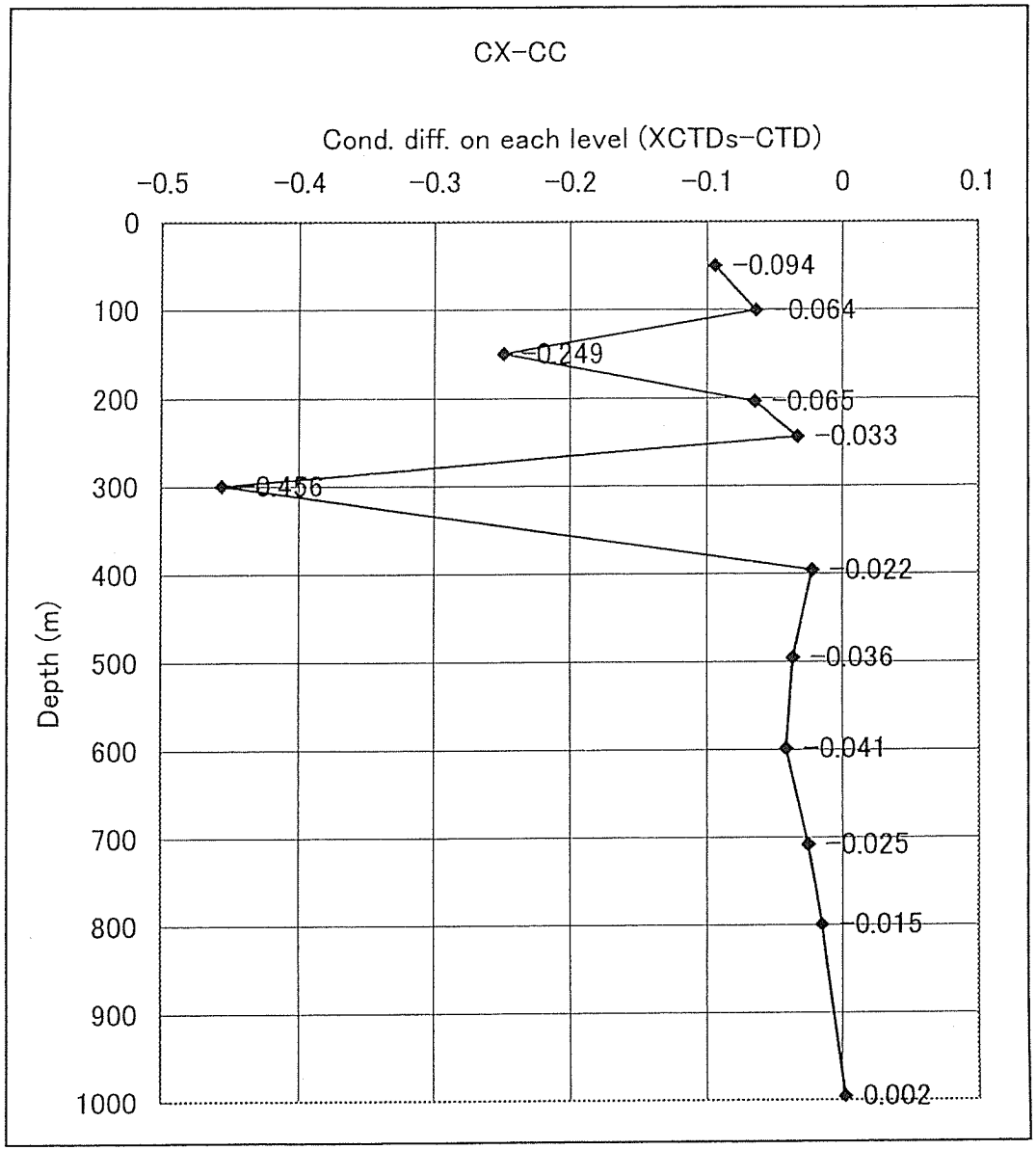

CX-CC
Cond. diff. on each level (XCTDs-CTD)
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0
100
200
300
400
500
600
700
800
900
1000
Depth (m)
-0.094
0.064
-0.249
-0.065
-0.033
-0.456
-0.022
-0.036
-0.041
-0.025
-0.015
0.002

Fig. 10-1-c

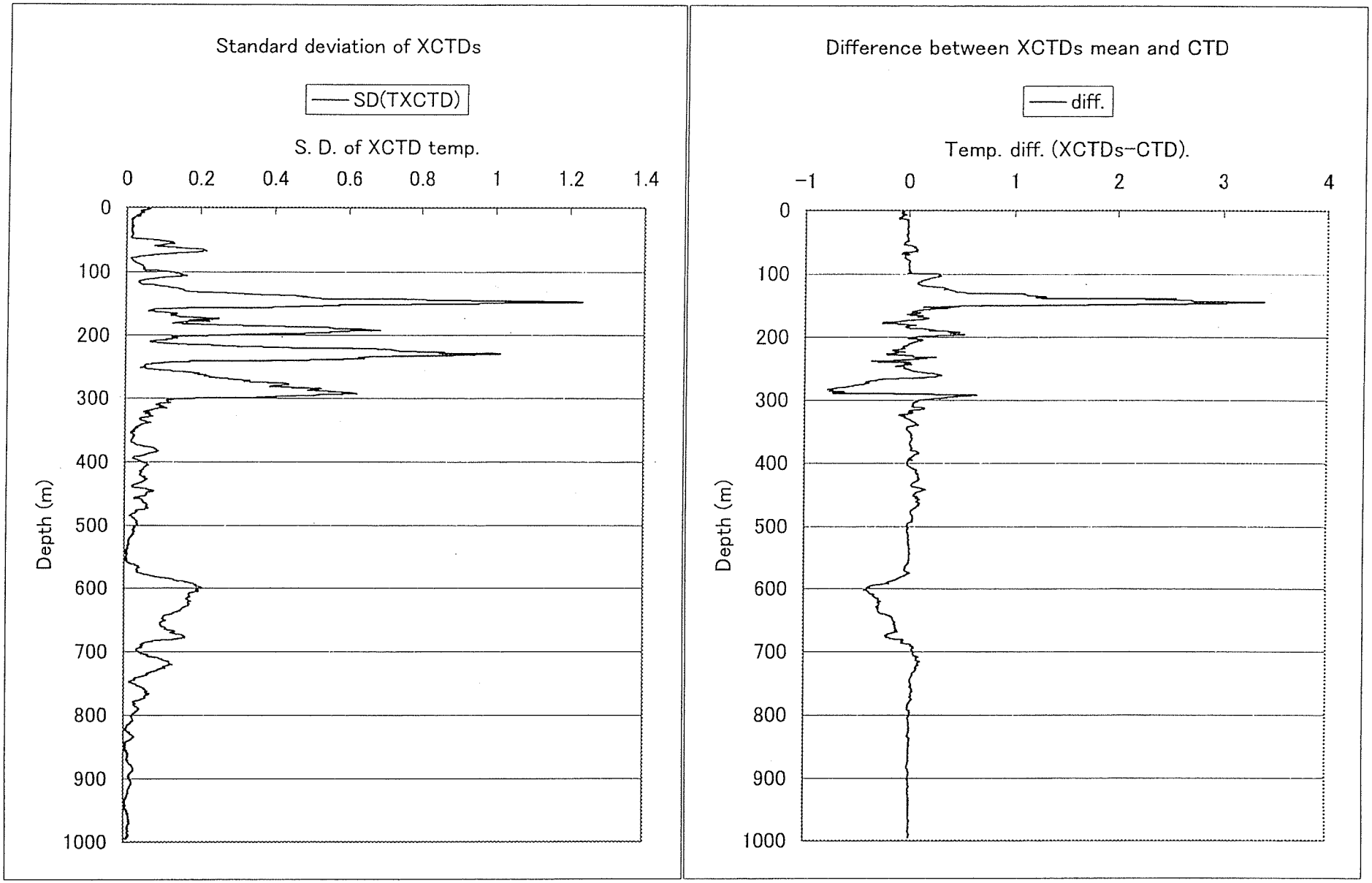

Standard deviation of XCTDs
SD(TXCTD)
S. D. of XCTD temp.
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000
Difference between XCTDs mean and CTD
diff.
Temp. diff. (XCTDs-CTD).
−1
0
1
2
3
4
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000

