Preliminary Report of the Hakuho Maru Cruise KH-90-2

September 3 - October 25, 1990

Eastern Tropical Pacific

Ocean Research Institute
University of Tokyo

1993

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By

The Scientific Members of the Expedition

Edited by

Makoto TERAZAKI

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Contents

Introduction

There are four currents in the Central Equatorial Pacific. The primary westward-flowing surface currents are the North Equatorial Current (about 10° N), and the South Equatorial Current (about 3° S). An eastward-flowing surface current, the North Equatorial Countercurrent, extends from about 4° N to about 10° N. These latitudinal boundaries are approximate because they migrate seasonally. The Equatorial Undercurrent has its core at 100–200 m depth. The Equatorial Pacific forms a biogeographical boundary between North Pacific species and South Pacific species because of these complex current systems. The Central Equatorial Pacific is a region of high productivity because of the upwelling of nutrients. Before El Niño, we had completed the N-S transect observation along 155° W in the Central Equatorial Pacific by the old Hakuho Maru in September–October, 1969 (KH-69-4 Cruise). This expedition led to remarkable advances in the study of nitrogen metabolism, biological productivity and biogeography of bacteria, plankton, micronekton and nekton. The objectives of the Hakuho Maru KH-90-2 Cruise were to study the biological productivity, biogeochemical circulation of nitrogen and carbon, and biogeography and vertical migration of zooplankton and micronekton in order to analyze the Equatorial Pacific Ecosystem and compare with previous data to more fully understand long-term variation in this region. The cruise consisted of three legs: leg 1, from Tokyo to Suva (Fiji); leg 2, from Suva to Papeete (Tahiti) and Papeete to Honolulu. The thirty scientists, including one foreign scientist (UK), from seven universities and five governmental organizations participated in many different types of observations on board the research cruise. Observational data obtained in the cruise will contribute to the Joint Global Ocean Flux Study (JGOFS).

On behalf of all scientists aboard, I would like to express my gratitude to Captain Hideji SHIMAMUNE and all the crew of the R. V. Hakuho Maru for their cooperation.

I would like to dedicate this report to the late Professor Takahisa NEMOTO who planned and implemented the KH-90-2 Cruise enthusiastically as chief scientist.

Makoto TERAZAKI
Chief Scientist of the Cruise

List of the scientists aboard

Terazaki,	Makoto:	Chief Scientist, Ocean Research Institute, University of Tokyo
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Otobe,	Hirotaka:	Ocean Research Institute, University of Tokyo
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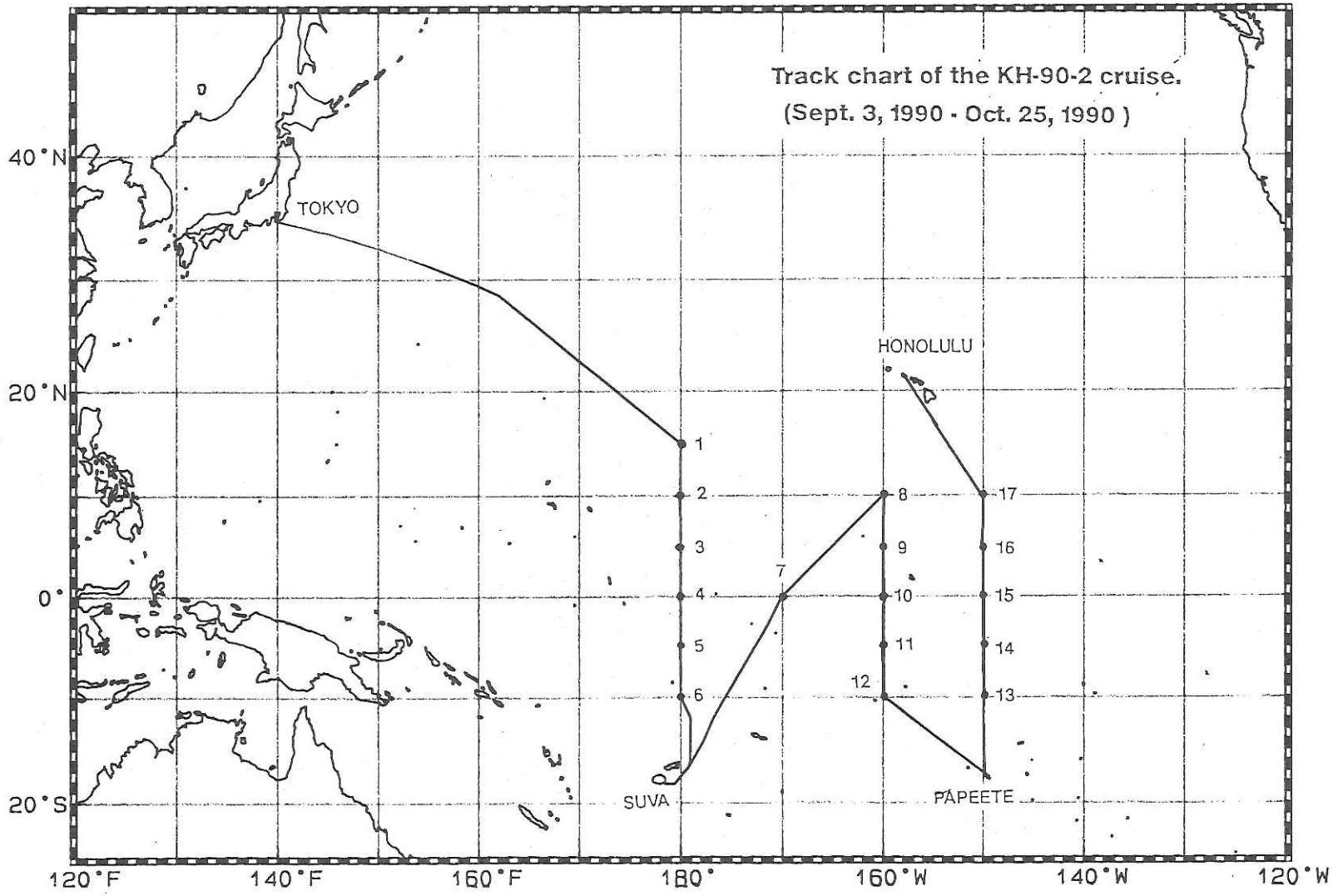
Miya,	Masaki:	Natural History Museum and Institute, Chiba
Muraoka,	Kensaku:	Kanagawa Prefectural Museum
Miller,	Axel:	Plymouth Marine Laboratory, UK


Track chart of the KH-90-2 cruise.
(Sept. 3, 1990 - Oct. 25, 1990)
TOKYO
HONOLULU
SUVA
PAPEETE
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
40°N
20°N
0°
20°S
120°F
140°F
160°F
180°
160°W
140°W
120°W

Measurements of Aerosols (RaA, RaC, Mie-particles and Condensation nuclei) and Electrical Conductivity in the Atmosphere near the Sea-surface

T. Tanji and M. Okino

1. Introduction

For ten years we have made measurements of RaA, RaC, Mie-particles, condensation nuclei and electrical conductivity in the atmosphere near the sea-surface over the Pacific Ocean to clarify the present condition of atmospheric environment. During this cruise we made measurements of those items mentioned above. Since the analysis of measuring results of Mie-particles and condensation nuclei is going on because of large numbers of data we present measuring results of radon daughters and electrical conductivity in this report.

2. Measuring methods and instruments

To make these measurements we have adopted the same method and instrument for each measuring item.

For RaA and RaC measurement we adopted a filter-pack method in which aerosols in sample air fed by suction pump are collected on a membrane filter and alpha events from radioactive aerosols on the filter are counted by a silicon semiconductor detector fitted with a multichannel pulse-height analyzer. We operated the system every four or eight hours a day during full period of the cruise. Each operation contained three counting phases, i.e. growth, decay 1 and decay 2. At the growth phase the system counted alpha events during the period of aerosol sampling on a filter. We set this phase 10,000 seconds. In two decay phases followed the growth one the system counted alpha events from aerosols on the filter after sampling. Each decay phase was set 1,000 seconds.

For Mie-particle measurement a light-scattering type particle counter was adopted. It operates automatically and counts aerosol particles in five ranges, i.e. 0.3–0.5 μm, 0.5–1.0 μm, 1.0–2.0 μm, 2.0–5.0 μm and over 5.0 μm in diameter. The system was set to count these particles every one liter of sample air and to calculate mean values of 10 counting results for each size range, generally over the open sea. The period of one counting cycle was 130 seconds.

For condensation nucleus measurement we adopted a Pollak type condensation nucleus counter. Basically this instrument consists of a pipe-shaped cloud chamber fitted with a lamp and a solar battery at one and the other ends of the chamber, respectively. It operated automatically every 78 seconds during full period of the cruise.

For measurement of atmospheric electrical conductivity a Gerdien type conductivity apparatus was adopted. Basically it consists of a cylindrical air condenser fitted with a vibrating reed electrometer. This apparatus measured alternately positive and negative conductivity at period 10 minutes, continuously during full period of the cruise.

3. Results and discussions on RaA concentration and electrical conductivity

Fig. 1 shows the cruise route and variation of ^{218}Po concentration and values of conductivity obtained during the period from 3 Sept. through 13 Dec. 1991. In the figure, the notations A, B, C, ..., Q, and A given on the abscissas are corresponded to those on cruise route and also the ordinate represents ^{218}Po concentration in x 10^{-2} Bq/m^3. Conductivities obtained on each route in fair weather are given in forms of 2.9–1.7 or 2.3 and those in bad weather are given in form (1.7), i.e. digit in parenthesis. Unit for conductivity is x 10^{-14} S/m. In the equatorial region from B to F, especially from B to E, ^{218}Po concentration showed considerable increase when the vessel approached close to islands. Concentration of ^{218}Po observed in these region seemed to be affected considerably from the islands as ^{222}Rn sources. The considerable low values of ^{218}Po concentration were found in the region from E to F, and their levels showed 0.5–2.5 x 10^{-2} Bq/m^3. These values are considered to be background level in the atmosphere over the central equatorial Pacific Ocean. Concentration of ^{218}Po showed large variation in the region from M to Q, and its fractions showed larger magnitudes and levels than those seen in the region from C to E. On this occasion it might be reasonable to see that radon and its daughters found in the atmosphere over the ocean of this region may be supplied from the many islands in various size existing along the cruise route.

In the region from 10°N–40°N and 140°E–180°E, Morita (1971) reported a mean conductivity of 2.1 x 10^{-14} S/m, Misaki et al. (1972) reported 2.5 x 10^{-14} S/m and Cobb (1973) gave the values 2.7 x 10^{-14} S/m (1915–29) and 2.2 x 10^{-14} S/m. Our values, 2.0–2.4 x 10^{-14} S/m, are somewhat higher than that of Morita and lower than that of Misaki. Although our present result seems to be similar to Morita's value, considering the properties of existing air mass, measuring conditions and other factors, the difference among these values seems to be significant.

We guess that it is surely important to know the circumstances of progressing atmospheric pollution using the results of conductivity measurements. Since we have not obtained sufficient data to make more detail discussions on the variations of conductivity at present, however, much more observation data are required. We wish to make some more measurements in the near future.

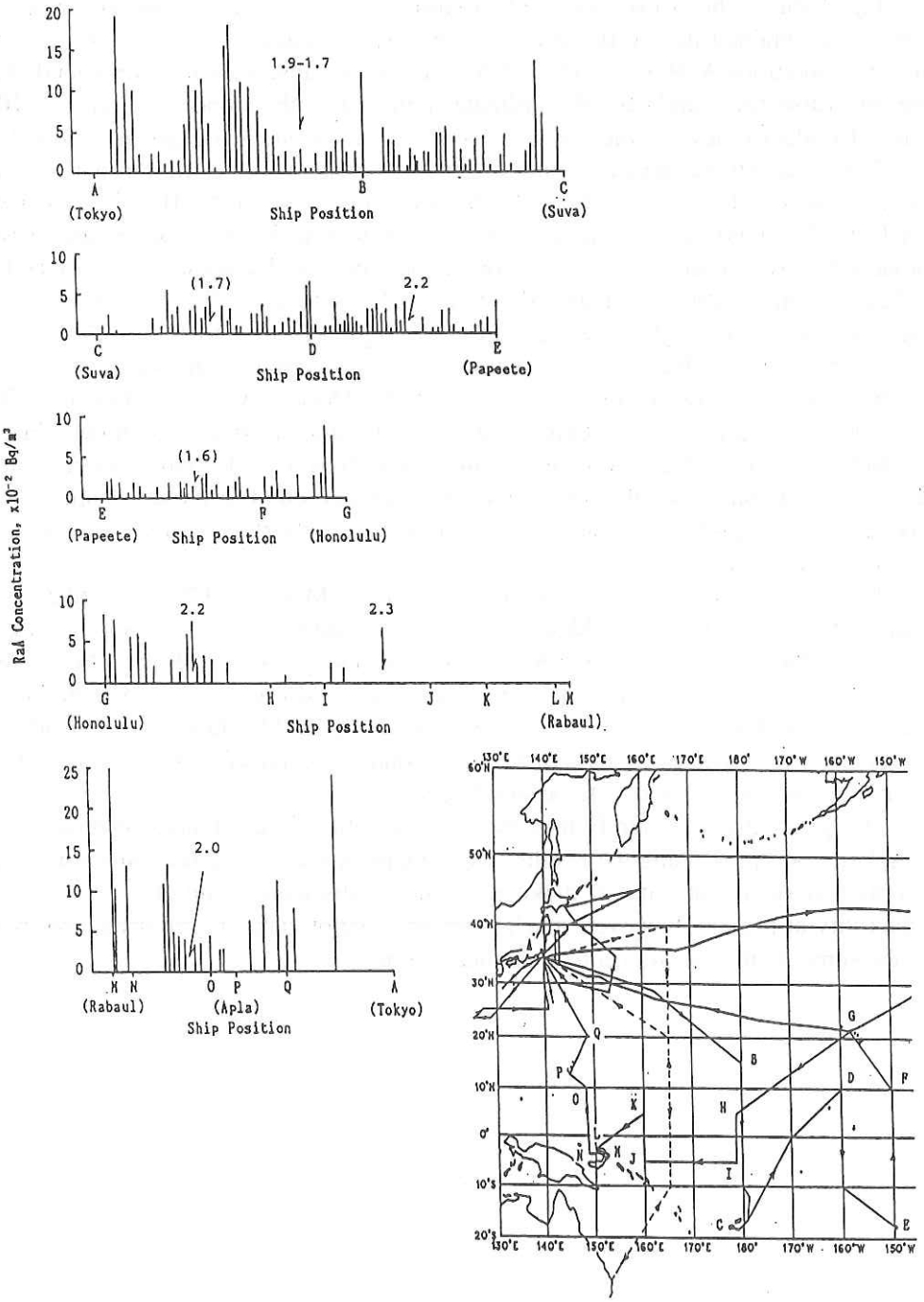


Fig. 1. Results of RaA concentration and electrical conductivity along the route of Hakuho-Maru's KH-90-2 and KH-90-3 cruises.

References

Cobb, W. E., Oceanic aerosol levels deduced from measurements of the electrical conductivity of the atmosphere, J. Atmos. Sci., **30**, 101–106, 1973

Cobb, W. E. and H. J. Wells, The electrical conductivity of oceanic air and its correlation to global atmospheric pollution, J. Atmos. Sci., **27**, 814–819, 1970

Misaki, M. and T. Takeuti, The extension of air pollution from land over ocean as revealed in the variation of atmospheric electric conductivity, J. Meteor. Soc. Japan, **48**, 263–269, 1970

Misaki, M., M. Ikegami, and I. Kanazawa, Atmospheric electrical conductivity measurement in the Pacific Ocean, exploring the background level of global pollution, J. Meteor. Soc. Japan, **50**, 497–500, 1972

Mochizuki, S., Radon and its daughters in the maritime atmosphere near Japan Islands, J. Meteor. Soc. Japan, **60**, 787–796, 1982

Mochizuki, S., T. Tanji, and M. Okino, Rn-222 and atmospheric electric conductivity in the atmosphere over the Pacific Ocean of the northern hemisphere, Res. Let. Atmos. Elect., **5**, 81–87, 1985

Morita, Y., The diurnal and latitudinal variation of electric field and electric conductivity in the atmosphere over the Pacific Ocean, J. Meteor. Soc. Japan, **49**, 56–58, 1971

Turekian, K. K., Y. Nozaki, and K. B. Larry, Geochemistry of atmospheric radon and radon products, Ann. Rev. Earth Planet Sci., **5**, 227–255, 1977

Measurements of Carbon Dioxide in the Atmosphere and in Seawater in the Central Pacific

M. Ishii and H. Y. Inoue

(1) Partial pressure of carbon dioxide in the atmosphere and in surface seawater

Continual measurements of partial pressure of carbon dioxide in the atmosphere (pCO_2(air)) and in surface seawater (pCO_2(sea)) were carried out with the automatic CO_2 analyzer (Inoue et al., 1987) throughout KH-90-2 cruise. For a pCO_2(air) measurement, a portion of air pumped continuously from the bow of the vessel was dried and introduced into the non-dispersive infrared (NDIR) analyzer. For a pCO_2(sea) measurement, seawater pumped up continuously from the bottom of the vessel was introduced into the equilibrator, where it was equilibrated with the air in a closed circuit. The seawater-equilibrated air was dried and introduced into NDIR analyzer. All measurements were conducted under ambient pressure and calibrated against four CO_2-in-air working standards (279ppm, 340ppm, 361ppm, 421ppm) which had been calibrated against the primary standard gases prepared by a gravimetric method. Values of pCO_2(sea) were corrected into account for seawater warming in inner piping by the equation given by Gordon and Jones (Gordon and Jones, 1973).

Meridional distributions of pCO_2(air) and pCO_2(sea) obtained from Leg 1 (from Tokyo to Suva) and Leg 3 (from Papeete to Honolulu) are shown in Figure 1a and 1b (preliminary data). Value of pCO_2(sea) ranged from 310 μatm to 440 μatm. In all four meridional sectors in KH-90-2 cruise, pCO_2(sea) was highly supersaturated in the equatorial region with its maximum between 0° to 6°S. Minimum values of pCO_2(sea) were observed between 10°N and 5°N where it was almost in equilibrium with the atmosphere, and south of 15°S where it was undersaturated.

In higher pCO_2(sea) regions around the equator, pCO_2(sea) increased as SST decreased, and maximum of pCO_2(sea) got higher toward the east, implying that pCO_2(sea) is remarkably dominated by the upwelling of the seawater in this region.

(2) $\delta^{13}C$ of the atmospheric CO_2

465 dm^3-flask samples of the air were collected during KH-90-2 cruise, which were brought back to our laboratory. After CO_2 concentration had been measured, CO_2 was isolated from each sample by a cryogenic distillation. $\delta^{13}C$ values were determined with a triple ion collector mass spectrometer.

$\delta^{13}C$ ranged from -7.71 ‰ to -8.80 ‰. Figure 2 shows the correlation between $\delta^{13}C$ and CO_2 concentration. Their linear correlation with the slope of about -0.06 ‰/ppm from the samples collected between 36°N and 8°N indicates that the variation of atmospheric CO_2 concentration in this region is dominated by CO_2 exchange between air and terrestrial biosphere, while indistinct correlation between 8°N and 17°S implies a relatively significant contribution from CO_2 air/sea exchange in the equatorial region.

(3) $\Delta^{14}C$ of the atmospheric CO_2

Air was introduced from upper bridge of the vessel at 10 m^3/h for 3 hours into large volume CO_2 sampler, where CO_2 in the air was thoroughly absorbed into 2N

carbonate-free sodium hydroxide solution. The sodium hydroxide solutions were brought back to our laboratory, which were treated with sulfuric acid and about 10 dm^3 of CO_2 was recovered from each sample. $\Delta^{14}C$ of the CO_2 was determined by benzene-synthesis/liquid scintillation method (The precision of the measurement was less than 5 ‰.).

Distribution of the atmospheric CO_2 $\Delta^{14}C$ over the central Pacific is shown in Figure 3. The mean value of $\Delta^{14}C$ in this region was 147 ‰, which seems a bit lower than that expected from the data obtained at Wellington, New Zealand (Manning et al., 1990).

(4) $\Delta^{14}C$ of the dissolved inorganic carbon

150 cm^3 of seawater samples were poisoned with 0.1 cm^3 of saturated $HgCl_2$ solution immediately after taken from the Niskin bottles. These samples were sealed and stored in a refrigerator. CO_2 were stripped of seawater samples in our laboratory. Their $\Delta^{14}C$ were determined with the accelerator mass spectrometer in Institute of Nuclear Sciences, New Zealand. Results are presented in Table I. $\Delta^{14}C$ of dissolved inorganic carbon in surface seawater is not in equilibrium with the atmospheric CO_2 $\Delta^{14}C$ that has been affected with the nuclear weapon tests in 1960s.

Table I. $\Delta^{14}C$ of dissolved inorganic carbon

0°, 150°W Depth/m	$\Delta^{14}C$/‰
0	$+ 79.3 \pm 7.8$
500	-110.6 ± 6.9
1501	-214.9 ± 6.2
1992	-243.5 ± 9.8

References

Gordon, L. I. and Jones, L. B. 1973. The effect of temperature on carbon dioxide partial pressure in sea water. *Mar. Chem.* 1, 317–322.

Inoue, H., Sugimura, Y. and Fushimi, K. 1987. Distribution of pCO_2 and $\delta^{13}C$ in the air and surface sea water in the western North Pacific. *Tellus* 39B, 228–242.

Manning, M. R., Lowe, D. C., Melhuish, W. H., Sparks, R. J., Wallace, G., Brenninkmeijer, C. A. M. and McGill, R. C. 1990. Theuse of radiocarbon measurements in atmospheric studies. *Radio Carbon*, 32, 37–58.

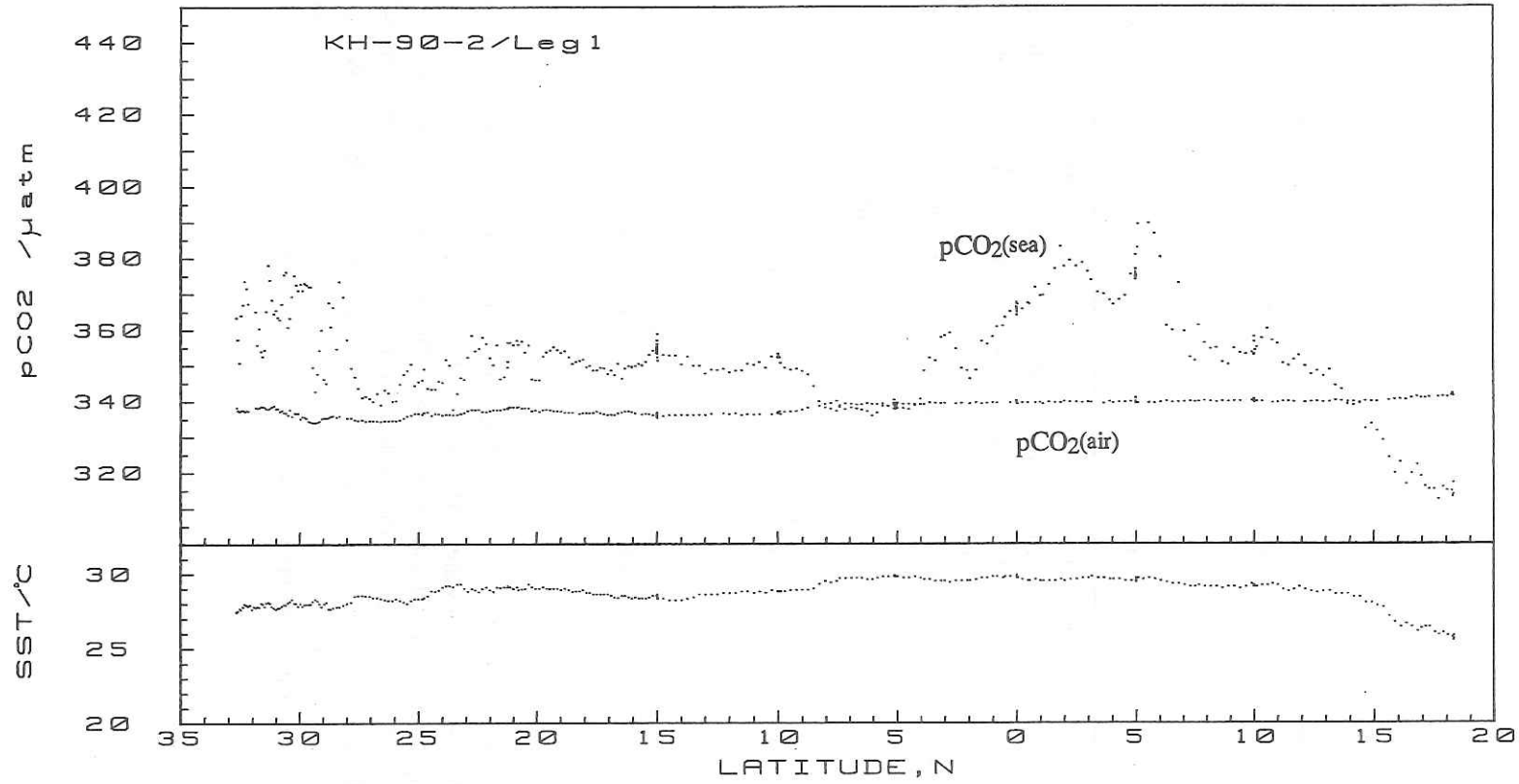


Figure 1a. Meridional distribution of $pCO_{2(air)}$ and $pCO_{2(sea)}$ obtained from KH-90-2, Leg 1 (Tokyo to Suva).

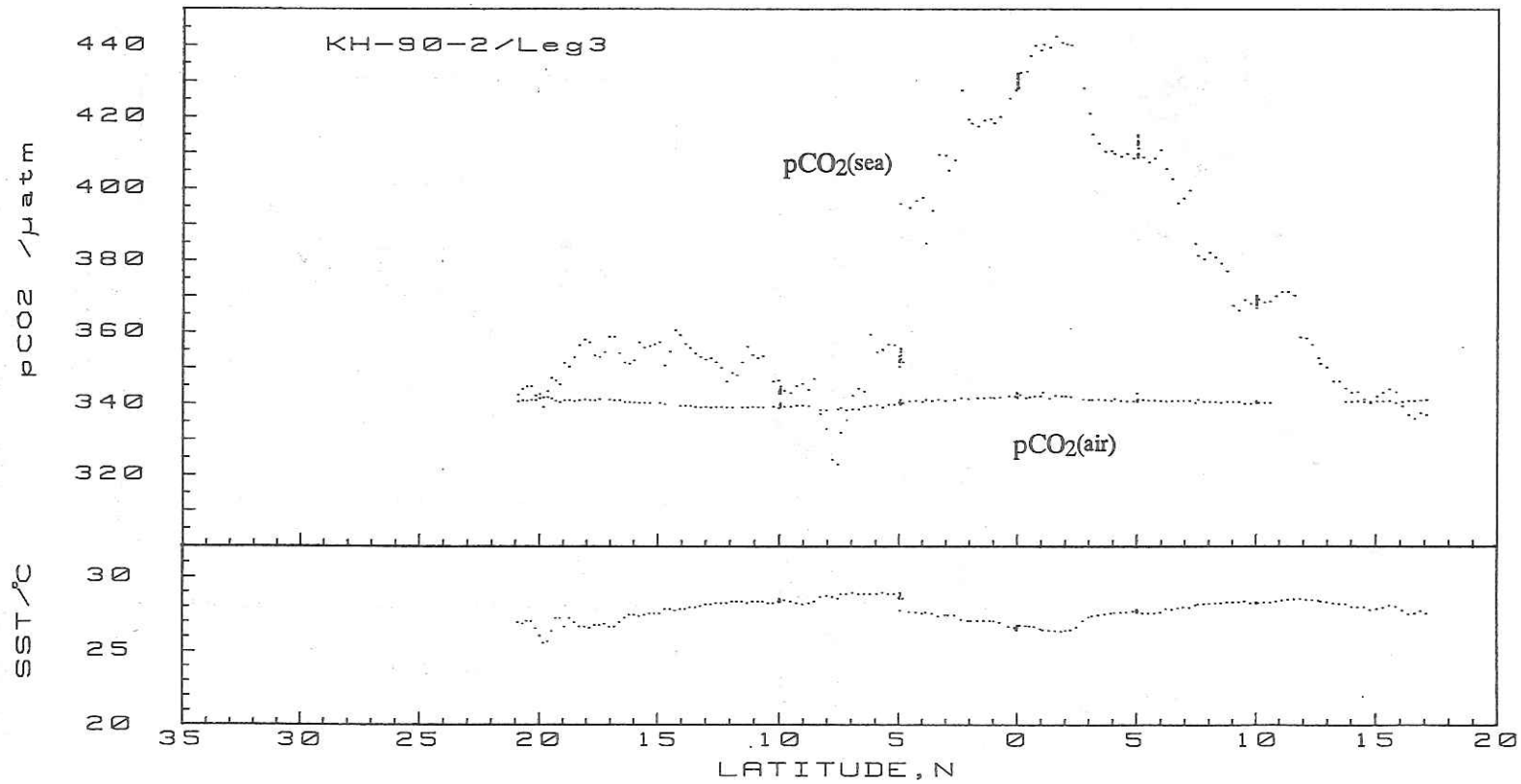


Figure 1b. Meridional distribution of $pCO_{2(air)}$ and $pCO_{2(sea)}$ obtained from KH-90-2, Leg 3 (Papeete to Honolulu).

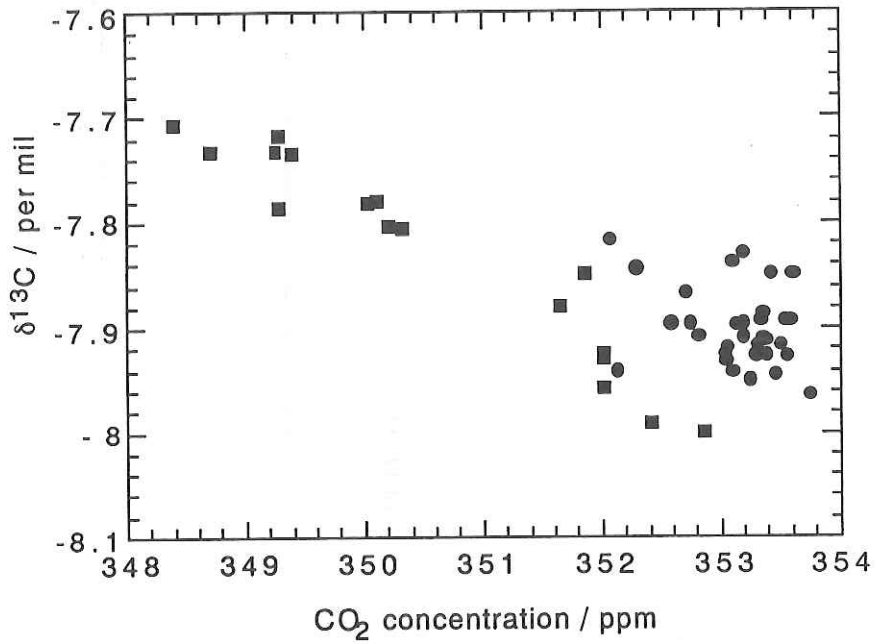


Figure 2. Correlation between $\delta^{13}C$ and CO_2 concentration in the atmosphere over thewestern and central Pacific.
■ : between 36°N and 8°N; ● : between 8°N and 17°S.

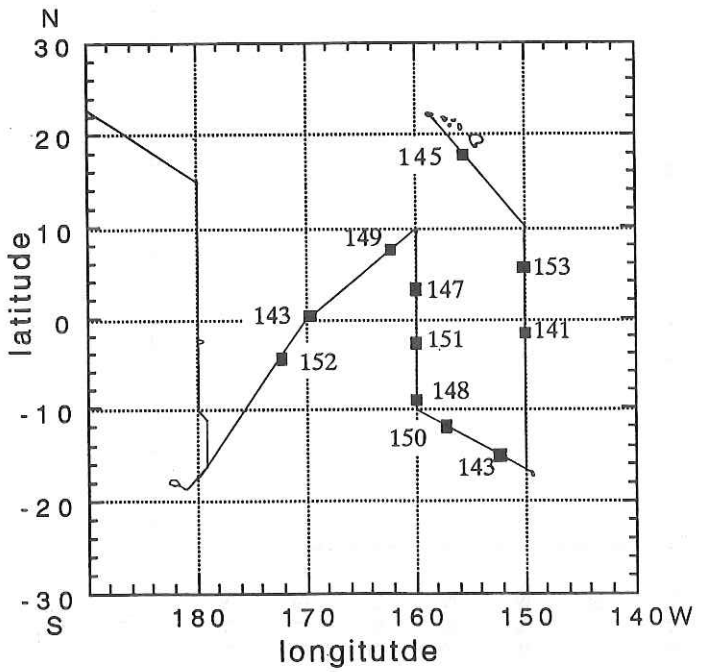


Figure 3. Distribution of the atmospheric CO_2 $\Delta^{14}C$ over the central Pacific.

Nitrogen Cycling in the Equatorial Pacific

T. Saino

Nitrogen cycling in the shallow water is predominantly mediated by biological activities of autotrophic and heterotrophic organisms. Biological processes of nitrogen transformation are accompanied with isotope fractionation to a degree depending on environmental conditions in the seawater. This study aims to understand the relationship of horizontal and vertical distributions of ^{15}N natural abundance in Particulate Organic Materials (POM) to various environmental conditions such as equatorial upwelling, horizontal zonation due to equatorial current system, and vertical gradient of irradiance and nutrients concentrations.

Following measurements were made:

1. Underway measurements of Temperature, Salinity, and In-vivo fluorescence of phytoplankton pigments.

   Surface seawater was pumped up from the ship bottom and introduced to the laboratory. The seawater was run through a Thermosalinograph (Alec Electric Co., ACT-20) and the record was logged with 1 min interval throughout the cruise.

2. Surface Current by Doppler Current Profiler

   Water current in the shallow depth was measured by an Acoustic Doppler Current Profiler (Furuno Electric Co.) which measures 3 depths at a time. Vertical profiles were obtained by a scanning mode operation; the measurement depth range (30m) was shifted with 2 minutes interval to 200m. Data were discarded when the ship speed course varied during the data aquisition.

3. Longitudinal hydrographic sections from 10°N to 10°S

   Three longitudinal hydrographic sections were made to the depth of 200m from 10°N to 10°S at 180°, 160°W and 150°W. Stations were placed after the recommendation of the JGOFS Eq. Pac. Workshop (1991). Vertical profiles of temperature, salinity, oxygen were measured by an OCTOPUS system (Ishimaru et al. 1984). Water samples for determinations of nutrients (nitrate, nitrite, ammonium, silicate, phosphate), chlorophyll a, and dissolved oxygen were also collected with a Rosette sampler of the OCTOPUS system.

   Nutrients were detemined on a Technicon Autoanalyser II following the method of the previous cruises of the Biochemistry Laboratory (Hattori 1986). Care was taken to run samples without delay from the sample collection. Chlorophyll a was determined fluorometrically on a Turner Design Fluorometer by the method of Suzuki and Ishimaru (1991). Dissolved oxygen was measured by the Winker's method (Carpenter 1966) using an automatic Titrator (Hirama Rika Co.,

ART3). Salinity of the water in the deepest bottle of each hydrocast was measured on an salinometer (Guildline, AutoSal.). The salinity and oxygen data of the CTD (Neil Brown, markIII) were calibrated against the bottle data.

4. Natural abundances of ^{15}N and ^{13}C in particulate organic materials (POM) from the surface of the Equatorial Pacific

Surface seawater pumped up from the ship bottom and prescreened by a 300um mesh was filtered through a Whatman GF/F filter. Approximtely 20 liter of the sample water was filtered with a filter. An air filter was attached to the air intake of the sample container to exclude contamination by air dust. A filter after filtration was rinsed with particle (>0.2μ) free salt water (3.5% NaCl). Filter samples were stored frozen (–80°C)) until analyses.

5. Natural abundance of ^{15}N in nitrate and POM from shallow wters of the Equatorial Pacific

Water samples were collected with 23-1 Niskin samplers from depths of 0, 30, 50, 100, 200, 300 and 500m at each regular station of legs 2 and 3. A 2.5 liter aliquot of filtered (GF/F) seawater was stored in a glass bottle with addition of HCl (6N, 5ml) at room temperature. ^{15}N abundance of nitrate was measured by a Mass Spectrometer (Hitachi RMU6E) following a newly developed procedure (Saino and Ohtsu, unpublished). Nitrate concentration as low as 1.5μM was measured successfully by the procedure.

POM samples were processed in the same way as stated in 4.

6. Vertical flux of particles at the Equatorial Pacific

Sediment trap experiment was made at a station (160W, Equator). An array of 10 sediment traps was deployed with a free drifting buoy to a depth of 500m for 24 hours. Paired conical traps were placed at 5 depths (55, 105, 190, 305, 505m) and sets of 8 cylindrical (65 mm x 700 mm) traps were placed at 5 depths (50, 100, 185, 300 and 500m).

Samples were distributed for opal and calcite (Noriki, Hokkaido University), POC/PON (Saino), amino acids and pigments (Montani, Kagawa Univ.) analyses and for microscopic inspection (Kuwata, University of Tokyo).

7. ^{14}C natural abundance of POM in the middepth water of the Equatorial Pacific

POM samples were collected from 0, 200 and 500m depths at stations 1, 7, 8, 10, 15, and 17 to measure its ^{14}C natural abundance. Approximately 400 liter of seawater was gravimetrically filtered with a GF/F filter. Sample container was rinsed with Milli-Q water before the sampling, and a Millipore HA filter was placed at the air intake of the container. Filter with sample residue was rinsed with particle (>0.2μ) free salt water (3.5% NaCl) and detatched from the filter holder in a clean room, and stored frozen.

Studies on Optical Characteristics and Sea Surface Temperature for the Photosynthetic Environment of Oceanic Phytoplankton

M. Kishino

Light energy penetrating into the sea diminishes almost exponentially with depth accompanying a drastic change of the energy spectrum as the results of absorption by various components such as phytoplankton, the other living and non-living particles, dissolved matter and the water itself in the sea. Such a change in light environment will directly affect the living life of phytoplankton.

Sea surface temperature distribution obtained from infrared satellite images will supply one of useful information on the dynamic events occurring in the sea, such as current, upwelling, warm core ring, frontal structure and/or eddy. These various dynamic events in the sea could also give some positive influences on the living life of phytoplankton.

In the present study, therefore, the following observations were carried out during the cruise.

Measurements of underwater spectral irradiance

Underwater downward and upward spectral irradiances were measured by a portable underwater irradiance meter. The design of the original instrument has been described by Kishino et al. (1984) (MER-1000 multichannel irradiance meter). The photodetectors are 16 separate silicon diodes and each of the diodes was covered with an interference filter having a wavelength of maximum transmittance at 402.4, 418.8, 438.5, 455.9, 473.3, 496.6, 516.2, 535.1, 554.8, 578.9, 595.3, 614.7, 633.8, 650.6, 677.7, or 694.5 nm with typical band width of 10 nm. The meter is rapidly scanned (about 10ms to scan entire spectrum), and several measurements were averaged at each depth. The instrument was calibrated with a 1000 W quartz-halogen irradiance standard lamp supplied by the National Bureau of Standard, USA, immediately before the cruise.

Measurements were conducted at Stns. 1, 5, 6, 7, 10,11, 13, 14, 16, and 17. An example of the downward spectral irradiances obtained at Stn. 16 was shown in Fig. 1. The maximum transmittance wavelength at 68.2m is about 490 nm and half band width is about 100 nm.

Measurements of optical properties of seawater

Absorption and total attenuation coefficients of seawater were measured against distilled water for reference by the opal glass method using a Shimadzu MPS-2000 (Okami et al., 1983). Seawater samples were collected with a Van Dorn sampler.

Surface temperature distribution by the NOAA/AVHRR satellite images in the Equatorial region

Original satellite data were received by the NOAA receiving system on the RV Hakuho-Maru. The original data will be processed for geometric distortion and radiometric corrections. Then, sea surface temperature of each image and mean values

of sea surface temperature will be estimated.

Reference

Kishino, M., C. R. Booth and N. Okami (1984): Underwater radiant energy absorbed by phytoplankton, detritus, dissolved organic matter, and pure water. Limnol. Oceanogr., **29**: 340–349.

Okami, N., M. Kishino, S. Sugihara, N. Takematsu and S. Unoki (1983): Analysis of ocean color spectra (III). Measurements of optical properties of sea water. J. Oceanogr. Soc. Japan, **38**: 362–372.

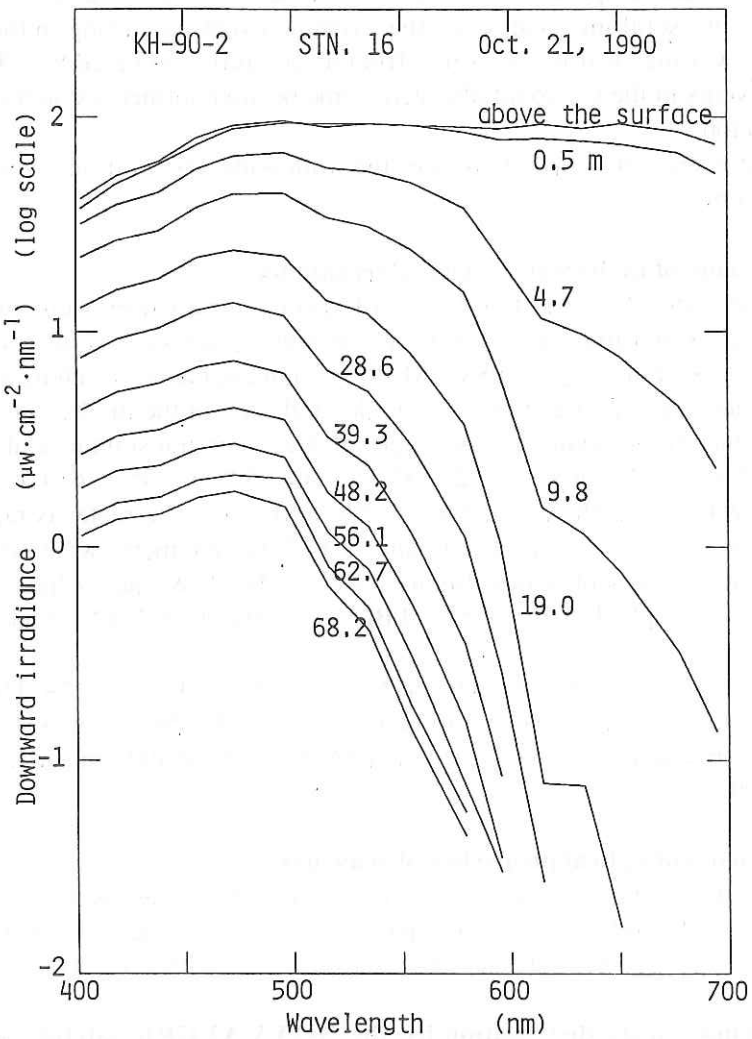


Fig. 1 Spectral distribution of downward irradiance at Stn. 16.

Primary Productivity in the Central Tropical Pacific

K. Furuya and K. Takahashi

Photosynthetic activity experiments and related observations were made in the central tropical Pacific, where a prominent upwelling produced a horizontal gradient of surface nitrate with eastward increase and polar ward decrease. Along the transect 12 stations were occupied, which distributed in well-stratified waters (Stns. 1, 2, 3 & 4), upwelled waters (Stns. 10, 11, 13, 14 & 15) and intermediate waters (Stns. 7, 8 & 9). Close attention was paid to avoid possible contamination of toxic and/or biologically active substances during sample-handling procedures. Seawater samples for photosynthesis measurements were collected with acid-rinsed Go-Flo bottles attached on a Kevlar rope, and treated according to "clean method." The following investigations were carried out.

I) Photosynthetic activity as a function of irradiance.

Photosynthesis vs. irradiance curves were determined for phytoplankton collected from three to six depths above 0.1% light level. Uptake of ^{14}C-labeled bicarbonate was measured under white and blue (peak wavelength, 480 nm) light with light gradient boxes (Lewis & Smith, 1983).

II) Simulated *in situ* measurements of primary productivity

Time courses of primary production were followed for 48 hours by an *in vitro* change in dissolved oxygen. DO was titrated after the Winkler method with an improved end-point detector fitted with microdispenser. Compositions of autotrophs and suspended particles were monitored with a flow cytometer during the incubations.

III) Time series observations of nutrient profiles and abundance of phyto- and zooplankton.

Nutrient profiles, abundance and composition of phyto- and zooplankton were determined for 26 hours at four-hours intervals during tracking of a drifting buoy at Stn. 11. The upper 200-m water column was sampled by Niskin bottles (25 depths) and a multiple layer open-close net (VMPS net). Hydrographic conditions and underwater light fields were monitored by OCTOPUS casts (Ishimaru *et al.*, 1984). *In situ* profiles of primary productivity was measured by DO change. This survey was carried out in cooperation with Dr. A. Tsuda of Ocean Research Institute, University of Tokyo.

Reference

Ishimaru, T., H. Otobe, T. Saino, H. Hasumoto & T. Nakai (1984): OCTOPUS, an octo parameter underwater sensor, for use in biological oceanography studies. J. Oceanogr. Soc. Japan, **40**: 207–212.

Lewis, M. R. & J. R. Smith (1983): A small volume, short incubation-time method for measurement of photosynthesis as a function of incident irradiance. Mar. Ecol. Progr. Ser., **13**: 99-102.

Characteristics of Population Structure and the Light Utilization Efficiency of the Surface and the Subsurface Phytoplankton in the Equatorial Upwelling Areas

M. Takahashi and M. Kishino

It has been widely recognized that the growth of planktonic algae is mainly limited by nutrients near the surface and by solar radiation near the bottom of the euphotic zone in the well stratified water column in the ocean. From the eastern to the central parts of the equatorial area, there occurs upwelling which could enhance nutrient supply into the shallow depths. Upwelling could also transfer phytoplankton cells from the deeper depths to the shallower depths and *vice versa*, which could minimize possible vertical differences of phytoplankton cells to the use of solar radiant energy. The present study was focussed on evaluating whether there is any differences developed in the population structure of planktonic algae with depths in the water column, and whether there is any differences developed vertically in the light harvesting and photosynthetic activity of the phytoplankton in the equatorial upwelling area.

For the experiments, the surface and the subsurface phytoplankton populations were collected from 10m and a depth ranging from 60m to 80m, respectively by Van Dorn bottles at Stns. 8, 9, 10, 11, 13, 14, 15 and 16. An aliquot of the water sample was filtered through Whatman GF/F glass fiber filter, and analyzed the photosynthetic pigments (chlorophylls, carotenoids and phycobiliproteins). Chlorophyll *a* and pheopigments were determined by the fluorometry after extraction of N,N-dimethylformamide according to Suzuki and Ishimaru (1990). Chlorophylls and carotenoids were separated by using a HPLC and determined the concentrations photometrically. Phycobiliproteins were extracted with phosphate buffer (pH=7.2) by grinding and sonication with a help of enzyme digestion, and determined the concentrations by the fluorometry. Photosynthetic pigment composition was used for the evaluation of population structure of planktonic algae as well as the biomass indicator for photosynthetic rates. Photosynthetic rate was determined in the laboratory by the 14C tracer method at the *in situ* temperatures. Daylight type fluorescent tubes were used for the light source (white), and the highest intensity obtained was about 2,000 $uE.m^{-2}.s^{-1}$. Red (600nm<), green (ca 550nm) and blue (ca 450nm) colors were separated using filters (Fuji film), and were used for the light sources as well. Initial slope of the photosynthesis-light curve was obtained for four different colors of light, and the P_{max} was obtained for the white light. Light absorption characteristics of planktonic algae were determined by the method by Kishino *et al.* (1985) using a MPS spectrophotometer (Shimazu). Radiation field in the water column was measured by an underwater spectro-radiometer.

No major differences of the population structure based upon photosynthetic pigments were noticed between the 10m and the subsurface populations, although there was distinct differences in the initial slope of the photosynthesis-light curves between them. The subsurface population had a steeper slope with low P_{max} compared with the 10m population. Entire euphotic zone had a very small temperature difference about 1°C over 100m, which suggested there was a vertical mixing of water but weak and

slightly dosrupted by water heating by solar radiation through the surface.

Photosynthetic pigment separation and determinations were done by Ms. R. Suzuki of the Ocean Research Institute and Dr. T. Ishimaru of the Tokyo University of Fisheries.

Kishino, M., M. Takahashi, N. Okami and S. Ichimura 1985. Estimation of the spectral absorption coefficients of phytoplankton in the sea. Bull. Mar. Sci. 37:634-642.

Suzuki, R. and T. Ishimaru 1990. An improved method for the determination of phytoplankton chlorophyll using N, N-dimethylformamide. J. Oceanogr. Soc. Japan 46:190–194.

Ecology of Diatoms in the Tropical Oceanic Waters

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Previous observational studies have revealed that many diatom species are always recognized in the tropical and subtropical waters in extremely small population size compared to the other planktonic algae and in highly stable population structure (Venrick 1990). On the other hand, diatoms have well been known often to be dominant and to develop large population size with great fluctuations as well as their great changes in the population structure in temperate and high latitude waters (Harris 1986). Depending upon many past studies carried out nutrient rich areas, diatoms are believed to have rapid growth responses to high nutrient concentrations and to be predominant in nutrient rich waters (Margalef 1978). Therefore the differences of diatom biomass between low latitudes and high latitudes may be explained by the differences in the nutrient concentrations of the environments. However recent studies showed that diatom population was still kept small even under high nutrient environment of the tropical upwelling region (Chaves 1989). This finding suggests that tropical oceanic diatoms might have different responses to the nutrient environment compared to those of high latitude species. Very little is still known about the response characteristics of diatoms to nutrients found in tropical and subtropical waters.

In this cruise, we attempted to evaluate the following four points of the tropical and subtropical oceanic diatoms as the first step to understand their life in the habitat; geographical distribution, cell viability, photosynthetic activity, and growth responses to nutrient enrichment.

Geographical distribution

For the determination of geographical distribution of diatom species, water samples of 10 to 20 liter were collected with Van Dorn or Niskin bottles at various discrete depths between 0 and 200m at Stns. 1, 2, 3, 4 and 5. The water samples were then concentrated by filtration through 10um plankton netting, and fixed with glutaraldehyde (2.5% v/v) for cell counting by the settling chamber method using an inverted microscope (Utermohl 1958).

For the determination of relative abundances of different sized phytoplankton, water samples were collected by Van Dorn bottles at 10m and at a subsurface depths varying from 70 to 110m at Stns. 7, 8 and 9, were separated by filtration through 10um Nitex netting, lum Nuclepore polycarbonate filter and Whatman GF/F glass fiber filters. Each fraction was then determined the chlorophyll *a* concentration by the fluorometric method after the extraction with dimethylformamide (Strickland and Parsons 1972).

Viability and photosynthetic activity of natural diatom cells

Viability of natural diatom cells was assessed by histological staining method using neutral red for vacuole and DAPI for DNA and by chlorophyll auto-fluorescence. Neutral red is a vital stain absorbed by living cells and accumulated in vacuole. Water samples of 40 to 100 liter were collected by Van Dorn bottles from 10m and a subsur-

face depth from 70 to 110m at Stns. 7, 8, 9, 11 and 14, and concentrated large cells through 10um and 100um Nitex nettings. Aliquots of the concentrated water sample were used for the neutral red staining and the determination of photosynthetic activity immediately after the concentration procedure. The rest of the concentrated sample was fixed with glutaraldehyde (2.5% v/v) for DAPI staining, for chlorophyll fluorescence, and cell counting.

Photosynthetic activity was determined by the ^{14}C method (Strickland and Parsons 1972). Each concentrated water sample was diluted with the filtered seawater of the same origin and incubated at light intensities varying from 0 to 1500 $uE.m^{-2}s^{-1}$ for 1 or 2 hours at the temperature where the original water sample was taken.

Growth responses of diatoms to nutrient enrichment

For the determination of nutrient responses of the tropical oceanic diatom cells, their growth responses to enriched nutrients were examined by bottle culture experiments. Water samples of 50 to 100 liter were collected by Van Dorn bottles at 10m or a bucket at the surface at Stns. 12 and 14, and put in a pair of 10 or 20 liter polycarbonate carboys. One of culture was enriched with the f/2 medium (final concentration; f/200) or only silicic acid, and the other was treated as control. The bottles were then incubated under the sun in a bath continuously supplied with surface water on the deck for 4 days. During the incubation, 3 liter of water was removed periodically from each culture bottle. Two liter of the sample was used for cell counting of diatoms after concentration by the reverse filtration through 10um Nitex netting, and the concentrated sample was fixed with glutaraldehyde (2.5% v/v). The rest of water sample was used for the size fractionation for the determination of chlorophyll *a* by the method mentioned above, and for nutrients analysis by the colorimetry using an autoanalyzer (Strickland and Parsons 1972).

References

Chavez, F. P. 1989. Size distribution of phytoplankton in the central and eastern tropical Pacific. Global Biogeochem. Cycles, 3:27–35.

Harris, G. P. 1986. Phytoplankton ecology. Chapman and Hall, London, pp. 384.

Margalef, R. 1978. Life-form of phytoplankton as survival alternatives in an unstable environment. Oceanologica Acta, 1:493–509.

Strickland, J. D. H. and T. R. Parsons 1972. A practical handbook of seawater analysis. Fish. Res. Bd. Can. Bull., No. 167, pp. 310

Venrick, E. L. 1990. Phytoplankton in an oligotrophic ocean: species structure and interannual variability. Ecology 71: 1547–1563.

