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HYDROGRAPHIC AND NUTRIENT DATA FROM R/V KNORR CRUISE 73, LEG 2 - FEBRUARY TO MARCH, 1978 - OFF THE COAST OF PERU

by

Robert B. Gagosian, Theodore Loder
Gale Nigrelli, Zofia Mlodzinska,
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January 1980

TECHNICAL REPORT

Prepared for the Office of Naval Research under Contract N00014-74-C-0262; NR 083-004, for the National Science Foundation under Grant OCE 77-26084, for the NOAA Office of Sea Grant under Grants 04-7-158-44034 and 04-8-M01-79 (to the University of New Hampshire University of Maine Cooperative Institutional Sea Grant Program.

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WOODS HOLE, MASSACHUSETTS 02543

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Approved for Distribution
Geoffrey Thompson, Chairman
Department of Chemistry

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ABSTRACT

In February and March of 1978 a major cruise was undertaken on the R/V KNORR off the Peruvian coast near 15^{o}S in order to investigate the organic biogeochemical processes associated with upwelling areas. The purpose of this report is to collate the large amount of hydrographic, nutrient, and plankton data generated from various investigators on this cruise and use the report as a standard for the cruise participants. Data for temperature, salinity, oxygen, nitrate, nitrite, ammonium, phosphate, silicate, chlorophyll a, productivity indices, and carbon fixation rates are given.

ACKNOWLEDGEMENTS

Several people contributed to the many analyses undertaken on this cruise. Barbara Kohn was responsible for generating the dissolved oxygen data. Luis Florez and Cesar Delgado from the Instituto del Mar in Callao, Peru were especially helpful on deck with Niskin and euphotic zone casts. We also wish to thank the officers and crew of the R/V KNORR for their assistance.

Support for this cruise was provided by the National Science Foundation, Grant OCE 77-26084 (To RBG), and the Office of Naval Research, Contract N00014-74-C0262 (to John W. Farrington). Travel support for T. Loder was kindly provided by the Marine Program Fund and the College of Engineering and Physical Sciences at the University of New Hampshire. Equipment and supplies for some nutrient analyses were partially funded by the NOAA Office of Sea Grant, Contracts 04-7-158-44034 and 04-8-M01-79 to the University of New Hampshire/ University of Maine Cooperative Institutional Sea Grant Program). Computer time for graphics preparation was provided by the Department of Earth Sciences at the University of New Hampshire.

Travel and salary support for J. Kogelshatz was provided by the National Science Foundation, Grant OCE 75-23722.

Special thanks are extended to John Farrington, who supervised and was responsible for the coring aspects of the cruise and *in situ* pump sampling program, and to Nicholas Staresinic and Gilbert Rowe for their direction of the sediment trap deployments.

I. INTRODUCTION

During February to March of 1978 a major cruise was undertaken on the R/V KNORR off the Peruvian coast near $15^{o}S$ in order to investigate the organic biogeochemical processes associated with upwelling areas. The major goals of this cruise were to collect appropriate samples to 1) determine the particulate flux of several classes of biogenic organic compounds to the sea floor, and 2) determine the reactions and rates of transformation for selected classes of organic compounds both in particulate matter and subsurface sediments. The approach used to accomplish these objectives was to analyze samples from (a) sediment traps deployed at different water depths, (b) all glass and stainless steel 22-liter seawater sample bottles, (c) box and Soutar cores, (d) plankton tows, and (e) *in situ* particulate filter pumps. The suite of samples collected from these samplers includes: twenty-one free drifting sediment trap deployments, nine moored sediment trap deployments, fifteen box cores, twelve Soutar cores, twenty-nine grab samples and gravity cores, one-hundred and sixteen large volume water samples, fifteen *in situ* pump lowerings, and thirty-one zooplankton tows. A tabulated list of these samples is available upon request.

These samples are being analyzed for organic compound classes by several groups (1) steroidal compounds and fatty alcohols - Dr. Robert B. Gagosian (W.H.O.I.), (2) fatty acids and hydrocarbons - Dr. John W. Farrington (W.H.O.I.) and (3) wax esters and triglycerides - Dr. Stuart G. Wakeham (W.H.O.I.). Selected samples are being analyed for (1) amino acids and carbohydrates - Dr. Walter Michaelis (University of Hamburg), (2) chlorophyll and its degradation products - Dr. Earl W. Baker and Mr. William Louda (Florida Atlantic University), (3) other organic nitrogen compounds - Dr. Cindy Lee (W.H.O.I.), and (4) volatile hydrocarbons - Dr. John M. Hunt (W.H.O.I.). The compound classes outlined above are quite different and represent a wide range of functional groups, reactivities, and stabilities found in total organic matter. Hence, the results from this study will add considerably to our knowledge of the flux of this material to the sea floor, as well as its transformation reactions.

In order to assess the effects of biological processes on the organic compound fluxes and transformation reactions, phytoplankton dynamics were studied (Dr. Richard Barber and Ms. Jane Kogelschatz - Duke Marine Laboratory), and zooplankton and benthic organisms were collected and biomass and species diversity determined (Dr. Gilbert Rowe - Brookhaven National Laboratory). Dr. John Hobbie (Marine Biological Laboratory) measured microbial biomass by the acridine-orange epifluorescence technique and ATP as well as heterotrophic activity by glucose-C^{14} uptake experiments.

In addition to the nutrient (nitrate, nitrite, silica, phosphate, and ammonium), chlorophyll a and phaeopigment, primary productivity (C-14 uptake), and hydrographic data reported in this memorandum, particulate and dissolved organic carbon and total phosphorous and nitrogen measurements were made on the water samples. This data will be reported elsewhere.

