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R/V Mirai Cruise Report
MR99-K04

July 23- August 19, 1999

Japan Marine Science and Technology Center
(JAMSTEC)

Contents

1. Introduction

Oceanic conditions in the subtropical and subarctic gyres, especially in and around the Kuroshio Extension, are thought to be important to the North Pacific decadal/interdecadal climate variabilities. In terms of global heat budget, the ocean in this region transfers the heat obtained in the tropics to the atmosphere. The area could also be a reservoir of greenhouse gases as anthropogenic CO2 by deep oceanic convection in winter season, which may convey these gasses to deep ocean. Main objectives of this research are to clarify the various processes in this region such as the variability of the Kuroshio Extension and mesoscale eddies, and distribution of the North Pacific Intermediate Water around the Kuroshio Extension.

And we study the historical change paleoceanographic conditions in the North Pacific Ocean. The time scales are from several hundred to thousand years. We research the north and south transfer of Kuroshio Extension area for the past twenty thousand years. We carried out sediment coring. We estimate paleoceanographic condition and paleoclimate from the sea floor sediments analysis.

This cruise is joint study Meteorological observation and Geophysical survey.

There are two Meteorological observation. The first is over the atmospheric aerosol particles. It is generally admitted that atmospheric aerosol particles have impact to the global climate directly and indirectly. The direct effects of aerosols on the climate are due to scattering solar radiation and absorbing infrared radiation. Aerosol particles also may indirectly influence on cloud formation process. To examine the effect of aerosols to the global climate, it is suitable to do the measurements of aerosols in oceanic atmosphere, whose aerosols are well-known as background aerosols. We have measured the background aerosol particles on board in the past fifteen expeditions of the R/V Hakuho Maru, Ocean Research Institute, the University of Tokyo. Main purposes of this cruise are the test of the kytoon observation on ship and the search of the best place for the sampling inlet.

The second is to clear and solve the problems of horizontal distribution and optical properties of aerosols, some observations using a kind of the module were carried out over the Northern Pacific Ocean. Furthermore, collections of the data for calibration and validation to the remote sensing data were performed simultaneously.

We conducted the geophysical survey to reveal the detailed process of the reorganization of the plate boundaries around the Pacific plate in Late Jurassic before the formation of Shatsky Rise. Bathymetric survey by a multi-narrow beam echo sounder exposed several troughs, which strike is NW-SE or E-W. There are negative magnetic and gravity anomalies over the troughs.

This cruise is certainly consist of atmosphere, watersphere and landsphere comprehensive observation study.

2. Summary

2.1 Ship

R/V Mirai

Captain Masaharu Akamine

Total 35 crew members

2.2 Cruise code

MR99-K04

2.3 Project name

Six kinds of project have been carried out in this joint cruise MR99-K04.

(1) Kuroshio Extention Study
(2) Paleoclimate study
(3) Study on aerosol particles over the North Pacific Ocean
(4) Studies on behaviors and climate influence of atmospheric aerosol and clouds over the subtropical and subarctic region of the Northern Pacific Ocean
(5) Validation for TRMM over Northern Pacific with shipboard Doppler radar
(6) Geophysical Survey

2.4 Undertaking institution

Japan Marine Science and Technology Center (JAMSTEC)

2-15, Natsushima, Yokosuka, 237, Japan

2.5 Chief scientist

Hirofumi Yamamoto (JAMSTEC)

2.6 Period

July 23 , 1999 - August 19, 1999

2.7 Ports of call

Sekinehama, Japan	(Departure; July 23, 1999)
Shimizu, Japan	(August 3-5, 1999)
Sekinehama, Japan	(Arrival; August 19, 1999)

2.8 Research participants

Total 35 scientists and technical stuff participated from 10 different institutions and universities.

2.9 Observation summary

2.9.1 Kuroshio Extention Study

In order to clarify the mesoscale oceanic structure, various kinds of observations have been carried out in and around the Kuroshio Extension (including subtropical region and the Kuroshio-Oyashio interfrontal region).

(1) CTD casts along 4 sections (150.0E, 152.5E, 155.0E, and 157.5E) across the Kuroshio Extension (32.5N-37.5N) down to 2000m depth with a small Rosette water sampler for temperature, salinity, dissolved oxygen and dissolved CO2 measurements.

CTD (Salinity, Temperature, Depth, Dissolved Oxygen,CO2): 48 casts down to 2000m(37 CTD casts), 4000m(9 CTD casts), 6500m(2 CTD casts validation)

(2) Mooring services: recovery and deployment of subsurface mooring of current meters at 37.5N, 152.5E

ADCP buoy recovery : 1 site (37 ° 19.338'N, 152 ° 28.347'E, Depth=5982m)

ADCP buoy deployment: 1 site (37 ° 19.206'N, 152 ° 28.865'E, Depth=5987m)

(3) XBT/XCTD/Bathymetry observations

(4) Surface meteorology: continuous

(5) ADCP measurements: continuous

(6) Doppler radar measurements: continuous

(7) Surface temperature, salinity measurements by intake method: continuous

(8) Paleo climate study in the western North Pacific

We study the historical change paleoceanographic conditions in the North Pacific Ocean. The time scales are from several hundred to thousand years. We research the north and south transfer of Kuroshio Extension area for the past twenty thousand years. We carried out sediment coring. We estimate paleoceanographic condition and paleoclimate from the sea floor sediments analysis.

Piston coring: 3 sites (40 ° 33.3'N, 142 ° 55.0'E, Depth=1555m)
(40 ° 05.0'N, 149 ° 51.0'E, Depth=5608m)
(37 ° 30.0'N, 152 ° 00.0'E, Depth=5848m)

2.9.2 Surface meteorology observation

(1) Study on aerosol particles over the North Pacific Ocean

In order to clarify the effect of aerosols to the global climate, marine aerosols and gasses have been measured. The kytoon observation up to about 700 m above the sea level and the search of the best place for the sampling inlet have also been carried.

(2) Studies on behaviors and climate influence of atmospheric aerosol and clouds over the subtropical and subarctic region of the Northern Pacific Ocean

To obtain the data for calibration and validation between remote sensing and surface measurements over the ocean, a series of simultaneous observations has been carried out about optical properties like as scattering and absorption coefficients and radiative properties as optical properties of atmospheric aerosols, the concentration and size distribution of surface aerosols over the subtropical and subpolar region of the Northern Pacific Ocean for 28days from July 23 to August 19, 1999. In addition of that, a sky radiometer was examined for to a fully automated ship-borne instrument and improved to the practical usage on same board.

2.9.3 Validation for TRMM over Northern Pacific with shipboard Doppler radar

Main theme to use Doppler radar is to investigate the structure of precipitation cloud systems which develops over Northern Pacific ocean, comparing with TRMM/PR(Tropical Rainfall Measuring Mission / the Precipitation Radar, the first spaceborne radar) data

2.9.4 Geophysical Survey

The survey area is situated southwest of Shatsky Rise. The seafloor age of the area is about 150 Ma just before the formation of Shatsky Rise. The gravity anomaly in the area from satellite altimeters (Sandwell and Smith, 1997), which is below -20 mgal, has a linear feature. The interval of survey lines was 5.5 nm and the length was 70 or 80 nm. The ship speed was about 15 knot. We used a proton magnetometer, a shipboard three components magnetometer for the geomagnetic measurement, a multi-narrow beam echo sounder with a sub-bottom profiler, SeaBeam 2112 system, for the bathymetric measurement, and a shipboard gravimeter for the gravity measurement.

2.10 Observed oceanic and atmospheric conditions

Leg.1 Sekinehama to Shimizu (23th July〜3th August)

It was misty condition from the evening to 9pm of the 24th. Visibility was so bad. The observation area was taken on the south-west of a high pressure area. It prominent south-west direction of this. The velocity of the wind was 4 classes. It was fine days.

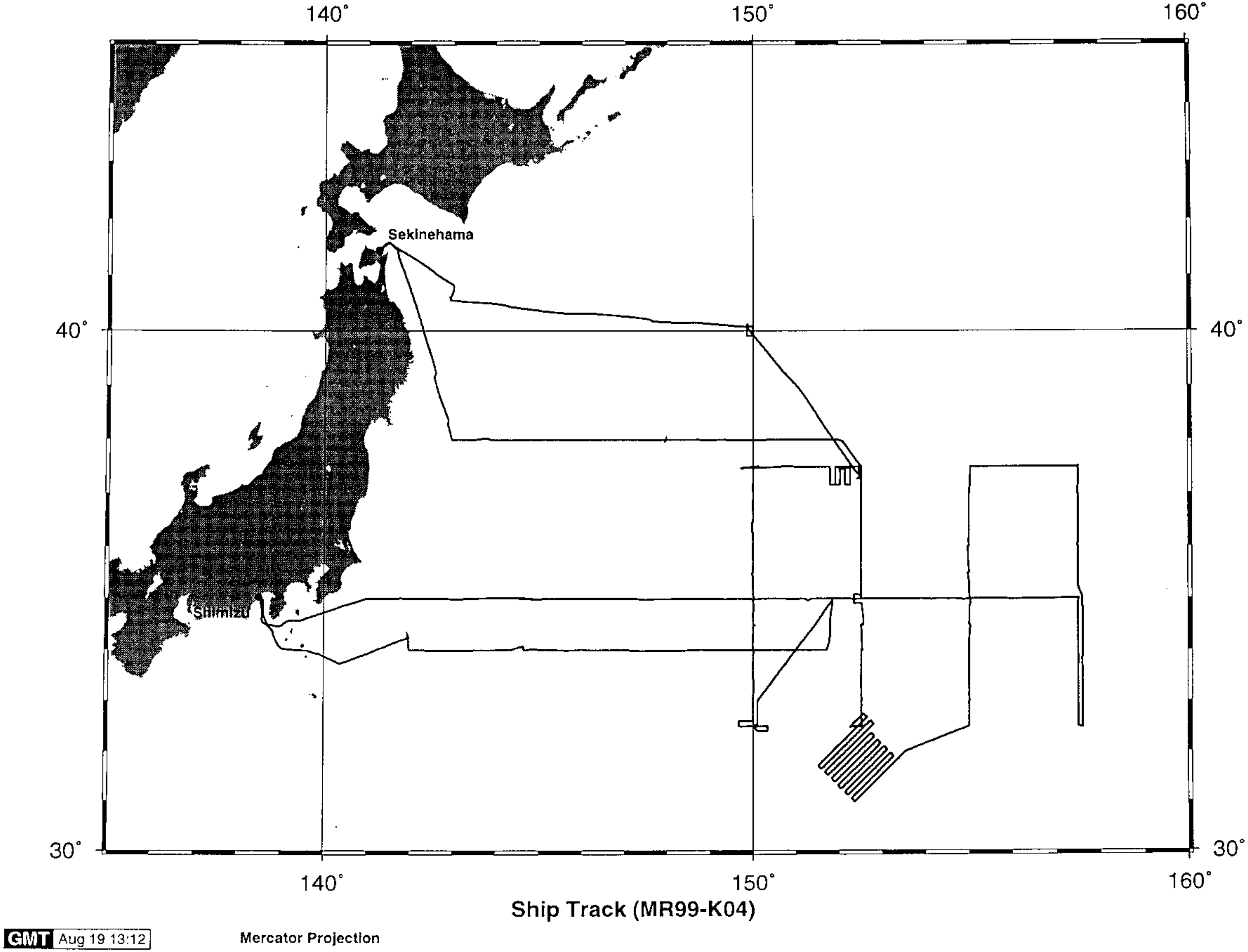
Leg.2 Shimizu to Sekinehama (5th August 〜 19th August)

We headed east port between a typhoon 8th and high pressure area after Shimizu port. It continued the eastward swell(max 3m) on 6th morning of this. It continued calm weather on the CTD observation area by the effcts of the high pressure area. The wind of the area were various direction. The velocity of the wind changed 3〜4 classes. It was prominent the south-westard wind which blowing in the low pressure zone near the north of Sahalin from

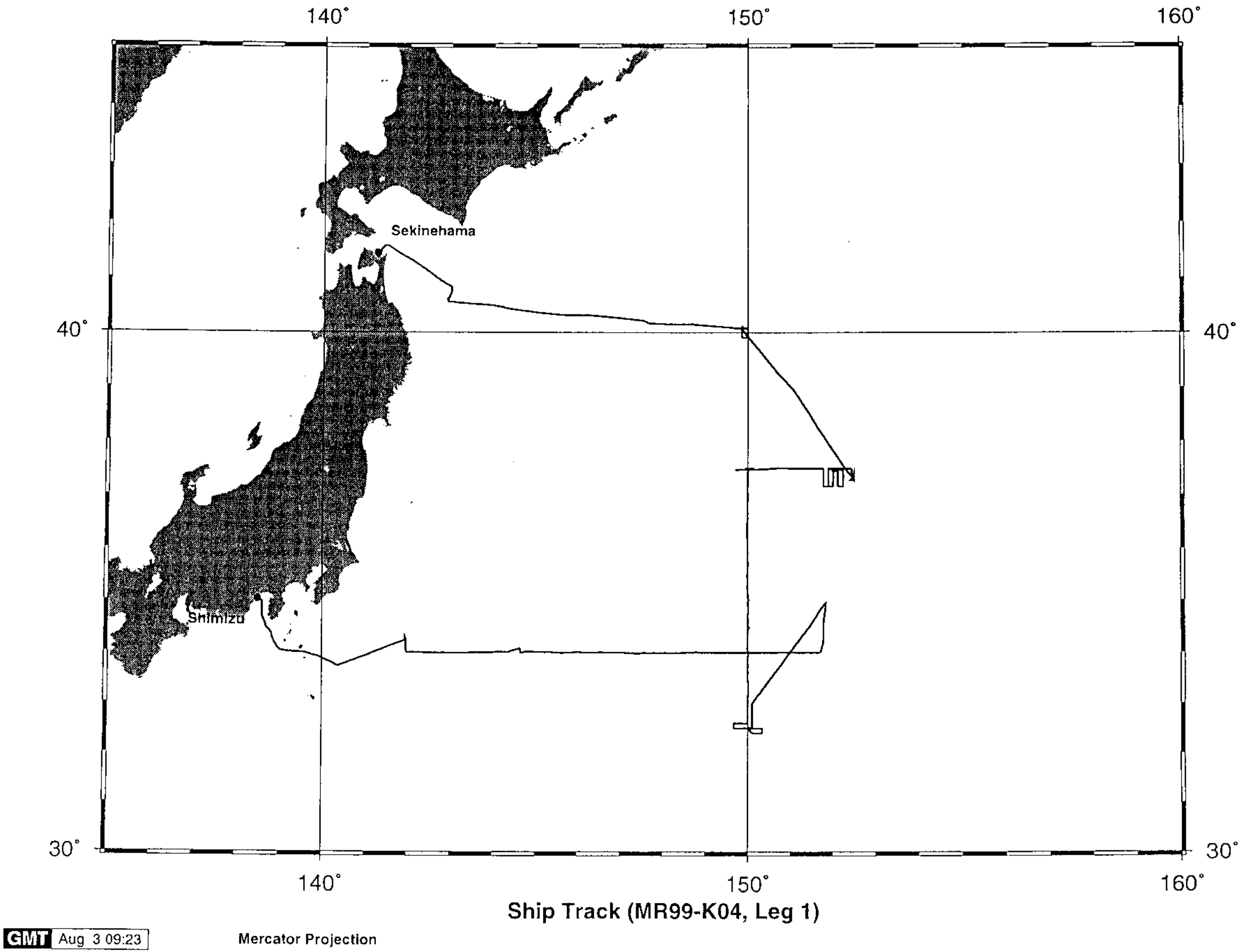
CTD observation area to Sekinehama.

3. Cruise Track

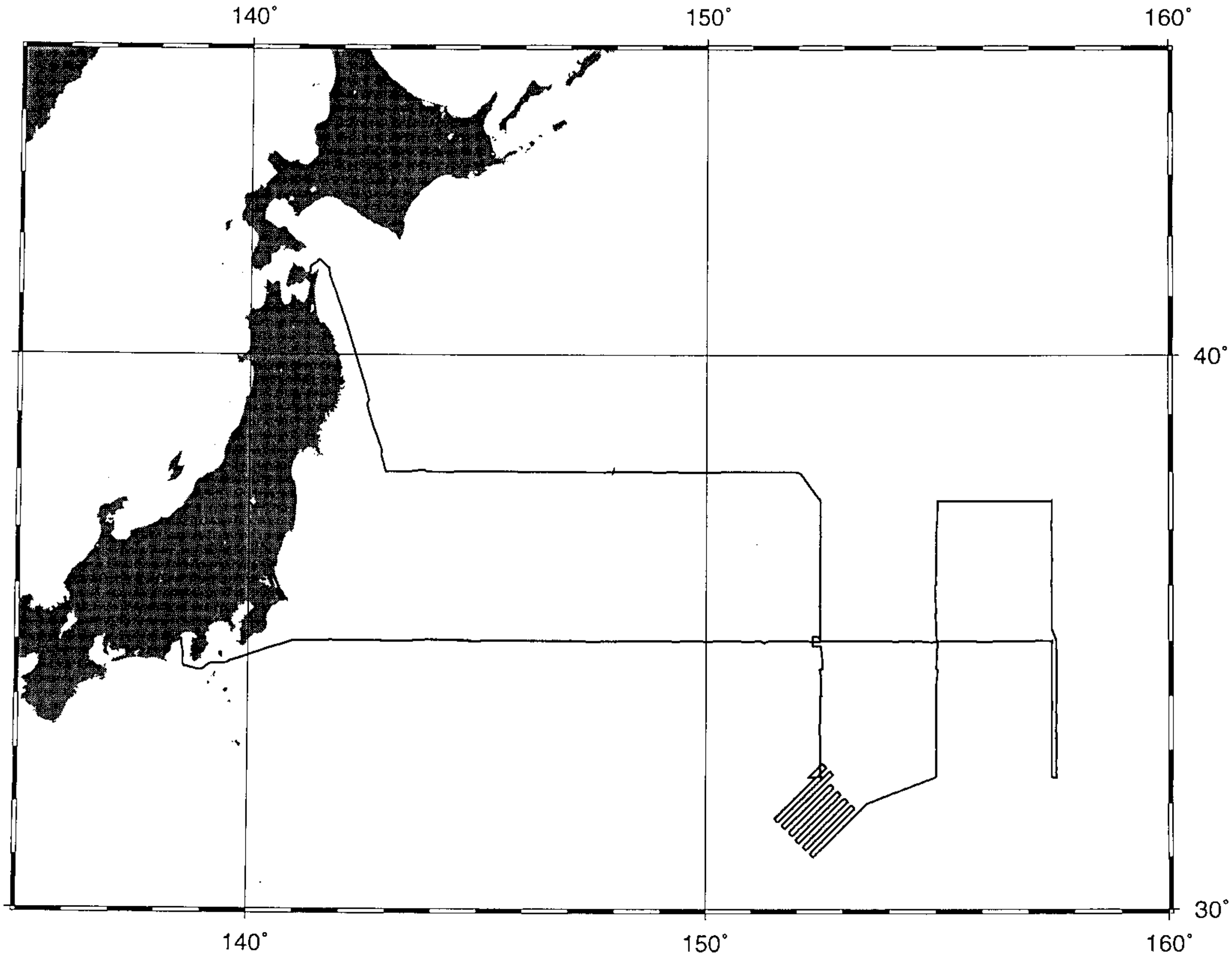
The Leg1 left Sekinehama port for Sanriku offing. We observed this Area. A few days later arrive at Shimizu port. The Leg2 left Shimizu port for Sanriku offing. A few days later arrive at Sekinehama port.



Ship Track (MR99-K04)



Ship Track (MR99-K04, Leg 1)



Ship Track (MR99-K04, Leg 2)

GMT Aug 19 12:51

Mercator Projection

4. Cruise Log

July 23 (Friday)

14:00 Departure from Sekinehama

Start of continuous observation (Shipboard ADCP, Aerosols, pCO2, etc.)

14:30 Briefing for safety life on the ship

15:00 Boat Drill

16:45 Konpira-san

18:30 Meeting on observations

July 24 (Saturday)

04:30-07:36 Sediment Sampling by Piston corer (40-33.28N, 142-54.96E, 1553m, 10m)

08:10-09:16 CTD & RMS (40-33.38N, 142.55E, 1500m)

July 25 (Sunday)

05:00-07:30 Bottom layer & topography survey (40-05N, 149-51E)

08:00-12:45 Sediment Sampling by Piston corer (40-04.99N, 149-51.00E, 5611m, 20m)

10:43-11:19 Atmosphere survey

13:15-14:30 CTD & RMS (40-05.96N, 149-50.65E, 2000m)

July 26 (Monday)

04:00-04:30 Preparation for recovery of ADCP buoy (04:00 release command)

04:30-08:25 ADCP buoy recovery (37-19.338N, 152-28.347E)

08:33-09:41 CTD & RMS (37-17.30N, 152-24.94E, 2000m)

10:27-11:20 Atmosphere survey

13:00-15:07 ADCP buoy deployment (37-19.03N, 152-28.76E)

15:55-17:44 Calibration of sinker position (37-19.03N, 152-28.76E)

19:00-02:40 Bottom layer & topography survey (37-30N, 152-00E)

July 27 (Tuesday)

05:55-09:46 Adjustment of CTD cables (Yoritori, 5500m)

06:00-07:16 Aerosol sampling using Balloon

08:40-09:00 Aerosol sampling using Balloon

10:29-11:41 CTD & RMS (37-30.01N, 151-59.56E, 2000m)

10:35-11:22 Atmosphere survey

12:00-17:00 Sediment Sampling by Piston corer (37-30.00N, 152-00.00E, 5850m, 20m)

17:13-03:50 Bottom layer & topography survey (37-30N, 152-00E)

July 28 (Wednesday)
09:00-11:16 CTD & RMS (37-29.77N, 150-01.03E, 4000m)
09:05-10:30 Aerosol sampling using Balloon
11:20-12:11 Atmosphere survey
12:26-12:32 XCTD (37-14.91N, 149-59.92E)
13:28-14:41 CTD & RMS (36-59.02N, 150-00.16E, 2000m)
15:35-15:40 XCTD (36-45.00N, 149-59.45E)
16:37-17:50 CTD & RMS (36-29.01N, 149-59.43E, 2000m)
18:44-18:49 XCTD (36-14.91N, 149-59.21E)
19:42-20:54 CTD & RMS (35-59.77N, 149-59.74E, 2000m)
21:59-22:05 XCTD (35-44.96N, 149-59.87E)
23:03-00:16 CTD & RMS (35-30.78N, 149-59.81E, 2000m)

July 29 (Tuesday)
01:29-01:35 XCTD (35-15.00N, 149-59.49E)
04:25-06:20 CTD & RMS (34-59.52N, 150-00.38E, 4000m)
05:51-07:09 Aerosol sampling using Balloon
08:18-08:24 XCTD (34-44.90N, 150-00.25E)
09:25-10:40 CTD & RMS (34-29.51N, 150-02.48, 2000m)
09:30-10:32 Aerosol sampling using Balloon
10:12-10:19 Atmosphere survey
11:52-11:58 XCTD (34-14.94N, 149-59.67E)
13:00-14:12 CTD & RMS (33-59.93N, 150-00.34E, 2000m)
15:18-15:23 XCTD (33-45.00N, 149-59.72E)
16:24-17:33 CTD & RMS (33-30.07N, 149-59.92E, 2000m)
18:39-18:44 XCTD (33-15.01N, 150-00.42E)
19:48-21:02 CTD & RMS (33-00.27N, 150-00.33E, 2000m)
23:35-05:00 Bottom layer & topography survey (32-30N, 150-00E)

July 30 (Friday)
05:20-06:53 Aerosol sampling using Balloon
05:22-07:40 CTD & RMS (32-30.47N, 150-00.08E, 4000m)
18:58-22:23 CTD & RMS (34-57.25N, 151-49.43E, 6130m)
23:42-02:14 CTD & RMS (34-57.80N, 151-50.02E, 4600m)

July 31 (Saturday)

03:30-03:58 CTD & RMS (34-57.93N, 151-49.96E, 400m)

07:59-08:01 XBT (33-59.91N, 151-39.96E)

08:32-09:16 Atmosphere survey

09:11-09:13 XBT (33-59.86N, 151-19.98E)

10:22-10:24 XBT (33-59.99N, 151-00.01E)

11:36-11:38 XBT (33-59.96N, 150-40.00E)

12:43-12:45 XBT (33-59.89N, 150-20.00E)

13:52-13:54 XBT (34-00.08N, 150-00.01E)

15:00-15:02 XBT (34-00.03N, 149-39.96E)

16:06-16:08 XBT (34-00.27N, 149-19.93E)

17:10-17:12 XBT (34-00.28N, 148-59.99E)

18:12-18:14 XBT (34-00.30N, 148-39.98E)

19:12-19:14 XBT (33-59.57N, 148-20.04E)

20:15-20:17 XBT (33-59.65N, 148-00.00E)

21:18-21:20 XBT (33-59.48N, 147-40.00E)

22:22-22:24 XBT (33-59.27N, 147-20.02E)

23:29-23:31 XBT (33-59.90N, 147-00.00E)

August 1 (Sunday)

00:35-00:37 XBT (34-00.15N, 146-39.93E)

01:39-01:41 XBT (33-59.91N, 146-20.01E)

02:44-02:46 XBT (34-00.50N, 146-00.04E)

03:50-03:52 XBT (33-59.81N, 145-40.00E)

05:08-05:10 XBT (34-00.64N, 145-19.97E)

06:35-06:37 XBT (34-00.77N, 145-00.08E)

08:09-08:11 XBT (33-59.91N, 144-39.25E)

08:26-09:45 Aerosol sampling using Balloon

10:59-11:01 XBT (34-00.53N, 144-20.00E)

12:02-12:04 XBT (34-00.53N, 144-00.00E)

13:05-13:07 XBT (34-00.00N, 144-40.01E)

14:05-14:07 XBT (34-00.00N, 143-20.00E)

15:03-15:05 XBT (33-59.73N, 143-00.01E)

16:00-16:02 XBT (33-59.49N, 142-39.97E)

16:58-17:00 XBT (33-59.90N, 142-20.01E)

17:58-18:00 XBT (34-00.03N, 142-00.00E)

August 2 (Monday)

08:49-09:30 Aerosol sampling using Balloon?

12:37-16:02 CTD & RMS (34-14.88N, 141-58.11E, 6500m)

17:14-18:40 CTD & RMS (34-14.97N, 141-58.07E, 2000m)

19:48-19:50 XBT (34-09.18N, 141-40.00E)

20:59-21:01 XBT (34-02.50N, 141-20.00E)

22:07-22:09 XBT (33-59.90N, 141-00.01E)

23:19-23:21 XBT (33-49.62N, 140-40.01E)

August 3 (Tuesday)

00:28-00:30 XBT (33-45.01N, 140-20.03E)

01:40-01:42 XBT (33-52.93N, 140-00.01E)

02:54-02:56 XBT (33-58.55N, 139-40.00E)

11:00 Arrival at Shimizu

August 4 (Wednesday)

10:15-15:30 Open house

August 5 (Thursday)

12:00 Departure from Shimizu

14:00 Boat Drill

14:30 Briefing for safety life on the ship

15:00 meeting on observations

18:32-18:34 XBT (34-43.71N, 140-00.10E)

19:28-19:30 XBT (34-49.84N, 140-19.88E)

20:27-20:29 XBT (34-54.99N, 140-39.91E)

21:21-21:23 XBT (35-00.02N, 140-59.78E)

22:13-22:15 XBT (35-00.12N, 141-20.17E)

23:08-23:10 XBT (35-00.18N, 141-40.18E)

August 6 (Friday)

00:07-00:09 XBT (35-00.23N, 142-00.02E)

01:10-01:12 XBT (34-59.89N, 142-20.01E)

02:16-02:18 XBT (35-00.08N, 142-40.00E)

03:37-03:39 XBT (34-59.70N, 143-00.08E)

04:43-04:45 XBT (35-00.05N, 143-20.08E)
06:05-06:07 XBT (35-00.57N, 143-40.03E)
07:17-07:19 XBT (35-01.17N, 144-00.05E)
08:31-08:33 XBT (35-01.22N, 144-19.99E)
09:39-09:41 XBT (35-00.81N, 144-39.98E)
10:18:11:25 Sea Beam calibration
13:05-13:07 XBT (34-59.78N, 145-00.01E)
14:04-14:06 XBT (34-59.96N, 145-20.02E)
15:00-15:02 XBT (35-00.09N, 145-40.07E)
15:54-15:56 XBT (35-00.15N, 146-00.06E)
16:48-16:50 XBT (35-00.22N, 146-20.05E)
17:43-17:45 XBT (35-00.12N, 146-40.01E)
18:42-18:44 XBT (35-00.32N, 147-00.07E)
19:45-19:47 XBT (34-59.52N, 147-20.12E)
20:07-20:23 Doppler Radar (RHI)
20:51-20:53 XBT (34-59.33N, 147-40.23E)
22:02-22:04 XBT (34-59.71N, 147-59.99E)
23:16-23:18 XBT (35-00.06N, 148-20.03E)

August 7 (Saturday)
00:25-00:27 XBT (35-00.18N, 148-40.01E)
01:31-01:33 XBT (35-00.21N, 149-00.00E)
02:35-02:37 XBT (34-59.72N, 149-20.03E)
03:38-03:40 XBT (35-00.19N, 149-40.12E)
04:36-04:38 XBT (34-59.77N, 150-00.06E)
05:34-05:36 XBT (34-59.95N, 150-20.02E)
06:35-06:37 XBT (34-59.97N, 150-40.14E)
07:36-07:38 XBT (34-59.78N, 150-59.97E)
08:30-10:20 Aerosol sampling using Balloon
09:38-10:10 Atmosphere survey
10:46-10:48 XBT (35-00.02N, 151-20.03E)
11:49-11:51 XBT (34-59.96N, 151-40.04E)
12:51-12:53 XBT (35-00.03N, 152-00.02E)
13:55-13:57 XBT (34-59.73N, 152-20.02E)
14:55-14:57 XBT (35-00.03N, 152-40.04E)
15:53-15:55 XBT (35-00.06N, 153-00.02E)

16:49-16:51 XBT (35-00.21N, 153-20.01E)
17:44-17:46 XBT (34-59.99N, 153-40.06E)
18:44-18:46 XBT (35-00.07N, 153-59.91E)
18:54-19:08 Doppler Radar (RHI)
19:50-19:52 XBT (34-59.98N, 154-19.97E)
20:30-20:45 Doppler Radar (RHI)
20:55-20:57 XBT (34-59.93N, 154-40.02E)
22:02-22:04 XBT (34-59.71N, 155-00.01E)
23:02-23:04 XBT (35-00.15N, 155-20.01E)

August 8 (Sunday)
00:05-00:07 XBT (35-00.01N, 155-39.99E)
01:06-01:08 XBT (34-59.75N, 156-00.00E)
02:08-02:10 XBT (35-00.01N, 156-20.02E)
03:10-03:12 XBT (35-00.06N, 156-40.00E)
04:14-04:16 XBT (35-00.07N, 157-00.00E)
05:17-05:19 XBT (35-00.86N, 157-20.01E)
06:19-08:33 CTD & RMS (35-00.95N, 157-30.39E, 4000m)
06:50-07:15 Aerosol sampling using Balloon
09:46-09:51 XCTD (34-45.03N, 157-29.91E)
10:57-12:09 CTD & RMS (34-30.09N, 157-30.16E, 2000m)
13:19-13:24 XCTD (34-15.01N, 157-29.94E)
14:26-15:38 CTD & RMS (34-00.05N, 157-29.95E, 2000m)
16:45-16:50 XCTD (33-45.01N, 157-30.33E)
17:45-18:00 Doppler Radar (RHI)
17:55-19:08 CTD & RMS (33-29.88N, 157-30.17E, 2000m)
19:22-19:38 Doppler Radar (RHI)
20:13-20:18 XCTD (33-14.99N, 157-29.95E)
21:20-22:35 CTD & RMS (32-59.74N, 157-29.93E, 2000m)
23:38-23:40 XCTD (32-44.96N, 157-30.14E)

August 9 (Monday)
00:40-02:25 CTD & RMS (32-29.72N, 157-29.77E, 3000m)
13:22-13:24 XCTD (35-15.00N, 157-30.00E)
14:28-15:40 CTD & RMS (35-30.13N, 157-30.10E, 2000m)
16:30-16:45 Doppler Radar (RHI)

16:46-16:51 XCTD (35-45.00N, 157-29.97E)
17:50-19:02 CTD & RMS (35-59.78N, 157-29.78E, 2000m)
18:07-18:23 Doppler Radar (RHI)
20:07-20:12 XCTD (36-15.00N, 157-30.01E)
21:16-22:29 CTD & RMS (36-29.82N, 157-29.78E, 2000m)
23:36-23:41 XCTD (36-45.05N, 157-29.90E)

August 10 (Tuesday)
00:42-01:54 CTD & RMS (36-59.84N, 157-29.54E, 2000m)
03:02-03:07 XCTD (37-14.99N, 157-29.88E)
04:10-06:23 CTD & RMS (37-29.41N, 157-30.09E, 4000m)
04:24-06:01 Aerosol sampling using Balloon
14:33-16:51 CTD & RMS (37-30.17N, 155-01.10E, 4000m)
14:44-16:08 Aerosol sampling using Balloon
16:52-17:08 Doppler Radar (RHI)
17:57-18:02 XCTD (37-15.02N, 155-01.31E)
19:05-20:15 CTD & RMS (37-00.18N, 155-00.10E, 2000m)
21:23-21:28 XCTD (36-45.00N, 155-00.06E)
22:30-23:40 CTD & RMS (36-29.94N, 154-59.95E, 2000m)

August 11 (Wednesday)
00:47-00:52 XCTD (36-14.99N, 154-59.95E)
01:55-03:08 CTD & RMS (36-00.24N, 154-59.28E, 2000m)
04:21-04:26 XCTD (35-45.01N, 154-59.02E)
05:35-06:45 CTD & RMS (35-30.02N, 154-59.09E, 2000m)
07:56-08:01 XCTD (35-15.03N, 155-00.04E)
09:03-11:17 CTD & RMS (34-59.37N, 155-01.12E, 4000m)
12:21-12:26 XCTD (34-44.97N, 155-00.69E)
13:26-14:37 CTD & RMS (34-29.58N, 155-01.01E, 2000m)
15:37-15:53 Doppler Radar (RHI)
15:42-15:47 XCTD (34-15.00N, 155-00.43E)
16:48-18:08 CTD & RMS (33-59.63N, 155-00.12E, 2000m)
19:12-19:17 XCTD (33-45.01N, 155-00.21E)
20:12-21:56 CTD & RMS (33-29.50N, 155-00.11E, 2000m)
22:59-23:04 XCTD (33-15.00N, 154-59.92E)

August 12 (Thursday)
00:06-01:44 CTD & RMS (32-59.98N, 154-59.81E, 2000m)
02:48-02:53 XCTD (32-45.00N, 154-59.98E)
03:56-06:33 CTD & RMS (32-30.22N, 154-59.91E, 4000m)
12:18-24:00 Proton Magnetometer survey
14:30-14:45 Doppler Radar (RHI)

August 13 (Friday)
00:00-24:00 Proton Magnetometer survey

August 14 (Saturday)
00:00-24:00 Proton Magnetometer survey

August 15 (Sunday)
00:00-07:50 Proton Magnetometer survey
08:44-10:59 CTD & RMS (32-29.86N, 152-30.44E, 4000m)
12:10-12:15 XCTD (32-45.00N, 152-29.96E)
13:17-14:28 CTD & RMS (33-00.07N, 152-30.32E, 2000m)
14:07-14:23 Doppler Radar (RHI)
15:35-15:40 XCTD (33-14.98N, 152-29.74E)
15:37-15:53 Doppler Radar (RHI)
16:40-17:53 CTD & RMS (33-30.08N, 152-30.22E, 2000m)
17:15-17:30 Doppler Radar (RHI)
18:59-19:04 XCTD (33-45.01N, 152-30.13E)
20:04-21:17 CTD & RMS (33-59.92N, 152-30.96E, 2000m)
22:25-22:30 XCTD (34-14.98N, 152-29.74E)
23:39-00:58 CTD & RMS (34-29.62N, 152-31.79E, 2000m)

August 16 (Monday)
02:11-02:16 XCTD (34-45.00N, 152-32.02E)
02:54-04:54 Bottom layer & topography survey (35-00N, 152-30E)
05:00-07:20 CTD & RMS (34-59.97N, 152-30.66E, 4000m)
10:58-11:03 XCTD (35-14.98N, 152-29.98E)
12:30-13:54 CTD & RMS (35-30.00N, 152-29.79E, 2000m)
14:59-15:04 XCTD (35-45.01N, 152-29.76E)
16:05-17:33 CTD & RMS (35-59.96N, 152-29.82E, 2000m)

18:42-18:47 XCTD (36-14.99N, 152-29.70E)

19:56-21:16 CTD & RMS (36-29.68N, 152-30.05E, 2000m)

22:26-22:31 XCTD (36-45.01N, 152-29.93E)

23:32-01:53 CTD & RMS (36-59.99N, 152-30.07E, 3000m)

August 17 (Tuesday)

02:06-02:54 CTD & RMS (37-00.00N, 152-30.01E, 1000m)

03:58-04:03 XCTD (37-15.01N, 152-29.92E)

05:05-07:12 CTD & RMS (37-30.93N, 152-30.23E, 4000m)

05:17-07:15 Aerosol sampling using Balloon

07:49-08:30 CTD & RMS (37-30.23N, 152-29.07E, 500m)

08:44-11:08 Aerosol sampling using Balloon

09:39-09:41 XBT (37-40.60N, 152-00.02E)

11:38-11:43 XCTD (37-59.97N, 152-00.25E)

12:40-12:42 XBT (38-00.38N, 151-39.96E)

13:38-13:40 XBT (38-00.30N, 151-20.03E)

14:37-14:39 XBT (38-00.01N, 151-00.00E)

14:52-15:08 Doppler Radar (RHI)

15:35-15:37 XBT (38-00.33N, 150-39.92E)

16:33-16:35 XBT (37-59.99N, 150-19.92E)

17:33-17:38 XCTD (37-59.96N, 149-59.98E)

18:35-18:37 XBT (37-59.96N, 149-39.99E)

19:34-19:36 XBT (38-00.00N, 149-20.09E)

20:33-20:35 XBT (37-59.90N, 148-59.96E)

21:35-21:33 XBT (38-00.41N, 148-40.21E)

22:30-22:32 XBT (38-00.16N, 148-20.20E)

23:34-23:39 XCTD (38-00.01N, 147-59.97E)

23:41-00:14 Calibration for ship board magnetometer

August 18 (Wednesday)

01:08-01:10 XBT (37-59.83N, 147-39.99E)

02:10-02:12 XBT (37-59.98N, 147-20.00E)

03:13-03:15 XBT (38-00.01N, 146-59.95E)

04:16-04:18 XBT (38-00.24N, 146-39.94E)

05:17-05:19 XBT (38-00.31N, 146-19.95E)

06:19-06:24 XCTD (37-59.88N, 146-00.28E)

07:23-07:25 XBT (38-00.01N, 145-40.00E)
08:23-08:25 XBT (38-00.22N, 145-20.11E)
09:23-09:25 XBT (38-00.27N, 145-00.06E)
10:22-10:24 XBT (38-00.13N, 144-40.21E)
11:23-11:25 XBT (37-59.89N, 144-20.35E)
12:34-12:39 XCTD (37-59.89N, 143-59.98E)
13:49-13:51 XBT (38-01.01N, 143-40.01E)
14:58-15:00 XBT (38-00.12N, 143-19.94E)
16:05-16:10 XCTD (37-59.97N, 142-59.98E)

August 19 (Thursday)
12:00 Arrival at Sekinehama

5.Participants List

R/V Mirai Scientists and Technical Staff during MR99-K04

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松本　健寛	Takeo Matsumoto MWJ
阿部　恒平	Kohei Abe MWJ
小林　不二夫	Fujio Kobayashi MWJ
村木　広明	Hiroaki Muraki MWJ
加藤　綾	Aya Kato MWJ
横川　真一朗	Shinichiro Yokogawa MWJ
富樫　尚孝	Naotaka Togashi MWJ
宗　　輝	Akira So MWJ
田辺　誠	Makoto Tanabe
富樫　武人	Takehito Togashi MWJ
岡田　徹也	Tetsuya Okada **北海道放送株式会社** **〒**060-8501 **札幌市中央区北１条西５丁目** Nishi5cyhome kita1jyo Cyuou-ku,Sapporo, Japan
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R/V Mirai Crew Members during MR99-K04 Leg1

氏名	Family	Given	性別	職名	Rank
赤嶺　正治	Akamine	Masaharu	男	船　長	Master
栗原　賢二	Kurihara	Kenji	男	一航士	Chief Officer
柴田　雄治	Shibata	Yuji	男	次一航	1st Officer
丸山　博記	Maruyama	Hiroki	男	二航士	2nd Officer
浅沼　充信	Asanuma	Mitsunobu	男	三航士	3rd Officer
井上　徹	Inoue	Toru	男	機関長	Chief Engineer

池田　稔	Ikeda	Minoru	男	一機士	1st Engineer
鳴海　弘晃	Narumi	Hiroaki	男	二機士	2nd Engineer
升野　孝治	Masuno	Koji	男	三機士	3rd Engineer
中林　秋司	Nakabayashi	Shuji	男	通信長	C.R.Officer
宍戸　啓一郎	Shisido	Keiichiro	男	二通士	2nd.R.Officer
石川　憲悦	Ishikawa	Kenetsu	男	甲板長	Able Seaman
佐藤　稔	Sato	Minoru	男	甲板手	Able Seaman
成尾　久司	Naruo	Hisashi	男	甲板手	Able Seaman
山本　保行	Yamamoto	Yasuyuki	男	甲板手	Able Seaman
木下　洋一	Kinoshita	Hirokazu	男	甲板手	Able Seaman
柏谷　次男	Kashiwaya	Tsugio	男	甲板手	Able Seaman
堀田　一徳	Horita	Kazunori	男	甲板手	Able Seaman
田崎　昭夫	Tasaki	Akio	男	甲板手	Able Seaman
工藤　和義	Kudo	Kazuyoshi	男	甲板手	Able Seaman
佐藤　剛	Sato	Tsuyoshi	男	甲板手	Able Seaman
谷本　丞	Tanimoto	Jyo	男	甲板手	Able Seaman
大重　明人	Oshige	Akito	男	甲板手	Able Seaman
村田　昭二	Murata	Shoji	男	操機長	No.1 Oiler
阿部　昭三	Abe	Shozo	男	操機手	Oiler
吉川　利三	Yoshikawa	Toshimi	男	操機手	Oiler
井上　二三男	Inoue	Fumio	男	操機手	Oiler
宮崎　隆	Miyazaki	Takashi	男	操機手	Oiler
杉本　吉弘	Sugimoto	Yoshihiro	男	操機手	Oiler
古賀　康明	Koga	Yasuaki	男	司厨長	Chief Steward
栗田　保隆	Kurita	Yasutaka	男	司厨手	Cook
秋田　天行	Akita	Takayuki	男	司厨手	Cook
濱邊　竜弥	Hamabe	Tatsuya	男	司厨手	Cook
上村　功三	Uemura	Kozo	男	司厨手	Cook
林田　博幸	Hayashida	Hiroyuki	男	司厨手	Cook

R/V Mirai Crew Members during MR99-K04 Leg2

氏名	Family	Given	性別	職名	Rank
赤嶺　正治	Akamine	Masaharu	男	船　長	Master
栗原　賢二	Kurihara	Kenji	男	一航士	Chief Officer
柴田　雄治	Shibata	Yuji	男	次一航	1st Officer
丸山　博記	Maruyama	Hiroki	男	二航士	2nd Officer
浅沼　充信	Asanuma	Mitsunobu	男	三航士	3rd Officer
渡邊　陽一郎	Watanabe	Yoichiro	男	機関長	Chief Engineer
池田　稔	Ikeda	Minoru	男	一機士	1st Engineer
鳴海　弘晃	Narumi	Hiroaki	男	二機士	2nd Engineer

升野　孝治	Masuno	Koji	男	三機士	3rd Engineer
宍戸啓一郎	Shishido	Keiichirou	男	通信長	C.R.Officer
森岡　直人	Morioka	Naoto	男	二通士	2nd.R.Officer
石川　憲悦	Ishikawa	Kenetsu	男	甲板長	Able Seaman
佐藤　稔	Sato	Minoru	男	甲板手	Able Seaman
成尾　久司	Naruo	Hisashi	男	甲板手	Able Seaman
山本　保行	Yamamoto	Yasuyuki	男	甲板手	Able Seaman
木下　洋一	Kinoshita	Hirokazu	男	甲板手	Able Seaman
柏谷　次男	Kashiwaya	Tsugio	男	甲板手	Able Seaman
堀田　一徳	Horita	Kazunori	男	甲板手	Able Seaman
小国　久夫	Oguni	Hisao	男	甲板手	Able Seaman
田崎　昭夫	Tasaki	Akio	男	甲板手	Able Seaman
工藤　和義	Kudo	Kazuyoshi	男	甲板手	Able Seaman
佐藤　剛	Sato	Tsuyoshi	男	甲板手	Able Seaman
谷本　丞	Tanimoto	Jyo	男	甲板手	Able Seaman
村田　昭二	Murata	Shoji	男	操機長	No.1 Oiler
阿部　昭三	Abe	Shozo	男	操機手	Oiler
吉川　利三	Yoshikawa	Toshimi	男	操機手	Oiler
井上　二三男	Inoue	Fumio	男	操機手	Oiler
宮崎　隆	Miyazaki	Takashi	男	操機手	Oiler
杉本　吉弘	Sugimoto	Yoshihiro	男	操機手	Oiler
古賀　康明	Koga	Yasuaki	男	司厨長	Chief Steward
栗田　保隆	Kurita	Yasutaka	男	司厨手	Cook
秋田　天行	Akita	Takayuki	男	司厨手	Cook
大田　仁志	Ota	Hitoshi	男	司厨手	Cook
上村　功三	Uemura	Kozo	男	司厨手	Cook

Embarkation Period

	Sekinehama	Shimizu	Sekinehama
Hirofumi Yamamoto	↑		↓
Yasushi Yoshikawa	↑		↓
Masahiko Murata	↑		↓
Takaki Hatayama	↑	↓	
Hideaki Hase	↑	↓	
Eiichi Kikawa	↑	↓	
Tadamichi Oba	↑	↓	
Kaori Aoki	↑	↓	
Miki Amou	↑	↓	
Masae Horii	↑	↓	
Moriyoshi Yamauchi	↑	↓	
Kazuhiko Miura	↑		↓
Takeshi Hara	↑		↓
Taisuke Yamazaki	↑		↓
Tatsuo Endo	↑		↓
Atsushi Ueda	↑		↓
Masao Nakanishi		↑	↓
Atsushi Oshida		↑	↓
Masafumi Hirose		↑	↓
Kinji Furukawa			
Kunio Yoneyama			
Tsuyoshi Matsumoto			
Toshio Furuta	↑		↓
Fumitaka Yoshiura	↑		↓
Sugawara Toshikatsu	↑	↓	
Hidefumi Mitani		↑	↓
Motoi Matsuhashi	↑		↓
Takeo Matsumoto	↑		↓
Kohei Abe	↑	↓	
Fujio Kobayashi	↑		↓
Hiroaki Muraki	↑		↓
Kato Aya	↑		↓
Shinichiro Yokokawa	↑		↓
Naotaka Togashi	↑	↓	
Teruki So		↑	↓
Makoto Tanabe		↑	↓
Tetsuya Okada	↑	↓	
Masatugu Takase	↑	↓	
Takehito Togashi			

6. General Observation

6.1. Meteorological measurement

6.1.1 Surface meteorological observation

(1) Personnel

Fumitaka Yoshiura (GODI) ：Operation leader

(2) Objectives

To record the weather conditions.

(3) Measured parameters

Press.:	Atmospheric pressure adjusted to the sea surface level [hPa]
Dry Air Temp.:	Atmospheric dry temperature [deg－C]
Dew P.T.:	Dew point temperature [deg－C]
RH:	Relative humidity [%]
Rain:	Previous 1 hour precipitation [mm]
W.D.:	10 minutes averaged wind direction [deg]
W.S.:	10 minutes averaged wind speed [m/s]
SST:	Sea surface temperature [deg－C]
Wv.Ht:	Significant wave height measured first 20 minutes at every 3 hours (0200, 0500, 0800, 1100, 1400, 1700, 2000, 2300UTC) [m]
Wv.PD:	Period of Wv.Ht [sec]
Radiation:	Short and long wave radiation from solar（upward looking radiometer）[MJ/m^2]

(3) Methods

We observed several surface meteorological parameters during the cruise by KOAC-7800 weather data processor and sensors assembled by Koshin Denki, Japan. Sensors are listed below.

Sensor	Type	Maker	Location（Altitude from baseline）
Anemometer:	KE-500	Koshin Denki, Japan	Formast（30.16m）
Thermometer:	FT	Koshin Denki, Japan	Compass Deck（24.85m）
Dew point meter:	DW-1	Koshin Denki, Japan	Compass Deck（24.85m）
Barometer:	F-451	Yokogawa, Japan	Weather observation room, Captain Deck（19.50m）
Rain gauge:	50202	Young, U.S.A.	Compass Deck（25.35m）
Optical Rain gauge:	ORG-115DR	SCTI, U.S.A.	Compass Deck（24.70m）
Radiometer:	MS-801（short wave）	Eiko Seiki, Japan	Radar mast（34.70m）
	MS-200（long wave）	Eiko Seiki, Japan	Albedo boom（14.86m）
Wave height meter:	MW-2	Tsurumi-seiki, Japan	Bow（16.00m）

Radiometers are located on the top of the radar mast for downward radiation.

Sea water sampling pomp ran from Jul.23 10:09Z to Aug.02 23:24Z, from Aug.05 09:30Z to Aug.18 08:55Z .

All data was stored in MO disk every 6 seconds.

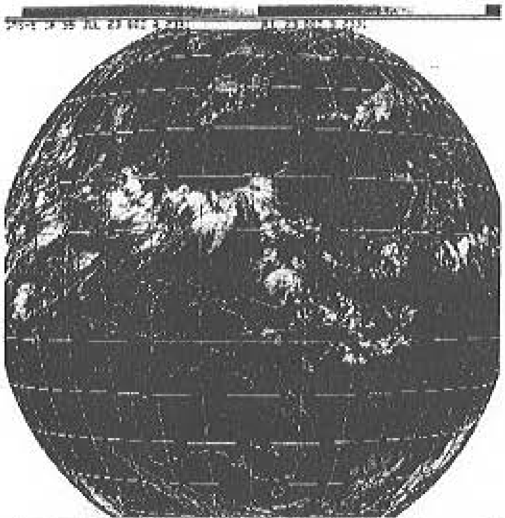
(4) Preliminary Result

Table 6.1.1-1 and Figure 6.1.1.-1－4 show the results of observation.

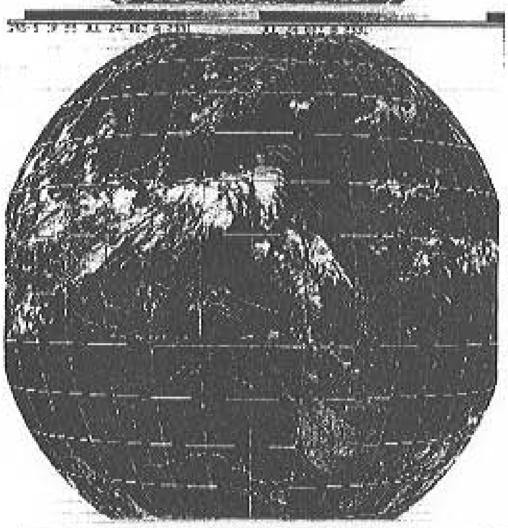
(5) Data archive

Surface meteorological data will be submitted to the DMO (Data Management Office), JAMSTEC and will be under their control. Every 6 seconds data files, every 10 minutes data files and every 1hour data files are contained in the 3.5”MO disk.

Jul. 23 00Z



Jul. 24 00Z



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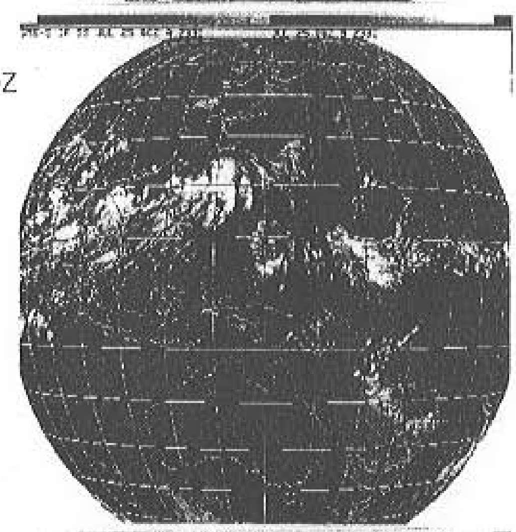

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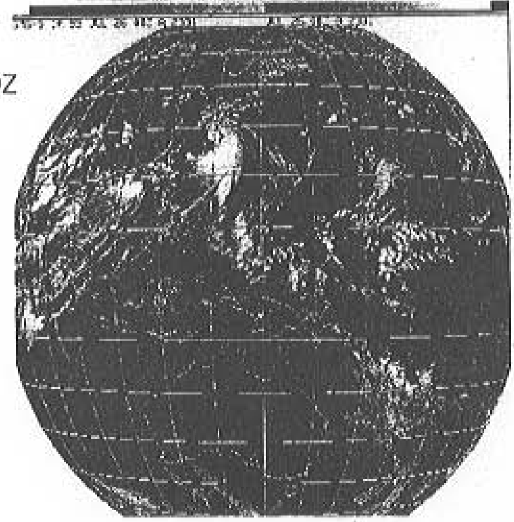

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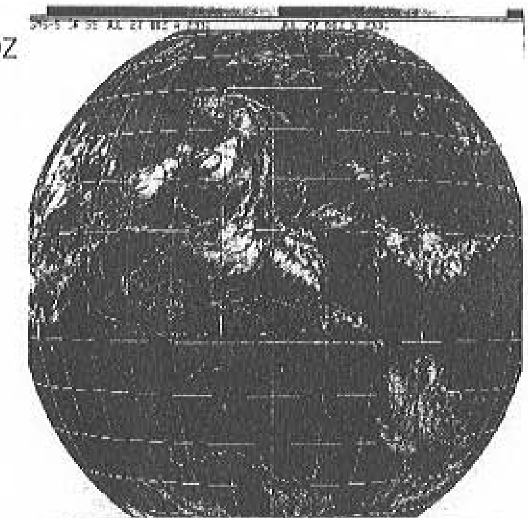
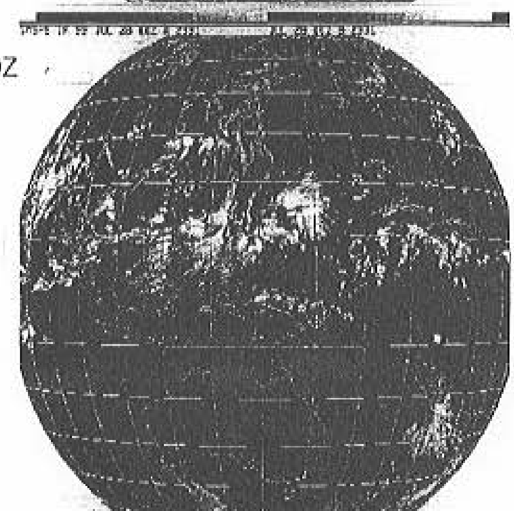
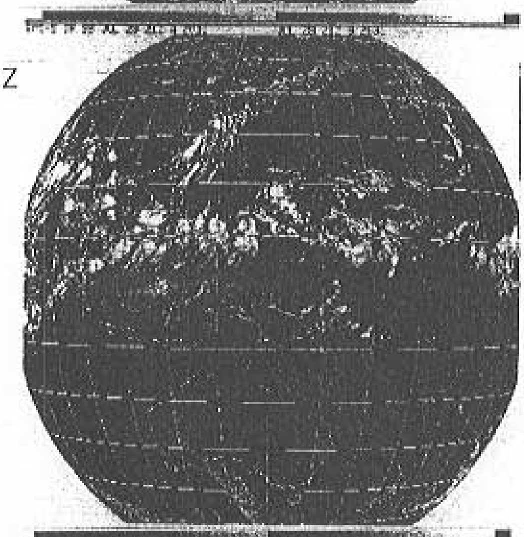


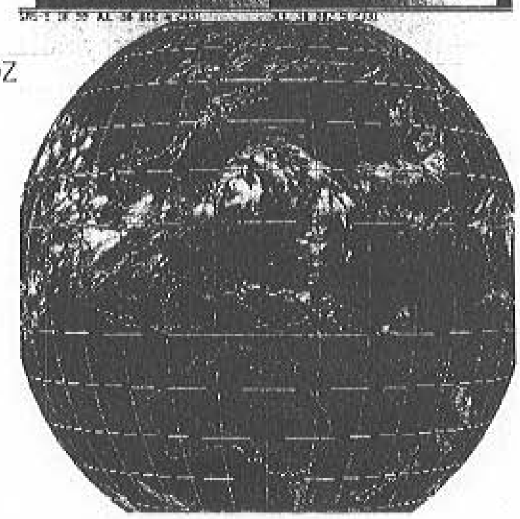
Jul. 28 00Z



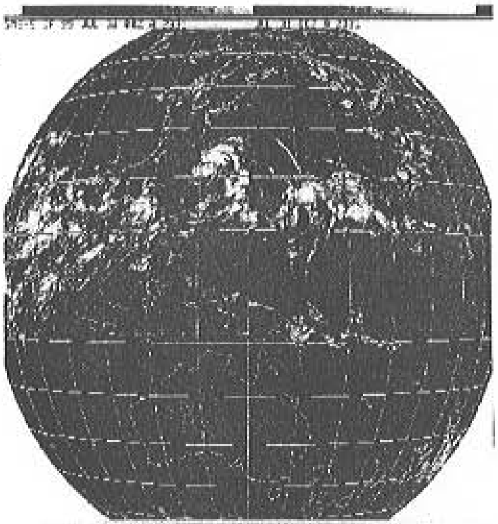
Jul. 28 21Z



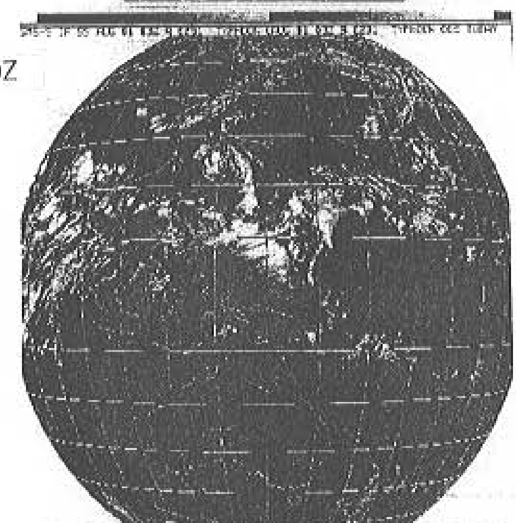
Jul. 30 00Z



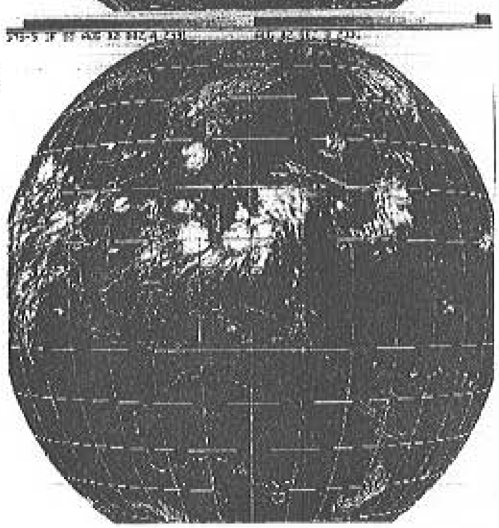
Jul. 31 00Z



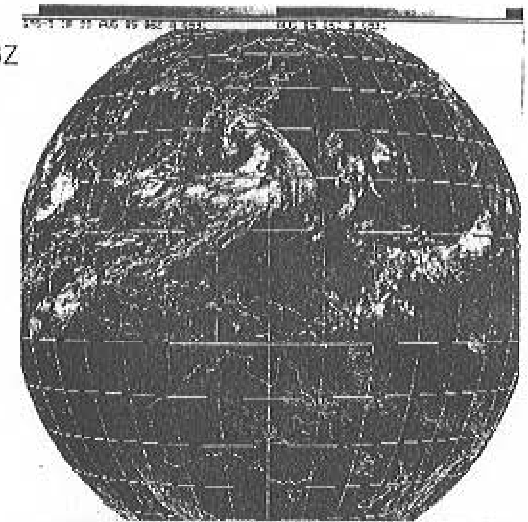
Aug. 01 00Z



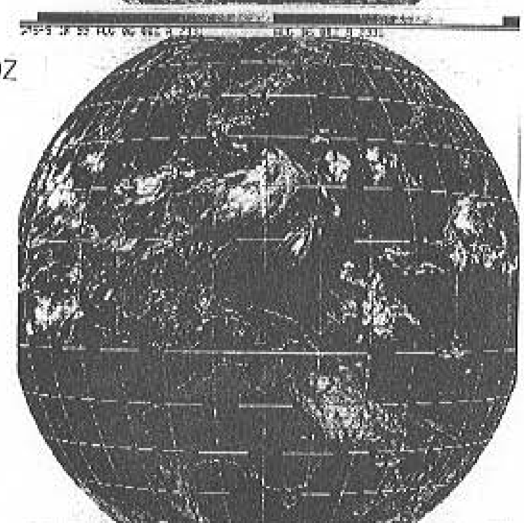
Aug. 02 00Z



Aug. 05 06Z

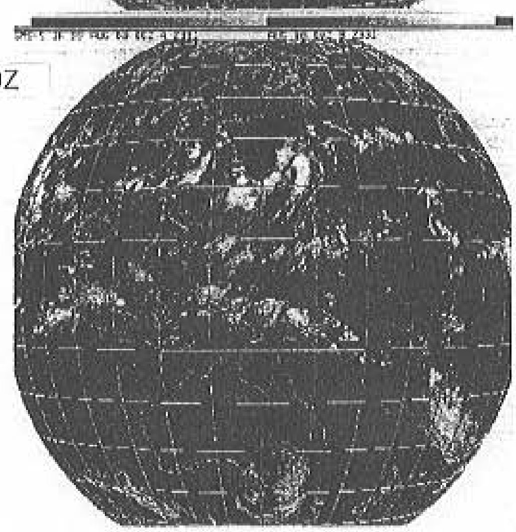


Aug. 06 00Z

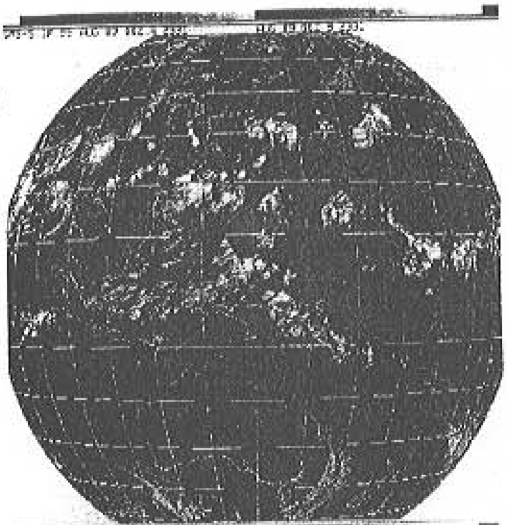


Aug. 07 00Z

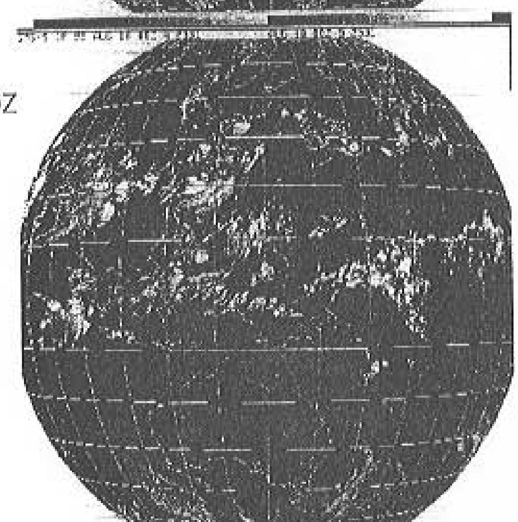
Aug. 08 00Z



Aug. 09 00Z



Aug. 10 00Z



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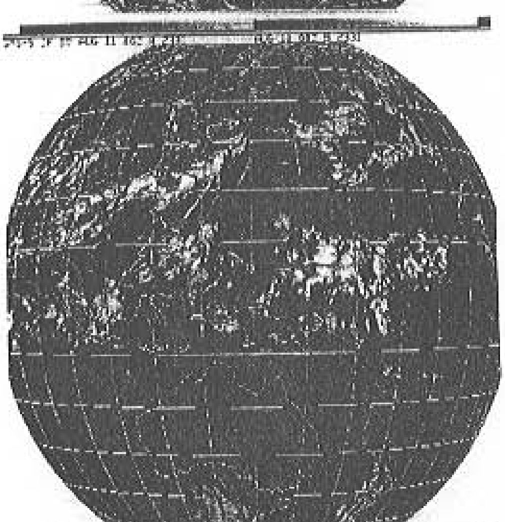
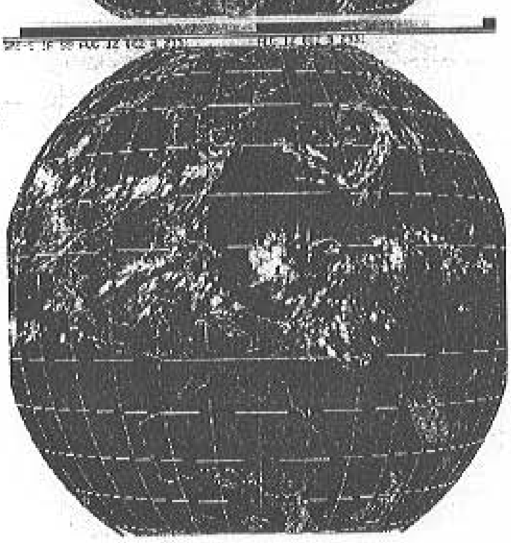


Aug. 12 00Z



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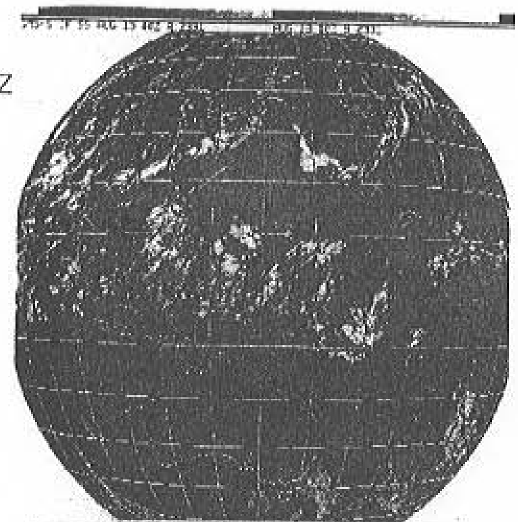

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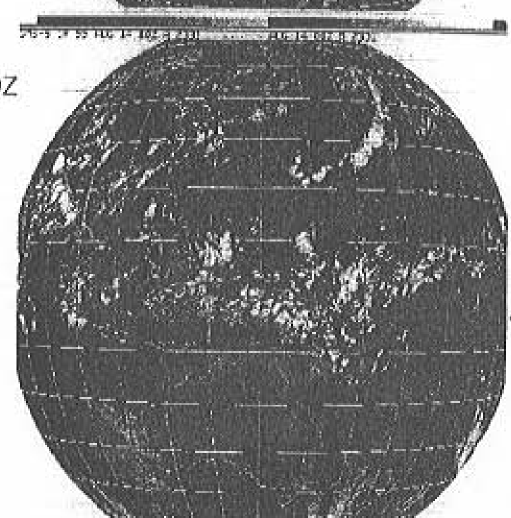

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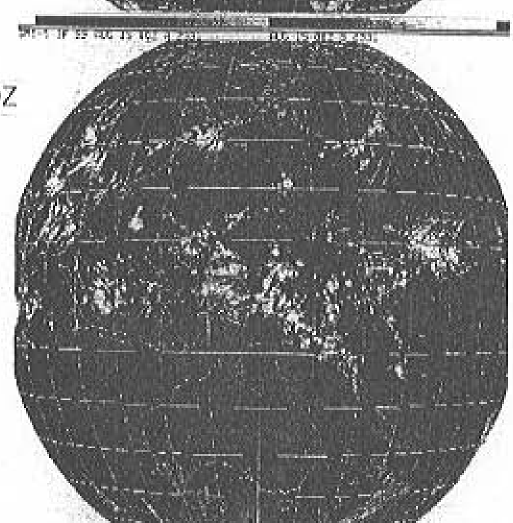

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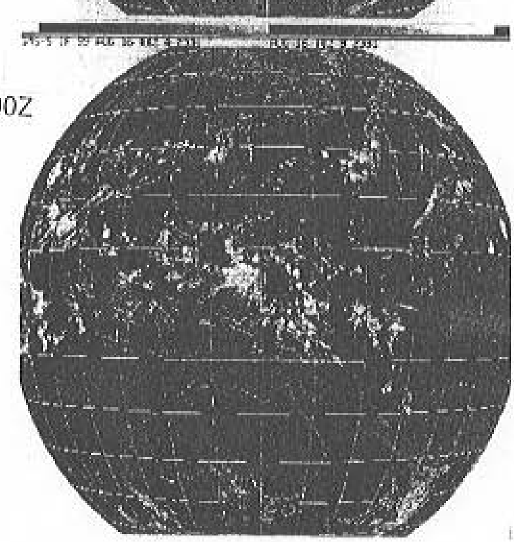
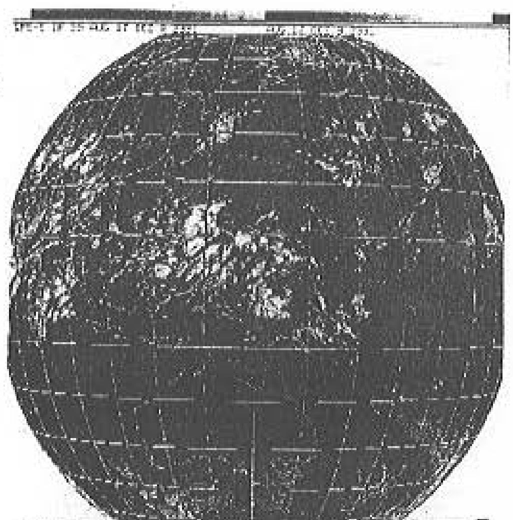
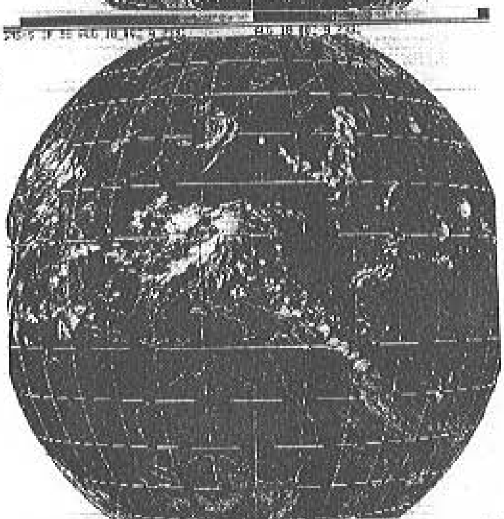


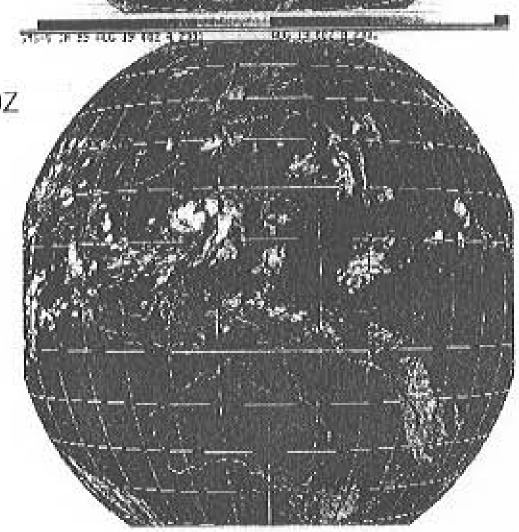
Aug. 17 00Z



Aug. 18 00Z.



Aug. 19 00Z



6.1.2 Ceilometer

Personal

Fumitaka Yoshiura（GODI）：Operation Leader

（1） Parameter

（2.1） Cloud base height ［m］

（2.2） Backscatter profile， sensitivity and range normalized at 30m resolution

（2） Methods

We measured cloud base height and backscatter profiles using CT－25K（Vaisala， Finland） ceilometer throuhout MR99－K04 cruise from departure of Sekinehama， Japan on 23 July 1999 to the arrival of Sekinehama， Japan on 19 August 1999．

Major parameters for the measurement configuration are as follows；

Laser source：	Indium Gallium Arsenide（InGaAs） Dionde
Transmitting wave length：	905±5nm at 25 deg-C
Transmitting average power：	8.9 mW
Repetition rate：	5.57 kHz
Detector：	Silicon avalanche phttodiode（APD）
	Responsibilitiy at 905 nm：65 A/W
Measurement range：	0－7.5 km
Resolution：	50 ft in full range
Sampling rate：	60 sec

（3） Preliminary results

Examples of lidar echo images are shown on the following pages． These shows time-series variation of cloud base height and rainfall．

（4） Data archives

Cielometer data obtained during this cruise will be submitted to the DMO（Data Management Office）， JAMSTEC and will be under their control．

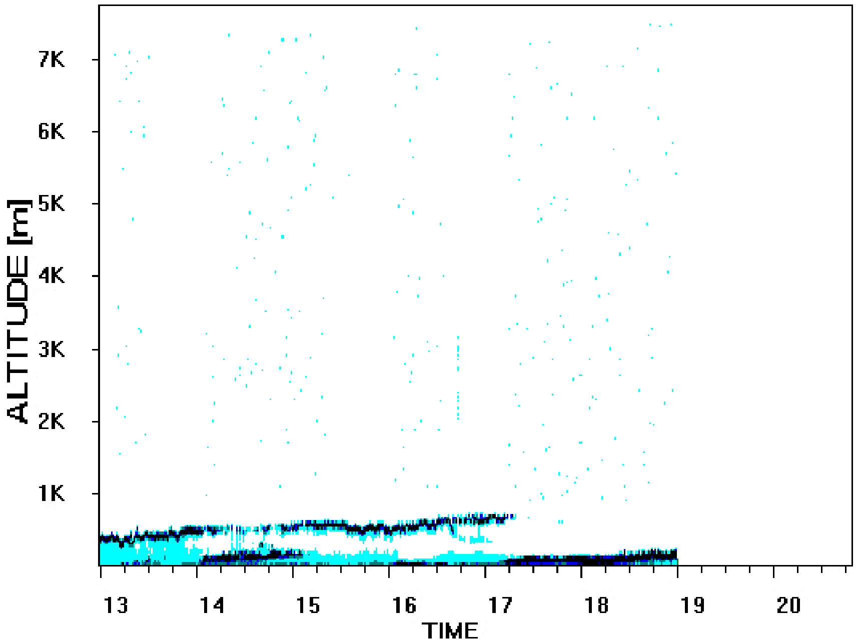


Fig. 6.1.3－1　24／13Z ～ 24／19Z July 1999

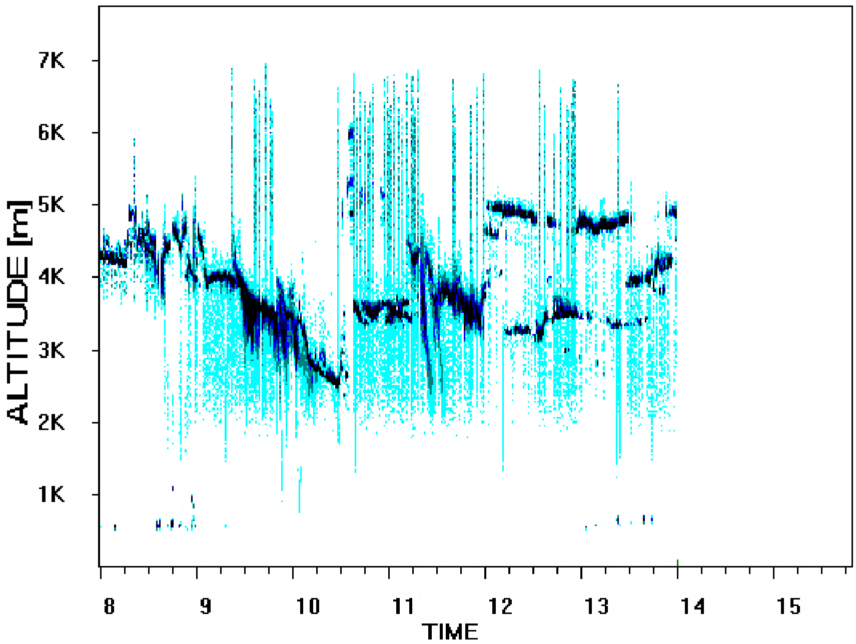


Fig. 6.1.3－2　16／08Z ～ 16／14Z Aug. 1999

6.2 Surface temperature and salinity

(1) Personnel

Shinichiro Yokogawa (MWJ)

(2) Objectives

To monitor continuously the physical, chemical and biological characteristic of sea surface water.

(3) Parameters

Temperature, salinity, dissolved oxygen, fluorescence, particle size of plankton in the surface water.

(4) Methods

The Continuous Sea Surface Water Monitoring System is located in the "sea surface monitoring laboratory" on R/V Mirai. It can automatically measure temperature, salinity, dissolved oxygen, fluorescence and particle size of plankton in the surface water every one minute. Measured data are saved every one minute together with time and the position of ship, and displayed in the data management PC machine. This system is connected to shipboard LAN-system and provides the acquired data for p-CO_2 measurement system, etc.

Sea surface water was continuously pumped up from the seachest of the ship at 4.5 meters depth to the laboratory and then flowed into the Continuous Sea Surface Water Monitoring System and p-CO_2 measurement system etc. through a steel pipe. The flow rate of surface water for the Continuous Sea Surface Water Monitoring System was controlled by some valves and passed through some sensors i.e. temperature, salinity and dissolved oxygen etc. through vinyl-chloride pipes.

Specification and calibration date of the sensors are listed below.

a-1) Temperature and salinity sensors

SEACAT THERMOSALINOGRAPH

Model: SBE-21, SEA-BIRD ELECTRONICS, INC.

Serial number: 2113117-2641

Measurement range: Temperature -5 to +35 deg-C, Salinity 0 to 6.5 S/m

Accuracy: Temperature 0.01 deg-C/6month, Salinity 0.001 S/m/month

Resolution: Temperature 0.001 deg-C, Salinity 0.0001 S/m

Calibration date: 13-May-98 (mounted on 17-Oct-98 in this system)

a-2) Ship bottom oceanographic thermometer (mounted at the back of the pump for surface water)

Model: SBE 3S, SEA-BIRD ELECTRONICS, INC.

Serial number: 2607

Measurement range: -5 to +35 deg-C

Initial Accuracy: 0.001 deg-C per year typical

Stability: 0.002 deg-C per year typical

Calibration date: 16-Jun-98 (mounted on 17-Oct-98 in this system)

b) Dissolved oxygen sensor

Model: 2127, Oubisufair Laboratories Japan INC.

Serial number: 31757

Measurement range: 0 to 14 ppm

Accuracy: ±1% at 5 deg-C of correction range

Stability: 1% per month

Calibration date: 6-Feb-99

c) Fluorometer

Model: 10-AU-005, TURNER DESIGNS

Serial number: 5562 FRXX

Detection limit: 5 ppt or less for chlorophyll a

Stability: 0.5% per month of full scale

d) Particle size sensor

Model: P-05, Nippon Kaiyo LTD.

Serial number: P5024

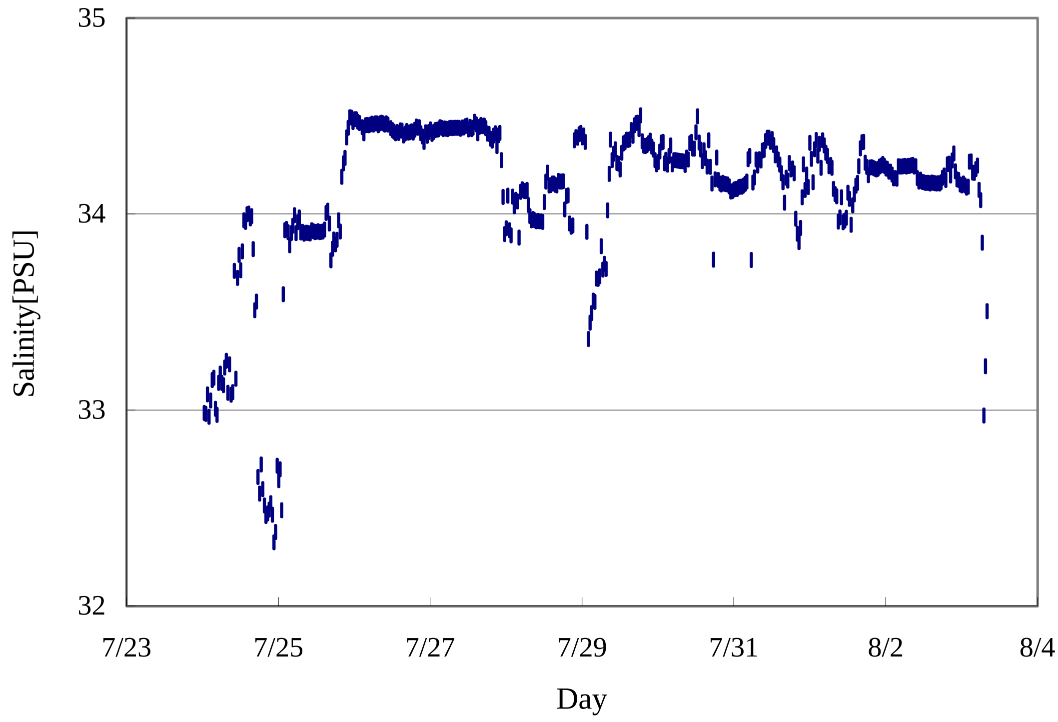
Accuracy: ±10% of range
Measurement range: 0.02681mm to 6.666mm
Reproducibility: ±5%
Stability: 5% per week

e) Flowmeter

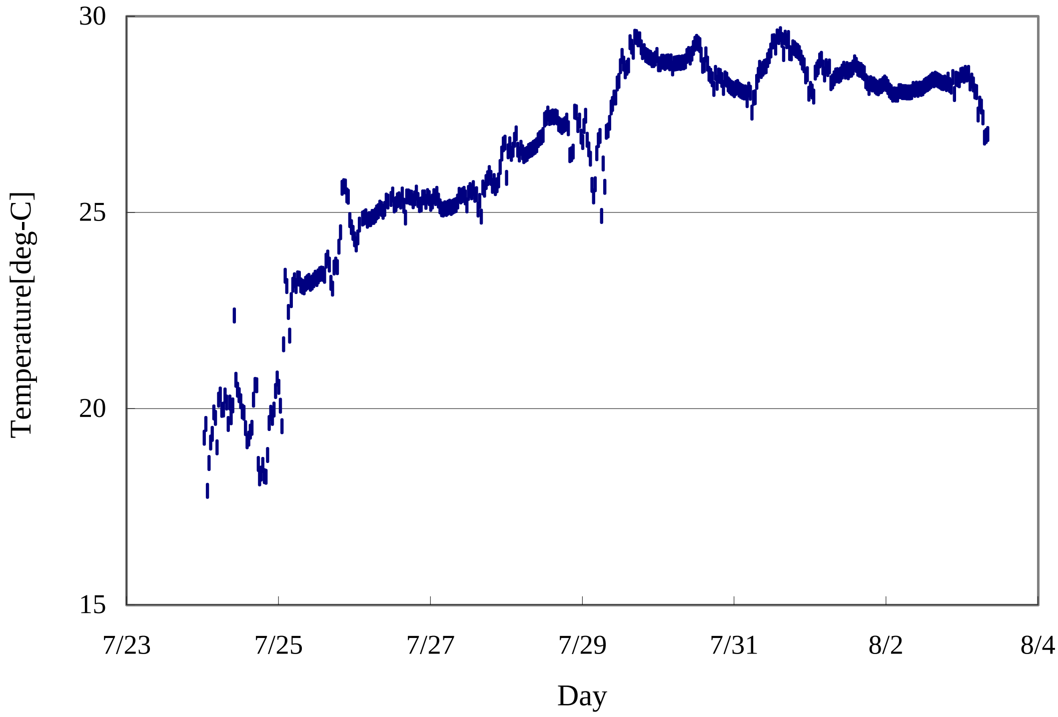
Model: EMARG2W, Aichi Watch Electronics LTD.
Serial number: 8672
Measurement range: 0 to 30 L/min
Accuracy: ±1%
Stability: ±1% per day

(5) Results

Preliminary data along the ship's track are shown in Fig.6.2-1～Fig.6.2-4. They show the respective trend of temperature, salinity and dissolved oxygen distributions on the ship's track every 30 minutes. Fig.6.2-1 and Fig.6.2-2 is the graph between Leg.1. Fig.6.2-3 and Fig.6.2-4 is the graph between Leg.2.

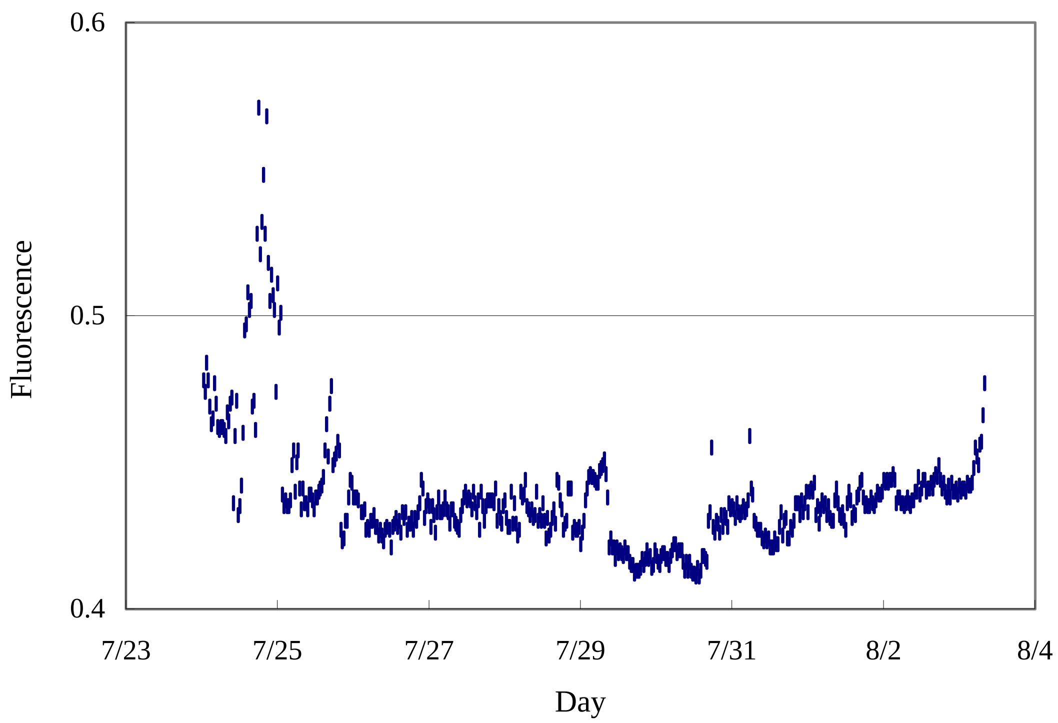


Distribution of sea surface salinity in the first Leg.

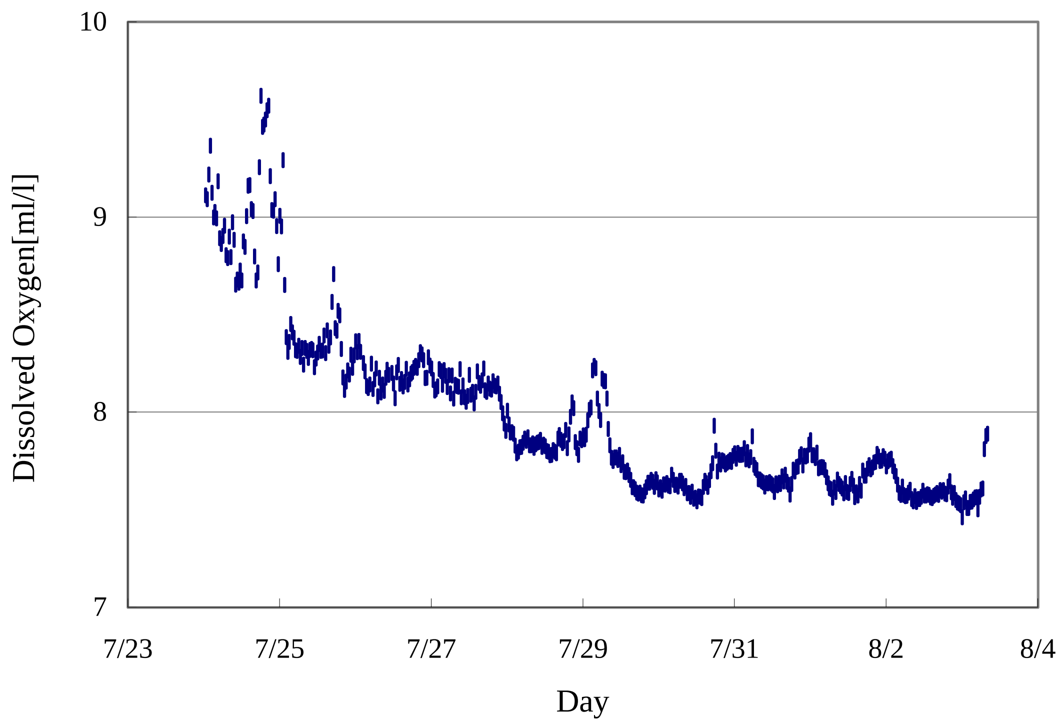


Distribution of sea surface temperature in the first Leg.

Fig.6.2-1 Sea surfece salinity and temperature

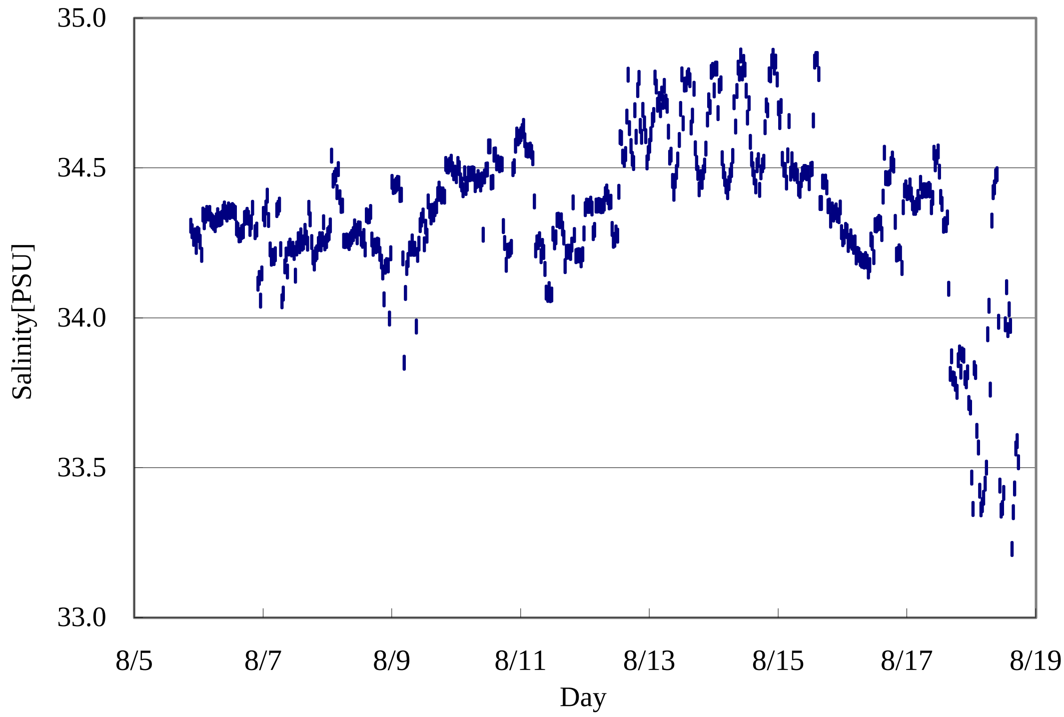


Distribution of sea surface fluorescence in the first Leg.

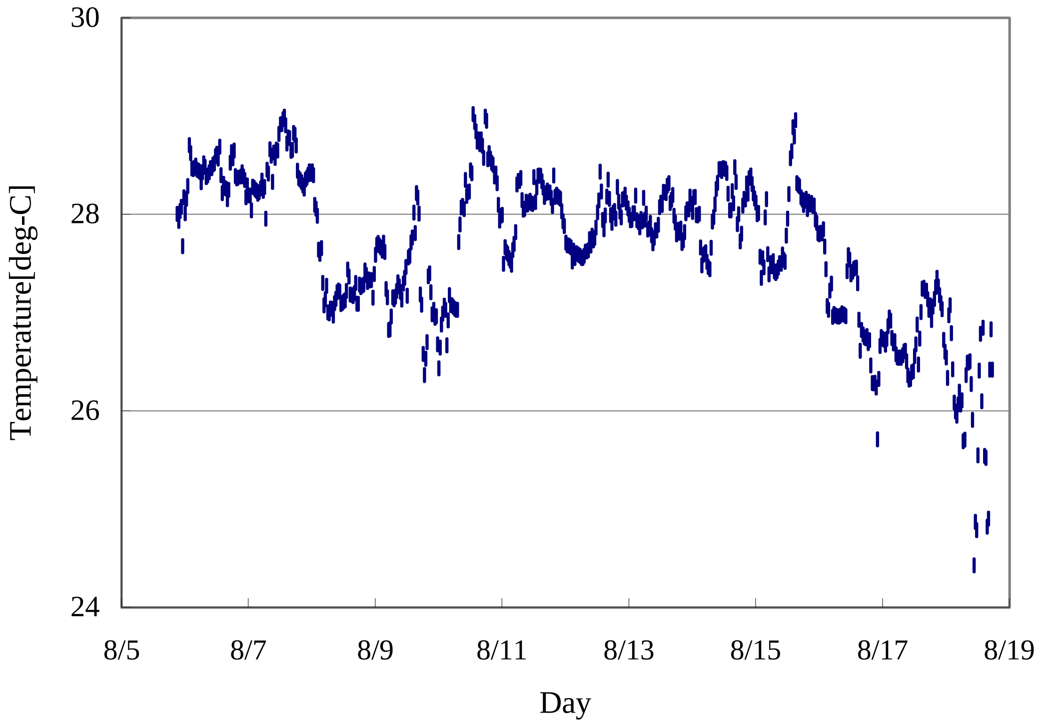


Distribution of sea surface Dissolved Oxygen in the first Leg.

Fig.6.2-2 Sea surface fluorescence and Dissolved Oxygen

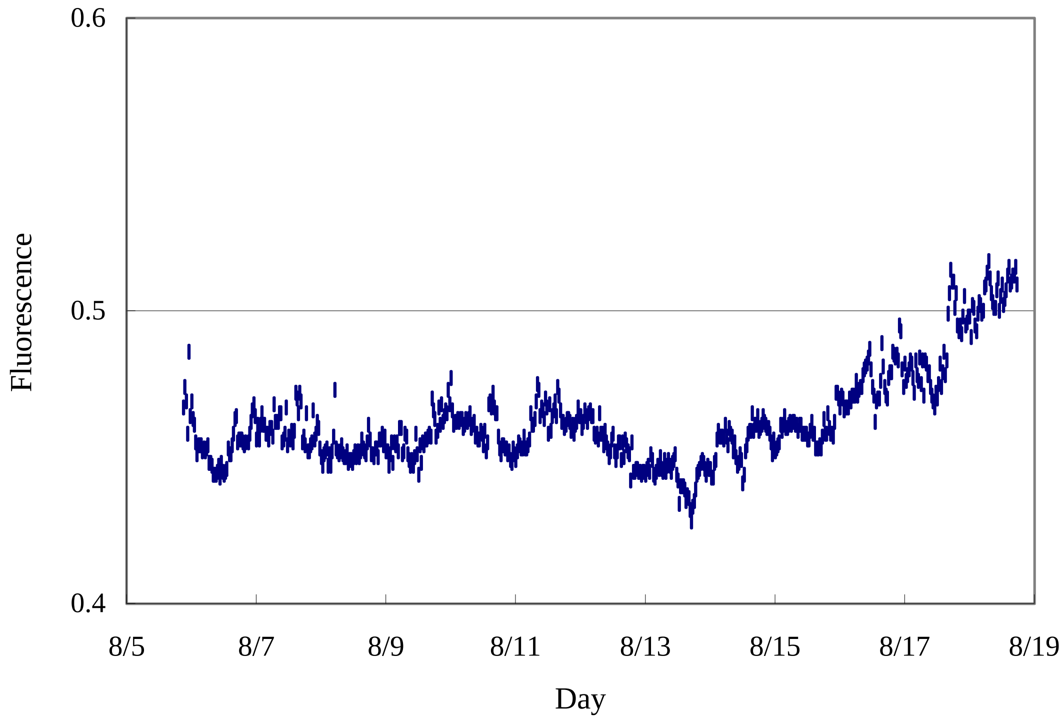


Distribution of sea surface salinity in the second Leg.

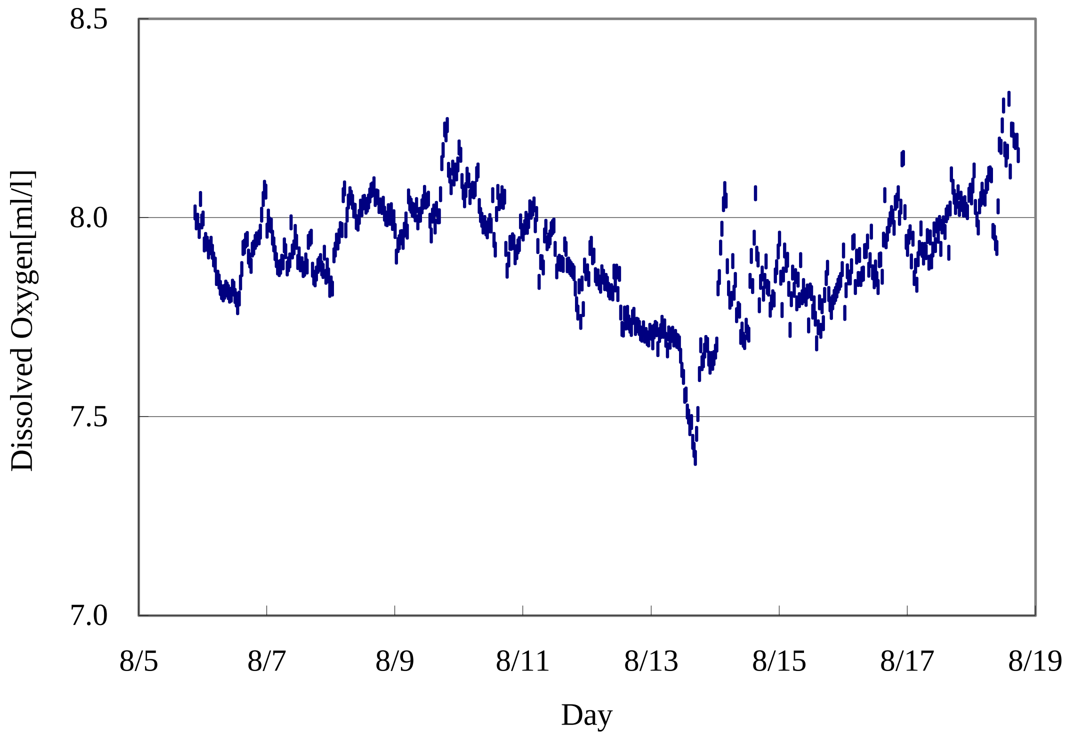


Distribution of sea surface temperature in the second Leg.

Fig.6.2-3 Sea surfece salinity and temperature



Distribution of sea surface fluorescence in the second Leg.



Distribution of sea surface Dissolved Oxygen in the second Leg.

Fig.6.2-4 Sea surface fluorescence and Dissolved Oxygen

6.3 Shipboard ADCP

Personnel

Fumitaka Yoshiura (GODI) : Operation Leader

(1) Parameters

(1.1) N-S (North-South) and E-W (East-West) velocity components of each depth cell [cm/s]

(1.2) Echo intensity of each depth cell [dB]

(2) Methods

We measured current profiles by VM-75 (RD Instruments, Inc. U.S.A.) shipboard ADCP (Acoustic Doppler Current Profiler) throughout MR99-K01 cruise from the departure of Mutsu, Japan on 23 July 1999 to the arrival of Mutsu, Japan on 19 August 1999 via Shimizu.

Major parameters for the measurement configuration are as follows;

Frequency :	75kHz
Average :	every 300 sec
Depth cell length :	1600 cm
No. of depth cells :	40
First depth cell position :	30.9 m
Last depth cell position :	654.9 m
ADCP ensemble time :	32.4 sec
Ping per ADCP raw data :	8

(3) Preliminary results

Two-hourly current vectors of 2-hour running mean averaged data are plotted for 30.9m-layer (Fig.6.5-1, Fig.6.5-2, Fig.6.5-3, Fig.6.5-4), 206.9m-layer (Fig.6.5-5, Fig.6.5-6, Fig.6.5-7, Fig.6.5-8) respectively. We could not plot whole cruise data in one sheet because of the software limitation.

(4) Data archives

ADCP data obtained in this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be under their control.

