Preliminary Report
of
The Hakuhō Maru Cruise KH-72-1
(CSK, IBP)

May 11 - August 3, 1972
The Seas of Southeast Asia

Ocean Research Institute
University of Tokyo
1975

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By

The Scientific Members of the Expedition

Edited by

Ryuzo Marumo

Introduction

Theme of present cruise of Hakuhō-Maru is to study marine ecosystem in the seas around the Southeastern Asia especially in the pelagic waters. The comprehensive marine biological studies are undertaken along with some geophysical investigations. Biological works have covered researches on phytoplankton, zooplankton, micronecton, benthos and organic compounds of the particulated matters in the sea.

These works are pronounced as a part of International Biological Program (IBP) and a cruise of Cooperative Studies of the Kuroshio (CSK) and these are partially supported by a grant from the Ministry of Education of Japan. All works are carried out successfully on board.

On behalf of scientists and crews aboard, I would like to express hearty thanks to government organizations and people of countries for their kind receptions where we visited to call and to take a rest. These warm hospitalities and generous arrangements are great help for our achievement of the research of this cruise. I also thank the crew of Hakuhō-Maru for their capable cooperation throughout this long cruise of KH-72-1.

Ryuzo Marumo
Chief Scientist

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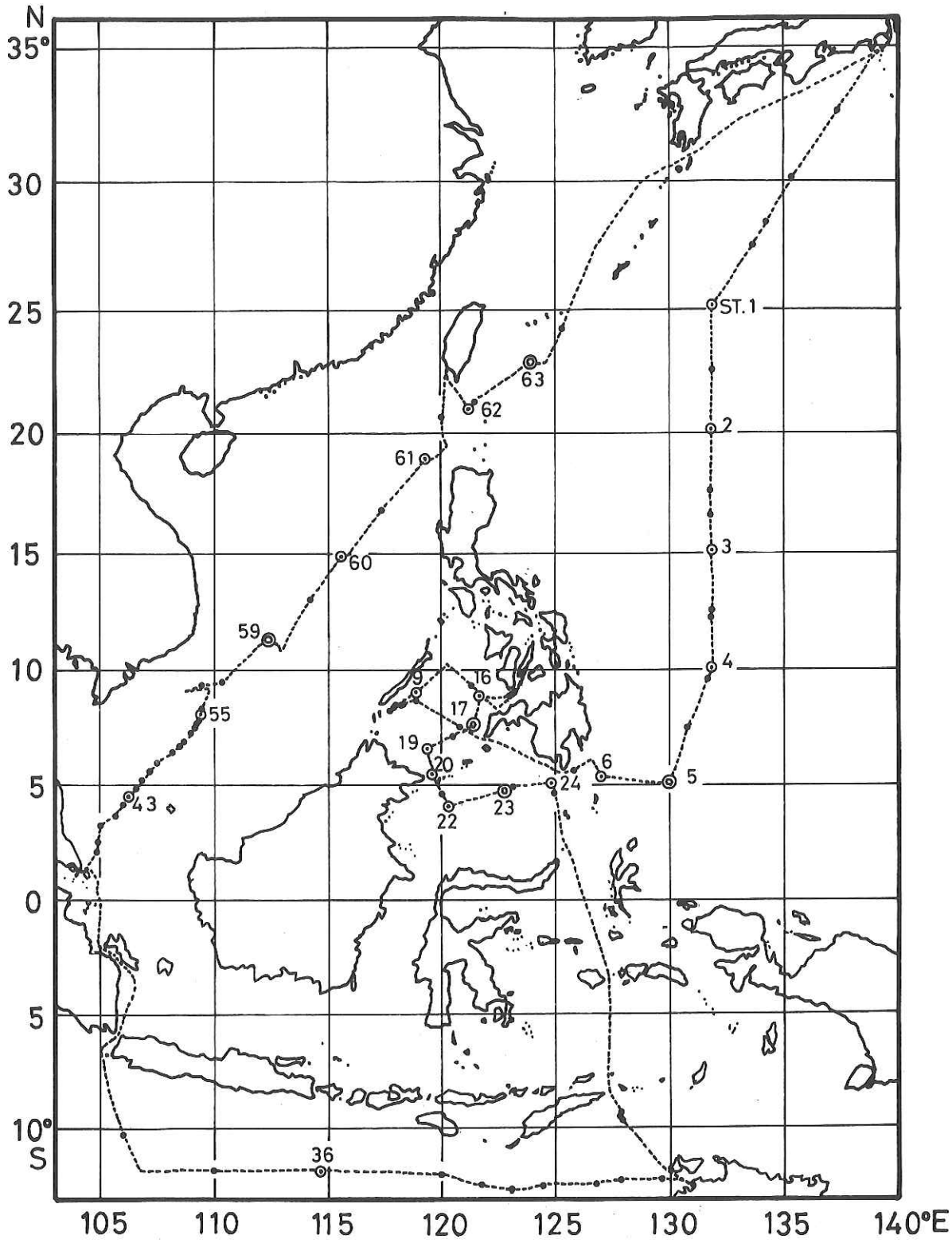


Fig. 1. Track chart of KH-72-1.

Cruise itinerary

	Arrival	Departure
Tokyo		May 11, 1972
Cebu, Philippine	May 29	June 1
Darwin, Australia	June 21	June 24
Singapore	July 4	July 8
Kaohsiung, Taiwan	July 22	July 26
Tokyo	August 3, 1972	

Scientists aboard

Marumo, Ryuzo Chief Scientist	Ocean Res. Inst., Univ. of Tokyo
Nemoto, Takahisa	Ocean Res. Inst., Univ. of Tokyo
Horikoshi, Masuoki	Ocean Res. Inst., Univ. of Tokyo
Ishii, Takeo	Ocean Res. Inst., Univ. of Tokyo
Murano, Masaaki	Ocean Res. Inst., Univ. of Tokyo
Segawa, Jiro	Ocean Res. Inst., Univ. of Tokyo
Kawaguchi, Kouichi	Ocean Res. Inst., Univ. of Tokyo
Ohta, Suguru	Ocean Res. Inst., Univ. of Tokyo
Nakai, Toshisuke	Ocean Res. Inst., Univ. of Tokyo
Otobe, Hirotaka	Ocean Res. Inst., Univ. of Tokyo
Hasumoto, Hiroshi	Ocean Res. Inst., Univ. of Tokyo
Aizawa, Yasushi	Ocean Res. Inst., Univ. of Tokyo
Terazaki, Makoto	Ocean Res. Inst., Univ. of Tokyo
Aoki, Ichiro	Ocean Res. Inst., Univ. of Tokyo
Shiraishi, Manabu	Ocean Res. Inst., Univ. of Tokyo
Somiya, Hiroaki	Fac. of Agriculture, Nagoya Univ.
Ikeya, Noriyuki	Fac. of Science, Shizuoka Univ.
Imajima, Minoru	National Science Museum, Tokyo
Okamura, Osamu	Fac. of Liberal Arts and Science, Kochi Univ.
Otsuki, Tadashi	Fac. of Agriculture, Univ. of Tokyo
Sudo, Shinpei	Fac. of Science, Tokyo Metropolitan Univ.
Yamaguchi, Yukuya	Fac. of Science, Tokyo Kyoiku Univ.
Nishizawa, Satoshi	Fac. of Agriculture, Tohoku Univ.
Ichikawa, Toshihiro	Fac. of Agriculture, Tohoku Univ.
Taniguchi, Akira	Fac. of Fisheries, Hokkaido Univ.
Shiga, Naonobu	Fac. of Fisheries, Hokkaido Univ.
Zvi Ben-Avraham	Woods Hole Inst. Oceanogr.

Outline of the research

R. Marumo

Studies on Marine Ecosystem in the Seas of Southeast Asia were done on KH-72-1 Cruise by the research vessel Hakuhō Maru, Ocean Research Institute, University of Tokyo, in the period from May 11 to August 3, 1972.

The knowledge on marine ecosystems in the seas of Southeast Asia is very poor, especially for deep-sea organisms, except some results obtained by several expeditions of Siboga, Albatross, Snellius, etc. The flora and fauna are very diverse and there exist various interesting and peculiar biological phenomena in these waters. For example, the Sulu Sea is surrounded by high sills, so that the deep water is not exchanged with that of the neighbouring seas and consequently a closed ecosystem is formed there. Trichodesmium, a blue-green alga, inhabits only the tropical and subtropical seas, and its contribution to the economy of the sea is quite different from that of diatoms and other phytoplankton.

Twenty-seven scientists participated on this cruise from 10 universities and institutions in Japan and USA. Sixty-four observational stations were occupied throughout the Philippine Sea, Sulu Sea, Celebes Sea, Timor Sea, Indian Ocean and South China Sea (Figure 1). At major four stations such as sts. 5, 17, 23 and 59, Hakuhō Maru stayed 2-4 days in order to complete all research items.

For biological, biochemical and hydrographical researches were done Nansen casts, BT observations, STD observations, sampling by 25-l Van Dorn sampler and 200-l water sampler, measurements of transparency and measurements of underwater spectrum of natural light (ORI spectro-radiometer) and solar radiation (Corczynski solarimeter and Beckman radiometer). For plankton collections were used Norpac net, MTD net, ORI net and IKMT. For benthos collections were used Scoop sampler, 3-m beam trawl, otter trawl, Smith-McIntyer's sampler, Phleger core sampler, gravity corer and underwater camera.

Furthermore, observations on the echo pattern of individual fish, sea birds, gravity and magnetics were carried out.

CSK standard solutions provided by the courtesy of Dr. Ken Sugawara, Sagami Chemical Research Center, were used as the references for chemical analyses of oxygen and nutrient salts in the sea water samples.

The biological study on this cruise forms a part of International Biological Programme (IBP) and Cooperative Studies of the Kuroshio (CSK) and it was partially supported by a grant from the Ministry of Education, Japan.

We would like to express our hearty thanks for the warmful hospitality given by people during the stay in Sebu, Darwin, Singapore and Kaohsiung. Many thanks are also extended to crew members of Hakuhō Maru for their helpful cooperation throughout the long cruise period of 85 days.

1. Hydrography

R. Marumo, T. Nakai, H. Otobe and H. Hasumoto

(1) The Philippine Sea (Section I)

According to water temperature (Fig. 5) and salinity profiles (Fig. 6), along 132°E, the North Equatorial Current streamed westwards in the north of st. 4 and the Equatorial Countercurrent existed between sts. 4 and 5. The North Pacific Intermediate Water penetrated as a toungue of the salinity minimum layer directing to around 300 m at st. 4, and above this toungue the North Pacific Tropical Saline Water was found as the salinity maximum layer. The remarkably high saline water around 100 m at st. 5 seems to have been originated from the South Pacific Ocean. The surface low saline water at st. 4 presumably formed by the precipitation shows a striking contrast to the high saline water just below this layer. The oxygen content was uniform, almost 4.5-5.0 ml/l, in the surface layer through this section (Fig. 8), and the oxygen minimum layer below 2.0 ml/l was distributed along the lower part of the North Pacific Intermediate Water. Concerning on the character of watermasses, sts. 1, 2 and 3 are of the North western Pacific Central Water and sts. 4 and 5 are of the Pacific Equatorial Water.

(2) The Celebes Sea (Section II)

According to the distribution of σt along Section II (Fig. 16), the current directed northwards in the east side of st. 6 and southwards in the west side of this station, respectively. The former seems to be a part of the Equatorial Countercurrent, while the latter seems to be a part of the North Equatorial Current flowing into the Celebes Sea as clearly shown by salinity distribution (Fig. 15). The water below 1000 m in the Celebes Sea was homogeneous, 3.6°C in temperature, 34.59 ‰ in salinity and 2.2 ml/l in oxygen, and such homogeneity indicates that this deep water is scarcely interchanged with the open sea water prevented by high sills surrounding the Celebes Sea. In this deep water phosphate content was slightly higher,

3.0 μg atoms/l, than that in the Sulu Sea and silicate content was fairly high in the west part of this sea.

(3) The Sulu Sea (Section II)

The temperature attained 30°C in the surface layer and it decreased sharply through a remarkable thermocline around 100 m to the level of 10°C in the deep layer from 700 m to the bottom. The weak temperature minimum was formed around 1200 m by the effect of adiabatical compression and the potential temperature shows a quite constant value of 9.9°C below 1000 m. Salinity and oxygen content were also almost constant, 34.45-34.48 ‰ and 4.3-4.6 ml/l, in this water. The low saline water overspreading the surface layer seems to have come from the South China Sea.

(4) The South China Sea (Section III)

The temperature was higher and the salinity was lower in the water below 2000 m in the South China Sea, compared with those in other seas. The surface salinity, especially in the southern region, was considerably low, owing to the inflow of river waters. Such surface low saline water spreaded to the Bashi Channel and the Sulu Sea. The salinity showed the maximum around 200 m and the minimum around 450 m, respectively, but both of these values are rather low because of the influence by the reciprocative current in connection with monsoon.

The weak minimum oxygen content of 2 ml/l existed around 700-800 m, and such a layer was rather thick in the southern region. Silicate was rich throughout the South China Sea, especially in the surface at sts. 55 and 59, presumably because of the effect of land waters.

(5) The Indian Ocean

At only a station, st. 36, occupied in the Indian Ocean, salinity and oxygen content in the deep water were slightly smaller than those in the Pacific side.

(6) Comparison of hydrographic elements in the deep water of different seas

Observed temperature, potential temperature, salinity, density, dissolved oxygen, phosphate, silicate and nitrate in the depth of 3000 m are compared in different seas (Table 1). The degree of isolation from other seas depends on the depth of sills surrounding marginal seas, and it ranks from the Sulu Sea, the Celebes Sea to the South China Sea.

Table 1. Comparison of hydrographic elements in 3000 m depth of different seas

Sea	Indian Ocean (St. 36)	Philippine Sea (St. 5)	South China Sea (St. 59)	Celebes Sea (St. 23)	Sulu Sea (St. 17)
Temperature observed (°C)	1.64	1.59	2.37	3.60	10.29
Potential temperature (°C)	1.41	1.36	2.13	3.33	9.88
Salinity (‰)	34.73	34.675	34.63	34.59	34.475
Density (σt)	27.81	27.77	27.69	27.53	26.53
Dissolved oxygen (ml/l)	3.75	3.35	2.55	2.20	1.37
Phosphate (µg atoms/l)	2.60	2.84	2.95	3.10	2.35
Silicate (µg atoms/l)	132	149	196	124	85
Nitrate (µg atoms/l)	37	35	42	44	29

2. Simultaneous STD operation with Smith-McIntyre sampling and Nansen cast

T. Nakai, H. Hasumoto and H. Otobe

Simultaneous STD (Bisset Berman Model 9060 self contained temperature salinity depth recorder) operations were done in two ways. STD was fixed within the iron frame together with Smith-McIntyre sampler and soner pinger (5 stations). STD was, in another way, attached to the end of wire instead of the weight in serial Nansen observations (7 stations). Thus, the vertical distribution of temperature and salinity was obtained simultaneously with benthos samplings or hydrographical observations. Two depth ranges (500 m, 2000 m) were switched by exchanging electric pannel. Analogue data were recorded on pressure sensitive chart paper by self contained cylindrical X-Y recorder.

3. Measurement of underwater and solar radiations

T. Nakai, H. Otobe and H. Hasumoto

The vertical and spectral distributions of natural light in the sea was obtained by measuring the downwelling radiance and irradiance from the surface to 60 m at 4 stations. The instrument was already detailed in Preliminary Report of the Hakuhō Maru KH-69-3 (1969).

The intensity of the total hemispherical radiation from the sun and sky in the open ocean was measured by Gorczynski solarimeter and Beckman radiometer on the upper bridge deck continuously throughout the cruise.

4. Vertical distribution of particulate proteins, chlorophylls, ribonucleic and deoxyribonucleic acids

Y. Yamaguchi

For the estimation of a total microbial biomass, 700 water samples were collected with Van Dorn samplers from various depths at 19 stations. The sampling stations and depths were all the same as for particulate organic carbon and nitrogen. In addition, samples were collected from just above the sea bottom at 19 stations by using a Phleger corer and 7 samples from the surface skin at st. 17. Water samples were filtered through glass fiber filters (Whatman GF/C) and immediately kept under -20°C on ship board. The amounts of chlorophyll a, proteins, ribonucleic and deoxyribonucleic acids were determined by the method of Iwamura et al. (1967, 1970). This work was carried out in collaboration with Dr. S. Ichimura.

5. Distribution of particulate organic matter (carbon and nitrogen) and total respiration by ultraplankton

S. Nishizawa and T. Ichikawa

About 25 liter water samples were dipped by the routine Van-Dorn casts from each of 20-25 m depth layers at 19 stations. The waters sampled were filtered and washed with 3 % sodium chloride solution on board, and the filter pads were stored at -20°C for later analyses of organic carbon and nitrogen. At 5 out of the 19 routine stations, the Van Dorn casts were repeated twice with a time interval of 20-24 hours and the results are expected to give a general range of sampling errors.

At 7 stations, 200-400 liters of water were sampled from each of 50 and 500 m (occasionally 1000 m) depth layers, and the suspensions were concentrated using a floating type gentle concentrator with a

final water volume of about 500 ml. The concentrates were filled in 100 ml oxygen bottles and incubated at 7°C for 24 hours. The decrease in dissolved oxygen during the incubation was measured to obtain the time rate of total respiration due to the ultraplankton associated with suspended material.

6. Vertical distribution of phytoplankton

A. Taniguchi

To study the regional variation of phytoplankton distribution in various sea areas, 216 one-liter water samples were collected at 10 fixed depth (0, 10, 20, 30, 50, 75, 100, 150, 200 and 300 m) at 22 stations. The water samples were preserved by adding 10 ml of neutralized formaline and carried back to the land laboratory for microscopic examination. The regional characteristics of vertical distribution of diatoms will be mainly discussed in relation to those of hydrographic conditions.

7. Ecology on *Trichodesmium*

R. Marumo and H. Hasumoto

In order to investigate the distribution of *Trichodesmium*, 500-ml of sea water were obtained from Van Dorn sampler in the layer from the surface to 200 m at 22 stations. These water samples were preserved by adding 15-ml of neutralized formalin, and then filtered by Millipore Filter (HA) and prepared to the permanent slide mountings on board. Net samples were also used for ecological study of this alga. Blooms of *Trichodesmium erythraeum* were observed several times in various regions and preblooms of *T. thiebautii* were observed mainly in the Sulu Sea.

8. Ecology of decapod shrimps

Y. Aizawa

Biogeographical studies of meso- and bathypelagic decapod shrimps were carried out. The materials were collected mainly using a ORI-net and Isaacs-Kidd mid-water trawl which were towed obliquely down to about 1000 m depth. After sorting to species levels, the biomass was measured to study the ecology of these shrimps in the deep waters. The rearing experiments of this early larvae stages were also carried out to study the metamorphosis from eggs to larvae.

9. Histological study on deep sea fish eyes

H. Somiya

The histological study was made on the ocular structure of some micronectonic deep sea fishes, mainly of Gonostomatidae and Myctophidae, collected from different depths. The eyes were fixed in Bouin or 10 % formalin and embedded in paraffin for optical microscopic study. Some samples were fixed in 1 % OsO_4 in Milloning's buffer glucose and embedded in Epon for electron-microscopic study. The results will be analyzed especially considering their phylogeny and ecological characteristics.

10. Ecology of fish micronecton

K. Kawaguchi and I. Aoki

The geographical distribution, vertical distribution and vertical migration of the mesopelagic fish micronecton were studied by ORI-net towing, sometimes equipped with opening-closing device, in the Philippine Sea, the Sulu Sea, the Celebes Sea, the South China Sea and the Indian Ocean. The species composition of these fishes will

be analyzed to compare the time-spacial distribution structures of the fish micronecton community, mainly composed of fishes belonging to the two families of Myctophidae and Gonostomatidae, in each area surveyed.

11. Taxonomy and distribution of mysids

M. Murano

About 90 species of mysids were collected through various towings of different types of plankton nets, such as ORI-net, Isaacs-Kidd mid-water trawl, bottom-net and a net attached to the mouth part of a beam trawl. Some specimens collected from deep sea bottom are considered to be new to the science.

12. Larval development of palinurid and scyllarid lobsters

M. Murano

The rearing experiments were done to study the characteristics of the larval development of palinurid and scyllarid lobsters. The metamorphosis from the final phyllosoma stage to puerulus or natant stage was observed through the maintenance of the larvae in this cruise.

13. Reproduction of deep sea euphausiids

T. Nemoto

The maturity and fecundity of deep sea euphausiids were examined. Two big euphausiids, Thysanopoda cornuta and T. egregia, showed the accessary growth after the maturity of reproductive organs. Although the number of samples were rather few, the matured eggs in ovary of

these euphausiids were ranging from 100 to 300. Many undeveloped eggs were observed in ovary and they may be spawn in next chance. The healthy euphausiids were also maintained in 300 ml oxygen bottles, and excretion of euphausiids was examined by analyzing of water samples remained.

14. Species and distribution of appendicularians

N. Shiga

This study dealt with relationship between the distribution of appendicularians and nature of water masses, and day-night change in vertical distribution of the animals. Sampling was carried out with Motoda's horizontal nets in the areas surveyed at both day and night times. About 340 samples collected will be examined in taxonomical study and their distribution will be analyzed in relation to hydrographic conditions.

15. Respiration and decomposition of zooplankton

S. Sudo

This study was one of the attempts to compare the field data with the experimental data in laboratory concerning the biological circulation of carbon and nitrogen mass in the sea. About 15 species of zooplankton, mainly composed of copepods, were collected and maintained to measure their respiration and excretion rates. Activity of respiration was measured by Bechmann dissolved oxygen analyzer, and samples for the study of decomposition of zooplankton bodies were frozen at $-20^{\circ}C$ immediately after the collection and they will be examined in laboratory.

16. Biology of chaetognaths

M. Terazaki

The geographical distribution of chaetognaths in the Philippine Sea, Sulu Sea, Celebes Sea, South China Sea and the East China Sea was studied. Gut contents in chaetognaths were surveyed mainly for specimens caught from deep waters. The quantity of lipids in the body of meso- and bathypelagic species was also examined in laboratory.

17. Trawling of megalobenthos

M. Imajima, M. Horikoshi and S. Ohta

Two types of gear were used for the collecting of megalobenthos; a beam trawl and an otter trawl. The former was the Agassiz-Sigsby type of 3 m span, with an inner net of finer mesh. At a few stations, the trawl bag was doubled so as to make a twin net of 6 m span. At one station in the Sulu Sea (st. 20; ca. 500 m), the trawling was carried out by means of an otter trawl which had the span of 13 m and had an inner net of finer mesh. The numbers of trawling stations established were 12 in the Sulu Sea and its neighbouring waters (200-4890 m), 7 in the Timor Sea (50-690 m), and 8 in the South China Sea (60-1720 m). In the Sulu Sea, many sponges of various species were collected even in the deepest part of the sea. This is thought to indicate the presence of water movement on the sea floor in the greater parts of the Sulu Sea.

18. Quantitative sampling of smaller macrobenthos

M. Horikoshi, M. Imajima and S. Ohta

Two samples of sediment were obtained at each station by two

Smith-McIntyre's Spring-loaded Bottom Samplers (1/10 m^2), which were set in an iron frame (ORI Double-sampler Frame). On the deck, the sediment within the grab backet of the samplers was divided into equal halves before washing through a set of sieves of 2.0, 1.0 and 0.5 mm meshes. The washed materials were fixed with 10 % formalin neutralized by hexamine (hexamethylene-tetramine). The touching bottom of the frame-samplers complex was monitored by an echo-sounder on the continental shelf in the shallow-seas, and in deep-seas by a pinger which was put within the frame. The frame-samplers complex worked properly even at the depth of 4500 m in the Sulu Sea, and 6 stations were established in the Sulu Sea, 8 in the Timor Sea and 12 stations in the South China Sea.

19. Deep sea photographing

M. Horikoshi, S. Ohta, T. Nakai,
H. Hasumoto and H. Otobe

Series of bottom photographs were taken at some of the trawling stations with the aid of EG and G Underwater Camera. Various sorts of benthic animals including demersal fishes were photographed along with the tracks and holes of unknown invertebrates. Photographs of remains of terrestrial plants such as a coconut shell and some twigs were also taken. Differences in the habitat of two ophiuroideans were known; one species was living on the sea bed and the other was clinging to alcyonarian-like objects protruding from the sea floor. Numerically dominant animals in the trawl catch tended to be photographed repeatedly at the same station, suggesting that the assessment of the population density of epibenthic megalobenthos including demersal fish would be quite possible.

