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Tropical Ocean Climate Study (TOCS)

KY9801 Cruise Report

January 3, 1998 - February 1, 1998

Japan Marine Science and Technology Center

CONTENTS

1. Cruise Summary

Ship:	R/V KAIYO
Chief Investigator:	Kentaro Ando (Leg-1)
	Toshihiko Yano (Leg-2)
	(Japan Marine Science and Technology Center)
Cruise Code:	KY9801
Project Title:	Tropical Ocean Climate Study
Period:	January 3, 1998 - February 1, 1998
Ports of call:	Majuro, Republic of Marshall Islands
	Truk (Chuuk), Federated States of Micronesia
	Koror, Republic of Palau
Institutions:	JAMSTEC
	MWJ (Marine Works Japan)
	NME (Nippon Marine Enterprise)
	PMEL (Pacific Marine Environmental Laboratory)
	BPPT (Badan Pengkajian dan Penerapan Technologi)

Purpose:

The purpose of this cruise is to observe the physical oceanographic and atmospheric conditions in and over the tropical western Pacific for better understanding of the air-sea interaction and its relation to the ENSO (El Nino / Southern Oscillation) and global climate change.

Observation Summary:

The TOCS (Tropical Ocean Climate Study) group in Japan Marine Science and Technology Center (JAMSTEC) and Badan Pengkajian dan Penerapan Technologi (BPPT) of Indonesia conducted 49 CTD/DO (Conductivity, Temperature and Depth/ Dissolved Oxygen) casts and current measurement by shipboard ADCP. Three subsurface ADCP moorings at 0N165E, 0N147E and 0N142E were recovered and re-deployed during this cruise. The 7 ADCPs are now being moored in the surveyed area (0N165E, 0N156E, 0N147E, 0N142E, 0N138E, 2S142E, 2.5S142E).

The TAO project group in Pacific Marine Environmental Laboratory (PMEL/NOAA) and the TOCS group in JAMSTEC conducted the 3 repairs, 3 recoveries, 5 deployments of ATLAS buoys along the 165E, 156E, 147E and 137E line.

Preliminary Results (by Hiroshi Matsuura) :

The TOCS cruise, KY9801, is conducted at the time when atmospheric scientists and oceanographers at various institutions are discussing if the El Nino of 1997 was decaying or not. It is not appropriate to state any specific comments regarding this issue from the data we have obtained during this cruise at the time of this writing; however, after some calibrations and careful analysis, we believe we can provide some useful information regarding to the oceanic responses to El Nino in the western tropical Pacific at the beginning and at the developing stage of El Nino.

The meridional transects of CTD casts during this cruise are at 165E, 147E, 142E and at 138E. During the previous TOCS cruise in the summer of 1997 (KY9709), we have observed that the salinity front in the surface layer was sifted southward and located at about the equator. This southward sift of the salinity front in El Nino year was reported by other scientists in the past. It was also found that there was a low salinity water (salinity < 33.6 psu) in the surface layer centered at about 5N in the summer of 1997. However, the salinity cross section at 165E obtained from this cruise shows no salinity front at the equator. Instead, at the northern edge of the transect (8N), it shows the sign of the front. At this and at other longitude, near surface salinity observed during this cruise is higher than those observed during previous cruise. Comparison with CTD records obtained at the beginning of 1997 (KY9702) indicates that the near surface salinity observed during this cruise is even higher than those observed during KY9702. This high salinity anomaly is also evident on zonal crossesction at the equator. It may be possible that this trend of high salinity in the surface layer observed during this cruise is caused by lesser precipitation in this region (which caused drought in many western tropical pacific islands as well as serious forest fire in Indonesia) due to the El Nino condition. Before ending the preliminary description of the CTD data, it is noted that the mixing layer depths along 138E line are considerably shallower than those observed during KY9702 and it appears that SEC is located at about 3N.

Current measurements by moored ADCPs at 142E, 147E and at 165E (these moorings were recovered and re-deployed during this cruise) are appeared to be successful. The time series shown in this report are raw data and corrections will be made (correction of depth variation and geo-magnetic anomaly as well as removal of spikes and interpolations where data are missing) later. At 50m, zonal currents at 142E and at 147E are appeared to be highly correlated as before except during the period between day 225 and 275. At the beginning of the records, there are two noticeable events when currents were eastward and both of them were followed by the periods of westward current. These events are also clearly seen at 100m but not at 150m. There is another event of eastward current starting from about day 150. After this event, currents at this depth became weakly eastward until about day 225. The current at 50m at 165E differ from those at 142E and at 147E considerably. At this longitude, events of eastward current occurred fairly periodically throughout the record. At 100m, zonal currents at 142E and at 147E are appeared to be less correlated than those at 50m except during those events described above. At 165E, periodic events of eastward current are seen until about day 175. These periodic events are correlated to those at 50m at this location. At 150m, zonal currents at 147E appeared to show low frequency modulation, period of which is about 100days. At 165E, there was a event of strong westward current started from about day 50 at this depth. This event appeared to be correlated to the one seen at 50m and at 100m. After this event, current at this longitude is predominantly eastward (EUC). Meridional currents at 142E shows fairly periodic motions (period is about 20-25 days) at the beginning of the records at 50m. These periodic motions are not evident at 147E. This lack of correlation of meridional currents between these two locations agrees to the results of analysis applied to the data obtained in previous years.

Acknowledgment:

We would like to express our special thanks to Captain Ishida and his crew members of R/V KAIYO . This cruise will not be success without their expert skills.

We also would like to express our special thanks to the Indonesian security officer Capt. Tri Wiyanto as well as Indonesian Scientists Ir. Fadli Syamsudim and Ir. Muhamad Ilyas who helped us during the recovery and re-deployment of ATLAS buoys and ADCP buoys. Their help was much appreciated.

The instruments (CTD, shipboard ADCP etc.) and moorings were set up and operated by technical staffs (Section 11). Each section in this report were also written by the staffs.

2. List of Instruments

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

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

CTD Fish for 10,500m(TOCS Group)

		Date of Calibration
Primary:	T-sensor S/N 1462	(21-Oct.-1997)
	S-sensor S/N 1045	(21-Oct.-1997)
Secondary:	T-sensor S/N 1465	(21-Oct.-1997)
	S-sensor S/N 1174	(21-Oct.-1997)
P-sensor S/N 41223		(24-Sep.-1993)
DO-sensor S/N 130311		(03-Sep.-1996)

(2) Water sampler

·Carousel S/N 329833, Sea Bird Electronics,Inc.,USA

(3) Shipboard ADCP (Acoustic Doppler Current Profiler)

VM-75,RD Instruments, USA

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

(4) Dissolved Oxygen

·TOA Portable Dissolved Oxygen Meter Model DO-25A

·Metrohn Model 726DMS Titrino/ 10ml of titration vessel

·Pt.Electrode/ 6.0401.100

·SBE13, Sea Bird Electronics,Inc.,USA

(5) Bottle Salinity

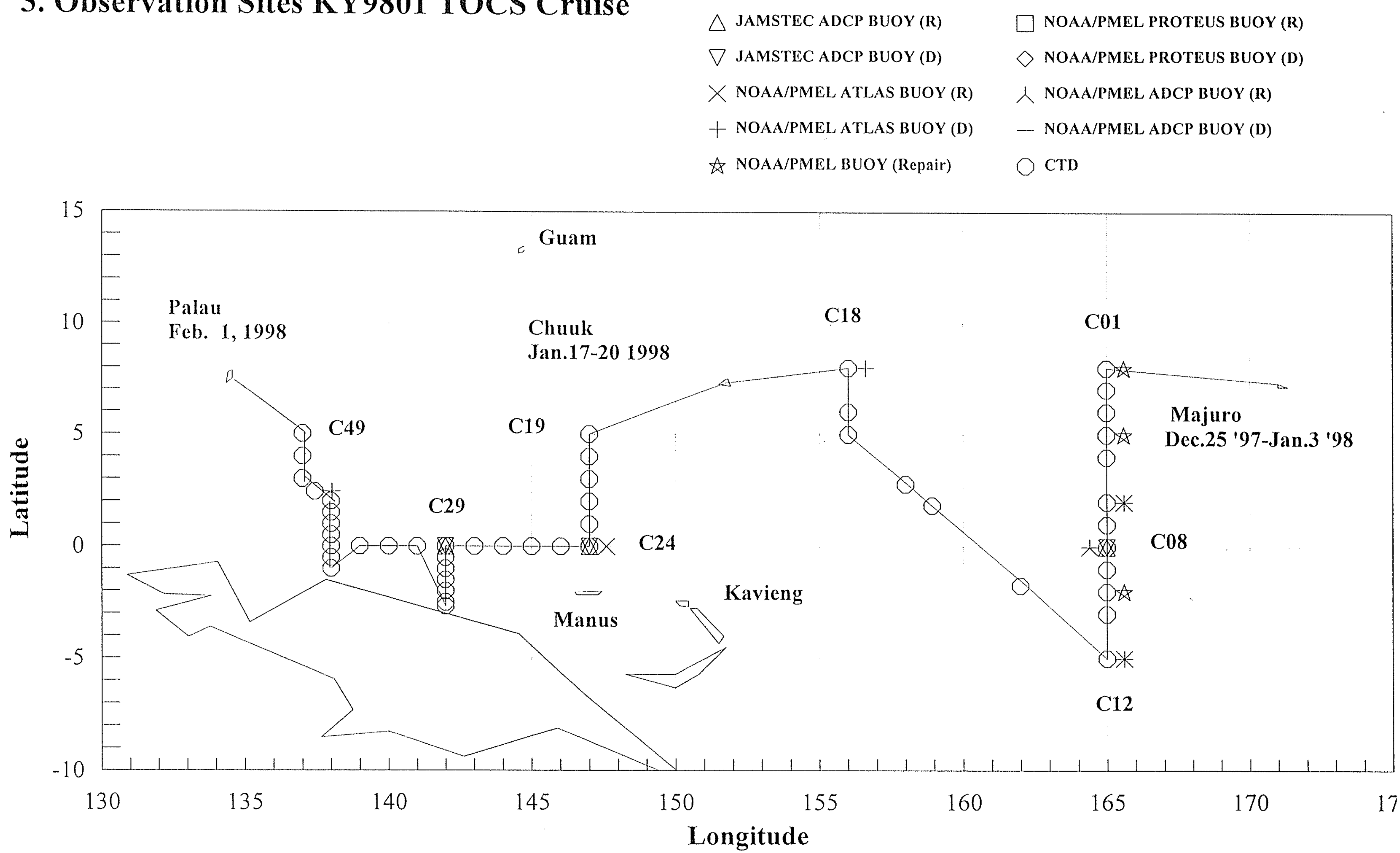
·Guildline Autosal Model8400B

(6) pCO2 and TCO2

·The MRI CO2 Measuring System

·The MRI Coulometric TCO2 Measuring System

3. Observation Sites KY9801 TOCS Cruise



3-01

4.1 CTD Cast Table

St.	Time(GMT)	Latitude	Longitude
C 01	04 Jan. '98 22 : 12	07 ° 59.195 ' N	165 ° 03.185 ' E
C 02	05 Jan. '98 04 : 24	07 ° 01.521 ' N	165 ° 00.047 ' E
C 03	05 Jan. '98 10 : 58	06 ° 01.064 ' N	164 ° 59.917 ' E
C 04	05 Jan. '98 21 : 58	05 ° 01.206 ' N	165 ° 01.283 ' E
C 05	06 Jan. '98 04 : 20	04 ° 00.797 ' N	165 ° 00.046 ' E
C 06	07 Jan. '98 00 : 52	01 ° 58.756 ' N	164 ° 57.752 ' E
C 07	07 Jan. '98 07 : 34	01 ° 00.046 ' N	164 ° 59.772 ' E
C 08	08 Jan. '98 23 : 43	00 ° 00.496 ' N	165 ° 18.754 ' E
C 09	09 Jan. '98 06 : 43	00 ° 59.562 ' S	164 ° 51.190 ' E
C 10	09 Jan. '98 21 : 03	01 ° 55.830 ' S	164 ° 25.296 ' E
C 11	10 Jan. '98 03 : 44	02 ° 59.713 ' S	164 ° 41.963 ' E
C 12	10 Jan. '98 23 : 12	04 ° 59.494 ' S	165 ° 13.324 ' E
C 13	11 Jan. '98 21 : 57	01 ° 44.356 ' S	162 ° 12.954 ' E
C 14	12 Jan. '98 22 : 01	01 ° 51.394 ' N	158 ° 55.181 ' E
C 15	13 Jan. '98 04 : 52	02 ° 47.486 ' N	158 ° 05.341 ' E
C 16	13 Jan. '98 21 : 11	05 ° 00.580 ' N	156 ° 05.403 ' E
C 17	14 Jan. '98 04 : 16	05 ° 59.302 ' N	156 ° 00.109 ' E
C 18	15 Jan. '98 00 : 31	08 ° 05.969 ' N	156 ° 00.460 ' E
C 19	21 Jan. '98 07 : 57	04 ° 58.361 ' N	147 ° 00.594 ' E
C 20	21 Jan. '98 14 : 14	04 ° 00.672 ' N	147 ° 00.571 ' E
C 21	21 Jan. '98 20 : 32	02 ° 59.985 ' N	146 ° 59.986 ' E
C 22	22 Jan. '98 02 : 38	02 ° 02.285 ' N	146 ° 59.888 ' E
C 23	22 Jan. '98 09 : 02	01 ° 01.343 ' N	146 ° 59.821 ' E
C 24	23 Jan. '98 04 : 32	00 ° 01.672 ' S	146 ° 59.360 ' E
C 25	24 Jan. '98 09 : 25	00 ° 00.014 ' N	146 ° 01.847 ' E
C 26	24 Jan. '98 15 : 15	00 ° 00.012 ' S	145 ° 01.017 ' E
C 27	24 Jan. '98 21 : 06	00 ° 00.088 ' S	143 ° 59.889 ' E
C 28	25 Jan. '98 02 : 58	00 ° 00.114 ' S	143 ° 00.851 ' E
C 29	26 Jan. '98 00 : 06	00 ° 00.183 ' N	141 ° 57.957 ' E
C 30	26 Jan. '98 03 : 38	00 ° 29.365 ' S	141 ° 59.723 ' E
C 31	26 Jan. '98 07 : 10	00 ° 59.939 ' S	141 ° 59.877 ' E
C 32	26 Jan. '98 10 : 22	01 ° 29.381 ' S	141 ° 59.940 ' E
C 33	26 Jan. '98 13 : 57	01 ° 59.069 ' S	141 ° 57.011 ' E
C 34	26 Jan. '98 17 : 14	02 ° 27.975 ' S	141 ° 55.600 ' E
C 35	26 Jan. '98 19 : 10	02 ° 39.576 ' S	141 ° 59.878 ' E
C 36	27 Jan. '98 11 : 06	00 ° 03.094 ' S	141 ° 00.709 ' E
C 37	27 Jan. '98 16 : 24	00 ° 00.197 ' N	140 ° 00.748 ' E
C 38	27 Jan. '98 22 : 01	00 ° 00.103 ' S	138 ° 59.894 ' E
C 39	28 Jan. '98 04 : 48	00 ° 59.149 ' S	138 ° 00.513 ' E
C 40	28 Jan. '98 08 : 44	00 ° 30.699 ' S	137 ° 59.766 ' E
C 41	28 Jan. '98 12 : 17	00 ° 01.440 ' S	137 ° 59.536 ' E
C 42	28 Jan. '98 15 : 57	00 ° 30.265 ' N	137 ° 59.360 ' E
C 43	28 Jan. '98 19 : 22	00 ° 59.865 ' N	137 ° 59.867 ' E
C 44	28 Jan. '98 22 : 53	01 ° 29.321 ' N	137 ° 59.601 ' E
C 45	29 Jan. '98 02 : 29	01 ° 59.795 ' N	137 ° 59.742 ' E
C 46	29 Jan. '98 22 : 59	02 ° 26.790 ' N	137 ° 25.460 ' E
C 47	30 Jan. '98 04 : 04	02 ° 59.569 ' N	137 ° 00.868 ' E
C 48	30 Jan. '98 09 : 45	03 ° 59.515 ' N	137 ° 00.015 ' E
C 49	30 Jan. '98 15 : 28	04 ° 58.554 ' N	136 ° 59.950 ' E

4.2 CTD Profiles

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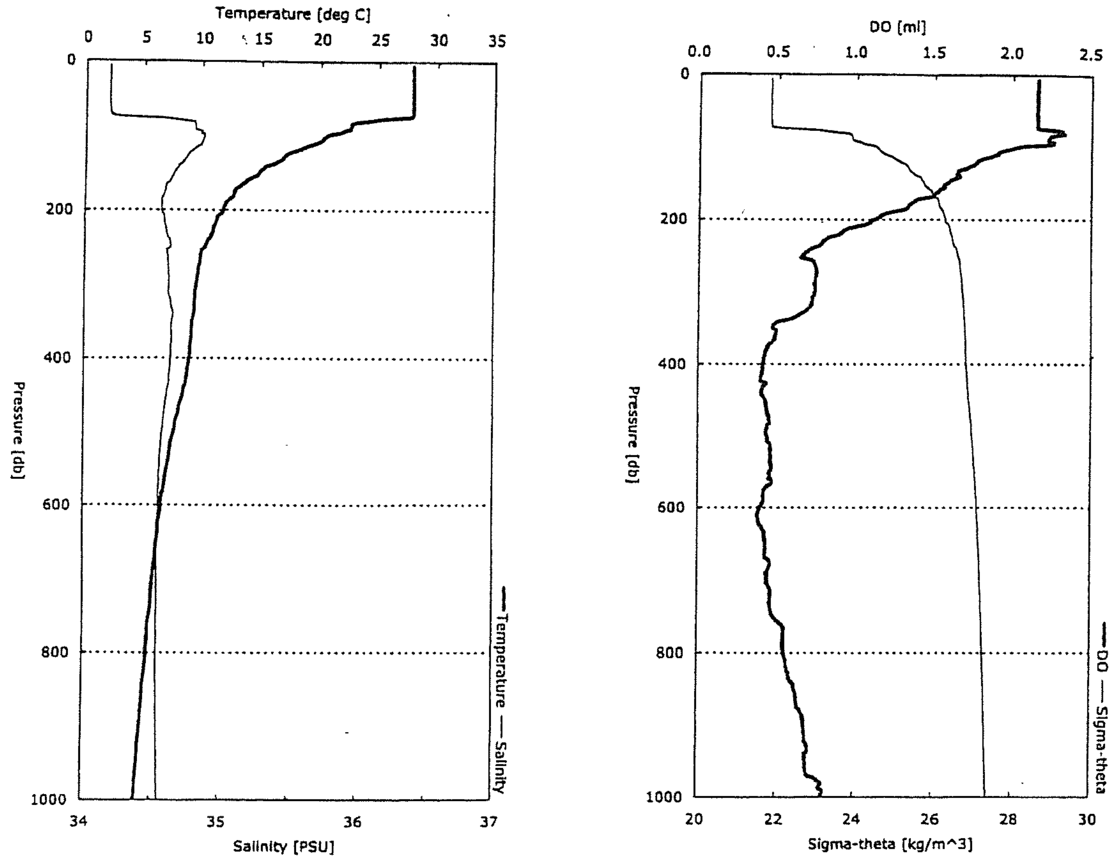

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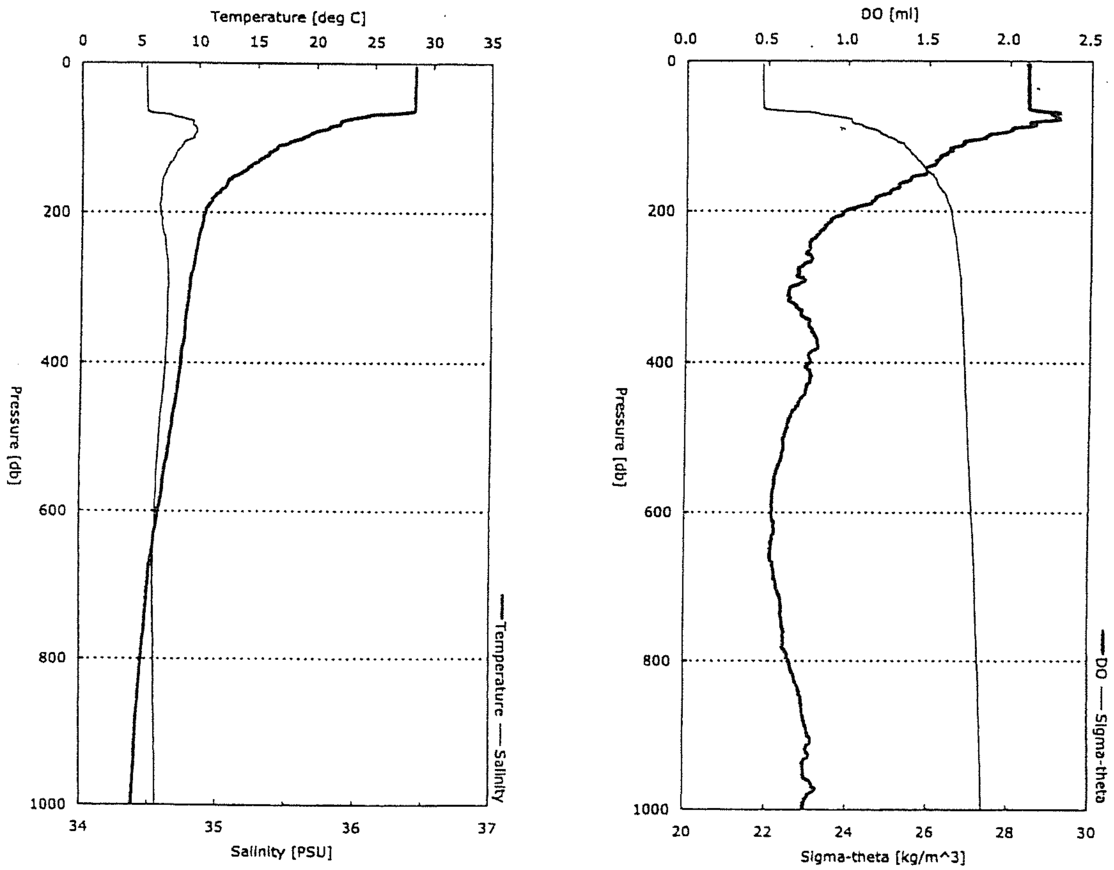

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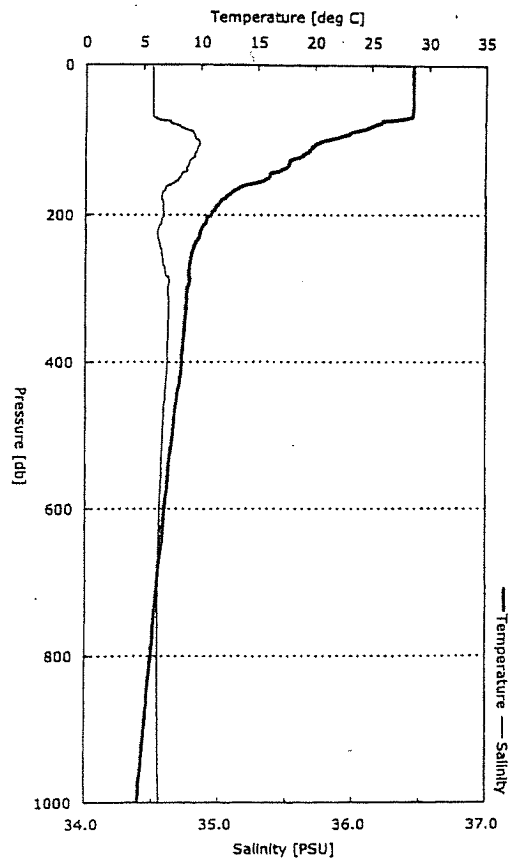
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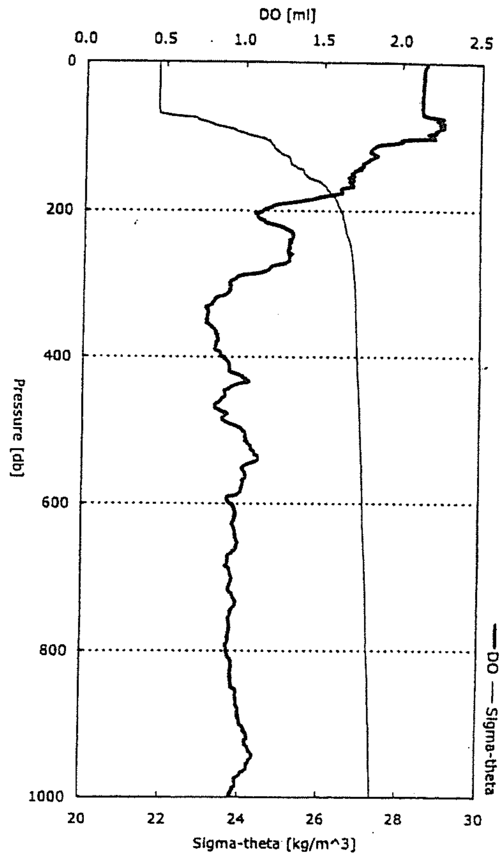
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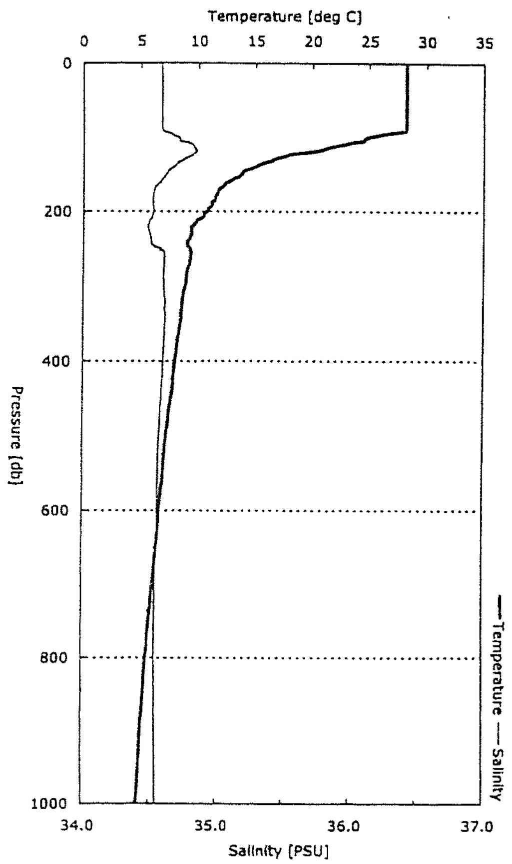
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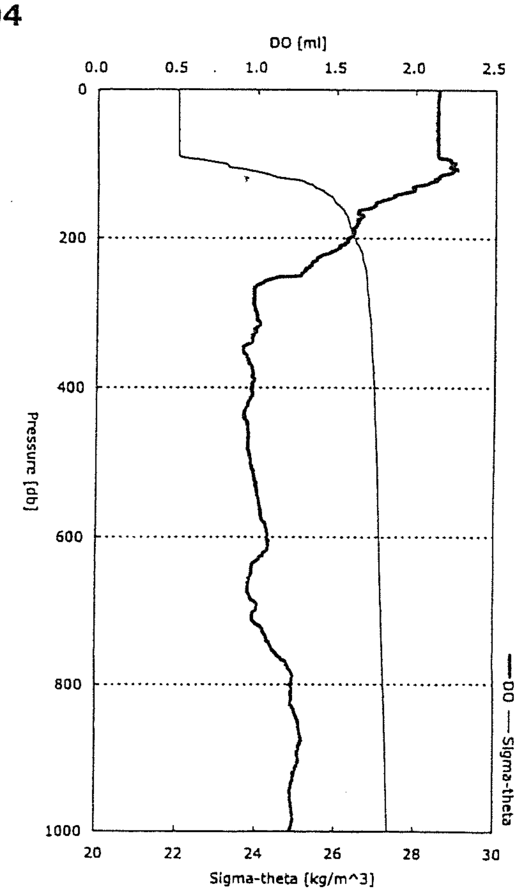
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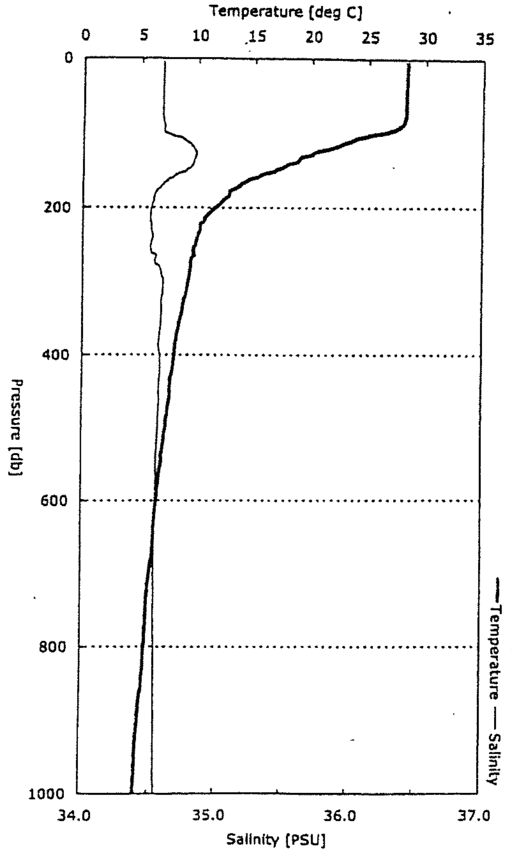
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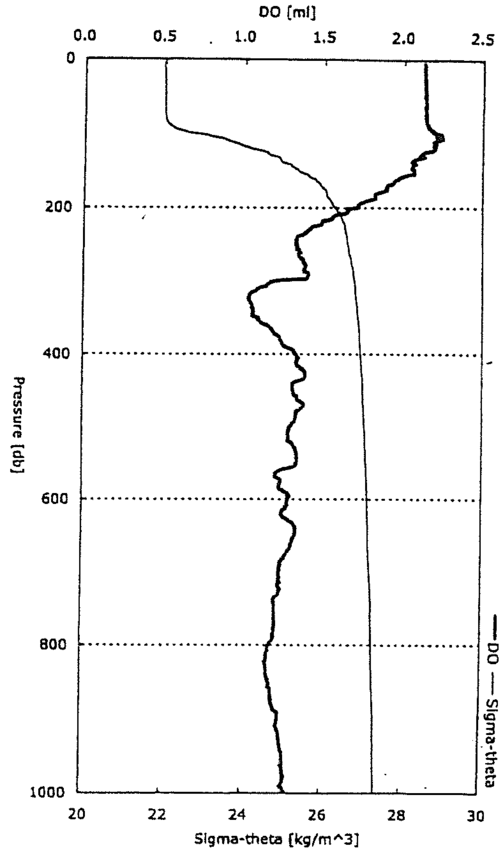
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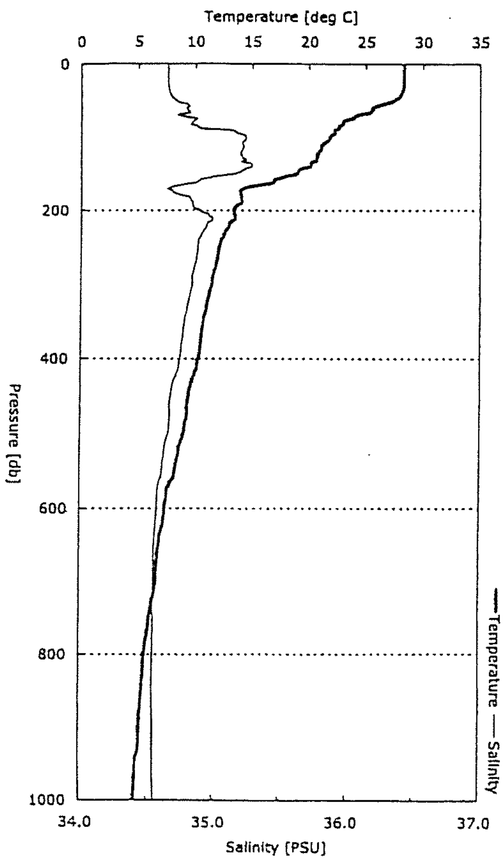
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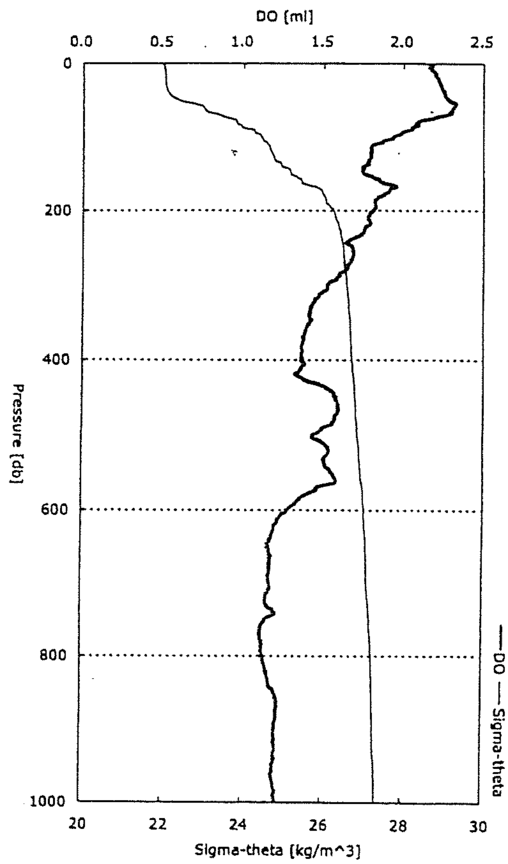
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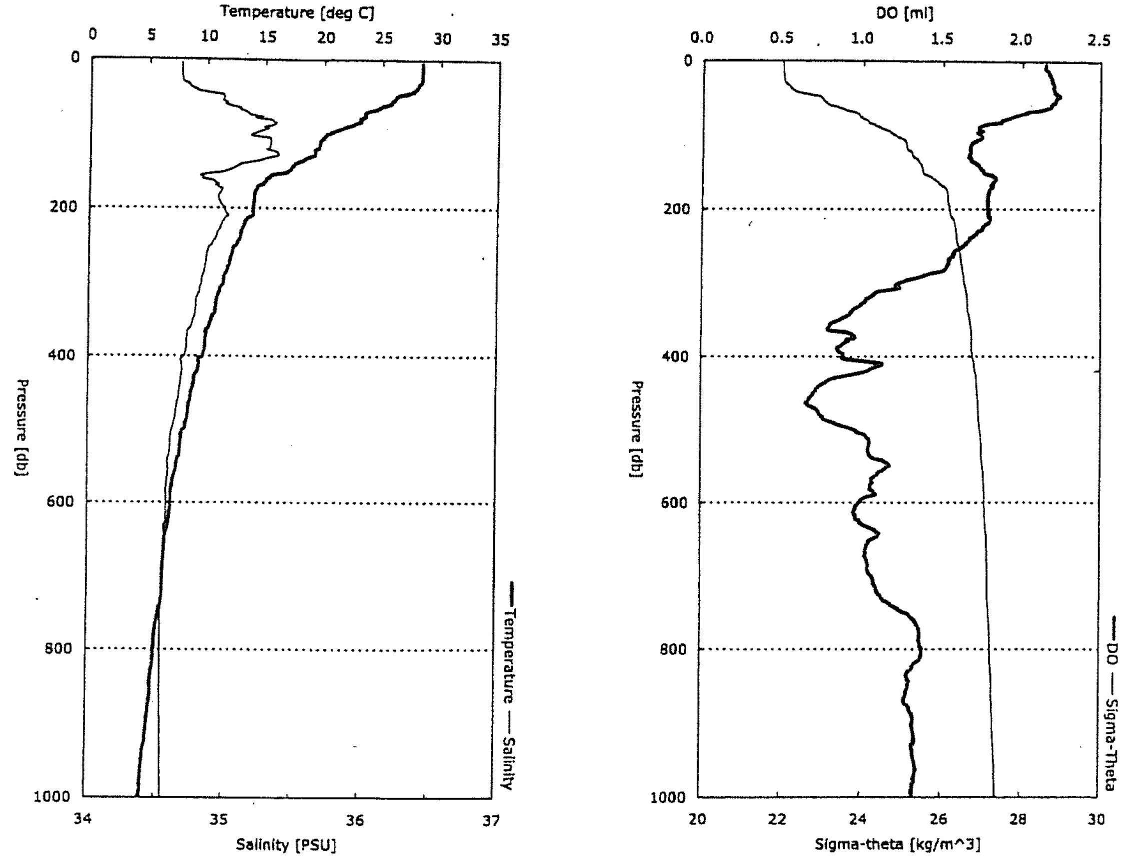

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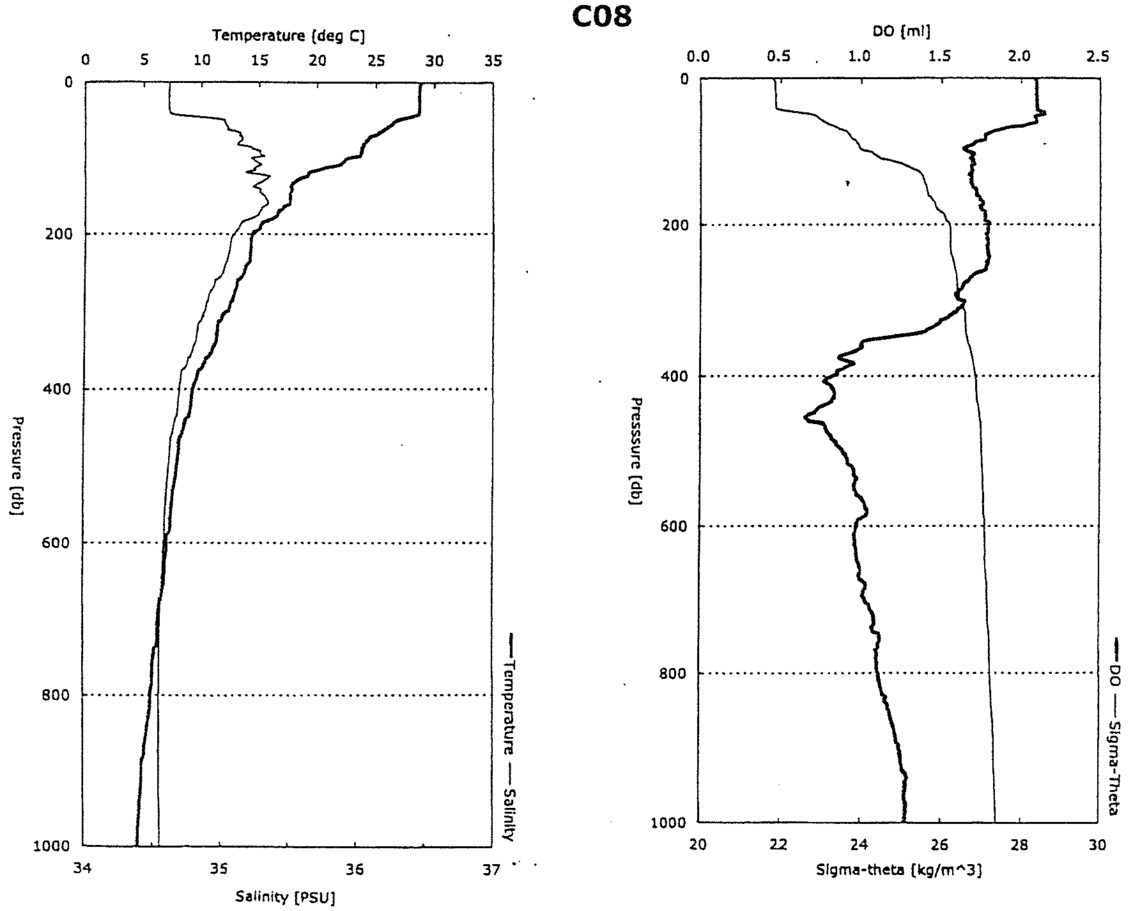

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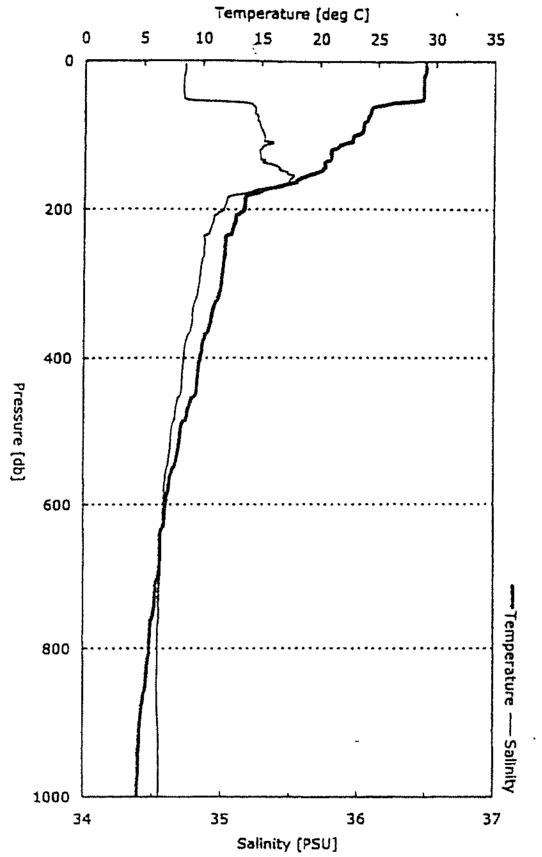
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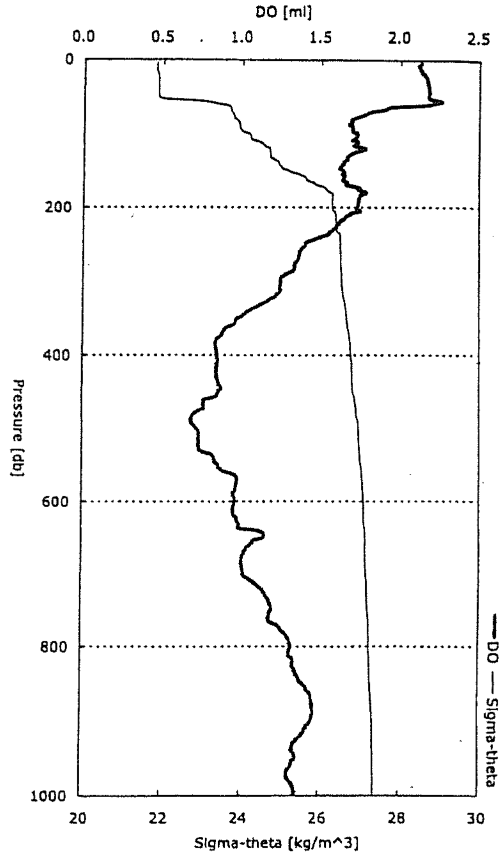
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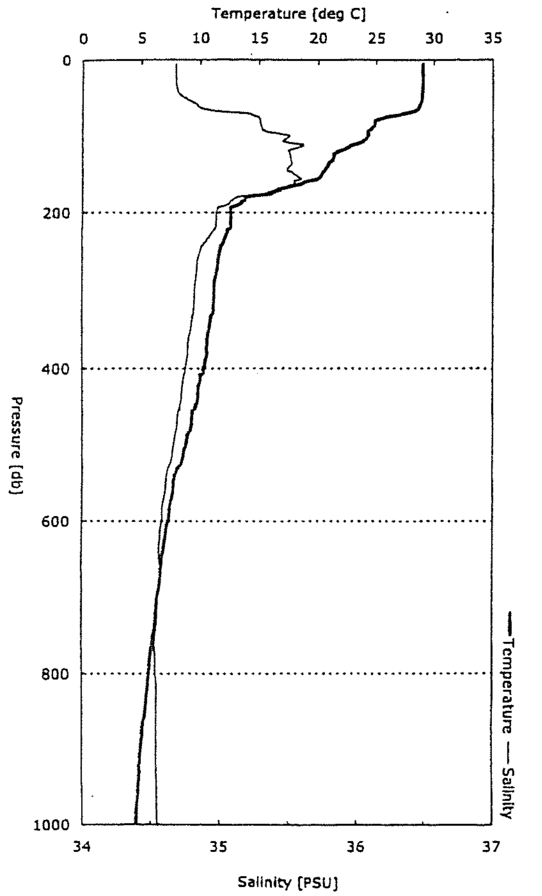
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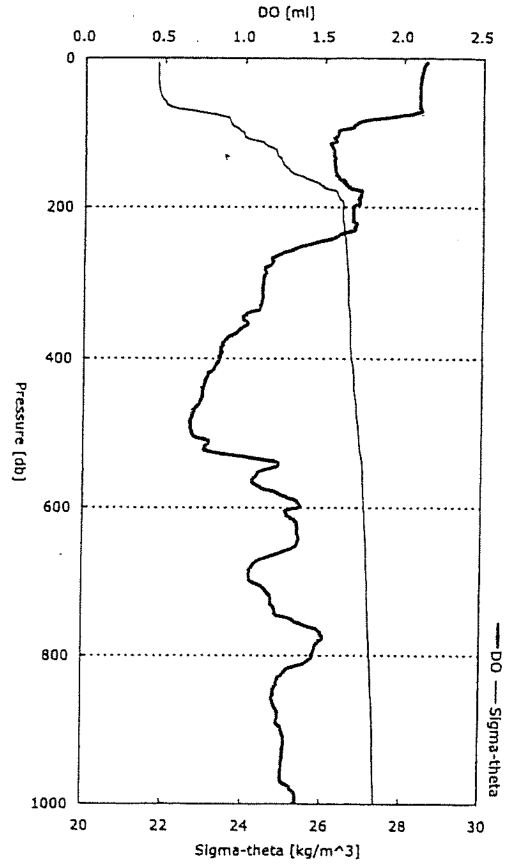
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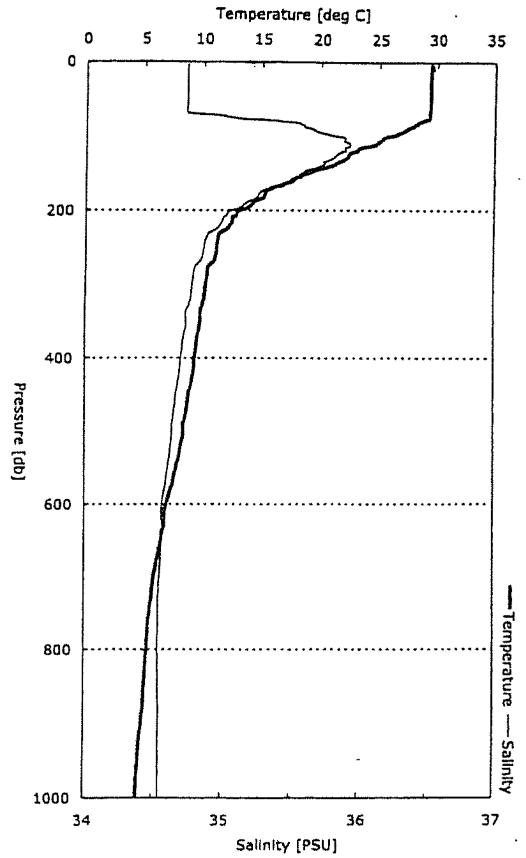
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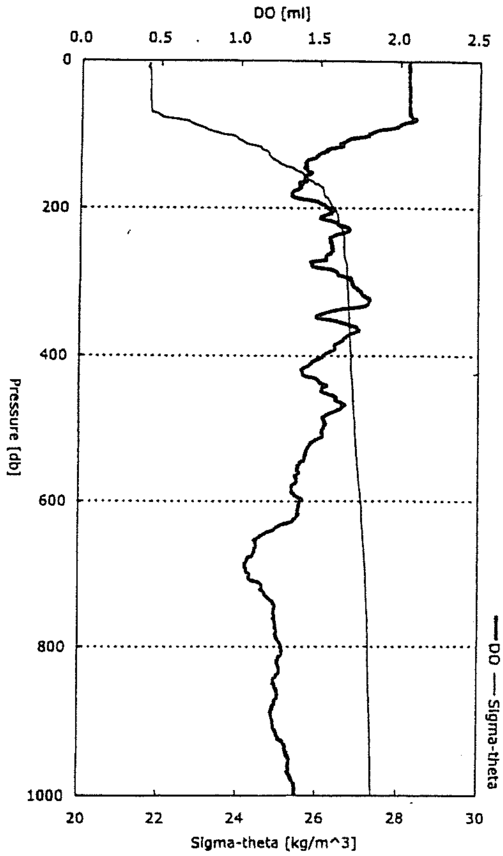
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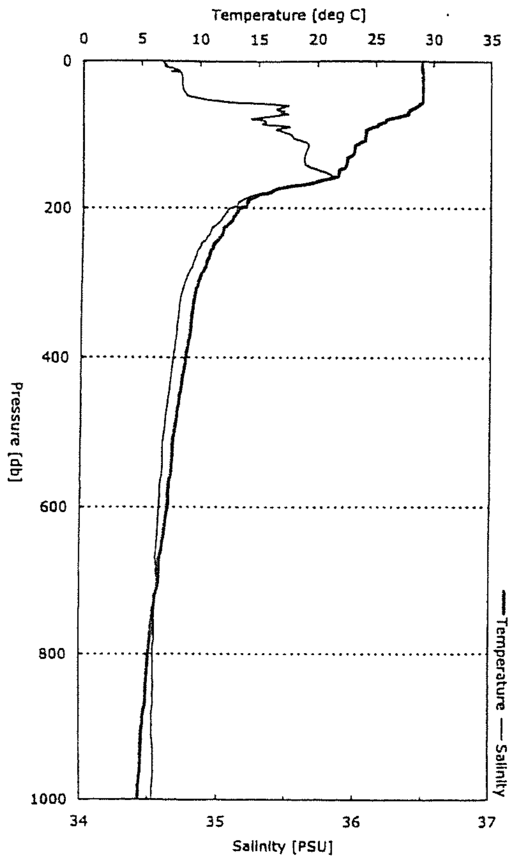
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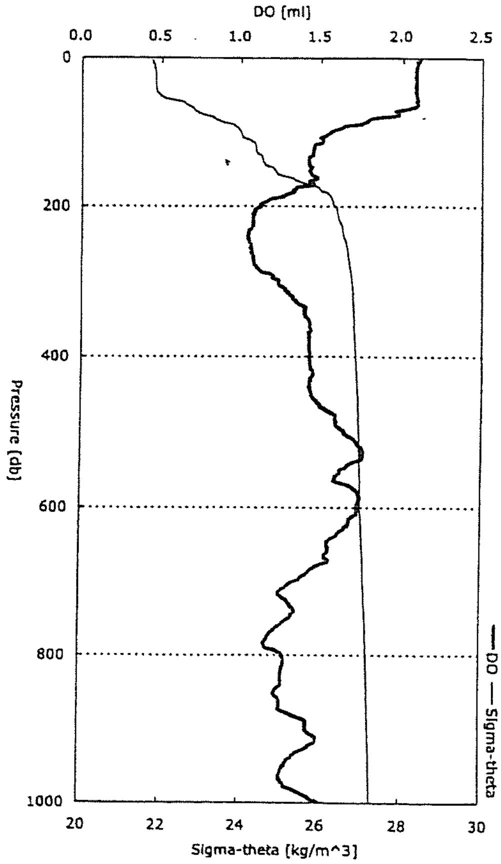
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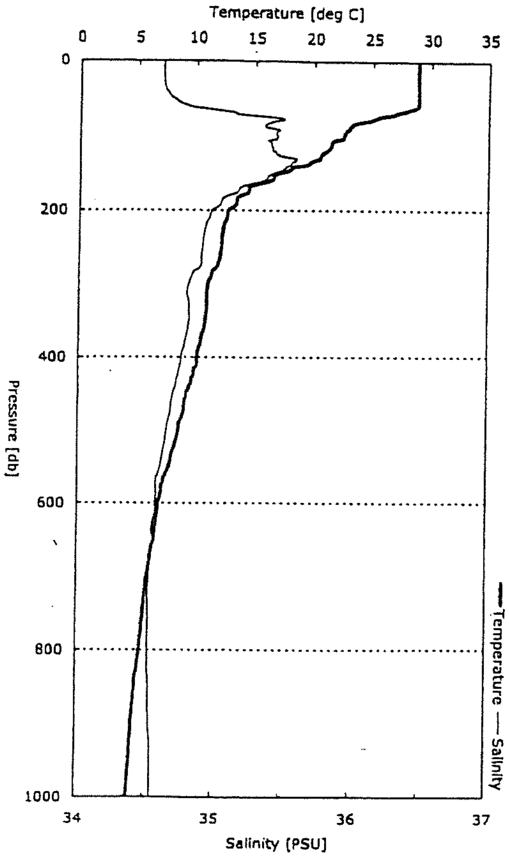

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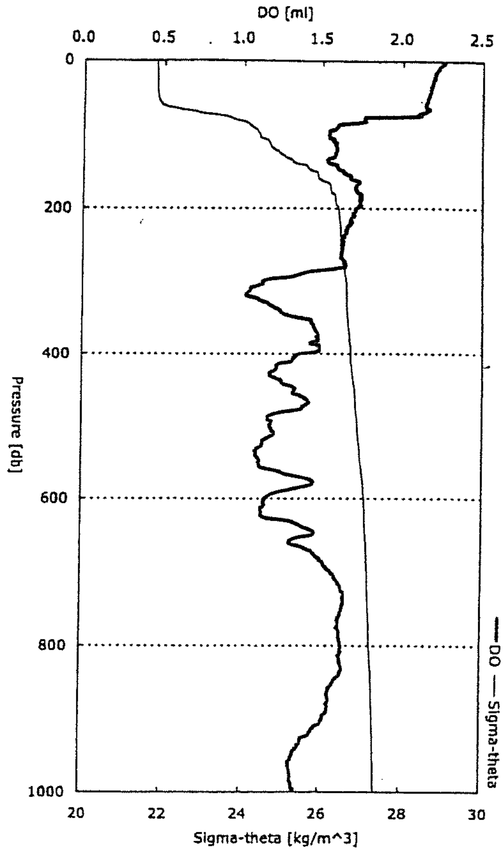

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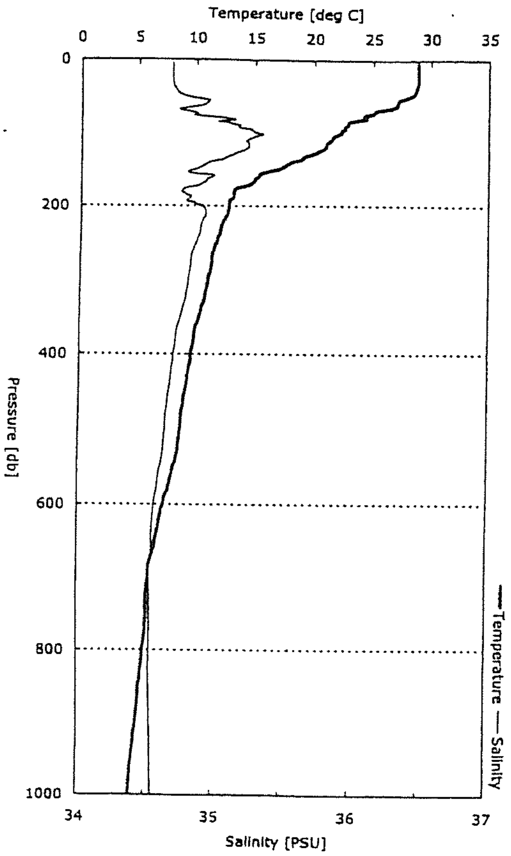

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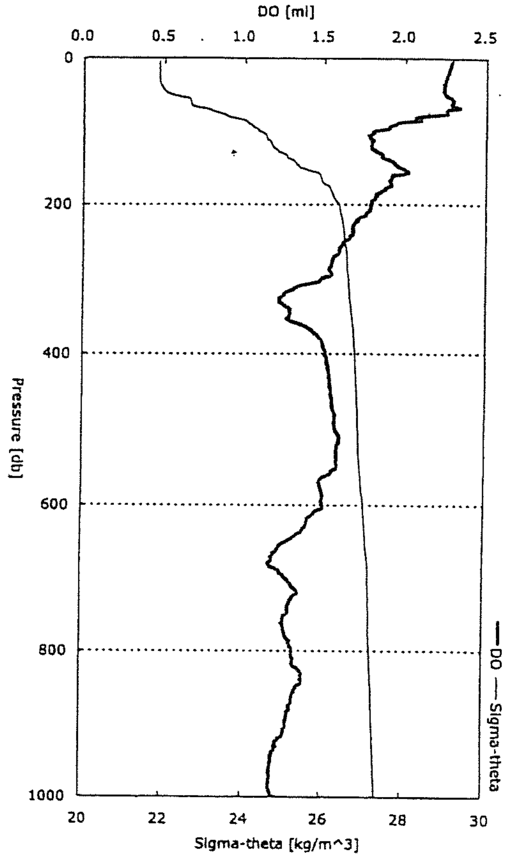