Fig. 10-2-a

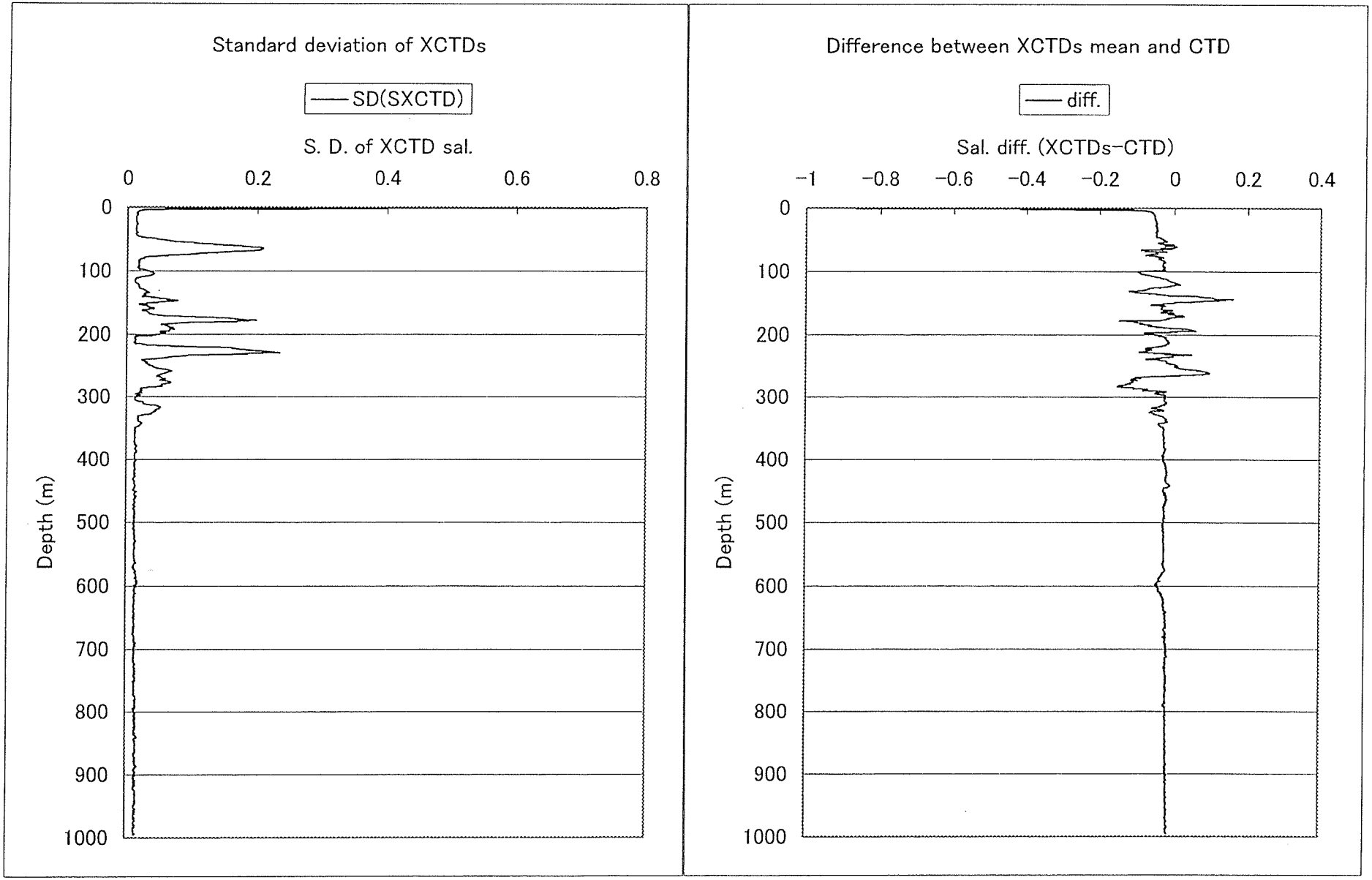

Standard deviation of XCTDs
SD(SXCTD)
S. D. of XCTD sal.
0
0.2
0.4
0.6
0.8
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000
Difference between XCTDs mean and CTD
diff.
Sal. diff. (XCTDs−CTD)
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4

Fig. 10-2-b

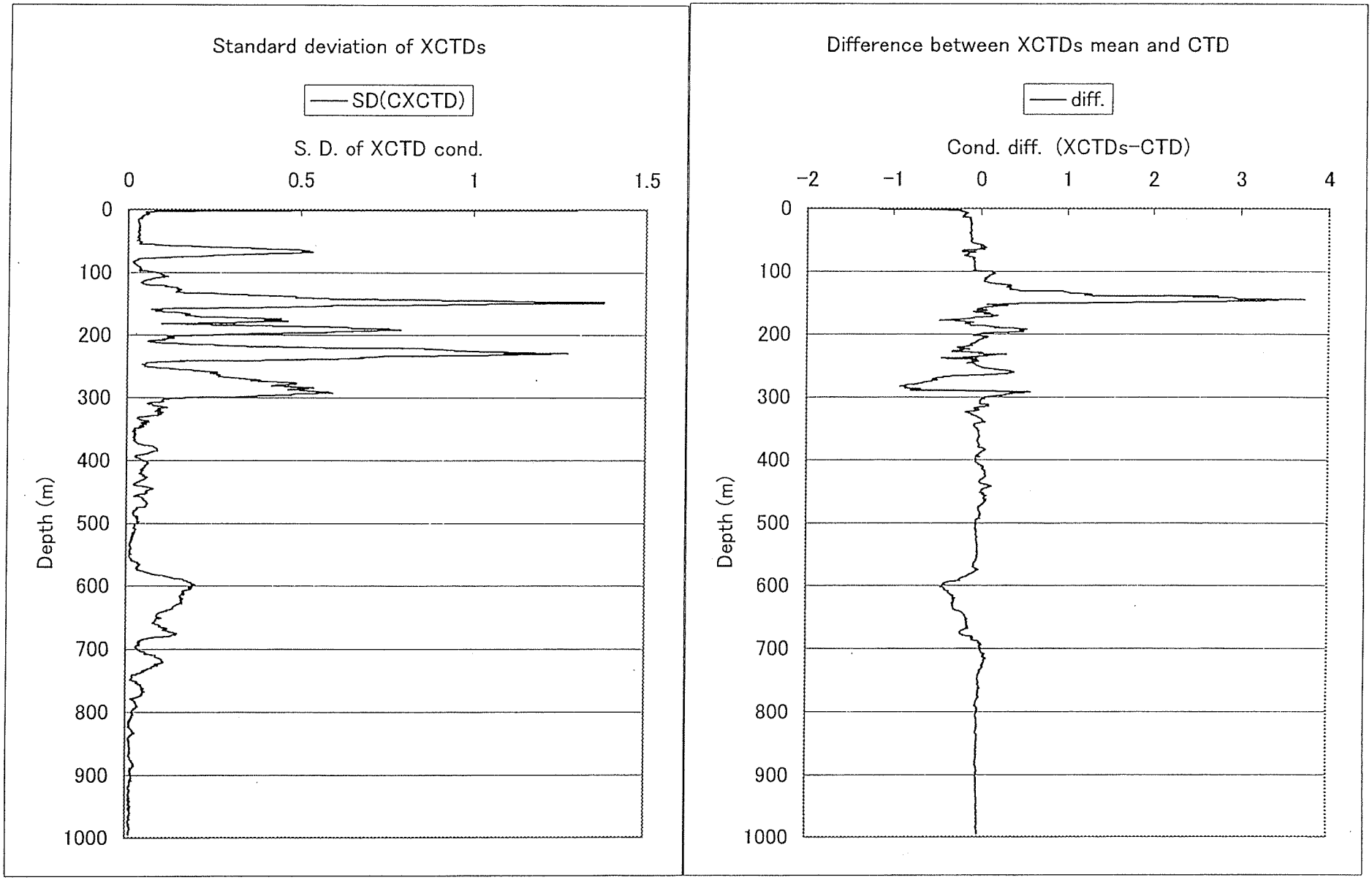

Standard deviation of XCTDs
SD(CXCTD)
S. D. of XCTD cond.
0
0.5
1
1.5
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000
Difference between XCTDs mean and CTD
diff.
Cond. diff. (XCTDs-CTD)
-2
-1
0
1
2
3
4
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000