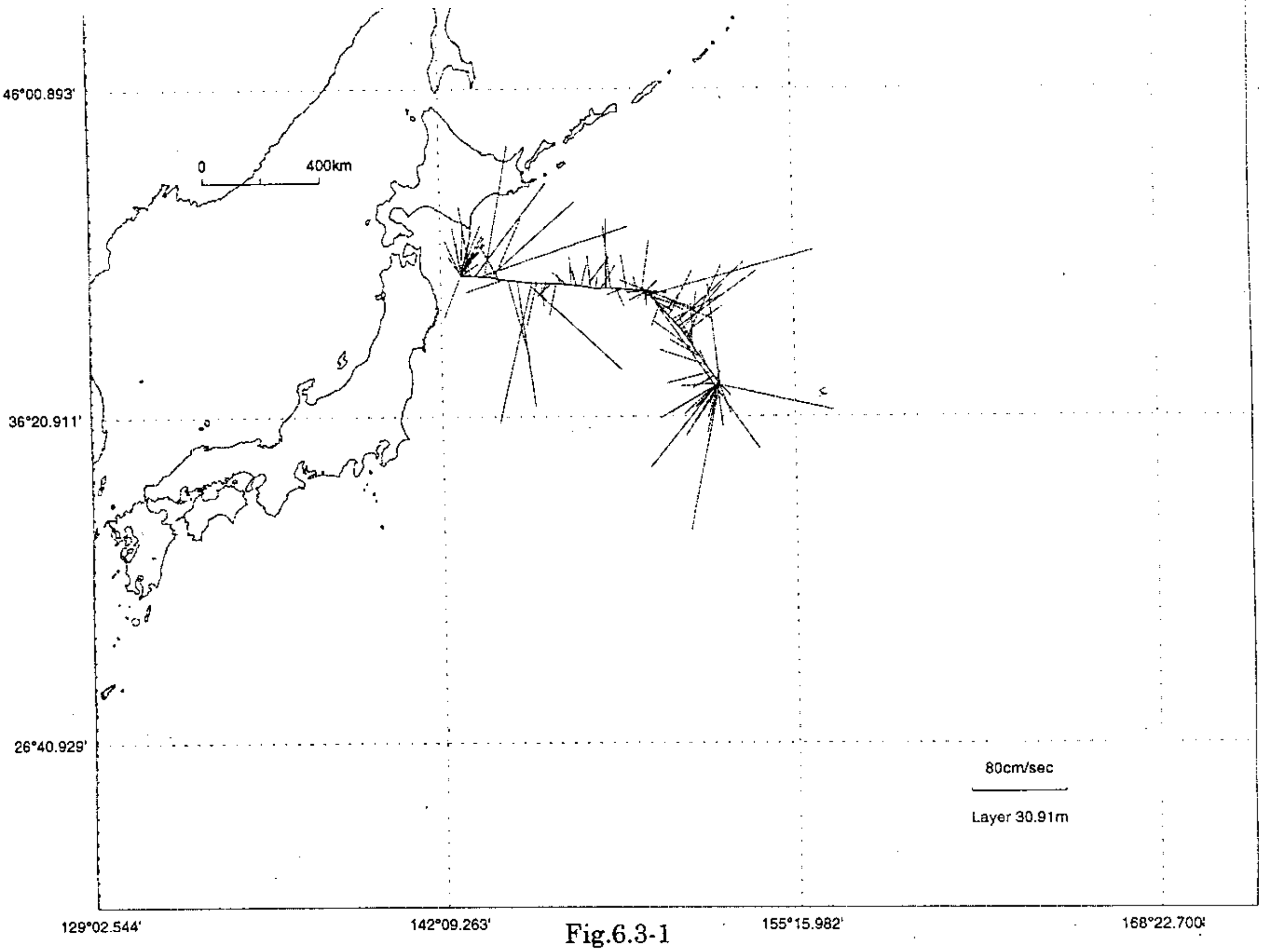


Fig.6.3-1

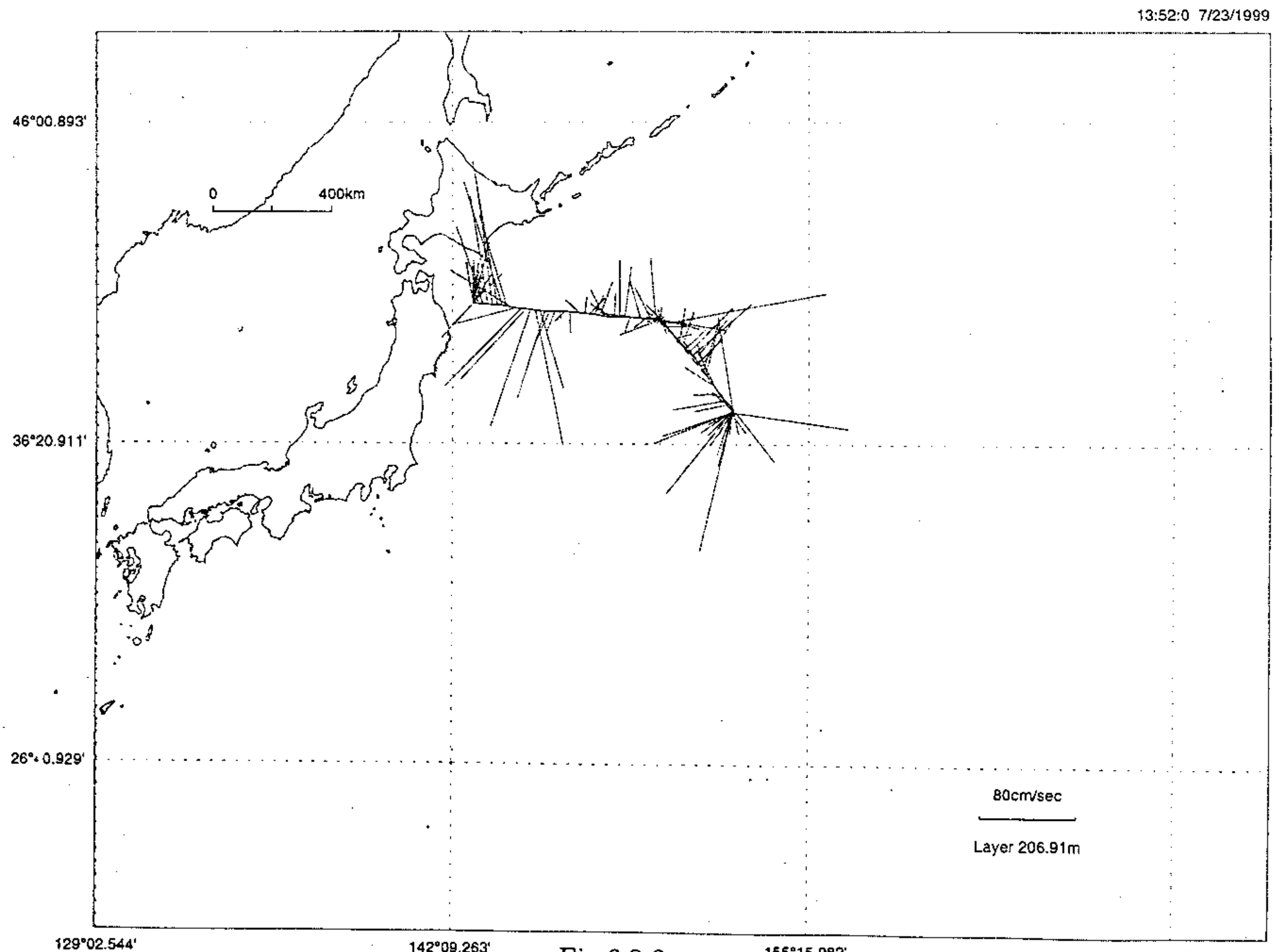


Fig.6.3-2

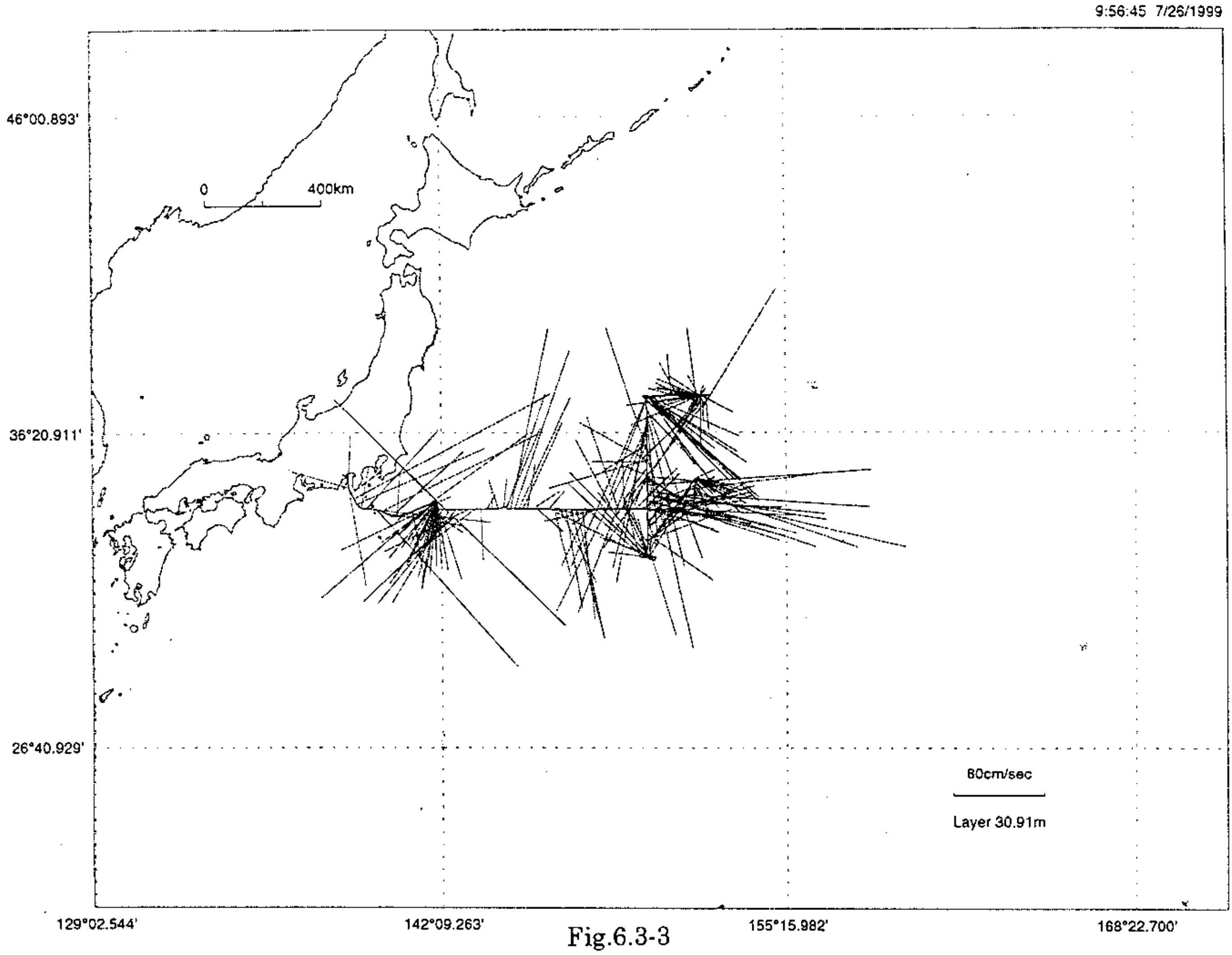


Fig.6.3-3

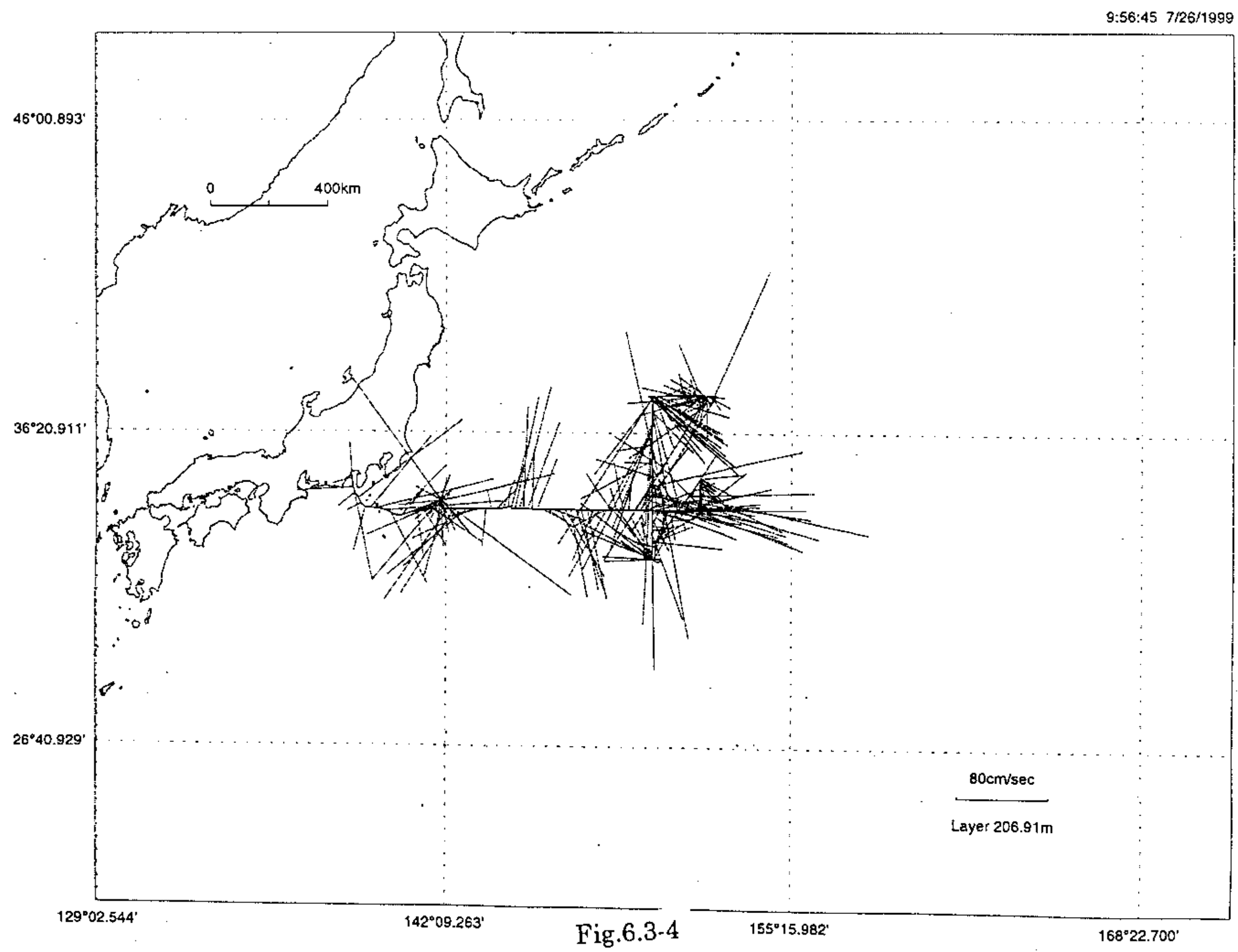


Fig.6.3-4

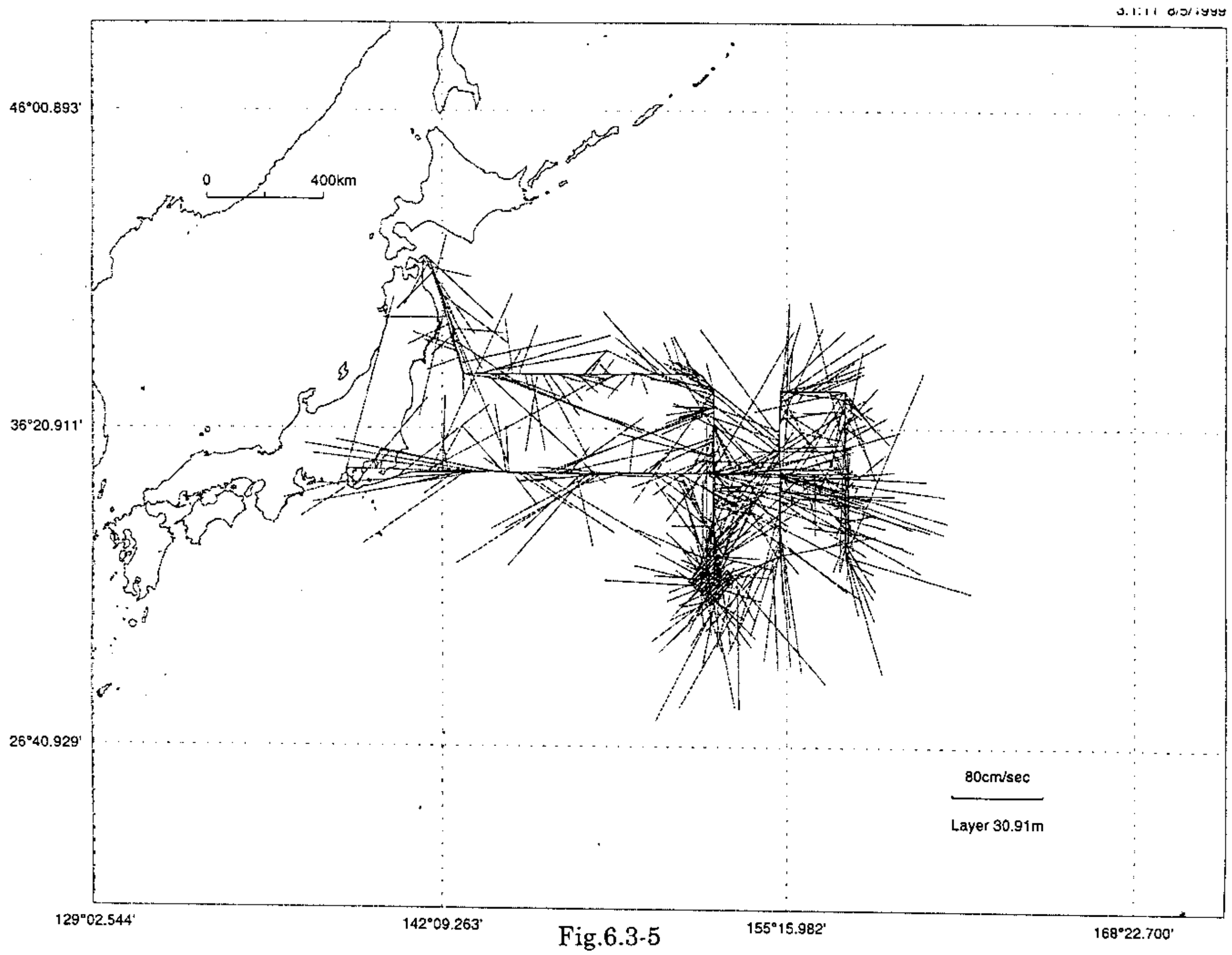


Fig.6.3-5

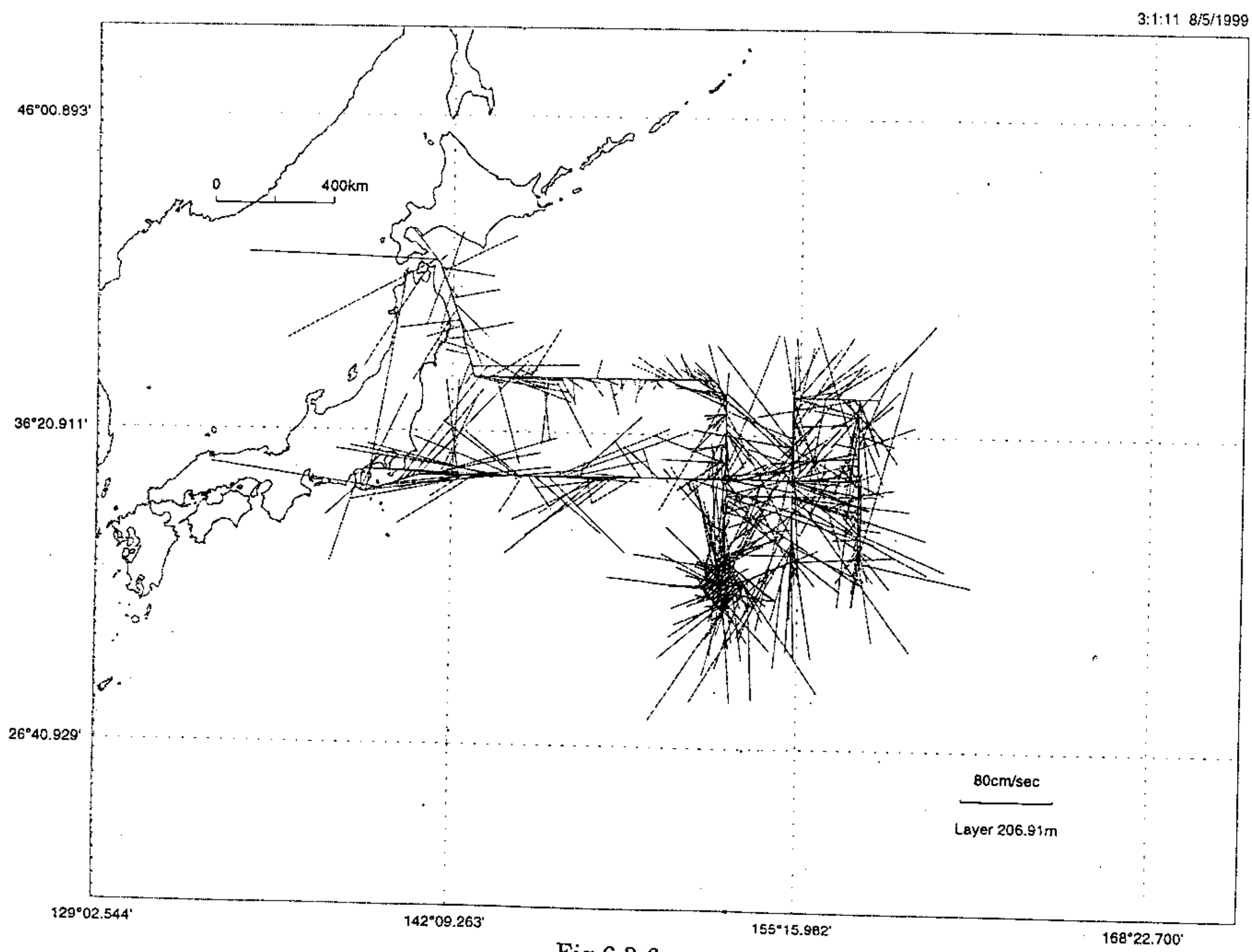


Fig.6.3-6

7.1 CTD, XBT, XCTD

Oceanic conditions in the subtropical and subarctic gyres, especially in and around the Kuroshio Extension, are thought to be important to the North Pacific decadal/interdecadal climate variabilities. In terms of global heat budget, the ocean in this region transfers the heat obtained in the tropics to the atmosphere. The area could also be a reservoir of greenhouse gases as anthropogenic CO2 by deep oceanic convection in winter season, which may convey these gasses to deep ocean. Objectives of this research are to clarify the various processes in this region such as the variability of the Kuroshio Extension and mesoscale eddies, and distribution of the North Pacific Intermediate Water around the Kuroshio Extension.

7.1.1 CTD

Personnel

Yasushi Yoshikawa (JAMSTEC): Researcher
Masahiko Murata (JAMSTEC): Researcher
Hirofumi Yamamoto (JAMSTEC): Researcher
Hideaki Hase (JAMSTEC): Researcher
Takaki Hatayama (JAMSTEC): Researcher
Takeo Matsumoto (MWJ):Operation leader
Fujio Kobayashi (MWJ)
Hidefumi Mitani (MWJ)
Motoki Matsuhashi (MWJ)
Hiroaki Muraki (MWJ)
Aya Katou (MWJ)
Akira So (MWJ)
Takehito Togashi (MWJ)
Makoto Tanabe (MWJ)

(1)Objectives

Oceanic conditions in the subtropical and subarctic gyres, especially in and around the Kuroshio Extension, are thought to be important to the North Pacific decadal/interdecadal climate variabilities. In terms of global heat budget, the ocean in this region transfers the heat obtained in the tropics to the atmosphere. The area could also be a reservoir of greenhouse gases as anthropogenic CO2 by deep oceanic convection in winter season, which may convey these gasses to deep ocean. Objectives of this research are to clarify the various processes in this region such as the variability of the Kuroshio Extension and mesoscale eddies, and distribution of the North Pacific Intermediate Water around the Kuroshio Extension.

In order to clarify the mesoscale oceanic structure, various kinds of observations have been carried out in and around the Kuroshio Extension (including subtropical region and the Kuroshio-Oyashio interfrontal region). CTD measurements along 4 sections (150.0E, 152.5E, 155.0E, and 157.5E) across the Kuroshio Extension (32.5N-37.5N) have been carried out. Each cast is designed as, down to 2000m in every 0.5 degree sites where with small Rosette water sampler for temperature and salinity measurements. In every 2.5 degree sites it is designed as, down to 4000m with a small Rosette water sampler for temperature, salinity, dissolved oxygen and dissolved CO2 measurements.

(2)Parameters

Temperature, Conductivity, Pressure, Dissolved Oxygen(D.O.)

(3)Methods

CTD/Rosette Multi-bottle Array Systems(CTD/RMS) were used during this cruise. It was the 12-liters 12-positions intelligent General Oceanic RMS(GO1016) water sampler with Sea-Bird Electronics Inc. CTD(SBE9plus). The sensors attached on CTD were one temperature sensor, one conductivity sensor, one pressure sensor, one D.O. sensor and altimeter sensor. Items of CTD Cast Table(Table2.1) are position, date(JTS), time(JTS).

The CTD raw data was acquired on real time by using the SEASAVE utility from the SEASOFT software(ver.4.236) provided by SBE and stored on the hard disk of a H.P. personal computer. Water samplings were made during up cast by sending a fire command from the computer.

The CTD raw data was processed by using the SEASOFT(ver.4.207). Data processing procedures and used utilities of the SEASOFT were as follows:

DATCNV : Converts the binary raw data to output on physical units. Output items are scan number, depth, pressure, temperature, salinity, oxygen, sigma-theta, and sigma-t. This utility selects the CTD data when bottles closed to output on another file.

SECTION : Remove the unnecessary data.

BINAVG : Calculates the averaged data in every 1 db..

ROSSUM : Edits the data of water sampled to output a summary file.

SPLIT : Splits the data made by BINAVG into down cast data.

Specifications of the sensors are listed below.

CTD : SBE 911 plus CTD system

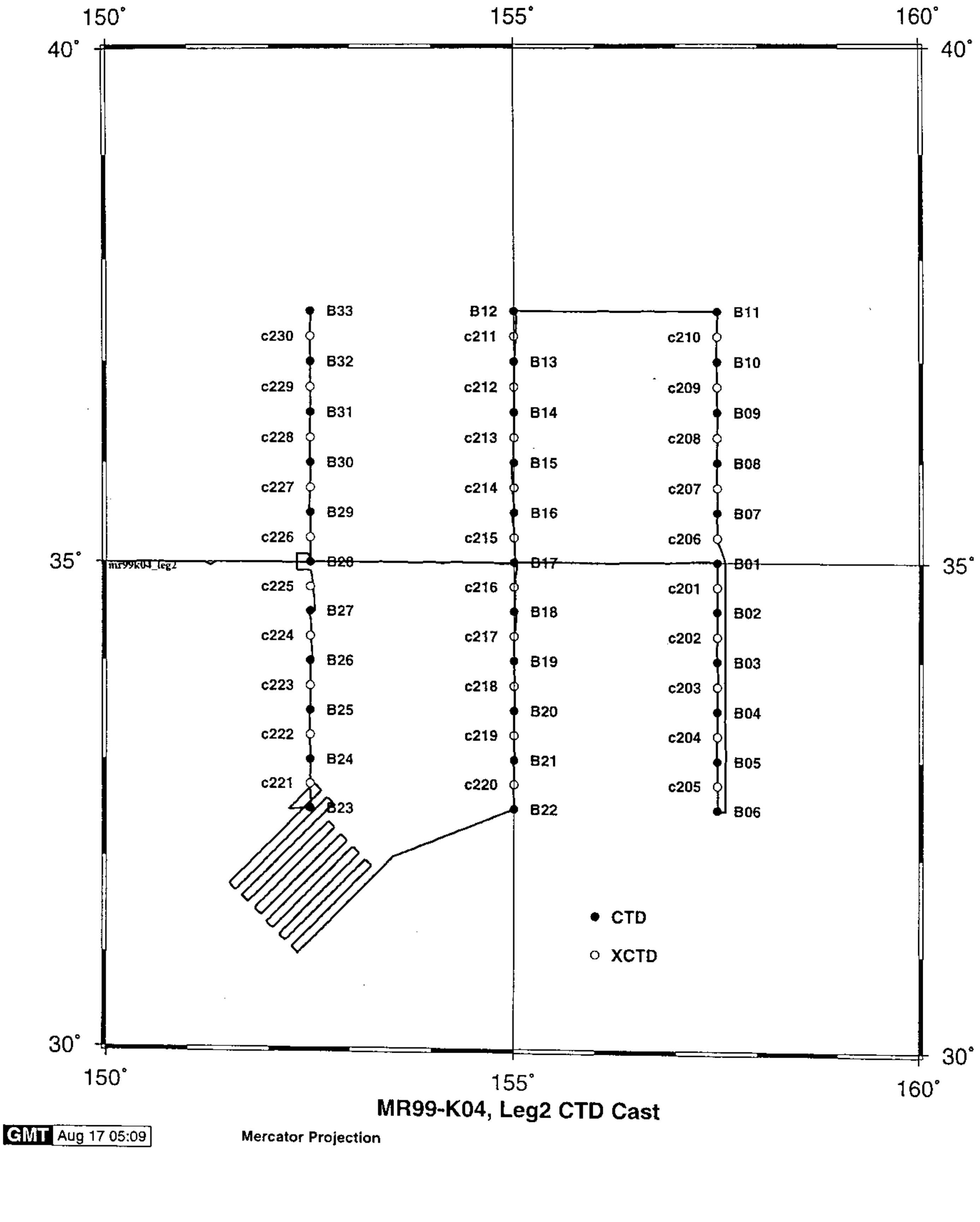
- Under water unit:CTD 9plus (S/N 09P9833-0357,Sea-Bird Electronics,Inc.)
- Temperature sensor:SBE3-04/F Primary Sensor (S/N 031524,Sea-Bird Electronics,Inc.)
- Conductivity sensor:SBE4-04/0 Primary Sensor (S/N 041203,Sea-Bird Electronics,Inc.)
- Oxygen sensor:MODEL 13-04-B (S/N 130338,Sea-Bird Electronics,Inc.)
- Deck unit: SBE11 (S/N 11P801-0308,Sea-Bird Electronics,Inc.)

(4)Result

See the attached figures(fig.2.1).

(5)Data archive

All of raw and processed CTD data files were copied into 3.5 inch magnetic optical disks(230MB,640MB) and submitted to JAMSTEC Data Management Office.



MR99-K04, Leg2 CTD Cast

Mercator Projection

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1203
CALIBRATION DATE: 07-Jan-99s

CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHIJ COEFFICIENTS

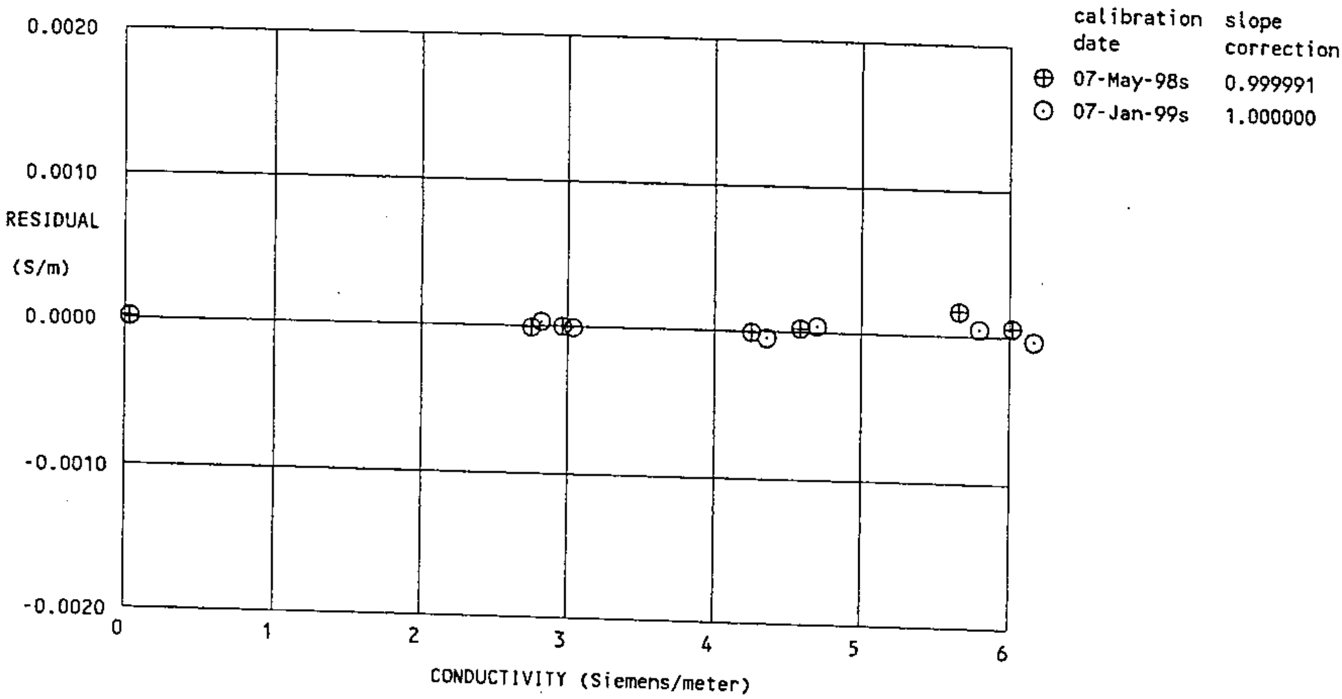
g = -4.05095365e+00
h = 4.93353651e-01
i = 9.25309278e-05
j = 2.19182519e-05
CPcor = -9.57e-08 (nominal)
CTcor = 3.25e-06 (nominal)

ABCDM COEFFICIENTS

a = 4.58570931e-05
b = 4.93572804e-01
c = -4.05168502e+00
d = -8.59016432e-05
m = 3.8
CPcor = -9.57e-08 (nominal)

BATH TEMP (IPTS-68 °C)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.86420	-0.00000	-0.00000
-1.4070	35.0939	2.79022	8.03029	2.79024	0.00002
1.1332	35.0955	3.00914	8.29979	3.00913	-0.00001
15.2512	35.0947	4.32656	9.76386	4.32651	-0.00005
18.6887	35.0915	4.66952	10.10980	4.66955	0.00003
29.2324	35.0892	5.76601	11.14237	5.76605	0.00004
32.6717	35.0846	6.13521	11.46863	6.13518	-0.00003

Conductivity = $(g + hf^2 + if^3 + jf^4) / [10(1 + \delta t + \epsilon p)]$ Siemens/meter
Conductivity = $(af^m + bf^2 + c + dt) / [10(1 + \epsilon p)]$ Siemens/meter
t = temperaure [deg C]; p = pressure [decibars]; δ = CTcor; ϵ = CPcor;
Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1524
CALIBRATION DATE: 06-Jan-99s

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.83482411e-03
h = 6.75392734e-04
i = 2.64046579e-05
j = 2.12695952e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.68151424e-03
b = 6.00623608e-04
c = 1.48319736e-05
d = 2.12839340e-06
f_0 = 6158.924

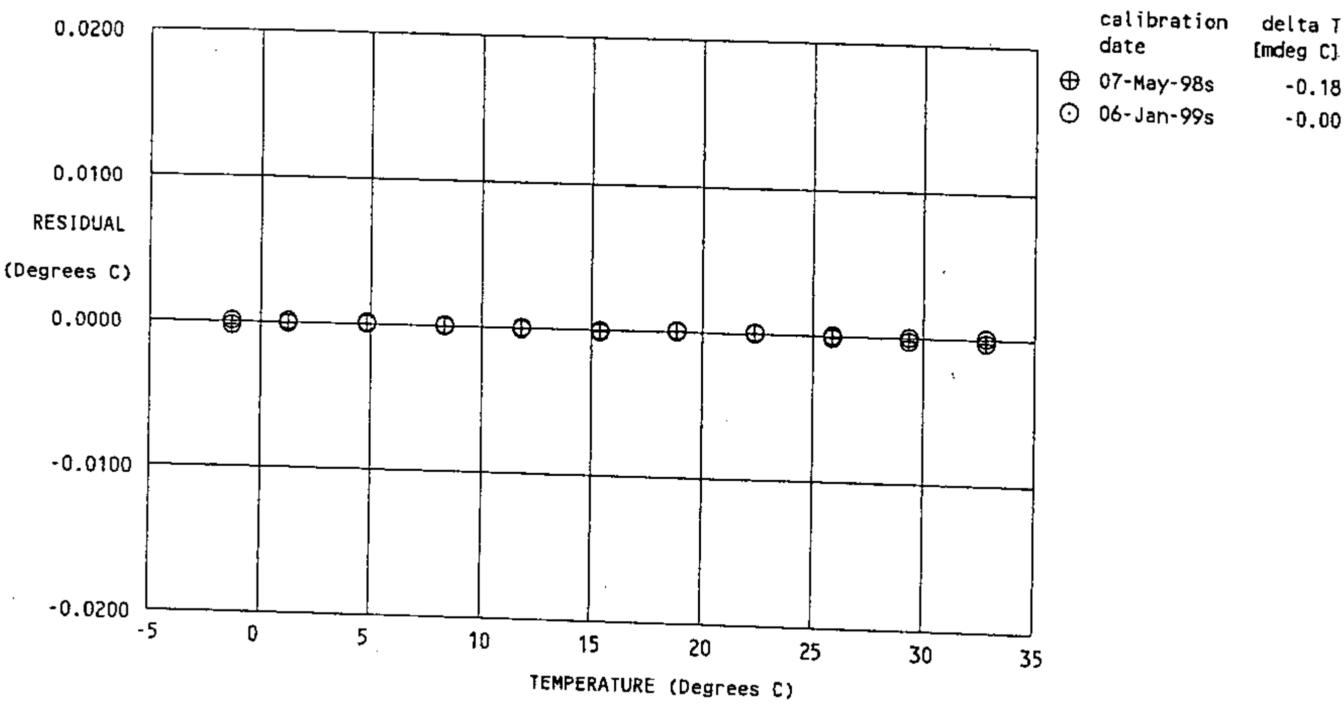
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
-1.5223	6158.924	-1.5223	-0.00002
1.0395	6522.550	1.0395	0.00002
4.6131	7055.252	4.6131	0.00004
8.1198	7607.555	8.1198	0.00001
11.6236	8189.416	11.6236	-0.00004
15.1840	8812.175	15.1839	-0.00007
18.6475	9449.193	18.6475	0.00005
22.1490	10125.128	22.1490	0.00005
25.6768	10839.295	25.6768	0.00000
29.1481	11575.130	29.1481	-0.00004
32.6228	12345.175	32.6228	0.00001

Temperature ITS-90 $= 1/\{g + h[\ell n(f_0/f)] + i[\ell n^2(f_0/f)] + j[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 $= 1/\{a + b[\ell n(f_0/f)] + c[\ell n^2(f_0/f)] + d[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).

Residual = instrument temperature - bath temperature



SBE

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Telephone:(206) 643-9866 Telex: 292915 SBEI UR Fax: (206) 643-9954

DISSOLVED OXYGEN SENSOR CALIBRATION: S/N 130338 17 July 1998

Sensor type:

Beckman, Module S/N 80521-08

Sensor Current

m	=	2.4542 E-7
b	=	-4.1231 E-10

The use of these constants in a linear equation of the form

$$I = mV + b$$

will yield DO sensor membrane current as a function of sensor output voltage.

Sensor Compensation Temperature

k	=	8.9604
c	=	-6.9052

The use of these constants in a linear equation of the form

$$T = kV + c$$

will yield membrane temperature as a function of temperature channel voltage with a maximum error of about 0.5 deg C. The correction to dissolved oxygen resulting from the use of this calibration should be sufficient to achieve the precision of which the sensor is capable.

SEASOFT Coefficients based on Oxfit Calibration Results

Soc	2.5056	
Boc	-0.0223	
tcor	-0.033	(nominal)
pcor	1.50e-4	(nominal)
tau	2.0	(nominal)
wt	0.67	(nominal)

barometer	=	1010.604	mB
Twater	=	4.442	deg C
Tcomp	=	4.151	deg C
Isat	=	0.469	uA
Iair	=	0.493	uA
Izero	=	0.008	uA

CALIBRATION
AFTER
MODIFICATIONS

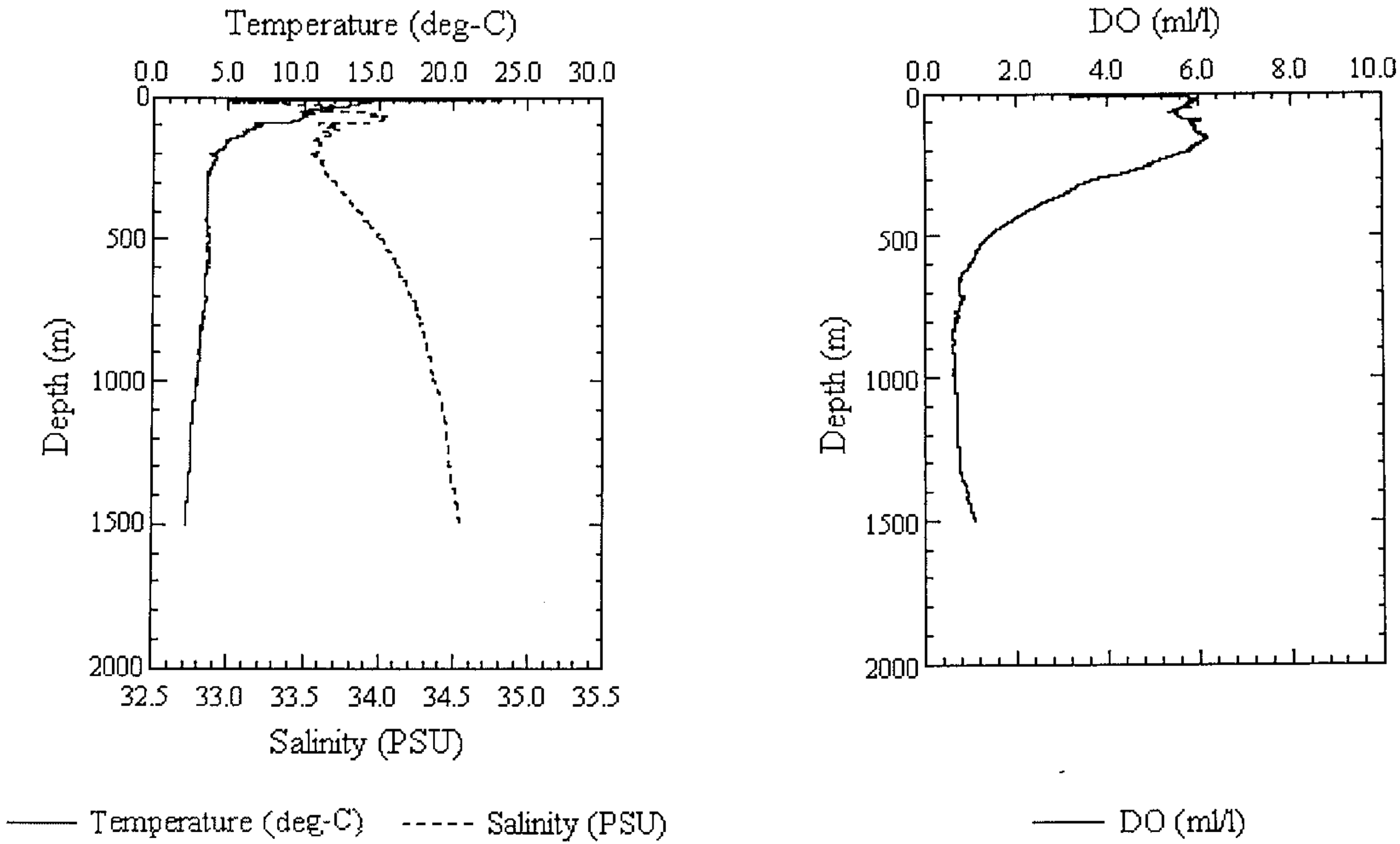
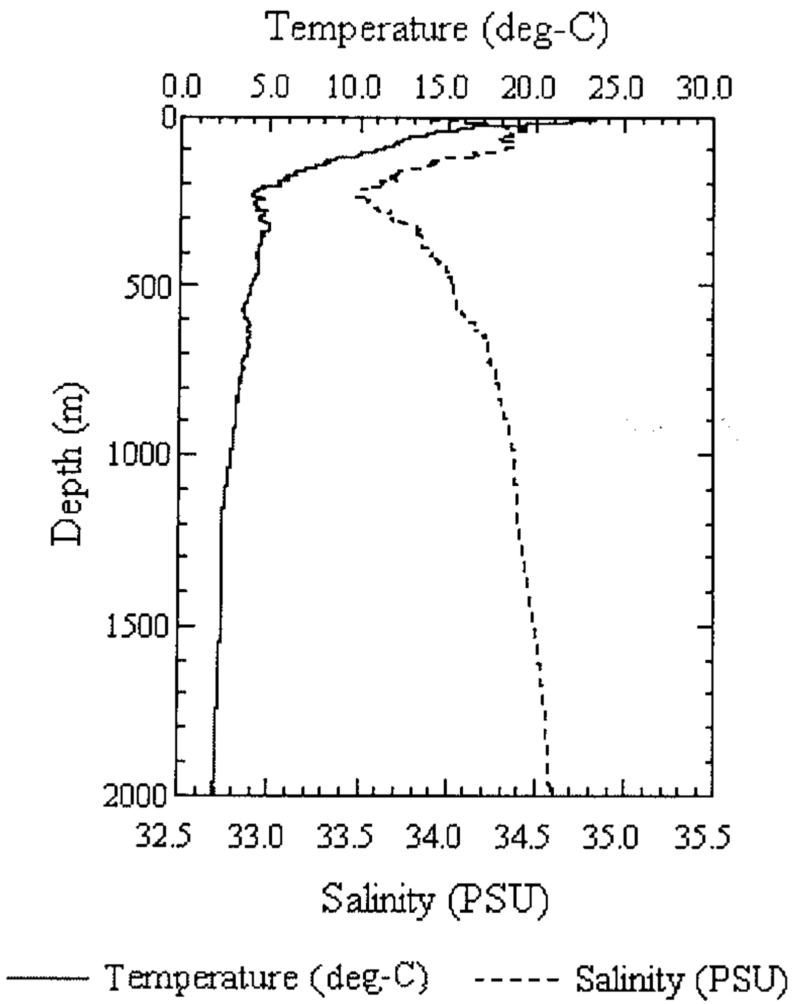


Fig. 2.1.1 CTD profile at St.A01

MWJ



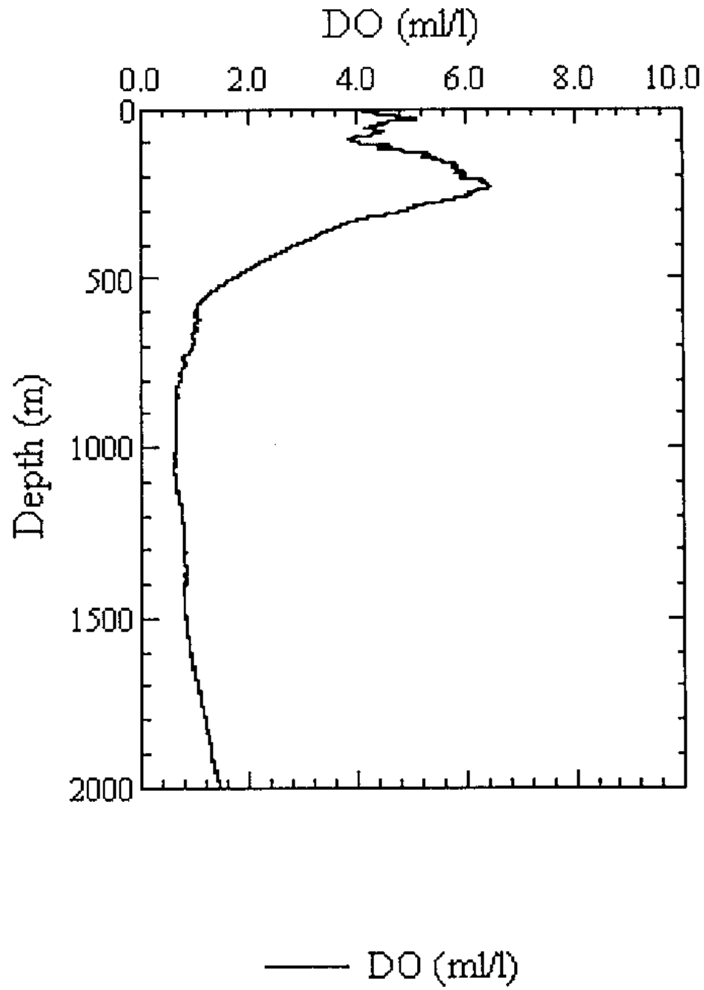


Fig. 2.1.2 CTD profile at St.A02

MWJ

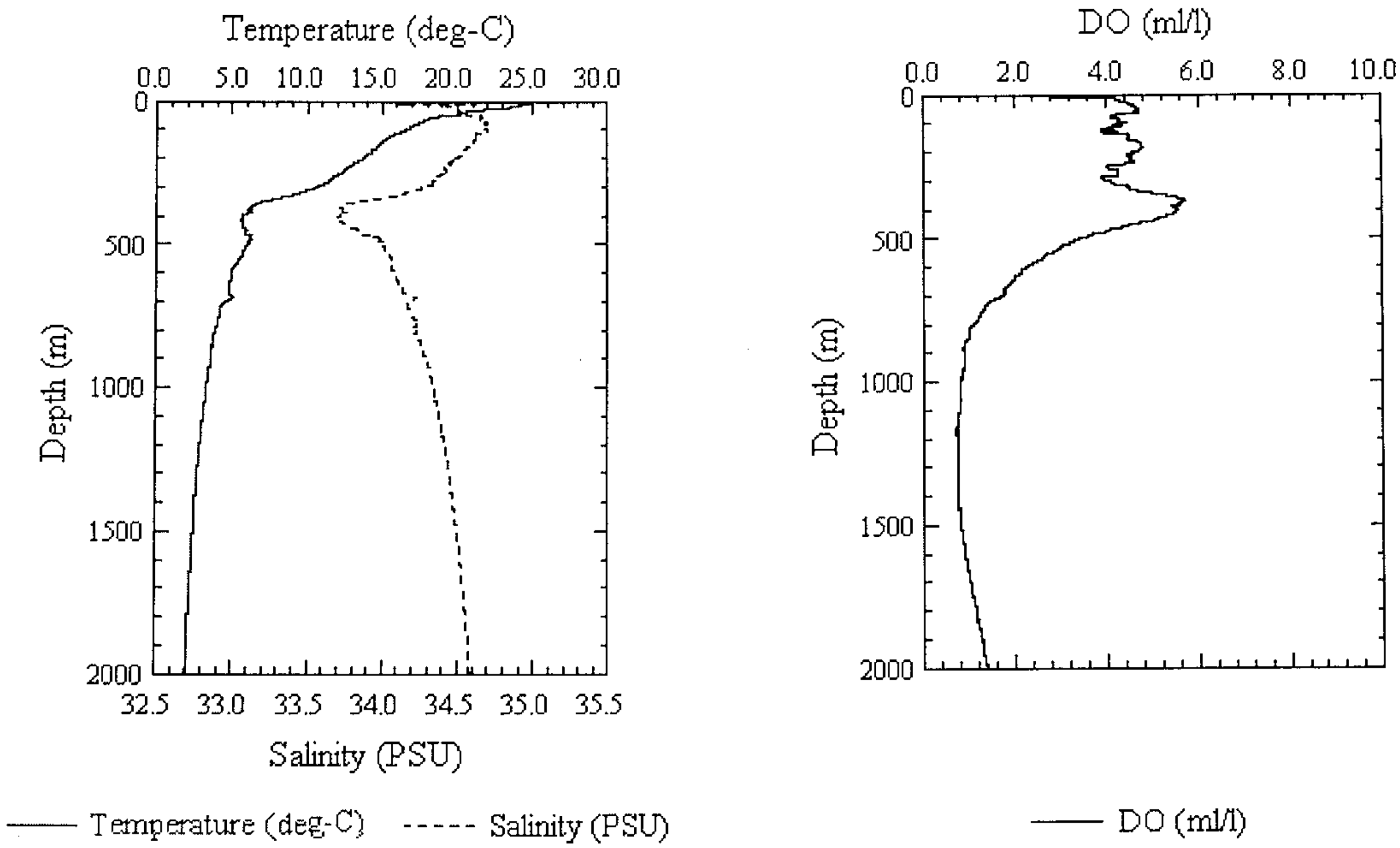


Fig. 2.1.3 CTD profile at St.A03

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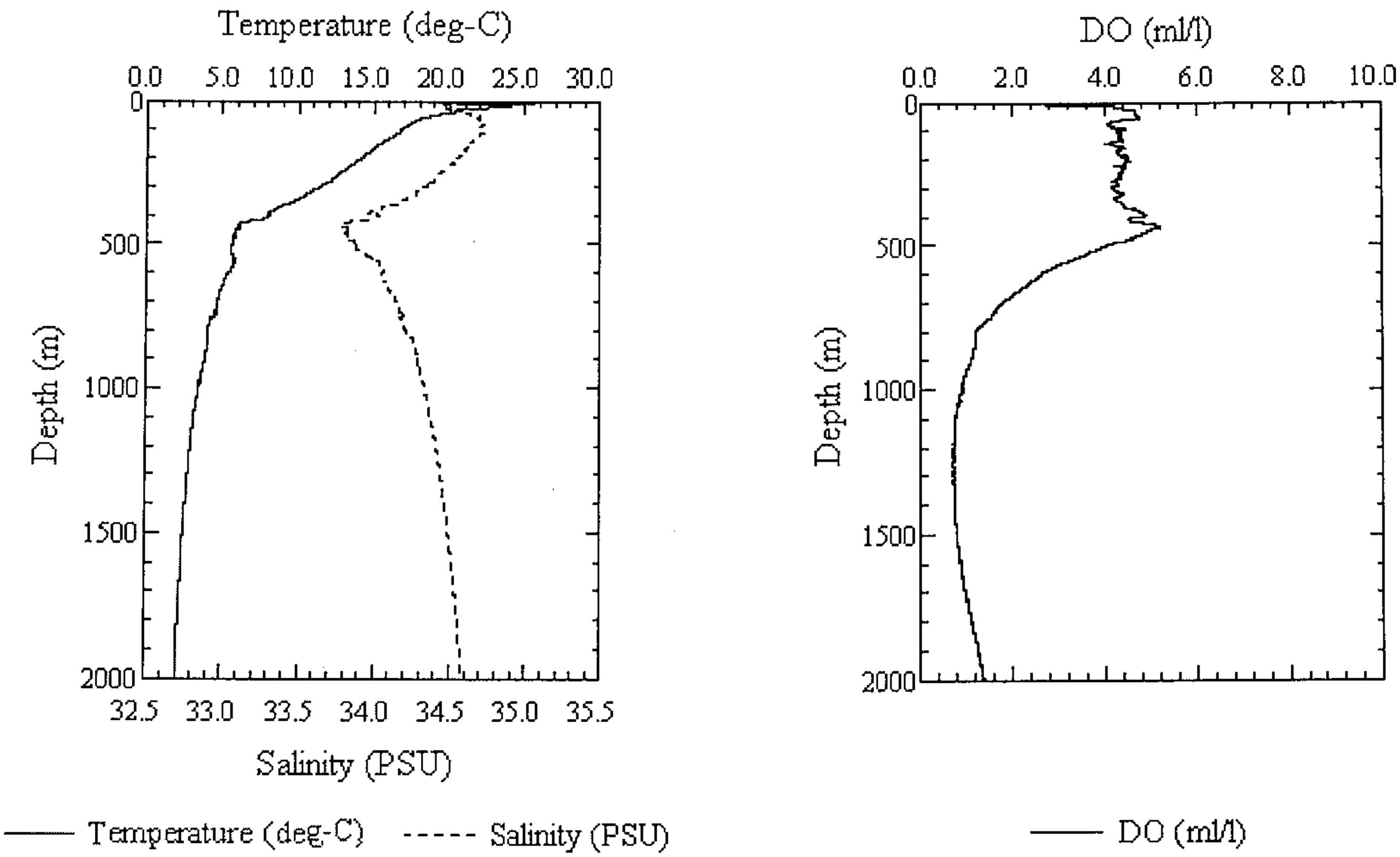


Fig. 2.1.4 CTD profile at St.A04

MWJ

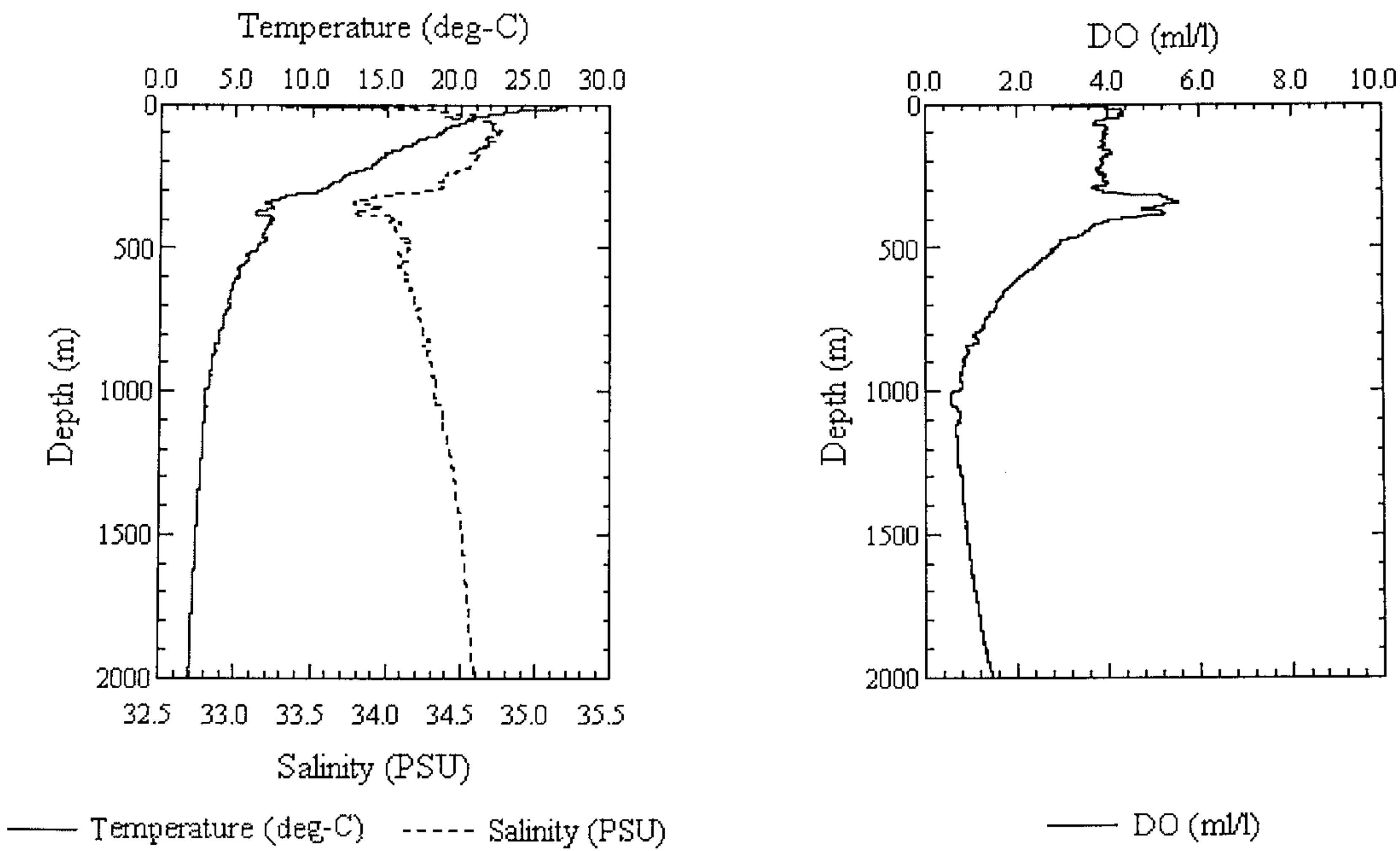
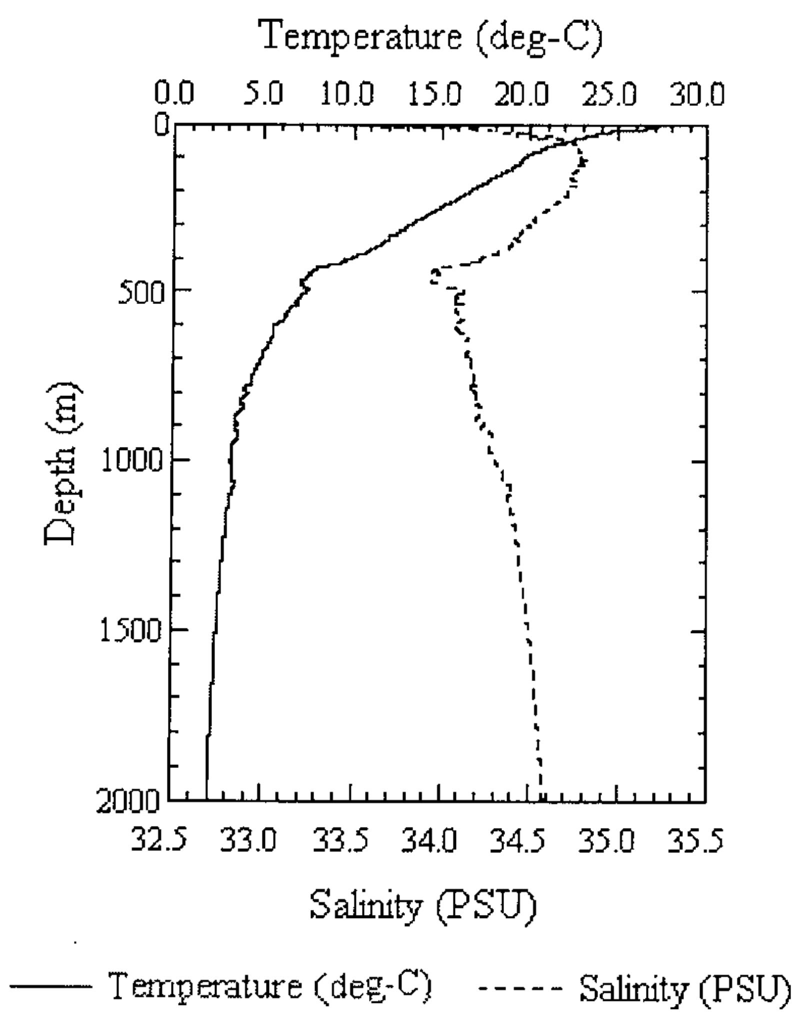


Fig. 2.1.5 CTD profile at St.A06

MWJ



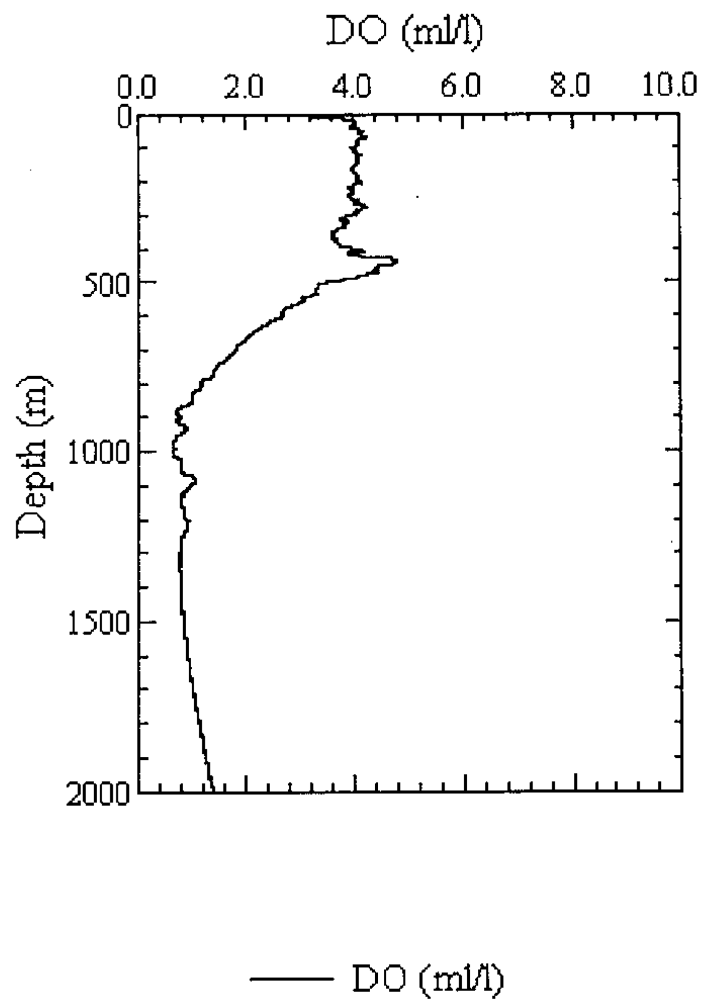


Fig. 2.1.6 CTD profile at St.A07

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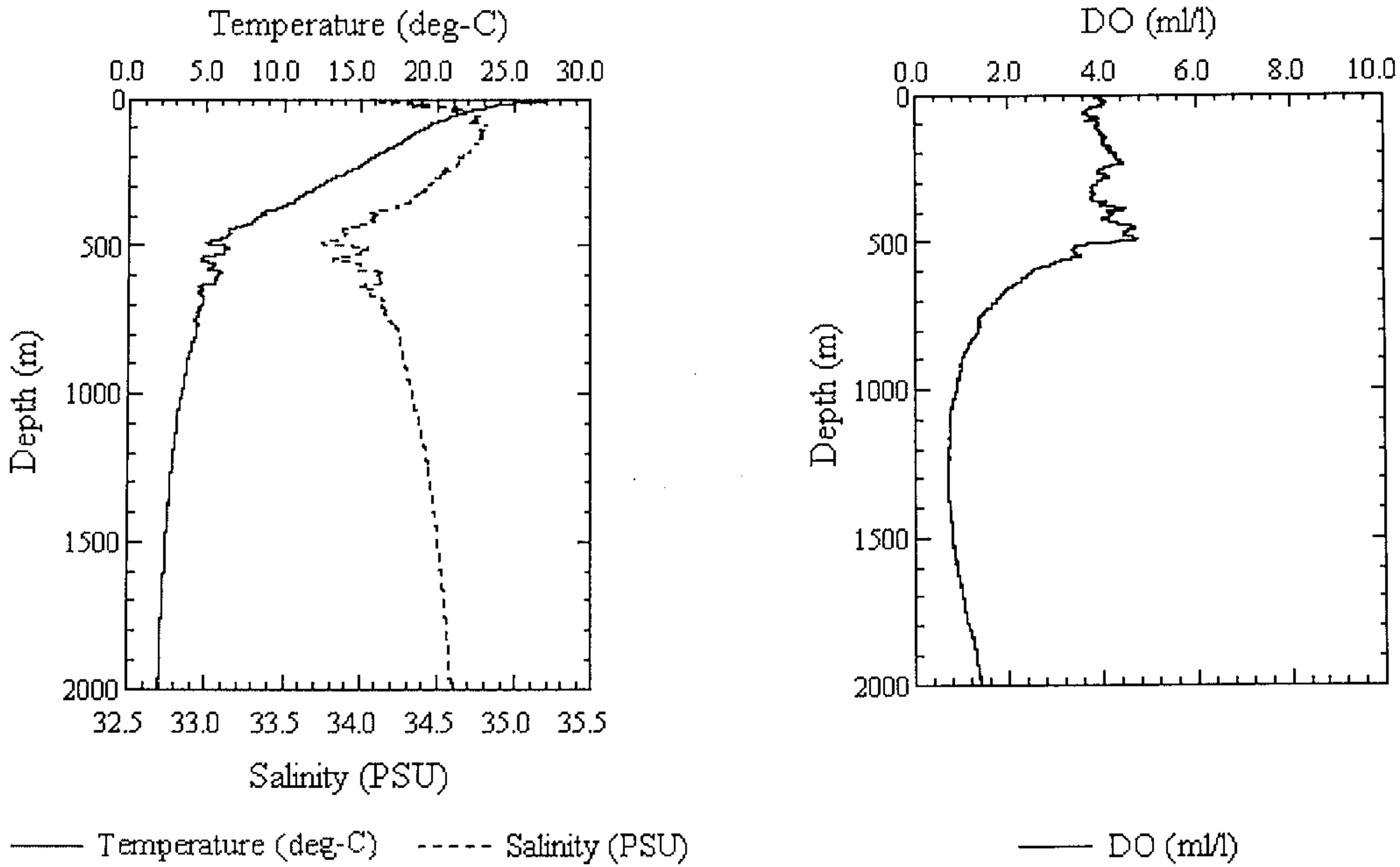

Fig. 2.1.7 CTD profile at St.A08

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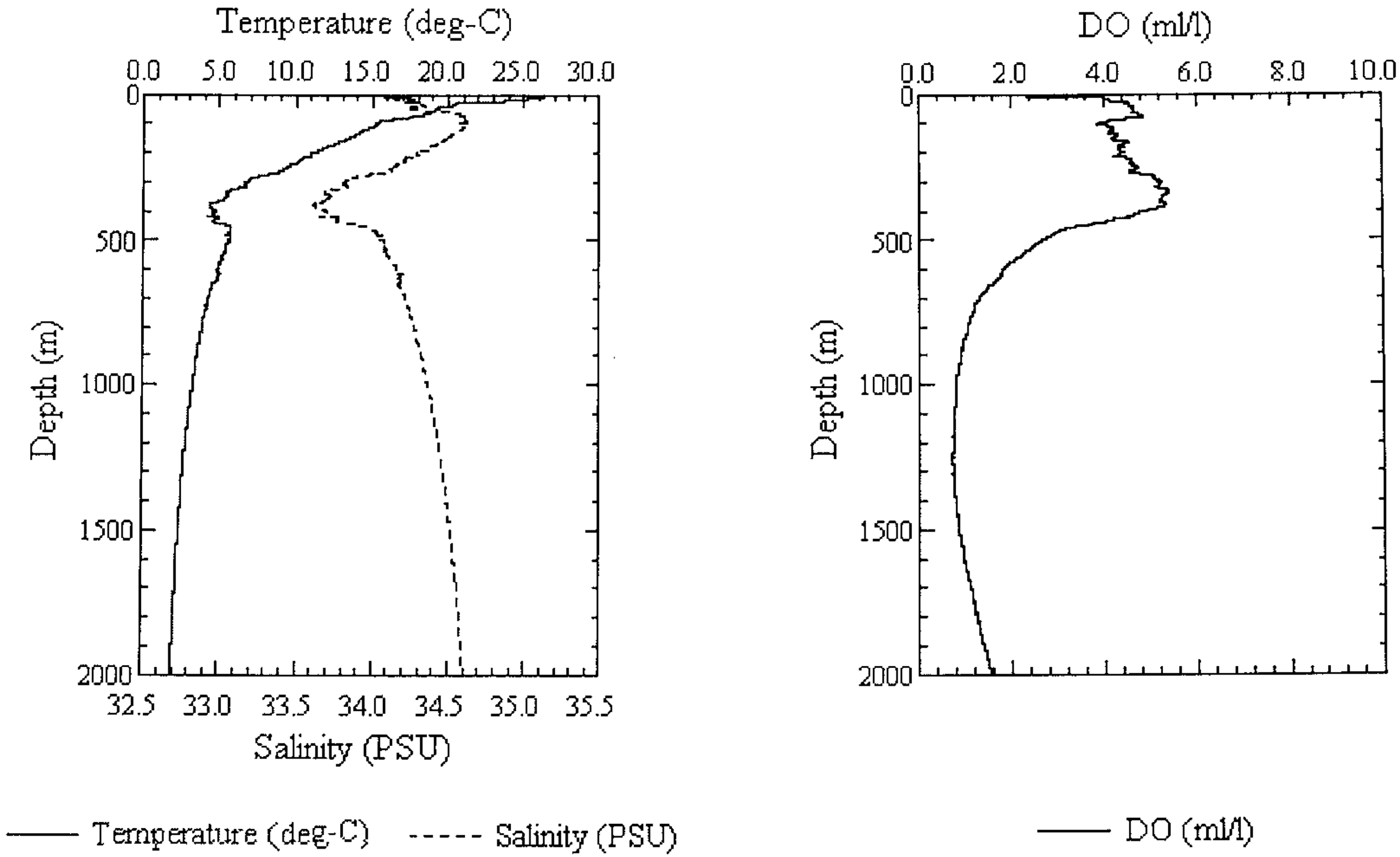

Fig. 2.1.8 CTD profile at St.A09

MWJ

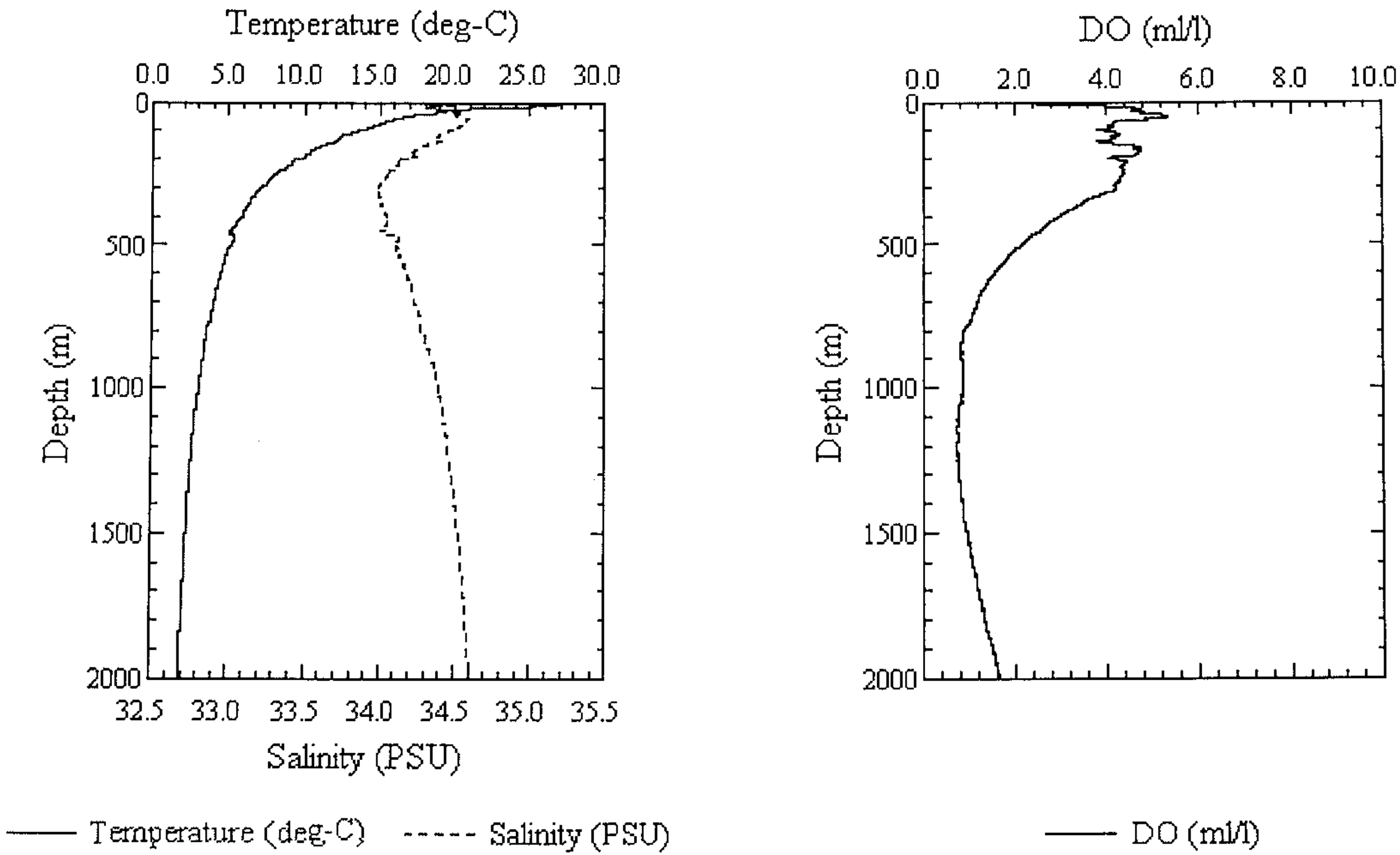

Fig. 2.1.9 CTD profile at St.A10

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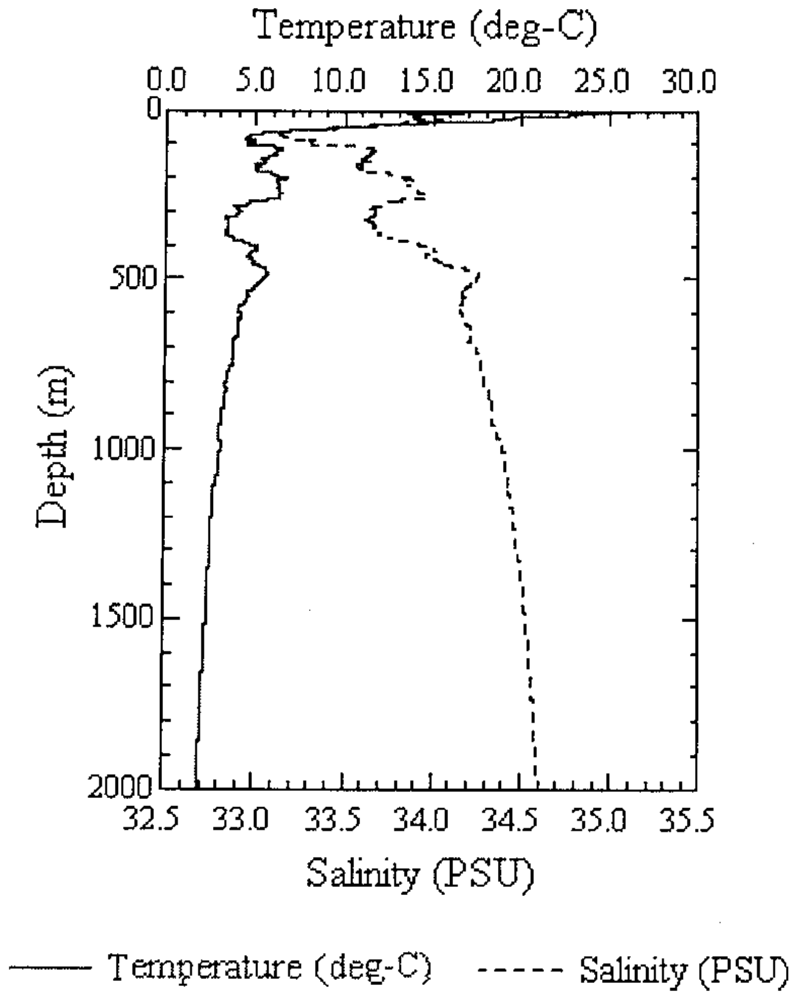

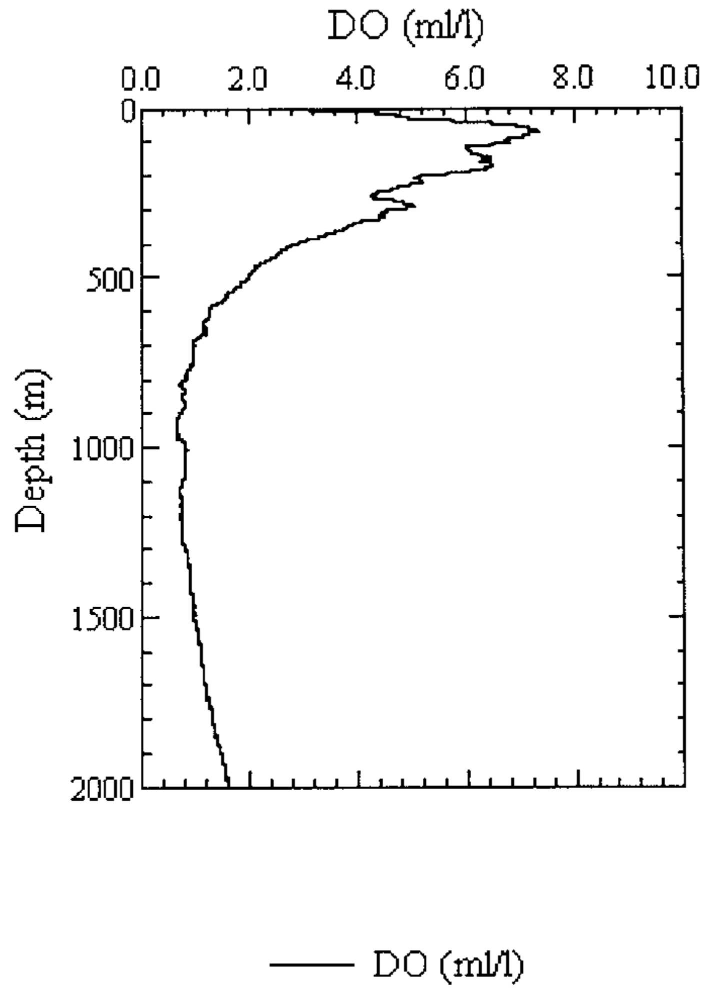

Fig. 2.1.10 CTD profile at St.A11

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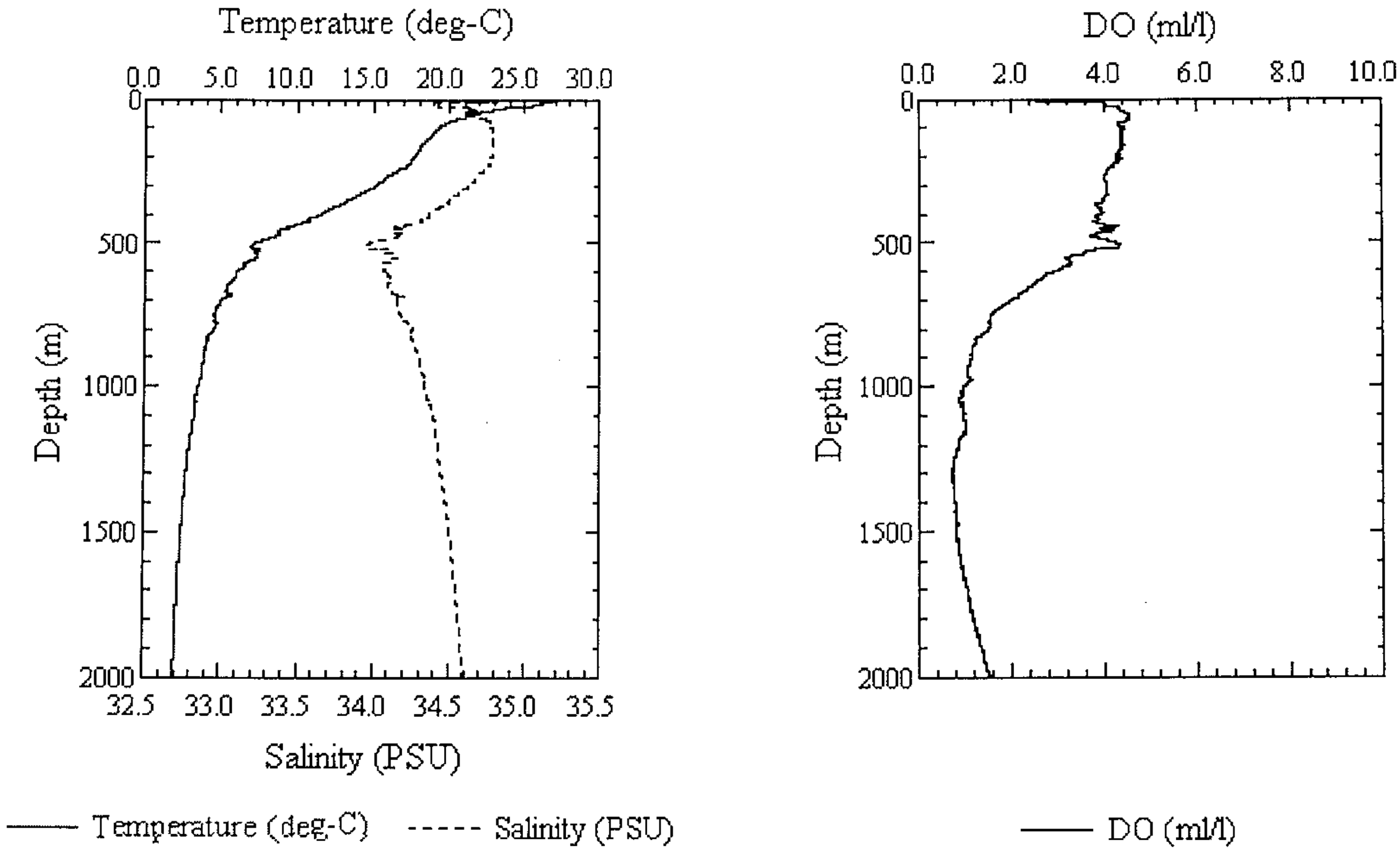

Fig. 2.1.11 CTD profile at St.A12

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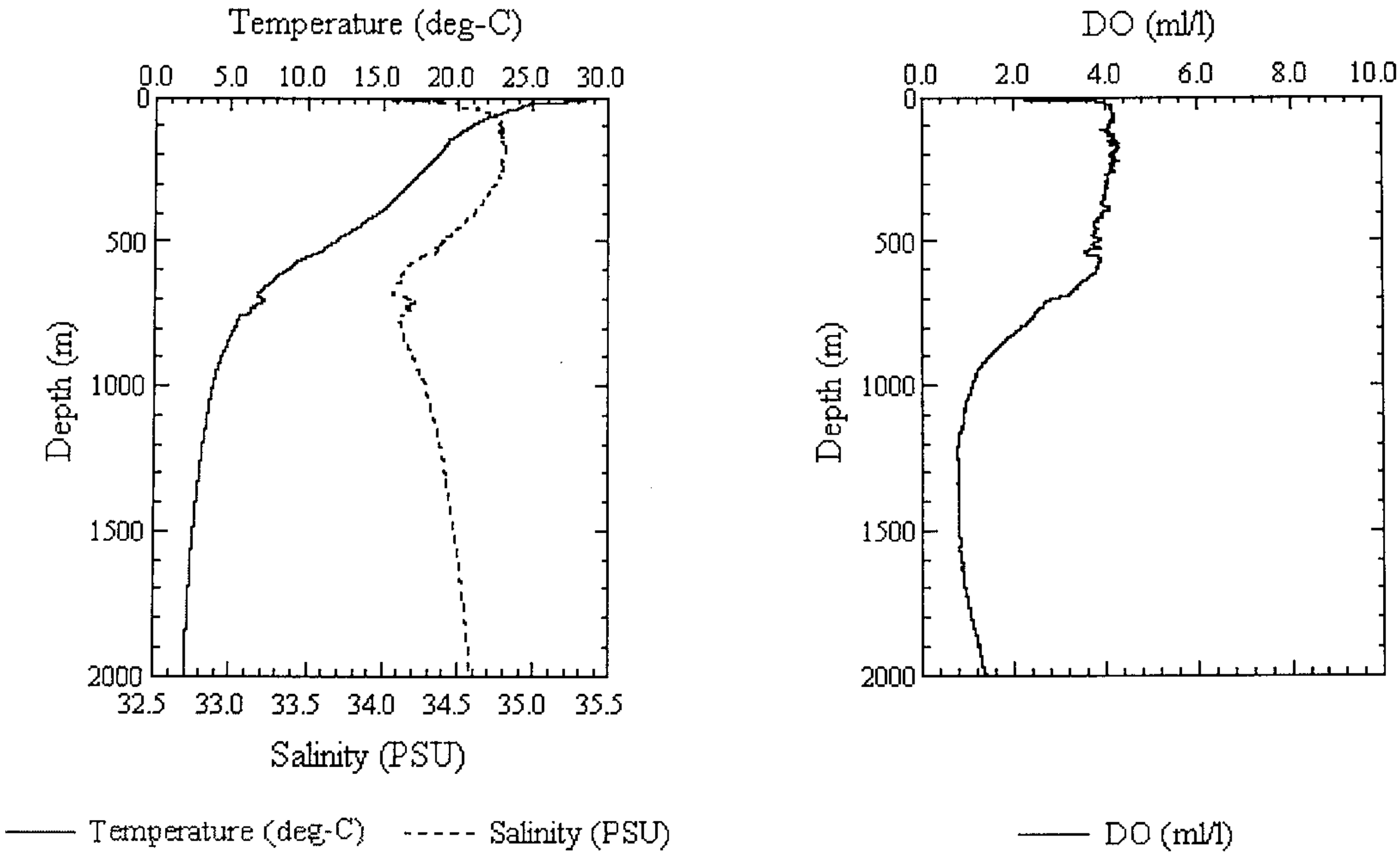

Fig. 2.1.12 CTD profile at St.A13

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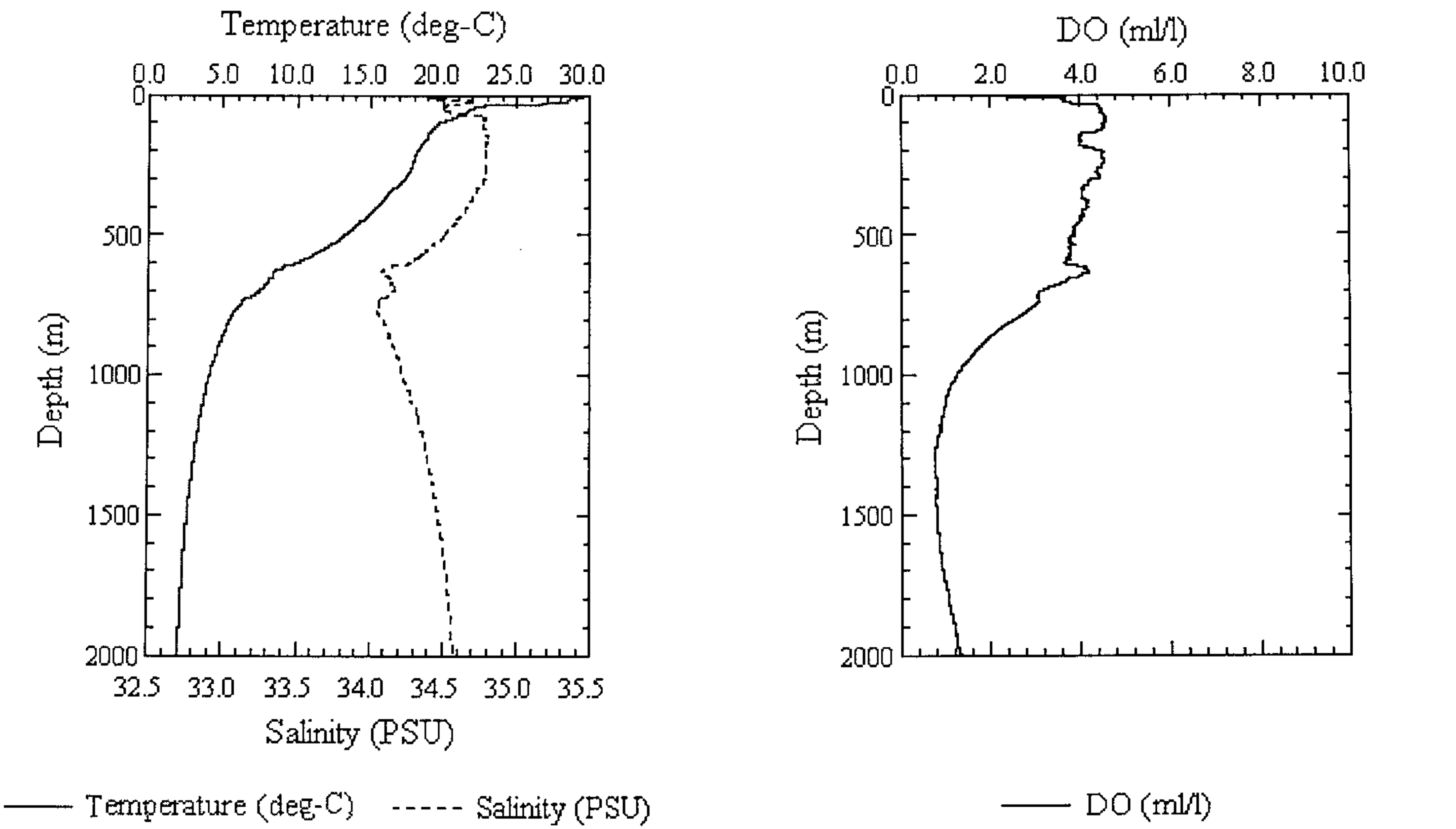

Fig. 2.1.13 CTD profile at St.A14

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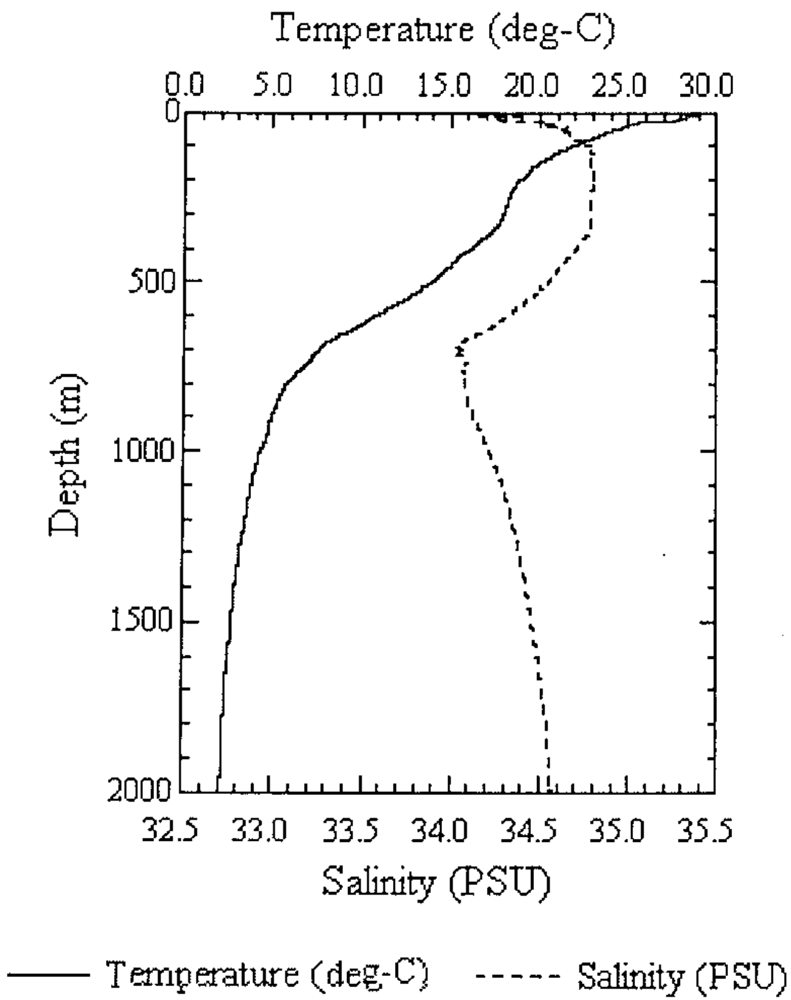

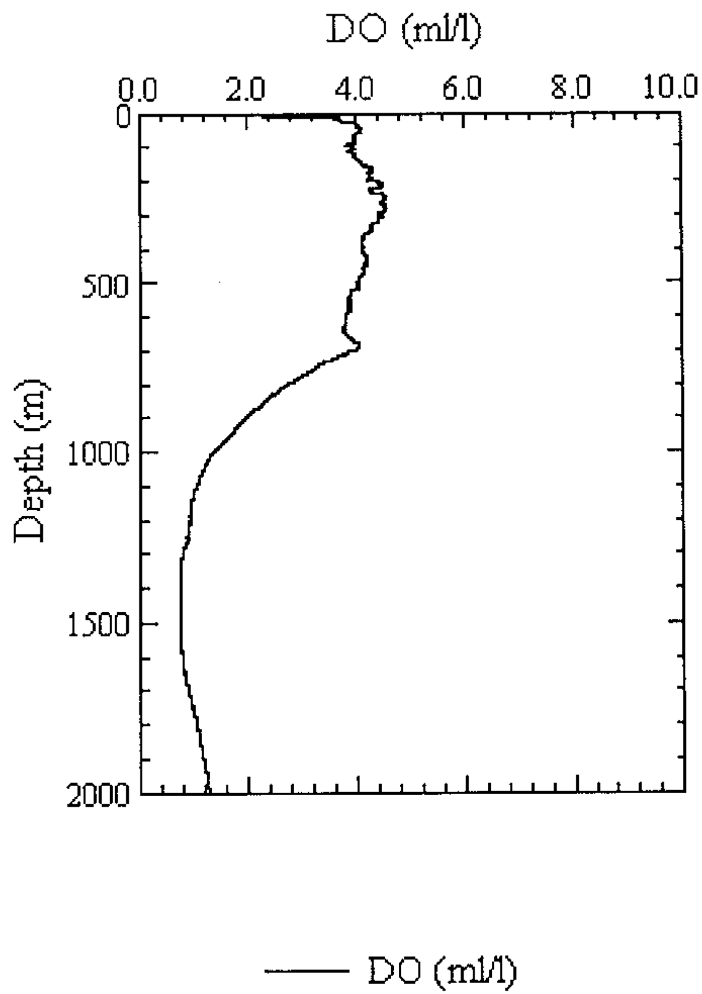

Fig. 2.1.14 CTD profile at St.A15

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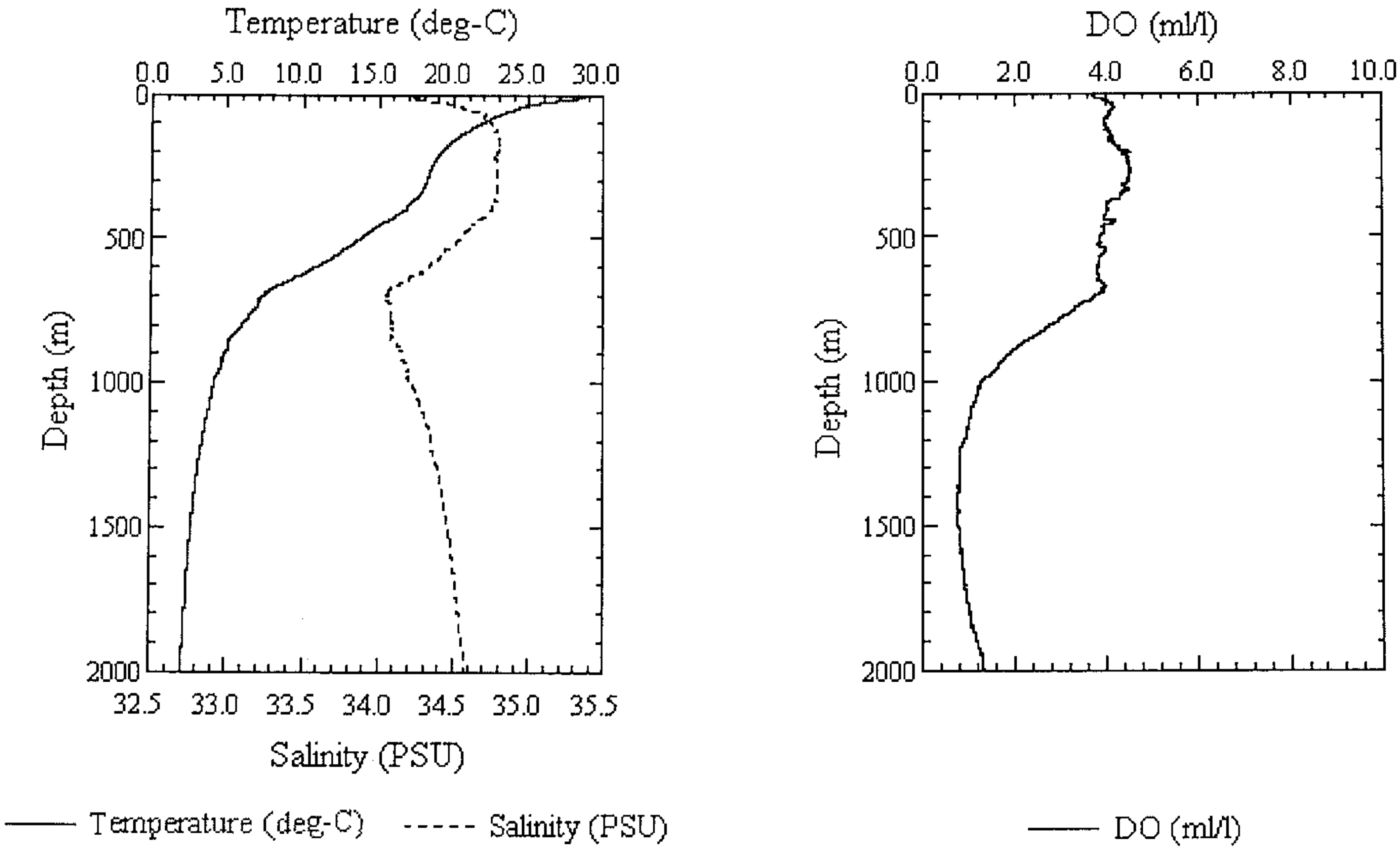

Fig. 2.1.15 CTD profile at St.A16

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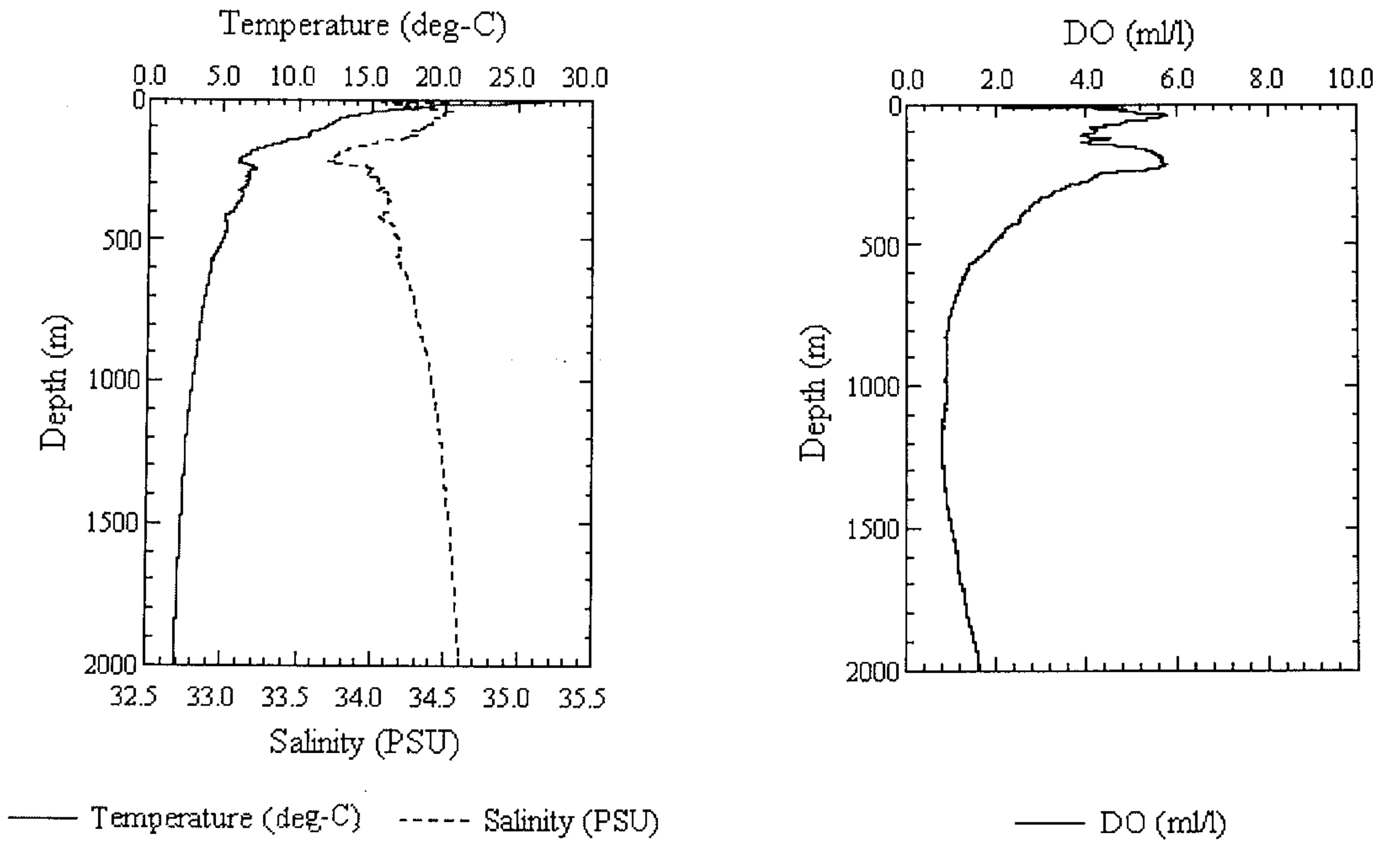