Silicoflagellete Assemblages in the Central Equatorial Pacific

S. Nishida and M. Kumon

During the Hakuho-Maru KH-90-2 cruise, 18 series of vertical silicoflagellete samples were collected in the central Equatorial Pacific. Sampling stations are listed in Table 1. At each station water samples were taken from 0, 10, 30, 50, 60, 70, 80, 90, 100, 110, 120, 130, 150, 175, 200 meter in depth with Niskin-type water samplers and a part of the samples were presented for routine analysis. Quantitative silicoflagellete samples were prepared by filtration using a 0.8μm pore-size filters on the board, dried at room temperature and stored in a plastic case. Present silicoflagellete results were fully linked with the oceanographic data of KH-90-2 cruise.

On a shore laboratory a dried filterared sample was cut out in 10 by 10 millimeter square and mounted on a slide glass with immersion oil for microscopic observation. This was then identified and counted under a light microscope. Normally silicoflagellete taxonomy is based on its siliceous skelton morphology. Under a light microscope, silicoflagellete specimen was identified. Numbers of each species in a unit area of sample were counted. This was then calculated to a unit volume of water, usually adopted fora liter of water sample. In the present samples two genera and six species of silicoflagelletes were found and maximum population was attained to about 170 individuals in a liter of water. Identified silicoflagellete taxa were presented in Figure 2 and their occurrences were shown in Table 2.

Vertical silicoflagellete community structures in the three meridian sections were shown in the Figure 1. In the study, four characteristic silicoflagellete assemblages were assigned. They were *Dictyocha messanensis* assemblage A, *Distephanus pulchra* assemblage, *Distephanus messanensis* assemblage B and *Dictyocha mandrei* assemblage. Results showed that, *Dictyocha messanensis* assemblage A occupied the superior position in the southern Equatorial current which was accompanied with *Distephanus messanensis* forma *spinosa*. *Distephanus pulchra* assemblage characterized a predominant group in the northern margin of an upwelling current area of the Equatorial countercurrent. It showed further that, *Distephanus messanensis* assemblage B was found in the Equatorial undercurrent. *Dictyocha mandrei* assemblage was restricted in the northern Equatorial current.

Table 1. List of stations

Station No.	Latitude	Longitude	Date	Sampling Time (GMT)	Surface water temperature
1	14° 58.8' N	179° 57.6' E	1990-09-10, 11	22:07-02:10	28.39° C
2	9° 59.0' N	179° 59.0' E	1990-09-12	08:31-11:21	28.80° C
3	5° 07.1' N	179° 59.8' E	1990-09-13, 14	21:33-01:06	29.92° C
4	0° 01.2' N	179° 53.5' E	1990-09-15	06:47-09:27	29.92° C
5	5° 00.2' S	179° 57.7' E	1990-09-16	19:58-23:25	29.46° C
7	0° 01.7' S	170° 01.2' W	1990-09-28	00:48-04:26	28.47° C
OCT-T	7° 13.1' N	162° 47.1' W	1990-09-30	21:05-21:25	30.20° C
8	10° 05.3' N	160° 00.9' W	1990-10-01	18:04-23:57	28.63° C
9	5° 01.6' N	160° 02.4' W	1990-10-03	04:36-08:10	28.97° C
10	0° 02.3' N	160° 01.1' W	1990-10-04	20:08-23:15	27.69° C
11	5° 01.0' S	160° 01.0' W	1990-10-06	12:43-15:34	27.96° C
12	10° 01.0' S	160° 01.9' W	1990-10-09	02:13-05:09	28.46° C
13	10° 00.8' S	149° 57.9' W	1990-10-17	09:26-12:19	28.40° C
14	5° 01.5' S	150° 00.6' W	1990-10-18	18:27-21:08	27.80° C
15	0° 01.4' S	149° 58.5' W	1990-10-20	04:50-07:29	26,60° C
16	4° 59.5' N	150° 02.1' W	1990-10-21	15:46-18:25	28.80° C
17	9° 59.0' N	150° 00.6' W	1990-10-23	00:01-03:05	28.70° C

Table 2. Silicoflagellate abundance in the central Equatorial Pacific.
Pesented in numbers of individuals per liter of sea water.

Station	Species	Depth (m)															
		0	10	30	50	60	70	80	90	100	110	120	130	150	175	200
1	Dictyocha messanensis	3	5	8	55	33	20	30	33	38	35	23	55	43	23	8
	D. mandrai	-	-	-	-	-	5	8	3	3	8	-	18	8	8	-
	D. sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
2	Dictyocha messanensis	-	-	3	8	5	20	-	23	23	-	10	3	5	5	8
	Distephanus pulchra	-	-	-	-	-	-	-	-	85	25	68	10	3	10	5
3	Dictyocha messanensis	60	46	60	42	46	59	145	134	163	153	21	19	31	126	80
	D. mess. forma spinosa	-	-	-	-	-	-	-	-	-	6	2	-	-	-	-
	Distephanus pulchra	-	-	-	-	-	-	-	-	-	29	4	2	10	2	6
4	Dictyocha messanensis	10	15	19	21	46	6	15	8	6	10	13	10	17	61	40
5	Dictyocha messanensis	43	21	31	19	8	17	13	36	17	10	10	15	25	48	48
	D. sp.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
7	Dictyocha messanensis	23	29	34	19	25	21	10	8	10	6	15	6	23	48	34
	D. mess. forma spinosa	-	-	2	-	-	2	-	-	-	4	2	2	-	6	-
OCT-T	Dictyocha messanensis	10	-	10	13		15	37	16	11	9		8	16	27	32
	Distephanus pulchra	-	-	-	-		-	-	34	57	53		37	75	55	30
8	Dictyocha messanensis	5	2	17	34	86	48	10	8	15	29	29	21	40	54	19
	Distephanus pulchra	-	-	-	-	-	15	23	44	38	37	23	48	17	21	4
	Ds. sp.	-	-	-	-	-	-	-	-	-	4	-	4	-	-	-
9	Dictyocha messanensis	10	9	7	-	9	16	5	7	11	14	9	9	9	5	2
	D. mess. forma spinosa	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-
	Distephanus pulchra	-	-	-	-	-	-	-	-	2	7	7	9	-	-	-
10	Dictyocha messanensis	64	41	43	54	25	20	20	21	5	5	2	-	7	9	46
	D. mess. forma spinosa	14	2	7	12	2	5	5	2	2	2	-	-	-	-	2
	Distephanus pulchra	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
11	Dictyocha messanensis	18	9	50	50	23	28	14	11	20	7	7	18	18	21	23
	D. mess. forma spinosa	-	2	-	-	2	2	2	-	5	-	-	-	-	2	-
	D. sp.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
12	Dictyocha messanensis	21	29	29	19	23	13	8	6	13	6	19	2	15	4	6
13	Dictyocha messanensis	19	21	10	4	10	17	10	10	15	10	8	6	2	6	6
14	Dictyocha messanensis	80	54	46	31	48	27	46	27	27	27	17	15	55	36	23
	D. mess. forma spinosa	-	-	-	-	-	-	-	-	-	-	-	4	2	-	-
	Distephanus pulchra	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
15	Dictyocha messanensis	48	48	38	15	21	10	4	11	2	2	10	4	13	15	50
	D. mess. forma spinosa	2	-	-	4	-	-	-	2	-	-	-	-	-	4	2
	Distephanus pulchra	-	-	-	-	-	-	-	-	-	2	-	2	2	-	-
16	Dictyocha messanensis	15	13	8	-	6	10	4	10	8	10	8	2	6	13	10
	Distephanus pulchra	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-
17	Dictyocha messanensis	2	4	2	6	10	2	17	2	10	4	4	-	21	8	2
	Distephanus pulchra	-	-	-	-	-	-	-	2	2	2	2	-	4	-	-

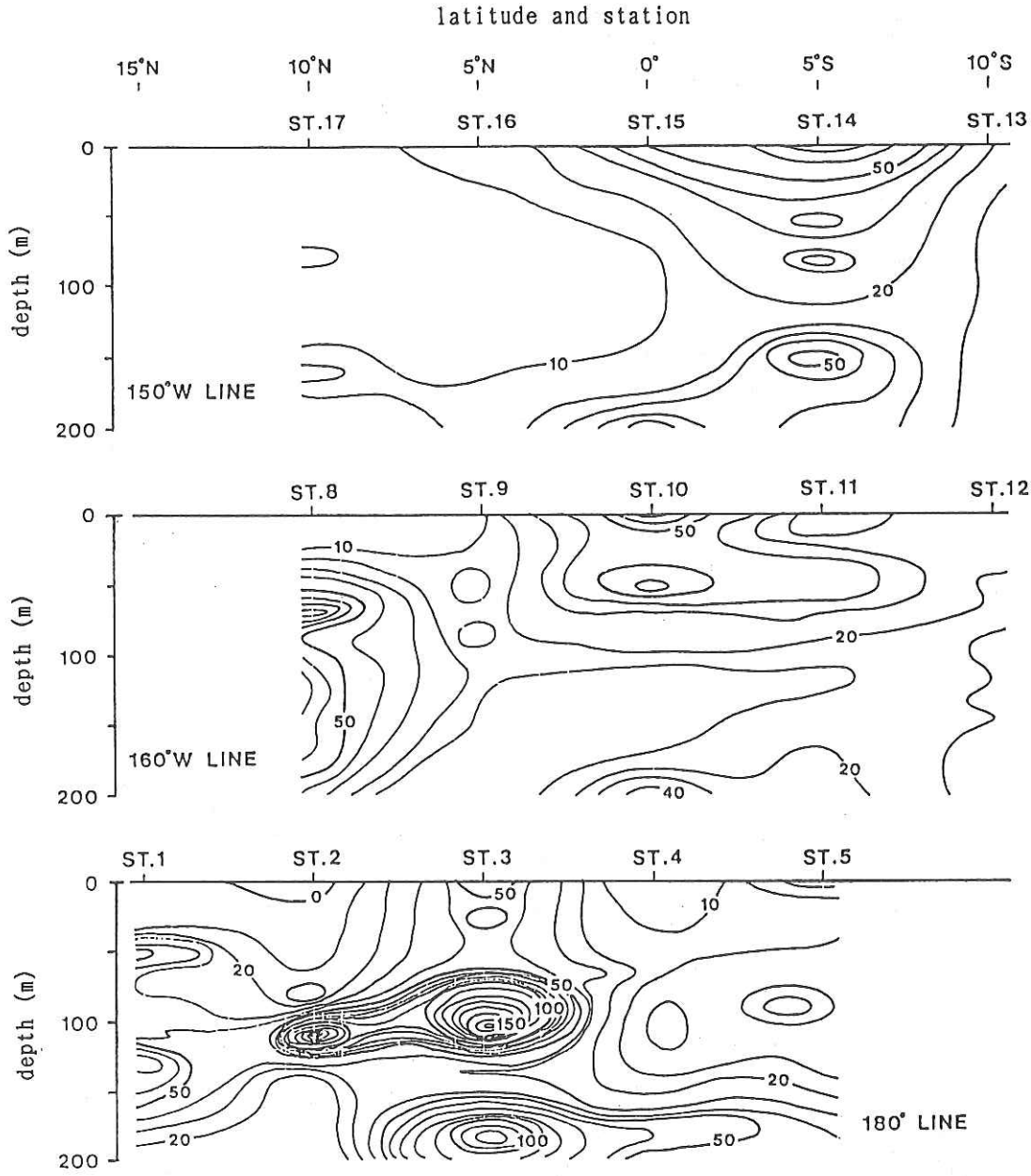


Figure 1. Silicoflagellete distribution in vertical sections in the Equatorial Pacific. Numbers in the figure indicate silicoflagellete abundance per liter of sea water.

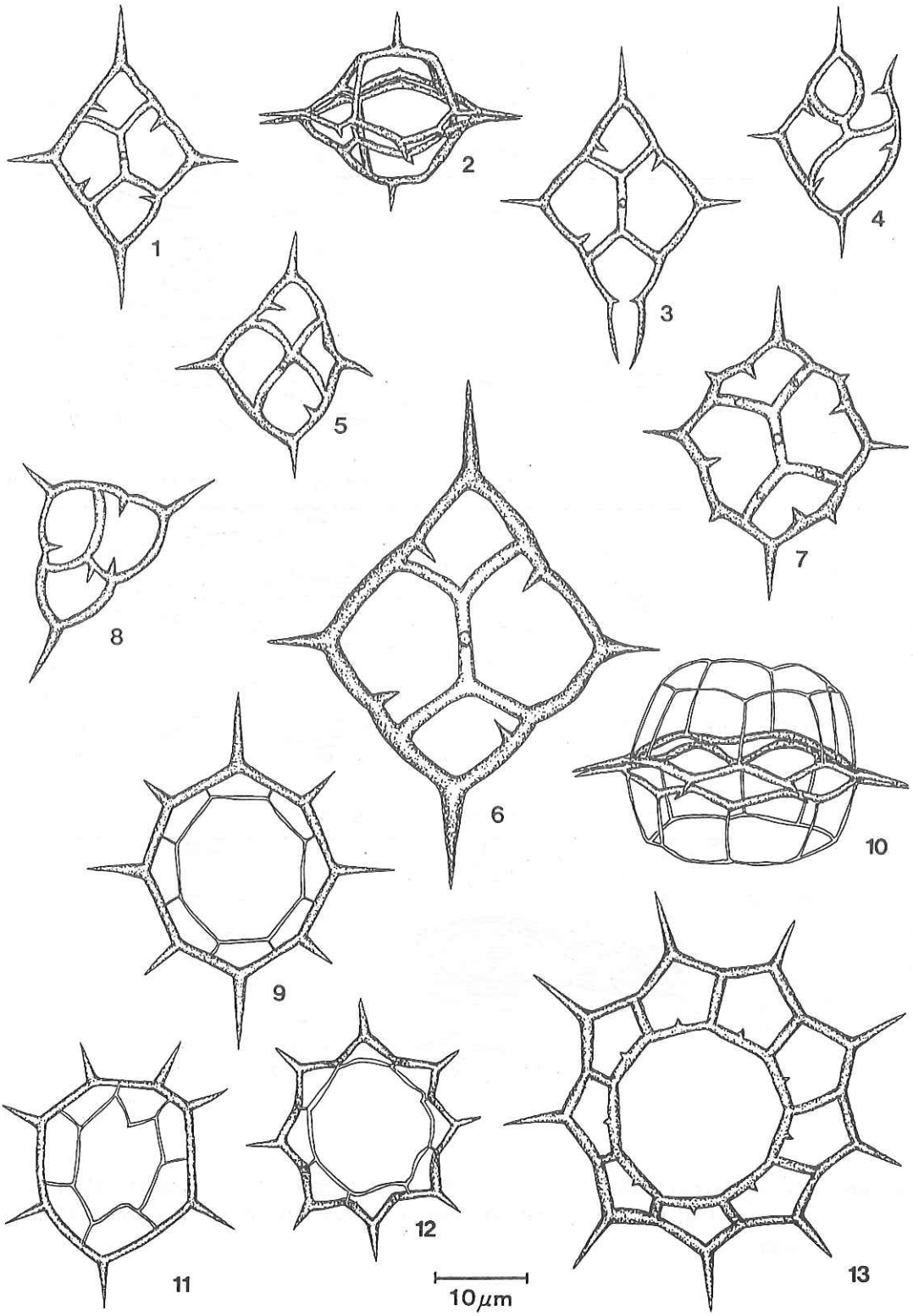

1
2
3
4
5
6
7
8
9
10
11
12
13
10μm

Figure 2. Modern silicoflagelletes in the central Equatorial Pacific

1–5: *Dictyocha messanensis* Haeckel

1 A normal skelton; KH-90-2-St. 1/175m

2 Double skelton; KH-90-2-St. 9/70m

3 An aberrant skelton with variation of basal ring; KH-90-2-St. 9/130m

4 An aberrant skelton with variation of basal and apical structures; KH-90-2-St. 11/30m

5 An aberrant skelton with variation of basal ring and reduced apical bar; KH-90-2-St. 4/150m

6: *Dictyocha messanensis* forma *spinosa* Lemmermann

A normal skelton; KH-90-2-St. 10/10m

7: *Dictyocha mandrai* Ling

A normal skelton; KH-90-2-St. 1/80m

8: *Dictyocha* sp.

A normal skelton; KH-90-2-St. 1/150m

9–12: *Distephanus pulchra* (Schiller) Ling and Takahashi

9 A normal skelton; KH-90-2-St. 2/120m

10 Double skelton; KH-90-2-OCT-T/175m

11 A seven-sided variant; KH-90-2-St. 2/100m

12 An aberrant skelton with variation of basal ring; KH-90-2-St. 9/130m

13: *Distephanus* sp.

A normal skelton; KH-90-2-St. 8/110m

Taxonomical and Ecological Studies of Brachyuran Larvae

K. Muraoka

The purpose of this work is to investigate classification and zoogeographical distribution of brachyuran larvae in the Central Equatorial Pacific Ocean. The samples were collected by the various kinds of nets, ORI net, MTD net and IKMT-EMPS (Isaacs-Kidd Midwater Trawl with Electric Multi-layer Plankton Samplers) net during research cruise of Hakuho Maru KH-90-2 from September 3 to October 27, 1990. The samples caught with these nets were preserved immediately in 5 % buffered formalin sea water after collection. The brachyuran larvae were sorted out from the samples.

The specific name and the number of specimens for each larvae are listed in Table 1. The larvae obtained from each station were mainly classified into three families, Portunidae, Xanthidae and Grapsidae.

It is very interesting that the megalopae obtained from St. 10 were especially large-sized specimens in the carapace (Fig 1, D & D'). The size of carapace is 8.5 mm in length including rostral spine and 4.5 mm in width. The total length including the abdomen is about 13.5 mm. This is the largest megalopa that I have ever collected larvae of Subsection Brachyrhyncha. In the features, the dorsal surface of carapace is smooth and naked. The rostrum is horizontally projecting forward and triangular in shape. In thoracic sternum, the last segment is armed with a pair of flat spines on the posterolateral border. The cheliped is rather robust. Ambulatory legs are very slender. In the fourth ambulatory leg, the dactylus is elongate oval in outline. The megalopa is very similar to kind of the family Portunidae in the general outline. Furthermore, it seems that the species belongs to the genus *Charybdis* in the features of appendages.

In general, the crabs of most kinds belong to this genus inhabit the shallow sea bottom of sand or sandy mud near the coast, however, present larvae were obtained from the open sea far from land. This is very interesting subject for inquiry from the stand-point of the dispersal of species which inhabit the shallow sea bottom.

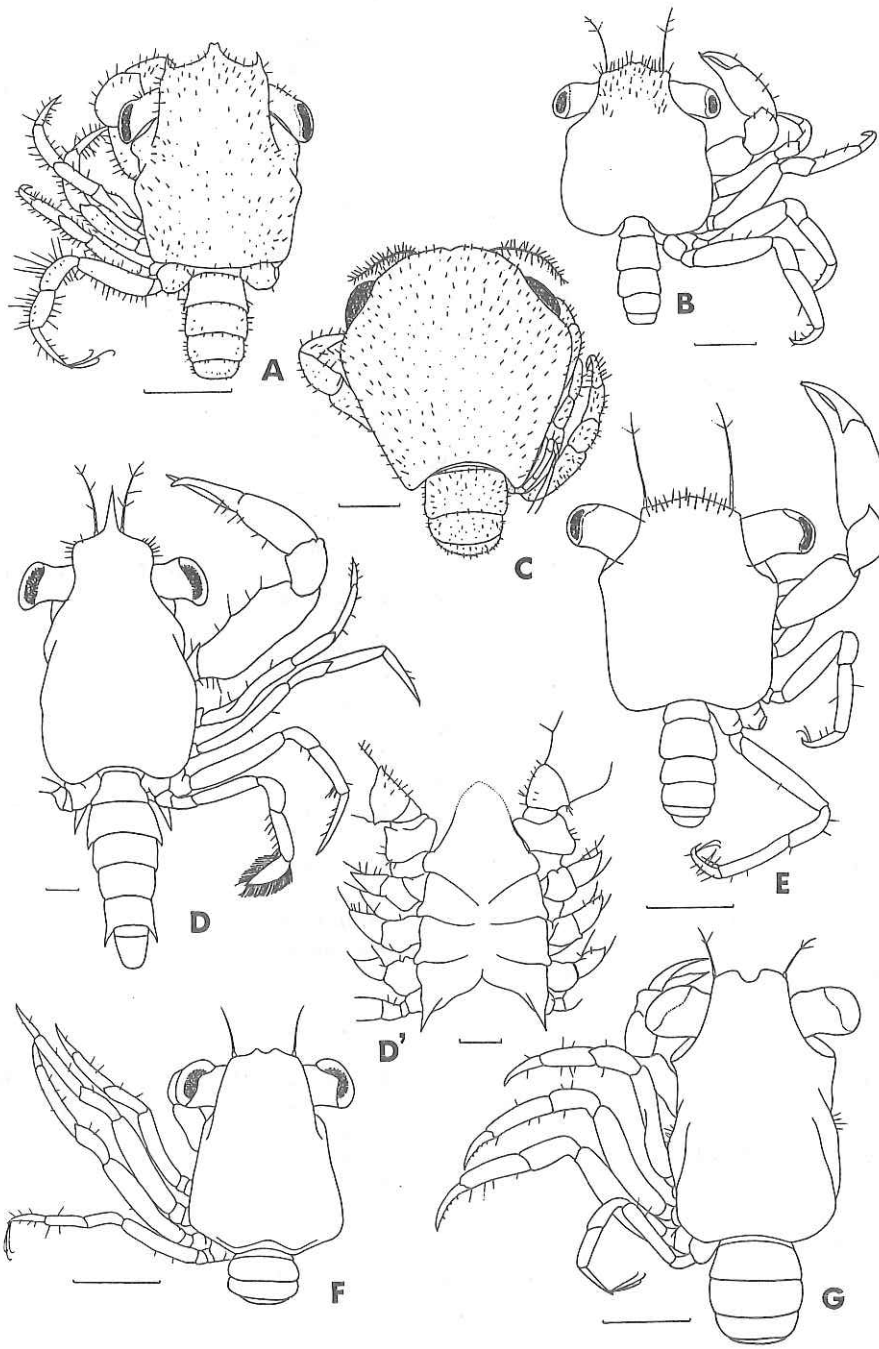
Table 1. Brachyuran larvae collected by nets of various kinds during KH-90-2 Cruise

St.	Date	Ship Time	Position		Species	No.	Net
3	09/14	02:14–02:24	05–04.4	N	Portunidae	2	S
			179–59.0	E	Xanthidae	1	
4	09/15	17:20–18:32	00–00.3	N	Portunidae	1	O
			179–57.6	E	Xanthidae	1	
4	09/15	23:00–23:20	00–01.2	N	Portunidae	1	M
			179–54.3	E	Xanthidae	1	
Su	09/22	21:30–21:50			*Portunus* sp.	1	K
					Sesarma sp.	1	
7	09/27	20:29–20:44	00–02.8	S	*Planes* sp.	1	S
			169–57.2	W			
7	09/28	02:18–03:02	00–05.4	S	Grapsidae	1	M
			170–03.7	W			
7	09/28	09:38–10:45	00–08.3	S	*Trapezia* sp. (Fig. E)	1	M
			170–03.7	W			
9	10/02	21:27–21:42	05–01.9	N	*Dynomene* sp. (Fig. C)	1	S
			160–02.5	W	*Myra* sp.	1	
					Portudidae	1	
9	10/02	21:22–22:39	05–02.0	N	*Portunus* sp.	2	O
			160–02.6	W	*Grapsus* sp. (Fig. B)	1	
9	10/02	23:40–02:52	05–02.7	N	*Percnon* sp.	1	I
			160–01.3	W			
9	10/03	01:22–01:32	04–58.2	N	*Pilumnus* sp.	5	S
			160–01.7	W	*Pilumnus* sp. (Fig. A)	2	
					Grapsus sp.	1	
10	10/04	13:16–16:22	00–01.0	N	*Charybdis?* sp. (Fig. D)	14	I
			159–58.5	W	Portunidae	1	
					Xanthidae	2	
					Xanthidae	1	
					Percnon sp.	1	
10	10/04	20:12–21:28	00–01.0	S	Portunidae	2	O
			159–54.8	W			
10	10/04	20:19–20:34	00–01.1	S	Xanthidae	3	S
			159–54.6	W			
10	10/04	22:28–01:41	00–03.5	N	Portunidae	1	I
			159–54.4	W			
11	10/06	06:48–09:59	05–01.9	S	Grapsidae	1	I
			160–03.0	W			
11	10/06	22:16–23:30	05–00.8	S	Portunidae	1	O
			160–01.9	W	Xanthidae	1	
11	10/06	22:23–22:38	05–00.8	S	Portunidae	1	S
			160–02.0	W			
12	10/08	18:28–18:43	10–01.3	S	Portunidae	1	S
			160–01.7	W			
Pa	10/14	23:00–23:20			Grapsidae? (Fig. G)	1	K
13	10/17	20:29–21:44	10–00.7	S	Xanthidae	1	O
			149–57.8	W	Grapsidae	1	
15	10/20	03:29–03:44	00–01.3	S	Xanthidae	1	S
			149–55.6	W	Grapsidae (Fig. F)	1	

Abbreviations:
O, ORI net, Oblique, Wire out 2000 m; S, ORI-69 net, Side hauls; I, IKMT+EMPS net; M, MTD net; K, Kitahara-type net, 30 cm in diameter.

Fig. 1. Some brachyuran megalopae from the Central Equatorial Pacific Ocean.

A. *Pilmnus* sp. (Xanthidae) (St. 9); B. *Grapsus* sp. (Grapsidae) (St. 9); C. *Dynomene* sp. (Dynomenidae) (St. 9); D. *Charybdis* sp. [huge] (Portunidae) (St. 10); D'. thoracic sternum; E. *Trapezia* sp. (Xanthidae) (St. 7); F. Grapsoid sp. (Grapsidae) (St. 15); G. Grapsoid ? sp. (Grapsidae) (Papeete harbor). Bar scales represent 1 mm.



Taxonomic and Biogeographic Studies on the Pelagic Shrimps and Mysids in the Central Tropical Pacific

T. Kikuchi

Aims

1) To characterize the general geographical distribution patterns of mesopelagic shrimps and mysids

2) To investigate the role of mesopelagic shrimps and mysids in relation to the mesopelagic food web

Methods

Mesopelagic shrimps and mysids were obtained by oblique hauls of 10-foot IKMT, IKPT and 10-foot IKMT-EMPS (Isaacs-Kidd Midwater Trawl with Electric Multi-layer Plankton Sampler) samplers.

Results

The species list of pelagic shrimps are shown in Table 1.

Fifty species of shrimps, representing 11 genera of Pleocyemata, 8 genera of Dendrobranchiata, and one genus of Reptantia occurred at 17 stations.

Taxonomical studies on unidentified specimens and the species which seem to be new to science are now being analyzed.

Table 1. List of species occurred in the KH-90-2 cruise

Species Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Pleocyemata																	
Parapasiphae sulcatifrons				1			2									1	
Pasiphaea sp.		1					1					1					1
Acanthephyra acutifrons	2				1	1		1									
A. cucullata							5	2		2							
A. curtirostris		1	3	1			23	9	2	29	7	2	1	2	8	12	9
A. indica			7	8			2	1	6	5	1			1	5	6	
A. prionota	1								1	1				1			
A. smithi	1	4	1	4	6	3	9	10	4	3	1				2	7	5
A. sp.		1				1			1								1
Ephyrina benedicti										1					1		
Hymenodora gracilis							3		1	3	3	1	1	4	3		
Janicella spinicauda			1		8	21	3			8	1		5				
Meningodora longisulca			1											1		1	
M. mollis										1		1					
M. vesca			2	1						1	2	2	1		1		
M. n. sp.							15		2	1	4	1	1	5	8		
Notostomus elegans				1						1							
N. gibbosus				1	1		5			3						1	
N. murrari													1				
Oplophorus typus			3	3	3	1	11		3	15	4	1		1	3	1	
Systellaspis cristata			1		1		2		1	2			2				1
S. debilis	1	3			10	9					4	3	4				
Parapandalis richardi		5	2	2	1		3		6	8	2		1		6	4	
Dendrobranchiata																	
Plesiopenaeus sp.																	
Hymenopenaeus sp.							1		1					1			
Funchalia taaningi							1			2					3	2	3
Gennadas bouvieri	1	10	1	1									2	9			
G. capensis	1	3															
G. incertus			1													5	4
G parvus		1		1									1	1	12	6	
G. propinquus	1	6	1					3									2
G. scutatus			3	5			3						4	17	38	135	34
G. tinayrei																	5
G. spp.	1	6	2	84	52	24	30	57	66	105	28	16	7		1		6
Bentheogennema intermedia		1					1	3		4					2	2	1
Bentheogennema sp.	1	4	3		1		2	2	4	2	4			3	1	7	1
Sergestes erectus	2						1									7	7
S. seminudus											3						
S. sargassi																	4
S. spp.	2	9	9	14	27	25	88	69	51	167	6	8	2	20	46	19	77
Sergia bigemmea	1																
S. challengeri										1					15		
S. crebra				1						1		3					8
S. filicta									1	1				1	1		3
S. gardineri							1	2		2				3	17	21	8
S. tenuiremis															1		
S. spp.	1	5	3	31	27	9	37	15	55	110	17	10	6	13	1	2	2
Reptantia																	
Stereomastis sp.									1								
unidentified					1			2									1
Mysidacea	6	9	11	9	1		26	17	25	96	10	4	9	12	47	32	11

Zooplankton Collected by a VMPS in the Central Equatorial Pacific Ocean

T. Toda, H. Sugisaki, B.-C. Oh, J. Nishikawa, H. Kobayashi, T. Kikuchi and M. Terazaki

Plankton samplings were made using a VMPS (Vertical Multiple Plankton Sampler) of 0.1mm mesh (XX13) at 17 stations on KH-90-2 cruise in the central Pacific Ocean. Samples were collected at four depth layers: surface-100m, 100–250m, 250–500m, and 500–750m. They were preserved in 10 % formalin seawater solution neutralized with sodium tetraborate.

After the settling volumes were measured to estimate plankton biomass, the samples were filtered with the cloth of 0.3mm mesh (GG54), and sorted out in various categories. The categories are as follows: Forminifera, Radiolaria, other Protozoa, Cnidaria, Ctenophora, Annelida, Chaetognatha, Cladocera, Ostracoda, Copepoda, Amphipoda, Luciferidae, Crustacean nauplii, other Crustacea, Pteropoda, Heteropoda, other Mollusca, Echinoderm larvae, Appendicularia, Salpida, Doliolida, Pyrosomida, Pices, eggs, and unidenitified organisms.

High biomass were recognized at the stations along 170° W, 160° W and 150° W of the east side of the investigated area by the influence of upwellings (Fig. 1). Biomass of the stations on the most western longitude (180° WE), except for St. 6, are significantly lower than the other stations (Fig. 1). There is a line of quantitative discontinuity of plankton biomass between 170° W and 180° WE. The plankton sample of St. 6 had considerably high settling volume, and included many needle-like transparent unidentified materials. Individual numbers of every taxa in all samples are shown in Table 1. The detailed systematic and zoogeographic studies are in progress by several specialists.

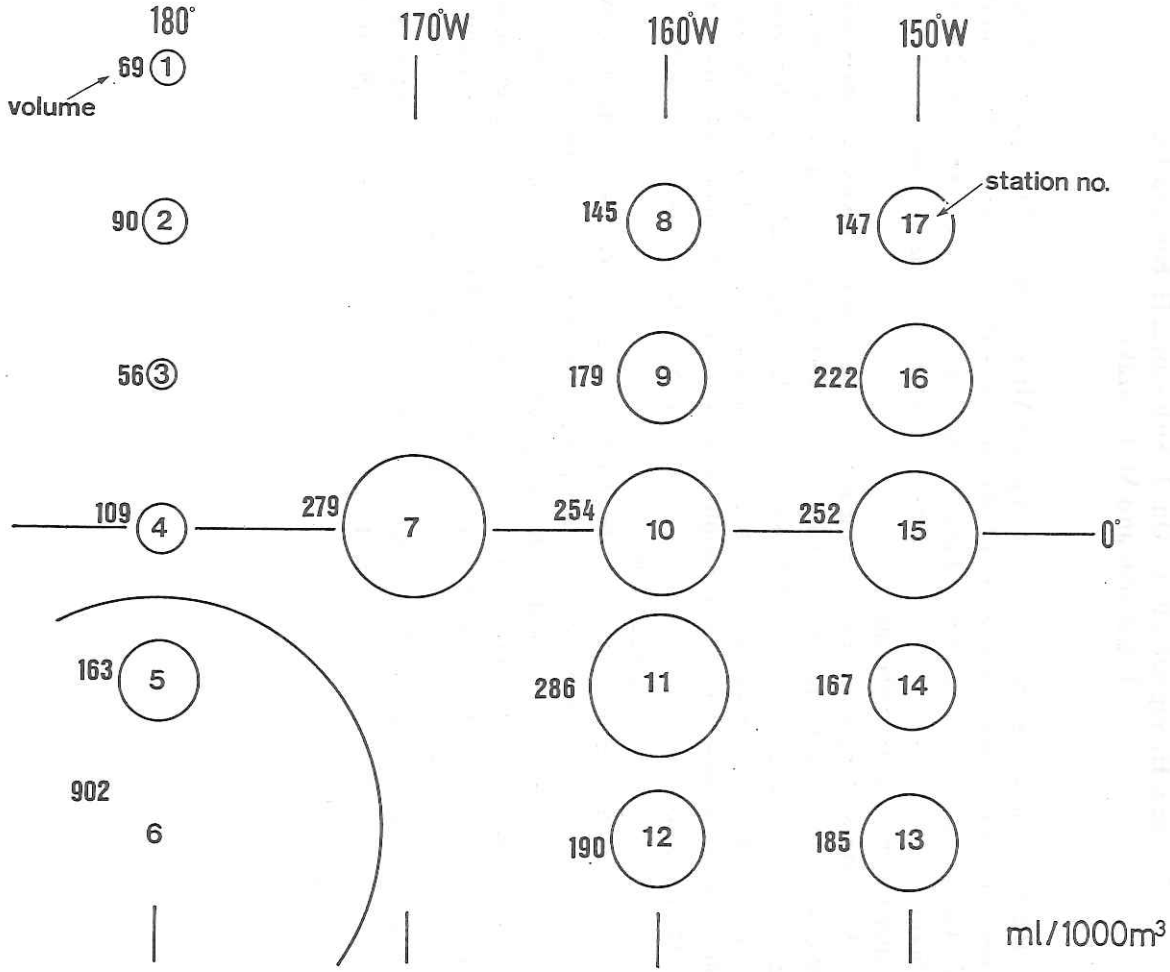


Fig. 1. Settling volumes of net plankton collected by a VMPS (ml/1000^3).

Table 1. Individual numbers of zooplankton collected by a VMPS (inds./1000m^3)).

Bottle No.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Satation	1	1	1	1	2	2	2	2	3
Day/Night									Night
Sampling Depths	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m
Forminifera	0	0	0	0	0	27	32	16	600
Radiolaria	40	0	48	0	400	853	448	16	120
other Protozoa	0	0	0	0	0	0	0	0	0
Total Protozoa	40	0	48	0	400	880	480	32	720
Cnidaria	200	293	96	0	2880	267	816	64	40
Ctenophora	0	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	0	0	96	80	2720	1013	496	0	40
Chaetognatha	4560	693	416	128	7680	3360	304	160	720
Cladocera	0	0	0	0	1680	0	0	0	0
Ostracoda	80	3067	896	256	6080	1413	1616	256	240
Copepoda	25960	19813	10976	8864	161320	25200	19408	10416	23320
Amphipoda	40	27	16	0	160	0	0	0	0
Luciferidae	0	0	0	0	0	0	0	0	0
other Crustacea	240	427	0	64	4960	80	64	16	120
Total Crustacea	26320	23333	11888	9184	174200	26693	21088	10688	23680
Pteropoda	40	133	32	0	880	0	112	32	40
Heteropoda	0	0	0	0	0	0	0	0	0
Cephalopoda	0	0	0	0	0	0	0	0	0
other Mollusca	0	27	16	0	0	0	16	0	0
Total Mollusca	40	160	48	0	880	0	128	32	40
Echinoderm larvae	0	0	0	0	0	0	0	0	0
Appendicularia	160	133	0	0	3520	53	1088	64	4040
Salpida	80	27	0	0	400	0	48	0	40
Doliolida	40	720	0	0	240	0	512	16	0
Pyrosomida	0	0	0	0	0	0	0	0	0
Pices	40	0	16	16	440	0	176	0	40
Total numbers/tow	31480	25360	12608	9408	193360	32267	25136	11056	29360
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	0	0	0	0	0	0	0	0
"Circle"	0	0	0	0	0	0	0	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
Satation	3	3	3	3	3	3	3	4	4
Day/Night	Night	Night	Night	Day	Day	Day	Day	Night	Night
Sampling Depths	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m
Forminifera	0	0	0	840	80	16	0	0	800
Radiolaria	53	176	16	240	80	48	144	0	0
other Protozoa	0	0	0	0	0	0	0	0	0
Total Protozoa	53	176	16	1080	160	64	144	0	800
Cnidaria	240	0	16	120	160	0	0	3200	640
Ctenophora	0	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	267	80	336	0	267	80	752	1960	1200
Chaetognatha	2240	1360	128	600	2773	304	416	17600	2693
Cladocera	0	0	0	80	0	0	0	800	0
Ostracoda	1813	768	320	0	2400	880	336	440	2773
Copepoda	24053	15344	14064	10640	31760	16608	15200	174200	44587
Amphipoda	80	0	0	0	53	0	0	160	187
Luciferidae	0	0	0	0	0	0	0	120	27
other Crustacea	240	48	48	0	160	96	0	0	800
Total Crustacea	26187	16160	14432	10720	34373	17584	15536	175720	48373
Pteropoda	27	0	0	0	0	32	0	2520	293
Heteropoda	0	0	0	0	0	0	0	120	27
Cephalopoda	0	0	0	0	0	0	0	80	0
other Mollusca	27	0	0	0	27	0	0	0	80
Total Mollusca	53	0	0	0	27	32	0	2720	400
Echinoderm larvae	0	0	0	0	0	0	0	280	27
Appendicularia	133	32	0	3200	107	16	16	2880	347
Salpida	0	0	0	0	0	0	0	280	0
Doliolida	0	0	0	0	0	0	0	440	27
Pyrosomida	0	0	0	0	0	0	0	0	0
Pices	160	16	0	0	80	16	0	1440	133
Total numbers/tow	29333	17824	14928	15720	37947	18096	16864	206520	54640
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	0	0	0	0	16	0	0	80
"Circle"	0	0	0	0	0	0	0	0	0

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*
Satation	4	4	4	4	4	4	5	5	5
Day/Night	Night	Night	Day	Day	Day	Day	Night	Night	Night
Sampling Depths	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m
Forminifera	48	144	3440	400	0	0	1280	2747	512
Radiolaria	496	544	240	773	560	224	202560	213	544
other Protozoa	0	0	0	0	0	0	0	0	0
Total Protozoa	544	688	3680	1173	560	224	203840	2960	1056
Cnidaria	0	96	3400	1173	384	48	5760	1627	768
Ctenophora	0	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	64	544	2440	1573	272	400	7040	1947	272
Chaetognatha	320	656	24760	2373	1072	320	14560	2613	544
Cladocera	0	0	1400	0	0	0	0	0	0
Ostracoda	672	2096	520	2640	2960	560	160	4693	2288
Copepoda	7024	39568	180560	34347	30896	20432	276480	58320	24768
Amphipoda	16	16	360	187	16	0	2080	400	0
Luciferidae	0	0	120	0	0	0	480	0	0
other Crustacea	32	48	1800	640	768	48	4480	2373	800
Total Crustacea	7744	41728	184760	37813	34640	21040	283680	65787	27856
Pteropoda	0	192	1600	613	64	16	1440	293	560
Heteropoda	0	0	320	133	0	0	320	80	32
Cephalopoda	0	0	0	0	0	0	160	107	0
other Mollusca	0	32	280	53	16	0	160	107	0
Total Mollusca	0	224	2200	800	80	16	2080	587	592
Echinoderm larvae	0	0	320	0	0	0	320	80	0
Appendicularia	0	0	5920	80	176	0	19680	1600	32
Salpida	0	0	1040	0	0	16	1440	0	0
Doliolida	0	16	320	27	0	0	0	240	0
Pyrosomida	0	0	0	0	0	0	0	0	0
Pices	0	48	360	27	16	16	640	0	0
Total numbers/tow	8672	44000	229200	45040	37200	22080	539040	77440	31120
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	192	0	27	0	0	0	0	0
"Circle"	0	0	0	0	0	0	0	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*
Satation	5	5	5	5	5	6	6	6	6
Day/Night	Night	Day	Day	Day	Day				
Sampling Depths	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m
Forminifera	704	0	2293	128	352	42240	0	160	16
Radiolaria	144	0	267	416	112	7680	827	0	32
other Protozoa	0	0	0	0	0	1280	0	0	0
Total Protozoa	848	0	2560	544	464	51200	827	160	48
Cnidaria	208	8960	773	176	48	640	800	48	0
Ctenophora	0	0	27	0	16	0	0	0	0
Annelida (Polychaeta)	336	4400	1627	112	288	2560	2080	448	192
Chaetognatha	160	27360	2507	368	80	22400	3200	416	16
Cladocera	0	0	0	0	0	0	0	0	16
Ostracoda	496	2000	3920	1424	400	0	5387	2448	272
Copepoda	18592	249520	59920	20192	26736	652160	56720	28576	7680
Amphipoda	16	7600	560	0	224	0	80	16	16
Luciferidae	0	80	27	0	0	0	0	0	0
other Crustacea	240	8720	1653	80	192	1920	533	960	144
Total Crustacea	19344	267920	66080	21696	27552	654080	62720	32000	8128
Pteropoda	256	2720	107	64	192	6400	80	112	0
Heteropoda	96	0	27	0	0	0	0	0	0
Cephalopoda	0	0	0	0	0	0	0	0	0
other Mollusca	80	0	0	0	32	0	0	0	0
Total Mollusca	432	2720	133	64	224	6400	80	112	0
Echinoderm larvae	0	0	0	0	0	0	0	0	0
Appendicularia	288	8400	2160	128	464	51840	2160	0	512
Salpida	16	880	0	0	16	0	0	0	0
Doliolida	32	1200	640	0	0	5760	240	0	0
Pyrosomida	0	0	0	0	0	0	0	0	0
Pices	16	560	133	0	32	1280	53	48	32
Total numbers/tow	21680	322400	76640	23088	29184	796160	72160	33232	8928
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	0	0	0	0	0	0	0	0
"Circle"	0	0	0	0	0	0	0	0	0
Comments						Trich			

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*37*	*38*	*39*	*40*	*41*	*42*	*43*	*44*	*45*
Satation	7	7	7	7	7	7	7	7	8
Day/Night	Night	Night	Night	Night	Day	Day	Day	Day	Night
Sampling Depths	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m
Forminifera	0	5627	0	0	28320	5813	1072	2032	1920
Radiolaria	0	133	272	160	3760	827	2240	336	480
other Protozoa	0	0	0	0	0	0	0	64	0
Total Protozoa	0	5760	272	160	32080	6640	3312	2432	2400
Cnidaria	5840	667	144	368	20320	2347	368	320	2800
Ctenophora	0	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	3680	1280	320	464	3680	1467	528	560	3360
Chaetognatha	19360	2853	1120	224	17760	4107	1392	256	7120
Cladocera	80	0	0	0	80	0	0	0	880
Ostracoda	1520	1680	2480	672	400	1733	3504	1120	3680
Copepoda	407360	95093	35360	27568	346000	76587	43216	37088	201920
Amphipoda	800	267	32	32	2000	267	32	64	800
Luciferidae	560	0	0	0	640	0	0	0	0
other Crustacea	12720	1360	112	320	5360	1813	1440	80	2960
Total Crustacea	423040	98400	37984	28592	354480	80400	48192	38352	210240
Pteropoda	5520	240	0	256	880	2507	1456	256	800
Heteropoda	160	53	0	0	240	53	80	32	80
Cephalopoda	240	0	0	16	160	0	0	16	0
other Mollusca	0	0	0	0	400	0	32	80	80
Total Mollusca	5920	293	0	272	1680	2560	1568	384	960
Echinoderm larvae	720	0	0	32	6080	0	0	0	0
Appendicularia	17040	347	0	112	23840	533	0	1456	4960
Salpida	1440	0	0	0	800	80	0	64	400
Doliolida	1360	0	0	48	1600	80	0	0	720
Pyrosomida	0	0	0	0	0	0	0	0	0
Pices	1120	240	48	32	720	0	96	48	0
Total numbers/tow	479520	109840	39888	30304	463040	98213	55456	43872	232960
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	0	496	0	0	0	592	0	0
"Circle"	0	0	32	0	0	0	288	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*46*	*47*	*48*	*49*	*50*	*51*	*52*	*53*	*54*
Satation	8	8	8	8	8	8	8	9	9
Day/Night	Night	Night	Night	Day	Day	Day	Day	Night	Night
Sampling Depths	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m
Forminifera	-	144	0	0	27	128	0	0	800
Radiolaria	-	224	0	80	1333	128	320	1360	213
other Protozoa	-	0	0	0	0	0	0	0	0
Total Protozoa	-	368	0	80	1360	256	320	1360	1013
Cnidaria	-	0	544	1600	773	32	1440	6080	347
Ctenophora	-	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	-	144	640	720	1493	64	672	5200	693
Chaetognatha	-	176	128	14160	907	160	176	16480	1093
Cladocera	-	16	80	80	0	0	128	80	0
Ostracoda	-	480	480	80	4907	304	608	960	3120
Copepoda	-	12736	31072	35200	47867	16464	39696	353120	27653
Amphipoda	-	0	96	0	80	16	288	720	187
Luciferidae	-	0	0	0	27	0	0	160	0
other Crustacea	-	32	480	0	133	192	624	6880	320
Total Crustacea	-	13264	32208	35360	53013	16976	41344	361920	31280
Pteropoda	-	48	192	240	267	16	192	1360	53
Heteropoda	-	0	0	0	0	0	48	240	0
Cephalopoda	-	0	0	0	27	0	16	0	0
other Mollusca	-	16	0	80	0	0	80	80	27
Total Mollusca	-	64	192	320	293	16	336	1680	80
Echinoderm larvae	-	0	0	0	0	0	0	2400	0
Appendicularia	-	32	304	8640	2160	48	3648	25200	1173
Salpida	-	0	80	400	267	0	432	1520	0
Doliolida	-	16	80	160	347	0	480	1120	53
Pyrosomida	-	0	0	0	0	0	0	0	0
Pices	-	0	64	0	187	16	48	320	133
Total numbers/tow	-	14064	34240	61440	60800	17568	48896	423280	35867
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	16	0	0	133	0	0	0	0
"Circle"	0	0	0	0	0	0	0	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*55*	*56*	*57*	*58*	*59*	*60*	*61*	*62*	*63*
Satation	9	9	9	9	9	9	10	10	10
Day/Night	Night	Night	Day	Day	Day	Day	Night	Night	Night
Sampling Depths	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m
Forminifera	64	592	56000	2853	96	272	15120	10693	784
Radiolaria	864	336	13920	133	320	160	80	1520	320
other Protozoa	0	0	0	0	0	0	0	0	0
Total Protozoa	928	928	69920	2987	416	432	15200	12213	1104
Cnidaria	624	576	10560	800	112	64	13440	987	192
Ctenophora	16	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	256	1072	5920	747	176	528	6080	1360	512
Chaetognatha	368	336	16640	1387	304	400	29200	1173	864
Cladocera	0	0	1600	0	0	0	0	0	0
Ostracoda	1200	592	0	2907	1600	464	3280	3040	1968
Copepoda	17760	29904	250240	39707	25344	20544	276720	47573	23952
Amphipoda	48	64	1280	240	32	80	5200	587	32
Luciferidae	0	16	480	0	0	0	1280	27	0
other Crustacea	160	320	4800	1680	560	80	14640	880	48
Total Crustacea	19168	30896	258400	44533	27536	21168	301120	52107	26000
Pteropoda	48	240	2880	747	16	144	4320	213	48
Heteropoda	16	80	960	0	16	64	720	0	0
Cephalopoda	0	0	0	0	0	0	0	0	0
other Mollusca	0	16	0	80	0	16	480	0	48
Total Mollusca	64	336	3840	827	32	224	5520	213	96
Echinoderm larvae	0	272	480	0	0	0	3280	80	0
Appendicularia	0	1264	16000	853	80	224	11040	907	32
Salpida	0	0	800	0	0	0	720	0	0
Doliolida	0	128	640	187	0	48	800	107	0
Pyrosomida	0	0	0	0	0	0	0	0	0
Pices	0	128	1120	80	0	48	2320	533	16
Total numbers/tow	21424	35936	384320	52400	28656	23136	388720	69680	28816
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	80	0	0	0	0	0	0	187	0
"Circle"	176	0	0	0	0	0	0	213	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*64*	*65*	*66*	*67*	*68*	*69*	*70*	*71*	*72*
Satation	10	10	10	10	10	11	11	11	11
Day/Night	Night	Day	Day	Day	Day	Night	Night	Night	Night
Sampling Depths	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m
Forminifera	880	28800	8080	1088	1040	7480	5840	80	416
Radiolaria	272	36160	720	672	480	1040	320	176	112
other Protozoa	0	0	0	0	112	0	0	0	0
Total Protozoa	1152	64960	8800	1760	1632	8520	6160	256	528
Cnidaria	80	15840	80	896	80	1800	267	128	0
Ctenophora	0	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	416	2240	1067	560	576	4280	1360	352	480
Chaetognatha	160	17440	907	1744	368	8120	2480	592	240
Cladocera	0	0	0	0	16	0	0	0	0
Ostracoda	528	960	2613	3504	608	1760	2720	1360	496
Copepoda	18032	240160	36400	28496	33552	316640	45387	22912	12256
Amphipoda	0	2720	107	80	32	600	747	48	48
Luciferidae	0	1760	0	0	48	240	0	0	0
other Crustacea	160	5600	1920	2272	192	6040	720	80	128
Total Crustacea	18720	251200	41040	34352	34448	325280	49573	24400	12928
Pteropoda	112	160	800	560	224	1160	0	16	0
Heteropoda	48	640	0	32	32	480	0	0	0
Cephalopoda	0	0	0	0	0	40	0	0	0
other Mollusca	16	320	53	32	32	1000	0	0	32
Total Mollusca	176	1120	853	624	288	2680	0	16	32
Echinoderm larvae	32	14560	0	0	736	40	0	0	0
Appendicularia	160	12960	0	32	1328	21840	80	0	784
Salpida	0	480	133	0	0	40	0	0	0
Doliolida	0	1280	133	0	0	200	267	0	0
Pyrosomida	0	0	27	0	16	0	0	0	0
Pices	96	480	53	32	32	160	160	32	32
Total numbers/tow	20992	382560	53093	40000	39504	372960	60347	25776	15024
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	0	213	0	0	0	0	48	16
"Circle"	64	0	0	0	0	0	0	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*73*	*74*	*75*	*76*	*77*	*78*	*79*	*80*	*81*
Satation	11	11	11	11	12	12	12	12	12
Day/Night	Day	Day	Day	Day	Night	Night	Night	Night	Day
Sampling Depths	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m
Forminifera	19680	6373	0	144	0	1280	128	240	4480
Radiolaria	2880	160	912	48	0	80	192	144	160
other Protozoa	0	0	0	0	0	0	0	0	0
Total Protozoa	22560	6533	912	192	0	1360	320	384	4640
Cnidaria	2080	1413	144	16	3520	400	304	96	3200
Ctenophora	0	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	1760	4133	48	336	8160	1013	288	176	2720
Chaetognatha	37440	4640	208	176	20800	1413	528	160	26720
Cladocera	0	0	0	0	0	0	0	0	640
Ostracoda	800	4133	32	288	2240	2773	1440	368	480
Copepoda	209280	25467	1280	14736	149200	25413	10832	12176	208480
Amphipoda	160	187	0	16	240	53	0	32	160
Luciferidae	320	0	0	0	0	0	0	0	160
other Crustacea	2880	453	16	112	6480	1280	64	64	1120
Total Crustacea	213440	30240	1328	15152	158160	29520	12336	12640	211040
Pteropoda	3680	640	16	16	4160	107	112	128	2720
Heteropoda	0	133	16	0	320	0	0	0	0
Cephalopoda	0	27	0	0	0	0	0	0	0
other Mollusca	1120	107	0	0	320	0	0	0	480
Total Mollusca	4800	907	32	16	4800	107	112	128	3200
Echinoderm larvae	0	27	0	0	0	0	0	16	1760
Appendicularia	64480	2293	0	0	22720	1200	48	80	140800
Salpida	0	0	176	0	0	0	0	0	320
Doliolida	0	213	0	0	400	80	0	0	0
Pyrosomida	0	0	0	0	0	0	0	0	0
Pices	0	107	0	16	160	53	48	32	0
Total numbers/tow	346560	50507	2848	15904	218720	35147	13984	13712	394400
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	0	0	32	0	0	0	0	0
"Circle"	0	0	144	0	0	0	0	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*82*	*83*	*84*	*85*	*86*	*87*	*88*	*89*	*90*
Satation	12	12	12	13	13	13	13	14	14
Day/Night	Day	Day	Day						
Sampling Depths	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m
Forminifera	1173	496	32	1080	80	64	0	37920	1573
Radiolaria	133	192	32	0	267	144	16	800	880
other Protozoa	0	0	0	0	0	0	0	0	0
Total Protozoa	1307	688	64	1080	347	208	16	38720	2453
Cnidaria	187	192	16	720	320	48	0	3040	640
Ctenophora	0	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	3413	368	48	4600	1733	176	0	3680	1573
Chaetognatha	1813	384	80	10280	1200	704	96	23840	2693
Cladocera	0	0	0	2720	0	0	0	0	0
Ostracoda	3093	2368	160	2600	3653	2032	112	800	3227
Copepoda	13387	13952	4304	248480	43520	13904	11312	190080	40507
Amphipoda	27	0	0	400	107	16	0	800	347
Luciferidae	27	0	0	0	0	0	16	800	133
other Crustacea	267	528	80	14080	1200	240	80	11520	1307
Total Crustacea	16800	16848	4544	268280	48480	16192	11520	204000	45520
Pteropoda	533	1248	64	1680	107	16	32	2720	293
Heteropoda	27	0	0	80	0	0	0	320	107
Cephalopoda	0	0	0	0	0	0	0	0	0
other Mollusca	27	16	0	440	27	0	0	0	0
Total Mollusca	587	1264	64	2200	133	16	32	3040	400
Echinoderm larvae	0	0	0	0	0	0	0	1280	27
Appendicularia	5253	32	0	20880	933	32	400	94080	1227
Salpida	27	0	0	0	0	32	0	0	0
Doliolida	0	0	0	0	0	0	0	160	0
Pyrosomida	27	0	0	0	0	0	0	0	0
Pices	0	16	32	120	0	0	0	0	160
Total numbers/tow	29413	19792	4848	308160	53147	17408	12064	371840	54693
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	64	0	0	0	0	0	0	0
"Circle"	0	0	0	0	0	0	0	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*91*	*92*	*93*	*94*	*95*	*96*	*97*	*98*	*99*
Satation	14	14	15	15	15	15	15	15	15
Day/Night			Night	Night	Night	Night	Day	Day	Day
Sampling Depths	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m
Forminifera	320	320	14400	3627	576	1552	-	-	-
Radiolaria	240	192	160	800	432	128	-	-	-
other Protozoa	0	80	0	0	48	80	-	-	-
Total Protozoa	560	592	14560	4427	1056	1760	-	-	-
Cnidaria	128	32	3280	907	192	208	-	-	-
Ctenophora	0	0	0	0	0	0	-	-	-
Annelida (Polychaeta)	288	352	8400	3653	624	928	-	-	-
Chaetognatha	320	336	22160	7307	1472	432	-	-	-
Cladocera	0	0	280	0	0	0	-	-	-
Ostracoda	1920	240	7120	5333	1696	784	-	-	-
Copepoda	11408	16128	273360	81520	27648	21536	-	-	-
Amphipoda	16	0	3520	640	16	64	-	-	-
Luciferidae	0	32	960	133	0	0	-	-	-
other Crustacea	208	80	10920	2027	304	112	-	-	-
Total Crustacea	13552	16480	296160	89653	29664	22496	-	-	-
Pteropoda	16	32	3360	267	16	32	-	-	-
Heteropoda	0	0	760	80	0	16	-	-	-
Cephalopoda	0	0	0	0	0	0	-	-	-
other Mollusca	0	16	400	107	16	0	-	-	-
Total Mollusca	16	48	4520	453	32	48	-	-	-
Echinoderm larvae	0	0	6600	267	0	32	-	-	-
Appendicularia	16	496	33200	187	0	320	-	-	-
Salpida	0	0	800	0	0	0	-	-	-
Doliolida	0	0	960	27	0	0	-	-	-
Pyrosomida	16	0	80	0	0	0	-	-	-
Pices	32	16	2040	480	16	48	-	-	-
Total numbers/tow	14928	18352	392760	107360	33056	26272	-	-	-
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	16	0	0	0	32	0	0	0	0
"Circle"	0	0	0	0	0	0	0	0	0
Comments									

KH90-2 Plankton Data of VMPS Net Samples (inds./1000m^3)

Bottle No.	*100*	*101*	*102*	*103*	*104*	*105*	*106*	*107*	*108*
Satation	15	16	16	16	16	17	17	17	17
Day/Night	Day								
Sampling Depths	500-750m	0-100m	100-250m	250-500m	500-750m	0-100m	100-250m	250-500m	500-750m
Forminifera	-	8200	3627	736	400	2560	320	160	48
Radiolaria	-	1000	293	112	32	320	400	208	144
other Protozoa	-	0	0	0	0	0	0	0	0
Total Protozoa	-	9200	3920	848	432	2880	720	368	192
Cnidaria	-	14800	5493	176	64	4160	427	96	64
Ctenophora	-	0	0	0	0	0	0	0	0
Annelida (Polychaeta)	-	1040	2213	160	368	5000	1493	464	304
Chaetognatha	-	5440	5840	384	240	19360	1653	544	480
Cladocera	-	0	0	0	0	1880	0	0	16
Ostracoda	-	120	3040	1520	288	4240	3760	2144	368
Copepoda	-	357840	63760	22624	13040	424240	47760	24960	25984
Amphipoda	-	4120	373	80	0	120	53	32	0
Luciferidae	-	1520	0	0	0	40	0	0	0
other Crustacea	-	10640	1920	512	128	4640	640	272	112
Total Crustacea	-	374240	69093	24736	13456	435160	52213	27408	26480
Pteropoda	-	1400	1040	160	64	1200	80	32	32
Heteropoda	-	1400	400	0	32	120	27	0	0
Cephalopoda	-	0	0	0	0	0	0	0	0
other Mollusca	-	480	27	16	80	160	0	0	0
Total Mollusca	-	3280	1467	176	176	1480	107	32	32
Echinoderm larvae	-	720	267	0	112	0	0	0	0
Appendicularia	-	7600	613	0	16	18280	960	0	224
Salpida	-	880	27	0	0	320	0	0	0
Doliolida	-	200	347	0	0	3040	773	0	32
Pyrosomida	-	0	0	0	0	0	0	0	0
Pices	-	960	27	0	0	360	80	0	0
Total numbers/tow	-	418360	89307	26480	14864	490040	58427	28912	27808
Eggs	+	+	+	+	+	+	+	+	+
Crustasean nauplii	+	+	+	+	+	+	+	+	+
Unidentified & others	+	+	+	+	+	+	+	+	+
"Star"	0	0	0	0	0	0	0	0	0
"Circle"	0	0	0	0	0	0	0	0	0
Comments									

Net Plankton Biomass in the Central Pacific Equatorial Water

M. Terazaki

A NORPAC-twin net consisting of 0.10 mm and 0.33 mm-mesh nets was towed vertically from a depth of 200 m to the surface at 17 stations. The tows were carried out mostly at night to collect epipelagic zooplankton. Collections were preserved in 10% formalin seawater solution neutralized with sodium tetraborate. Settling volumes was measured to estimate net plankton biomass. Highest biomass (41.2 cc/10 m^3) was recognized at Stn. 6 because of blooming of algae.