The rationale for undertaking these studies in coastal Peruvian waters is as follows: the transformation of organic matter in seawater is difficult to trace in most marine environments because of the low concentrations involved, and the slow rates of intermolecular reactions relative to the physical processes of transport into and out of the area of study. An upwelling area provides an excellent system for overcoming these problems. In these areas organic compounds are biosynthesized in large quantities, are subjected to both oxidizing and reducing conditions, and have large-particle fluxes to the sea floor. Indeed, from floating sediment trap deployments, Staresinic (1978) found the flux of particulate organic carbon to be 120-840 mg organic·C/M^2/day (17-21% of primary productivity) off the coast of Peru relative to 4.2-6.3 mg organic·C/-M^2/day for the western North Atlantic (Rowe and Gardner, 1979). Thus, rates of diagenesis are expected to be fast enough to be observed and the differences in the transformations and interactions under different redox conditions can be studied within a compact geographic area.

The main hydrographic station locations (Fig. 1, Table 1) in the Peru upwelling area occupied on this cruise were chosen because: 1) the area is highly productive most of the year. 2) A great deal of work has already been done in the zone and many of the recent results of the National Science Foundation - Coastal Upwelling Ecosystems Analysis (CUEA) Program are now currently available for use as important ancillary data. Two CUEA groups took part in the cruise (Dr. Gilbert Rowe, Brookhaven National Laboratory, and Dr. Richard Barber, Duke Marine Laboratory). 3) Terrestrial organic matter input is low in the area. 4) The area is fairly accessible and affords the opportunity for future work. It is difficult to obtain samples for follow-up studies from other upwelling areas such as the North Arabian Sea and the southwest African shelf due to their remoteness.

The purpose of this report is to collate the large amount of hydrographic, nutrient, and plankton data from various investigators and use it as a standard for the cruise participants (Table 2). A brief documentation of methods is also presented. However, the reader is referred to the scientific papers originating from the cruise for a critical discussion of the data.

II. METHODS

A. Temperature, Salinity, and Oxygen

Samples for hydrographic analyses were collected using Teflon-lined Nansen bottles. Temperatures were recorded with reversing thermometers and corrected

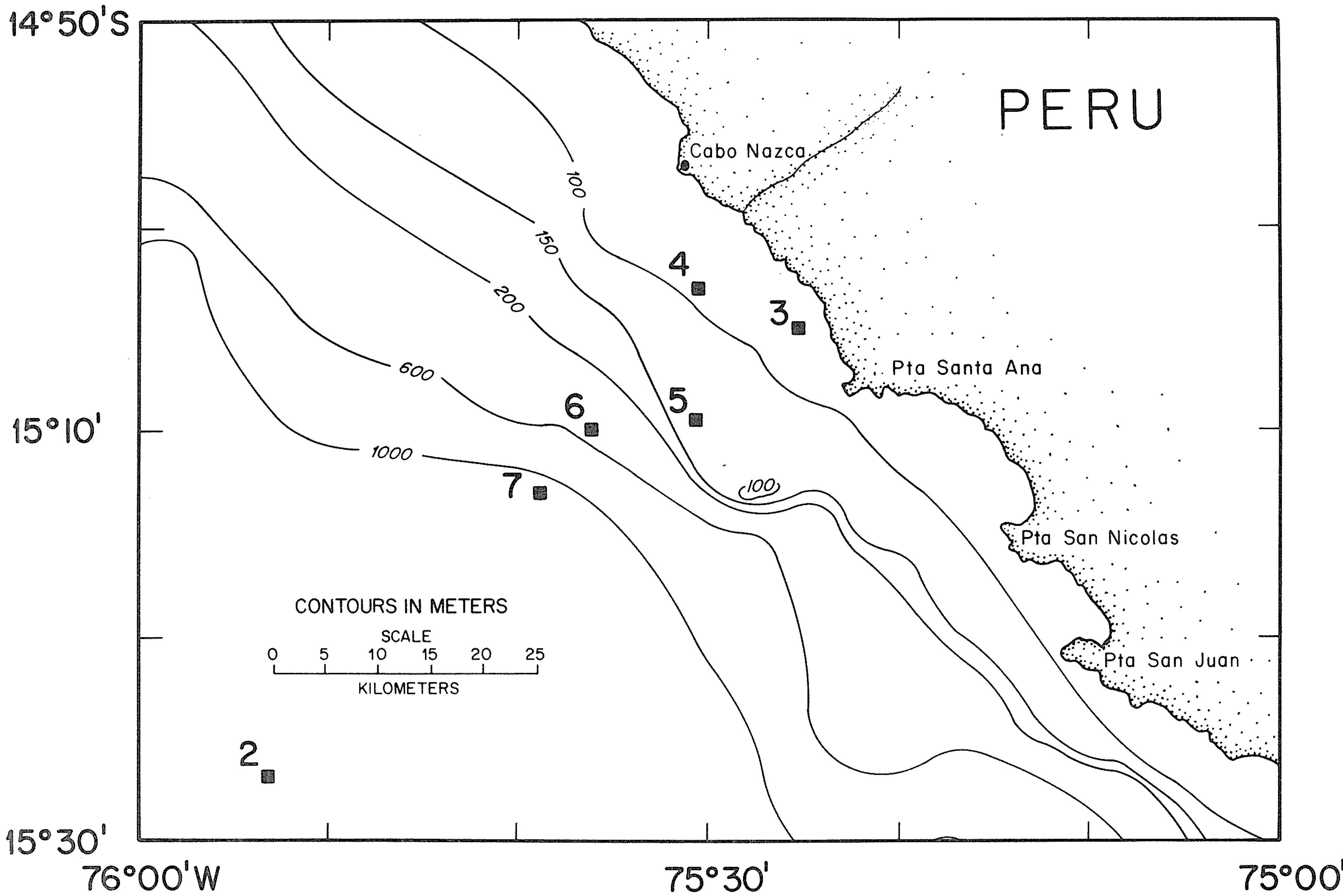


Fig. 1. Locations of main sampling locations made during R/V KNORR Cruise 73-2 - February-March, 1978.