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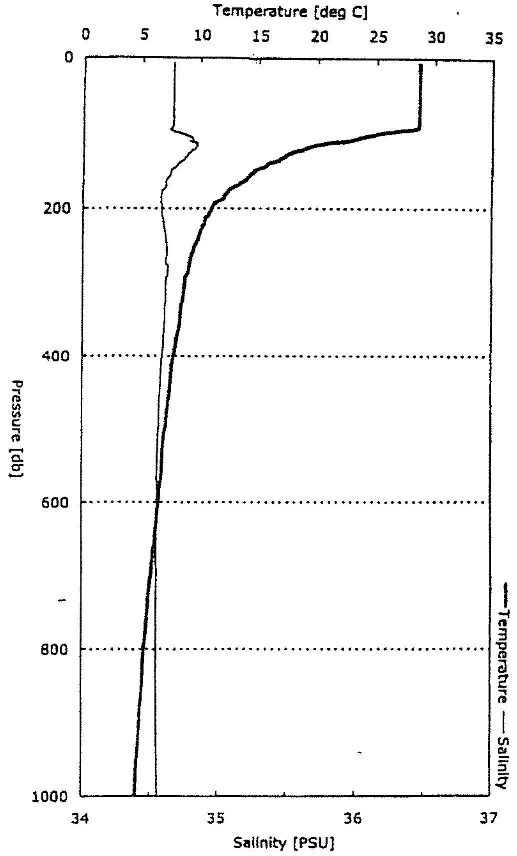
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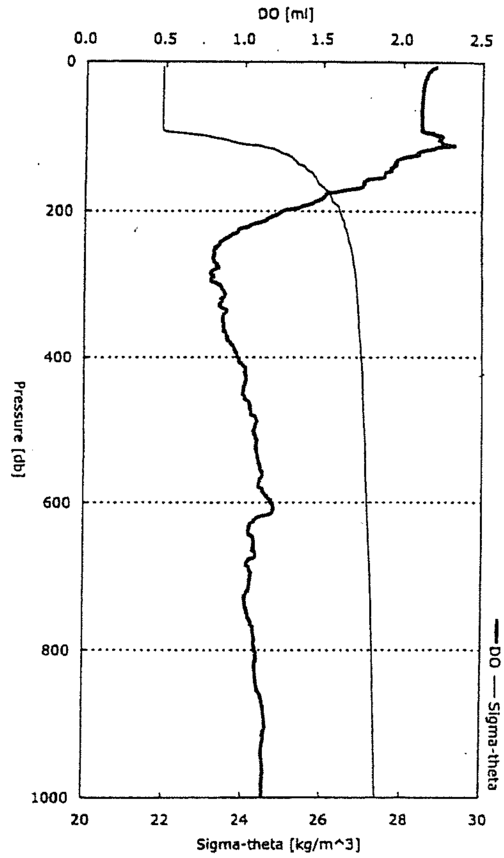
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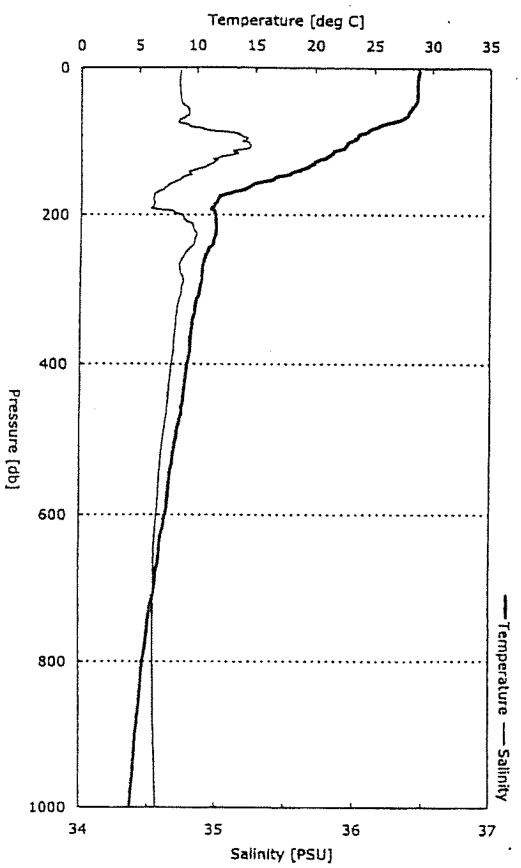
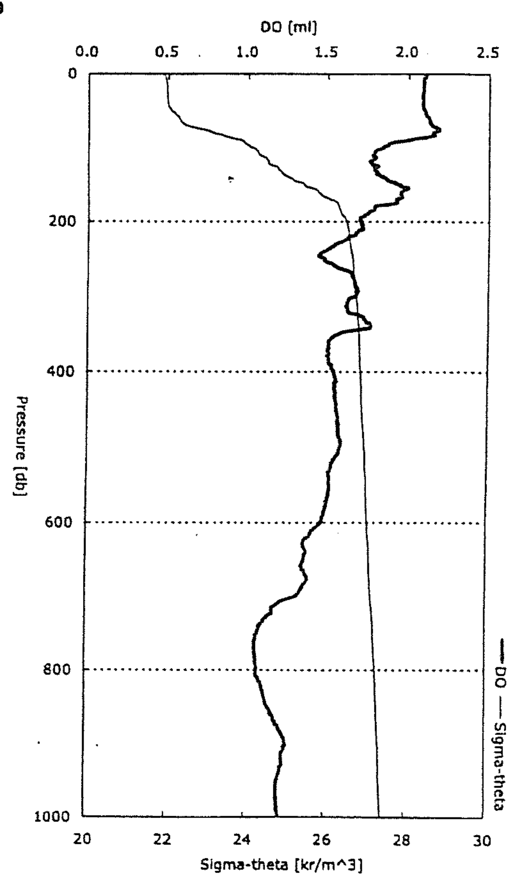
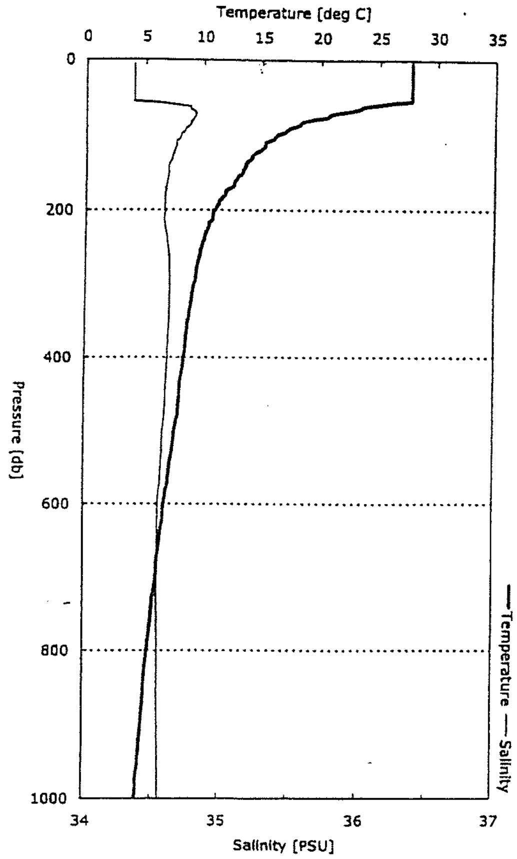
—DO —Sigma-theta

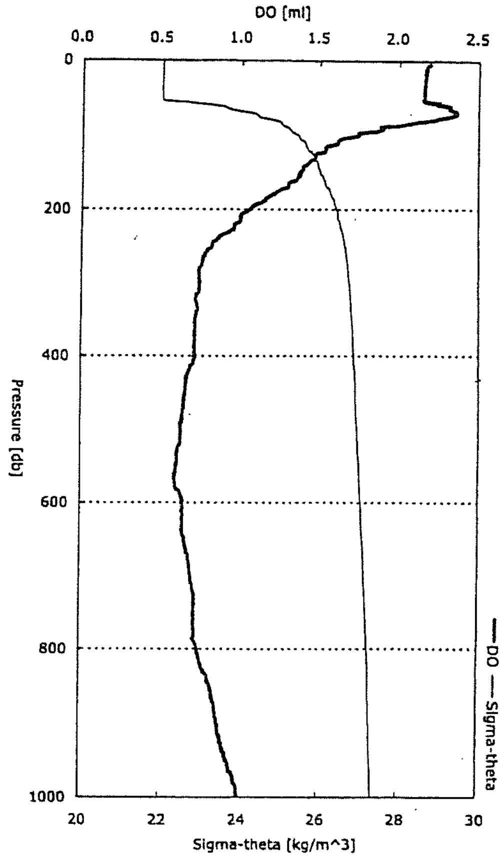
C16


Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

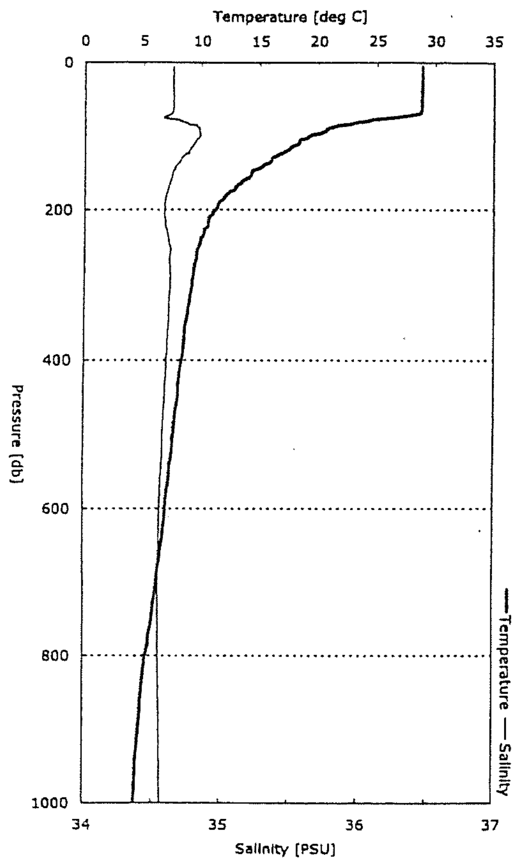

DO (ml)
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kr/m^3]
—DO —Sigma-theta

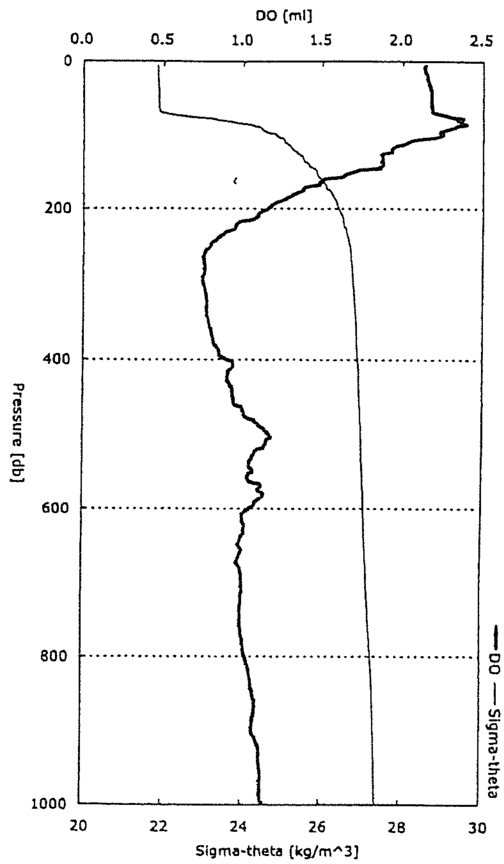
C17


Temperature [deg C]
0 5 10 15 20 25 30 35
0 200 400 600 800 1000
Pressure [db]
34 35 36 37
Salinity [PSU]
—Temperature — Salinity

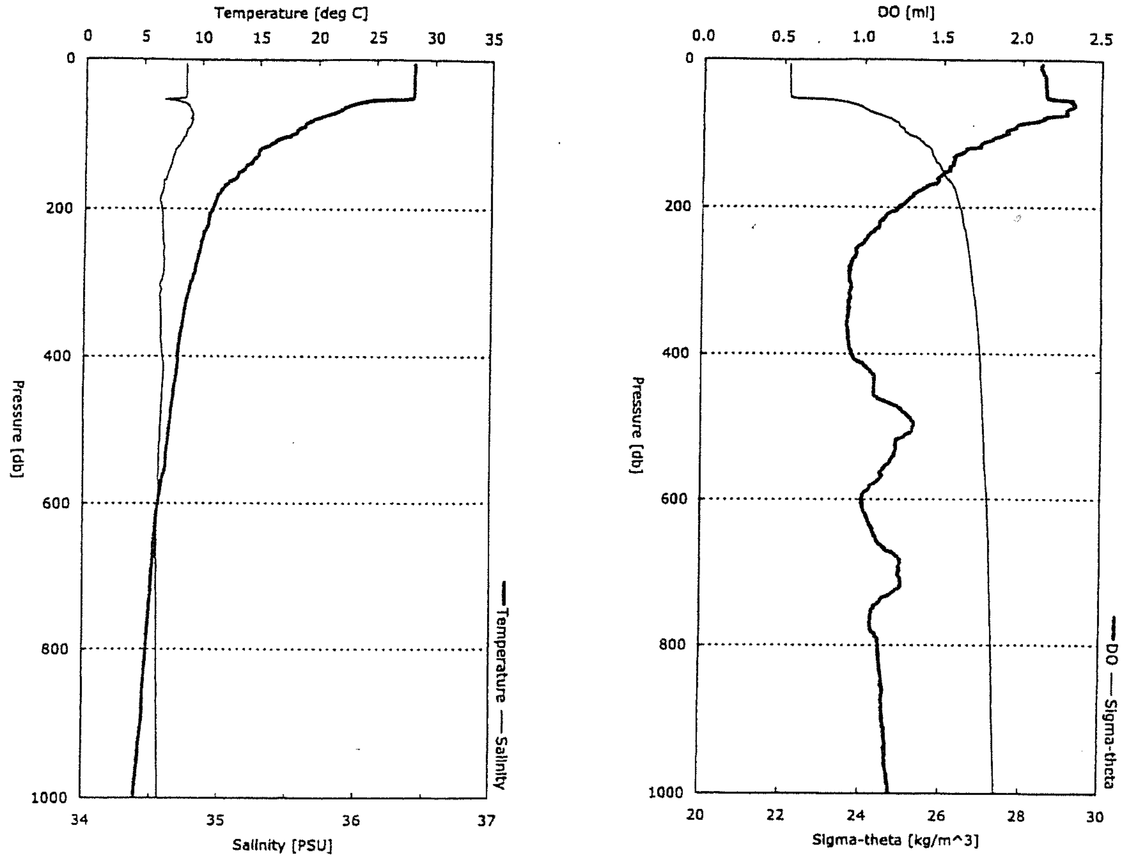

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0 200 400 600 800 1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C18

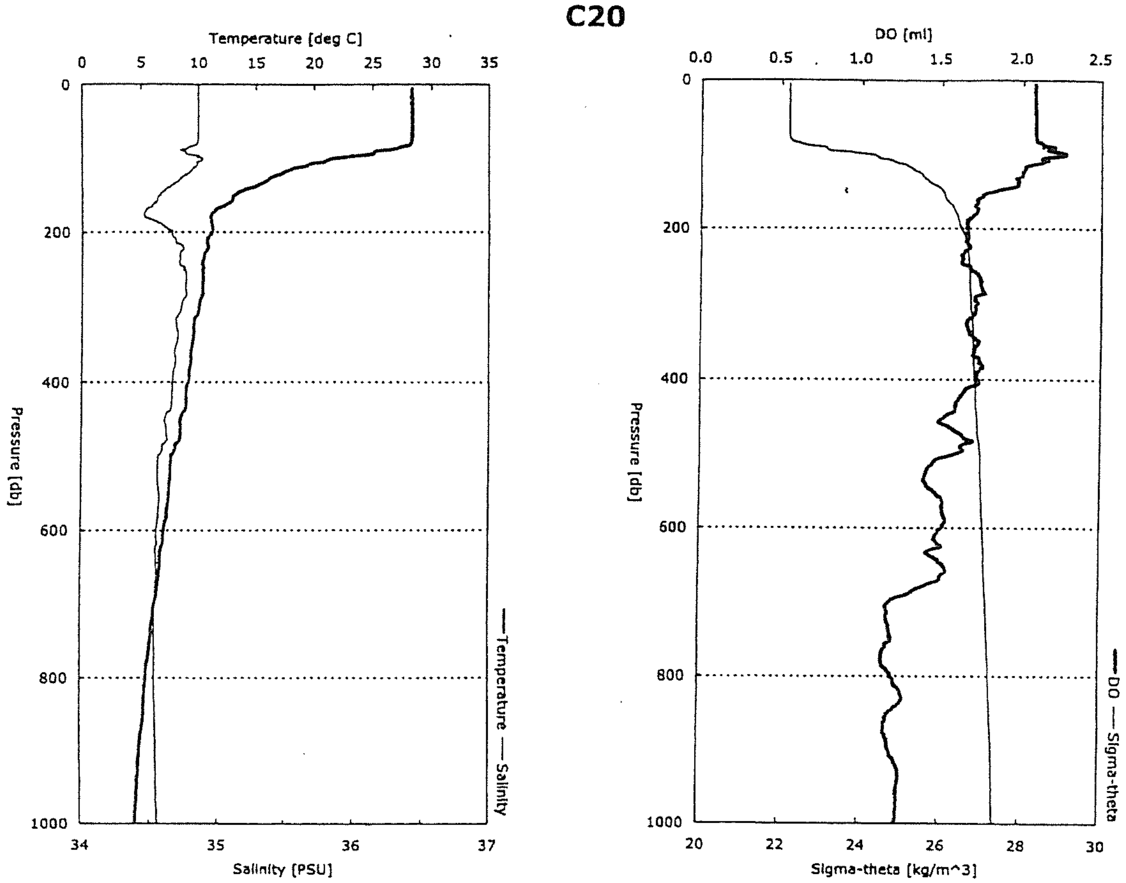

Temperature [deg C]
0 5 10 15 20 25 30 35
0 200 400 600 800 1000
Pressure [db]
34 35 36 37
Salinity [PSU]
—Temperature — Salinity


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0 200 400 600 800 1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

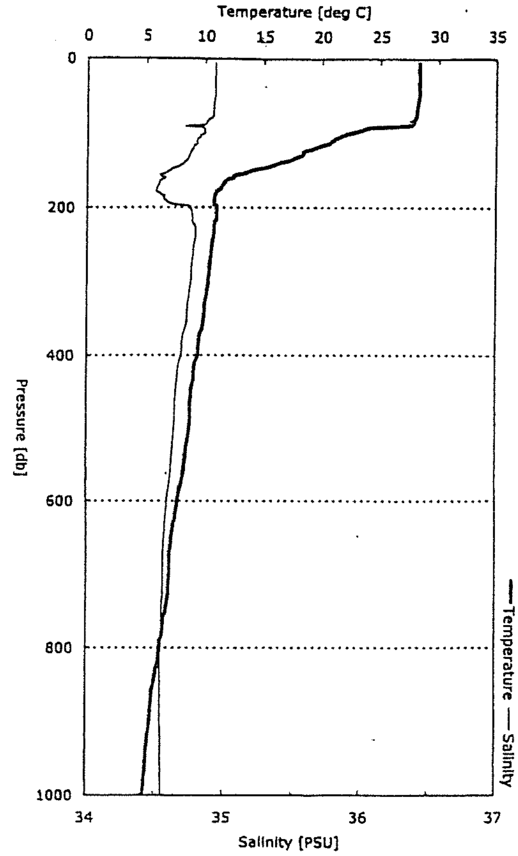
C19


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
Temperature — Salinity
DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO — Sigma-theta

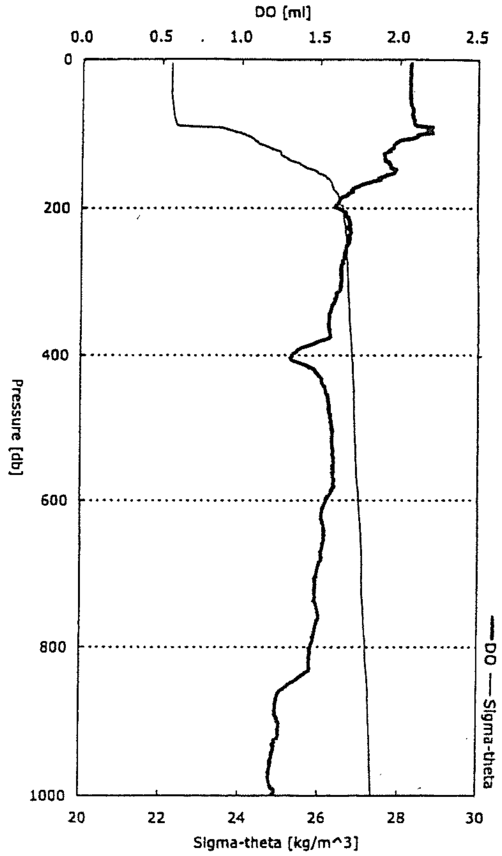
C20


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
Temperature — Salinity
DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO — Sigma-theta

C21

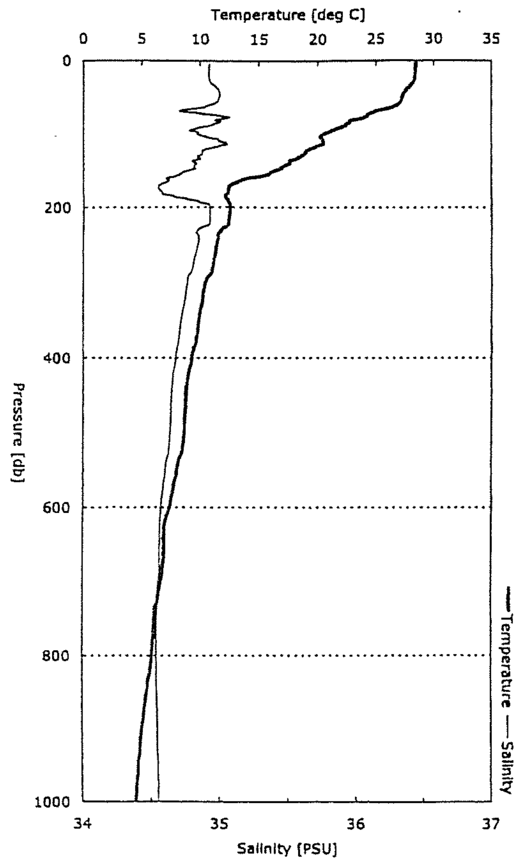


Temperature [deg C]
0
5
10
15
20
25
30
35
0
200
400
600
800
1000
Pressure [db]
34
35
36
37
Salinity [PSU]
—Temperature —Salinity

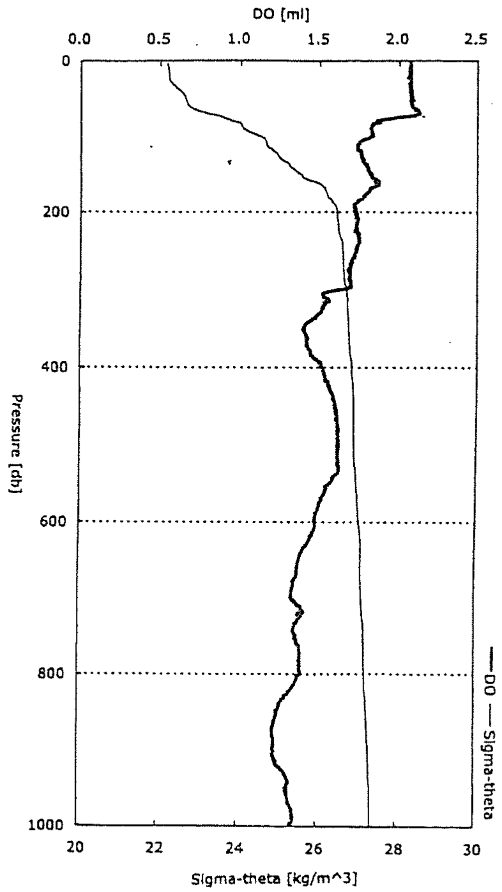


DO [ml]
0.0
0.5
1.0
1.5
2.0
2.5
0
200
400
600
800
1000
Pressure [db]
20
22
24
26
28
30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C22

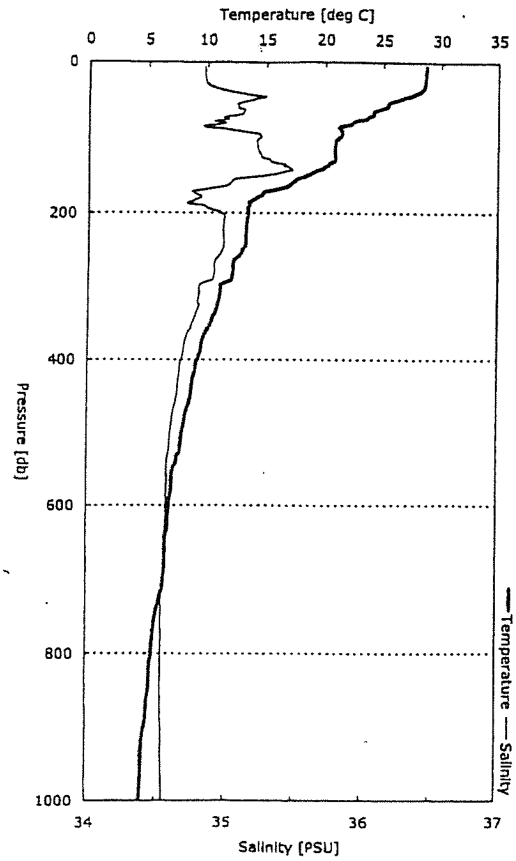


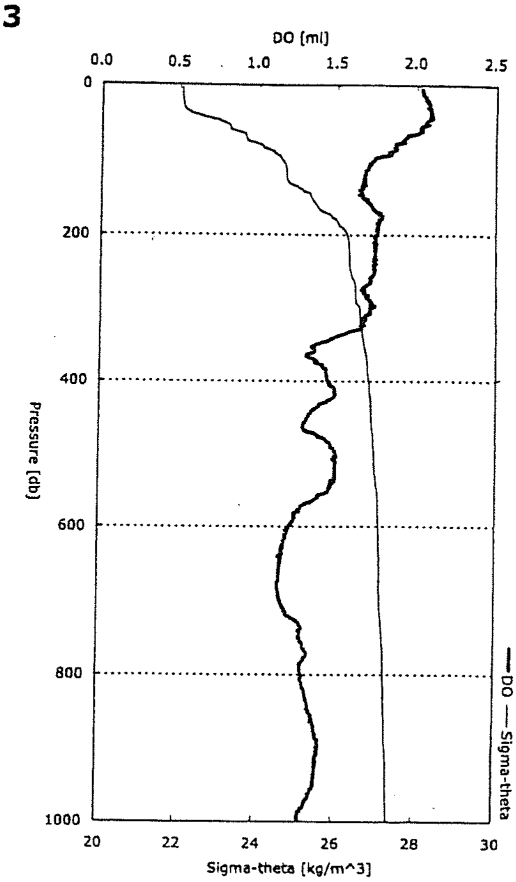
Temperature [deg C]
0
5
10
15
20
25
30
35
0
200
400
600
800
1000
Pressure [db]
34
35
36
37
Salinity [PSU]
—Temperature —Salinity



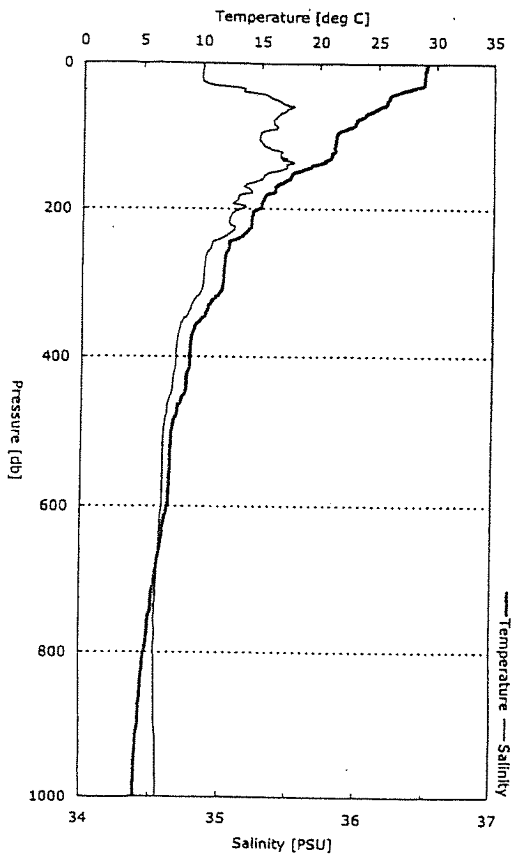
DO [ml]
0.0
0.5
1.0
1.5
2.0
2.5
0
200
400
600
800
1000
Pressure [db]
20
22
24
26
28
30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

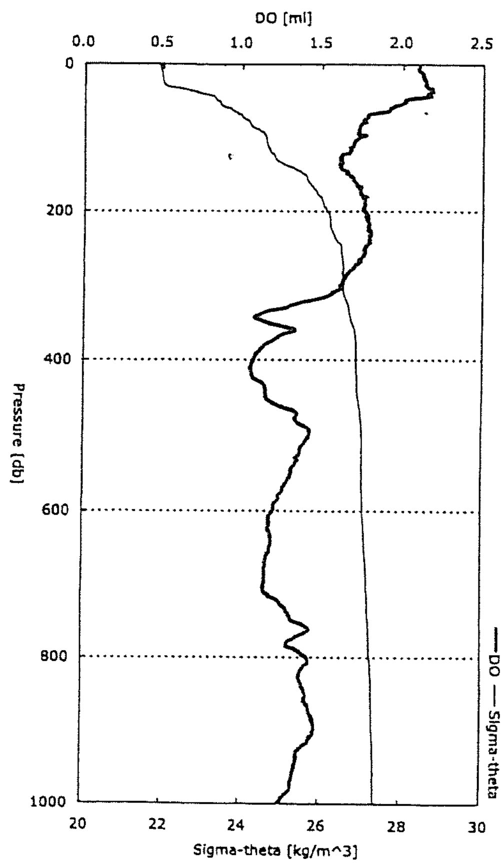
C23


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

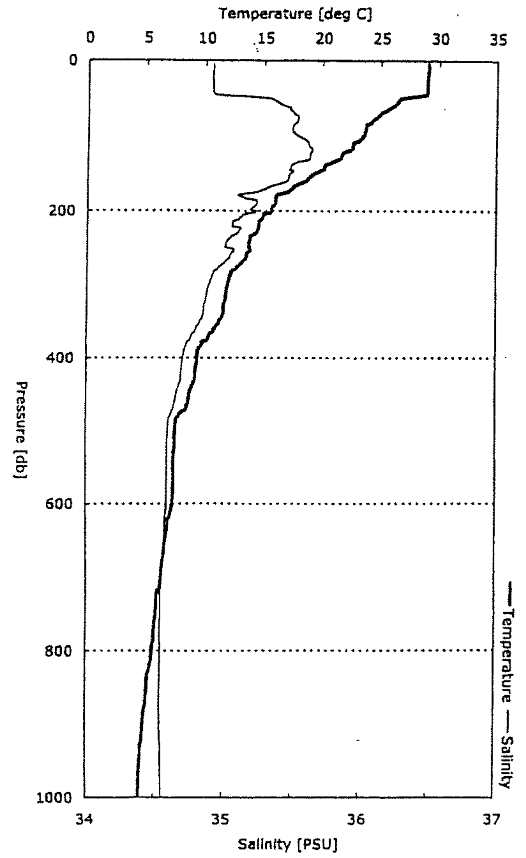

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C24

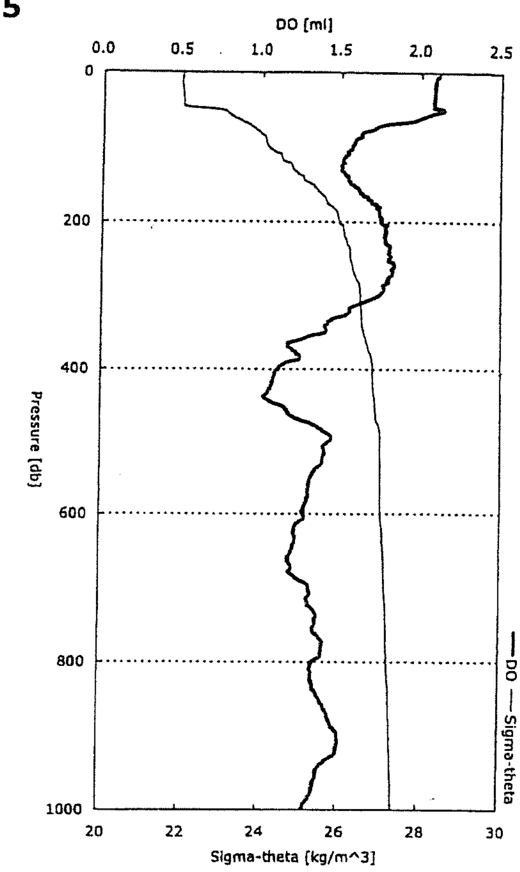

Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C25

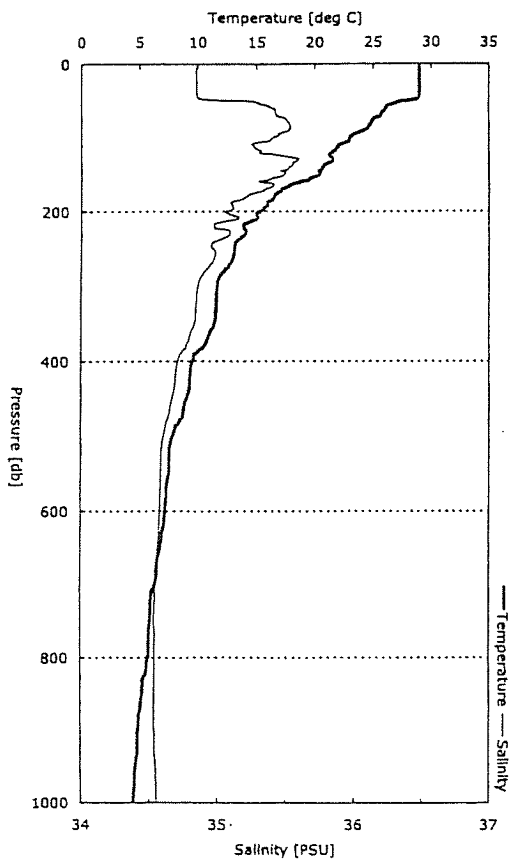


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

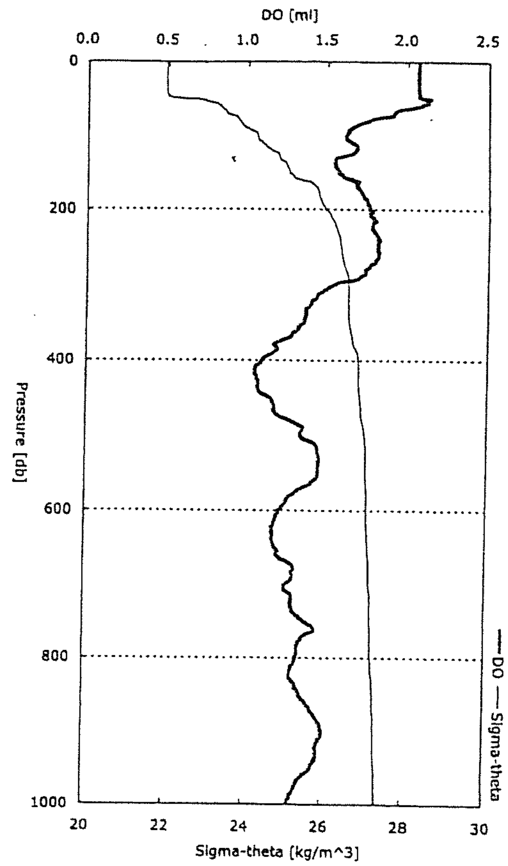


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C26

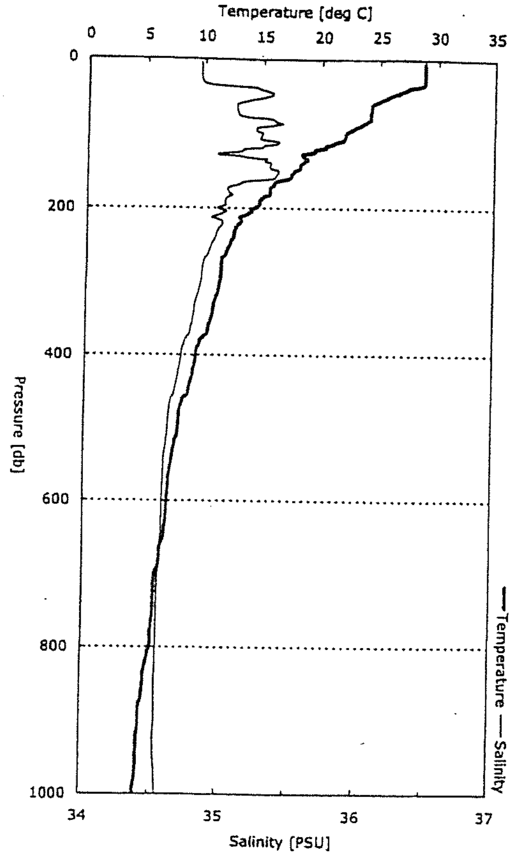


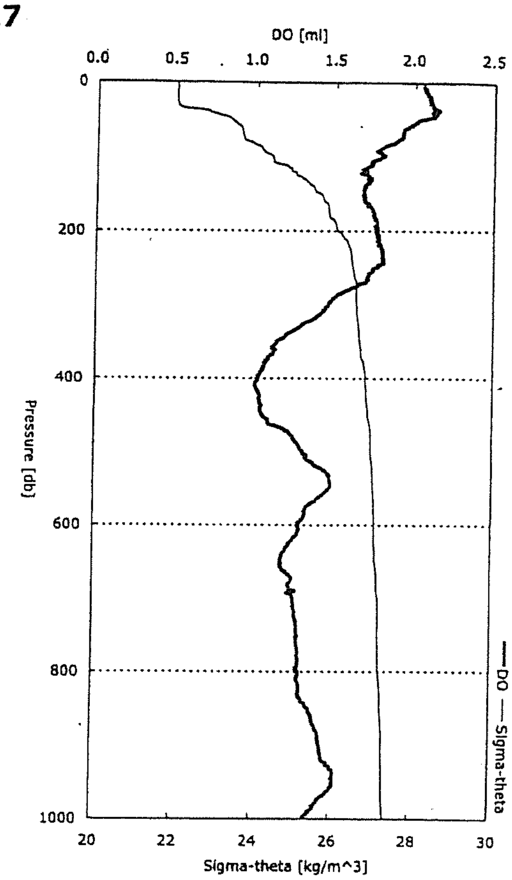
Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity



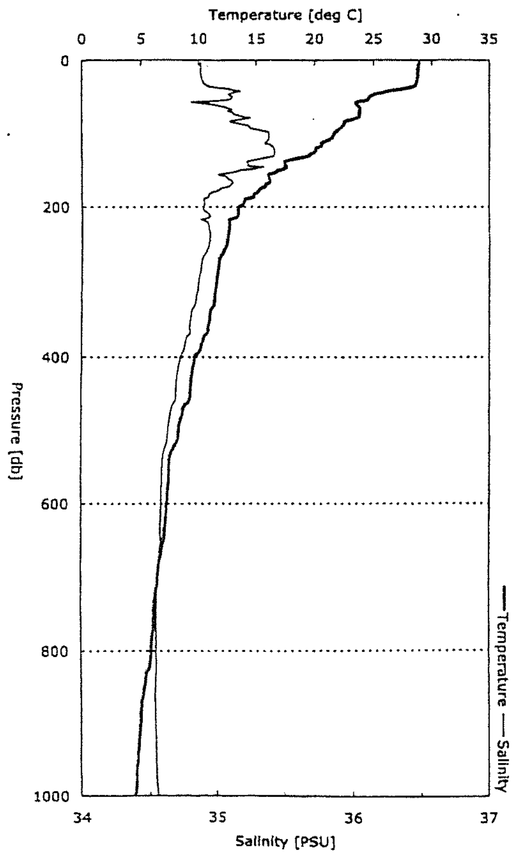
DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

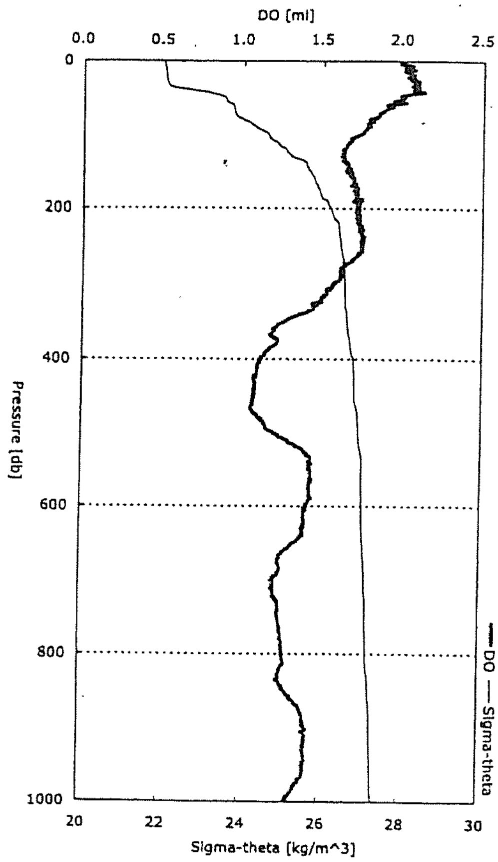
C27


Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
Temperature
Salinity

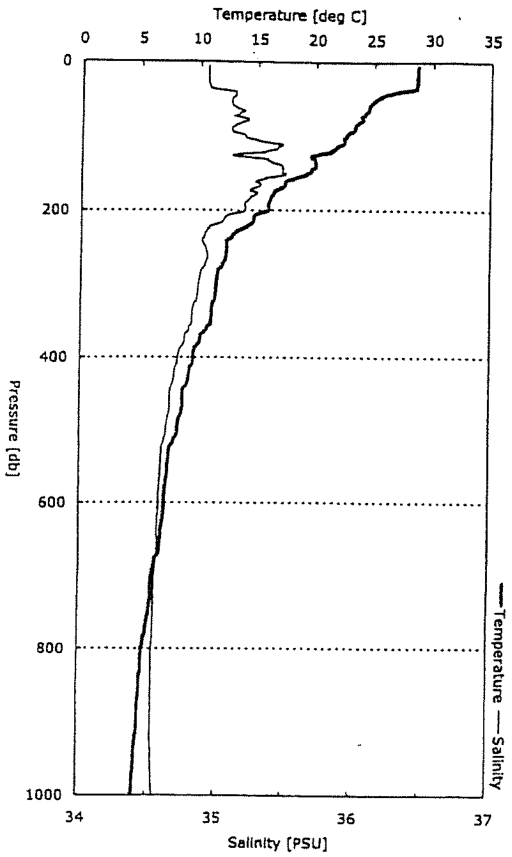

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO
Sigma-theta

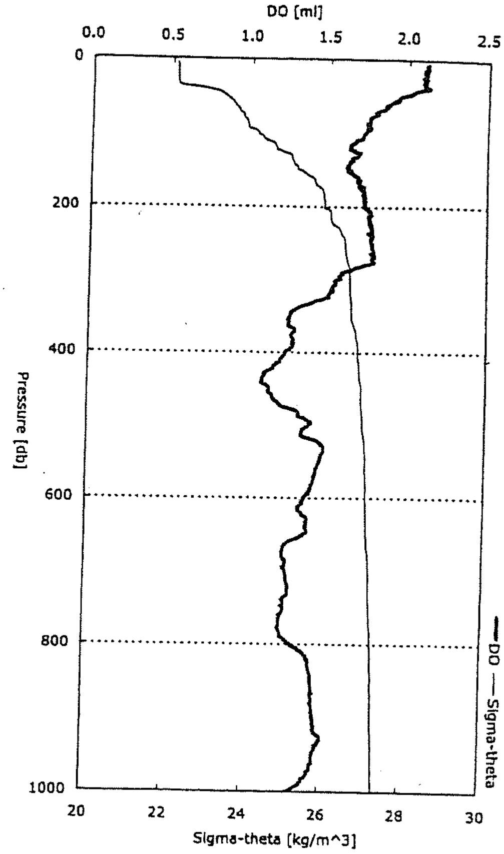
C28


Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
Temperature
Salinity

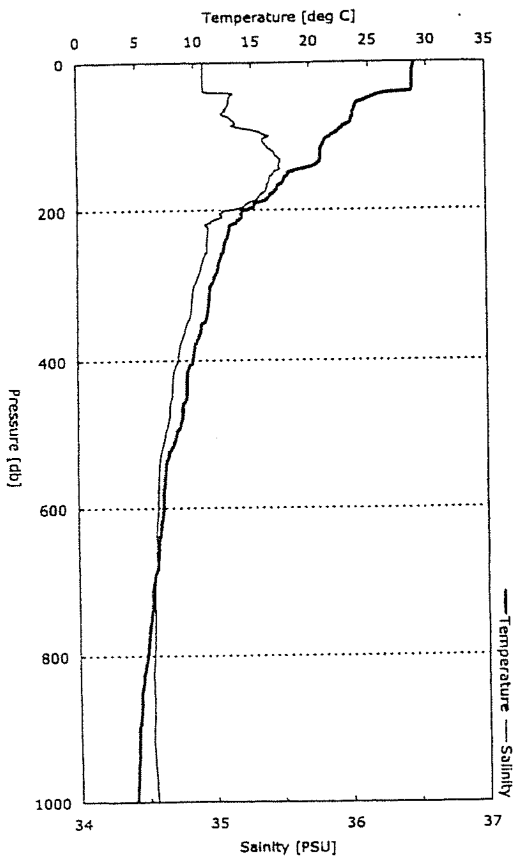

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO
Sigma-theta

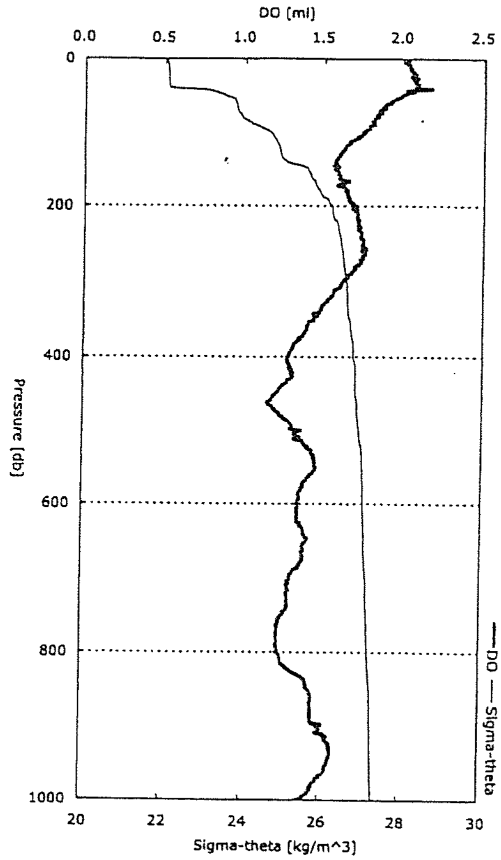
C29


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
Temperature — Salinity

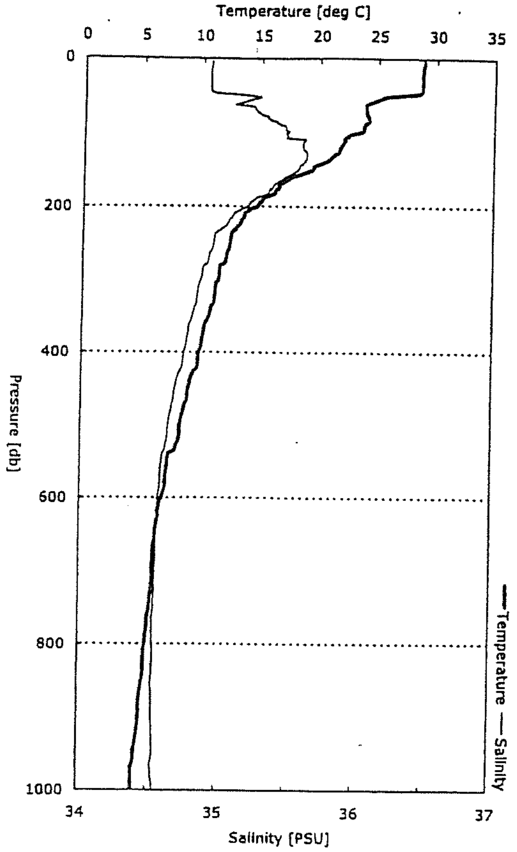

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO — Sigma-theta

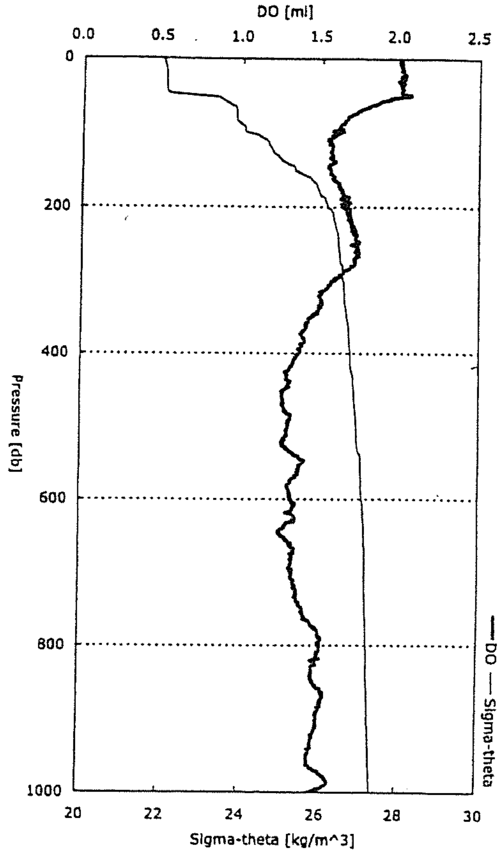
C30


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Sainity [PSU]
Temperature — Salinity