Generally, biomass increased as going the east by the effect of the equatorial upwelling. The biomass along 155°W line which were collected with a NORPAC net from a depth of 150 m to the surface in September–October, 1969 during the KH-69-4 cruise, was lower than the biomass along 150°W and 160°W lines in 1990 (Fig. 1). The amount of chlorophyll-a in the epipelagic layer showed a similar tendency.

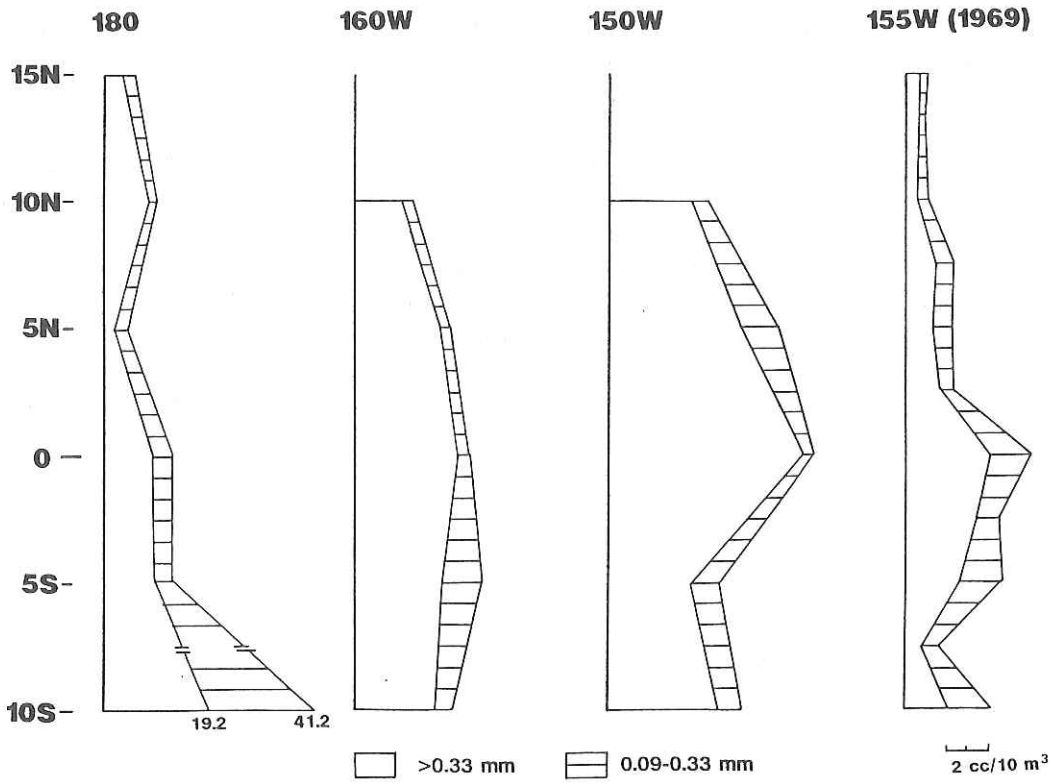


Fig. 1. Net plankton biomass in the epipelagic layer of the central Pacific Equatorial water.

Distribution of Salpidae (Tunicata) in the Central Pacific Ocean

J. Nishikawa and M. Terazaki

Knowledge on the abundance and distribution of salps in the central Pacific Ocean is relatively scarce, but important in considering the ecological role of them as primary consumers or competitors of other herbivorous zooplankton. In the present report, we described some preliminary data about the species composition, the vertical distribution and the horizontal distribution of salps.

Zooplankton samplings were made at 17 stations during the cruise (See track chart). The samples were taken with an Isaacs-Kidd midwater trawl (IKMT net, Isaacs and Kidd 1953; 5 mm mesh). At 11 stations, a cod-end device, Multiple Plankton Sampler (MPS, Pearcy et al. 1977), was attached to the net for investigating the vertical distribution. The net was towed obliquely with 3000, 3500 or 4000 m of wire out. After the collection, the samples were immediately fixed with 5 % buffered formalin seawater. Later, salps were sorted out from the samples, their wet weight measured and the individual numbers counted with identification of species and generations.

Species composition: Thirteen species of salps (including *Cyclosalpa* spp.) were found (Table 1). The dominant species by number were *Thalia democratica, Iasis zonaria* and *Salpa fusiformis*, and the relative percentages of them to total salp number were 29.2 %, 17.6 % and 16.6 %, respectively.

Vertical distribution: Figs. 1 and 2 show vertical distributions of the 2 dominant species, *T. democratica* and *S. fusiformis*. Most of *T. democratica* were distributed in the shallowest sampling layer, and there were no differences in the patterns of vertical distribution between day and night (Fig. 1). On the other hand, *S. fusiformis* were more commonly found in the deeper layer at day time than at night time (Fig. 2). This indicates that *S. fusiformis* undergoes diel vertical migration.

Horizontal distribution: Fig. 3 shows the horizontal distribution of the total number of salps in the research area. The highest number (5.2 inds./1000m^3) and wet weight (3.4 mg/m^3) was recorded at Stn. 11 (5°S, 160°W). During the cruise, a remarkable equatorial upwelling was observed from 170° W to 150° W and between 5° N and 10° S (See other scientists' reports and oceanographic data of the hydrocast). Both total number and total wet weight were significantly higher at the upwelling stations than at the non-upwelling stations (Mann-Whitney U-test, $p<0.01$), showing that salps are more abundant in regions of upwelling. Each dominant species showed similar distribution patterns, however, a slight difference was recognized; *T. democratica* occurred in relatively high numbers at the stations north of 0°, while *I. zonaria* tended to be distributed mainly at southern stations. *S. fusiformis* had no clearly distinguishing features.

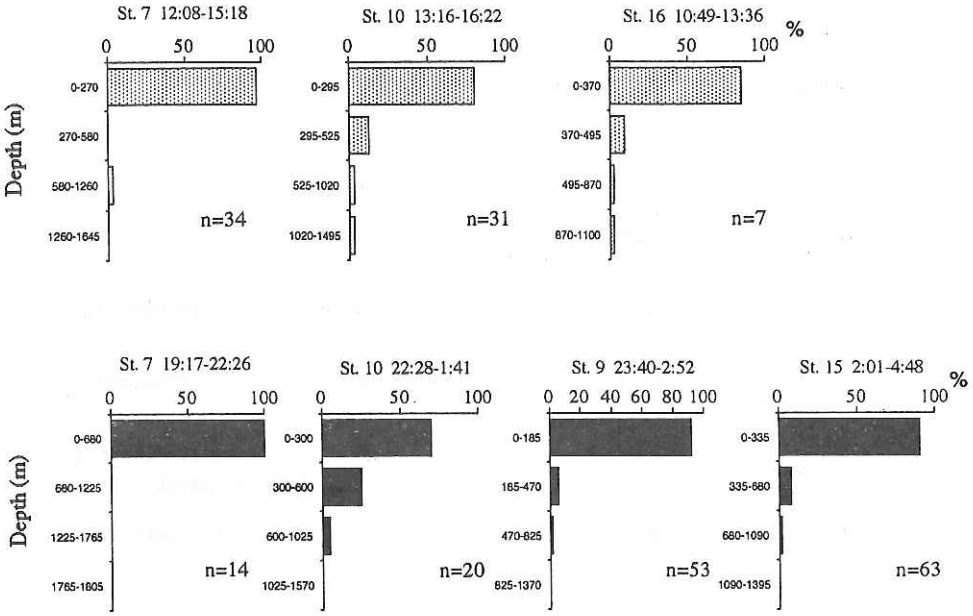


Fig. 1. Vertical distribution of *Thalia democratica* in daytime (top) and night time (bottom) samplings.

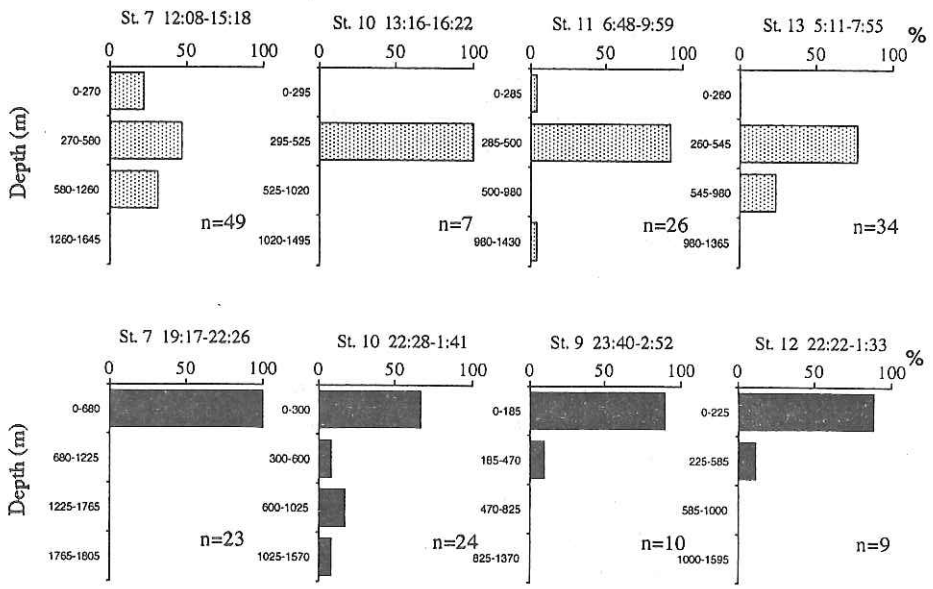


Fig. 2. Vertical distribution of *Salpa fusiformis* in daytime (top) and night time (bottom) samplings.

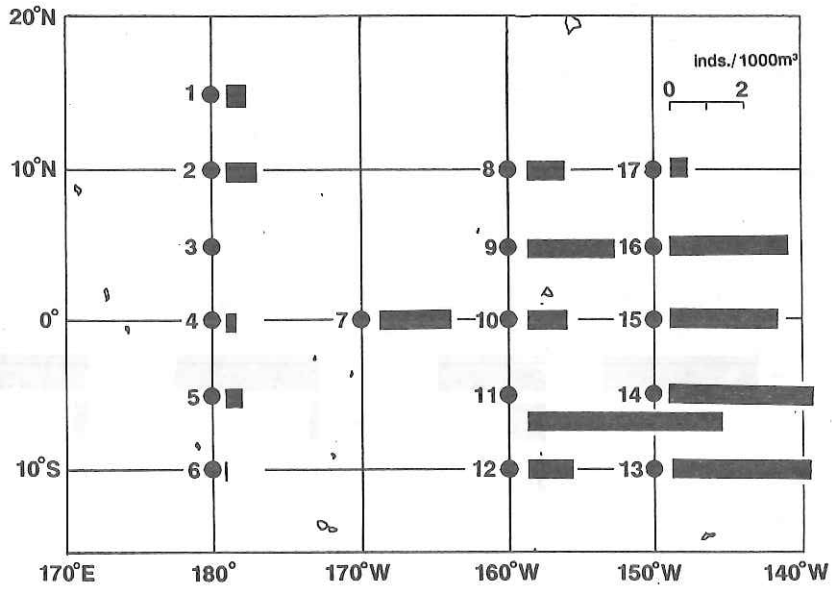


Fig. 3. Horizontal distribution of the total number of salps.

Table 1. Species list and their percentages to the total number.

Species	% Total salp number
Thalia democratica	29.2
Salpa fusiformis	16.6
S. maxima	5.7
S. aspera	4.5
S. younti	1.0
Iasis zonaria	17.6
Traustedtia multitentaculata	7.6
Pegea condoederata	4.7
P. bicaudata	0.1
Metcalfina hexagona	3.7
Cyclosalpa spp.	2.9
Weelia cylindrica	1.9
Ritteriella amboinensis	0.1
Unidentified sp.	4.4

Zoogeography and Systematics of the Midwater Fishes from the Central Equatorial Pacific

M. Miya

A total of 19 oblique hauls were made using a 10-foot Isaacs-Kidd Midwater trawl (IKMT) during the KH-90-2 cruise of the R/V Hakuho-Maru in the central equatorial Pacific. This report presents the preliminary results on the primary sorting of the midwater fishes.

One to seven sampling stations were located at five-degree interval from 15°N to 15°S along 180°, 170°, 160°E, and 150°E. The net was towed obliquely from the surface to an average depth of 1239 m. All fishes were sorted on board, identified at least to family and counted after sea-water formalin fixation (ca. 10 %).

A total of 3,266 fish was collected, from which 40 families, 69 genera, and at least 120 species were recognized (Table). Fishes of the family Gonostomatidae were exceptionally abundant, comprising 1,996 fish (61.1 %), followed by Myctophidae (479 fish, 14.7 %) and Sternoptychidae (457 fish, 14.0 %). Among gonostomatids, genus *Cyclothone* was most numerically dominant, comprising 98.9 %.

These fishes will be examined in terms of their geographic distribution patterns in relation to various environmental factors. Some of the rare fishes have already been provided with systematic studies. One of the alepocephalid fish from Sta. 15 (0°, 150°E) was an undescribed species (*Bajacalifornia* sp.) which will be published as a new by Miya and Markle (in press).

Table List of the midwater fishes collected during KH-90-2 cruise

Taxa	Number of fish
NEMICHTYIDAE (N=10)	
Avocettina acuticeps	1
Avocettina sp.	1
Nemichthys spp.	8
SERRIVOMERIDAE (N=52)	
Serrivomer spp.	52
EURYPHARYNGIDAE (N=5)	
Eurypharynx pelecanoides	5
BATHYLAGIDAE (N=1)	
Nansenia sp.	1
OPISTHOPROCTIDAE (N=2)	
Dolichopteryx spp.	2
ALEPOCEPHALIDAE (N=2)	
Alepocephalidae gen. sp.	1
Photostylus albipenis	1
PLATYTROCTIDAE (N=1)	
Searsia sp.	1
GONOSTOMATIDAE (N=1,996)	
Cyclothone acclinidens	824
Cyclothone alba	212
Cyclothone obscura	112
Cyclothone pallida	506
Cyclothone parapallida	29
Cyclothone pseudopallida	123
Cyclothone signata	167
Diplophos spp.	3
Gonostoma atlanticum	7
Gonostoma ebelingi	5
Gonostoma elongatum	8
STERNOPTYCHIDAE (N=457)	
Argyropelecus affinis	9
Argyropelecus gigas	1
Argyropelecus lychnus	3
Argyropelecus olfersi	1
Argyropelecus sladeni	4
Argyropelecus spp.	8
Danaphos sp.	30
Sternoptyx pseudobscura	2
Sternoptyx spp.	399
PHOTICHTHYIDAE (N=49)	
Ichthyococcus ovata	1
Vinciguerria nimbaria	10
Vinciguerria lucetia	1
Vinciguerria spp.	37
CHAULIODONTIDAE (N=8)	
Chauliodus spp.	8
ASTRONESTHIDAE (N=14)	
Astronesthes spp.	9
Borostomias elucens	2
Borostomias spp.	3
MELANOSTOMIIDAE (N=9)	
Bathophilus sp.	1
Echiostoma barbatum	1
Eustomias spp.	2
Leptostomias spp.	3
Photonectes sp.	1
Melanostomias sp.	1
MALACOSTEIDAE (N=5)	
Malacosteus niger	2
Photostomias guernei	3
IDIACANTHIDAE (N=3)	
Idiacanthus spp.	3
SCOPELARCHIDAE (N=7)	
Scopelarchus guentheri	1
Scopelachoides signifer	5
Scopelarchus sp.	1
SCOPELOSAURIDAE (N=2)	
Scopelosaurus spp.	2
GIGANTURIDAE (N=1)	
Gigantura sp.	1
PARALEPIDIDAE (N=2)	
Paralepis spp.	2
EVERMANNELLIDAE (N=4)	
Coccorella atrata	1
Odontostomops normalops	2
Evermannella indica	1
OMOSUDIDAE (N=2)	
Omosudis lowęri	2
NEOSCOPELIDAE (N=5)	
Scopelengys tristis	5
MYCTOPHIDAE (N=479)	
Benthosema suborbitale	2
Bolinichthys photothorax	27
Ceratoscopelus warmingi	103
Diaphus andersoni	3
Diaphus antonbruuni	1
Diaphus diadematus	3
Diaphus diademophilus	1
Diaphus effulgens	2
Diaphus fragilis	4
Diaphus fulgens?	16
Diaphus garmani	3
Diaphus luetkeni	4
Diaphus malayanus	10
Diaphus nielseni	3
Diaphus parri	1
Diaphus perspicillatus	1
Diaphus regani	15
Diaphus schmidti	2
Diaphus similis	4
Diaphus splendidus	10
Diaphus termophilus	5
Diaphus theta?	3
Diaphus trachops	1
Diaphus umbroculus	2
Diaphus spp.	28
Diogenichthys atlanticus	3
Hygophum proximum	16
Lampadena luminosa	8
Lampadena speculigera	1
Lampadena urolampa	1
Lampadena urophaos	1
Lampadena spp.	11
Lampanyctus spp.	109
Myctophum asperum	1
Myctophum aurolaternatum	8
Myctophum lychnobium	3
Myctophum nitidulum	2
Protomyctophum beckeri	1
Symbolophorus evermani	18
Taaningichthys paurolychnus	4
Myctophid juvenile	38
MELANONIDAE (N=4)	
Melanonus spp.	4
BREGMACEROTIDAE (N=6)	
Bregmaceros spp.	6
MACROURIDAE (N=1)	
Macrouridae gen. sp.	1
CERATIIDAE (N=5)	
Ceratias spp.	5
GIGANTACTIDAE (N=1)	
Rhinchactis sp.	1
LINOPHRYNIDAE (N=1)	
Linophryne sp.	1
ONEIRODIDAE (N=7)	
Oneoirodes spp.	7
HIMANTOLOPHIDAE (N=10)	
Himantolophus spp.	10
MELANOCETIDAE (N=5)	
Melanocetus spp.	5
RADICEPHALIDAE (N=2)	
Radiicephalus elongatus	2
STYLEPHORIDAE (N=2)	
Stylephorus chordatus	2
ANOPLOGASTERIDAE (N=1)	
Anoplogaster cornuta	1
MELAMPHAIDAE (N=93)	
Melamphaes spp.	13
Poromitra crassiceps	1
Poromitra megalops	5
Poromitra spp.	29
Scopeloberyx opisthopterus	1
Scopeloberyx robustus	1
Scopeloberyx spp.	20
Scopelogadus spp.	23
OREOSOMATIDAE (N=2)	
Oreosomatid juvenile	2
CYCLOPTERIDAE (N=1)	
Paraliparis sp.	1
CHIASMODONTIDAE (N=4)	
Pseudoscopelus altipinnis	4
NOMEIDAE (N=5)	
Psenes spp.	5

Systematical and Ecological Studies of Pelagic Cephalopods in the Eastern Tropical Pacific

T. Kubodera

In order to investigate cephalopod fauna and biomass in the eastern Tropical Pacific, squids and octopuses were sorted out from the samples collected by the various types of micronecton nets, ie. 10-foot IKMT, 10-foot IKMT+EMPS, ORI33 and ORI69, during the research cruise KH-90-2 of the R/V Hakuho Maru in 1990. Cephalopod larvae obtained from various depth layers at two stations by MTD nets day and night samplings were also examined for clarifying diurnal vertical migration of cephalopod larvae.

These micronecton nets were towed obliquely from the depths at about 800–1800 m. In total, 254 individuals of cephalopod were collected by 31 sampling operations. From which, 27 species belonging 15 families were identified (Table 1). ORI33 and ORI69 nets provided many small rhynchoteuthion larvae in the family Ommastrephidae most of which are considered to be *Sthenoteuthis oualaniensis*. Abundance of rhynchoteuthion larvae was relatively high at the stations on the equator and tended to decrease going away from the equator (Fig. 1). 10-foot IKMT samplings contributed relatively larger individuals in which *Pterygioteuthis giardi, Liocranchia reinhardti, Helicocranchia pfefferi* and *Japetella diaphana* were dominated.

At St. 7 on the equator, MTD nets were towed 8 layers from the surface to 300 m depth at day-time and 15 layers from the surface to 1000 m depth at night-time and 84 and 75 individuals of smaller than few mm in DML were collected, respectively. MTD nets samplings of 8 layers from the surface to 500 m depth at St. 11 located at 5°S provided 8 individuals at day and 22 at night. Although MTD net samples were too small to identify into species, majority of them were rhynchoteuthion larvae comprising 93 individuals at St. 7 and 13 at St. 11. Day and night vertical distributions of rhynchoteuthion larvae indicated their diurnal vertical migration from 100–200 m depth at day-time to the waters shallower than 100 m depth at night-time (Fig. 2).

Table 1. Cephalopods collected with micronecton nets oblique tows during the researach cruise KH-90-2 of the R/V *Hakuho Maru* in the central tropical Pacific in 1990.

Station	St. 1		St. 2		St. 4		St. 5		St. 6	ST. 7			ST. 8	
Net	IKMT	ORI33	IKMT	ORI33	IKMT	ORI33	IKMT	ORI33	IKMT	IKMT	IKMT	ORI69	IKMT	ORI69
	EMPS	2000	3000	2000	3000	2000	3000	2000	3000	EMPSd	EMPSn	2000	EMPS	2000
Depth (m)	1051	1125	892	ND	865	863	832	1025	ND	1805	1800	1862	1480	1197
ENOPLOTEUTHIDAE														
Abralia armata	1													
Abralia sp.							1			2				
Abraiopsis cf. *lineata*								3						
Enoploteuthidae sp.												3		1
Pterygioteuthis giardi	1		1	5		3	1	1						
Pterygioteuthis sp.													1	
OCTOPOTEUTHIDAE														
Octopoteuthis cf. *megaptera*														
Octopoteuthis sp. larva														
ONYCHOTEUTHIDAE														
Onychoteuthidae sp. larva							1					1		
Onychia sp.												1		
BATHYTEUTHIDAE														
Bathyteuthis abyssicola				1									2	
HISTIOTEUTHIDAE														
Histioteuthis cf. *cerasina*										1				
Histioteuthis cf. *pacifica*											1			
Histioteuthis heteropsis													1	
NEOTEUTHIDAE														
Neoteuthis sp.											1			
OMMASTREPHIDAE														
Sthenoteuthis oualaniensis					1	1								
Rhynchoteuthion larva						18		1				10		1
LEPIDOTEUTHIDAE														
Lepidoteuthis? sp. larva														
CHIROTEUTHIDAE														
Chiroteuthis sp.						1								
MASTIGOTEUTHIDAE														
Mastigoteuthis cf. *grimaldii*						1								
Mastigoteuthis sp.										1				
CRANCHIIDAE														
Liocranchia reinhardti										2				
Liocranchia valdiviae														
Liocranchia sp. larva														
Helicocranchia pfefferi						2				3		3		
Cranchia scabra														
Megalocranchia sp.							1		1					
Leachia (P) sp.														
Bathothauma lyromma														
Broken Unid. larva								1						
VAMPYROTEUTHIDAE														
Vampyroteuthis infernalis													1	
BOLITAENIDAE														
Japetella diaphana	1												1	1
Eledonella pygmaea											1			
OCTOPODIDAE														
Octopus sp. larva														
ARGONAUTIDAE														
Argonauta sp.								1						
Total	3	0	1	6	1	26	4	7	1	9	3	18	6	3

Station	St. 9		St. 10			St. 11		St. 12		St. 14		St. 15		St. 16		ST. 17		
Net	IKMT	ORI69	IKMT	IKMT	ORI69	IKMT	ORI69	IKMT	ORI69	IKMT	ORI69	IKMT	ORI69	IKMT	ORI69	IKMT	ORI69	
	EMPS	2000	EMPSd	EMPSn	2000	EMPS	2000	EMPS	2000	EMPS	1704	EMPS	2000	EMPS	2000	3500	2000	
Depth (m)	1370	1679	1495	1570	ND	1430	1662	1645	1108	1345	ND	1395	ND	1130	ND	ND	ND	Total
ENOPLOTEUTHIDAE																		
Abralia armata																		1
Abralia sp.			1									2	1					7
Abraiopsis cf. *lineata*								1							1	1		6
Enoploteuthidae sp.			1		7		2				1		2		5	1	1	24
Pterygioteuthis giardi	1			1					1	2		2				1		20
Pterygioteuthis sp.			1															2
OCTOPOTEUTHIDAE														1	1			2
Octopoteuthis cf. *megaptera*		1							1									2
Octopoteuthis sp. larva																		
ONYCHOTEUTHIDAE																		
Onychoteuthidae sp. larva		1			2						1							6
Onychia sp.			1									1					1	4
BATHYTEUTHIDAE																		
Bathyteuthis abyssicola																		3
HISTIOTEUTHIDAE																		
Histioteuthis cf. *cerasina*																		1
Histioteuthis cf. *pacifica*																		1
Histioteuthis heteropsis																		1
NEOTEUTHIDAE																		
Neoteuthis sp.											1							2
OMMASTREPHIDAE																		
Sthenoteuthis oualaniensis					2							2	2		1			9
Rhynchoteuthion larva		4		1	16		3				3	1	3		8			69
LEPIDOTEUTHIDAE																		
Lepidoteuthis? sp. larva					1													1
CHIROTEUTHIDAE																		
Chiroteuthis sp.						1												2
MASTIGOTEUTHIDAE																		
Mastigoteuthis cf. *grimaldii*											1							2
Mastigoteuthis sp.			1	2														4
CRANCHIIDAE													1		1			2
Liocranchia reinhardti	1	2	4	5	2		1					1						18
Liocranchia valdiviae				1		2		1		1		1				1		7
Liocranchia sp. larva												1		1				2
Helicocranchia pfefferi	1	2			4	2												17
Cranchia scabra	1										1							2
Megalocranchia sp.			1															3
Leachia (P) sp.									1									1
Bathothauma lyromma										1		1						2
Broken Unid. larva					3							1	2		2		1	10
VAMPYROTEUTHIDAE																		
Vampyroteuthis infernalis			1									1		1				4
BOLITAENIDAE																		
Japetella diaphana	1				1	1	1	1		1				3				12
Eledonella pygmaea			1															2
OCTOPODIDAE																		
Octopus sp. larva											1						1	2
ARGONAUTIDAE																		
Argonauta sp.																		1
Total	5	10	12	10	38	6	7	3	3	5	9	14	11	6	19	4	4	254

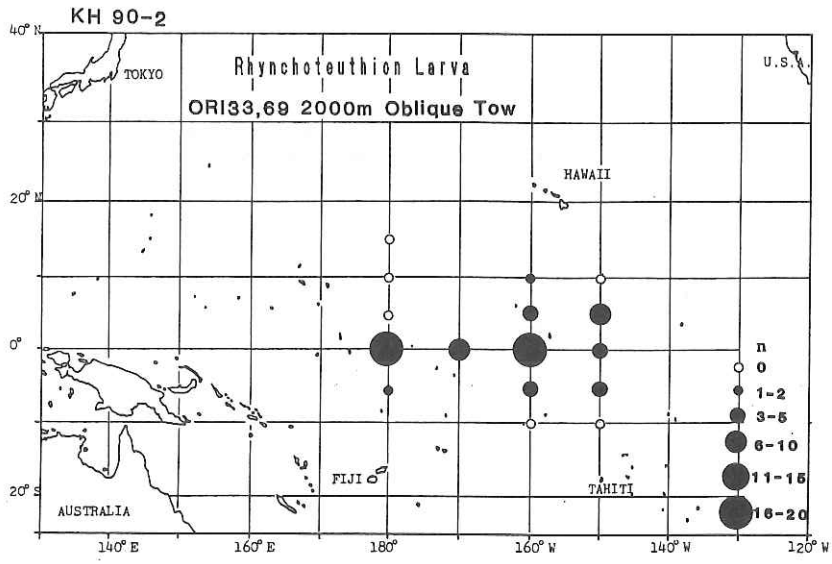


Fig. 1. Relative abundance of rhynchoteuthion larvae collected by ORI33 and ORI69 nets oblique sampling paying wire 2000 m out during the research cruise KH-90-2 of the R/V Hakuho Maru in 1990.

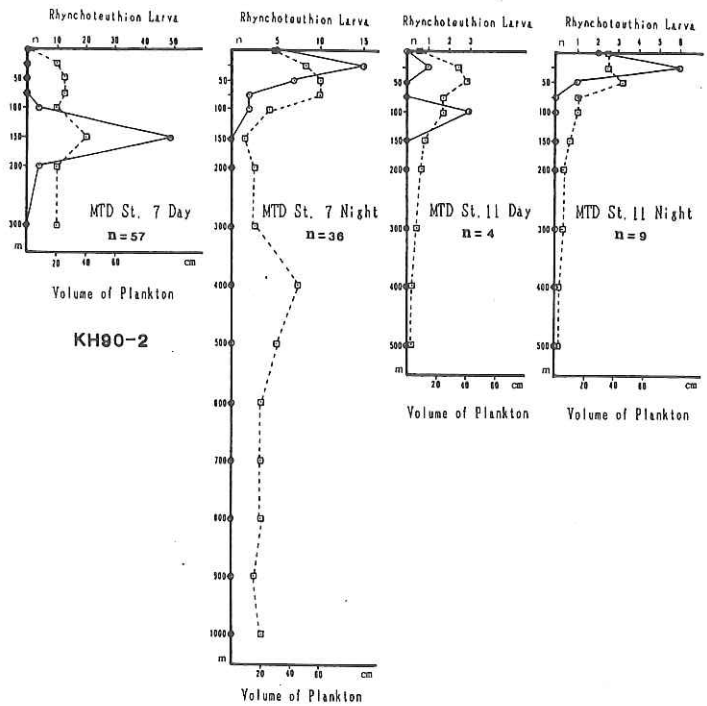


Fig. 2. Vertical distribution of rhynchoteuthion larvae collected by MTD nets at St. 7 and St. 11 during the research cruise KH-90-2 of the R/V Hakuho Maru in 1990. Number of rhynchoteuthion larvae, volume of plankton and the depth at which the net was towed were not revised with filtering volume and depth recorder.

Oceanographic Data of Hydrocast (1)

Station 1 Date 1990/09/10,11 Lat. 15° 00'N
Depth 5491m Time 22:07-2:10 Long. 179° 59'E

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0		28.396	34.511				34.628			1.1	0.181	0.41	0.01	0.0	0.039	0.016	0			
10	10.1	28.482	34.575	3.28			34.564	4.75	-0.28	1.0	0.138	0.40	0.00	0.0	0.043	0.006	10		28.50	34.562
30	30.4	28.386	34.676	3.23			34.567			0.9	0.131	0.41	0.00	0.1	0.043	0.021	30		28.42	34.514
50	49.6	27.876	34.661	3.31	44	27.86	34.650	4.84	-0.32	0.9	0.085	0.41	0.00	0.0	0.048	0.027	50		27.94	
60	60.5	27.518	34.658	3.38			34.646			1.1	0.105	0.42	0.01	0.0	0.063	0.024	60		27.64	34.638
70	68.3	26.861	34.687	3.50			34.685	4.94	-0.35	0.9	0.078	0.42	0.00	0.1	0.067	0.042	70		26.92	34.675
80	79.9	26.282	34.956	3.58			34.890			0.9	0.052	0.40	0.00	0.0	0.105	0.063	80		26.53	34.888
90	90.5	26.004	34.999	3.54			34.990	5.05	-0.40	0.0	0.039	0.38	0.00	0.0	0.116	0.077	90		26.06	34.988
100	99.4	25.403	35.011	3.56			34.999			0.8	0.056	0.40	0.01	0.0	0.137	0.092	100	104.4	25.48	34.991
110	109.8	24.817	35.050	3.48	105	25.08	35.048	4.90	-0.16	0.9	0.052	0.38	0.01	0.0	0.179	0.122	110		25.58	35.033
120	119.2	24.311	35.102	3.51			35.075			0.9	0.041	0.39	0.01	0.1	0.200	0.185	120	123.0	24.45	35.079
130	129.9	23.802	35.123	3.46			35.110	4.75	0.07	0.7	0.052	0.44	0.01	0.0	0.179	0.363	130	133.9	23.85	35.112
150	150.2	22.784	35.126	3.28			35.100			1.4	0.133	0.72	0.10	0.0	0.189	0.316	150	152.4	22.70	35.110
175	174.4	19.622	34.971	3.16			34.975	4.95	1.11	2.7	0.344	3.17	0.03	0.1	0.095	0.170	175	180.6	20.12	34.981
200	199.2	17.317	34.742	3.09			34.803			4.5	0.540	5.53	0.01	0.0	0.003	0.015	200	205.0	17.76	34.807
300	299.7	11.252	34.363	2.07			34.333	2.89	3.29	20.9	1.673	19.35	0.01	0.0	0.002	0.012				
400	399.4	9.000	34.462	1.13	386	9.244	34.423			37.7	2.391	30.12	0.00	0.0						
500	500.2	7.642	34.420	0.92			34.403	1.06	5.63	52.2	2.732	34.27	0.01	0.0						
750	749.3	5.684	34.500	1.02			34.491			76.9	3.015	38.51	0.00	0.0						
1000	999.9	4.603	34.535	1.28			34.527	1.23	5.95	96.0	3.071	39.29	0.00	0.0						
1250	1247.3	3.711	34.565	1.61			34.557			113.7	3.056	39.11	0.00	0.0						
1500	1500.0	2.964	34.574	1.99			34.583	2.63	4.95	129.9	2.982	38.52	0.00	0.1						
2000	1999.4	2.171	34.636	2.48			34.621			145.9	2.886	37.22	0.00	0.0						
2500	2500.3	1.799	34.660	2.85			34.649	2.95	4.87	152.5	2.781	36.35	0.00	0.0						
3000	3005.0	1.604	34.678	3.08	2991	1.618	34.666			154.8	2.746	35.25	0.00	0.0						

Oceanographic Data of Hydrocast (2)

Station 2 Date 1990/9/12. Lat. 10° 00'N
Depth 5890m Time 8:31-11:21 Long. 179° 59'E

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0		28.801	34.368				34.421			0.9	0.067	0.01	0.00	0.01	0.034	0.017	0			34.423
10	9.8	28.643	34.552	3.39			34.416	4.67	-0.21	0.8	0.057	0.02	0.00	0.04	0.031	0.014	10		28.80	34.422
30	30.6	28.397	34.529	3.40			34.393			0.8	0.074	0	0.02	0.02	0.034	0.018	30		28.61	34.389
50	49.5	27.847	34.650	3.55	43	28.320	34.481	4.81	-0.29	1.0	0.073	0.02	0.02	0.00	0.058	0.031	50		28.00	34.521
60	61.0	26.773	34.663	3.70			34.621			1.0	0.063	0.04	0.01	0.01	0.077	0.043	60		28.57	34.718
70	70.8	24.955	34.767	3.92			34.774	5.04	-0.31	0.8	0.001	0.04	0.02	0.01	0.082	0.041	70		25.02	34.800
80	79.7	24.569	34.830	3.75			34.822			0.8	0.027	0.05	0.01	0.00	0.104	0.058	80		22.89	34.857
90	90.0	22.241	34.912	3.83			34.896	4.94	0.03	1.4	0.097	0.09	0.01	0.00	0.148	0.104	90		21.75	34.901
100	100.1	20.785	34.822	3.51			34.859			2.4	0.263	0.98	0.07	0.03	0.208	0.261	100	107.7	19.16	34.752
110	110.2	18.889	34.747	3.10	103	19.044	34.737	3.85	1.43	5.1	0.522	5.13	0.32	0.01	0.208	0.319	110	115.1	16.04	34.581
120	120.7	16.874	34.742	2.89			34.640			7.3	0.780	8.67	0.28	0.01	0.180	0.289	120			34.694
130	129.0	14.857	34.543	2.75			34.517	3.25	2.47	10.7	1.021	12.25	0.10	0.02	0.161	0.233	130	126.7	14.80	34.506
150	150.5	12.923	34.530	2.19			34.438			15.9	1.354	17.43	0.02	0.00	0.082	0.228	150		13.65	34.445
175	174.2	11.628	34.449	1.44			34.446	2.10	4.02	23.0	1.827	23.03	0.02	0.01	0.035	0.128	175	179.8	11.62	34.447
200	200.2	10.875	34.573	0.85	189	10.864	34.557			29.5	2.247	29.24	0.01	0.02	0.015	0.027	200		19.32	34.584
300	299.6	9.418	34.636	0.76			34.629	0.90	5.51	36.0	2.545	33.53	0.02	0.03	0.003	0.014				
400	400.6	8.659	34.627	0.76			34.613			41.7	2.614	35.04	0.01	0.01						
500	499.7	7.722	34.570	1.05			34.557	1.14	5.53	49.7	2.753	35.63	0.02	0.09						
750	749.4	5.769	34.543	1.16			34.531			74.1	3.038	39.03	0.02	0.00						
1000	999.8	4.535	34.564	1.50			34.554	1.46	5.73	95.3	3.031	39.84	0.01	0.02						
1250	1249.8	3.636	34.588	1.80			34.549			114.8	3.041	39.13	0.02	0.00						
1500	1500.0	3.025	34.607	2.10			34.597	2.09	5.37	128.2	2.902	38.04	0.01	0.01						
2000	2000.0	2.271	34.641	2.47	1988	2.287	34.629	2.42	5.18	146.6	2.822	36.63	0.02	0.04						

Oceanographic Data of Hydrocast (3)

Station 3 Date 1990/09/13,14 Lat. 5° 06'N
Depth 5671m Time 21:33-1:06 Long. 180° 00'E

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0		29.923	34.186				34.204			1.1		0.06	0.01	0.04	0.069	0.034	0			
10	10.6	29.960	34.207	3.10			34.200			1.0		0.11	0.01	0.02	0.077	0.033	10		30.00	
30	30.9	29.959	34.207	3.04			34.196			1.1		0.05	0.01	0.04	0.075	0.034	30		30.01	
50	50.5	29.966	34.210	3.04			34.196			1.2		0.05	0.00	0.04	0.077	0.032	50		30.02	
60	60.2	29.971	34.214	3.04			34.195			1.2		0.04	0.01	0.05	0.079	0.034	60		29.99	
70	70.3	29.881	34.511	3.20			34.324			1.2		0.01	0.00	0.04	0.101	0.043	70		30.01	
80	80.1	29.508	35.102	3.19			34.662			1.6		0.06	0.00	0.04	0.142	0.075	80		29.56	
90	90.2	29.057	35.198	3.05			35.157			1.7		0.00	0.00	0.07	0.218	0.143	90		29.26	
100	99.9	28.198	35.124	2.93			35.147			1.8		0.05	0.01	0.08	0.271	0.281	100	98.3	28.70	
110	110.2	26.844	34.893	2.78			34.893			2.0		0.07	0.10	0.07	0.309	0.535	110	109.0	27.05	
120	120.7	25.797	34.881	2.77			34.870			3.3		3.99	0.47	0.03	0.211	0.475	120			
130	130.8	24.782	34.834	2.77			34.793			3.5		3.29	0.22	0.07	0.133	0.413	130	131.1	24.29	
150	150.4	21.321	34.835	2.60			34.824			8.6		8.39	0.02	0.05	0.082	0.182	150	155.8	19.34	
175	174.9	15.511	34.743	1.98			34.634			17.1		15.99	0.00	0.08	0.035	0.069	175	180.9	14.87	
200	199.6	12.954	34.623	1.45			34.599			23.7		22.29	0.00	0.03	0.024	0.041	200	202.6	12.90	
250	249.4	10.128	34.659	1.42			34.645			34.5		29.69	0.00	0.08						
300	300.1	9.435	34.652	1.58			34.638			36.3		30.39	0.00	0.04						
400	401.1	8.438	34.621	1.62			34.609			40.3		31.29	0.00	0.04						
550	550.6	7.109	34.577	0.92			34.566			58.1		37.19	0.00	0.04						
750	751.1	5.560	34.553	1.29			34.543			79.0		38.29	0.00	0.04						
1000	999.9	4.465	34.567	1.71			34.557			79.0		38.19	0.00	0.04						
1250	1249.9	3.609	34.591	2.00			34.580			117.4		37.49	0.00	0.04						
1500	1501.5	2.975	34.614	2.19			34.605			134.2		37.19	0.02	0.10						
2000	2017.0	2.283	34.646	2.56																

Oceanographic Data of Hydrocast (4)

Station 4 Date 1990/10/15. Lat. 6° 01'N
Depth 5169m Time 6:47-9:27 Long. 179° 54'E

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0		29.927	34.935				34.942			1.3	0.040	0.00	0.00	0.05	0.079	0.033	0		29.90	34.947
10	9.7	29.734	34.943	3.08				4.67	-0.30	1.2	0.320	0.00	0.00	0.01	0.088	0.031	10		29.78	34.934
30	30.2	29.714	34.950	3.15						1.2	0.047	0.00	0.00	0.03	0.092	0.057	30		29.77	34.981
50	50.3	29.698	34.968	3.07	26	29.680	34.939	4.81	-0.44	1.2	0.034	0.00	0.01	0.03	0.155	0.116	50		29.77	35.020
60	60.3	29.698	34.997	3.09			34.953			1.2	0.045	0.02	0.01	0.03	0.275	0.180	60		29.68	35.330
70	70.4	29.628	35.061	3.10			34.985	4.69	-0.31	1.2	0.152	0.40	0.07	0.20	0.350	0.278	70		29.42	35.393
80	80.1	29.399	35.341	3.10						1.6	0.170	0.52	0.07	0.33	0.275	0.216	80		29.39	35.395
90	89.8	29.320	35.364	3.05			35.329	4.58	-0.19	1.6	0.223	1.10	0.20	0.71	0.199	0.133	90		29.14	35.581
100	99.7	28.852	35.478	2.83	96	29.040	35.455			2.3	0.497	4.48	0.95	0.06	0.193	0.219	100	102.7	27.72	35.560
110	110.0	26.973	35.629	2.64			35.592	4.67	0.89	3.0	0.544	6.61	0.14	0.10	0.155	0.235	110	112.4	26.03	35.407
120	120.2	26.056	35.569	2.59			35.564			3.6	0.591	7.47	0.05	0.11	0.151	0.278	120	122.5	24.91	35.343
130	129.8	24.632	35.402	2.52			35.383	3.39	1.36	4.0	0.599	7.80	0.05	0.15	0.139	0.255	130	132.8	24.25	35.264
150	149.5	22.781	35.180	2.52			35.157			4.6	0.608	8.46	0.01	0.03	0.104	0.181	150	152.8	22.76	35.126
175	174.7	19.656	35.172	2.77			35.154	3.33	1.86	7.4	0.774	9.97	0.00	0.03	0.028	0.049	175	182.8	19.21	34.966
200	200.4	17.478	35.008	2.63	196	17.723	34.988			23.4	1.675	23.47	0.00	0.09	0.012	0.028	200			
300	298.9	11.767	34.844	1.99			34.841	2.77	3.32	20.1	1.542	22.57	0.00	0.07	0.002	0.018				
400	399.7	9.781	34.539	1.09			34.725			31.9	2.283	33.97	0.00	0.03						
500	499.8	7.711	34.610	1.58			34.601	1.63	5.03	42.6	2.561	36.17	0.00	0.03						
750	749.3	5.849	34.549	2.02			34.540			62.6	2.609	37.97	0.00	0.00						
1000	998.5	4.786	34.555	2.11			34.555	2.14	5.00	83.3	2.679	38.57	0.00	0.02						
1250	1249.2	3.803	34.585	2.23			34.580			106.8	2.718	39.07	0.00	0.07						
1500	1499.1	3.133	34.606	2.51			34.604	2.38	5.06	122.9	2.751	38.56	0.01	0.09						
2000	2002.9	2.247	34.649	2.68	1975	2.255	34.642	2.65	4.96	146.5	2.763	37.85	0.02	0.10						

Oceanographic Data of Hydrocast (5)

Station 5 Date 1990/10/16. Lat. 5° 00'S
Depth 5684m Time 19:58-23:25 Long. 179° 58'E

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0		29.465	35.330				35.343			1.3	0.186	0.80	0.02	0.10	0.126	0.054	0			
10	9.1	29.525	35.344	3.10			35.330	4.61	-0.24	1.3	0.154	0.80	0.02	0.16	0.139	0.056	10			35.374
30	28.9	29.469	35.344	3.08			35.356			1.4	0.147	1.00	0.02	0.23	0.170	0.079	30			35.375
50	50.0	29.454	35.372	3.07	44	29.440	35.358	4.61	-0.23	1.4	0.237	1.05	0.03	0.17	0.174	0.083	50			
60	59.7	29.417	35.396	3.08			35.384			1.4	0.232	1.36	0.03	0.20	0.180	0.084	60			35.438
70	65.2	29.365	35.407	3.03			35.393	4.62	-0.24	1.5	0.265	1.71	0.04	0.20	0.170	0.111	70			35.459
80	80.4	29.290	35.408	3.04			35.395			1.5	0.289	1.93	0.04	0.29	0.199	0.112	80			35.468
90	89.0	29.274	35.405	3.05			35.397	4.58	-0.19	1.5	0.257	1.91	0.04	0.39	0.196	0.122	90			35.470
100	100.0	29.106	35.532	3.06			35.395			1.5	0.308	1.97	0.04	0.38	0.189	0.128	100			35.481
110	110.5	29.055	35.530	3.09	113	29.220	35.397	4.56	-0.15	1.5	0.317	2.04	0.05	0.39	0.183	0.142	110			35.491
120	119.5	28.897	35.576	2.99			35.419			1.6	0.322	1.96	0.08	0.72	0.174	0.144	120	122.3	29.01	35.479
130	129.4	28.321	35.779	2.82			35.621	4.22	0.24	1.6	0.417	1.88	0.58	1.18	0.177	0.224	130	132.3	28.56	35.635
150	149.8	26.723	36.015	2.64			35.828			1.5	0.445	2.72	2.15	0.07	0.117	0.208	150	152.1	27.30	35.837
175	174.1	24.826	36.252	2.53			36.081	3.49	1.22	1.5	0.645	5.55	0.05	0.07	0.047	0.151	175	179.1	24.46	36.110
200	200.1	20.156	35.843	2.13			35.875			3.5	0.786	8.61	0.01	0.05	0.029	0.050	200			35.772
300	299.0	11.276	34.932	1.80	294	11.662	34.866	1.78	4.37	18.9	1.977	24.60	0.00	0.12	0.007	0.003				
400	400.0	9.480	34.812	1.88			34.719			25.7	2.189	28.60	0.00	0.12						
500	500.2	8.403	34.737	2.26			34.645	2.42	4.14	27.5	2.176	28.59	0.01	0.09						
750	749.4	6.177	34.559	2.69			34.542			46.1	2.466	32.60	0.00	0.05						
1000	999.3	4.757	34.541	2.66	980	4.772	34.529	2.62	4.53	69.5	2.628	34.50	0.00	0.05						
1250	1248.7	3.668	34.576	2.71			34.569			108.9	2.649	35.20	0.00	0.11						
1500	1488.6	3.034	34.601	2.88			34.596	2.76	4.70	108.5	2.774	35.20	0.00	0.09						
2000	2002.2	2.154	34.650	3.06			34.640	2.97	4.65	132.3	2.714	34.39	0.01	0.15						