Fig. 2.1.16 CTD profile at St.G11

MWJ

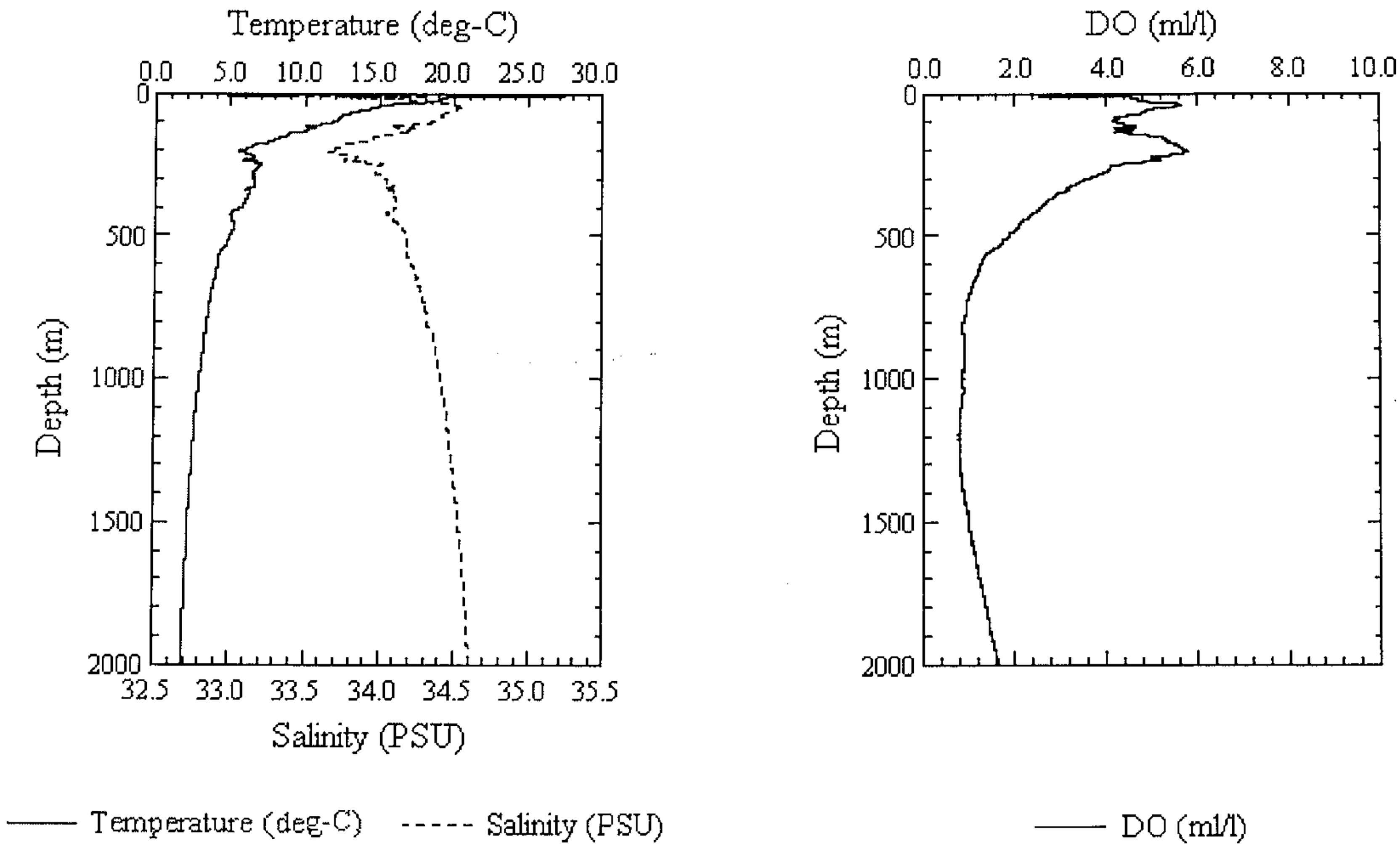
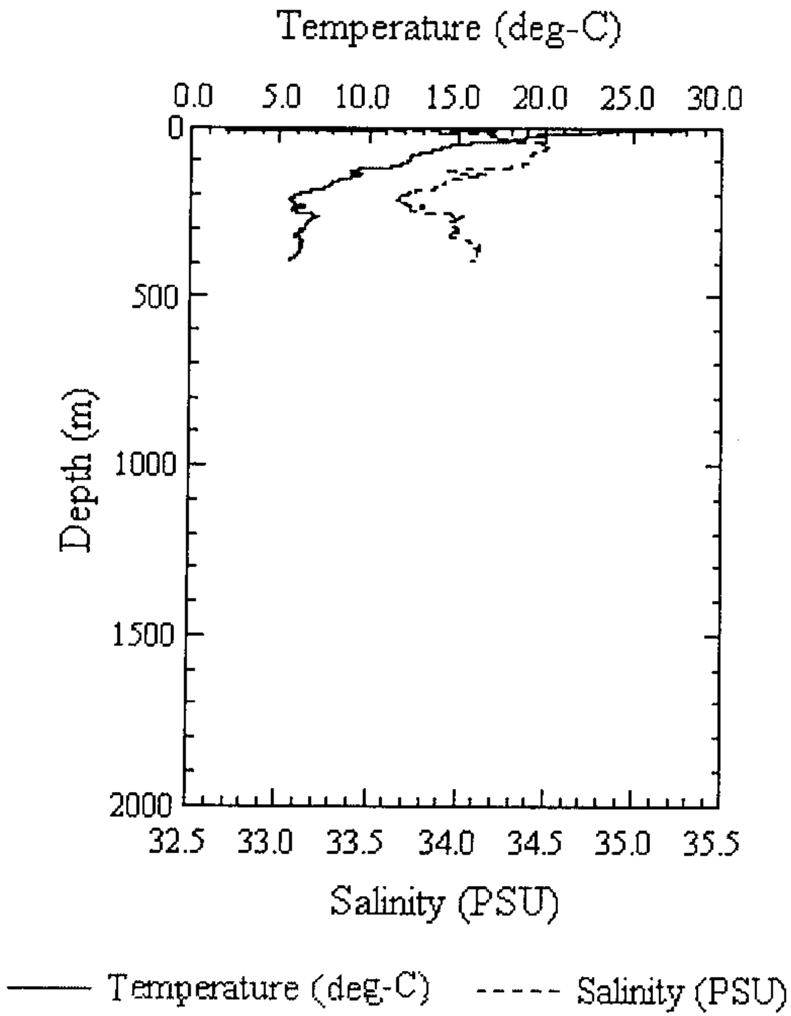


Fig. 2.1.17 CTD profile at St. G12

MWJ



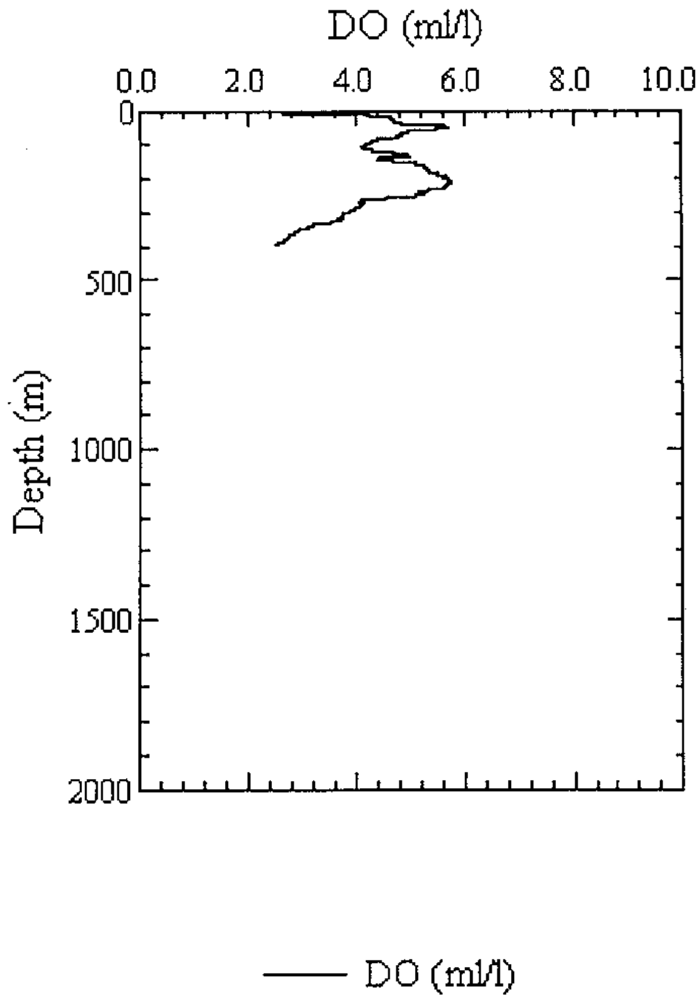


Fig. 2.1.18 CTD profile at St.G13

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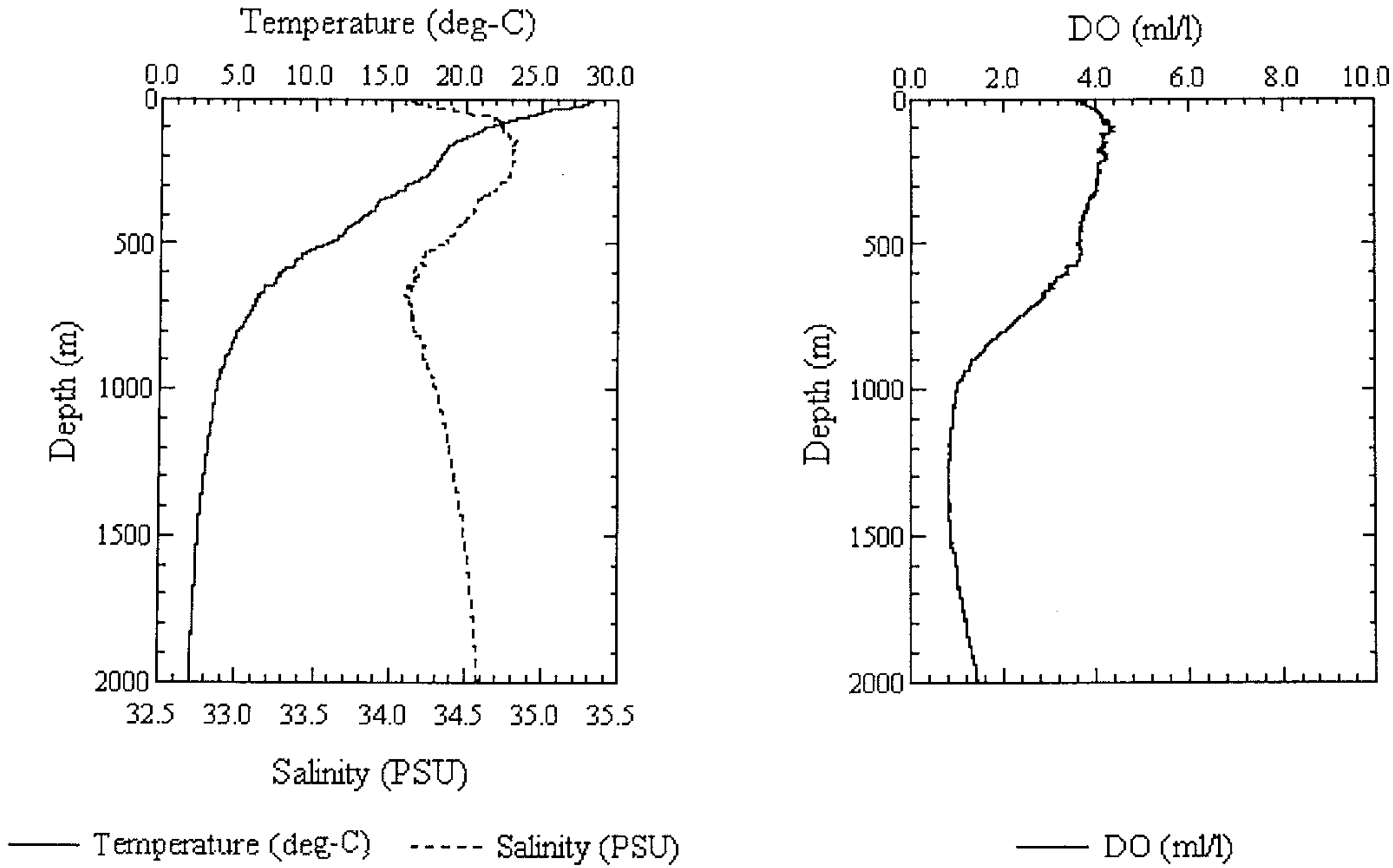

Fig. 2.1.19 CTD profile at St. G31A

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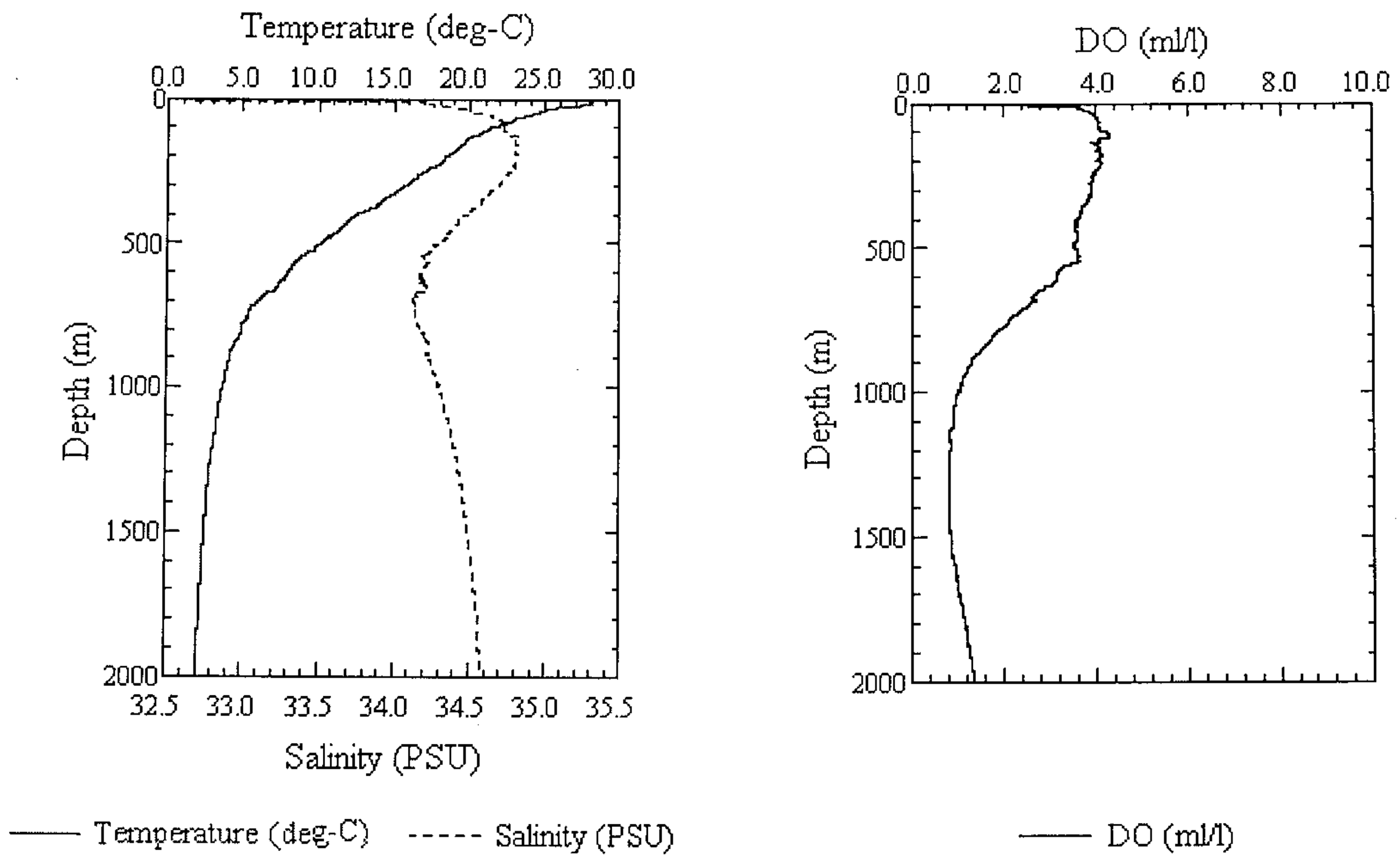

Fig. 2.1.20 CTD profile at St. G32

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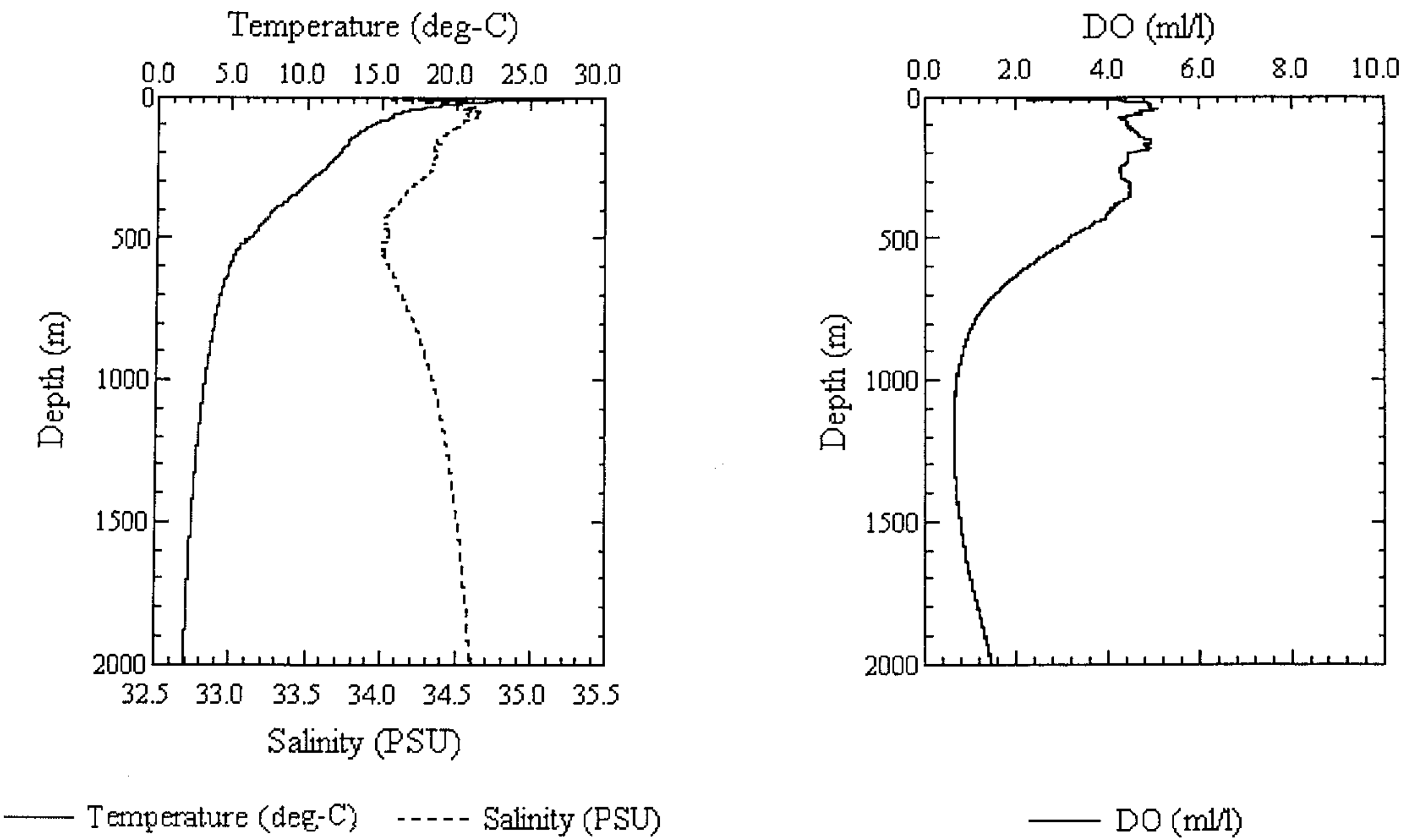

Fig. 2.1.21 CTD profile at St.B01

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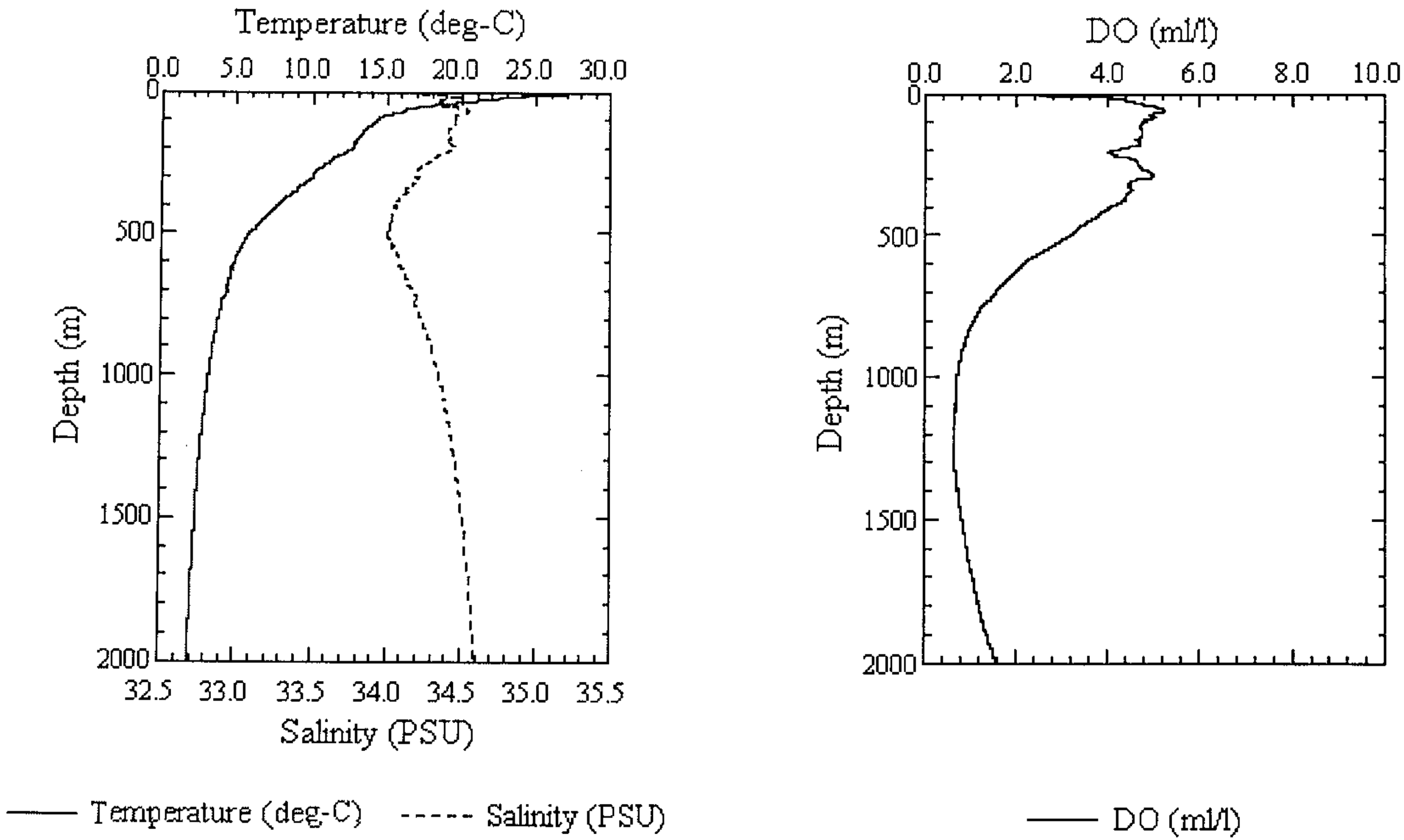

Fig. 2.1.22 CTD profile at St.B02

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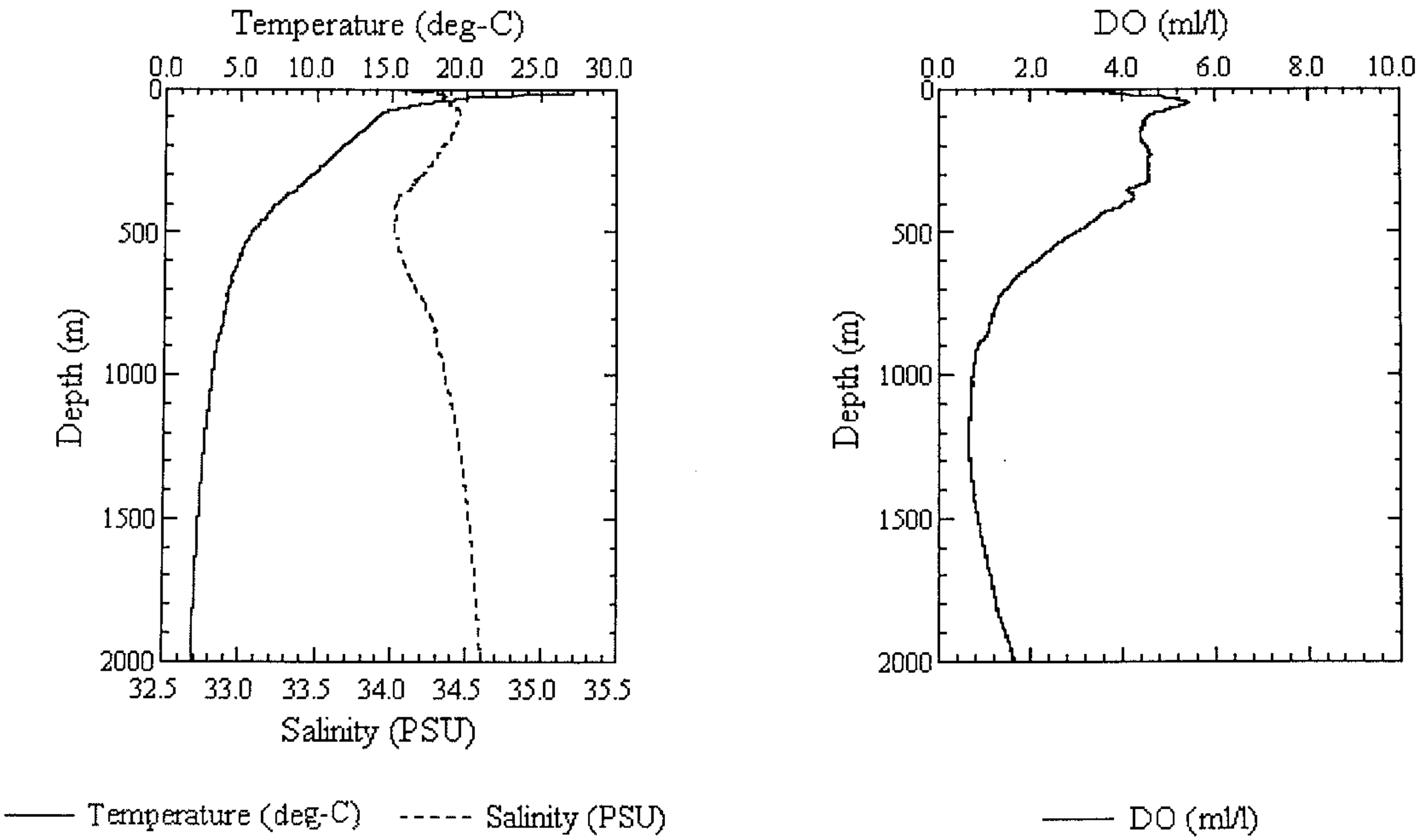

Fig. 2.1.23 CTD profile at St.B03

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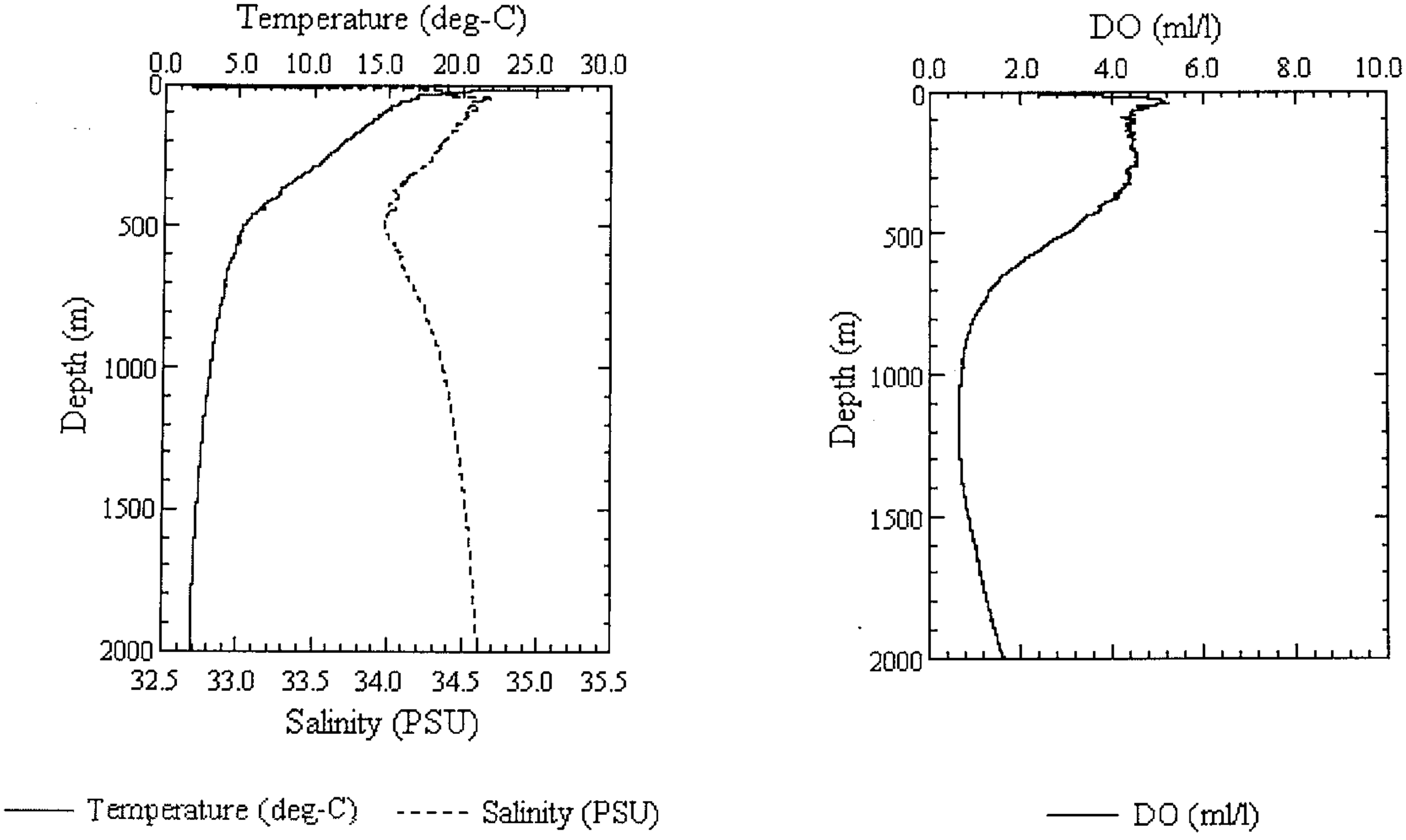

Fig. 2.1.24 CTD profile at St.B04

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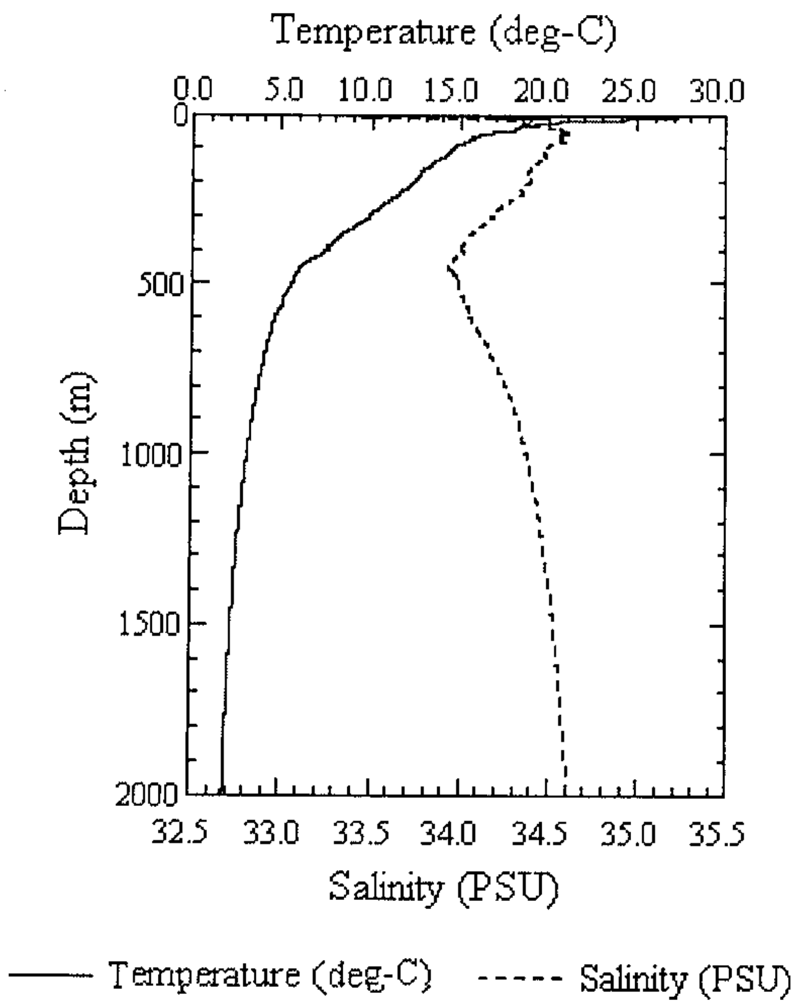

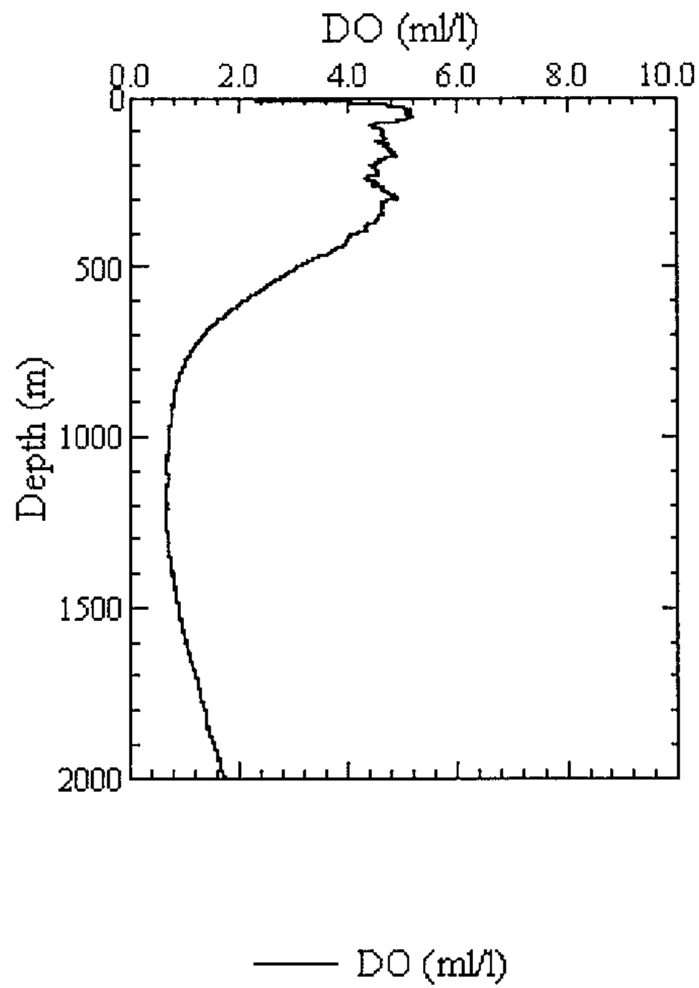

Fig. 2.1.25 CTD profile at St.B05

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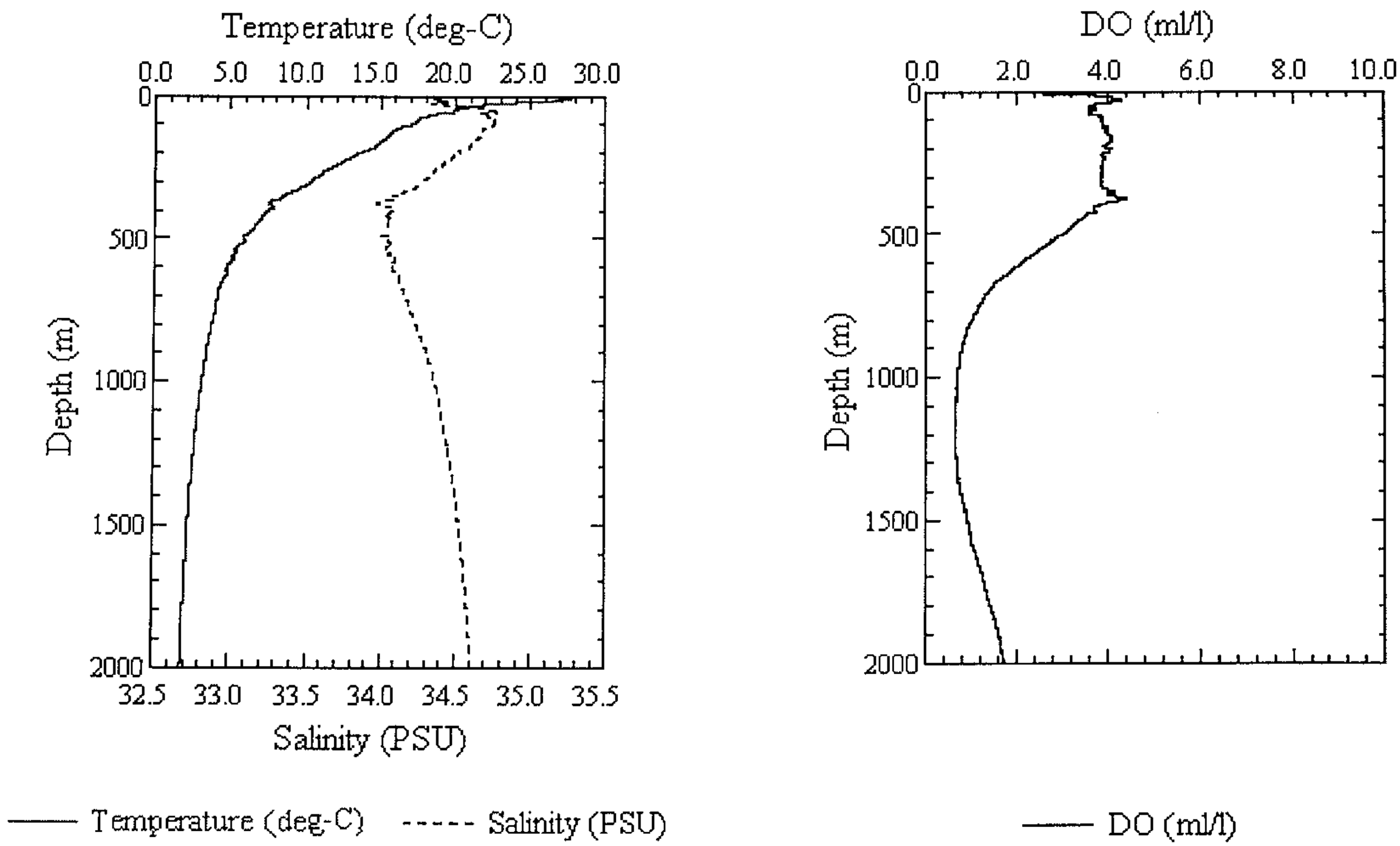

Fig. 2.1.26 CTD profile at St.B06

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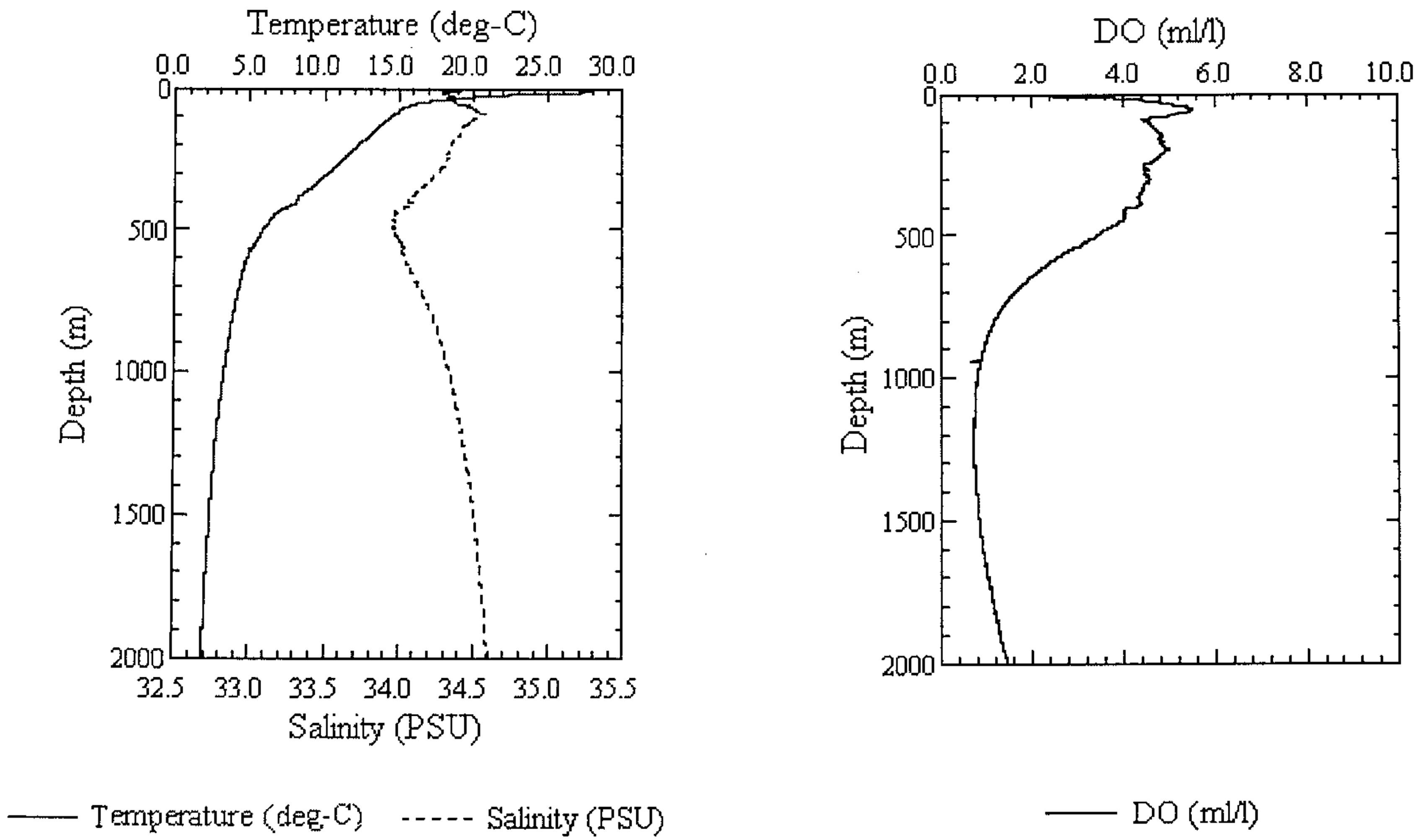

Fig. 2.1.27 CTD profile at St.B07

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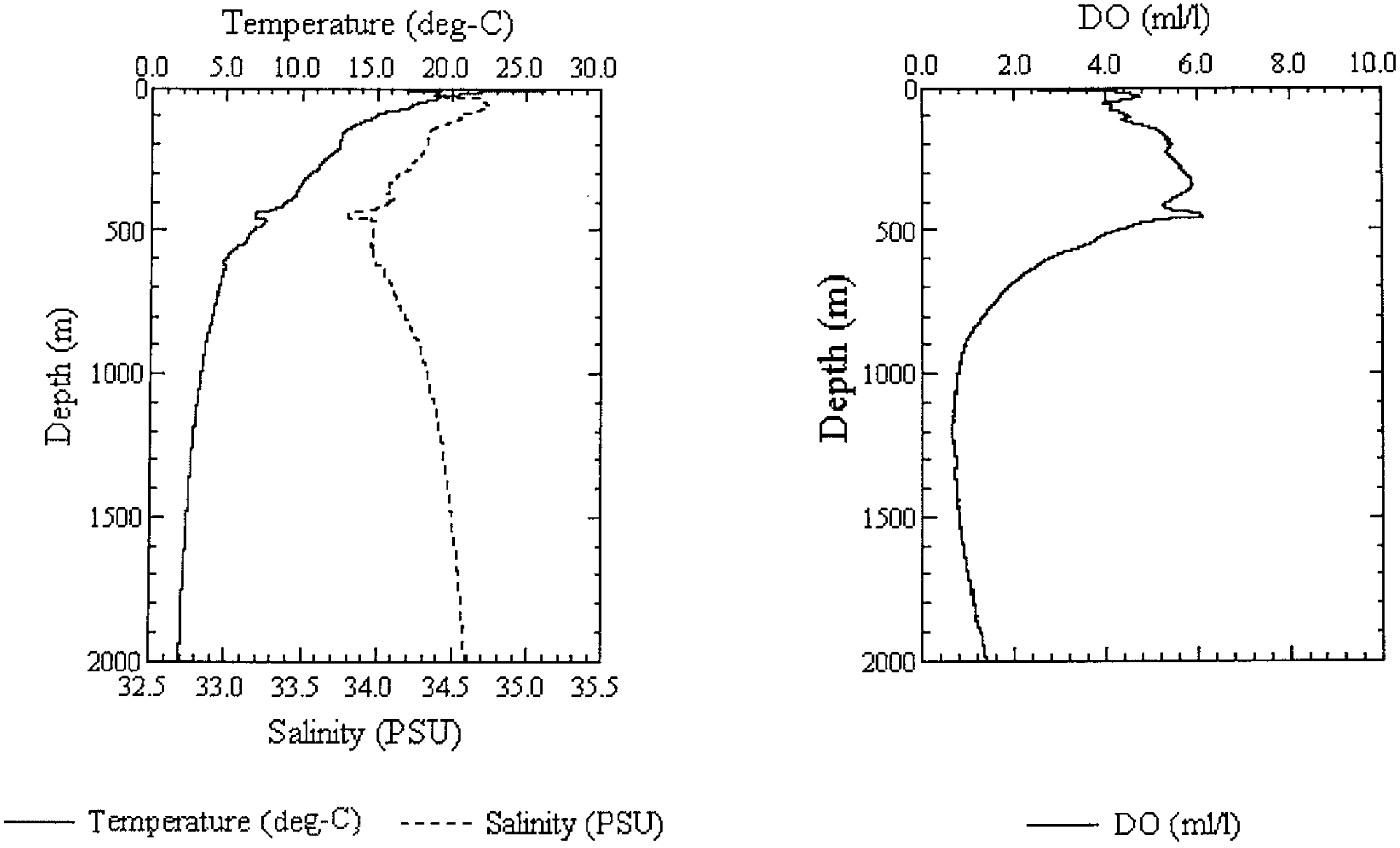

Fig. 2.1.28 CTD profile at St.B08

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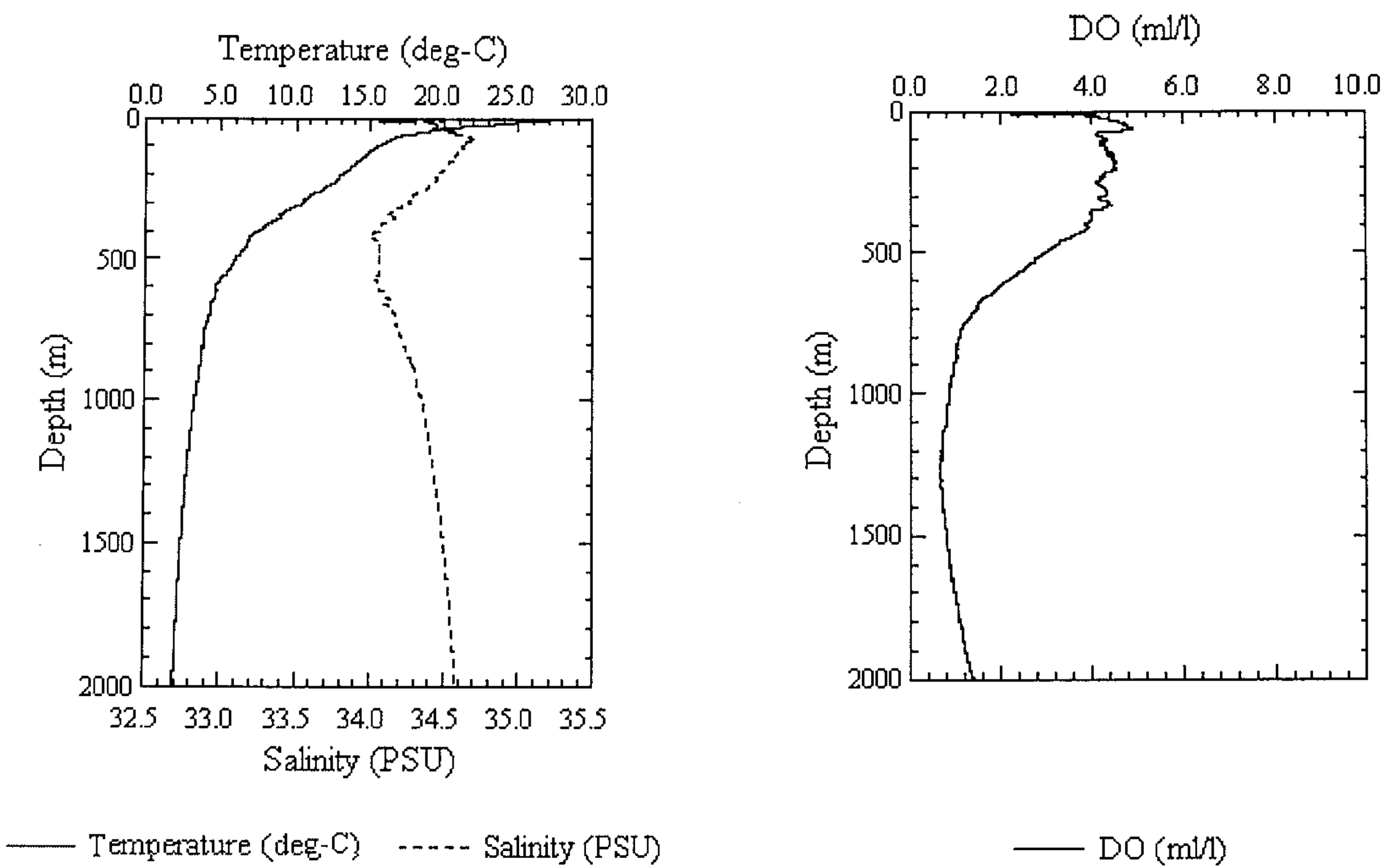

Fig. 2.1.29 CTD profile at St.B09

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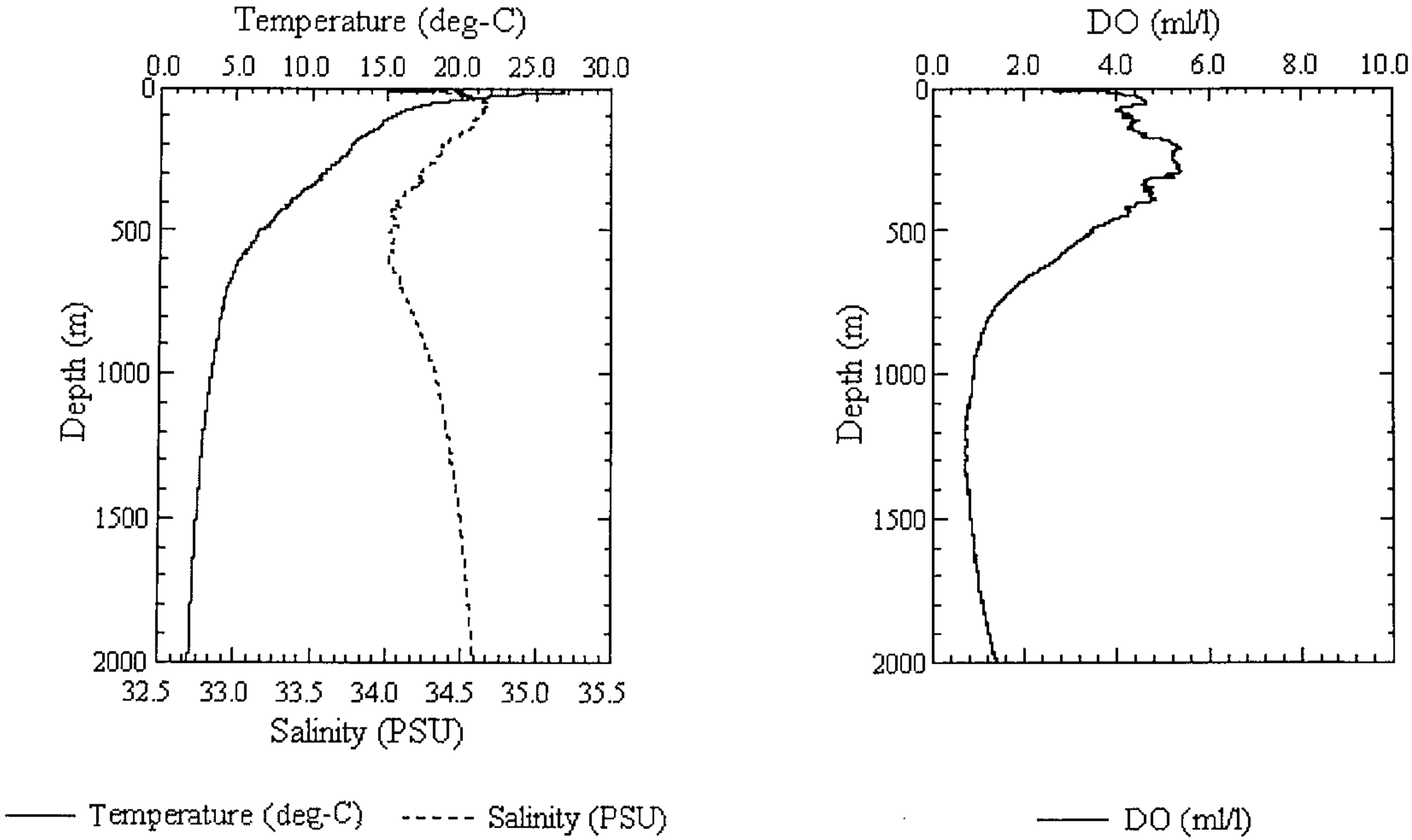

Fig. 2.1.30 CTD profile at St.B10

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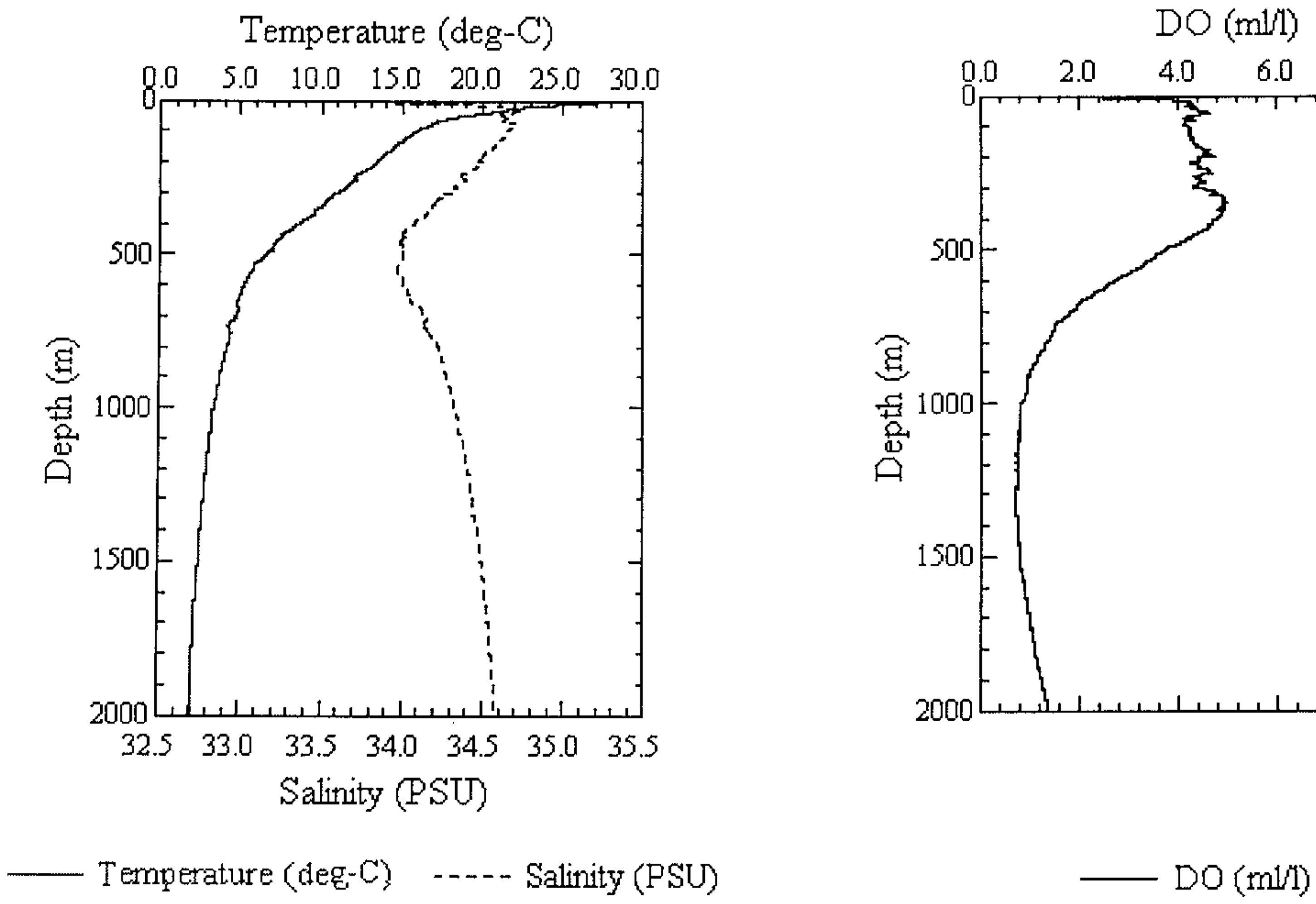

Fig. 2.1.31 CTD profile at St.B11

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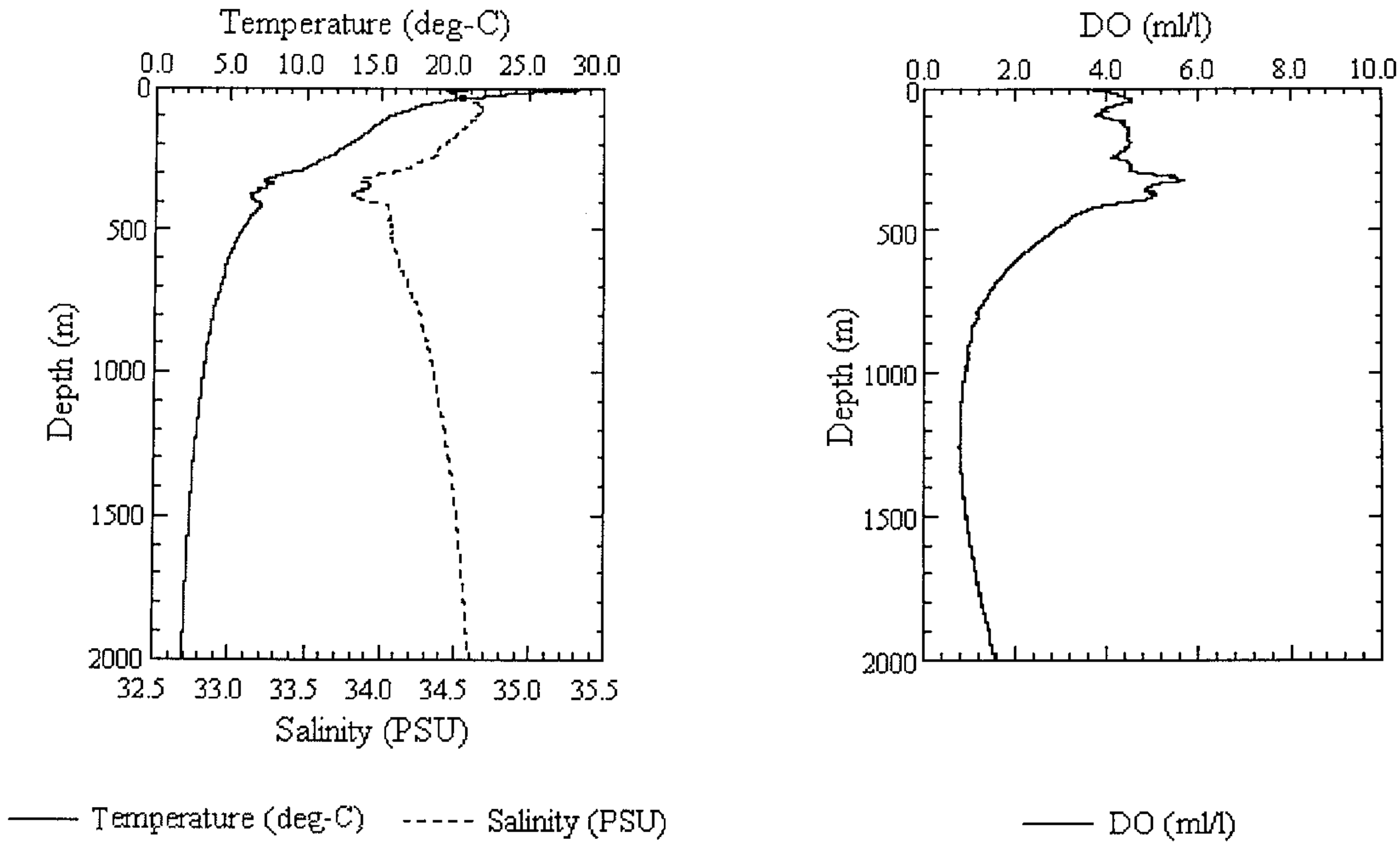

Fig. 2.1.32 CTD profile at St.B12

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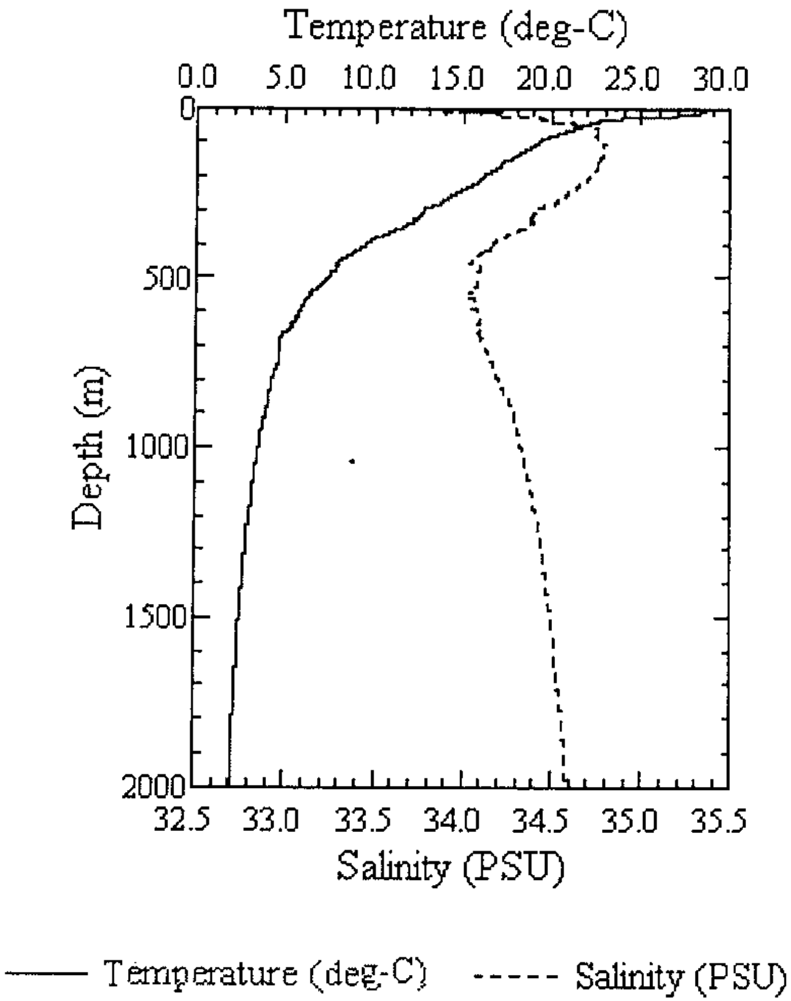

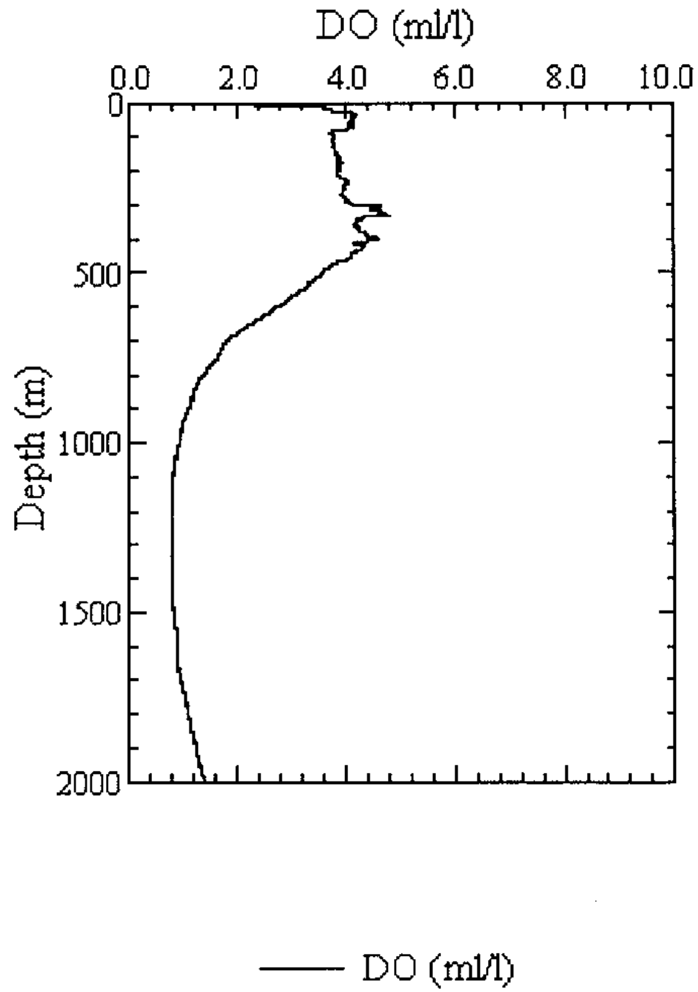

Fig. 2.1.33 CTD profile at St.B13

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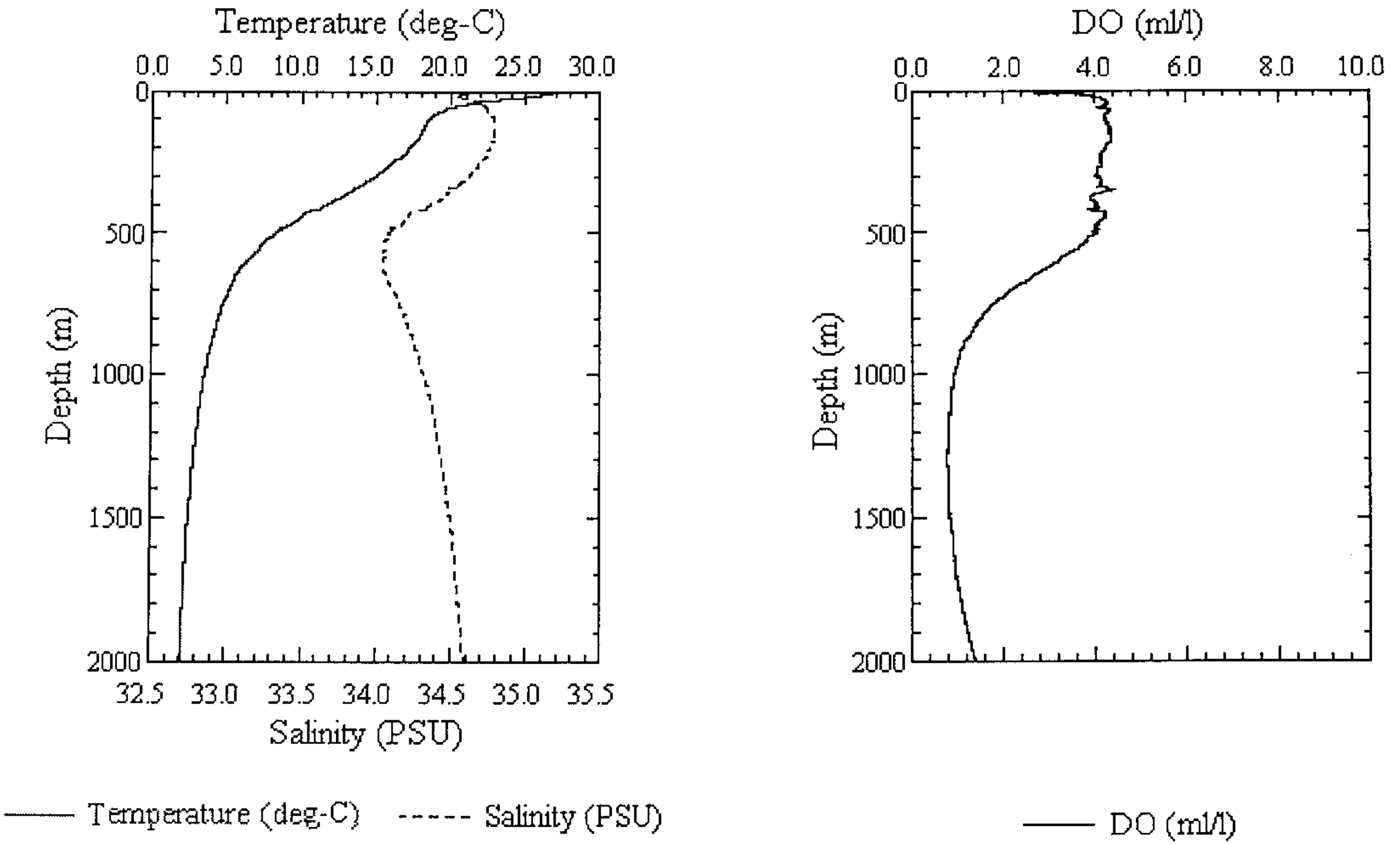

Fig. 2.1.34 CTD profile at St.B14

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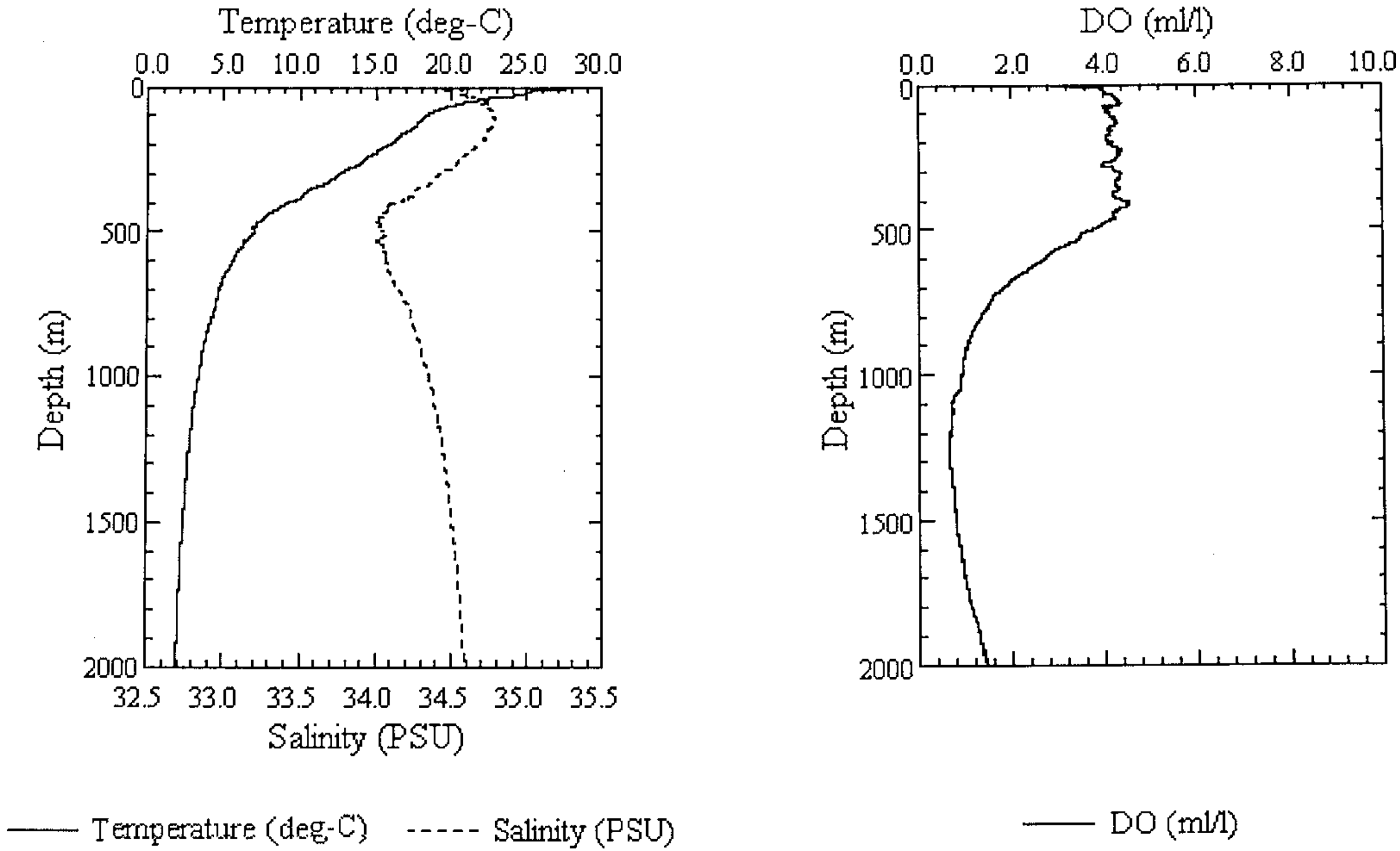

Fig. 2.1.35 CTD profile at St.B15

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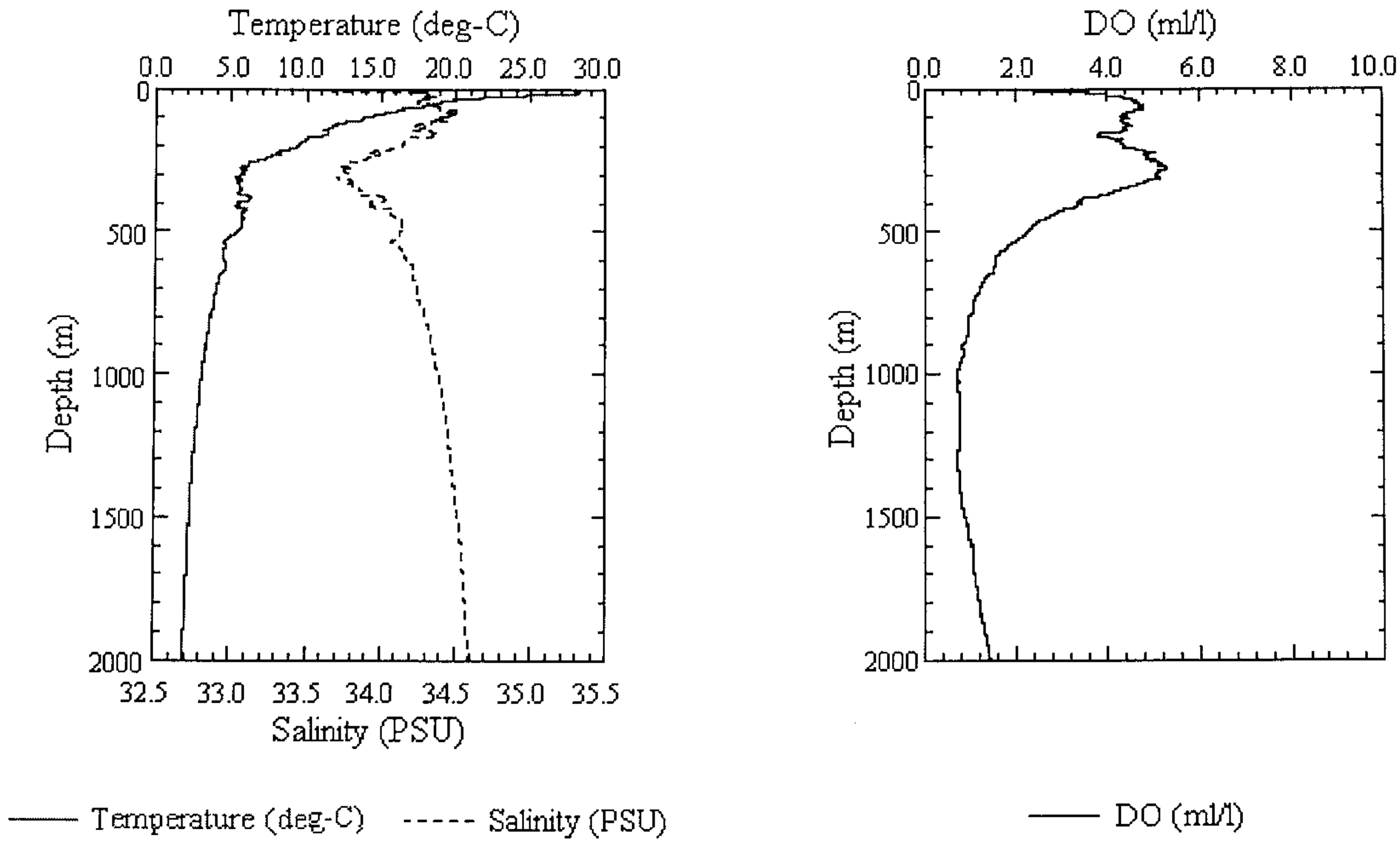

Fig. 2.1.36 CTD profile at St.B16

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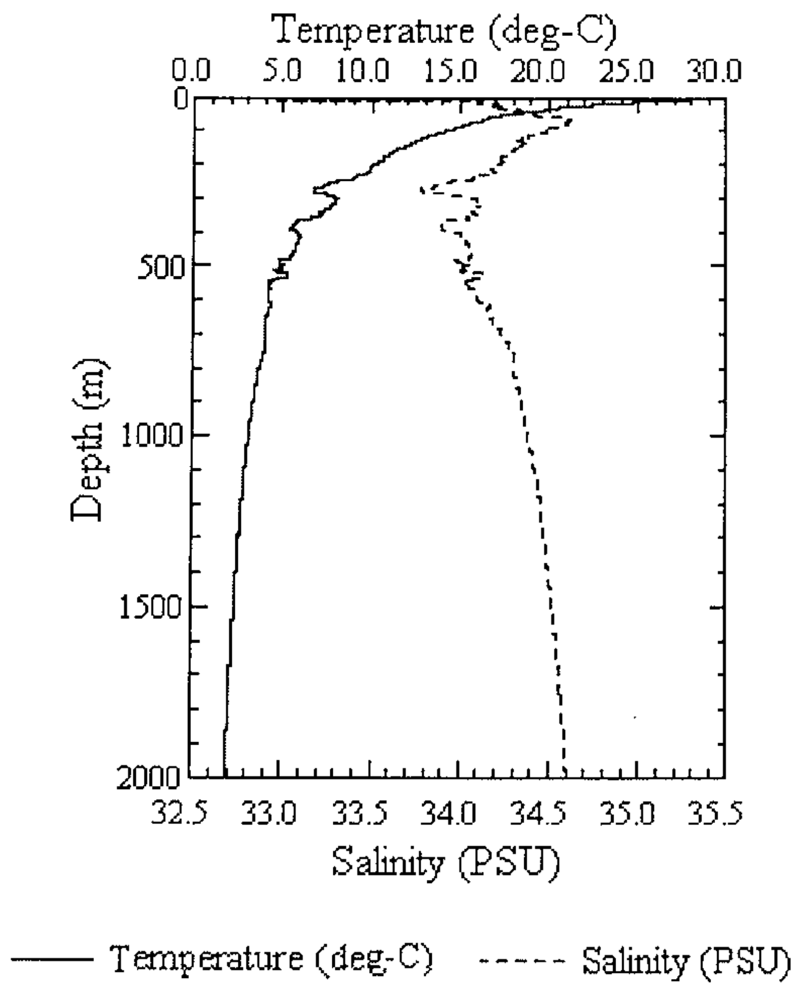

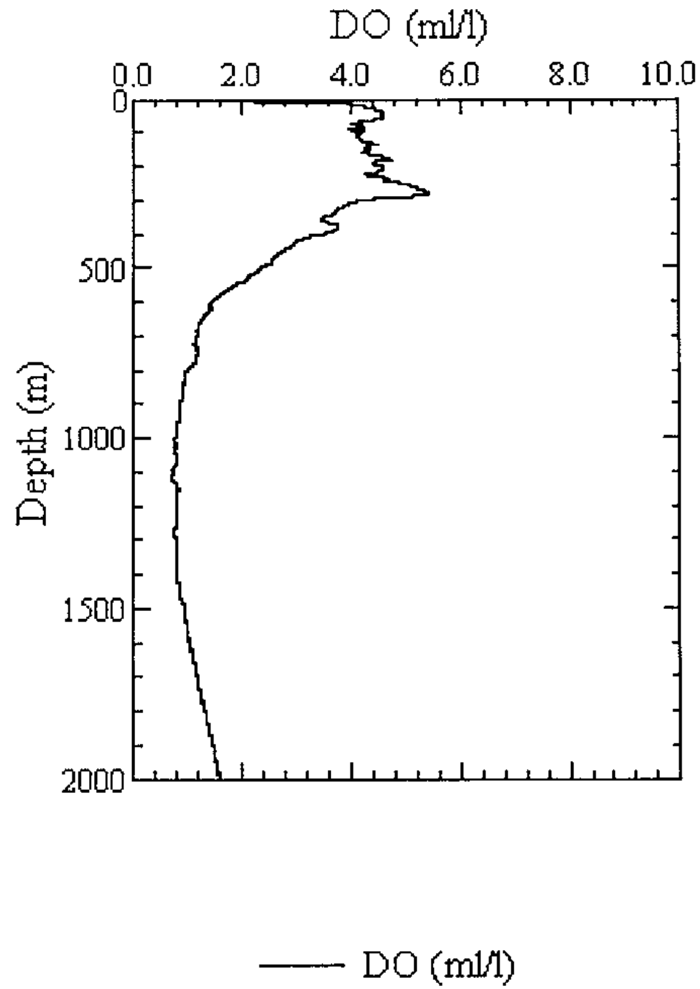

Fig. 2.1.37 CTD profile at St.B17

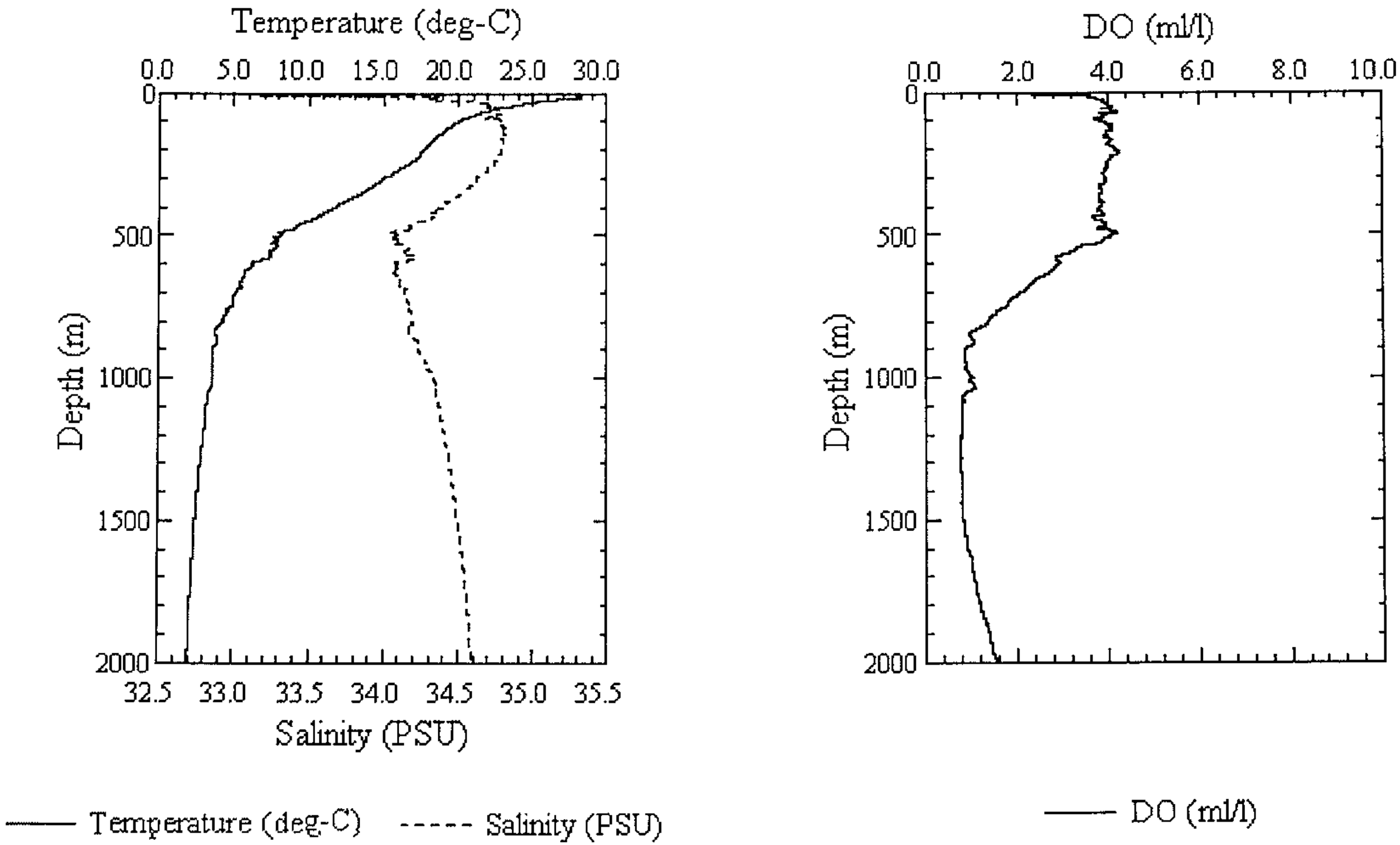

Fig. 2.1.38 CTD profile at St.B18

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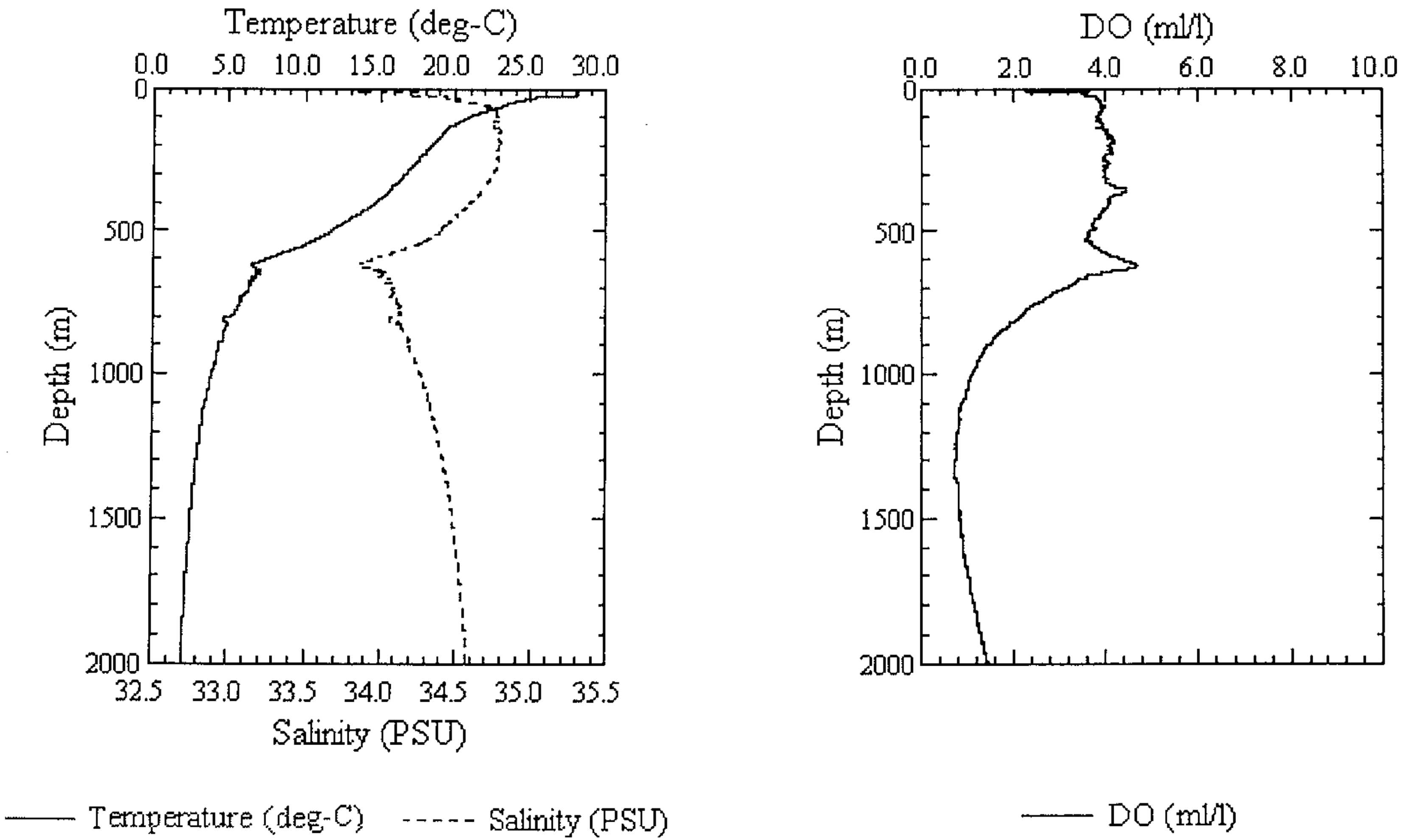

Fig. 2.1.39 CTD profile at St.B19

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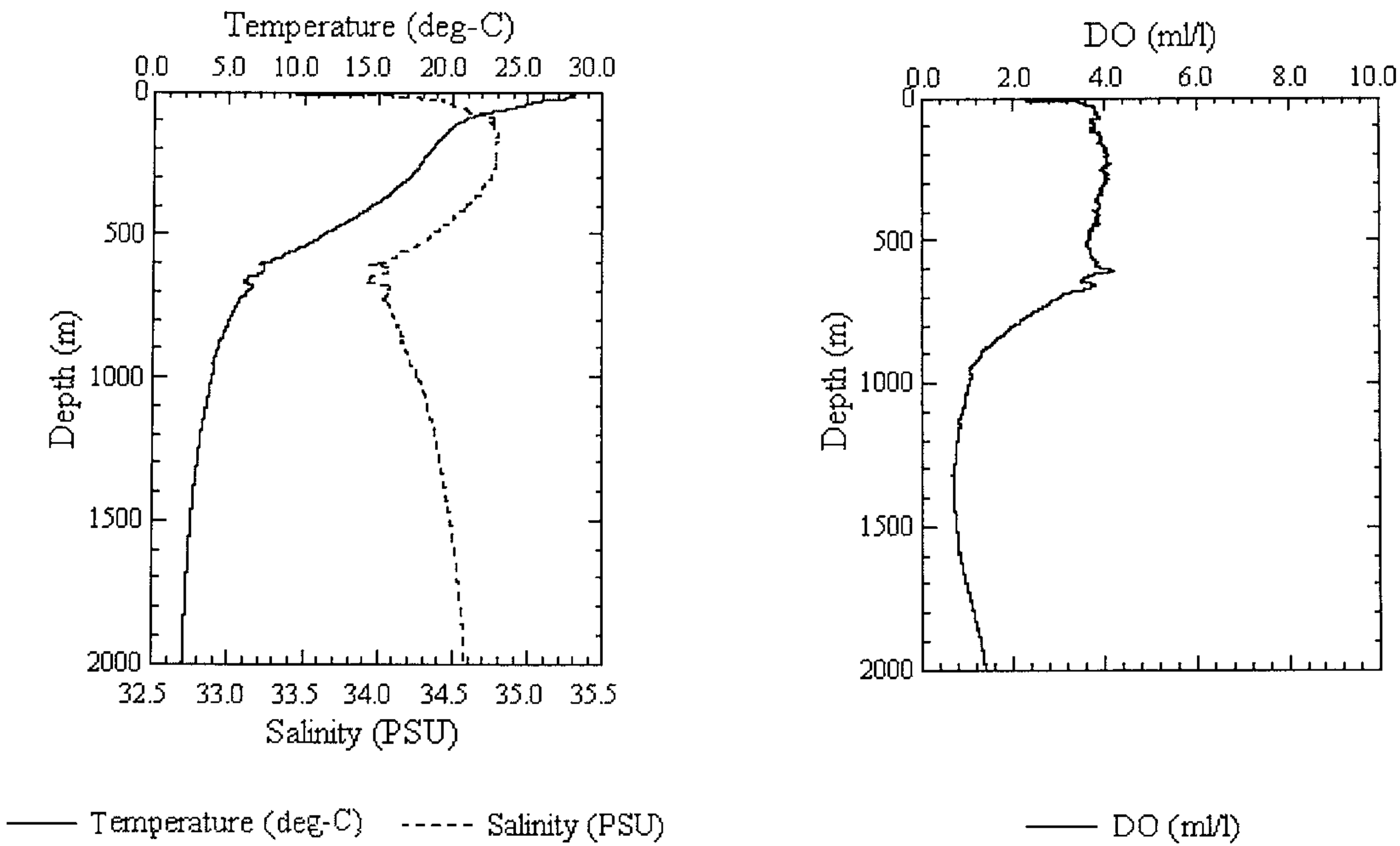

Fig. 2.1.40 CTD profile at St.B20

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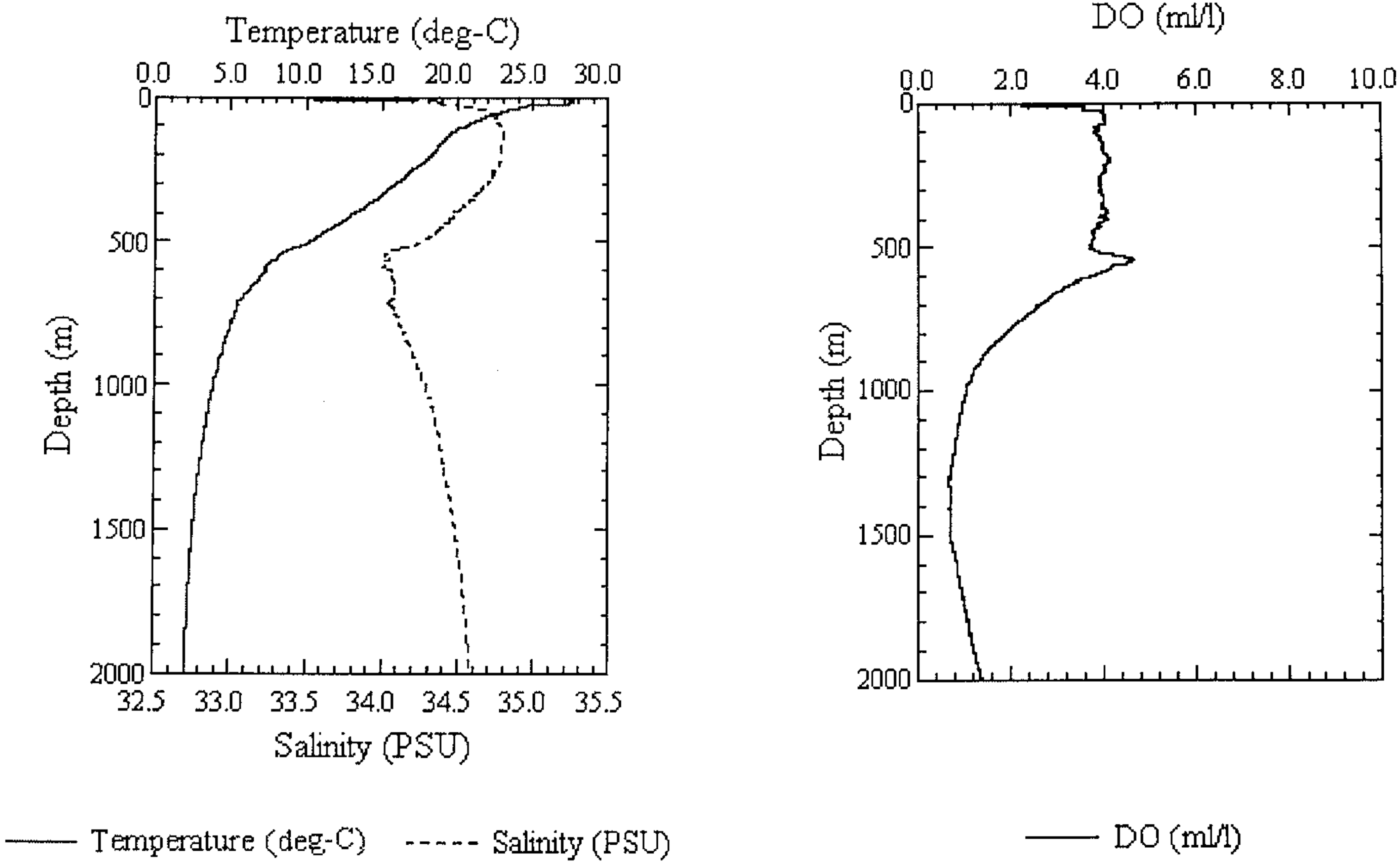

Fig. 2.1.41 CTD profile at St.B21

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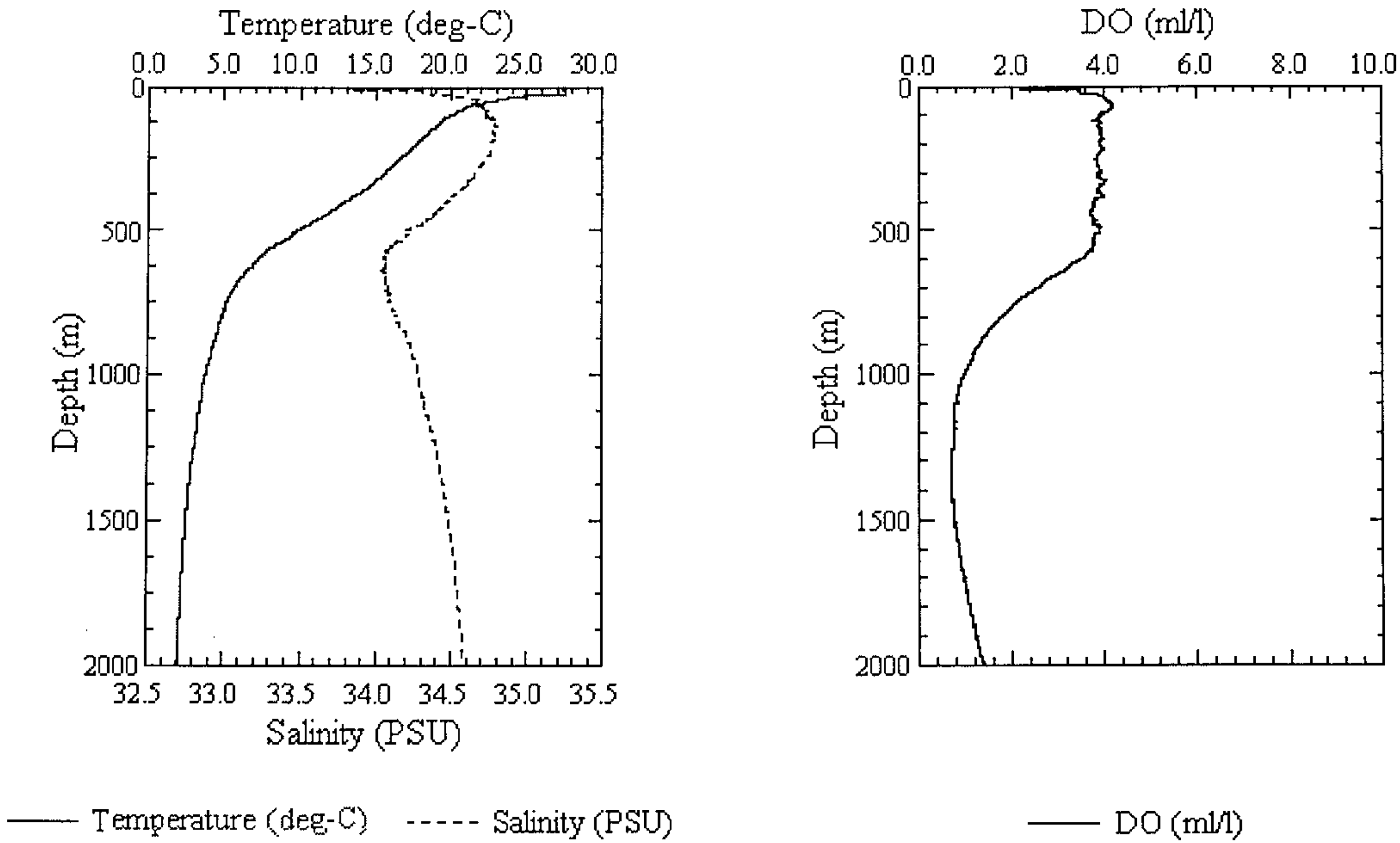

