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CRUISE REPORT

TOCS K9601

January-February 1996

TOCS CRUISE REPORT NO.6

JAMSTEC

CONTENTS

1. Cruise Summary

Ship: R/V KAIYO

Institute: Japan Marine Scienceand Technology Center

Chief scientist: Yoshifumi Kuroda, JAMSTEC (Palau-Kavieng)

Chief scientist: Koichi Takao, JAMSTEC (Kavieng-Guam)

Co-Chief scientist: Djoko Hartoyo, BPPT

Cruise code: K9601

Project title: Tropical Ocean Climate Study (TOCS)

Period: 24 January 1996 - 26 February 1996

Port of call:

Majuro, Republic of Marshall Islands (21-24 January 1996)
Kavieng, Papua New Guinea (7 -9 February 1996)
Palau, Republic of Palau (26-29Februry 1996)

Purpose:

The purpose of this cruise was to observe physical oceanographic conditions in the western tropical Pacific for better understanding of ocean-atmosphere interaction and its affects on the ENSO phenomena (El Nino/Southern Oscillation) and climate change. The cruise was carried out under the research program of Tropical Ocean Climate Study (TOCS) at the Japan Marine Science and Technology Center. The program is supported by the Science and Technology Agency of Japan. The cruise was conducted as a joint cruise between BPP Teknologi, Indonesia and JAMSTEC. Mr.Djoko Hartoyo, Handoko Manoto (BPPT) and Mr. Bagus Puji Wahyono (Security Officer) participated in the cruise. During this cruise recoveries and deployments of meteorological and oceanographic buoys as part of the Tropical Atmosphere Ocean (TAO) array were conducted by Pacific Marine Environmental Laboratory (PMEL) of National Oceanic and Atmospheric Administration (NOAA), USA. Mr. Andrew Shepherd and Mr. Stephen Smith of PMEL participated in the cruise for the moorings.

Observation summary:

The following measurements were completed: 66 CTD (Conductivity-Temperature-Depth profiler) casts, 75 upper air soundings (Omega sonde), continuous ADCP (Acoustic Doppler Current Profiler) measurements, CO_2 measurements, 2 recoveries and 3 deployments of subsurface current meter buoys. 4 Recoveries, 7 deployments and repair of TAO surface buoys were also carried out including a drifting buoy recovery.

Observational results:
The observational results are summarized preliminaly as follows although further analysis and dicussion will be needed.

The ocean and atmospheric data showed that the ocean was in anti El Nino phase.

The water temperatures in the surface mixing layer were extremly high in the western Pacific. The sea surface temperature was above 29℃ all over our observation region. High SST (above 30℃) was observed in the east of 146E along the equator where clear barrier layer could be seen. The depth of 20℃ isotherm was about 180m. We observed over 30.2℃ down to 50 m depth from 156E to 151E along the equator, which was warmer than the temperature at 165E of 30℃. The convergence of surface currents was observed around 165E in the December-January Laser leg which was carried out just before this TOCS leg by R/V Kaiyo. From 156E to 151E, we observed the active convection which resulted in less salinity water of 34.5 psu in the mixing layer. On the contraly the salinity was high over 35.0 psu at 165E where the trade winds and were dominant and the air was dry. Thus the warm water was well developed in the western Pacific.

The atmospheric condition was as follows. From 165E to 156E, easterlies were dominant at the sea surface, especially along the 165E the easterlies were strengthened. From 156E to Kavieng, the winds were weakened. The direction of the sea surface wind changed from easterly to westerly at 145E. As shown in atmosheric sounding data, this tendency of wind was also observed in the lower layer. The atmosphere was dry (moisture) where it was dominated by easterly (westerly). Thus it is thought that the region of equatorial convection existed between 145E and 150E.

CTD section along the equator shows interesting feature around the Equatorial Under Current zone. Temperature and salinity had vertical structure with multi-steps and multi-peaks. This vertical scale was about 20-40m. Temperature inversion layers were observed in many CTD casts, particularly between 138E and 144E. It is shown in T-S diagram that the water originated in North Pacific intrudes into the equatorial region where the South Pacific Water occupied. As shown in dissolved oxygen analysis this tendency was not obvious around the EUC, but it was seen under the EUC. The water intrusion may be occure under the thermocline.

CTD observations were also carried on across the equator at 138E, 142E, 147E and 165E. On 142E line there existed high disolved oxygen layer at 500-600m depth near the New Guinea coast, that could be corresponding to the lower part of the New Guinea Coastal Under Current. The same tendency was seen on 138E line, though the maxtum value (0-45S,500m) was lower than that of on 142E line.

Below the current the Antarctic Intermediate Water was seen on 142E line, shown in T-S diagram as low salinity water (<34.5psu) on the 27.2 sigma-theta surface. Though this water is thought to flow north-westward along the New Guinea Coast, on 138E line the low salinity water was not observed.

On the equator we recovered two subsurface ADCP buoys at 142E and at 147E. In this cruise we proceeded preliminaly analysis. The current data were recorded in good condition (from 300m depth to sea serface over 1 year). We deployed two subsurface ADCP buoys at the same positions and one at 165E.

Shipboard ADCP measured the currents along the cruise track. We could see the vertical structure of the flow above 600m. We will analyze these data with the CTD data. It may give us more detailed feature of water mass distribution and equatorial current system.

Finally, we would like to thank Captain Ishida and crew members of 'KAIYO' for exellent supports during TOCS K9601 cruise. It is their support that made this research successful.

2. List of Shipboard Instruments

(1) CTD (Conductivity-Temperature-Depth profiler)
SBE 9-11 plus system, Sea Bird Electronics, Inc., USA
for 6800m depth

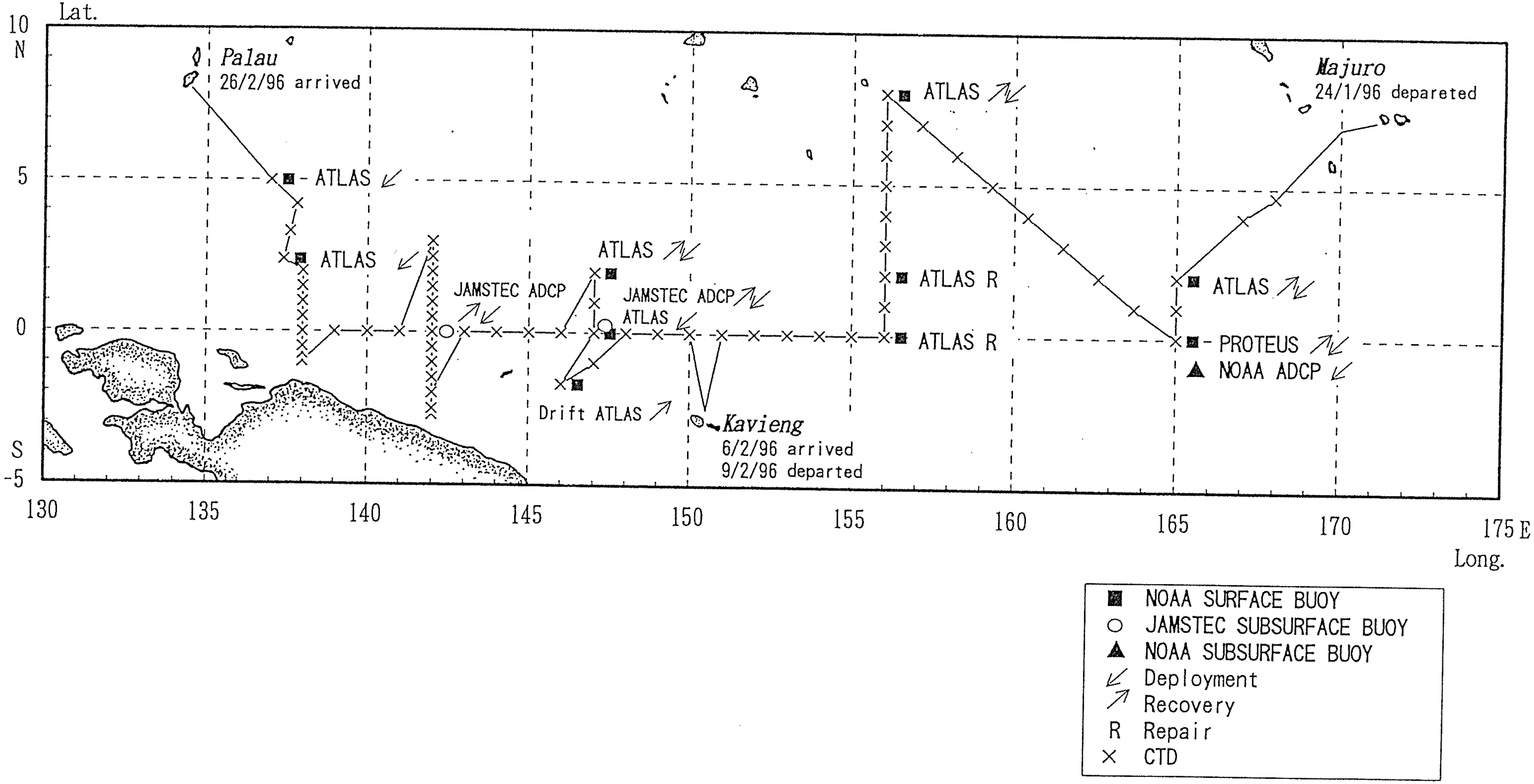
(2) Shipboard ADCP (Acoustic Doppler Current Profiler)
a. JLN610, Japan Radio Co.Ltd
(125kHz, 6m bin width, 3 depth layers of 20m, 50m and 80m)
b. VM-75, RD Instruments, USA
(75kHz, 16m bin length, Nominal range 560m starting 30m depth)

(3) Upper air soundings (Omega sonde)
Digi CORA MW11 Vaisala, Finland
Omega Sonde Rs-80N

(4) Dissolved Oxygen
TOA Portable Dissolved Oxygen Meter Model DO-25A
Metrohn Model 716 DMS Titrino / 10ml of titration vessel
Pt Electrode / 6.0401.100
SBE 13, Sea Bird Electronics, Inc., USA

(5) CO_2
Model 5011 and 5012, UIC Inc., USA

3. Observation Sites K9601 TOCS Cruise



3.01

4. CTD Cast

CTD Observation with Dissolved Oxygen meter.

Objectives :

To measure vertical profiles of temperature, salinity and dissolved oxygen in the western Pacific along the equator by using CTD with Dissolved Oxygen meter.

Methods :

We observed vertical profiles of conductivity, temperature and dissolved oxygen down to 1000 m depth by using CTD system (SBE9plus CTD underwater unit, SBE11plus CTD deck unit and a PC machine). Data are obtained at the scan rate of 24 Hz and stored in the computer. After each casting, we converted the data into ascii code with computing physical value. Salinity value was calculated by using the conductivity and the pressure. We removed near the sea surface data which were inaccurate. After averaging every 1 db, the data was split into up and down cast data sets.

The CTD has primary and secondary sensor for conductivity and temperature. We analyzed the data obtained by primary sensor.

We conducted a pre–cruise calibration for the pressure sensor by a dead weight tester at JAMSTEC. It found that an offset value for the pressure sensor to be +5 db. So we converted each pressure value as +5 db in the convert process.

In each CTD cast, bottle sampling by using a Rosette system (12 position, 5 liter Niskin samplers) was carried out in order to measure dissolved oxygen and salinity.

Instruments and Software :

CTD : Sea–Bird Electronics,Inc.,model

SBE9plus CTD underwater unit	S/N 09p8010–0319
SBE11plus CTD deck unit	S/N 11p8010–0307
Pressure sensor	S/N 41223
Temperature sensor (primary)	S/N 031462
Temperature sensor (secondary)	S/N 031465
Conductivity sensor (primary)	S/N 041045
Conductivity sensor (secondary)	S/N 041174
Dissolved Oxygen sensor	S/N 130311

Software : Sea–Bird Electronics,Inc.,model : SEASOFT Ver.4.031

4.1 CTD Sites

Figure 4.1 shows CTD sites.

Pressure, salinity, temperature and dissolved oxygen were measured in each sites from sea surface to 1000m depth by each sensor.

The seawater samples for an electrode method and Winkler method were collected by 5 liter Niskin sample in 50,100,150,200,250,300,350,400,500,600,800,1000m depth.

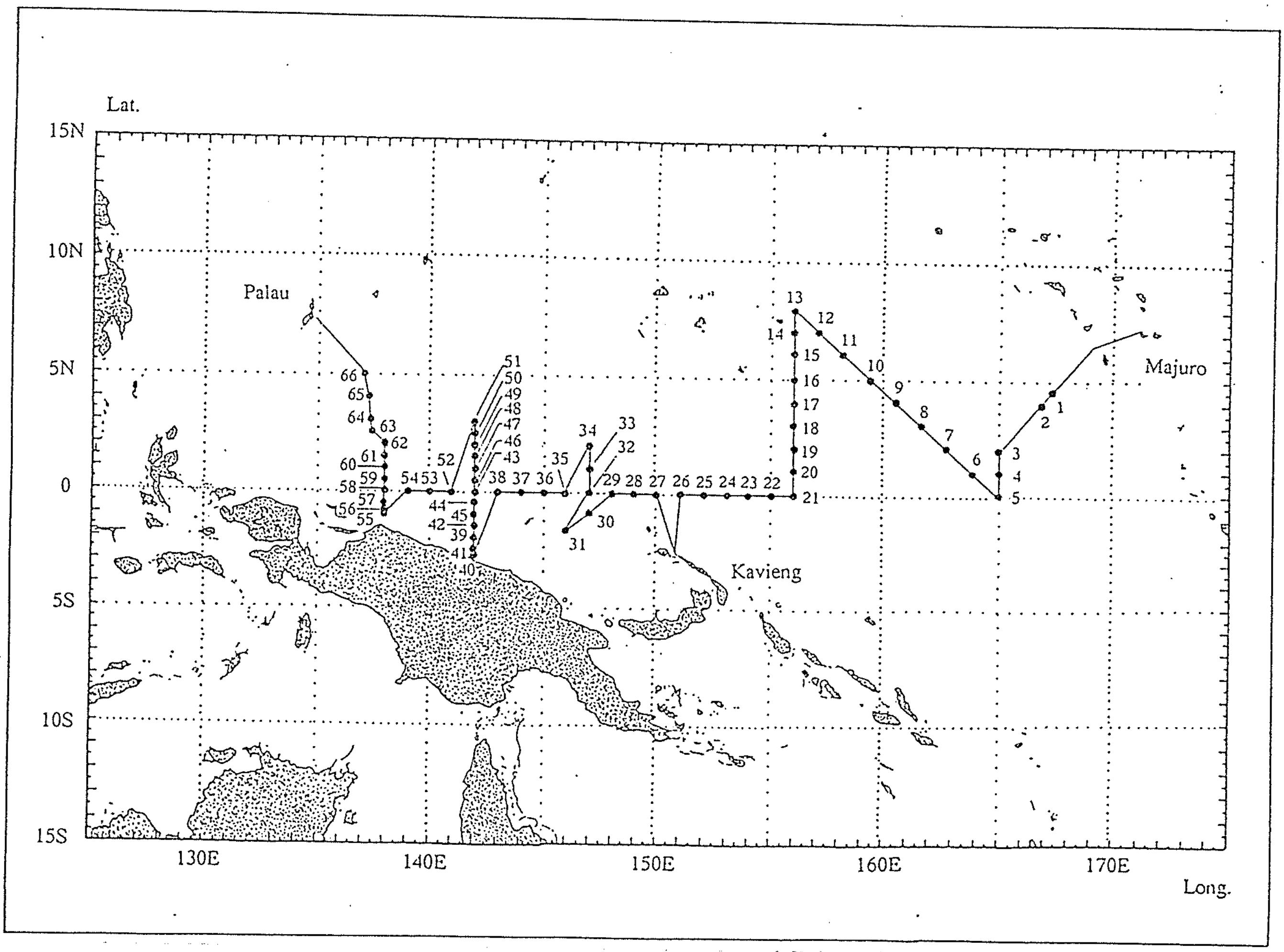
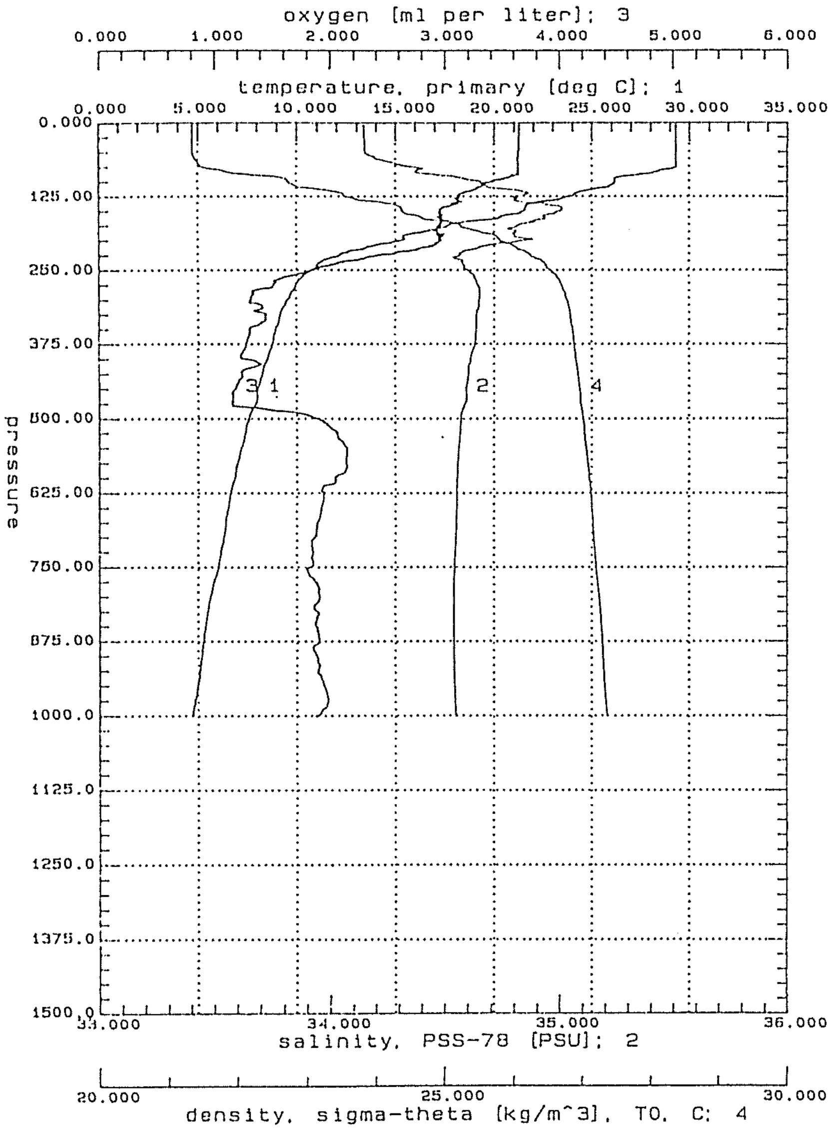


Fig. 4.1 CTD Sites

4.2 CTD Casts Table

No.	Time(GMT)	Latitude			Longitude		
C01	24-Jan-96 22:28	4°	41.927′	N	167°	36.657′	E
C02	25-Jan-96 04:06	4°	02.528′	N	166°	59.662′	E
C03	27-Jan-96 23:48	1°	58.553′	N	164°	58.372′	E
C04	28-Jan-96 06:44	1°	00.150′	N	164°	59.873′	E
C05	30-Jan-96 00:40	0°	00.048′	N	164°	59.081′	E
C06	30-Jan-96 08:22	1°	00.001′	N	163°	52.906′	E
C07	30-Jan-96 16:45	1°	59.518′	N	162°	46.878′	E
C08	31-Jan-96 00:57	2°	59.861′	N	161°	39.664′	E
C09	31-Jan-96 09:00	3°	59.679′	N	160°	33.468′	E
C10	31-Jan-96 17:30	4°	59.622′	N	159°	26.406′	E
C11	01-Feb-96 02:20	5°	59.365′	N	158°	17.879′	E
C12	01-Feb-96 10:47	6°	59.904′	N	157°	12.026′	E
C13	02-Feb-96 00:30	7°	59.890′	N	156°	00.642′	E
C14	02-Feb-96 06:37	7°	00.108′	N	155°	59.956′	E
C15	02-Feb-96 12:40	6°	00.156′	N	156°	00.299′	E
C16	02-Feb-96 18:41	5°	00.040′	N	156°	00.046′	E
C17	03-Feb-96 02:30	4°	00.400′	N	155°	59.150′	E
C18	03-Feb-96 09:25	3°	00.239′	N	155°	59.755′	E
C19	03-Feb-96 22:15	2°	00.283′	N	156°	04.720′	E
C20	04-Feb-96 07:32	0°	59.927′	N	155°	59.874′	E
C21	04-Feb-96 20:03	0°	00.360′	S	156°	07.350′	E
C22	05-Feb-96 04:25	0°	00.253′	S	154°	59.389′	E
C23	05-Feb-96 09:59	0°	00.023′	S	154°	00.006′	E
C24	05-Feb-96 15:40	0°	00.359′	S	152°	59.294′	E
C25	05-Feb-96 21:45	0°	00.482′	S	151°	59.730′	E
C26	06-Feb-96 03:40	0°	00.746′	S	150°	59.744′	E
C27	09-Feb-96 13:30	0°	00.323′	S	150°	00.072′	E
C28	09-Feb-96 19:05	0°	00.028′	N	148°	59.903′	E
C29	10-Feb-96 00:38	0°	00.004′	N	148°	00.071′	E
C30	10-Feb-96 08:50	1°	00.051′	S	147°	02.951′	E
C31	11-Feb-96 05:21	1°	40.425′	S	146°	00.116′	E
C32	12-Feb-96 05:08	0°	00.001′	N	147°	00.811′	E
C33	13-Feb-96 08:15	0°	59.548′	N	146°	59.954′	E
C34	14-Feb-96 04:56	2°	00.036′	N	146°	59.368′	E
C35	14-Feb-96 16:57	0°	00.101′	S	145°	59.980′	E
C36	14-Feb-96 22:40	0°	00.301′	N	145°	00.541′	E
C37	15-Feb-96 04:31	0°	00.016′	N	144°	00.607′	E
C38	15-Feb-96 10:30	0°	00.157′	S	143°	00.394′	E
C39	15-Feb-96 23:05	2°	04.974′	S	142°	08.258′	E
C40	16-Feb-96 03:33	2°	40.001′	S	142°	01.006′	E
C41	16-Feb-96 05:18	2°	30.247′	S	141°	58.682′	E
C42	16-Feb-96 11:00	1°	30.498′	S	142°	00.296′	E
C43	17-Feb-96 03:53	0°	00.241′	S	142°	01.539′	E
C44	17-Feb-96 07:00	0°	29.768′	S	142°	00.336′	E
C45	17-Feb-96 10:10	0°	59.923′	S	142°	00.393′	E
C46	17-Feb-96 18:33	0°	29.950′	N	141°	59.941′	E
C47	17-Feb-96 21:46	0°	59.643′	N	141°	59.970′	E

C48	18-Feb-96 00:21	1°	29.580′	N	141°	59.795′	E
C49	18-Feb-96 04:57	2°	00.064′	N	142°	00.034′	E
C50	18-Feb-96 08:05	2°	30.016′	N	141°	59.994′	E
C51	18-Feb-96 11:17	2°	59.835′	N	141°	59.809′	E
C52	19-Feb-96 06:20	0°	00.011′	S	141°	00.372′	E
C53	19-Feb-96 13:41	0°	00.131′	N	140°	00.326′	E
C54	19-Feb-96 21:20	0°	00.069′	S	139°	00.217′	E
C55	20-Feb-96 06:57	1°	00.075′	S	138°	00.118′	E
C56	20-Feb-96 09:15	0°	44.926′	S	137°	59.940′	E
C57	20-Feb-96 11:42	0°	30.292′	S	137°	59.951′	E
C58	20-Feb-96 15:46	0°	00.006′	S	138°	04.425′	E
C59	20-Feb-96 19:48	0°	29.953′	N	138°	00.040′	E
C60	20-Feb-96 23:45	0°	59.808′	N	137°	59.941′	E
C61	21-Feb-96 03:43	1°	30.022′	N	138°	00.199′	E
C62	21-Feb-96 07:34	1°	59.945′	N	137°	59.834′	E
C63	22-Feb-96 01:40	2°	26.488′	N	137°	23.538′	E
C64	22-Feb-96 06:16	2°	59.822′	N	137°	19.000′	E
C65	22-Feb-96 12:30	3°	59.790′	N	137°	10.165′	E
C66	23-Feb-96 02:10	4°	59.027′	N	137°	59.477′	E
AT1	27-Jan-96 01:41	2°	00.442′	N	165°	01.290′	E
AT2	28-Jan-96 19:07	0°	00.371′	N	164°	59.363′	E
SAL	03-Feb-96 23:40	2°	00.278′	N	156°	04.687′	E



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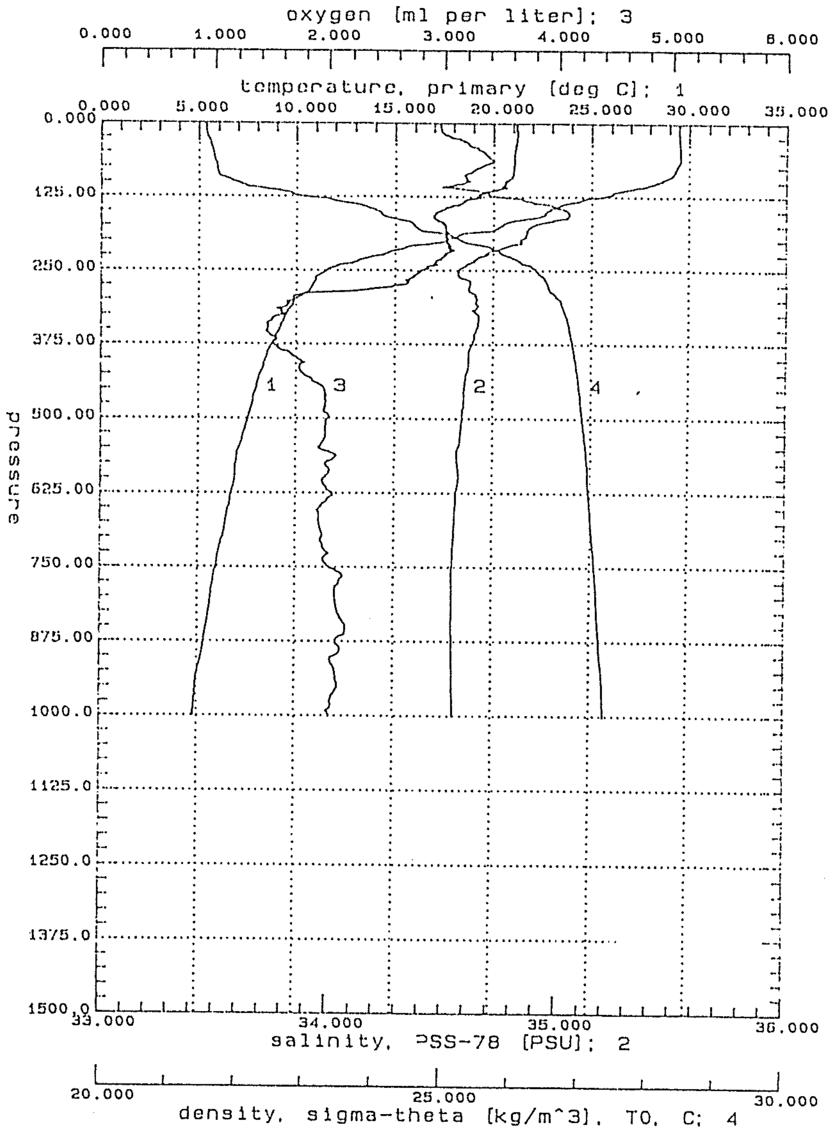

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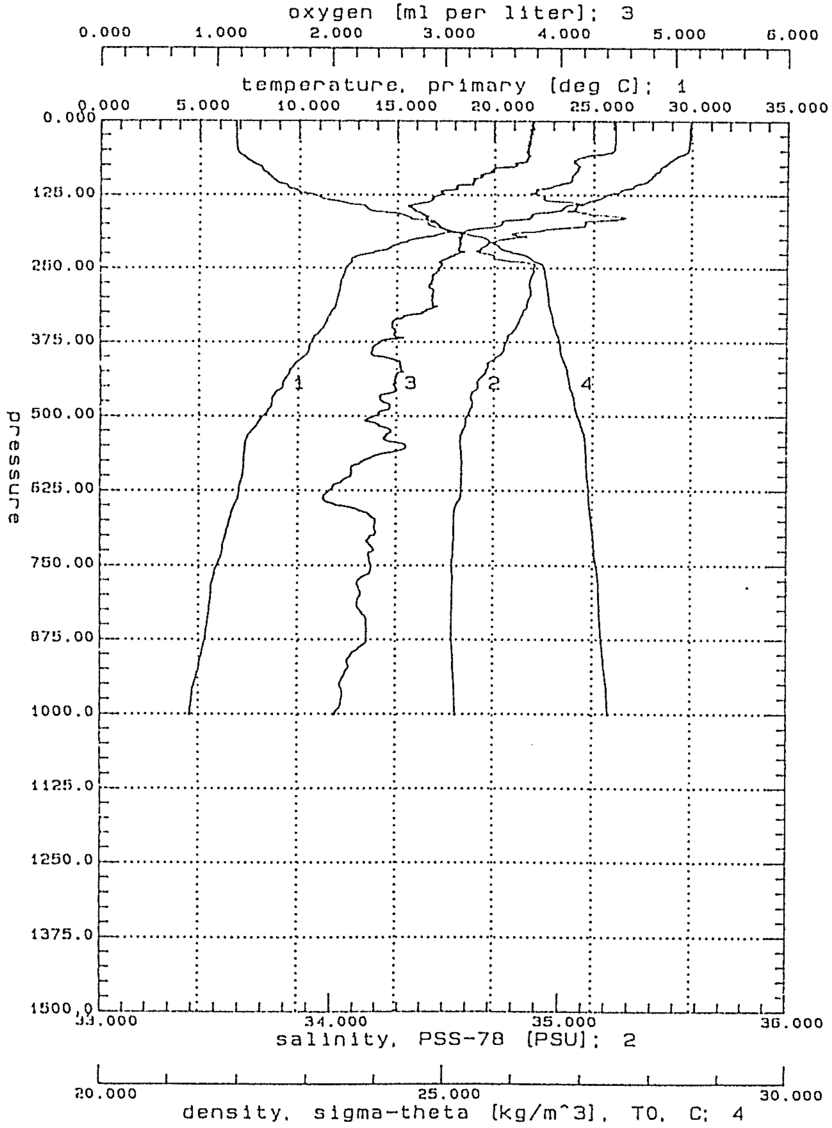

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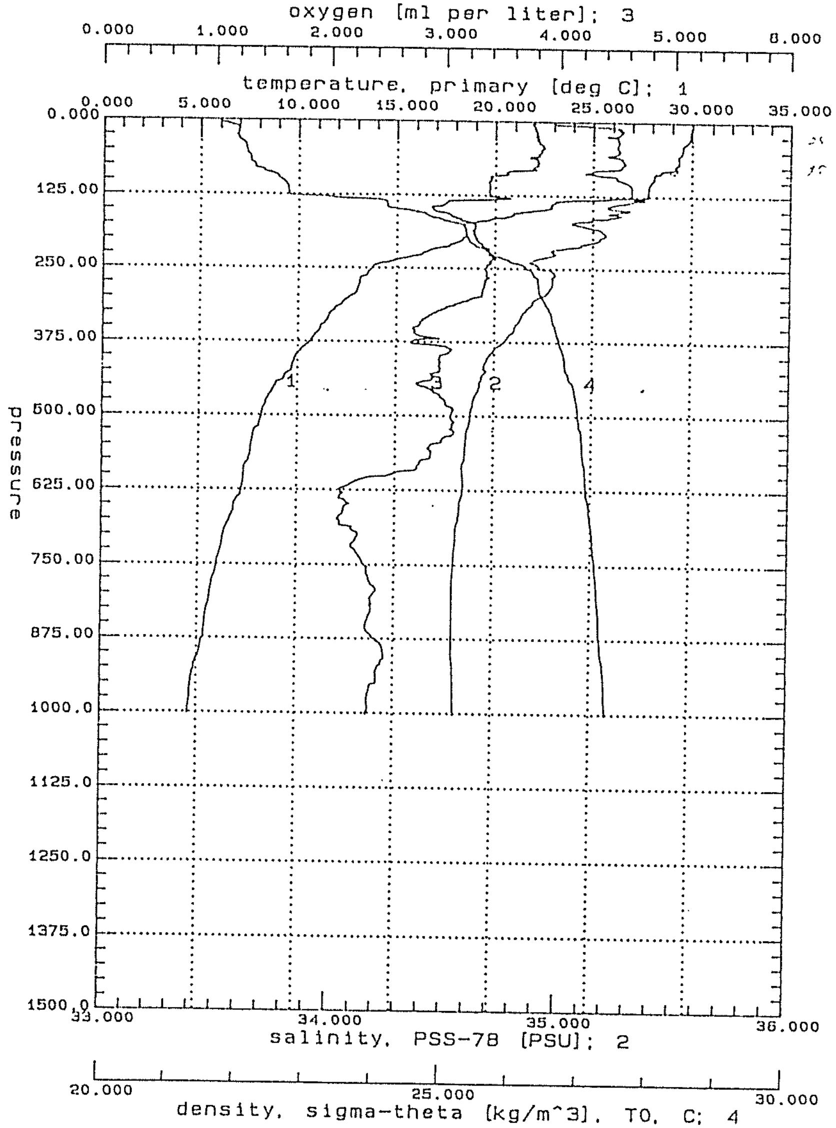

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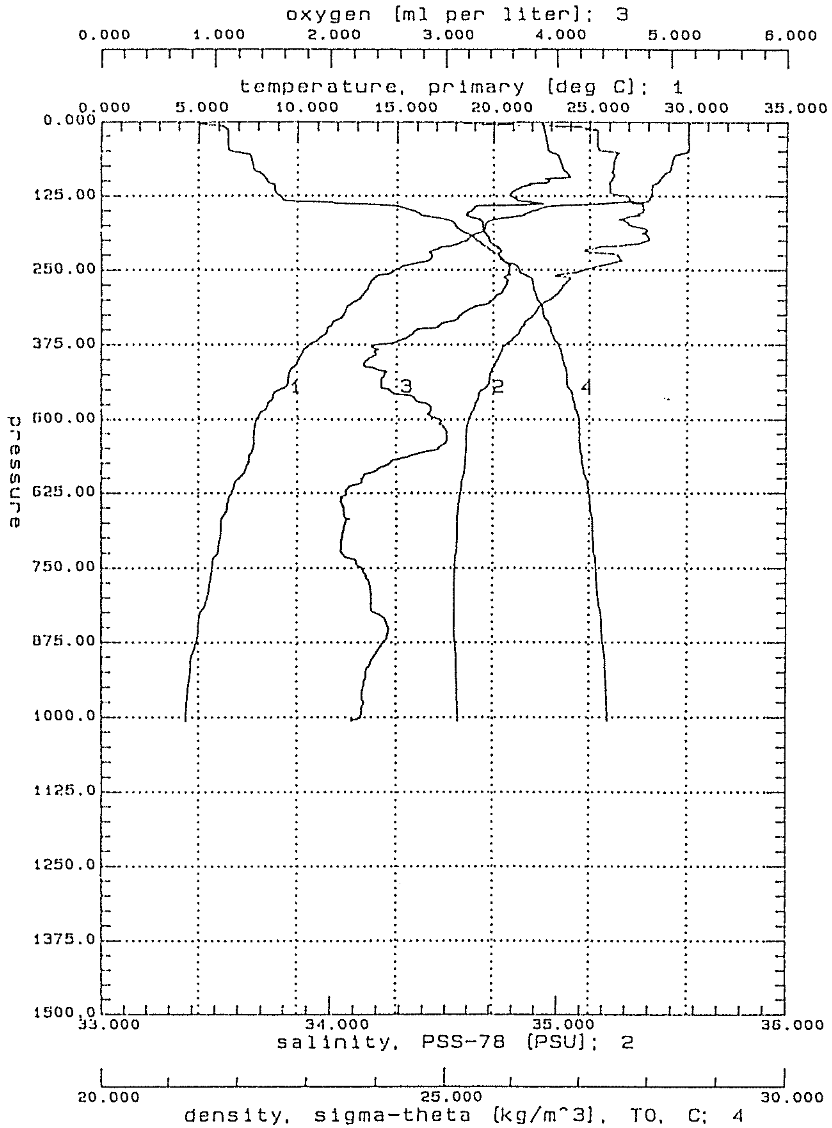

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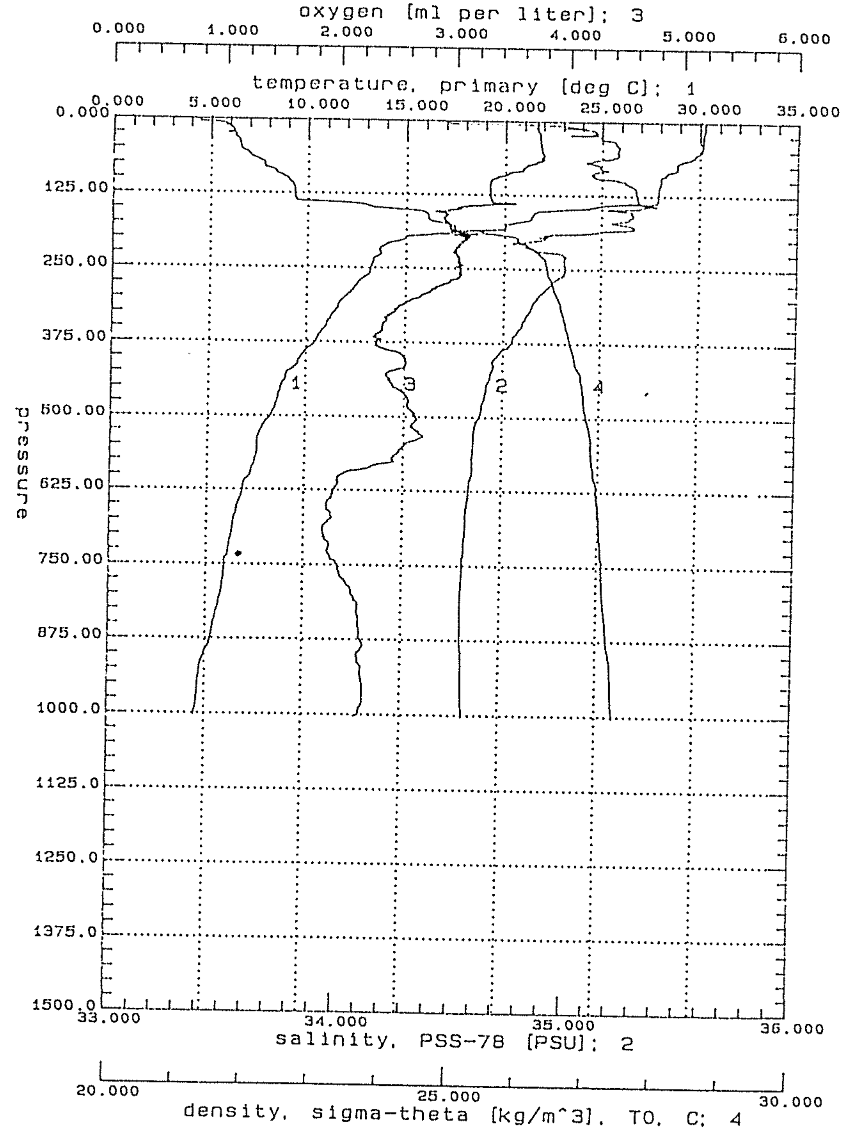

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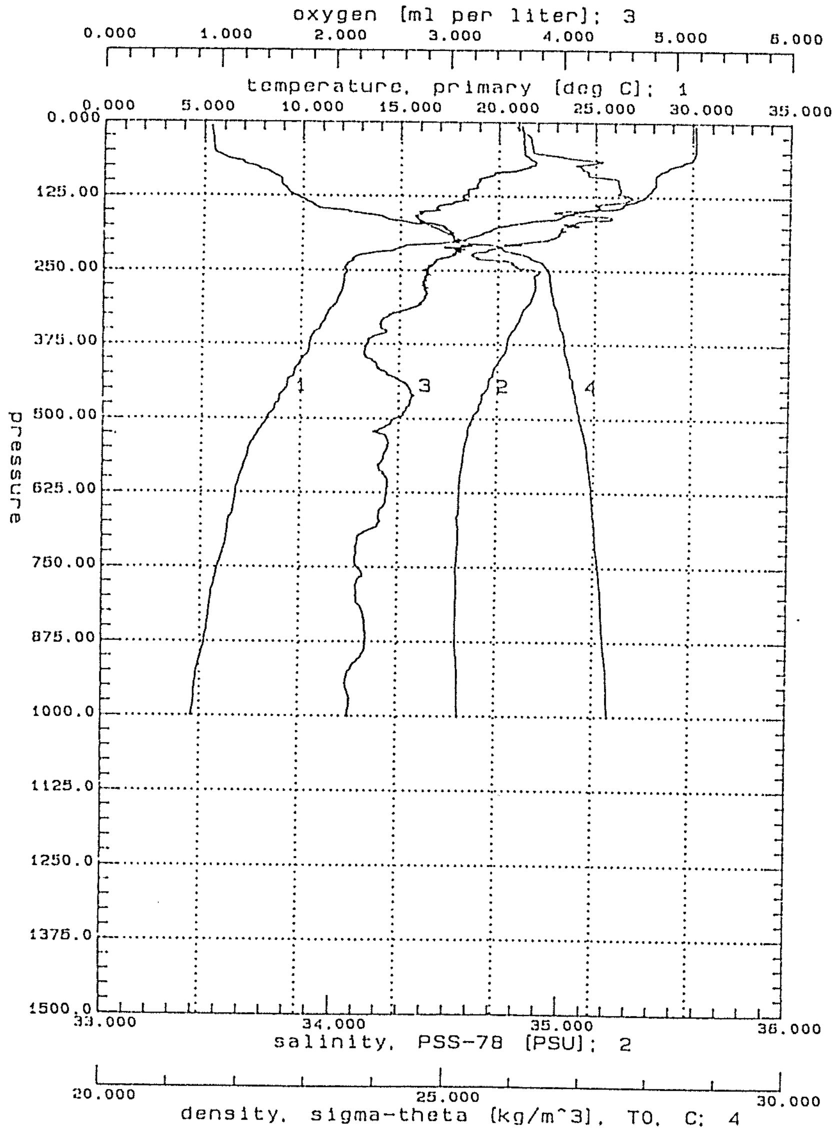

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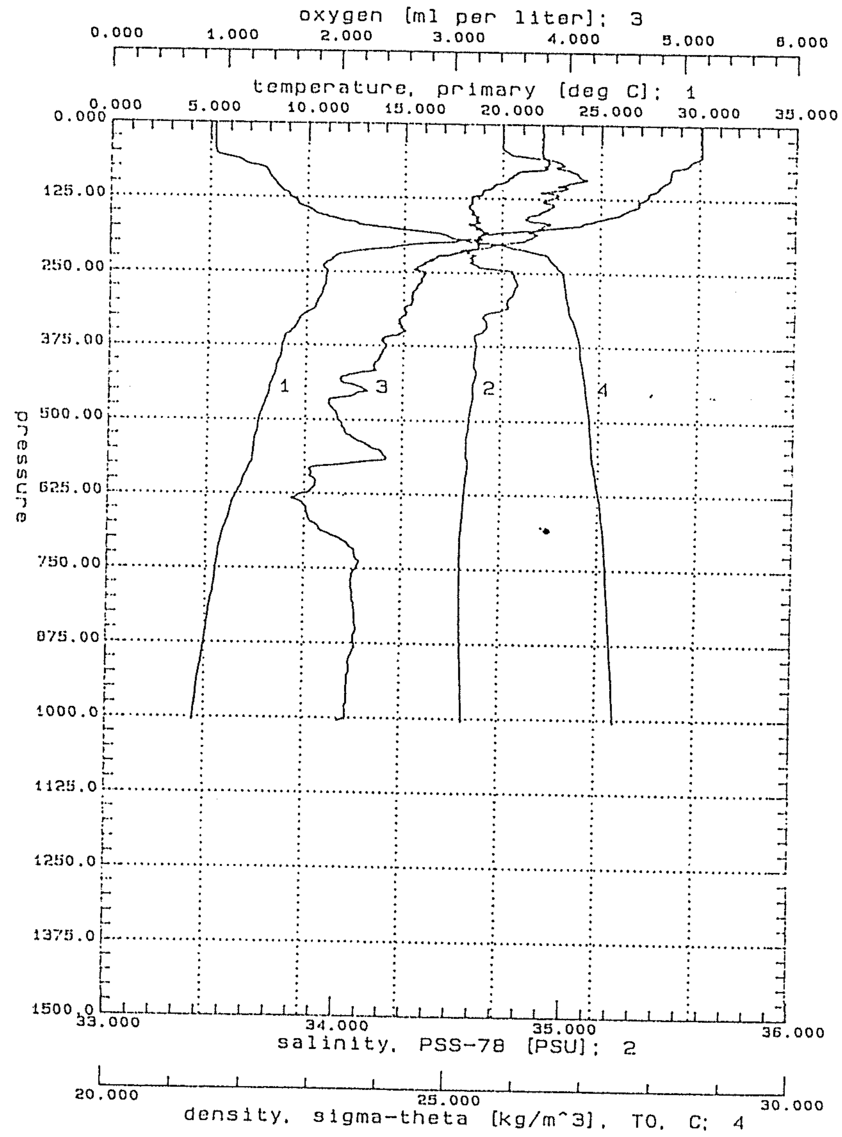

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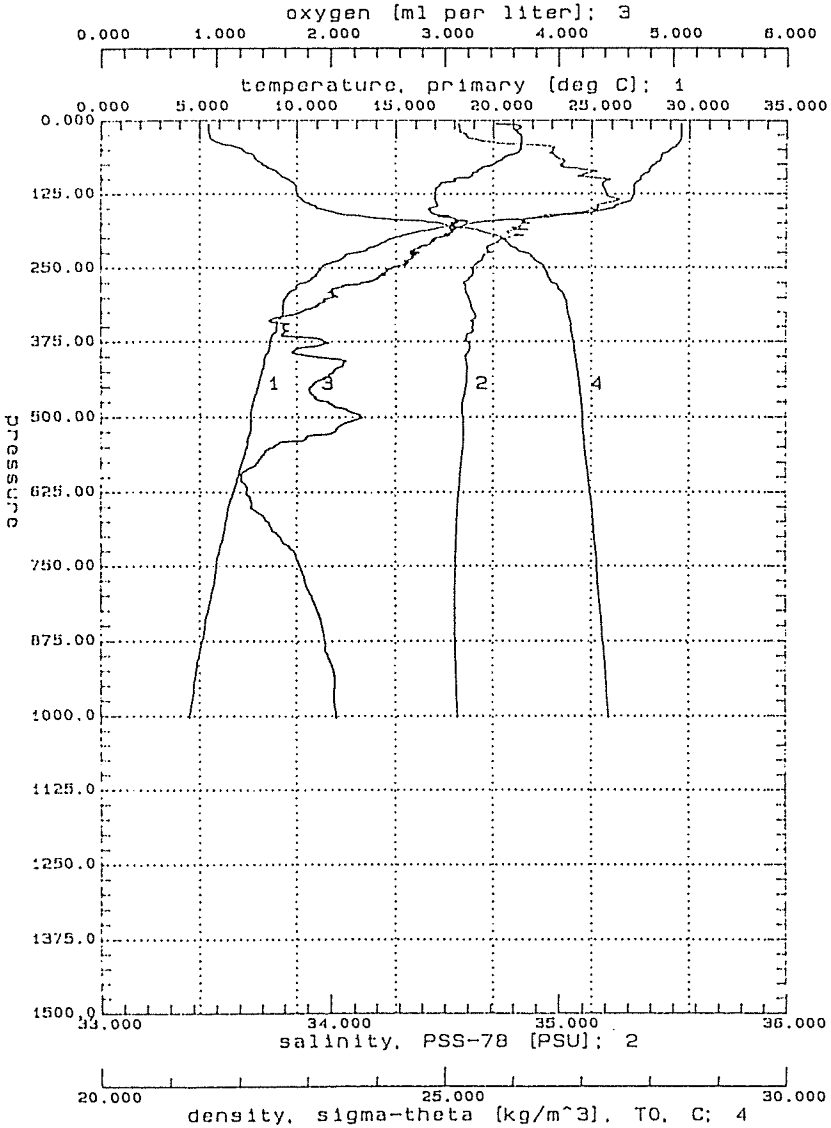

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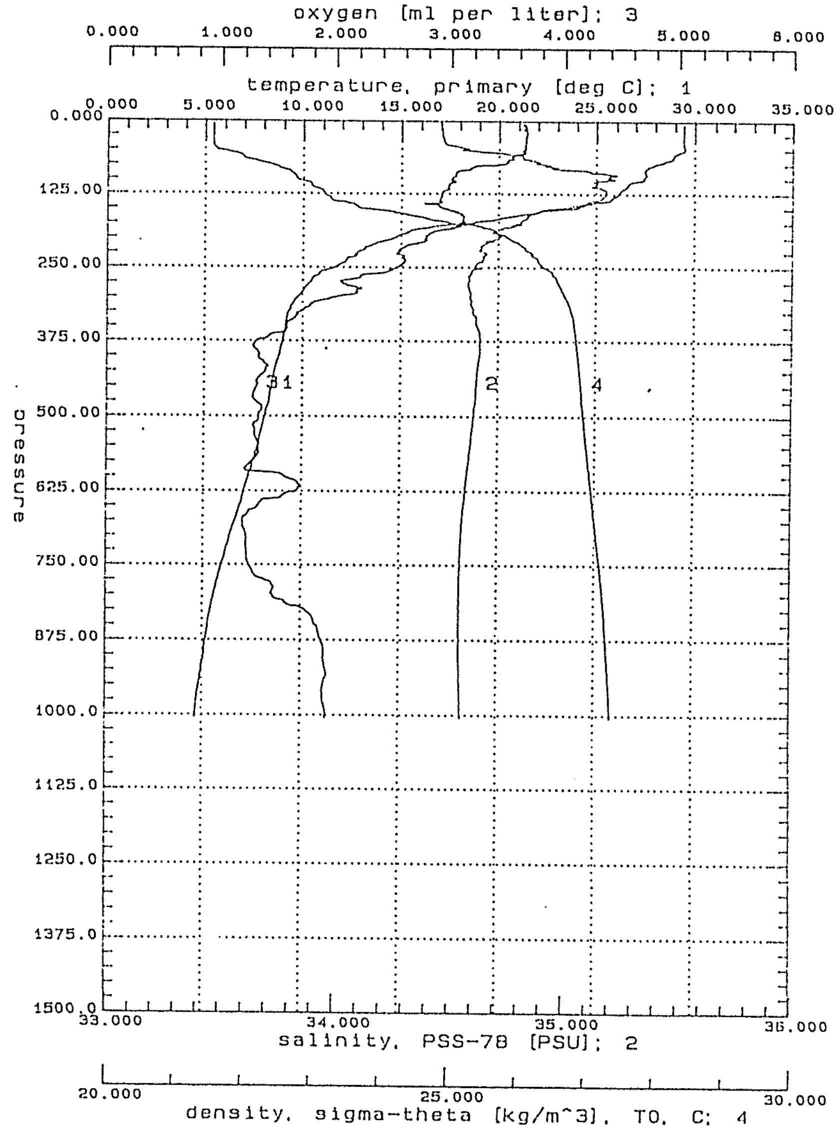

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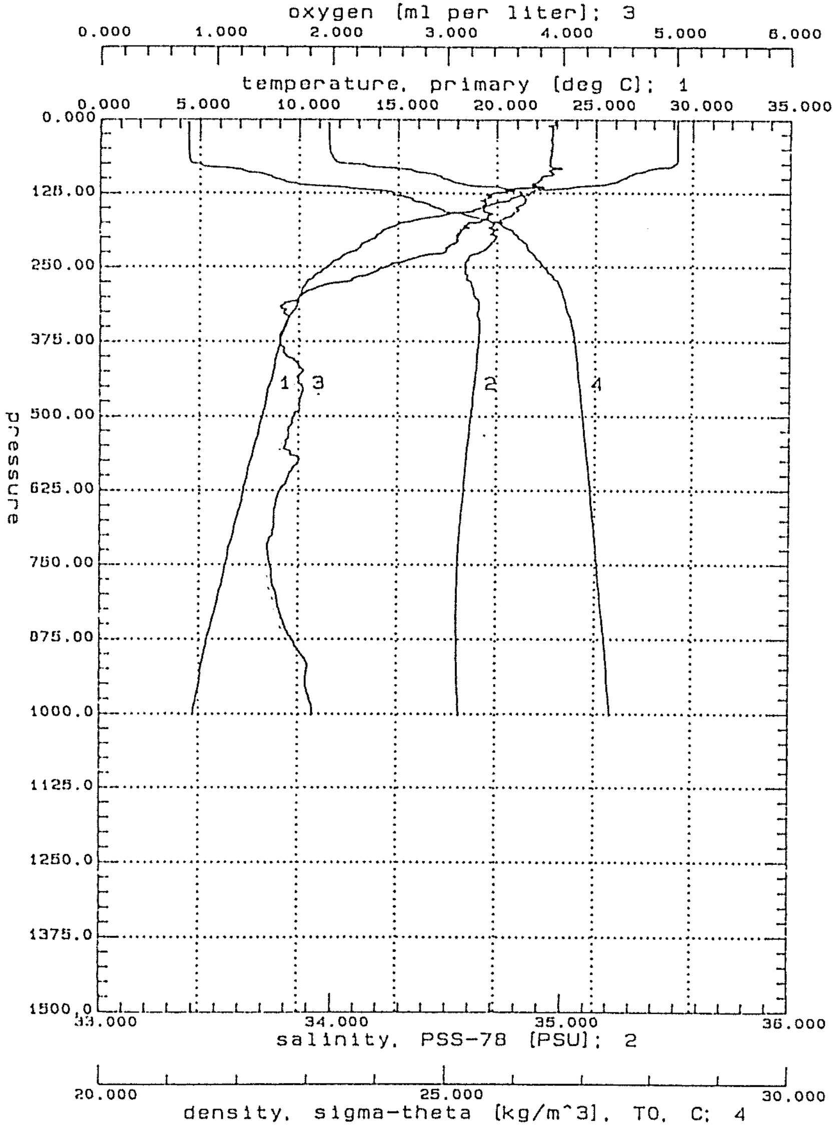

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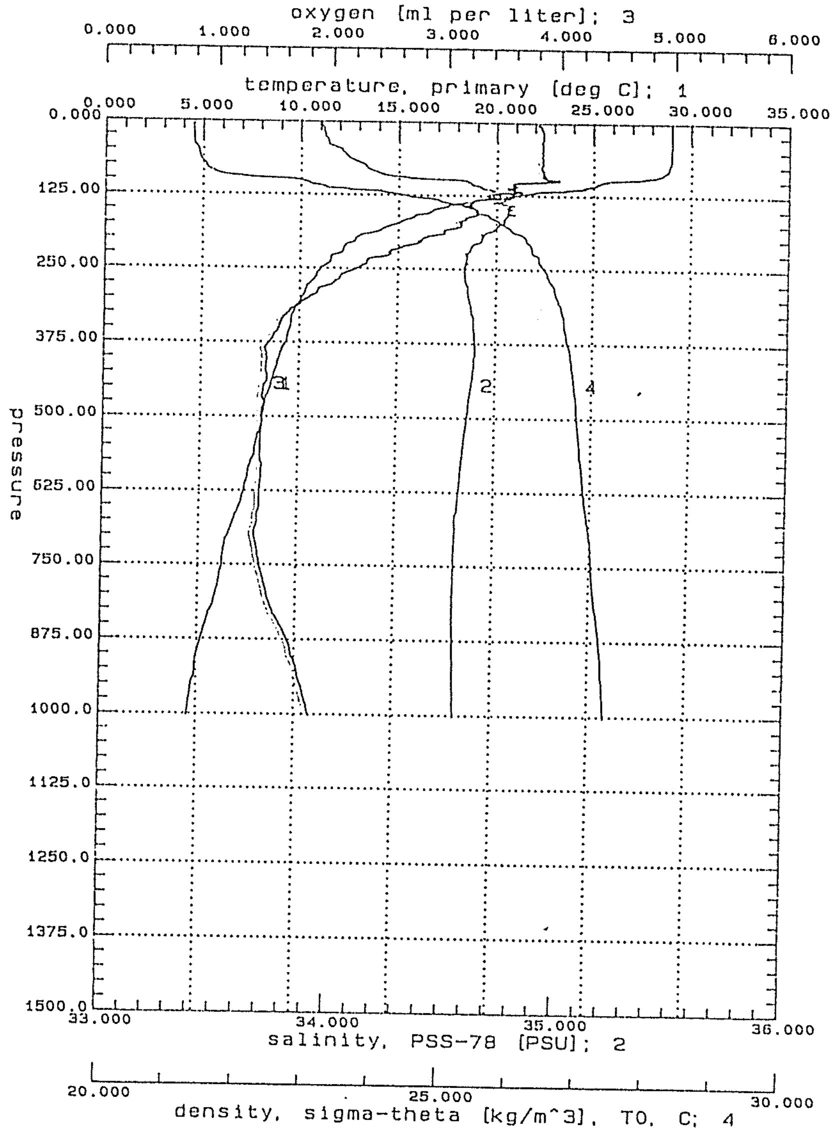

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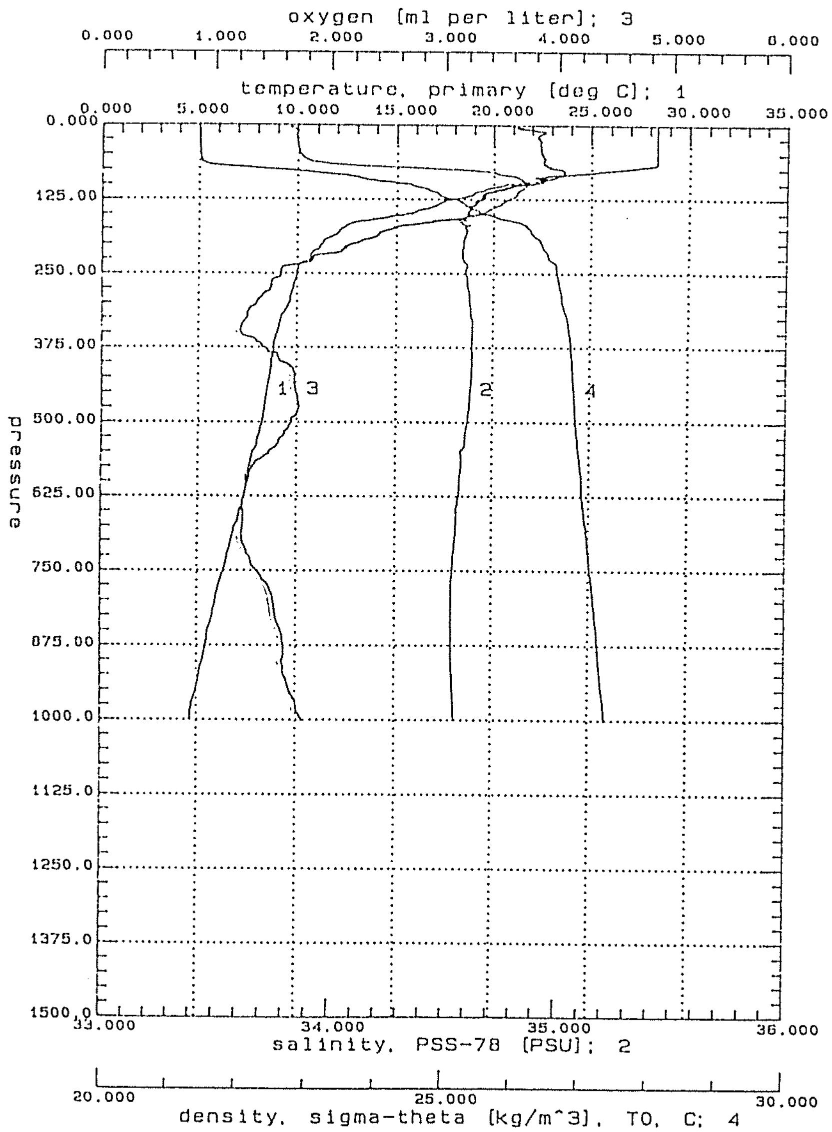

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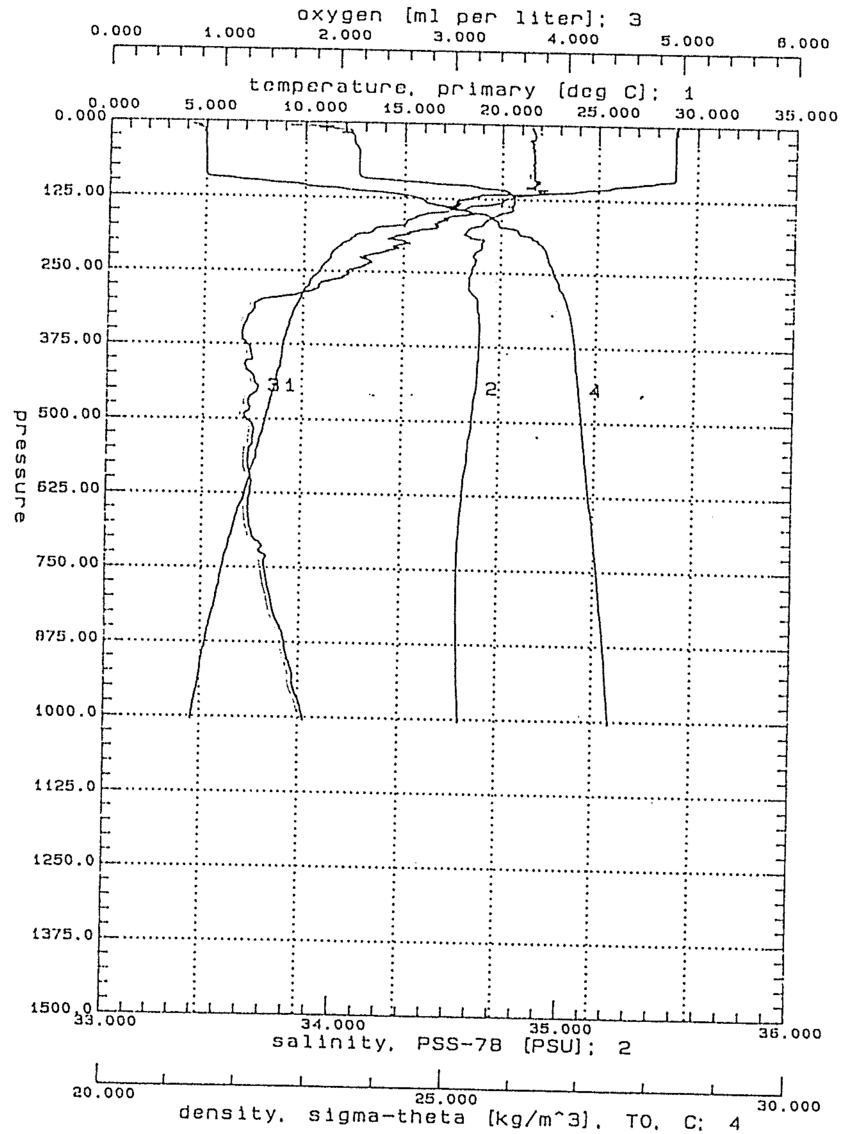

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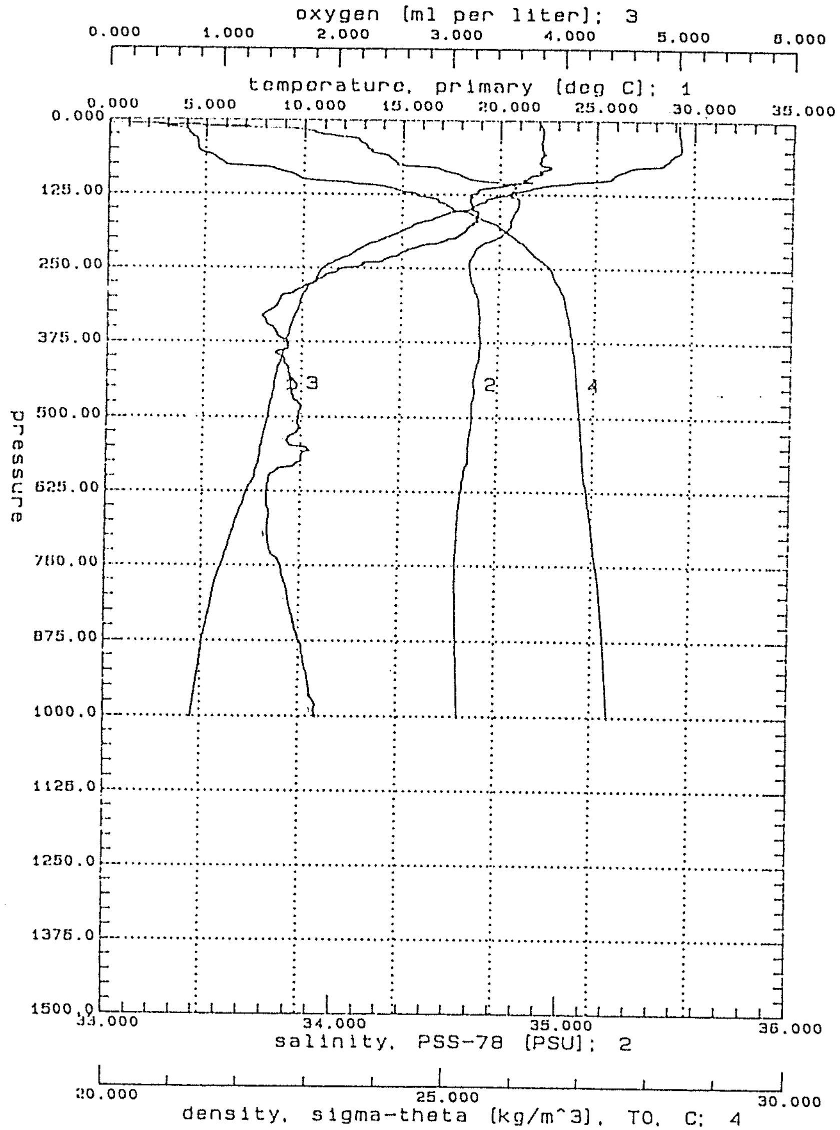

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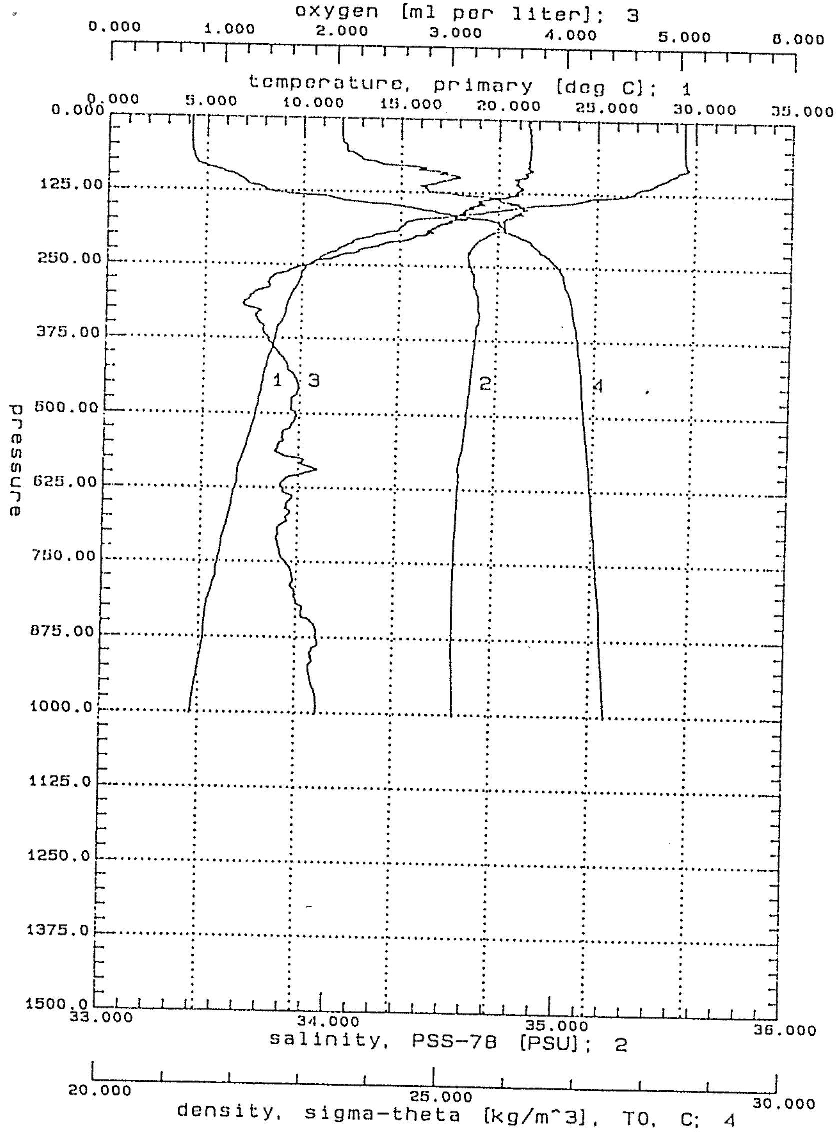

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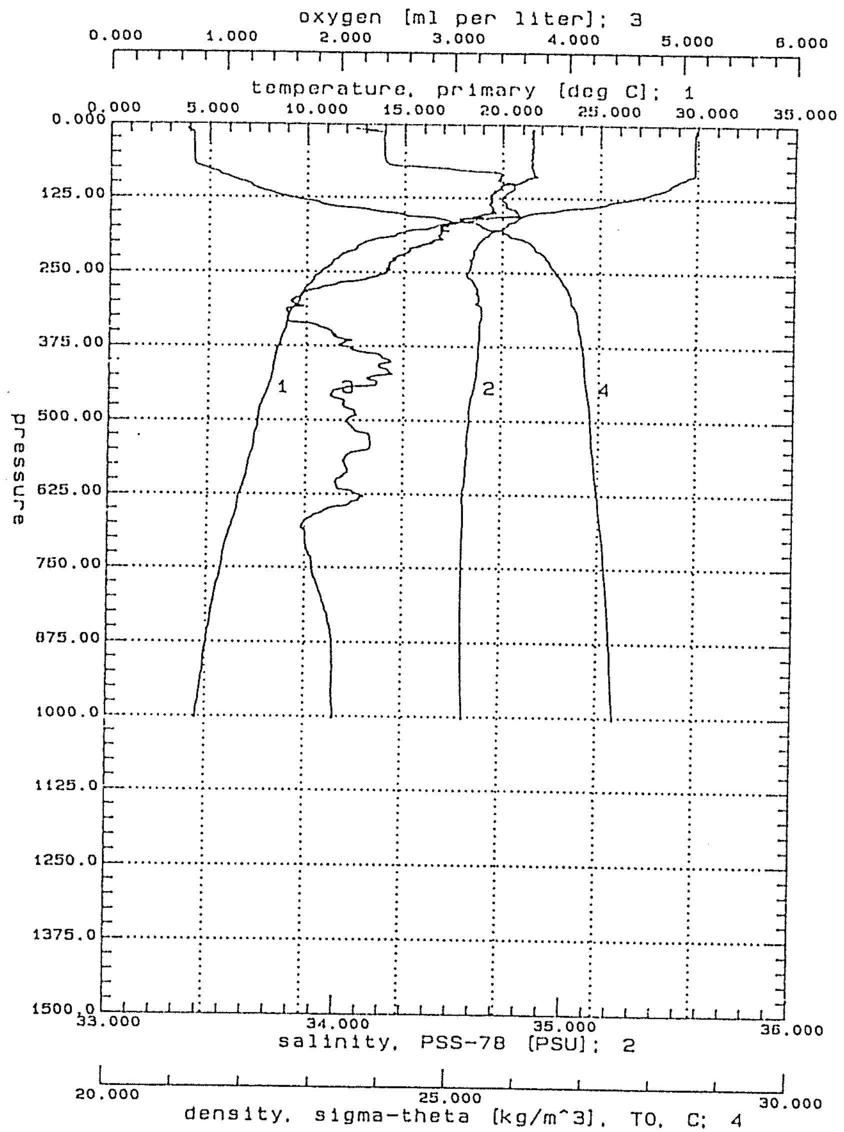

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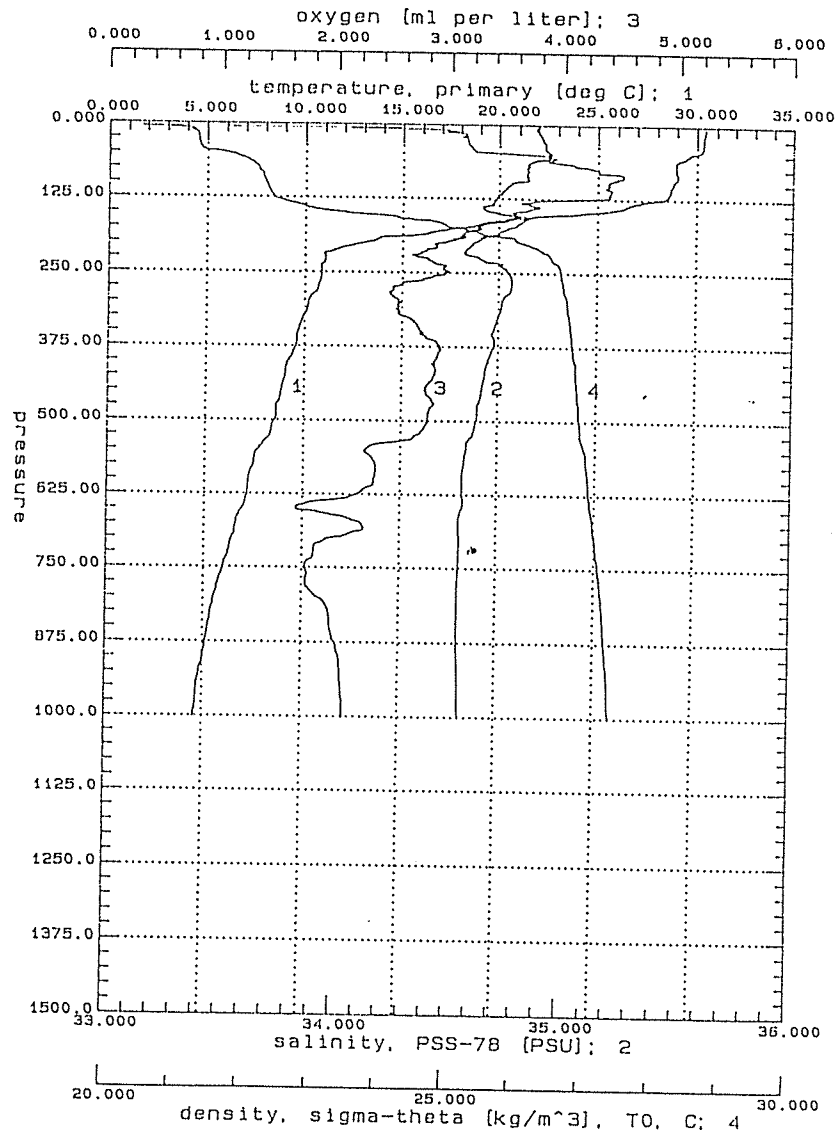

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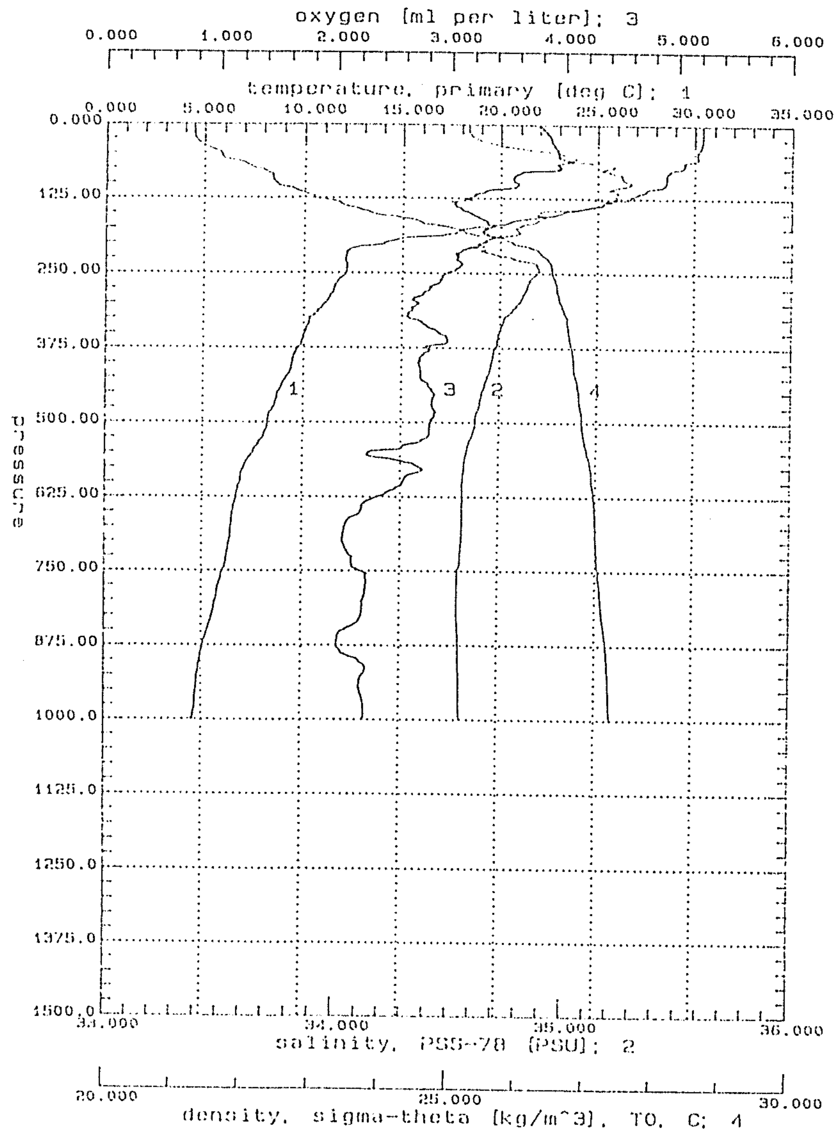

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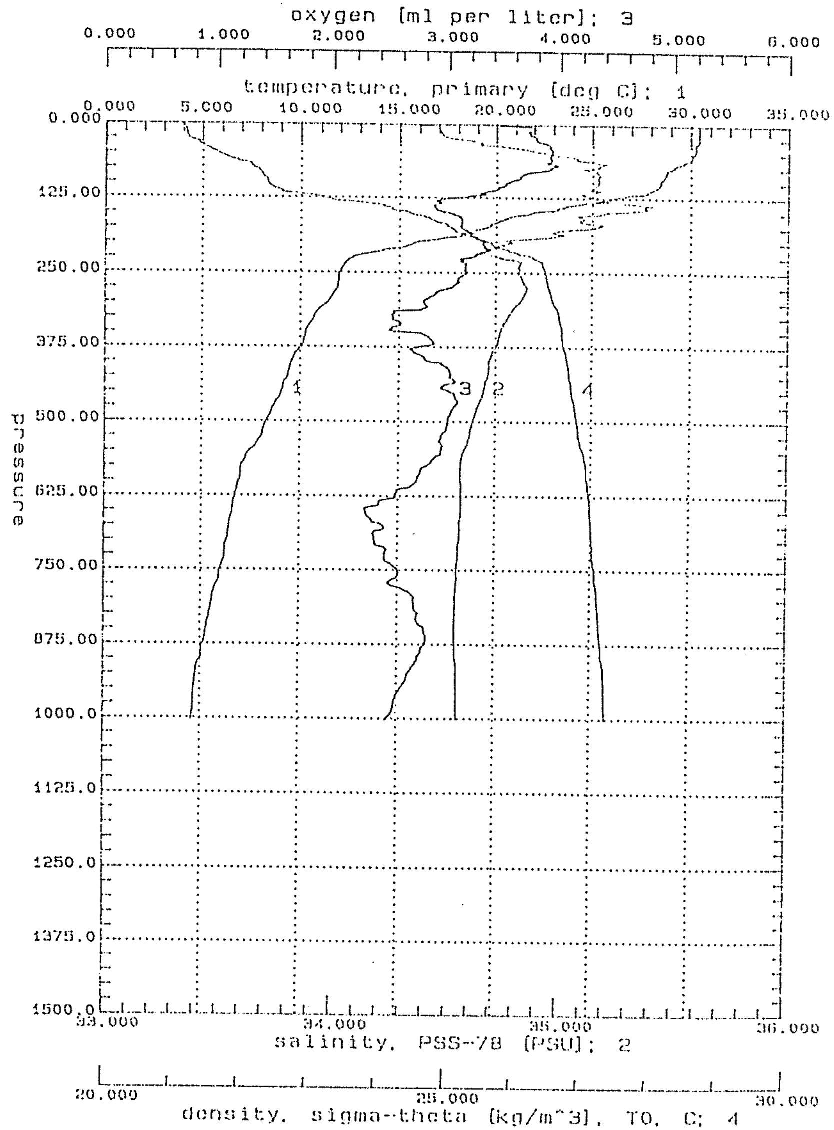

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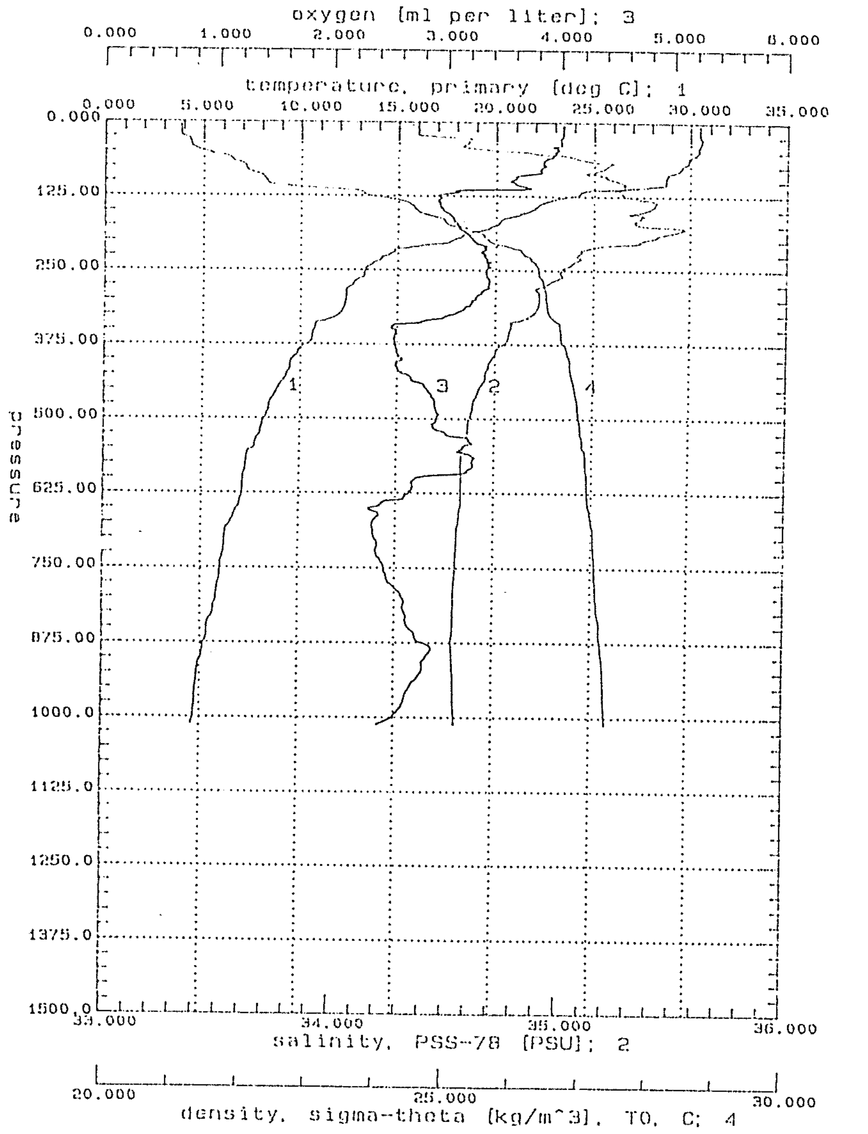

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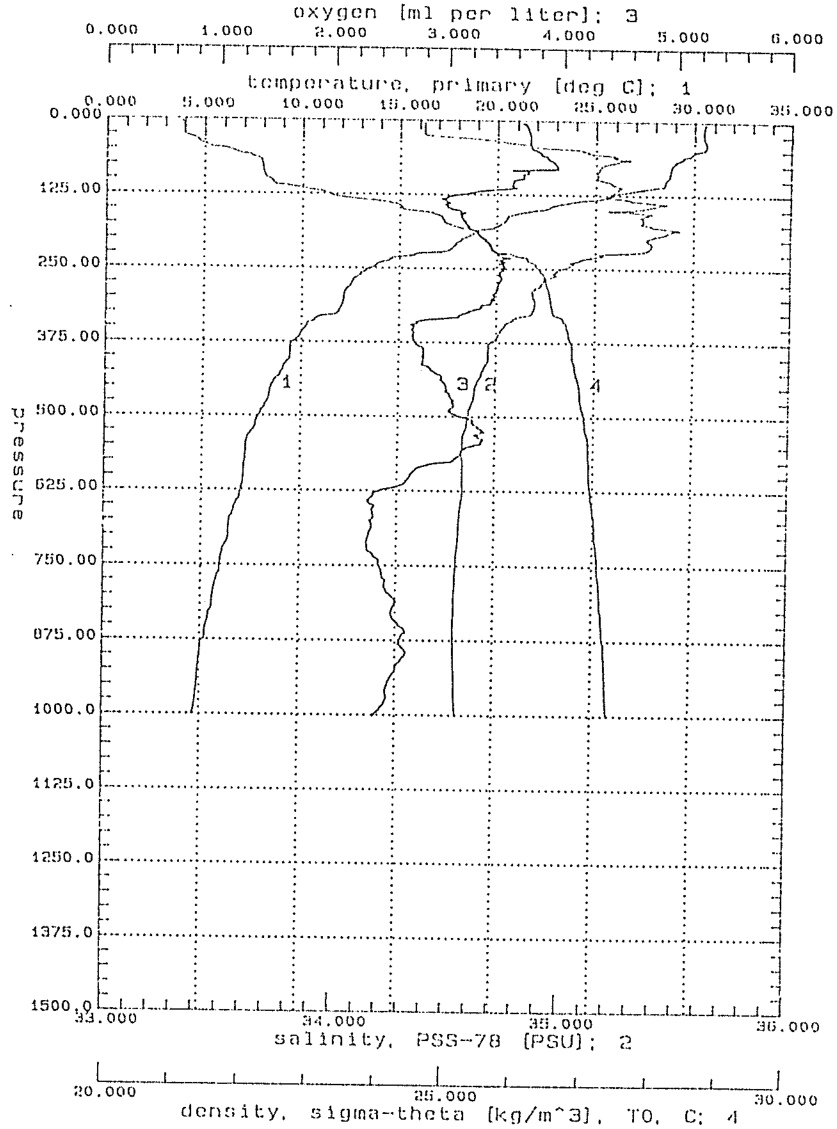

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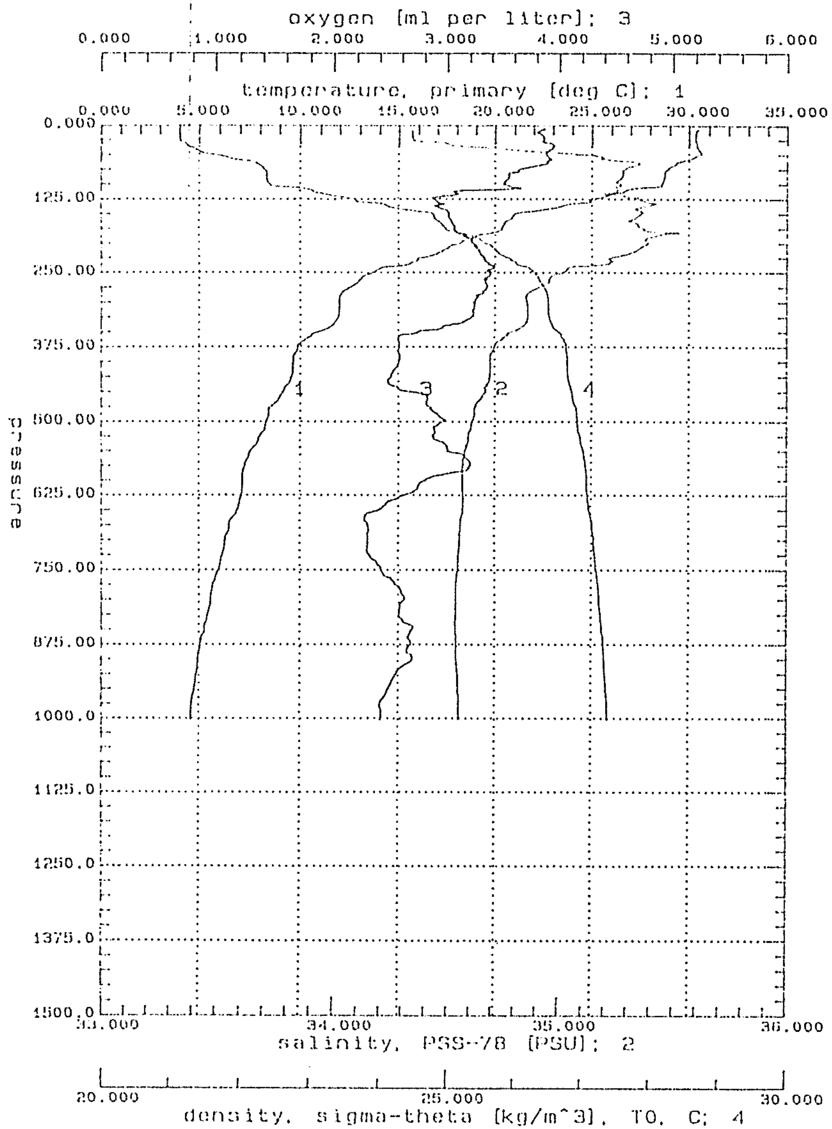

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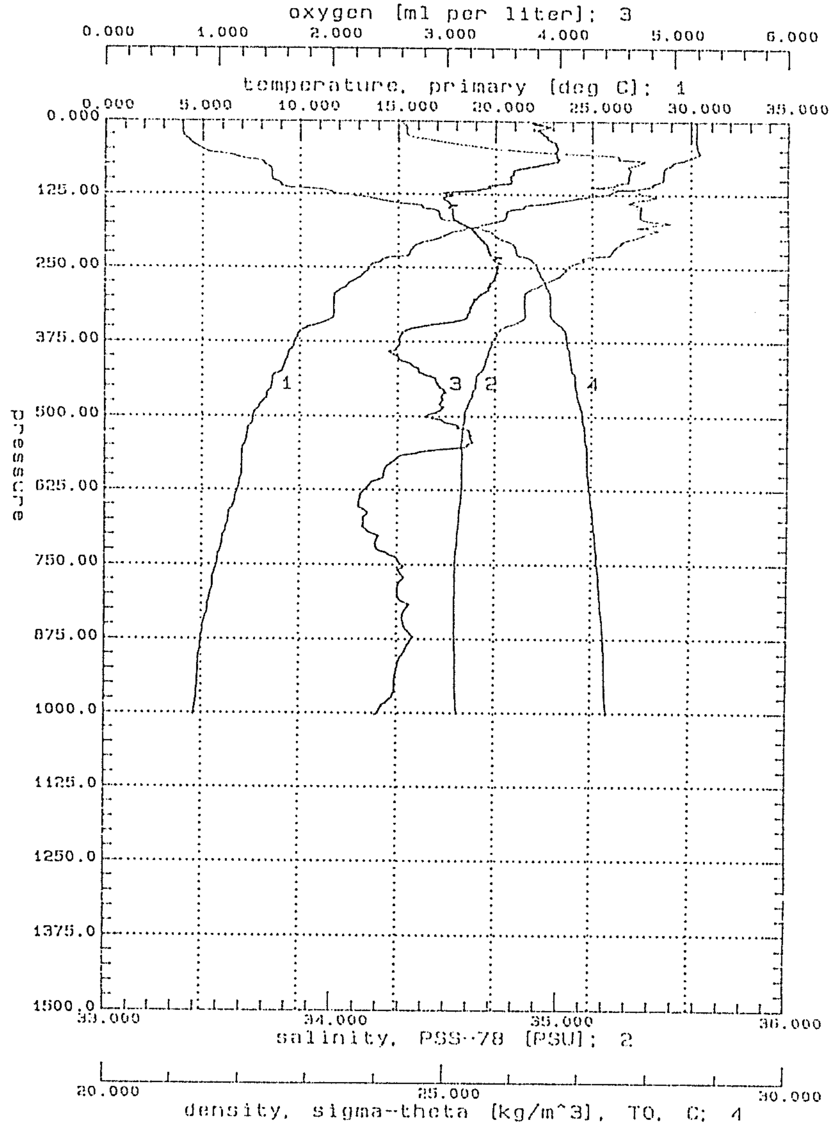

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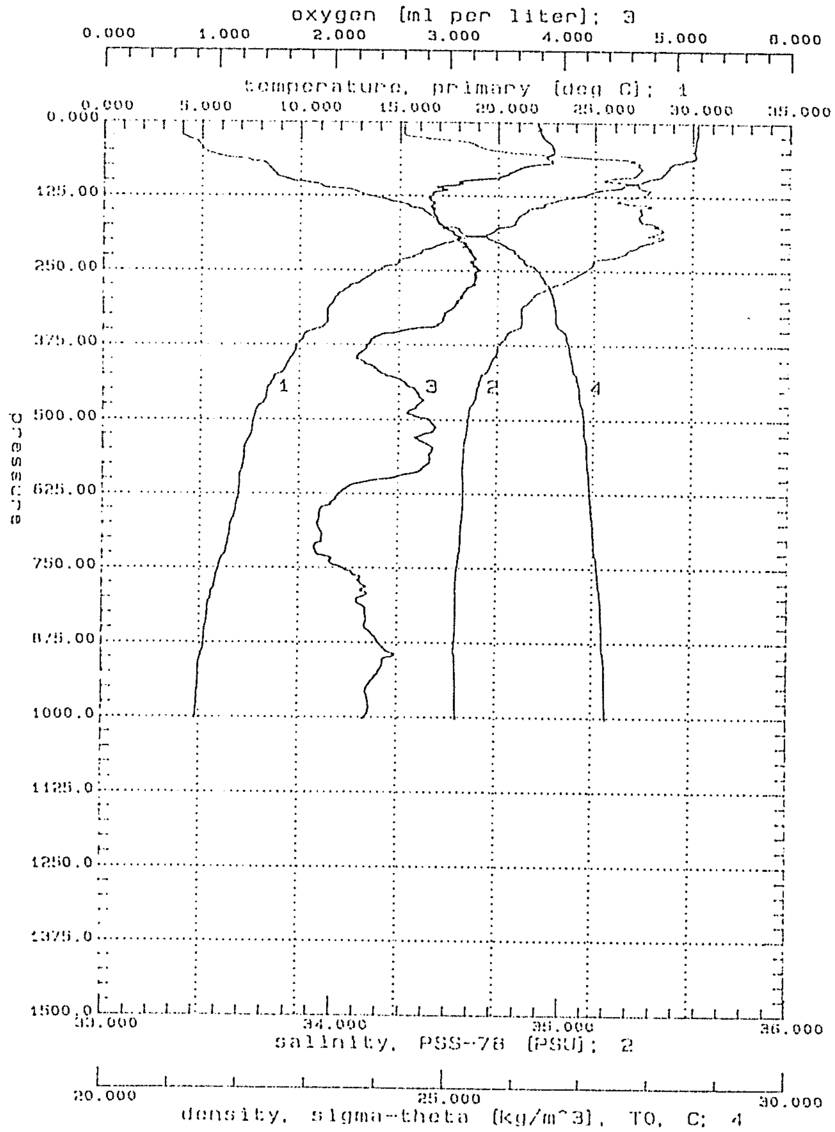

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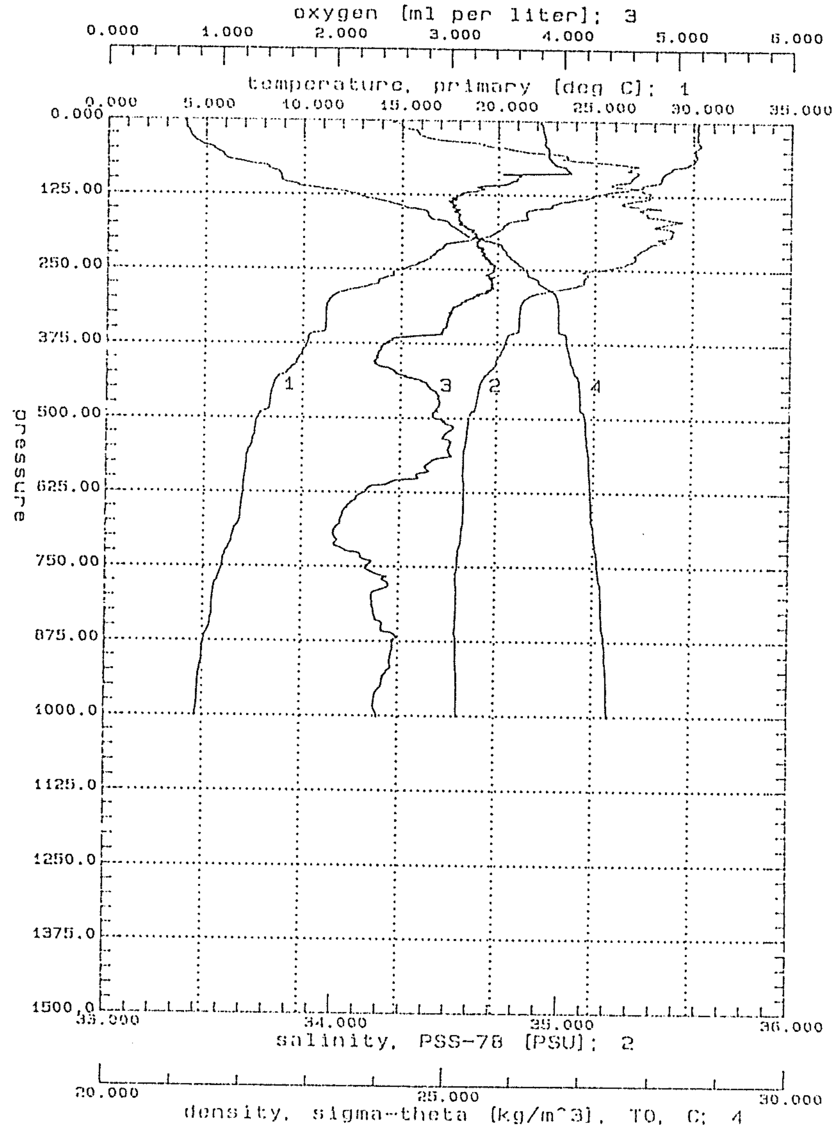

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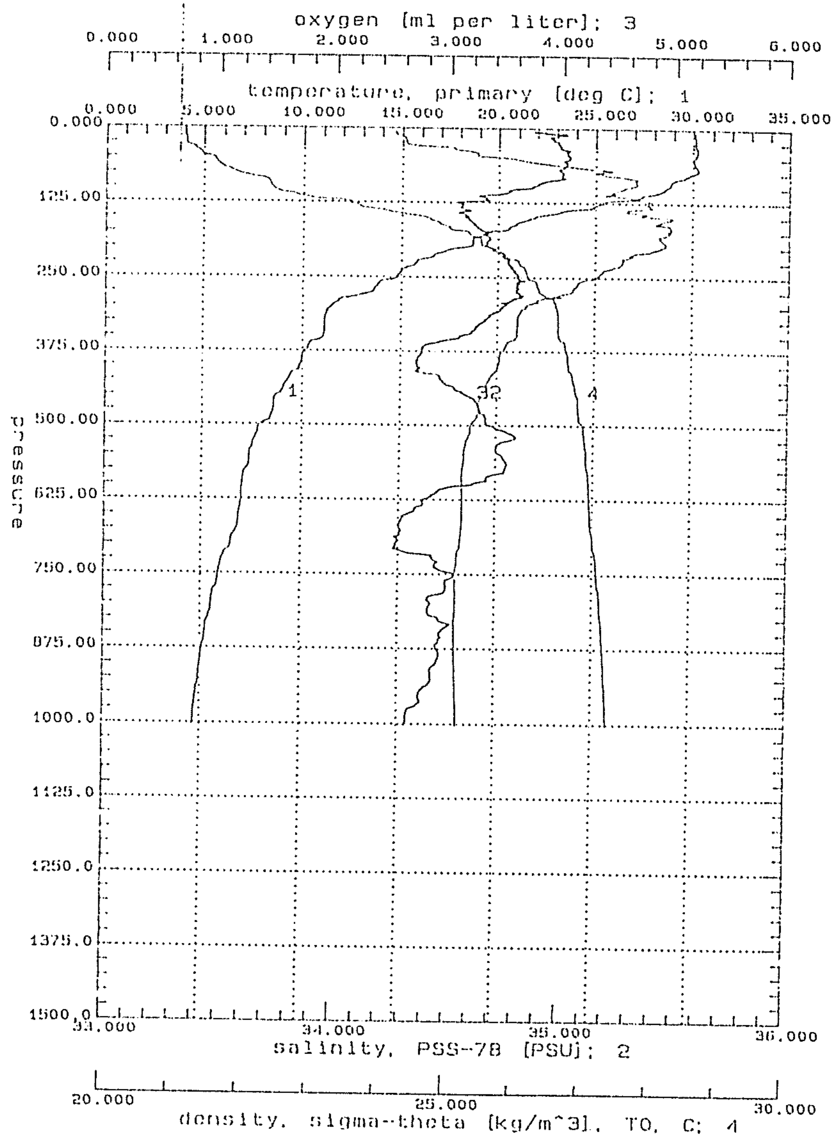

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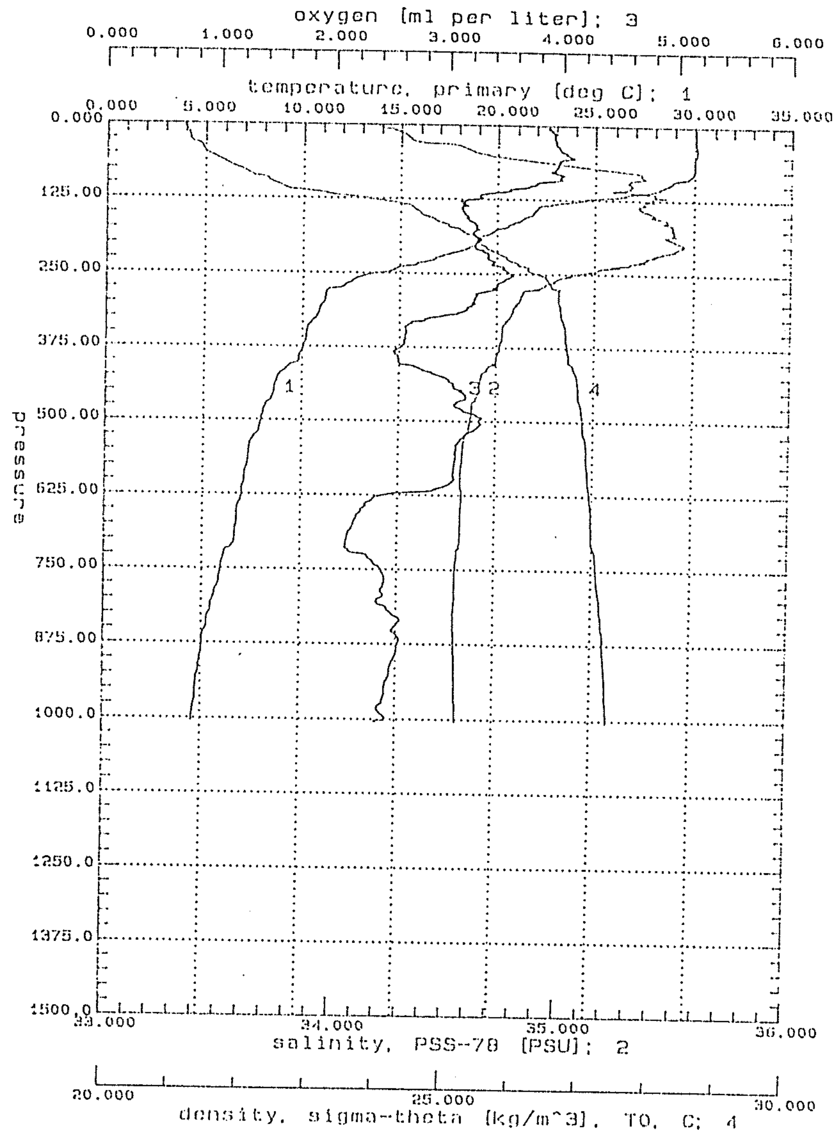

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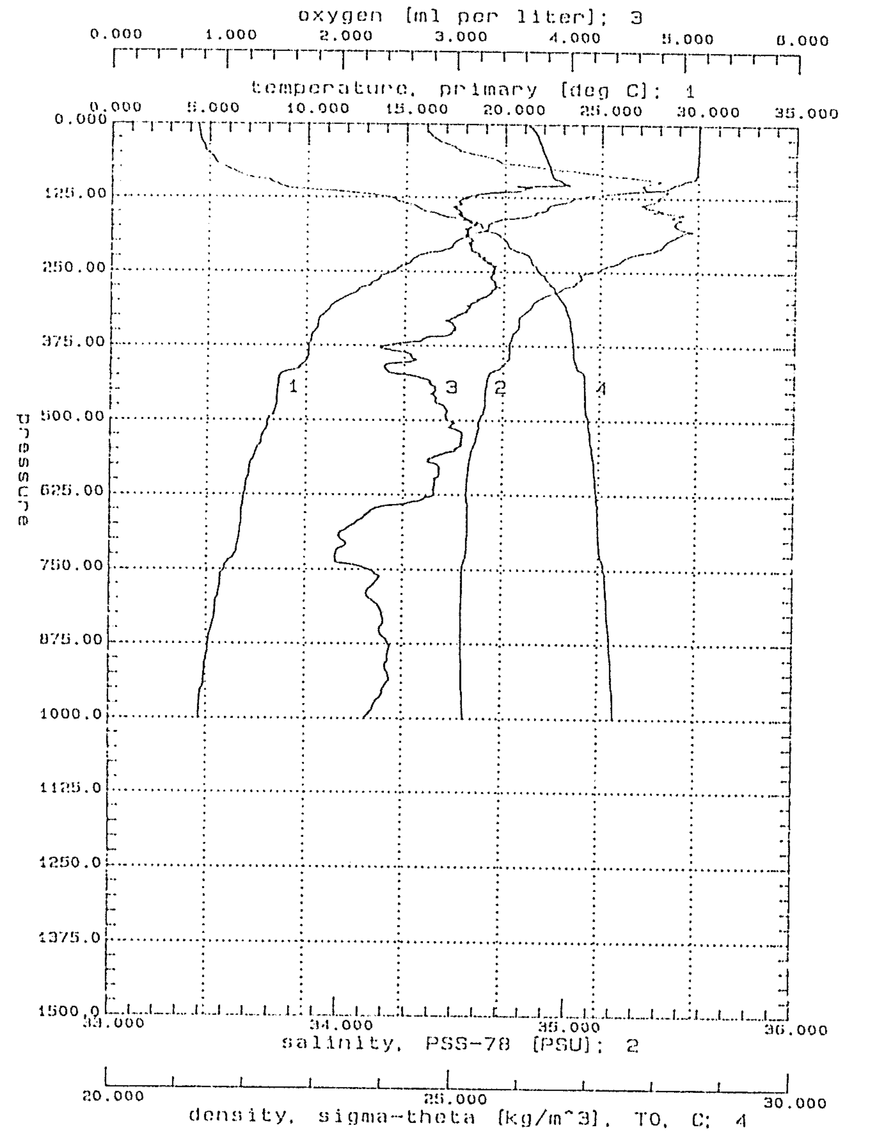

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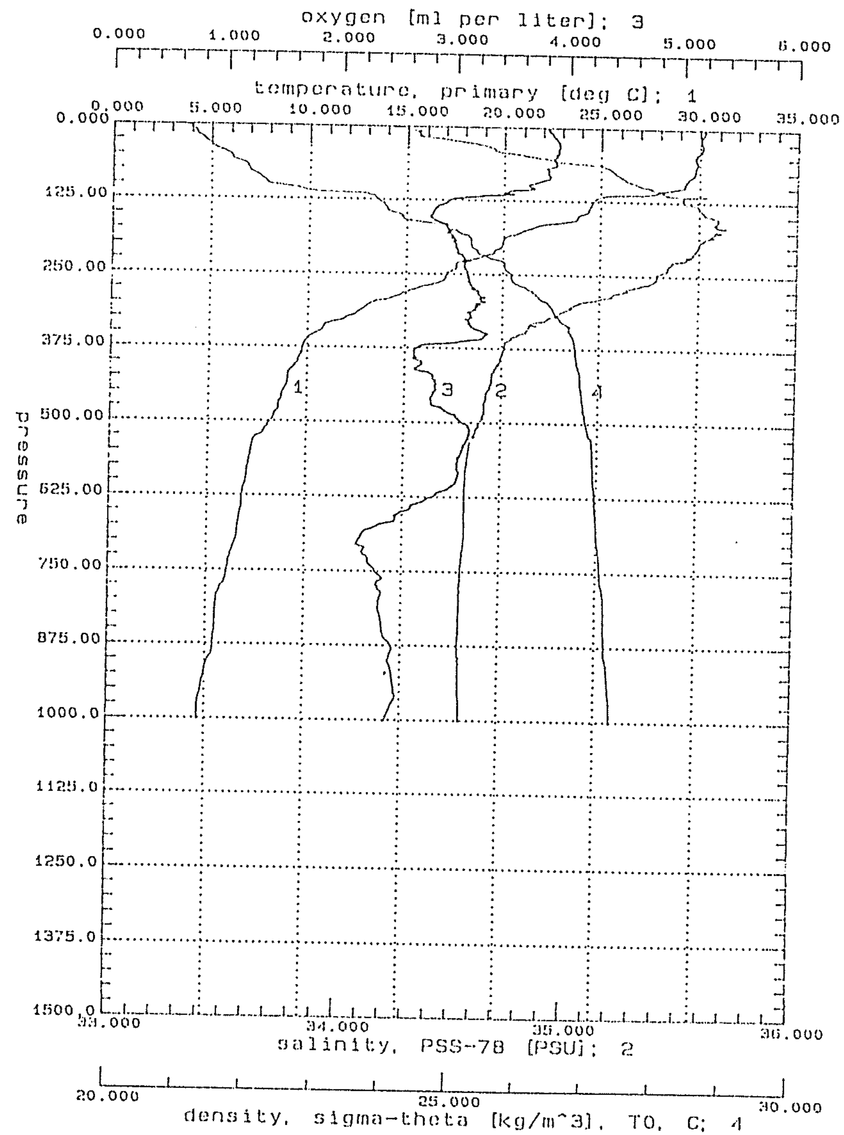

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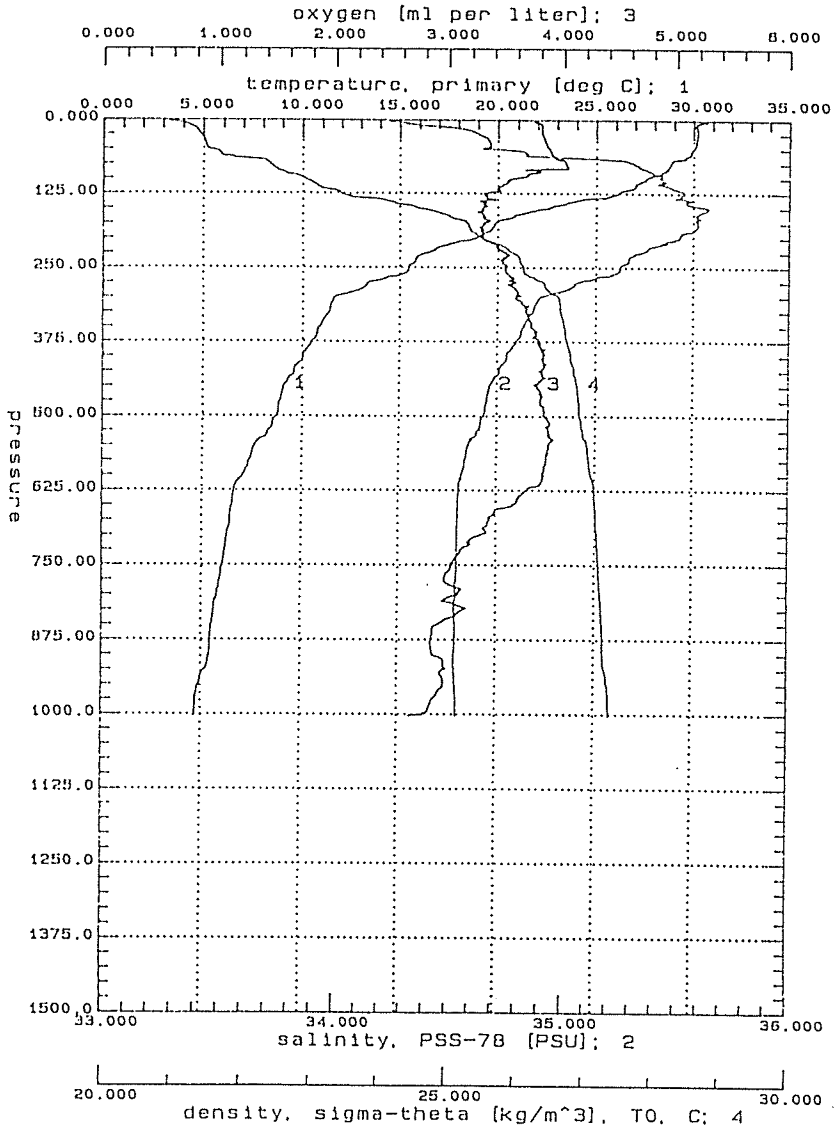

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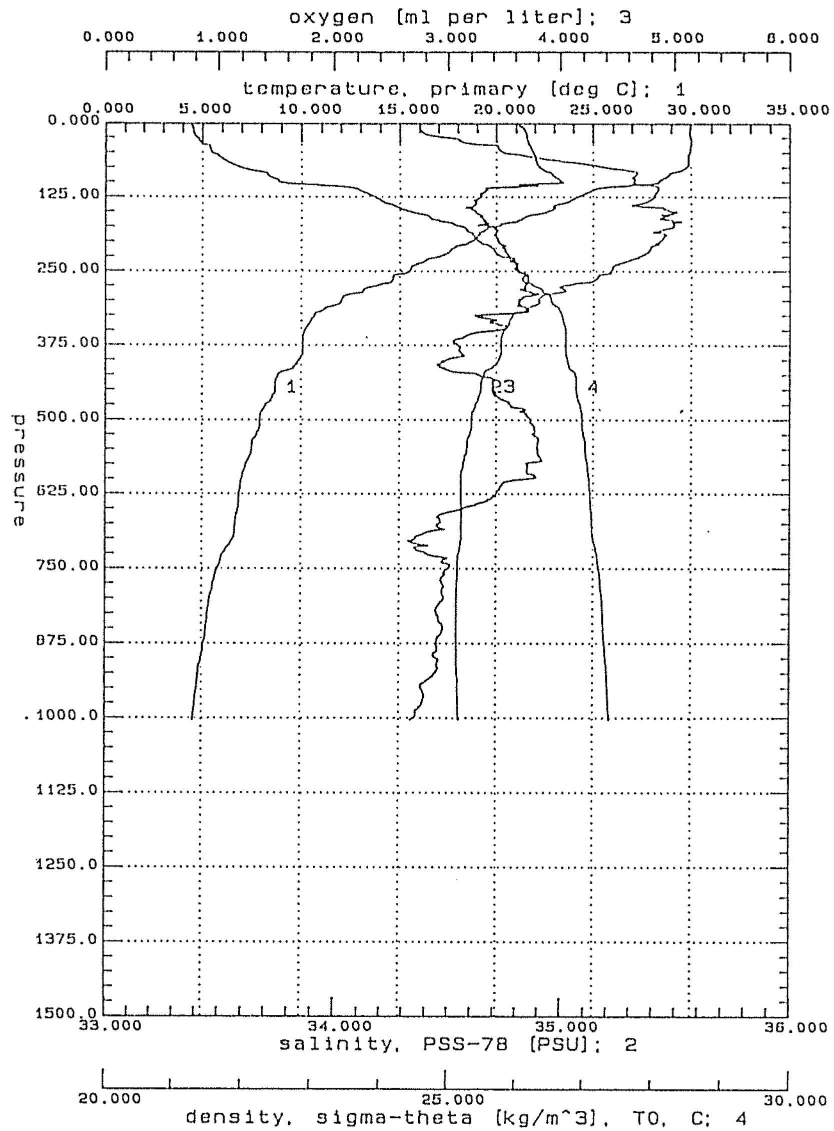

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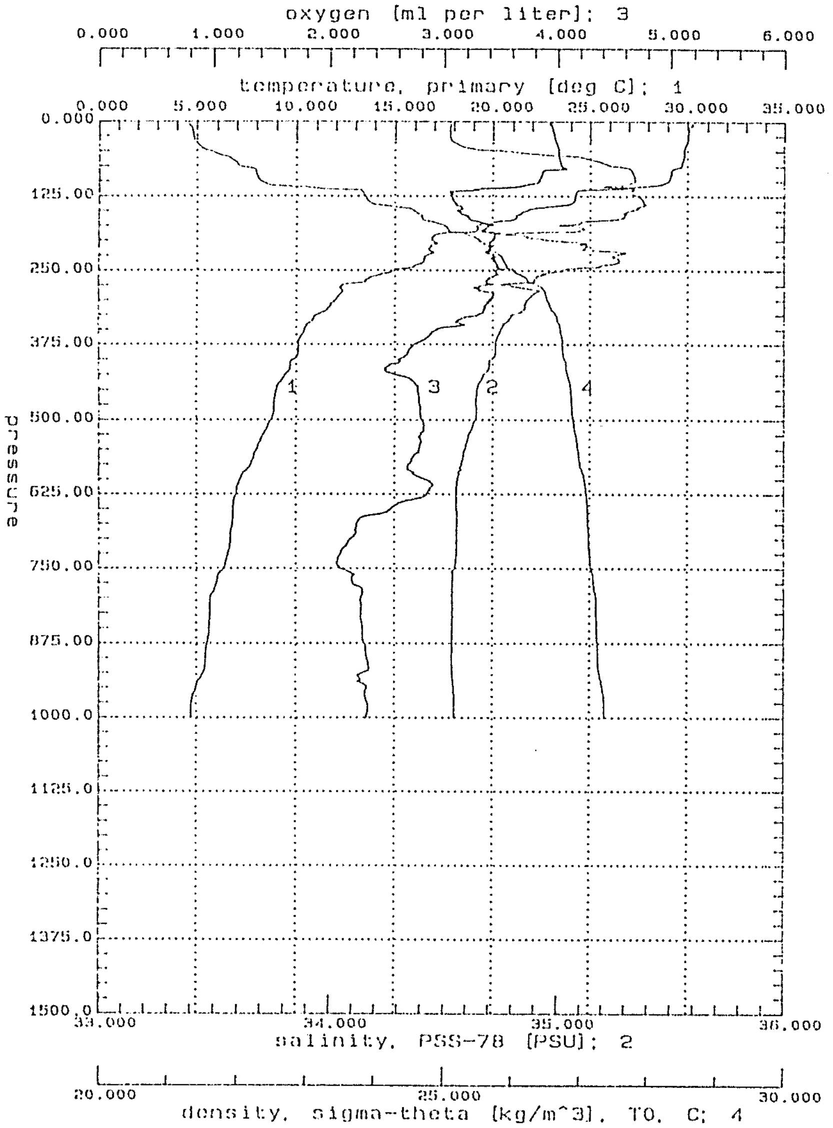

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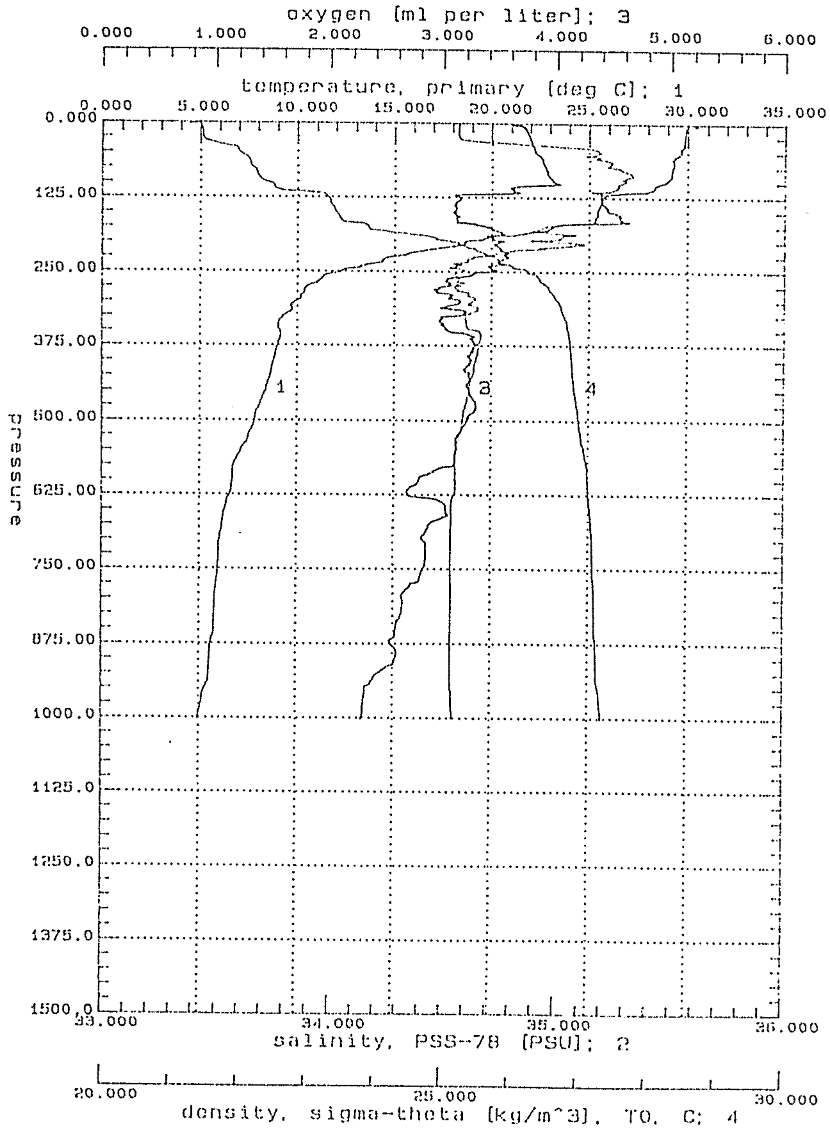

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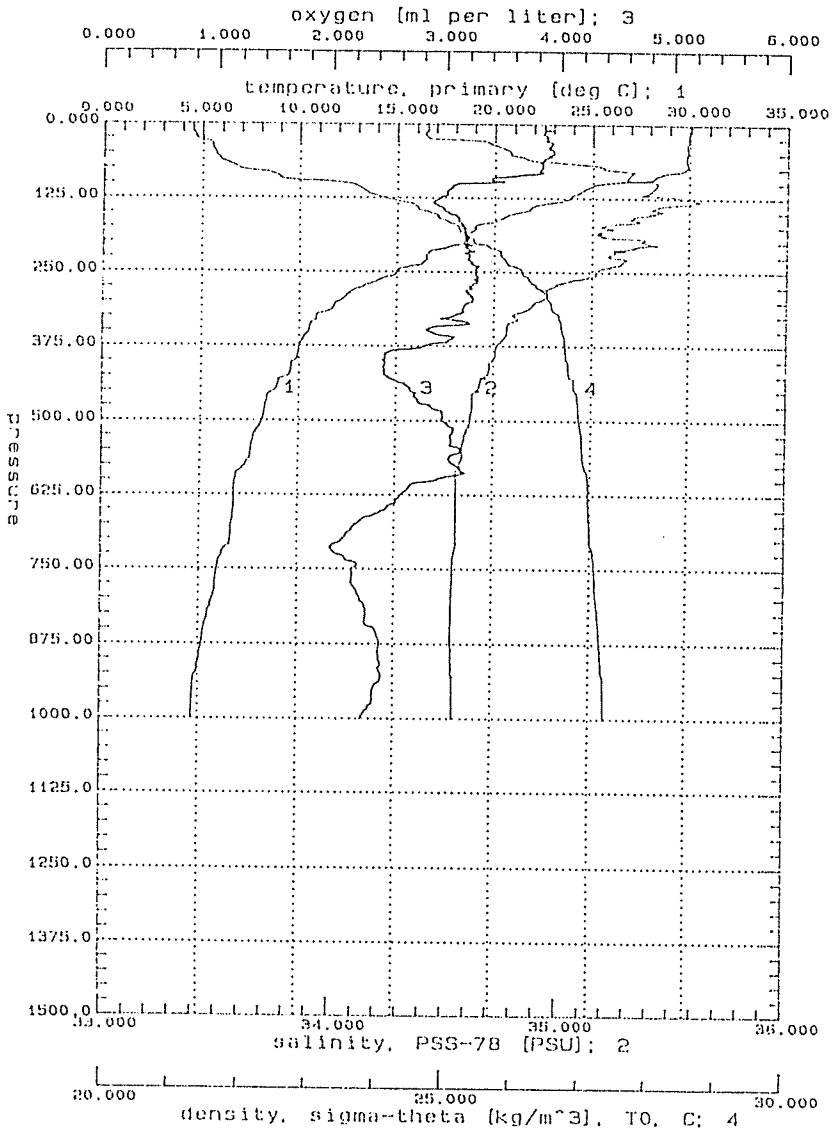

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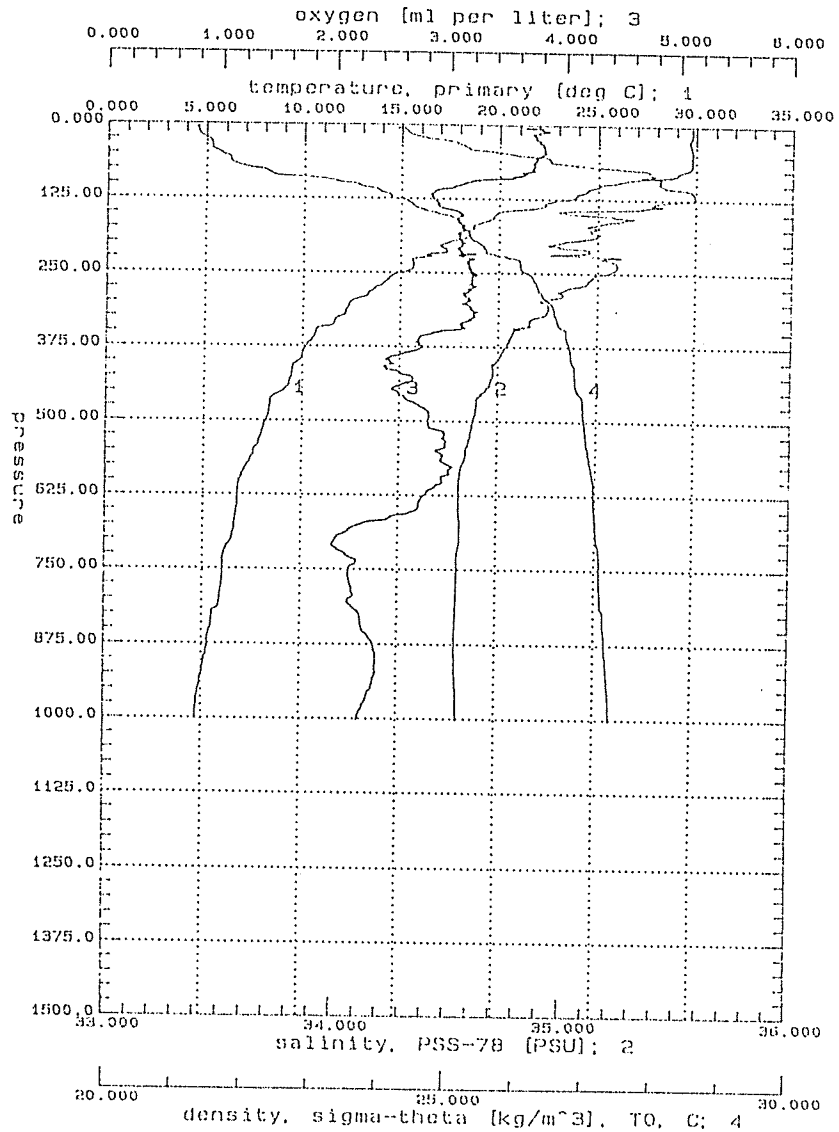

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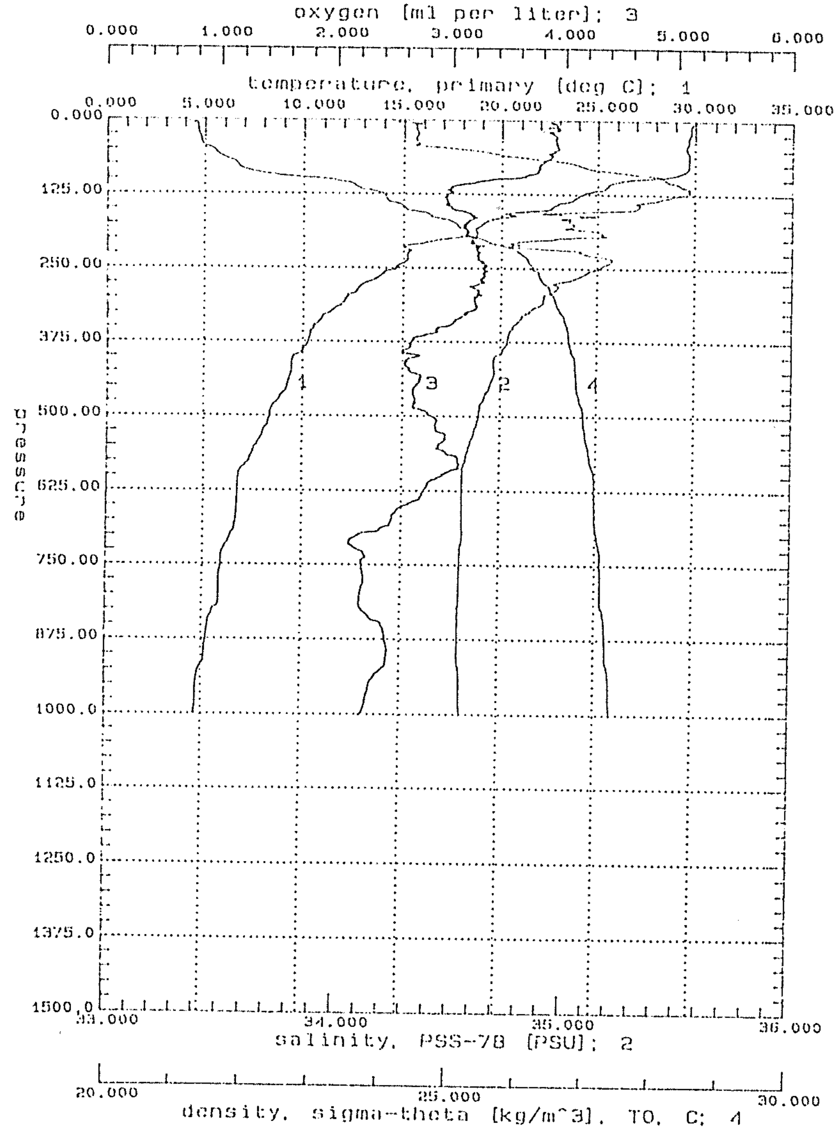

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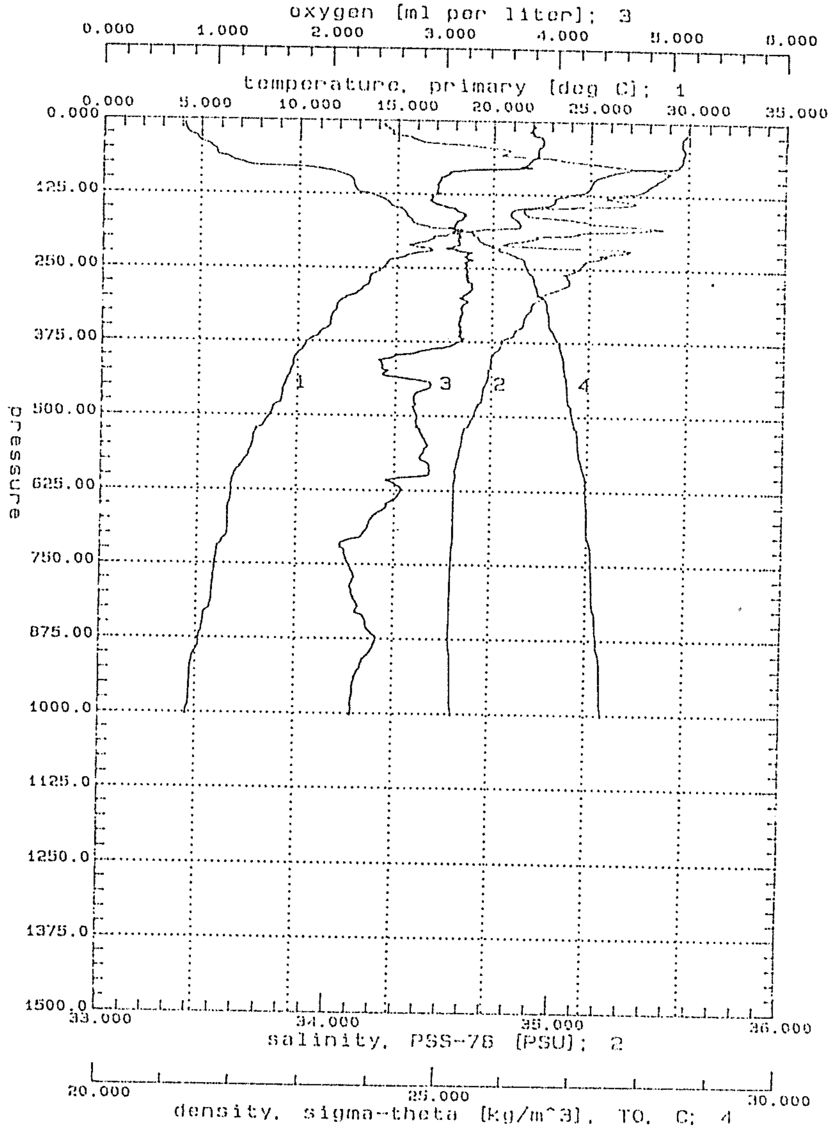

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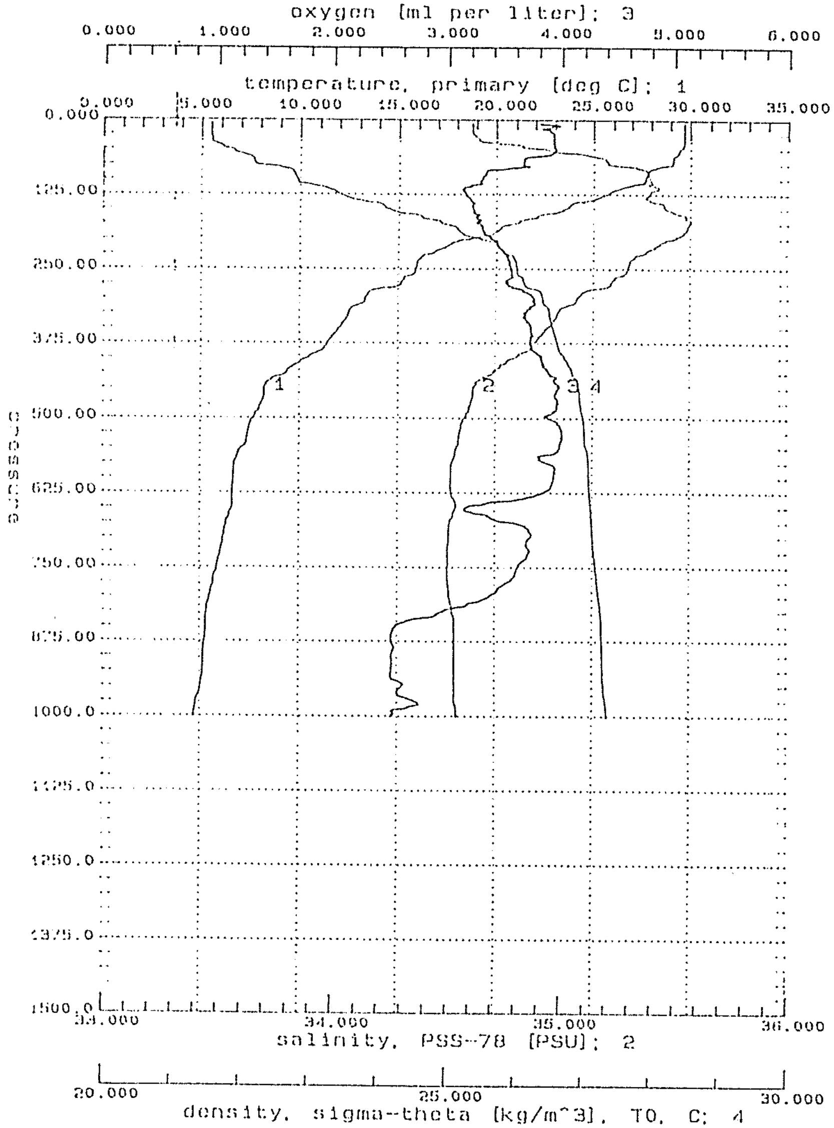
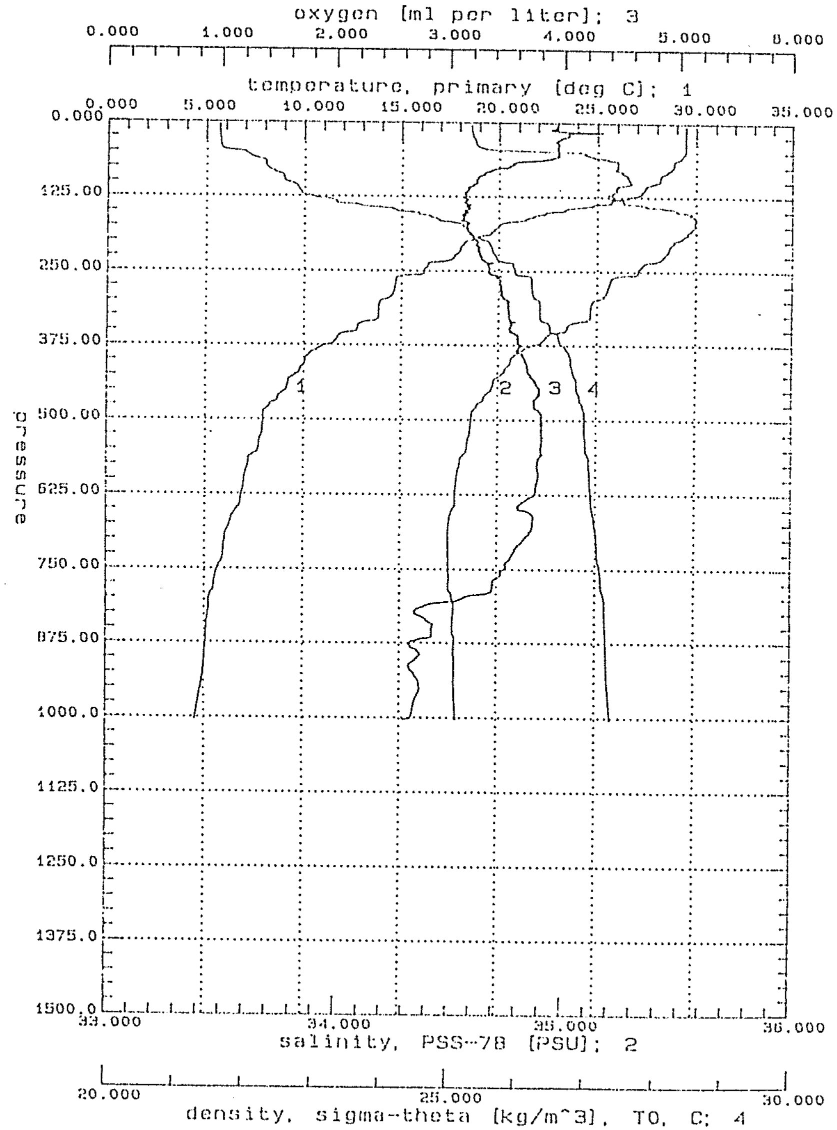


DTOCSC39.CN... TOCS ... CTD 39 (02 05S, ... 96021...UTC



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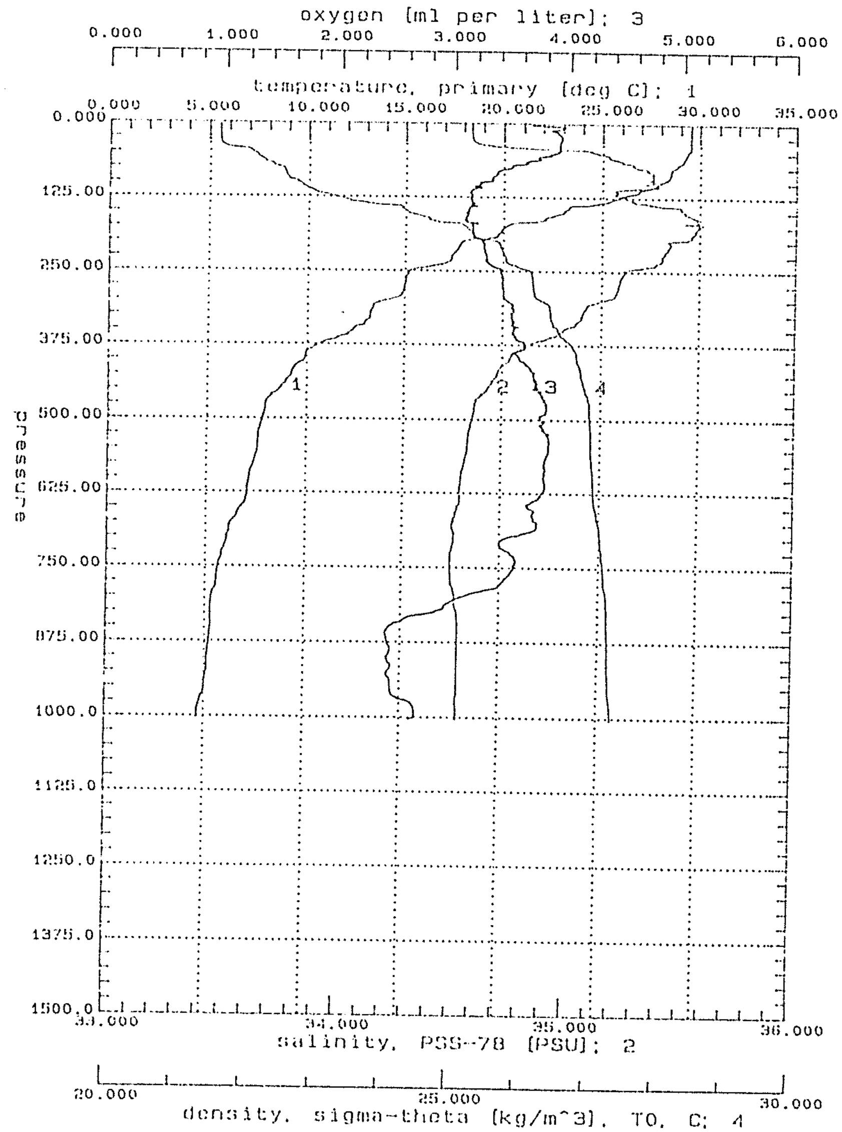

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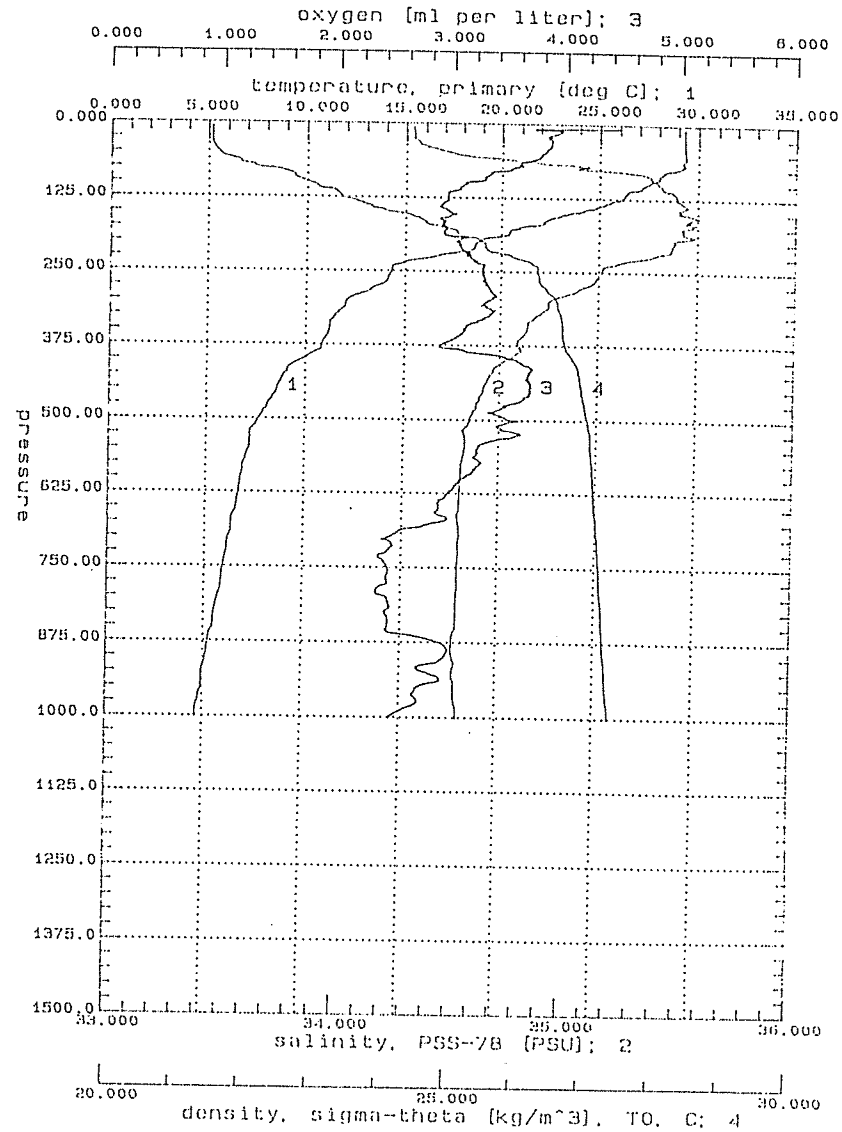

