Preliminary Report
of
The Hakuho Maru Cruise
KH-03-1
leg 1, leg 2

13 May ~ 23 June 2003

Tokyo – Hilo – Honolulu

Ocean Research Institute
The University of Tokyo
2005

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Cruise for
observations of water masses and currents
in the western and central North Pacific

by

The Scientific Members of the Cruise

Edited by

Masaki KAWABE

CONTENTS

1. Cruise Narrative

The cruise KH-03-1 of R.V. *Hakuho Maru* was conducted for 119 days between May 13 and September 8 in 2003 for integrated study of the Pacific Ocean; 1) physical oceanography on the long-term variations of the North Pacific, 2) marine geochemistry in the eastern Pacific, and 3) geophysical/geological investigation on the Manihiki Plateau.

We carried out the surveys for physical oceanography in legs 1 and 2 of the cruise KH-03-1 for 43 days from May 13 to June 23 (local time) in 2003, with port calls at Hilo in Hawaii Island (29 May - 1 June) and Honolulu (20-23 June).

Study subjects of the cruise KH-03-1 legs 1 and 2 are

(1) to study water characteristics and currents in deep layer in the western and central North Pacific (Ocean Research Institute, the University of Tokyo),

(2) to study formation, circulation, and variation of water masses in surface and intermediate layers in the central North Pacific (Tohoku University),

(3) to measure density ratios in the western and central North Pacific and study the coefficient of diffusion (Tokyo University of Fisheries),

(4) to study marine atmospheric aerosols and their influence on the earth environment (Ocean Research Institute, the University of Tokyo).

The primary observations were full-depth casts for water temperature, salinity, and dissolved oxygen with $CTDO_2$ (conductivity, temperature, depth, oxygen profiler), current velocity with LADCP (lowered acoustic Doppler current profiler), and chemical parameters of water samples taken with Niskin bottles. We equipped $CTDO_2$ sensors, 24 Niskin bottles, and an LADCP with a battery on the water sampler frame. Salinity, dissolved oxygen, and nutrients of water samples were measured on board, and the sample values of salinity and oxygen were used for the calibration of sensor values of $CTDO_2$. Helium, tritium, dissolved inorganic carbon, total alkalinity, and chlorofluorocarbons of sampled waters will be measured at land facilities after the cruise. At all CTD stations, water temperature, salinity, and dissolved oxygen at sea surface were measured by sampling surface water with a bucket, and salinity of the intake water was measured to correct the data of salinograph.

In order to avoid a touch and collision to sea bottom of the underwater instruments on the water sampler frame, we attached an altimeter and a bottom-touch-switch to the frame. The altimeter monitored the distance from sea bottom within 40 m or more. The bottom-touch-switch hanging a 10-m string and a weight let us know that the instruments reached less than 10 m above bottom by ringing buzzer in the laboratory of the vessel. These worked well throughout the legs 1 and 2.

Temperature and salinity data of CTD and XCTD (expendable CTD) were sent to the Japan Meteorological Agency by the TESAC telegram in nearly real time. Throughout the legs of the cruise, we measured current velocity in a surface layer with shipboard ADCP of the Furuno Electric Co., Ltd. and the RD Instruments, and marine atmospheric aerosols. We made soundings with Seabeam and gravity measurement along the cruise track outside the Exclusive Economic Zone of the United States of America.

Leg 1 (Tokyo – Hilo)

After departing from Tokyo, we headed towards the mooring point south of the Shatsky Rise (Sta. M4, 30°20′N, 155°20′E). On the way to the Shatsky Rise, we made XCTD casts at 16 points and prepared the ropes and glass spheres for the mooring deployment. The XCTD probes reached down to a depth of about 900 m, although the ship speed was not reduced at time of the casts.

We deployed the moored current meters at Stas. M4 and M3 (30°50′N, 155°59′E) on the southern slope of the Shatsky Rise to measure the velocity of the deep western boundary current. Prior to the deployment, we made a CTD cast at the same place as M4 (Sta. C00) and checked the CTD system. Then, we proceeded toward 42°N, 170°E, casting XCTD probes at 20 points.

We made full-depth CTD casts at intervals of 1-degree latitude from 42°N to 35°N along 170°E (C01~C08). At the time, an atmospheric low was developing in the northern region and proceeded eastward. We changed the cruise plan by heading to 35°N, 180° and casting XCTD probes at 14 points.

Along 180°, CTD casts were made at intervals of 1-degree latitude from 35°N to 38°N (C09~C12). Then we headed to 35°N, 175°W to avoid a northern strong low, and casted XCTD probes at 7 points on the way. CTD casts along 175°W were made at intervals of 1-degree latitude from 35°N to 38°N (C13~C16). At C15 and C16, large swells were coming; probably due to the swells, the armored cable of the CTD kinked at about one meter from the edge of the cable. We cut the CTD cable at several meters from the edge and reconnected the underwater CTD unit. We had been concerned about strong twists of the CTD cable since the beginning of this cruise, and the concern continued throughout the cruise.

After the CTD cast at C16, we steered for the port of call, Hilo in the Big Island of Hawaii. On the way to Hilo, we casted XCTD probes at 23 points and tried the new-type on-board gravity meter (S57 LaCoste and Romberg ZLS Ultrasys).

Totally, we deployed 10 profiling floats during leg 1. A float was from the group of Tohoku University, and others were from the Frontier Observational Research System for Global Change (FORSGC), which asked us to deploy them for the Argo project. In leg 1, we made CTD casts at 17 stations and XCTD casts at 80 points totally. At nine CTD stations, we measured nutrients and sampled water for dissolved inorganic carbon and total alkalinity. At three and two CTD stations, we sampled water for tritium and helium, respectively.

The Japanese Standard Time is earlier by 19 hours than the Hawaiian time. We adjusted the time on the ship five times (May 14 21:00, 17 1:00, 22 5:00, 25 21:00, 28 1:00) by forwarding one hour, and returned one day at the dateline at midnight between May 24 and May 25. Then we spent 48 hours on May 24.

Leg 2 (Hilo – Honolulu)

We left Hilo at 14:00 on June 1 under fine clear weather. We headed to the first CTD station in leg 2, C17 (8°50′N, 165°W), and casted XCTD probes at 16 points from 19°30′N at intervals of 40-minute latitude.

Along 165°W, we made CTD casts at 37 stations from 8°50′N to 44°30′N (C17~C53). The first two stations (C17, C18) were located in the tropical convergence zone, and the CTD observations were made in heavy rains. Thereafter, the sea and weather were calm. In particular, the CTD casts between 20°N and 35°N were made in extremely calm sea and clear weather.

In leg 2, water sampling was made at all the CTD stations for salinity and dissolved oxygen and at almost every two stations for nutrients, dissolved inorganic carbon, total alkalinity, and chlorofluorocarbons (CFCs). The water for CFCs was sampled in ampoules filled with nitrogen gas, and after the sampling the upper part above the sampled water was filled with nitrogen gas, and finally the ampoules were sealed using a burner.

At C37 (29°N, 165°W), seawater leaked into the connecting part between the cable and the underwater unit of CTD, and the data transfer to the onboard unit became impossible. A similar leakage of seawater happened at a different part of the cable in the second cast at C37. Such water leakage moreover happened at C50, C51, and C52 north of 42°N, at which swells of the sea were significant. About two hours were lost at each of these stations to repair the connecting part of CTD. As a result, we could not observe north of 44°30′N.

After the CTD cast at C53, we headed to 42°N, 155°W. We made XCTD casts between 42°N and 25°N at intervals of 1-degree latitude. On the way, we were noticed about missile operations of the United States Navy in the northern region of Hawaii. We shifted the ship route between 31°N and 25°N to the east by 4-degree longitude at maximum.

In leg 2, we made CTD casts at 37 stations totally with measurements of salinity and dissolved oxygen of water samples. At 20 stations among them, we measured nutrients and sampled water for dissolved inorganic carbon and total alkalinity. We moreover sampled water for CFCs at 17 stations and for helium and tritium at 5 stations. XCTD probes were casted at 34 points, and 11 profiling floats of the FORSGC were deployed.

In total during legs 1 and 2 of the KH-03-1 cruise, we made $CTDO_2$ with water samples at 54 stations, XCTD at 114 points, and deployed 21 profiling floats. We obtained quite valuable data for study of water circulations and properties in the western and central North Pacific.

Acknowledgements

I really express my gratitude to the captain and crew of R.V. *Hakuho Maru* and the scientists joining the KH-03-1 cruise for their cooperation throughout the cruise. Success in the observations was due to their devoted and complete work.

Chief Scientist (KH-03-1 legs 1, 2)

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2. Summary of the measurement and correction

A. Water Sample

A1. Instrument

Seawater was sampled from 12-liter Niskin bottles mounted at 24 places on a Sea-Bird Electronics Carousel water sampler (SBE 32).

A2. Conductivity

Conductivity of water samples was measured with a salinometer Guildline Portasal Model 8410A (Serial Number 63893) which was standardized by IAPSO Standard Seawater (Ocean Scientific International Ltd.) of Batch P141 (K_{15}= 0.99993). The measurement was done in Laboratory 5 in which air temperature was kept a little lower than water temperature in the salinometer water bath. (Initially we made it in Laboratory 6 for water samples at C00-C06, but the salinomater was not stable.)

A3. Dissolved Oxygen

Dissolved oxygen of water samples was measured with an automatic recording titrator Hirama Laboratories ART-3 and Metrohm Shibata 798 MPT Titrion. We used 0.05 mol l^{-1} Sodium Thiosulfate Solution (Wako Pure Chemical Industries Ltd.) (factor = 0.999) for titration of the former instrument and 0.02 mol l^{-1} Sodium Thiosulfate Solution (factor = 1.00) for the latter. The latter new-type titrator is more stable in measurement than the former.

The oxygen values by the former titrator were larger by 0.016 ml l^{-1} on average than those by the latter one. Then, by subtracting this difference from the former values, the oxygen values were unified into the latter ones.

A4. Nutrients

Method

Seawater samples were collected in 10 ml screw-capped plastic tube from 12-L Niskin sampler.

Nitrate + Nitrite Nitrogen: Nitrate is reduced quantitatively to nitrite by cadmium metal in the form of an open tubular cadmium reactor (OTCR). The nitrite thus formed plus any originally present in the sample is determined as an azo dye (absorbance maximum, 550 nm) following its diazotization with sulfanilamide and subsequent coupling with N-1-naphthylethylenediamine.

Phosphate: Phosphate reacts with molybdenum (VI) and antimony (III) in an acid medium to form a phosphoantimonylmolybdenum complex which is subsequently reduced by ascorbic acid to a heteropolyblue with an absorbance maximum at 880 nm.

Silicate: B-molybdosilicic acid is formed by the reaction of silicate with molybdate at a pH of 1 to 1.8. The B-molybdosilicic acid is reduced by ascorbic acid to form molybdenum blue with an absorbance maximum at 630 nm.

Nitrite: Nitrite measurement in performed separate channel, omitting cadmium reactor. The method and reagents are described in nitrite + nitrate procedure section.

Apparatus and reagents

Nitrate + nitrite, phosphate and silicate are analyzed by a BRAN + LUBBE AACS II Auto Analyzer.

[Reagents for nitrate + nitrite analysis]

Working imidazole buffer: 6.0 g imidazole is dissolved in Milli-Q water with 1.0 ml conc. sulfuric acid, and make up to 1000 ml. And then added 2 ml 50 % Triton X-100.

Working sulfanilamide: 10.0 g sulfanilamide is dissoled in Milli-Q water with 100 ml conc. hydrochloric acid. After making up to 1000 ml, 1 ml Triton X-100 is added.

N-1-naphthylethylenediamine dihydrochloride (NED) solution: Dissolve 0.5 g of NED in approximately 900 ml of Milli-Q water contained in a 1000 ml volumetric flask.

[Reagents for phosphate analysis]

Stock molybdate solution: Dissolve 0.12 g of antimony potassium tartrate and 5.6 g sodium molybdate in 800 ml of Milli-Q water with 35 ml sulfuric acid contained in a 1000 ml volumetric flask. Dilute to the mark with Milli-Q water. Store at 4°C in a polyethylene bottle.

Working ascorbic acid: 0.55 g of ascorbic acid in 100 mL of stock molybdate solution and added 2 mL 15 % SLS (sodium lauryl sulfate, W/V) solution.

[Reagents for silicate analysis]

Working sodium molybdate: 15.0 g sodium molybdate is dissolved in 800 ml Milli-Q water with 6.0 ml sulfuric acid. Dilute the solution to the mark and 20 ml 15 % SLS solution added.

Working oxalic acid: 50.0 g of oxalic acid is dissolved in Milli-Q water and make up to 1000 ml.

Working ascorbic acid: 2.5 g of ascorbic acid is dissolved in 100 ml Milli-Q water.

Standards

Standard solutions were prepared in laboratory before cruise. Preparation procedures of standard solutions were described in JGOFS protocol.

[A-standards]

Stock Nitrate Nitrogen (37500 μM): Dissolve 3.7912 g of dry potassium nitrate in approximately 900 ml of deionized Milli-Q water contained in a 1000 ml volumetric flask. Dilute the solution to the mark with deionized Milli-Q water and mix it well.

Stock Phosphate (2500 μM): Dissolve 0.3402 g of dry potassium dihydrogen phosphate in 900 ml of deionized Milli-Q water contained in a 1000 ml volumetric flask. Dilute the solution to the mark with deionized Milli-Q water and mix it well.

Stock Nitrite (2000 μM): Dissolve 0.1380 g sodium nitrite in 900 ml of deionized Milli-Q water contained in a 1000 ml volumetric flask. Dilute the solution to the mark with deionized Milli-Q water and mix it well.

[B-standards]

Stock nitrogen (750 μM), phosphate (50 μM) and silicate (2500 μM) solution: Transfer 0.4701 g sodium silicofluoride to a 1000 ml polypropylene flask containing 800 ml of deionized Milli-Q water. The solution is gentry stirred and dissolved completely. Add each 20 ml of nitrogen and phosphate A-standards to the flask and dilute to the mark with deionized milli-Q water. This solution should be prepared every week.

Nitrite solution (20 μM): 1.0 ml nitrite A-standard is diluted to 100 ml and mixed well. The solution should be prepared every analysis.

B Matrix solution: 500 ml deionized Milli-Q water for preparation of the B-standards.

[C-standards]

Working C-standards should be prepared every analysis. Concentrations, given in Table 1, are obtained by diluting the given volumes of B-standard and secondary Matrix solution to 500 ml with Low Nutrients Sea Water.