20. Quantitative sampling of the benthic Foraminifera

N. Ikeya

Quantitative collectings of the benthic Foraminifera were carried out using mainly a Phleger Core Sampler. At some stations, however, a coring tube of the same diameter was inserted into undisturbed sediment within Smith-McIntyre Grab Sampler just after hauling in on the deck. The topmost 1 cm of the core sample was out and fixed with neutral fomalin, and following 5 cm was also preserved. The numbers of stations established were 10 in the Sulu Sea, 6 in the Timor Sea and 14 in the South China Sea.

21. Studies on the marine humic acid in the sediments

T. Ohtsuki

For the investigation of the properties and distributions of marine humic acid in relation to the influence of land water, various types of sediments were collected from different depths at 28 stations on continental shelves and in deep seas. Most of these samples were collected by several small-sized scoop-samplers attached to a beam trawl, and at some stations a Smith-McIntyre sampler was used. In addition to these samplings, core samplings were made by means of a 120 kg gravity corer with a pipe of 2 m in length and of 8.1 cm in inner diameter. The amounts of chlorophyll and pheo-pigment, which are considered to be related to the nature of marine humic acid, were also measured by a fluorometric method of current use.

Table 2. Data on benthos samplings - 1.

Station No.	Area	Position	Depth	Instrument
7	off Davao Bay	05°37.9'N, 125°50.0'E - 05°39.5'N, 125°50.7'E	3229 - 3230 m	3 m Beam Trawl
8	Sulu Sea	08°44.6'N, 119°05.4'E - 08°44.8'N, 119°06.2'E	2030 - 2030 m	3 m Beam Trawl
10	Sulu Sea	08°09.2'N, 117°53.8'E - 08°10.5'N, 117°54.5'E	200 - 215 m	3 m Beam Trawl
11	Sulu Sea	08°12.7'N, 117°59.6'E - 08°11.8'N, 117°58.4'E	285 - 306 m	3 m Beam Trawl
12	Sulu Sea	08°19.0'N, 118°09.1'E - 08°18.7'N, 118°08.5'E	495 - 500 m	3 m Beam Trawl
13	Sulu Sea	08°20.8'N, 118°19.8'E - 08°20.6'N, 118°18.8'E	730 - 738 m	3 m Beam Trawl
14	Sulu Sea	08°31.6'N, 118°35.7'E - 08°32.6'N, 118°36.8'E	1712 - 1840 m	3 m Beam Trawl
17	Sulu Sea	07°31.3'N, 121°33.2'E - 07°31.0'N, 121°33.5'E	4890 - 4890 m	6 m Beam Trawl
18	Sulu Sea	07°02.7'N, 120°35.7'E - 07°03.8'N, 120°36.2'E	4430 - 4510 m	6 m Beam Trawl
19	Sulu Sea	06°34.8'N, 119°28.2'E - 06°33.7'N, 119°28.6'E	3260 - 3270 m	3 m Beam Trawl
20	Sibutu Passage	05°40.9'N, 119°46.3'E - 05°43.1'N, 119°47.0'E	460 - 514 m	Otter Trawl
21	Celebes Sea	04°31.4'N, 120°00.6'E - 04°31.8'N, 120°00.4'E	2750 - 2778 m	3 m Beam Trawl
26	Timor Sea	09°27.0'S, 127°58.6'E - 09°28.5'S, 127°56.1'E	610 - 690 m	3 m Beam Trawl
27	Timor Sea	09°30.9'S, 127°56.6'E	465 - 490 m	3 m Beam Trawl
28	Timor Sea	09°34.4'S, 128°06.0'E - 09°33.5'S, 128°03.4'E	295 - 296 m	3 m Beam Trawl
29	Sahul Shelf	12°17.3'S, 129°40.9'E - 12°17.2'S, 129°41.8'E	49 - 52 m	3 m Beam Trawl
30	Sahul Shelf	12°24.8'S, 128°00.1'E - 12°24.8'S, 128°00.2'E	115 - 115 m	3 m Beam Trawl
32	Sahul Shelf	12°37.3'S, 124°33.9'E - 12°36.0'S, 124°36.4'E	74 - 78 m	3 m Beam Trawl
33	off Sahul Shelf	12°42.2'S, 123°07.6'E - 12°42.0'S, 123°08.5'E	535 - 547 m	3 m Beam Trawl
42	South China Sea	04°03.2'N, 106°09.3'E - 04°03.2'N, 106°09.4'E	85 - 88 m	3 m Beam Trawl
45	South China Sea	05°13.5'N, 107°00.8'E - 05°13.7'N, 107°01.1'E	60 - 60 m	3 m Beam Trawl
48	South China Sea	06°21.2'N, 108°18.3'E - 06°20.9'N, 108°18.2'E	93 - 93 m	3 m Beam Trawl
50	South China Sea	06°51.6'N, 108°47.2'E - 06°51.6'N, 108°48.9'E	132 - 137 m	3 m Beam Trawl
52	South China Sea	07°26.3'N, 109°14.9'E - 07°30.2'N, 109°13.2'E	265 - 286 m	3 m Beam Trawl
54	South China Sea	07°50.0'N, 109°23.8'E - 07°50.3'N, 109°25.1'E	760 - 777 m	3 m Beam Trawl
56	South China Sea	08°17.4'N, 109°34.0'E	1040	Otter Trawl
57	South China Sea	09°14.5'N, 109°38.5'E - 09°15.0'N, 109°39.9'E	1680 - 1720 m	3 m Beam Trawl

Table 3. Data on benthos samplings - 2.

Station No.	Area	Position	Depth	Amount of Sediment			
8	Sulu Sea	08°43.9'N, 119°09.8'E	2010 m	6.0	6.0	2.0	2.5
10	Sulu Sea	08°07.5'N, 117°52.5'E	202 m	1.3	1.4	0.9	0.8
12	Sulu Sea	08°18.6'N, 118°10.2'E	495 m	6.0	6.0		
13	Sulu Sea	08°22.9'N, 118°20.2'E	809 m	8.0	7.5	8.0	7.5
18	Sulu Sea	07°06.5'N, 120°32.8'E	4320 m	7.0	7.0		
20	Sibutu Passage	05°37.9'N, 119°45.7'E	449 m	3.0	3.0	2.7	2.7
26	Timor Sea	09°29.6'S, 127°55.0'E	634 m	2.0	2.3	2.2	2.5
27	Timor Sea	09°30.6'S, 127°55.5'E	505 m	6.0	6.5	5.5	5.5
28	Timor Sea	09°33.5'S, 128°59.5'E	300 m	3.0	2.5	3.1	3.7
29	Sahul Shelf	12°17.3'S, 129°40.7'E	49 m	3.5	2.0		
30	Sahul Shelf	12°24.9'S, 127°59.5'E	115 m	5.9	7.8		
31	Sahul Shelf	12°28.5'S, 126°55.5'E	92 m	7.2	7.4		
32	Sahul Shelf	12°37.2'S, 124°35.0'E	80 m	1.5	1.3		
33	off Sahul Shelf	12°42.5'S, 123°07.3'E	530 m	6.7	6.0		
38	South China Sea	02°07.0'N, 104°53.0'E	69 m	7.8	7.6		
39	South China Sea	02°35.5'N, 105°00.0'E	65 m	7.9	7.4	7.2	6.1
40	South China Sea	03°19.0'N, 105°09.2'E	71 m	7.0	8.2	7.8	7.2
41	South China Sea	03°38.6'N, 105°51.0'E	80 m	9.6	7.2		
42	South China Sea	04°03.2'N, 106°08.0'E	85 m	7.5	7.0	7.8	7.0
43	South China Sea	04°30.1'N, 106°25.6'E	91 m	8.1	8.0	7.8	7.1
44	South China Sea	04°52.9'N, 106°44.5'E	130 m	5.6	5.9		5.7
45	South China Sea	05°11.0'N, 107°59.3'E	63 m	5.1	4.2	4.0	4.5
46	South China Sea	05°32.8'N, 107°14.5'E	60 m	1.9	2.7	2.4	3.1
47	South China Sea	05°56.2'N, 107°39.2'E	70 m	3.7	3.5	2.2	3.7
49	South China Sea	06°40.0'N, 108°31.8'E	109 m	2.7	2.7	3.6	3.2
50	South China Sea	06°51.5'N, 108°51.5'E	137 m	3.5	3.8	5.0	4.6

22. Study on counting the echo pattern of individual fish by pattern analysis

T. Ishii and M. Shiraishi

(1) Collection of the echo signals (F-observation)

The echo signals of the fish detector, recorded in the magnetic tape, were obtained at 34 stations (sts. F-1~F-34, 9 in the Pacific Ocean, 5 in the Sulu Sea, 2 in the Celebes Sea, 6 in the Indian Ocean, 6 in the South China Sea and 6 in the Bashi Strait).

In the first half of F-observations (F-1~F-16), the echo signals were recorded at the ship speed of 6 knots for 30 minutes at each station in daytime, and BT observation was also conducted at each station. In the latter half except 3 stations (F-23~F-25), these recordings were carried out continuously in three levels of ship speeds (2, 4 and 6 or 4, 6 and 8 kt) at the same observation point in order to analyze the variation of the echo pattern with ship speed. Details of the observation are as follows:

Ship speed (knot)		2	4	6	8
Position	12°S, 114°E	F-17	F-18	F-19	
	10°S, 106°E	F-20	F-21	F-22	
	9°N, 110°E		F-23*		
	13°N, 114°E		F-24	F-25	
	16°N, 117°E		F-26	F-27	F-28
	20°N, 120°E		F-29	F-30	F-31
	21°N, 121°E		F-32	F-33	F-34

(* The observation was failed because of the bad weather.)

The counting of echo patterns from the records obtained in this cruise is left for the future work.

(2) Development of the softwear for the echo pattern counting system in the online real time process

During previous cruises (KH-69-4, KH-70-4 and KH-71-4), the computer program and system were already completed for recognizing

and counting the echo pattern with the off-line system. In these pattern analysis systems, there are three cases for the use of data channel; a) Reading from fish detector to the core memory, b) Writing from the core memory to the outer magnetic drum, c) Reading from the outer drum to the core for the punch-out of the data. It is impossible to process two or more functions simultaneously, and the data processing terminated abnormally caused by timing error.

The input data in the off-line system are read from the paper tape punched by the other program, so that the timing error for the data channel never occurs in any time.

In this cruise, the system for the pattern analysis of echo in the on-line real time process was completed in consideration of the data channel status mentioned above. Some programs in that system were improved on from the debugging, so that it was possible to count echo patterns on condition that values of several preset parameters were put a restriction (the interval of transmission, the depth range for counting, the low slice level of echo signal, etc.).

(3) Analysis of the echo pattern for the automatic mask designing system

For counting the echo pattern of large sized individuals by that system mentioned above, it is necessary to design the standard pattern, which is called the mask due to this mode of the method of comparison. However, the shape of the echo pattern is very variable even when the same fish is recorded, depending on the shape of the beam, ship speed, reflection loss of fish, depth of fish, sea condition, etc.

The standard mask is designed to work automatically with the echo signals recorded in the combination of preset parameters (ship speed, depth of fish, etc.), and that standard mask must be applied for the echo counting in the same condition.

For this purpose, in the first step, new programs were completed in this cruise. New programs were as follows:

Program 9: From the echo data, the concurrence of elements, called the set or subset, is extracted and these characters of that concurrence is surveyed. These informations are stored with the digital value of echo signal on the magnetic tape in digital type (MT).

Program 10: The print-out of the data from MT stored by the Program 9.

Program 11: The print-out of the character table for the data store by the Program 9 in each station.

Detailed analysis of the set or subset is now in progress.

23. Sea bird observations

Y. Tanaka* and K. Nanba*

All the sea birds in the visible field of about 7 mile radius were observed and counted on the bridge deck (11 m high from the sea) using binoculars (Fig. 35, Tables 4 and 5).

1) Sixteen species of birds were identified. 2) Brown boobies (Leucogaster) and red-footed boobies (Sula sula) were found throughout the sea area of the Southeast Asia, but blue-faced boobies (Sula dactylatra) were not found at all. 3) On the distribution of boobies, red-footed boobies were flocked in the tropical coral seas, but brown boobies flew in single in the western part of the North Pacific Ocean, the South China Sea and the East China Sea. 4) White-tailed tropic birds (Phaethon lepturus) were found on the sea between 12°N and 23°N. 5) Wedge-tailed shearwaters (Paffinus pacificus) and pale-footed shearwaters (Puffinus carneipes) were mostly observed within about 200 nautical miles from land. 6) It was clarified that Christmas Island in the Indian Ocean is one of the breeding places of brown boobies, red-footed boobies, white-tailed tropic birds, red-tailed tropic birds (Phaethon rubricauda) and brown noddy (Anous

stolidus).

(* Officers of Hakuhō Maru)

Table 4. Data on sea bird observations

Date	Sula leucogaster	Sula sula	Fregata minor, ariel	Sterna hirundo	Sterna fuscata	Sterna anaethetus	Thalasseus bergii	Anous stolidus	Sterninae	Phaethon lepturus	Phaethon rubricauda	Pterodroma hypoleuca	Bulweria bulwerii hypoleuca	Puffinus pacificus	Puffinus carneipes	Calonectris leucomelas	Procellariidae	Total	Running observation hour	Drifting observation hour
5-12						5						1	2					8	10	0
5-13												1	13					14	10	0
5-14	1					1							2					4	5	3
5-15																		0	2	6
5-16																		0	8	0
5-17										1			2	1				4	8	0
5-18																2		2	10	0
5-19													10	61		2		73	3	9
5-20										1								1	0	8
5-21										7				3		19		29	8	0
5-22																		0	0	8
5-23																		0	0	4
5-24		517	1						105							3		626	9	0
5-25	1	8	1						5			2				30		47	7	2
5-26		35																35	4	4
5-27		11																11	1	10
5-28		258																258	10	0
6- 1																		0	7	0
6- 2									8									8	0	8
6- 3		91							30									121	5	4
6- 4		39	2															41	0	8
6- 5		42	1						44	1								88	0	8
6- 6																		0	0	8
6- 7		36							50									86	2	8
6- 8		3	10						202									215	3	6
6- 9		282	31	2	232				400			1						948	2	8
6-10		10	3	100	100													213	4	4
6-11			2	34	34												8	78	0	8
6-12									2									2	3	5
6-13		1							1									2	0	8
6-14					1													1	3	0
6-15								1										1	0	8
6-16				16	39													55	9	0
6-17				2	4					1								7	9	0
6-18	1	60		8	10			49										128	11	0
6-19	1			2	17						1			2				23	2	6
6-20				31			55											86	8	0
6-25	1	7		2			1											11	5	3
6-26	4		2		162		25										16	209	7	3
6-27		31	35		10					2				72	72			222	8	0
6-28		1								2				1	1			5	0	8
6-29			22		1					3	1			98	189			314	10	0
6-30			2							1				7	141			151	6	4
7- 1	146	96	64					150		10	4			2				472	12	0
7- 2			2			4		6										12	6	0
7- 3			4		4													8	9	0
7- 9																		0	4	4
7-10																		0	5	2
7-11																		0	2	3
7-12					9													9	4	4
7-13	5				6									41				52	8	2
7-14														2				2	0	8
7-15					4													4	0	8
7-16																		0	0	8
7-17							2											2	7	0
7-18																3		3	0	8
7-19				1										4		6		11	9	0
7-20																		0	0	8
7-21					2											27	2	31	11	0
7-27																		0	2	6
7-28										2						1	1	4	0	8
7-29					10									5		50		65	0	8
7-30													2					2	4	0
7-31	1												2			5		8	4	0

Table 5. Density of sea birds in different sea areas.

Sea area	Total number of birds observed (Σ n)	Number of days of observation (d)	Σ n/d	Number of species observed	Number of times observed (f)	Σ n/f
West of North Pacific Ocean	135	11	12	8	122	1
Sulu Sea	2697	15	180	9	157	17
Celebes Sea	139	7	20	7	58	2
Molucca Sea and Banda Sea	135	2	68	6	33	4
Timor Sea	329	4	82	9	35	9
Indian Ocean	1164	5	233	9	62	19
Java Sea	20	2	10	4	13	2
South China Sea	114	13	9	7	94	1
East China Sea	79	5	16	7	42	2

24. Observations of gravity and magnetics

J. Segawa and Z. Ben-Avraham

Gravity and magnetic field were measured all through the cruise by the use of a LaCoste and Romberg gravity meter and a Proton magnetometer. The data obtained are now being processed and interpreted, and it will need time for us to summarize all the data of this cruise. An interesting result has been obtained, however, about the Philippine basin, and so it is reported here.

We crossed the West Philippine basin along 132°E longitude in the so-called "Central Basin Fault" which runs in the direction of N50°W. So far this fault has been thought to be merely a branched one which once prevailed over all the west Pacific basin. But, according to the present survey, the fault has proved to be a ridge. This ridge, which we named "Philippine ridge", or "Palaeo Philippine ridge", is aseismic in contrast to a generally approved fact that all the ridges are seismic. Its symmetric topography, symmetric magnetic anomalies and gravity anomaly distribution are definitely to be assigned to the ridge which produced magma and composed ocean crust by spreading. Observed profiles of bathymetry, gravity anomaly and magnetic anomaly across the ridge between 20°N and 10°N along the line of 132°E are shown in Fig. 36.

The symmetric distribution of magnetic anomalies about the axis of the Philippine ridge is the most important discovery of this survey. We have got a conclusion that the Philippine ridge was once a center of spreading of the west Philippine basin floor in the Mesozoic era, but that it ceased activity at the early stage of the Cenozoic and subsided, but remains its relic in the bathymetry and magnetic anomaly.

Table 6. Data from Nansen serial observations at St. 1.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
1	25-03.0N	131-59.4E	May 14, 1972	06:14-07:53	4700m	28m	25.8°C	S-6m/s	S-3	WSW-2	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	25.7	34.927	23.09	4.62	95	0.48	15.2	0.5	0.03	90.3
10	23.51	934	76	95	98	0.00	4.9	0.1	0.04	72.8
19	22.21	963	24.16	5.06	98	0.00	3.9	0.0	0.08	54.6
29	21.23	35.093	53	23	101	0.00	6.0	0.0	0.02	82.5
48	20.83	060	61	59	106	0.00	6.4	0.1	0.01	44.2
72	20.56	009	65	11	96	0.00	4.3	0.1	0.01	185.9
96	20.24	34.986	73	08	95	0.00	6.0	0.1	0.03	196.9
144	19.46	946	90	02	93	0.01	4.9	0.6	0.07	239.2
194	18.53	926	25.11	4.86	88	0.14	7.1	8.9	0.05	37.7
287	17.07	907	46	55	81	0.32	7.3	4.8	0.04	1.3
382	15.99	841	66	73	84	0.35	9.4	4.7	0.05	0.0
476	14.32	724	93	74	80	0.63	14.9	6.8	0.03	
570	12.75	586	26.14	38	72	0.91	23.7	8.6	0.08	
757	7.35	253	81	3.01	44	2.07	57.0	22.5	0.05	
943	4.94	320	27.17	2.01	28	2.87	101.2	29.4	0.06	

D (m)	T (°C)	S (‰)	σ_t
0	25.7	34.93	23.09
10	23.51	93	76
20	22.00	97	24.23
30	21.20	35.09	53
50	20.81	05	62
75	20.53	00	65
100	20.20	34.99	73
150	19.34	95	93
200	18.43	93	25.14
300	16.92	90	48
400	15.72	82	69
500	13.96	70	26.00
600	12.11	52	22
800	6.37	25	95
1000	(4.73)	(35)	(27.21)

Table 7. Data from Nansen serial observations at St. 2.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
2	20-01.5N	131-57.8E	May 15, 1972	10:15-11:48	5900m	40m	28.4°C	SE-6m/s	SE-3	SE-3	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	27.4	34.591	22.33	4.66	98	0.00	11.3	0.2	0.00	55.2
10	27.51	585	28	60	97	0.00	7.2	0.0	0.00	55.2
19	26.66	559	54	71	98	0.00	6.7	0.1	0.00	63.0
29	25.65	579	86	90	100	0.00	8.9	0.1	0.00	96.2
48	24.19	704	23.39	5.01	100	0.00	8.6	0.2	0.00	115.0
72	23.01	801	81	4.85	95	0.00	4.7	0.1	0.00	139.7
96	22.23	799	24.02	5.00	97	0.00	9.4	0.0	0.00	275.6
144	20.78	905	52	4.94	93	0.00	6.4	0.4	0.11	286.6
192	19.06	857	94	71	87	0.19	8.6	2.3	0.01	0.0
288	16.20	742	25.53	56	80	0.42	9.9	5.9	0.00	0.6
385	13.77	528	89	34	72	0.82	16.2	10.0	0.00	0.6
481	10.88	306	26.28	3.90	62	1.29	29.0	16.4	0.00	
576	7.90	187	67	2.75	41	2.15	53.6	23.6	0.00	
765	5.56	320	27.09	1.69	24	2.79	83.3	33.3	0.00	
953	4.36	427	32	69	23	3.01	107.1	34.6	0.00	

D (m)	T (°C)	S (‰)	σ_t
0	27.4	34.59	22.33
10	27.51	585	28
20	26.60	56	55
30	25.55	58	87
50	24.08	72	23.44
75	22.93	80	82
100	22.13	80	24.06
150	20.59	90	56
200	18.81	85	98
300	15.90	72	25.59
400	13.38	495	95
500	10.26	27	26.37
600	7.43	19	75
800	5.30	345	27.15
1000	(4.15)	(44)	(36)

Table 8. Data from Nansen serial observations at St. 3.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
3	14-57.4N	131-58.8E	May 16, 1972	18:00-19:00	5900m	21m	28.0°C	E-7m/s	E-3	E-3	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
							(μg atoms/l)			
0	28.4	34.399	21.84	4.52	97	0.02	8.8	0.2	0.00	75.4
9	28.52	385	81	57	98	0.00	9.9	0.4	0.01	87.1
19	28.35	455	91	59	99	0.03	8.0	0.1	0.01	78.0
28	28.23	528	22.00	61	98	0.00	10.7	0.1	0.00	91.6
47	27.50	609	30	84	102	0.00	12.3	0.0	0.00	137.1
70	27.20	615	39	75	100	0.00	10.4	0.1	0.00	130.0
94	26.92	686	54	83	103	0.00	10.0	0.1	0.00	204.1
141	25.72	573	83	77	100	0.00	11.1	0.1	0.00	336.0
188	22.80	984	24.01	13	85	0.16	14.1	1.3	0.02	74.7
282	16.58	707	25.41	3.92	77	0.63	15.5	6.8	0.01	2.6
376	12.40	424	26.08	70	65	1.19	27.7	15.8	0.00	1.3
471	8.99	229	55	14	51	1.83	45.2	24.4	0.00	
565	6.97	306	91	2.26	34	2.52	68.4	27.4	0.01	
755	5.34	434	27.21	1.80	26	2.75	89.3	32.3	0.00	
947	4.28	522	40	2.11	29	2.86	107.1	37.2	0.00	

D (m)	T (°C)	S (‰)	σ_t
0	28.4	34.40	21.84
10	28.51	385	81
20	28.34	46	91
30	28.19	535	22.01
50	27.45	61	31
75	27.16	625	41
100	26.83	68	56
150	25.35	60	97
200	21.90	97	24.24
300	15.74	655	25.57
400	11.40	345	26.22
500	8.27	24	66
600	6.52	335	98
800	5.07	46	27.26
1000	(4.04)	(54)	(44)

Table 9. Data from Nansen serial observations at St. 4.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
4	10-01.2N	132-00.0E	May 17, 1972	20:20-21:20	5600m	-	28.5°C	E-2.5m/s	E-1	E-1	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
							(μg atoms/l)			
0	29.4	33.902	21.13	4.61	101	0.00	14.0	0.3	0.00	251.5
9	29.23	809	12	65	101	0.00	18.6	0.3	0.00	191.7
19	29.20	809	13	62	100	0.00	10.4	0.1	0.00	135.8
28	28.86	961	24	84	104	0.00	14.9	0.2	0.00	85.1
47	27.86	34.377	99	72	100	0.07	16.6	0.3	0.00	81.9
71	24.08	811	23.50	31	86	0.19	14.6	1.2	0.00	306.1
94	21.01	787	24.36	3.64	69	0.58	14.9	6.2	0.23	273.0
141	15.82	638	25.53	06	53	1.14	24.3	15.6	0.03	118.0
187	12.57	556	26.16	2.47	40	1.72	37.5	22.1	0.00	0.0
280	9.73	557	67	1.86	29	2.24	43.1	27.7	0.00	0.0
372	8.81	614	86	2.60	40	2.15	42.3	28.2	0.00	0.0
465	7.83	574	99	36	35	2.34	48.8	32.1	0.00	0.0
558	7.31	555	27.05	27	33	2.48	51.2	30.8	0.00	0.0
745	6.32	539	17	70	39	2.46	58.9	33.3	0.00	
937	5.36	537	28	25	32	2.70	77.4	34.6	0.00	