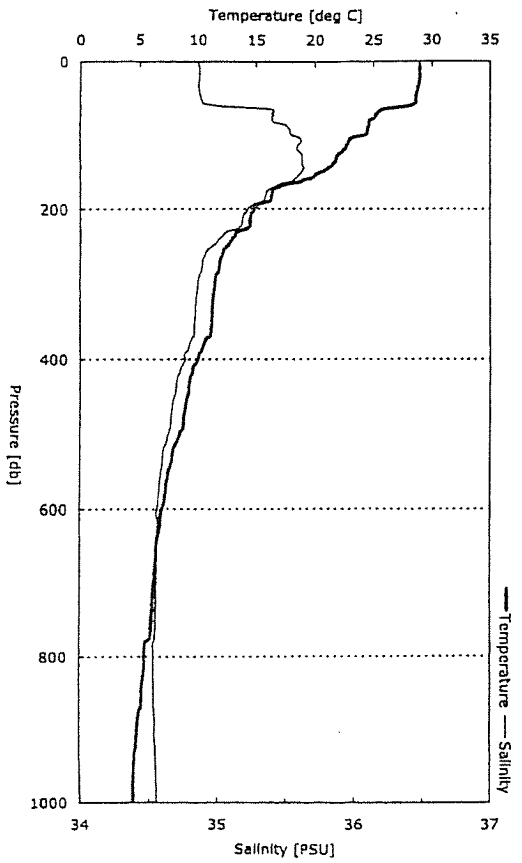

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO — Sigma-theta

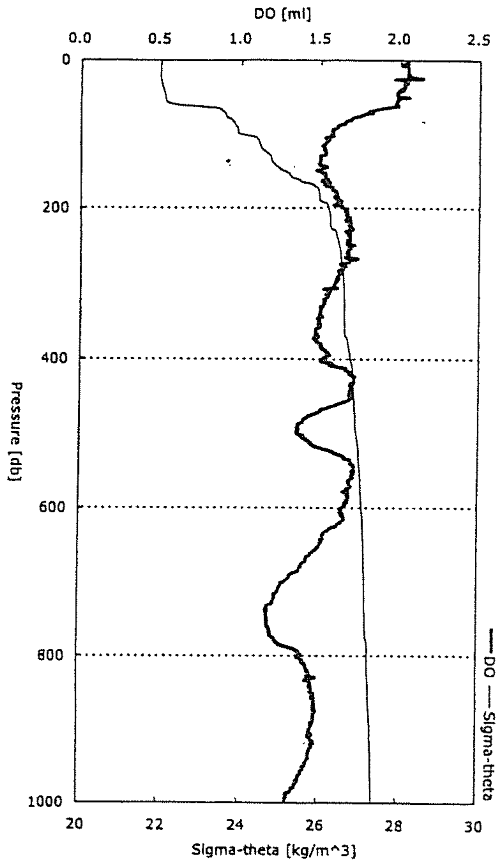
C31


Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

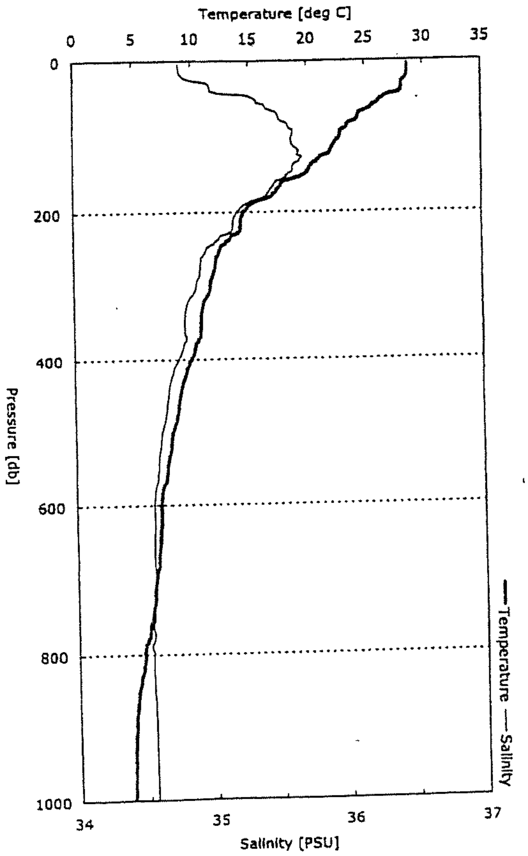

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C32

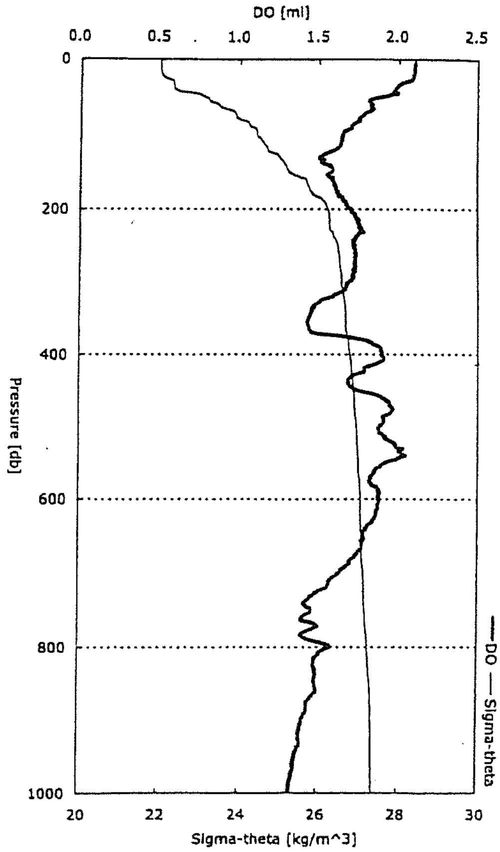

Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
—Temperature —Salinity


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C33

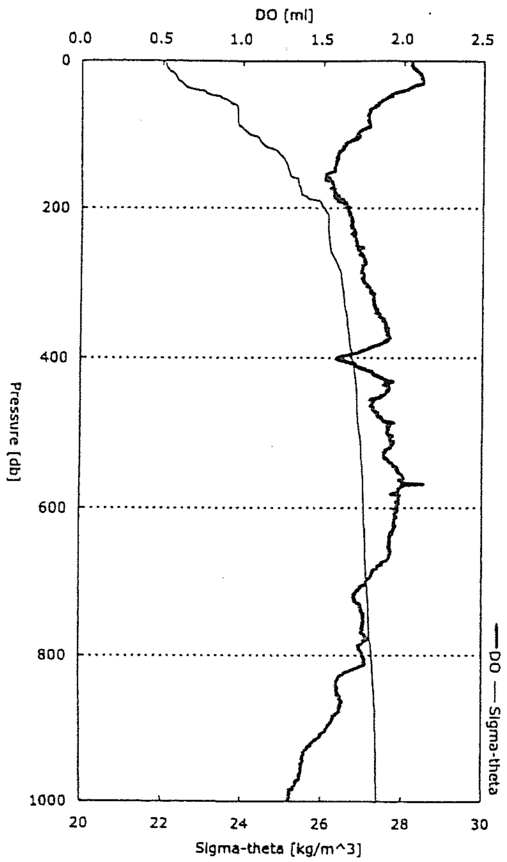


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

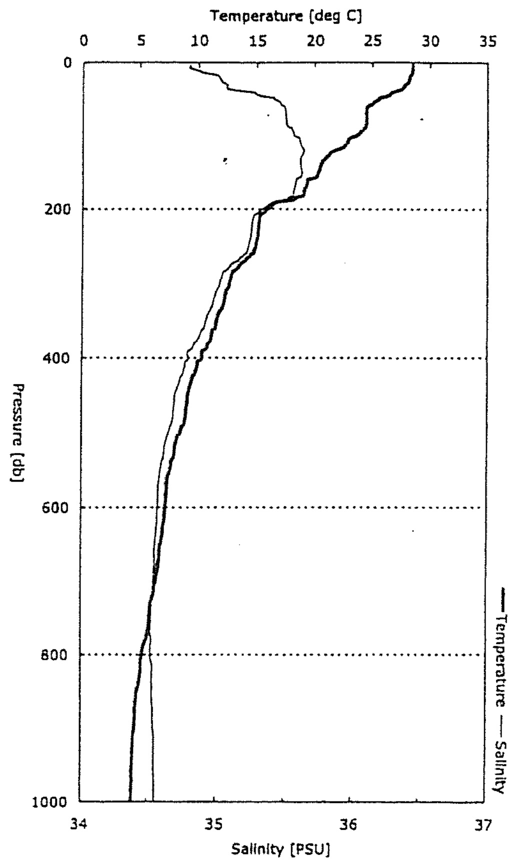


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C34

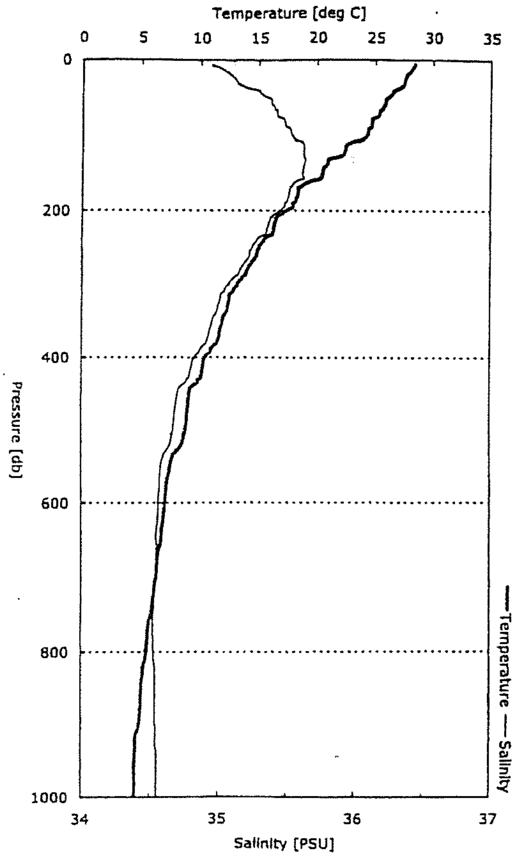


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

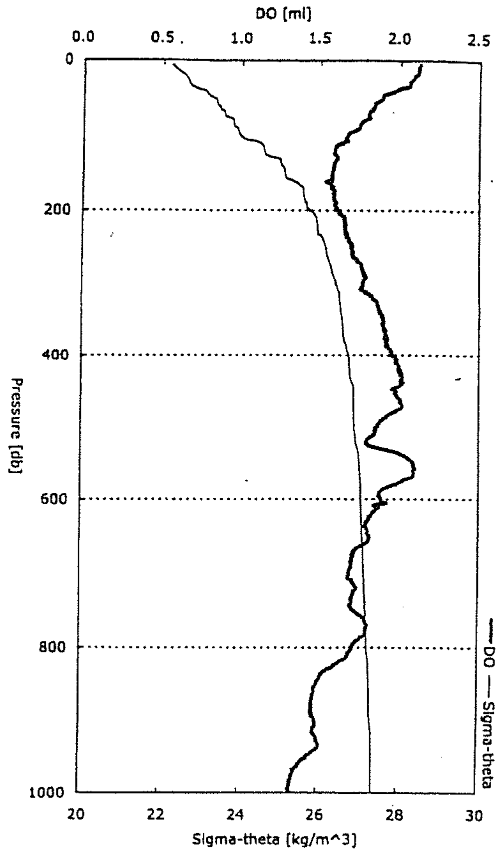


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

C35

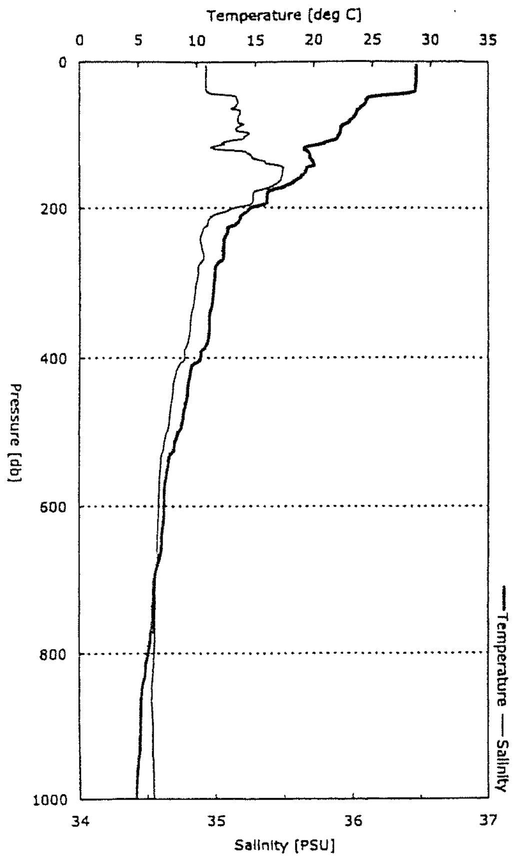


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

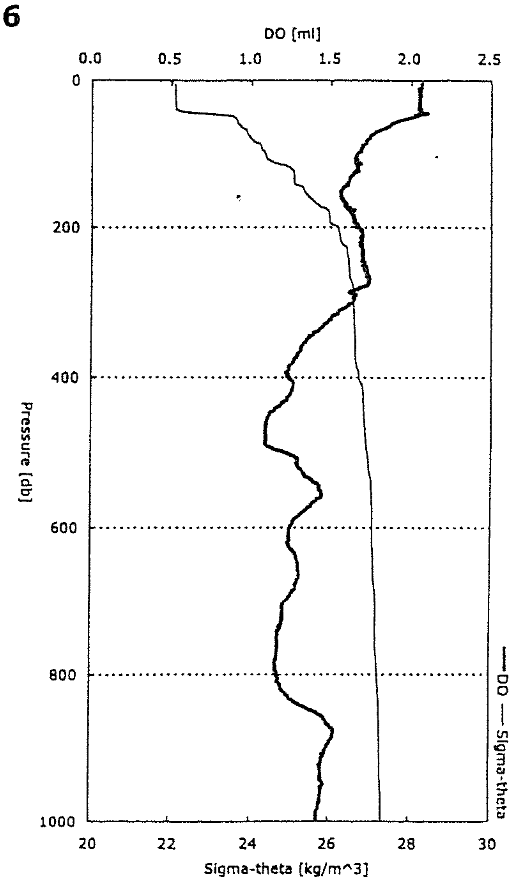


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C36

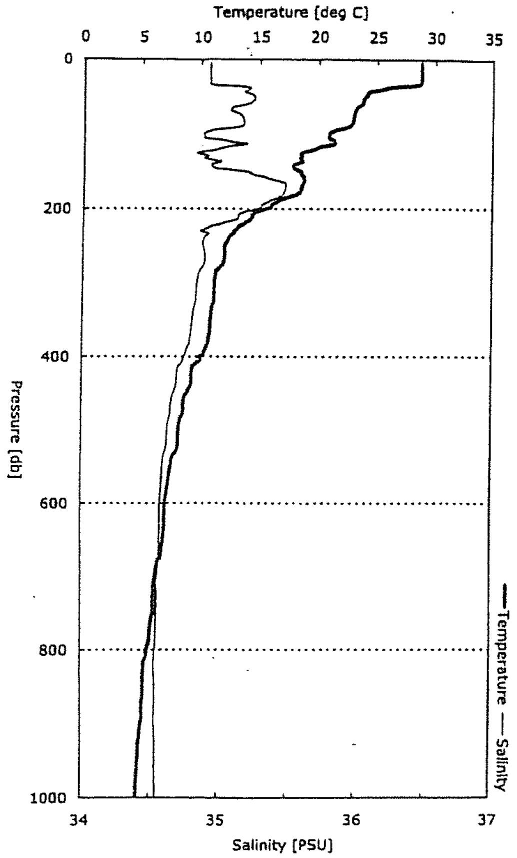


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

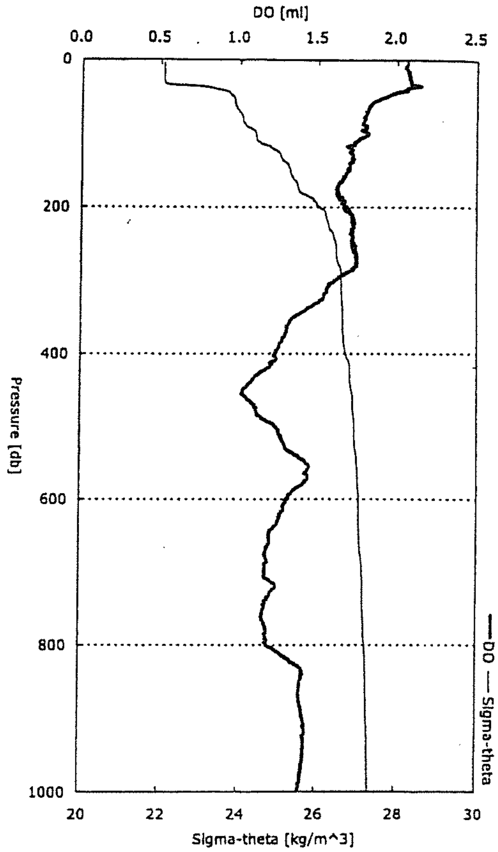


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C37

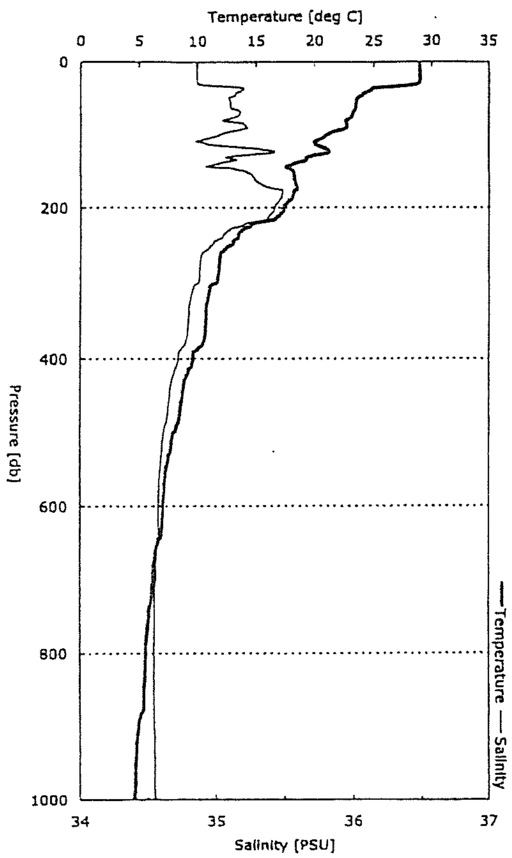


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

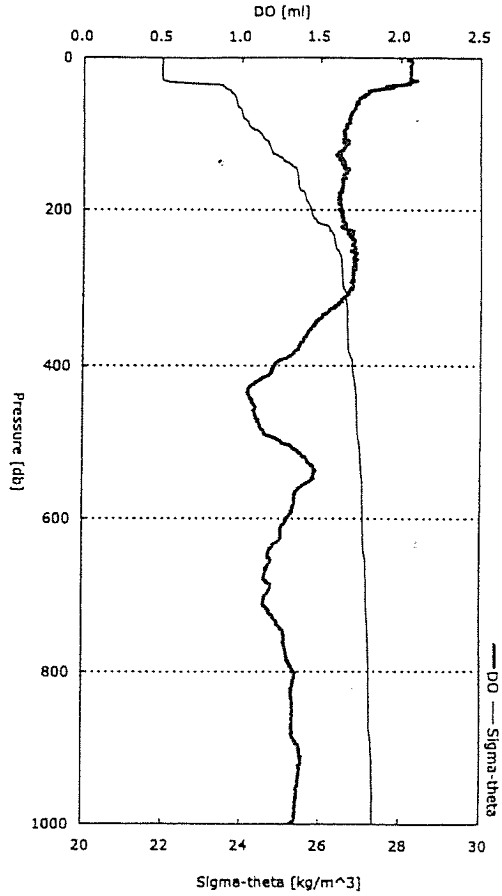


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C38

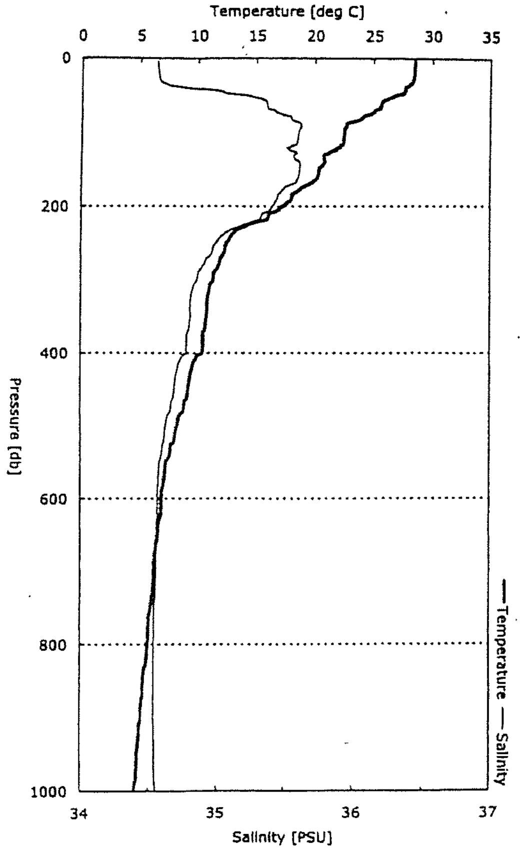


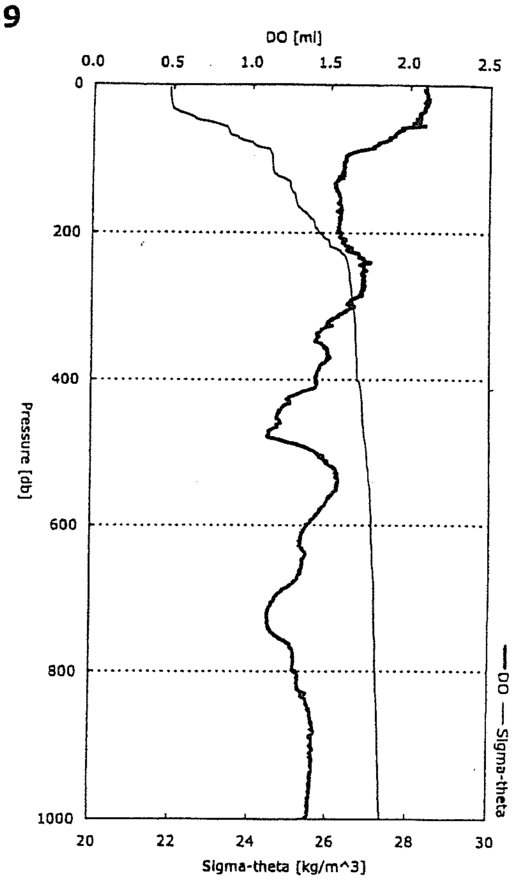
Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity



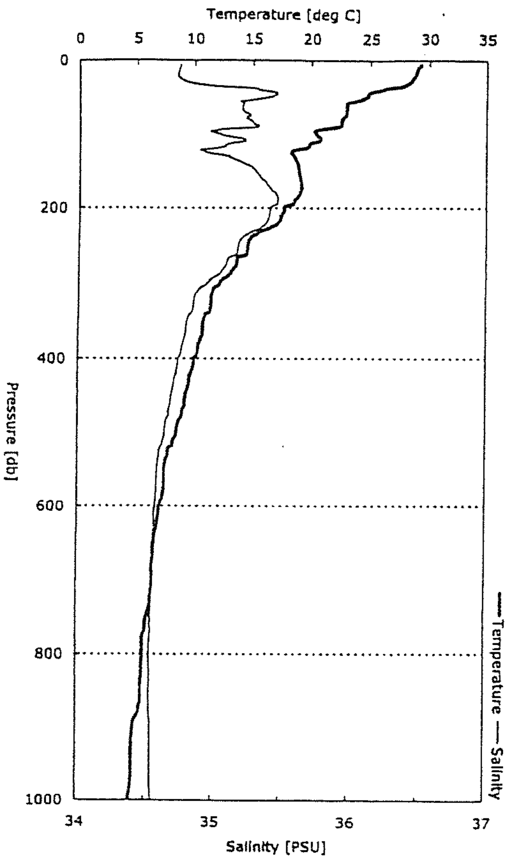
DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

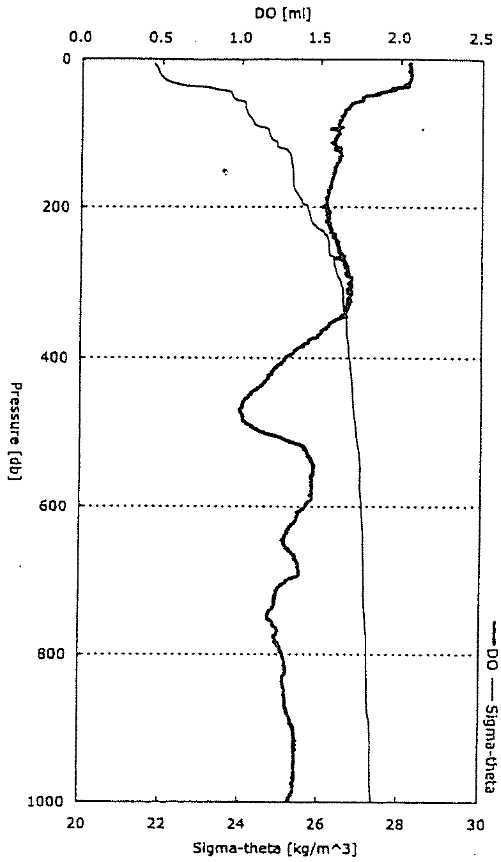
C39


Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
Temperature — Salinity

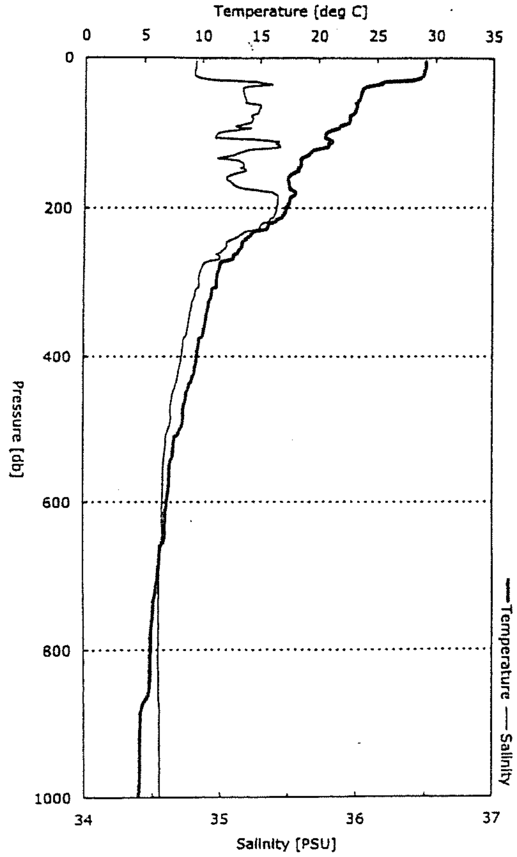

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO — Sigma-theta

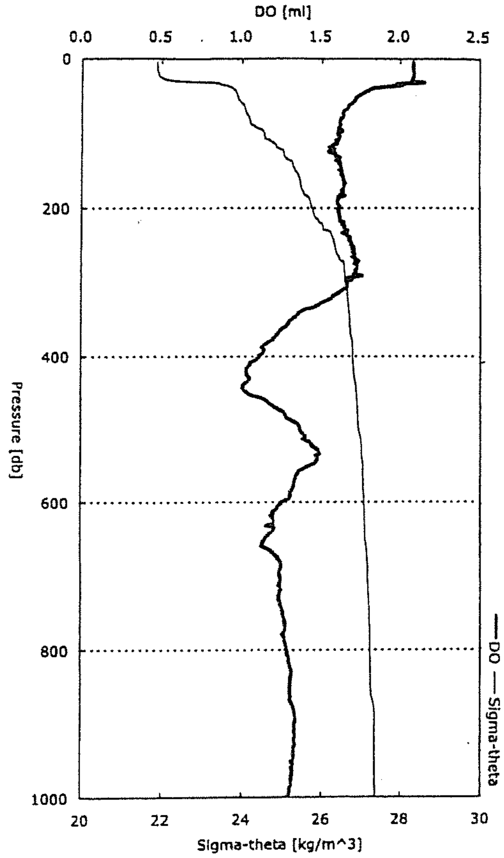
C40


Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
Temperature — Salinity

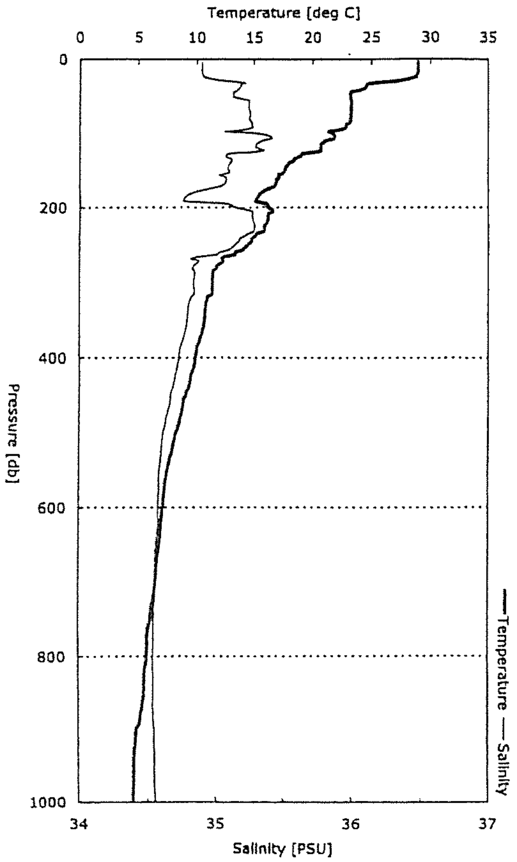

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
DO — Sigma-theta

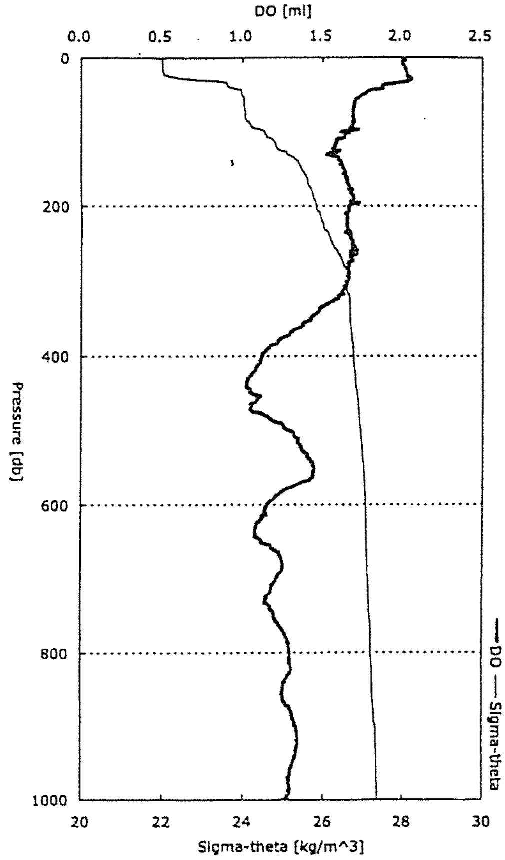
C41


Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

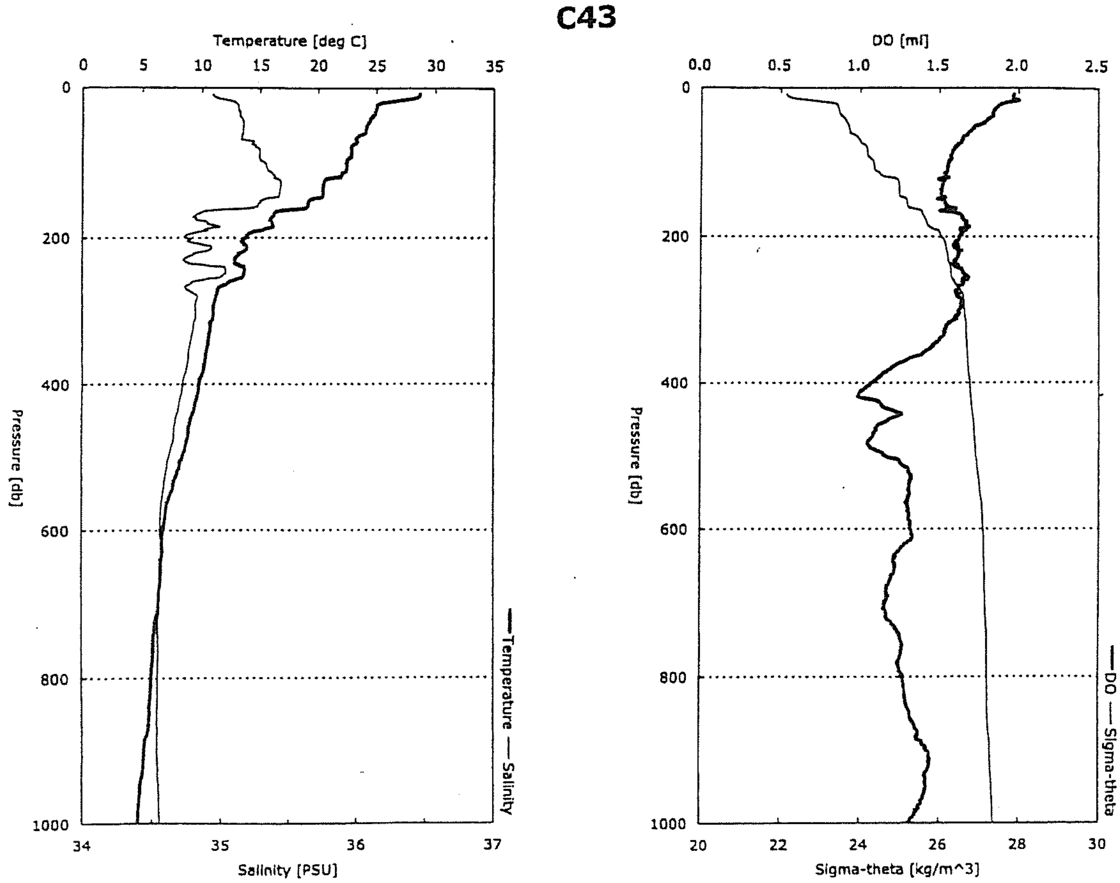

DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C42

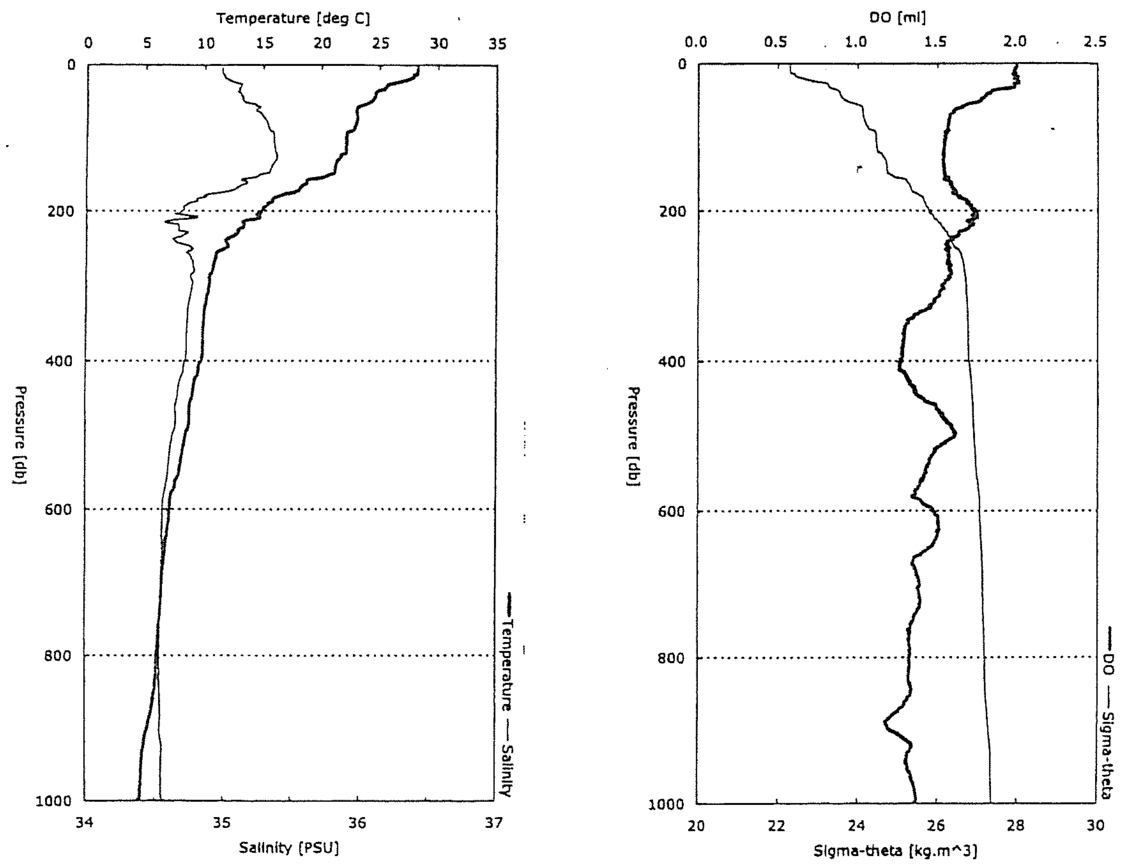

Temperature [deg C]
0 5 10 15 20 25 30 35
0
200
400
600
800
1000
Pressure [db]
34 35 36 37
Salinity [PSU]
—Temperature —Salinity


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0
200
400
600
800
1000
Pressure [db]
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

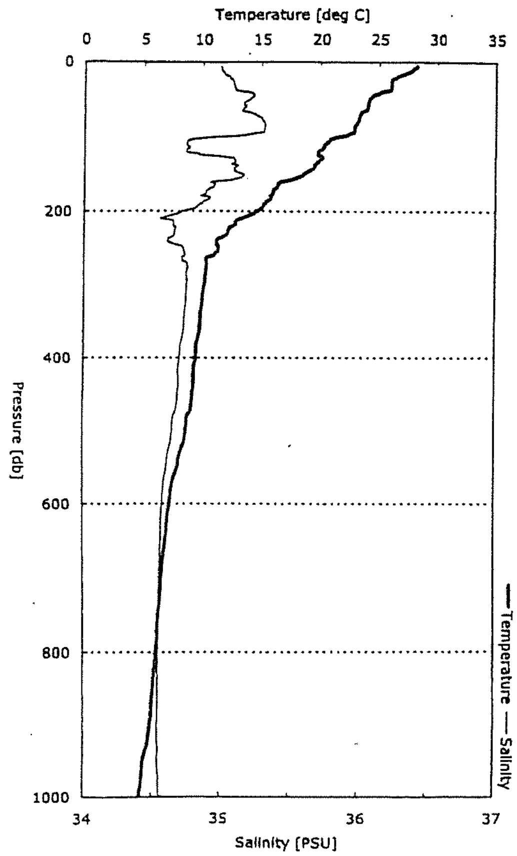
C43


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature — Salinity
DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

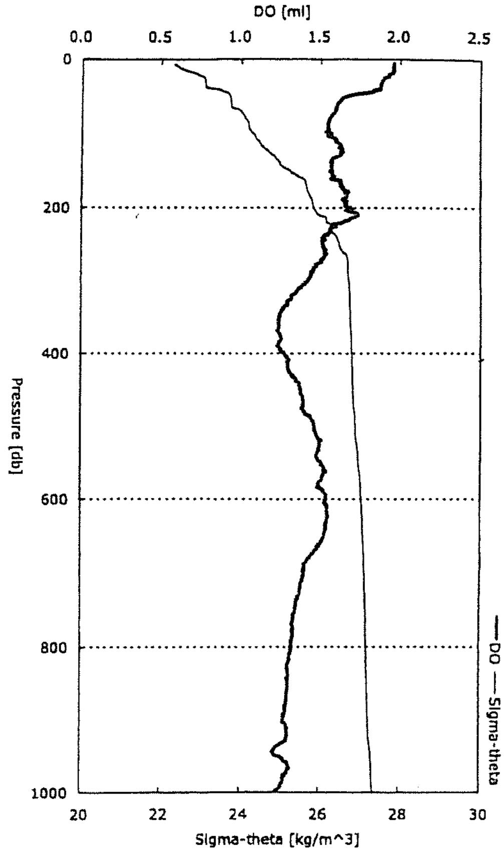
C44


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature — Salinity
DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
20 22 24 26 28 30
Sigma-theta [kg.m^3]
—DO —Sigma-theta

C45

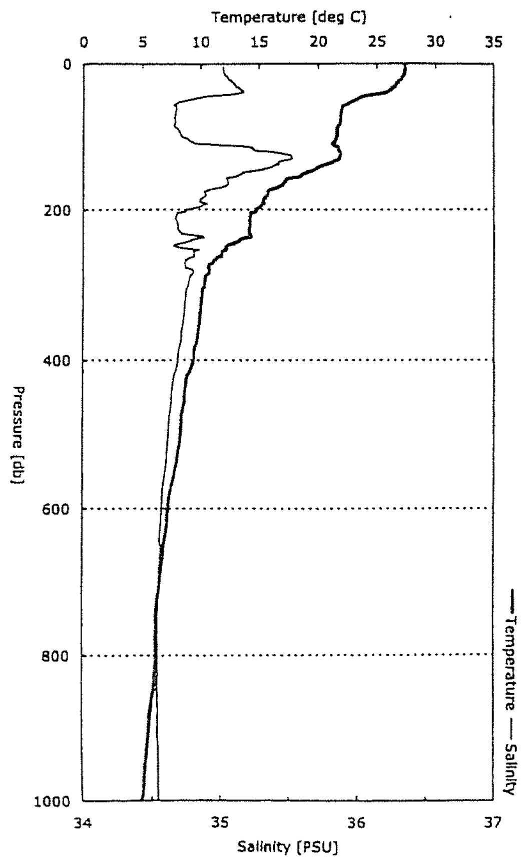


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

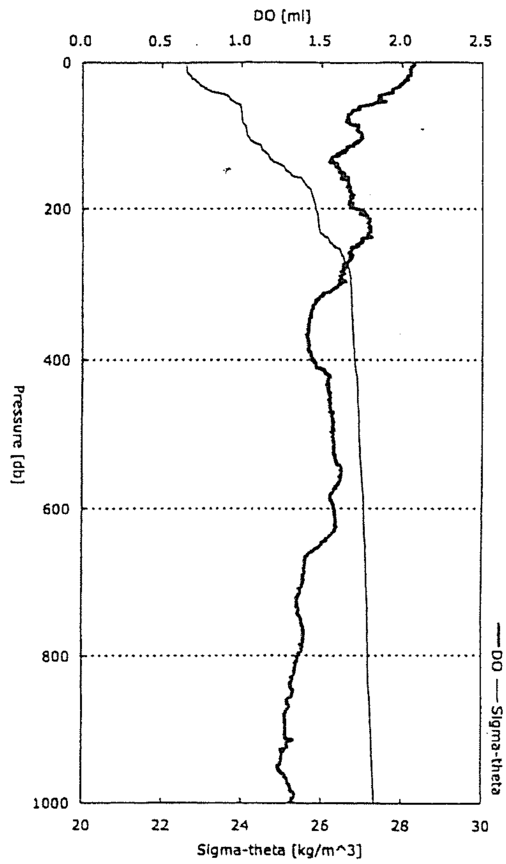


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C46

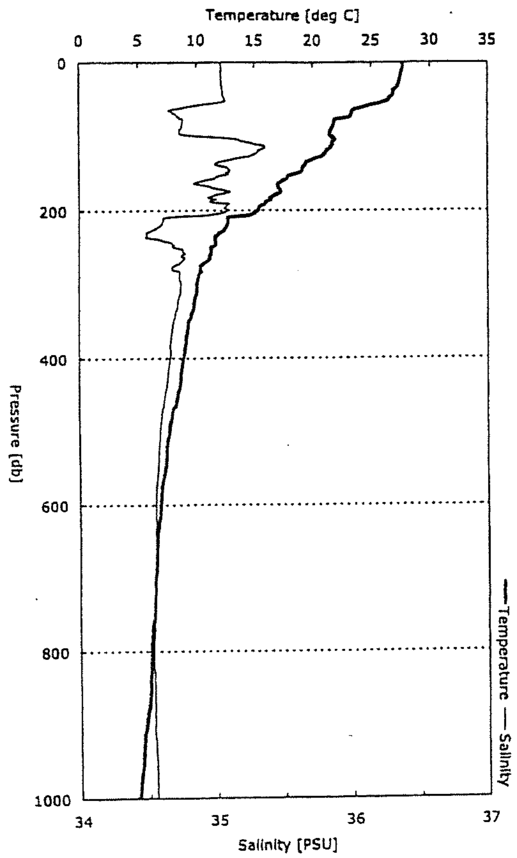


Temperature [deg C]
0 5 10 15 20 25 30 35
Pressure [db]
0 200 400 600 800 1000
34 35 36 37
Salinity [PSU]
—Temperature —Salinity

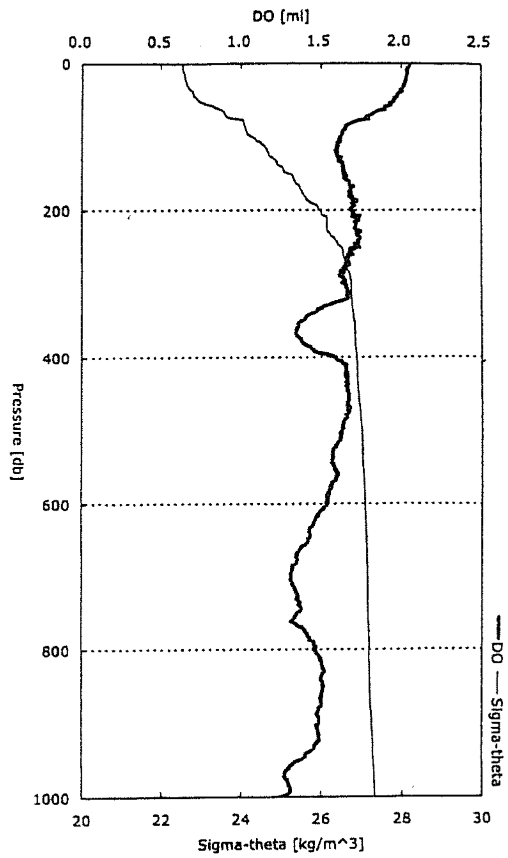


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
Pressure [db]
0 200 400 600 800 1000
20 22 24 26 28 30
Sigma-theta [kg/m^3]
—DO —Sigma-theta

C47

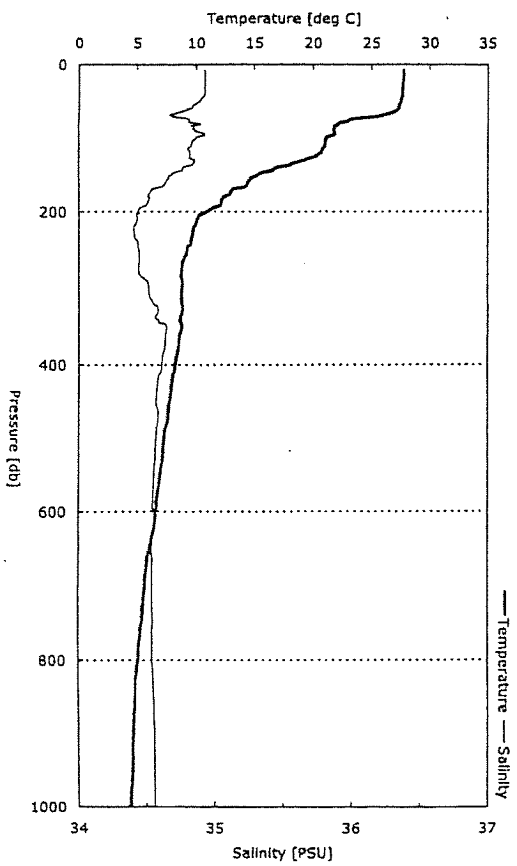


Temperature [deg C]
0 5 10 15 20 25 30 35
0 200 400 600 800 1000
Pressure [db]
Temperature — Salinity
34 35 36 37
Salinity [PSU]

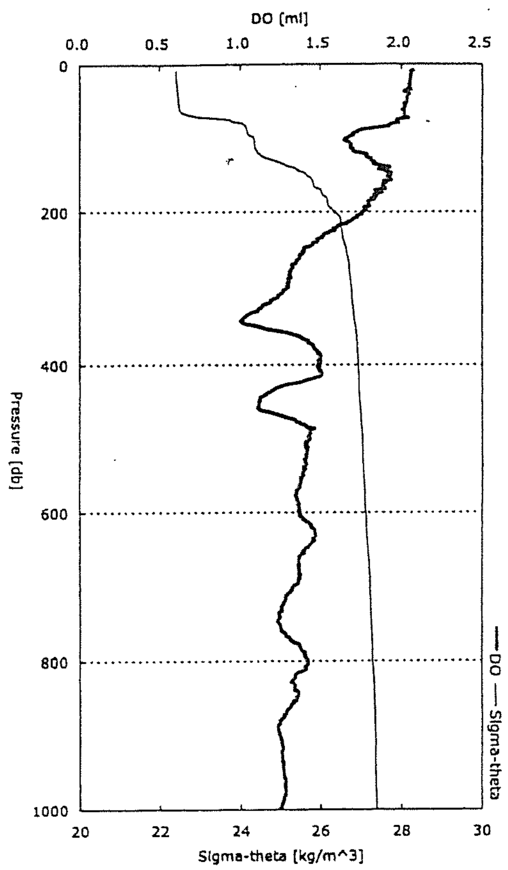


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0 200 400 600 800 1000
Pressure [db]
DO — Sigma-theta
20 22 24 26 28 30
Sigma-theta [kg/m^3]

C48

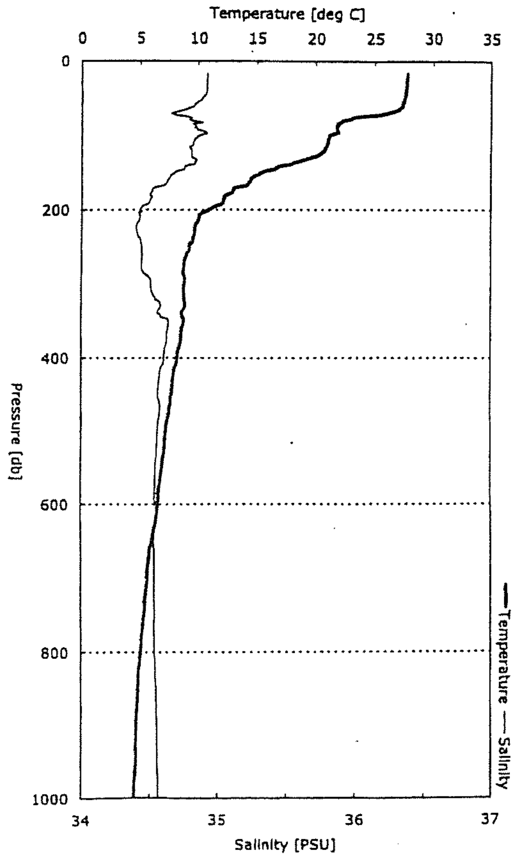


Temperature [deg C]
0 5 10 15 20 25 30 35
0 200 400 600 800 1000
Pressure [db]
Temperature — Salinity
34 35 36 37
Salinity [PSU]

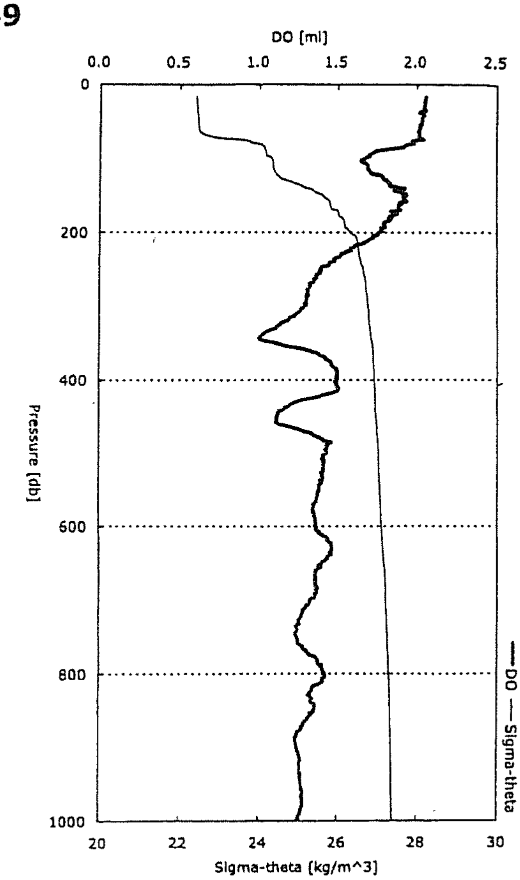


DO [ml]
0.0 0.5 1.0 1.5 2.0 2.5
0 200 400 600 800 1000
Pressure [db]
DO — Sigma-theta
20 22 24 26 28 30
Sigma-theta [kg/m^3]

C49



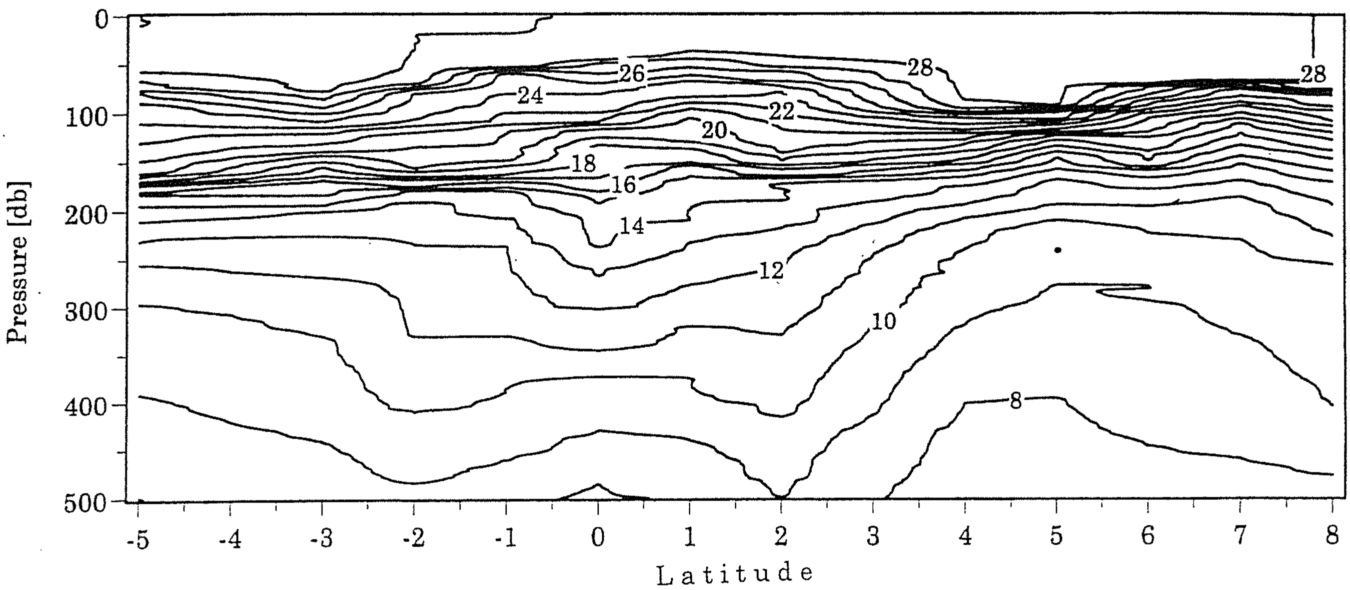
Temperature [deg C]
0
5
10
15
20
25
30
35
Pressure [db]
0
200
400
600
800
1000
34
35
36
37
Salinity [PSU]
Temperature
Salinity



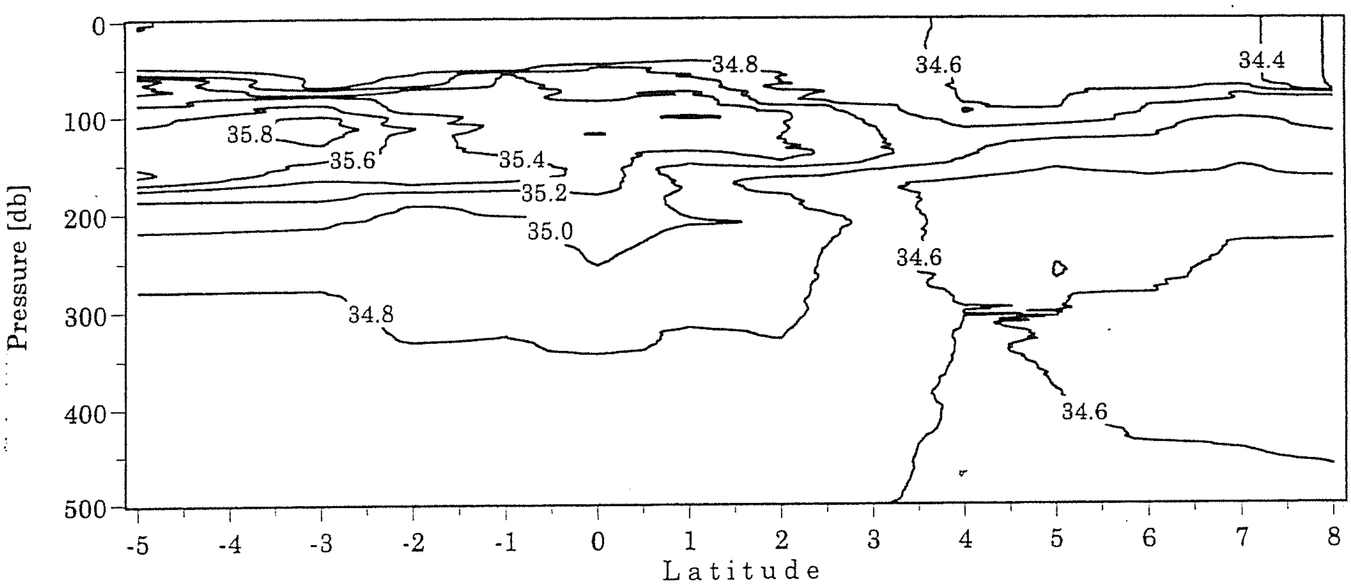
DO [ml]
0.0
0.5
1.0
1.5
2.0
2.5
Pressure [db]
0
200
400
600
800
1000
20
22
24
26
28
30
Sigma-theta [kg/m^3]
DO
Sigma-theta

4.3 CTD Sections

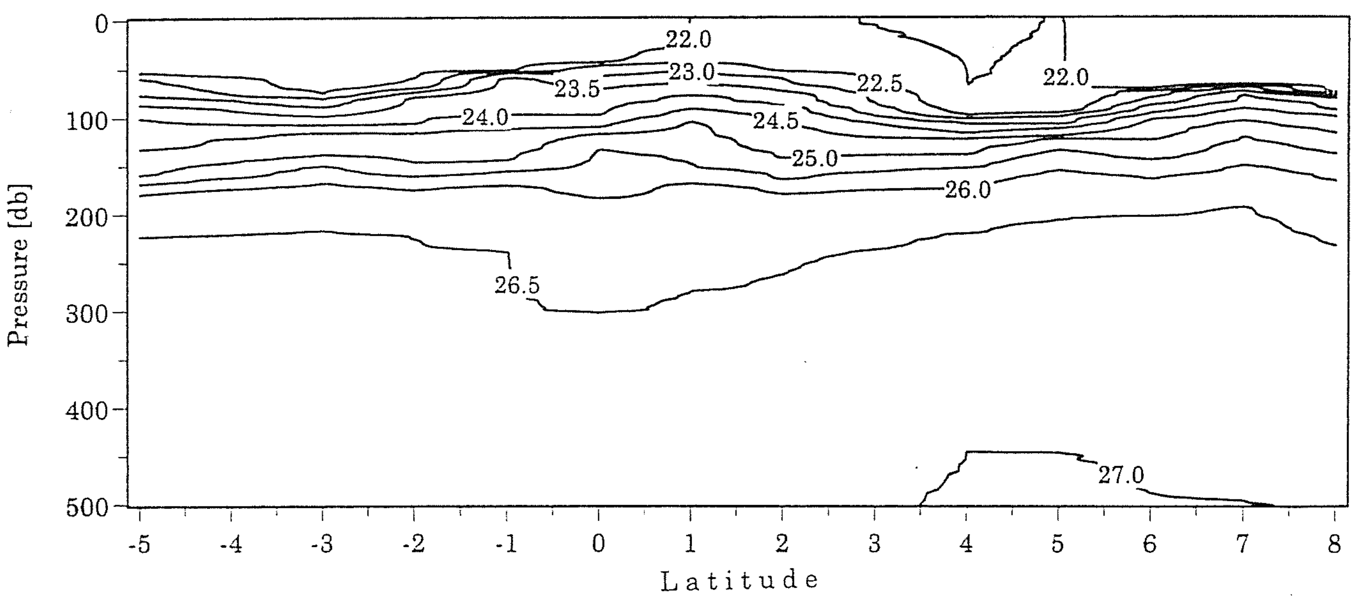
165E Temperature [deg-C]



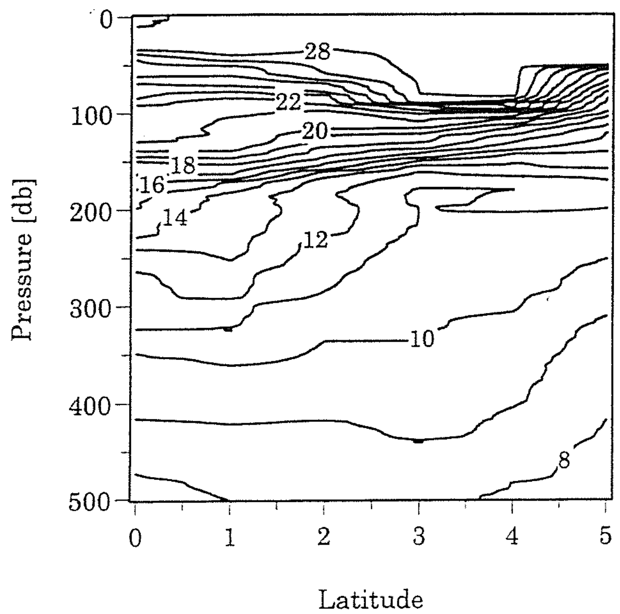
165E Salinity [PSU]