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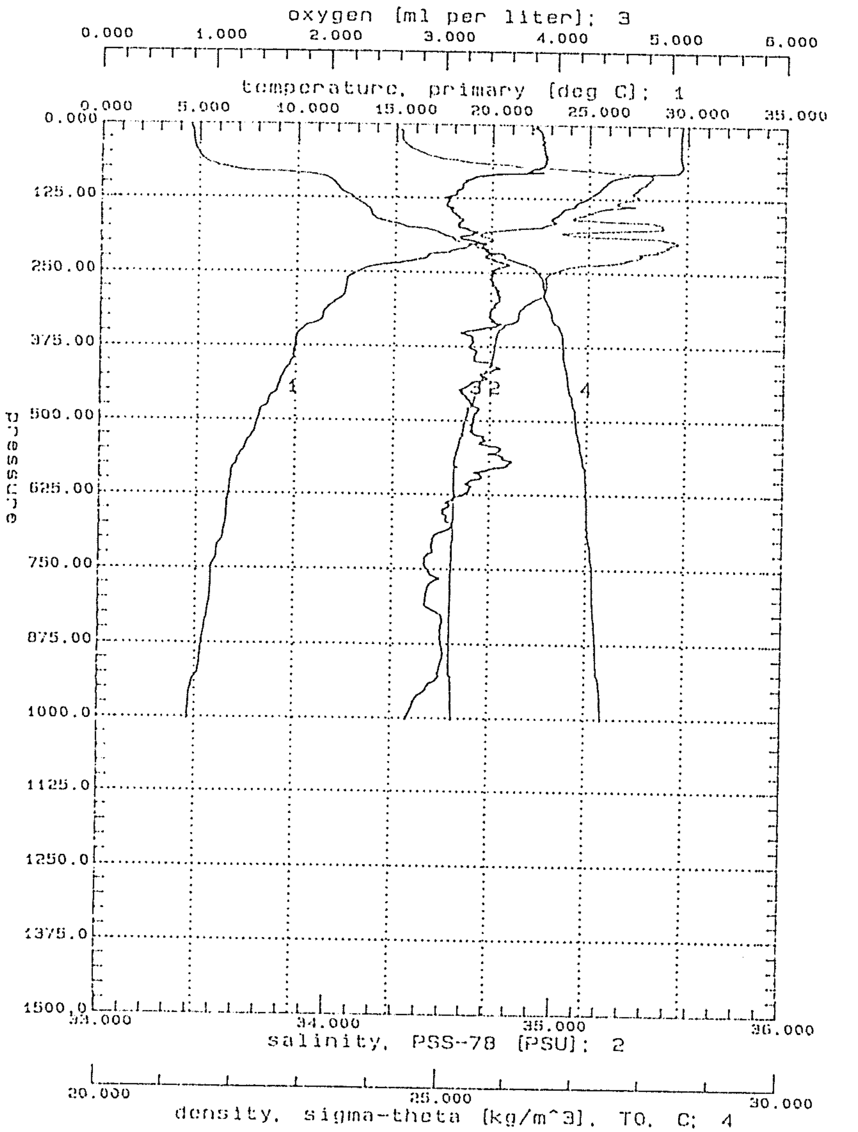

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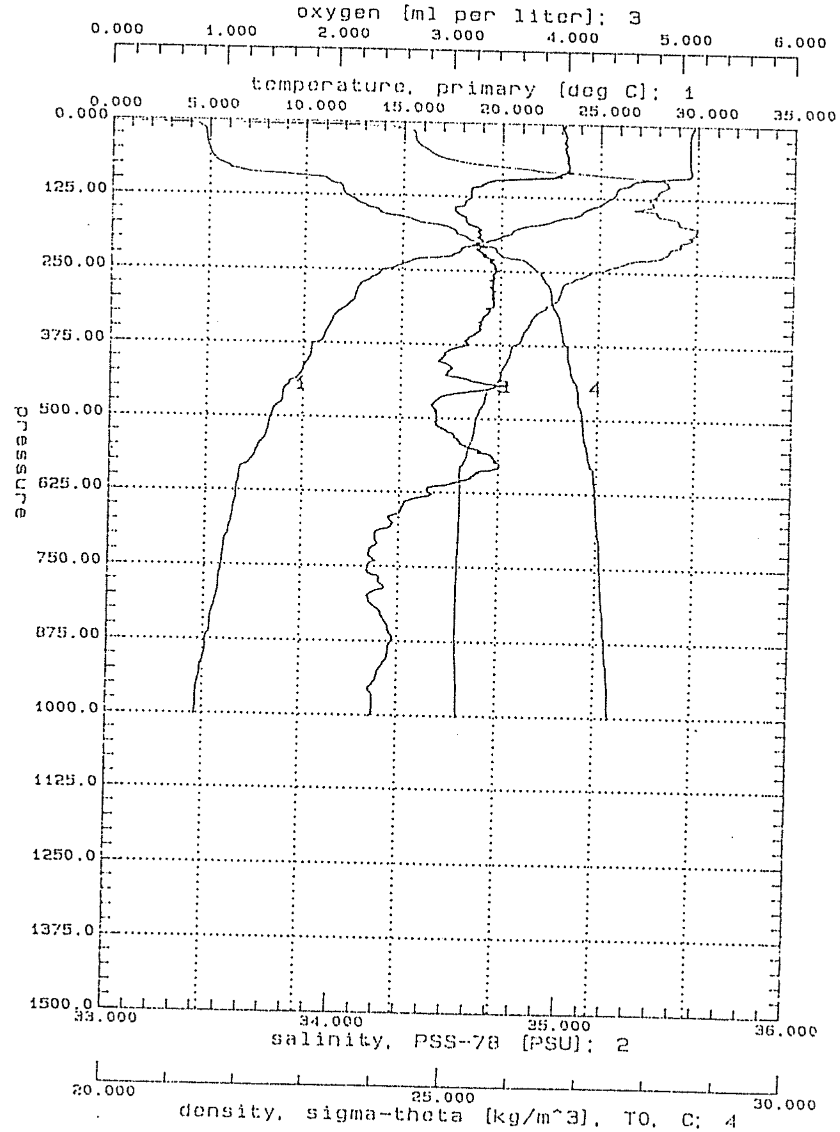

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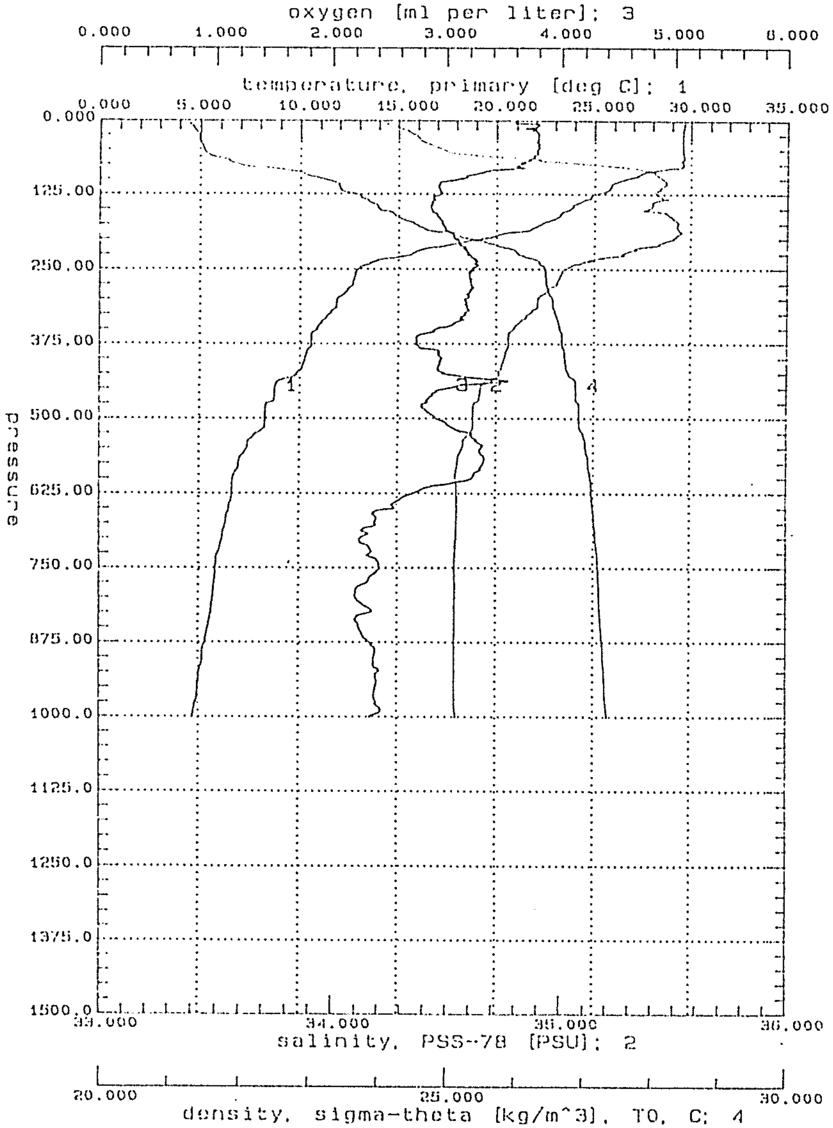

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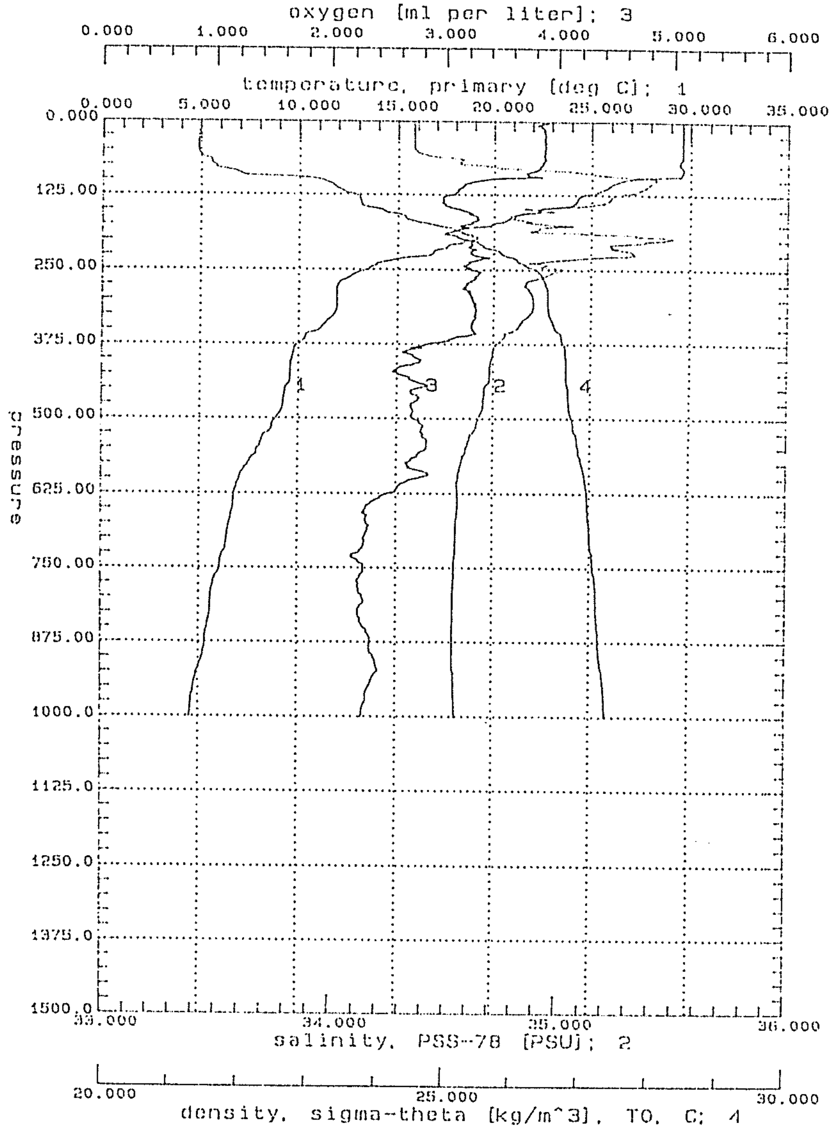

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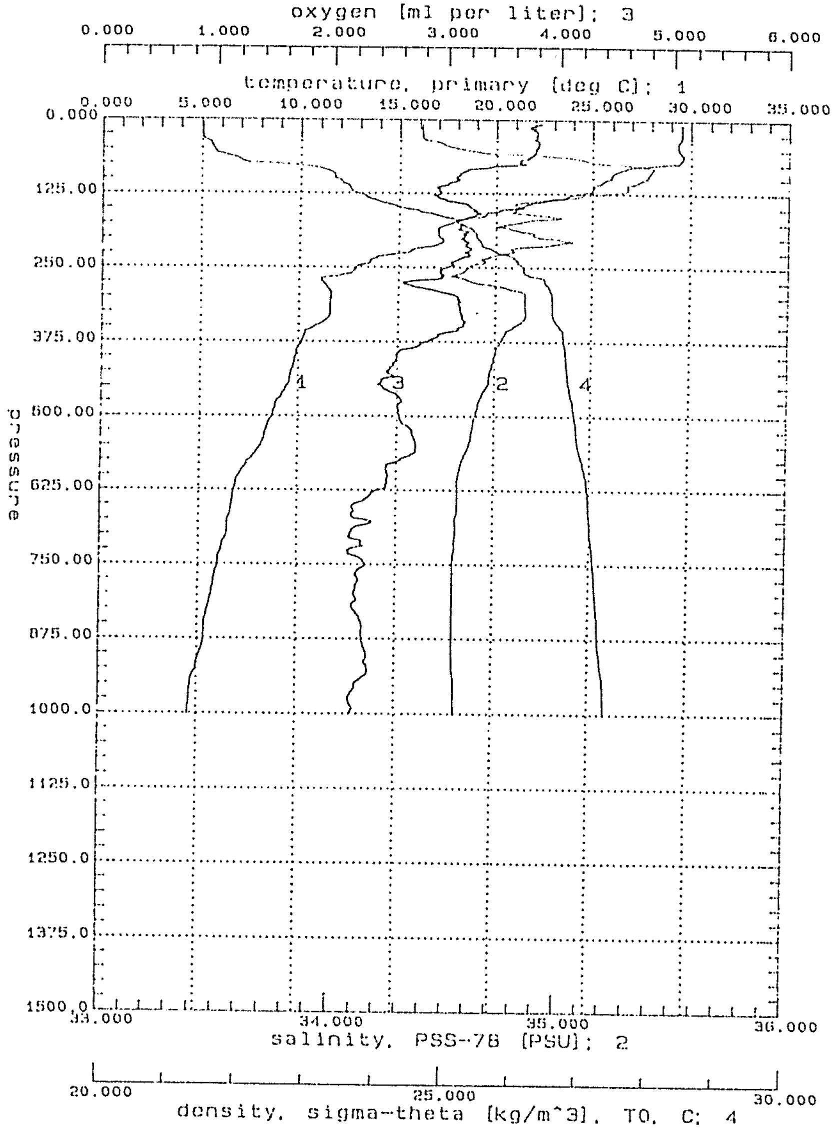

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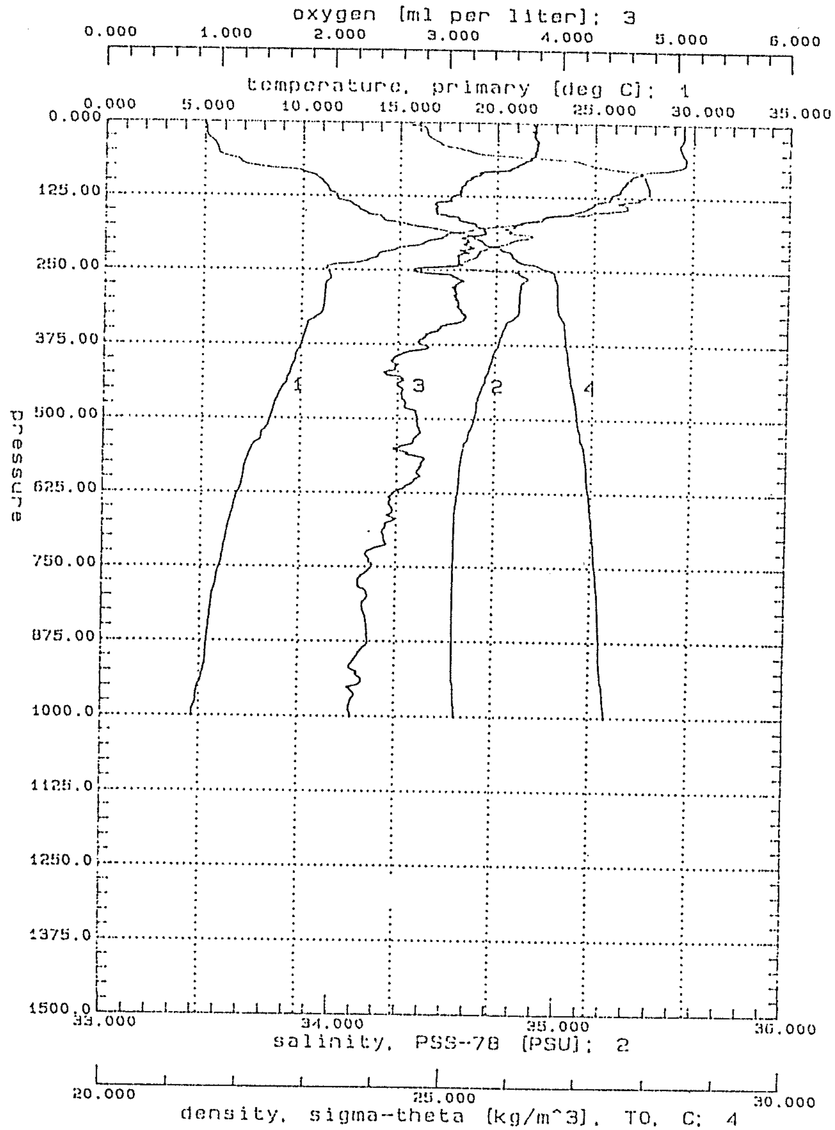

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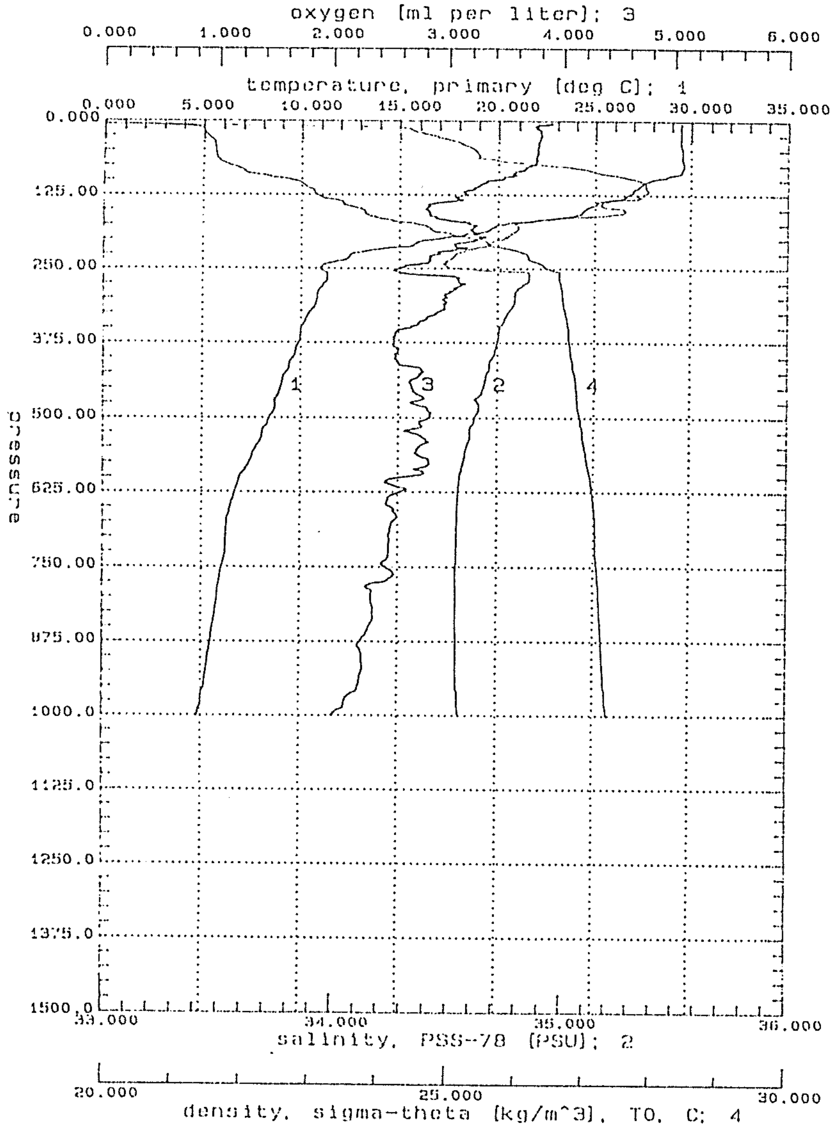

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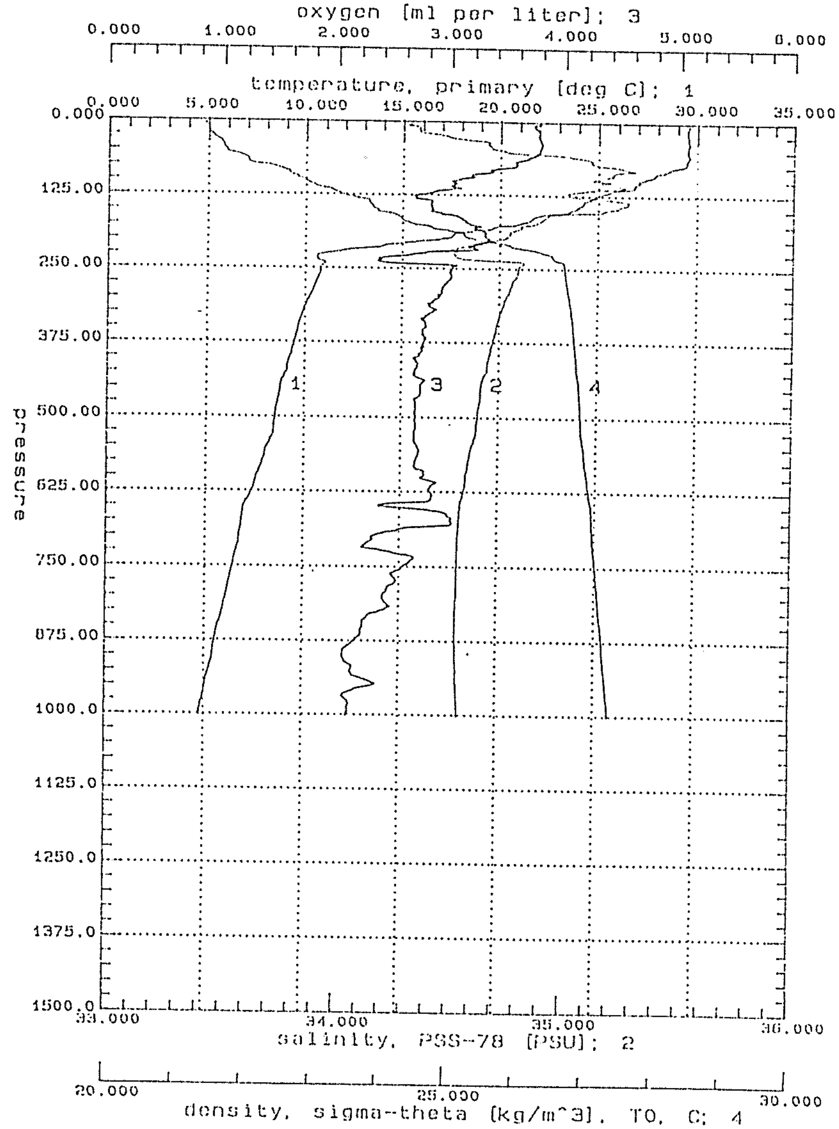

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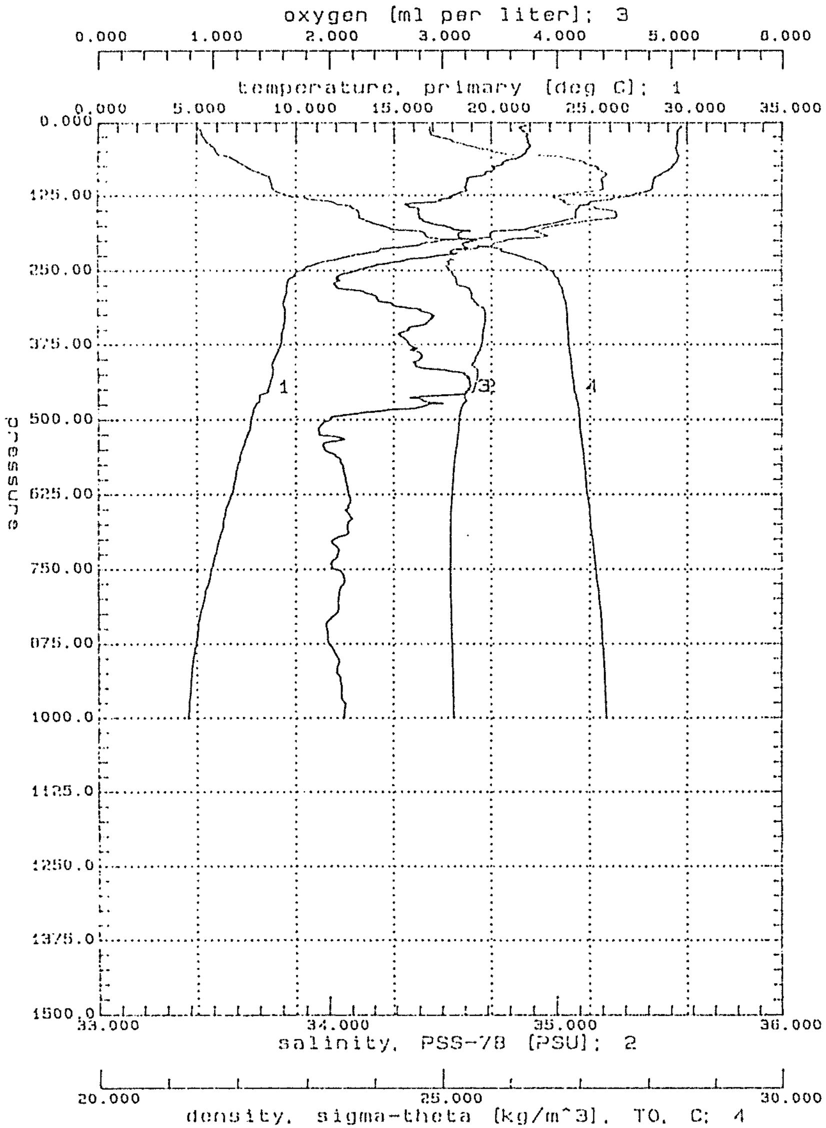

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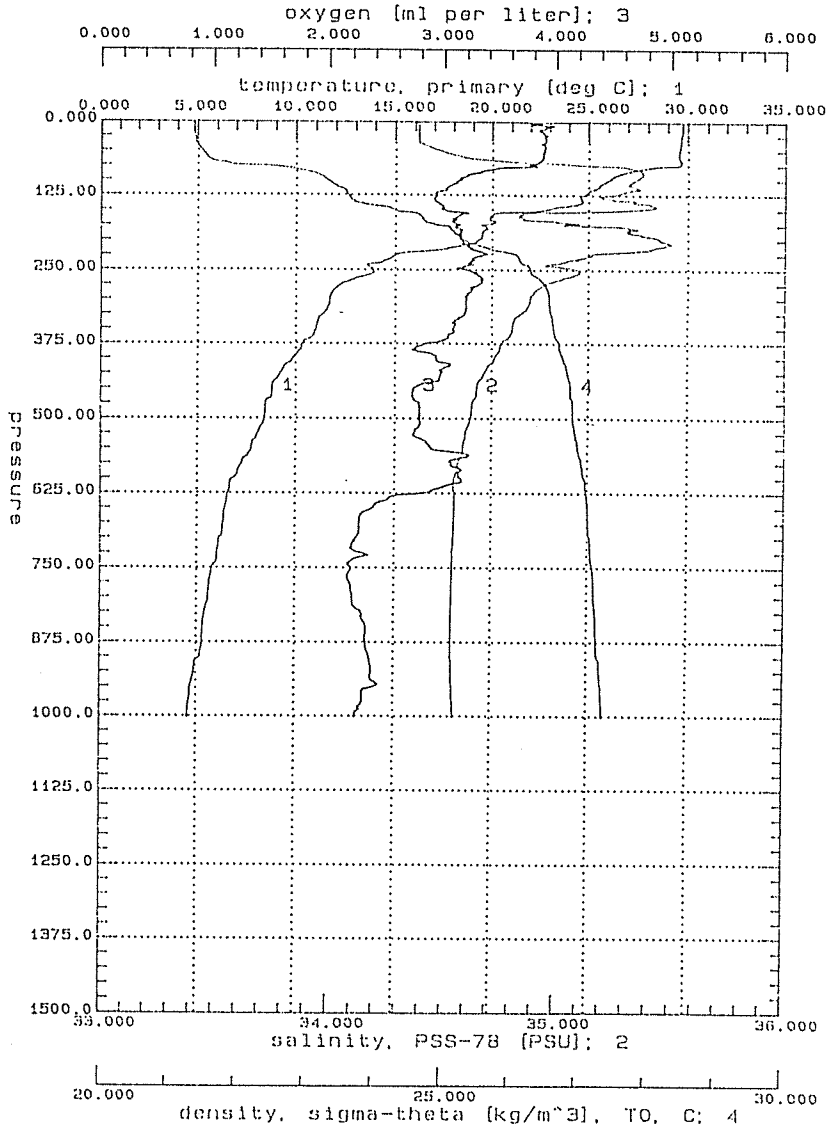

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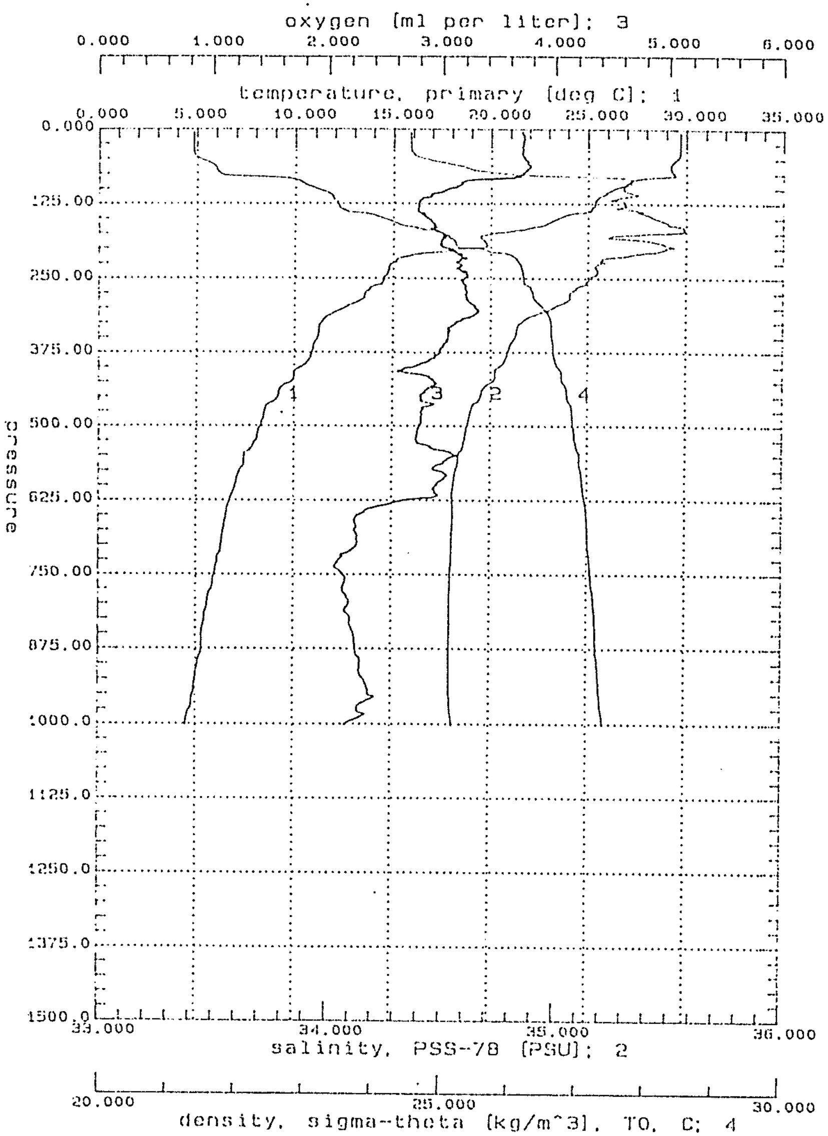

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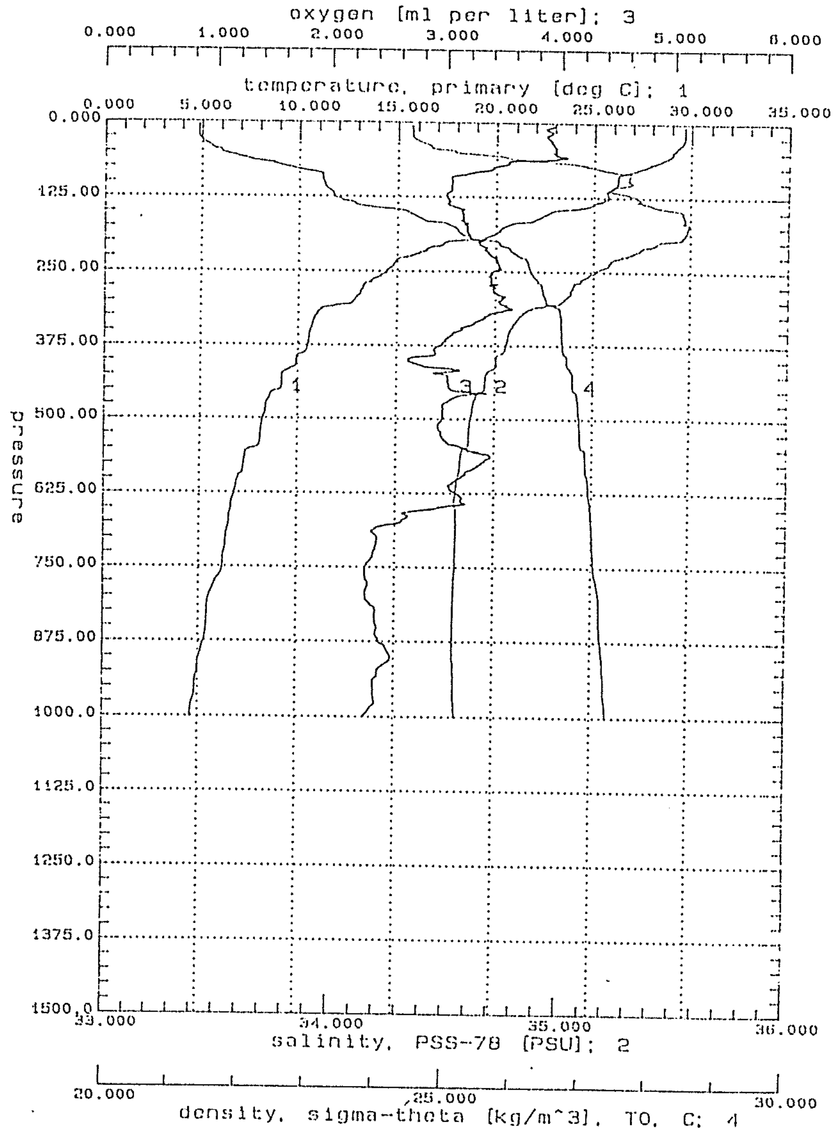

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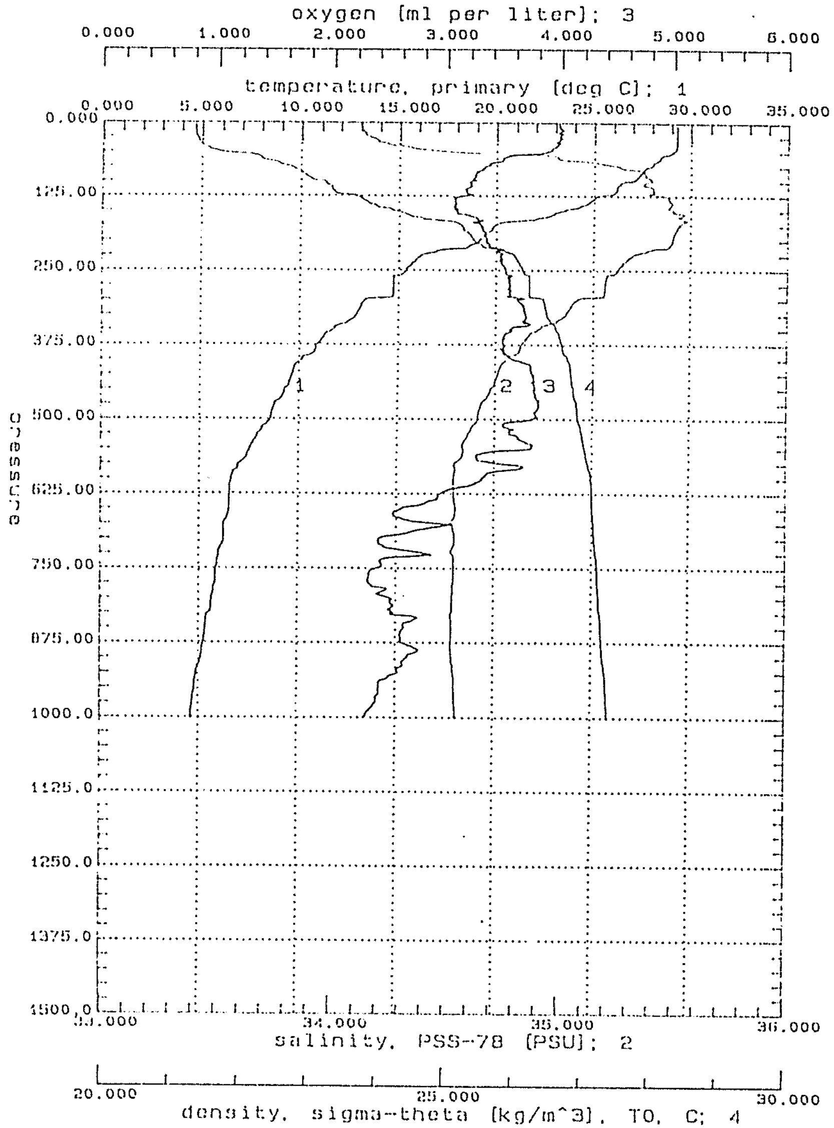

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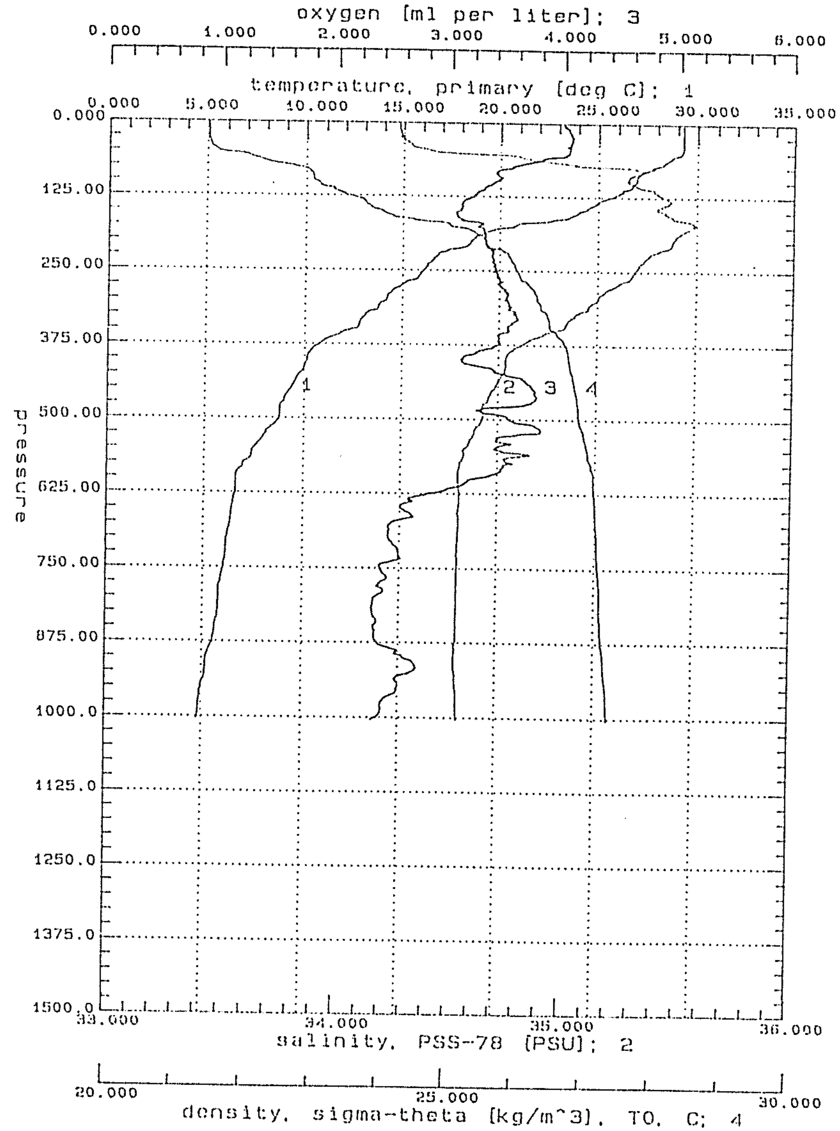

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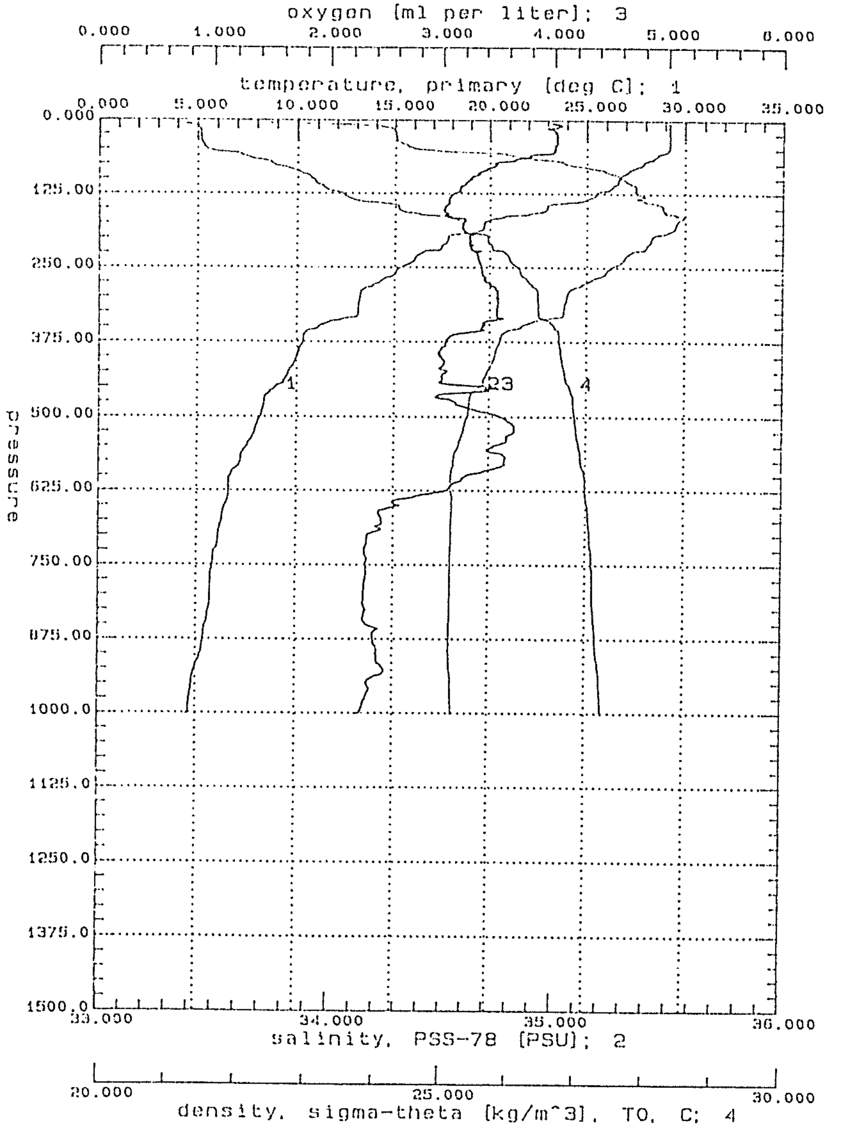

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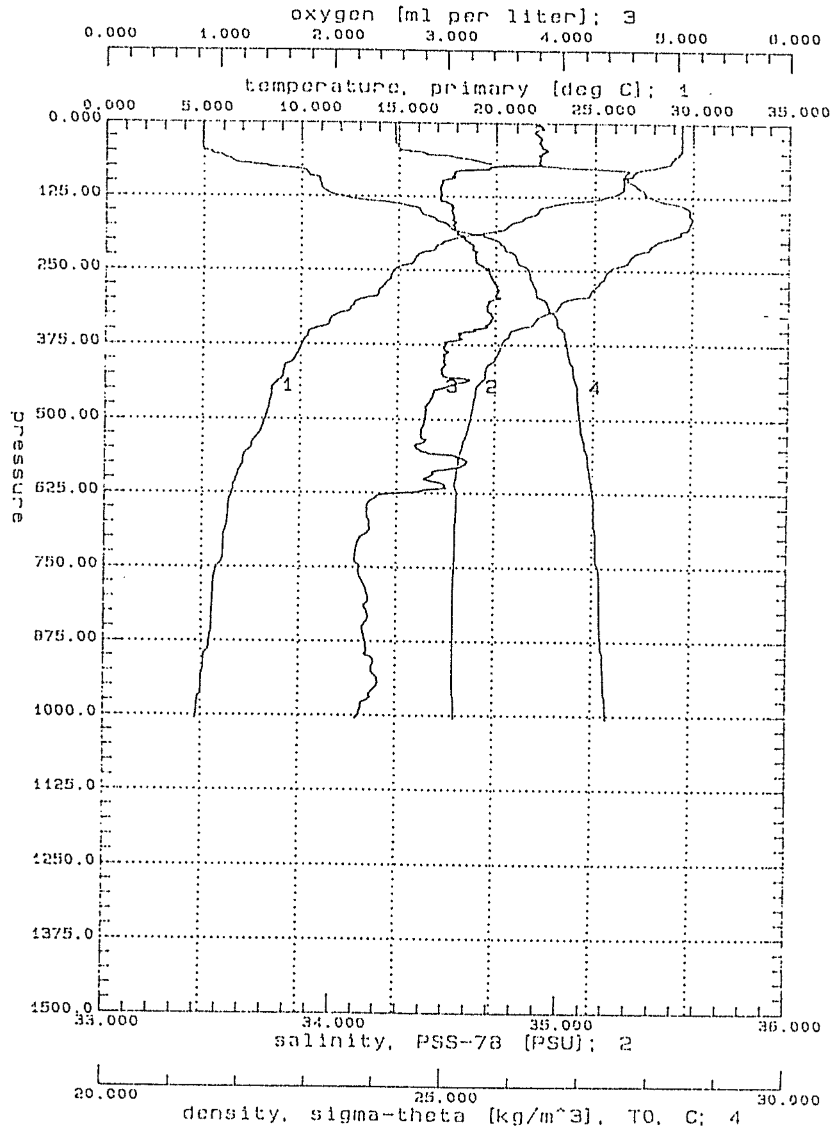

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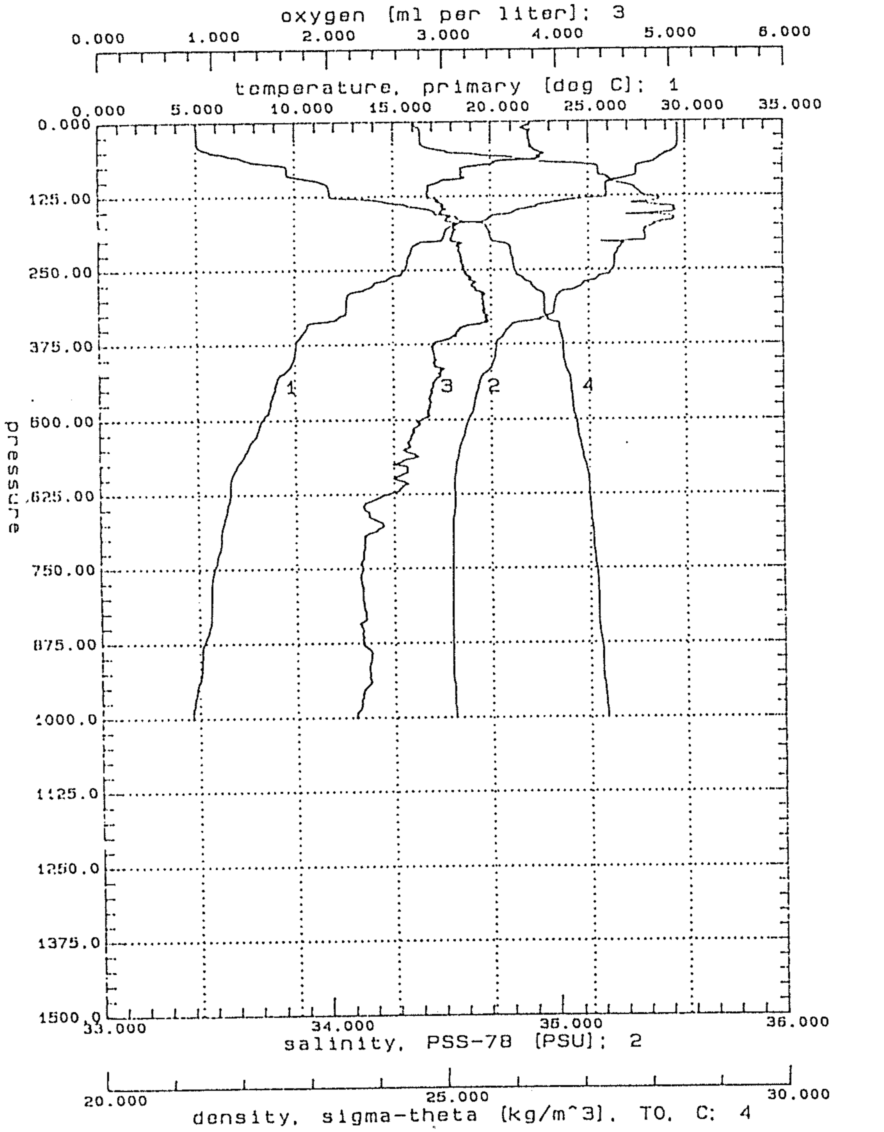

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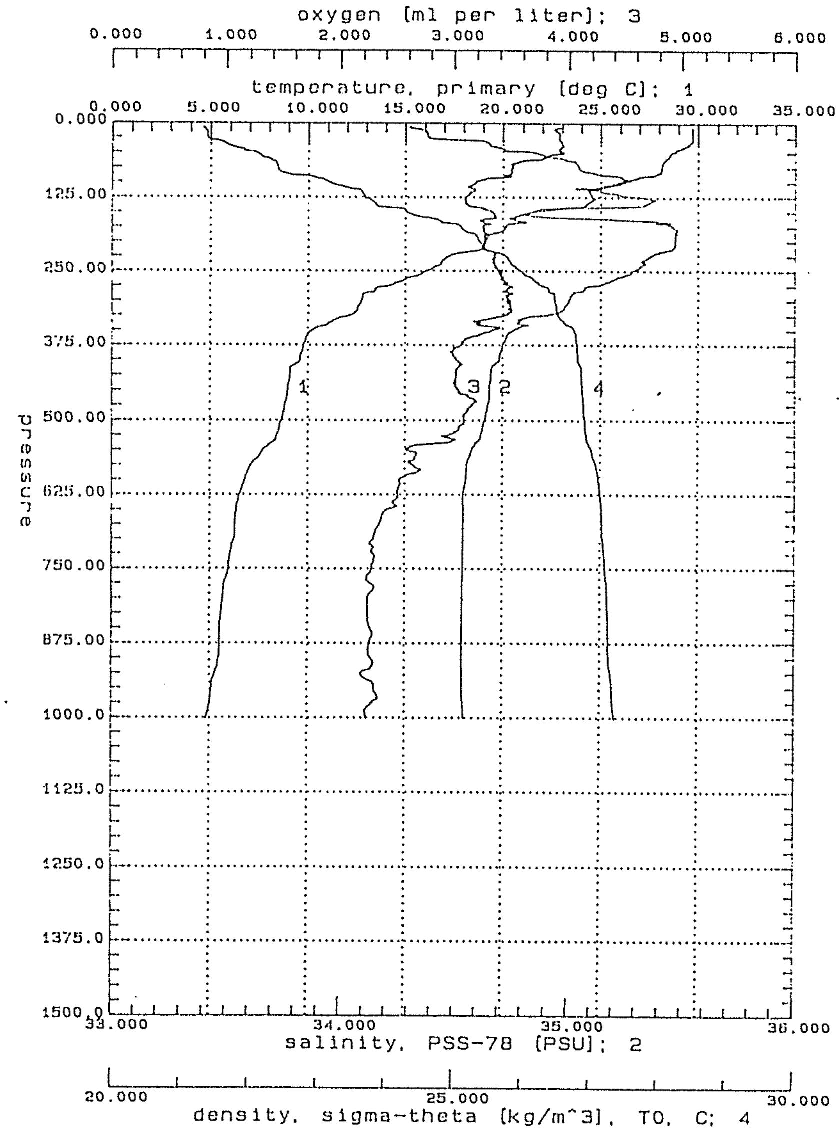

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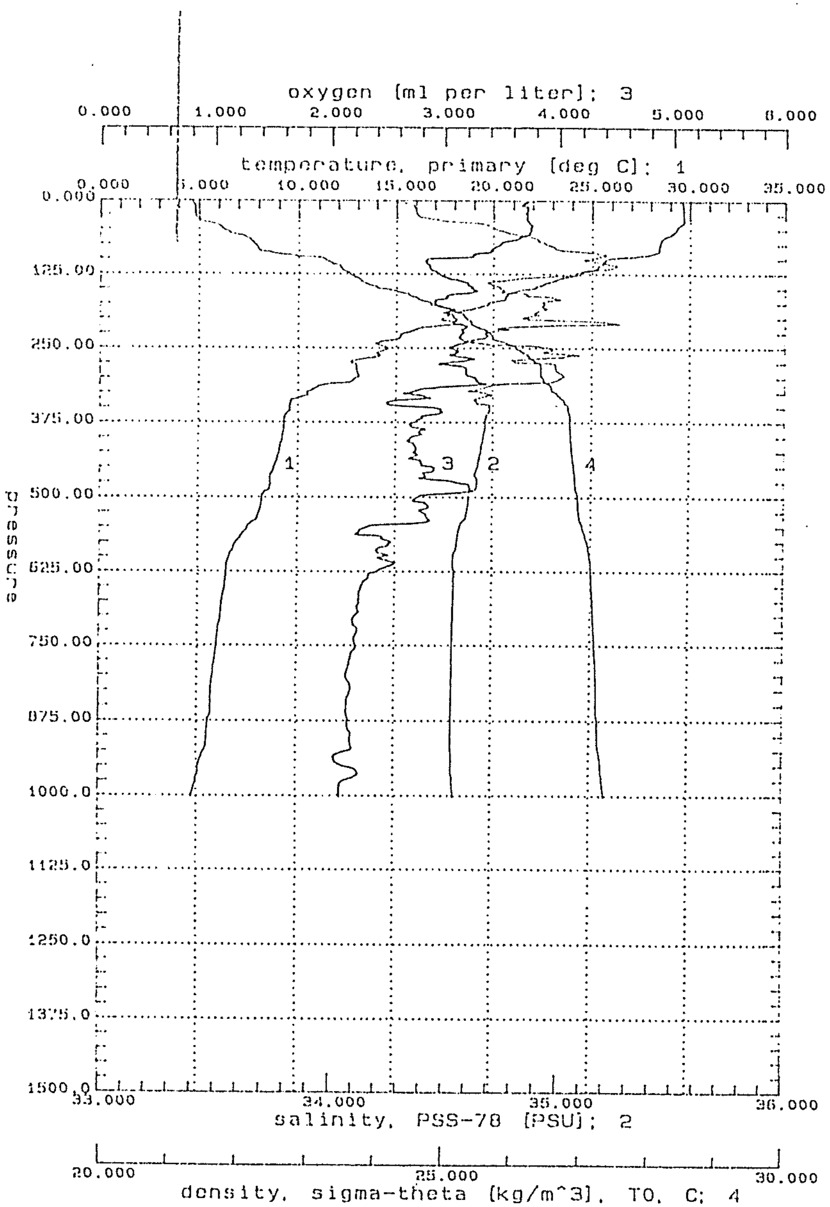

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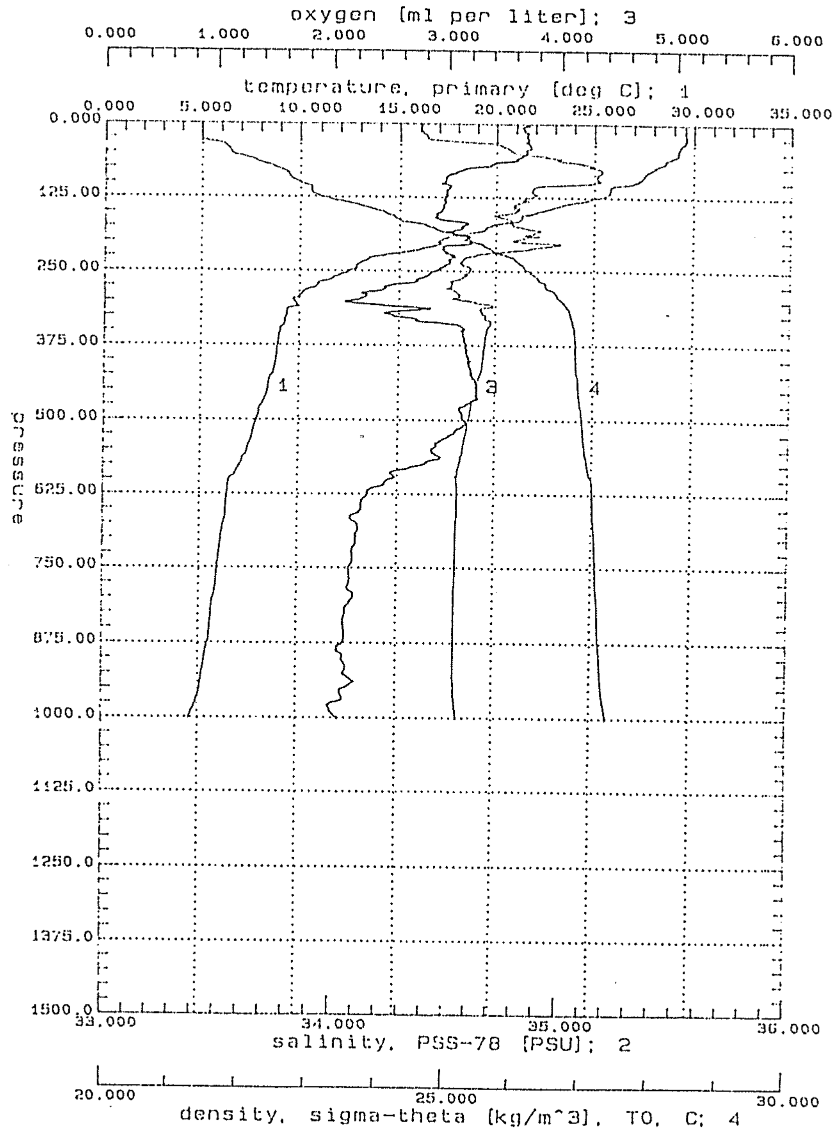

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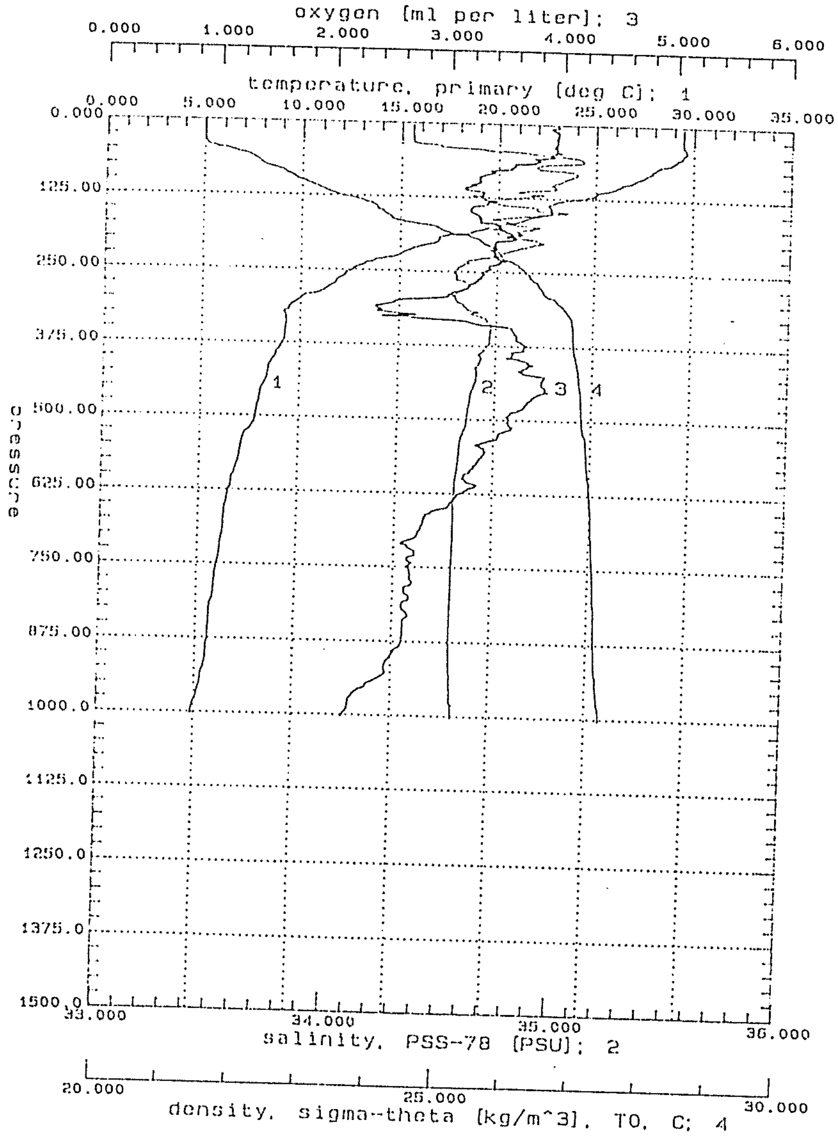

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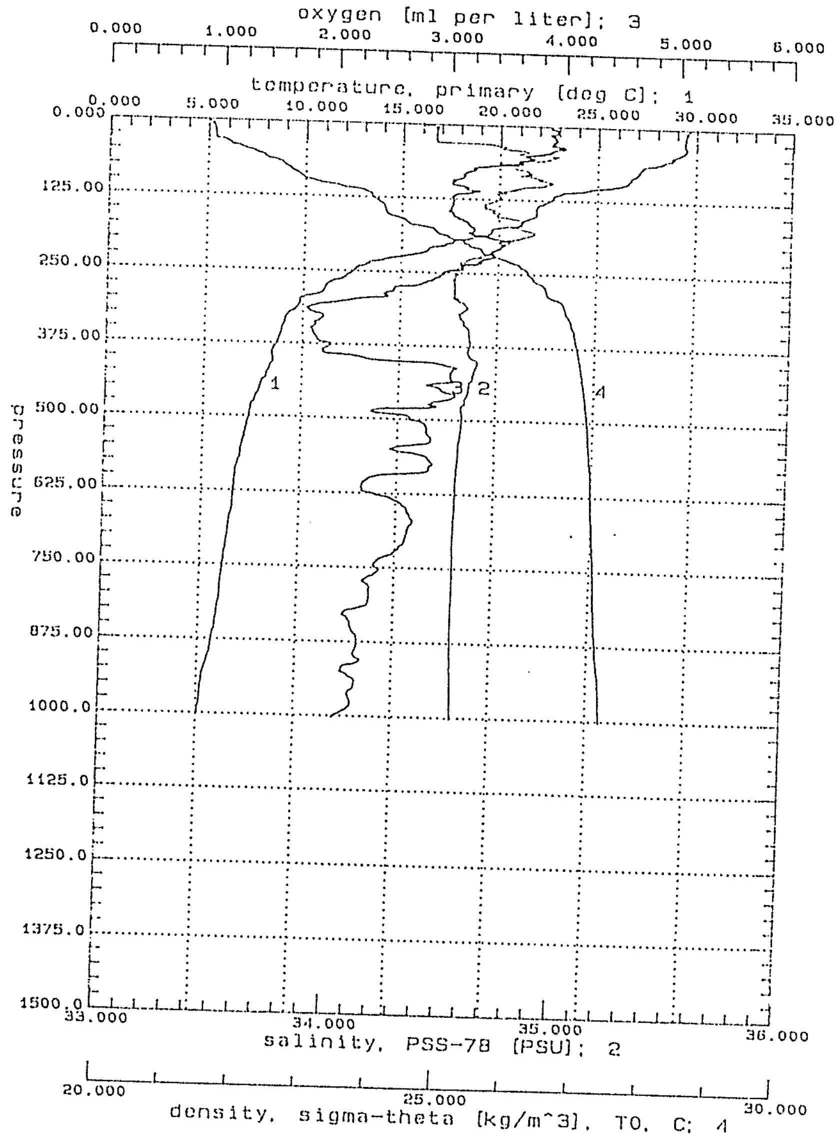

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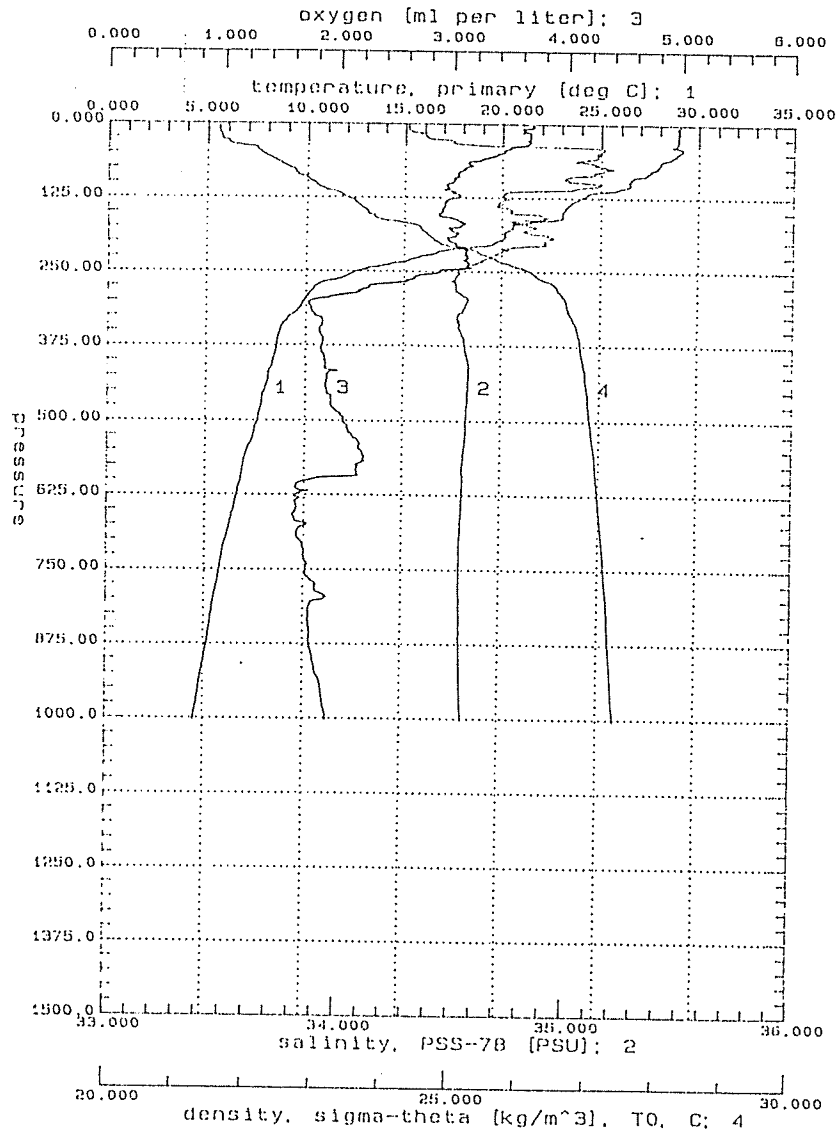

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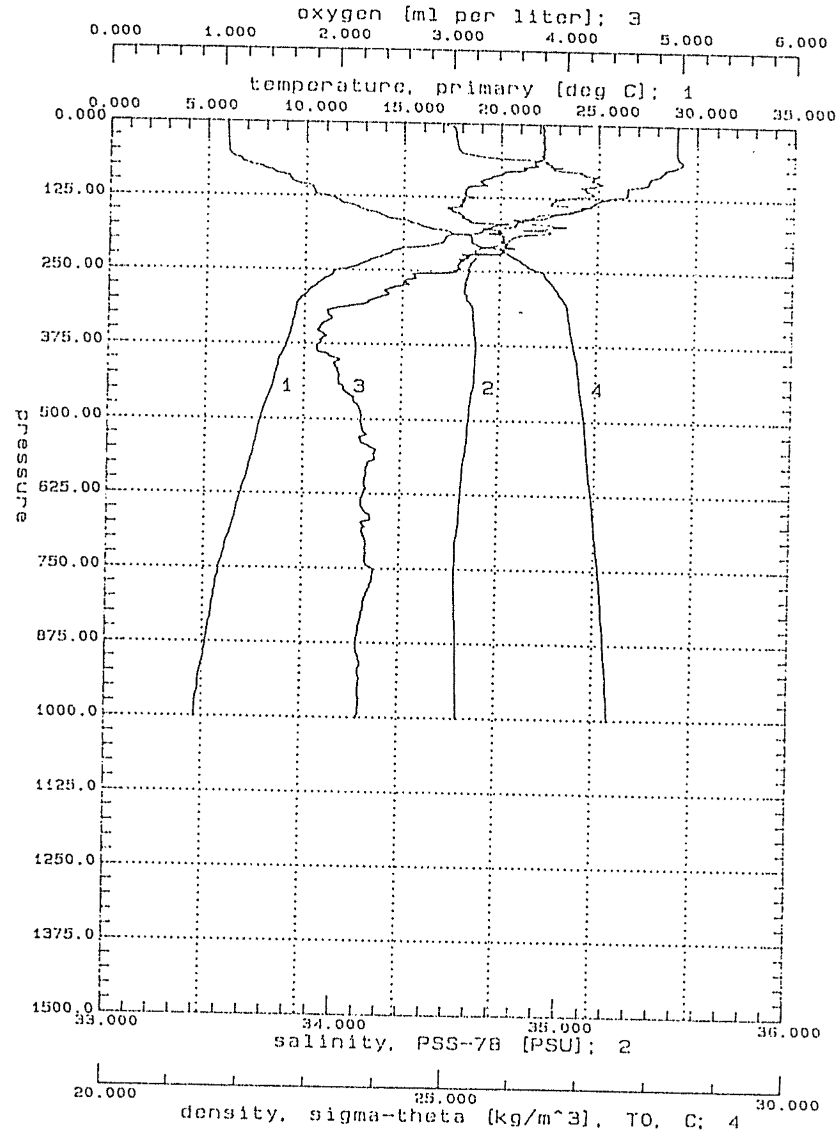

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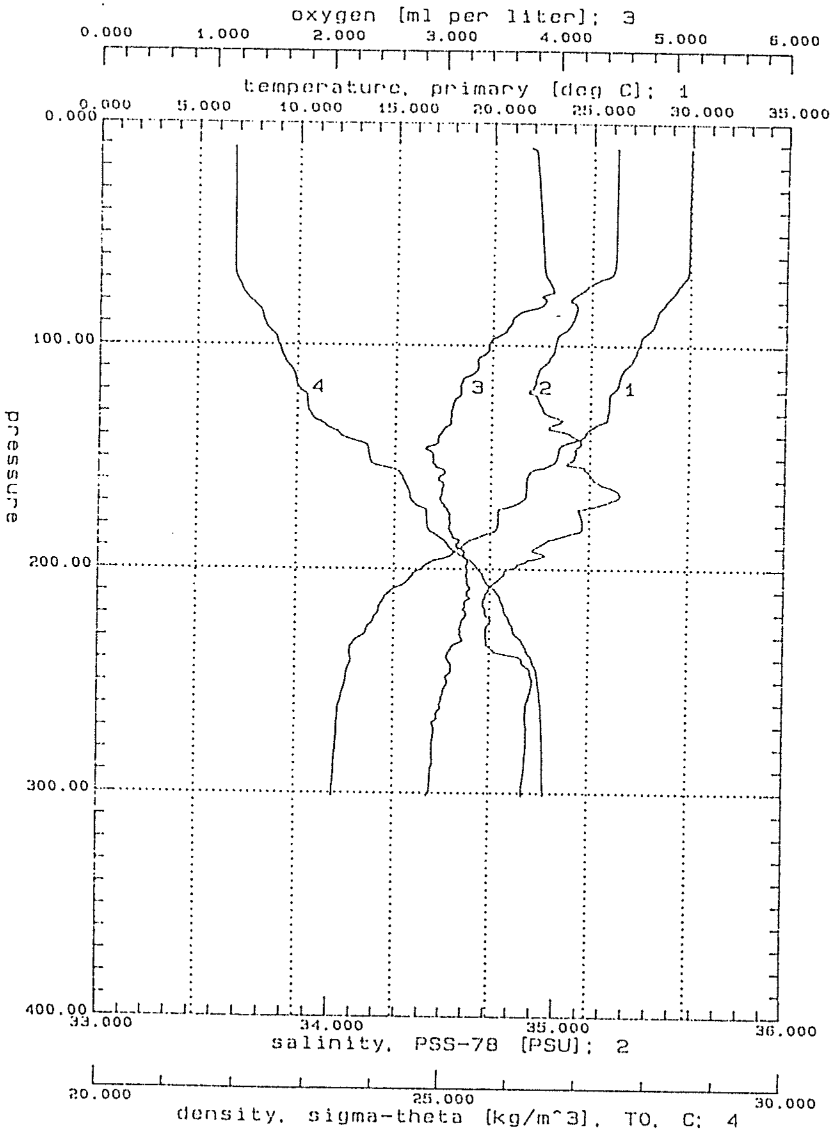
4.37



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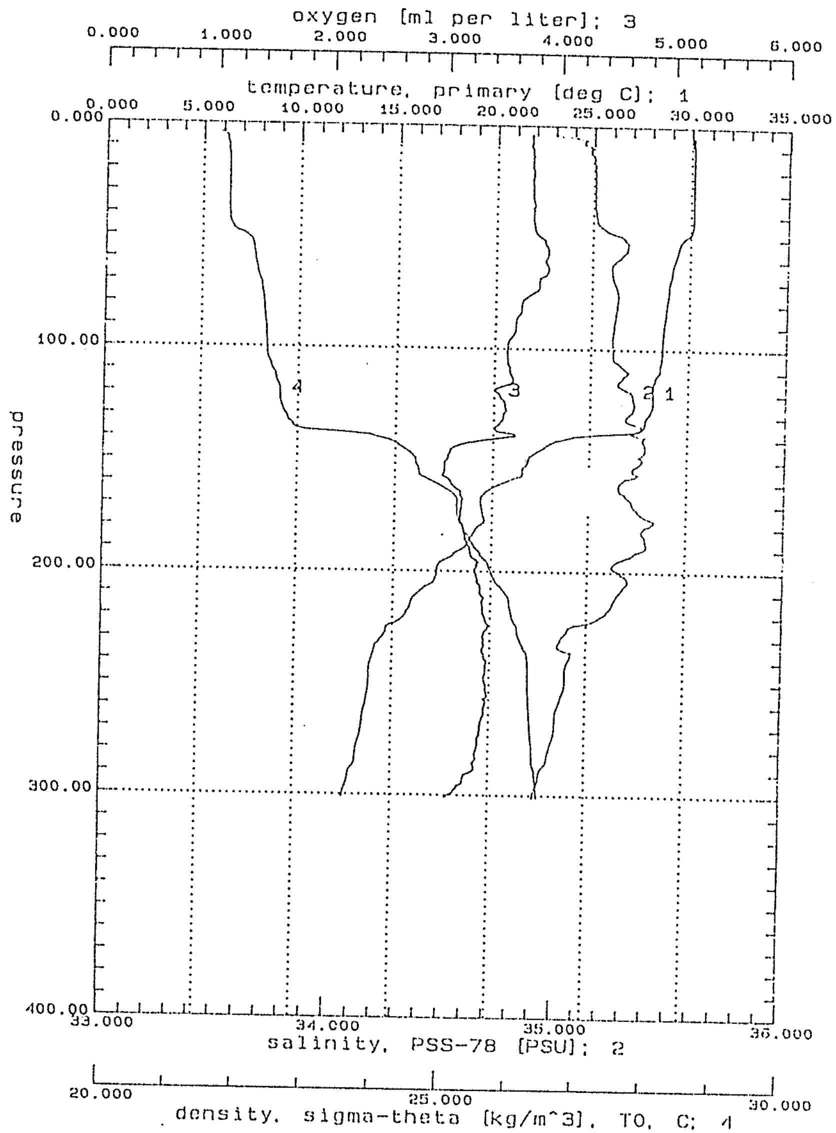
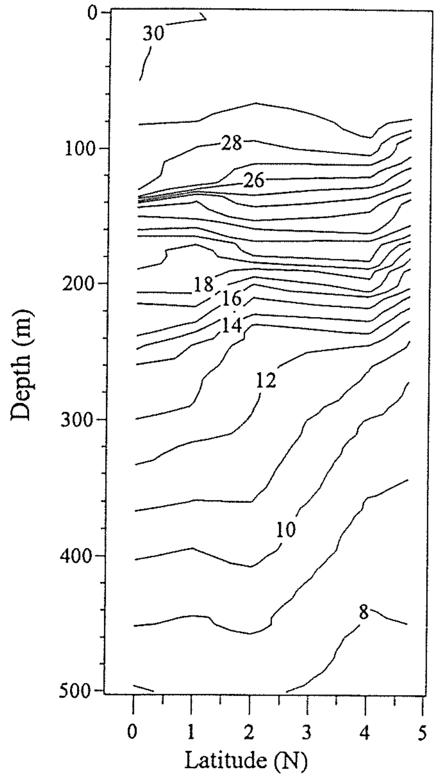


DTOCSAT2.CNV: TOCS K9601 ATLAS-2 (00-00S, 164-59E) 96012819UT

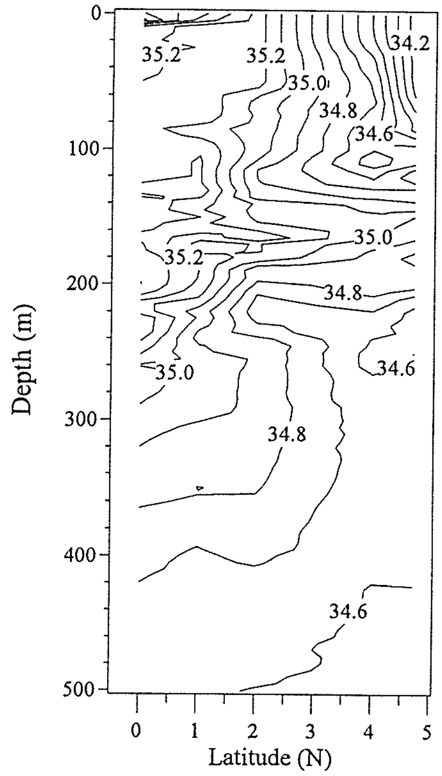
4. 4 CTD Sections

Between Stn.C01 and C05 (along 165E)

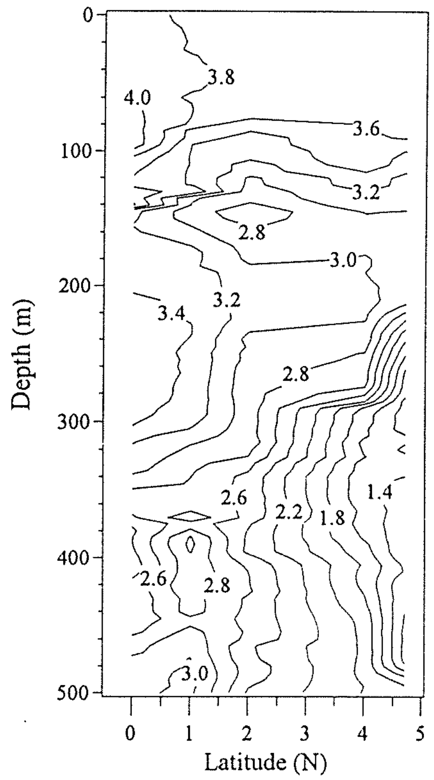
Temp. section (deg.C.)



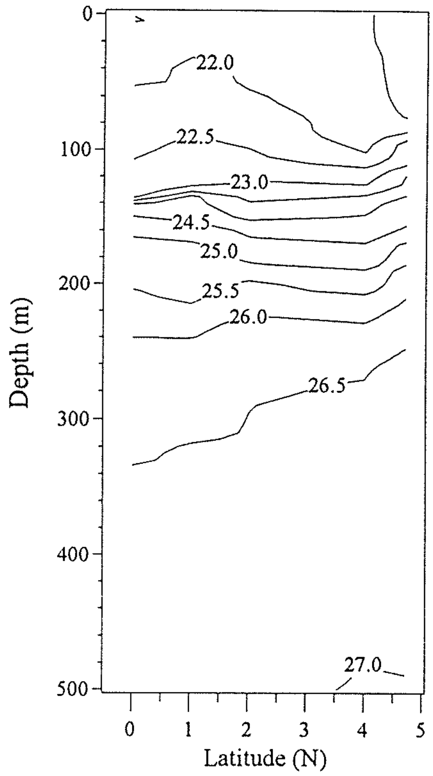
Sal. section (PSU)



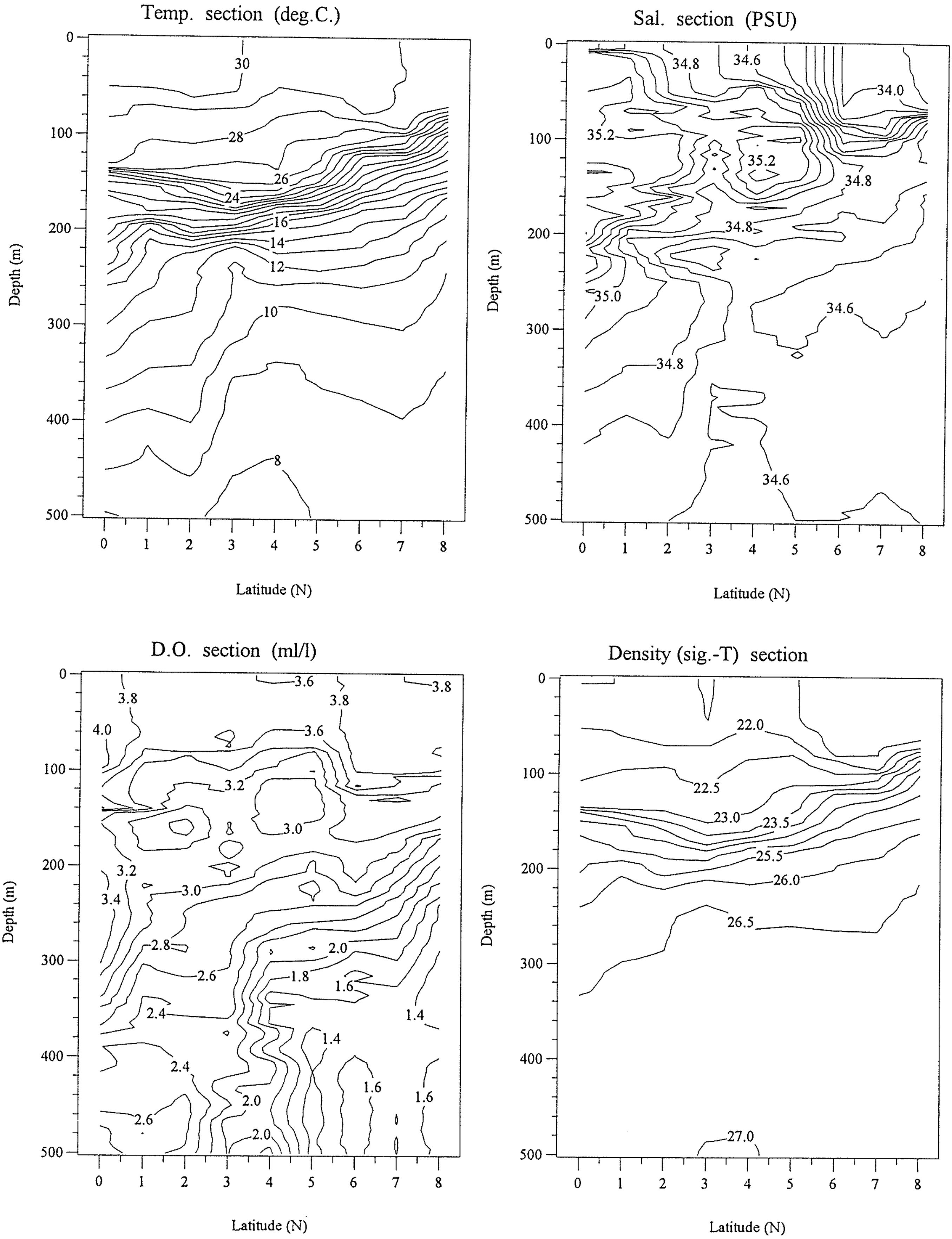
D.O. section (ml/l)



Density (sig.-T) section

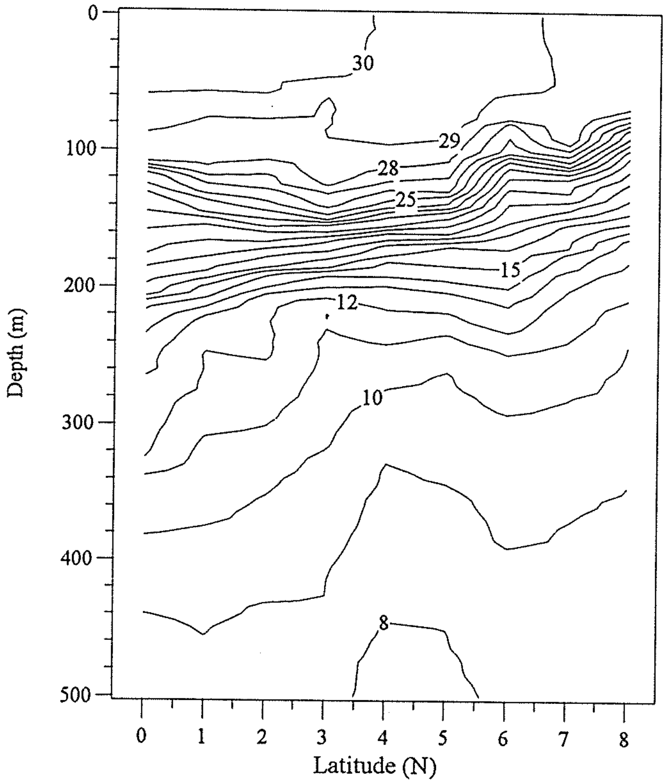


Between Stn.C05 and C013 (from 0,165E to 8N156E)

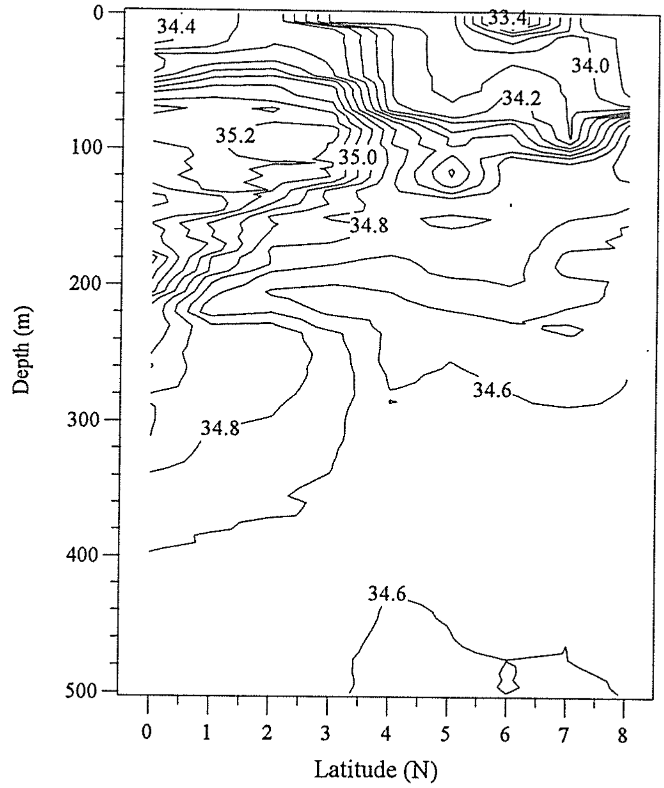


Between Stn.C13 and C21 (along 156E)

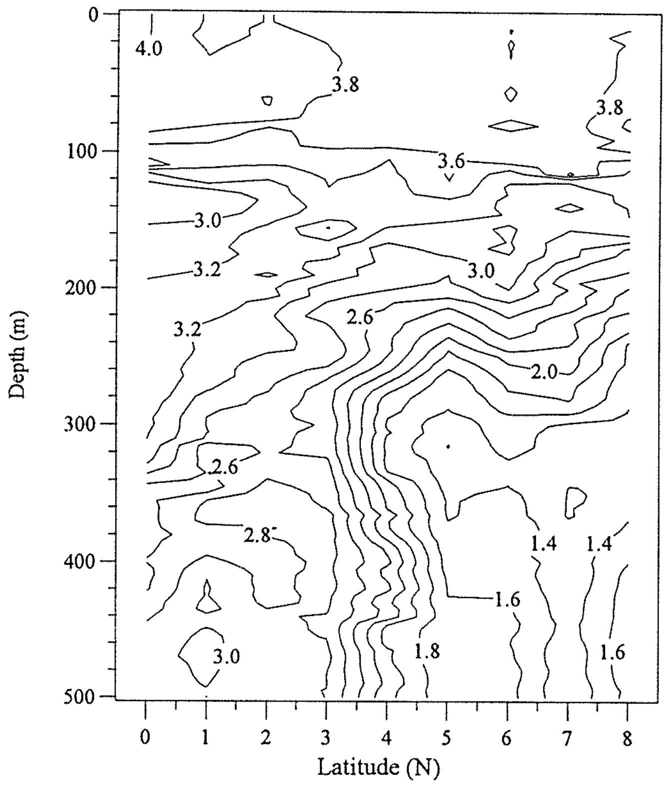
Temp. section (deg.C.)



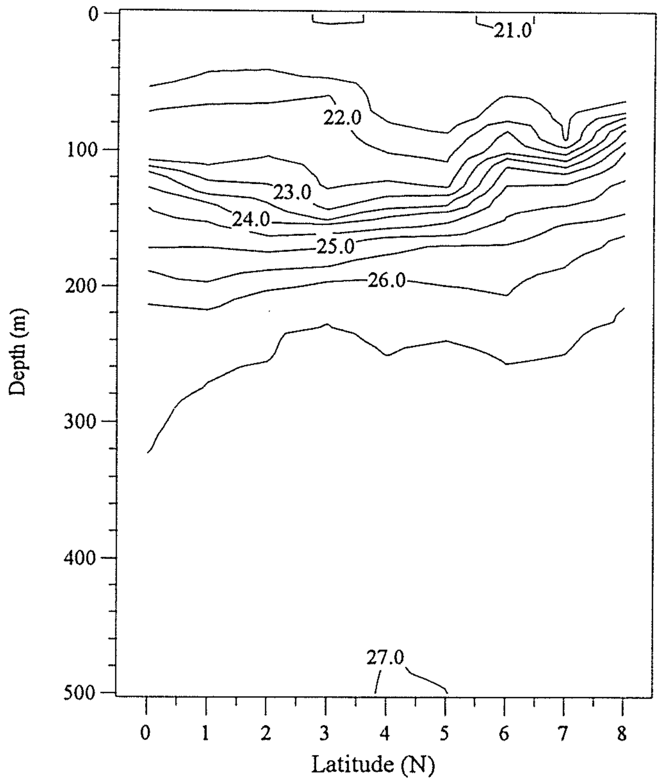
Sal. section (PSU)



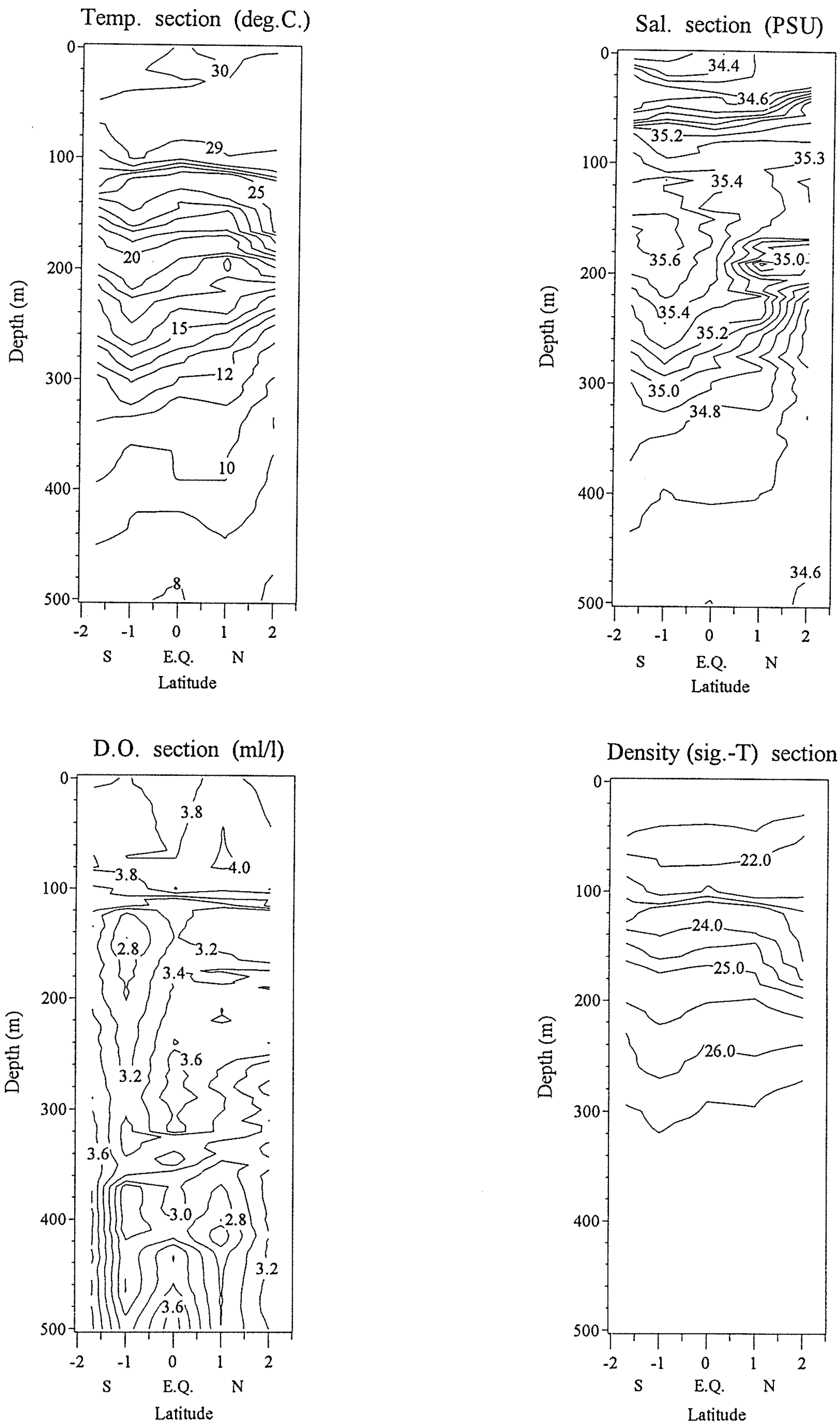
D.O. section (ml/l)



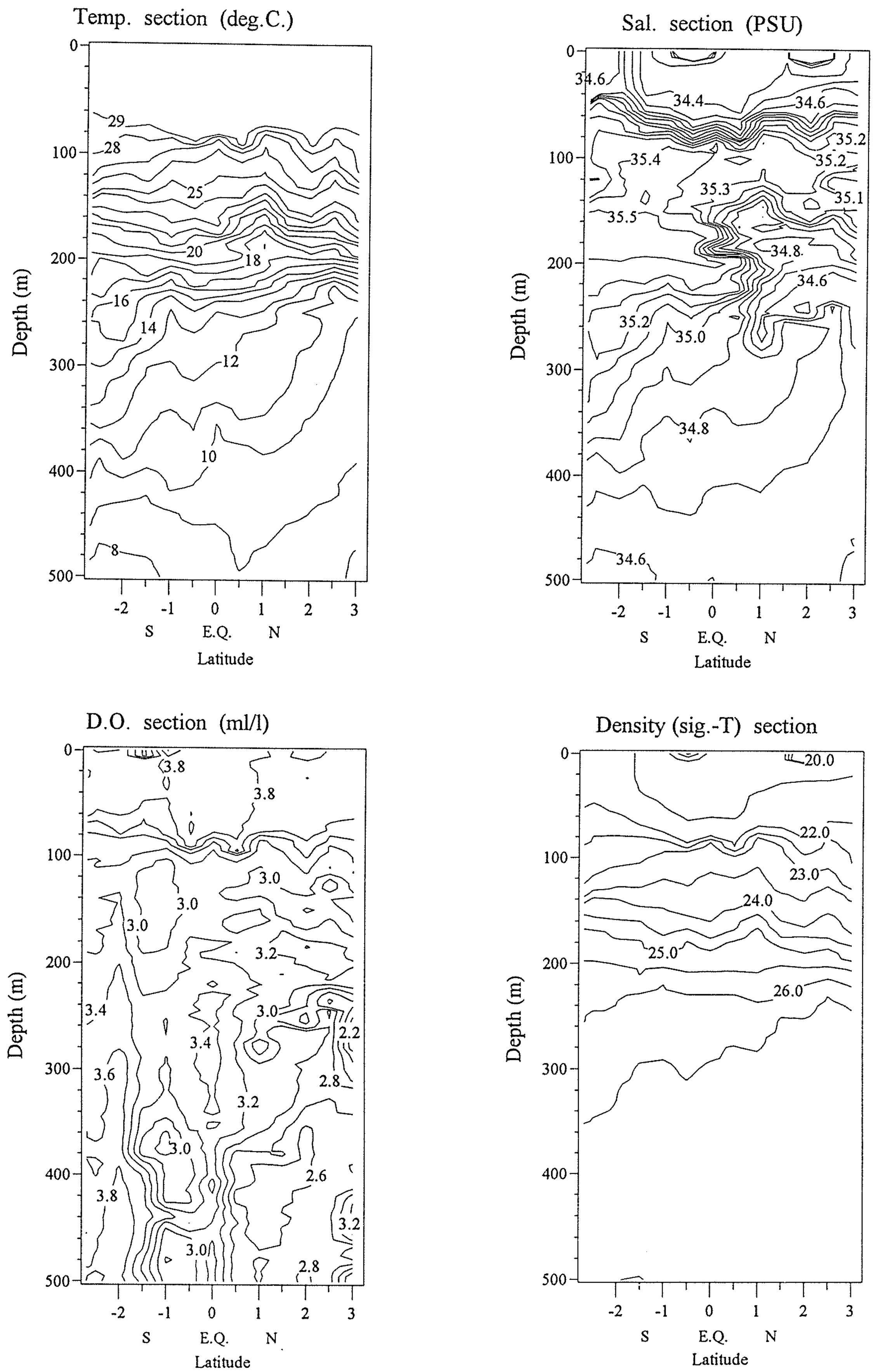
Density (sig.-T) section



Between Stn.C30 and C34 (along 147E)

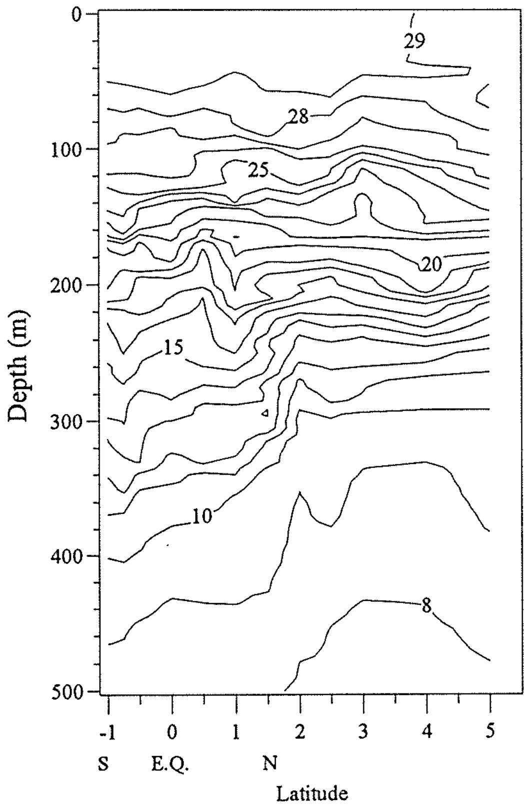


Between Stn.C39 and C51 (along 142E)

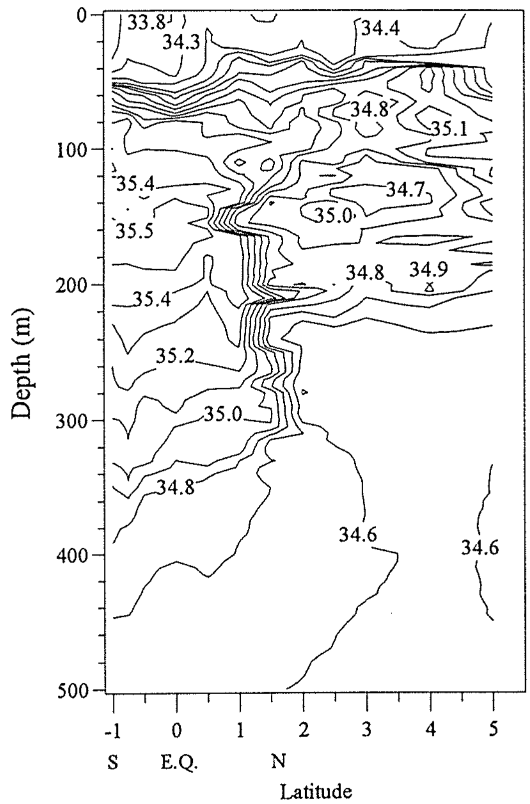


Between Stn.C55 and C66 (along 138E)

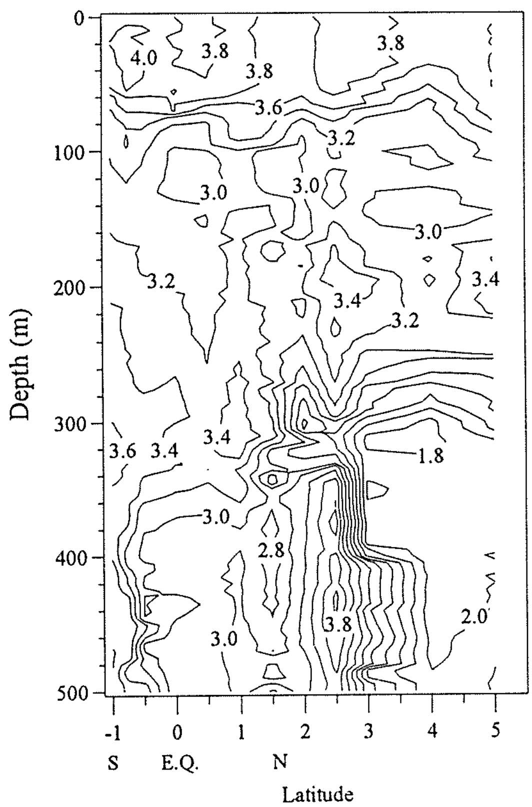
Temp. section (deg.C.)



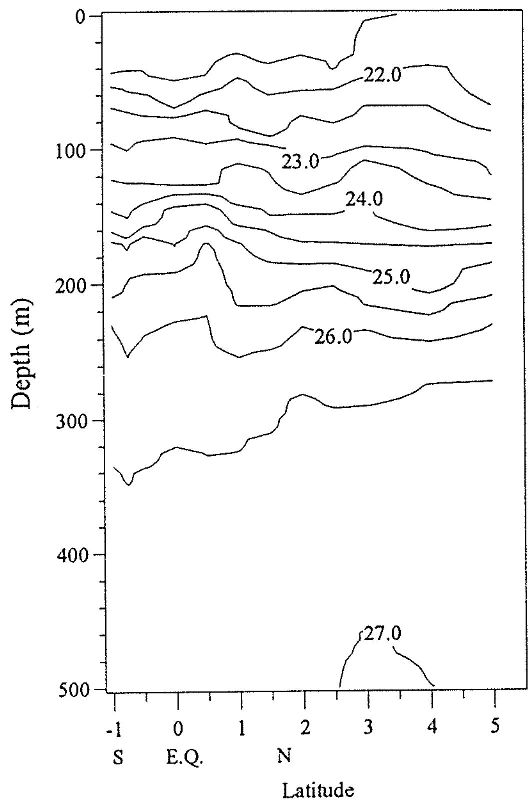
Sal. section (PSU)

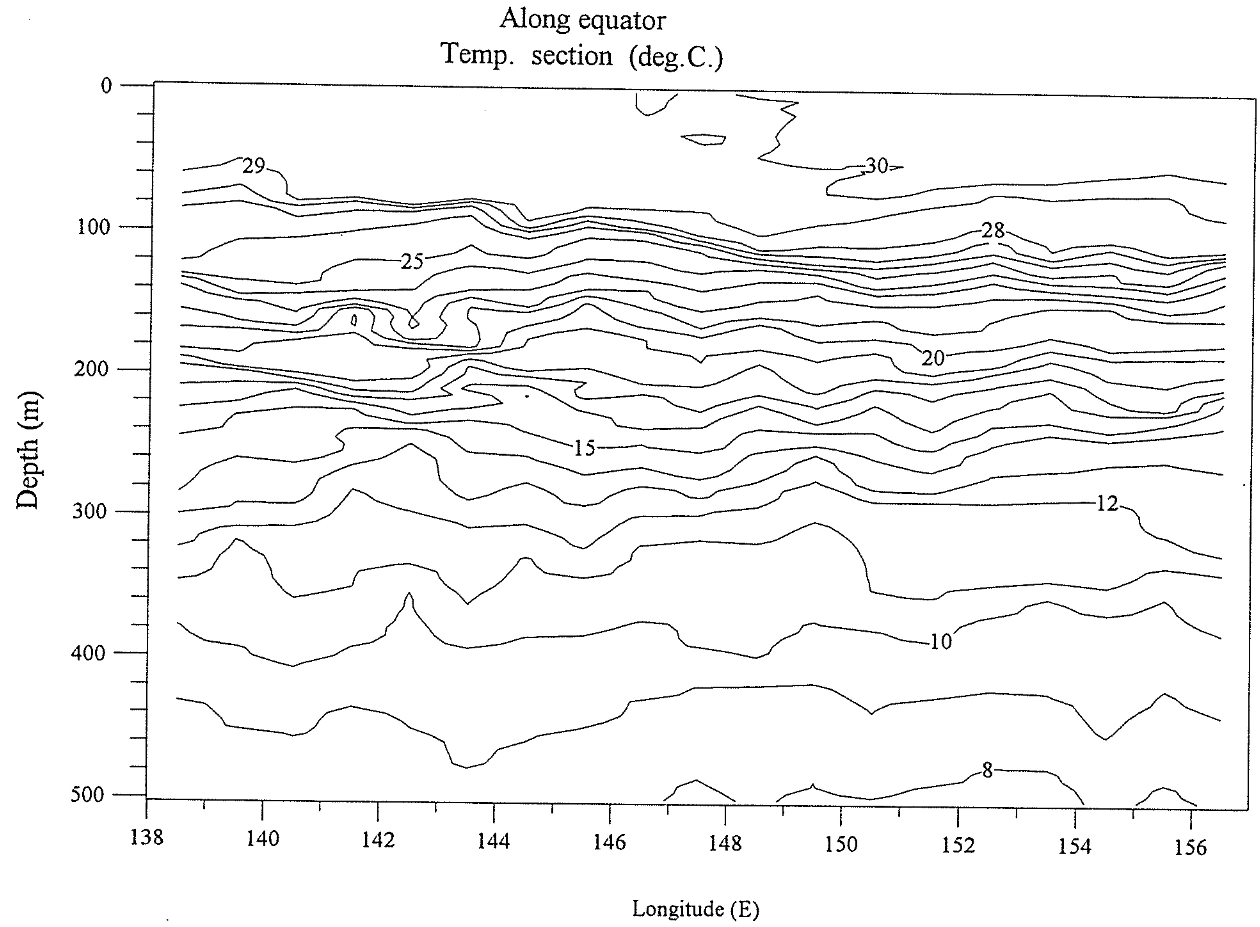


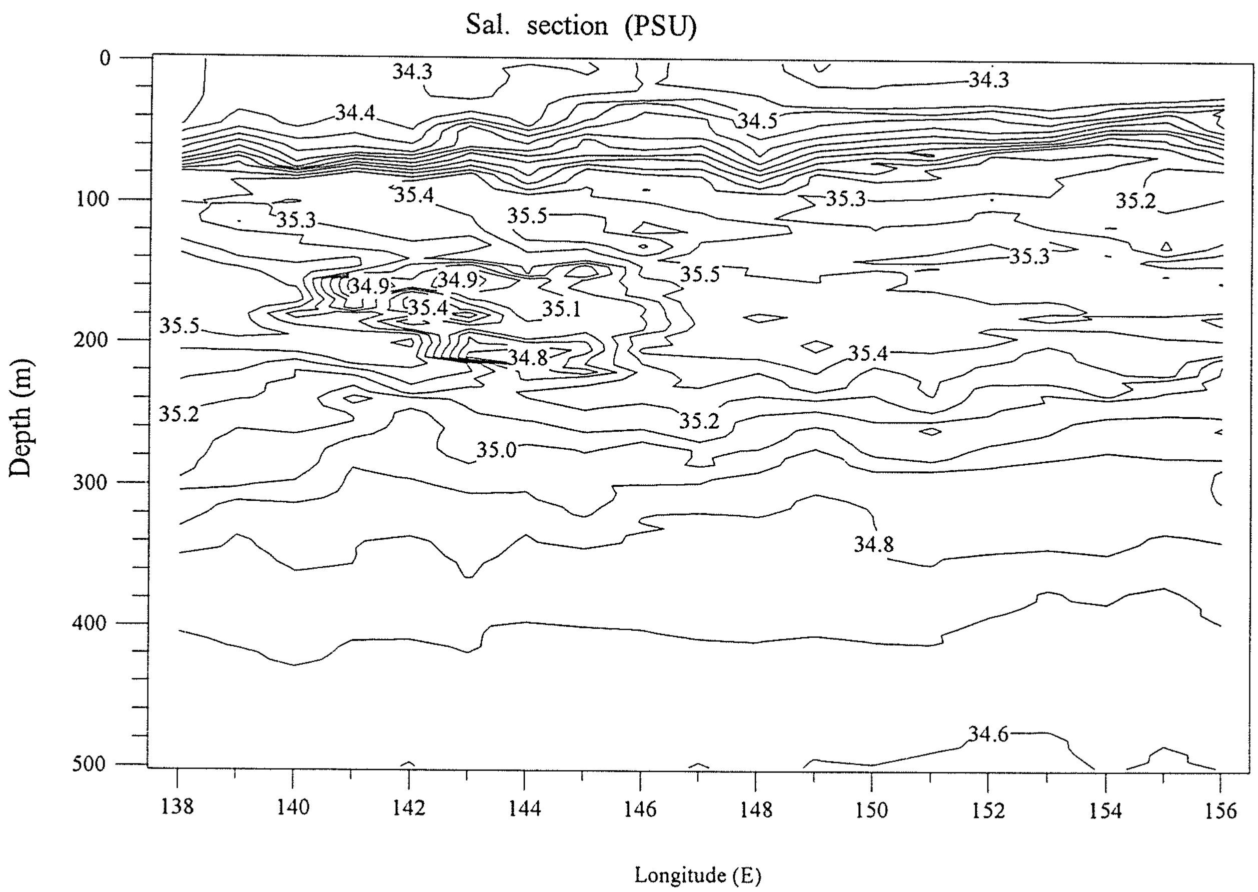
D.O. section (ml/l)

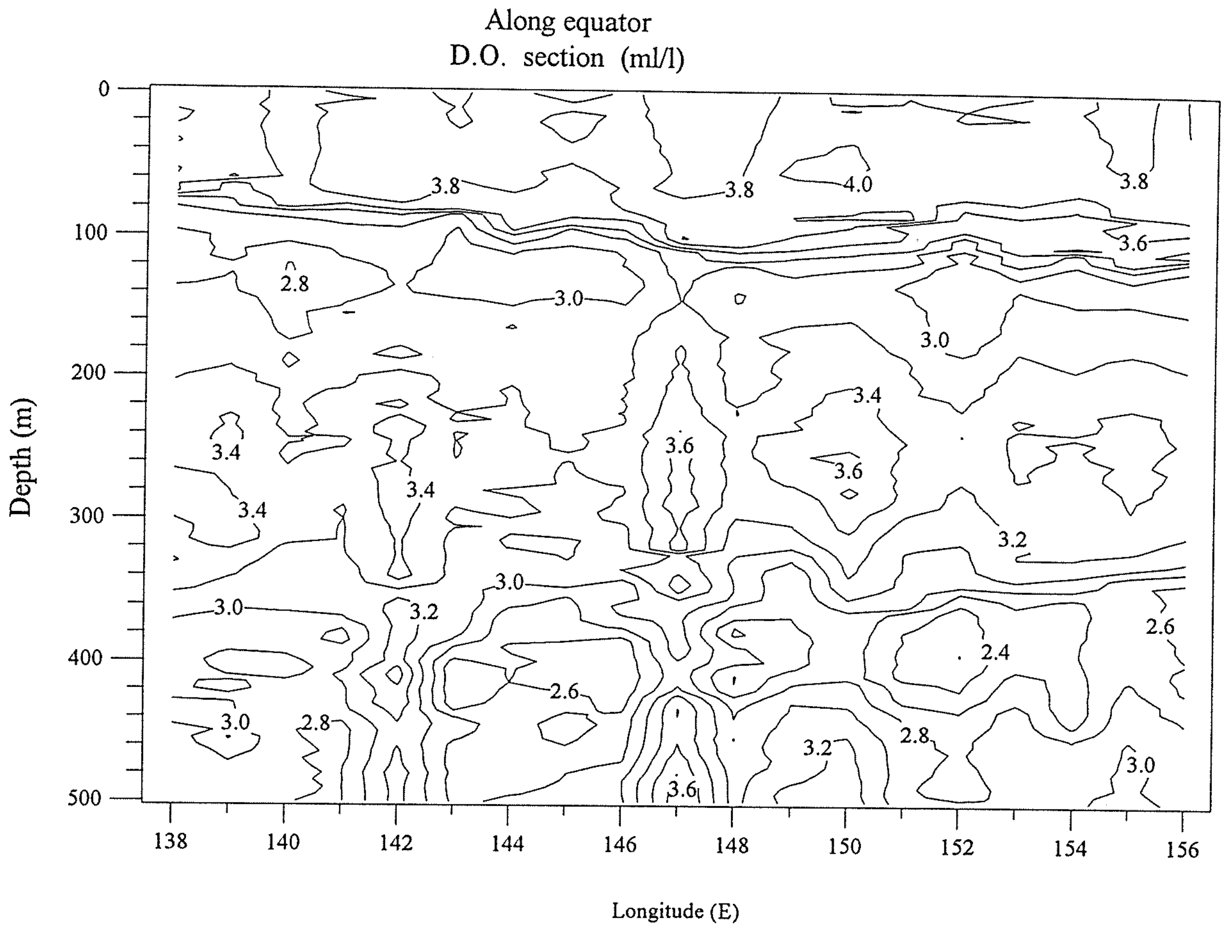


Density (sig.-T) section




Along equator
Temp. section (deg.C.)
Depth (m)
0
100
200
300
400
500
29
30
28
25
20
15
12
10
8
138
140
142
144
146
148
150
152
154
156
Longitude (E)


Sal. section (PSU)
Depth (m)
0
100
200
300
400
500
34.3
34.3
34.4
34.5
35.4
35.3
35.5
35.3
35.2
35.3
34.9
34.9
35.4
35.1
35.5
35.5
34.8
35.4
35.2
35.2
35.0
34.8
34.6
138
140
142
144
146
148
150
152
154
156
Longitude (E)


Along equator
D.O. section (ml/l)
Depth (m)
Longitude (E)
0
100
200
300
400
500
138
140
142
144
146
148
150
152
154
156
3.8
3.8
4.0
3.8
3.6
2.8
3.0
3.0
3.4
3.6
3.6
3.4
3.4
3.4
3.2
3.0
3.0
3.2
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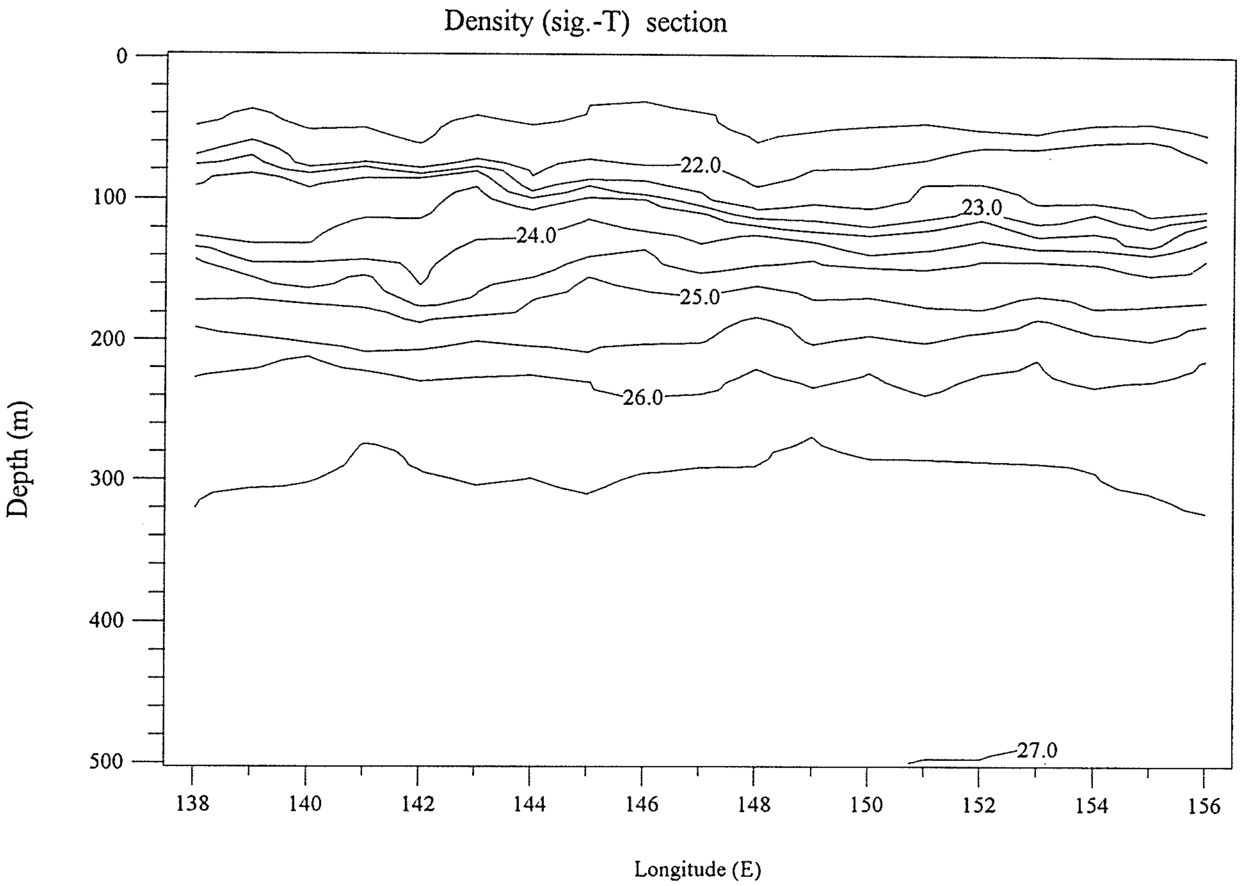
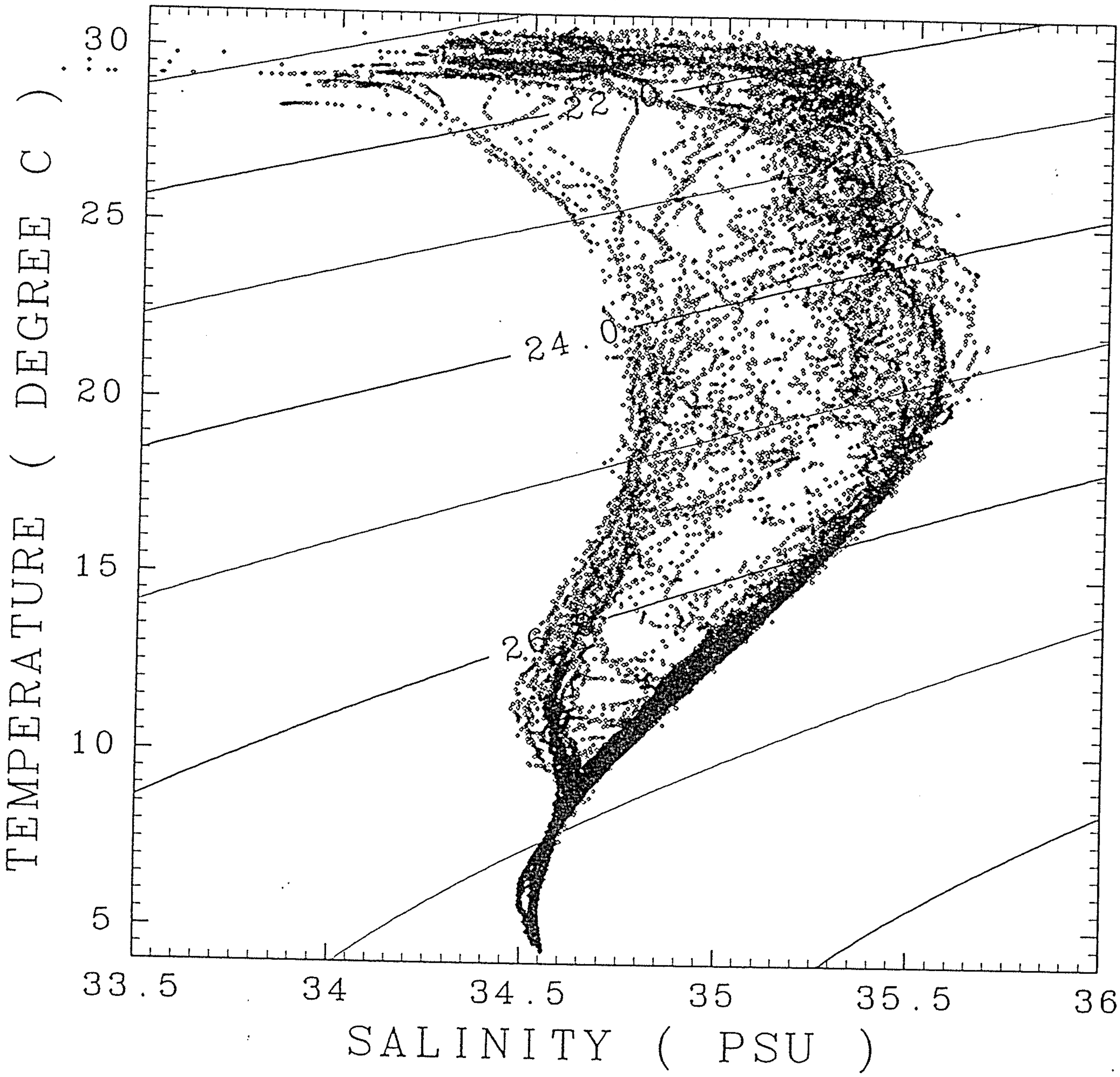
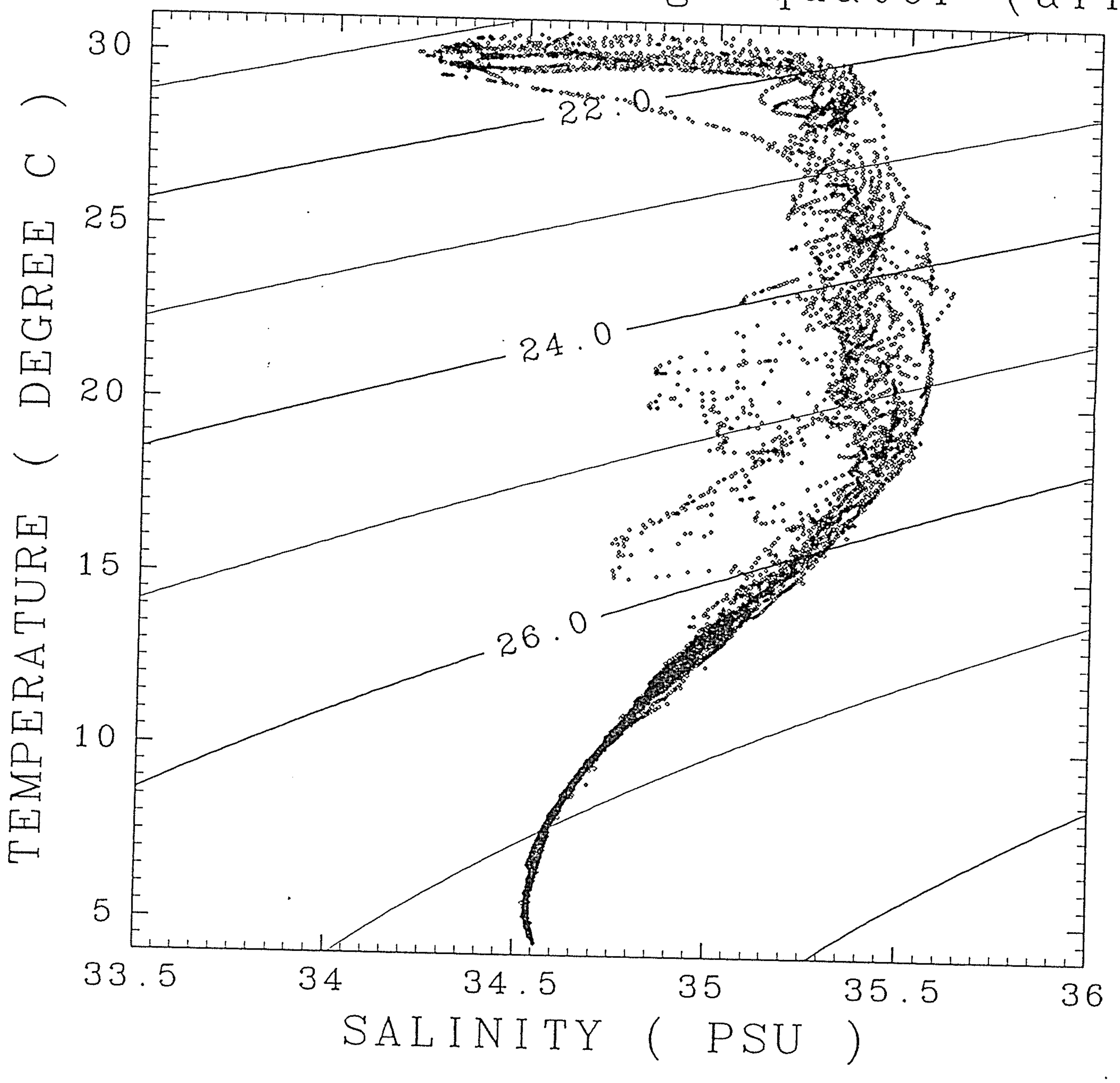
2.8
3.0
3.6


Density (sig.-T) section
Depth (m)
Longitude (E)
0
100
200
300
400
500
138
140
142
144
146
148
150
152
154
156
22.0
23.0
24.0
25.0
26.0
27.0

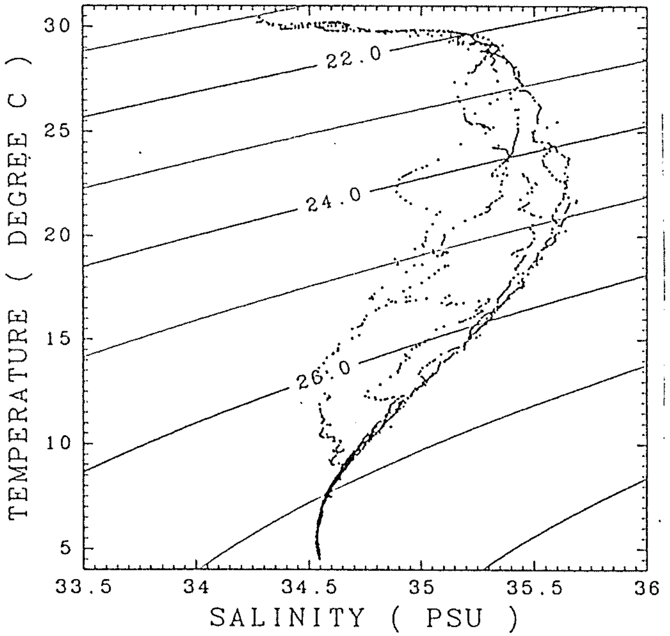
T-S diagram ALL



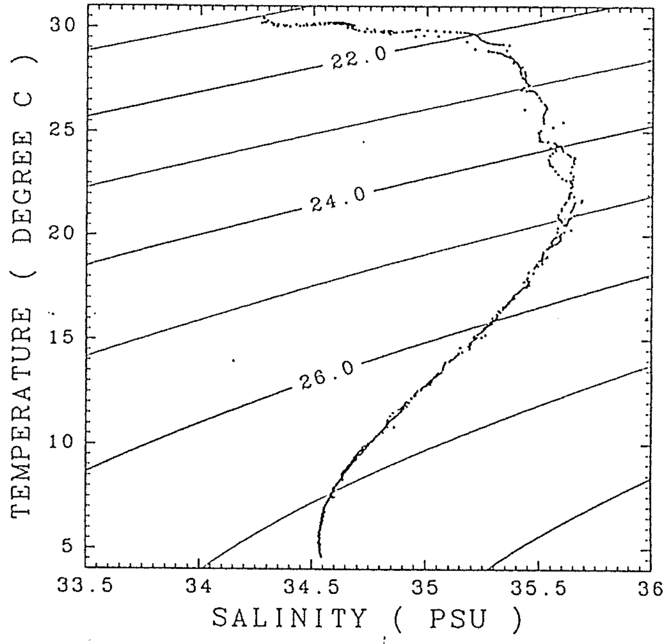
T-S diagram along equator (all



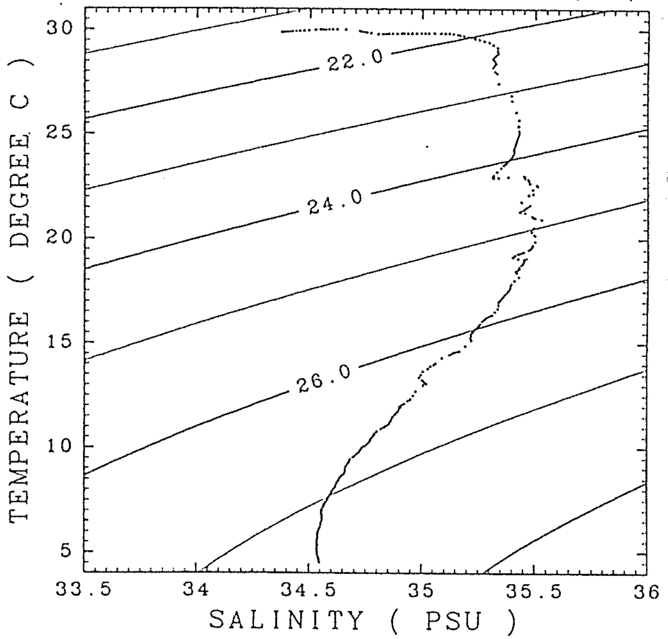
T-S diagram along 147E (all)



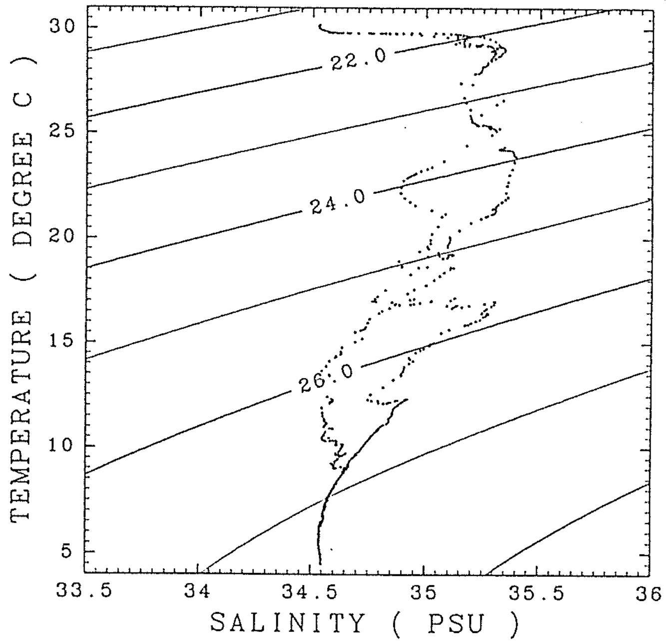
T-S diagram along 147E (South)

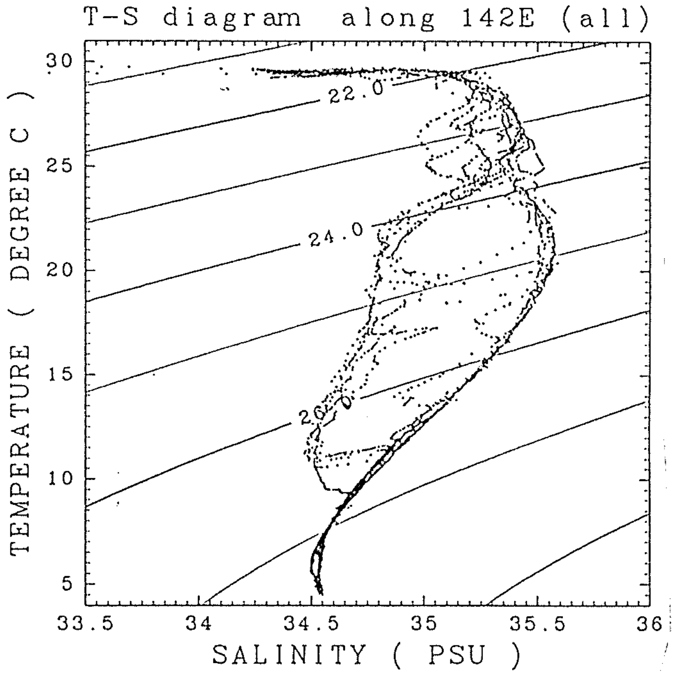


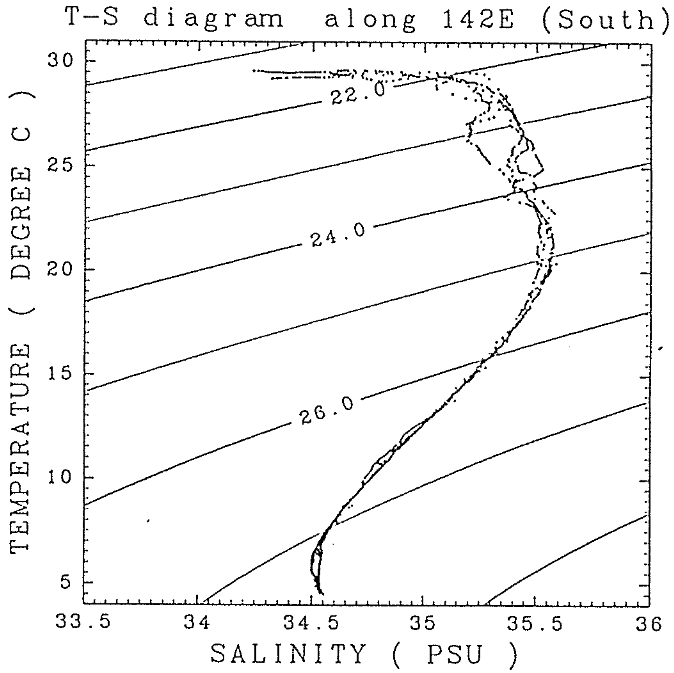
T-S diagram along 147E (EQ)

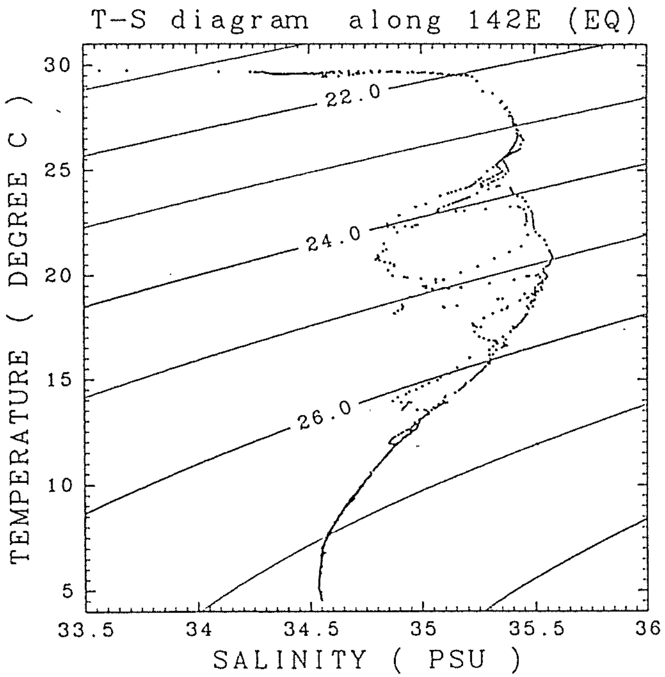


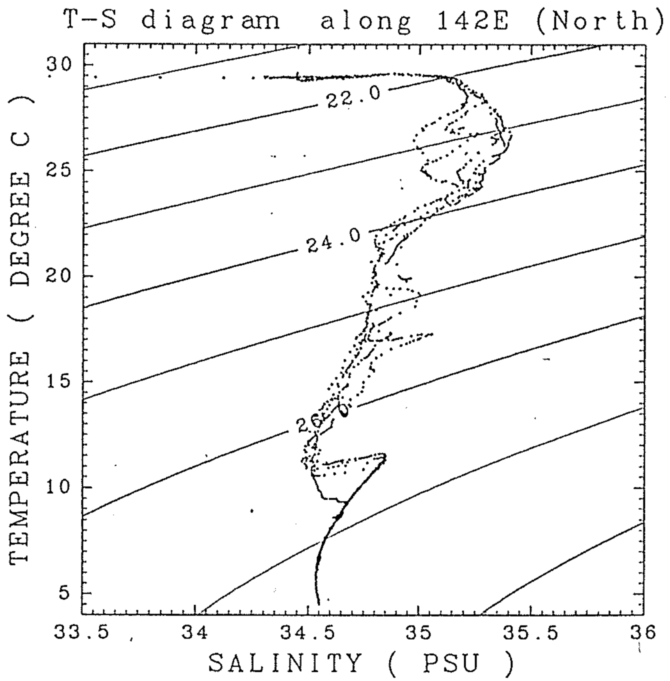
T-S diagram along 147E (North)

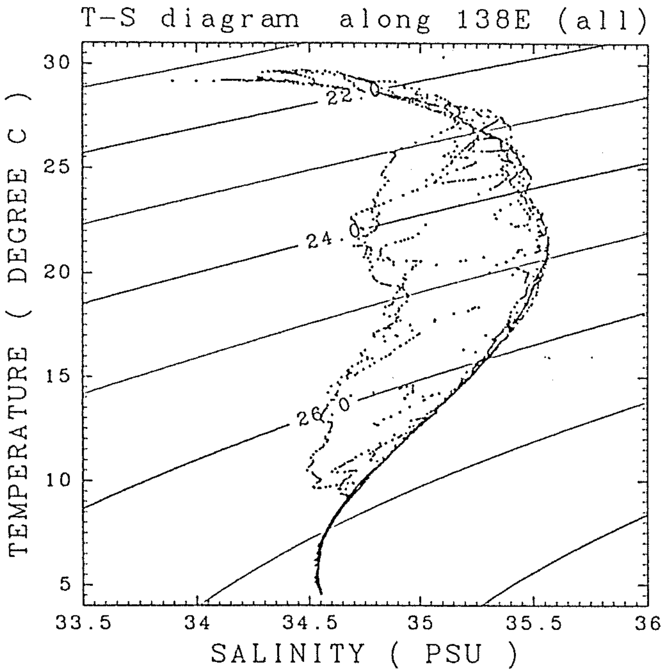


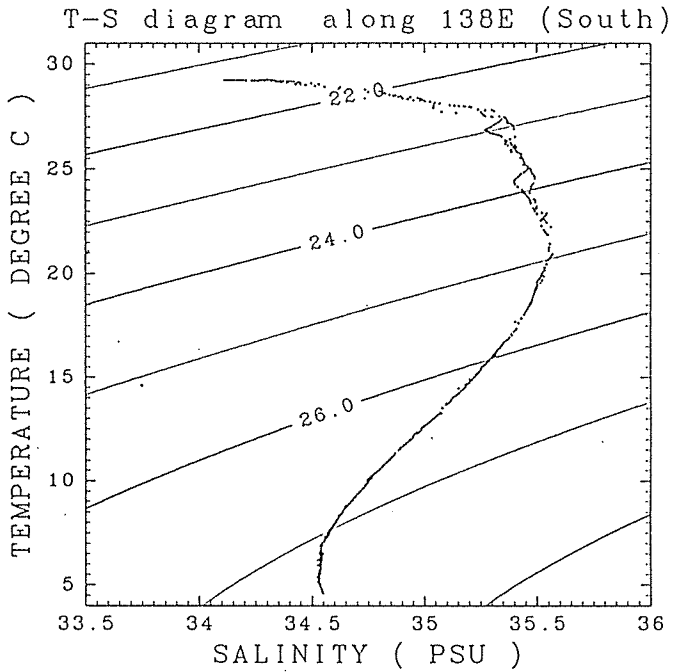

T-S diagram along 142E (all)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
5
10
15
20
25
30
33.5
34
34.5
35
35.5
36
22.0
24.0
26.0

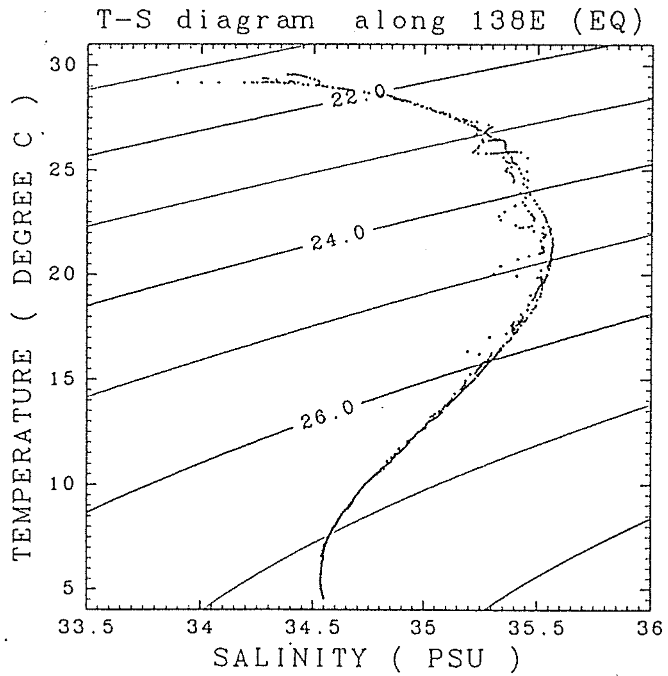

T-S diagram along 142E (South)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
5
10
15
20
25
30
33.5
34
34.5
35
35.5
36
22.0
24.0
26.0

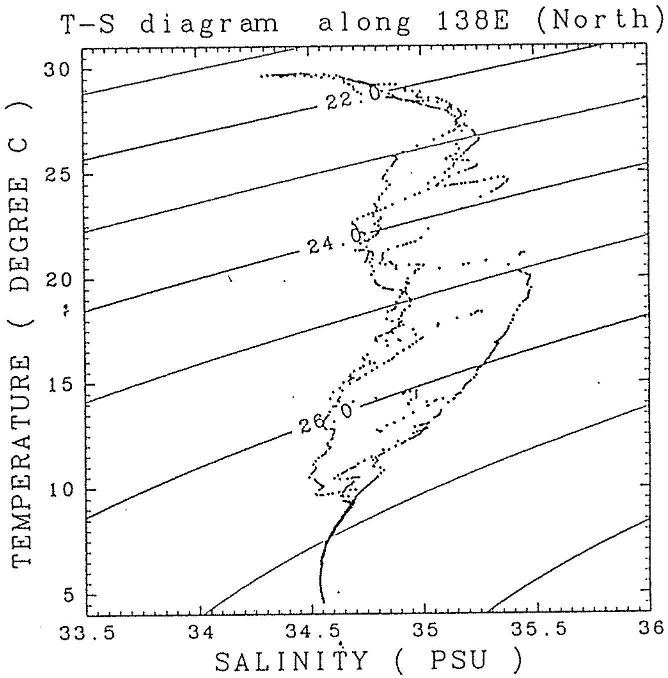

T-S diagram along 142E (EQ)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
5
10
15
20
25
30
33.5
34
34.5
35
35.5
36
22.0
24.0
26.0


T-S diagram along 142E (North)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
5
10
15
20
25
30
33.5
34
34.5
35
35.5
36
22.0
24.0
26


T-S diagram along 138E (all)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
22.0
24.0
26.0


T-S diagram along 138E (South)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
22.0
24.0
26.0


T-S diagram along 138E (EQ)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
22.0
24.0
26.0


T-S diagram along 138E (North)
TEMPERATURE (DEGREE C)
SALINITY (PSU)
22.0
24.0
26.0

4.5 Bottle Salinity

Objectives

The salinity measured by Autosal were compared with CTD data.

Materials and Methods

Samples were collected at 12 layers from 5 stations by Niskin water sampler. Samples were stored in 250ml Phoenix brown glass bottles with screw caps and kept until measurements.

Salinity were measured using Guildline Autosal model 8400B. It was carried out in the third laboratory of the ship and the bath temperature was 27 °C during the measurement of the leg.1 samples and 24 during that of leg.2 samples. Standardization was carried out using IAPSO standards seawater (Batch P124; Ocean Scientific International Ltd.). To check the drift of the data, Sub-standard seawater was measured every 8 samples.