D (m)	T (°C)	S (‰)	σ_t
0	29.4	33.90	21.13
10	29.23	81	12
20	29.18	81	13
30	28.78	34.00	41
50	27.60	445	22.14
75	23.38	815	23.71
100	20.25	775	24.55
150	15.17	615	25.66
200	11.95	55	26.27
300	9.48	57	74
400	8.52	605	92
500	7.62	565	27.02
600	7.09	55	07
800	6.04	535	20
1000	(5.06)	(545)	(34)

Table 10. Data from Nansen serial observations at St. 5.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
5	05-01.8N	130-09.8E	May 19, 1972	07:36-11:30	5100m	32m	27.1°C	SW-2m/s	SW-1	WSW-1	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	29.4	33.890	21.14	4.60	100	0.03	14.1	0.0	0.01	216.4
9	29.63	929	09	60	101	0.02	16.2	0.5	0.10	214.5
18	29.17	34.228	47	72	103	0.04	18.5	0.2	0.02	252.5
26	27.84	855	22.36	57	97	0.15	14.1	0.3	0.02	402.6
44	27.44	982	58	23	90	0.37	18.8	2.6	0.35	492.3
65	27.13	35.189	85	3.81	80	0.51	18.8	2.5	0.42	458.2
86	26.16	257	23.20	43	71	0.63	13.2	7.0	0.13	300.9
129	23.81	252	92	22	64	0.75	21.5	8.6	0.03	83.2
173	19.66	128	24.98	20	60	0.96	30.9	12.0	0.02	16.5
262	13.99	34.630	25.93	04	51	1.41	38.2	19.5	0.02	5.8
352	11.57	556	26.35	2.67	43	1.84	48.2	16.2	0.01	1.9
444	10.50	696	65	90	46	1.85	40.0	22.4	0.00	1.9
537	7.74	547	98	05	30	2.48	58.2	32.3	0.02	0.0
726	5.99	521	27.20	31	33	2.76	75.0	28.7	0.01	
918	5.00	551	35	20	31	2.86	85.3	35.1	0.03	
1146	3.77	573	50	30	31	3.03	103.5	36.3	0.07	
1432	3.04	600	59	46	33	2.99	122.9	34.0	0.08	
1910	2.26	635	69	76	36	3.01	143.8	37.4	0.05	
2387	1.82	657	74	3.04	39	2.90	127.9	36.3	0.07	
2864	1.60	672	77	33	43	2.84	149.4	35.4	0.02	
3342	1.56	678	78	42	44	2.83	147.6	34.8	0.07	
3819	1.56	681	78	51	45	2.84	142.9	35.8	0.05	

D (m)	T (°C)	S (‰)	σ_t
0	29.4	33.89	21.14
10	29.63	93	09
20	28.75	34.60	88
30	27.70	89	22.44
50	27.35	35.035	65
75	26.80	24	23.00
100	25.47	25	41
150	22.02	26	24.44
200	17.80	34.83	25.22
300	12.75	605	26.17
400	10.45	565	56
500	8.35	54	88
600	6.93	54	27.08
800	5.55	535	26
1000	4.55	56	40
1200	3.57	58	52
1500	2.91	605	60
2000	2.16	64	70
2500	1.74	66	75
3000	1.59	675	77
3500	1.56	68	78
4000	(1.56)	(685)	(78)

Table 11. Data from Nansen serial observations at St. 6.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp	Wind	Sea	Swell	Weather
6	05-21.8N	127-02.4E	May 22, 1972	04:37-07:47	3400m	40m	28.6°C	WSW-6m/s	WSW-3	x-2	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	29.2	34.030	21.27	4.50	98	0.01	30.6	0.0	0.02	122.2
9	29.33	011	24	65	101	0.00	29.1	0.6	0.00	107.9
19	29.34	015	24	64	101	0.00	31.8	0.3	0.03	110.5
28	29.34	013	24	53	99	0.00	23.8	0.4	0.01	108.6
46	28.24	148	71	5.02	108	0.03	32.6	0.2	0.01	128.1
70	26.58	630	22.61	4.62	96	0.09	25.6	0.2	0.03	252.9
93	24.76	939	23.39	32	87	0.09	24.1	0.6	0.07	406.6
139	18.35	832	25.07	3.95	72	0.47	32.1	6.0	0.03	49.4
185	15.90	701	57	4.31	75	0.58	37.1	8.0	0.03	16.9
278	9.96	480	26.58	1.98	31	2.17	64.4	26.9	0.04	2.0
370	7.81	468	91	2.14	32	2.50	77.9	30.0	0.02	2.0
462	7.08	464	27.02	59	38	2.52	80.6	28.2	0.00	0.0
555	6.71	482	07	3.00	44	2.62	82.9	28.2	0.02	0.0
741	5.90	553	24	2.50	36	2.61	92.4	33.3	0.04	
930	4.70	561	39	57	36	2.84	106.5	36.6	0.01	
994	4.60	571	41	38	33	2.85	115.9	32.0	0.00	
1280	3.43	592	55	43	33	2.95	133.8	35.3	0.04	
1754	2.46	626	67	64	35	2.99	148.2	31.3	0.04	
2227	1.94	650	73	87	37	2.92	180.3	35.8	0.04	
2702	1.70	668	76	3.35	43	2.87	160.9	35.9	0.02	
3177	1.56	684	78	46	45	2.83	173.2	34.6	0.05	

D (m)	T (°C)	S (‰)	σ_t
0	29.2	34.03	21.27
10	29.33	01	24
20	29.34	015	24
30	29.34	015	24
50	27.70	25	96
75	26.22	77	22.82
100	23.94	935	23.64
150	17.66	81	25.11
200	14.80	66	78
300	9.34	475	26.68
400	7.49	465	96
500	6.91	47	27.04
600	6.54	495	11
800	5.56	56	28
1000	4.45	57	42
1200	3.66	585	52
1500	2.90	61	60
2000	2.15	64	70
2500	1.77	66	74
3000	1.61	68	77

Table 12. Data from Nansen serial observations at St. 9.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp	Wind	Sea	Swell	Weather
9	08-59.0N	119-01.8E	May 25, 1972	11:39-14:00	1900m	20m	29.4°C	SSW-2m/s	SSW-1	1	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_3-Si	NO_3-N	NO_2-N	Chl
							(μg atoms/l)			(μg/m³)
0	29.6	33.669	20.89	4.58	100	0.04	5.3	7.7	0.02	975.0
10	29.76	34.052	21.12	69	103	0.00	34.7	0.1	0.02	1126.1
19	28.97	073	41	57	99	0.00	36.8	0.1	0.02	1309.7
29	27.76	090	83	67	99	0.02	36.5	0.2	0.01	374.4
48	26.32	241	22.40	44	92	0.20	26.5	0.6	0.15	2379.0
71	24.46	159	88	3.74	75	0.52	28.2	3.2	0.11	874.2
93	21.66	250	23.77	2.56	49	1.00	28.8	6.8	0.04	354.2
139	17.93	442	24.88	29	41	1.30	42.6	8.3	0.02	61.7
185	16.71	453	25.18	28	40	1.41	43.8	10.0	0.04	0.0
278	13.76	498	87	1.97	33	1.75	58.2	12.1	0.03	0.0
371	12.16	487	26.20	2.22	36	1.86	61.2	13.7	0.04	7.2
464	11.13	469	36	06	33	2.00	65.6	14.5	0.04	7.8
558	10.57	460	45	07	32	2.11	71.5	14.6	0.04	0.0
748	10.20	457	52	1.96	31	2.16	74.4	16.0	0.04	0.0
935	10.10	465	55	94	30	2.20	72.1	15.9	0.04	
1122	10.06	461	55	2.13	33	2.22	76.2	14.8	0.04	
1404	10.11	460	55	1.73	27	2.28	84.1	16.1	0.06	
1686	10.12	469	55	60	25	2.34	83.8	15.8	0.05	

D (m)	T (°C)	S (‰)	σ_t
0	29.6	33.67	20.89
10	29.76	34.05	21.12
20	28.85	075	44
30	27.68	095	85
50	26.25	24	22.42
75	24.00	165	23.05
100	20.89	295	24.02
150	17.62	45	97
200	16.31	46	25.28
300	13.40	495	95
400	11.82	48	26.24
500	10.85	465	42
600	10.42	46	47
800	10.16	46	53
1000	10.08	465	55
1200	10.08	46	55
1500	10.11	465	55

Table 13. Data from Nansen serial observations at St. 16.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
16	08-48.1N	121-48.4E	June 2, 1972	05:10-10:14	4950m	34m	27.6°C	NNW-3.0m/s	NNW-2	2	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_3-Si	NO_3-N	NO_2-N	Chl
							(μg atoms/l)			(μg/m³)
0	29.3	33.796	21.10	4.59	100	0.02	8.2	0.1	0.06	-
10	29.39	777	06	79	104	0.03	5.9	0.3	0.02	387.7
19	28.94	34.070	41	90	106	0.01	10.6	0.2	0.03	423.8
29	27.90	104	79	82	102	0.04	5.6	0.2	0.02	376.1
49	27.00	199	22.14	64	97	0.07	8.8	0.2	0.05	588.2
73	26.48	329	41	03	84	0.25	8.2	4.4	0.46	547.3
97	25.48	335	74	3.76	77	0.41	12.9	6.0	0.12	325.6
143	20.16	329	24.23	2.07	39	1.24	27.6	17.5	0.42	35.1
189	15.10	491	25.59	1.99	34	1.63	36.8	23.5	0.06	-
287	12.89	467	26.02	37	22	2.02	52.4	27.7	0.03	7.4
380	11.93	470	22	64	26	1.97	50.3	28.2	0.04	-
473	11.23	473	35	2.00	31	1.97	52.6	25.1	0.03	0.0
566	10.64	455	44	1.99	31	2.09	56.5	28.7	0.02	0.0
753	10.25	451	49	88	29	2.15	61.8	30.2	0.02	0.3
943	10.10	456	54	82	28	2.18	70.0	28.7	0.05	
1132	10.09	459	55	54	24	2.28	67.6	30.7	0.10	
1413	10.12	462	55	54	24	2.29	77.9	28.9	0.05	
1883	10.14	467	55	47	23	2.29	74.7	29.4	0.07	
2445	10.22	472	53	59	25	2.32	80.0	31.2	0.06	
2930	10.29	473	53	37	21	2.30	83.5	30.2	0.05	
3402	10.36	474	52	39	22	2.30	87.6	30.2	0.05	
4356	10.51	475	48	65	26	2.41	91.8	30.5	0.25	
4645	10.57	474	47	61	25	2.45	92.9	29.4	0.11	

D (m)	T (°C)	S (‰)	σ_t
0	29.3	33.795	21.10
10	29.39	775	06
20	28.85	34.075	45
30	27.85	11	82
50	26.97	205	22.16
75	26.45	33	42
100	25.25	33	78
150	19.28	375	24.51
200	14.62	49	25.68
300	12.73	47	26.05
400	11.77	47	24
500	11.05	46	37
600	10.52	455	45
800	10.20	45	52
1000	10.10	455	54
1200	10.10	46	55
1500	10.13	465	55
2000	10.16	47	54
2500	10.23	47	53
3000	10.30	475	52
3500	10.37	475	50
4000	10.45	475	48
4500	10.56	475	47

Table 14. Data from Nansen serial observations at St. 17.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
17	07-36.4N	121-30.9E	June 3, 1972	14:45-19:35	4800m	-	31.4°C	NW-2.0m/s	NW-1	- 0	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	30.1	33.784	20.79	4.83	106	0.01	52.4	0.0	0.03	182.0
10	29.42	735	21.00	47	97	0.04	31.8	0.0	0.01	216.4
19	29.47	784	02	56	100	0.02	25.0	0.1	0.00	256.1
29	28.97	34.143	47	66	101	0.01	32.1	0.0	0.00	326.3
48	27.97	255	71	82	103	0.04	27.6	0.3	0.00	705.9
71	26.52	315	22.38	01	83	0.30	33.2	2.4	0.59	1235.0
95	23.73	274	23.20	2.98	59	0.78	47.1	6.7	0.06	234.0
142	18.78	374	24.63	15	39	2.14	50.6	12.2	0.01	29.9
190	15.63	456	25.44	1.80	31	1.65	60.0	16.4	0.00	11.0
285	13.15	455	97	66	27	1.93	49.4	14.3	0.03	1.3
378	11.86	463	26.23	58	26	2.04	53.2	20.3	0.05	7.2
472	11.26	460	34	63	26	2.09	56.8	28.2	0.02	
565	10.72	455	43	64	26	2.18	60.6	26.9	0.03	
752	10.23	452	52	67	26	2.22	65.3	29.2	0.00	
939	10.10	460	54	63	25	2.24	67.6	28.7	0.03	
1127	10.08	460	54	57	24	2.26	73.8	28.7	0.04	
1407	10.12	460	54	54	24	2.33	74.1	30.2	0.03	
1875	10.14	467	54	42	22	2.33	80.6	30.7	0.02	
2356	10.20	476	54	34	21	2.34	83.5	30.7	0.03	
2824	10.26	476	53	38	22	2.33	84.1	30.0	0.04	
3297	10.33	478	52	36	21	2.35	87.1	28.2	0.03	
3772	10.42	475	49	34	21	2.34	84.7	29.4	0.10	
4250	10.50	474	48	35	21	2.35	89.4	30.6	0.15	
4536	10.55	476	47	37	22	2.37	85.9	30.2	0.09	

D (m)	T (°C)	S (‰)	σ_t
0	30.1	33.785	20.79
10	29.42	735	21.00
20	29.45	80	04
30	28.92	34.15	49
50	27.90	265	74
75	26.20	315	22.48
100	23.03	275	23.39
150	18.15	385	24.79
200	15.25	455	25.52
300	12.89	455	26.02
400	11.68	46	26
500	11.10	46	36
600	10.60	455	44
800	10.19	455	53
1000	10.09	46	54
1200	10.09	46	54
1500	10.12	465	54
2000	10.16	47	54
2500	10.22	475	54
3000	10.29	475	53
3500	10.37	475	52
4000	10.46	475	49
4500	10.53	475	47

Table 15. Data from Nansen serial observations at St. 19.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
19	06-34.7N	119-28.3E	June 8, 1972	19:57-23:15	3350m	-	29.3°C	ESE-4.0m/s	ESE-2	2	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	29.6	33.986	21.13	4.56	100	0.04	28.2	0.1	0.00	144.3
10	29.71	976	10	54	100	0.00	24.1	0.3	0.00	200.8
19	29.70	975	10	62	101	0.00	25.6	0.0	0.02	102.7
29	28.66	34.015	47	78	103	0.02	26.5	0.2	0.00	217.1
48	25.56	086	22.53	3.83	78	0.34	28.2	4.0	0.45	185.2
71	23.03	184	23.34	2.64	52	0.78	37.1	14.1	0.10	0.0
94	20.54	293	24.11	21	42	1.02	46.2	15.4	0.08	0.0
141	17.07	439	25.08	1.98	35	1.34	51.5	17.6	0.13	2.9
187	15.31	458	50	82	31	1.50	57.4	18.1	0.10	0.0
280	12.98	455	26.00	82	30	1.85	80.3	27.6	0.08	4.6
373	11.88	460	22	64	26	1.98	76.5	28.9	0.04	0.0
465	10.96	462	39	72	27	2.08	83.5	29.0	0.02	
558	10.50	457	46	73	27	2.15	87.1	30.7	0.02	
744	10.18	458	53	73	27	2.17	95.6	31.5	0.01	
931	10.09	464	55	67	26	2.20	85.3	31.5	0.05	
1297	10.08	463	55	59	25	2.24	98.5	30.7	0.03	
1569	10.13	467	55	50	23	2.28	108.5	30.7	0.05	
2028	10.16	476	54	40	22	2.32	105.9	32.0	0.03	
2488	10.22	480	54	35	21	2.34	100.9	32.5	0.03	
2952	10.29	479	53	33	21	2.34	111.5	32.8	0.02	
3148	10.31	482	53	36	21	2.34	106.2	32.8	0.02	

D (m)	T (°C)	S (‰)	σ_t
0	29.6	33.985	21.13
10	29.71	975	10
20	29.68	975	10
30	28.45	34.02	53
50	25.35	095	22.58
75	22.55	20	23.49
100	19.88	32	24.31
150	16.65	445	25.19
200	14.89	46	60
300	12.71	455	26.04
400	11.59	46	27
500	10.77	46	42
600	10.39	46	49
800	10.14	46	54
1000	10.09	465	55
1200	10.08	465	55
1500	10.11	465	55
2000	10.16	475	54
2500	10.22	48	54
3000	10.30	48	53

Table 16. Data from Nansen serial observations at St. 20.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
20	05-38.3N	119-48.0E	June 10, 1972	00:15-01:10	480m	–	28.2°C	ESE-4.0m/s	ESE-2	2	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
							(μg atoms/l)			
0	28.9	34.097	21.44	4.55	98	0.00	3.5	0.0	0.11	927.8
10	28.74	093	50	67	101	0.00	4.7	0.2	0.02	858.0
19	28.27	113	68	75	102	0.02	3.5	0.2	0.02	1009.1
29	27.92	153	83	58	98	0.02	4.7	0.3	0.03	1719.2
49	26.76	175	22.21	52	94	0.25	5.6	2.8	0.49	1098.5
73	24.82	220	82	3.80	77	0.47	11.5	6.6	0.44	645.1
97	22.02	287	23.70	2.98	57	0.78	18.5	12.7	0.10	316.8
144	20.01	339	24.28	47	46	1.05	22.4	12.6	0.10	95.8
190	17.02	414	25.08	17	38	1.41	32.6	20.9	0.00	240.5
283	12.42	453	26.10	1.90	31	1.89	50.6	28.2	0.03	30.8
374	11.58	457	27	76	28	2.03	54.4	30.5	0.03	0.0
420	11.25	458	33	71	27	2.04	58.2	30.2	0.03	

D (m)	T (°C)	S (‰)	σ_t
0	28.9	34.095	21.44
10	28.74	095	50
20	28.23	12	70
30	27.87	155	84
50	26.70	175	22.22
75	24.50	225	94
100	21.85	29	23.75
150	19.70	35	24.37
200	16.33	425	25.26
300	12.19	455	26.15
400	11.40	46	32

Table 17. Data from Nansen serial observations at St. 22.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
22	03-57.5N	120-25.2E	June 11, 1972	02:47-07:18	4440m	28m	27.8°C	SE-3.5m/s	SE-1	1	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
							(μg atoms/l)			
0	29.3	34.069	21.30	4.60	100	0.00	35.3	0.2	0.02	1116.3
10	29.36	089	29	56	99	0.00	30.6	0.0	0.03	1031.8
19	28.82	229	58	65	100	0.00	30.6	0.1	0.00	342.8
29	28.64	223	63	63	100	0.00	34.1	0.2	0.01	302.9
47	28.30	386	88	67	100	0.02	27.9	0.1	0.01	308.1
69	25.71	802	23.00	38	90	0.10	6.5*	0.5	0.04	716.6
92	21.80	783	24.13	3.88	75	0.38	38.5	4.9	0.07	184.6
138	17.86	746	25.15	91	70	0.63	37.1	8.5	0.08	37.0
184	15.71	649	57	70	64	0.92	36.5	2.6	0.05	11.0
279	11.14	437	26.34	2.92	46	1.74	64.4	10.9	0.03	2.0
339	9.88	456	55	35	36	2.09	82.9	28.7	0.03	2.0
422	8.33	489	85	14	32	2.34	88.5	20.2	0.02	2.6
503	7.61	531	98	21	33	2.50	85.9	29.5	0.01	
665	6.49	549	27.16	34	34	2.63	96.8	27.4	0.01	
830	5.48	562	30	34	33	2.75	107.1	33.3	0.01	
1002	4.81	570	38	28	32	2.88	124.7	33.8	0.04	
1268	4.14	582	46	20	30	2.95	140.9	35.9	0.04	
1729	3.72	592	52	22	30	2.99	145.3	38.4	0.01	
1957	3.60	595	53	24	30	3.04	148.2	32.0	0.06	
2383	3.58	587*	53	19	30	3.04	142.4	37.2	0.02	
2819	3.59	598	53	21	30	3.04	140.9	37.2	0.02	
3262	3.62	597	53	17	29	3.10	155.6	37.1	0.05	
3534	3.12	596	53	10	28	3.08	165.9	38.4	0.08	

* Value doubtful

D (m)	T (°C)	S (‰)	σ_t
0	29.3	34.07	21.30
10	29.36	09	29
20	28.80	23	58
30	28.62	225	63
50	28.17	45	95
75	24.40	80	23.39
100	21.07	775	24.34
150	17.28	73	25.26
200	14.66	60	78
300	10.64	435	26.42
400	8.70	48	79
500	7.65	53	98
600	6.94	545	27.09
800	5.65	56	27
1000	4.82	57	38
1200	4.26	58	45
1500	3.88	59	50
2000	3.60	595	53
2500	3.58	595	53
3000	3.60	595	53
3500	3.62	595	53

Table 18. Data from Nansen serial observations at St. 23.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
23	04-35.0N	122-54.4E	June 12, 1972	14:00-18:26	4900m	30m	29.3°C	SE-7.0m/s	SE-3	2	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	28.9	34.071	21.42	4.51	98	0.00	9.4	0.1	0.00	218.4
10	28.94	060	41	55	98	0.02	10.3	0.1	0.00	244.7
20	28.46	291	74	58	98	0.02	10.3	1.7	0.00	148.2
29	27.62	487	22.16	56	97	0.08	8.8	0.1	0.00	223.2
49	26.68	496	46	56	95	0.09	10.0	0.5	0.01	525.5
73	25.76	664	88	31	89	0.15	9.1	0.7	0.24	94.9
97	23.29	783	24.00	07	80	0.26	10.6	2.6	0.09	159.9
146	21.51	899	31	3.97	75	0.27	6.8	2.8	0.04	144.9
195	17.20	705	25.26	62	64	0.74	14.4	9.1	0.02	26.6
294	11.45	460	26.30	2.80	45	1.71	30.9	23.1	0.02	4.6
387	9.45	447	64	25	35	2.24	46.8	31.3	0.00	
482	7.72	506	95	02	30	2.50	52.1	30.8	0.00	
578	7.06	531	27.06	23	30	2.54	56.8	32.1	0.00	
768	5.68	544	26	40	34	2.73	73.5	38.5	0.00	
959	4.69	570	39	40	33	2.90	95.9	38.5	0.00	
1150	4.10	578	47	21	30	2.98	108.8	38.5	0.00	
1437	3.76	586	51	15	29	3.00	115.0	38.5	0.00	
1730	3.69	592	52	29	30	3.04	117.1	38.5	0.00	
1918	3.60	591	53	20	31	3.00	121.2	38.5	0.00	
2097	3.59	592	53	21	30	3.05	114.4	43.6	0.00	
2469	3.59	593	53	25	30	3.10	121.2	43.6	0.00	
2839	3.60	592	53	22	30	3.10	123.5	43.6	0.02	
3202	3.60	589	53	13	29	3.15	124.7	43.6	0.02	

D (m)	T (°C)	S (‰)	σ_t
0	28.9	34.07	21.42
10	28.94	06	41
20	28.46	29	74
30	27.60	49	22.16
50	26.66	50	47
75	25.70	675	90
100	23.12	795	24.03
150	21.38	90	34
200	16.85	685	25.34
300	11.25	455	26.33
400	9.19	455	68
500	7.57	51	97
600	6.95	535	27.08
800	5.50	55	28
1000	4.51	57	41
1200	4.02	58	48
1500	3.74	59	51
2000	3.59	59	53
2500	3.59	59	53
3000	3.60	59	53