	MAT(ml)	B-std	NO_3+NO_2-N(μM)	PO_4-P(μM)	SiO_2(μM)
C-0	40	0	0	0	0
C-1	35	5	7.7	0.5	25.0
C-2	30	10	15.4	1.0	50.0
C-3	25	15	23.1	1.5	75.0
C-4	30	20	30.8	2.0	100.0
C-5	15	25	38.5	2.5	125.0
C-6	10	30	46.2	3.0	150.0
C-7	0	40	61.6	4.0	200.0

Table 1 Working calibrants for nutrients

B. $CTDO_2$

B1. Instrument

The $CTDO_2$ was a Sea-Bird Electronics instrument for 6500 db (SBE9plus). The sensor of conductivity was manufactured by the Sea-Bird Electronics, Inc.

(SBE4) who claimed a resolution of 0.00004 S m^{-1} (0.0004 mmho cm^{-1}) and an accuracy of ±0.0003 S m^{-1} (±0.003 mmho cm^{-1}). The sensor of water temperature was manufactured by the Sea-Bird Electronics, Inc. (SBE3plus) who claimed a resolution of 0.0002°C and an initial accuracy of ±0.001°C. The sensor of pressure was manufactured by the Paroscientific Digiquartz (Model 4xK) with a resolution of 0.001% of full scale and an accuracy of ±0.015% of full scale (6000-db range). The sensor of dissolved oxygen was manufactured by the Sea-Bird Electronics, Inc. (SBE43) who claimed an accuracy of 2 % of saturation.

The $CTDO_2$ underwater instrument was CTD SBE9plus (SN 23797-0608) equipped with conductivity sensor SBE 4 (SN 2436), temperature sensor SBE3plus (SN 2905), pressure sensor (SN 80017), and oxygen sensor SBE43 (SN 0098).

B2. Data Collection

Full signals of frequency digitized 24 times per second were sent from the underwater CTD unit SBE9plus, received with the onboard unit SBE11plus, and converted to output sequences of RS232C. The data were collected with the Sea-Bird Electronics CTD operating software SEASOFT, using an IBM-compatible personal computer EPSON Endeavor Pro. The full signals of frequency were stored in the hard disc during the lowering CTD cast and were copied in magnetic optical discs at the deepest point of the cast.

B3. Calibration

The sensors of conductivity, temperature, and dissolved oxygen were calibrated by the Sea-Bird Electronics, Inc. prior to the cruise. The obtained new coefficients were used in the CTD operating software SEASOFT.

a. Pressure

Pressure data were corrected by subtracting the pressure-sensor value in the air of 1.1 db (leg 1) and 1.0 db (leg 2) for the pressure sensor.

b. Conductivity

Conductivity data were moreover calibrated using water-sample data. The ratio of conductivity from water sample to that from CTD (CF) was calculated. Vertical change of CF was expressed with polynomials of pressure P (db) such as

$$CF = a + bP + cP^2 + dP^3 + eP^4 + fP^5.$$

The sensor value of conductivity was multiplied by CF computed from the above equation and the following coefficients a~f for station groups.

leg 1

1) C07, C08 (used for C00~C08)

$a\sim f$ = 1.000008, .1002494E-7, -.2007036E-10, .2610606E-14, 0.0, 0.0

2) C09~C16

$a\sim f$ = 0.9999333, .2589616E-6, -.1879684E-9, .4405661E-13, -.3402546E-17, 0.0

leg 2

1) C18~C26 (used for C17 also)

$a\sim f$ = 1.000035, -.2451646E-7, -.7293595E-11, .1391498E-14, 0.0, 0.0

2) C27~C36

$a\sim f$ = 1.000015, .8373433E-7, -.9537757E-10, .2448010E-13, -.1922940E-17, 0.0

3) C37A~C46 (used for C37 also)

$a\sim f$ = 1.000002, .1718346E-6, -.1938042E-9, .6634202E-13, -.9479772E-17, .4898685E-21

4) C47~C53

$a\sim f$ = 1.000135, -.1063262E-6, .1855796E-10, -.1118381E-14, 0.0, 0.0

c. Dissolved Oxygen

Oxygen data were obtained with the method in the World Ocean Circulation Experiment (WOCE) Operations Manual, WOCE Hydrographic Programme Office Report WHPO 91-1, WOCE Report No. 68/91. Dissolved oxygen was calculated from the polarographic oxygen sensor electric current with the algorithm

$$O_x = \left[A(O_c + B\frac{dO_c}{dt} + E) + C\exp(-0.03\,T) \right] O_x^*(T,S)\,\exp\left[DT + FP\right]$$

where O_x is the concentration of dissolved oxygen (ml l^{-1}), O_c the oxygen electric current (mA), T, S, and P are water temperature (°C), salinity (psu), and pressure (db) measured with CTD, $O_x^*(T,S)$ the saturated oxygen for T and S, and t is time (sec). The six parameters $A\sim F$ were determined with a nonlinear least squares fitting to the oxygen of water samples. The result of the coefficients is shown below.

leg 1

1) C00~C16

$A\sim F$ = 0.340, 0.541, 0.279, 0.005, -1.373, 0.000139

leg 2

2) C17~C19

$A\sim F$ = 0.342, 7.021, 0.020, 0.001, -0.645, 0.000149

3) C20~C36, C37A, C38~C39 (used for C37 also)

$A\sim F$ = 0.337, 2.475, 0.166, 0.004, -1.037, 0.000141

4) C40~C53

$A\sim F$ = 0.349, -0.252, 0.346, 0.006, -1.540, 0.000139

C. XCTD

We used probes of TSK XCTD-1. The depth of a falling probe was computed with the equation that

$$z = 3.42543 \cdot t - 0.00047026 \cdot t^2.$$

The data were recorded with TSK MK-130 (Tsurumi Seiki Co., Ltd).

D. Shipboard ADCP

D1. ADCP (Furuno Electric Co., Ltd.)

Current velocities at three depths of 20 m, 50 m, and 100 m were measured at an interval of 15 seconds. The data were averaged for every minute and recorded with Doppler Sonar Current Profiler System CI-20H.

D2. ADCP (RD Instruments)

Current velocities at 64 levels at an interval of 16 m from 32–m depth down to about 1000 m were measured with Broadband 38 kHz ADCP and recorded every two minutes.

Uncertainty of the ship heading direction decreases accuracies of the measured flow direction relative to the ship head and the measured velocity components. The ship heading direction data by the gyrocompass was manually input with a resolution of one degree when the system was switched on. Inaccuracy of this input is a source of measurement error. Another error source is a deviation in direction of the shipboard transducer from the original design.

According to Joyce (1989; *Journal of Atmospheric and Oceanic Technology*, **6**, 169-172), the correct velocity (u_w, v_w) is given from a ship speed (u_s, v_s) and a measured ADCP velocity (u_d, v_d) as

$$u_w = u_s + (1+\beta)(u'_d \cos\alpha - v'_d \sin\alpha)$$

$$v_w = v_s + (1+\beta)(u'_d \sin\alpha + v'_d \cos\alpha),$$

where α is the error in orientation of transducer, and $1+\beta$ is the scale factor.

The values of α and β were estimated by comparing the ship speed obtained from bottom tracking with that from the Global Positioning System. The result is

α (rad) = -0.0057, β = -0.0324 (before 0:30 on May 28),

α (rad) = 0.0105, β = -0.0254 (after 0:30 on May 28).

The current velocity data from the RDI ADCP should be corrected with the above equations and coefficients.

E. Lowered ADCP

An ADCP instrument of 300 kHz Work Horse manufactured by RD Instruments was attached to the CTD-water sampler frame and used as a lowered ADCP in order to obtain vertical profiles of horizontal velocity. The transducer was set downward, and a buttery package was mounted on the frame. We selected 4-meter bins, 1 ping per ensemble, and 1 ping per second. Data were stored in the underwater ADCP unit and recovered on the deck after the cast.

Noises and an influence of vertical move and rotation of the ADCP unit must be removed from the original data. Further processes of data should be made after the cruise to obtain correct data of current velocity.

3. List of Scientists Aboard

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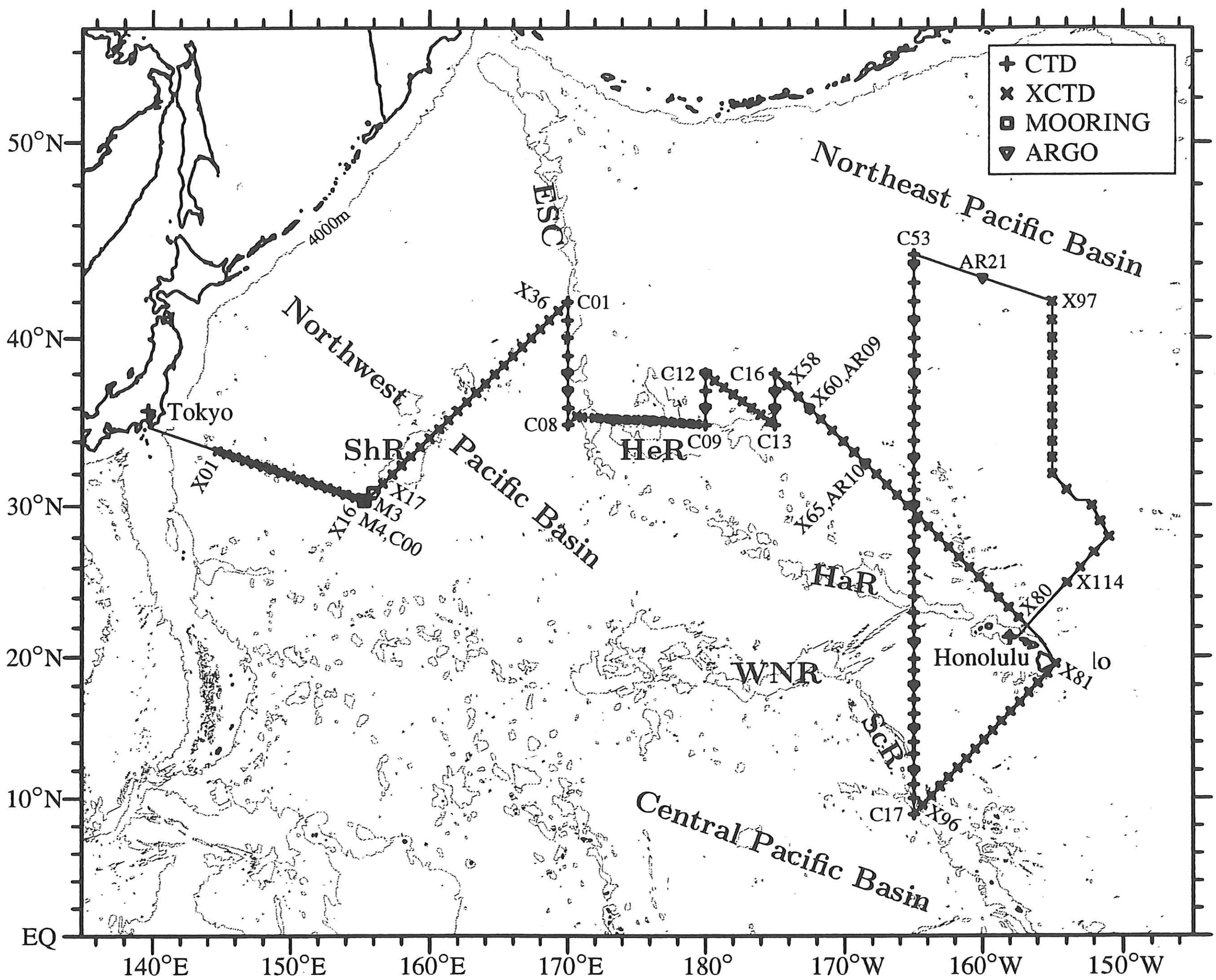
[1,5] Participating leg 1 and 5, [1-4] Participating through leg 1 to 4.

4. Track Chart



ShR:	Shatzky Rise;	**ESC**:	Emperor Seamount Chain
HeR:	Hess Rise;	**HaR**:	Hawaiian Ridge
WNR:	Wake-Necker Ridge;	**ScR**:	Sculpin Ridge

5. Time Table

Leg-1 (Tokyo → Hilo)

	Date	LOCAL TIME (0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24)
1	05/13	Tokyo
2	05/14	X01, X02, X03, X04, X05, +1hr, X06
3	05/15	X07, X08, X09, X10, X11, X12, X13, X14, X15, X16
4	05/16	C00, M4, M3, X17
5	05/17	X18, X19, X20, X21, X22, X23, X24, X25
6	05/18	+1hr, X26, X27, X28, X29, X30, X31, X32, X33
7	05/19	X34, X35, X36, C01, C02, C03
8	05/20	C03, C04, C05 AR01, C06 AR02
9	05/21	C06 AR02, C07, C08, X37, X38, X39
10	05/22	X40, AR03,X41, X42, +1hr, X43, X44, AR04,X45, X46, X47, X48, X49, X50
11	05/23	C09, C10 AR05, C11, C12 AR06
12	05/24	X51, X52, X53, X54, X55, X56, X57, C13
13		C14 AR07, C15 AR08, C16
14	05/25	X58, X59, AR09,X60, X61, X62, X63, +1hr, X64
15	05/26	AR10,X65, X66, X67, X68, X69, X70, X71
16	05/27	X72, X73, Test of gravity meter, X74, X75, X76
17	05/28	+1hr, X77, X78, X79, X80
18	05/29	Hilo

Leg-2 (Hilo → Honolulu)

	Date	LOCAL TIME (0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24)
21	06/01	Hilo, X81, X82, X83
22	06/02	X84, X85, X86, X87, X88, X89, X90, X91
23	06/03	X92, X93, X94, X95, X96, C17
24	06/04	C18, C19, C20, AR11
25	06/05	C21, C22, C23, AR12, C24
26	06/06	C24, C25, C26, AR13, C27
27	06/07	C28, C29, AR14, C30
28	06/08	C31, C32, C33, C34
29	06/09	C35, AR15, C36, C37, C37A
30	06/10	C38, AR16, C39, C40
31	06/11	C41, AR17, C42, C43
32	06/12	C44, C45, C46, AR18, C47
33	06/13	C47, C48, C49, AR19, C50
34	06/14	C50, C51, C52, AR20, C53
35	06/15	C53, AR21
36	06/16	X97, X98, X99, X100, X101
37	06/17	X102, X103, X104, X105, X106, X107, X108
38	06/18	X109, X110, X111, X112
39	06/19	X113, X114
40	06/20	Honolulu