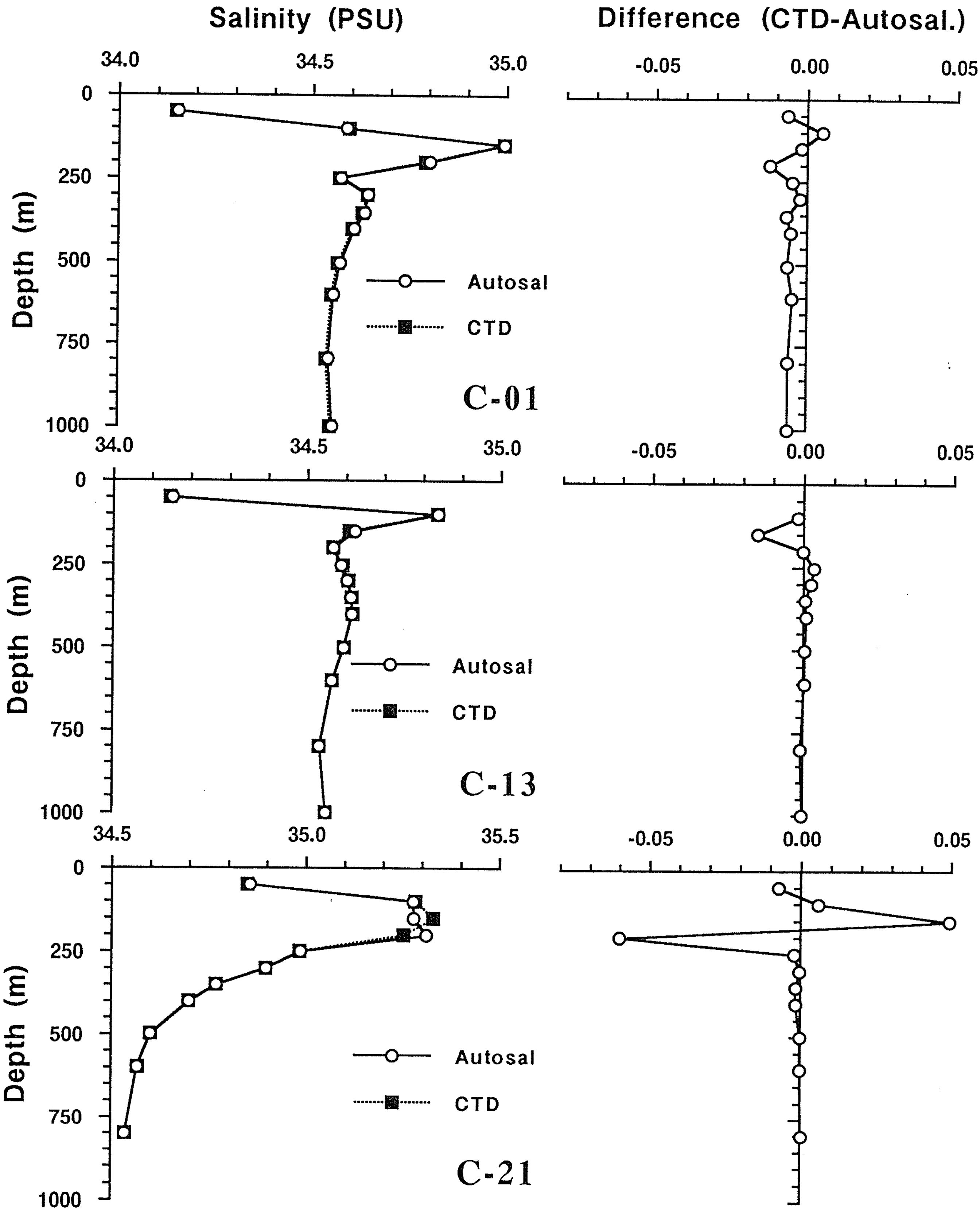
Preliminary results

The results were shown at tables and figures.

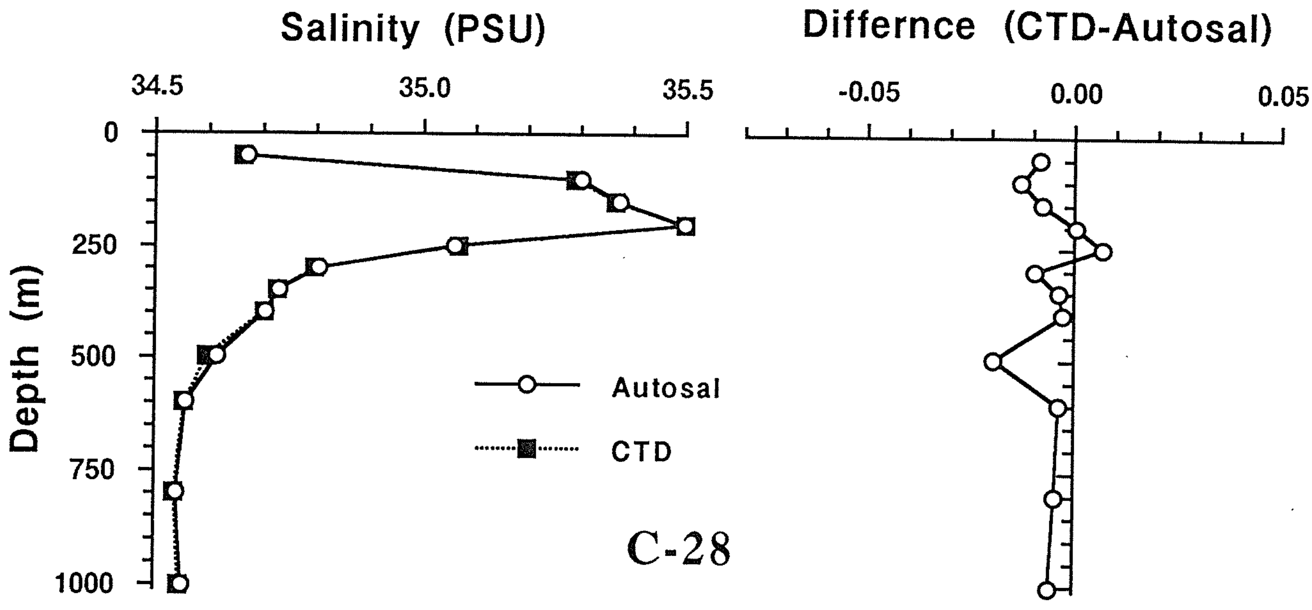
The differences between Autosal and CTD salinity below the 300m depth were less than 0.004 except St. C-01 and St. C-28. In these layers, these difference were about 0.005-0.007 at St. C-01 and about 0.003-0.019 at St.C-28. These difference above 250 m depth were ranged from 0.0003 to 0.0602 caused by halocline. The standard deviation of measurements below 300m depth except St. C-01 and St. C-28 were 0.0013 (n=21) and that of all layers were 0.0158 (n=35).

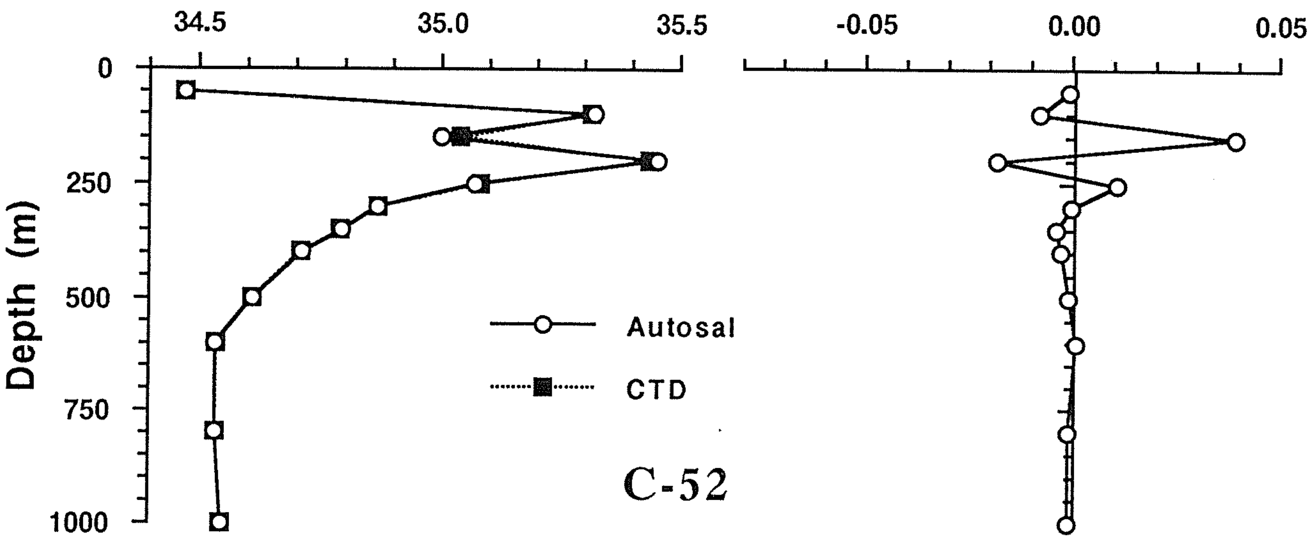
St. No.	Depth (m)	Sal. (PSU) A	CTD Sal. (PSU) B	Diiference B-A
C01	1000	34.5529	34.5465	-0.0064
	796	34.5419	34.5356	-0.0063
	602	34.5540	34.5490	-0.0050
	505	34.5712	34.5645	-0.0067
	403	34.6074	34.6018	-0.0056
	354	34.6344	34.6275	-0.0069
	300	34.6427	34.6402	-0.0025
	250	34.5731	34.5679	-0.0051
	200	34.8025	34.7900	-0.0125
	149	34.9952	34.9931	-0.0021
	101	34.5877	34.5925	0.0048
	50	34.1520	34.1452	-0.0067
C13	999	34.5499	34.5494	-0.0005
	800	34.5333	34.5323	-0.0010
	601	34.5648	34.5650	0.0002
	501	34.5944	34.5947	0.0003
	401	34.6159	34.6167	0.0008
	350	34.6133	34.6137	0.0004
	300	34.6034	34.6057	0.0023
	253	34.5872	34.5904	0.0032
	200	34.5666	34.5663	-0.0003
	150	34.6227	34.6074	-0.0153
	100	34.8383	34.8362	-0.0021
C21	1004	34.5482	34.5482	0.0000
	800	34.5362	34.5363	0.0001
	598	34.5673	34.5669	-0.0004
	499	34.6007	34.6003	-0.0004
	400	34.6994	34.6976	-0.0018
	349	34.7699	34.7681	-0.0018
	299	34.8971	34.8965	-0.0005
	249	34.9858	34.9835	-0.0023
	201	35.3118	35.2516	-0.0602
	151	35.2792	35.3286	0.0494
	100	35.2772	35.2829	0.0057
	50	34.8558	34.8483	-0.0075

St. No.	Depth (m)	Sal. (PSU) A	CTD Sal. (PSU) B	Difference B-A
C28	1002	34.5521	34.5463	-0.0058
	800	34.5412	34.5366	-0.0046
	599	34.5586	34.5550	-0.0036
	497	34.6166	34.5973	-0.0193
	399	34.7054	34.7028	-0.0026
	349	34.7308	34.7272	-0.0036
	300	34.8055	34.7961	-0.0094
	249	35.0602	35.0671	0.0069
	200	35.4986	35.4991	0.0005
	149	35.3743	35.3666	-0.0077
	100	35.3016	35.2888	-0.0128
	49	34.6707	34.6624	-0.0083
C52	1000	34.5490	34.5482	-0.0008
	799	34.5362	34.5354	-0.0008
	600	34.5357	34.5368	0.0011
	499	34.6113	34.6106	-0.0007
	398	34.7128	34.7102	-0.0026
	350	34.7937	34.7899	-0.0038
	300	34.8684	34.8683	-0.0001
	251	35.0706	35.0815	0.0109
	200	35.4533	35.4352	-0.0181
	150	34.9998	35.0391	0.0393
	99	35.3226	35.3148	-0.0078
	50	34.4727	34.4719	-0.0008



Vertical profile of bottle and CTD salinity


Salinity (PSU)
Differnce (CTD-Autosal)
34.5
35.0
35.5
-0.05
0.00
0.05
0
250
500
750
1000
Depth (m)
Autosal
CTD
C-28


34.5
35.0
35.5
-0.05
0.00
0.05
0
250
500
750
1000
Depth (m)
Autosal
CTD
C-52

4.6 Dissolved Oxygen Measurement

T. Shiribiki and K. Komine

Sanyo Techno Marine, Inc., Japan

Objective :

Measurement of dissolved oxygen using DO meter with correction of the Winkler titration.
Comparison of DO meter data corrected by the Winkler titration with CTD-DO data .

Instruments:

DO Meter : TOA Portable Dissolved Oxygen Meter Model DO-25A
Titrator : Metrohm Model 716 DMS Titrino / 10ml of titration vessel
Detector : Pt Electrode / 6.0401.100
Software : Data acquisition / Metrohm , METRODATA / 6.6013.000
Endpoint calculation / it was written in N88BASIC / MS-DOS(NEC)
DO Sensor : SEA BIRD ELECTRONICS, Inc., SBE 13 (BECMAN)

Methods :

The samples for DO Meter were collected from 5-liter Niskin water samplers into 100ml D.O.glass bottles. In each cast (see Fig. 4.1), several samples for the Winkler titration were collected into calibrated BOD flasks (ca,180ml)(see Green and Carritt 1966). During sampling, 3-bottle-volume of sample water was overflowed and sampling water temperature was measured .

After the sampling, the samples were immediately measured by D.O.Meter with salinity correction. Before the measurement, the DO Meter was adjusted to 0-100%(see TOA DO Meter operation manual).

The samples for the titration method were analyzed within 2 hours. The D.O. values were obtained by Metrohm piston buret of 10ml with Pt Electrode using whole bottle titration in the laboratory controlled temperature (ca,22 ' C).

We corrected the values of the DO Meter with calibration factors. The factors were a linear regression line based on the Winkler titration Value vs DO Meter Value.

The standardizations have been done everyday before the sample titration.

We refered to the WHP Operations and Methods(Culberson,1991).

Reproducibility:

(1) DO Meter Value

179 pairs of samples were analyzed as replicates taken same Niskin bottle.

Difference of replicates samples was an average of 0.008 ml/l, and standard deviation (2 sigma) of 0.016 ml/l (0.35% of D.O. maximum in this cruise)

(2) Winkler Titration Value

In the same way, 93 pairs of samples were analyzed. Difference was an average of 0.006 ml/l, and standard deviation (2 sigma) of 0.015 ml/l (0.32% of D.O. maximum in this cruise).

Results :

(1) DO Meter Value Correction

Linear regression line was obtained by 557 pairs of DO Meter - Winkler data.(Fig. 4.6.1) We corrected all DO Meter data by this formula, and corrected D.O. data were shows in Table 4.6.1.

Formula : $Y = 0.131 + 0.978 \times X$ (n = 557)
$R = 0.999$
Y : Winkler value (ml/l)   X : DO Meter value (ml/l)

(2) CTD-DO Sensor Value correction

In the same way, linear regression line was obtained by 998 pairs of CTD-DO Sensor - corrected D.O. data.(Fig. 4.6.2)

Formula : $Y = -0.411 + 1.298 \times X$ (n = 998)
$R = 0.969$
Y : Corrected D.O. value (ml/l) X : CDT-DO value (ml/l)

(3) Contour

Contours in Fig.4.6.3 were made from corrected dissolved oxygen data in Table 4.6.1.

Equator Line	: Stn 21,22,23,24,25,26,27,28,29,32,35,36,37,38,43,52,53,54,58
165 E Line	: Stn 3,4, 5
Line 3	: Stn 5,6,7,8,9,10,11,12,13
156 E Line	: Stn 13,14,15,16,17,18,19,20,21
147 E Line	: Stn 30, 32, 33, 34
142 E Line	: Stn 39,40,41,42,43,44,45,46,47,48,49,50,51
138 E Line	: Stn 55,56,57,58,59,60,61,62

(4) Coments

Contour along Equator shows that water with same D.O. concentrations extend at same layer. But in section of equator, each water with different concentrations meets vertically below 400m depth.

High-D.O.(>3ml/l) water are presents to 500m depth in south side near island. And in north (5 N ~) low water (< 2ml/l) are presents below 400m depth.

Reference :

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

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

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

Horibe,Y., Y. Kodama and K.Shigehara(1972) Errors in sampling procedure for the determimation 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 used for the determimation of dissolved oxygen, Deep-Sea Res., 15, 237-238.

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

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

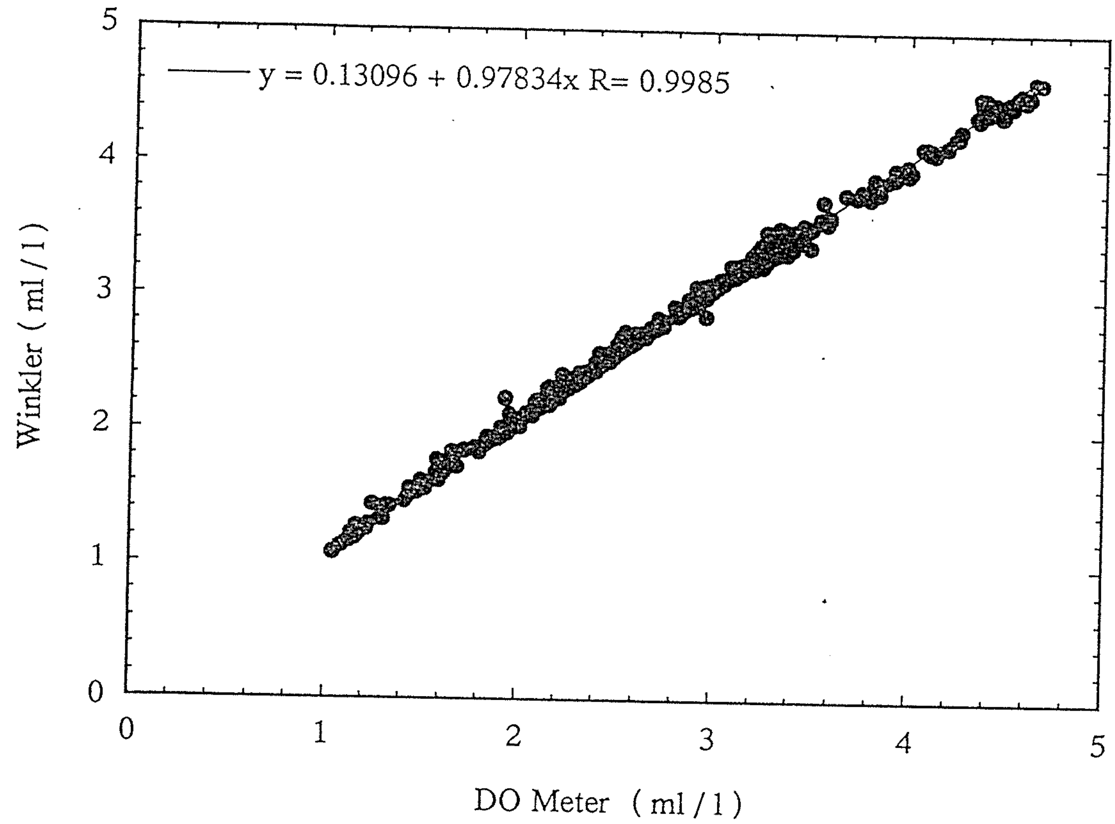


Fig. 4.6.1 DO Meter - Winkler

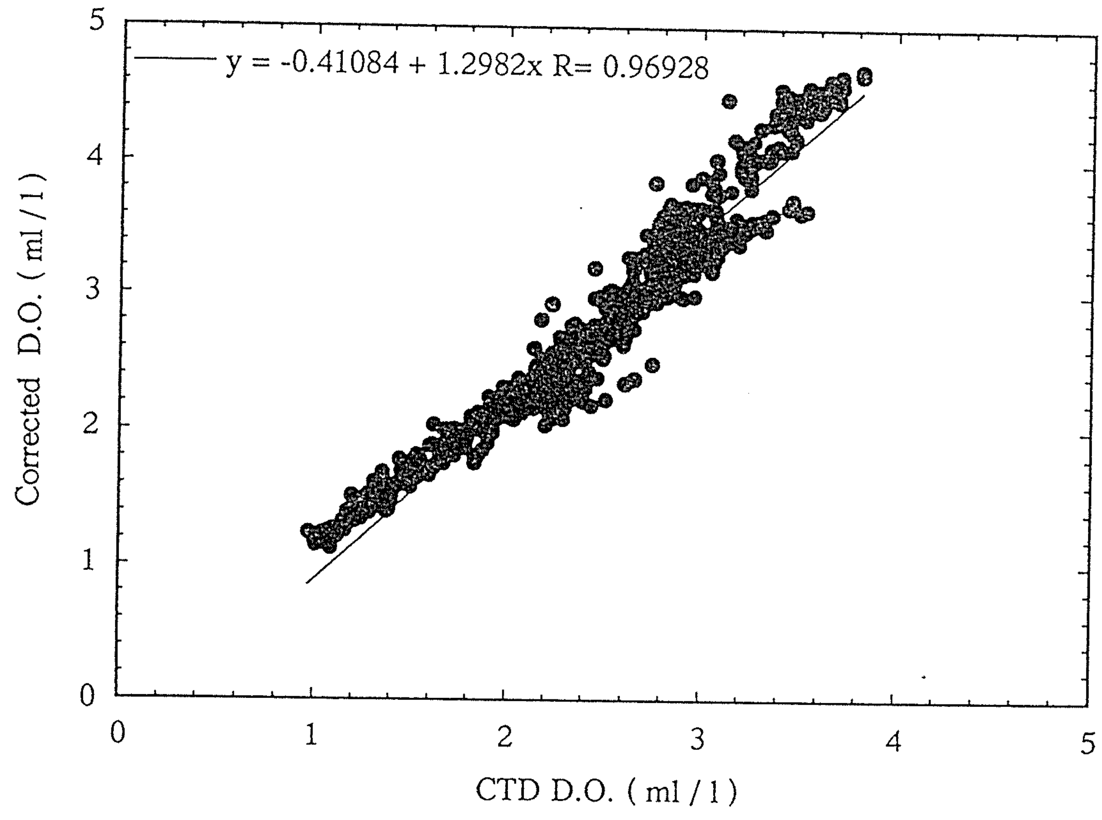


Fig. 4.6.2 CTD D.O. - Corrected D.O.

Equator Line

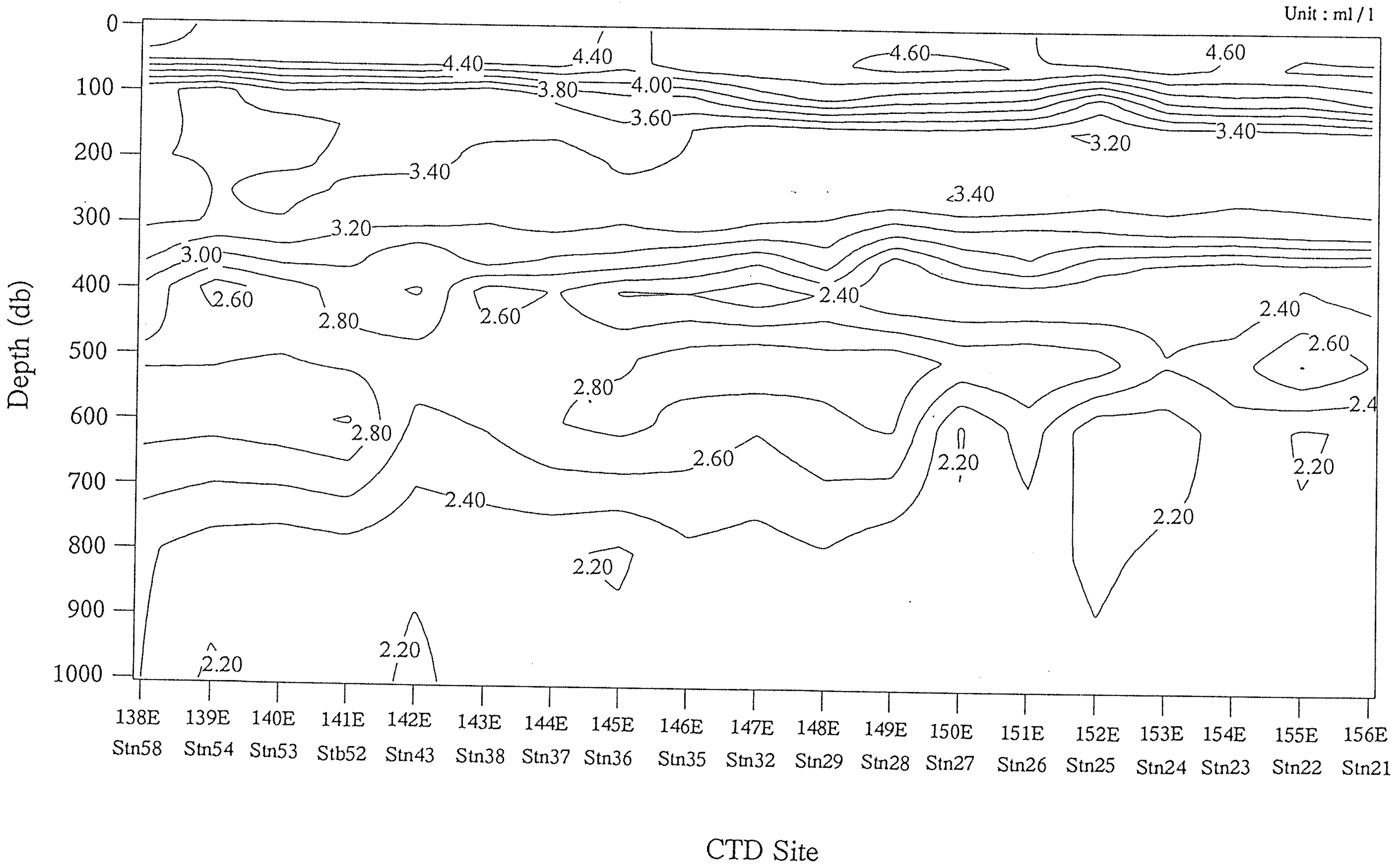


Fig. 4.6.3 (1) Dissolved Oxygen Contour

4.60

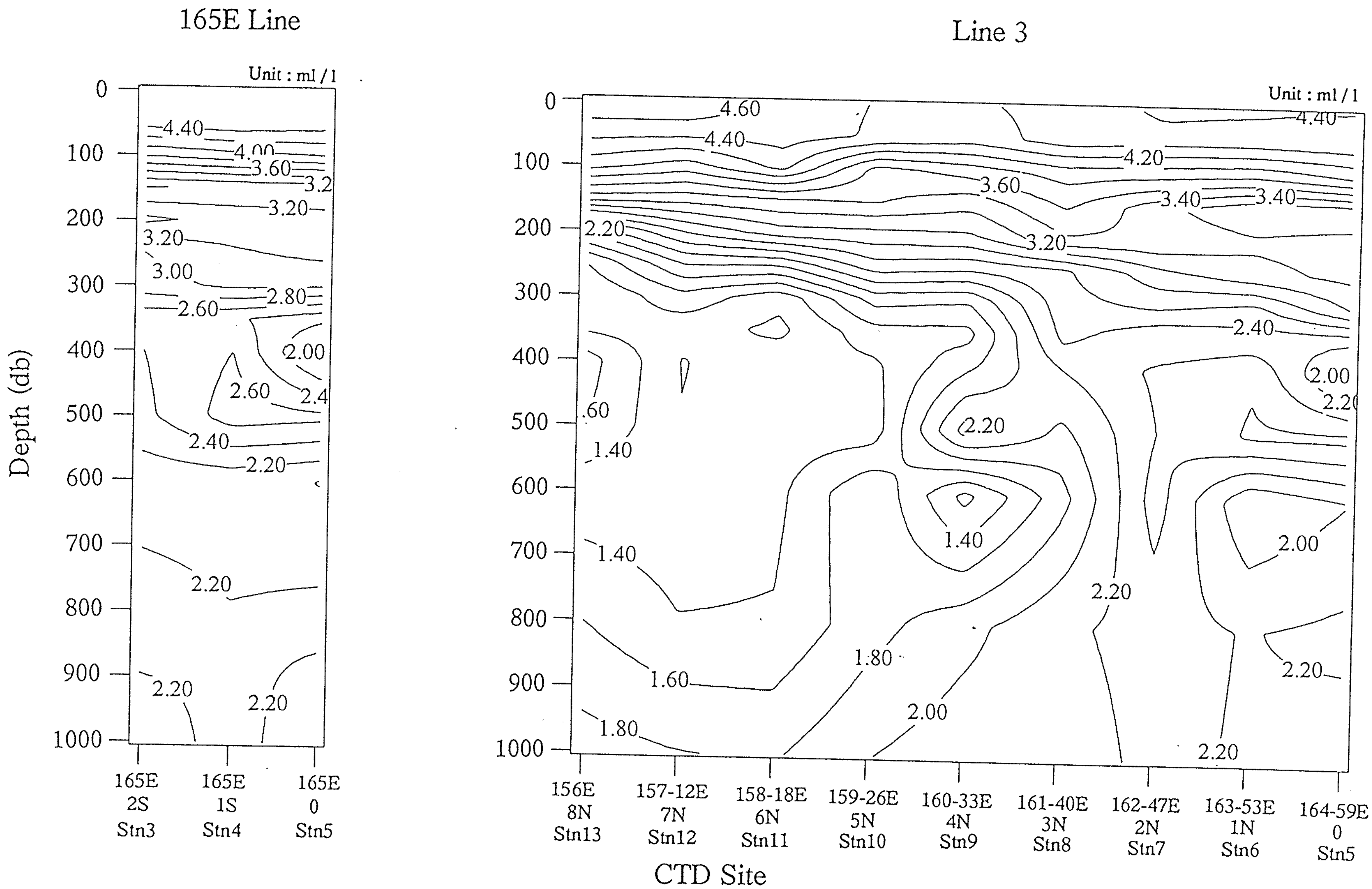


Fig. 4.6.3 (2) Dissolved Oxygen Contour

156E Line

Unit : ml / l

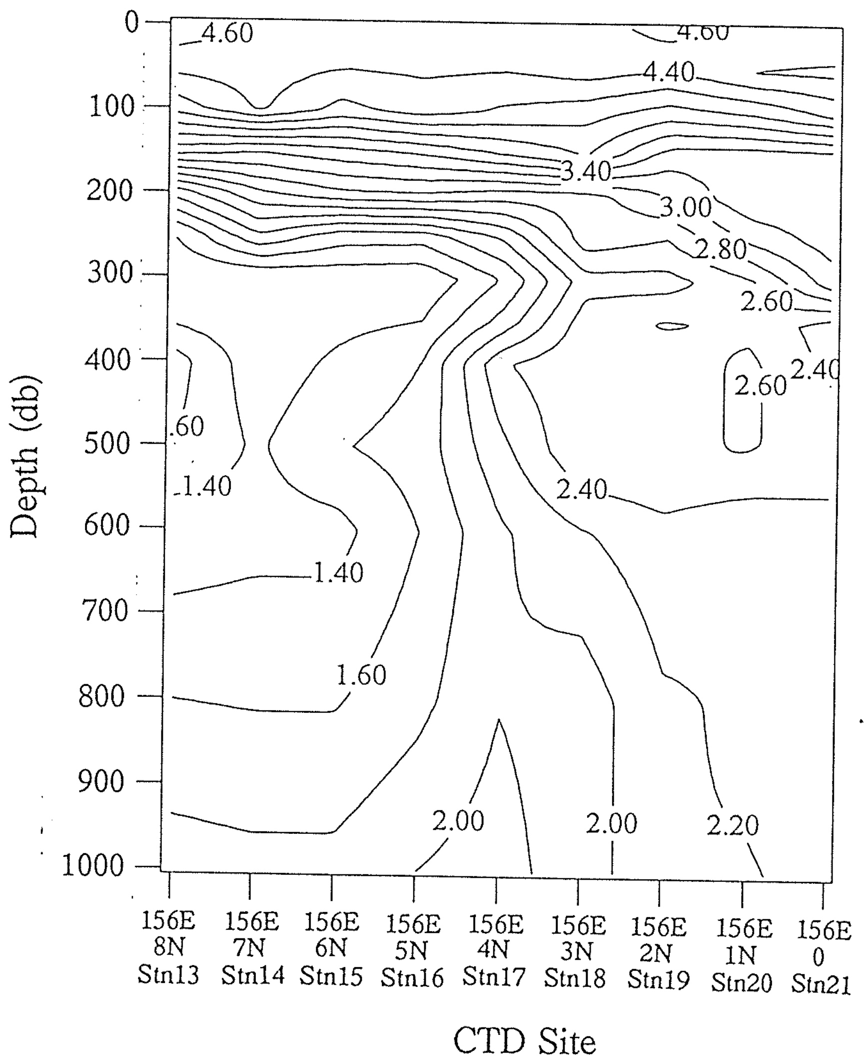


Fig. 4.6.3 (3) Dissolved Oxygen Contour

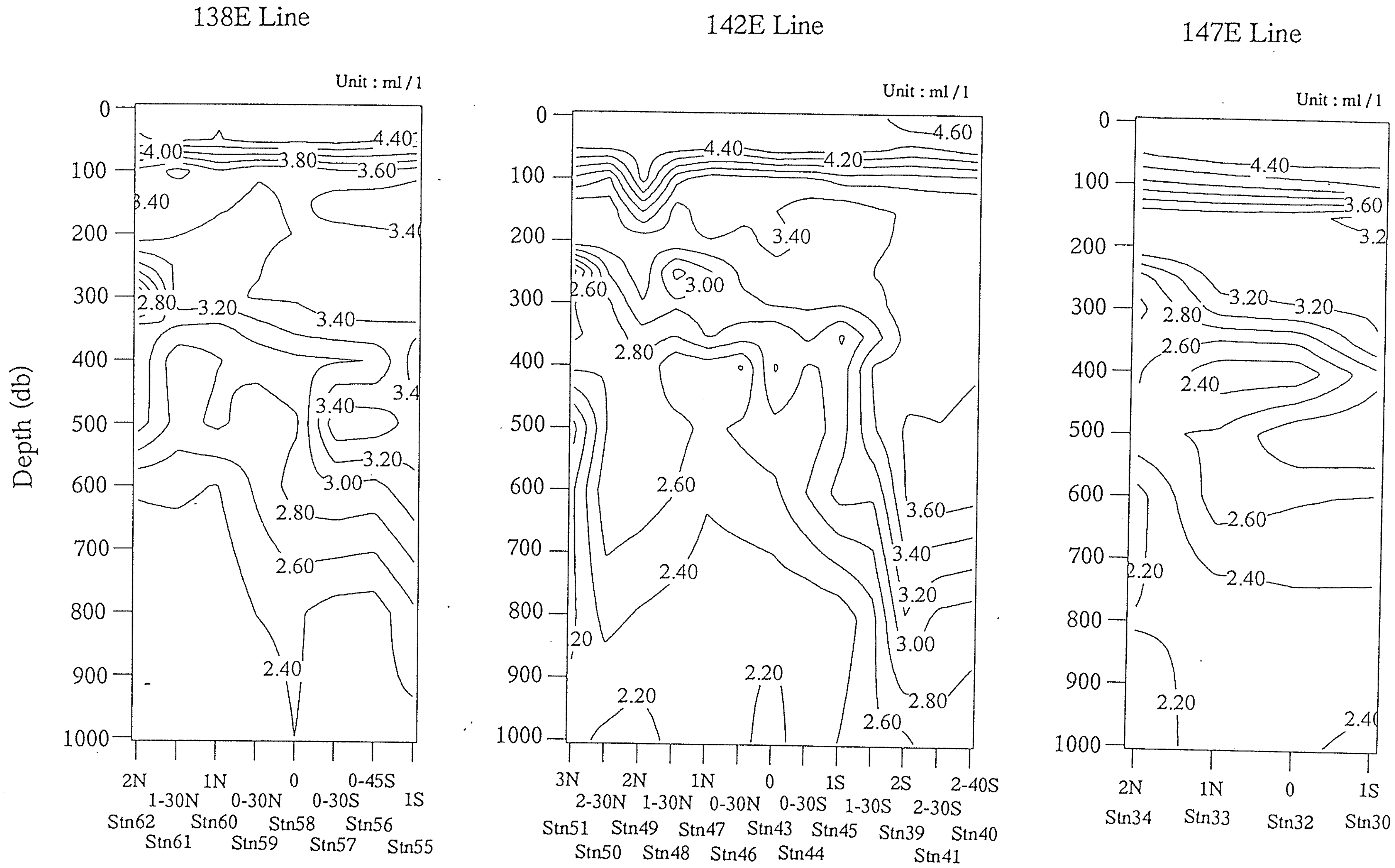


Fig. 4.6.3 (4) Dissolved Oxygen Contour

Table 4.6.1 (1)

K9601	STN. 1	K9601	STN. 2	K9601	STN. 3	K9601	STN. 4	K9601	STN. 5
4° 42 N	167° 37E	4° 03 N	166° 60E	1° 59 N	164° 58E	1° N	165° E	0° N	164° 59E
Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)
0	4.50	0	4.47	0	4.45	0	4.50	0	4.40
50	4.48	50	4.48	49	4.50	49	4.55	50	4.50
101	4.03	100	4.14	100	3.84	99	3.93	100	3.99
149	3.28	149	3.23	152	2.99	152	3.03	153	3.05
200	3.20	199	3.25	202	3.44	199	3.34	201	3.29
250	1.52	250	2.60	252	3.00	249	3.17	249	3.25
300	1.25	299	1.31	302	2.93	300	3.05	299	3.00
354	1.19	350	1.46	351	2.48	349	2.43	347	2.24
403	1.41	399	1.65	402	2.41	401	2.60	398	1.87
505	2.30	500	1.95	500	2.35	501	2.70	495	2.65
602	1.99	600	1.88	599	2.08	599	2.08	599	1.99
796	2.00	798	n.d.	800	2.31	798	2.21	799	2.25
1000	2.04	999	2.15	1000	2.08	999	2.28	1002	2.09

K9601	STN. 6	K9601	STN. 7	K9601	STN. 8	K9601	STN. 9	K9601	STN. 10
1° N	163° 53E	2° N	162° 47E	3° N	161° 40E	4° ' N	160° 33E	5° N	159° 26E
Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)
0	4.39	0	4.38	0	4.47	0	4.37	0	4.39
51	4.45	52	4.44	49	4.50	52	4.29	51	4.37
100	3.81	100	3.86	98	3.89	100	3.69	100	3.53
152	3.02	149	3.25	149	3.63	150	3.26	150	3.41
201	3.24	199	3.36	200	3.38	200	2.97	200	2.93
250	3.13	250	2.94	250	2.57	251	2.44	248	2.52
299	2.56	301	2.65	300	2.53	301	1.82	300	1.89
349	2.28	351	2.22	348	2.46	351	1.53	349	1.53
400	2.57	400	2.44	398	2.21	400	1.76	399	1.37
499	2.63	500	2.40	499	1.95	498	2.31	500	1.28
600	1.81	600	2.49	600	1.71	600	1.13	599	1.80
800	2.19	800	2.28	796	2.17	799	1.93	801	1.72
1001	2.18	999	2.25	1002	2.08	1002	2.12	1001	1.99

K9601	STN. 11	K9601	STN. 12	K9601	STN. 13	K9601	STN. 14	K9601	STN. 15
5° 59 N	158° 18E	7° N	157° 12E	8° N	156° 01E	7° N	156° E	6° N	156° E
Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)
0	4.49	0	n.d.	0	n.d.	0	n.d.	0	4.51
48	4.50	54	4.46	50	4.48	49	4.50	50	n.d.
100	4.26	101	3.90	100	4.10	101	4.43	100	4.13
149	3.38	150	3.30	150	3.33	150	3.23	150	3.33
200	2.91	204	2.63	200	2.12	202	2.57	203	2.75
249	2.01	250	2.02	253	1.42	250	2.00	250	1.70
301	1.26	299	1.54	300	1.24	300	1.24	301	1.28
350	1.15	349	1.29	350	1.35	351	1.24	351	1.34
400	1.32	398	1.19	401	1.68	400	1.27	401	1.44
501	1.29	500	1.21	501	1.60	500	1.37	501	1.58
600	1.34	600	1.26	601	1.27	600	1.33	602	1.33
800	1.42	799	1.41	800	1.60	800	1.58	800	1.58
1001	1.77	1000	1.81	999	n.d.	1003	1.86	1000	1.86

K9601	STN. 16	K9601	STN. 17	K9601	STN. 18	K9601	STN. 19	K9601	STN. 20
5° N	156° E	4° N	155° 59E	3° N	156° E	2° N	156° 05 E	1° N	156° E
Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)	Dep. (db)	O2(ml/l)
0	4.46	0	4.51	0	4.49	0	n.d.	0	4.47
50	n.d.	50	n.d.	51	4.49	50	4.40	49	4.60
100	4.29	100	4.16	100	4.08	101	3.90	99	4.01
149	3.43	149	3.62	152	3.81	150	3.30	151	3.27
199	2.78	200	2.68	202	2.71	198	2.99	200	3.36
250	1.69	250	2.04	251	2.71	249	2.60	248	3.03
299	1.23	299	1.62	300	2.32	300	2.32	299	2.55
350	1.40	350	1.89	350	2.51	352	2.62	349	2.55
401	1.60	401	2.38	399	2.58	402	2.48	400	2.65
500	1.69	500	2.15	497	2.59	501	2.60	500	2.60
601	1.60	599	1.97	599	2.18	599	2.33	601	2.23
800	1.74	798	1.99	800	1.88	801	2.17	800	2.23
1001	2.00	1002	2.10	999	n.d.	999	2.19	1001	2.19

Table 4.6.1 (2)

K9601	STN.21	K9601	STN.22	K9601	STN.23	K9601	STN.24	K9601	STN.25
0° N	156° 07E	0° N	154° 59E	0° N	154° E	0° N	152° 59E	0° N	152° E
Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)
0	4.43	0	4.56	0	4.53	0	n.d.	0	n.d.
50	4.64	49	4.62	49	4.56	49	n.d.	49	4.53
100	4.23	100	4.05	102	4.11	100	4.02	101	3.51
151	3.30	152	3.27	152	3.23	151	3.25	153	3.16
201	3.38	200	3.38	201	3.34	200	3.37	200	3.30
249	3.29	249	3.25	249	3.23	248	3.33	249	3.26
299	3.09	300	3.06	299	3.01	300	3.02	300	2.98
349	2.30	349	2.34	351	2.29	351	2.37	350	2.46
400	2.35	401	2.43	401	2.23	399	2.32	400	2.23
499	2.60	501	2.81	501	2.54	499	2.41	496	2.71
598	2.23	600	2.18	601	2.31	601	2.08	599	2.04
800	2.25	800	n.d.	798	2.23	800	2.25	801	2.17
1004	2.23	1000	2.24	1000	2.22	998	n.d.	1000	2.25

K9601	STN.26	K9601	STN.27	K9601	STN.28	K9601	STN.29	K9601	STN.30
0° 01 N	151° E	0° N	150° E	0° N	149° E	0° · N	148° E	1° N	147° 04E
Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)
0	4.58	0	4.56	0	4.51	0	4.58	0	4.51
48	4.59	49	4.62	49	4.68	47	4.55	49	4.51
98	3.96	100	4.03	100	4.09	99	4.27	100	4.19
150	3.25	150	3.31	149	3.33	151	3.30	149	3.10
200	3.33	202	3.36	200	3.27	201	3.32	200	3.28
249	3.37	249	3.42	249	3.34	249	3.39	250	3.28
299	2.95	300	2.99	300	2.88	299	3.12	299	3.23
348	2.78	349	2.61	349	2.28	349	2.90	350	3.18
399	2.21	399	2.20	399	2.21	399	2.43	399	2.73
500	2.80	500	2.75	497	2.95	500	2.88	499	3.00
600	2.50	599	2.18	599	2.83	599	2.75	600	2.58
800	2.28	799	2.23	800	2.23	799	2.38	799	2.32
1001	2.36	1000	2.34	1002	2.41	1000	2.25	1001	2.43

K9601	STN.31	K9601	STN.32	K9601	STN.33	K9601	STN.34	K9601	STN.35
1° 40 N	146° E	0° N	147° E	1° N	147° E	2° N	147° E	0°	146° E
Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)
0	4.64	0	4.49	0	4.55	0	4.49	0	4.49
50	4.61	51	4.58	49	4.55	49	4.42	48	4.58
100	3.76	98	4.10	101	4.03	102	3.95	99	3.79
148	3.34	148	3.26	152	3.31	152	3.26	151	3.40
200	3.31	198	3.35	205	3.38	202	3.28	201	3.38
250	3.32	249	3.37	251	3.30	249	2.72	250	3.37
300	3.26	301	3.16	300	3.09	300	2.55	302	3.25
351	3.30	350	2.62	348	2.60	350	2.69	349	2.80
400	3.25	399	2.26	399	2.27	400	2.61	399	2.41
500	3.21	501	2.98	499	2.63	499	2.56	500	2.90
599	2.99	601	2.62	600	2.71	600	2.12	599	2.73
799	2.38	799	2.31	799	2.21	799	2.21	801	2.35
1000	2.49	1002	2.38	998	2.29	1001	2.08	1000	2.34

K9601	STN.36	K9601	STN.37	K9601	STN.38	K9601	STN.39	K9601	STN.40
0°	145° E	0°	144° E	0°	143° E	2° 05 S	142° 08E	2° 40 S	142° 01E
Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)	Dep.(db)	02(ml/l)
0	n.d.	0	4.50	0	4.49	0	n.d.	0	4.49
50	n.d.	50	4.51	49	4.48	51	4.34	50	4.48
100	n.d.	99	3.66	98	3.40	101	3.65	101	3.67
150	n.d.	150	3.45	148	3.45	152	3.43	150	3.48
200	n.d.	200	3.31	200	3.34	200	3.43	200	3.43
253	3.35	250	3.40	250	3.34	251	3.46	250	3.46
302	3.18	301	3.25	303	3.19	300	3.56	300	3.53
351	2.94	350	2.97	350	3.13	350	3.48	349	3.53
400	2.38	400	2.61	400	2.49	401	3.50	398	3.58
500	2.78	500	2.78	499	2.73	500	3.64	499	3.66
598	2.87	600	2.80	600	n.d.	601	3.62	598	3.67
799	2.16	800	2.24	800	2.27	799	3.19	800	2.88
999	2.30	1000	2.27	1000	2.32	1000	2.53	1002	2.68

Table 4.6.1 (3)

K9601	STN.41	K9601	STN.42	K9601	STN.43	K9601	STN.44	K9601	STN.45
2° 30 S	141° 59E	1° 30 S	142° E	0°	142° E	0° 30 S	142° E	1° S	142° E
Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)
0	n.d.	0	4.53	0	4.58	0	4.49	0	4.46
50	4.39	51	4.43	50	4.55	49	4.49	50	4.46
101	3.68	100	3.64	100	3.51	100	3.53	99	3.66
150	3.43	150	3.36	149	3.40	149	3.29	149	3.24
200	3.46	200	3.38	200	3.47	199	3.35	200	3.34
250	3.53	250	3.42	249	3.32	249	3.32	249	3.30
300	3.53	301	3.32	300	3.22	300	3.23	300	3.20
349	3.49	349	3.12	350	2.81	350	3.06	350	2.78
399	3.54	399	3.45	399	3.03	400	2.76	399	2.89
497	3.61	500	3.38	500	2.73	499	2.67	500	2.91
600	3.72	599	3.04	600	2.55	600	2.81	601	3.08
799	2.93	799	2.52	797	2.25	799	2.21	799	2.25
1001	2.75	1000	2.58	1000	n.d.	999	2.30	999	2.40

K9601	STN.46	K9601	STN.47	K9601	STN.48	K9601	STN.49	K9601	STN.50
0° 30 N	142° E	1° N	142° E	1° 30 N	142° E	2° N	142° E	2° 30 N	142° E
Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)
0	4.41	0	4.40	0	n.d.	0	4.49	0	4.47
49	4.40	50	4.43	50	4.51	50	n.d.	50	4.47
99	3.51	100	3.46	101	3.66	99	4.51	99	3.59
149	3.44	151	3.54	151	3.31	149	3.85	150	3.27
199	3.35	200	3.39	200	3.35	200	3.27	200	3.32
248	3.25	250	2.97	251	2.72	249	3.34	250	3.02
300	3.15	300	3.10	301	3.05	300	3.19	299	2.77
350	2.89	351	3.04	350	2.81	350	2.93	350	2.67
401	2.38	400	2.49	402	2.43	401	2.78	400	2.62
500	2.65	500	2.55	501	2.67	500	n.d.	499	2.61
597	2.50	600	2.43	600	2.61	599	2.71	600	2.75
799	2.23	798	2.26	795	2.32	800	2.38	799	2.47
1000	2.26	1000	2.28	999	2.25	1000	2.10	1000	2.17

K9601	STN.51	K9601	STN.52	K9601	STN.53	K9601	STN.54	K9601	STN.55
3° N	142° E	0°	142° E	0°	140° E	0°	139° E	1° S	138° E
Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)
0	n.d.	0	4.52	0	4.51	0	4.44	0	4.51
50	4.43	50	4.55	50	4.52	50	4.48	50	4.36
100	3.77	99	3.53	100	3.60	100	3.33	100	3.46
149	3.22	150	3.42	148	3.32	149	3.35	150	3.23
200	3.40	200	3.43	198	3.37	199	3.38	200	3.42
248	2.15	251	3.38	250	3.44	249	3.39	249	3.48
299	2.60	300	3.23	301	3.39	300	3.39	299	3.52
348	2.58	350	3.06	350	3.10	348	2.97	349	3.36
400	2.67	398	2.89	400	2.70	399	2.50	399	3.51
499	1.93	499	2.73	500	2.80	500	2.78	499	3.31
601	2.18	600	3.02	600	2.94	600	2.88	600	3.17
800	2.17	799	2.32	800	2.28	799	2.31	800	2.56
1001	2.27	1000	2.34	1000	2.31	1001	2.17	1001	2.32

K9601	STN.56	K9601	STN.57	K9601	STN.58	K9601	STN.59	K9601	STN.60
0° 45 S	138° E	0° 30 S	138° E	0°	138° E	0° 30 N	138° E	1° N	138° E
Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)
0	4.53	0	4.53	0	n.d.	0	4.47	0	4.42
50	4.41	50	4.49	49	4.47	49	4.50	50	4.39
100	3.57	100	3.56	99	3.45	99	3.43	97	3.60
150	3.26	150	3.29	150	3.45	149	3.34	151	3.45
200	3.44	200	3.47	197	3.41	199	3.34	200	3.32
249	3.48	250	3.51	248	3.54	250	3.38	250	3.38
300	3.52	300	3.58	300	3.43	300	3.42	302	3.35
350	3.36	348	3.32	350	3.26	349	3.12	351	2.93
400	3.01	399	2.98	399	2.95	400	2.87	400	2.79
499	3.53	498	3.56	500	2.78	499	2.68	501	2.85
599	2.93	600	2.98	600	2.90	600	2.64	601	2.39
798	2.29	799	2.31	800	2.43	799	n.d.	799	2.23
1001	2.38	1001	2.34	1004	2.40	1001	2.31	1000	2.28

Table 4.6.1 (4)

K9601	STN.61	K9601	STN.62	K9601	STN.63	K9601	STN.64	K9601	STN.65
1° 30 N	138° E	2° N	138° E	2° 26 S	137° 24E	3° S	137° 19E	4° S	137° 10E
Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)	Dep.(db)	O2(ml/l)
0	n.d.	0	4.49	0	4.66	0	4.58	0	4.49
50	4.45	49	4.38	50	4.55	50	4.27	50	4.18
100	3.32	100	3.53	101	3.65	100	3.46	100	3.55
149	3.60	150	3.32	150	3.43	150	3.38	150	3.38
200	3.41	200	3.53	200	3.40	199	3.63	201	3.37
250	3.25	249	2.96	250	3.04	250	2.96	251	2.77
300	3.37	300	2.16	300	2.09	300	1.78	301	1.78
349	2.97	350	3.13	350	3.15	350	1.78	352	1.89
400	2.64	399	3.14	400	3.17	400	2.98	401	1.92
501	2.72	500	3.10	501	3.01	500	2.74	500	2.24
600	2.44	600	2.42	600	2.80	600	2.24	600	n.d.
800	2.23	801	2.25	800	2.55	800	2.41	799	2.00
1001	2.23	1001	2.23	1000	2.11	1001	2.13	1000	2.14

K9601	STN.66
4° 59 S	136° 59E
Dep.(db)	O2(ml/l)
0	4.34
50	n.d.
100	3.56
150	3.18
201	3.39
251	2.69
301	1.82
352	1.39
401	1.47
500	1.65
599	1.67
799	1.91
1000	2.04

5. Meteorological Measurements

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

5.1 Atmospheric Sounding

Method :

We observed vertical profiles of pressure, temperature, relative humidity, and wind speed/direction by using VAISALA DigiCORA MW 11 semi–Automatic Radiosonde System. The system consists of Main processor (MW11), Local VLF Antenna (CAS11B/CAA21), UHF Telemetry Antenna (RB21), Microdisk Recorder (MF12), Ground Check Set (GC22), printer (EPSON LX–1050), Balloon Launcher (ASAP JAMSTEC), and Radiosonde (RS80). The range and accuracy of parameters measured by the radiosonde are as follows ;

Parameter	Range	Accuracy
Pressure	1060 – 3 hPa	0.5 hPa
Temperature	–90 – +60 deg–C	0.2 deg–C
Relative humidity	0 – 100 %	3 %
Wind speed	0 – 180 m/s	0.5 m/s.

The surface data were measured by using handy humidity and temperature meter (YOKOGAWA 2451 –01), shipboard Aneroid barometer (YANAGI type 8A) and wind speed/direction meter (OGASAWARA).

We launched the radiosonde with balloon every 6 hours at 00Z, 06Z, 12Z, and 18Z from 30th JAN '96 to 2nd FEB '96 and from 10th FEB '96 to 21st FEB '96. So we obtained 75 sounding data. Table 5–1 shows Radiosonde Launch Log.

Preliminary Result :

Fig.5–1 shows the EMAGRAM and wind profiles with sounding time (YYMMDDTT UTC) and position.

On the east of 147E, the easterly wind almost dominated except to around 200 hPa (about 12000 m height) observed from 12Z 1st Feb to 18Z 3rd Feb ((7N,157E) – (8N,156E) – (2N,156E) lines). The atmosphere of this area was dry except to the northern side of 7N.

On the other hand, we observed the westerly wind at lower layer on the west of 147E. As going toward the west on the equator, the wind speed increased from 4 m/s (145E) to 10 m/s (138E). And the height of westerly wind zone also became higher from 830 hPa (about 1000 m height) at 145E to 750 hPa (about 3000 m height) at 138E.

In the southern hemisphere, also, there was westerly wind area near 700 hPa (about 3000 m height) on the 142E line. At the lower layer where it was dominated by westerly wind, the atmosphere was dry. On the other hand, the easterly wind existed from 700 hPa to 500 hPa (about 3000 m to 6000 m height) brought the moist air.

In some cases, there existed the clearly inversion layer like the reported one before TOCS or other cruise.

Table 5-1

Radio Sonde Launch Log Sites

No.	Time(UTC) YYMMDDTT	Position lat.	Long.	Surface Press. (hP)	Surface Temp. (DEG-C)	Surface RH (%)	Surface W.D. (deg)	Surface W.S. (m/s)	Max Aititude (hPa)	Max Aititude (m)	Cloud Amount	Cloud Type
01	96013006	00 32 N	164 24 E	1002.0	28.8	67	130	4.3	49.4	20,600	3	Cu
02	96013012	01 15 N	163 35 E	1006.8	28.5	73	168	5.8	49.7	20,626	5	Cu
03	96013018	01 59 N	162 47 E	1004.1	27.4	76	calm	0.0	51.6	20,318	5	Cu, Sc
04	96013100	02 44 N	161 58 E	1007.3	27.5	78	050	4.2	37.0	22,371	10	Cu, Sc
05	96013106	03 28 N	161 09 E	1001.6	28.7	75	091	8.7	33.0	23,917	10-	Cu, Sc
06	96013112	04 11 N	160 21 E	1006.9	27.9	79	082	9.5	53.2	20,175	9	Sc, Cu
07	96013118	04 59 N	159 27 E	1005.6	28.2	79	060	9.0	49.7	20,559	2	Cu, Sc
08	96020100	05 36 N	158 45 E	1007.8	27.7	83	060	8.0	46.0	21,716	6	Cu, Sc
09	96020106	06 15 N	158 00 E	1005.6	27.8	82	084	8.4	47.6	20,806	8	Cu, Sc, As
10	96020112	06 59 N	157 12 E	1007.8	26.2	88	065	10.0	39.6	21,938	10	Sc
11	96020118	07 44 N	156 22 E	1005.1	25.9	95	070	11.5	37.0	22,331	3	Sc
12	96020200	08 00 N	155 59 E	1007.8	27.8	81	080	10.0	39.5	21,965	4	Cu, Cb, Sc, As
13	96020206	07 16 N	156 01 E	1005.0	28.2	81	078	8.3	37.9	22,181	10	Sc
14	96020212	06 17 N	156 00 E	1006.8	28.0	79	089	6.9	44.8	21,182	4	Cu, Ci
15	96020218	05 09 N	156 00 E	1003.0	28.2	81	100	7.0	40.5	21,752	3	Cu, Sc
16	96020300	04 36 N	156 00 E	1007.8	29.9	73	095	6.4	45.6	21,080	4	Cu
17	96020306	03 42 N	156 00 E	1003.4	29.4	75	088	5.3	37.6	22,217	5	Cu, Cb
18	96020312	02 54 N	156 00 E	1007.3	28.8	83	065	3.1	44.4	21,261	6	Cb, Cu, Ac
19	96020318	02 04 N	156 04 E	1005.5	25.9	92	calm	0.0	51.4	20,336	5	Cb, Sc, As
20	96020400	02 00 N	156 04 E	1008.3	27.6	77	060	3.5	42.4	21,517	10	Cu, Sc
21	96020406	01 18 N	156 02 E	1005.1	28.8	73	072	2.2	53.0	20,199	9	Cu, Cb, Sc
22	96020412	00 39 N	156 03 E	1007.8	28.9	79	041	4.5	39.0	22,063	8	Cu, Sc
23	96020418	00 00 S	156 05 E	1005.8	28.7	79	040	5.0	52.6	20,232	4	Cu, Sc, As
24	96020500	00 00 S	156 07 E	1007.5	29.3	74	035	5.0	30.3	23,538	2	Cu, Cb
25	96020506	00 01 S	154 52 E	1005.7	29.2	80	078	3.1	103.6	13,027	10	Cb
26	96020512	00 01 S	153 56 E	1007.8	28.7	76	026	5.3	91.2	17,098	10	Cb, Cu, Sc
27	96020518	00 01 S	152 50 E	1007.0	26.1	86	178	6.0	49.1	20,665	10	Cb, Cu
28	96020600	00 03 S	151 43 E	1009.1	26.7	87	125	2.7	32.2	23,217	10	Cu, Sc
29	96020606	00 07 S	150 59 E	1006.1	28.6	77	021	5.9	31.9	23,234	10-	Cu, Cb
30	96021000	00 00 S	148 18 E	1004.5	28.8	72	089	4.3	41.4	21,698	5	Cu
31	96021006	00 32 S	147 31 E	1007.3	28.9	72	080	2.6	29.6	23,703	5	Cb, Cu, Sc
32	96021012	01 10 S	146 54 E	1008.7	28.4	71	158	4.4	47.2	20,904	8	Sc
33	96021018	01 49 S	146 16 E	1007.8	28.2	76	107	1.7	50.4	20,486	9	Cu, Sc
34	96021100	02 46 S	146 23 E	1009.7	29.6	71	141	2.2	35.7	22,622	7	Cu, Sc
35	96021106	01 41 S	146 00 E	1006.1	30.1	68	135	3.2	43.8	21,343	4	Cu, Sc
36	96021112	01 03 S	146 22 E	1008.3	29.0	71	084	5.4	48.4	20,748	1	Cu
37	96021118	00 21 S	146 46 E	1007.4	28.8	76	096	6.9	57.4	19,734	3	Cu, As
38	96021200	00 02 S	146 56 E	1009.8	29.8	66	040	2.0	40.1	21,920	1	Cu, As
39	96021206	00 00 S	147 01 E	1006.3	32.1	59	075	3.0	33.1	23,055	3	Cu
40	96021212	00 01 S	146 50 E	1008.3	27.2	79	045	2.0	40.1	21,896	0	
41	96021218	00 02 N	146 53 E	1006.8	28.3	76	042	3.0	49.1	20,666	2	Cu
42	96021300	00 00 N	146 53 E	1009.3	28.6	72	015	7.0	41.9	21,623	5	Sc, Cu
43	96021306	00 27 N	147 00 E	1005.8	30.4	59	005	4.8	32.2	23,184	2	Ci, Ac
44	96021312	01 13 N	147 00 E	1007.3	28.5	79	039	5.2	46.1	21,052	0+	Cu
45	96021318	01 50 N	147 01 E	1005.5	27.9	80	031	5.2	40.6	21,775	1	Ac
46	96021400	02 01 N	147 01 E	1008.3	29.1	71	060	2.0	41.0	21,730	3	Sc, Cu, Ac
47	96021406	01 59 N	147 01 E	1004.4	29.8	71	353	3.5	41.0	21,723	3	Cu, Cb
48	96021412	01 02 N	146 31 E	1007.3	27.8	83	297	3.5	51.5	20,387	3	Sc, As
49	96021418	00 01 S	146 00 E	1004.9	28.0	78	315	3.5	57.8	19,661	3	Sc, Cu
50	96021500	00 01 S	145 01 E	1007.2	28.5	76	293	4.2	38.0	22,198	7	Cu, Sc
51	96021506	00 01 S	144 00 E	1003.2	29.6	73	315	5.3	50.2	20,483	5	Cu, Cb
52	96021512	00 01 S	143 01 E	1006.3	27.1	86	268	5.6	56.1	19,866	8	As, Cu
53	96021518	01 07 S	142 35 E	1004.7	28.0	80	294	9.6	58.3	19,605	10-	Cu, Cb, Sc
54	96021600	02 06 S	142 09 E	1008.5	28.0	83	290	11.5	55.9	19,918	10	Sc
55	96021606	02 31 S	141 59 E	1004.5	26.7	84	283	9.8	53.5	20,107	8	Cu, Sc, Ci
56	96021612	01 31 S	142 00 E	1006.8	28.4	88	275	8.0	52.3	20,285	9	Sc
57	96021618	00 38 S	142 00 E	1006.2	25.8	80	227	4.9	102.6	16,373	10	Sc
58	96021700	00 01 S	142 00 E	1008.2	27.0	81	245	5.0	47.1	20,918	1	Ac, Ci
59	96021706	00 08 S	142 02 E	1006.1	29.6	72	334	1.5	35.1	22,676	4	Cu, Cb, Ci
60	96021712	00 57 S	142 02 E	1008.3	28.5	72	305	6.1	61.8	19,318	0+	Sc
61	96021718	00 15 N	142 01 E	1006.3	27.9	81	300	7.8	48.1	20,776	2	Cu
62	96021800	01 04 N	142 00 E	1009.2	26.9	81	309	6.4	33.0	23,050	10-	Sc, Cu
63	96021806	02 00 N	142 00 E	1006.0	27.5	82	240	2.0	38.2	22,141	9	Sc, Cu, Cb
64	96021812	02 59 N	142 00 E	1008.7	26.7	91	270	2.0	51.4	20,394	10	St
65	96021818	02 10 N	141 44 E	1007.3	28.0	81	259	3.6	59.2	19,540	7	Cu, Sc
66	96021900	01 08 N	141 23 E	1009.3	29.4	74	269	6.6	42.0	21,630	9	Cb, Cu
67	96021906	00 09 N	141 03 E	1005.8	27.7	80	263	11.4	43.2	21,433	6	Ac, Cu, Ci
68	96021912	00 00 N	140 22 E	1007.7	28.4	81	239	7.3	56.9	19,768	3	Cu
69	96021918	00 00 S	139 38 E	1007.3	26.3	85	272	3.0	48.0	20,754	10	Cu, Cb, Sc
70	96022000	00 08 S	138 54 E	1009.3	25.6	85	299	14.4	60.0	19,478	10	Sc, Cu
71	96022006	00 49 S	138 11 E	1006.2	27.2	84	266	12.1	53.8	20,106	10	Su, Cu
72	96022012	00 34 S	138 00 E	1006.8	28.6	76	271	9.5	43.5	21,393	2	Cu, Sc
73	96022018	00 06 N	138 04 E	1005.2	28.2	81	272	9.6	51.6	20,338	10	Cu, Sc
74	96022100	00 54 N	138 00 E	1007.5	27.3	83	268	7.4	72.8	18,362	9	Cu, Sc, Cb
75	96022106	01 40 N	138 00 E	1006.4	27.0	83	253	4.4	39.7	21,943	10	As, Sc, Cu

Fig 5-1 Emagram & Wind Profile

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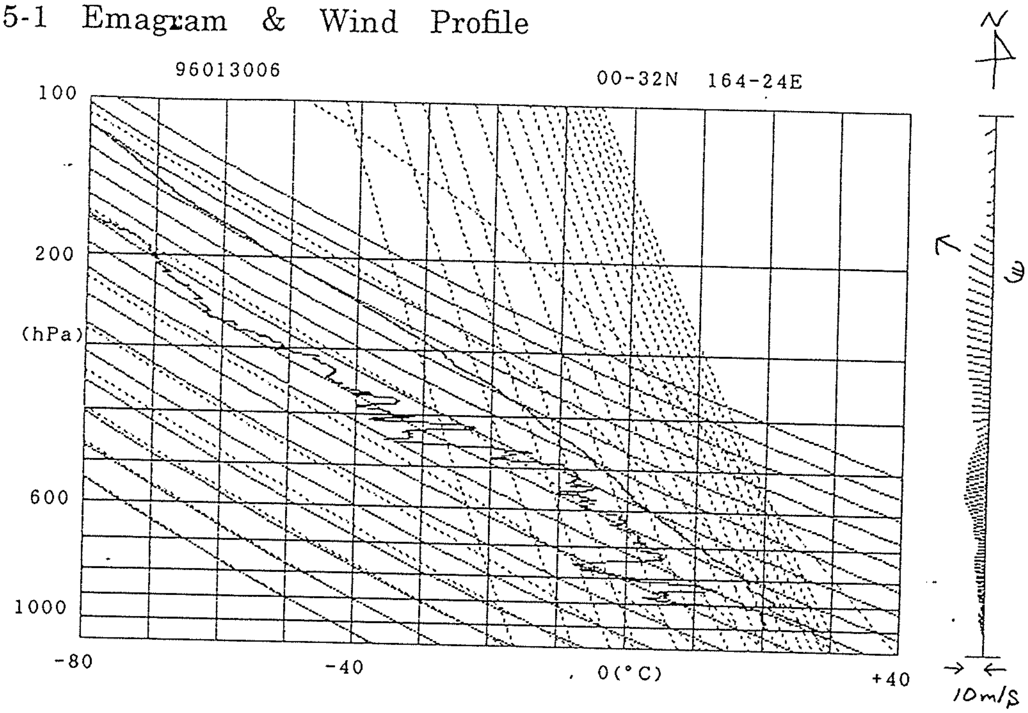

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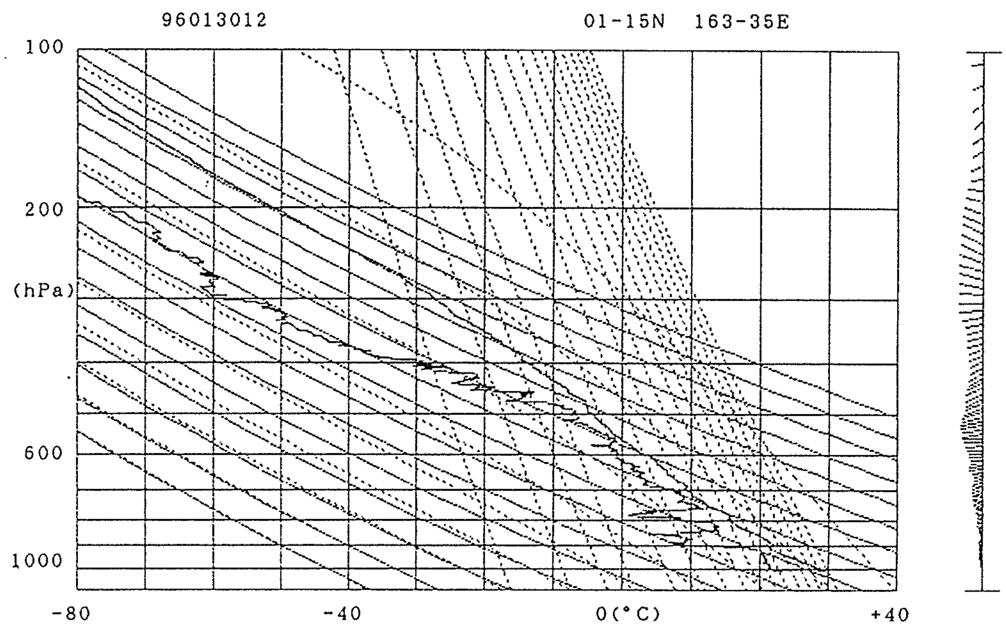

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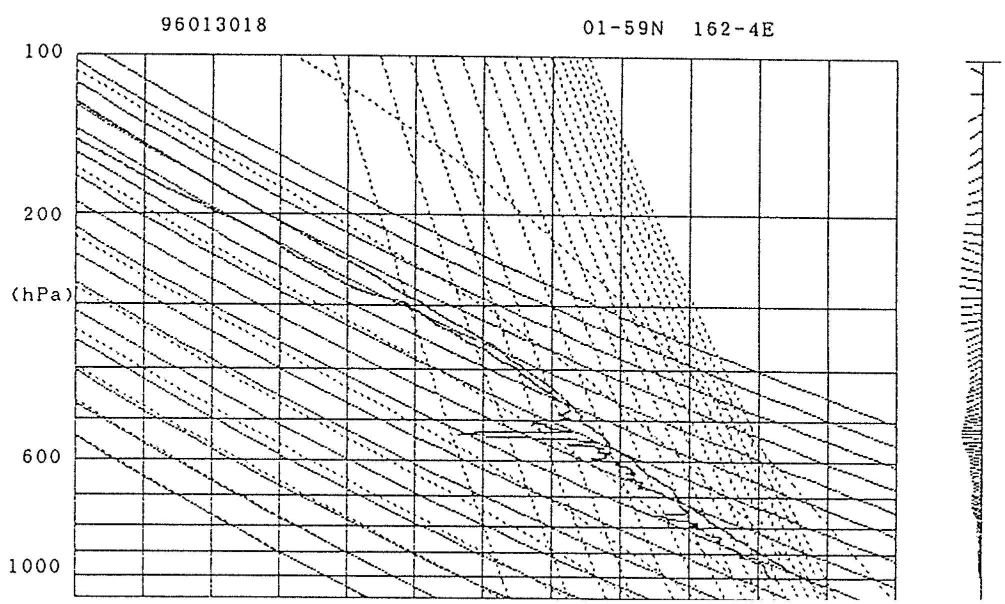

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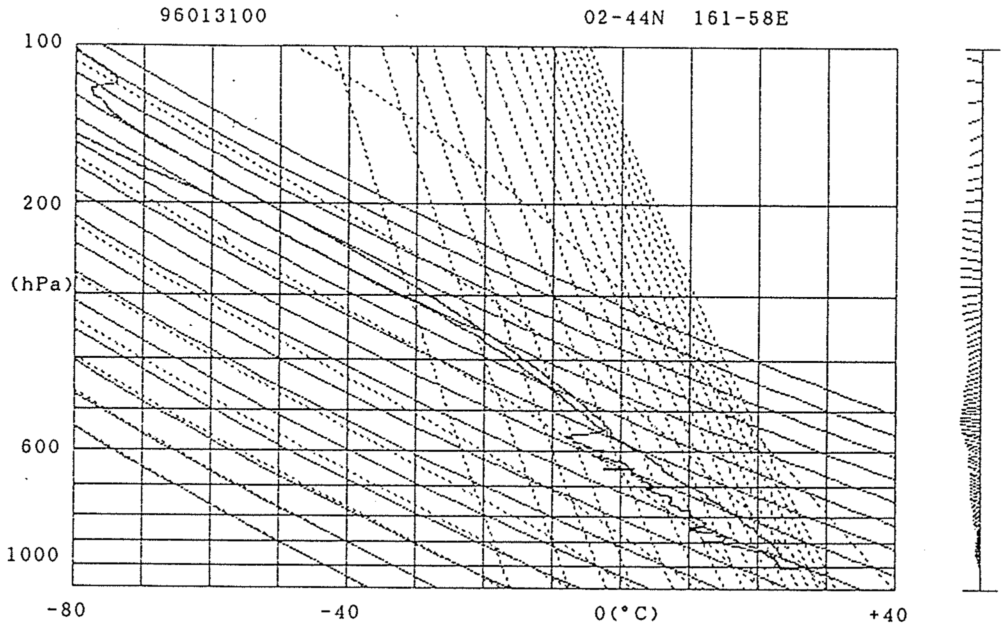
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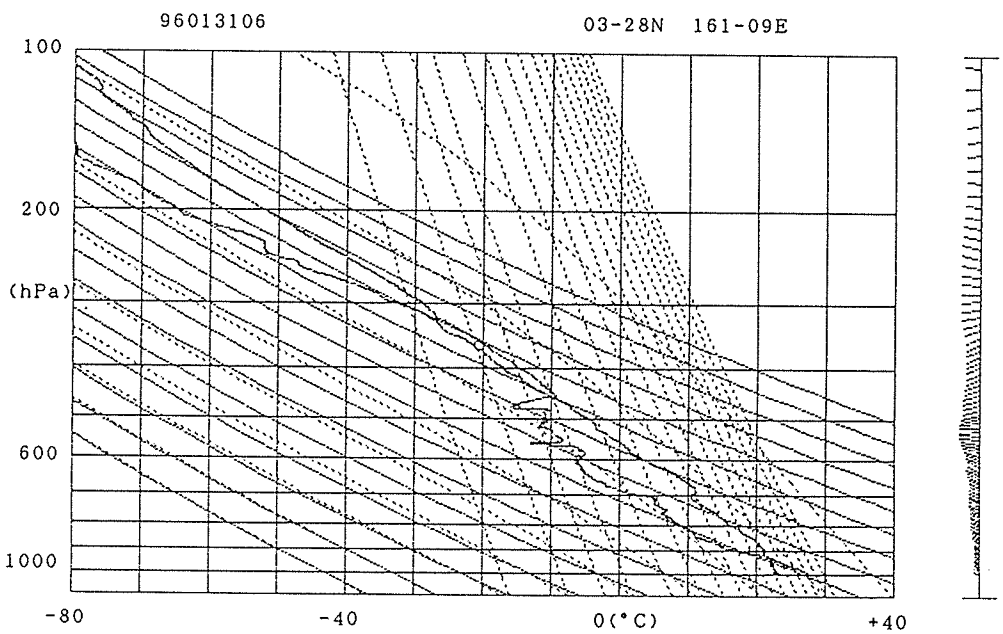
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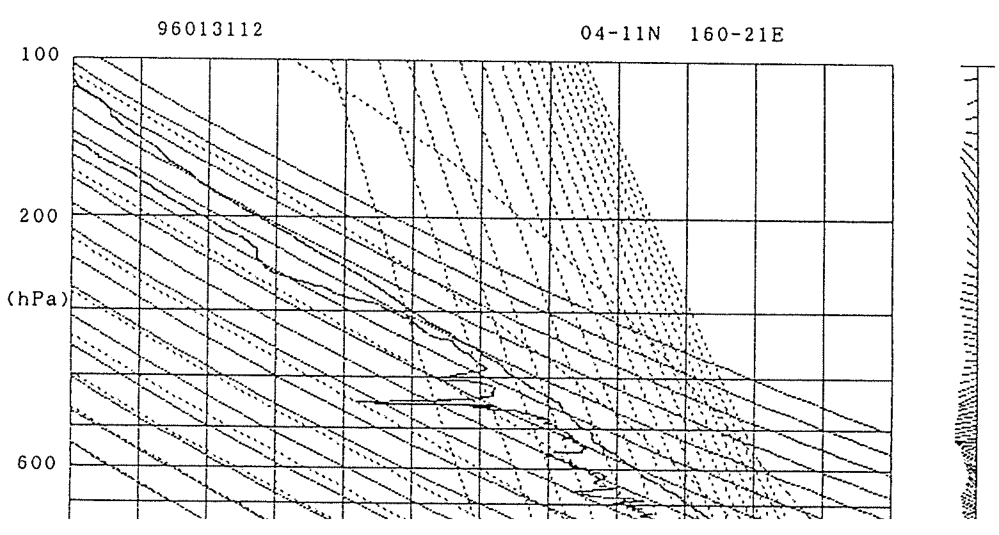
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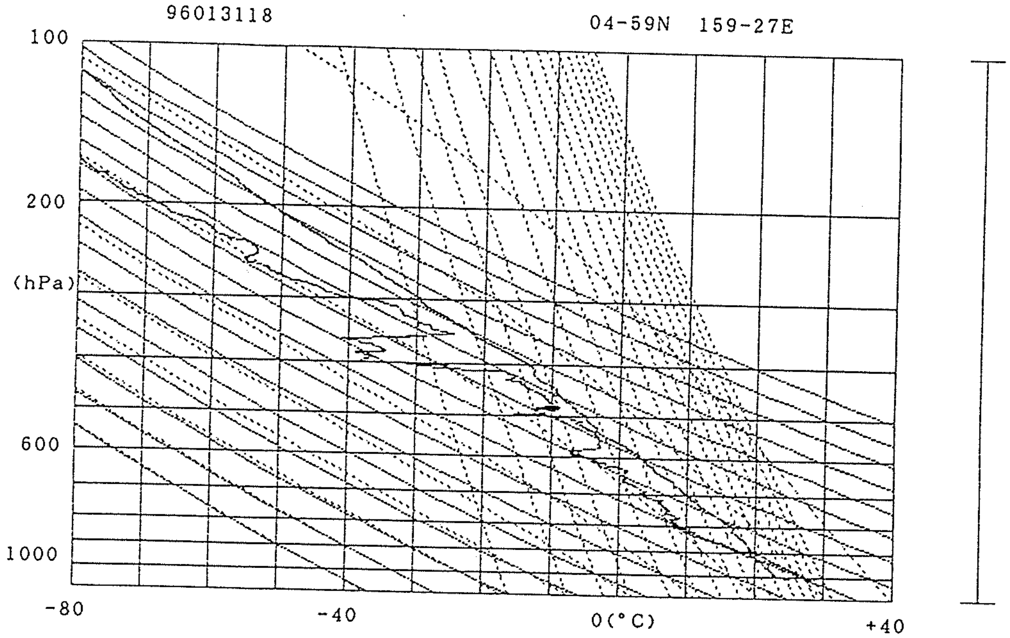

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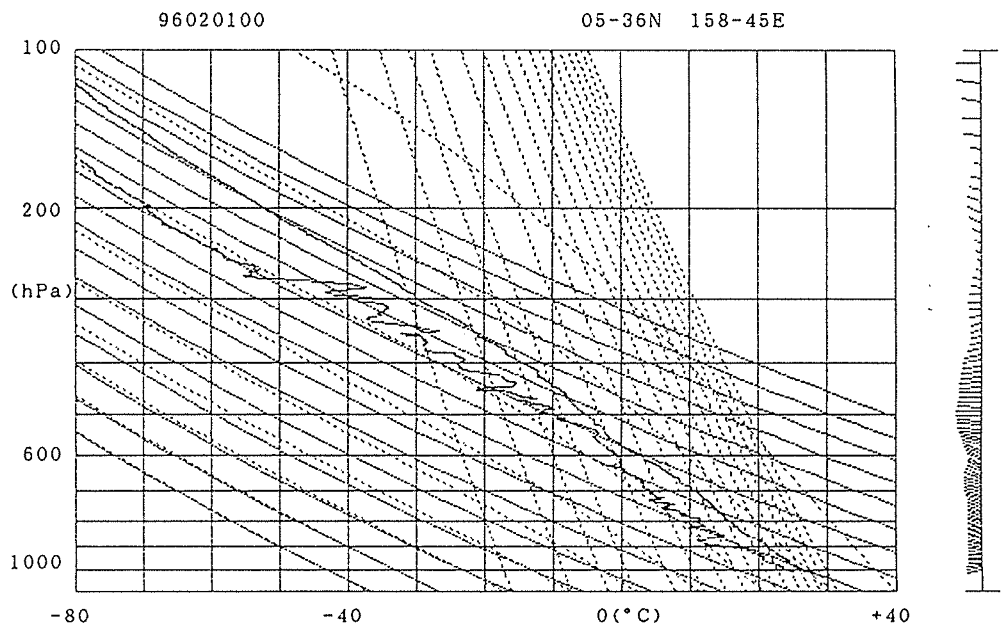

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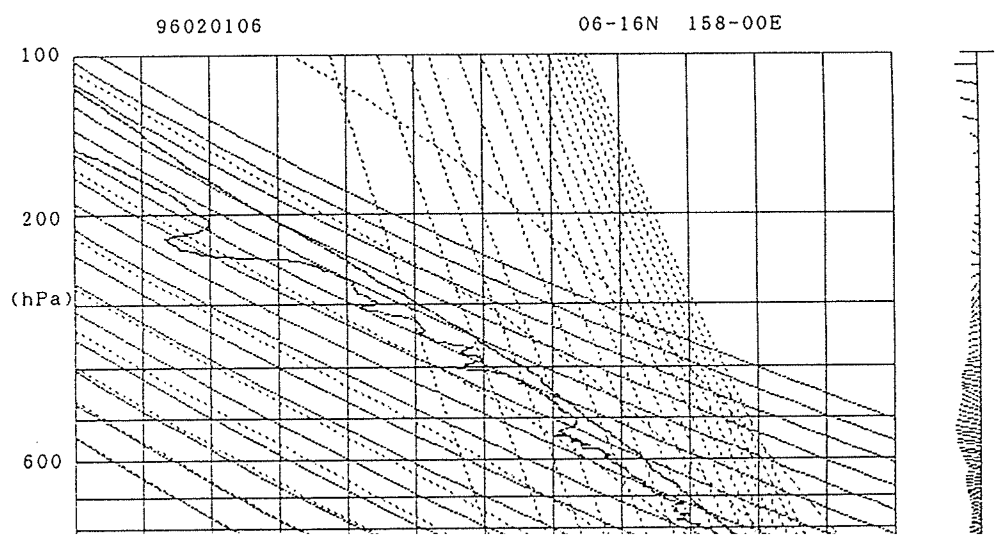

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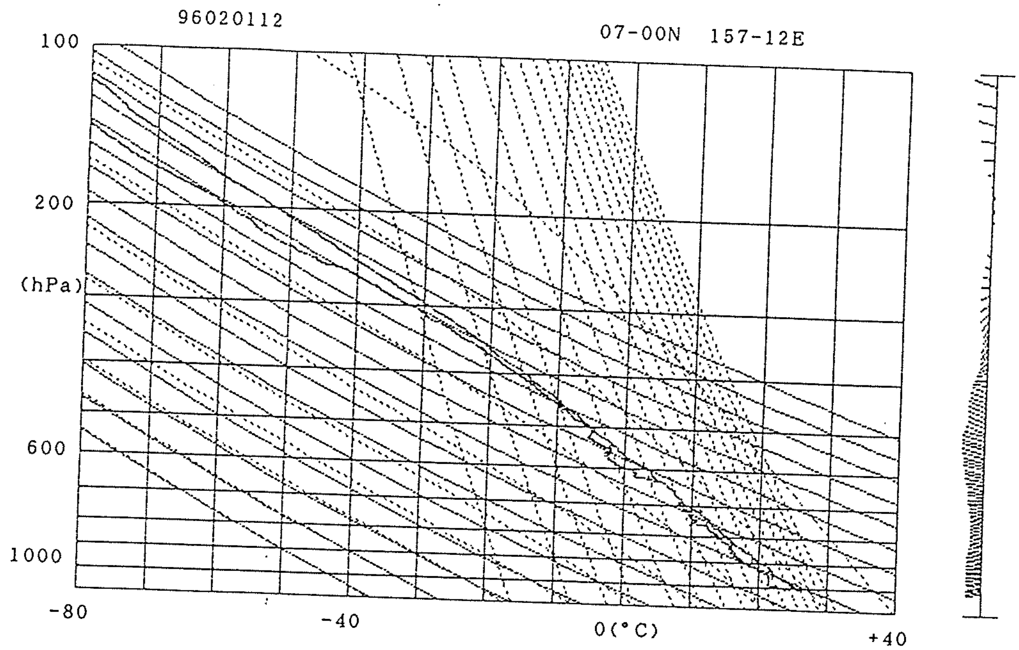

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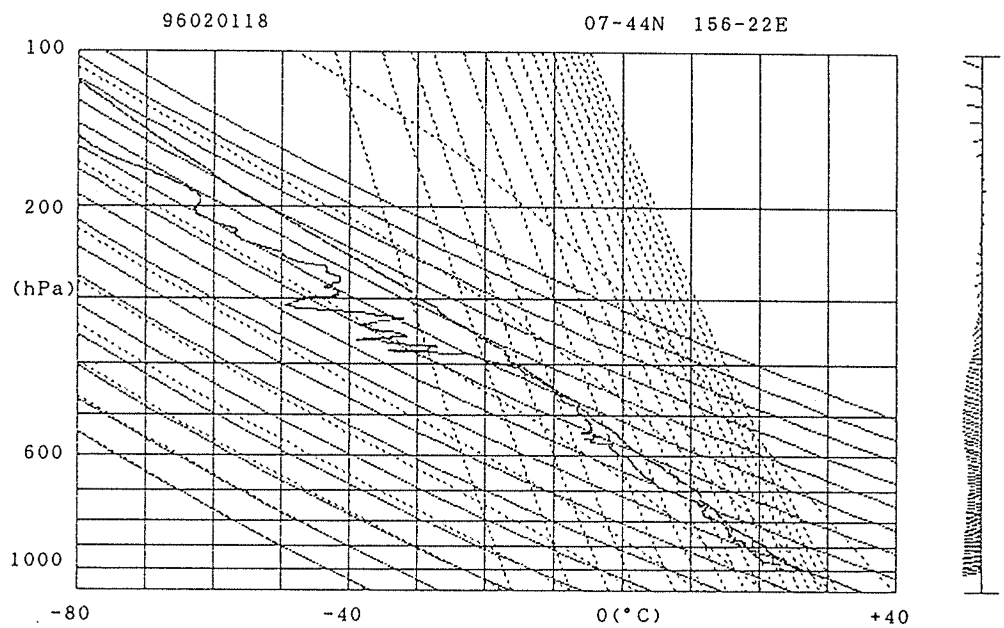

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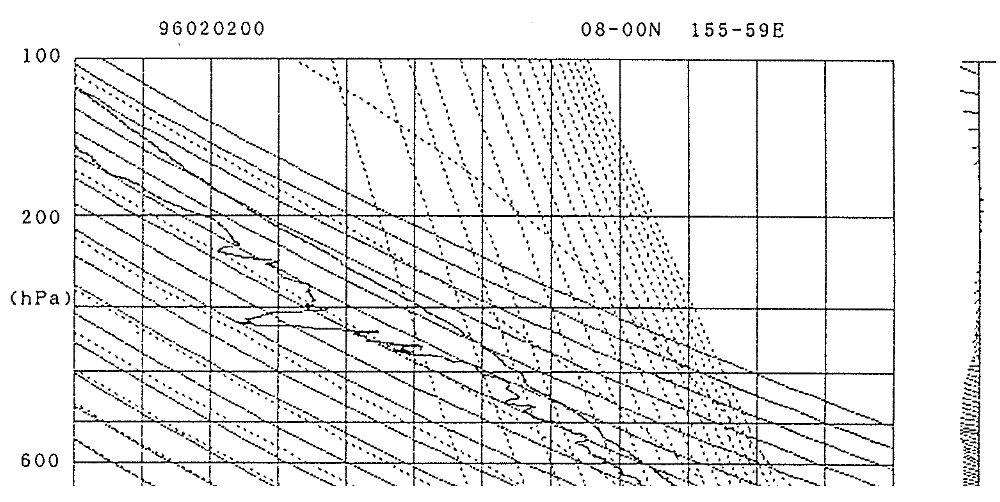

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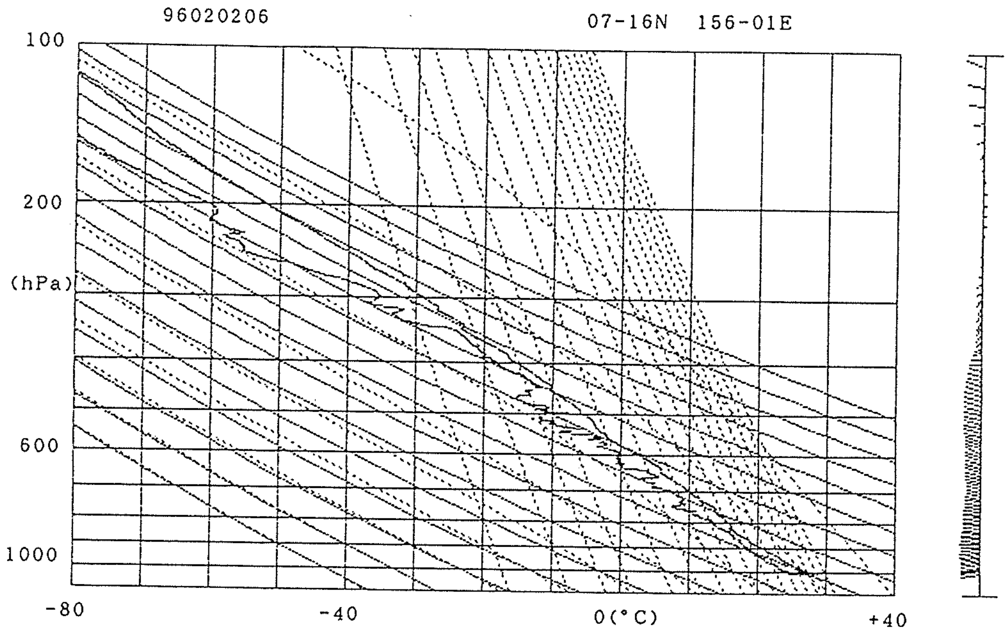
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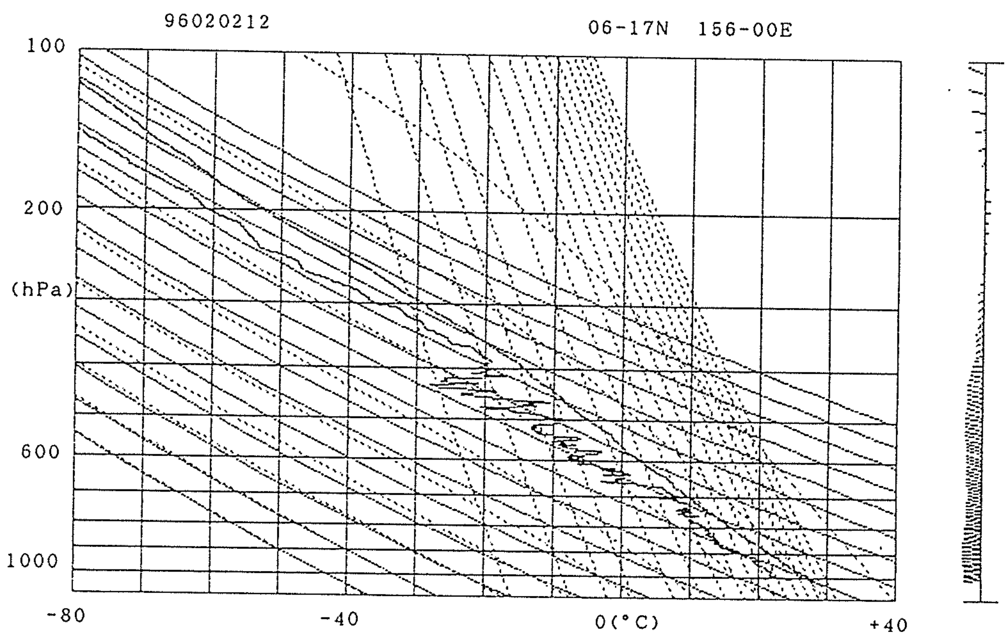
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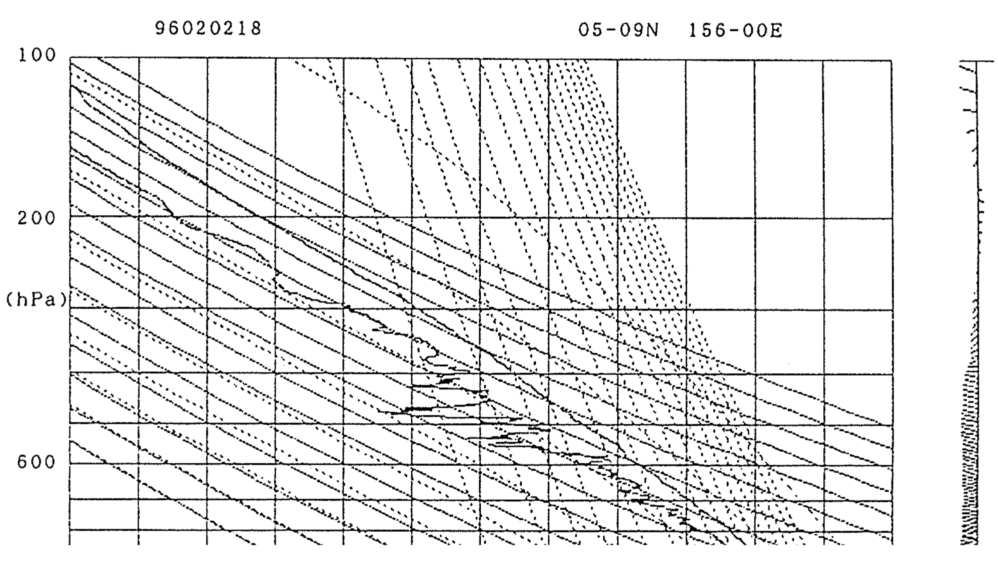
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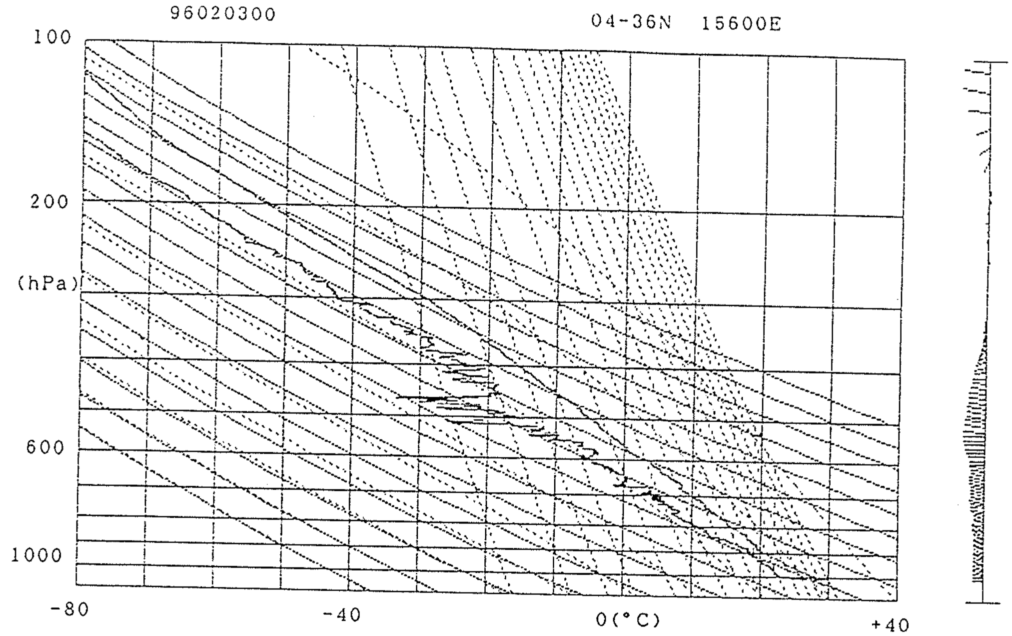
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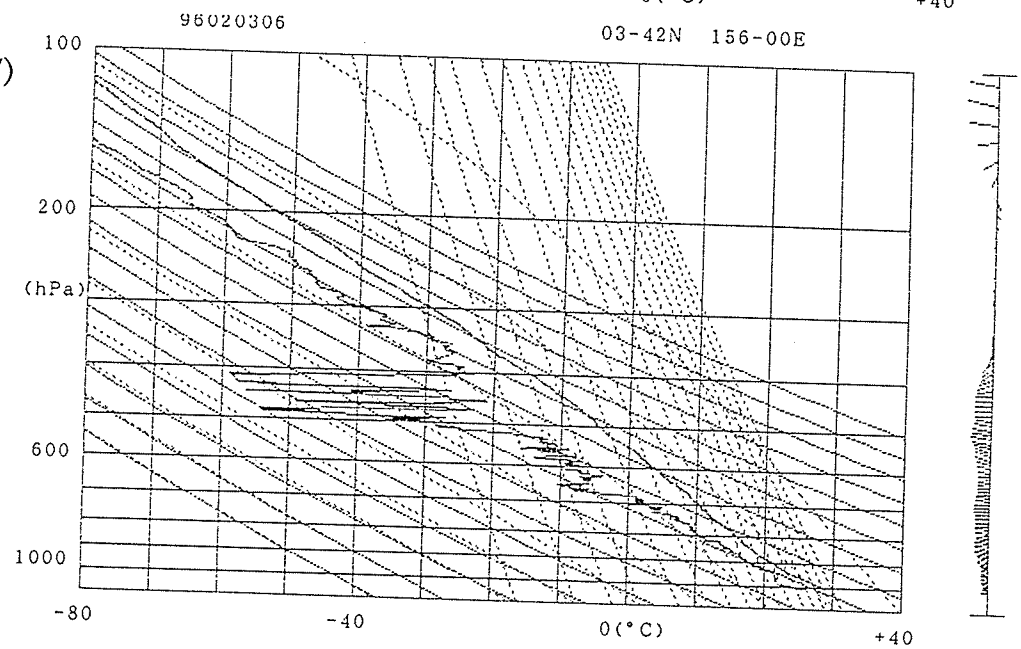
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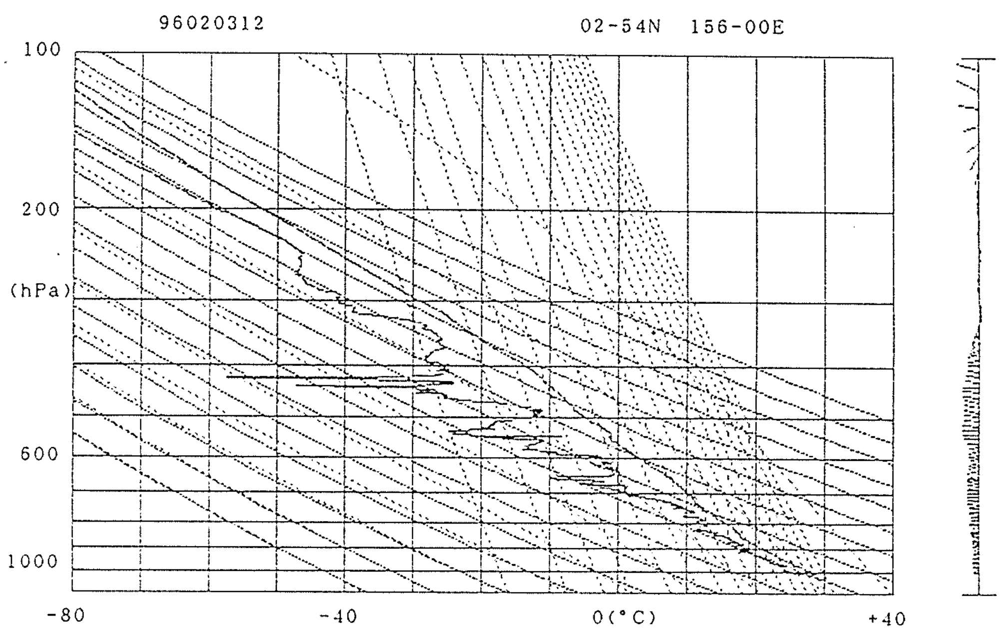
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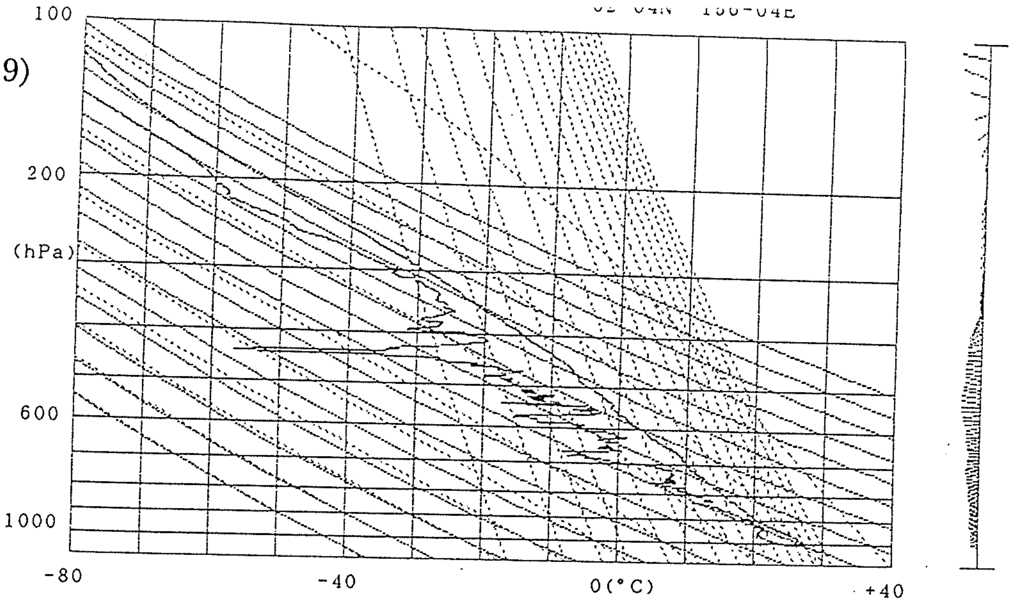
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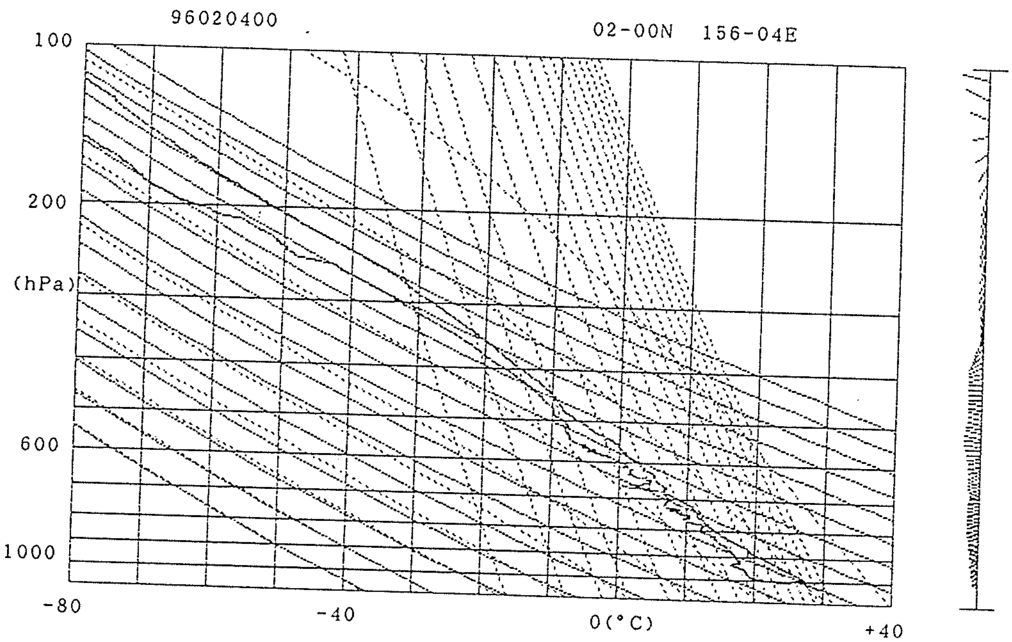
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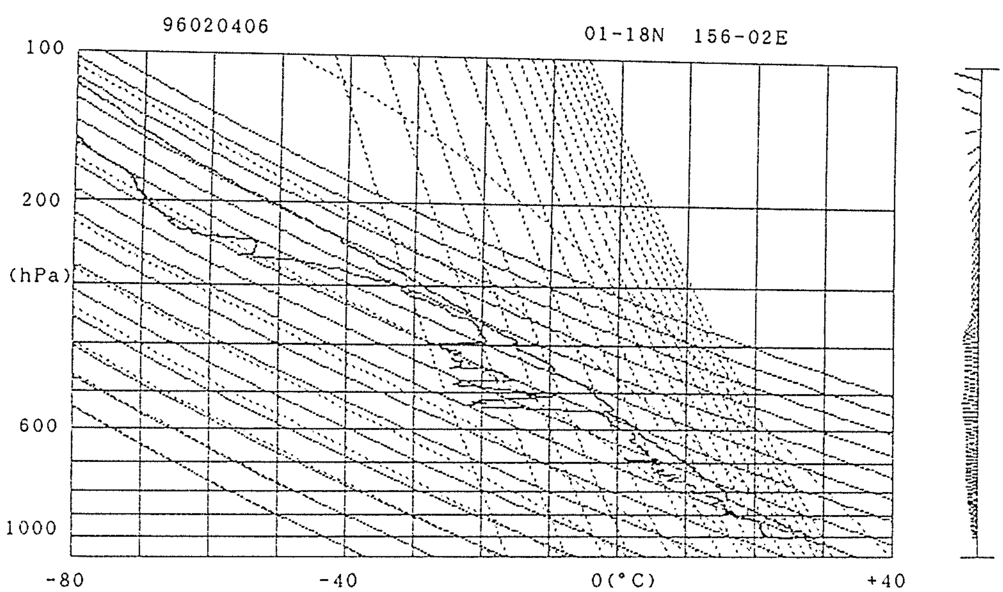
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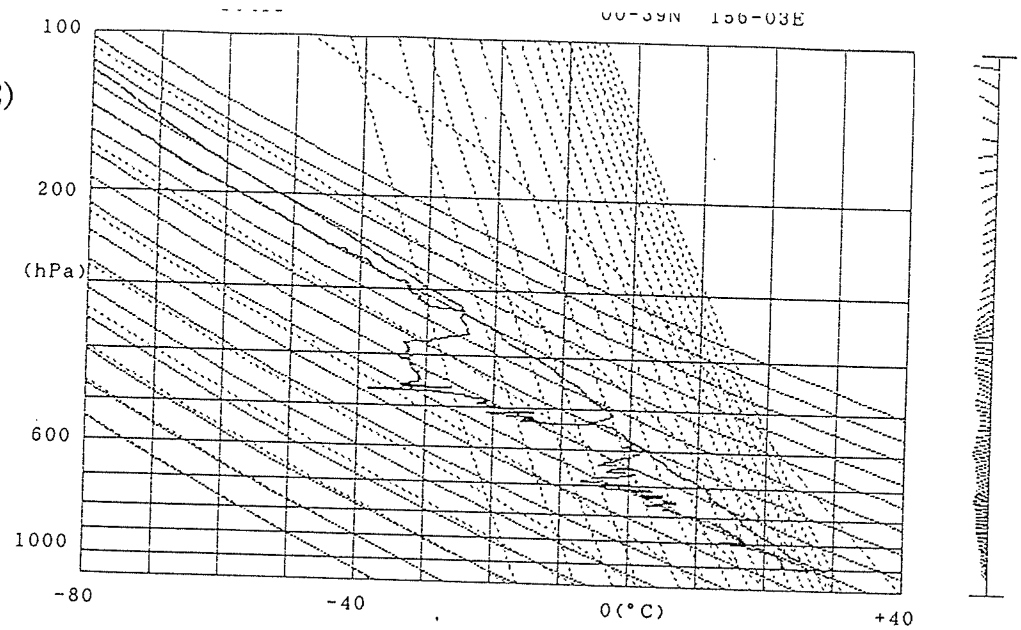
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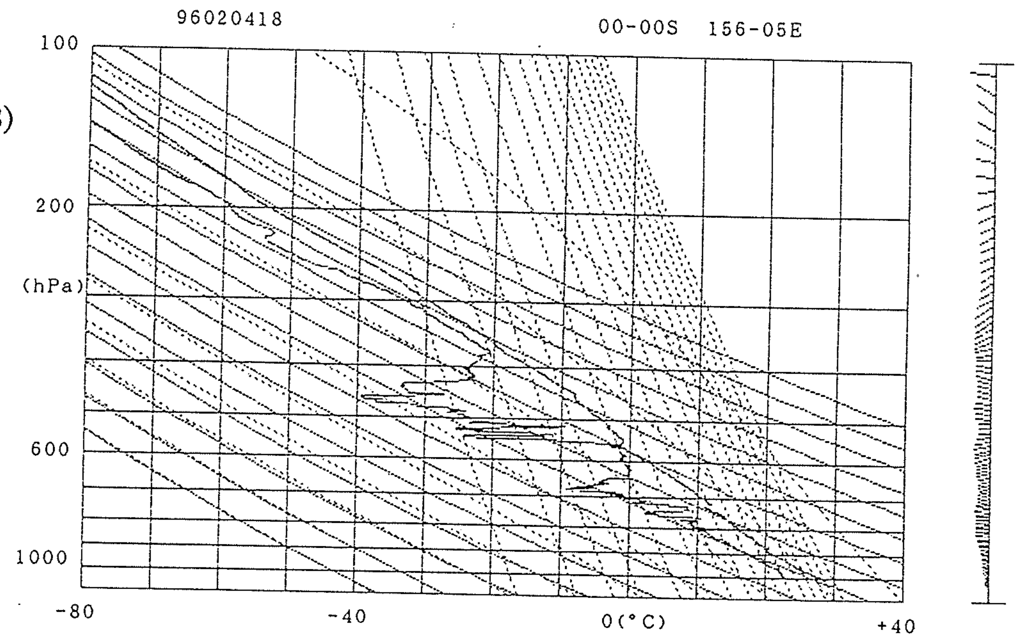
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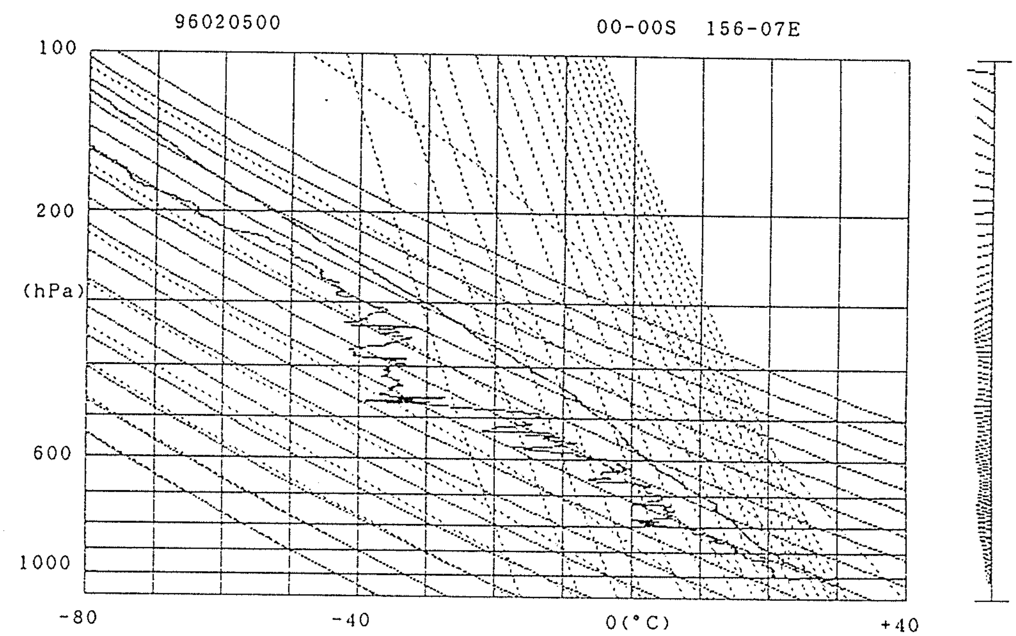
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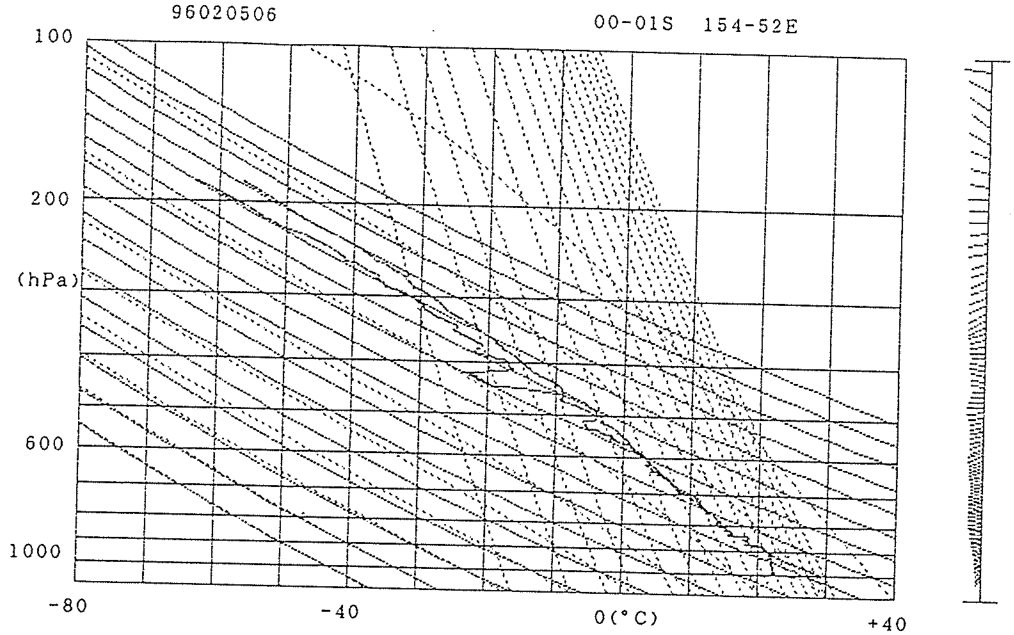
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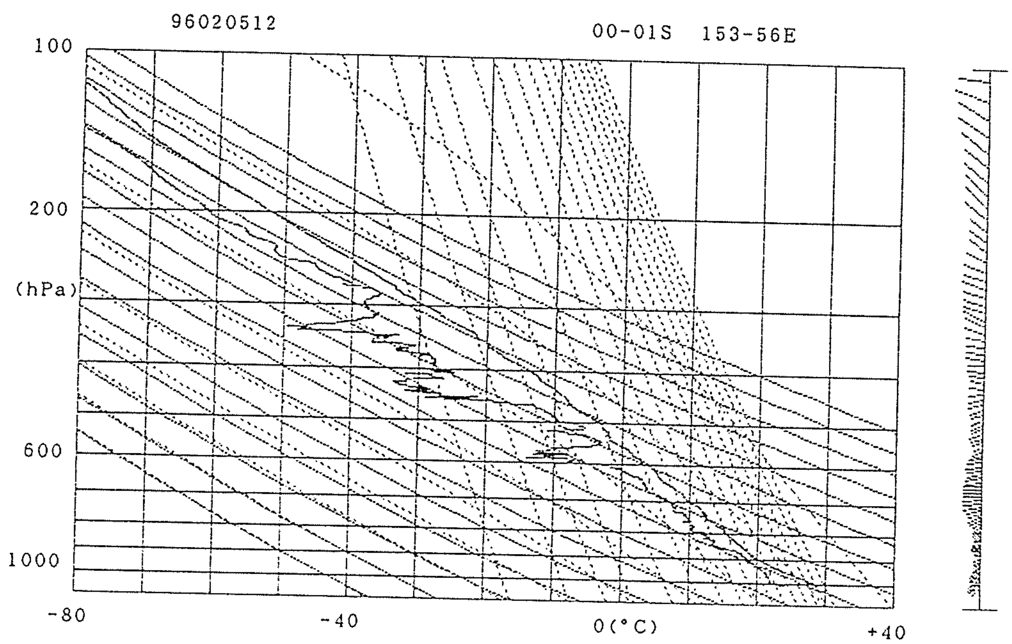
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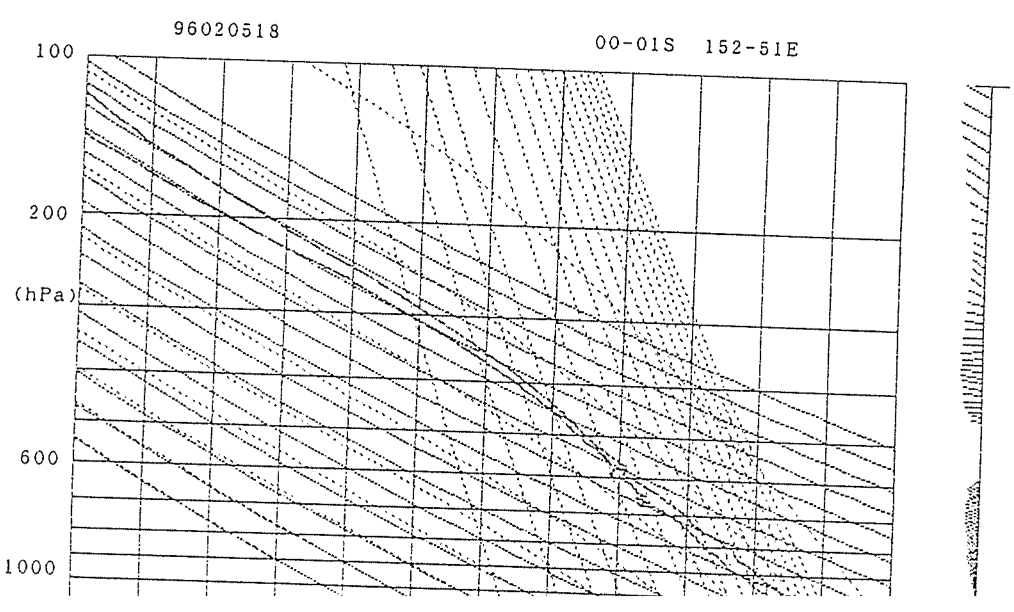
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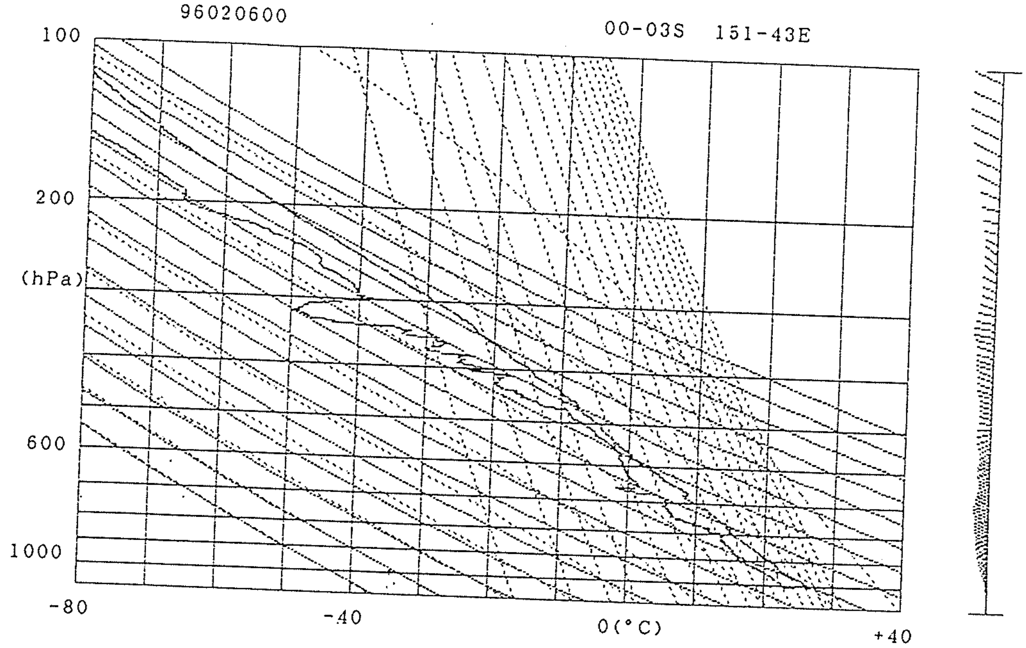
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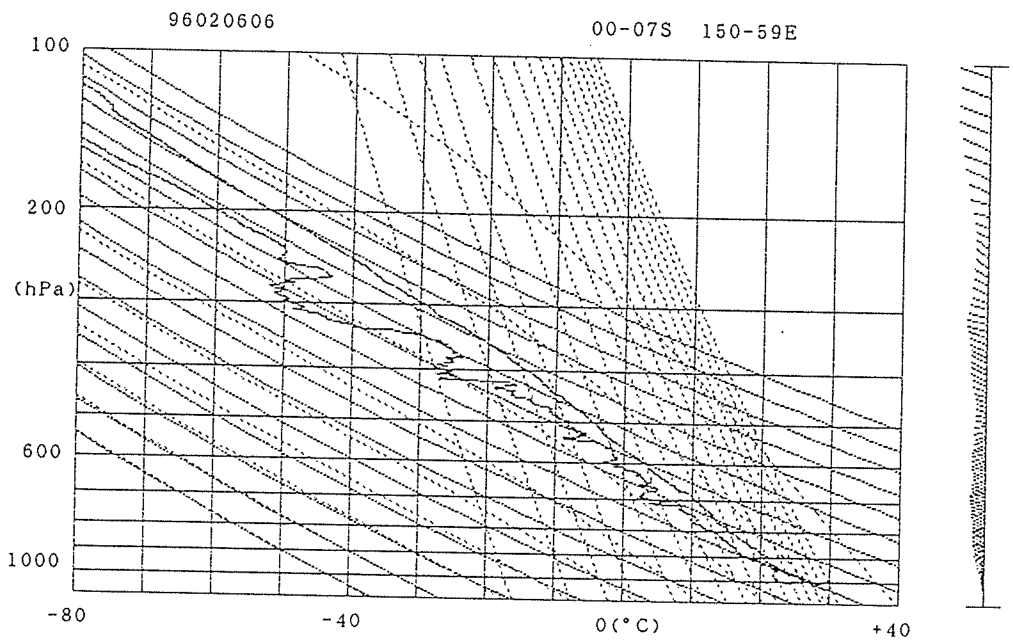
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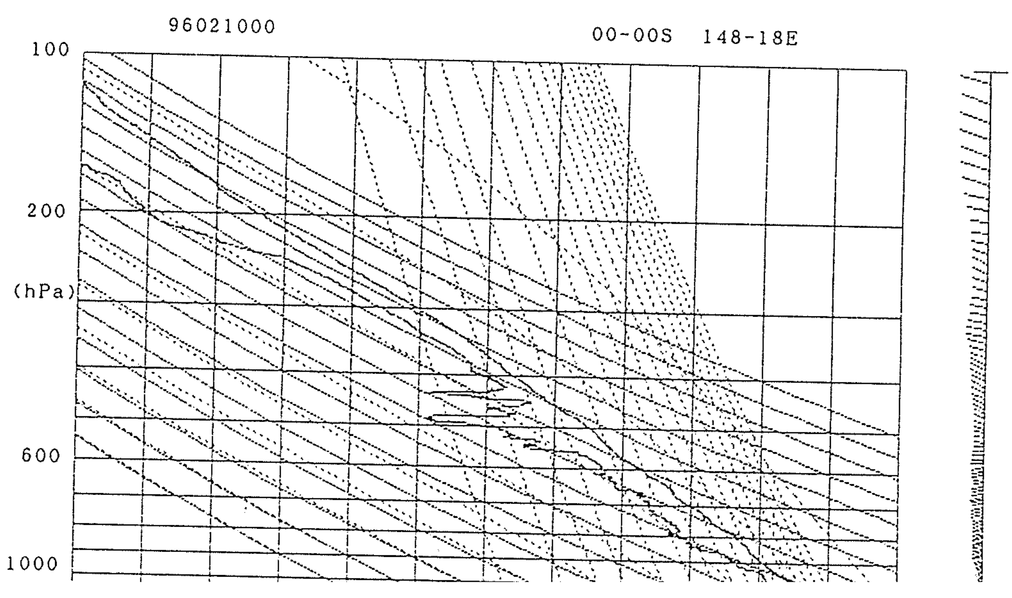
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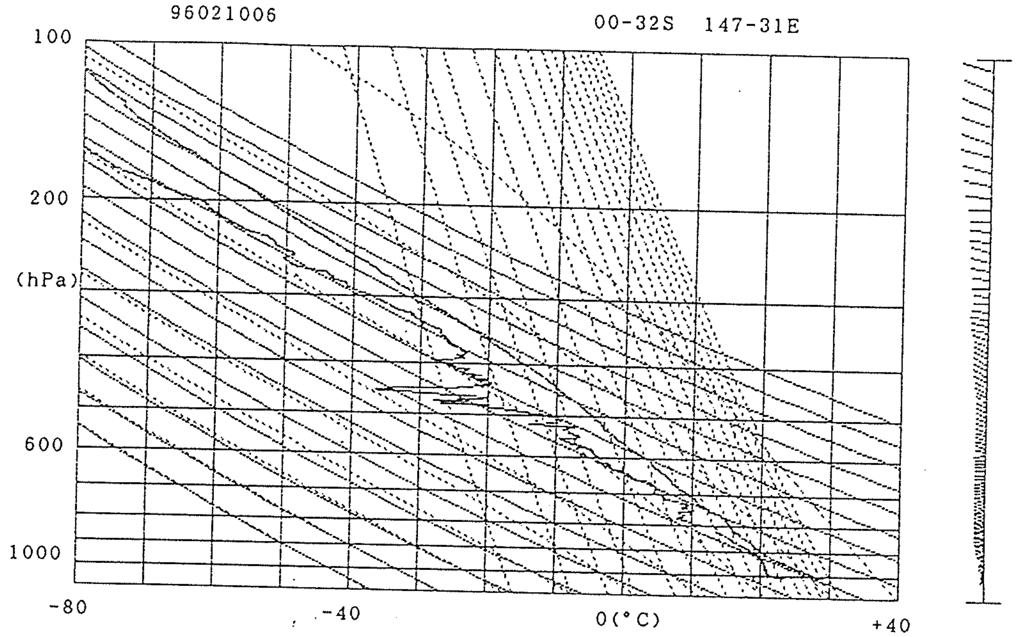
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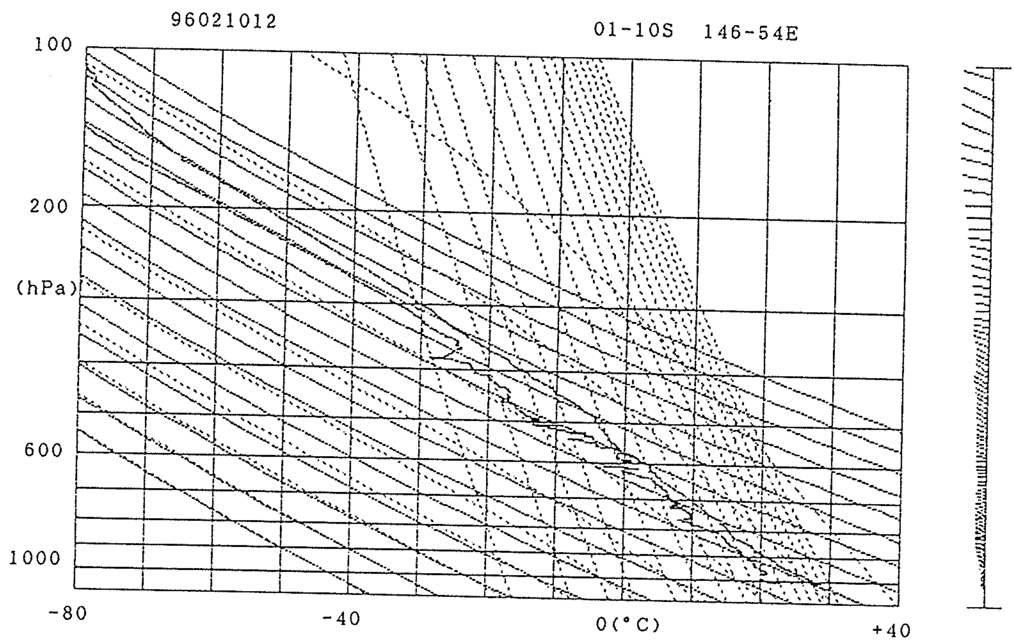
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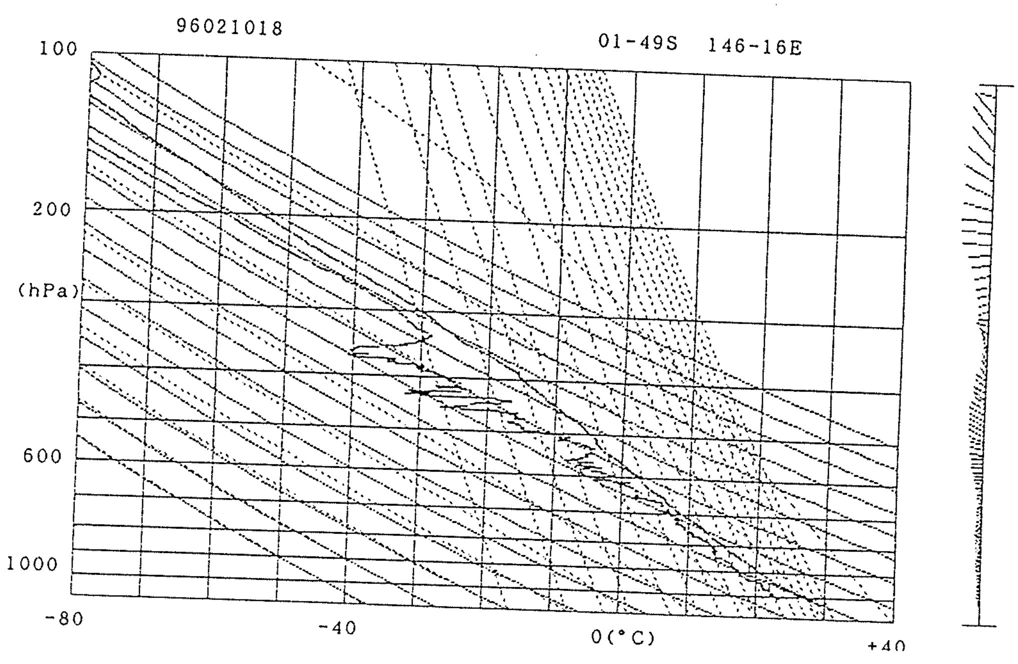
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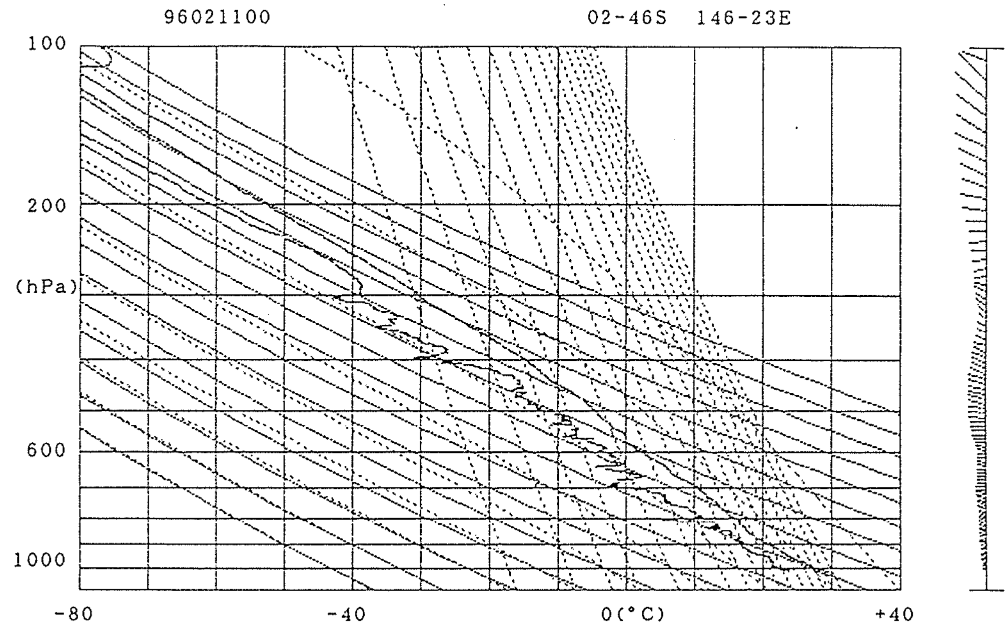
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(hPa)
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1000
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+40

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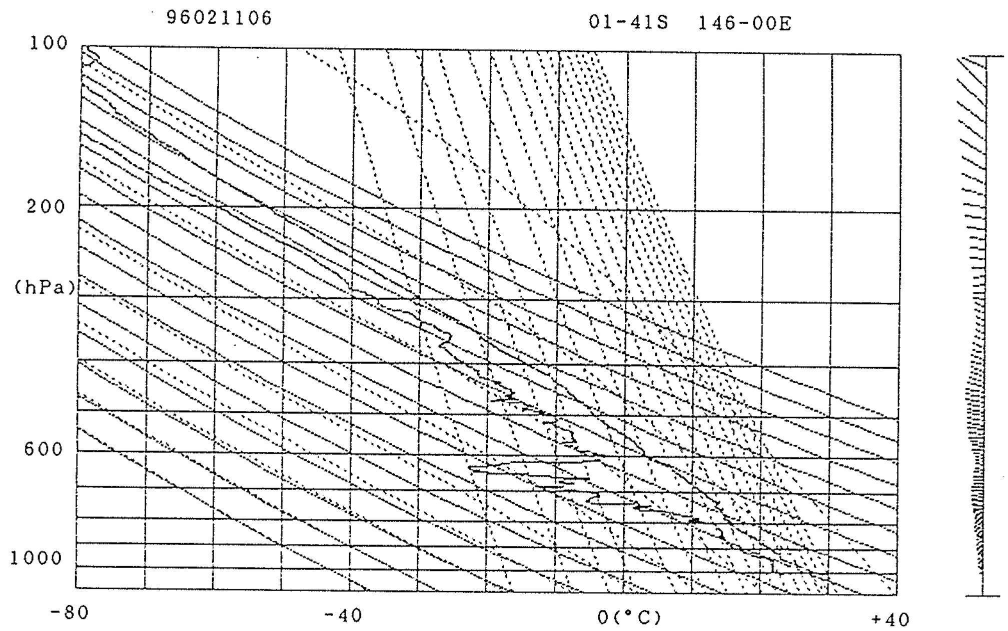
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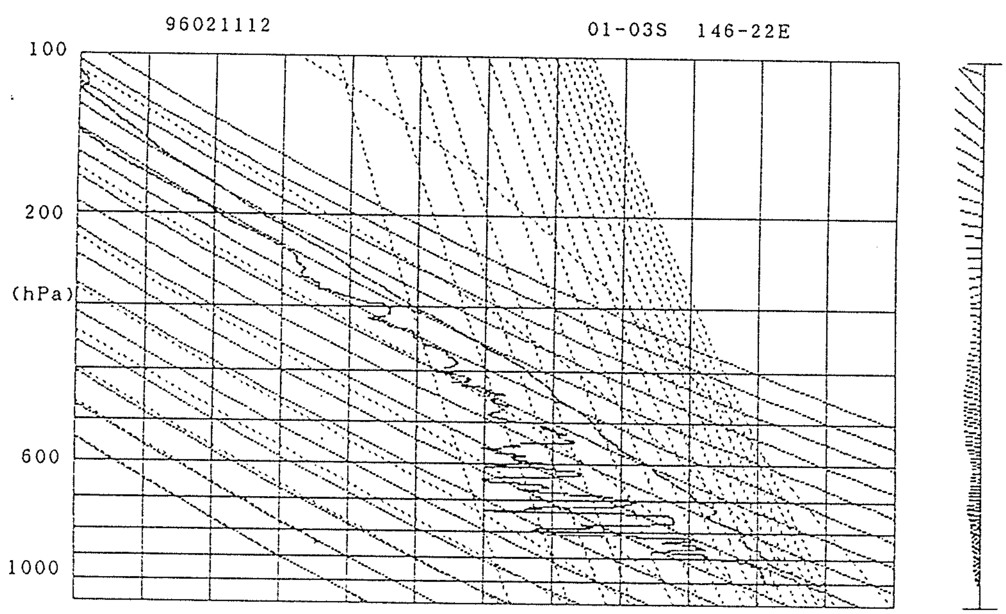
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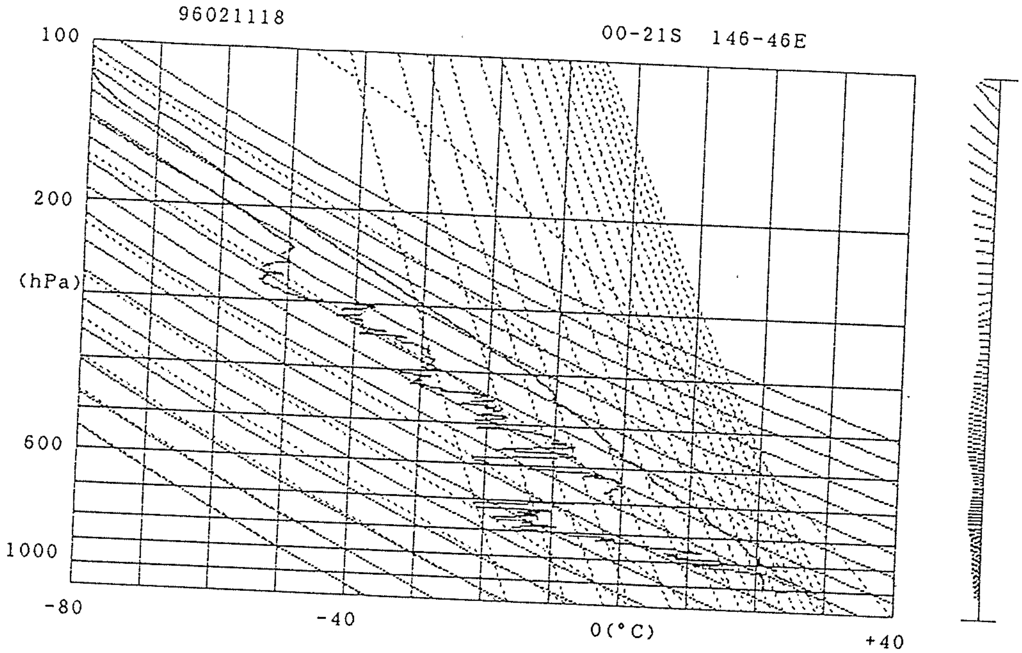
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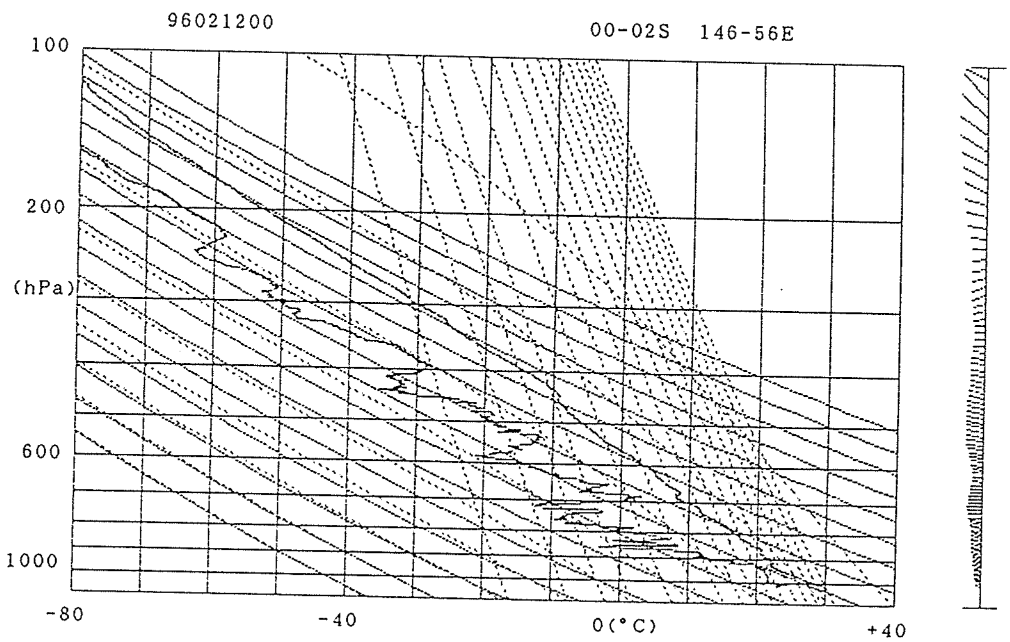
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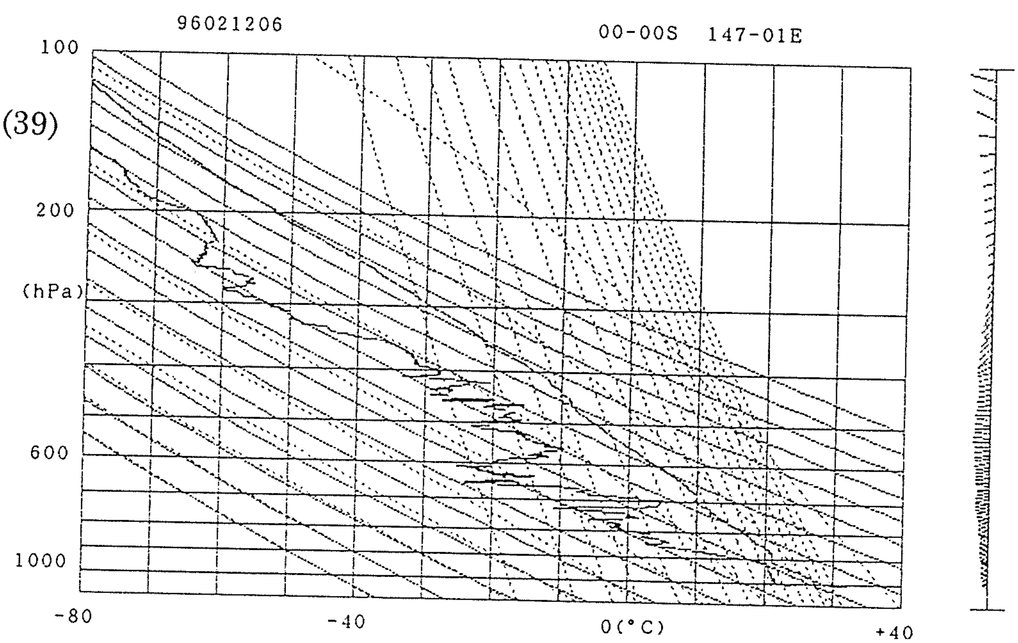
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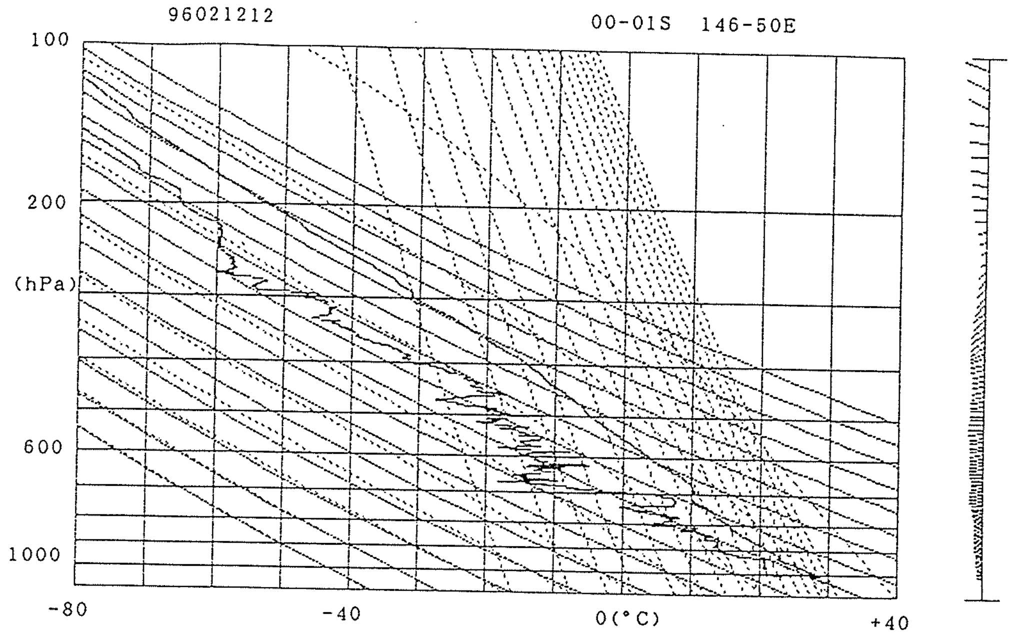
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+40

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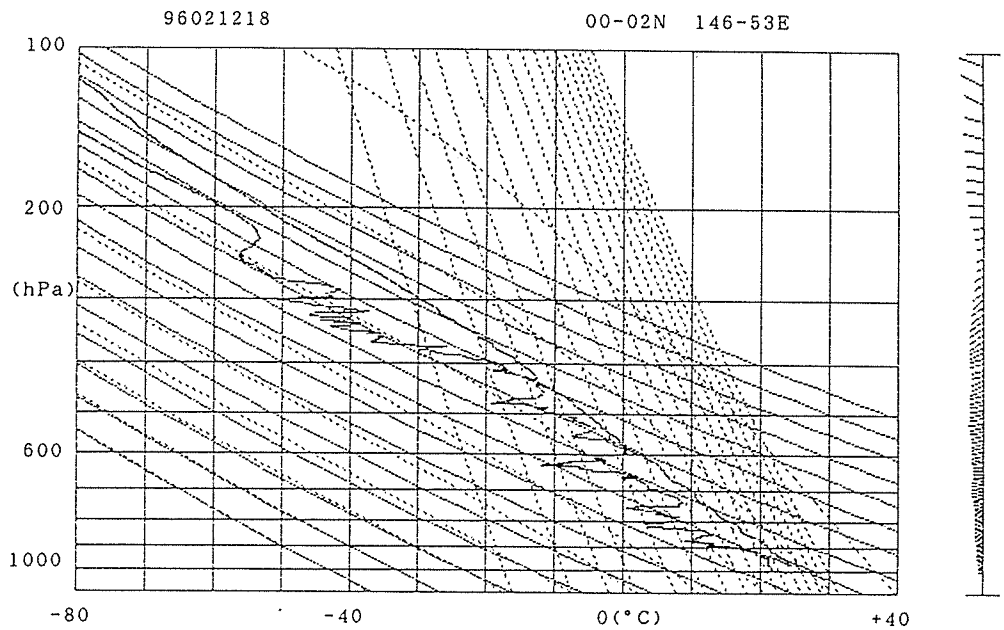
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(hPa)
600
1000
-80
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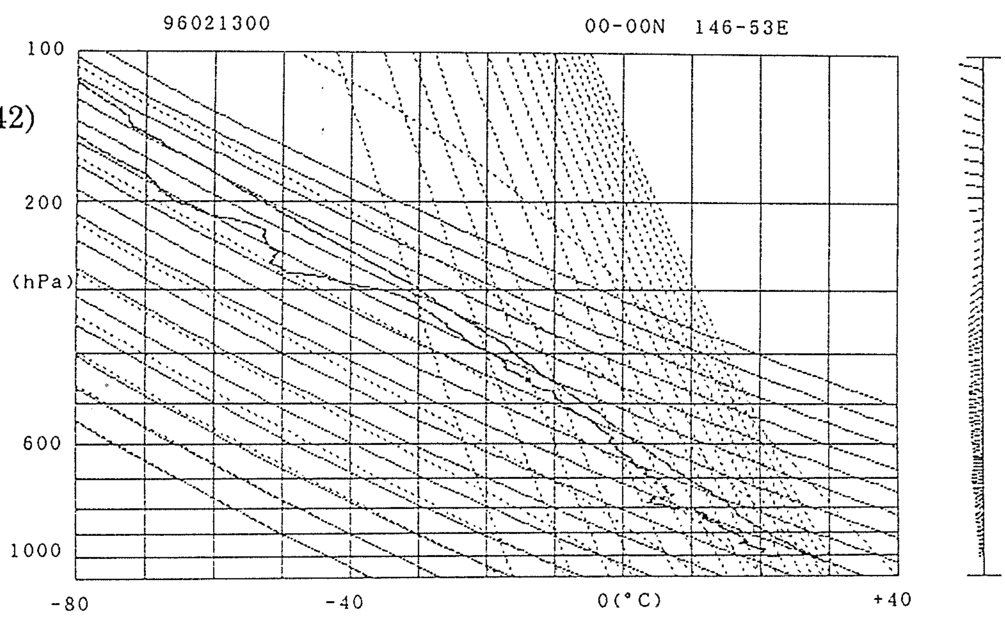
0(°C)
+40