TABLE 1

Main sampling station locations for R/V KNORR 73-2.

Hydrostation Number	Station	Location S	Location W	Depth (m)
993	2	$15^{o}26.8'$	$75^{o}53.3'$	4269
994	3	$15^{o}04.8'$	$75^{o}25.1'$	30
995	4	$15^{o}02.9'$	$75^{o}30.2'$	90
996	5	$15^{o}09.4'$	$75^{o}30.5'$	136
997	6	$15^{o}09.9'$	$75^{o}36.0'$	400
998	7	$15^{o}12.9'$	$75^{o}38.7'$	1025

TABLE 2

Personnel participating in R/V KNORR Cruise 73, Leg 2 -- February 18th-March 17th, 1978 -- Balboa, Panama to Callao, Peru.

	Name	Title	Affiliation
1.	Dr. Robert B. Gagosian	Chief Scientist/Associate Scientist	Woods Hole Oceanographic Institution
2.	Dr. John W. Farrington	Associate Scientist	Woods Hole Oceanographic Institution
3.	Dr. Zofia Mlodzinska	Research Associate	Woods Hole Oceanographic Institution
4.	Ms. Gale Nigrelli	Research Associate	Woods Hole Oceanographic Institution
5.	Ms. Mary B. True	Research Associate	Woods Hole Oceanographic Institution
6.	Mr. C. Hovey Clifford	Research Associate	Woods Hole Oceanographic Institution
7.	Mr. Joaquim B. Livramento	Research Assistant	Woods Hole Oceanographic Institution
8.	Mr. David H. Mason	Research Assistant	Woods Hole Oceanographic Institution
9.	Mr. Keith A. Francis	Research Assistant	Woods Hole Oceanographic Institution
10.	Ms. Jane B. Alford	Laboratory Assistant	Woods Hole Oceanographic Institution
11.	Mr. Jerome P. Dean, Jr.	Laboratory Assistant	Woods Hole Oceanographic Institution
12.	Ms. Susan M. Lemay	Laboratory Assistant	Woods Hole Oceanographic Institution
13.	Ms. Susan M. Henrichs	Graduate Student	Woods Hole/M.I.T. Joint Program
14.	Mr. Nicholas Staresinic	Graduate Student	Woods Hole/M.I.T. Joint Program
15.	Ms. Barbara A. Kohn	Graduate Student	Woods Hole/M.I.T. Joint Program
16.	Dr. Gilbert T. Rowe	Oceanographer	Brookhaven National Laboratories
17.	Dr. John E. Hobbie	Senior Scientist	Marine Biological Laboratory
18.	Dr. Theodore C. Loder	Associate Professor	University of New Hampshire
19.	Ms. Jane E. Kogelshatz	Research Assistant	Duke Marine Laboratory
20.	Mr. William B. Bowden	Research Assistant	Marine Biological Laboratory
21.	Dr. Franz Heinzer	Guest Postdoctoral Fellow	CIBA-GEIGY, Switzerland
22.	Mr. Cesar A. Delgado	Marine Biologist	Instituto del Mar, Peru
23.	Mr. Luis A. Florez	Marine Biologist	Instituto del Mar, Peru

using the W.H.O.I. hydrographic reduction program HYD-1. Density and potential temperatures were calculated using a program kindly provided by Dr. Peter Brewer. Salinity samples were taken in soft glass screw bottles and analyzed on board ship using a Guildline Autosal Salinometer (Model 8400) with a stated accuracy of ± 0.003 ppt. Oxygen samples were run on board ship using a modified Winkler procedure (Carpenter, 1965).

B. Nutrients

All nutrient analyses were run on board using either the 2-channel Technicon AutoAnalyzer of the University of New Hampshire (UNH) (silicate and phosphate) or the W.H.O.I. AutoAnalyzer (nitrate, nitrite and ammonium). The following methods were used with slight modifications as described by Glibert and Loder (1977): silicate (TIS, 1973c, phosphate (TIS, 1973a), nitrate (TIS, 1972), nitrite (nitrate method with the reduction column removed), and ammonium (Adamski, 1976). All refractive index, turbidity and chemical salt corrections were applied to the data where appropriate (Loder and Glibert, 1977).

The water samples for nutrient analyses were stored in the dark under refrigeration until analysis in seawater-aged and sample-rinsed polyethylene bottles. Mercuric chloride (final concentration ∿ 100 ppm) was added as a preservative to the silicate and phosphate sample bottles to inhibit bacterial activity. Although the addition of $HgCl_2$ had no apparent effect on the silicate concentrations, it did cause an increase in the phosphate concentration of 6-7 percent at high phosphate concentrations (∿ 2 μm/l). This increase of phosphate occurred within minutes after the addition of the $HgCl_2$ to the unfiltered samples and was possibly due to the release of phosphate from the phytoplankton present. Analyses were generally run within 12 hours of collection. Unfiltered samples were analyzed since a study on the cruise indicated that there was no significant difference between filtered and unfiltered samples at the 95% confidence level. The average standard deviations for replicate samples run at the same time are given in Table 3. Samples from a single cast were run at the same time and often in duplicate so that minor changes in concentrations are probably real even though the changes may be less than the daily or longer-term reproducibility.

A separate set of samples from most of the euphotic and regular station casts were frozen and shipped to Duke Marine Laboratory for analyses, some of which were done up to six months after collection (Kogelshatz et al., 1979). The samples were thawed and analyzed using Technicon AutoAnalyzer procedures based on the manual methods of Murphy and Riley (1962) for reactive phosphate, and the methods of Armstrong et al. (1967) for dissolved silicate, nitrate and nitrite. Ammonium was measured by the phenol-hypochlorite method of Koroleff (1970). These automated methods have been described by Friedrich and Whitledge (1972).