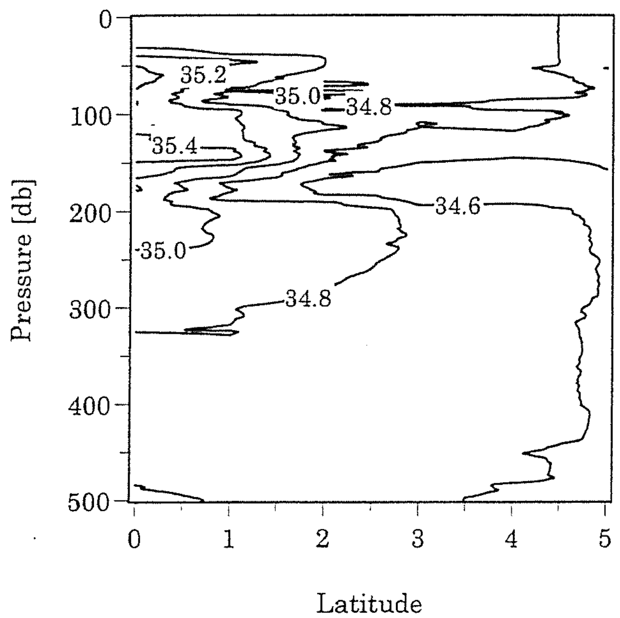
165E Sigma-theta



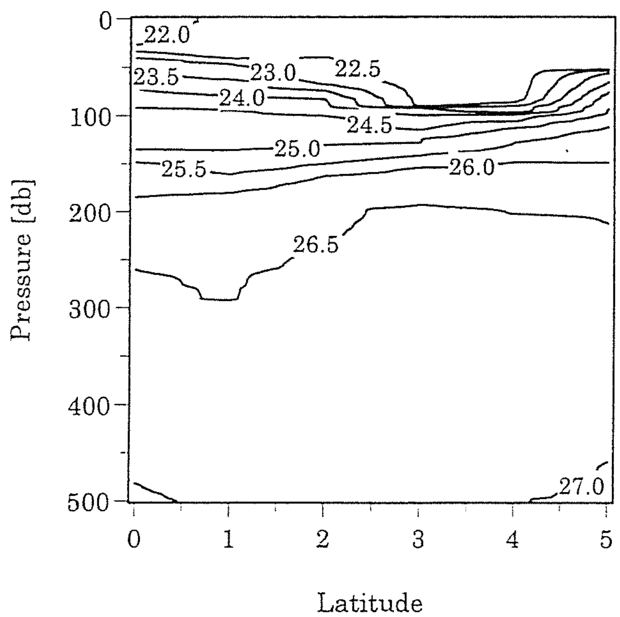
147E Temperature [deg-C]



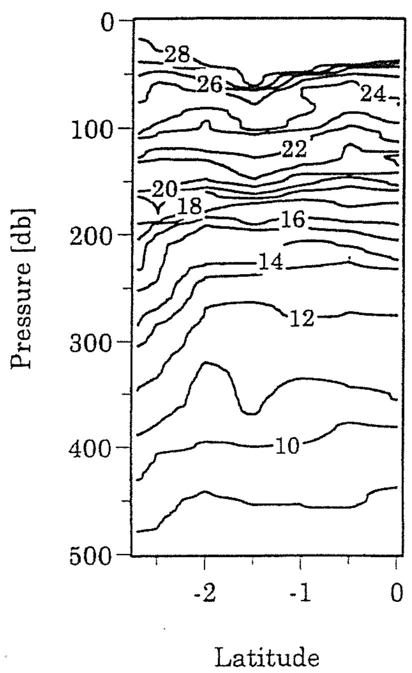
147E Salinity [PSU]



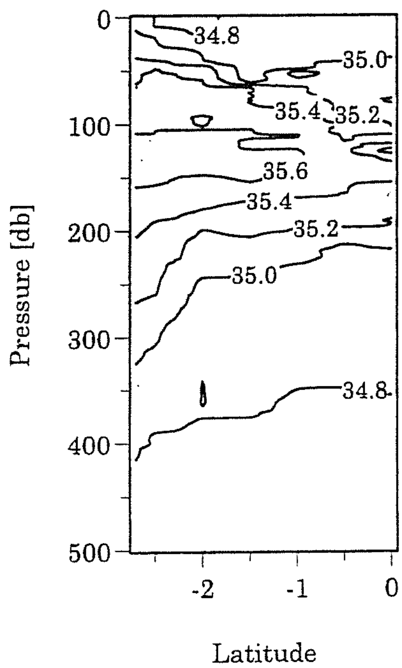
147E Sigma-theta



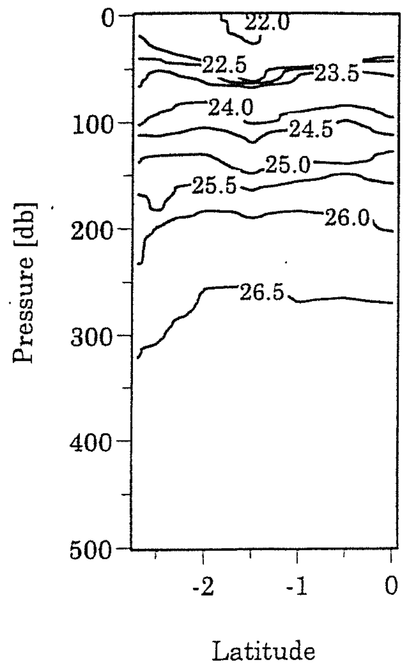
142E Temperature [deg-C]



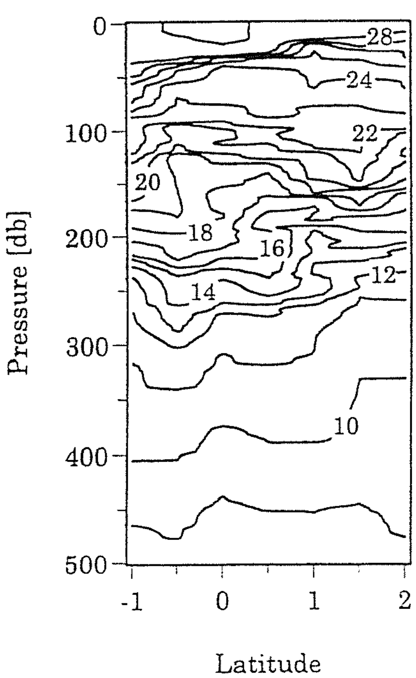
142E Salinity [PSU]



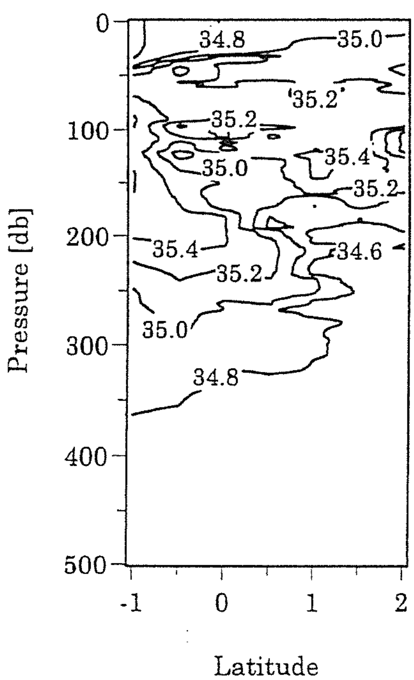
142E Sigma-theta



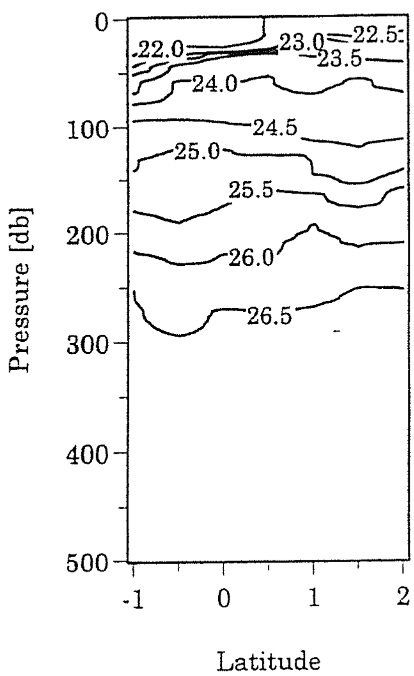
138E Temperature [deg-C]



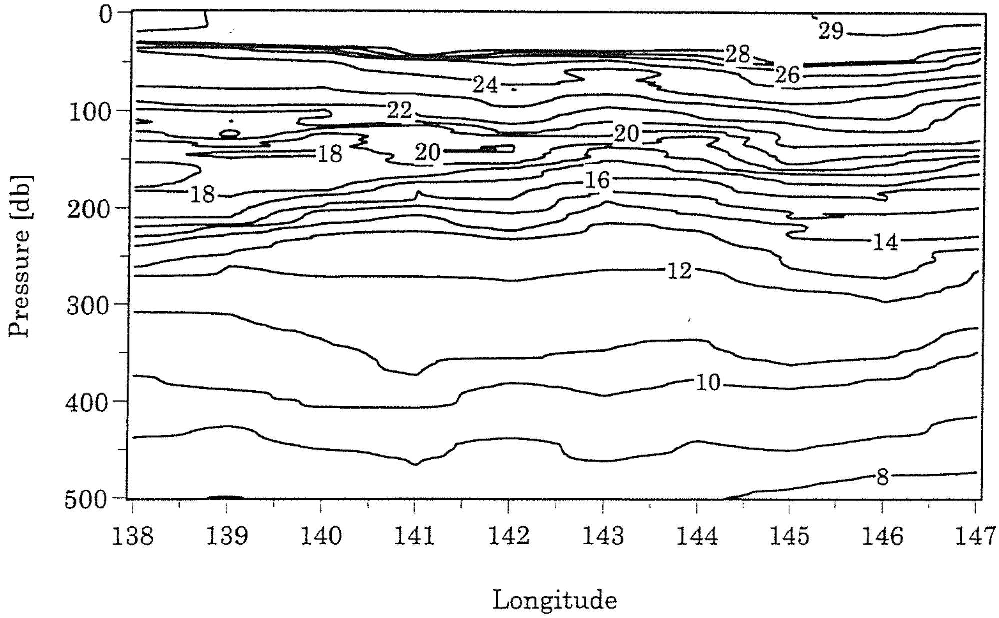
138E Salinity [PSU]



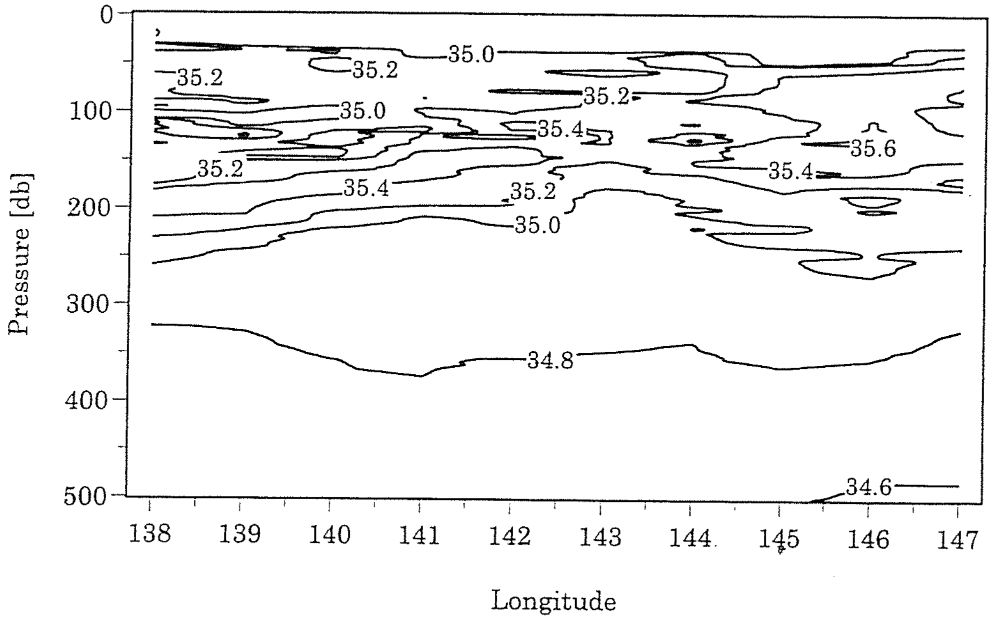
138E Sigma-theta



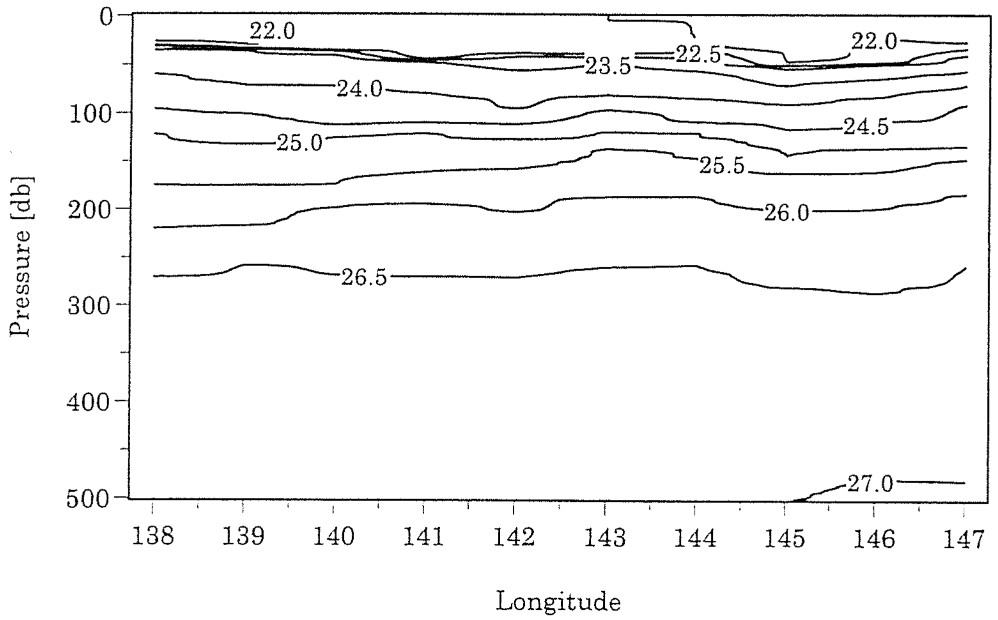
Equator Temperature [deg-C]



Equator Salinity [PSU]

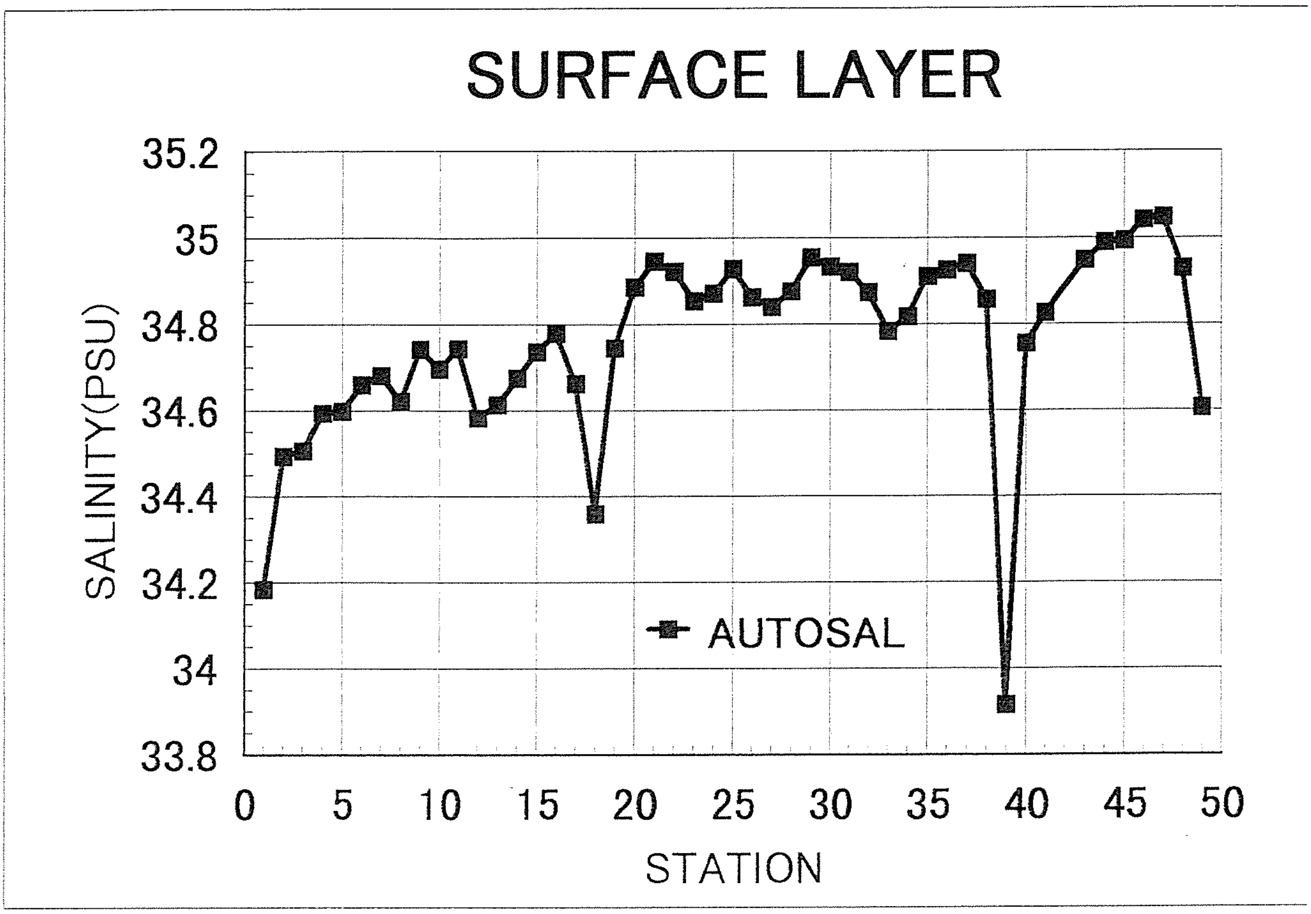


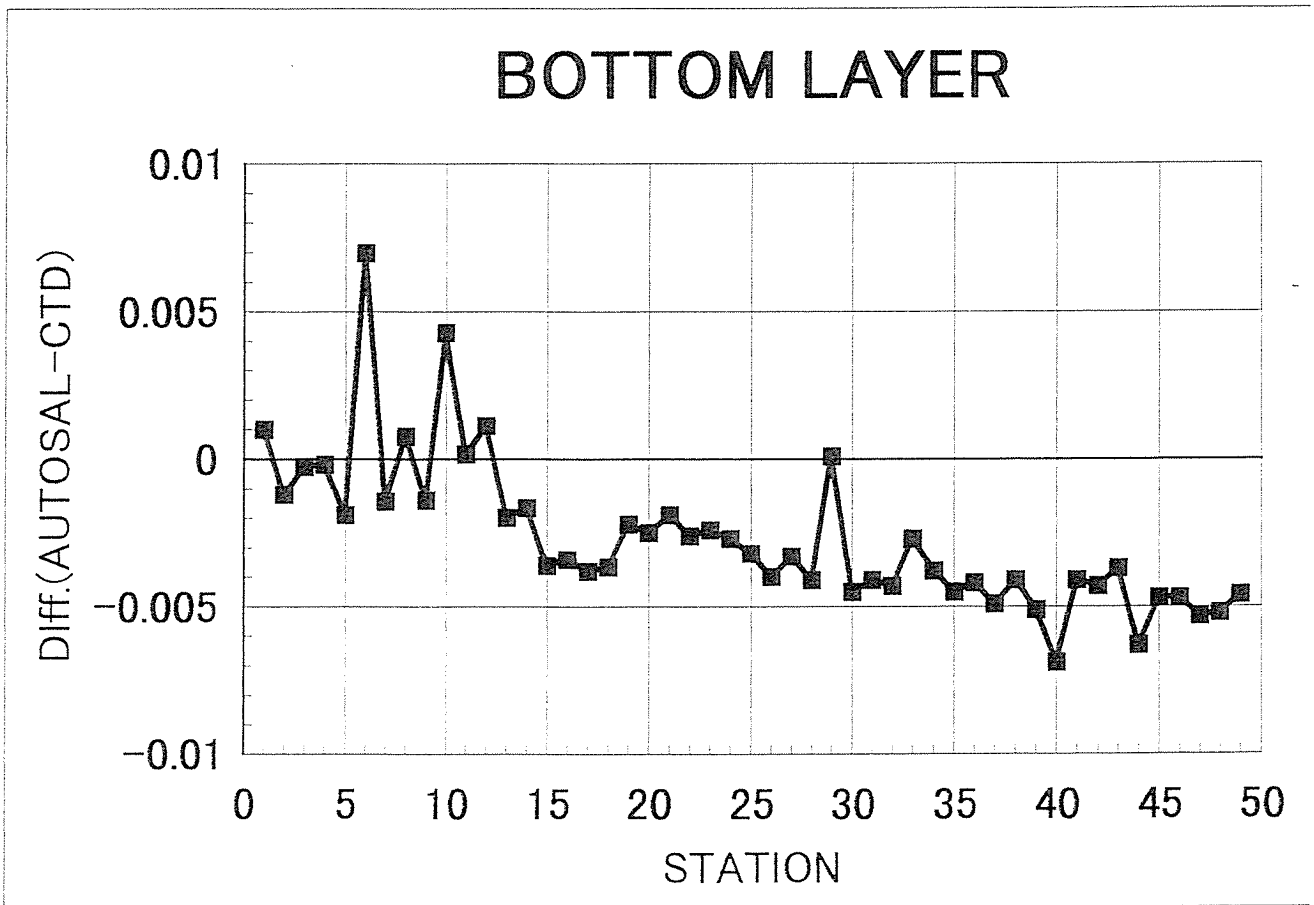
Equator Sigma-theta



4. 4 Bottle Salinity

STATION		CTD BOTTOM	AUTOSAL BOTTOM	Difference (AUTOSAL-CTD)	AUTOSAL SURFACE
	0				
REG.1	1	34.5572	34.5582	0.0010	34.1842
	2	34.5598	34.5586	-0.0012	34.4943
	3	34.5553	34.5551	-0.0002	34.5061
	4	34.5399	34.5397	-0.0002	34.5940
	5	34.4948	34.4929	-0.0019	34.5989
	6	34.5522	34.5592	0.0070	34.6603
	7	34.5380	34.5366	-0.0014	34.6806
	8	34.5537	34.5545	0.0008	34.6217
	9	34.5484	34.5470	-0.0014	34.7424
	10	34.5490	34.5533	0.0043	34.6961
	11	34.5480	34.5482	0.0002	34.7434
	12	34.5315	34.5326	0.0011	34.5826
	13	34.5537	34.5517	-0.0020	34.6135
	14	34.5573	34.5556	-0.0017	34.6749
	15	34.5628	34.5592	-0.0036	34.7361
	16	34.5567	34.5533	-0.0034	34.7802
	17	34.5626	34.5588	-0.0038	34.6629
	18	34.5601	34.5564	-0.0037	34.3587
REG.2	19	34.5590	34.5568	-0.0022	34.7449
	20	34.5566	34.5541	-0.0025	34.8855
	21	34.5512	34.5493	-0.0019	34.9458
	22	34.5557	34.5531	-0.0026	34.9222
	23	34.5545	34.5521	-0.0024	34.8534
	24	34.5564	34.5537	-0.0027	34.8708
	25	34.5563	34.5531	-0.0032	34.9279
	26	34.5569	34.5529	-0.0040	34.8617
	27	34.5556	34.5523	-0.0033	34.8400
	28	34.5574	34.5533	-0.0041	34.8765
	29	34.5544	34.5545	0.0001	34.9551
	30	34.5535	34.5490	-0.0045	34.9338
	31	34.5507	34.5466	-0.0041	34.9206
	32	34.5552	34.5509	-0.0043	34.8739
	33	34.5536	34.5509	-0.0027	34.7835
	34	34.5545	34.5507	-0.0038	34.8178
	35	34.5509	34.5464	-0.0045	34.9113
	36	34.5457	34.5415	-0.0042	34.9259
	37	34.5489	34.5440	-0.0049	34.9411
	38	34.5509	34.5468	-0.0041	34.8566
	39	34.5521	34.5470	-0.0051	33.9158
	40	34.5559	34.5490	-0.0069	34.7546
	41	34.5489	34.5448	-0.0041	34.8264
	42	34.5548	34.5505	-0.0043	
	43	34.5530	34.5493	-0.0037	34.9482
	44	34.5555	34.5492	-0.0063	34.9896
	45	34.5544	34.5497	-0.0047	34.9939
	46	34.5485	34.5438	-0.0047	35.0414
	47	34.5517	34.5464	-0.0053	35.0477
	48	34.5618	34.5566	-0.0052	34.9299
	49	34.5626	34.5580	-0.0046	34.6052


SURFACE LAYER
35.2
35
34.8
34.6
34.4
34.2
34
33.8
SALINITY(PSU)
AUTOSAL
0
5
10
15
20
25
30
35
40
45
50
STATION


BOTTOM LAYER
0.01
0.005
0
−0.005
−0.01
Diff.(AUTOSAL−CTD)
0
5
10
15
20
25
30
35
40
45
50
STATION

4.5 Dissolved Oxygen Measurement

T. Shiribiki [1] and S. Higuchi [2]

[1] :Sanyo Techno Marine, Inc., Japan [2] :Marine Works Japan, LTD.

Objectives:

Measurement of dissolved oxygen (below D.O.) using D.O.meter corrected by the Winkler titration processed to the WHP Operations and Methods(Culberson,1991).

Comparison of D.O.meter data corrected by the Winkler titration with CTD D.O. data.

Instruments:

D.O.meter ; TOA Portable Dissolved Oxygen Meter Model DO-25A
Titrator ; Metrohm Model 716 DMS Totrino/ 10ml of titration vessel
Ditector ; Pt Electrode/ 6.0401.100
Software ; Data acquisition/ Metrohm,METRODATA/ 6.6040.100

Methods :

The 12 piston Niskin water samplers (Go 1015) sampled sea water during CTD upcast.

The water samples for D.O. were sampled from the 5-liter Niskin water samplers into 100ml D.O. glass bottles. In each cast, several water samples for the Winkler titration were also sampled to calibrated BOD flasks (ca, 180 ml) (see Green and Carritt 1966).

During sampling, water corresponded to three times of D.O. bottles was used to flush, then water temperature was measured during sampling.After the sampling, we analyzed D.O. with salinity correction within 30 minutes.(Before measurement, the D.O.meter was adjusted to 0-100% (see TOA D.O.meter operation manual)).

The samples for the titration method were analyzed within 2 hours. These samples were analyzed by Metrohm piston buret of 10ml with Pt Erectrode using Whole bottle titration in thelaboratory under controlled temperature (ca, 23 ° c)

The standerdizations have been performed every day before the sample titration.

The data from the D.O.meter were corrected with calibration factors. The factors were decided by linear regression based on the Winkler titration value vs D.O.meter Value.

Reproducibility:

(1) D.O.meter Value

141 pairs of samples were analyzed as replicates taken by same Niskin bottle. The average a nd standard deviations (2 sigma) of difference of replicates samples were 0.005 ml/l and 0.012 ml/l (0.25% of D.O.maximum (4.51 ml/l)in this cruise).

(2) Winkler Titration Value

71 pairs of samples were analyzed. The average and std.(2 sigma) of difference was 0.008 ml/l and 0.029 ml/l (0.64 % of D.O. maximum (4.529 ml/l) in this cruse).

Results :

(1) Correction of D.O.meter Values

Linear regression line listed below was obtained form pairs of D.O.meter-Winkler data. (Fig.4.5.1)

All D.O.meter data were calibrated by this formula.(corrected D.O. data were Shown in Table 4.5.1)

Formula : $Y = 0.088 + 0.998 \times X$ (n = 306)

$R = 0.998$

Y : Winkler Value (ml/ l) X : D.O. meter Value (ml/ l)

(2) CTD-D.O. Sensor Value correction

The two kinds of alculated polinominary regression curve for upcast and downcast were obtained from 582 pairs of CTD D.O.Sensor and corrected D.O.data. (Fig.4.5.2)

For upcast : $Y = 0.524 + 0.833 \times X + 0.499 \times X^2$ (n = 582)

$R = 0.973$

Y : Corrected D.O. Value (ml/ l) X : CTD-D.O. Sensor Upcast Value (ml/ l)

For downcast : $Y = 0.492 + 0.686 \times X + 0.515 \times X^2$ (n = 582)

$R = 0.946$

Y : Corrected D.O. Value (ml/ l) X : CTD-D.O. Sensor Downcast Value (ml/ l)

(3) Contour plots

Contour plots in Fig.4.5.3 were made from corrected dissolved oxygen data in Table.4.5.1.

138 E Line : Stn 39,40,41,42,43,44,45,46,47,48,49
142 E Line : Stn 29,30,31,32,33,34,35
147 E Line : Stn 19,20,21,22,23,24
165 E Line : Stn 1,2,3,4,5,6,7,8,9,10,11,12
Equator Line : Stn 24,25,26,27,28,29,36,37,38,41

(4) Vertical plofiles

All vertical plofiles in this cruise are showed in Fig.4.5.4. These data were used from corrected D.O. data in Table.4.6.1

(5) Comparison of D.O. Sensor's value and corrected D.O. value

To compare D.O. Sensor's value and corrected D.O. value, we calculated root mean squares (below R.M.S.) are calculated for each depth and stations by this formula.

$$R.M.S. = \sqrt{\frac{1}{n} \Sigma (X_i - Y_i)^2}$$

X_i : corrected D.O. value Y_i : D.O. Sensor's Value

The upcast and downcast R.M.S. values for each stations and depth are showed in Fig.4.5.4 and Table 4.5.2.

In this cruise, R.M.S. value is larger than last cruise value, so we think D.O. sensor condition is bat in comparison to last cruise..

(6) Comments

In all stations, D.O. concentrations is more than 3.00 ml/l above 100 db depth.

There are minmum layer (< 2.00ml/l) in the earstern area at adout 400 db depth along equator.

Along 147E sections, the D.O. front below 500db are very clear near equator, but not so along 138E. But in south sections (along 142E line), that is too clear.

In 165E sections, there are D.O. front from 5N to 8N, that is very low value (<2.00 ml/l), on the other hand, higt D.O. water (about more than 2.10 ml/l) comes to about 1000 db near equotar ~ 1 N from south sections. And near 1S, D.O. minimum layer is at 300 ~ 500 db.

References :

Culberson,C.H. (1991) Dissolved Oxygen, in WHP Oparations and Methods, Woods Hole., pp1-15

Culberson,C.H.,G.Knapp,R.T.Williams and F.Zemlyak (1991) A comparison of methods for the ditermination of dissolved oxygen in sea water (WHPO 91-2),Woods Hole.

Green,E.J. and D.E.Carritt (1966) An Improved Iodine Determination Flask for Whole-bottle Titrations, Analyst, 91, 207-208.

Horibe,Y.,Y.Kodama and K.Shigehara (1972) Errors in sampling procedure for the determination of dissolved oxygen by Winkler method,J. Oceanogr. Soc, Jpn., 28, 203-206.

Murray,N.,J.P.Riley and T.R.S.Wilson (1968) The solubility of oxygen in Winkler reagents used for determination of dissolved oxygen, Deep-Sea Res., 15, 237-238

S.Kitagawa and K.Taira (1993) Measurement of dissolved oxygen by an electrode method, Umi no Kagaku (in Japanese), 2, 15-18.

TOA Electronics Ltd. (1991) DO-25A Portable Dissolved Oxygen meter Oparation Manual, Tokyo, 29

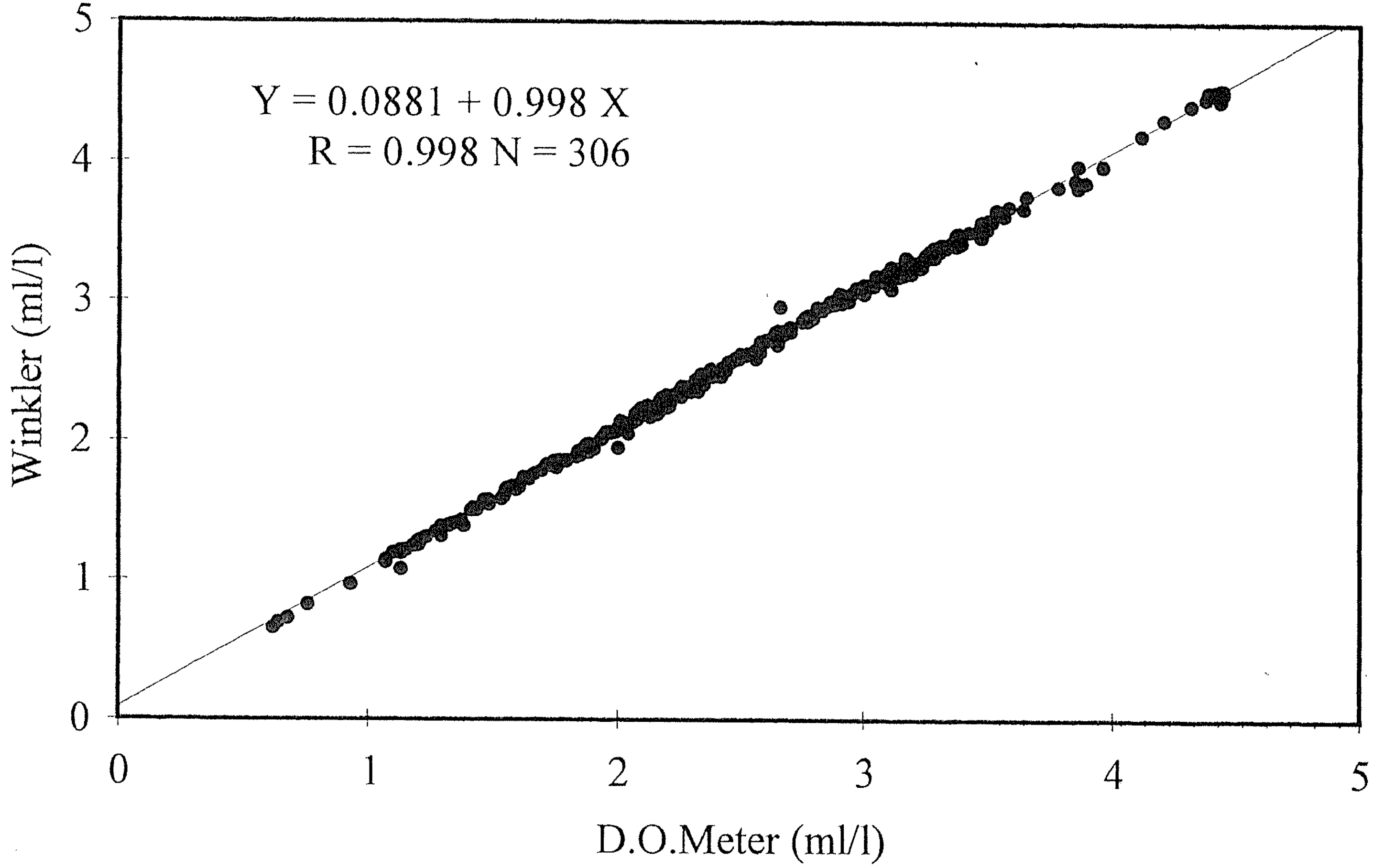
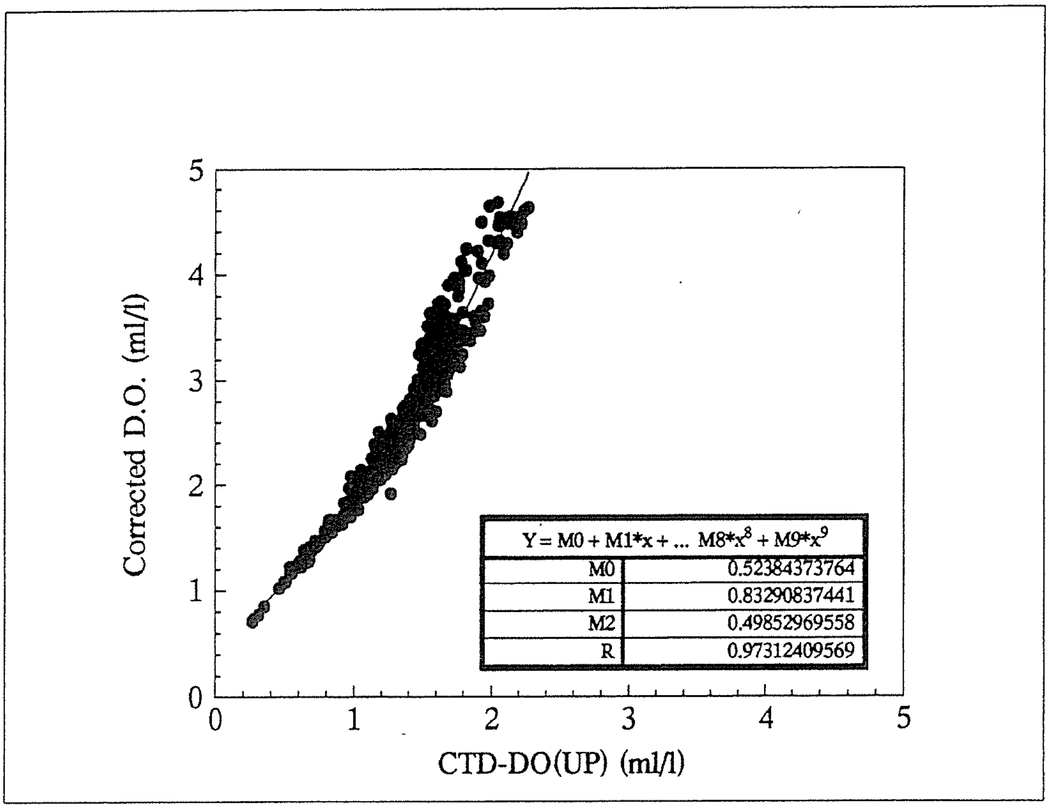


Fig.4.5.1 D.O. Meter - Winkler



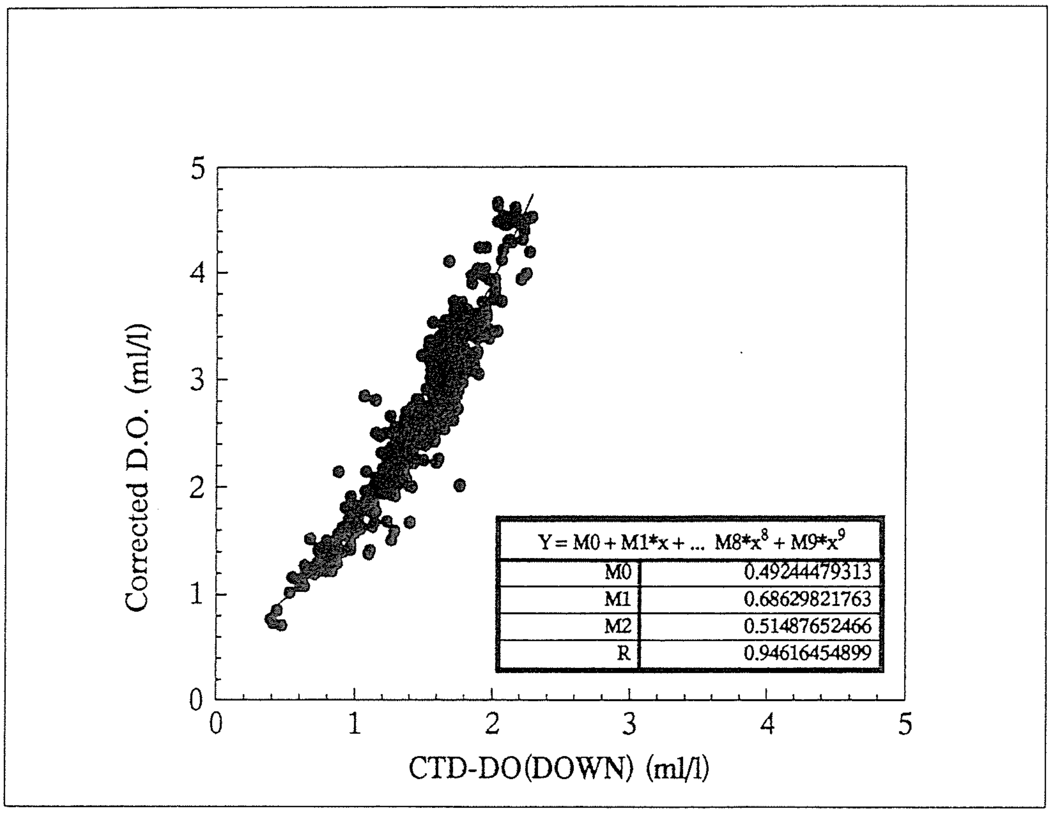


Fig.4.5.2 CTD D.O. Sensor vs Corrected D.O.