6. Summary of Observation Stations

STN: Station number
TYPE: CTD=CTDO only, ROS=CTDO plus water sampler, MOR=Mooring, XCTD=XCTD, FLOAT=Argo float
CODE: BE=Beginning of cast or mooring deployment, BO=Bottom time for cast, EN=Time cast completed, DE=Time mooring, or XCTD or Argo float was deployed
DEPTH: Bottom depth in meters
MAXPR: Maximum pressures in decibars (for CTD/ROS)
PARAM: Sampling parameters (for ROS)
1=Salinity, 2=Dissolved Oxygen, 3-6=Nutrients (PO_4,SiO_2,NO_2+NO_3,NO_2), 7=Total Carbon, 8=CFCs, 9=He, 10=^{3}H
LADCP=Lowered ADCP
COMMENT: *comments*

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STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/*COMMENT*
X01	XCTD	051403	0108	DE	33°25.80′N	144°41.17′E	5646		*TSK XCTD-1*
X02	XCTD	051403	0321	DE	33°14.75′N	145°20.39′E	5595		*TSK XCTD-1*
X03	XCTD	051403	0541	DE	33°02.88′N	146°01.22′E	5720		*TSK XCTD-1*
X04	XCTD	051403	0755	DE	32°51.51′N	146°40.72′E	5780		*TSK XCTD-1*
X05	XCTD	051403	1012	DE	32°40.14′N	147°20.11′E	5900		*TSK XCTD-1*
X06	XCTD	051403	1229	DE	32°28.77′N	147°59.75′E	5866		*TSK XCTD-1*
X07	XCTD	051403	1455	DE	32°17.09′N	148°40.37′E	5752		*TSK XCTD-1*
X08	XCTD	051403	1716	DE	32°05.45′N	149°20.11′E	4548		*TSK XCTD-1*
X09	XCTD	051403	1939	DE	31°53.78′N	150°00.04′E	5736		*TSK XCTD-1*
X10	XCTD	051403	2204	DE	31°41.76′N	150°41.36′E	5723		*TSK XCTD-1*
X11	XCTD	051503	0019	DE	31°30.74′N	151°19.50′E	4554		*TSK XCTD-1*
X12	XCTD	051503	0234	DE	31°18.93′N	151°59.95′E	5744		*TSK XCTD-1*
X13	XCTD	051503	0448	DE	31°07.24′N	152°39.83′E	5828		*TSK XCTD-1*
X14	XCTD	051503	0707	DE	30°55.52′N	153°20.04′E	5790		*TSK XCTD-1*
X15	XCTD	051503	0925	DE	30°43.69′N	154°00.00′E	5945		*TSK XCTD-1*
X16	XCTD	051503	1149	DE	30°32.00′N	154°40.00′E	5699		*TSK XCTD-1*
C00	ROS	051503	1756	BE	30°20.50′N	155°19.57′E	5642		LADCP
C00	ROS	051503	1843	BO	30°20.48′N	155°19.06′E	5627	2512	1-6 *SBE9p608 CTDO*
C00	ROS	051503	1929	EN	30°20.38′N	155°18.77′E	5620		
M4	MOR	051503	2155	BE	30°21.35′N	155°20.54′E	5654		*1 RCM11, 1 3D-ACM, 3 current meters*
M4	MOR	051503	2348	DE	30°19.72′N	155°19.22′E	5647		*Transmitter 40.100MHz, A/R 3C*
M3	MOR	051603	0401	BE	30°50.78′N	155°58.73′E	5086		*1 RCM11, 1 3D-ACM, 2 current meters*
M3	MOR	051603	0517	DE	30°48.42′N	155°59.61′E	5170		*Transmitter 40.200MHz, A/R 3A*
X17	XCTD	051603	1310	DE	31°24.07′N	156°40.13′E	4245		*TSK XCTD-1*
X18	XCTD	051603	1612	DE	31°58.33′N	157°20.57′E	3358		*TSK XCTD-1*
X19	XCTD	051603	1900	DE	32°31.54′N	157°59.99′E	2718		*TSK XCTD-1*
X20	XCTD	051603	2148	DE	33°04.99′N	158°40.01′E	2713		*TSK XCTD-1*
X21	XCTD	051703	0040	DE	33°38.26′N	159°20.10′E	3111		*TSK XCTD-1*
X22	XCTD	051703	0335	DE	34°11.16′N	160°00.14′E	3470		*TSK XCTD-1*
X23	XCTD	051703	0630	DE	34°44.30′N	160°40.32′E	3770		*TSK XCTD-1*
X24	XCTD	051703	0919	DE	35°16.64′N	161°20.01′E	4076		*TSK XCTD-1*
X25	XCTD	051703	1210	DE	35°49.29′N	162°00.11′E	4501		*TSK XCTD-1*
X26	XCTD	051703	1512	DE	36°20.91′N	162°39.73′E	4324		*TSK XCTD-1*
X27	XCTD	051703	1813	DE	36°53.00′N	163°20.00′E	4551		*TSK XCTD-1*

STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/*COMMENT*
X28	XCTD	051703	2107	DE	37°24.94′N	164°00.04′E	5152		*TSK XCTD-1*
X29	XCTD	051703	2348	DE	37°56.47′N	164°40.08′E	5230		*TSK XCTD-1*
X30	XCTD	051803	0234	DE	38°27.99′N	165°20.42′E	4810		*TSK XCTD-1*
X31	XCTD	051803	0517	DE	38°58.62′N	166°00.12′E	5556		*TSK XCTD-1*
X32	XCTD	051803	0757	DE	39°29.29′N	166°40.00′E	5105		*TSK XCTD-1*
X33	XCTD	051803	1037	DE	40°00.06′N	167°20.13′E	5664		*TSK XCTD-1*
X34	XCTD	051803	1317	DE	40°30.36′N	168°00.29′E	5603		*TSK XCTD-1*
X35	XCTD	051803	1554	DE	41°00.15′N	168°39.81′E	5626		*TSK XCTD-1*
X36	XCTD	051803	1835	DE	41°30.24′N	169°19.98′E	5485		*TSK XCTD-1*
C01	ROS	051803	2152	BE	41°59.78′N	169°59.84′E	5175		LADCP
C01	ROS	051803	2325	BO	41°59.71′N	169°59.56′E	5178	5318	1-7,9,10 *SBE9p608 CTDO*
C01	ROS	051903	0044	EN	41°59.80′N	169°59.39′E	5178		
C02	ROS	051903	0511	BE	40°59.81′N	169°59.96′E	3677		LADCP
C02	ROS	051903	0620	BO	40°59.72′N	169°59.67′E	3670	3720	1,2 *SBE9p608 CTDO*
C02	ROS	051903	0724	EN	40°59.86′N	169°59.53′E	3635		
C03	ROS	051903	1140	BE	40°00.08′N	170°00.08′E	4644		LADCP
C03	ROS	051903	1307	BO	40°00.36′N	170°00.35′E	4653	4862	1-7 *SBE9p608 CTDO*
C03	ROS	051903	1419	EN	40°00.11′N	170°00.70′E	4890		
C04	ROS	051903	1858	BE	39°00.16′N	170°00.90′E	5835		LADCP
C04	ROS	051903	2042	BO	39°00.12′N	170°01.62′E	5891	6093	1,2 *SBE9p608 CTDO*
C04	ROS	051903	2210	EN	39°00.07′N	170°02.15′E	5895		
C05	ROS	052003	0310	BE	38°00.90′N	170°00.12′E	4689		LADCP
C05	ROS	052003	0433	BO	38°01.25′N	169°59.87′E	4751	4879	1-7 *SBE9p608 CTDO*
C05	ROS	052003	0544	EN	38°01.44′N	169°59.57′E	4882		
AR01	FLOAT	052003	0551	DE	38°01.51′N	169°59.49′E	4798		*Isopycnal APEX*
C06	ROS	052003	1037	BE	37°00.45′N	170°00.28′E	5151		LADCP
C06	ROS	052003	1209	BO	37°00.49′N	170°00.45′E	5152	5300	1,2 *SBE9p608 CTDO*
C06	ROS	052003	1323	EN	37°00.38′N	170°00.66′E	5152		
AR02	FLOAT	052003	1335	DE	37°00.41′N	170°00.78′E	5155		*Isopycnal APEX*
C07	ROS	052003	1808	BE	36°00.17′N	170°01.34′E	5176		LADCP
C07	ROS	052003	1941	BO	35°59.97′N	170°02.85′E	5199	5329	1-7 *SBE9p608 CTDO*
C07	ROS	052003	2101	EN	35°59.59′N	170°03.67′E	5183		
C08	ROS	052103	0145	BE	35°00.28′N	170°01.19′E	5416		LADCP
C08	ROS	052103	0317	BO	35°00.00′N	170°02.07′E	5397	5583	1-7 *SBE9p608 CTDO*
C08	ROS	052103	0438	EN	34°59.85′N	170°02.48′E	5401		
X37	XCTD	052103	0739	DE	35°30.61′N	170°40.07′E	4611		*TSK XCTD-1*
X38	XCTD	052103	0853	DE	35°27.72′N	171°05.03′E	1072		*TSK XCTD-1*
X39	XCTD	052103	1130	DE	35°24.79′N	171°59.57′E	1481		*TSK XCTD-1*
X40	XCTD	052103	1327	DE	35°22.49′N	172°40.44′E	4993		*TSK XCTD-1*
AR03	FLOAT	052103	1527	DE	35°20.56′N	173°20.10′E	4797		*APEX*
X41	XCTD	052103	1530	DE	35°20.56′N	173°20.47′E	4798		*TSK XCTD-1*
X42	XCTD	052103	1733	DE	35°18.69′N	174°00.04′E	4798		*TSK XCTD-1*
X43	XCTD	052103	1932	DE	35°18.02′N	174°40.29′E	4892		*TSK XCTD-1*
X44	XCTD	052103	2142	DE	35°17.32′N	175°23.44′E	4932		*TSK XCTD-1*
AR04	FLOAT	052103	2335	DE	35°16.55′N	176°00.24′E	4895		*APEX*
X45	XCTD	052103	2337	DE	35°16.54′N	176°00.45′E	4896		*TSK XCTD-1*
X46	XCTD	052203	0134	DE	35°13.86′N	176°40.15′E	4727		*TSK XCTD-1*
X47	XCTD	052203	0331	DE	35°10.91′N	177°19.60′E	3413		*TSK XCTD-1*

STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/*COMMENT*	
X48	XCTD	052203	0536	DE	35°08.22′N	177°59.93′E	3800		*TSK XCTD-1*	
X49	XCTD	052203	0749	DE	35°05.46′N	178°40.24′E	3362		*TSK XCTD-1*	
X50	XCTD	052203	0947	DE	35°02.70′N	179°20.22′E	4104		*TSK XCTD-1*	
C09	ROS	052203	1211	BE	34°59.92′N	179°59.79′W	3744		LADCP	
C09	ROS	052203	1315	BO	34°59.43′N	179°59.95′W	3718	3804	1-7	*SBE9p608 CTDO*
C09	ROS	052203	1412	EN	34°59.10′N	179°59.95′E	3693			
C10	ROS	052203	1836	BE	36°00.14′N	179°59.93′W	4735		LADCP	
C10	ROS	052203	1959	BO	36°00.27′N	179°59.97′E	4738	4859	1,2	*SBE9p608 CTDO*
C10	ROS	052203	2110	EN	36°00.22′N	179°59.98′E	4736			
AR05	FLOAT	052203	2118	DE	36°00.17′N	179°59.90′E	4736		*Isopycnal APEX*	
C11	ROS	052303	0123	BE	36°59.94′N	179°59.76′W	5303		LADCP	
C11	ROS	052303	0310	BO	36°59.92′N	179°58.85′W	5304	5464	1-7	*SBE9p608 CTDO*
C11	ROS	052303	0430	EN	37°00.04′N	179°58.18′W	5319			
C12	ROS	052303	0835	BE	38°00.18′N	179°59.54′W	5434		LADCP	
C12	ROS	052303	1011	BO	38°00.18′N	179°58.97′W	5436	5601	1,2,9	*SBE9p608 CTDO*
C12	ROS	052303	1130	EN	37°59.96′N	179°58.49′W	5438			
AR06	FLOAT	052303	1138	DE	37°59.96′N	179°58.47′W	5438		*Isopycnal APEX*	
X51	XCTD	052303	1415	DE	37°36.48′N	179°19.90′W	5445		*TSK XCTD-1*	
X52	XCTD	052303	1632	DE	37°12.67′N	178°39.95′W	5302		*TSK XCTD-1*	
X53	XCTD	052303	1852	DE	36°48.78′N	177°59.77′W	5243		*TSK XCTD-1*	
X54	XCTD	052303	2115	DE	36°25.00′N	177°20.05′W	5292		*TSK XCTD-1*	
X55	XCTD	052303	2342	DE	36°00.86′N	176°39.92′W	4693		*TSK XCTD-1*	
X56	XCTD	052403	0209	DE	35°36.64′N	175°59.90′W	3815		*TSK XCTD-1*	
X57	XCTD	052403	0434	DE	35°12.05′N	175°19.77′W	4678		*TSK XCTD-1*	
C13	ROS	052403	0611	BE	34°59.90′N	174°39.71′W	5388		LADCP	
C13	ROS	052403	0747	BO	34°59.75′N	174°59.84′W	5382	5567	1-7,9,10	*SBE9p608 CTDO*
C13	ROS	052403	0907	EN	34°59.37′N	174°59.82′W	5362			
C14	ROS	052403	1333	BE	35°59.80′N	174°59.62′W	4862		LADCP	
C14	ROS	052403	1500	BO	35°59.06′N	174°59.76′W	4774	5021	1,2	*SBE9p608 CTDO*
C14	ROS	052403	1612	EN	35°58.54′N	175°00.04′W	4728			
AR07	FLOAT	052403	1621	DE	35°58.42′N	174°59.91′W	4622		*APEX*	
C15	ROS	052403	2114	BE	36°59.63′N	174°59.75′W	4544		LADCP	
C15	ROS	052403	2238	BO	36°58.99′N	174°59.68′W	4485	4620	1-7	*SBE9p608 CTDO*
C15	ROS	052403	2343	EN	36°58.60′N	174°59.68′W	4574			
AR08	FLOAT	052403	2355	DE	36°58.39′N	174°59.63′W	4678		*Isopycnal APEX*	
C16	ROS	052503	0603	BE	37°59.76′N	175°00.16′W	4552		LADCP	
C16	ROS	052503	0726	BO	37°59.54′N	175°00.40′W	4574	4807	1,2	*SBE9p608 CTDO*
C16	ROS	052503	0835	EN	37°59.31′N	175°00.70′W	4762			
X58	XCTD	052503	1235	DE	37°18.94′N	174°08.70′W	5342		*TSK XCTD-1*	
X59	XCTD	052503	1559	DE	36°39.98′N	173°20.65′W	5772		*TSK XCTD-1*	
AR09	FLOAT	052503	1935	DE	36°00.04′N	172°31.36′W	5437		*APEX*	
X60	XCTD	052503	1937	DE	36°00.00′N	172°31.29′W	5444		*TSK XCTD-1*	
X61	XCTD	052503	2306	DE	35°19.85′N	171°42.90′W	5756		*TSK XCTD-1*	
X62	XCTD	052603	0231	DE	34°39.74′N	170°54.42′W	5766		*TSK XCTD-1*	
X63	XCTD	052603	0557	DE	34°00.01′N	170°06.81′W	5764		*TSK XCTD-1*	
X64	XCTD	052603	0923	DE	33°20.03′N	169°19.51′W	5822		*TSK XCTD-1*	
AR10	FLOAT	052603	1248	DE	32°39.88′N	168°32.38′W	5804		*APEX*	
X65	XCTD	052603	1250	DE	32°39.76′N	168°32.25′W	5822		*TSK XCTD-1*	

STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/*COMMENT*	
X66A	XCTD	052603	1623	DE	31°58.84′N	167°44.41′W	5638		*TSK XCTD-1*	
X67	XCTD	052603	1936	DE	31°20.02′N	166°59.44′W	5657		*TSK XCTD-1*	
X68	XCTD	052603	2303	DE	30°40.00′N	166°13.17′W	5608		*TSK XCTD-1*	
X69	XCTD	052703	0230	DE	29°59.74′N	165°27.34′W	5377		*TSK XCTD-1*	
X70	XCTD	052703	0557	DE	29°20.00′N	164°42.13′W	5418		*TSK XCTD-1*	
X71	XCTD	052703	0926	DE	28°40.02′N	163°57.07′W	5327		*TSK XCTD-1*	
X72	XCTD	052703	1251	DE	28°00.01′N	163°12.19′W	5441		*TSK XCTD-1*	
X73	XCTD	052703	1628	DE	27°20.02′N	162°27.56′W	4879		*TSK XCTD-1*	
X74	XCTD	052803	0224	DE	26°40.28′N	161°43.41′W	2875		*TSK XCTD-1*	
X75	XCTD	052803	0559	DE	26°00.02′N	160°59.26′W	4868		*TSK XCTD-1*	
X76	XCTD	052803	0921	DE	25°20.01′N	160°15.52′W	4856		*TSK XCTD-1*	
X77	XCTD	052803	1242	DE	24°39.20′N	159°31.06′W	4700		*TSK XCTD-1*	
X78	XCTD	052803	1558	DE	23°59.89′N	158°48.33′W	4612		*TSK XCTD-1*	
X79	XCTD	052803	1923	DE	23°20.25′N	158°05.80′W	4496		*TSK XCTD-1*	
X80	XCTD	052803	2254	DE	22°40.31′N	157°22.92′W	4564		*TSK XCTD-1*	

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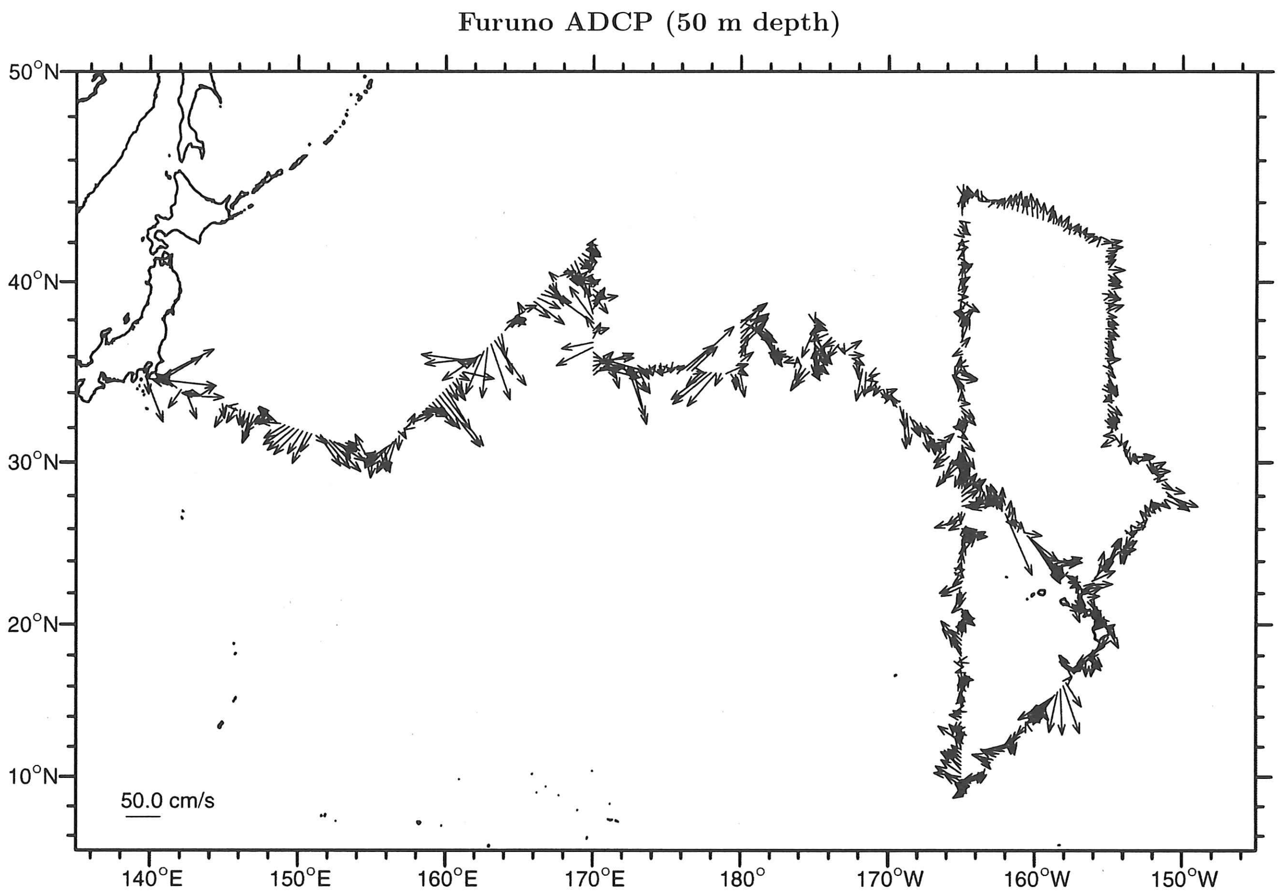
STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/*COMMENT*	
X81	XCTD	060203	0208	DE	19°30.00′N	154°43.89′W	1529		*TSK XCTD-1*	
X82	XCTD	060203	0516	DE	18°49.98′N	155°19.40′W	2351		*TSK XCTD-1*	
X83	XCTD	060203	0829	DE	18°09.96′N	155°58.85′W	5033		*TSK XCTD-1*	
X84	XCTD	060203	1149	DE	17°30.18′N	156°38.12′W	4736		*TSK XCTD-1*	
X85	XCTD	060203	1511	DE	16°49.87′N	157°17.82′W	5021		*TSK XCTD-1*	
X86	XCTD	060203	1834	DE	16°09.94′N	157°56.65′W	5368		*TSK XCTD-1*	
X87	XCTD	060203	2147	DE	15°29.90′N	158°35.81′W	5572		*TSK XCTD-1*	
X88	XCTD	060303	0100	DE	14°50.01′N	159°14.76′W	5515		*TSK XCTD-1*	
X89	XCTD	060303	0418	DE	14°09.95′N	159°53.63′W	5602		*TSK XCTD-1*	
X90	XCTD	060303	0739	DE	13°29.95′N	160°32.34′W	5553		*TSK XCTD-1*	
X91	XCTD	060303	1056	DE	12°50.03′N	161°10.79′W	5590		*TSK XCTD-1*	
X92	XCTD	060303	1415	DE	12°09.92′N	161°49.31′W	5161		*TSK XCTD-1*	
X93	XCTD	060303	1734	DE	11°29.99′N	162°27.86′W	5315		*TSK XCTD-1*	
X94	XCTD	060303	2053	DE	10°49.98′N	163°05.92′W	4811		*TSK XCTD-1*	
X95	XCTD	060403	0008	DE	10°10.05′N	163°44.01′W	3967		*TSK XCTD-1*	
X96	XCTD	060403	0325	DE	09°29.98′N	164°22.14′W	4558		*TSK XCTD-1*	
C17	ROS	060403	0733	BE	08°49.77′N	165°00.09′W	4973		LADCP	
C17	ROS	060403	0904	BO	08°49.87′N	165°01.16′W	4978	5107	1-10	*SBE9p608 CTDO*
C17	ROS	060403	1017	EN	08°50.15′N	165°01.53′W	4998			
C18	ROS	060403	1551	BE	09°59.80′N	165°00.17′W	3739		LADCP	
C18	ROS	060403	1657	BO	09°59.90′N	165°00.36′W	3726	3805	1,2	*SBE9p608 CTDO*
C18	ROS	060403	1754	EN	09°59.91′N	165°00.33′W	3743			
C19	ROS	060403	2209	BE	11°00.06′N	165°00.35′W	4766		LADCP	
C19	ROS	060403	2335	BO	11°00.25′N	165°00.66′W	4770	4912	1,2	*SBE9p608 CTDO*
C19	ROS	060503	0046	EN	11°00.35′N	165°00.88′W	4763			
C20	ROS	060503	0451	BE	12°00.28′N	164°59.92′W	5102		LADCP	
C20	ROS	060503	0618	BO	12°00.48′N	164°59.85′W	5101	5242	1-8	*SBE9p608 CTDO*
C20	ROS	060503	0734	EN	12°00.50′N	164°59.86′W	5100			
AR11	FLOAT	060503	0740	DE	12°00.49′N	164°59.86′W	5102		*APEX*	
C21	ROS	060503	1227	BE	13°09.85′N	165°00.24′W	5296		LADCP	
C21	ROS	060503	1358	BO	13°09.29′N	165°00.31′W	5307	5463	1,2	*SBE9p608 CTDO*
C21	ROS	060503	1530	EN	13°08.94′N	165°00.48′W	5314			

STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/	*COMMENT*
C22	ROS	060503	1922	BE	13°59.96′N	165°00.18′W	5466		LADCP	
C22	ROS	060503	2100	BO	14°00.39′N	165°00.27′W	5474	5640	1-8	*SBE9p608 CTDO*
C22	ROS	060503	2222	EN	14°00.88′N	165°00.28′W	5472			
C23	ROS	060603	0235	BE	15°00.00′N	164°59.89′W	5376		LADCP	
C23	ROS	060603	0406	BO	15°00.28′N	164°59.65′W	5364	5532	1,2	*SBE9p608 CTDO*
C23	ROS	060603	0523	EN	15°00.63′N	164°59.51′W	5340			
AR12	FLOAT	060603	0530	DE	15°00.62′N	164°59.47′W	5340		*APEX*	
C24	ROS	060603	0941	BE	16°00.18′N	164°59.97′W	5289		LADCP	
C24	ROS	060603	1115	BO	16°00.56′N	164°59.63′W	5278	5433	1-8	*SBE9p608 CTDO*
C24	ROS	060603	1233	EN	16°00.93′N	164°59.42′W	5274			
C25	ROS	060603	1645	BE	17°00.08′N	165°00.16′W	5438		LADCP	
C25	ROS	060603	1821	BO	17°00.29′N	164°59.93′W	5440	5602	1,2	*SBE9p608 CTDO*
C25	ROS	060603	1943	EN	17°00.64′N	164°59.67′W	5442			
C26	ROS	060603	2358	BE	18°00.14′N	165°00.08′W	5469		LADCP	
C26	ROS	060703	0135	BO	18°00.59′N	164°59.95′W	5472	5654	1-10	*SBE9p608 CTDO*
C26	ROS	060703	0254	EN	18°00.81′N	164°59.77′W	5454			
AR13	FLOAT	060703	0303	DE	18°00.82′N	164°59.79′W	5455		*APEX*	
C27	ROS	060703	0711	BE	19°00.19′N	165°00.00′W	5360		LADCP	
C27	ROS	060703	0845	BO	19°00.41′N	165°00.21′W	5355	5530	1,2	*SBE9p608 CTDO*
C27	ROS	060703	1005	EN	19°00.45′N	165°00.30′W	5357			
C28	ROS	060703	1340	BE	19°49.92′N	164°59.88′W	5010		LADCP	
C28	ROS	060703	1508	BO	19°49.78′N	164°59.81′W	5013	5149	1-8	*SBE9p608 CTDO*
C28	ROS	060703	1625	EN	19°49.62′N	164°59.84′W	5011			
C29	ROS	060703	2124	BE	20°59.83′N	164°59.87′W	4820		LADCP	
C29	ROS	060703	2248	BO	20°59.73′N	164°59.42′W	4830	4948	1,2	*SBE9p608 CTDO*
C29	ROS	060803	0000	EN	20°59.60′N	164°59.18′W	4830			
AR14	FLOAT	060803	0013	DE	20°59.43′N	164°59.08′W	4828		*APEX*	
C30	ROS	060803	0437	BE	22°00.07′N	165°00.12′W	4578		LADCP	
C30	ROS	060803	0554	BO	22°00.10′N	165°00.23′W	4580	4686	1-8	*SBE9p608 CTDO*
C30	ROS	060803	0702	EN	22°00.15′N	165°00.46′W	4582			
C31	ROS	060803	1120	BE	22°59.94′N	165°00.20′W	4401		LADCP	
C31	ROS	060803	1240	BO	22°59.61′N	165°00.41′W	4401	4501	1,2	*SBE9p608 CTDO*
C31	ROS	060803	1346	EN	22°59.36′N	165°00.45′W	4406			
C32	ROS	060803	1826	BE	24°04.89′N	164°59.99′W	4466		LADCP	
C32	ROS	060803	1944	BO	24°04.97′N	165°00.24′W	4477	4574	1-8	*SBE9p608 CTDO*
C32	ROS	060803	2051	EN	24°05.00′N	165°00.58′W	4475			
C33	ROS	060903	0036	BE	25°00.20′N	164°59.89′W	4918		LADCP	
C33	ROS	060903	0200	BO	25°00.30′N	164°59.83′W	4920	5052	1,2	*SBE9p608 CTDO*
C33	ROS	060903	0313	EN	25°00.26′N	164°59.49′W	4920			
C34	ROS	060903	0723	BE	26°00.03′N	164°59.84′W	4655		LADCP	
C34	ROS	060903	0845	BO	25°59.98′N	164°59.98′W	4677	4765	1-10	*SBE9p608 CTDO*
C34	ROS	060903	0954	EN	25°59.41′N	165°00.15′W	4637			
C35	ROS	060903	1415	BE	26°59.24′N	164°59.94′W	4808		LADCP	
C35	ROS	060903	1535	BO	26°59.99′N	165°00.39′W	4810	4936	1,2	*SBE9p608 CTDO*
C35	ROS	060903	1646	EN	26°59.95′N	165°00.70′W	4813			
AR15	FLOAT	060903	1653	DE	26°59.98′N	165°00.73′W	4814		*APEX*	
C36	ROS	060903	2101	BE	28°00.16′N	164°59.66′W	4915		LADCP	
C36	ROS	060903	2234	BO	28°00.50′N	164°59.32′W	4960	5081	1-8	*SBE9p608 CTDO*