Fig. 2.1.42 CTD profile at St.B22

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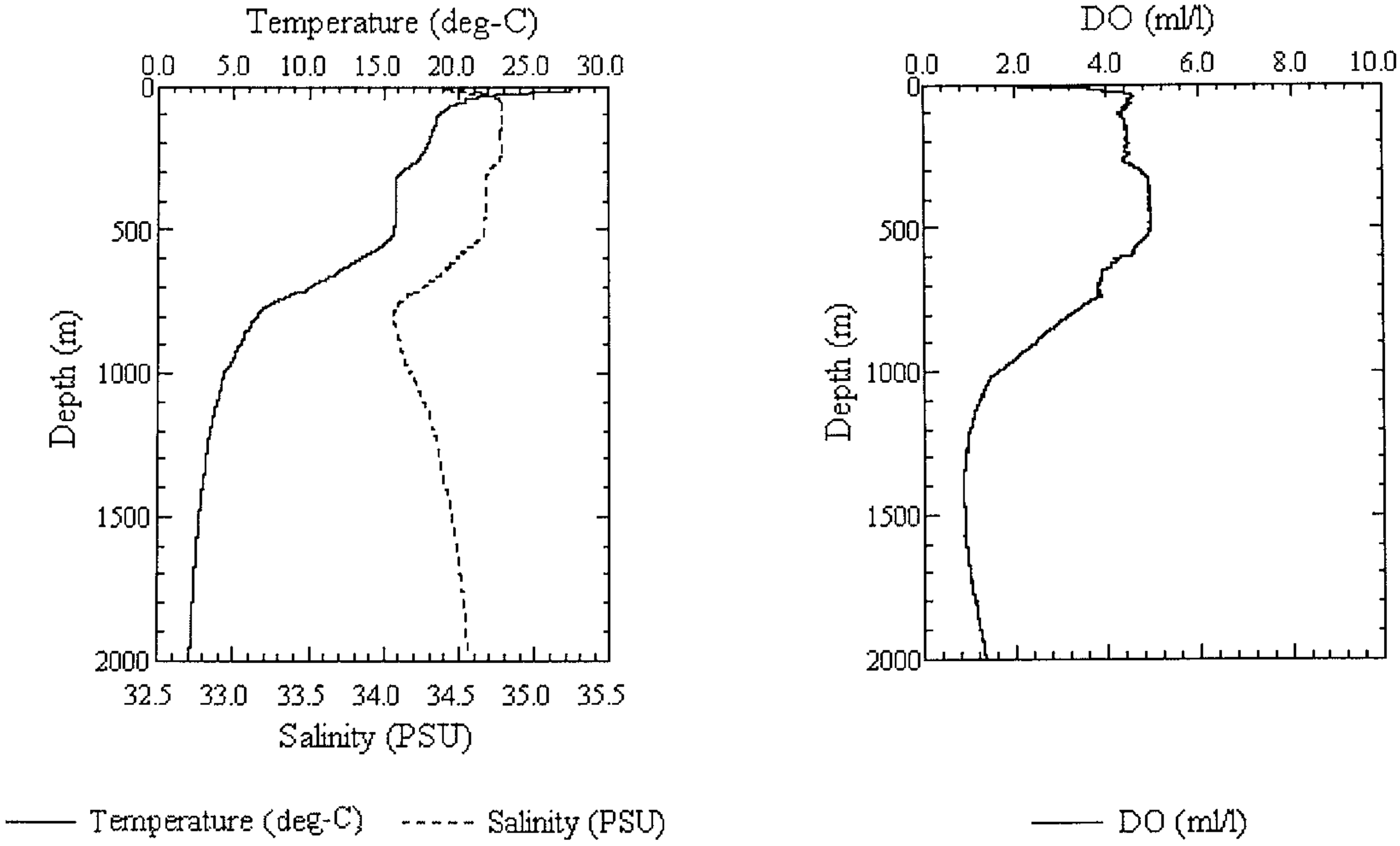
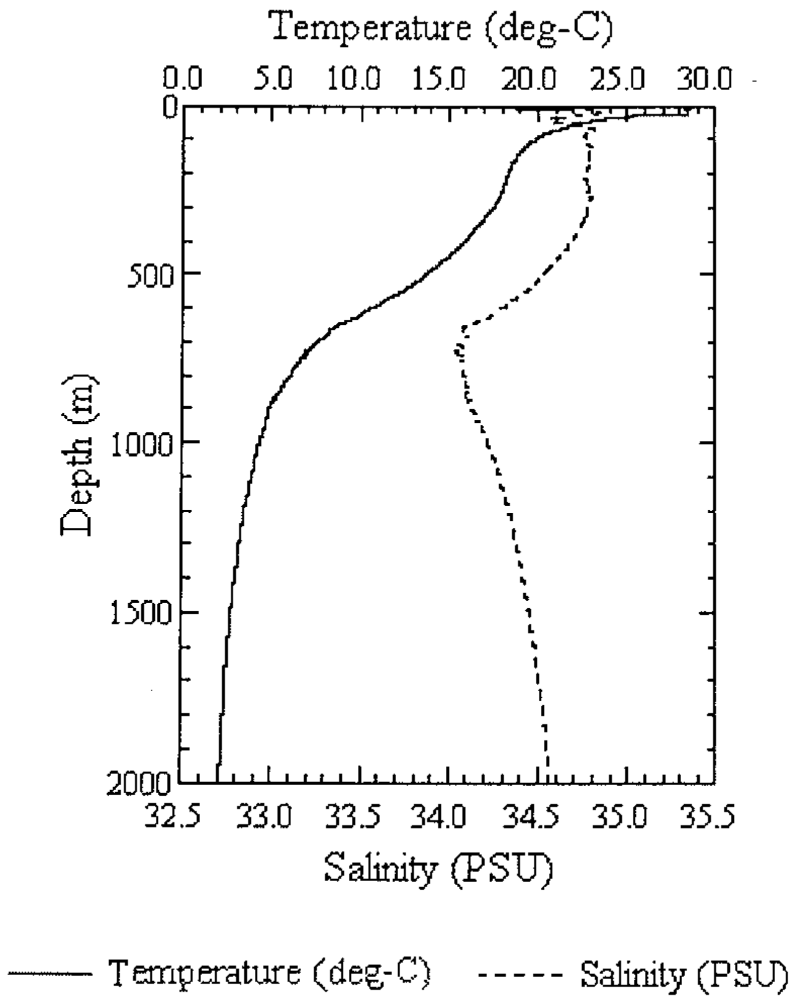


Fig. 2.1.43 CTD profile at St.B23

MWJ



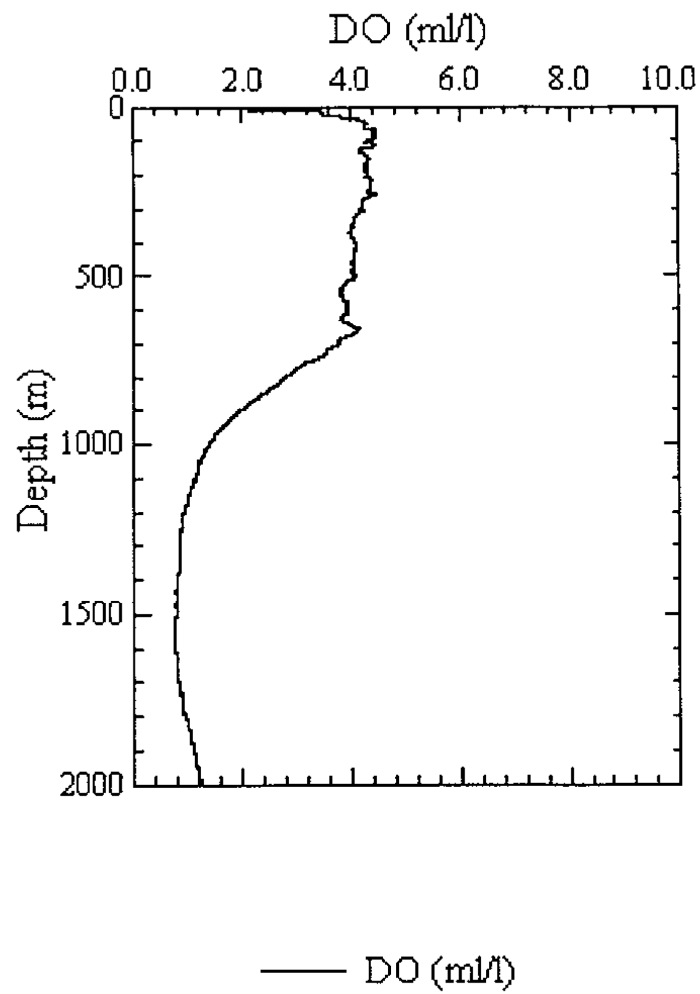


Fig. 2.1.44 CTD profile at St.B24

MWJ

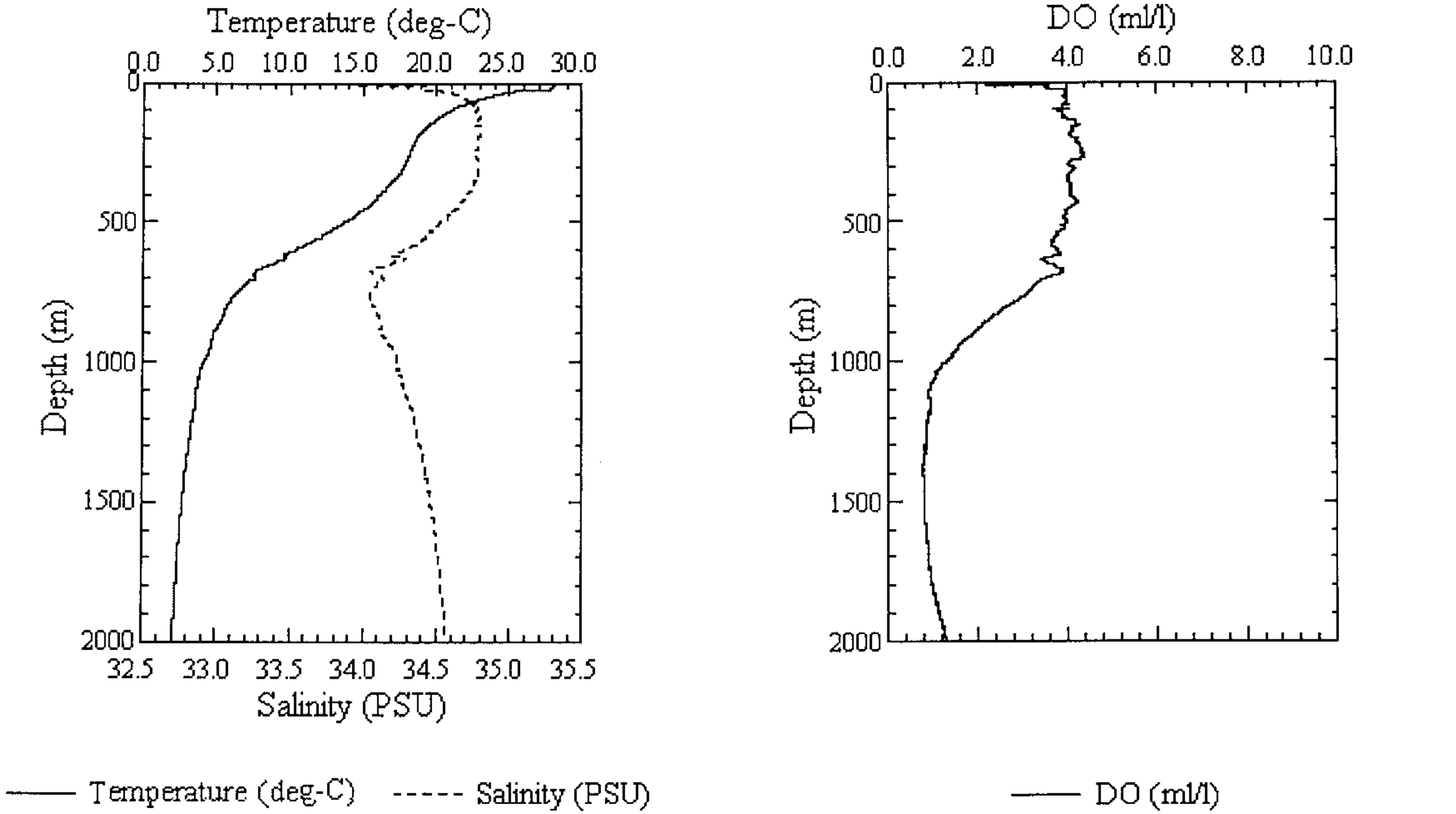
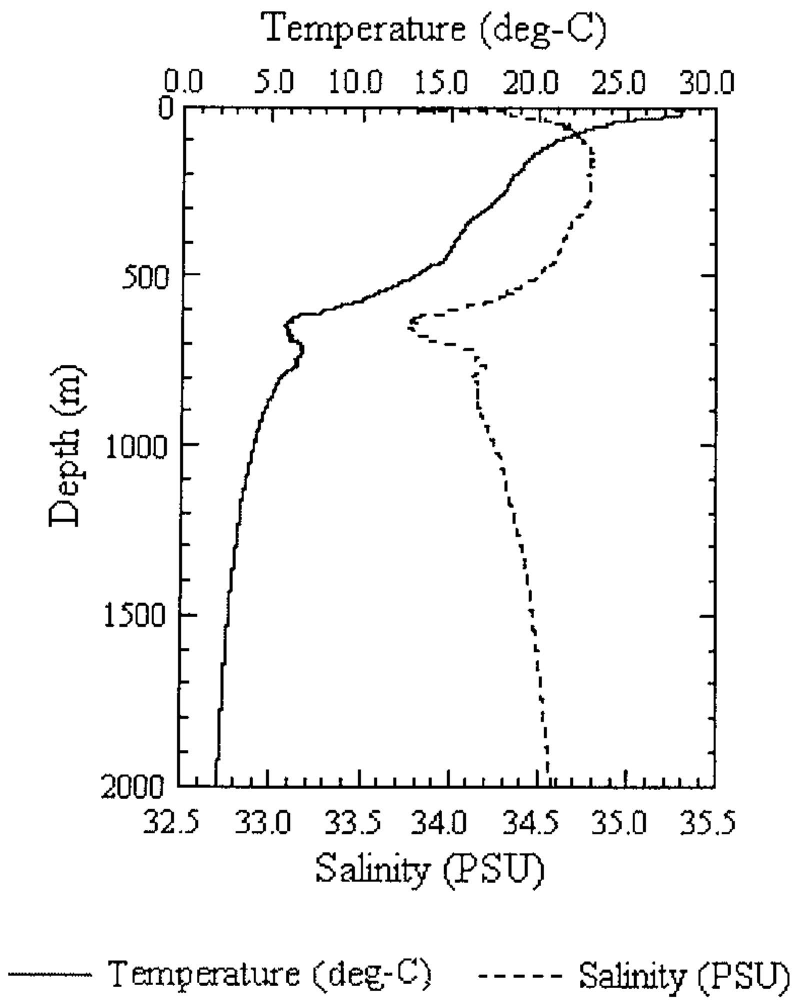


Fig. 2.1.45 CTD profile at St.B25

MWJ



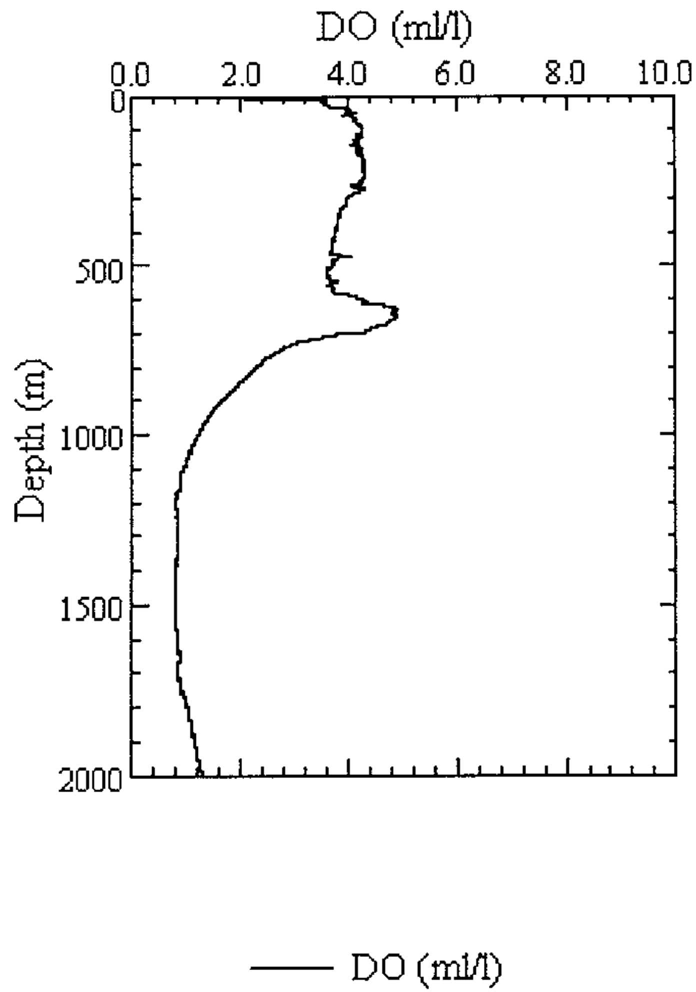


Fig. 2.1.46 CTD profile at St.B26

MWJ

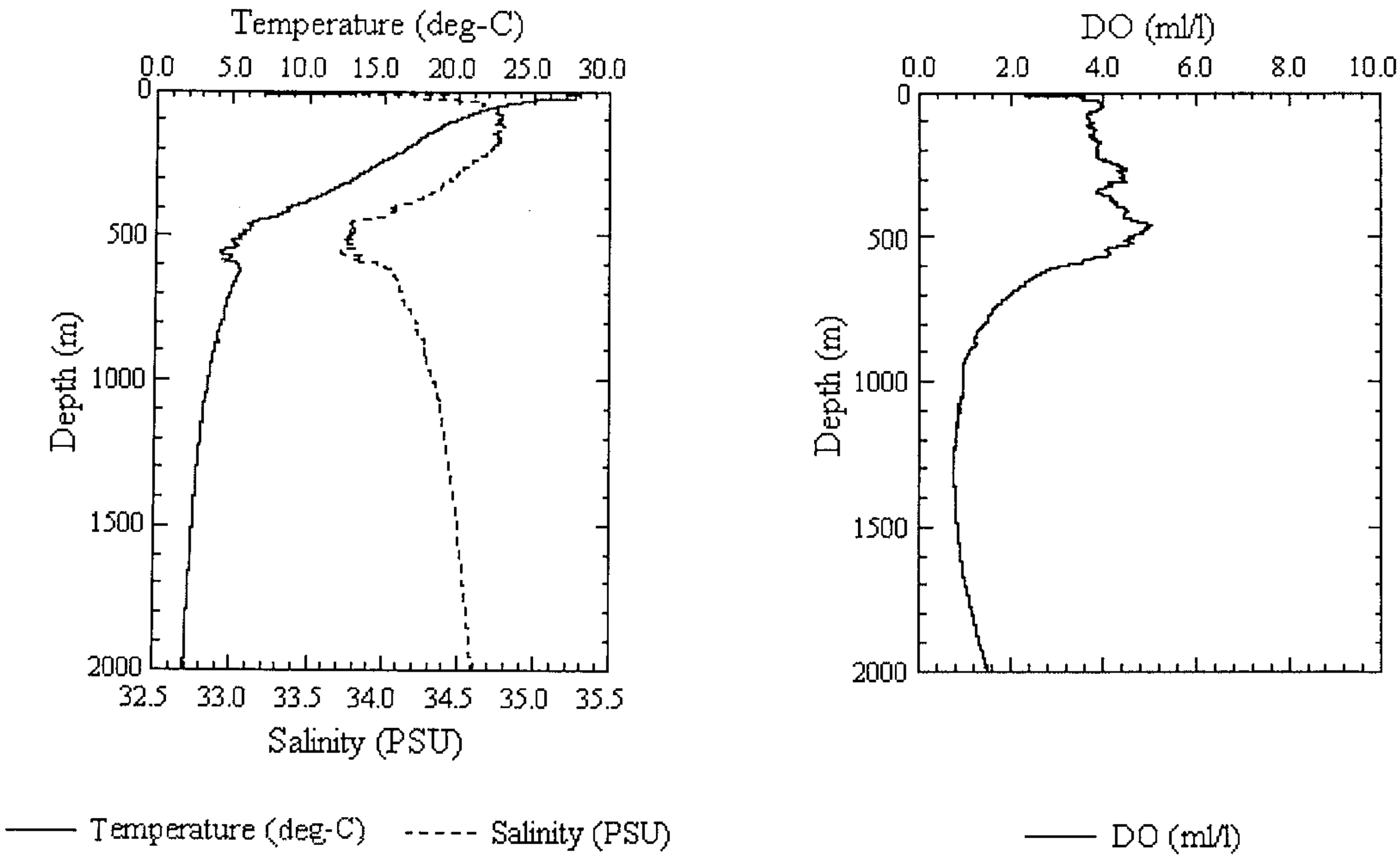
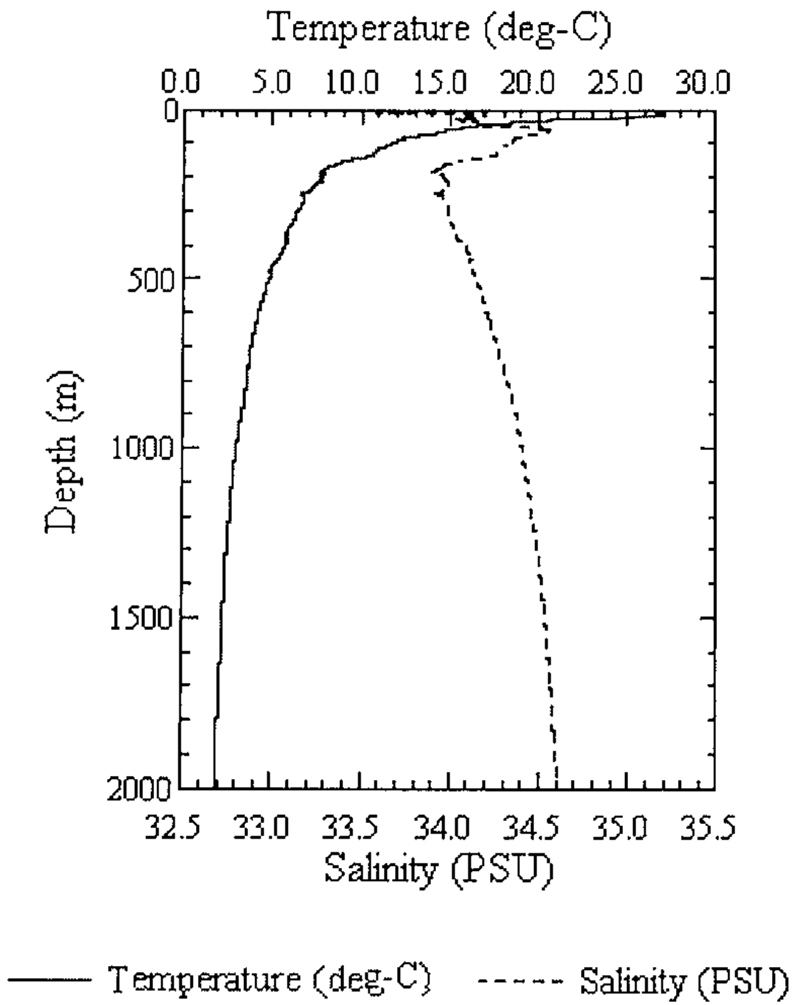


Fig. 2.1.47 CTD profile at St.B27

MWJ



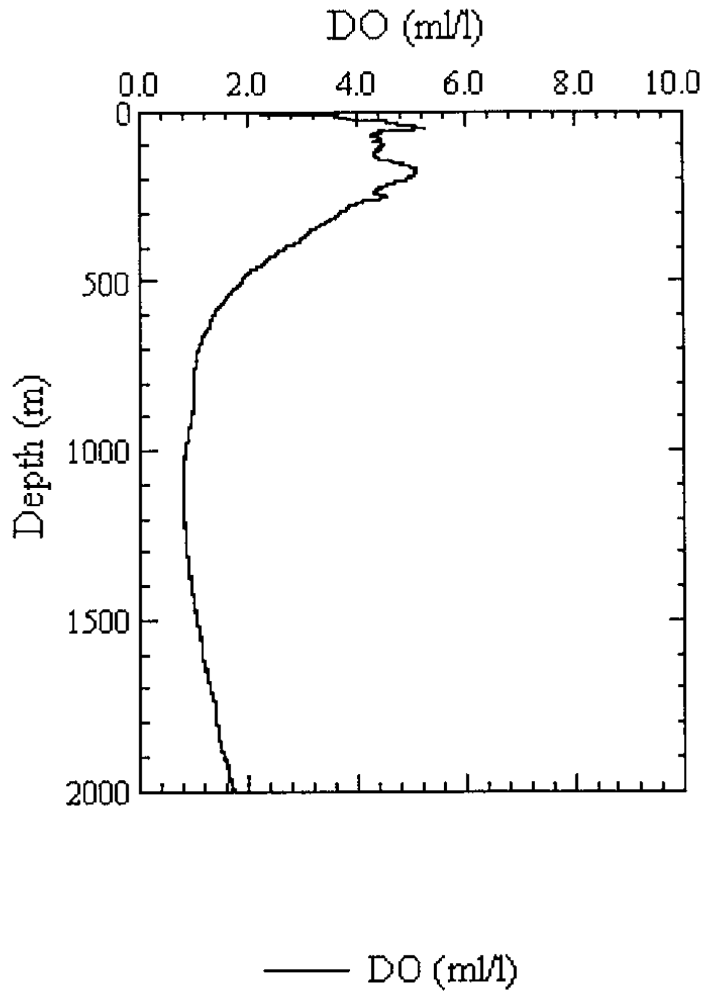


Fig. 2.1.48 CTD profile at St.B28

MWJ

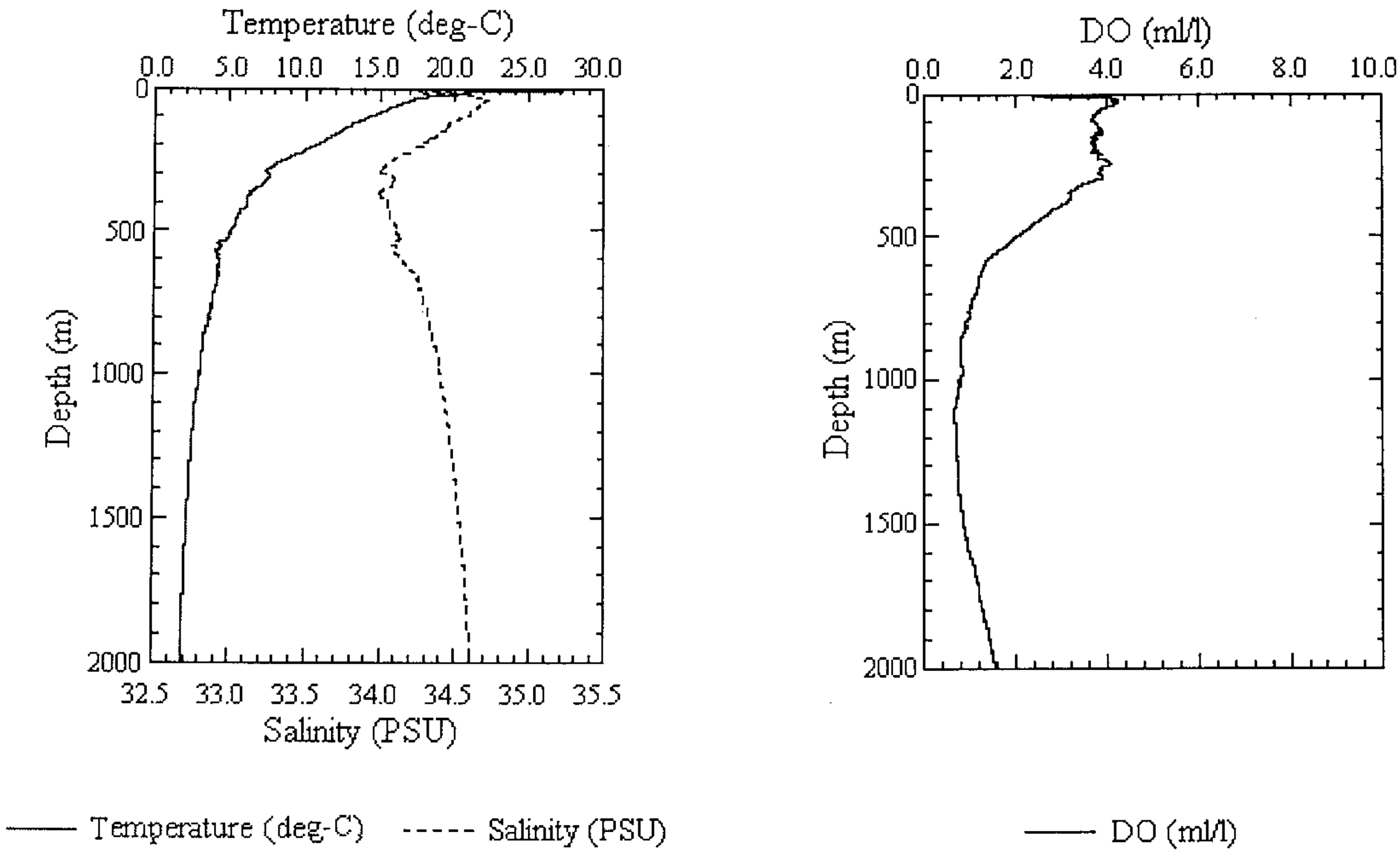


Fig. 2.1.49 CTD profile at St.B29

MWJ

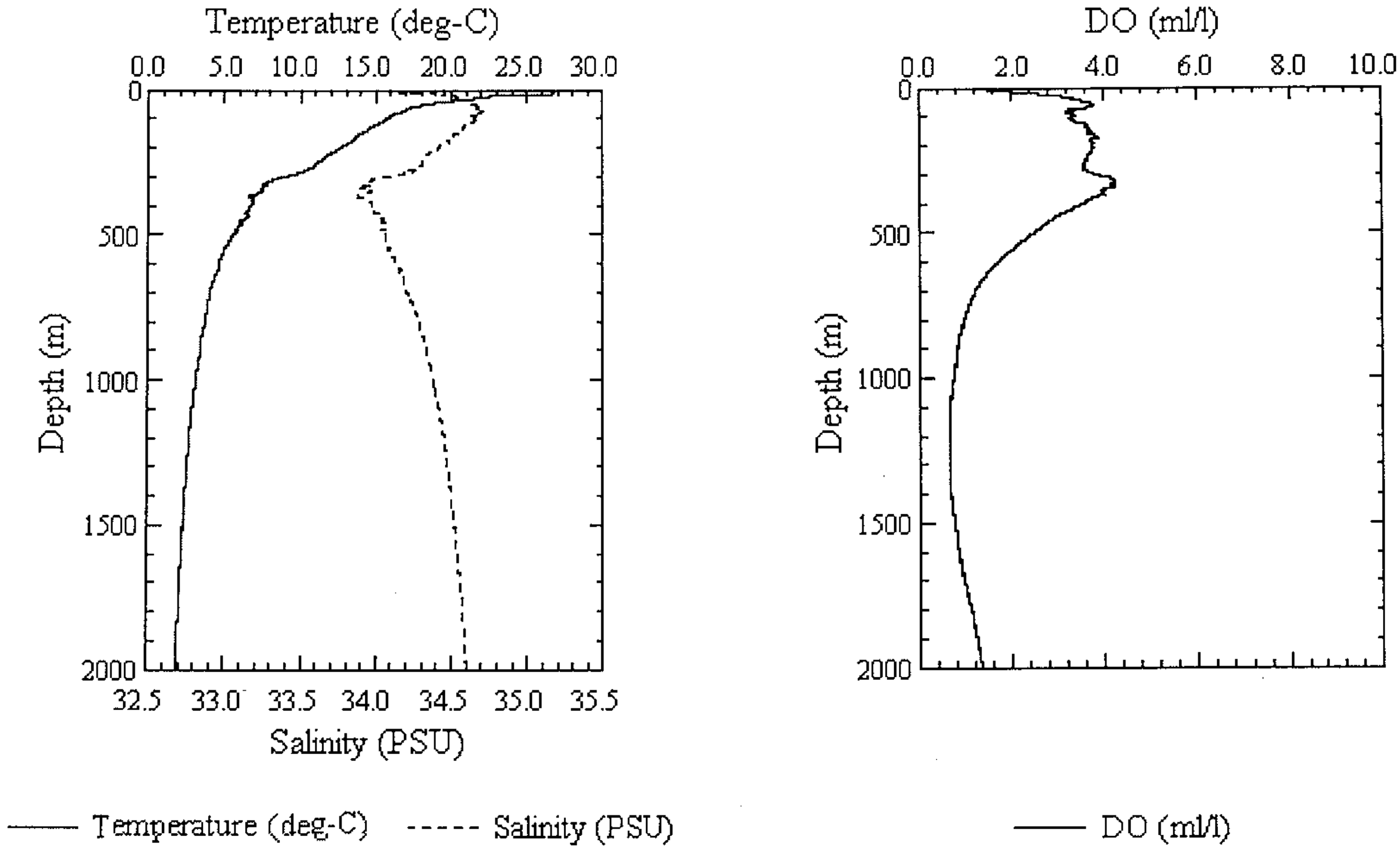
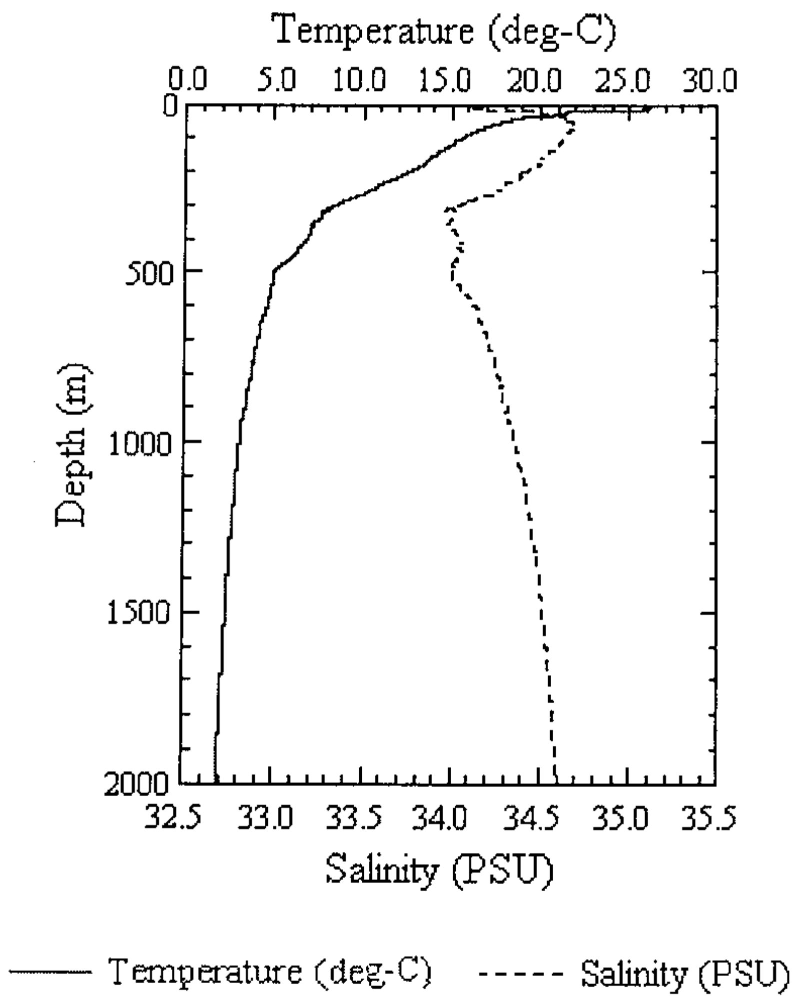


Fig. 2.1.50 CTD profile at St.B30

MWJ



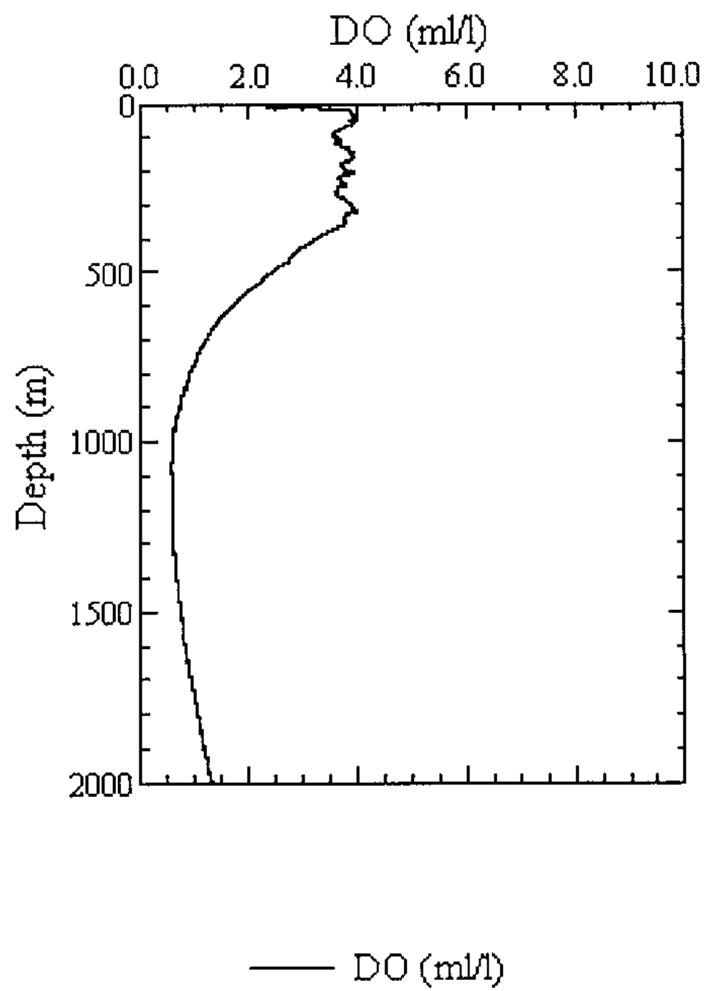
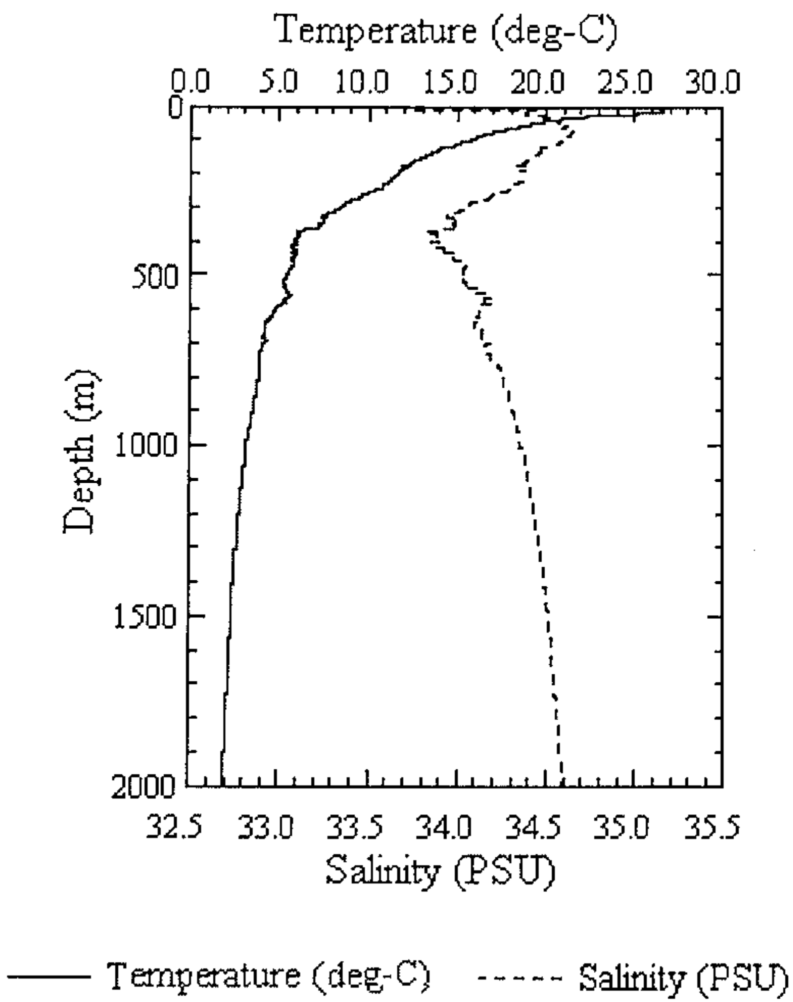


Fig. 2.1.51 CTD profile at St.B31

MWJ



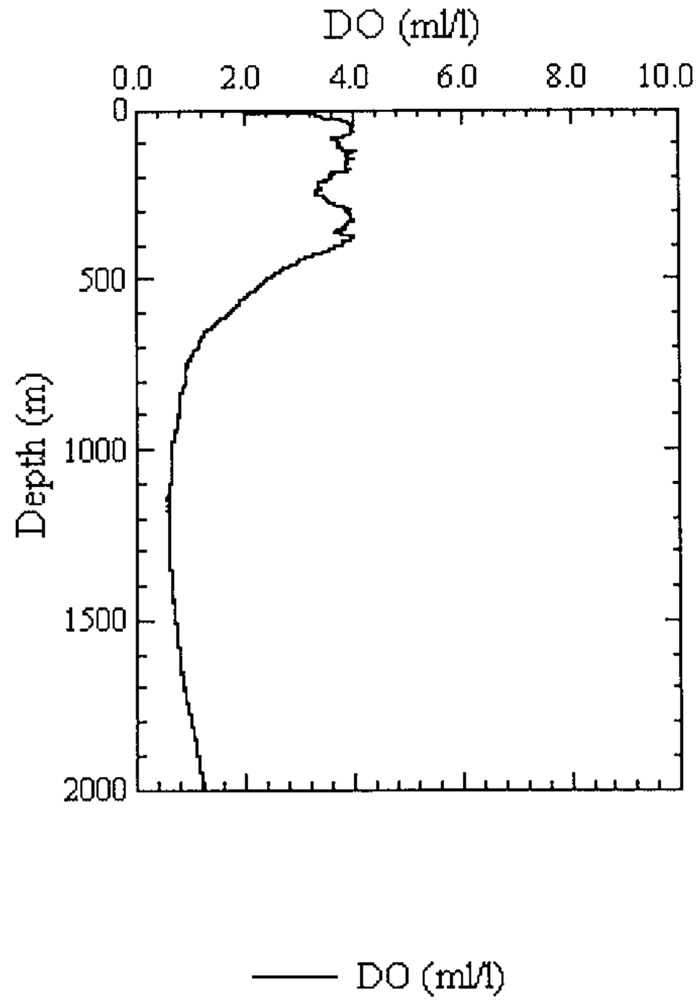


Fig. 2.1.52 CTD profile at St.B32

MWJ

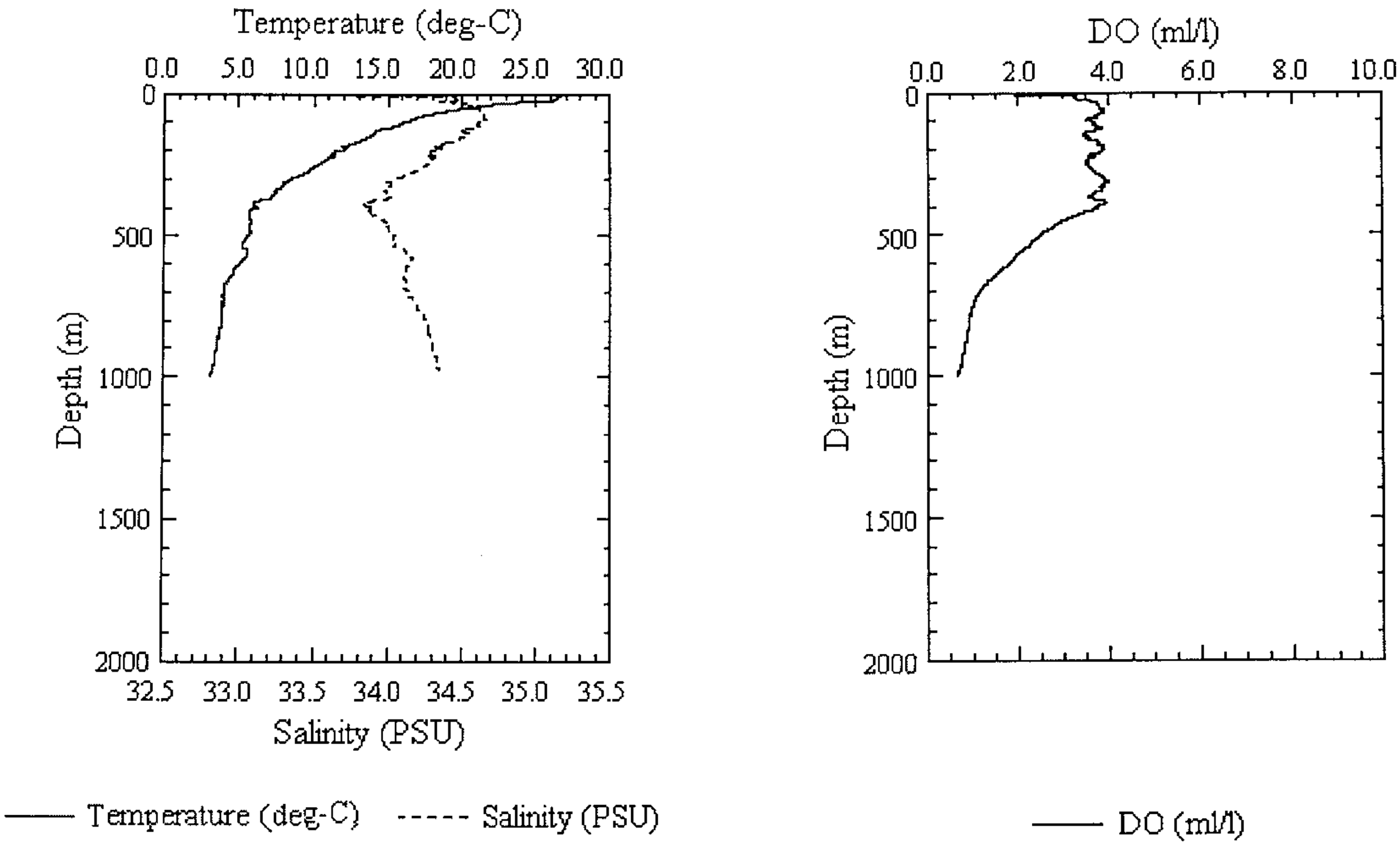


Fig. 2.1.53 CTD profile at St.B32A

MWJ

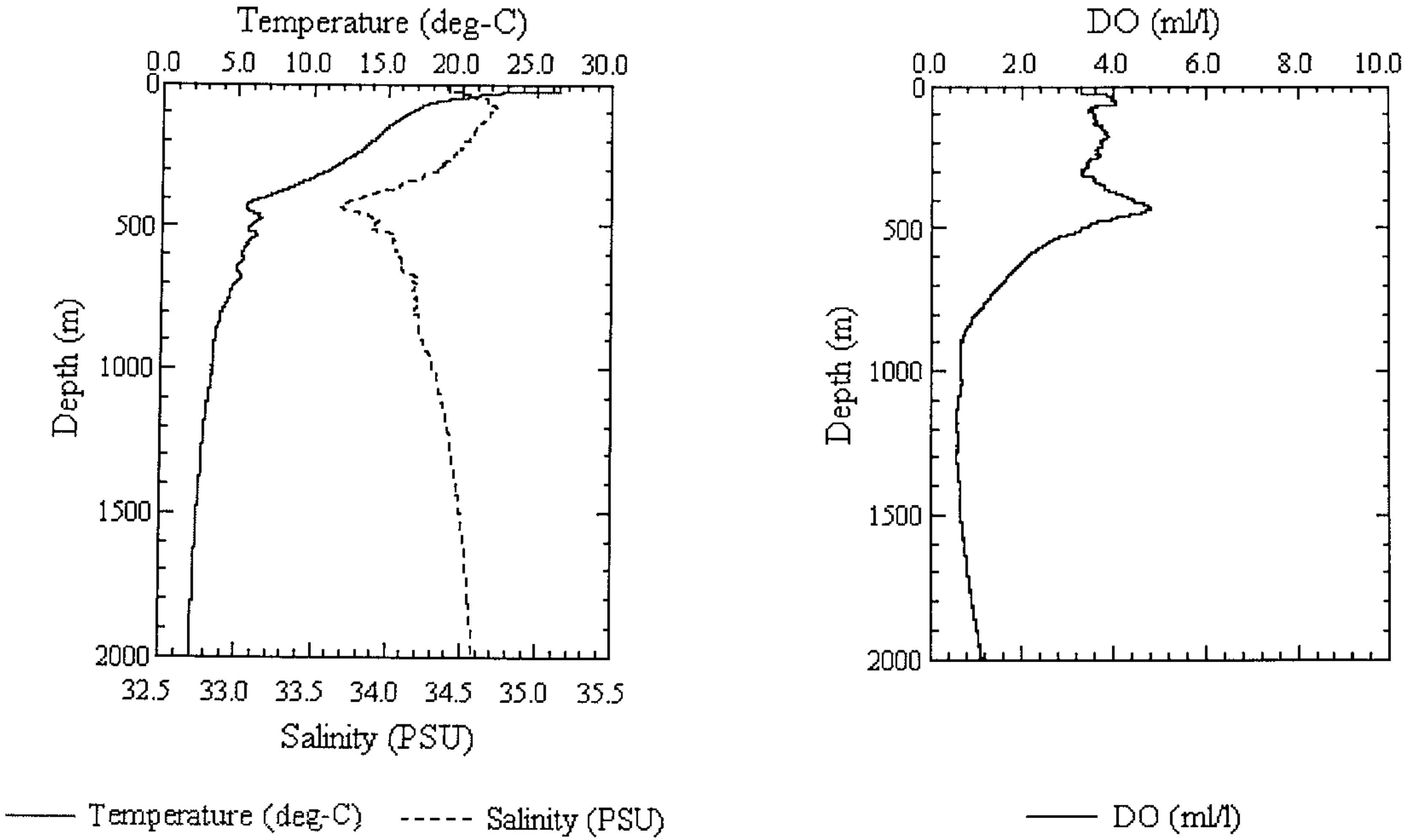
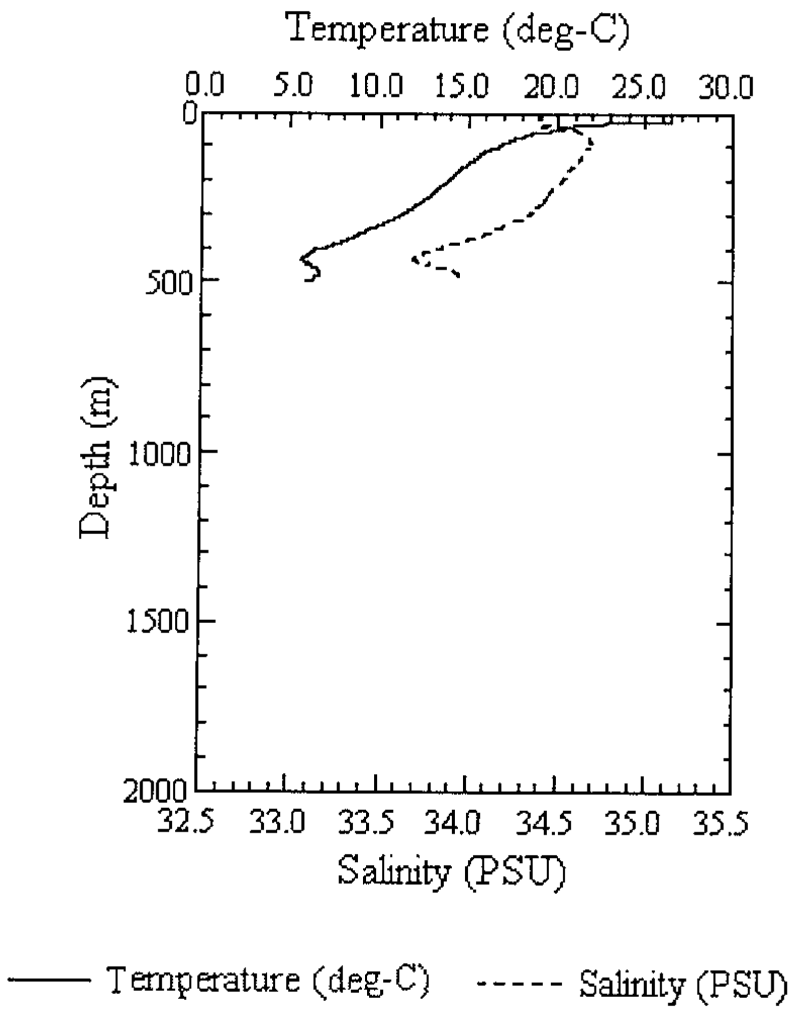


Fig. 2.1.54 CTD profile at St.B33

MWJ



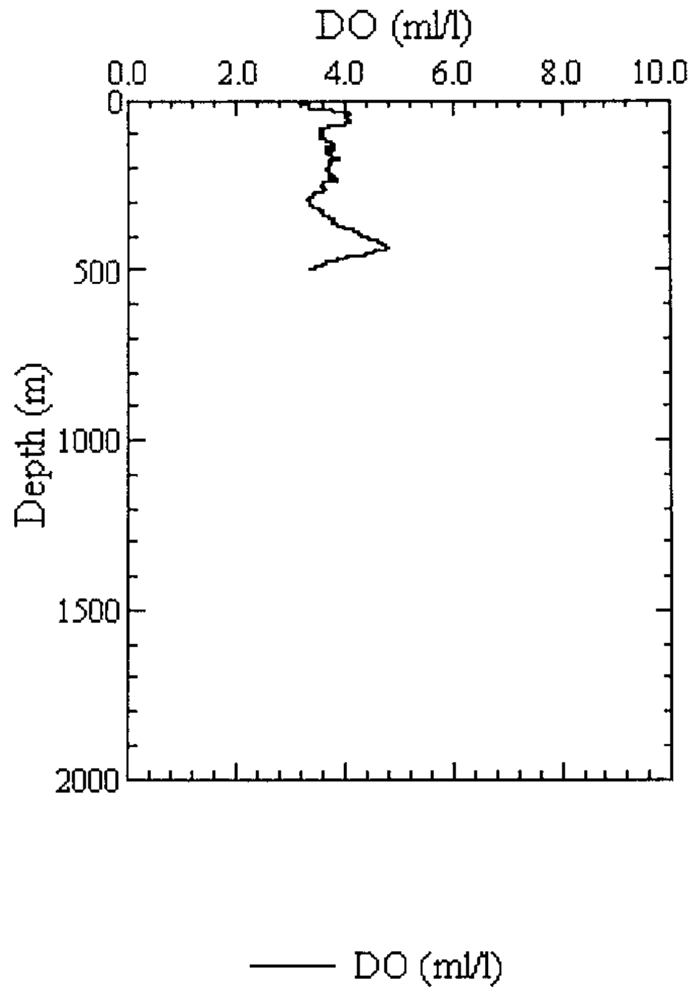
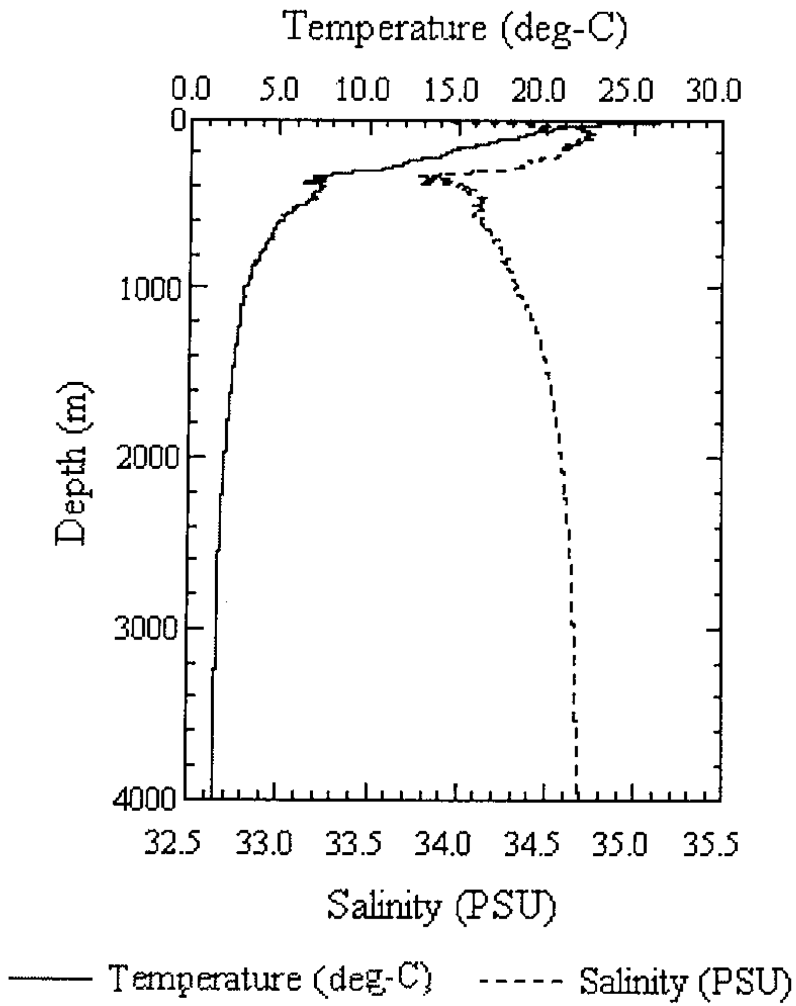


Fig. 2.1.55 CTD profile at St.B33A

MWJ



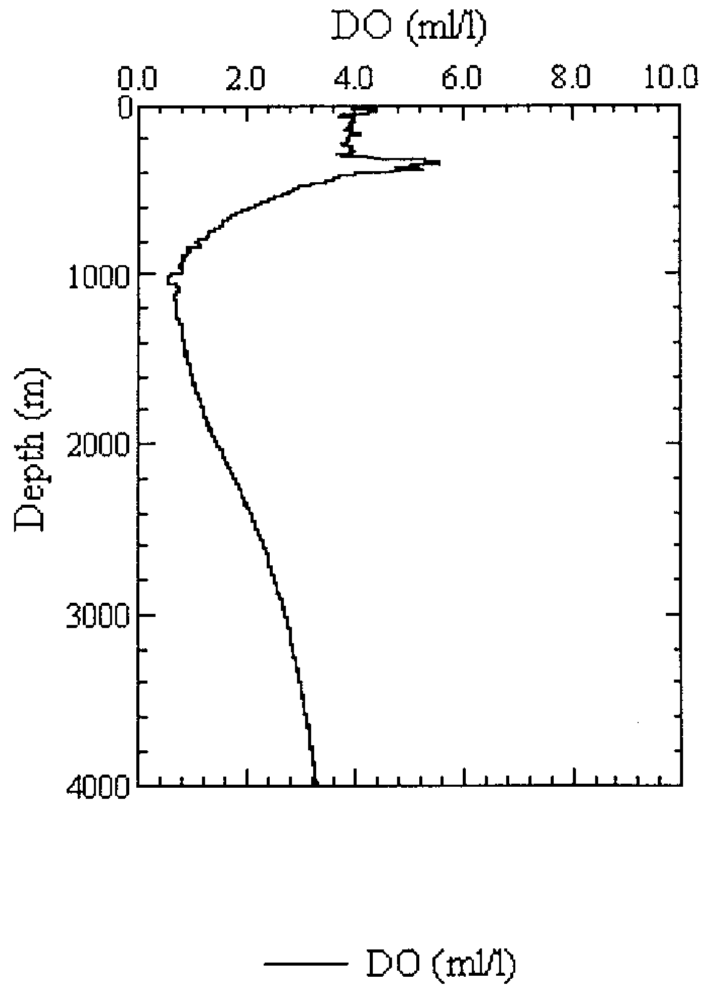


Fig. 2.2.1 CTD profile at St.A06

MWJ

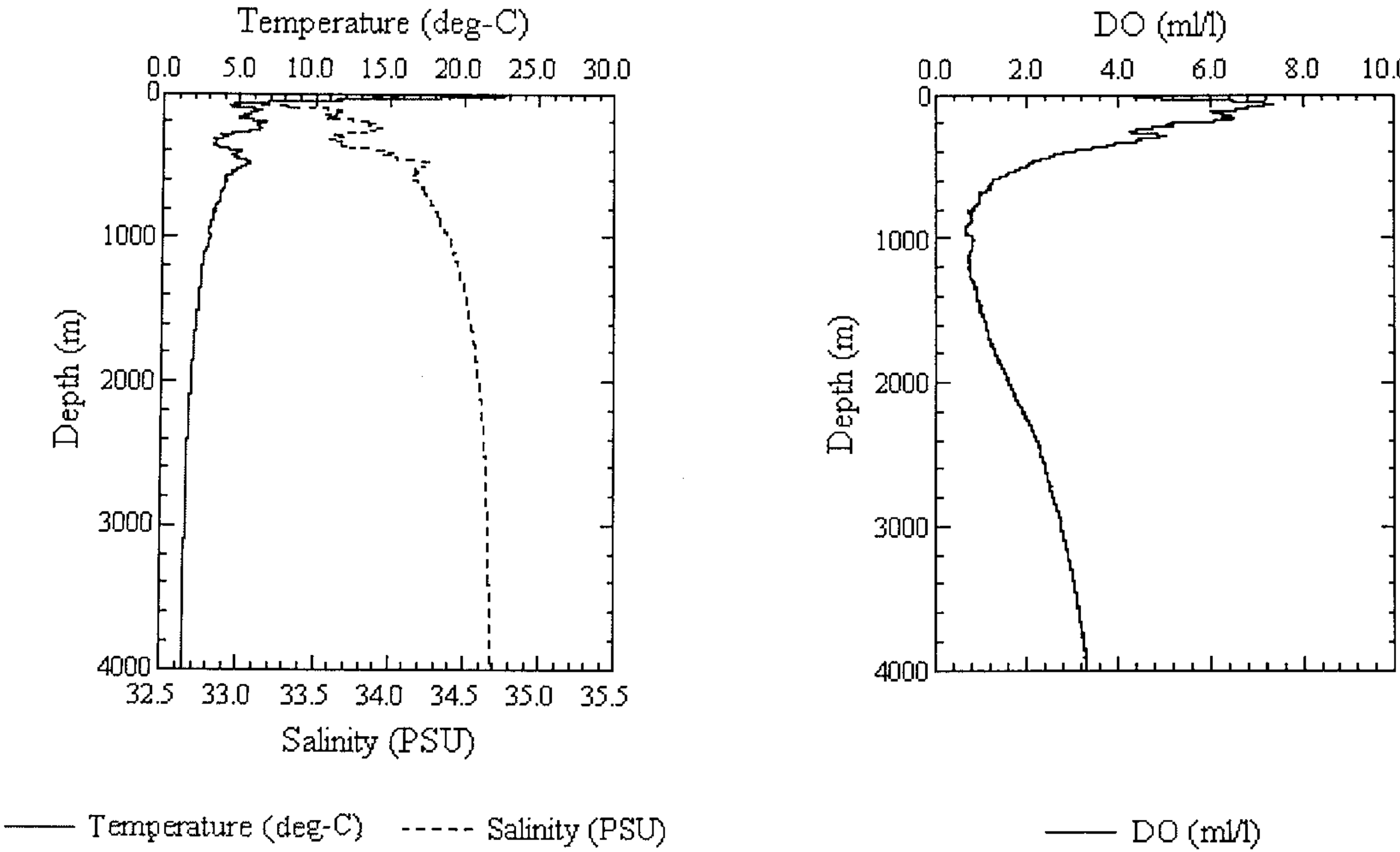
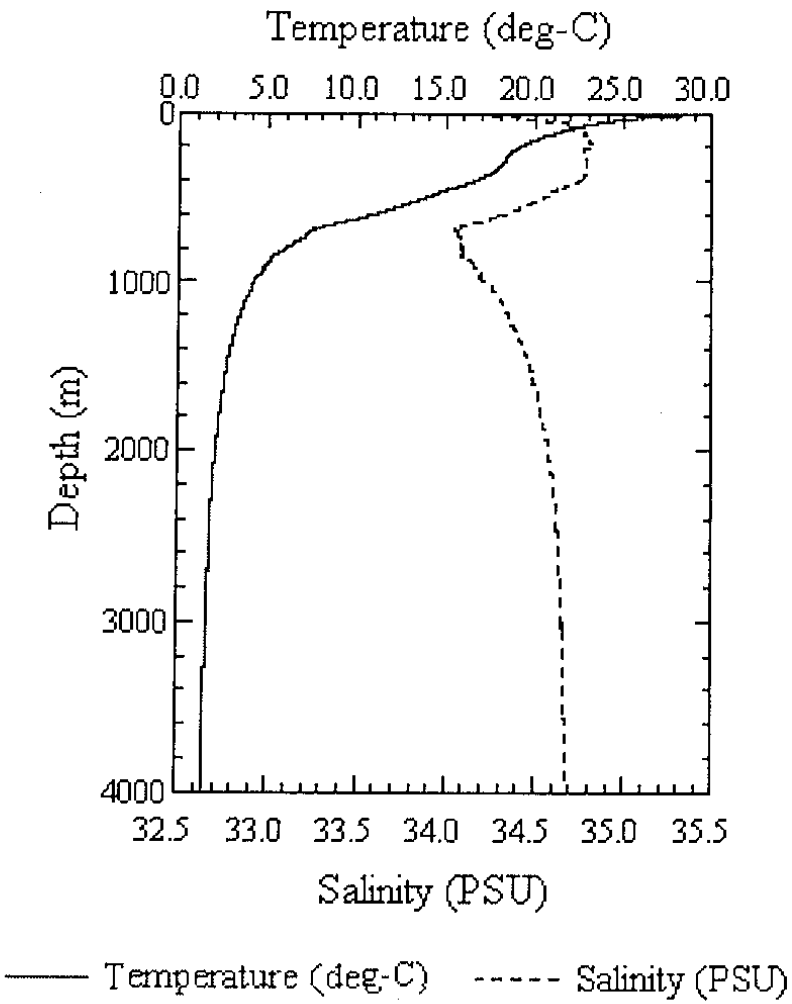


Fig. 2.2.2 CTD profile at St.A11

MWJ



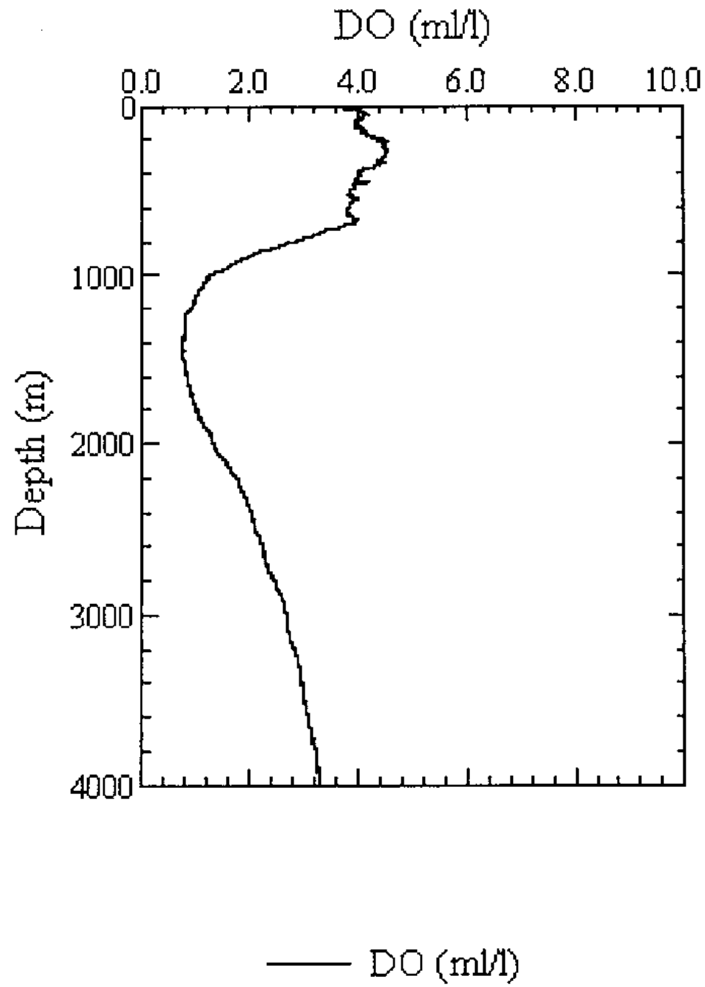
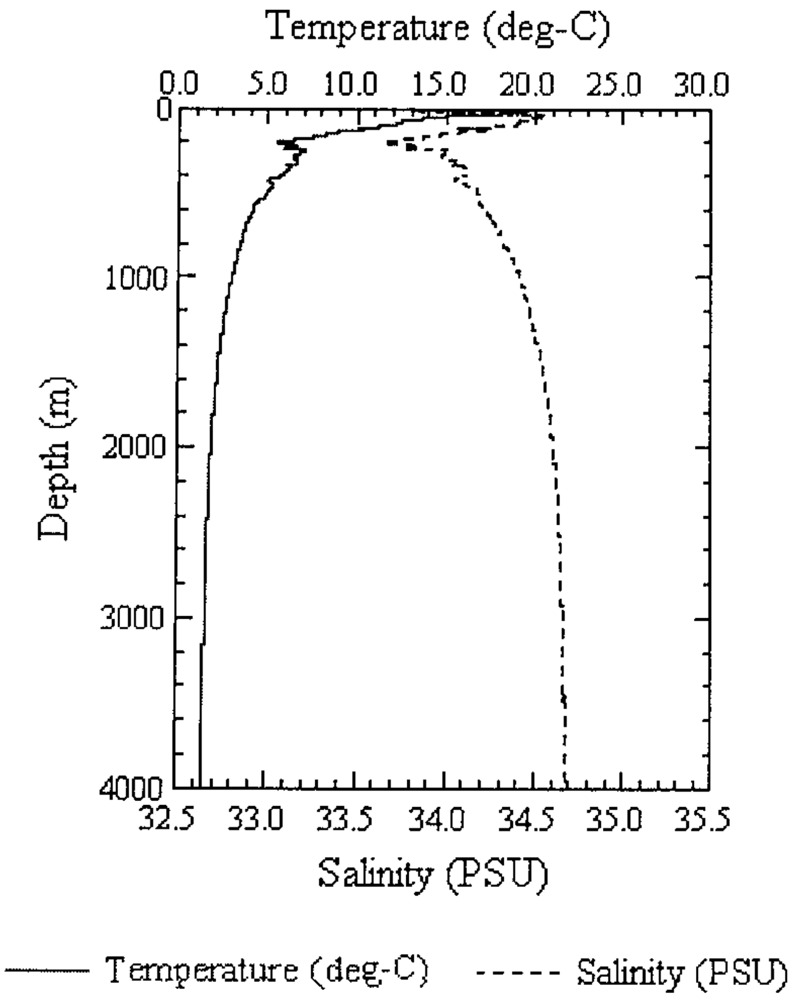


Fig. 2.2.3 CTD profile at St.A16

MWJ



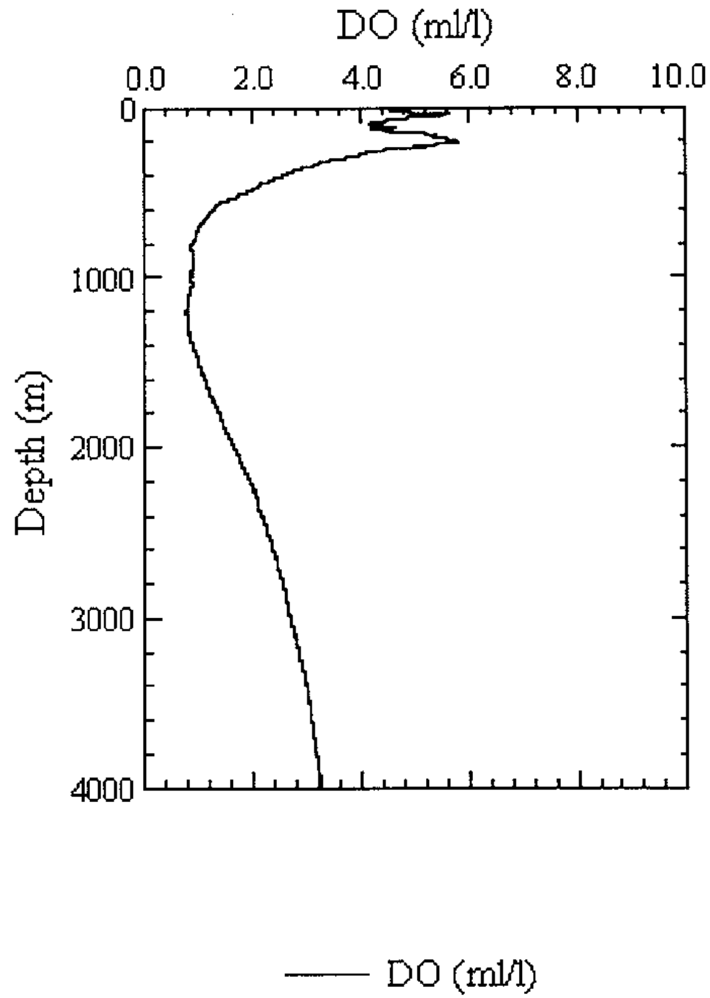


Fig. 2.2.4 CTD profile at St. G12

MWJ

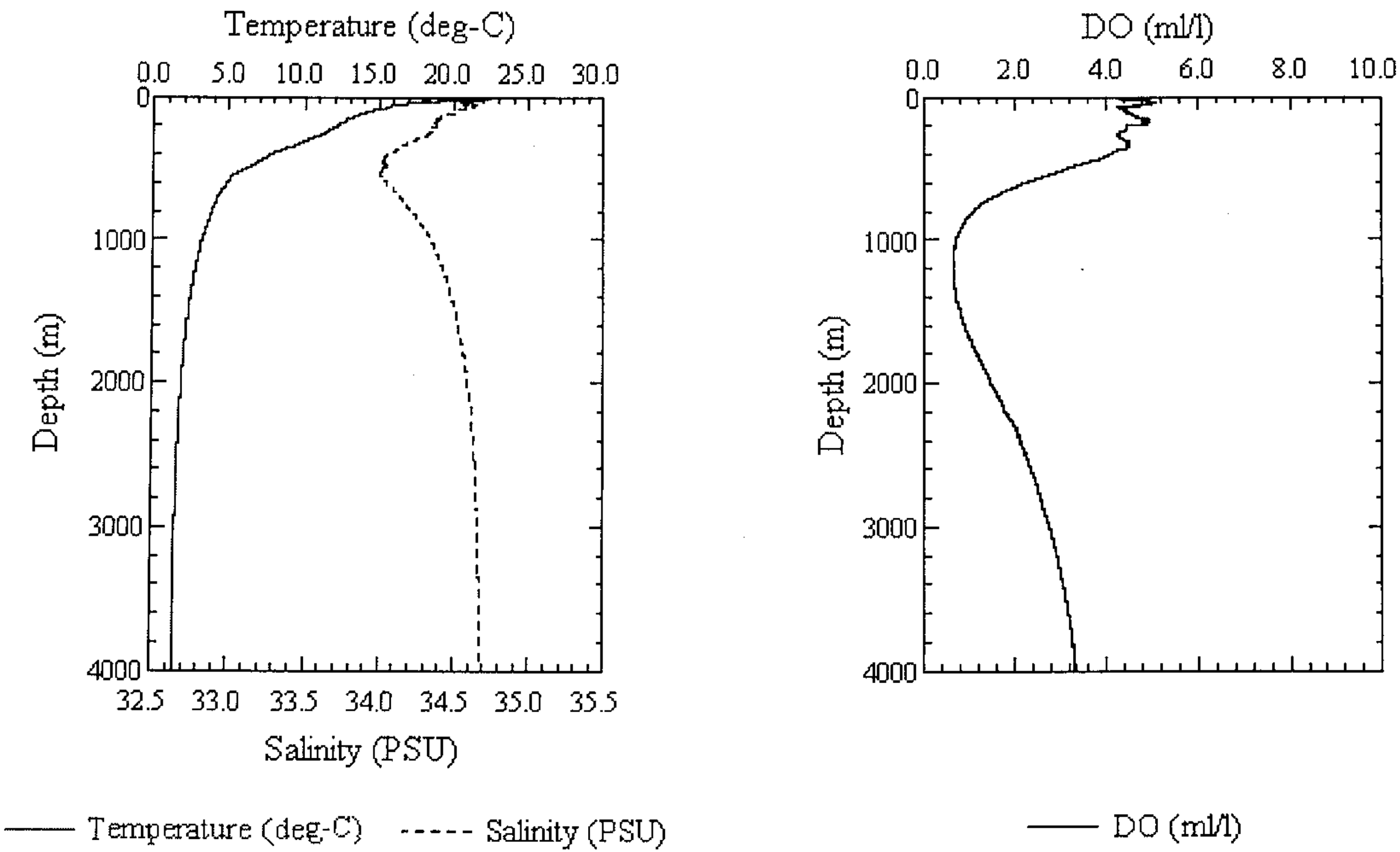


Fig. 2.2.5 CTD profile at St.B01

MWJ

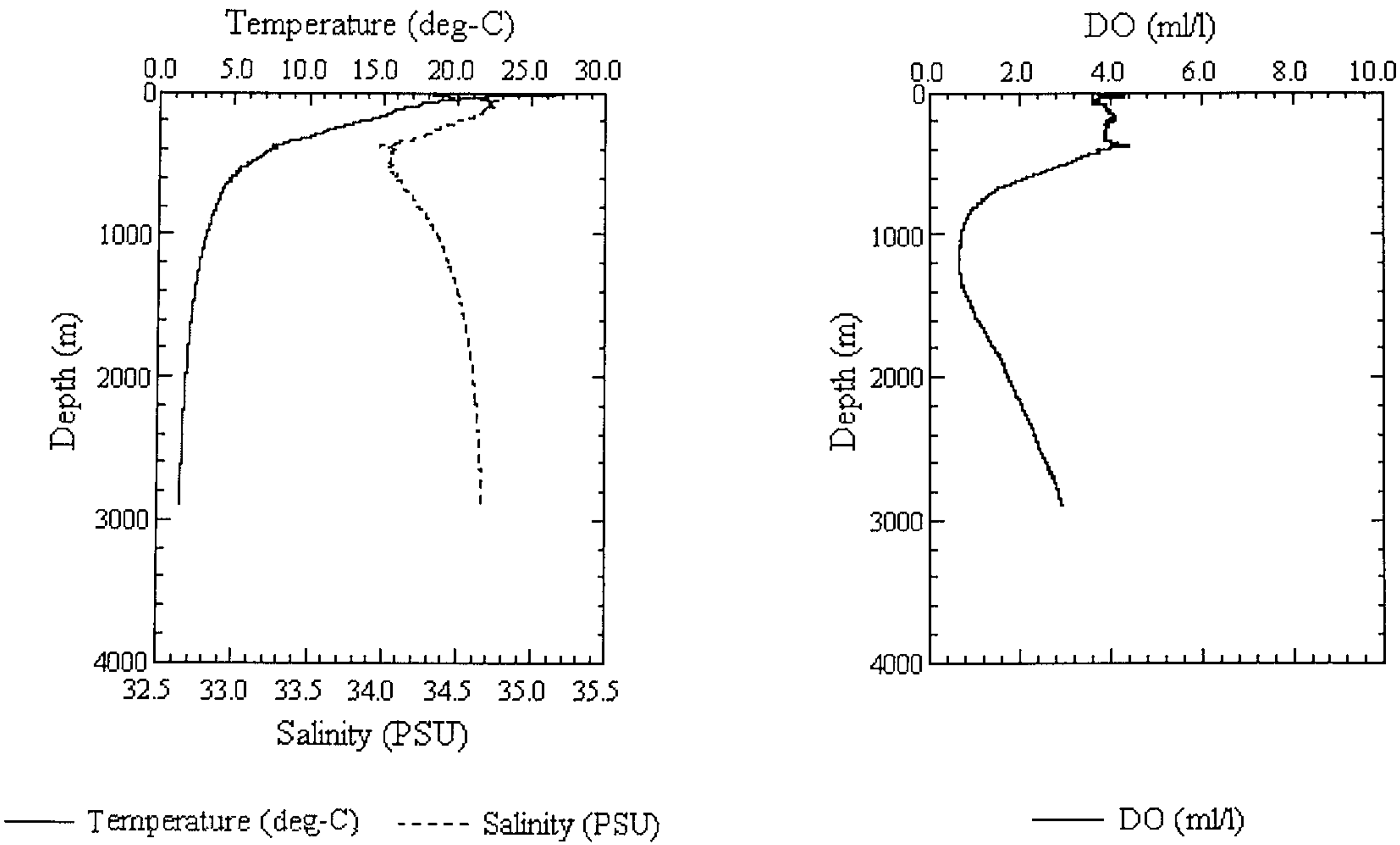


Fig. 2.2.6 CTD profile at St.B06

MWJ

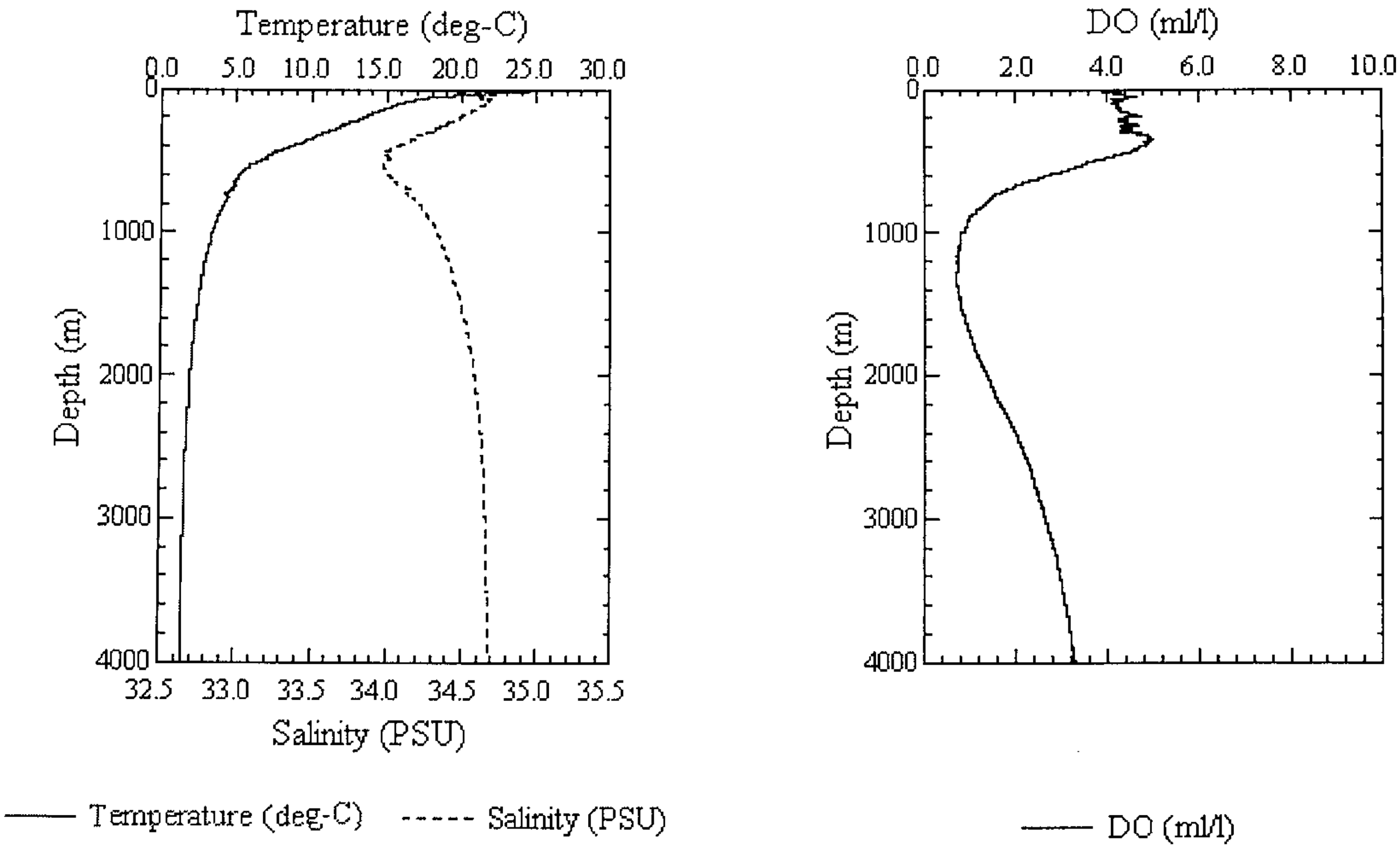
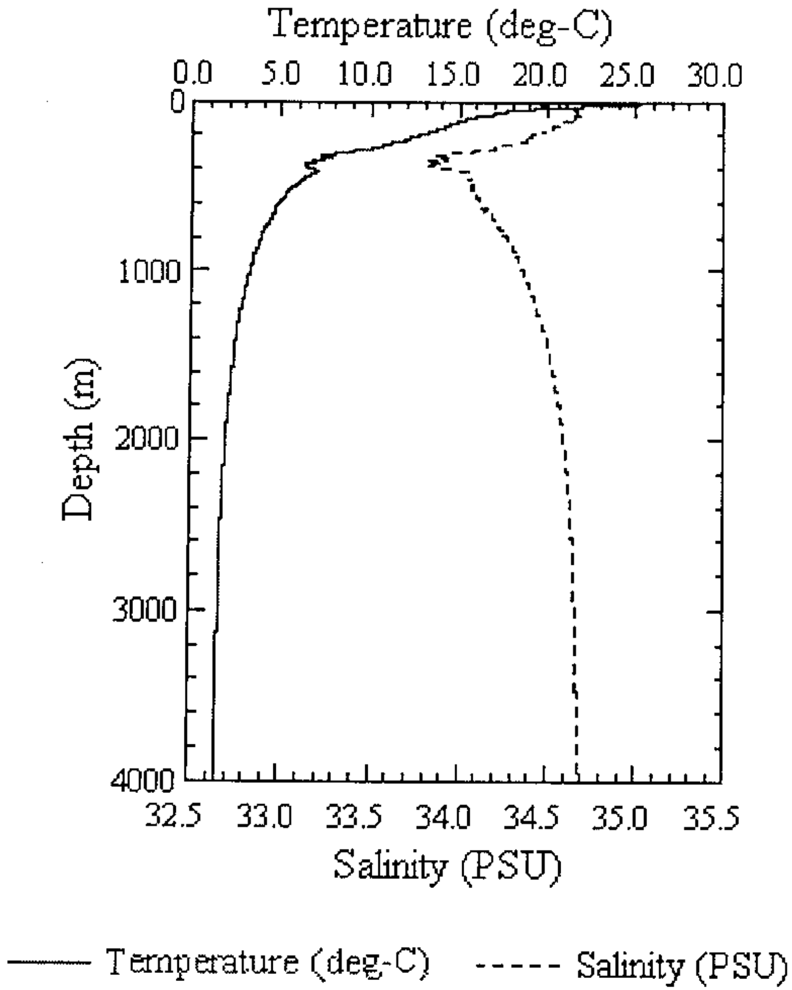


Fig. 2.2.7 CTD profile at St.B11

MWJ



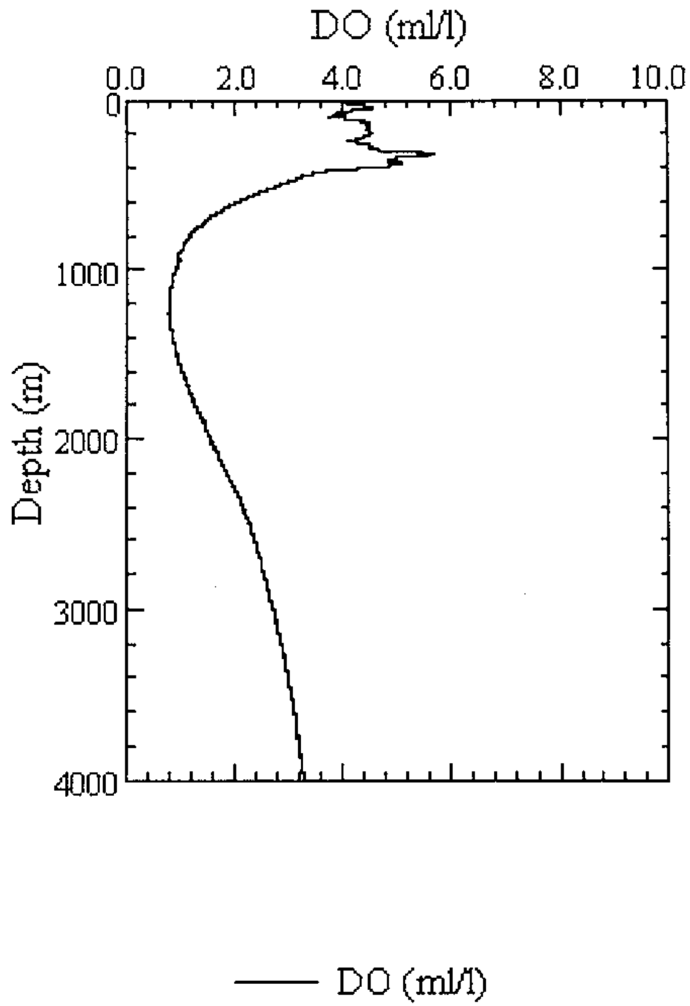


Fig. 2.2.8 CTD profile at St.B12

MWJ

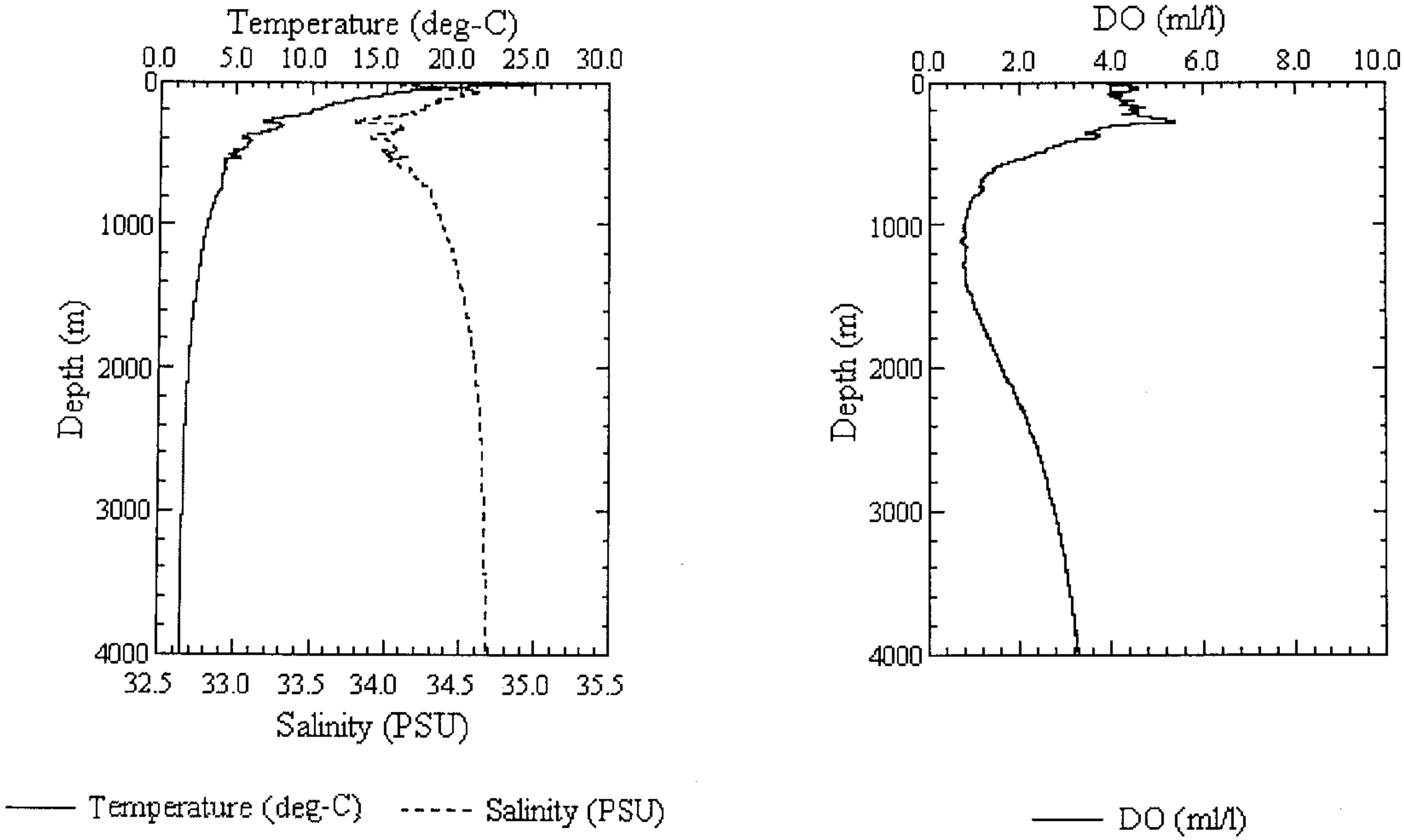


Fig. 2.2.9 CTD profile at St.B17

MWJ

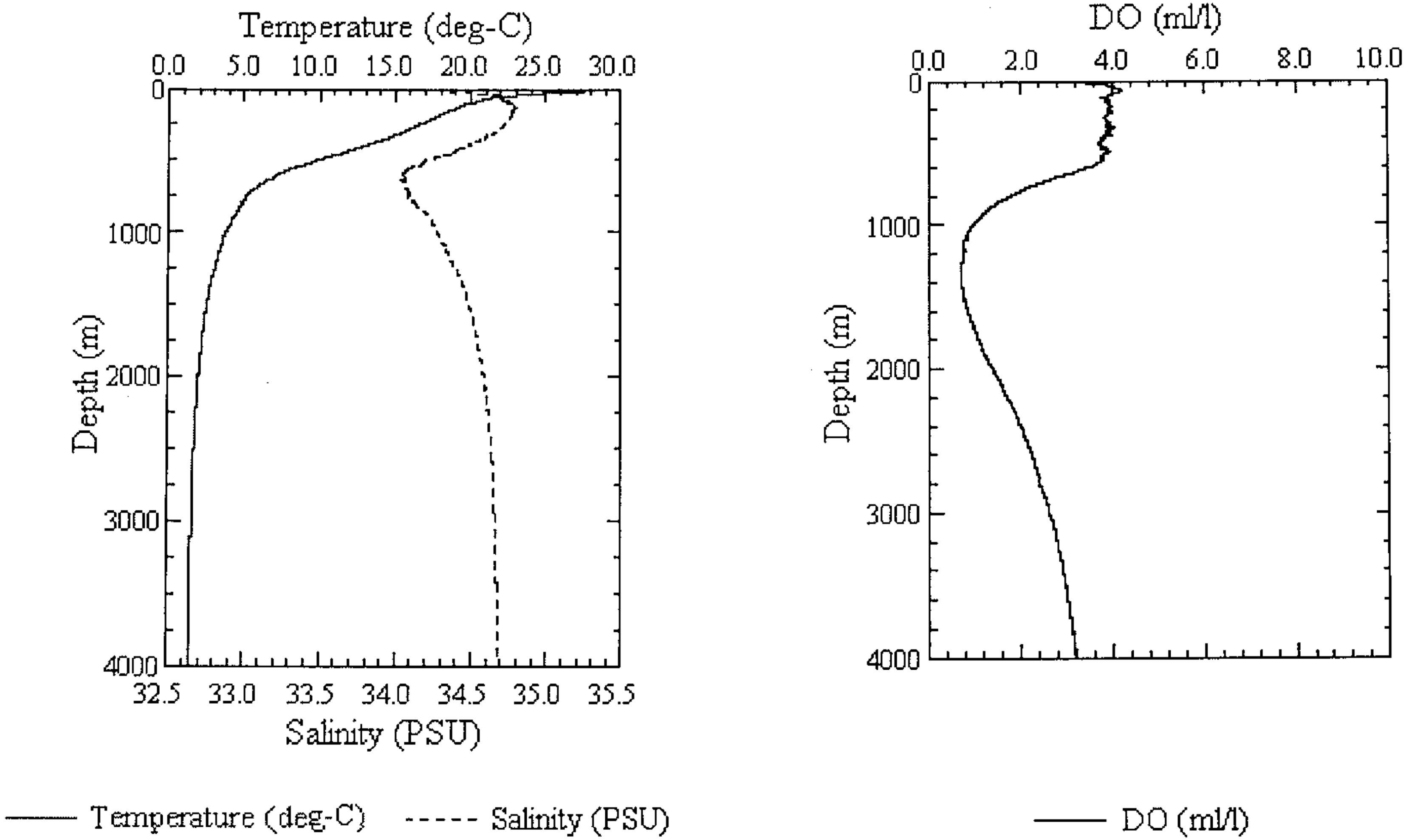


Fig. 2.2.10 CTD profile at St.B22

MWJ

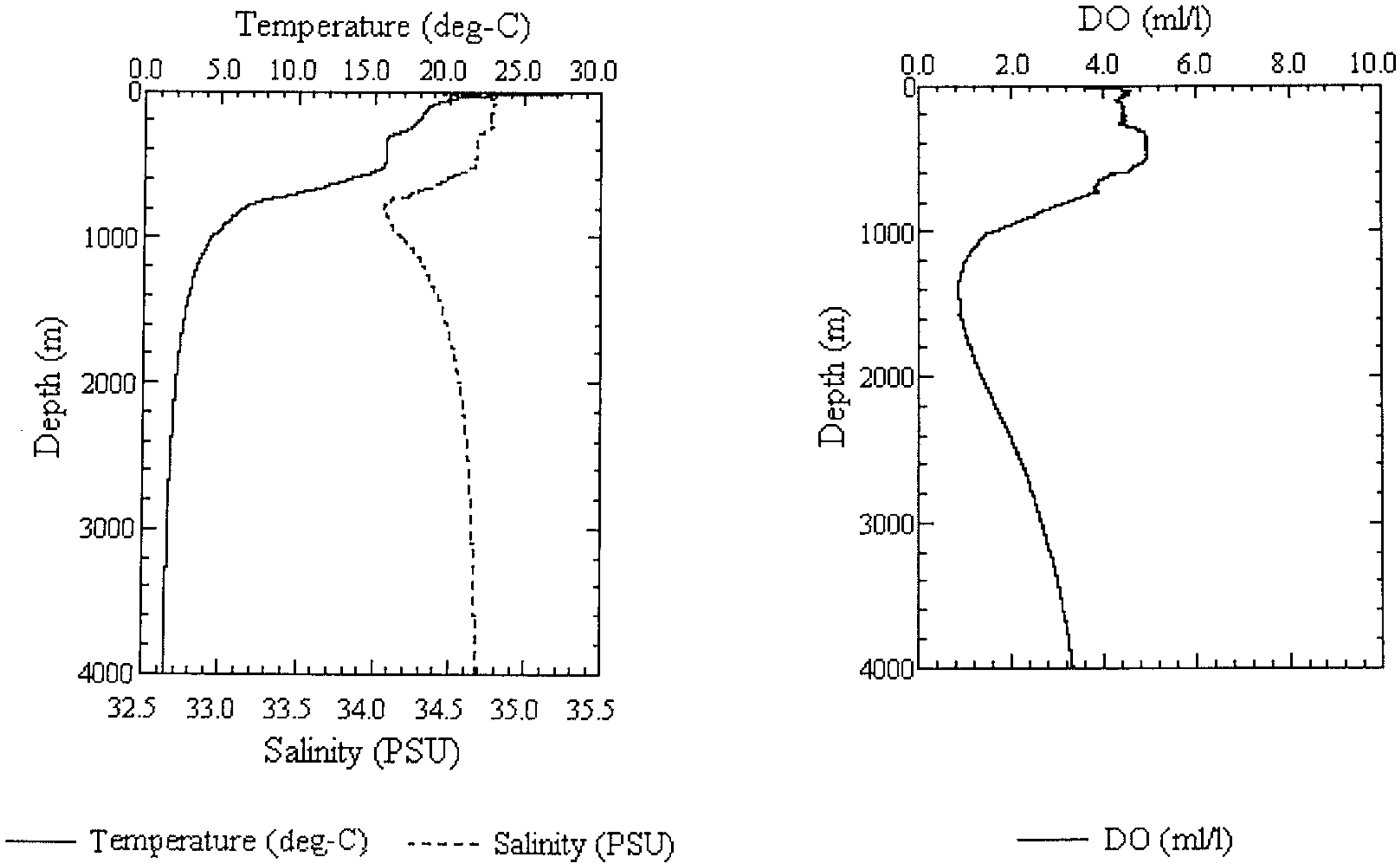


Fig. 2.2.11 CTD profile at St.B23

MWJ

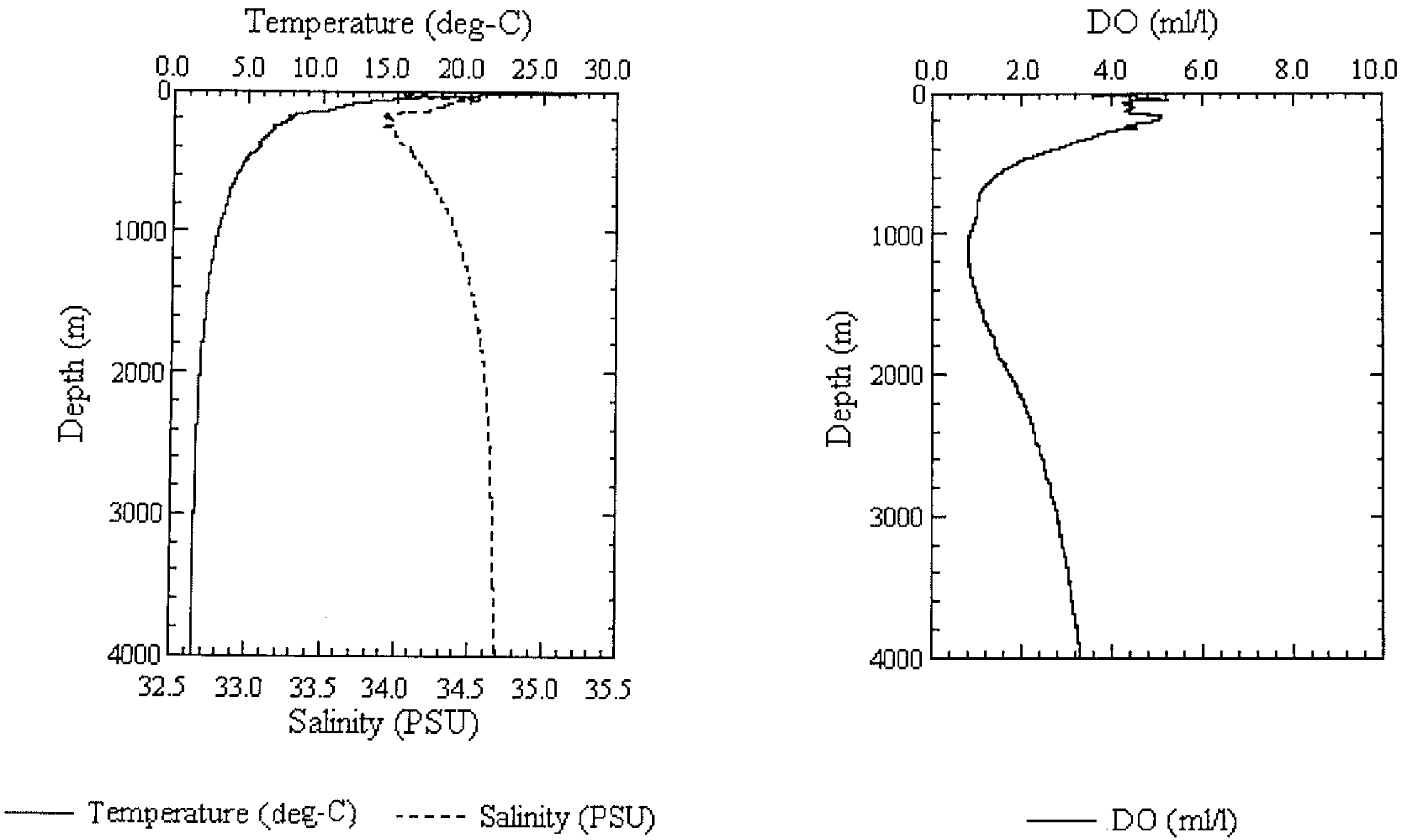
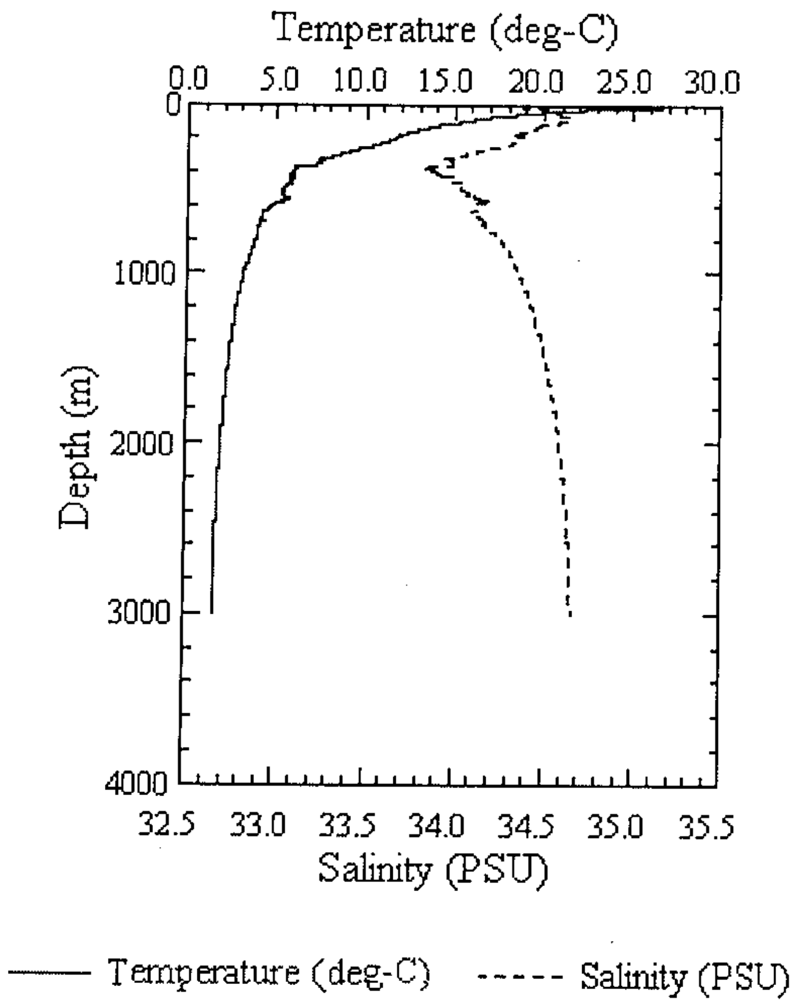