(42)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(hPa)
600
1000
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0(°C)
+40

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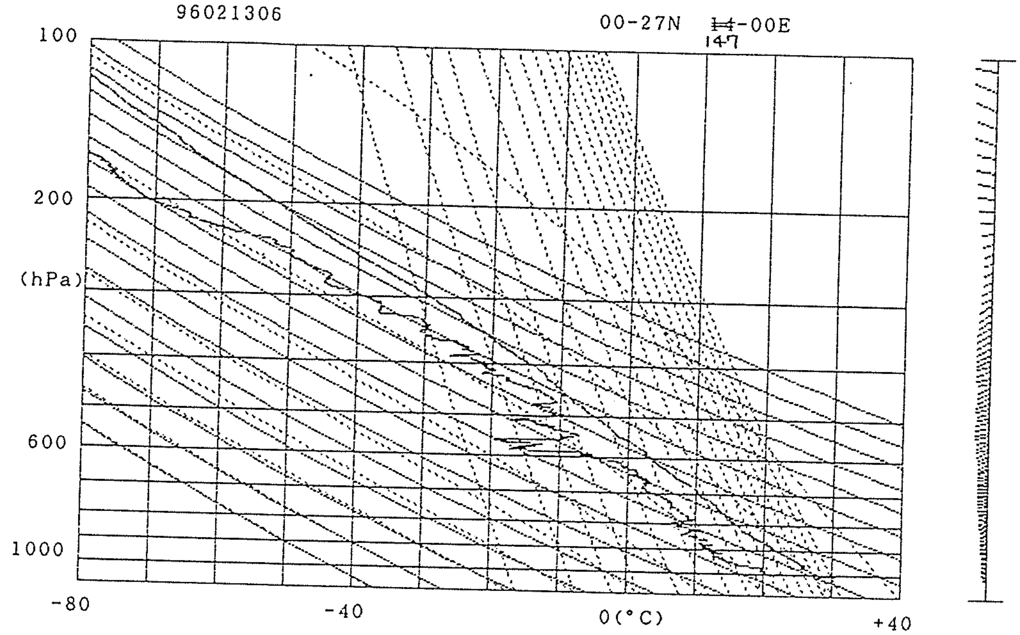
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200
(hPa)
600
1000
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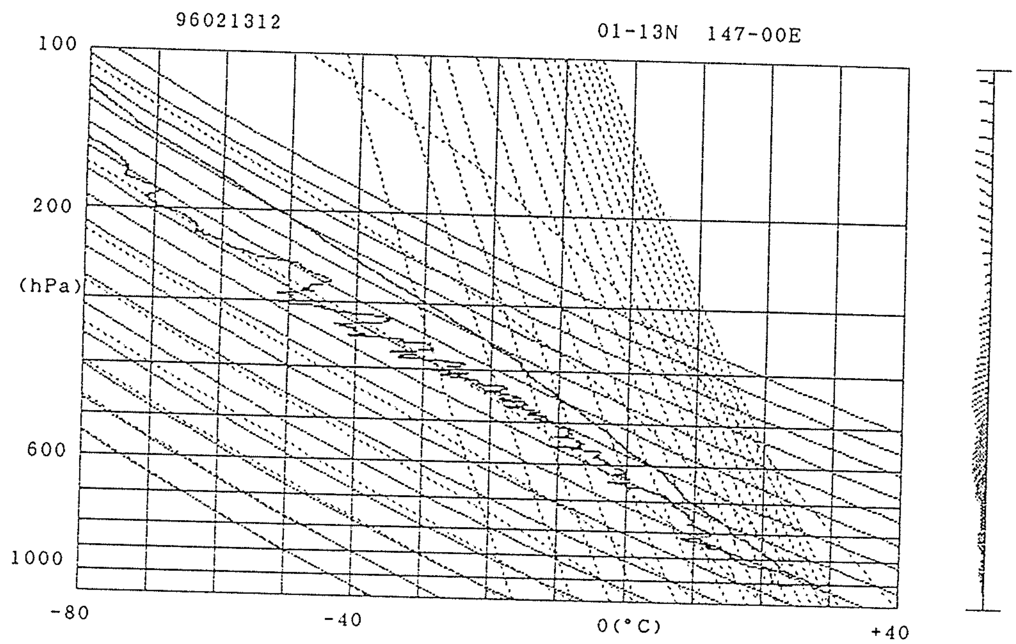
-40
0(°C)
+40

(44)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(hPa)
600
1000
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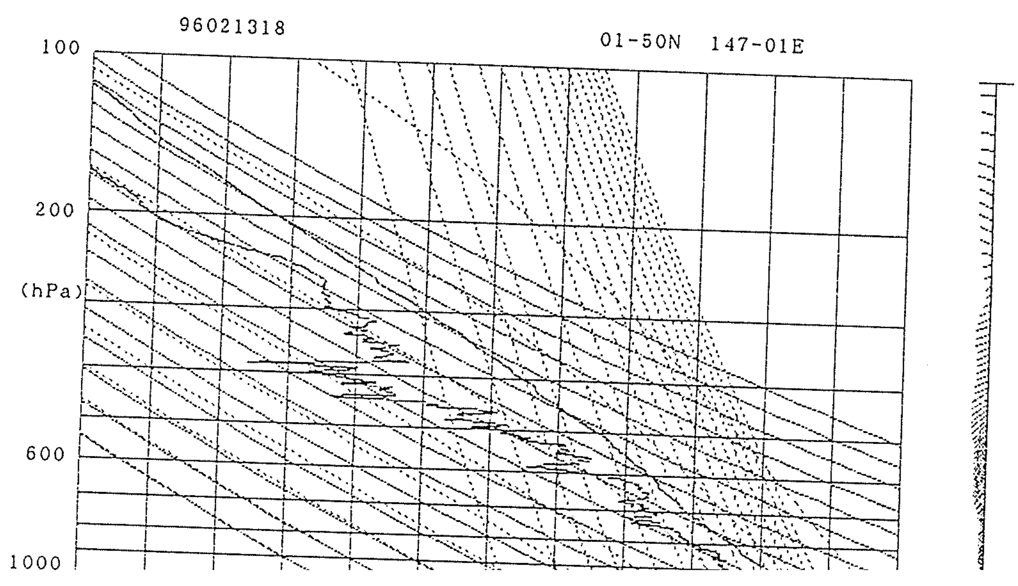
-40
0(°C)
+40

(45)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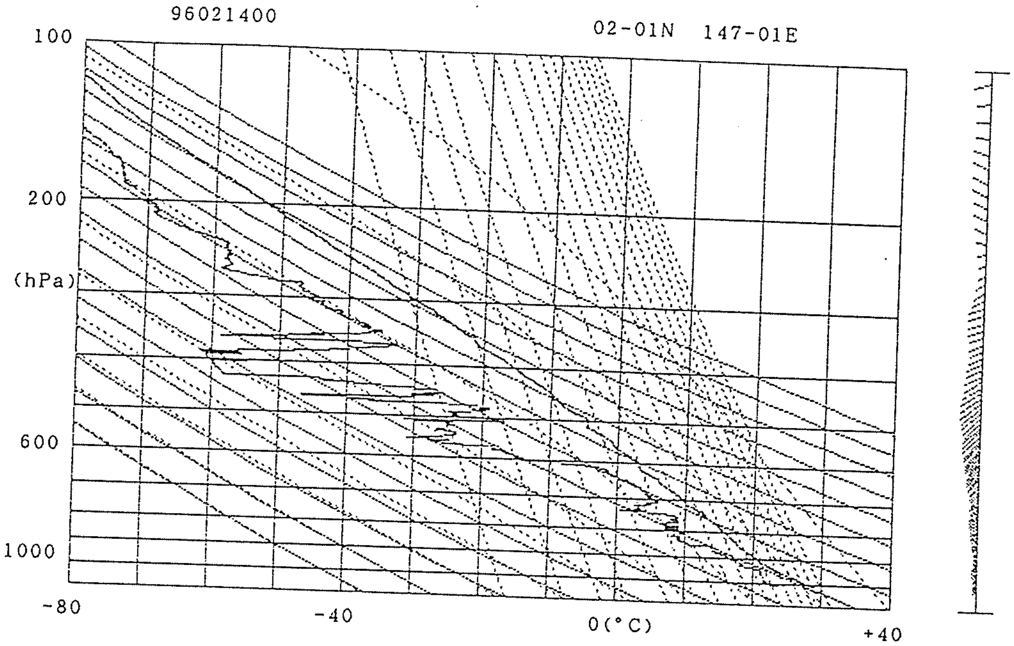
200
(hPa)
600
1000

(46)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(hPa)
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1000
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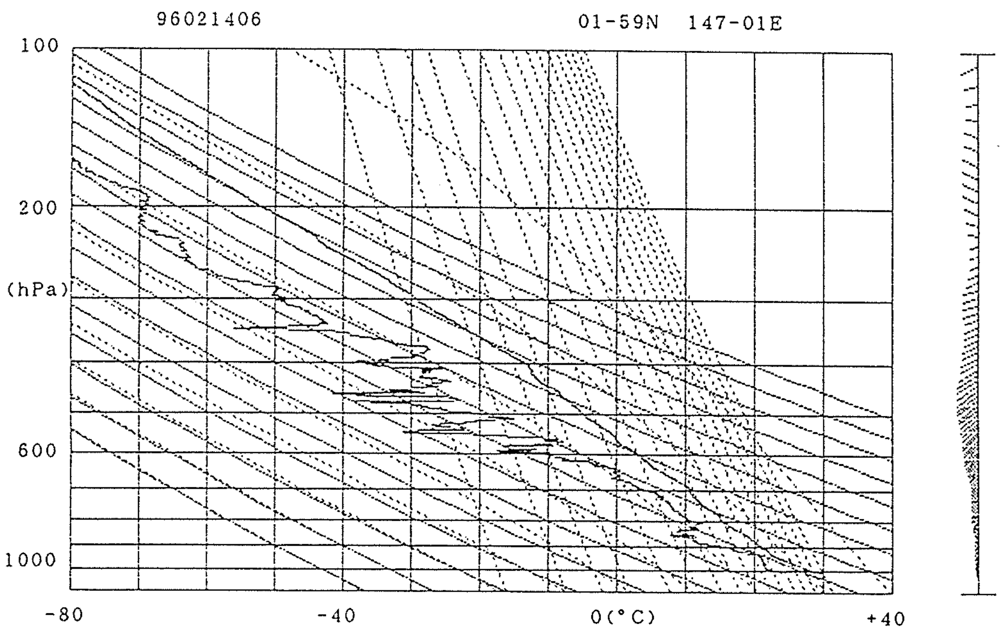
0(°C)
+40

(47)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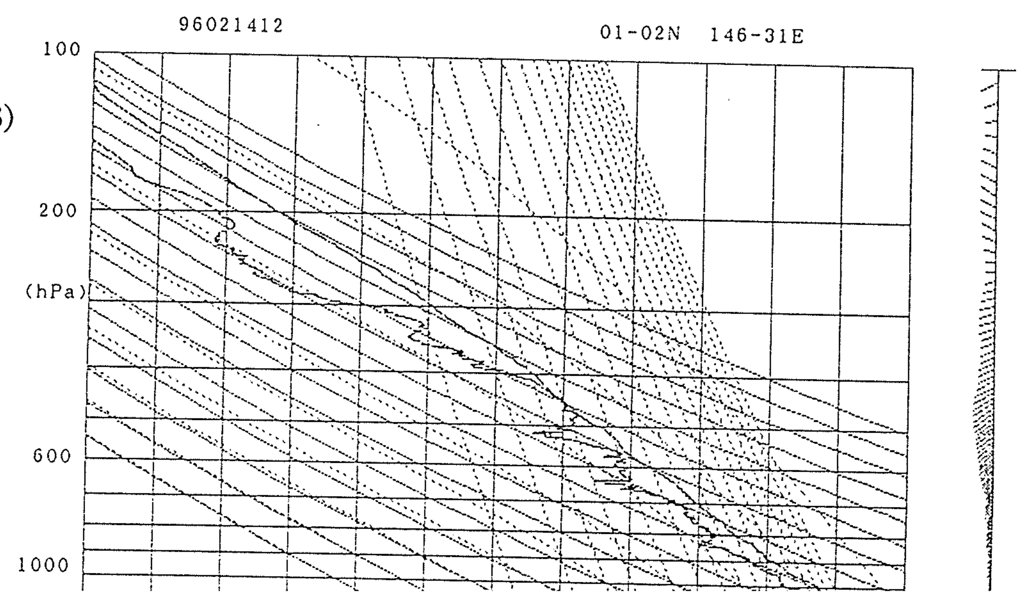
+40

(48)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01-02N 146-31E
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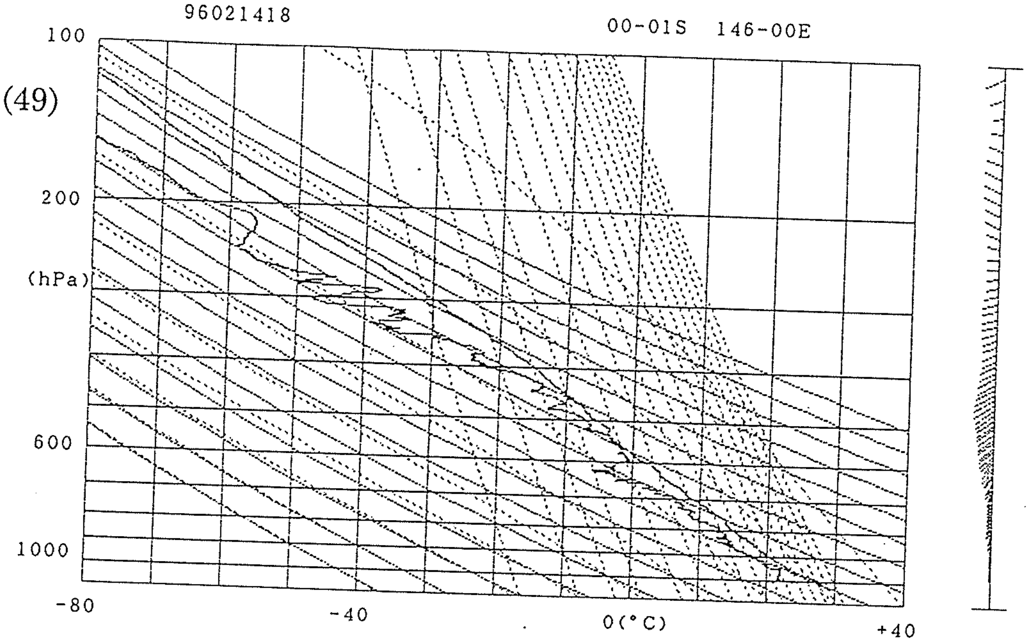
200
(hPa)
600
1000

(49)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(hPa)
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1000
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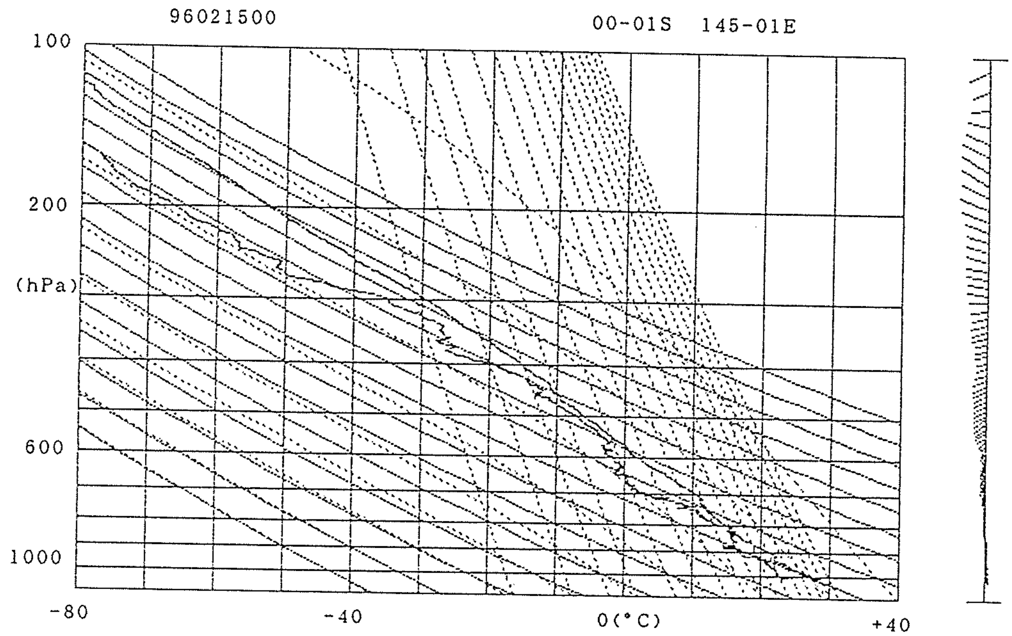
-40
0(°C)
+40

(50)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(hPa)
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1000
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-40
0(°C)
+40

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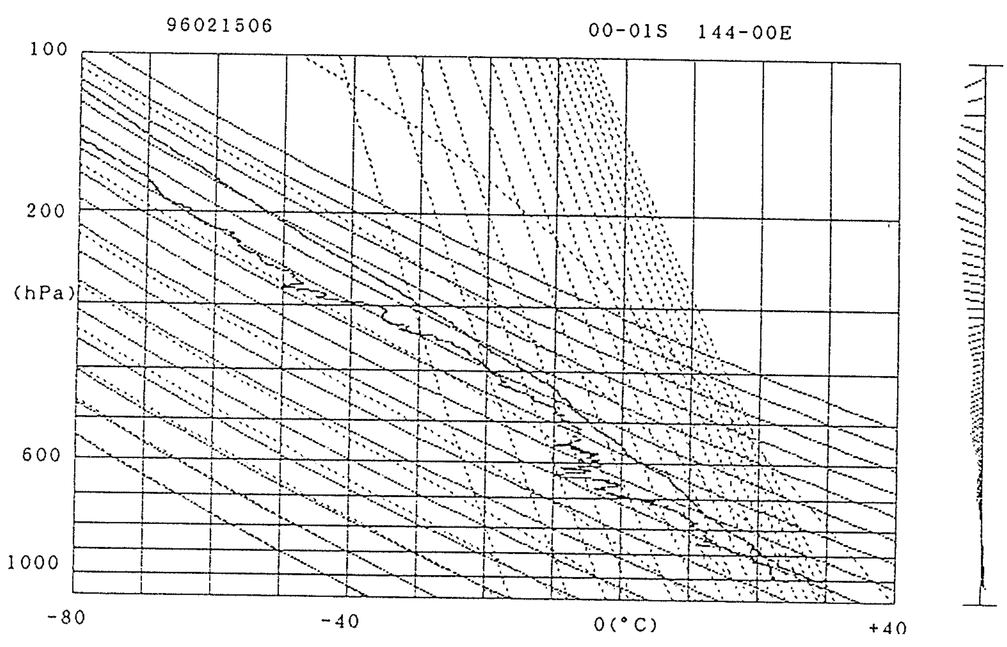
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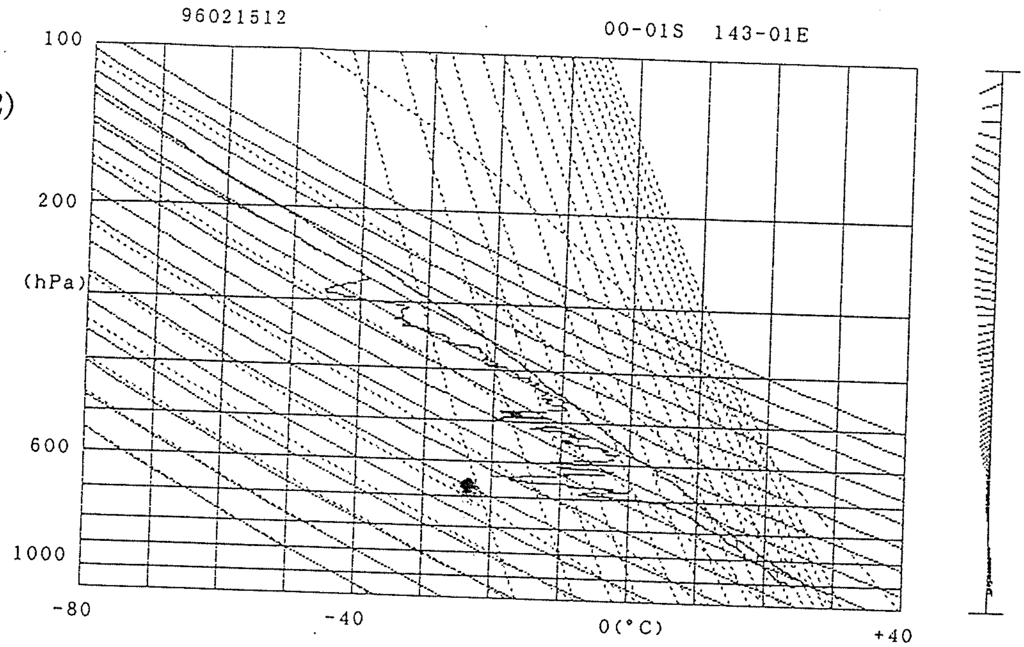
0(°C)
+40

(52)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(hPa)
600
1000
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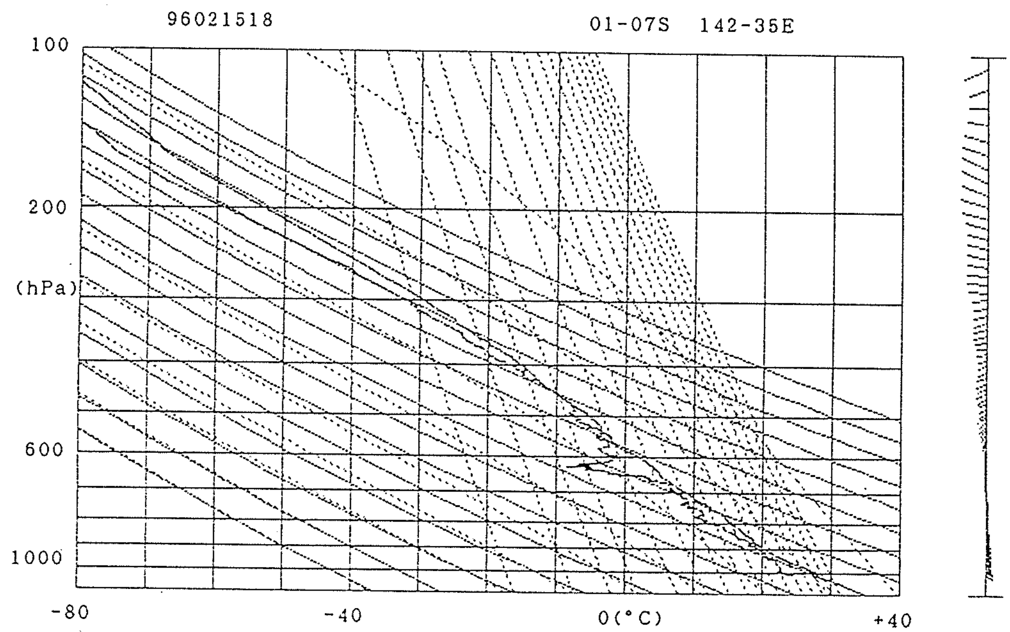
-40
0(°C)
+40

(53)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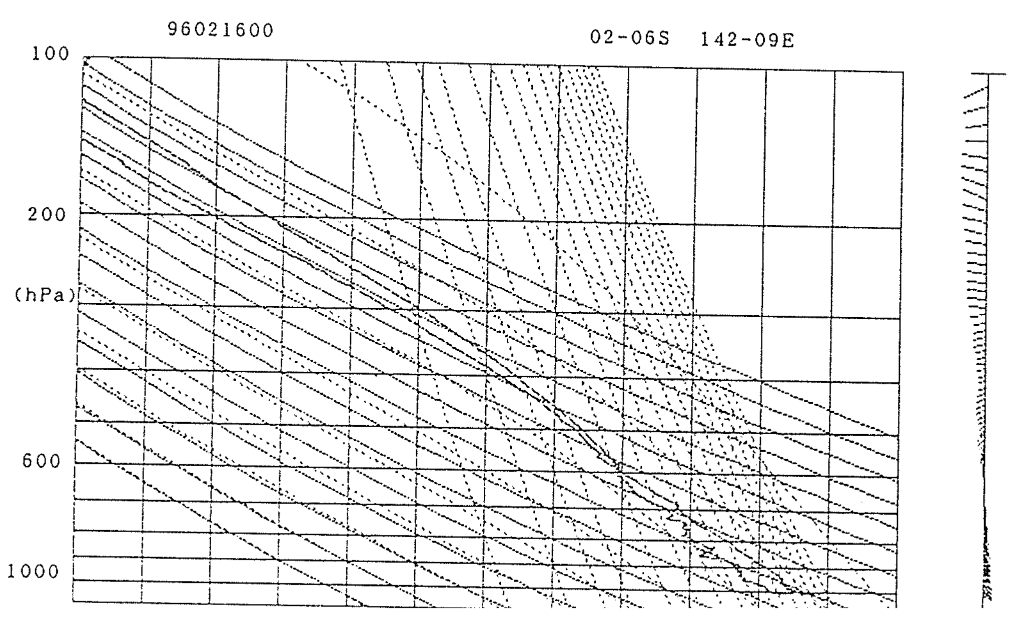
200
(hPa)
600
1000
-80
-40
0(°C)
+40

(54)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(hPa)
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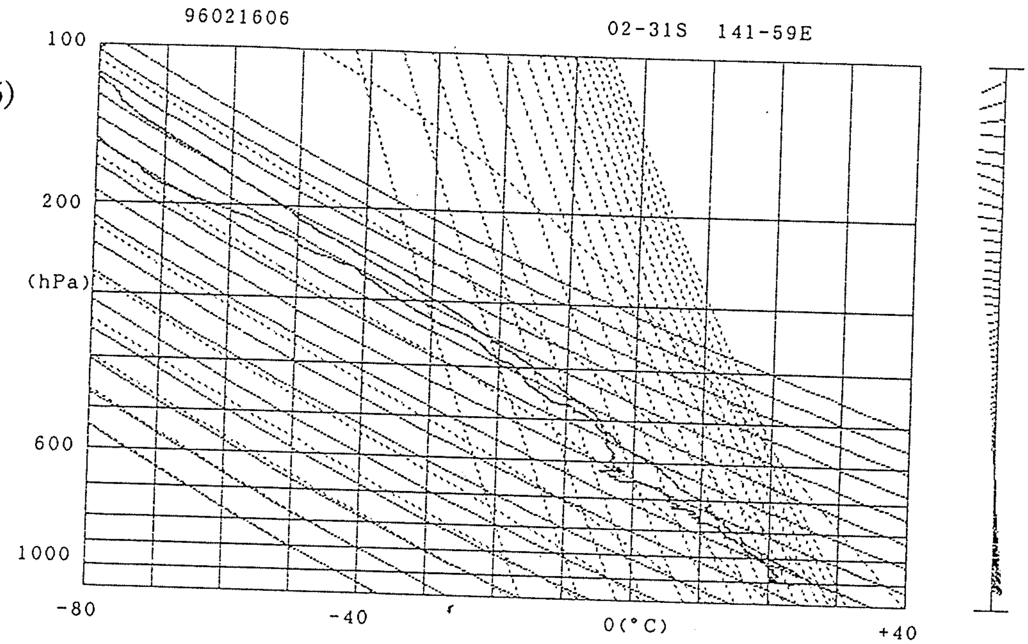

96021606
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200
(hPa)
600
1000
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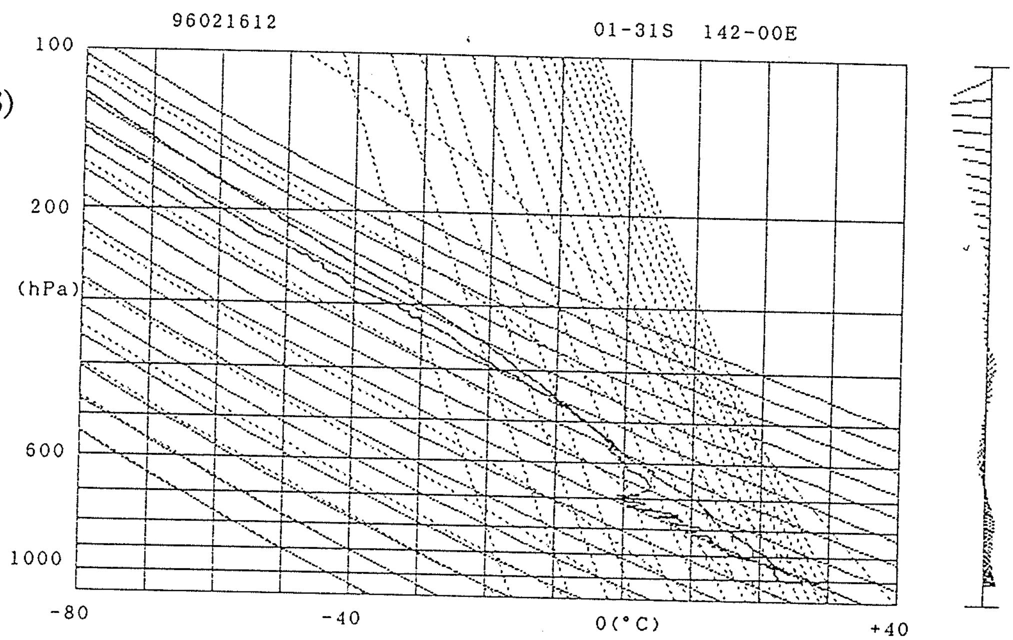
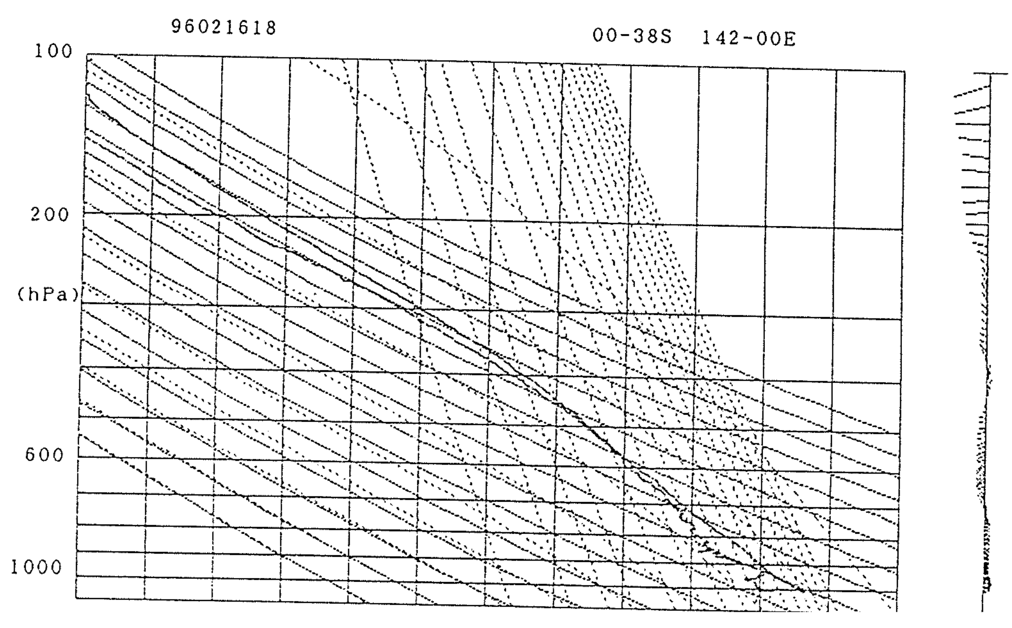
-40
0(°C)
+40

(56)



96021612
01-31S 142-00E
100
200
(hPa)
600
1000
-80
-40
0(°C)
+40

(57)



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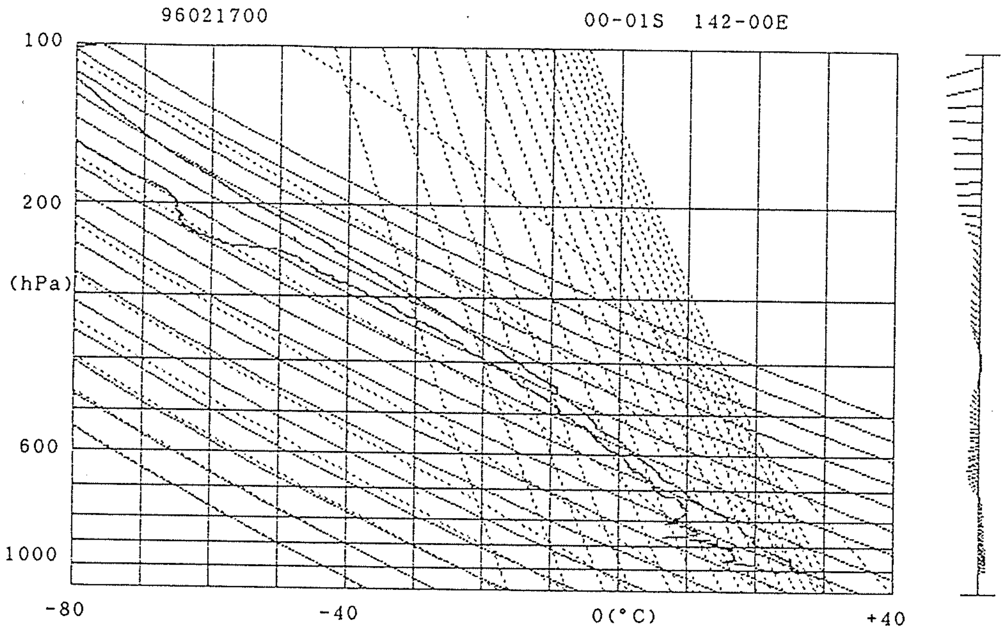
200
(hPa)
600
1000

(58)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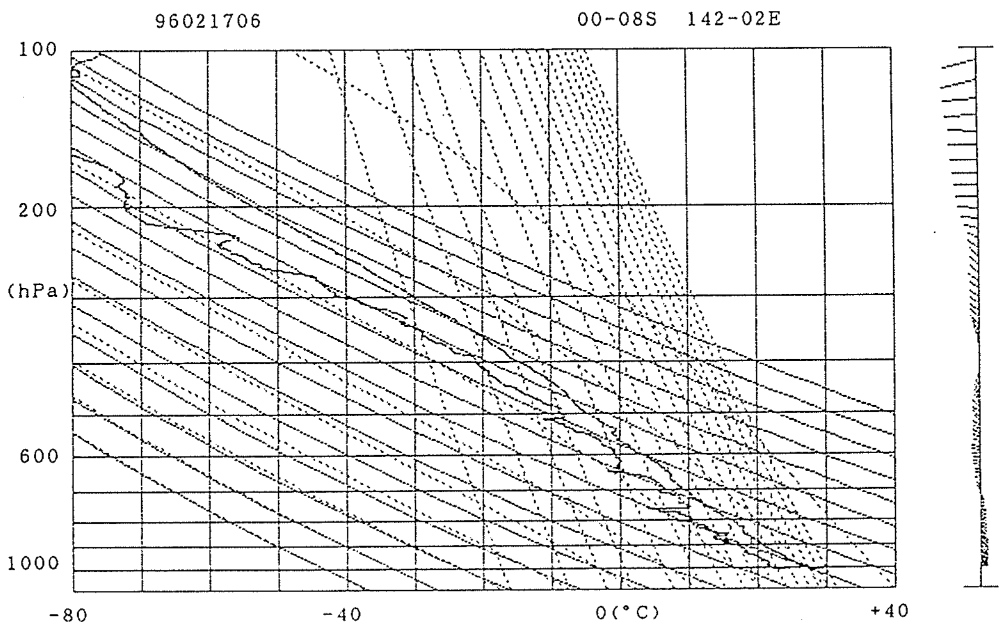
200
(hPa)
600
1000
-80
-40
0(°C)
+40

(59)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(hPa)
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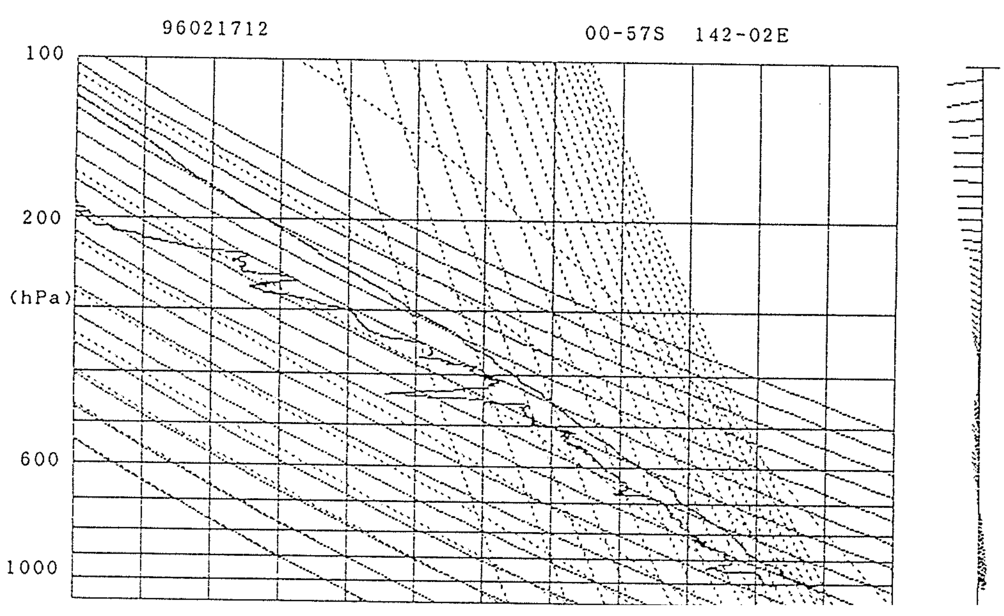
0(°C)
+40

(60)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(hPa)
600
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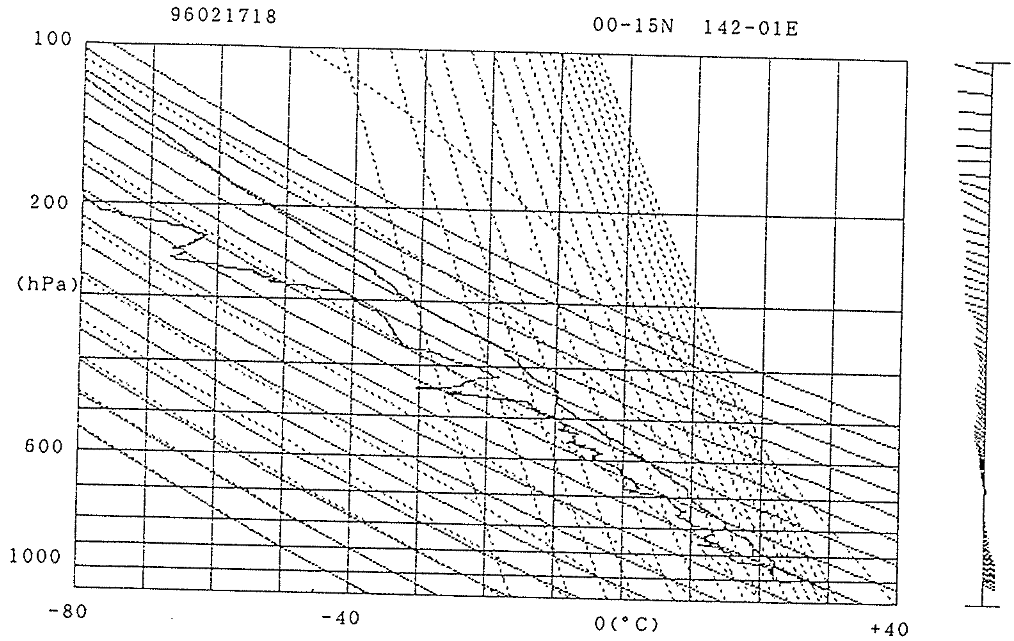
(61)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1000
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0(°C)
+40

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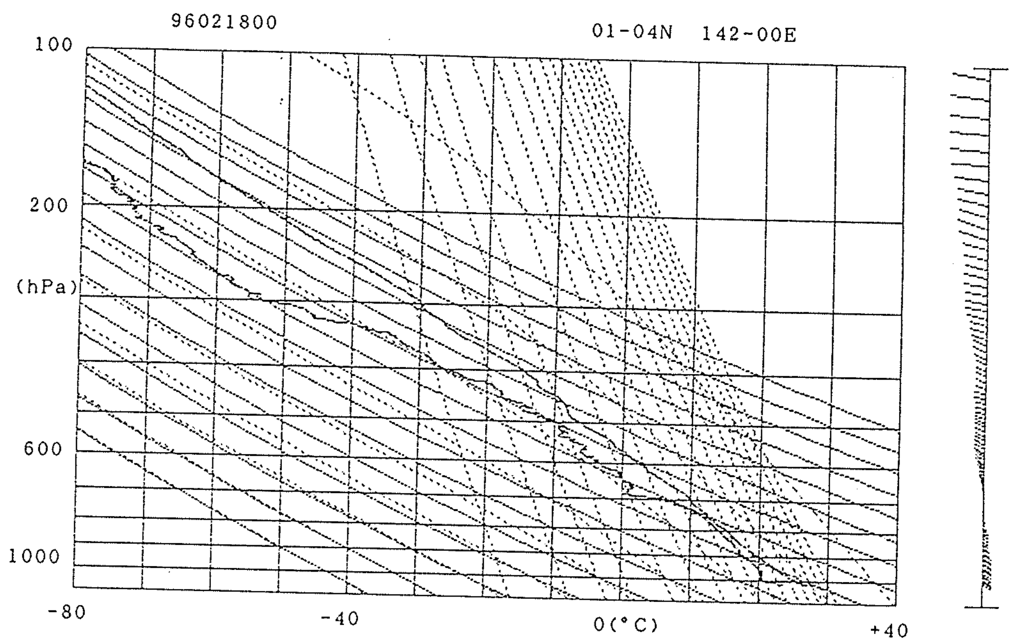
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1000
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-40
0(°C)
+40

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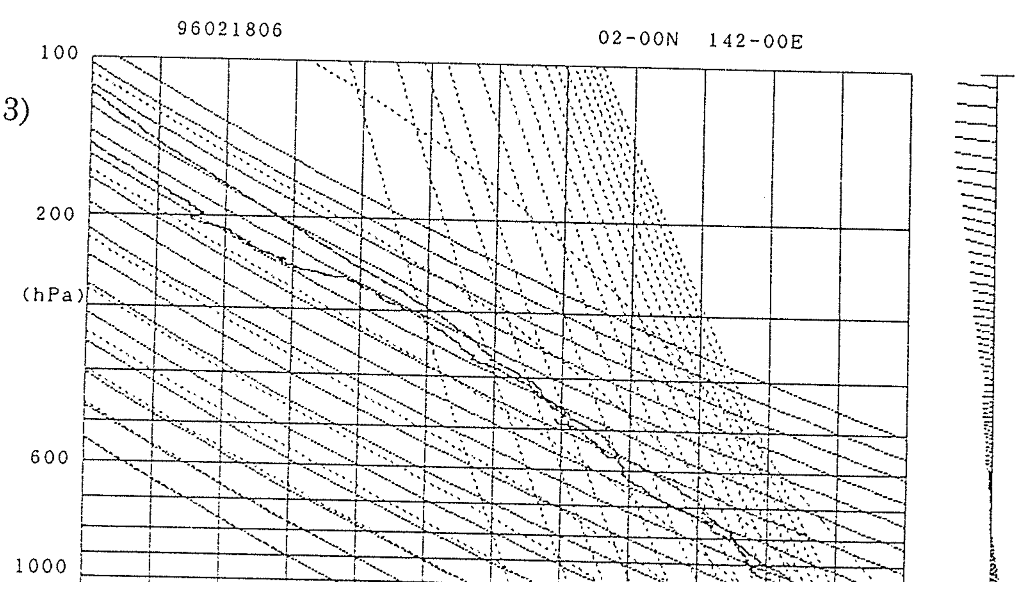
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200
(hPa)
600
1000

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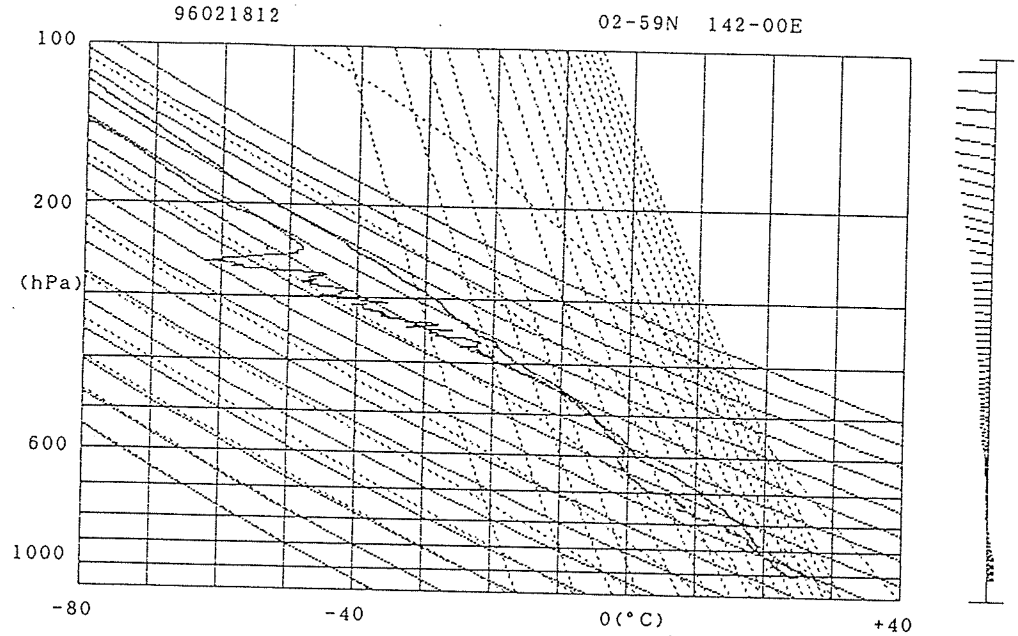
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600
1000
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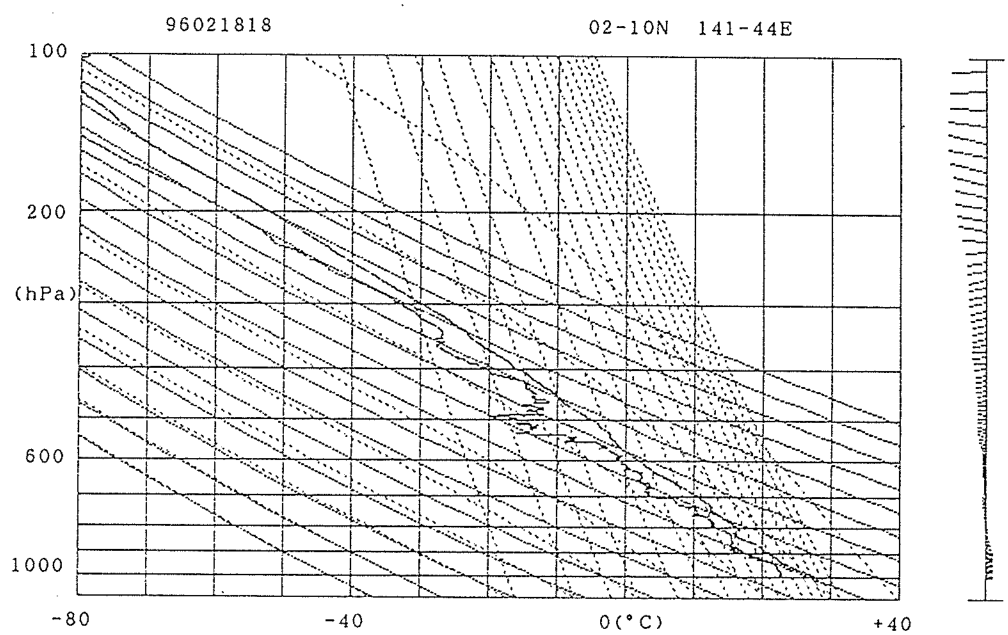
0(°C)
+40

(65)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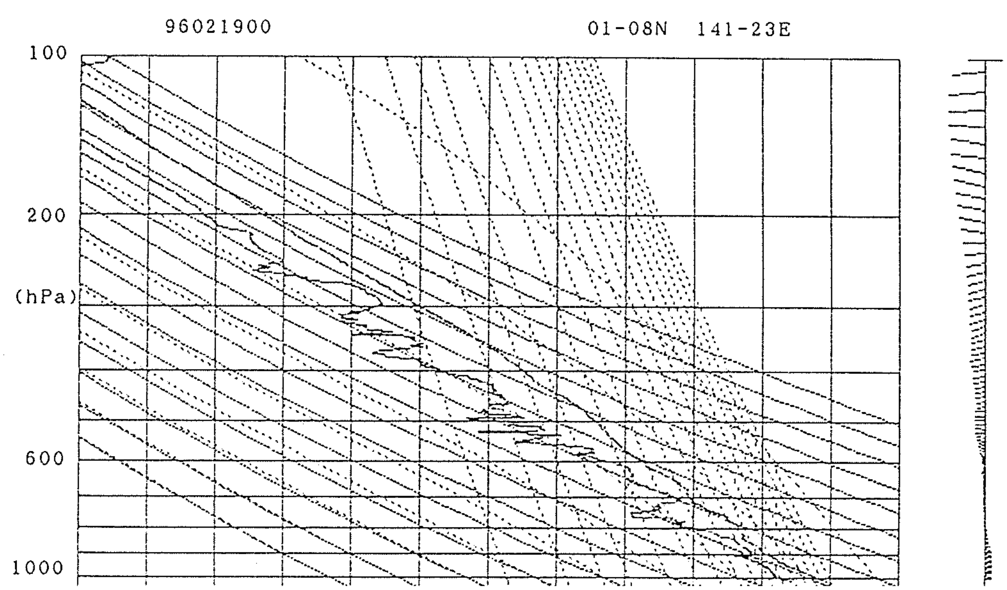
(hPa)
600
1000
-80
-40
0(°C)
+40

(66)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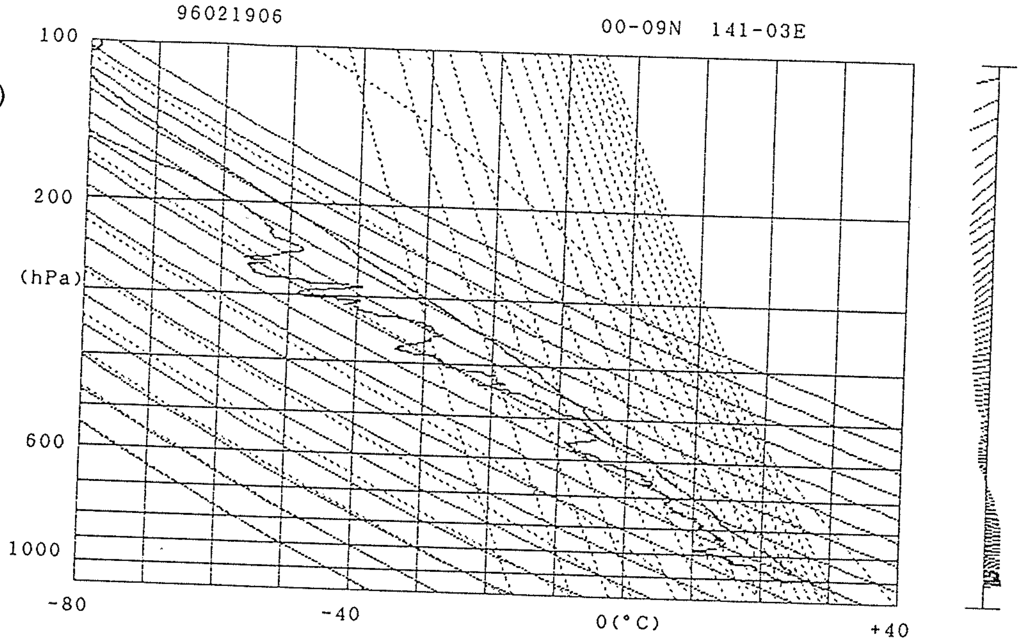
200
(hPa)
600
1000

(67)



96021906
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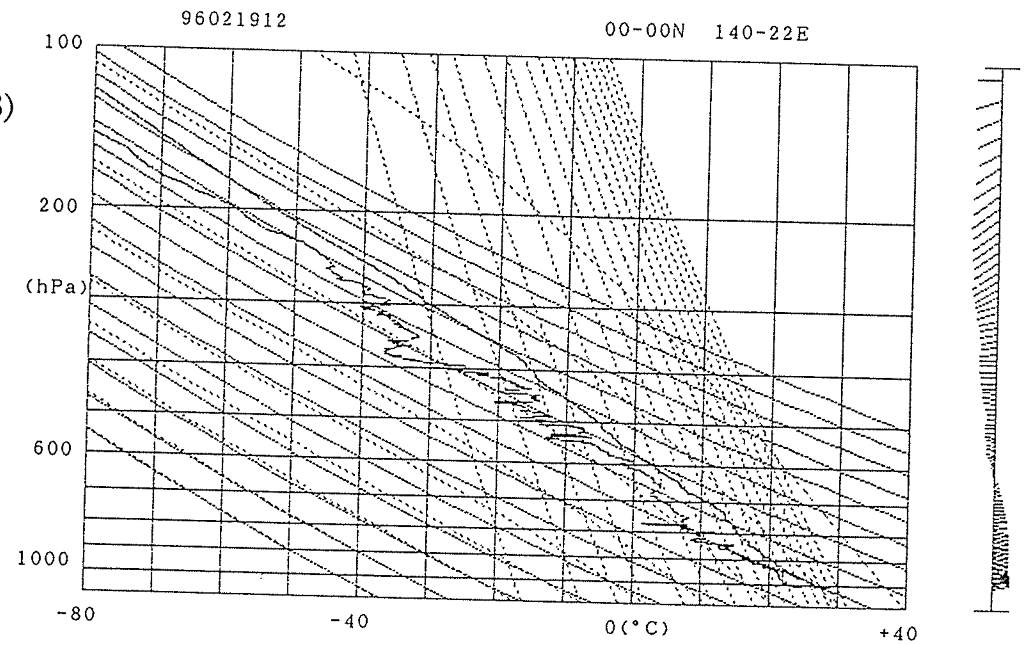
0(°C)
+40

(68)



96021912
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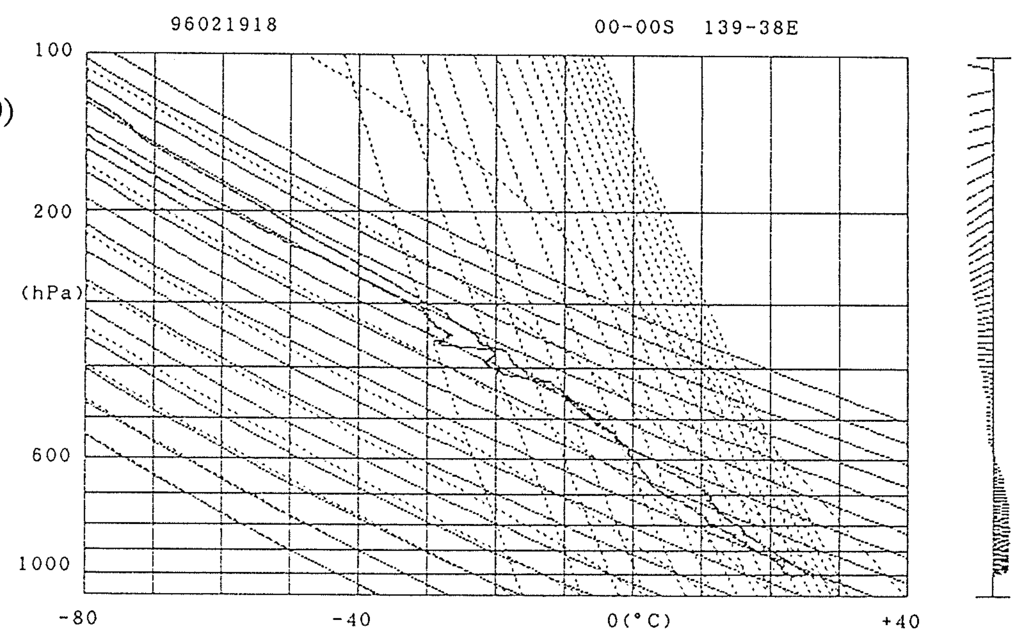
(hPa)
600
1000
-80
-40
0(°C)
+40

(69)



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1000
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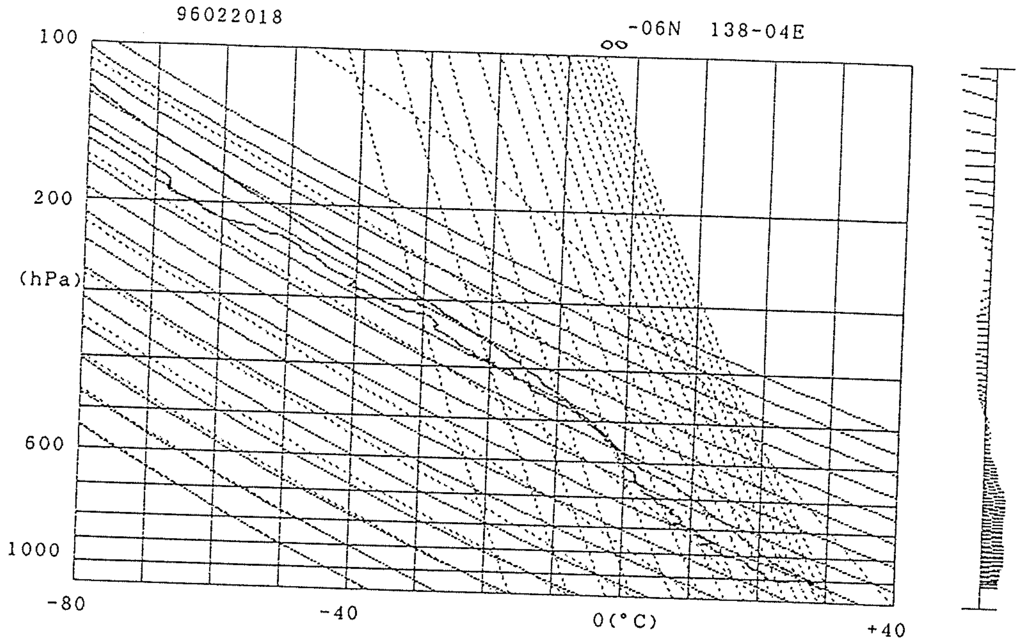
+40

(70)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1000
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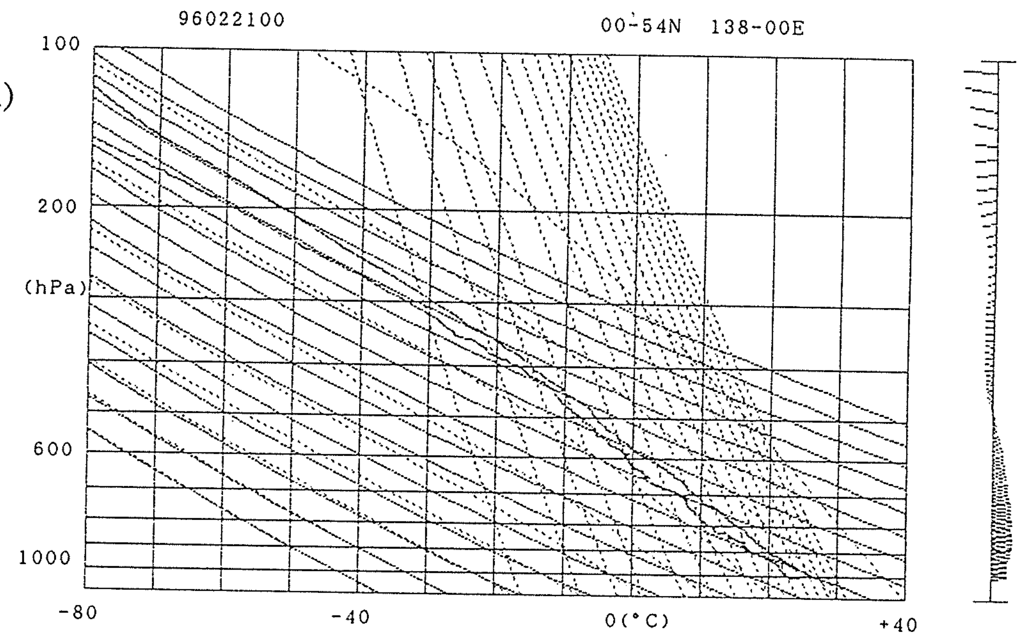
0(°C)
+40

(71)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(hPa)
600
1000
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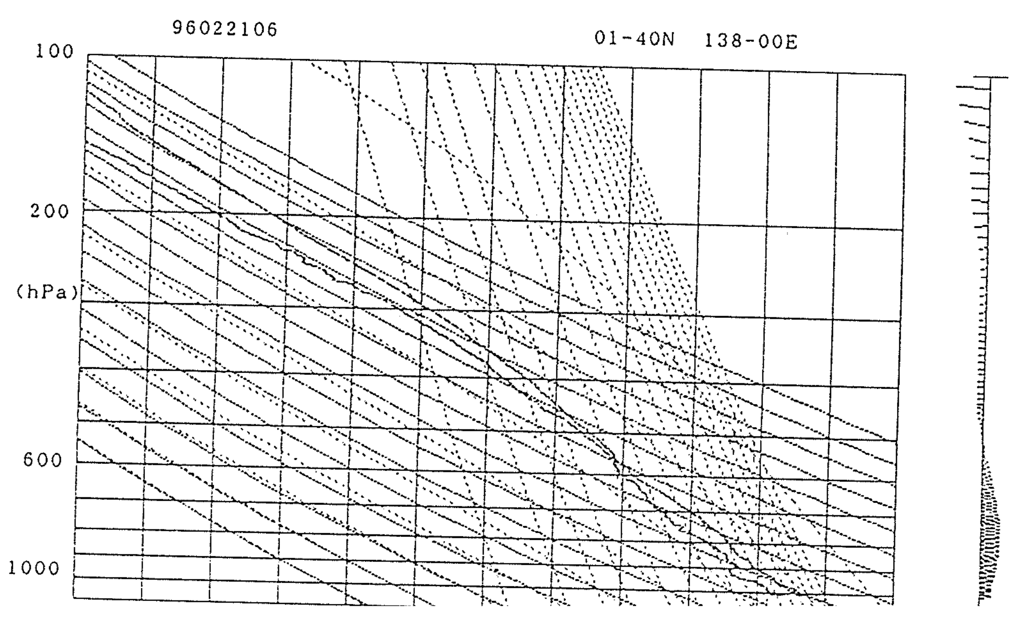
0(°C)
+40

(72)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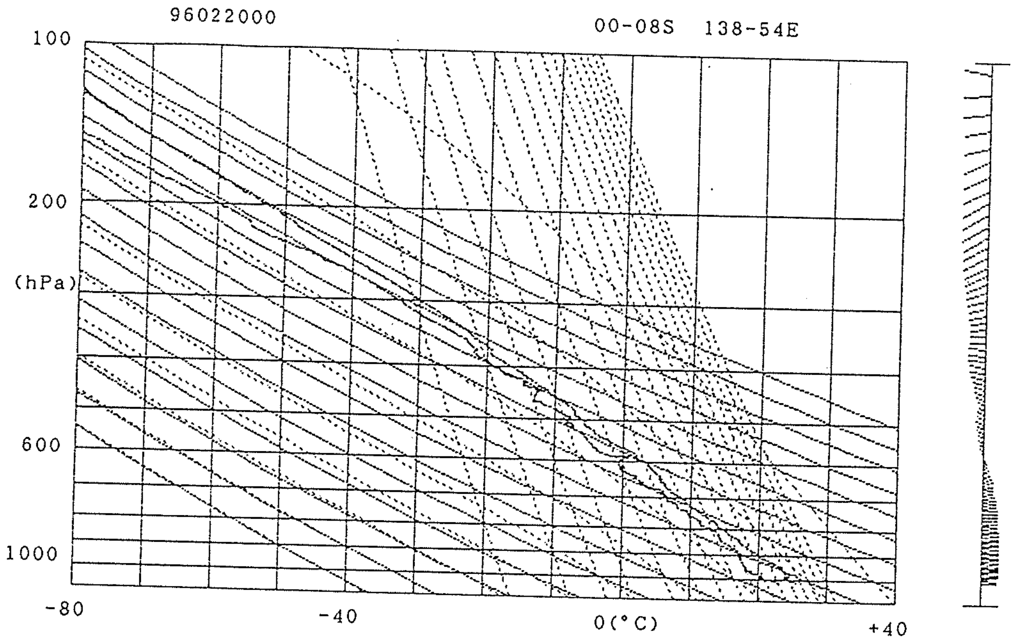
(hPa)
600
1000

(73)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(hPa)
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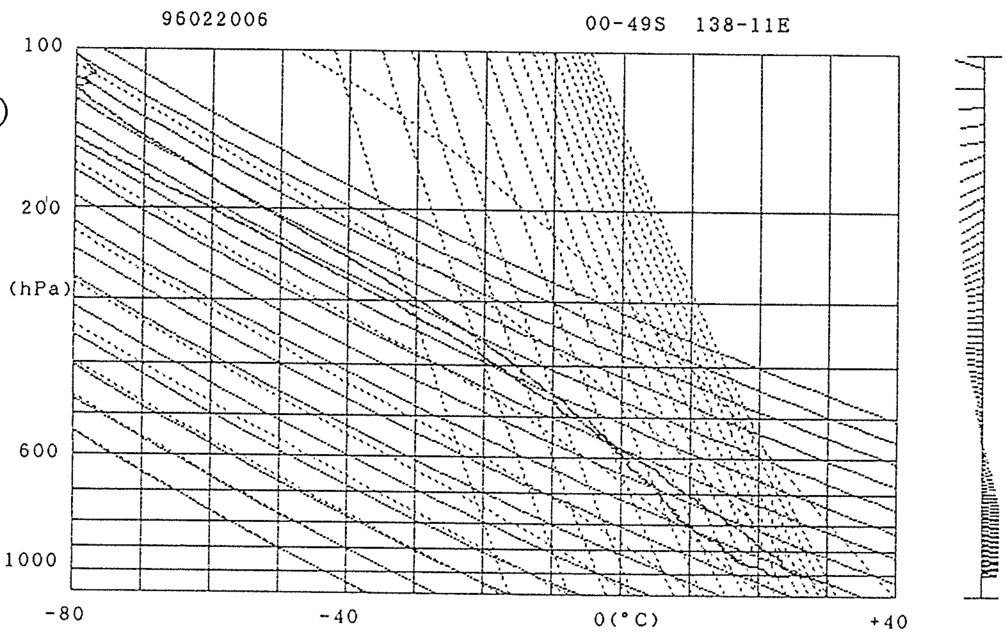
1000
-80
-40
0(°C)
+40

(74)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(hPa)
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1000
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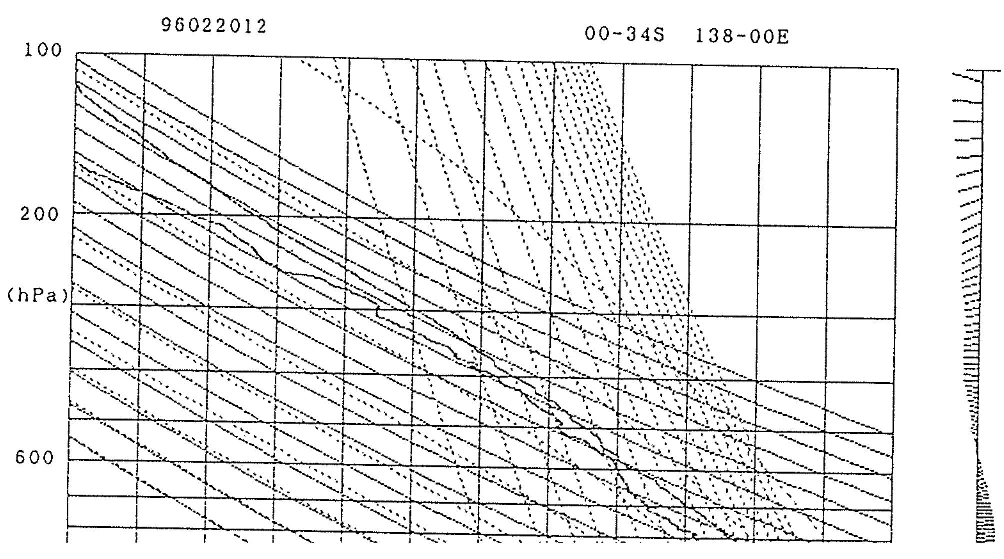
0(°C)
+40

(75)


96022012
00-34S 138-00E
100
200
(hPa)
600

5.2 Surface Meteorological Measurements

We observed some surface meteorological parameters (pressure, dry air temperature, wet air temperature, dewpoint temperature, sea temperature, relative humidity, wind speed/direction, cloud amount and weather) every 3 hours from Majro to Kavieng and form Kavieng to Palau. The parameters were recorded by officer and crew of R/V KAIYO according to the Ship's Weather Observation Reports.

Table 5−2 and Fig.5−2 shows results of the observation.

Table 5-2 Surface Meteorological Mesurements

Time UTC		Ship's T.		Position lat.	Long.	W.D. (16)	W.S. (m/s)	Weather	Press. (hP)	Dry Temp. (DEG-C)	Wet Temp. (DEG-C)	Sea W.T. (DEG-C)	Dew P.T. (DEG-C)	RH (%)	Cloud Amount
				MAJURO											
95 JAN 24	3	JAN 24	15	6 58 N	170 23 E	ENE	7.5	c	1003.9	30.8	26.5	29	25.0	72	9
	6		18	6 49 N	170 4 E	ENE	8.2	c	1005.3	28.5	26.0	29	25.1	83	9
	9		21	6 34 N	169 31 E	ENE	5.5	o	1006.8	26.5	25.8	29	25.8	94	9
	12		23	6 11 N	169 3 E	ENE	10.8	r	1006.8	26.0	25.8	29	26.0	99	10
	15	25	2	5 42 N	168 36 E	ENE	8.2	r	1003.4	26.0	24.5	29	23.6	88	10
	18		5	5 18 N	168 12 E	ESE	15.1	r	1004.1	24.0	23.5	29	23.3	95	10
	21		8	4 52 N	167 47 E	E	10.1	o	1005.4	25.0	24.0	29	23.6	92	8
25	0		11	4 38 N	167 31 E	ENE	9.7	o	1006.3	27.2	25.0	29	24.3	83	9
	3		14	4 10 N	167 7 E	E	5.7	o	1003.2	27.5	25.4	29	24.8	84	10
	6		17	3 56 N	166 52 E	E	5.0	o	1004.1	28.0	24.5	29	23.2	75	8
	9		20	3 31 N	166 29 E	S	2.0	o	1004.2	27.0	25.0	29	24.3	84	7
	12		23	3 43 N	166 40 E	E	7.7	bc	1005.3	26.8	25.4	29	25.0	89	5
	15	26	2	4 10 N	167 7 E	E	8.5	bc	1002.3	26.4	25.1	29	24.6	90	7
	18		5	4 37 N	167 34 E	SE	8.9	bc	1002.0	27.0	26.0	29	25.7	92	7
	21		8	5 4 N	167 59 E	E	10.4	c	1004.4	27.5	23.5	29	21.9	72	8
26	0		11	5 28 N	168 22 E	ENE	8.3	o	1006.8	26.6	25.1	29	24.5	88	10
	3		14	5 18 N	168 13 E	E	11.7	o	1003.7	27.0	25.8	29	25.1	90	10
	6		17	4 53 N	167 36 E	SE	8.3	o	1004.2	26.0	25.0	29	24.6	92	9
	9		20	4 27 N	167 23 E	SE	7.5	o	1005.2	26.0	23.0	29	21.8	77	10
	12		23	4 1 N	166 58 E	SE	8.5	o	1006.9	26.2	24.9	29	24.6	89	9
	15	27	2	3 36 N	166 34 E	ESE	13.2	o	1004.1	26.4	25.0	29	24.5	89	10
	18		5	3 3 N	166 9 E	SW	3.5	c	1005.7	25.5	23.5	29	22.7	85	7
	21		8	2 43 N	165 43 E	SW	4.0	bc	1006.2	27.0	24.5	29	23.6	82	4
27	0		11	2 15 N	165 16 E	SE	5.3	bc	1007.3	29.4	24.8	30	23.4	69	4
	3		14	2 0 N	165 1 E	ESE	2.5	bc	1003.7	31.5	27.5	30	26.2	74	4
	6		17	2 0 N	164 59 E	ENE	2.6	bc	1004.0	28.8	25.6	30	24.5	78	3
	9		20	2 1 N	164 57 E	E	2.5	bc	1007.1	28.0	24.0	30	22.5	72	4
	12		23	2 2 N	164 54 E	E	5.3	bc	1008.5	28.5	24.9	30	23.7	74	3
	15	28	2	2 3 N	164 52 E	E	5.0	b	1005.7	27.8	24.5	30	23.3	76	0
	18		5	2 1 N	164 55 E	ENE	6.2	bc	1007.2	28.0	24.5	30	23.2	75	2
	21		8	2 0 N	164 57 E	ENE	5.0	bc	1008.1	28.5	24.5	29	23.0	72	3
28	0		11	1 59 N	164 58 E	NE	5.0	bc	1008.3	30.8	25.8	30	23.2	67	3
	3		14	1 39 N	164 60 E	NE	11.0	b	1005.2	29.0	25.5	30	24.3	75	1
	6		17	1 7 N	164 59 E	NE	5.5	bc	1006.1	28.0	23.5	30	21.7	68	3
	9		20	0 45 N	164 60 E	NE	5.1	bc	1008.7	28.0	23.0	30	20.9	65	3
	12		23	0 13 N	165 0 E	ENE	6.4	bc	1008.3	28.4	25.1	30	23.8	76	3
	15	29	2	0 3 N	164 59 E	NE	3.5	b	1005.2	26.7	24.5	30	23.7	83	2
	18		5	N/A N/A N/A	N/A N/A N/A	E	5.0	bc	1006.5	28.0	23.0	30	20.9	65	2
	21		8	N/A N/A N/A	N/A N/A N/A	NE	4.5	bc	1007.1	29.0	25.0	30	23.5	72	N/A
29	0		11	0 0 N	165 4 E	ENE	5.5	bc	1007.8	29.0	24.5	30	22.8	69	3
	3		14	0 0 N	165 6 E	ENE	5.5	bc	1003.8	29.2	25.3	30	24.3	73	3
	6		17	0 1 S	165 3 E	E	5.5	bc	1003.2	28.5	24.5	30	23.0	72	4
	9		20	0 3 S	165 0 E	ENE	5.5	bc	1006.7	27.0	23.0	30	21.4	72	3
	12		23	0 4 S	164 58 E	ENE	6.0	bc	1007.3	28.4	24.2	30	22.5	71	3
	15	30	2	0 6 S	164 55 E	ENE	5.0	b	1006.5	27.2	24.4	30	23.5	80	2
	18		5	0 1 S	164 59 E	E	5.2	bc	1004.2	26.5	23.5	30	22.3	78	3
	21		8	0 0 S	164 58 E	E	5.1	bc	1007.1	29.0	25.1	30	23.2	73	4
30	0		11	0 1 N	164 60 E	E	5.4	bc	1007.3	29.9	25.4	30	23.9	70	4
	3		14	0 14 N	164 44 E	ESE	6.2	bc	1006.5	32.0	27.0	30	25.4	68	4
	6		17	0 40 N	164 15 E	E	4.1	bc	1004.1	30.0	25.0	30	23.2	66	5
	9		20	1 0 N	163 52 E	SE	4.3	bc	1005.3	28.0	24.5	30	23.2	75	5
	12		23	1 22 N	163 28 E	SSE	5.5	bc	1006.8	28.8	24.8	30	23.5	72	4
	15	31	2	1 47 N	163 0 E	NE	9.9	c	1007.7	26.8	25.2	30	24.5	87	9
	18		5	N/A N/A N/A	N/A N/A N/A	WSW	1.2	bc	1004.3	27.0	24.1	30	22.9	79	N/A
	21		8	N/A N/A N/A	N/A N/A N/A	NE	5.8	o	1006.2	27.5	25.0	30	24.1	82	N/A
31	0		11	2 52 N	161 48 E	E	5.0	o	1006.5	28.9	25.4	30	24.3	75	10
	3		14	3 10 N	161 28 E	ESE	7.7	r	1007.2	28.2	25.5	30	24.3	81	10
	6		17	3 36 N	160 60 E	E	6.5	o	1003.7	29.0	26.0	30	25.0	79	9
	9		20	N/A N/A N/A	N/A N/A E	ENE	7.0	o	1005.2	28.0	25.0	29	23.9	78	9
	12		23	4 18 N	160 14 E	E	8.7	c	1006.9	28.6	25.1	29	23.7	75	N/A
	15	1	1	4 42 N	159 47 E	ESE	10.1	c	1006.5	27.9	25.1	29	23.3	81	8
	18		4	4 60 N	159 26 E	ENE	8.9	o	1007.2	27.8	25.1	29	23.4	81	9
	21		7	5 20 N	159 3 E	ENE	6.0	c	1006.2	28.0	25.0	29	23.9	79	7
FEB 1	0		10	5 43 N	158 37 E	ENE	7.6	c	1007.9	29.4	25.4	29	24.1	72	7
	3		13	6 1 N	158 16 E	E	12.0	c	1006.8	29.5	26.4	29	25.5	79	8
	6		16	6 23 N	157 53 E	E	8.4	c	1007.2	29.7	27.0	29	26.1	82	8
	9		19	6 47 N	157 26 E	ENE	8.2	c	1006.1	27.5	25.5	29	24.8	85	7
	12		22	7 4 N	157 8 E	NE	7.3	o	1007.6	26.6	25.0	29	24.5	87	10
	15	2	1	7 27 N	156 42 E	ENE	10.0	c	1006.0	26.7	25.6	28	25.2	90	10
	18		4	7 51 N	156 14 E	ENE	11.2	q	1005.3	26.8	25.2	28	24.3	87	7
	21		7	7 60 N	155 58 E	ENE	13.1	o	1004.7	27.3	25.0	28	24.2	83	10
2	0		10	8 0 N	156 1 E	ENE	12.0	c	1007.8	27.5	26.0	28	25.5	89	7
	3		13	7 5 N	155 60 E	ENE	9.2	r	1005.1	27.0	25.1	28	24.3	86	10
	6		16	7 6 N	155 60 E	ENE	9.7	r	1004.6	25.5	24.2	28	23.4	90	N/A
	9		19	6 41 N	156 0 E	E	8.7	o	1005.7	27.8	25.7	29	24.7	84	10
	12		22	6 6 N	156 0 E	E	7.0	c	1006.8	27.5	24.5	29	23.4	78	5
	15	3	1	5 41 N	156 0 E	E	6.3	bc	1005.7	28.0	25.0	29	23.9	78	3
	18		4	5 6 N	156 0 E	ESE	5.0	bc	1004.7	27.5	25.5	29	24.8	85	5
	21		7	5 0 N	156 3 E	E	7.1	bc	1004.6	29.2	26.0	29	24.9	78	5
3	0		10	4 27 N	156 0 E	E	6.3	bc	1007.3	29.5	26.5	29	25.5	80	4
	3		13	4 0 N	156 0 E	E	2.5	bc	1004.8	30.0	26.0	30	24.6	73	4
	6		16	3 33 N	155 60 E	E	5.3	bc	1003.6	29.4	26.0	30	24.8	77	4
	9		19	3 3 N	156 0 E	ESE	3.5	bc	1005.2	29.2	25.8	30	23.9	77	5

	21		7	2	1 N	156	5 E	SSE	2.0	c	1006.6	29.8	25.6	30	24.1	71	7
4	0		10	2	0 N	156	5 E	ESE	2.0	o	1008.2	28.5	24.5	30	23.0	72	10
	3		13	1	41 N	156	3 E	NE	1.2	c	1005.9	29.5	26.0	30	24.8	76	9
	6		16	1	10 N	156	1 E	NE	2.4	c	1004.7	29.0	25.2	30	23.5	74	9
	9		19	1	55 N	156	1 E	NNE	5.4	c	1005.4	29.4	25.2	30	23.6	71	9
	12		22	0	34 N	156	4 E	NE	4.0	c	1007.5	29.0	26.0	30	25.0	79	8
	15	5	1	0	12 N	156	5 E	NNE	4.6	c	1007.1	27.5	26.0	30	25.5	88	8
	18		4	0	0 N	156	5 E	NE	4.0	bc	1005.8	28.0	26.0	30	25.3	85	6
	21		7	0	0 N	156	7 E	NE	5.0	bc	1006.2	29.5	25.4	30	24.1	72	6
5	0		10	0	0 N	155	54 E	NE	4.1	bc	1007.5	33.0	26.5	30	24.3	60	3
	3		13	0	0 N	155	17 E	NE	5.8	bc	1006.5	30.6	26.2	30	24.0	71	5
	6		16	0	0 S	154	49 E	ENE	2.2	c	1004.3	30.2	26.0	30	24.5	72	8
	9		19	0	0 S	154	11 E	NE	4.0	c	1005.4	28.1	25.2	30	26.1	79	8
	12		22	0	0 N	153	43 E	NNW	5.6	r	1007.1	26.2	23.0	30	21.8	75	10
	15	6	1	0	0 N	153	5 E	NNW	5.0	o	1007.0	27.2	25.2	30	24.3	85	10
	18		4	0	0 S	152	41 E	SSW	4.4	r	1006.5	26.0	25.0	30	24.6	92	10
	21		7	0	0 S	152	5 E	SE	2.3	c	1007.6	27.4	25.2	30	24.7	84	8
6	0		10	0	0 S	151	42 E	E	2.1	o	1008.8	28.0	26.5	30	26.0	89	10
	3		13	0	0 N	151	5 E	NE	5.4	c	1007.3	27.2	26.0	30	25.6	91	8
	6		16	0	15 S	150	58 E	NE	2.9	c	1005.4	28.0	25.4	30	24.3	81	9
	9		19	0	39 S	150	56 E	SE	5.2	c	1007.6	27.1	24.5	30	23.2	81	8
	12		22	1	16 S	150	51 E	E	2.6	bc	1009.6	27.0	23.0	30	21.4	71	4
	15	7	1	1	52 S	150	48 E	ENE	1.8	bc	1007.8	28.2	25.0	31	23.9	77	5
	18			KAVIENG													
	21																
7	0																
	3																
	6																
	9																
	12																
	15																
	18																
	21																
8	0																
	3																
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	12																
	15																
	18																
	21																
9	0																
	3																
9	6	9	16	1	27 S	150	23 E	WSW	8.2	c	1007.1	28.3	25.1	31	23.8	77	4
	9		19	0	52 S	150	14 E	NNE	3.2	c	1008.3	28.3	25.0	30	23.8	76	3
	12		22	0	17 S	150	5 E	NNW	4.0	bc	1009.2	27.5	24.5	30	23.2	78	4
	15	10	1	0	0 N	149	51 E	NW	2.5	c	1008.9	27.5	25.0	30	24.1	84	8
	18		4	0	0 N	149	13 E	E	1.4	c	1007.8	27.6	24.6	30	23.4	78	8
	21		7	0	0 N	148	45 E	E	2.5	c	1007.8	28.0	24.6	29	23.2	75	8
10	0		10	0	0 N	148	7 E	SE	4.5	c	1009.3	29.5	26.1	30	24.8	77	7
	3		13	0	14 S	147	46 E	SE	3.3	bc	1008.3	29.0	25.0	30	23.5	72	2
	6		16	0	39 S	147	23 E	E	5.1	bc	1006.6	29.1	25.0	30	23.5	71	7
	9		19	1	0 S	147	3 E	W	1.5	bc	1008.5	27.8	25.4	30	24.5	76	6
	12		22	1	12 S	146	52 E	SSE	4.4	o	1008.9	28.0	24.5	30	22.8	75	9
	15	11	1	1	35 S	146	30 E	SSE	1.9	o	1008.3	28.0	25.0	29	23.9	78	10
	18		4	1	55 S	146	10 E	ESE	1.2	c	1007.5	28.2	24.8	30	23.7	76	6
	21		7	2	25 S	146	10 E	E	2.3	c	1007.2	28.1	24.5	30	23.2	74	6
11	0		10	2	39 S	146	20 E	SE	1.5	c	1009.3	28.9	25.4	30	24.3	75	7
	3		13	2	6 S	146	4 E	ESE	2.5	c	1007.7	30.1	25.8	30	24.6	71	9
	6		16	1	34 S	146	0 E	ESE	3.2	c	1005.4	31.4	26.4	30	24.8	67	10
	9		19	1	12 S	146	19 E	ENE	4.0	c	1006.8	29.1	25.3	30	23.6	73	9
	12		22	0	58 S	146	24 E	E	5.3	bc	1008.3	28.0	24.5	30	23.4	75	3
	15	12	1	0	36 S	146	36 E	E	4.3	bc	1008.0	28.2	24.7	29	23.4	75	3
	18		4	0	15 S	146	50 E	ESE	7.2	bc	1007.0	28.6	24.8	29	23.5	74	4
	21		7	0	1 S	146	57 E	ESE	4.0	bc	1008.8	28.6	25.1	29	23.8	75	2
12	0		10	0	1 S	146	56 E	NE	2.0	bc	1009.8	31.5	25.5	30	24.1	62	3
	3		13	0	0 S	146	57 E	ESE	2.0	bc	1008.3	32.4	26.2	29	23.9	62	2
	6		16	0	0 N	147	1 E	E	3.1	bc	1005.6	30.2	25.6	30	23.9	69	3
	9		19	0	0 S	146	52 E	ENE	2.0	bc	1006.5	29.5	25.0	30	23.4	70	2
	12		22	0	1 S	146	49 E	ENE	2.0	bc	1008.3	28.5	24.3	30	23.0	71	2
	15	13	1	0	1 S	146	49 E	ENE	2.0	bc	1007.8	28.9	24.9	30	23.5	72	2
	18		4	0	2 N	146	53 E	NNE	3.1	bc	1006.8	28.6	25.5	30	24.4	77	6
	21		7	0	0 S	146	51 E	NNE	6.0	c	1007.2	28.1	25.9	29	25.3	84	8
13	0		10	0	0 S	146	54 E	NNE	7.0	c	1009.3	29.8	24.8	30	22.8	66	9
	3		13	0	4 N	146	59 E	NNE	5.2	bc	1007.0	30.8	24.6	30	22.2	60	4
	6		16	0	36 N	146	60 E	NNW	4.4	bc	1005.8	30.1	24.2	30	21.7	62	3
	9		19	0	60 N	146	59 E	S	3.5	bc	1007.2	28.8	25.4	N/A	24.2	76	4
	12		22	1	17 N	146	60 E	NE	4.6	bc	1007.4	28.3	24.8	30	23.4	75	3
	15	14	1	1	35 N	147	1 E	NNE	7.6	bc	1006.8	28.2	25.2	29	24.0	78	1
	18		4	1	54 N	147	1 E	NNE	4.6	b	1005.3	28.0	25.2	29	23.7	79	1
	21		7	2	1 N	147	1 E	NE	4.0	bc	1007.2	28.4	25.0	29	23.7	76	3
14	0		10	2	2 N	147	0 E	ENE	2.0	bc	1008.3	32.0	26.0	29	23.9	62	4
	3		13	1	60 N	146	57 E	NNW	2.7	bc	1006.4	28.2	25.6	29	24.4	81	3
	6		16	1	60 N	146	60 E	N	3.5	bc	1003.8	30.6	25.4	30	23.9	65	4
	9		19	1	28 N	146	44 E	W	1.8	bc	1005.9	28.5	25.4	30	24.4	78	3
	12		22	0	54 N	146	37 E	SW	3.1	bc	1007.3	28.0	25.2	30	23.8	80	3
	15	15	0	0	18 N	146	9 E	NW	3.0	bc	1006.5	27.9	24.8	29	23.9	78	1
	18		3	0	0 S	145	57 E	W	4.7	bc	1004.7	28.0	24.9	30	23.9	78	6
	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	6		15	0	0 S	143	52 E	NW	7.1	c	1003.0	30.4	26.0	29	24.4	71	6
	9		18	0	1 N	143	16 E	WNW	7.6	c	1004.2	27.6	24.9	29	24.0	80	4
	12		21	0	9 S	142	57 E	WNW	8.4	c	1006.3	27.0	24.8	29	23.5	84	5
	15	16	0	0	42 S	142	44 E	W	8.4	o	1005.3	28.0	24.5	29	22.8	75	10
	18		3	1	18 S	142	31 E	NW	10.0	bc	1004.1	28.0	25.5	29	24.6	82	6
	21		6	1	50 S	142	19 E	W	13.1	o	1005.5	27.8	24.7	29	23.8	77	9
16	0		9	2	5 S	142	9 E	W	10.0	r	1008.8	26.6	24.5	29	23.8	84	10
	3		12	2	34 S	142	1 E	W	14.0	r	1007.8	27.0	24.1	29	22.9	79	10
	6		15	2	30 S	141	59 E	W	6.0	c	1004.8	25.0	24.5	29	24.3	95	9
	9		18	1	54 S	142	0 E	WNW	11.6	c	1005.3	27.2	25.3	29	24.7	86	9
	12		21	1	29 S	142	1 E	W	6.9	r	1006.2	28.4	25.6	29	24.4	78	9
	15	17	0	0	60 S	141	60 E	W	6.9	o	1007.3	27.9	26.0	29	25.3	86	10
	18		3	0	30 S	141	59 E	SW	2.5	r	1006.2	26.0	22.0	29	20.3	70	10
	21		6	0	6 S	141	60 E	WSW	6.3	r	1007.0	25.9	24.2	29	23.7	87	10
17	0		9	0	0 S	141	60 E	WNW	5.0	bc	1008.2	27.5	26.0	29	25.5	89	5
	3		12	0	0 S	142	0 E	WNW	4.0	c	1007.5	29.0	25.4	29	24.3	74	8
	6		15	0	18 S	142	1 E	WSW	2.8	bc	1005.8	30.0	25.5	29	23.9	69	4
	9		18	0	46 S	142	1 E	NW	7.7	bc	1006.5	28.3	25.8	29	25.4	82	3
	12		21	0	48 S	142	2 E	NW	6.1	bc	1008.3	28.1	25.0	29	23.9	77	2
	15	18	0	0	11 S	142	0 E	NW	8.4	bc	1008.3	28.5	25.0	29	23.7	75	2
	18		3	0	25 N	142	0 E	NW	7.2	bc	1006.0	28.0	26.0	29	25.3	85	1
	21		6	0	51 N	142	0 E	NNW	7.4	bc	1007.3	27.6	25.8	29	25.2	80	5
18	0		9	1	15 N	141	60 E	NW	3.6	o	1009.1	27.0	24.6	29	23.6	82	9
	3		12	1	38 N	142	0 E	NW	3.9	o	1007.8	26.0	24.6	29	24.0	90	9
	6		15	2	5 N	142	0 E	W	3.1	r	1005.8	27.5	24.5	29	23.4	78	9
	9		18	2	32 N	142	0 E	WSW	4.8	c	1007.6	27.5	24.5	29	23.4	78	8
	12		21	2	59 N	142	0 E	W	3.7	r	1009.5	26.8	25.5	29	25.1	89	10
	15	19	0	2	30 N	141	50 E	NW	2.6	r	1009.3	27.8	25.8	29	25.4	85	9
	18		3	2	0 N	141	40 E	W	4.7	bc	1007.1	27.0	23.5	29	22.1	74	2
	21		6	1	30 N	141	30 E	WNW	7.6	bc	1007.7	28.4	25.3	29	24.4	77	7
19	0		9	1	0 N	141	20 E	WSW	8.3	bc	1008.9	29.6	25.4	29	24.1	71	8
	3		12	0	30 N	141	10 E	W	7.2	c	1007.9	29.9	26.5	30	25.3	77	8
	6		15	0	2 N	141	1 E	W	11.0	c	1005.8	28.0	25.0	29	23.9	78	6
	9		18	0	0 S	140	42 E	W	9.5	c	1006.2	27.1	25.4	29	24.9	86	8
	12		21	0	1 N	140	15 E	WSW	9.4	bc	1007.8	27.0	25.5	29	25.0	88	2
	15	20	0	0	0 N	139	57 E	WNW	14.7	q	1008.3	26.0	25.0	29	24.6	92	10
	18		3	0	0 N	139	30 E	NW	13.0	r	1007.2	25.0	21.0	29	19.2	70	10
	21		6	0	0 N	139	2 E	NNW	6.0	r	1006.8	27.2	25.8	29	25.4	89	9
20	0		9	0	13 S	138	48 E	NW	10.9	o	1009.9	26.8	24.0	29	22.9	80	10
	3		12	0	35 S	138	26 E	W	5.5	o	1008.9	27.1	25.1	29	24.3	84	10
	6		15	0	54 S	138	6 E	W	10.7	o	1006.1	27.2	24.5	29	23.6	80	10
	9		18	0	45 S	138	0 E	W	11.3	c	1005.3	26.8	25.4	29	25.0	88	10
	12		21	0	30 S	137	60 E	W	9.5	bc	1006.8	27.8	25.6	29	24.8	84	4
	15	21	0	0	7 S	138	1 E	WNW	11.0	q	1007.8	26.0	25.0	29	24.6	92	10
	18		3	0	14 N	138	3 E	W	9.1	c	1004.8	27.0	24.0	29	22.9	78	8
	21		6	0	36 N	138	1 E	WSW	7.1	c	1006.2	27.9	25.2	29	24.0	80	7
21	0		9	0	60 N	138	0 E	W	8.4	o	1007.6	27.0	25.1	29	24.3	85	10
	3		12	1	23 N	138	0 E	NNW	7.9	r	1007.1	26.0	24.3	29	23.9	86	10
	6		15	1	46 N	138	0 E	WSW	2.9	o	1006.3	27.0	25.0	29	24.3	85	10
	9		18	2	3 N	137	56 E	SW	4.9	r	1007.1	26.2	24.6	29	24.0	87	10
	12		21	2	14 N	137	42 E	NW	6.0	o	1007.9	26.0	25.0	29	24.6	92	10
	15	22	0	2	24 N	137	28 E	NW	6.4	c	1007.9	26.5	24.5	29	23.8	85	8
	18		3	2	26 N	137	24 E	WNW	5.0	bc	1006.3	26.8	24.0	29	22.9	79	3
	21		6	2	26 N	137	25 E	WNW	6.0	c	1007.1	26.5	24.0	29	23.0	81	9
22	0		9	2	26 N	137	26 E	NW	10.0	c	1008.3	29.0	25.5	29	24.3	75	7
	3		12	2	30 N	137	24 E	NW	7.0	c	1007.3	28.0	25.7	29	24.6	96	7
	6		15	2	59 N	137	19 E	N	6.3	bc	1005.3	28.8	25.2	29	24.8	80	7
	9		18	3	21 N	137	16 E	NNE	9.0	o	1006.1	27.0	24.5	29	23.6	81	8
	12		21	3	56 N	137	11 E	NNE	11.7	c	1007.8	27.6	25.4	28	24.7	84	7
	15	23	0	4	14 N	137	8 E	NNE	13.1	bc	1007.3	27.6	24.8	28	24.1	79	3
	18		3	4	42 N	137	3 E	ENE	12.4	c	1006.5	26.2	25.1	28	24.6	91	4
	21		6	4	59 N	137	1 E	NE	8.0	r	1006.1	25.0	23.5	28	22.9	87	6
23	0		9	4	58 N	136	57 E	NE	13.0	bc	1007.2	27.0	25.0	28	24.3	85	4
	3		12	5	0 N	136	59 E	NE	10.0	c	1006.3	28.4	26.0	28	25.1	83	8
	6		15	4	56 N	136	52 E	ENE	13.0	o	1004.3	28.3	25.3	28	23.7	78	9
	9		18	5	6 N	137	1 E	NE	10.6	o	1006.5	28.5	24.5	28	23.0	72	10
	12		21	5	14 N	137	9 E	SSW	10.3	r	1008.8	24.6	23.6	28	23.1	92	10
	15	24	0	5	15 N	137	5 E	SE	9.6	r	1008.8	24.2	23.6	28	23.1	95	10
	18		3	5	15 N	137	5 E	NNE	8.0	o	1005.3	25.0	24.0	28	23.6	92	10
	21		6	5	13 N	137	5 E	NE	13.5	o	1004.8	27.5	24.5	28	23.4	79	10
24	0		9	5	24 N	137	2 E	ENE	18.5	o	1006.0	27.9	25.4	28	24.6	81	10
	3		12	6	40 N	137	37 E	ENE	13.9	o	1006.3	28.0	25.6	28	24.6	83	10
	6		15	5	56 N	136	7 E	ENE	11.9	o	1004.3	29.0	25.5	28	23.9	75	10
	9		18	6	11 N	135	36 E	ENE	9.0	r	1005.1	28.0	24.5	28	23.2	75	10
	12		21	6	28 N	135	6 E	ENE	8.8	o	1007.8	27.6	25.2	27	24.1	83	10
	15	25	0	6	43 N	134	35 E	SE	5.2	o	1007.9	26.0	24.8	27	24.6	91	10

PALAU

*wether bc : Fine but cloudy (cloud 3 to 7)
c : Cloudy (cloud 8 to 10)
o : Overcast (cloud 10)
r : Rain
q : Squalls

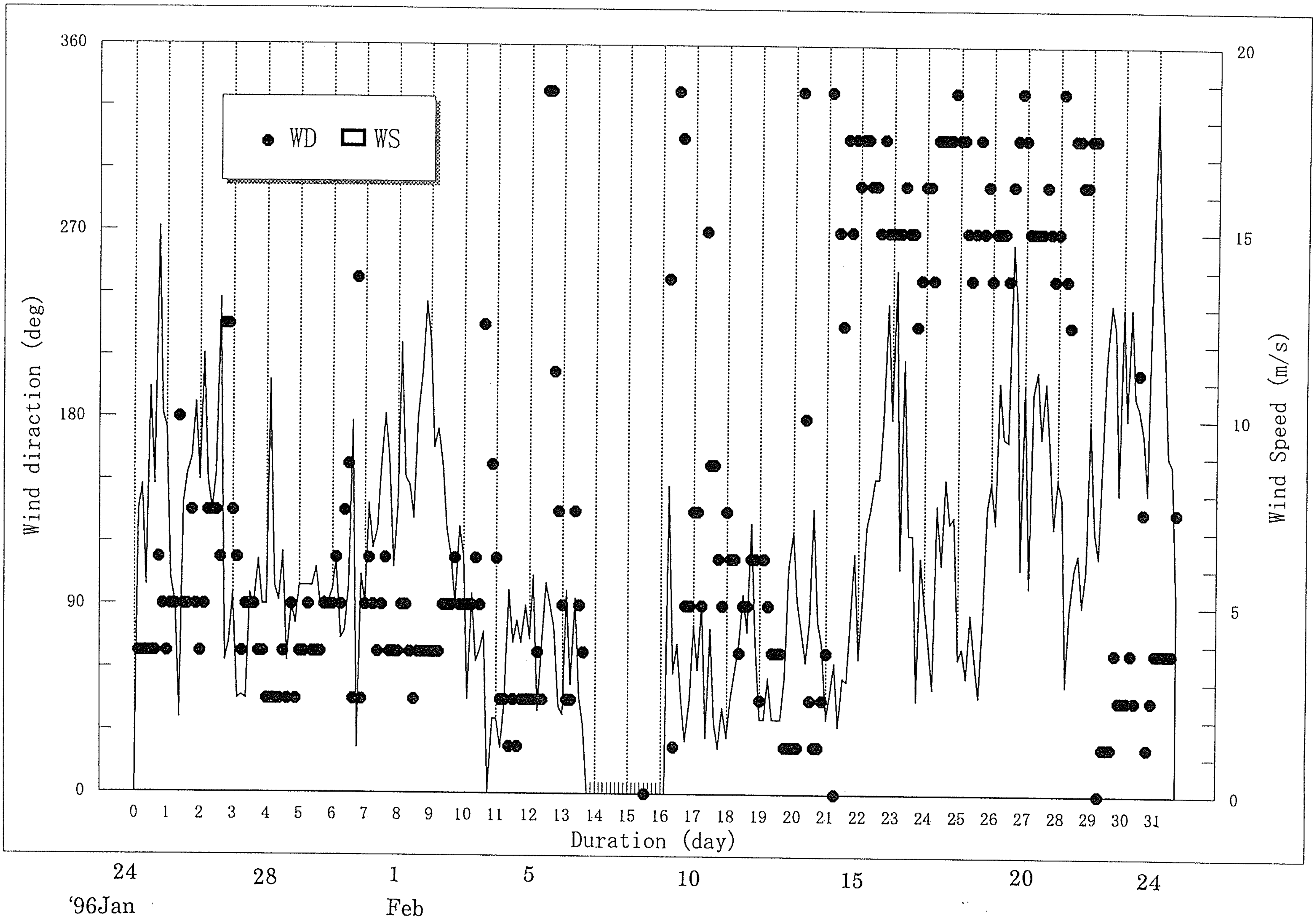
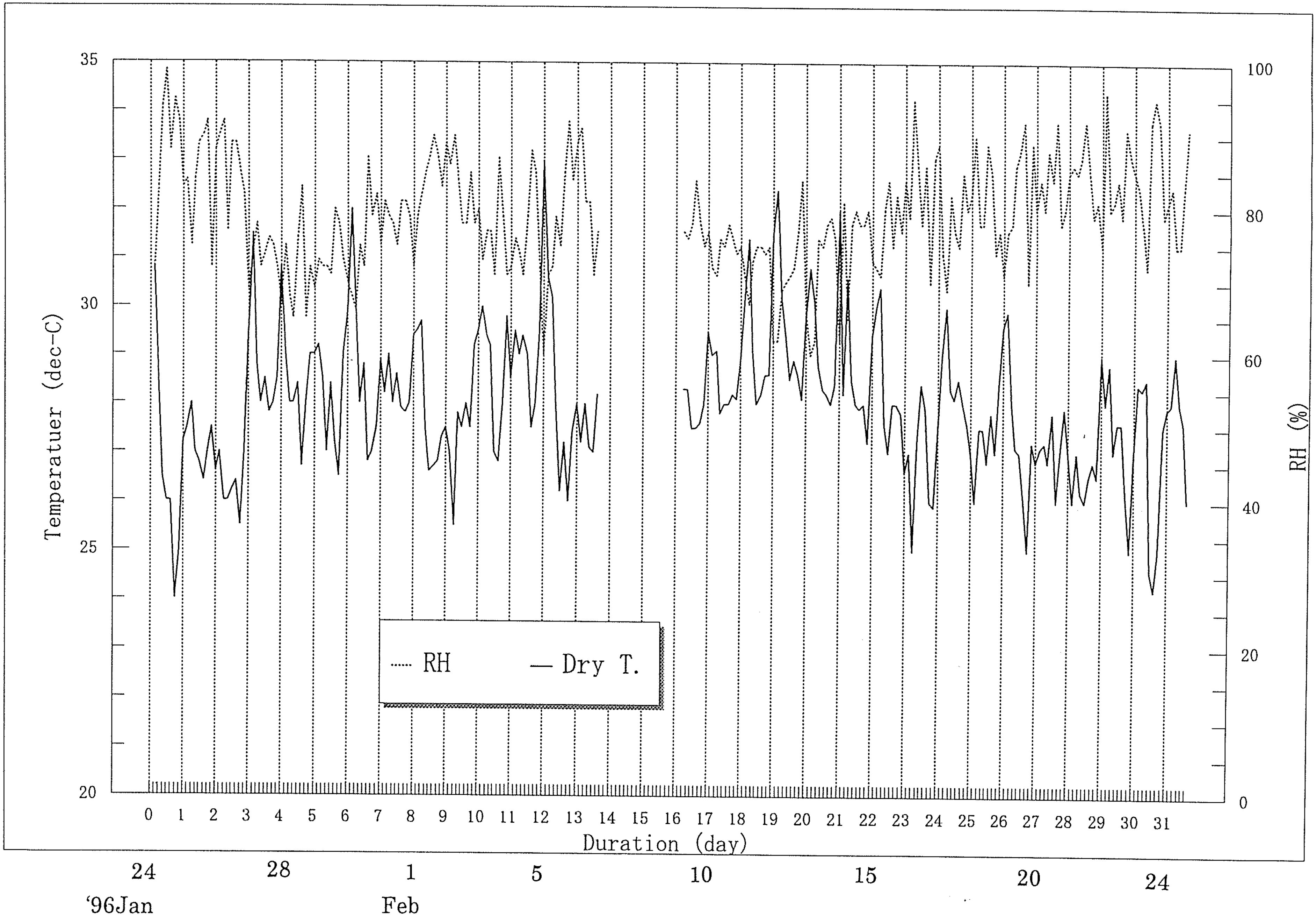
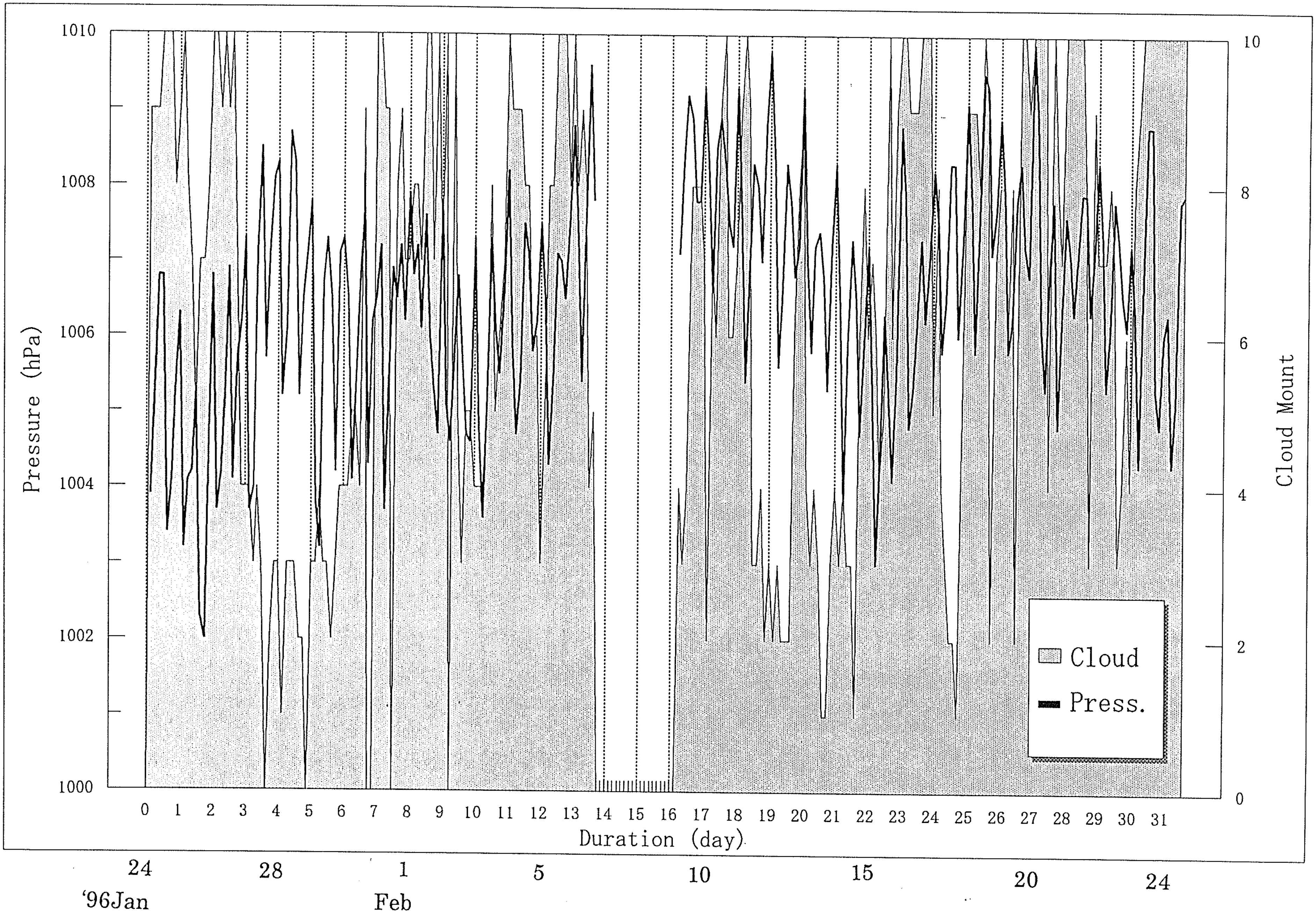


Fig 5-2 Surface Meteorological Measurement



35
30
25
20
Temperatuer (dec-C)
100
80
60
40
20
0
RH (%)
RH
Dry T.
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Duration (day)
24 28 1 5 10 15 20 24
'96Jan
Feb



Pressure (hPa)
1010
1008
1006
1004
1002
1000
Cloud Mount
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Duration (day)
Cloud
Press.
24
'96Jan
28
1
Feb
5
10
15
20
24

6. Shipboard ADCP Velocity Maps

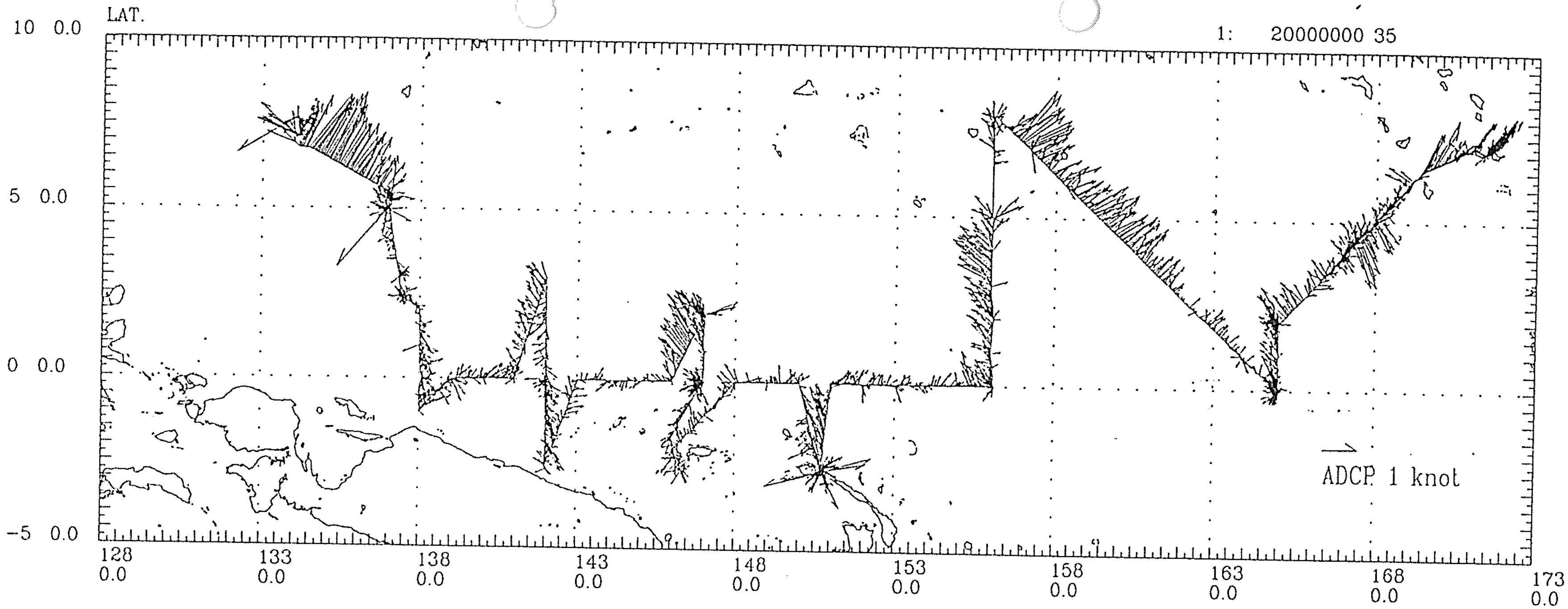
Measurement of current vectors by ADCP

Current direction and velocity along the curise truck was measured continuously by a JRC ADCP (Acoustic Doppler Current Profiler) mounted on KAIYO. Current was measured at 3 layers (20m,50m and 80m depth). The sampling interval was every one minute. The current data were recorded on a harddisk of VAX station with ship's position data observed by GPS. Vector images for curret direction and velocity were based on the data which were picked up every 20 minutes from original data. For drawing figures, we used a program, PLOT79ADCP, which had been written by Dr. I.ASANUMA (JAMSTEC) based on PLOT79.

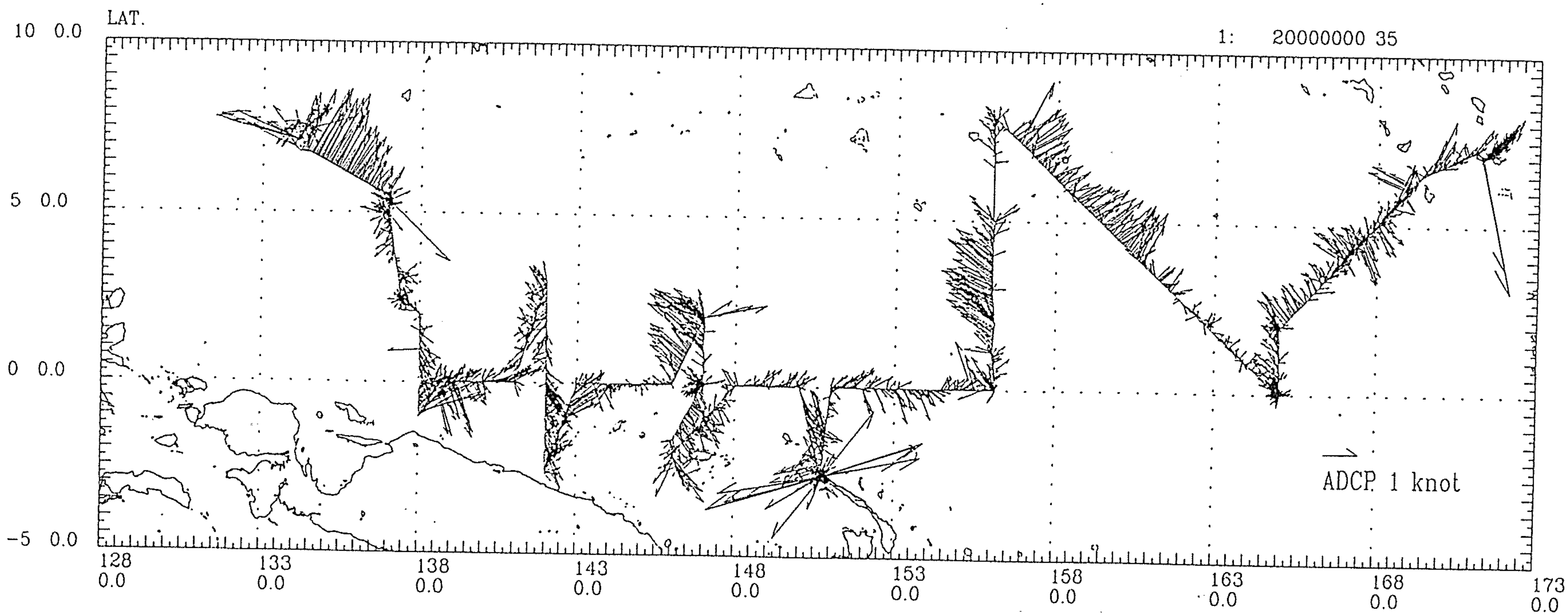
Results are shown in the figures on following pages. The figures were separately drawn 3 layers.

We also use another ADCP of RD Instruments (VM-75), which measured velocity structure upper 700m depth with 16-m vertical resolution. Data were averaged to 5-min intervals, about 1.5 km resolution in horizontal. These data were strored with GPS data during all the time in this cruise.

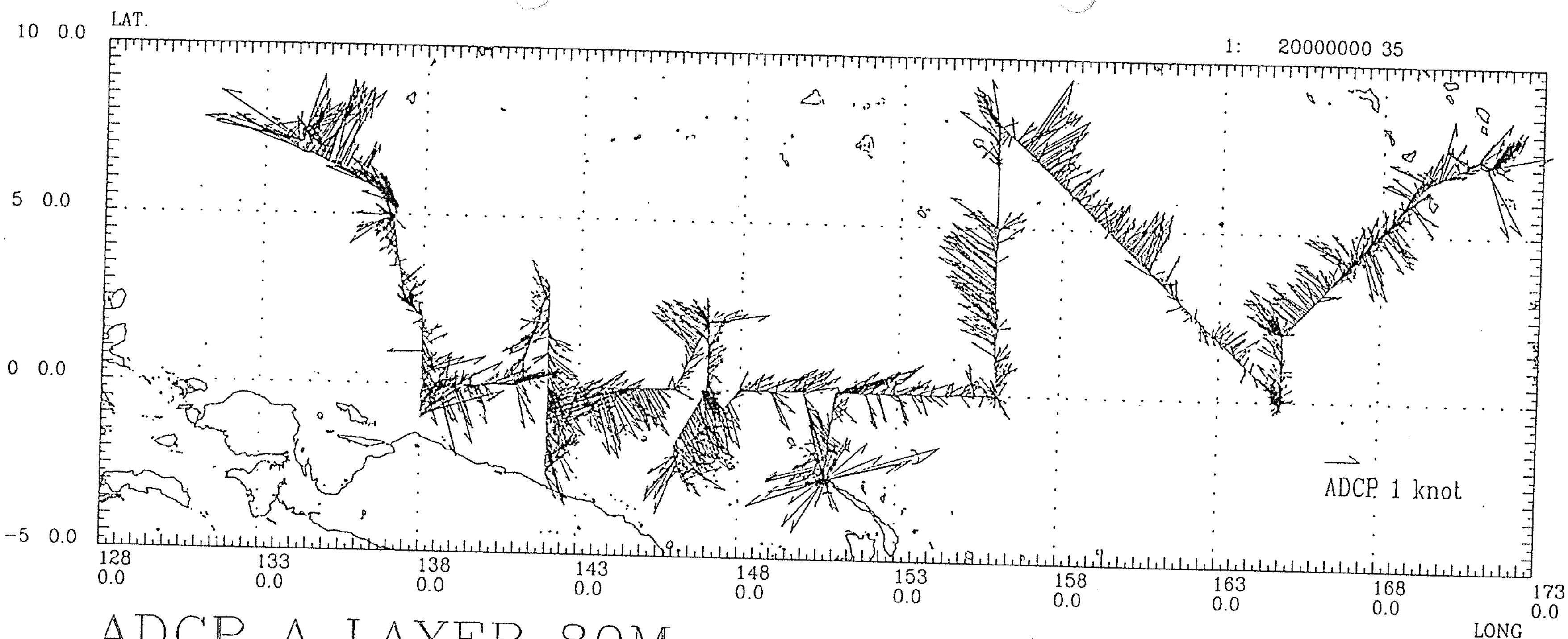
The ADCP measuremt will be continued from Palau to Japan. We'll analyze the data after this measurement.



ADCP C LAYER 20M



ADCP B LAYER 50M



ADCP A LAYER 80M

7 JAMSTEC ADCP MOORING

To get the knowledge of physical process in the western equatorial Pacific. In this cruise(K96-01), we recovered two ADCP moorings at (00 ° N, 142 ° E) and (00 ° N,147 ° E), and deployed two ADCP moorings at the same place.

Instrument:

ADCP

- Distance to first bin : 17.5 m
- Pings per ensemble : 16
- Time per ping : 2.00 s
- Bin length : 8.68 m
- Sampling Interval : 3600 s
    - Serial Number: 1221(Mooring No.950104-00N147E)
    - Serial Number: 1150(Mooring No.950107-00N142E)
    - Serial Number: 1222(Mooring No.960212-00N147E)
    - Serial Number: 1277(Mooring No.960217-00N142E)

CTD

- SBE-16
- Sampling Interval : 1800 s
    - Serial Number: 1286(Mooring No.950104-00N147E)
    - Serial Number: 1279(Mooring No.950107-00N142E)
    - Serial Number: 1281(Mooring No.960212-00N147E)
    - Serial Number: 1277(Mooring No.960217-00N142E)

CTD is mounted ADCP buoy with the flame.

Deployment

Two ADCP moorings were deployed at (0 ° N, 147 ° E), (0 ° N, 142 ° E). The moorings were planed to make the ADCP buoy placed at about 290 m. When we deployed, we adjusted length of the nylon rope. Because the bottom depth of points were shallower than that of our plan. After we released the anchor, we monitored depth of the acoustic releaser(Fig.7-1). The descent rate was about 3.0 m/sec both stations. After the mooring landed, we calibrated each position of the mooring.

Result of calibration

Mooring No.960212-00N147E

- Lat: 00 ° 00.571N
- Long:146 ° 52.860E

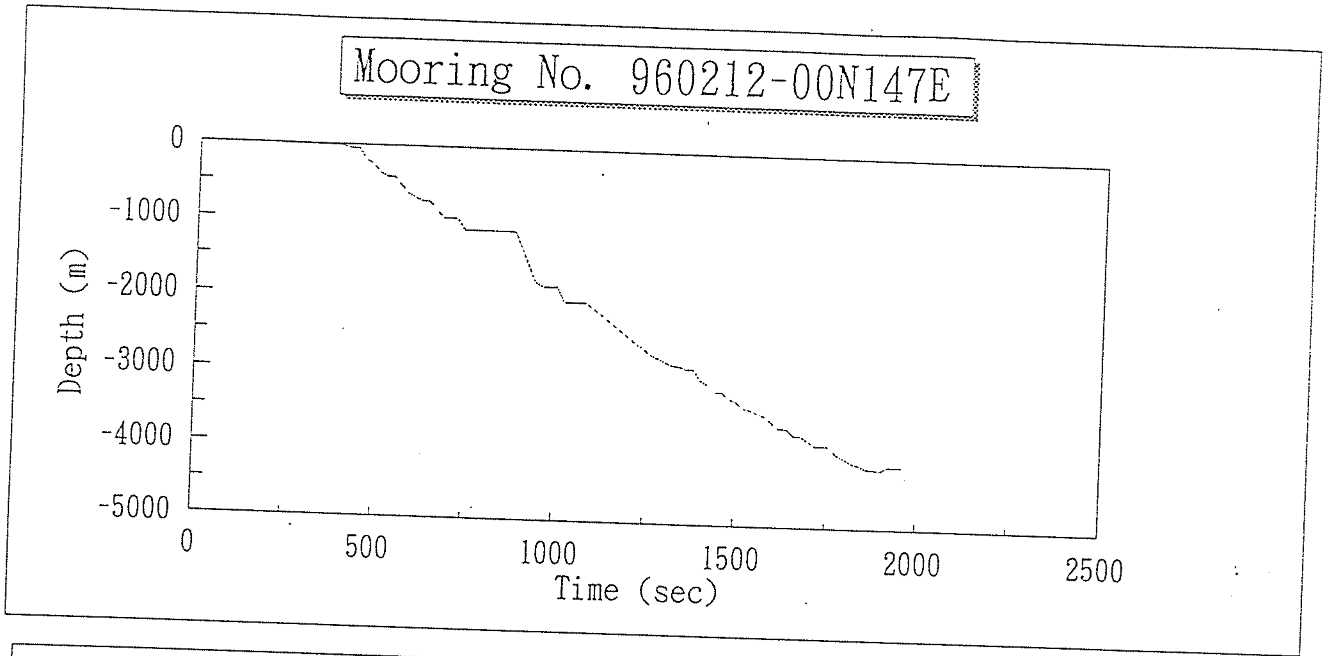
Mooring No.960217-00N142E

- Lat: 00 ° 00.073N
- Long:142 ° 00.240E

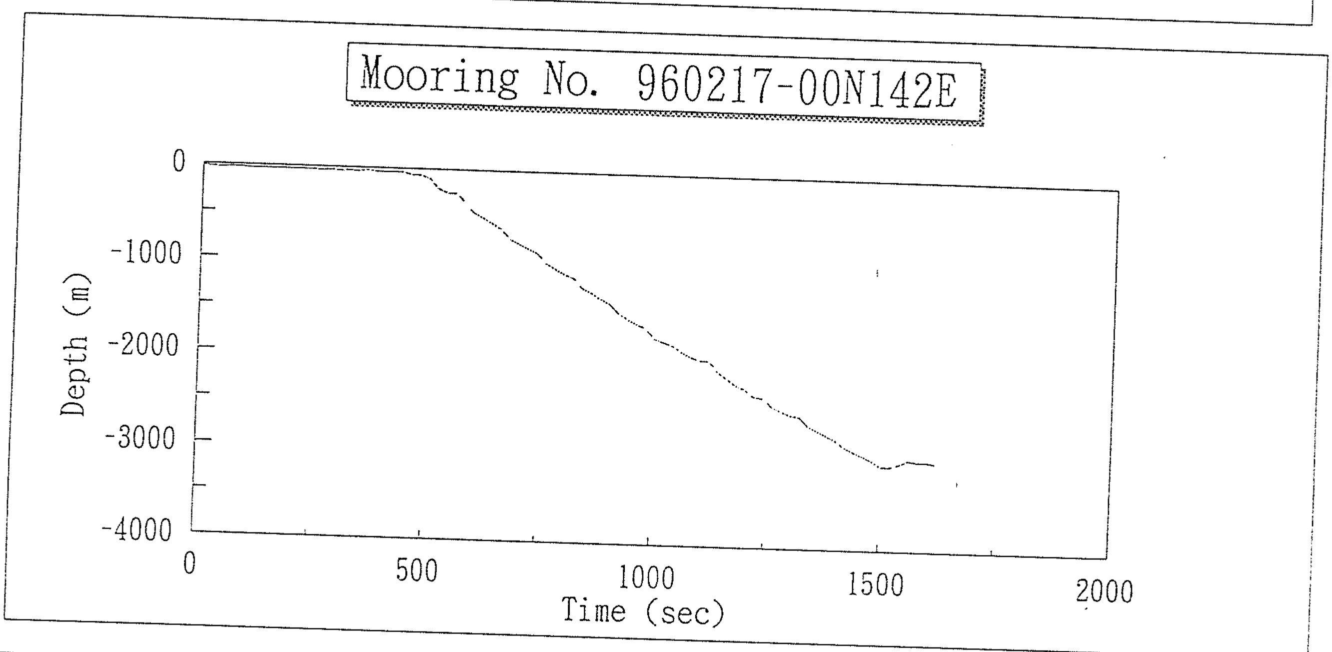
Recovery

We recovered two ADCP moorings which were deployed on Jan.1995(K94-06). After the release, we could find the ADCP buoy and glass balls at 142 ° E, but glass balls didn't appear on sea-surface at 147 ° E.

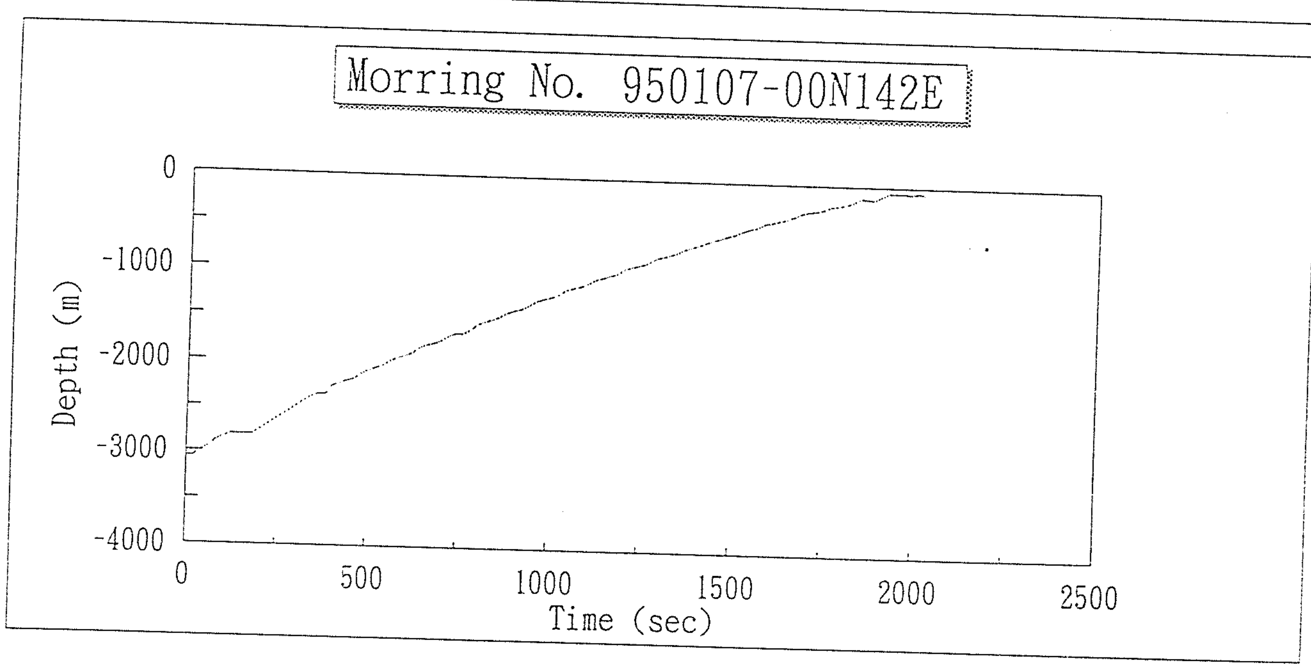
After the recovery, we uploaded ADCP and CTD data into a computer, then the raw data were converted into ASCII code. Fig. 7-2 ~ 7-29 shows CTD data (depth, temperature, salinity) every month. Fig. 7-30 ~ 7-57 shows the velocity data (east ward and northward component) at 30 m depth.