Oceanographic Data of Hydrocast (6)

Station 7 Date 1990/9/28. Lat. 0° 01'S
Depth 5520m Time 0:48-4:26 Long. 170° 01'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0		28.478	35.068				35.253	4.72	-0.26	1.40	0.288	2.01	0.25	0.02	0.237	0.128	0			
10		28.383	35.365	3.16	7	28.520	35.230	4.76	-0.30	1.75	0.272	2.00	0.26	0.01	0.243	0.136	10		28.27	
30		28.249	35.370	3.09			35.236			1.75	0.260	2.07	0.27	0.04	0.312	0.218	30		28.44	
50		28.176	35.403	3.09			35.276	4.63	-0.15	1.75	0.278	2.38	0.31	0.04	0.347	0.256	50		28.36	
60		28.119	35.436	3.07	55	28.280	35.301			1.75	0.332	2.52	0.34	0.16	0.344	0.255	60		28.31	
70		28.085	35.455	3.04			35.321	4.54	-0.63	1.75	0.371	2.63	0.36	0.15	0.316	0.244	70		28.27	
80		28.023	35.468	3.03			35.336			1.82	0.359	2.78	0.40	0.31	0.278	0.217	80		28.25	
90		27.947	35.456	3.04			35.326	4.57	-0.29	1.89	0.351	2.94	0.45	0.52	0.218	0.201	90		28.11	
100		27.871	35.501	2.93			35.336			1.96	0.451	3.11	0.57	0.50	0.151	0.145	100	97.3	28.07	
110		27.580	35.644	2.90			35.508	4.28	0.23	2.03	0.506	4.36	0.98	0.06	0.079	0.084	110	107.8	27.96	
120		27.205	35.690	2.63	124	27.350	35.555			2.45	0.603	6.18	0.26	0.02	0.073	0.130	120	122.4	27.47	
130		25.106	35.650	2.48			35.526	3.51	1.19	3.15	0.661	7.96	0.07	0.04	0.056	0.080	130	130.0	25.58	
150		20.912	35.314	2.60			35.196			5.40	0.767	9.65	0.03	0.01	0.034	0.059	150	150.2	21.07	
175		18.776	35.455	2.52			35.335	3.25	2.02	5.26	0.830	10.91	0.01	0.09	0.019	0.028	175	185.5	18.40	
200		15.433	35.272	2.53			35.127			8.86	1.063	13.82	0.01	0.02	0.004	0.015	200		15.22	
300		11.782	34.945	1.77			34.848	2.33	3.74	18.99	1.684	23.98	0.02	0.03	0.001	0.015				
400		9.644	34.811	1.82			34.716			31.59	2.409	36.71	0.01	0.01						
500		8.095	34.713	1.12	494	8.226	34.631	1.06	5.55	38.39	2.751	37.18	0.01	0.02						
750		5.869	34.638	1.78			34.552			57.69	2.820	38.59	0.01	0.01						
1000		4.574	34.633	2.08			34.553	1.06	6.11	78.39	2.860	38.55	0.01	0.00						
1250		3.608	34.658	2.08			34.584			102.09	2.935	39.73	0.01	0.08						
1500		3.060	34.606	2.42	1476	3.066	34.599	2.45	5.00	114.29	3.049	38.60	0.01	0.11						
2000		2.291	34.645	2.65			34.642	2.60	5.00	135.29	3.253	38.42	0.01	0.01						
2500		1.849	34.669	2.01			34.664	3.00	4.68	142.09	3.056	37.37	0.01	0.02						
3000		1.653	34.679	3.27			34.689	3.26	4.47	142.49	3.145	36.41	0.01	0.01						

Oceanographic Data of Hydrocast (7)

Station 8 Date 1990/10/1. Lat. 10° 04'N
Depth 5216m Time 18:04-23:57 Long. 160° 00'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0		28.639	33.943				34.190	4.70	-0.23	1.64	0.120	0.12	0.05	0.05	0.104	0.033	0			
10	9.1	28.724	34.175	3.21			34.179	4.69	-0.22	1.64	0.133	0.03	0.05	0.12			10		28.750	
30	30.4	28.715	34.235	3.29			34.632			1.64	0.142	0.08	0.04	0.05	0.170	0.093	30		26.640	
50	50.3	27.201	34.650	3.68			34.665	4.96	-0.40	2.29	0.173	0.01	0.11	0.05	0.189	0.107	50		27.190	
60	60.6	25.894	34.658	3.71			34.623			3.61	0.365	2.09	0.24	0.12	0.240	0.183	60		24.190	
70		22.051	34.633	3.76			34.598	3.91	1.08	6.25	0.666	6.97	0.24	0.06	0.234	0.221	70		19.080	
80		18.052	34.574	3.29			34.626			6.91	0.694	7.82	0.20	0.08	0.211	0.207	80		16.990	
90		16.965	34.648	3.42			34.522	3.15	2.33	10.90	1.055	13.32	0.14	0.06	0.189	0.211	90		15.480	
100		15.049	34.635	2.46			34.456			14.91	1.429	18.50	0.10	0.06	0.170	0.209	100	102.2	14.280	
110		13.728	34.547	2.18			34.453	1.96	3.90	18.96	1.681	22.25	0.07	0.06	0.142	0.205	110	110.0	13.670	
120		13.177	34.556	1.39			34.528			24.20	2.145	28.06	0.05	0.06	0.243	0.172	120	125.0	12.640	
130		12.351	34.632	0.92			34.652	0.51	5.51	28.51	2.376	32.22	0.04	0.11	0.040	0.124	130	128.8	12.240	
150		11.703	34.768	0.45			34.715			30.57	2.447	34.01	0.04	0.07	0.008	0.033	150	150.1	11.771	
175		11.106	34.803	0.74			34.706	0.47	5.70	31.61	2.495	34.11	0.05	0.04	0.004	0.038	175	176.7	11.186	
200		10.817	34.794	0.54			34.691			35.07		35.97	0.05	0.10	0.001	0.029	200	204.8	10.783	
300		9.923	34.786	0.40			34.660	0.34	6.00	40.31	2.758	37.19	0.05	0.12	0.004	0.019				
400		9.201	34.752	0.35			34.600			48.77	2.941	38.08	0.05	0.16						
500		8.192	34.648	0.41			34.532	0.44	6.16	77.82	3.284	42.88	0.04	0.07						
750		5.908	34.610	0.53			34.552			101.96	3.346	44.05	0.05	0.09						
1000		4.561	34.555	1.04			34.576	1.41	5.78	119.83	3.223	42.90	0.04	0.04						
1250		3.703	34.580	1.53			34.606			139.73	3.198	41.82	0.04	0.07						
1500		2.882	34.608	1.95			34.643	2.36	5.13	158.43	3.056	40.37	0.04	0.05						
2000		2.154	34.649	2.54			34.667	2.69	4.94	165.03	2.799	39.30	0.04	0.04						
2500		1.840	34.671	2.83			34.678	3.07	4.61	165.83	2.874	38.34	0.04	0.03						
3000		1.648	34.683	3.87			34.677	3.15	4.63	165.83	2.903	38.39	0.05	0.03						

Oceanographic Data of Hydrocast (8)

Station 9 Date 1990/10/3. Lat. 5° 01'N
Depth 3529m Time 4:36-8:10 Long. 160° 01'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0	0.0	28.979	34.931				34.940	4.67	-0.24	0.69	0.392	0.486	0.02	0.15	0.151	0.098	0			
10	9.8	28.935	34.946	3.07			34.937	4.71	-0.28	0.78	0.287	0.442	0.02	0.17	0.164	0.089	10		28.93	
30	29.9	28.887	34.956	2.99			34.948			0.66	0.298	0.487	0.03	0.08	0.186	0.103	30		28.93	
50	50.9	28.832	34.981	2.99			34.970	4.69	-0.25	0.68	0.298	0.642	0.04	0.11	0.215	0.164	50		28.85	
60	60.7	28.660	35.106	3.03			34.976			0.77	0.318	0.697	0.04	0.11	0.209	0.170	60		28.85	
70	70.1	28.609	35.118	2.97			34.995	4.67	-0.22	0.72	0.356	0.976	0.08	0.20	0.230	0.199	70		28.80	
80	80.6	28.132	35.164	2.93			35.032			1.01	0.436	1.679	0.29	0.30	0.196	0.266	80		28.44	
90	90.1	27.942	35.156	2.92			35.025	4.43	0.07	0.77	0.425	1.726	0.43	0.32	0.240	0.237	90		28.06	
100	101.2	27.557	35.112	2.90			35.006			1.25	0.446	1.823	0.52	0.25	0.148	0.296	100	104.1	27.66	
110	109.1	26.774	35.061	2.87	112	2.764	34.954	4.32	0.27	1.14	0.415	1.570	0.52	0.19	0.133	0.301	110	106.6	26.49	
120	121.4	25.728	35.005	2.83			34.869			1.56	0.449	1.782	0.44	0.17	0.126	0.206	120	123.6	25.77	
130	130.0	25.251	35.075	2.49			34.925	3.89	0.81	2.11	0.551	3.604	0.51	0.03	0.117	0.208	130	127.6	25.14	
150	151.2	19.920	34.986	2.22			34.846			6.09	0.862	9.935	0.02	0.01	0.019	0.045	150	147.3	21.57	
175	175.9	17.168	34.834	1.89			34.731	2.69	2.77	11.51	1.228	15.104	0.01	0.01	0.037	0.071	175	173.1	17.26	
200	198.3	17.786	34.833	1.34			34.641			19.84	1.804	22.847	0.00	0.01	0.010	0.025	200	208.2	12.80	
300	299.9	9.299	34.751	1.34			34.651	1.53	4.90	33.24	2.340	32.769	0.00	0.01	0.002	0.014				
400	399.9	8.322	34.710	1.51	393	8.43	34.614			37.45	2.492	34.111	0.00	0.03						
500	499.9	7.634	34.689	1.15			34.594	1.27	5.41	44.40	2.759	37.411	0.00	0.01						
750	749.3	5.732	34.633	1.52			34.602			66.59	2.986	39.897	0.00	0.06						
1000	999.4	4.506	34.639	1.65			34.556	1.60	5.59	90.68	3.093	40.909	0.00	0.01						
1250	1251.4	3.727	34.658	1.80																
1500	1499.2	3.153	34.608	2.05			34.599	1.87	5.57	126.23	3.155	40.975	0.00	0.05						
2000	2000.5	2.296	34.645	2.53			34.636	2.35	5.24	145.76	3.046	39.611	0.00	0.02						
2500	2499.5	1.865	34.671	2.92			34.661	2.76	4.92	154.03	2.825	38.445	0.00	0.02						
3000	3001.1	1.717	34.681	3.13	2986	1.713	34.674	3.04	4.68	154.21	2.720	37.653	0.00	0.01						

Oceanographic Data of Hydrocast (9)

Station 10 Date 1990/10/4. Lat. 0° 01'N
Depth 5166m Time 20:08-23:15 Long. 160° 01'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0	0.0	27.693	35.458				35.403	4.85	-0.35	1.38		3.39	0.20	0.12	0.376	0.199	0			
10	10.3	27.681	35.515	3.22			35.378	4.78	-0.27	1.41	0.406	3.39	0.19	0.15	0.331	0.210	10		27.91	
30	30.2	27.799	35.391	3.12			35.379			1.37	0.467	3.40	0.20	0.11	0.366	0.222	30		27.86	
50	50.1	27.792	35.393	3.12			35.380	4.76	-0.26	1.28	0.450	3.44	0.21	0.16	0.338	0.244	50		27.84	
60	59.9	27.765	35.397	3.07	53	27.710	35.386			1.44	0.481	3.58	0.28	0.18	0.290	0.251	60		27.82	
70	70.0	27.667	35.422	2.93			35.419	4.57	-0.07	1.42	0.476	3.93	0.45	0.25	0.249	0.191	70		27.78	
80	80.8	27.470	35.509	2.80			35.490			1.83	0.566	4.76	0.69	0.19	0.148	0.159	80		27.71	
90	91.0	27.273	35.551	2.74			35.528	4.16	0.37	1.80	0.563	5.64	0.78	0.14	0.079	0.094	90		27.81	
100	99.4	27.172	35.542	2.68			35.527			1.89	0.583	5.95	0.73	0.07	0.076	0.105	100	91.3	27.39	
110	110.5	26.715	35.663	2.68			35.528	3.87	0.70	1.86	0.643	6.93	0.44	0.02	0.069	0.111	110	102.6	27.19	
120	120.4	24.887	35.777	2.36	123	26.030	35.619			2.62	0.735	8.72	0.05	0.04	0.045	0.063	120	106.2	26.75	
130	130.3	22.736	35.395	2.37			35.290	3.21	1.70	4.36	0.780	9.75	0.04	0.08	0.024	0.073	130	113.5	25.10	
150	150.4	20.425	35.339	2.47			35.214			5.52	0.900	10.46	0.02	0.03	0.007	0.010	150	135.5	21.66	
175	174.5	16.987	35.256	2.56			35.137	3.36	2.10	8.33	1.016	12.71	0.01	0.03	0.010	0.019	175	176.9	19.09	
200	200.4	13.913	35.061	2.45			34.960			14.02	1.271	17.16	0.01	0.02	0.002	0.019	200	186.8	14.63	
300	300.2	11.713	34.935	1.06			34.832	1.55	4.53	23.99	2.030	27.18	0.01	0.04	0.002	0.020				
400	400.1	9.599	34.807	0.78			34.707			34.55	2.514	33.93	0.00	0.02						
500	500.7	8.373	34.652	1.14	493	8.385	34.639	0.94	5.62	40.47	2.650	35.44	0.00	0.02						
750	750.7	5.892	34.561	1.78			34.550			61.78	2.667	36.37	0.00	0.05						
1000	1001.6	4.531	34.562	2.04			34.552	2.08	5.11	85.79	2.789	36.47	0.00	0.01						
1250	1249.9	3.715	34.586	2.11			34.576			105.75	2.785	36.94	0.00	0.02						
1500	1500.7	2.906	34.616	2.36	1480	2.910	34.603	2.40	5.08	124.59	2.766	36.53	0.00	0.05						
2000	1994.6	2.263	34.651	2.61			34.636	2.58	5.02	141.71	2.794	36.17	0.00	0.01						

Oceanographic Data of Hydrocast (10)

Station 11 Date 1990/10/6. Lat. 5° 00'S
Depth 5232m Time 12:43-15:34 Long. 160° 01'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0	0.0	27.96	35.495				35.509	4.77	-0.28	2.29	0.675	4.60	0.13	0.09	0.164	0.107	0			35.507
10	10.1	27.96	35.512	3.13				4.74	-0.26	2.32	0.713	4.60	0.13	0.14	0.155	0.102	10		27.97	35.501
30	28.9	27.96	35.513	3.12						2.16	0.683	4.61	0.12	0.14	0.158	0.099	30		28.01	35.501
50	49.4	27.81	35.635	3.11			35.495	4.77	-0.28	2.20	0.679	4.62	0.12	0.11	0.129	0.094	50		27.98	35.498
60	60.0	27.80	35.634	3.13						2.17	0.691	4.60	0.12	0.06	0.167	0.104	60		28.01	35.499
70	68.5	27.76	35.628	3.08			35.489			2.20	0.699	4.60	0.12	0.22	0.186	0.113	70		27.98	35.497
80	79.4	27.63	35.616	3.10			35.476			2.17	0.730	4.78	0.12	0.38	0.202	0.170	80		27.88	35.480
90	90.4	27.60	35.609	3.15			35.474			2.27	0.690	4.83	0.13	0.53	0.208	0.189	90		27.72	35.476
100	99.5	27.68	35.490	3.07			35.469			2.30	0.796	5.04	0.14	0.72	0.180	0.149	100	99.9	27.55	35.468
110	109.1	27.48	35.478	3.09			35.462	4.66	-0.11	2.26	0.726	4.94	0.14	0.62	0.142	0.140	110	113.0	27.53	35.466
120	120.5	27.46	35.483	3.11	122	27.410	35.465			2.23	0.713	4.99	0.14	0.75	0.107	0.109	120	122.8	27.50	35.480
130	128.4	27.42	35.475	3.05			35.463	4.64	-0.12	2.27	0.789	5.00	0.15	0.73	0.079	0.087	130	133.0	27.47	35.469
150	149.9	27.20	35.529	2.87			35.525			2.36	0.875	5.12	1.45	0.14	0.076	0.108	150	155.2	26.58	35.725
175	174.1	23.55	36.241	2.56			36.169	3.70	1.11	1.94	0.889	5.71	0.02	0.11	0.040	0.071	175	-	-	36.174
200	199.9	19.13	35.703	2.30			35.679			4.82	1.238	11.96	0.01	0.11	0.010	0.019	200	207.2	18.24	35.541
300	299.7	10.97	34.930	1.40			34.816	1.43	4.75	23.11	2.329	29.55	0.00	0.04	0.001	0.010				
400	399.8	9.38	34.807	1.46			34.706			27.91	2.473	32.15	0.00	0.14						
500	499.6	8.17	34.736	1.04	492	8.339	34.643	0.87	5.71	38.81	2.905	38.18	0.00	0.03						
750	750.8	6.03	34.638	1.88			34.545			52.21	3.001	38.55	0.00	0.03						
1000	1000.7	4.39	34.629	2.23			34.544	2.22	4.99	82.21	3.066	39.18	0.00	0.08						
1250	1247.6	3.44	34.655	2.76			34.571			103.81	3.083	38.52	0.00	0.07						
1500	1500.1	2.91	34.679	2.80	1479	2.992	34.595	2.58	4.90	118.61	3.089	38.62	0.01	0.04						
2000	2002.4	2.12	34.720	3.03	1990	2.174	34.637	3.00	4.62	136.71	3.010	37.54	0.00	0.02						

Oceanographic Data of Hydrocast (11)

Station 12 Date 1990/10/9. Lat. 10° 01'S
Depth 4828m Time 2:13-5:09 Long. 160° 02'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0	0.0	28.468	35.216				35.745	4.82	-0.35	0.97	0.315	0.76	0.02	0.13	0.101	0.069	0			
10	10.1	28.506	35.762	3.05			35.753	4.82	-0.38	0.64	0.352	0.52	0.02	0.25	0.114	0.071	10		28.50	
30	30.2	28.444	35.773	3.02			35.759			0.97	0.299	0.59	0.02	0.34	0.136	0.077	30		28.50	
50	50.6	28.436	35.775	3.03			35.764	4.79	-0.35	0.64	0.309	0.56	0.02	0.07	0.155	0.094	50		28.47	
60	59.8	28.431	35.776	3.01	66	26.430	35.765			0.64	0.285	0.47	0.01	0.08	0.183	0.113	60		28.48	
70	70.4	28.426	35.786	2.96			35.773	4.79	-0.35	0.97	0.274	0.19	0.02	0.28	0.151	0.090	70		28.48	
80	80.0	28.367	35.787	2.99			35.793			0.97	0.272	0.17	0.01	0.16	0.158	0.113	80		28.51	
90	90.1	28.360	35.809	2.95			35.775	4.81	-0.36	0.97	0.231	0.38	0.00	0.07	0.161	0.106	90		28.42	
100	100.6	28.296	35.806	2.88			35.792			0.97	0.237	0.32	0.01	0.13	0.164	0.125	100	98.7	28.39	
110	109.9	27.513	35.972	2.79			35.972	4.51	-0.03	1.29	0.340	0.51	0.22	0.58	0.205	0.282	110	114.0	27.68	
120	120.3	27.182	36.079	2.79			36.068			1.29	0.327	0.52	0.33	0.52	0.148	0.343	120	122.7	27.48	
130	129.7	26.534	36.230	2.67	122	26.570	36.216	4.14	0.42	1.29	0.422	0.96	1.26	0.16	0.158	0.239	130	133.4	26.89	
150	150.2	24.938	36.428	2.64			36.406			1.29	0.489	2.52	0.97	0.05	0.095	0.151	150	156.4	25.55	
175	174.9	24.037	36.539	2.72			35.412	3.92	0.84	0.97	0.532	3.50	0.11	0.06	0.051	0.092	175	180.6	24.17	
200	200.0	22.764	36.424	2.75			-			0.97	0.545	3.96	0.02	0.06	0.024	0.038	200	207.2	22.43	
300	300.4	14.054	35.145	1.94			-	2.42	3.36	9.43	1.603	17.77	0.02	0.07	0.003	0.003				
400	400.8	10.251	34.834	2.21	395	10.369	34.729			19.99	2.066	27.04	0.01	0.07						
500	500.0	7.726	34.672	2.59			34.577	2.92	3.73	28.03	2.226	29.93	0.01	0.09						
750	750.6	5.650	34.606	2.35			34.578			49.94	2.665	35.91	0.01	0.06						
1000	999.8	4.430	34.612	2.64			34.529	2.72	4.49	71.09	2.775	36.69	0.02	0.06						
1250	1250.0	3.531	34.640	2.82	1230	3.608	34.558			91.01	2.799	36.51	0.01	0.09						
1500	1500.3	2.972	34.667	2.98			34.585	2.99	4.47	104.73	2.786	36.67	0.02	0.05						
2000	2000.8	2.225	34.644	3.22	1988	2.218	34.632	3.29	4.32	123.13	2.723	35.87	0.02	0.06						

Oceanographic Data of Hydrocast (12)

Station 13 Date 1990/10/17 Lat. 10° 01'S
Depth 4063m Time 9:26-12:19 Long. 149° 58'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0							35.727			0.85	0.48	3.23	0.06	0.20	0.145	0.082	0			
10	9.2	28.042	35.826	3.10			35.695	4.58	-0.11	0.87	0.43	3.14	0.06	0.03	0.136	0.081	10		28.24	
30	29.5	28.045	35.826	3.08						1.02	0.46	3.14	0.05	0.05	0.133	0.088	30		28.26	
50	50.2	28.051	35.827	3.10			35.695	4.58	-0.11	0.83	0.48	3.08	0.06	0.04	0.133	0.091	50		28.25	
60	59.3	27.804	35.856	3.08			35.718			0.92	0.47	2.87	0.06	0.10	0.218	0.190	60		27.99	
70	69.2	27.685	35.910	3.02			35.780	4.47	0.03	1.08	0.46	2.58	0.08	0.25	0.215	0.262	70		27.90	
80	80.2	27.529	35.986	3.24			35.863			1.37	0.47	2.26	0.24	0.40	0.211	0.312	80		27.87	
90	89.9	27.299	36.076	2.94			35.953	4.18	0.34	1.19	0.52	2.04	0.67	0.26	0.208	0.272	90		27.66	
100	100.2	27.063	36.142	2.90			36.013			1.21	0.48	1.99	0.80	0.19	0.193	0.306	100	-	26.60	
110	109.6	26.731	36.206	2.93			36.066	4.00	0.53	1.16	0.59	2.66	1.20	0.03	0.186	0.211	110	114.0	27.12	
120	119.3	26.349	36.247	2.87			36.114			1.25	0.58	3.94	1.10	0.09	0.151	0.213	120	125.0	26.86	
130	129.6	26.078	36.268	2.79	120	26.230	36.139	3.78	0.82	1.20	0.64	4.68	0.71	0.07	0.136	0.196	130	134.3	26.27	
150	150.5	24.529	36.408	2.72			36.314			1.22	0.60	5.14	0.22	0.06	0.082	0.145	150	153.7	24.24	
175	175.1	23.110	36.438	2.82			36.358	3.82	1.01	0.89	0.61	4.64	0.03	0.00	0.033	0.049	175	184.1	23.19	
200	200.3	21.493	36.087	2.78			36.056			1.12	0.67	5.79	0.02	0.00	0.016	0.019	200	207.6	21.46	
300	299.1	13.262	35.023	1.79			34.966	2.14	3.75	10.88	1.70	19.69	0.01	0.05	0.001	0.008				
400	400.1	9.455	34.767	2.01	394	9.566	34.677			23.55	2.20	29.03	0.01	0.04						
500	499.1	7.563	34.680	2.27			34.589	2.37	4.31	32.15	2.28	32.10	0.04	0.11						
750	750.0	5.437	34.609	2.28			34.527			55.17	2.60	36.48	0.01	0.00						
1000	1000.1	4.498	34.616	2.46			34.542	2.36	4.82	72.56	2.64	37.20	0.02	0.01						
1250	1248.8	3.528	34.643	2.89	-	3.604	34.566			92.48	2.64	36.47	0.01	0.04						
1500	1500.3	3.031	34.596	3.08			34.589	2.89	4.56	103.43	2.59	35.97	0.02	0.03						
2000	2000.7	2.234	34.644	3.27	1988	2.229	34.637	3.11	4.49	121.93	2.54	35.53	0.02	0.04						

Oceanographic Data of Hydrocast (13)

Station 14 Date 1980/10/18. Lat. 5° 01S
Depth 4682m Time 18:27-21:08 Long. 150° 01W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0							35.527			1.75	0.51	4.54	0.13	0.13	0.129	0.087	0			35.528
10	10.5	27.578	35.524	3.23			35.516	4.63	-0.12	1.75	0.48	4.51	0.13	0.12	0.139	0.081	10		27.61	35.514
30	30.3	27.524	25.522	3.14			35.517			1.05	0.50	4.56	0.13	0.19	0.136	0.095	30		27.58	35.512
50	50.1	27.518	35.522	3.13			35.514	4.66	-0.15	1.40	0.54	4.49	0.13	0.16	0.148	0.104	50		27.58	35.510
60	60.8	27.355	35.644	3.30	64	27.510	35.516			1.75	0.49	4.55	0.13	0.27	0.148	0.112	60		27.55	35.509
70	70.4	27.346	35.641	3.35			35.514	4.64	-0.12	1.75	0.57	4.54	0.13	0.27	0.167	0.100	70		27.53	35.508
80	81.2	27.300	35.638	3.20			35.507			1.75	0.50	4.63	0.13	0.23	0.180	0.134	80		27.52	35.507
90	91.6	27.154	35.630	3.35			35.500	4.65	-0.13	1.75	0.52	4.79	0.14	0.32	0.189	0.175	90		27.35	35.500
100	101.1	27.107	35.627	3.37			35.497			1.75	0.53	4.78	0.15	0.36	0.208	0.236	100	101.0	27.35	35.494
110	109.8	27.086	35.625	3.33			35.497	4.63	-0.12	1.75	0.54	4.74	0.16	0.41	0.174	0.213	110	114.2	27.31	34.491
120	120.6	27.054	35.625	3.48			35.491			1.75	0.52	4.73	0.16	0.51	0.164	0.179	120	119.4	27.26	35.488
130	130.3	26.914	35.618	3.25	122	27.080	35.483	4.56	-0.11	1.75	0.56	4.76	0.20	0.63	0.155	0.181	130	136.0	27.07	35.473
150	150.4	25.193	36.079	2.95			35.916			1.75	0.65	5.59	0.47	0.08	0.076	0.116	150	156.8	23.50	35.926
175	176.2	20.639	35.954	2.54			35.868	3.55	1.52	1.75	0.74	6.80	0.00	0.01	0.027	0.041	175	180.4	19.33	35.683
200	200.5	16.270	35.420	1.70			34.302			4.56	1.14	12.73	0.02	0.20	0.011	0.012	200	207.4	15.77	35.223
300	302.3	10.138	34.861	0.99			34.768	1.30	5.00	26.44	2.36	31.51	0.01	0.04	0.002	0.008				
400	400.7	8.916	34.787	0.68	394	9.023	34.691			36.73	2.71	37.06	0.01	0.04						
500	500.4	7.889	34.726	0.97			34.635	0.93	5.72	41.56	2.80	38.73	0.01	0.00						
750	749.8	5.914	34.640	1.79			34.551			54.72	2.78	38.24	0.01	0.09						
1000	1000.6	4.337	34.631	2.18			34.554	2.24	4.97	82.57	2.85	38.40	0.01	0.19						
1250	1250.3	3.415	34.659	2.38	1241	3.490	34.581			104.94	2.84	38.33	0.02	0.03						
1500	1500.4	2.902	34.612	2.52			34.610	2.55	4.92	120.84	2.87	38.20	0.01	0.02						
2000	2000.6	2.236	34.651	2.72	1988	2.333	34.644	2.74	4.85	138.34	2.84	37.59	0.02	0.03						

Oceanographic Data of Hydrocast (14)

Station 15 Date 1990/10/20. Lat. 0° 01S
Depth 4434m Time 4:50-7:29 Long. 149° 59W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0							35.114			2.76	0.59	4.69	0.23	0.30	0.196	0.133	0			
10	10.4	26.440	35.117	3.29			35.105	4.72	-0.11	2.75	0.59	4.67	0.23	0.30	0.186	0.106	10		26.43	
30	29.7	26.235	35.119	3.09			35.110			2.88	0.63	4.89	0.28	0.64	0.215	0.179	30		26.24	
50	50.4	26.128	35.143	3.02			35.128	4.54	0.09	2.94	0.62	5.11	0.36	0.60	0.268	0.255	50		26.17	
60	60.6	25.948	35.271	2.97			35.145				0.67				0.265	0.226	60		26.12	
70	70.4	25.900	35.292	2.90			35.162	4.32	0.33	3.01	0.66	5.50	0.39	0.57	0.268	0.273	70		26.08	
80	80.1	25.817	35.305	2.80			35.177			3.02	0.66	5.65	0.39	0.53	0.256	0.279	80		26.05	
90	90.1	25.671	35.334	2.72			35.194	4.11	0.55	3.14	0.67	5.93	0.39	0.85	0.215	0.222	90		25.96	
100	100.1	25.581	35.347	2.70			35.215			3.27	0.72	6.20	0.38	0.48	0.218	0.212	100	95.2	25.83	
110	110.3	25.435	35.381	2.78			35.251	3.82	0.85	3.33	0.73	6.75	0.36	0.34	0.177	0.195	110	105.9	25.70	
120	121.4	24.421	35.336	2.40			35.217			4.26	0.76	8.16	0.19	0.25	0.136	0.186	120	113.0	25.42	
130	130.8	23.464	35.362	2.31			35.234	3.23	1.60	4.64	0.80	9.29	0.09	0.14	0.123	0.086	130	123.0	24.46	
150	149.3	21.394	35.286	2.29			35.131			6.47	0.86	10.59	0.02	0.41	0.043	0.097	150	137.3	22.81	
175	174.7	17.068	35.285	2.38			35.180	3.17	2.27	8.31	1.03	13.08	0.02	0.14	0.014	0.024	175	158.4	20.11	
200	200.0	13.442	35.040	1.97			35.079			16.05	1.42	19.55	0.01	0.54	0.004	0.023	200	184.7	15.18	
300	300.2	11.382	34.919	0.79			35.213	0.85	5.28	27.06	2.30	32.47	0.01	0.06	0.000	0.027				
400	399.7	9.475	34.805	0.80			34.712			33.86	2.56	36.34	0.00	0.06						
500	499.6	7.783	34.713	1.22			34.612	1.35	5.30	42.77	2.70	38.67	0.00	0.30						
750	749.5	5.834	34.640	1.72			34.554			60.33	2.73	39.28	0.01	0.14						
1000	1000.6	4.565	34.566	1.90			34.557	1.96	5.21	84.68	2.87	39.81	0.01	0.21						
1250	1252.0	3.616	34.592	2.00			34.585			106.78	2.95	40.21	0.01	0.41						
1500	1500.6	2.812	34.624	2.29			34.616	2.33	5.15	126.15	2.87	39.99	0.01	0.43						
2000	1992.0	2.219	34.656	2.51			34.648	2.55	5.06	141.57	2.74	39.28	0.01	0.10						

Oceanographic Data of Hydrocast (15)

Station 16 Date 1990/10/21. Lat. 5° 00'N
Depth 4943m Time 15:46-18:25 Long. 150° 01'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

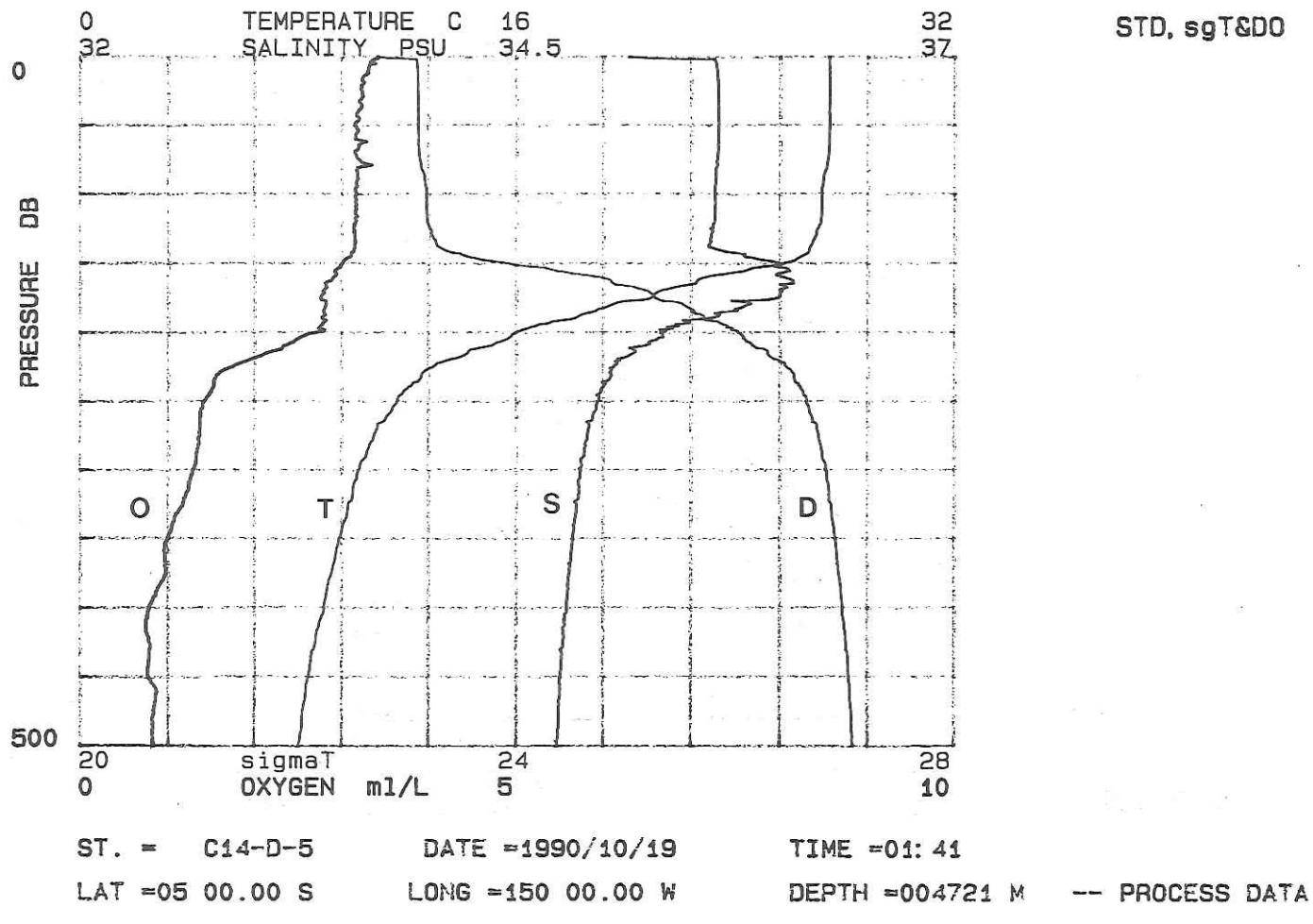
Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0							34.555			1.45	0.13	0.14	0.02	0.23	0.079	0.134	0			34.583
10	9.7	28.281	34.823	2.97	5	28.58	34.634	4.55	-0.07	1.59	0.18	0.37	0.04	0.27	0.151	0.076	10		28.51	34.665
30	29.8	27.579	35.144	3.00			35.010			1.67	0.32	1.68	0.15	0.30	0.205	0.145	30		27.92	34.983
50	49.7	27.452	35.165	3.00			35.027	4.59	-0.06	1.88	0.34	1.90	0.18	0.27	0.246	0.169	50		27.70	35.029
60	59.7	27.372	35.185	3.22		27.48	35.049			2.45	0.64	5.10	0.36	0.54	0.183	0.225	60		27.64	35.045
70	69.6	27.277	35.185	3.16			35.051	4.59	-0.05	2.02	0.37	2.48	0.23	0.43	0.183	0.218	70		27.50	35.052
80	79.9	27.251	35.199	3.11			35.060			1.97	0.40	2.65	0.23	0.44	0.218	0.161	80		27.47	-
90	89.8	27.257	35.208	3.25			35.062	4.62	-0.09	2.12	0.36	2.67	0.24	0.45	0.221	0.187	90		27.45	35.074
100	99.3	27.217	35.207	3.34			35.073			2.14	0.39	2.73	0.24	0.74	0.211	0.182	100	99.7	27.44	35.079
110	110.0	27.093	35.228	3.14			35.101	4.58	-0.01	2.02	0.47	3.32	0.26	0.93	0.189	0.183	110	109.1	27.33	35.092
120	119.6	26.538	35.275	3.66			35.138			2.42	0.58	4.32	0.44	0.70	0.167	0.165	120	120.4	26.72	
130	127.6	26.420	35.260	2.93			35.131	4.30	0.30	2.44	0.59	4.37	0.59	0.76	0.133	0.153	130	132.4	26.62	
150	148.2	24.622	35.166	2.15			35.032			3.88	0.66	6.41	0.89	0.40	0.082	0.131	150	151.9	24.32	
175	169.2	20.153	34.962	1.72	134	25.28	34.843	2.80	2.36	8.64	1.02	12.76	0.10	0.37	[0.045]	[0.084]	175	182.9	17.06	
200	199.6	13.861	34.750	1.00			34.631			19.81	1.90	24.07	0.02	0.33	0.023	0.035	200	202.3	13.47	
300	299.1	9.879	34.690	0.93			34.674	1.21	5.13	32.22	2.45	33.04	0.01	0.18	[0.000]	[0.017]				
400	400.2	8.941	34.662	0.63			34.647			37.23	2.65	35.95	0.00	0.57						
500	505.3	8.013	34.624	0.70	499	8.009	34.608	0.75	5.81	44.72	2.82	37.85	0.00	0.32						
750	749.5	5.682	34.562	0.96			34.549			72.51	3.15	42.43	0.01	0.16						
1000	1000.0	4.491	34.573	1.43			34.560	1.63	5.53	91.66	3.11	41.62	0.01	0.63						
1250	1249.9	3.637	34.597	1.67			34.584			111.67	3.10	41.21	0.01	0.15						
1500	1499.8	2.988	34.620	1.93	1491	3.003	34.607	1.95	5.50	127.53	3.06	40.77	0.01	0.13						
2000	1999.3	2.192	34.655	2.36			34.642	2.37	5.24	144.95	2.86	39.24	0.01	0.14						

Oceanographic Data of Hydrocast (16)

Station 17 Date 1990/10/23. Lat. 10° 00'N
Depth 5170m Time 0:01-3:05 Long. 150° 01'W

CTDO Data *Rosette Sampler Data* *Niskin (NR) Data*

Sample No.	Press. (dB)	T (℃)	S (PSU)	O2 (ml/l)	D (dB)	T (℃)	S (PSU)	O2 (ml/l)	AOU (ml/l)	SiO2 (μM/l)	PO4 (μM/l)	NO3 (μM/l)	NO2 (μM/l)	NH4 (μM/l)	Chl. a (μg/l)	Phaeo. (μg/l)	Sample No.	D (dB)	T (℃)	S (PSU)
0							33.865			1.60	0.14	0.01	0.00	0.13	0.073	0.031	0			33.866
10	9.7	28.534	33.874	3.21			33.852	4.41	0.06	1.51	0.14	0.05	0.00	0.21	0.072	0.031	10		28.58	33.867
30	30.1	28.269	34.001	3.16			33.987			1.68	0.16	0.10	0.01	0.36	0.107	0.066	30		28.51	33.931
50	51.2	19.343	35.016	2.37			34.578	4.37	0.83	4.25	0.49	3.12	0.01	0.37	0.196	0.194	50		20.42	33.584
60	60.7	15.279	34.584	1.74	49	15.854	34.498			11.84	1.24	15.07	0.13	0.53	0.177	0.228	60		15.85	34.498
70	70.4	14.360	34.595	1.37			34.494	1.98	3.79	15.88	1.62	20.25	0.70	0.35	0.161	0.193	70		14.66	34.504
80	79.9	13.543	34.660	0.79			34.526			20.40	1.94	25.68	0.48	0.79	0.145	0.176	80		13.67	34.519
90	90.8	12.750	34.661	0.32			34.578	0.80	5.16	23.35	2.13	28.83	0.23	0.08	0.120	0.169	90		12.82	34.599
100	100.2	12.376	34.763	0.26			34.656			26.25	2.32	31.80	0.16	0.42	0.085	0.204	100	104.6	12.50	34.664
110	110.3	12.110	34.783	0.25			34.673	0.34	5.70	26.56	2.32	32.13	0.06	0.13	0.060	0.200	110			34.682
120	119.8	11.878	34.793	0.28			34.689			27.67	2.34	32.81	0.03	0.14	0.054	0.170	120	124.6	11.85	34.695
130	130.8	11.548	34.806	0.33	119	11.774	34.700	2.23	3.88	28.65	2.34	33.09	0.01	0.14	0.033	0.107	130	132.5	11.67	34.703
150	150.7	11.286	34.737	0.35			34.713			29.36	2.34	33.23	0.01	0.35	0.016	0.034	150	152.8	11.27	34.708
175	175.6	11.001	34.723	0.39			34.714	0.42	5.76	30.00	2.32	33.56	0.01	0.29	0.006	0.025	175	183.5	10.93	34.712
200	201.5	10.664	34.720	0.39			34.709			30.99	2.32	33.88	0.00	0.06	0.001	0.026	200		10.64	34.707
300	301.0	9.930	34.699	0.24			34.688	0.28	6.06	34.78	2.44	35.37	0.00	0.08						
400	400.6	9.184	34.659	0.17	394	9.251	34.651			40.56	2.64	36.14	0.00	0.45						
500	501.0	8.059	34.600	0.25			34.586	0.37	6.23	51.00	2.80	37.32	0.00	0.28						
750	750.4	5.930	34.544	0.47			34.532			74.93	3.03	42.08	0.01	0.27						
1000	1000.7	4.623	34.561	1.10			34.552	1.17	5.96	93.67	2.97	42.11	0.00	0.11						
1250	1250.1	3.742	34.589	1.47	1241	3.756	34.586			112.04	2.94	41.50	0.01	0.30						
1500	1500.9	3.152	34.608	1.73			34.598	1.81	5.62	125.50	2.87	40.90	0.00	0.48						
2000	2000.8	2.228	34.650	2.18	1988	2.224	34.637	2.29	5.31	146.02	2.89	39.48	0.01	0.39						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32
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5
10
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LONG =150 00.00 W
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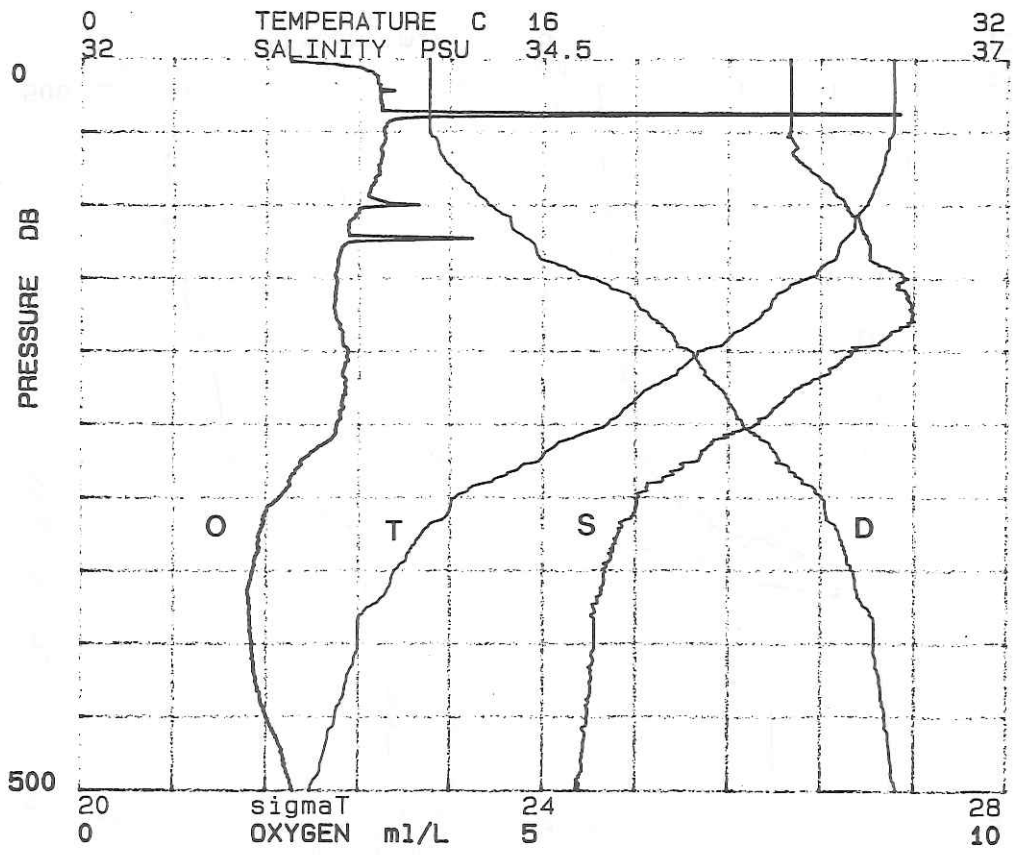

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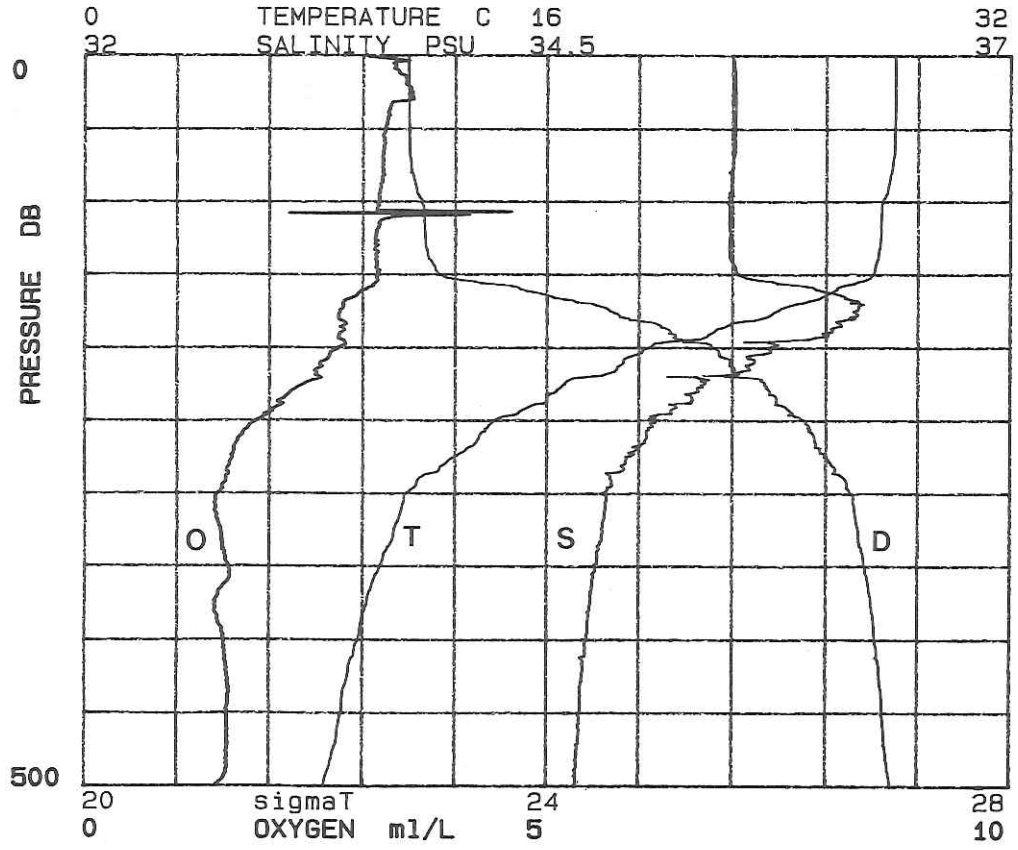

STD, sgT&DO

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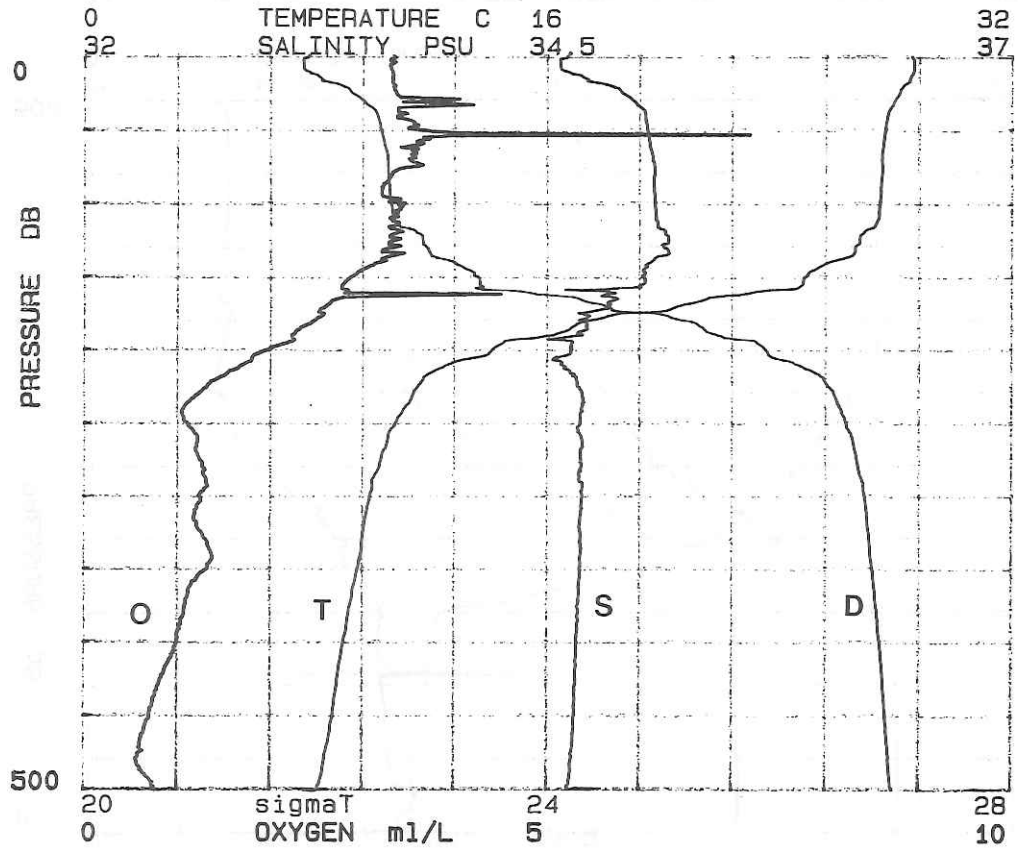