Fig. 2.2.12 CTD profile at St.B28

MWJ



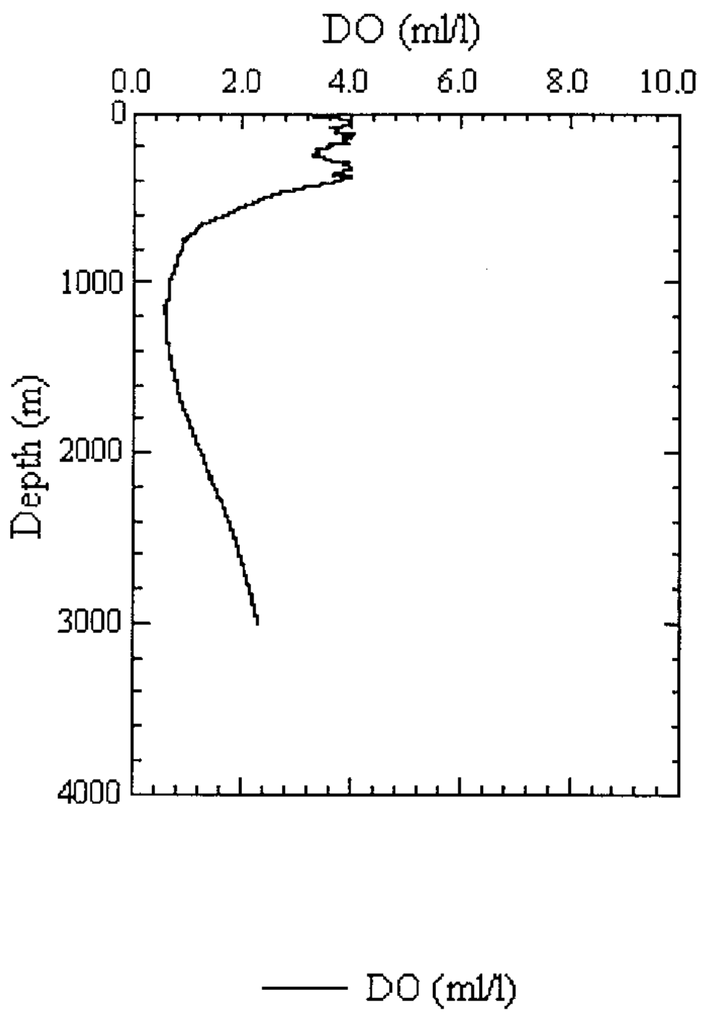


Fig. 2.2.13 CTD profile at St.B32

MWJ

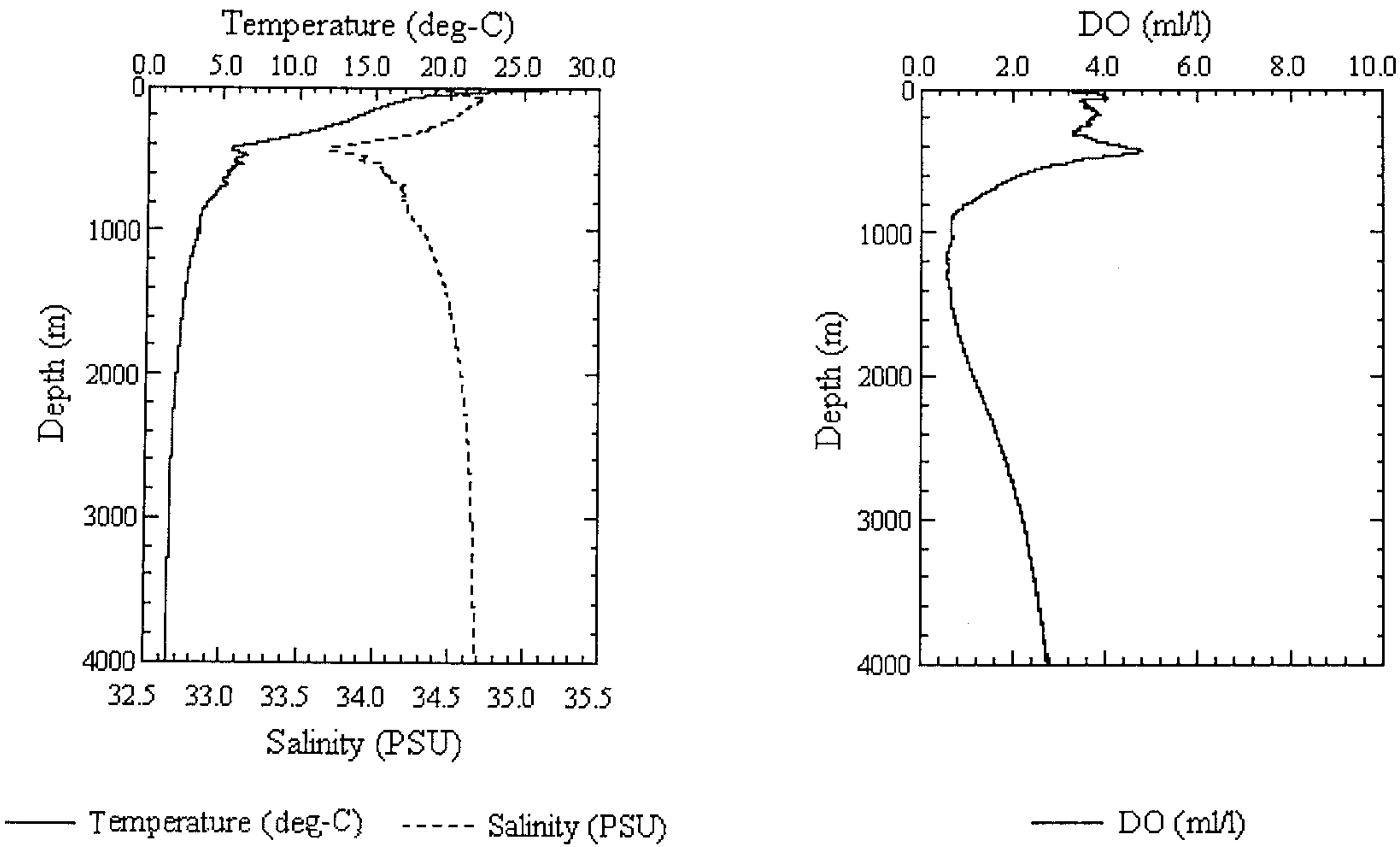


Fig. 2.2.14 CTD profile at St.B33

MWJ

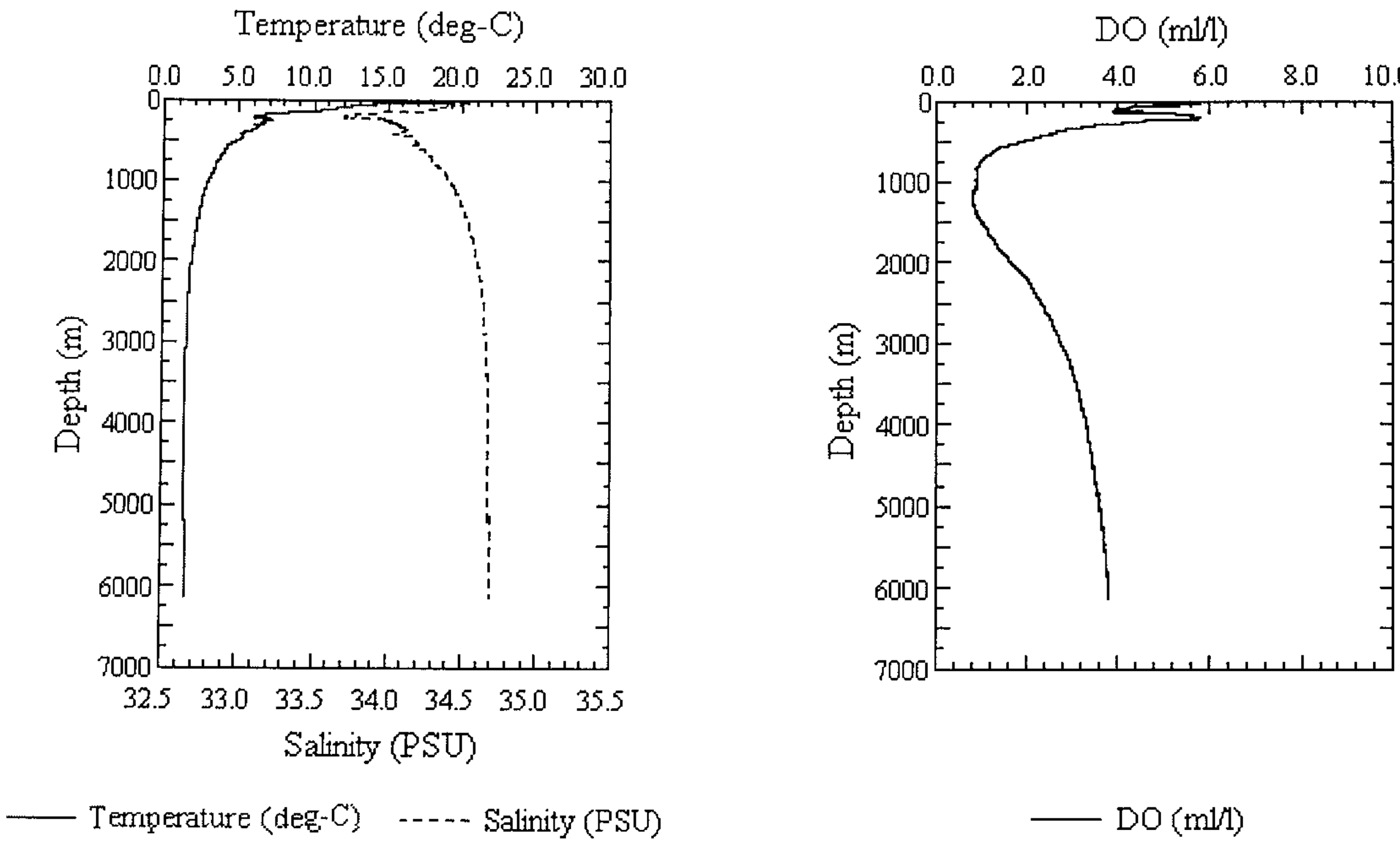
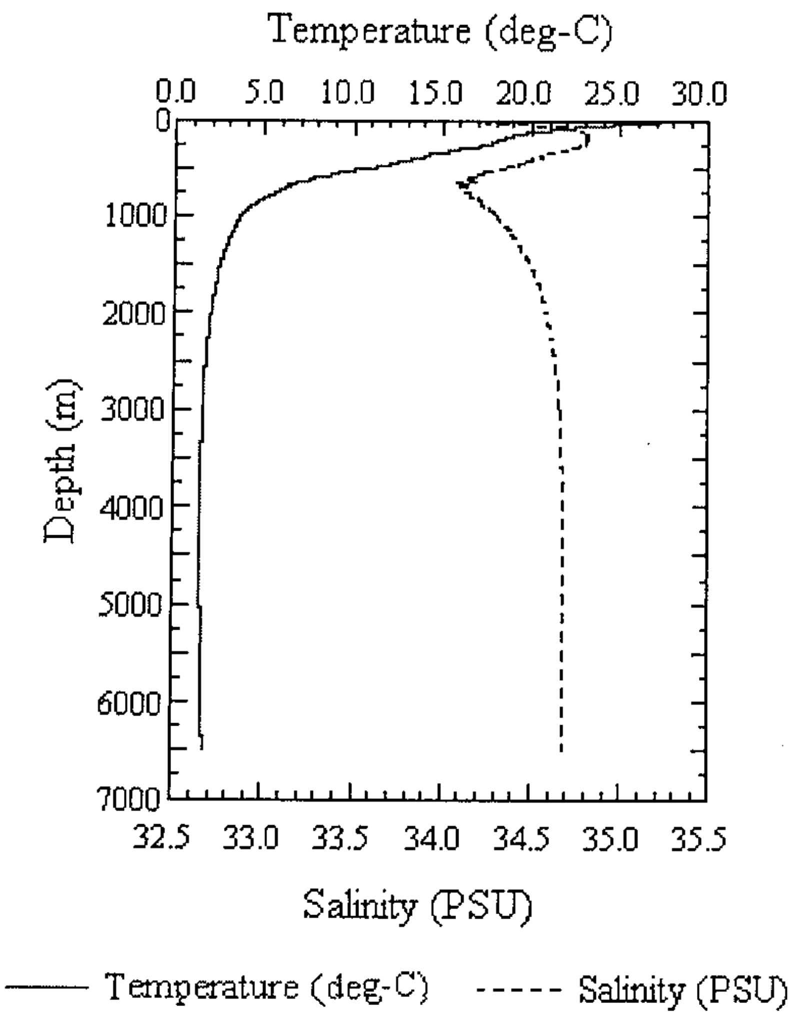


Fig. 2.3.1 CTD profile at St.G11

MWJ



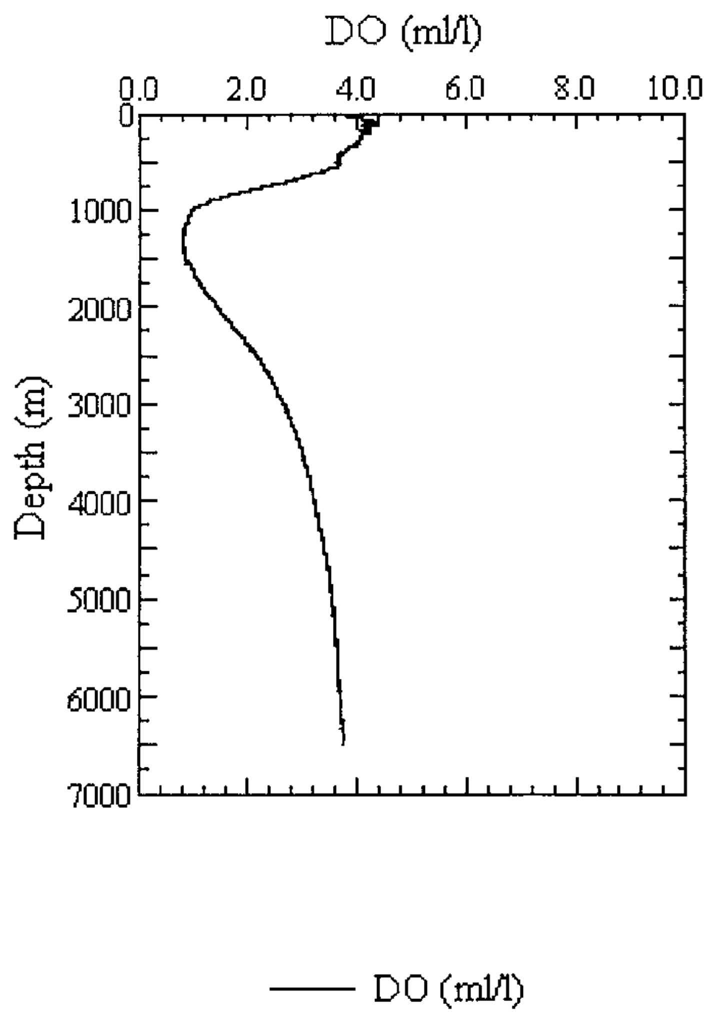


Fig. 2.3.2 CTD profile at St. G31A

MWJ

7.1.2 Salinity measurements of sampled seawater for validation of CTD cast data

Personnel

Takeo Matsumoto(MWJ)

Fujio Kobayashi(MWJ)

(1)Objectives

To check the quality of CTD salinity.

(2)Parameters

Salinity of sampled water

(3)Method

Seawater samples were collected with a bucket for the surface, 12-liter Niskin bottles for the deepest layer(6492m) and the other layers. They were stored in 250ml Phoenix brown glass bottles. The salinity measurements were carried out using “Guildline Autosal 8400B Salinometer”, which was modified by addition of an Ocean Scientific International peristaltic-type sample intake pump, with a bath temperature of 24deg-C. The instrument was operated in the “Autosal Room” of R/V Mirai. A double conductivity ratio was defined as a median of 31 readings of the salinometer. Data collection was started after 5 seconds and it took about 10 seconds to collect 31 readings by a personal computer. The salinometer standardzations were made with IAPSO Standard Seawater batch P134 whose conductivity is 0.99989(salinity 34.996). Sub-standard seawater was used to check the drift of the Autosal.

(4)Results

Analysis data of all samples were shown in Table.3.1. Ten pairs of duplicate samples taken by the same Niskin bottle and bucket were analyzed to estimate the precision of this method. To check the salinity data of CTD, we compared the salinity of all samples except for the surface samples.

(5)Data archive

The data of salinity sample will be submitted to the DMO at JAMSTEC.

Table.3.1.1 Analyzed sample(Leg1)

Sample No.	Depth (m)	Autosal		CTD	CTD-Autosal
		2k	Sal(psu)	Sal(psu)	difference(psu)
1	0	1.90350	33.1091	no data	-
2	1498	1.97519	34.5123	34.5439	0.0316
3	1498	1.97519	34.5123	34.5439	0.0316
4	599	1.95604	34.1366	34.1368	0.0002
5	599	1.95604	34.1366	34.1368	0.0002
6	300	1.93478	33.7202	33.7126	-0.0076
7	300	1.93478	33.7202	33.7126	-0.0076
8	149	1.92139	33.4584	33.3874	-0.0710
9	149	1.92138	33.4582	33.3874	-0.0708
10	100	1.93335	33.6922	33.6815	-0.0107
11	100	1.93333	33.6919	33.6815	-0.0104
12	50	1.93559	33.7361	33.6656	-0.0705
13	50	1.93561	33.7365	33.6656	-0.0709
14	1998	1.97886	34.5844	34.5860	0.0016
15	998	1.96838	34.3786	34.3751	-0.0035
16	0	2.00616	35.1213	no data	-
17	1998	1.97882	34.5836	34.5833	-0.0003
18	0	1.97219	34.4534	no data	-
19	1997	1.97871	34.5814	34.5798	-0.0016
20	1498	1.97409	34.4907	34.4909	0.0002
21	0	1.94742	33.9677	no data	-
22	1999	1.97911	34.5893	34.5886	-0.0007
23	1999	1.97911	34.5893	34.5886	-0.0007
24	998	1.96539	34.3199	34.3177	-0.0022
25	498	1.95626	34.1409	34.1465	0.0056
26	498	1.95621	34.1399	34.1465	0.0066
27	400	1.95249	34.0670	34.0656	-0.0014
28	300	1.96119	34.2375	34.2576	0.0201
30	200	1.97816	34.5706	34.5709	0.0003
31	150	1.98228	34.6515	34.6588	0.0073
32	100	1.98770	34.7581	34.7539	-0.0042
33	100	1.98774	34.7589	34.7539	-0.0050
34	75	1.98634	34.7313	34.7322	0.0009
36	50	1.97584	34.5250	34.4129	-0.1121
37	31	1.96899	34.3906	34.3838	-0.0068
38	10	1.94680	33.9555	33.9409	-0.0142
39	1997	1.97877	34.5826	34.5829	0.0003
40	500	1.95513	34.1187	34.1206	0.0019
41	99	1.98877	34.7791	34.7733	-0.0058
42	1997	1.97734	34.5545	34.5875	0.0330
43	501	1.95167	34.0509	34.0582	0.0073
44	100	1.99016	34.8064	34.8045	-0.0019
45	1997	1.97960	34.5989	34.5983	-0.0006
46	500	1.95134	34.0445	34.0433	-0.0012
47	101	1.97814	34.5702	34.5552	-0.0150
48	1998	1.97979	34.6026	34.6039	0.0013
49	500	1.95524	34.1209	34.1197	-0.0012
50	101	1.97381	34.4852	34.4921	0.0069
51	0	1.93323	33.6899	no data	-
52	1996	1.97914	34.5899	34.5994	0.0095
53	1002	1.96930	34.3967	34.3967	0.0000
54	1996	1.97917	34.5904	34.5994	0.0090
55	499	1.95873	34.1893	34.1981	0.0088

56	499	1.95882	34.1911	34.1981	0.0070
57	400	1.94261	33.8735	33.8629	-0.0106
58	300	1.92612	33.5509	33.5456	-0.0053
59	201	1.94342	33.8893	33.8837	-0.0056
60	151	1.93211	33.6680	33.6695	0.0015
61	100	1.93553	33.7349	33.7357	0.0008
62	100	1.93558	33.7359	33.7357	-0.0002
63	76	1.90897	33.2159	33.1368	-0.0791
64	50	1.92721	33.5722	33.6839	0.1117
65	31	1.94765	33.9722	34.0424	0.0702
66	11	1.93999	33.8222	33.8475	0.0253
67	1997	1.97926	34.5922	34.5921	-0.0001
68	500	1.94741	33.9675	33.9632	-0.0043
69	100	1.98897	34.7830	34.7805	-0.0025
70	1997	1.97862	34.5796	34.5797	0.0001
71	500	1.96887	34.3882	34.3942	0.0060
72	99	1.98866	34.7769	34.7742	-0.0027
73	1998	1.97843	34.5759	34.5742	-0.0017
74	500	1.97443	34.4974	34.5011	0.0037
75	100	1.98743	34.7528	34.7495	-0.0033
76	1999	1.97797	34.5669	34.5675	0.0006
77	500	1.97625	34.5331	34.5378	0.0047
78	101	1.98839	34.7716	34.7753	0.0037
79	1998	1.97853	34.5779	34.5769	-0.0010
80	1998	1.97851	34.5775	34.5769	-0.0006
81	999	1.96067	34.2273	34.2264	-0.0009
82	500	1.97641	34.5362	34.5400	0.0038
83	500	1.97641	34.5362	34.5400	0.0038
84	399	1.98711	34.7465	34.7462	-0.0003
85	300	1.98897	34.7830	34.7805	-0.0025
86	201	1.98905	34.7846	34.7817	-0.0029
87	150	1.98963	34.7960	34.7937	-0.0023
88	101	1.98746	34.7534	34.7494	-0.0040
89	101	1.98733	34.7508	34.7494	-0.0014
90	74	1.98480	34.7011	34.6922	-0.0089
91	50	1.98031	34.6128	34.5830	-0.0298
92	30	1.97277	34.4648	34.4571	-0.0077
93	10	1.96015	34.2172	34.2429	0.0257
94	6125	1.98438	34.6928	34.6900	-0.0028
95	6125	1.98429	34.6910	34.6900	-0.0010
97	5991	1.98430	34.6912	34.6900	-0.0012
98	5611	1.98415	34.6883	34.6894	0.0011
99	5107	1.98409	34.6871	34.6881	0.0010
100	4102	1.98366	34.6787	34.6815	0.0028
101	4102	1.98373	34.6800	34.6815	0.0015
102	3602	1.98337	34.6730	34.6745	0.0015
103	3201	1.98298	34.6653	34.6669	0.0016
104	2801	1.98245	34.6549	34.6541	-0.0008
105	2402	1.98026	34.6119	34.6360	0.0241
106	2088	1.97827	34.5728	34.6124	0.0396
107	1742	1.97834	34.5741	34.5728	-0.0013
108	0	1.95489	34.1140	no data	-
109	4604	num	num	34.6857	-
110	4604	1.98403	34.6859	34.6857	-0.0002
111	2402	1.98127	34.6317	34.6358	0.0041
112	1494	1.97640	34.5360	34.5352	-0.0008
113	1494	1.97645	34.5370	34.5352	-0.0018

114	1294	1.97406	34.4901	34.4899	-0.0002
115	1095	1.97161	34.4420	34.4405	-0.0015
116	896	1.96840	34.3790	34.3777	-0.0013
117	896	1.96840	34.3790	34.3777	-0.0013
118	697	1.96328	34.2785	34.2773	-0.0012
119	546	1.95890	34.1926	34.1911	-0.0015
120	546	1.95889	34.1924	34.1911	-0.0013
193		1.96943	34.3992	環境モニター	-
194		1.94687	33.9569	環境モニター	-
195		1.93861	33.7952	環境モニター	-
196		1.95456	34.1076	環境モニター	-

GEOSECSの２番目のステーション分の水は２レグの水と一緒に分析をした。

Table.3.1.2 Analyzed sample(Leg2)

Sample No.	Depth (m)	Autosal 2k	Autosal Sal(psu)	CTD Sal(psu)	CTD-Autosal difference(psu)
121	0	1.95756	34.1664	no data	-
122	6492	1.98439	34.6930	34.6880	-0.0050
123	5942	1.98423	34.6899	34.6876	-0.0023
124	5205	1.98462	34.6975	34.6868	-0.0107
125	5029	1.98411	34.6875	34.6863	-0.0012
126	4467	1.98411	34.6875	34.6834	-0.0041
128	3982	1.98371	34.6796	34.6780	-0.0016
129	3724	1.98354	34.6763	34.6747	-0.0016
130	3634	1.98348	34.6751	34.6727	-0.0024
131	3284	1.98305	34.6667	34.6649	-0.0018
132	2985	1.98257	34.6572	34.6564	-0.0008
133	2737	1.98213	34.6486	34.6453	-0.0033
134	2241	1.98014	34.6095	34.6089	-0.0006
135	1935	1.97824	34.5722	34.5708	-0.0014
136	1744	1.97697	34.5472	34.5460	-0.0012
137	1343	1.97211	34.4518	34.4496	-0.0022
138	952	1.96297	34.2725	34.2700	-0.0025
139	800	1.95912	34.1970	34.2003	0.0033
140	648	1.95960	34.2064	34.2065	0.0001
141	505	1.96267	34.2666	34.2609	-0.0057
142	399	1.97353	34.4797	34.4816	0.0019
143	250	1.98736	34.7514	34.7483	-0.0031
144	150	1.99079	34.8188	34.8061	-0.0127
145	79	1.98290	34.6637	34.6577	-0.0060
146	19	1.96181	34.2497	34.2397	-0.0100
147	?	2.00847	35.1668	no data	-
leg2					
150	0	1.96312	34.2754	no data	-
151	1997	1.96893	34.3894	34.5930	0.2036
152	1997	1.96892	34.3892	34.5930	0.2038
153	997	1.96612	34.3343	34.3374	0.0031
154	499	1.95111	34.0400	34.0392	-0.0008
155	499	1.95124	34.0425	34.0392	-0.0033
156	398	1.95326	34.0821	34.0825	0.0004
158	200	1.97062	34.4226	34.3454	-0.0772
159	151	num	num	34.4266	-
160	100	1.97602	34.5286	34.5284	-0.0002
161	100	1.97598	34.5278	34.5284	0.0006
162	75	1.97881	34.5834	34.5611	-0.0223
163	50	1.97584	34.5250	34.4897	-0.0353
164	30	1.97105	34.4310	34.4239	-0.0071
165	10	1.96210	34.2554	34.2394	-0.0160
166	1997	1.97960	34.5989	34.5976	-0.0013
167	499	1.94950	34.0084	34.0077	-0.0007
168	99	1.97163	34.4424	34.4436	0.0012
1	1996	1.97978	34.6024	34.6014	-0.0010
2	499	1.95031	34.0243	34.0193	-0.0050
3	101	1.97175	34.4447	34.4416	-0.0031
4	1998	1.97979	34.6026	34.6038	0.0012
5	500	1.94812	33.9814	33.9802	-0.0012
6	100	1.97426	34.4940	34.4922	-0.0018
7	1997	1.98018	34.6103	34.6081	-0.0022
8	500	1.94863	33.9914	33.9911	-0.0003

9	101	1.97477	34.5040	34.5010	-0.0030
10	0	1.97166	34.4430	no data	-
11	1995	1.98029	34.6124	34.6097	-0.0027
13	998	1.96792	34.3696	34.3670	-0.0026
14	500	1.95190	34.0554	34.0532	-0.0022
16	399	1.95165	34.0505	34.0431	-0.0074
17	300	1.96473	34.3070	34.3103	0.0033
18	199	1.97549	34.5182	34.5244	0.0062
20	100	1.98686	34.7416	34.7424	0.0008
21	100	1.98683	34.7410	34.7424	0.0014
22	74	1.98532	34.7113	34.6971	-0.0142
23	50	1.98467	34.6985	34.6629	-0.0356
24	30	1.97740	34.5557	34.5785	0.0228
25	10	1.97153	34.4404	34.4301	-0.0103
26	1997	1.97923	34.5916	34.5902	-0.0014
27	499	1.94787	33.9765	33.9729	-0.0036
28	100	1.97584	34.5250	34.5242	-0.0008
30	1996	1.97887	34.5846	34.5859	0.0013
31	499	1.94777	33.9745	33.9742	-0.0003
32	100	1.97680	34.5439	34.5438	-0.0001
33	1997	1.97893	34.5857	34.5848	-0.0009
34	500	1.95228	34.0629	34.0582	-0.0047
36	100	1.98069	34.6203	34.6197	-0.0006
37	1997	1.97890	34.5851	34.5835	-0.0016
38	499	1.95188	34.0550	34.0574	0.0024
39	100	1.98062	34.6189	34.6200	0.0011
40	0	1.97372	34.4834	no data	-
41	1996	1.97880	34.5823	34.5812	-0.0011
42	998	1.96567	34.3254	34.3229	-0.0025
43	1996	1.97865	34.5802	34.5812	0.0010
44	499	1.94981	34.0145	34.0144	-0.0001
45	499	1.94980	34.0143	34.0144	0.0001
46	399	1.95282	34.0735	34.0679	-0.0056
47	300	1.96243	34.2619	34.2649	0.0030
48	200	1.97207	34.4510	34.4615	0.0105
49	149	1.97643	34.5366	34.5392	0.0026
50	100	1.98097	34.6258	34.6343	0.0085
51	100	1.98097	34.6258	34.6343	0.0085
52	75	1.98311	34.6679	34.6752	0.0073
53	50	1.98132	34.6327	34.6090	-0.0237
54	29	1.98135	34.6333	34.6098	-0.0235
55	10	1.97282	34.4658	34.4580	-0.0078
56	0	1.97498	34.5082	no data	-
57	1996	1.97941	34.5952	34.5925	-0.0027
58	1996	1.97937	34.5944	34.5925	-0.0019
59	999	1.96774	34.3660	34.3627	-0.0033
60	499	1.95260	34.0691	34.0650	-0.0041
61	499	1.95265	34.0701	34.0650	-0.0051
62	400	1.95064	34.0307	34.0114	-0.0193
63	299	1.95110	34.0399	34.0434	0.0035
64	200	1.96975	34.4055	34.4212	0.0157
66	100	1.98207	34.6474	34.6463	-0.0011
67	100	1.98209	34.6478	34.6463	-0.0015
68	75	1.98365	34.6785	34.6760	-0.0025
69	50	1.98108	34.6280	34.6269	-0.0011
70	30	1.97587	34.5256	34.5198	-0.0058
71	10	1.97435	34.4958	34.5055	0.0097

72	1998	1.97882	34.5836	34.5850	0.0014
73	500	1.95327	34.0823	34.0819	-0.0004
74	100	1.98881	34.7799	34.7728	-0.0071
75	1997	1.97902	34.5875	34.5843	-0.0032
76	499	1.95356	34.0880	34.0860	-0.0020
77	100	1.98870	34.7777	34.7757	-0.0020
78	1996	1.97919	34.5908	34.5906	-0.0002
79	501	1.95089	34.0356	34.0417	0.0061
80	100	1.98843	34.7724	34.7703	-0.0021
81	1998	1.97932	34.5934	34.5915	-0.0019
82	500	1.95562	34.1283	34.1257	-0.0026
83	99	1.96860	34.3829	34.3926	0.0097
84	0	1.95287	34.0744	no data	-
85	1998	1.97916	34.5902	34.5992	0.0090
86	1998	1.97935	34.5940	34.5992	0.0052
87	999	1.96840	34.3790	34.3770	-0.0020
88	500	1.94977	34.0137	34.0189	0.0052
89	500	1.94970	34.0123	34.0189	0.0066
90	400	1.94367	33.8942	33.8682	-0.0260
91	300	1.95504	34.1170	34.1093	-0.0077
92	200	1.95824	34.1797	34.1831	0.0034
93	150	1.96662	34.3441	34.3462	0.0021
94	100	1.97369	34.4828	34.4888	0.0060
95	100	1.97367	34.4824	34.4888	0.0064
97	75	1.97942	34.5954	34.5953	-0.0001
98	50	1.95534	34.1228	34.3087	0.1859
100	10	1.95264	34.0699	34.0520	-0.0179
101	1996	1.97854	34.5781	34.5901	0.0120
102	498	1.95039	34.0258	34.0196	-0.0062
103	100	1.98926	34.7887	34.7824	-0.0063
104	1997	1.97886	34.5844	34.5827	-0.0017
105	500	1.96926	34.3959	34.3959	0.0000
106	100	1.98819	34.7677	34.7611	-0.0066
107	1996	1.97892	34.5855	34.5845	-0.0010
108	499	1.96799	34.3709	34.3749	0.0040
109	99	1.98661	34.7366	34.7271	-0.0095
110	1997	1.97745	34.5567	34.5828	0.0261
111	498	1.96300	34.2730	34.2763	0.0033
112	99	1.98870	34.7777	34.7737	-0.0040
113	0	1.96838	34.3786	no data	-
114	1997	1.97600	34.5282	34.5862	0.0580
115	1997	1.97633	34.5347	34.5862	0.0515
116	999	1.96370	34.2868	34.2841	-0.0027
117	499	1.95999	34.2140	34.2177	0.0037
118	499	1.95998	34.2138	34.2177	0.0039
119	398	1.97330	34.4752	34.4790	0.0038
120	299	1.98311	34.6679	34.6661	-0.0018
169	200	1.98753	34.7547	34.7507	-0.0040
170	149	1.98850	34.7738	34.7708	-0.0030
171	100	1.98654	34.7353	34.7262	-0.0091
172	100	1.98667	34.7378	34.7262	-0.0116
173	77	1.98509	34.7068	34.6958	-0.0110
174	51	1.98189	34.6439	34.6334	-0.0105
175	30	1.97462	34.5011	34.4778	-0.0233
176	10	1.96765	34.3643	34.3546	-0.0097
197		1.95875	34.1897	環境モニター	-
198		1.96068	34.2275	環境モニター	-

199		1.95722	34.1597	環境モニター	-
200		1.96168	34.2472	環境モニター	-
201		1.96028	34.2197	環境モニター	-
202		1.96395	34.2917	環境モニター	-
203		1.94759	33.9710	環境モニター	-
204		1.97275	34.4644	環境モニター	-
205		1.96711	34.3537	環境モニター	-
1	0	1.97447	34.4981	no data	-
2	1997	1.97816	34.5706	34.5684	-0.0022
3	1997	1.97818	34.5710	34.5684	-0.0026
4	998	1.95860	34.1868	34.1802	-0.0066
5	500	1.98337	34.6730	34.6703	-0.0027
6	500	1.98334	34.6724	34.6703	-0.0021
7	400	1.98371	34.6796	34.6756	-0.0040
8	300	1.98441	34.6934	34.6906	-0.0028
9	200	1.98895	34.7826	34.7773	-0.0053
10	150	1.98880	34.7797	34.7747	-0.0050
11	100	1.98907	34.7850	34.7790	-0.0060
12	75	1.98894	34.7824	34.7764	-0.0060
14	50	1.98837	34.7712	34.7625	-0.0087
15	30	1.98067	34.6199	34.5609	-0.0590
16	10	num	num	34.4622	-
17	200	1.98886	34.7809	34.7773	-0.0036
18	150	1.98883	34.7803	34.7747	-0.0056
19	1996	1.97683	34.5445	34.5645	0.0200
20	500	1.97655	34.5390	34.5363	-0.0027
21	100	1.98845	34.7728	34.7675	-0.0053
22	1997	1.97820	34.5714	34.5697	-0.0017
23	500	1.97591	34.5264	34.5296	0.0032
24	100	1.98846	34.7730	34.7681	-0.0049
25	1998	1.97825	34.5724	34.5704	-0.0020
26	500	1.97386	34.4862	34.4882	0.0020
27	99	1.98542	34.7132	34.7052	-0.0080
28	1995	1.97914	34.5899	34.5882	-0.0017
30	500	1.93935	33.8097	33.8087	-0.0010
31	100	1.98778	34.7596	34.7551	-0.0045
32	1998	1.97963	34.5995	34.5992	-0.0003
33	1998	1.97966	34.6001	34.5992	-0.0009
34	101	1.98083	34.6231	34.6202	-0.0029
36	101	1.98084	34.6233	34.6202	-0.0031
37	0	1.97125	34.4349	no data	#VALUE!
38	1996	1.97863	34.5798	34.5789	-0.0009
39	1996	1.97858	34.5789	34.5789	0.0000
40	200	1.97589	34.5260	34.5260	0.0000
41	200	1.97594	34.5270	34.5260	-0.0010
42	501	1.94456	33.9117	33.8987	-0.0130
43	501	1.94452	33.9109	33.8987	-0.0122
44	150	1.97955	34.5979	34.5959	-0.0020
45	100	1.98360	34.6775	34.6679	-0.0096
46	100	1.98366	34.6787	34.6679	-0.0108
47	75	1.98307	34.6671	34.6635	-0.0036
48	50	1.98014	34.6095	34.5888	-0.0207
49	30	1.97103	34.4306	34.3735	-0.0571
50	10	1.96979	34.4063	34.4089	0.0026
206		1.96748	34.3609	環境モニター	-
207		1.97600	34.5282	環境モニター	-
208		1.97452	34.4991	環境モニター	-

209		1.97307	34.4707	環境モニター	-
211		1.97040	34.4182	環境モニター	-

7.1.3 Dissolved Oxygen Measurement

Personnel
Shinichiro Yokogawa (MWJ) :Operation leader
Hiroaki Muraki (MWJ)

(1) Objectives
Precise determination of D.O. using the Winkler titration with potentiometric detection.

(2) Parameters
D.O. in sea water

(3) Instruments and Methods
(a) Instruments and Apparatus
Dispenser: Eppendorf Comforpette 4800 / 1000 μl
OPTIFIX / 2ml
Metrohm Model 725 Multi Dosimat / 20ml
Titrator: Metrohm Model 716 DMS Titrino / 10ml of titration vessel
Pt electrode / 6.0403.100 (NC)
Software: Data acquisition / Metrohm, METRODATA / 606013.000 Endpoint evalution

(b) Methods:
Samples were collected from 12L Niskin bottles and a bucket for the surface to the volumetrically caribrated dry grass bottles, and 2-3 times of bottle volumes of sample water were overflowed during each sampling. The sampling bottles consists of the ordinary BOD flask (ca. 200ml) and grass stopper with long nipple, modified from the nipple presented in Green and Carritt (1966). The samples were fixed dissolved oxygen immediately following to measure the water temperature at the time of sampling for correction of the volume of sampling bottle. The bottles were kept at a wood box in the laboratory until titraion.
The analytical method and the preparation of reagents were fundamentally done according to the WHP Operations and Methods (Culberson, 1991). We used 0.07N thiosulfate of titrant at this cruise and volumetric apparatus except with titrator were calibrated before this cruise. We started analysis about 1 hours later after the fixation of dissolved oxygen. Titration and the end-point determination were made by 2 sets of Metrohm titrators with the automatic piston buret of 10ml and Pt electrode using whole bottle titration in the laboratory under controlled temperature. The water temperature in the laboratory was ca. 22℃ during this cruise. The end point was determined by the potentiometric method and evaluated by the second-derivative curve method with computerization.
Concentration of dissolved oxygen was calculated by equation (8) of WHP Operations and Methods (Culberson, 1991). However the amount of dissolved oxygen in the reagents was reported 0.0017ml at 25.5℃ (Murray et al., 1968), we used the value (=0.0027ml at 21℃) measured at the same laboratory in 1995 WOCE cruise in this cruise.
Dissolved oxygen concentrations were not corrected by seawater blank.

(4) Preliminary results
We analyzed 378 samples with 16 stations. Winkler D.O. and CTD D.O. value were shown to the table. Table.7.1.3-1 is the Leg-1's table. Table.7.1.3-2 is the Leg-2's table.

(5) References
Culberson,C.H. (1991) Dissolved oxygen, In WOCE Operations Manual, Volume 3: The Observational Program, Section 3.1: WOCE Hydrographic Program, Part 3.1.3: WHP Operations and Methods, WHP Office Report WHPO 91-1 / WOCE Report No.68/91
Culberson,C.H., G.Knapp, M.C.Stalcup, R.T.Williams and F.Zemlyak (1991) A comparison methods for the determination of dissolved Oxigen in seawater, WHP Office Report WHPO 91-2
Green,E.J. and D.E.Carritt (1966) An improved iodine determination for whole-bottle titrations,

Analyst, 91, 207-208
Murray, J.N., J.P.Riley and T.R.S.Wilson (1968) The solubility of oxygen in Winkler reagents used for determination of dissolved oxigen, Deep-Sea Res., 15, 237-238

Stn.A01 (mL/L)

Depth	Winkler	CTD
1498.3	1.1785	1.0943
599.1	1.008	0.8374
299.6	3.3125	3.08887
149.4	6.303	5.92764
100.1	5.9135	5.34723
49.9	5.902	5.31913
0	5.609	

Stn.A02 (mL/L)

Depth	Winkler	CTD
199.4	6.132	5.49205
99.3	4.903	4.24096
74.6	4.212	3.74766
49.7	4.548	4.00535
19.7	5.549	4.69821
0	5.064	

Stn.A04 (mL/L)

Depth	Winkler	CTD
200.2	4.682	4.08005
100.2	4.752	4.01243
74.9	4.624	3.86514
50.5	5.1665	4.52994
20.5	5.197	4.31796
0	4.893	

Stn.A06 (mL/L)

Depth	Winkler	CTD
1998.7	1.712	1.43324
998.4	0.6845	0.42956
498.9	2.714	2.39098
399.6	3.7045	3.3319
299.9	4.105	3.63323
199.8	4.0955	3.5837
149.9	4.2335	3.68431
99.7	4.449	3.79224
75.1	4.397	3.72694
50	4.591	4.11017
30.5	5.0815	4.24011
10.1	4.774	3.89201
0	4.759	

Stn.A11 (mL/L)

Depth	Winkler	CTD
1996.3	1.8155	1.57001
1001.8	1.006	0.75998
499.2	1.9	1.6708
400.5	2.8565	2.55534
299.9	4.473	4.12074
200.5	4.578	4.22516
150.6	5.7425	5.24724
99.7	5.674	5.19422
75.7	6.9235	6.55331
50.3	7.1565	6.40089
30.6	5.9535	5.06459
10.9	5.2395	4.38023
0	4.906	

Stn.A16 (mL/L)

Depth	Winkler	CTD
1998.2	1.589	1.31577
998.7	1.3035	1.04498
499.6	4.072	3.6004
398.9	4.3675	3.81654
300	4.881	4.24741
200.8	4.9565	4.31121
150.4	4.7065	4.07964
100.6	4.5245	3.86711
74.4	4.6925	3.97951
50.3	4.857	4.09185
30.2	4.9255	4.04206
10.5	4.635	3.70349
0	4.586	

Stn.G11 (mL/L)

Depth	Winkler	CTD
6124.8	3.8645	3.77489
5991.5	3.863	3.75307
5611.1	3.826	3.66687
5106.6	3.754	3.53717
4102	3.518	3.22794
3601.9	3.314	3.0014
3201.5	3.125	2.79849
2801.5	2.8295	2.51113
2088	2.049	1.73861
1741.5	1.5685	1.27132
0	4.697	

Stn.G12 (mL/L)

Depth	Winkler	CTD
4603.9	3.6455	3.46554
2402.5	2.462	2.13583
1493.6	1.2565	0.97244
1294.4	1.05	0.76356
1094.9	1.04	0.76292
896.3	1.067	0.79989
697.1	1.167	0.90735
546	1.5905	1.31618

Stn.G13 (mL/L)

Depth	Winkler	CTD
396	2.6135	2.44683
299.9	3.756	3.49929
199.9	5.744	5.26462
124.4	5.183	4.75585
70	5.198	4.55534
10.1	5.0585	3.90934

Stn.G31 (mL/L)

Depth	Winkler	CTD
6492	3.7905	3.74941
5942.8	3.766	3.6384
5204.6	3.715	3.50008
5029.4	3.694	3.46255
4466.5	3.5895	3.32079
3982.2	3.428	3.13831
3723.8	3.335	3.04082
3633.7	3.284	2.9883
3283.7	3.0935	2.78216
2985.3	2.893	2.58184
2736.8	2.658	2.35124
2240.8	2.026	1.72618
0	4.63	

Stn.G32 (mL/L)

Depth	Winkler	CTD
1934.7	1.5585	1.28904
1743.7	1.344	1.06791
1343.5	1.013	0.74966
951.9	1.192	0.92881
800.3	1.8575	1.56393
648.2	2.753	2.39301
504.6	3.771	3.2953
399.2	3.955	3.43603
250.1	4.3885	3.70482
149.9	4.68	3.9087
79.3	4.961	4.03073
19.3	4.632	3.63405

Table.7.1.3-1 Winkler D.O. and CTD D.O. value (Leg-1)

Stn.B01 (mL/L)

Depth	Winkler	CTD
498.9	3.0905	2.72071
398.4	4.1225	3.63108
300.5	4.4665	3.92465
199.8	5.213	4.59082
151	5.105	4.4432
100.4	5.0495	4.39518
75.1	5.1135	4.48339
50.3	5.822	5.0842
30.1	5.8065	4.91105
10	4.815	3.85049
0	4.719	

Stn.B06 (mL/L)

Depth	Winkler	CTD
1995.4	1.966	1.69497
998.1	0.835	0.59579
499.3	2.8955	2.54617
399.1	3.9245	3.47145
299.6	3.949	3.47854
198.9	4.283	3.74603
149.1	4.391	3.78586
100.1	4.358	3.73441
73.9	4.17	3.53133
49.9	4.381	3.73328
29.9	5.0595	4.20381
9.8	4.647	3.71647
0	4.651	

Stn.B11 (mL/L)

Depth	Winkler	CTD
1995.9	1.5895	1.30742
998.4	0.92	0.67651
498.6	3.558	3.14233
399.4	4.7415	4.21321
299.6	4.6655	4.11543
199.6	4.4815	3.9407
149.3	4.6105	4.00795
99.7	4.7555	4.15089
74.6	4.7215	4.08087
49.8	5.211	4.61724
29.3	5.23	4.39211
10.2	4.686	3.82274
0	4.693	

Stn.B12 (mL/L)

Depth	Winkler	CTD
1996.4	1.7425	1.46077
998.5	0.943	0.6943
499.2	2.6545	2.32506
399.8	3.6355	3.30431
299.3	4.767	4.29718
199.7	4.537	4.11313
150.4	4.81	4.2174
100.2	4.526	3.97146
74.5	4.3205	3.70763
50	5.0295	4.26005
30.3	5.2215	4.32763
10.2	4.799	3.74142
0	4.662	

Stn.B17 (mL/L)

Depth	Winkler	CTD
1998.2	1.829	1.57004
999.4	0.982	0.71479
500.5	2.212	1.90514
400.2	3.268	2.95322
300.2	3.647	3.30534
200.3	4.701	4.18281
149.9	4.504	4.01572
99.9	4.6245	4.06503
75.2	4.647	4.08022
49.8	5.477	4.71438
30.1	5.3075	4.52684
10.1	4.6425	3.73167
0	4.627	

Stn.B22 (mL/L)

Depth	Winkler	CTD
1996.5	1.6735	1.37452
998.9	1.138	0.85959
498.8	4.155	3.59832
398.2	4.125	3.52288
299.4	4.3295	3.66556
199.7	4.496	3.78479
149.4	4.6015	3.87565
99.9	4.82	4.07732
76.5	5.116	4.26951
50.5	5.187	4.27728
30.1	5.0585	4.07054
10.3	4.605	3.62585
0	4.612	

Stn.B23 (mL/L)

Depth	Winkler	CTD
1997.6	1.516	1.26085
998	1.4655	1.21374
499.8	5.37	4.53934
400	5.3845	4.59711
299.5	5.217	4.49359
200	4.9165	4.19423
149.8	4.9735	4.23697
99.9	4.904	4.15471
75.2	5.1135	4.34177
49.7	5.289	4.44348
30.2	5.41	4.47109
10.1	4.7505	3.69431
0	4.624	

Stn.B33 (mL/L)

Depth	Winkler	CTD
1996.1	1.586	1.10538
199.4	4.4885	3.39815

Stn.B33a (mL/L)

Depth	Winkler	CTD
500.6	3.9375	3.35405
150.1	4.5515	3.52413
100.1	4.585	3.52609
74.8	4.6995	3.57961
50.1	5.4175	4.0758
30	5.4645	4.03269
10	4.8765	3.39427
0	4.693	

Table.7.1.3-2 Winkler D.O. and CTD D.O. value (Leg-2)

7.1.4 CO_2 measurement

(1) Partial pressure of CO_2 (pCO_2) in the atmosphere and sea surface

Concentrations of CO_2 in the atmosphere and the sea surface were measured continuously during the entire cruise by the automated system with a non-dispersive infrared (NDIR) analyzer (BINOS™). It runs on half hour or two hours cycle during which four standards, an ambient air sample, and a head space sample from the equilibrator were analyzed.

The ambient air sample taken from the bow is introduced into the NDIR through a mass flow controller which controls the air flow rate at about 0.5L/min, a cooling unit, a perma pure dryer, and a desiccant holder ($Mg(ClO_4)_2$).

The equilibrator has shower head space in the top through which surface water is forced at a rate of 5-8L/min. Air in the head space is circulated with an air pump at 0.5-0.8L/min in a closed loop through two cooling units, a perma pure dryer, and the desiccant holder.

For calibration, compressed gas standards with nominal mixing ratios of 270, 330, 360, 410, ppmv (parts per million by volume) were used.

In this cruise, measurement of discrete pCO_2 was also tested. From this test, it was found that a seawater of 1000 ml was necessary for 100 % equilibration in case of using membrane-type equilibrator.

(2) Total Alkalinity

Samples were drawn from 12 L drawn from 12 L Niskin™ bottles into 250 ml polyethylene bottles. Bottles were rinsed twice and filled from the bottom, overflowing a volume while taking care not to entrain any bubbles. The bottles were then sealed by a screw cap with an inner cap and stored at room temperature for maximum of 24 hours prior to analysis.

The total alkalinity titration system consists of a titrator (Radiometer, TitraLab™, TIM900) and an autoburette (Radiometer, ABU901). The titration was made by adding HCl (0.1N) to seawater past the carbonic acid point. Glass (Radiometer, REF201) and reference (Radiometer REF201) electrodes were used to measure emf. The repeatability of measured total alkalinity was 0.1 % on average.

Seawaters for measurement of total alkalinity were taken at 10 stations. All the values reported are set to the Dickson's CRM.

(3) Total dissolved inorganic carbon (TDIC)

a.Underway TDIC

Concentration of TDIC in the sea surface water collected by a pump from a depth of 4 m was continuously measured every 20 minutes by a coulometer (Carbon Dioxide Coulometer Model 5012, UIC Inc.). Seawater was introduced into a receptacle (nominal 30 cm^3) and 2 cm^3 of 10 percents (v/v) phosphoric acid was added to evole CO_2 gas. The evolved CO_2 gas was purged by CO_2 free nitrogen gas (purity;99.9999%) for 12 minutes at a flow rate of 130 cm^3/min. and was absorbed into an electrolyte solution. Acids formed by reacting with the absorbed CO_2 in the solution were titrated with hydrogen ions. The titration was monitored by the coulometer. Using a calibration curve produced from a series of sodium carbonates (0, 500, 1000, 1500, 2000, 2500 mM), TDICs were determined from titration values. All the values reported are set to the Dickson's CRM.

b.Discrete TDIC

Concentrations of TDIC in seawater collected by CTD hydrocasts were measured by the almost the same procedure as the underway TDIC measurement. The seawater was taken into a glass bottle (250 cm^3) and 30 cm^3 was used for the determination of TDIC.

Seawaters for measurement of TDIC were taken at 10 stations. All the values reported are set to the Dickson's CRM.

(4) Water sampling for C^{14} measurement

During this cruise, surface seawaters were taken at an interval of a few hours. The seawaters were collected into a glass bottle (250 cm3) and saturated mercuric chloride (50 µl) was added to prevent further biological activity.

7.1.5 XCTD/XBT measurements

(1) Personnel

Yasushi Yoshikawa (JAMSTEC): Researcher

Fumitaka Yoshiura (GODI): Operation Leader

Toshio Furuta (GODI): Operator

Shuji Nakabayashi (GODI): C.R. Officer

Keiichiro Shishido (GODI): C.R. Officer

Naoto Morioka (GODI): 2nd. R. Officer

(2) Objectives

XCTD and/or XBT measurements have been carried out along 7 sections in order to observe mesoscale features in the Kuroshio Extension. The Objectives for XCTD measurements are to clarify the distribution of NPIW across the Kuroshio Extension, and to clarify the blend tendency of the core of NPIW along the downstream. Total of 40 XCTD measurements have been carried in the 4 CTD meridional sections, in order to interpolate every 2 CTD casts. Total of 91 XBT measurements have been carried along 34-00N and 35-00N. Another east-west section along 37-30N has been observed by using 40 XBTs and 10 XCTDs. These east-west sections are helpful to understand features of Kuroshio meander, eddies, and NIPW distribution.

(3) Measurement Parameters

XBT and XCTD operation system in the R/V Mirai are provided. Both XBT probes and XCTD probes, we brought in, are made by the Tsurumi-Seiki, Japan. XBT probe is T-7 type, which can measure temperature profile upper 760m deep. XCTD can measure profiles of temperature and conductivity upper 1000m deep.

(4) Locations of XBT/XCTD casts

(4-1) Locations of XCTD casts along 150-00E (July 27-29)

(37-14.91N, 149-59.92E), (36-45.00N, 149-59.45E), (36-14.91N, 149-59.21E),
(35-44.96N, 149-59.87E), (35-15.00N, 149-59.49E), (34-44.90N, 150-00.25E),
(34-14.94N, 149-59.67E), (33-45.00N, 149-59.72E), (33-15.01N, 150-00.42E),
(32-45.00N, 150-00.00E)

(4-2) Locations of XCTD casts along 152-30E (August 15-16)

(32-45.00N, 152-30.00E), (33-15.00N, 152-30.00E), (33-45.00N, 152.30.00E),
(34-15.00N, 152-30.00E), (34-45.00N, 152-30.00E), (35-15.00N, 152-30.00E),

(35-45.00N, 152-30.00E), (36-15.00N, 152-30.00E), (36-45.00N, 152-30.00E), (37-15.00N, 152-30.00E),

(4-3) Locations of XCTD casts along 155-00E (August 10-12)
(37-15.02N, 155-01.31E), (36-45.00N, 155-00.06E), (36-14.99N, 154-59.95E), (35-45.01N, 154-59.02E), (35-15.03N, 155-00.04E), (34-44.97N, 155-00.69E), (34-15.00N, 155-00.43E), (33-45.01N, 155-00.21E), (33-15.00N, 154-59.92E), (32-45.00N, 154-59.98E)

(4-4) Locations of XCTD casts along 157-30E (August 8-10)
(34-45.03N, 157-29.91E), (34-15.01N, 157-29.94E), (33-45.01N, 157-30.33E), (33-14.99N, 157-29.95E), (32-44.96N, 157-30.14E), (35-15.00N, 157-30.00E), (35-45.00N, 157-29.97E), (36-15.00N, 157-30.01E), (36-45.05N, 157-29.90E), (37-14.99N, 157-29.88E)

(4-5) Locations of XBT casts along 34-00N (July 31- August 3)
(33-59.91N, 151-39.96E), (33-59.86N, 151-19.98E), (33-59.99N, 151-00.01E), (33-59.96N, 150-40.00E), (33-59.89N, 150-20.00E), (34-00.08N, 150-00.01E), (34-00.03N, 149-39.96E), (34-00.27N, 149-19.93E), (34-00.28N, 148-59.99E), (34-00.30N, 148-39.98E), (33-59.57N, 148-20.04E), (33-59.65N, 148-00.00E), (33-59.48N, 147-40.00E), (33-59.27N, 147-20.02E), (33-59.90N, 147-00.00E), (34-00.15N, 146-39.93E), (33-59.91N, 146-20.01E), (34-00.50N, 146-00.04E), (33-59.81N, 145-40.00E), (34-00.64N, 145-19.97E), (34-00.77N, 145-00.08E), (33-59.91N, 144-39.25E), (34-00.53N, 144-20.00E), (34-00.53N, 144-00.00E), (34-00.00N, 144-40.01E), (34-00.00N, 143-20.00E), (33-59.73N, 143-00.01E), (33-59.49N, 142-39.97E), (33-59.90N, 142-20.01E), (34-00.03N, 142-00.00E), (33-45.01N, 140-20.03E), (33-52.93N, 140-00.01E), (33-58.55N, 139-40.00E)

(4-6) Locations of XBT casts along 35-00N (August 5-8)
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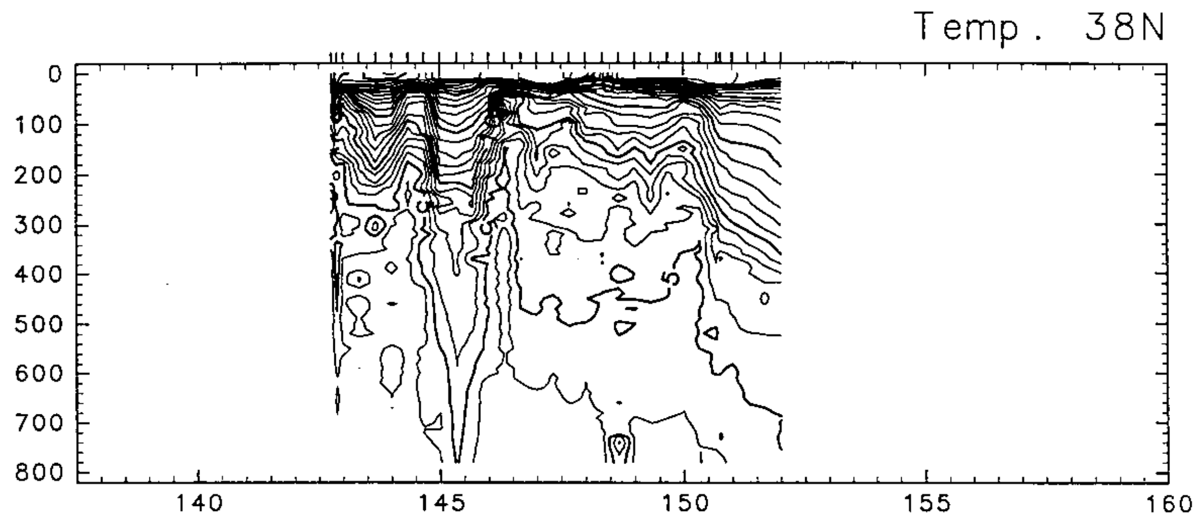
(35-00.32N, 147-00.07E), (34-59.52N, 147-20.12E), (34-59.33N, 147-40.23E), (34-59.71N, 147-59.99E), (35-00.06N, 148-20.03E), (35-00.18N, 148-40.01E), (35-00.21N, 149-00.00E), (34-59.72N, 149-20.03E), (35-00.19N, 149-40.12E), (34-59.77N, 150-00.06E), (34-59.95N, 150-20.02E), (34-59.97N, 150-40.14E), (34-59.78N, 150-59.97E), (35-00.02N, 151-20.03E), (34-59.96N, 151-40.04E), (35-00.03N, 152-00.02E), (34-59.73N, 152-20.02E), (35-00.03N, 152-40.04E), (35-00.06N, 153-00.02E), (35-00.21N, 153-20.01E), (34-59.99N, 153-40.06E), (35-00.07N, 153-59.91E), (34-59.98N, 154-19.97E), (34-59.93N, 154-40.02E), (34-59.71N, 155-00.01E), (35-00.15N, 155-20.01E), (35-00.01N, 155-39.99E), (34-59.75N, 156-00.00E), (35-00.01N, 156-20.02E), (35-00.06N, 156-40.00E), (35-00.07N, 157-00.00E), (35-00.86N, 157-20.01E),

(5) Data archive

Those data transmitted to the Japan Meteorological Agency as the Batty report in a 24 hours they observed. All data will be archived at JAMSTEC data management computer after Y. Yoshikawa will calibrate them.

(6) Figures of the Temperature and Salinity Sections observed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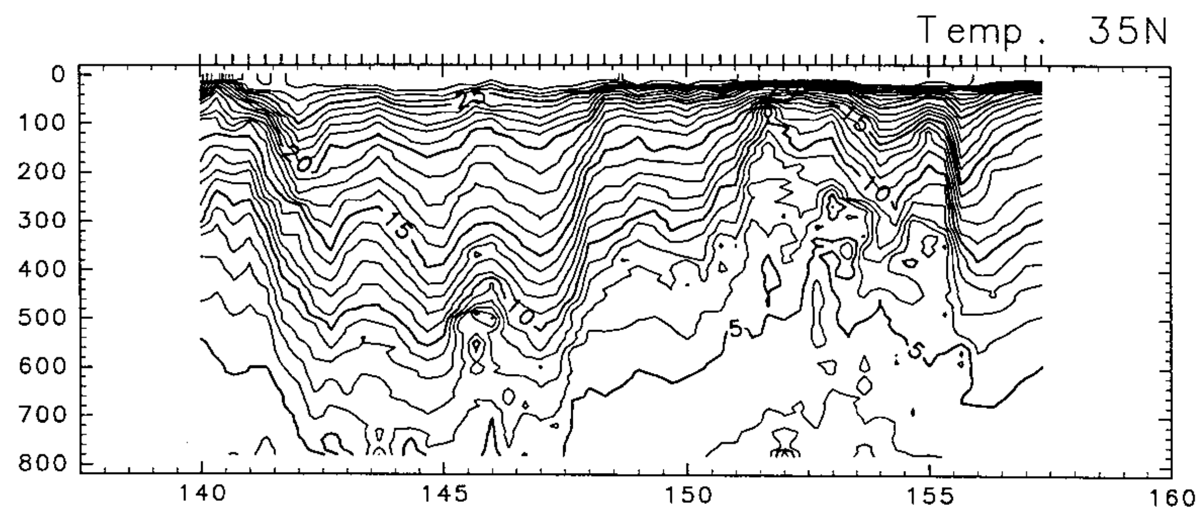
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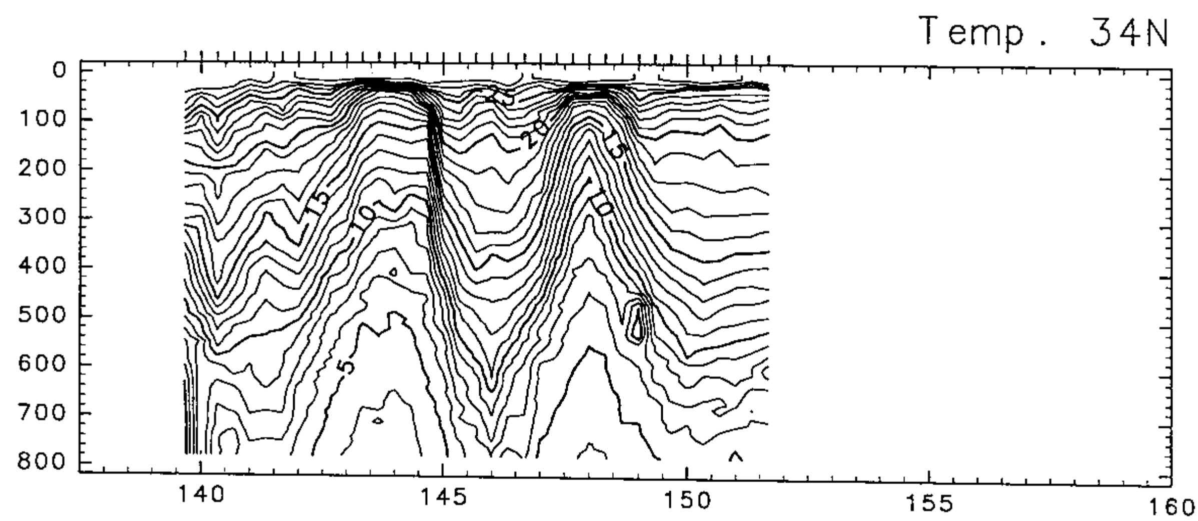
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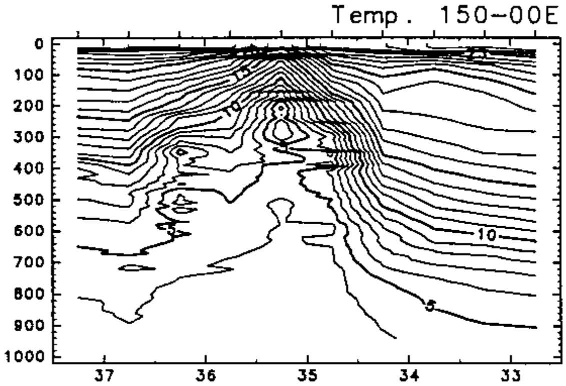
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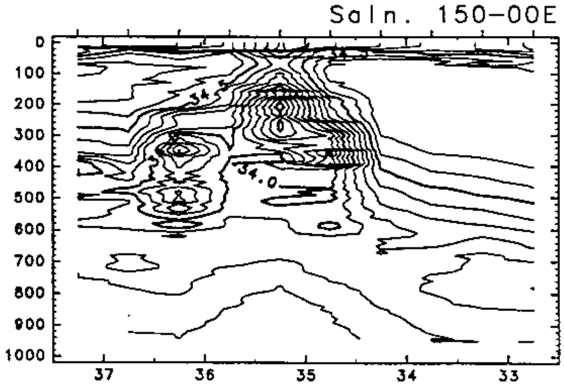
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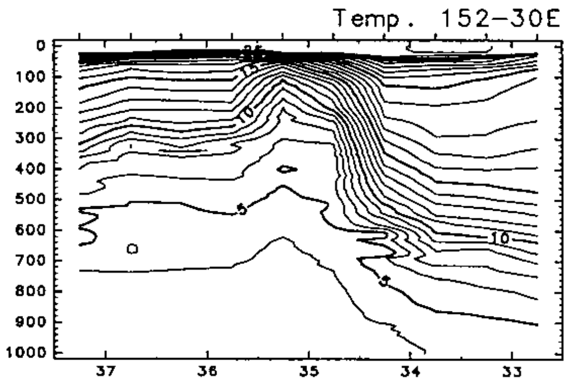
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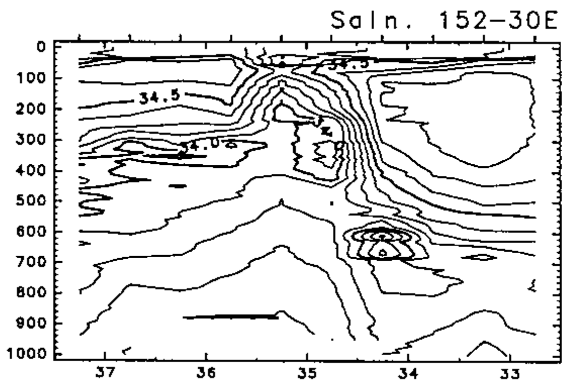
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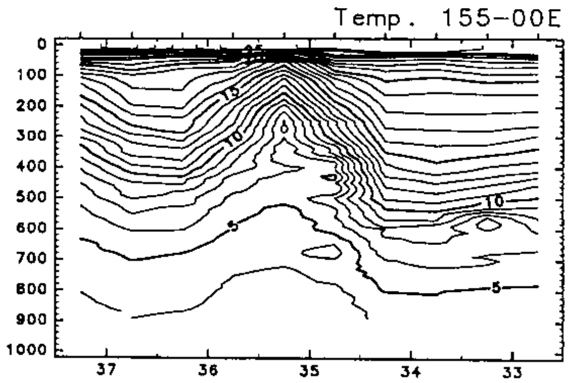
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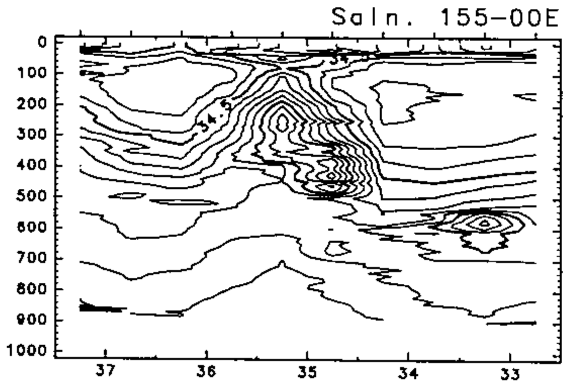
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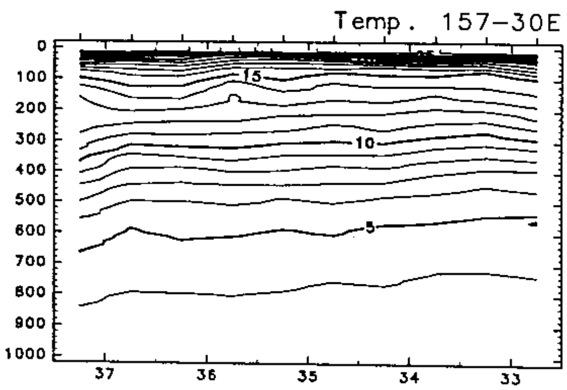
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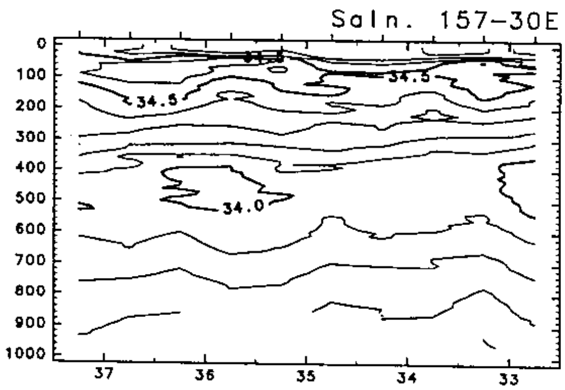
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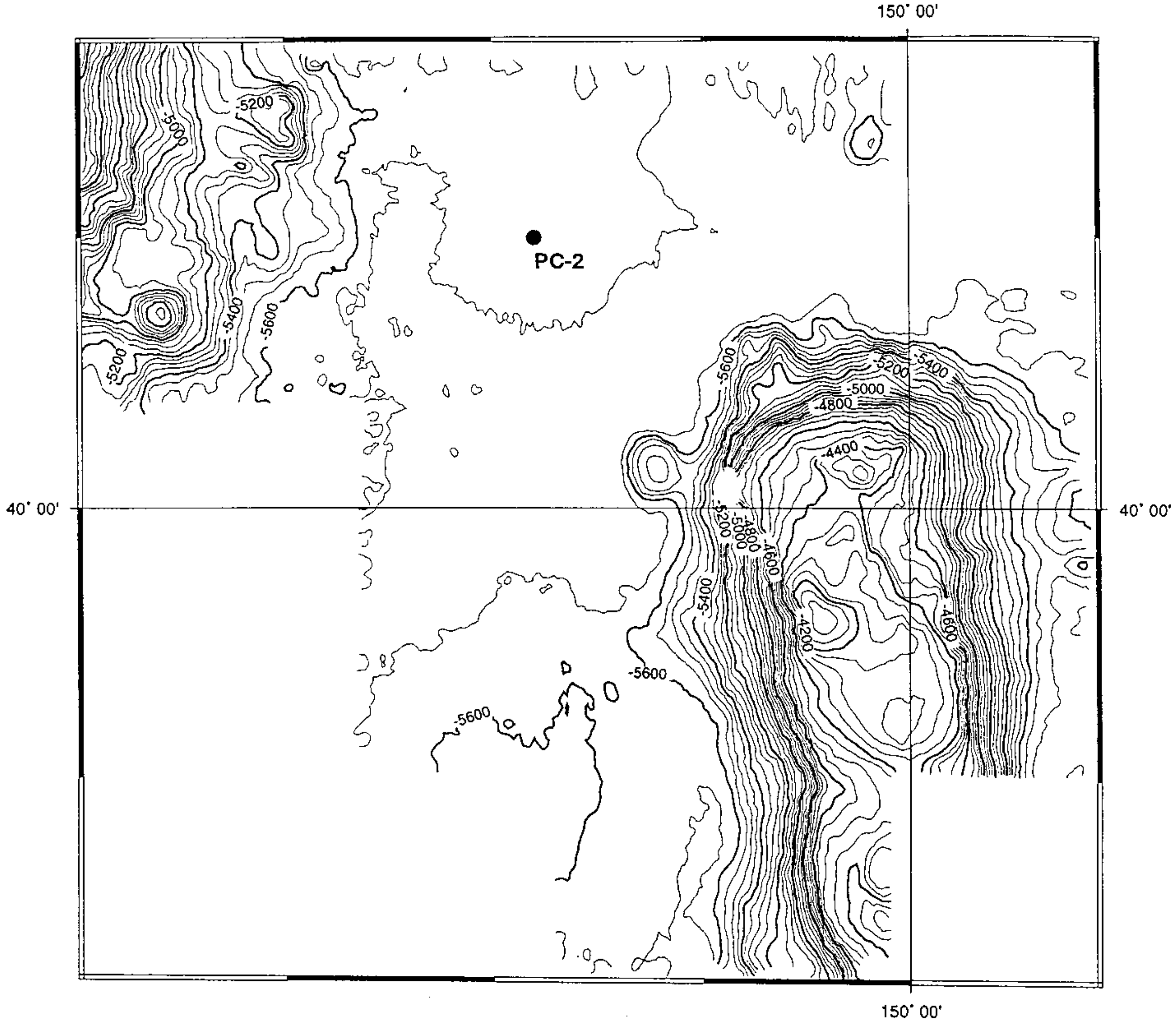
A02 Site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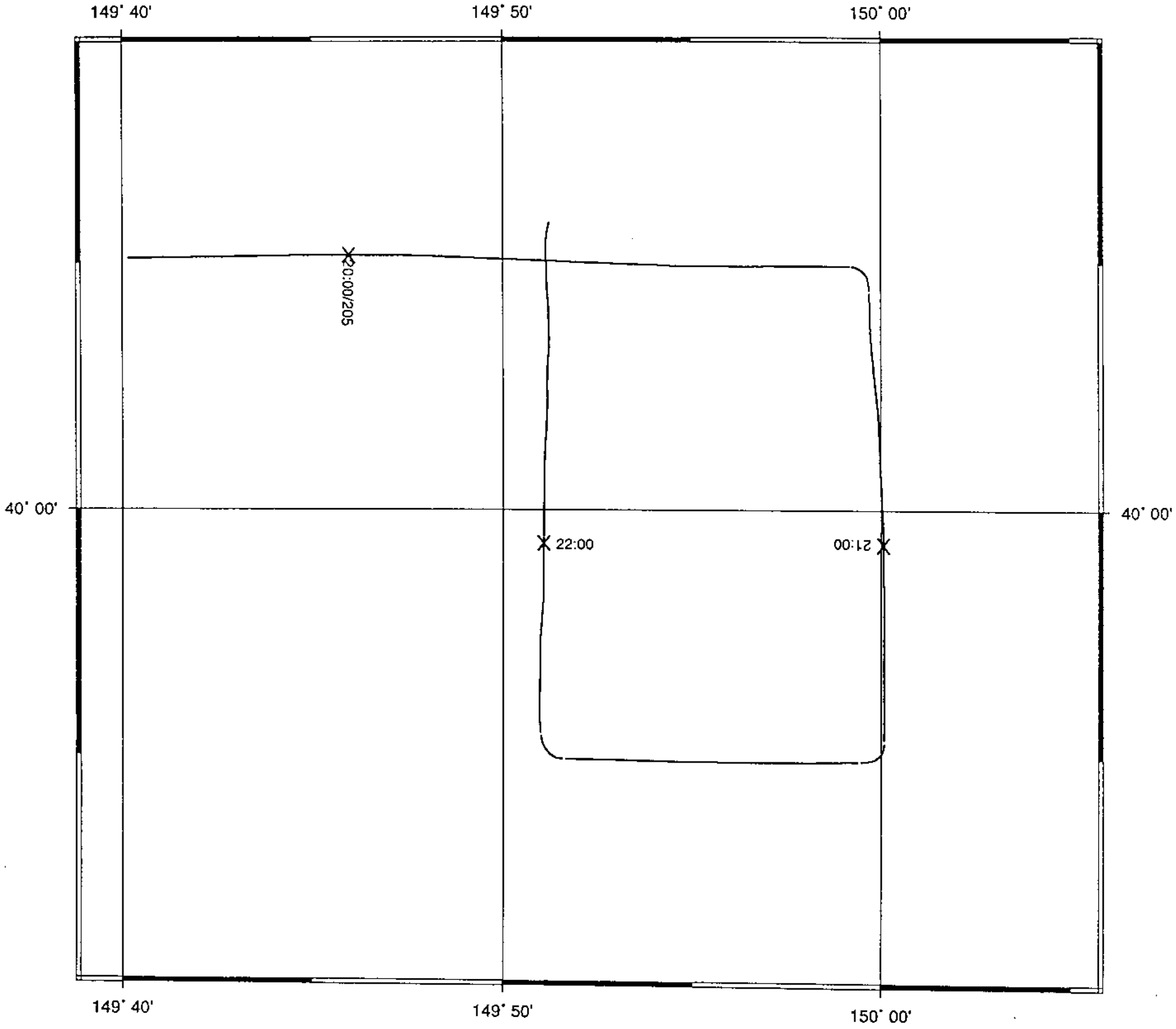
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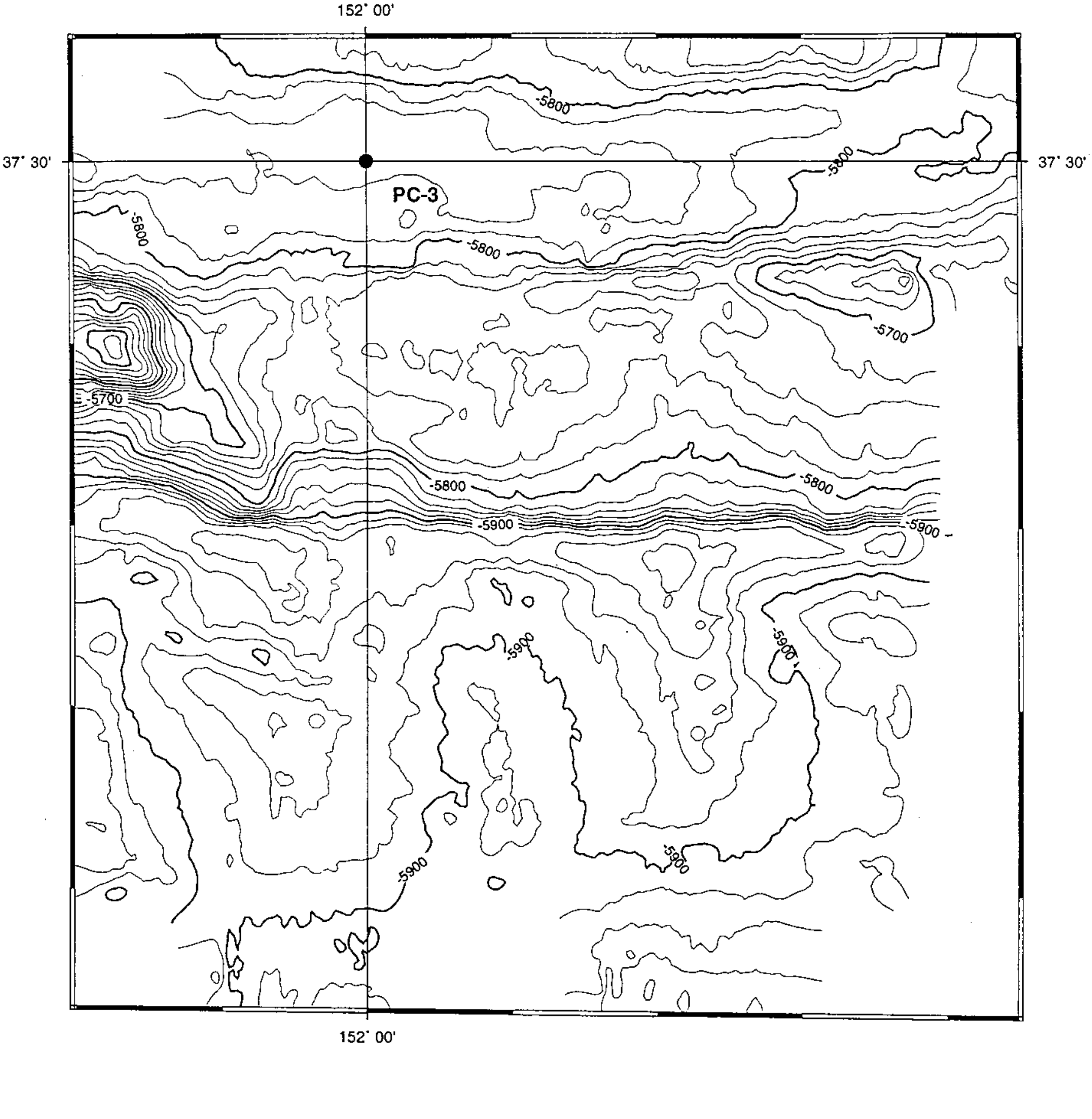
A03 Site



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37° 30'
37° 30'
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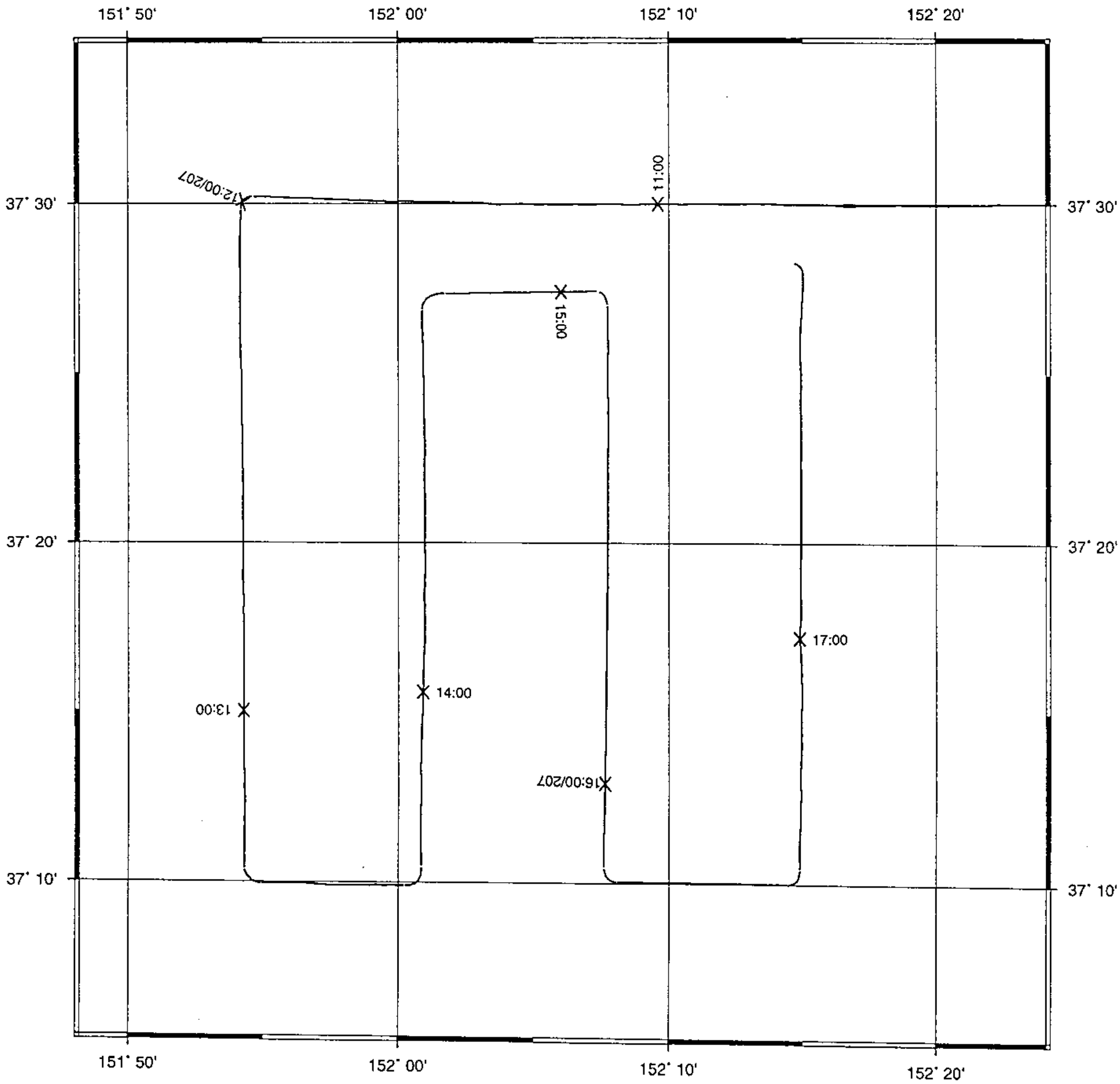
-5900
152° 00'

A03 Site



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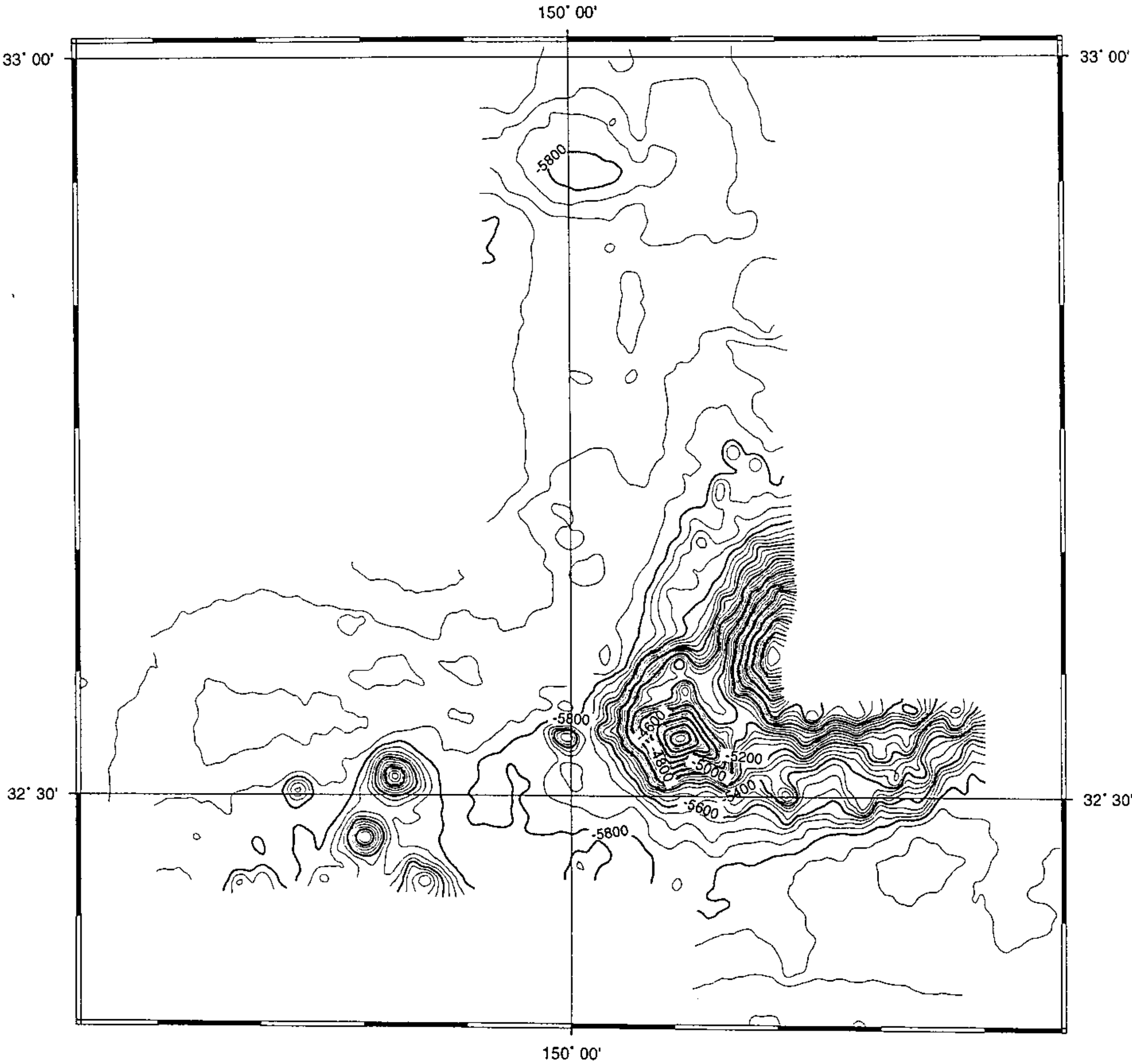
Bouy Site South



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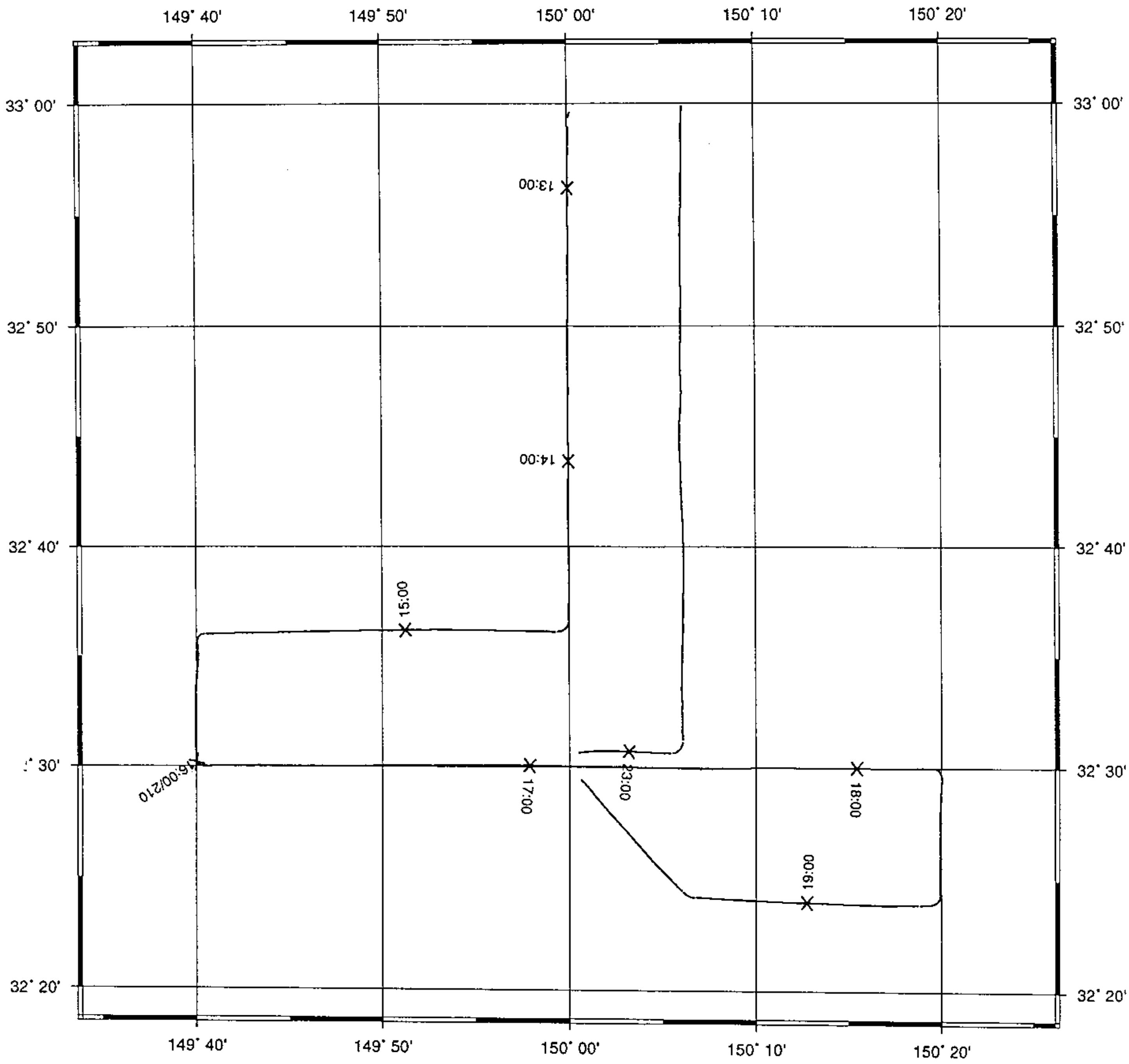
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14:00
15:00
16:00/210
17:00
18:00
19:00
23:00

7.2 ADCP BUOY Subsurface mooring

Personal

Hirofumi Yamamoto (JAMSTEC) Principal investigator
Yasushi Yoshikawa (JAMSTEC)
Takeo Matsumoto (MWJ)
Fujio Kobayashi (MWJ)
Toshikatsu Sugawara (MWJ)
Naotaka Togashi (MWJ)
Motoi Matsuhashi (MWJ)
Hiroaki Muraki (MWJ)

(1) Objectives

The purpose is to get the knowledge of subsurface ocean circulation in the North Pacific Ocean. In the cruise(MR99-K04),we recovered one subsurface ADCP mooring at 37° 19.34N-152° 28.35E,and deployed one subsurface ADCP mooring at 37° 19.04N-152° 28.76E.

(2) Parameters

Current profiles
Echo intensity

(3) Instrument

Recover ADCP

Serial Number:1257(Mooring No.98042037152E)

RDI BB-ADCP

Distance to first bin: 8m
Pings per ensemble: 16
Time per ping: 2.00s
Bin length: 8.00m
Sampling Interval: 3600s

Deployed ADCP

Serial Number: 562(Mooring No.99072637152E)

RDI NB-ADCP

Distance to first bin: 8m
Pings per ensemble: 16
Time per ping: 2.00s

Bin length: 8.00m

Sampling Interval: 3600s

(4) Recovery

We recovered one subsurface ADCP mooring at 37 ° 19.34N-152 ° 28.35E which were deployed on 20.April.1998(MR98-03).We monitored depth of acoustic releaser after we released the anchor.

(5) Deployment

One ADCP mooring was deployed at 37 ° 19.04N-152 ° 28.76E.The mooring was designed to moor the ADCP 5600m. After we dropped the anchor, we monitored depth of the acoustic releaser. The descending rate was .2.2m/sec. Table.1.1 shows position of mooring.

Table.1.1 ACDP buoy Position of Mooring

Recovery

	Release Comand Sending	Top Buoy Emergence	Start	Finish
Date	1999/7/26	1999/7/26	1999/7/26	1999/7/26
Time	4:54 (JST)	5:00 (JST)	5:40 (JST)	8:25 (JST)
Latitude	-	-	-	-
Longitude	-	-	-	-
Depth	-	-	-	-

Deploy

	Start	Sinker Drop	Releaser Calibration
Date	1999/7/26	1999/7/26	1999/7/26
Time	13:00 (JST)	15:06 (JST)	-
Latitude	37° 22.3345'N	37° 19.2064'N	37° 19.0346'N
Longitude	152° 29.6176'E	152° 28.8647'E	152° 28.7615'E
Depth	-	5,987m	-

Releaser Calibration

	Releaser Calibration			
	1-1	1-2	1-3	
Date	1999/7/26	1999/7/26	1999/7/26	
Time	-	-	-	
Latitude	37° 19.4486'N	37° 19.4496'N	37° 19.4506'N	
Longitude	152° 28.2523'E	152° 28.2531'E	152° 28.2540'E	
Distance	5,903m	5,904m	5,906m	
	2-1	2-2	2-3	2-4
Date	1999/7/26	1999/7/26	1999/7/26	1999/7/26
Time	-	-	-	-
Latitude	37° 18.9569'N	37° 18.9496'N	37° 18.9416'N	37° 18.9003'N
Longitude	152° 28.9225'E	152° 28.9257'E	152° 28.9287'E	152° 28.9338'E
Distance	5,815m	5,885m	5,851m	5,822m
	3-1	3-2	3-3	
Date	1999/7/26	1999/7/26	1999/7/26	
Time	-	-	-	
Latitude	37° 18.6995'N	37° 18.6923'N	37° 18.6845'N	
Longitude	152° 27.6109'E	152° 27.6014E	152° 27.5923'E	
Distance	6,107m	6,110m	6,120m	

ADCP BUOY

		Deploy
Date		1999/7/26
Position	Releaser calibration	37° 19.0346'N 152° 28.7615'E
Current meter	Model	NB-ADCP
	S/N	562
	Depth	400m
	Interval	120min
	Model	RCM-9
	S/N	292
	Depth	500m
	Interval	120min
	Model	RCM-8
	S/N	11665
	Depth	1,000m
	Interval	120min
	Model	RCM-8
	S/N	11667
	Depth	2,000m
	Interval	120min
	Model	RCM-8
	S/N	11031
	Depth	4,000m
	Interval	120min
Releaser (Nichiyu)	S/N	42373C 44033D
Transponder (Benthos)	S/N	50351
	Receive	13.0kHz
	Tranmit	15.0kHz

係留系構成図

船舶及び航海番号：「みらい」MR98-03
設置日時：平成10年4月20日
設置位置：37° 19.338'N,　152°28.347'E
設置水深：5982m
係留系全長：5620m

○	ADCP		S/N 1257, 150kHz, SC, BB-BW150
§	チェーン	5.0m	
‖	ワイヤー	60m	
◎§	ガラスフロート	7個	
∫	ベクトラントエル	10m	
◆	アンデラー		S/N 11708
∬	ケブラーロープ	1.5m	
|	ケブラーロープ	502m	
◎§	ガラスフロート	7個	
∫	ベクトラントエル	10m	
◆	アンデラー		S/N 11710
∬	ケブラーロープ	1.5m	
|	ケブラーロープ	502m	
■	トランスポンダ		S/N 46422, Rx:13.0kHz, Tx:14.5kHz
|	ケブラーロープ	502m	
◎§	ガラスフロート	6個	
∫	ベクトラントエル	10m	
◆	アンデラー		S/N 11709 (arc)
∬	ケブラーロープ	1.5m	
|	ケブラーロープ	1002m	
|	ケブラーロープ	1002m	
◎§	ガラスフロート	4個	
∫	ベクトラントエル	10m	
◆	アンデラー		S/N 10774 (arc)
∬	ケブラーロープ	1.5m	
|	ケブラーロープ	182m	
|	ケブラーロープ	184m	
|	ケブラーロープ	482m	
◎§	ガラスフロート	6個	
∫	ベクトラントエル	10m	
▲	切り離し装置		S/N 4219-1C
§	チェーン	2.5m	
|	ケブラーロープ	1002m	
▲	切り離し装置		S/N 4271-3G　10000m用
§	チェーン	2.5m	
Ⅱ	ナイロンロープ	90m	
§	チェーン	5.0m	
＝	シンカー	1.8ton (air)	

備考：ADCP、アンデラー流速計のサンプリング間隔は、2時間に設定。

設置係留系構成図

船舶	「みらい」
航海番号	MR99-K04
日時	平成11年7月27日
位置	37° 19.0346'N 152° 28.7615'E
水深	5,987m
係留系全長	5600m

○	ADCP	NB-ADCP	S/N 531
§	チェーン	5.0m	
‖	ワイヤー	60m	
◎§	ガラスフロート	7個	
∫	ベクトラントエル	10m	
◆	アンデラー流速計	RCM9	S/N 292
|	ケプラーロープ	500m	
◎§	ガラスフロート	5個	
∫	ベクトラントエル	10m	
◆	アンデラー流速計	RCM8	S/N 11665
∬	ケプラーロープ	1.5m	
|	ケプラーロープ	500m	S/N M5-14
■	トランスポンダ	BENTHOS	S/N 50351
|	ケプラーロープ	500m	S/N M5-12
◎§	ガラスフロート	6個	
∫	ベクトラントエル	10m	
◆	アンデラー流速計	RCM8	S/N 11667
∬	ケプラーロープ	1.5m	
|	ケプラーロープ	1000m	S/N M10-10
|	ケプラーロープ	1000m	S/N M10-11
◎§	ガラスフロート	4個	
∫	ベクトラントエル	10m	
◆	アンデラー流速計	RCM8	S/N 11031
∬	ケプラーロープ	1.5m	
|	ケプラーロープ	500m	S/N M5-13
◎§	ガラスフロート	6個	
∫	ベクトラントエル	10m	
▲	切り離し装置	NICHIYU L	S/N 42373C
§	チェーン	2.5m	
|	ケプラーロープ	1000m	S/N M10-12
▲	切り離し装置	NICHIYU L	S/N 44033D
§	チェーン	2.5m	
II	ナイロンロープ	90m	
§	チェーン	2.5m	
〓	シンカー	8ton(air)	

備考：ADCP、アンデラー流速計のサンプリング間隔は２時間に設定。

AANDERAA INSTRUMENTS
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Calibration Sheet
RCM 8
Serial No. 11708

Calibration points

Original (to accompany instrument)

Ch. No.	Parameter	Sensor	Range	Calibration points and corresponding readings			Unit
1	Reference			Fixed reading, N:	250		
2	Temperature	Sensor 1227	Low: -2.4	Cal. point	1.05	20.94	degrees C
			to 21.4 C	Reading, N	162	1003	
			Wide: -0.3	Cal. point	1.07	31.04	degrees C
			to 32.1 C	Reading, N	43	986	
			High: 10.1	Cal. point	10.67	34.32	degrees C
			to 36.0 C	Reading, N	28	961	
3	Conductivity	Cell 2994	0 - 74	Cal. point	0.07	49.86	mmho/cm
		No. 4658	mmho/cm	Reading, N	0	689	
4	Pressure	Sensor 3249	0 - 9000	Cal. point	62.27	542.14	kg/cm2
		No. 3249	PSIA	Reading, N	120	872	
5	Direction	Compass 1248		Cal. point	90	270	degrees magn.
		No. 20599		Reading, N	256	765	
6	Speed	Rotor 2916		Individual units not calibrated			

Conductivity Cell, reading with sea-water loop:

100 ohm, N = 388

1000 ohm, N = 38

Information about calibration is given in Chapter 6 in the Operating Manual for RCM 7/8 (TD No. 159).

Coefficients

Value of parameter in given unit = $A + BN + CN^2 + DN^3$

Ch. No.	Parameter	A	B	C	D	Unit
1	Reference	0	1	0	0	
2	Temp. Low	-2.633E+00	2.290E-02	-1.344E-06	1.937E-09	degrees C
	Temp. Wide	-4.646E-01	3.604E-02	-8.388E-06	4.300E-09	degrees C
	Temp. High	9.977E+00	2.477E-02	-1.549E-06	2.214E-09	degrees C
3	Conductivity[1]	7.226E-02	7.226E-02	0	0	mmho/cm
4	Pressure	-1.430E+01	6.381E-01	0	0	kg/cm2
5	Direction	1.000E+00	3.500E-01	0	0	degrees magn.
6	Speed	1.100E+00	2.906E-01	0	0	cm/sec.

[1] Cell form factor: K = 2.810 cm^{-1}

Place Nesttun Date 13/2 19 98

Signature Ingunn Bjerke

Form No 320

November 1994

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AANDERAA INSTRUMENTS
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Calibration Sheet
RCM 8
Serial No. 11710

Calibration points

Original (to accompany instrument)

Ch. No.	Parameter	Sensor	Range	Calibration points and corresponding readings			Unit
1	Reference			Fixed reading, N:	274		
2	Temperature	Sensor 1227	Low: -2.4 to 21.4 C	Cal. point	1.05	20.94	degrees C
				Reading, N	161	1003	
			Wide: -0.3 to 32.1 C	Cal. point	1.07	31.06	degrees C
				Reading, N	41	986	
			High: 10.1 to 36.0 C	Cal. point	10.67	34.32	degrees C
				Reading, N	26	961	
3	Conductivity	Cell 2994 No. 4661	0 - 74 mmho/cm	Cal. point	0.00	49.91	mmho/cm
				Reading, N	0	691	
4	Pressure	Sensor 3249 No. 1211	0 - 9000 PSIA	Cal. point	62.27	542.14	kg/cm2
				Reading, N	115	864	
5	Direction	Compass 1248 No. 20571		Cal. point	90	270	degrees magn.
				Reading, N	255	766	
6	Speed	Rotor 2916		Individual units not calibrated			

Conductivity Cell, reading with sea-water loop:

100 ohm, N = 390

1000 ohm, N = 39

Information about calibration is given in Chapter 6 in the Operating Manual for RCM 7/8 (TD No. 159).