Mooring No. 960212-00N147E
Depth (m)
0
-1000
-2000
-3000
-4000
-5000
Time (sec)
0
500
1000
1500
2000
2500



Mooring No. 960217-00N142E
Depth (m)
0
-1000
-2000
-3000
-4000
Time (sec)
0
500
1000
1500
2000



Morring No. 950107-00N142E
Depth (m)
0
-1000
-2000
-3000
-4000
Time (sec)
0
500
1000
1500
2000
2500

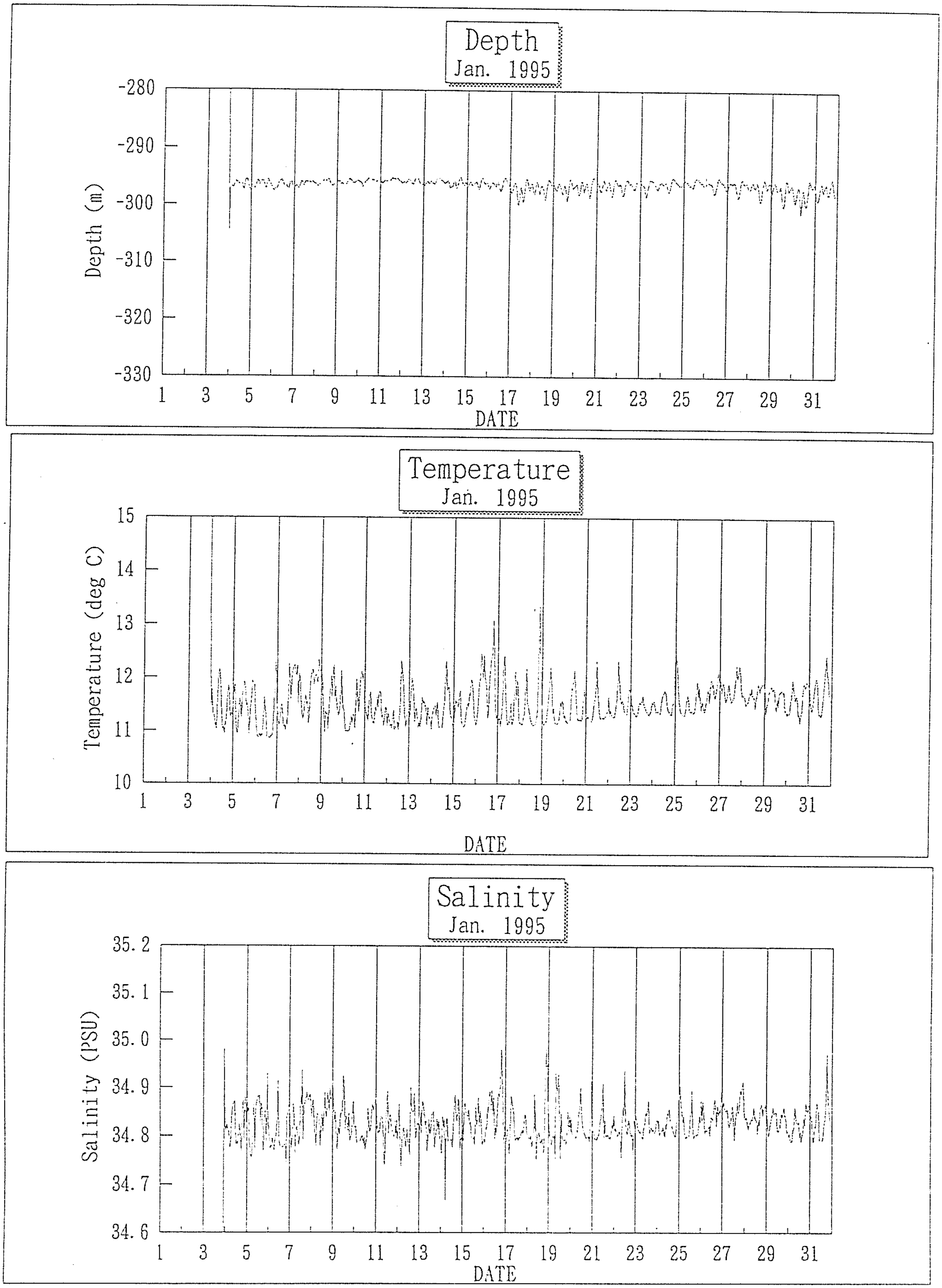
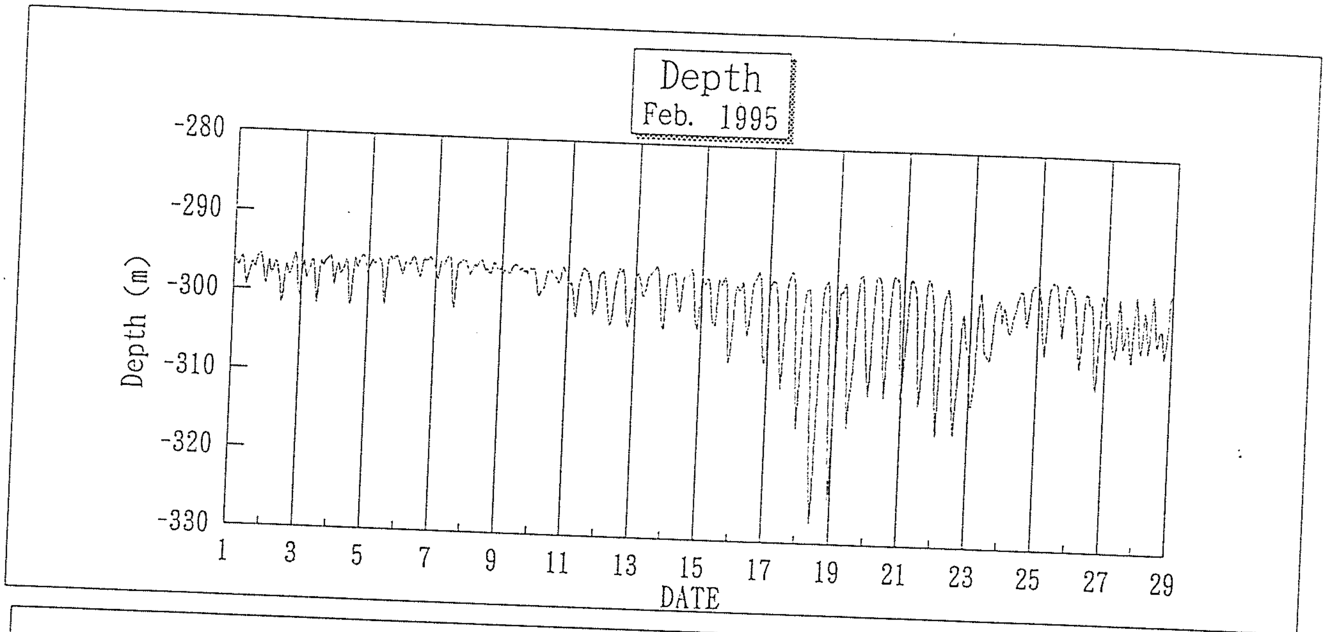
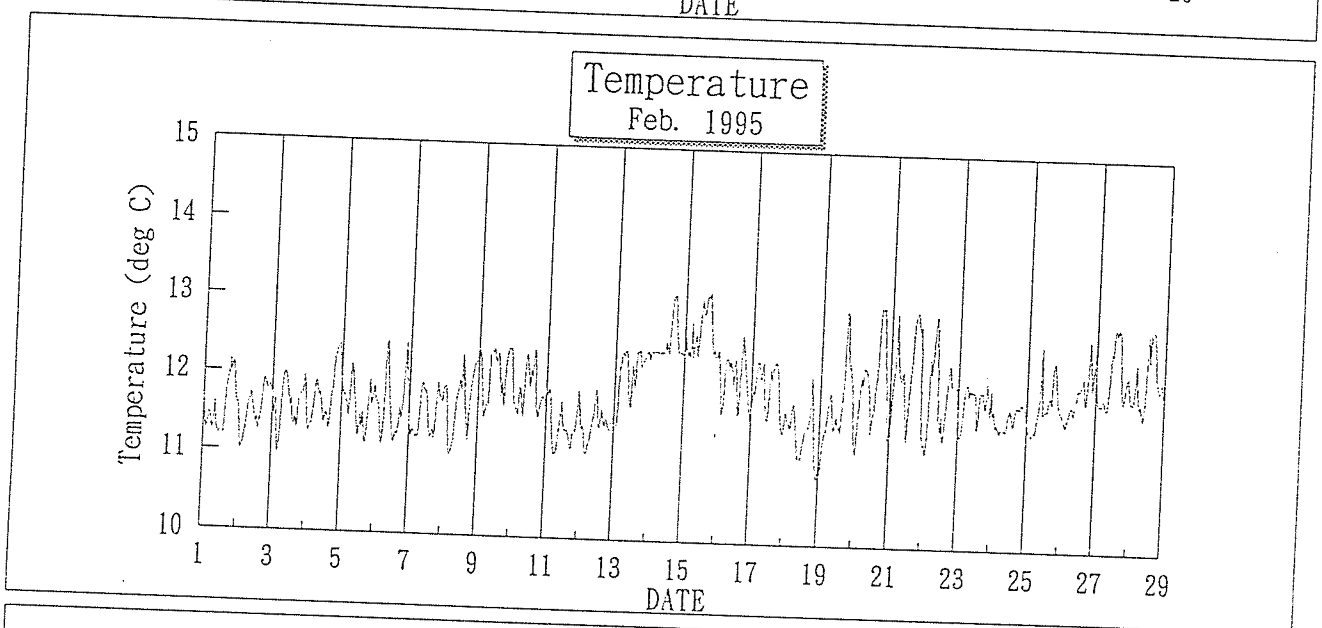
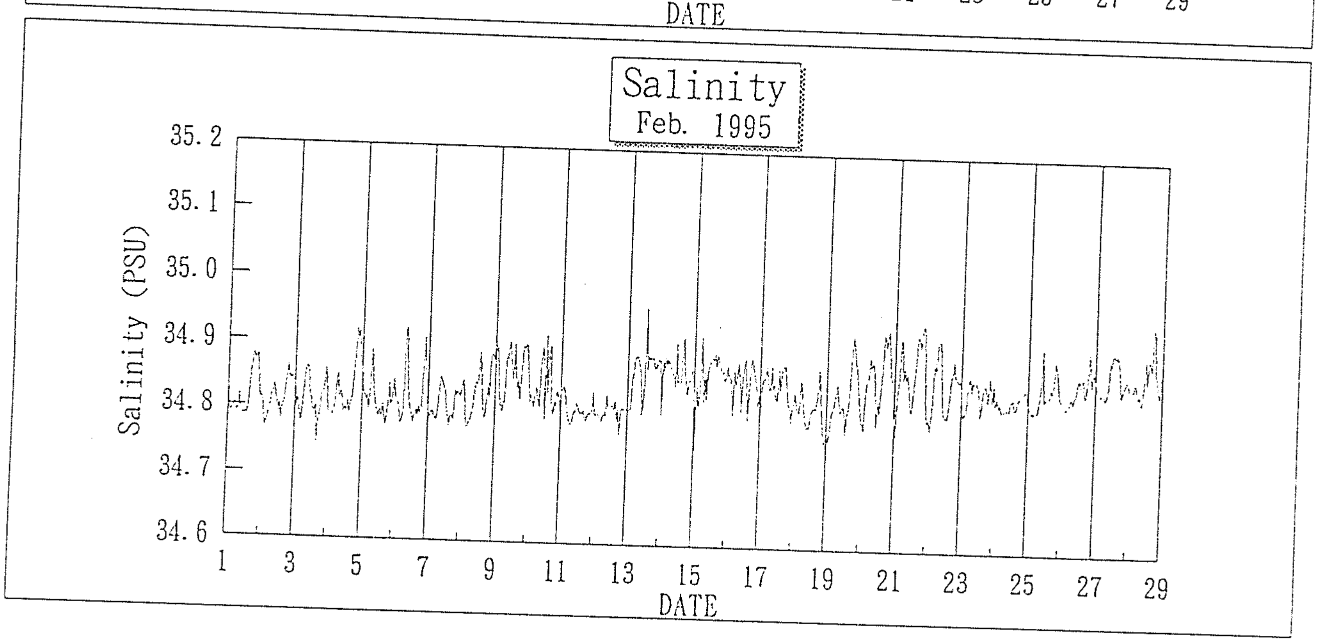


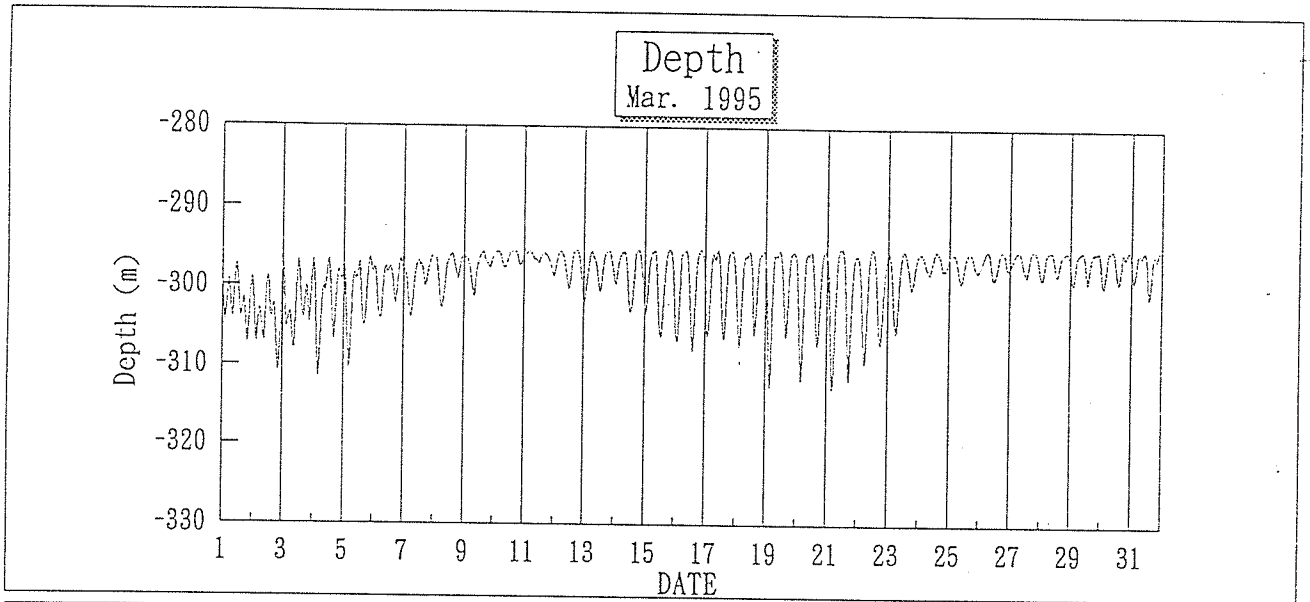
Fig 7-2 Tme Series of Depth, Temperture, Salinity

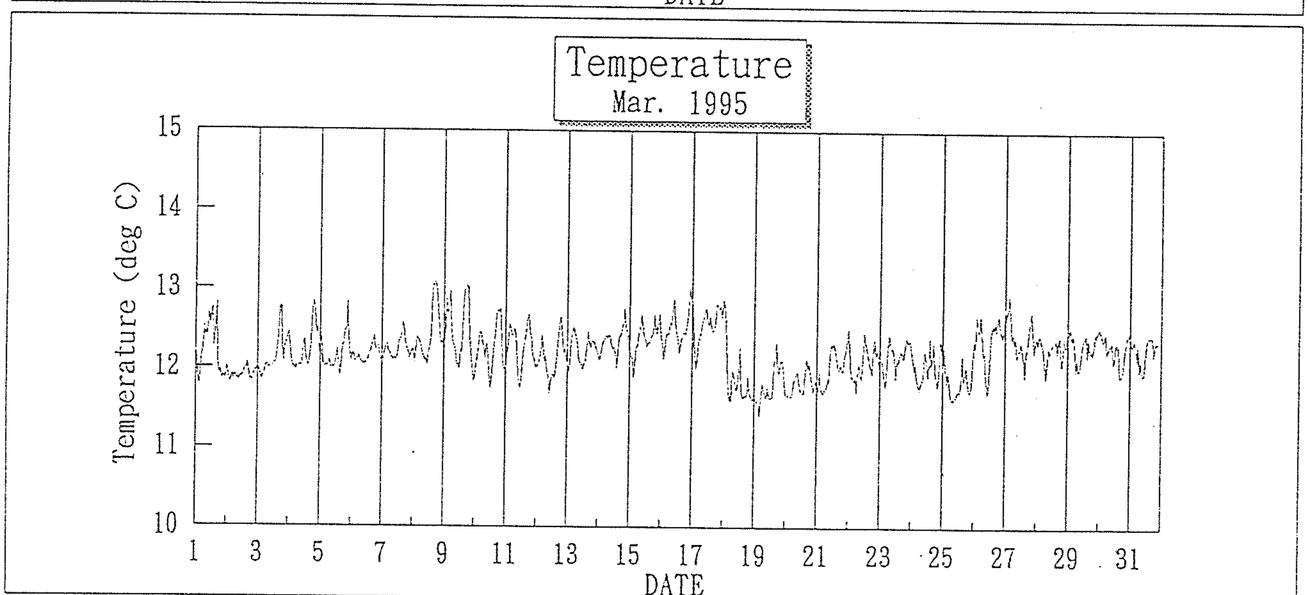
Mooring No. 950104-00N147E











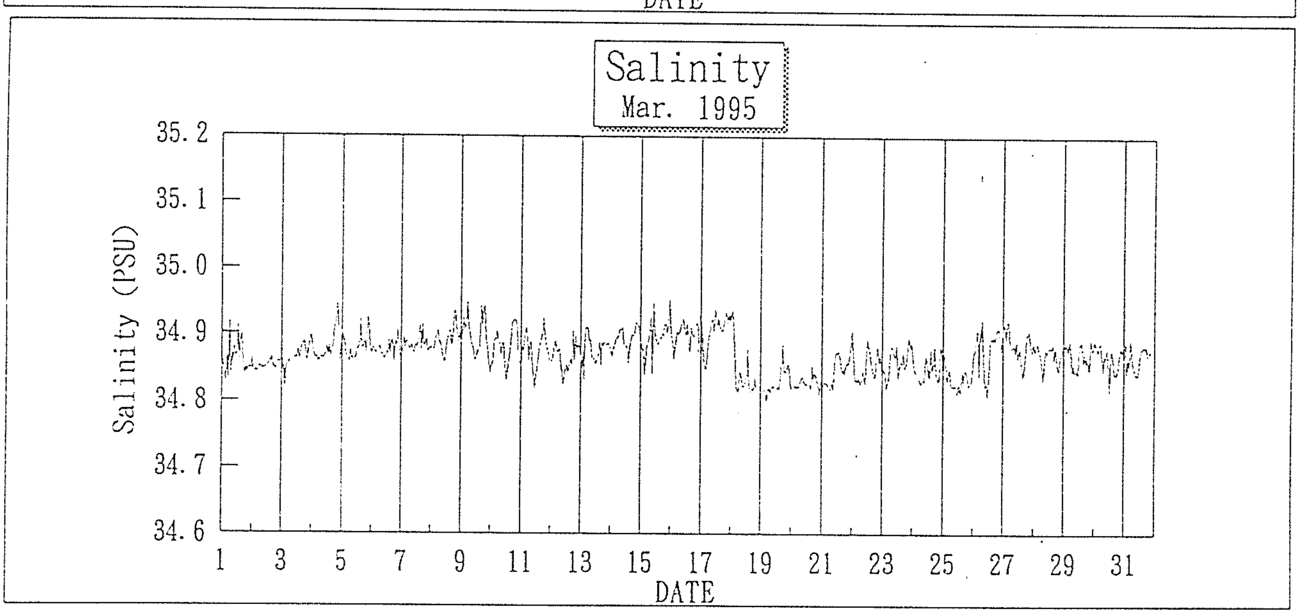
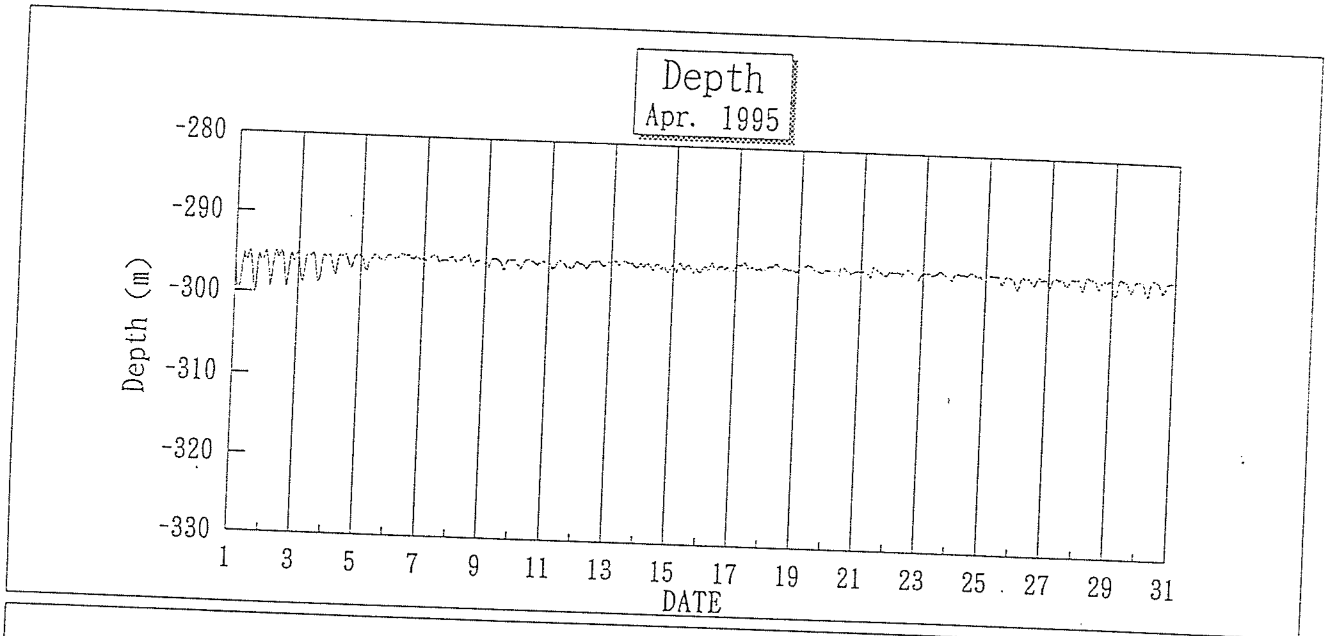
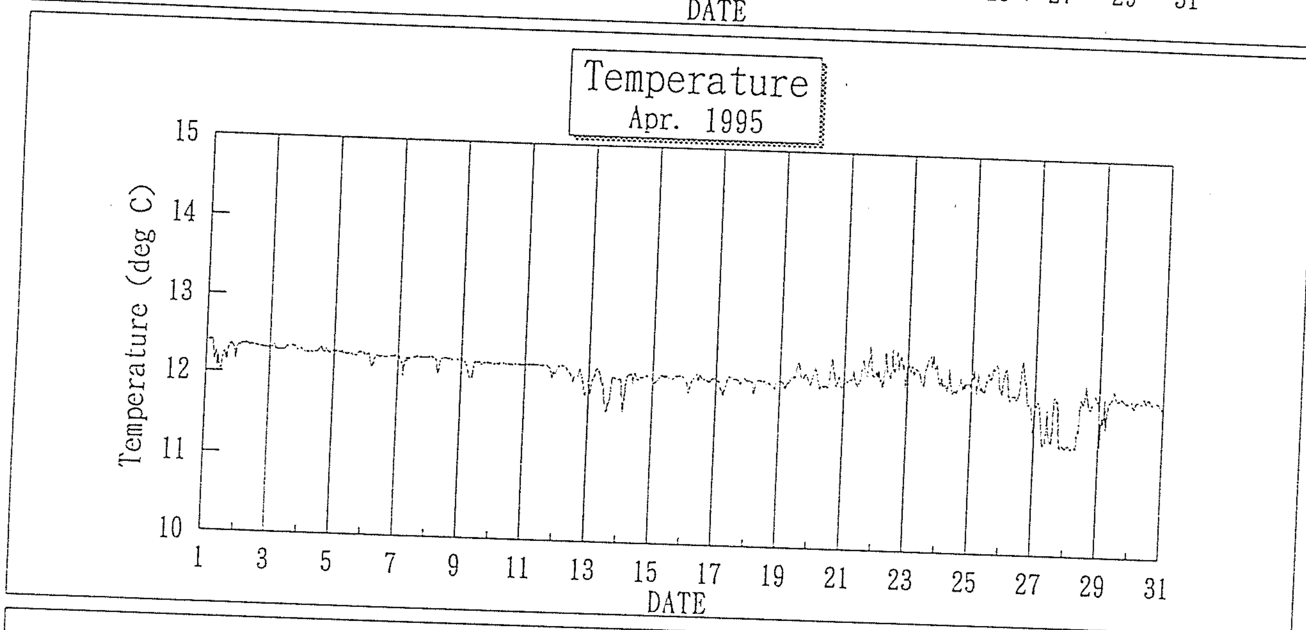
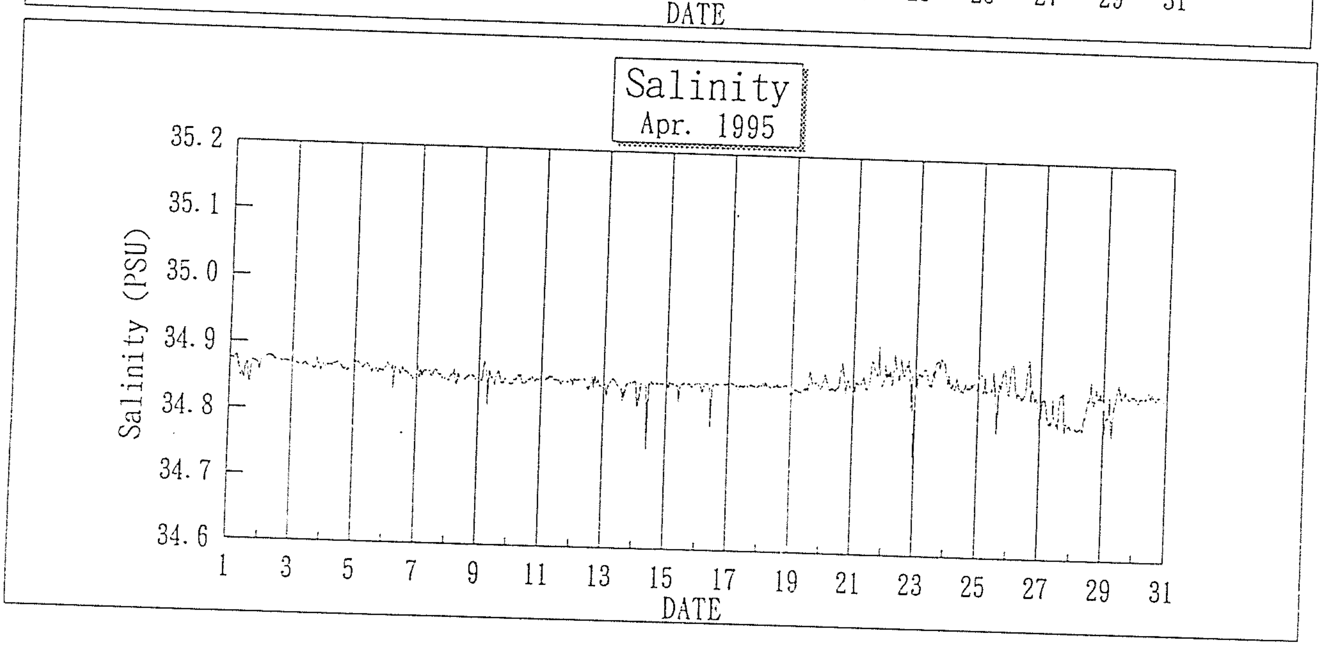


Fig 7-4 Tme Series of Depth, Temperture, Salinity


Depth
Apr. 1995
Depth (m)
-280
-290
-300
-310
-320
-330
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE


Temperature
Apr. 1995
Temperature (deg C)
15
14
13
12
11
10
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE


Salinity
Apr. 1995
Salinity (PSU)
35.2
35.1
35.0
34.9
34.8
34.7
34.6
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE

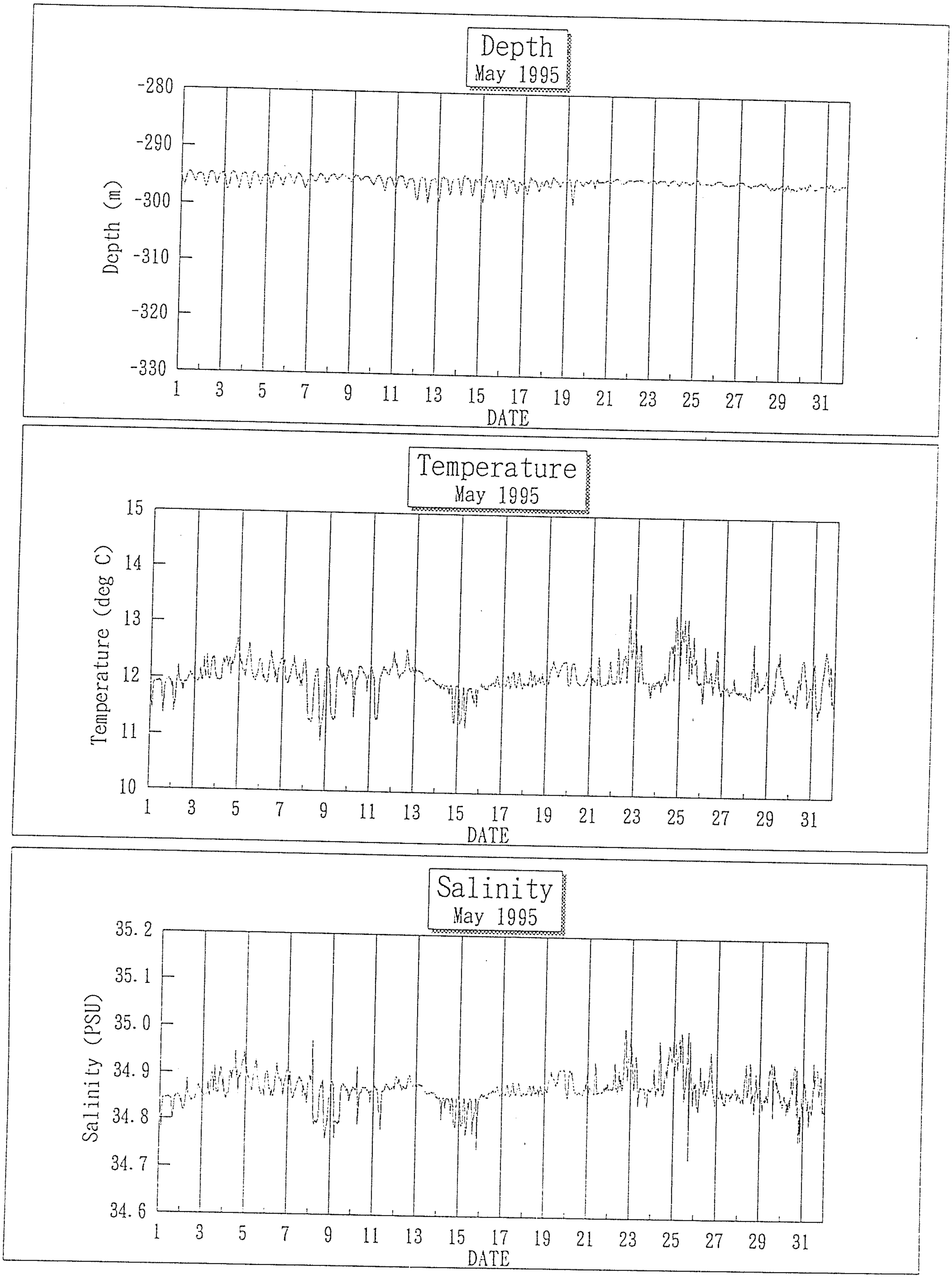
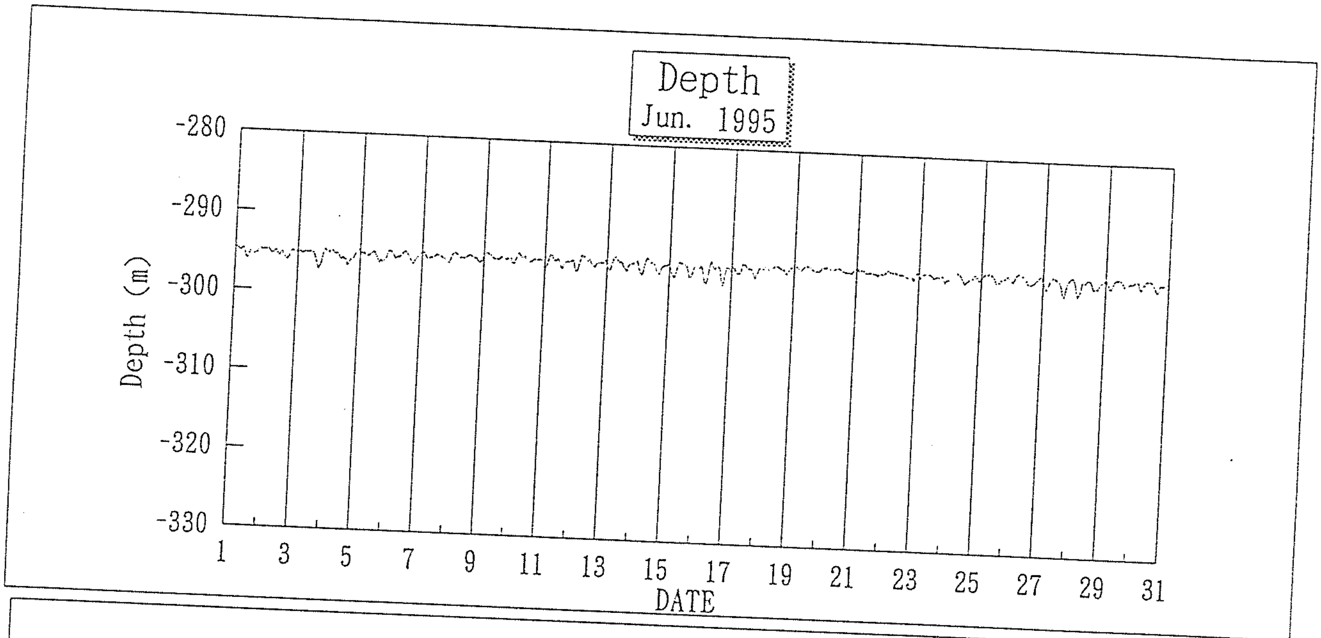
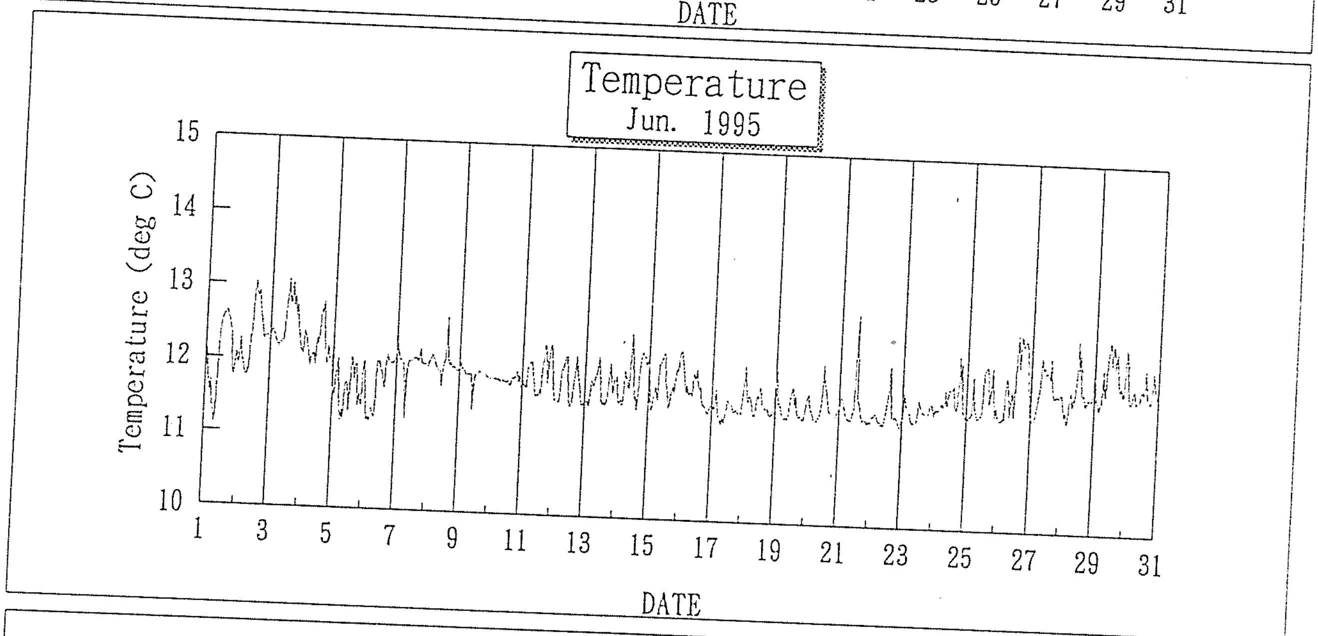
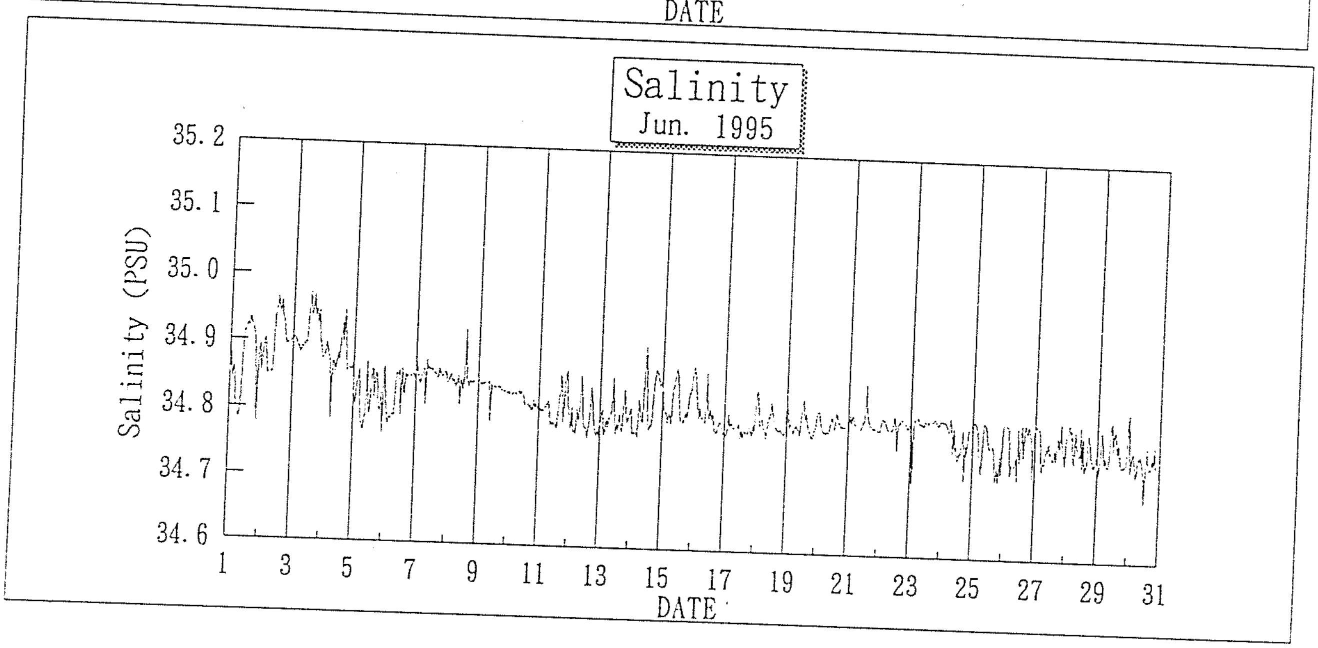


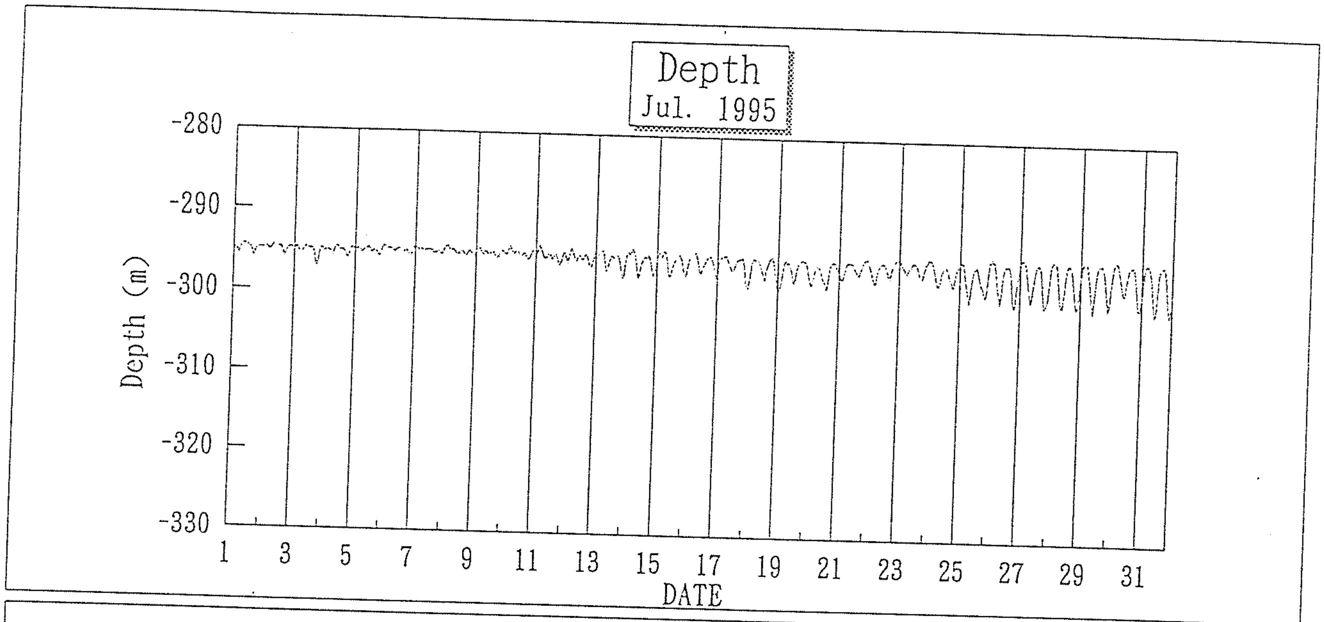
Fig 7-6 Tme Series of Depth, Temperture, Salinity

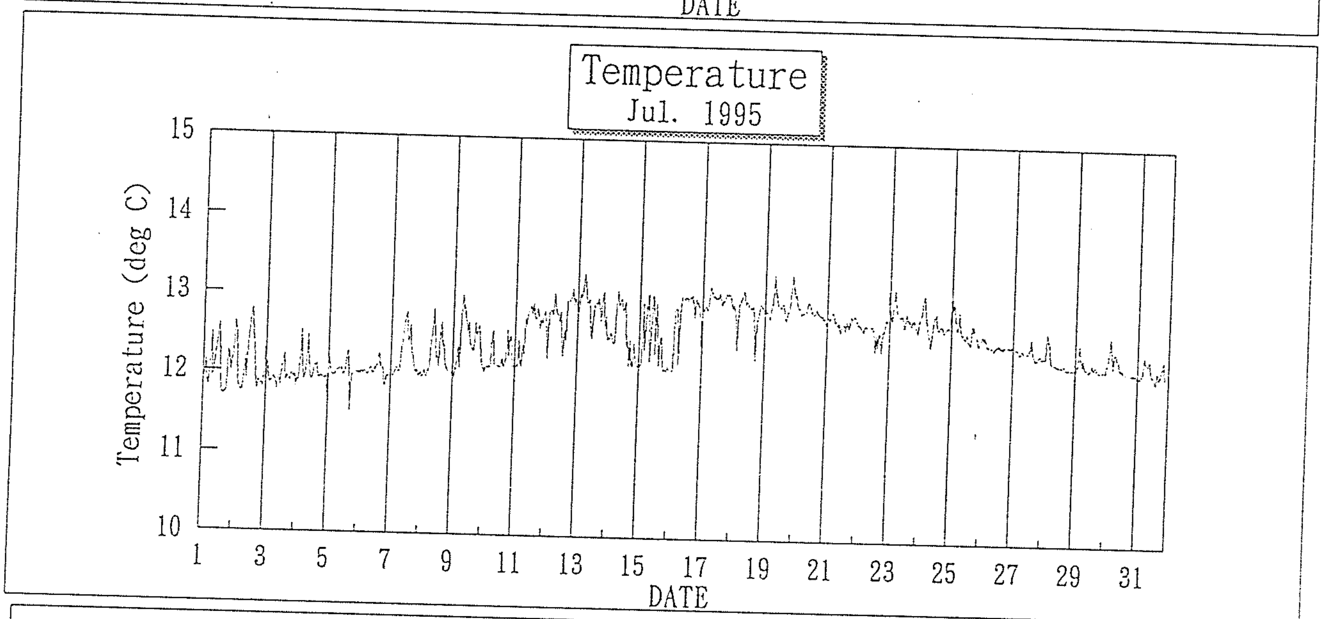

Depth
Jun. 1995
Depth (m)
-280
-290
-300
-310
-320
-330
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE


Temperature
Jun. 1995
Temperature (deg C)
15
14
13
12
11
10
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE


Salinity
Jun. 1995
Salinity (PSU)
35.2
35.1
35.0
34.9
34.8
34.7
34.6
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE

Mooring No. 950104-00N147E





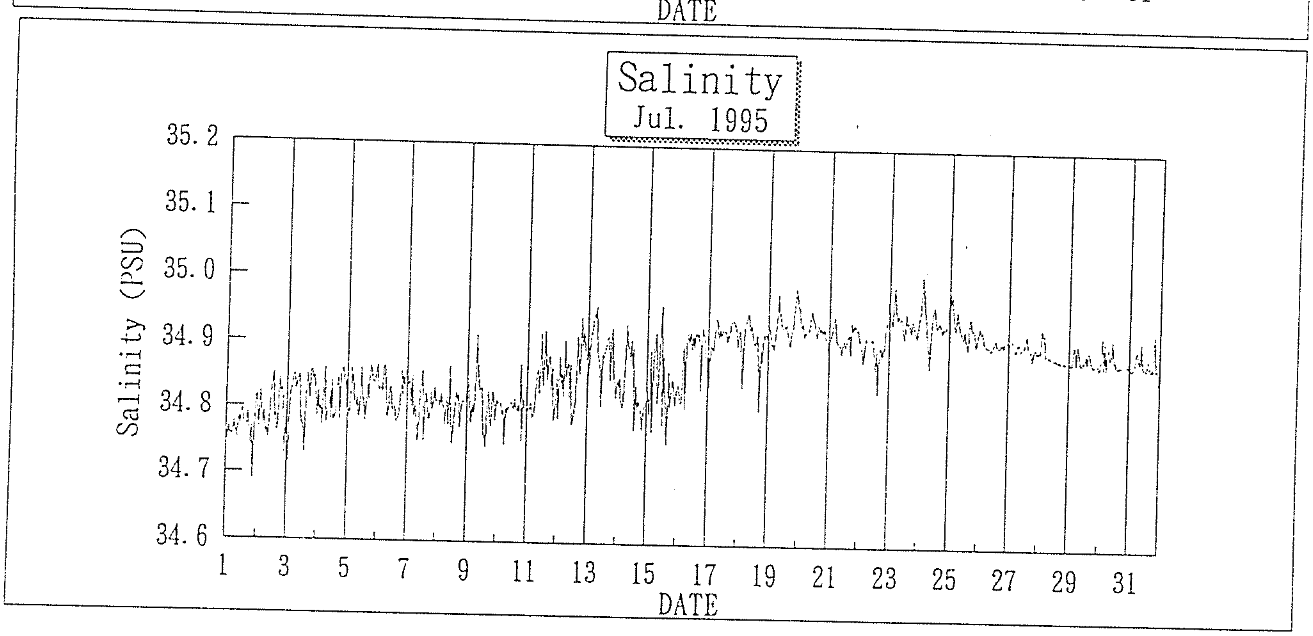
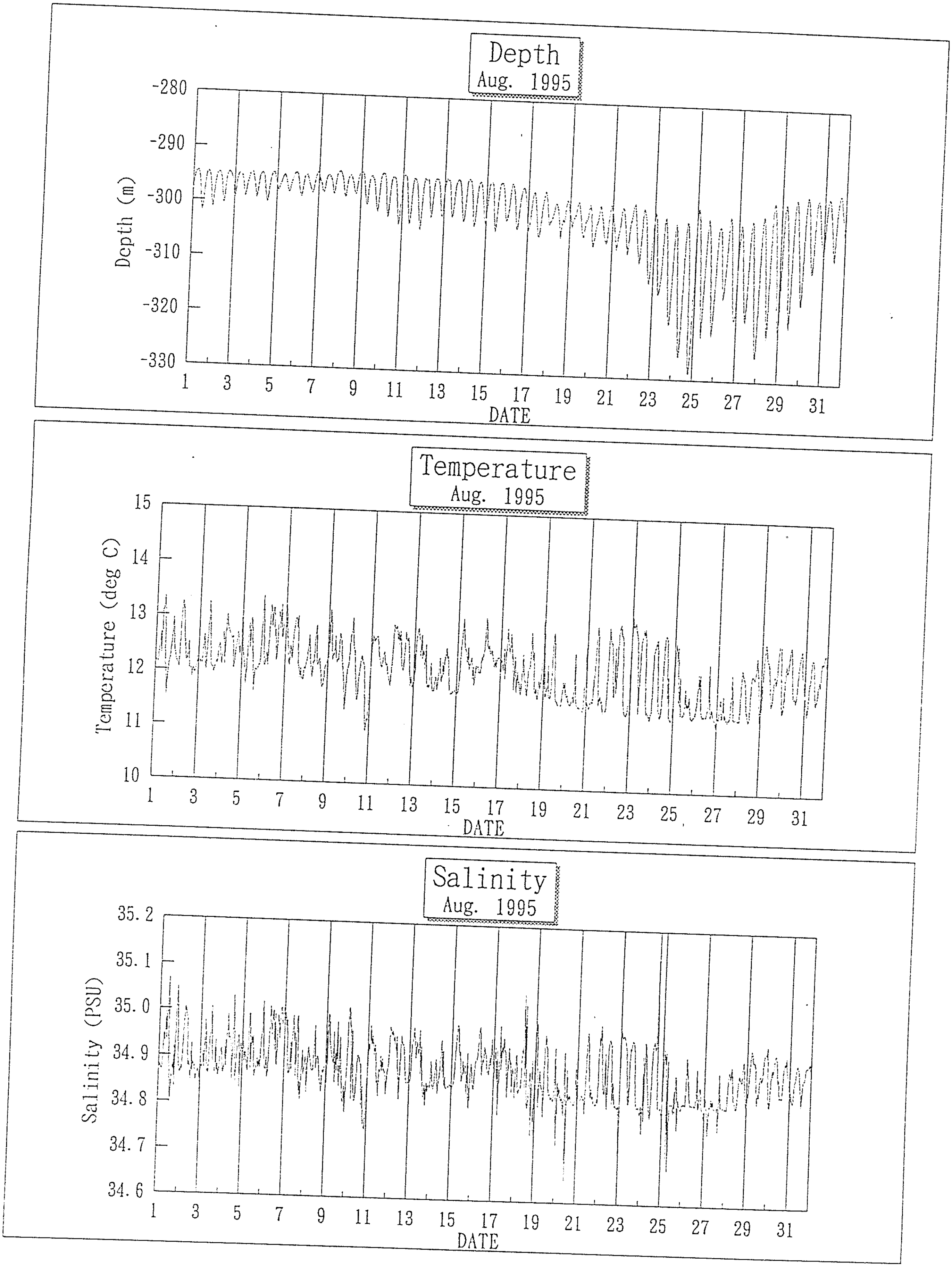
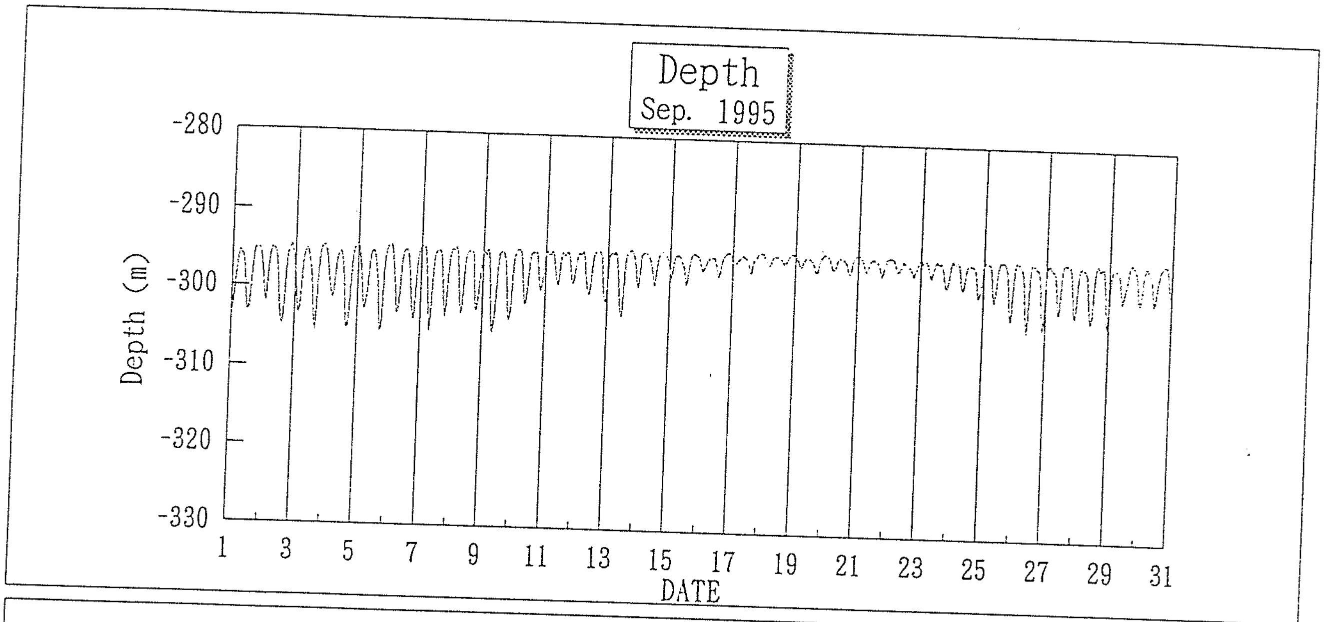


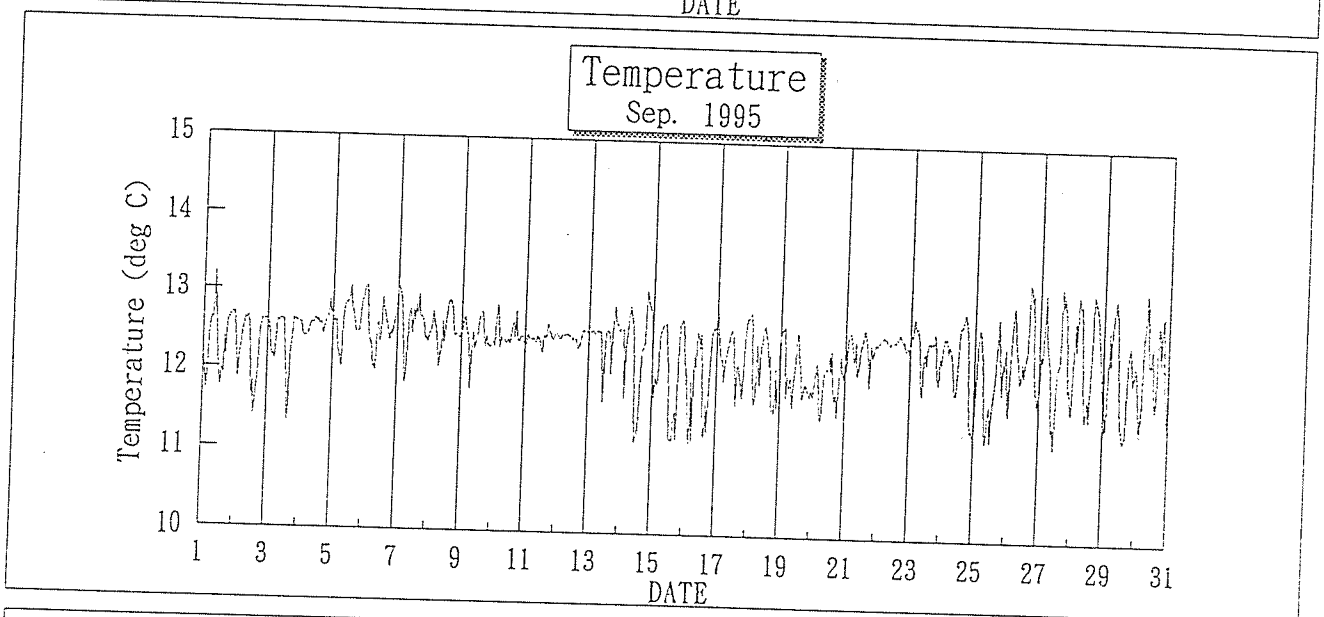
Fig 7-8 Tme Series of Depth, Temperture, Salinity

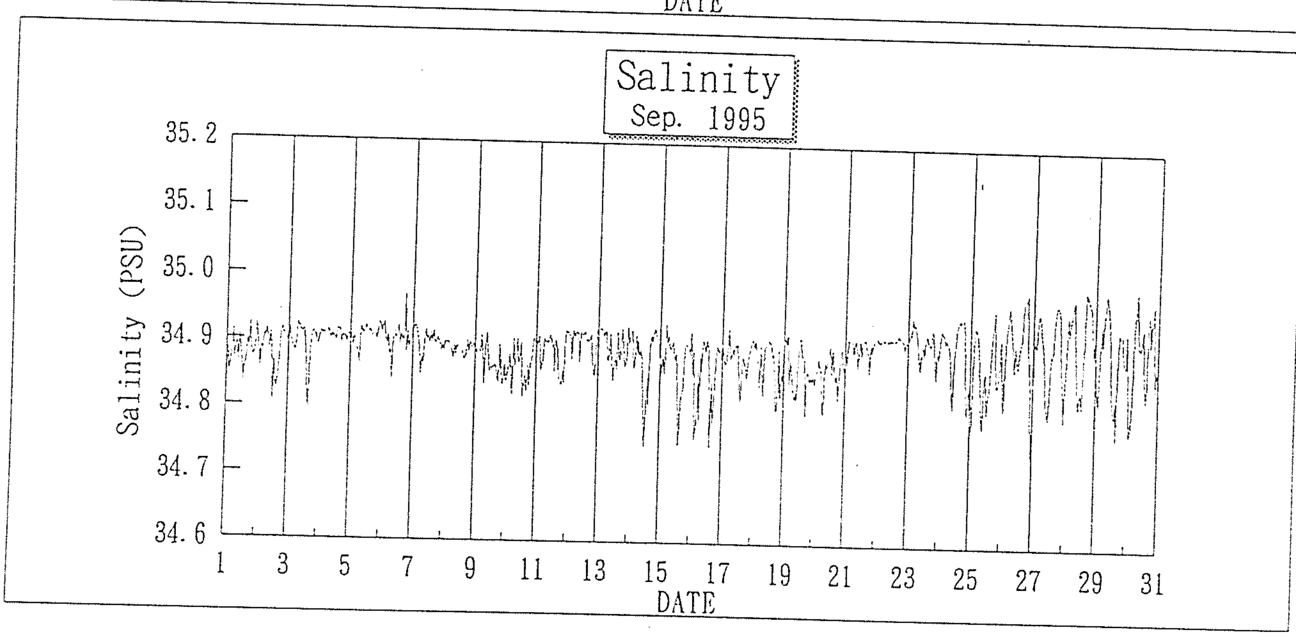
Mooring No. 950104-00N147E

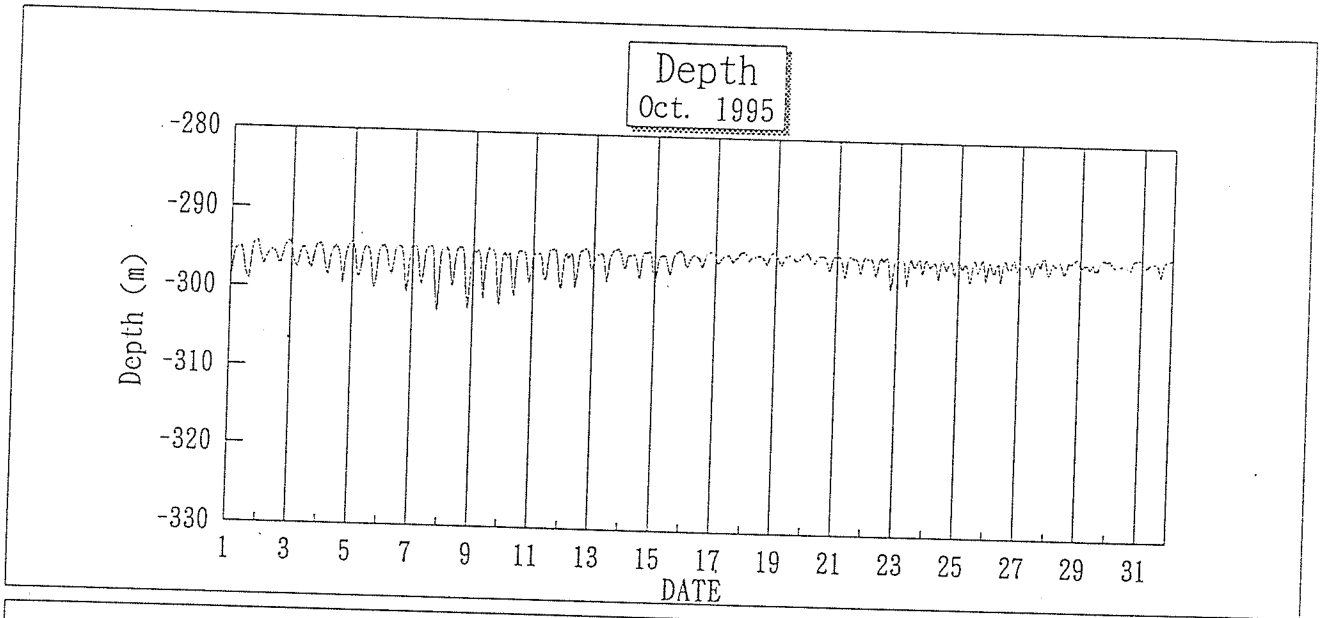


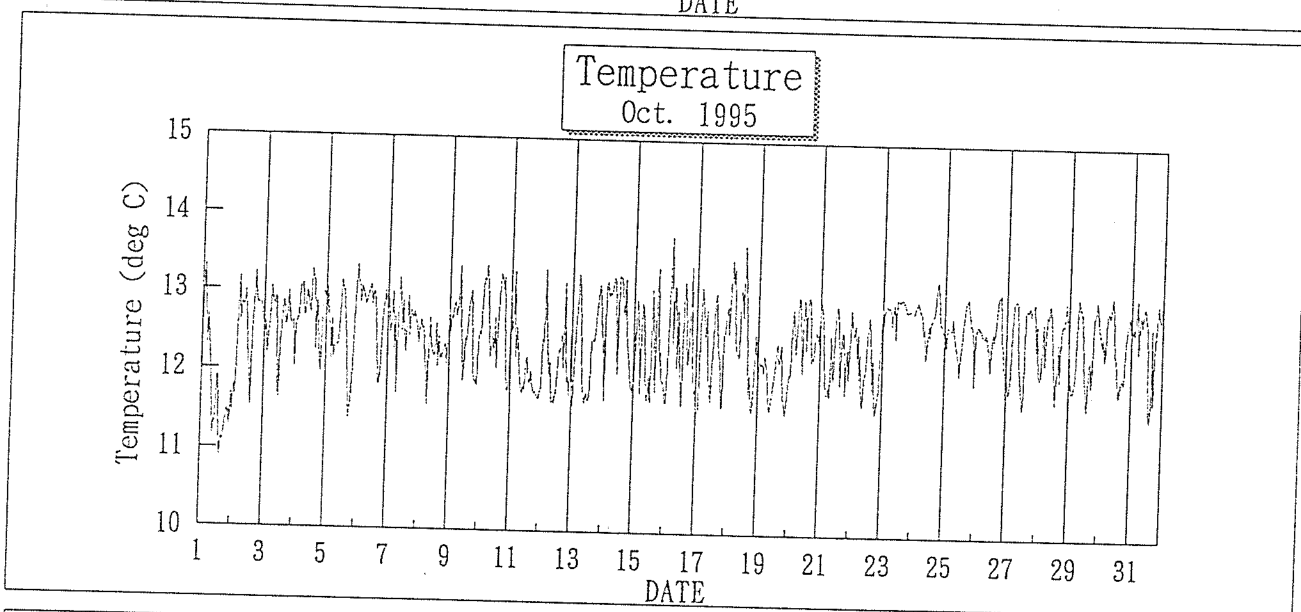
Mooring No. 950104-00N147E











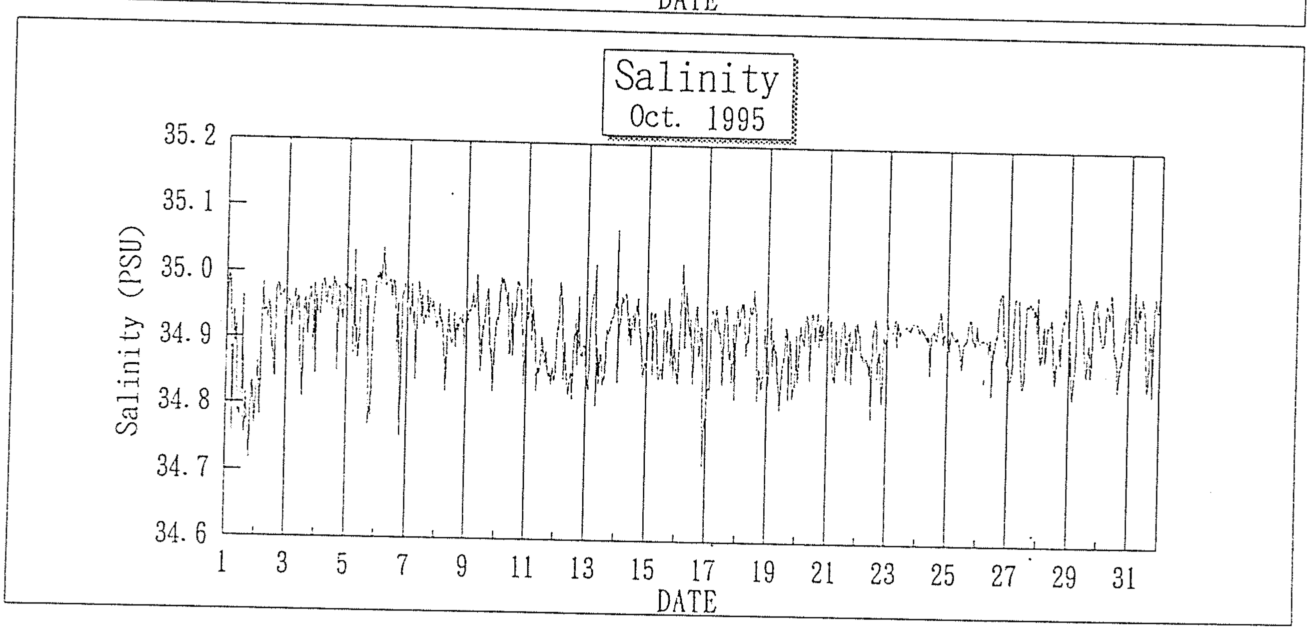
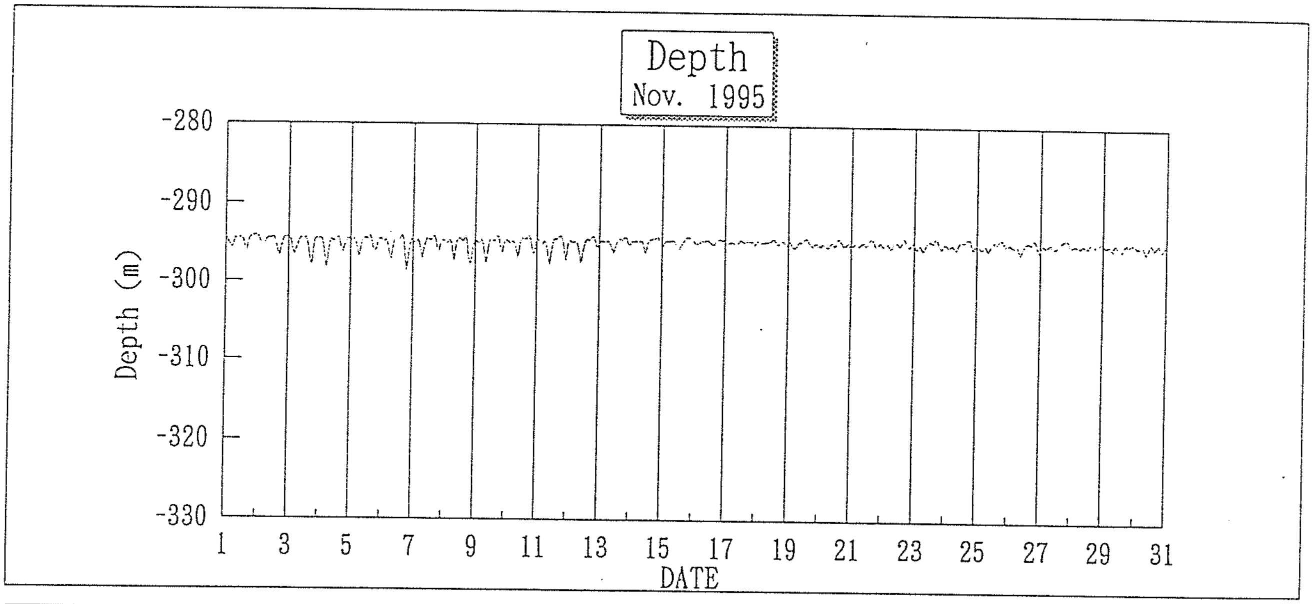
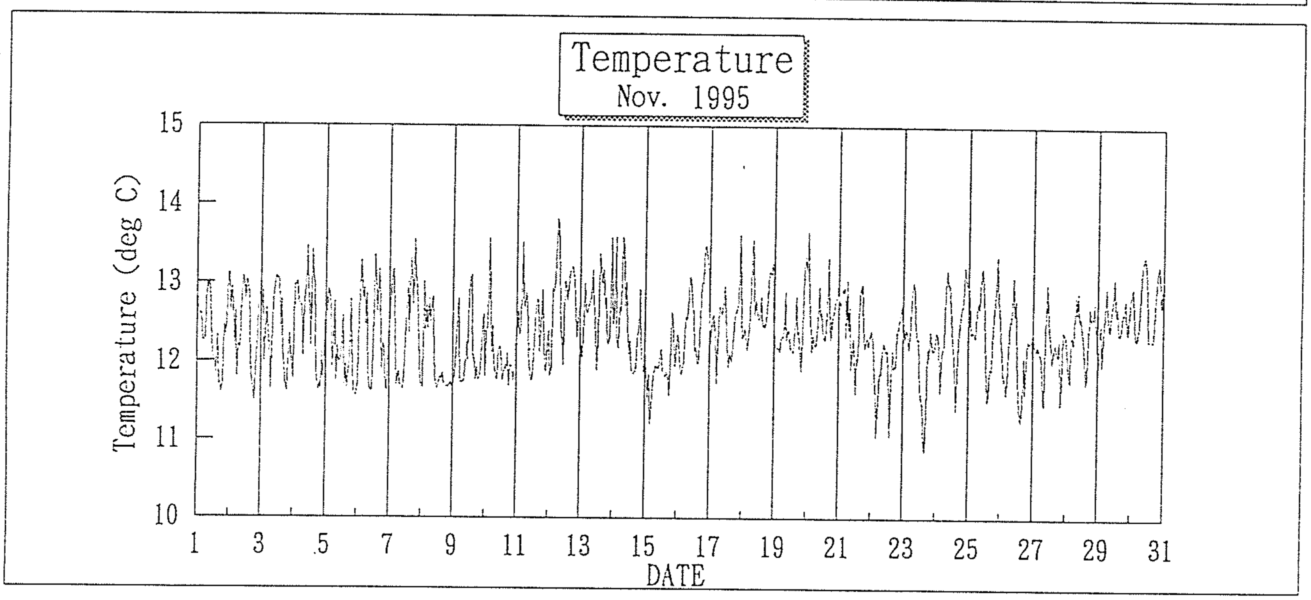


Fig. 7-11 Tme Series of Depth, Temperture, Salinity





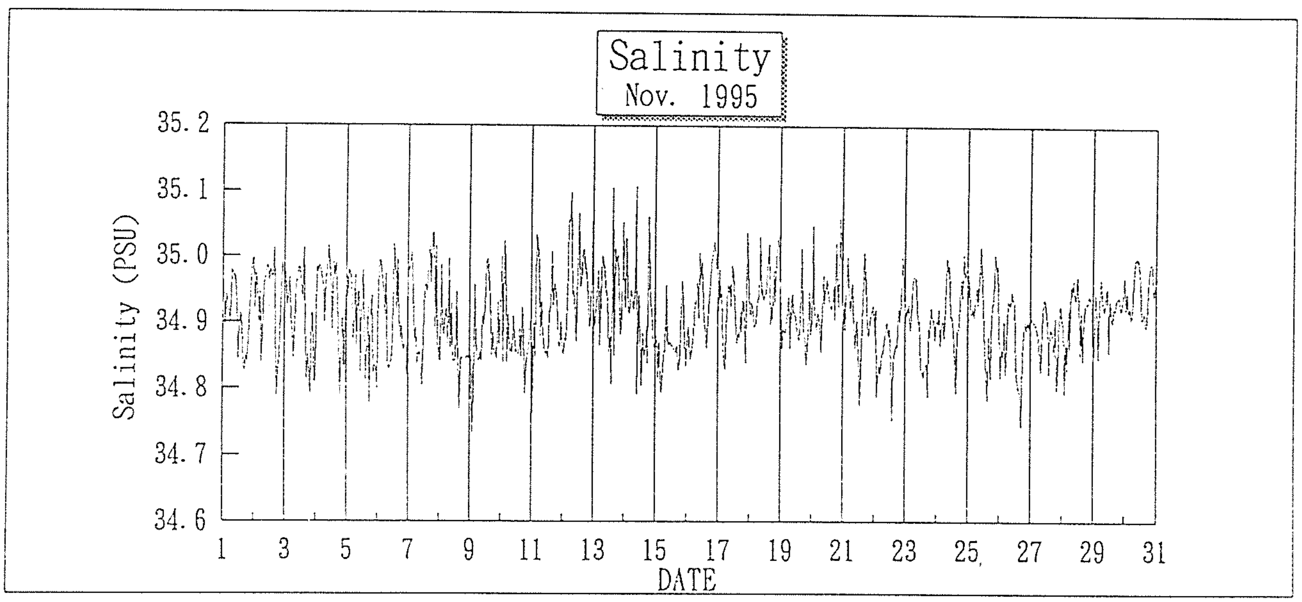


Fig 7-12 Tme Series of Depth, Temperture, Salinity

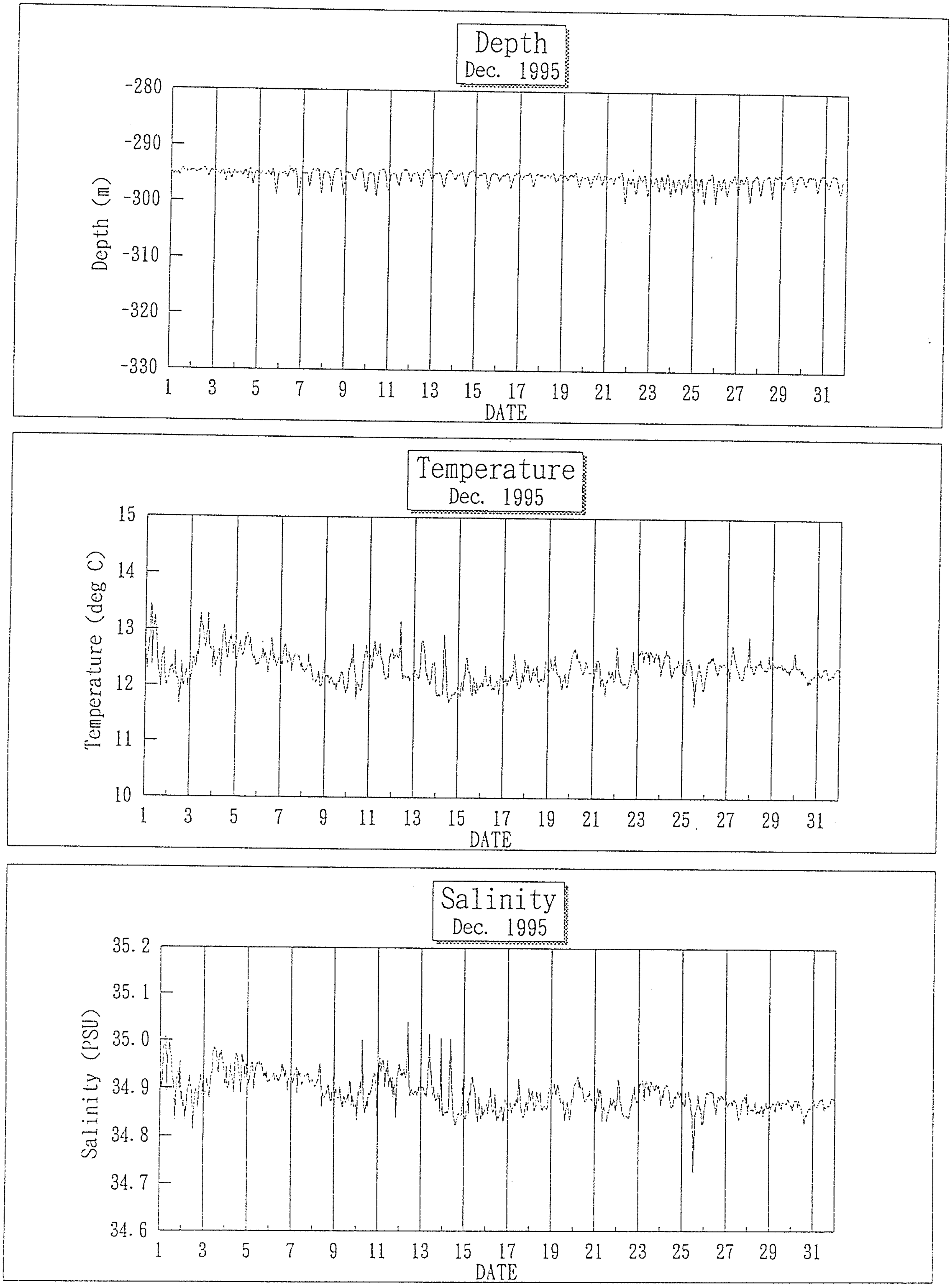
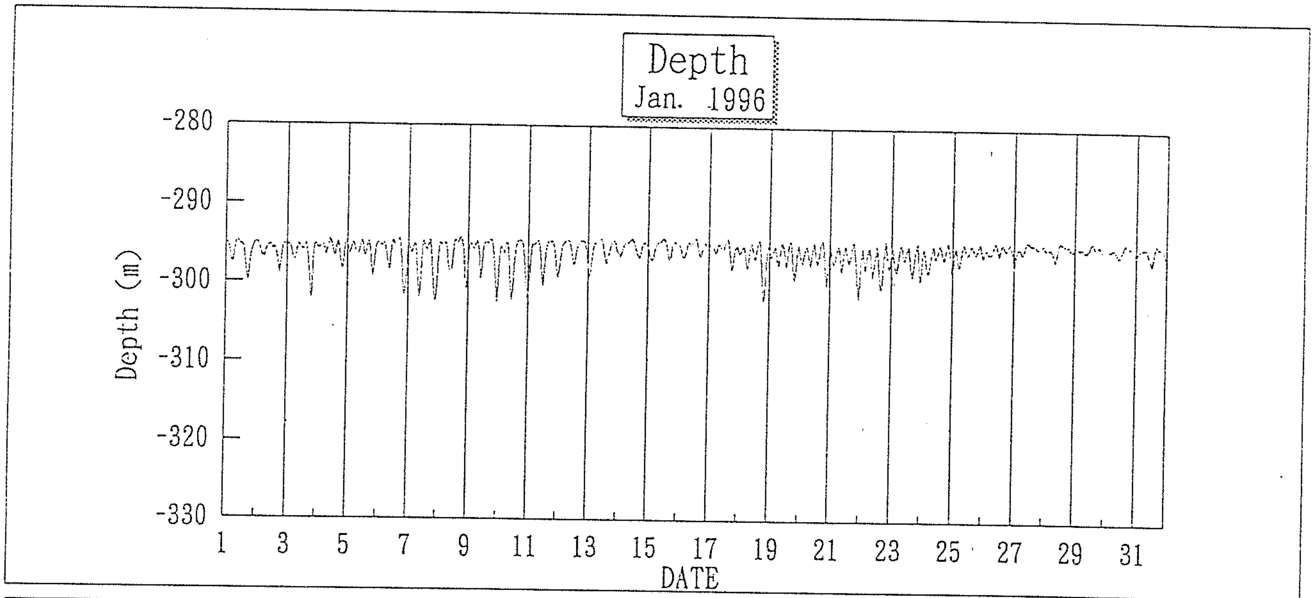
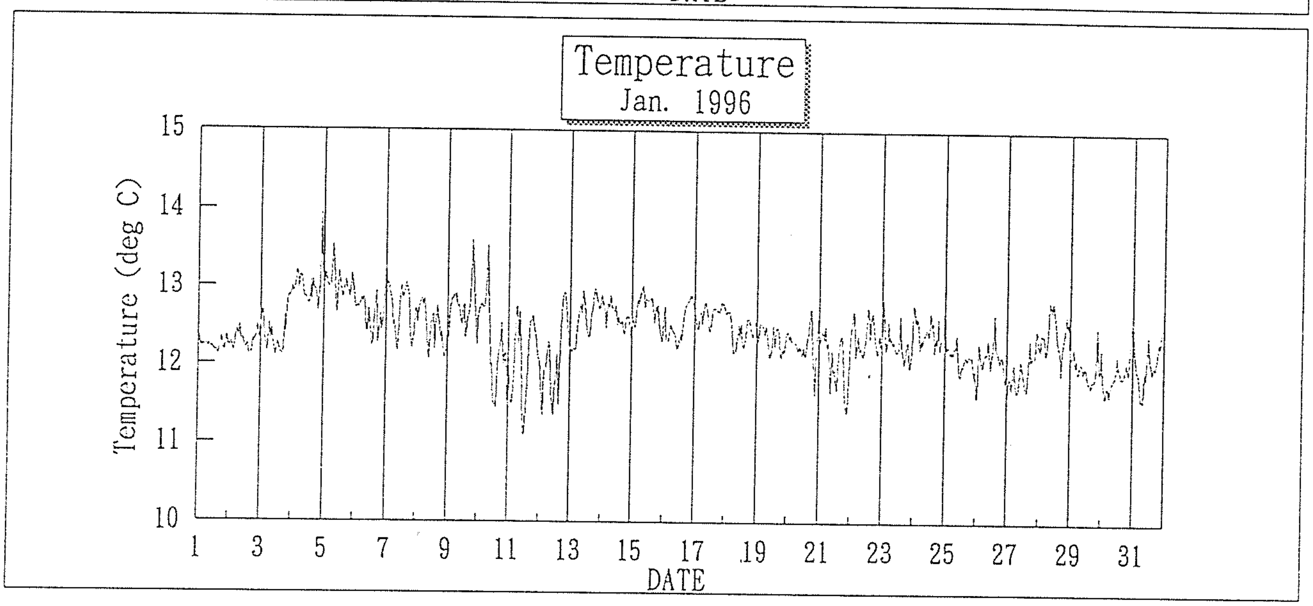


Fig 7-13 Tme Series of Depth, Temperture, Salinity





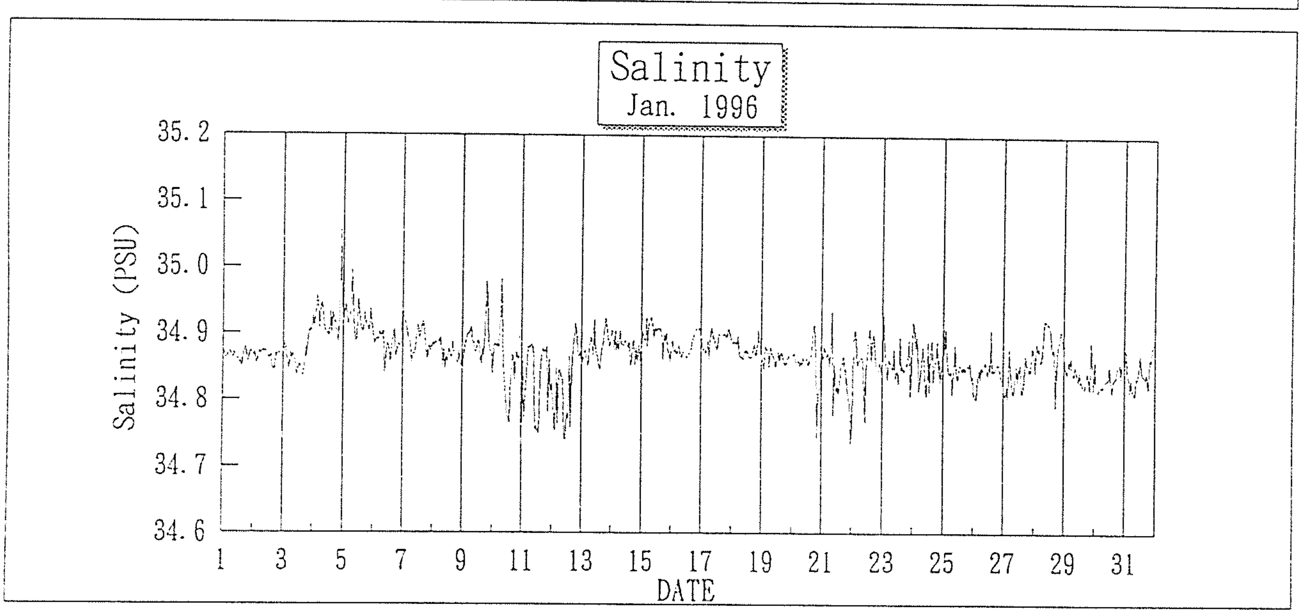


Fig 7-14 Tme Series of Depth, Temperture, Salinity

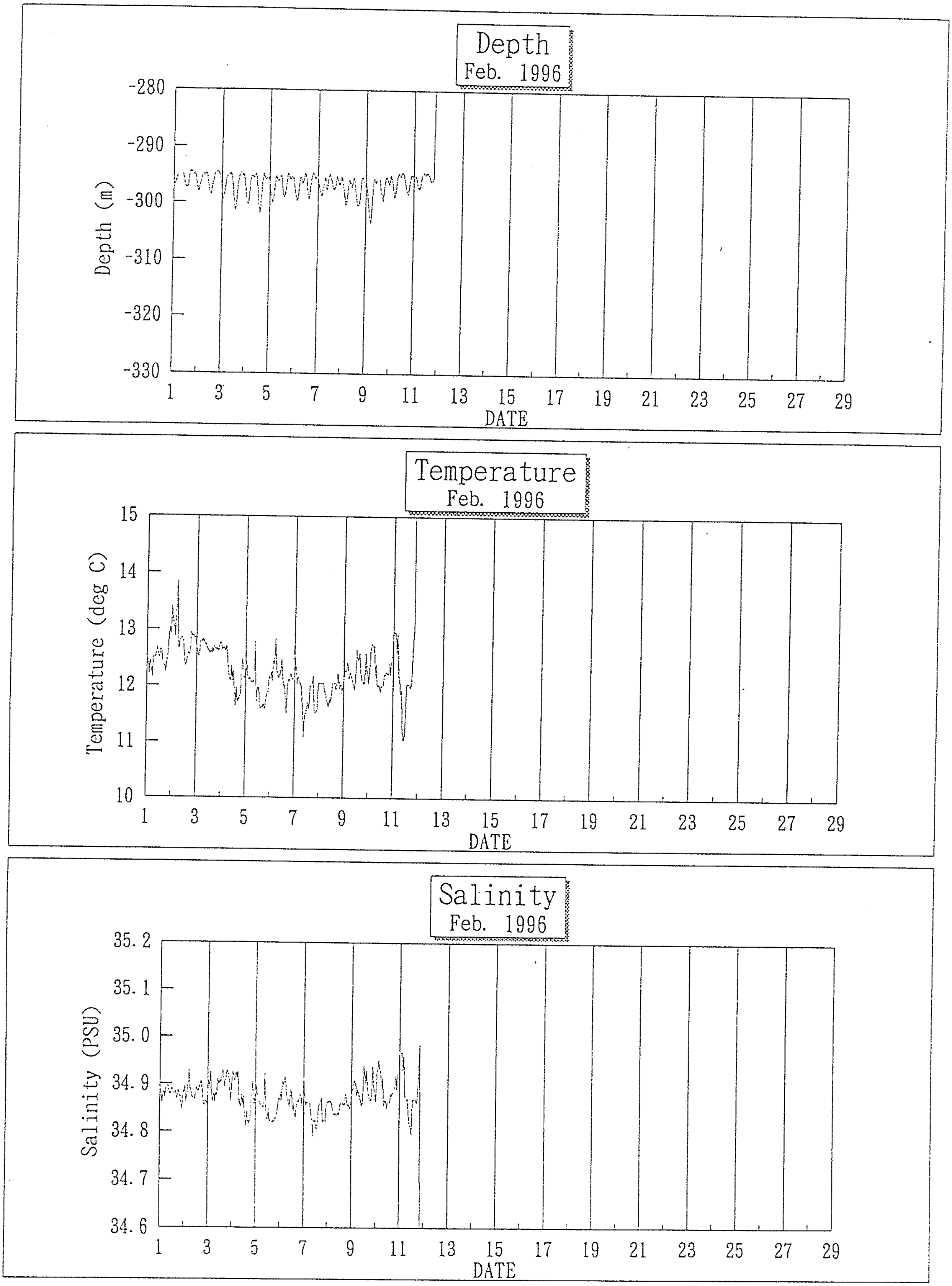
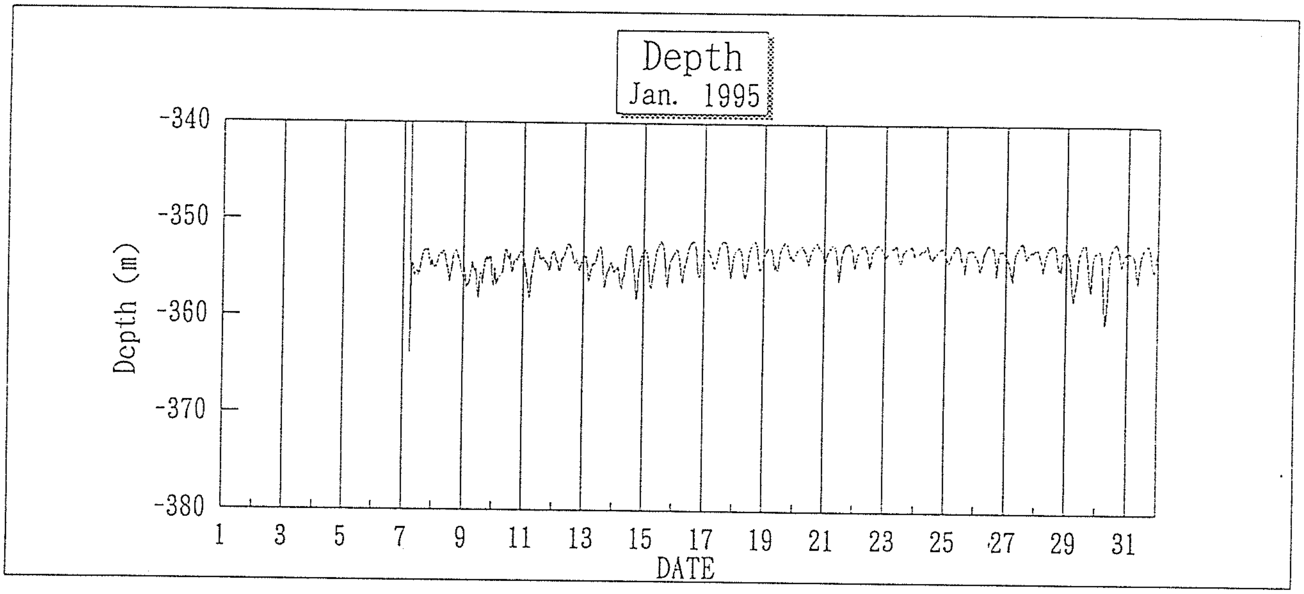
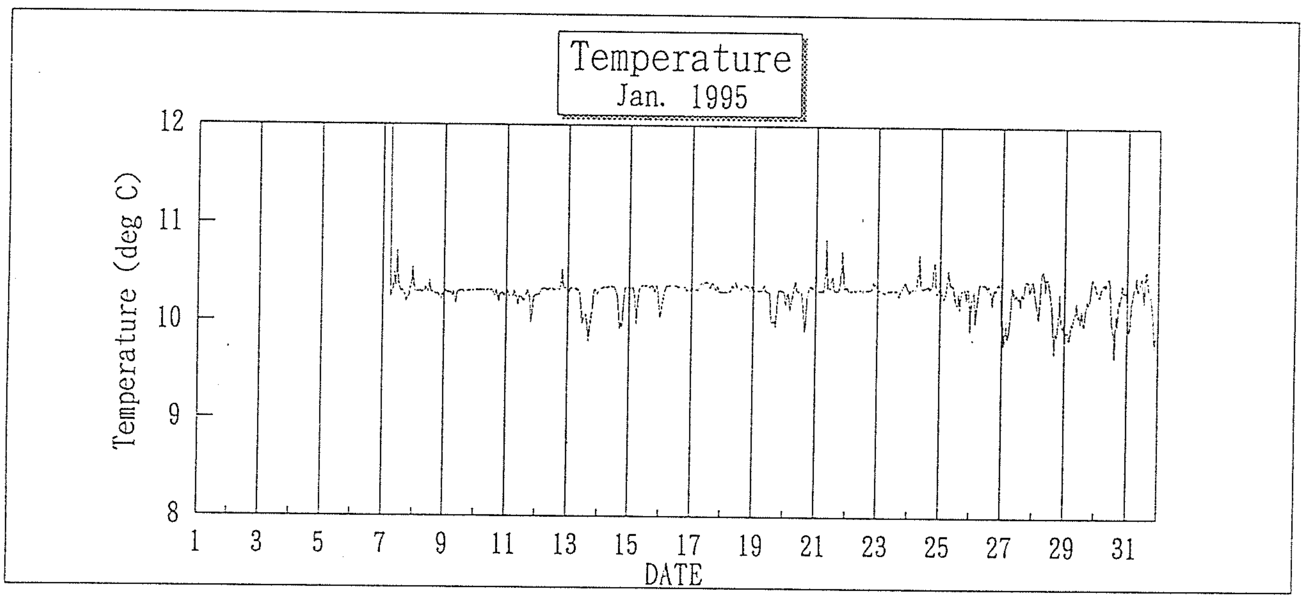


Fig 7-15 Tme Series of Depth, Temperture, Salinity





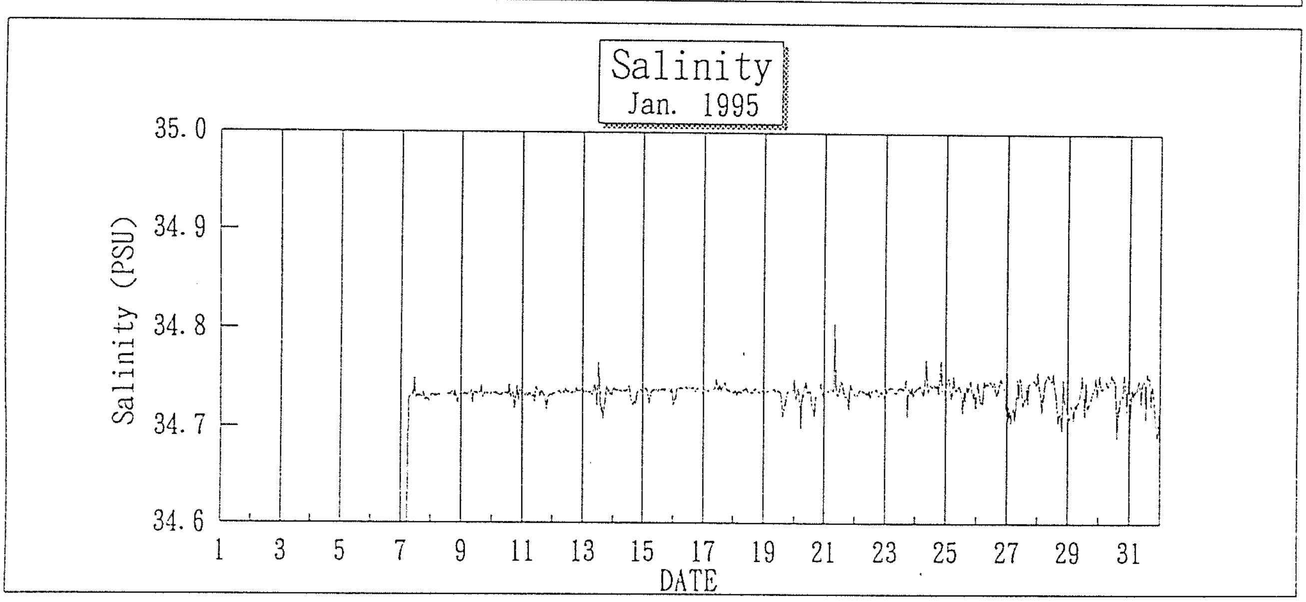
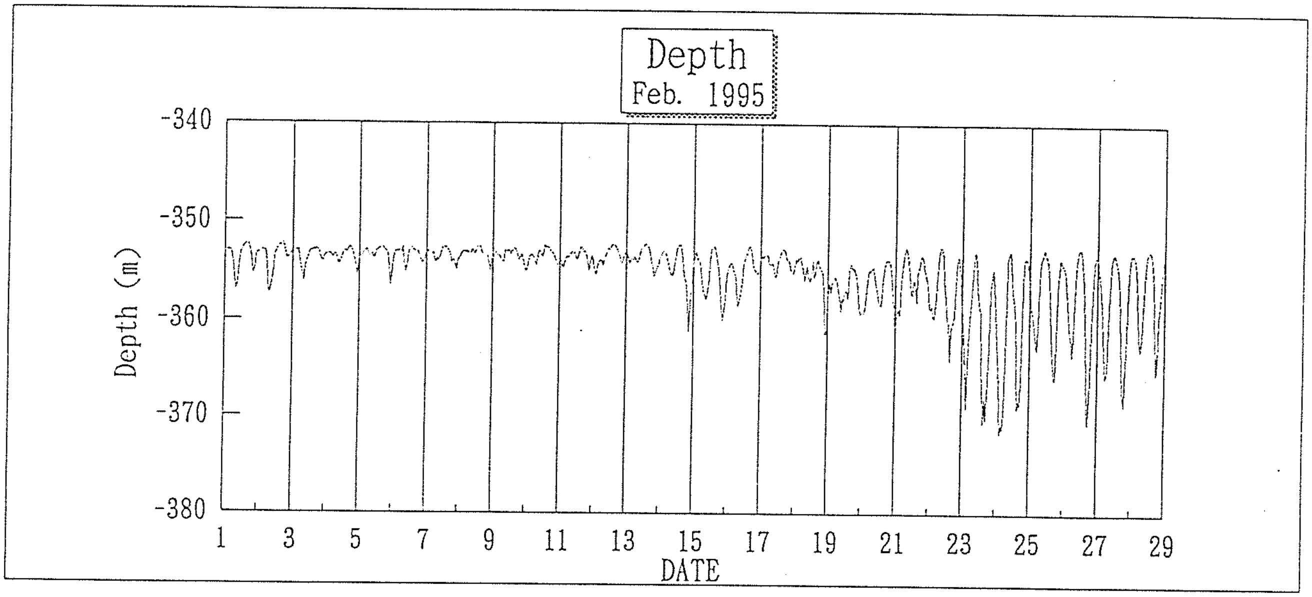
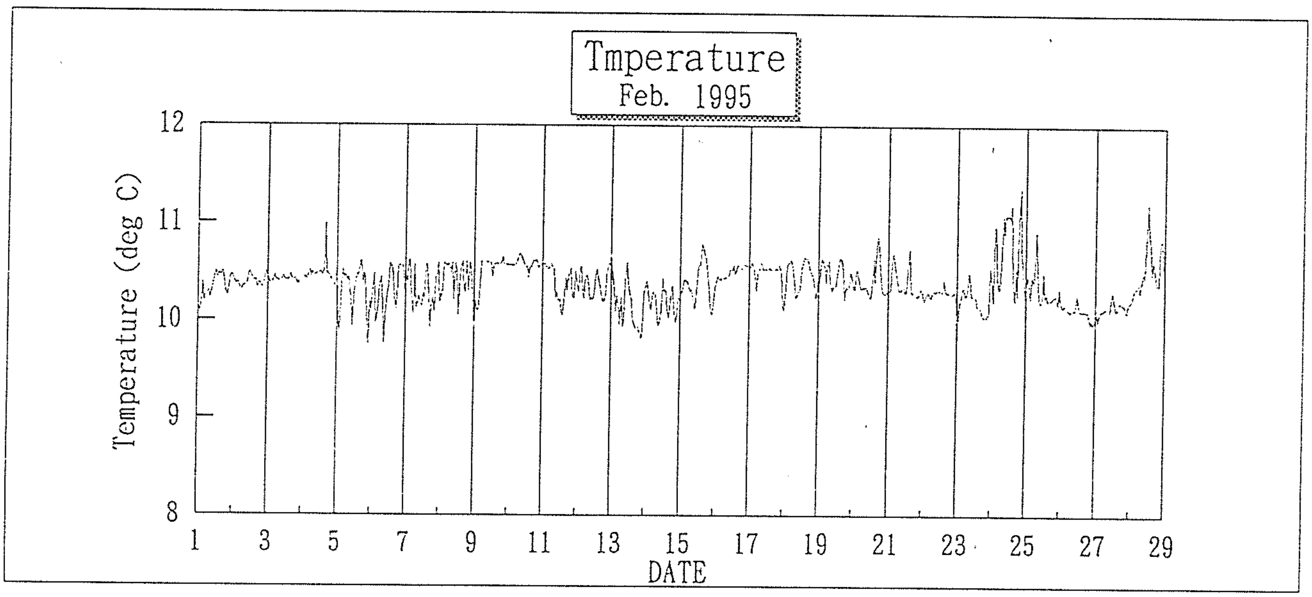


Fig 7-16 Time Series of Depth, Temperature, Salinity





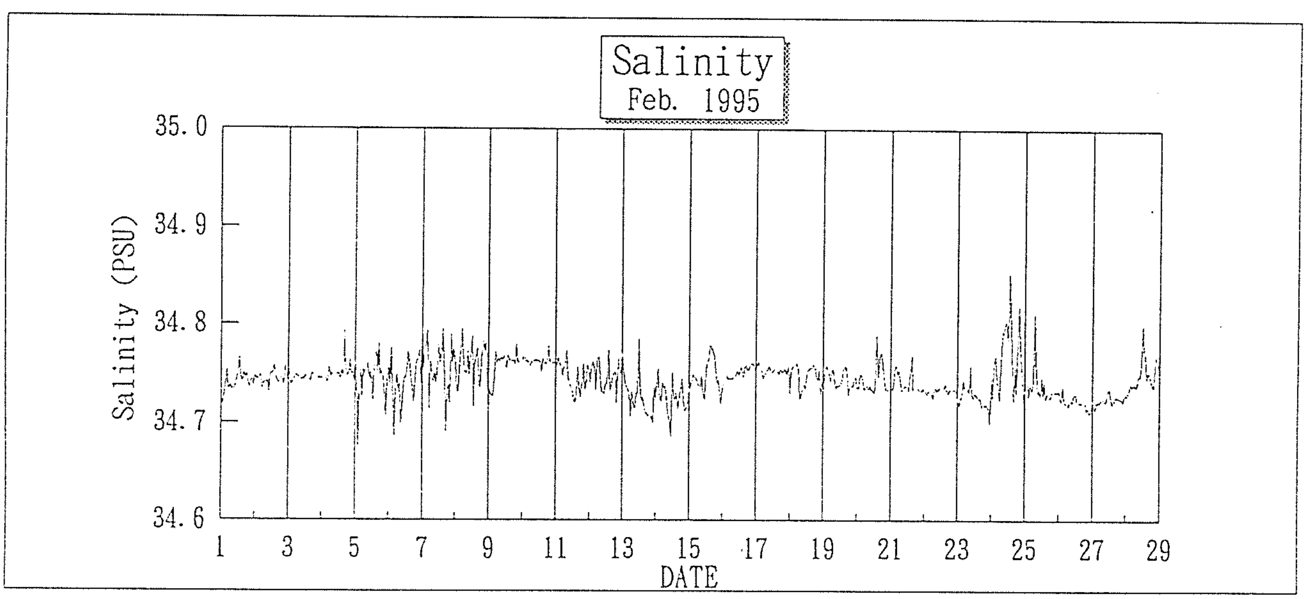
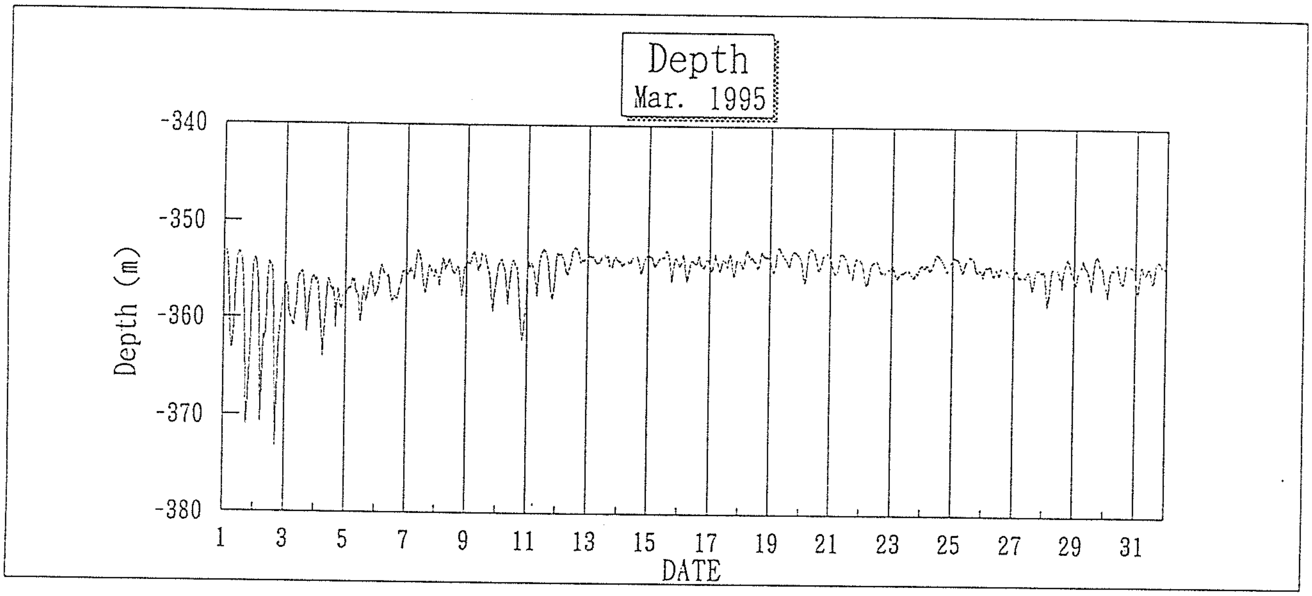
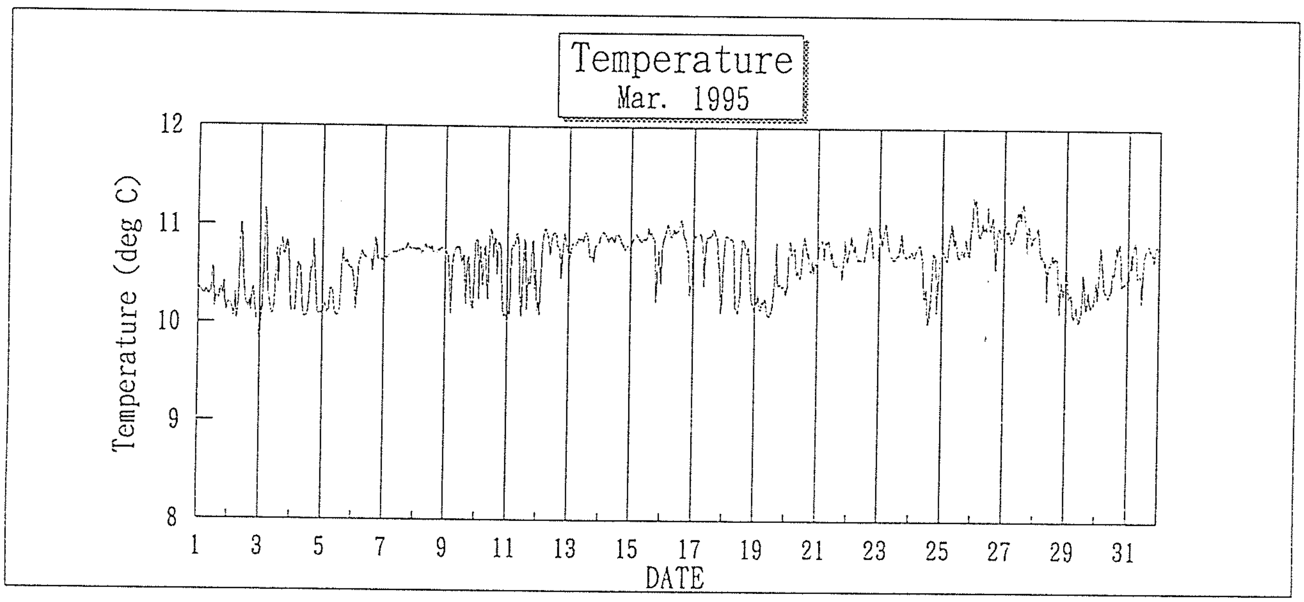


Fig 7-17 Time Series of Depth, Temperature, Salinity





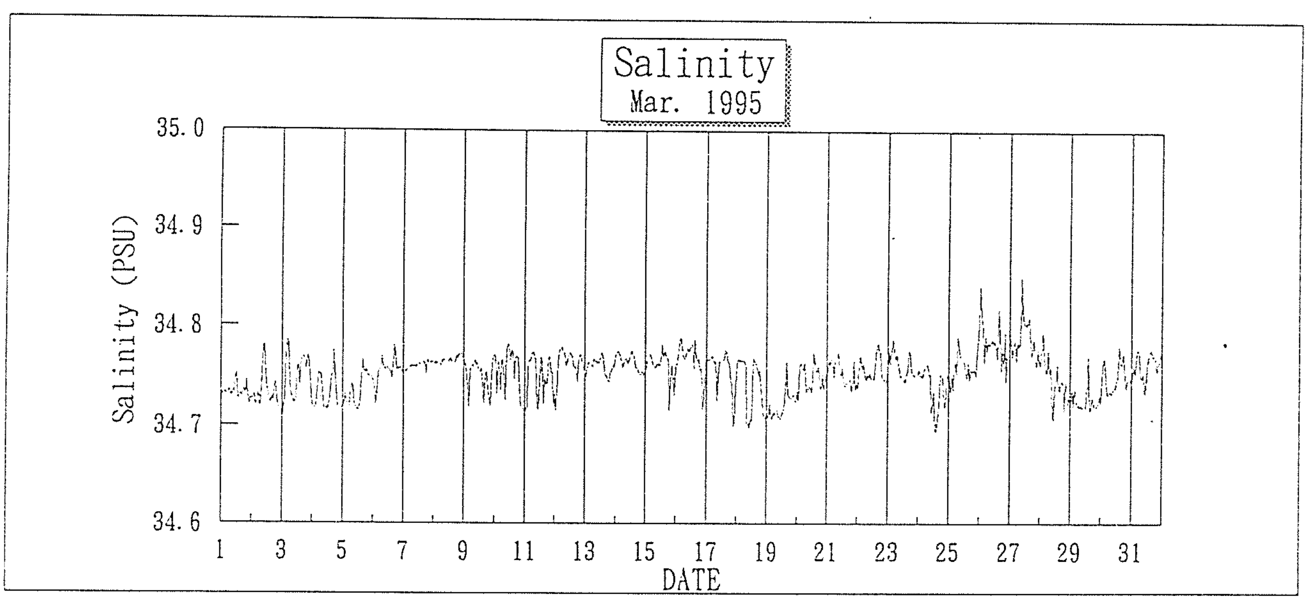
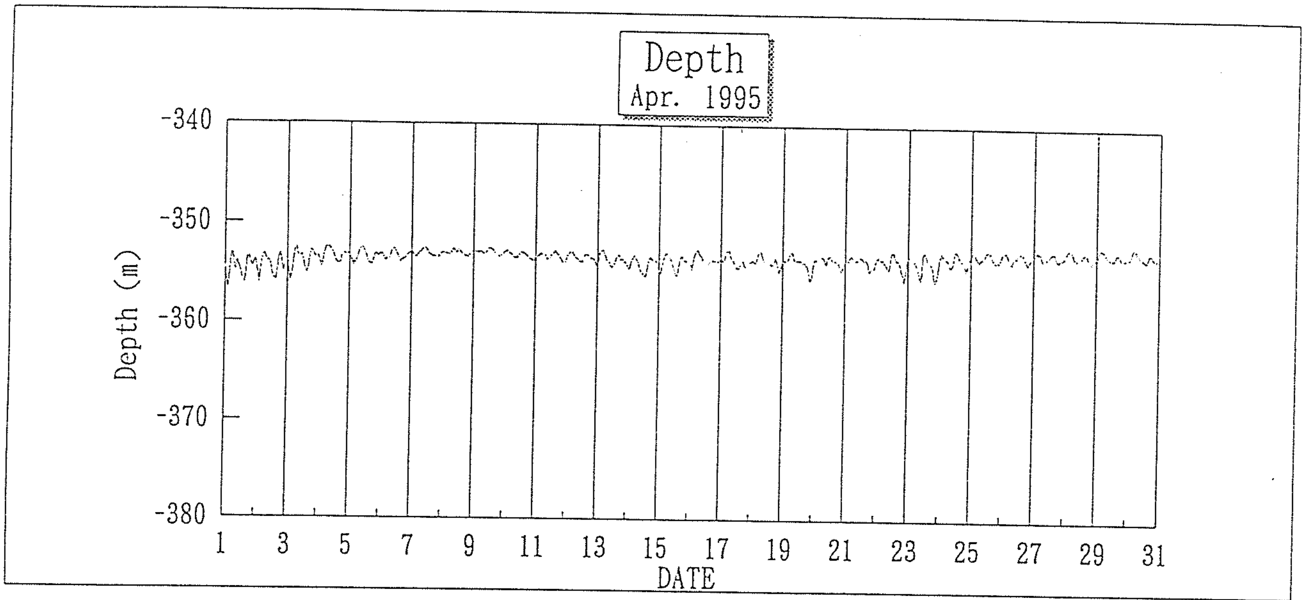
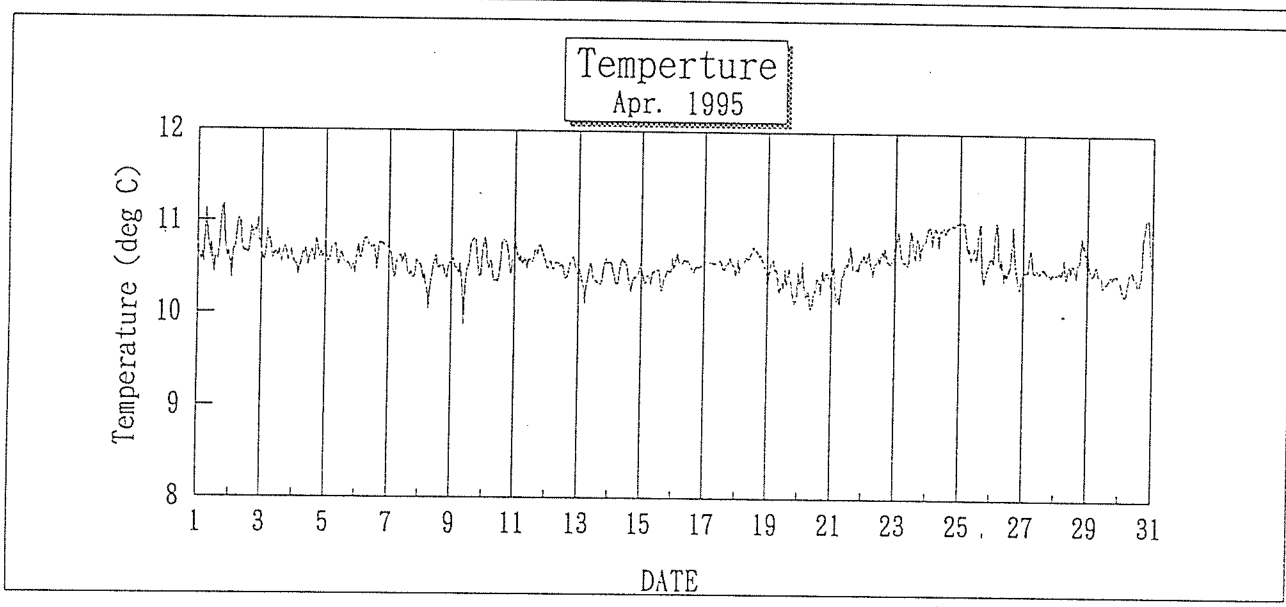


Fig 7-18 Time Series of Depth, Temperature, Salinity





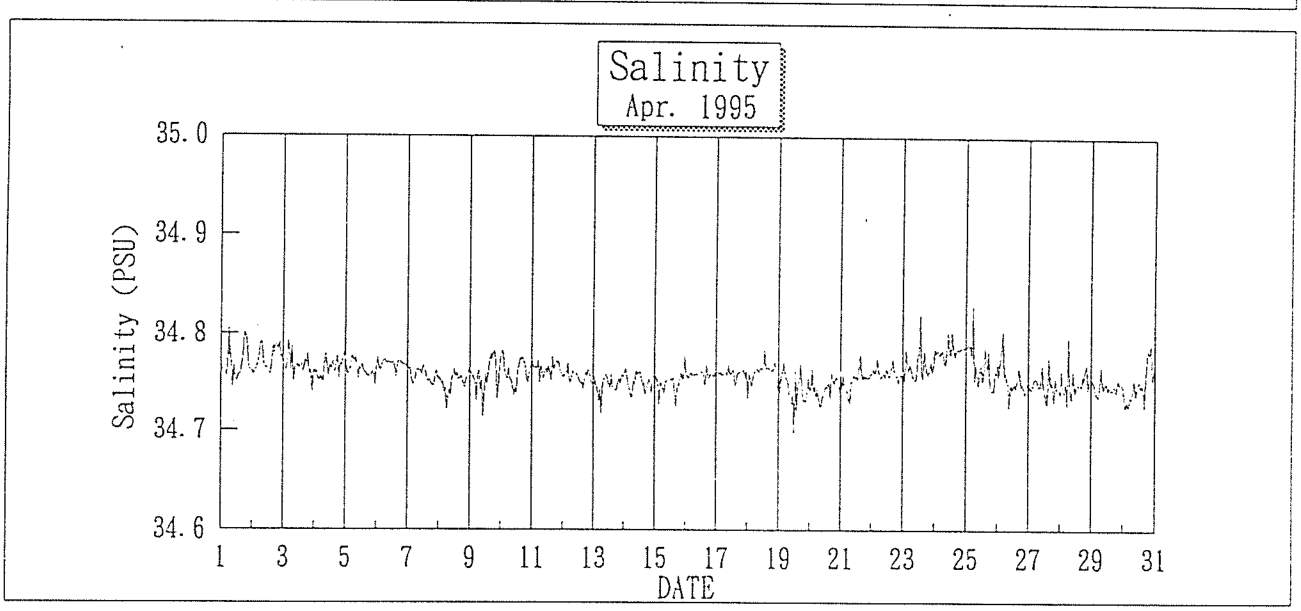


Fig 7-19 Time Series of Depth, Temperature, Salinity

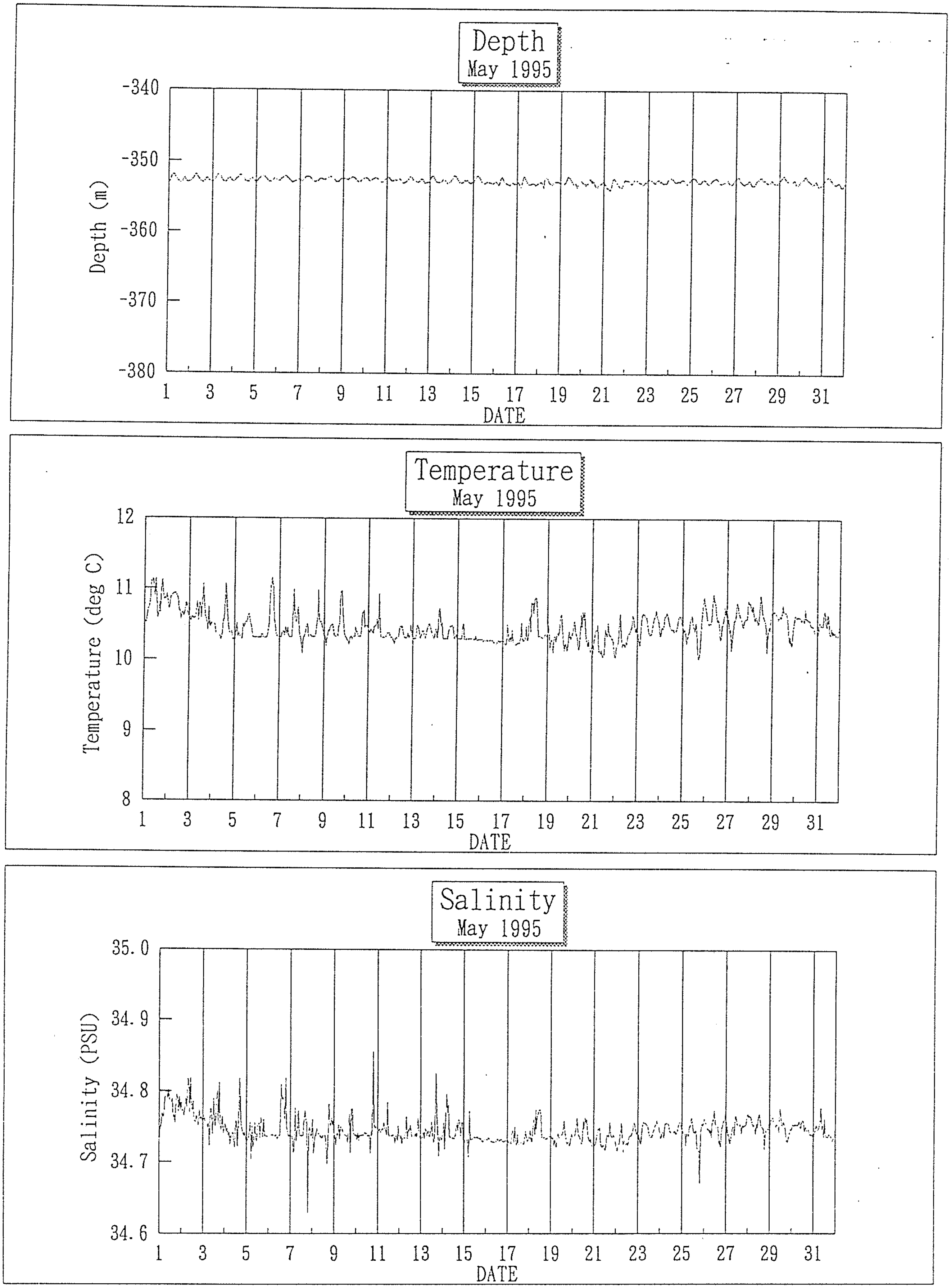
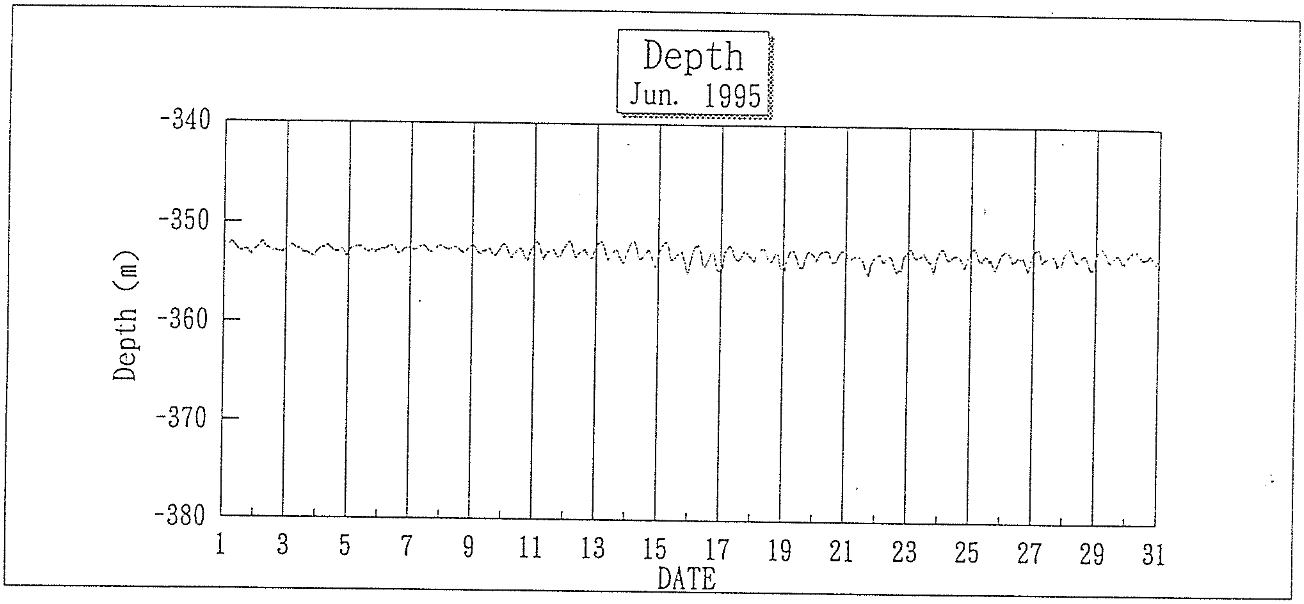
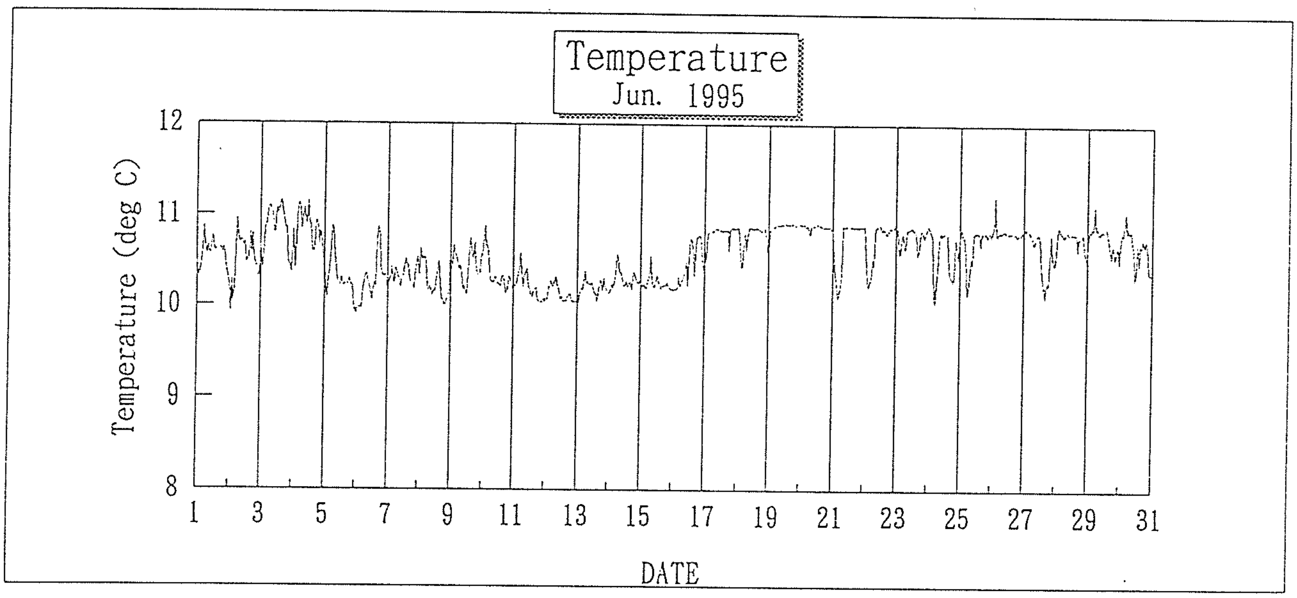


Fig 7-20 Time Series of Depth, Temperature, Salinity





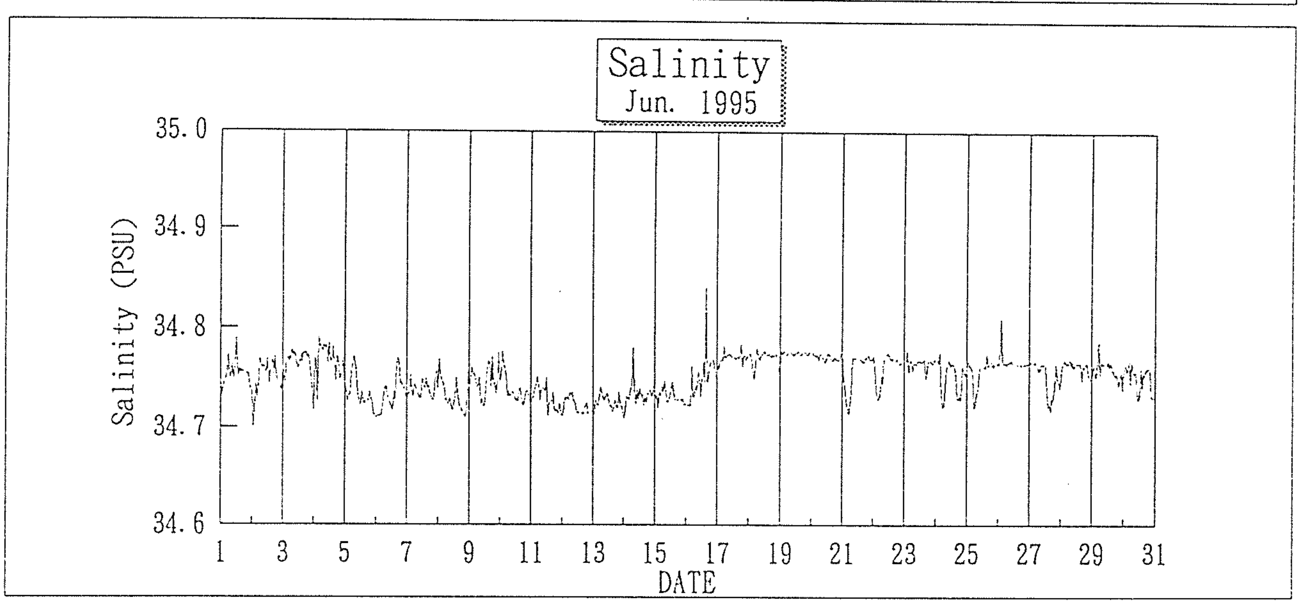
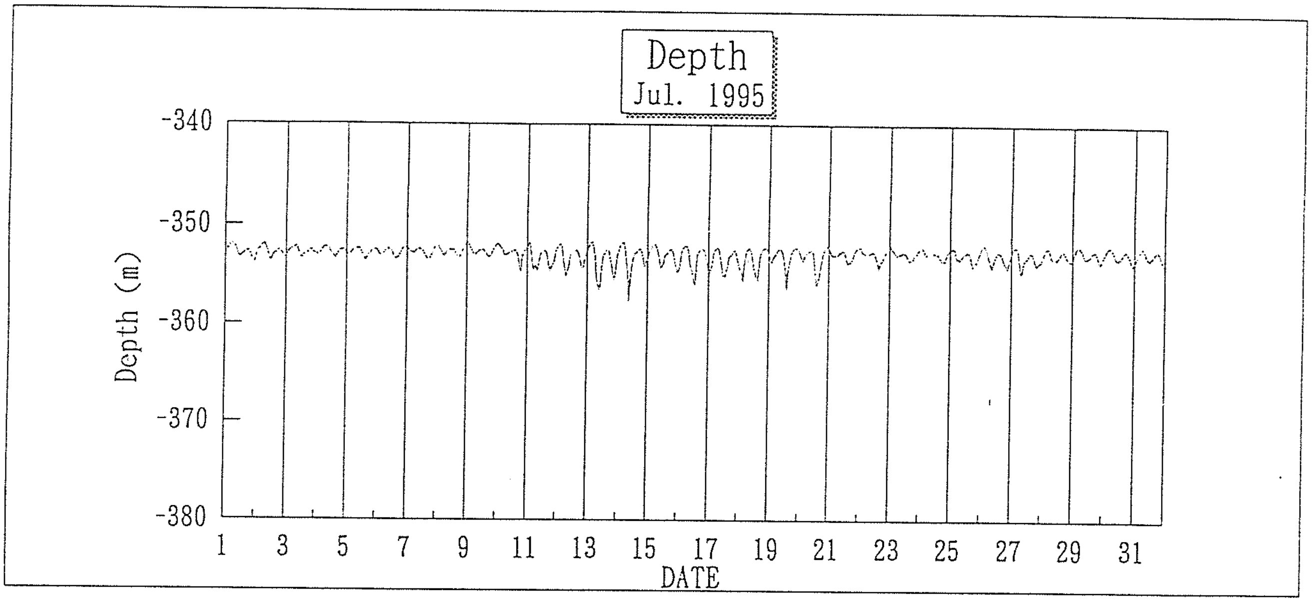
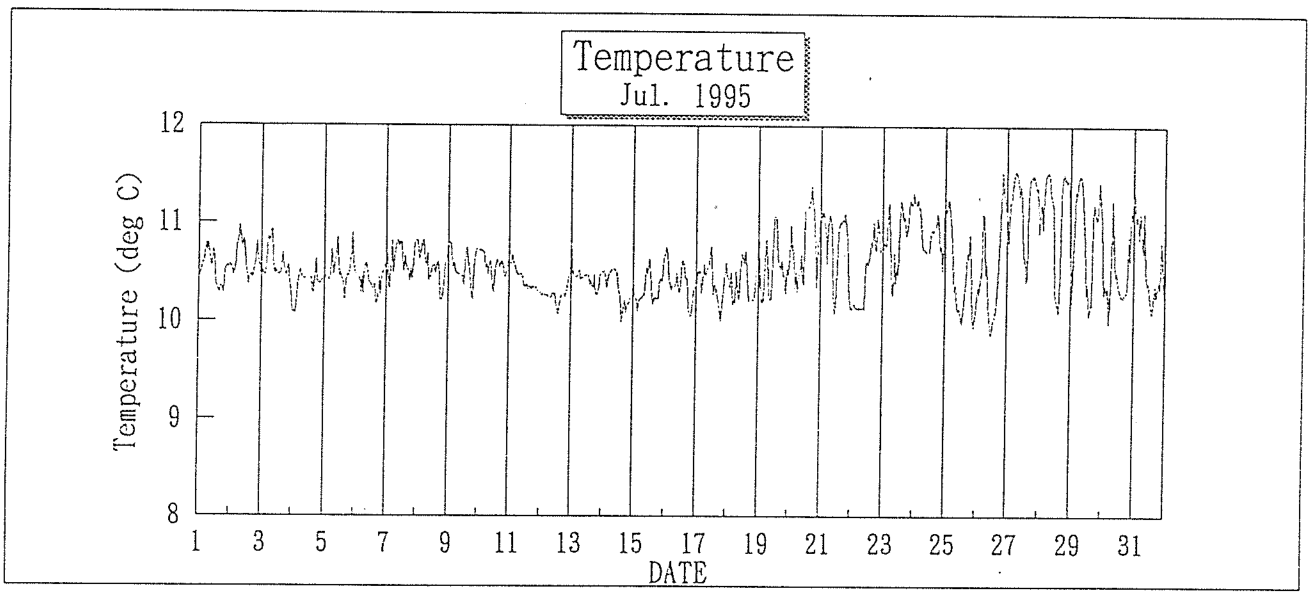


Fig 7-21 Time Series of Depth, Temperature, Salinity





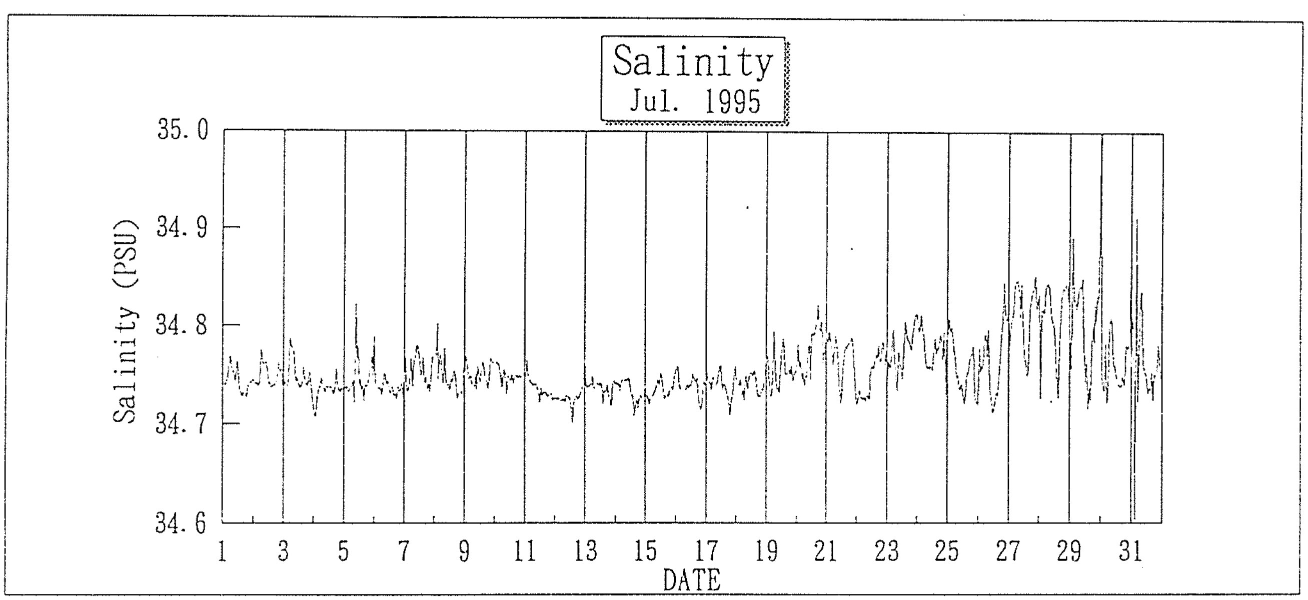


Fig 7-22 Time Series of Depth, Temperature, Salinity

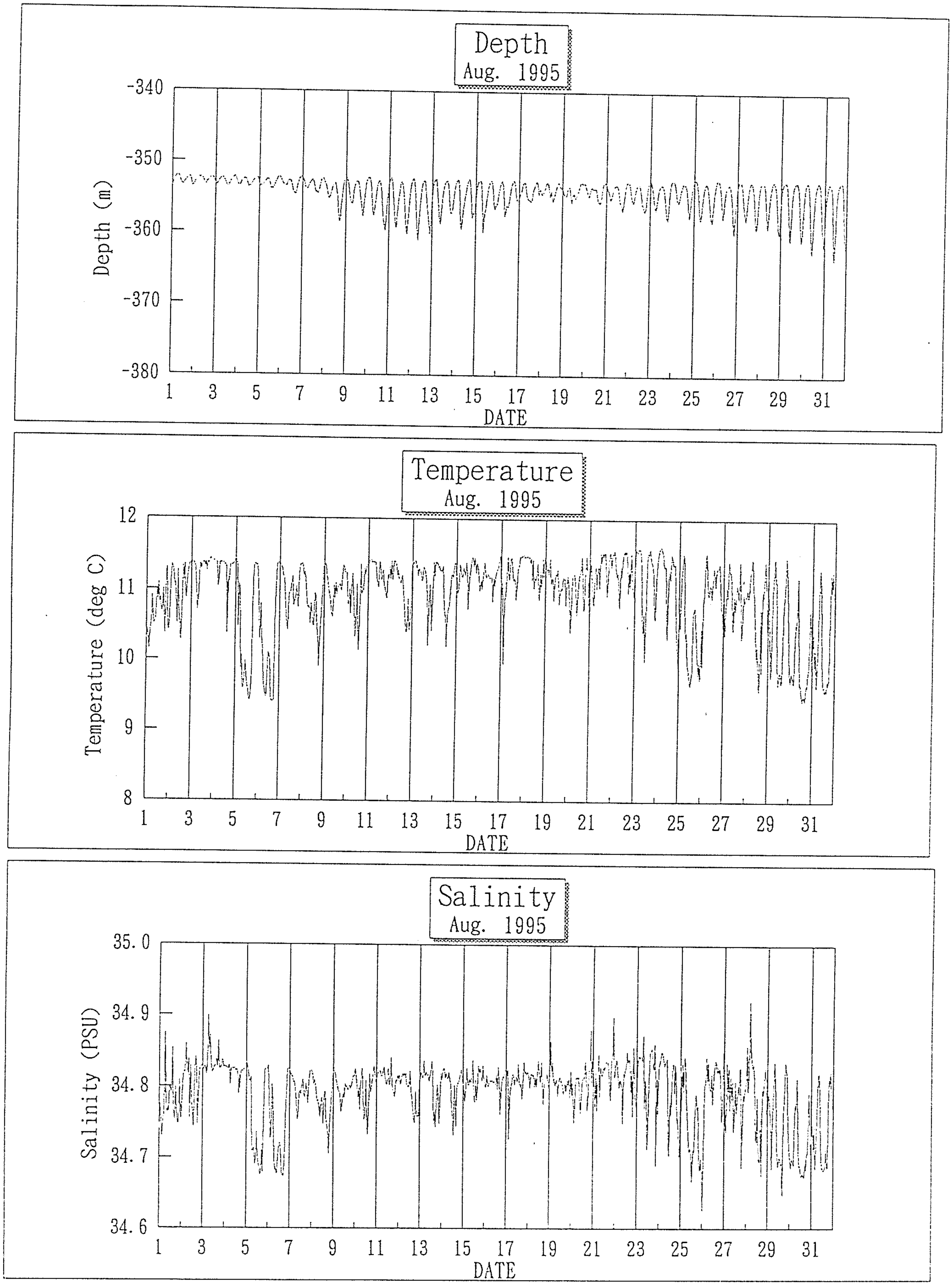


Fig 7-23 Time Series of Depth, Temperature, Salinity

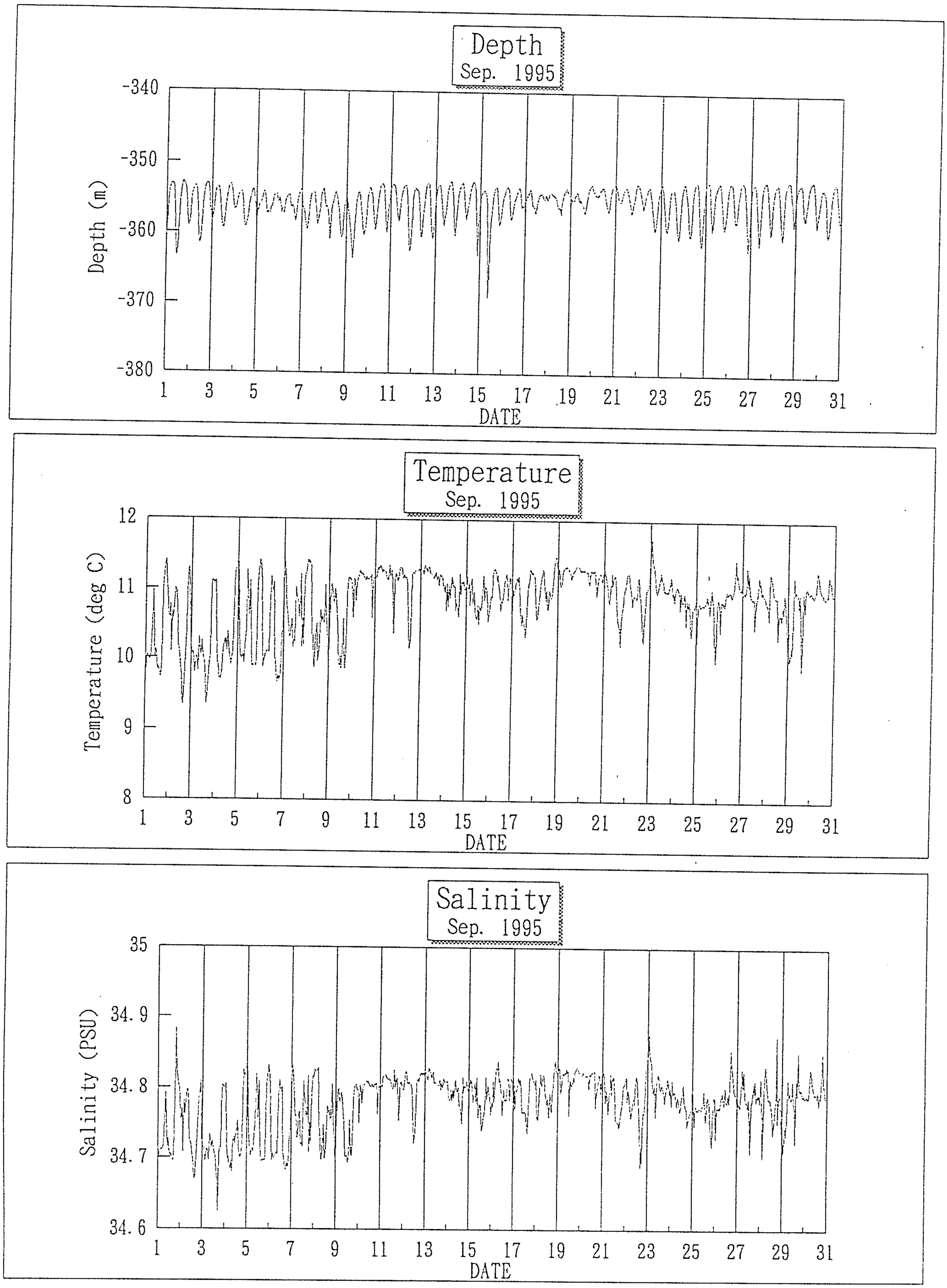
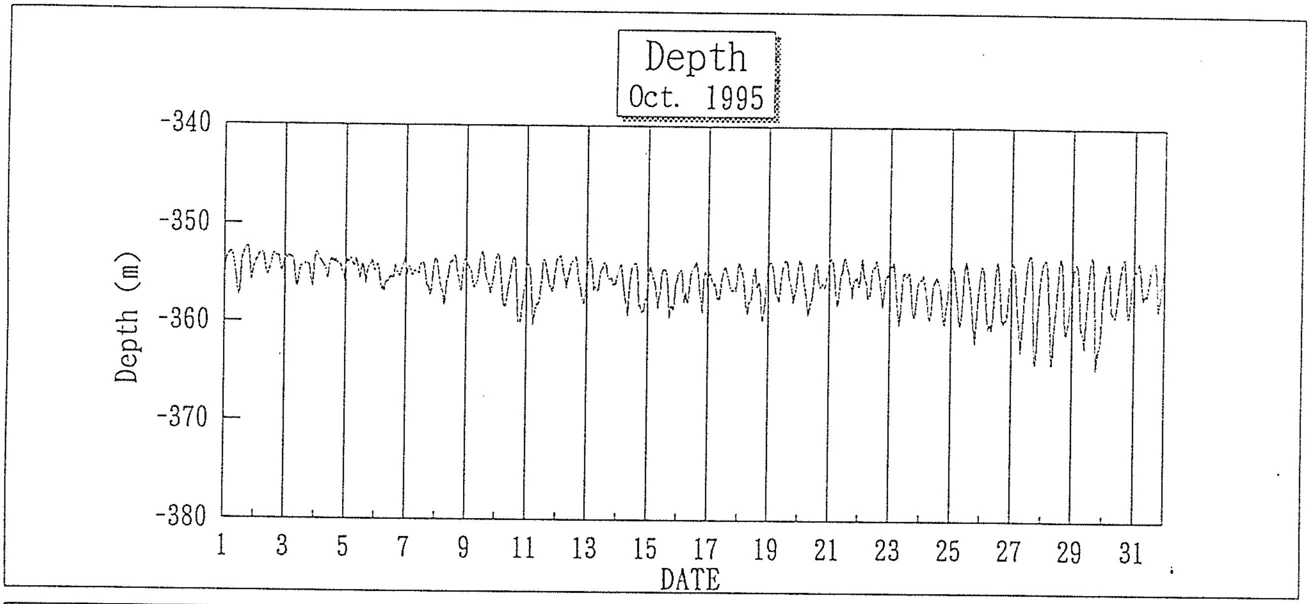
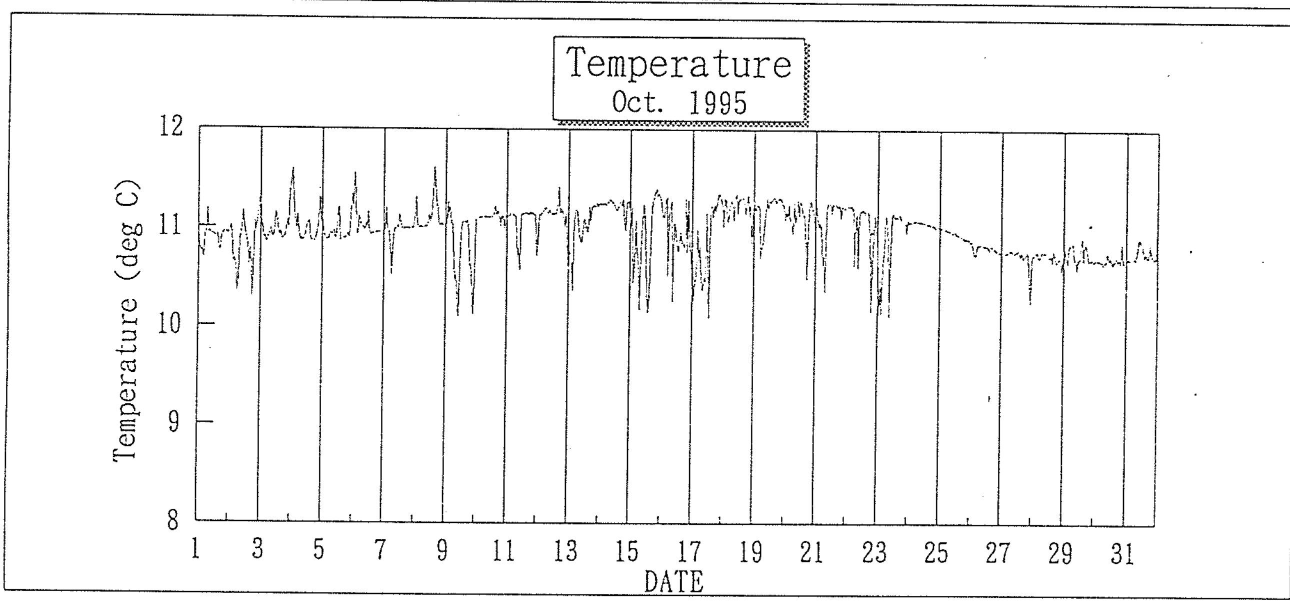


Fig 7-24 Time Series of Depth, Temperature, Salinity





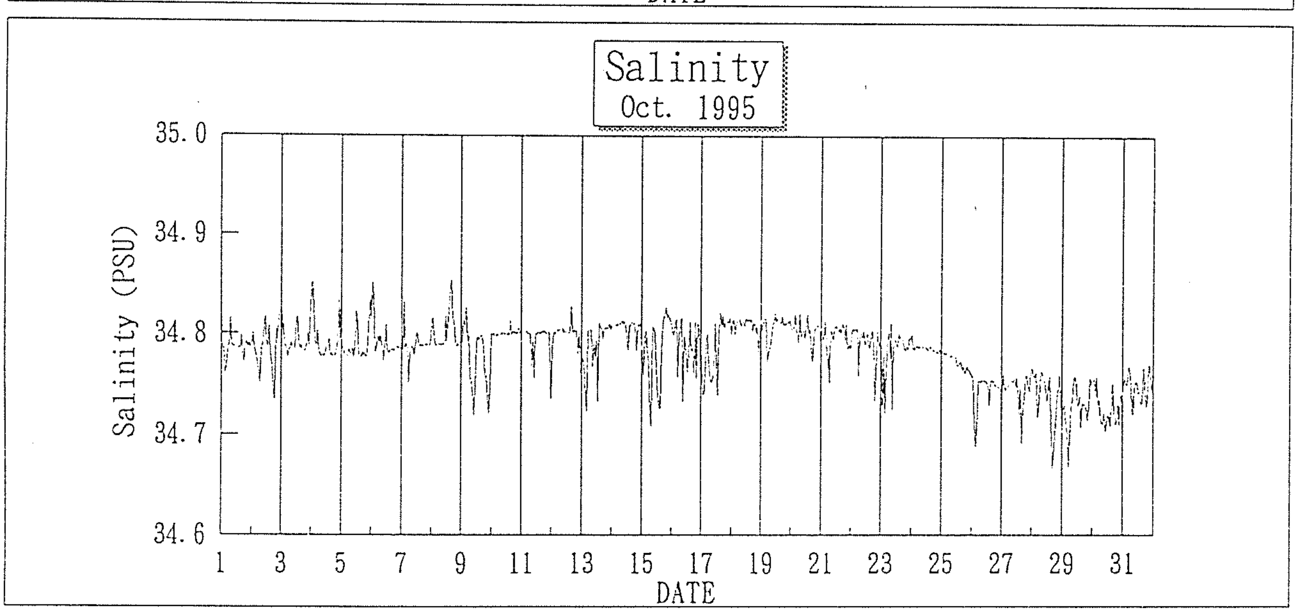


Fig 7-25 Time Series of Depth, Temperature, Salinity

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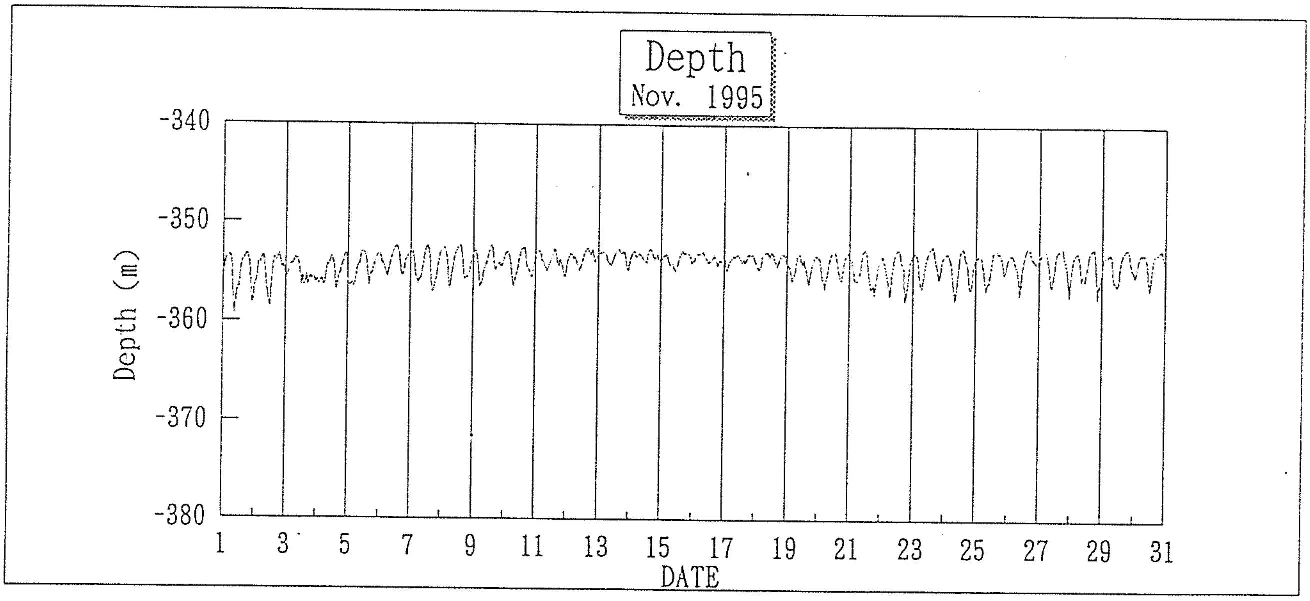
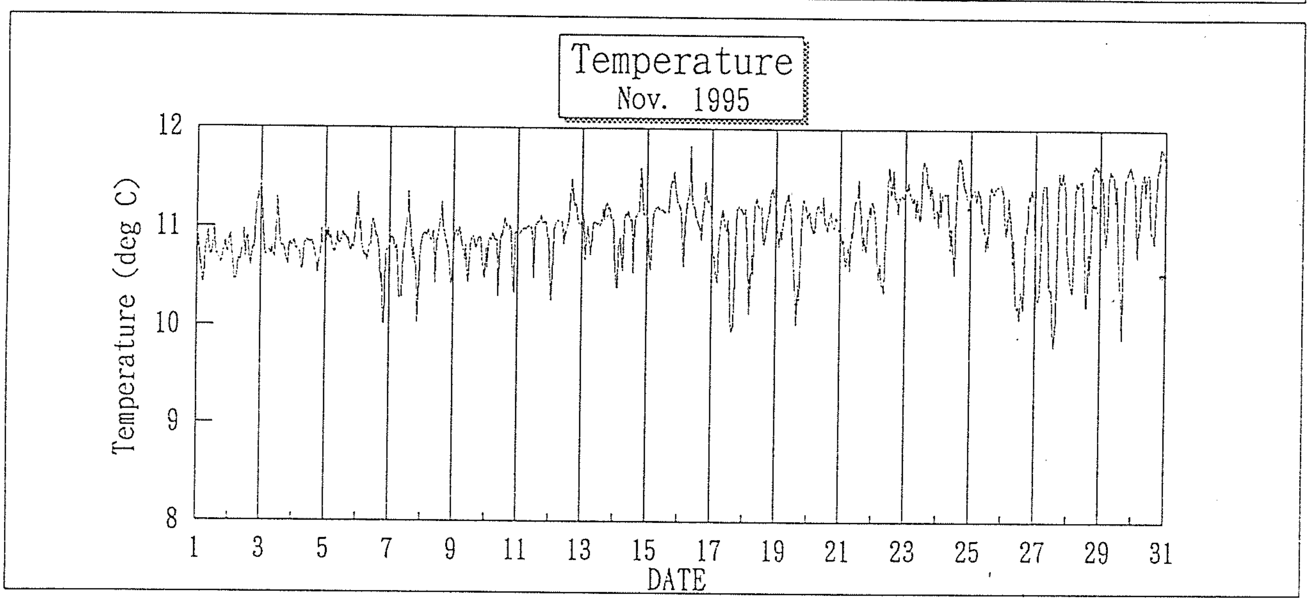




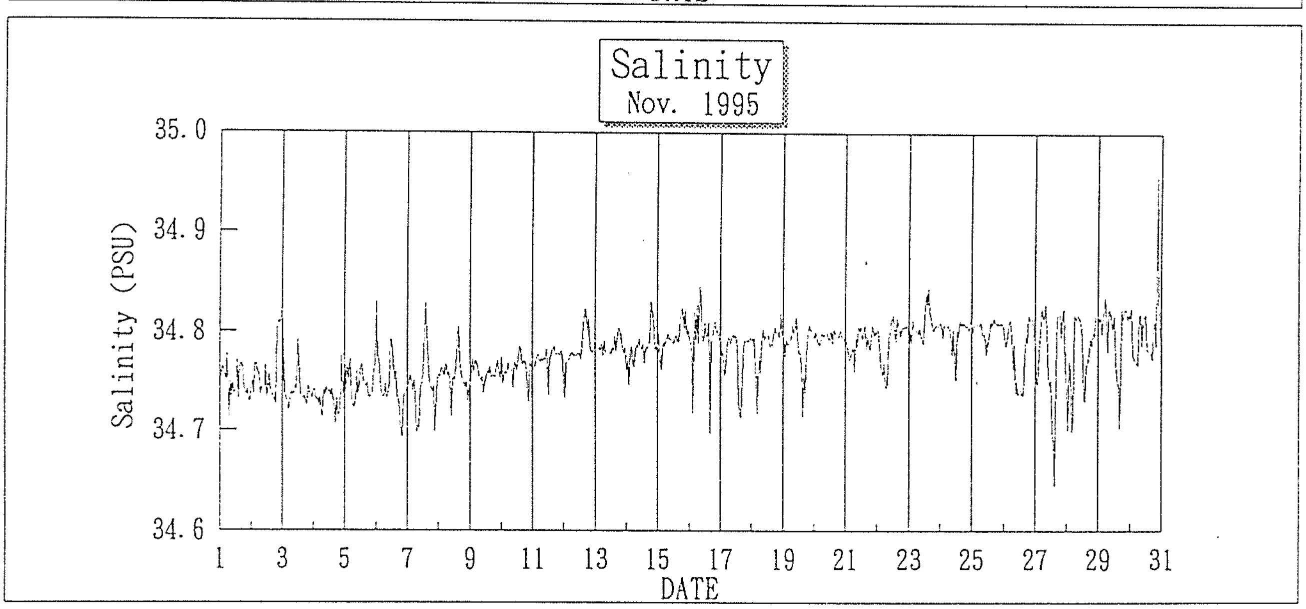
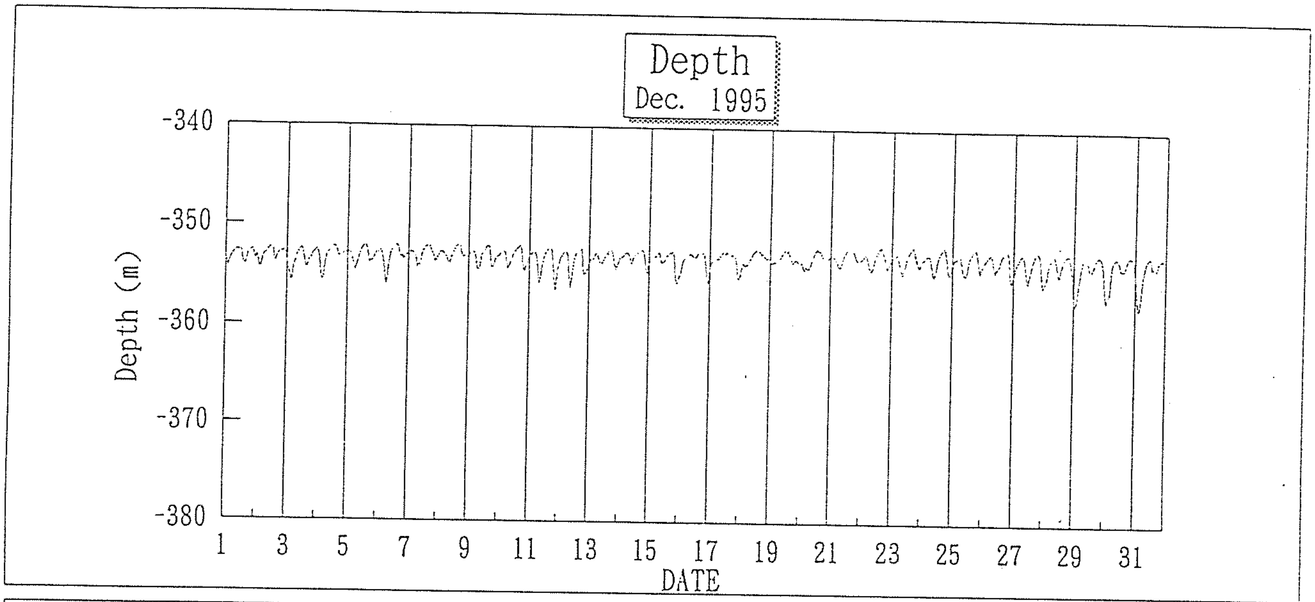
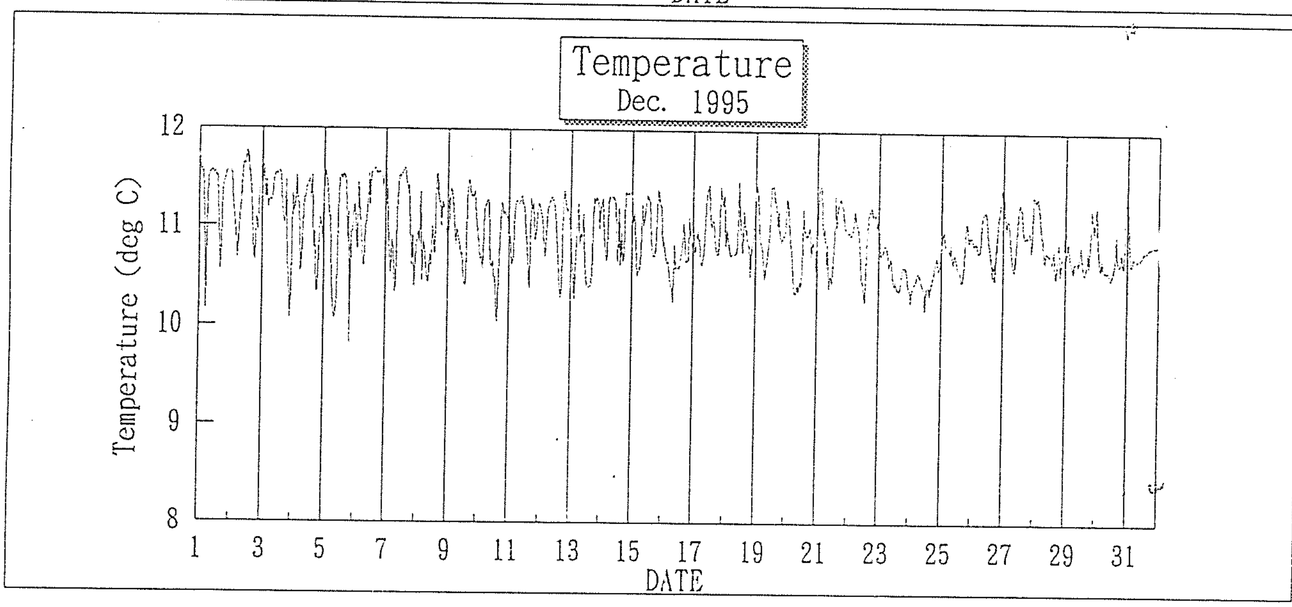