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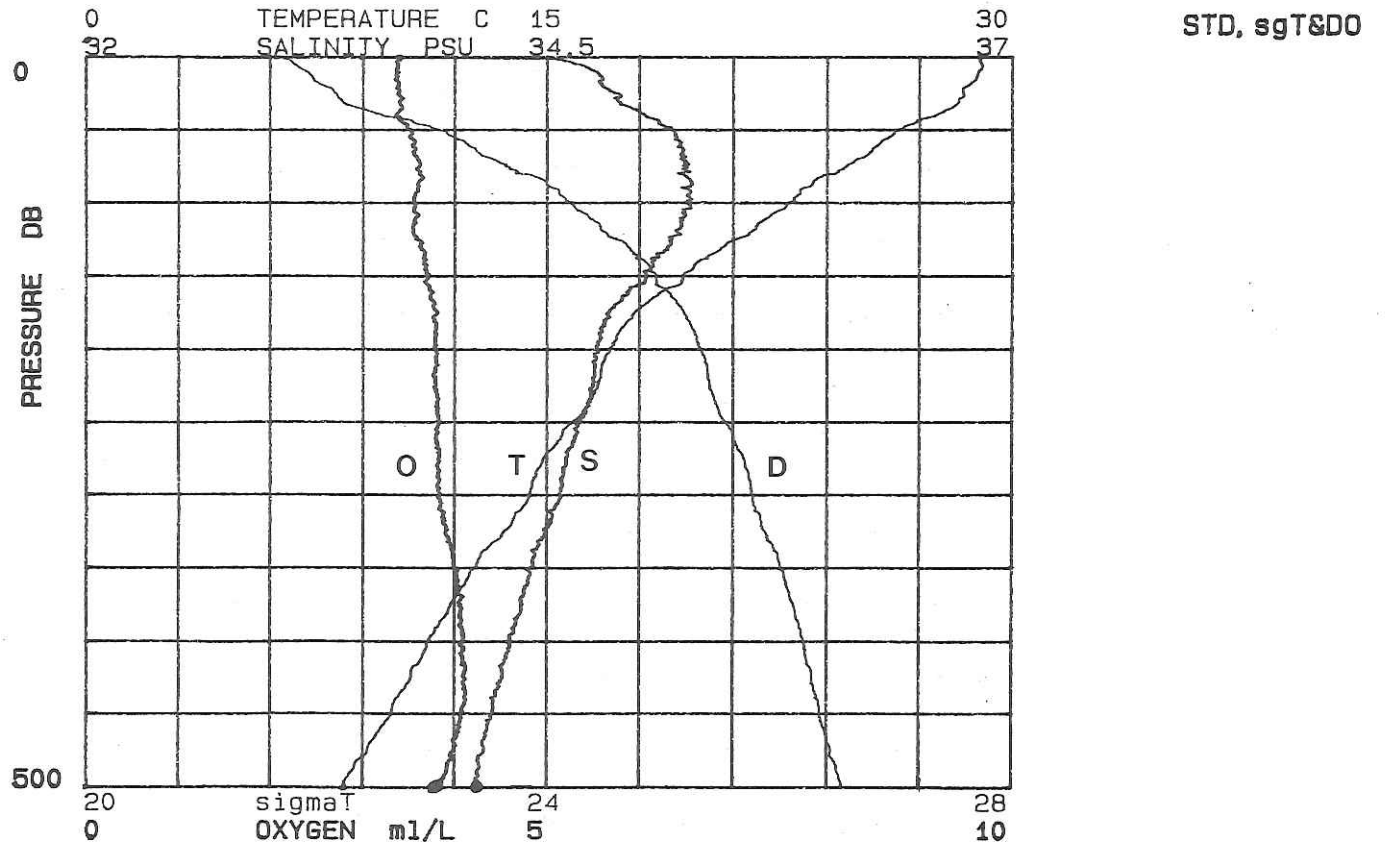
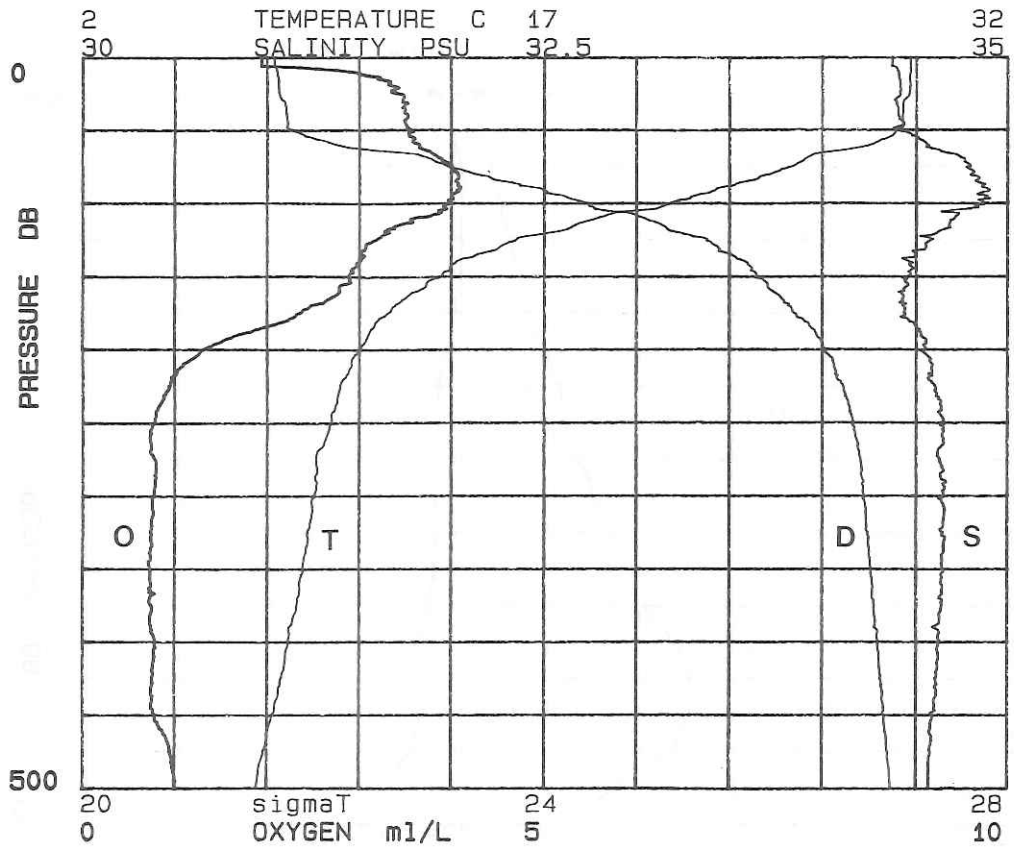


STD, sgT&DO

ST. = C0 DATE =1990/09/09 TIME =03: 38

LAT =21 13.86 N LONG =172 01.34 E DEPTH =005461 M -- PROCESS DATA



STD, sgT&DO

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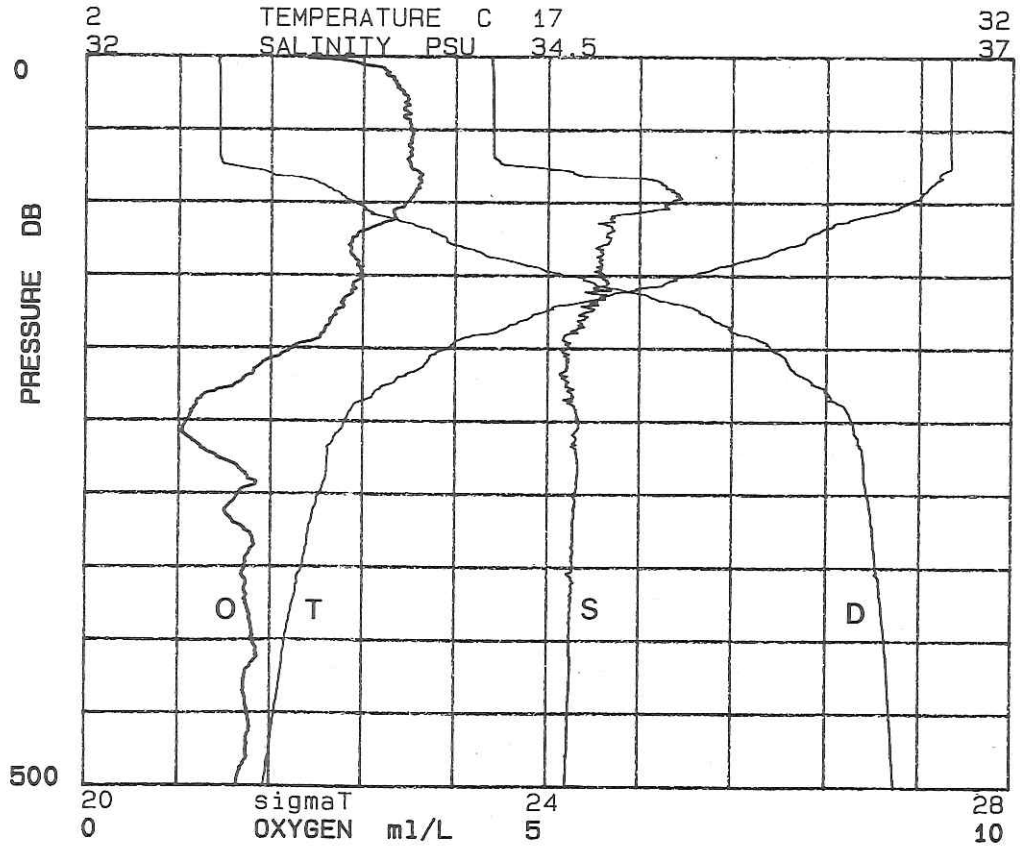
LAT =09 59.90 N LONG =179 59.81 E DEPTH =005896 M -- PROCESS DATA



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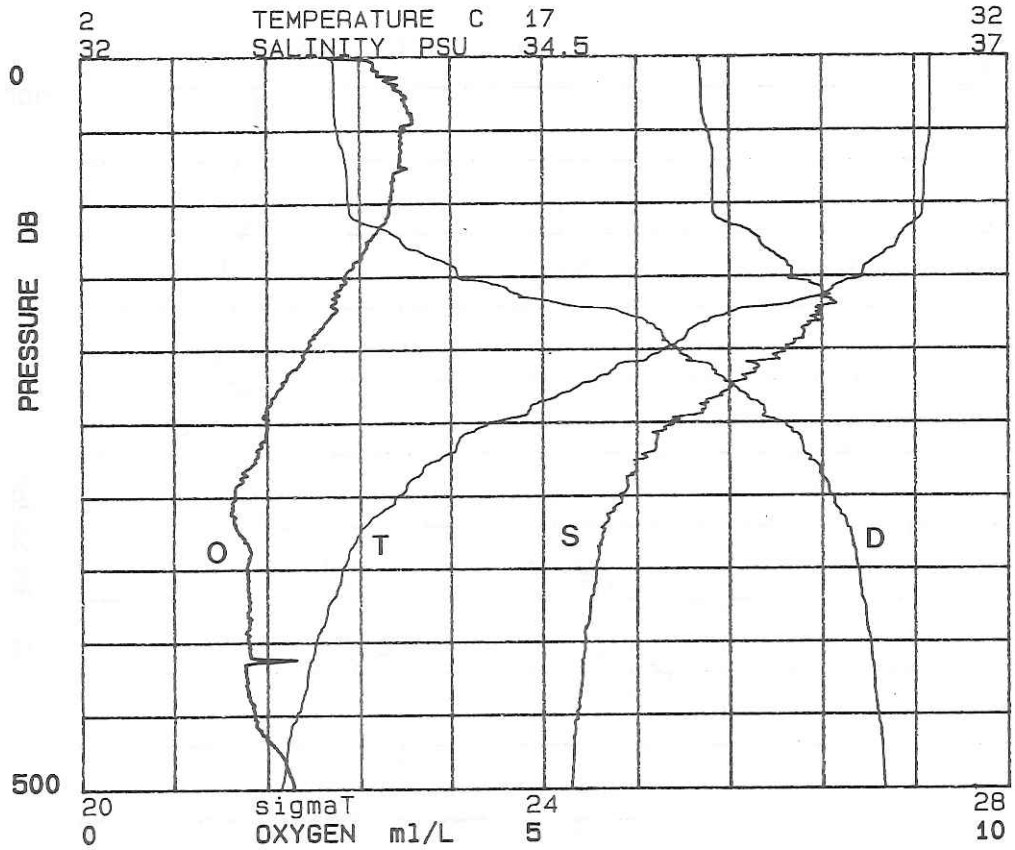

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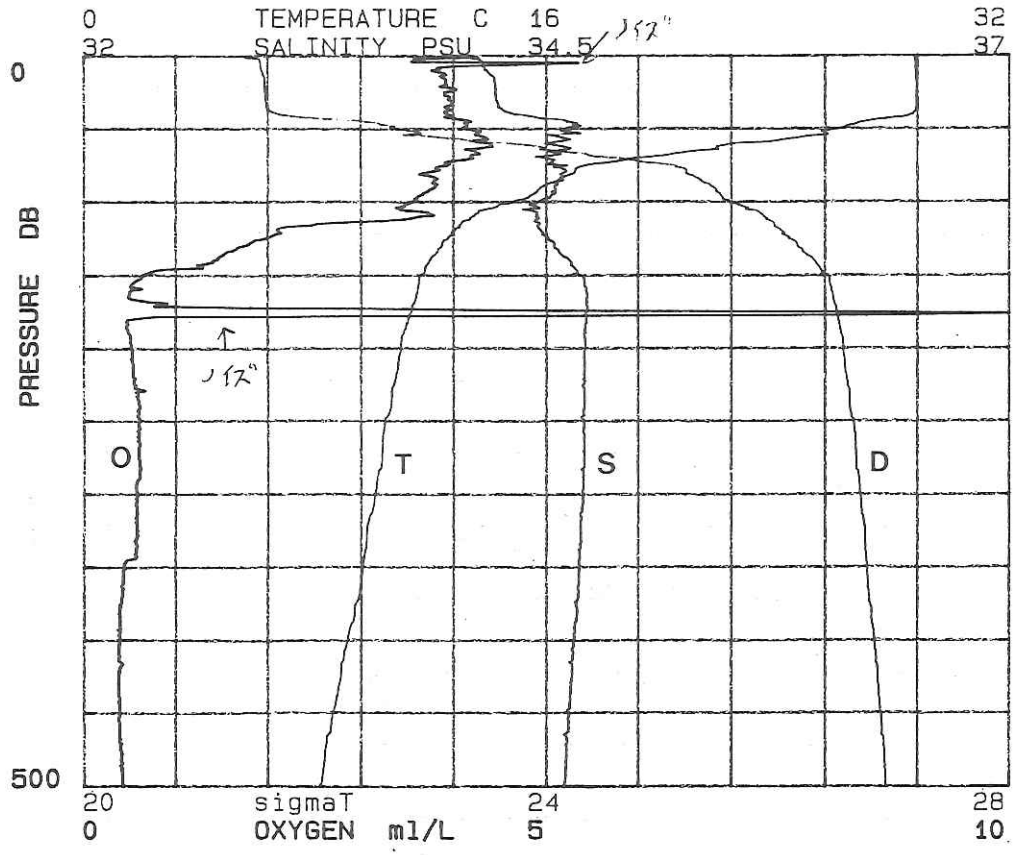

STD, sgT&DO

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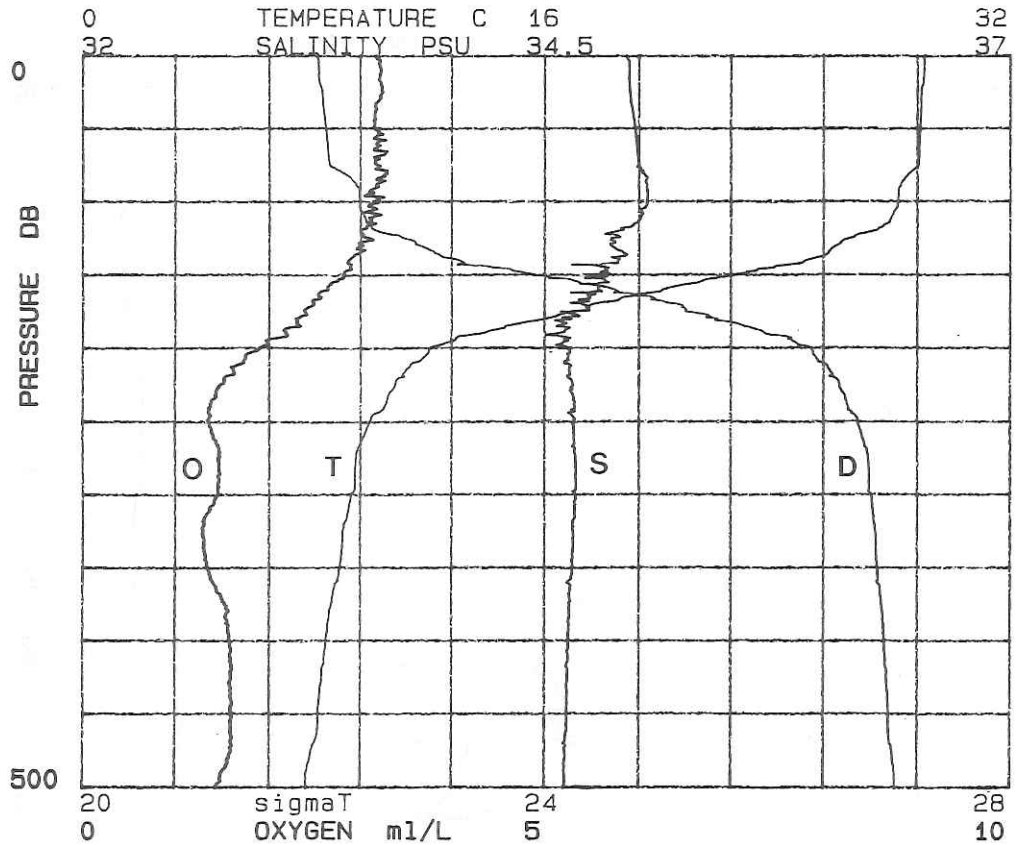

STD, sgT&DO

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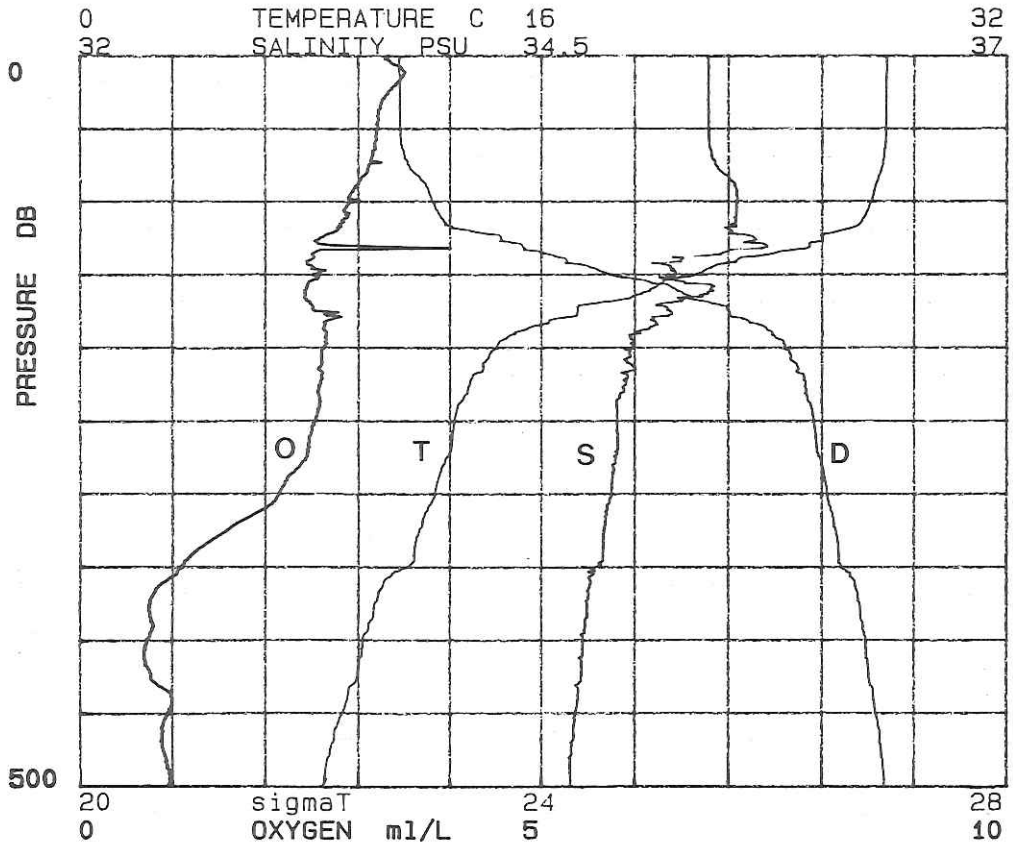

STD, sgT&DO

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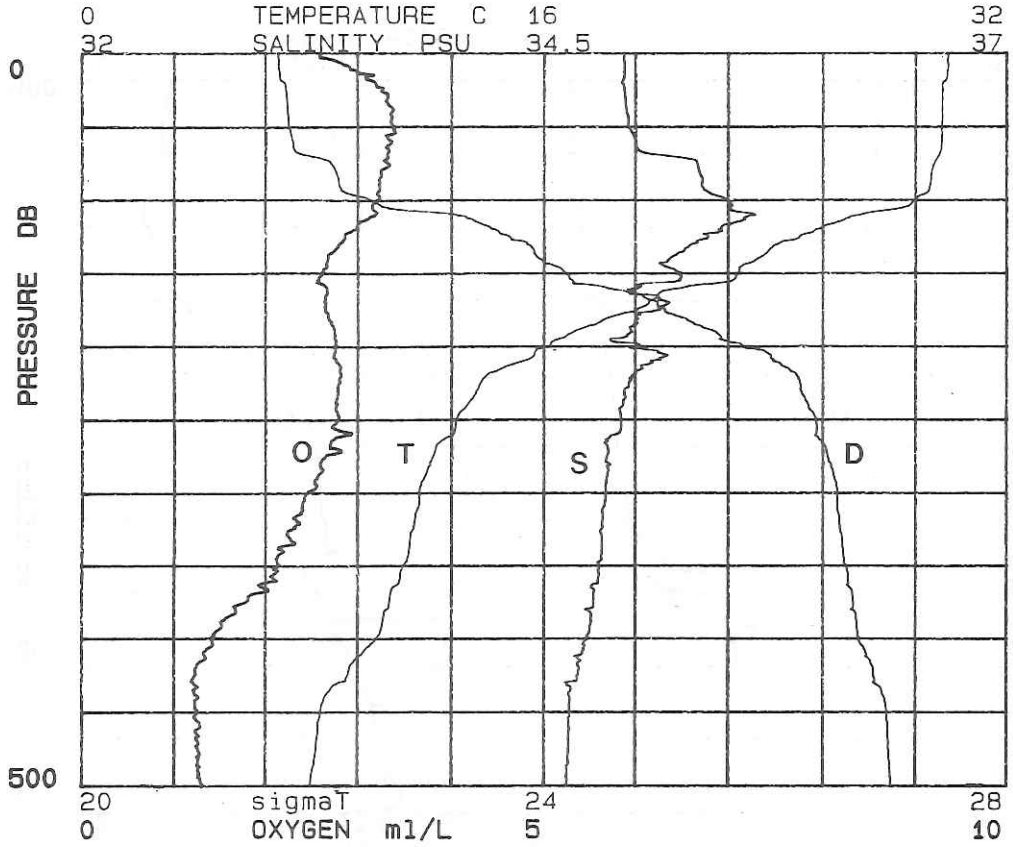

STD, sgT&DO

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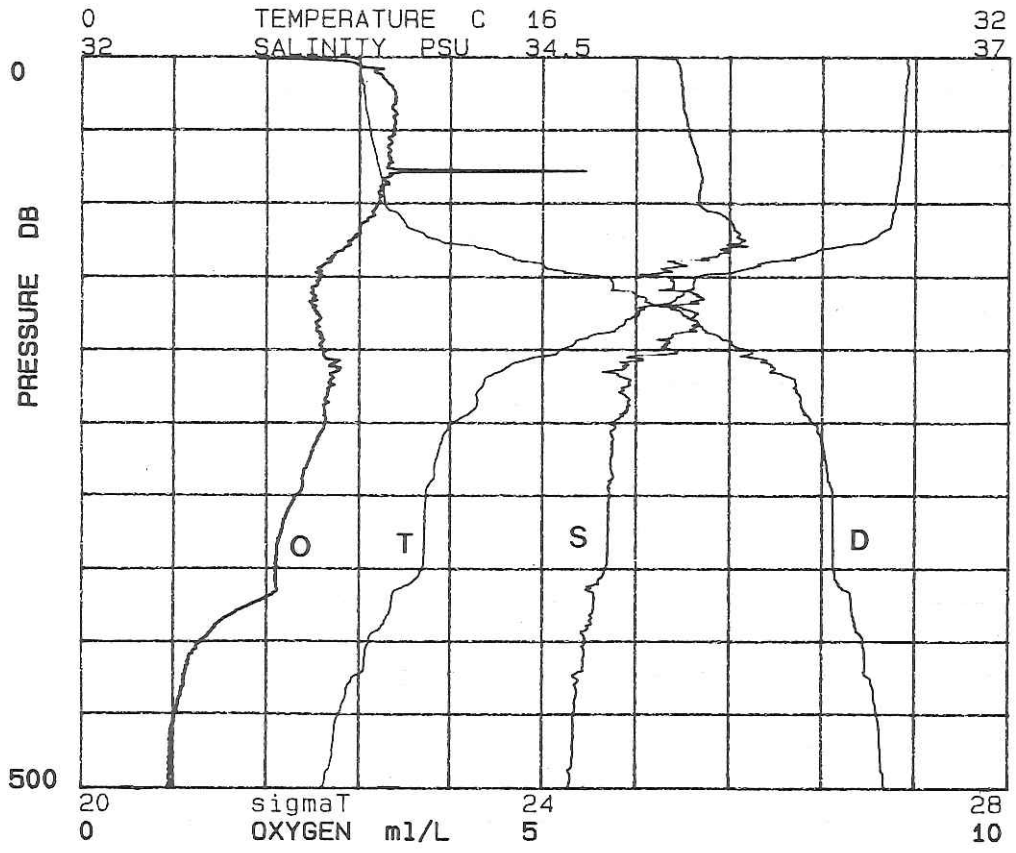

STD, sgT&DO

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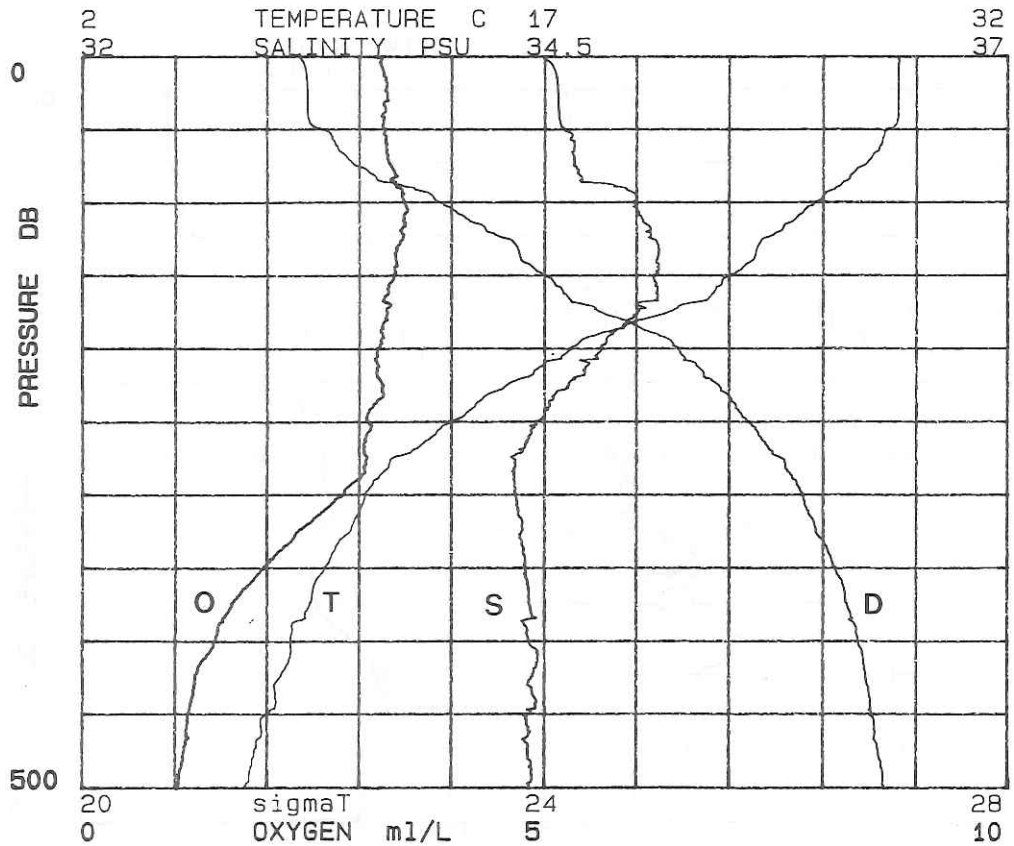
LAT =00 01.46 S LONG =170 01.02 W DEPTH =005385 M -- PROCESS DATA



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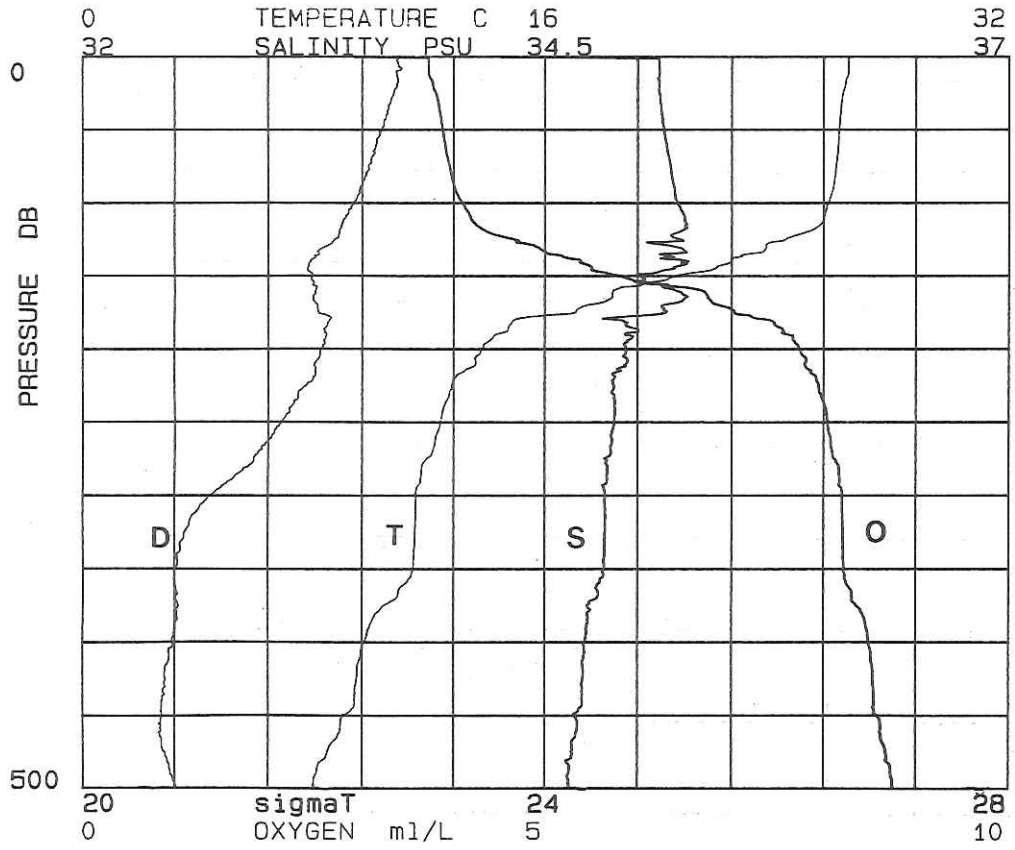

STD, sgT&DO

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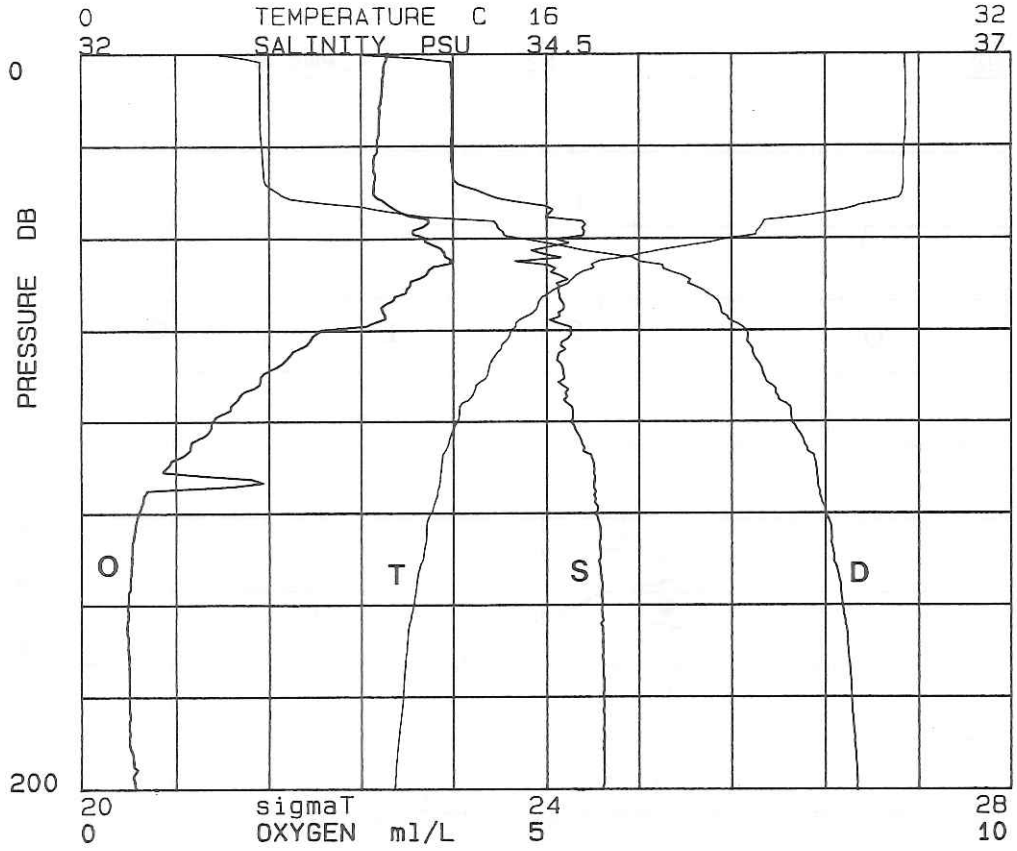
LAT =00 00.51 S LONG =149 58.91 W DEPTH =004446 M -- PROCESS DATA



STD, sgT&DO

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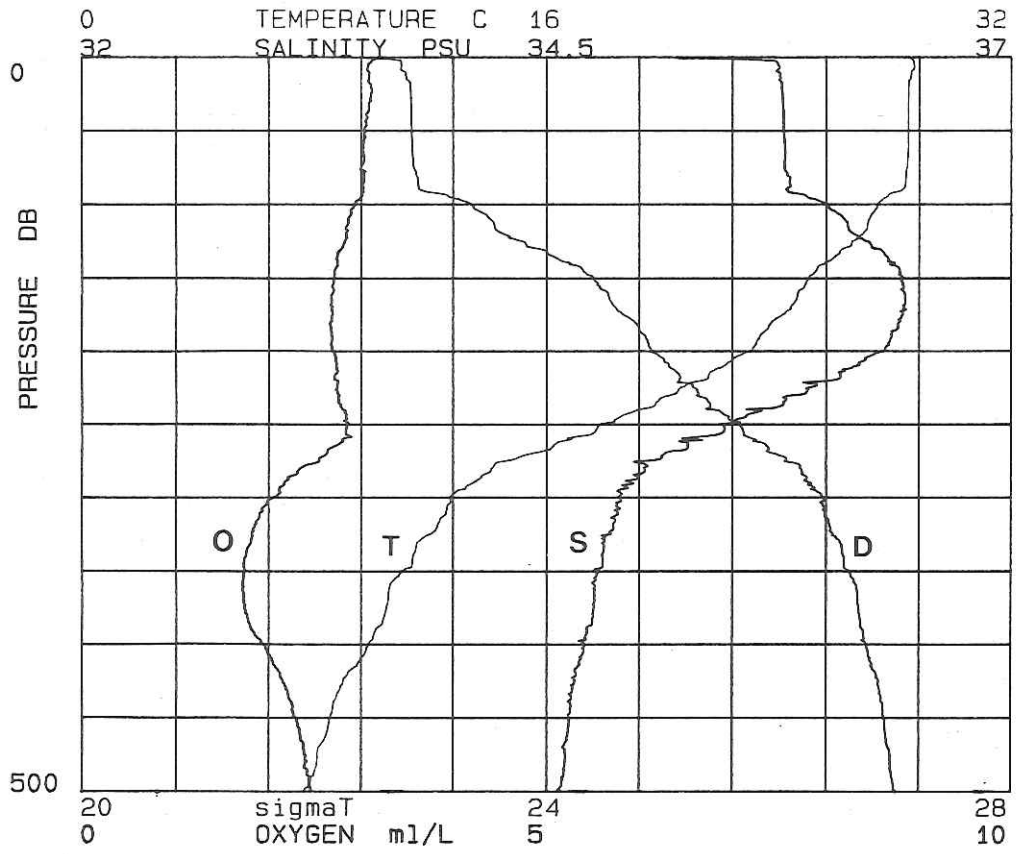

STD, sgT&DO

ST. = C12-D-2 DATE =1990/10/09 TIME =04:27

LAT =10 00.89 S LONG =160 01.93 W DEPTH =004740 M -- PROCESS DATA

KH-90-2 LEG1 - 180W 10N-10S OCTOPUS

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-01	0	28.39	34.492	21.882	4.783	-0.304	0.153	0.00	0.00	0.010	0.39	0.048	0.024
15N	17	28.39	34.556	21.929	n.d.	n.d.	0.154	0.80	0.10	0.016	0.40	0.056	0.016
180W	37	28.40	34.559	21.930	n.d.	n.d.	0.140	0.80	0.00	0.010	0.38	0.054	0.020
	57	27.87	34.632	22.156	n.d.	n.d.	0.108	1.40	0.00	0.012	0.39	0.054	0.018
	79	26.95	34.678	22.489	n.d.	n.d.	0.108	1.00	0.00	0.010	0.39	0.067	0.044
	100	25.93	34.993	23.049	n.d.	n.d.	0.108	0.80	0.00	0.009	0.48	0.116	0.077
	200	18.16	34.830	25.102	4.085	1.267	0.527	3.90	0.10	0.025	5.06	0.035	0.114

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-02	0	28.82	34.277	21.577	4.701	-0.248	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
10N	10	28.83	34.367	21.643	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
180W	30	28.57	34.380	21.739	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	40	28.59	34.413	21.756	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	50	28.09	34.512	21.994	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	60	26.41	34.679	22.659	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	70	25.02	34.797	23.180	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	80	23.86	34.842	23.561	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	90	22.26	34.907	24.073	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	100	20.26	34.812	24.547	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	110	17.96	34.685	25.040	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	130	14.34	34.488	25.719	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	150	12.98	34.425	25.952	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	175	11.51	34.463	26.263	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	200	10.76	34.568	26.482	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-03	0	29.74	33.807	20.918	4.679	-0.280	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
7.5N	10	29.56	33.926	21.066	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
180W	30	29.35	33.939	21.148	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	40	29.27	34.186	21.360	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	50	29.21	34.220	21.406	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	60	29.15	34.246	21.445	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	70	28.59	34.340	21.701	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	80	26.67	34.639	22.548	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	90	24.41	34.795	23.361	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	100	22.82	34.832	23.857	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	110	21.63	34.874	24.223	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	130	17.31	34.720	25.224	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	150	14.52	34.535	25.716	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	175	12.15	34.585	26.238	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	200	11.02	34.627	26.482	1.405	4.788	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-04B	0	28.75	33.543	21.050	4.565	-0.089	0.122	1.20	0.24	0.080	0.32	0.081	0.025
5N	10	29.93	34.204	21.151	4.589	-0.212	0.095	1.20	0.01	0.030	0.37	0.067	0.024
180W	30	29.94	34.200	21.142	n.d.	n.d.	0.115	1.20	0.02	0.030	0.37	0.068	0.033
	50	29.95	34.201	21.139	4.545	-0.170	0.107	1.60	0.00	0.010	0.43	0.063	0.029
	70	29.99	34.251	21.165	n.d.	n.d.	0.109	1.30	0.02	0.010	0.44	0.088	0.031
	100	28.68	35.193	22.311	4.545	-0.104	0.237	1.80	0.05	0.000	0.45	0.269	0.153
	110	27.17	34.966	22.636	n.d.	n.d.	0.326	2.00	0.07	0.090	0.82	0.369	0.407
	120	26.13	34.873	22.894	3.820	0.820	0.360	3.30	0.03	0.400	2.20	0.088	0.598
	130	n.d.	n.d.	n.d.	n.d.	n.d.	0.440	3.90	0.09	0.320	4.18	0.199	0.411
	150	n.d.	n.d.	n.d.	3.607	n.d.	0.519	5.60	0.03	0.070	5.13	0.104	0.239
	175	17.12	34.750	25.293	n.d.	n.d.	0.989	13.30	0.04	0.020	11.68	0.039	0.058
	200	14.04	34.631	25.893	2.465	3.347	1.478	19.70	0.04	0.020	17.98	0.025	0.048

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-05	0	29.94	34.241	21.175	5.772	-1.397	0.111	1.00	0.59	0.000	0.27	0.010	0.051
4N	10	29.93	34.247	21.183	4.623	-0.247	0.145	0.80	0.00	0.010	0.27	0.041	0.021
180W	30	29.93	34.246	21.182	4.600	-0.225	0.134	0.80	0.00	0.010	0.29	0.047	0.026
	50	29.90	34.245	21.189	4.651	-0.274	0.131	1.00	0.03	0.010	0.32	0.076	0.051
	70	29.59	34.891	21.779	4.744	-0.360	0.106	1.10	0.01	0.000	0.31	0.045	0.022
	80	29.57	35.223	22.038	4.685	-0.308	0.209	0.60	0.01	0.010	0.32	0.189	0.128
	90	28.63	35.102	22.261	4.667	-0.220	0.236	1.40	0.06	0.020	0.34	0.275	0.224
	100	27.89	35.181	22.563	4.176	0.322	0.299	1.60	0.04	0.060	0.63	0.359	0.428
	110	26.92	35.033	22.764	3.887	0.687	0.438	2.00	0.05	0.540	2.76	0.309	0.489
	130	25.13	35.008	23.305	3.491	1.224	0.582	3.50	0.04	0.130	5.37	0.151	0.303
	150	21.75	34.927	24.229	3.564	1.440	0.545	5.10	0.05	0.020	5.58	0.076	0.235
	175	18.78	34.895	24.996	3.219	2.068	0.876	9.70	0.26	0.020	9.48	0.032	0.039
	200	15.93	34.702	25.534	3.060	2.532	1.202	15.60	0.04	0.020	13.08	0.016	0.024

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-06	0	30.04	34.239	21.139	4.628	-0.260	0.063	1.90	0.22	0.000	0.51	0.064	0.035
3N	10	29.61	34.691	21.625	4.604	-0.217	0.043	1.30	0.04	0.000	0.26	0.064	0.037
180W	30	29.62	34.687	21.616	4.638	-0.252	0.089	1.20	0.04	0.000	0.29	0.068	0.040
	50	29.55	34.765	21.700	4.644	-0.255	0.098	1.20	0.01	0.000	0.32	0.110	0.070
	60	28.80	34.959	22.095	4.590	-0.152	0.187	1.50	0.04	0.000	0.30	0.167	0.118
	70	28.60	35.204	22.347	4.490	-0.044	0.254	2.00	0.02	0.050	0.54	0.312	0.272
	80	28.28	35.197	22.447	4.310	0.159	0.325	1.80	0.01	0.330	1.46	0.359	0.360
	90	27.81	35.203	22.606	4.038	0.466	0.451	2.00	0.04	0.880	2.81	0.290	0.446
	110	26.43	35.241	23.078	3.613	0.993	0.520	3.10	0.02	0.390	5.78	0.224	0.361
	130	25.35	35.202	23.385	3.573	1.119	0.609	2.70	0.04	0.330	5.93	0.224	0.343
	150	22.80	35.073	24.044	3.265	1.643	0.684	5.00	0.04	0.020	7.56	0.069	0.076
	175	0.00	0.000	0.000	3.312	0.000	0.854	8.10	0.02	0.000	9.82	0.038	0.063
	200	14.26	34.758	25.944	3.241	2.540	1.275	17.90	0.02	0.000	15.50	0.005	0.017

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-07	0	29.64	34.496	21.468	4.616	-0.226	0.066	1.10	0.02	0.010	0.21	0.057	0.028
2N	10	29.64	34.518	21.483	4.881	-0.493	0.106	1.40	0.00	0.020	0.21	0.060	0.028
180W	30	29.66	34.543	21.496	4.673	-0.286	0.095	1.10	0.02	0.020	0.18	0.072	0.037
	50	29.57	35.148	21.980	4.945	-0.566	0.122	1.10	0.03	0.020	0.22	0.189	0.096
	60	29.50	35.218	22.056	4.749	-0.367	0.137	1.10	0.04	0.020	0.22	0.211	0.117
	70	28.87	35.208	22.260	4.671	-0.244	0.216	1.40	0.05	0.070	0.43	0.294	0.230
	80	28.40	35.210	22.417	4.338	0.122	0.311	1.80	0.08	0.270	1.32	0.389	0.421
	90	27.87	35.191	22.576	4.030	0.469	0.386	2.10	0.11	0.310	2.61	0.359	0.462
	110	26.53	35.323	23.106	3.575	1.022	0.582	3.10	0.03	0.170	6.41	0.164	0.385
	130	25.87	35.319	23.312	3.500	1.148	0.670	3.30	0.02	0.050	7.09	0.126	0.278
	150	22.07	35.083	24.260	3.294	1.678	0.654	6.00	0.02	0.020	8.46	0.036	0.074
	175	17.95	34.847	25.165	3.377	1.995	0.889	9.70	0.03	0.010	10.94	0.025	0.035
	200	13.12	34.585	26.046	2.734	3.191	1.499	21.80	0.02	0.010	19.11	0.008	0.018

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-08	0	29.85	34.742	21.580	4.739	-0.369	0.077	0.90	0.02	0.000	0.31	0.064	0.025
1N	10	29.83	34.757	21.597	4.625	-0.256	0.134	1.10	0.00	0.000	0.25	0.064	0.026
180W	30	29.81	34.747	21.597	4.753	-0.382	0.067	1.10	0.01	0.000	0.23	0.074	0.031
	50	29.77	35.043	21.834	4.797	-0.429	0.084	1.10	0.01	0.000	0.23	0.133	0.062
	60	29.70	35.164	21.948	4.774	-0.404	0.131	1.40	0.01	0.010	0.20	0.211	0.144
	70	29.68	35.229	22.003	4.828	-0.459	0.184	1.30	0.04	0.010	0.23	0.300	0.209
	80	29.51	35.288	22.105	4.698	-0.319	0.173	1.30	0.10	0.040	0.46	0.419	0.300
	90	29.26	35.330	22.220	4.562	-0.166	0.254	1.30	0.18	0.100	0.78	0.344	0.306
	100	28.81	35.409	22.430	4.047	0.379	0.497	2.30	0.03	0.460	4.35	0.218	0.353
	110	28.06	35.375	22.655	3.566	0.915	0.621	3.30	0.02	0.130	6.40	0.145	0.281
	130	25.86	35.201	23.227	3.250	1.402	0.271	5.00	0.04	0.010	8.15	0.066	0.150
	150	22.49	35.146	24.188	3.387	1.546	1.310	18.00	0.02	0.000	16.43	0.019	0.033
	175	18.64	34.937	25.063	3.198	2.102	1.308	17.90	0.08	0.000	16.35	0.004	0.014
	200	14.12	34.712	25.938	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-09	0	29.94	34.715	21.528	4.760	-0.397	0.140	1.20	0.08	0.020	0.30	0.071	0.035
0.5N	10	29.77	34.819	21.666	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
180W	30	29.75	34.828	21.680	4.773	-0.398	0.082	0.90	0.01	0.030	0.32	0.085	0.005
	50	29.75	34.855	21.698	4.713	-0.340	0.062	0.90	0.01	0.030	0.30	0.098	0.039
	70	29.69	35.091	21.897	4.703	-0.331	0.065	0.90	0.01	0.030	0.30	0.123	0.057
	80	29.45	35.312	22.144	4.773	-0.390	0.115	1.10	0.02	0.020	0.32	0.297	0.176
	95	29.26	35.347	22.235	4.899	-0.503	0.210	1.40	0.08	0.080	0.55	0.449	0.327
	100	29.03	35.437	22.378	4.760	-0.351	0.240	1.30	0.15	0.100	0.85	0.158	0.106
	110	28.64	35.489	22.548	4.511	-0.075	0.492	2.10	0.02	1.350	3.60	0.249	0.180
	130	26.40	35.436	23.234	4.311	0.293	0.492	2.10	0.04	1.340	3.59	0.246	0.285
	150	22.21	35.153	24.272	3.752	1.205	0.655	2.80	0.02	0.050	6.63	0.170	0.277
	175	18.63	34.911	25.045	3.264	2.038	0.859	9.40	0.06	0.020	10.83	0.027	0.057
	200	15.38	35.030	25.910	3.398	2.245	1.042	11.10	0.02	0.030	13.80	0.002	0.020

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-10	0	n.d.	n.d.	n.d.	4.898	n.d.	0.134	0.80	0.13	0.020	0.31	0.079	0.040
0NS	10	29.76	34.927	21.751	4.777	-0.406	0.148	1.00	0.02	0.010	0.31	0.085	0.070
180W	30	29.72	34.931	21.767	4.732	-0.358	0.089	1.10	0.06	0.010	0.27	0.098	0.039
	50	29.71	34.938	21.775	4.946	-0.572	0.139	1.10	0.01	0.010	0.26	0.110	0.085
	70	29.69	35.000	21.828	4.720	-0.347	0.096	1.30	0.03	0.010	0.25	0.294	0.190
	80	29.48	35.317	22.136	4.732	-0.351	0.220	1.30	0.13	0.070	0.62	0.136	0.103
	90	29.32	35.347	22.213	4.741	-0.350	0.198	1.40	0.28	0.080	0.78	0.489	0.070
	100	28.99	35.440	22.395	4.722	-0.310	0.267	1.50	0.57	0.130	1.02	0.218	0.161
	110	28.24	35.553	22.729	4.313	0.151	0.504	3.10	0.10	1.290	3.45	0.177	0.166
	130	23.87	35.239	23.860	3.462	1.351	0.708	4.00	0.04	0.060	8.15	0.180	0.199
	150	21.26	35.102	24.497	3.265	1.779	0.684	5.20	0.04	0.030	8.90	0.085	0.178
	175	17.51	35.000	25.390	3.356	2.056	0.855	10.00	0.01	0.020	11.38	0.017	0.033
	200	15.70	35.138	25.920	3.368	2.235	1.059	9.60	0.02	0.020	13.68	0.001	0.022

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-11	0	29.69	35.018	21.841	4.660	-0.286	0.000	1.30	0.08	0.030	0.49	0.120	0.068
0.5S	10	29.70	35.019	21.839	4.651	-0.278	0.003	1.30	0.01	0.030	0.42	0.026	0.013
180W	30	29.61	35.010	21.861	4.678	-0.299	0.018	1.30	0.02	0.030	0.42	0.158	0.091
	50	29.60	35.010	21.865	4.792	-0.412	0.010	1.30	0.02	0.030	0.42	0.120	0.079
	70	29.60	35.012	21.869	4.680	-0.300	0.038	1.30	0.03	0.030	0.46	0.202	0.159
	80	29.58	35.092	21.934	4.718	-0.339	0.125	1.20	0.18	0.050	0.56	0.300	0.188
	90	29.51	35.334	22.140	4.660	-0.281	0.148	1.40	0.24	0.080	0.75	0.319	0.241
	100	29.36	35.355	22.206	4.654	-0.266	0.133	1.30	0.29	0.090	0.92	0.262	0.171
	110	29.30	35.361	22.232	4.554	-0.162	0.133	1.70	0.53	0.110	1.15	0.199	0.155
	130	23.25	35.348	24.122	3.232	1.629	0.643	4.30	0.00	0.040	8.70	0.101	0.217
	150	20.69	35.281	24.790	3.164	1.926	0.663	4.80	0.03	0.030	9.41	0.063	0.117
	175	17.74	35.233	25.514	3.325	2.057	0.803	7.90	0.03	0.020	10.98	0.015	0.034
	200	15.62	35.173	25.966	3.331	2.279	1.016	8.60	0.07	0.010	13.49	0.002	0.029

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-12	0	29.68	35.117	21.920	4.704	-0.332	0.063	1.45	0.08	0.000	0.00	0.151	0.076
1S	10	29.68	35.115	21.917	4.631	-0.259	0.087	1.45	0.03	0.000	0.00	0.151	0.090
180W	30	29.69	35.116	21.915	4.631	-0.260	0.036	1.60	0.03	0.000	0.00	0.151	0.083
	50	29.62	35.108	21.933	4.499	-0.123	0.087	1.67	0.03	0.000	0.00	0.148	0.126
	70	29.55	35.155	21.993	3.096	1.284	0.165	1.60	0.12	0.010	0.01	0.224	0.155
	80	29.52	35.320	22.127	4.622	-0.244	0.149	1.45	0.29	0.030	0.28	0.294	0.223
	90	29.44	35.335	22.164	4.669	-0.285	0.136	1.60	0.25	0.050	0.37	0.246	0.245
	100	29.33	35.353	22.214	4.653	-0.263	0.168	1.52	0.35	0.070	0.49	0.218	0.244
	110	29.33	35.364	22.222	4.621	-0.231	0.320	1.67	0.69	0.090	0.80	0.151	0.119
	130	25.57	35.529	23.563	4.638	0.028	0.453	2.72	0.07	0.500	5.46	0.123	0.184
	150	21.70	35.475	24.661	3.801	1.192	0.786	3.99	0.03	0.030	9.31	0.057	0.131
	175	20.21	35.448	25.047	3.077	2.055	0.897	4.89	0.01	0.000	9.23	0.028	0.052
	200	16.76	35.277	25.782	3.067	2.416	0.958	5.50	0.02	0.030	12.87	0.017	0.033

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-13	0	29.57	35.428	22.190	4.644	-0.272	0.193	1.67	0.65	0.050	0.28	0.265	0.125
2S	10	29.57	35.383	22.156	4.774	-0.401	0.116	1.45	0.08	0.040	0.26	0.281	0.149
180W	30	29.56	35.385	22.162	4.680	-0.306	0.055	1.52	0.10	0.040	0.26	0.306	0.167
	50	29.53	35.384	22.172	4.718	-0.342	0.176	1.45	0.14	0.040	0.26	0.347	0.227
	60	29.49	35.378	22.178	4.612	-0.233	0.125	1.30	0.20	0.040	0.25	0.360	0.229
	70	29.47	35.370	22.179	4.623	-0.243	0.168	1.37	0.28	0.030	0.29	0.189	0.410
	80	29.43	35.370	22.194	4.651	-0.268	0.207	1.52	0.45	0.050	0.31	0.303	0.246
	90	29.41	35.370	22.200	4.555	-0.170	0.225	1.37	0.48	0.050	0.34	0.243	0.197
	110	29.26	35.396	22.270	4.548	-0.153	0.236	1.97	0.60	0.070	0.79	0.148	0.108
	130	28.18	35.626	22.802	4.108	0.358	0.531	2.04	0.00	1.970	2.33	0.082	0.084
	150	26.37	35.836	23.545	3.719	0.877	0.633	2.19	0.03	0.080	5.38	0.069	0.100
	175	19.72	35.619	25.306	2.824	2.348	0.971	4.44	0.03	0.020	9.69	0.018	0.029