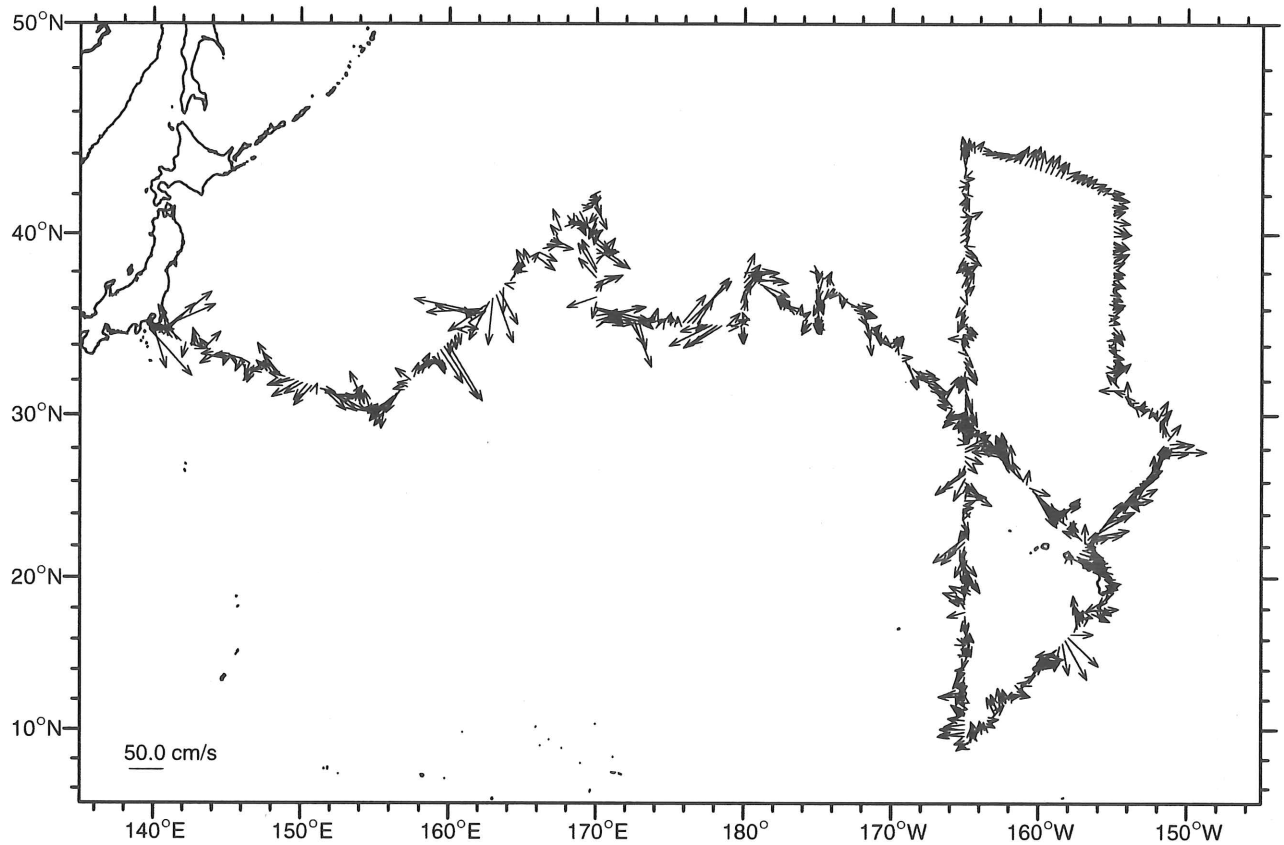
STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/	*COMMENT*
C36	ROS	060903	2346	EN	28°00.57′N	164°59.14′W	4960			
C37	CTD	061003	0511	BE	28°59.95′N	165°00.02′W	5175		LADCP	
C37	CTD	061003	0610	BO	29°00.02′N	165°00.07′W	5175	3325		*SBE9p608 CTDO*
C37	CTD	061003	0704	EN	29°00.08′N	165°00.20′W	5172			
C37A	ROS	061003	0805	BE	29°00.12′N	165°00.20′W	5174		LADCP	
C37A	ROS	061003	0937	BO	29°00.67′N	165°00.21′W	5193	5324	1-7	*SBE9p608 CTDO*
C37A	ROS	061003	1055	EN	29°00.84′N	165°00.18′W	5207			
C38	ROS	061003	1459	BE	30°00.23′N	165°00.28′W	5346		LADCP	
C38	ROS	061003	1634	BO	30°00.43′N	165°00.36′W	5347	5507	1,2	*SBE9p608 CTDO*
C38	ROS	061003	1756	EN	30°00.77′N	165°00.35′W	5357			
AR16	FLOAT	061003	1803	DE	30°00.94′N	165°00.31′W	5358		*APEX*	
C39	ROS	061003	2217	BE	30°59.79′N	165°00.20′W	5631		LADCP	
C39	ROS	061003	2356	BO	30°59.07′N	164°59.85′W	5659	5834	1-8	*SBE9p608 CTDO*
C39	ROS	061103	0122	EN	30°58.44′N	164°59.52′W	5649			
C40	ROS	061103	0547	BE	32°00.08′N	165°00.10′W	5811		LADCP	
C40	ROS	061103	0729	BO	32°00.25′N	165°00.17′W	5808	6002	1,2	*SBE9p608 CTDO*
C40	ROS	061103	0855	EN	32°00.21′N	165°00.25′W	5805			
C41	ROS	061103	1308	BE	32°59.96′N	165°00.05′W	5602		LADCP	
C41	ROS	061103	1445	BO	32°59.74′N	165°00.14′W	5600	5787	1-8	*SBE9p608 CTDO*
C41	ROS	061103	1608	EN	32°59.62′N	165°00.24′W	5600			
AR17	FLOAT	061103	1614	DE	32°59.54′N	165°00.24′W	5599		*APEX*	
C42	ROS	061103	2028	BE	33°59.96′N	165°00.07′W	5626		LADCP	
C42	ROS	061103	2208	BO	33°59.96′N	165°00.34′W	5626	5812	1,2	*SBE9p608 CTDO*
C42	ROS	061103	2331	EN	33°59.87′N	165°00.59′W	5623			
C43	ROS	061203	0339	BE	34°59.98′N	165°00.16′W	5650		LADCP	
C43	ROS	061203	0519	BO	34°59.89′N	165°00.18′W	5648	5843	1-10	*SBE9p608 CTDO*
C43	ROS	061203	0641	EN	34°59.78′N	165°00.05′W	5654			
C44	ROS	061203	1058	BE	36°00.01′N	164°59.98′W	5625		LADCP	
C44	ROS	061203	1235	BO	35°59.81′N	165°00.03′W	5621	5805	1,2	*SBE9p608 CTDO*
C44	ROS	061203	1357	EN	35°59.63′N	165°00.21′W	5630			
C45	ROS	061203	1751	BE	36°55.27′N	164°59.79′W	6132		LADCP	
C45	ROS	061203	1940	BO	36°55.46′N	164°59.24′W	6129	6352	1-8	*SBE9p608 CTDO*
C45	ROS	061203	2110	EN	36°55.31′N	164°58.68′W	6044			
C46	ROS	061303	0134	BE	38°00.23′N	164°59.84′W	5288		LADCP	
C46	ROS	061303	0306	BO	38°00.19′N	164°59.56′W	5283	5440	1-7	*SBE9p608 CTDO*
C46	ROS	061303	0421	EN	38°00.14′N	164°59.50′W	5282			
AR18	FLOAT	061303	0427	DE	38°00.15′N	164°59.48′W	5283		*APEX*	
C47	ROS	061303	0842	BE	38°59.94′N	164°59.45′W	5363		LADCP	
C47	ROS	061303	1012	BO	38°59.63′N	164°59.13′W	5356	5518	1,2	*SBE9p608 CTDO*
C47	ROS	061303	1135	EN	38°59.31′N	164°59.08′W	5356			
C48	ROS	061303	1553	BE	40°00.08′N	164°59.88′W	5484		LADCP	
C48	ROS	061303	1728	BO	40°00.09′N	164°59.88′W	5480	5701	1-8	*SBE9p608 CTDO*
C48	ROS	061303	1848	EN	40°00.01′N	164°59.75′W	5492			
C49	ROS	061303	2257	BE	41°00.00′N	164°59.74′W	5259		LADCP	
C49	ROS	061403	0026	BO	40°59.67′N	164°59.72′W	5234	5412	1,2	*SBE9p608 CTDO*
C49	ROS	061403	0142	EN	40°59.53′N	164°59.72′W	5224			
AR19	FLOAT	061403	0156	DE	40°59.60′N	164°59.55′W	5232		*APEX*	
C50	ROS	061403	0848	BE	42°00.10′N	164°59.92′W	5716		LADCP	

STN	TYPE	DATE	GMT	CODE	LATITUDE	LONGITUDE	DEPTH	MAXPR	PARAM/*COMMENT*	
C50	ROS	061403	1029	BO	42°00.06′N	165°00.09′W	5713	5902	1-8	*SBE9p608 CTDO*
C50	ROS	061403	1150	EN	41°59.87′N	164°59.90′W	5722			
C51	ROS	061403	1813	BE	42°59.86′N	164°59.92′W	5584		LADCP	
C51	ROS	061403	1953	BO	42°59.56′N	164°59.85′W	5579	5764	1,2	*SBE9p608 CTDO*
C51	ROS	061403	2118	EN	42°59.33′N	164°59.75′W	5594			
C52	ROS	061503	0306	BE	44°00.11′N	165°00.02′W	5411		LADCP	
C52	ROS	061503	0442	BO	44°00.11′N	165°00.26′W	5333	5600	1-10	*SBE9p608 CTDO*
C52	ROS	061503	0601	EN	44°00.05′N	165°00.29′W	5404			
AR20	FLOAT	061503	0611	DE	44°00.09′N	165°00.44′W	5378		*APEX*	
C53	ROS	061503	0845	BE	44°29.80′N	164°59.84′W	5404		LADCP	
C53	ROS	061503	1030	BO	44°29.53′N	165°00.15′W	5402	5563	1-7	*SBE9p608 CTDO*
C53	ROS	061503	1148	EN	44°29.19′N	165°00.59′W	5403			
AR21	FLOAT	061603	0211	DE	43°15.85′N	159°59.94′W	5556		*APEX*	
X97	XCTD	061603	1619	DE	41°59.92′N	155°00.16′W	4890		*TSK XCTD-1*	
X98A	XCTD	061603	2005	DE	40°59.33′N	155°00.06′W	5337		*TSK XCTD-1*	
X99	XCTD	061603	2347	DE	40°00.06′N	154°59.88′W	4942		*TSK XCTD-1*	
X100	XCTD	061703	0333	DE	39°00.05′N	154°59.87′W	5207		*TSK XCTD-1*	
X101	XCTD	061703	0722	DE	38°00.09′N	154°59.90′W	5456		*TSK XCTD-1*	
X101A	XCTD	061703	0734	DE	37°57.85′N	154°59.92′W	5448		*TSK XCTD-1*	
X102	XCTD	061703	1113	DE	37°00.03′N	154°59.88′W	5593		*TSK XCTD-1*	
X103	XCTD	061703	1455	DE	36°00.02′N	154°59.89′W	5553		*TSK XCTD-1*	
X104	XCTD	061703	1835	DE	34°59.90′N	154°59.95′W	5661		*TSK XCTD-1*	
X105A	XCTD	061703	2217	DE	33°58.93′N	154°59.97′W	5585		*TSK XCTD-1*	
X106	XCTD	061803	0150	DE	33°00.08′N	154°59.90′W	5482		*TSK XCTD-1*	
X107A	XCTD	061803	0534	DE	31°59.45′N	154°58.26′W	5536		*TSK XCTD-1*	
X108	XCTD	061803	1024	DE	31°00.05′N	153°58.00′W	5439		*TSK XCTD-1*	
X109	XCTD	061803	1803	DE	30°00.04′N	152°08.27′W	5264		*TSK XCTD-1*	
X110	XCTD	061803	2215	DE	29°00.03′N	151°33.23′W	5282		*TSK XCTD-1*	
X111	XCTD	061903	0225	DE	27°59.97′N	150°58.53′W	5362		*TSK XCTD-1*	
X112	XCTD	061903	0722	DE	26°59.81′N	151°58.57′W	5250		*TSK XCTD-1*	
X113	XCTD	061903	1219	DE	26°00.00′N	152°57.61′W	5260		*TSK XCTD-1*	
X114	XCTD	061903	1714	DE	24°59.85′N	153°56.67′W	5069		*TSK XCTD-1*	