Fig. 10-2-c

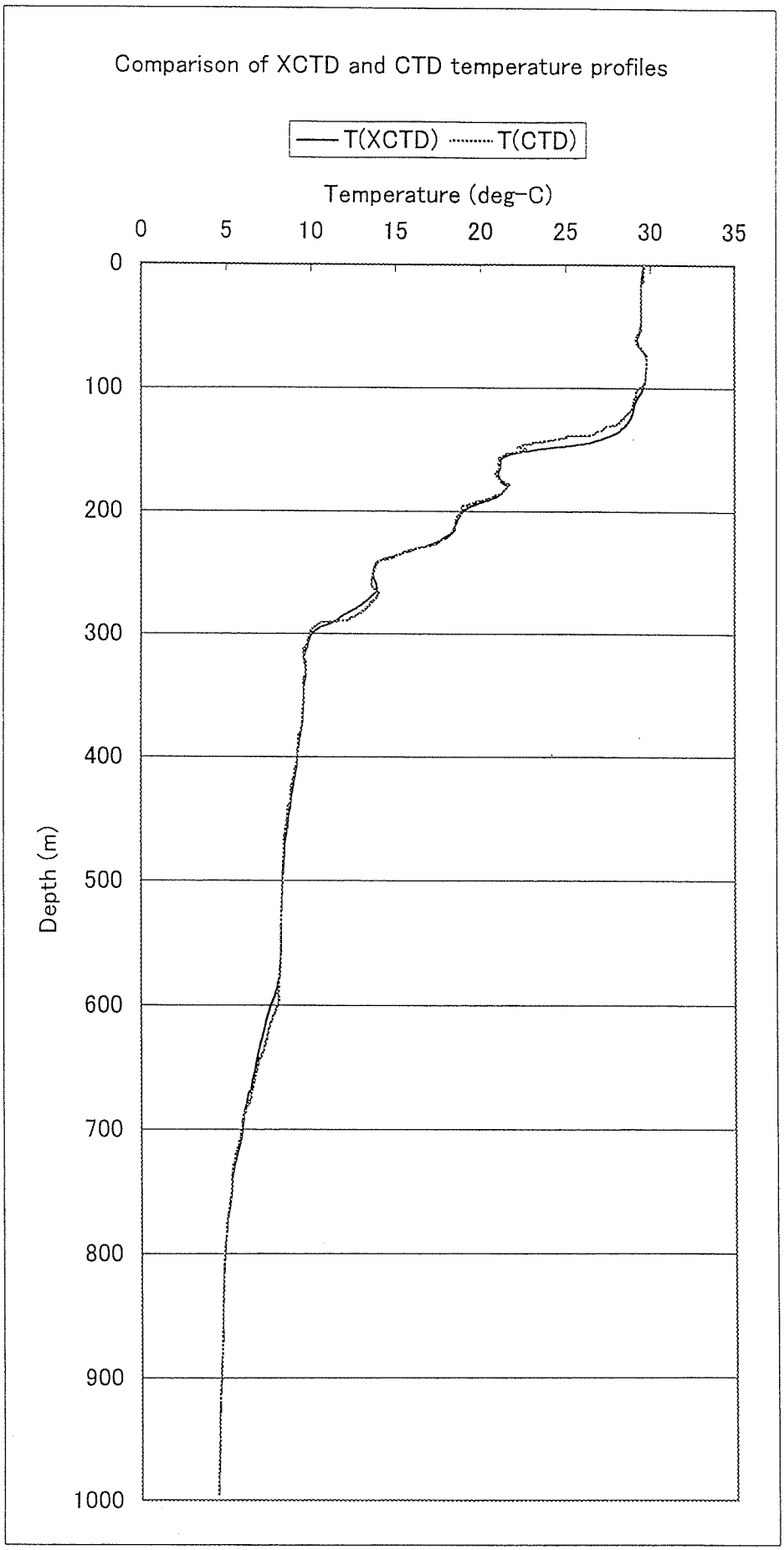

Comparison of XCTD and CTD temperature profiles
T(XCTD)
T(CTD)
Temperature (deg-C)
0
5
10
15
20
25
30
35
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000