The regression equations and graphs comparing this data to the W.H.O.I. and U.N.H. data are given in Figure 2. The nitrate and nitrite data sets agreed reasonably well as indicated by the regression data. The Duke silicate values were slightly higher than the UNH values with increased scatter for the samples with concentrations above ∿ 23 μm/l. It is not clear if these differences are due to handling and storage effects or the use of different methods and standards. The UNH phosphate values were slightly higher than the Duke values, particularly at the higher phosphate concentrations. Although this difference is partly due to the addition of $HgCl_2$, as mentioned above, storage effects, different methods and standards may also have contributed to these differences.

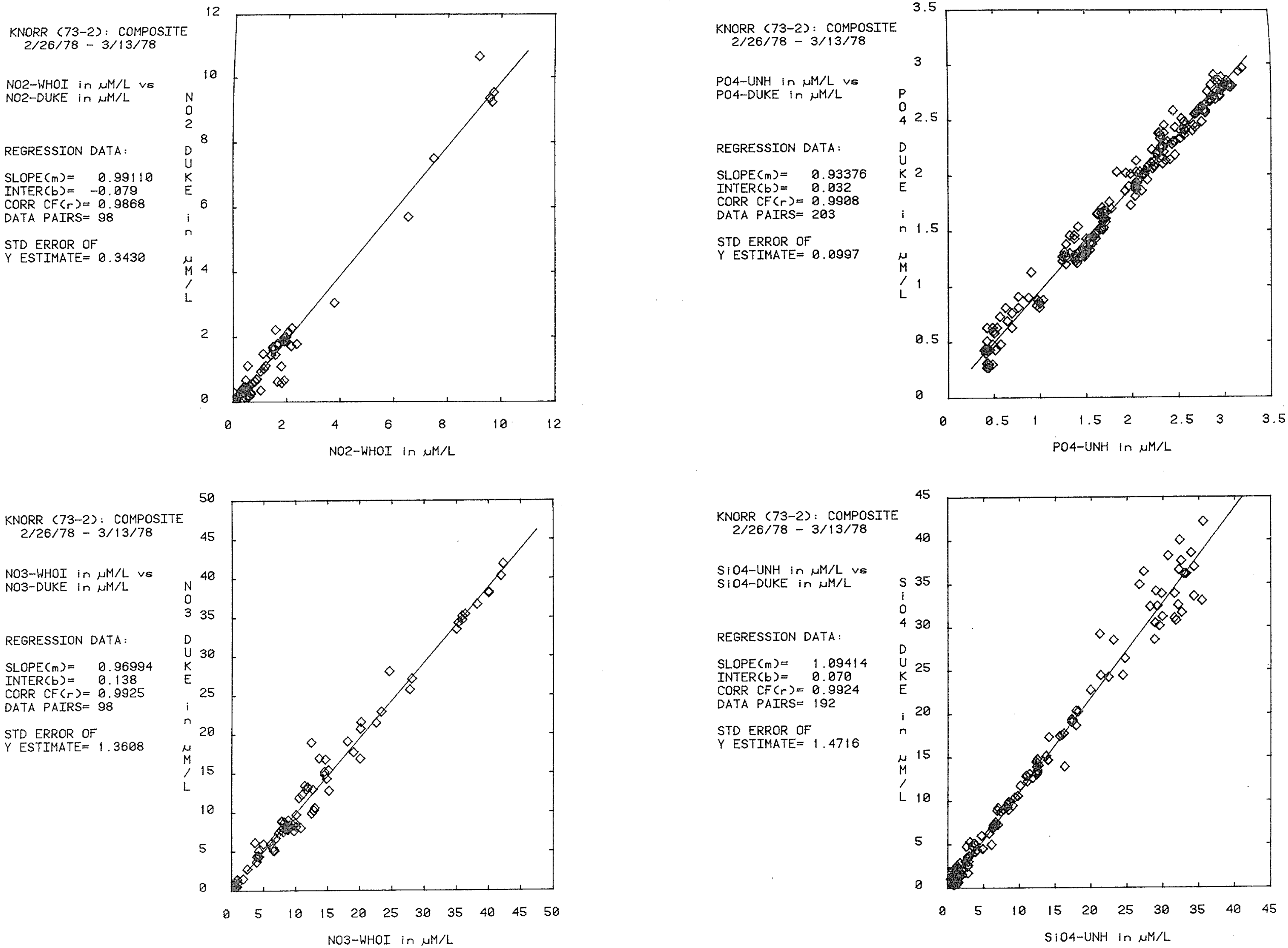


Fig. 2. Comparison plots and regressions of the Duke nutrient data relative to the W.H.O.I. and U.N.H. data

TABLE 3

Average standard deviations for replicate nutrient samples analyzed at the same time.

Nutrient	Range of Sample Concentrations (μmole/liter)	Standard Deviation (± μmoles/liter)
Phosphate	0-3.5	0.02
Silicate	0-35	0.03
	0-150	0.3
Nitrate	0-10	0.15
	0-30	0.26
Nitrite	0-4	0.02
	0-10	0.03
Ammonium	0-2	0.01
	0-8	0.05

C. Chlorophyll a and Phaeopigments

Chlorophyll *a* and phaeopigments were determined by the fluorometric technique (Yentsch and Menzel, 1963; Holm-Hansen et al., 1965) using a Turner Designs Model 10-005 R fluorometer that was calibrated repeatedly throughout the cruise. The fluorometer was calibrated with a known quantity of chlorophyll *a* determined spectrophotometrically using the SCOR/UNESCO extinction technique and equations (SCOR/UNESCO, 1966). Serial dilutions of the acetone extract of chlorophyll *a* were used to calculate the fluorometer calibration factor (K) with Equation 1.

$$K = \frac{\text{Chl a } (\mu g/ml)}{\frac{(F_o - F_a)}{S}} \qquad (1)$$

F_o and F_a are the fluorometer reading before (F_o) and after (F_a) acidifying the extract with two drops of 5% HCl. S is a value obtained by multiplying the two scale settings at which the F_o and F_a were read.