Coefficients

Value of parameter in given unit = $A + BN + CN^2 + DN^3$

Ch. No.	Parameter	A	B	C	D	Unit
1	Reference	0	1	0	0	
2	Temp. Low	-2.606E+00	2.288E-02	-1.344E-06	1.937E-09	degrees C
	Temp. Wide	-3.909E-01	3.597E-02	-8.388E-06	4.300E-09	degrees C
	Temp. High	1.003E+01	2.472E-02	-1.549E-06	2.214E-09	degrees C
3	Conductivity 1)	0.000E+00	7.223E-02	0	0	mmho/cm
4	Pressure	-1.141E+01	6.407E-01	0	0	kg/cm2
5	Direction	1.000E+00	3.500E-01	0	0	degrees magn.
6	Speed	1.100E+00	2.906E-01	0	0	cm/sec.

1) Cell form factor: K = 2.817 cm^{-1}

Place Nesttun Date 19/2 19 98

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Calibration Sheet

RCM 8

Serial No. 11709

Calibration points

Original (to accompany instrument)

Ch. No.	Parameter	Sensor	Range	Calibration points and corresponding readings			Unit
1	Reference			Fixed reading, N:	254		
2	Pressure	Sensor 3249 S/N 1210	0 - 9000 PSIA	Cal. point	62.27	342.34	kg/cm2
				Reading, N	122	861	
				Cal. point			
				Reading, N			
				Cal. point			
				Reading, N			
3	Conductivity	Cell 2994 No.4660	0 - 74 mmho/cm	Cal. point	0.00	50.03	mmho/cm
				Reading, N	0	689	
4	Temperature	Sensor 1227	Arctic: -2.6 to 5.6 C	Cal. point	1.05	5.04	degrees C
				Reading, N	470	966	
5	Direction	Compass 1248 No.20570		Cal. point	90	270	degrees magn.
				Reading, N	259	762	
6	Speed	Rotor 2916		Individual units not calibrated			

Conductivity Cell, reading with sea-water loop:

100 ohm, N = 391

1000 ohm, N = 39

Information about calibration is given in Chapter 6 in the Operating Manual for RCM 7/8 (TD No. 159).

Coefficients

Value of parameter in given unit = $A + BN + CN^2 + DN^3$

Ch. No.	Parameter	A	B	C	D	Unit
1	Reference	0	1	0	0	
2	Pressure	-1.695E+01	6.494E-01	0	0	kg/cm2
3	Conductivity[1)]	0.000E+00	7.261E-02	0	0	mmho/cm
4	Temperature	-2.751E+00	8.146E-03	-1.601E-07	7.991E-11	degrees C
5	Direction	1.000E+00	3.500E-01	0	0	degrees magn.
6	Speed	1.100E+00	2.906E-01	0	0	cm/sec.

[1)] Cell form factor: K = 2.840 cm^{-1}

Place Nesttun Date 13/2 19 98

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Form No 320

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Calibration Sheet

RCM 8

Serial No. 10774

Calibration points

Original (to accompany instrument)

Ch. No.	Parameter	Sensor	Range	Calibration points and corresponding readings			Unit
1	Reference			Fixed reading, N: 641			
2	Pressure	Sensor 3249 S/ 491	0 - 9000 PSIA	Cal. point	62.27	542.14	kg/cm2
				Reading, N	127	887	
				Cal. point			
				Reading, N			
				Cal. point			
				Reading, N			
3	Conductivity	Cell 2994 No. 3357	0 - 74 mmho/cm	Cal. point	0.07	50.19	mmho/cm
				Reading, N	0	689	
4	Temperature	Sensor 1227	Arctic: -2.6 to 5.6 C	Cal. point	1.05	5.04	degrees C
				Reading, N	462	965	
5	Direction	Compass 1248 No. 18394		Cal. point	90	270	degrees magn.
				Reading, N	251	769	
6	Speed	Rotor 2916		Individual units not calibrated			

Conductivity Cell, reading with sea-water loop:

100 ohm, N = 388

1000 ohm, N = 38

Information about calibration is given in Chapter 6 in the Operating Manual for RCM 7/8 (TD No. 159).

Coefficients

Value of parameter in given unit = $A + BN + CN^2 + DN^3$

Ch. No.	Parameter	A	B	C	D	Unit
1	Reference	0	1	0	0	
2	Pressure	-1.792E+01	6.314E-01	0	0	kg/cm2
3	Conductivity[1]	7.273E-02	7.273E-02	0	0	mmho/cm
4	Temperature	-2.635E+00	8.034E-03	-1.601E-07	7.991E-11	degrees C
5	Direction	1.000E+00	3.500E-01	0	0	degrees magn.
6	Speed	1.100E+00	2.906E-01	0	0	cm/sec.

[1] Cell form factor: K = 2.828 cm^{-1}

Place Nestkun Date 19/2 19 98

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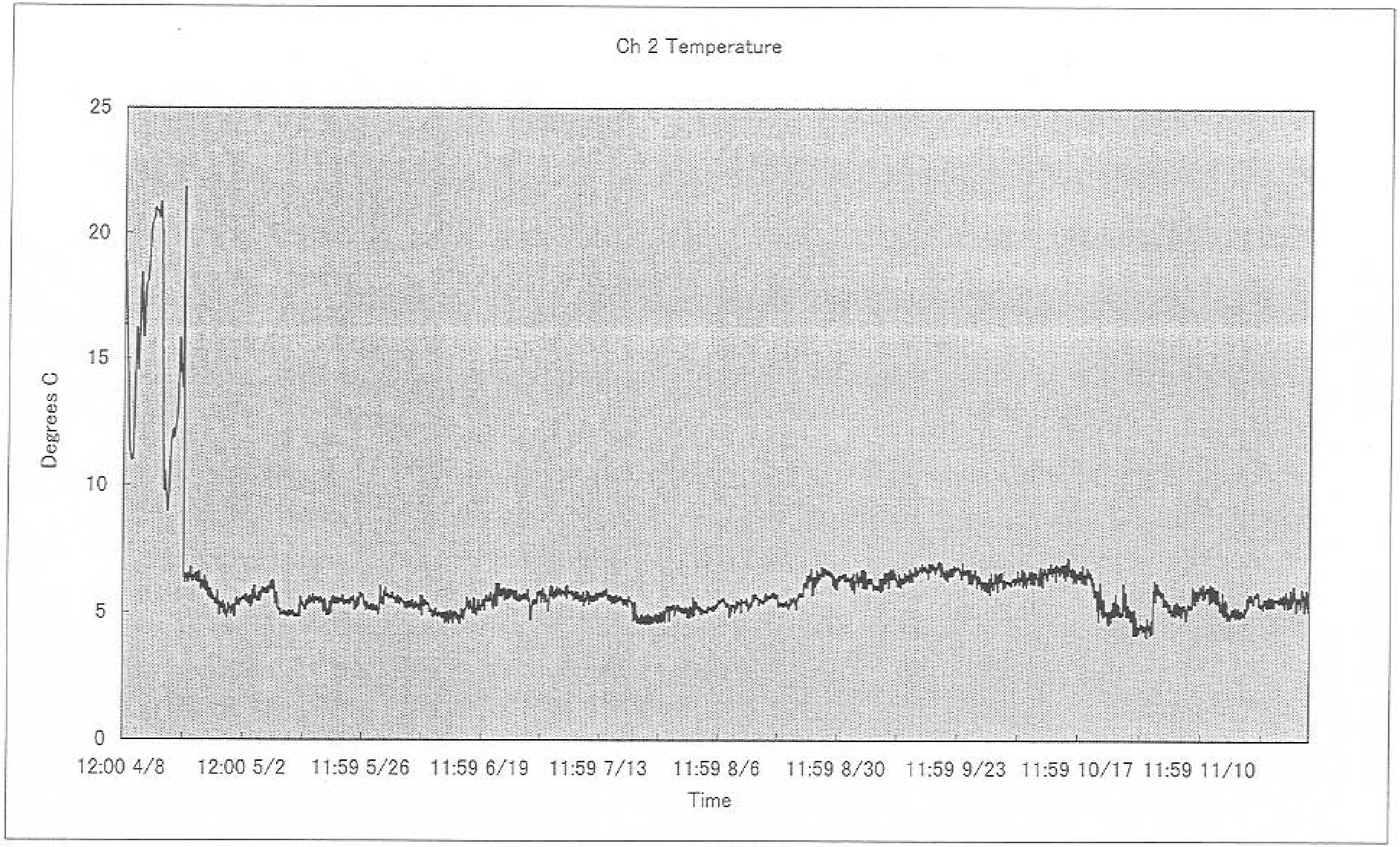
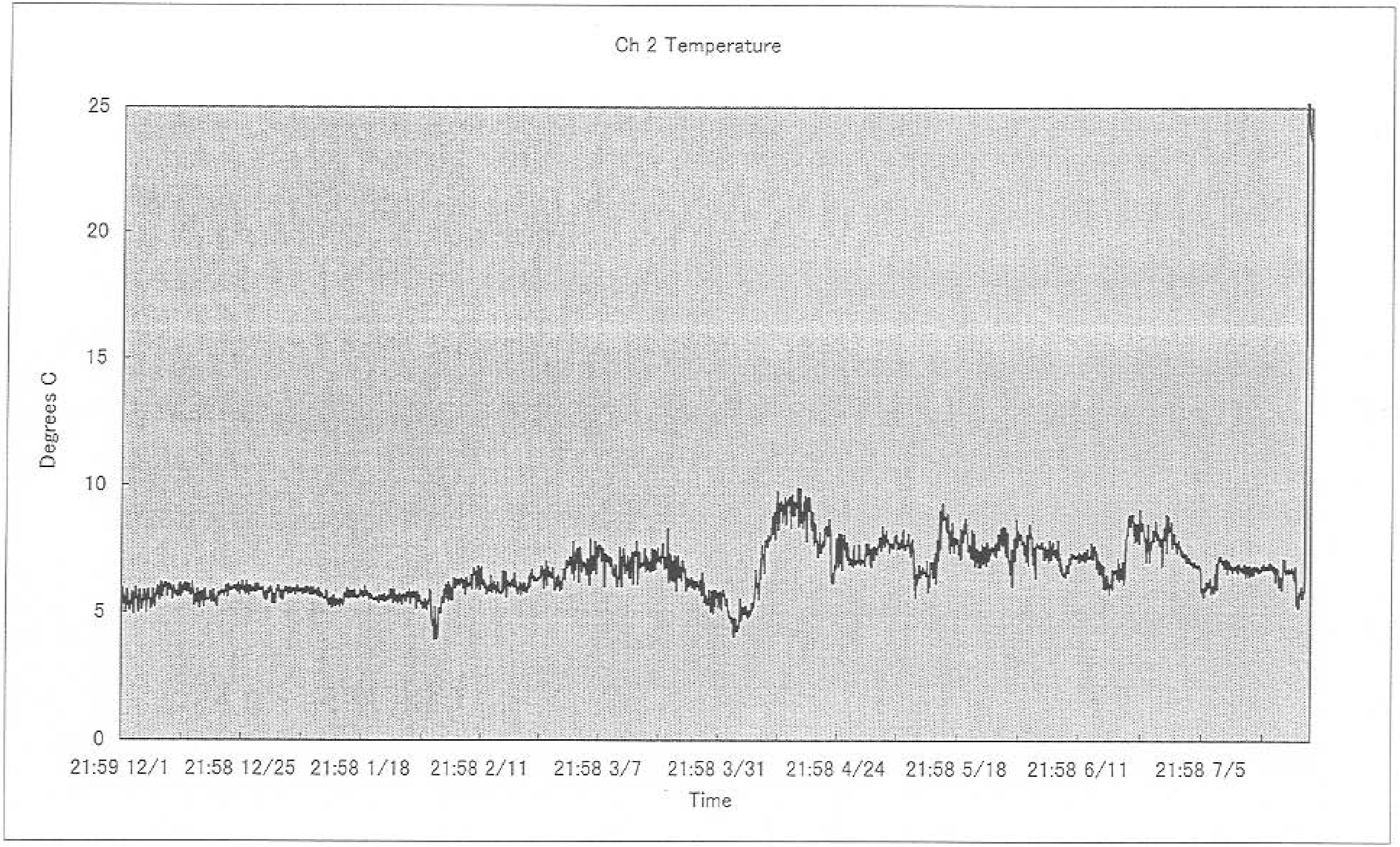


Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

Data processed by 4059
Aanderaa Instruments AS



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Sampling interval: 120 minutes

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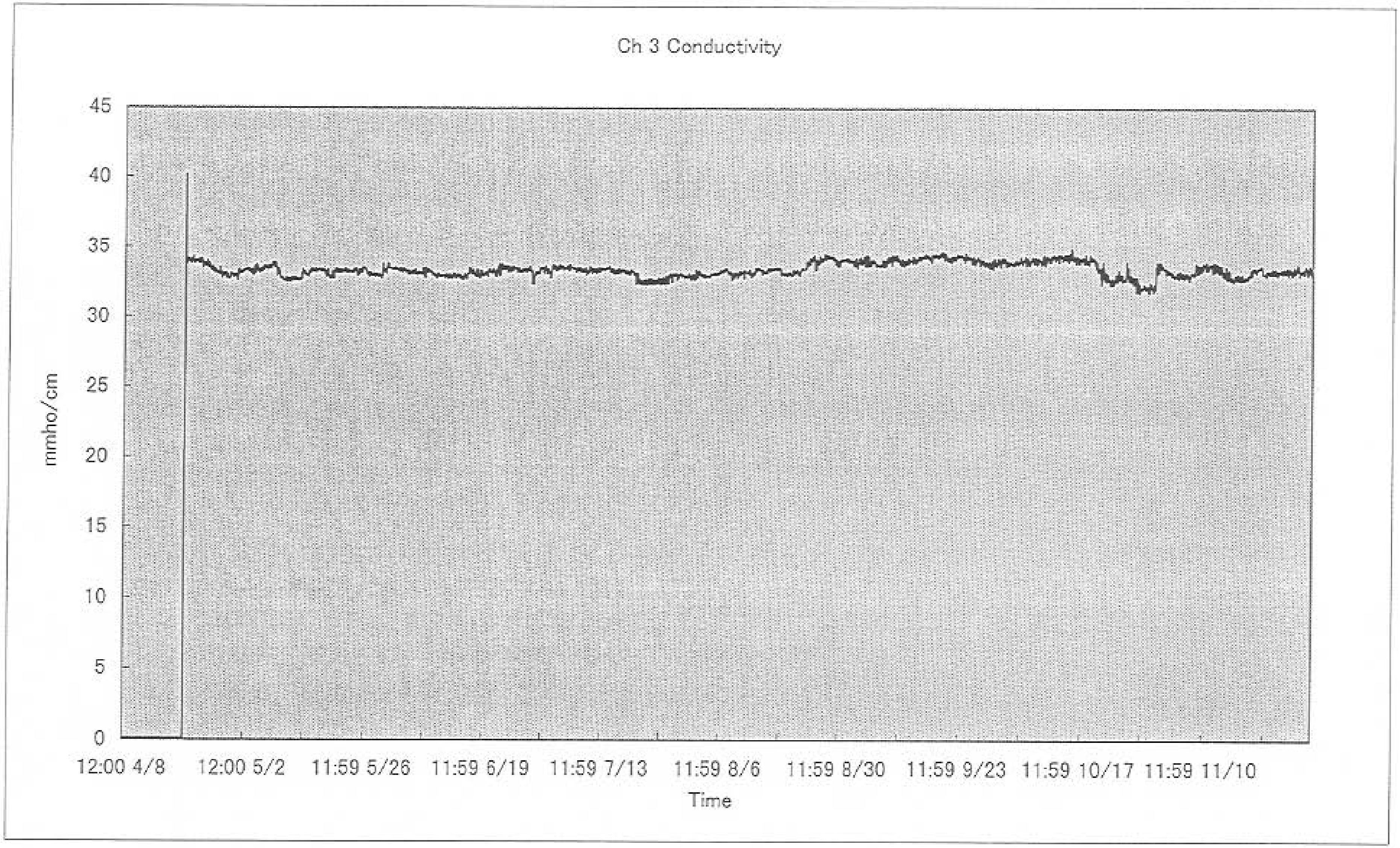

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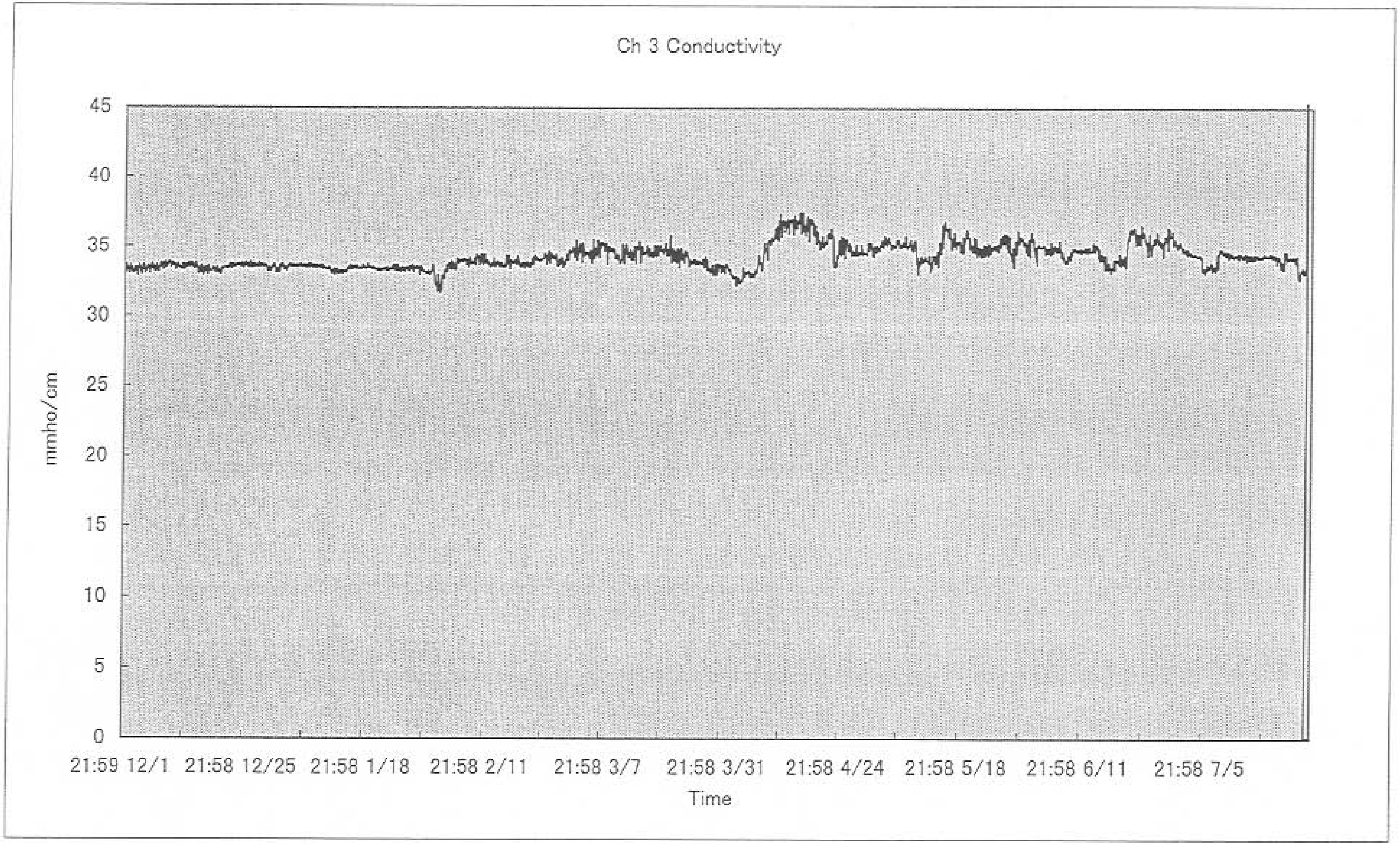

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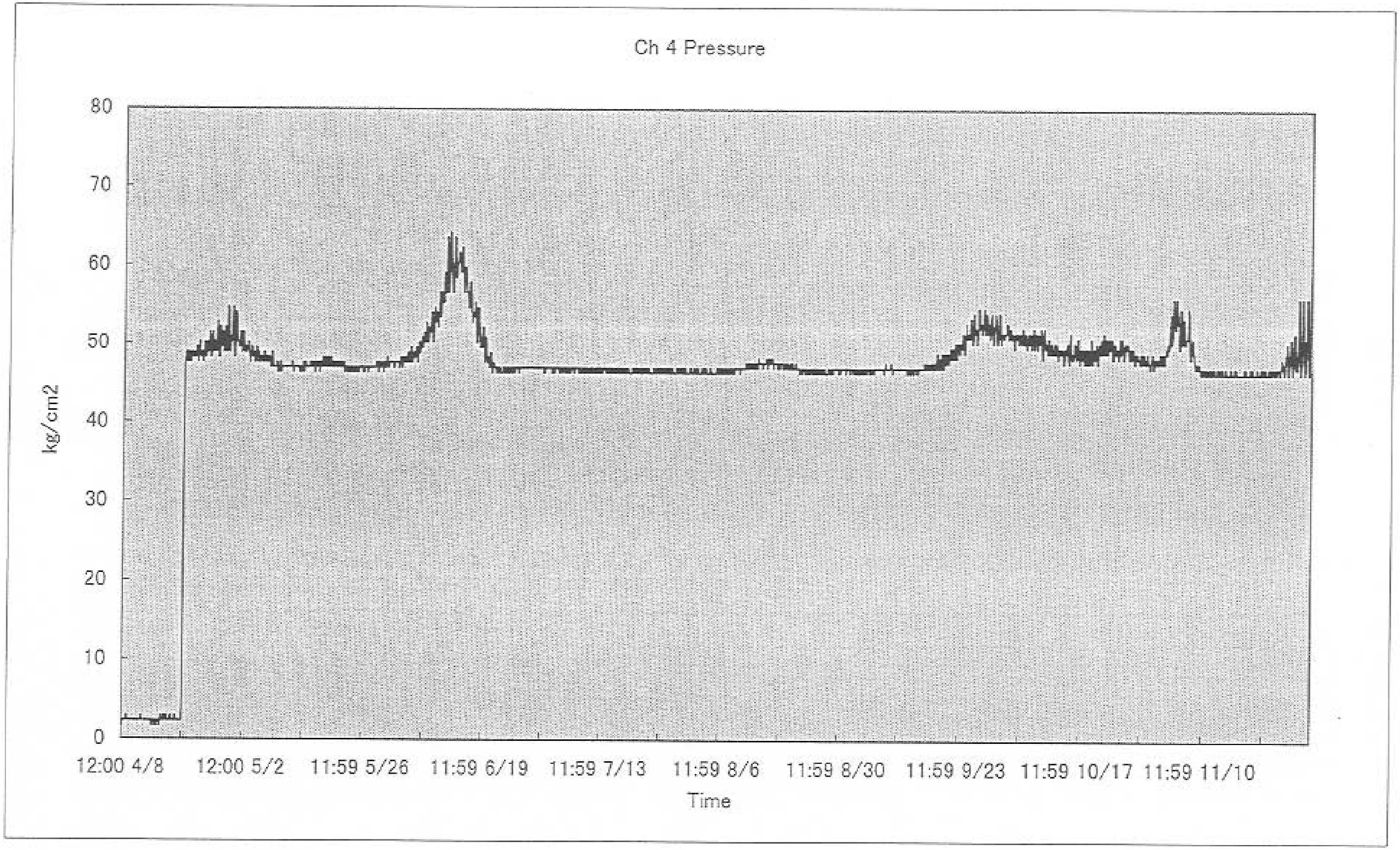

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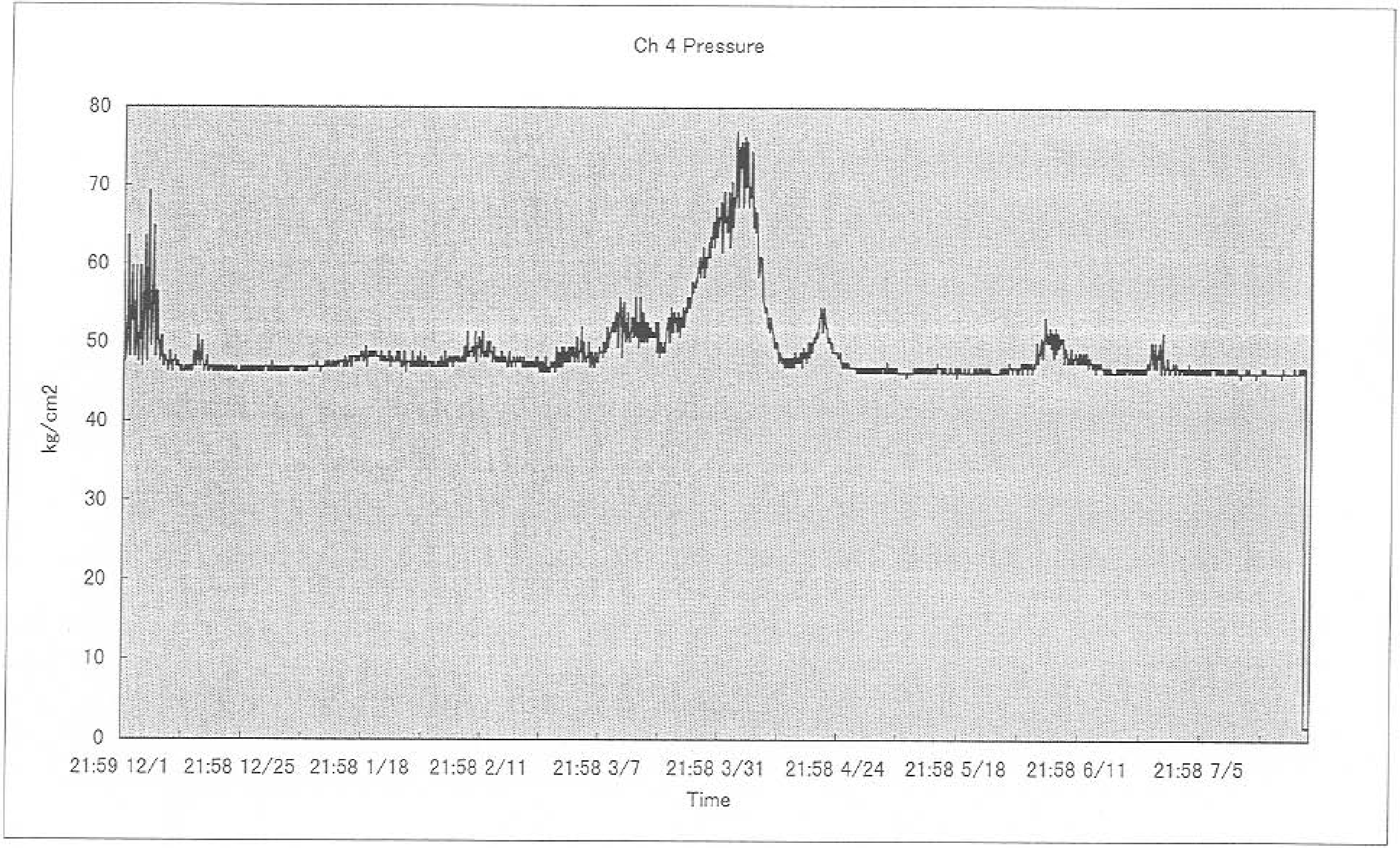

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Sampling interval: 120 minutes

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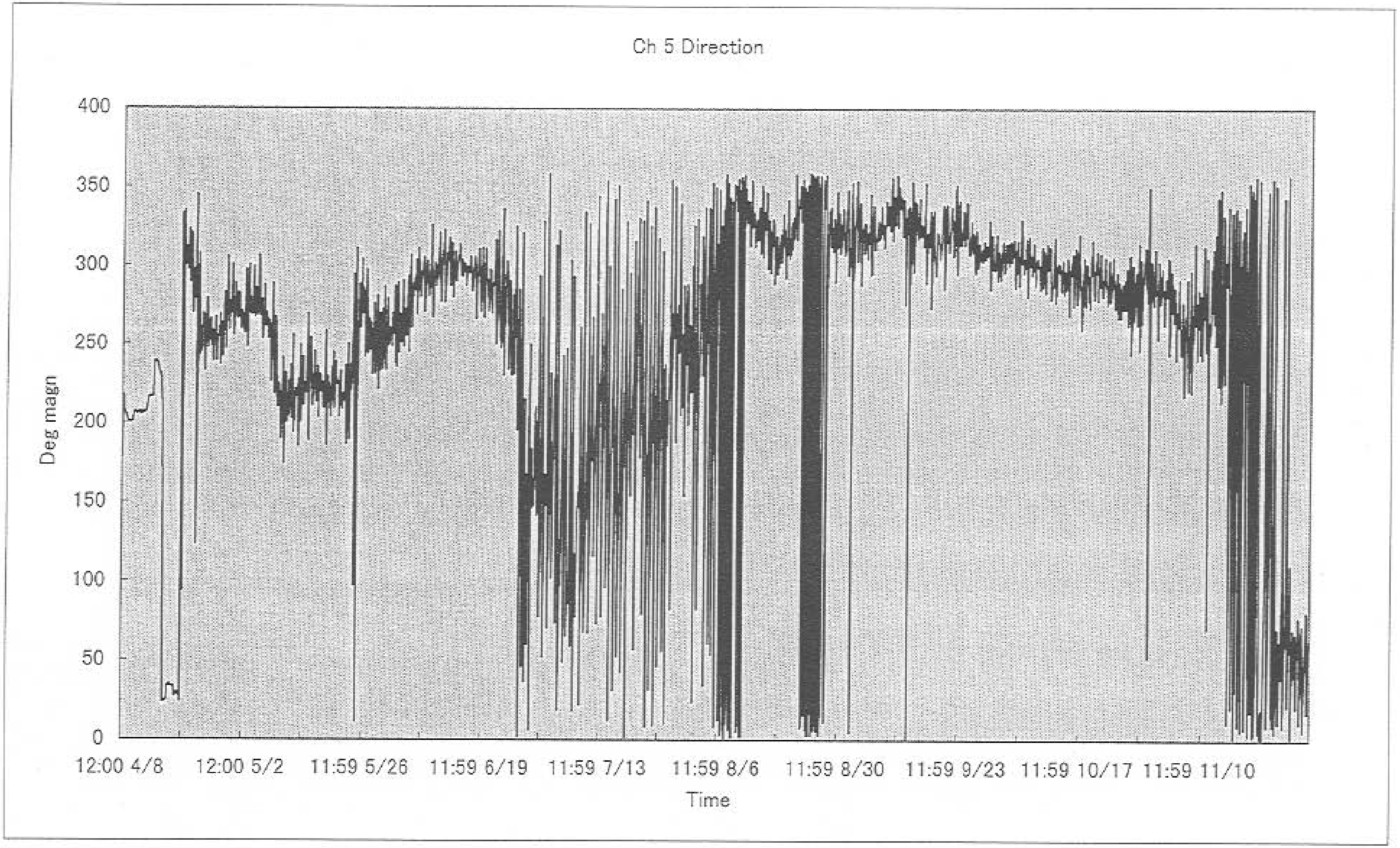

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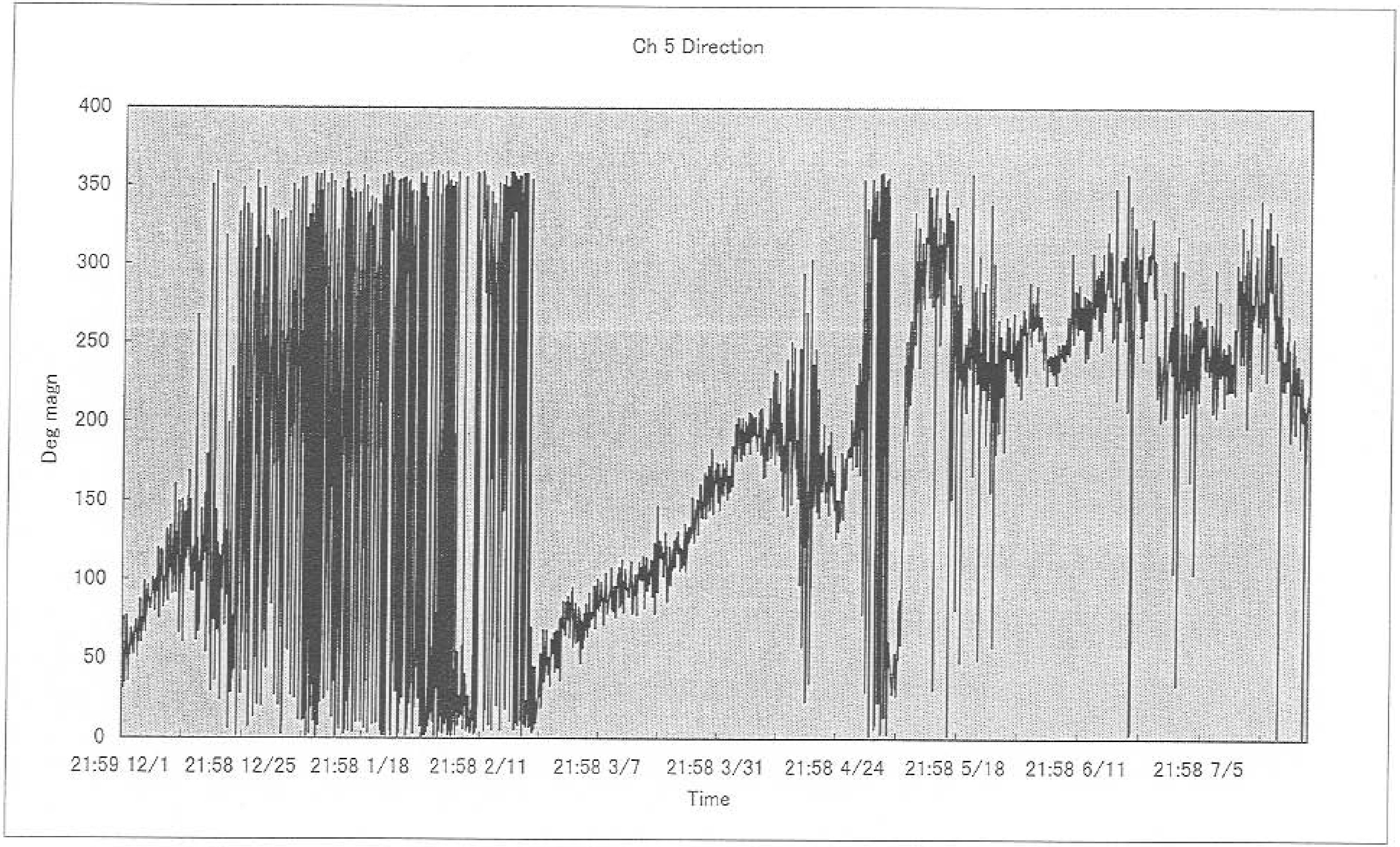

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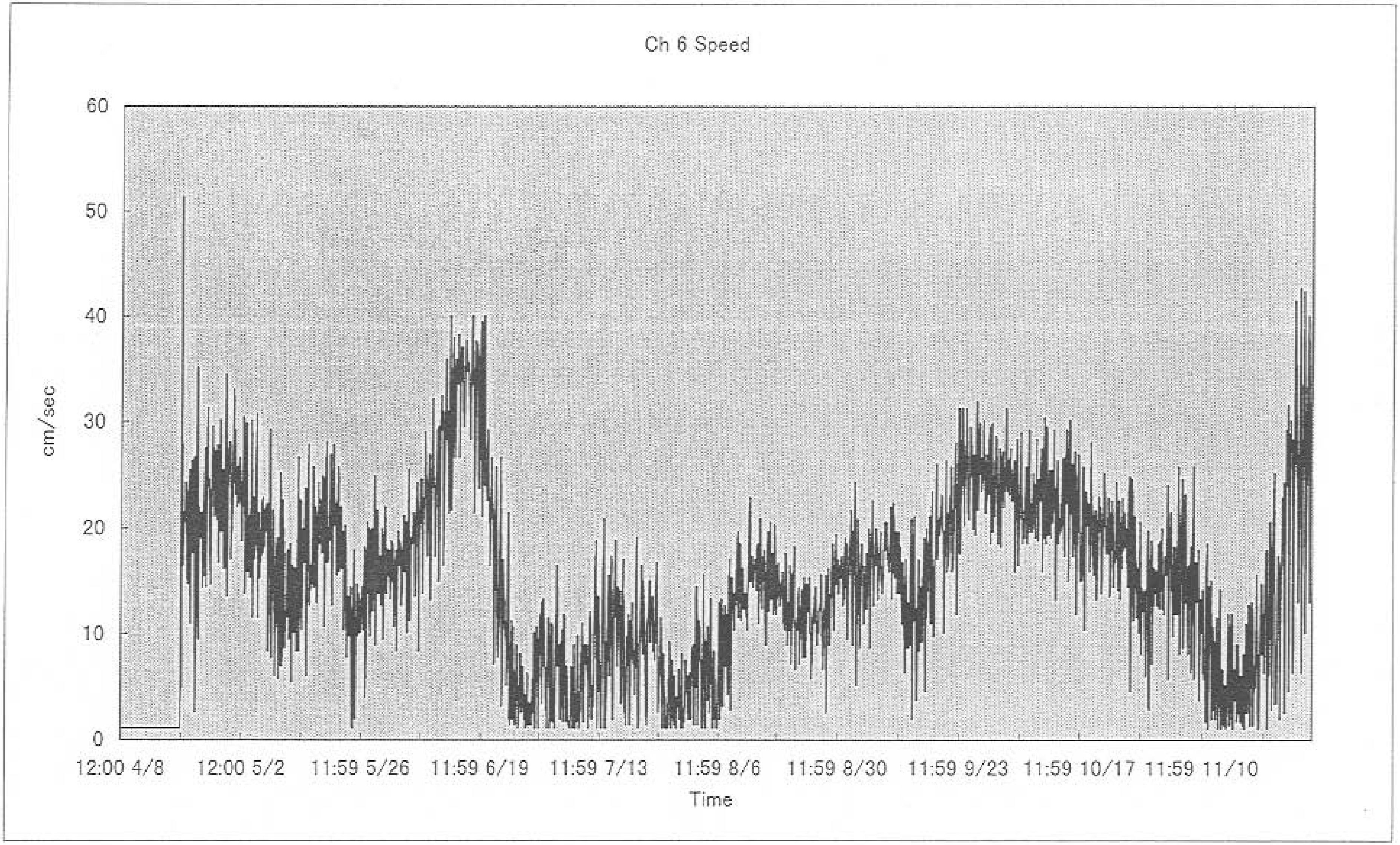

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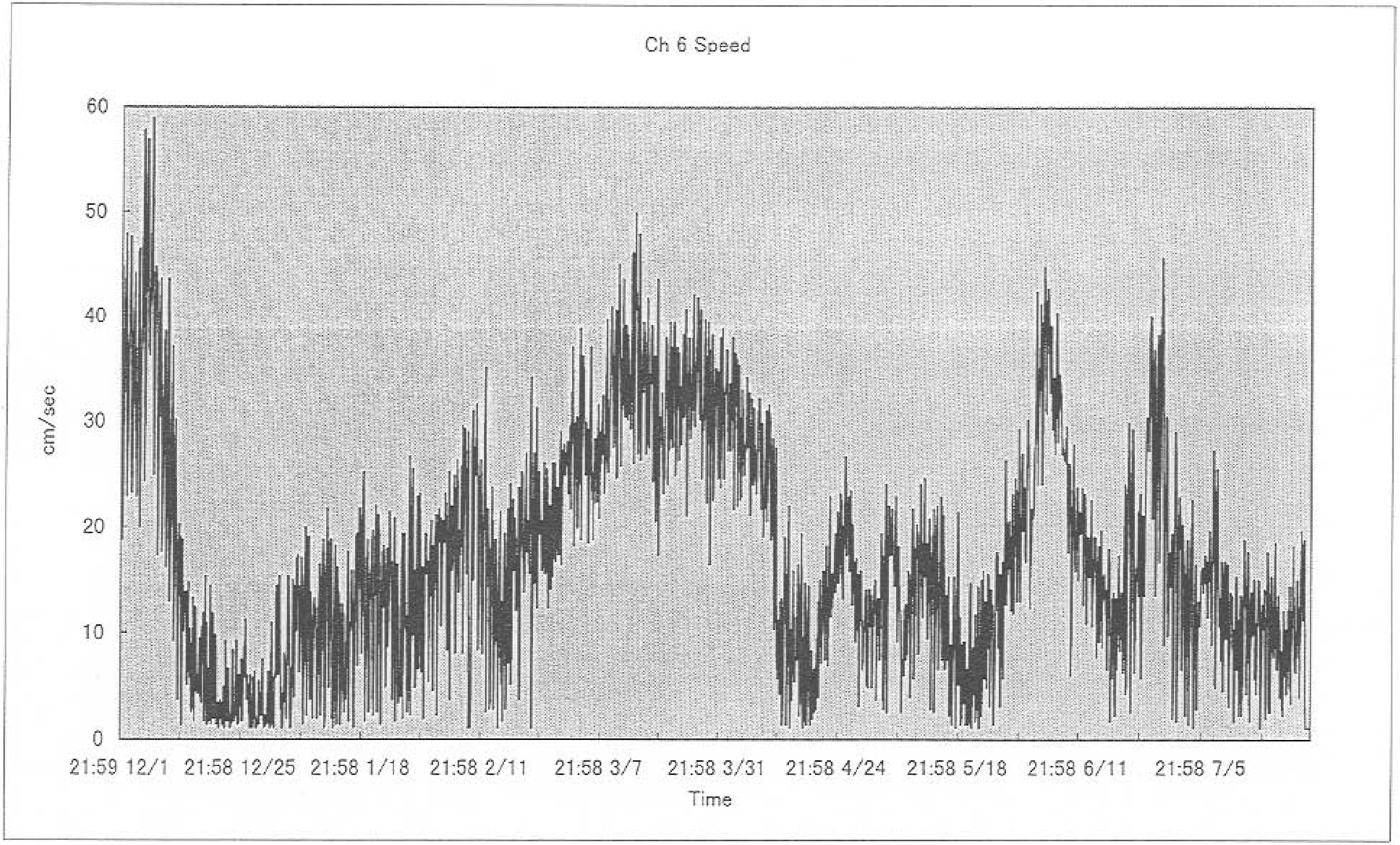

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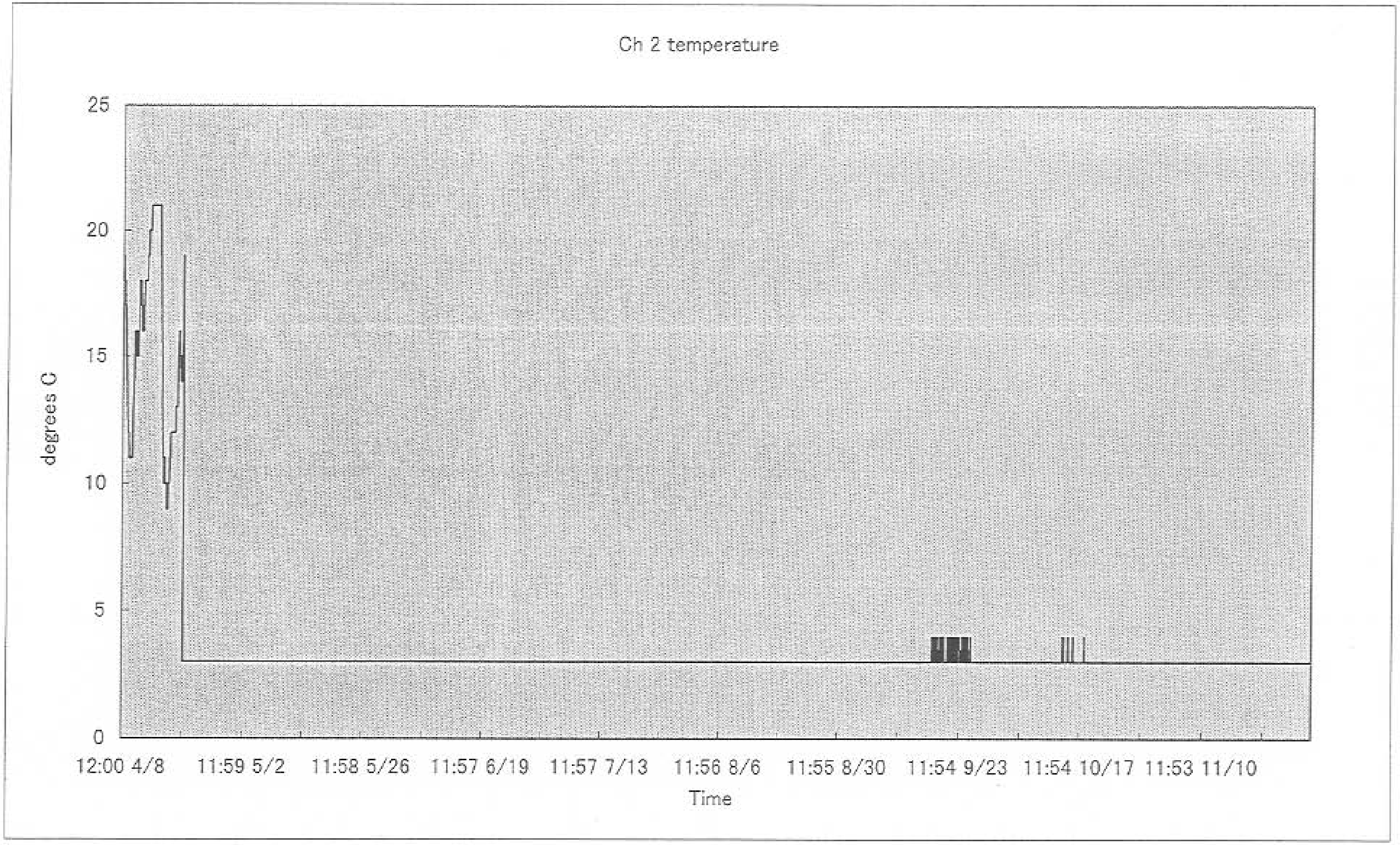

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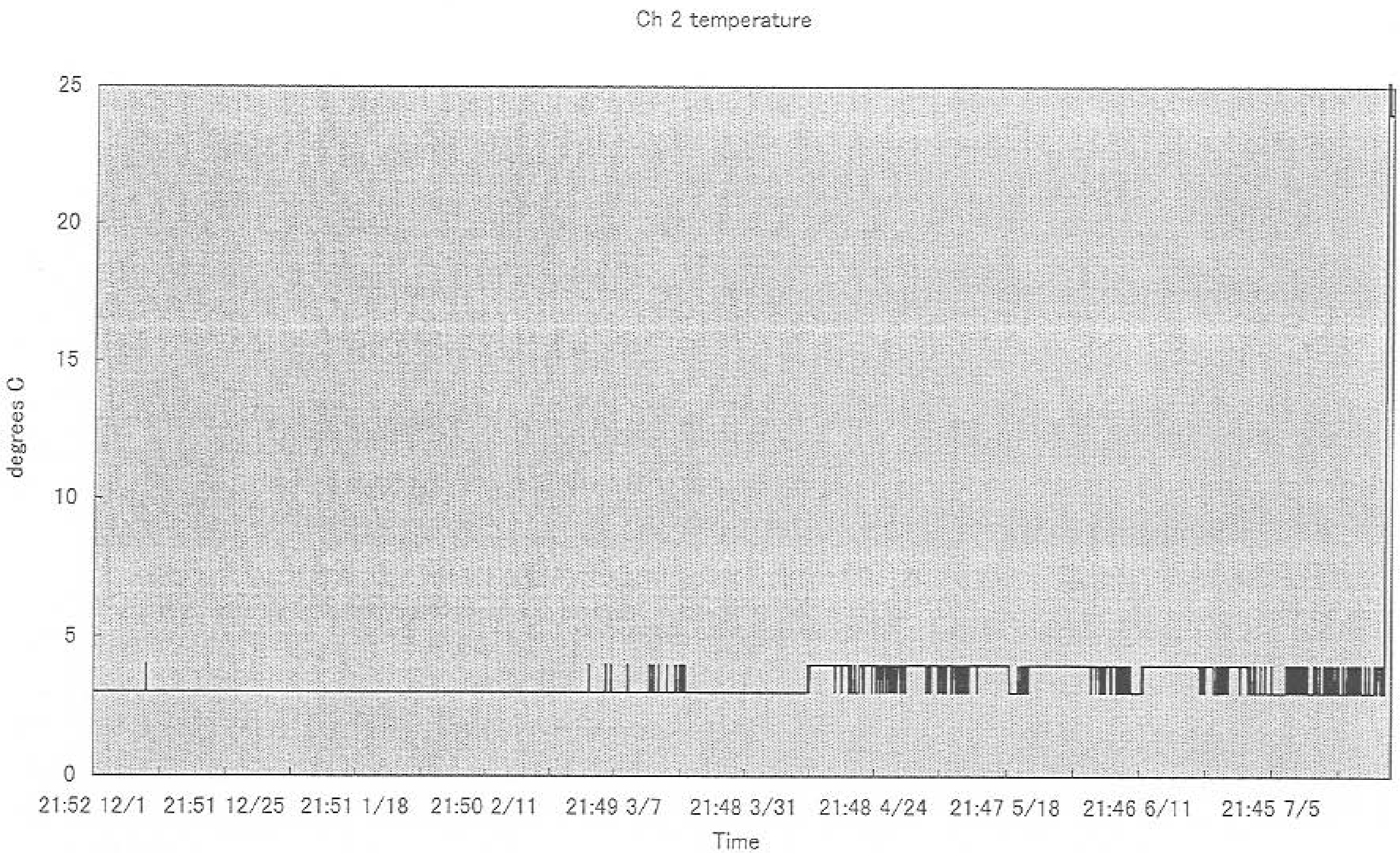

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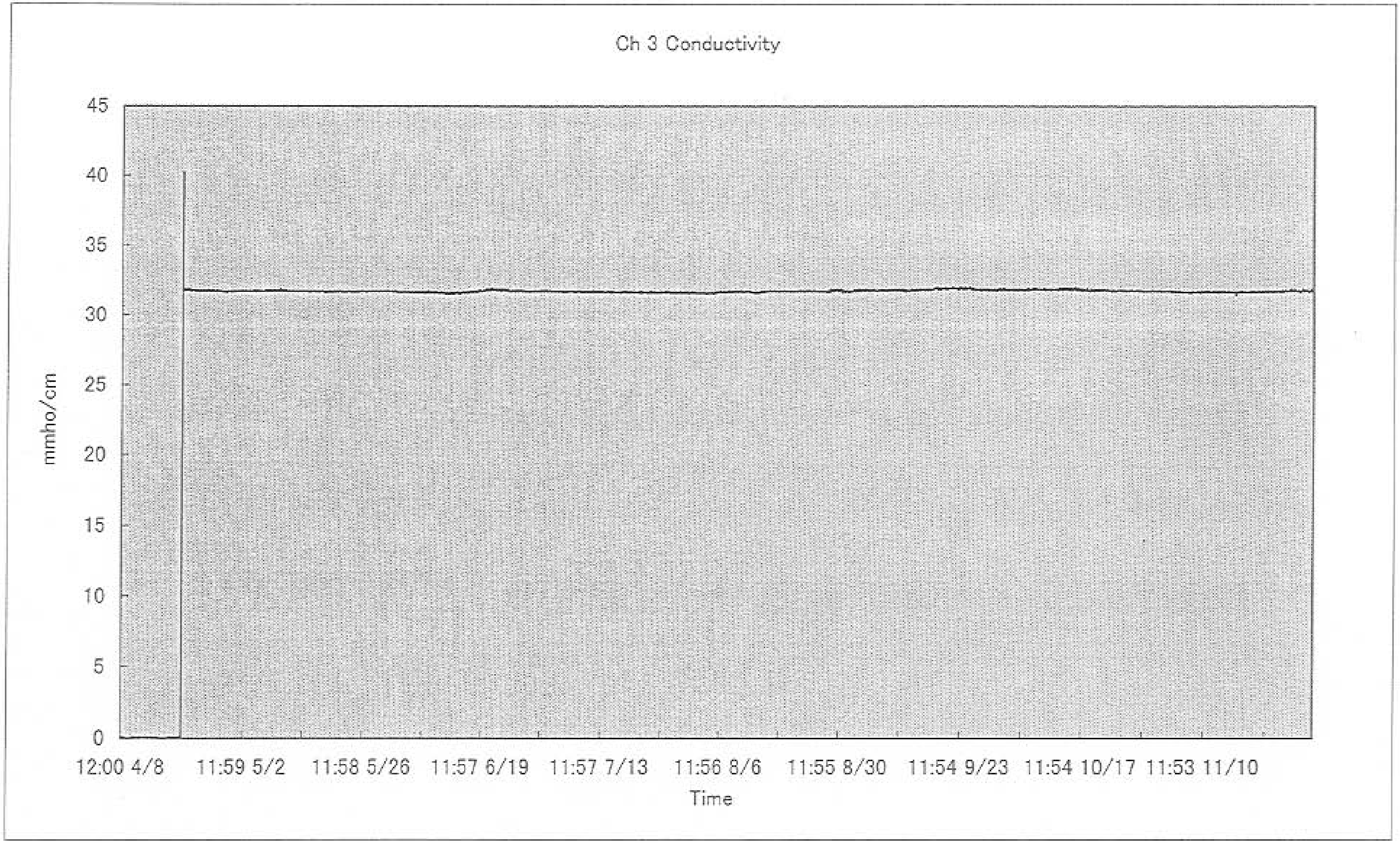
Aanderaa Instruments AS



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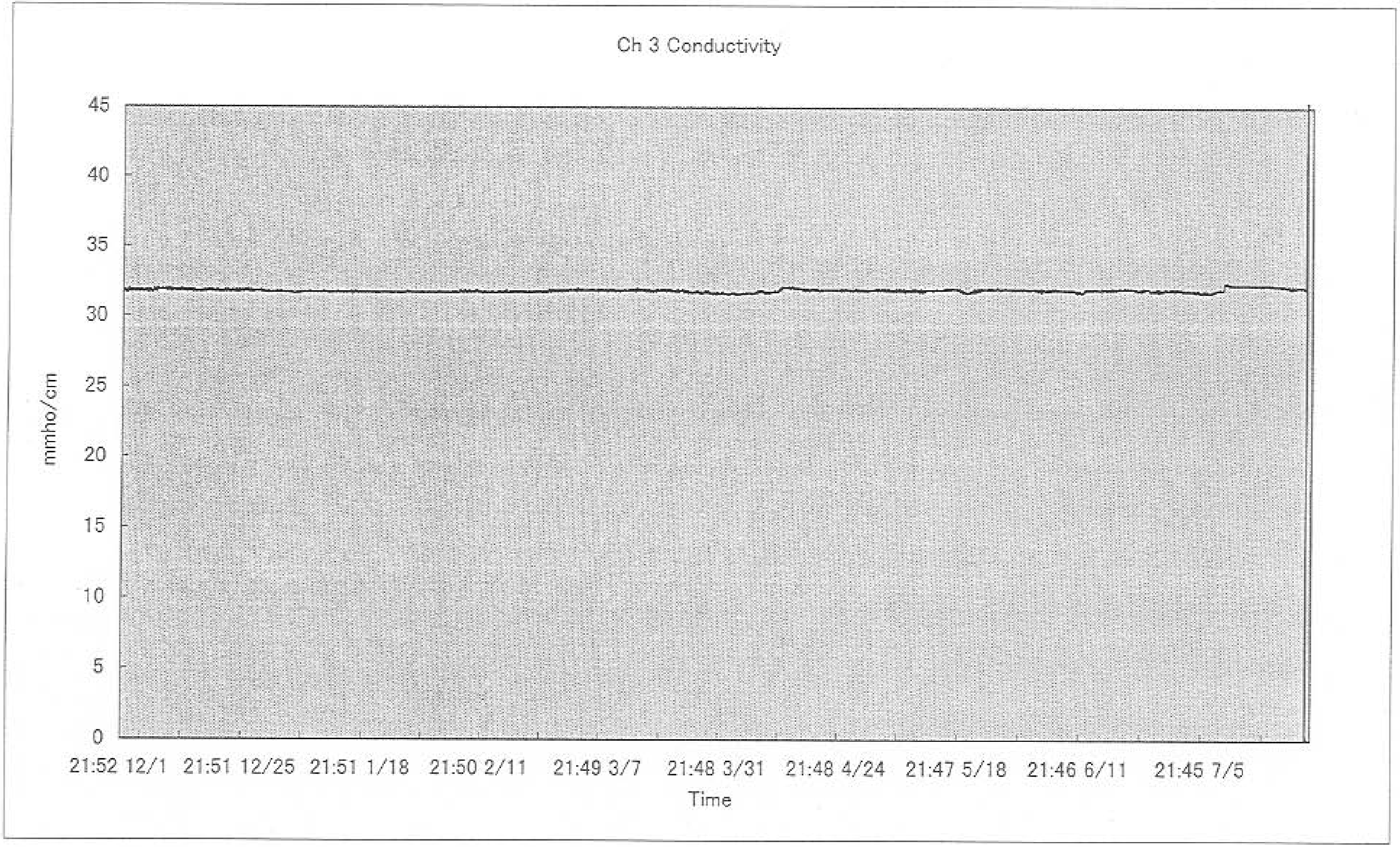

Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

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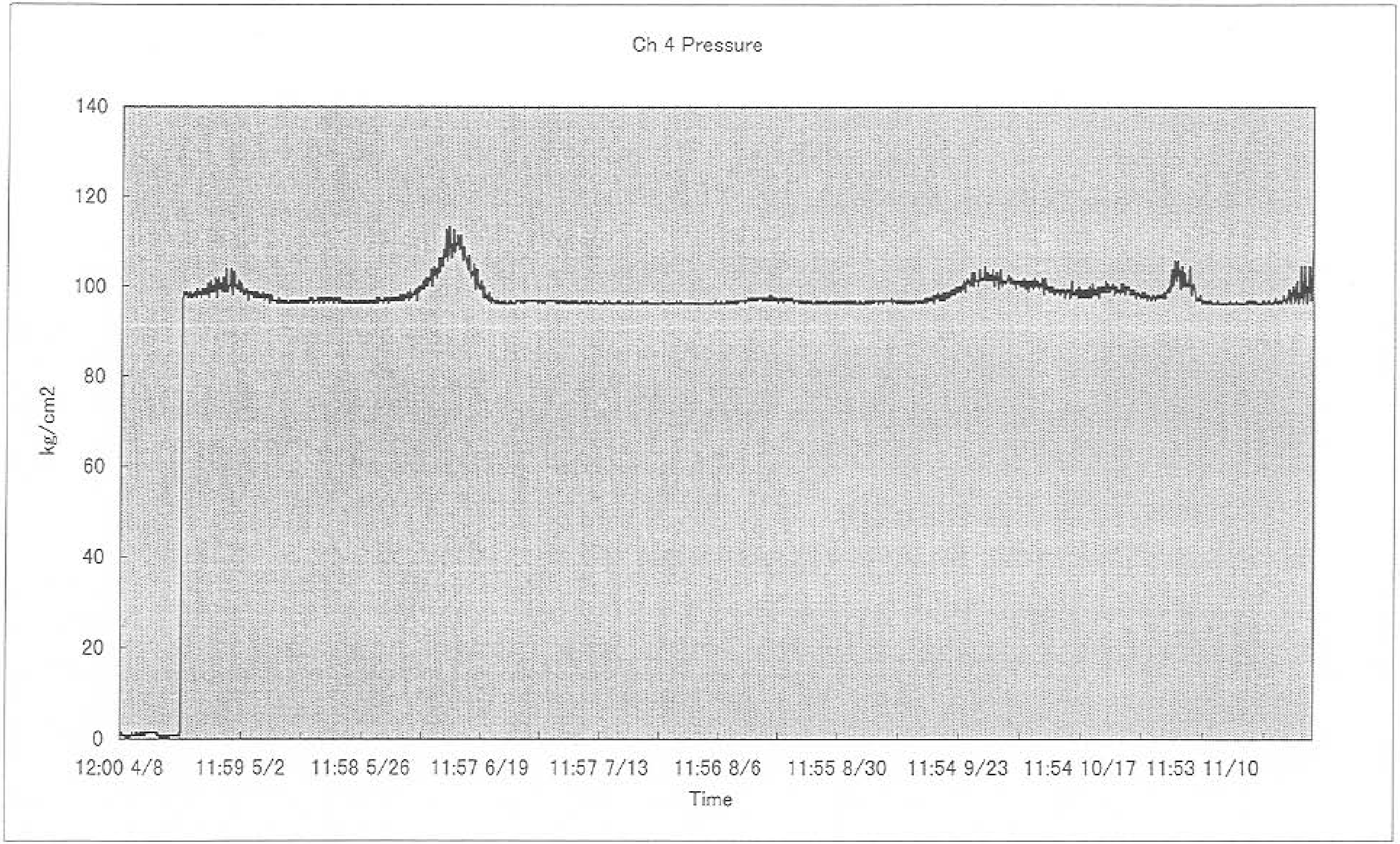
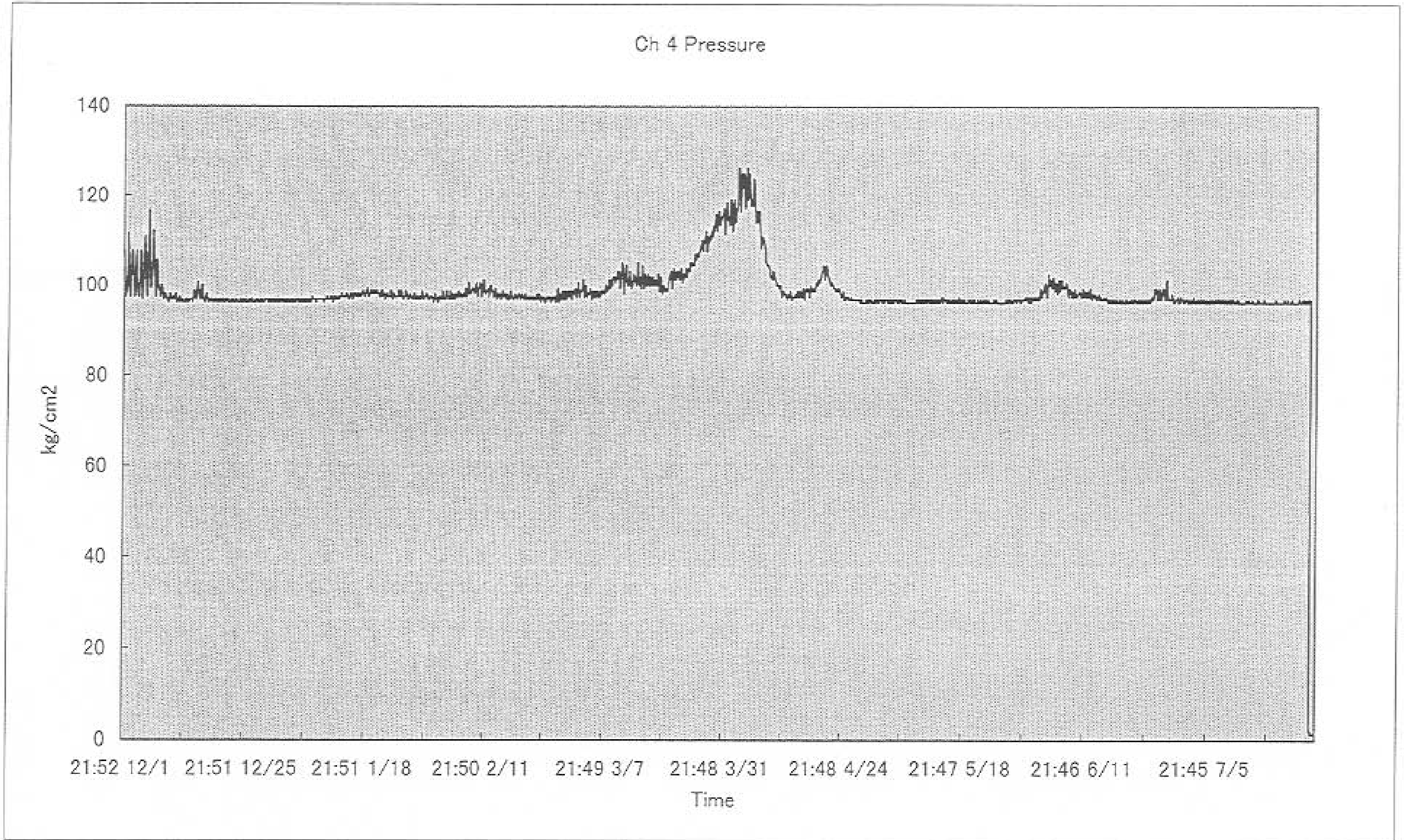
Aanderaa Instruments AS



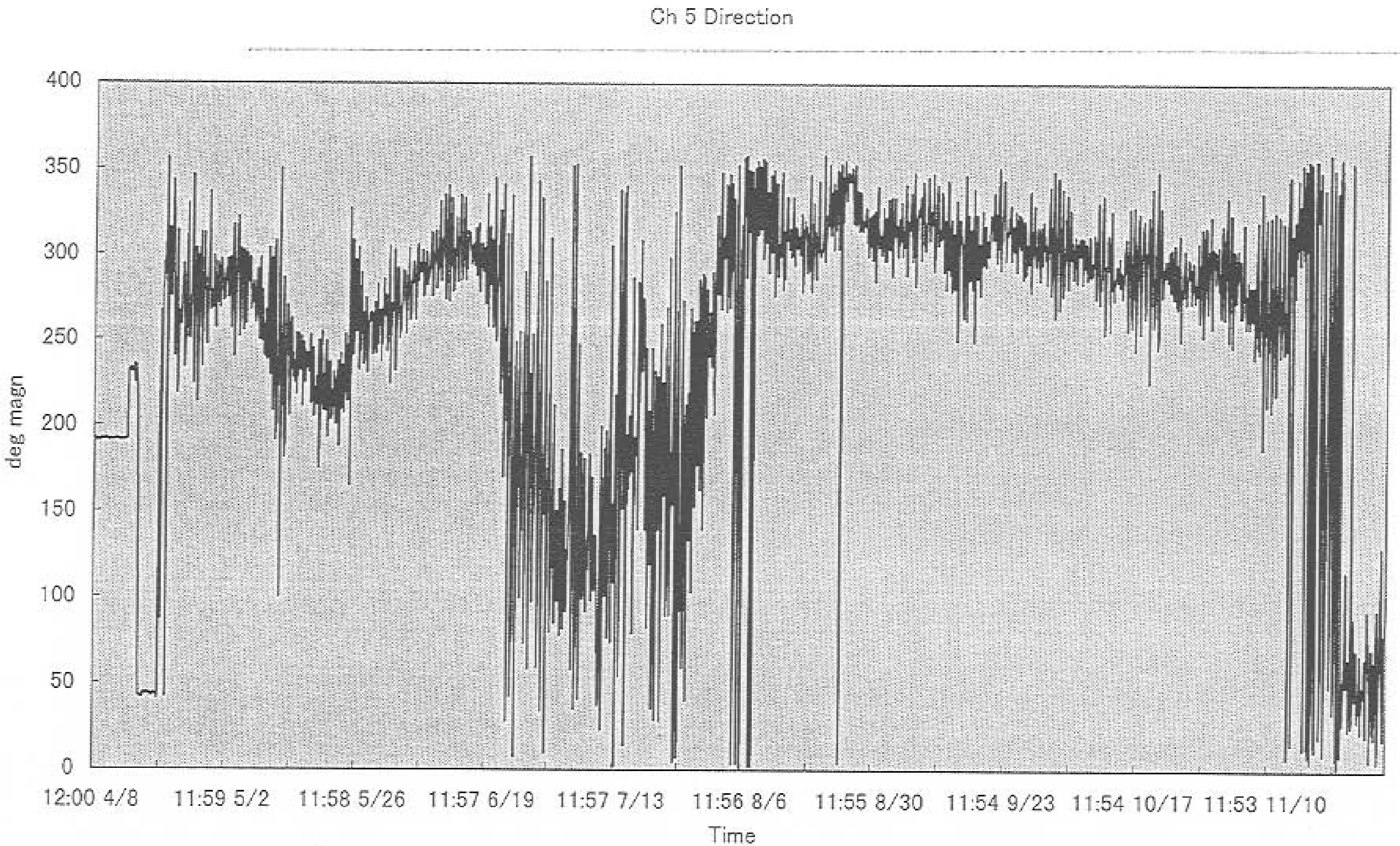
Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

Data processed by 4059
Aanderaa Instruments AS



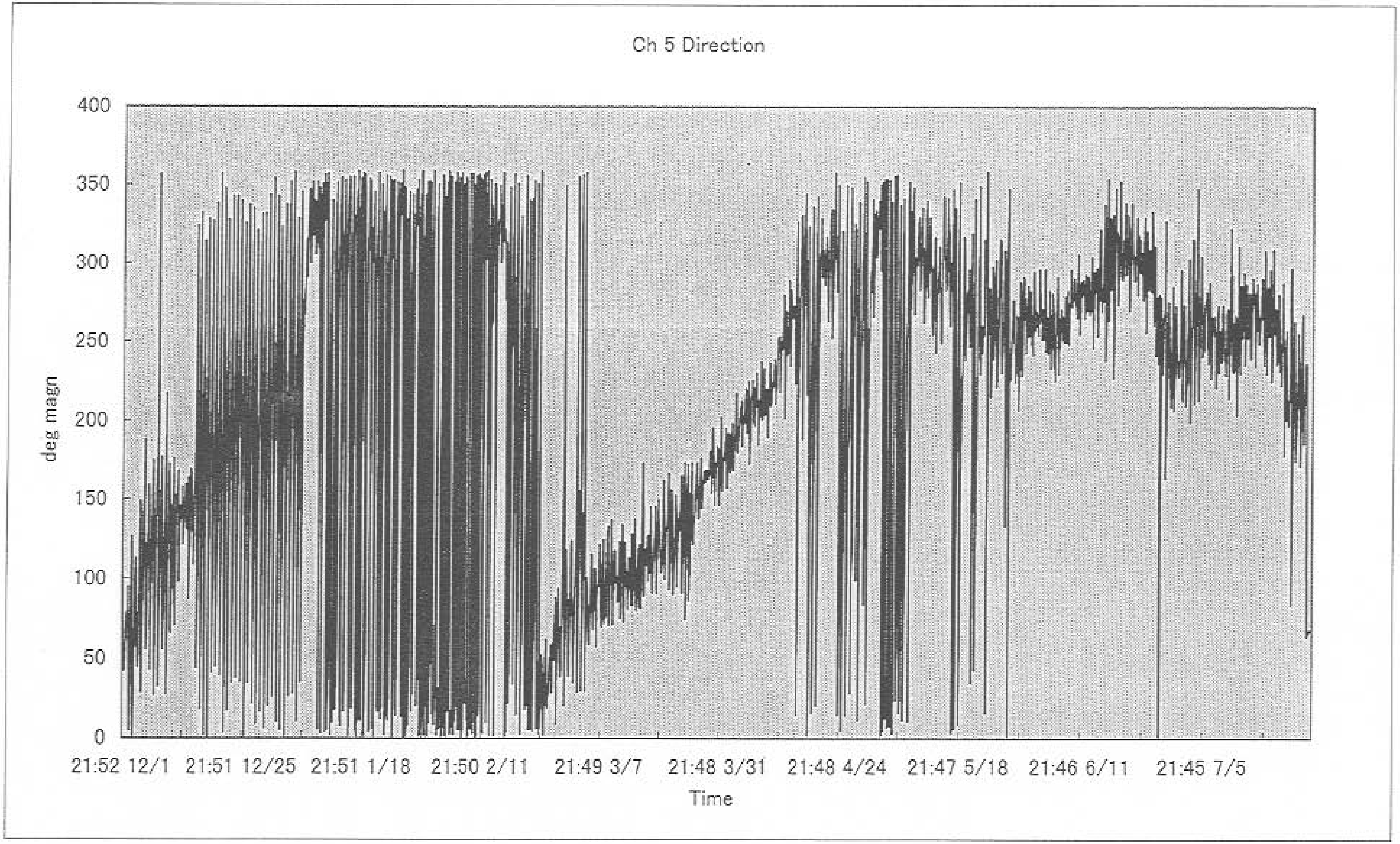
Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

Data processed by 4059
Aanderaa Instruments AS



Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

Data processed by 4059
Aanderaa Instruments AS



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Sampling interval: 120 minutes

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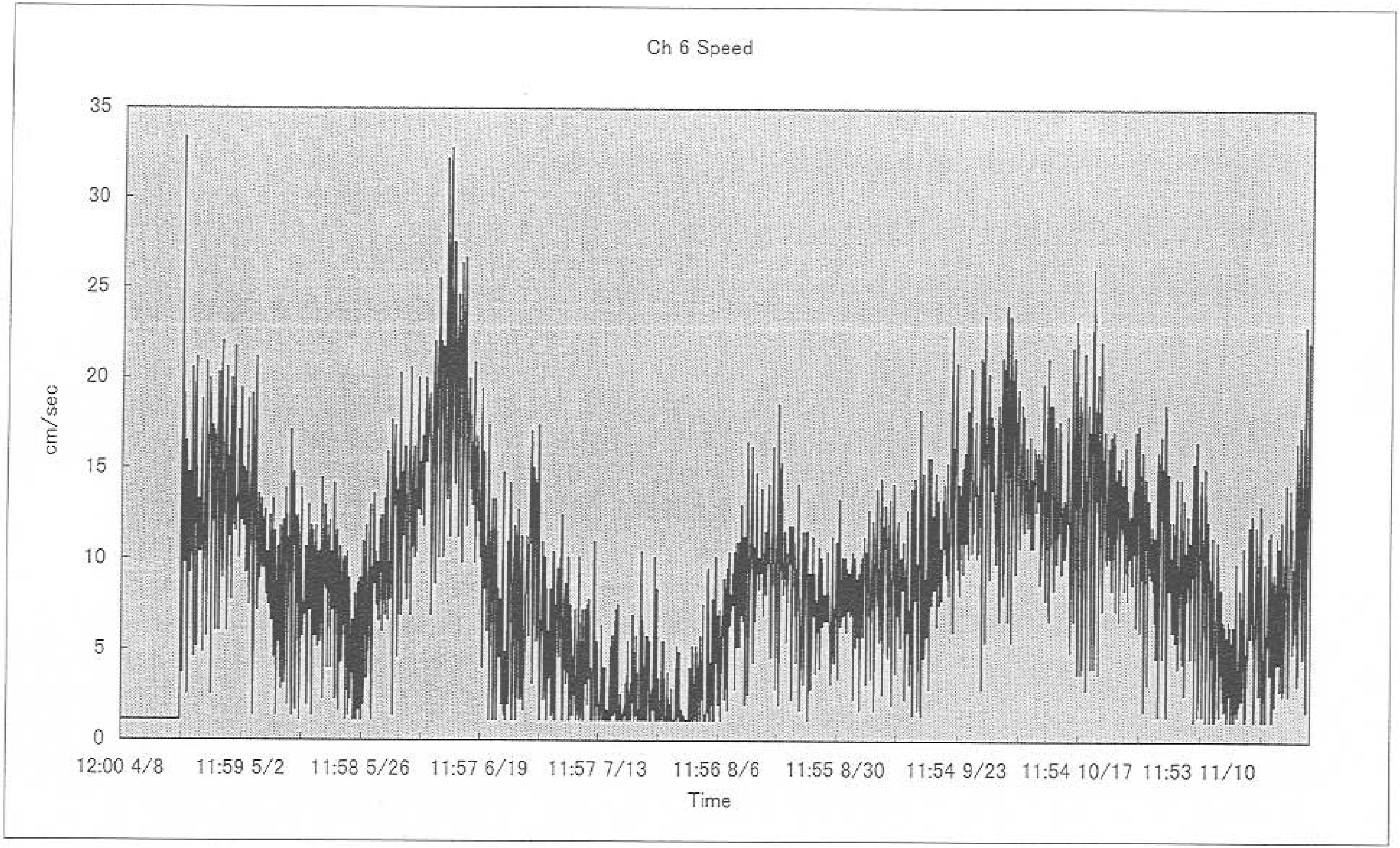
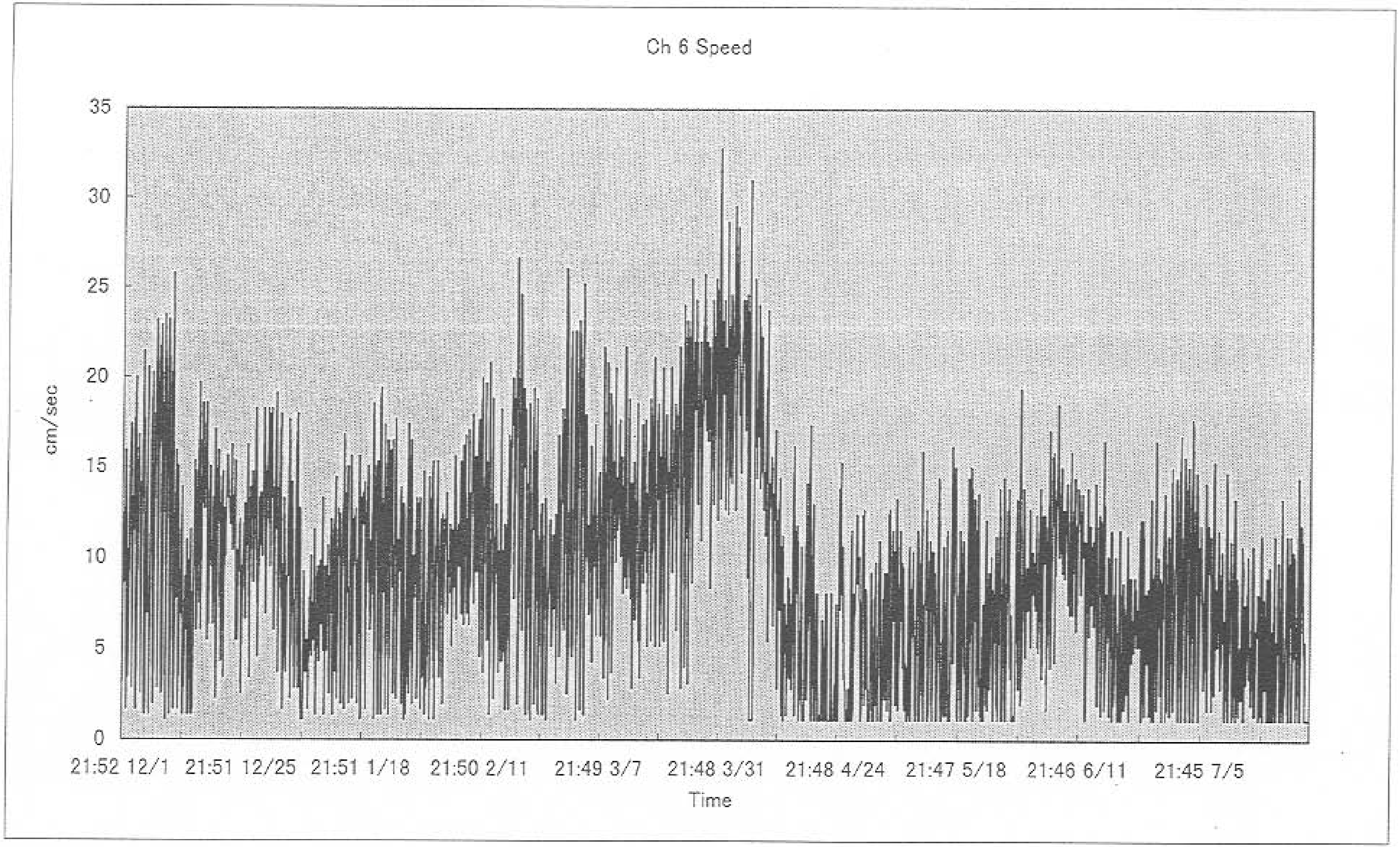
Aanderaa Instruments AS



Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

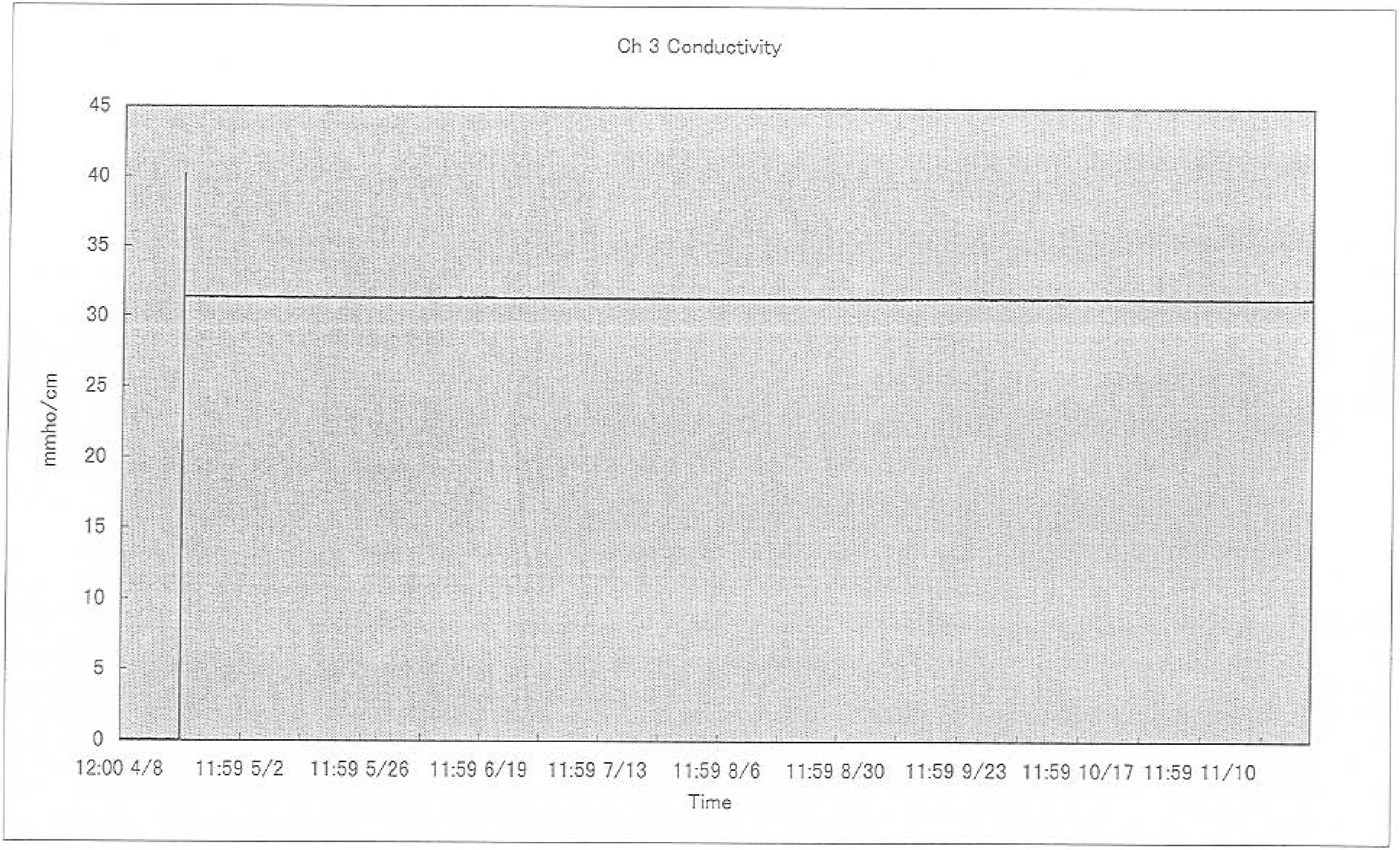
Data processed by 4059
Aanderaa Instruments AS



Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

Plot of time series in engineering units

MR98-03,11709



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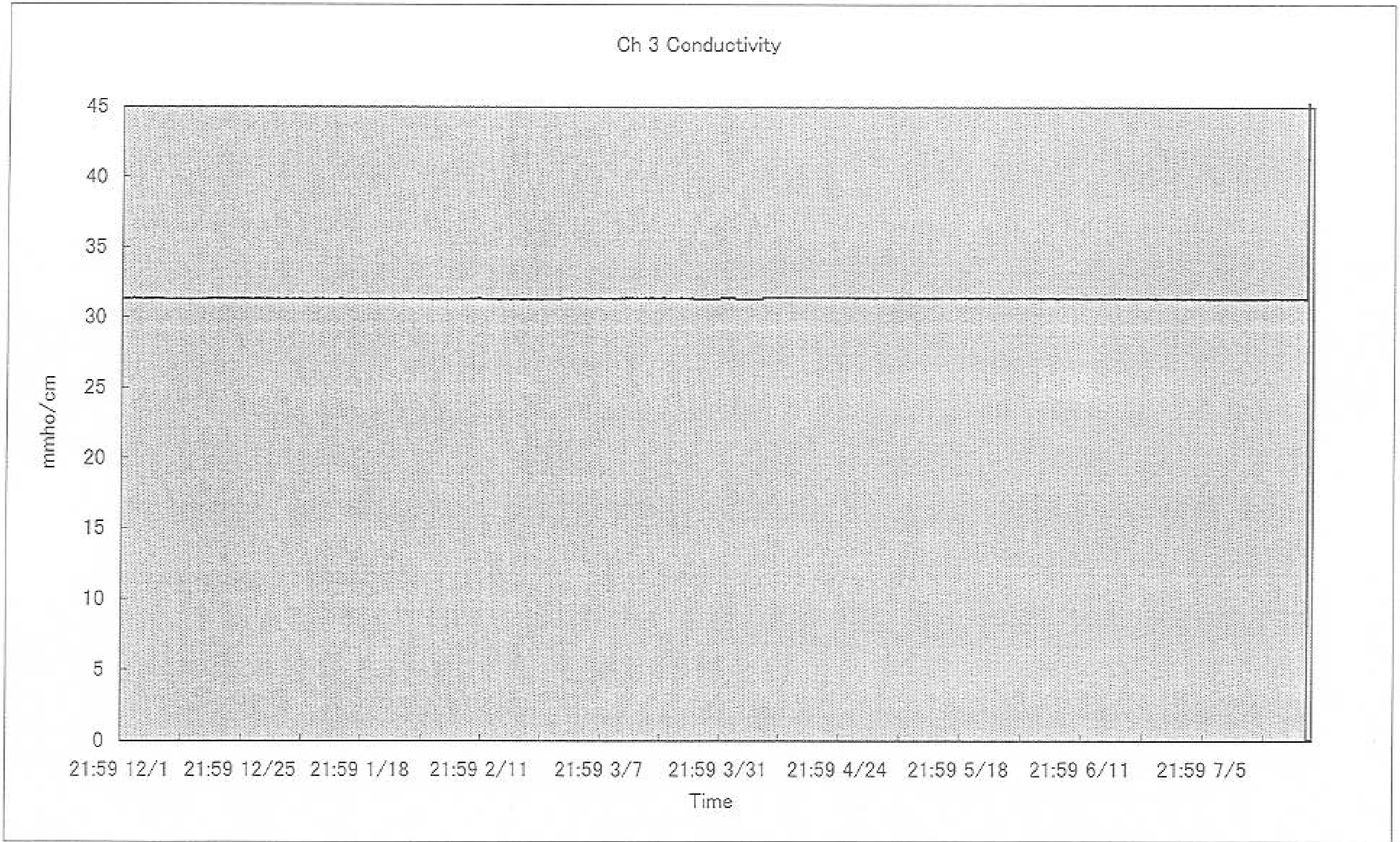

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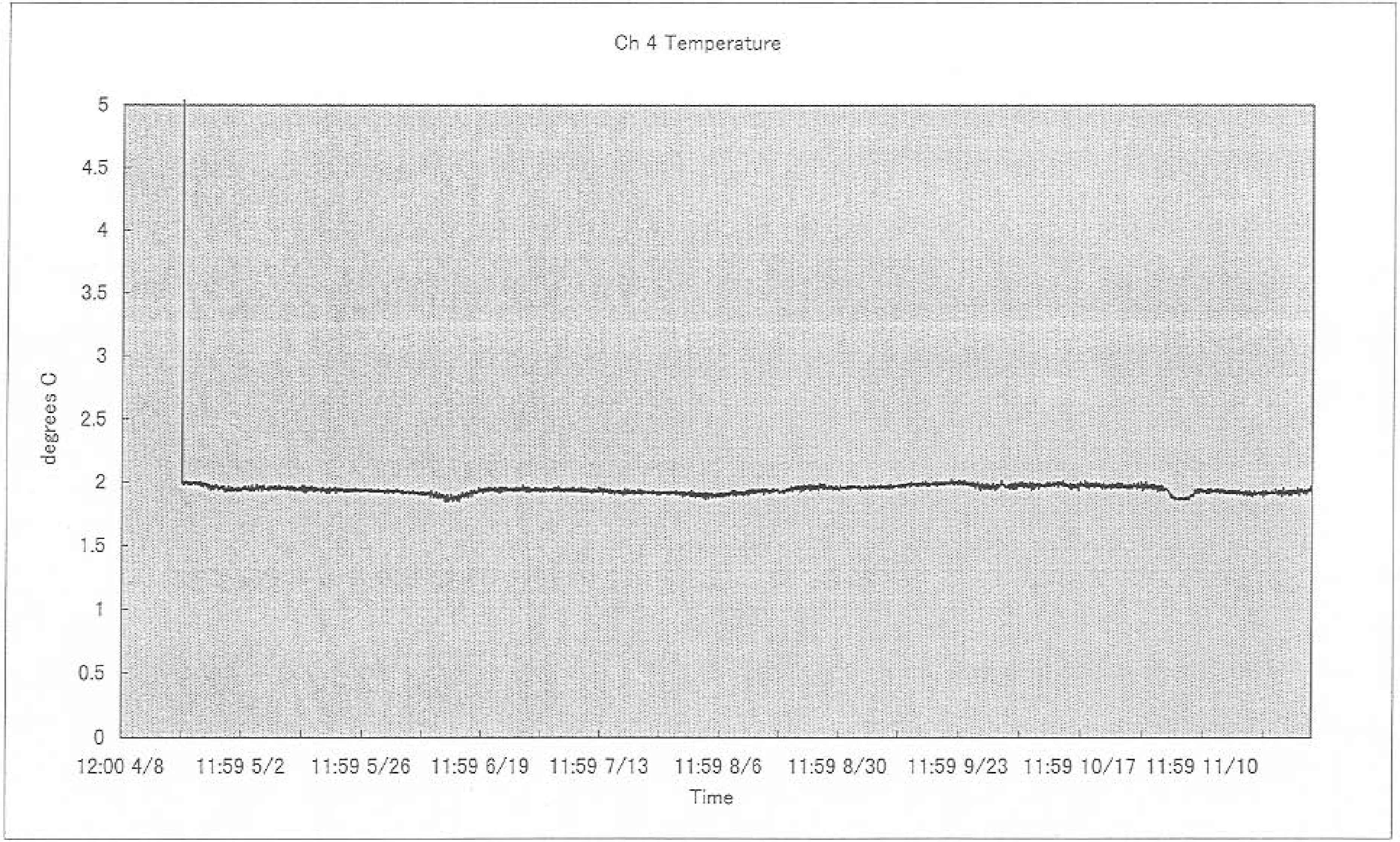

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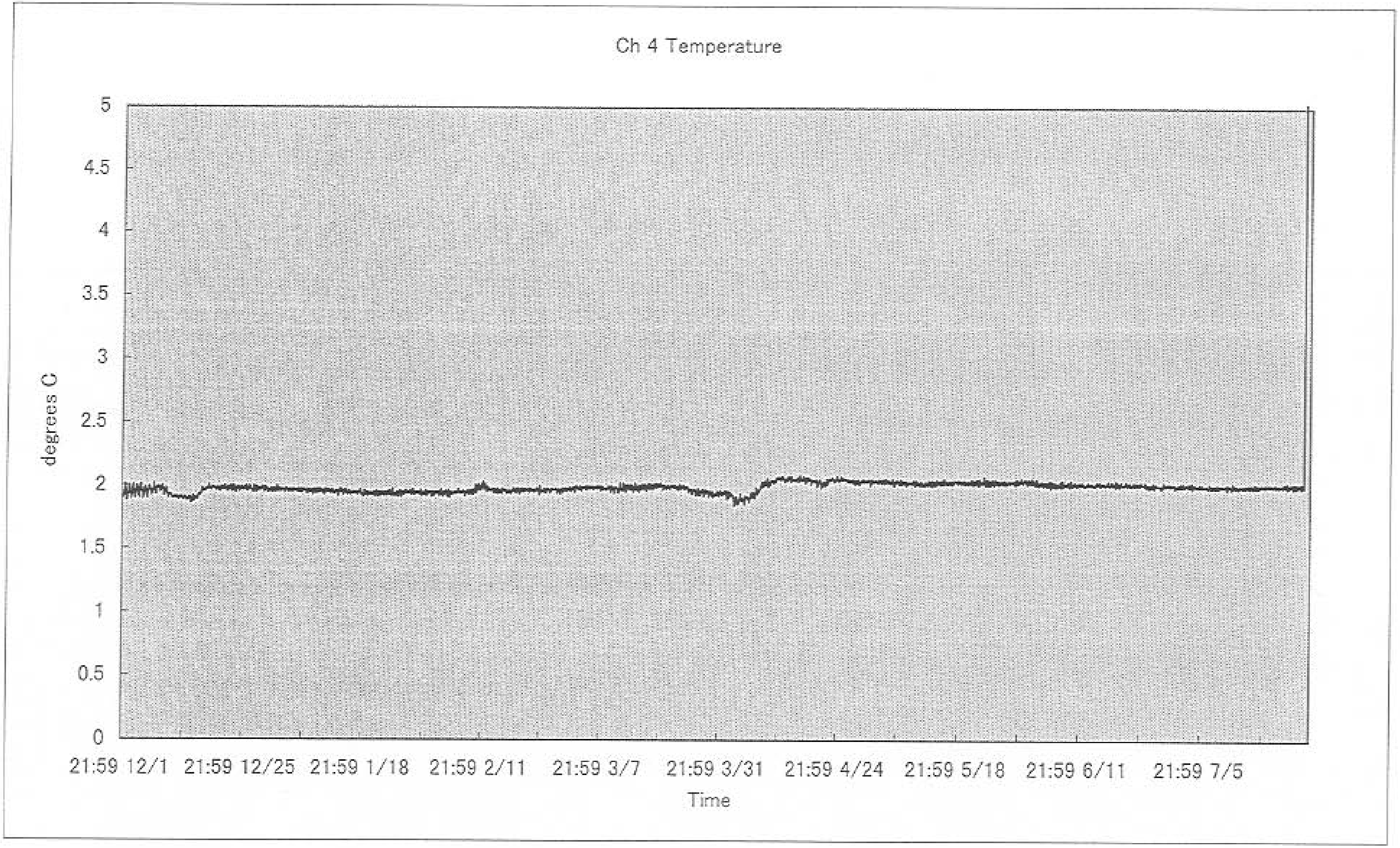

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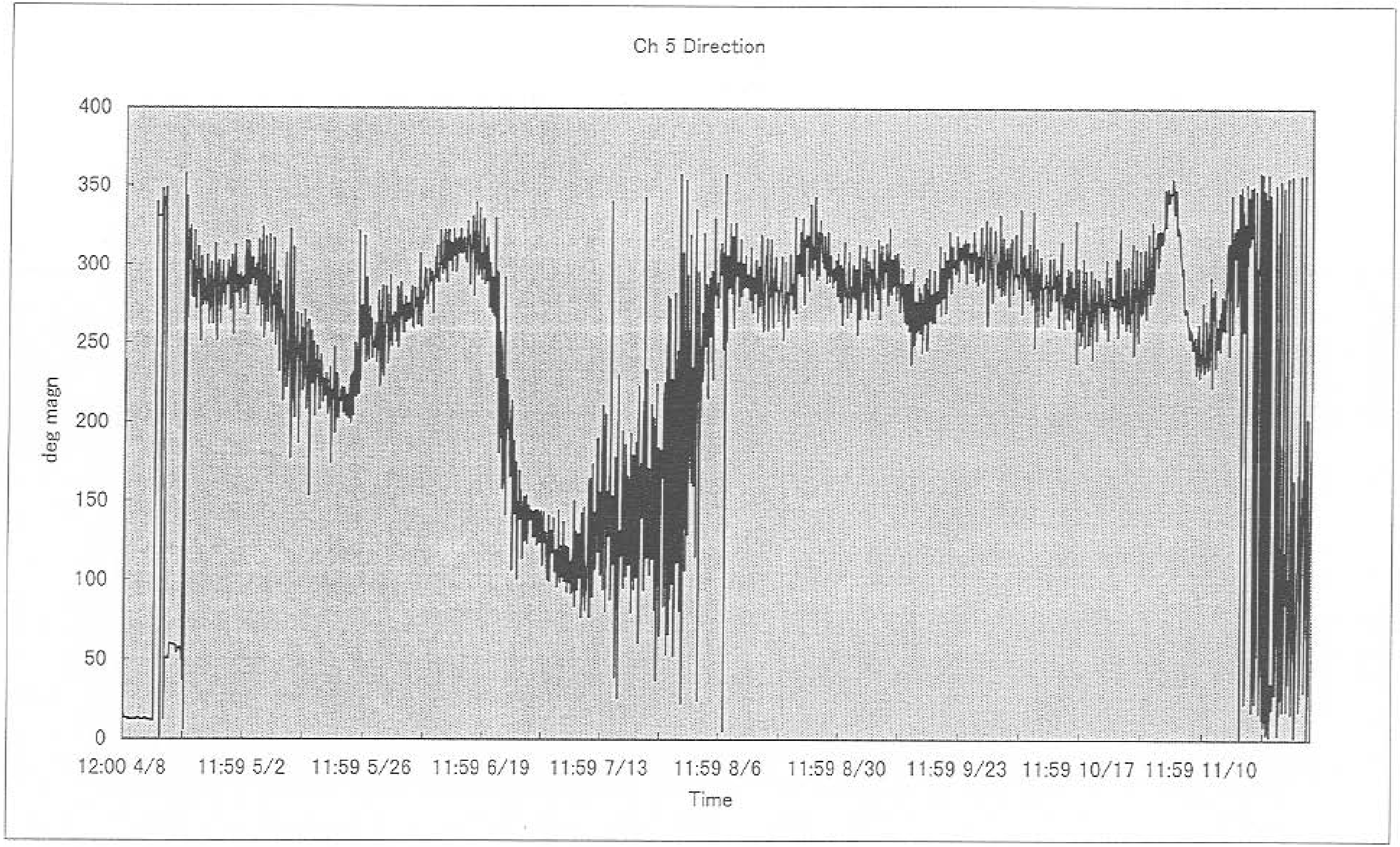

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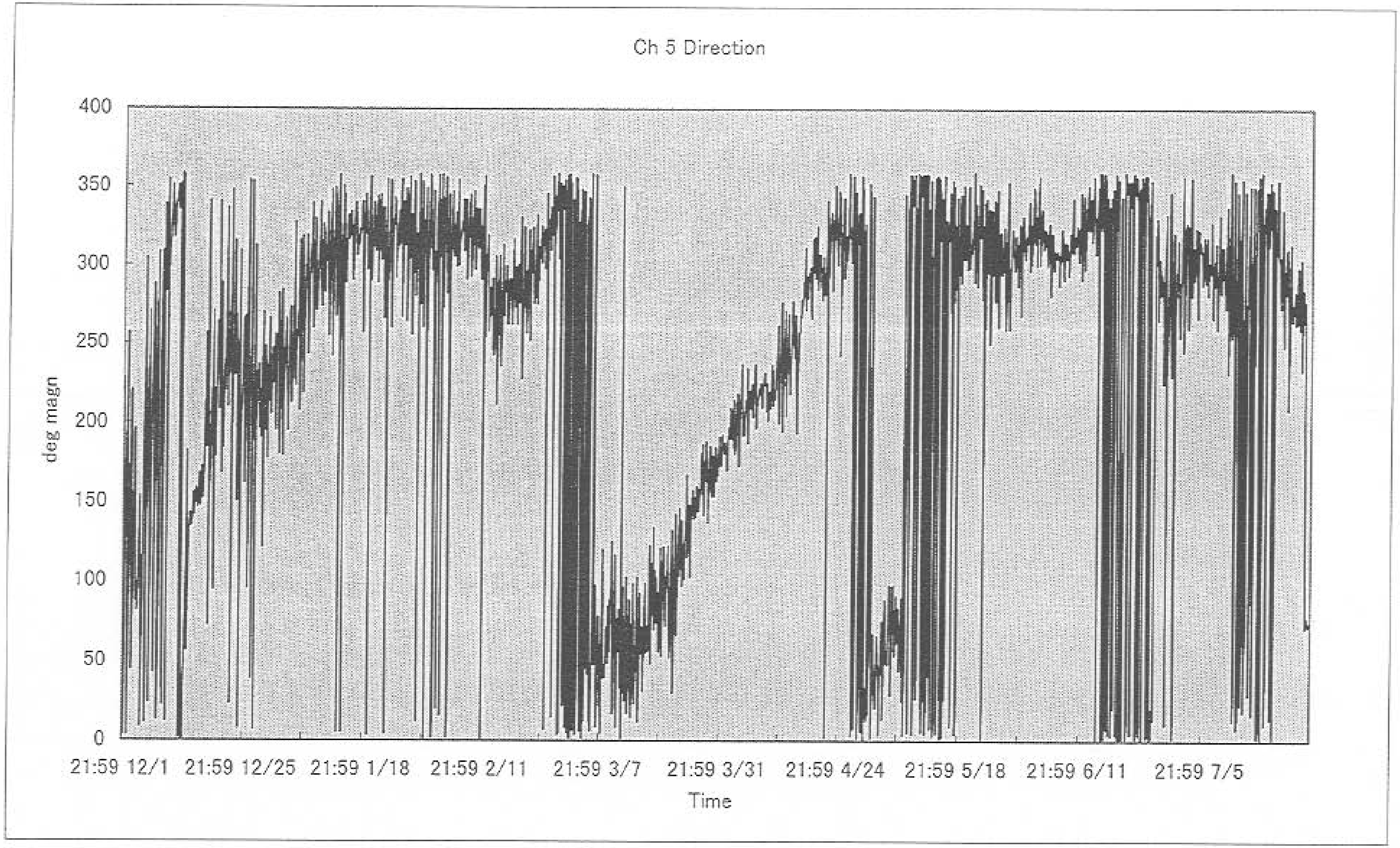