Fig. 10-3-a

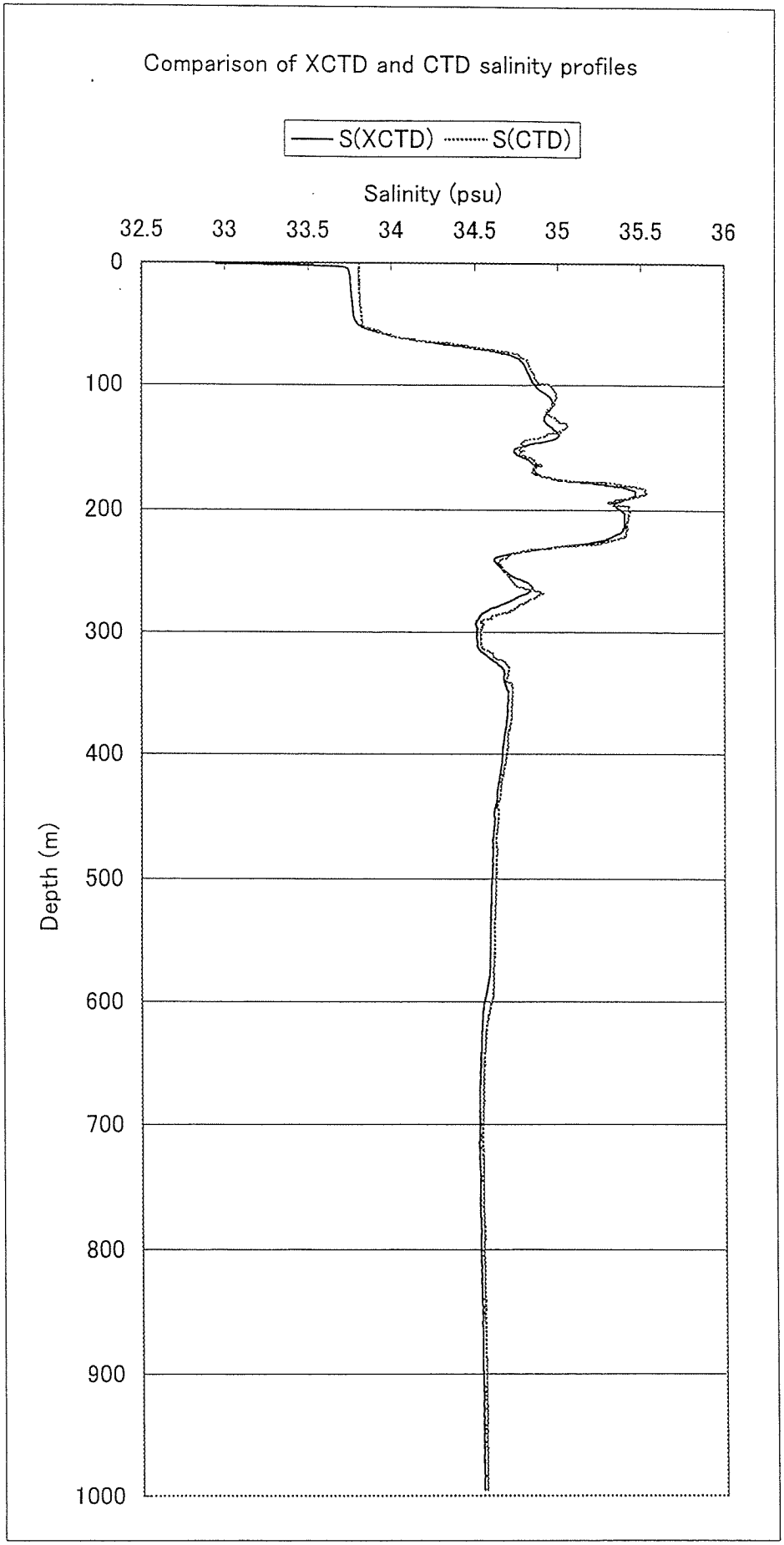

Comparison of XCTD and CTD salinity profiles
S(XCTD)
S(CTD)
Salinity (psu)
32.5
33
33.5
34
34.5
35
35.5
36
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000

Fig. 10-3-b

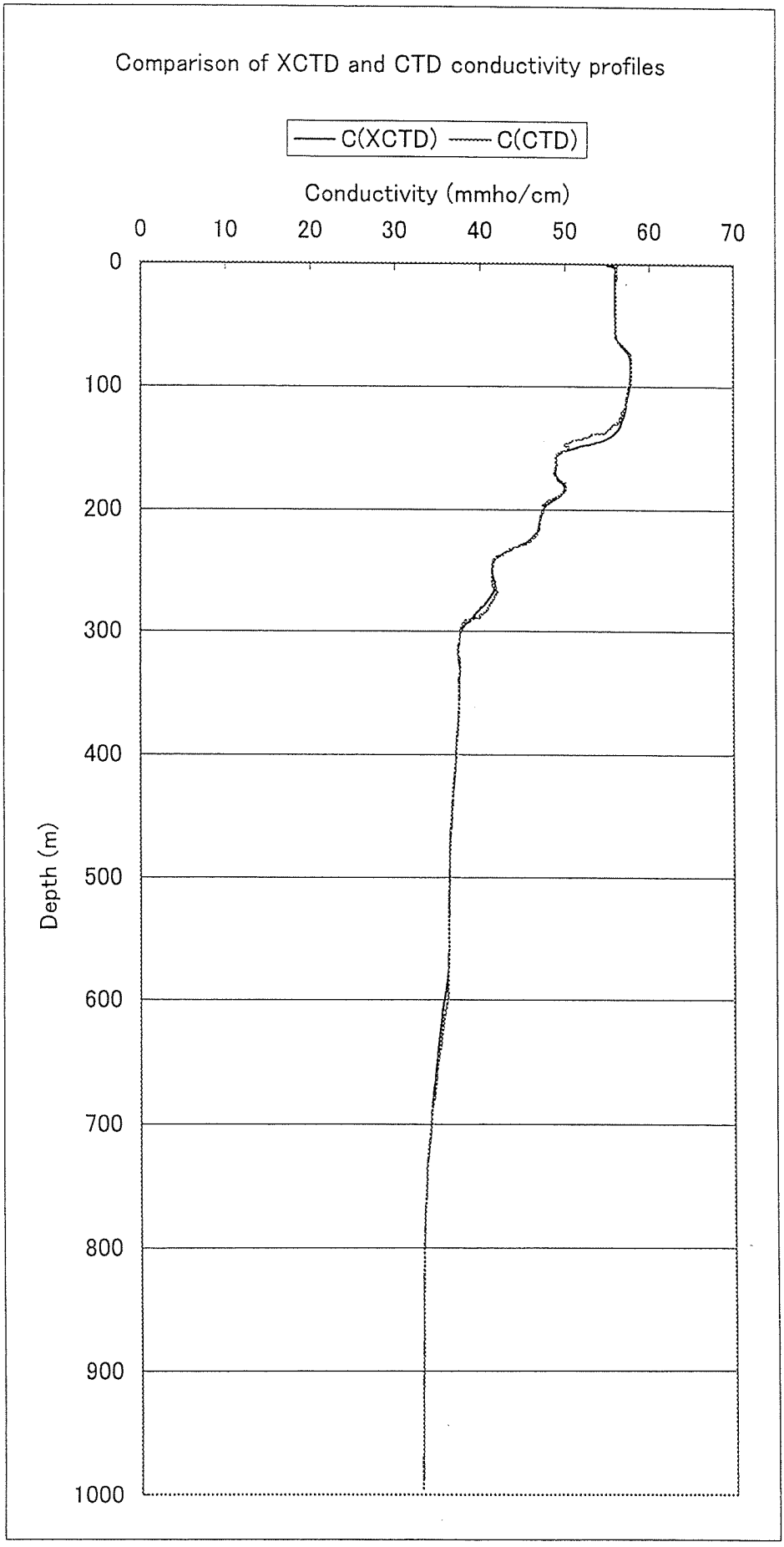

Comparison of XCTD and CTD conductivity profiles
C(XCTD)
C(CTD)
Conductivity (mmho/cm)
0
10
20
30
40
50
60
70
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000

Fig. 10-3-c

11. Summary Report

KY9909

Maria Jayvee B. Udarbe
Marine Science Institute
University of the Philippines
(10/20 to11/04/99)

First of all I would like to express my gratitude to the Japan Marine Science and Technology Center (JAMSTEC) through Chief Scientist, Yuji Kashino, for allowing me to participate in the Tropical Ocean Climate Study (TOCS) Autumn 1999 Cruise on board the research vessel 'Kaiyo'. As a new full time physical oceanography researcher in the Marine Science Institute of the University of the Philippines, being a part of this cruise has given me first-hand experience in conducting research in this part of the world ocean which is considered as important yet complicated region.

For me, this research cruise is special for various reasons some of which are as follows: It is the longest time I have ever been continuously out in the sea (without getting seasick), it is my first time to conduct study in more than one territorial waters within a cruise, and enjoy good weather and sea state almost throughout the duration of the cruise.

The task that was given me was to help in the collection of data for the Lowered Acoustic Doppler Current Profiler (LADCP). Although I still do not fully understand how this instrument works in detail, it is fascinating for me to see the vertical current structures until about 2000 m measured by this instrument. I am grateful to Eric Firing for sharing his expertise. It is also exciting to see the results from the CTD and shipboard ADCP (aside from just reading published articles) and be able to have informal discussions with the scientists on board as we see interesting features.

Overall, I think the cruise was well planned and well implemented. I am very much impressed by how all the activities were coordinated. It is my first time to observe the deployment of current meter mooring. I am amazed to see how the crew members and the technicians work together to perform such a big task efficiently and quite fast. Each step prior to deployment was obviously carefully planned. This is true also during the retrieval of the mooring south of Mindanao.

Aside from really good food, the other bonus in this cruise is the display of beautiful clouds during the early part of the day and at sunsets. We also had some birds that hitchhiked with us which were fun to watch. I enjoyed learning some Japanese and Indonesian words and culture as well.