Table 19. Data from Nansen serial observations at St. 24.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
24	05-00.2N	124-56.2E	June 15, 1972	00:35-05:55	4900m	33m	27.5°C	SE-5.0m/s	SE-2	2	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	27.7	34.415	22.09	4.48	95	0.01	2.9	0.3	0.00	800.8
10	27.77	416	06	50	96	0.02	7.1	0.0	0.02	479.7
20	27.66	450	12	53	96	0.07	3.8	0.1	0.00	451.1
29	27.51	445	16	53	96	0.03	3.5	0.2	0.01	481.0
49	26.46	506	55	69	98	0.13	2.4	0.8	0.10	906.8
73	25.24	572	98	15	84	0.20	5.6	0.0	0.12	573.6
97	24.98	734	23.17	24	88	0.16	4.4	0.0	0.10	470.6
144	19.51	779	24.75	3.80	70	0.46	7.6	5.7	0.10	106.6
193	17.11	95	25.27	73	66	0.73	11.5	8.7	0.08	24.7
290	12.67	494	26.09	2.97	49	1.37	26.5	14.8	0.03	6.5
387	8.86	377	67	27	34	2.17	47.4	18.8	0.00	6.5
482	7.85	417	86	09	31	2.43	54.7	29.5	0.01	3.9
579	7.00	518	27.06	18	32	2.61	57.1	35.1	0.28	
770	5.38	550	31	23	32	2.76	79.7	26.9	0.02	
962	4.78	564	38	18	30	2.89	94.7	35.4	0.03	
1151	4.21	575	45	19	30	2.97	105.0	37.1	0.08	
1439	3.79	585	51	17	30	3.04	113.2	38.4	0.02	
1922	3.62	591	53	17	29	3.03	118.2	38.4	0.02	
2413	3.59	594	53	24	30	3.04	118.8	38.4	0.02	
2892	3.60	593	53	16	29	3.04	120.9	38.4	0.07	
3372	3.63	595	53	21	30	3.05	124.7	40.9	0.13	
3860	3.69	596	53	08	28	3.11	125.3	41.0	0.04	

D (m)	T (°C)	S (‰)	σ_t
0	27.7	34.415	22.09
10	27.77	415	06
20	27.60	45	14
30	27.48	445	17
50	26.40	51	56
75	25.18	58	99
100	24.80	745	23.25
150	19.20	77	24.83
200	16.80	68	25.35
300	12.20	475	26.17
400	8.65	38	73
500	7.70	43	90
600	6.78	525	27.09
800	5.27	555	32
1000	4.66	565	39
1200	4.12	575	46
1500	3.74	585	51
2000	3.61	59	53
2500	3.59	595	53
3000	3.61	595	53
3500	3.65	595	53
4000	(3.70)	(595)	(53)

Table 20. Data from Nansen serial observations at St. 36.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
36	11-57.8S	114-30.6E	June 28, 1972	16:17-19:33	3150m	22m(10°)	25.9°C	SE-6m/s	SE-3	4	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	26.3	34.064	22.26	4.48	93	0.05	12.4	13.7	0.02	344.5
10	26.82	052	11	63	96	0.09	3.2	0.0	0.02	440.7
20	26.80	054	12	50	94	0.07	8.8	0.0	0.02	452.4
30	26.75	056	13	60	96	0.13	5.3	0.0	0.02	522.6
47	26.73	046	13	63	96	0.08	1.5	0.0	0.02	561.6
70	26.66	032	13	52	100	0.08	4.4	0.0	0.03	361.7
94	25.22	444	87	3.21	65	0.61	10.0	0.0	0.08	150.2
142	21.74	539	23.97	2.83	54	1.02	14.1	5.2	0.04	12.4
190	17.56	602	25.09	78	50	1.30	21.8	11.8	0.03	2.6
286	12.22	569	26.23	46	40	1.86	37.7	15.7	0.03	1.3
387	10.07	694	74	64	41	1.96	43.2	21.5	0.02	
478	8.30	602	95	30	35	2.26	54.4	21.7	0.03	
571	7.49	594	27.05	16	32	2.52	68.2	34.2	0.02	
760	6.32	597	21	15	31	2.70	81.8	32.9	0.02	
949	5.26	608	37	18	31	2.79	97.7	33.9	0.01	
1142	4.51	615	45	22	31	2.86	110.0	35.2	0.09	
1430	3.51	673	60	60	35	2.85	116.5	37.1	0.02	
1907	2.60	728	73	3.08	41	2.75	122.1	37.4	0.02	
2396	2.08	732	78	42	45	2.67	127.9	37.9	0.02	
2865	1.70	724	80	71	48	2.63	131.2	36.8	0.02	

D (m)	T (°C)	S (‰)	σ_t
0	26.3	34.065	22.26
10	26.82	05	11
20	26.80	055	12
30	26.75	055	13
50	26.72	045	13
75	26.54	04	16
100	24.92	46	98
150	21.00	55	24.19
200	16.86	60	25.27
300	11.90	58	26.32
400	9.60	685	80
500	8.07	60	97
600	7.30	595	27.08
800	6.10	60	25
1000	5.06	61	38
1200	4.30	625	49
1500	3.35	69	61
2000	2.49	73	74
2500	2.00	73	79
3000	(1.64)	(73)	(81)

Table 21. Data from Nansen serial observations at St. 43.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
43	4-30.2N	106-25.6E	July 9, 1972	20:00-20:17	91m	-	28.9°C	SSW-6m/s	SSW-3	3	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_3-N	NO_2-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	28.6	33.264	20.90	4.47	96	0.00	2.7	0.0	0.03	539.5
10	28.83	263	87	53	97	0.00	3.5	0.0	0.01	499.2
20	28.84	266	87	52	97	0.00	5.6	0.4	0.02	500.5
30	28.83	259	87	55	98	0.00	1.5	0.0	0.02	598.0
50	28.58	376	21.01	51	97	0.01	3.5	0.0	0.06	884.0
75	22.11	34.012	23.47	3.69	70	0.46	11.2	0.0	0.23	534.3

D (m)	T (°C)	S (‰)	σ_t
0	28.6	33.265	20.90
10	28.83	265	87
20	28.84	265	87
30	28.83	26	87
50	28.58	375	21.01
75	22.11	34.01	23.47

Table 22. Data from Nansen serial observations at St. 55.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
55	8-00.7N	109-30.4E	July 11, 1972	19:20-20:40	830m	-	29.0°C	SW-10m/s	SW-5	SW-4	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_3-Si (μg atoms/l)	NO_3-N	NO_2-N	Chl (μg/m³)
0	28.4	33.487	21.16	4.59	98	0.00	58.5	0.0	0.00	284.7
9	28.48	483	15	56	98	0.00	51.5	0.0	0.00	182.3
18	28.48	482	15	56	98	0.00	57.4	0.0	0.00	235.9
26	28.46	484	15	49	96	0.00	60.9	0.0	0.00	187.2
43	28.38	495	18	54	97	0.01	51.5	0.0	0.02	197.9
65	28.00	560	34	51	96	0.02	50.3	0.0	0.02	404.6
85	23.87	894	22.87	81	95	0.08	39.4	0.0	0.03	421.2
128	20.59	34.159	24.00	3.64	68	0.52	52.4	4.3	0.12	110.1
170	16.16	542	25.39	2.54	44	1.23	58.2	9.8	0.11	3.9
255	12.72	516	26.09	34	38	1.59	70.3	13.3	0.16	1.9
376	10.01	450	55	12	33	2.09	93.5	21.0	0.02	
470	8.60	438	77	62	40	1.14	57.9	12.0	0.07	
565	7.62	453	94	1.79	27	2.53	119.7	27.0	0.05	
756	5.90	492	27.06	82	26	2.81	140.3	33.7	0.04	

D (m)	T (°C)	S (‰)	σ_t
0	28.4	33.485	21.16
10	28.48	485	15
20	28.48	485	15
30	28.45	485	15
50	28.35	505	19
75	26.50	72	94
100	22.62	995	23.31
150	18.00	34.50	24.93
200	14.75	55	25.70
300	11.60	485	26.29
400	9.62	44	61
500	8.30	44	83
600	7.31	46	97
800	(5.55)	(50)	(27.11)

Table 23. Data from Nansen serial observations at St. 59.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp	Wind	Sea	Swell	Weather
59	11-19.2N	112-32.0E	July 14, 1972	17:00-20:55	4200m	27m	28.4°C	SSW-13m/s	SSW-5	SW-4	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_3-Si (μg atoms/l)	NO_3-N	NO_2-N	Chl (μg/m³)
0	27.9	33.442	21.29	4.55	96	0.00	44.1	0.0	0.00	319.1
8	27.94	444	29	74	100	0.00	44.7	0.0	0.00	247.6
17	27.95	451	29	59	97	0.00	39.7	0.0	0.02	228.1
25	27.94	452	29	62	98	0.00	42.4	0.0	0.02	227.5
41	27.91	457	30	71	100	0.00	39.1	0.0	0.03	228.1
59	27.65	450	38	76	100	0.00	34.7	0.0	0.00	332.1
77	23.42	34.030	23.11	60	90	0.03	31.5	0.0	0.02	386.1
112	18.80	424	24.65	3.09	56	0.82	45.9	10.8	0.08	104.0
146	16.52	558	25.31	2.77	49	1.11	46.5	14.5	0.04	24.0
212	14.05	546	85	3.01	51	1.31	53.8	11.0	0.06	4.6
276	12.04	496	26.22	2.50	40	1.67	73.2	18.4	0.04	
341	10.63	458	44	10	33	2.03	87.1	25.8	0.04	
406	9.43	446	64	23	34	2.14	96.5	29.7	0.04	
545	7.62	454	93	1.93	29	2.55	117.4	31.8	0.04	
705	6.11	480*	27.15*	2.27**	32**	2.98**	202.9**	36.2	0.05	
1025	4.05	557	45	1.99	27	2.99	180.0	38.2	0.15	
1285	3.24	590	57	2.10	28	3.02	190.3	35.0	0.03	
1715	2.72	614	62	25	30	3.06	202.1	37.6	0.02	
2150	2.44	629	68	46	32	2.97	207.9	42.1	0.02	
2590	2.37	629	69	51	33	3.01	175.6	42.0	0.05	
3030	2.37	632	69	55	34	2.94	196.2	42.0	0.13	
3468	2.41	629	69	61	34	2.96	202.1	42.0	0.07	

* Interporated value
** Value doubtful

D (m)	T (°C)	S (‰)	σ_t
0	27.9	33.44	21.29
10	27.94	445	29
20	27.95	45	29
30	27.93	455	29
50	27.85	455	31
75	24.10	975	22.87
100	19.90	34.335	24.32
150	16.34	56	25.37
200	14.46	555	78
300	11.49	48	26.32
400	9.55	445	63
500	8.17	45	84
600	7.09	46	27.01
800	5.38	50	27
1000	4.19	55	44
1200	3.45	58	54
1500	2.92	605	60
2000	2.50	625	67
2500	2.38	63	69
3000	2.37	63	69
3500	(2.41)	(63)	(69)

Table 24. Data from Nansen serial observations at St. 60.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
60	14-47.3N	115-42.8E	July 17, 1972	21:18-00:40	4300m	26m	28.5°C	SW-10m/s	SW-4	WSW-4	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_3-N	NO_2-N	Chl (μg/m^3)
0	28.1	33.478	21.23	4.47	95	0.00	5.6	0.0	0.15	174.8
10	28.22	592	30	44	95	0.00	4.4	0.0	0.01	162.5
20	28.23	593	30	50	96	0.00	6.8	0.1	0.03	141.0
29	28.20	603	32	57	97	0.00	3.5	0.2	0.01	145.6
49	23.62	891	22.94	82	95	0.06	10.6	0.0	0.04	250.2
73	21.53	34.125	23.71	08	78	0.37	6.5	3.5	0.14	457.2
98	19.95	302	24.27	3.42	62	0.65	9.7	6.6	0.06	164.4
147	16.69	572	25.28	02	53	1.06	17.1	13.1	0.05	33.8
196	14.49	552	77	2.72	46	1.38	24.1	16.8	0.03	0
294	11.34	467	26.33	69	43	1.81	116.8	22.8	0.04	0.7
393	9.60	439	61	16	33	2.19	75.3	25.8	0.04	
491	8.34	440	81	06	31	2.48	72.1	32.1	0.02	
589	7.34	445	96	07	30	2.60	83.5	33.7	0.02	
784	5.64	486	27.22	1.89	27	2.91	102.9	36.2	0.05	
980	4.34	535	40	2.00	28	3.06	125.0	36.8	0.02	
1179	3.62	566	51	04	28	3.15	124.7	38.8	0.08	
1472	2.92	600	60	15	29	3.15	131.5	42.1	0.04	
1959	2.48	614	65	39	31	3.16	142.9	42.0	0.10	
2445	2.40	630	68	50	33	3.16	152.7	36.2	0.08	
2928	2.36	626	68	50	33	3.16	167.1	42.0	0.05	
3410	2.40	630	68	83	37	3.13	160.9	44.6	0.08	

D (m)	T (°C)	S (‰)	σ_t
0	28.1	33.48	21.23
10	28.22	59	30
20	28.23	595	30
30	28.20	605	32
50	23.50	90	22.98
75	21.40	34.135	23.76
100	19.80	32	24.33
150	16.52	575	25.34
200	14.34	55	79
300	11.20	465	26.35
400	9.50	44	63
500	8.24	44	83
600	7.24	445	97
800	5.52	49	27.24
1000	4.25	54	41
1200	3.57	57	51
1500	2.87	60	60
2000	2.47	615	66
2500	2.40	63	68
3000	2.37	63	68
3500	(2.40)	(63)	(68)

Table 25. Data from Nansen serial observations at St. 61.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
61	18-49.9N	119-26.4E	July 20, 1972	03:30-07:15	4250m	-	27.0°C	SSW-5m/s	SSW-3	SSW-2	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_3-N	NO_2-N	Chl (μg/m^3)
0	26.9	33.478	21.63	4.50	94	0.00	7.9	1.0	0.00	246.6
10	26.94	450	61	54	95	0.00	9.4	0.9	0.02	196.9
19	26.59	473	73	57	95	0.00	9.1	0.4	0.00	214.5
29	26.44	520	82	54	93	0.00	15.0	0.6	0.00	421.2
49	25.39	736	22.32	22	86	0.06	9.1	0.5	0.18	728.0
73	22.49	34.127	23.46	3.81	74	0.33	10.9	3.3	0.06	185.2
97	20.66	291	24.08	51	66	0.52	8.2	6.0	0.06	20.4
146	17.57	552	25.06	02	54	0.87	12.4	11.3	0.02	33.8
195	15.16	561	62	2.74	47	1.23	25.9	13.5	0.05	0.6
293	11.71	476	26.25	62	42	1.62	36.8	18.4	0.06	1.3
391	10.15	447	53	52	39	1.91	52.7	20.5	0.02	
489	8.55	436	77	20	33	2.20	70.9	27.4	0.04	
587	7.61	440	92	13	32	2.41	81.2	30.5	0.04	
782	6.02	471	27.16	10	30	2.59	96.8	35.5	0.02	
978	4.62	516	36	10	29	2.78	118.2	37.1	0.00	
1171	3.72	554	49	27	31	2.85	128.5	38.2	0.00	
1462	3.01	593	59	18	29	2.95	146.5	42.1	0.02	
1948	2.51	614	64	47	33	2.94	149.7	42.1	0.01	
2434	2.39	625	68	56	34	2.92	151.5	42.1	0.03	
2920	2.34	622	68	57	34	2.91	123.2	44.7	0.00	
3406	2.37	625	68	72	36	2.90	152.1	44.7	0.04	

D (m)	T (°C)	S (‰)	σ_t
0	26.9	33.48	21.63
10	26.94	45	61
20	26.57	475	73
30	26.42	525	83
50	25.25	77	22.37
75	22.36	34.14	23.50
100	20.47	31	24.14
150	17.35	555	25.12
200	14.95	56	68
300	11.59	475	26.30
400	10.00	445	55
500	8.43	435	79
600	7.50	44	94
800	5.88	475	27.18
1000	4.51	52	38
1200	3.49	56	52
1500	2.96	595	60
2000	2.49	615	65
2500	2.38	625	68
3000	2.34	625	68
3500	(2.37)	(625)	(68)

Table 26. Data from Nansen serial observations at St. 62.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
62	20-51.0N	121-17.1E	July 27, 1972	00:35-03:50	3670m	-	27.4°C	SW-5m/s	SW-3	WSW-4	fine

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	27.6	33.428	21.39	4.54	96	0.00	23.2	0.0	0.00	300.9
10	27.70	425	35	70	99	0.00	17.1	0.0	0.00	226.8
20	27.22	443	50	64	97	0.00	17.9	0.0	0.09	299.0
30	27.10	460	57	60	96	0.00	10.9	0.0	0.04	370.5
49	26.93	568	70	39	91	0.04	13.5	0.0	0.20	177.4
74	27.21	34.506	22.32	56	96	0.01	15.3	0.0	0.03	254.1
99	26.20	683	77	62	96	0.05	14.4	0.0	0.05	237.2
149	19.02	804	24.97	14	76	0.43	20.0	0.7	0.03	29.9
198	17.50	773	25.25	27	76	0.52	18.8	3.0	0.05	12.3
295	15.63	647	59	3.97	69	0.81	22.1	5.2	0.03	6.5
391	12.14	490	26.20	2.99	48	1.55	41.5	13.6	0.03	
485	9.80	445	58	57	40	1.94	58.8	14.6	0.01	
579	8.26	395	79	60	39	2.16	66.8	17.4	0.02	
768	5.48	417	27.18	13	30	2.67	101.2	21.8	0.00	
962	4.20	504	40	26	31	2.82	121.2	34.2	0.00	
1152	3.55	551	50	26	31	2.86	117.1	36.8	0.00	
1435	2.77	596	61	49	33	2.94	135.9	39.5	0.00	
1903	2.35	617	67	67	35	2.91	144.1	39.5	0.00	
2368	2.22	627	69	77	36	2.90	143.8	36.8	0.00	
2832	2.22	624	69	74	36	2.88	139.1	39.5	0.00	
3298	2.22	625	69	78	36	2.88	150.3	39.5	0.00	

D (m)	T (°C)	S (‰)	σ_t
0	27.6	33.43	21.39
10	27.70	425	35
20	27.22	44	50
30	27.10	46	57
50	26.93	58	72
75	27.21	34.51	22.32
100	26.10	69	80
150	19.00	805	24.97
200	17.47	77	25.26
300	15.54	635	60
400	11.88	485	26.24
500	9.56	43	61
600	7.95	39	83
800	5.20	43	27.22
1000	4.05	515	42
1200	3.39	56	53
1500	2.68	60	62
2000	2.31	62	68
2500	2.22	625	69
3000	2.22	625	69

Table 27. Data from Nansen serial observations at St. 63.

Station	Latitude	Longitude	Date	Ship time	Depth	Transp.	Air temp.	Wind	Sea	Swell	Weather
63	22-50.6N	124-00.4E	July 28, 1972	04:43-07:56	6120m	39m	27.0°C	E-4m/s	E-2	SW-3	cloudy

D (m)	T (°C)	S (‰)	σ_t	O_2 (ml/l)	O_2Sat (%)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	Chl ($\mu g/m^3$)
						(μg atoms/l)				
0	28.1	34.131	21.73	4.58	98	0.00	27.7	0.5	0.00	386.1
10	28.14	131	72	51	96	0.00	24.4	0.3	0.00	332.1
19	27.96	147	81	59	98	0.00	22.7	0.0	0.02	263.2
29	27.95	159	82	57	97	0.01	27.9	0.9	0.02	219.0
48	27.86	180	86	64	99	0.01	26.5	0.0	0.02	438.7
73	26.72	598	22.54	44	93	0.10	21.5	0.0	0.05	444.6
97	25.29	624	23.00	47	91	0.08	27.1	0.0	0.25	202.1
145	22.42	752	94	62	90	0.04	25.0	0.0	0.22	47.4
194	20.88	787	24.40	60	87	0.10	21.8	1.0	0.05	66.3
293	18.08	830	25.15	44	80	0.29	27.9	3.7	0.06	8.4
392	16.19	734	53	32	76	0.53	38.5	5.2	0.01	
489	13.30	499	97	02	67	1.00	40.9	11.0	0.03	
586	9.49	238	26.47	3.43	53	1.77	63.2	21.0	0.03	
781	5.83	227	99	1.92	27	2.84	102.1	29.5	0.04	
978	4.66	426	27.28	89	26	3.01	133.8	28.3	0.05	
1177	3.54	467	44	84	25	3.14	149.4	36.7	0.08	
1472	2.81	557	58	2.18	29	3.12	181.8	39.4	0.09	
1962	2.10	616	69	73	36	3.14	172.7	39.4	0.10	
2455	1.77	654	74	99	39	3.08	158.5	42.1	0.02	
2775	1.65	663	76	3.29	43	2.98	146.8	42.1	0.03	
3138	1.59	671	77	34	43	2.97	153.8	42.1	0.03	

D (m)	T (°C)	S (‰)	σ_t
0	28.1	34.13	21.73
10	28.14	13	72
20	27.96	15	81
30	27.95	16	82
50	27.82	185	88
75	26.62	60	22.56
100	25.11	63	23.06
150	22.25	76	24.01
200	20.68	79	44
300	17.95	83	25.18
400	16.00	72	57
500	12.79	47	26.04
600	9.15	215	52
800	5.70	245	27.02
1000	4.52	43	31
1200	3.46	475	45
1500	2.77	565	58
2000	2.05	62	69
2500	1.75	655	74
3000	1.62	67	77