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-14	0	29.84	35.312	22.010	4.596	-0.240	0.123	1.45	0.29	0.040	0.14	0.215	0.078
3S	10	29.61	35.291	22.072	4.672	-0.300	0.104	1.30	0.01	0.040	0.09	0.215	0.107
180W	30	29.55	35.301	22.100	4.732	-0.356	0.118	1.37	0.05	0.040	0.16	0.107	0.066
	50	29.44	35.360	22.181	4.783	-0.400	0.176	1.45	0.26	0.070	0.33	0.208	0.124
	60	29.40	35.363	22.198	4.697	-0.311	0.202	1.67	0.43	0.060	0.34	0.145	0.104
	70	29.39	35.365	22.203	4.633	-0.247	0.203	1.60	0.47	0.060	0.43	0.449	0.259
	80	29.39	35.366	22.206	4.611	-0.224	0.232	1.45	0.55	0.060	0.46	0.357	0.228
	90	29.38	35.368	22.209	4.507	-0.120	0.209	1.30	0.68	0.100	0.46	0.319	0.216
	110	29.35	35.382	22.231	4.581	-0.192	0.298	1.82	0.76	0.100	0.69	0.259	0.160
	130	29.03	35.419	22.366	4.517	-0.107	0.428	1.82	1.26	0.290	1.50	0.133	0.127
	150	27.96	35.725	22.951	4.044	0.436	0.481	1.97	0.03	2.350	1.50	0.082	0.066
	175	21.30	35.812	25.029	3.030	1.989	0.863	3.24	0.04	0.050	7.00	0.027	0.054
	200	15.58	35.250	26.034	2.261	3.352	1.374	9.33	0.14	0.040	13.76	0.009	0.009

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-15	0	29.79	35.112	21.878	4.632	-0.267	0.190	1.01	0.14	0.040	0.23	0.120	0.061
4S	10	29.74	35.175	21.942	4.623	-0.257	0.111	1.16	0.07	0.000	0.25	0.117	0.064
180W	30	29.60	35.169	21.985	4.657	-0.281	0.070	1.08	0.03	0.000	0.20	0.136	0.066
	50	29.56	35.288	22.089	4.752	-0.376	0.085	1.01	0.03	0.010	0.39	0.224	0.133
	60	29.45	35.421	22.225	4.701	-0.321	0.221	1.60	0.07	0.030	1.36	0.306	0.214
	70	29.36	35.434	22.264	4.665	-0.279	0.286	1.53	0.13	0.030	1.49	0.309	0.232
	80	29.23	35.409	22.290	4.625	-0.229	0.294	2.13	0.35	0.040	2.06	0.284	0.225
	90	29.19	35.404	22.300	4.577	-0.178	0.333	1.68	0.34	0.050	2.14	0.237	0.180
	110	29.00	35.401	22.363	4.494	-0.081	0.443	1.98	0.80	0.050	2.48	0.193	0.129
	130	27.89	35.726	22.974	4.171	0.314	0.473	2.50	0.41	1.660	2.47	0.114	0.157
	150	26.67	35.876	23.481	3.744	0.828	0.596	1.90	0.07	0.580	4.91	0.066	0.111
	175	22.99	36.026	24.712	3.285	1.579	0.762	2.27	0.08	0.030	6.77	0.040	0.068
	200	20.57	35.800	25.219	2.872	2.215	0.932	3.69	0.04	0.020	9.48	0.023	0.031

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-16	0	29.62	35.224	22.019	4.777	-0.404	0.222	1.53	0.14	0.020	0.59	0.151	0.065
5S	10	29.47	35.340	22.156	4.686	-0.305	0.218	1.53	0.08	0.020	0.50	0.120	0.068
180W	30	29.48	35.343	22.158	4.676	-0.295	0.291	1.46	0.10	0.020	0.59	0.129	0.058
	50	29.45	35.387	22.201	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	70	29.32	35.402	22.255	4.666	-0.276	0.361	1.53	0.27	0.040	1.59	0.155	0.105
	90	29.24	35.397	22.277	4.618	-0.222	0.349	1.60	0.27	0.050	1.75	0.183	0.113
	100	29.21	35.401	22.290	4.613	-0.215	0.309	1.53	0.36	0.040	1.81	0.180	0.116
	110	28.92	35.494	22.457	4.639	-0.223	0.339	1.53	0.44	0.050	1.82	0.177	0.116
	120	28.38	35.664	22.766	4.271	0.180	0.400	1.75	1.12	0.330	1.59	0.145	0.223
	130	27.96	35.733	22.954	4.153	0.327	0.453	1.68	0.59	1.120	1.53	0.123	0.242
	150	26.61	35.956	23.560	3.718	0.857	0.558	1.53	0.02	2.050	2.71	0.098	0.184
	175	23.02	35.995	24.681	3.295	1.568	0.787	2.42	0.02	0.020	6.16	0.010	0.028
	200	20.42	35.763	25.232	2.870	2.233	0.974	4.51	0.01	0.010	9.10	0.021	0.037

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-17	0	29.14	35.460	22.360	4.600	-0.199	0.247	1.96	0.10	0.010	0.27	0.115	0.057
7.5S	10	29.19	35.357	22.265	4.679	-0.279	0.218	1.15	0.06	0.000	0.27	0.115	0.062
180W	30	29.09	35.351	22.293	4.625	-0.217	0.236	1.15	0.07	0.000	0.25	0.120	0.057
	50	29.07	35.354	22.303	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	60	28.98	35.366	22.343	4.617	-0.202	0.199	1.15	0.04	0.000	0.25	0.160	0.114
	70	28.97	35.366	22.347	4.643	-0.227	0.185	1.22	0.05	0.000	0.25	0.195	0.131
	80	28.96	35.369	22.350	4.612	-0.196	0.222	1.15	0.12	0.010	0.31	0.210	0.150
	90	28.94	35.376	22.363	4.598	-0.181	0.231	1.00	0.12	0.010	0.34	0.215	0.157
	110	28.02	35.515	22.772	4.064	0.416	0.480	1.08	0.56	0.440	2.61	0.195	0.222
	130	26.70	35.727	23.359	3.551	1.023	0.670	1.59	0.04	1.160	6.02	0.150	0.239
	150	25.93	35.998	23.805	3.495	1.131	0.645	1.59	0.07	0.090	6.43	0.090	0.179
	175	24.29	36.095	24.382	3.359	1.395	0.679	1.59	0.09	0.030	7.27	0.043	0.081
	200	21.56	35.923	25.039	3.144	1.849	0.819	2.33	0.08	0.020	9.42	0.014	0.018

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-18	0	30.02	35.186	21.855	4.600	-0.254	0.191	0.19	0.09	0.010	0.07	0.076	0.033
10S	10	29.05	35.224	22.213	4.710	-0.296	0.221	0.19	0.15	0.000	0.04	0.105	0.049
180W	30	28.93	35.217	22.246	4.679	-0.257	0.216	0.19	0.05	0.010	0.03	0.115	0.057
	50	28.92	35.221	22.253	4.589	-0.166	0.218	0.27	0.05	0.000	0.04	0.135	0.077
	60	28.92	35.224	22.257	4.623	-0.200	0.231	0.49	0.09	0.000	0.00	0.155	0.085
	70	28.91	35.226	22.261	4.656	-0.233	0.218	0.19	0.07	0.000	0.00	0.180	0.094
	80	28.93	35.258	22.277	4.655	-0.233	0.234	0.34	0.12	0.010	0.06	0.225	0.135
	90	28.83	35.307	22.350	4.454	-0.027	0.290	0.27	0.15	0.090	0.54	0.297	0.230
	110	27.15	35.551	23.081	n.d.	n.d.	0.649	0.78	0.22	1.030	5.26	0.205	0.378
	130	26.08	35.659	23.503	3.461	1.162	0.716	1.74	0.15	0.450	6.47	0.130	0.281
	150	25.21	35.868	23.932	3.293	1.393	0.693	1.66	0.08	0.050	7.87	0.060	0.174
	175	23.90	35.959	24.395	3.194	1.595	0.719	1.66	0.13	0.020	7.85	0.390	0.076
	200	22.46	35.983	24.833	3.146	1.766	0.782	1.59	0.05	0.010	8.74	0.020	0.029

KH-90-2 LEG2 - 170W 0NS & 160W 10N-10S OCTOPUS

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-19	0	28.63	35.234	22.358	4.874	-0.431	0.369	2.04	0.04	0.240	2.22	0.221	0.079
0NS	10	28.46	35.230	22.414	4.802	-0.346	0.357	1.91	0.07	0.240	2.21	0.221	0.097
170W	30	28.40	35.247	22.447	4.852	-0.392	0.372	2.04	0.05	0.270	2.38	0.445	0.079
	50	28.34	35.274	22.485	4.803	-0.340	0.398	2.04	0.18	0.300	2.61	0.328	0.242
	70	28.27	35.323	22.547	4.623	-0.156	0.443	2.17	0.28	0.290	2.92	0.319	0.259
	90	28.15	35.338	22.596	4.569	-0.094	0.482	2.17	0.39	0.400	3.08	0.256	0.207
	100	28.08	35.321	22.608	4.727	-0.246	0.484	2.24	0.63	0.470	3.26	0.161	0.160
	110	27.98	35.454	22.738	4.393	0.092	0.525	2.40	0.07	1.180	3.93	0.092	0.096
	120	27.64	35.534	22.909	4.348	0.160	0.573	2.35	0.05	1.090	4.45	0.079	0.084
	130	26.95	35.584	23.170	3.887	0.671	0.680	2.68	0.03	0.090	7.22	0.063	0.128
	150	21.26	35.178	24.558	3.245	1.797	0.785	4.76	0.03	0.030	9.44	0.040	0.070
	175	19.67	35.312	25.085	3.236	1.951	0.837	5.05	0.04	0.010	10.50	0.021	0.040
	200	17.21	35.142	25.571	3.391	2.048	0.972	7.54	0.03	0.010	12.50	0.010	0.026

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-20	0	28.73	34.214	21.562	4.829	-0.367	0.140	2.89	0.03	0.120	0.96	0.058	0.023
10N	10	28.73	34.212	21.559	4.633	-0.171	0.133	2.86	0.10	0.120	0.99	0.042	0.037
160W	30	28.74	34.239	21.577	4.741	-0.280	0.109	2.86	0.02	0.120	0.99	0.183	0.225
	50	26.51	34.661	22.615	4.965	-0.349	0.162	2.93	0.01	0.120	0.99	0.129	0.167
	70	20.98	34.610	24.201	4.470	0.615	0.447	3.63	0.09	0.170	2.56	0.073	0.187
	80	16.71	34.594	25.271	3.796	1.716	0.746	4.49	0.04	0.240	5.36	0.164	0.030
	90	16.07	34.571	25.400	3.763	1.819	0.838	5.06	0.05	0.210	6.61	0.041	0.201
	100	15.35	34.527	25.529	3.170	2.494	1.028	5.77	0.02	0.210	8.21	0.246	0.140
	110	13.52	34.455	25.865	2.363	3.518	1.461	7.59	0.03	0.170	11.52	0.297	0.155
	130	12.38	34.522	26.145	1.142	4.878	2.091	10.55	0.02	0.140	15.98	0.196	0.346
	150	11.64	34.683	26.411	0.455	5.654	2.386	12.48	0.01	0.130	n.d.	0.028	0.006
	175	11.27	34.701	26.493	0.489	5.668	2.391	12.49	0.07	0.130	32.66	0.039	0.015
	200	10.96	34.696	26.546	0.373	5.826	2.404	13.36	0.06	0.130	34.16	0.013	0.005

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-21	0	29.35	33.915	21.129	4.684	-0.260	0.159	0.48	0.05	0.000	0.01	0.164	0.092
7.5N	10	29.36	33.914	21.126	4.605	-0.181	0.121	0.48	0.01	0.000	0.00	0.177	0.094
160W	30	29.37	33.917	21.124	4.686	-0.264	0.126	0.48	0.01	0.000	0.01	0.177	0.105
	50	29.17	34.039	21.283	4.609	-0.175	0.173	0.48	0.00	0.000	0.01	0.211	0.142
	70	28.05	34.497	21.997	4.729	-0.226	0.185	0.55	0.02	0.000	0.01	0.249	0.184
	90	25.66	34.677	22.892	4.824	-0.143	0.216	0.63	0.03	0.000	0.02	0.227	0.181
	100	22.38	34.780	23.942	4.469	0.483	0.398	1.27	0.02	0.030	0.41	0.230	0.235
	110	20.79	34.733	24.346	4.159	0.939	0.527	1.82	0.02	0.140	1.62	0.246	0.230
	120	18.18	34.630	24.943	3.743	1.613	0.839	2.69	0.07	0.340	3.79	0.177	0.253
	130	13.90	34.573	25.878	1.960	3.871	1.854	7.66	0.02	0.050	12.02	0.133	0.189
	150	12.54	34.606	26.177	1.285	4.711	2.177	9.84	0.02	0.010	14.86	0.104	0.131
	175	11.24	34.647	26.457	0.975	5.189	2.438	11.87	0.05	0.000	16.97	0.019	0.044
	200	10.65	34.648	26.565	1.327	4.915	2.387	12.61	0.03	0.010	16.91	0.005	0.021

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-22	0	29.00	34.935	22.011	4.898	-0.474	0.265	0.63	0.35	0.030	0.20	0.164	0.092
5N	10	29.02	34.936	22.007	4.741	-0.318	0.214	0.63	0.04	0.020	0.16	0.177	0.094
160W	30	28.90	34.939	22.049	4.741	-0.310	0.223	0.63	0.09	0.030	0.19	0.177	0.105
	50	28.87	34.964	22.078	4.644	-0.211	0.228	0.63	0.13	0.040	0.28	0.211	0.142
	70	28.83	34.986	22.108	4.560	-0.124	0.233	0.71	0.08	0.050	0.35	0.249	0.184
	80	28.67	35.006	22.173	4.679	-0.233	0.259	0.71	0.19	0.070	0.45	0.227	0.181
	90	28.24	35.043	22.347	4.542	-0.065	0.347	0.87	0.46	0.290	0.79	0.230	0.235
	100	28.18	35.032	22.356	4.577	-0.096	0.342	0.79	0.34	0.380	0.70	0.246	0.230
	110	27.73	34.972	22.459	4.494	0.022	0.342	0.95	0.30	0.450	0.59	0.177	0.253
	130	26.08	34.855	22.897	4.304	0.340	0.352	1.11	0.23	0.420	0.59	0.133	0.189
	150	23.12	34.867	23.796	3.771	1.115	0.512	1.66	0.07	0.360	2.34	0.104	0.131
	175	17.13	34.714	25.264	2.855	2.608	1.190	5.09	0.07	0.010	8.27	0.019	0.044
	200	12.31	34.620	26.235	2.177	3.849	2.029	10.57	0.25	0.010	14.45	0.005	0.021

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-23	0	28.18	35.037	22.362	4.694	-0.213	0.083	2.15	n.d.	0.140	1.58	0.196	0.093
4N	10	28.19	35.074	22.386	4.769	-0.289	0.329	2.15	0.33	0.120	1.52	0.183	0.106
160W	30	28.17	35.074	22.390	4.746	-0.265	0.308	2.15	0.34	0.120	1.50	0.208	0.120
	50	27.89	35.041	22.458	4.918	-0.416	0.321	2.15	0.40	0.200	1.68	0.290	0.276
	70	27.27	35.087	22.695	4.720	-0.173	0.486	2.54	0.37	0.330	3.09	0.284	0.265
	80	27.23	35.103	22.720	4.661	-0.111	0.456	2.54	0.49	0.340	3.23	0.268	0.281
	90	27.21	35.106	22.727	4.570	-0.020	0.433	2.54	0.62	0.330	3.33	0.249	0.256
	100	27.21	35.127	22.742	4.506	0.044	0.438	2.54	0.50	0.330	3.33	0.243	0.273
	110	27.19	35.132	22.754	4.299	0.253	0.452	2.54	0.49	0.340	3.47	0.199	0.180
	130	26.79	35.073	22.835	4.166	0.417	0.468	2.74	0.35	0.560	3.75	0.129	0.131
	150	25.18	35.007	23.290	0.000	0.000	0.677	4.11	0.08	0.950	6.49	0.066	0.111
	175	18.18	34.759	25.042	2.669	2.683	1.070	10.98	0.42	0.040	13.34	0.026	0.062
	200	13.74	34.619	25.946	1.614	4.234	1.730	20.82	0.30	0.050	20.66	0.009	0.016

	depth	Temp	Salinity	Sigma-t	oxygen	AOU	phosph	SiO2	NH4	NO2	NO3	Chl-a	heo-a-a
OCT-24	0	28.44	35.030	22.268	4.757	-0.295	0.314	2.15	0.07	0.120	0.80	0.174	0.054
3N	10	28.36	35.030	22.294	4.727	-0.260	0.309	1.95	0.02	0.120	0.80	0.167	0.064
160W	30	28.25	35.034	22.335	4.720	-0.245	0.387	1.95	0.08	0.140	0.88	0.208	0.081
	50	28.06	35.065	22.420	4.704	-0.216	0.386	2.15	0.06	0.260	1.55	0.303	0.202
	70	27.81	35.048	22.491	3.610	0.898	0.385	2.15	0.07	0.260	1.64	0.325	0.235
	80	27.73	35.055	22.522	4.588	-0.074	0.429	2.15	0.20	0.280	1.83	0.316	0.262
	90	27.59	35.048	22.561	4.577	-0.053	0.409	2.15	0.27	0.310	2.06	0.275	0.274
	100	27.29	35.055	22.663	4.371	0.175	0.421	2.34	0.31	0.350	2.26	0.243	0.244
	110	27.13	35.051	22.711	4.435	0.123	0.473	2.74	0.29	0.700	3.10	0.208	0.243
	130	25.90	35.025	23.081	3.954	0.700	0.607	3.52	0.02	1.030	4.90	0.151	0.206
	150	21.17	34.857	24.337	2.960	2.099	0.943	8.62	0.01	0.050	11.42	0.063	0.139
	175	16.60	34.713	25.386	2.635	2.883	1.297	14.91	0.04	0.030	16.15	0.032	0.057
	200	11.38	34.637	26.423	2.505	3.640	1.803	26.94	0.05	0.020	23.11	0.006	0.020

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-25	0	28.25	35.046	22.343	4.696	-0.221	0.361	1.80	0.15	0.180	1.33	0.148	0.083
2N	10	28.26	35.045	22.342	4.637	-0.162	0.379	1.80	0.08	0.180	1.33	0.145	0.082
160W	30	28.19	35.048	22.367	4.666	-0.186	0.351	1.60	0.09	0.170	1.31	0.180	0.102
	50	28.17	35.048	22.372	4.641	-0.159	0.393	1.60	0.09	0.180	1.30	0.189	0.103
	70	28.16	35.048	22.374	4.623	-0.141	0.371	1.80	0.11	0.180	1.35	0.202	0.127
	80	28.16	35.047	22.376	4.677	-0.195	0.266	1.60	0.14	0.180	1.38	0.085	0.041
	90	28.14	35.047	22.380	4.616	-0.133	0.338	1.80	0.13	0.190	1.39	0.054	0.300
	100	27.44	35.029	22.594	4.490	0.046	0.423	1.80	0.16	0.410	1.87	0.249	0.202
	110	26.78	35.033	22.809	4.119	0.466	0.573	2.59	0.06	0.930	3.70	0.275	0.310
	130	24.27	34.967	23.534	3.547	1.239	0.721	4.39	0.02	0.460	7.00	0.129	0.170
	150	19.91	34.828	24.653	3.035	2.144	1.065	9.57	0.01	0.030	12.21	0.060	0.117
	175	15.83	34.676	25.537	2.674	2.930	1.302	15.36	0.02	0.020	16.58	0.034	0.055
	200	12.03	34.747	26.387	2.230	3.826	1.693	23.35	0.03	0.010	23.80	0.006	0.019

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-26	0	27.76	35.276	22.676	4.661	-0.156	0.015	2.12	0.09	0.190	4.92	0.344	0.216
1N	10	27.76	35.277	22.677	n.d.	n.d.	0.101	2.12	0.17	0.190	4.88	0.328	0.221
160W	30	27.76	35.279	22.680	4.773	-0.267	0.068	1.93	0.12	0.190	4.88	0.360	0.240
	50	27.74	35.279	22.688	4.720	-0.213	0.448	1.93	0.17	0.200	4.92	0.353	0.300
	70	27.72	35.284	22.695	4.650	-0.142	0.504	2.12	0.31	0.220	5.03	0.338	0.265
	80	27.71	35.291	22.706	4.649	-0.140	0.505	2.12	0.39	0.250	5.18	0.325	0.249
	90	27.68	35.300	22.723	4.602	-0.090	0.519	2.31	0.47	0.320	5.65	0.303	0.267
	100	27.61	35.328	22.766	4.468	0.047	0.610	2.31	0.62	0.420	6.16	0.303	0.271
	110	27.46	35.341	22.825	4.170	0.357	0.547	2.70	0.15	0.690	8.24	0.252	0.285
	130	25.73	35.098	23.190	3.514	1.151	0.606	3.67	0.06	0.060	10.56	0.129	0.174
	150	18.04	34.923	25.203	3.168	2.193	1.163	6.56	0.03	0.010	19.02	0.021	0.027
	175	14.24	34.732	25.928	3.167	2.617	0.930	17.35	0.05	0.010	26.43	0.008	0.020
	200	12.61	34.717	26.251	2.789	3.195	1.460	21.59	0.03	0.000	31.78	0.005	0.018

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-27	0	27.80	35.358	22.726	4.718	-0.217	0.464	1.93	0.73	0.200	5.52	0.344	0.198
0.5N	10	27.80	35.358	22.724	4.700	-0.199	0.481	1.93	0.11	0.200	5.43	0.335	0.211
160W	30	27.81	35.357	22.723	4.772	-0.272	0.433	1.93	0.06	0.200	5.47	0.335	0.229
	50	27.79	35.353	22.726	4.713	-0.212	0.467	1.93	0.14	0.210	5.45	0.350	0.235
	60	27.78	35.352	22.728	4.686	-0.184	0.438	1.93	0.22	0.220	5.42	0.328	0.221
	70	27.76	35.357	22.739	4.727	-0.223	0.460	2.12	0.22	0.320	5.52	0.294	0.219
	80	27.72	35.390	22.776	4.570	-0.064	0.503	2.31	0.33	0.460	5.98	0.243	0.201
	90	27.67	35.423	22.818	4.481	0.028	0.552	2.31	0.30	0.600	6.69	0.202	0.159
	110	27.28	35.435	22.952	4.058	0.479	0.603	2.70	0.07	0.600	9.72	0.151	0.163
	130	23.71	35.289	23.943	3.625	1.199	0.758	4.63	0.04	0.030	15.07	0.069	0.107
	150	19.83	35.069	24.857	3.189	1.990	0.799	7.91	0.04	0.010	16.82	0.041	0.034
	175	15.87	35.028	25.798	3.299	2.290	1.067	11.19	0.10	0.020	21.16	0.013	0.020

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-28	0	27.69	35.458	22.836	4.7	-0.194	0.394	1.38	0.12	0.200	3.39	0.376	0.199
0NS	10	27.68	35.515	22.883	4.69	-0.185	0.406	1.41	0.15	0.190	3.39	0.331	0.210
160W	30	27.80	35.391	22.751	n.d.	n.d.	0.467	1.37	0.11	0.200	3.40	0.366	0.222
	50	27.79	35.393	22.755	4.96	-0.460	0.450	1.28	0.16	0.210	3.44	0.338	0.244
	60	27.77	35.397	22.767	n.d.	n.d.	0.481	1.44	0.18	0.280	3.58	0.290	0.251
	70	27.67	35.422	22.817	3.91	0.599	0.476	1.42	0.25	0.450	3.93	0.249	0.191
	80	27.47	35.509	22.947	n.d.	n.d.	0.566	1.83	0.19	0.690	4.76	0.148	0.159
	90	27.27	35.551	23.042	3.15	1.385	0.563	1.80	0.14	0.780	5.64	0.079	0.094
	100	27.17	35.542	23.068	n.d.	n.d.	0.583	1.89	0.07	0.730	5.95	0.076	0.105
	110	26.72	35.663	23.305	1.96	2.614	0.643	1.86	0.02	0.440	6.93	0.069	0.111
	120	24.89	35.777	23.960	n.d.	n.d.	0.735	2.62	0.04	0.050	8.72	0.045	0.063
	130	22.74	35.395	24.307	0.51	4.394	0.780	4.36	0.08	0.040	9.75	0.024	0.073
	150	20.43	35.339	24.906	n.d.	n.d.	0.900	5.52	0.03	0.020	10.46	0.007	0.010
	175	16.99	35.256	25.713	0.47	4.990	1.016	8.33	0.03	0.010	12.71	0.010	0.019
	200	13.91	35.061	26.252	n.d.	n.d.	1.271	14.02	0.02	0.010	17.16	0.002	0.019

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-29	0	27.87	35.450	22.772	4.596	-0.103	0.440	1.70	0.06	0.150	3.60	0.325	0.220
0.5S	10	27.88	35.450	22.771	4.615	-0.122	0.517	1.70	0.29	0.150	3.65	0.319	0.201
160W	30	27.88	35.449	22.768	4.593	-0.101	0.541	1.70	0.12	0.150	3.61	0.319	0.216
	50	27.89	35.457	22.772	4.745	-0.254	0.556	1.70	0.20	0.150	3.69	0.145	0.534
	70	27.93	35.505	22.795	4.516	-0.028	0.570	1.84	0.37	0.160	3.84	0.252	0.177
	80	27.96	35.549	22.818	4.491	-0.007	0.736	1.98	0.26	0.160	4.07	0.151	0.112
	90	27.92	35.551	22.831	4.507	-0.020	0.574	1.98	0.50	0.170	4.12	0.117	0.071
	100	27.78	35.531	22.863	4.597	-0.099	1.418	1.84	0.24	0.190	3.76	0.240	0.165
	110	27.45	35.552	22.987	4.231	0.291	0.598	2.27	0.23	0.970	4.44	0.073	0.031
	130	25.55	35.779	23.759	3.641	1.021	0.807	2.55	0.06	0.360	7.44	0.050	0.056
	150	19.98	35.476	25.129	2.919	2.233	0.966	4.97	0.03	0.020	11.48	0.020	0.024
	175	16.09	35.157	25.846	3.184	2.376	1.900	9.23	0.27	0.010	14.18	0.015	0.015
	200	13.34	34.936	26.275	3.017	2.869	1.484	15.51	0.03	0.020	18.47	0.002	0.014

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-30	0	27.86	35.452	22.779	4.571	-0.076	0.536	2.27	0.13	0.160	3.64	0.309	0.211
1S	10	27.86	35.452	22.778	4.615	-0.121	0.537	1.70	0.05	0.160	3.59	0.309	0.225
160W	30	27.86	35.452	22.776	4.602	-0.109	0.529	1.70	0.11	0.160	3.60	0.312	0.233
	50	27.88	35.458	22.777	4.578	-0.086	0.563	1.70	0.47	0.160	3.65	0.312	0.215
	70	27.93	35.493	22.786	4.537	-0.049	0.549	1.98	0.10	0.150	3.77	0.262	0.189
	80	27.97	35.545	22.811	4.514	-0.031	0.612	1.98	0.35	0.150	3.97	0.186	0.146
	90	27.96	35.545	22.814	4.470	0.014	0.657	2.27	0.42	0.150	4.10	0.104	0.094
	100	27.92	35.540	22.823	4.444	0.043	0.629	2.27	0.46	0.220	4.03	0.085	0.066
	110	27.80	35.538	22.861	4.369	0.127	0.651	2.27	0.44	0.410	4.04	0.044	0.046
	130	25.58	35.852	23.806	3.507	1.150	0.875	2.83	0.05	0.400	7.28	0.047	0.065
	150	20.16	35.644	25.208	2.740	2.390	1.170	5.39	0.00	0.010	12.61	0.006	0.007
	175	17.25	35.298	25.682	2.887	2.544	1.209	7.53	0.01	0.000	14.23	0.011	0.010
	200	15.06	35.142	26.067	2.931	2.744	1.376	11.09	0.03	0.010	17.02	0.025	0.027

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-31	0	28.07	35.517	22.758	4.629	-0.152	0.536	1.59	0.05	0.14	3.81	0.316	0.172
2S	10	28.04	35.515	22.766	4.599	-0.120	0.546	1.44	0.17	0.14	3.84	0.341	0.194
160W	30	28.00	35.514	22.777	4.727	-0.246	0.566	1.44	0.05	0.15	3.79	0.363	0.215
	50	28.00	35.515	22.780	4.584	-0.102	0.559	1.44	0.04	0.15	3.86	0.379	0.217
	70	28.00	35.526	22.787	4.604	-0.122	0.583	1.44	0.18	0.15	3.90	0.341	0.222
	80	28.00	35.546	22.803	4.524	-0.043	0.599	1.59	0.21	0.16	4.01	0.278	0.206
	90	27.98	35.561	22.819	4.585	-0.103	0.643	1.73	0.38	0.16	4.23	0.199	0.191
	100	27.97	35.561	22.822	4.562	-0.079	0.621	1.88	0.36	0.16	4.27	0.161	0.139
	110	27.97	35.561	22.823	4.635	-0.152	0.556	1.88	0.44	0.16	4.29	0.026	0.020
	130	27.82	35.571	22.881	4.512	-0.018	n.d.	n.d.	n.d.	n.d.	n.d.	0.066	0.062
	150	23.63	35.941	24.462	3.476	1.336	0.862	2.74	0.05	0.33	7.88	0.047	0.080
	175	17.03	35.394	25.809	2.430	3.021	1.462	9.25	0.05	0.02	17.31	0.021	0.034
	200	14.44	35.118	26.184	2.271	3.477	1.692	14.76	0.04	0.02	21.22	0.009	0.016

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-32	0	28.09	35.555	22.779	4.557	-0.082	0.575	2.31	0.49	0.13	4.09	0.189	0.118
3S	10	28.09	35.551	22.774	4.585	-0.111	0.535	2.02	0.22	0.13	4.07	0.234	0.171
160W	30	27.99	35.544	22.804	4.557	-0.075	0.547	2.02	0.23	0.13	4.08	0.199	0.133
	50	27.98	35.544	22.808	4.544	-0.061	0.544	2.02	0.23	0.13	4.09	0.256	0.170
	70	27.98	35.543	22.805	4.555	-0.072	0.518	2.02	0.26	0.13	4.08	0.249	0.180
	90	27.98	35.543	22.806	4.553	-0.070	0.542	2.02	0.26	0.13	4.11	0.000	0.000
	100	27.98	35.544	22.807	4.683	-0.200	0.533	2.02	0.27	0.13	4.12	0.000	0.000
	110	27.97	35.540	22.809	4.550	-0.066	0.570	2.02	0.27	0.13	4.11	0.246	0.173
	120	27.88	35.523	22.825	4.530	-0.039	0.535	2.02	0.29	0.14	4.11	0.227	0.181
	130	27.58	35.486	22.894	4.476	0.037	0.547	2.02	0.47	0.19	4.17	0.234	0.178
	150	25.67	35.756	23.705	3.899	0.753	0.737	2.31	0.04	2.72	4.68	0.107	0.135
	175	20.14	35.766	25.307	3.006	2.121	1.784	4.33	0.04	0.03	10.69	0.047	0.086
	200	15.30	35.212	26.067	1.923	3.722	1.734	11.86	0.04	0.01	20.01	0.011	0.019

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-33	0	27.94	35.507	22.791	4.528	-0.042	0.615	2.20	0.08	0.130	3.98	0.133	0.084
4S	10	27.95	35.507	22.789	n.d.	n.d.	0.629	2.20	0.15	0.130	3.98	0.133	0.084
160W	30	27.94	35.506	22.792	4.689	-0.202	0.611	2.20	0.13	0.130	3.99	0.638	0.496
	50	27.88	35.500	22.805	4.655	-0.164	0.631	2.20	0.16	0.130	4.02	0.183	0.117
	70	27.72	35.474	22.840	4.601	-0.098	0.621	2.05	0.25	0.180	4.09	0.268	0.237
	90	27.62	35.462	22.862	4.614	-0.102	0.626	2.20	0.33	0.210	4.17	0.265	0.244
	100	27.59	35.458	22.871	4.682	-0.168	0.653	2.05	0.47	0.220	4.21	0.234	0.229
	110	27.45	35.426	22.892	4.550	-0.025	0.677	2.20	0.62	0.270	4.23	0.208	0.207
	120	27.46	35.470	22.920	4.484	0.039	0.724	2.20	0.73	0.250	4.52	0.164	0.190
	130	26.86	35.547	23.172	4.368	0.198	0.818	2.35	0.79	0.900	5.06	0.085	0.199
	150	24.44	35.866	24.164	3.831	0.917	0.839	2.35	0.03	2.880	4.78	0.073	0.130
	175	22.89	36.039	24.753	3.579	1.294	0.853	2.05	0.05	0.490	6.28	0.057	0.131
	200	16.06	35.284	25.951	2.054	3.504	1.694	11.73	0.02	0.020	19.99	0.017	0.033

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-34	0	27.96	35.501	22.781	4.686	-0.201	0.585	0.75	1.43	0.13	4.80	0.196	0.129
5S	10	27.96	35.502	22.783	4.641	-0.155	0.708	0.75	0.19	0.11	4.74	0.177	0.105
160W	30	27.96	35.502	22.782	4.649	-0.164	0.648	0.75	0.07	0.12	4.69	0.391	0.237
	50	27.97	35.502	22.778	4.621	-0.137	0.660	0.75	0.05	0.12	4.72	0.196	0.122
	70	27.97	35.500	22.778	4.615	-0.130	0.701	0.75	0.13	0.11	4.73	0.164	0.118
	80	27.96	35.499	22.780	4.662	-0.177	0.676	0.75	0.11	0.11	4.78	0.194	0.122
	90	27.71	35.480	22.846	4.613	-0.110	0.722	0.82	0.45	0.12	4.94	0.221	0.220
	100	27.50	35.467	22.906	4.570	-0.050	0.738	0.88	0.61	0.14	5.06	0.193	0.197
	120	27.46	35.473	22.922	4.497	0.025	0.748	0.88	0.77	0.14	5.09	0.114	0.117
	130	27.41	35.470	22.937	4.498	0.029	0.775	0.88	0.73	0.15	5.14	0.088	0.099
	150	26.99	35.594	23.166	4.093	0.462	0.811	0.95	0.32	1.18	5.13	0.082	0.109
	175	22.26	36.093	24.972	3.542	1.383	0.794	0.75	0.07	0.02	5.86	0.035	0.096
	200	17.82	35.498	25.698	2.822	2.543	1.190	2.44	0.03	0.02	12.26	0.013	0.014

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-35	0	28.69	35.539	22.567	n.d.	n.d.	0.473	1.96	0.12	0.090	3.54	0.148	0.079
7.5S	10	28.65	35.557	22.595	4.668	-0.234	0.456	1.82	0.13	0.100	3.48	0.148	0.079
160W	30	28.54	35.565	22.637	4.667	-0.226	0.439	1.82	0.13	0.090	3.53	0.341	0.222
	50	28.53	35.568	22.645	4.820	-0.378	0.472	1.68	0.05	0.100	3.42	0.196	0.129
	60	28.53	35.570	22.646	4.665	-0.223	0.452	1.68	0.06	0.100	3.42	0.186	0.139
	70	28.52	35.572	22.649	4.573	-0.131	0.504	1.54	0.15	0.090	3.42	0.193	0.104
	80	28.50	35.578	22.661	n.d.	n.d.	0.462	1.40	0.24	0.090	3.07	0.237	0.168
	90	28.46	35.596	22.688	n.d.	n.d.	0.446	1.26	0.41	0.080	2.62	0.243	0.205
	110	28.41	35.635	22.733	4.524	-0.075	0.426	1.12	0.53	0.080	2.23	0.193	0.172
	130	28.40	35.656	22.753	4.306	0.144	0.450	1.12	0.85	0.230	1.69	0.158	0.196
	150	28.19	35.732	22.881	4.000	0.463	0.472	1.40	0.10	1.730	1.93	0.107	0.210
	175	26.99	36.080	23.531	3.727	0.815	0.548	1.12	0.15	0.050	4.16	0.044	0.090
	200	24.16	36.396	24.647	3.758	0.998	0.575	1.12	0.06	0.020	4.71	0.021	0.030

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-36	0	28.60	35.753	22.758	4.584	-0.152	0.258	1.12	0.02	0.020	1.19	0.129	0.066
10S	10	28.50	35.756	22.795	4.709	-0.269	0.284	1.12	0.19	0.010	1.20	0.126	0.072
160W	30	28.45	35.762	22.818	4.812	-0.369	0.284	1.12	0.16	0.020	0.99	0.297	0.187
	50	28.44	35.764	22.821	n.d.	n.d.	0.269	1.12	0.13	0.010	0.91	0.170	0.111
	70	28.40	35.770	22.839	n.d.	n.d.	0.259	1.12	0.32	0.010	0.63	0.183	0.124
	80	28.36	35.798	22.872	4.565	-0.117	0.232	1.26	0.14	0.000	0.25	0.177	0.112
	90	27.77	35.881	23.129	4.504	-0.014	0.270	1.68	0.32	0.010	0.37	0.202	0.163
	100	27.39	35.995	23.338	4.282	0.233	0.309	1.54	0.47	0.200	0.36	0.196	0.263
	110	27.15	36.071	23.473	4.224	0.306	0.310	1.54	0.41	0.270	0.41	0.174	0.278
	130	26.94	36.130	23.585	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	150	25.36	36.376	24.268	3.874	0.786	0.472	1.54	0.06	1.560	2.12	0.129	0.199
	175	23.99	36.381	24.689	3.601	1.170	0.528	1.40	0.00	0.060	4.07	0.056	0.084
	200	22.65	36.237	24.972	3.774	1.114	0.569	1.68	0.17	0.020	4.13	0.031	0.041

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	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-37	0	28.19	35.711	22.864	4.697	-0.233	0.460	1.31	0.19	0.100	2.18	0.158	0.106
10S	10	28.18	35.710	22.866	4.595	-0.131	0.430	1.31	0.15	0.100	2.17	0.158	0.109
150W	30	28.18	35.712	22.867	4.592	-0.128	0.410	1.31	0.11	0.100	2.20	0.322	0.205
	50	28.18	35.712	22.866	4.581	-0.118	0.410	1.31	0.12	0.100	2.19	0.164	0.107
	70	28.14	35.708	22.877	4.570	-0.103	0.440	1.48	0.27	0.110	2.21	0.186	0.124
	80	27.83	35.790	23.039	4.438	0.049	0.440	1.48	0.55	0.220	1.87	0.252	0.285
	90	27.67	35.894	23.170	4.396	0.101	0.430	1.64	0.68	0.270	1.02	0.262	0.312
	100	27.48	35.953	23.279	4.365	0.144	0.410	1.64	0.63	0.200	0.48	0.211	0.280
	110	27.19	35.950	23.369	4.114	0.416	0.490	2.30	0.30	1.640	1.47	0.186	0.261
	130	25.84	36.204	23.988	3.815	0.812	0.610	1.80	0.06	1.450	4.38	0.129	0.217
	150	24.54	36.232	24.410	3.697	1.033	0.600	1.97	0.11	0.080	5.40	0.069	0.111
	175	22.90	36.213	24.882	3.725	1.142	0.600	1.64	0.08	0.050	5.05	0.023	0.023
	200	21.90	36.110	25.087	4.591	0.366	0.580	1.64	0.09	0.040	4.94	0.012	0.016

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-38	0	28.13	35.605	22.803	4.599	-0.129	0.410	1.64	0.21	0.170	3.33	0.136	0.085
7.5S	10	28.14	35.604	22.801	4.674	-0.204	0.410	1.64	0.15	0.180	3.30	0.142	0.093
150W	30	28.12	35.603	22.805	4.636	-0.165	0.410	1.64	0.19	0.170	3.31	0.316	0.190
	50	28.02	35.603	22.837	4.588	-0.110	0.370	1.64	0.17	0.160	3.25	0.221	0.187
	70	27.90	35.604	22.879	4.634	-0.147	0.440	1.64	0.22	0.160	3.21	0.297	0.321
	80	27.83	35.613	22.907	4.629	-0.137	0.420	1.64	0.44	0.170	3.15	0.316	0.334
	90	27.71	35.596	22.935	4.580	-0.078	0.420	1.64	0.60	0.220	3.24	0.243	0.317
	100	27.68	35.620	22.961	4.477	0.025	0.450	1.80	0.71	0.300	3.41	0.237	0.283
	110	27.55	35.803	23.141	4.320	0.188	0.460	1.97	0.70	0.920	2.15	0.196	0.317
	130	26.37	35.894	23.590	3.896	0.698	0.550	1.97	0.08	1.270	4.66	0.082	0.124
	150	24.89	36.142	24.236	3.724	0.980	0.590	1.80	0.06	0.090	6.02	0.049	0.079
	175	21.03	35.926	25.188	3.671	1.369	0.640	1.97	0.09	0.050	6.25	0.021	0.023
	200	17.47	35.408	25.712	3.180	2.224	0.950	3.94	0.09	0.030	11.14	0.006	0.013

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-39	0	27.52	35.508	22.928	4.635	-0.117	0.560	2.30	0.14	0.260	5.08	0.158	0.099
5S	10	27.52	35.508	22.931	4.707	-0.190	0.480	2.46	0.22	0.240	5.08	0.145	0.104
150W	30	27.52	35.507	22.928	4.667	-0.150	0.500	2.30	0.20	0.240	5.07	0.271	0.220
	50	27.52	35.506	22.928	4.847	-0.330	0.480	2.46	0.25	0.250	5.08	0.151	0.112
	70	27.44	35.500	22.951	n.d.	n.d.	0.510	2.30	0.30	0.250	5.18	0.167	0.187
	80	27.30	35.492	22.989	4.710	-0.176	0.520	2.46	0.35	0.280	5.31	0.208	0.247
	90	27.22	35.486	23.010	4.624	-0.083	0.550	2.46	0.46	0.320	5.31	0.193	0.244
	100	27.22	35.486	23.011	4.644	-0.104	0.560	2.30	0.49	0.330	5.31	0.189	0.211
	110	27.17	35.484	23.024	4.609	-0.065	0.520	2.30	0.37	0.370	5.27	0.170	0.173
	130	26.79	35.456	23.126	4.571	0.002	0.600	2.46	0.74	0.500	5.12	0.142	0.168
	150	24.56	35.896	24.150	3.779	0.959	0.790	2.46	0.07	1.240	6.43	0.069	0.111
	175	21.07	35.859	25.128	3.590	1.450	0.700	2.30	0.06	0.070	7.52	0.034	0.057
	200	17.39	35.390	25.719	3.119	2.294	0.930	4.44	0.04	0.040	11.70	0.010	0.020

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-40	0	27.52	35.511	22.931	4.678	-0.161	0.550	1.80	0.17	0.230	5.40	0.148	0.097
4S	10	27.53	35.511	22.928	4.655	-0.139	0.503	1.84	0.17	0.220	5.39	0.139	0.103
150W	30	27.53	35.510	22.929	4.670	-0.153	0.523	1.79	0.14	0.220	5.39	0.284	0.185
	50	27.47	35.506	22.944	4.662	-0.141	0.550	1.67	0.18	0.220	5.43	0.158	0.120
	70	27.18	35.461	23.005	4.666	-0.122	0.525	1.87	0.32	0.240	5.57	0.208	0.174
	80	27.08	35.457	23.033	4.604	-0.052	0.550	1.88	0.60	0.270	5.69	0.224	0.267
	90	27.03	35.470	23.058	4.584	-0.029	0.588	1.86	0.54	0.250	5.72	0.202	0.257
	100	27.01	35.469	23.065	4.634	-0.077	0.585	1.87	0.56	0.270	5.70	0.202	0.260
	110	26.94	35.471	23.087	4.557	0.004	0.584	1.91	0.64	0.310	5.67	0.193	0.237
	130	26.79	35.454	23.123	4.613	-0.040	0.557	1.96	0.66	0.410	5.55	0.123	0.148
	150	26.15	35.674	23.493	4.086	0.531	0.682	1.94	0.03	2.910	5.12	0.076	0.126
	175	19.53	35.632	25.366	3.244	1.946	0.895	2.71	0.02	0.140	10.31	0.036	0.088
	200	15.30	35.191	26.053	1.860	3.787	1.682	11.36	0.00	0.030	22.90	0.016	0.036

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-41	0	27.30	35.503	22.997	4.638	-0.104	0.520	1.90	0.19	0.230	5.76	0.136	0.113
3S	10	27.30	35.503	22.997	n.d.	n.d.	0.570	1.91	0.21	0.230	5.74	0.145	0.100
150W	30	27.31	35.503	22.996	4.626	-0.093	0.525	2.02	0.18	0.230	5.69	0.180	0.073
	50	27.31	35.503	22.993	4.615	-0.082	0.548	1.90	0.21	0.230	5.71	0.167	0.104
	70	27.27	35.499	23.005	4.601	-0.065	0.500	1.88	0.22	0.230	5.77	0.161	0.117
	80	27.26	35.498	23.007	4.649	-0.111	0.579	1.92	0.26	0.230	5.74	0.164	0.121
	90	27.21	35.493	23.017	4.663	-0.122	0.522	1.99	0.26	0.230	5.76	0.170	0.093
	100	27.14	35.479	23.031	4.564	-0.017	0.585	2.07	0.45	0.250	5.80	0.167	0.136
	110	26.95	35.470	23.083	4.484	0.076	0.618	2.02	0.62	0.370	5.76	0.136	0.153
	130	26.61	35.494	23.211	4.400	0.187	0.650	2.03	0.77	0.790	5.63	0.107	0.138
	150	21.97	35.709	24.763	3.476	1.486	0.860	2.68	0.00	4.460	5.88	0.053	0.065
	175	15.96	35.256	25.954	1.996	3.575	1.543	10.04	0.00	0.020	20.88	0.027	0.048
	200	13.92	35.030	26.227	0.709	5.103	2.159	19.34	0.00	0.010	31.83	0.014	0.024

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-42	0	26.22	35.211	23.120	n.d.	n.d.	0.530	2.81	0.23	0.510	5.77	0.284	0.236
2S	10	26.22	35.211	23.120	4.588	0.036	0.510	2.77	0.14	0.500	5.76	0.275	0.191
150W	30	26.22	35.211	23.121	4.591	0.033	0.550	2.75	0.17	0.500	5.74	0.278	0.195
	50	26.17	35.209	23.137	4.535	0.093	0.590	2.80	0.27	0.510	5.79	0.300	0.253
	70	26.14	35.214	23.147	4.522	0.108	0.550	2.72	0.32	0.520	5.81	0.271	0.252
	80	26.10	35.219	23.164	4.474	0.158	0.510	2.70	0.39	0.530	5.84	0.259	0.236
	90	25.99	35.205	23.187	4.185	0.457	0.590	2.88	0.49	0.540	5.89	0.038	0.330
	100	26.03	35.242	23.203	4.384	0.254	0.560	2.76	0.57	0.600	5.85	0.155	0.127
	110	26.11	35.283	23.211	4.320	0.311	0.570	2.65	0.47	0.650	5.80	0.139	0.110
	130	26.00	35.312	23.266	4.219	0.420	0.590	2.76	0.51	1.140	5.68	0.088	0.089
	150	20.29	35.550	25.103	3.383	1.738	0.980	3.71	0.07	4.770	7.76	0.063	0.110
	175	13.85	35.014	26.229	0.834	4.987	2.130	17.60	0.10	0.140	30.58	0.025	0.048
	200	12.98	34.929	26.342	0.517	5.413	2.280	21.41	0.22	0.130	33.98	0.012	0.018

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-43	0	26.30	35.168	23.064	4.557	0.062	0.510	3.12	1.77	0.640	5.70	0.271	0.151
1S	10	26.18	35.167	23.101	4.542	0.086	0.530	3.07	0.10	0.630	5.73	0.271	0.155
150W	30	26.08	35.181	23.143	4.468	0.167	0.520	3.12	0.10	0.690	5.76	0.120	0.082
	50	25.97	35.222	23.209	4.281	0.362	0.550	3.11	0.12	0.770	6.10	0.136	0.110
	60	25.88	35.231	23.243	4.214	0.436	0.580	3.15	0.21	0.780	6.26	0.133	0.117
	70	25.87	35.244	23.254	4.245	0.405	0.590	3.20	0.27	0.790	6.28	0.092	0.183
	80	25.85	35.241	23.260	4.222	0.430	0.560	3.15	0.44	0.760	6.22	0.306	0.304
	90	25.88	35.263	23.267	4.199	0.450	0.610	3.13	0.43	0.780	6.10	0.211	0.211
	110	25.87	35.281	23.283	0.000	4.649	0.610	3.05	0.38	0.880	6.27	0.170	0.086
	130	24.63	35.675	23.961	3.527	1.210	0.760	3.17	0.11	1.290	8.74	0.069	0.107
	150	19.67	35.574	25.284	2.773	2.405	1.090	5.62	0.11	0.150	14.89	0.027	0.041
	175	16.97	35.309	25.757	2.814	2.646	1.180	7.59	0.10	0.140	16.46	0.015	0.019
	200	14.14	35.032	26.181	2.849	2.937	1.410	13.40	0.09	0.120	20.60	0.007	0.015

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-44	0	26.44	35.151	23.007	4.557	0.052	0.620	2.62	0.03	0.530	5.47	0.265	0.161
0.5S	10	26.26	35.153	23.064	4.572	0.050	0.660	2.62	0.09	0.530	5.44	0.265	0.186
150W	30	26.13	35.176	23.123	4.463	0.169	0.680	2.62	0.10	0.590	5.56	0.372	0.231
	50	26.11	35.224	23.166	4.320	0.312	0.660	2.62	0.10	0.660	5.90	0.319	0.385
	60	26.11	35.294	23.218	4.181	0.449	0.680	2.62	0.07	0.750	6.19	0.215	0.428
	70	26.08	35.383	23.296	4.082	0.548	0.690	2.62	0.09	0.820	6.53	0.215	0.233
	80	26.05	35.454	23.357	3.971	0.659	0.730	2.47	0.08	1.110	6.63	0.183	0.192
	90	26.03	35.451	23.362	4.140	0.492	0.720	2.62	0.00	1.090	6.65	0.129	0.261
	110	25.77	35.570	23.534	3.881	0.769	0.750	2.47	0.08	1.270	6.79	0.117	0.140
	130	24.28	35.816	24.174	3.298	1.464	0.920	2.62	0.07	0.100	9.89	0.058	0.089
	150	19.76	35.372	25.107	3.035	2.141	0.920	4.94	0.07	0.040	11.71	0.031	0.044
	175	16.25	35.056	25.731	3.176	2.369	1.130	9.74	0.03	0.040	14.93	0.009	0.013
	200	13.94	34.945	26.157	2.993	2.820	1.440	14.18	0.05	0.020	20.03	0.003	0.014

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-45	0	26.25	35.107	23.033	4.618	0.007	0.600	2.78	0.26	0.520	5.06	0.246	0.194
0 N S	10	26.25	35.107	23.034	4.595	0.029	0.580	2.78	0.28	0.510	5.03	0.246	0.194
150W	30	26.16	35.121	23.073	4.535	0.096	0.620	2.78	0.23	0.640	5.24	0.249	0.213
	50	26.07	35.137	23.112	4.443	0.195	0.630	2.78	0.25	0.730	5.43	0.252	0.253
	70	26.03	35.157	23.140	4.339	0.301	0.650	3.09	0.34	0.840	5.73	0.243	0.226
	80	26.00	35.171	23.160	4.323	0.319	0.670	3.24	0.28	0.830	5.89	0.208	0.239
	90	25.90	35.176	23.193	4.410	0.239	0.680	3.24	0.14	0.820	6.12	0.199	0.206
	100	25.71	35.186	23.263	4.269	0.396	0.680	3.40	0.08	0.720	6.41	0.196	0.220
	110	25.44	35.195	23.350	4.102	0.583	0.710	3.55	0.00	0.650	6.91	0.174	0.198
	130	23.41	35.080	23.874	3.521	1.335	0.800	4.79	0.02	0.170	9.39	0.114	0.208
	150	20.33	35.025	24.692	3.025	2.108	0.920	7.26	0.05	0.030	11.81	0.039	0.094
	175	17.05	35.168	25.631	3.142	2.314	1.070	8.34	0.10	0.010	14.13	0.012	0.022
	200	13.51	34.912	26.221	2.811	3.055	1.500	15.00	0.21	0.010	21.25	0.001	0.023