I commend Yuji Kashino for a job well done for this cruise. I believe most of the success of it can be attributed to his careful planning and attention to details. I also thank him for allowing me to be a part of this study and for involving filipino scientist in general. I learned a lot from his sharing of model results and previous studies in the region. I appreciate all the help extended to me by the technicians of NME and MWJ and the scientists from Indonesia (Rahadian and Antoni Wibowo) for helping me particularly in connecting the cables for the LADCP. Meal times has been warm and pleasant due to the stories and sharing of Captain Yukawa. I thank Yukawa-san and his crew members for their individual contributions to make this cruise an enjoyable and memorable one.

SUMMARY REPORT
THE TROPICAL OCEAN CLIMATE STUDY (TOCS) KY9909 CRUISE

by :
Rahadian[1], Antony Wibowo[2]

1. Baruna Jaya Technical Services Unit, BPPT
2. Directorate of Technology for Natural Resources Inventory, BPPT

1. Introduction

The western equatorial Pacific Ocean circulation and its variability is important to understand because it has potentially large impacts on the Earth's climate. These are the Mindanao Current, the North Equatorial Current, the North Equatorial Countercurrent, the South Equatorial Current, the New Guinea Coastal Current, the Mindanao Under Current, the New Guinea Coastal Under Current, the Equatorial Under Current and the Nothern and Southern Subsurface Countercurrent. All of these make up very complicated circulation system. These current play important roles in the reditribution of warm in the oceans and hence in global climate changes as well. The western equatorial Pacific Ocean plays an important role in the development of El Nino-Southern Oscillation (ENSO) events [cf. *Webster and Lukas*, 1992], and it may be a key component of the global thermohaline circulation by its involvment in the Pacific-to-Indian Ocean throughflow [e.g., *Gordon*, 1986; *Godfrey et al.*, 1993].

Although many researchers have observed in the western equatorial Pacific Ocean this decade, its description from observations is still incomplete. In particular, there is very little observation data in the western equatorial Pacific Ocean. The surface current pattern has been described by Wyrtki [1961] using historical data; Lukas et al. [1991] using surface drifter, hydrographic and shipboard Acoustics Doppler Current Profiller (ADCP) data and Fine et al. [1994] using hydrographic and tracer (Bomb tritium and CFCs) data. During the Tropical Ocean Climate Studies (TOCS) cruise, Kashino et al. using hydrographic data, shipboard ADCP to observe current profile and using ADCP and current meter mooring to get time series data of current around the western equatorial Pacific Ocean. At the last TOCS cruise [February, 1999], Kashino et al. used Lowered (LADCP) to get vertical profile of the current until 2000m depth around this area.

Participation of Indonesia scientist in the Tropical Ocean Climate Study (TOCS) based on BPPT (Agency for the Assesment and Application of Technology) and JAMSTEC (Japan Marine Science and Technology Center) implementing arrangement for FY 1999/2000. In according with Memorandum of Understanding (MOU) as an umbrella between Japan-Indonesian government joint co-operations in science and technology development.

2. Purpose

The purpose of this cruise is to observe currents, temperature, salinity etc., in the western equatorial Pacific to understand the ENSO (El Nino/Southern Oscillation) phenomena. Because El Nino is occurred with migration of the warm water pool in the western equatorial Pacific, variability of the warm water pool is focused in this study. Additionally, a sea water flow from the pacific to the Indian Ocean in the Indonesian Seas, i.e., the Indonesian Throughflow is also focused because this flow might be related to the warm water pool variability.

3. The TOCS KY9909 Deployment Cruise

In the autumn of 1999, we held a joint survey with JAMSTEC around the western equatorial Pacific Ocean. Cruise number is generally abbreviated as follow : KY9909. KY is the ship name Kaiyo. The number 9909 means the ninth cruise in 1999, conducted by JAMSTEC.

This cruise divided into 2 Legs. The Leg 1 of cruise started from Palau on October 20, 1999 and finished in Palau on November 6, 1999. The observation purpose of this Leg are :

- Recovered the current meter buoy at 5.07 N, 125.38 E and deployed the ADCP buoy at 6.5 N, 126.45 E on Philipine EEZ to observed the variability of the Mindanao Current.
- Current observation by a shipboard ADCP along cruise track.
- Hydrographic observation by CTD, Lowered ADCP, XCTD and sampled water analysis to observed the Mindanao Current and Mindanao Undercurrent.
- Measurement of CO_2 concentration of sea surface water and air.

The Leg 2 of cruise started from Palau on November 8, 1999 and finished in Kavieng on November 24, 1999. The observation purpose of this Leg are :

- Recovered ATLAS buoys at 0 N, 147 E (Papua New Guinea EEZ), 5 N, 147 E (Micronesia EEZ) and 2.4 N, 137.5 E (Open sea).
- Recovered and deployed ADCP buoys at 0 N, 138 E (Indonesian EEZ), 2.5 S, 142 E and 0 N, 147 E (Papua New Guinea EEZ).
- Hydrographic observation by CTD and XCTD.
- Current observation by a shipboard ADCP along cruise track
- Measurement of CO_2 concentration of sea surface water and air.

The parameters of this cruise include :

a. CTD, Water Sampler and Dissolved Oxygen

- CTD casts were performed until 2000m depth using SBE-911 plus system. SBE-911 has several sensors. These sensors measured conductivity, temperature, pressure and dissolved oxygen. At all CTD casts, 2 (two) Niskin bottles (capacity 5L) was used to get water sample at 2000m depth.

- Water sample were stored on 250 ml Phoenix brown glass bottles with screw caps. These sample were analyzed by autosal to determine salinity value and crosscheck by salinity from measurement of CTD.
- XCTD (Expandable Conductivity, Temperature and Depth) casts were performed to measure temperature, salinity vertical profile until 1000m depth.
- CTD and XCTD data were processed using SEASOFT provided by Sea Bird Electronics and some programs.

b. ADCP (Acoustics Doppler Current Profillers)

- Lowered ADCP (LADCP); Two acoustic Doppler profilers were attached to the rosette and used for lowered profiling. Two 250-kHz instruments were mounted at the bottom of the rosette looking down and the top of rossete looking up. The data were dumped from the LADCP to a PC via a serial line (RS-422). Casts of CTD were conducted using the Lowered ADCP by University of Hawaii to measure vertical profile of the current until 2000m depth.
- Vessel Mounted ADCP (VM ADCP) or Shipboard ADCP ; Along the ship track, R/V Kaiyo was available GPS (Global Positioning System), mounts the Narrow-Band ADCP at 75 kHz frequency and 30 degree beam angle manufactured by RD Instrument. Shipboard ADCP was set up to collect data with sampling interval 5 minutes, 16m bin length, 64 depth cells, normal range 560m and starting 30m depth.
- LADCP and VM ADCP data was processed using CODAS (Common Oceanographyc Data Access System), which developed by Univ. Hawaii.

c. Mooring System

- STD ATLAS (Automated Temperature Line Acquisition System) moorings were recovered to get weather data in the western equatorial Pacific. STD ATLAS consists of surface measurements of wind speed and direction, air temperature and relative humadity, subsurface measurements of sea surface temperature and a thermistor chain cable down to 500 m, consisting of 10 temperatures and 2 pressures. Data was processed via a tower-mounted data logger (tube) and transmitted via ARGOS satellite.
- Subsurface ADCP moorings were recovered and deployed to get knowledge of physical process in the western equatorial Pacific. There were three kind of instruments, ADCP, CTD and current meter. ADCP was set up to collect data with 2 seconds per ping, 8m bin length, 16 pings per ensemble and sampling interval 3600 seconds. SBE-16 CTD set up to collect data with sampling interval 1800s.
- Current meter mooring (Five AANDERAA-current meters and one CTD) was deployed to get measurements of the variability of the Mindanao current. The AANDERAA-current meter was installed to measure time series of current data at several depth.

d. Underway

- CO_2 concentration measurement in marine boundary air (twice every 1.5 h) and in air equilibrated with surface seawater (three times every 1.5 h) were performed using the MRI CO_2 measuring system.
- SST (Sea Surface Temperature) measurement were performed three time a day by taking a surface seawater with a backette and the temperature at the seawater intake at seachest every one hour in order to compare the insitu temperature and that at the equilibrator for xCO_2 correction.