Fig. 7-26 Time Series of Depth, Temperature, Salinity





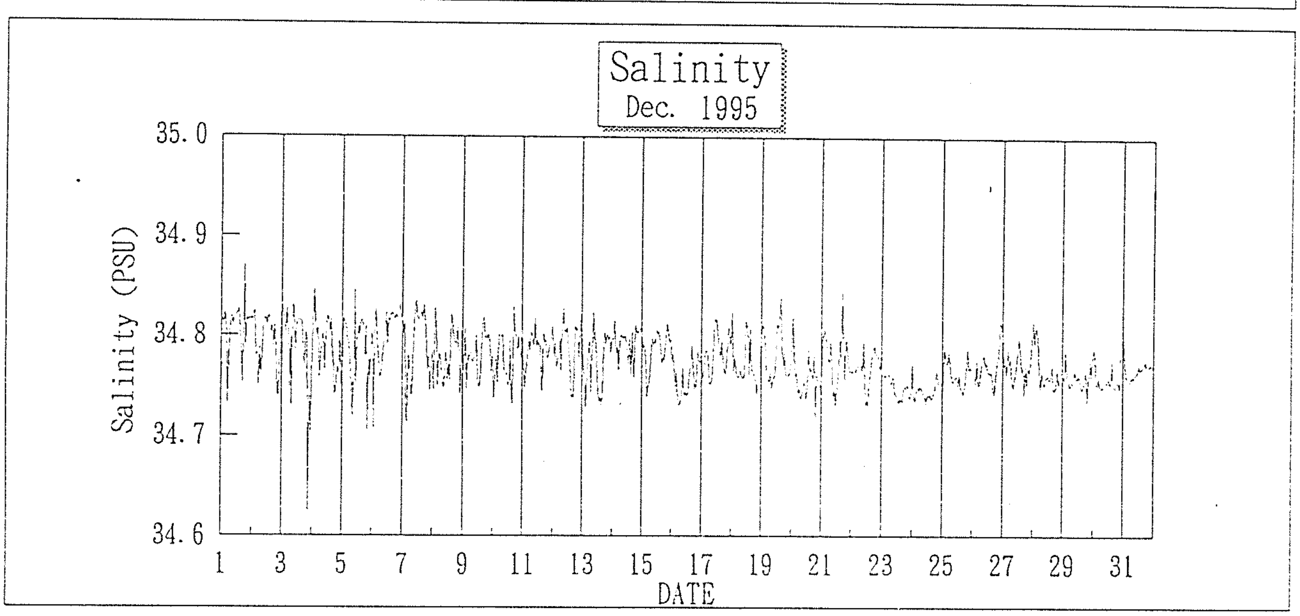
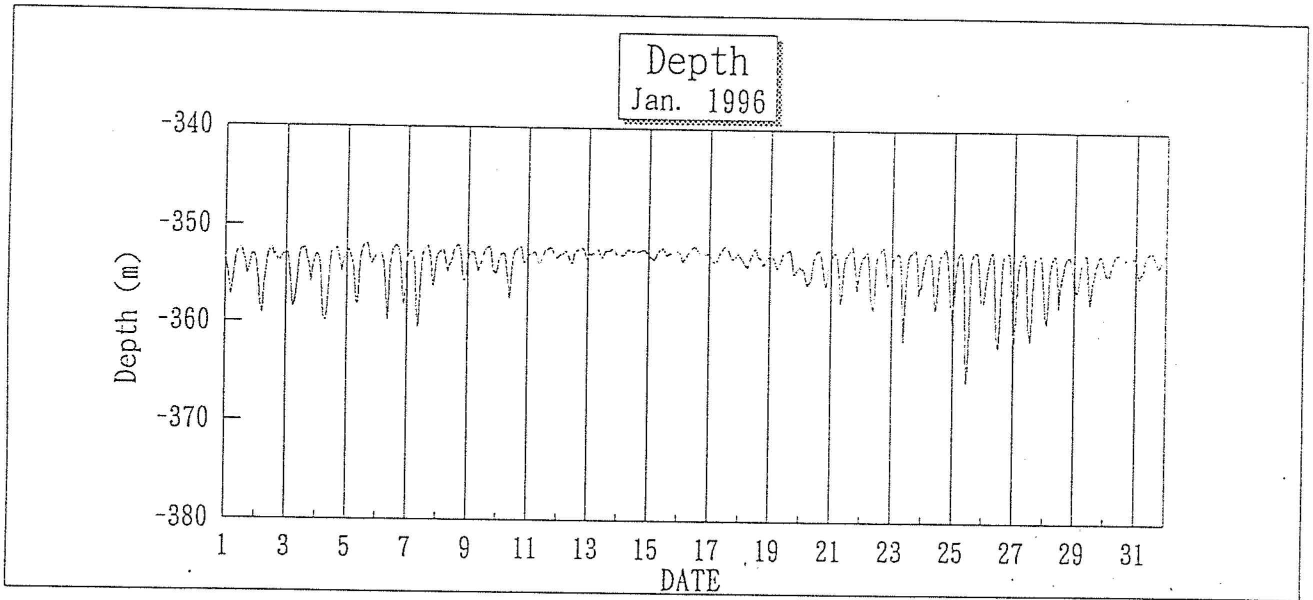
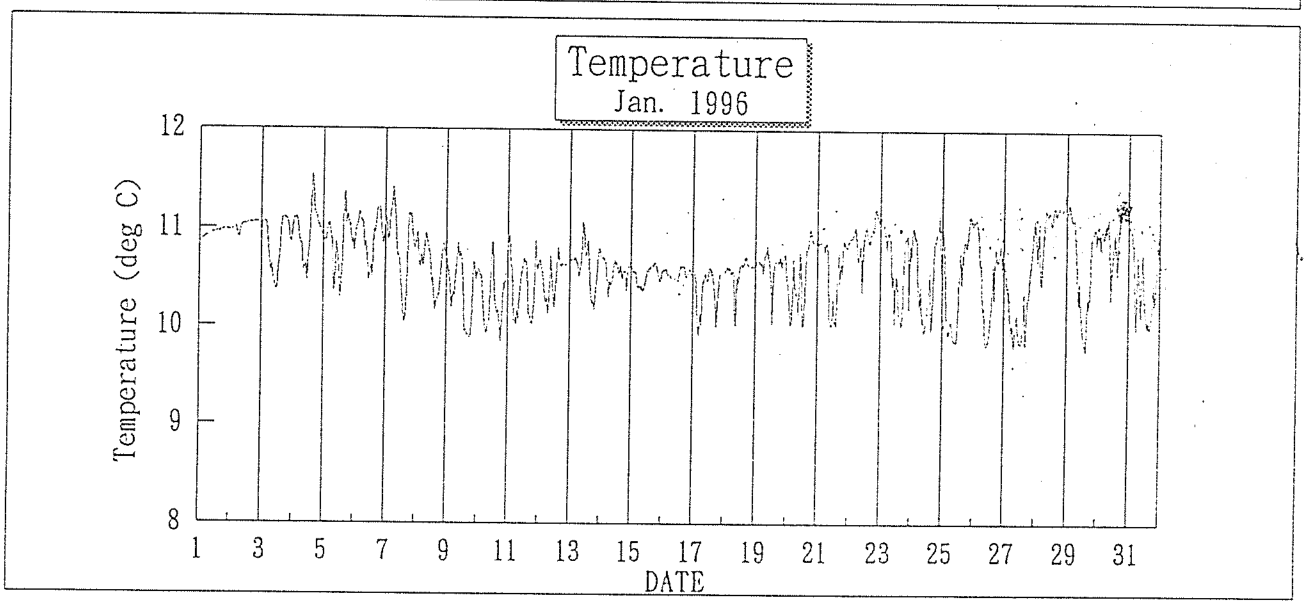


Fig 7-27 Time Series of Depth, Temperature, Salinity





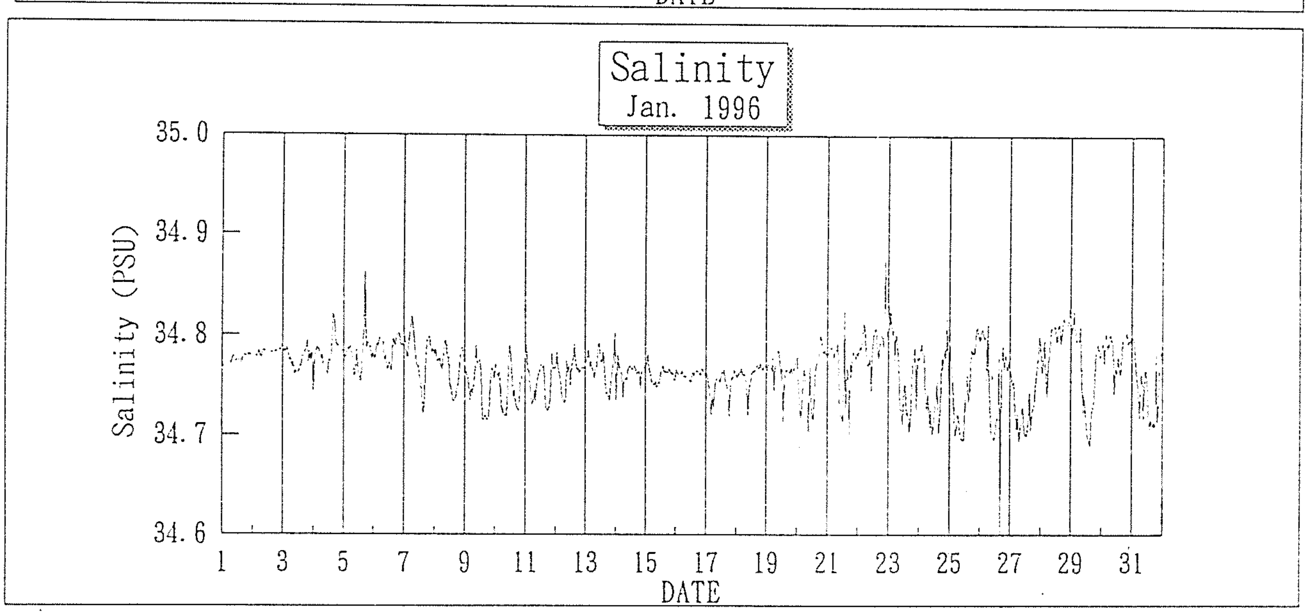
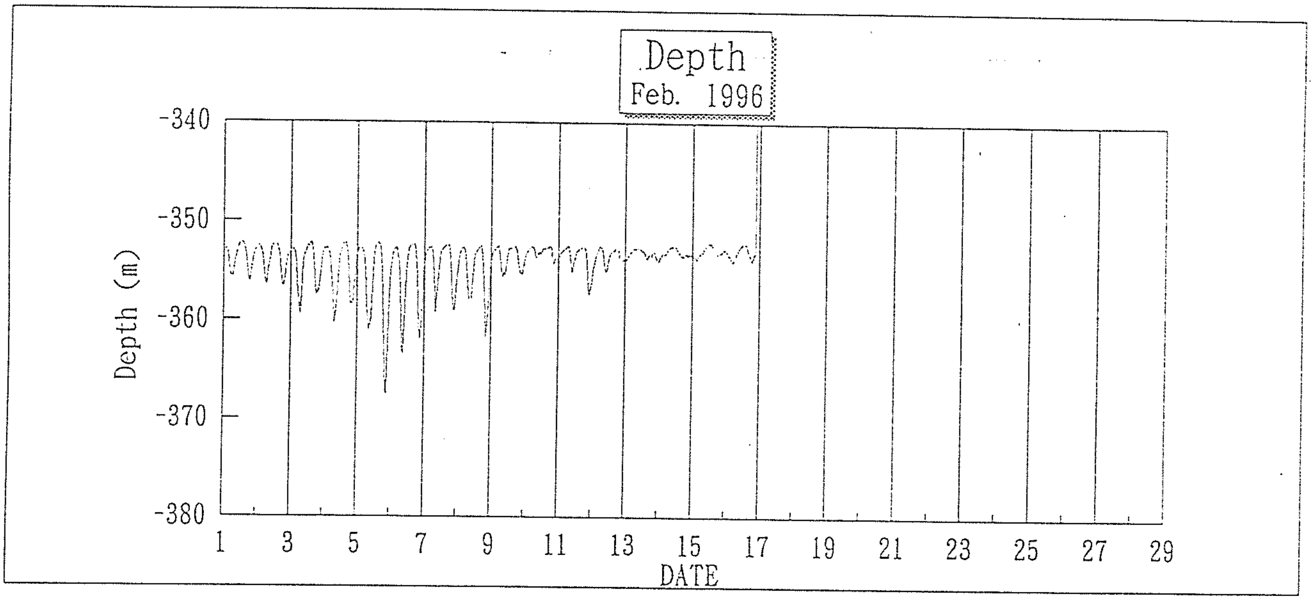
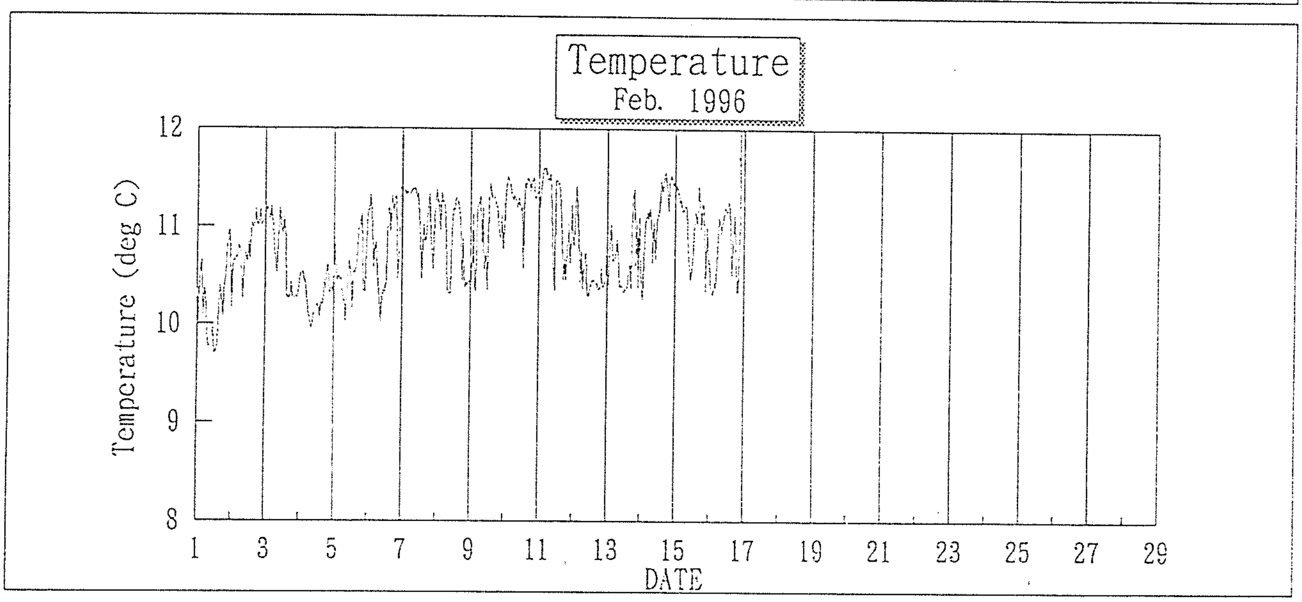


Fig 7-28 Time Series of Depth, Temperature, Salinity





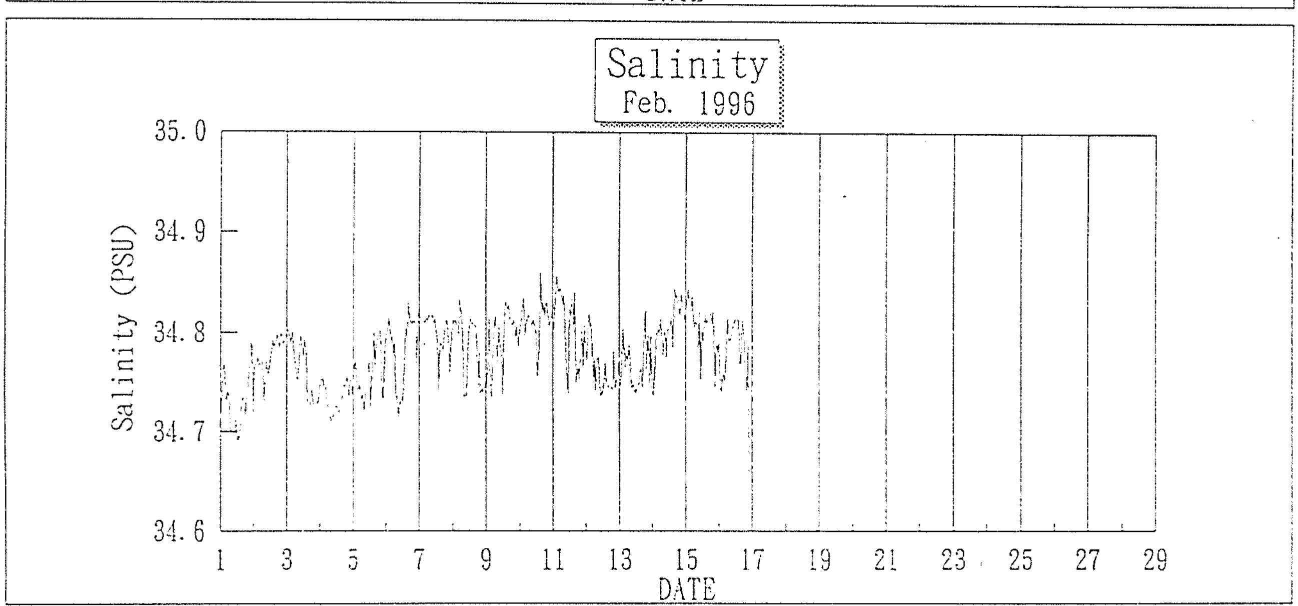
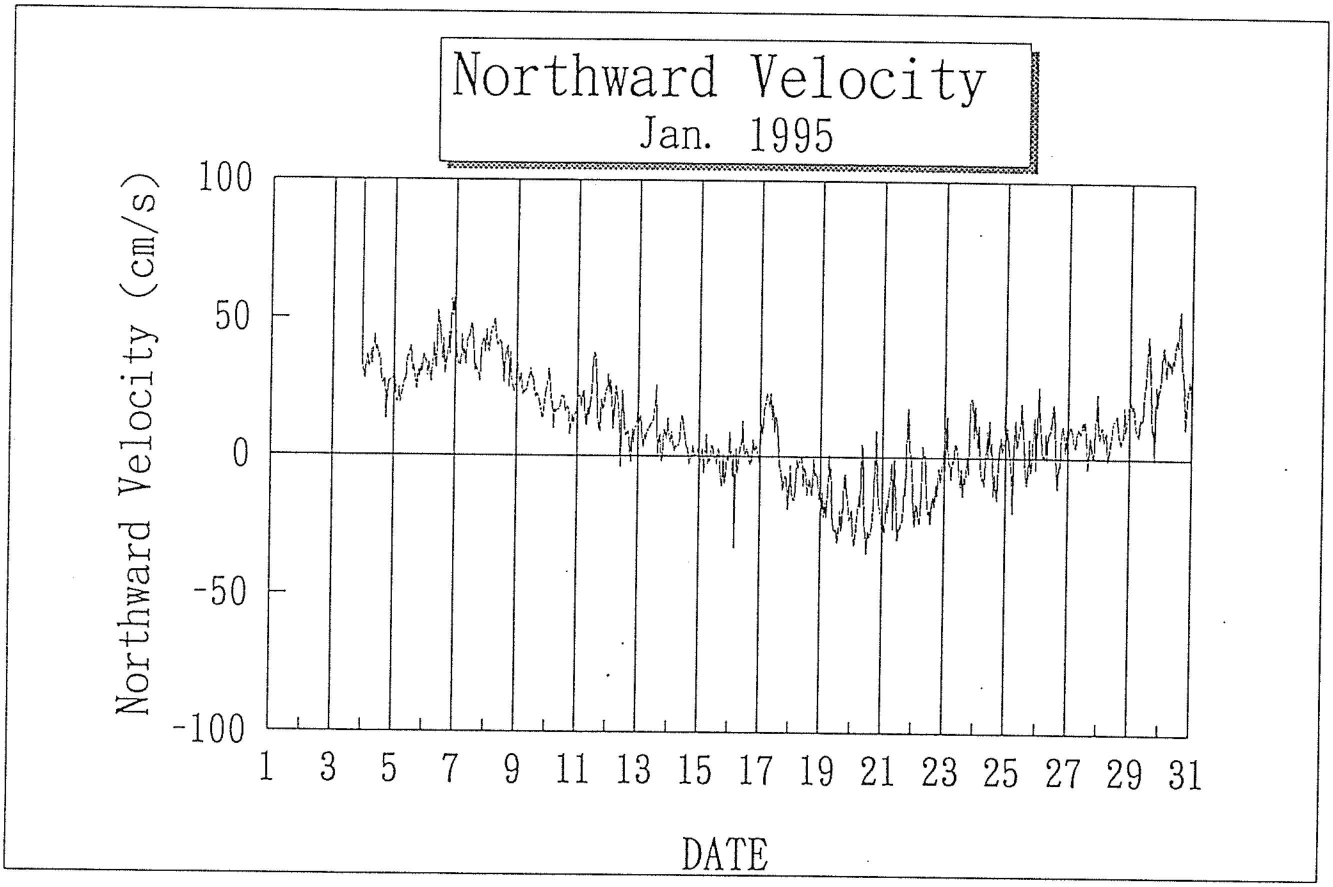


Fig. 7-29 Time Series of Depth, Temperature, Salinity



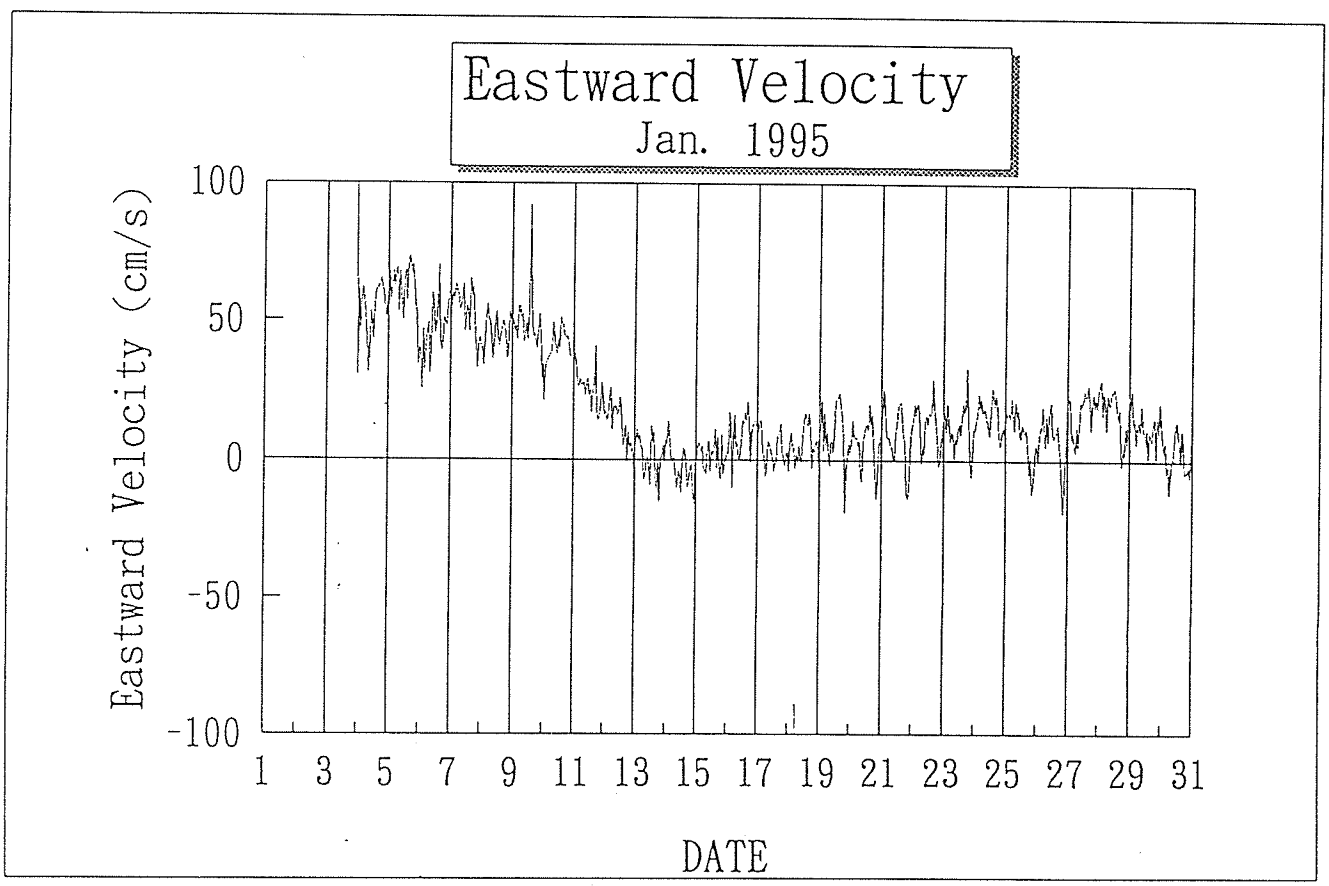
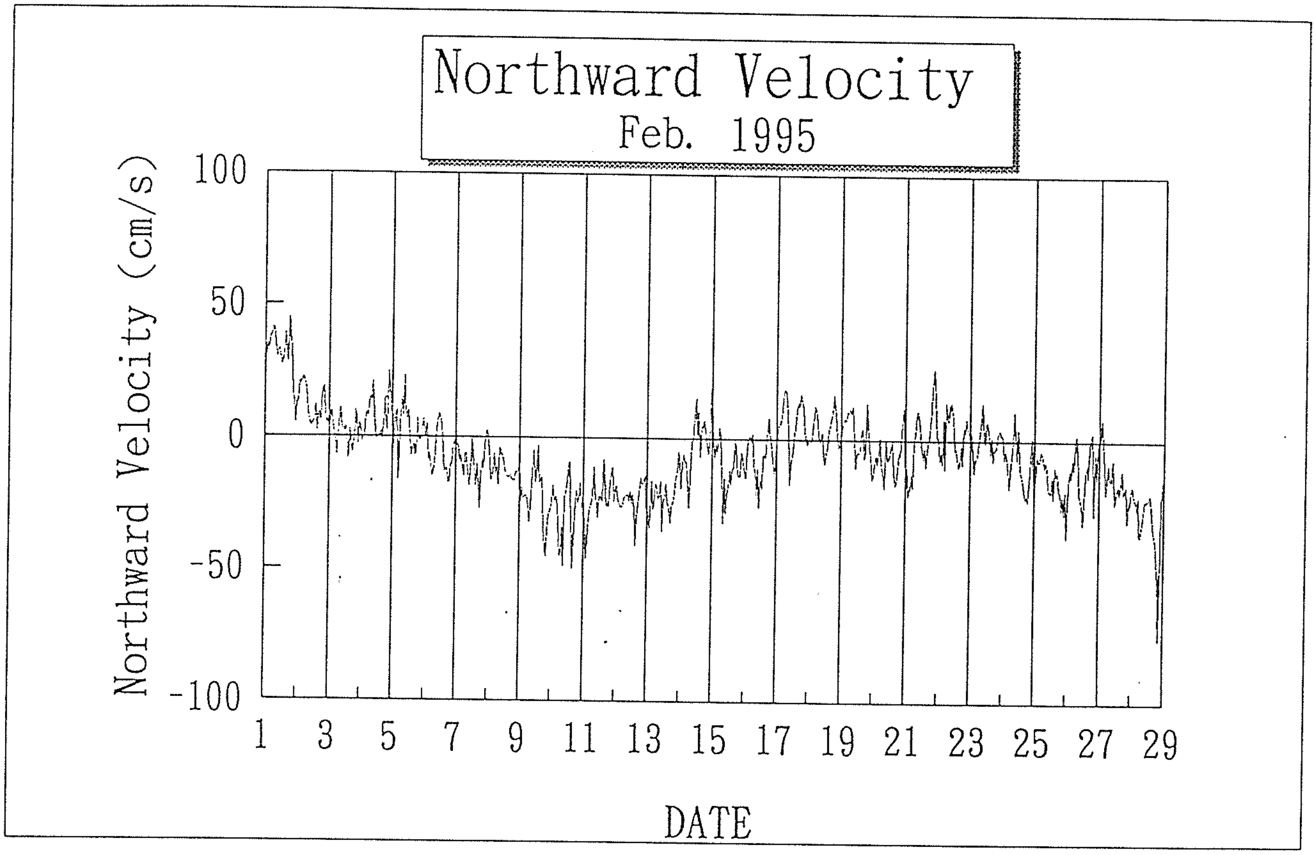


Fig 7-30 Time Serise of Velocity



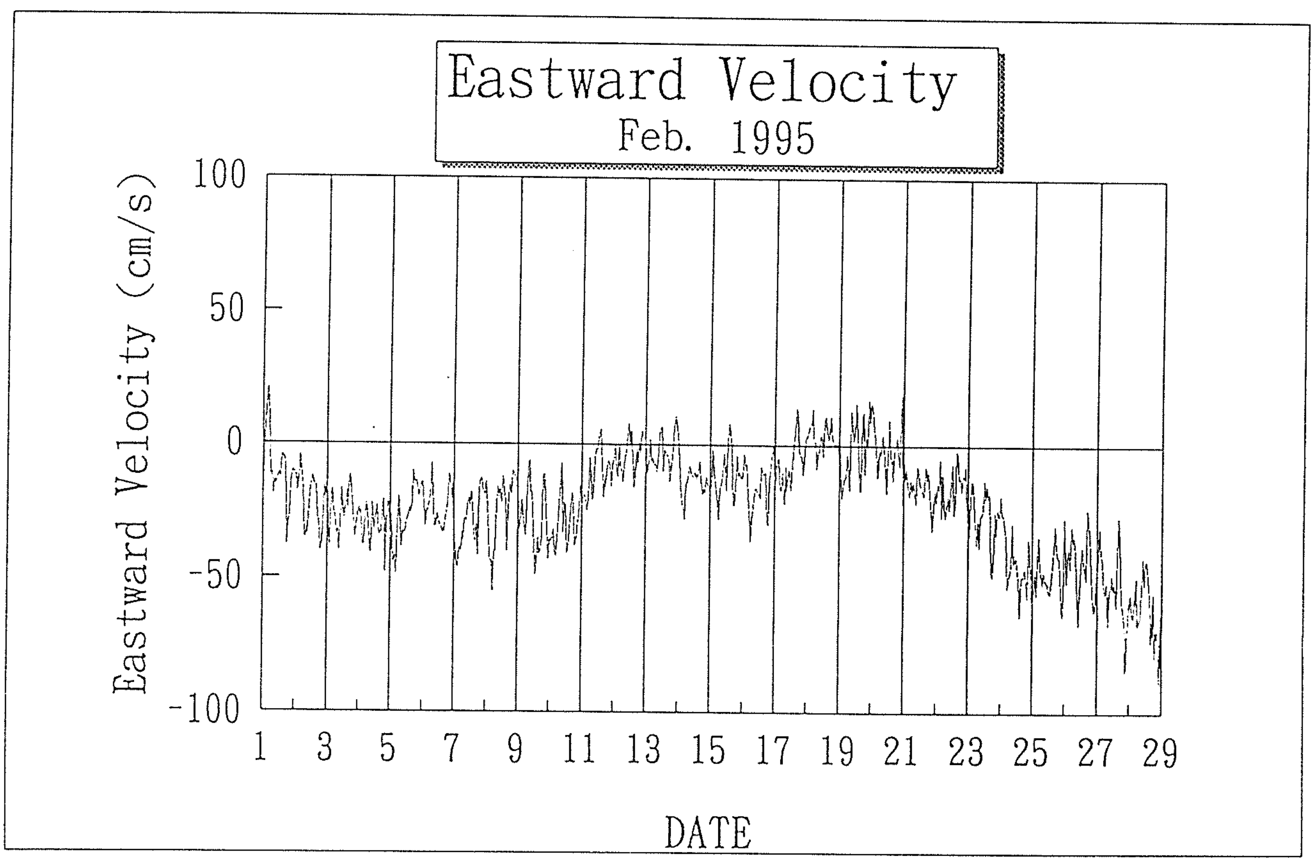
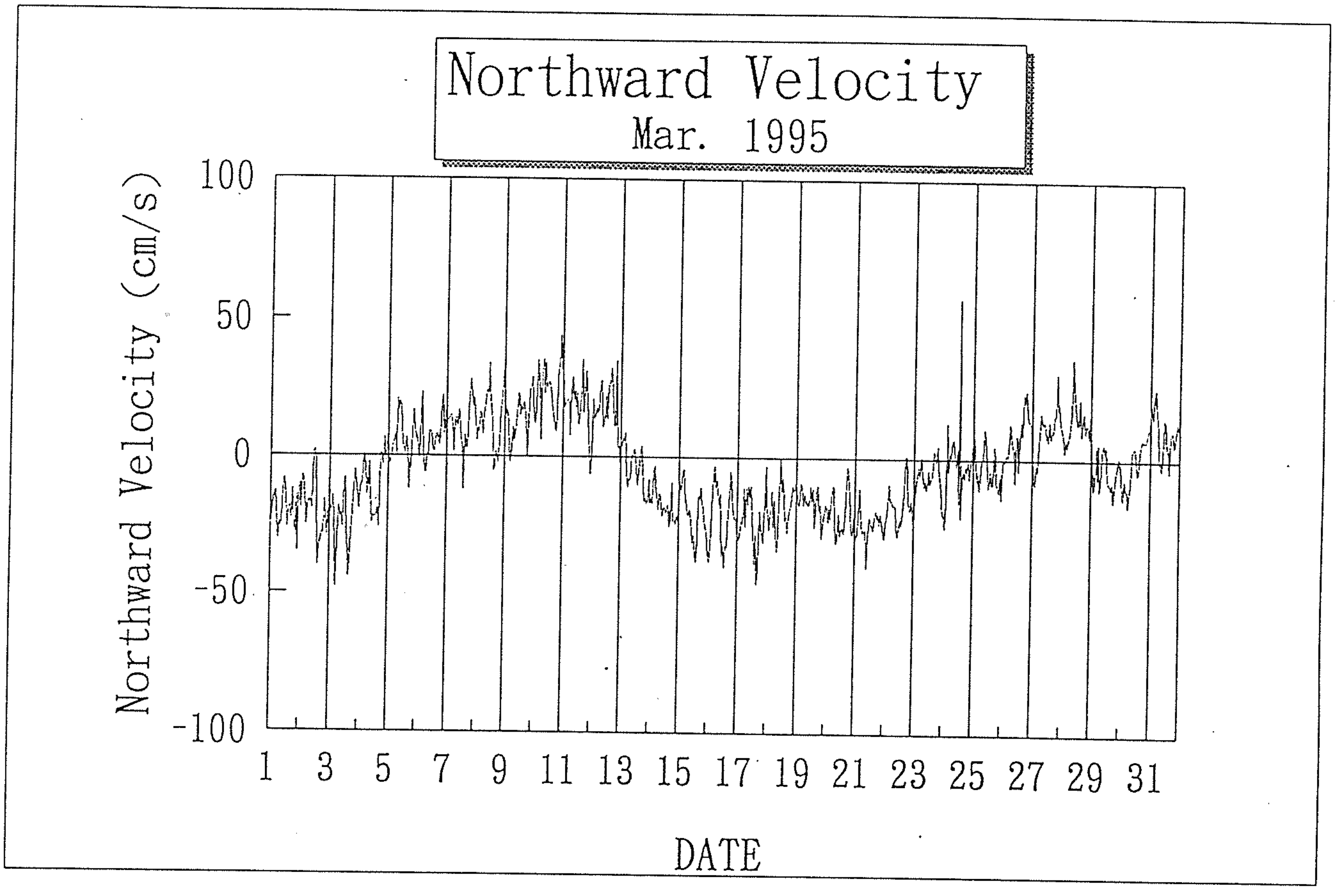


Fig 7-31 Time Serise of Velocity



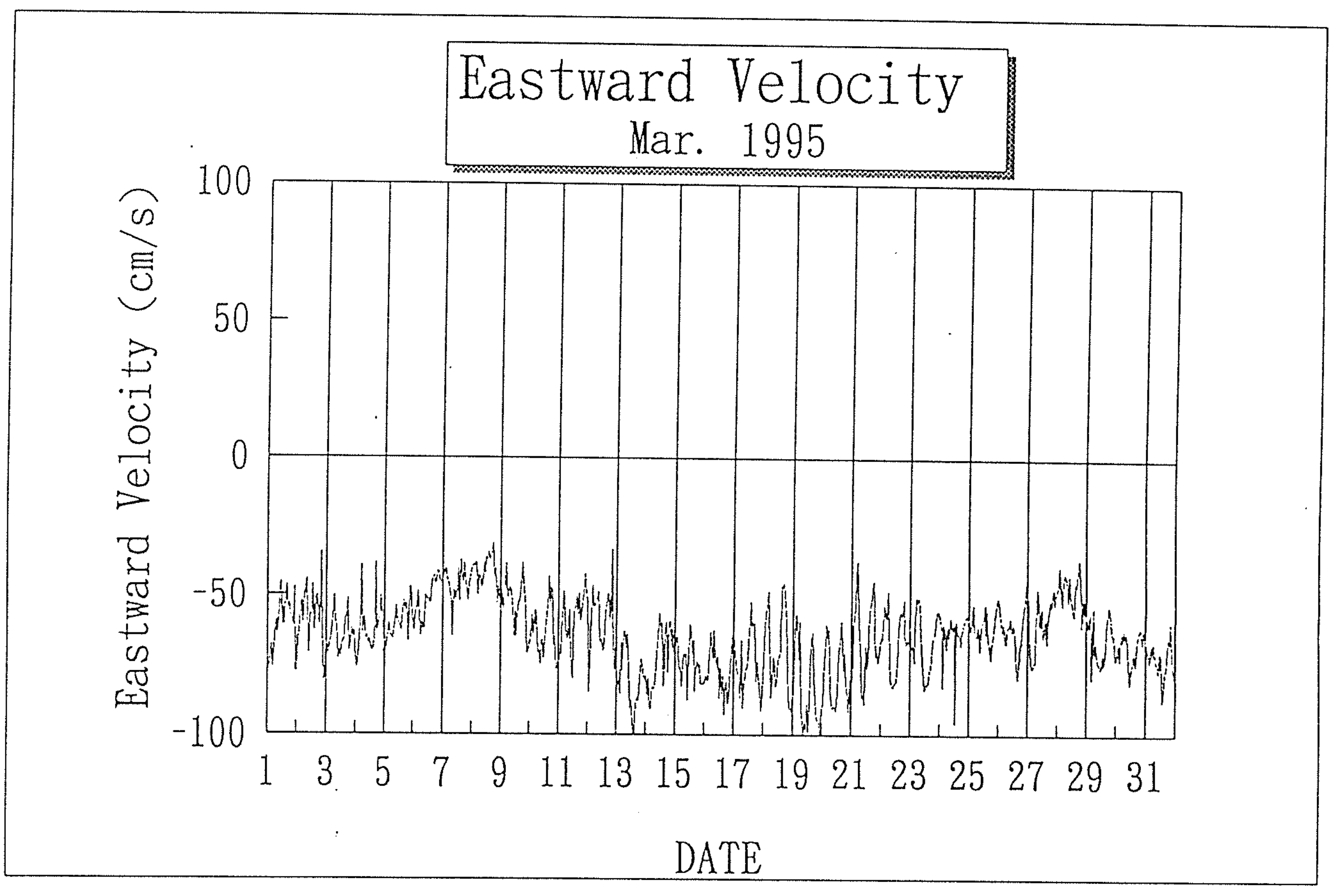
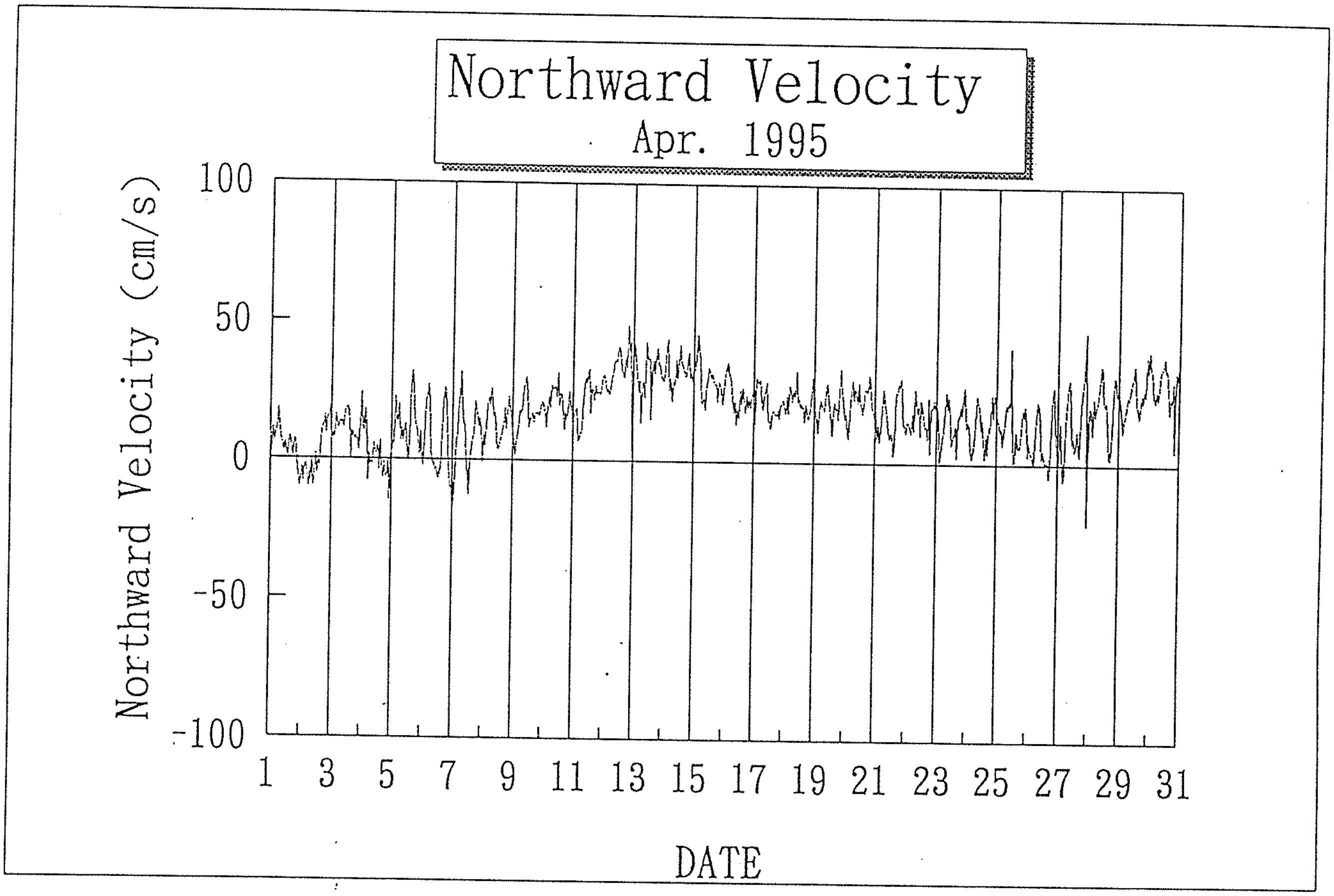
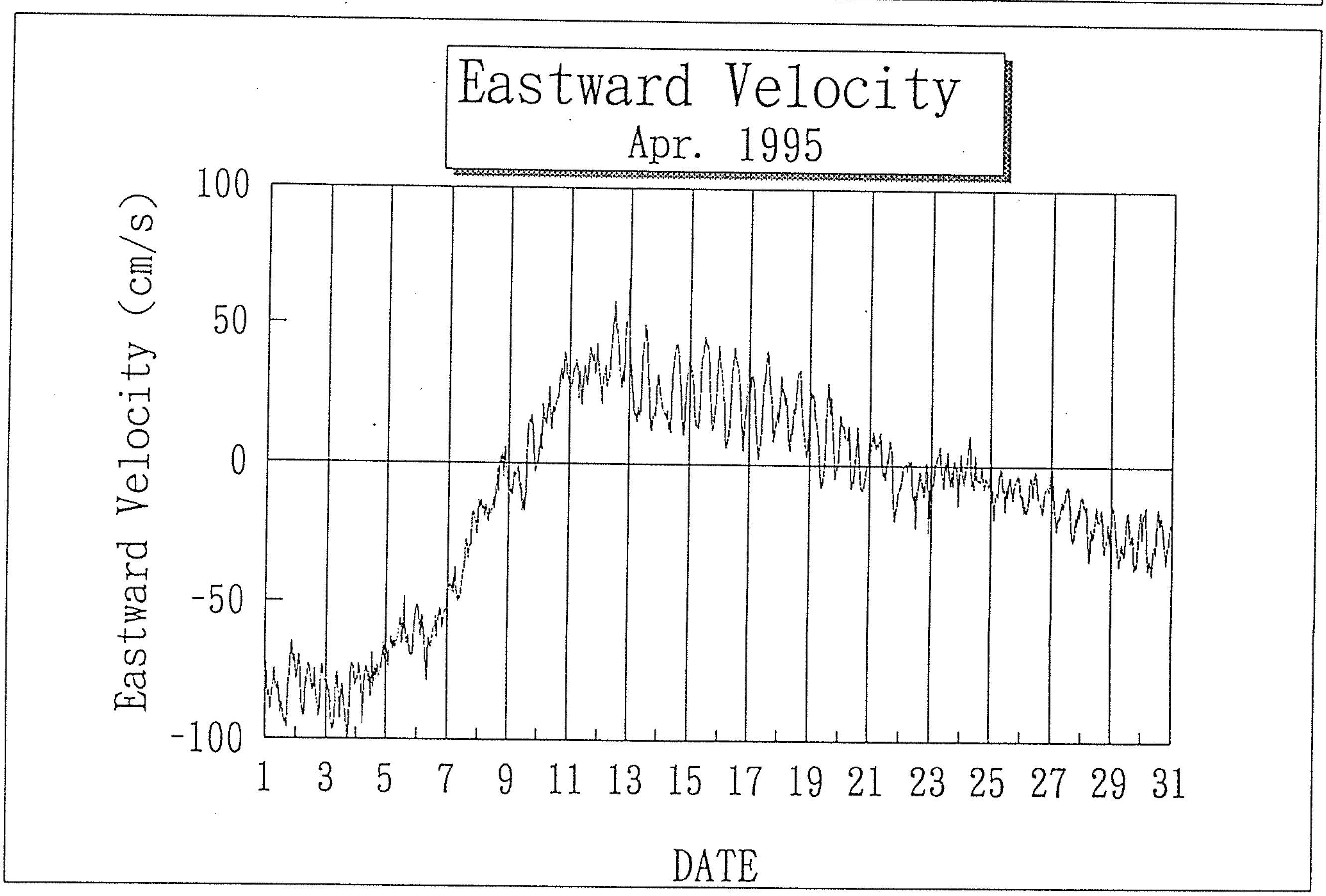


Fig 7-32 Time Serise of Velocity





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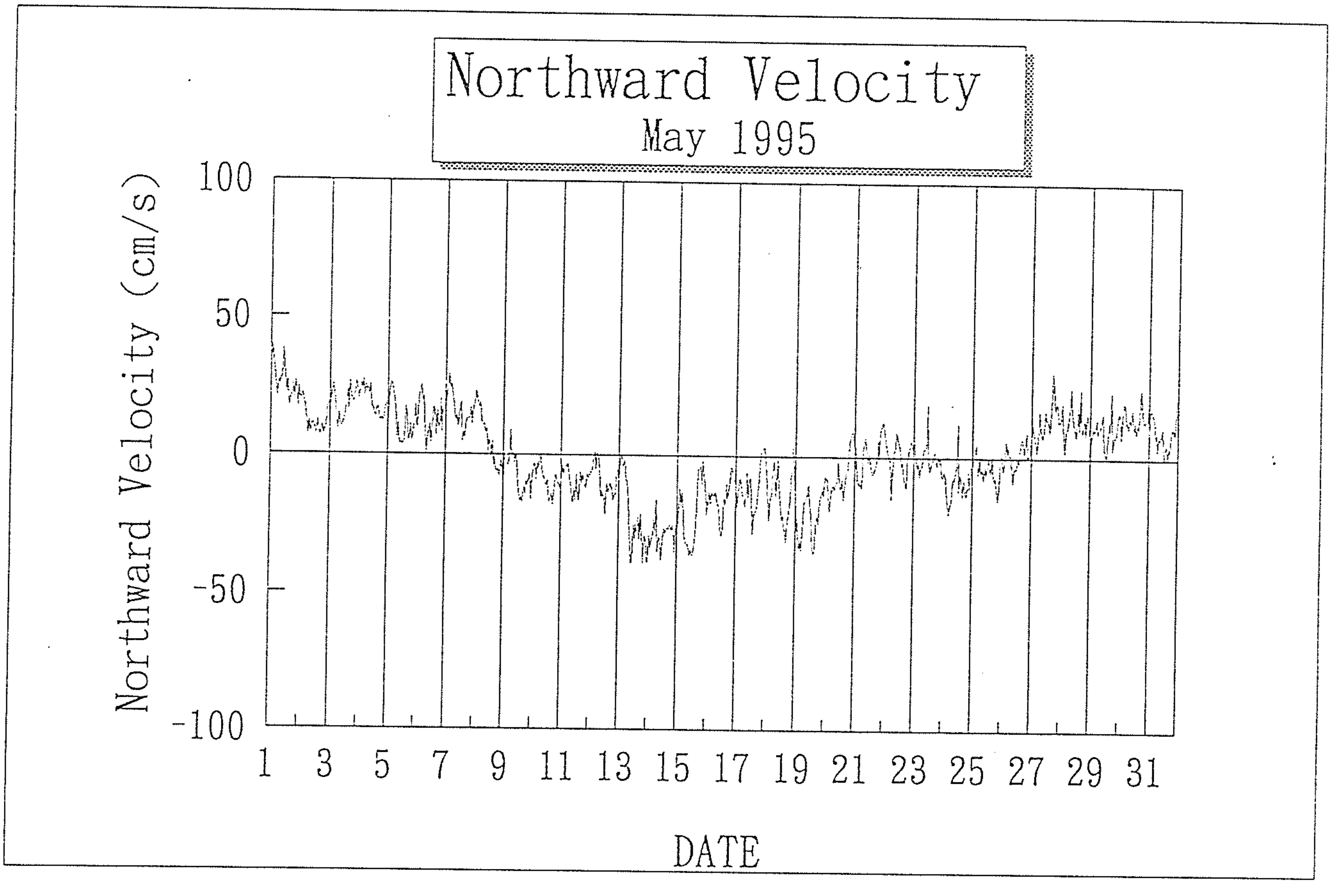


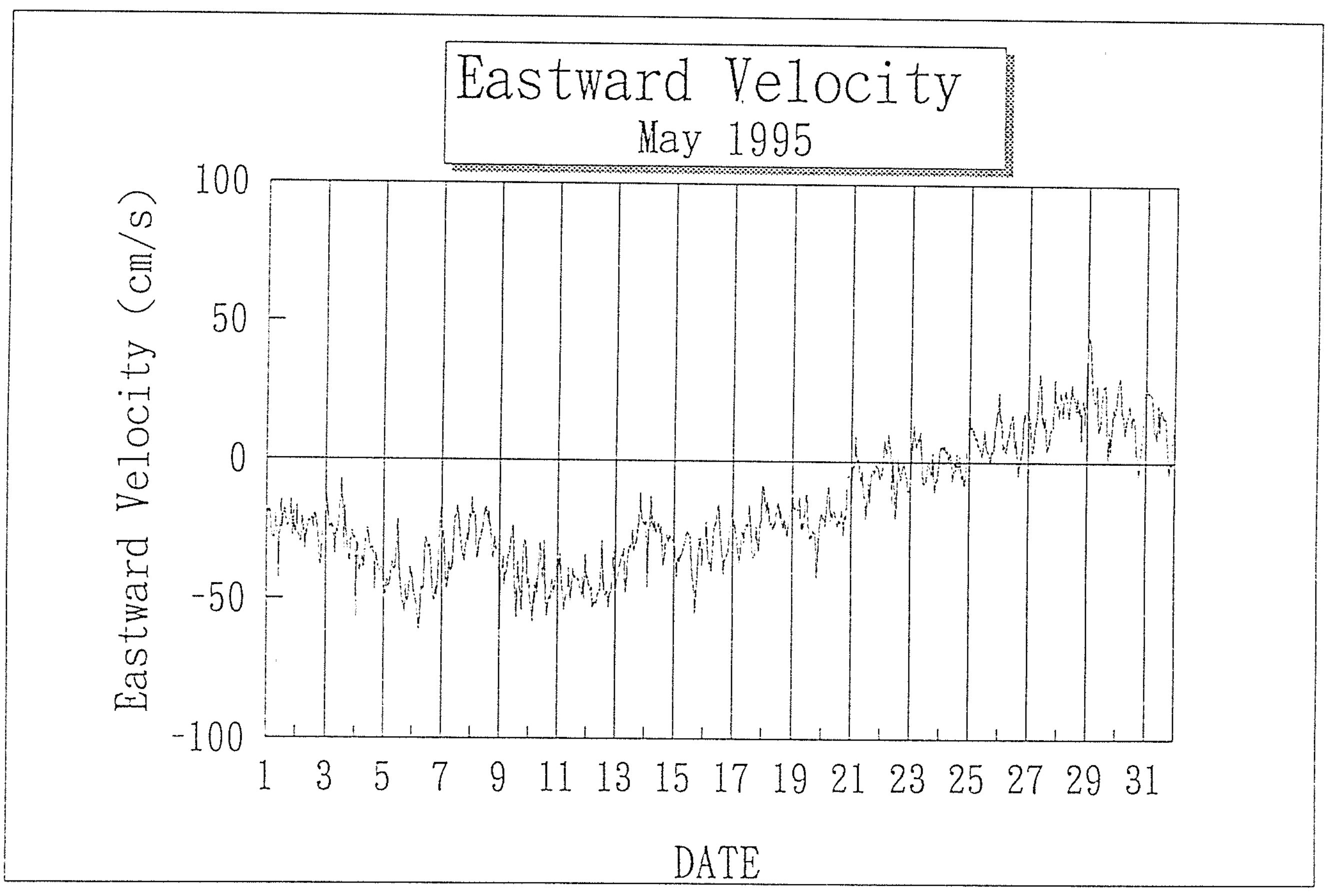
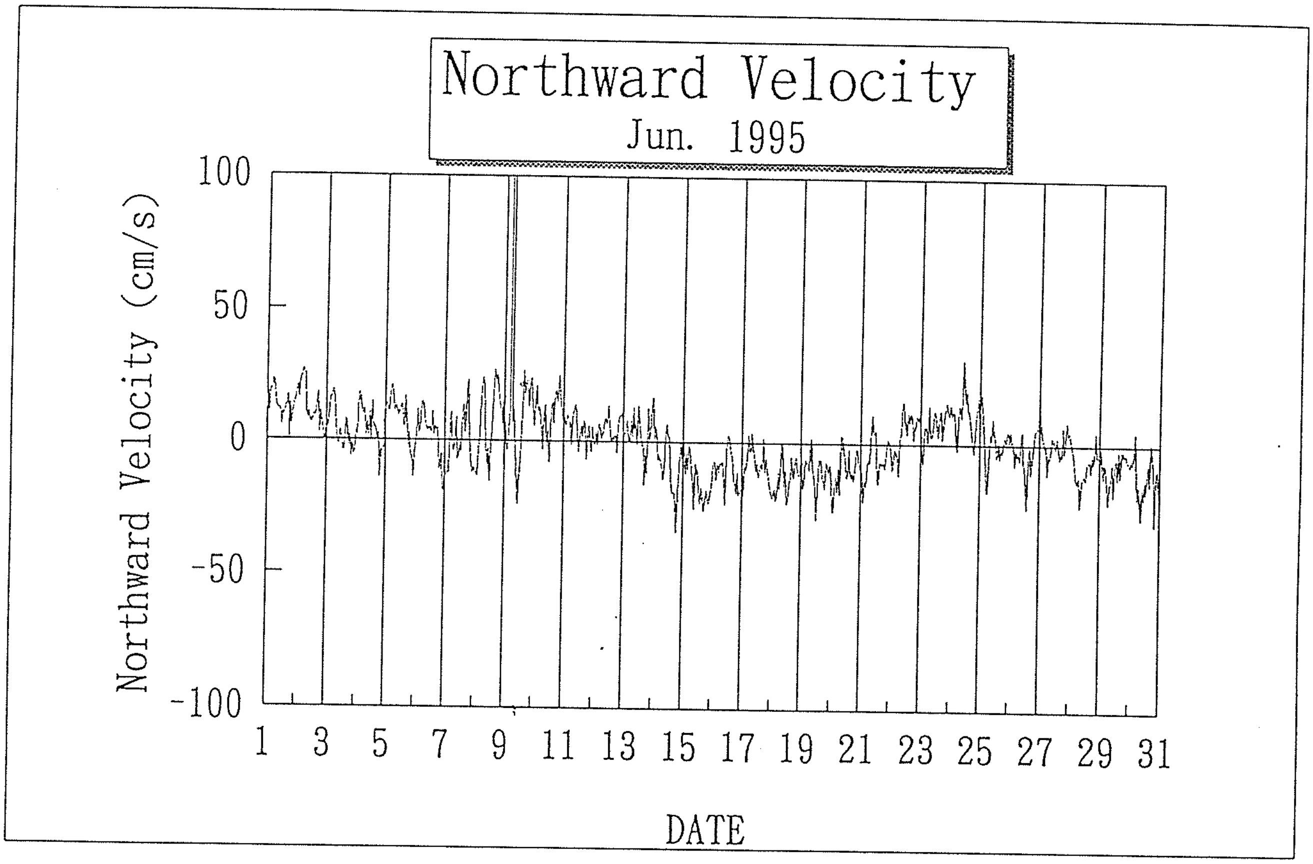


Fig 7-34 Time Serise of Velocity



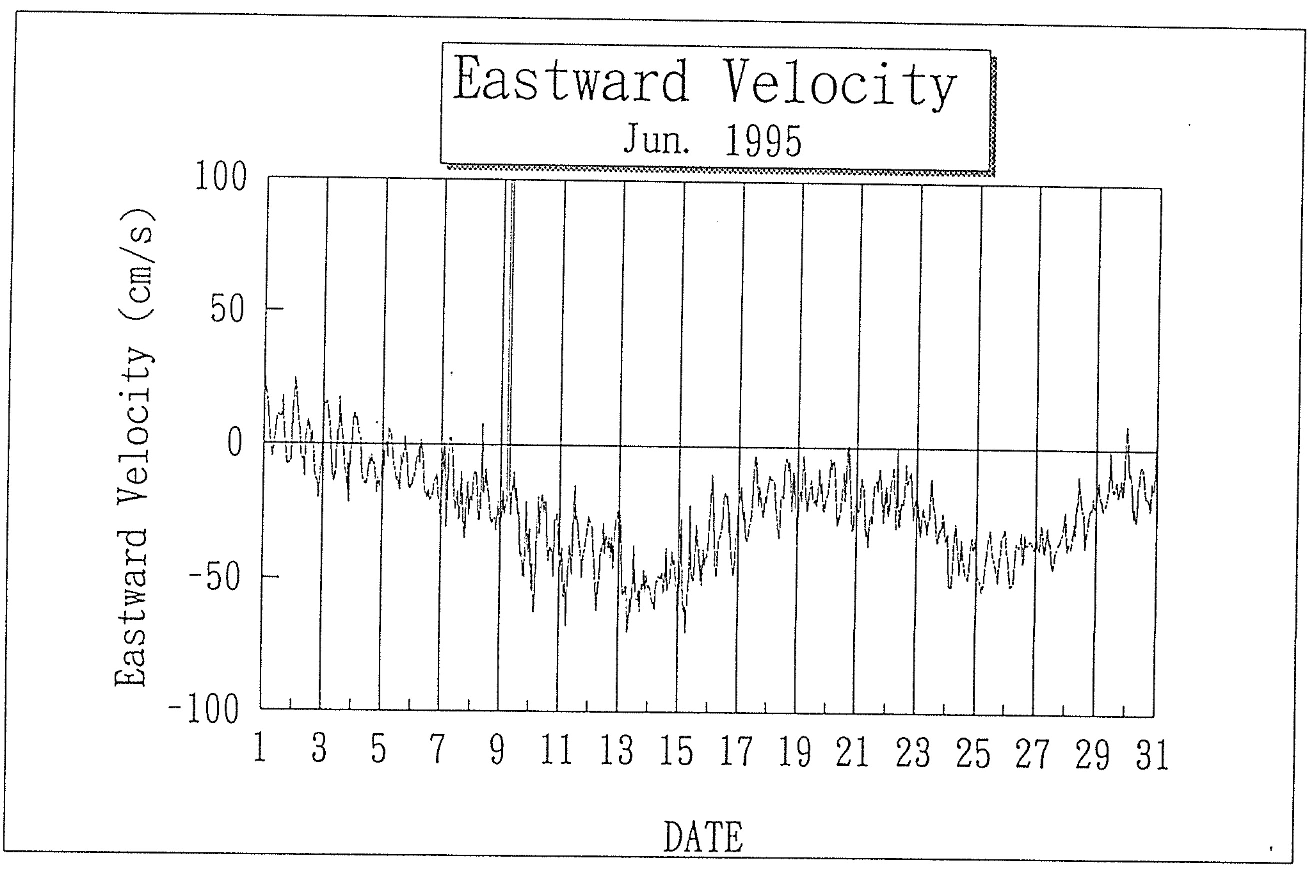
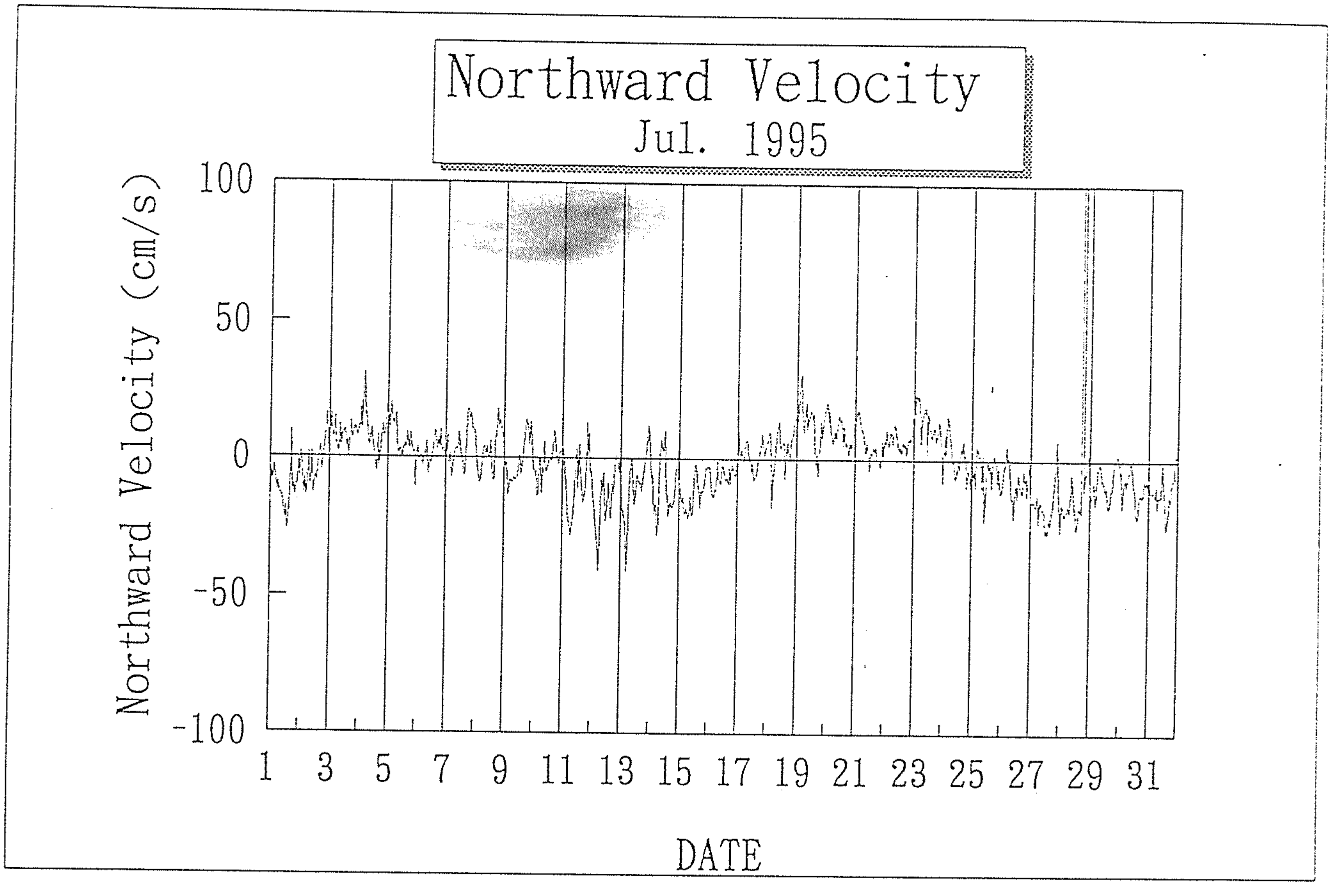


Fig 7-35 Time Serise of Velocity



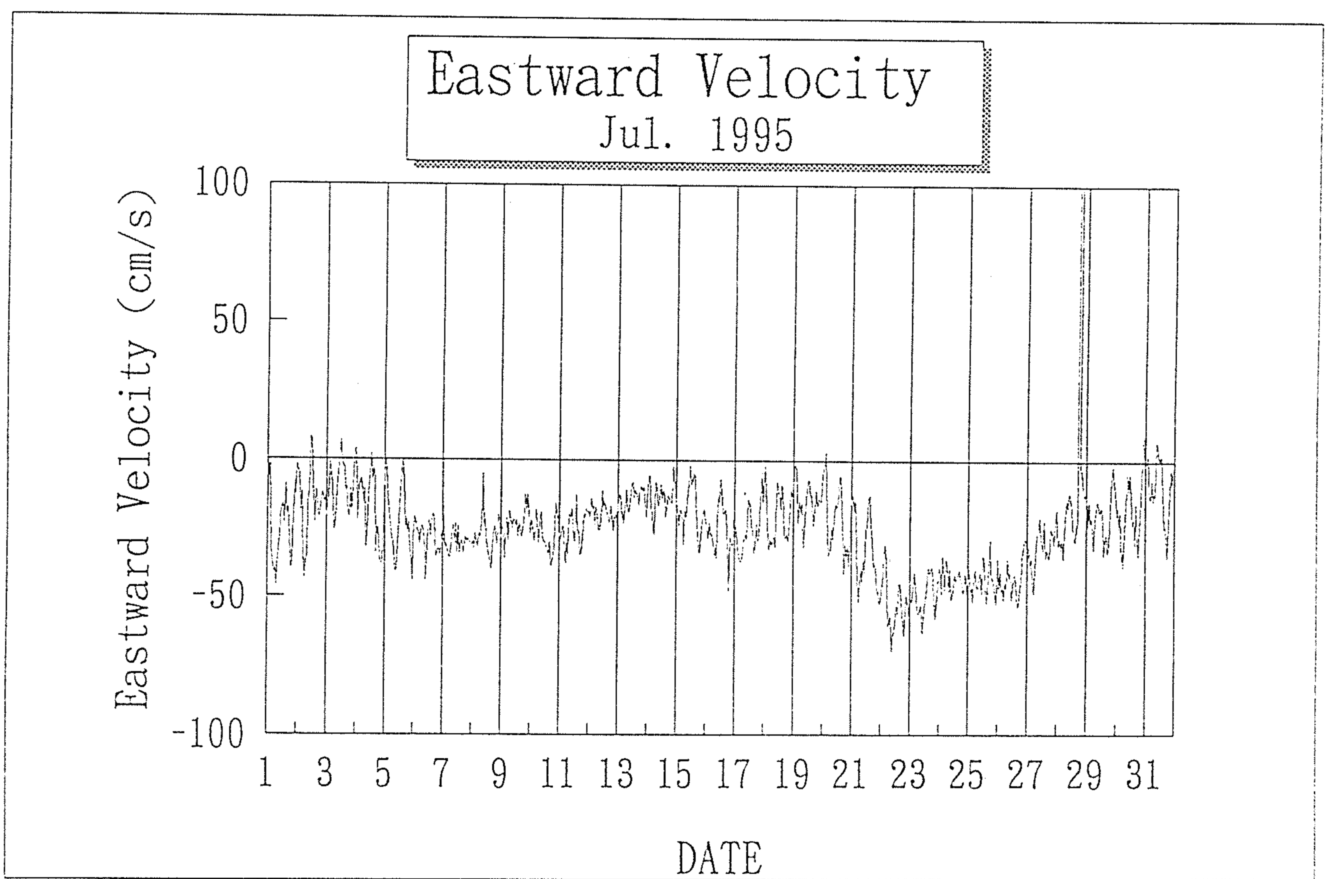
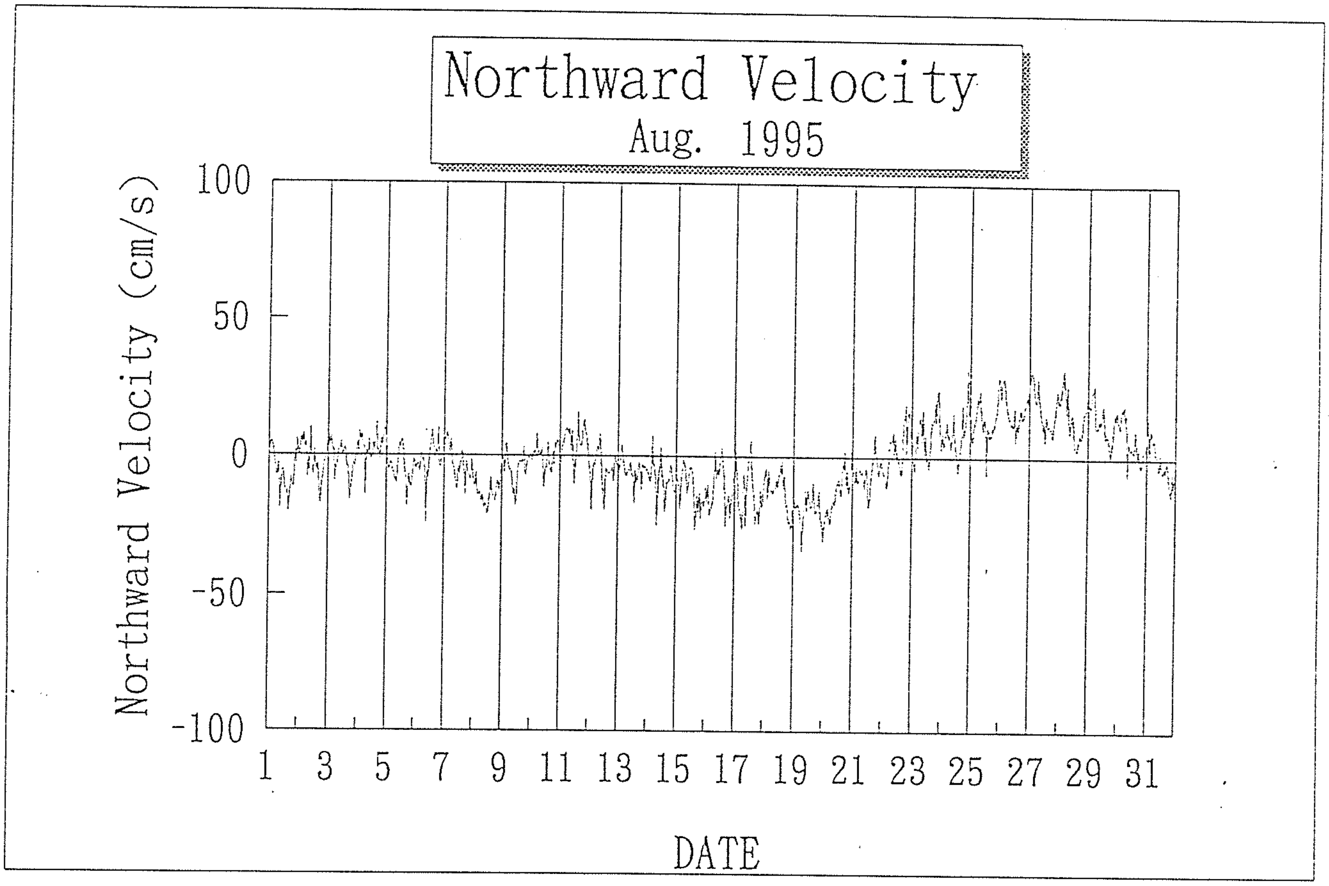


Fig 7-36 Time Serise of Velocity



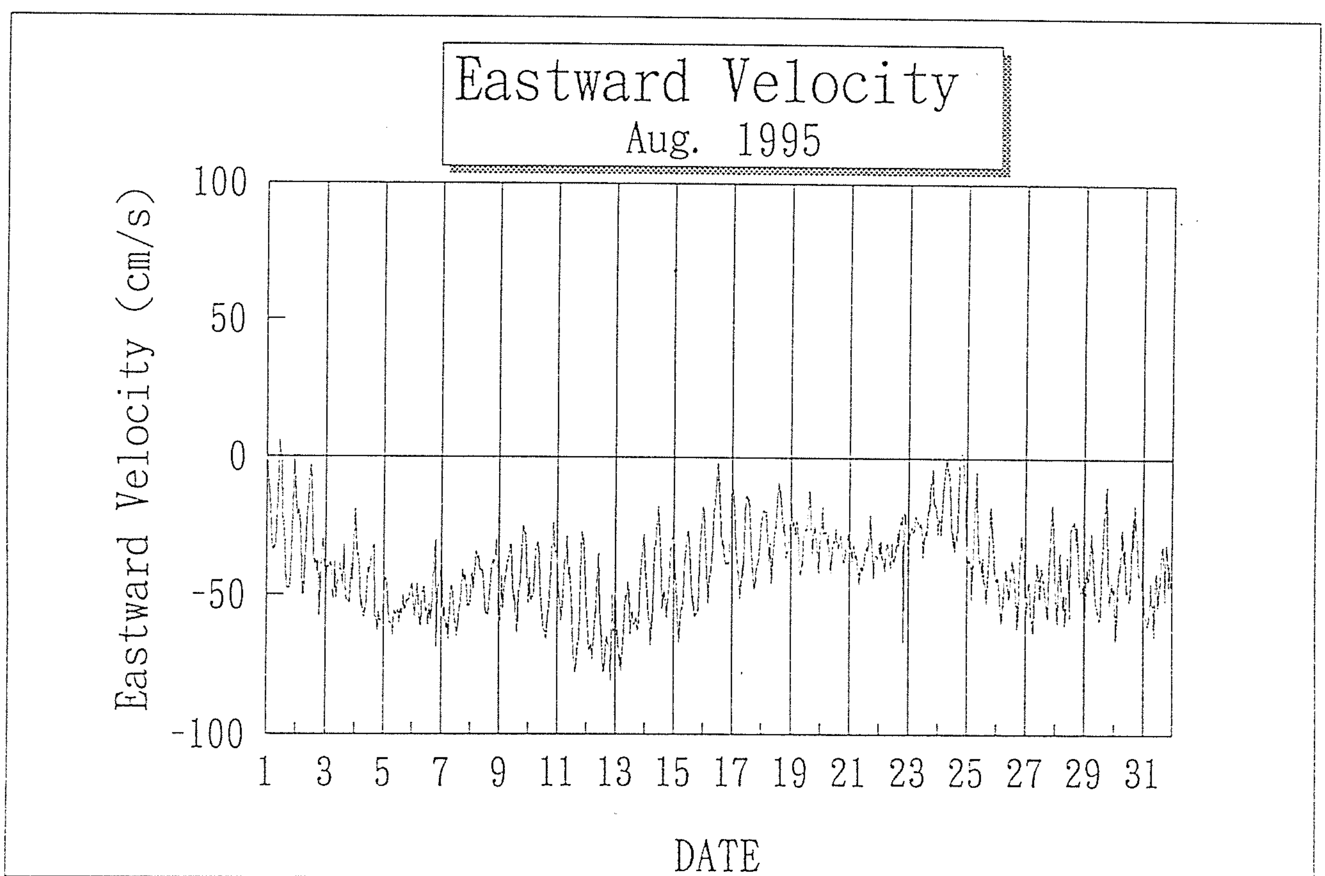
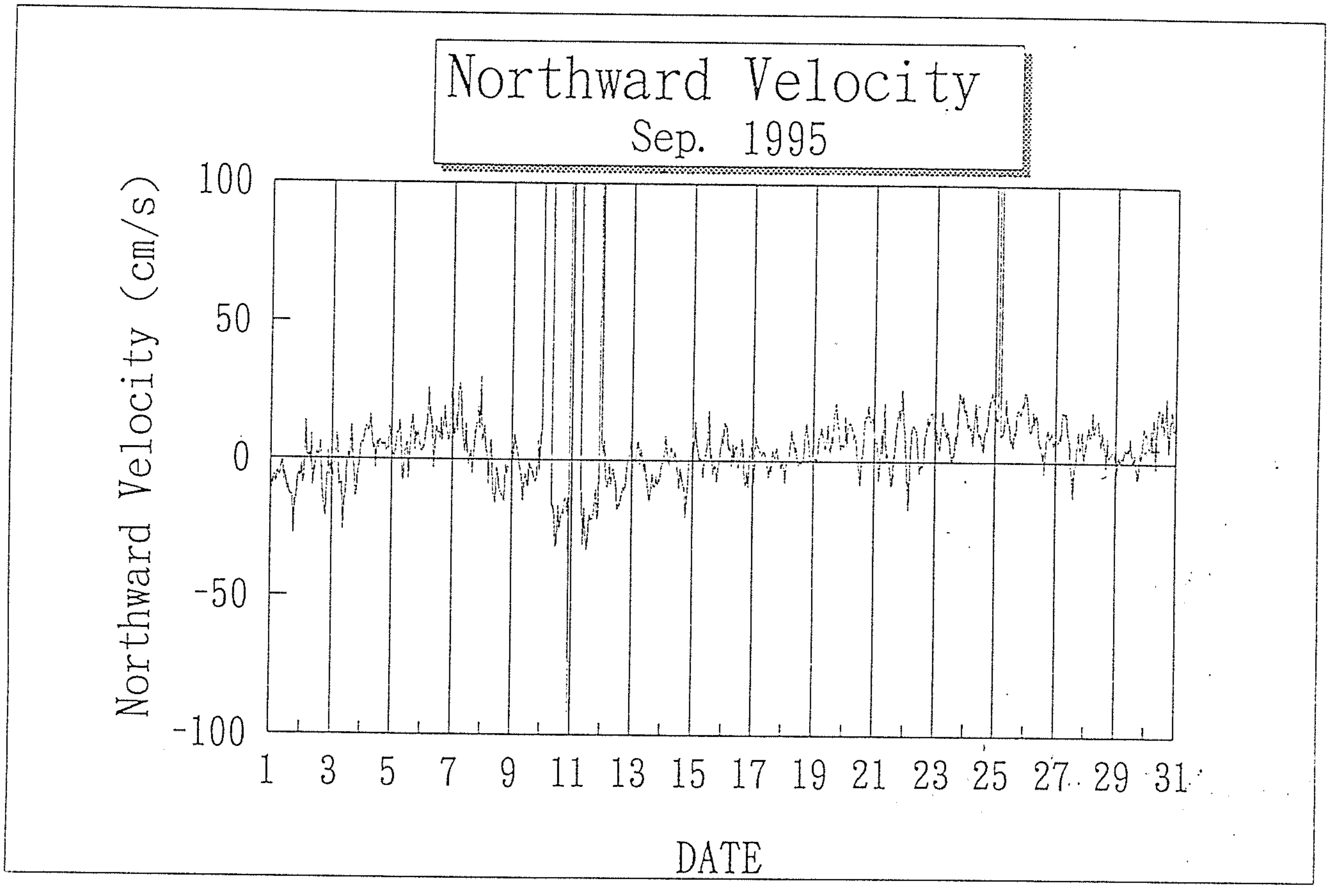


Fig 7-37 Time Serise of Velocity



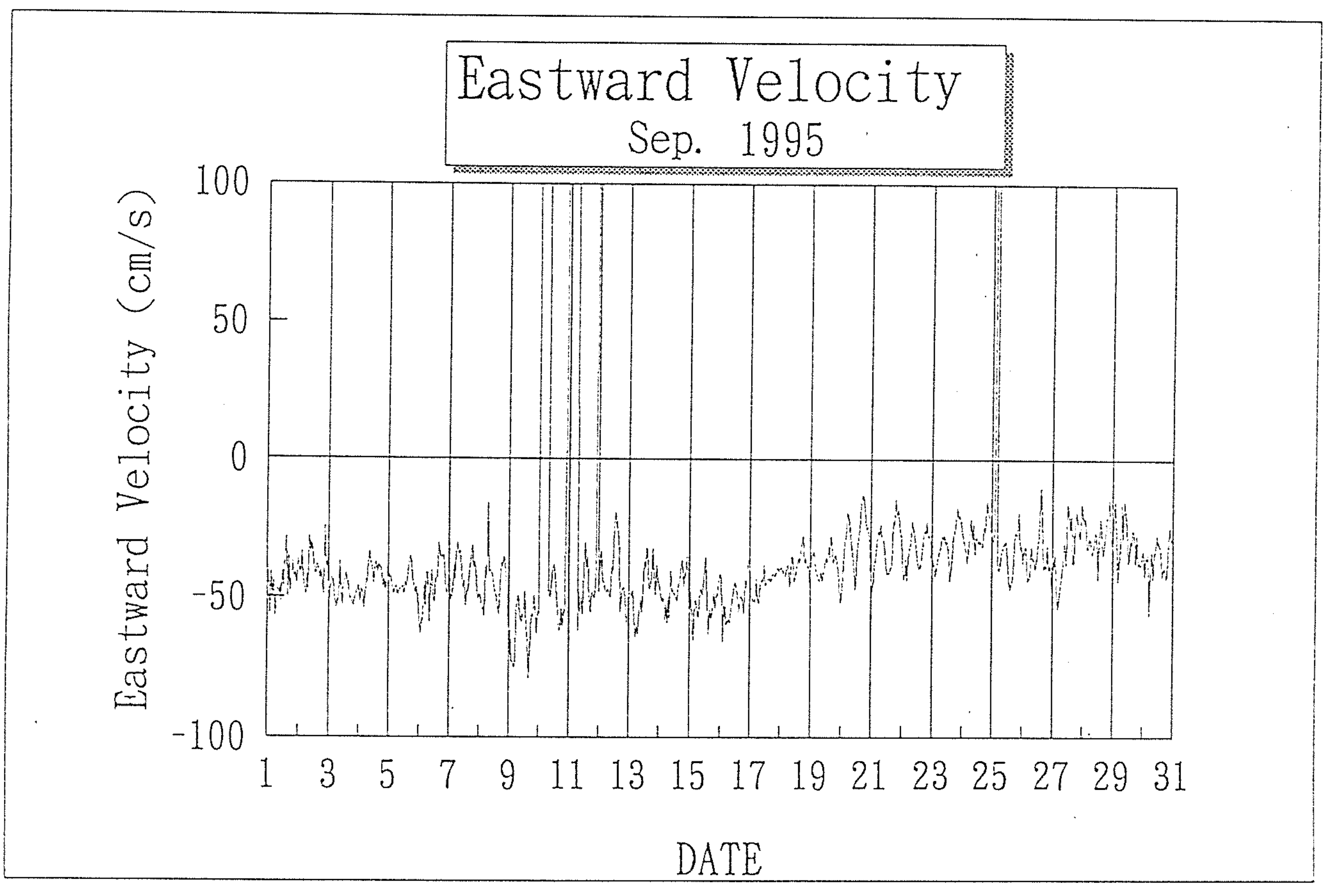
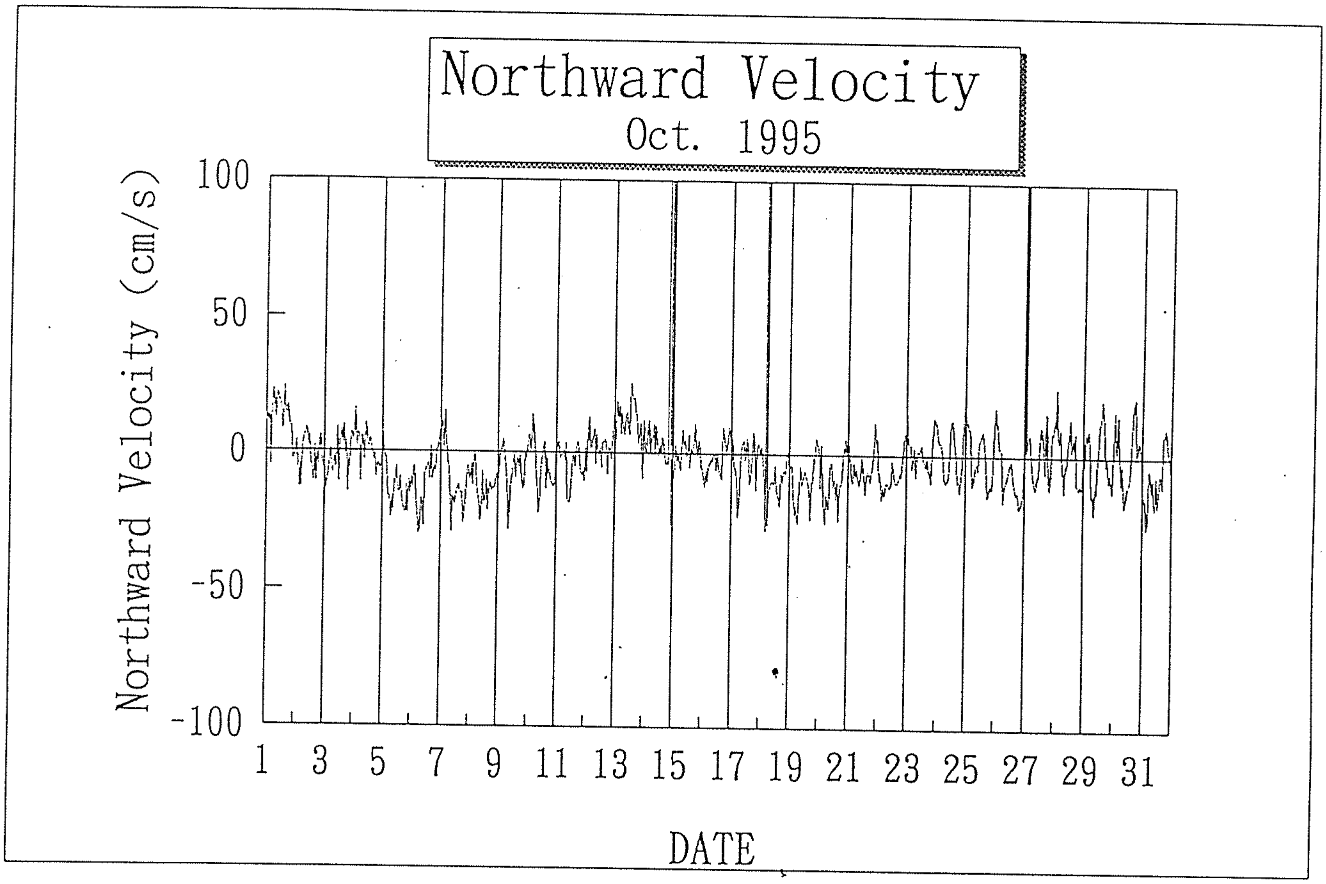


Fig 7-38 Time Serise of Velocity



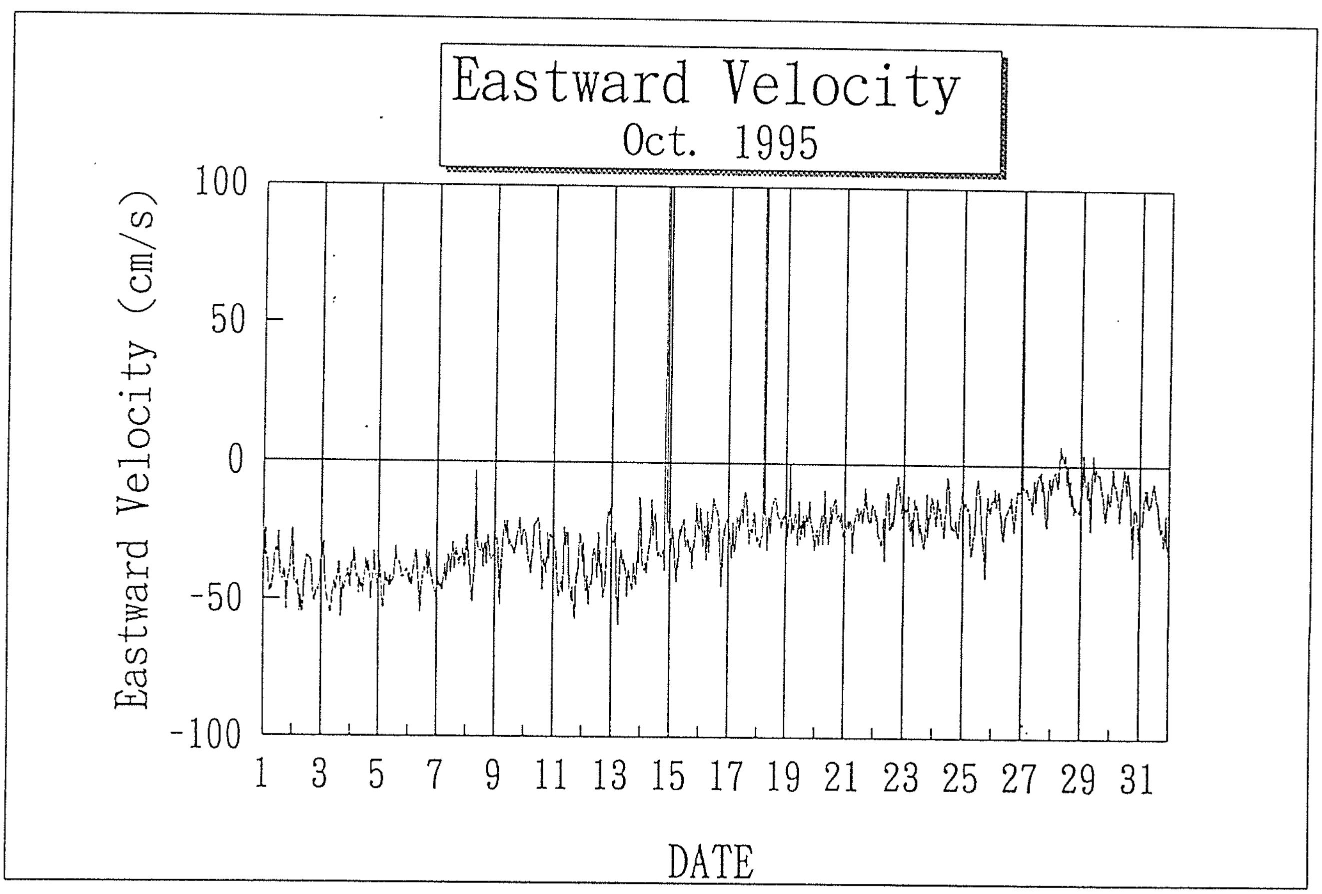
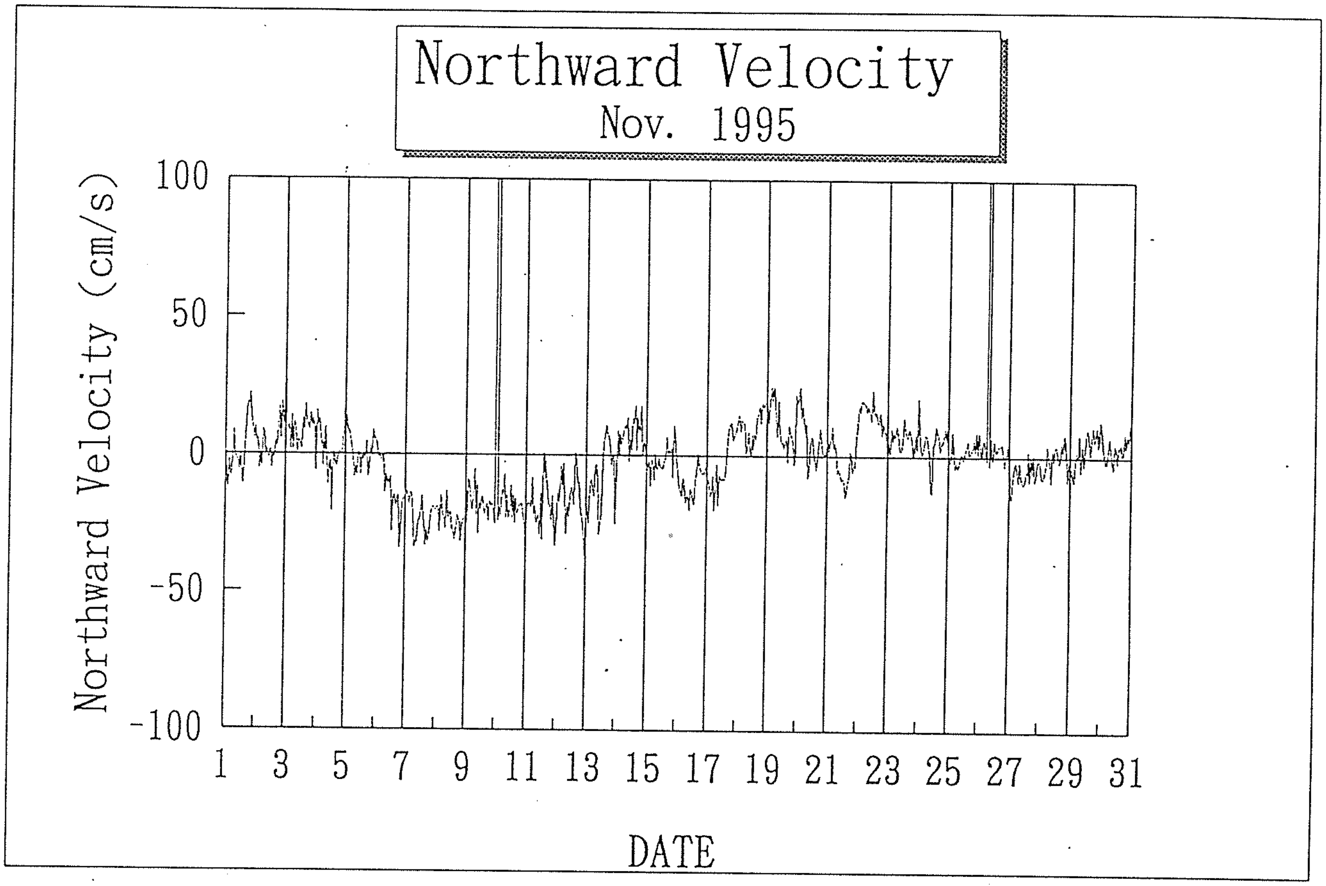


Fig 7-39 Time Serise of Velocity



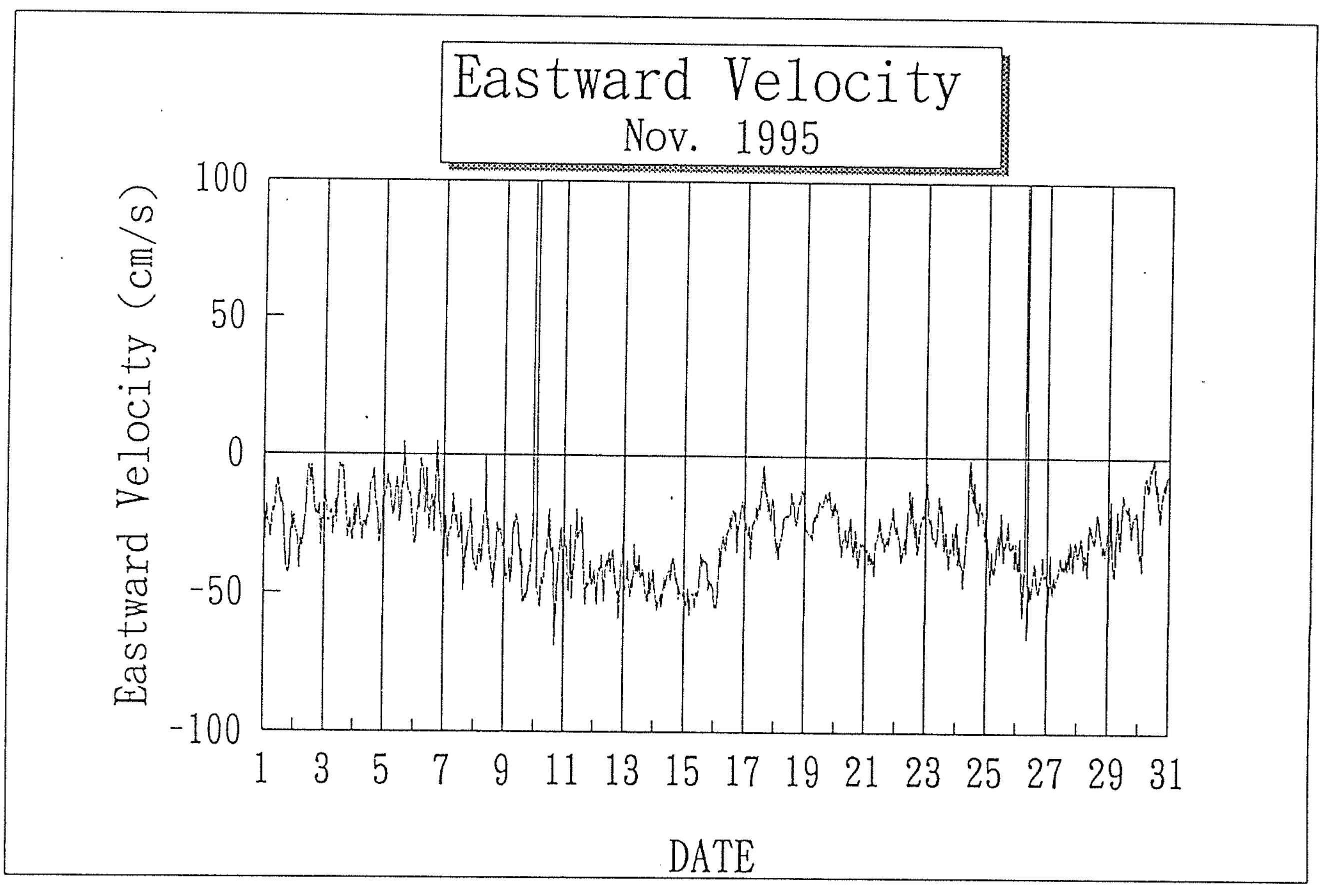
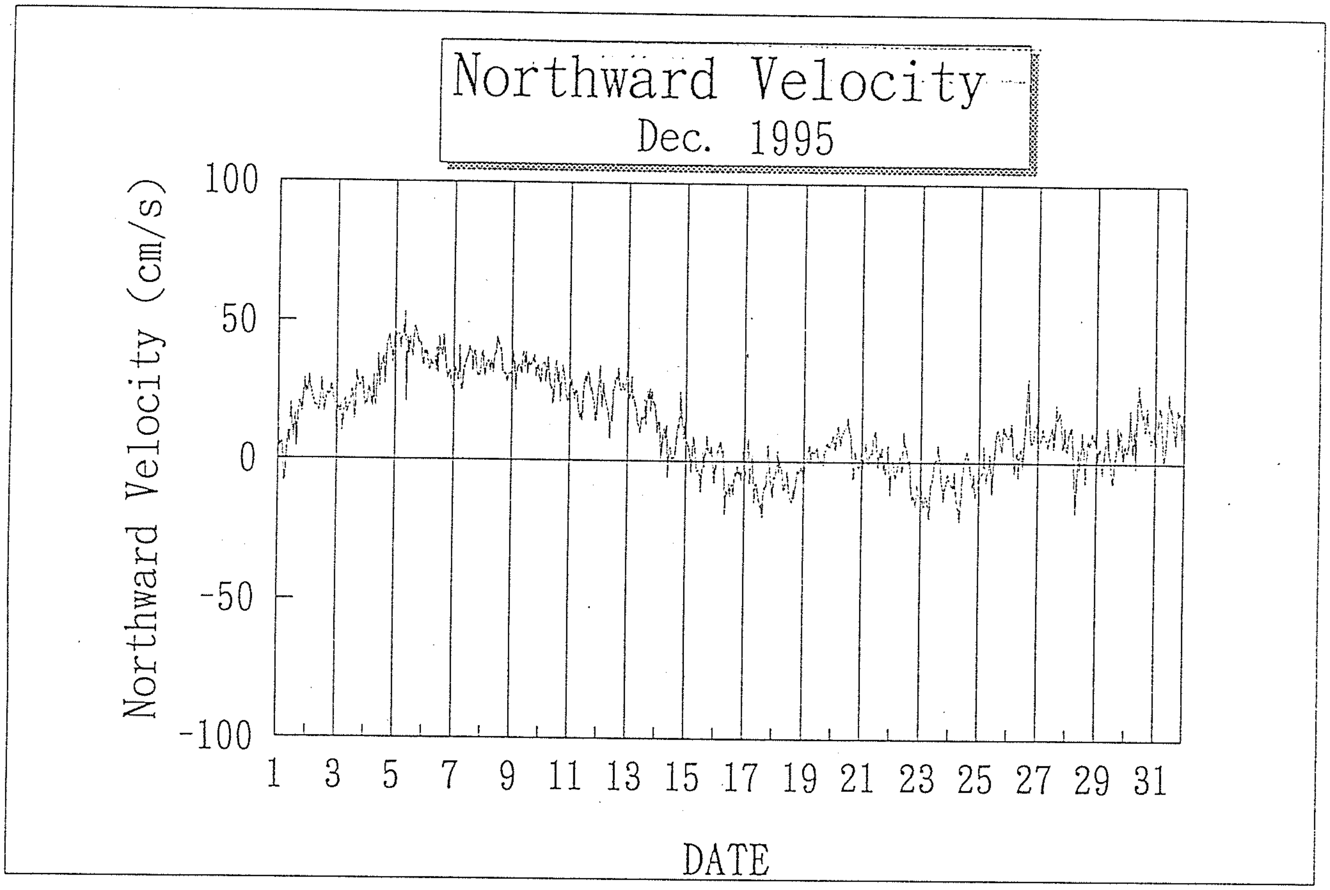
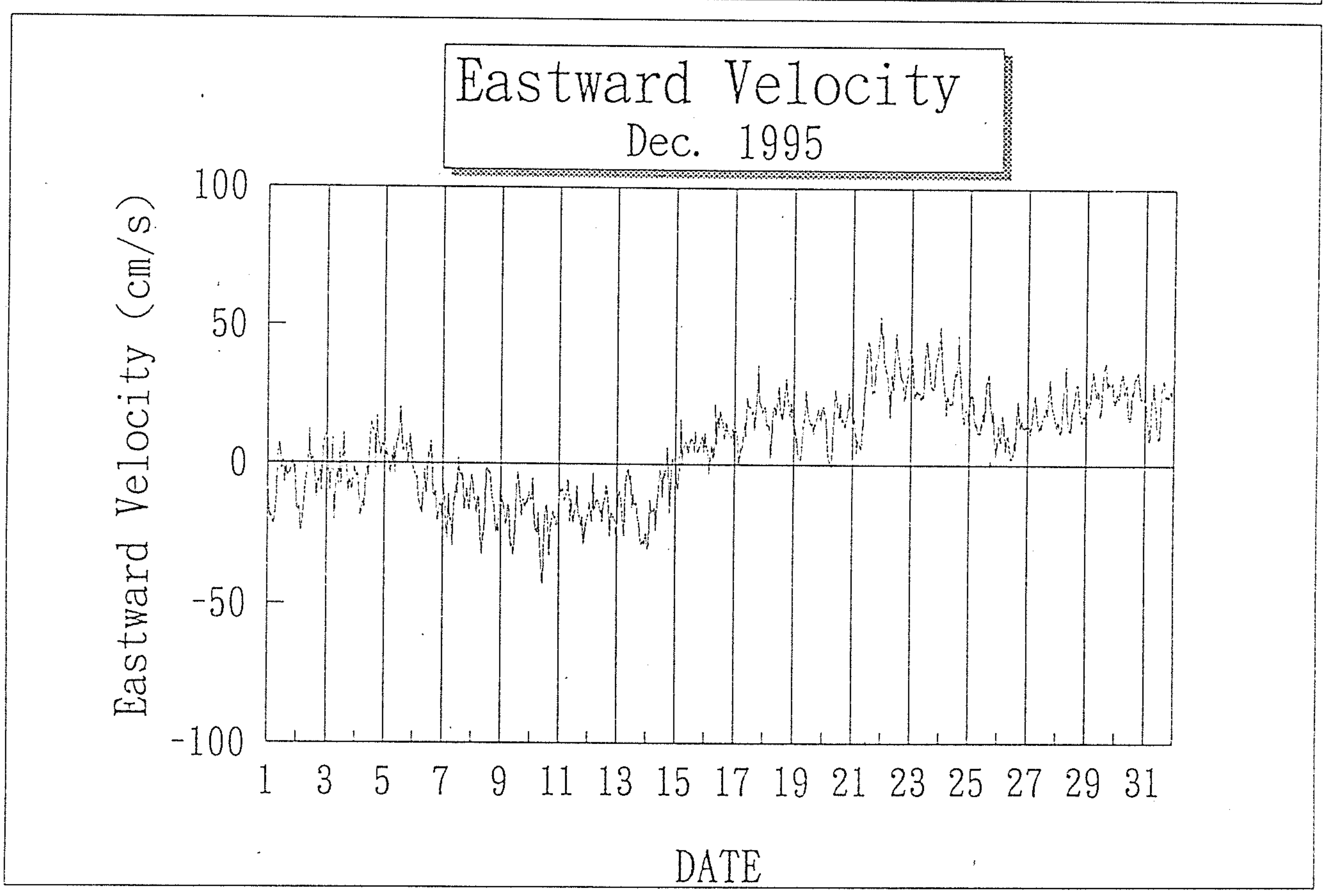


Fig 7-40 Time Serise of Velocity





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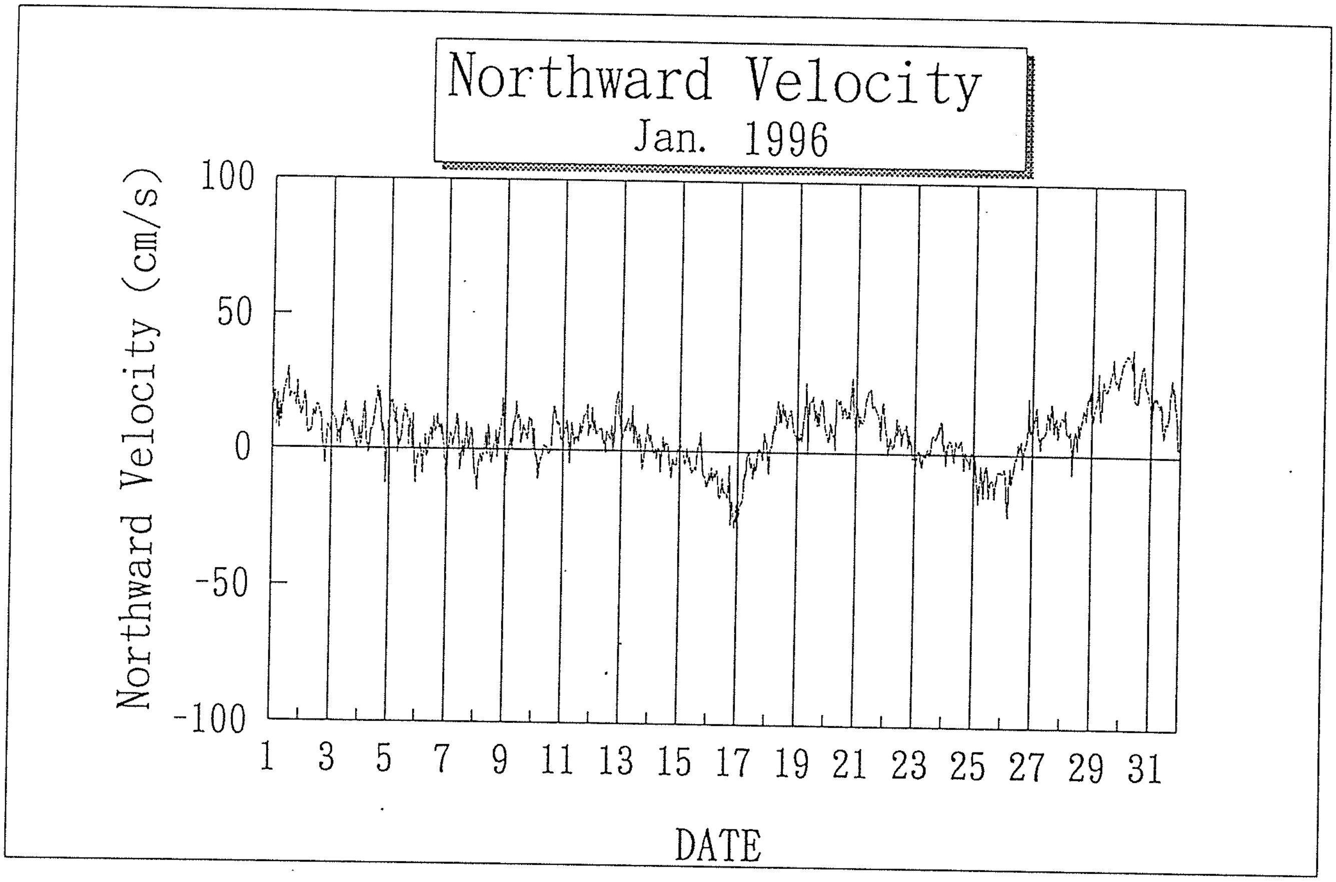


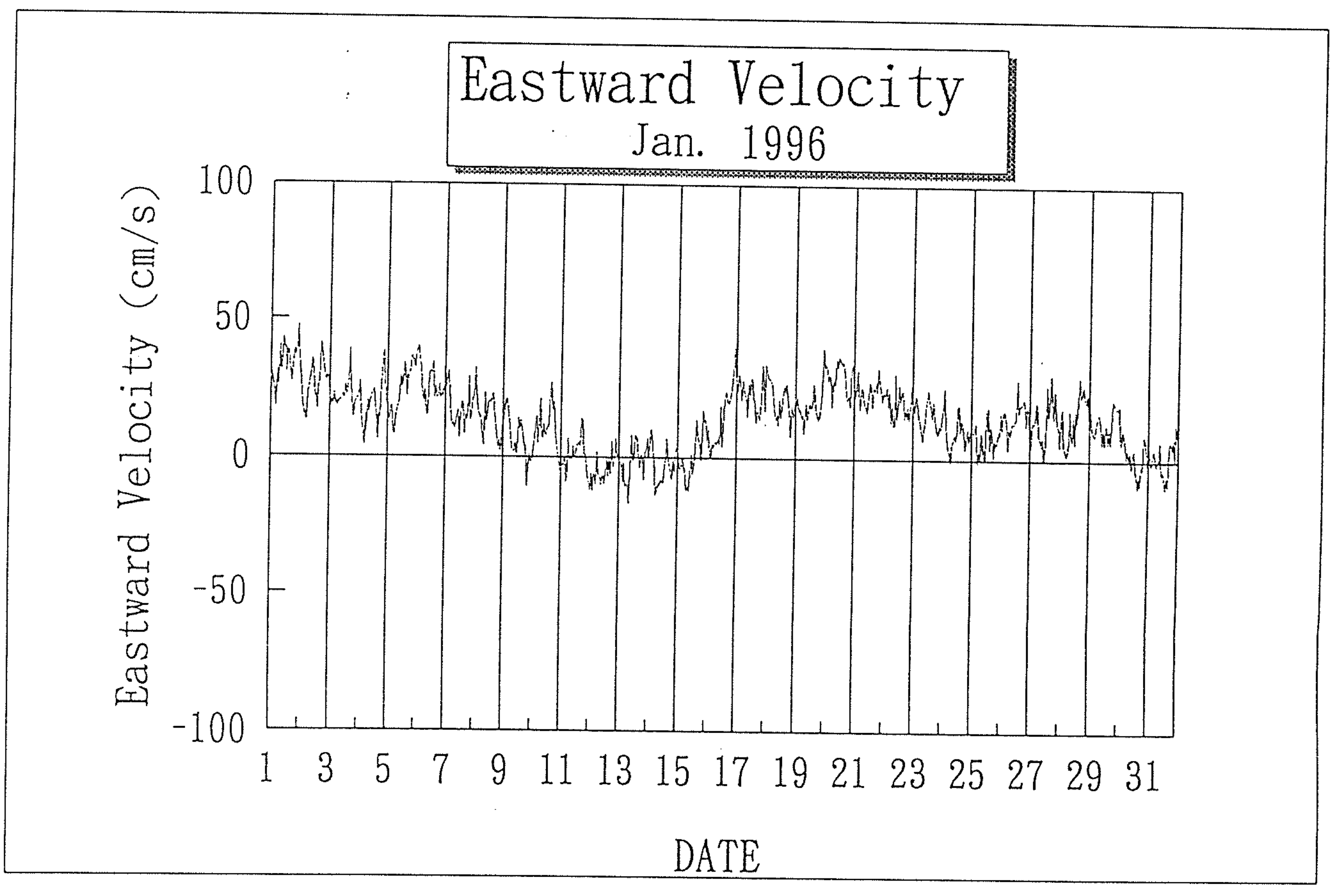
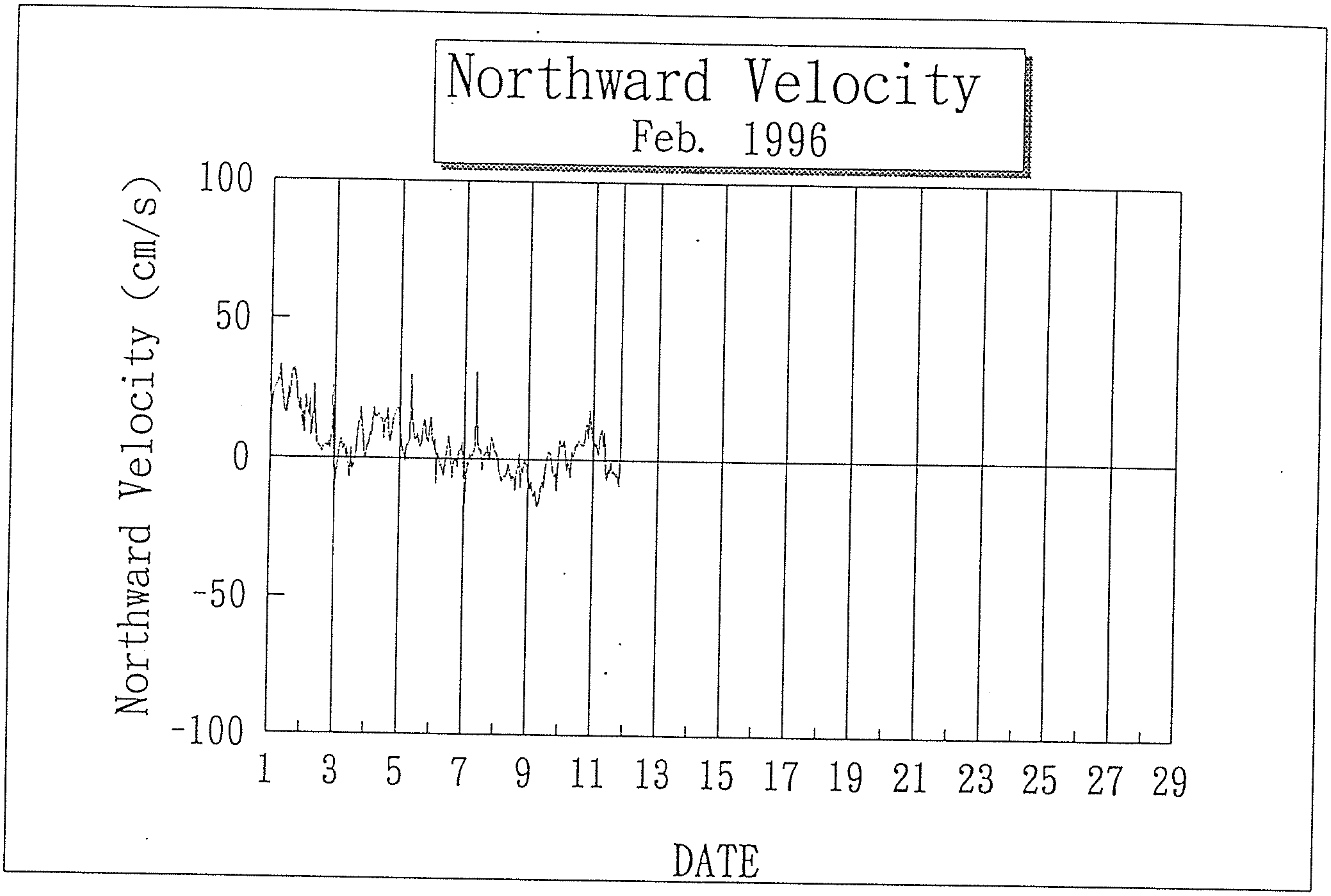


Fig 7-42 Time Serise of Velocity



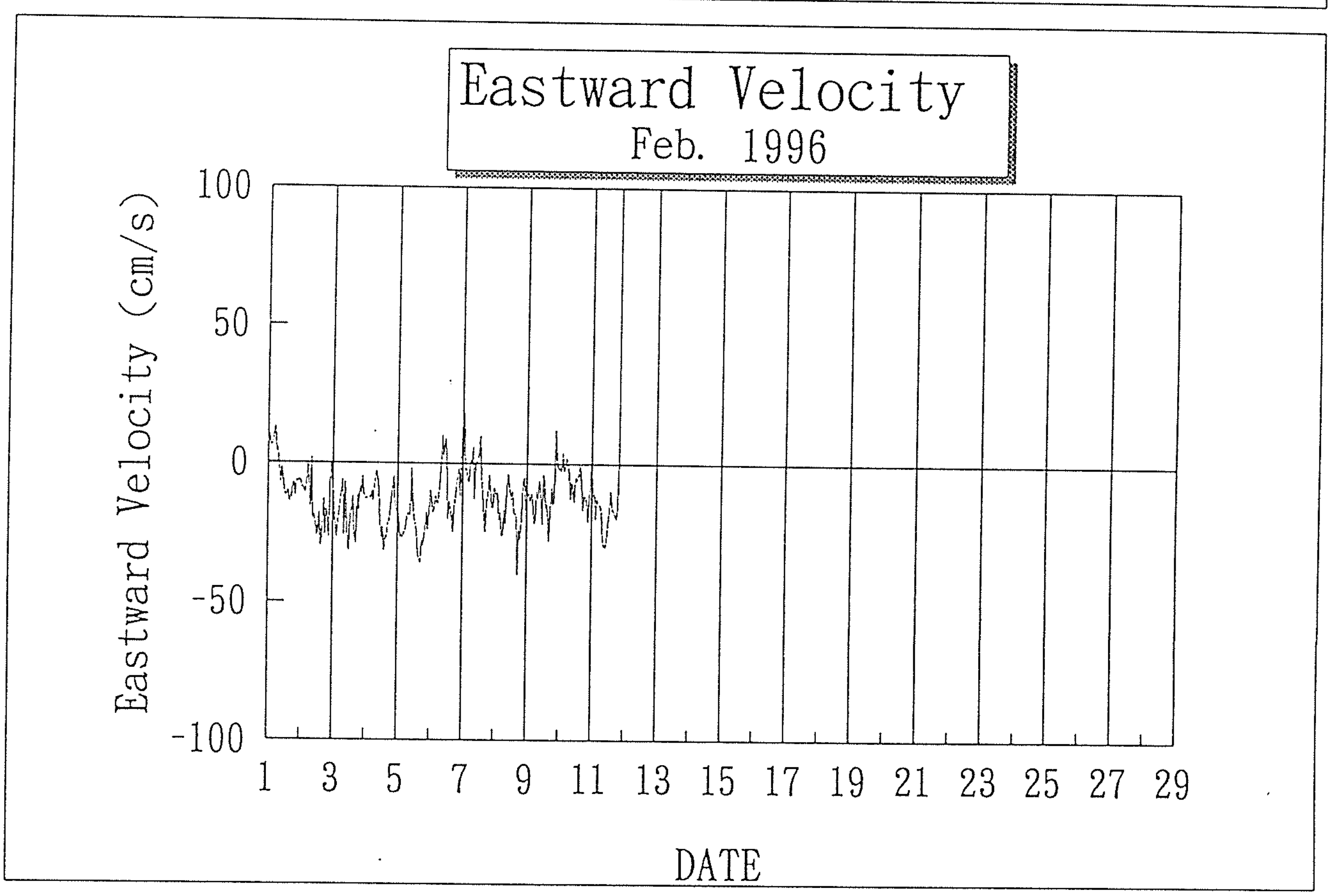
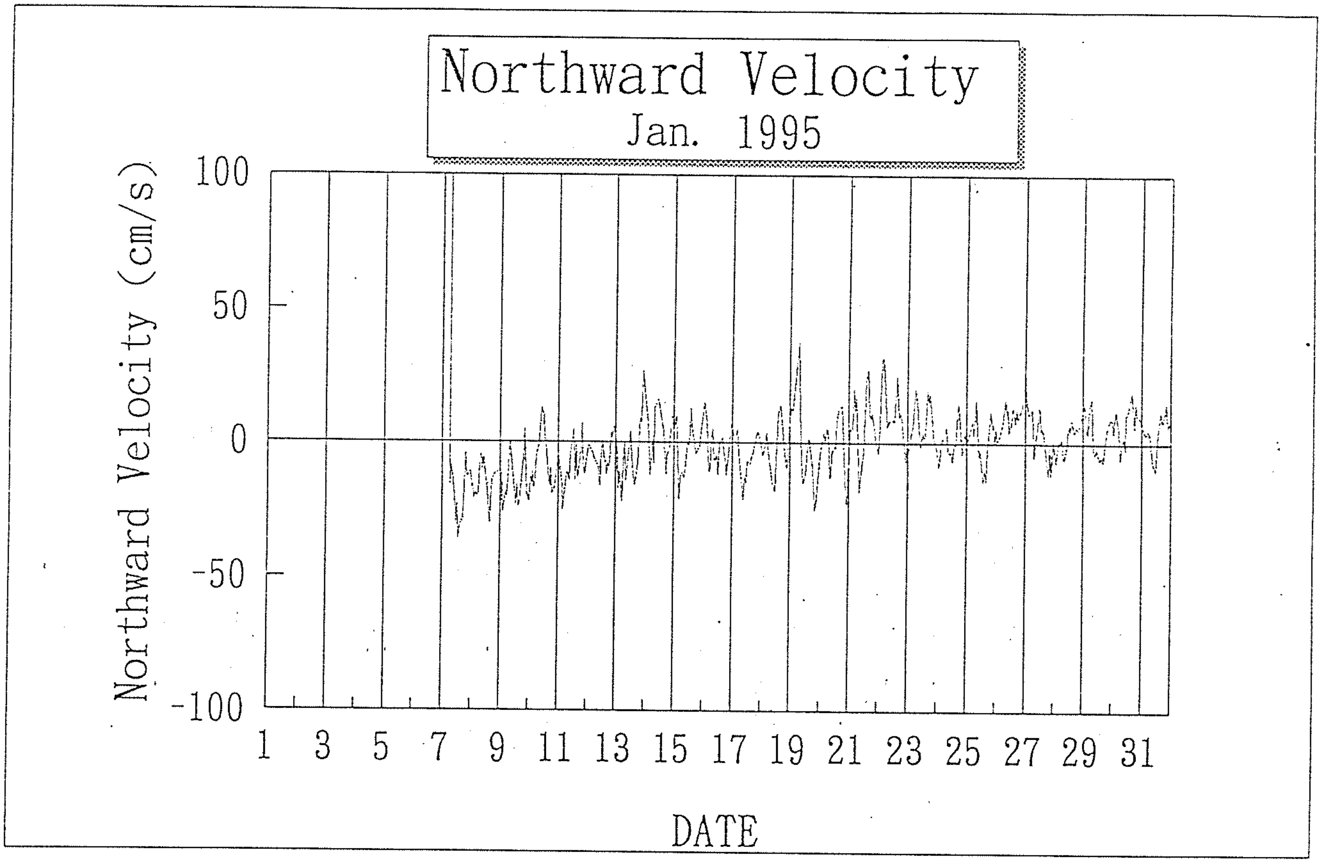


Fig 7-43 Time Serise of Velocity



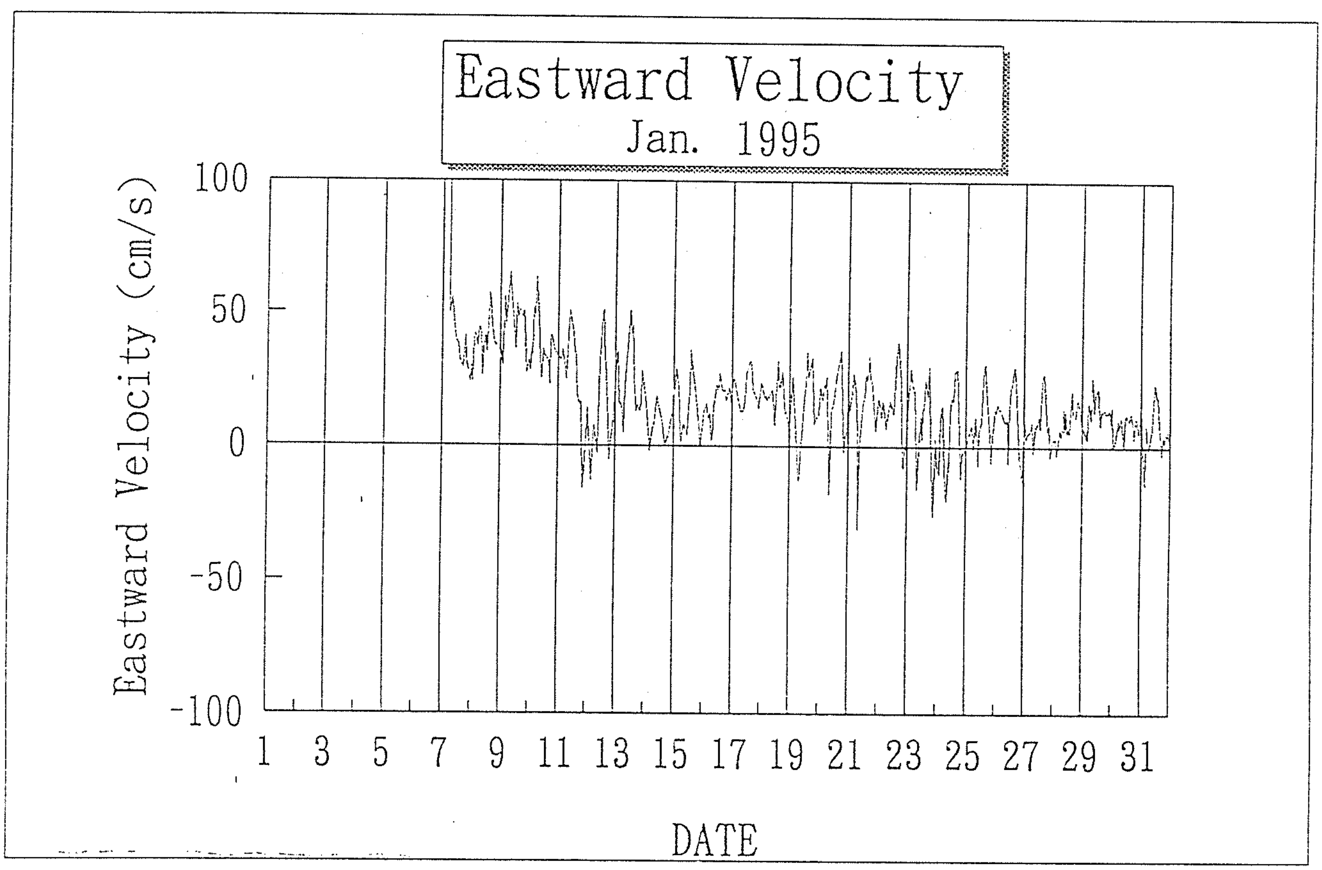
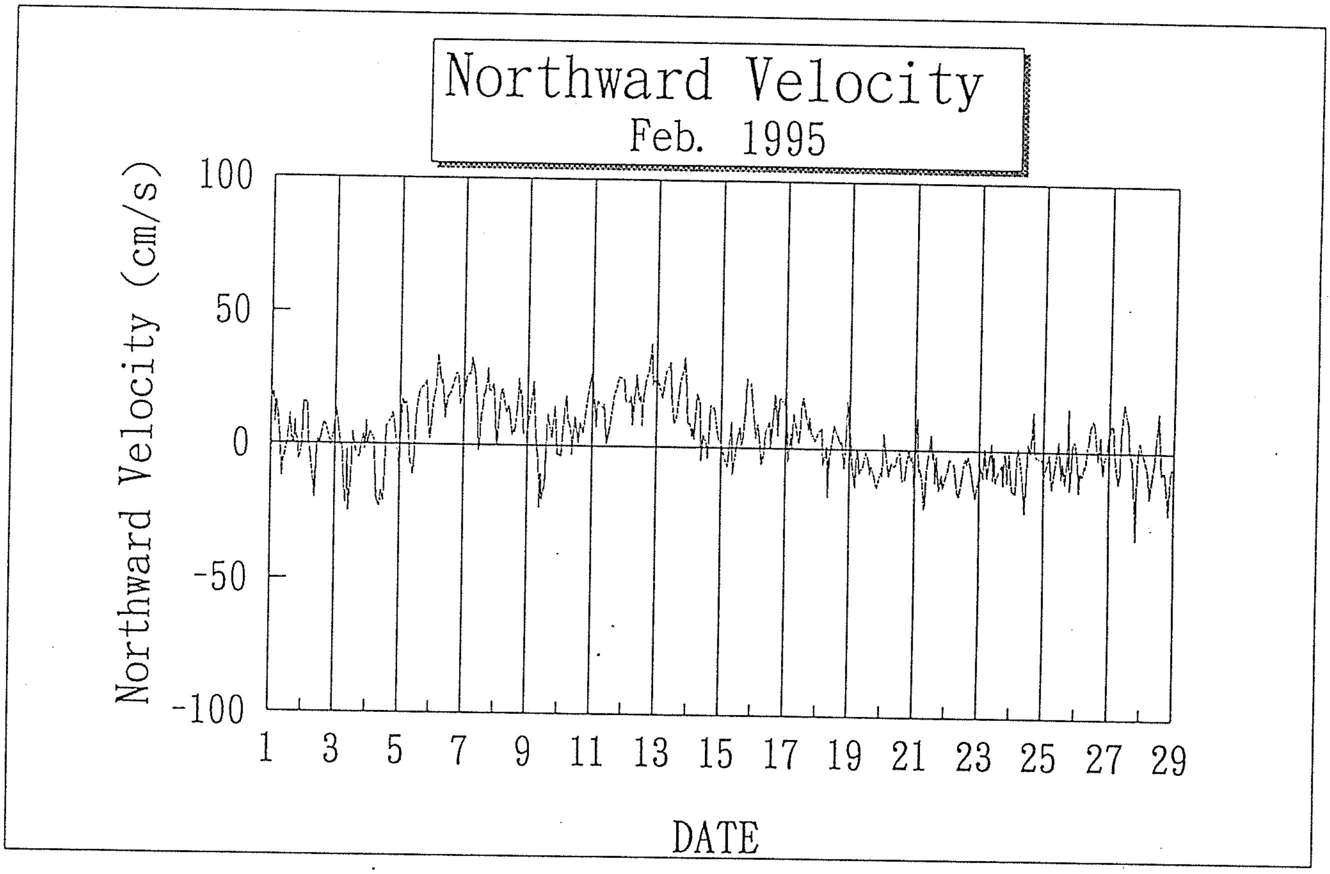


Fig 7-44 Time Serise of Velocity



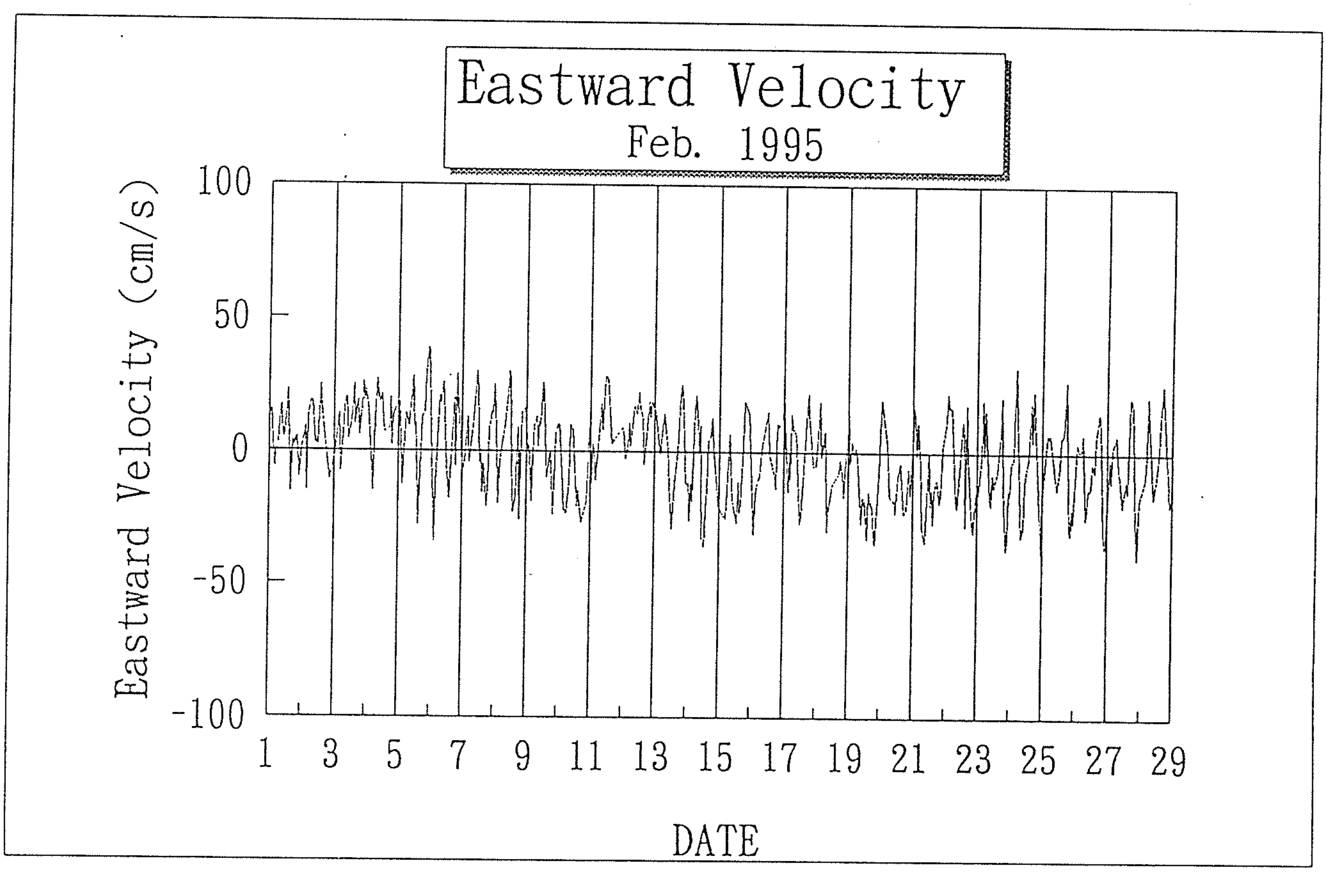
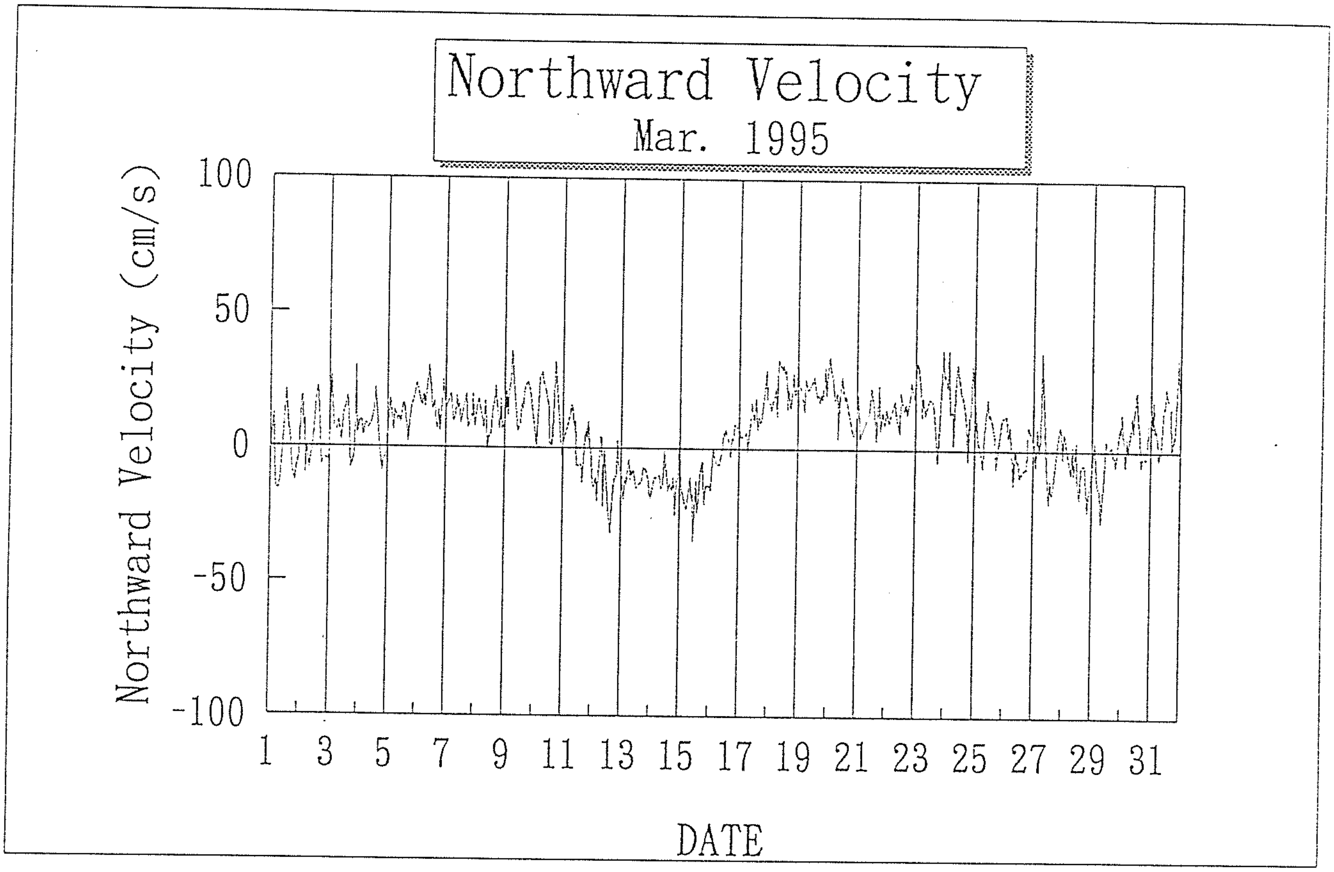


Fig 7-45 Time Serise of Velocity



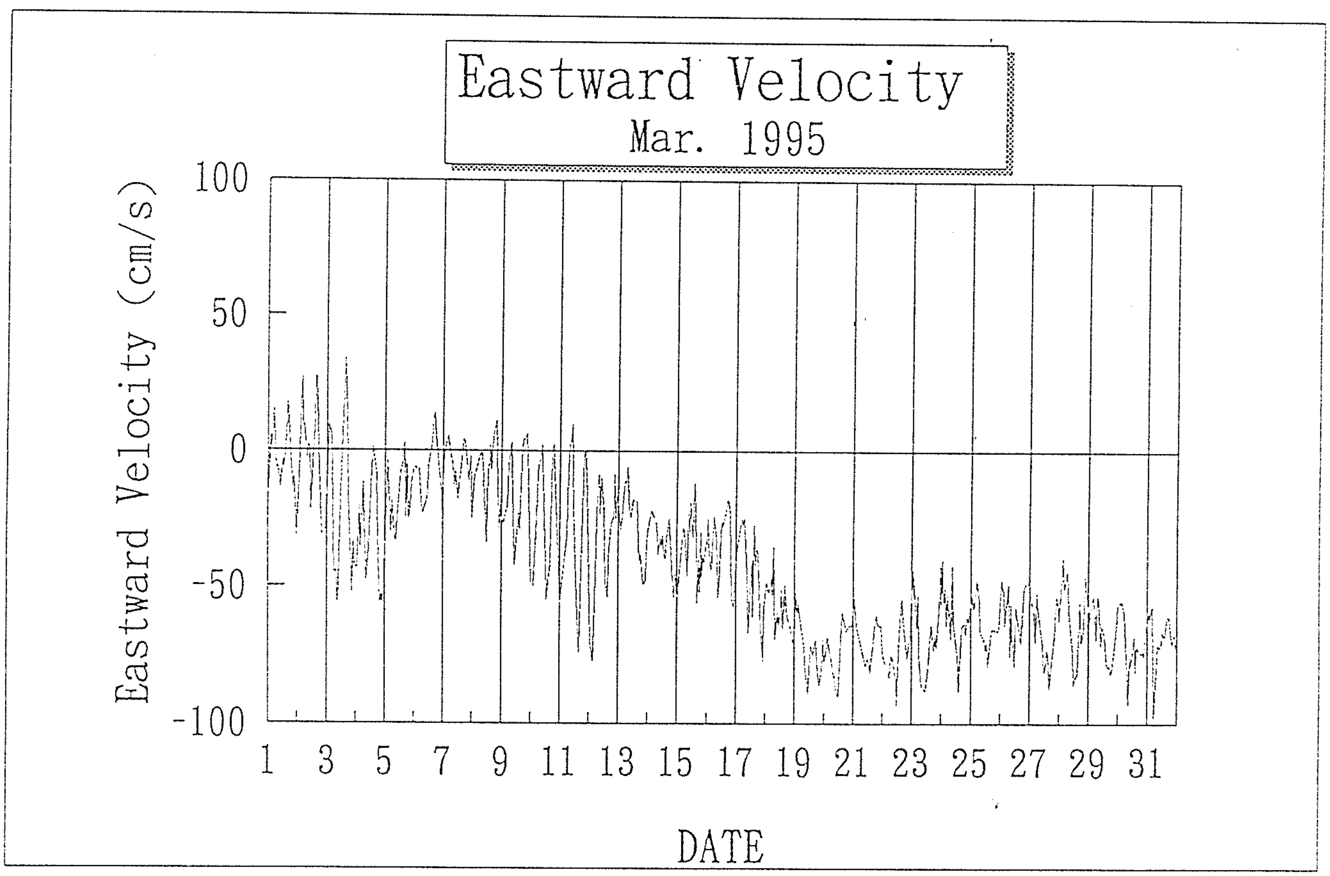
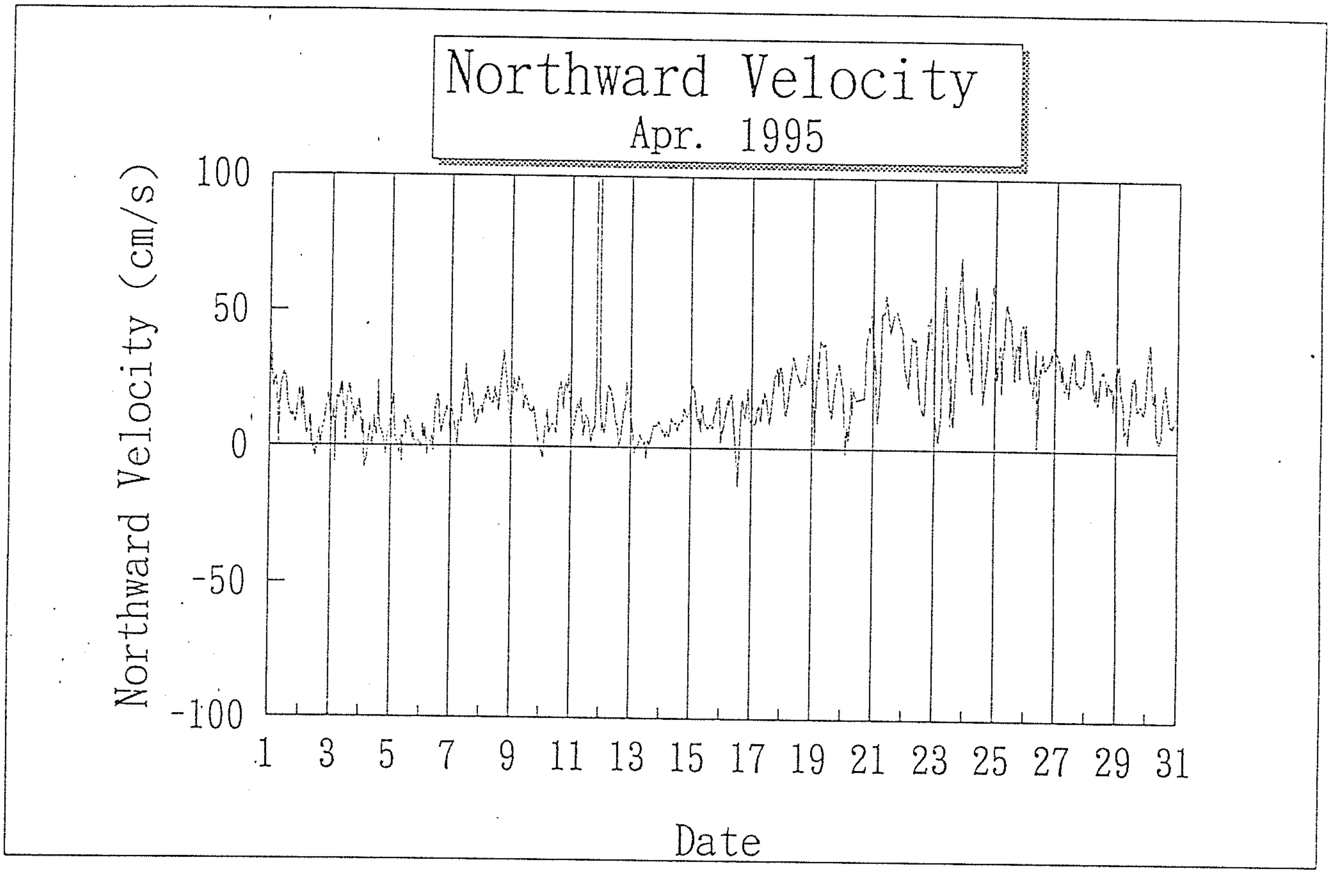