Table 28. Data from BT observations

Station	Date		Ship time	Lat.	Long.	Temp. (°C)													Max.		SLD
						0(m)	10	20	30	50	75	100	125	150	175	200	225	250	Dep. (m)	Temp. (°C)	(m)
F-1	May	13	10:09	28-20.9N	134-20.4E	21.4	21.2	20.8	20.6	20.1	18.8	18.6	18.3	18.0	17.8	17.5	17.4	16.8	270	16.2	10
1		14	05:05	25-00.6N	131-59.4E	25.4	25.3	23.2	21.6	20.9	20.5	20.2	19.8	19.4	19.0	18.5	18.0	17.5	265	16.9	10
F-2		14	11:12	25-00.1N	132-02.2E	26.0	24.9	22.8	21.7	21.3	20.5	20.3	19.8	19.1	18.8	18.4	18.1	17.5	270	16.8	20
F-3		15	09:39	20-05.3N	131-57.3E	27.5	27.4	26.6	25.6	24.7	23.4	22.6	21.7	20.9	20.3	19.4	18.6	17.6	270	16.6	20
2		15	10:09	20-01.6N	131-58.1E	27.1	27.1	27.1	27.3	24.0	22.9	22.2	21.5	20.6	20.1	19.1	18.3	17.3	272	15.2	20
F-4		16	10:11	16-35.1N	131-57.0E	28.4	28.4	28.4	28.4	27.0	26.6	26.3	25.3	23.7	22.2	21.5	20.0	18.5	250	18.5	38
3		16	17:54	14-56.7N	132-00.0E	28.5	28.5	28.3	28.3	28.3	27.4	27.0	26.6	25.7	25.1	23.5	20.7	18.4	264	16.6	50
F-5		17	10:39	12-14.5N	132-55.4E	29.2	29.0	29.0	28.7	28.7	28.3	27.3	26.2	22.6	20.4	18.5	–	–	215	17.2	20
4		17	20:08	10-00.5N	132-00.0E	29.3	29.1	29.1	29.0	28.0	25.2	20.9	17.1	14.0	12.7	11.9	11.0	9.8	263	9.2	30
F-6		18	11:09	09-36.0N	131-38.9E	29.7	29.3	29.2	29.2	28.4	26.5	23.3	20.3	15.3	13.3	12.2	11.2	10.0	270	9.3	30
5		19	07:31	05-01.2N	130-07.2E	29.5	29.5	29.5	29.2	27.6	27.1	26.2	25.3	21.9	19.9	18.7	18.6	15.7	260	13.5	20
F-7		21	08:51	04-50.1N	130-46.7E	29.4	29.3	29.3	28.3	27.0	26.9	25.3	23.8	20.5	19.3	18.3	16.4	14.4	270	12.5	20
6		22	04:22	05-22.6N	127-03.1E	29.2	29.2	29.2	29.2	28.1	26.6	24.9	22.3	20.0	17.2	16.1	13.9	11.6	270	9.5	30
F-8		22	17:48	05-17.0N	127-07.9E	29.5	29.4	29.3	29.2	28.3	26.6	25.7	22.3	18.0	16.7	14.7	13.0	11.3	270	8.7	37
F-9		23	12:50	05-38.5N	125-49.8E	29.3	28.8	28.7	28.6	28.4	27.2	26.3	25.8	21.9	21.0	18.1	14.4	14.0	270	11.5	0
F-10		24	13:10	07-30.0N	120-53.1E	30.7	30.3	29.4	29.0	26.7	25.1	23.2	20.0	17.5	16.3	15.0	13.9	13.9	270	12.6	19
16	June	2	05:00	08-48.0N	121-49.5E	29.3	29.3	28.9	28.0	27.0	26.6	25.9	24.2	21.7	17.5	15.2	14.2	13.2	263	12.4	19
F-12		3	11:10	08-18.7N	121-34.2E	29.4	29.1	28.7	27.5	27.2	26.3	24.1	26.1	16.9	15.9	14.5	13.5	13.0	270	12.3	20
17		3	14:37	07-36.5N	121-30.0E	29.7	29.4	29.4	28.6	27.7	26.0	23.5	20.7	18.5	16.3	15.4	14.3	13.3	267	12.8	24
F-13		8	14:33	07-07.5N	120-31.6E	29.1	29.1	29.1	27.9	27.5	26.1	24.4	21.6	18.5	16.8	15.1	14.2	13.4	270	12.6	20
19		8	19:45	06-34.3N	119-28.7E	29.6	29.6	29.7	29.7	27.5	25.0	21.1	18.8	16.8	15.5	14.6	14.0	13.0	262	12.5	30
20		10	00:07	05-38.3N	119-48.0E	28.8	28.5	27.9	27.5	26.3	24.5	22.2	20.5	20.4	18.2	17.2	14.2	13.5	268	12.0	9
F-14		10	14:56	05-14.8N	119-43.1E	29.4	28.7	28.2	27.3	26.2	24.6	23.5	21.3	18.4	17.3	16.6	16.3	15.2	270	13.8	0
22		11	02:40	03-58.5N	120-27.4E	29.3	29.1	28.7	28.6	28.4	27.5	25.0	21.8	14.0	17.0	15.8	15.5	14.8	272	12.2	18
F-15		12	10:40	04-34.0N	122-54.1E	28.7	28.7	28.3	27.8	27.3	26.5	24.6	22.7	22.5	19.9	17.5	16.3	15.3	270	11.9	29
23		12	13:51	04-35.5N	122-55.5E	28.9	28.7	28.6	27.8	26.8	25.7	24.8	23.0	22.6	20.2	17.2	16.2	14.3	274	10.3	20
F-16		14	13:08	05-59.0N	123-10.2E	28.7	28.5	28.4	28.3	27.8	26.7	26.1	24.5	22.4	17.4	16.2	16.0	12.5	270	11.2	8
24		15	00:24	05-00.5N	124-57.5E	28.6	28.6	27.6	27.3	26.6	25.5	25.2	22.8	21.1	20.2	19.7	14.9	11.6	265	10.1	10
35		27	03:06	12-00.0S	120-00.0E	26.9	26.9	26.9	26.9	26.9	26.8	26.8	25.0	22.3	18.1	15.4	13.7	10.9	261	10.4	80
36		28	16:05	11-57.5S	114-33.3E	26.8	26.8	26.8	26.8	26.8	26.8	23.9	22.3	21.2	19.0	16.0	14.4	13.1	255	11.6	80
F-17		29	10:55	12-01.0S	114-44.6E	26.6	26.6	26.6	26.6	26.0	26.6	26.1	23.8	21.2	20.1	17.6	15.3	13.0	270	11.6	90
37		30	06:26	11-52.1S	109-57.0E	26.4	26.4	26.4	26.6	26.8	27.2	27.1	23.2	21.1	19.4	16.7	15.3	12.6	250	12.6	(100)
F-22	July	1	10:05	10-15.3S	106-08.9E	26.7	26.7	26.7	26.7	26.7	26.7	23.6	21.2	18.8	17.5	14.2	13.0	11.4	270	10.3	
43		9	19:58	04-30.2N	106-25.6E	28.7	28.6	28.6	28.6	28.6	23.2	21.5	–	–	–	–	–	–	115	21.5	50
55		11	19:14	08-00.7N	109-29.8E	28.4	28.4	28.4	28.4	28.2	27.5	23.2	21.1	17.8	16.2	14.7	13.9	12.6	263	12.2	50
F-23		13	11:25	09-26.2N	110-27.1E	27.7	27.7	27.7	27.7	27.7	27.7	23.8	22.1	20.8	19.4	17.0	15.7	13.7	270	12.0	92
59		14	16:54	11-21.4N	112-30.8E	27.9	27.9	27.9	27.9	27.9	24.2	22.3	19.0	16.6	15.9	14.7	14.7	12.7	280	10.9	60
F-25		17	10:39	12-57.5N	114-22.7E	28.3	28.3	28.3	28.2	28.2	24.5	22.4	20.5	18.9	17.5	16.0	14.7	13.4	270	12.4	65
60		17	21:08	14-46.8N	115-41.0E	28.2	28.2	28.2	28.2	25.6	22.1	20.2	18.7	17.2	16.1	14.8	13.8	12.8	270	11.5	40
F-27		19	13:37	16-37.2N	117-24.0E	28.3	28.2	28.2	28.2	28.2	23.0	20.1	18.7	16.7	15.7	14.6	13.7	12.6	270	11.1	50
61		20	03:26	18-48.5N	119-26.6E	26.9	26.9	26.9	26.5	25.8	24.2	22.0	20.0	18.3	16.3	15.1	14.2	12.9	265	12.0	25
F-30		21	09:34	20-33.4N	120-02.5E	27.8	27.8	27.8	27.8	27.7	24.7	21.7	18.2	17.9	16.6	15.0	13.7	11.9	270	11.0	45
62		27	00:22	20-50.0N	121-16.8E	27.6	27.5	27.4	27.0	26.8	27.0	26.2	23.9	21.8	18.4	17.7	17.1	16.9	263	15.7	23
F-33		27	15:00	21-10.3N	121-22.3E	28.4	28.4	28.4	28.4	28.4	27.8	26.9	24.2	23.6	21.1	19.3	17.9	15.9	270	13.0	60
63		28	04:36	22-49.9N	124-01.1E	28.1	28.1	27.9	27.9	27.8	26.8	25.6	24.1	22.5	21.4	20.7	19.9	19.3	265	18.8	65

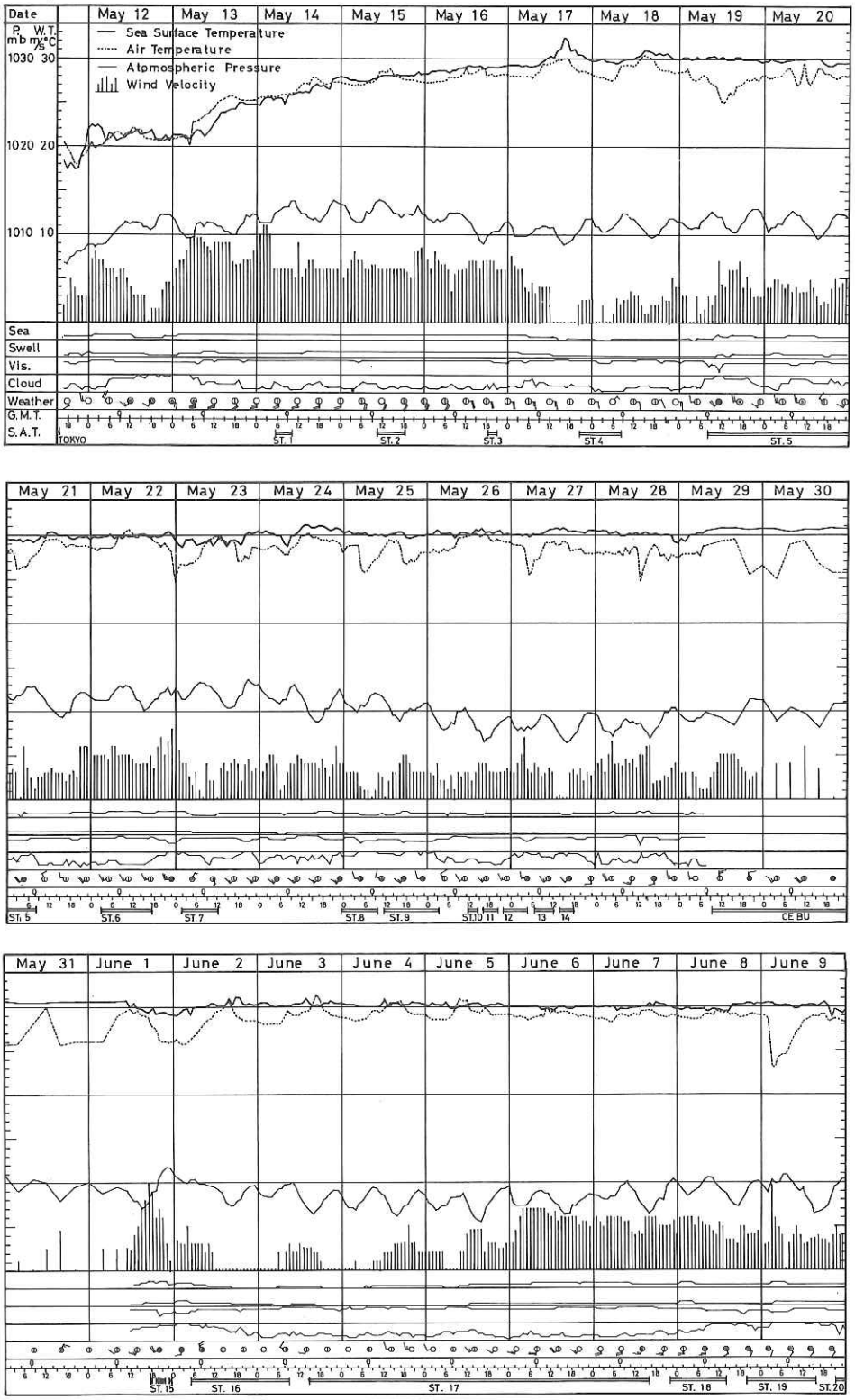


Fig. 2. General weather conditions.

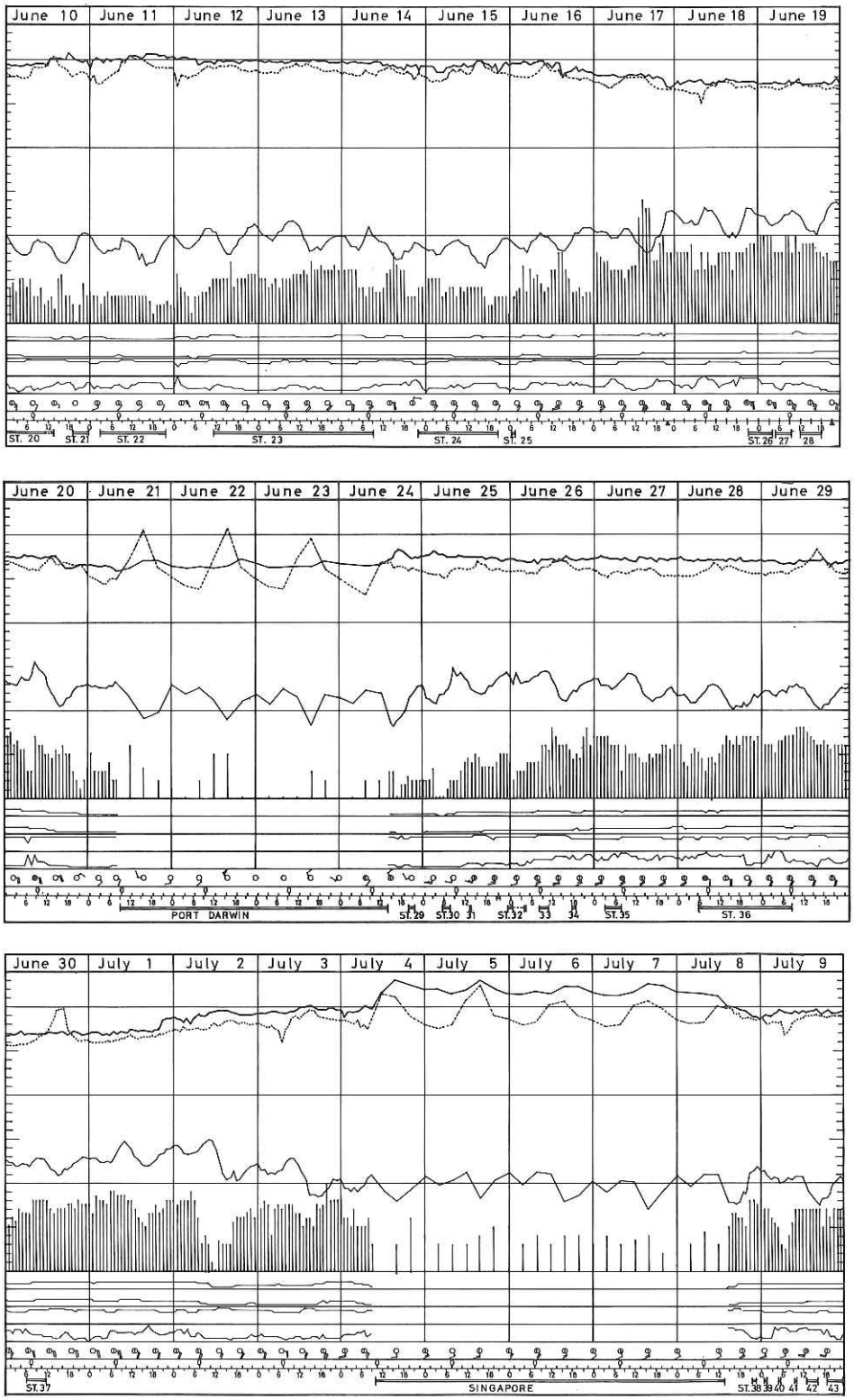
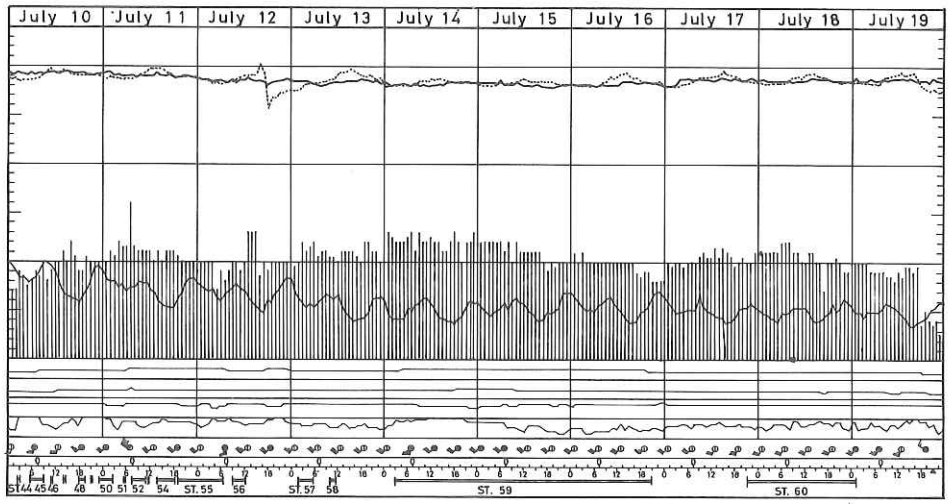
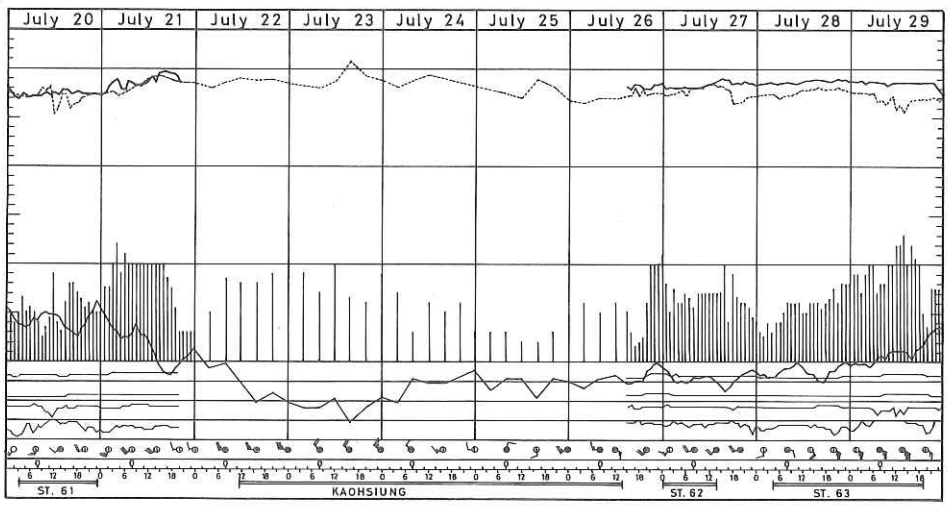


Fig. 3. General weather conditions (continued).





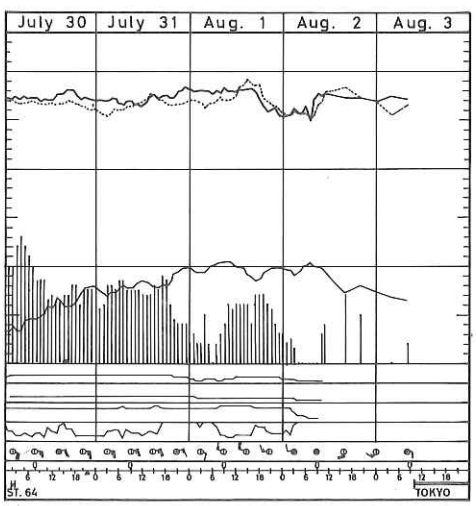


Fig. 4. General weather conditions (continued).

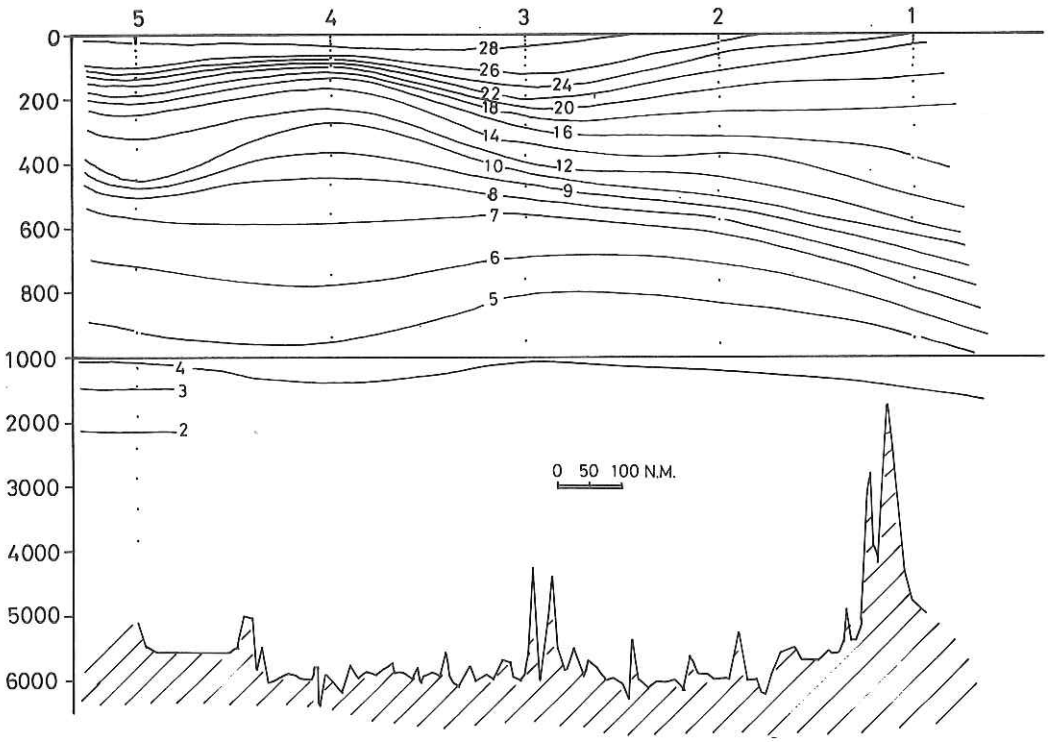


Fig. 5. Water temperature (°C) along Section I.

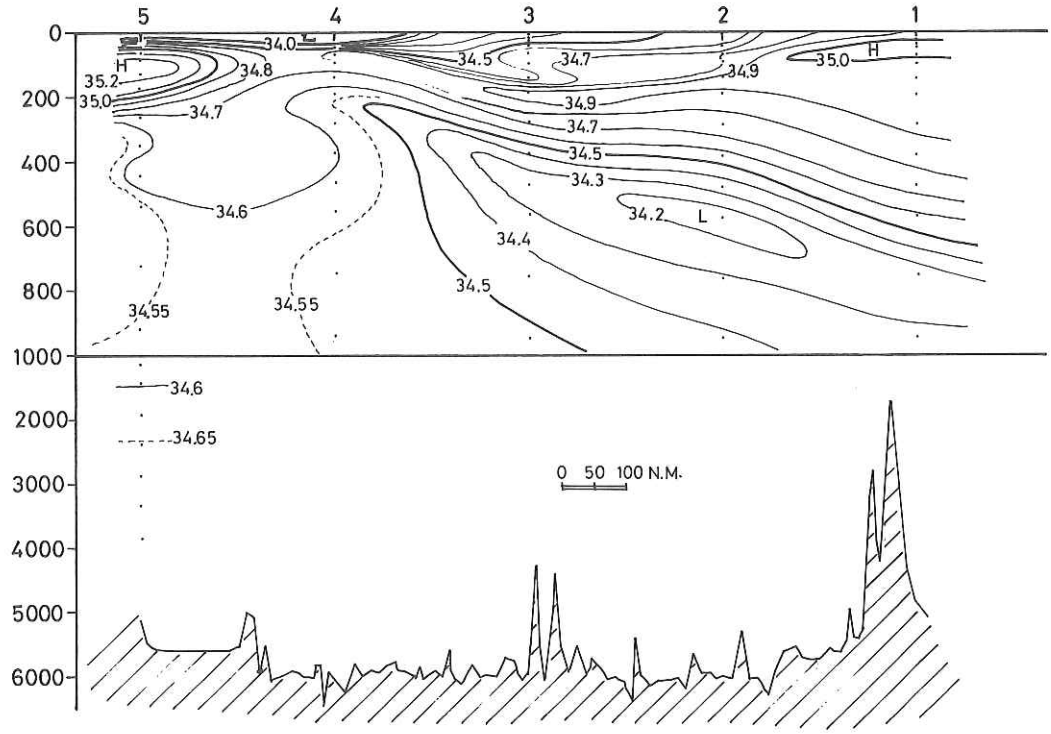


Fig. 6. Salinity (‰) along Section I.

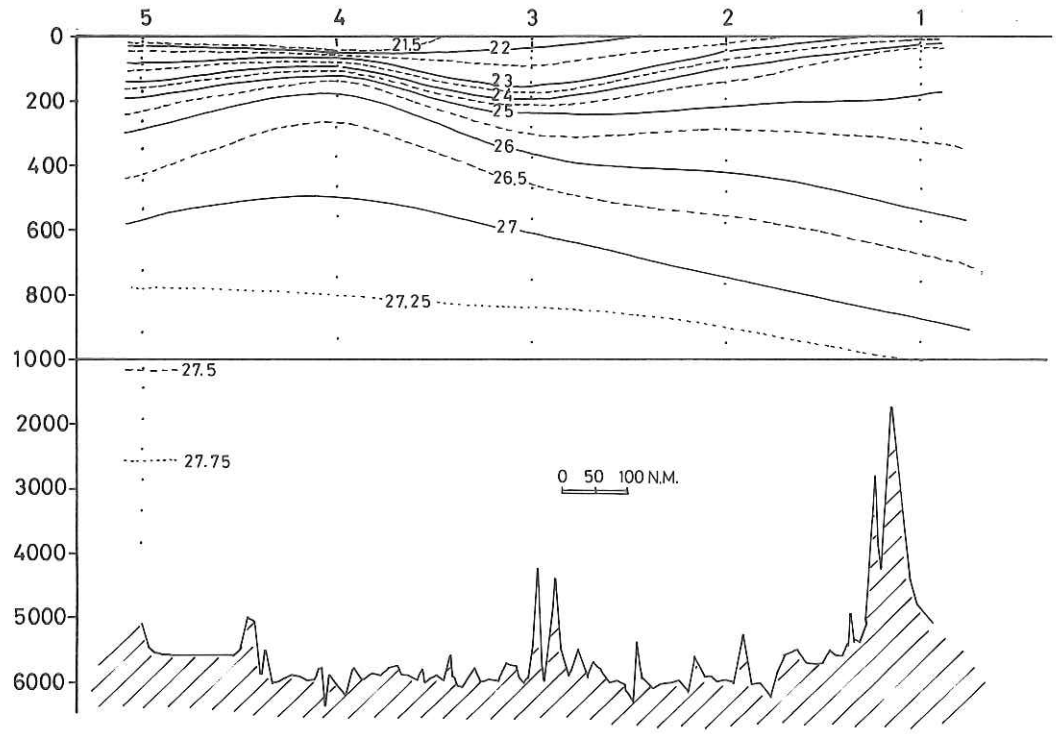


Fig. 7. σ_t along Section I.