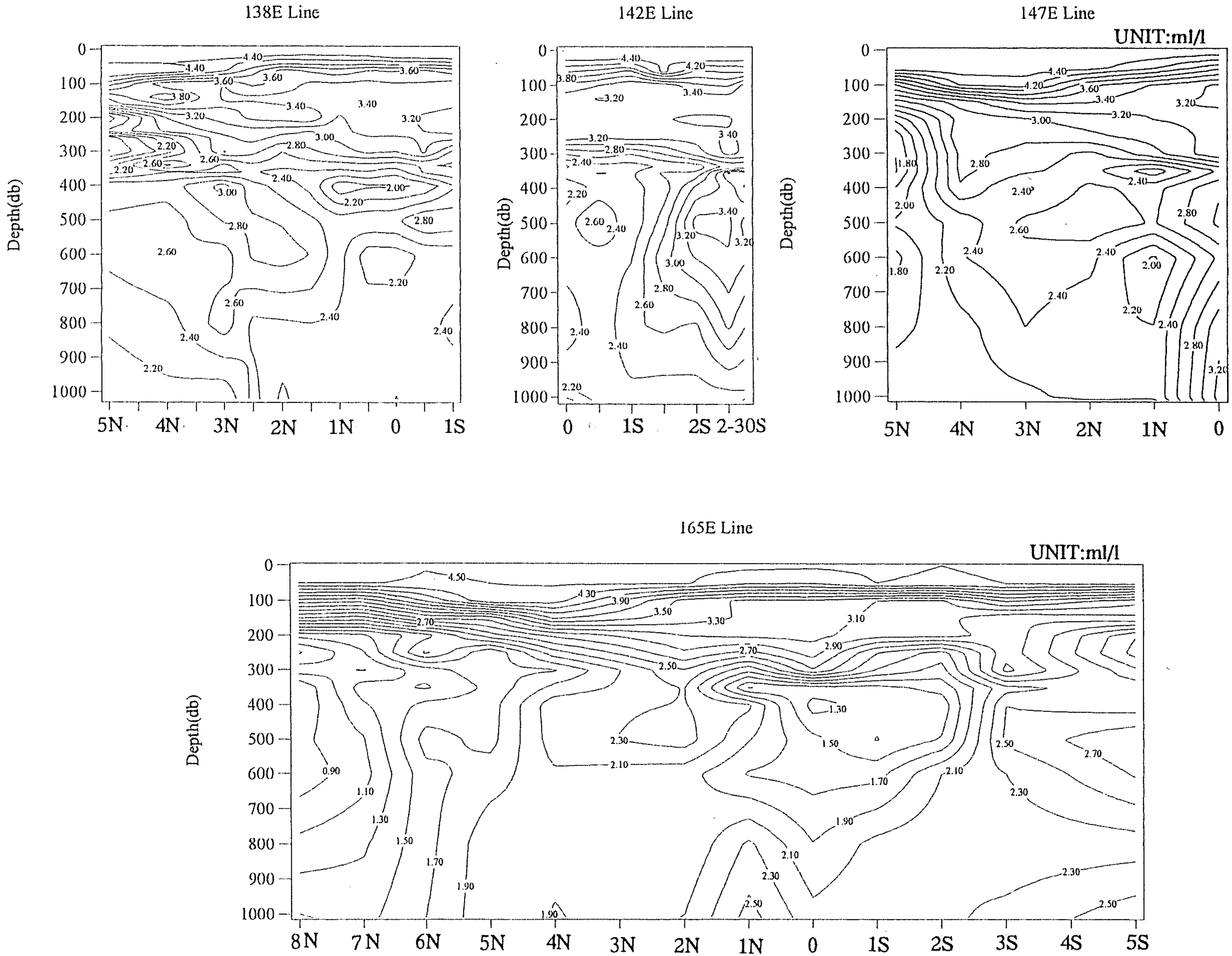


Fig.4.5.3 (1) Contour Plot

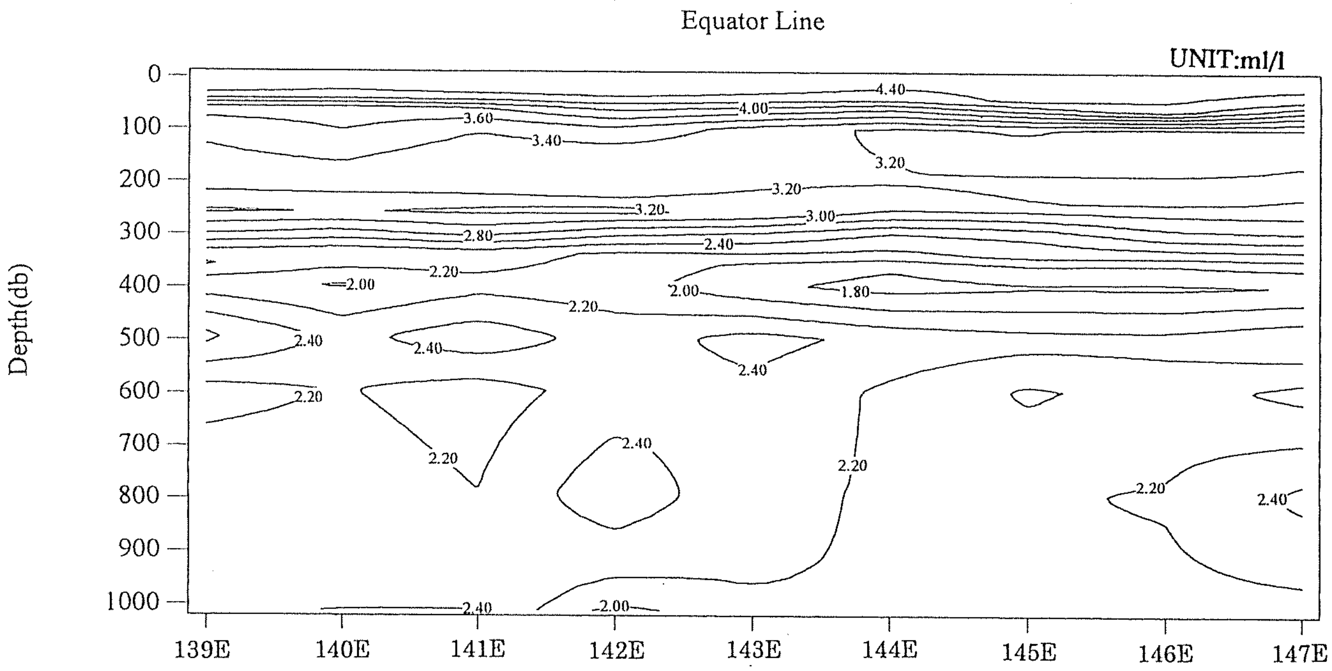


Fig.4.5.3 (2) Contour Plot

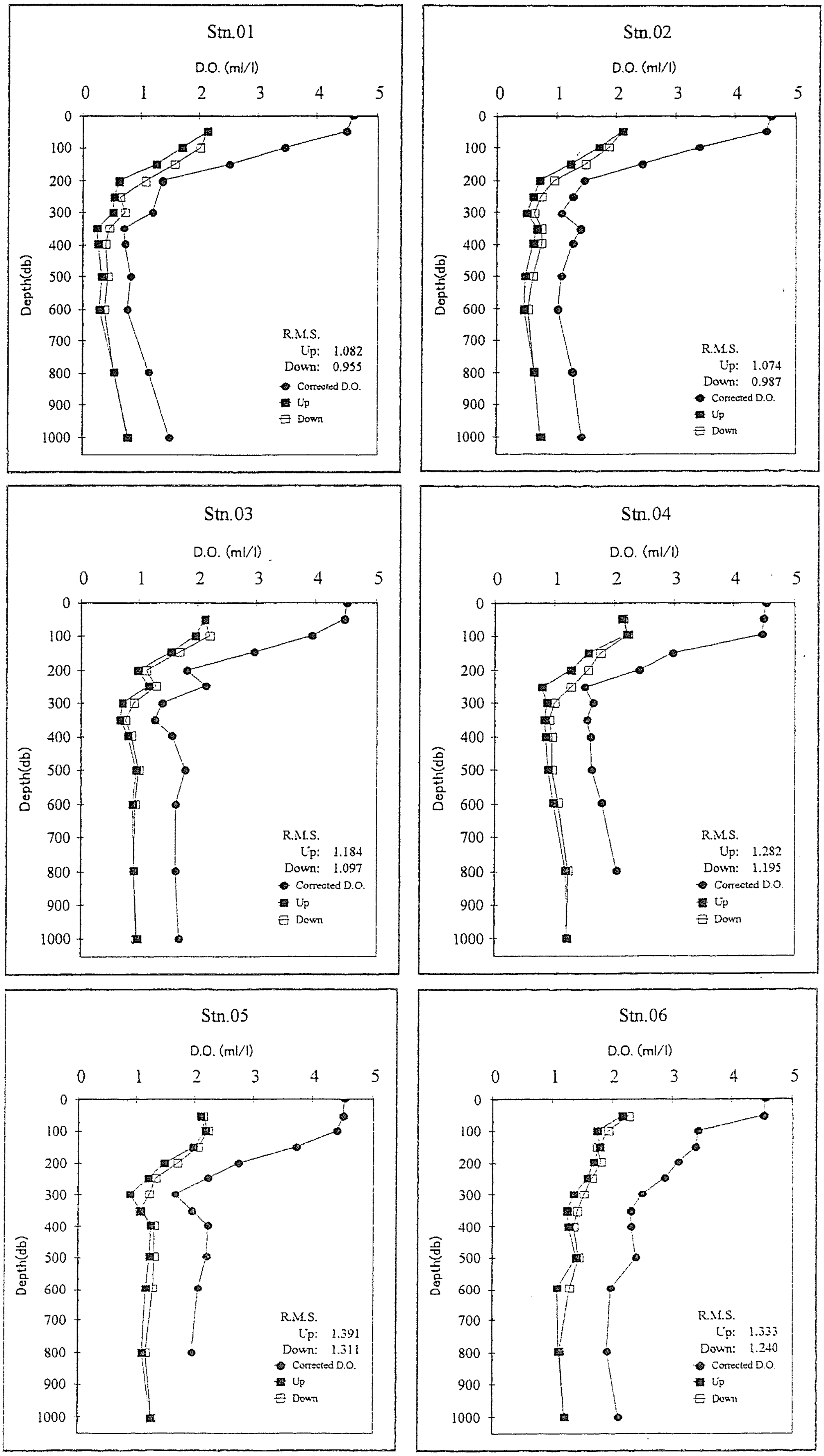


Fig.4.5.4 (1) Vertical Profile

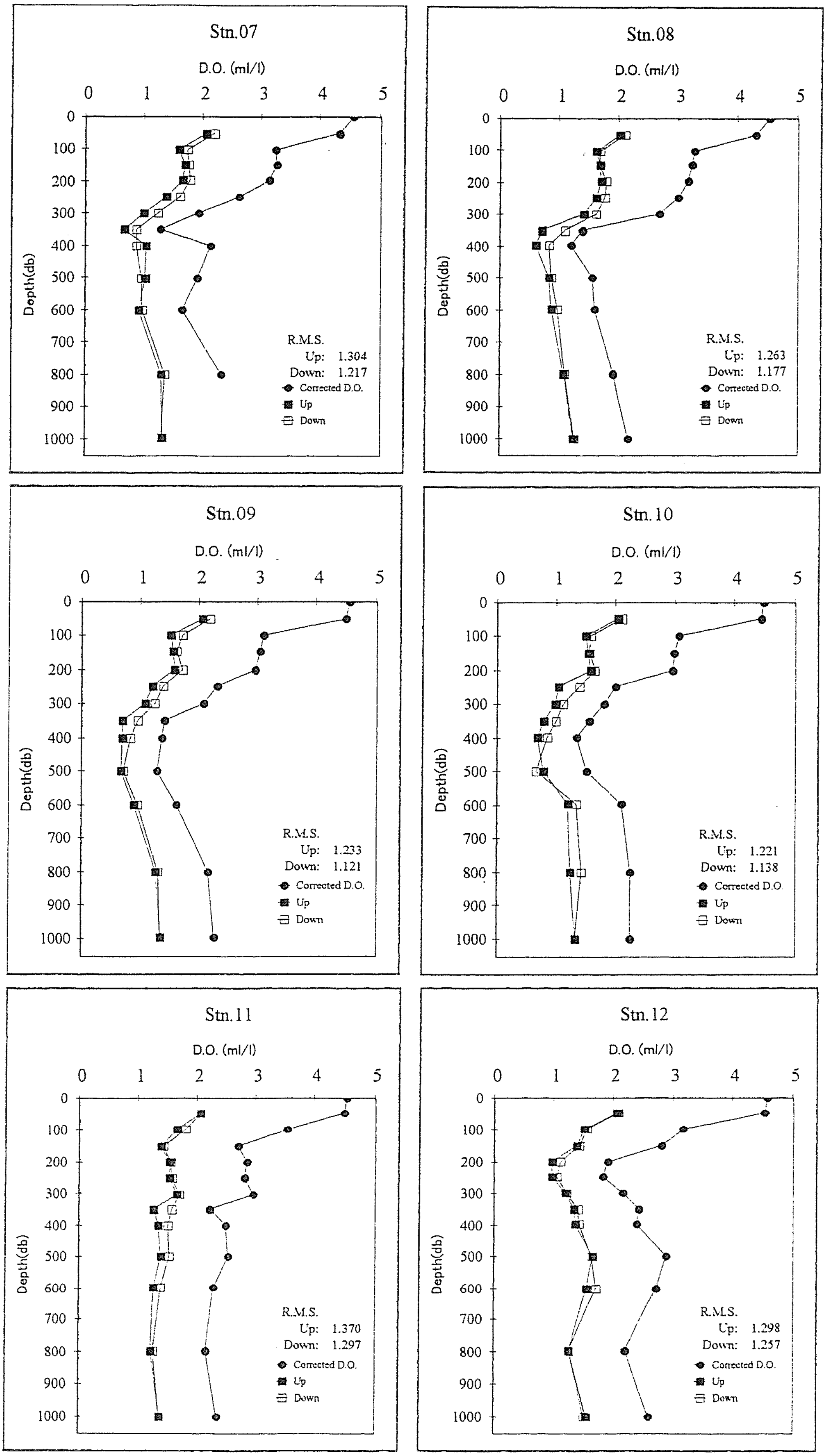


Fig.4.5.4 (2) Vertical Profile

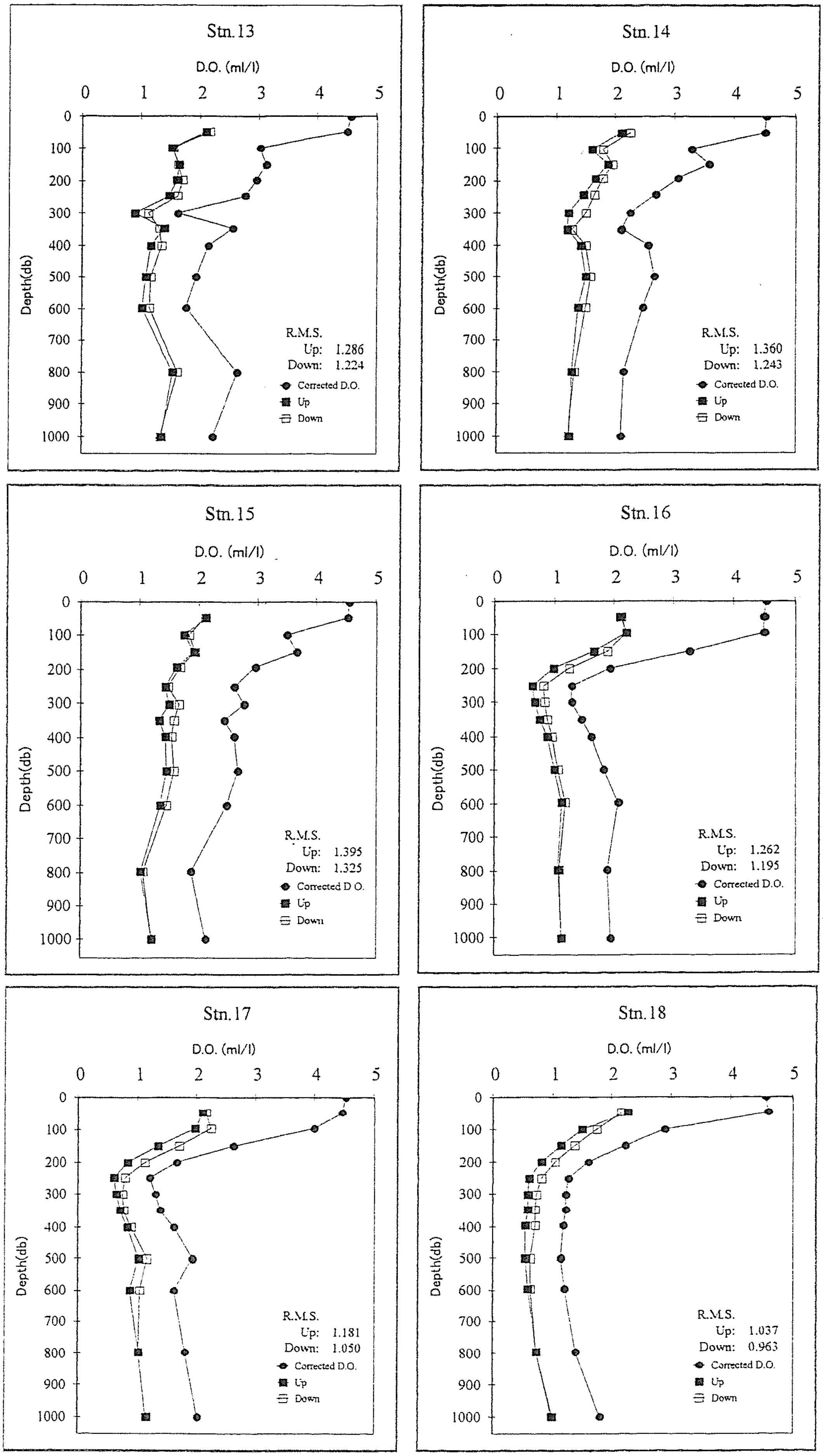


Fig.4.5.4 (3) Vertical Profile

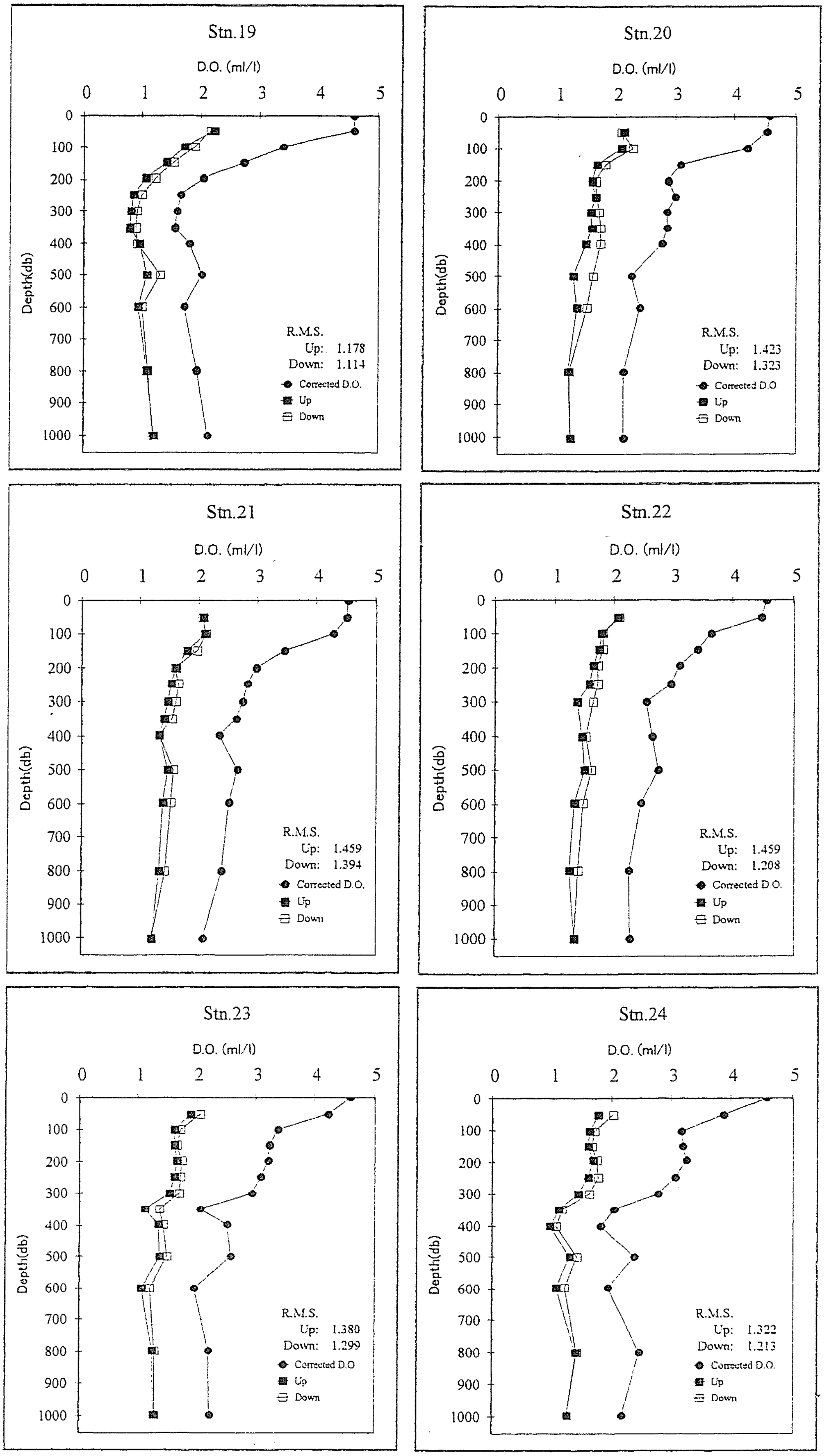


Fig.4.5.4 (4) Vertical Profile

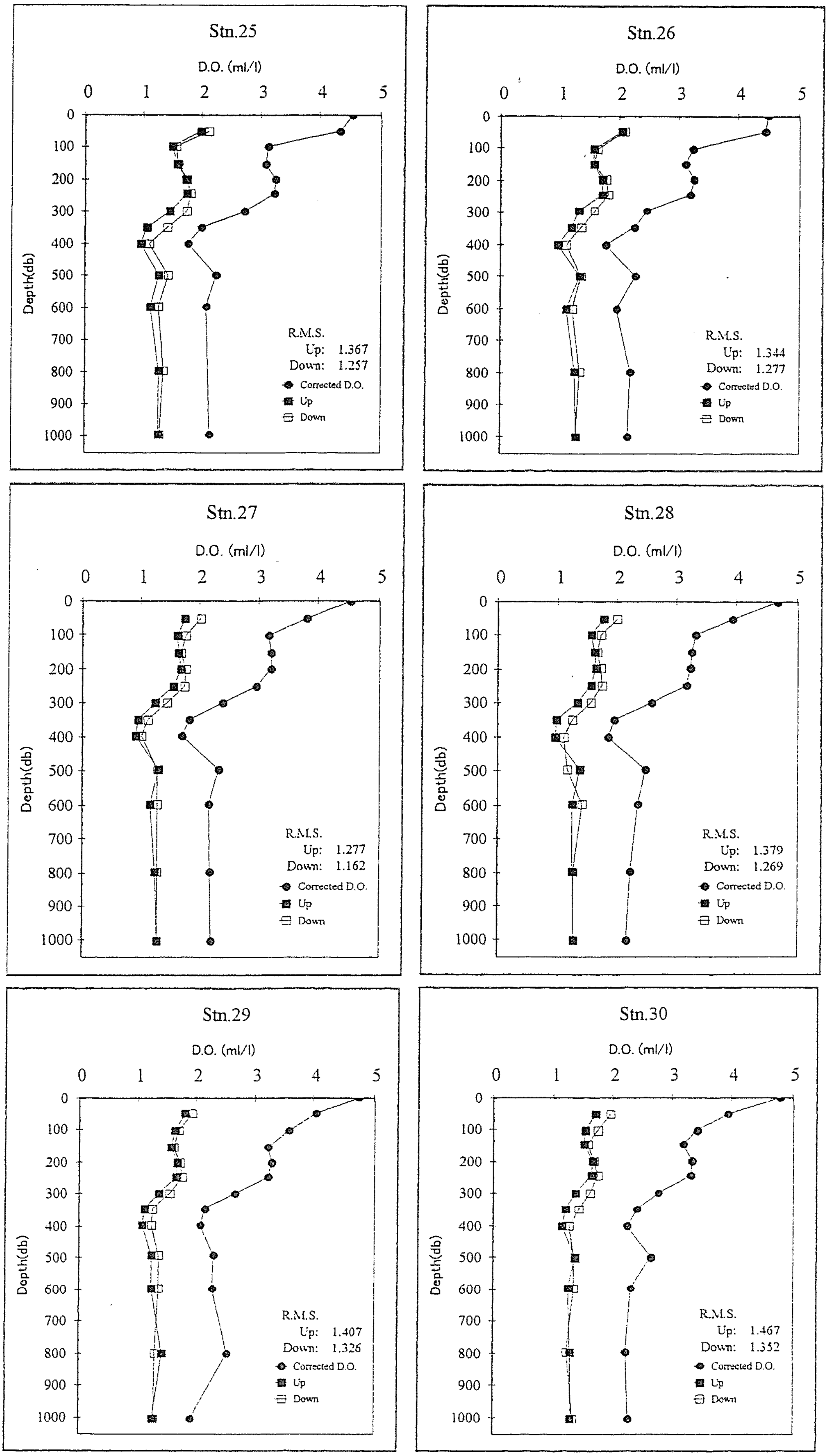


Fig.4.5.4 (5) Vertical Profile

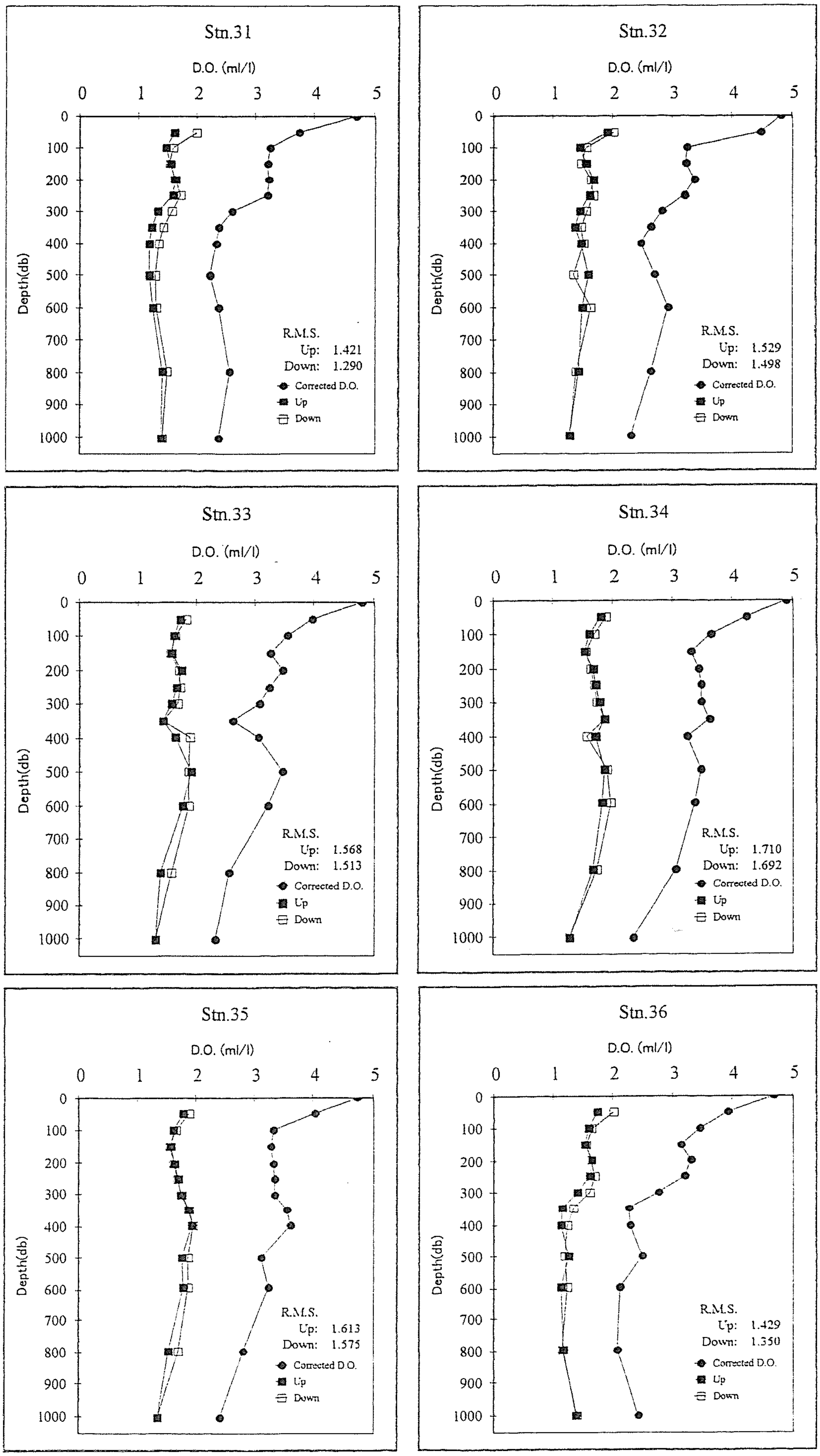


Fig.4.5.4 (6) Vertical Profile

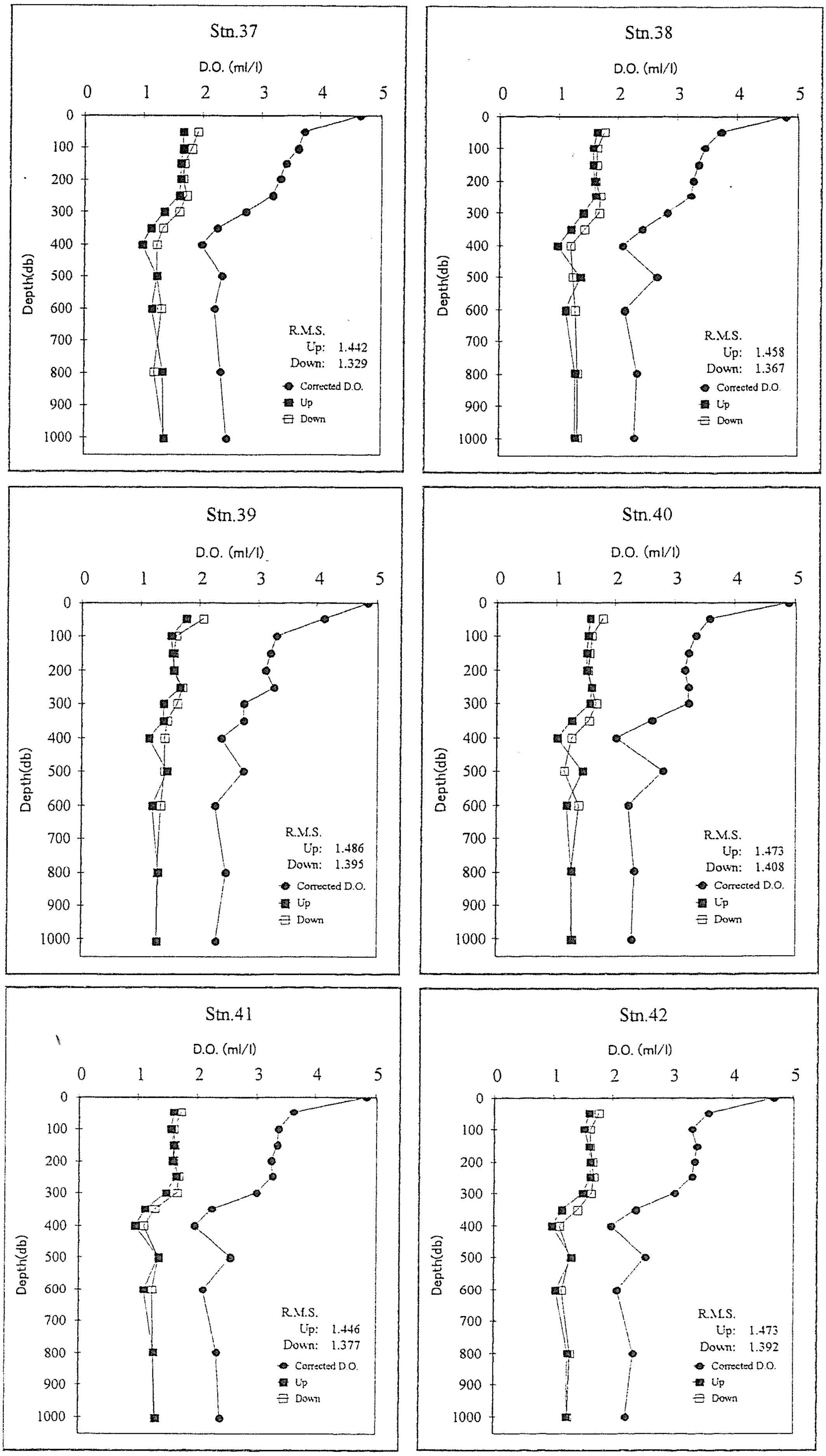


Fig.4.5.4 (7) Vertical Profile

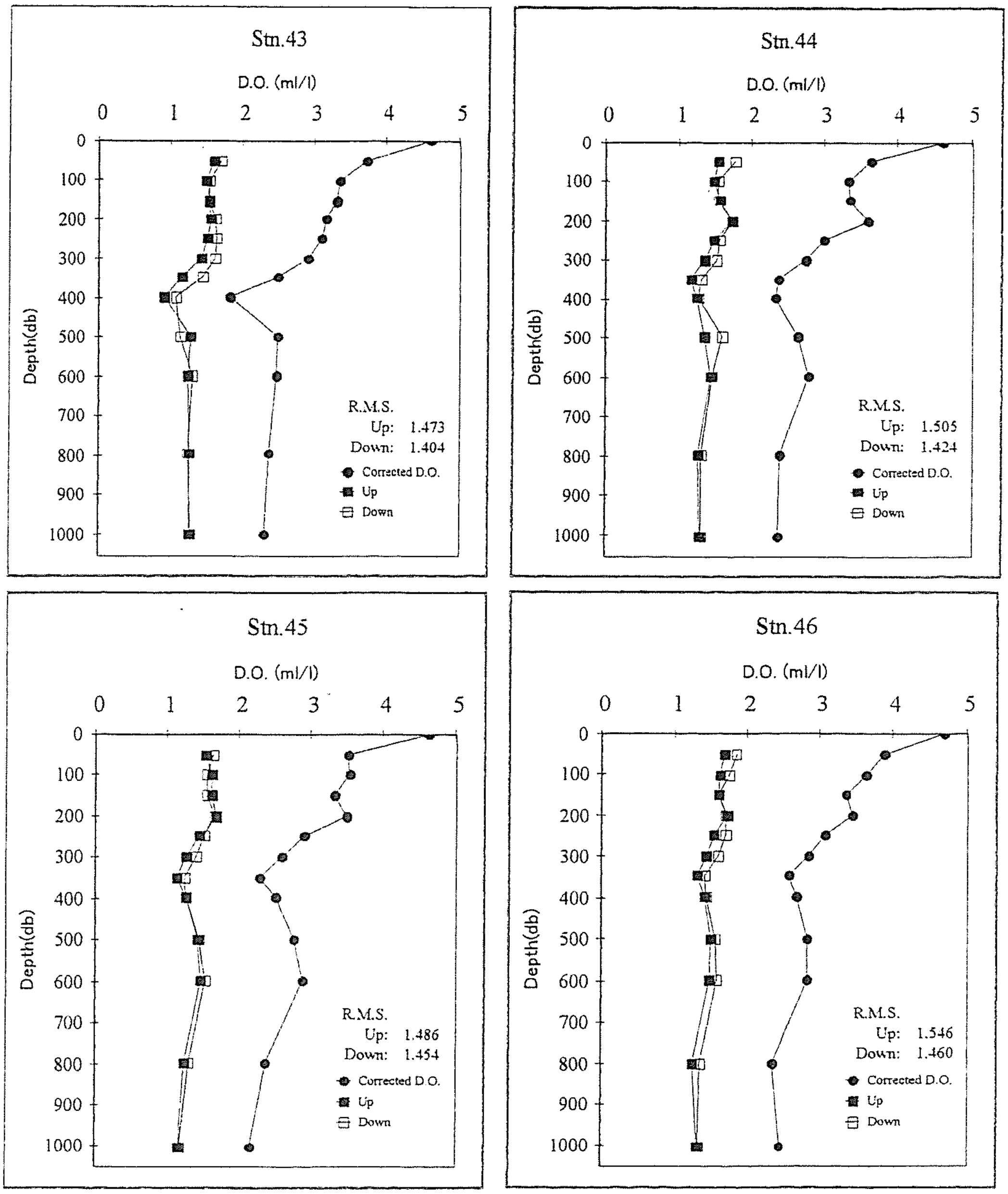


Fig.4.5.4 (8) Vertical Profile

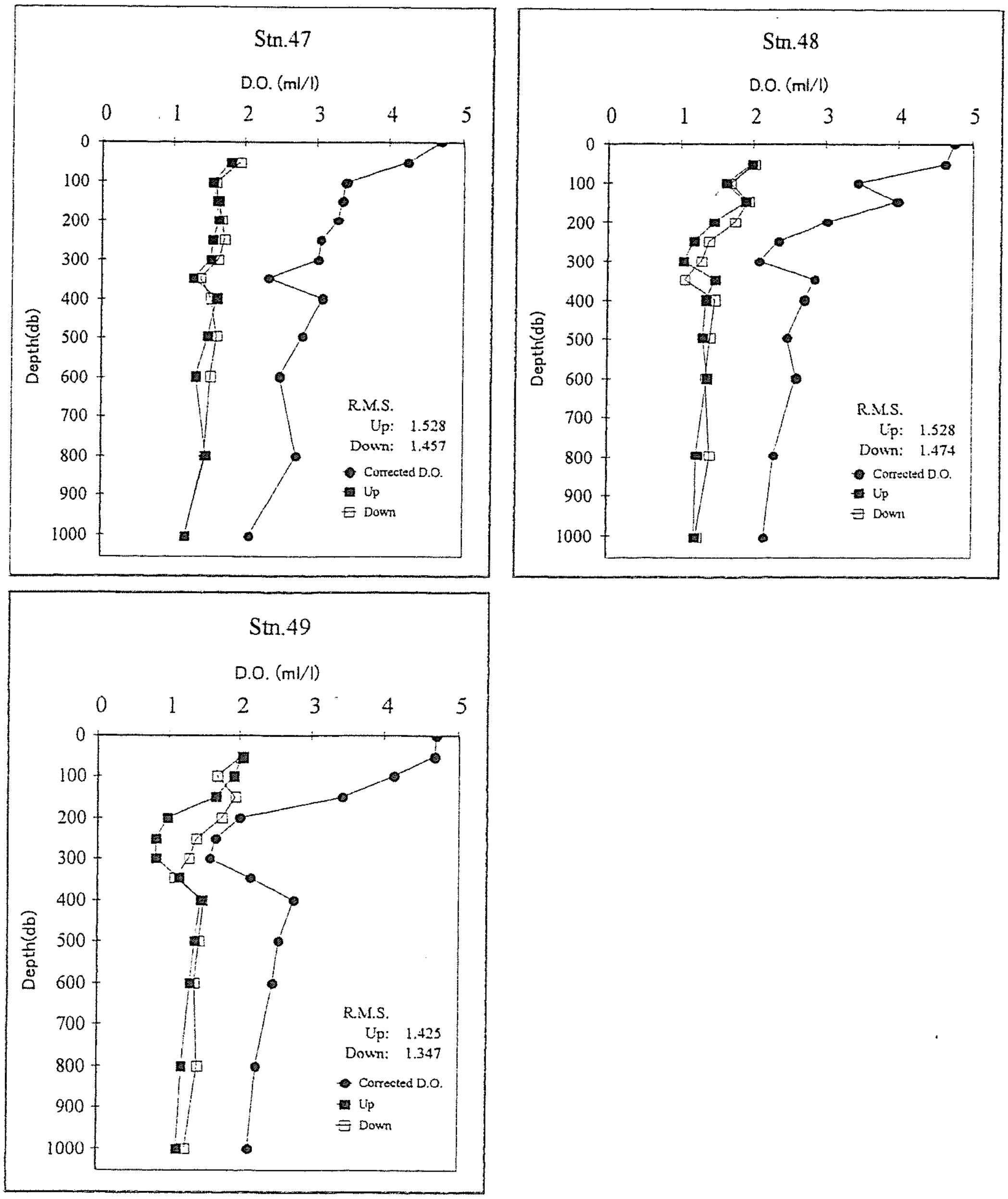


Fig.4.5.4 (9) Vertical Profile

Table 4.5.1 (1)

Stn	1
165 E	8 N
Depth(db)	D.O.(ml/l)
0	4.59
49	4.50
99	3.45
149	2.52
202	1.38
251	N.D.
299	1.22
349	0.71
399	0.73
501	0.85
600	0.77
798	1.16
1000	1.50

Stn	2
165 E	7 N
Depth(db)	D.O.(ml/l)
0	4.59
50	4.51
100	3.39
150	2.43
201	1.47
253	1.28
303	1.08
351	1.41
397	1.27
498	1.08
601	1.02
796	1.27
1001	1.43

Stn	3
165 E	6 N
Depth(db)	D.O.(ml/l)
0	4.51
49	4.48
100	3.94
148	2.96
200	1.82
250	2.15
299	1.40
350	1.27
399	1.56
500	1.79
600	1.63
799	1.63
1001	1.70

Stn	4
165 E	5 N
Depth(db)	D.O.(ml/l)
0	4.53
50	4.50
98	4.47
150	2.97
200	2.42
251	1.51
300	1.65
350	1.55
400	1.60
500	1.63
599	1.80
799	2.05
1001	N.D.

Stn	5
165 E	4 N
Depth(db)	D.O.(ml/l)
0	4.54
51	4.52
101	4.40
152	3.73
200	2.75
249	2.22
298	1.68
349	1.96
397	2.24
497	2.21
599	2.07
800	1.97
1005	N.D.

Stn	6
165 E	2 N
Depth(db)	D.O.(ml/l)
0	4.55
51	4.53
99	3.43
149	3.39
199	3.10
250	2.87
300	2.50
349	2.31
400	2.31
500	2.40
599	1.98
798	1.92
1002	2.10

Stn	7
165 E	1 N
Depth(db)	D.O.(ml/l)
0	4.56
54	4.32
102	3.25
151	3.27
199	3.15
249	2.63
299	1.93
349	1.29
400	2.14
502	1.91
602	1.68
800	2.34
999	N.D.

Stn	8
165 E	0
Depth(db)	D.O.(ml/l)
0	4.54
51	4.30
104	3.27
148	3.23
199	3.17
250	2.99
300	2.68
350	1.41
398	1.22
500	1.56
596	1.61
799	1.91
1002	2.16

Stn	9
165 E	1 S
Depth(db)	D.O.(ml/l)
0	4.55
51	4.50
99	3.10
148	3.04
200	2.96
249	2.31
300	2.08
351	1.42
400	1.38
500	1.29
600	1.63
800	2.17
999	2.28

Stn	10
165 E	2 S
Depth(db)	D.O.(ml/l)
0	4.50
50	4.46
101	3.06
150	2.97
200	2.95
250	2.01
299	1.81
349	1.57
399	1.36
498	1.52
598	2.10
800	2.26
1001	2.26

Stn	11
165 E	3 S
Depth(db)	D.O.(ml/l)
0	4.54
48	4.50
100	3.53
149	2.71
201	2.85
251	2.82
302	2.96
352	2.23
401	2.50
498	2.55
598	2.30
799	2.17
1001	2.35

Stn	12
165 E	5 S
Depth(db)	D.O.(ml/l)
0	4.57
50	4.53
100	3.17
149	2.82
200	1.91
249	1.83
298	2.16
349	2.43
399	2.40
499	2.89
600	2.72
798	2.20
1000	2.61

Stn	13
162-13 E	1-44 S
Depth(db)	D.O.(ml/l)
0	4.57
48	4.52
99	3.02
149	3.12
199	2.96
250	2.78
300	1.63
348	2.56
400	2.15
500	1.95
599	1.77
800	2.64
1001	2.24

Stn	14
158-55 E	1-51 N
Depth(db)	D.O.(ml/l)
0	4.54
51	4.52
103	3.29
149	3.58
196	3.05
247	2.68
299	2.25
349	2.11
401	2.56
500	2.66
599	2.47
800	2.15
1001	2.10

Stn	15
158 E	2-47 N
Depth(db)	D.O.(ml/l)
0	4.55
49	4.53
101	3.50
151	3.66
196	2.96
251	2.61
302	2.76
349	2.44
399	2.60
499	2.66
600	2.47
797	1.87
1001	2.12

Stn	16
156 E	5 N
Depth(db)	D.O.(ml/l)
0	4.53
50	4.50
98	4.49
150	3.26
200	1.94
251	1.30
300	1.30
350	1.46
400	1.62
500	1.84
599	2.08
798	1.89
1003	1.97

Stn	17
156 E	6 N
Depth(db)	D.O.(ml/l)
0	4.54
50	4.48
98	3.99
150	2.62
202	1.67
250	1.22
300	1.32
351	1.41
400	1.62
500	1.95
600	1.63
798	1.82
1000	2.02

Stn	18
156 E	8 N
Depth(db)	D.O.(ml/l)
0	4.57
49	4.62
99	2.90
151	2.22
202	1.61
252	1.27
305	1.24
349	1.24
398	1.19
498	1.16
597	1.22
797	1.41
1000	1.82

Stn	19
147 E	5 N
Depth(db)	D.O.(ml/l)
0	4.59
50	4.59
100	3.39
148	2.73
199	2.05
250	1.67
301	1.61
351	1.57
400	1.81
500	2.03
599	1.74
799	1.95
1002	2.12

Stn	20
147 E	4 N
Depth(db)	D.O.(ml/l)
0	4.57
49	4.54
100	4.20
150	3.08
203	2.87
251	2.99
300	2.85
350	2.85
399	2.78
499	2.26
599	2.39
798	2.12
1003	2.12

Stn	21
147 E	3 N
Depth(db)	D.O.(ml/l)
0	4.54
51	4.52
101	4.29
149	3.46
200	2.98
250	2.84
301	2.74
351	2.65
398	2.35
498	2.66
599	2.52
800	2.40
1005	2.09

Stn	22
147 E	2 N
Depth(db)	D.O.(ml/l)
0	4.55
51	4.48
101	3.65
148	3.41
196	3.10
249	2.95
299	2.54
401	2.65
499	2.75
598	2.46
797	2.25
1002	2.28

Stn	23
147 E	1 N
Depth(db)	D.O.(ml/l)
0	4.59
52	4.22
101	3.38
148	3.22
199	3.20
249	3.08
299	2.93
349	2.07
399	2.53
501	2.58
600	1.96
797	2.21
999	2.23

Stn	24
147 E	0
Depth(db)	D.O.(ml/l)
0	4.57
51	3.86
102	3.16
150	3.18
196	3.25
250	3.06
299	2.78
350	2.05
400	1.81
501	2.38
599	1.94
801	2.45
998	2.16

Stn	25
146 E	0
Depth(db)	D.O.(ml/l)
0	4.53
52	4.32
101	3.12
154	3.08
200	3.25
247	3.22
299	2.73
349	2.00
400	1.77
498	2.26
599	2.09
797	N.D.
999	2.15

N.D.= No Data

Table 4.5.1 (2)

Stn	26
145 E	0
Depth(db)	D.O.(ml/l)
0	4.49
49	4.46
102	3.22
151	3.10
198	3.25
246	3.19
297	2.46
346	2.26
400	1.78
500	2.27
601	1.97
799	2.18
1001	2.15

Stn	27
144 E	0
Depth(db)	D.O.(ml/l)
0	4.53
52	3.80
103	3.16
153	3.20
203	3.21
251	2.95
301	2.40
350	1.84
399	1.72
496	2.34
596	2.16
797	2.18
1006	2.20

Stn	28
143 E	0
Depth(db)	D.O.(ml/l)
0	4.67
51	3.93
101	3.31
149	3.25
199	3.23
248	3.16
300	2.59
351	1.96
402	1.85
497	2.47
596	2.35
797	2.24
1005	2.17

Stn	29
142 E	0
Depth(db)	D.O.(ml/l)
0	4.75
50	4.04
103	3.57
153	3.22
201	3.29
250	3.23
299	2.66
346	2.16
397	2.08
493	2.31
598	2.29
801	2.55
1003	1.92

Stn	30
142 E	0-30 S
Depth(db)	D.O.(ml/l)
0	4.80
54	3.94
102	3.41
148	3.19
199	3.34
247	3.31
299	2.76
350	2.41
400	2.26
501	2.64
599	2.32
797	2.24
1003	2.27

Stn	31
142 E	1 S
Depth(db)	D.O.(ml/l)
0	4.70
51	3.75
101	3.24
149	3.20
201	3.23
249	3.21
300	2.61
350	2.38
401	2.34
500	2.22
600	2.38
799	2.57
1004	2.38

Stn	32
142 E	1-30 S
Depth(db)	D.O.(ml/l)
0	4.83
51	4.49
101	3.25
150	3.22
202	3.38
250	3.20
300	2.83
349	2.64
400	2.48
500	2.70
602	2.94
799	2.64
999	2.31

Stn	33
142 E	2 S
Depth(db)	D.O.(ml/l)
0	4.81
52	3.97
99	3.55
151	3.27
203	3.47
252	3.25
300	3.09
350	2.62
399	3.05
500	3.48
602	3.23
800	2.57
1003	2.33

Stn	34
142 E	2-30 S
Depth(db)	D.O.(ml/l)
0	4.90
49	4.24
99	3.64
150	3.31
200	3.43
249	3.47
299	3.48
349	3.61
400	3.24
499	3.47
598	3.38
799	3.05
1004	2.36

Stn	35
142 E	2-40 S
Depth(db)	D.O.(ml/l)
0	4.74
50	4.04
101	3.33
151	3.29
204	3.34
253	3.35
302	3.36
351	3.55
399	3.61
498	3.13
595	3.25
797	2.81
1005	2.41

Stn	36
141 E	0
Depth(db)	D.O.(ml/l)
0	4.69
50	3.94
101	3.46
150	3.15
198	3.30
249	3.20
299	2.78
350	2.28
401	2.29
499	2.50
599	2.12
797	2.08
1002	2.43

Stn	37
140 E	0
Depth(db)	D.O.(ml/l)
0	4.65
51	3.72
102	3.61
149	3.41
198	3.30
248	3.19
300	2.73
351	2.25
401	1.98
501	2.34
600	2.21
799	2.32
1005	2.41

Stn	38
139 E	0
Depth(db)	D.O.(ml/l)
0	4.81
50	3.72
100	3.45
150	3.35
201	3.27
250	3.22
301	2.83
350	2.42
400	2.08
499	2.66
600	2.13
799	2.34
999	2.29

Stn	39
138 E	1 S
Depth(db)	D.O.(ml/l)
0	4.85
49	4.12
99	3.30
149	3.21
201	3.13
253	3.26
301	2.74
351	2.74
402	2.37
500	2.74
600	2.28
800	2.45
1009	2.29

Stn	40
138 E	1-30 S
Depth(db)	D.O.(ml/l)
0	4.89
50	3.57
100	3.36
149	3.23
200	3.17
251	3.22
301	3.23
352	2.63
401	2.03
500	2.81
600	2.24
799	2.34
1003	2.30

Stn	41
138 E	0
Depth(db)	D.O.(ml/l)
0	4.84
50	3.62
101	3.38
150	3.36
199	3.24
249	3.26
300	2.99
350	2.25
401	1.97
500	2.57
600	2.10
798	2.33
1004	2.40

Stn	42
138 E	0-30 N
Depth(db)	D.O.(ml/l)
0	4.67
50	3.60
101	3.32
153	3.41
200	3.38
249	3.32
300	3.04
351	2.39
401	1.98
500	2.56
601	2.08
800	2.36
1001	2.22

Stn	43
138 E	1 N
Depth(db)	D.O.(ml/l)
0	4.61
53	3.73
105	3.36
153	3.31
202	3.16
248	3.10
300	2.92
348	2.50
399	1.83
498	2.50
599	2.47
796	2.37
1002	2.31

Stn	44
138 E	1-30 N
Depth(db)	D.O.(ml/l)
0	4.61
50	3.64
100	3.34
151	3.36
200	3.59
249	2.99
299	2.75
350	2.38
399	2.33
496	2.64
599	2.80
799	2.40
1003	2.37

Stn	45
138 E	2 N
Depth(db)	D.O.(ml/l)
0	4.64
51	3.52
101	3.53
149	3.33
202	3.50
250	2.91
300	2.60
350	2.30
399	2.52
498	2.78
599	2.90
797	2.37
1004	2.17

Stn	46
137-26 E	2-26 N
Depth(db)	D.O.(ml/l)
0	4.69
52	3.90
105	3.64
149	3.37
200	3.45
250	3.08
298	2.86
347	2.58
398	2.68
499	2.83
599	2.84
800	2.35
1006	2.46

Stn	47
137 E	3 N
Depth(db)	D.O.(ml/l)
0	4.70
52	4.24
102	3.40
149	3.36
200	3.29
249	3.06
299	3.01
348	2.34
397	3.09
496	2.82
597	2.50
800	2.72
1004	2.08

Stn	48
137 E	4 N
Depth(db)	D.O.(ml/l)
0	4.76
52	4.64
99	3.43
148	3.97
200	3.01
250	2.36
298	2.09
347	2.85
399	2.70
497	2.48
597	2.61
799	2.30
1005	2.17

Stn	49
137 E	5 N
Depth(db)	D.O.(ml/l)
0	4.69
51	4.67
99	4.11
149	3.42
200	2.01
251	1.67
300	1.59
348	2.14
400	2.75
499	2.55
600	2.46
800	2.22
1000	2.12

N.D.= No Data

Table 4.5.2 R.M.S. for each depth in this cruise

Niskin	Depth(db)	R.M.S.	
		Up (ml/l)	Down (ml/l)
1	1000	0.939	0.931
2	800	0.993	0.953
3	600	1.043	0.935
4	500	1.101	1.071
5	400	1.046	0.956
6	350	1.065	0.950
7	300	1.094	1.038
8	250	1.347	1.238
9	200	1.449	1.378
10	150	1.600	1.527
11	100	1.802	1.737
12	50	2.307	2.210

5. Meteorological Measurements

Objectives: To promote our understanding about the air-sea interaction over the "warm water pool" area.

We observed some surface meteorological parameters (pressure, dry air temperature, wet air temperature, dew point temperature, sea surface temperature, wind speed/direction, cloud amount and weather) every 3 hours from Majuro to Chuuk and from Chuuk to Palau.

The parameters were recorded by officers and crew of R/V KAIYO according to the Ship's Weather Observation Reports.

Table 5 shows results of observation.

In addition, rain gauge (RM. Young, Model 50202) was set on the compass deck and data are taken every minutes. Data were stored onto PC (NEC, PC9801NS/E) through the data logger (Eikoseiki, SOLAC III, MP-090).

Table 5 Surface Meteorological Measurements

Time UTC	Time LUT	Position Latitude	Position Longitude	W.D. (16deg)	W.S. (m/s)	Weather	Press. (hPa)	Dry Temp. (DEG-C)	Sea W.T. (DEG-C)	Wet Temp. (DEG-C)	Dew P.T. (DEG-C)	Cloud Amount
Majuro Departure												
Jan 03 06	Jan 03 16	07° 13.9' N	170° 45.5' E	NE	6.8	bc	1008.5	26.8	27	24.4	23.6	3
Jan 03 09	Jan 03 19	07° 11.9' N	170° 11.8' E	NE	7.6	c	1010.6	27.0	27	25.2	24.8	8
Jan 03 12	Jan 03 22	07° 09.6' N	169° 40.9' E	ENE	9.2	bc	1010.4	26.0	27	24.0	23.2	3
Jan 03 15	Jan 04 01	07° 07.7' N	169° 09.9' E	NE	8.8	bc	1009.1	26.0	27	24.5	24.0	N/A
Jan 03 18	Jan 04 04	07° 09.7' N	168° 38.2' E	ENE	9.8	b	1009.6	26.0	28	24.2	23.2	1
Jan 03 21	Jan 04 07	07° 15.3' N	168° 11.2' E	NE	11.3	bc	1011.0	27.5	27	23.5	21.9	3
Jan 04 00	Jan 04 10	07° 22.2' N	167° 42.6' E	NE	9.2	bc	1010.0	29.0	27	25.0	23.5	3
Jan 04 03	Jan 04 13	07° 28.5' N	167° 18.0' E	ENE	8.0	bc	1008.2	27.5	26	24.5	23.4	4
Jan 04 06	Jan 04 16	07° 33.8' N	166° 53.0' E	NE	8.6	bc	1008.6	28.6	28	25.1	23.7	6
Jan 04 09	Jan 04 19	07° 40.5' N	166° 25.2' E	NE	6.5	bc	1010.6	27.0	28	24.0	22.9	3
Jan 04 12	Jan 04 22	07° 46.8' N	165° 59.2' E	NE	9.7	bc	1011.1	26.8	27	24.2	23.2	1
Jan 04 15	Jan 05 01	07° 52.0' N	165° 33.2' E	NE	9.6	bc	1010.1	25.5	27	24.0	23.4	N/A
Jan 04 18	Jan 05 04	07° 57.5' N	165° 08.1' E	ENE	8.8	bc	1010.2	25.9	28	24.0	23.2	3
Jan 04 21	Jan 05 07	07° 59.2' N	165° 03.8' E	ENE	8.6	bc	1012.0	27.0	28	24.5	23.6	4
Jan 05 00	Jan 05 10	07° 46.9' N	165° 02.8' E	ENE	10.8	bc	1009.5	28.0	27	25.3	24.8	5
Jan 05 03	Jan 05 13	07° 14.8' N	265° 01.0' E	ENE	9.4	bc	1007.6	26.0	28	26.0	26.0	4
Jan 05 06	Jan 05 16	06° 52.4' N	164° 59.5' E	ENE	10.6	bc	1007.6	28.9	28	27.4	27.0	4
Jan 05 09	Jan 05 19	06° 20.4' N	165° 00.4' E	ENE	11.3	bc	1010.6	27.6	28	27.4	27.3	5
Jan 05 12	Jan 05 22	05° 58.8' N	164° 59.5' E	ENE	10.8	bc	1011.0	26.4	28	26.0	25.8	3
Jan 05 15	Jan 06 01	05° 38.5' N	165° 01.1' E	NE	11.7	bc	1009.4	26.0	28	24.0	23.2	N/A
Jan 05 18	Jan 06 04	05° 18.2' N	165° 01.5' E	ENE	8.6	bc	1010.0	27.0	29	24.0	22.9	4
Jan 05 21	Jan 06 07	05° 01.4' N	165° 01.8' E	ENE	9.7	c	1012.0	27.5	29	24.0	22.7	9
Jan 06 00	Jan 06 10	04° 46.2' N	165° 00.5' E	NE	9.4	c	1011.5	28.2	28	24.4	22.9	7
Jan 06 03	Jan 06 13	04° 13.6' N	165° 00.4' E	ENE	8.6	bc	1008.0	28.0	28	24.5	23.2	4
Jan 06 06	Jan 06 16	03° 51.6' N	164° 59.4' E	ENE	8.6	bc	1007.1	27.8	29	24.7	23.5	4
Jan 06 09	Jan 06 19	03° 22.9' N	165° 00.0' E	ENE	9.7	bc	1008.8	27.5	29	25.0	24.1	4
Jan 06 12	Jan 06 22	02° 54.6' N	164° 59.9' E	ENE	8.6	bc	1009.5	27.0	28	24.8	24.1	4
Jan 06 15	Jan 07 01	02° 27.5' N	165° 00.0' E	ENE	6.6	bc	1008.5	27.0	28	24.8	24.0	N/A
Jan 06 18	Jan 07 04	01° 59.5' N	164° 59.6' E	ENE	7.6	bc	1008.0	25.5	29	25.0	24.8	4
Jan 06 21	Jan 07 07	01° 08.9' N	164° 59.6' E	ENE	7.6	c	1009.6	28.5	28	25.5	24.4	8
Jan 07 00	Jan 07 10	01° 59.3' N	164° 56.4' E	NE	9.3	c	1008.6	27.2	28	26.2	25.9	9
Jan 07 03	Jan 07 13	01° 48.2' N	164° 57.0' E	NE	7.3	c	1006.5	27.6	28	25.4	24.8	9
Jan 07 06	Jan 07 16	01° 15.9' N	164° 59.1' E	NE	7.3	bc	1006.7	29.0	28	25.6	21.0	7
Jan 07 09	Jan 07 19	00° 54.3' N	164° 58.7' E	NE	8.1	bc	1008.8	28.0	28	25.0	23.9	7
Jan 07 12	Jan 07 22	00° 31.7' N	164° 59.4' E	NE	8.8	bc	1008.6	27.6	28	25.4	24.7	8
Jan 07 15	Jan 08 01	00° 10.8' N	164° 59.7' E	ENE	6.2	bc	1008.0	27.6	28	25.0	24.1	N/A
Jan 07 18	Jan 08 04	00° 00.8' S	164° 58.5' E	NE	8.1	bc	1007.6	28.8	28	25.3	24.0	3
Jan 07 21	Jan 08 07	00° 00.5' S	164° 58.8' E	NE	8.6	bc	1009.0	28.5	28	25.5	24.4	5
Jan 08 00	Jan 08 10	00° 01.7' S	164° 57.5' E	NE	8.7	bc	1009.1	28.9	28	25.8	24.7	5
Jan 08 03	Jan 08 13	00° 01.0' S	164° 57.2' E	NE	8.6	bc	1007.5	29.0	28	26.0	25.0	6
Jan 08 06	Jan 08 16	00° 01.2' S	164° 56.5' E	NE	8.1	bc	1006.5	31.5	29	27.5	26.2	5
Jan 08 09	Jan 08 19	00° 02.4' S	164° 51.2' E	NE	8.1	bc	1009.6	28.5	29	26.0	25.1	4
Jan 08 12	Jan 08 22	00° 03.7' S	164° 52.4' E	NE	8.3	bc	1009.4	27.8	28	25.6	24.9	4
Jan 08 15	Jan 09 01	00° 01.5' S	165° 07.0' E	NE	10.0	bc	1008.0	27.8	29	25.4	24.6	N/A
Jan 08 18	Jan 09 04	00° 00.5' N	165° 19.4' E	NE	11.3	bc	1007.7	27.8	29	26.0	25.4	4
Jan 08 21	Jan 09 07	00° 00.1' S	165° 16.1' E	NE	7.6	bc	1009.5	29.2	29	27.8	27.3	4
Jan 09 00	Jan 09 10	00° 00.8' S	165° 16.6' E	NE	6.2	bc	1008.3	30.9	29	28.0	27.1	5
Jan 09 03	Jan 09 13	00° 21.5' S	165° 08.2' E	ENE	6.5	bc	1007.0	28.8	29	25.8	25.0	5
Jan 09 06	Jan 09 16	00° 53.2' S	164° 54.3' E	NE	6.5	c	1006.5	29.0	29	26.5	25.7	9
Jan 09 09	Jan 09 19	01° 09.9' S	164° 46.3' E	NE	5.4	o	1009.6	28.4	29	26.6	26.0	8
Jan 09 12	Jan 09 22	01° 28.5' S	164° 38.8' E	NE	5.2	c	1010.1	28.2	29	25.8	24.9	6
Jan 09 15	Jan 10 01	01° 43.7' S	164° 31.8' E	NNE	3.8	c	1008.6	28.0	28	27.0	26.7	N/A
Jan 09 18	Jan 10 04	01° 54.7' S	164° 29.4' E	NNE	5.4	bc	1008.0	27.8	29	25.8	25.1	5
Jan 09 21	Jan 10 07	01° 55.7' S	164° 25.3' E	NE	6.5	bc	1008.6	28.6	29	26.2	25.3	7
Jan 10 00	Jan 10 10	02° 21.7' S	164° 31.9' E	NNE	3.0	c	1009.0	29.9	29	26.8	25.8	8
Jan 10 03	Jan 10 13	02° 53.0' S	164° 40.1' E	NE	5.0	bc	1007.6	29.0	29	26.0	25.0	7
Jan 10 06	Jan 10 16	03° 13.0' S	164° 45.2' E	N	2.7	bc	1007.0	29.0	29	26.4	25.5	7
Jan 10 09	Jan 10 19	03° 38.2' S	164° 51.5' E	NNE	2.7	c	1009.1	28.6	30	26.2	25.3	9
Jan 10 12	Jan 10 22	04° 07.4' S	164° 58.8' E	N	1.5	c	1009.6	28.2	29	26.0	25.3	9
Jan 10 15	Jan 11 01	04° 33.1' S	165° 05.4' E	NNW	4.0	c	1007.2	28.0	29	26.5	26.0	N/A
Jan 10 18	Jan 11 04	04° 57.3' S	165° 12.3' E	WSW	2.2	c	1007.2	27.0	29	25.5	25.0	10
Jan 10 21	Jan 11 07	04° 58.6' S	165° 12.9' E	NNW	2.7	c	1008.6	28.0	29	26.8	26.4	9
Jan 11 00	Jan 11 10	05° 00.0' S	165° 12.7' E	NNW	6.7	bc	1007.7	31.4	29	26.6	25.4	6
Jan 11 03	Jan 11 13	04° 39.4' S	164° 52.8' E	N	14.4	bc	1005.6	30.0	29	27.0	26.0	6
Jan 11 06	Jan 11 16	04° 11.3' S	164° 27.8' E	N	7.0	bc	1005.8	29.8	29	27.0	26.1	6
Jan 11 09	Jan 11 19	03° 43.5' S	164° 02.2' E	N	7.6	o	1008.0	29.0	29	26.8	26.0	10
Jan 11 12	Jan 11 22	03° 14.8' S	163° 35.8' E	NNW	6.5	c	1009.3	28.2	29	26.2	25.5	9
Jan 11 15	Jan 12 01	02° 47.7' S	163° 11.0' E	N	7.1	c	1008.1	28.0	29	?24.6	?25.5	N/A
Jan 11 18	Jan 12 04	02° 19.7' S	162° 44.8' E	N	8.1	bc	1008.2	27.8	29	26.2	25.7	5
Jan 11 21	Jan 12 07	01° 52.1' S	162° 20.0' E	NNE	8.1	bc	1009.8	27.8	29	25.0	24.0	5
Jan 12 00	Jan 12 10	01° 32.3' S	162° 01.5' E	NE	7.1	c	1009.6	31.0	29	28.2	27.3	8
Jan 12 03	Jan 12 13	01° 06.2' S	161° 37.8' E	NE	4.2	bc	1007.6	28.0	29	26.0	25.3	6
Jan 12 06	Jan 12 16	00° 38.5' S	161° 12.3' E	NE	9.2	bc	1007.2	29.2	29	26.8	26.0	6
Jan 12 09	Jan 12 19	00° 10.4' S	160° 46.4' E	NNE	7.6	c	1009.4	28.4	29	26.2	25.4	9
Jan 12 12	Jan 12 22	00° 18.4' N	160° 21.3' E	W	7.3	c	1010.9	26.6	28	24.6	23.9	5
Jan 12 15	Jan 13 01	00° 46.4' N	159° 55.0' E	ENE	6.2	o	1009.6	26.0	28	25.0	24.6	N/A
Jan 12 18	Jan 13 04	01° 14.1' N	159° 28.7' E	NE	10.3	r	1008.5	26.5	29	25.8	25.4	10
Jan 12 21	Jan 13 07	01° 43.4' N	159° 03.1' E	NE	9.2	b	1010.2	28.0	29	25.8	25.0	2
Jan 13 00	Jan 13 10	02° 02.0' N	158° 44.7' E	NE	8.7	bc	1009.6	30.8	28	28.0	27.1	3
Jan 13 03	Jan 13 13	02° 30.1' N	158° 20.0' E	NE	8.8	bc	1009.0	31.0	29	27.0	25.7	4
Jan 13 06	Jan 13 16	02° 49.3' N	158° 02.4' E	NE	7.0	bc	1007.2	29.2	29	26.8	26.0	4
Jan 13 09	Jan 13 19	03° 17.7' N	157° 38.0' E	NE	11.3	bc	1010.0	28.2	29	25.2	24.1	5
Jan 13 12	Jan 13 22	03° 45.7' N	157° 13.5' E	NE	10.9	bc	1010.5	27.6	28	26.4	26.1	6
Jan 13 15	Jan 14 01	04° 13.0' N	156° 48.6' E	ENE	10.3	bc	1009.6	27.2	29	25.2	24.5	6
Jan 13 18	Jan 14 04	04° 39.3' N	156° 24.6' E	ENE	12.4	bc	1009.0	27.2	29	25.0	24.2	6
Jan 13 21	Jan 14 07	05° 00.5' N	156° 05.7' E	ENE	9.7	c	1012.1	27.6	29	25.2	24.2	8