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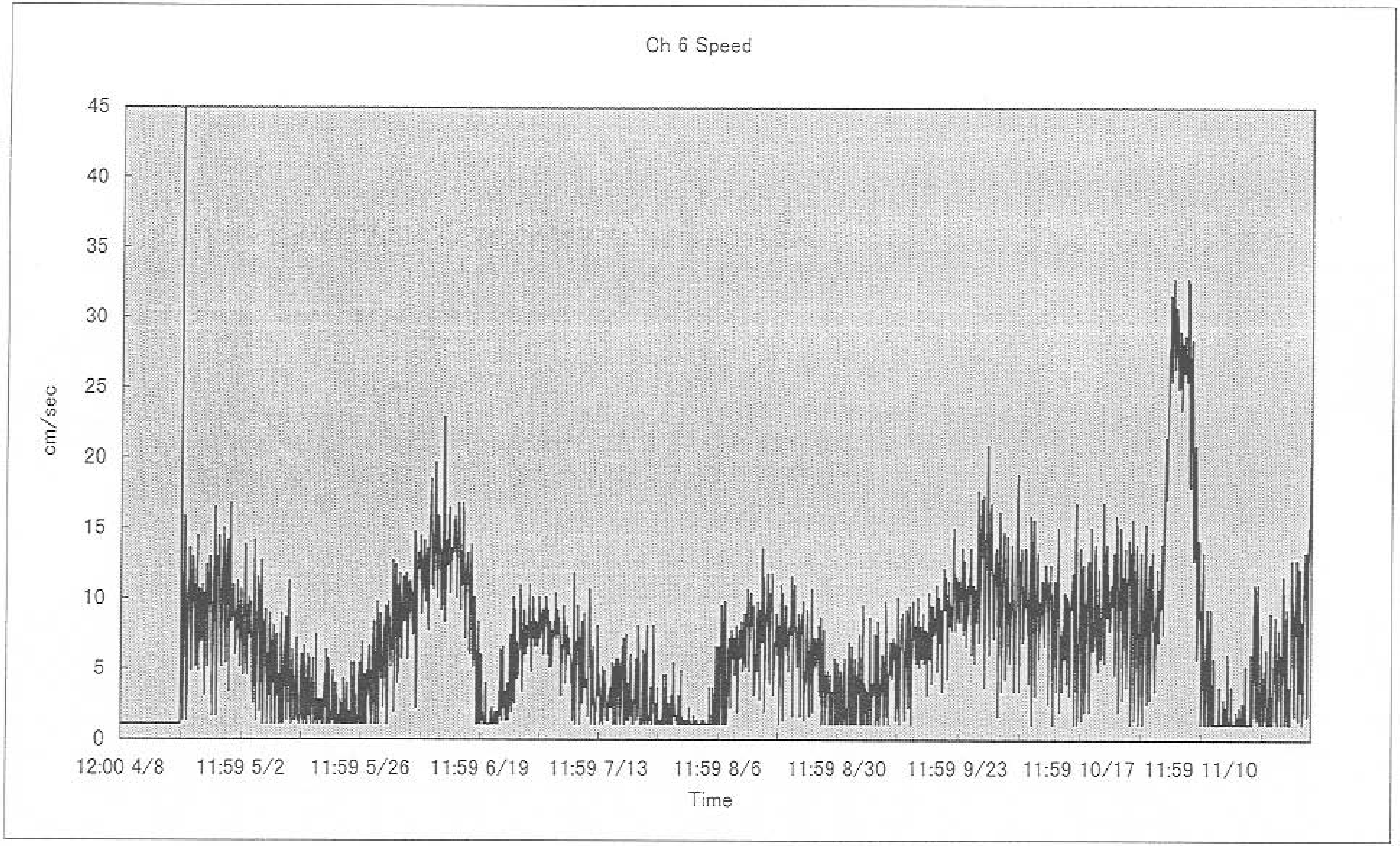

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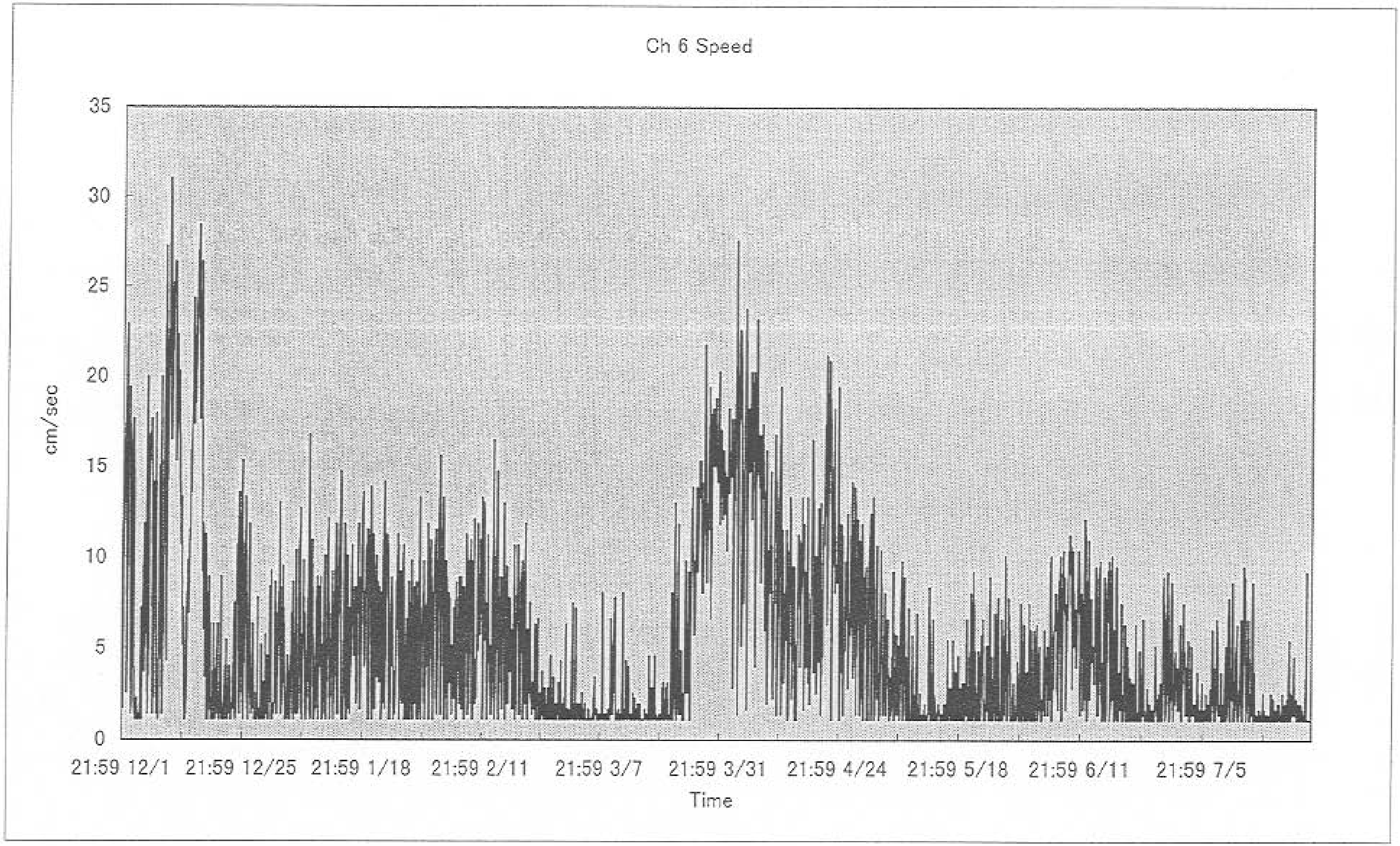

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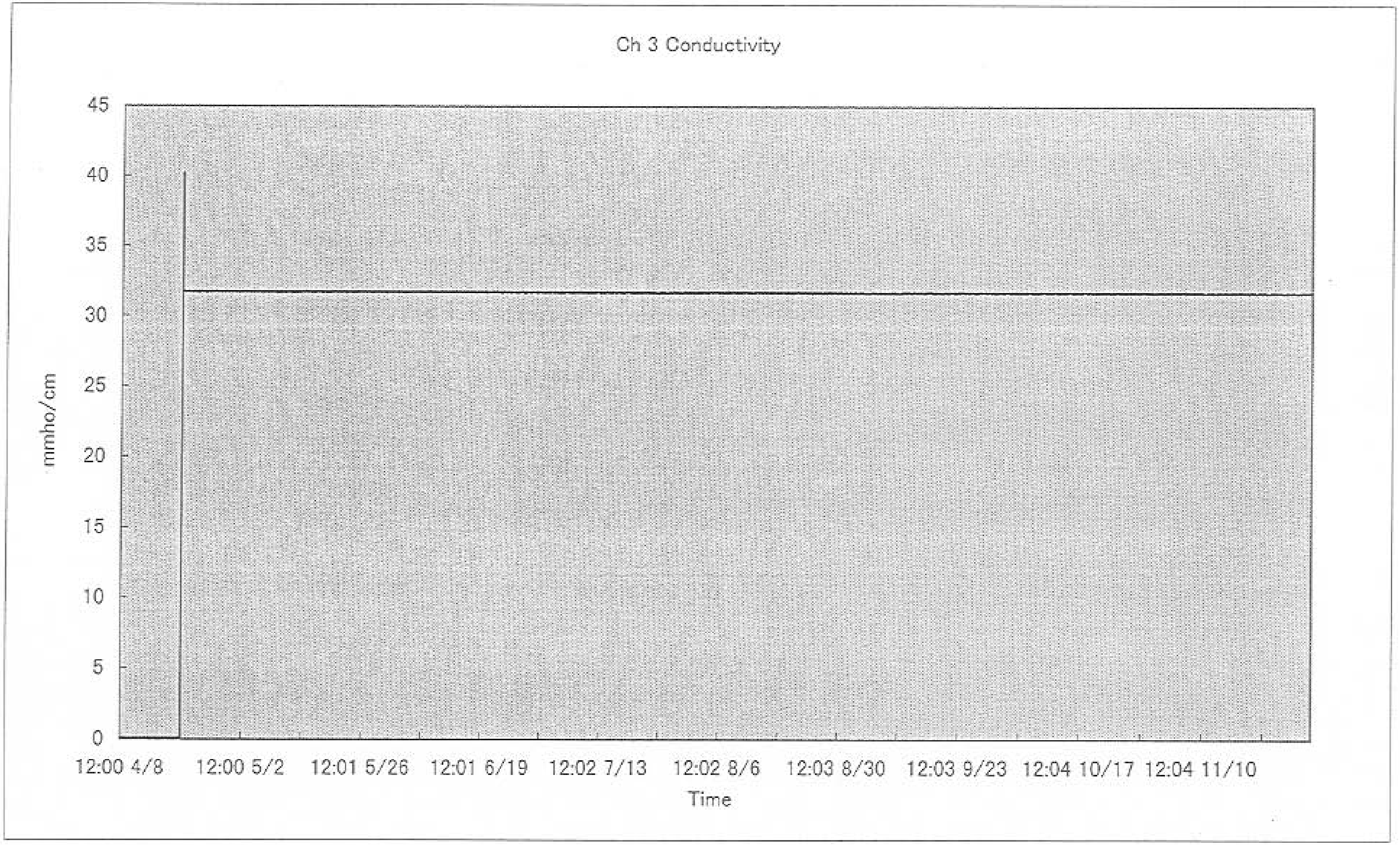

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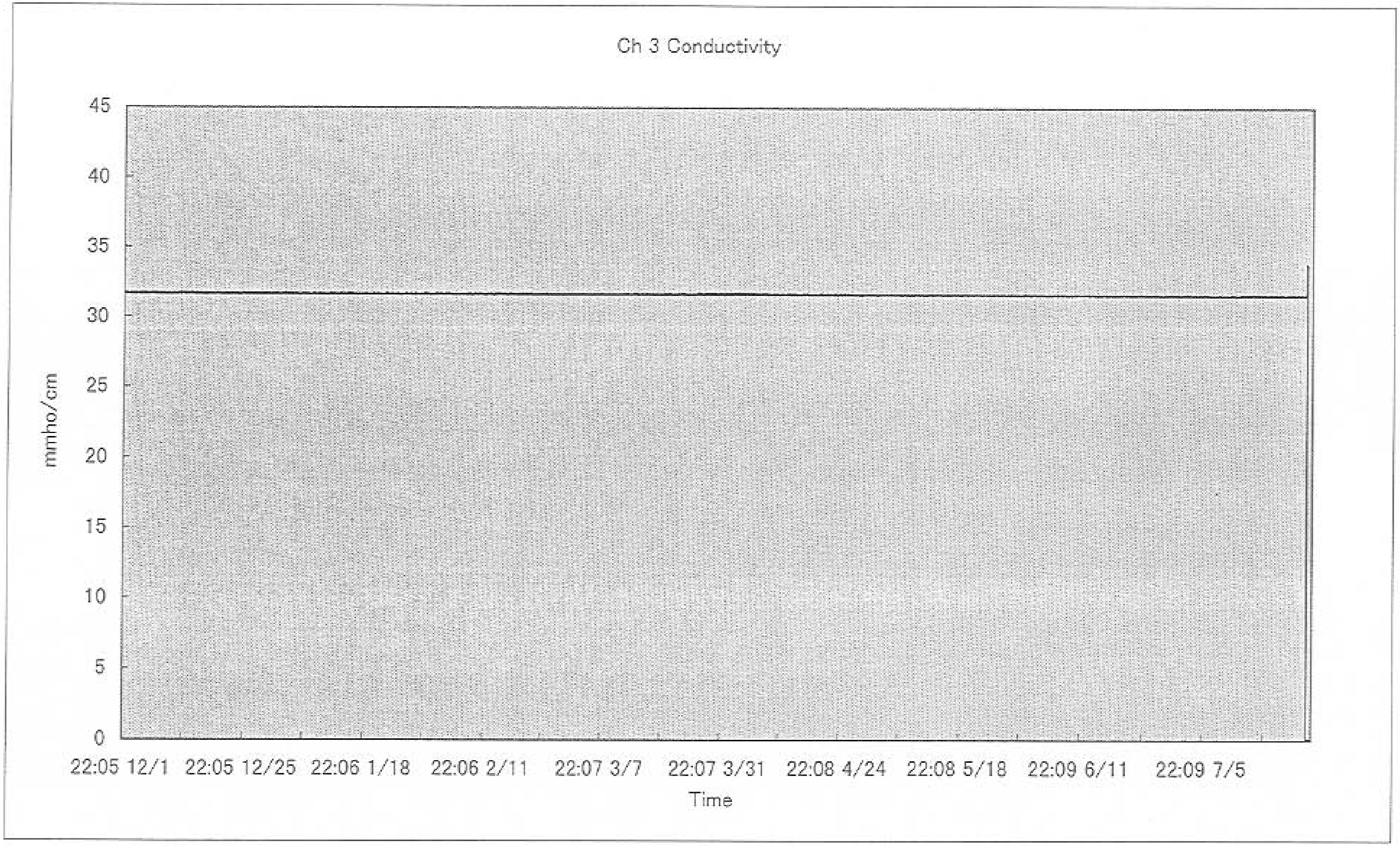

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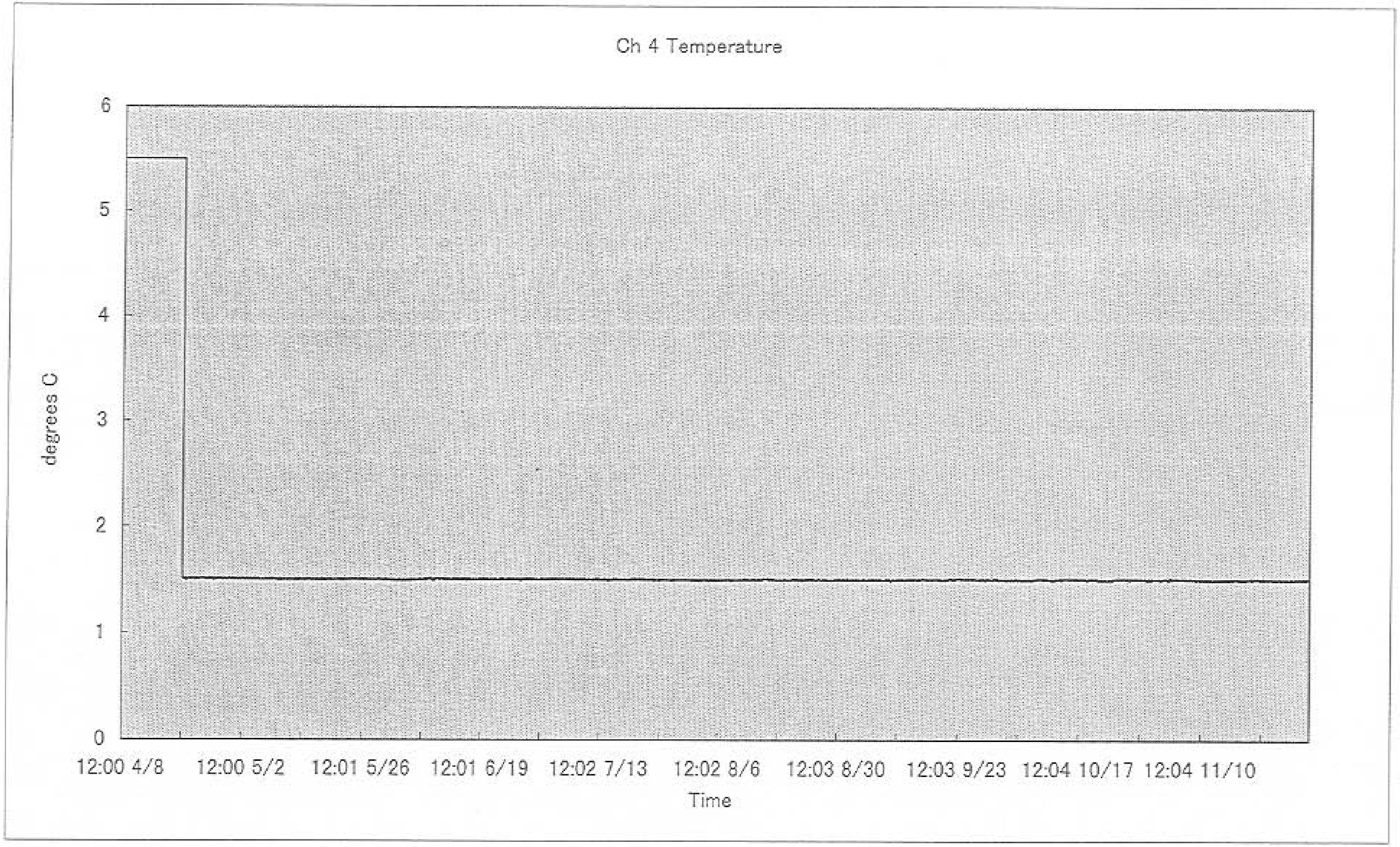

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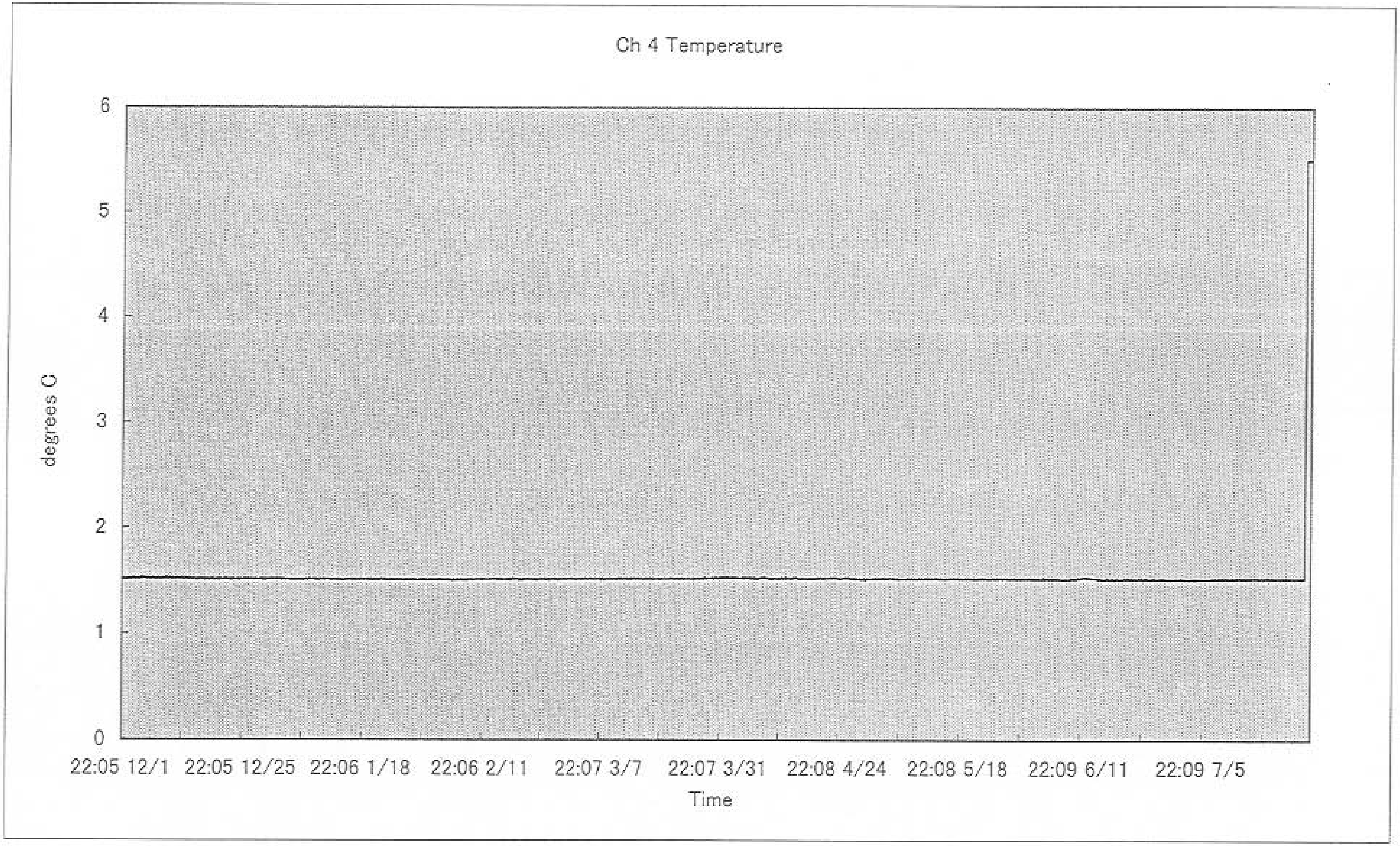

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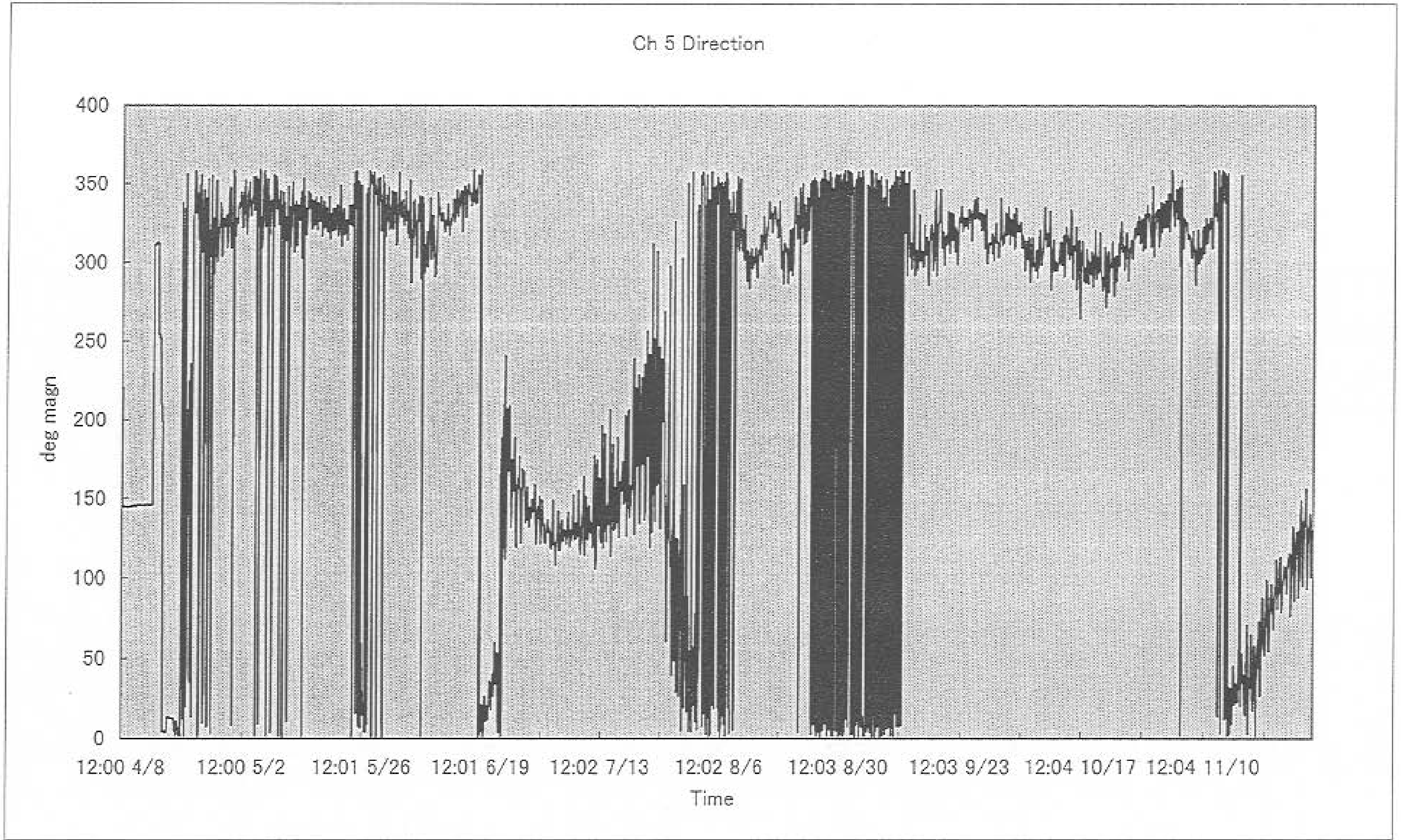

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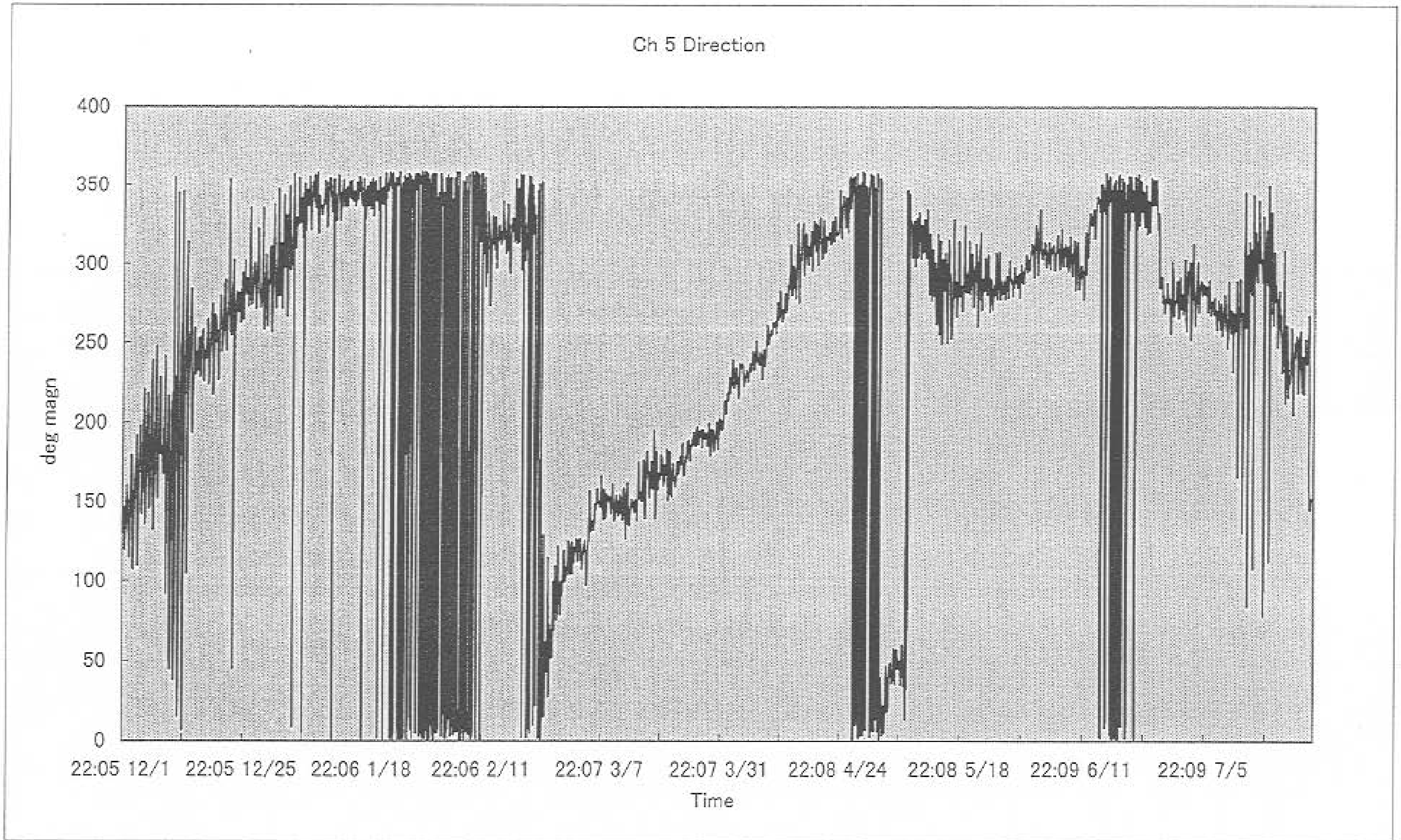

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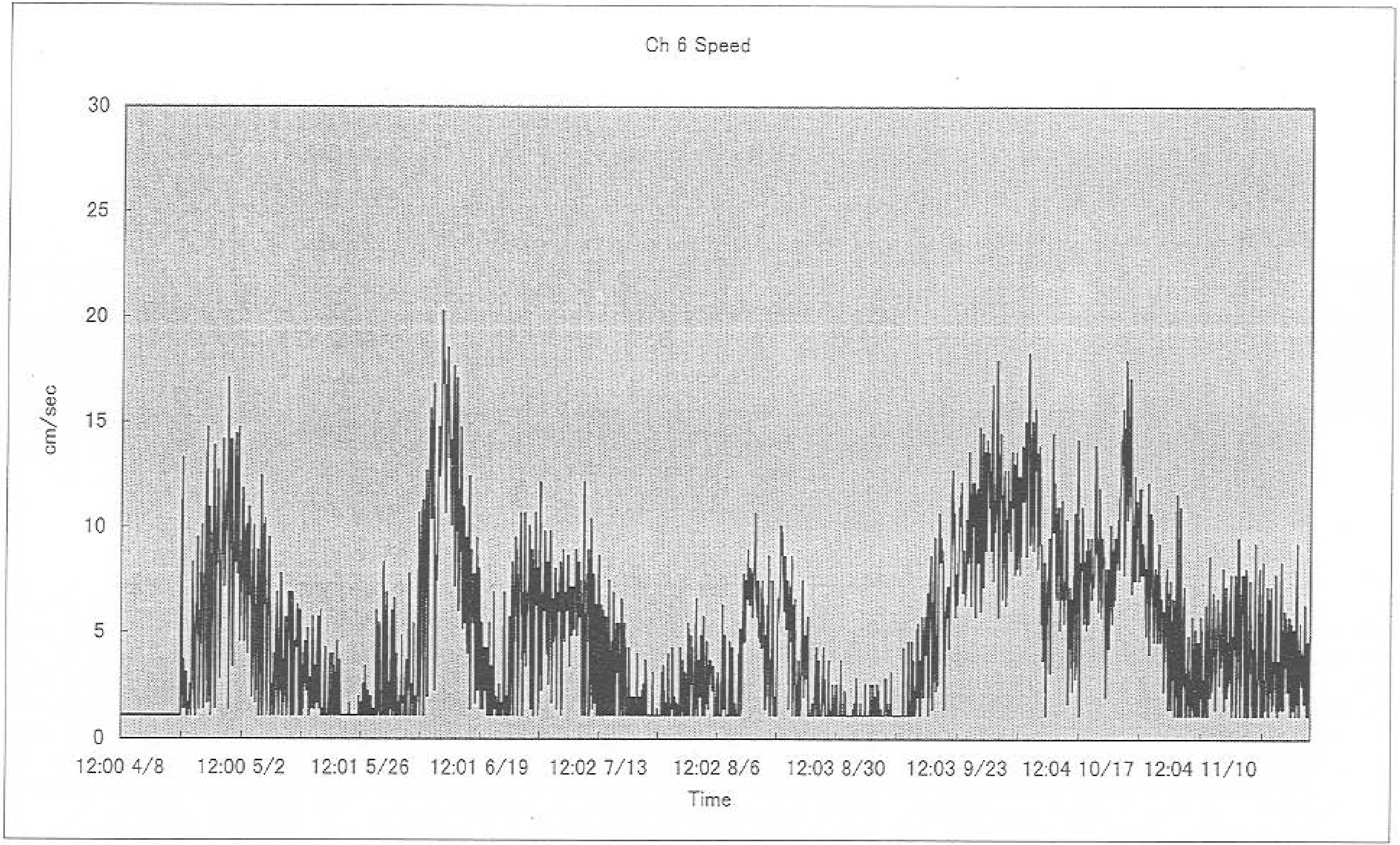

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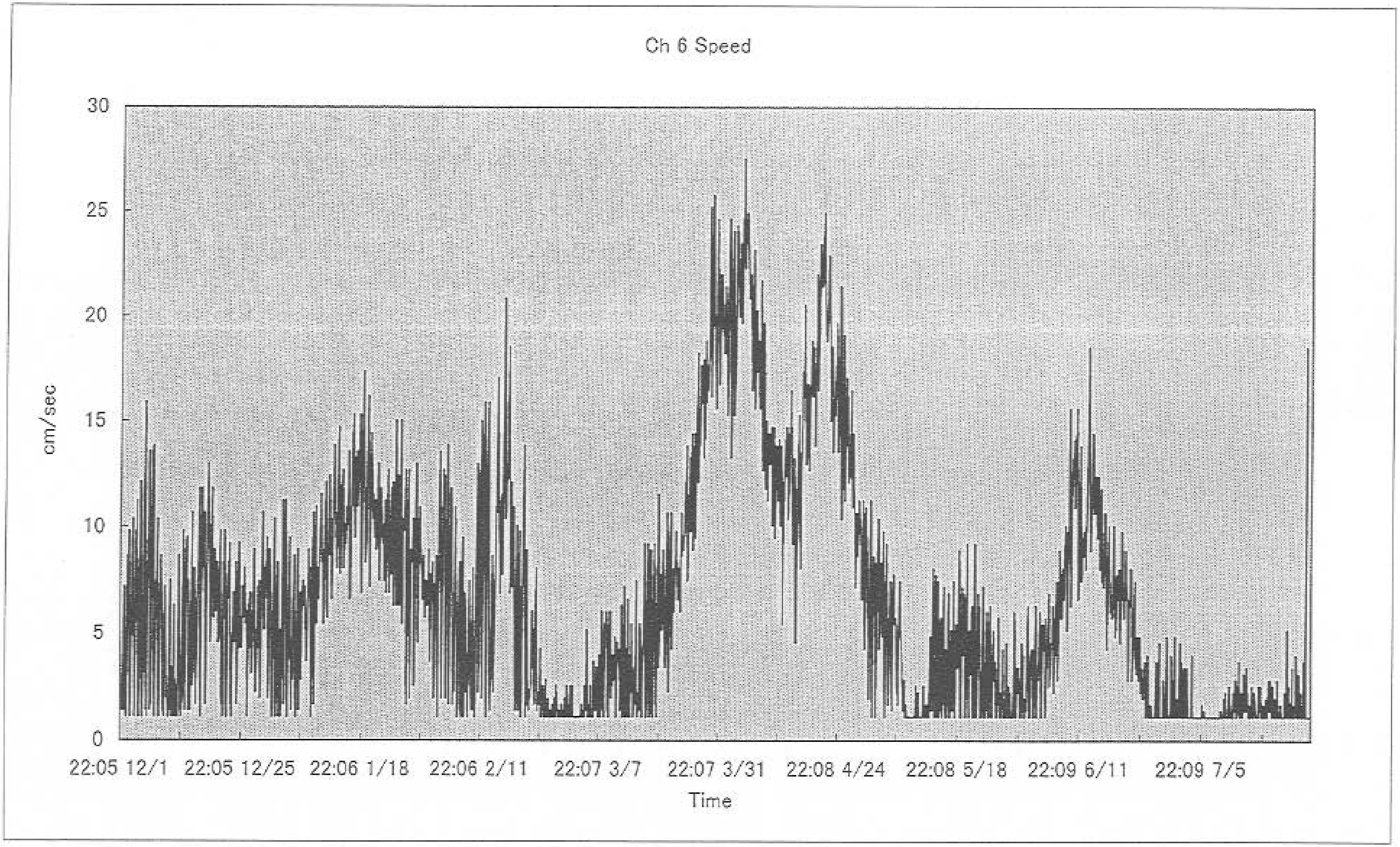


Data from 98/4/8 to 99/7/27
Sampling interval: 120 minutes

Data processed by 4059
Aanderaa Instruments AS

7.3 Sediment

Hirobumi Yamamoto (JAMSTEC): Group leader, Index physical property analysis
Eiichi Kikawa (JAMSTEC): Paleomagnetic analysis
Tadamichi Oba (Hokkaido University): Stable isotope analysis
Moriyoshi Yamauchi (Konan Boys' High School): Radiolaria analysis
Kaori Aoki (Hokkaido University): Sediment description, volcanic geochemical analysis
Miki Amou (Hokkaido University): Organic geochemical analysis
Masae Horii (Nagoya University): Paleomagnetic analysis
Toshikatsu Sugawara (Marine Works Japan Ltd.): Operation of coring and MST
Motoi Matsuhashi (Marine Works Japan Ltd.): MST and Soft-X ray analysis
Naotaka Togashi and Hiroaki Muraki (Marine Works Japan Ltd.): Soft-X ray analysis
Aya Kato (Marine Works Japan Ltd.): Color measurements and Soft-X ray analysis.

(1)Objectives

Primary objective of sediment coring in the north western Pacific is to investigate the historical change of paleoceanographic conditions (primary production, sea surface temperature, flux and transport process of particulate matter, and redox condition near the sea floor), paleoclimate (flux of terrigeneous materials and ice rafted materials), and volcanic activity through the Quaternary period.

(2)Coring equipment

10 or 20 m-long duralumin piston corer

Two different size piston corers were used for the present study. One type consists of a 1250 kg weight, a 20 m-long duralumin pipe (5 m x 4), and 80 mm inner diameter of the pipe. Another type has a 2500 kg weight, a 10 m-long duralumin pipe (5 m x 2), and 115 mm inner diameter of the pipe. We used a multiple core sampler “Ashura” equipped with a 80 kg weight and three sub-cores of 60 cm length and 73 mm inner diameter for the pilot corer.

Site survey

For reliable coring, the site survey was usually carried out with the 12kHz SEA BEAM 2100 Multibeam Bathymetric Survey System and 3-4kHz sub-bottom Profiling System in order to take a sea-bottom topographic map and geological and sedimentological information of the subsurface sediment, respectively. It shows survey map (Fig.7-3-1, Fig.7-3-2).

A02 Site

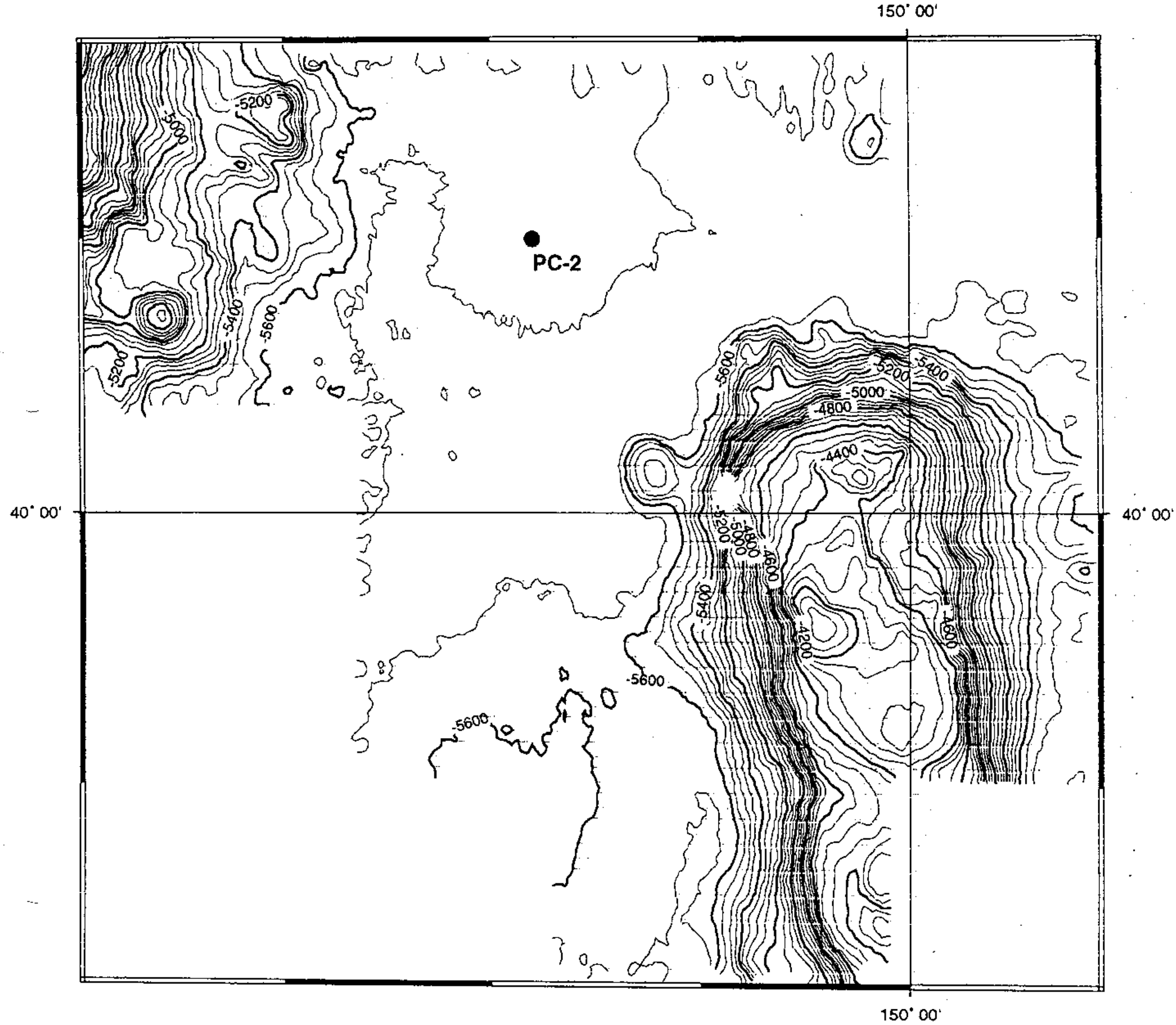


Fig. 7-3-1 A02 Site survey map

A03 Site

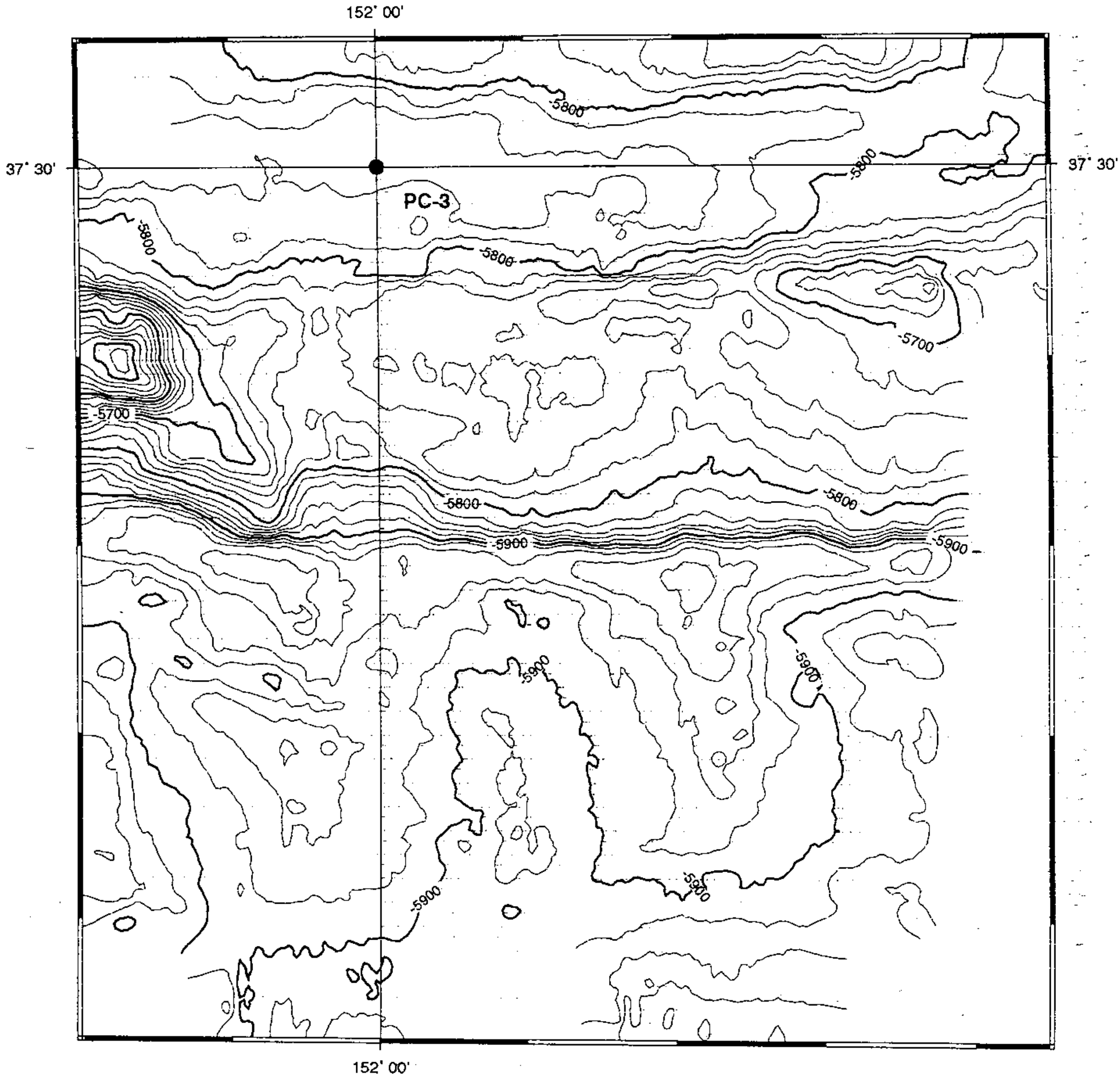


Fig. 7-3-2 A03 Site survey map

Positioning system

Global positioning system (GPS) of Tokyo datum and WGS84 were used to determine a geographic position.

(3)Sampling procedures

Sampling of bottom surface Quaternary sediments were carried out using the large diameter (115 mm) and medium diameter (80 mm) size corers. A sediment core with 478 cm length was obtained by the large diameter corer and two sediment cores with 1813 cm and 1876 cm length were obtained by the medium diameter corer (Table 7-3-1). A strait line was drown on the piston core tube by a paint marker and the sediment sample was pushed out and cut into 1 m length each. The edge of each section was capped with a urethane board, then marked with colored tapes, white to identify the top of the section and red for the bottom.

After carrying the section into the laboratory, magnetic susceptibility of the sediment was measured at every 2 cm intervals for the large diameter core. Whole-round sections of the medium diameter core were run through the multisensor track (MST). The MST includes the gamma-ray attenuation porosity evaluator (GRAPE), the P-wave logger, and a volume magnetic susceptibility meter. Each section was split lengthwise into working and archive halves with a stainless wire. After splitting, the length of the working and archive halves were measured and every 10 cm interval was marked by putting a plastic pin into the sediment.

Visual core description were performed on the working halves of the cores based on color classification in standard Munsell notation. The color measurement was made with a Minolta CM-2010 color refractometer. The cores were photographed with a color film, a whole core at a time. Close-up photographs were taken for particular sedimentological features. Sediment slabs of 1 cm thick were taken for soft X-ray analysis using a plastic case of 20 cm long and 5 cm wide. The sub-sample photographed by the soft X-ray will be used for volcanic ash analysis. The archive halve of each core section was sealed into a plastic bag and stored in a cold- room maintained about 4C in the R/V “Mirai”. After the cruise, the archive halves will be stored at JAMSTEC under 4C.

The working halves of the core were continuously sub-sampled for future analysis as follows (Figure 7-3-3).

Metal case (25 x 25 x 2500 mm) for organic geochemistry

U-channel (20 x 20 x 1000 mm) for paleomagnetic analysis

Large “Kabuse” (21 x 7 x 1000 mm) for radiolarian assemblage analysis

Small; “Kabuse” (16 x 7 x 1000 mm) for diatom assemblage analysis

Soft X-ray (30 x 7 x 200 mm) for physical property, gain size and clay mineral analysis

The sample for radio and stable isotope analysis were taken continuously using metal case

Station No.	St.A01	St.A02	St.A03
Piston Core	**PC-01**	**PC-02**	**PC-03**
Date	7/23	7/24	7/26
Latitude	40 ° 33.3 ′	40 ° 05.0 ′	37 ° 30.0 ′
Longitude	142 ° 55.0 ′	149 ° 51.0 ′	152 ° 00.0 ′
Water Depth	1,555m	5608m	5848m
Core Type	HOKKAIDO Univ.	JAMSTEC	JAMSTEC
	5m*2 10m	5m*4 20m	5m*4 20m
Head Weight	2.5t	1.25t	1.25t
φ	115mm	80mm	80mm

St.A01 (PC-01)

Section	S. Length	Core Length
1	69cm	69cm
2	100cm	169cm
3	102cm	271cm
4	101cm	372cm
5	95cm	467cm
CC	11cm	478cm
Total Length		478cm

Pirot Core
21.0cm

St.A02 (PC-02)

Section	S. Length	Core Length
1	98cm	98cm
2	101cm	199cm
3	99cm	298cm
4	107cm	405cm
5	99cm	504cm
6	99cm	603cm
7	102cm	705cm
8	98cm	803cm
9	98cm	901cm
10	96cm	997cm
11	98cm	1095cm
12	97cm	1192cm
13	102cm	1294cm
14	103cm	1397cm
15	101cm	1498cm
16	101cm	1599cm
17	101cm	1700cm
18	101cm	1801cm
CC	12cm	1813cm
Total Length		1813cm

Multiple Core
A 31.6cm
B 31.2cm
C 30.8cm

St.A03 (PC-03)

Section	S. Length	Core Length
1	87cm	87cm
2	96cm	183cm
3	99cm	282cm
4	100cm	382cm
5	98cm	480cm
6	97cm	577cm
7	97cm	674cm
8	98cm	772cm
9	98cm	870cm
10	98cm	968cm
11	98cm	1066cm
12	99cm	1165cm
13	98cm	1263cm
14	99cm	1362cm
15	99cm	1461cm
16	99cm	1560cm
17	101cm	1661cm
18	101cm	1762cm
19	101cm	1863cm
CC	13cm	1876cm
Total Length		1876cm

Multiple Core
A 27.5cm
B 30.0cm
C 28.5cm

Table 7-3-1 Summary of section length and core length.

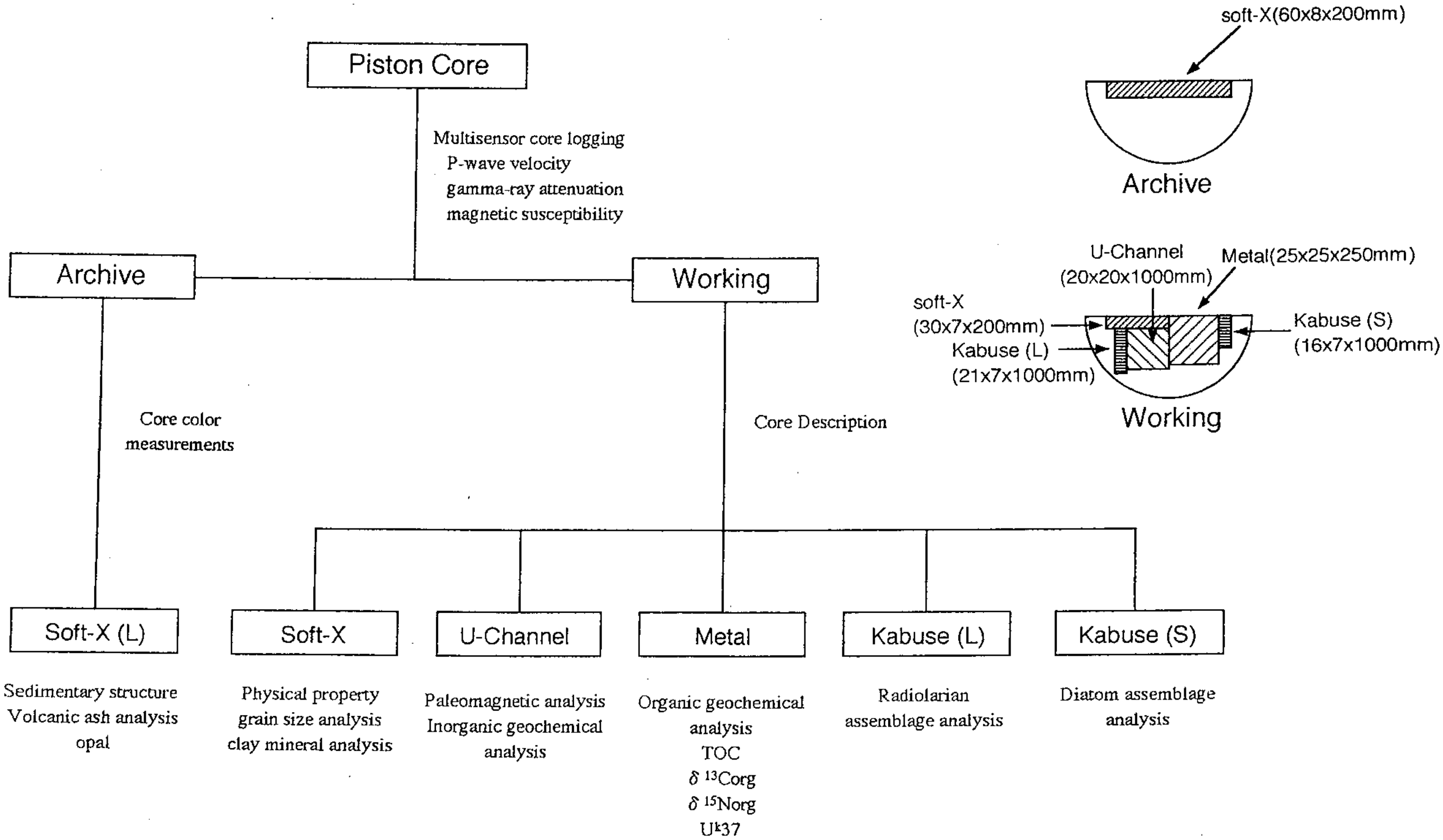


Fig. 7-3-3 Paleoceanographic Analysis Method of the Cruise MR99-K04

from the large diameter core. The remaining sediments in the working halves were stored in the cold-room of the R/V "Mirai".

(4)Visual core description

Kaori Aoki (Hokkaido Univ.)

Three piston cores associated with "Ashura" pilot cores were obtained from the north west Pacific Ocean. A large diameter core (PC-1) with 478 cm length was collected at station A01 on the continental slope off Hachinohe at water depth of 1555 m, where is the same location of previous piston core MR97-04, station 1. We tried to retrieve a piston core from the previous site, because the core MR97-04, station 1 failed to recover the surface sediment of the sea floor due to the incomplete wire lengths between the piston and pilot cores. In order to get the surface sediment of the sea floor, a long pilot core wire (17.04 m) was prepared for the present piston coring at station A01, compared to the length (13.95 m) of the main wire. Actually it was too long by about 1.85 m from the best wire length (15.19 m) for the pilot core. Consequently, about half length above the 10 m corer was filled with sea water. However, the surface sediment of the sea floor was successfully recovered in the both "Ashura" and piston corers, as evidenced by the presence of alive organisms such as sea urchin and lugworm at the brown colored top sediments of these cores. The PC-1 core consists of dark olive relatively massive silty clay including large number of foraminifera, sporadic occurrence of round gravels and pumice grains from granule to pebble size, and several ash layers (Figure 7-3-4). Slightly laminated layers are observed between 310 cm and 360 cm from the top of the core. A 20 m long piston core (medium diameter size) was used at station A02 and A03 with the "Ashura" pilot cores. The top 15-20 cm of the both piston cores (PC-2 and PC3) show brownish color, suggesting oxidized condition, and are compared with those of the "Ashura" cores. This means that the piston coring at these sites were carried out successfully without missing the surface sediments of the sea floor during the piston coring. The PC-2 core (18.13 m length) shows gray colored massive clay including relatively abundant diatom and radiolarian fossils, although dark greenish gray layers and bioturbated layers are observed sporadically (Figure 7-3-4). This core contains relatively large number of ash layers, at least 17 ash layers are recognized (Table 7-3-2). The PC-3 core (18.76 cm length) consists of an alternation of grayish olive and olive black massive clay, although dark greenish gray laminated layers, burrows, and ash layers are observed sporadically (Figure 7-3-4). This core also includes diatom and radiolarian fossils as well as core PC-2. The sediments below a volcanic ash layer between 324 and 329 cm is more compacted than the sediments above the ash layer.

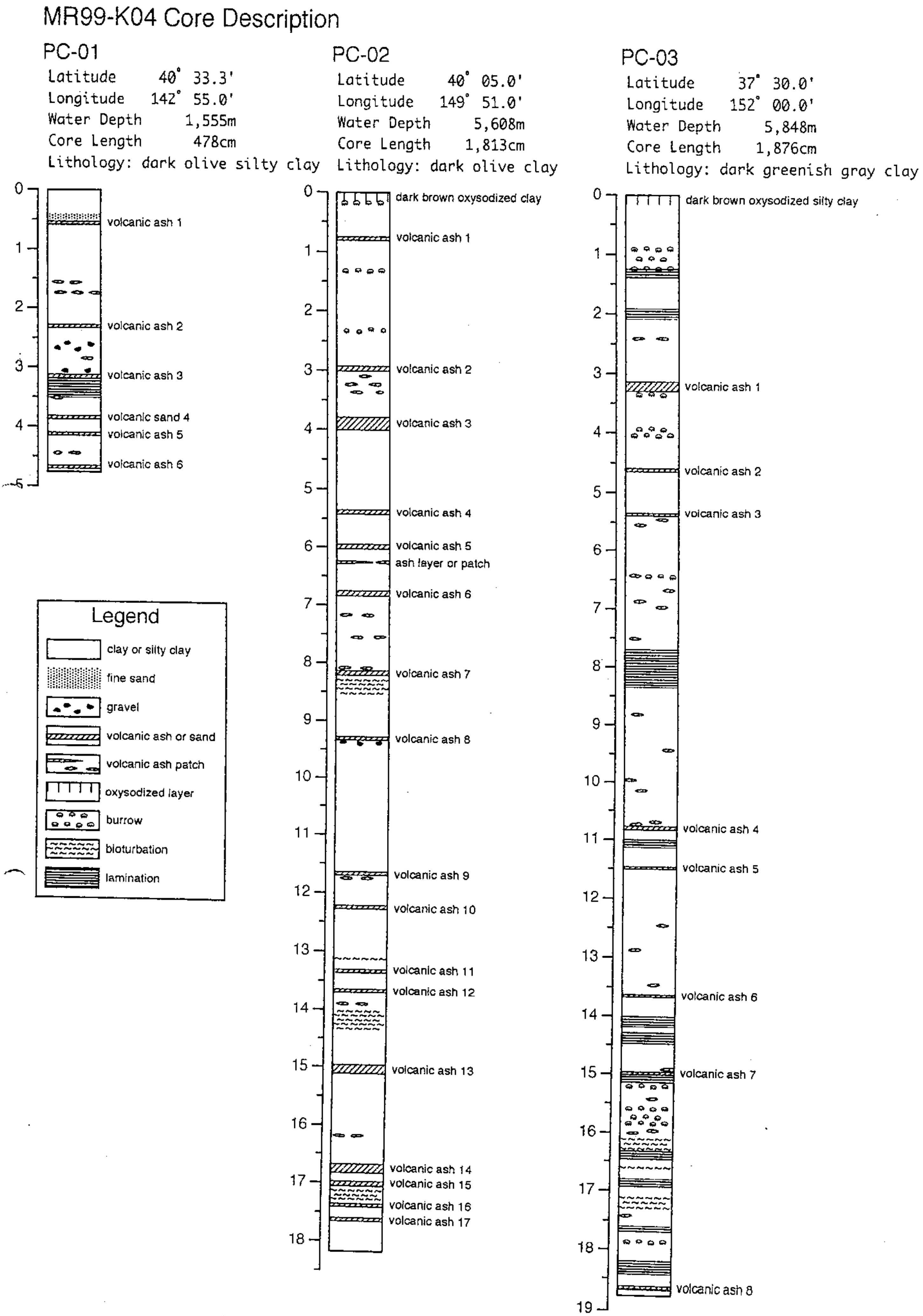


Fig. 7-3-4 preliminary columnar section of three piston cores

PC-01

Ash	Section No.	Interval (cm)	Core Depth (cm)	Thickness (cm)
1	1	55.0 - 56.0	55.0 - 56.0	1.0
2	3	57.0 - 65.0	226.0 - 234.0	8.0
3	4	37.0 - 40.0	308.0 - 311.0	3.0
4	5	8.0 - 11.0	380.0 - 383.0	3.0
5	5	41.0 - 46.0	413.0 - 418.0	5.0
6	CC	0.0 - 1.0	467.0 - 468.0	1.0

PC-02

Ash	Section No.	Interval (cm)	Core Depth (cm)	Thickness (cm)
1	1	75.0 - 80.0	75.0 - 80.0	5.0
2	2	96.0 - 99.0	295.0 - 299.0	4.0
	3	0.0 - 1.0		
3	4	81.0 - 107.0	379.0 - 405.0	26.0
4	6	30.0 - 40.0	534.0 - 544.0	10.0
5	6	92.0 - 99.0	596.0 - 604.0	8.0
	7	0.0 - 1.0		
6	7	74.0 - 80.5	677.0 - 683.5	6.5
7	9	10.0 - 18.5	813.0 - 821.5	8.5
8	10	26.0 - 30.0	927.0 - 931.0	4.0
9	12	70.0 - 73.0	1165.0 - 1168.0	3.0
10	13	40.0 - 45.0	1232.0 - 1237.0	5.0
11	14	37.0 - 40.0	1331.0 - 1334.0	3.0
12	14	71.0 - 73.0	1365.0 - 1367.0	2.0
13	15	97.0 - 101.0	1494.0 - 1510.0	16.0
	16	0.0 - 12.0	-	
14	17	69.0 - 84.0	1668.0 - 1683.0	15.0
15	17	100.0 - 101.0	1699.0 - 1704.5	5.5
	18	0.0 - 4.5	-	
16	18	35.0 - 40.0	1735.0 - 1740.0	5.0
17	18	61.0 - 64.0	1761.0 - 1764.0	3.0

PC-03

Ash	Section No.	Interval (cm)	Core Depth (cm)	Thickness (cm)
1	4	32.0 - 47.0	314.0 - 329.0	15.0
2	5	77.0 - 81.0	459.0 - 463.0	4.0
3	6	53.0 - 57.0	533.0 - 537.0	4.0
4	12	11.0 - 20.0	1077.0 - 1086.0	9.0
5	12	81.5 - 83.0	1147.5 - 1149.0	1.5
6	15	4.5 - 6.5	1366.5 - 1368.5	2.0
7	16	36.5 - 38.5	1497.5 - 1499.5	2.0
8	CC	0.0 - 5.0	1863.0 - 1868.0	5.0

Table 7-3-2 Summary of volcanic ash layer in cored material of the cruise

(5) Multisensor core logging

P-wave velocity, gamma-ray attenuation and magnetic susceptibility were measured on whole-core sections before splitting using the on board GEOTEK multisensor core logger. We collected these data at 2 cm intervals for one multiple core and through a piston core from each sampling site. Since piston cores were cut into about 1-m sections and a core liner was 1.1-m long, there usually existed about 10-cm gaps at section breaks. Several measured points near section breaks, showing high gamma-ray attenuation and low magnetic susceptibility values, were removed to avoid confusion.

P-wave velocity was obtained for multiple cores by calibrating the raw data using a multiple core liner filled with distilled water. For piston cores P-wave velocity could not be measured, because there was always gap between the core liner and the sediment which prevents P-wave to transfer through the sediment.

The gamma-ray attenuation (GRA) data were converted to wet bulk density, using a standard sample which consists of a cylindrical piece of aluminum of varying thickness surrounded by distilled water in a sealed liner. Here we call the calculated density as GRA density to distinguish it from the more precisely measured density on discrete samples. For the gamma-ray attenuation measurements a 5 mm collimator hole was used during this leg and the measurement time was set to be 30 seconds for a single measurement. We corrected the observed drift in gamma-ray count rates by estimating the gamma source intensity from the values measured on voids at section breaks.

Magnetic susceptibility were measured using a loop sensor with a 10 cm inner diameter and are shown in volume specific SI unit (dimensionless).

For piston cores, GRA density and magnetic susceptibility were plotted with depth in Figs 7-3-5 to 7-3-7 for each site (St. A01,A02 and A03) in conjunction with the color reflectance indices.

(6)Magnetic susceptibility (hand-operated)

For the site ST. A01 (core diameter = 10cm), magnetic susceptibility were measured by hand using the MS2 (Bartington instruments Ltd.). Measurement was conducted using a loop sensor with a 12.5 cm inner diameter and are shown in volume specific SI unit (dimensionless). We collected these data at 2 cm intervals through the piston core.

After measurements of every sections, we measured blank and confirmed there was

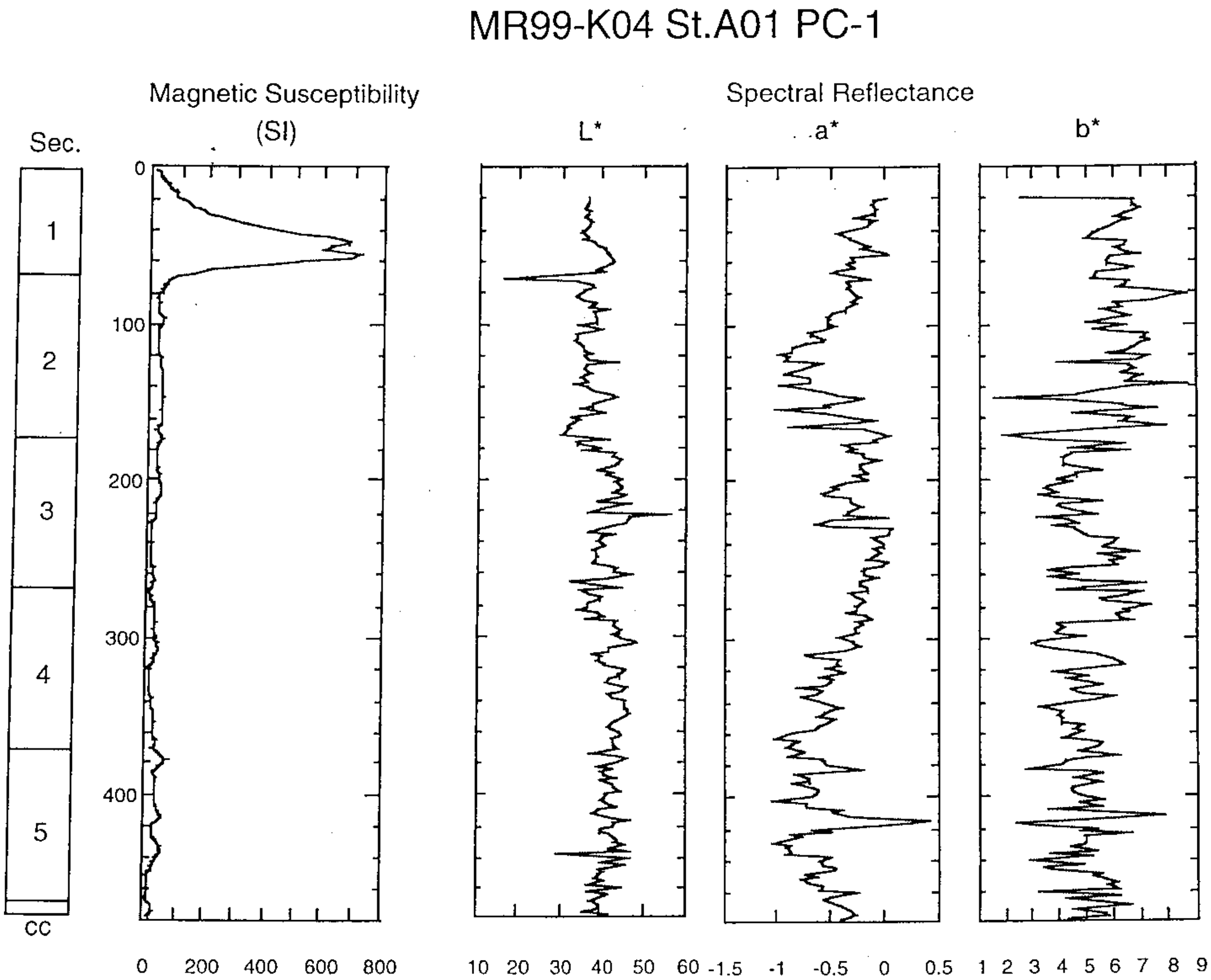


Fig. 7-3-5 Magnetic Susceptibility and Spectral Reflectance St. A01

Marine Works Japan Ltd.

MR99-K04 St.A02 PC-2

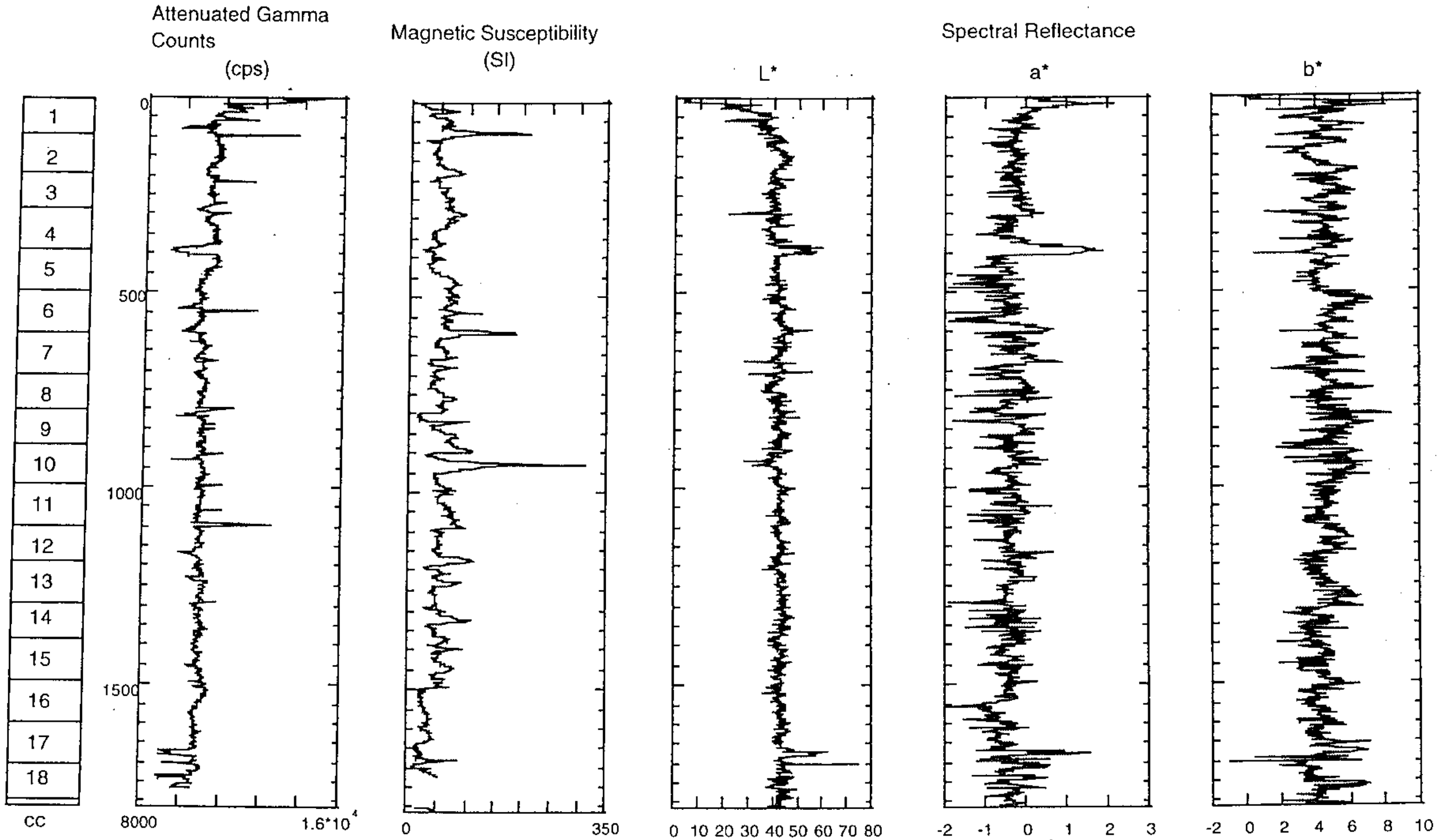


Fig. 7-3-6 Magnetic Susceptibility and Spectral Reflectance St. A02

Marine Works Japan Ltd.

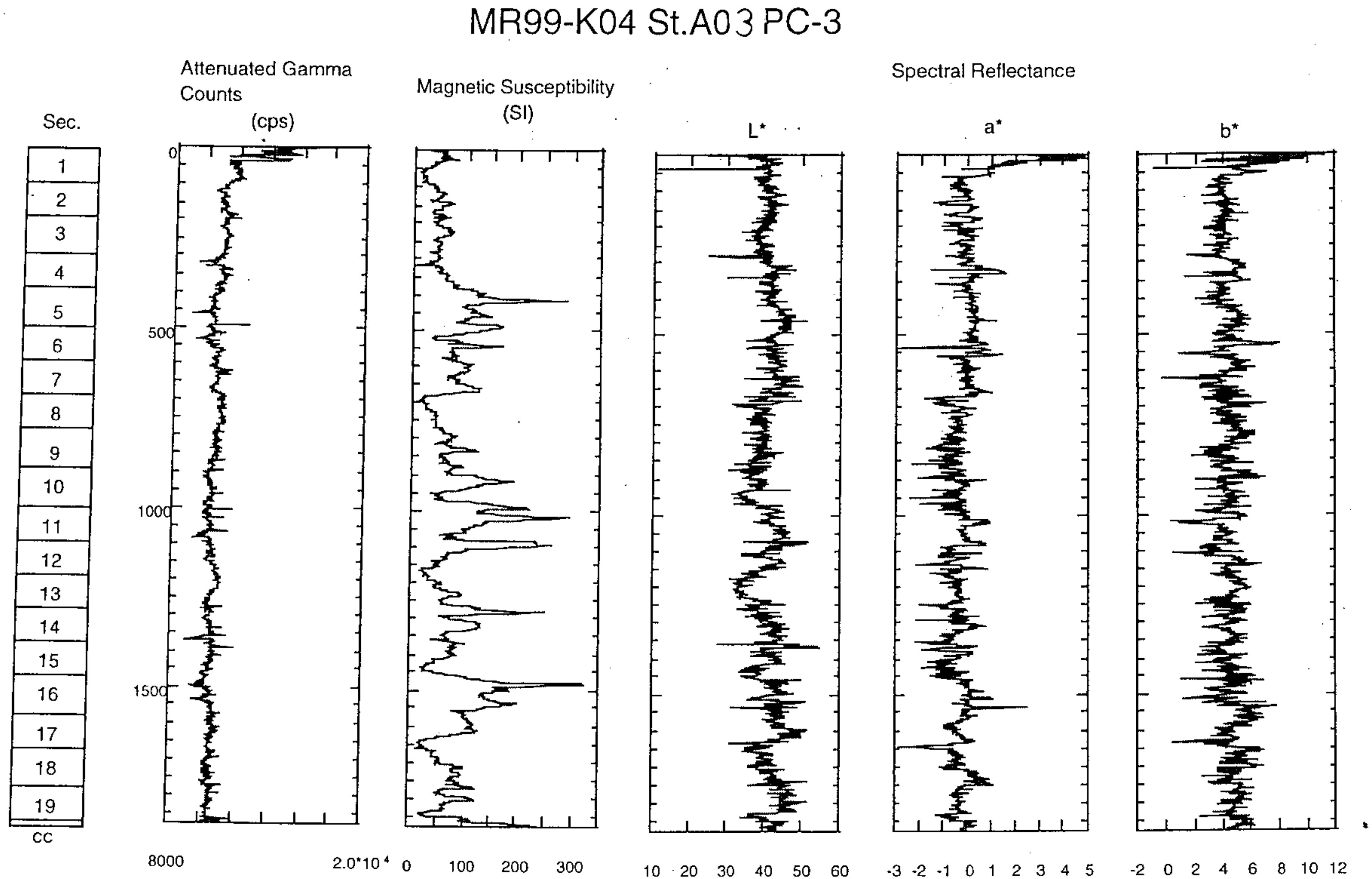


Fig. 7-3-7 Magnetic Susceptibility and Spectral Reflectance St. A03

Marine Works Japan Ltd.

little noise and drift.

(7)Future analysis

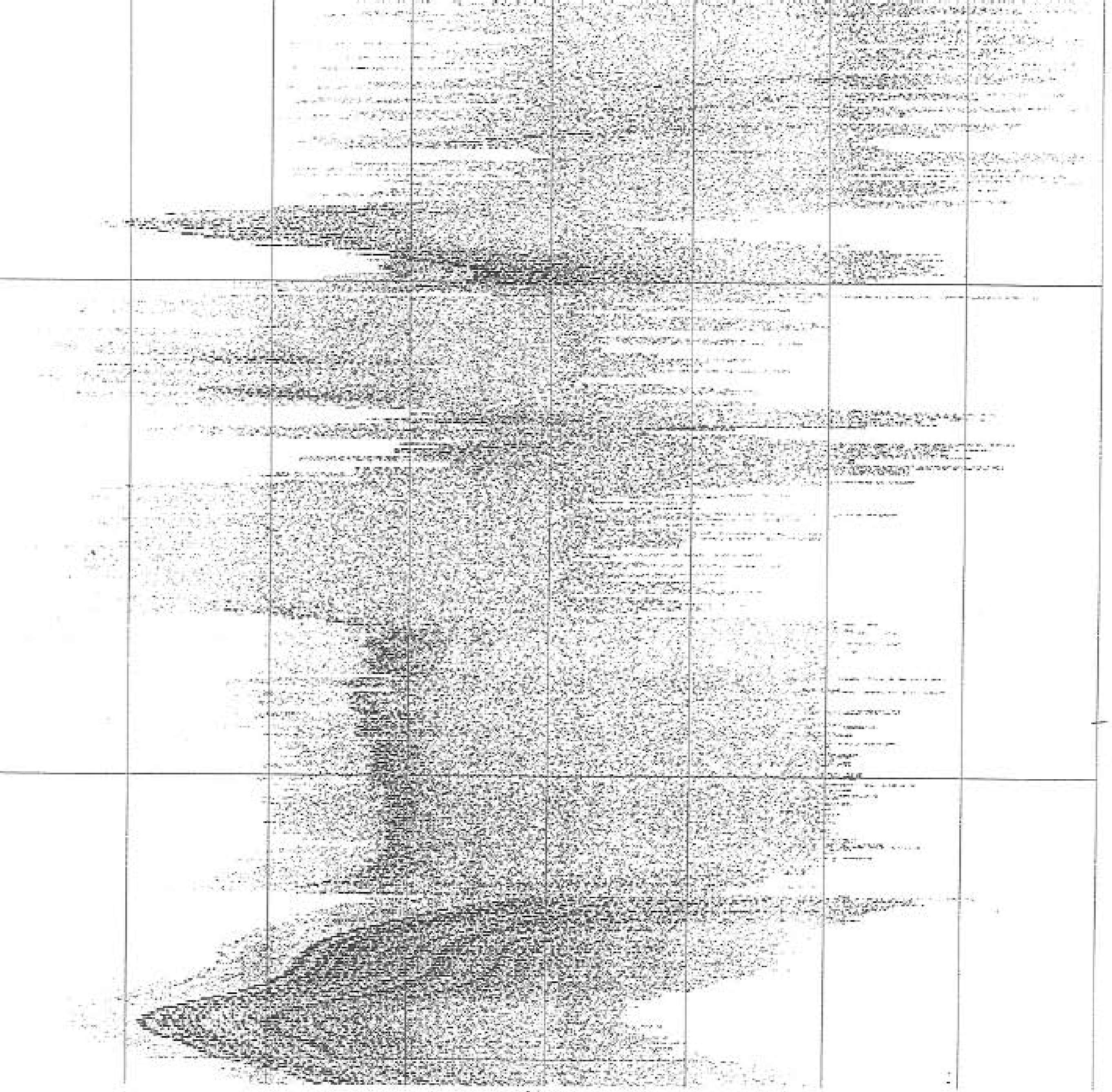
① Index physical properties (wet bulk density, dray bulk density, water content) should be measured at JAMSTEC. The sub-sample in U-channel containers (20 x 20 x 1000 mm) should be measured for paleomagnetic analysis at JAMSTEC. Wet bulk weight of a sample material should be measured as soon as possible after the cruise at JAMSTEC. After drying at 60C for a day, the dry weight of the sample will be measured. The weight loss of sample materials will be considered those water contents after the calibration of the salt effect.

② Index chemical properties (CHN analysis) will be measured at JAMSTEC.

③ Paleomagnetic analysis will be carried out at JAMSTEC.

The other analyses are planed as follows:

^{14}C dating, ^{10}Be analysis, ^{18}O and ^{13}C of foraminifera, volcanic ash, hydrocarbon and alkenones analysis (Hokkaido Univ.), radiolarian analysis (Konan Boys’ High School).



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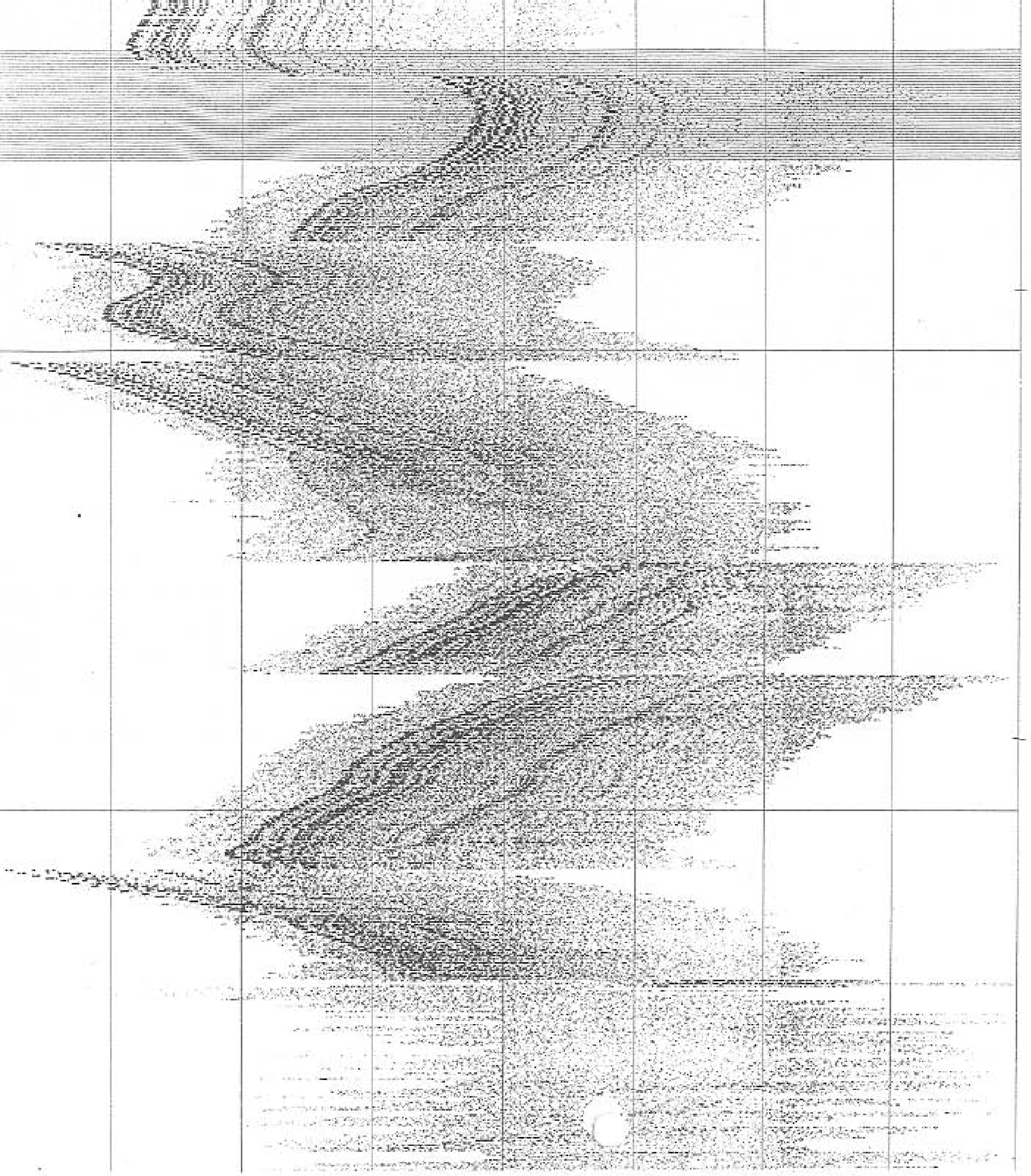
A02Si1a



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on crs 270 → 360°

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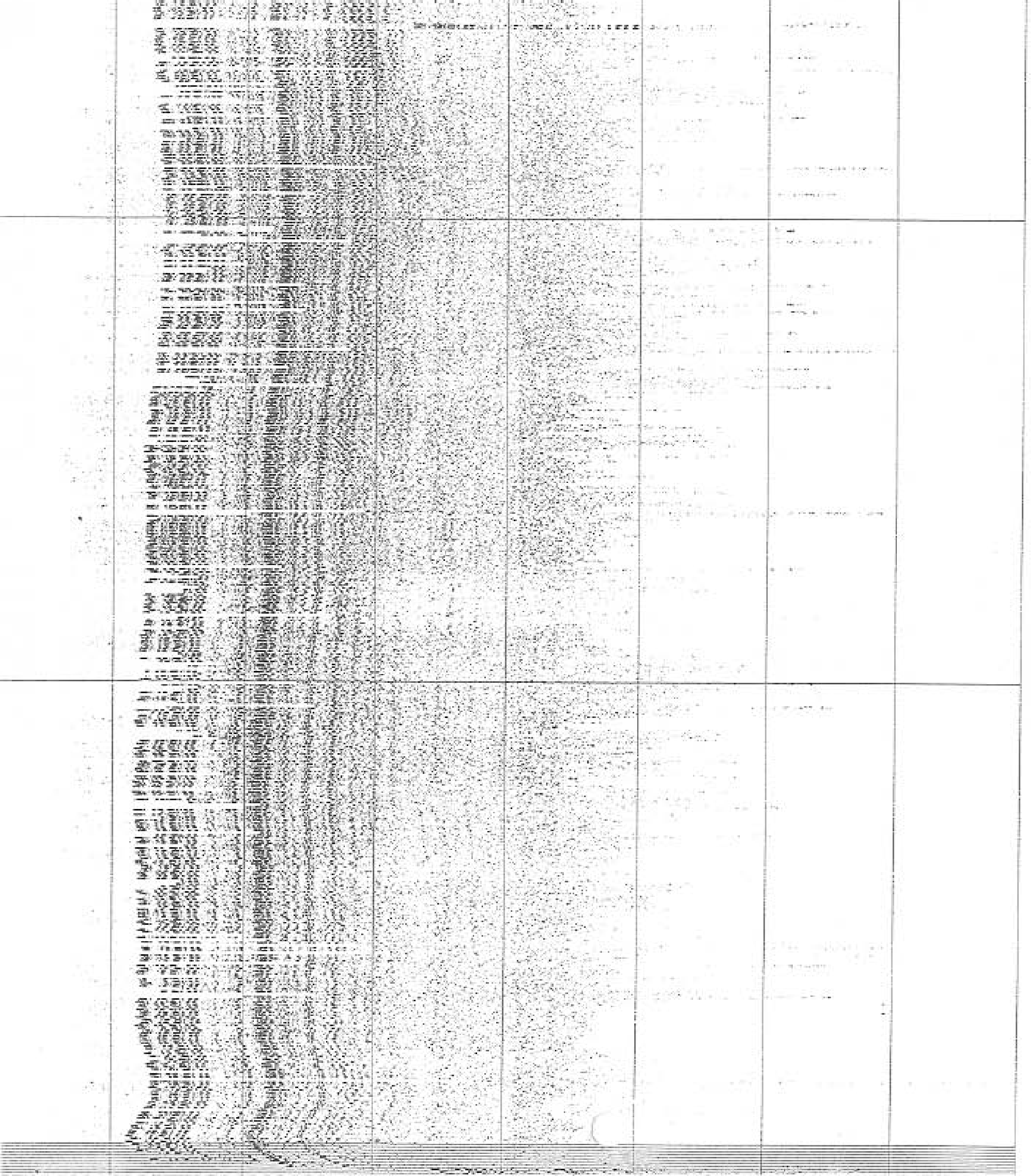
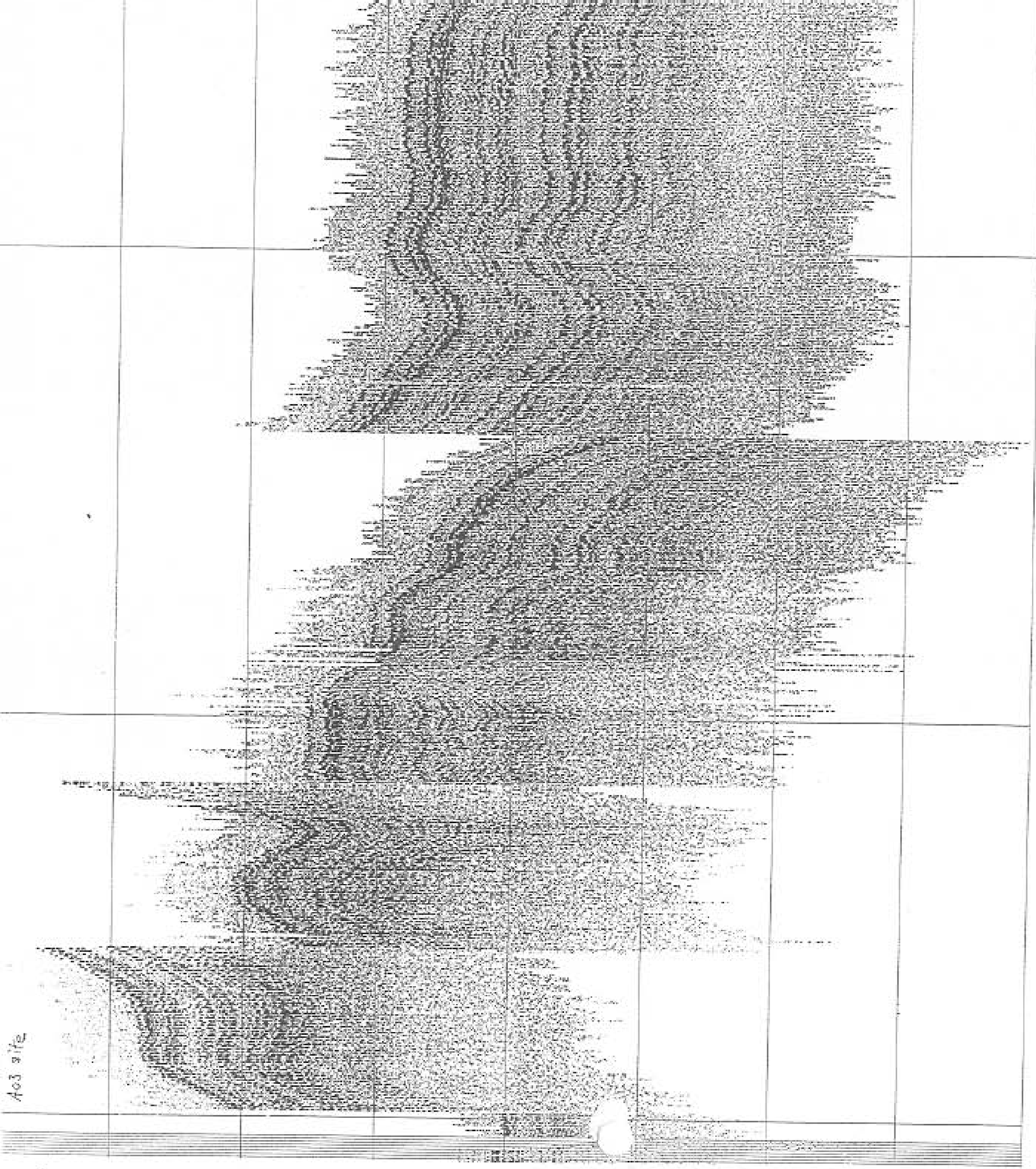


24:Jul:1999:23:55:01:07400msT07600msB:0400452.250N1495050.130E256.10D 0.00K

24:Jul:1999:23:18:29:07400msT07600msB:0400459.110N14951 2.510E240.30D 0.00K

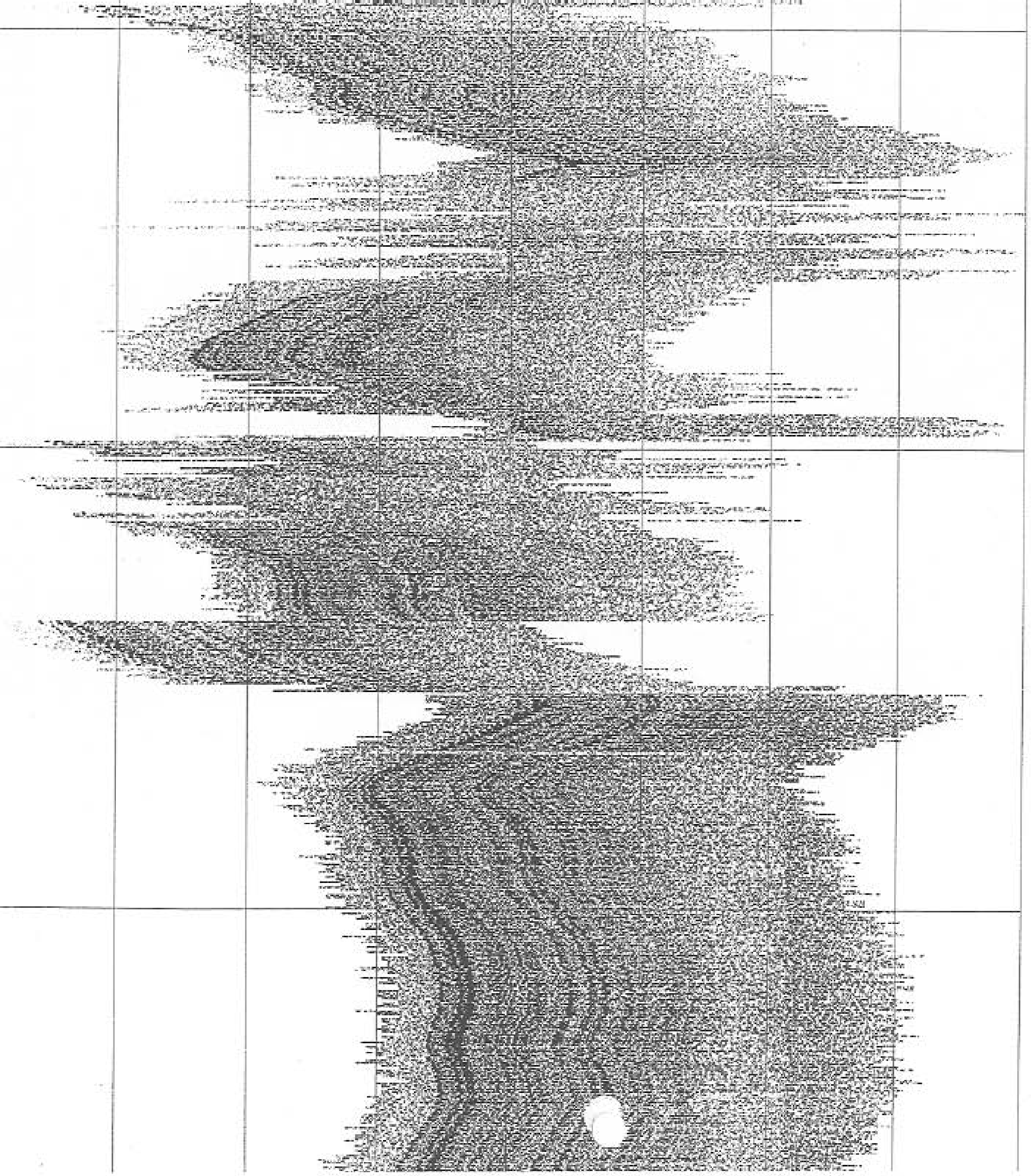
24 [illegible] :1999:22:42:01:07400msT07600msB:0400518.040N1495123.570E219.00D 0.00K



26:Jul:1999:11:08:18:07650msT07850msB:00000 0.000S00000 0.000W 0.00D 0.00

26:Jul:1999:10:31:58:07600msT07800msB:00000 0.000S00000 0.000W 0.00D 0.00Kt

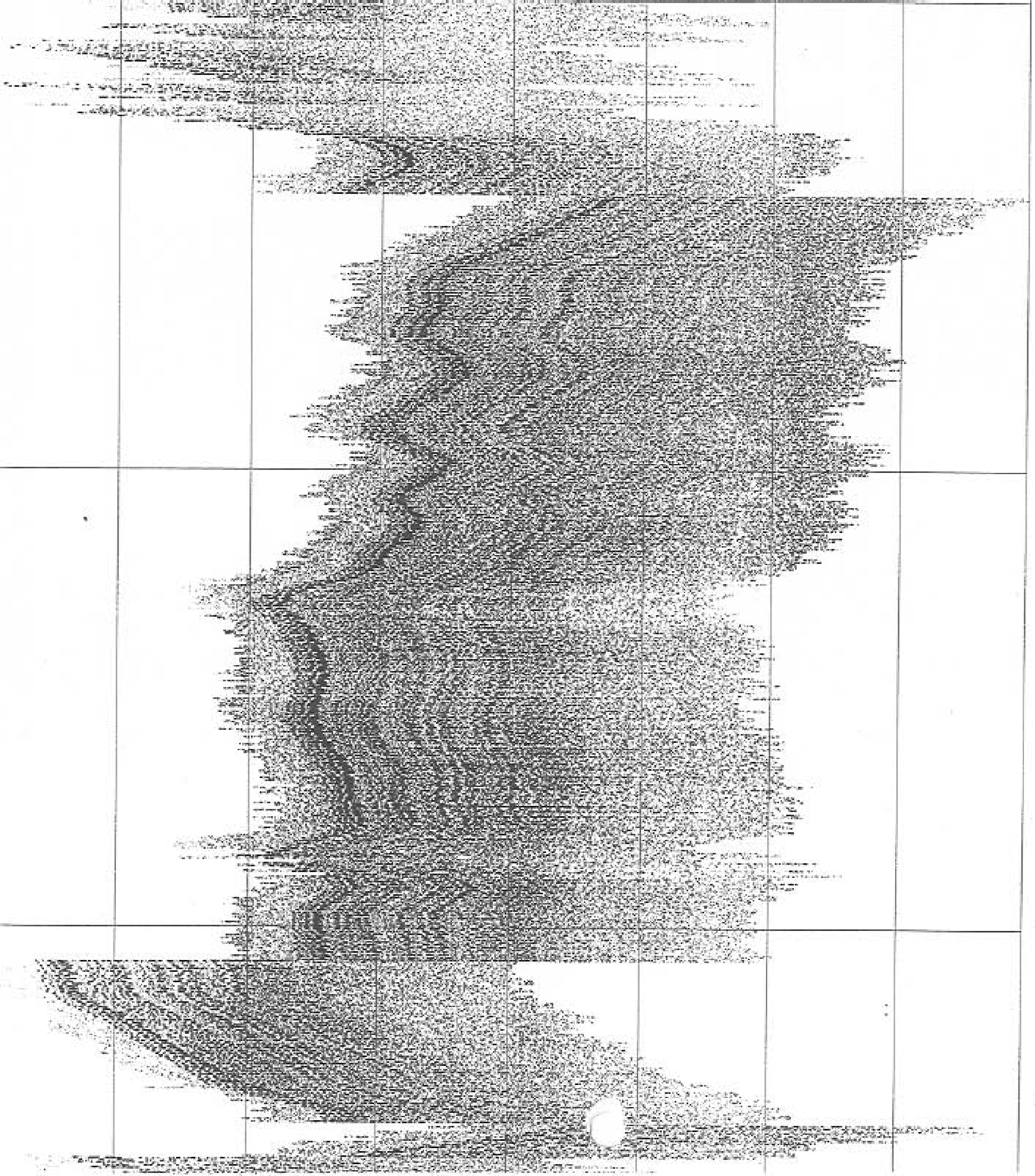
26/27 1999:09:19:03:07500msT07900msB:0372313.930N15227 5.310E 0.40D 0.00Kts
1999:16:25:34:07500msT07900msB:0372047.680N1500650.310E271.97D 0.00Kts



26:Jul:1999:12:54:40:07800msT08000msB:00000 0.002500000 0.000W 0.000 0.00K

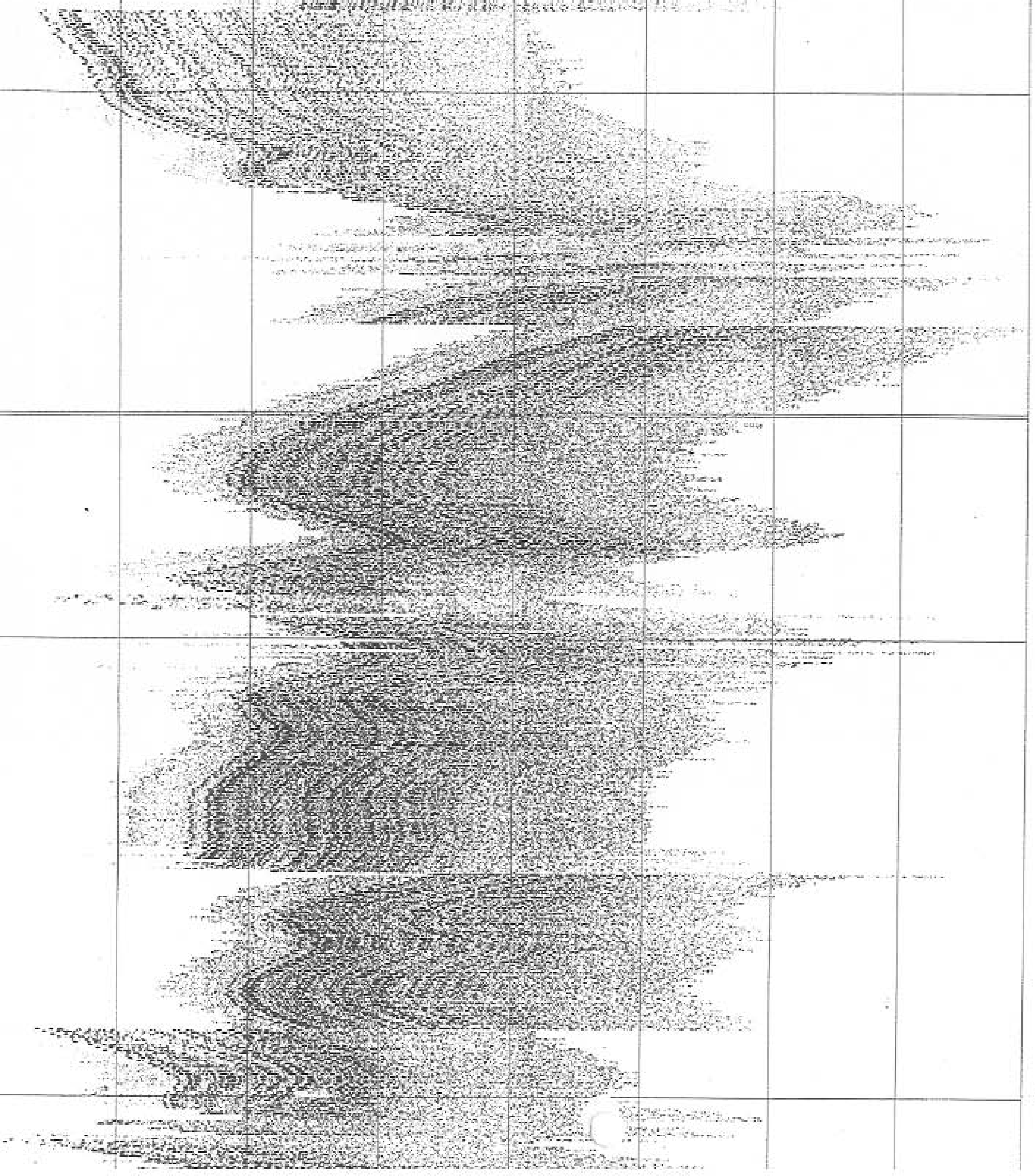
26:Jul:1999:12:21:53:07550msT07750msB:00000 0.002500000 0.000W 0.00D 0.00K

26:Jul:1999:11:44:58:07650msT07850msB:00000 0.002500000 0.000W 0.000 0.00K



26:Jul:1993:13:52:23:07750msT07950msB:00000 0.000S00000 0.000W 0.00D 0.00K

26:Jul:1998:13:15:13:07750msT07950msB:00000 0.000S00000 0.000W 0.00D 0.00K

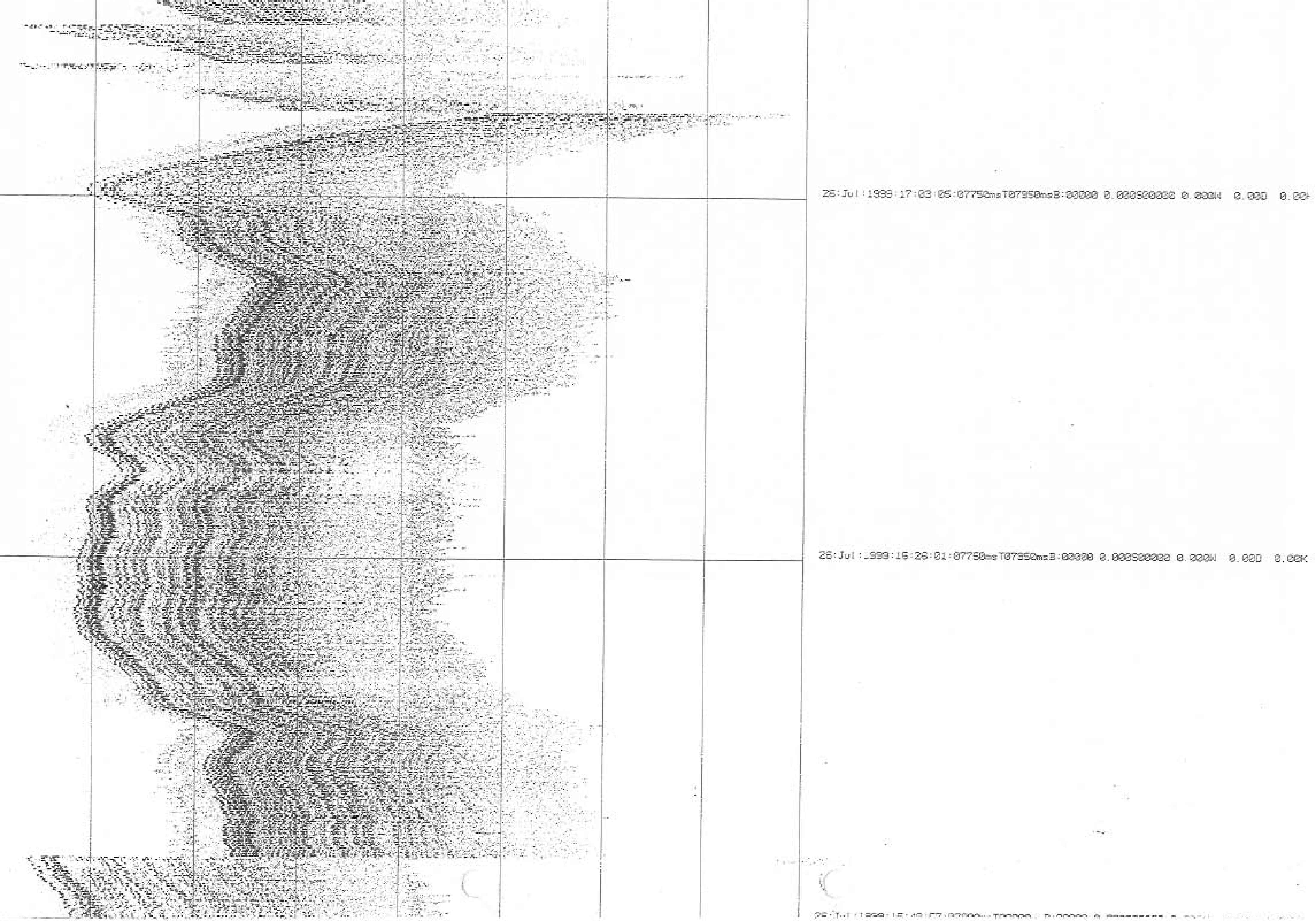


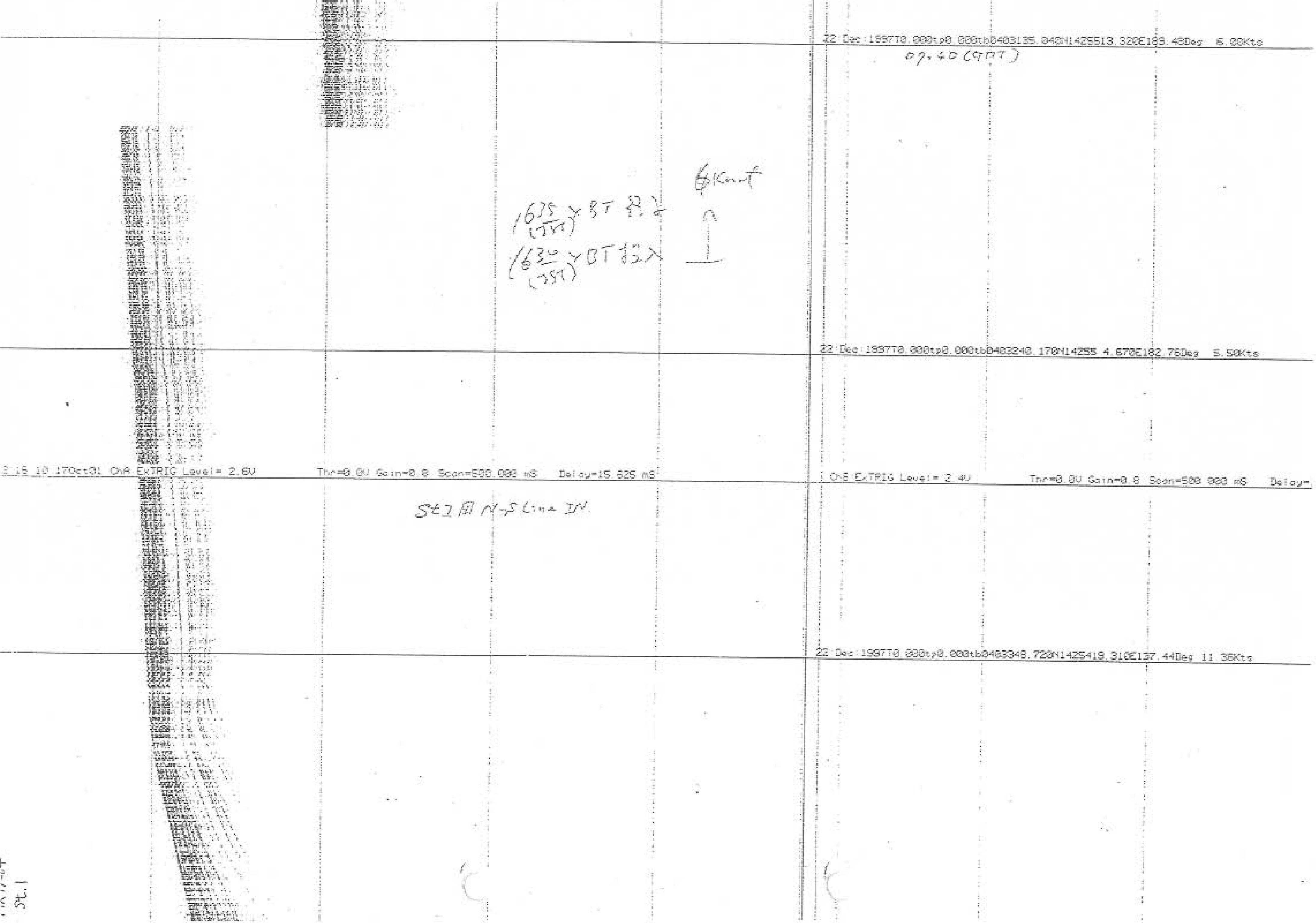
26:Jul:1999:15:48:57:07800msT08000msB:00000 0.000500000 0.000W 0.000 0.00K

26:Jul:1999:15:23:40:07550msT07750msB:00000 0.000500000 0.000W 0.00D 0.00K

26:Jul:1999:15:05:57:07600msT07800msB:00000 0.000500000 0.000W 0.00D 0.00K

26:Jul:1999:14:29:28:07600msT07800msB:00000 0.000500000 0.000W .0.00D 0.00K


26:Jul:1999:17:03:05:07750msT07950msB:00000 0.000500000 0.000W 0.000 0.00
26:Jul:1999:16:26:01:07750msT07950msB:00000 0.000500000 0.000W 0.00D 0.00K


22 Dec:1997T0.000tp0.000tb0403135.040N1425513.320E189.48Deg 6.00Kts
07,40 (GMT)
6Knot
1635 (JST) XBT 終了
1630 (JST) XBT 投入
22 Dec:1997T0.000tp0.000tb0403240.170N14255 4.670E182.76Deg 5.50Kts
2 15 10 17Oct01 ChA ExTRIG Level= 2.6V
Thr=0.0V Gain=0.8 Scan=500.000 mS Delay=15.625 mS
ChB ExTRIG Level= 2.4V
Thr=0.0V Gain=0.8 Scan=500.000 mS Delay=
St.7 目 N-S Line IN
22 Dec:1997T0.000tp0.000tb0403348.720N1425419.310E137.44Deg 11.38Kts

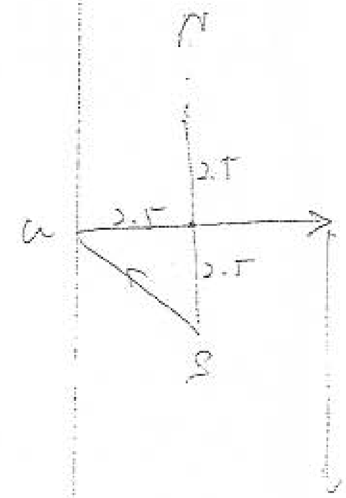
22:Dec:1997T0.000tp0.000tb0402934.970N14255 5.140E201.88Deg 4.50Kts

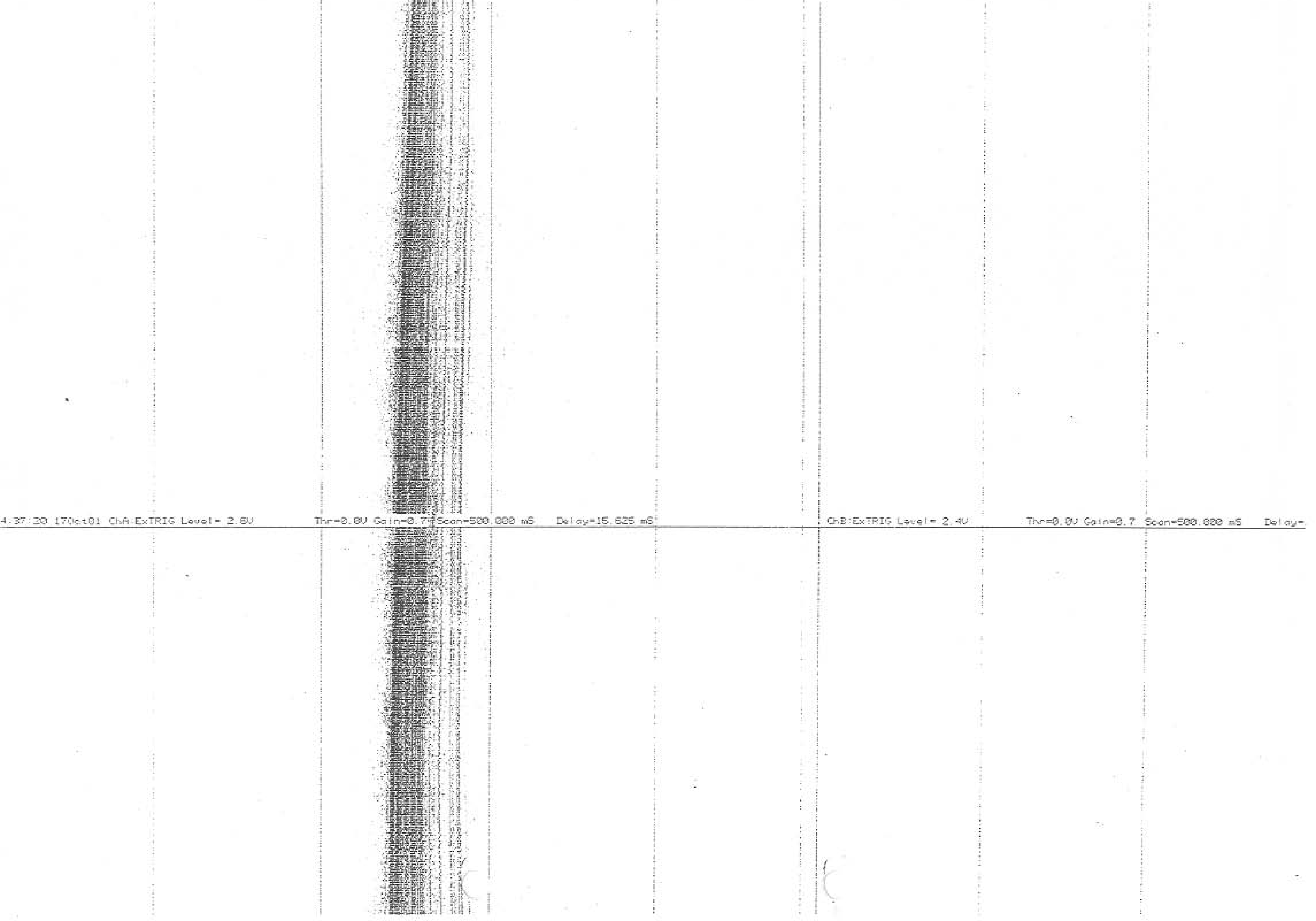
22:Dec:1997T0.000tp0.000tb0403033.430N1425515.640E200.55Deg 5.50Kts

22 [illegible]:1997T0.000tp0.000tb0403135.040N1425513.320E199.48Deg 6.00Kts

02:40 (GMT)

SE -> NW




4:37:30 17Oct01 ChA:ExTRIG Level= 2.8V
Thr=0.0V Gain=0.7 Scan=500.000 mS
Delay=15.625 mS
ChB:ExTRIG Level= 2.4V
Thr=0.0V Gain=0.7 Scan=500.000 mS
Delay=

H. Kraut

ca 90°

7.4.1 Study on aerosol particles over the North Pacific Ocean

In order to clarify the effect of aerosols to the global climate, marine aerosols and gas have been measured. The kytoon observation up to about 700 m asl and the search of the best place for the sampling inlet have also been carried.