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-46	0	26.55	35.096	22.930	4.602	-0.001	0.540	2.63	0.18	0.480	4.65	0.170	0.108
0.5N	10	26.47	35.099	22.956	4.754	-0.147	0.560	2.73	0.26	0.490	4.68	0.180	0.127
150W	30	26.41	35.111	22.986	4.465	0.147	0.570	2.90	0.29	0.580	4.85	0.208	0.174
	50	26.32	35.143	23.037	4.473	0.144	0.610	2.85	0.34	0.680	5.18	0.224	0.188
	60	26.27	35.158	23.065	4.197	0.424	0.620	3.18	0.30	0.750	5.42	0.237	0.233
	70	26.24	35.171	23.085	4.313	0.310	0.630	3.19	0.24	0.780	5.58	0.218	0.223
	80	26.23	35.173	23.088	4.123	0.501	0.630	3.30	0.35	0.820	5.58	0.208	0.229
	90	26.22	35.173	23.093	4.074	0.551	0.650	2.95	0.34	0.840	5.62	0.193	0.208
	110	26.08	35.171	23.133	3.876	0.759	0.680	3.45	0.32	0.900	5.99	0.180	0.145
	130	24.66	35.052	23.482	3.273	1.479	0.860	5.08	0.14	0.480	9.18	0.095	0.201
	150	18.87	34.884	24.965	3.154	2.124	1.010	9.64	0.10	0.040	13.13	0.029	0.059
	175	14.64	34.837	25.924	3.190	2.544	1.240	13.39	0.12	0.030	16.53	0.008	0.022
	200	13.23	34.816	26.203	2.921	2.982	1.610	18.94	0.04	0.030	22.17	0.004	0.017

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-47	0	26.95	35.089	22.799	4.726	-0.155	0.510	2.69	0.17	0.440	4.11	0.161	0.085
1N	10	26.73	35.083	22.865	4.702	-0.114	0.510	2.64	0.15	0.430	4.14	0.170	0.111
150W	30	26.65	35.100	22.903	4.599	-0.005	0.540	2.71	0.53	0.500	4.30	0.224	0.126
	50	26.52	35.128	22.963	4.555	0.048	0.570	2.76	0.25	0.600	4.71	0.268	0.252
	60	26.49	35.133	22.978	4.454	0.151	0.570	2.77	0.39	0.610	4.76	0.265	0.240
	70	26.45	35.138	22.994	4.487	0.121	0.610	2.81	0.35	0.630	4.89	0.265	0.266
	80	26.43	35.142	23.004	4.586	0.023	0.590	2.82	0.31	0.630	5.01	0.221	0.220
	90	26.40	35.144	23.012	4.570	0.041	0.600	2.76	0.23	0.640	5.02	0.218	0.215
	110	26.38	35.144	23.019	4.525	0.088	0.600	2.84	0.35	0.640	5.11	0.208	0.203
	130	26.29	35.146	23.048	4.506	0.113	0.610	2.85	0.36	0.690	5.31	0.170	0.165
	150	24.55	35.040	23.505	3.630	1.131	0.780	4.74	0.06	0.590	8.71	0.114	0.182
	175	15.34	34.737	25.694	2.827	2.830	1.380	16.36	0.01	0.040	18.55	0.021	0.034
	200	13.33	34.721	26.108	2.177	3.717	1.790	21.48	0.04	0.030	25.05	0.023	0.051

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-48	0	26.93	35.108	22.819	4.826	-0.254	0.480	2.45	0.47	0.410	4.01	0.186	0.103
2N	10	26.88	35.104	22.830	4.634	-0.058	0.430	2.52	0.28	0.390	4.00	0.234	0.142
150W	30	26.74	35.107	22.879	4.630	-0.043	0.490	2.46	0.38	0.420	4.16	0.237	0.175
	50	26.67	35.111	22.902	4.641	-0.049	0.480	2.68	0.51	0.440	4.34	0.215	0.378
	60	26.66	35.112	22.907	4.608	-0.015	0.460	2.52	0.57	0.440	4.34	0.230	0.203
	70	26.64	35.113	22.914	4.609	-0.015	0.500	2.53	0.45	0.440	4.45	0.230	0.199
	80	26.62	35.113	22.920	4.654	-0.059	0.570	2.47	0.64	0.440	4.50	0.224	0.209
	90	26.61	35.114	22.926	4.677	-0.080	0.530	3.61	0.73	0.450	4.53	0.221	0.183
	110	26.57	35.117	22.939	4.625	-0.026	0.550	3.20	0.63	0.460	4.61	0.205	0.174
	130	26.53	35.121	22.954	4.598	0.004	0.580	2.72	1.08	0.470	4.75	0.193	0.172
	150	22.34	34.859	24.014	3.456	1.498	0.800	5.53	0.12	0.850	9.48	0.101	0.152
	175	13.81	34.722	26.011	2.198	3.638	1.630	20.27	0.18	0.050	25.46	0.039	0.102
	200	12.02	34.826	26.449	1.432	4.622	2.070	23.20	0.20	0.030	31.64	0.007	0.026

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-49	0	27.38	35.101	22.670	4.576	-0.038	0.430	2.15	0.12	0.690	2.73	0.167	0.104
3N	10	27.30	35.088	22.683	4.542	0.003	0.400	2.25	0.23	0.680	2.65	0.006	0.459
150W	30	27.20	35.130	22.748	4.479	0.072	0.460	2.31	0.31	0.790	3.24	0.265	0.208
	50	27.13	35.174	22.805	n.d.	n.d.	0.510	2.34	0.34	0.870	3.63	0.275	0.224
	60	27.09	35.178	22.821	4.464	0.095	0.490	2.35	0.27	0.910	3.67	0.309	0.286
	70	27.05	35.182	22.836	4.361	0.200	0.540	2.44	0.69	1.050	3.81	0.294	0.273
	80	26.97	35.178	22.858	4.342	0.225	0.520	2.48	0.34	1.110	3.87	0.271	0.274
	90	26.85	35.182	22.900	4.302	0.274	0.560	2.57	0.43	1.240	3.98	0.252	0.253
	110	26.75	35.170	22.921	4.369	0.215	0.550	2.61	0.48	1.000	4.44	0.205	0.192
	130	26.32	35.146	23.041	4.356	0.262	0.650	2.80	0.60	0.790	5.12	0.133	0.149
	150	20.18	34.826	24.579	2.732	2.421	1.090	9.00	0.25	0.170	14.42	0.079	0.152
	175	15.08	34.670	25.699	2.293	3.397	1.580	17.27	0.18	0.050	21.95	0.032	0.100
	200	12.20	34.623	26.258	2.186	3.853	1.880	24.40	0.15	0.020	27.07	0.010	0.018

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-50	0	27.60	35.016	22.533	4.571	-0.047	0.440	2.07	0.03	0.370	1.33	0.129	0.087
4N	10	27.62	35.017	22.528	4.602	-0.079	0.340	1.59	0.11	0.350	1.30	0.148	0.079
150W	30	27.57	35.001	22.533	4.582	-0.055	0.380	1.62	0.48	0.430	1.61	0.170	0.111
	50	27.35	35.064	22.649	4.591	-0.050	0.390	1.68	0.09	0.630	2.33	0.211	0.150
	60	26.80	35.115	22.864	4.414	0.167	0.496	2.14	0.18	0.985	3.70	0.243	0.212
	70	26.67	35.105	22.898	4.546	0.045	0.514	2.20	0.29	0.570	4.13	0.199	0.159
	80	26.47	35.114	22.969	4.510	0.097	0.549	2.36	0.35	0.587	4.55	0.155	0.163
	90	26.44	35.116	22.979	4.498	0.110	0.540	2.52	0.36	0.597	4.53	0.164	0.161
	110	26.44	35.116	22.980	4.503	0.106	0.548	2.46	0.42	0.559	4.66	0.142	0.165
	130	26.13	35.144	23.097	4.249	0.383	0.620	2.78	0.39	1.000	5.24	0.079	0.127
	150	25.76	35.143	23.213	2.474	2.187	0.660	3.40	0.25	1.228	5.92	0.082	0.106
	175	17.40	34.707	25.193	3.958	1.476	1.290	12.46	0.00	0.132	17.45	0.054	0.134
	200	13.05	34.616	26.084	1.405	4.527	2.110	23.89	0.03	0.075	29.37	0.011	0.025

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-51	0	28.71	34.549	21.819	4.603	-0.148	0.190	1.38	0.01	0.020	0.10	0.114	0.063
5N	10	28.66	34.560	21.845	4.612	-0.154	0.190	1.36	0.08	0.040	0.17	0.126	0.058
150W	30	27.93	34.961	22.386	4.645	-0.144	0.310	1.84	0.19	0.260	1.39	0.205	0.120
	50	27.66	35.028	22.522	4.735	-0.216	0.350	1.87	0.24	0.370	1.86	0.218	0.147
	60	27.61	35.043	22.551	4.578	-0.055	0.360	1.94	0.53	0.390	2.01	0.215	0.154
	70	27.58	35.048	22.564	4.661	-0.136	0.370	1.90	0.09	0.410	2.12	0.215	0.157
	80	27.42	35.052	22.617	4.591	-0.055	0.440	2.13	0.53	0.460	2.53	0.218	0.187
	90	27.39	35.052	22.630	4.575	-0.036	0.420	2.06	0.19	0.480	2.52	0.218	0.151
	110	27.37	35.083	22.659	4.635	-0.095	0.430	2.23	0.26	0.490	2.89	0.227	0.206
	130	26.66	35.141	22.929	4.478	0.113	0.560	2.58	0.17	0.830	4.31	0.155	0.152
	150	24.18	35.003	23.589	3.744	1.049	0.720	4.07	0.05	1.665	6.68	0.079	0.138
	175	17.66	34.722	25.141	2.661	2.745	1.230	10.98	0.03	0.099	16.25	0.047	0.101
	200	13.88	34.616	25.914	1.616	4.216	2.010	20.75	0.03	0.064	27.55	0.020	0.044

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-52	0	28.99	33.835	21.189	4.544	-0.092	0.090	1.26	0.18	0.010	0.06	0.215	0.150
7.5N	10	29.00	33.839	21.189	4.585	-0.134	0.080	1.13	0.03	0.010	0.02	0.227	0.152
150W	30	28.99	34.071	21.368	4.544	-0.097	0.100	1.18	0.07	0.010	0.03	0.290	0.208
	50	29.12	34.272	21.475	4.472	-0.040	0.110	1.22	0.08	0.020	0.03	0.379	0.210
	60	29.08	34.270	21.487	4.635	-0.200	0.100	1.20	0.05	0.010	0.03	0.357	0.232
	70	29.08	34.315	21.521	4.494	-0.060	0.140	1.17	0.02	0.020	0.01	0.104	0.044
	80	26.61	34.648	22.572	4.612	-0.004	0.130	1.57	0.08	0.020	0.05	0.215	0.193
	90	24.71	34.695	23.196	4.589	0.169	0.200	2.25	0.02	0.210	0.27	0.158	0.113
	110	17.71	34.650	25.075	3.211	2.193	0.860	9.00	0.16	0.900	11.76	0.155	0.268
	130	14.68	34.611	25.740	2.053	3.684	1.510	17.29	0.21	0.150	22.57	0.114	0.258
	150	12.64	34.597	26.152	0.724	5.261	2.170	24.84	0.03	0.070	30.81	0.054	0.206
	175	11.60	34.667	26.406	0.684	5.431	2.250	28.49	0.07	0.030	32.76	0.039	0.087
	200	11.12	34.698	26.518	0.479	5.698	2.340	30.25	0.05	0.030	34.47	0.005	0.007

	Depth	Temp	Salinity	Sigma-t	Oxy	AOU	PO4	SiO2	NH4	NO2	NO3	Chl-a	Pheo-a
OCT-53	0	28.54	33.876	21.369	4.544	-0.061	0.060	1.65	0.20	0.010	0.00	0.077	0.042
10N	10	28.53	33.876	21.372	4.588	-0.104	0.130	1.63	0.07	0.000	0.03	0.095	0.053
150W	30	28.47	33.880	21.396	4.606	-0.118	0.110	1.67	0.06	0.010	0.01	0.079	0.034
	40	28.29	34.110	21.628	n.d.	n.d.	0.110	1.68	0.02	0.010	0.03	0.104	0.073
	50	24.98	34.564	23.016	4.821	-0.082	0.220	2.33	0.03	0.020	0.13	0.215	0.118
	60	19.55	34.534	24.523	4.012	1.211	0.670	5.79	0.15	0.440	6.19	0.155	0.239
	70	15.99	34.472	25.342	2.785	2.808	1.260	12.13	0.12	1.430	15.82	0.170	0.248
	90	13.49	34.534	25.932	1.235	4.647	1.920	20.66	0.24	0.480	27.09	0.126	0.191
	110	12.53	34.623	26.194	0.382	5.615	2.000	26.50	0.08	0.170	32.62	0.073	0.187
	130	11.89	34.677	26.359	0.374	5.703	2.360	28.44	0.19	0.040	34.02	0.000	0.000
	150	11.53	34.687	26.435	0.396	5.728	2.360	29.56	0.00	0.030	34.34	0.027	0.072
	175	11.15	34.693	26.509	0.393	5.780	2.360	30.50	0.05	0.040	34.60	0.009	0.034
	200	10.85	34.690	26.561	0.562	5.651	2.310	31.18	0.02	0.030	34.80	0.004	0.041

Column	Observed Item	Unit
Depth	Bottle depth, estimated from CTD pressure	m
Temp.	Temperature measured by CTD	° C
Salinity	Salinity measured by CTD, calibrated	psu
Sigma-t	σ_t, calculated	
Oxy.	Dissolved Oxygen, Titrated	ml/*l*
AOU	Apparent Oxygen Utilization	ml/*l*
PO4	Phosphate	μg at./*l*
SiO2	Silicate	μg at./*l*
NH4	Ammonia	μg at./*l*
NO2	Nitrite	μg at./*l*
NO3	Nitrate	μg at./*l*
Chl-a	Chlorophyll-*a*	μg/*l*
Pheo-a	Pheophytin-*a*	μg/*l*

Items observed at each station
Leg 1

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      ----- 04 SEP.90 (GMT) -----
S-1   01:09 34°01.460N 144°00.540E    0m  SURFACE SAMPLING START
S-1   01:21 34°01.080N 144°02.660E    0m  SURFACE SAMPLING FINISH
      ----- 05 SEP.90 (GMT) -----
S-2   00:02 32°32.870N 150°11.830E 5838m  SURFACE SAMPLING START
S-2   00:13 32°32.330N 150°13.570E 5717m  SURFACE SAMPLING FINISH
      ----- 06 SEP.90 (GMT) -----
S-3   00:01 30°40.290N 156°21.839E 5911m  SURFACE SAMPLING START
S-3   00:11 30°39.710N 156°23.669E 5647m  SURFACE SAMPLING FINISH
S-4   23:07 28°34.150N 162°09.529E 4989m  SURFACE SAMPLING FINISH
      ----- 07 SEP.90 (GMT) -----
S-5   23:01 24°51.280N 167°13.589E 6147m  SURFACE SAMPLING START
S-5   23:09 24°51.110N 167°14.079E 6148m  SURFACE SAMPLING FINISH
      ----- 08 SEP.90 (GMT) -----
S-6   23:14 21°13.950N 172°01.559E 5460m  NO3 WINCH TEST START
S-6   23:59 21°13.830N 172°01.339E 5463m  NO3 WINCH TEST FINISH
      ----- 09 SEP.90 (GMT) -----
S-6   00:01 21°13.810N 172°01.339E 5461m  CTD-RMS TEST START
S-6   00:09 21°13.760N 172°01.319E 5463m  SURFACE SAMPLING START
S-6   00:21 21°13.710N 172°01.279E 5463m  SURFACE SAMPLING FINISH
S-7   22:01 18°13.240N 175°54.499E 4347m  SURFACE SAMPLING START
S-7   22:11 18°12.230N 175°55.799E 4366m  SURFACE SAMPLING FINISH
      ----- 10 SEP.90 (GMT) -----
OC-1  20:18 15°00.060N 179°59.909E 5369m  OCTOPUS START
OC-1  20:28 15°00.050N 179°59.669E 5384m  OCTOPUS DEEPEST
OC-1  20:35 15°00.050N 179°59.529E 5406m  OCTOPUS FINISH
ST 1  20:48 15°00.010N 179°59.179E 5503m  VAN DORN SAMPLING START
ST 1  21:27 14°59.920N 179°59.019E 5522m  VAN DORN SAMPLING FINISH
C-1   22:07 14°59.860N 179°58.979E 5521m  CTD-RMS START
ST 1  22:44 14°59.760N 179°58.669E 5531m  NORPAC NET START
C-1   23:10 14°59.660N 179°58.559E 5532m  CTD-RMS DEEPEST
ST 1  23:12 14°59.650N 179°58.559E 5535m  NORPAC NET FINISH
      ----- 11 SEP.90 (GMT) -----
C-1   00:41 14°59.230N 179°58.169E 5537m  CTD-RMS FINISH
ST 1  00:56 14°59.100N 179°58.049E 5538m  NISKIN SAMPLING(SHALLOW) START
ST 1  01:41 14°58.820N 179°57.689E 5531m  NISKIN SAMPLING(SHALLOW) SEND M
ESS
ST 1  01:45 14°58.800N 179°57.659E 5539m  NISKIN SAMPLING(SHALLOW) ARR ME
SS
ST 1  02:10 14°58.640N 179°57.469E 5533m  NISKIN SAMPLING(SHALLOW) FINISH
ST 1  02:10 14°58.640N 179°57.469E 5535m  IRRADIANCE MEASUREMENT STARTT
ST 1  02:38 14°58.380N 179°57.029E 5512m  IRRADIANCE MEASUREMENT FINISH
ST 1  02:54 14°58.560N 179°57.199E 5524m  ORI NET START
ST 1  03:04 14°58.800N 179°57.409E 5533m  ORI SIDE NET START
ST 1  03:36 14°59.720N 179°57.809E 5530m  ORI SIDE NET FINISH
ST 1  03:44 14°59.970N 179°57.879E 5527m  ORI NET DEEPEST
ST 1  04:20 15°00.400N 179°58.569E 5523m  ORI NET FINISH
ST 1  04:55 14°59.960N 179°57.459E 5535m  ORI-VMPS START
ST 1  05:43 14°59.840N 179°57.009E 5533m  ORI-VMPS FINISH
ST 1  05:53 14°59.790N 179°56.839E 5533m  ORI-VMPS FINISH
ST 1  05:53 14°59.790N 179°56.829E 5534m  LV SAMPLING START
ST 1  06:10 14°59.730N 179°56.579E 5531m  LV SAMPLING SEND MESS
ST 1  06:13 14°59.710N 179°56.539E 5522m  LV SAMPLING ARR MESS
ST 1  06:30 14°59.610N 179°56.309E 5523m  LV SAMPLING FINISH
ST 1  06:43 14°59.670N 179°56.169E 5519m  LV SAMPLING START 2ND
ST 1  06:49 14°59.690N 179°56.109E 5528m  LV SAMPLING SEND MESS
ST 1  06:54 14°59.700N 179°56.089E 5524m  LV SAMPLING ARR MESS
ST 1  07:09 14°59.770N 179°56.089E 5532m  LV SAMPLING FINISH 700M 2ND
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ST 1 07:09 14°59.780N 179°56.089E 5519m LV SAMPLING START 700M 3RD
ST 1 07:21 14°59.830N 179°55.999E 5532m LV SAMPLING SEND MESS
ST 1 07:25 14°59.850N 179°55.979E 5527m LV SAMPLING ARR MESS
ST 1 07:47 14°59.880N 179°55.949E 5532m LV SAMPLING FINISH 700M 3RD
ST 1 07:48 14°59.880N 179°55.949E 5528m LV SAMPLING START 500M
ST 1 08:00 14°59.900N 179°55.889E 5527m LV SAMPLING SEND MESS
ST 1 08:01 14°59.900N 179°55.879E 5523m LV SAMPLING ARR MESS
ST 1 08:10 14°59.930N 179°55.859E 5530m LV SAMPLING FINISH 500M 1ST
ST 1 08:23 14°59.960N 179°55.849E 5526m LV SAMPLING START 500M 2ND
ST 1 08:31 14°59.990N 179°55.839E 5530m LV SAMPLING SEND MESS
ST 1 08:32 14°59.990N 179°55.839E 5528m LV SAMPLING ARR MESS
ST 1 08:48 15°00.050N 179°55.829E 5535m LV SAMPLING FINISH FAILURE
ST 1 08:52 15°00.060N 179°55.829E 5537m LV SAMPLING START 500 3RD
ST 1 08:58 15°00.070N 179°55.809E 5538m LV SAMPLING SEND MESS
ST 1 09:00 15°00.070N 179°55.809E 5534m LV SAMPLING ARR MESS
ST 1 09:16 15°00.140N 179°55.809E 5537m LV SAMPLING FINISH
ST 1 09:45 15°00.140N 179°55.839E 5543m IKMT+MPS START
ST 1 10:39 14°59.870N 179°58.379E 5538m IKMT+MPS DEEPEST
ST 1 10:50 14°59.830N 179°58.779E 5530m ORI SIDE NET START
ST 1 10:54 14°59.840N 179°58.959E 5523m ORI SIDE NET FINISH
ST 1 11:40 14°59.750N 179°59.729W 5261m IKMT+MPS FINISH
----- 12 SEP.90 (GMT) -----
OC-2 08:06 09°59.900N 179°59.879E 5894m OCTOPUS START
OC-2 08:13 09°59.890N 179°59.739E 5890m OCTOPUS DEEPEST
OC-2 08:19 09°59.870N 179°59.639E 5887m OCTOPUS FINISH
C2 08:31 09°59.850N 179°59.519E 5893m CTD-RMS START
ST 2 08:51 09°59.860N 179°59.469E 5893m NORPAC NET START
C2 09:09 09°59.860N 179°59.399E 5889m CTD-RMS DEEPEST
ST 2 09:27 09°59.810N 179°59.379E 5900m NORPAC NET FINISH
C2 10:14 09°59.330N 179°59.309E 5867m CTD-RMS FINISH
ST 2 10:24 09°59.260N 179°59.289E 5853m NISKIN SAMPLING(SHALLOW) START
ST 2 10:57 09°59.000N 179°59.099E 5911m NISKIN SAMPLING(SHALLOW) SEND M
ESS
ST 2 11:00 09°58.980N 179°59.069E 5915m NISKIN SAMPLING(SHALLOW) ARR ME
SS
ST 2 11:21 09°58.820N 179°58.899E 5895m NISKIN SAMPLING(SHALLOW) FINISH
ST 2 11:24 09°58.790N 179°58.859E 5887m VAN DORN SAMPLING START
ST 2 11:49 09°58.640N 179°58.669E 5850m VAN DORN SAMPLING FINISH
ST 2 12:11 09°58.500N 179°58.409E 5864m ORI-VMPS START
ST 2 12:42 09°58.350N 179°58.279E 5869m ORI-VMPS FINISH
ST 2 12:59 09°58.060N 179°57.779E 5831m ORI NET START
ST 2 13:07 09°57.910N 179°57.509E 5809m ORI SIDE NET START
ST 2 13:18 09°57.840N 179°57.069E 5811m ORI SIDE NET FINISH
ST 2 13:45 09°57.730N 179°55.909E 5700m ORI NET DEEPEST
ST 2 14:20 09°57.120N 179°54.999E 5622m ORI NET FINISH
ST 2 14:28 09°56.926N 179°54.756E 5573m IKMT START
ST 2 15:20 09°54.210N 179°53.709E 5833m IKMT DEEPEST WIRE OUT 3000 M
ST 2 16:14 09°52.620N 179°53.129E 5827m IKMT FINISH
----- 13 SEP.90 (GMT) -----
OC- 3 02:16 07°30.000N 179°59.559E 5912m OCTOPUS START
OC- 3 02:23 07°30.080N 179°59.539E 5913m OCTOPUS DEEPEST
OC- 3 02:32 07°30.180N 179°59.539E 5909m OCTOPUS FINISH
OC-4A 13:37 05°00.190N 179°59.579E 5641m OCTOPUS START
OC-4A 13:44 05°00.230N 179°59.589E 5640m OCTOPUS DEEPEST
OC-4A 13:53 05°00.280N 179°59.559E 5639m OCTOPUS FINISH
ST 3 14:09 05°00.660N 179°59.199E 5609m ORI NET START
ST 3 14:14 05°00.820N 179°59.049E 5619m ORI SIDE NET START
ST 3 14:25 05°01.100N 179°58.779E 5610m ORI SIDE NET FINISH
ST 3 14:48 05°01.720N 179°58.169E 5552m ORI NET DEEPEST
ST 3 15:22 05°02.370N 179°57.639E 5569m ORI NET FINISH

ST 3 15:35 05°02.580N 179°57.599E 5562m ORI-VMPS START
ST 3 16:12 05°02.670N 179°57.829E 5556m ORI-VMPS FINISH
ST 3 16:24 05°02.660N 179°57.899E 5553m NBS-BPS & NISKIN SAMPLING (4000 M) S
ST 3 17:51 05°02.790N 179°58.289E 5558m SUNRISE & PUT OFF REGULAION LIGHTS
ST 3 18:00 05°02.790N 179°58.339E 5558m NBS-BPS & NISKIN SAMPLING SEND MESS
ST 3 20:19 05°03.310N 179°58.849E 5632m NBS-BPS & NISKIN SAMPLING FINISH
OC-4B 20:28 05°03.440N 179°58.809E 5623m OCTOPUS START
OC-4B 20:38 05°03.590N 179°58.829E 5659m OCTOPUS DEEPEST
OC-4B 20:40 05°03.620N 179°58.839E 5648m OCTOPUS FINISH
ST 3 20:52 05°03.850N 179°59.009E 5624m VAN DORN SAMPLING START
ST 3 21:24 05°04.330N 179°59.339E 5623m VAN DORN SAMPLING FINISH
C 3 21:33 05°04.480N 179°59.419E 5621m CTD-RMS START
ST 3 21:44 05°04.680N 179°59.549E 5606m NORPAC NET START
ST 3 22:23 05°05.170N 179°59.599E 5656m NORPAC NET FINISH
C 3 22:44 05°05.542N 179°59.914E 5671m CTD-RMS DEEPEST
ST 3 22:49 05°05.610N 179°59.899E 5670m IRRADIANCE MEASUREMENT STARTT
ST 3 22:57 05°05.720N 179°59.879E 5677m IRRADIANCE MEASUREMENT FINISH
----- 14 SEP.90 (GMT) -----
ST 3 00:02 05°06.600N 179°59.929E 5714m CTD-RMS FINISH
ST 3 00:11 05°06.730N 179°59.949E 5716m NISKIN SAMPLING(SHALLOW) START NR
ST 3 00:43 05°07.110N 179°59.889W 5714m NISKIN SAMPLING(SHALLOW) SEND MESS
ST 3 01:06 05°07.310N 179°59.689W 5714m NISKIN SAMPLING(SHALLOW) FINISH
ST 3 01:17 05°07.310N 179°59.809W 5712m ORI-VMPS START
ST 3 01:46 05°07.260N 179°59.539W 5703m ORI-VMPS FINISH
ST 3 01:56 05°07.250N 179°59.429W 5708m IKMT START
ST 3 02:37 05°04.750N 179°59.109W 5533m IKMT DEEPEST
ST 3 02:50 05°04.380N 179°59.049W 5554m ORI SIDE NET START
ST 3 03:19 05°03.480N 179°58.909W 5552m ORI SIDE NET FINISH
ST 3 03:28 05°03.220N 179°58.859W 5546m IKMT FINISH
OC-5 08:06 04°00.100N 179°59.839E 5702m OCTOPUS START
OC-5 08:13 04°00.205N 179°59.710E 5705m OCTOPUS DEEPEST
OC-5 08:20 04°00.290N 179°59.579E 5705m OCTOPUS FINISH
OC-6 12:40 03°00.010N 179°59.529E 5145m OCTOPUS START
OC-6 12:49 03°00.150N 179°59.349E 5142m OCTOPUS DEEPEST
OC-6 12:59 03°00.290N 179°59.159E 5164m OCTOPUS FINISH AND DEAD SLOW AHEAD
OC-7 17:19 02°00.010N 179°59.729E 5218m OCTOPUS START
OC-7 17:25 02°00.070N 179°59.669E 5220m OCTOPUS DEEPEST WIRE OUT 220M
OC-7 17:37 02°00.210N 179°59.489E 5227m OCTOPUS FINISH
OC-8 21:59 01°00.020N 179°59.819E 5744m OCTOPUS START
OC-8 22:05 01°00.040N 179°59.669E 5726m OCTOPUS DEEPEST
OC-8 22:10 01°00.060N 179°59.589E 5728m OCTOPUS FINISH
OC-8 22:12 01°00.040N 179°59.519E 5726m a/co to 180°
----- 15 SEP.90 (GMT) -----
OC-9 00:21 00°30.080N 179°59.609E 5591m OCTOPUS START STOP ENG
OC-9 00:31 00°30.120N 179°59.639E 5604m OCTOPUS START AGAIN
OC-9 00:36 00°30.120N 179°59.649E 5609m OCTOPUS DEEPEST
OC-9 00:48 00°30.100N 179°59.689E 5611m OCTOPUS FINISH
OC-10 03:13 00°00.040N 179°59.219E 5212m OCTOPUS START
OC-10 03:32 00°00.140N 179°58.779E 5202m OCTOPUS DEEPEST
ST 4 03:35 00°00.140N 179°58.769E 5201m VAN DORN SAMPLING START
OC-10 03:48 00°00.120N 179°58.619E 5194m OCTOPUS FINISH
ST 4 03:49 00°00.110N 179°58.609E 5195m KEVLAR FINISHED
ST 4 04:19 00°00.100N 179°58.209E 5175m VAN DORN SAMPLING FINISH

ST 4 04:25 00°00.120N 179°58.119E 5172m VMPS START
ST 4 04:51 00°00.170N 179°57.909E 5167m VMPS DEEPEST WIRE OUT 750M
ST 4 05:08 00°00.230N 179°57.849E 5166m VMPS FINISH
ST 4 05:18 00°00.300N 179°57.689E 5160m ORI NET START
ST 4 05:23 00°00.350N 179°57.479E 5158m ORI SIDE NET START
ST 4 05:54 00°00.640N 179°55.999E 5149m ORI SIDE NET FINISH
ST 4 05:59 00°00.690N 179°55.779E 5147m SUNSET & PUT ON REGULATION LIGH
TS
ST 4 06:00 00°00.700N 179°55.739E 5150m ORI NET DEEPEST
ST 4 06:35 00°01.000N 179°54.679E 5154m ORI NET FINISH
ST 4 06:47 00°01.120N 179°54.409E 5167m CTD-RMS START
ST 4 06:58 00°01.180N 179°54.329E 5167m NORPAC NET START
ST 4 07:14 00°01.190N 179°54.319E 5167m NORPAC NET FINISH
ST 4 07:14 00°01.200N 179°54.319E 5167m NORPAC NET START 2ND
ST 4 07:22 00°01.220N 179°54.259E 5169m CTD-RMS DEEPEST
ST 4 07:35 00°01.240N 179°54.169E 5170m NORPAC NET FINISH 2ND
ST 4 07:37 00°01.240N 179°54.159E 5170m NORPAC NET START 3RD
ST 4 07:49 00°01.230N 179°54.149E 5169m NORPAC NET FINISH 3RD
ST 4 07:51 00°01.230N 179°54.149E 5170m NORPAC NET START 4TH
ST 4 08:05 00°01.260N 179°54.079E 5169m NORPAC NET FINISH 4TH
ST 4 08:23 00°01.280N 179°53.949E 5168m CTD-RMS FINISH
ST 4 08:31 00°01.280N 179°53.859E 5167m NISKIN SAMPLING(SHALLOW) START
ST 4 08:59 00°01.270N 179°53.579E 5168m NISKIN SAMPLING(SHALLOW) SEND M
ESS
ST 4 09:27 00°01.180N 179°53.309E 5168m NISKIN SAMPLING(SHALLOW) FINISH
ST 4 09:40 00°01.110N 179°53.179E 5169m VMPS START
ST 4 09:58 00°01.030N 179°53.009E 5168m VMPS DEEPEST
ST 4 10:14 00°00.960N 179°52.849E 5170m VMPS FINISH
ST 4 10:22 00°00.960N 179°52.869E 5167m IKMT START
ST 4 10:42 00°00.000N 179°53.529E 5158m PASSED THE EQUATER
ST 4 11:09 00°01.230S 179°54.359E 5135m IKMT DEEPEST
ST 4 11:58 00°02.490S 179°54.819E 5150m IKMT FINISH
OC-11 14:09 00°30.080S 179°59.459E 5360m OCTOPUS START
OC-11 14:17 00°30.060S 179°59.419E 5376m OCTOPUS DEEPEST
OC-11 14:29 00°30.000S 179°59.349E 5360m OCTOPUS FINISH
OC-11 14:30 00°29.990S 179°59.339E 5360m OCTOPUS START
OC-11 14:41 00°30.020S 179°59.199E 5350m OCTOPUS FINISH
OC-12 16:54 00°59.890S 179°59.679E 5300m OCTOPUS START
OC-12 17:02 00°59.910S 179°59.559E 5296m OCTOPUS DEEPEST
OC-12 17:25 00°59.940S 179°59.099E 5291m OCTOPUS FINISH & SLOW AHEAD ENG
OC-13 21:37 02°00.110S 179°59.549E 5356m OCTOPUS START
OC-13 21:41 02°00.110S 179°59.469E 5354m OCTOPUS DEEPEST
OC-13 21:53 02°00.090S 179°59.169E 5349m OCTOPUS FINISH SLOW AHEAD ENG
----- 16 SEP.90 (GMT) -----
OC-14 02:00 03°00.050S 179°59.329E 5038m OCTOPUS START
OC-14 02:20 03°00.100S 179°59.219E 5035m OCTOPUS FINISH
OC-15 06:27 04°00.060S 179°59.799E 5753m OCTOPUS START
OC-15 06:33 04°00.100S 179°59.709E 5787m OCTOPUS DEEPEST
OC-15 06:44 04°00.180S 179°59.539E 5865m OCTOPUS FINISH SLOW AHEAD ENG
ST-5 11:04 05°00.830S 179°59.309E 5752m ORI NET START
ST-5 11:11 05°00.570S 179°59.329E 5758m ORI SIDE NET START
ST-5 11:21 05°00.170S 179°59.379E 5744m ORI SIDE NET FINISH
ST-5 11:40 04°59.360S 179°59.439E 5602m ORI NET DEEPEST
ST-5 12:16 04°58.970S 179°59.159E 5569m ORI NET FINISH
ST-5 12:27 04°58.970S 179°59.059E 5563m ORI-VMPS START
ST-5 13:01 04°59.160S 179°58.909E 5598m ORI-VMPS FINISH
ST-5 13:13 04°59.220S 179°58.889E 5605m NBS-BPS START
ST-5 14:59 04°59.480S 179°58.799E 5603m NBS-BPS SEND MESS
ST-5 15:33 04°59.440S 179°58.909E 5603m NBS-BPS ARR MESS
ST-5 16:20 04°59.430S 179°58.879E 5603m COM'CED HEAVING UP

ST-5 18:02 04°59.400S 179°58.659E 5620m NBS-BPS & NISKIN SAMPLING FINIS
H
OC-16 18:13 04°59.480S 179°58.609E 5625m OCTOPUS START
OC-16 18:20 04°59.530S 179°58.559E 5633m OCTOPUS DEEPEST
OC-16 18:33 04°59.470S 179°58.449E 5612m OCTOPUS FINISH
OC-16 18:37 04°59.460S 179°58.409E 5614m KEVLER SAMPLING START
OC-16 18:47 04°59.410S 179°58.309E 5604m OCTOPUS START
ST-5 19:04 04°59.330S 179°58.159E 5616m KEVLAR SAMPLING START
ST-5 19:15 04°59.280S 179°58.029E 5641m KEVLAR SAMPLING FINISH
ST-5 19:19 04°59.280S 179°57.989E 5637m VAN DORN SAMPLING START
ST-5 19:45 04°59.420S 179°57.969E 5647m VAN DORN SAMPLING FINISH
ST-5 19:58 04°59.490S 179°57.929E 5649m CTD-RMS START
ST-5 20:12 04°59.560S 179°57.899E 5663m NORPAC NET START
ST-5 20:57 04°59.790S 179°57.889E 5675m NORPAC NET FINISH
ST-5 21:00 04°59.810S 179°57.889E 5681m IRRADIANCE MEASUREMENT STARTT
ST-5 21:05 04°59.820S 179°57.869E 5684m CTD-RMS DEEPEST
ST-5 21:37 04°59.910S 179°57.779E 5710m IRRADIANCE MEASUREMENT FINISH
ST-5 22:04 05°00.010S 179°57.749E 5729m CTD-RMS FINISH
ST-5 22:20 05°00.060S 179°57.719E 5725m NISKIN SAMPLING(SHALLOW) START
ST-5 22:21 05°00.070S 179°57.719E 5728m NORPAC NET START
ST-5 22:39 05°00.150S 179°57.709E 5733m NORPAC NET FINISH
ST-5 23:00 05°00.240S 179°57.749E 5736m NISKIN SAMPLING(SHALLOW) SEND M
ESS
ST-5 23:25 05°00.340S 179°57.829E 5733m NISKIN SAMPLING(SHALLOW) FINISH
ST-5 23:35 05°00.340S 179°57.839E 5735m VMPS STARTED
----- 17 SEP.90 (GMT) -----
ST-5 00:05 05°00.440S 179°57.799E 5754m ORI-VMPS FINISH
ST-5 00:18 05°00.990S 179°57.749E 5786m IKMT START 2000 M
ST-5 01:11 05°04.480S 179°57.819E 5897m IKMT DEEPEST 3000 M
ST-5 01:14 05°04.630S 179°57.839E 5897m ORI SIDE NET START
ST-5 01:45 05°05.790S 179°57.599E 5783m ORI SIDE NET FINISH
ST-5 02:01 05°06.460S 179°57.569E 5704m IKMT FINISH
OC-17 11:54 07°30.050S 179°59.419E 4383m OCTOPUS START
OC-17 12:01 07°30.050S 179°59.299E 4418m OCTOPUS DEEPEST
OC-17 12:13 07°30.030S 179°59.089E 4528m OCTOPUS FINISH
ST 6 22:29 10°00.000S 179°59.389E 4345m NBS+BPS START
ST 6 22:38 10°00.030S 179°59.289E 4363m NORPAC NET START
ST 6 23:29 10°00.240S 179°58.889E 4453m NORPAC NET FINISH
ST 6 23:32 10°00.270S 179°58.899E 4461m BPS DEEPEST
----- 18 SEP.90 (GMT) -----
ST 6 00:02 10°00.430S 179°58.939E 4461m NORPAC NET FINISH
ST 6 00:02 10°00.430S 179°58.939E 4464m IRRADIANCE MEASUREMENT STARTT
ST 6 00:44 10°00.540S 179°58.839E 4474m IRRADIANCE MEASUREMENT FINISH
ST 6 01:02 10°00.590S 179°58.799E 4476m FINISHD BPS SAMPLER
ST 6 01:11 10°00.600S 179°58.729E 4481m ORI-VMPS START
OC-18 01:14 10°00.610S 179°58.709E 4482m OCTOPUS START
OC-18 01:22 10°00.610S 179°58.639E 4485m OCTOPUS DEEPEST
OC-18 01:35 10°00.620S 179°58.549E 4487m OCTOPUS FINISH
ST-6 01:43 10°00.640S 179°58.489E 4489m ORI-VMPS FINISH
ST-6 01:56 10°00.830S 179°58.769E 4486m IKMT START
ST-6 02:40 10°02.370S 179°59.139W 4387m IKMT DEEPEST 3000M
ST-6 02:42 10°02.440S 179°59.089W 4357m ORI SIDE NET START
ST-6 03:14 10°03.250S 179°58.489W 4357m ORI SIDE NET FINISH
ST-6 03:27 10°03.600S 179°58.229W 4361m IKMT FINISH
S-8 22:07 14°26.330S 179°01.859W 2234m SURFACE SAMPLING FINISH

Leg 2

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     ----- 23 SEP.90 (GMT) -----
S-9   22:07 15°18.080S 178°23.039W 2018m  SURFACE SAMPLING START
OC T1 22:09 15°18.080S 178°23.079W 1804m  OCTOPUS TEST STARTED
S-9   22:24 15°18.030S 178°23.309W 1924m  SURFACE SAMPLING FINISH
OC T1 22:32 15°18.030S 178°23.459W 2164m  OCTOPUS TEST FINISH
     ----- 24 SEP.90 (GMT) -----
S-10  22:02 10°22.080S 175°47.479W 3600m  SURFACE SAMPLING START
S-10  22:11 10°20.860S 175°46.769W 3613m  SURFACE SAMPLING FINISH
     ----- 25 SEP.90 (GMT) -----
OC T3 22:09 05°23.690S 172°54.219W 5851m  OCTOPUS START
OC T3 22:12 05°23.710S 172°54.269W 5853m  SURFACE SAMPLING START
S-11  22:12 05°23.720S 172°54.289W 5851m  SURFACE SAMPLING START
OC T3 22:17 05°23.760S 172°54.399W 5849m  OCTOPUS DEEPEST
S-11  22:26 05°23.850S 172°54.649W 5844m  SURFACE SAMPLING FINISH
OC T3 22:31 05°23.930S 172°54.779W 5845m  OCTOPUS FINISH
     ----- 27 SEP.90 (GMT) -----
S-12  21:02 00°38.820S 170°19.599W 5646m  SURFACE SAMPLING START
S-12  21:05 00°38.330S 170°19.369W 5601m  SURFACE SAMPLING FINISH
     ----- 28 SEP.90 (GMT) -----
OC-19 00:17 00°00.180N 170°00.039W 5489m  OCTOPUS START
OC-19 00:24 00°00.210N 170°00.169W 5483m  OCTOPUS DEEPEST
OC-19 00:37 00°00.150N 170°00.099W 5493m  OCTOPUS FINISH
ST 7  00:48 00°00.010N 170°00.379W 5494m  CTD-RMS START
ST 7  01:05 00°00.030S 170°00.379W 5515m  NORPAC NET START
ST 7  01:40 00°00.200S 170°00.009W 5522m  NORPAC NET FINISH
ST 7  01:46 00°00.640S 170°00.809W 5520m  CTD-RMS DEEPEST
ST 7  01:51 00°00.590S 170°00.799W 5522m  IRRADIANCE MEASUREMENT START
ST 7  02:24 00°00.990S 170°00.949W 5533m  IRRADIANCE MEASUREMENT FINISH
ST 7  03:21 00°01.430S 170°01.009W 5544m  CTD-RMS FINISH
ST 7  03:27 00°01.500S 170°01.029W 5544m  NISKIN SAMPLING(SHALLOW) START
ST 7  03:58 00°01.710S 170°01.239W 5556m  NISKIN SAMPLING(SHALLOW)  MESS
ST 7  04:01 00°01.720S 170°01.219W 5555m  NISKIN SAMPLING AV MESS
ST 7  04:26 00°01.980S 170°01.329W 5551m  NISKIN SAMPLING FINISH
ST 7  04:42 00°02.070S 170°01.209W 5531m  ORI NET START
ST 7  05:14 00°02.210S 170°00.679W 5501m  SUNSET & PUT ON LIGHTS
ST 7  05:27 00°02.270S 170°00.459W 5525m  ORI NET DEEPEST
ST 7  06:03 00°02.280S 170°00.279W 5520m  ORI NET FINISH
ST 7  06:16 00°02.320S 170°00.079W 5461m  IKMT+MPS START
ST 7  07:26 00°02.860S 169°57.289W 5341m  IKMT+MPS DEEPEST
ST 7  07:29 00°02.870S 169°57.239W 5350m  ORI SIDE NET START
ST 7  07:45 00°02.850S 169°56.839W 5351m  ORI SIDE NET FINISH
ST 7  09:31 00°04.120S 169°54.879W 5441m  IKMT+MPS FINISH
ST 7  09:44 00°04.110S 169°55.249W 5446m   VMPS START
ST 7  09:59 00°04.250S 169°55.459W 5448m  VMPS DEEPEST
ST 7  10:15 00°04.460S 169°55.429W 5441m  VMPS FINISH
ST 7  10:26 00°04.510S 169°55.719W 5422m  MTD START
ST 7  11:24 00°04.840S 169°57.399W 5400m  MTD START TOWING
ST 7  11:57 00°05.140S 169°59.129W 5311m  MTD MESS CAST
ST 7  12:22 00°05.330S 169°59.799W 5493m  MTD MESS CAST AGAIN
ST 7  12:43 00°05.420S 169°59.779W 5496m  MTD FINISH
ST 7  13:00 00°05.510S 170°00.119W 5495m  MTD START SHALLOW
ST 7  13:24 00°05.570S 169°59.869W 5483m  MTD START TOWING
ST 7  13:54 00°05.770S 169°58.989W 5381m  MTD MESS CAST
ST 7  14:13 00°05.920S 169°58.919W 5335m  MTD FINISH
ST 7  14:30 00°06.050S 169°59.359W 5340m  LV SAMPLING START
ST 7  14:48 00°06.130S 169°59.739W 5401m  LV SAMPLING SEND MESS
ST 7  14:53 00°06.170S 169°59.739W 5398m  LV SAMPLING ARR MESS
ST 7  15:05 00°06.240S 169°59.859W 5381m  LV SAMPLING START AGAIN
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ST 7 15:15 00°06.280S 169°59.979W 5374m LV SAMPLING SEND MESS
ST 7 15:20 00°06.320S 169°59.969W 5371m LV SAMPLING ARR MESS
ST 7 15:40 00°06.390S 170°00.229W 5408m LV SAMPLING FINISH
ST 7 15:43 00°06.400S 170°00.319W 5424m LV SAMPLING START 2ND
ST 7 15:58 00°06.460S 170°00.469W 5458m LV SAMPLING SEND MESS
ST 7 16:01 00°06.490S 170°00.449W 5439m LV SAMPLING ARR MESS
ST 7 16:23 00°06.550S 170°00.809W 5518m LV SAMPLING FINISH 2ND
ST 7 16:26 00°06.550S 170°00.909W 5518m LV SAMPLING START 3RD
ST 7 16:40 00°06.590S 170°01.069W 5523m LV SAMPLING SEND MESS
ST 7 16:43 00°06.610S 170°01.039W 5521m LV SAMPLING ARR MESS
ST 7 17:04 00°06.650S 170°01.299W 5517m LV SAMPLING FINISH 3RD
ST 7 17:07 00°06.650S 170°01.379W 5516m SUNRISE & PUT OFF LIGHTS
OC19B 17:27 00°06.670S 170°01.889W 5492m OCTOPUS START
OC19B 17:33 00°06.680S 170°02.009W 5483m OCTOPUS DEEPEST
ST 7 17:35 00°06.690S 170°02.019W 5481m KEVLAR SAMPLING START
OC19B 17:47 00°06.760S 170°02.119W 5469m OCTOPUS FINISH
ST 7B 17:56 00°06.800S 170°02.269W 5466m KEVLAR SAMPLING FINISH
ST 7 17:57 00°06.810S 170°02.289W 5466m VAN DORN SAMPLING START
ST 7 18:53 00°07.430S 170°03.049W 5512m VAN DORN SAMPLING FINISH
ST 7 18:54 00°07.450S 170°03.069W 5511m NISKIN SAMPLING(SHALLOW) START
ST 7 19:42 00°07.970S 170°03.279W 5422m NISKIN SAMPLING SEND MESS
ST 7 19:46 00°07.980S 170°03.249W 5418m NISKIN SAMPLING ARR MESS
ST 7 20:15 00°08.280S 170°03.359W 5418m NISKIN SAMPLING FINISH
ST 7 20:25 00°08.290S 170°03.659W 5440m MTD START
ST 7 21:01 00°08.260S 170°04.589W 5476m MTD START TOWING
ST 7 21:29 00°08.260S 170°05.489W 5526m MTD MESS CAST
ST 7 22:05 00°08.320S 170°06.239W 5513m MTD FINISH
ST 7 22:14 00°08.330S 170°06.539W 5501m VMPS START
ST 7 22:31 00°08.500S 170°06.679W 5487m VMPS DEEPEST
ST 7 22:48 00°08.680S 170°06.629W 5487m VMPS FINISH
ST 7 23:02 00°08.520S 170°06.699W 5486m IKMT+MPS START

----- 29 SEP.90 (GMT) -----

ST 7 00:17 00°06.850S 170°03.929W 5547m IKMT+MPS DEEPEST
ST 7 00:20 00°06.790S 170°03.889W 5547m ORI SIDE NET START
ST 7 00:52 00°06.090S 170°03.139W 5543m ORI SIDE NET FINISH
ST 7 02:17 00°05.160S 170°01.399W 5537m IKMT+MPS FINISH STOP ENG
ST 7 02:22 00°05.100S 170°01.519W 5537m CHANGED ENG TO DIESEL MOTION
S 13 21:02 02°54.530N 167°04.339W 5501m SURFACE SAMPLING START
S 13 21:06 02°55.010N 167°03.889W 5405m SURFACE SAMPLING FINISH

----- 30 SEP.90 (GMT) -----

OC T4 21:05 07°13.170N 162°47.169W 4465m OCTOPUS START
S 14 21:06 07°13.180N 162°47.169W 4466m SURFACE SAMPLING START
S 14 21:11 07°13.200N 162°47.159W 4468m SURFACE SAMPLING FINISH
OC T4 21:25 07°13.240N 162°47.109W 4466m OCTOPUS FINISH

----- 01 OCT.90 (GMT) -----

ST 8 13:33 10°00.140N 160°00.179W 5229m ORI-VMPS START
ST 8 14:14 10°00.050N 160°00.569W 5237m ORI-VMPS FINISH
ST 8 14:28 10°00.280N 160°00.569W 5230m ORI NET START
ST 8 14:33 10°00.440N 160°00.439W 5222m ORI SIDE NET START
ST 8 14:48 10°00.870N 160°00.029W 5216m ORI SIDE NET FINISH
ST 8 15:03 10°01.170N 159°59.629W 5217m ORI NET DEEPEST
ST 8 15:39 10°01.700N 159°59.259W 5230m ORI NET FINISH
ST 8 15:54 10°01.890N 159°59.299W 5243m LV SAMPLING START
ST 8 16:13 10°02.090N 159°59.389W 5246m LV SAMPLING SEND MESS
ST 8 16:16 10°02.090N 159°59.369W 5243m LV SAMPLING ARR MESS
ST 8 16:29 10°02.100N 159°59.379W 5243m SUNRISE & PUT OFF LIGHTS
ST 8 16:36 10°02.100N 159°59.369W 5250m LV SAMPLING FINISH
ST 8 16:39 10°02.090N 159°59.369W 5244m LV SAMPLING START 2ND
ST 8 16:51 10°02.100N 159°59.319W 5241m LV SAMPLING SEND MESS
ST 8 16:55 10°02.080N 159°59.309W 5244m LV SAMPLING ARR MESS

ST 8 17:14 10°02.020N 159°59.269W 5248m LV SAMPLING FINISH 2ND
ST 8 17:17 10°02.020N 159°59.279W 5404m LV SAMPLING START 3RD
ST 8 17:28 10°02.010N 159°59.289W 5245m LV SAMPLING SEND MESS
ST 8 17:35 10°02.060N 159°59.279W 5244m LV SAMPLING ARR MESS
ST 8 17:55 10°02.080N 159°59.229W 5241m LV SAMPLING FINISH 3RD
ST 8 18:04 10°02.060N 159°59.179W 5246m NISKIN SAMPLING(SHALLOW) START
ST 8 18:48 10°02.260N 159°59.259W 5239m NISKIN SAMPLING SEND MESS
ST 8 18:53 10°02.280N 159°59.269W 5239m NISKIN SAMPLING ARR MESS
ST 8 19:22 10°02.740N 159°59.349W 5222m NISKIN SAMPLING FINISH
OC 20 19:30 10°02.850N 159°59.329W 5223m OCTOPUS START
OC 20 19:38 10°02.890N 159°59.319W 5221m OCTOPUS DEEPEST
OC 20 19:50 10°03.060N 159°59.299W 5214m OCTOPUS FINISH
ST 8 19:52 10°03.080N 159°59.299W 5217m KEVLAR SAMPLING START
ST 8 20:13 10°03.160N 159°59.419W 5218m KEVLAR SAMPLING FINISH
ST 8 20:13 10°03.160N 159°59.419W 5219m VAN DORN SAMPLING START
ST 8 21:09 10°03.510N 160°00.129W 5213m VAN DORN SAMPLING FINISH
ST 8 21:26 10°03.710N 160°00.159W 5216m CTDO+RMS START
ST 8 21:35 10°03.800N 160°00.179W 5215m NORPAC NET START
ST 8 22:10 10°04.110N 160°00.229W 5210m NORPAC NET FINISH
ST 8 22:20 10°04.150N 160°00.259W 5216m CTDO+RMS DEEPEST
ST 8 23:57 10°04.780N 160°00.479W 5217m CTD-RMS FINISH

----- 02 OCT.90 (GMT) -----

ST 8 00:10 10°04.820N 160°00.629W 5232m NISKIN SAMPLING(SHALLOW) START
ST 8 00:48 10°05.300N 160°00.919W 5698m NISKIN SAMPLING SEND MESS
ST 8 01:16 10°05.540N 160°01.019W 5213m NISKIN SAMPLING FINISH
ST 8 01:27 10°05.680N 160°00.979W 5206m ORI-VMPS START
ST 8 02:01 10°05.890N 160°00.999W 5217m ORI-VMPS FINISH
ST 8 02:11 10°06.050N 160°00.979W 5212m IKMT+MPS START
ST 8 02:19 10°06.210N 160°00.649W 5225m IKMT+MPS START AGAIN
ST 8 03:32 10°05.470N 159°57.129W 5249m IKMT+MPS DEEPEST
ST 8 03:37 10°05.400N 159°56.999W 5252m ORI SIDE NET START
ST 8 04:08 10°05.290N 159°56.069W 5237m ORI SIDE NET FINISH
ST 8 04:47 10°04.510N 159°54.859W 5170m SUNSET & PUT ON LIGHTS A
ST 8 05:38 10°03.690N 159°53.489W 5257m IKMT+MPS FINISH
ST 8 05:46 10°03.700N 159°53.589W 5253m CHANGED ENG TO DIESEL MOTION
ST 8 05:47 10°03.700N 159°53.599W 5255m SLOW AHEAD ENG
OC-21 16:53 07°29.730N 159°59.679W 4419m OCTOPUS START
OC-21 17:00 07°29.820N 159°59.559W 4428m OCTOPUS DEEPEST
OC-21 17:14 07°30.010N 159°59.319W 4438m OCTOPUS FINISH