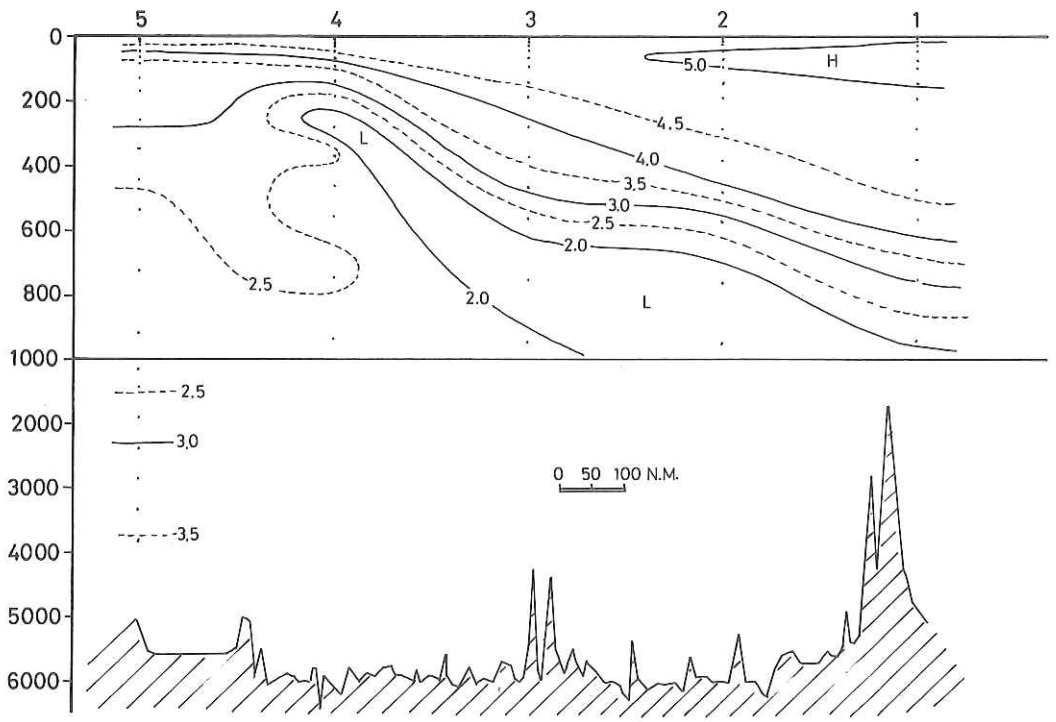


Fig. 8. Dissolved oxygen (ml/l) along Section I.

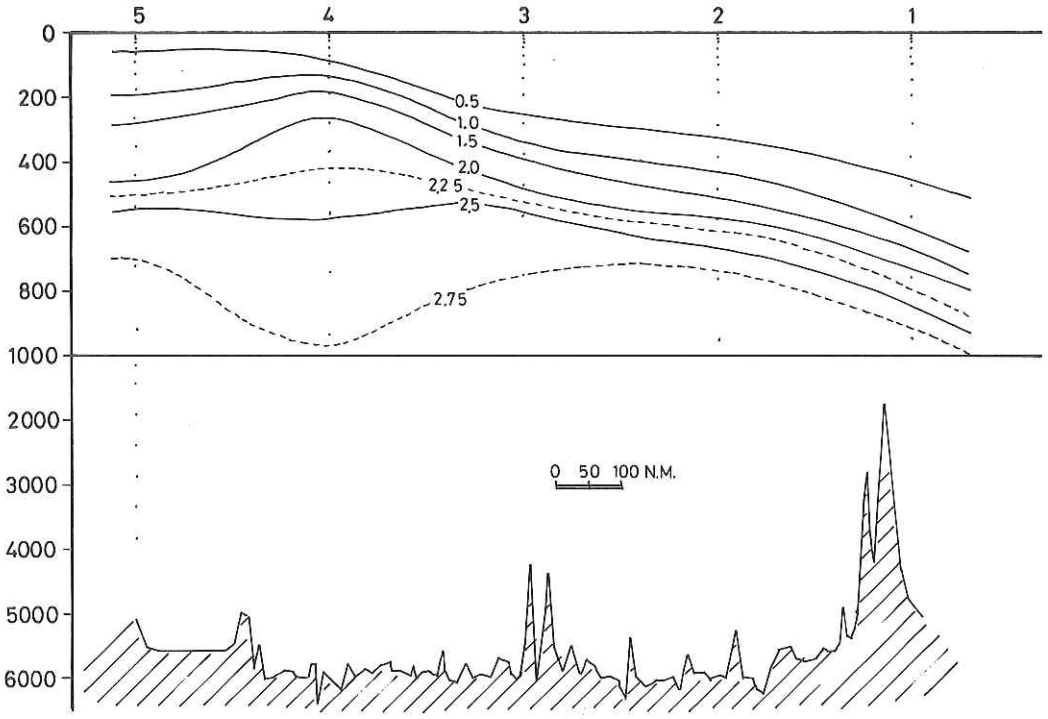


Fig. 9. PO_4-P (µg atoms/l) along Section I.

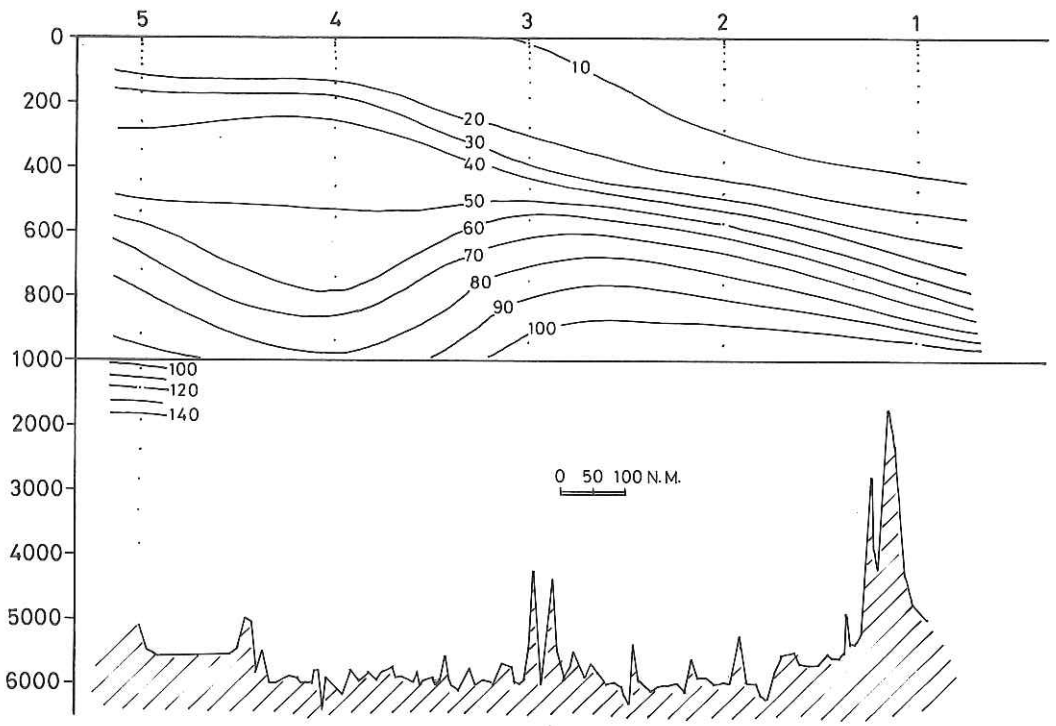


Fig. 10. SiO_2-Si (µg atoms/l) along Section I.

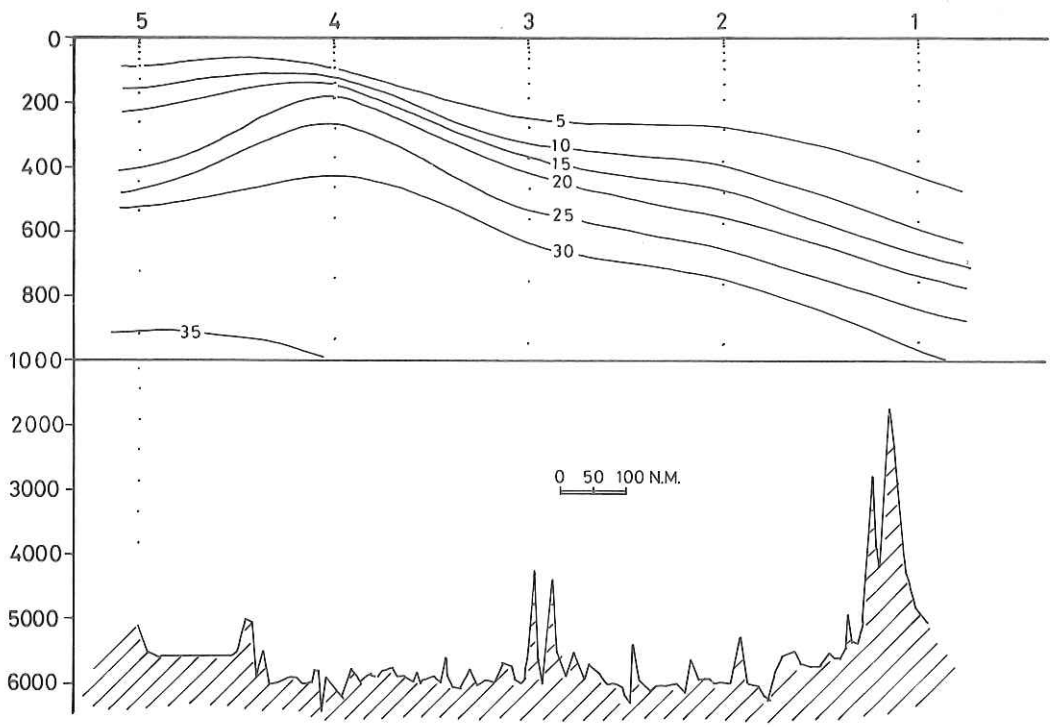


Fig. 11. NO_3-N (µg atoms/l) along Section I.

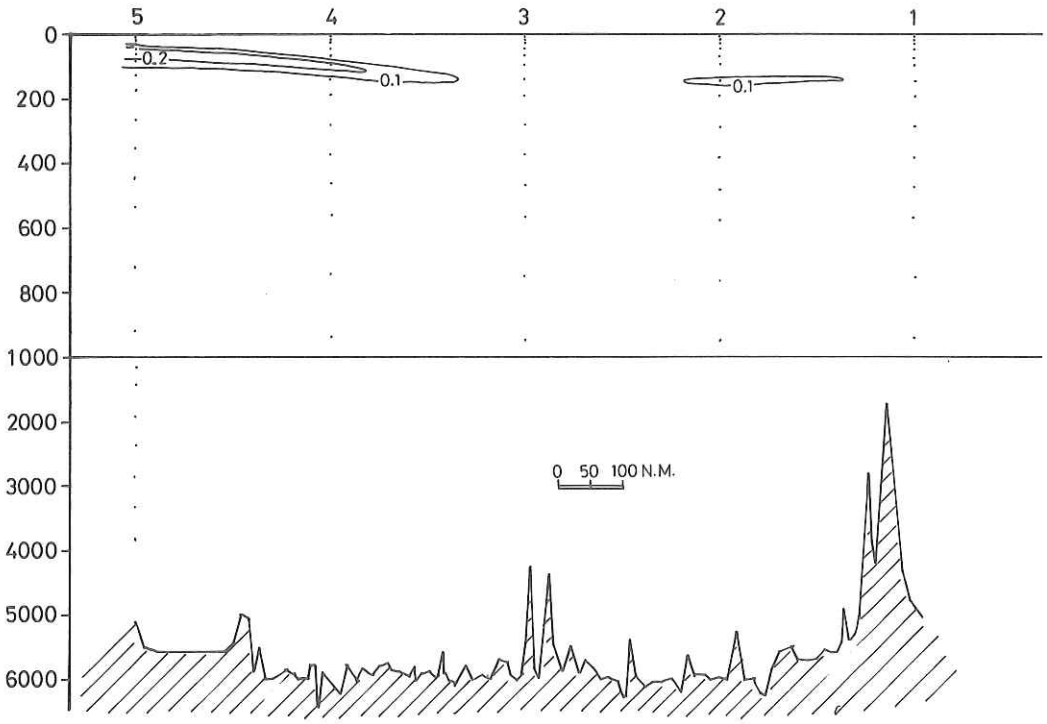


Fig. 12. NO_2-N (µg atoms/l) along Section I.

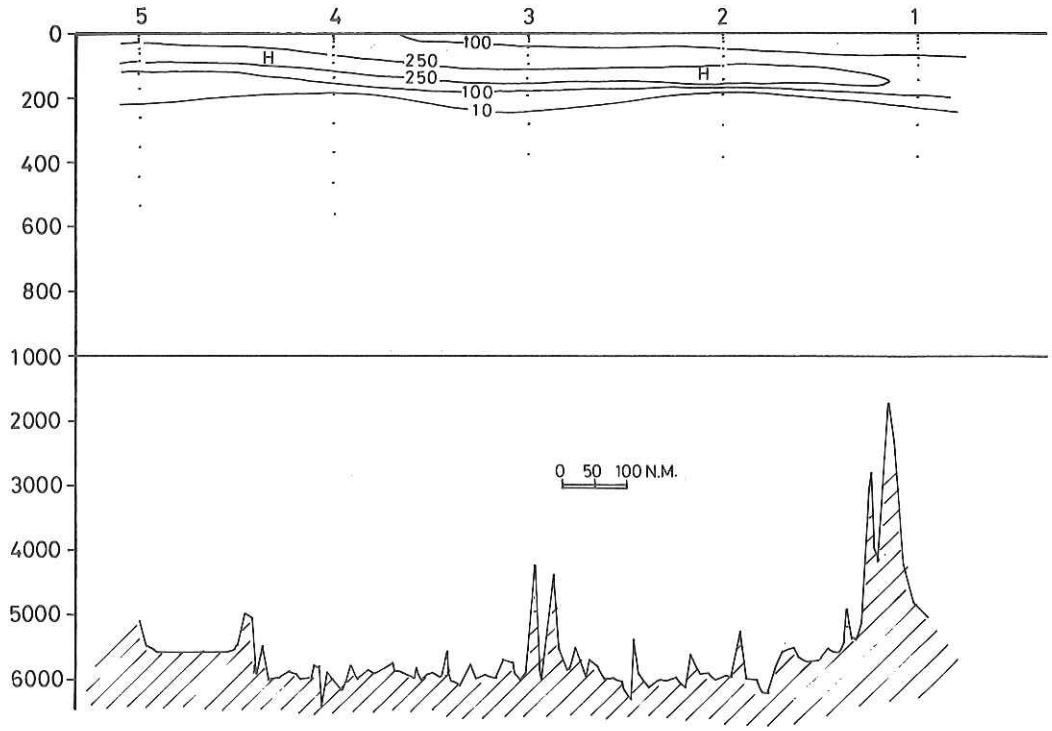


Fig. 13. Chlorophyll a ($\mu g/m^3$) along Section I.

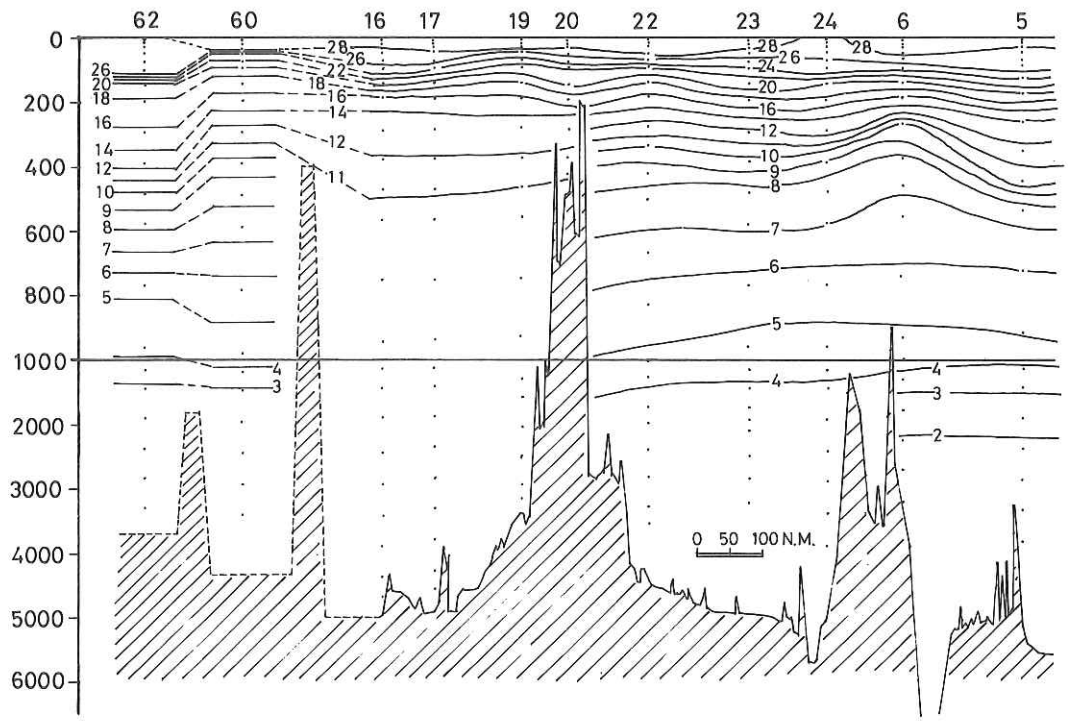


Fig. 14. Water temperature (°C) along Section II.

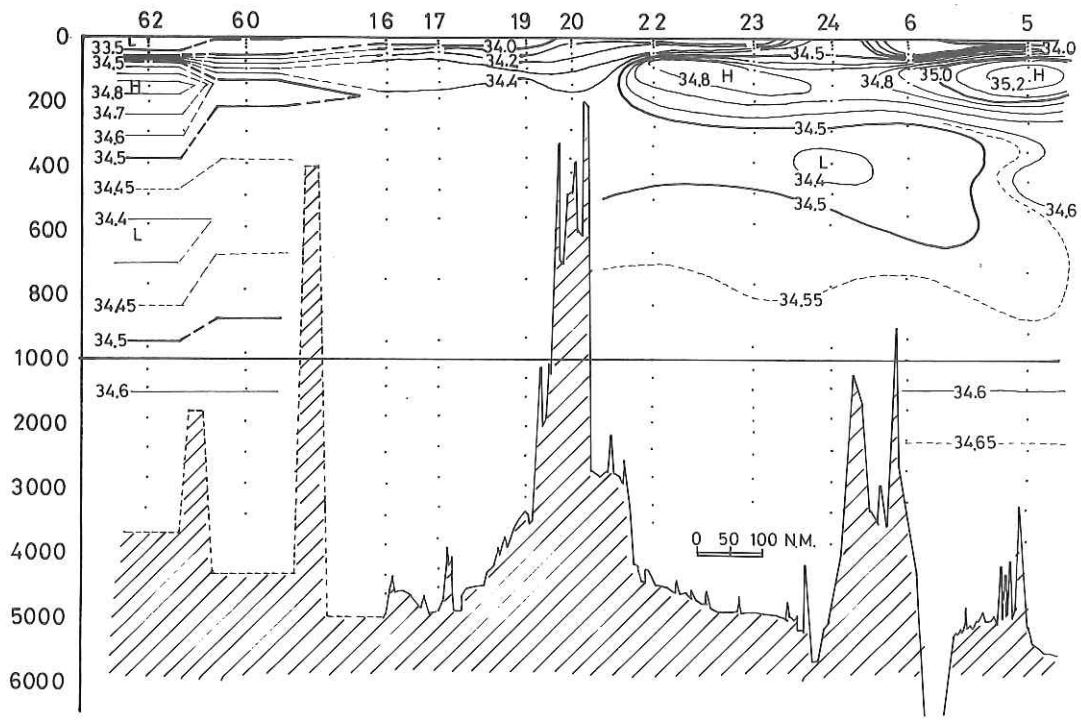


Fig. 15. Salinity (‰) along Section II.

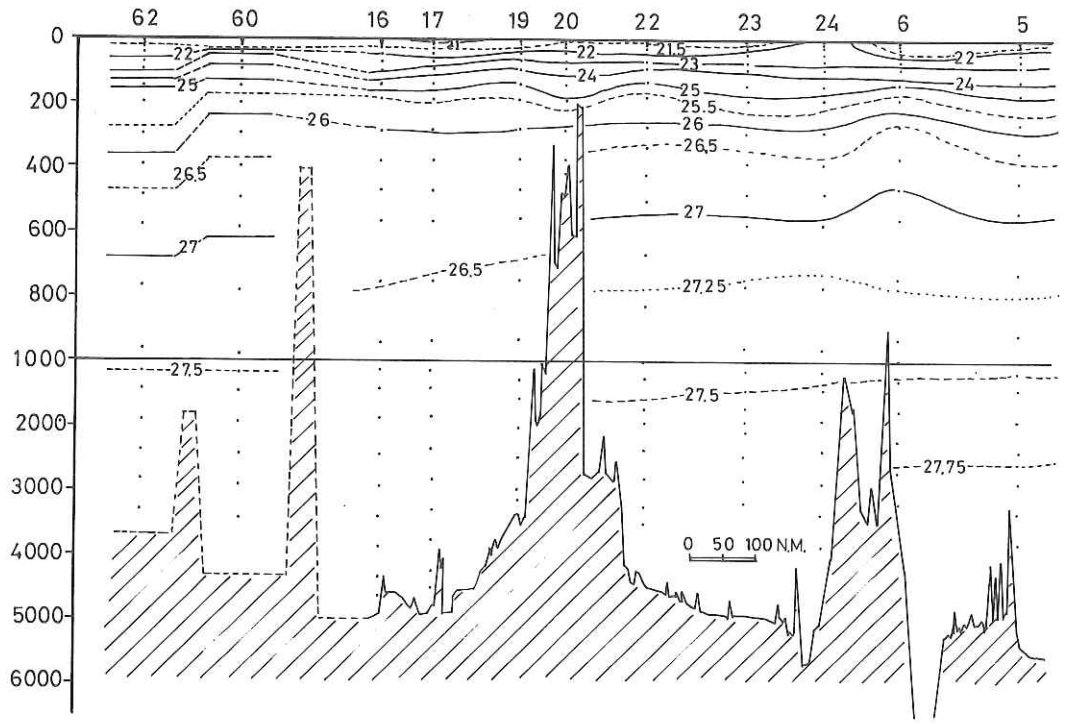


Fig. 16. σ_t along Section II.

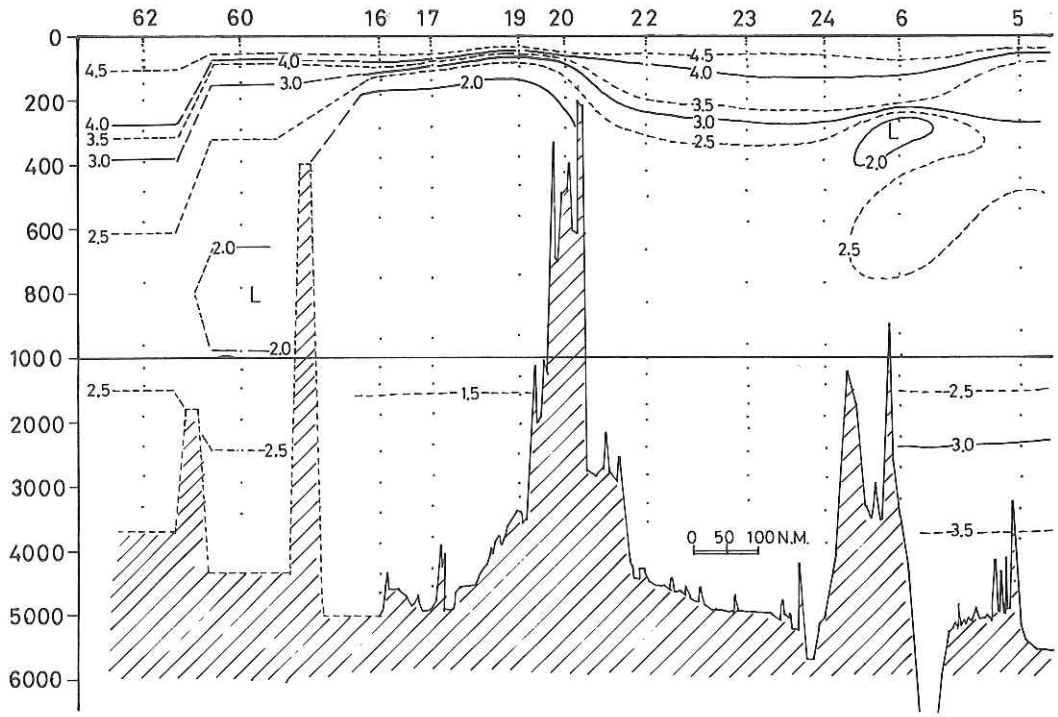


Fig. 17. Dissolved oxygen (ml/l) along Section II.