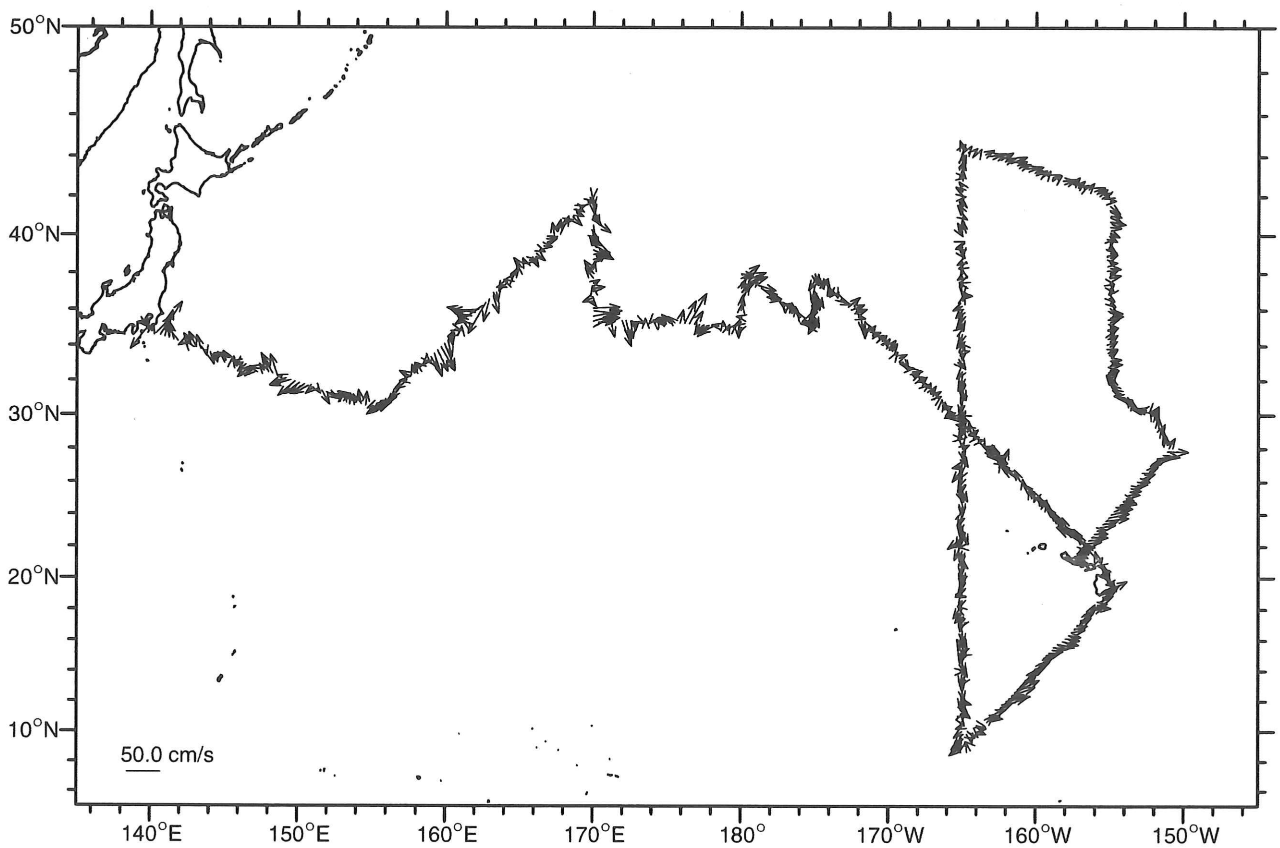
7. Chart of Surface Currents



RDI ADCP (50 m depth)



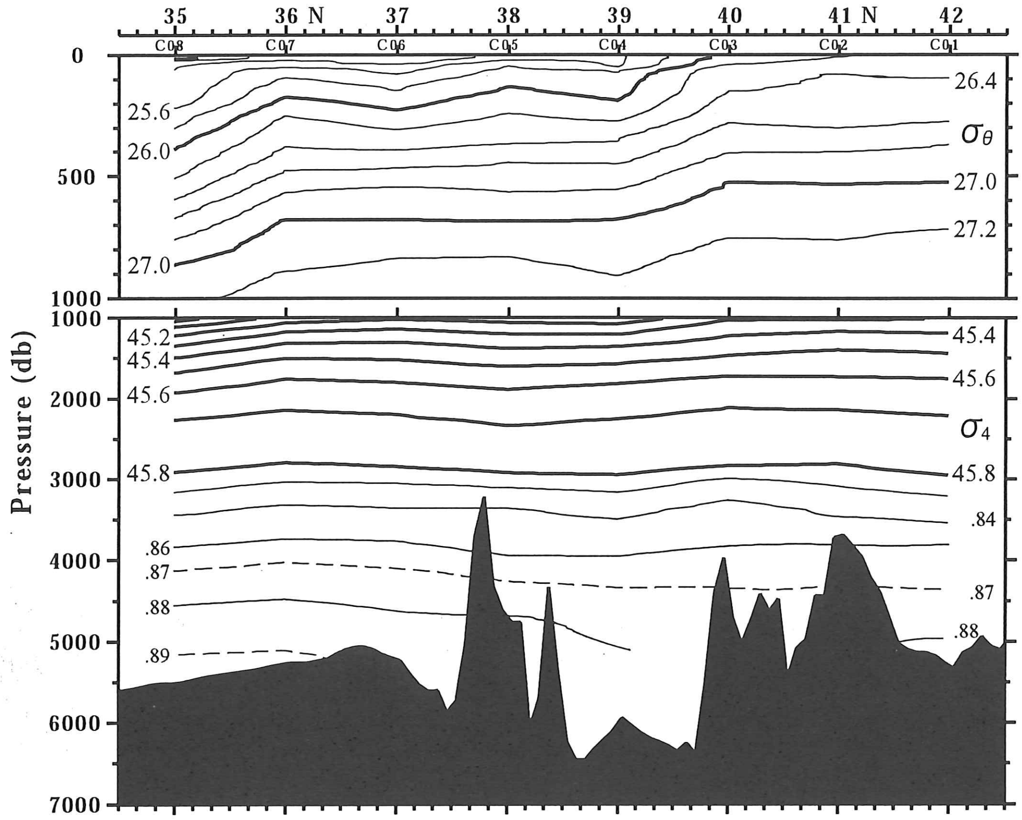
RDI ADCP (500 m depth)



8. Vertical Sections of CTDO2 Data

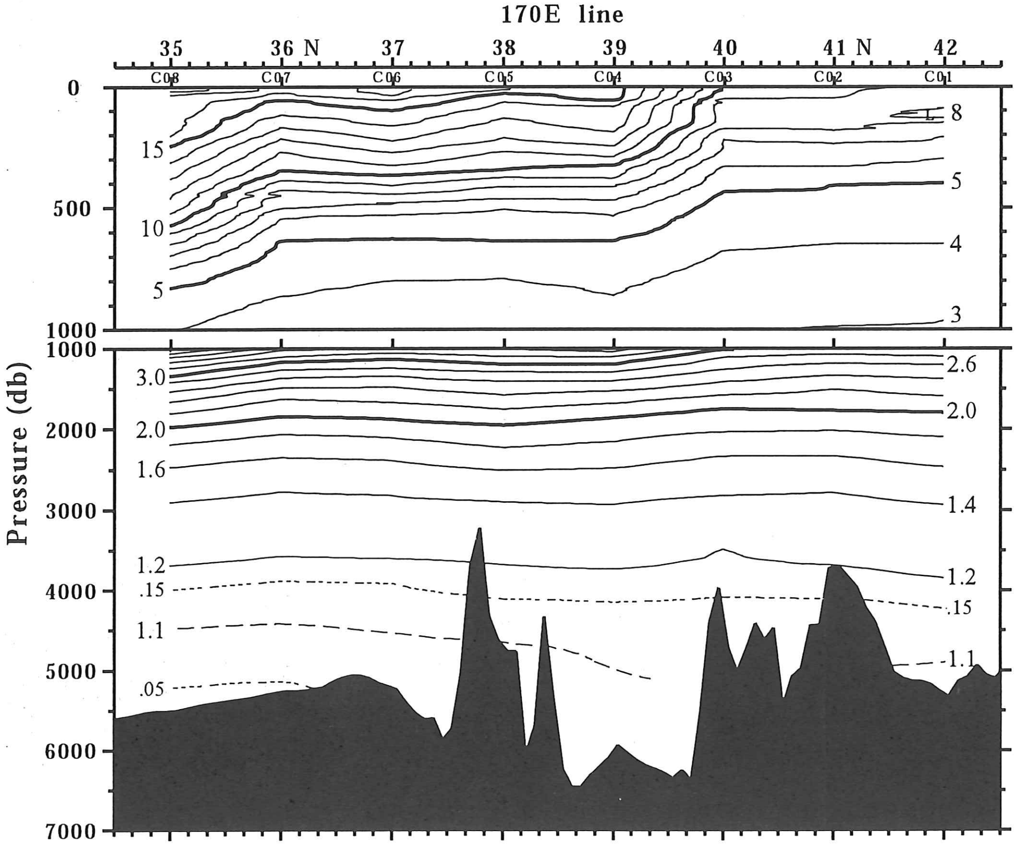
POTENTIAL DENSITY

170E line



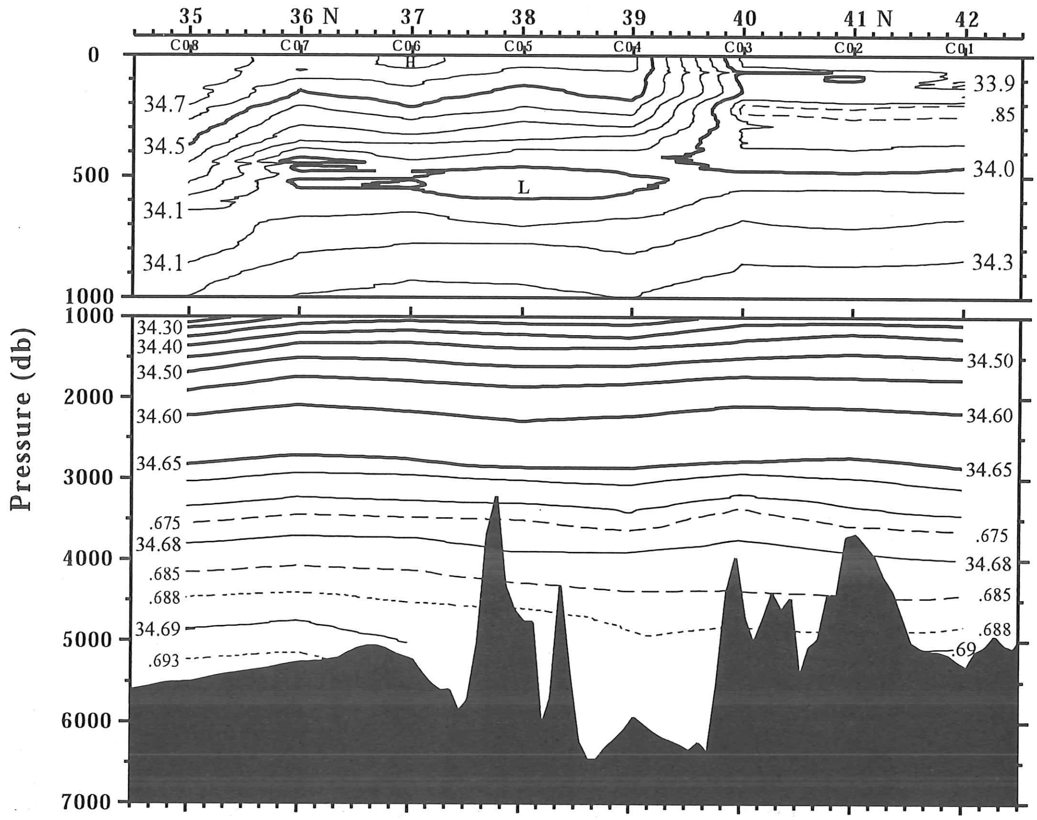
POT. TEMPERATURE (deg C)

170E line



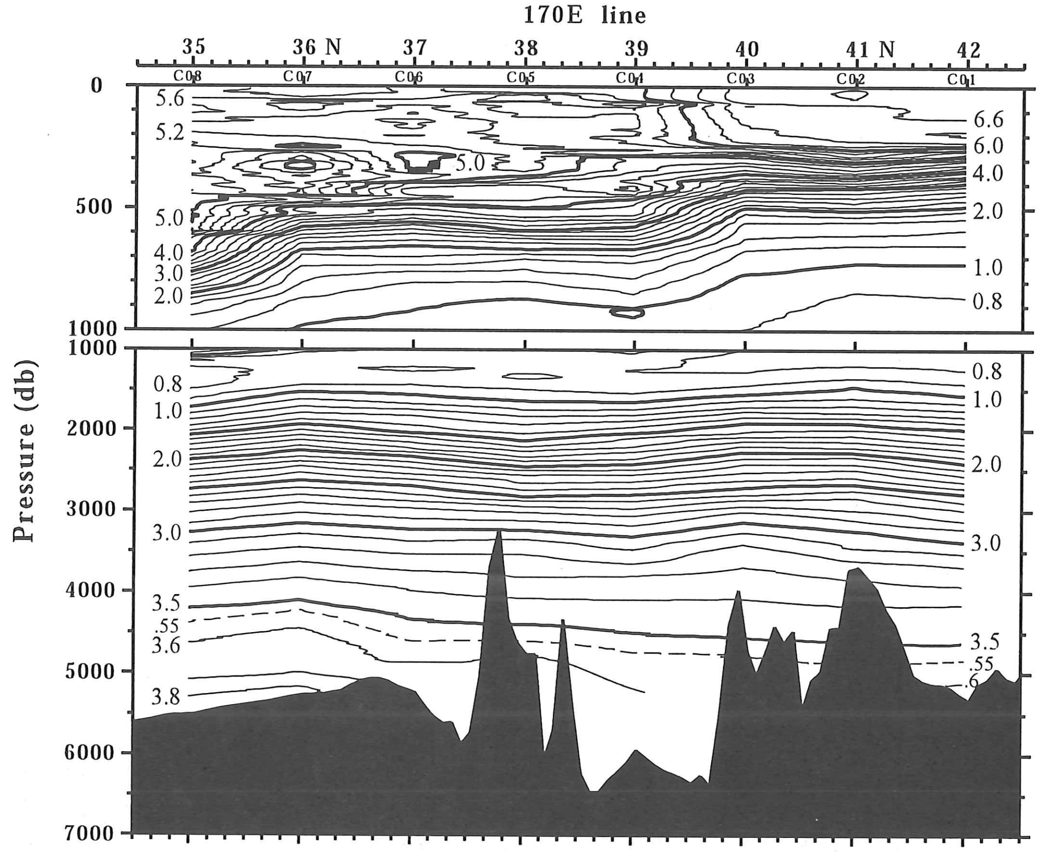
SALINITY (psu)