Once the calibration factor (K) is established, chlorophyll *a* and phaeopigment concentrations are calculated using the Equations 2 and 3 derived from Lorenzen (1966).

$$\text{Chl a } (\mu g/l) = \frac{\frac{K(F_o - F_a)v_e}{S}}{V_f} \qquad (2)$$

$$\text{Phaeo } (\mu g/l) = \frac{\frac{K\,(2.1\ F_a - F_o)v_e}{S}}{V_f} \qquad (3)$$

In these equations the units of K are μg/ml, v_e is the extract volume (ml), V_f is the filtration volume (l) and was normally 0.025 l. The value 2.1 is the ratio of F_o:F_a observed for chlorophyll a in the absence of phaeopigments and was established experimentally for each fluorometer. In Equations 2 and 3 the pigment units are in μg/l (equivalent to mg/m^3).

III. PRESENTATION FORMAT

Tabular and graphic presentation of the data have been organized on a station-by-station basis (Fig. 1) and by cast type within each station. Niskin data are presented first, followed by an ordered sequence of paired morning (AM) and evening (PM) euphotic zone data, and finally by Bodman (large volume water sample) data. Exceptions to this basic format are Station 3, for which no Niskin data were collected, and euphotic casts 993-35 and 998-188 which lack a corresponding PM or AM cast respectively.

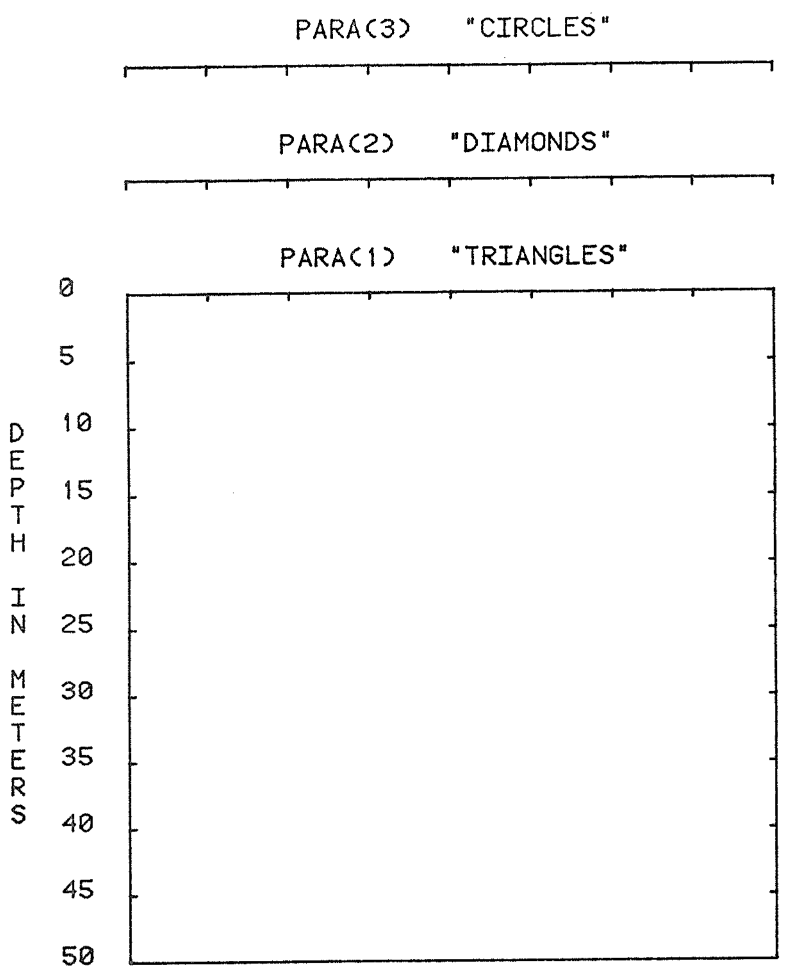
In several cases individual Niskin casts were compiled to form a complete water column profile. For example: Station 7 Niskin cast is comprised of four independent casts, Nos. 144, 166, 177, and 179 which together describe the water column from the surface to 1000 meters. For combined cases for which the individual casts are separated in time (> 24 hr), shaded symbols have been used to distinguish one sampling event from another. Nutrient and hydrographic data from euphotic casts 995-52, 997-107, and 998-144 are identical to that recorded for corresponding Niskin depths at the same station because the same casts were used for both sets of data.

Parametric units and graphic labelling notation used throughout this report are summarized in Table 4. Figure numbers have been keyed to both station number and cast type. For example: Figure 47-4E identifies this figure as a plot of euphotic data from Station 4, the forty-seventh figure in the report.

B and N denote Bodman and Niskin casts. Those figures for which Duke nitrate values have been inserted where W.H.O.I. analyses were not available are so indicated.

TABLE 4

KNORR (73-2): CAST #, STAT # (CAST TYPE)
DATE   MESSENGER TIME



PARAMETRIC UNITS USED IN FIGURES:

DATE	PERU LOCAL DATE
TIME	PERU LOCAL TIME @ MESSENGER DROP EXPRESSED IN HOURS
DEPTH	in METERS
TEMPERATURE	in DEGREES CELCIUS
SALINITY	in PARTS/THOUSAND
OXYGEN	in mLITERS/LITER
NITRATE	in µGRAM-ATOMS/LITER
SILICATE	"
PHOSPHATE	"
CHLOROPHYLL	in µGRAMS/LITER
CARBON FIX.	in µGRAMS/LITER/DAY
PRODUCTIVITY INDEX	in µGCARBON/µGCHLOROPHYLL/DAY

REFERENCES

Adamski, J. M. (1976). Simplified Kjeldahl nitrogen determination for seawater by a semi-automated persulfate digestion method. Anal. Chem., 48: 1194.