4. Data Collection Program Comments

4.1. The Leg. 1 of TOCS KY9909 cruise

During this cruise, we have performed 72 CTD and LADCP casts, took 36 water samples and 7 XCTD casts. CTD and LADCP casts were performed until 2000m depth while XCTD casts was performed until 1000m depth. LADCP worked well. The first measurement, beginning at St-1 (7-00N, 133-56E) and continued to west until arrived at St-24 (7-00N, 126-44E). At St-25 (6-50N, 126-45E) was deployed ADCP buoy at 3.437m depth. In addition to moored ADCP, we moored one CTD (SBE-16) and two AANDERA current meters. ADCP and CTD was installed at 250m depth while each current meters at 400m and 700m depth. At this mooring, we used two benthos acoustic releasers and 1.800kg anchor weight. The mooring was going along smoothly and finished after about 1.5 hours.

After performed ADCP buoy deployment at St-25, Kaiyo moved to southeast until arrived at St-32 (5-27N, 127-15E). After finished at this point, Kaiyo moved to southwest to recovered current meter buoy at St-33 (5-07N, 125-38E). The mooring was deployed in February 1999. At this station, we recovered five current meter at 170m, 300m, 500m, 700m and 1000m depth. We also recovered one CTD (SBE-16). The bottom acoustic releaser worked well so we can recovered all acoustic releasers to the surface water.

After recovered current meter mooring, Kaiyo moved to St-34 (5-27N, 127-15E) and continued the trip moved to southeast until arrived at St-45 (0-45N, 130-00E). From St-45 to St-60 (8-00N, 130-00E) Kaiyo moved to north. From St-60, Kaiyo moved to southwest until arrived at St-66 (5-00N, 127-30E). Furthermore Kaiyo moved to east until arrived at St-72 (5-00 N, 130-00 E). This is a last point at leg-1 cruise so Kaiyo back to Palau for resupplying of logistics.

4.2. The Leg. 2 of TOCS KY9909 cruise

The main activity in this cruise is buoy works. During this cruise, we have performed 6 buoy works at 6 mooring stations. we performed ATLAS buoy recovery three times, recovered and deployed ADCP buoy three times. For Hydrographic

observation, we have performed 50 XCTD casts, 6 CTD casts and taking 6 water samples. XCTD casts was performed until 1000m depth while XCTD casts wast performed until 1000m depth. At this cruise we did not use LADCP because those instrument was take away back to Univ. of Hawaii.

In this cruise we used more XCTD than CTD. There was some reason why we performed it. The main reason is save time, we wouldn't loss time if we performed XCTD casts because the XCTD measurement was performed when the ship was in motion. On the contrary, we would loss time about 1.5 hours at every one station if we performed CTD cast because the CTD measurement was performed when the ship stopped. Another reason is we operated XCTD easier than CTD.

The first measurement, beginning at St-73 (7-00N, 135-00E) and continued to south until arrived at St-87 (0-10N, 135-00E). From this point, Kaiyo moved to northeast to St-88 (2-26N, 137-25E) for recovered ATLAS buoy at 4479m depth. The buoy was deployed about 9 months ago (278 days). The acoustic releaser worked well so the mooring was going along smoothly and finished after about 2.5 hours. We also was performed XCTD casts for 12 times. The purpose of that was to compared and corrected between conductivity, temperature and pressure values from XCTD and CTD (SBE-911 plus), because the CTD measurement by SBE-911 plus was more accurate and better than XCTD.

After recovered ATLAS mooring, Kaiyo moved to south until arrived at St-93 (0-00N, 138-00E). At this station, we recovered and deployed ADCP buoy at 3.907m depth. We recovered ADCP and CTD at 250 m depth and AANDERA current meter at 700 m depth. The buoy was deployed in February 1999. The bottom acoustic releaser did not work well so we can reovered only one acoustic releaser (upper acoustic releaser) and we lossed time about 45 minutes. After finished to recovery the ADCP mooring, we continued to deploy another ADCP buoy. At this station, ADCP and CTD (SBE-16) was installed at 250m depth while AANDERA current meters at 700m depth. We used two benthos acoustic releasers and 1.800 kg anchor weight. The mooring was going along smoothly and finished after about 4 hours.

Kaiyo moved to south after finished with mooring work until arrived at St-96 (1-15S, 138-00E) and continued the trip to northeast until arrived at St-97 (0-00N, 139-00E) and then moving along equator until arrived at St-100 (0-00N, 142-00E). From St-100 to St-106 (2-30S, 142-00E) Kaiyo moved to south. At St-106, we recovered and deployed ADCP buoy at 3.441m depth. The specification of ADCP mooring that recovered and deployed same as at St-93. Acoustic releaser worked well. The mooring was going along smoothly and finished after about 3.5 hours.

From St-106, Kaiyo moved to north until arrived St-107 (0-00N, 143-00E). From this station, Kaiyo moving along equator again until arrived at St-111 (0-00 N, 147-00 E). At this station, we have performed three big jobs, i.e. recovered ADCP buoy, deployed ADCP buoy and recovered ATLAS buoy. At first, we recovered and deployed ADCP buoy at 4.505m depth. The specification of ADCP mooring that recovered and deployed same as previously station. Acoustic releaser worked well and the mooring was going along smoothly. After finished with this job, Kaiyo moved to south until arrived at St-114 (1-30S, 147-00E) and then return to previously station to recovered ATLAS buoy. ATLAS buoy was deployed about 9 months ago

(290 days) at 4.448m depth. At this station, acoustic releaser worked well so the mooring was going along smoothly and finished after about 2.5 hours.

Furthermore, Kaiyo moved to north until arrived at St-125 (5-00N, 147-00E). At this station, we recovered ATLAS buoy at 4.282m depth. The buoy was deployed about 15 months (444 days). The acoustic releaser worked well so the mooring was going along smoothly and finished after about 2.5 hours. This was a last point of TOCS KY9909 cruise. After finished all job at this cruise, Kaiyo go back to Kavieng for resupplying of logistics.

5. Comments and Suggestions

5.1. Comments

The TOCS KY9909 cruise were conducted on board the R/V Kaiyo in the Palau EEZ, Philipine EEZ, Indonesian EEZ and Papua New Guinea EEZ. The cruise track were designed to contribute the purpose of this cruise and to observed sea water flow from the Pacific to the Indian Ocean in the Indonesian Seas. In general, we have successed in our cruise because all was going along smoothly.

During this cruise, we have gotten many of data i.e. CTD, XCTD, LADCP, shipboard ADCP and mooring data. Part of the data has processed on board R/V Kaiyo along this cruise. We have gotten temperature and salinity profile at each station and cross section of temperature and salinity profile at many stations from CTD and XCTD data. From shipboard ADCP data, we have gotten current profile along the cruise track at several depth. We also have gotten time series data of current, temperature and salinity at several stations from mooring data.

Furthermore, the above mentioned processed data will be analyzed to complete previously observations around the western equatorial pacific ocean. We hope that we will get more information to understand the ENSO phenomena.

5.2. Suggestions

We really hope that the implementation of the TOCS program will directly benefit to predict the climate change and behavior of sea in the area obsevation, especially in the Japan and Indonesia, and we are strongly support for doing more discussions and presentations with other scientist to accommodate any idea and to report recent result from our data.