170E line

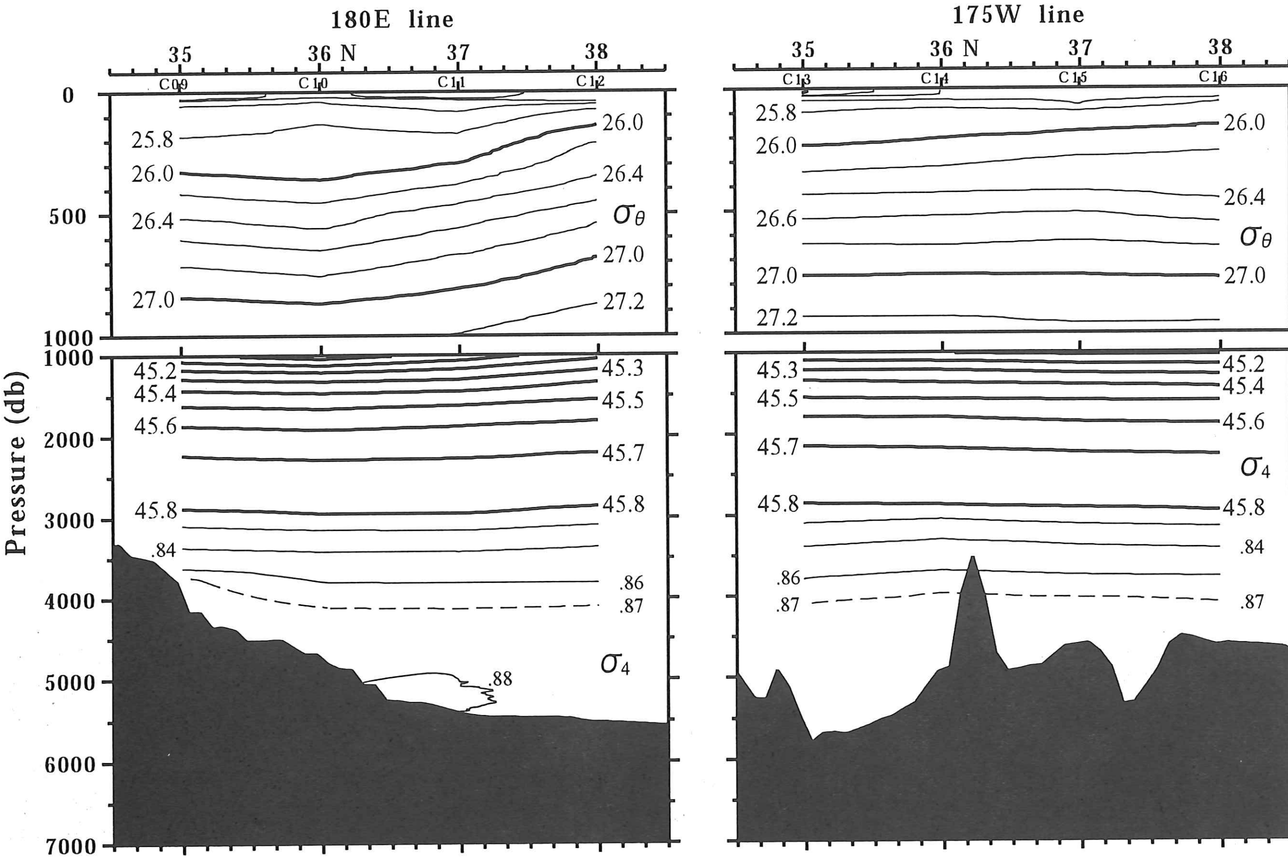


DISSOLVED OXYGEN (ml/l)

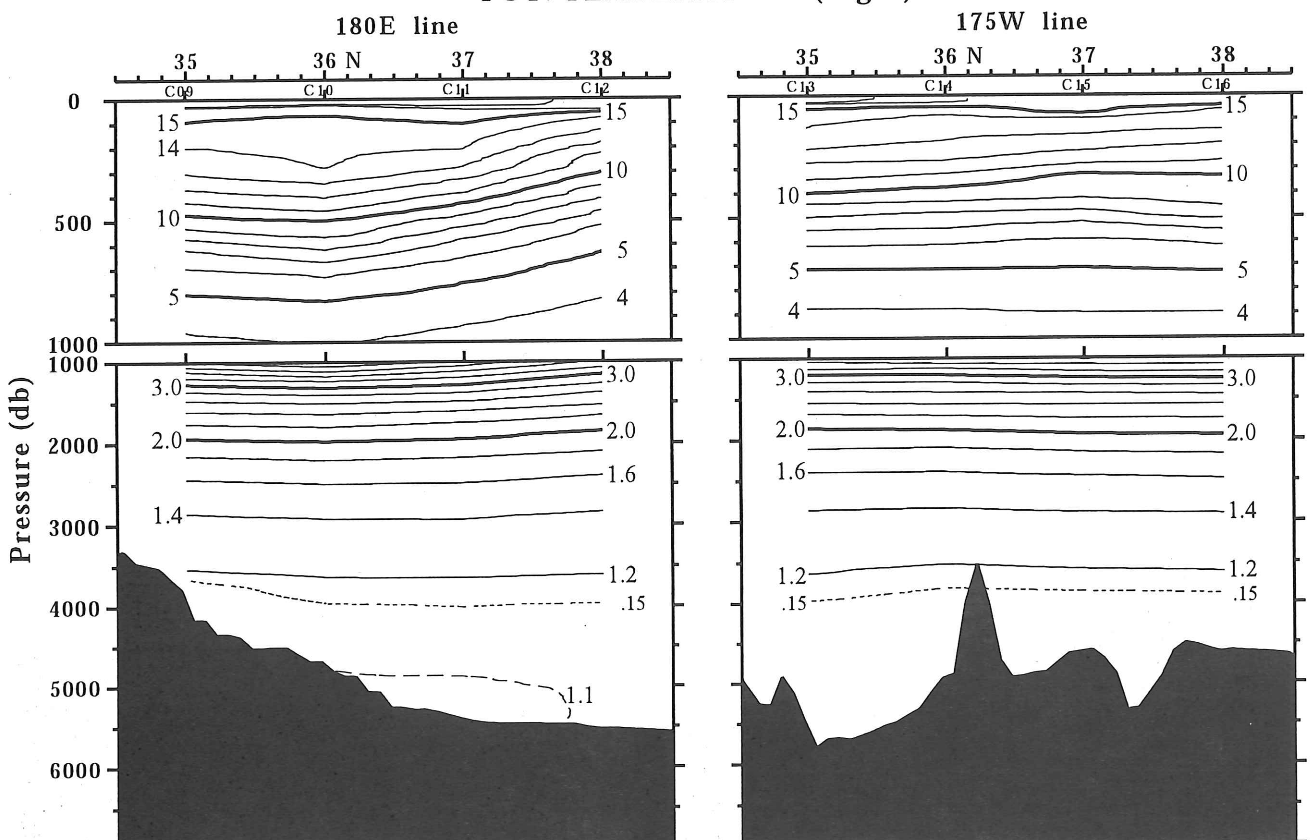
170E line



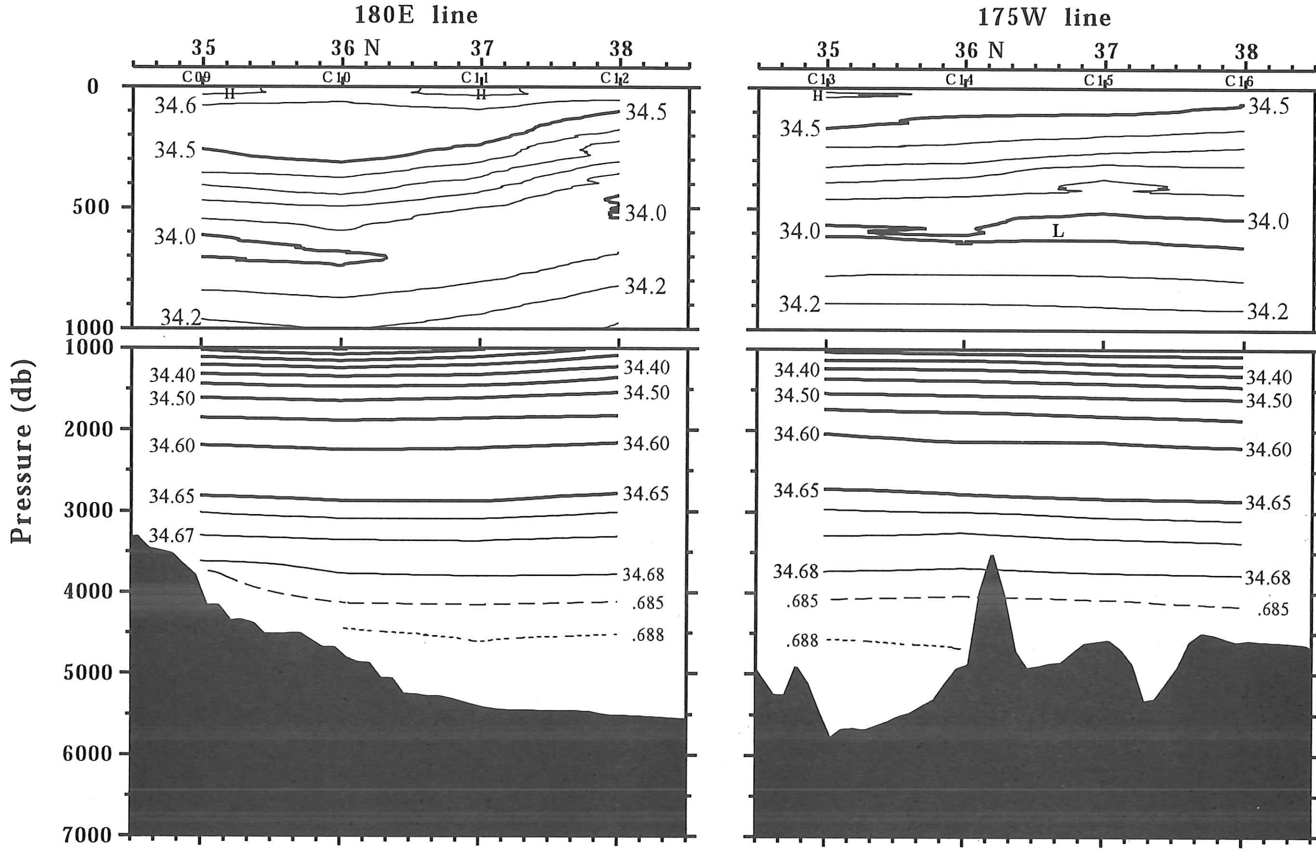
POTENTIAL DENSITY



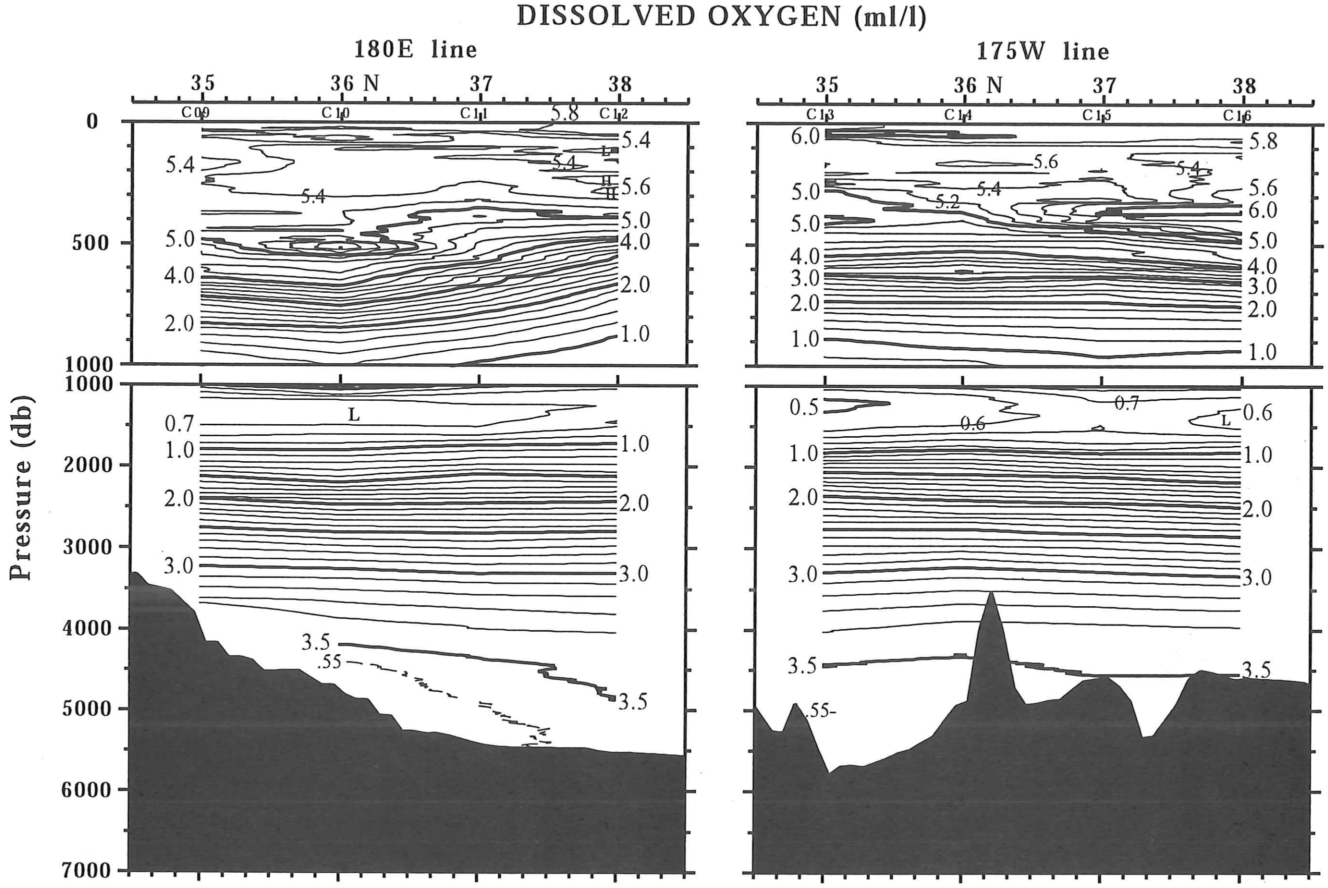
POT. TEMPERATURE (deg C)