Fig 7-46 Time Serise of Velocity



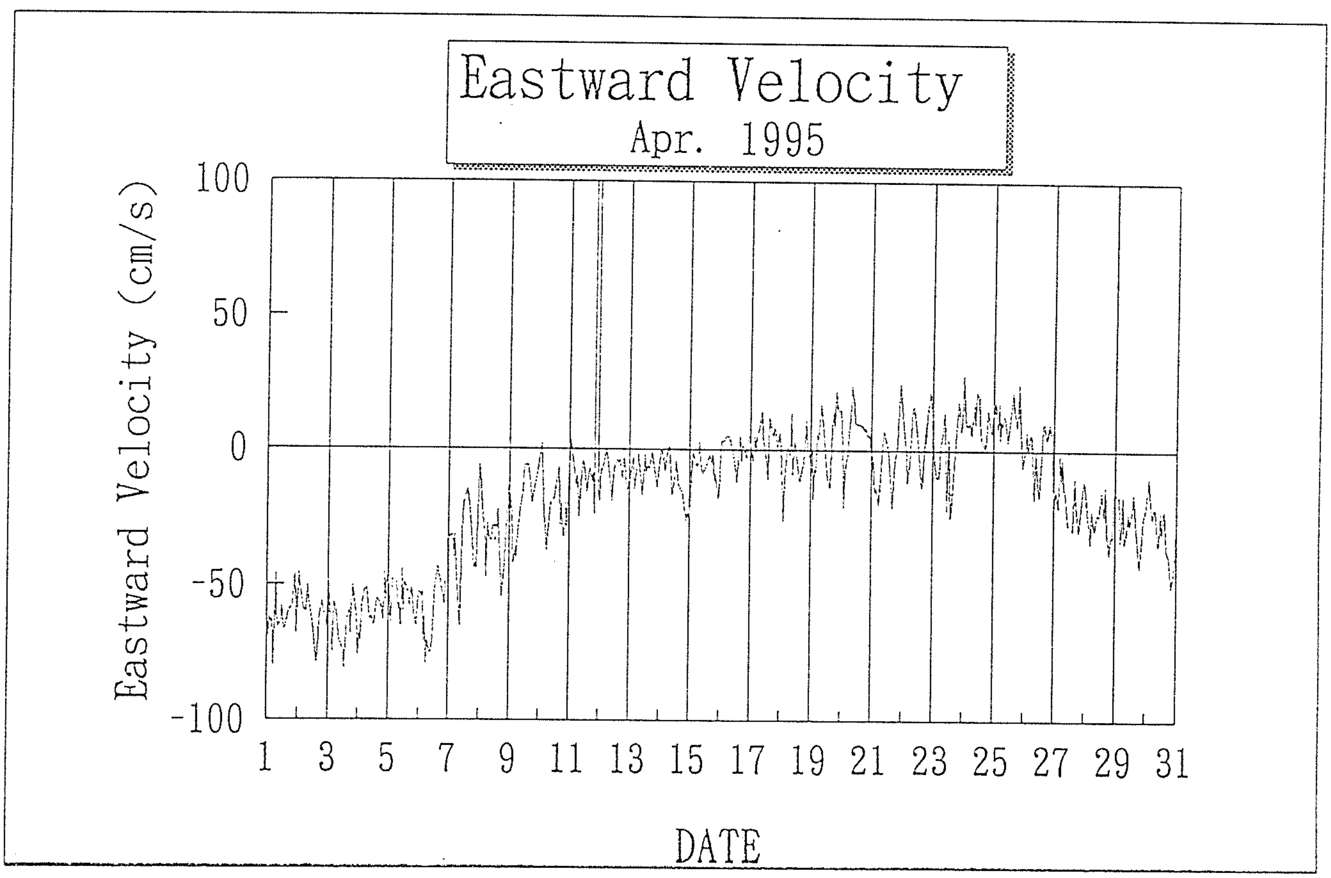
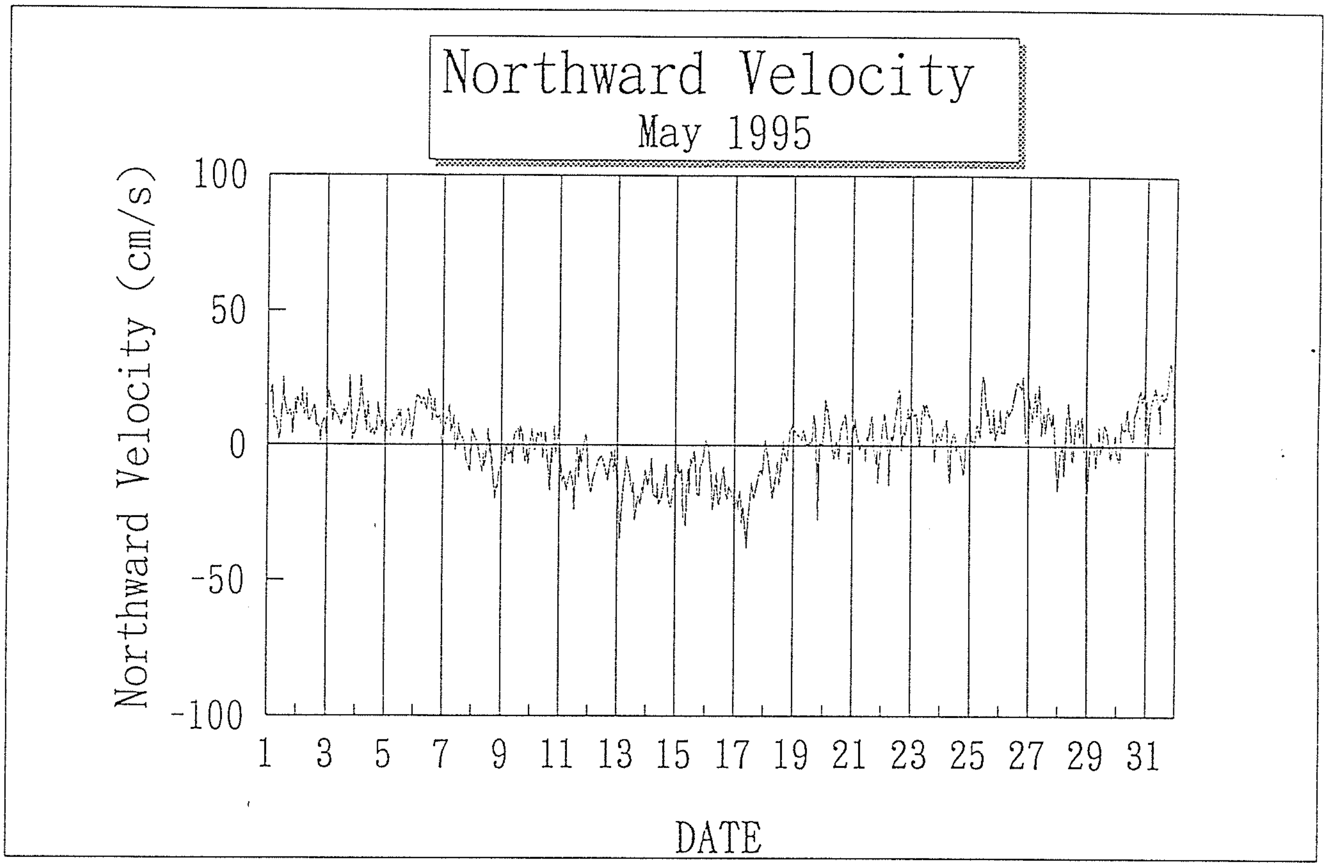


Fig 7-47 Time Serise of Velocity



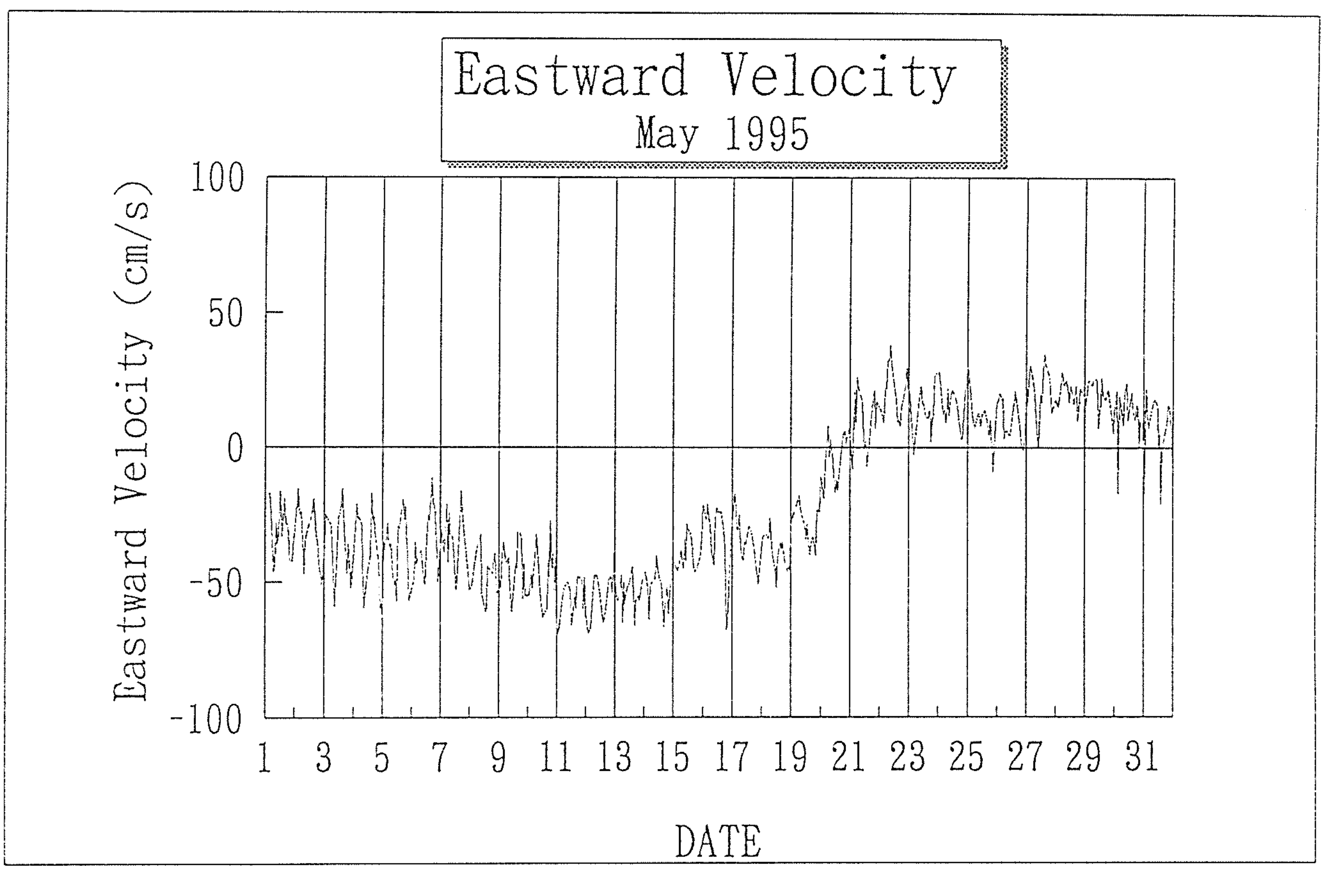
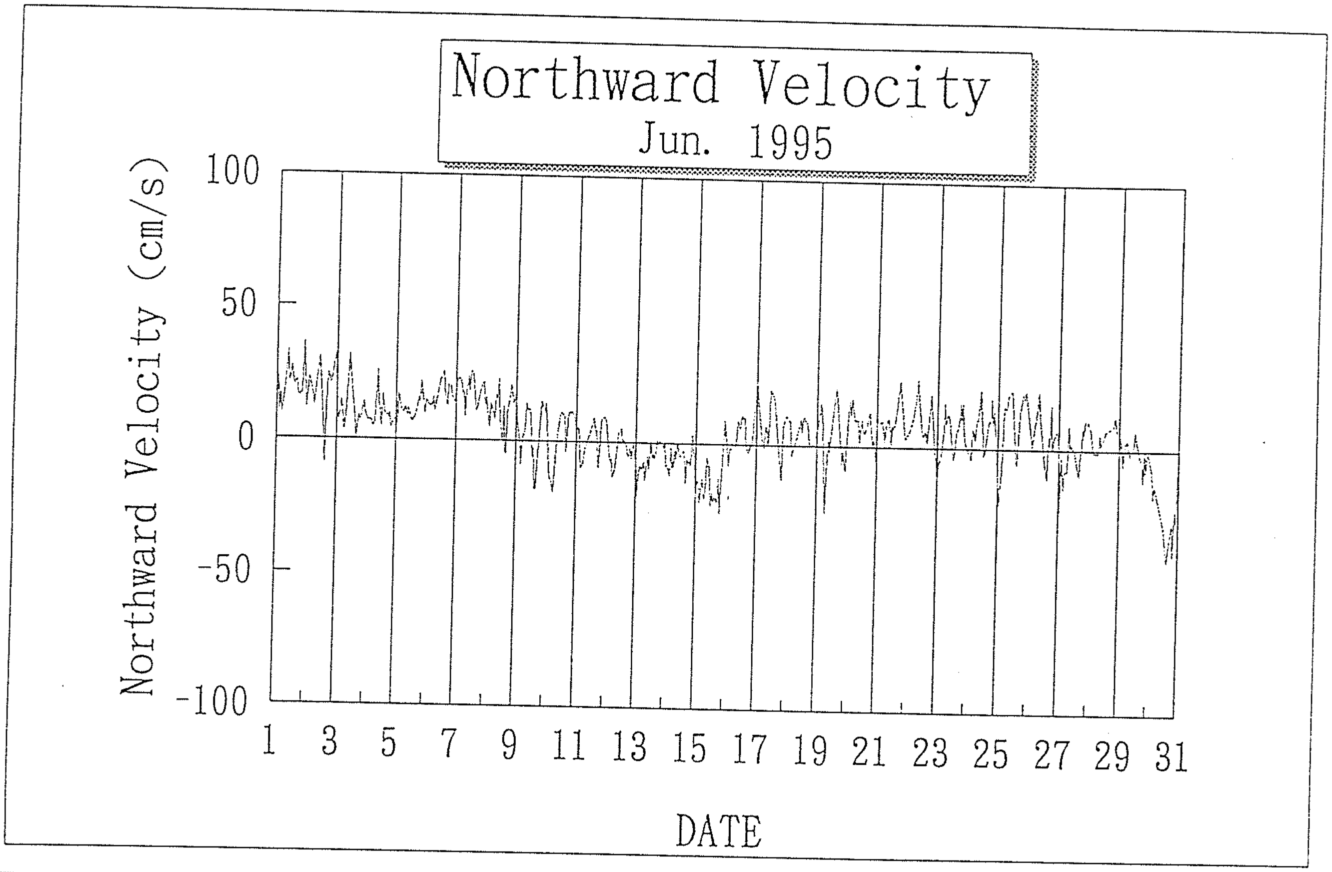


Fig 7-48 Time Serise of Velocity



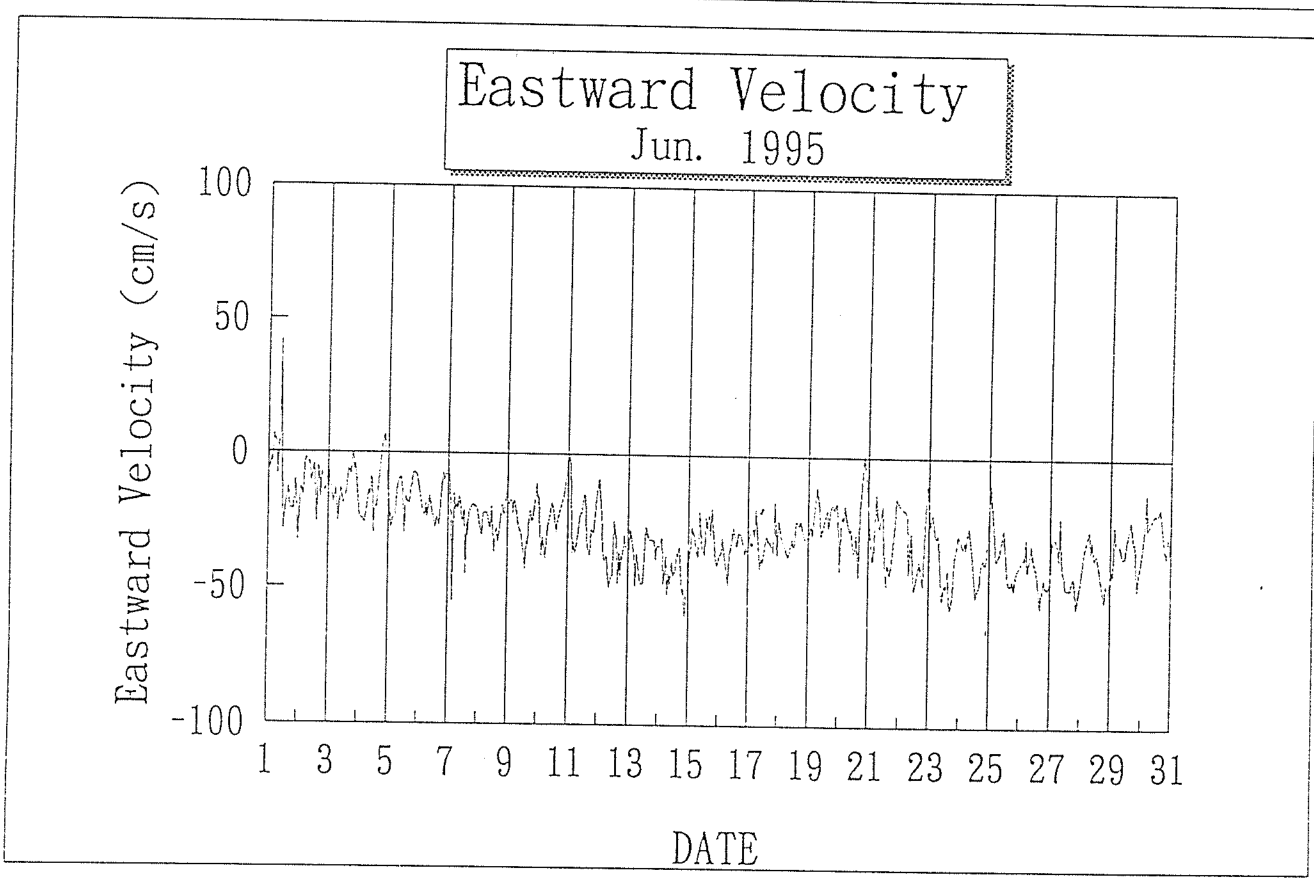
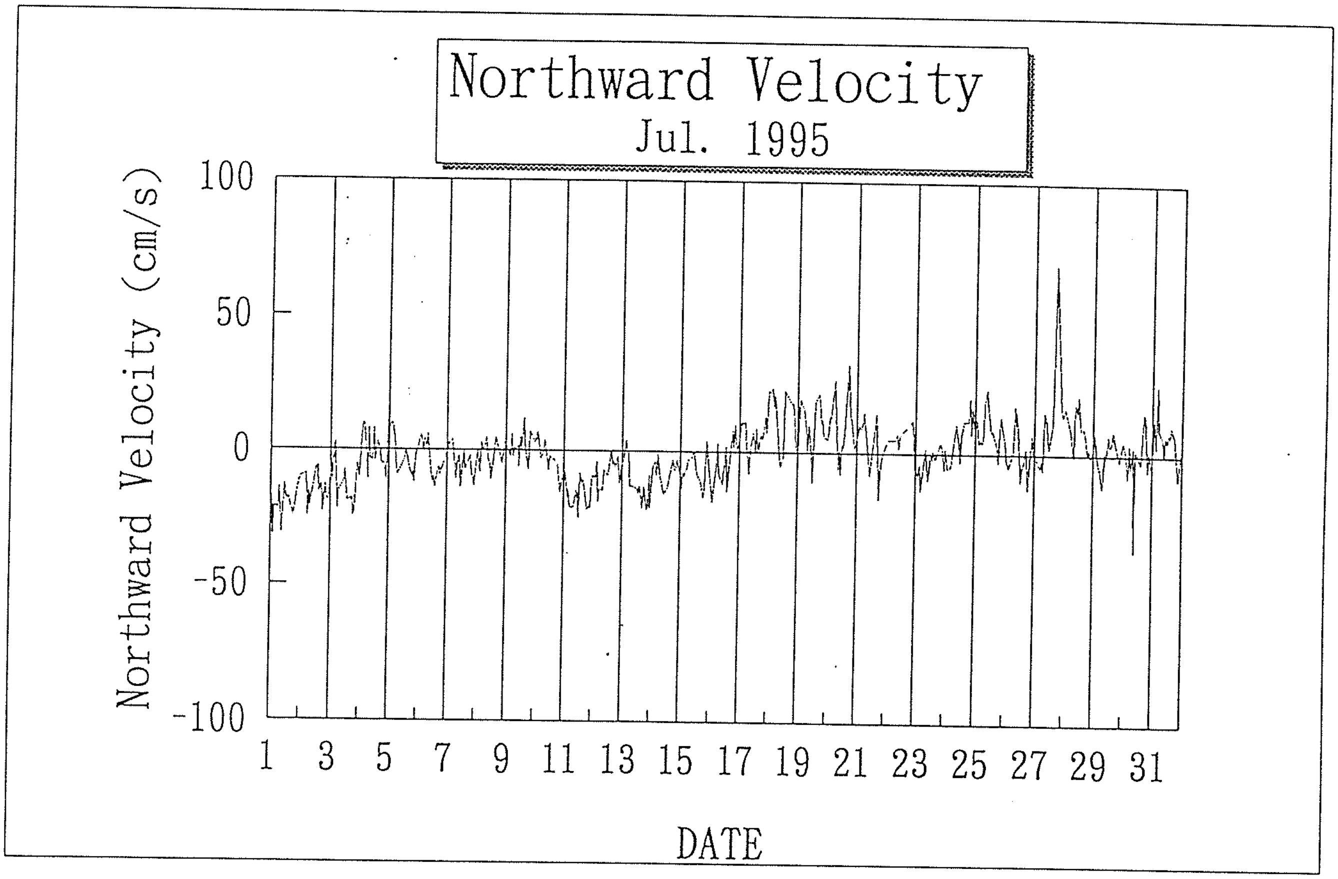


Fig 7-49 Time Serise of Velocity



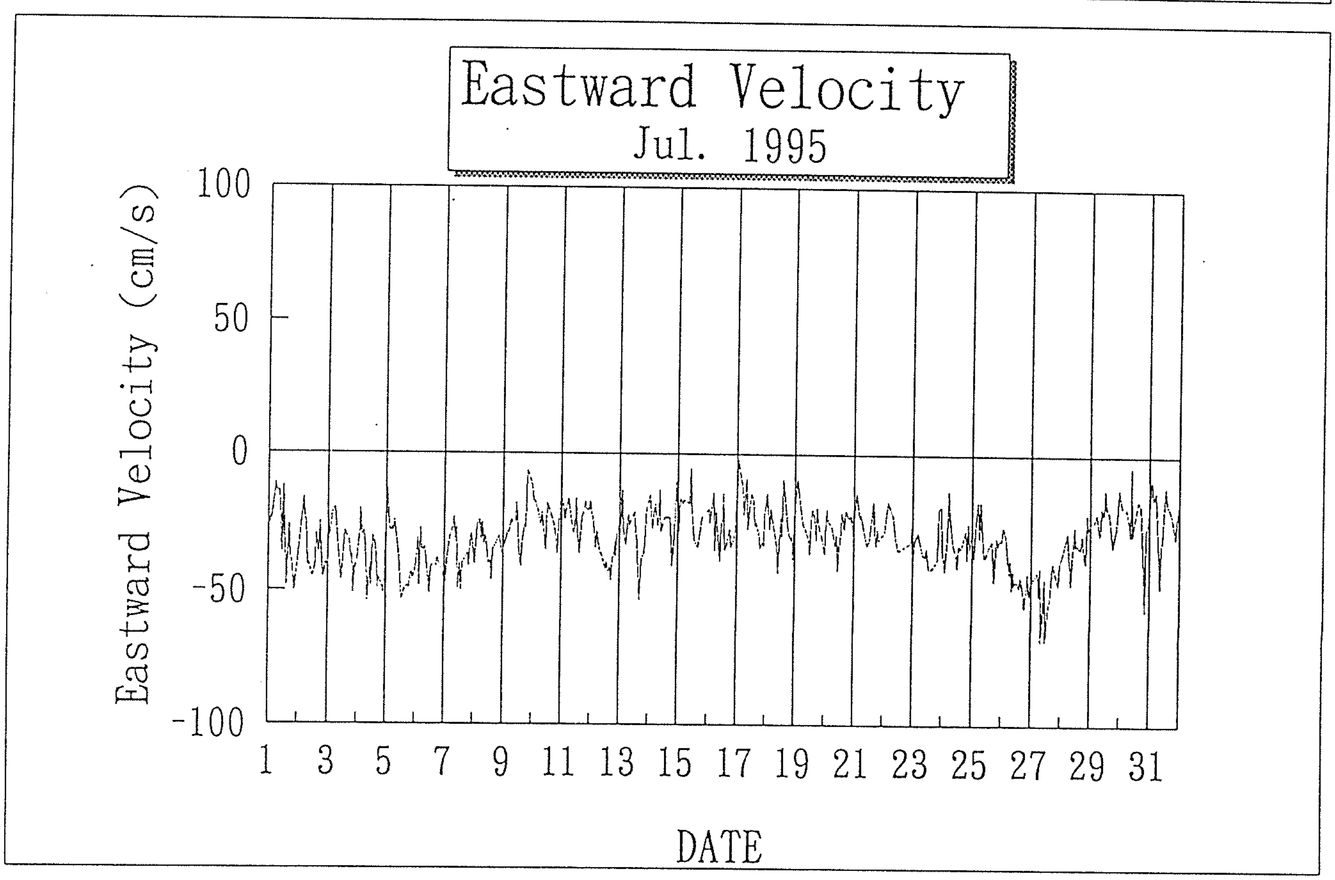
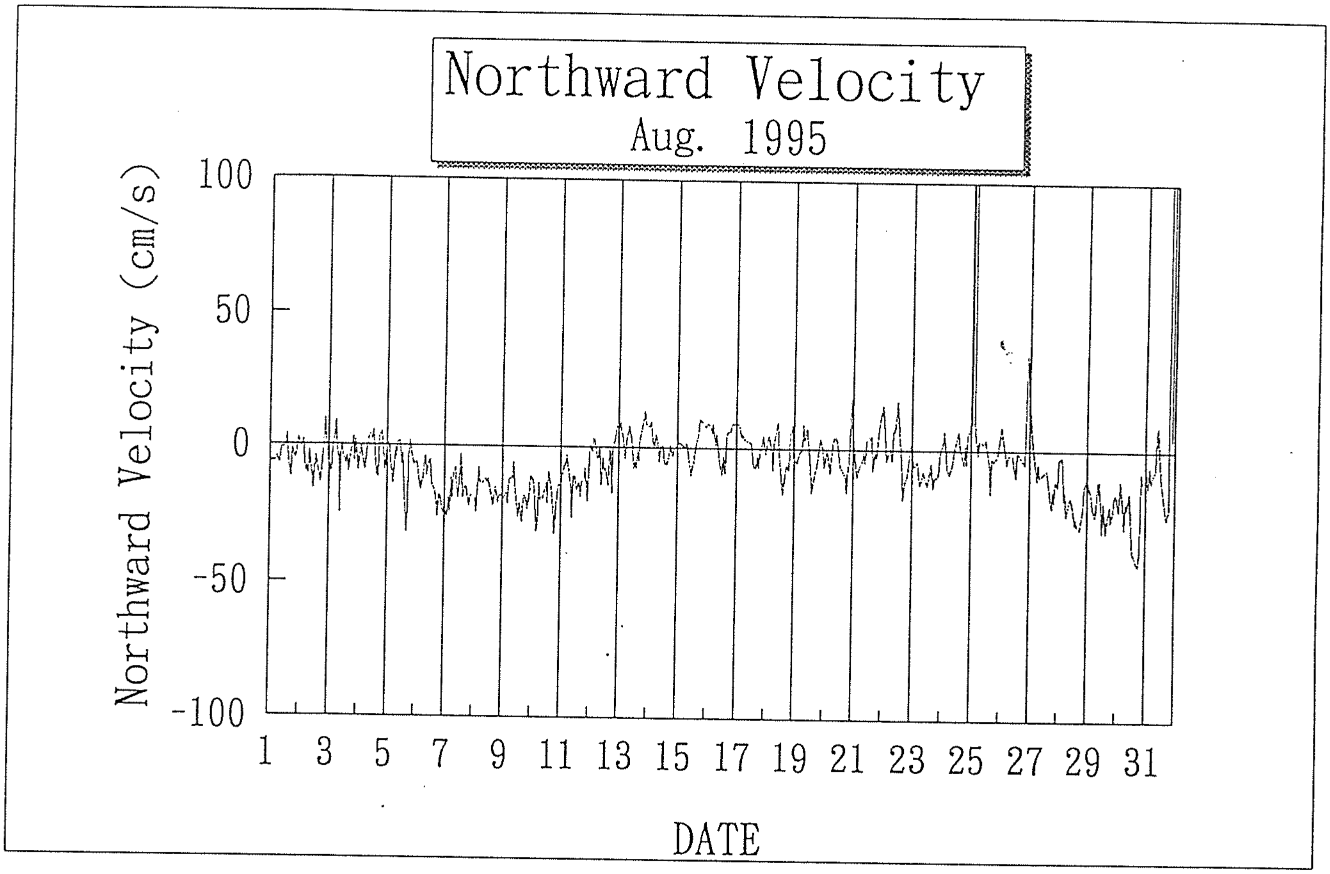


Fig 7-50 Time Serise of Velocity



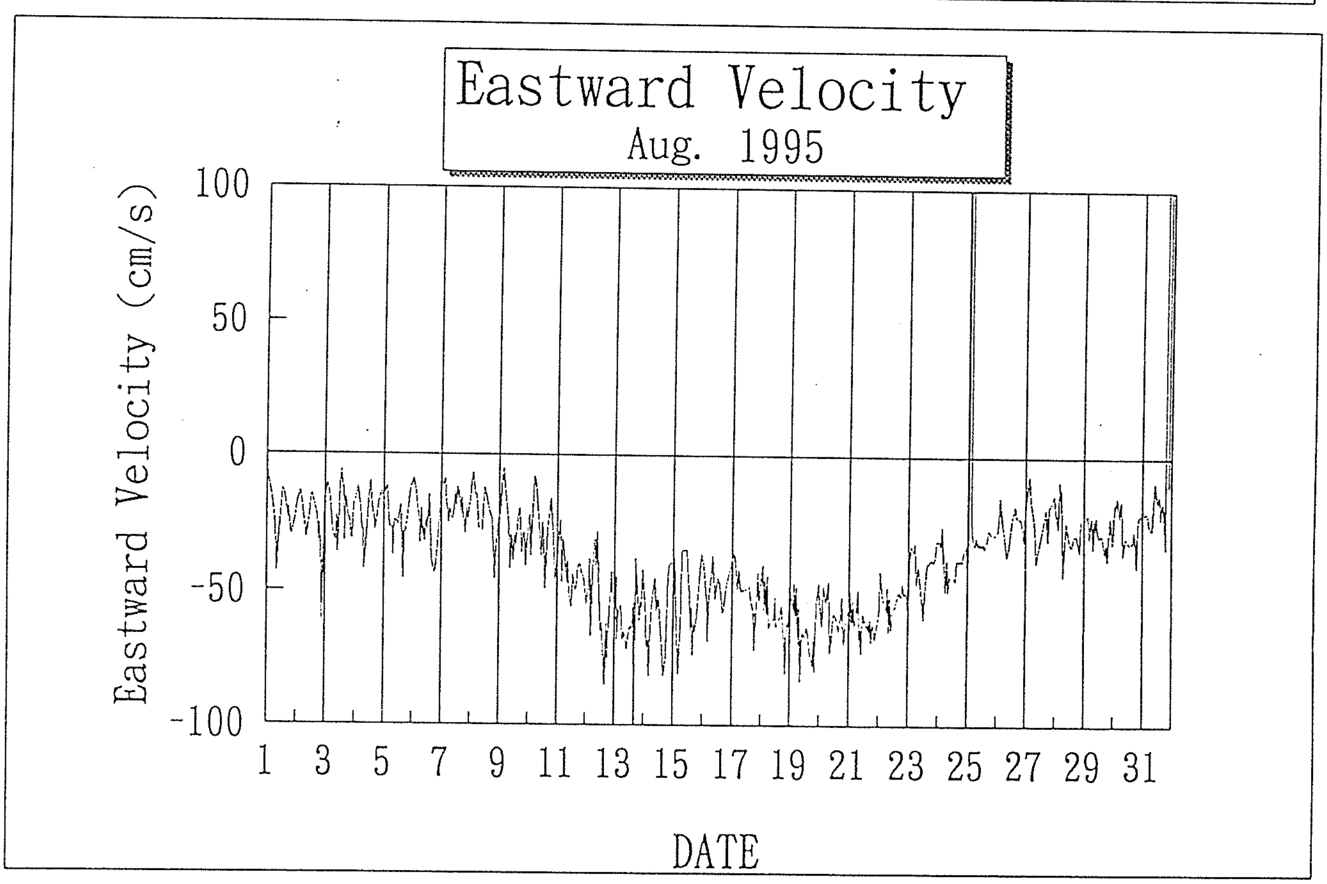
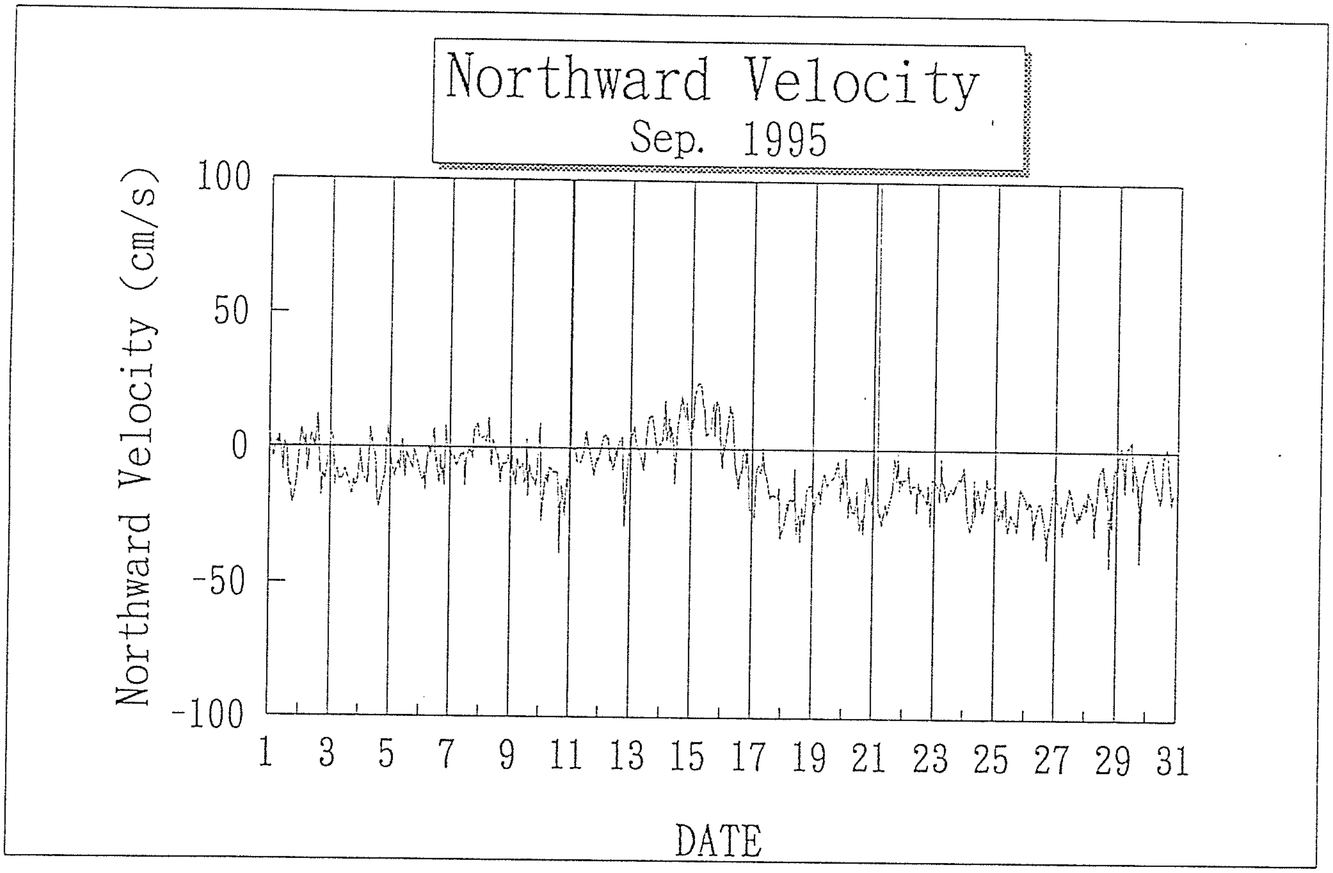


Fig 7-51 Time Serise of Velocity



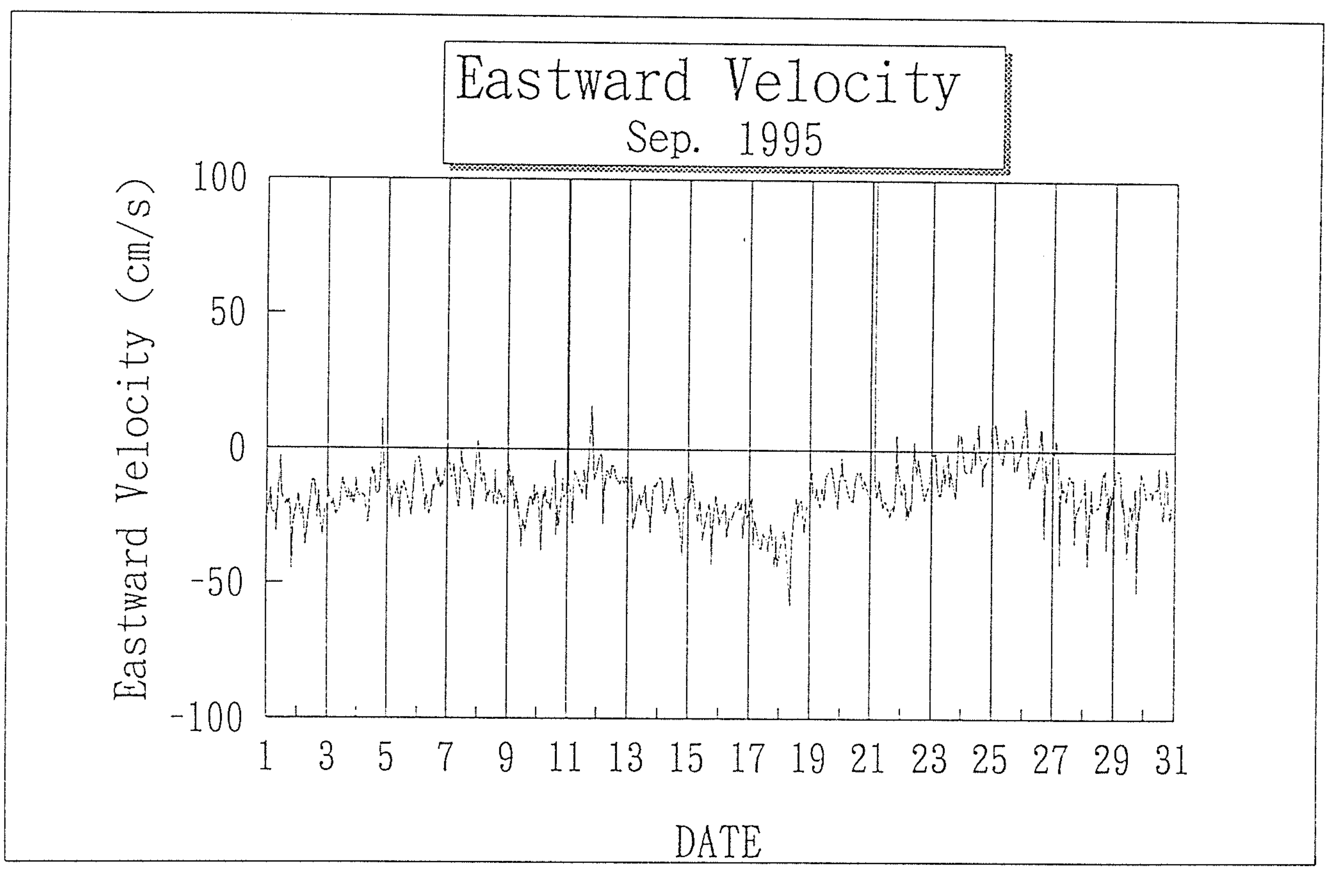
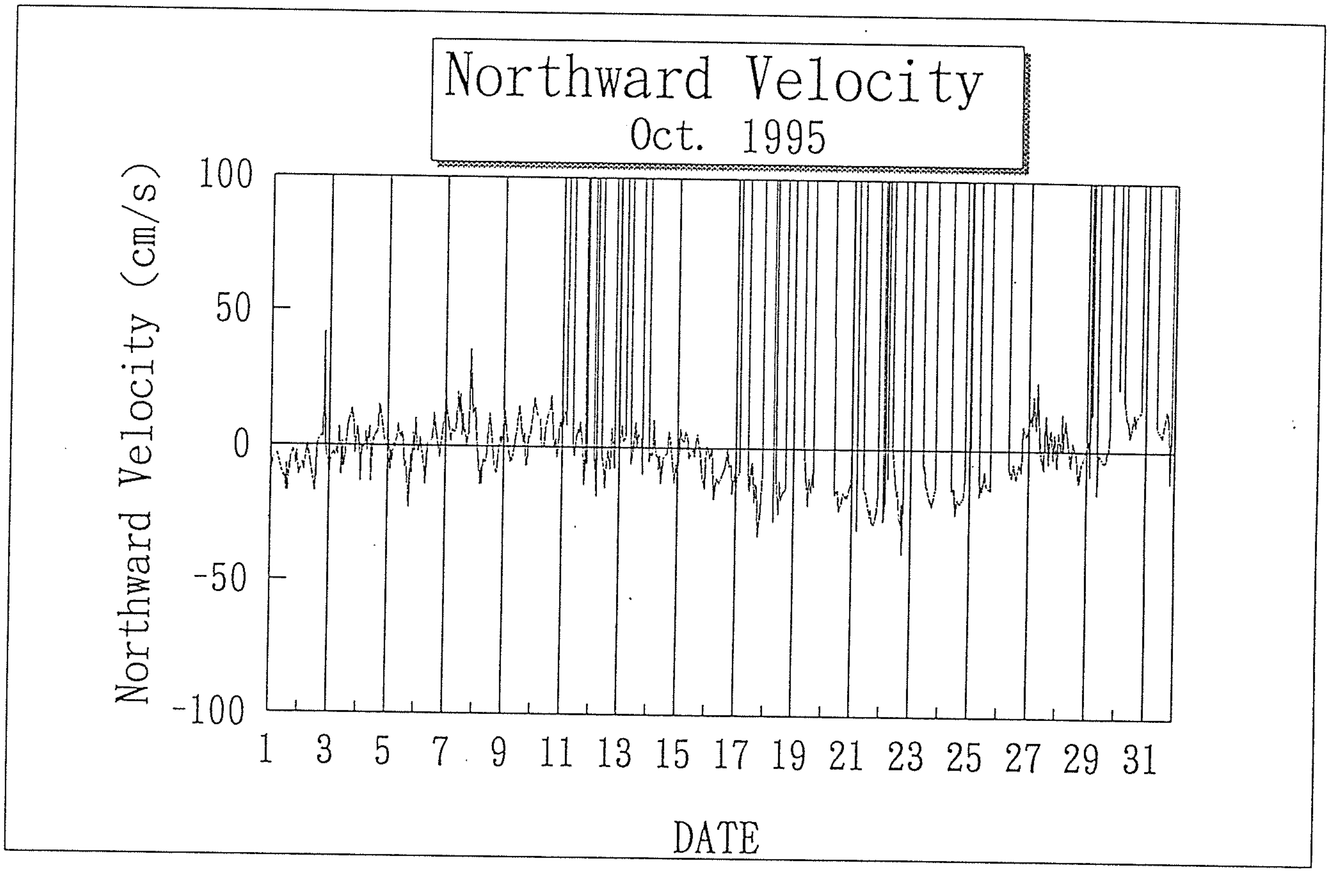
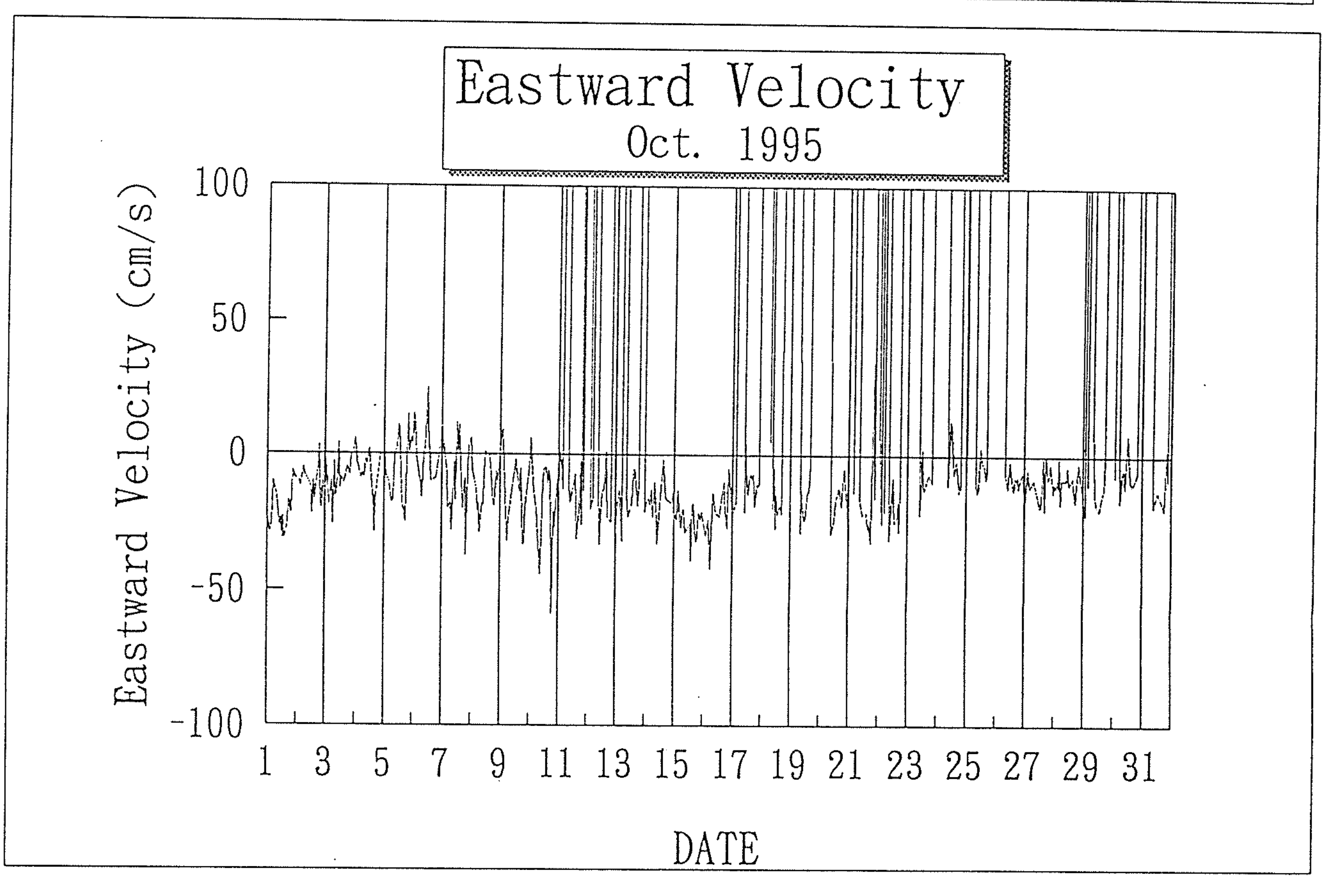
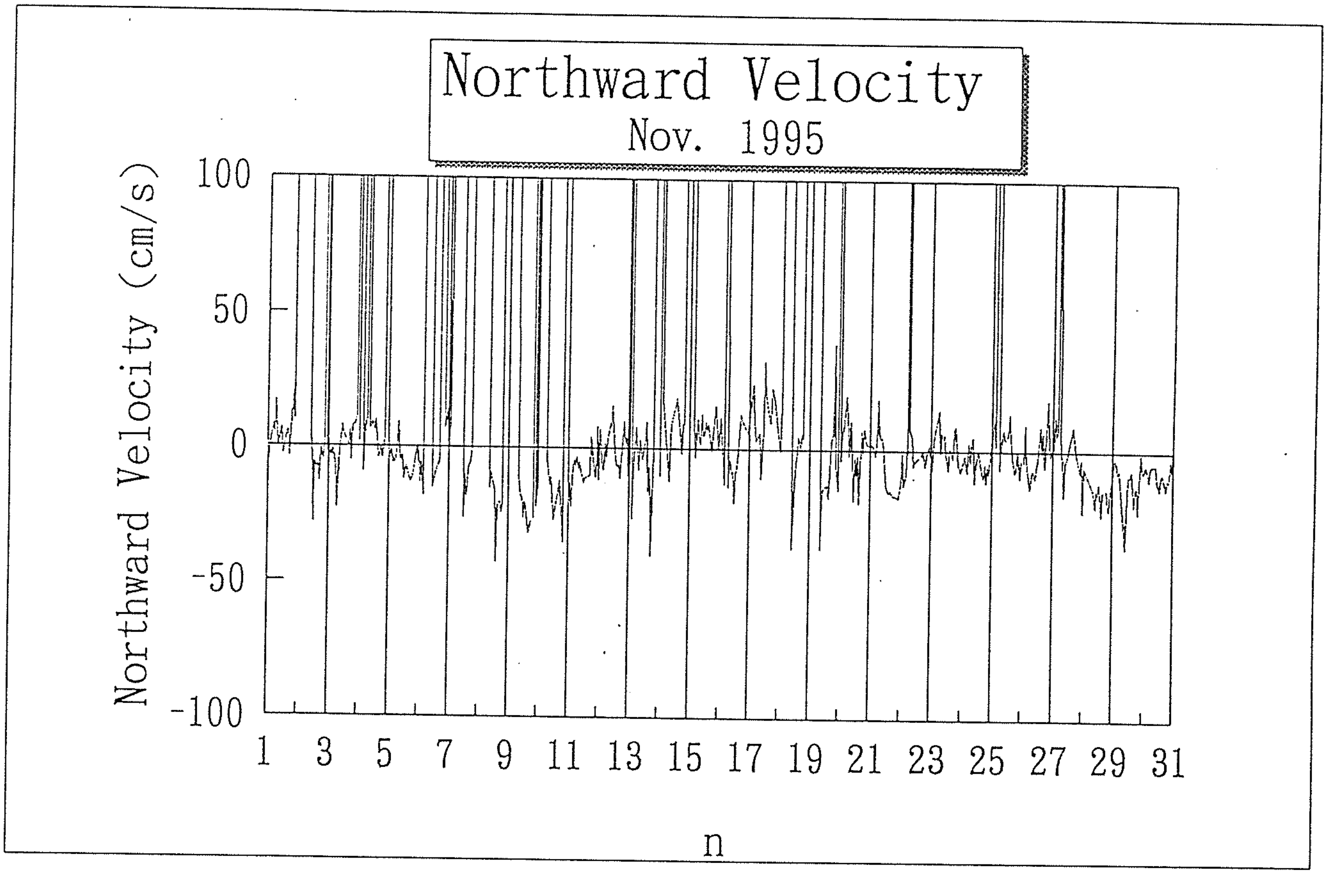


Fig 7-52 Time Serise of Velocity


Northward Velocity
Oct. 1995
Northward Velocity (cm/s)
100
50
0
-50
-100
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE


Eastward Velocity
Oct. 1995
Eastward Velocity (cm/s)
100
50
0
-50
-100
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
DATE



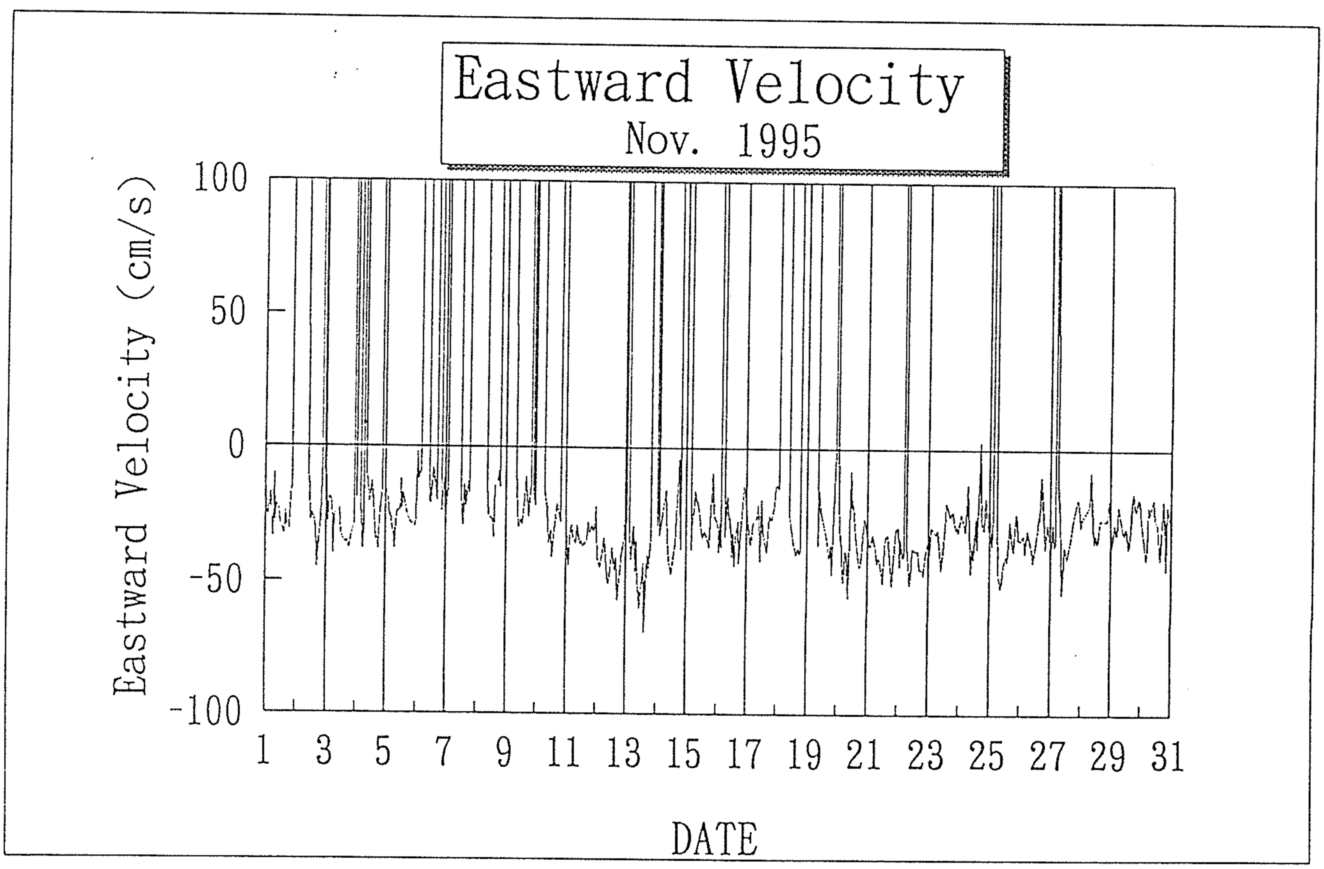
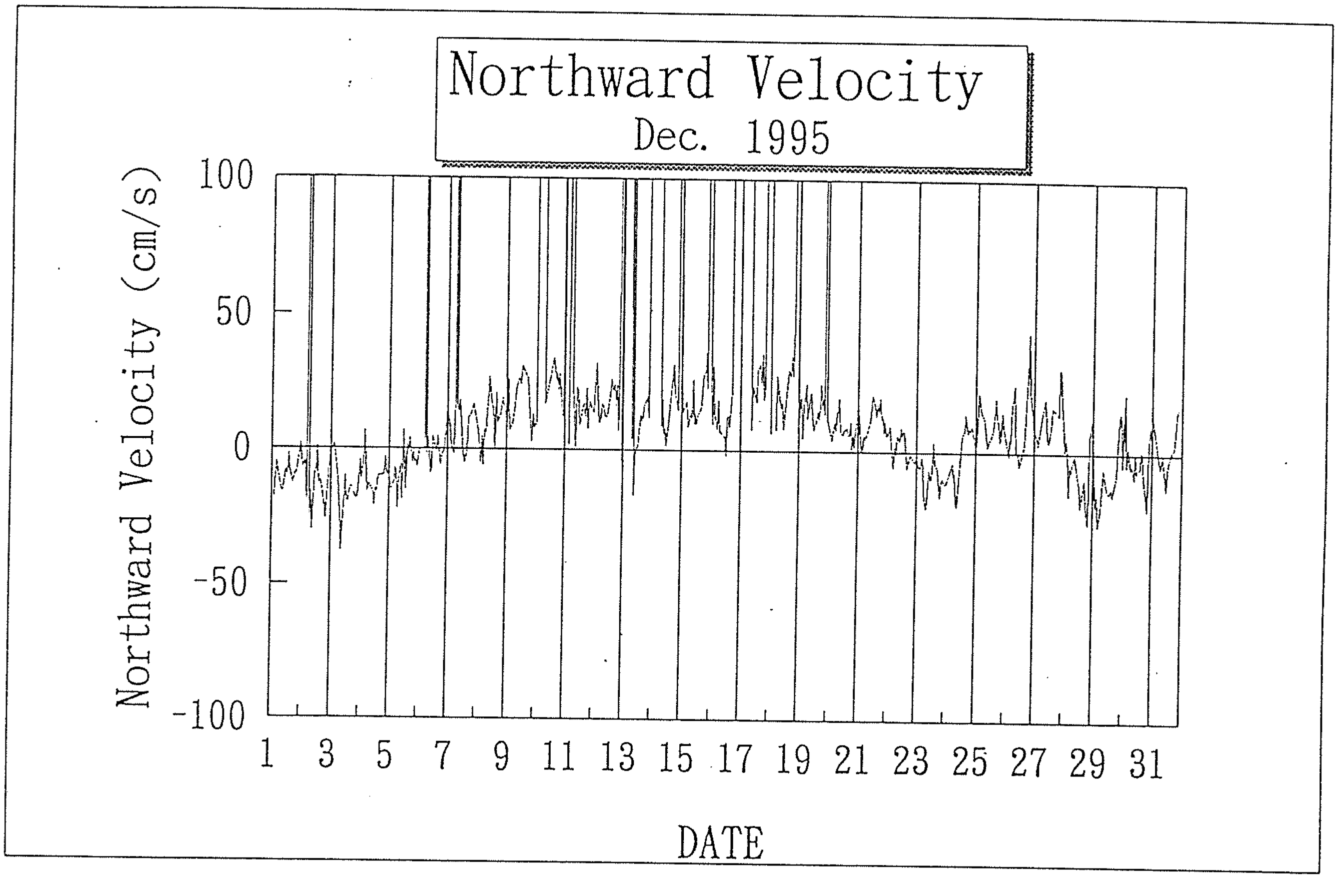


Fig 7-54 Time Serise of Velocity



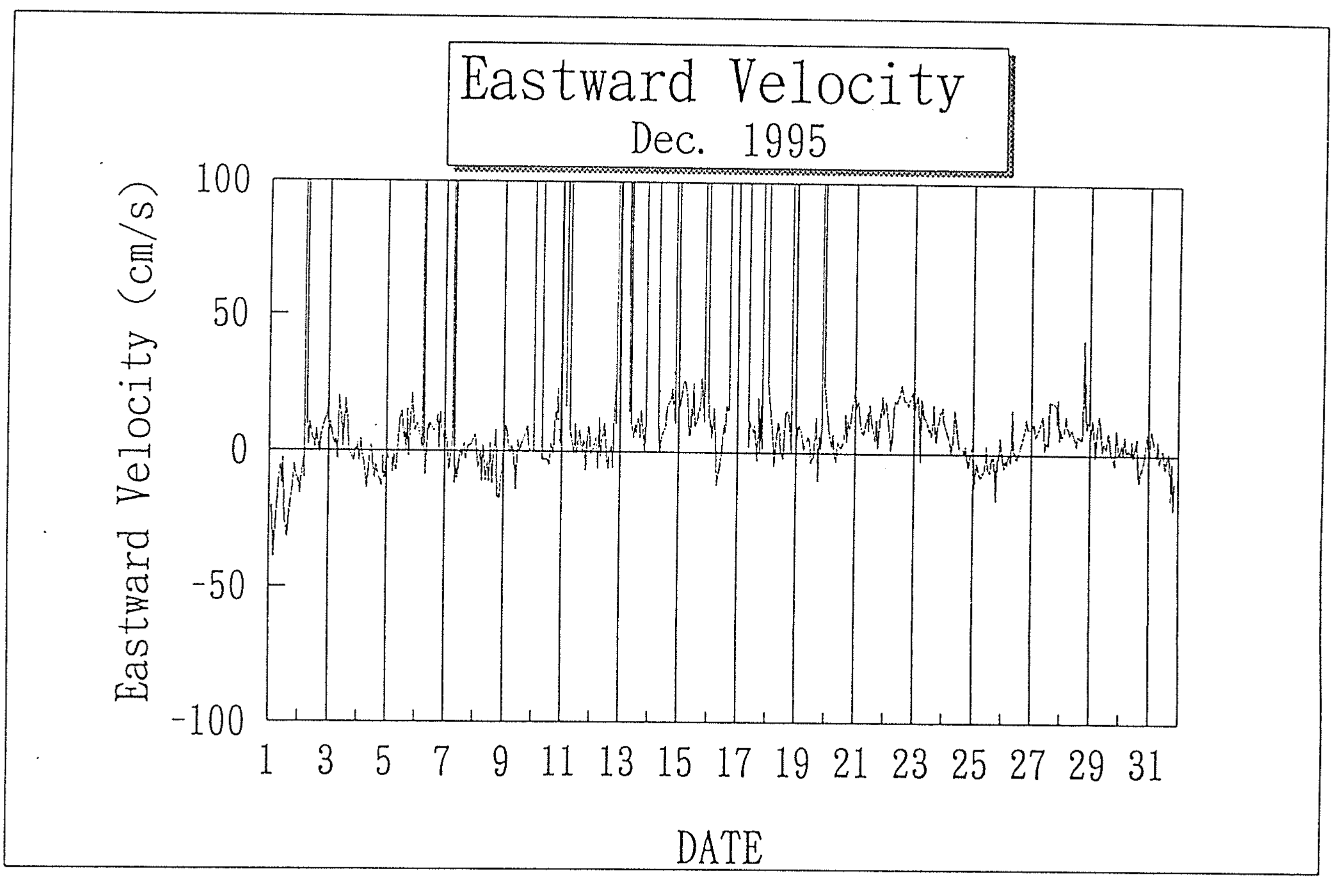
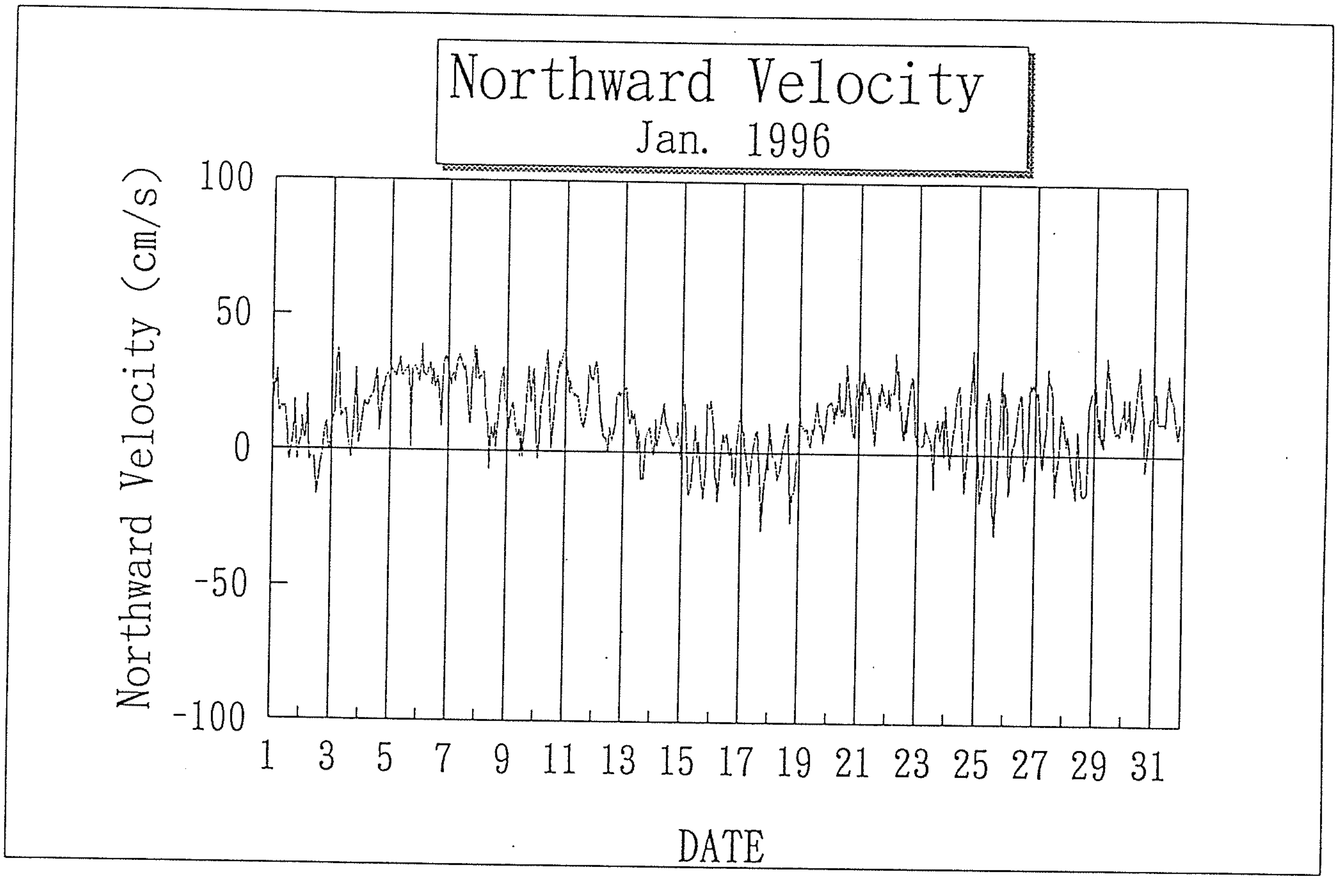


Fig 7-55 Time Serise of Velocity



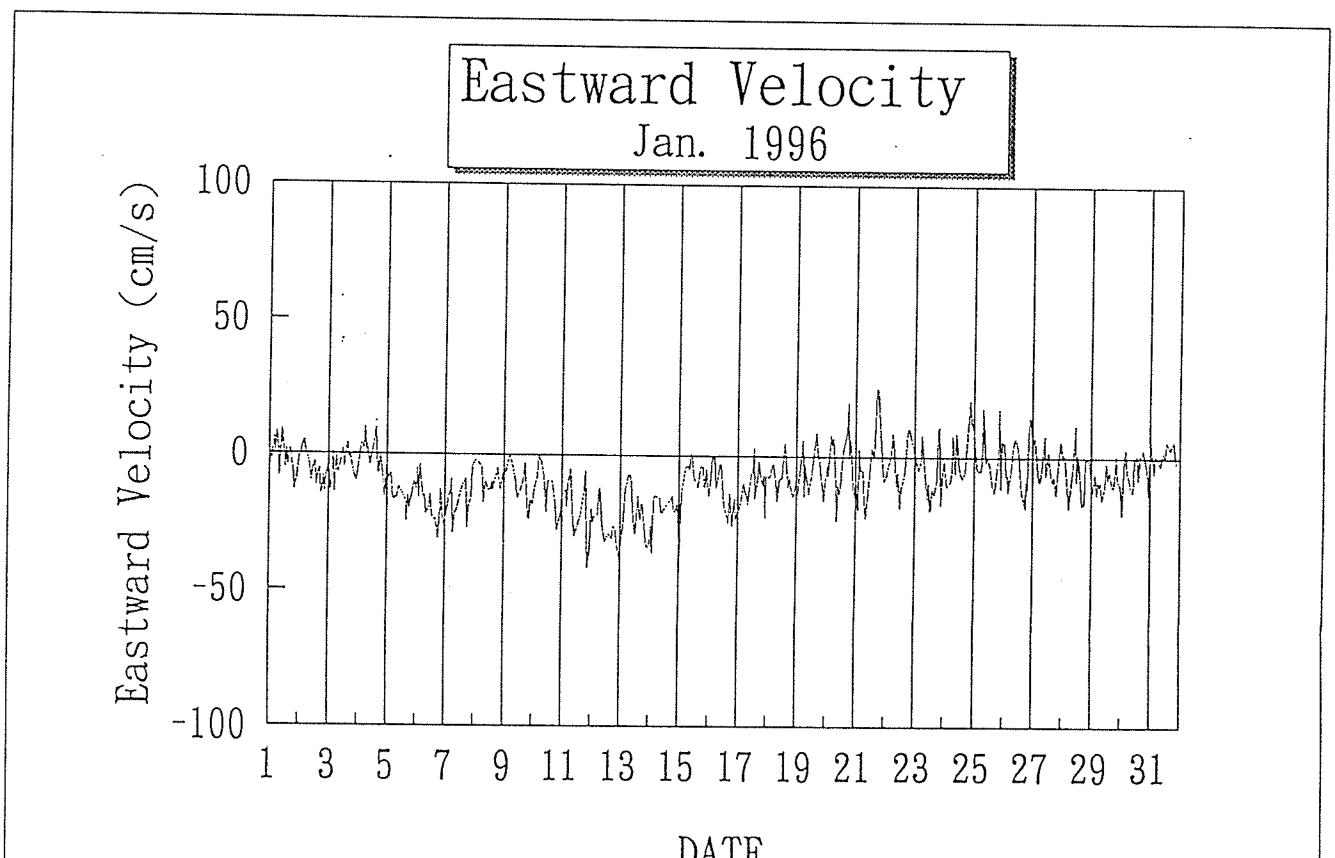
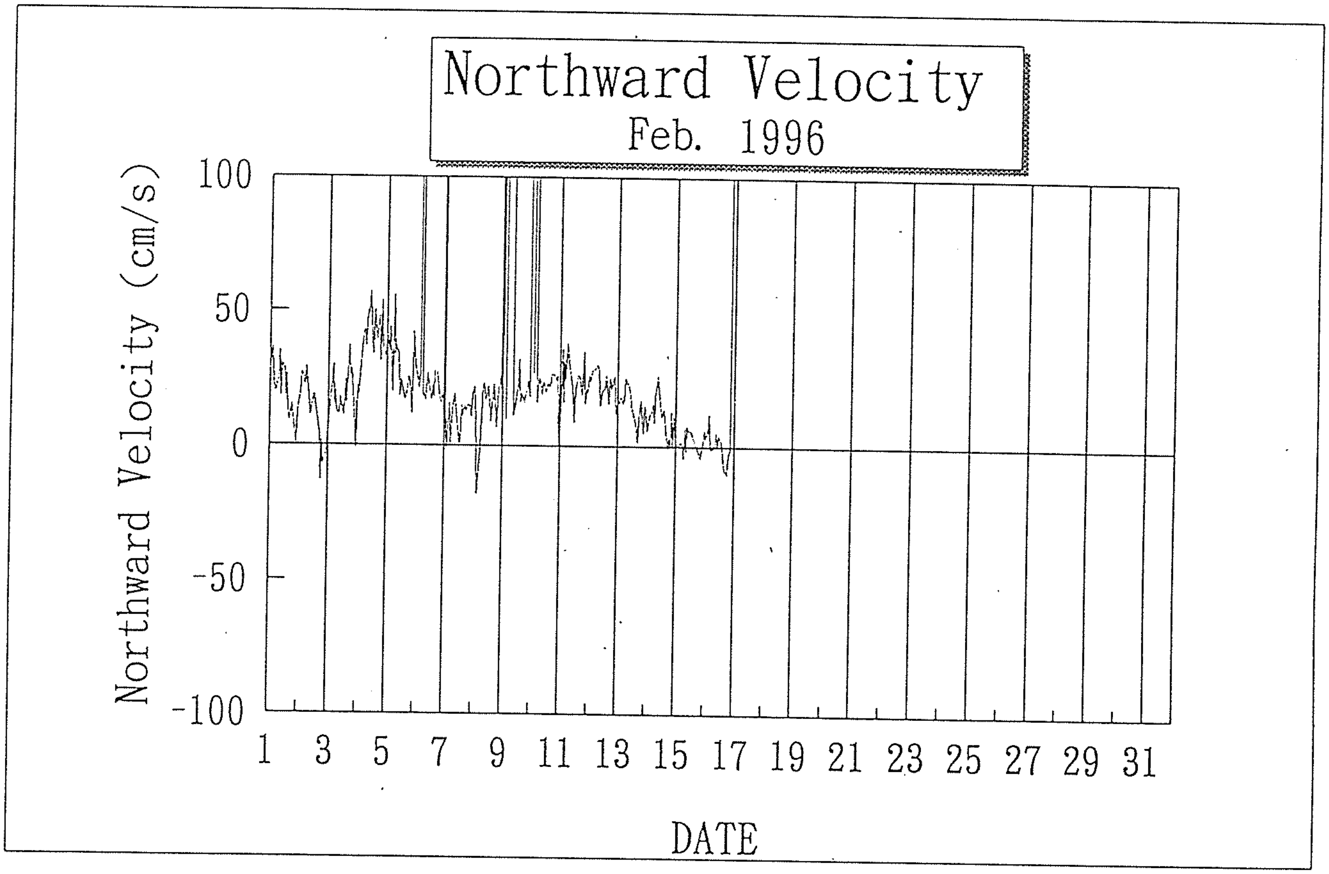


Fig 7-56 Time Serise of Velocity



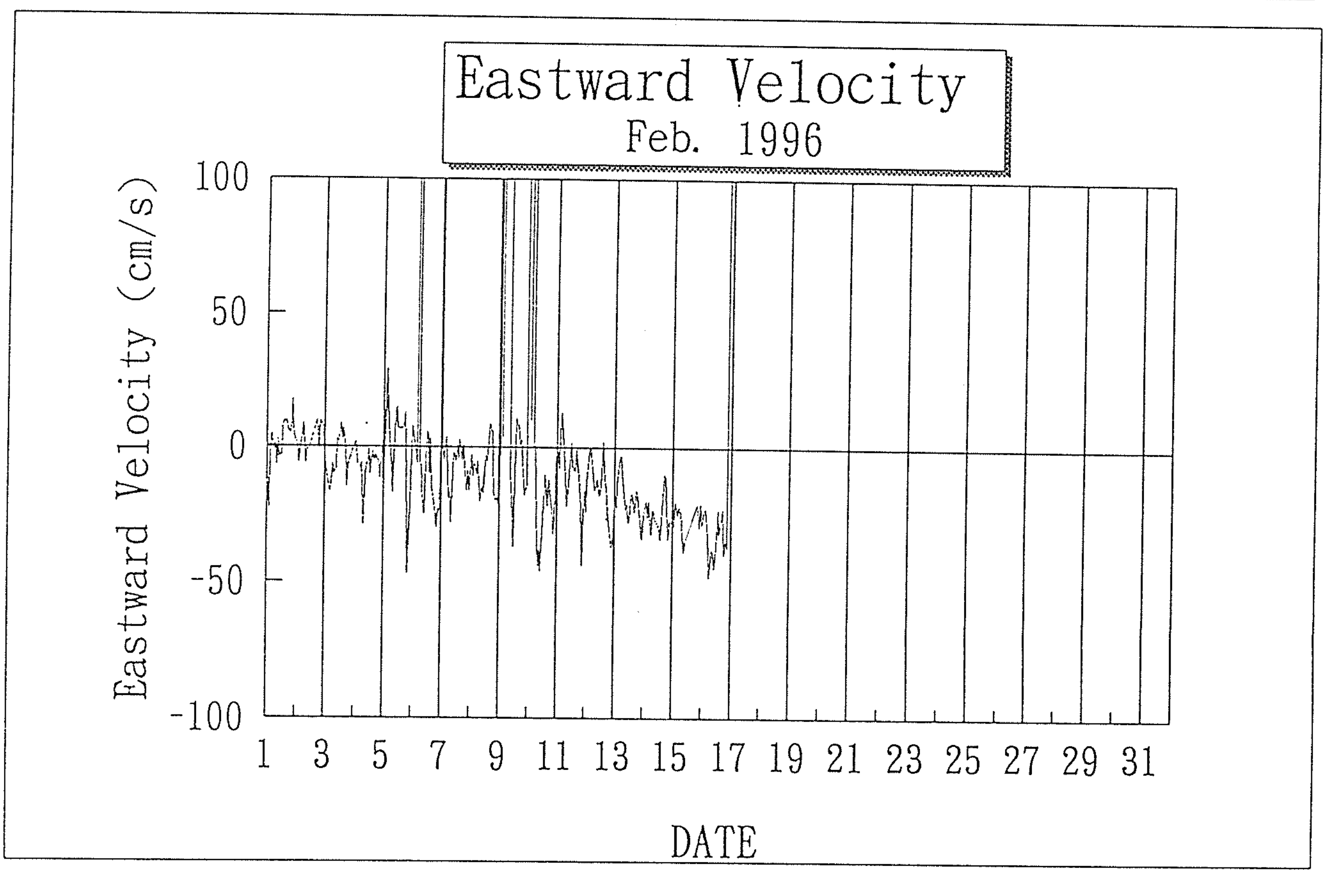


Fig 7-57 Time Serise of Velocity

Table 7-1

DEPLOYMENT & RECOVERY

MOORING No. 950104-00N147E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	A. ITO
POSITION	00° N 147° E	(R)	
DEPTH	4490m		
PERIOD	1995.01.04 ~ 1996.	NAVIGATION SYSTEM :	WGS 84
No.of DAYS	365		
LENGTH :	4149.1 m	DEPTH of BUOY : 270 m	BUOYANCY : kg

ACOUSTIC RELEASER

TYPE (上)	865A-DB-13	TYPE (下)	865A-DB-13
S/N	634	S/N	631
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	OK	TEST on DECK	OK

DEPLOYMENT

DATE 1995.01.04 20:50 ~ 22:36 SHIP KAIYO CRUSE No. K94-06

WEATHER bc CONDITIONS 1.0m 8.8 DIR. of WIND 40° VEL. of WIND 4.5m

DEPTH 4466 m DEPTH of A.R. 4451 m DESCEND. RATE m/s BUOY 20:55

POS. of SHIP 00° 00.855S 146° 57.721 E HOR.RANGE 1414 m SINKER 22:36

POS. of DEP. 00° 01.412S 146° 57.279 E DIRECTION ° DISAPPEAR. :

POS. of MOORING 00° 01.391S 146° 57.170E LANDING :

NOTE

リリーサーが眠っていたため着底までの追跡できず。
先端ブイ水没の確認は太陽光によってできず。

SSBL	TIME	S/R	DEPTH

RECOVERY

DATE 1996.02.11 20:24 ~ 23:15 SHIP KAIYO CRUSE No. K96-01

WEATHER bc CONDITIONS 2 DIR. of WIND 115° VEL. of WIND 5.0m

START of RELEASE 20 : 32 FINISH of RELEASE 20:31 :

POS. of DISCOVERY 00° 01.3 S 146° 56.6E ASCENDING RATE m/s

DIRECTION 086° DISTANCE 925 m

NOTE

ベントスガラス玉 200m付近で浮上停止
ケブラーロープ3000m分巻き上げた時 水面に浮上
20 51 ~ 20 55, 21:00 ~ 21:04, 21:06 ~ 終了迄
コンピュータ ハングアップの為 トランポンダ位置, 水深不明.

SSBL	TIME	S/R	DEPTH

TIME RECORD

Table 7-2

MOORING NO.: 950105-00N147E

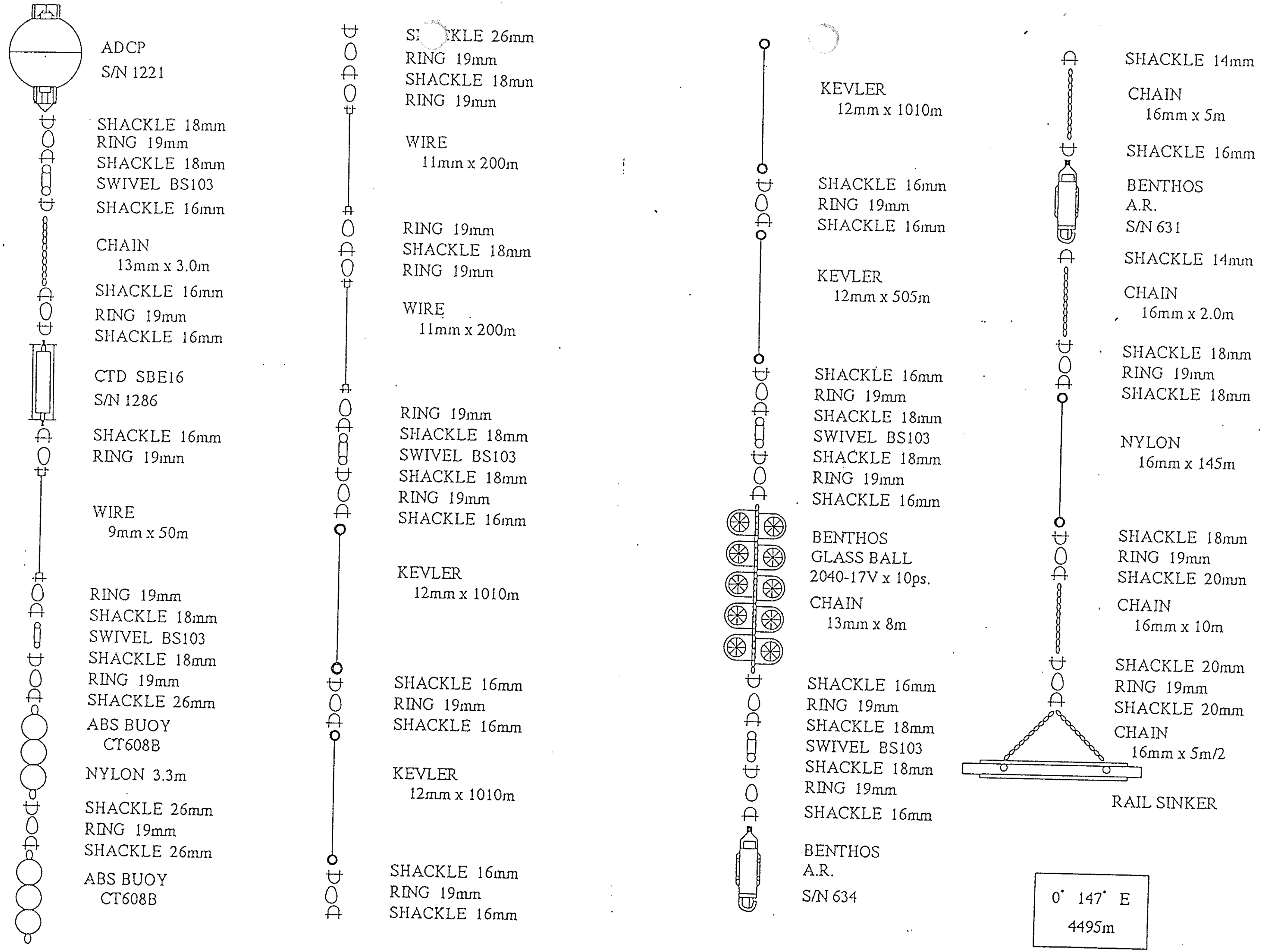
		DEPLOYMENT		RECOVERY (Date: 96.02.11)	
		START : 20:50 FINISH: 22:36		START: 20.29 FINSH: 23:15 UTC.	
ITEMS	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	1221	20:55		21:58	
CTD	1282	20:55		22:03	
WIRE ROPE	50m	20:58		22:05~22:07	
ABS BUOY	CF-608B ×6	21:03		22:09	
WIRE ROPE	200m	21:05~21:10		22:12~22:15	
WIRE ROPE	200m	21:12~21:15		22:17~22:20	
KEVLER ROPE	1010m	21:20~21:31		22:23~22:40	
KEVLER ROPE	1010m	21:33~21:41		22:42~08:56	
KEVLER ROPE	1010m	21:45~21:55		22:58~23.07	巻き上げた時 ガラス玉水面
KEVLER ROPE	505m	21:57~22:03		23.10~23.13	
GLASS BALL	2040-17V ×10	22:09		23:14	
A.R.	634	22:09		23:15	
A.R.	631	22:10		23:15	
NYLON ROPE	145m	22:10~22:13			
CHAIN	10m	22:31	22:15~22:25 航走		
ANCHOR		22:36			

GLASS BALLは回収したものを使用せず、全て新品を使用
NYLON ROPEは設計より30m短くする。

ENABLE 20:29
RELESE 20:32
ADCPブイ水面 20:35
作業艇降下 21:28
ブイにロープ 21:50
ベントスガラス玉、水面まで浮上せず.
Tブラー 3000m分巻き上げた時
水面に浮上.

Fig 7-58

7.62



Mooring No. 950104-00N147E

Table 7-3

DEPLOYMENT & RECOVERY

MOORING No. 950107-00N142E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	Y. KURODA
POSITION	0°, 142°E	(R)	
DEPTH	3390m		
PERIOD	1995.01.07 ~ 1996.02.17	NAVIGATION SYSTEM :	WGS 87
No.of DAYS	400		

LENGTH : m DEPTH of BUOY : m BUOYANCY : kg

ACOUSTIC RELEASER

TYPE (上)	865ADB-13	TYPE (下)	865A-DB-13
S/N	635	S/N	662
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	14.5 kHz	TRANSMIT F.	13.5 kHz
ENABLE C.	G	ENABLE C.	B
RELEASE C.	F	RELEASE C.	A
BATTERY	2 year	BATTERY	2 year
TEST on DECK	OK	TEST on DECK	OK

(00°-00.017N. 141°-59.022E

DEPLOYMENT

DATE	1995.01.07 04:00~05:23	SHIP	KAIYO	CRUSE No.	K94-06
WEATHER	C. 9 CONDITIONS 1.8m 8.4sec	DIR. of WIND	280	VEL. of WIND	9 m/s
DEPTH	3390 m DEPTH of A.R. m	DESCEND. RATE	2.8 m/s	BUOY	04:02
POS. of SHIP	00°00.017N 141°58.518E	HOR.RANGE	930 m	SINKER	05:23
POS. of DEP.	00°00.015N 141°59.020E	DIRECTION	90°	DISAPPEAR.	:
POS. of MOORING	00°00.017N 141°58.862E			LANDING	05:43

NOTE

Start : 00-00.106N, 142°-00.754E 3357m 4:00 1.8kt.
Kevler : 00-00.056N, 142°-00.496E 3386m 4:23 1.9kt.
Nylon : 00-00.068N, 141°-59.368E 3394m 4:59 2.3kt.

SSBL	TIME	S/R	DEPTH

RECOVERY

DATE	1996.02.16 22:00~02.17 00:04	SHIP	KAIYO	CRUSE No.	K96-01
WEATHER	r CONDITIONS 3	DIR. of WIND	230°	VEL. of WIND	14 m/sec
START of RELEASE	22:00	FINISH of RELEASE	22:03		
POS. of DISCOVERY	00°00S 141°58.9E			ASCENDING RATE	m/s
DIRECTION	356°	DISTANCE	23/ m		

NOTE

リリースは新しい方の船上局で行った.

SSBL	TIME	S/R	DEPTH

TIME RECORD

Table 7-4

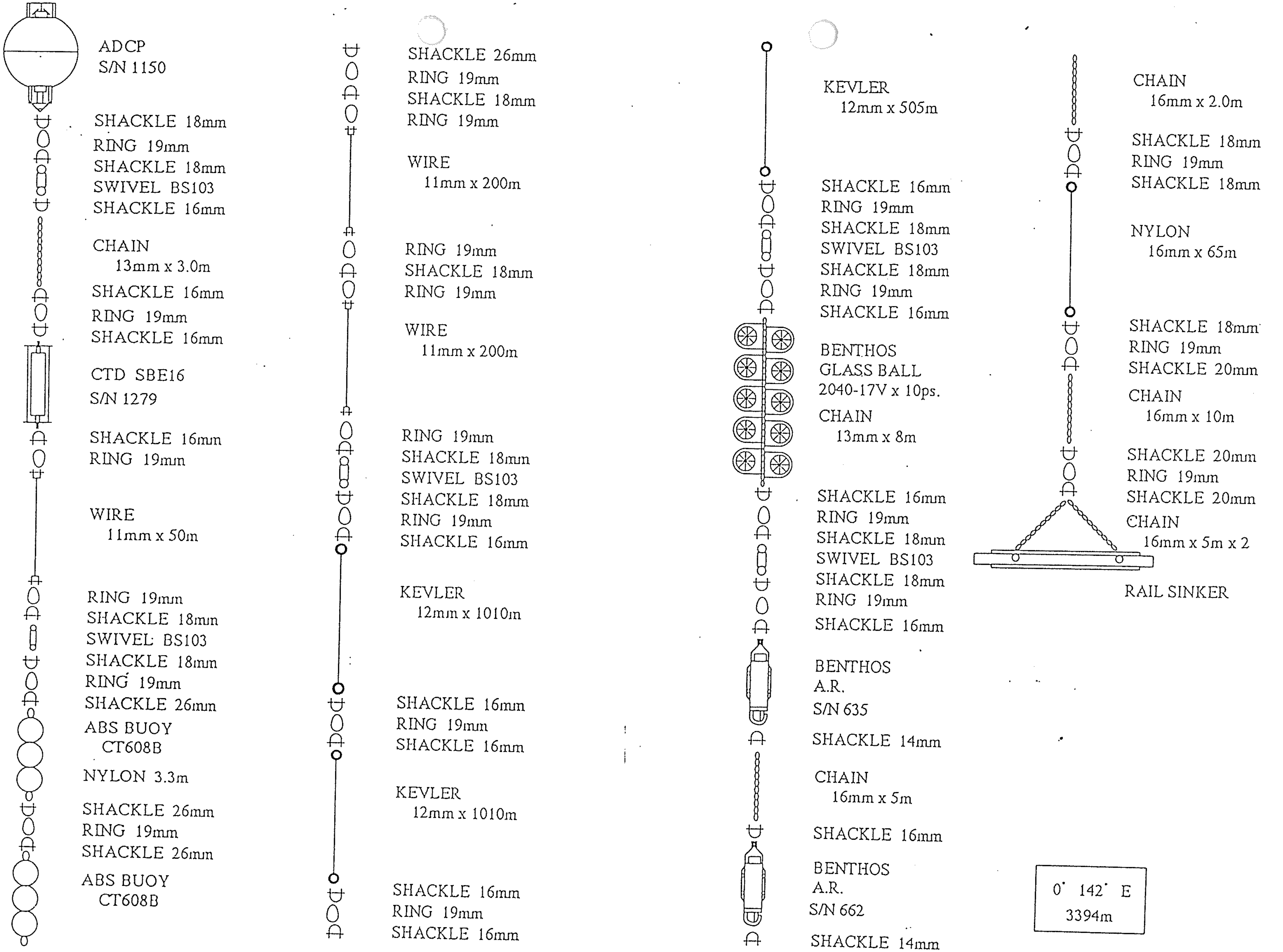
MOORING NO.: 950107-00N142E

		DEPLOYMENT		RECOVERY (Date: 96.02.16)	
		START: 04:00 FINISH: 05:23		START: 23:06 FINSH: 00:04 UTC	
ITEMS	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	1150	04:02		23:06	
CTD	1279	04:02		23:11	
WIRE ROPE	50m	04:03~04:04		23:12~23:14	
ABS BUOY	CT-608B x 6	04:08		23:16	
WIRE ROPE	200m	04:10~04:14		23:18~23:21	
WIRE ROPE	200m	04:17~04:21		23:22~23:24	
KEVLER ROPE	1010m	04:24~04:36		23:26~23:40	
KEVLER ROPE	1010m	04:38~04:49		23:42~23:55	
KEVLER ROPE	505m	04:50~04:56		23:57~00:02	
GLASS BALL	2040-17V x 10	05:04		00:03	
A.R.	635	05:04		00:04	
A.R.	662	05:04		00:04	
NYLON ROPE	65m	05:04~05:05	05:06 ~05:16 航走		
CHAIN	10m				
ANCHOR		05:23			

04:00のADCP作動確認後 投入
147°Eと同位置で回収したシャックル、リング、スウィベル、チェーンを再使用する。
アンカーレッコの時、ふれ止めを切り離すところをストーンフックを切り離してしまった。

ENABLE 22:00
RELEASE 22:02
作業艇降下 22:40
ブイにロープ 22:51

Fig 7-59



Mooring No. 950107-00N142E

7.65

Table 7-5

DEPLOYMENT & RECOVERY

MOORING No. 960212 - 00N147E

PROJECT	TOCS	TIME	UTC
AREA	熱帯赤道	RECORDER (D)	M. FUJISAKI
POSITION	00°N 147°E	(R)	
DEPTH			

PERIOD 1996.02.12 ~ NAVIGATION SYSTEM : WGS84

No.of DAYS

LENGTH : 4189.5 m DEPTH of BUOY : 294.6 m BUOYANCY : kg

ACOUSTIC RELEASER

TYPE (上)	865A-DB-13	TYPE (下)	865A-DB-13
S/N	632	S/N	693
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	14.0 kHz	TRANSMIT F.	14.5 kHz
ENABLE C.	D	ENABLE C.	F
RELEASE C.	C	RELEASE C.	E
BATTERY	2 YEARS	BATTERY	2 YEARS
TEST on DECK	OK	TEST on DECK	OK

DEPLOYMENT

DATE 1996.02.12 21:51~23:23 SHIP KAIYO CRUSE No. K96-01

WEATHER C CONDITIONS 3 DIR. of WIND NNE VEL. of WIND 4m

DEPTH 4345 m DEPTH of A.R. m DESCEND. RATE m/s BUOY :

POS. of STRT 00° 01.273S 146° 50.749E HOR.RANGE m

POS. of DEP. 00° 00.412N 146° 53.029E SINKER 23 : 23 DISAPPEAR. :

POS. of MOORING 00° 00.571 N 146° 52.860E LANDING 23 : 49

NOTE

SN693のA.R.の反応よりもSN632の方が良かったため追跡はSN632で行った。

ATLAS設置ポイント(00°00.02N, 146°59.861E)より約7マイル西に設置。

	TIME	S/R	DEPTH
SSBL			

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

	TIME	S/R	DEPTH
SSBL			

TIME RECORD

Table 7-6

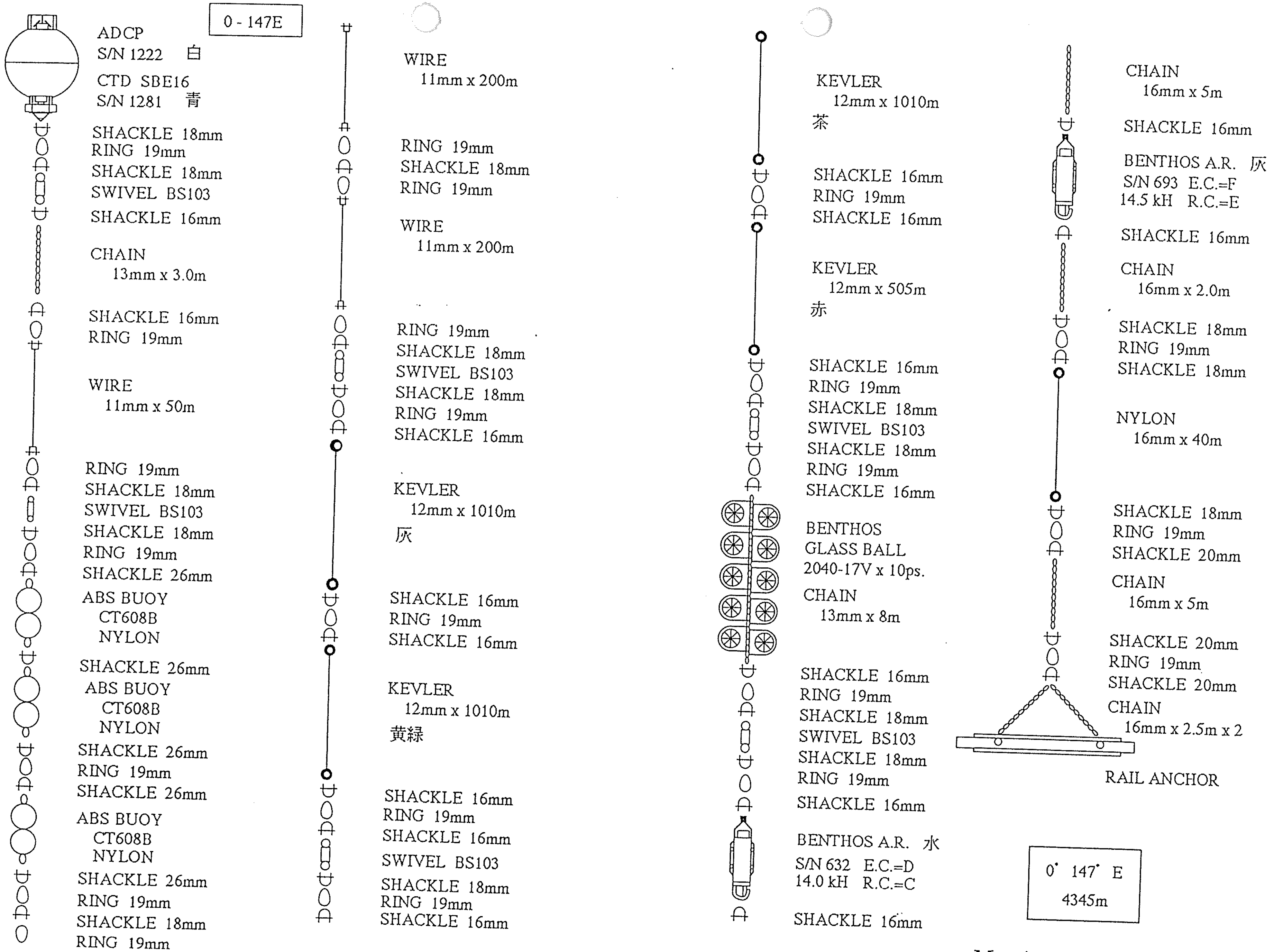
MOORING NO. 960212-00N147E

		DEPLOYMENT		RECOVERY (Date:)	
		START : 21:51 FINISH : 23:23		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	1222	21:53			
CTD		21:53	ADCPブイに取り付け		
WIRE ROPE	50m	21:54~21:55			
ABS BUOY	2連	21:56			
〃	2連	21:56			
〃	2連	21:56			
WIRE ROPE	200m	21:57~21:59			
〃	200m	22:03~22:06			
KEVLER ROPE	1010m	22:10~22:25			
〃	1010m	22:27~22:42			
〃	1010m	22:44~22:57			
〃	500m	22:59~23:07			
Benthos Glass Ball	10	23:11			
A.R.	632	23:11			
〃	639	23:12			
NYLON ROPE	40m	23:16~23:17			
ANCHOR		23:23			

NYLON
基本設定 160m → 40m で設置

Fig 7-60

7.68



Mooring No. 960212-00N147E

Table 7-7

DEPLOYMENT & RECOVERY

MOORING No. 960217 - 00N 142E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	M. FUJISAKI
POSITION	00° N 142° E	(R)	
DEPTH	3394 m		
PERIOD	1996. 02. 17 ~	NAVIGATION SYSTEM :	WGS 84
No.of DAYS			

LENGTH : 3101 m DEPTH of BUOY : 293 m BUOYANCY : kg

ACOUSTIC RELEASER

TYPE (上)	865A - DB-13	TYPE (下)	865A - DB-13
S/N	630	S/N	691
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.	D
RELEASE C.	A	RELEASE C.	C
BATTERY	2 YEAR	BATTERY	2 YEAR
TEST on DECK	OK	TEST on DECK	OK

DEPLOYMENT

DATE 1996. 02 17 01:02 ~ 02:04 SHIP KAIYO CRUSE No. K96-01

WEATHER C CONDITIONS 3 DIR. of WIND 270° VEL. of WIND 6.0m/sec

DEPTH 3380 m DEPTH of A.R. 3215 m DESCEND. RATE m/s BUOY 01 : 02

POS. of STRT 00° 00.033S 142° 02.782E HOR.RANGE m

POS. of DEP. 00° 00.032S 142° 00.309E SINKER 02:04 DISAPPEAR. :

POS. of MOORING 00° 00.093S 142° 00.240E LANDING 02 : 24

NOTE

・ガラス玉は同ポイントで回収したものを使用
チェーンは交換せず。インシュロック交換。
・ナイロンロープ
170m → 158m

SSBL	TIME	S/R	DEPTH

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

TIME RECORD

Table 7-8

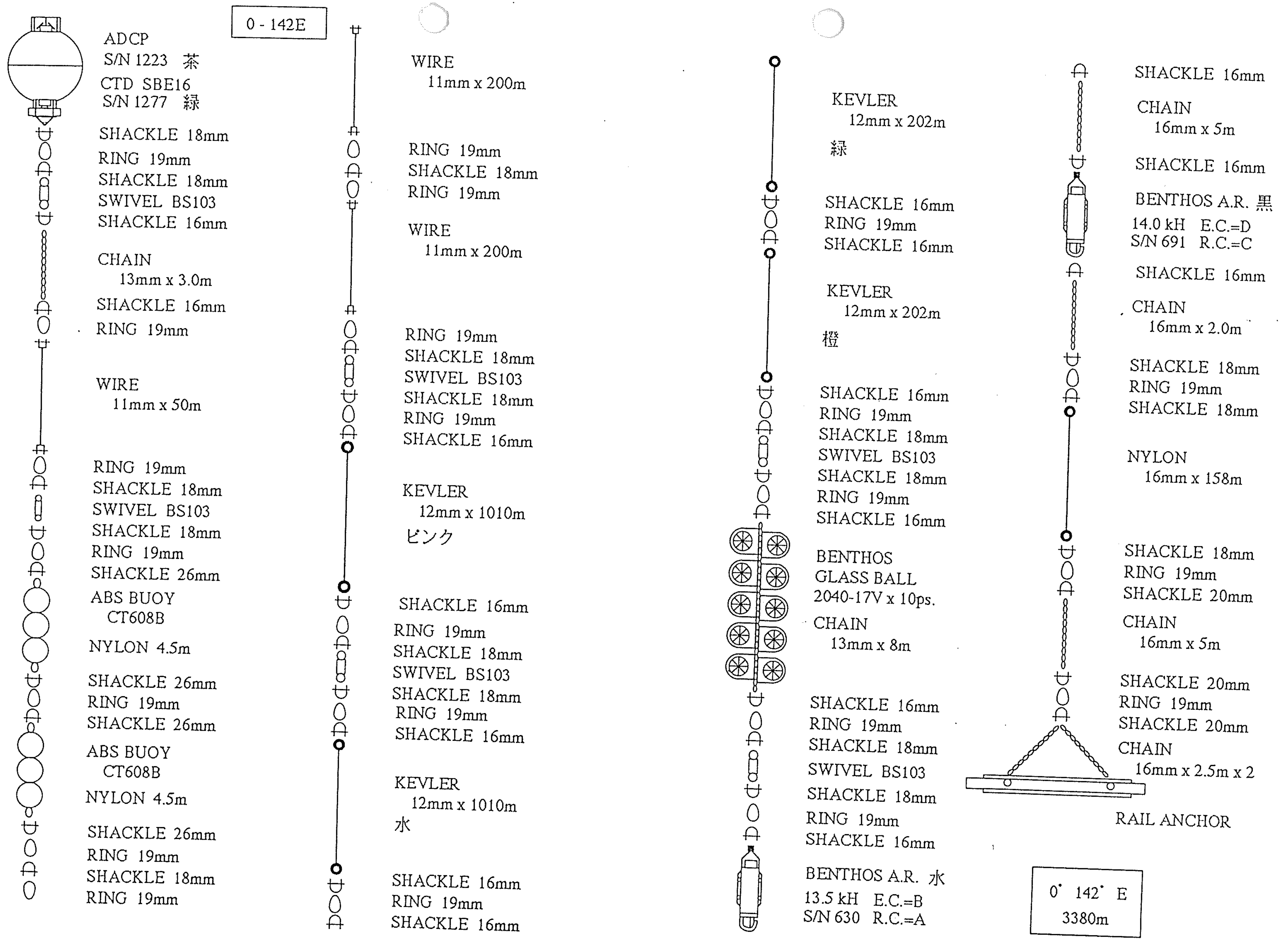
MOORING NO. 960217-00N142E

		DEPLOYMENT		RECOVERY (Date:)	
		START : 01:02 FINISH : 02:04 UTC		START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	1223	01:02			
CTD	1277	01:02			
WIRE ROPE	50m	01:02~01:04			
ABS BUOY	3ps.	01:05			
"	3ps.	01:05			
WIRE ROPE	200m	01:06~01:09			
"	200m	01:11~01:17			
KEVLER ROPE	1010m	01:19~01:31			
"	1010m	01:34~01:42			
"	200m	01:44~01:48			
"	200m	01:49~01:53			
Glass Ball	10ps.	01:54			
A. R.	630	01:55			
"	691	01:55			
NYLON ROPE	158m	01:56~01:58			
ANCHOR		02:04			

ナイロンロープ
170m → 158m

Fig 7-61

7.71



Mooring No. 960217-00N142E

8. TAO Array Summary

NOAA/Pacific Marine Environmental Laboratory
TOCS Cruise Summary
RV Kaiyo

Participants: Andrew Shepherd
Steve Smith

Dates: January 24, to February 26, 1996

Ports: Majuro, Marshall Islands - Kavieng, Papua New Guinea - Koror, Palau

Overview:

PMEL participated in a joint cruise with JAMSTEC aboard the R/V Kaiyo to service the ATLAS moorings in the western Pacific of the Tropical Atmosphere-Ocean (TAO) array. Six ATLAS moorings, consisting of surface buoys with thermistor chains down to 500 meters were deployed at 2N, 165E; 8N and 2N, 156E; 0 and 2N 147E; 2 30N and 5N 137E. Two ATLAS moorings were sucessfully recovered from 2N 165E and 2N 147E. A current meter surface mooring, consisting of current meters, Seacats, MTRs and an Eppley radiation sensor, and a subsurface ADCP mooring were deployed at the equator at 165E. A PROTEUS mooring was also successfully recovered at the equator at 165E.

In addition to the scheduled cruise work the Kaiyo successfully serviced the surface instrumentation at two ATLAS mooring sites, 2N and 0 156E. The 2N, 156E ATLAS required the replacement of the STI rain gauge sensor and the retreival of the data from the storage unit and the installation of a new battery. This was accomplished using only 2 hours of station time. The refurbishment of the rain gauge system was also required at 0, 156E along with the replacement of damaged instrumentation to the ATLAS system, retrieval of data from the AMP along with installation of a new battery, and the replacement of the Eppley radiation sensor. This work was completed in only three hours of ship time.

During the cruise the Kaiyo deviated from it's cruise tract and recovered an ATLAS surface buoy(ET-353) which had broken lose and drifted from it's moored position. This was successfully completed within 3 miles of the Purdy islands that lie south of Manus Island, PNG.

The only work that we were not able to accomplish which was scheduled was the recovery and deployment of the 7N, 137E ATLAS site. Due to weather this was impossible and will be done by another ship sometime in the future.

Operations:

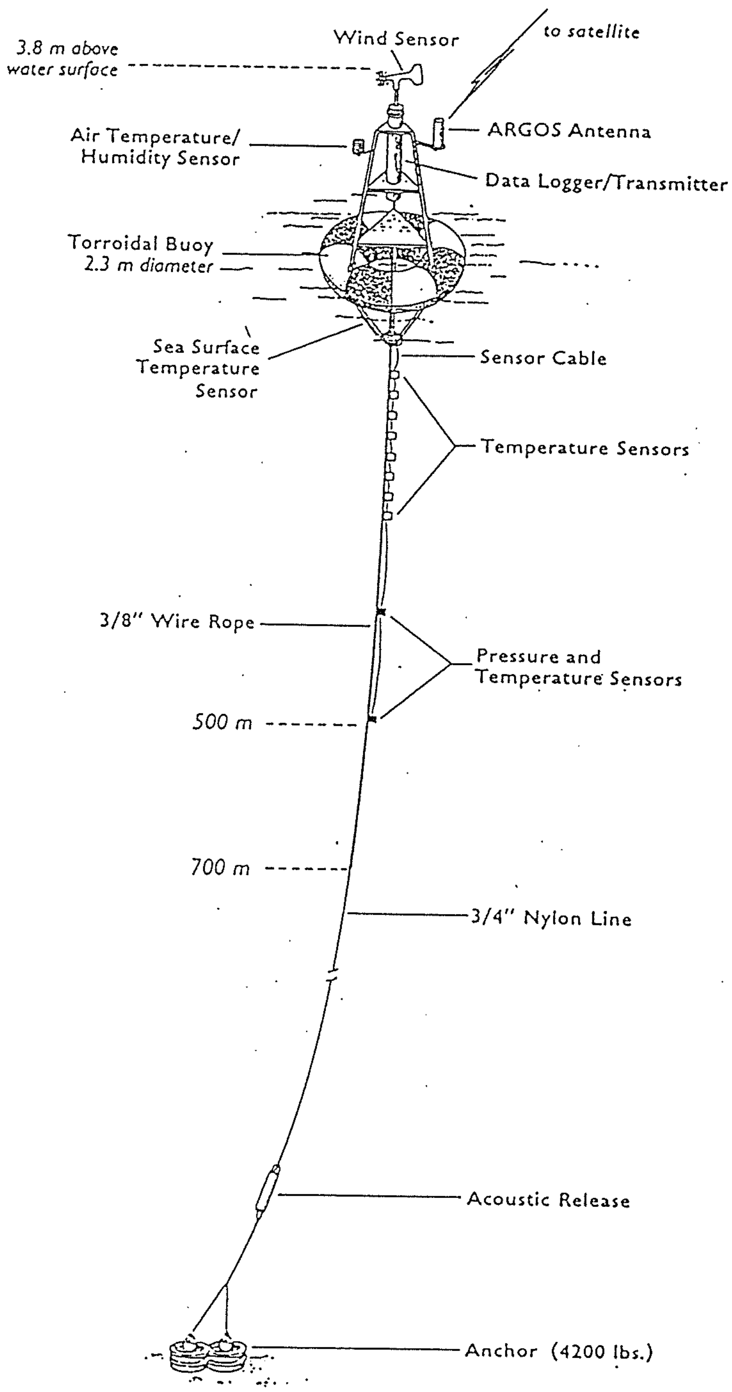
MOORING	TIME/DATE	LOCATION	OPERATION
ET-309	02:13 1/27/96	02 00.28N, 165 02.34E	Recovery
ET-375	22:47 1/27/96	01 59.78N, 164 58.70E	Deployment
TC-5	19:43 1/28/96	00 00.53N, 165 00.85E	Recovery
WA-01	03:25 1/29/96	00 00.01S, 165 06.07E	Deployment
WM-01	22:28 1/29/96	00 00.10N, 165 00.70E	Deployment
ET-376	23:48 2/01/96	07 59.90N, 155 59.82E	Deployment
ET-343	22:00 2/03/96	01 59.81N, 156 05.04E	Rain Gauge Refurbishment
ET-342	20:00 2/04/96	00 00.74N, 156 10.06E	AMP & Rain Gauge Refurb
ET-353	23:20 2/10/96	02 46.00S, 146 22.88E	Drifter Recovery
ET-377	04:48 2/12/96	00 00.11N, 146 59.22E	Deployment
ET-307	21:05 2/13/96	02 00.01N, 147 00.93E	Recovery
ET-378	04:39 2/14/96	02 00.05N, 146 59.70E	Deployment
ET-379	01:20 2/22/96	02 26.33N, 137 24.47E	Deployment

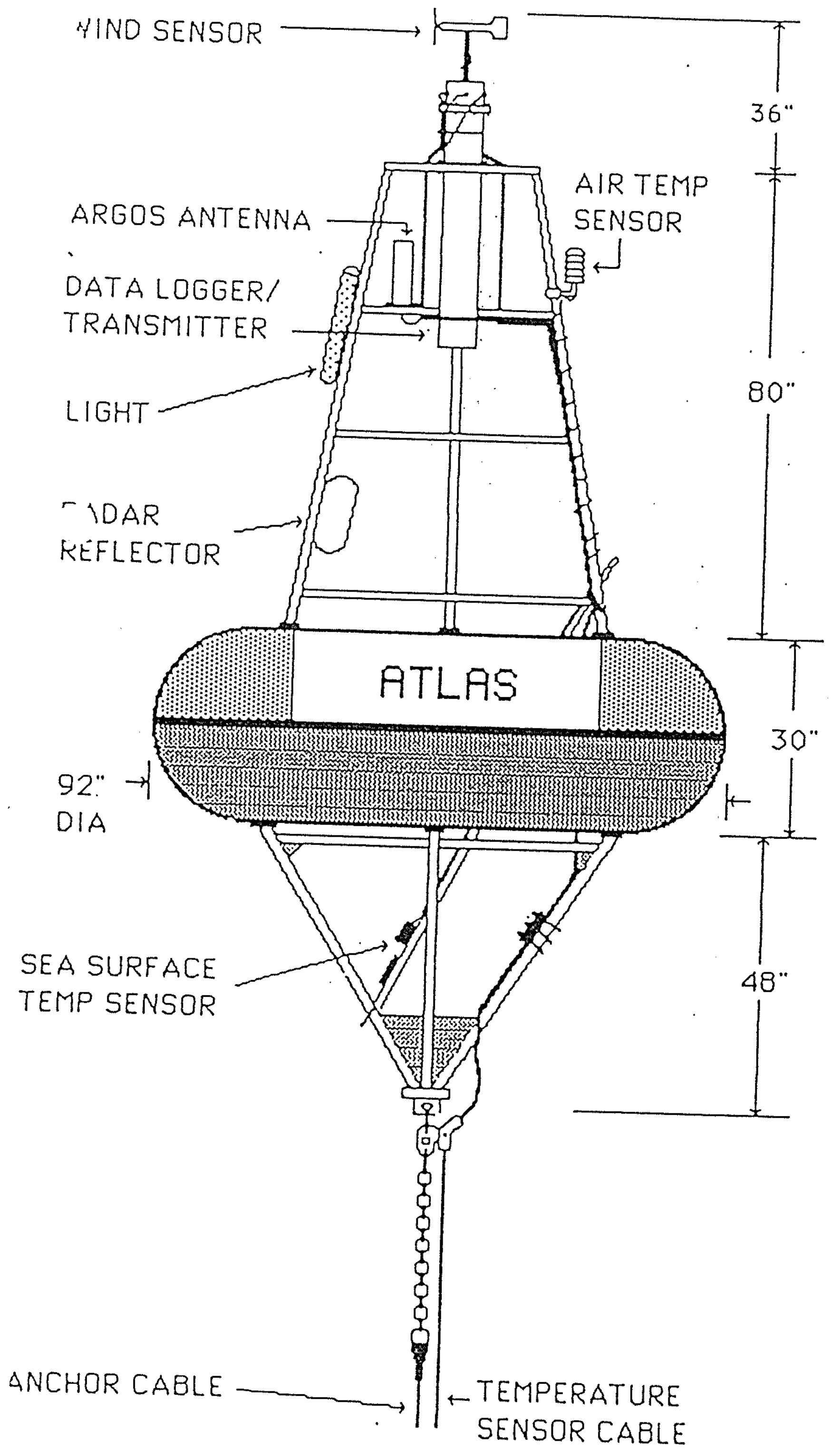
ET-380 01:47 2/23/96 04 59.87N, 136 58.16E Deployment

Acknowledgements:

On behalf of Dr. McPhaden and the TAO Project office I would like to thank the officers and crew of the Kaiyo for a very sucessful and enjoyable cruise. Mooring operations went extremely well. The crew expertly handled all the mooring operations in a very competent and professional manner. It was a pleasure working and sailing on the Kaiyo and Steve and I look forward to sailing with you in the future.

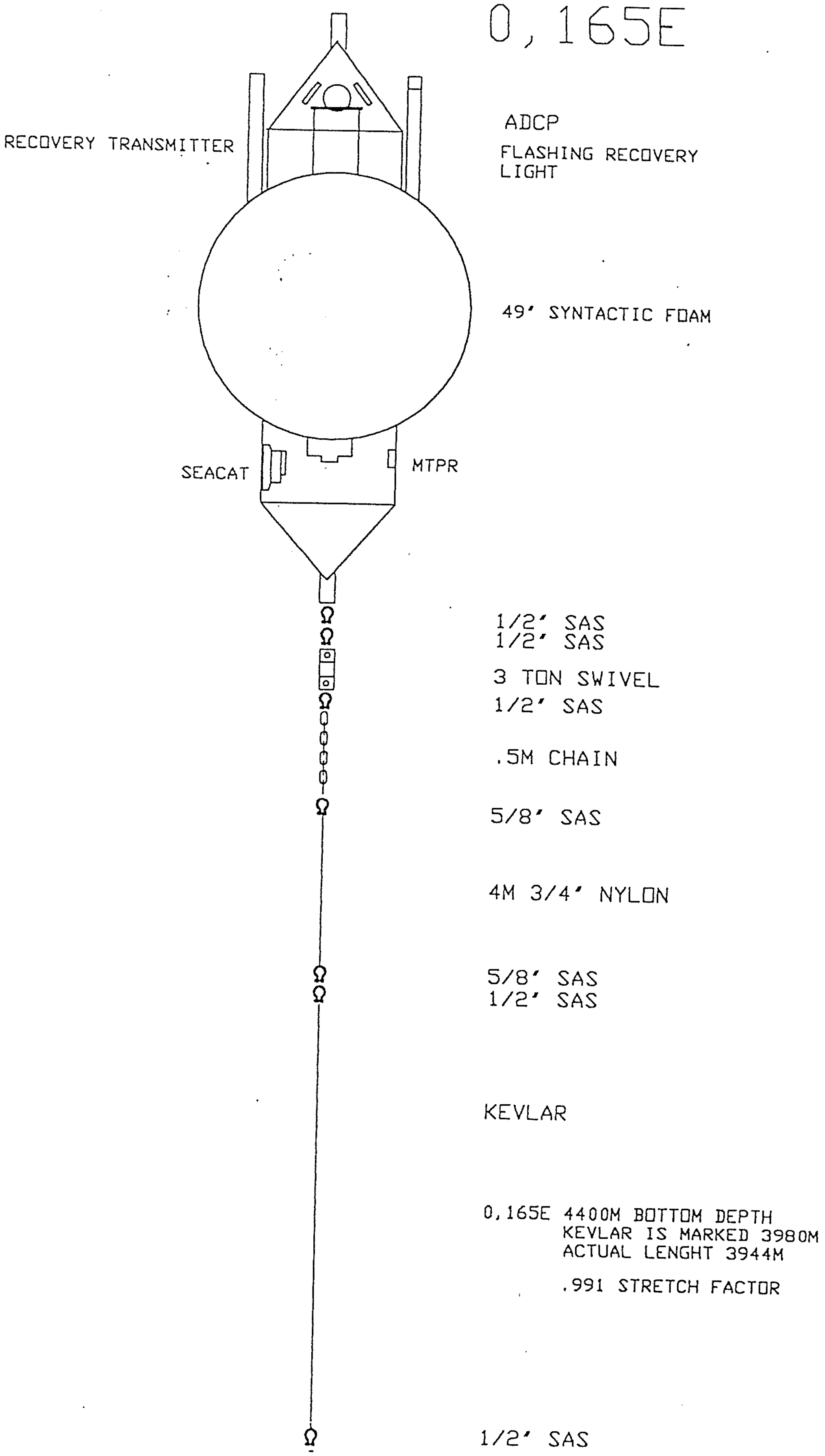
ATLAS MOORING

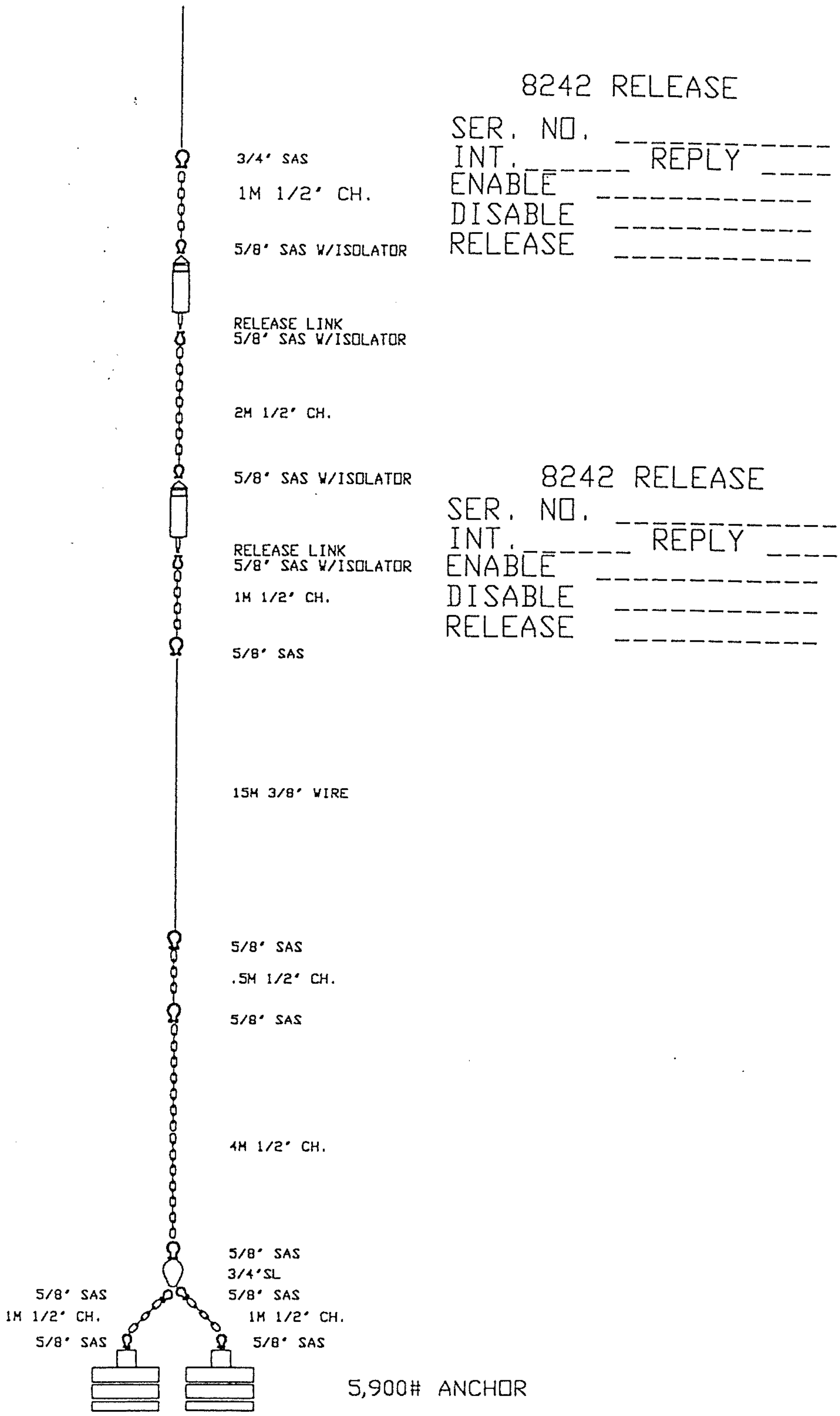


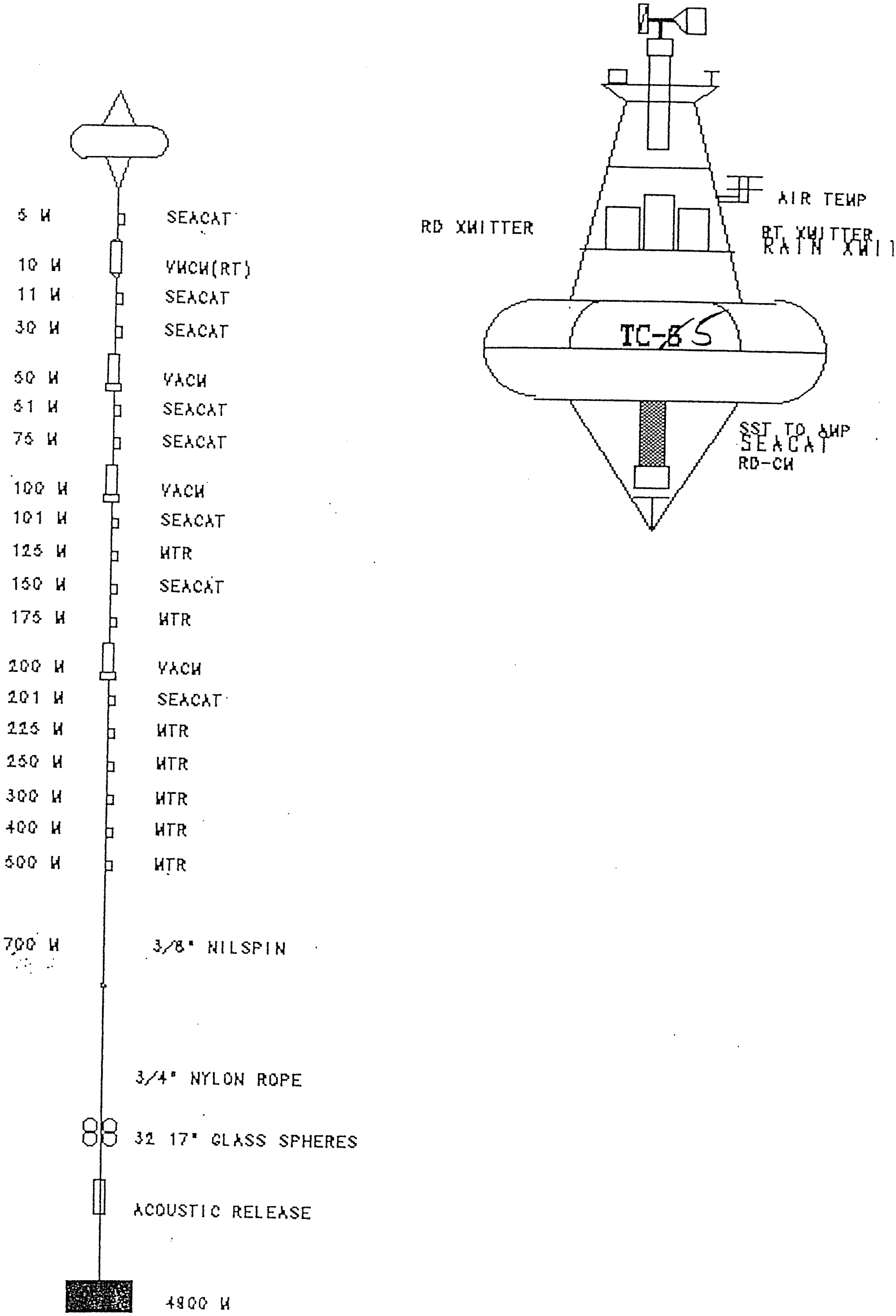


ATLAS MOORING

The ATLAS buoy is toroidally shaped fiberglas over foam with an aluminum tower and a stainless steel bridle. When completely rigged, the system shown has an air weight of approx. 500 pounds, a net buoyancy of nearly 4000 pounds, and an overall height of 16 feet. The wind sensor is installed after deployment to preven damage by the crane during the lifting process.


0, 165E
RECOVERY TRANSMITTER
ADCP
FLASHING RECOVERY LIGHT
49' SYNTACTIC FOAM
SEACAT
MTPR
1/2' SAS
1/2' SAS
3 TON SWIVEL
1/2' SAS
.5M CHAIN
5/8' SAS
4M 3/4' NYLON
5/8' SAS
1/2' SAS
KEVLAR
0,165E 4400M BOTTOM DEPTH
KEVLAR IS MARKED 3980M
ACTUAL LENGHT 3944M
.991 STRETCH FACTOR
1/2' SAS


8242 RELEASE
SER. NO. ___________
INT. ______ REPLY ____
ENABLE ___________
DISABLE ___________
RELEASE ___________
3/4' SAS
1M 1/2' CH.
5/8' SAS W/ISOLATOR
RELEASE LINK
5/8' SAS W/ISOLATOR
2M 1/2' CH.
5/8' SAS W/ISOLATOR
8242 RELEASE
SER. NO. ___________
INT. ______ REPLY ____
ENABLE ___________
DISABLE ___________
RELEASE ___________
RELEASE LINK
5/8' SAS W/ISOLATOR
1M 1/2' CH.
5/8' SAS
15M 3/8' WIRE
5/8' SAS
.5M 1/2' CH.
5/8' SAS
4M 1/2' CH.
5/8' SAS
3/4'SL
5/8' SAS
1M 1/2' CH.
5/8' SAS
5/8' SAS
1M 1/2' CH.
5/8' SAS
5,900# ANCHOR


5 M SEACAT
10 M VMCM(RT)
11 M SEACAT
30 M SEACAT
50 M VACM
51 M SEACAT
75 M SEACAT
100 M VACM
101 M SEACAT
125 M MTR
150 M SEACAT
175 M MTR
200 M VACM
201 M SEACAT
225 M MTR
250 M MTR
300 M MTR
400 M MTR
500 M MTR
700 M 3/8" NILSPIN
3/4" NYLON ROPE
32 17" GLASS SPHERES
ACOUSTIC RELEASE
4900 M
AIR TEMP
RD XMITTER
RT XMITTER
RAIN XMIT
TC-5
SST TO AMP
SEACAT
RD-CM

9. CO_2 measurements

9. 1 Patial pressure of CO_2 in the atmosphere and ocean

(1) Tittle

Distribution of atmospheric and oceanic CO_2 in the equatorial Pacific during January - February, 1996.

(2) Scientists

H. Yoshikawa[1)], M. Ishii[1)], T.Kitao[2)], and Y.Ishida[2)]
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Kansai Environmental Engineering Center Co.LTD. (KEEC)
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(3) Objective

Atmospheric CO_2, known as a greenhouse gas, has been increasing due to the emission of anthropogenic CO_2. It has increased approximately 25% in comparison with the pre-industrial era (280 ppm). In order to predict the level of atmospheric CO_2 in the future, it is necessary to better understand the present inventory among global carbon reservoirs: atmosphere, biosphere and ocean.

CO_2 exchange between the atmosphere and ocean plays an important role in determining the level of atmospheric CO_2. The difference in partial pressure of CO_2 between the ocean and the atmosphere (delta pCO_2) is the driving force for air/sea CO_2 exchange. Central equatorial Pacific acts as a source for atmospheric CO_2, but time and spatial distribution of delta pCO_2 is not enough to elucidate the interannual variation in CO_2 outflux. During this cruise, measurements of pCO_2 were made to study the interannual change CO_2 outflux from the ocean to the atmosphere in the equatorial Pacific regions.

(4) Method

Measurements of the CO_2 concentration in the background air and the equilibrated with surface seawater were made using the MRI CO_2 measuring system. Air sample was taken from the top of the bridge into the 2nd laboratory. Sea water was continuously taken from the bottom of the ship and then was introduced into the MRI equilibrator at the 2nd laboratory.

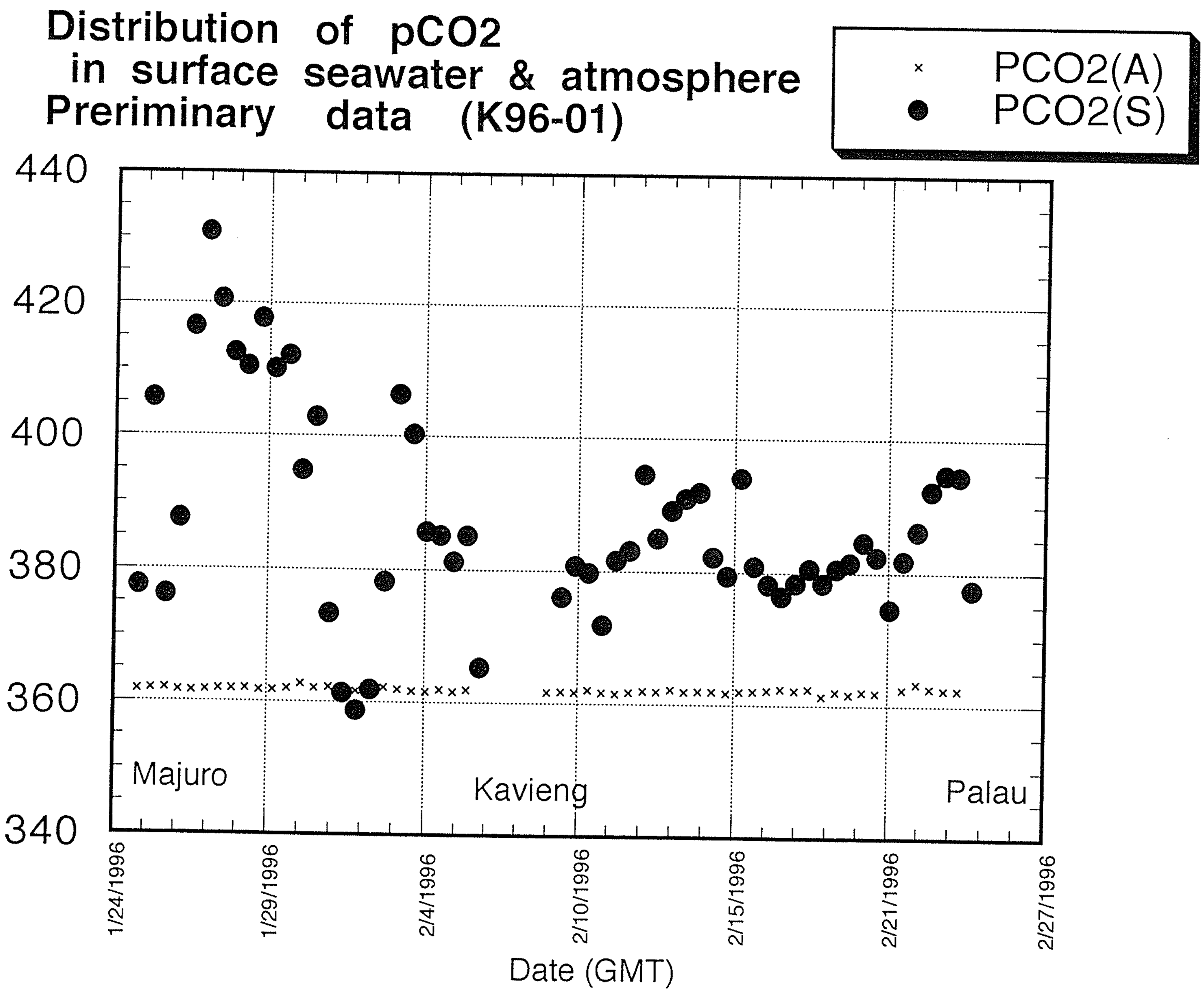
(5) Equipment

We used a non-dispersive infrared gas analyzer (BINOS 4, Germany) to determine the CO_2 concentration. CO_2 concentration will be published based on the WMO X85 mole fraction scale after this cruise, then the measurements in this report are tentative. Because four CO_2 calibration gases will be re-analayzed at our laboratory after this cruise to evaluate a concentration drift.

(6) Result

Figure 1 show geographical distributions of pCO_2 in air and surface seawater from Majuro to Kavieng and from Kavieng to Palau. Only two measurements in a day were tentatively calculated from the data set for every 1 hour.

9.03


Distribution of pCO2
in surface seawater & atmosphere
Preriminary data (K96-01)
PCO2(A)
PCO2(S)
pCO2 (ppm)
440
420
400
380
360
340
Majuro
Kavieng
Palau
1/24/1996
1/29/1996
2/4/1996
2/10/1996
2/15/1996
2/21/1996
2/27/1996
Date (GMT)

9.2 Total inorganic carbon in the ocean

(1) Tittle

Spatial variation of the total inorganic carbon in the equatorial Pacific during January - February, 1996.

(2) Scientists

M. Ishii[1)], H. Yoshikawa[1)], T. Kitao[2)], and Y. Ishida[2)]
[1)]Geochemical Research Department
Meteorological Research Institute (MRI)
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[2)]Department of Ocean Carbon Flux Study
Kansai Environmental Engineering Center Co.LTD. (KEEC)
2-3-39, Nakazakinishi, Kitaku, Osaka, 530 JAPAN

(3) Objective

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 surface seawater in the equatorial Pacific exhibits pronounced spatial and temporal variabilities as a result of the strong upwelling, biological activities, air-sea CO_2 exchange, etc. Coupling with pCO2(sea) data, we are aiming at describing the carbonate system in this region and clarify the factors those are responsible for its variation.

(4) Method

Surface seawater was pumped up continuously from the bottom of the ship and the portion of it was introduced (1L/min) into the MRI coulometric TCO_2 measuring system at the 2nd laboratory. TCO_2 and seawater temperature were automatically measured once every an hour.

TCO_2 in the standard seawater was also determined occasionally to calibrate system.

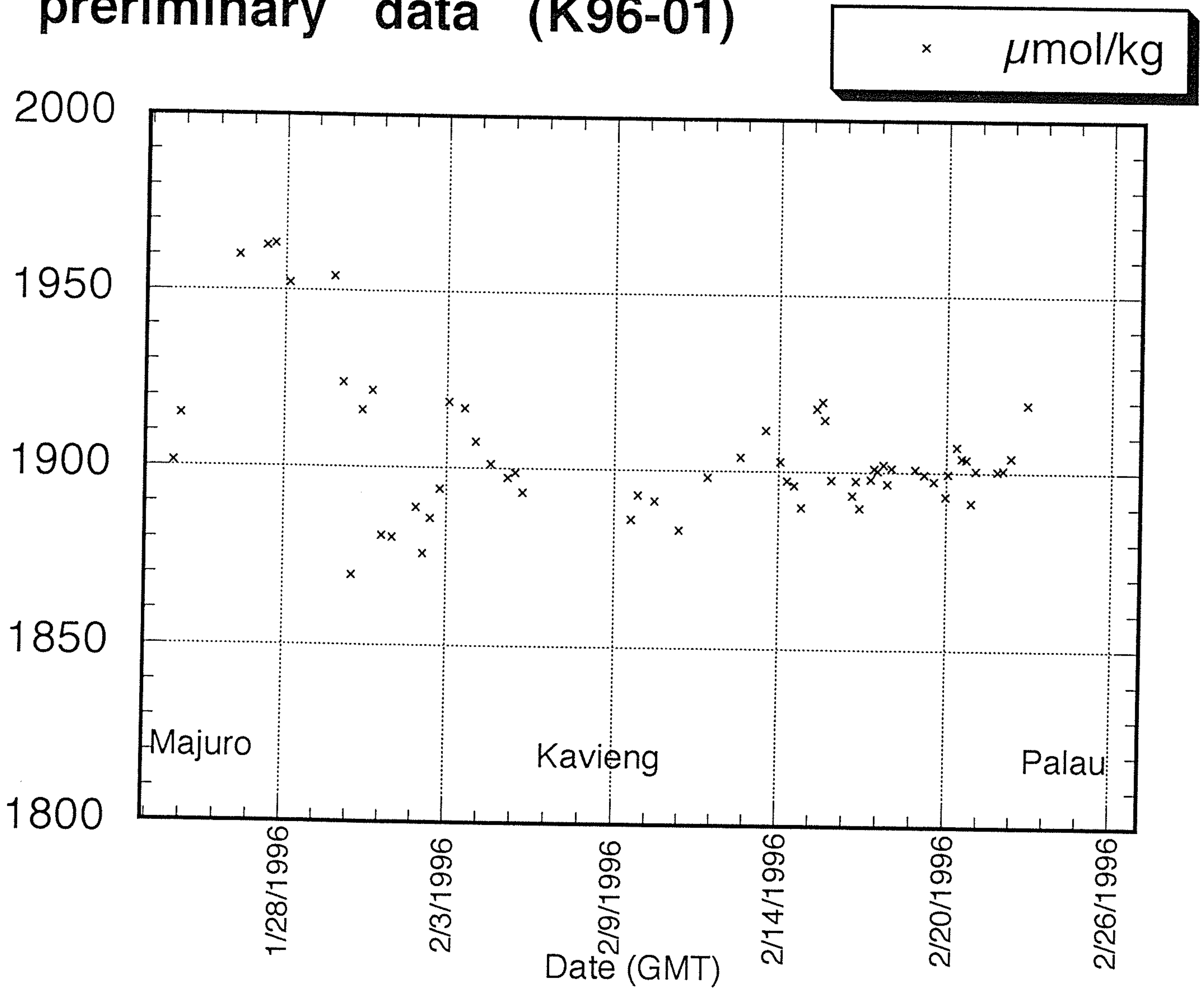
(5) Equipment

For the determination of the CO_2 amount, we used CO_2 coulometer (Model 5011 and 5012 UIC Inc., USA). CO_2 extraction from the seawater and determination of its amount were automatically operated.

(6) Result

Data analysis including background correction, efficiency change correction, and seawater density calculation have not been made completely during this cruise. Figure 1 shows tentative TCO_2 measurements in the surface seawater at each CTD stations from Majuro to Kavieng and from Kavieng to Palau.

Distribution of TCO2 in surface seawater preriminary data (K96-01)



10 Scientific summary

K9601 TOCS cruise was performed in the western Pacific under the condition of the anti El Nino phase. The water temperatures in the surface mixing layer were extremly high. We observed over 30.2℃ down to 50 m depth west of156E along the equator, which was warmer than the temperature at165E of 30℃. In the High SST region we observed the active convection which resulted in less salinity water of 34.5 psu in the mixing layer where clear barrier layer existed. The depth of 20℃ isotherm was about 180m. On the contraly the salinity was high over 35.0 psu at 165E where the surface trade winds and were dominant and the air was dry. Thus the warm water was well developed in the western Pacific. The sea surface and lower atmospheric condition shows that the air convection was occurred over the warm water pool.

We observed a lot of temperature inversion layers around the Equatorial Under Current zone. Temperature and salinity had vertical structure with multi-steps and multi-peaks with the vertical scale of about 20-40m, particularly between 138E and 144E. It could be the intrusion of the North Pacific Water into the Equatorial region. The dissolved oxygen distribution shows this phenomena may be also occur below the EUC.

The high dissolved oxygen water corresponding to the lower part of the New Guinea Coastal Under Current was observed south of 2S on 142E line and south of 0.5S on 138E line. Below the current the Anterctic Intermediate Water was seen on 142E line, shown in T-S diagram as low salinity water (<34.5psu) on the 27.2 sigma-theta surface. Though this water is thought to flow north-westward along the New Guinea Coast, on 138E line the low salinity water was not observed. It is necessary to analyze the current data of ADCP concerned with the water mass.

11. SUMMARY REPORT
TROPICAL OCEAN CLIMATE STUDY
R/V KAIYO K9601 January 24-February 26, 1996

Djoko HARTOYO and Handoko MANOTO
BPPT-Indonesia

INTRODUCTION

1. Background

The Tropical Ocean Climate Study cruise have been carried out by Research Vessel KAIYO in Tropical Western Pacific within and outside Indonesia Economic Exclusive Zone on February 1996. This survey activity based on The Implementing arrangement between BPPT (Agency for the Assessment and Application of Technology) and JAMSTEC (Japan Marine Science and Technology Center) signed in April 5th, 1995 by Shin-ichi Ishii (executive Director JAMSTEC) and Prof. MT. Zen (Deputy Chairman for Natural Resources Development, BPP Teknologi).

2. Purpose

The main purpose of TOCS cruise is to observe Physical Oceanographic condition in the Western Pacific to archive a better understanding of Ocean-atmosphere interaction affecting on the ENSO phenomena. This mechanism is very important to predict the anomaly of ENSO. The long purpose for this study that the data base could be process with numeric modeling to make clear the mechanism of ENSO phenomena.

3. Time duration and field

Tropical Ocean Climate Study cruise was done on January 24th, 1996 to February 27th, 1996, started from Majuro and ended at Palau with port call in Kavieng. The area consists as Pacific Ocean, Indonesia EEZ Northern Irian Jaya/Papua New Guinea along 2.40° South to 7.00° North and 137.00° to 168.00° East.