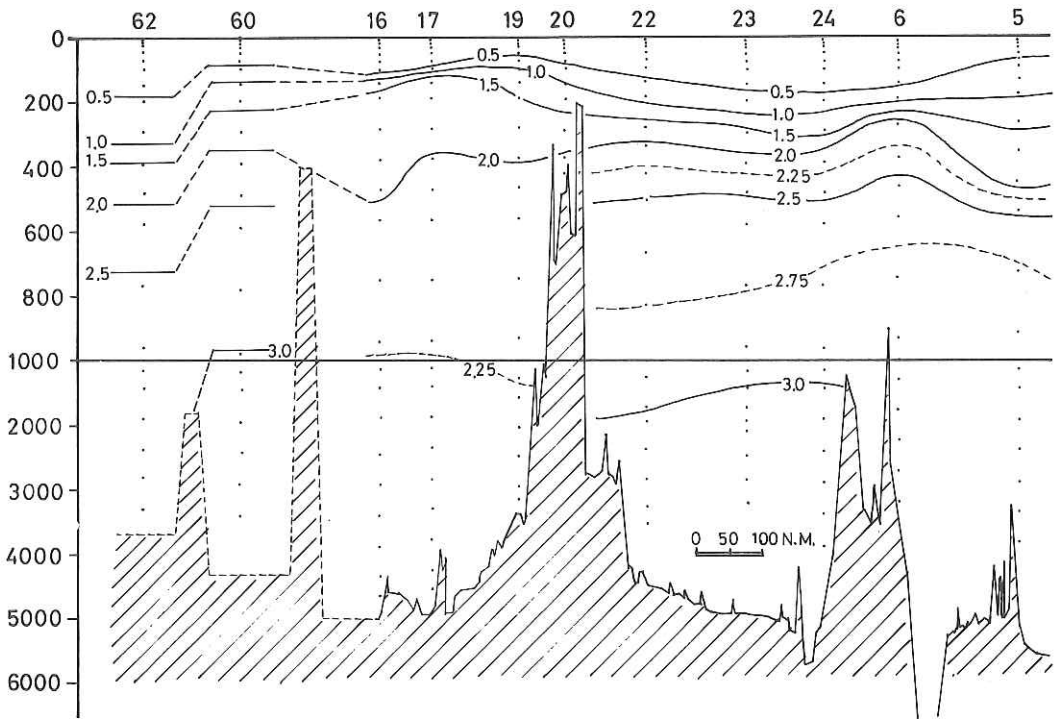


Fig. 18. PO4-P (μg atoms/l) along Section II.

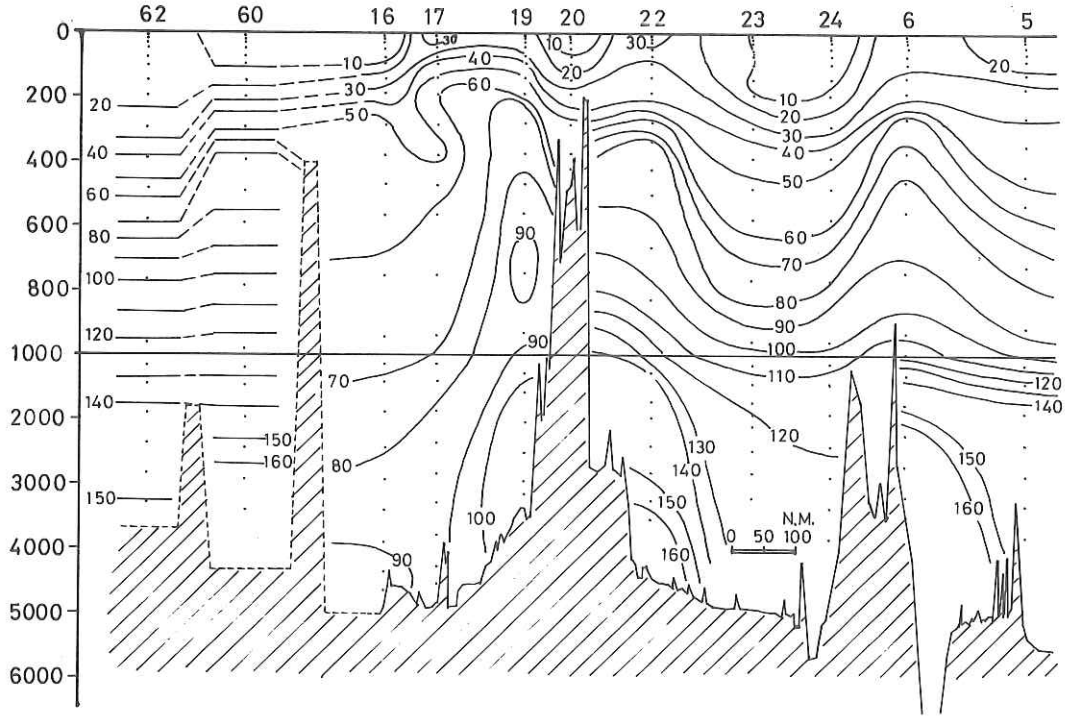


Fig. 19. SiO_2-Si (μg atoms/l) along Section II.

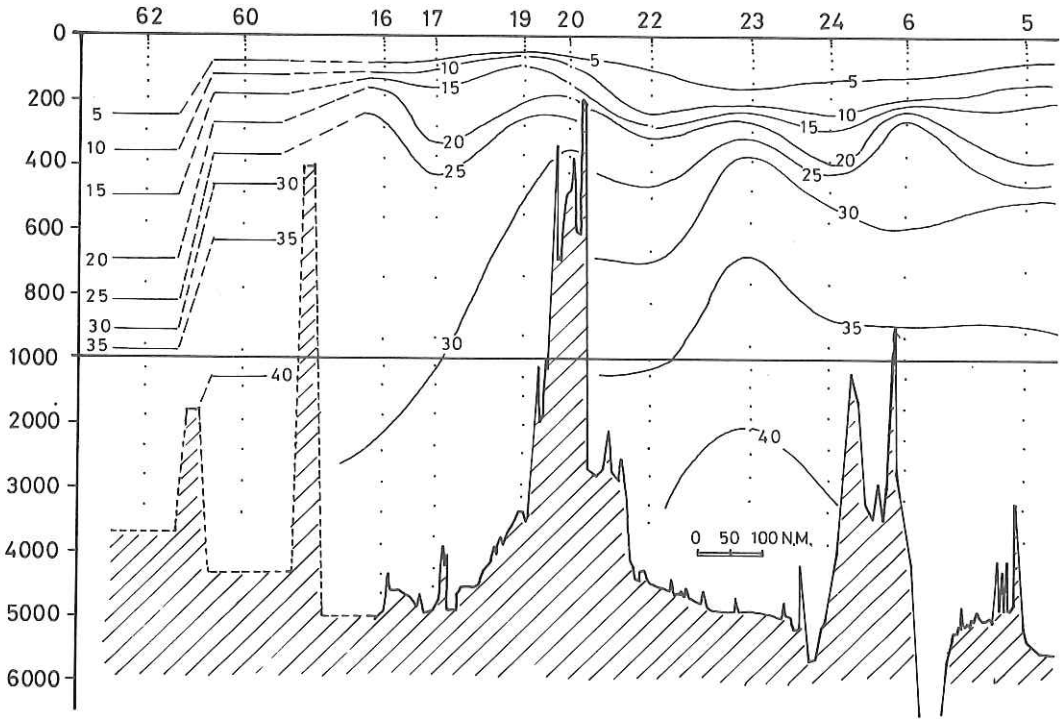


Fig. 20. NO_3-N (μg atoms/l) along Section II.

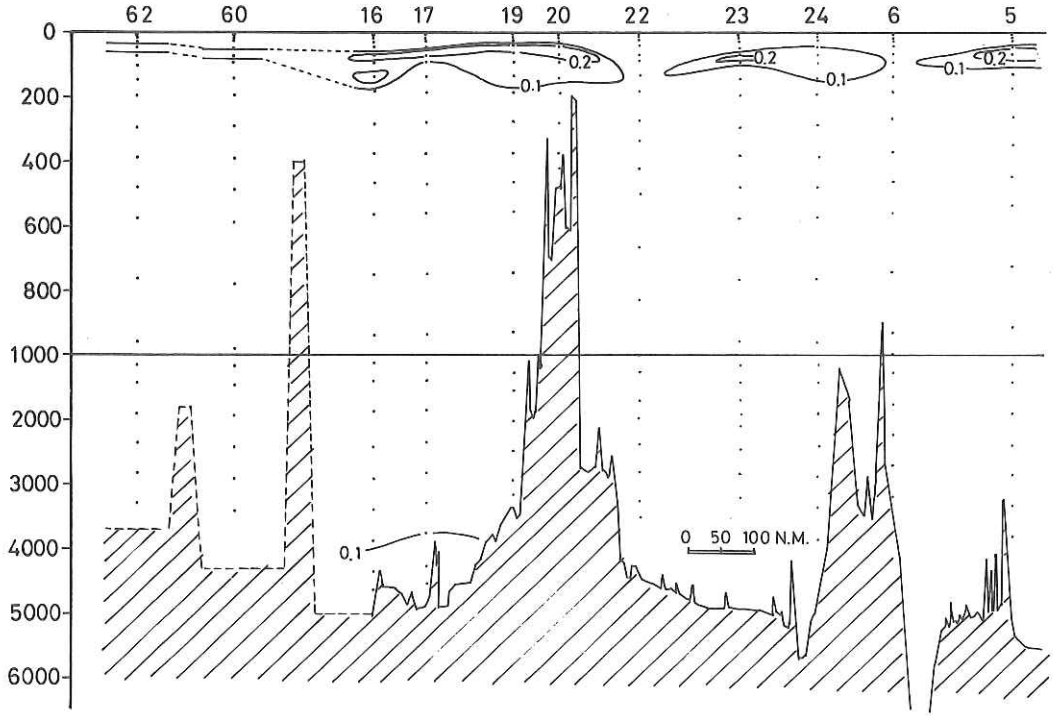


Fig. 21. NO_2-N (μg atoms/l) along Section II.

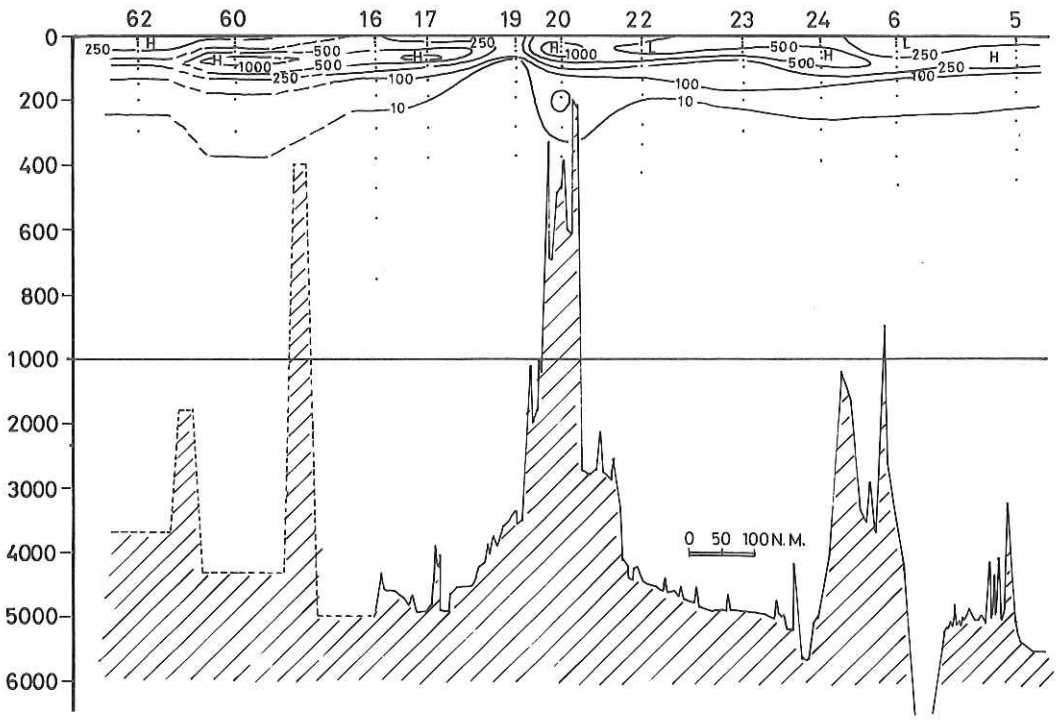


Fig. 22. Chlorophyll a ($\mu g/m^3$) along Section II.

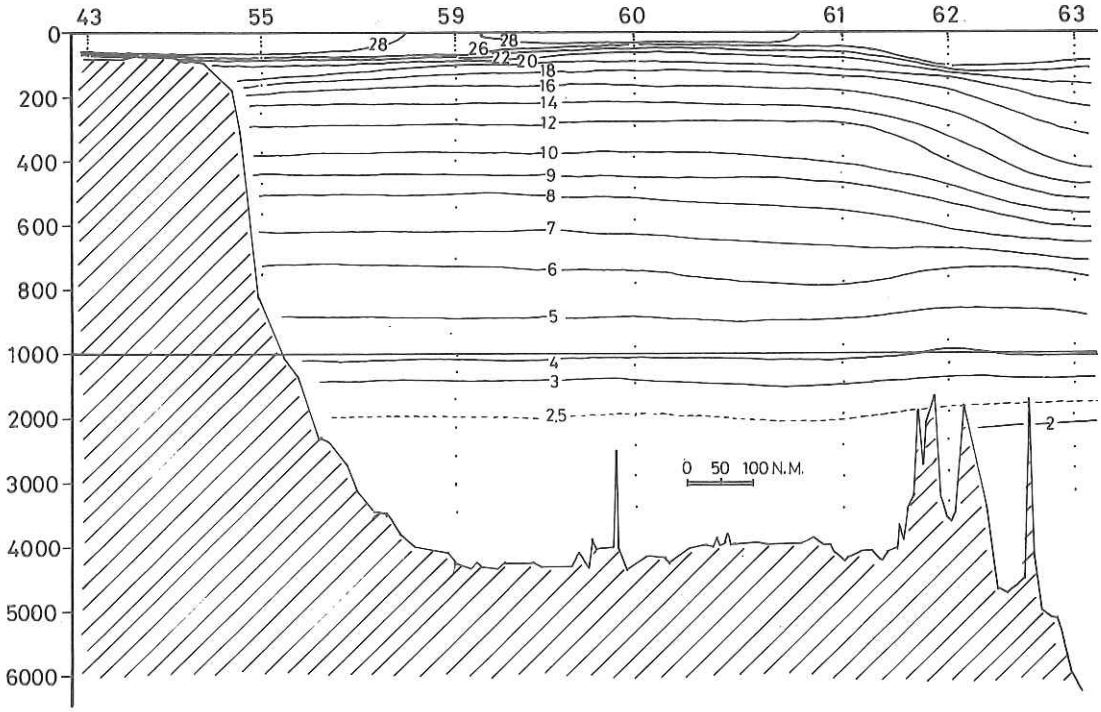


Fig. 23. Water temperature (°C) along Section III.

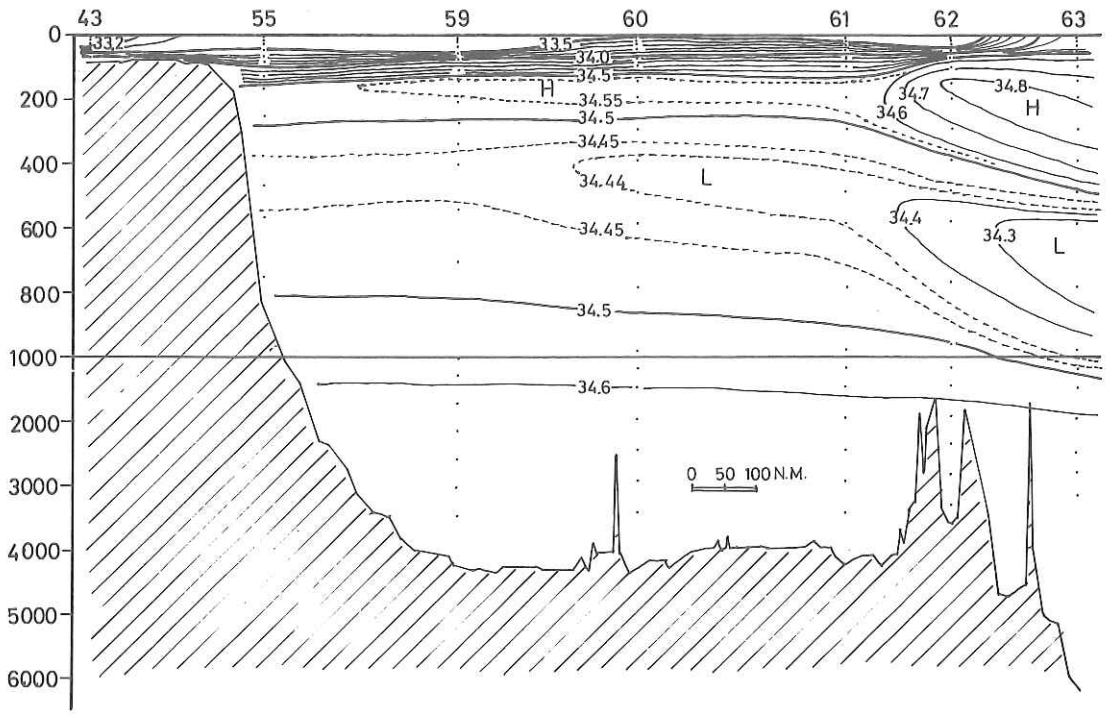


Fig. 24. Salinity (‰) along Section III.

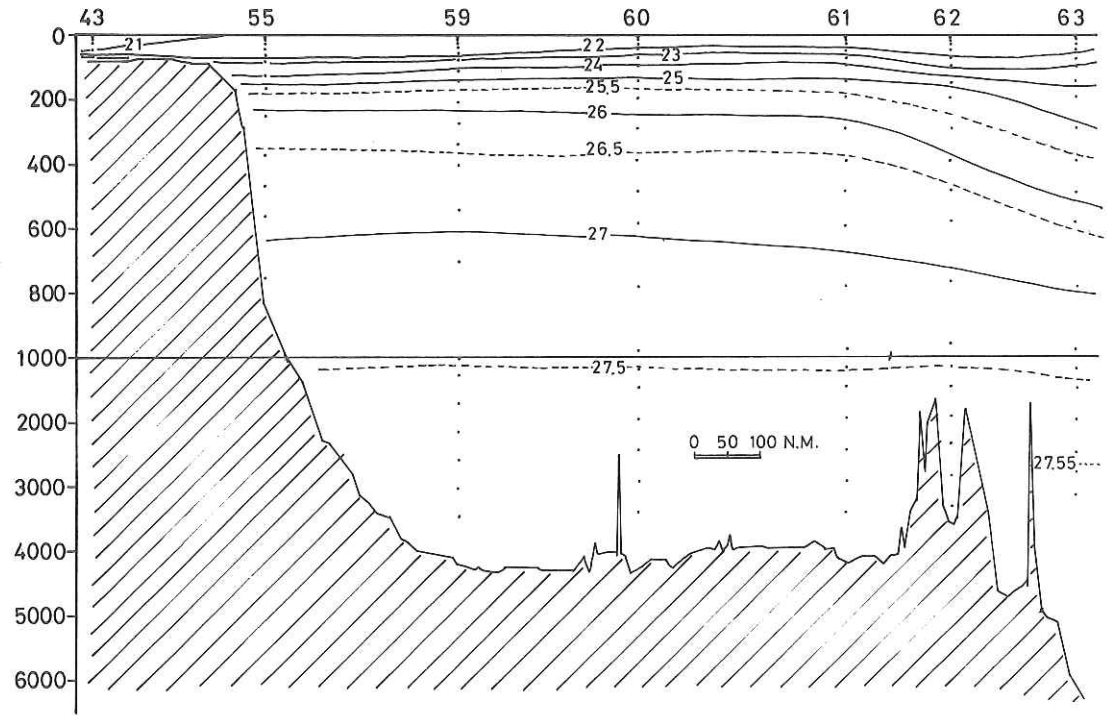


Fig. 25. σ_t along Section III.

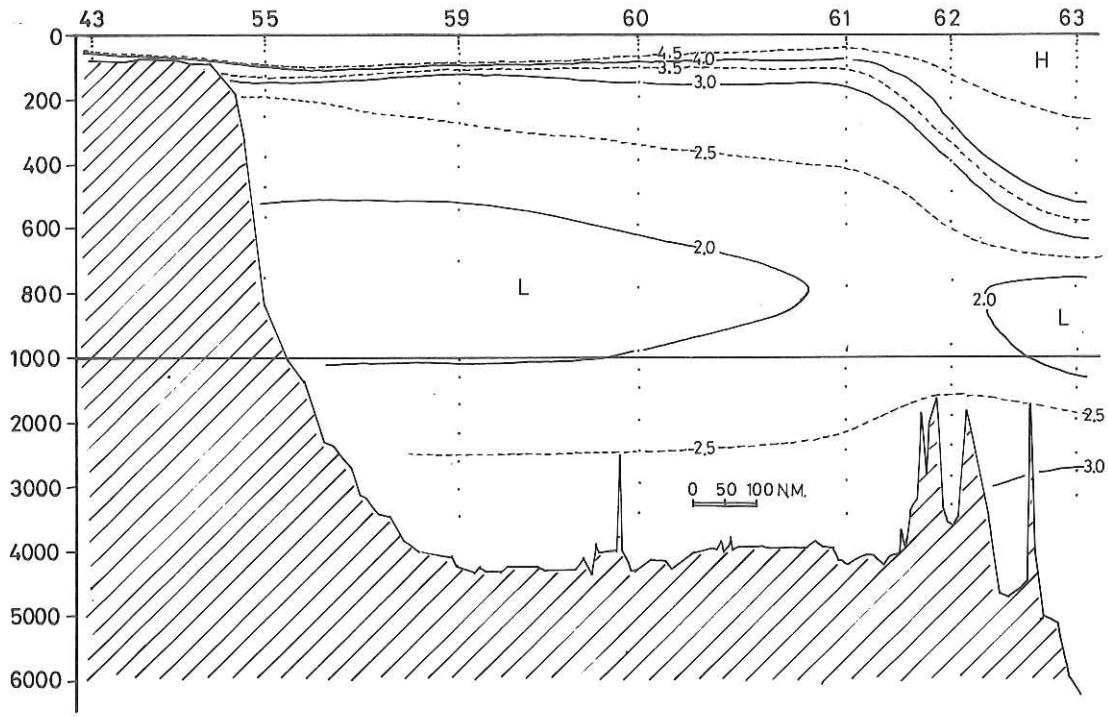


Fig. 26. Dissolved oxygen (ml/l) along Section III.