Armstrong, F.A.J., C. R. Stearns and J.D.H. Strickland (1967). The measurement of upwelling and subsequent biological processes by means of the Technicon AutoAnalyzer and associated equipment. Deep Sea Res., 14: 381-389.

Carpenter, J. H. (1965). The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method. Limnol. Oceanogr., 10: 141-143.

Friederich, G. E. and T. E. Whitledge (1972). AutoAnalyzer procedures for nutrients. In: Phytoplankton Growth Dynamics, Technical Series 1, Chemostat Methodology and Chemical Analyses (S. P. Pavlou, ed.), Special Report No. 52, Department of Oceanography, University of Washington, Seattle, WA. pp. 38-60.

Glibert, P. M. and T. C. Loder (1977). Automated analysis of nutrients in seawater: a manual of techniques. W.H.O.I. Technical Report No. 77-47.

Holm-Hansen, O., C. J. Lorenzen, R. W. Holmes and J.D.H. Strickland (1965). Fluorometric determination of chlorophyll. J. Cons. Perm. Int. Explor. Mer., 30: 3-15.

Kogelschatz, J. E., R. T. Barber and L. M. Garrigan (1979). Productivity data from Peru. R/V KNORR Cruise 73-2 and 73-3 - February-March, 1978. CUEA Data Report 57. 130 pp.

Koroleff, F. (1970). Information on techniques and methods for seawater analysis. Int. Con. Explor. Sea, Interlab. Report No. 3: 19-22.

Loder, T. C. and P. M. Glibert (1977). Blank and salinity corrections for automated nutrient analysis of estuarine and seawaters. In: Advances in Automated Analysis, v. 2. Proc. Technicon International Congress, 1976. Also available as Report No. UNH-SG-JR-101.

Lorenzen, C. J. (1966). A method for the continuous measurement of in vivo chlorophyll concentration. Deep Sea Res., 13: 223-227.

Murphy, J. and J. P. Riley (1962). A modified single solution method for the determination of phosphate in natural waters. Anal. Chim. Acta, 27: 31-36.

Rowe, G. T. and W. D. Gardner (1979). Sedimentation rates in the slope water of the northwest Atlantic Ocean measured directly with sediment traps. J. Mar. Res., 37: 581-599.

References (Continued)

SCOR/UNESCO (1966). Determination of photosynthetic pigments in seawater. Report of SCOR/UNESCO. Working group 17 (Paris): Monographs in Oceanographic Methodology, 1. 69 pp.

Staresinic, N. (1978). The vertical flux of particulate organic matter in the Peru coastal upwelling as measured with a free-drifting sediment trap. Ph.D. Thesis, W.H.O.I./M.I.T. Joint Program in Biological Oceanography.

Technicon Industrial Systems (1972). Nitrate and nitrite in water and seawater. Industrial Method No. 168-71W.

Technicon Industrial Systems (1973a). Orthophosphate in water and seawater. Industrial Method No. 155-71W.

Technicon Industrial Systems (1973b). Nitrite in water and seawater. Industrial Method No. 161-71W.

Technicon Industrial Systems (1973c). Silicates in water and seawater. Industrial Method No. 186-72W.

Yentsch, C. S. and D. W. Menzel (1963). A method for the determination of phytoplankton chlorophyll and phaeophytin by fluorescence. Deep Sea Res., 10: 221-231.

FIGURES OF DISSOLVED OXYGEN, POTENTIAL TEMPERATURE, SALINITY, SILICATE, NITRATE,

PHOSPHATE, PRODUCTIVITY INDEX, CHLOROPHYLL A, AND 24 HOUR - C -

FIXATION FOR NISKIN, EUPHOTIC ZONE, AND BODMAN CASTS

FOR STATIONS 2-7 (TABLE 1).