----- 03 OCT.90 (GMT) -----

OC22A 04:08 05°00.190N 160°00.299W 3421m OCTOPUS START
OC22A 04:13 05°00.250N 160°00.389W 3407m OCTOPUS DEEPEST
OC22A 04:25 05°00.290N 160°00.659W 3461m OCTOPUS FINISH
ST 9 04:32 05°00.410N 160°00.809W 3474m SUNSET & PUT ON LIGHTS
ST 9 04:36 05°00.500N 160°00.889W 3473m CTD-RMS START
ST 9 05:04 05°00.730N 160°01.219W 3507m NORPAC NET START
ST 9 05:33 05°00.780N 160°01.409W 3523m NORPAC NET FINISH
ST 9 05:37 05°00.790N 160°01.439W 3529m CTD-RMS DEEPEST
ST 9 07:02 05°01.190N 160°02.049W 3534m CTD-RMS FINISH
ST 9 07:09 05°01.280N 160°02.139W 3541m NISKIN SAMPLING(SHALLOW) START
ST 9 07:39 05°01.600N 160°02.429W 3613m NISKIN SAMPLING SEND MESS
ST 9 07:48 05°01.680N 160°02.449W 3613m NISKIN SAMPLING ARR MESS
ST 9 08:10 05°01.850N 160°02.589W 3602m NISKIN SAMPLING FINISH
ST 9 08:22 05°01.960N 160°02.609W 3600m ORI NET START
ST 9 08:27 05°01.940N 160°02.529W 3580m ORI SIDE NET START
ST 9 08:42 05°01.970N 160°02.209W 3606m ORI SIDE NET FINISH
ST 9 09:03 05°01.880N 160°01.759W 3587m ORI NET DEEPEST
ST 9 09:40 05°02.000N 160°01.049W 3555m ORI NET FINISH
ST 9 09:51 05°02.240N 160°01.139W 3486m VMPS START
ST 9 10:07 05°02.330N 160°01.229W 3461m VMPS DEEPEST

ST 9 10:24 05°02.480N 160°01.209W 3452m VMPS FINISH
ST 9 10:39 05°02.700N 160°01.379W 3401m IKMT+MPS START
ST 9 11:52 04°59.210N 160°01.649W 3539m IKMT+MPS DEEPEST
ST 9 12:20 04°58.220N 160°01.679W 3455m ORI SIDE NET START
ST 9 12:32 04°57.840N 160°01.689W 3446m ORI SIDE NET FINISH
ST 9 13:56 04°55.120N 160°01.939W 3522m IKMT+MPS FINISH
OC22B 14:05 04°55.240N 160°02.039W 3474m OCTOPUS START
OC22B 14:11 04°55.360N 160°02.119W 3462m OCTOPUS DEEPEST
OC22B 14:17 04°55.440N 160°02.179W 3459m OCTOPUS FINISH
ST 9 14:24 04°55.530N 160°02.249W 3455m KEVLAR SAMPLING START
ST 9 14:49 04°55.900N 160°02.459W 3455m KEVLAR SAMPLING FINISH
ST 9 14:50 04°55.914N 160°02.462W 3451m VAN DORN SAMPLING START
ST 9 15:37 04°56.160N 160°02.539W 3525m VAN DORN SAMPLING FINISH
ST 9 15:38 04°56.170N 160°02.539W 3522m NISKIN SAMPLING(SHALLOW) START
ST 9 16:19 04°56.320N 160°02.729W 3572m COM'CED HEAVING UP
ST 9 16:27 04°56.350N 160°02.759W 3578m SUNRISE & PUT OFF LIGHTS
ST 9 16:47 04°56.370N 160°02.879W 3590m NISKIN SAMPLING FINISH
ST 9 16:53 04°56.390N 160°02.899W 3589m ORI-VMPS START
ST 9 17:28 04°56.570N 160°03.079W 3588m ORI-VMPS FINISH
OC-23 21:48 03°59.960N 160°00.079W 5692m OCTOPUS START
OC-23 21:55 04°00.030N 160°00.149W 5482m OCTOPUS DEEPEST
OC-23 22:14 04°00.380N 160°00.369W 5681m OCTOPUS FINISH

----- 04 OCT.90 (GMT) -----

OC-24 02:50 03°00.160N 160°00.039W 5600m OCTOPUS START
OC-24 02:51 03°00.180N 160°00.049W 5608m OCTOPUS DEEPEST
OC-24 03:03 03°00.480N 160°00.239W 5759m OCTOPUS FINISH
OC-24 03:09 03°00.630N 160°00.349W 5631m OCTOPUS RESTART
OC-24 03:15 03°00.750N 160°00.429W 5631m OCTOPUS DEEPEST
OC-24 03:29 03°01.070N 160°00.649W 5602m OCTOPUS FINISH
OC-25 08:08 02°00.180N 159°59.979W 4339m OCTOPUS START
OC-25 08:15 02°00.320N 160°00.079W 4105m OCTOPUS DEEPEST
OC-25 08:32 02°00.580N 160°00.369W 4136m OCTOPUS FINISH SLOW AHEAD ENG
OC-26 13:09 01°00.000N 160°00.129W 5021m OCTOPUS START
OC-26 13:17 01°00.090N 160°00.279W 5022m OCTOPUS DEEPEST
OC-26 13:32 01°00.350N 160°00.499W 5024m OCTOPUS FINISH
OC-26 13:33 01°00.380N 160°00.519W 5023m SLOW AHEAD ENG
OC-27 15:55 00°29.960N 160°00.039W 4857m OCTOPUS START
OC-27 16:03 00°30.120N 160°00.169W 4881m OCTOPUS DEEPEST
OC-27 16:18 00°30.280N 160°00.289W 4893m OCTOPUS FINISH
OC-28 18:42 00°00.010S 160°00.139W 5146m OCTOPUS START
OC-28 18:50 00°00.030N 160°00.299W 5152m OCTOPUS DEEPEST
ST-10 18:58 00°00.010N 160°00.379W 5151m KEVLAR SAMPLING START
OC-28 19:06 00°00.050N 160°00.519W 5157m OCTOPUS FINISH
ST-10 19:15 00°00.150N 160°00.719W 5162m VAN DORN SAMPLING START
ST-10 19:18 00°00.190N 160°00.779W 5158m KEVLAR SAMPLING FINISH
ST-10 20:01 00°00.390N 160°01.489W 5164m VAN DORN SAMPLING FINISH
ST-10 20:08 00°00.470N 160°01.679W 5164m CTDO+RMS START
ST-10 20:17 00°00.610N 160°01.769W 5166m NORPAC NET START
ST-10 21:01 00°01.140N 160°01.459W 5166m CTDO+RMS DEEPEST
ST-10 21:53 00°01.500N 160°01.209W 5169m NORPAC NET FINISH
ST-10 22:13 00°01.700N 160°01.099W 5164m CTDO+RMS FINISH
ST-10 22:20 00°01.820N 160°01.039W 5159m NISKIN SAMPLING(SHALLOW) START
ST-10 22:54 00°02.340N 160°01.119W 5156m NISKIN SAMPLING SEND MESS
ST-10 22:56 00°02.380N 160°01.109W 5156m NISKIN SAMPLING ARR MESS
ST-10 23:15 00°02.650N 160°01.119W 5144m NISKIN SAMPLING FINISH
ST-10 23:22 00°02.760N 160°01.199W 5145m ORI-VMPS START
ST-10 23:56 00°03.100N 160°01.109W 5129m ORI-VMPS FINISH

----- 05 OCT.90 (GMT) -----

ST-10 00:16 00°02.980N 160°00.879W 5134m IKMT+MPS START
ST-10 01:22 00°00.960N 159°58.519W 5134m IKMT+MPS START

ST-10 01:47 00°00.490N 159°57.919W 5138m ORI SIDE NET START
ST-10 02:17 00°00.040N 159°57.079W 5109m ORI SIDE NET FINISH
ST-10 03:26 00°00.920S 159°55.169W 5136m IKMT+MPS FINISH
ST-10 03:37 00°00.830S 159°54.979W 5141m LV SAMPLING START
ST-10 03:43 00°00.760S 159°54.929W 5142m IRRADIANCE MEASUREMENT START
ST-10 03:55 00°00.470S 159°54.789W 5138m LV SAMPLING SEND MESS
ST-10 03:59 00°00.680S 159°55.009W 5136m LV SAMPLING ARR MESS
ST-10 04:11 00°00.680S 159°54.969W 5138m IRRADIANCE MEASUREMENT FINISH
ST-10 04:33 00°00.580S 159°55.109W 5138m SUNSET & PUT ON REGULATION LIGH
TS
ST-10 04:37 00°00.570S 159°55.049W 5142m LV SAMPLING SEND MESS
ST-10 05:00 00°00.330S 159°54.959W 5108m NORPAC NET START
ST-10 05:01 00°00.310S 159°54.969W 5108m LV SAMPLING FINISH
ST-10 05:07 00°00.180S 159°55.019W 5103m LV SAMPLING START
ST-10 05:17 00°00.050S 159°54.989W 5099m LV SAMPLING SEND MESS
ST-10 05:23 00°00.020N 159°54.929W 5090m LV SAMPLING ARR MESS
ST-10 05:25 00°00.040N 159°54.909W 5087m NORPAC NET FINISH
ST-10 05:41 00°00.100N 159°54.899W 5088m LV SAMPLING FINISH
ST-10 05:51 00°00.130N 159°54.979W 5093m NISKIN SAMPLING(SHALLOW) START
ST-10 06:32 00°00.520N 159°54.899W 5096m NISKIN SAMPLING SEND MESS
ST-10 06:36 00°00.520N 159°54.879W 5094m NISKIN SAMPLING ARR MESS
ST-10 07:02 00°00.830N 159°54.749W 5134m NISKIN SAMPLING FINISH
ST-10 07:12 00°00.980N 159°54.809W 5141m ORI NET START
ST-10 07:19 00°01.090N 159°54.649W 5137m ORI SIDE NET START
ST-10 07:34 00°01.410N 159°54.309W 5127m ORI SIDE NET FINISH
ST-10 07:54 00°01.840N 159°53.889W 5131m ORI NET DEEPEST
ST-10 08:30 00°03.240N 159°53.689W 5044m ORI NET FINISH
ST-10 08:41 00°03.460N 159°54.009W 5020m VMPS START
ST-10 08:58 00°03.540N 159°54.199W 5008m VMPS DEEPEST
ST-10 09:15 00°03.490N 159°54.169W 5015m VMPS FINISH
ST-10 09:29 00°03.540N 159°54.359W 4998m IKMT+MPS START
ST-10 10:41 00°01.750N 159°51.359W 5121m IKMT+MPS DEEPEST
ST-10 12:43 00°00.610S 159°48.079W 5172m IKMT+MPS FINISH STOP ENG
ST-10 13:02 00°01.500S 159°48.469W 5145m FULL AHEAD ENG
ST-10 13:07 00°02.680S 159°48.569W 5141m RUNG UP ENGINES
OC-29 15:11 00°29.990S 159°50.279W 4495m CHANGED ENG TO ELECTRIC MOTION
OC-29 15:14 00°29.940S 159°50.369W 4463m OCTOPUS START
OC-29 15:21 00°29.890S 159°50.489W 4429m OCTOPUS DEEPEST
OC-29 15:36 00°29.800S 159°50.729W 4430m OCTOPUS FINISH
OC-30 17:57 00°59.880S 160°00.169W 5185m OCTOPUS START
OC-30 18:01 00°59.870S 160°00.279W 5192m CHANGED ENG TO ELECTRIC MOTION
OC-30 18:04 00°59.860S 160°00.369W 5197m OCTOPUS DEEPEST
OC-30 18:16 00°59.840S 160°00.609W 5194m OCTOPUS FINISH
OC-31 22:31 01°59.990S 160°00.129W 5175m OCTOPUS START
OC-31 22:47 02°00.060S 160°00.559W 5190m OCTOPUS FINISH
----- 06 OCT.90 (GMT) -----
OC-32 02:58 03°00.080S 160°00.199W 5353m CHANGED ENG TO ELECTRIC MOTION
OC-32 02:58 03°00.080S 160°00.209W 5353m OCTOPUS START
OC-32 03:04 03°00.110S 160°00.379W 5349m OCTOPUS DEEPEST
OC-32 03:16 03°00.190S 160°00.649W 5334m OCTOPUS FINISH
OC-33 08:07 03°59.950S 160°00.049W 5457m OCTOPUS START
OC-33 08:12 04°00.000S 160°00.189W 5463m OCTOPUS DEEPEST
OC-33 08:25 04°00.070S 160°00.569W 5469m OCTOPUS FINISH
ST 11 12:43 05°00.160S 160°00.139W 5190m CTD-RMS START WIRE OUT 2000
ST 11 12:48 05°00.190S 160°00.259W 5203m NORPAC NET START
ST 11 13:22 05°00.450S 160°00.509W 5232m CTD-RMS DEEPEST
ST 11 13:31 05°00.500S 160°00.559W 5236m NORPAC NET FINISH
ST 11 14:22 05°00.740S 160°00.789W 5180m CTD-RMS FINISH
ST 11 14:29 05°00.780S 160°00.829W 5157m NISKIN SAMPLING(SHALLOW) START
ST 11 15:05 05°01.010S 160°01.039W 5150m NISKIN SAMPLING SEND MESS

ST 11 15:10 05°01.020S 160°01.059W 5151m NISKIN SAMPLING ARR MESS
ST 11 15:34 05°01.110S 160°01.189W 5167m NISKIN SAMPLING FINISH
OC-34 15:47 05°01.190S 160°01.299W 5139m OCTOPUS START
OC-34 15:54 05°01.230S 160°01.389W 5085m OCTOPUS DEEPEST
OC-34 16:07 05°01.260S 160°01.659W 5019m OCTOPUS FINISH
ST 11 16:09 05°01.270S 160°01.749W 5090m KEVLAR SAMPLING START AT 0449
ST 11 16:23 05°01.330S 160°02.009W 5199m SUNRISE & PUT OFF LIGHTS
ST 11 16:48 05°01.570S 160°02.329W 5208m VAN DORN SAMPLING START
ST 11 16:55 05°01.630S 160°02.399W 5190m KEVLAR SAMPLING FINISH
ST 11 17:37 05°01.900S 160°02.869W 5153m VAN DORN SAMPLING FINISH
ST 11 17:47 05°01.940S 160°02.959W 5153m IKMT START
ST 11 18:59 05°00.210S 159°59.849W 5174m IKMT DEEPEST
ST 11 19:03 05°00.130S 159°59.739W 5163m ORI SIDE NET START
ST 11 19:34 04°59.540S 159°58.919W 5109m ORI SIDE NET FINISH
ST 11 21:05 04°57.880S 159°56.549W 5069m IKMT+MPS FINISH
ST 11 22:21 04°58.800S 159°57.859W 5115m BUOY(DRIFTER) IN
ST 11 22:35 04°58.840S 159°58.189W 5011m OCTOPUS START D-1
ST 11 22:48 04°58.860S 159°58.409W 4960m OCTOPUS FINISH OCD-01
ST 11 22:56 04°58.910S 159°58.519W 5015m NISKIN SAMPLING START D-1
ST 11 23:07 04°59.010S 159°58.649W 5096m IRRAD MEASUREMENT START D-1
ST 11 23:30 04°59.220S 159°58.959W 5096m NISKIN SEND MESS
ST 11 23:33 04°59.240S 159°58.999W 5097m NISKIN SAMPLING ARR MESS
ST 11 23:43 04°59.320S 159°59.089W 5099m IRRADIANCE MEASUREMENT FINISH
ST 11 23:57 04°59.450S 159°59.299W 5120m NISKIN SAMPLING FINISH D -

----- 07 OCT.90 (GMT) -----

ST 11 00:06 04°59.550S 159°59.469W 5154m ORI-VMPS START D-1
ST 11 00:29 04°59.680S 159°59.649W 5163m ORI-VMPS FINISH D-1
ST 11 00:52 04°59.780S 159°59.869W 5175m ORI-VMPS START
ST 11 01:22 04°59.840S 160°00.019W 5177m ORI-VMPS FINISH
ST 11 01:33 04°59.770S 159°59.999W 5176m ORI NET START WIRE OUT 500 M
ST 11 01:55 04°59.710S 159°59.409W 5151m ORI NET FINISH
ST 11 01:58 04°59.710S 159°59.359W 5149m ORI NET START WIRE OUT 500M
ST 11 02:22 04°59.700S 159°58.819W 5113m ORI NET FINISH
OCD02 03:29 04°59.360S 160°00.149W 5181m OCTOPUS START
OCD02 03:35 04°59.380S 160°00.249W 5187m OCTOPUS DEEPEST
OCD02 03:40 04°59.410S 160°00.339W 5188m OCTOPUS FINISH
ST 11 03:44 04°59.440S 160°00.439W 5194m NISKIN SAMPLING START AT D
ST 11 04:23 04°59.770S 160°00.869W 5195m NISKIN SAMPLING SEND MESS
ST 11 04:33 04°59.810S 160°00.919W 5189m SUNSET & PUT ON LIGHTS
ST 11 04:58 05°00.050S 160°01.059W 5151m NISKIN SAMPLING FINISH AT
ST 11 05:01 05°00.090S 160°01.089W 5151m ORI-VMPS START AT D-2
ST 11 05:28 05°00.270S 160°01.209W 5139m ORI-VMPS FINISH AT D-2
ST 11 05:38 05°00.320S 160°01.259W 5136m ORI NET START (500M) AT D-2
ST 11 05:51 05°00.320S 160°00.939W 5163m OCTOPUS DEEPEST WIRE OUT 500M
ST 11 06:01 05°00.340S 160°00.869W 5195m ORI NET FINISH AT D-2
ST 11 06:03 05°00.340S 160°00.829W 5220m ORI NET START 500M 2ND AT D-2
ST 11 06:15 05°00.310S 160°00.539W 5219m ORI NET DEEPEST WIRE OUT 500M
ST 11 06:24 05°00.310S 160°00.449W 5213m ORI NET FINISH AT D-2
ST 11 06:33 05°00.380S 160°00.639W 5230m ORI-VMPS START AT D-2
ST 11 07:10 05°00.480S 160°00.889W 5154m ORI-VMPS FINISH AT D-2
ST 11 07:17 05°00.490S 160°00.929W 5141m OCTOPUS START OCD-03
ST 11 07:24 05°00.490S 160°00.949W 5136m OCTOPUS DEEPEST OCD-03
ST 11 07:29 05°00.490S 160°00.979W 5133m OCTOPUS FINISH OCD-03
ST 11 07:35 05°00.490S 160°01.009W 5129m NISKIN SAMPLING START D-3
ST 11 08:10 05°00.660S 160°01.289W 5098m NBS-BPS SEND MESS D-3
ST 11 08:13 05°00.660S 160°01.319W 5091m NISKIN SAMPLING ARR MESS
ST 11 08:36 05°00.840S 160°01.519W 4937m NISKIN SAMPLING FINISH D-3
ST 11 08:40 05°00.830S 160°01.569W 4899m VMPS START D-3
ST 11 09:04 05°00.850S 160°01.679W 4902m VMPS FINISH D-3
ST 11 09:17 05°00.840S 160°01.889W 5023m ORI NET START

ST 11 09:21 05°00.750S 160°02.029W 5105m ORI SIDE NET START
ST 11 09:38 05°00.480S 160°02.569W 5191m ORI SIDE NET FINISH
ST 11 09:55 05°00.180S 160°03.069W 5120m ORI NET DEEPEST
ST 11 10:33 04°59.650S 160°04.399W 5064m ORI NET FINISH
OCD04 11:02 04°59.470S 160°02.079W 5184m OCTOPUS START
OCD04 11:08 04°59.500S 160°02.159W 5172m OCTOPUS DEEPEST
OCD04 11:14 04°59.520S 160°02.259W 5169m OCTOPUS FINISH
ST 11 11:22 04°59.540S 160°02.439W 5158m NISKIN SAMPLING START D-4
ST 11 11:55 04°59.790S 160°02.789W 5116m NISKIN SAMPLING SEND MESS
ST 11 11:57 04°59.810S 160°02.809W 5119m NISKIN SAMPLING ARR MESS
ST 11 12:24 05°00.080S 160°03.099W 5110m NISKIN SAMPLING FINISH D-4
ST 11 12:29 05°00.040S 160°03.119W 5111m ORI-VMPS START D-4
ST 11 12:51 05°00.050S 160°03.239W 5108m ORI-VMPS FINISH D-4
ST 11 12:59 05°00.020S 160°03.319W 5107m MTD START D-4
ST 11 13:33 05°00.200S 160°03.279W 5111m MTD START TOWING D-4
ST 11 14:03 05°00.310S 160°02.599W 5188m MTD MESS CAST D-4
ST 11 14:33 05°00.450S 160°02.549W 5195m MTD FINISH D-4
OCD05 15:29 04°59.650S 160°02.939W 5112m OCTOPUS START
OCD05 15:34 04°59.650S 160°02.999W 5111m OCTOPUS DEEPEST
OCD05 15:40 04°59.680S 160°03.069W 5104m OCTOPUS FINISH
ST 11 15:45 04°59.690S 160°03.139W 5106m NISKIN SAMPLING START AT D
ST 11 16:21 04°59.900S 160°03.579W 5097m NISKIN SAMPLING SEND MESS
ST 11 16:22 04°59.900S 160°03.589W 5099m SUNRISE & PUT OFF LIGHTS
ST 11 16:25 04°59.910S 160°03.619W 5102m NISKIN SAMPLING ARR MESS
ST 11 16:48 05°00.070S 160°03.819W 5099m NISKIN SAMPLING FINISH AT
ST 11 16:55 05°00.130S 160°03.889W 5090m ORI-VMPS START AT D-5
ST 11 17:19 05°00.230S 160°04.089W 5091m ORI-VMPS FINISH AT D-5
ST 11 17:52 04°58.950S 160°04.249W 5076m NISKIN SAMPLING START AT D
ST 11 18:10 04°59.000S 160°04.389W 5075m NISKIN SAMPLING SEND MESS
ST 11 18:16 04°58.990S 160°04.419W 5067m NISKIN SAMPLING ARR MESS
ST 11 19:01 04°59.230S 160°04.779W 5069m NISKIN SAMPLING FINISH AT D
ST 11 19:05 04°59.240S 160°04.839W 5068m OCTOPUS START
ST 11 19:09 04°59.240S 160°04.919W 5071m OCTOPUS DEEPEST
ST 11 19:32 04°59.260S 160°05.269W 5109m OCTOPUS FINISH FAILURE
ST-11 19:36 04°59.270S 160°05.339W 5124m NISKIN SAMPLING) START D-6
ST-11 20:06 04°59.370S 160°05.699W 5195m NISKIN SAMPLING SEND MESS
ST-11 20:30 04°59.480S 160°05.889W 5187m NISKIN SAMPLING FINISH D-6
ST-11 20:40 04°59.550S 160°05.999W 5173m VMPS START D-6
ST-11 20:52 04°59.630S 160°06.109W 5161m VMPS DEEPEST D-6
ST-11 21:04 04°59.720S 160°06.239W 5151m VMPS FINISH D-6
ST-11 21:46 04°59.940S 160°06.369W 5139m 1010 MTD START D-6
ST-11 21:49 04°59.980S 160°06.359W 5125m MTD START TOWING
ST-11 21:54 05°00.060S 160°06.229W 5138m MTD START TOWING
ST-11 22:24 05°00.520S 160°05.719W 5132m MTD MESS CAST
ST-11 22:52 05°00.890S 160°05.639W 5135m MTD FINISH
ST-11 23:33 04°58.230S 160°05.679W 5111m BUOY(DRIFTER) OUT

----- 08 OCT.90 (GMT) -----

ST-11 00:11 04°58.210S 160°05.959W 5189m HOVE UP DRIFTER BUOY
OCD07 00:18 04°58.210S 160°06.049W 5217m OCTOPUS START
OCD07 00:25 04°58.200S 160°06.169W 5240m OCTOPUS FAILURE AND STOPPED IT
ST 11 00:31 04°58.200S 160°06.279W 5241m NISKIN SAMPLING START D-7
ST 11 00:54 04°58.270S 160°06.529W 5231m NISKIN FAILURE AND TRY AGAIN
OCD07 01:11 04°58.380S 160°06.729W 5200m OCTOPUS START
OCD07 01:16 04°58.400S 160°06.789W 5203m OCTOPUS DEEPEST
OCD07 01:20 04°58.400S 160°06.829W 5205m OCTOPUS FINISH
ST 11 01:26 04°58.400S 160°06.889W 5198m NISKIN SAMPLING START D-7
ST 11 01:54 04°58.550S 160°07.169W 5117m NISKIN SAMPLING SEND MESS
ST 11 01:58 04°58.550S 160°07.189W 5113m NISKIN SAMPLING ARR MESS
ST 11 02:16 04°58.640S 160°07.349W 5109m NISKIN SAMPLING FINISH D-7
ST 11 02:20 04°58.660S 160°07.399W 5108m ORI-VMPS START D-7

ST 11 02:42 04°58.720S 160°07.529W 5108m ORI-VMPS FINISH D-7
OC-35 13:18 07°30.160S 159°59.969W 5153m OCTOPUS START
OC-35 13:23 07°30.140S 160°00.019W 5155m OCTOPUS DEEPEST
OC-35 13:38 07°30.030S 160°00.199W 5089m OCTOPUS FINISH

----- 09 OCT.90 (GMT) -----

ST 12 00:07 09°59.860S 160°00.179W 4610m ORI-VMPS START
ST 12 00:39 09°59.920S 160°00.329W 4624m ORI-VMPS FINISH
ST 12 00:47 09°59.890S 160°00.399W 4634m OCTOPUS START
ST 12 01:05 09°59.910S 160°00.699W 4681m OCTOPUS FINISH
ST 12 01:11 09°59.930S 160°00.809W 4681m KEVLAR SAMPLING START
ST 12 01:27 09°59.980S 160°01.059W 4729m VAN DORN SAMP. START AT 1412
ST 12 01:28 09°59.980S 160°01.059W 4731m KEVLAR SAMPLING FINISH AT 1418
ST 12 01:56 09°59.970S 160°01.559W 4742m VAN DORN SAMPLING FINISH
ST 12 02:13 09°59.990S 160°01.779W 4737m CTD-RMS START
ST 12 02:26 10°00.010S 160°01.879W 4744m NORPAC NET START
ST 12 02:54 10°00.220S 160°01.929W 4784m CTD-RMS DEEPEST WIRE OUT 2000M
ST 12 04:08 10°00.850S 160°01.939W 4828m CTD-RMS FINISH
ST 12 04:14 10°00.890S 160°01.939W 4826m NISKIN SAMPLING(SHALLOW) START
ST 12 04:35 10°01.020S 160°01.949W 4833m SUNSET & PUT ON LIGHTS
ST 12 04:44 10°01.050S 160°01.999W 4838m NISKIN SAMPLING SEND MESS
ST 12 04:49 10°01.080S 160°01.999W 4837m NISKIN SAMPLING ARR MESS
ST 12 05:09 10°01.180S 160°02.029W 4852m NISKIN SAMPLING FINISH
ST 12 05:21 10°01.240S 160°01.909W 4862m ORI NET START
ST 12 05:28 10°01.290S 160°01.689W 4922m ORI SIDE NET START
ST 12 05:44 10°01.370S 160°01.219W 4854m ORI SIDE NET FINISH
ST 12 05:57 10°01.450S 160°00.799W 4790m ORI NET DEEPEST
ST 12 06:41 10°01.710S 159°59.779W 4631m ORI NET FINISH
ST 12 06:49 10°01.680S 159°59.829W 4640m NISKIN SAMPLING(SHALLOW) START
ST 12 07:21 10°01.910S 159°59.969W 4704m NISKIN SAMPLING SEND MESS
ST 12 07:26 10°01.900S 159°59.919W 4696m NISKIN SAMPLING ARR MESS
ST 12 07:54 10°02.060S 160°00.109W 4747m NISKIN SAMPLING FINISH
ST 12 08:21 10°01.940S 160°00.479W 4817m VMPS START
ST 12 08:48 10°02.130S 160°00.549W 4851m VMPS DEEPEST
ST 12 09:09 10°02.110S 160°00.689W 4863m VMPS FINISH
ST 12 09:20 10°02.210S 160°00.499W 4868m IKMT+MPS START
ST 12 10:33 10°02.840S 159°56.969W 4455m IKMT+MPS DEEPEST
ST 12 10:37 10°02.850S 159°56.829W 4637m ORI SIDE NET START
ST 12 10:57 10°02.890S 159°56.109W 5251m ORI SIDE NET FINISH
ST 12 12:36 10°03.040S 159°52.719W 5641m IKMT+MPS FINISH
S-15 21:02 11°12.490S 158°17.589W 5278m SURFACE SAMPLING START
S-15 21:08 11°13.060S 158°16.809W 5280m SURFACE SAMPLING FINISH
S-15 21:11 11°13.470S 158°16.249W 5282m RUNG UP ENGINES

----- 10 OCT.90 (GMT) -----

S 16 20:07 14°25.350S 153°51.439W 4862m SURFACE SAMPLING FINISH

Leg 3

----- 16 OCT.90 (GMT) -----

S -17 20:03 12°41.980S 149°56.630W 4653m SURFACE SAMPLING START
S -17 20:11 12°41.930S 149°56.810W 4668m FLOWMETER CAL. START
S -17 20:20 12°41.940S 149°56.940W 4665m OCTOPUS TEST START
S -17 20:28 12°42.030S 149°56.980W 4667m SURFACE SAMPLING FINISH
S -17 20:36 12°42.100S 149°57.020W 4672m OCTOPUS TEST FINISH
S -17 20:44 12°42.170S 149°57.090W 4675m FLOWMETER CAL. FINISH
S -17 20:50 12°42.210S 149°57.140W 4678m VMPS CAL. START
S -17 21:29 12°42.440S 149°57.630W 4687m VMPS CAL. FINISH

----- 17 OCT.90 (GMT) -----

ST-13 08:27 10°00.000S 149°57.170W 3815m VMPS START
ST-13 08:49 10°00.180S 149°57.390W 3921m VMPS DEEPEST
ST-13 08:50 10°00.180S 149°57.390W 3927m NORPAC NET START
ST-13 09:13 10°00.290S 149°57.480W 3981m VMPS FINISH
ST-13 09:26 10°00.340S 149°57.560W 4031m CTDO+RMS START
ST-13 09:53 10°00.450S 149°57.620W 4063m NORPAC NET FINISH
ST-13 10:08 10°00.520S 149°57.640W 4063m CTD-RMS DEEPEST
ST-13 11:17 10°00.840S 149°57.800W 4086m CTD-RMS FINISH
ST-13 11:29 10°00.820S 149°57.810W 4087m NISKIN NR START AT 0125
ST-13 11:54 10°00.890S 149°57.920W 4090m NISKIN NR SEND MESS
ST-13 12:19 10°00.910S 149°57.950W 4089m NISKIN NR FINISH
ST-13 12:29 10°00.760S 149°57.820W 4087m ORI NET START
ST-13 12:38 10°00.750S 149°57.490W 4064m ORI SIDE NET START
ST-13 12:53 10°00.720S 149°56.980W 3910m ORI SIDE NET FINISH
ST-13 13:10 10°00.550S 149°56.420W 3760m ORI DEEPEST WIRE OUT 2000 M
ST-13 13:44 10°00.160S 149°55.600W 3331m ORI NET FINISH
ST-13 13:54 10°00.140S 149°55.680W 3400m NISKIN SAMPLING(SHALLOW) START
ST-13 14:30 10°00.350S 149°55.860W 3533m NISKIN SAMPLING SEND MESS
ST-13 14:35 10°00.360S 149°55.880W 3537m NISKIN SAMPLING ARR MESS
ST-13 15:01 10°00.560S 149°56.040W 3651m NISKIN SAMPLING FINISH
ST-13 15:08 10°00.600S 149°56.130W 3670m IKMT+MPS START
ST-13 16:22 10°00.980S 149°52.790W 3249m IKMT+MPS DEEPEST
ST-13 16:26 10°01.010S 149°52.670W 3271m ORI SIDE NET START
ST-13 16:37 10°00.920S 149°52.340W 3312m ORI SIDE NET FINISH
ST-13 18:00 10°00.810S 149°49.540W 3595m IKMT+MPS FINISH
OC-37 18:07 10°00.810S 149°49.650W 3595m OCTOPUS START
OC-37 18:13 10°00.840S 149°49.730W 3589m OCTOPUS DEEPEST
OC-37 18:24 10°00.900S 149°49.850W 3580m OCTOPUS FINISH
ST-13 18:24 10°00.910S 149°49.850W 3582m IRRADIANCE MEASUREMENT START
ST-13 18:25 10°00.910S 149°49.860W 3578m KEVLAR SAMPLING START
ST-13 18:59 10°01.160S 149°50.180W 3550m IRRADIANCE MEASUREMENT FINISH
ST-13 19:00 10°01.170S 149°50.190W 3544m VAN DORN SAMPLING START
ST-13 19:02 10°01.180S 149°50.210W 3543m KEVLAR SAMPLING FINISH
ST-13 19:48 10°01.340S 149°50.550W 3520m VAN DORN SAMPLING FINISH

----- 18 OCT.90 (GMT) -----

OC-38 06:13 07°30.080S 150°00.090W 5129m OCTOPUS START
OC-38 06:19 07°30.150S 150°00.170W 5126m OCTOPUS DEEPEST
OC-38 06:31 07°30.290S 150°00.340W 5125m OCTOPUS FINISH
OC-39 16:58 05°00.110S 150°00.090W 4796m OCTOPUS START
OC-39 17:03 05°00.130S 150°00.160W 4773m OCTOPUS DEEPEST
OC-39 17:13 05°00.180S 150°00.350W 4742m OCTOPUS FINISH
ST-14 17:20 05°00.220S 150°00.460W 4738m KEVLAR SAMPLING START
ST-14 17:37 05°00.340S 150°00.580W 4731m KEVLAR SAMPLING FINISH
ST-14 17:38 05°00.340S 150°00.580W 4734m VAN DORN SAMPLING START
ST-14 18:13 05°00.570S 150°00.570W 4714m VAN DORN SAMPLING FINISH
ST-14 18:27 05°00.660S 150°00.560W 4698m CTDO+RMS START
ST-14 18:38 05°00.720S 150°00.560W 4683m OCTOPUS START
ST-14 19:09 05°00.860S 150°00.520W 4682m CTDO+RMS DEEPEST
ST-14 19:14 05°00.880S 150°00.490W 4687m NORPAC NET FINISH

ST-14 19:15 05°00.880S 150°00.480W 4690m IRRADIANCE MEASUREMENT START
ST-14 19:49 05°01.140S 150°00.620W 4702m IRRADIANCE MEASUREMENT FINISH
ST-14 20:16 05°01.370S 150°00.700W 4764m CTDO+RMS FINISH
ST-14 20:22 05°01.430S 150°00.730W 4785m NISKIN SAMPLING(SHALLOW) START
ST-14 20:48 05°01.570S 150°00.670W 4795m NISKIN SAMPLING SEND MESS
ST-14 20:56 05°01.600S 150°00.640W 4790m 1051 NISKIN SAMPLING ARR M
ST-14 21:08 05°01.680S 150°00.620W 4794m NISKIN SAMPLING FINISH
ST-14 21:17 05°01.600S 150°00.510W 4762m ORI NET START
ST-14 21:23 05°01.490S 150°00.260W 4749m ORI SIDE NET START
ST-14 21:38 05°01.270S 149°59.720W 4793m ORI SIDE NET FINISH
ST-14 22:22 05°00.740S 149°58.810W 4861m ORI DEEPEST WIRE LENGTH 1737.6
ST-14 22:56 05°00.220S 149°57.810W 4868m ORI NET FINISH
ST-14 23:16 05°00.290S 149°57.930W 4837m NISKIN SAMPLING(SHALLOW) START
ST-14 23:51 05°00.470S 149°57.950W 4836m NISKIN SAMPLING SEND MESS
ST-14 23:56 05°00.460S 149°57.950W 4835m NISKIN SAMPLING ARR MESS
----- 19 OCT.90 (GMT) -----
ST-14 00:18 05°00.560S 149°58.030W 4835m NISKIN SAMPLING FINISH
ST-14 00:29 05°00.500S 149°57.980W 4836m IKMT+MPS START
ST-14 01:42 04°59.720S 149°54.620W 4952m IKMT+MPS DEEPEST
ST-14 03:25 04°58.630S 149°51.240W 4858m IKMT+MPS FINISH
ST-14 03:36 04°58.600S 149°51.390W 4882m ORI-VMPS START
ST-14 03:52 04°58.630S 149°51.400W 4889m SUNSET & PUT ON LIGHTS
ST-14 04:13 04°58.710S 149°51.510W 4884m ORI-VMPS FINISH
OC-40 08:15 03°59.990S 149°59.980W 4676m OCTOPUS START
OC-40 08:22 03°59.950S 150°00.070W 4681m OCTOPUS DEEPEST
OC-40 08:33 03°59.900S 150°00.220W 4684m OCTOPUS FINISH SLOW AHEAD ENG
OC-41 12:32 02°59.980S 150°00.030W 4693m OCTOPUS START
OC-41 12:37 02°59.910S 150°00.020W 4695m OCTOPUS DEEPEST
OC-41 12:51 02°59.800S 149°59.860W 4685m OCTOPUS FINISH
OC-42 16:53 01°59.890S 150°00.070W 4797m OCTOPUS START
OC-42 16:59 01°59.880S 150°00.100W 4795m OCTOPUS DEEPEST
OC-42 17:08 01°59.880S 150°00.110W 4795m OCTOPUS FINISH
OC-43 21:16 01°00.150S 150°00.100W 4632m OCTOPUS START
OC-43 21:23 01°00.190S 150°00.260W 4659m OCTOPUS DEEPEST
OC-43 21:37 01°00.320S 150°00.550W 4674m OCTOPUS FINISH
OC-44 23:54 00°29.830S 150°00.110W 4479m OCTOPUS START
----- 20 OCT.90 (GMT) -----
OC-44 00:13 00°29.930S 149°59.990W 4476m OCTOPUS FINISH
ST-15 02:32 00°00.110N 150°00.230W 4451m ORI-VMPS START
ST-15 03:12 00°00.090S 150°00.270W 4449m ORI-VMPS FINISH
ST-15 03:23 00°00.140S 150°00.500W 4447m ORI NET START
ST-15 03:49 00°00.290S 149°59.730W 4447m SUNSET & PUT ON LIGHTS
ST-15 04:06 00°00.410S 149°59.180W 4449m ORI NET DEEPEST
ST-15 04:09 00°00.420S 149°59.140W 4446m ORI SIDE NET START
ST-15 04:31 00°00.560S 149°58.760W 4442m ORI SIDE NET FINISH
ST-15 04:42 00°00.630S 149°58.510W 4441m ORI NET FINISH
ST-15 04:50 00°00.600S 149°58.700W 4443m CTD-RMS START
ST-15 04:59 00°00.750S 149°58.770W 4439m NORPAC NET START
ST-15 05:28 00°00.950S 149°58.640W 4434m CTD-RMS DEEPEST
ST-15 05:40 00°01.060S 149°58.580W 4434m NORPAC NET FINISH
ST-15 06:39 00°01.260S 149°58.340W 4429m CTD-RMS FINISH
ST-15 06:45 00°01.300S 149°58.400W 4427m NISKIN SAMPLING(SHALLOW) START
ST-15 07:10 00°01.470S 149°58.580W 4425m NISKIN SAMPLING SEND MESS
ST-15 07:29 00°01.640S 149°58.640W 4422m NISKIN SAMPLING FINISH
ST-15 07:40 00°01.630S 149°58.780W 4421m LV SAMPLING START
ST-15 07:52 00°01.620S 149°58.860W 4421m LV SAMPLING SEND MESS
ST-15 08:11 00°01.610S 149°58.940W 4422m LV SAMPLING FINISH
ST-15 08:20 00°01.610S 149°59.120W 4421m LV SAMPLING START 500M
ST-15 08:28 00°01.620S 149°59.160W 4422m LV SAMPLING SEND MESS
ST-15 08:31 00°01.620S 149°59.140W 4422m LV SAMPLING ARR MESS

ST-15 08:41 00°01.620S 149°59.230W 4421m LV SAMPLING FINISH
ST-15 08:53 00°01.620S 149°59.470W 4423m LV SAMPLING START
ST-15 09:03 00°01.630S 149°59.530W 4420m LV SAMPLING SEND MESS
ST-15 09:14 00°01.630S 149°59.580W 4421m LV SAMPLING FINISH
ST-15 09:24 00°01.620S 149°59.780W 4423m LV SAMPLING START
ST-15 09:35 00°01.610S 149°59.840W 4422m LV SAMPLING SEND MESS
ST-15 09:49 00°01.640S 149°59.930W 4423m LV SAMPLING FINISH
ST-15 09:53 00°01.630S 149°59.990W 4422m NISKIN SAMPLING(SHALLOW) START
ST-15 10:27 00°01.790S 149°59.920W 4418m NISKIN SAMPLING SEND MESS
ST-15 10:35 00°01.780S 149°59.800W 4412m NISKIN SAMPLING ARR MESS
ST-15 10:59 00°02.000S 149°59.770W 4403m NISKIN SAMPLING FINISH
ST-15 11:10 00°02.040S 149°59.850W 4412m ORI-VMPS START
ST-15 11:48 00°02.250S 149°59.670W 4411m ORI-VMPS FINISH
ST-15 12:00 00°02.220S 149°59.710W 4414m IKMT+MPS START
ST-15 13:18 00°01.340S 149°55.970W 4418m IKMT+MPS DEEPEST
ST-15 13:29 00°01.250S 149°55.620W 4426m ORI SIDE NET START
ST-15 13:43 00°01.130S 149°55.260W 4425m ORI SIDE NET FINISH
ST-15 13:48 00°01.100S 149°55.130W 4426m ORI SIDE NET START
ST-15 13:58 00°01.030S 149°54.870W 4429m ORI SIDE NET FINISH
ST-15 14:53 00°00.580S 149°53.240W 4442m IKMT+MPS FINISH
OC-45 14:59 00°00.550S 149°53.180W 4441m OCTOPUS START
OC-45 15:18 00°00.430S 149°52.990W 4445m OCTOPUS FINISH
ST-15 15:22 00°00.400S 149°53.050W 4446m KEVLAR SAMPLING START
ST-15 15:42 00°00.680S 149°53.230W 4441m SUNRISE & PUT OFF LIGHTS
ST-15 16:20 00°01.120S 149°53.730W 4428m KEVLAR SAMPLING FINISH
ST-15 16:20 00°01.120S 149°53.730W 4428m VAN DORN SAMPLING START
ST-15 16:54 00°01.410S 149°54.240W 4429m VAN DORN SAMPLING FINISH
OC-46 19:34 00°29.900N 150°00.190W 4383m OCTOPUS START
OC-46 19:40 00°29.940N 150°00.270W 4382m OCTOPUS DEEPEST
OC-46 19:53 00°29.800N 150°00.360W 4381m OCTOPUS FINISH
OC-46 19:56 00°29.910N 150°00.490W 4382m a/co to 001°
OC-46 20:05 00°31.480N 150°00.560W 4393m RUNG UP ENGINES
OC-47 22:01 01°00.060N 150°00.130W 4432m STOP ENG
OC-47 22:02 01°00.080N 150°00.170W 4433m OCTOPUS START
OC-47 22:11 01°00.110N 150°00.380W 4431m OCTOPUS DEEPEST AT 1208
OC-47 22:19 01°00.090N 150°00.490W 4431m OCTOPUS FINISH
OC-47 22:26 01°00.420N 150°00.690W 4432m FULL AHEAD ENG
----- 21 OCT.90 (GMT) -----
OC-48 02:15 01°59.950N 150°00.090W 4514m OCTOPUS START
OC-48 02:21 02°00.060N 150°00.150W 4510m OCTOPUS DEEPEST
OC-48 02:32 02°00.180N 150°00.220W 4501m OCTOPUS FINISH
OC-49 06:26 03°00.030N 150°00.050W 4955m OCTOPUS START
OC-49 06:34 03°00.230N 150°00.020W 4959m OCTOPUS DEEPEST
OC-49 06:46 03°00.440N 149°59.990W 4966m OCTOPUS FINISH
OC-50 10:34 04°00.120N 149°59.920W 5039m OCTOPUS START
OC-50 10:42 04°00.220N 150°00.060W 5038m OCTOPUS DEEPEST
OC-50 10:53 04°00.440N 150°00.120W 5039m OCTOPUS FINISH
ST-16 14:40 04°59.650N 150°00.140W 5152m VAN DORN SAMPLING START
ST-16 15:10 04°59.670N 150°00.340W 5120m KEVLAR SAMPLING START
ST-16 15:14 04°59.660N 150°00.400W 5106m VAN DORN SAMPLING FINISH
ST-16 15:33 04°59.650N 150°00.590W 5062m KEVLAR SAMPLING FINISH
ST-16 15:45 04°59.620N 150°00.740W 5016m SUNRISE & PUT OFF LIGHTS
ST-16 15:46 04°59.620N 150°00.760W 5013m CTD-RMS START
ST-16 15:58 04°59.620N 150°00.900W 4970m NORPAC NET START
ST-16 16:27 04°59.680N 150°01.130W 4943m CTD-RMS DEEPEST
ST-16 16:56 04°59.650N 150°01.520W 4970m NORPAC NET FINISH
ST-16 17:00 04°59.660N 150°01.560W 4972m IRRADIANCE MEASUREMENT START
ST-16 17:28 04°59.710N 150°01.820W 4998m IRRADIANCE MEASUREMENT FINISH
ST-16 17:30 04°59.700N 150°01.860W 4999m CTD-RMS FINISH
ST-16 17:35 04°59.660N 150°01.950W 5002m NISKIN NR START

ST-16 18:07 04°59.580N 150°02.120W 5014m NISKIN NR SEND MESS
ST-16 18:25 04°59.530N 150°02.130W 5013m NISKIN NR FINISH
OC-51 18:29 04°59.500N 150°02.200W 5014m OCTOPUS START
OC-51 18:38 04°59.480N 150°02.310W 5013m OCTOPUS DEEPEST
OC-51 18:46 04°59.460N 150°02.440W 5014m OCTOPUS FINISH
ST-16 18:58 04°59.340N 150°02.490W 5013m ORI NET START
ST-16 19:11 04°59.110N 150°02.280W 4993m ORI SIDE NET START
ST-16 19:33 04°58.110N 150°02.250W 4943m ORI NET DEEPEST
ST-16 19:41 04°57.780N 150°02.300W 4963m ORI SIDE NET FINISH
ST-16 20:09 04°56.550N 150°02.930W 4996m ORI NET FINISH
ST-16 20:49 04°55.760N 150°02.370W 4945m IKMT+MPS START
ST-16 22:06 04°57.280N 150°06.280W 4959m IKMT+MPS DEEPEST
ST-16 22:09 04°57.260N 150°06.450W 4963m ORI SIDE NET START
ST-16 22:40 04°57.020N 150°07.490W 4955m ORI SIDE NET FINISH
ST-16 23:39 04°56.650N 150°09.660W 5064m IKMT+MPS FINISH
ST-16 23:47 04°56.570N 150°09.920W 5062m NISKIN SAMPLING(SHALLOW) START
----- 22 OCT.90 (GMT) -----
ST-16 00:24 04°56.420N 150°10.160W 5055m NISKIN SAMPLING(SHALLOW) SEND MESS
ST-16 00:29 04°56.420N 150°10.180W 5059m NISKIN SAMPLING(SHALLOW) ARR MESS
ST-16 00:54 04°56.360N 150°10.320W 5077m NISKIN SAMPLING(SHALLOW) FINISH

ST-16 01:02 04°56.320N 150°10.380W 5083m ORI-VMPS START
ST-16 01:36 04°56.260N 150°10.500W 5103m ORI-VMPS FINISH
ST-16 01:43 04°56.230N 150°10.600W 5116m SLOW AHEAD ENG
ST-16 01:47 04°56.310N 150°10.730W 5130m s/co on 004°
ST-16 01:52 04°56.860N 150°10.720W 5124m FULL AHEAD ENG
OC-52 12:19 07°31.340N 150°00.010W 5013m STOP ENG AND OCTOPUS START
OC-52 12:25 07°31.230N 149°59.980W 5019m OCTOPUS DEEPEST
OC-52 12:38 07°30.970N 150°00.000W 5035m OCTOPUS FINISH
OC-52 12:39 07°30.940N 150°00.010W 5032m SLOW AHEAD ENG
OC-53 23:02 10°00.090N 150°00.140W 5071m OCTOPUS START
OC-53 23:08 10°00.110N 150°00.090W 5068m OCTOPUS DEEPEST
OC-53 23:17 10°00.140N 150°00.060W 5072m OCTOPUS FINISH
ST 17 23:28 10°00.070N 150°00.320W 5128m VAN DORN SAMPLING START
ST 17 23:57 09°59.890N 150°00.560W 5166m VAN DORN SAMPLING FINISH
----- 23 OCT.90 (GMT) -----
ST 17 00:01 09°59.860N 150°00.600W 5167m CTD-RMS START
ST 17 00:11 09°59.820N 150°00.690W 5175m IRRADIANCE MEASUREMENT START
ST 17 00:54 09°59.610N 150°00.700W 5167m IRRADIANCE MEASUREMENT FINISH
ST 17 00:54 09°59.610N 150°00.700W 5167m NORPAC NET START
ST 17 00:57 09°59.600N 150°00.690W 5170m CTD-RMS DEEPEST
ST 17 01:30 09°59.470N 150°00.580W 5151m NORPAC NET FINISH
ST 17 02:00 09°59.280N 150°00.580W 5142m CTD-RMS FINISH
ST 17 02:13 09°59.200N 150°00.590W 5139m NISKIN NR START
ST 17 02:40 09°59.040N 150°00.610W 5134m NISKIN NR SEND MESS
ST 17 03:05 09°58.920N 150°00.620W 5130m NISKIN NR FINISH
ST 17 03:09 09°58.900N 150°00.670W 5136m ORI NET START
ST 17 03:18 09°58.890N 150°00.930W 5164m ORI SIDE NET START
ST 17 03:41 09°58.890N 150°01.700W 5258m SUNSET & PUT ON LIGHTS
ST 17 03:49 09°58.890N 150°01.970W 5280m ORI SIDE NET FINISH
ST 17 03:52 09°58.890N 150°02.060W 5282m ORI NET DEEPEST
ST 17 04:27 09°58.800N 150°02.760W 5310m ORI NET FINISH
ST 17 04:32 09°58.790N 150°02.850W 5309m NISKIN SAMPLING(SHALLOW) START
ST 17 05:14 09°58.500N 150°02.830W 5310m NISKIN SAMPLING SEND MESS
ST 17 05:19 09°58.460N 150°02.840W 5311m NISKIN SAMPLING ARR MESS
ST 17 05:33 09°58.370N 150°02.820W 5312m NISKIN SAMPLING SEND MESS
ST 17 05:38 09°58.350N 150°02.830W 5312m NISKIN SAMPLING ARR MESS
ST 17 05:59 09°58.190N 150°02.860W 5319m NISKIN SAMPLING FINISH

ST 17 06:05 09°58.170N 150°03.020W 5323m ORI NET START
ST 17 06:31 09°58.140N 150°03.930W 5343m ORI NET FINISH 600M
ST 17 06:39 09°58.110N 150°04.040W 5345m VMPS START
ST 17 06:54 09°57.970N 150°04.110W 5339m VMPS DEEPEST
ST 17 07:16 09°57.730N 150°04.240W 5341m VMPS FINISH
ST 17 07:26 09°57.680N 150°04.390W 5341m LV SAMPLING START
ST 17 07:39 09°57.640N 150°04.520W 5339m LV SAMPLING ARR MESS
ST 17 07:50 09°57.540N 150°04.620W 5338m LV SAMPLING FINISH
ST 17 08:02 09°57.580N 150°04.690W 5337m LV SAMPLING START
ST 17 08:13 09°57.560N 150°04.680W 5335m LV SAMPLING ARR MESS
ST 17 08:22 09°57.530N 150°04.640W 5332m LV SAMPLING FINISH
ST 17 08:33 09°57.480N 150°04.620W 5332m LV SAMPLING START
ST 17 08:44 09°57.380N 150°04.640W 5333m LV SAMPLING ARR MESS
ST 17 08:54 09°57.330N 150°04.810W 5327m LV SAMPLING FINISH
ST 17 09:06 09°57.340N 150°05.200W 5332m IKMT+MPS START
ST 17 09:57 09°57.710N 150°07.870W 5311m IKMT+MPS DEEPEST 3500M
ST 17 10:38 09°57.800N 150°09.310W 5304m ORI SIDE NET START
ST 17 10:39 09°57.800N 150°09.340W 5305m ORI SIDE NET START AGAIN
ST 17 10:55 09°57.840N 150°09.920W 5306m ORI SIDE NET FINISH
ST 17 11:24 09°57.910N 150°10.890W 5292m IKMT+MPS FINISH STOP ENG