(1) Continuous measurement of particle number concentration and size distribution

condensation particle counter : 2022A (r>0.leg 1) or 2025A (leg 2), TSI Co. Ltd.

optical particle counters : KC18 and KC01, Rion Co. Ltd.

r>0.05, 0.075, 0.1, 0.15, 0.25, 0.5, 1, 2.5 μ m)

(2) Continuous measurement of mass concentration of carbonaceous particles

carbon monitor : C5400, R&P Co.

(3) continuous measurement of radon daughter concentration

radon daughter monitor

(4) Measurement of particle concentration profile with kytoon system

kytoon : 7 m3 in volume, up to 700 m

optical particle counter (r>0.15, 0. 5 μ m) : KM07, Rion Co. Ltd.

(5) Measurement of particle concentration at various place

optical particle counter (r>0.15, 0. 5 μ m) : KM07, Rion Co. Ltd.

for-mast, rader mast, inlet of sampling pole and sampling tube

(6) Observation of solar radiation

portable sunphotometer (λ : 368, 500, 675, 778, and 862 nm) : MS-120(S), Eko Co.)

(7) Sampling of aerosols and gas

low volume sampler

aerosols : nuclepore filter (0.8 μ m in pore size)

gas : Whatman-41 impregated with K2CO3

cascade impactor (Model I-1L, PIXE Int. Corp.)

carbon-covered nitrocellulose film supported on an electron microscopic grid

canister : gas (two station)

(8) gas measurement

gas chromatograph (Shimazu GC-14B) equipped with a flame photometric detector

carbonyl sulfide (COS) , carbon sulfide (CH2) , dimethyl sulfide (DMS)

SO2 meter (Tokyo Denki Keiki Co.)

Table 7.4.1.1 Measuring list of the number concentration profile with OPC on the kytoon

No.	date	start time	stop time	max. length (m)	size range (diameter)	latitude	longitude	remarks	filename
1	1999/7/27	8:40	8:51	100	> 0.3, 1.0 um	37-30N	151-58E	A03	MR99KYT1.DAT
2	1999/7/28	9:22	9:39	200	> 0.3, 1.0 um	37-30N	150-00E	A06	MR99KYT2.DAT
3	1999/7/29	5:51	6:18	300	> 0.3, 1.0 um	35-00N	150-00E	A10	MR99KYT3.DAT
4	1999/7/29	9:35	10:01	500	> 0.3, 1.0 um	34-30N	150-01E	A12	MR99KYT4.DAT
5	1999/7/30	5:33	6:06	500	> 0.3, 1.0 um	32-30N	150-00E	A16	MR99KYT5.DAT
6	1999/8/1	8:33	9:02	300	> 0.3, 1.0 um	34-02N	144-39E	drifting	MR99KYT6.DAT
7	1999/8/7	8:40	8:51	100	> 0.3, 1.0 um	35-00N	?144E		MR99KYT7.DAT
8	1999/8/7	9:02	9:28	300	> 0.3, 1.0 um	35-00N	?144E		MR99KYT7.DAT
9	1999/8/8	6:57	7:16	200	> 0.3, 1.0 um	35-00N	157-30E	B01	MR99KYT8.DAT
10	1999/8/10	4:24	5:07	500	> 0.3, 1.0 um	37-30N	157-30E	B11	MR99KYT9.DAT
11	1999/8/10	14:48	15:37	700	> 0.3, 1.0 um	37-30N	155-00E	B12	MR99KYTA.DAT
12	1999/8/15	9:10	9:57	700	> 0.3, 1.0 um	32-30N	152-30E	B23	MR99KYTB.DAT
13	1999/8/17	5:17	5:47	300	> 0.3, 1.0 um	37-30N	152-30E	B33	MR99KYTC.DAT
14	1999/8/17	6:42	7:16	300	> 0.3, 1.0 um	37-30N	152-30E	B33	MR99KYTD.DAT
15	1999/8/17	8:47	9:18	300	> 0.3, 1.0 um	37-35N	152-25E	sailing	MR99KYTE.DAT
16	1999/8/17	10:23	11:09	700	> 0.3, 1.0 um	37-52N	152-08E	sailing	MR99KYTF.DAT

Table 7.4.1.2 Measuring list of the number concentration with OPC at the various places

No.	date	start time	stop time	place	size range (diameter)	latitude	longitude	remarks	filename
1	1999/7/25	10:43	10:56	rader-mast	> 0.3, 0.5 um	40-05N	149-51E	A02	MR99MST1.DAT
2	1999/7/25	11:01	11:19	for-mast	> 0.3, 0.5 um	40-05N	149-51E	A02	MR99MST1.DAT
3	1999/7/25	11:22	11:27	sampling pole	> 0.3, 0.5 um	40-05N	149-51E	A02	MR99MST1.DAT
4	1999/7/26	9:34	9:49	rader-mast	> 0.3, 1.0 um	37-17N	152-25E		MR99MST2.DAT
5	1999/7/26	10:02	10:08	sampling pole	> 0.3, 1.0 um	37-17N	152-26E		MR99MST2.DAT
6	1999/7/26	10:10	10:16	sampling tube I	> 0.3, 1.0 um	37-17N	152-28E		MR99MST2.DAT
7	1999/7/26	10:18	10:22	sampling tube T	> 0.3, 1.0 um	37-17N	152-29E		MR99MST2.DAT
8	1999/7/26	10:27	10:41	rader-mast	> 0.3, 0.5 um	37-17N	152-29E		MR99MST2.DAT
9	1999/7/26	10:50	11:12	for-mast	> 0.3, 1.0 um	37-17N	152-29E		MR99MST2.DAT
10	1999/7/26	11:19	11:25	sampling pole	> 0.3, 0.5 um	37-16N	152-30E		MR99MST2.DAT
11	1999/7/27	10:25	10:31	sampling pole	> 0.3, 1.0 um	37-30N	152-00E	A03	MR99MST3.DAT
12	1999/7/27	10:35	10:46	rader-mast	> 0.3, 1.0 um	37-30N	152-00E	A03	MR99MST3.DAT
13	1999/7/27	10:52	11:09	for-mast	> 0.3, 1.0 um	37-30N	152-00E	A03	MR99MST3.DAT
14	1999/7/27	11:14	11:19	sampling pole	> 0.3, 1.0 um	37-30N	151-59E	A03	MR99MST3.DAT
15	1999/7/28	11:21	11:33	rader-mast	> 0.3, 1.0 um	37-29N	150-02E	sailing	MR99MST4.DAT
16	1999/7/28	11:43	12:00	for-mast	> 0.3, 1.0 um	37-25N	150-00E	sailing	MR99MST4.DAT
17	1999/7/28	12:04	12:09	sampling pole	> 0.3, 1.0 um	37-20N	150-00E	sailing	MR99MST4.DAT
18	1999/7/29	10:11	10:19	rader-mast	> 0.3, 1.0 um	34-29N	150-02E	A12	MR99MST5.DAT

19	1999/7/29	10:20	10:26	sampling pole	> 0.3, 1.0 um	34-29N	150-02E	A12	MR99MST5.DAT
20	1999/7/30	6:21	6:29	rader-mast	> 0.3, 1.0 um	32-30N	150-00E	A16	MR99MST6.DAT
21	1999/7/30	6:30	6:34	sampling pole	> 0.3, 1.0 um	32-30N	150-00E	A16	MR99MST6.DAT
22	1999/7/30	6:40	6:50	for-mast	> 0.3, 1.0 um	32-31N	150-00E	A16	MR99MST6.DAT
23	1999/7/31	8:21	8:25	sampling pole	> 0.3, 1.0 um	34-00N	151-34E	sailing	MR99MST7.DAT
24	1999/7/31	8:32	8:43	rader-mast	> 0.3, 1.0 um	34-00N	151-30E	sailing	MR99MST7.DAT
25	1999/7/31	8:49	9:07	for-mast	> 0.3, 1.0 um	34-00N	151-23E	sailing	MR99MST7.DAT
26	1999/8/7	9:37	9:38	sampling pole	> 0.3, 1.0 um	35-00N	?144E		MR99YKT7.DAT
27	1999/8/7	9:39	9:50	rader-mast	> 0.3, 1.0 um	35-00N	?144E		MR99YKT7.DAT
28	1999/8/7	9:55	10:09	for-mast	> 0.3, 1.0 um	35-00N	?144E		MR99YKT7.DAT
29	1999/8/8	7:25	7:36	rader-mast	> 0.3, 1.0 um	35-00N	157-30E	B01	MR99YKT8.DAT
30	1999/8/8	7:40	7:57	for-mast	> 0.3, 1.0 um	35-00N	157-30E	B01	MR99YKT8.DAT
31	1999/8/8	8:02	8:09	sampling pole	> 0.3, 1.0 um	35-00N	157-30E	B01	MR99YKT8.DAT
32	1999/8/9	12:30	17:30	rader-mast	> 0.3, 1.0 um		157-30E	sailing	MR99MSTA.DAT
29	1999/8/10	5:22	5:33	rader-mast	> 0.3, 1.0 um	37-30N	157-30E	B11	MR99YKT9.DAT
30	1999/8/10	5:35	5:54	for-mast	> 0.3, 1.0 um	37-30N	157-30E	B11	MR99YKT9.DAT
31	1999/8/10	6:15	6:22	sampling pole	> 0.3, 1.0 um	37-30N	157-30E	B11	MR99YKT9.DAT
32	1999/8/13	10:30	17:32	sampling pole	> 0.3, 5.0 um			sailing	MR99SP1.DAT
33	1999/8/14	8:10	17:32	sampling pole	> 0.3, 1.0 um			sailing	MR99SP2.DAT
34	1999/8/15	13:10	17:52	sampling pole	> 0.3, 0.5 um	33 34N	152-30N	sailing	MR99SP3.DAT
35	1999/8/16	6:40	17:42	sampling tube '	> 0.3, 0.5 um	35 36N	152-30E	sailing	MR99ST1.DAT
36	1999/8/18	8:40		for-mast	> 0.3, 1.0 um	38N	145E	sailing	MR99MSTB.DAT

Table 7.4.1.3

Sampling list of aerosols with filter holder

Filter No	date and time JST		sampling volume		sampling period(min)	total sampling volume(little)	start point		stop point		remarks
	start	stop	start	stop			latitude	longitude	latitude	longitude	
1	7/22 19:20	7/23 8:38	5.75 l/min	6.25 l/min	798	4560	41-20N	141-20	41-20N	141-20E	
2	7/23 16:28	7/23 21:40	6.0 l/min	6.25 l/min	312	1900	41-24N	141-51			
3	7/24 8:19	7/24 9:42	6.0 l/min	6.25 l/min	83	500	40-33N	142-55			contamination
4	7/24 9:55	7/24 21:53	6.5 l/min	6.75 l/min	718	4700	40-32N	143-07			
5	7/24 21:55	7/25 5:40	6.5 l/min	6.75 l/min	465	3000	40-14N	147-14			
	7/25 11:53	7/25 13:30	6.5 l/min	7.0 l/min	97	630	40-01N	149-50			
6	7/25 15:23	7/26 3:12	7.5 l/min	6.75 l/min	709	5300	39-55N	150-00	37-23N	152-24E	
7	7/26 8:35	7/26 9:49	7.5 l/min	7.5 l/min	74	560	37-17N	152-24			
	7/26 10:30	7/26 11:25	7.5 l/min	7.5 l/min	55	410	37-17N	152-24			
	7/26 13:05	7/26 14:50	7.5 l/min	7.5 l/min	105	790	37-19N	152-28			
	7/26 18:12	7/26 5:52	7.5 l/min	7.5 l/min	700	5300	37-22N	152-27			
8	7/27 17:55	7/28 2:39	6.75 l/min	6.0 l/min	464	3100	37-13N	152-01	37-28N	149-43E	
9	7/28 11:25	7/28 13:21	6.0 l/min	6.25 l/min	114	700	37-05N	149-59	37-00N	150-00E	
	7/28 14:51	7/28 16:30	6.25 l/min	6.25 l/min	99	600	37-00N	150-00	36-00N	150-00E	
	7/28 18:12	7/28 19:36	6.25 l/min	6.25 l/min	84	530	36-23N	149-58	36-00N	150-00E	
	7/28 21:06	7/28 22:53	6.25 l/min	6.25 l/min	107	669	36-00N	150-00	35-31N	149-59E	
10	7/29 7:45	7/29 9:10	6.25 l/min	6.25 l/min	85	530	34-52N	150-00	34-30N	150-00E	
	7/29 11:06	7/29 12:50	6.25 l/min	6.25 l/min	104	650	34-30N	150-00	34-00N	150-00E	
	7/29 14:35	7/29 16:17	6.25 l/min	6.25 l/min	102	638	34-00N	150-00	33-30N	149-59E	
	7/29 17:46	7/29 19:40	6.25 l/min	6.25 l/min	114	713	33-27N	150-00	33-00N	150-00E	
	7/29 22:13	7/29 23:48	6.25 l/min	6.25 l/min	95	590	32-54N	150-00	32-30N	150-00E	
	7/30 8:20	7/30 18:50	6.25 l/min	6.25 l/min	630	3940	32-30N	150-00			
11	7/31 8:31	8/1 6:19	6.25 l/min	6.25 l/min	1308	8180	33-59N	151-31	34-00N	145-07E	
12	8/1 10:36	8/1 18:06	6.25 l/min	6.25 l/min	450	2810	34-01N	144-26	34-01N	141-58E	
	8/2 19:04	8/3 4:58	6.25 l/min	6.25 l/min	602	3760	34-13N	141-52	34-01N	139-03E	
13	8/3 4:59	8/3 9:36	6.25 l/min	6.25 l/min	277	1730	34-01N	139-03			
14	8/5 13:16	8/6 1:20	6.25 l/min	6.25 l/min	724	4530	34-46N	138-35	34-59N	142-23E	
15	8/6 1:21	8/6 10:40	6.25 l/min	6.25 l/min	559	3490	34-59N	142-23	35-04N	144-43E	
16	8/6 12:43	8/7 1:23	6.75 l/min	7.25 l/min	760	5130	34-59N	144-53	35-04N	144-43E	

17	8/7	1:24	8/7	6:56	7.25 l/min	7.25 l/min	332	2400	35-00N	148-58	35-00N	148-58E	
	8/7	7:25	8/7	8:09	7.25 l/min	7.25 l/min	44	320	34-59N	150-57			
	8/7	10:48	8/7	17:09	7.25 l/min	7.25 l/min	381	2760	35-00N	151-21	35-00N	153-28E	
18	8/7	17:10	8/8	5:10	7.25 l/min	7.25 l/min	720	5220	35-00N	153-28	35-00N	157-19E	
19	8/8	9:05	8/8	10:44	7.25 l/min	7.25 l/min	99	720	34-54N	157-29	34-30N	157-30E	
	8/8	12:29	8/8	14:15	7.25 l/min	7.25 l/min	106	113	34-27N	157-30	34-00N	157-29E	
	8/8	15:52	8/8	17:33	7.25 l/min	7.25 l/min	101	732	33-58N	157-29	33-32N	157-30E	
	8/8	20:04	8/8	21:02	7.25 l/min	7.25 l/min	58	420	33-17N	157-30	33-01N	157-29E	
	8/8	23:00	8/9	0:40	7.25 l/min	7.25 l/min	100	725	32-54N	157-30	33-29N	157-30E	
	8/9	7:32	8/9	14:18	7.25 l/min	7.25 l/min	406	2940	33-40N	157-36	35-29N	157-30E	
20	8/9	15:55	8/9	17:40	7.25 l/min	7.25 l/min	105	761	35-31N	157-30	35-59N	157-30E	
	8/9	19:15	8/9	21:04	7.00 l/min	7.25 l/min	109	763	36-01N	157-29	36-30N	157-30E	
	8/9	22:39	8/10	0:41	7.25 l/min	7.25 l/min	122	885	36-30N	157-30	37-00N	157-30E	
	8/10	6:35	8/10	13:55	7.25 l/min	7.25 l/min	440	3190	37-29N	157-29	37-29N	155-08E	
21	8/10	17:30	8/10	18:54	7.25 l/min	7.25 l/min	84	600	37-21N	155-01	37-00N	155-00E	contamination
	8/10	20:30	8/11	1:03	7.25 l/min	7.25 l/min	273	1980	36-57N	155-00	36-10N	154-59E	probability
22	8/11	1:04	8/11	1:55	7.25 l/min	7.25 l/min	51	370	36-10N	154-59	36-00N	154-59E	
	8/11	3:40	8/11	5:20	7.25 l/min	7.25 l/min	100	725	35-54N	154-58	35-31N	154-59E	
23	8/12	7:13	8/12	17:12	7.25 l/min	7.25 l/min	599	4340	32-28N	154-54	31-04N	152-26E	Rn conc' high
24	8/12	18:16	8/12	22:44	7.25 l/min	7.25 l/min	268	1940	31-07N	152-20			contamination
	8/13	9:14	8/13	13:27	7.25 l/min	7.25 l/min	253	1830	32-03N	152-01	31-16N	152-04E	probability
25	8/13	14:10	8/13	18:35	7.25 l/min	7.25 l/min	265	1920	31-21N	152-47	32-08N	152-56E	
	8/13	19:28	8/13	23:14	7.25 l/min	7.25 l/min	226	1640	32-09N	151-55	31-27N	151-58E	
	8/14	0:29	8/14	9:22	7.25 l/min	7.25 l/min	533	3860	31-33N	151-44	31-34N	151-47E	
26	8/14	10:30	8/14	16:15	7.25 l/min	7.25 l/min	345	2500	31-39N	152-36			
	8/14	16:45	8/15	6:42	7.25 l/min	7.25 l/min	717	5200	32-31N	152-30	32-29N	152-27E	
27	8/15	12:21	8/15	13:00	7.25 l/min	7.25 l/min	39	283	32-47N	152-30	32-58N	152-30E	
	8/15	14:54	8/15	16:26	7.25 l/min	7.25 l/min	92	670	33-04N	152-30	33-28N	152-30E	
	8/15	18:14	8/15	19:47	7.25 l/min	7.25 l/min	93	670	33-33N	152-30	33-57N	152-29E	
	8/16	10:16	8/16	11:50	7.25 l/min	7.25 l/min	94	760	35-04N	152-29	35-28N	152-29E	
	8/16	14:07	8/16	15:52	7.25 l/min	7.25 l/min	105	760	35-32N	152-29	35-58N	152-29E	
	8/16	17:51	8/16	19:41	7.25 l/min	7.25 l/min	110	798	36-02N	152-29	36-30N	152-29E	
	8/16	21:41	8/16	23:19	7.25 l/min	7.25 l/min	98	711	36-34N	152-29	36-59N	152-29E	
28	8/17	12:32	8/18	1:01	7.25 l/min	7.25 l/min	29	210	38-00N	151-42	37-59N	147-41E	contamination
29	8/18	1:02	8/18	8:32	7.25 l/min	7.25 l/min	422	3060	37-59N	147-41	38-00N	145-16E	
	8/18	10:16	8/18	19:12	7.25 l/min	7.25 l/min	536	3890	38-00N	144-40	38-45N	142-41E	

Table 7.4.1.4

Sampling list of aerosols with impactor

sampling volume 1 l/min
sampling place compass : sampling box on the compass deck
radar mast : radar mast (height-8m from compass deck)
meter : sampling height with kytoon

time JST

No	date	start time	stop time	latitude	longitude	place	case No	remarks
1	1999.7.22	19:35	20:05	41-20N	141-20E	compass	No1-1	
2	1999.7.23	17:46	18:16	41-13N	141-14E	compass	No1-2	
3	1999.7.24	8:38	9:08	40-33N	142-55E	compass	No1-3	
4	1999.7.24	12:55	13:25	40-28N	148-08E	compass	No1-4	
5	1999.7.24	18:13	18:43	40-18N	145-55E	compass	No1-5	
6	1999.7.25	0:25	0:55	40-09N	148-08E	compass	No1-16	
7	1999.7.25	5:42	6:12	40-02N	149-59E	compass	No1-17	
8	1999.7.25	20:16	20:46	38-54N	151-05E	compass	No1-18	
9	1999.7.26	10:47	11:17	37-17N	152-30E	compass	No1-19	
10	1999.7.26	10:47	11:17	37-17N	152-30E	radar mast	No1-20	
11	1999.7.27	8:57	?	37-30N	151-59E	100m	No2-1	failure
12	1999.7.27	10:50	11:20	37-30N	152-00E	compass	No2-2	
13	1999.7.27	10:50	11:20	37-30N	152-00E	radar mast	No2-3	
14	1999.7.28	9:55	10:25	37-29N	150-01E	200m	No2-4	
15	1999.7.28	11:50	12:20	37-30N	150-00E	compass	No2-5	
16	1999.7.28	11:50	12:20	37-30N	150-00E	radar mast	No2-6	
17	1999.7.28	18:35	19:05	36-16N	149-59E	compass	No2-15	
18	1999.7.29	6:35	7:05	35-00N	150-00E	300m	No2-16	
19	1999.7.29	7:49	8:19	34-52N	150-00E	compass	No2-17	
20	1999.7.29	10:07	10:27	34-30N	150-00E	300m	No2-18	
21	1999.7.29	10:07	10:27	34-30N	150-00E	compass	No2-19	
22	1999.7.29	22:14	23:24	32-54N	150-00E	compass	No2-20	
23	1999.7.30	6:16	6:46	32-30N	150-00E	300m	No3-1	
24	1999.7.30	6:22	6:52	32-30N	150-00E	compass	No3-2	
25	1999.7.30	6:15	6:45	34-50N	151-43E	compass	No3-3	
26	1999.7.31	8:45	9:15	33-59N	151-17E	compass	No3-4	
27	1999.7.31	8:45	9:15	33-59N	151-17E	radar mast	No3-5	
28	1999.7.31	20:07	20:37	33-59N	148-01E	compass	No3-16	
29	1999.8.1	6:23	6:35	34-00N	145-01E	compass	No3-17	
30	1999.8.1	9:08	9:38	34-00N	144-40E	300m	No3-18	
31	1999.8.1	9:08	9:38	34-00N	144-40E	compass	No3-19	
32	1999.8.1	17:22	17:52	34-00N	142-11E	compass	No3-20	
33	1999.8.3	5:01	5:31	34-01N	139-03E	compass	No4-1	
34	1999.8.5	13:18	13:48	34-44N	138-35E	compass	No4-3	
35	1999.8.5	21:22	21:52	35-00N	141-01E	compass	No4-4	
36	1999.8.6	7:33	8:03	35-01N	144-04E	compass	No4-5	
37	1999.8.6	18:28	18:58	35-00N	146-55E	compass	No4-16	
38	1999.8.7	4:45	5:15	34-59N	150-03E	compass	No4-17	
39	1999.8.7	9:37	10:07	35-00N	144E?	300m	No4-18	
40	1999.8.7	10:49	11:19	35-00N	151-21E	compass	No4-19	
41	1999.8.7	19:48	20:18	35-00N	154-01E	compass	No4-20	
42	1999.8.8	7:42	8:12	35-00N	157-30E	radar mast	No5-1	
43	1999.8.8	7:42	8:12	35-00N	157-30E	compass	No5-2	
44	1999.8.8	23:01	23:31	32-54N	157-30E	compass	No5-3	
45	1999.8.10	5:21	5:51	37-30N	157-30E	300m	No5-4	
46	1999.8.10	5:27	5:57	37-30N	157-30E	compass	No5-5	
47	1999.8.10	15:51	16:21	37-30N	155-00E	500m	No5-16	failure

48	1999.8.10	15:51	16:21	37-30N	155-00E	compass	No5-17	
49	1999.8.12	7:15	7:45	32-28N	154-54E	compass	No5-18	
50	1999.8.12	18:17	18:47	31-07N	152-20E	compass	No5-19	
51	1999.8.13	14:13	14:43	31-22N	152-01E	compass	No5-20	
52	1999.8.14	0:31	1:01	31-33N	151-55E	compass	No6-1	
53	1999.8.14	10:32	11:02	31-39N	151-45E	compass	No6-2	
54	1999.8.14	22:25	22:55	31-49N	151-30E	compass	No6-3	
55	1999.8.15	10:16	10:46	32-30N	152-30E	700m	No6-4	
56	1999.8.15	10:18	10:48	32-30N	152-30E	compass	No6-5	
57	1999.8.17	6:00	6:30	37-30N	152-30E	300m	No6-16	
58	1999.8.17	6:04	6:34	37-30N	152-30E	compass	No6-17	
59	1999.8.17	9:35	10:05	37-52N	152-09E	300m	No6-18	
60	1999.8.17	9:41	10:11	37-53N	152-09E	compass	No6-19	
61	1999.8.17	17:15	17:45	37-60N	150-00E	compass	No6-20	
62	1999.8.18	6:35	7:05	37-59N	145-55E	compass	No7-1	

Table 7.4.1.5 Sampling list of atmospheric gas (OCS,CS_2,DMS) with gas chromatograph

No	date	start time	stop time	latitude	longitude	remarks
1	7/23/99	12:55	13:06	41-23N	141-15E	ship stopped
2	7/23/99	17:46	17:57	41-14N	142-12E	failure
3	7/23/99	20:00	20:13	40-55N	142-50E	
4	7/23/99	20:45	20:56	40-48N	143-00E	bow sampling
5	7/23/99	23:14	23:25	40-41N	142-59E	
6	7/24/99	0:01	0:12	40-36N	142-55E	ship stopped
7	7/24/99	8:05	8:16	40-33N	142-55E	ship stopped
8	7/24/99	10:13	10:24	40-32N	143-12E	
9	7/24/99	12:50	13:02	40-29N	144-06E	
10	7/24/99	15:04	15:14	40-23N	144-51E	inlet change
11	7/24/99	18:50	19:02	40-19N	146-09E	
12	7/25/99	0:23	0:33	40-09N	148-05E	
13	7/25/99	15:32	15:42	39-54N	150-02E	
14	7/25/99	20:06	20:16	38-58N	151-03E	
15	7/26/99	1:20	1:30	37-50N	152-01E	
16	7/26/99	14:34	14:44	37-20N	152-28E	
17	7/27/99	22:29	22:39	37-30N	151-04E	
18	7/28/99	11:45	11:55	37-26N	150-00E	
19	7/28/99	16:20	16:30	36-32N	150-00E	
20	7/29/99	0:32	0:42	35-29N	149-59E	
21	7/29/99	10:45	10:55	34-29N	150-03E	
22	7/29/99	11:24	11:35	34-22N	150-00E	
23	7/29/99	12:43	12:54	34-02N	150-00E	
24	7/29/99	16:06	16:16	33-33N	150-00E	
25	7/30/99	8:30	8:41	32-36N	150-06E	canister sampling
26	7/30/99	11:27	11:38	33-20N	150-23E	
27	7/30/99	14:20	14:30	33-58N	150-57E	
28	7/30/99	18:20	18:30	34-51N	151-43E	
29	7/31/99	7:27	7:37	34-06N	151-44E	
30	7/31/99	16:35	16:46	34-00N	149-11E	
31	7/31/99	20:12	20:22	33-59N	148-01E	
32	8/1/99	1:01	1:11	34-00N	146-32E	
33	8/1/99	6:18	6:28	34-00N	145-04E	
34	8/1/99	13:26	13:36	34-00N	143-36E	
35	8/1/99	17:10	17:20	34-00N	142-17E	
36	8/2/99	23:20	23:30	33-50N	140-40E	

37	8/3/99	4:51	5:02	34-01N	139-07E	
38	8/3/99	7:03	7:14	34-29N	138-42E	
39	8/3/99	9:12	9:22	34-56N	138-36E	
40	8/5/99	16:51	17:51	34-35N	139-23E	
41	8/5/99	21:10	21:20	34-59N	140-55E	
42	8/6/99	3:11	3:21	35-00N	142-55E	
43	8/6/99	12:53	13:03	35-00N	144-55E	
44	8/6/99	18:30	18:40	35-00N	146-55E	
45	8/7/99	1::04	1:15	35-00N	148-51E	
46	8/7/99	7::25	7:35	35-00N	150-55E	
47	8/7/99	15::11	15:21	35-00N	152-45E	
48	8/7/99	21:44	21:54	34-59N	154-54E	
49	8/8/99	4:23	4:33	35-00N	157-02E	
50	8/8/99	15:51	16:10	33-58N	157-30E	
51	8/8/99	23:30	23:42	32-47N	157-30E	H_2 generator out of order
52	8/9/99	19:45	19:55	36-09N	157-30E	
53	8/10/99	6:42	6:52	37-30N	157-28E	
54	8/10/99	10:11	10:21	37-30N	156-21E	
55	8/10/99	17:08	17:18	37-28N	155-02E	
56	8/11/99	0:24	0:34	36-21N	155-00E	
57	8/11/99	18:52	19:02	33-51N	155-00E	
58	8/12/99	6:53	7:05	32-30N	154-59E	
59	8/12/99	10:33	10:43	32-10N	154-01E	
60	8/12/99	16:47	16:57	31-10N	152-33E	
61	8/14/99	20:28	20:38	31-52N	151-51E	
62	8/15/99	11:21	11:32	32-32N	152-31E	
63	8/15/99	18:46	18:58	33-41N	152-30E	
64	8/16/99	10:25	10:36	35-06N	152-30E	canister sampling
65	8/16/99	18:39	18:49	36-14N	152-30E	
66	8/17/99	9:58	10:08	37-44N	152-17E	
67	8/17/99	17:29	17:39	38-00N	150-02E	
68	8/17/99	23:20	23:31	38-00N	148-05E	
69	8/18/99	6:14	6:24	38-00N	146-03E	
70						
71						
72						
73						

7.4.2 Studies on behaviors and climate influence of atmospheric aerosol and clouds over the subtropical and subarctic region of the Northern Pacific Ocean

Personnel

On board scientists

Tatsuo Endoh (Institute of Low Temperature Science, Hokkaido University) Associate Professor
Atsushi Ueda (Graduate school of Engineering, Hokkaido Univ.) : Graduate student of Master Course,

Co-workers not on board

Tamio Takamura (Center of environmental remote sensing science, Chiba University) Professor
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Teruyuki Nakajima (Center of climate system research, University of Tokyo) Professor

(1) Objects/Introduction

One of the most important objects is the collection of calibration and validation data from the surface (Nakajima et al.1996, 1997 and 1999). It may be considered for the observation over the widely opening of the huge ocean to be desired ideally because of horizontal homogeneity. Furthermore, the back ground values of aerosol concentration are easily obtained over there (Ohta et al.1996, Miura et al. 1997 and Takahashi et al. 1996) and vertical profile of aerosol concentration are obtained by means of extrapolation up to the scale height. It is desired to compare the integrated value of these profile of aerosol concentration with optical thickness observed by the optical and radiative measurement (Hayasaka et al. 1998, Takamura et al.1994). Facing this object, the optical and radiative observations were carried out by the Sky Radiometer providing more precise radiation data as the radiative forcing for global climate.

(2) Measuring parameters

Atmospheric optical thickness, Ångstrom coefficient of wave length efficiencies,

Direct irradiating intensity of solar, and forward upto back scattering intensity with scattering angles of 2-140degree and seven different wave lengths

GPS provides the position with longitude and latitude and heading direction of the vessel, and azimuth and elevation angle of sun. Horizon sensor provides rolling and pitching angles.

Concentration and size distribution of atmospheric aerosol,

Aerosol number concentration with size ranges, chemical component of aerosol particles, atomic analysis of aerosol, scattering coefficient and absorption coefficient.

(3) Methods

The instruments used in this work are shown as following.(see Table-7-4-2-1)

Sky Radiometer was measuring irradiating intensities of solar radiation through seven different filters with the scanning angle of 2-140 degree. These data will provide finally optical thickness, Åangstrom exponent and size distribution of atmospheric aerosols with a kind of retreaval method.

Optical Particle Counter was measuring the size of large aerosol particle and counting the number concentration with laser light scattering method and providing the size distribution in 0.3,0.5,1.0,2.0 and 5.0 micron of diameter with real time series display graphically.

Integrated Nepherometer was measuring scattering coefficient for whole angle 7-175 degree.

Absorption Photometer was measuring absorption coefficient with extinction method.

Aerosol Filtering Sampler was providing aerosol particle and some chemical components in the manner of impacting method onto the filter paper every six or eight hour distinguishing the day and night time.

(4) Results

Information of data and sample obtained are sammerized in Table-7-4-2-2and3. The sky radiometer has been going well owing to more calm and silent condition and circumstances about shivering problems provided by the R/V Mirai whose engines are supported by well defined cushions. Therefore, measured values will be expected to be considerably stable and provide good calculated parameters in higher quality. However, some noise waves were found to interfere the 16channel marine band of VHF from sky radiometer. Fortunately the origin and source were identified by using a VHF wide band receiver and the interference wave was kept by heavily shielding with the ground and decreased to recovery of 80%.

Aerosols size distribution of number concentration have been measured by the Particle Counter and data obtained are displayed in real time by a kind of time series *in situ* with 5stages of size range of 0.3, 0.5, 1.0, 2.0, and 5.0 micron in diameter.

The scattering coefficients of aerosols were observed to be extremely low like as the back ground values in the middle of wide ocean. It may be considered that clean air streams were brought from the middle of the Pacific Ocean by southeasterly wind caused by several typhoons developing around Okinawa and southern part of Korean peninsula.

Filter sampling was performed with the special cautions for contamination from the ship of ourselves caused by frequent stoppages for other deep soundings.

(5)Data archive

This aerosol data by the Particle Counter will be able to be archived soon and anytime. However, the data of other kind of aerosol measurements are not archived so soon and developed, examined , arranged and finally provided as available data after a certain duration. All data will archived at ILTS (Endoh)and Engineering school(Ohta), Hokkaido University after the quality check and submitted to JAMSTEC within 3-year.

(6)Other remarks

Schedule in observational duration

20 July 1999: Carrying the all equipment, materials and tools by a cargo vehicles and departure from Hokkaido University

21 July 1999: Carrying the observational equipment in the R/V Mirai, installing and arranging .

23 July 1999: Leaving the port of Sekinehama and starting of the observation as Leg 1 of MR99-K04.

03 July 1999: Entering into the port of Shimizu, repairing sky radiometer and moving compass deck to roof of stabilizer.

05 July 1999: Leaving the port of Shimizu and starting the observation again as Leg 2 of MR99-K04.

19 July 1999: Entering and coming back the port of Sekinehama.

20 July 1999: Carrying the observational equipment and materials out.

(7)References

Takamura, T., et al., 1994: Tropospheric aerosol optical properties derived from lidar, sun photometer and optical particle counter measurements. Applied Optics, Vol. 33, No. 30,7132-7140.

Hayasaka, T., T. Takamura, et al., 1998: Stratification and size distribution of aerosols retrieved from simultaneous measurements with lidar, a sunphotometer, and an aureolemeter. Applied Optics, 37(1998), No 6, 961-970.

Nakajima, T., T. Endoh and others(7 parsons) 1999: Early phase analysis of OCTS radiance data for aerosol remote sensing., IEEE Transactions on Geoscience and Remote Sensing, Vol. 37, No. 2, 1575-1585.

Nakajima, T., et al., 1997: The current status of the ADEOS-Ⅱ/GLI mission. Advanced and Next-generation SatellitesⅡ, eds. H. Fujisada, G . Calamai, M. N. Sweeting, SPIE 2957, 183-190.

Nakajima, T., and A. Higurashi, 1996: AVHRR remote sensing of aerosol optical properties in the Persian Gulf region, the summer 1991. J . Geophys. Res., 102, 16935-16946.

Ohta, S., et al., 1997: Variation of atmospheric turbidity in the area around Japan. Journal of Global Environment Engineering, Vol.3, 9-21.

Ohta, S., et al., 1996: Chemical and optical properties of lower tropspheric aerosols measured at Mt. Lemmon in Arizona, Journal of Global Environment Engineering,
Vol.2,67-78.

Takahashi, T., T. Endoh, et al., 1996: Influence of the growth mechanism of snow particles on their chemical composition. Atmospheric Environment, Vol.30, No. 10/11, 1683-1692.

Miura, K., S. Nakae, et al.,: Optical properties of aerosol particles over the Western Pacific Ocean, Proc. Int. Sym. Remote Sensing, 275-280, 1997.

Data inventory

Table-7-4-2-1. Information of obtained data inventory(Method)

==

Item,	Name	Instrument	Site position
Optical thickness Aengstrom exp.	Endoh	sky radiomete(Prede,POM-01MK2)	compass deck roof of stabilizer
Aerosol Size dis- tribution	Endoh	particle counter(Rion,KC-01C)	compass deck(inlet) & chosasiki-situ
Scattering coef.	Ueda	Nephelometer(Radiance Res.,M903)	as above
Absorption coef.	Ueda	Absorption Photometer(Radiance Res.)	as above
Filter sampling	Ueda	Nuclerpore filter, Pump	as above

Table-7-4-2-2 (Data and Sample inventory)

==

Data/Sample	rate	site	object	name	state	remarks
Sun & Sky light	1/5min (fine daytime)	roof of stabilizer	optical thickness Ångstrom expt.	Endoh	land analysis	7/23-8/1'99 8/5-8/19'99
Size distri- bution of aerosols	1/2.5min	compass deck	concentration of aerosols	Endoh	on board	7/23-8/19'99
aerosols	3/day	compass deck	analysis of atom	Ueda	land analysis	detail as follows

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Table-7-4-2-3(continued to the previous table)

Table 7-4-2-3(1) Filter sampling

＜Quartz fiber filter＞

filter NO.	date and time (JST)		sampling period (min)	sampling volume (m^3)	start point		end point	
	start	end			latitude	longitude	latitude	longitude
1	7/23 15:37	7/23 21:44	367	7.3	41-32N	141-36E	40-35N	142-55E
2	7/24 9:58	7/24 15:44	346	6.8	40-33N	143-07E	40-22N	145-04E
3	7/24 16:06 7/25 15:18 7/27 17:50	7/25 4:46 7/26 3:13 7/28 2:30	1995	40.0	40-21N 39-56N 37-18N	145-12E 149-59E 152-01E	40-05N 37-25N 37-29N	149-42E 152-23E 149-48E
4	7/28 11:55 7/28 14:56 7/28 18:13 7/28 21:09 7/29 7:45 7/29 11:05 7/29 14:33 7/29 17:50 7/29 22:16 7/30 8:27 7/31 8:05	7/28 13:16 7/28 16:30 7/28 19:36 7/28 22:55 7/29 9:09 7/29 12:50 7/29 16:19 7/29 19:40 7/29 23:49 7/30 18:52 8/1 6:31	2833	56.4	37-23N 36-56N 36-23N 35-57N 34-54N 34-27N 33-56N 33-27N 32-54N 32-36N 34-00N	150-00E 150-00E 149-59E 150-00E 150-00E 150-00E 150-00E 150-00E 150-00E 150-06E 151-38E	37-01N 36-30N 36-01N 35-32N 34-32N 34-01N 33-30N 33-01N 32-36N 34-57N 34-01N	150-00E 150-00E 150-00E 150-00E 150-00E 150-00E 150-00E 150-00E 149-54E 151-50E 145-01E
5	8/1 10:13 8/2 19:07	8/1 18:05 8/3 9:34	1339	26.6	34-04N 34-13N	144-33E 141-52E	34-01N 35-00N	141-59E 138-35E
6	8/5 12:47	8/5 21:25	518	10.3				
7	8/5 21:35	8/6 10:26	771	15.3				
8	8/6 12:25 8/7 11:03	8/7 7:45 8/8 5:27	2264	44.8				
9	8/8 8:55 8/8 12:30 8/8 15:51 8/8 19:30 8/8 22:47 8/9 3:05 8/9 16:05 8/9 19:12 8/9 22:37 8/10 2:19 8/10 6:34 8/10 17:06 8/10 20:23 8/10 23:53	8/8 11:46 8/8 14:18 8/8 17:42 8/8 21:03 8/9 0:30 8/9 14:18 8/9 17:39 8/9 21:03 8/10 0:32 8/10 3:57 8/10 14:20 8/10 18:54 8/10 22:14 8/11 1:49	2418	48.1				
10	8/12 8:02 8/12 19:08	8/12 17:24 8/12 22:44	778	15.7				
11	8/12 23:42 8/13 4:09 8/13 9:21 8/13 14:07	8/13 3:35 8/13 8:37 8/13 13:32 8/13 18:39	1024	20.5				
12	8/13 19:26 8/14 0:08 8/14 5:18 8/14 10:26 8/14 16:57 8/15 11:20 8/15 14:50 8/15 18:45 8/15 21:41 8/16 10:11 8/16 14:05 8/16 16:00 8/16 21:57 8/17 12:29	8/13 23:35 8/14 4:42 8/14 9:37 8/14 15:55 8/14 21:50 8/15 13:09 8/15 16:32 8/15 19:58 8/15 23:53 8/16 11:56 8/16 15:59 8/16 19:40 8/16 23:25 8/18 7:56	3514	70.6				

Table 7-4-2-3(2) Filter sampling

<Teflon filter>

filter NO.	date and time (JST)		sampling period (min)	sampling volume (m3)	start point		end point	
	start	end			latitude	longitude	latitude	longitude
1	7/23 15:37	7/23 21:43	366	7.3	41-32N	141-36E	40-35N	142-55E
2	7/24 9:58	7/24 15:44	346	6.7	40-33N	143-07E	40-22N	145-04E
3	7/24 16:07	7/25 4:48	761	15.3	40-21N	145-12E	40-05N	149-42E
4	7/25 15:19 7/27 17:51	7/26 3:13 7/28 2:30	1233	24.0	39-56N 37-18N	149-59E 152-01E	37-25N 37-29N	152-23E 149-48E
5	7/28 11:56 7/28 14:55 7/28 18:14 7/28 21:10 7/29 7:46 7/29 11:05 7/29 14:33 7/29 17:51 7/29 22:16	7/28 13:16 7/28 16:30 7/28 19:36 7/28 22:55 7/29 9:09 7/29 12:50 7/29 16:19 7/29 19:40 7/29 23:49	858	17.1	37-23N 36-56N 36-23N 35-57N 34-54N 34-27N 33-56N 33-27N 32-54N	150-00E 150-00E 149-59E 150-00E 150-00E 150-00E 150-00E 150-00E 150-00E	37-01N 36-30N 36-01N 35-32N 34-32N 34-01N 33-30N 33-01N 32-36N	150-00E 150-00E 150-00E 150-00E 150-00E 150-00E 150-00E 150-00E 149-54E
6	7/30 8:28	7/30 18:52	624	12.5	32-36N	150-06E	34-57N	151-50E
7	7/31 8:06	7/31 11:32	206	4.1	34-00N	151-38E	34-00N	150-41E
8	7/31 11:43	8/1 6:31	1128	22.1	34-00N	150-37E	34-01N	145-01E
9	8/1 10:14 8/2 19:08	8/1 18:05 8/3 4:17	1020	20.3	34-04N 34-13N	144-33E 141-52E	34-01N 34-00N	141-59E 139-17E
10	8/3 4:35	8/3 9:34	299	6.0	34-01N	139-12E	35-00N	138-35E
11	8/5 12:47	8/5 21:25	518	10.2				
12	8/5 21:35	8/6 10:26	771	15.3				
13	8/6 12:25	8/7 7:46	1161	22.8				
14	8/7 11:04	8/8 5:27	1103	21.6				
15	8/8 8:56 8/8 12:30 8/8 15:51 8/8 19:31 8/8 22:47 8/9 3:05	8/8 10:46 8/8 14:18 8/8 17:42 8/8 21:03 8/9 0:30 8/9 14:18	1197	24.0				
16	8/9 16:06 8/9 19:12 8/9 22:38 8/10 2:20 8/10 6:35 8/10 17:06 8/10 20:23 8/10 23:54	8/9 17:39 8/9 21:03 8/10 0:32 8/10 3:57 8/10 14:20 8/10 18:54 8/10 22:14 8/11 1:49	1214	24.1				
17	8/12 8:02 8/12 19:08	8/12 17:24 8/12 22:44	778	15.4				
18	8/12 23:43 8/13 4:09 8/13 9:21 8/13 14:08	8/13 3:35 8/13 8:37 8/13 13:32 8/13 18:39	1022	20.6				
19	8/13 19:27 8/14 0:08 8/14 5:18 8/14 10:26 8/14 16:57	8/13 23:35 8/14 4:42 8/14 9:37 8/14 15:55 8/14 21:34	1387	27.8				
20	8/14 22:49 8/15 11:20 8/15 14:51 8/15 18:46 8/15 21:41 8/16 10:11 8/16 14:05 8/16 16:00 8/16 21:57	8/15 5:15 8/15 13:09 8/15 16:32 8/15 19:58 8/15 23:53 8/16 11:56 8/16 15:59 8/16 19:40 8/16 23:25	1267	25.3				
21	8/17 12:29	8/18 7:56	1167	24.5				

Table 7-4-2-3(3) Filter sampling

<Nuclepore filter>

filter NO.	date and time (JST) start		date and time (JST) end		sampling period (min)	sampling volume (m^3)	start point latitude	start point longitude	end point latitude	end point longitude
1	7/23	15:58	7/23	21:45	347	3.2	41-29N	141-42E	40-35N	142-55E
2	7/24	9:56	7/24	15:45	349	3.3	40-33N	143-06E	40-22N	145-05E
3	7/24	16:04	7/25	4:49	765	5.7	40-21N	145-11E	40-05N	149-42E
4	7/25 7/27	15:15 17:45	7/26 7/28	3:15 2:32	1247	12.3	39-57N 37-19N	149-58E 152-01E	37-24N 37-29N	152-23E 149-47E
5	7/28 7/28 7/28 7/28 7/29 7/29 7/29 7/29 7/29	11:53 14:54 18:12 21:05 7:44 11:03 14:30 17:45 22:13	7/28 7/28 7/28 7/28 7/29 7/29 7/29 7/29 7/29	13:16 16:29 19:35 22:53 9:10 12:47 16:16 19:38 23:46	871	8.7	37-24N 36-56N 36-24N 35-58N 34-54N 34-28N 33-57N 33-28N 32-55N	150-00E 150-00E 149-59E 150-00E 150-00E 150-00E 150-00E 150-00E 150-00E	37-01N 36-30N 36-01N 35-32N 34-32N 34-01N 33-31N 33-01N 32-36N	150-00E 150-00E 149-59E 150-00E 150-00E 150-00E 150-00E 150-00E 149-56E
6	7/30	8:24	7/30	18:50	626	6.3	32-42N	150-06E	34-57N	151-50E
7	7/31	8:01	7/31	11:30	209	2.3	34-00N	151-40E	34-00N	150-41E
8	7/31	11:44	8/1	6:29	1125	11.0	34-00N	150-37E	34-01N	145-01E
9	8/1 8/2	10:11 19:06	8/1 8/3	18:05 4:18	1026	10.2	34-04N 34-13N	144-34E 141-53E	34-01N 34-00N	141-58E 139-17E
10	8/3	4:34	8/3	9:32	298	2.9	34-01N	139-12E	34-59N	138-35E
11	8/5	12:46	8/5	21:12	506	4.9				
12	8/5	21:22	8/6	10:27	785	7.7				
13	8/6	12:24	8/7	7:42	1158	10.9				
14	8/7	11:02	8/8	5:23	1101	10.5				
15	8/8 8/8 8/8 8/8 8/8 8/9	8:45 12:28 15:52 19:28 22:45 3:04	8/8 8/8 8/8 8/8 8/9 8/9	10:45 14:17 17:40 21:02 0:29 14:19	1210	12.3				
16	8/9 8/9 8/9 8/10 8/10 8/10 8/10 8/10	16:04 19:13 22:36 2:18 6:33 17:05 20:24 23:50	8/9 8/9 8/10 8/10 8/10 8/10 8/10 8/11	17:38 21:03 0:32 3:55 14:17 18:53 22:13 1:47	1215	12.0				
17	8/12 8/12	7:53 19:02	8/12 8/12	17:22 22:42	789	7.54				
18'	8/12	23:42	8/13	3:31	231	2.25				
18	8/13 8/13 8/13	4:08 9:23 14:06	8/13 8/13 8/13	8:33 13:30 18:36	782	7.66				
19	8/13 8/14 8/14 8/14 8/14	19:24 0:08 5:16 10:24 16:56	8/13 8/14 8/14 8/14 8/14	23:34 4:40 9:34 15:53 21:32	1385	13.77				
20	8/14 8/15 8/15 8/15 8/15 8/16 8/16 8/16 8/16	22:51 11:18 14:38 18:44 21:38 10:10 14:04 17:49 21:55	8/15 8/15 8/15 8/15 8/15 8/16 8/16 8/16 8/16	5:12 13:05 16:30 19:57 23:54 11:55 15:58 19:38 23:23	1165	11.7				
21	8/17	12:25	8/18	7:53	1168	11.0				

7.5 Validation for TRMM over Northern Pacific with shipboard Doppler radar

Personnel

Masafumi Hirose (Nagoya University)

Fumitaka Yoshiura (GODI)

(1) Objectives

Main theme to use Doppler radar is to investigate the structure of precipitation cloud systems which develops over Northern Pacific ocean, comparing with TRMM/PR(Tropical Rainfall Measuring Mission / the Precipitation Radar, the first spaceborne radar) data.

(2) Parameters

Spatial and temporal distribution of two parameters, radar reflectivity and Doppler velocity, are obtained for 120 km radius and 7.5 minutes intervals by 17 or 15-elevations volume scan. The horizontal radar reflectivity fields are also obtained for 200 km radius and 7.5 minutes intervals by one elevation (0.7 degrees) PPI (Plan Position Indicator) scan.

(3) Methods

Major hardware specifications of the Doppler radar are as follows;

Type: RC-52B (Mitsubishi Electric Co. Ltd., Japan)

Frequency: 5290MHz

Beam Width: Better than 1.5 degrees

Output Power: 250kW (PEP)

Signal Processor: RVP-6 (Sigmet Inc., U.S.A.)

Application S/W: IRIS/Open (Sigmet Inc., U.S.A.)

Inertial navigation unit: DRUH (Honeywell Inc., U.S.A.)

Doppler radar operation consists of three operational modes; PPI which provides the horizontal echo distribution with one elevation angle, CAPPI (Constant Altitude PPI) which produces the precipitation map at constant altitude changing radar antenna elevation (the sequence is called Volume scan), and RHI (Range and Height Indicator) which cut the vertical cross section at certain azimuth. The parameters of each mode are shown in Table 7.5-1.

Table 7.5-1 the parameters for each tasks

	Intensity-mode PPI	Volume Scan	RHI
Pulse Width	2 [μs]	0.5 [μs]	
Scan Speed	18 [deg./sec.]		Automatically determined
PRF	260 [Hz]	720/900 [Hz]	
Sweep Integration	32 samples		
Ray Spacing	1.0 [deg.]		0.2 [deg]
Bin Spacing	250 [m]	125 [m]	
Elevations	0.7 [deg.]	17-angle-mode { 0.7,1.4,2.1,3.0, 4.0,5.0,6.0,7.1,8.2,9.5,11.0, 12.5,14.5,17.0,20.0,24.0,30.0 } 15-angle-mode { 0.7,1.4,2.2,3.1 4.1,5.2,6.4,7.7,9.1,10.6,12.5, 15.0,17.5,22.0,28.0 } [deg.]	0.0 to 85.0 [deg.]
Azimuths	Full Circle		Optional
Filters	None		
Gain Control	Fixed		
Range Averaging	None		

・Radar task configuration

In this cruise, two observational modes were set out. As a regular mode, one 7.5-minute-sequence of Doppler radar tasks (a series of Doppler mode volume scan with 17-elevations and one intensity mode PPI scan) was used. It was operated continuously in the operational area except for the time of radar check and the time TRMM overpassed. The other mode, called TRMM mode, consisted of the volume scan with 15-elevations, three RHI, and one PPI. The mode was operated at the near position of the TRMM satellite to get the data simultaneously.

・Calibration

Mean power [dBm] of the radar output and pulse repetition frequencies (PRF) were measured every operational day by Hewlett Packard 435B power meter and Hewlett Packard 5361B pulse c/w microwave counter, respectively. Transmitting pulse width was measured 4 times during the cruise using Hewlett Packard 54600B oscilloscope. Radar peak output power in dBm is;

(Peak output power) = (Measured mean power) – 10Log(Pulse width × PRF) + (coupler loss)

where (coupler loss) = 50.6dB from the radar manufacturer

Results of radar peak output power during this cruise is shown in Fig. 7.5-1.

Receiver linearity was checked 4 times using Hewlett Packard 83732B synthesized signal generator and IRIS/Open zauto utility. Slope dB/AD were varied from 0.3233 to 0.3272 for 2 μs, 0.3257 to 0.3274 for 0.5 μs.

(4) Preliminary results

We had chances to meet with TRMM 20 times on the following days during the cruise.
6th 11:14(34 59, 147 29), 7th 10:02(35 00, 154 04), 11:38(35 00, 154 34), 8th 08:50(33 30, 157 30), 10:27(33 28, 157 30), 9th 07:38†, 09:14(36 00, 157 30), 10th 08:02(37 29, 155 02), 11th 06:48(34 15, 155 00), 08:25(34 00, 155 00), 10:01(33 50, 155 00), 12th 05:35(31 34, 153 01), 13th 06:03(31 29, 152 09), 09:12†, 14th 04:47†, 08:00†, 15th 05:11(33 00, 152 30), 06:47(33 16, 152 30), 08:24(33 30, 152 30), 16th 05:35(35 39, 152 30) [UTC] (Lat., Lon.)

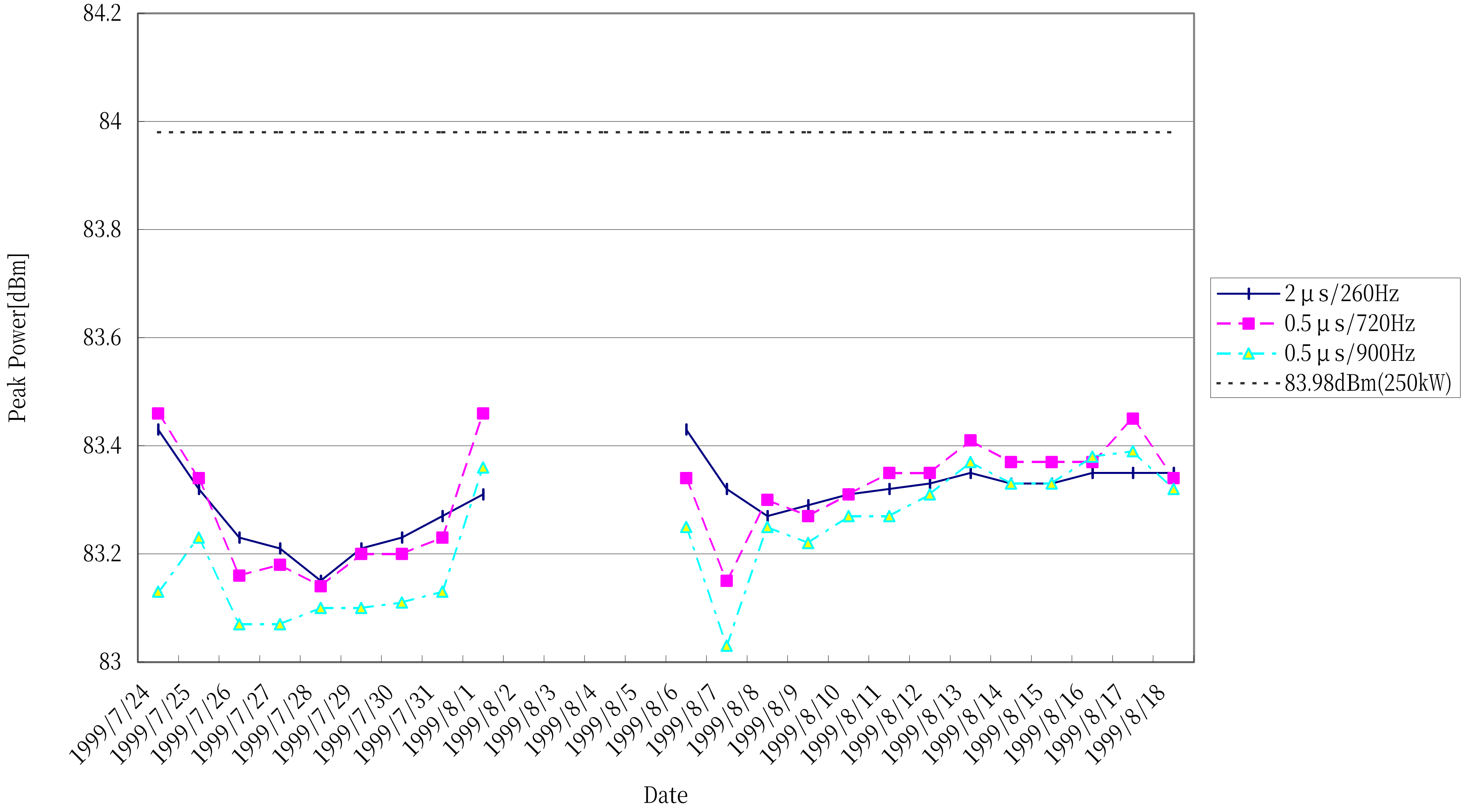
†: No echo, so regular mode was used.

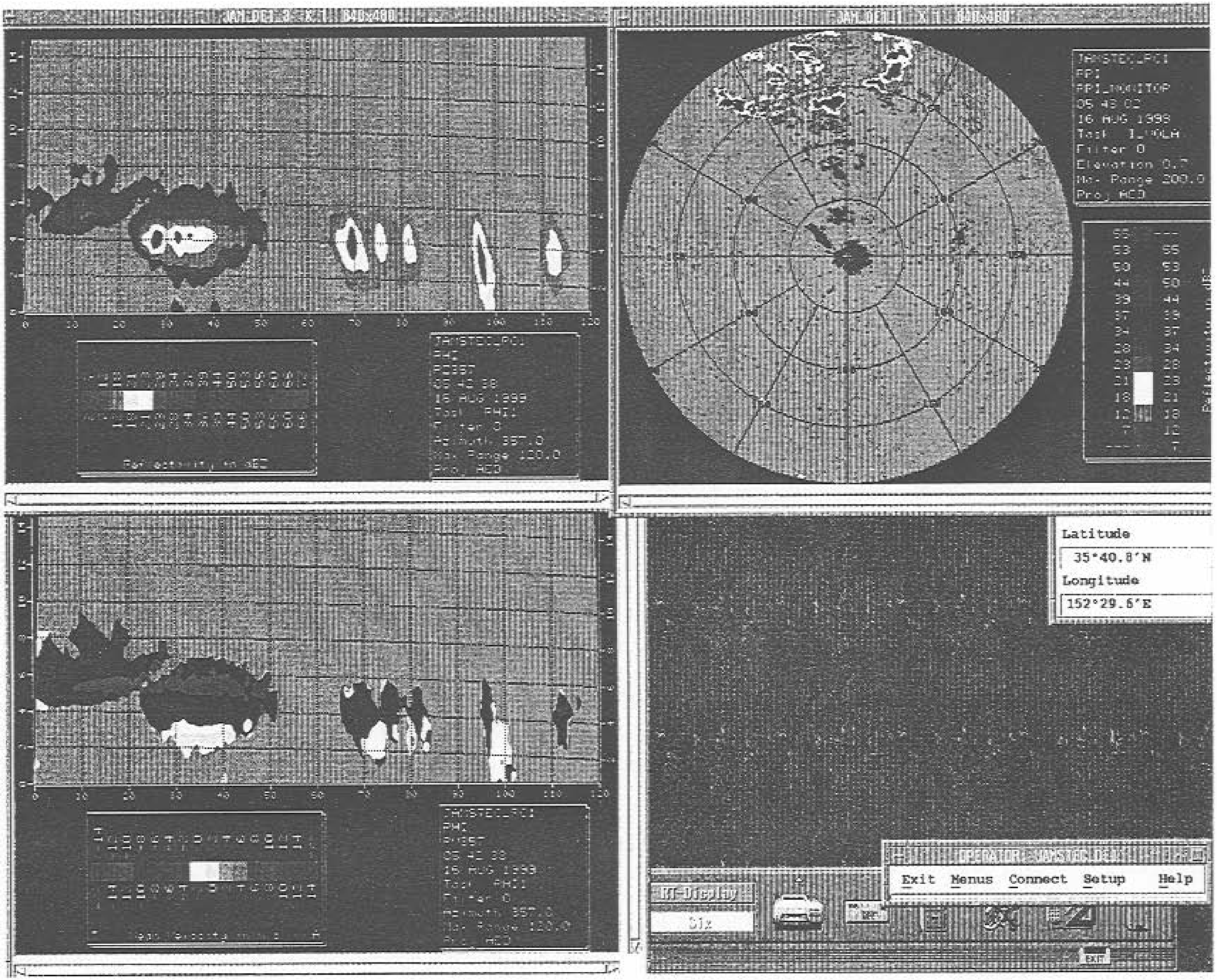
Some examples of observed radar echo images are shown on the following pages. The detailed analyses will be done after this cruise by NASDA/EORC (Contact : K. Furukawa, S. Shimizu).

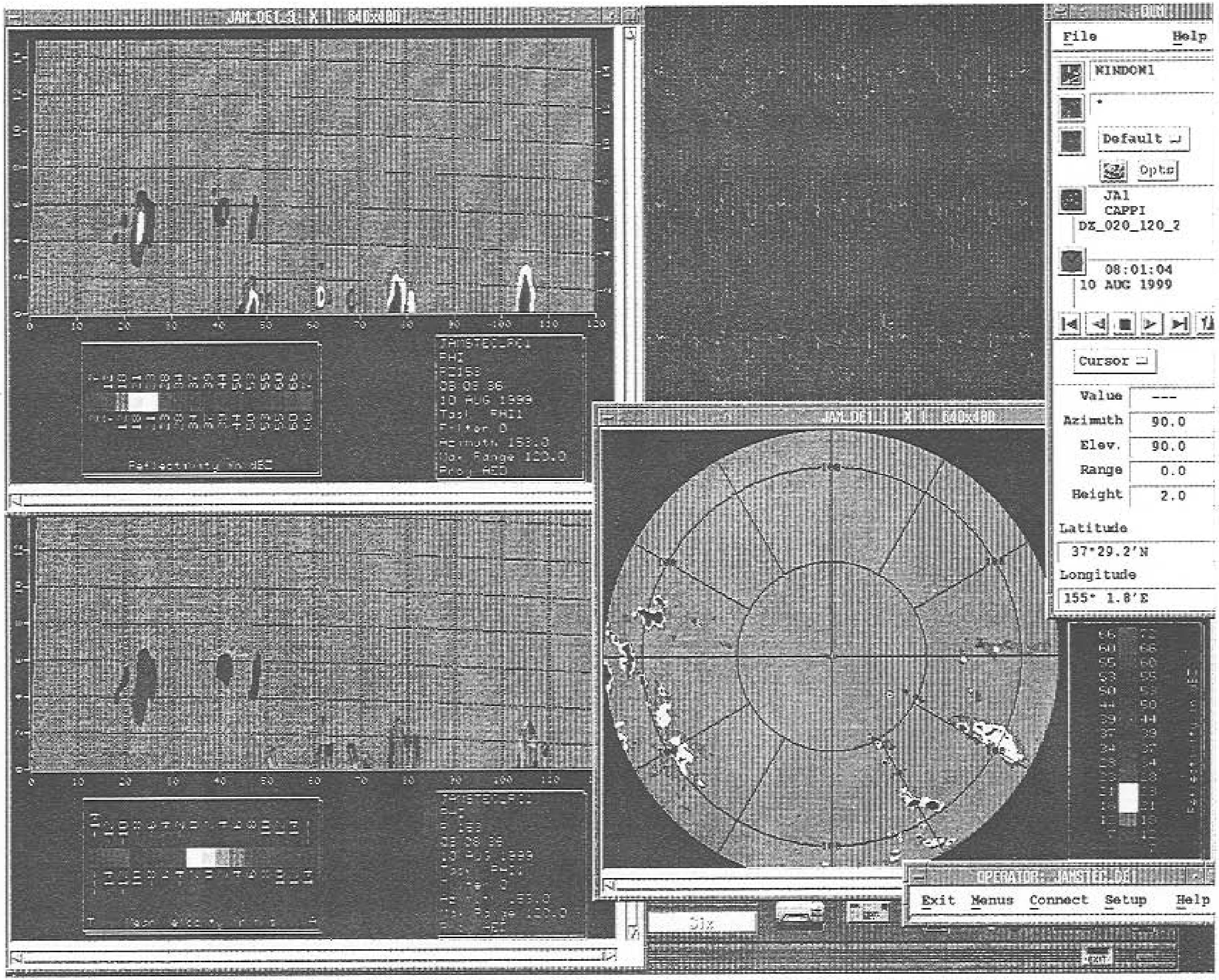
(5) Data archives

The inventory information of the Doppler radar data obtained in this cruise will be submitted to the Data Management Office of JAMSTEC. The original data will be archived at the Ocean Research Department of JAMSTEC (Contact : K. Yoneyama) and will be kept by NASDA/EORC.

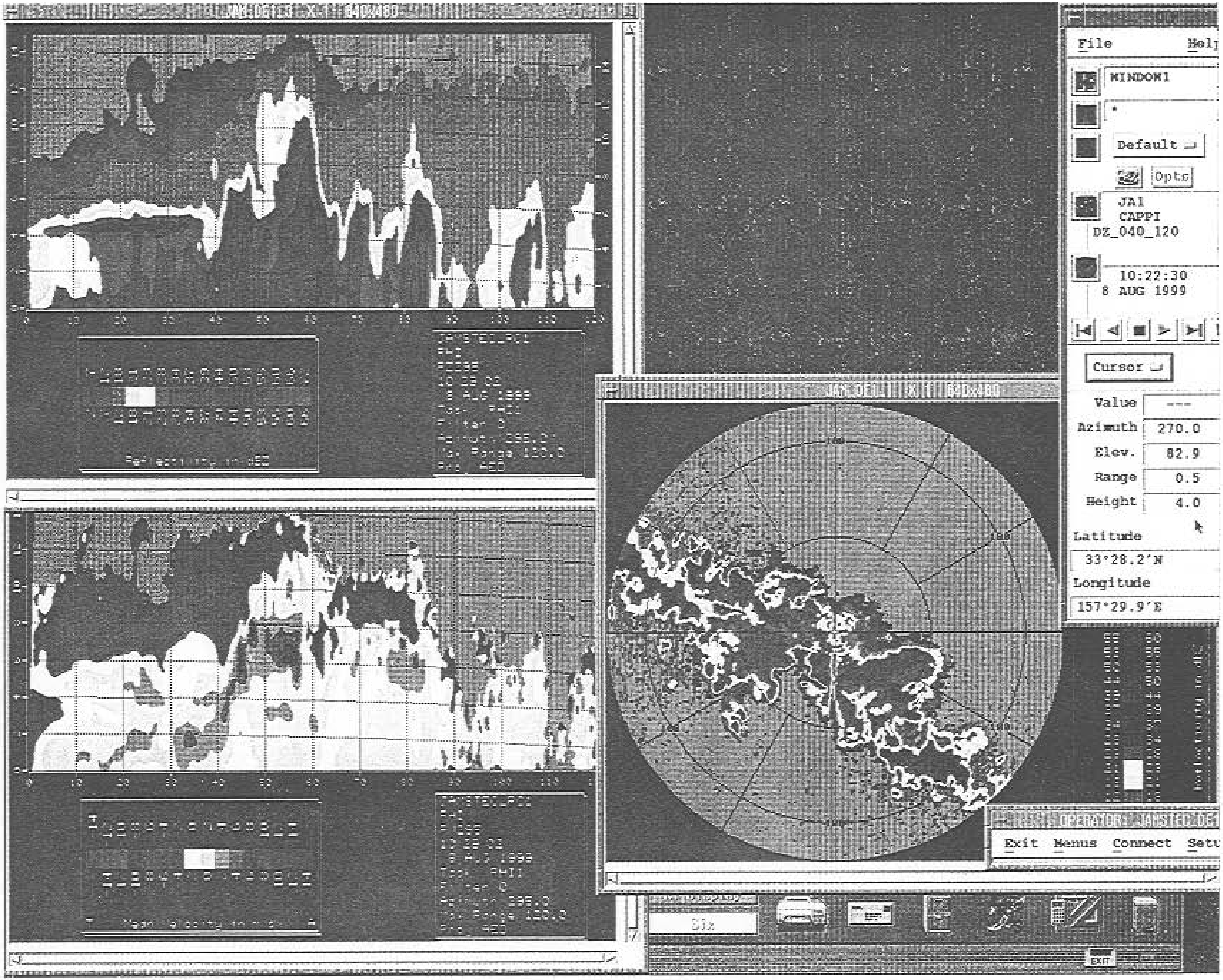
Fig. 7.5.1-1 MR99-k4 Doppler Radar OBS




Latitude
35°40.8'N
Longitude
152°29.6'E
Exit Menus Connect Setup Help



JAM_OE1_3 X 1 640x480
File
Help
WINDOW1
Default
Opts
JA1
CAPPI
DZ_020_120_2
08:01:04
10 AUG 1999
Cursor
Value ---
Azimuth 90.0
Elev. 90.0
Range 0.0
Height 2.0
Latitude
37°29.2'N
Longitude
155° 1.8'E
JAM_OE1_1 X 1 640x480
OPERATOR: JAMSTEC_OE1
Exit Menus Connect Setup Help


640x480
File
WINDOW1
Default
Opts
JA1
CAPPI
DZ_040_120
10:22:30
8 AUG 1999
Cursor
Value
Azimuth 270.0
Elev. 82.9
Range 0.5
Height 4.0
Latitude
33°28.2'N
Longitude
157°29.9'E
Exit Menus Connect
EXIT

Geophysical Survey

Masao Nakanishi (Ocean Research Institute, the University of Tokyo)
Atsushi Oshida (Kawasaki Geological Engineering Co. Ltd.)
Toshio Furuta (GODI)

Introduction

Shatsky Rise is an oceanic plateau located about 1600 km east of Japan. It is about 450 km wide and 1650 km long and is an oldest oceanic plateau among existent oceanic plateaus. It was formed by a mantle plume that captured the Pacific-Izanagi-Farallon triple junction during Late Jurassic to Early Cretaceous (Nakanishi et al., 1999). Before the formation of the Shatsky Rise, a reorganization of plate boundaries between Pacific and Izanagi plates and between Pacific and Farallon plates occurred (Nakanishi et al., 1989).

We conducted the geophysical survey in the leg 2 of MR99-K04 to reveal the detailed process of the reorganization of the plate boundaries around the Pacific plate.

Survey

Fig. 1 shows the survey lines. The survey area is situated southwest of Shatsky Rise. The seafloor age of the area is about 150 Ma just before the formation of Shatsky Rise. The gravity anomaly in the area from satellite altimeters (Sandwell and Smith, 1997), which is below -20 mgal, has a linear feature.

The interval of survey lines was 5.5 nm and the length was 70 or 80 nm. The ship speed was about 15 knot. We used a proton magnetometer, a shipboard three components magnetometer for the geomagnetic measurement, a multi-narrow beam echo sounder with a sub-bottom profiler, SeaBeam 2112 system, for the bathymetric measurement, and a shipboard gravimeter for the gravity measurement.

Preliminary Results

The preliminary results are as follows. More detailed studies on shore will give us new information to reveal the tectonics of the Pacific plate before the formation of Shatsky Rise.

Bathymetry

Troughs and seamounts are remarkable bathymetric features in the survey area (Fig. 2). The bottoms of the troughs are deeper than 6000 m. There are several portions deeper than 6300 m. The troughs near 31°40’N, 151°50’E and 31°25’N, 152°40’E have an NW-SE strike. There is an other trough between the troughs, which strike is E-W.

There are several seamounts in the survey area. The seamount near 31°40’N, 152°40’E has a linear bathymetric feature, which strikes are E-W and NNW-SSE. The seamount near 32°35’N, 153°E has an NE-SW strike.

Magnetic Anomalies

We show only the result of measurement by the proton magnetometer in this report because the analysis of shipboard three components magnetometer needs a lot of time. Magnetic anomalies were calculated using the 1995 International Geomagnetic Reference Field 1995 (IAGA Division Working Group 8, 1995).

Magnetic anomalies have a range from -400 nT to 500 nT (Fig. 3). Negative magnetic anomalies are dominant. The positive anomaly north of 32°30’N, which strike is ENE-WSW, corresponds with the Mesozoic magnetic anomaly lineation M20 identified by Nakanishi et al. (1999). The age of the lineation is about 146 Ma. There is one linear positive magnetic anomaly south of 31°40’N and west of 152°40’E. The linear anomaly has a WWN-EES strike. There are several conical magnetic anomalies, which are due to seamounts.

Gravity Anomalies

Negative gravity anomalies are dominant (Fig. 4). The gravity anomaly has a range from -40 mgal to 20 mgal. Most of gravity anomalies are due to bathymetric relief. Bathymetric troughs have a negative gravity anomaly. Most of seamount have a positive gravity anomaly.

References

IAGA Division Working Group 8, International geomagnetic field: 1995 revision. *J. Geomagn. Geoelectr.*, *47*, 1257-1261, 1995.

Nakanishi, M., K. Tamaki, and K. Kobayashi, Mesozoic magnetic anomaly lineations and seafloor spreading history of the northwestern Pacific, *J. Geophys. Res.*, 94, 15437-15462, 1989.

Nakanishi, M, W. W. Sager, and A. Klaus, Magnetic lineations within Shatsky Rise, northwest Pacific Ocean: Implications for hot spot-triple junction interaction and oceanic plateau formation, *J. Geophys. Res.*, 104, 7539-7556, 1999.

Sandwell, D.T., and W. H .F. Smith, Marine gravity anomaly from Geosat and ERS-1 satellite altimetry, *J. Geophys. Res.*, 102, 10039-10054, 1997.

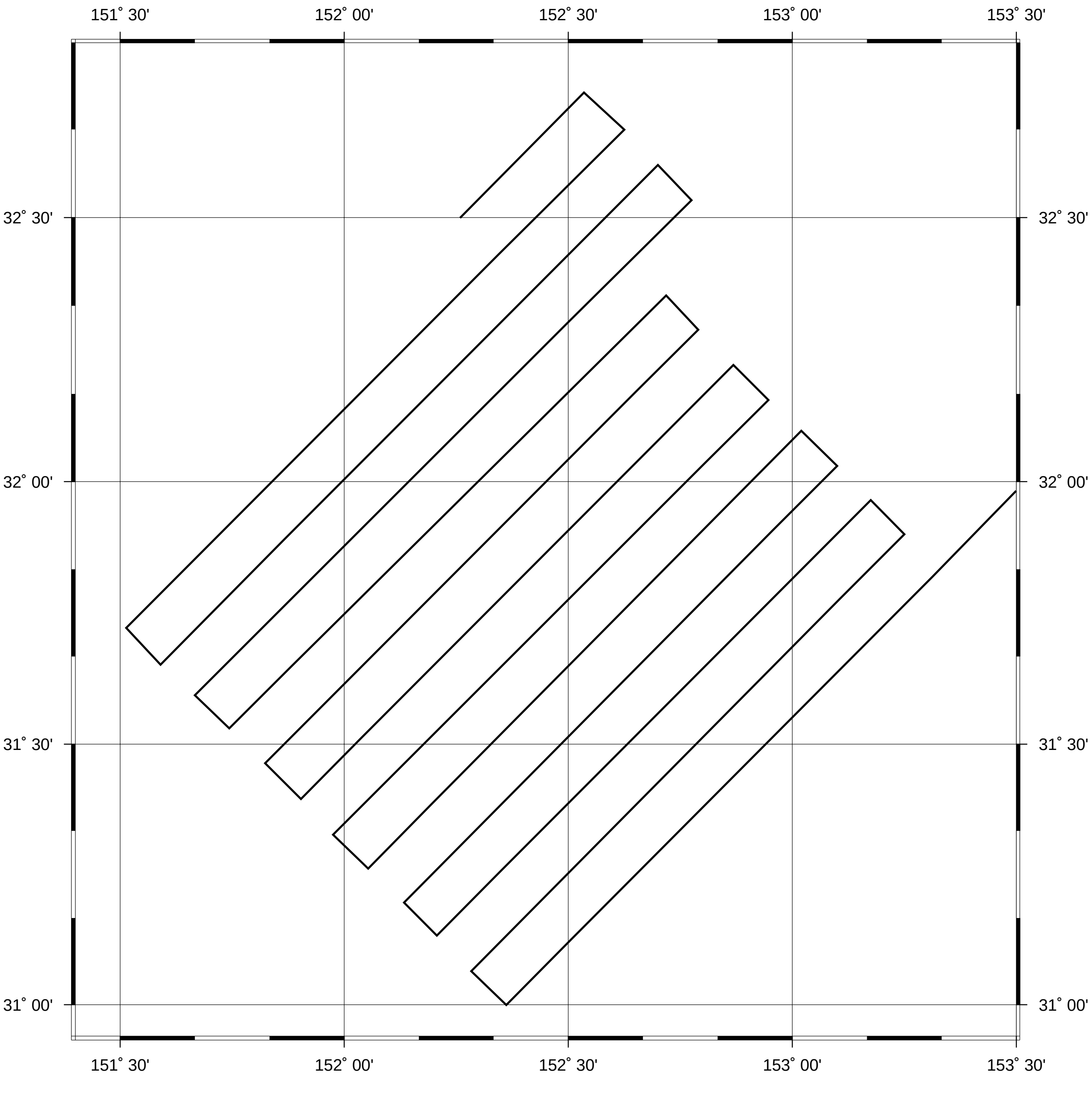


Fig. 1. The track chart of the geophysical survey.

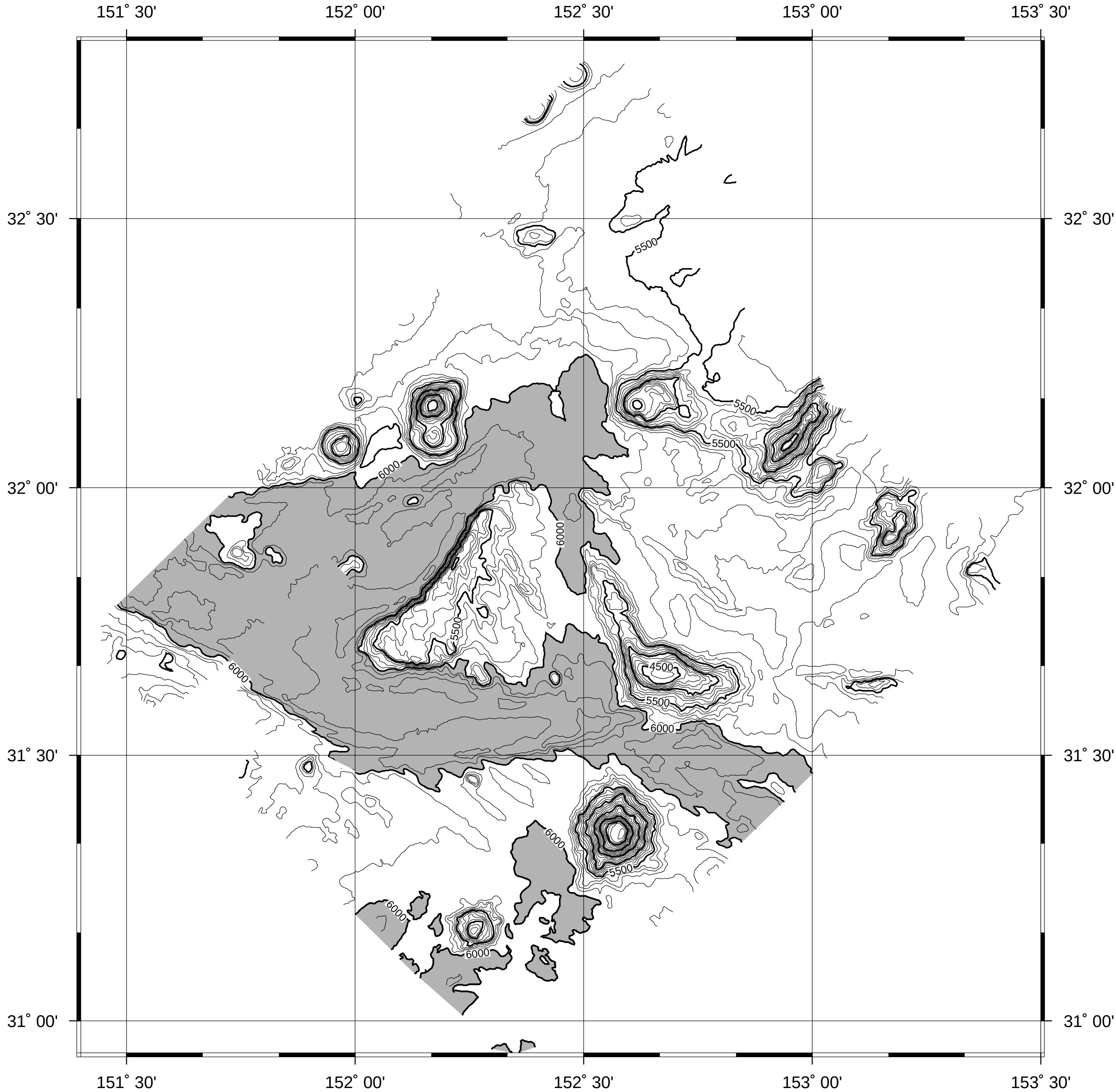


Fig. 2. Bathymetric map made using SeaBeam data. Contour interval is 100 m. Shaded areas are below 6000 m depth.

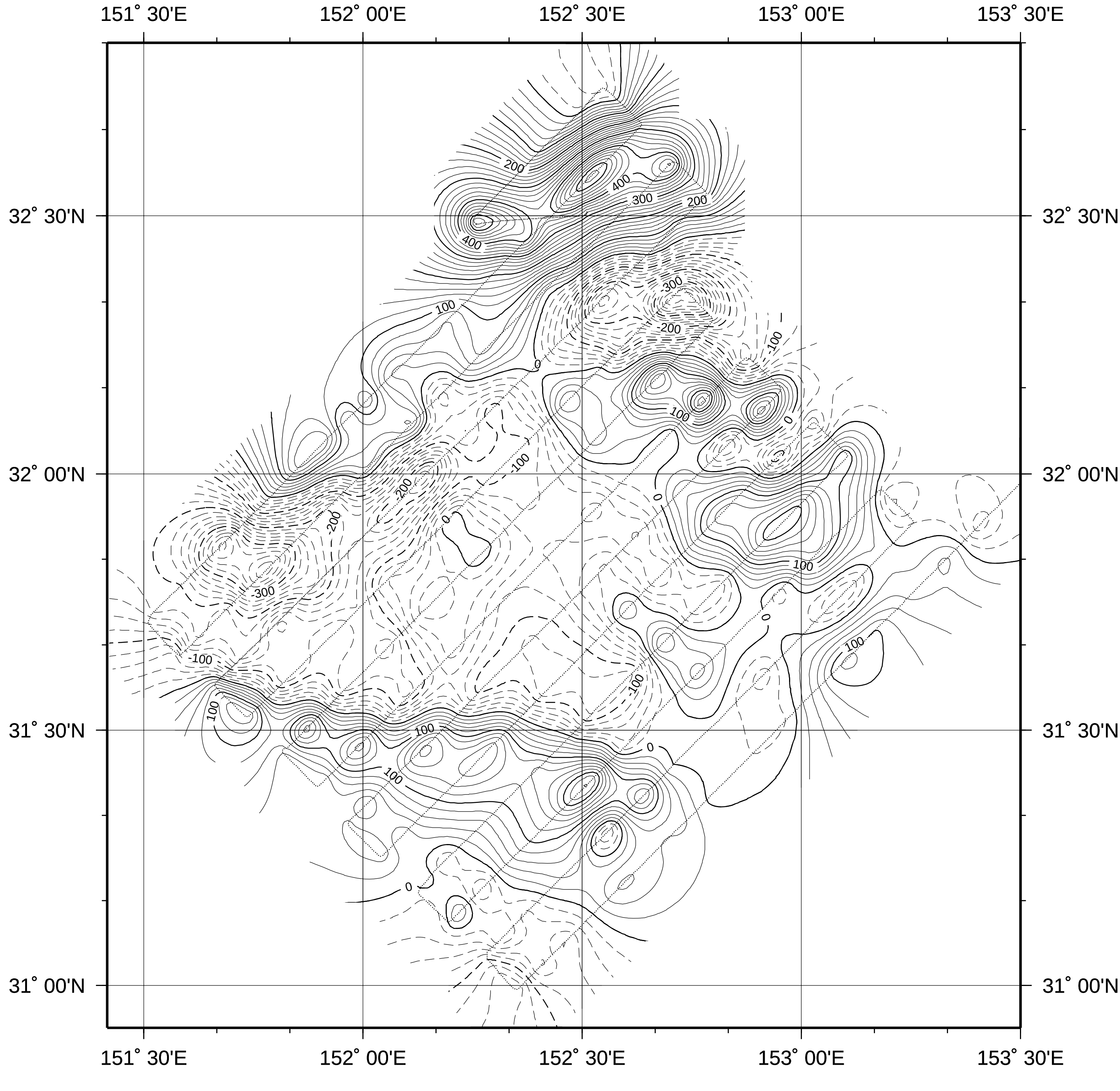


Fig. 3. Magnetic anomaly map made by geomagnetic data of the proton magnetometer. Contour interval is 20 nT. Solid lines denote positive magnetic anomalies. Dashed lines denote negative magnetic anomalies. Thin lines are the survey lines.

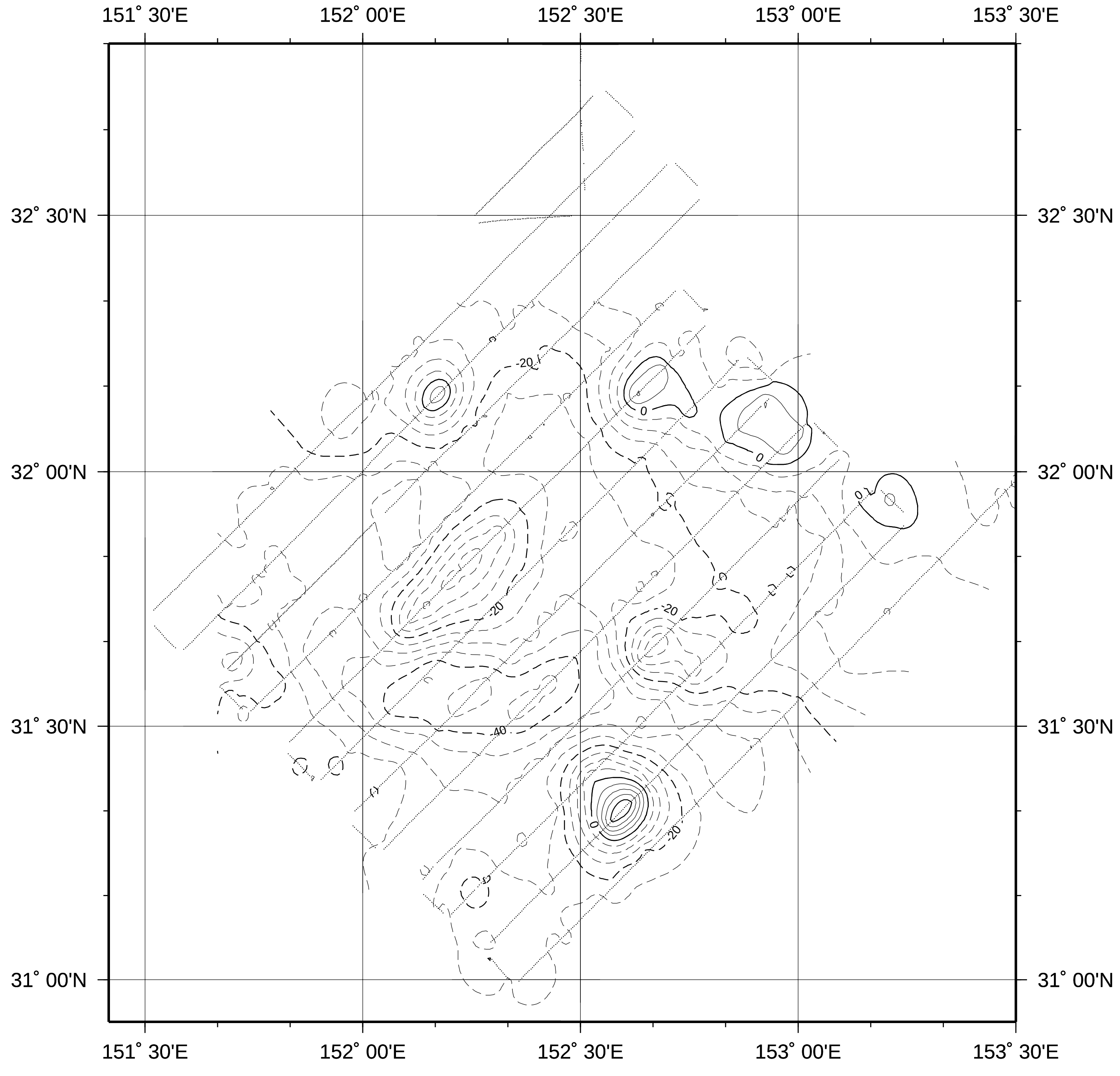


Fig. 4. Gravity anomaly map made by gravimeter data. Contour interval is 5 mgal. Solid lines denote positive gravity anomalies. Dashed lines denote negative gravity anomalies. Thin lines are the survey lines.