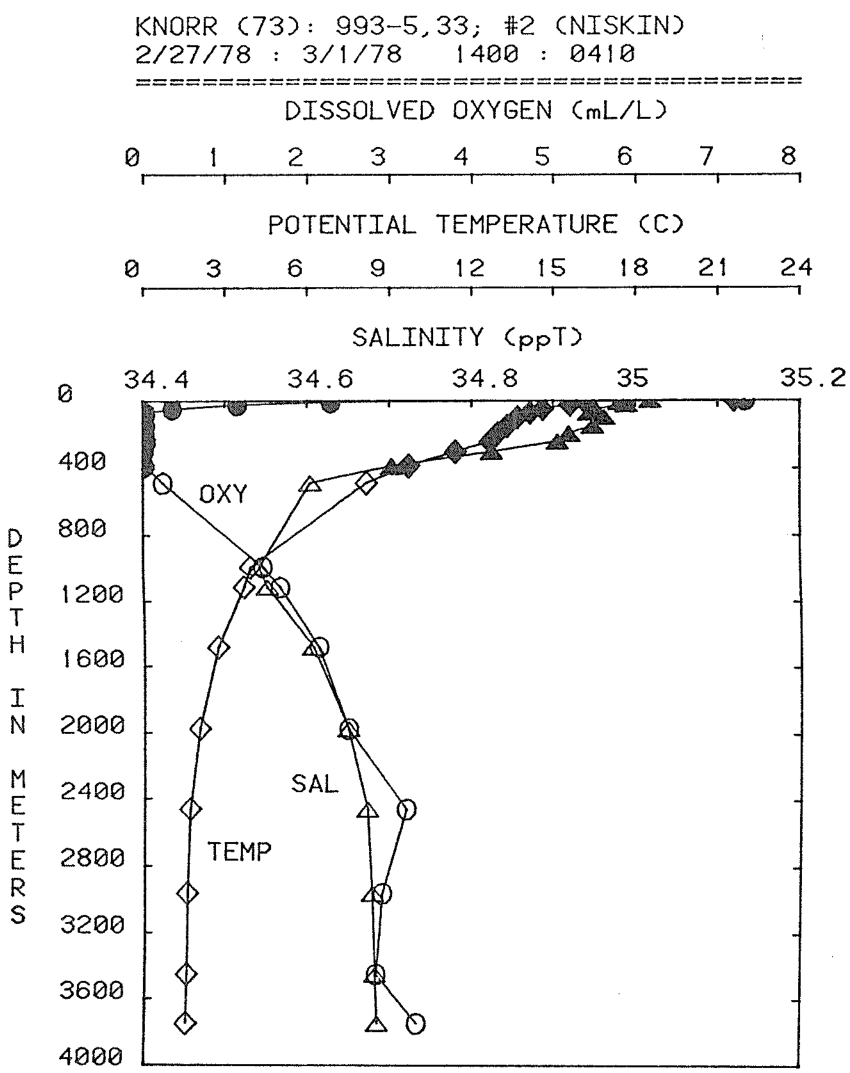


Fig. 3-2N

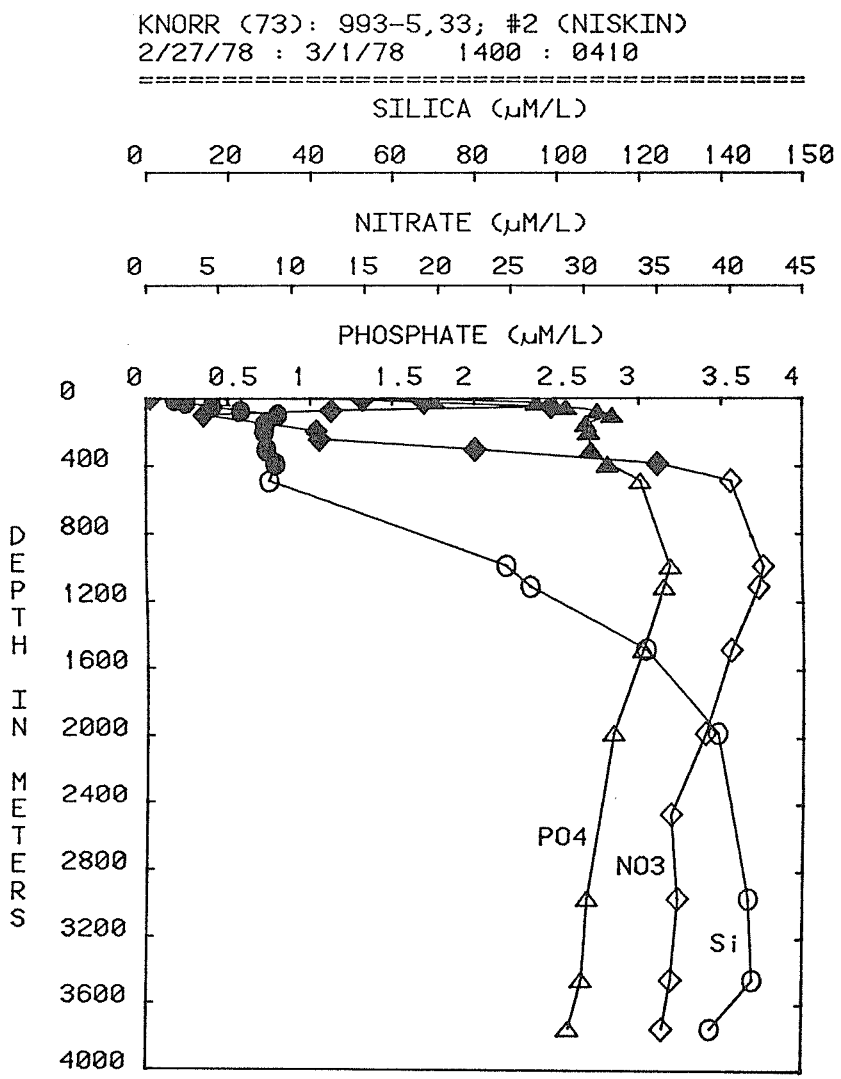


Fig. 4-2N

Niskin data, Station 2. Open symbols indicate data from 3/1/78, shaded symbols from 2/27/78.