Additionally, we also hope that data from this obsevartion can used to complete previously data and increase accurate for data analysis of the ENSO phenomena. Second, to be able to clarify the mechanism affecting climate change with scales of several months until several years would not only speed up the development of ocean dynamics, but would also increase understanding of the characteristics of circulation system and its thermal structure in the western equatorial Pacific ocean. Therefore we hope that there will be very active and useful discussion

at this time and next time on the future directions of the TOCS program. Finally, we sincerely hope TOCS program will also contribute to the promotion of international cooperation in the western equatorial Pacific ocean.

Acknowledgements

The Kaiyo TOCS cruise in October 1999 was a joint cruise by the Japan Marine Science and Technology Center (JAMSTEC), Japan and Badan Pengkajian dan Penerapan Teknologi (BPPT), Indonesia. We would like to thank Mr. Yuji Kashino, chief scientist of JAMSTEC for his kind of instruction, suggestion and discussion in development of our cruise.

We would like also to thank Captain Osamu Yukawa and the crew of R/V Kaiyo; technicians of the Marine Work Japan Co. Ltd and Nihon Marine Enterprise Co. Ltd and colleagues of BPPT and JAMSTEC for their efforts in conducting this cruise.

References

1. Fine, Rana A., Roger Lukas, Frederick M. Bingham, Mark J. Warner and Richard H. Gammon, The western equatorial Pacific : *A water mass crossroads*, J. Geophysical Research, Vol. 99, 25,063-25,080, 1994.
2. Gordon, A. L., Interocean exchange of thermocline water, J. Geophysical research, Vol. 91, 5037-5046, 1986.
3. Lukas, Roger, E. Firing, P. Hacker, Philip L. Richardson, Curtis A. Collins, Rana Fine, and Richard Gammon, Observation of the Mindanao Current During the Western Equatorial Pacific Ocean Circullation Study, Vol. 96, 7089-7104, 1991.

Appendices

A-1. Time table

Time Table of TOCS KY9909 Cruise (Time in this table is that used in R/V Kaiyo.)

October 20 (Wed) Fine

09:00	Departure from Koror (Republic of Palau)
10:00 – 11:00	Fire drill
15:25 – 16:33	St.001 (7-00N, 133-56E) CTD, LADCP, water sampling and XCTD
19:25 – 20:33	St.002 (7-00N, 133-30E) CTD and LADCP
23:35 –	St.003 (7-00N, 133-00E) Start of CTD, LADCP and water sampling

October 21 (Thu) Fine

00:32 – 00:39	Test of acoustic releasers at 4000m depth at St.003
– 01:49	End of observation at St.003
04:53 – 05:46	St.004 (7-00N, 132-30E) CTD and LADCP
08:57 – 10:12	St.005 (7-00N, 132-00E) CTD, LADCP and water sampling
13:17 – 14:22	St.006 (7-00N, 131-30E) CTD and LADCP
17:34 – 18:39	St.007 (7-00N, 131-00E) CTD, LADCP and water sampling
22:03 – 22:53	St.008 (7-00N, 130-30E) CTD and LADCP

October 22 (Fri) Fine

02:16 – 03:15	St.009 (7-00N, 130-00E) CTD, LADCP and water sampling
05:05 – 06:11	St.010 (7-00N, 129-45E) CTD, LADCP and XCTD
07:53 – 08:58	St.011 (7-00N, 129-30E) CTD, LADCP and water sampling
10:53 – 11:40	St.012 (7-00N, 129-15E) CTD and LADCP
13:30 – 14:21	St.013 (7-00N, 129-00E) CTD, LADCP and water sampling
16:11 – 17:01	St.014 (7-00N, 128-45E) CTD and LADCP
18:49 – 19:41	St.015 (7-00N, 128-30E) CTD, LADCP and water sampling
21:27 – 22:15	St.016 (7-00N, 128-15E) CTD and LADCP

October 23 (Sat) Fine

00:01 – 00:50	St.017 (7-00N, 128-00E) CTD, LADCP and water sampling
02:33 – 03:15	St.018 (7-00N, 127-45E) CTD and LADCP
04:56 – 05:43	St.019 (7-00N, 127-30E) CTD, LADCP and water sampling
06:55 – 07:36	St.020 (7-00N, 127-20E) CTD and LADCP
08:44 – 09:47	St.021 (7-00N, 127-10E) CTD and LADCP
10:53 – 12:00	St.022 (7-00N, 127-00E) CTD, LADCP and water sampling
12:55 – 14:00	St.023 (7-00N, 126-52E) CTD and LADCP

14:54 – 16:11 St.024 (7-00N, 126-44E) CTD, LADCP, water sampling and XCTD
17:25 – Start of bottom topography survey (Sea Beam) around St.025

October 24 (Sun) Fine

– 04:52 End of bottom topography survey
07:35 – 09:21 ADCP buoy deployment at St.025 (6-49.596N, 126-42.722E)
09:48 – 10:43 St.025 (6-48N, 126-42E) CTD and LADCP
11:35 – 12:36 St.026 (6-49N, 126-34E) CTD, LADCP and water sampling
13:23 – 14:20 St.027 (6-40N, 126-35E) CTD and LADCP
15:19 – 16:21 St.028 (6-30N, 126-40E) CTD, LADCP and water sampling
17:15 – 18:21 St.029 (6-21N, 126-45E) CTD and LADCP
19:41 – 20:48 St.030 (6-08N, 126-52E) CTD, LADCP and water sampling
22:28 – 23:32 St.031 (5-54N, 127-40E) CTD and LADCP

October 25 (Mon) Cloudy

02:34 – 03:34 St.032 (5-27N, 127-15E) CTD, LADCP and water sampling
07:38 at 5-46.000N, 126-41.963E
12:00 at 6-05.999N, 126-00.001E
20:33 at 4-45.079N, 126-39.861E

October 26 (Tue) Fine

02:37 at 5-11.998N, 125-34.010E
04:20 at 4-54.000N, 125-38.009E
07:19 – 08:34 Current meter mooring recovery at St.33 (5-07N, 125-38E)
09:28 – 10:04 St.033 (5-07N, 125-41E) CTD and LADCP
19:34 – 20:42 St.034 (5-27N, 127-15E) CTD, LADCP and water sampling
23:35 – St.035 (5-00N, 127-30E) Start of CTD and LADCP

October 27 (Wed) Cloudy

– 00:46 End of observation at St.035
04:01 – 04:58 St.036 (4-33N, 127-45E) CTD, LADCP and water sampling
08:20 – 09:10 St.037 (4-06N, 128-00E) CTD, LADCP and XCTD
12:24 – 12:48 St.038 (3-39N, 128-15E) CTD, LADCP and water sampling
15:45 – 16:35 St.039 (3-12N, 128-30E) CTD and LADCP
19:35 – 20:34 St.040 (2-45N, 128-45E) CTD, LADCP and water sampling

October 28 (Thu) Cloudy

00:07 – 01:09	St.041 (2-18N, 129-00E) CTD and LADCP
04:32 – 05:38	St.042 (1-51N, 129-15E) CTD, LADCP and water sampling
09:30 – 08:39	St.043 (1-24N, 128-30E) CTD and LADCP
12:23 – 13:22	St.044 (0-57N, 129-45E) CTD, LADCP and water sampling
15:11 – 15:45	St.045 (0-45N, 130-00E) CTD, LADCP and XCTD
17:50 – 19:00	St.046 (1-00N, 130-00E) CTD, LADCP and water sampling
22:02 – 23:02	St.047 (1-30N, 130-00E) CTD and LADCP

October 29 (Fri) Fine

02:09 – 03:05	St.048 (2-00N, 130-00E) CTD, LADCP and water sampling
03:45 – 10:16	Bottom topography survey (Sea Beam) around St.048
14:10 – 15:10	St.049 (2-30N, 130-00E) CTD and LADCP
18:16 – 19:14	St.050 (3-00N, 130-00E) CTD, LADCP and water sampling
22:12 – 23:04	St.051 (3-30N, 130-00E) CTD and LADCP