Table 5 Surface Meteorological Measurements

Time UTC	Time LUT	Position Latitude	Position Longitude	W.D. (16deg)	W.S. (m/s)	Weather	Press. (hPa)	Dry Temp. (DEG-C)	Sea W.T. (DEG-C)	Wet Temp. (DEG-C)	Dew P.T. (DEG-C)	Cloud Amount
Jan 14 00	Jan 14 10	05° 09.8' N	156° 03.8' E	NE	9.7	bc	1011.7	28.2	29	26.0	25.3	5
Jan 14 03	Jan 14 13	05° 45.8' N	156° 01.4' E	NNE	11.9	bc	1010.0	30.6	29	26.0	24.4	3
Jan 14 06	Jan 14 16	06° 09.4' N	155° 59.3' E	NE	14.0	bc	1009.6	29.4	29	25.2	23.7	3
Jan 14 09	Jan 14 19	06° 42.5' N	155° 57.9' E	NE	14.6	bc	1010.6	27.6	29	24.8	23.8	7
Jan 14 12	Jan 14 22	06° 15.9' N	155° 56.1' E	NE	13.3	bc	1012.1	27.0	28	23.8	22.7	5
Jan 14 15	Jan 15 01	07° 44.3' N	155° 54.9' E	NE	12.9	bc	1011.3	26.8	28	23.4	22.1	N/A
Jan 14 18	Jan 15 04	08° 05.0' N	155° 54.8' E	ENE	13.5	bc	1010.0	26.6	28	23.5	22.3	4
Jan 14 21	Jan 15 07	08° 04.0' N	155° 58.4' E	ENE	15.1	bc	1010.6	26.6	28	23.3	22.0	4
Jan 15 00	Jan 15 10	08° 05.2' N	155° 01.5' E	ENE	15.0	bc	1011.0	27.4	28	23.9	22.5	7
Jan 15 03	Jan 15 13	08° 00.7' N	155° 00.9' E	ENE	13.4	bc	1009.2	27.6	28	25.8	25.3	4
Jan 15 06	Jan 15 16	07° 57.5' N	155° 51.5' E	ENE	16.7	b	1008.6	28.0	27	24.0	22.5	2
Jan 15 09	Jan 15 19	07° 56.0' N	155° 47.5' E	ENE	13.0	bc	1010.6	27.4	27	24.2	23.0	3
Jan 15 12	Jan 15 22	07° 51.1' N	155° 36.6' E	ENE	12.9	bc	1011.0	27.0	28	24.8	24.1	5
Jan 15 15	Jan 16 01	07° 54.8' N	155° 46.7' E	E	13.8	bc	1009.8	25.5	28	25.0	24.8	N/A
Jan 15 18	Jan 16 04	07° 58.4' N	155° 54.6' E	E	15.1	bc	1009.2	26.6	28	24.0	23.0	3
Jan 15 21	Jan 16 07	07° 59.1' N	155° 48.3' E	E	13.5	bc	1011.1	27.8	28	24.2	22.9	3
Jan 16 00	Jan 16 10	07° 52.9' N	155° 14.6' E	E	9.5	bc	1011.7	33.0	28	25.2	22.2	3
Jan 16 03	Jan 16 13	07° 47.5' N	154° 38.5' E	ENE	9.6	bc	1009.6	28.5	27	24.5	23.0	2
Jan 16 06	Jan 16 16	07° 44.4' N	154° 03.3' E	ENE	10.8	bc	1008.5	28.2	28	24.8	23.5	3
Jan 16 09	Jan 16 19	07° 41.6' N	153° 32.9' E	ENE	13.0	bc	1010.6	27.8	28	25.0	24.0	3
Jan 16 12	Jan 16 22	07° 38.2' N	153° 01.9' E	ESE	13.3	bc	1011.6	27.6	28	25.0	24.1	4
Chuuk Arrival												
Chuuk Departure												
Jan 20 00	Jan 20 10	07° 30.9' N	151° 59.9' E	NNE	8.2	bc	1013.1	27.7	27	25.8	25.6	6
Jan 20 03	Jan 20 13	06° 58.2' N	152° 00.7' E	NE	8.8	bc	1011.0	27.9	27	26.0	25.3	6
Jan 20 06	Jan 20 16	06° 46.1' N	151° 41.0' E	NE	9.5	bc	1009.1	28.0	27	26.0	25.3	6
Jan 20 09	Jan 20 19	06° 30.1' N	150° 57.3' E	NE	11.9	bc	1010.6	27.5	29	25.3	24.5	6
Jan 20 12	Jan 20 22	06° 18.5' N	150° 24.2' E	NE	11.3	bc	1011.5	27.2	28	25.0	24.2	2
Jan 20 15	Jan 21 01	06° 06.6' N	149° 53.2' E	NE	9.6	c	1010.8	26.8	27	25.6	25.3	N/A
Jan 20 18	Jan 21 04	05° 54.2' N	149° 21.6' E	ENE	5.5	c	1009.7	24.8	27	24.0	23.7	N/A
Jan 20 21	Jan 21 07	05° 42.5' N	148° 49.2' E	E	9.2	c	1010.9	24.2	28	23.0	22.5	9
Jan 21 00	Jan 21 10	05° 30.0' N	148° 17.3' E	E	9.3	q	1012.6	26.4	28	25.0	24.5	9
Jan 21 03	Jan 21 13	05° 16.5' N	147° 46.9' E	ESE	9.3	bc	1010.6	28.8	27	26.4	25.6	6
Jan 21 06	Jan 21 16	05° 03.9' N	147° 17.7' E	ENE	4.9	r	1009.1	28.0	27	25.8	25.1	10
Jan 21 09	Jan 21 19	04° 55.7' N	147° 00.3' E	E	7.6	c	1010.6	25.5	28	24.0	23.4	9
Jan 21 12	Jan 21 22	04° 22.2' N	147° 01.4' E	ENE	6.2	bc	1011.5	26.7	28	24.3	23.6	2
Jan 21 15	Jan 22 01	04° 00.2' N	147° 00.2' E	ENE	6.2	bc	1010.4	25.6	27	25.0	24.8	N/A
Jan 21 18	Jan 22 04	03° 27.6' N	147° 00.3' E	ENE	6.0	bc	1009.1	26.7	27	25.2	24.7	5
Jan 21 21	Jan 22 07	02° 59.7' N	146° 59.7' E	NE	7.0	bc	1010.6	26.4	28	25.2	24.7	5
Jan 22 00	Jan 22 10	02° 29.8' N	147° 00.0' E	ENE	5.4	bc	1012.0	29.4	28	26.0	24.8	6
Jan 22 03	Jan 22 13	02° 02.2' N	146° 59.6' E	ENE	7.7	bc	1009.2	29.8	28	26.5	25.4	6
Jan 22 06	Jan 22 16	01° 32.7' N	146° 59.9' E	NNE	3.9	c	1008.1	28.0	28	25.6	24.6	7
Jan 22 09	Jan 22 19	01° 01.3' N	146° 59.8' E	NE	4.9	c	1010.2	27.8	29	25.4	24.5	8
Jan 22 12	Jan 22 22	01° 47.7' N	147° 00.2' E	E	4.3	bc	1010.6	27.8	29	25.3	24.3	5
Jan 22 15	Jan 23 01	00° 30.8' N	147° 02.8' E	NNE	6.4	bc	1009.2	27.8	29	25.8	25.1	N/A
Jan 22 18	Jan 23 04	00° 17.9' N	147° 01.5' E	NE	6.2	c	1008.0	27.6	28	25.2	24.7	N/A
Jan 22 21	Jan 23 07	00° 17.8' N	147° 03.9' E	NE	8.1	c	1008.2	27.6	29	25.3	24.5	8
Jan 23 00	Jan 23 10	00° 13.8' N	146° 58.5' E	NE	7.3	bc	1009.1	29.1	29	25.9	24.8	5
Jan 23 03	Jan 23 13	00° 00.9' N	146° 57.6' E	NE	8.8	bc	1008.0	29.0	28	25.6	24.3	5
Jan 23 06	Jan 23 16	00° 00.3' S	146° 58.4' E	NE	8.2	bc	1007.1	29.0	28	26.0	25.0	5
Jan 23 09	Jan 23 19	00° 02.2' S	146° 54.5' E	NE	8.6	bc	1008.6	28.4	29	25.6	24.6	4
Jan 23 12	Jan 23 22	00° 03.1' S	146° 52.5' E	NE	8.8	b	1010.0	28.0	29	25.0	23.9	0
Jan 23 15	Jan 24 01	00° 00.0' N	146° 52.7' E	NE	7.2	bc	1009.0	28.0	28	25.4	24.5	N/A
Jan 23 18	Jan 24 04	00° 01.0' S	146° 52.0' E	NE	7.2	bc	1007.0	28.0	28	25.4	24.5	N/A
Jan 23 21	Jan 24 07	00° 00.2' S	146° 52.4' E	NE	9.2	bc	1009.0	27.5	29	25.0	24.1	6
Jan 24 00	Jan 24 10	00° 00.1' S	146° 51.4' E	NNE	7.2	bc	1010.6	29.6	29	25.0	23.4	5
Jan 24 03	Jan 24 13	00° 01.2' S	146° 49.3' E	NE	7.7	bc	1010.0	28.8	29	24.8	23.3	4
Jan 24 06	Jan 24 16	00° 00.0' N	146° 42.3' E	NE	6.5	bc	1008.4	28.6	28	24.8	23.7	3
Jan 24 09	Jan 24 19	00° 00.0' N	146° 05.7' E	NE	7.0	bc	1009.8	28.6	29	25.0	23.7	4
Jan 24 12	Jan 24 22	00° 00.1' N	145° 37.9' E	NNE	5.9	bc	1011.5	28.0	29	24.8	23.3	1
Jan 24 15	Jan 25 01	00° 00.2' S	145° 00.1' E	NNE	7.6	bc	1011.0	27.8	28	25.6	24.8	N/A
Jan 24 18	Jan 25 04	00° 00.1' N	144° 36.2' E	NNE	7.8	bc	1010.1	27.6	28	25.8	25.3	N/A
Jan 24 21	Jan 25 07	00° 00.0' S	144° 00.6' E	NE	8.1	bc	1011.0	27.0	28	25.0	24.3	5
Jan 25 00	Jan 25 10	00° 00.1' S	143° 34.6' E	NE	7.3	bc	1013.2	31.4	29	26.4	24.7	4
Jan 25 03	Jan 25 13	00° 00.1' S	143° 00.9' E	NNE	7.0	bc	1011.9	28.6	28	26.0	25.1	4
Jan 25 06	Jan 25 16	00° 01.6' S	142° 54.7' E	NNE	5.2	bc	1010.0	28.4	29	25.2	24.0	5
Jan 25 09	Jan 25 19	00° 02.5' S	142° 48.0' E	NE	5.9	bc	1010.6	29.5	29	26.0	24.8	5
Jan 25 12	Jan 25 22	00° 01.8' S	142° 30.9' E	NE	7.3	bc	1010.3	27.7	29	25.0	24.3	0
Jan 25 15	Jan 26 01	00° 01.0' S	142° 12.4' E	ENE	6.9	bc	1012.6	27.4	28	26.0	25.5	N/A
Jan 25 18	Jan 26 04	00° 00.2' S	141° 59.6' E	ENE	4.7	bc	1011.5	27.2	28	25.2	24.5	N/A
Jan 25 21	Jan 26 07	00° 00.0' S	141° 57.4' E	NE	5.4	bc	1011.2	27.0	29	24.5	23.6	3
Jan 26 00	Jan 26 10	00° 00.2' N	141° 58.2' E	NE	6.0	bc	1013.2	28.7	29	25.2	23.9	2
Jan 26 03	Jan 26 13	00° 23.7' S	141° 59.3' E	NE	5.9	bc	1011.1	28.6	28	26.0	25.1	5
Jan 26 06	Jan 26 16	00° 47.9' S	141° 59.4' E	NE	6.6	bc	1009.0	28.6	28	26.6	25.9	6
Jan 26 09	Jan 26 19	01° 13.9' S	141° 59.5' E	NE	7.0	c	1010.2	28.0	29	26.0	25.3	9
Jan 26 12	Jan 26 22	01° 39.5' S	141° 58.9' E	ENE	8.0	c	1012.2	27.4	28	26.0	25.7	10
Jan 26 15	Jan 27 01	02° 03.5' S	141° 56.1' E	NNE	6.4	bc	1012.3	26.8	28	26.0	25.7	N/A
Jan 26 18	Jan 27 04	02° 28.1' S	141° 54.9' E	NNE	4.0	c	1011.0	27.0	28	25.8	25.4	N/A
Jan 26 21	Jan 27 07	02° 29.5' S	141° 55.7' E	NNE	7.0	q	1011.6	26.0	29	25.5	25.3	10
Jan 27 00	Jan 27 10	02° 01.8' S	141° 45.5' E	WSW	3.0	q	1014.1	27.7	28	25.0	24.0	10
Jan 27 03	Jan 27 13	01° 29.1' S	141° 32.5' E	WNW	4.1	q	1012.4	27.2	29	26.2	25.9	8
Jan 27 06	Jan 27 16	00° 57.3' S	141° 20.2' E	NNE	7.8	c	1008.6	29.6	28	27.6	27.0	8
Jan 27 09	Jan 27 19	00° 24.3' S	141° 08.6' E	NE	9.7	bc	1010.6	28.0	29	26.0	25.3	7
Jan 27 12	Jan 27 22	00° 02.6' S	141° 56.7' E	NE	8.0	bc	1013.0	27.7	29	25.7	24.8	4
Jan 27 15	Jan 28 01	00° 00.5' S	140° 18.5' E	NE	6.0	bc	1013.0	27.6	28	25.6	24.9	N/A
Jan 27 18	Jan 28 04	00° 00.2' S	139° 49.9' E	NE	7.1	bc	1011.6	27.2	28	25.4	24.8	N/A
Jan 27 21	Jan 28 07	00° 00.2' S	139° 11.8' E	NE	7.6	bc	1012.6	27.0	29	25.0	24.3	5

Table 5 Surface Meteorological Measurements

Time UTC	Time LUT	Position Latitude	Position Longitude	W.D. (16deg)	W.S. (m/s)	Weather	Press. (hPa)	Dry Temp. (DEG-C)	Sea W.T. (DEG-C)	Wet Temp. (DEG-C)	Dew P.T. (DEG-C)	Cloud Amount
Jan 28 00	Jan 28 10	00° 12.6' S	138° 46.0' E	NE	7.0	bc	1014.3	29.5	28	25.0	23.7	3
Jan 28 03	Jan 28 13	00° 43.1' S	138° 17.8' E	ENE	5.2	bc	1013.3	32.4	28	26.8	24.7	6
Jan 28 06	Jan 28 16	00° 56.6' S	138° 02.2' E	E	4.0	c	1010.6	30.5	28	27.5	27.3	8
Jan 28 09	Jan 28 19	00° 30.9' S	137° 59.4' E	NE	4.9	c	1011.6	30.5	29	26.5	25.2	8
Jan 28 12	Jan 28 22	00° 01.4' S	137° 59.7' E	NNE	6.5	bc	1013.0	27.8	29	24.8	23.7	2
Jan 28 15	Jan 29 01	00° 21.9' N	137° 58.7' E	ENE	5.6	bc	1013.2	27.4	28	25.4	24.7	N/A
Jan 28 18	Jan 29 04	00° 45.3' N	137° 59.1' E	NE	6.1	bc	1011.9	27.6	28	25.2	24.4	N/A
Jan 28 21	Jan 29 07	01° 08.9' N	137° 58.8' E	NE	7.6	bc	1011.9	27.0	29	24.5	23.6	4
Jan 29 00	Jan 29 10	01° 33.6' N	137° 58.8' E	NNE	8.1	bc	1014.6	29.2	29	26.2	25.2	3
Jan 29 03	Jan 29 13	01° 59.7' N	137° 59.0' E	NNE	8.3	bc	1013.0	30.0	29	26.5	25.3	4
Jan 29 06	Jan 29 16	02° 18.2' N	137° 34.0' E	NNE	8.2	bc	1011.6	27.8	27	26.0	25.4	5
Jan 29 09	Jan 29 19	02° 29.9' N	137° 26.6' E	NE	13.0	bc	1011.7	28.6	27	26.0	25.1	4
Jan 29 12	Jan 29 22	02° 42.2' N	137° 33.1' E	N	14.0	bc	1013.6	25.6	28	24.7	24.3	5
Jan 29 15	Jan 30 01	02° 32.0' N	137° 21.8' E	ENE	9.3	bc	1014.0	26.6	27	24.4	23.6	N/A
Jan 29 18	Jan 30 04	02° 26.0' N	137° 16.8' E	NE	8.2	c	1012.0	27.4	27	25.0	24.1	N/A
Jan 29 21	Jan 30 07	02° 24.7' N	137° 24.2' E	NE	9.0	c	1012.4	26.5	28	24.5	23.8	8
Jan 30 00	Jan 30 10	02° 25.8' N	137° 26.1' E	NE	9.1	bc	1014.0	27.5	28	25.1	24.0	3
Jan 30 03	Jan 30 13	02° 50.8' N	137° 08.0' E	ENE	8.2	bc	1013.1	28.2	27	25.4	24.3	5
Jan 30 06	Jan 30 16	03° 14.8' N	137° 00.4' E	NE	9.5	bc	1011.9	28.0	28	25.2	24.2	5
Jan 30 09	Jan 30 19	03° 51.9' N	137° 00.1' E	NE	10.8	bc	1012.7	29.4	28	26.6	25.7	4
Jan 30 12	Jan 30 22	04° 18.5' N	136° 59.8' E	NE	10.8	bc	1014.8	27.4	28	24.8	23.9	2
Jan 30 15	Jan 31 01	04° 54.3' N	137° 00.2' E	ENE	11.9	bc	1014.7	27.0	26	25.4	24.9	N/A
Jan 30 18	Jan 31 04	05° 08.5' N	136° 45.5' E	ENE	9.7	bc	1013.1	27.0	26	25.4	24.9	N/A
Jan 30 21	Jan 31 07	05° 26.8' N	136° 16.3' E	NE	10.3	bc	1013.5	26.9	28	24.2	23.3	3
Jan 31 00	Jan 31 10	05° 45.5' N	135° 45.1' E	ENE	10.3	bc	1016.0	28.1	27	25.1	24.0	7
Jan 31 03	Jan 31 13	06° 04.5' N	135° 14.2' E	ENE	9.0	bc	1014.7	27.6	27	24.8	23.8	4
Jan 31 06	Jan 31 16	06° 25.4' N	134° 41.5' E	ENE	8.3	bc	1012.6	27.6	27	24.8	23.8	4
Jan 31 09	Jan 31 19	06° 49.3' N	134° 12.5' E	ENE	8.6	bc	1016.0	27.2	28	24.9	24.1	7
Jan 31 12	Jan 31 22	06° 49.3' N	134° 12.5' E	S	9.0	bc	1015.6	28.0	26	24.5	23.2	1
Palau Arrival												

*weather
bc ;Fine but cloudy (cloud 3 to 7)
c ;Cloudy (cloud 8 to 10)
o ;Overcast (cloud 10)
q ;Squalls

6 . Shipbord ADCP

R/V Kaiyo mounts the VM(Vessel–Mounted)–NB(Narrow–Band) ADCP (Acoustic Doppler Current Plofiler) manufacutured by RD Instrument. The serial number of transducer is 501 of the frequency 77KHz and the 30degree beam angle.The ADCP was setas listed below.

Depth Cell Length : 4m

No. of Depth Cell : 64

Average Time : 30 sec

Tilt misalignment : 0.0

Pitch offset : 0.0

Roll offset : 0.0

7 . JAMSTEC ADCP MOORING

To get the knowledge of physical process in the western equatorial pacific.In this crui se (K98-01), we recovered three subsurface ADCP moorings at (00-165E) , (00-147E), and (00-142E),and deployed three 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

Recoreved ADCP

- Serial Number : 1224 (Mooring No.970131-00N165E)
- Serial Number : 1155 (Mooring No.970219-00N147E)
- Serial Number : 1154 (Mooring No.970222-00N142E)

Deployed ADCP

- Serial Number : 1152 (Mooring No.980108-00165E)
- Serial Number : 1153 (Mooring No.980123-00147E)
- Serial Number : 1221 (Mooring No.980125-00142E)

2) CTD

SBE-16

Sampling Interval : 1800s

Recoreved CTD

- Serial Number : 1288 (Mooring No.970131-00165E)
- Serial Number : 1275 (Mooring No.970219-00147E)
- Serial Number : 1276 (Mooring No.970222-00142E)

Deployed CTD

- Serial Number : 1285 (Mooring No.980108-00165E)
- Serial Number : 1153 (Mooring No.980123-00147E)
- Serial Number : 1281 (Mooring No.980125-00142E)

Deployment :

Three ADCP mooring were deployed at (00-165E), (00- 147E), and (00-142E) . The moorings were planed to make the ADCP buoy placed at about 280m.

After we dropped the anchor, we monitored depth of the acoustic releaser (Fig.7-1 ～7-3). The descending rate was about 2.3m/sec.

Each position of the mooring were showed below.

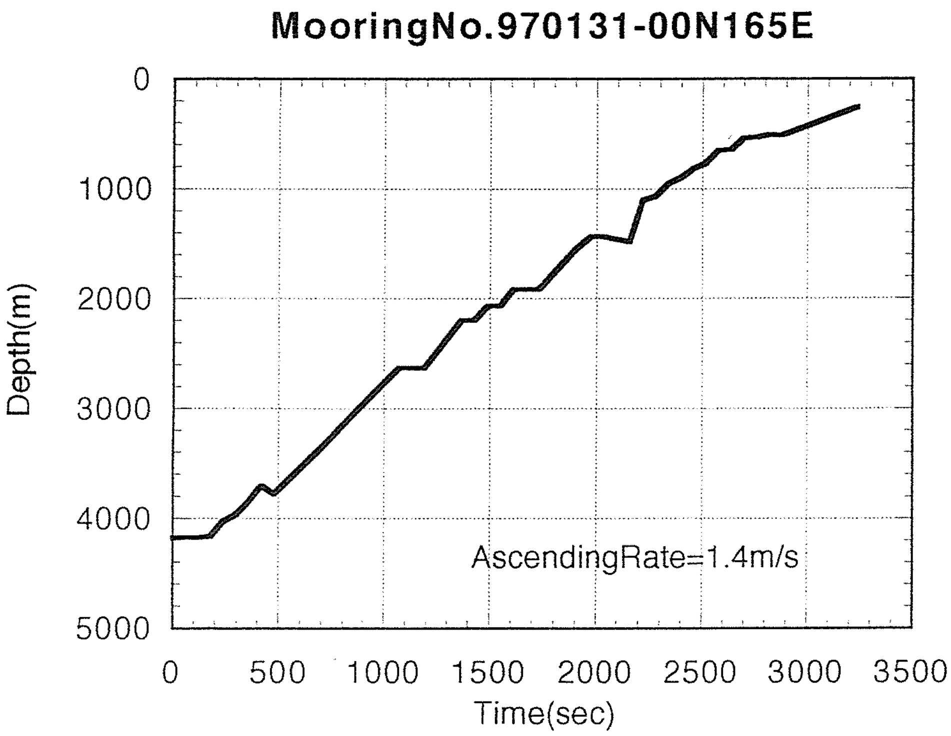
Results of calibration

- Mooring No.980108-00165E
  Lat: 0° 00.137S Long: 165° 17.695E
- Mooring No.980123-00147E
  Lat: 0° 00.252S Long: 146° 51.956E
- Mooring No.980125-00142E
  Lat: 0° 00.227N Long: 141° 58.240E

Recovery

We recovered three ADCP moorings which were deployed on Feb.1997 (K97-02). We monitored depth of acoustic releaser after we released the anchor (Fig.7-1 ～7-3).

After the recovery, we uploaded ADCP and CTD data into a computer, then raw d ata were converted into ASCII code. Results were shown in the figures on following pages. Fig.7-4 ～7-6 shows CTD depth, temperatureand salinity data . Fig.7-7 ～7-15 shows the velocity data (eastward and northward component) at 50m(25bins for 00-165E ADCP,27bins for 00-147E, 24bins for 00-142E,), 100m(19bins for 00-165E ADCP,21bins for 00-147E, 17bins for 00-142E,) and 150m(12bins for 00-165E ADC P,15bins for 00-147E, 11bins for 00-142E,) depth.



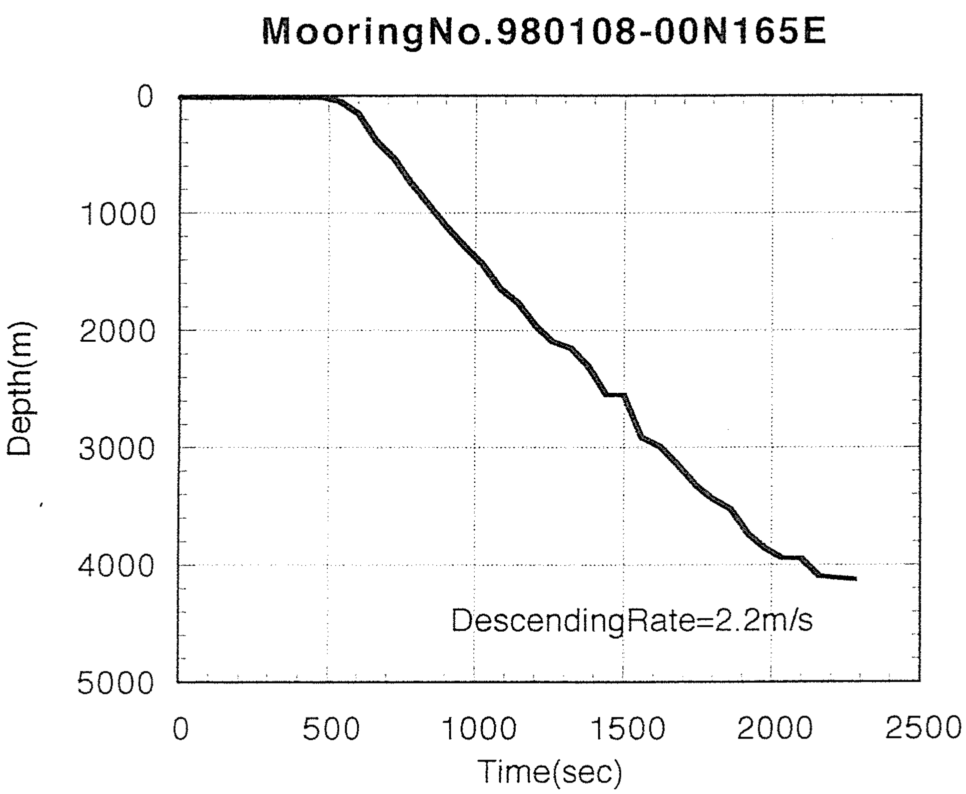
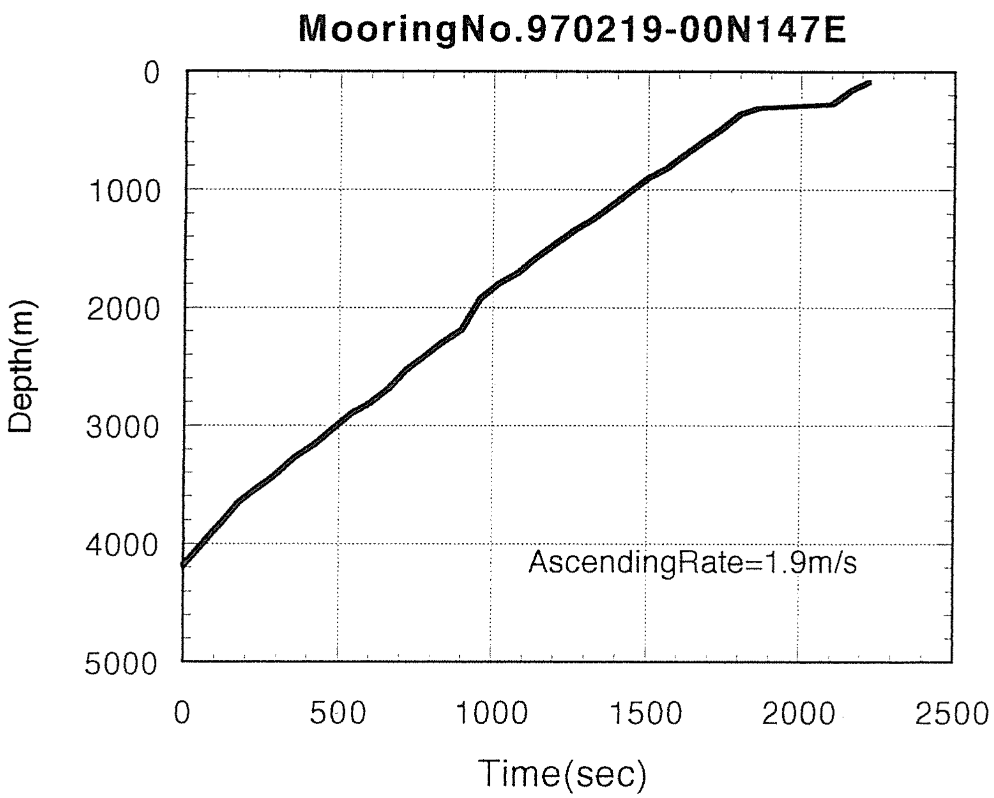


Fig. 7-1 Releaser Depth Monitor



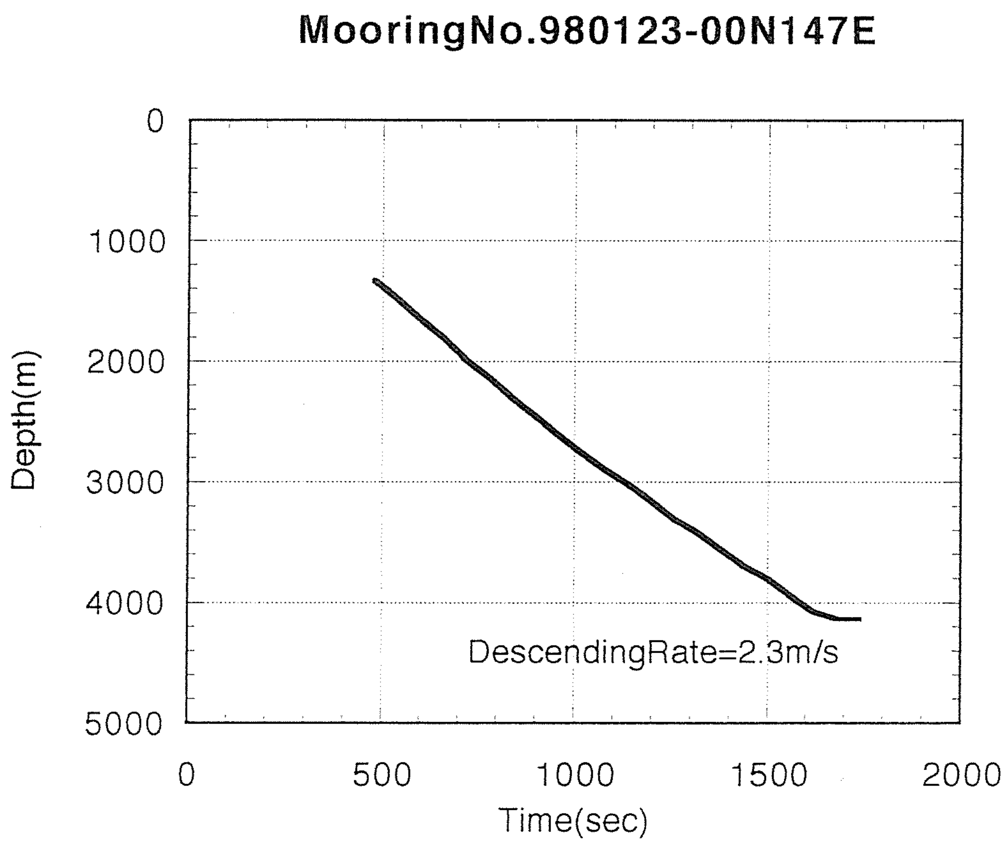
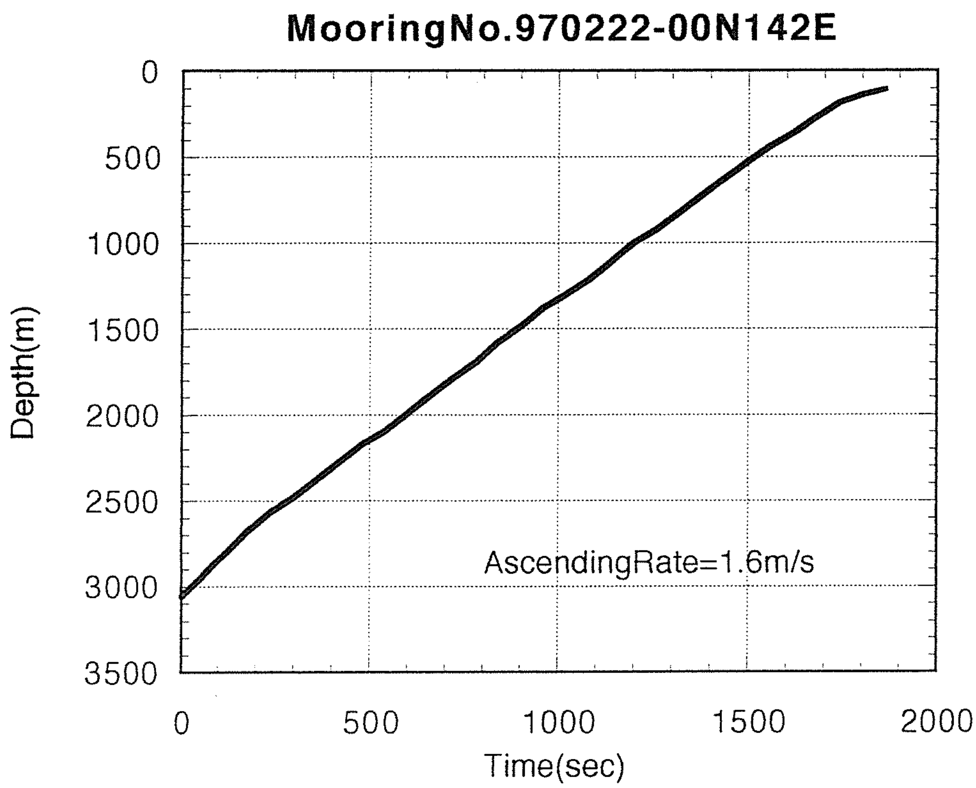


Fig. 7-2 Releaser Depth Monitor



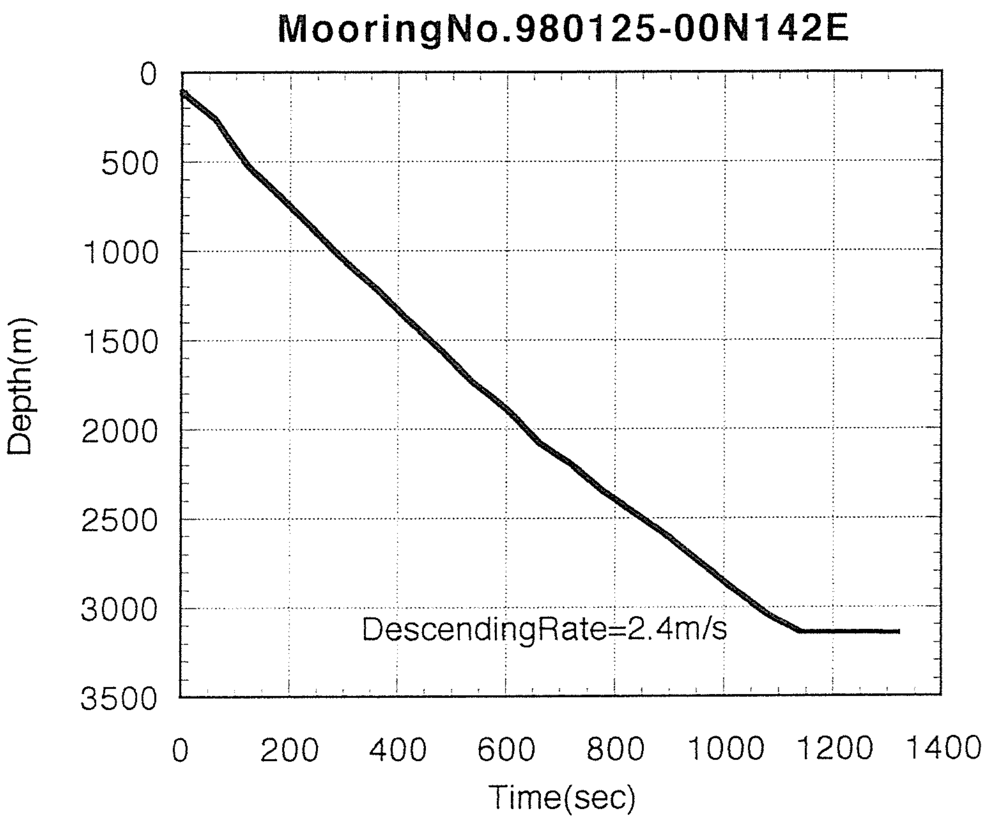
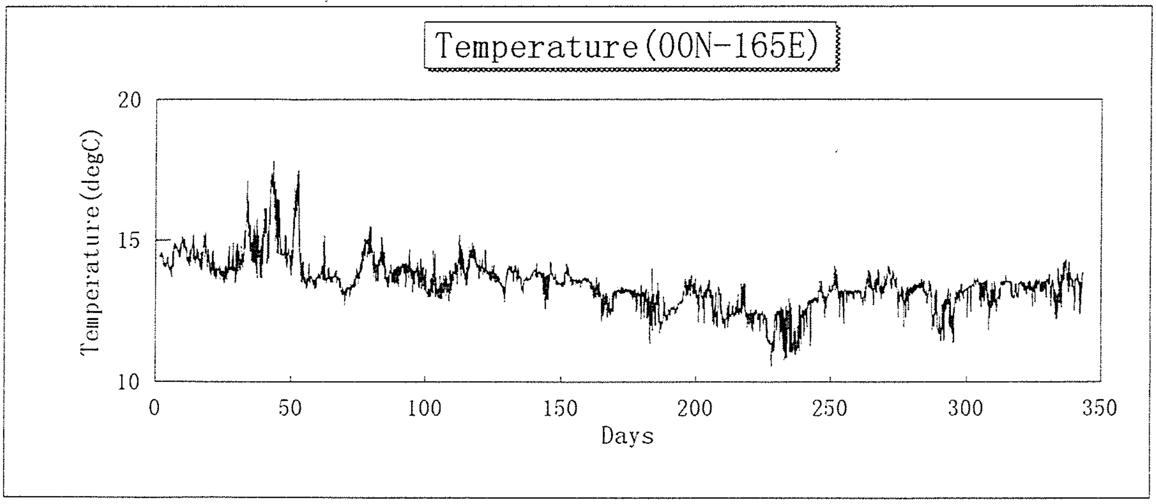
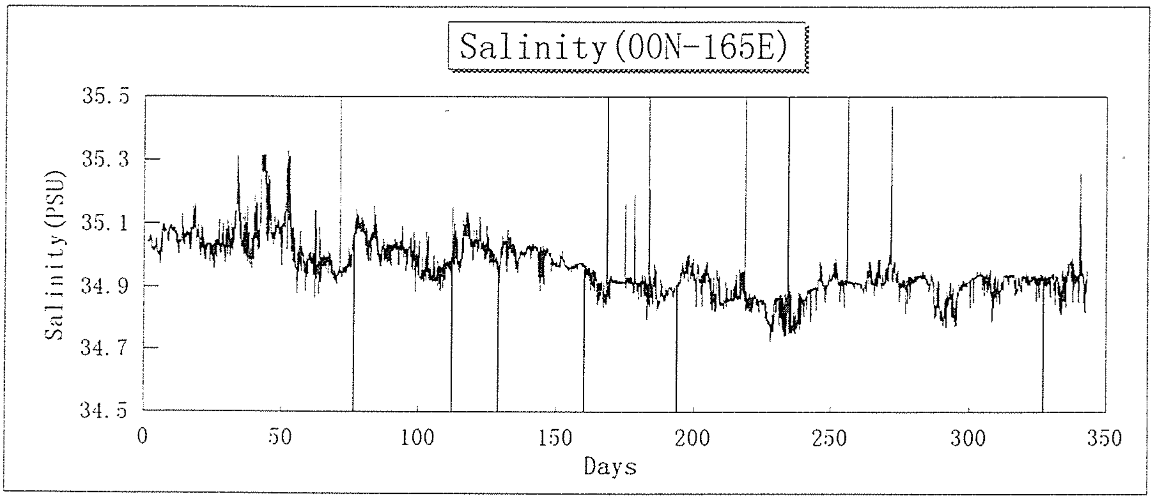


Fig. 7-3 Releaser Depth Monitor





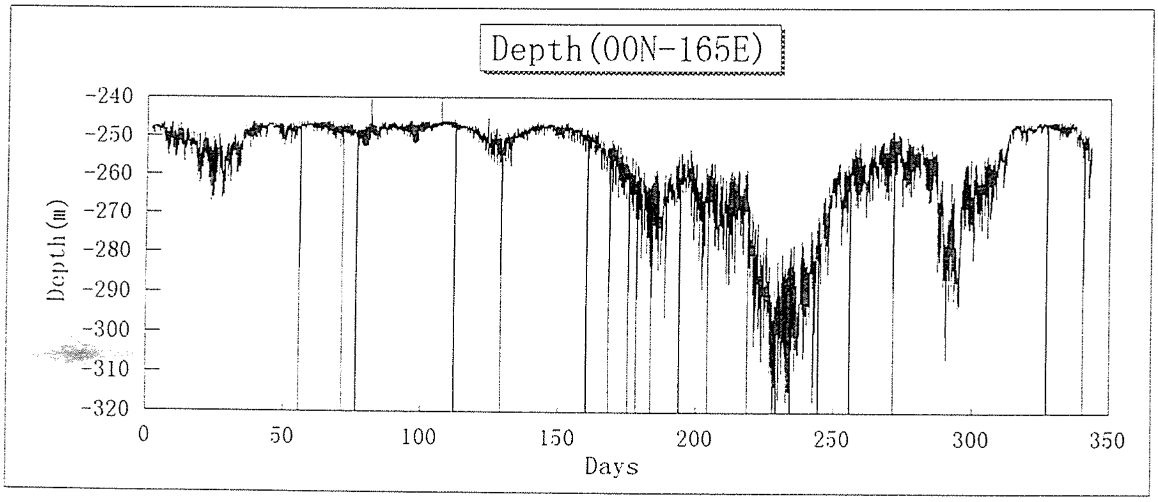
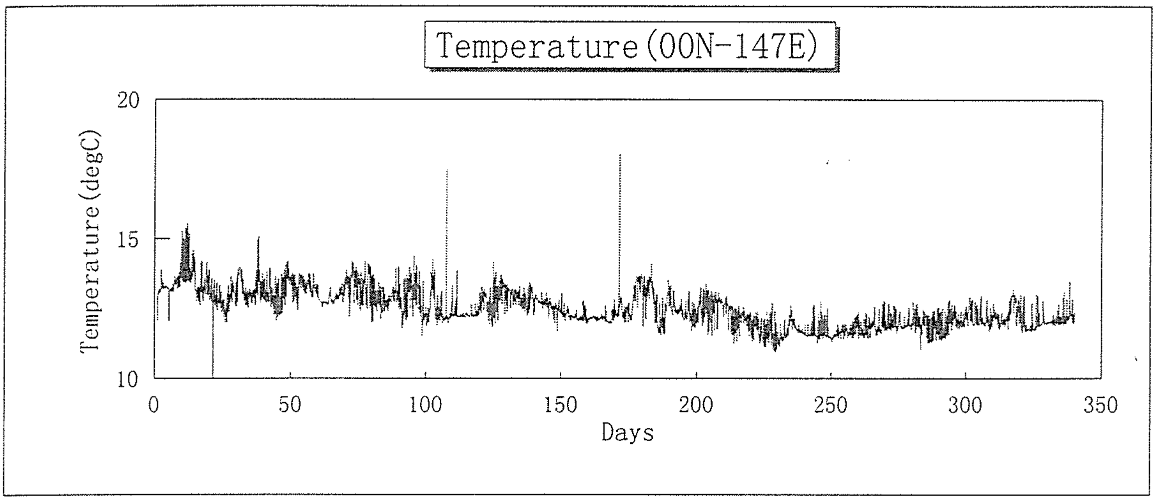
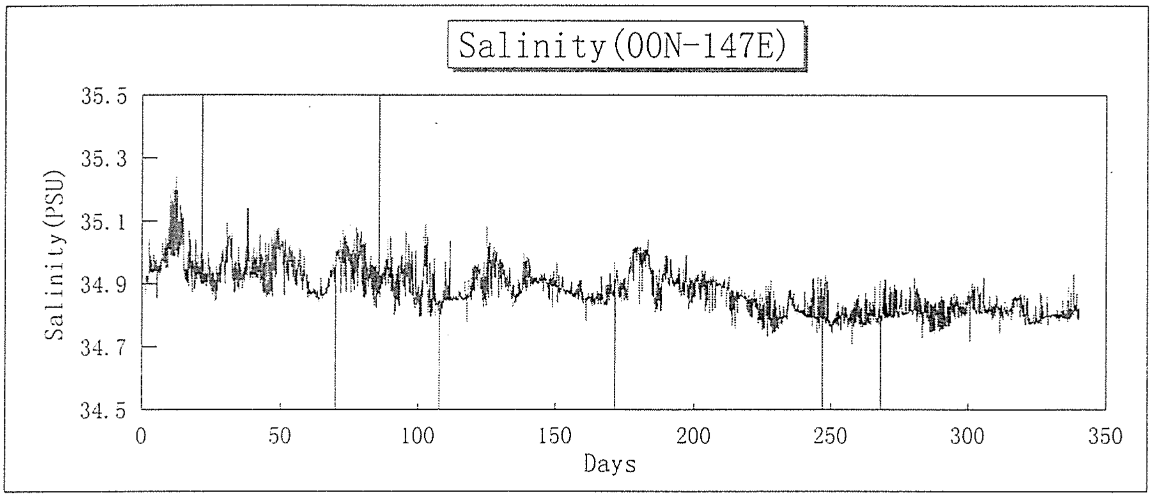


Fig. 7-4 Time Series of Temperature, Salinity, Depth





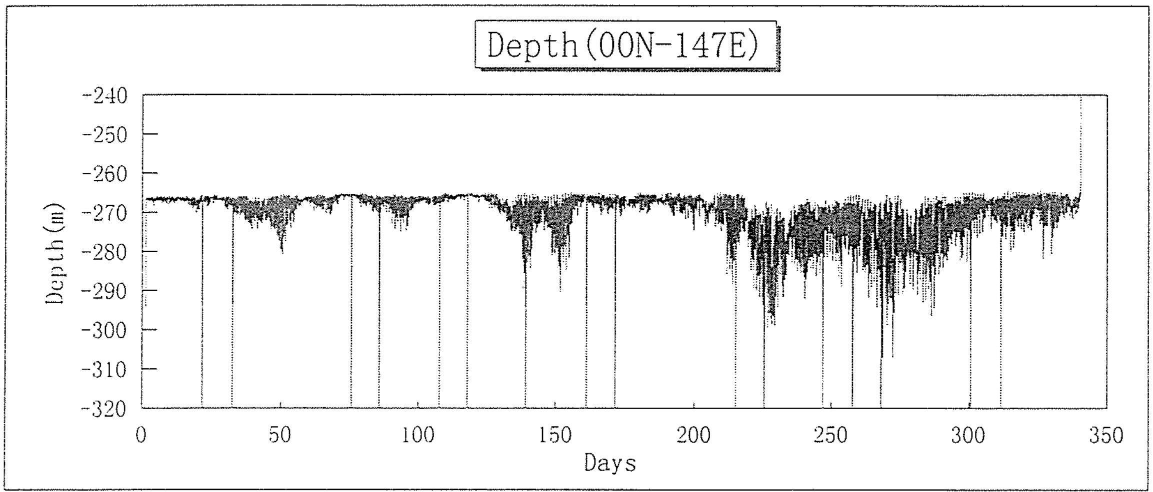


Fig. 7-5 Time Series of Temperature, Salinity, Depth

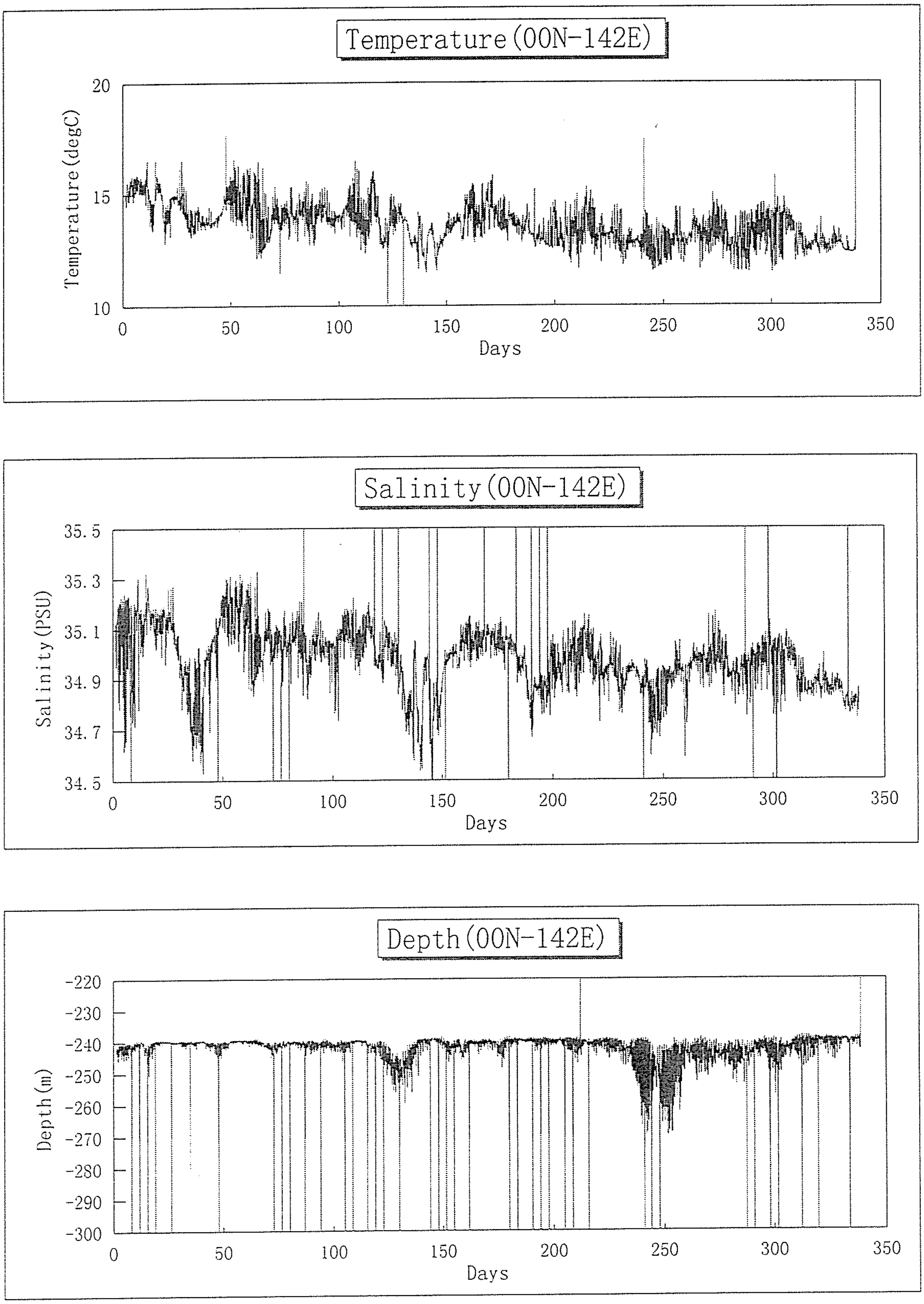
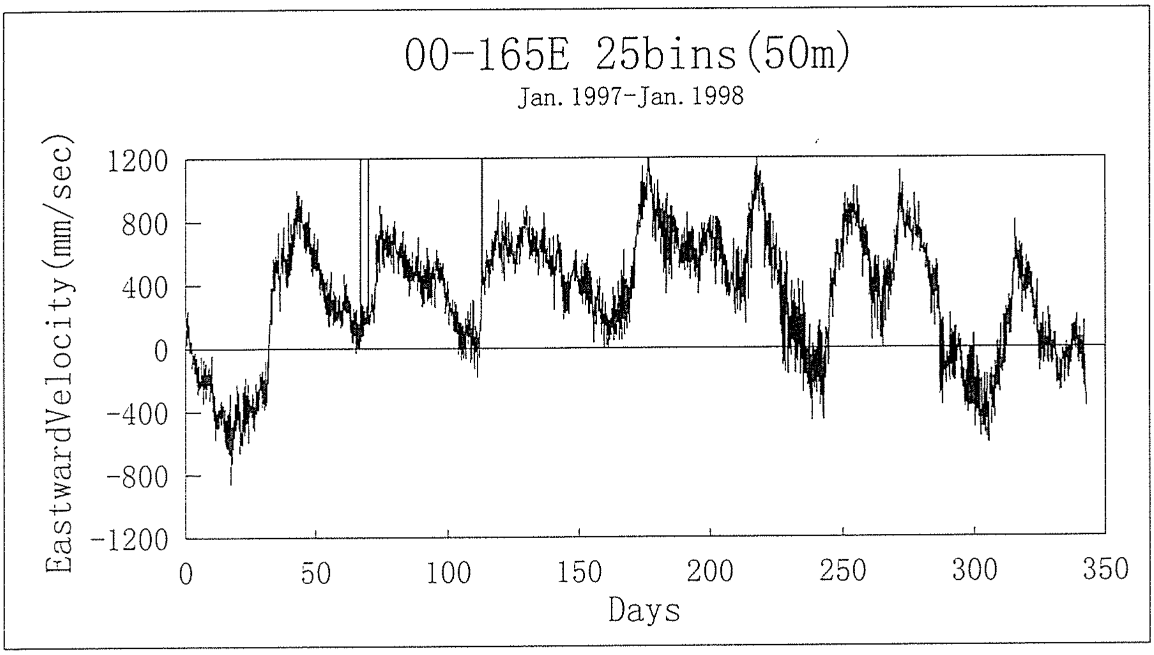


Fig. 7-6 Time Series of Temperature, Salinity, Depth



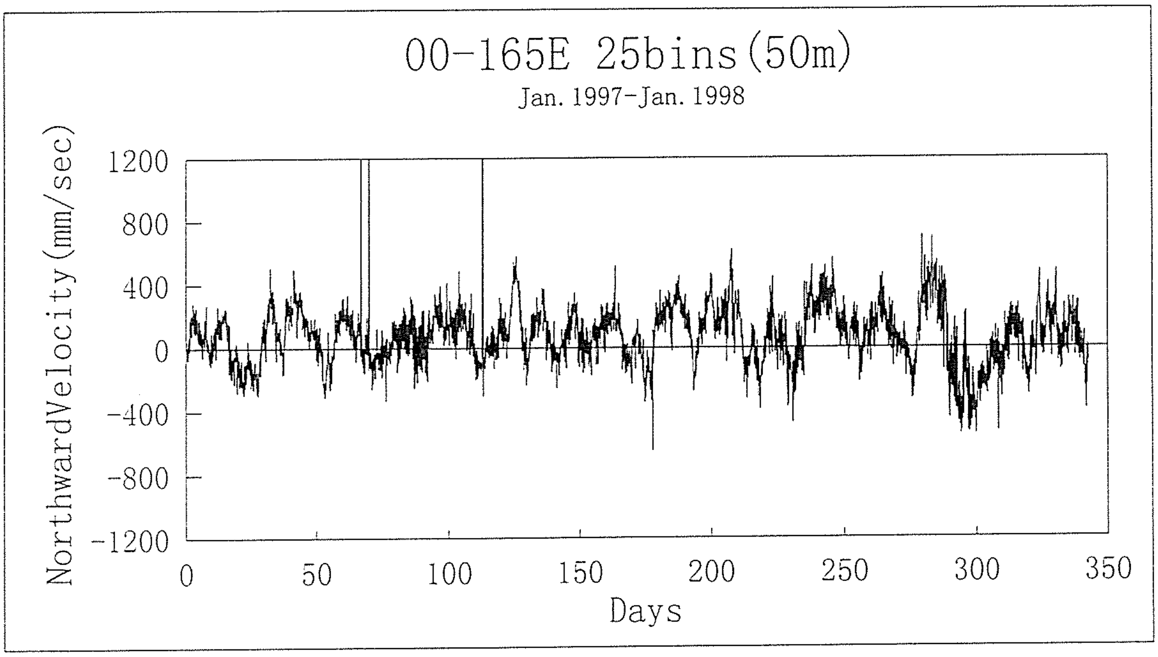
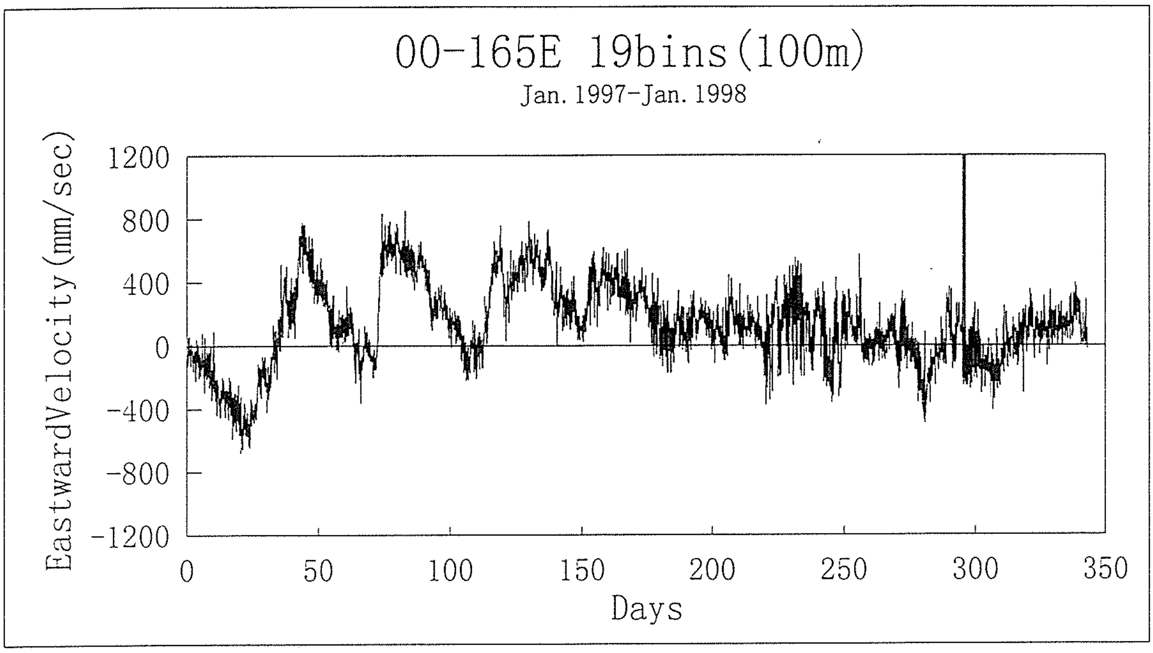