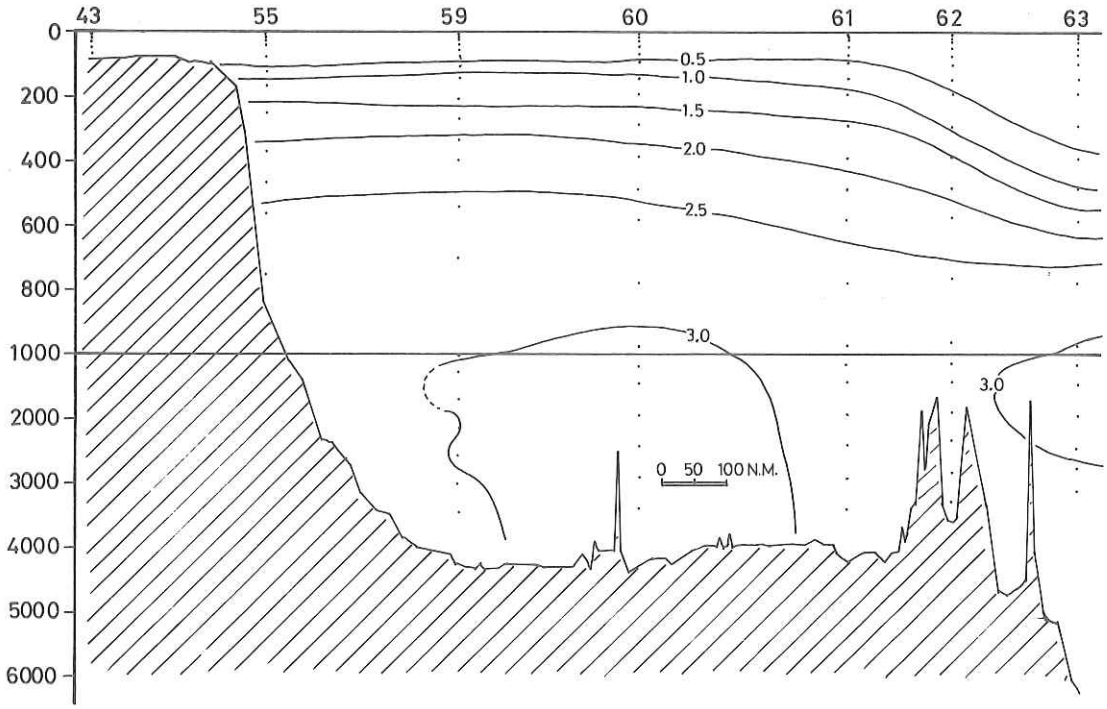


Fig. 27. PO_4-P (μg atoms/l) along Section III.

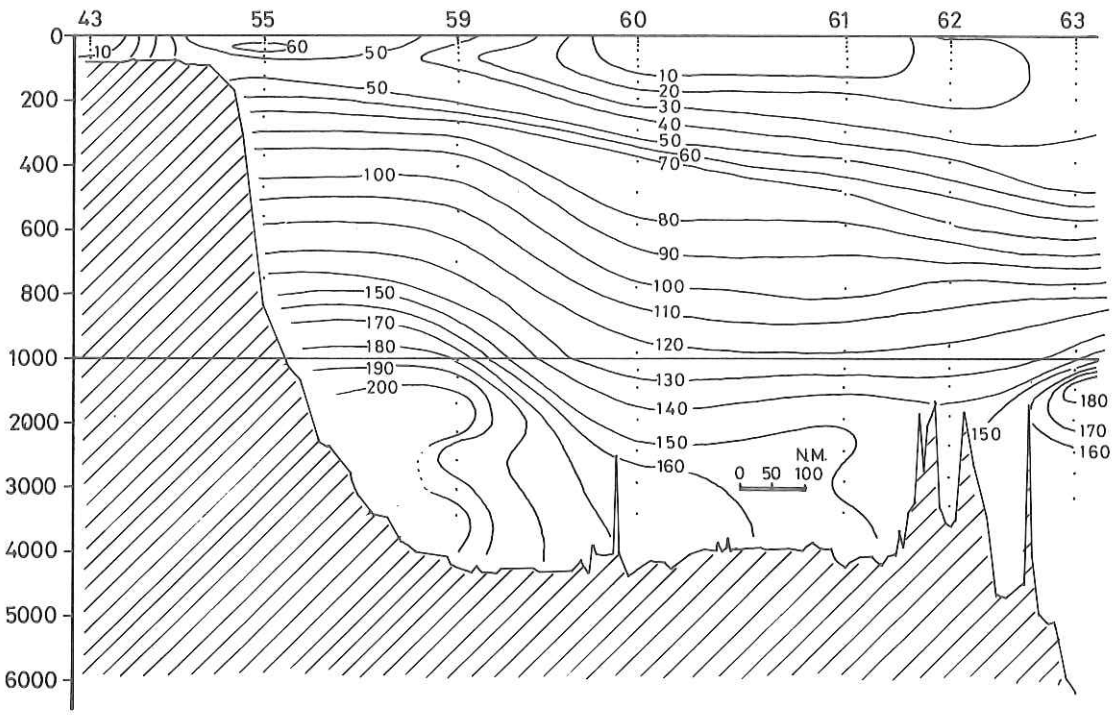


Fig. 28. SiO_2-Si (μg atoms/l) along Section III.

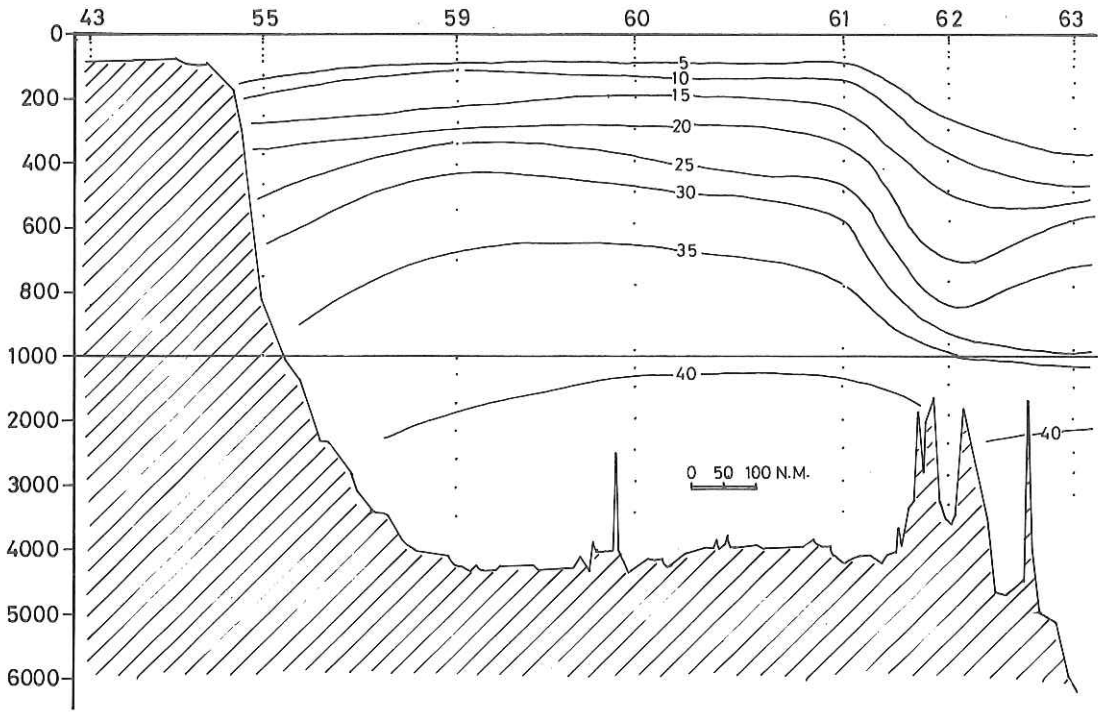


Fig. 29. NO_3-N (µg atoms/l) along Section III.

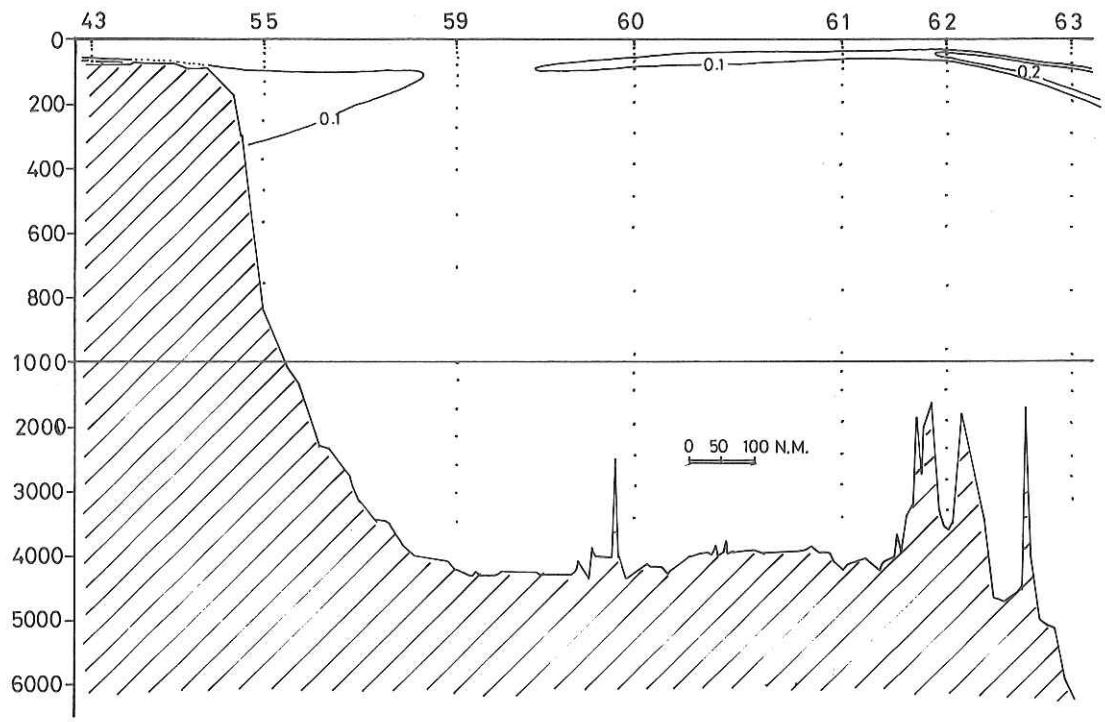


Fig. 30. NO_2-N (µg atoms/l) along Section III.

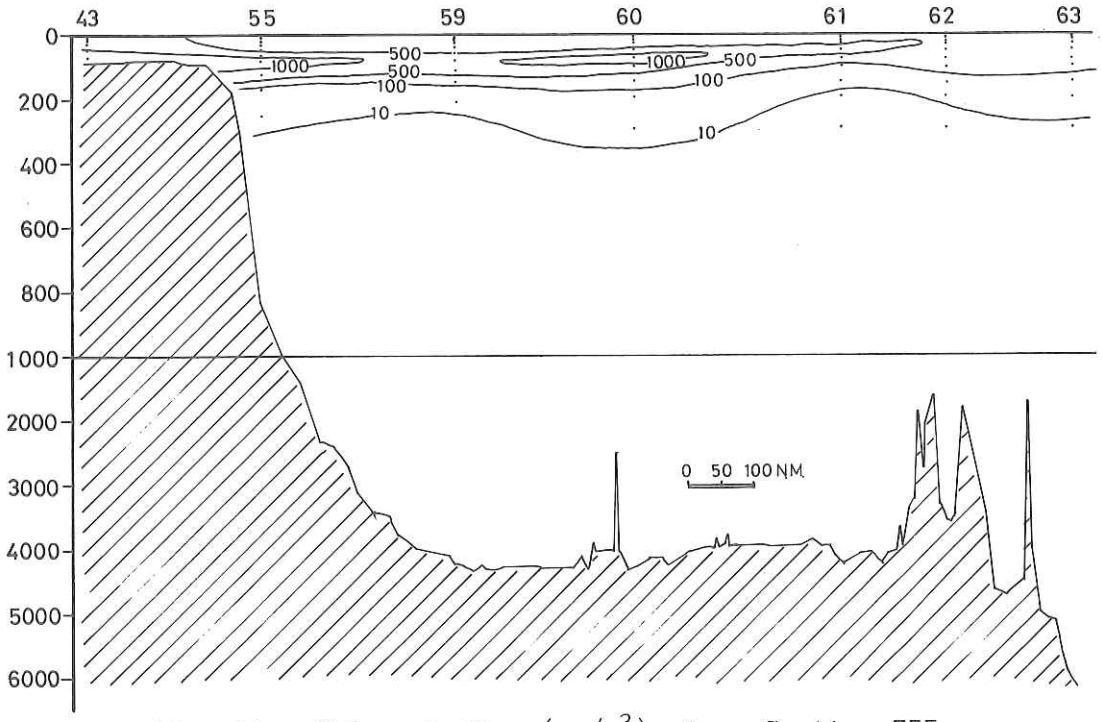


Fig. 31. Chlorophyll a ($\mu g/m^3$) along Section III.

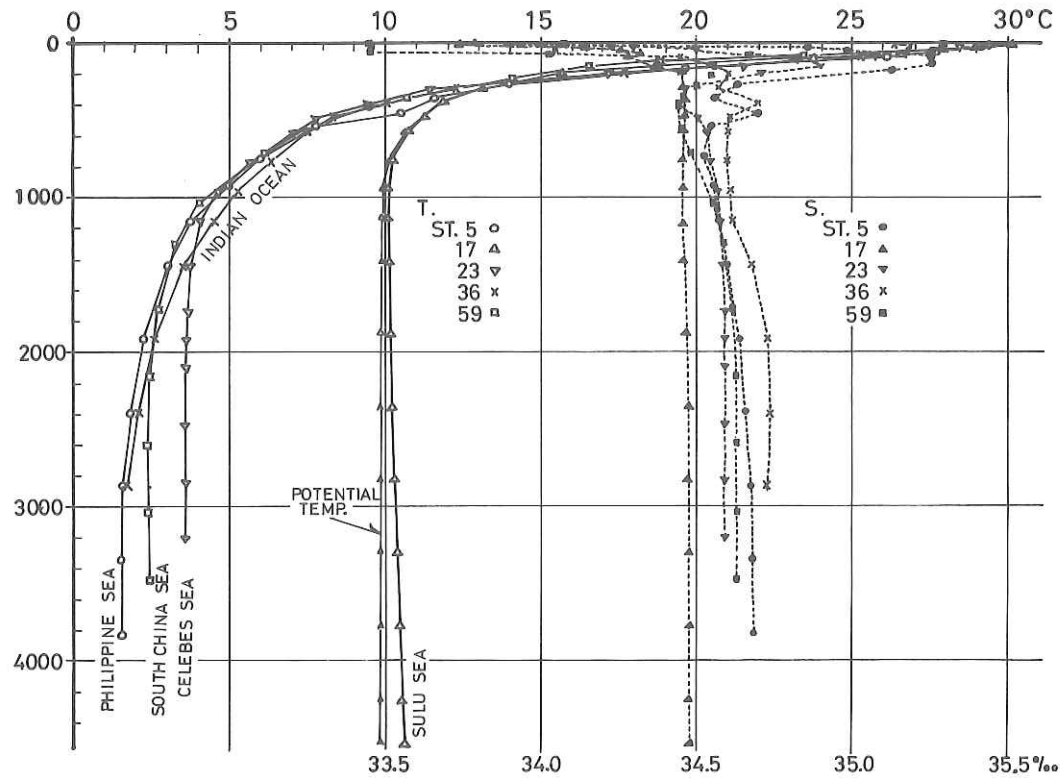


Fig. 32. Vertical distribution of water temperature and salinity.

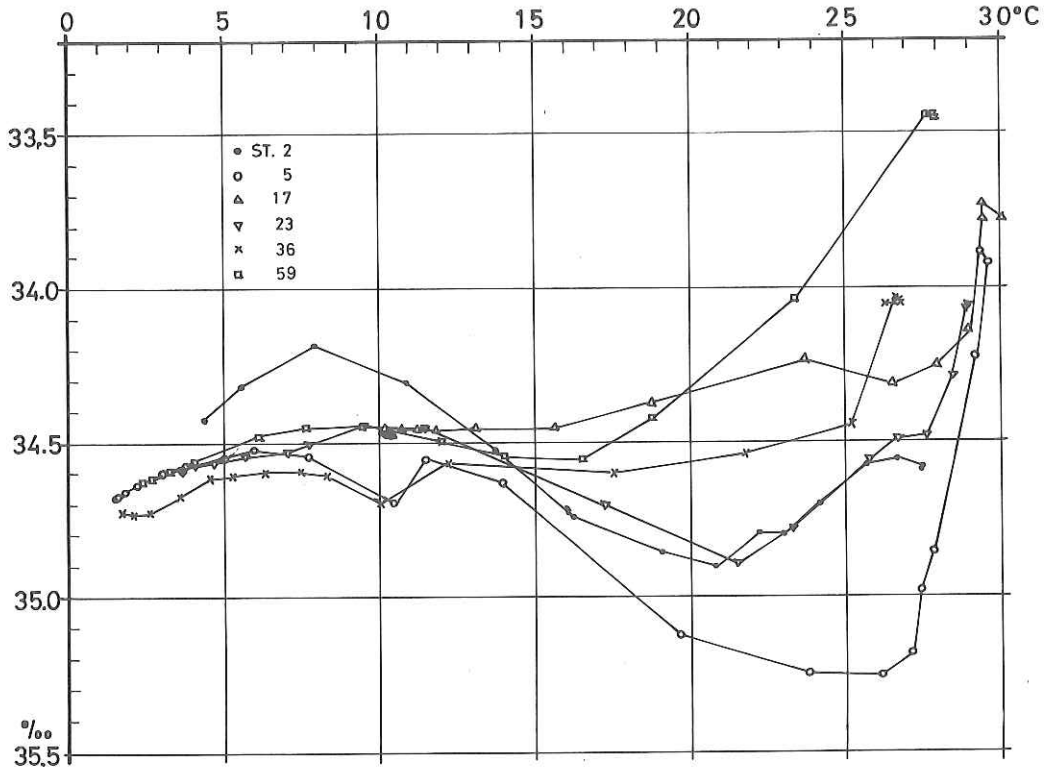


Fig. 33. T-S diagram.

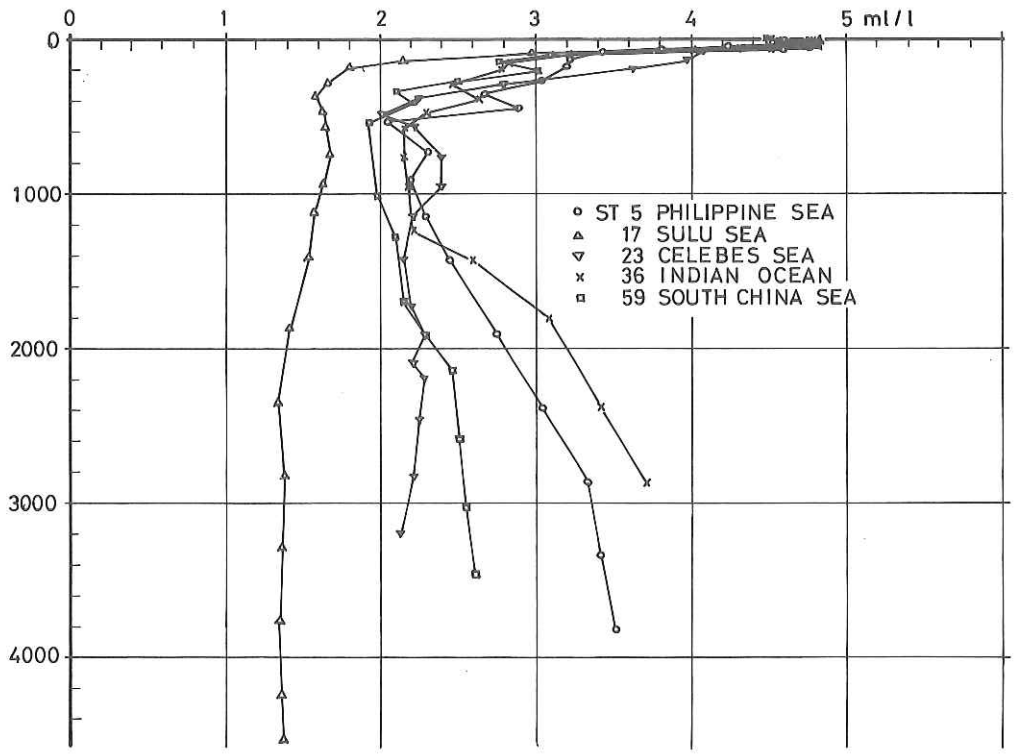


Fig. 34. Vertical distribution of dissolved oxygen.

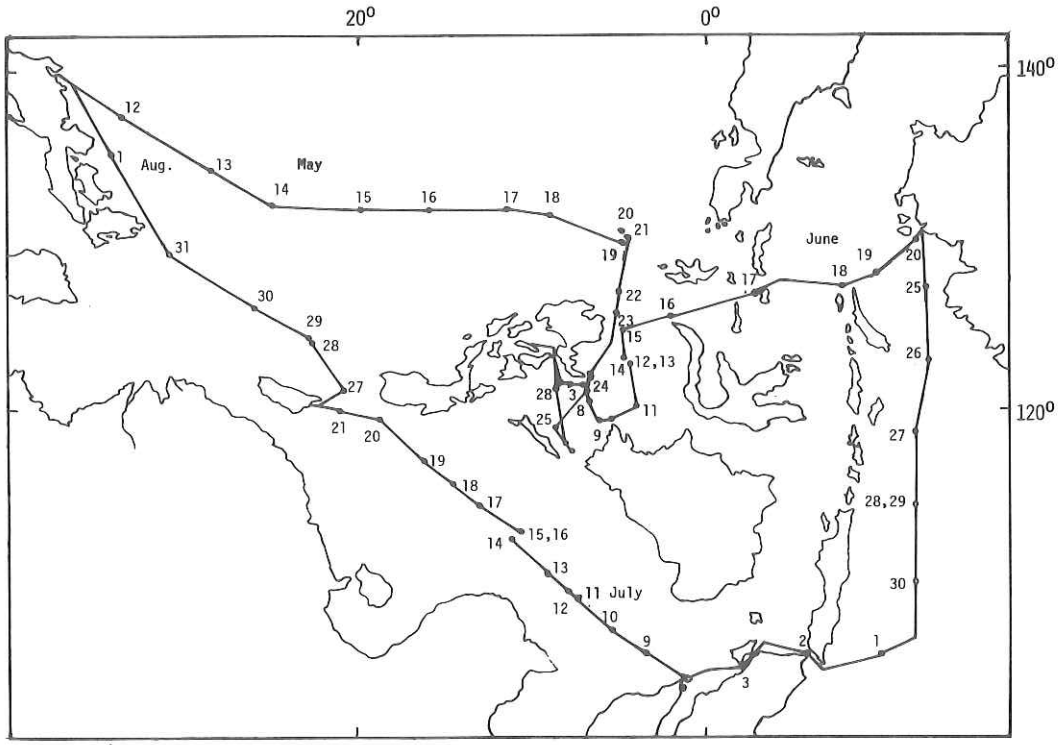


Fig. 35. Date (noon position) on sea bird observations.

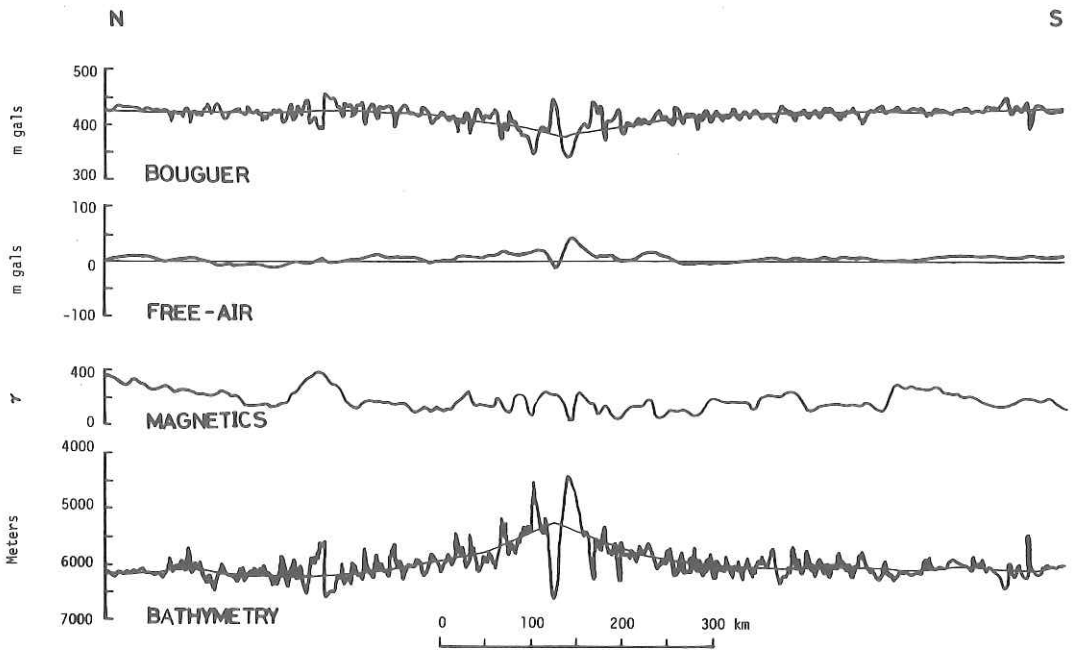


Fig. 36. Observed profiles of bathymetry, gravity anomaly and magnetic anomaly between 20°N and 10°N along 132°E.