October 30 (Sat) Fine

02:13 – 03:19	St.052 (4-00N, 130-00E) CTD, LADCP and water sampling
06:22 – 07:21	St.053 (4-30N, 130-00E) CTD and LADCP
10:16 – 11:18	St.054 (5-00N, 130-00E) CTD, LADCP, water sampling and XCTD
11:54 – 17:50	Bottom topography survey (Sea Beam) around St.054
20:41 – 21:44	St.055 (5-30N, 130-00E) CTD and LADCP

October 31 (Sun) Cloudy

00:43 – 01:43	St.056 (6-00N, 130-00E) CTD, LADCP and water sampling
04:51 – 05:46	St.057 (6-30N, 130-00E) CTD and LADCP
09:00 – 10:12	St.058 (7-00N, 130-00E) CTD, LADCP and water sampling
13:06 – 14:02	St.059 (7-30N, 130-00E) CTD and LADCP
16:59 – 18:08	St.060 (8-00N, 130-00E) CTD, LADCP, water sampling and XCTD
21:56 – 22:48	St.061 (7-30N, 129-35E) CTD and LADCP

November 1 (Mon) Rainy

02:38 – 03:40	St.062 (7-00N, 129-10E) CTD, LADCP and water sampling
07:50 – 08:44	St.063 (6-30N, 128-45E) CTD and LADCP
12:53 – 13:51	St.064 (6-00N, 128-20E) CTD, LADCP and water sampling
17:50 – 18:54	St.065 (5-30N, 127-55E) CTD and LADCP

November 2 (Tue) Rainy

05:30 – 06:00	St.067 (4-49N, 127-22E) CTD and LADCP
07:32 – 08:33	St.066 (5-00N, 127-30E) CTD, LADCP and water sampling
11:48 – 12:49	St.068 (5-00N, 128-00E) CTD, LADCP and water sampling
15:42 – 16:35	St.069 (5-00N, 128-30E) CTD and LADCP
19:33 – 20:32	St.070 (5-00N, 129-00E) CTD, LADCP and water sampling
23:32 –	St.071 (5-00N, 129-30E) Start of CTD and LADCP

November 3 (Wed) Cloudy

– 00:30	End of observation at St.071
03:31 – 04:35	St.072 (5-00N, 130-00E) CTD, LADCP and water sampling
07:56 – 09:40	Test of acoustic releasers at 4000m depth at St.072

November 4 (Thu) Fine

Cruise to Koror

November 5 (Fri) Cloudy

10:30	Arrive at Koror
14:00 – 15:00	Embarkation of ATLAS gear

November 6 (Sat) Cloudy

Preparation for Leg 2

November 7 (Sun) Rainy

Fueling

November 8 (Mon) Cloudy

09:30	Departure from Koror
10:00 – 11:00	Fire drill
19:47	St.073 (7-00N, 135-00E) XCTD
23:18	St.074 (6-30N, 135-00E) XCTD

November 9 (Tue) Cloudy

02:50	St.075 (6-00N, 135-00E) XCTD
06:13	St.076 (5-30N, 135-00E) XCTD

09:03 St.077 (5-00N, 135-00E) XCTD
11:47 St.078 (4-30N, 135-00E) XCTD
14:32 St.079 (4-00N, 135-00E) XCTD
17:19 St.080 (3-30N, 135-00E) XCTD
19:47 St.081 (3-00N, 135-00E) XCTD
22:23 St.082 (2-30N, 135-00E) XCTD

November 10 (Wed) Cloudy

01:07 St.083 (2-00N, 135-00E) XCTD
03:42 St.084 (1-30N, 135-00E) XCTD
06:18 St.085 (1-00N, 135-00E) XCTD
09:24 St.086 (0-30N, 135-00E) XCTD
11:22 St.087 (0-10N, 135-00E) XCTD

November 11 (Thu) Cloudy

07:24 – 09:56 ATLAS buoy recovery at St.088 (2-25N, 137-25E)
10:14 – 12:23 XCTD performance Test (13 XCTDs deployment during CTD cast)
] at St.088
15:00 Check TRITON buoy at St.089 (2-00N, 138-00E)
15:48 – 16:23 CTD and water sampling at St.089
20:25 St.090 (1-30N, 138-00E) XCTD
23:07 St.091 (1-00N, 138-00E) XCTD

November 12 (Fri) Fine

01:55 St.092 (0-30N, 138-00E) XCTD
06:00 Check TRITON buoy at St.093 (0-00N, 138-00E)
06:54 – 10:40 ADCP buoy recovery at St.093
12:33 – 14:24 ADCP buoy deployment at St.093
15:00 – 15:54 CTD, water sampling and XCTD at St.093
18:39 St.094 (0-30S, 138-00E) XCTD
21:20 St.095 (1-00S, 138-00E) XCTD
23:08 St.096 (1-15S, 138-00E) XCTD

November 13 (Sat) Fine

08:54 St.097 (0-00N, 139-00E) XCTD
15:20 St.098 (0-00N, 140-00E) XCTD

November 14 (Sun) Cloudy

00:15	St.099 (0-00N, 141-00E) XCTD
09:37	St.100 (0-00N, 142-00E) XCTD
13:24	St.101 (0-30S, 142-00E) XCTD
16:46	St.102 (1-00S, 142-00E) XCTD
19:56	St.103 (1-30S, 142-00E) XCTD
23:06	St.104 (2-00S, 142-00E) XCTD

November 15 (Mon) Fine

04:28	St.105 (2-43S, 142-00E) XCTD
06:48 – 08:48	ADCP buoy recovery at St.106 (2-30S, 142-00E)
09:28 – 11:10	ADCP buoy deployment at St.106
11:25 – 11:49	CTD and water sampling at St.106

November 16 (Tue) Fine

05:10	St.107 (0-00N, 143-00E) XCTD
11:17	St.108 (0-00N, 144-00E) XCTD
16:49	St.109 (0-00N, 145-00E) XCTD
22:24	St.110 (0-00N, 146-00E) XCTD

November 17 (Wed) Fine

00:15	Time lag adjustment (one hour ahead) to Kavieng Time
06:00	Check TRITON buoy at St.111 (0-00N.147-00E)
06:48 – 09:00	ADCP buoy recovery at St.111
09:43 – 11:51	ADCP buoy deployment at St.111
14:36	St.112 (0-30S, 147-00E) XCTD
17:29	St.113 (1-00S, 147-00E) XCTD
20:19	St.114 (1-30S, 147-00E) XCTD

November 18 (Thu) Fine

07:52 – 10:25	ATLAS buoy recovery at St.115 (0-00N, 147-00E)
11:17 – 11:50	CTD and water sampling at St.115
15:34	St.116 (0-30N, 147-00E) XCTD
19:15	St.117 (1-00N, 147-00E) XCTD
23:25	St.118 (1-30N, 147-00E) XCTD

November 19 (Fri) Fine

03:32	St.119 (2-00N, 147-00E) XCTD
07:34	St.120 (2-30N, 147-00E) XCTD
11:38	St.121 (3-00N, 147-00E) XCTD
15:48	St.122 (3-30N, 147-00E) XCTD
20:14	St.123 (4-00N, 147-00E) XCTD

November 20 (Sat) Fine

00:05	St.124 (4-30N, 147-00E) XCTD
07:49 – 10:14	ATLAS buoy recovery at St.125 (5-00N, 147-00E)
10:54 – 11:26	CTD and water sampling at St.125
13:00	Check TRITON buoy at St.125

November 21 (Sun) Rainy

Cruise to Kavieng

November 22 (Mon) Rainy

Cruise to Kavieng

November 23 (Tue) Fine

10:30	Arrive at Kavieng