Fig. 7-7 Time Series of Velocity



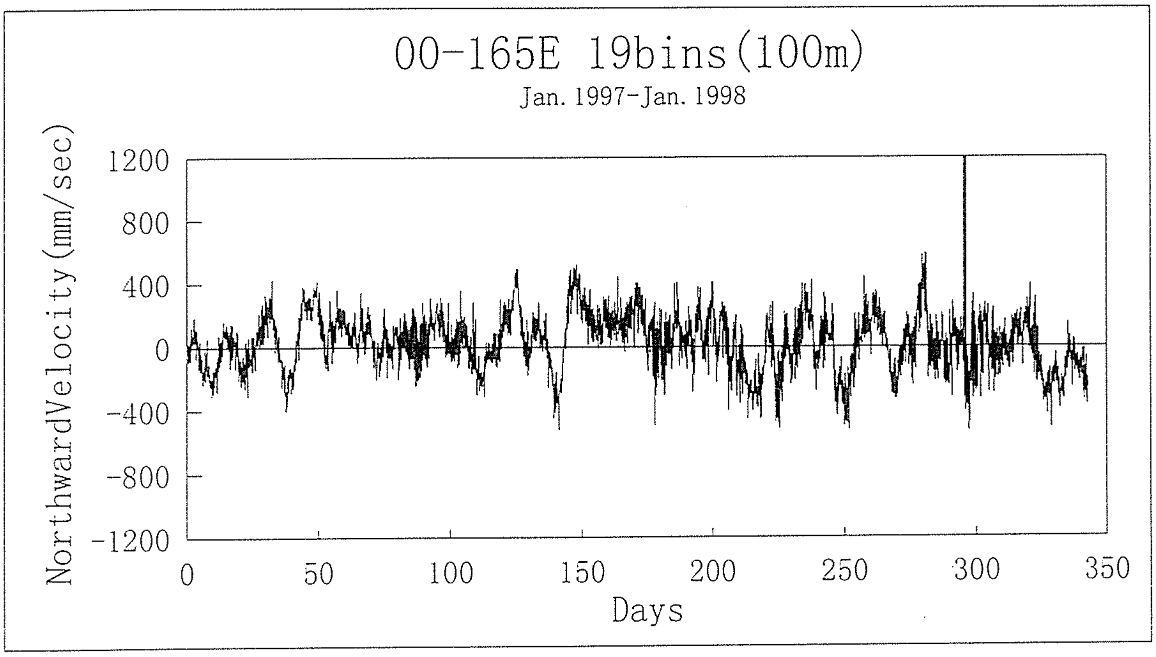
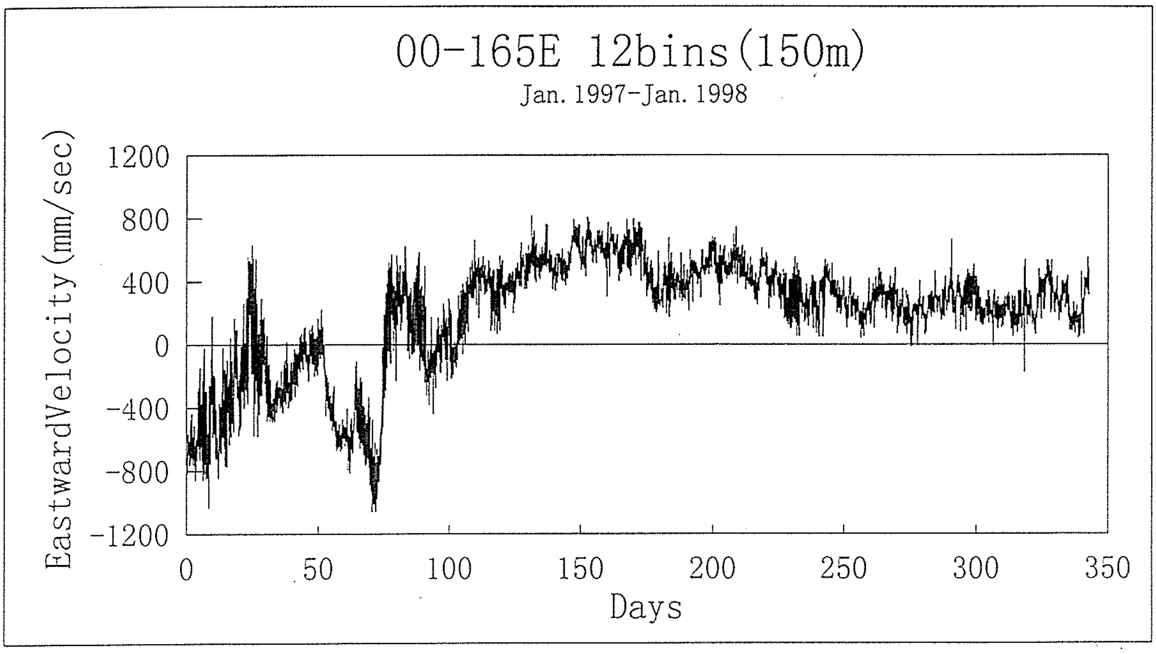


Fig. 7-8 Time Series of Velocity



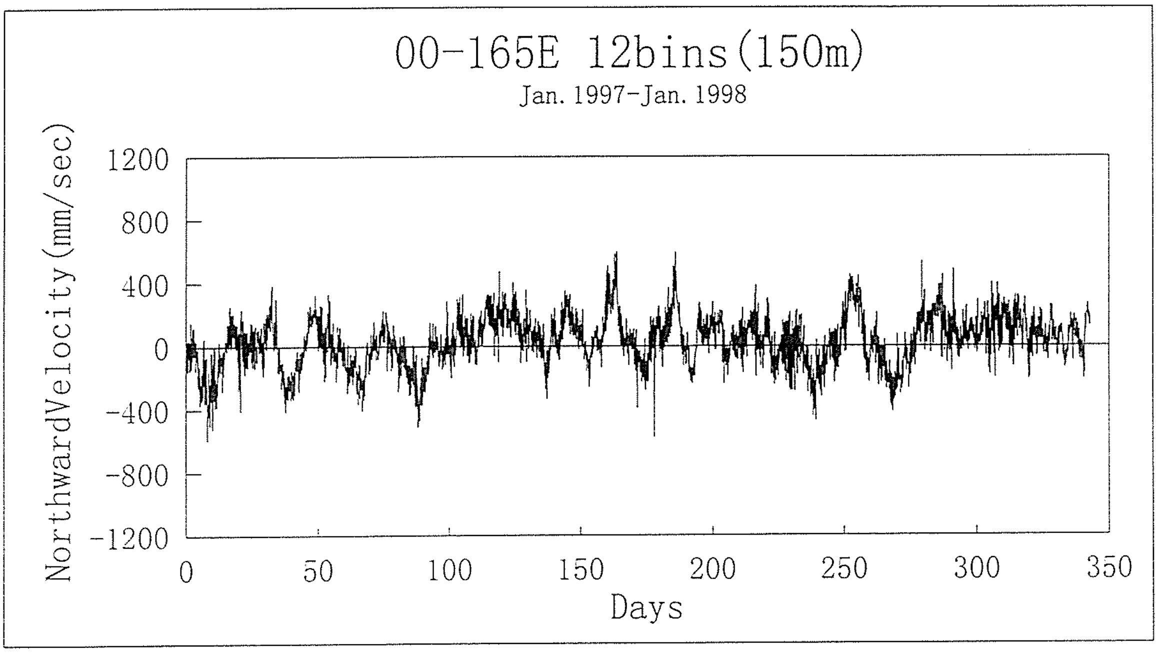
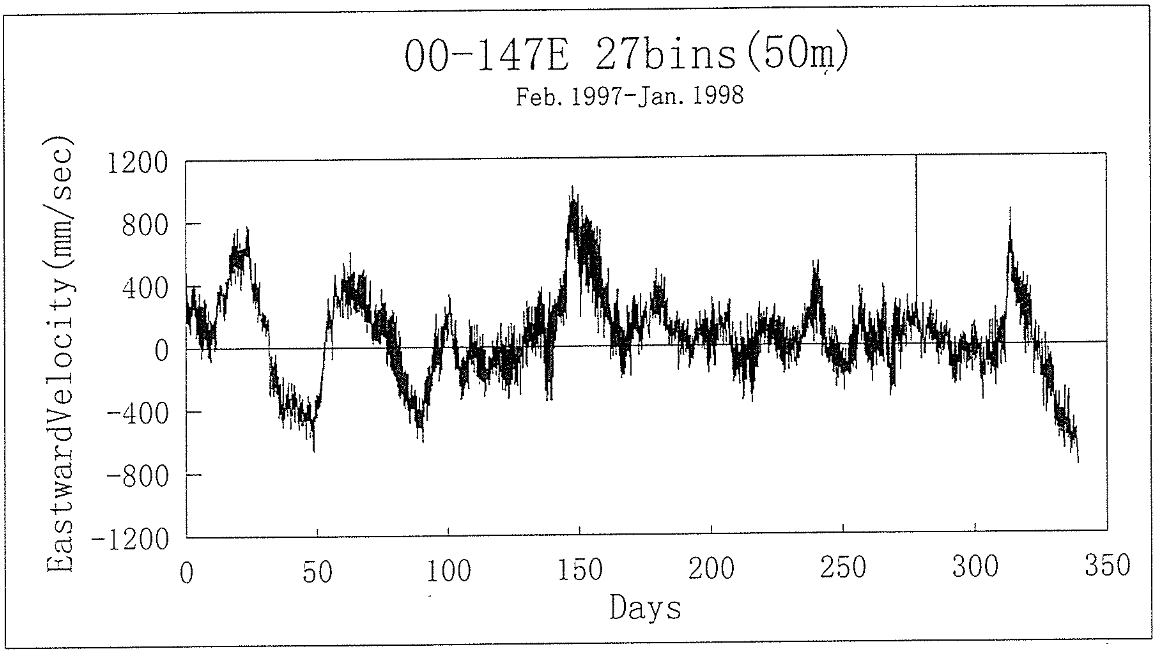


Fig. 7-9 Time Series of Velocity



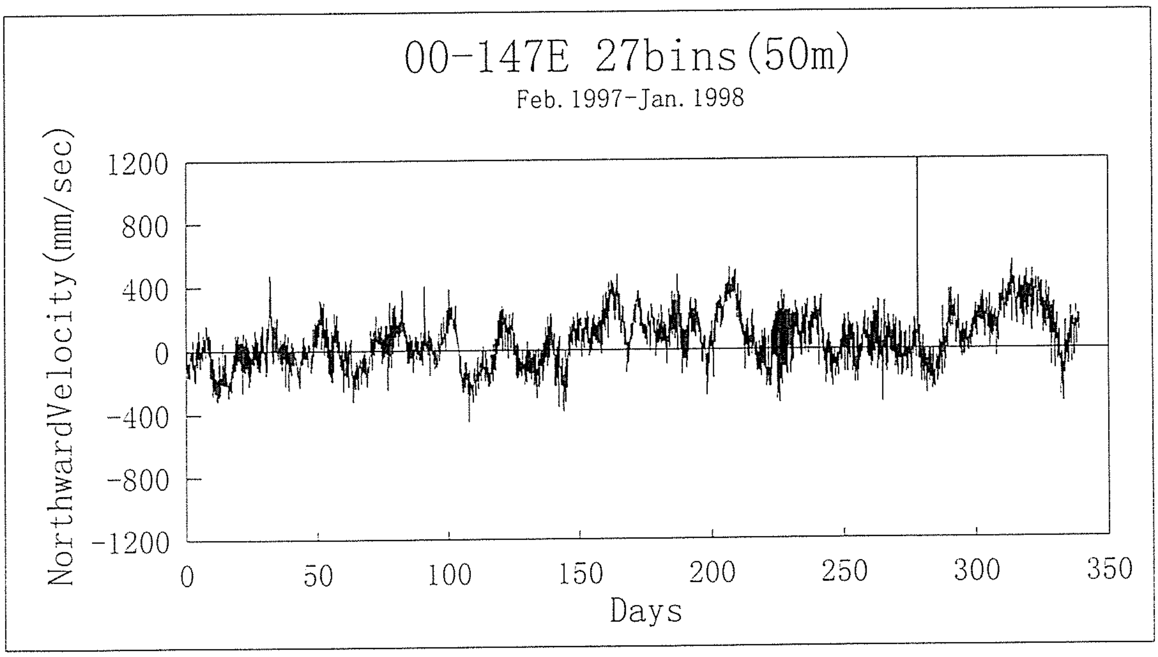
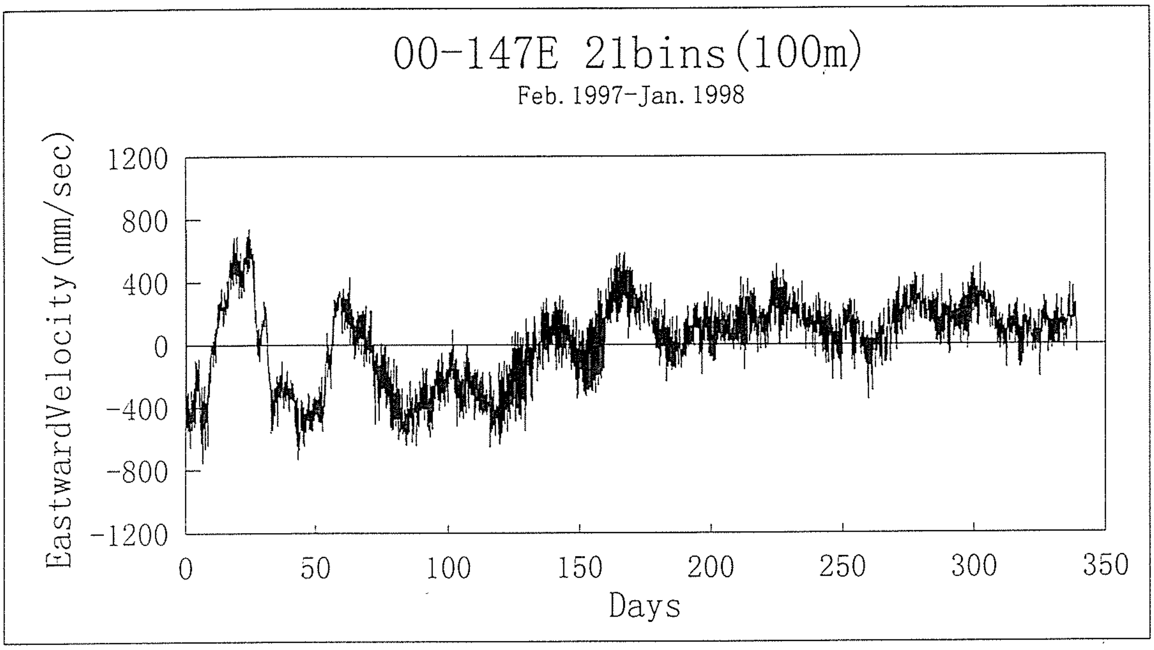


Fig. 7-10 Time Series of Velocity



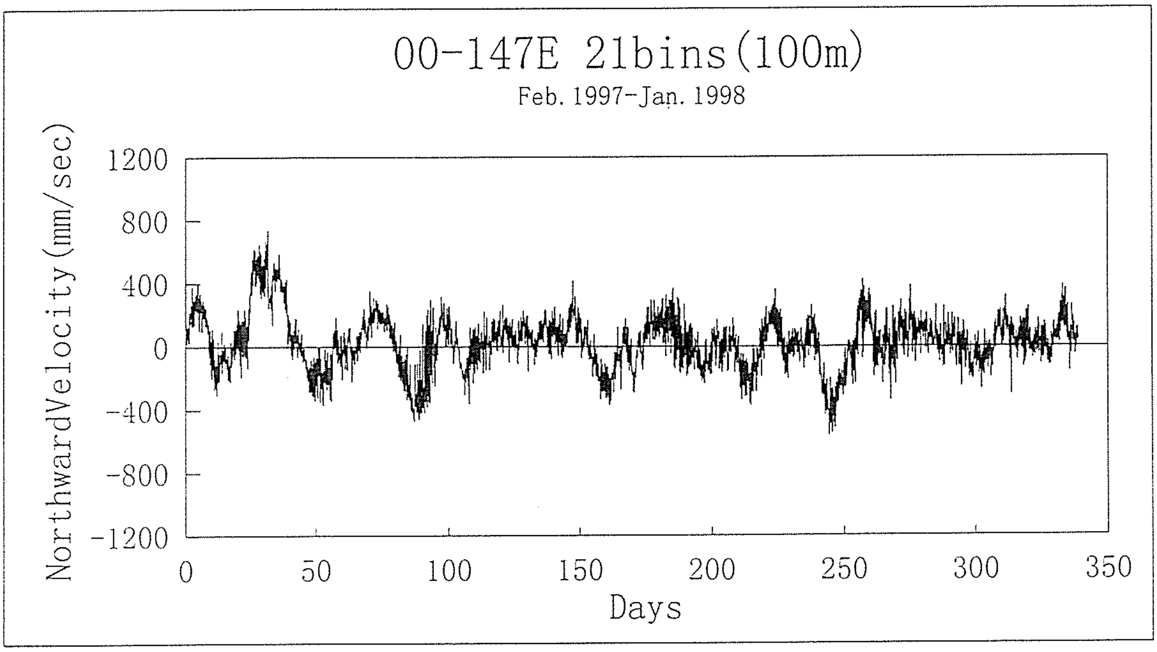
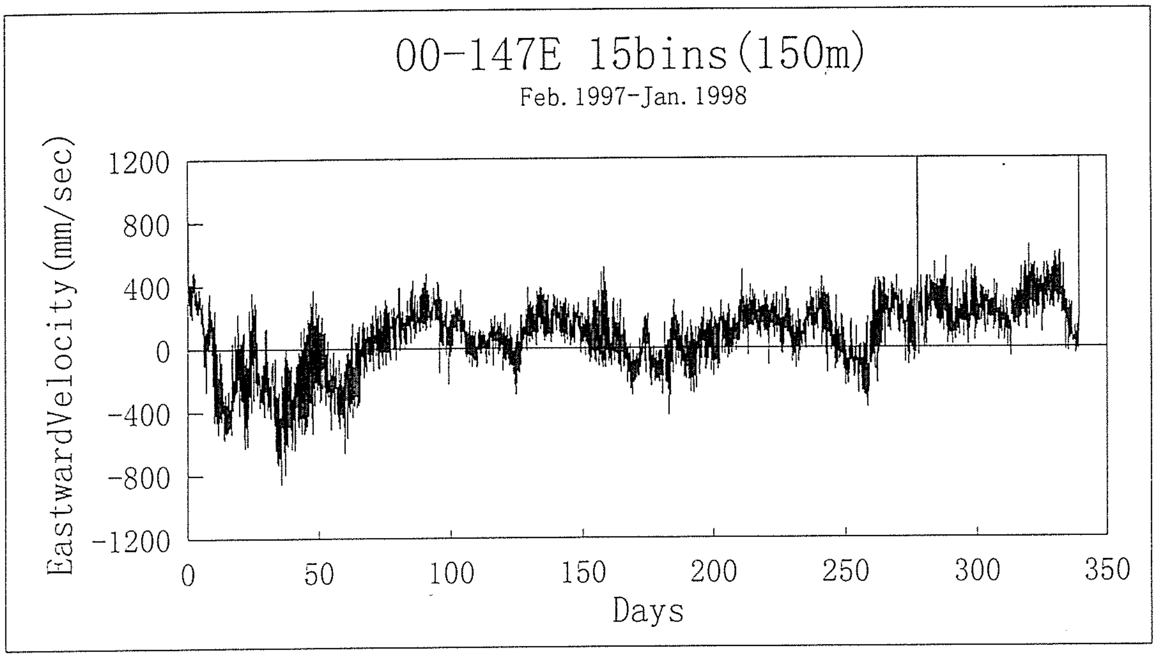


Fig. 7-11 Time Series of Velocity



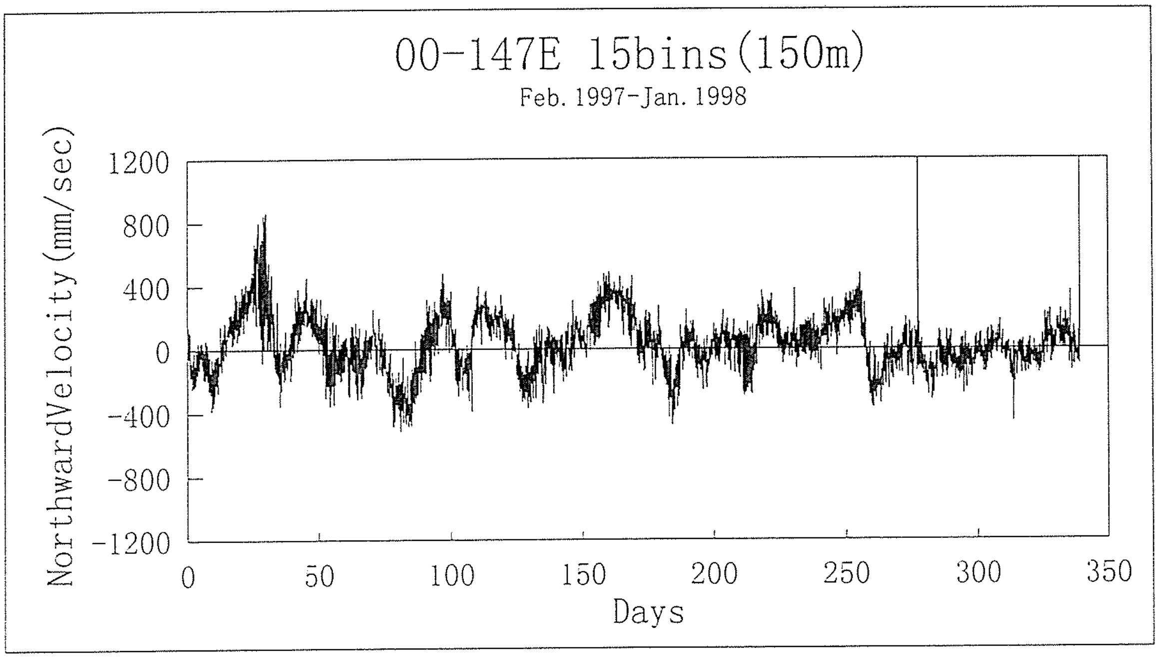
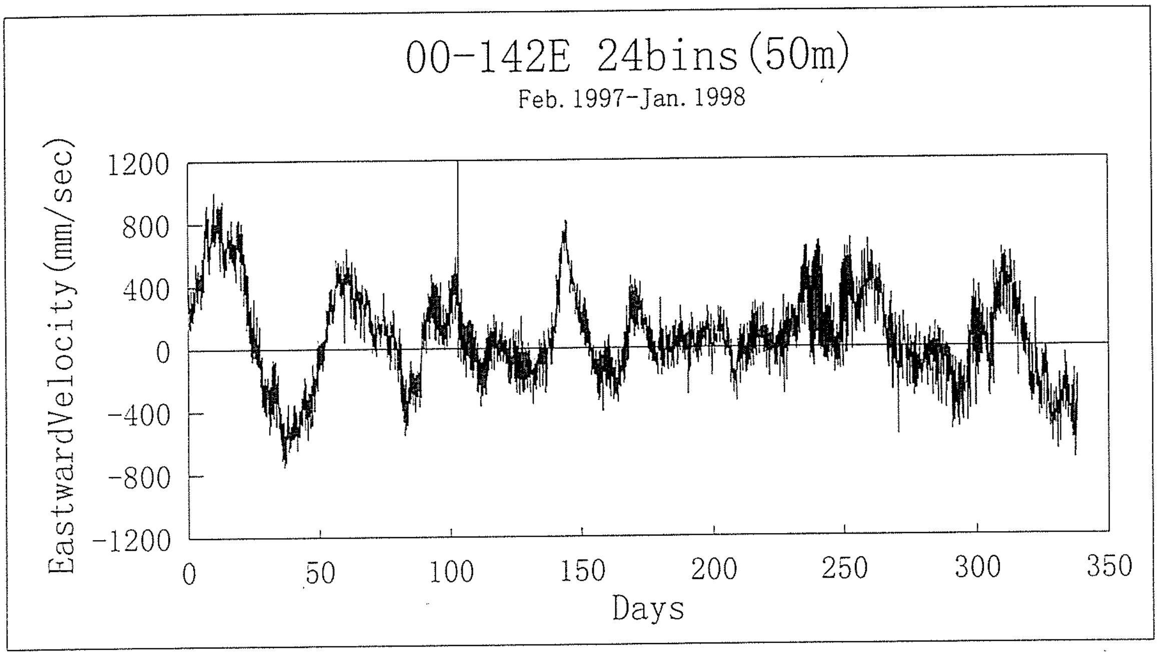


Fig. 7-12 Time Series of Velocity



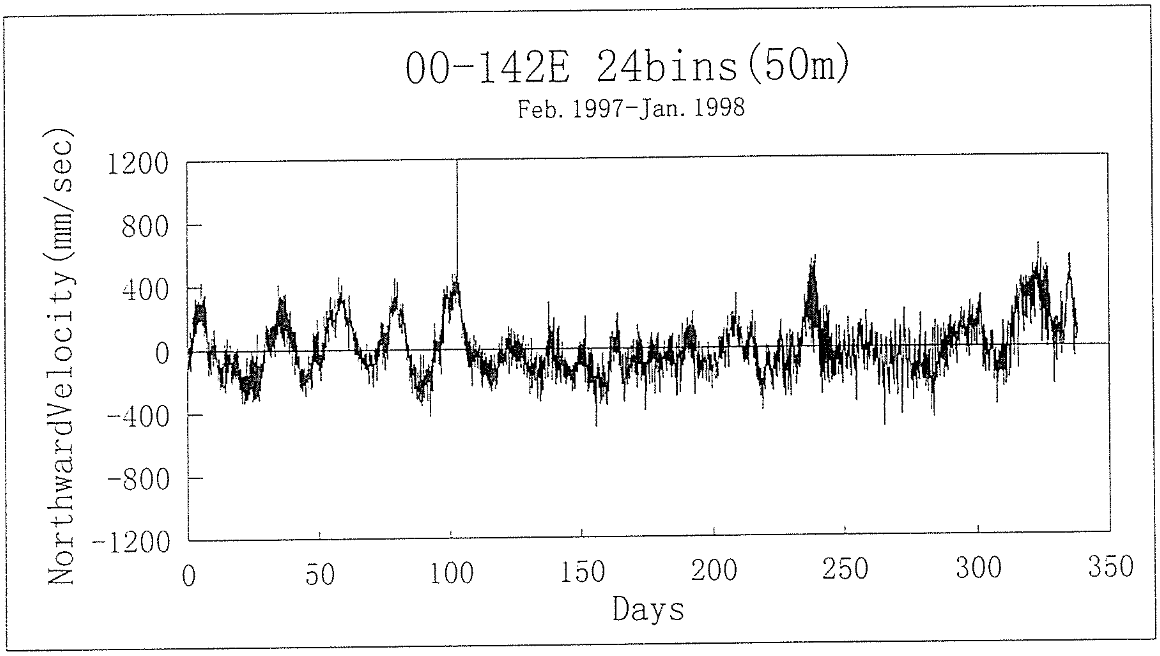
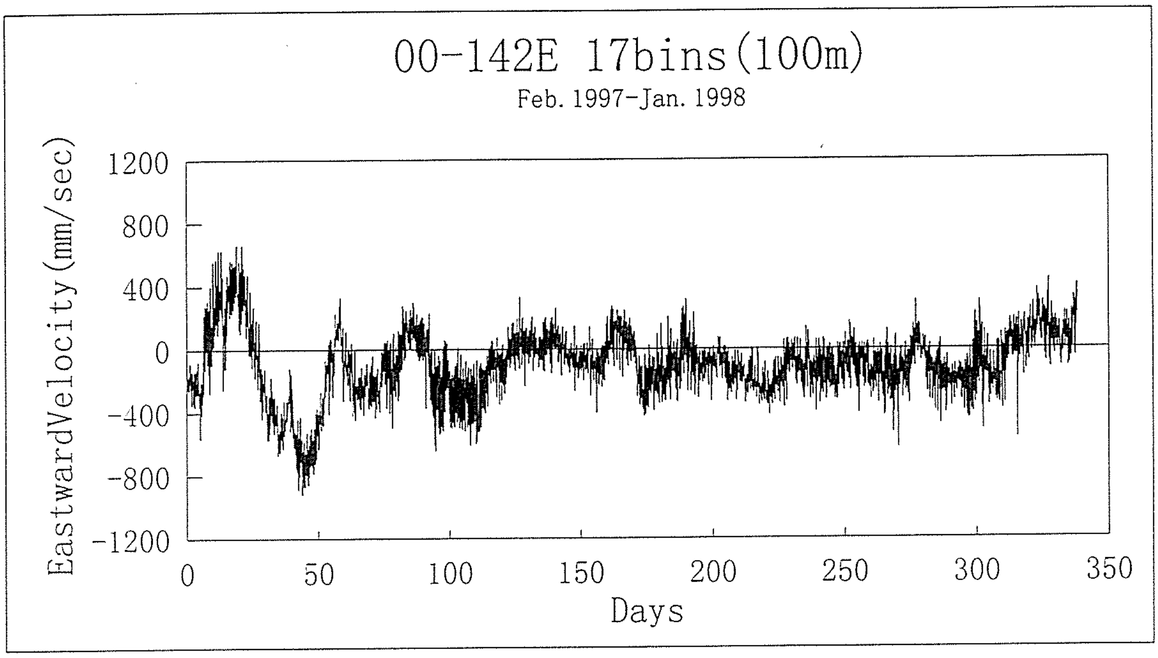


Fig. 7-13 Time Series of Velocity



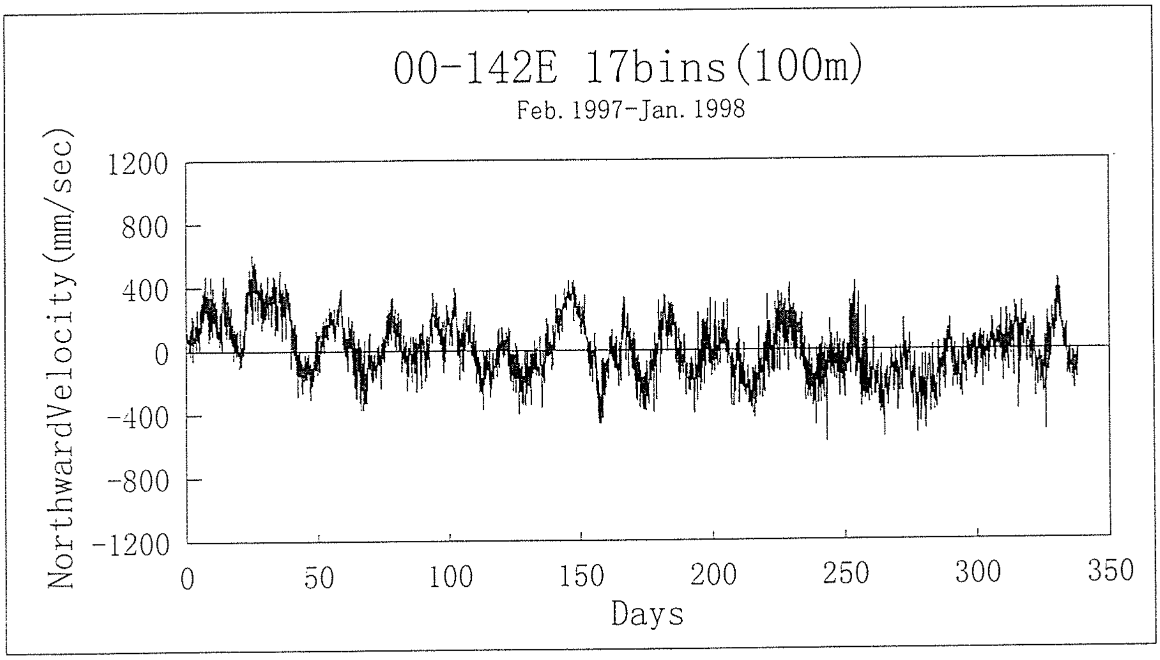
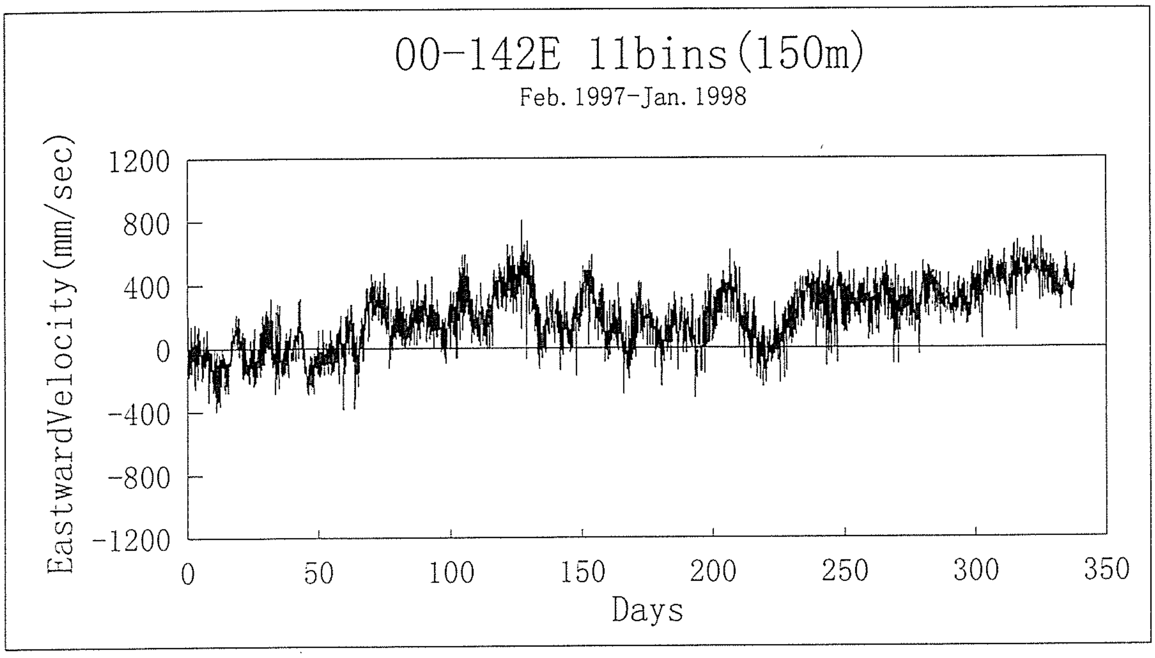


Fig. 7-14 Time Series of Velocity



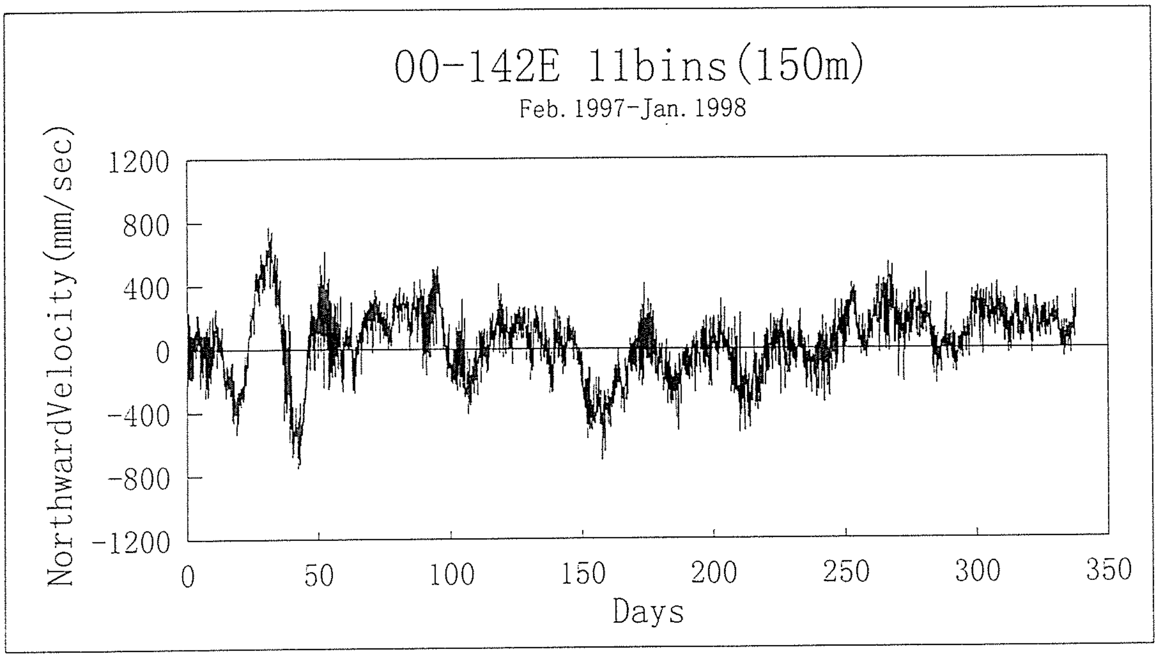


Fig. 7-15 Time Series of Velocity

DEPLOYMENT & RECOVERY

MOORING No. 980108 - 00N165E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	Kaneko
POSITION	0° - 165°E	(R)	
DEPTH	4380m		
PERIOD	1998.1.8 ~	NAVIGATION SYSTEM :	WGS84
No.of DAYS			
LENGTH : 4081.3 m	DEPTH of BUOY : 280.4 m	BUOYANCY : -945.7 kg	

ACOUSTIC RELEASER

TYPE	BENTHOS (upper)	TYPE	BENTHOS (bottom)
S/N	716	S/N	666
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.	F
RELEASE C.	B	RELEASE C.	E
BATTERY	2 years	BATTERY	2 years
TEST on DECK		TEST on DECK	

DEPLOYMENT

DATE '98.1.8 SHIP KAIYO CRUSE No. KY98-01

WEATHER bc CONDITIONS slight DIR. of WIND 50° VEL. of WIND 7.7 m/s

DEPTH 4380 m DEPTH of A.R. 4118 m DESCEND. RATE 2.2 m/s BUOY 22:00

POS. of STRT 0°01.363S 165°14.975E HOR.RANGE m

POS. of DEP. 0°00.063S 165°17.571E SINKER 23:16 DISAPPEAR. :

POS. of MOORING 0°00.137S 165°17.695E LANDING 23:46

NOTE

ADCP S/N 1152
CTD S/N 1285
SFブイ F-07

Depth
Top Buoy 4376m
Sinker 4377m

SSBL	TIME	S / R	DEPTH
S	23:16		20.2m
S	23:20		523.8m
B	23:23		1110.3m
L	23:29		2095.9m
	23:36		3147.2m
	23:46		4118m

RECOVERY

DATE SHIP CRUSE 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

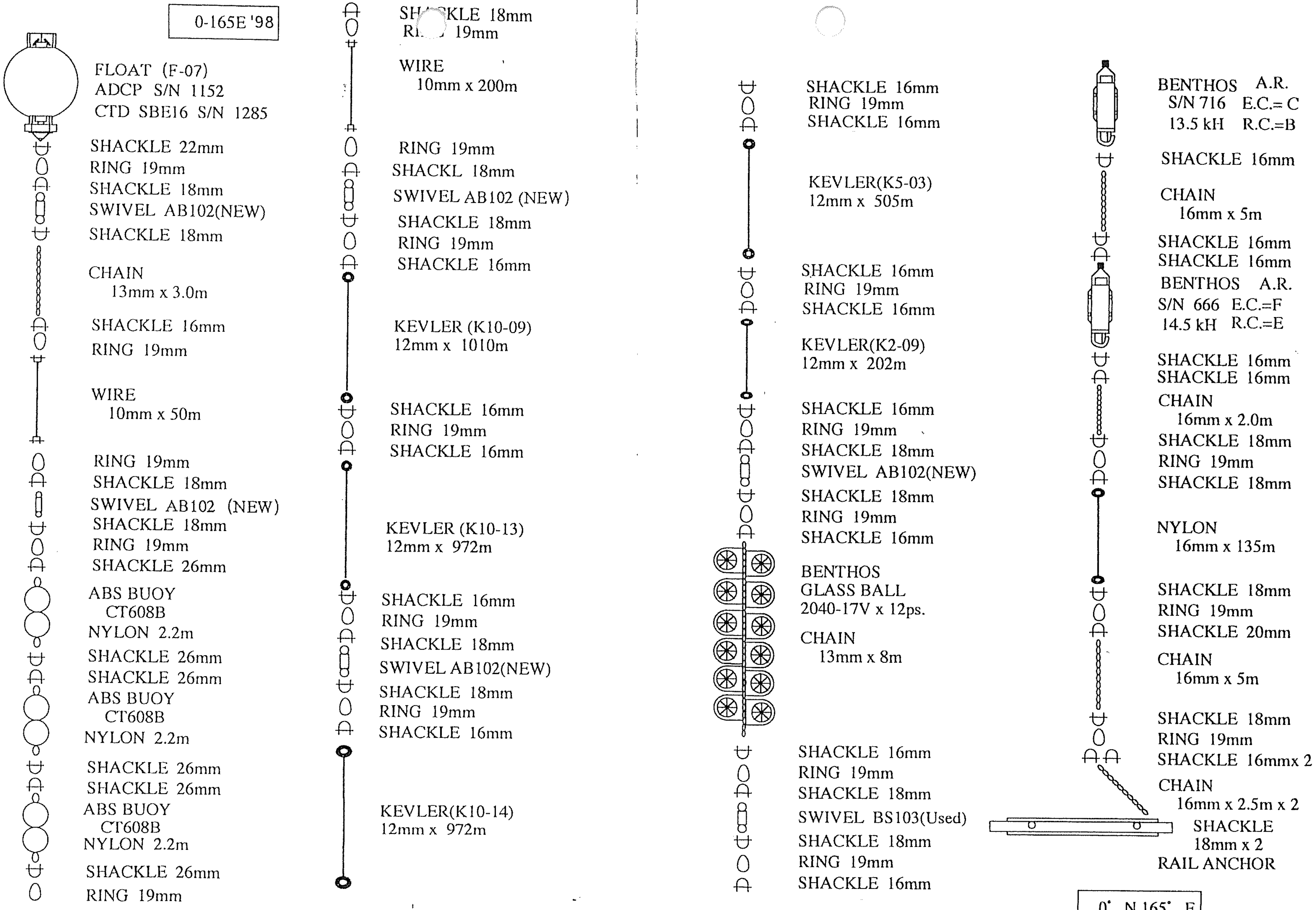
SSBL	TIME	S / R	DEPTH
S			
S			
B			
L			

TIME RECORD

MOORING NO. 980108-00N165E

		DEPLOYMENT		RECOVERY (Date:)	
		START : 21:58 FINISH : 23:16		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP & CTD	ADCP 1152 CTD 1285	22:00	F-07		
WIRE	50m	21:58 ~ 22:02			
ABS BUOY	× 2	22:02			
〃	× 2	22:02			
〃	× 2	22:02			
WIRE	200m	22:02 ~ 22:08			
KEVLER ①	K10-09 1010 m	22:13 ~ 22:24	K10-07 End		
〃 ②	K10-13 972 m	22:26 ~ 22:35			
〃 ③	K10-14 972 m	22:36 ~ 22:46			
〃 ④	K5-03 505 m	22:48 ~ 22:55			
〃 ⑤	K2-09 202 m	22:57 ~ 23:01			
GLASS BALL	12コ	23:06			
A.R.	716	23:07			
A.R.	666	23:07			
NYLON	135m	23:08 ~ 23:11			
ANCHOR		23:16			

0-165E '98



0° N 165° E
4380m

DEPLOYMENT & RECOVERY

MOORING No. 980124-00147E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	Kaneko
POSITION	0°-147°E	(R)	
DEPTH	4412m		
PERIOD		NAVIGATION SYSTEM :	WGS 84
No.of DAYS			
LENGTH : 4104 m	DEPTH of BUOY : 280.6 m	BUOYANCY : -945.7 kg	

ACOUSTIC RELEASER

TYPE	BENTHOS (upper)	TYPE	BENTHOS (bottom)
S/N	635	S/N	633
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.	E
RELEASE C.	F	RELEASE C.	D
BATTERY	2years	BATTERY	2years
TEST on DECK		TEST on DECK	

DEPLOYMENT

DATE	Jan. 24 '98			SHIP	KAIYO	CRUSE No.	KY9801
WEATHER	bc	CONDITIONS	1.5m	DIR. of WIND	NE	VEL. of WIND	7.7m/s
DEPTH	4384m	DEPTH of A.R.	4140m	DESCEND. RATE	2.6 m/s	BUOY	3:00
POS. of STRT	0°00.325S 146°52.423E			HOR.RANGE	m		
POS. of DEP.	0°00.241S 146°51.992E			SINKER	4:25	DISAPPEAR.	:
POS. of MOORING	0°00.252S 146°51.956E					LANDING	4:53

NOTE

スタットチェーン使用の為、シャックル変更あり

ナイロンロープ 195m → 200m

SSBL	TIME	S / R	DEPTH
S	4:33		1329.0
S	4:36		1804.3
B	4:40		2457.5
L	4:44		3022.1
	4:49		3701.4
	4:53		4140.7

RECOVERY

DATE				SHIP		CRUSE 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
S			
S			
B			
L			

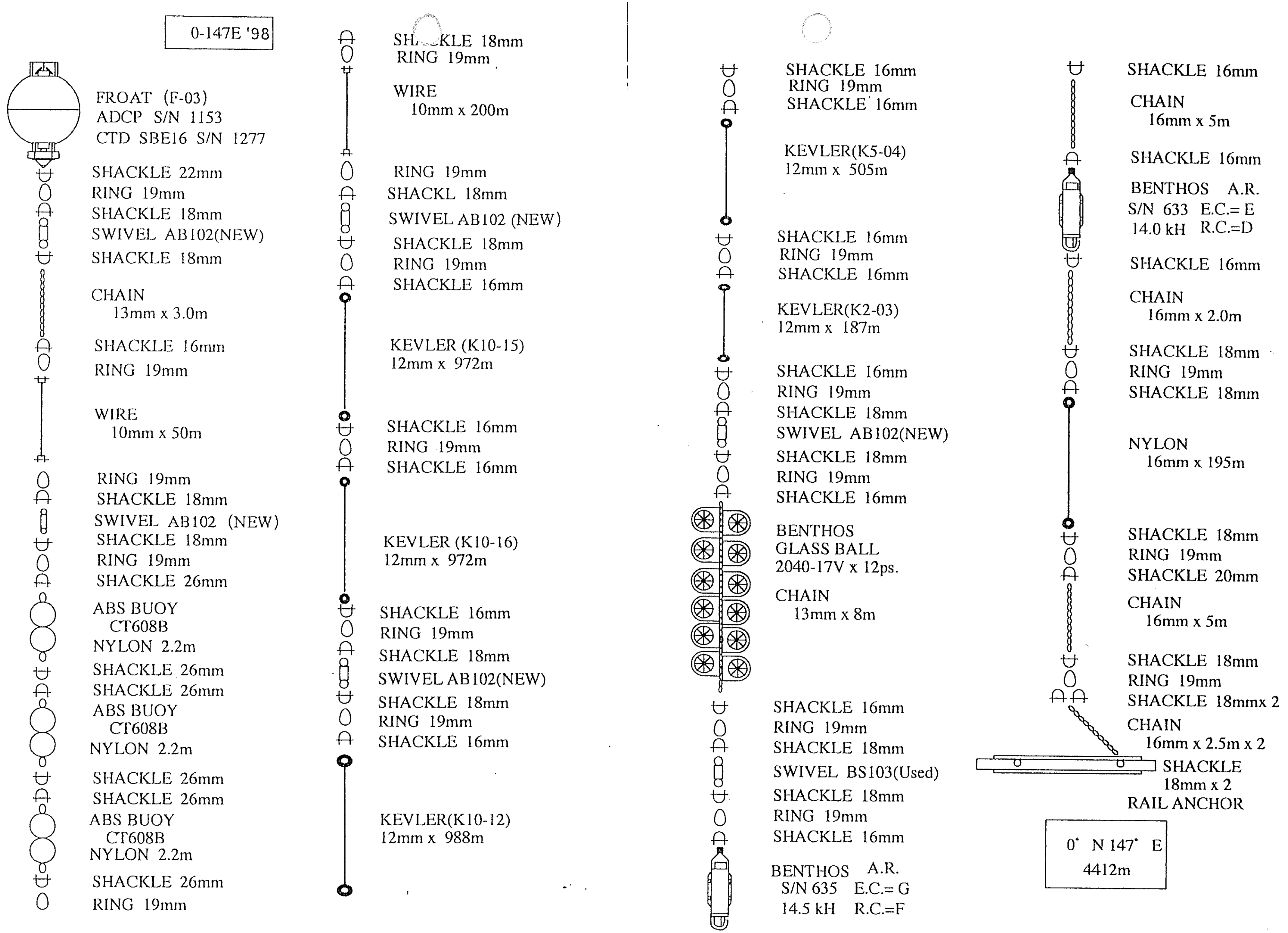
TIME RECORD

MOORING NO. 980124-00147E

		DEPLOYMENT		RECOVERY (Date:)	
		START : 2:57 FINISH : 4:25		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP & CTD	ADCP 1153 CTD 1277	3:00			
WIRE	50m	02:57~3:00			
ABS BUOY	2コ	3:01			
〃	2コ	3:01			
〃	2コ	3:01			
WIRE	200m	3:01~3:06			
KEVLER ①	K10-15 972m	3:10~3:27			
〃 ②	K10-16 972m	3:28~3:41			
〃 ③	K10-12 988m	3:42~3:56			
〃 ④	K5-04 505m	3:57~4:04			
〃 ⑤	K2-03 187m	4:06~4:09			
GLASS BALL	12コ	4:15			
A.R.	635	4:16			
A.R.	633	4:16			
NYLON	~~195~~ 200	4:17~4:22			
ANCHOR	1.8 Ton	4:25			

スタートチェーンの為 シャックル変更
ナイロンロープ 195m→200m

4462
4443
4455
4450
4414


0-147E '98
FROAT (F-03)
ADCP S/N 1153
CTD SBE16 S/N 1277
SHACKLE 22mm
RING 19mm
SHACKLE 18mm
SWIVEL AB102(NEW)
SHACKLE 18mm
CHAIN
13mm x 3.0m
SHACKLE 16mm
RING 19mm
WIRE
10mm x 50m
RING 19mm
SHACKLE 18mm
SWIVEL AB102 (NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 26mm
ABS BUOY
CT608B
NYLON 2.2m
SHACKLE 26mm
SHACKLE 26mm
ABS BUOY
CT608B
NYLON 2.2m
SHACKLE 26mm
SHACKLE 26mm
ABS BUOY
CT608B
NYLON 2.2m
SHACKLE 26mm
RING 19mm
SHACKLE 18mm
RING 19mm
WIRE
10mm x 200m
RING 19mm
SHACKL 18mm
SWIVEL AB102 (NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
KEVLER (K10-15)
12mm x 972m
SHACKLE 16mm
RING 19mm
SHACKLE 16mm
KEVLER (K10-16)
12mm x 972m
SHACKLE 16mm
RING 19mm
SHACKLE 18mm
SWIVEL AB102(NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
KEVLER(K10-12)
12mm x 988m
SHACKLE 16mm
RING 19mm
SHACKLE 16mm
KEVLER(K5-04)
12mm x 505m
SHACKLE 16mm
RING 19mm
SHACKLE 16mm
KEVLER(K2-03)
12mm x 187m
SHACKLE 16mm
RING 19mm
SHACKLE 18mm
SWIVEL AB102(NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
BENTHOS
GLASS BALL
2040-17V x 12ps.
CHAIN
13mm x 8m
SHACKLE 16mm
RING 19mm
SHACKLE 18mm
SWIVEL BS103(Used)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
BENTHOS A.R.
S/N 635 E.C.= G
14.5 kH R.C.=F
SHACKLE 16mm
CHAIN
16mm x 5m
SHACKLE 16mm
BENTHOS A.R.
S/N 633 E.C.= E
14.0 kH R.C.=D
SHACKLE 16mm
CHAIN
16mm x 2.0m
SHACKLE 18mm
RING 19mm
SHACKLE 18mm
NYLON
16mm x 195m
SHACKLE 18mm
RING 19mm
SHACKLE 20mm
CHAIN
16mm x 5m
SHACKLE 18mm
RING 19mm
SHACKLE 18mmx 2
CHAIN
16mm x 2.5m x 2
SHACKLE
18mm x 2
RAIL ANCHOR
0° N 147° E
4412m

DEPLOYMENT & RECOVERY

MOORING No. 980125-00N142E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	Kaneko
POSITION	0°-142°E	(R)	
DEPTH	3384m		
PERIOD	1998.1.25 ~	NAVIGATION SYSTEM :	WGS84
No.of DAYS			
LENGTH : 3076 m	DEPTH of BUOY : 282.4m	BUOYANCY : -937.5 kg	

ACOUSTIC RELEASER

TYPE	BENTHOS (Upper)	TYPE	BENTHOS (bottom)
S/N	719	S/N	631
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	14.0 kHz	TRANSMIT F.	13.5 kHz
ENABLE C.	E	ENABLE C.	C
RELEASE C.	D	RELEASE C.	B
BATTERY	2years	BATTERY	2years
TEST on DECK	OK	TEST on DECK	OK

DEPLOYMENT

DATE Jan. 25 '98 SHIP KAIYO CRUSE No. KY98-01

WEATHER bc CONDITIONS Smooth DIR. of WIND 050° VEL. of WIND 7.9 m/s

DEPTH 3388 m DEPTH of A.R. 3140 m DESCEND. RATE 2.4 m/s BUOY 22:22

POS. of STRT 0°00.087N, 141°56.273E HOR.RANGE m

POS. of DEP. 0°00.210N, 141°58.236E SINKER 23 : 32 DISAPPEAR. :

POS. of MOORING 0°00.227N, ~~[illegible]~~ 141°58.240E LANDING 23:53

NOTE

SSBL	TIME	S / R	DEPTH
S	23:34	[illegible]	109.2
S	23:36		515.0
B	23:39		1055.2
L	23:43		1740.8
	23:46		2198.7
	23:53		3142.4

RECOVERY

DATE SHIP CRUSE 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

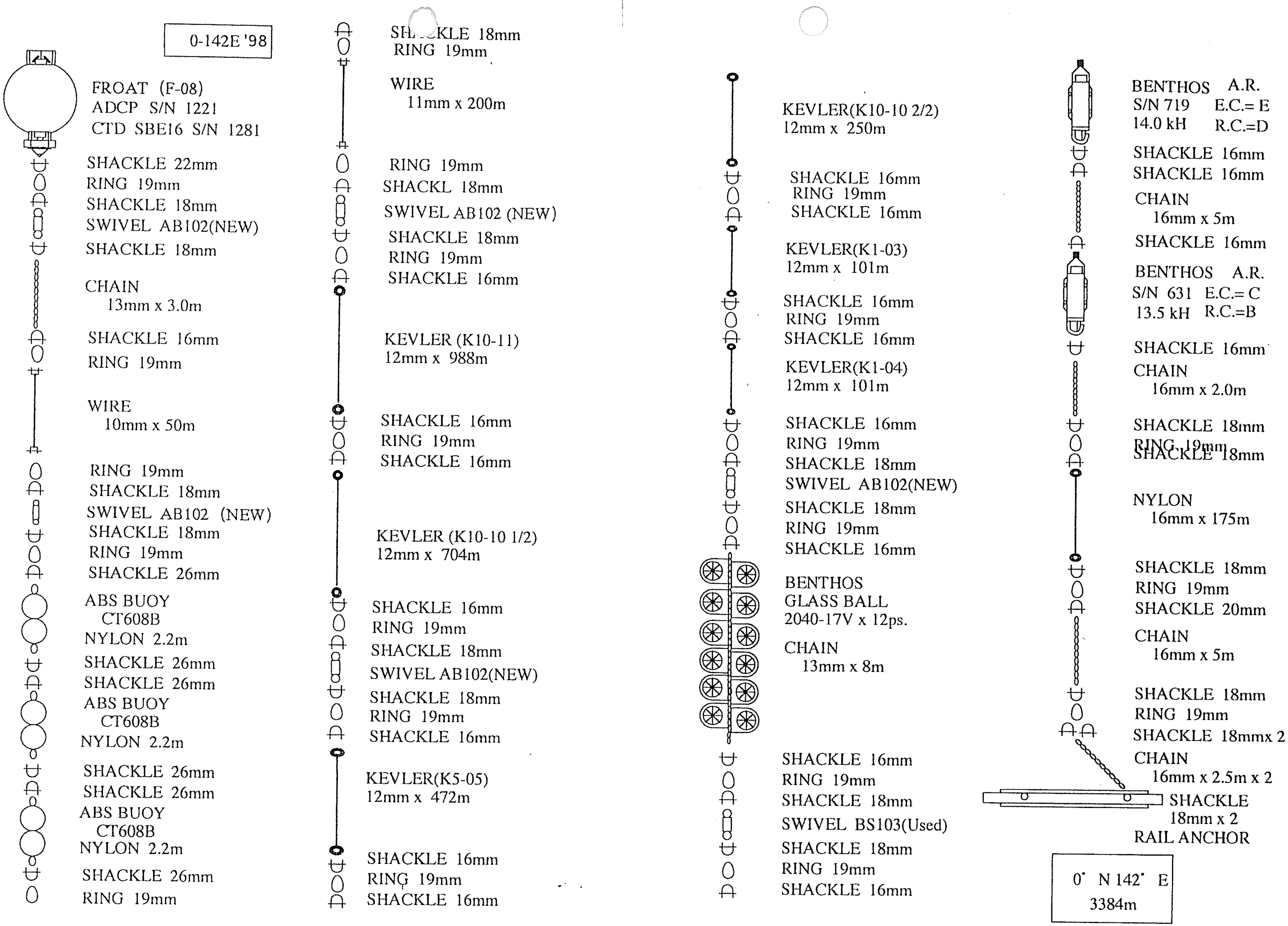
NOTE

SSBL	TIME	S / R	DEPTH
S			
S			
B			
L			

TIME RECORD

MOORING NO. 980125-00N142E

		DEPLOYMENT		RECOVERY (Date:)	
		START : 22:20 FINISH : 23:32		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP & CTD	ADCP CTD	22:22	F-08		
WIRE	50m	22:20 ~ 22:22			
ABS BUOY	2コ	22:25			
〃	2コ	22:25			
〃	2コ	22:25			
WIRE	200m	22:25 ~ 22:29			
KEVLER ①	K10-11 988m	22:35 ~ 22:51			
〃 ②	K10-10½ 704m	22:52 ~ 22:59			
〃 ③	K5-05 472m	23:00 ~ 23:08			
〃 ④	K10-10½ 250m	23:09 ~ 23:13			
〃 ⑤	K1-03 101m	23:14 ~ 23:16	[illegible]に [illegible]なし		
〃 ⑥	K1-04 101m	23:17 ~ 23:19	〃		
GLASS BALL	12コ	23:23			
A.R.	719	23:24			
A.R.	631	23:25			
NYLON	175m	23:25 ~ 23:28			
ANCHOR	1.8 Ton	23:32			


0-142E '98
FROAT (F-08)
ADCP S/N 1221
CTD SBE16 S/N 1281
SHACKLE 22mm
RING 19mm
SHACKLE 18mm
SWIVEL AB102(NEW)
SHACKLE 18mm
CHAIN
13mm x 3.0m
SHACKLE 16mm
RING 19mm
WIRE
10mm x 50m
RING 19mm
SHACKLE 18mm
SWIVEL AB102 (NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 26mm
ABS BUOY
CT608B
NYLON 2.2m
SHACKLE 26mm
SHACKLE 26mm
ABS BUOY
CT608B
NYLON 2.2m
SHACKLE 26mm
SHACKLE 26mm
ABS BUOY
CT608B
NYLON 2.2m
SHACKLE 26mm
RING 19mm
SHACKLE 18mm
RING 19mm
WIRE
11mm x 200m
RING 19mm
SHACKL 18mm
SWIVEL AB102 (NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
KEVLER (K10-11)
12mm x 988m
SHACKLE 16mm
RING 19mm
SHACKLE 16mm
KEVLER (K10-10 1/2)
12mm x 704m
SHACKLE 16mm
RING 19mm
SHACKLE 18mm
SWIVEL AB102(NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
KEVLER(K5-05)
12mm x 472m
SHACKLE 16mm
RING 19mm
SHACKLE 16mm
KEVLER(K10-10 2/2)
12mm x 250m
SHACKLE 16mm
RING 19mm
SHACKLE 16mm
KEVLER(K1-03)
12mm x 101m
SHACKLE 16mm
RING 19mm
SHACKLE 16mm
KEVLER(K1-04)
12mm x 101m
SHACKLE 16mm
RING 19mm
SHACKLE 18mm
SWIVEL AB102(NEW)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
BENTHOS
GLASS BALL
2040-17V x 12ps.
CHAIN
13mm x 8m
SHACKLE 16mm
RING 19mm
SHACKLE 18mm
SWIVEL BS103(Used)
SHACKLE 18mm
RING 19mm
SHACKLE 16mm
BENTHOS A.R.
S/N 719 E.C.= E
14.0 kH R.C.=D
SHACKLE 16mm
SHACKLE 16mm
CHAIN
16mm x 5m
SHACKLE 16mm
BENTHOS A.R.
S/N 631 E.C.= C
13.5 kH R.C.=B
SHACKLE 16mm
CHAIN
16mm x 2.0m
SHACKLE 18mm
RING 19mm
SHACKLE 18mm
NYLON
16mm x 175m
SHACKLE 18mm
RING 19mm
SHACKLE 20mm
CHAIN
16mm x 5m
SHACKLE 18mm
RING 19mm
SHACKLE 18mmx 2
CHAIN
16mm x 2.5m x 2
SHACKLE
18mm x 2
RAIL ANCHOR
0° N 142° E
3384m

DEPLOYMENT & RECOVERY

MOORING No. 970131-00N165E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	T.Katayama
POSITION	00° - 165° E	(R)	Kaneko
DEPTH	4380 m		
PERIOD	1997.1.31 ~ 1998.1.8	NAVIGATION SYSTEM :	WGS 84
No.of DAYS	342		
LENGTH :	4101 m	DEPTH of BUOY : 279 m	BUOYANCY : 1800 kg

ACOUSTIC RELEASER

TYPE	BENTHOS (上)	TYPE	BENTHOS (下)
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	O.K.	TEST on DECK	O.K.