SURVEY ACTIVITY

The Tropical Ocean Climate Study cruise activity contains as follow :

1. CTD (Conductivity, Temperature, Depth) observation

Sixty-six stations CTD including the 5 liter rosette water sampler with SBE 9 plus CTD for 6.800 m were used in TOCS cruise. The sensors attached on the CTD wire with two temperature sensors, two conductivity sensors, pressure sensor and dissolve oxygen sensor. The CTD observation depth are 1000 meters in every stations and two CTD cast at 300 m depth at ATLAS positions. The wire was a single conductor 10,6 mm Steel rope manufactured by Rochester cables and the winch was built by Tsurumi Seiki Japan.

2. Subsurface ADCP Moorings

Two-JAMSTEC subsurface ADCP moorings were recovered and deployed at (0, 147° E), (0, 142° E). One-NOAA subsurface ADCP mooring was deployed at the Equator, 165° E. The mooring system is design to obtain the variability of the equatorial current. Each mooring was equipped with Acoustic Doppler Current Profiler at 300 meters, one CTD SBE 16 at just below the ADCP. Two Benthos Acoustic releases used to release ADCP buoy from sinker on the recovery.

3. Atmospheric Sonde

Seventy-five of atmospheric sonde were done every 6 hours to measure upper air temperature, wind speed and direction, humidity and pressure. The sensor type is radiosonde type VAISALA DigiCORA MW 11 Automatic Radiosonde Set. Omegasonde were launched to air with balloon that contain Helium gas, the data were transmitted real time to receiver at the container on board.

4. Dissolved Oxygen Measurement

The measurement of dissolved oxygen was done on 66-positions in CTD stations with direct measured by sensor that be attach on CTD system and water sampler that collected from 5-Niskin water samples into 100 ml Dissolved Oxygen bottles at 1000, 800, 600, 500, 400, 350, 300, 250, 200, 150, 100, 50 meters depth in every stations. The samples for titration method were analyzed within 2 hours. The D. O values were obtained by

Metrohm piston burette of 10 ml with Pt Electrode using whole bottle titration in the laboratory with temperature controlled.

5. ATLAS and PROTEASE Surface Buoys

Six-surface buoys were deployed at (5° N, 165° E), (7° N, 156° E), (0, 147° E), (2° N,147° E), (2° N, 138° E), (5° N, 137° E) and four ATLAS buoys have been recovered at (2° N, 156° E), (2° N, 147° E), (5° N, 137° E), and one ATLAS Drifter. One ATLAS repaired at the Equator, 156° E, visiting ATLAS at 2° N, 156° E. One PPROTEUS buoy was recovered and deployed at the Equator, 165° E. The recovery and deployment ATLAS buoy at 5° N, 137° E was failed, because of bad weather (tropical depression). The ATLAS and PROTEUS moorings are designed to obtain surface meteorological data and subsurface sea temperature.

CONCLUSION

The recovery and deployment of ADCP subsurface buoys and ATLAS surface buoys have finished succesfully. Sixty-six stations CTD observation including water sampling for measurment of dissolved oxygen and Salinity were done along 137° E to 168° East Longitude and 7° North to 2.40° South Latitude. The operations during this cruise went absolutely well and The ship's personnel performed in an professional manner.

ACKNOWLEDGMENT

Finally The Tropical Ocean Climate Study cruise have been done succesfully. We would like to thank JAMSTEC for funding our trip and all expenses, our director, Dr., Indroyono Soesilo and Project Manager R/V Baruna Jaya Dipl. Ing. Basri M. Ganie for appointing us to participate in TOCS K9601 Cruise. Chief Scientist Yoshifumi Kuroda and Koichi Takao and Technical Staffs, Captain Sadao Ishida and crew members of Research Vessel KAIYO.
We also would like to appreciate a great discussion to H. Yoshikawa and T. Suzuki.

12. Participants list

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Atsuo Ito	NME
Mitsuru Hayashi	NME
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Keiko Komine	Sanyo
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Kevin Smith	PMEL

Kaiyo Crew Members

Captain	Sadao Ishida
Cheif Officer	Fusao Saito
Second Officer	Toshinobu Miyata
Third Officer	Takafumi Aoki
Jr. Third Officer	Akihisa Tsuji
Chief Engineer	Toshiichi Hirose
First Engineer	Hiroyoshi Kikkawa
Second Engineer	Kazuma Koto
Third Engineer	Yoshinobu Hiratsuka
Chief Radio Officer	Masahiro Aimono
Second Radio Officer	Fukuo Suda
Boatswain	Norio Nagatani
Able Seaman	Sakae Sasaki
Able Seaman	Yoshikane Oda
Able Seaman	Kingo Nakamura
Able Seaman	Kozo Yatogo
Sailor	Yosuke Chida
Sailor	Shigeru Kikuya
No.1 Oiler	Akira Terai
Oiler	Masaru Murao
Oiler	Katsushi Chiba
Oiler	Katsuyuki Miyazaki
Assistant Oiler	Toshikazu Ikeda
Chief Steward	Kiyotoshi Teranishi
Steward	Shinichi Amasaki
Steward	Takeshi Miyauchi
Steward	Tomihisa Morita
Steward	Teruyuki Yoshikawa

Appendices (in Japanese)

1. 航海要約
2. ひまわり画像

A-1

K9601　かいよう観測航海要約

マジュローケビエン　（黒田）

1996年（平成8年）1月23日にかいようはマジュロでPMELのブイ資材を積み込み，24日の8時に出港し，ADCP，CO_2 観測を開始した。1月25日には CTD 観測を開始した。急性腸炎の患者が 1 名でたため緊急入港に備え，1月25日20時40分にマジュロに向け転進した。その後容態が改善し医者の下船必要無しとの助言のもとに1月26日11時55分に再度2N,165Eの観測点に向けた。この結果2日の遅れとなり，0,165Eから直接8N,156Eへ向かうことにコースを変更した。1月27日に同点にてCTD付きATLASの回収，28日にCTDなしのスタンダードATLASの設置をした。また，29日にはPROTEUSブイの回収，ADCPブイの設置を行ない，翌30日にはPROTEUSブイの設置をおこなった。この係留作業の4日とも快晴，湿度も65%位で低く，東風5m/sの穏やかな海況のもと順調に作業が進んだ。30日には，またゾンデによる高層気象観測を開始した。2月2日に8N,156Eで10m/sの風，2mの波高のなかATLASブイの設置を行なった。なお，1995年10月以降通信のなかったブイは切り離し装置は確認されたものの表面ブイはなかった。5N に沿って収束帯がありしばしば降雨に出会った。156Eに沿ってCTD観測を続けた。2月4日には2N,156E，2月5日に0,156EのATLAS地点で雨量計の交換を行なった。その後赤道に沿い西進し，CTD観測を続けた。ケビエンに2月7日予定通り入港した。

ケビエンーパラオ　（吉川）

かいようはケビエンを2月9日の9時30分に出港し，ADCP，CO_2 観測を再開した。同日23時30分から後半の航海におけるCTD観測を赤道上で開始した。10日にはゾンデによる高層観測を再開した。2月11日には，ドリフトしているATLASブイを2°45'N, 146°23'Eにおいて無事回収した。12日には，0,147EにおいてADCPブイの回収とATLASブイの設置を行なった。翌13日には同点にてADCPブイを設置し，翌日のブイのポイントに向け北上した。2月14日には2N,147EにおいてATLASブイの回収と設置を行なった。15日は赤道に沿い西進しつつ，また16日は142Eに沿って，CTD観測を続けた。2月17日には0,142EでADCPブイの回収と設置を行なった。18日には142Eに沿って3Nまで北上し，CTD観測を続けて行なった。19日から21日にかけて赤道に沿った航路と138Eに沿った航路でCTD観測を行なった。21日に高層ゾンデの観測が終了した。2月22日には2°26' N,137°25'Eにおいて，ATLASブイを設置した。夕方より風が強まり，波が高くなってきた。翌23日波が高

く，悪天候の中，ATLAS ブイを 5N,137E に設置した。また，回収を予定した ATLAS ブイは切り離し装置の信号から位置の確認はできたが，海面ブイが発見できなかったため切り離しを行なわなかった。同日昼より波高が高く，航行が困難となったため，同海域で天候の回復をまった。24 日になっても海況が著しく悪いため，パラオに向け転進した。同日と 25 日は海況が回復した場合には最後に残った ATLAS ブイの回収と設置作業を行なうこととしたが，海況は悪い状態が続いた。海況が悪いことと ATLAS 地点への往復時間と作業時間を考慮した結果，最後の ATLAS の設置回収作業を断念した。2 月 26 日朝 9 時，パラオに入港した。

全航海を通じ，石田船長をはじめ“かいよう”乗組員の方々から支援を頂きましたことを感謝するしだいです。また，日海事海技部の方々からも専門的な技術支援を頂きましたことに感謝致します。

Time Table K9601

01/23/96 Local Time (-12=UTC)
  0845-1530 Loading PMEL buoy gear
01/24/96 Local Time (-12=UTC)
  0800 Depart Majuro
        ADCP and CO_2 measurements started
  1000 General meeting
  1300 Fire drill and safety education
  1400-1600 CTD Uinch test & ATLAS buoy assembly
01/25/96 Local Time (-11=UTC)
  0928-1023 04-41.927N,167-36.657E CTD01 CTD measurement started
  1500-1555 04-02.528N,166-59.662E CTD02
  2040 Change course to Majuro due to have a stomack ach patient
01/26/96 Local Time (-11=UTC)
  1155 Change course to 2N,165E due to recovery a stomack ach patient
01/27/96 Local Time (-11=UTC)
  1241-1306 02-00.442N,165-01.287E CTD AT1 (300m)
  1312-1700 ATLAS surface buoy recovery at 2N,165E
01/28/96 Local Time (-11=UTC)
  0733-0947 ATLAS buoy deployment at 01-59.772N,164-58.650E
  1047-1131 01-58.553N,164-58.372E CTD03
  1743-1834 01-00.150N,164-59.873E CTD04
01/29/96 Local Time (-11=UTC)
  0602-0618 00-00.2S,164-59.4E CTD AT2 (300m)
  0631-1000 PROTEUS buoy recovery at 0N,165E
  1303-1425 Subsurface ADCP mooring deployment at 0-0.001S,
        165-6.070E (Depth=4258m)
  1517-1551 ADCP buoy positioning
01/30/96 Local Time (-11=UTC)
  0620-0928 PROTEUS buoy deployment at 0-00.06S,164-59.97E
        (Depth=4400m)
  1136-1223 00-00.048N,164-59.081E CTD05
  1620 Started atmospheric sounding by sonde
  1923-2010 01-00.001N,163-52.906E CTD06
01/31/96 Local Time (-11=UTC)
  0335-0428 01-59.518N,162-46.878E CTD07
  1200-1245 02-59.861N,161-39.664E CTD08
  1956-2042 03-59.679N,160-33.468E CTD09

02/1/96 Local Time (-10=UTC)
0321-0413 04-59.622N,159-26.406E CTD10
1217-1300 05-59.365N,158-17.879E CTD11
2026-2109 06-59.904N,157-12.026E CTD12
02/2/96 Local Time (-10=UTC)
0745-0948 ATLAS buoy deployment at 07-59.90N,155-59.82E
(Depth=4831m)
1026-1109 07-59.890N,156-00.642E CTD13
1635-1724 07-00.108N,155-59.956E CTD14
2234-2315 06-00,156N,156-00.229E CTD15
02/3/96 Local Time (-10=UTC)
0443-0525 05-00.040N,156-00.046E CTD16
1228-1310 04-00.400N,155-59.150E CTD17
1920-2006 03-00.239N,155-59.755E CTD18
02/4/96 Local Time (-10=UTC)
0758-1057 Repair raingage of ATLAS buoy at 2N,156E
0814-0858 02-00.283N,156-04.720E CTD19
0935-1023 02-00.278N,156-04.687E CTD cast for bottol sampling down
to 1500m depth for standard water
1730-1812 00-59.927N,155-59.874E CTD20
02/5/96 Local Time (-10=UTC)
0525-0855 Repair raingage of ATLAS buoy at 0N,156E
0602-0745 00-00.360S,156-07.350E CTD21
1425-1506 00-00.253S,154-59.389E CTD22
1957-2030 00-00.023S,154-00.006E CTD23
02/6/96 Local Time (-10=UTC)
0138-0225 00-00.359S,152-59.294E CTD24
0741-0826 00-00.482S,151-59.703E CTD25
1330-1412 00-00.746S,150-59.744E CTD26
Last CTD measurement at 2S,151E in the first leg
02/07/96 Local Time (-10=UTC)
0700 Arrived at Kavieng
Bunkering
02/08/96 Local Time (-10=UTC)
1100 New members from Indonesia boarding on Kaiyo
02/09/96 Local Time (-10=UTC)
0930 Departed Kavieng
Started Ship-mounted ADCP measurements in the second leg
1100 General meeting

1400 Started CO_2 measurements in the second leg
2330-0030 00-00.323S,150-00.072E CTD27
first CTD measurement in the second leg

02/10/96 Local Time (-10=UTC)
0505-0550 00-00.028N,148-59.903E CTD28
1000 Started atmospheric sounding by sonde in the second leg (every six hours)
1038-1120 00-00.004N,148-00.071E CTD29
1850-1935 01-00.051S,147-02.951E CTD30

02/11/96 Local Time (-10=UTC)
0845-0930 Drifting ATLAS bouy recovery at 02-45S,146-23E
1300 Meeting
1515-1600 01-40.000S,147-00.000E CTD31

02/12/96 Local Time (-10=UTC)
0800-1045 Subsurface ADCP recovery at 00-00,147-00E
1300-1440 ALTAS bouy deployment at 00-00,147-00E
1508-1552 00-00.601N,147-00.811E CTD32

02/13/96 Local Time (-10=UTC)
0750-1030 Subsurface ADCP deployment at 00-00,147-00E
1815-1900 00-59.548N,146-59.954E CTD33

02/14/96 Local Time (-10=UTC)
0755-1030 ATLAS buoy recovery at 02-00N,147-00E
1250-1430 ATLAS buoy deployment at 02-00N,147-00E
1456-1538 02-00.036S,146-59.980E CTD34

02/15/96 Local Time (-9=UTC)
0157-0240 00-00.101S,145-59.980E CTD35
0740-0830 00-00.301N,145-00.541E CTD36
1331-1414 00-00.016N,144-00.607E CTD37
1930-2014 00-00.157S,143-00.394E CTD38

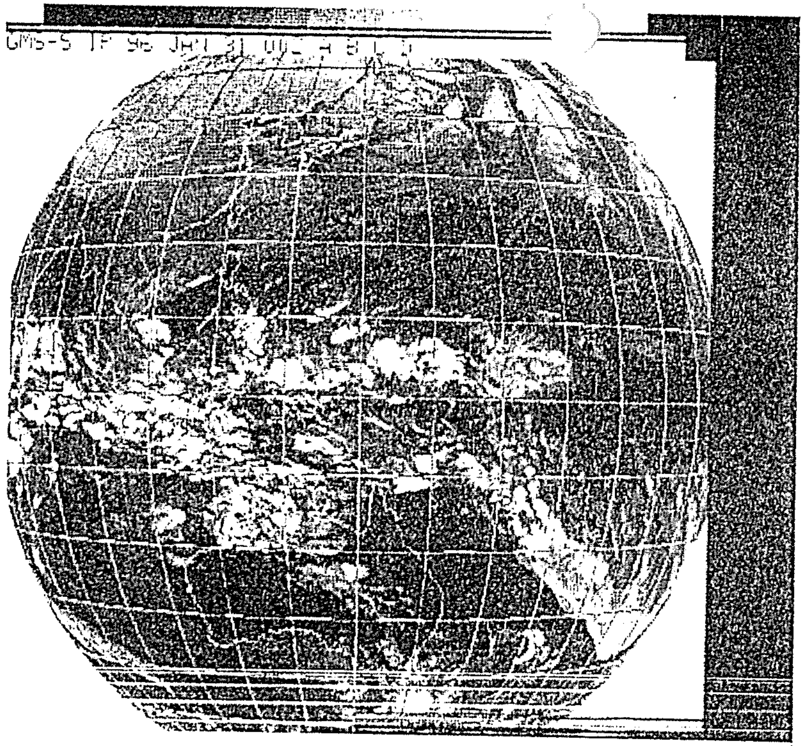
02/16/96 Local Time (-9=UTC)
0805-0845 02-04.974S,142-08.258E CTD39
1233-1320 02-40.001S,142-01.006E CTD40
1418-1501 02-30.247S,141-58.682E CTD41
2000-2045 01-30.498S,142-00.296E CTD42

02/17/96 Local Time (-9=UTC)
0750-0930 Subsurface ADCP recovery at 00-00,142-00E
1030-1140 Subsurface ADCP deployment at 00-00,142-00E
1253-1330 00-00.241S,142-01.539E CTD43
1600-1639 00-29.768S,142-00.336E CTD44

1910-1950 00-59.923S,142-00.393E CTD45
02/18/96 Local Time (-9=UTC)
0333-0412 00-29.950N,141-59.841E CTD46
0646-0728 00-59.643N,141-59.970E CTD47
1021-1100 01-29.580N,141-59.795E CTD48
1357-1435 02-00.064N,142-00.034E CTD49
1705-1745 02-30.016N,141-59.994E CTD50
2017-2056 02-59.835N,141-59.809E CTD51
02/19/96 Local Time (-9=UTC)
1520-1600 00-00.011S,141-00.372E CTD52
2241-2325 00-00.131N,140-00.326E CTD53
02/20/96 Local Time (-9=UTC)
0620-0700 00-00.069S,139-00.217E CTD54
1557-1635 01-00.075S,138-00.118E CTD55
1815-1855 00-44.926S,137-59.940E CTD56
2042-2125 00-30.292S,137-59.951E CTD57
02/21/96 Local Time (-9=UTC)
0050-0128 00-00.006S,138-04.425E CTD58
0448-0520 00-29.953N,138-00.040E CTD59
0848-0935 00-59.808N,137-59.941E CTD60
1243-1325 01-30.022N,138-00.199E CTD61
1420 Last atmospheric sounding by sonde
1634-1710 01-59.945N,137-59.834E CTD62
02/22/96 Local Time (-9=UTC)
0800-1020 ATLAS buoy deployment at 02-26N,137-24E
1040-1120 02-26.488N,137-23.538E CTD63
1516-1556 02-59.822N,137-19.000E CTD64
2130-2215 03-59.790N,137-10.165E CTD65
02/23/96 Local Time (-9=UTC)
0820-1050 ATLAS buoy deployment at 05-00N,136-59E
1110-1155 04-59.027N,136-59.477E CTD66
Last CTD measurement in the second leg
Stay around 5N,137E for the rough sea
02/24/96 Local Time (-9=UTC)
1000 Change course to Palau for the rough sea
2400 Last CO_2 measurement
02/25/96 Local Time (-9=UTC)
1000-1030 General meeting
1300-1430 CTD Uinch test (free fall, 3000m)

02/26/96 Local Time (-9=UTC)
0900 Arrival at Palau
Bunkering
02/27/96 Local Time (-9=UTC)
0800-1030 Unloading PMEL buoy gear

A-2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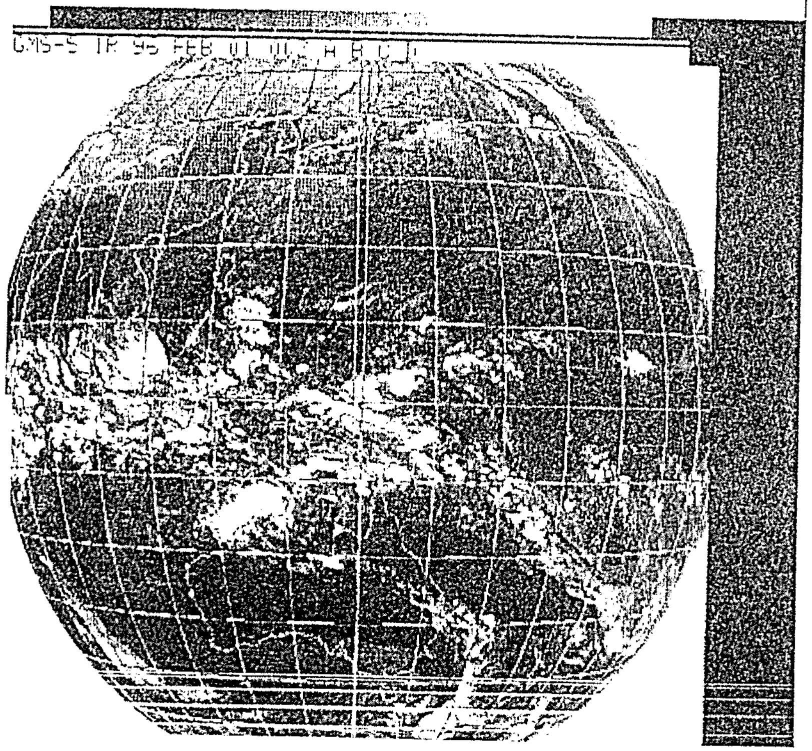
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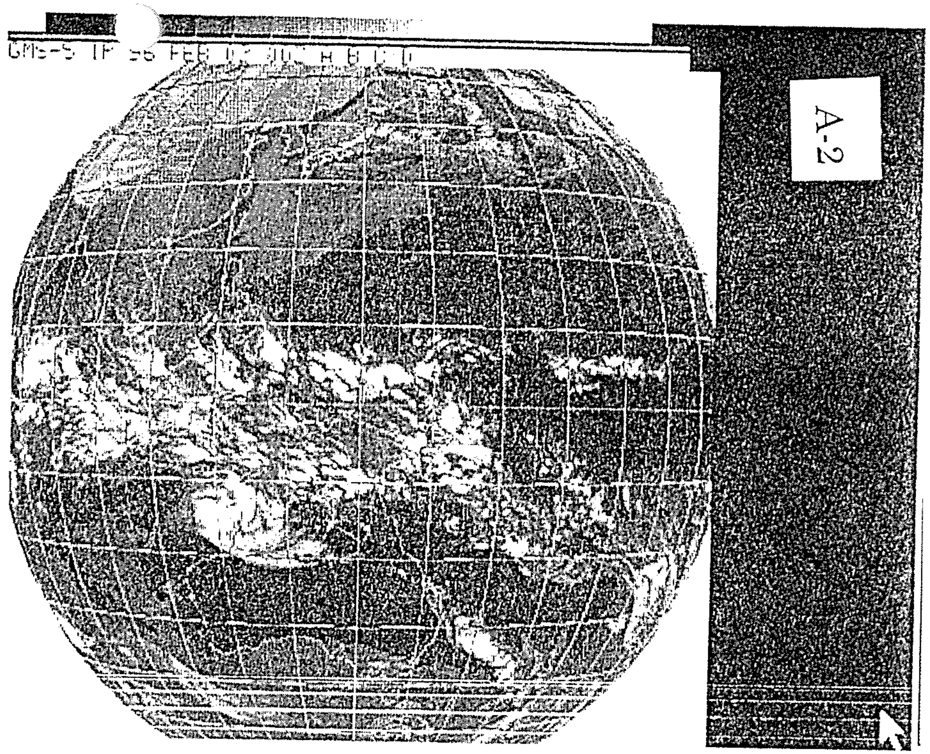
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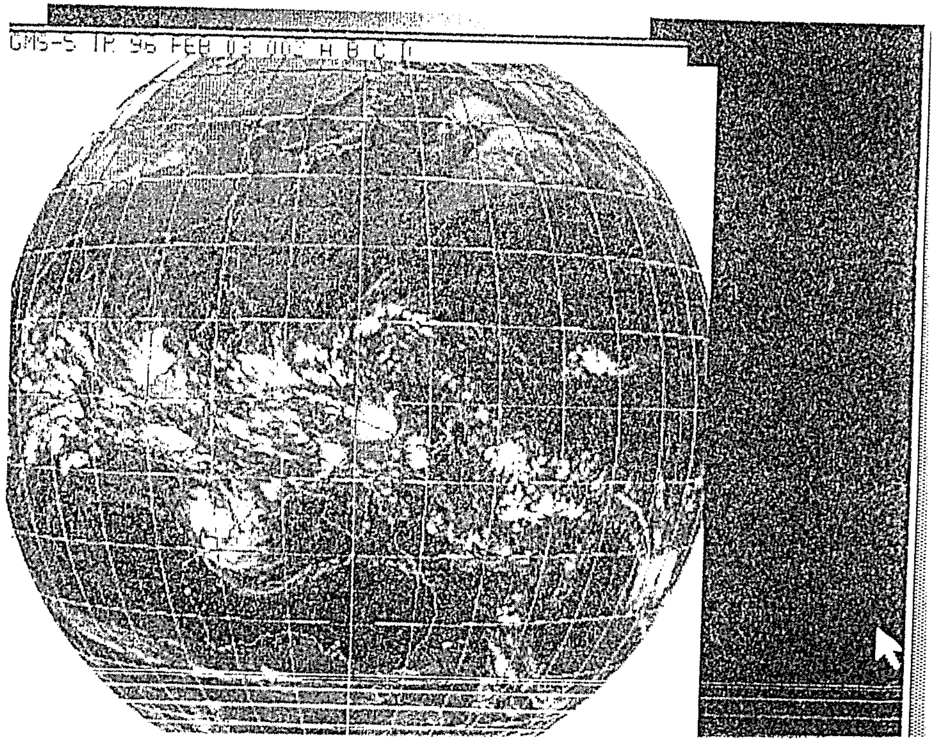
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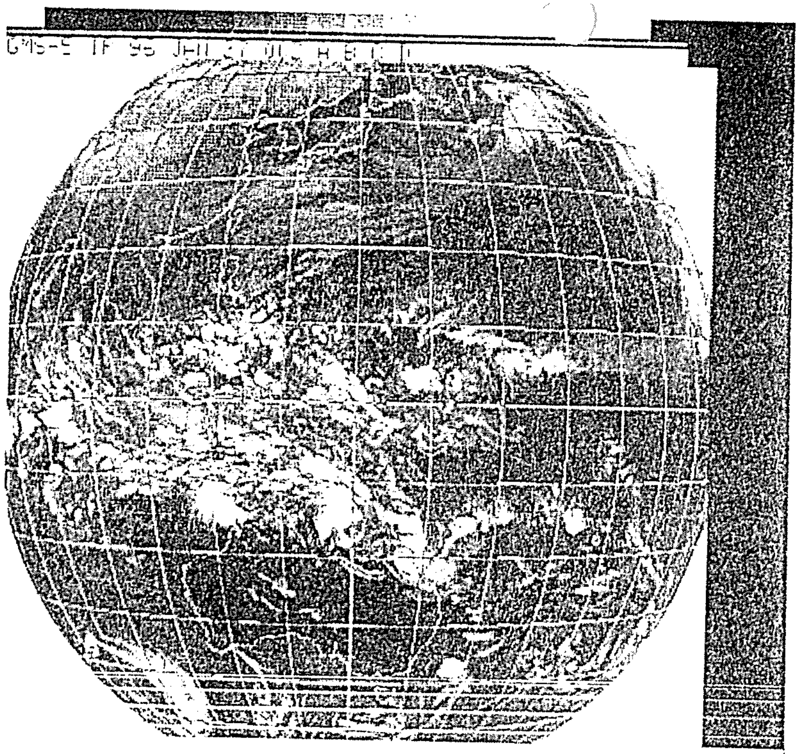

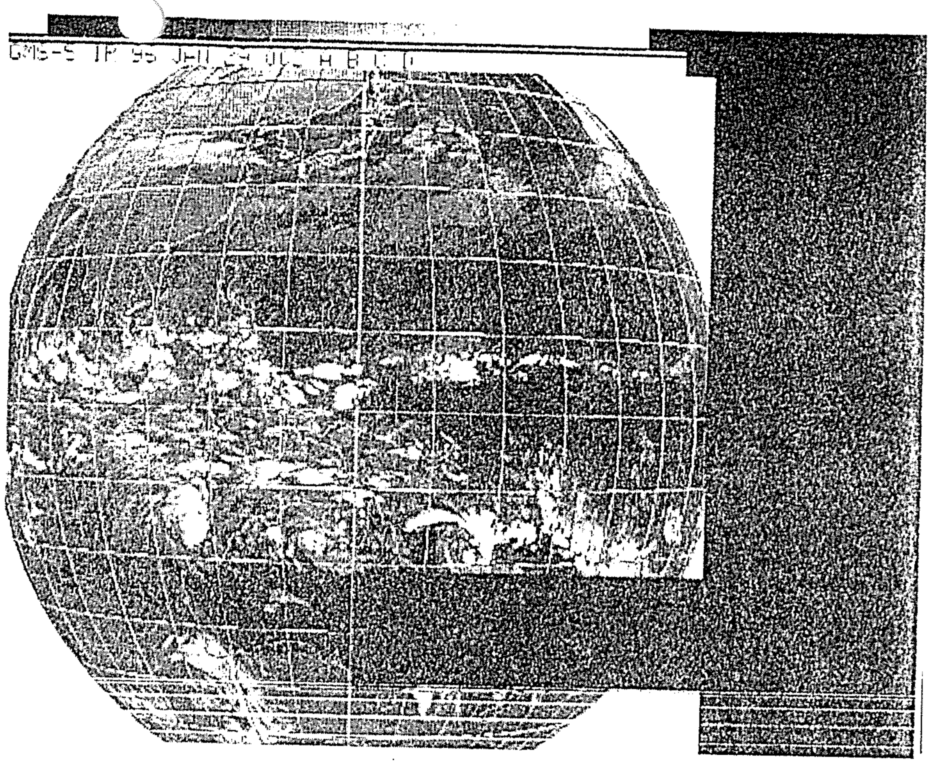

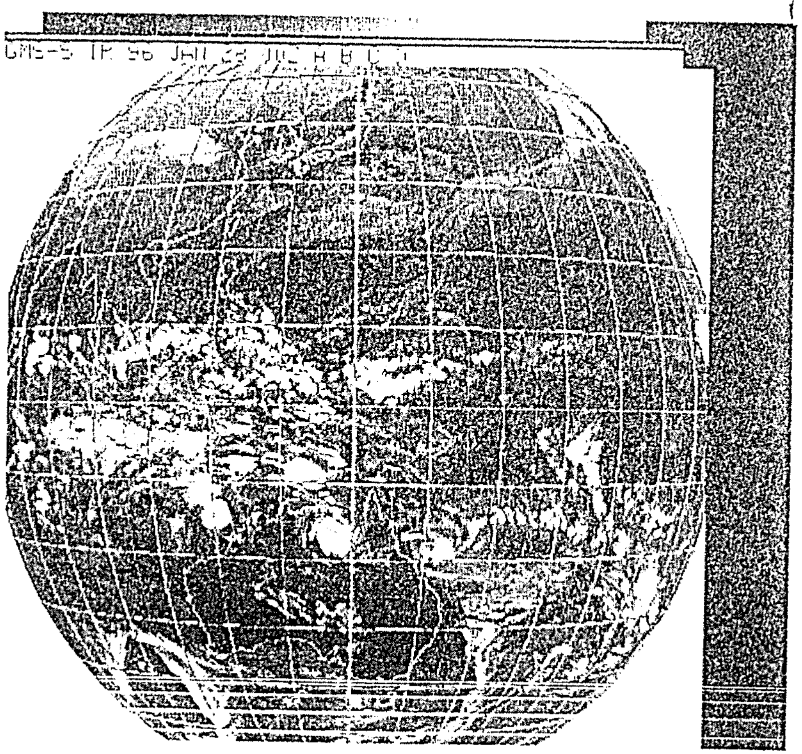

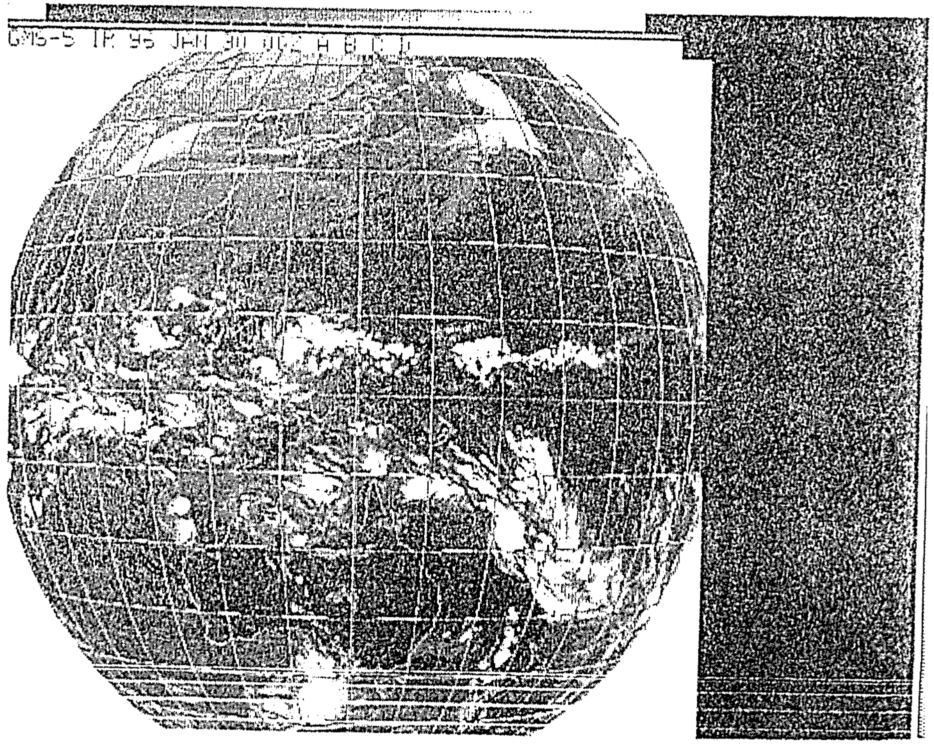

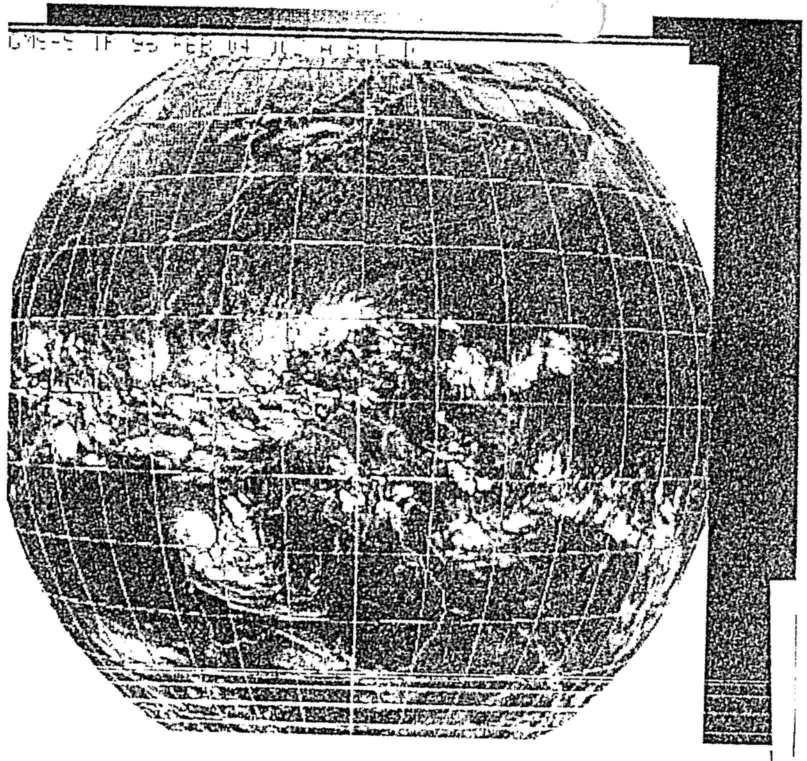
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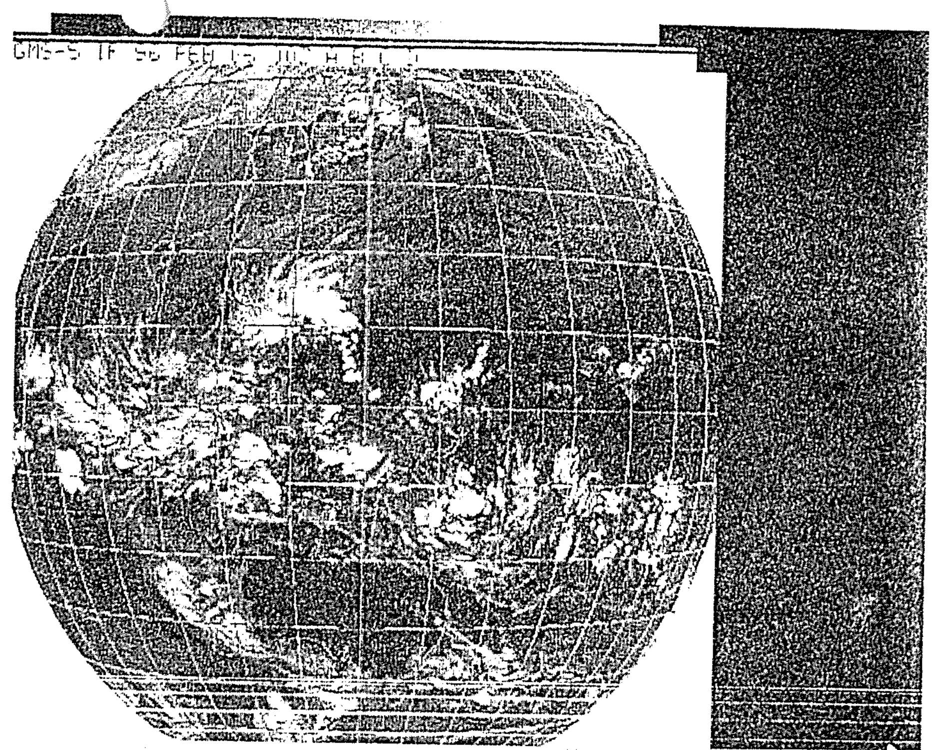
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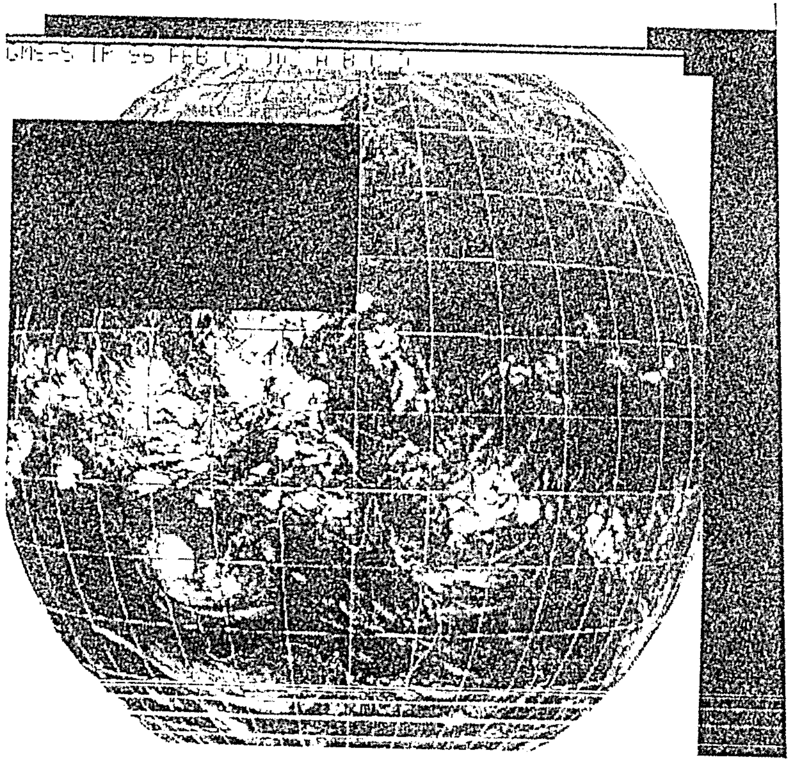
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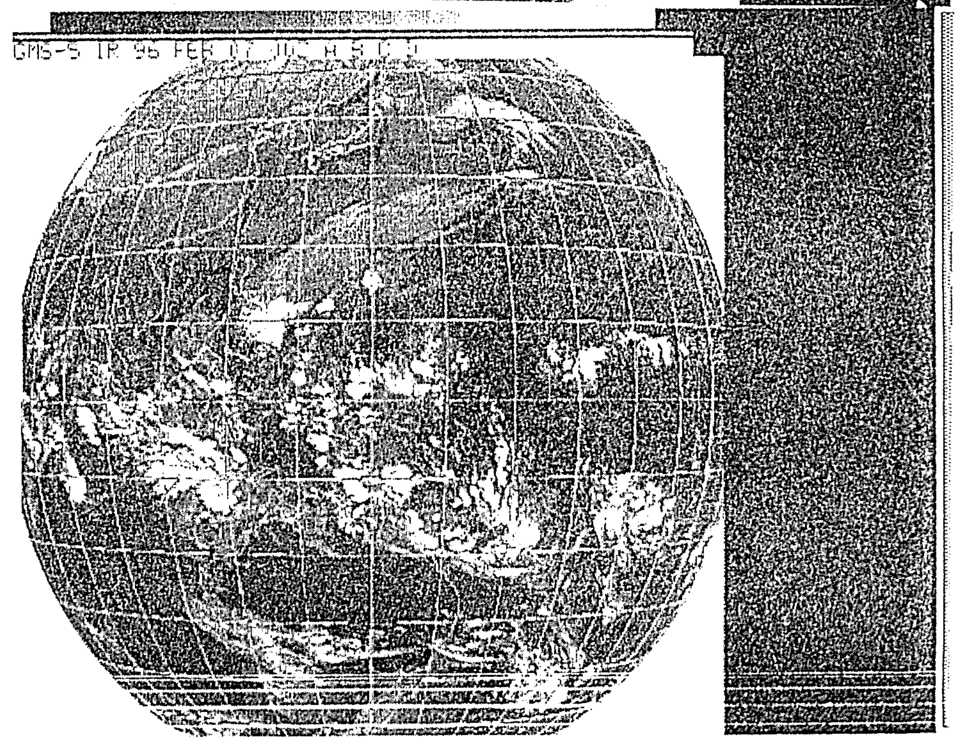
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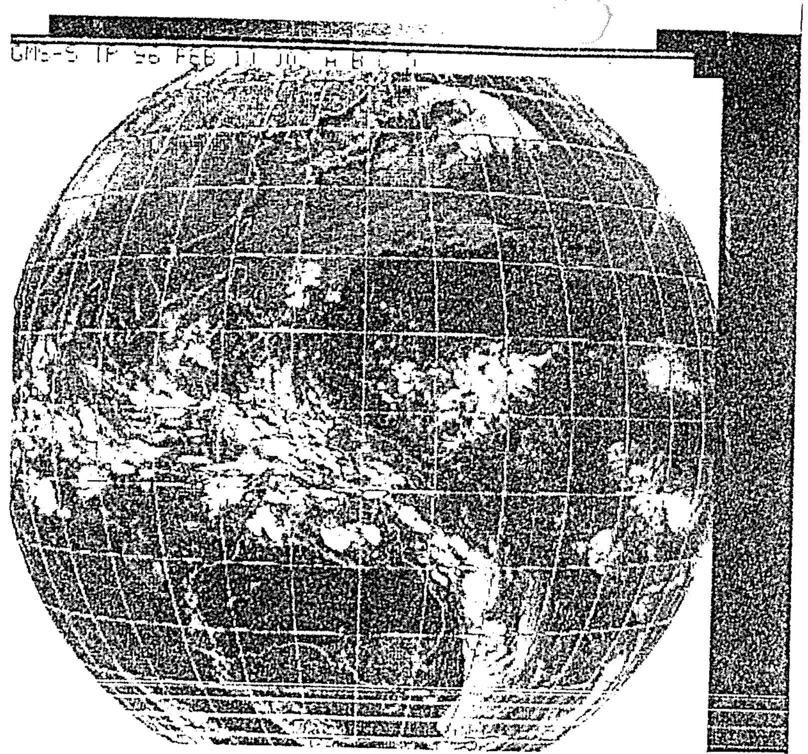
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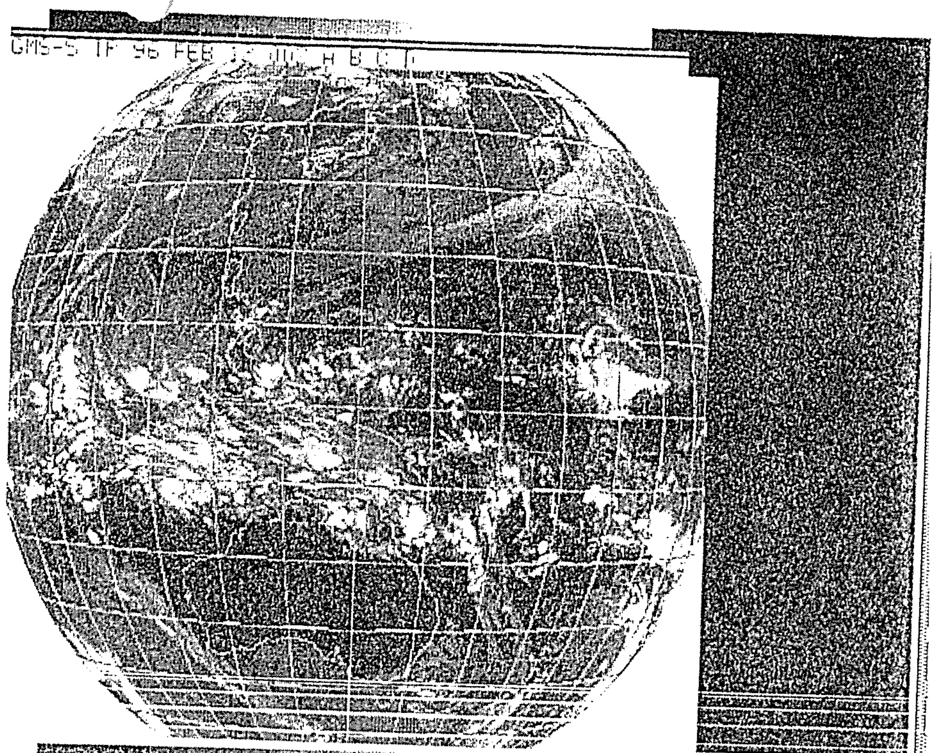
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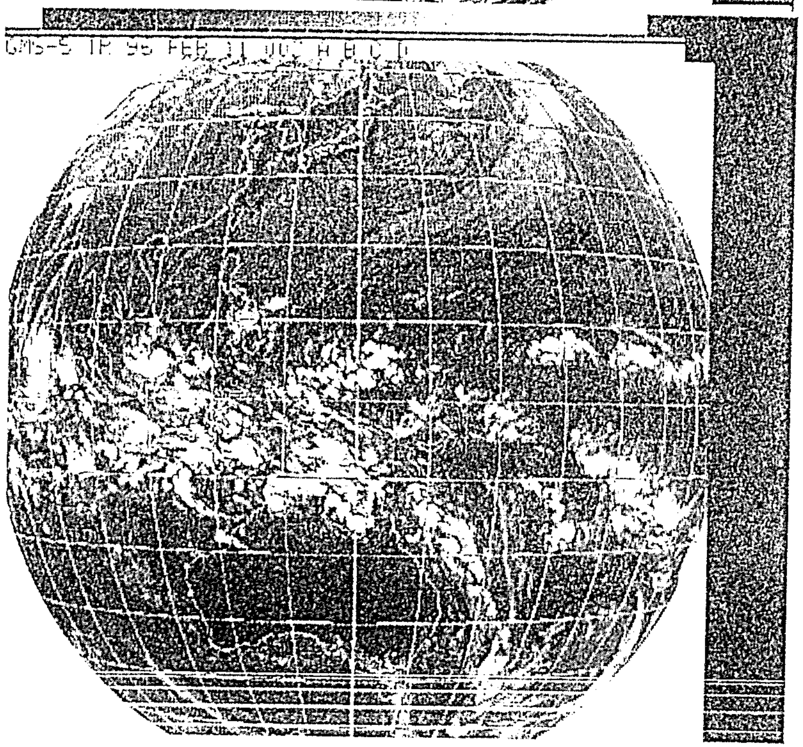
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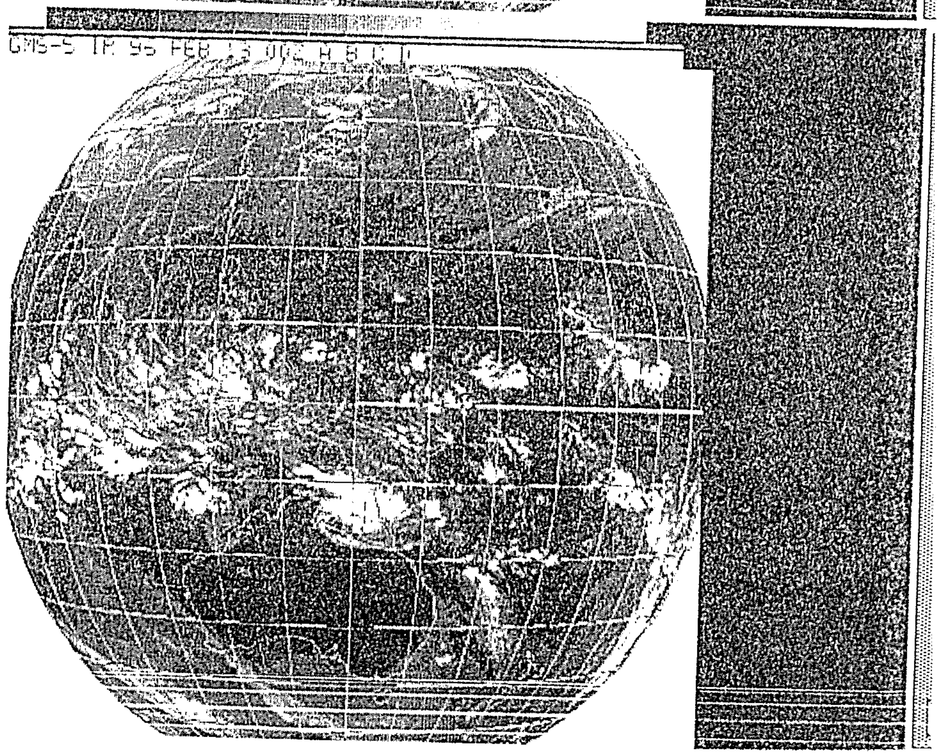
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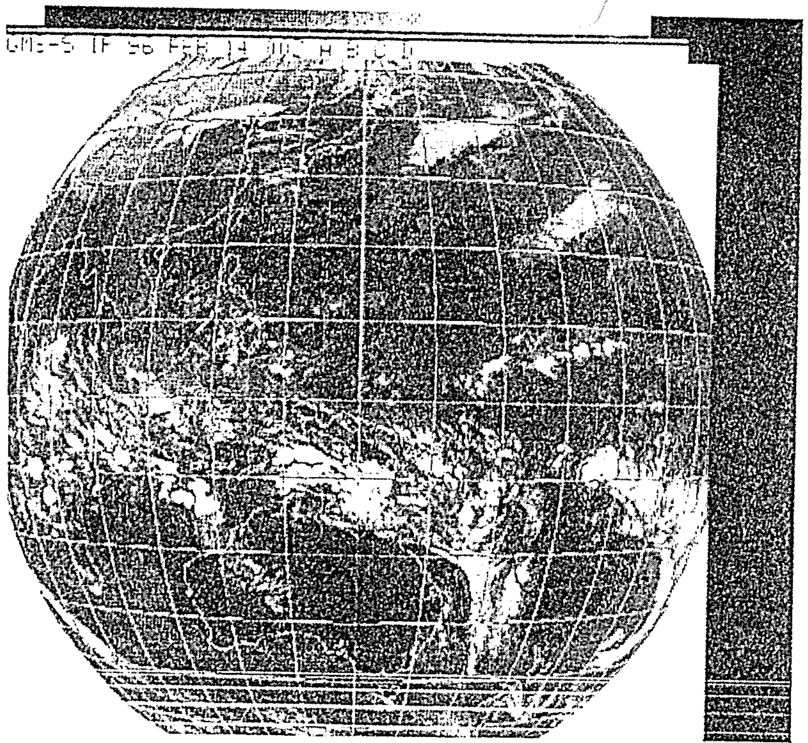
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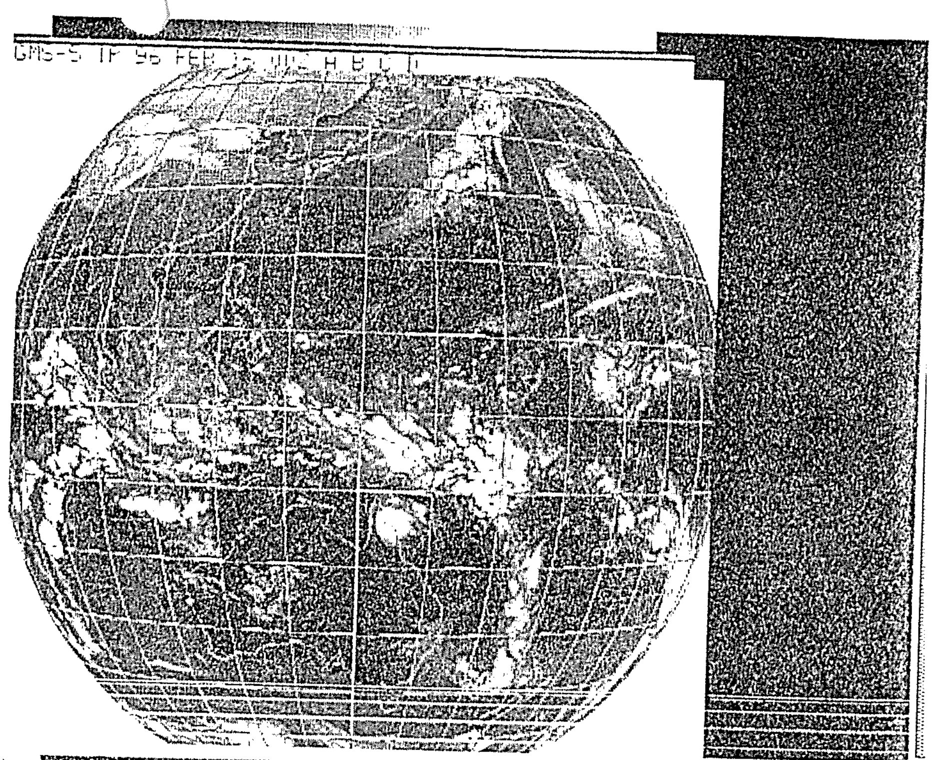
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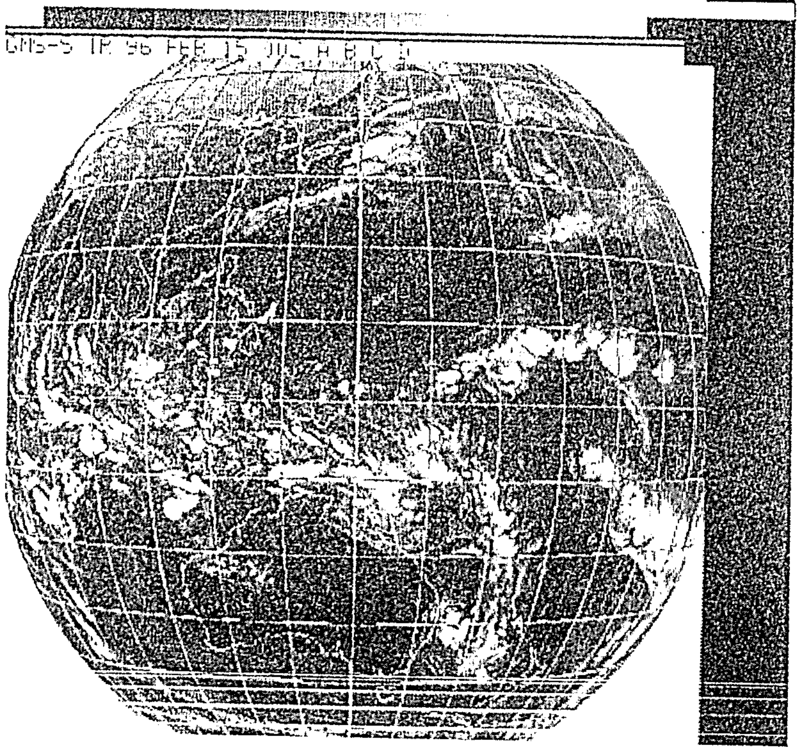
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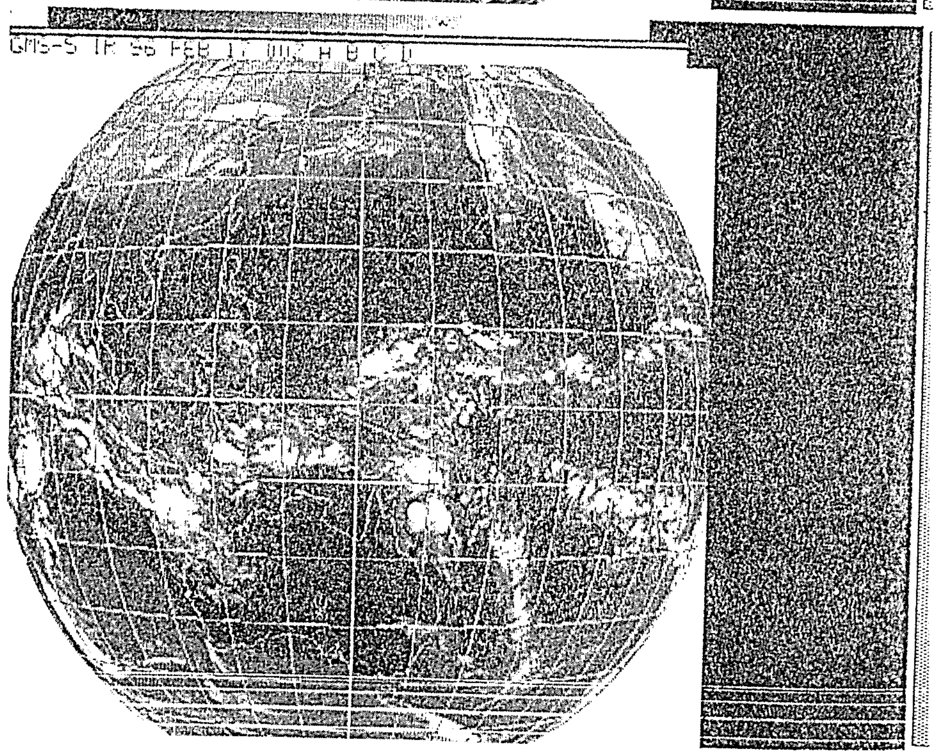
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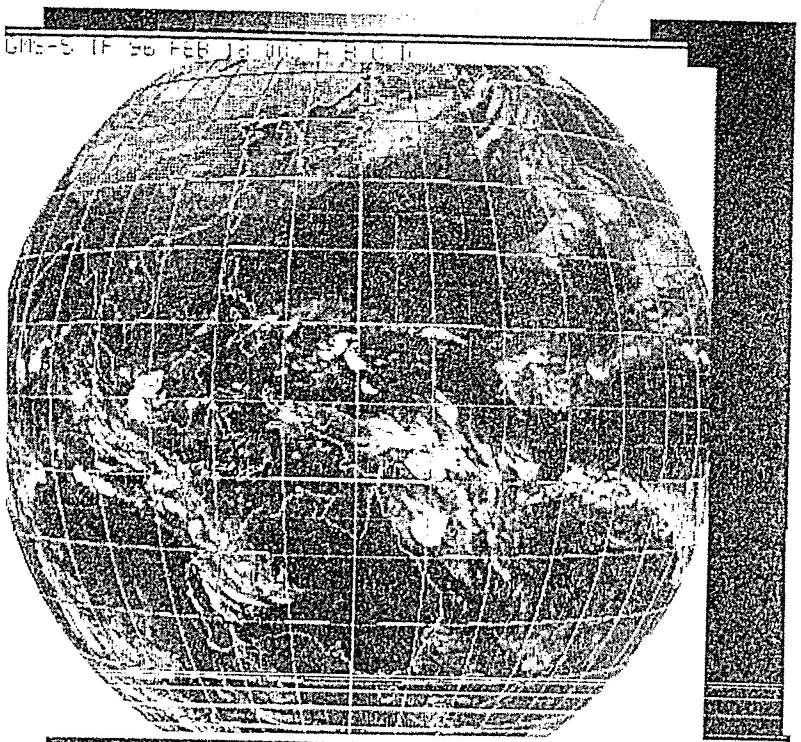
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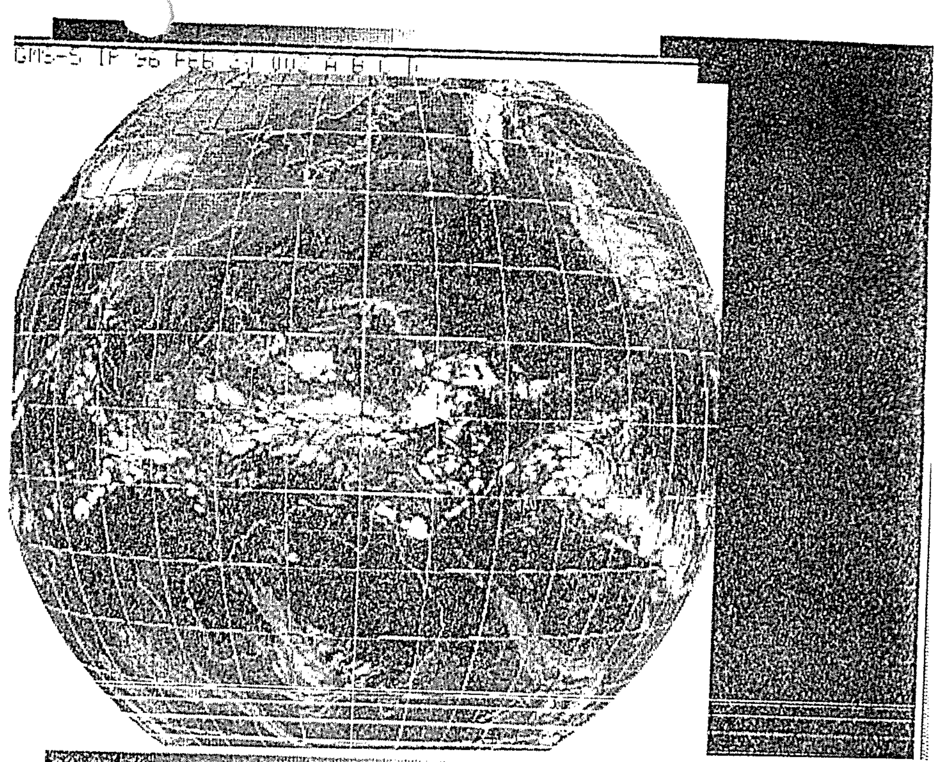
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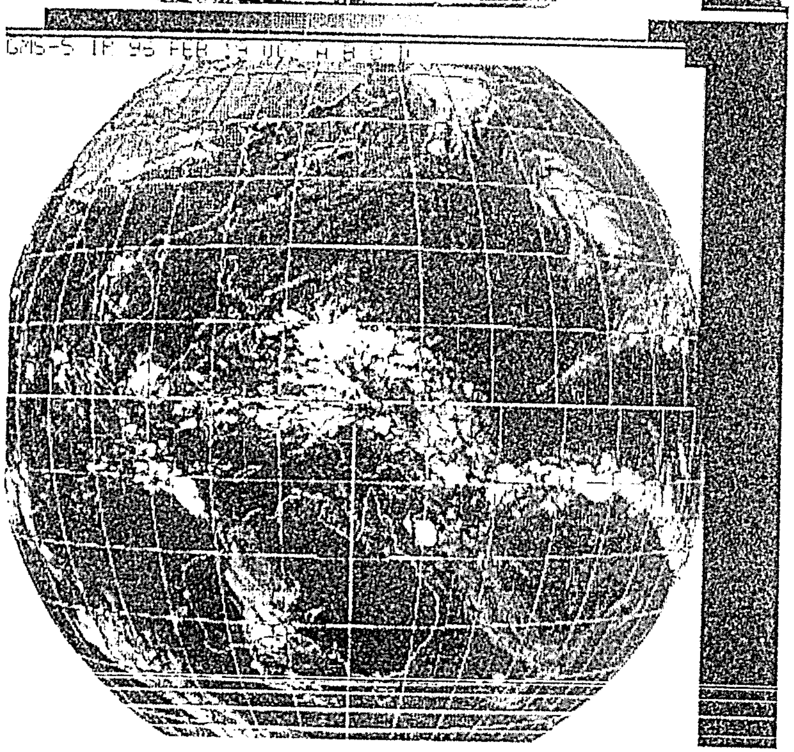
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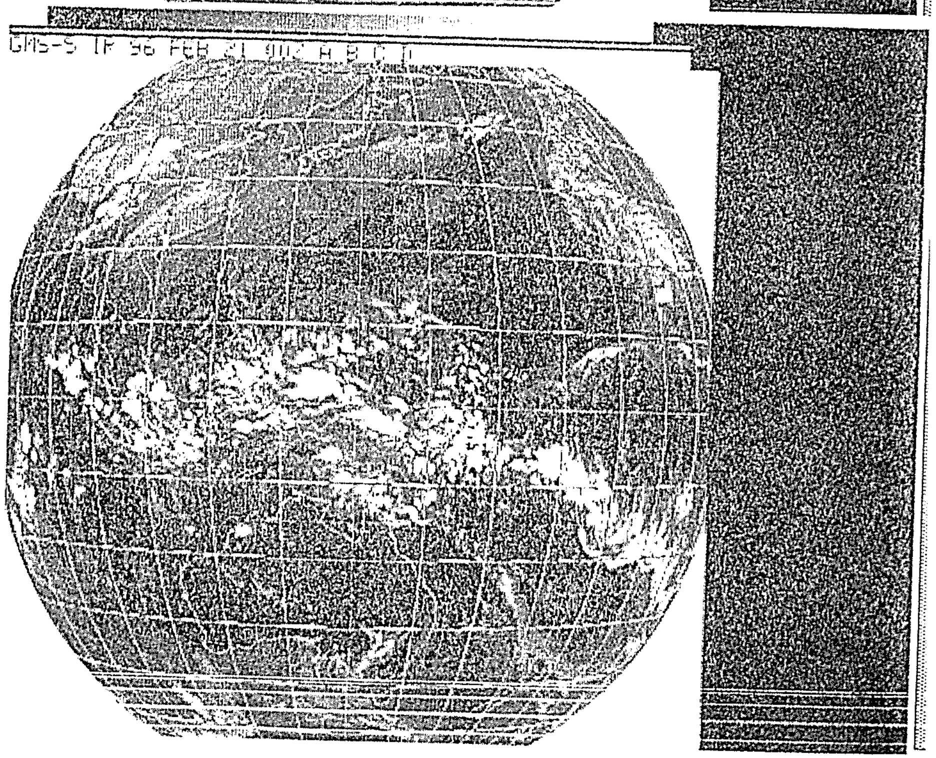
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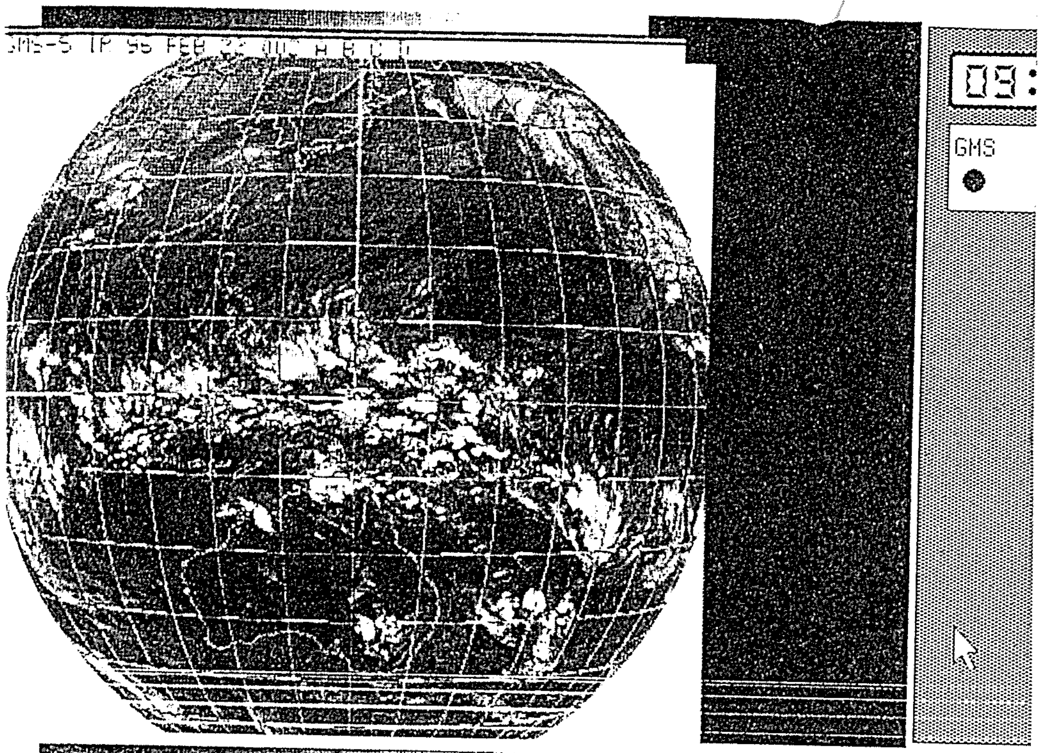
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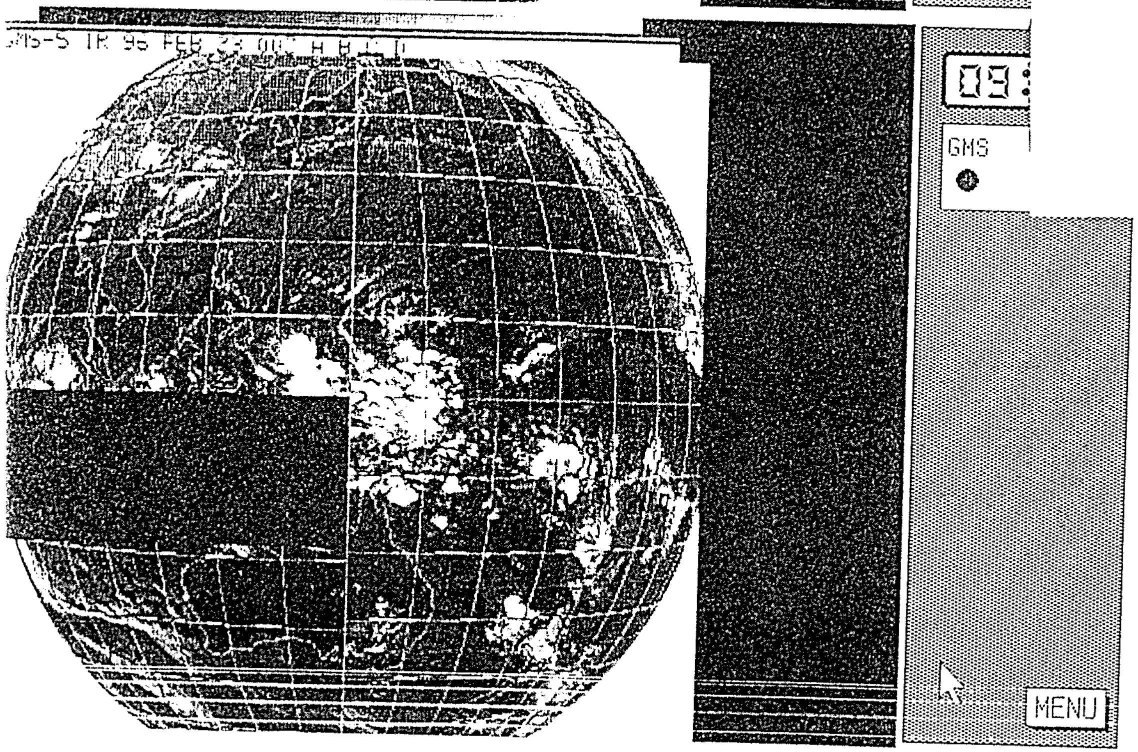
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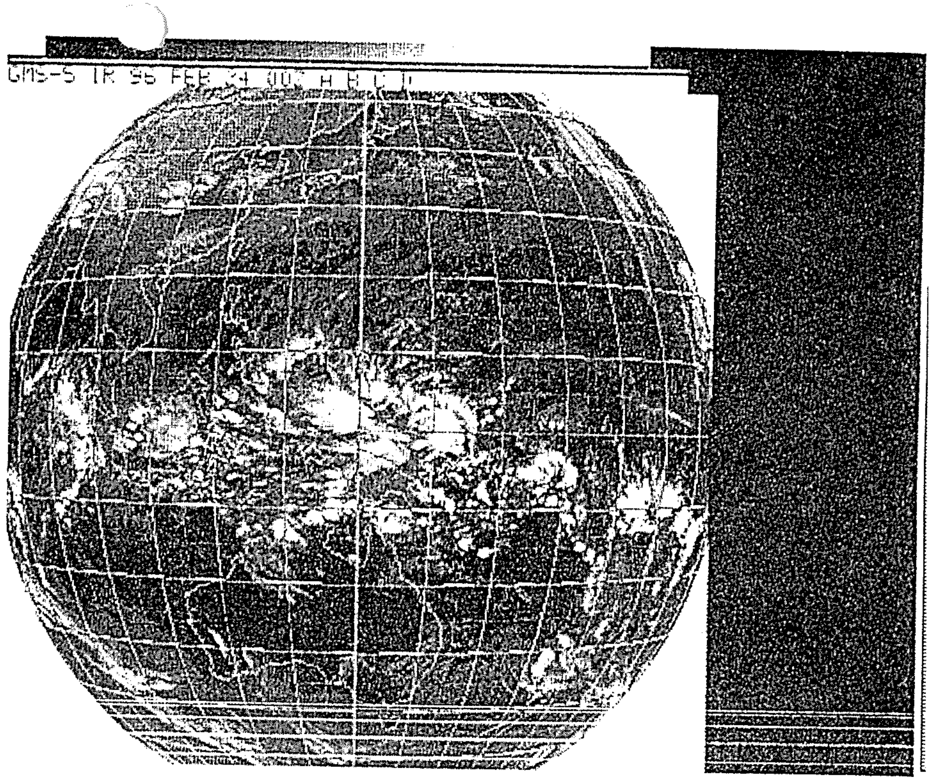

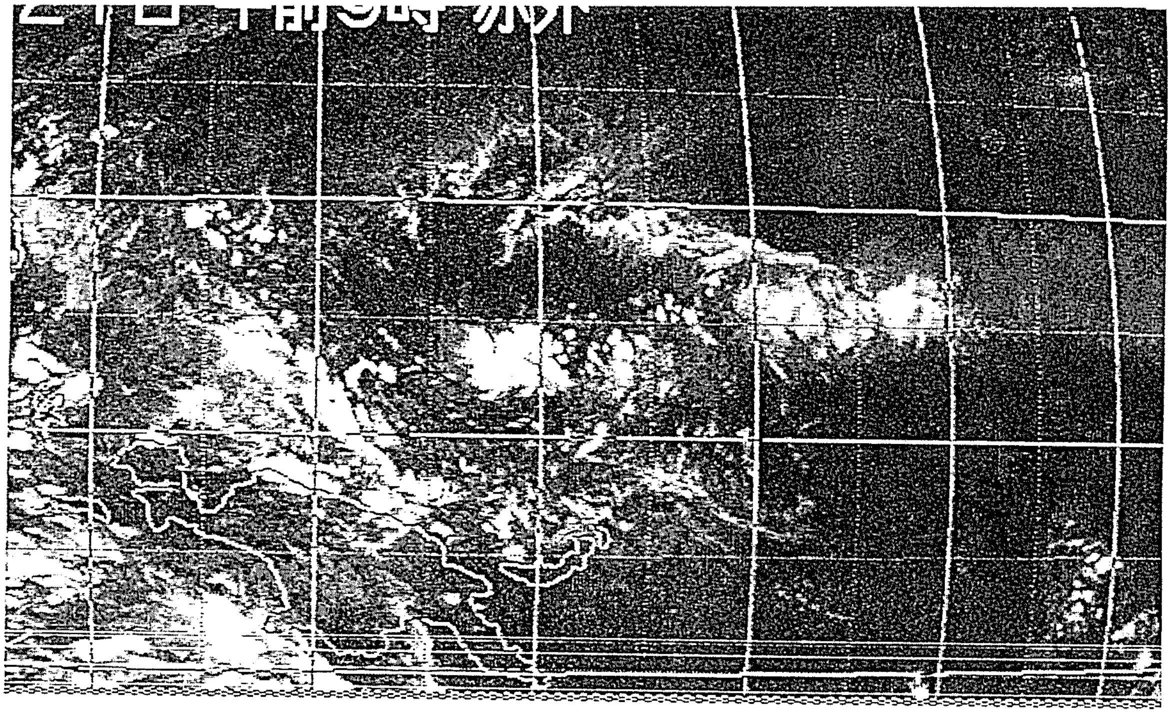

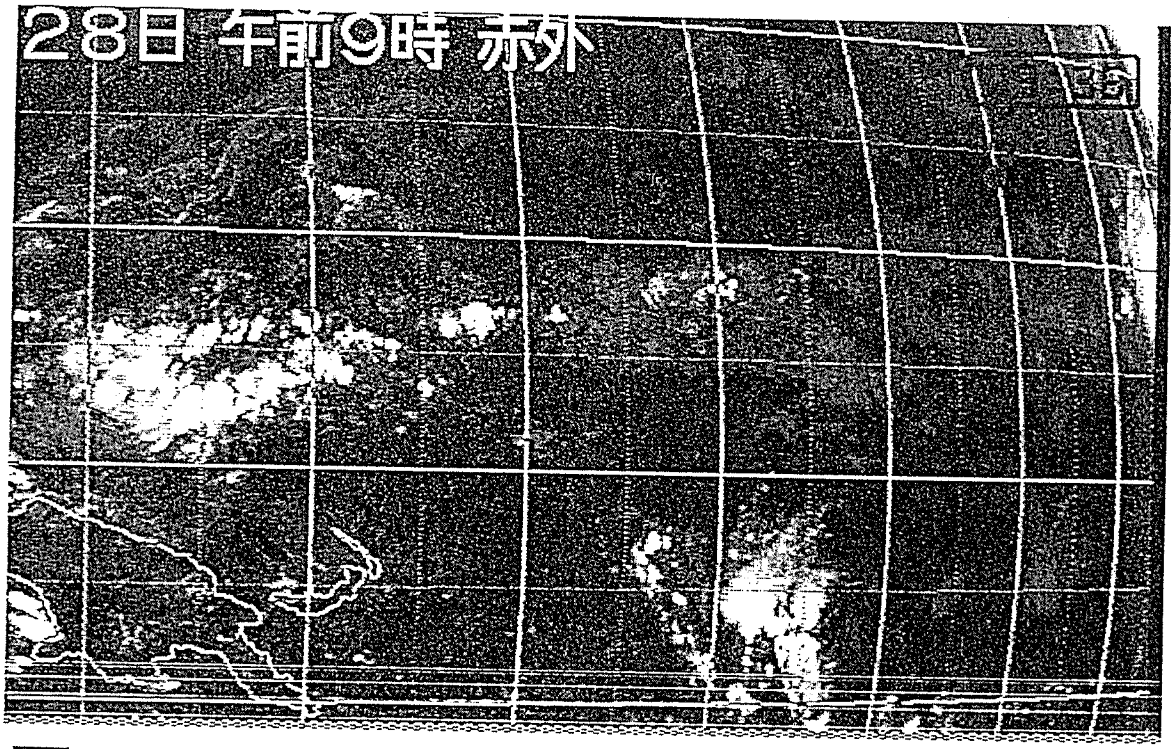
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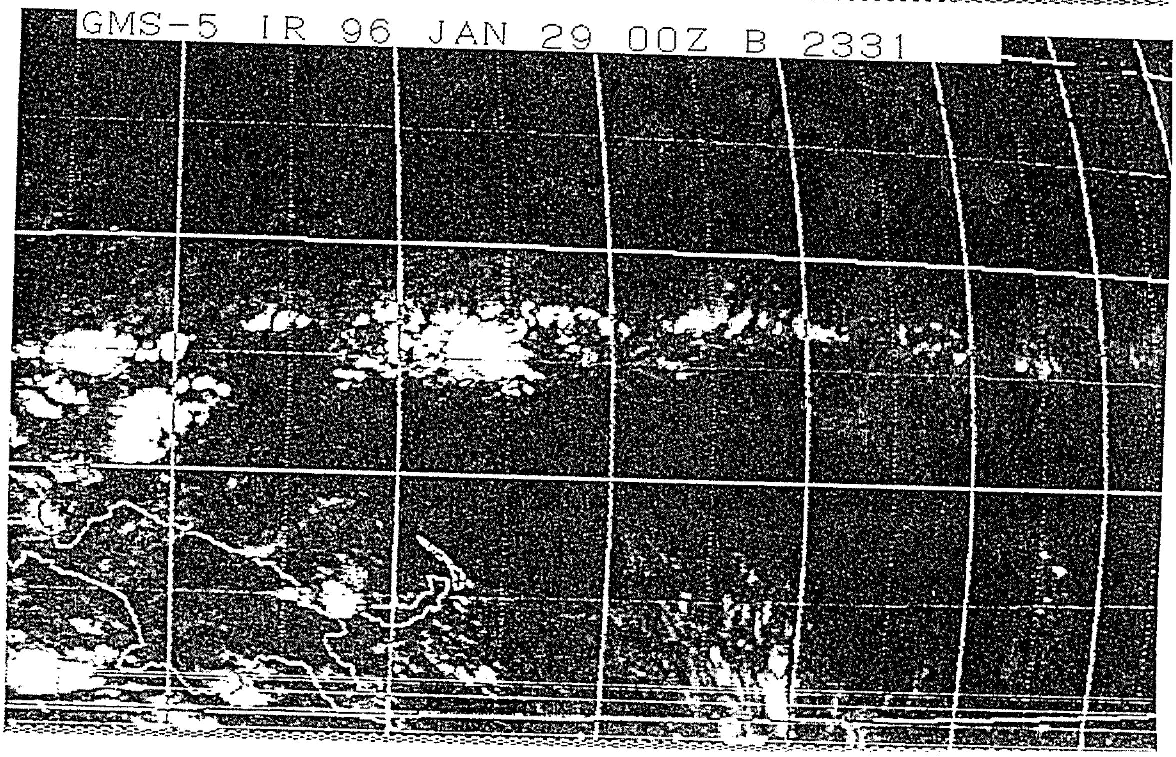
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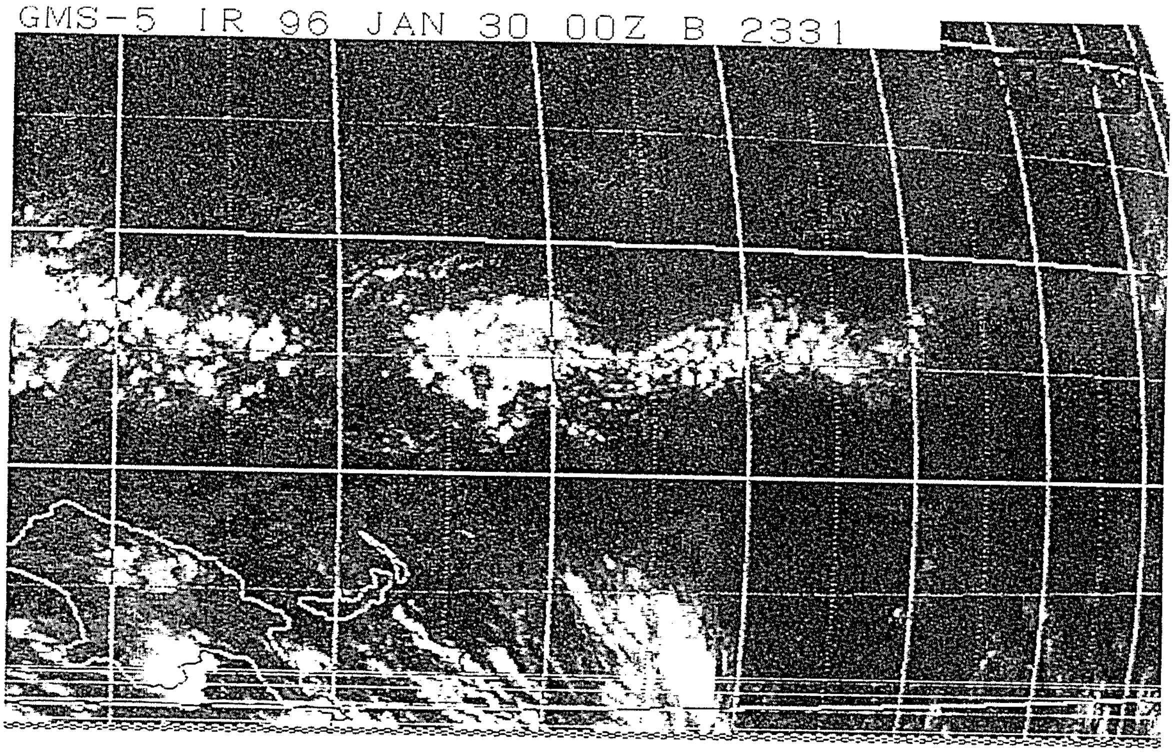
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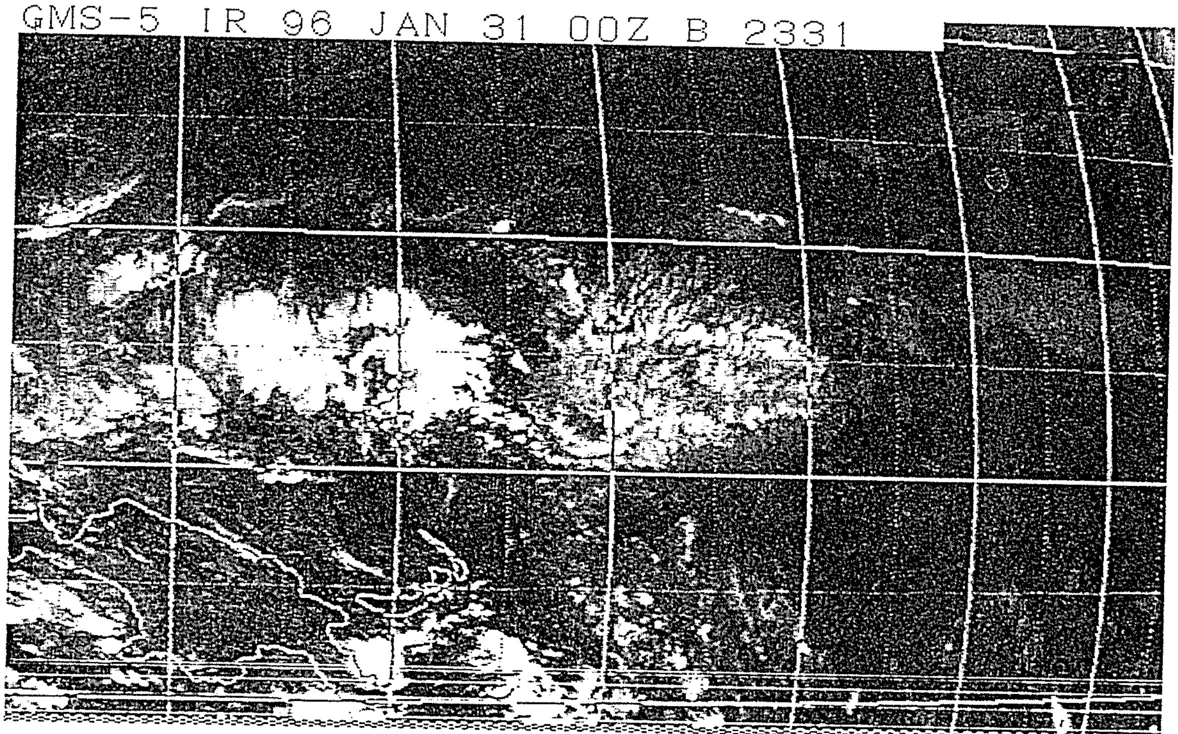
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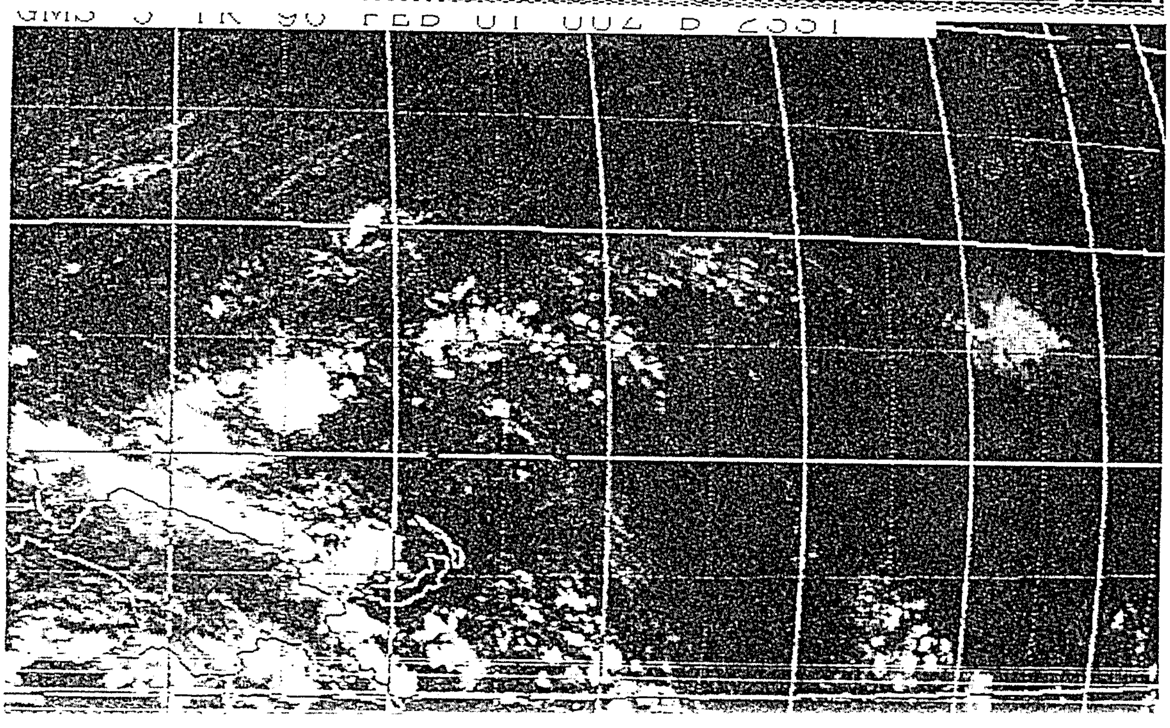

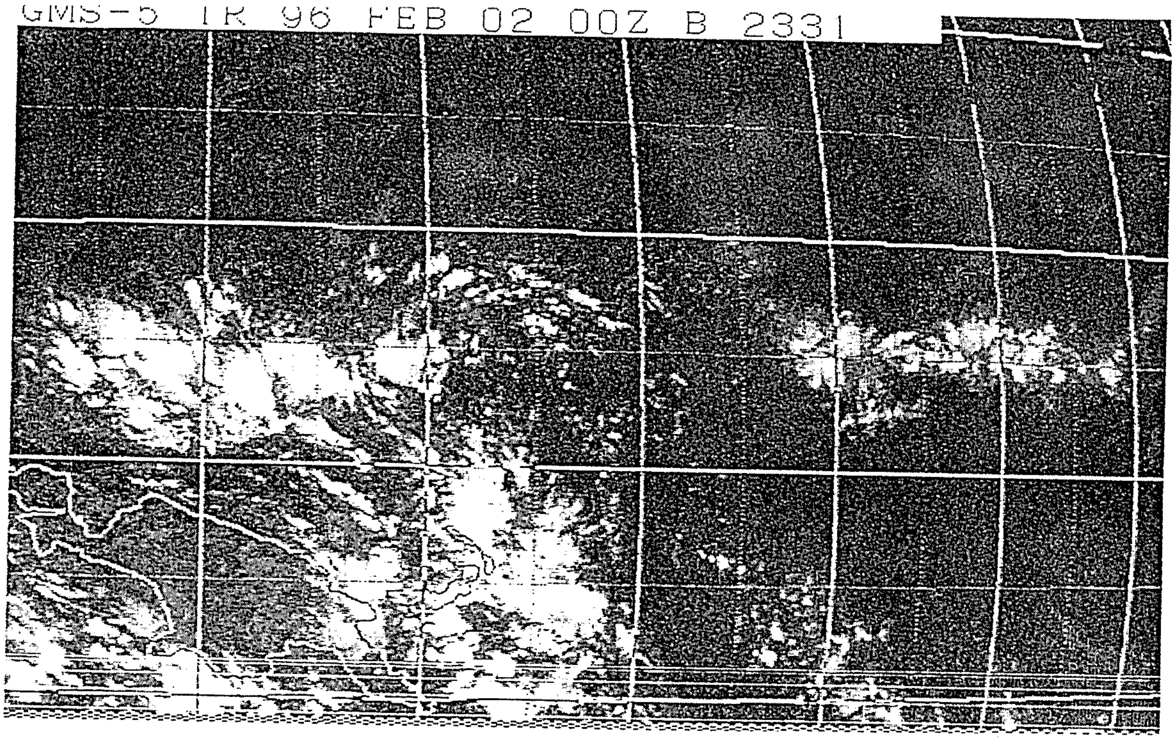

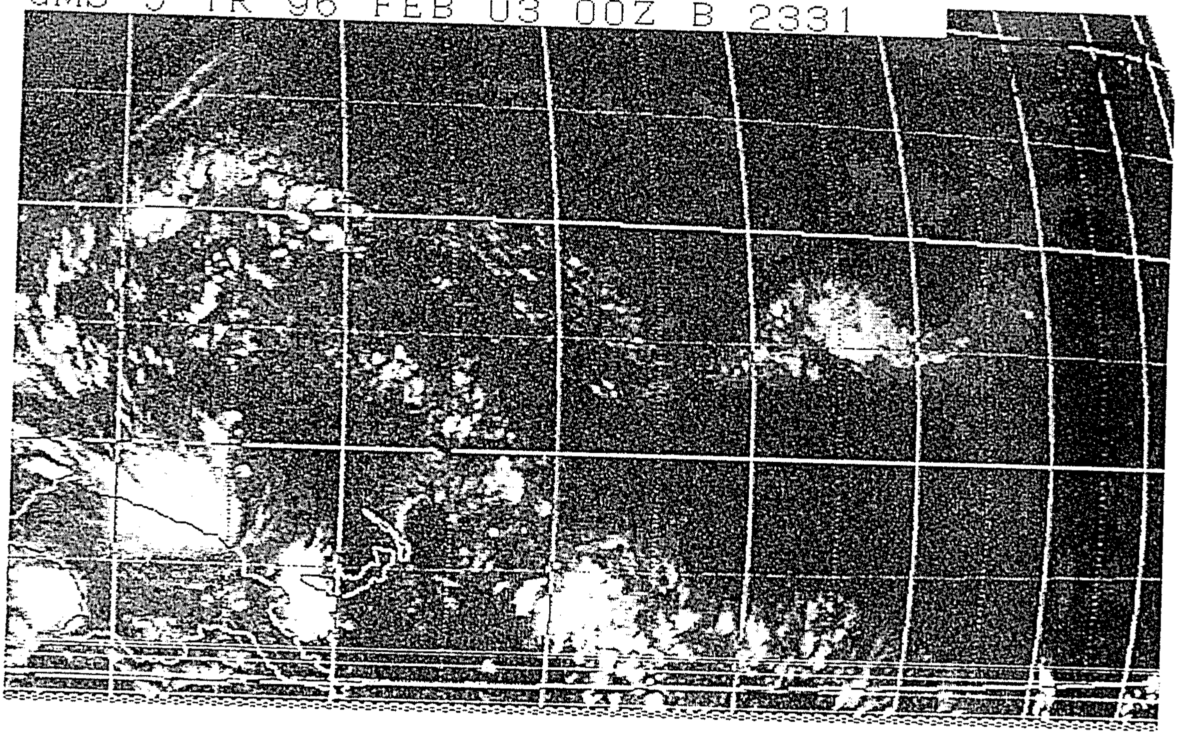

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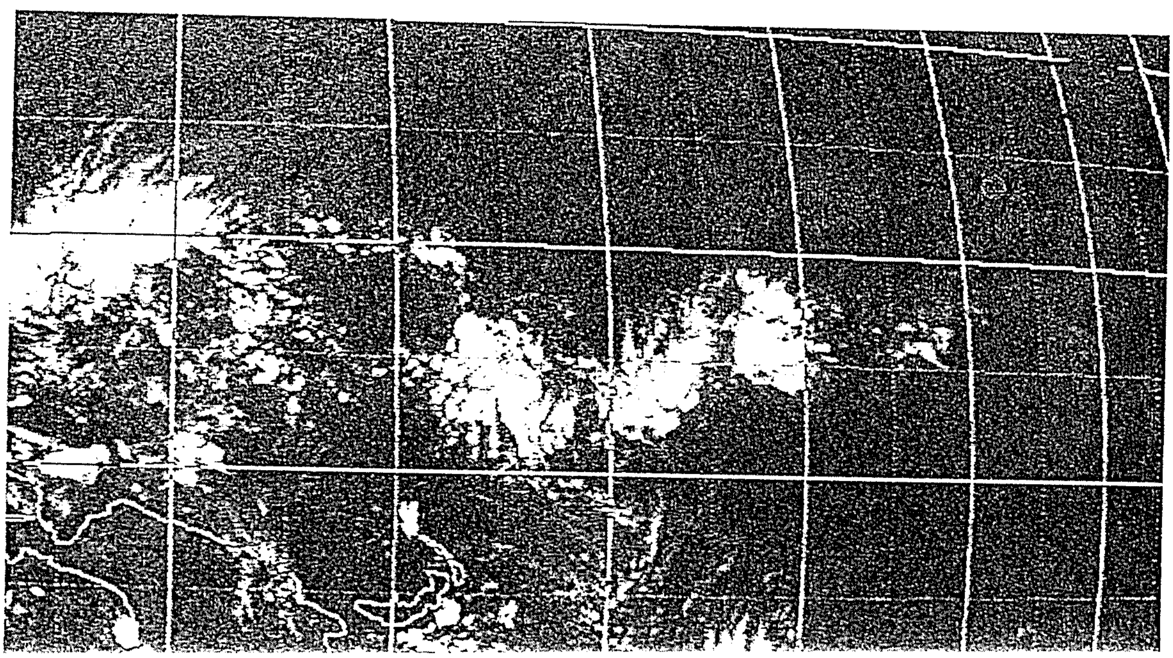

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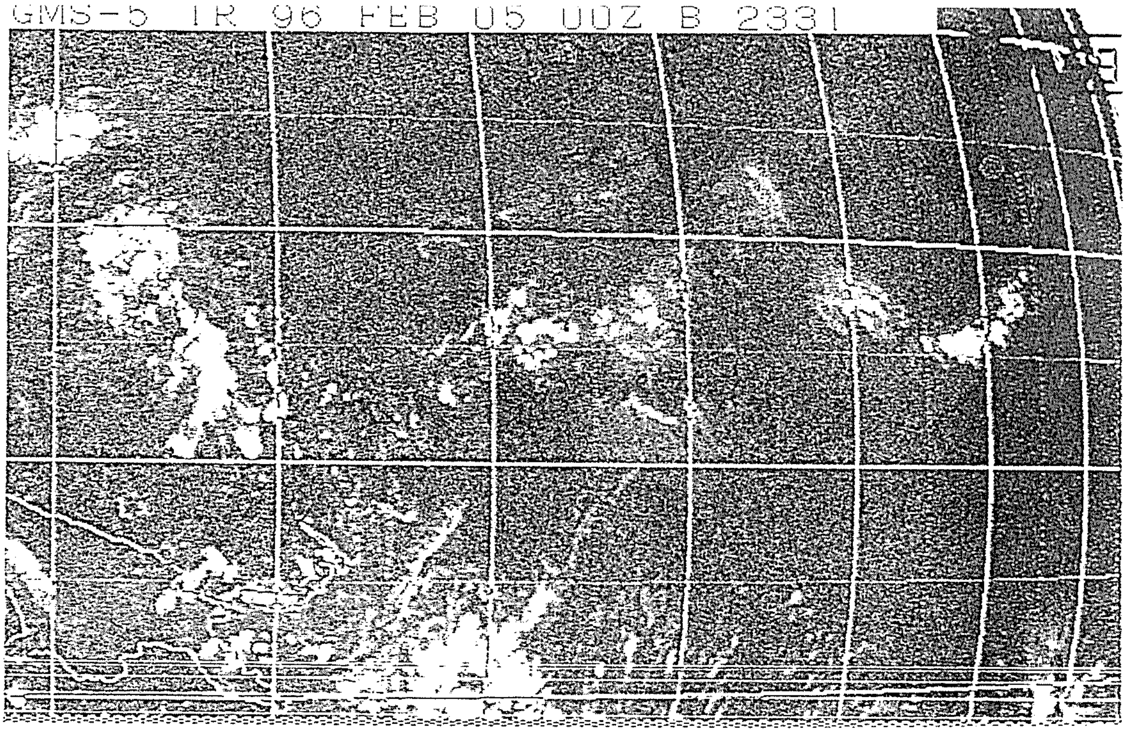

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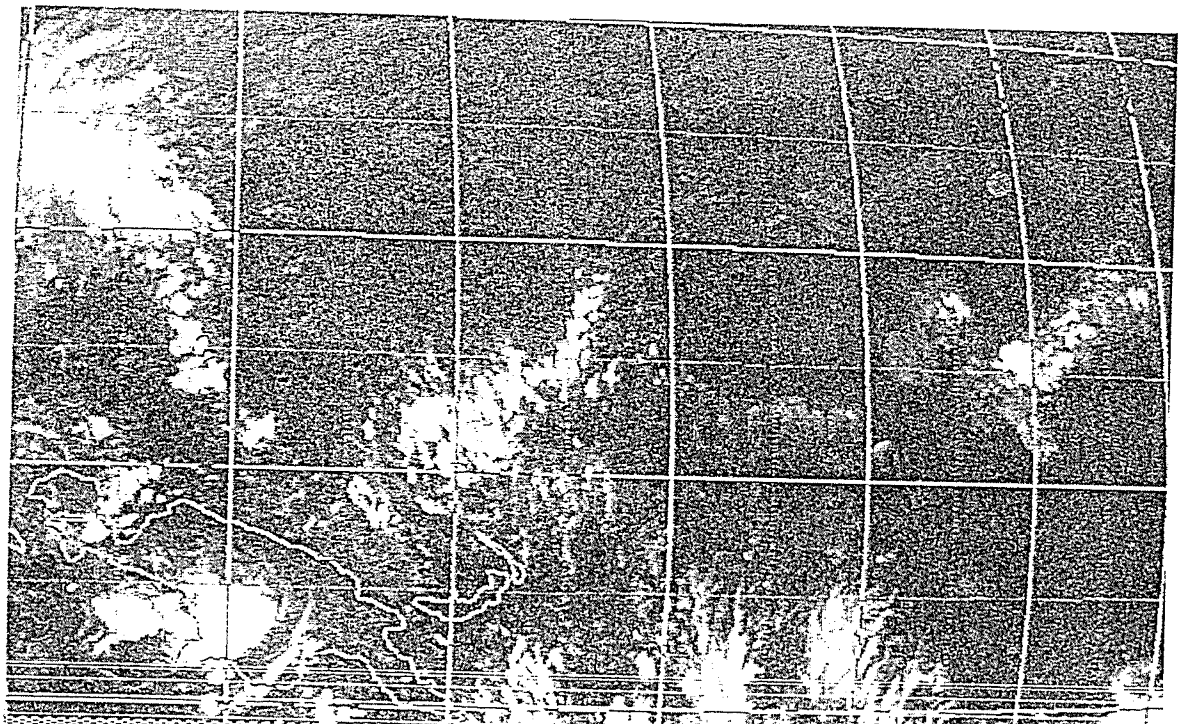

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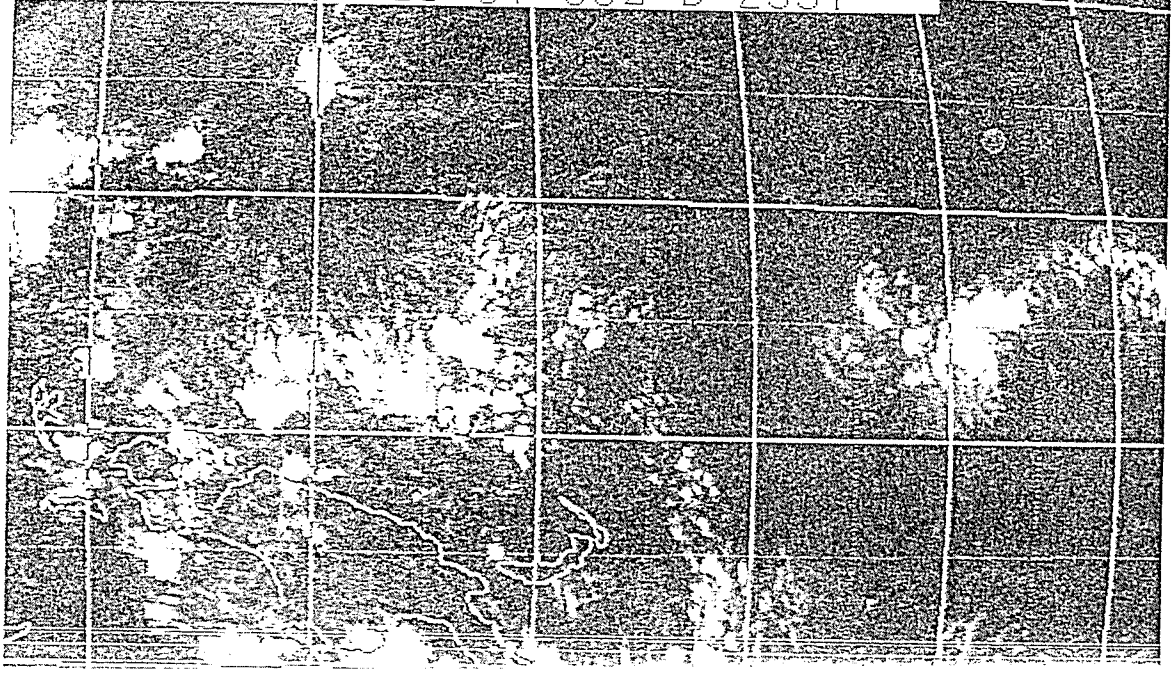

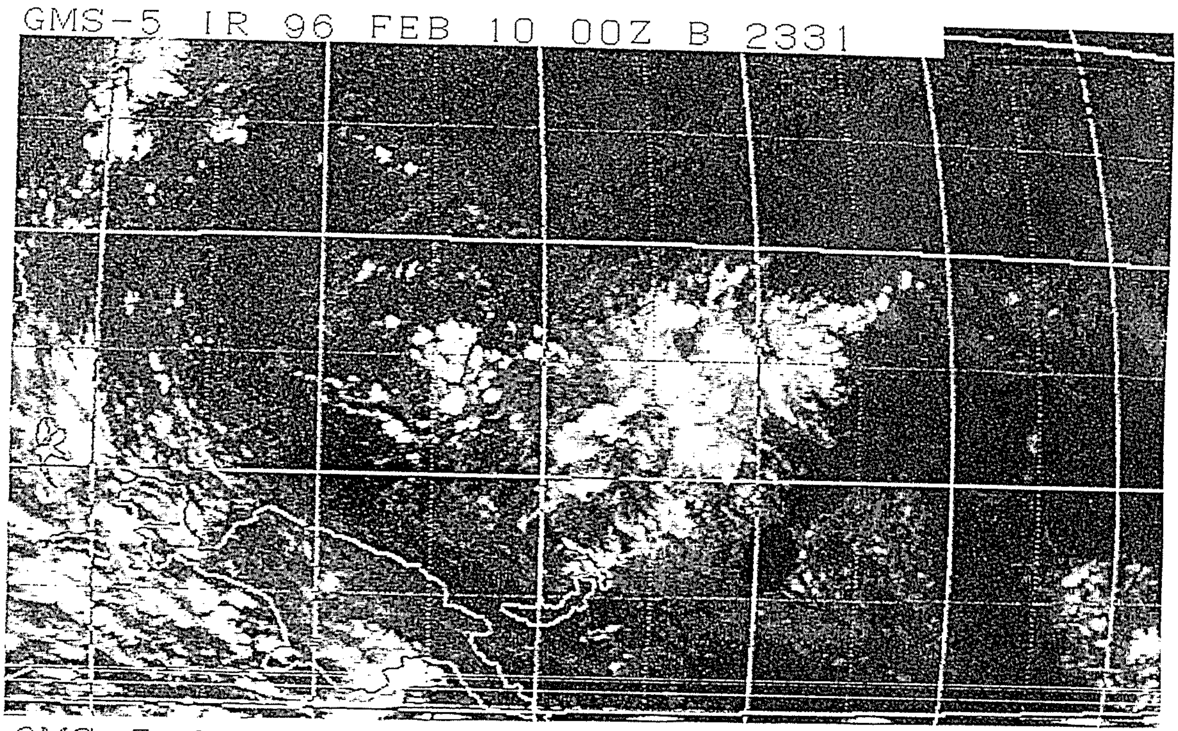
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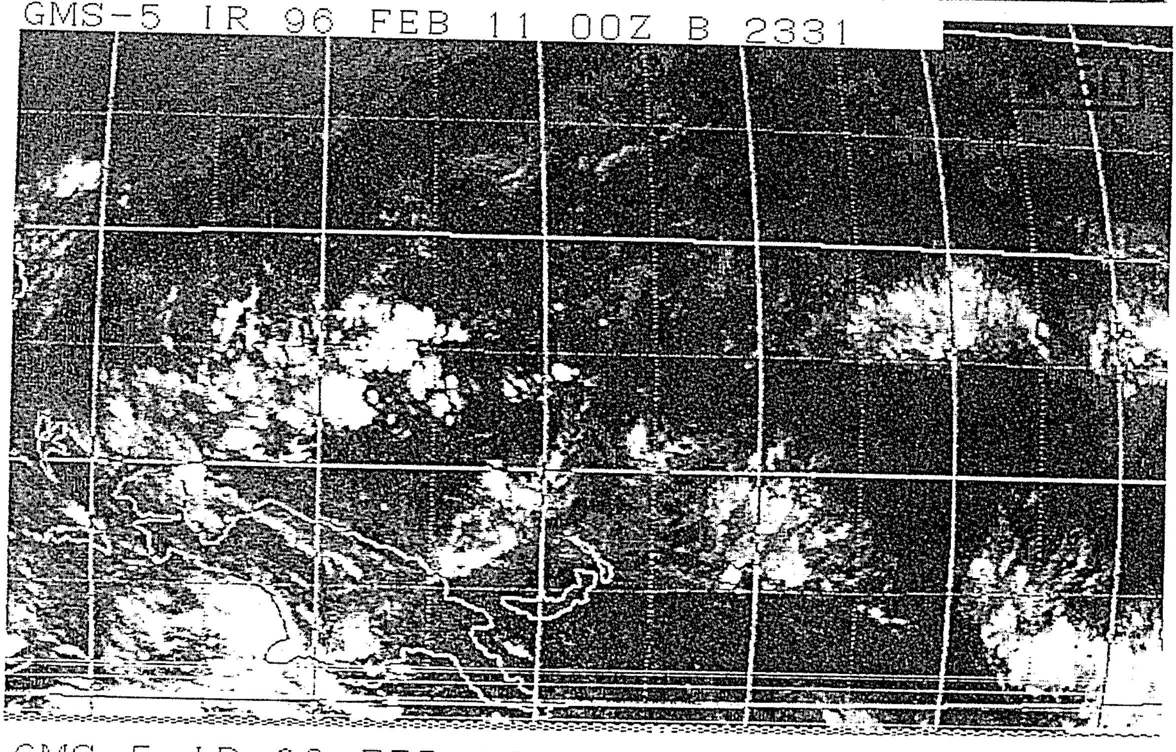
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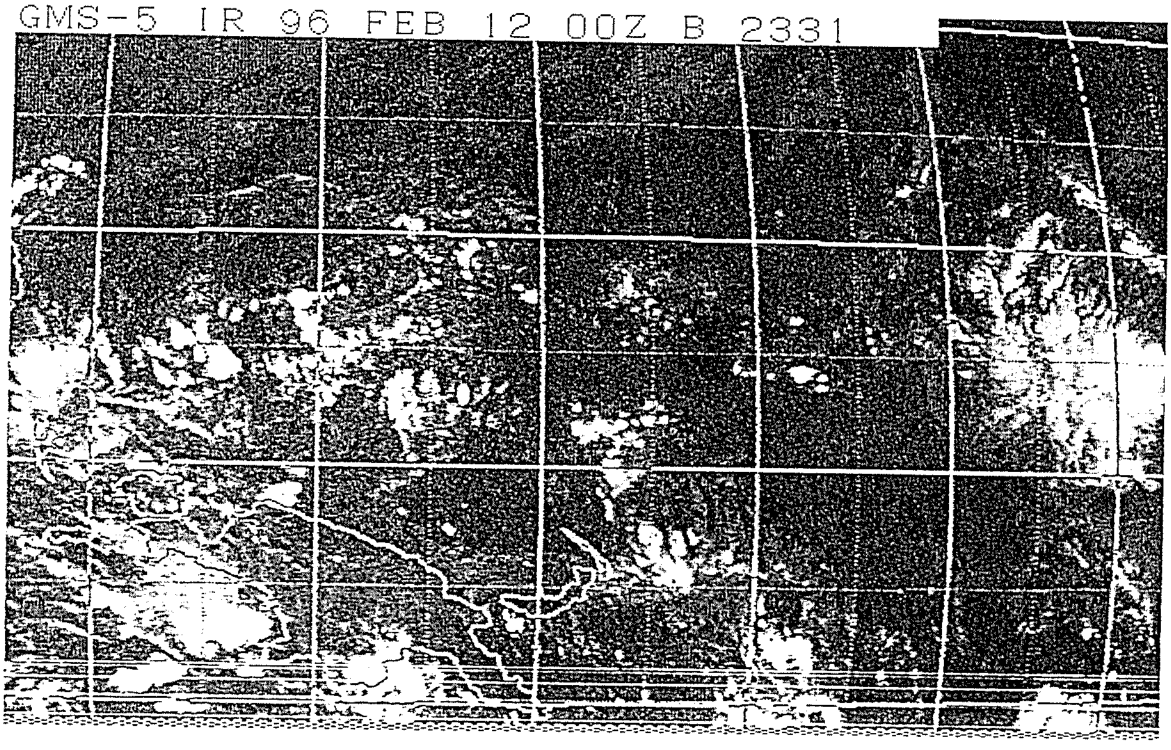
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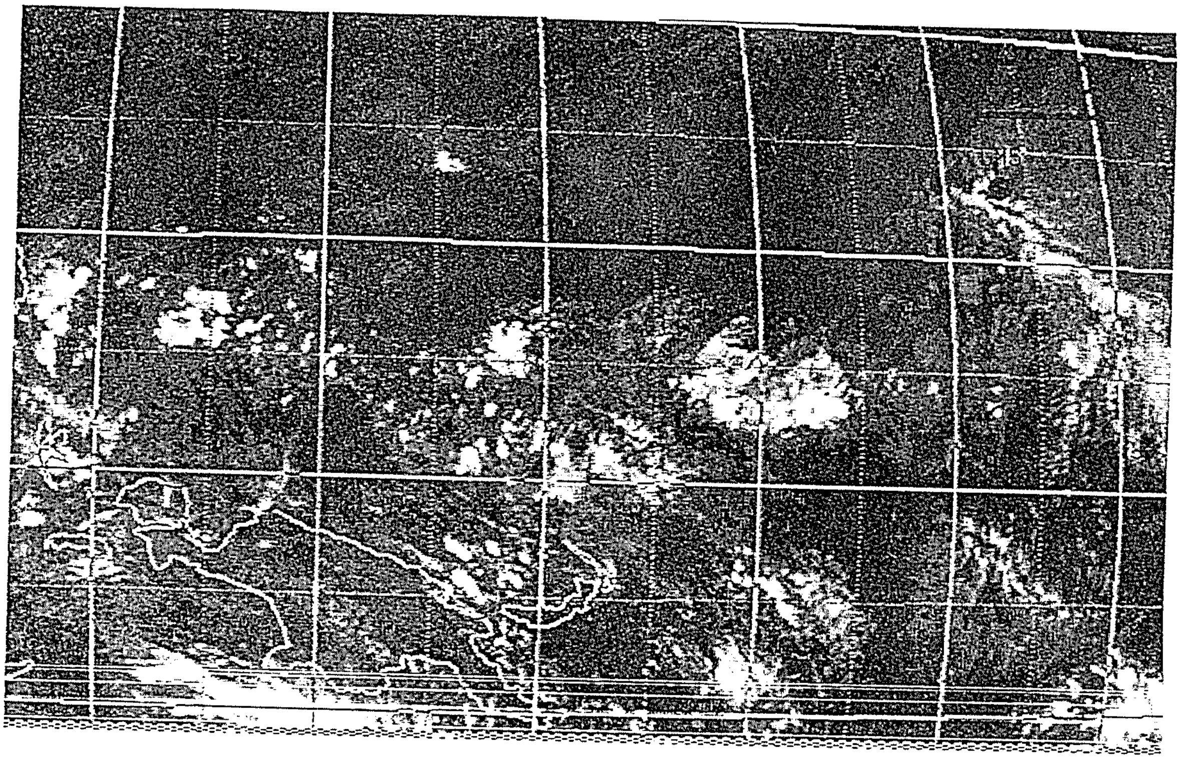

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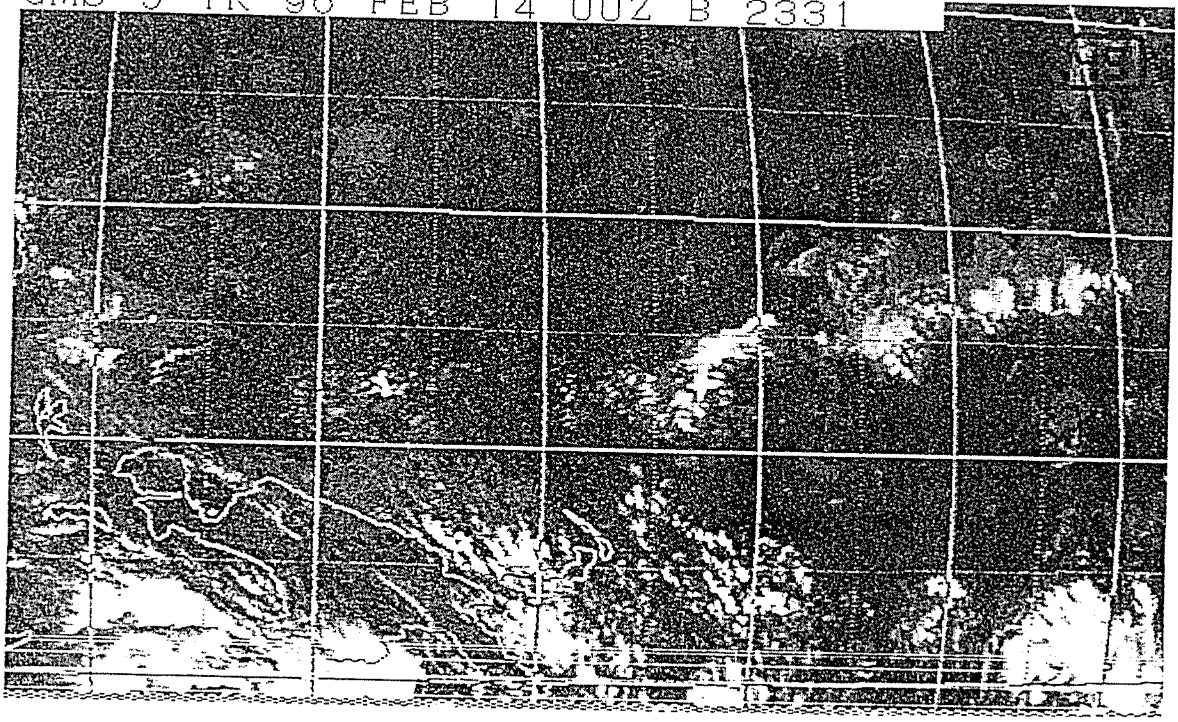

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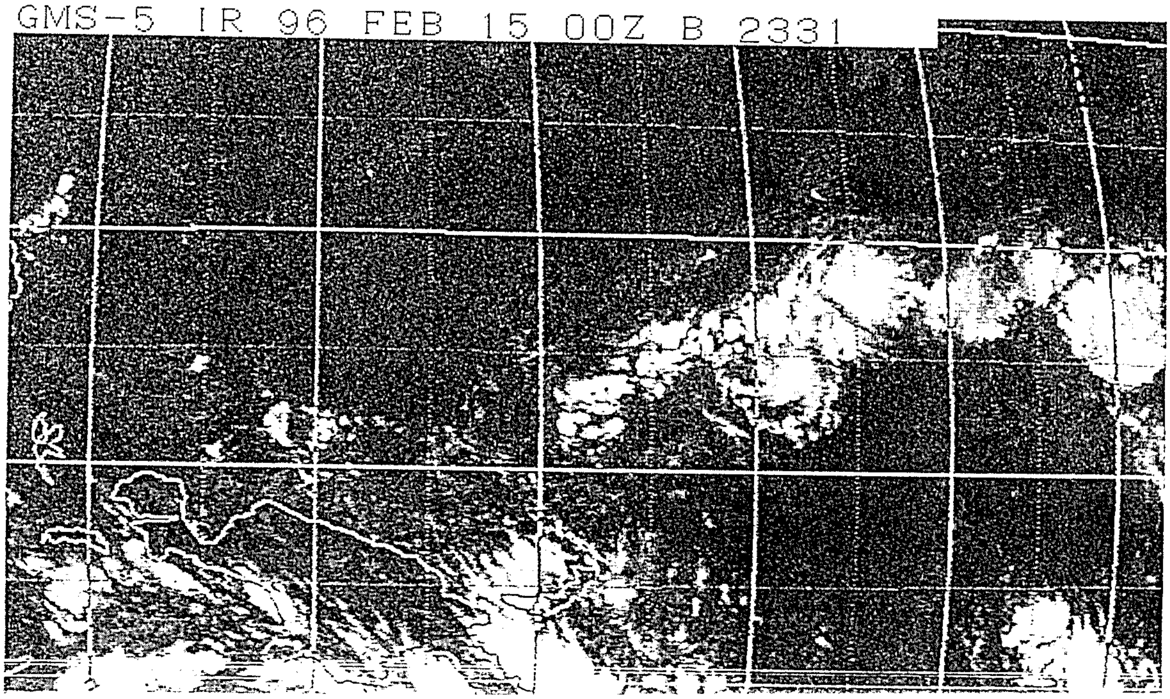

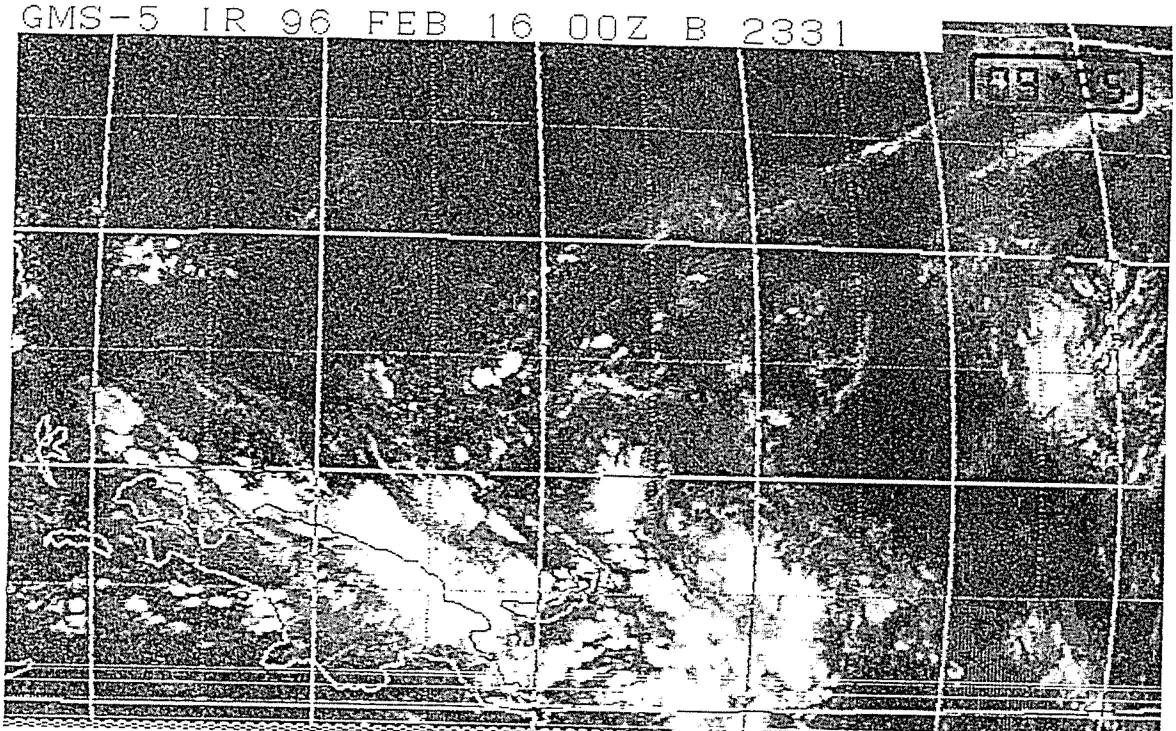
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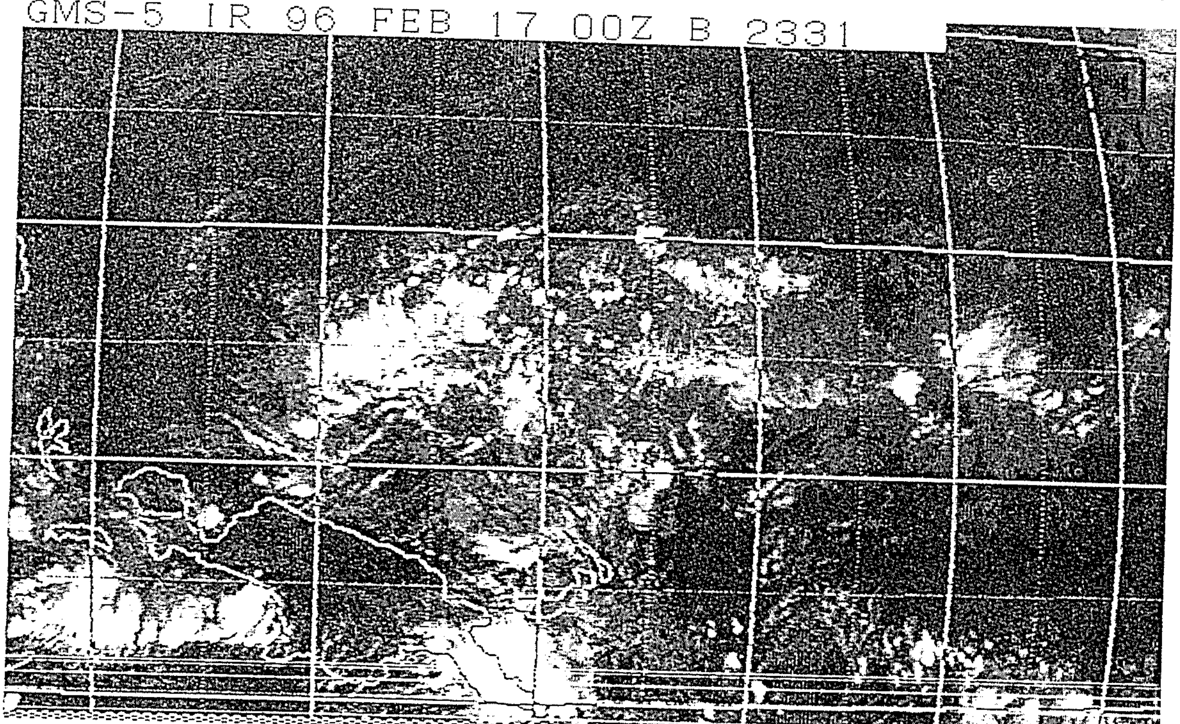
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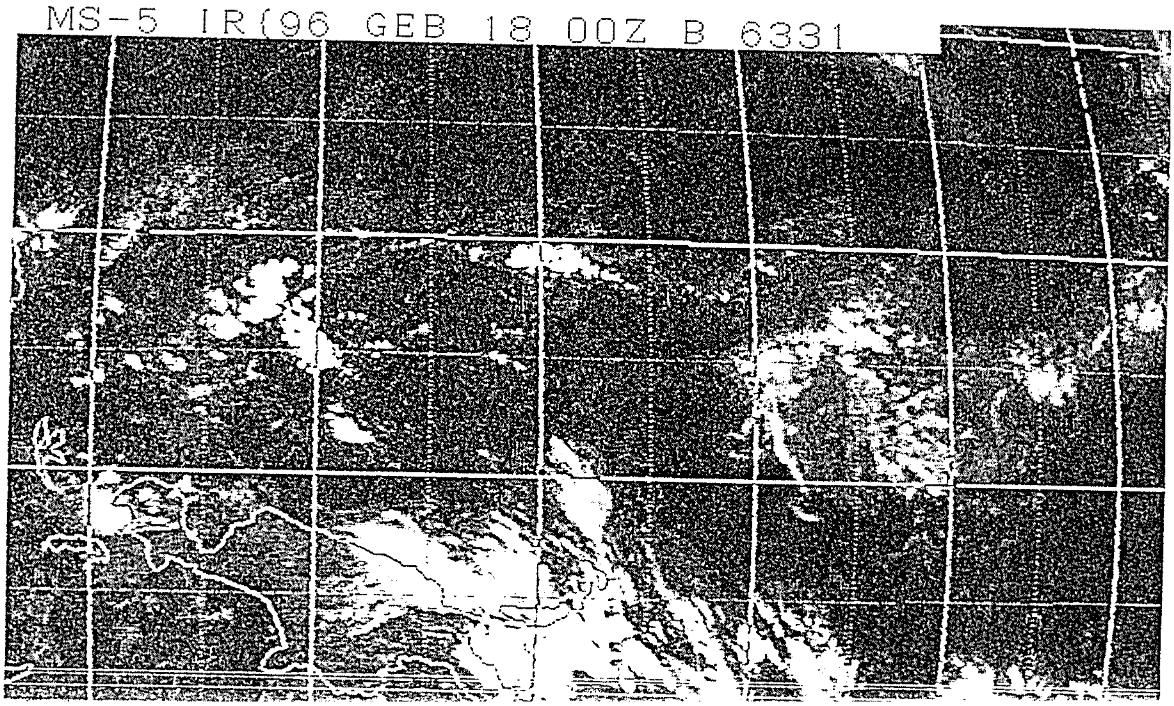
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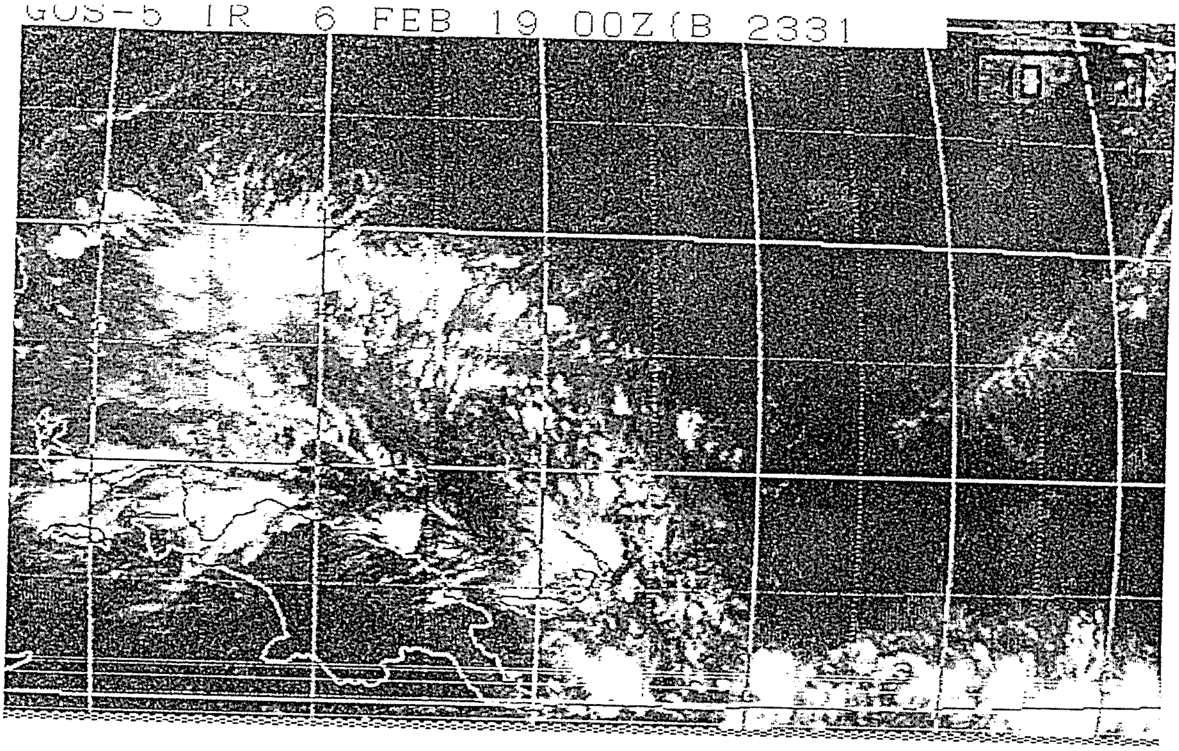
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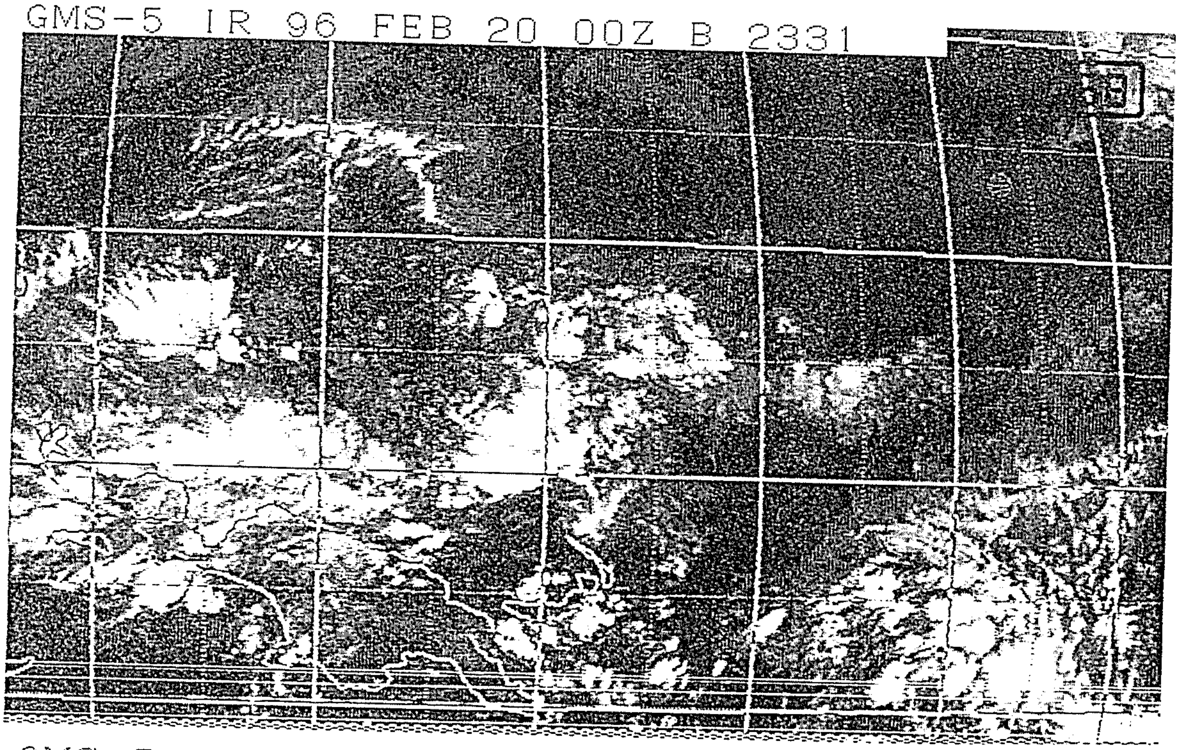
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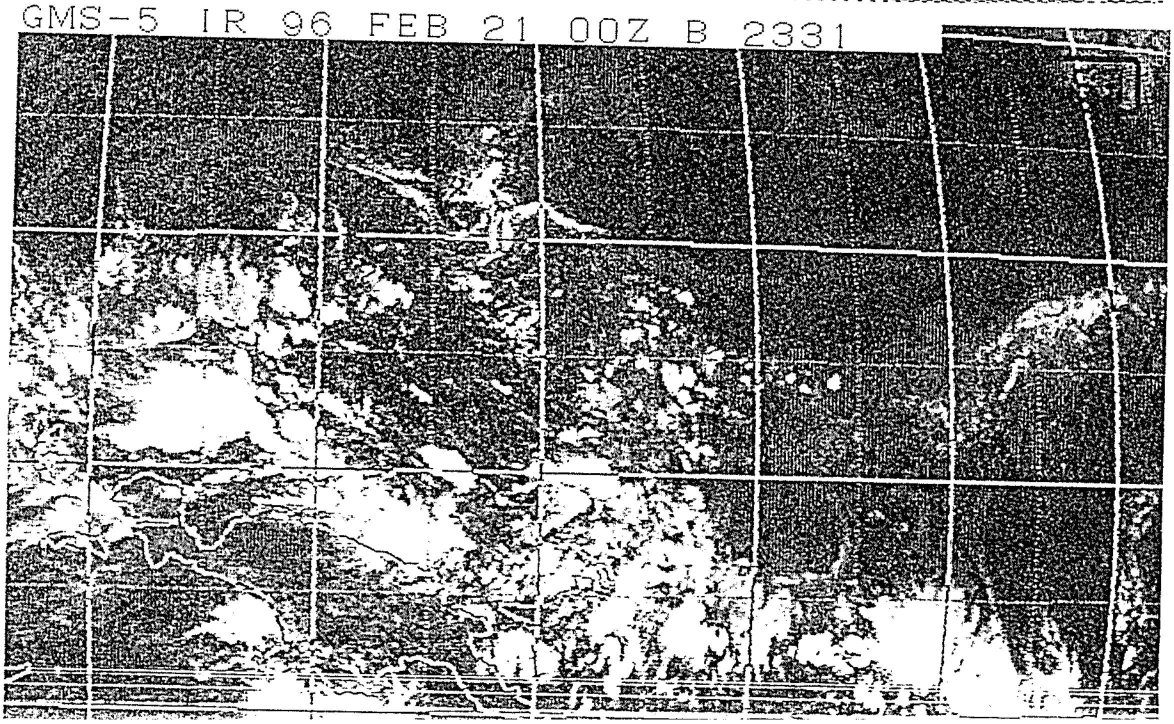
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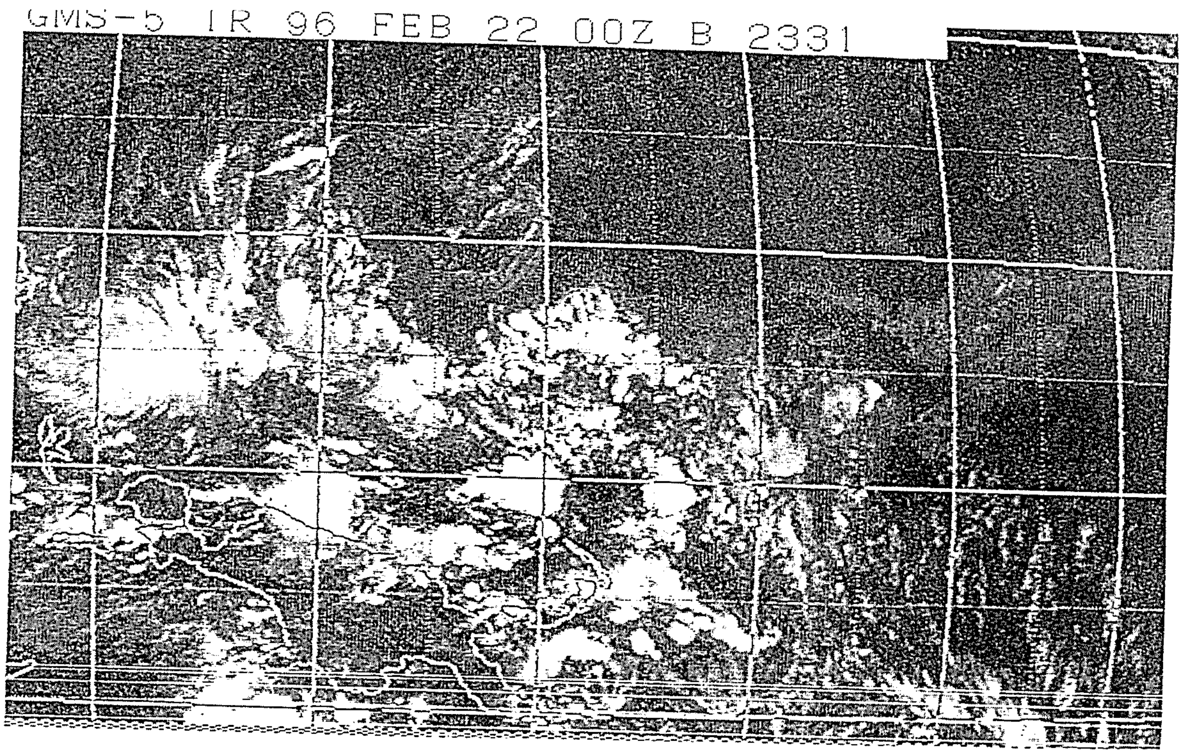
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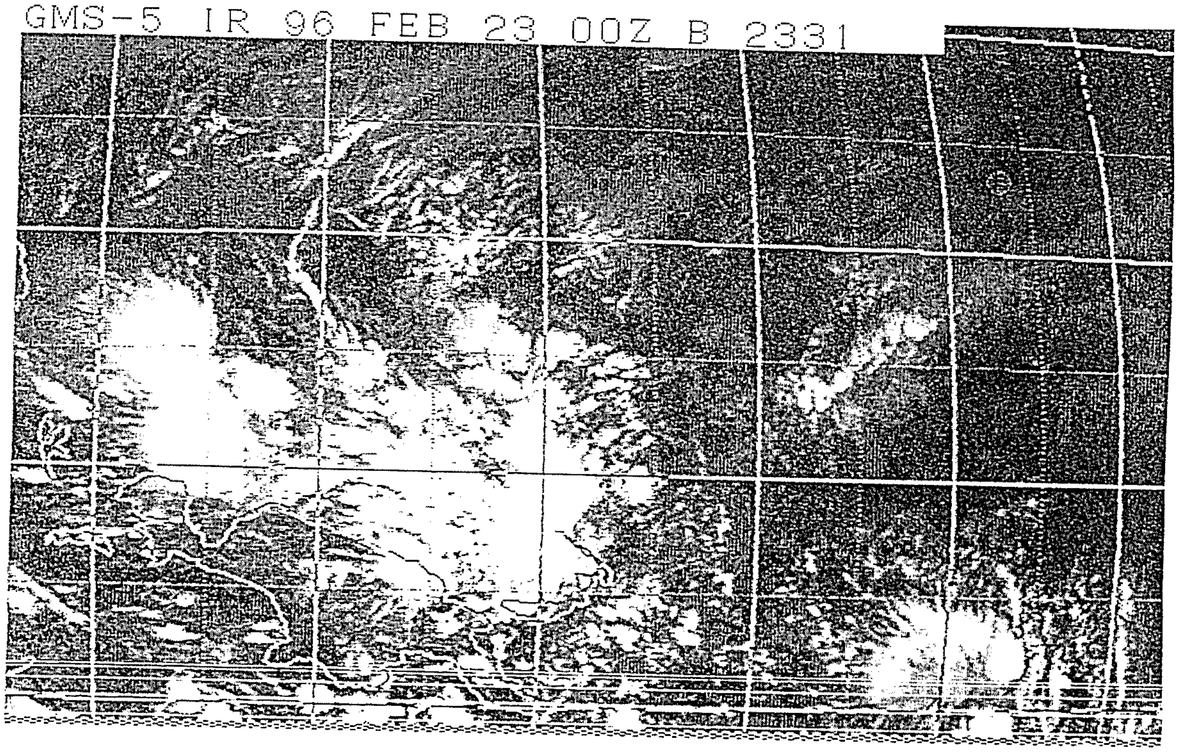
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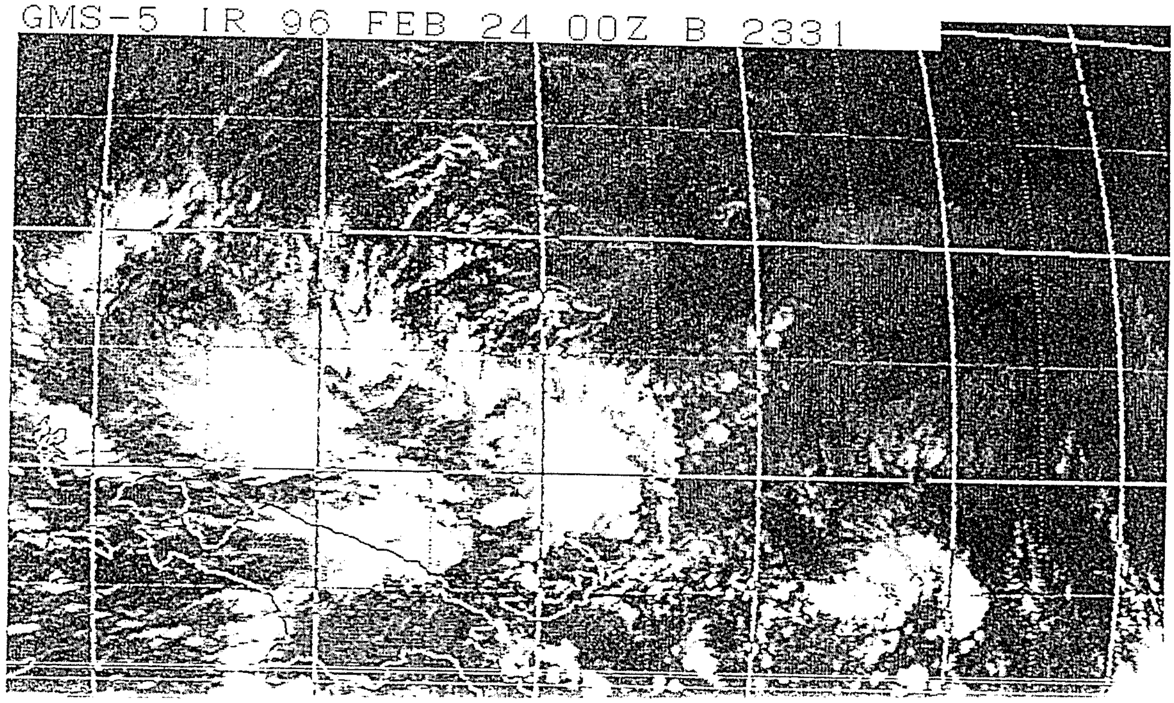
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