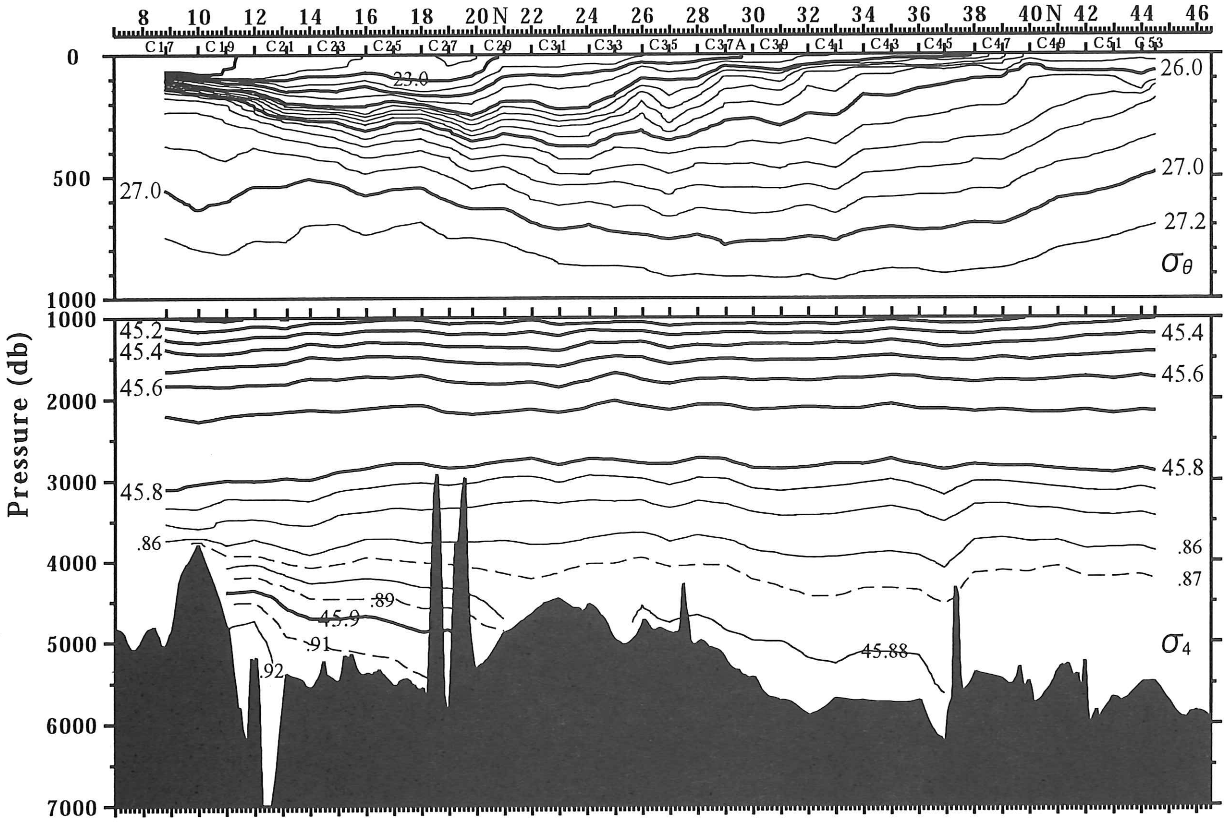
SALINITY (psu)



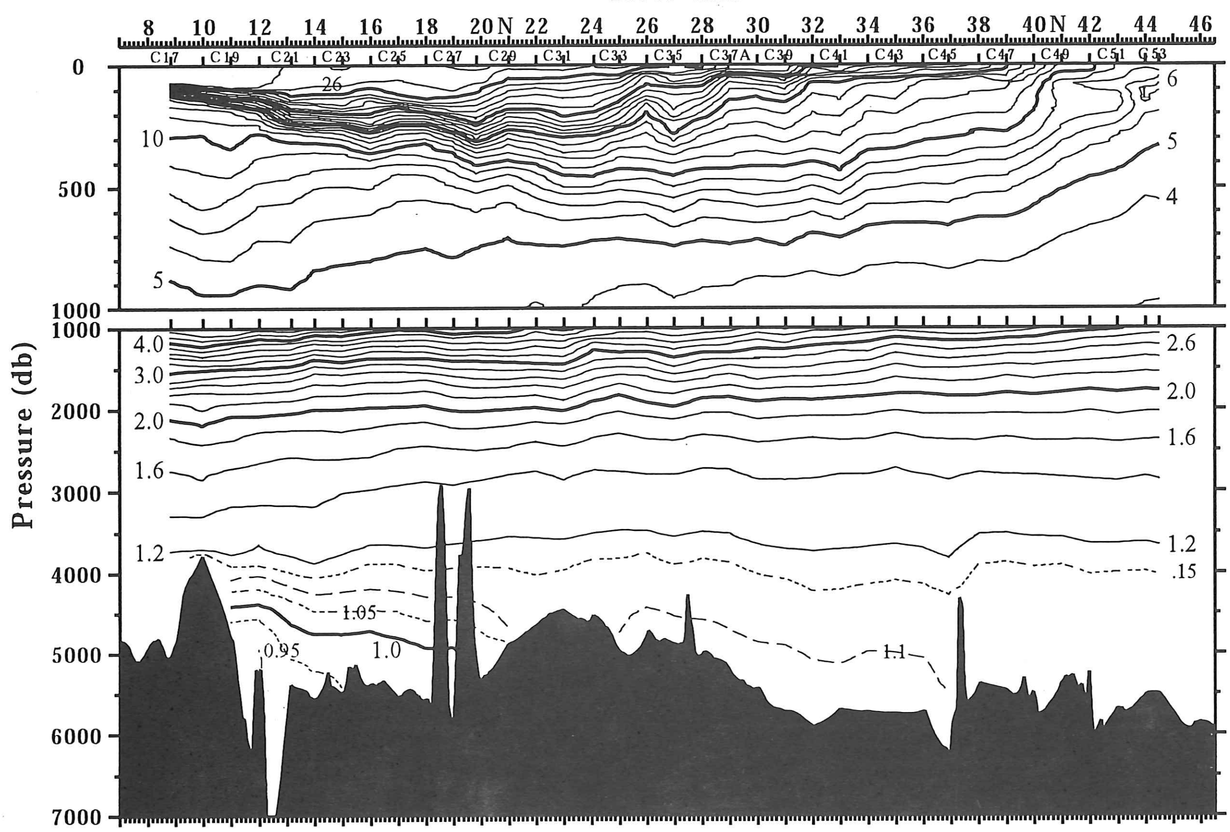
DISSOLVED OXYGEN (ml/l)



POTENTIAL DENSITY
165W line

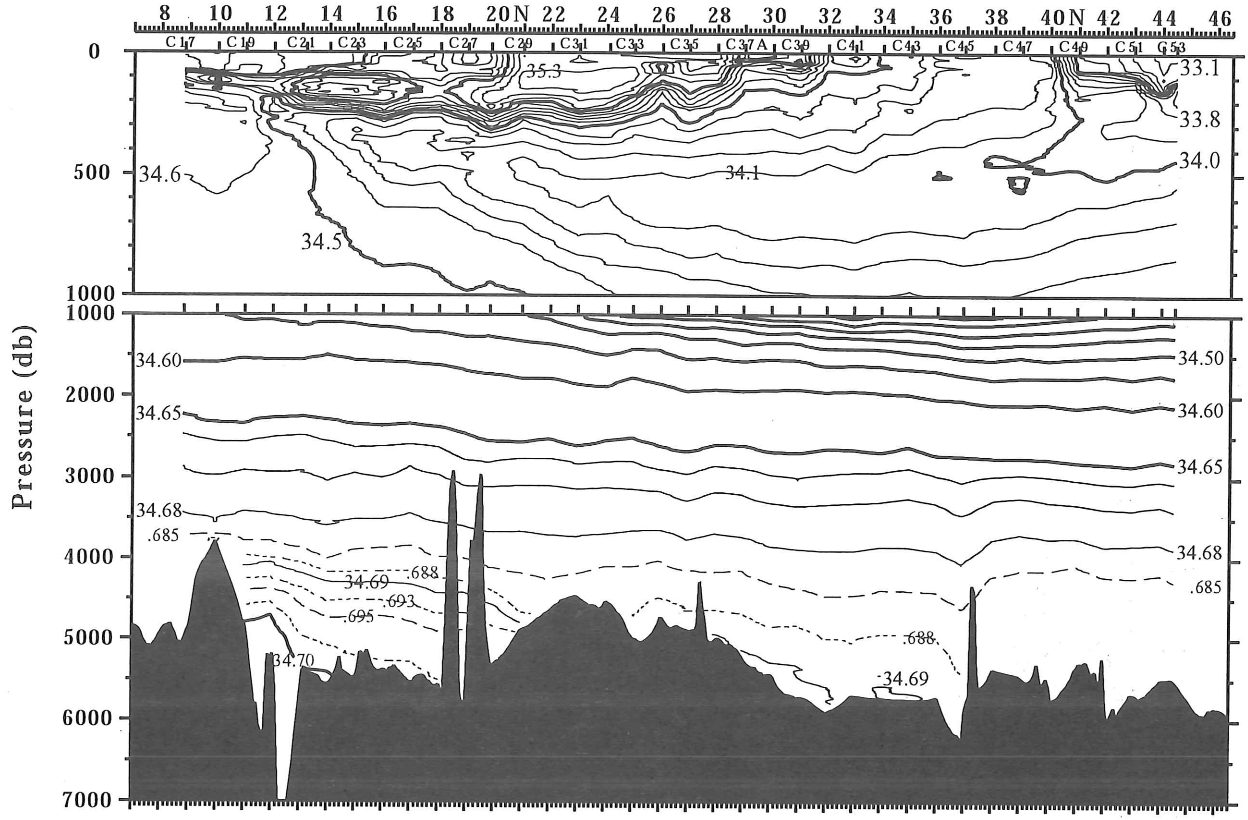


POT. TEMPERATURE (deg C)
165W line



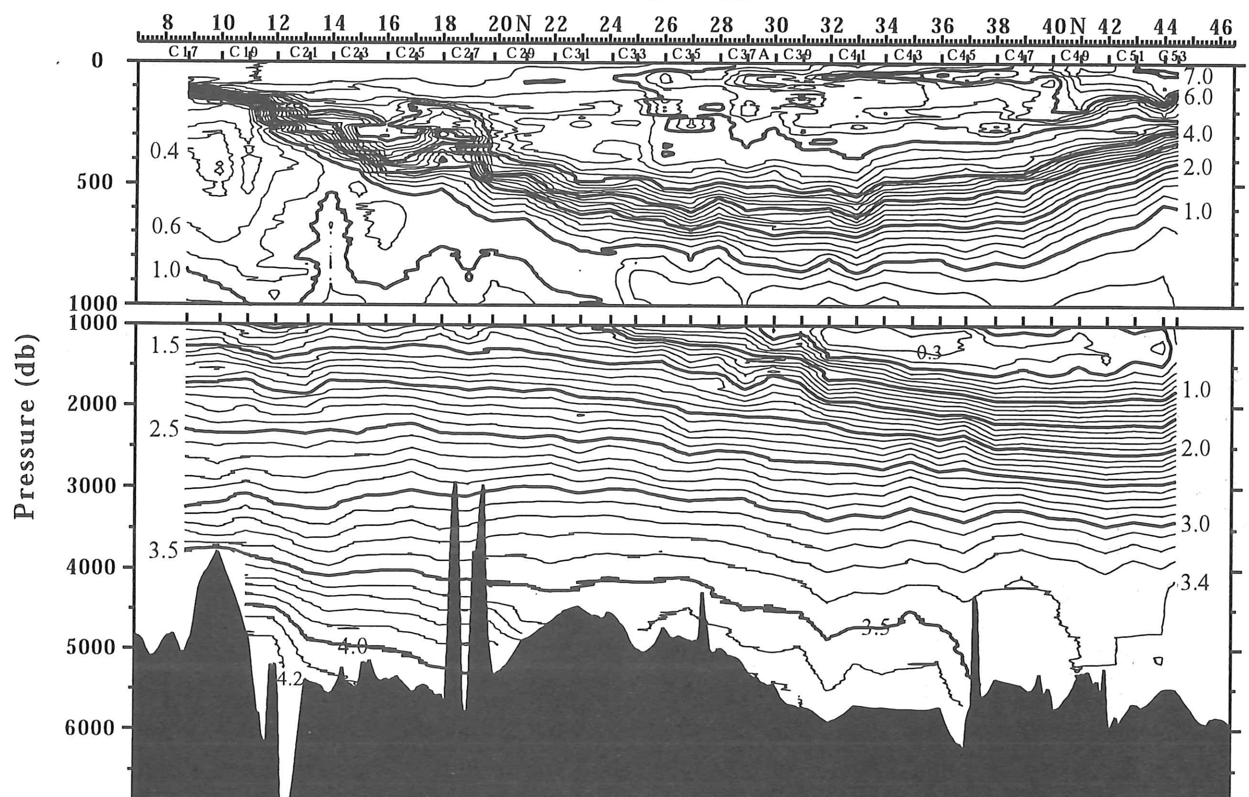
SALINITY (psu)

165W line



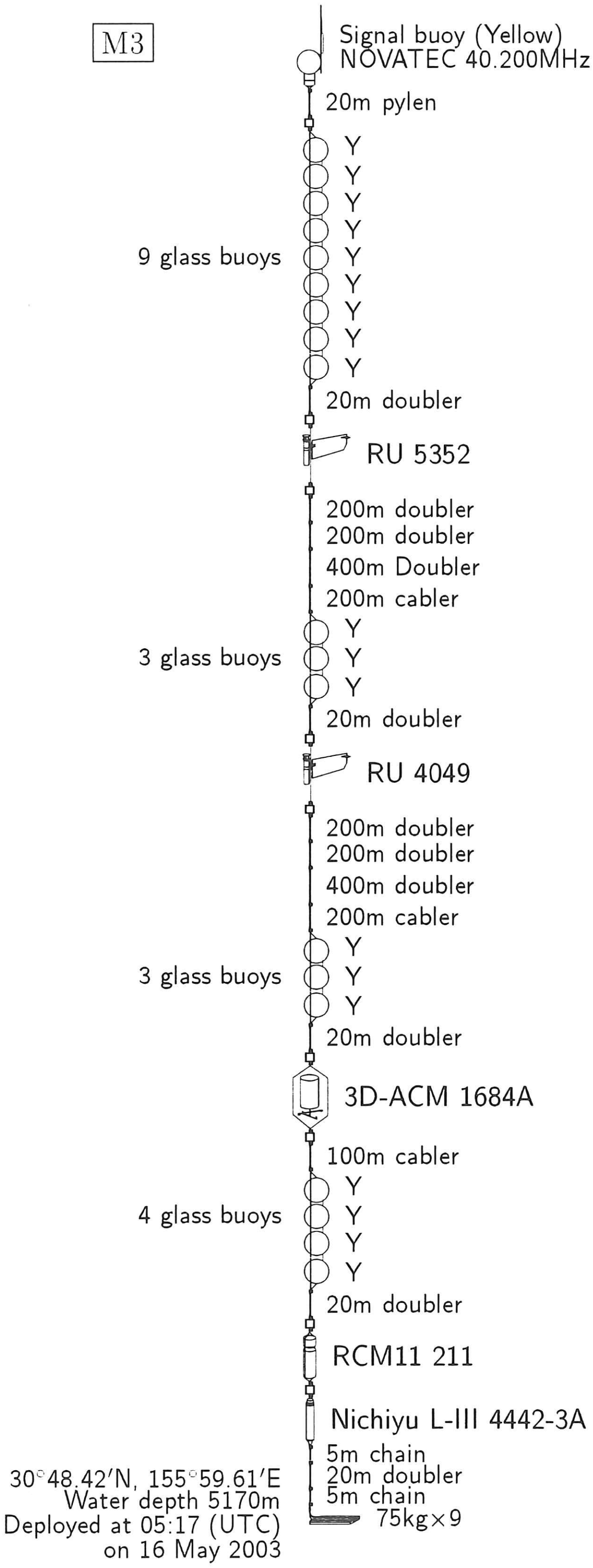
DISSOLVED OXYGEN (ml/l)

165W line



9. Mooring Systems

M3



M4