DEPLOYMENT

DATE	1/31 02:34 ~ 03:48			SHIP	KAIYO	CRUSE No.	K97-02
WEATHER	o	CONDITIONS	波高1.7m	DIR. of WIND	170°	VEL. of WIND	2.0 m/s
DEPTH	4380 m	DEPTH of A.R.	4273 m	DESCEND. RATE	2.7 m/s	BUOY	02 : 34
POS. of STRT	00° 00.015 N, 165° 14.204 E			HOR.RANGE	m		
POS. of DEP.	00° 00.003 N. 165° 17.716 E			SINKER	03 : 48	DISAPPEAR.	:
POS. of MOORING	00° 00.01 N, 165° 17.836 E					LANDING	04 : 13

NOTE
- ガラスブイは、ガラス玉・チェーン・シャックル共新しい物を使用、チェーンはピンクでスプレー。
- ナイロン長 150m.

SSBL	TIME	S / R	DEPTH
S	03:48		29.4 m
S	03:53		74.5
B	03:58		1721
L	04:03		2565
	04:07		3212
	04:13		4135

RECOVERY

DATE	'98 1.8			SHIP	KAIYO	CRUSE No.	KY9801
WEATHER	bc	CONDITIONS	3 m	DIR. of WIND	040°	VEL. of WIND	7.6 m/s
START of RELEASE	19 : 08			FINISH of RELEASE	19 : 08		
POS. of DISCOVERY	0° 00.023 S 165° 17.610 E					ASCENDING RATE	1.37 m/s
DIRECTION	°			DISTANCE	m		

NOTE

(下) E.C 18:55 4188m 4189.2m 4189.3m
(上) E.C 19:00
R.C 19:08 4166m
19:09 4110m

SSBL	TIME	S / R	DEPTH
S	19:08		4168.2m
S	19:23		3783.2m
B	19:29		2085 m
L	19:42		1103.1m
	19:52		511.1m
	19:59		256.7m

TIME RECORD

MOORING NO. 970131-00N165E

		DEPLOYMENT		RECOVERY (Date '98 1/8)	
		Start: 02:32 Finish: 03:48		Start: 19:43 Finish: 21:13	
ITEM	S/N etc	TIME	MEMO	TIME	MEMO
ADCP	1224	02:34	With CTD 1288	19:49	CTD 1288
WIRE	50m	02:35		19:53~19:56	
ABS BUOY	×2	02:38		19:58	
〃	×2	02:38		19:57	
〃	×2	02:38		19:57	
WIRE	200m	02:40~02:44		20:01~20:06	
〃	200m	02:45~02:49		20:06~20:10	
KEVLER	987m	02:51~02:57	(赤) K9606回収 0-138 (B)	20:10~20:27	12-987M 96-11(使)
〃	987m	02:58~03:05	(赤) K9606回収 0-138 (C)	20:27~20:44	
〃	987m	03:07~03:14	(赤) K9606回収 0-138 (A)	20:46~21:01	
〃	484m	03:30~03:35	(青) K9606回収 0-142 (C)	21:03~21:10	
GLASS BALL	×10	03:37	New. ピンク	21:12	
A.R.	663	03:37		21:12	663
A.R.	694	03:38		21:11	694
NYLON	150m	03:38~03:44			
SYNKER	×1	03:48	1.8ton		

ガラス玉は新規のものを使用.

DEPLOYMENT & RECOVERY

MOORING No. 970219-00147E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	Katayama
POSITION	0° S 147° E	(R)	
DEPTH	4345 m		
PERIOD	19. Feb. 1997 ~ 23. Jan. 1998	NAVIGATION SYSTEM :	WGS 84
No.of DAYS	340		

LENGTH : 4115 m　DEPTH of BUOY : 290 m　BUOYANCY : 1,800 kg

ACOUSTIC RELEASER

TYPE	BENTHOS (upper)	TYPE	BENTHOS (bottom)
S/N	634	S/N	690
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	14.5 kHz	TRANSMIT F.	13.5 kHz
ENABLE C.	F	ENABLE C.	C
RELEASE C.	E	RELEASE C.	B
BATTERY	2 years	BATTERY	2 years
TEST on DECK	O.K.	TEST on DECK	O.K.

DEPLOYMENT

DATE 1997.2.18　SHIP KAIYO　CRUSE No. K9702

WEATHER c　CONDITIONS うねり NE 1.8m　DIR. of WIND 030°　VEL. of WIND 4.5 m/s

DEPTH ~~4345~~ m　DEPTH of A.R. m　DESCEND. RATE 2.7 m/s　BUOY 23 : 50

POS. of STRT 0° 00.662S 146° 56.130E　HOR.RANGE m

POS. of DEP. 0° 00.344S 146° 52.422E　SINKER 01 : 25　DISAPPEAR. :

POS. of MOORING 0° 00.325S 146° 52.423E　LANDING :

NOTE 投入したガラスブイは、
ガラス玉．チェーン．シャックル共に新しい物を使用．
ガラス玉は10コ→12コへ変更．
ナイロン長117m→150m．

SSBL	TIME	S/R	DEPTH
	01:26		41.5 m
	01:31		861.3
	01:36		1744.2
	01:41		2639.9
	01:46		3393.2
	01:51		4119.1

RECOVERY

DATE 1998.1.23 ~ 24　SHIP KAIYO　CRUSE No. K9801

WEATHER bc　CONDITIONS 1.3m　DIR. of WIND 040°　VEL. of WIND 9.2 m/s

START of RELEASE 20:08　FINISH of RELEASE 23:20

POS. of DISCOVERY 0° 00.131S 146 51.393E　ASCENDING RATE 1.9 m/s

DIRECTION　DISTANCE m

NOTE
(上) 4273m
4273m
切り離しやり直し 20:20
(上) 4250m
4256m
3617m
4258m きれてない / 位置を変えた 21:01

(下)から応答なし
南側へまわる 20:43
(反対側から)
(上) 4203m (下)からは
4203m 応答なし
4207m

SSBL	TIME	S/R	DEPTH
	23:22		3708.8
	23:28		3000.3
	23:36		2017.0
	23:45		1025.1
	23:50		489.0
	23:53		242.6

E.C, R.C 何度かかけたが 応答なし．

ブイから離れた(1.5マイル)
(上) 5156m 21:30
5162m 21:37
21:41
21:50

ブイの近くへ戻った 22:59
22:07
(下)応答なし
23:12

TIME RECORD

MOORING NO. 9702-00147E

		DEPLOYMENT		RECOVERY (Date 1/24)	
		Start: 23:50 Finish: 01:25		Start: 0:05 Finish: 1:35	
ITEM	S/N etc	TIME	MEMO	TIME	MEMO
ADCP	1155	23:50	with CTD 1275	0:18	
WIRE	50m	23:50 ~ 23:51		0:20 ~ 0:23	
ABS BUOY	×2	23:53		0:25	
〃	〃	23:53		0:25	
〃	〃	23:53		0:25	
WIRE	200m	23:56 ~ 00:00		0:27 ~ 0:32	
〃	〃	00:03 ~ 00:05		0:32 ~ 0:36	
KEVLER	987m	00:09 ~ 00:18	K9606 2.5S-142E 回収 #2	0:36 ~ 0:52	K10-26
〃	〃	00:19 ~ 00:25	K9606 2.5S-142E 回収 #1	0:54 ~ 1:08	K10-19
〃	〃	00:26 ~ 00:34	K9606 0-156E 回収	1:10 ~ 1:25	K10-24
〃	487m	00:36 ~ 00:39	K9606 2.5-142E 回収 #3	1:26 ~ 1:34	K5-10
GLASS BALL	×12	00:45 ~ 00:47	NEW	1:35	
A.R.	634	00:47		1:35	
〃	690	00:47			
NYLON	150m	01:17 ~ 01:25	約20分(1マイル)航走.		
SYNKER		01:25	1.8Ton		

・ガラス玉は新しいのを使用.
ピンクのスプレーでカラーリング.
・ナイロンロープ 117m → 150m

上の方のケブラーに少しよりが入っていた.

DEPLOYMENT & RECOVERY

MOORING No. 970222 - 00N142E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	T. Katayama
POSITION	00° - 142° E	(R)	Kaneko
DEPTH	3380 m		
PERIOD	1997. 2. 22 ~ 1998. 1. 25	NAVIGATION SYSTEM :	WGS 84
No.of DAYS	338		

LENGTH : 3100 m DEPTH of BUOY : 280 m BUOYANCY : 1800 kg

ACOUSTIC RELEASER

TYPE	BENTHOS (上)	TYPE	BENTHOS (下)
S/N	662	S/N	692
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.	E
RELEASE C.	A	RELEASE C.	D
BATTERY	2 years	BATTERY	2 years
TEST on DECK	O.K.	TEST on DECK	O.K.

DEPLOYMENT

DATE 2/21 23:18 ~ 2/22 00:14 SHIP KAIYO CRUSE No. K97-02

WEATHER O CONDITIONS 波高 1.5m DIR. of WIND NNE VEL. of WIND 4.5 m/s

DEPTH 3384 m DEPTH of A.R. m DESCEND. RATE 2.5 m/s BUOY 23 : 19

POS. of STRT 00° 00.103 N, 141° 59.840 E HOR.RANGE m

POS. of DEP. 00° 00.379 N, 141° 58.025 E SINKER 00 : 14 DISAPPEAR. :

POS. of MOORING 00° 00.216 N, 141° 58.128 E LANDING :

NOTE
- シンタティックフロートブイは 0-147Eで回収した物を使用.
- ガラスブイは 0-147Eで回収した物を、チェーン(ピンクでスプレー) シャックルを交換して使用. チェーンは1.5m追加して. ガラス玉は10個から12個へ増やした.
- A.R. 692のENABLE TIMEを16時間から2時間へ変更.
- ナイロン長 140m

SSBL	TIME	S/R	DEPTH
S	00:15		28.4 m
S	00:20		847.5
B	00:25		1711.4
L	00:30		2448.4
	00:35		3061.0
	00:40		3082.3

RECOVERY

DATE Jan. 25 '98 SHIP KAIYO CRUSE No K98-01

WEATHER bC CONDITIONS 2 DIR. of WIND 040° VEL. of WIND 5.8 m/s

START of RELEASE 20:12 FINISH of RELEASE 20:12

POS. of DISCOVERY 0-00.166 N 141-57.863 E ASCENDING RATE 1.6 m/s

DIRECTION ° DISTANCE m

NOTE
20:10 E.C. 下のみおこした.
3212m
3212m
3213m
リリース後
3156m
3123m 浮上している

SSBL	TIME	S/R	DEPTH
S	20:13		3058.0
S	20:22		2097.1
B	20:27		1577.9
L	20:32		1105.1
	20:38		525.0
	20:43		138.6

TIME RECORD

MOORING NO. 970222 - 00N142E

		DEPLOYMENT		RECOVERY (Date 1/25)	
		Start : 23:18 (2/21) Finish: 00:14 (2/22)		Start : 20:45 Finish: 21:56	
ITEM	S/N etc	TIME	MEMO	TIME	MEMO
ADCP	1154	23:18	With CTD S/N 1276	20:54	
WIRE	50m	23:15~23:19	ワイヤーから投入開始	20:56~20:58	
ABS BUOY	×2	23:22		21:00	
〃	〃	23:22		21:00	
〃	〃	23:22		21:00	
WIRE	200m	23:22~23:28		21:02~21:07	
〃	200m	23:30~23:37		21:07~21:11	
KEVLER	987m	23:38~23:45	K9607 2S-142E #2 回収	21:12~21:29	K10-20
〃	988m	23:47~23:53		21:31~21:46	K10-25
〃	487m	23:55~0000	K9607 2S-142E #3 回収	21:47~21:55	K5-11
GLASS BALL	×12	00:06	チェーンをピンク New	21:57	
A.R.	662	00:06		21:57	
〃	692	00:07		21:56	
NYRON	140m	00:07~00:11			
SINKER	1.8ton	00:14			

・ガラスブイは0-147Eで回収したものを、チェーン・シャックルを交換して使用。ガラス玉 10コ→12コへ

・A.R. 692のENABLE TIMEを16hr→2hrへ

TAO MOORING OPERATIONS

NOAA's Pacific Marine Environmental Laboratory (PMEL), Seattle, Wa, USA

During the TOCS-98-01Cruise, Leg 1, aboard R/V KAIYO, 11 surface mooring sites of the TAO Buoy Array were serviced along the 165E and 156E meridians. The work included 4 deployments, 3 recoveries, 3 repairs, and 1 visit. The work performed is summarized in Table 1. Mooring types included Standard (STD) ATLAS (Automated Temperature Line Acquisition System), ATLAS2 , also known as Next Generation (NEXTGEN), and Currrent Meter.

Mooring work commenced at 8N,165E after transiting from Majuro. Operations then continued on a southward track along the 165E meridian, concluding at 5S. The ship transited northwestward to 5N,156E, then proceeded northward to finish operations at 8N,156E before transiting to Chuuk.

Scheduled repairs at 2S and the Equator, 156E had to be cancelled because of a late departure from Majuro caused by the late delivery of one of the two shipping containers of TAO mooring equipment. In addition, a scheduled recovery at 8N,156E was postponed until the summer TOCS KAYIO cruise due to rough weather that made small boat operations impossible.

Mooring Descriptions

All sites were surface buoy taut-line moorings scoped at 98.5% of the depth. STD ATLAS consists of surface measurements of wind speed and direction, air temperature, and relative humidity; subsurfrace measurements of sea surface temperature and a thermistor chain cable down to 500m, consisting of 10 temperatures and 2 pressures. Data is processed via a tower-mounted data logger (tube) and transmitted via ARGOS satellite.

ATLAS2 consists of surface measurements of wind speed and direction, air temperature, relative humidity, rainfall, and solar radiation; subsurface measurements of sea surface temperature and 10 individual inductively-coupled sensor modules down to 500m, each measuring temperature and two also measuring pressure. Data is processed via a tower mounted data-logger (tube) and transmitted via ARGOS satellite. The ATLAS2 uses newer technology and replaces the need for a second cable, thus simplifying recovery and deployment operations. ATLAS2 is the "next generation" of TAO instrumentation that is slowly replacing the existing STD ATLAS.

The Current Meter mooring for this cruise consisted of an ATLAS2 tube with sea surface temperature, and 4 mechanical Vector Measuring Current Meters (VACMs), as well as 15 Mini Temperature Recorders (MTRs) down to 500m.

Seabird Seacat Conductivity/Temperature recorders were also installed on the buoy bridles (at 1m) of all 165E deployed moorings.

Description of Operations

Repairs of the *8N,165E* buoy consisted of swapping the data logger tube, the radiation sensor, and installing a new wind sensor because the original one was damaged (probably by a fishing vessel). The rain gage also needed repair because of damage, and the tower was missing two of its wooden shelves. Similar repairs were carried out at *5N,165E* with a tube swap, radiation sensor swap, and replacement of the rotronics air temp/humidity sensor after the existing sensor's humidity failed. The STD ATLAS mooring at *2N,165E* had drifted 4 nm east of its original deployment site, but was undamaged and recovered successfully. The ATLAS2 deployment there went smoothly as well. At *0,165E* the current meter mooring was recovered without a problem, and the new replacement mooring was deployed successfully as well. The buoy at *2S,165E* was found damaged with evidence that it had been hit by a ship. The radiation sensor and mast were missing, all other tower sensors were damaged, and the tower ring was bent. A tube tube swap was performed and all sensors replaced. Recovery of the STD ATLAS at *5S,165E* was successful, as well as the deployment of the replacement ATLAS2 mooring.

Weather conditions were not a factor throughout the cruise until arrival at *5N,156E*. High winds and rough seas were encounterd, making dive operations to install a 1m bridle seacat unsafe, so the operation was cancelled. Rough seas persisted on the ship's track north and at *8N,156*. Rough seas there made launching of the small boat hazardous, so the decision was made to deploy the replacement mooring first. A seabeam survey was done the night before, 5nm north of the ATLAS buoy. This area was to be used for a future JAMSTEC Triton buoy deployment, but instead the bathymetery was used for the new STD ATLAS deployment. The ship remained at 8N,156E overnight to access weather conditions in the morning for the recovery. An attempt was made to launch the small boat, but was unsuccessful. The rough seas persisted, and recovery operations were cancelled. Recovery of ET-435 will most likely be re-scheduled for the summer 1998 TOCS KAIYO cruise. The ship then transited to Chuuk.

Acknowledgments

Thanks to Captain Ishida-san and Chief Scientist Kentaro Ando-san for a successful cruise. Mooring operations and ship handling were performed flawlessly by the expert skills of the Officers and Crew of the KAIYO. Buoy transmissions received at PMEL indicate all repaired and deployed buoys are working well and remain anchored. It should be noted that deployments during this cruise accomplished the complete transition of all moorings on the 165E line to the ATLAS2 system.

TABLE 1 - SUMMARY OF TAO MOORING OPERATIONS, TOCS-KAIYO-98-01

SITE	DATE	BUOY#	LATITUDE	LONGITUDE	TYPE	OPERATION
8N,165E	4 JAN 98	PM-23	7-59.1N	165-03.9E	ATLAS2 (NEXTGEN)	REPAIR
5N,165E	5 JAN 98	PM-24	5-01.5N	165-01.9E	ATLAS2 (NEXTGEN)	REPAIR
2N,165E	6 JAN 98	ET-432	1-59.3N	165-00.7E	STD ATLAS	RECOVER
2N,165E	6 JAN 98	PM-32	1-59.7N	164-56.8E	ATLAS2 (NEXTGEN)	DEPLOY
EQ,165E	7 JAN 98	WM-04	0-00.1S	164-59.5E	CURRENT METER	RECOVER
EQ,165E	8 JAN 98	PM-33	0-00.1S	164-59.7E	CURRENT METER	DEPLOY
2S,165E	9 JAN 98	PM-25	1-55.4S	164-25.3E	ATLAS2 (NEXGEN)	REPAIR
5S,165E	10 JAN 98	ET-433	4-59.9S	165-12.4E	STD ATLAS	RECOVER
5S,165E	10 JAN 98	PM-34	4-59.9S	165-12.2E	ATLAS2 (NEXTGEN)	DEPLOY
5N,156E	13 JAN 98	ET-464	5-00.3N	156-06.6E	STD ATLAS	VISIT
8N,156E	15 JAN 98	ET-483	8-05.1N	156-00.9E	STD ATLAS	DEPLOY

TAO MOORING OPERATIONS: LEG 2

NOAA's Pacific Marine Environmental Laboratory (PMEL), Seattle, Wa,USA

During the TOCS-98-01 cruise, leg 2, aboard R/V KAIYO, 3 surface mooring sites were serviced along the 147E and 137E meridians. The work involved 1 mooring recovery, 2 deployments, and 1 visit.

MOORING DESCRIPTIONS

All sites were surface buoy taut-line moorings with a scope of .985% of the depth of water. STANDARD ATLAS consists of surface measurements of wind speed and direction, air temperature, and relative humidity; sub surface measurements of sea surface temperature and a thermistor chain cable down to 500m. consisting of 10 temperatures and 2 pressures. data is processed via a tower mounted data-logger (tube) and transmitter via argos satellite.

DESCRIPTION OF OPERATIONS

5 N - 147E 21 January 1998

Consisted of a flyby, visual inspection of surface mooring, and confirmation of exact location. argos position vs actual position. Kaiyo arrived on site outside of the buoys regular transmit window. buoy position, and confirmation of good data were sent via fax to Kaiyo. Buoy transmissions were not necessary for this inspection.

0 - 147E 23 January 1998

Mooring operations consisted of a recovery and deployment of a standard atlas mooring. preliminary inspection of the buoy , displayed signs of fishing and vandalism. There were many short lines and the wind sensor was missing. The missing sensor made it unnecessary for any NOAA personnel to go out to the buoy . We attempted to communicate with the acoustic release from 0600-0700 (local) without success. After attempting to release the buoy, the buoy started to drift and had noticeably risen in the water. It was then decided that the buoy had released and we proceeded with recovery operations. For added precautionary measures , we prepared a hydrostatic nylon cutter that could be deployed in the remote possibility that the buoy had not released. All recovery operations went well.

Deployment of the replacement standard atlas mooring at LAT 00-00.15s LON 146-58.83e went very well .

2N-137E 30 JANUARY 1998

Mooring operations consisted of a deployment only at this site. Previous mooring has drifted and stopped transmitting , due to possible collision or vandalism. Due to no recovery, we were able to set up for deployment the afternoon of jan 29th. We started the deployment at 0600 and were finished with the deployment ,ctd, and flyby by 1030. Despite strong currents and rough seas, thedeployment of the TAO mooring ET485A went flawlessly.

Acknowledgments

Many thanks to Captain Ishida-san, chief scientist Yano-san and the very supportive scientific and ships crews. Their hard work on Mooring operations, ship handling, and small boat operations; directly contributed in making theTAO mooring operations, on TOCS cruise K9801 Legs 1 and 2 a success.

9. Carbon dioxide in the ocean

1. Participants

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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 zones. Its 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 during the strong ENSO period and 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 air ; xCO_2) in marine boundary air (twice every 1.5 h) and in air equilibrated with surface seawater (four times every 1.5 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 (BINOS 4 and Beckman 864) and four CO_2 standard gases (305 ppm, 339 ppm, 378 ppm, 409 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 into account.

We analysed TCO_2 in surface seawater using the MRI automated CO_2 extraction unit and a coulometer (UIC 5012). For continual TCO_2 analysis of surface seawater which was made concurrently with pCO_2 measurements, a portion of seawater (1L/min) pumped up from the seachest was introduced into the CO_2 extraction unit. Temperature of the seawater sample in the pipette was automatically measured before the sample was stripped of CO_2. Content of CO_2 in a standard gas (1% CO_2 in air; Nippon Sanso, Co.) were determined once every 3 hours to examine the performance of the coulometer. We also analysed CO_2 in Reference Seawater we prepared in MRI (2019.4 ± 0.9 μmol dm-3 at 20°C) which is traceable to the CRM provided by Dr. Dickson in Scripps Institution of Oceanography at least once during the each run of the system. The results for the Reference Seawater (Fig. 1) indicates that there was no significant bias and no change in calibration factor during the cruise. The data are to be revised after the correction for the blank and the density of the sample at the measured temperature.

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. 2) in order to compare the in situ temperature and that at the equilibrator for xCO_2 correction.

4. Results

Figure 3 show distributions of xCO_2 in air and surface seawater from Majuro to Chuuk and from Chuuk to Palau. Only two measurements in a day were tentatively calculated from the preliminary data set for every 1.5 h.

Figure 4 shows tentative TCO_2 measurements in the surface seawater at CTD stations from Majuro to Chuuk and from Chuuk to Palau.

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 during the strong ENSO event in more detail.

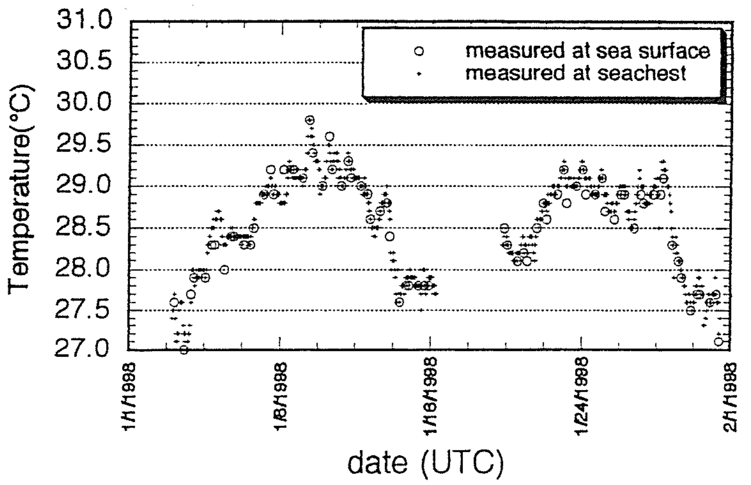

Fig.2 Distributions of seawater temperature.

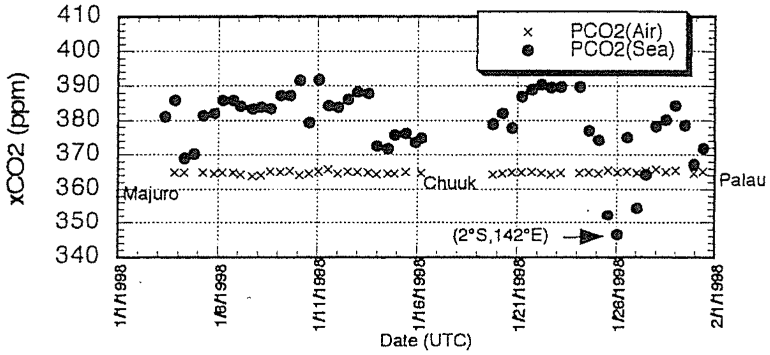

Fig. 3 Distribution of xCO_2 surface seawater and in marine boundary air (selected preliminary data)

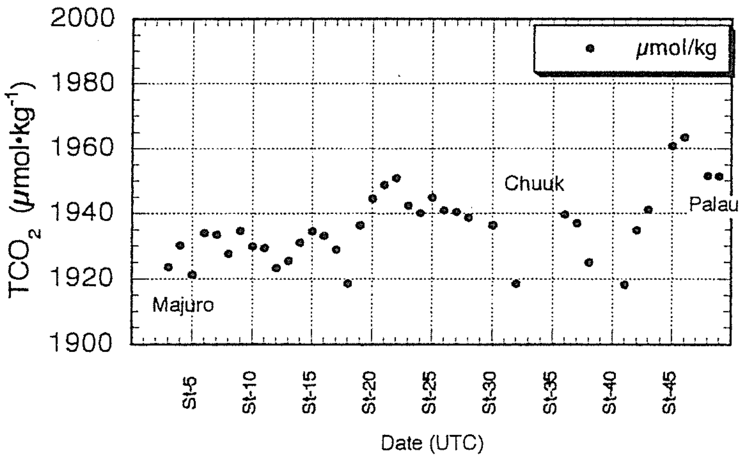

Fig. 4 Distribution of TCO_2 in surface seawater (preriminary data)

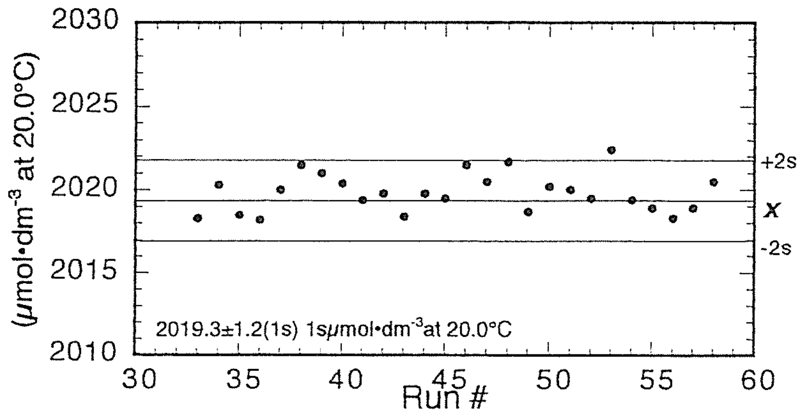

Fig. 1 Control chart for the analysis of Reference Seawater prepared in MRI (2019.4±09. μmol dm^{-3} at 20.0°C) which is traceable to the CRM prepared in SIO.

SUMMARY REPORT

THE SECOND LEG OF TOCS 9801 CRUISE

by:

Fadli Syamsudin[1], Muh. Ilyas[2]

1. Directorate of Technology for Natural Resources Inventory, BPPT

2. Management of Baruna Jaya Research Vessels Group, BPPT

1. Introduction

Participation of Indonesian scientist in The ongoing Tropical Ocean Climate Study (TOCS) based on BPPT (Agency for the Assessment and Application of Technology) and JAMSTEC (Japan Marine Science and Technology Center) Implementing Arrangement for FY 1997/1998. Under Memorandum of Understanding (MOU) as an umbrella between Japan-Indonesian Government joint co-operations in Science and Technology development.

The TOCS program is very important for both countries in the study of global climatic change where Indonesia and Japan have The direct impact of El Nino phenomena, such as: drought happen in Indonesia and the recent abnormal snow happen in Tokyo, Japan.

Some scientific backgrounds of The importance of both Indonesian Seas and Western Pacific waters have been reported by some scientists. Wyrtki (1987), wrote that the warm waters are piled up by the trade winds of the Pacific Ocean towards its western boundary. On the average, the sea level is higher on the Pacific side of the Indonesian archipelago than on the Indonesian side. This pressure gradient generates a transport of water through Pacific to Indian Ocean via Indonesian seas. Gordon (1986), reported that Inter Ocean transport with the Indonesian seas is the primary means of exporting excess freshwater from the North Pacific Ocean. The recent study was conducted by Kashino et all (1995), noted that South Pacific Ocean has also its contribution. Shortly to say that Western Equatorial Pacific water is playing an important role in the ENSO phenomena. Including in this issue, the Indonesian Troughflow is relevant to ENSO as it allows *seepage* of the Western Pacific`s warm pool water into the Indian Ocean, adjusting the volume of the warm pool.

2. Purpose

General purpose of TOCS programs are to observe physical oceanographic conditions in the western tropical pacific waters and to achieve better understanding of ocean - atmosphere interaction in affecting El Nino/Southern Oscillation (ENSO) phenomena.

The participation of Indonesian scientist in this cruise will look further the couple effects of Indonesian Seas through Indonesian Throughflow study and Western Pacific Ocean through TOCS program in the frame of Global Climatic Changes studies. Some point issues can be derived in those studies as follow:

- to identify water masses characteristics enter the Indonesian seas from Pacific Ocean side.
- to calculate better approximation of Pacific - Indian ocean throughflow transport with knowing how strength and variability of current transport in the seepage of Western Pacific Ocean to Indonesian seas.
- to track water masses and current movement in the conveyer belt system of global termohaline circulation from Pacific to Indian Ocean via Indonesian seas.

3. The Second Leg of TOCS 9801 Deployment Cruise

The present cruise is part of the Tropical Ocean Climate Study, TOCS 9801 phase, conducted by JAMSTEC. The components include :

a. CTD and Water Sampling

- CTD - O_2 cast are collected along cruise track down to 1000m depth, using a SeaBird SBE 9-11 Plus. These censors measured Salinity, Temperature, Pressure, and Oxygen content.
- Dissolved Oxygen (DO), Carbon Dioxide (CO_2), and salinity sampled at 50, 100, 150, 200, 250, 350, 400, 500, 600,800, and 1000 db.

b. Deployment Mooring

- Subsurface ADCP (Acoustic Doppler Current Profiler) mooring conducted by JAMSTEC at position of 0, 147E and 0, 142E, covering recovery and deployment. This equipment plan to record time series of current variability along 1 (one) year mooring time. The ADCPs mooring used in this cruise is 150 kHz Broad-band model, made by RD Instrument. The ADCPs is equipped in the hole of a spherical subsurface buoy and a CTD censor of Sea-Bird model SBE 16, attaching a few meters below the bottom of this subsurface buoy to monitor vertical migrations of the ADCP and the ambient temperature. The planned depth of this subsurface buoy was about 270 - 290m, making the heads of ADCP to look upward without any obstacles and there are no other oceanographic instruments between the buoy and a sinker.
- STD ATLAS moorings conducted by PMEL at position of 0, 147E, covering recovery and deployment and at 2-30N, 137-30E covering only deployment. The ATLAS gave real time meteorological surface data and sub surface water temperature at the mooring sites. The telemetric system using satellite made it possible to other community to pick the data

c. Underway

- Shipboard ADCP continuous measurement : hull 4 beam RDI`s ADCP of 75 kHz Narrow beam model seems to be working well during the tracks.
- Meteorological observation and (CO_2) measurements : measure every 3 hours manually, surface water sampling at 8, 16, and 20 LTM, and measure Sea Surface Temperature (SST). Atmospheric sonde used to measure air temperature, gust wind, wind speed and direction, pressure, humidity, solar radiation, intensity. This equipment was launched on air using balloon that contains of helium gas. The data transmitted to receiver in the container on board every 6 hours continuously.
- Navigation using the GPS.

4. Data Collection Program Comments

4.1 Ship and Tracks

We began the second leg (leg 2, Chuuk to Palau) at Truk (Federated State of Micronesia) on January 20, 1998, at 08.00 Local Time. Heading Southwest towards 147E 9-CTD transect, began CTD 19 (5N, 147E) at 5.00 PM. on January 21, 1998. Finishing 5 CTD station at CTD 23 before doing recovery and deployment of STD ATLAS and ADCP moorings on January 23 and 24, 1998 respectively. There is a little trouble when we released the acoustic release of ATLAS. It was not responding directly. We are waiting for more than 3 hours until the sea-watch in the bridge reported that they saw the ATLAS drifting. The second work of ADCP recovery and deployment has a similar trouble with the previous day, but they can release it successfully, even though the second acoustic still remain in the bottom of the sea. In general, both recovery and deployment have been conducted successfully.

Because of the limited time to get Palau in the first of February 1998, Chief Scientist eliminated the 3-CTD stations remain on 147E transect. The Kaiyo was steaming to west along the equator directly to begin CTD 25 (0, 146E) on January 24, 1998, at 06.00 PM local time until CTD 28 (0, 143E) on January 25, 1998 at 02.00 PM local time. The Kaiyo drifted along the night before beginning the recovery and deployment of ADCP mooring at position of 0, 142E, on January 26, 1998 in the morning. It was done efficiently and continued to begin 7-CTD 142E transect in the southern hemisphere at CTD 29 (0, 142E) on mid day and finished at CTD 35 (2 40S, 142E) on January 27, 1998, at 5.30 AM local time.

After finishing the 7-CTD 142E transect, the Kaiyo was steaming to North-Northwest to get CTD 36 (0, 141E) and finished 3 CTD station along the equator at CTD 38 (0, 139E) on January 28, 1998, at 09.00 AM local time. Then, the Kaiyo entered the Indonesian Economic Exclusive Zone to begin the 7-CTD 138E transect at CTD 39 (1S, 138E), 03.00 PM local time. The Kaiyo finished the 7-CTD 138E transect at CTD 45 (2N, 138E), on January 29, 1998, 01.00 PM local time. She was steaming to Northwest to get STD ATLAS deployment position at 2 26N, 137 26E.

We deployed STD ATLAS on January 30, 1998, at 06.15 AM local time and finished it at 09.00 AM. Then, we did CTD 46 before The Kaiyo steamed to Northwest to get the last 3-CTD 137E transect. We finished this transect at CTD 49 on January 31, 02.00 AM local time. There are 31 CTD stations finishing when we arrived Koror, Republic of Palau on February first, 1998, at 08.00 AM local time. There are some extra works for Barbeque and unloading of PMEL`gear in the container, before The Kaiyo goes back to her home at Yokosuka, Japan, on January 4, 1998.

4.2 Comments

- Recovery /Deployment of ATLAS and ADCP Moorings

The sequence of activities of the mooring sites will depend on time of arrival and environmental conditions. The mooring are floating out ADCP (Acoustic Doppler Current Profiler) and STD ATLAS first, anchor last. The ship movements are meant to lay out the approximately 4600m at floating mooring at 1.5 kts, releasing anchor (4000 pound of railroad wheels for ATLAS deployment and 1.8 ton of train-track for ADCP mooring). The target sites are already well surveyed beforehand by JAMSTEC and PMEL.

In this second leg of TOCS 9801cruise, there are 2 (two) recoveries and deployments of ADCP moorings and 1 (one) recovery and deployment and 1(one) only deployment of STD ATLAS moorings that have been already conducted successfully.

The CTD censors and bottle triggers performed well during the casting. We did not find the leakage of 5 liter Niskin Bottle during the water sampling and nearly did not find a problem of bottle trigger. The only one that should be checked was the Oxygen censor performances. It does not look stable during our watching.

In general, the CTD casts have been done successfully. There are 31 CTD stations (CTD 19 to CTD 49) that have been taken during the leg 2.

5. Future Work Plan Comments and Suggestions

5.1 Future Work Plan Comments

We are very sorry to say that we can not provide temporary result or our analysis of the second leg (leg 2) of the TOCS 9801 cruise in this summary report. We did not anticipate to bring our ctd data processing program which will make us possible to analyze current dynamic systems and water masses analysis of this cruise.

Here, we would like to share our idea for the future work plans of TOCS programs as follow:

a. Physical Oceanography Issues

- Using hydrographic (CTD) and ADCP data, we can derive current dynamic systems and water masses analysis, as was reported by Kuroda et all (1995) in his paper entitled, *Oceanic Structure in The Western Tropical Pacific Observed during TOCS Cruise*, and Kashino et all (1995),*The Water Masses between Mindanao and New Guinea*. It is possible to continue those results to see its variability of the oceanic structure in the western pacific water seasonally during the TOCS cruises (1993 - 1998). This variation of ocean circulation and water masses dynamics will make us closer to calculate the more exact contribution of heat transport in the study of global climatic changes. This identification and calculation will be better if we combine with the exact calculation of the Indonesian throughflow transport. In this issues, both scientists of JAMSTEC and BPPT can begin the cooperation with an intensive discussion in some joint writing papers and sharing data of Indonesian water and western pacific water, conducting by JAMSTEC.

b. Air-Sea Interaction issues

- Better understanding of TOCS program results will bring our calculation to know how it effects atmosphere well, adversely how atmosphere effects the sea condition. In this issues, study of meteorological aspect during the TOCS program are very important and urgent, such as study of southern oscillation index annually, inter-annually, decadal, etc and see its relation to sea surface temperature changes, cloudiness, rainfall characteristics, and any related atmospheric parameter.

5.2 Suggestions

- We are strongly support for doing more discussions and small presentations from both parties during the cruise, to accommodate any idea and to report recent result of our finding. Any original idea to solve the issues are inviting.
- During a CTD cast, it was better to put data position and GMT time during the CTD was in surface, in the bottom, and when it came back to surface. This position and time information will give us better correction for quality of CTD data.

Acknowledgments

We commend Captain Mr. Ishida and his fine crews aboard the KAIYO for solid and professional works, showing during the cruise. We can truly say it was very positive experience in working with this dedicated and amicable group of people. Their sincerity in accomplishing the objective of the cruise were particularly evident during the difficult work period.

We greatly appreciated the valued help and assistance provided by Chief Scientist Mr. Yano T., fellow researcher of JAMSTEC, Dr. Matsuura and all our colleagues on board Kaiyo. Their hard and effective work during long hours were key to achieving the TOCS 9801 cruise objectives.

Finally, we thank Dr. Ir. Indroyono Soesilo (Deputy Chairman BPPT for Natural Resources Development), Asep Karsidi Msc (Director of Technology for Natural Resources Inventory), Yusuf Surachman Msc (Ka. sub dit. TISDA-MAL) for their continuing supports of the TOCS program.

References

1. **Kuroda et all**, Oceanic Structure in The Western Tropical Pacific Observed during TOCS Cruise, Proceedings of International Workshop on the Throughflow Studies in and around Indonesian Waters, 1995.
2. **Yuji Kashino et all**, The Water Masses between Mindanao and New Guinea, Proceedings of International Workshop on the Throughflow Studies in and around Indonesian Waters, 1995.
3. **Gordon A.L.**, Inter Ocean exchange of Thermocline Water, J. Geophysical Research, Vol. 91, pp 5037 - 5047, 1986.
4. **Wyrtki K.**, Indonesian Throughflow and the Associated Pressure Gradient, J. Geophysical Research, Vol. 92, No. C12, pp. 12941 - 12946, 1987.

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Chief Engineer	Eiji Sakaguchi
First Engineer	Morito Takahama
Second Engineer	Kazunori Noguchi
Third Engineer	Keisuke Hayashida
Chief Radio Officer	Masayuki Sasaki
Second Radio Officer	Katsutoshi Kitamura
Boatswain	Ichiro Oba
Able Seaman	Akio Hama
Able Seaman	Yasuyuki Yamamoto
Able Seaman	Yoshikane Oda
Able Seaman	Masatsugu Hamaoka
Able Seaman	Yukio Fujimura
Able Seaman	Shigekazu Konno
No. Oiler	Masayuki Masunaga
Oiler	Masaru Kitano
Oiler	Makoto Kobayashi
Oiler	Kunio Honda
Oiler	Kazuo Abe
Chief Steward	Kaoru Takashima
Steward	Isamu Kashima
Steward	Takeshi Miyauchi
Steward	Jihei Nakatsuka
Steward	Shinsuke Tanaka

Appendices

A1 Time Table

A2 Report of the loss of acoustic releaser (in Japanese)

Time Table of TOCS KY9801 Cruise

Dec.25, 1997－Jan.3, 1998: Port of Majuro

Dec.30 (Tue)	Cloudy	(GMT+12)
0900－1100	Loading of PMEL's gear	
Jan.3 (Sat)	Fine	
0900－1100	Loading of PMEL's gear	
1440	Departure from Majuro	
1630	Start of Shipboard-ADCP,pCO2 etc. measurements	
1800	Start of Surface Meteorological measurement in every 3hours	
Jan.4 (Sun)	Fine	
0900－0930	Boat & Fire Drills	
0930－1130	Meeting for the first leg	
1300－1630	ATLAS buoys assembly & preparation for ADCP buoy	
Jan.5 (Mon)	Fine | Cloudy	(GMT+11)
0750－0900	Repair of Next Generation ATLAS (Swap Tube) (7-59N,165-04E)	
0910－0950	CTD-01 (7-59N,165-03E)	
1524－1610	CTD-02 (7-02N,165-00E)	
2156－2242	CTD-03 (6-01N,165-00E)	
Jan.6 (Tue)	Fine | Cloudy	
0745－0840	Repair of Next Generation ATLAS (Swap Tube) (5-02N,165-02E)	
0858－0933	CTD-04 (5-01N,165-01E)	
1517－1606	CTD-05 (4-01N,165-00E)	
Jan.7 (Wed)	Fine | Cloudy	
0607－0900	Recovery of Standard ATLAS (1-59N,165-01E)	
0935－1127	Deployment of Next Generation ATLAS (2-00N,164-57E)	
1149－1228	CTD-06 (1-59N,164-58E)	
1834－1917	CTD-07 (1-00N,165-00E)	

Jan.8 (Thu)	Fine | Cloudy
0635−0940	Recovery of CM Surface Buoy (0-00N,165-00E)
1043−1330	Deployment of CM Surface Buoy (0-00N,165-00E)
1430−1530	Preparation for ADCP buoy
Jan.9 (Fri)	Fine | Cloudy
0607−0825	Recovery of ADCP mooring (0-00N,165-17E)
0900−1020	Deployment of ADCP mooring (0-00N,165-17E)
1040−1119	CTD-08 (0-00N,165-19E)
1740−1821	CTD-09 (1-00S,164-51E)
Jan.10 (Sat)	Fine | Cloudy
0631−0751	Repair of Next Generation ATLAS (1-55S,164-25E)
0800−0838	CTD-10 (1-56S,164-25E)
1442−1530	CTD-11 (3-00S,164-42E)
Jan.11 (Sun)	Fine | Cloudy
0604−0750	Recovery of Standard ATLAS (5-00S,165-12E)
0840−0955	Deployment of Next Generation ATLAS (5-00S,165-12E)
1011−1052	CTD-12 (4-59S,165-13E)
Jan.12 (Mon)	Fine | Cloudy
0856−0934	CTD-13 (1-44S,162-13E)
Jan.13 (Tue)	Fine | Cloudy
0901−0942	CTD-14 (1-51N,158-55E)
1552−1633	CTD-15 (2-47N,158-05E)
Jan.14 (Wed)	Fine | Cloudy
0811−0855	CTD-16 (5-00N,156-05E)
0955−1030	Seabeam (5-05N,156-00E)
1515−1555	CTD-17 (5-59N,156-00E)

Jan.15 (Thu)	Fine
0515－0556	Seabeam (8-05N,156-00E)
0700－1100	Deployment of Standard ATLAS (8-05N,156-01E)
1129－1228	CTD-18 (8-05N,156-01E)
1343－1510	Seabeam (8-00N,156-00E)
Jan.16 (Fri)	Fine
0650	Recovery of Standard ATLAS (8N,156E) was canceled.
0700	Heading to Chuuk
Jan.17 (Sat)	Fine
0920	Arrival at Chuuk
Jan.20 (Tue)	Fine (GMT+10)
0830	Departure from Chuuk
1000	Start of shipboard-ADCP, pCO2 etc. measurements
1000	Start of Surface Meteorological measurement in every 3hours
1000－1100	Meeting for the second leg
1300－1330	Boat & Fire Drills
Jan.21 (Wed)	Cloudy
1730－1745	Inspection of Standard ATLAS (4-58N,147-01E)
1755－1838	CTD-19 (4-58N,147-01E)
Jan.22 (Thu)	Fine | Cloudy
0010－0055	CTD-20 (4-01N,147-01E)
0633－0713	CTD-21 (3-00N,147-00E)
1234－1314	CTD-22 (2-02N,147-00E)
1900－1940	CTD-23 (1-01N,147-00E)
Jan.23 (Fri)	Fine
0608－0936	Recovery of Standard ATLAS (0-18N,147-04E)
1217－1409	Deployment of Standard ATLAS (0-00S,146-59E)
1432－1514	CTD-24 (0-02S,146-59E)

Jan.24 (Sat)	Fine
0608－1135	Recovery of ADCP mooring (0-00S,146-52E)
1257－1425	Deployment of ADCP mooring (0-00S,146-52E)
1922－2000	CTD-25 (0-00N,146-02E)
Jan.25 (Sun)	Fine
0123－0154	CTD-26 (0-00S,145-01E)
0708－0753	CTD-27 (0-00S,144-00E)
1255－1338	CTD-28 (0-00S,143-01E)
Jan.26 (Mon)	Fine
0610－0756	Recovery of ADCP mooring (0-00N,141-58E)
0820－0932	Deployment of ADCP mooring (0-00N,141-58E)
1007－1048	CTD-29 (0-00N,141-58E)
1334－1419	CTD-30 (0-29S,142-00E)
1708－1748	CTD-31 (1-00S,142-00E)
2024－2102	CTD-32 (1-29S,142-00E)
2351－0035	CTD-33 (1-59S,141-57E)
Jan.27 (Tue)	Cloudy
0314－0355	CTD-34 (2-28S,141-56E)
0513－0547	CTD-35 (2-40S,142-00E)
2104－2142	CTD-36 (0-03S,141-01E)
Jan.28 (Wed)	Fine
0227－0308	CTD-37 (0-00N,140-01E)
0800－0842	CTD-38 (0-00S,139-00E)
1444－1532	CTD-39 (0-59S,138-01E)
1843－1920	CTD-40 (0-31S,138-00E)
2213－2254	CTD-41 (0-01S,138-00E)

Jan.29 (Thu)	Fine
0153－0239	CTD-42 (0-30N,137-59E)
0529－0607	CTD-43 (1-00N,138-00E)
0854－0936	CTD-44 (1-29N,138-00E)
1224－1309	CTD-45 (2-00N,138-00E)
Jan.30 (Fri)	Fine
0632－0840	Deployment of Standard ATLAS (2-26N,137-26E)
0900－0937	CTD-46 (2-27N,137-25E)
1400－1438	CTD-47 (3-00N,137-01E)
1943－2021	CTD-48 (4-00N,137-00E)
Jan.31 (Sat)	Fine
0129－0219	CTD-49 (4-59N,137-00E)
Feb.1 (Sun)	Fine
0800	Arrival at Palau (Pilot Station)

Appendix 2

平成 10 年 1 月 31 日

ADCP 係留系回収時における切離装置の亡失について

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1．概要

平成 10 年 1 月 24 日に実施した ADCP 係留系の回収時における切離装置の亡失について報告する。なお、原因については現時点では全く不明のため、主に回収作業開始から亡失に至るまでの行動を簡潔に記述する。

以下、時刻は船内時（日本時間＋1時間）を用いている。

2．回収対象の係留系

今回回収対象とした ADCP 係留系は、平成 9 年 2 月 18 日に設置したものである。設置位置は 0° 00.325S, 146° 52.423E で、設置点の水深は 4345m である。亡失した切離装置は Benthos 社製 865A（S/N 690）という形式で、2回目の使用であった。

なお、この係留系には2個の切離装置が直列に取り付けられていたため、系自体は上側切離装置を用いて回収することができた。また、ADCP によるデータも正常に取得されていた。

3．当時の海況

係留系設置位置付近では、約2ノットの西向きの流れが観測され、漂泊中は常に西に流されている状態であった。天候は晴、北北東、6m/s の風、うねり 1m、風浪 0.5m で、平穏な海況であった。

4．回収作業開始から亡失に至るまでの行動

各作業内容については時刻の記録を残している事項のみ記述しているが、それぞれの作業における漂泊中には、Enable, Release コマンドを複数回送っている。また、回収作業開始から切り離し・係留系の回収に至るまで、回収できた上側の切離装置は常に機能しており（コマンドに対する応答など）、深度確認が可能であった。

(1)第１回目切離作業

・1/24 0600 作業開始（トランスデューサー降下）。
設置位置から見て（以下同じ）西方約 500m。
双方の切離装置に対して Enable コマンドを送る。
下側切離装置からの（以下同じ）応答なし。

・0608　西約 740m。Release コマンドに対する応答なし。

・0613　西約 1040m。トランスデューサー揚収。移動開始。

(2)第２回目切離作業

・0624　西約 610m に接近。トランスデューサー降下。

・0625　西約 670m。Enable, Release コマンドに対する応答なし。

・0632　西約 910m。トランスデューサー揚収。南方に移動開始。

(3)第３回目切離作業

・0644　南約 330m。トランスデューサー降下。

・0645　南約 330m。Enable, Release コマンドに対する応答なし。

・0651　南西約 440m。トランスデューサー揚収。北方に移動開始。

(4)第４回目切離作業

・0700　北約 220m、トランスデューサー降下。Enable, Release コマンドに対する応答なし。

・0710　北西約 560m。トランスデューサー揚収。水深と同じくらいの距離をとるため、西方に移動開始。

(5)第５回目切離作業

・0727　西約 2870m。トランスデューサー降下。漂泊しつつ Enable, Release コマンドを送り続けたが応答なし。

・0810　西約 4500m。トランスデューサー揚収。0600 の作業開始位置近くに移動開始。

(6)第６回目切離作業

・0858　西北西約 800m。トランスデューサー降下。Enable, Release コマンドを送り続けたが応答なし。

・0912　西北西約 1300m。船上局を交換して、Enable, Release コマン

ドを送ったが応答なし。

・0920　西北西約1500m。下側切離装置は使用不能と判断し、上側切離装置を使用して切り離した（0922トップブイ浮上確認、以後系全体の回収作業を行った）。

5．原因

原因については想像の域を出ないが、全く応答がなかった（最初に応答らしきものがあったが疑わしい）ことから、電池内部のショートあるいは接触不良などによって電源が失われていたことが考えられる。

また、この機種のこれまでの実績から考えにくいことではあるが、機器内部への水漏れの可能性も捨てきれない。

6．今後の対策

係留系全体が失われることを防ぐために、以前から切離装置を1つの系に2組用いている（現に今回の回収作業ではその措置が有効に機能した）。この場合、切離装置を2組並列（通常は上下に、つまり「直列に」配置している）に用いて、どちらかが機能すれば他方も回収できるようにすることは原理的には可能であるが、切離装置部分でのチェーンの絡みが起きることは避けられず、並列配置の採用は現実的ではない。

また、原因が特定されていない現在の時点では、切離装置そのものについて特段の対策を講じることは困難であり、これまでのADCP係留系回収作業の実績（切離装置の亡失はTOCSが開始されて以来初めて）を勘案すると、今のところその必要はないと考えられる。