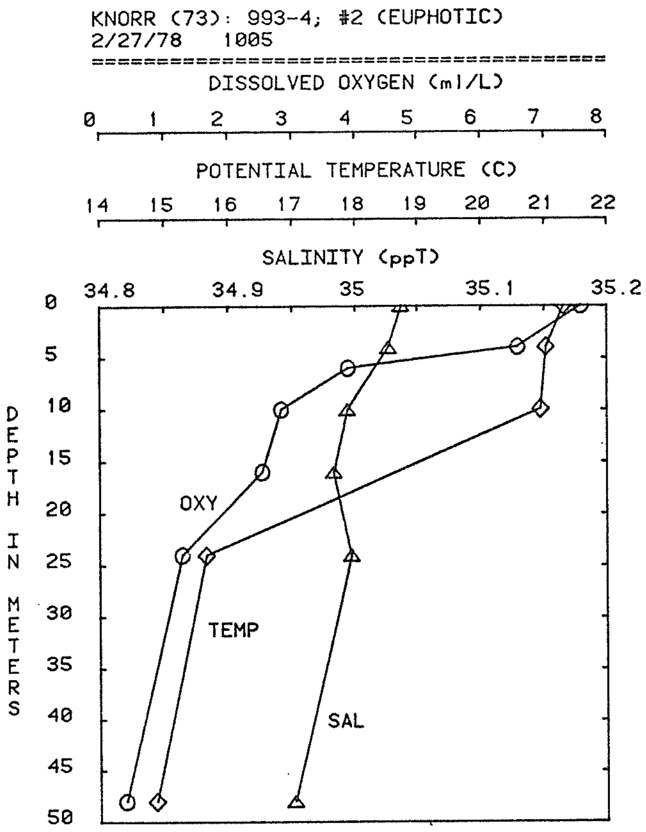


Fig. 5-2E

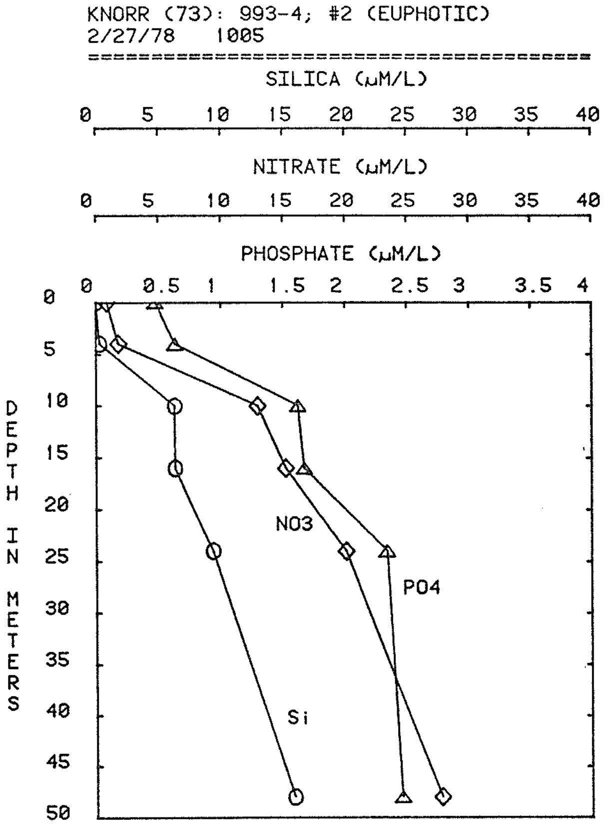


Fig. 6-2E

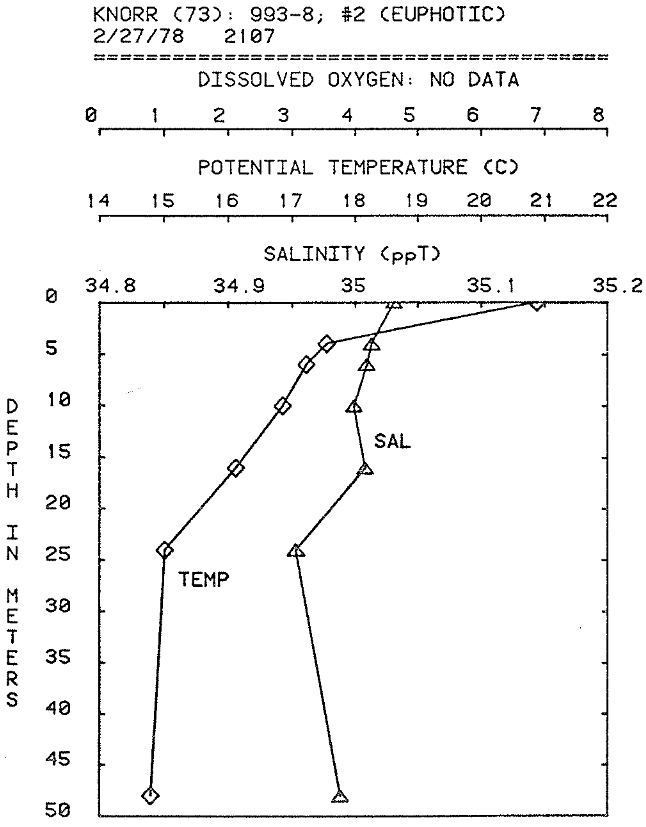


Fig. 7-2E

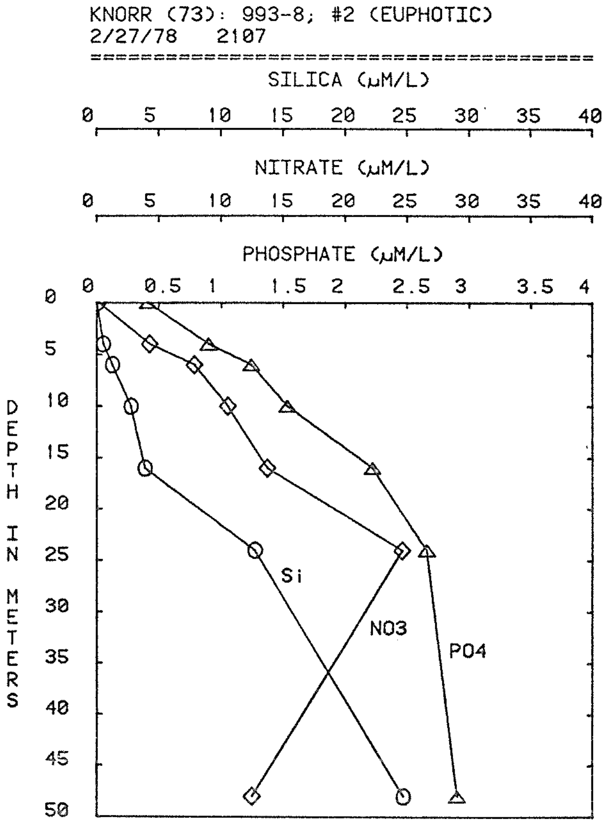


Fig. 8-2E

AM/PM euphotic data, Station 2: 2/27/78.

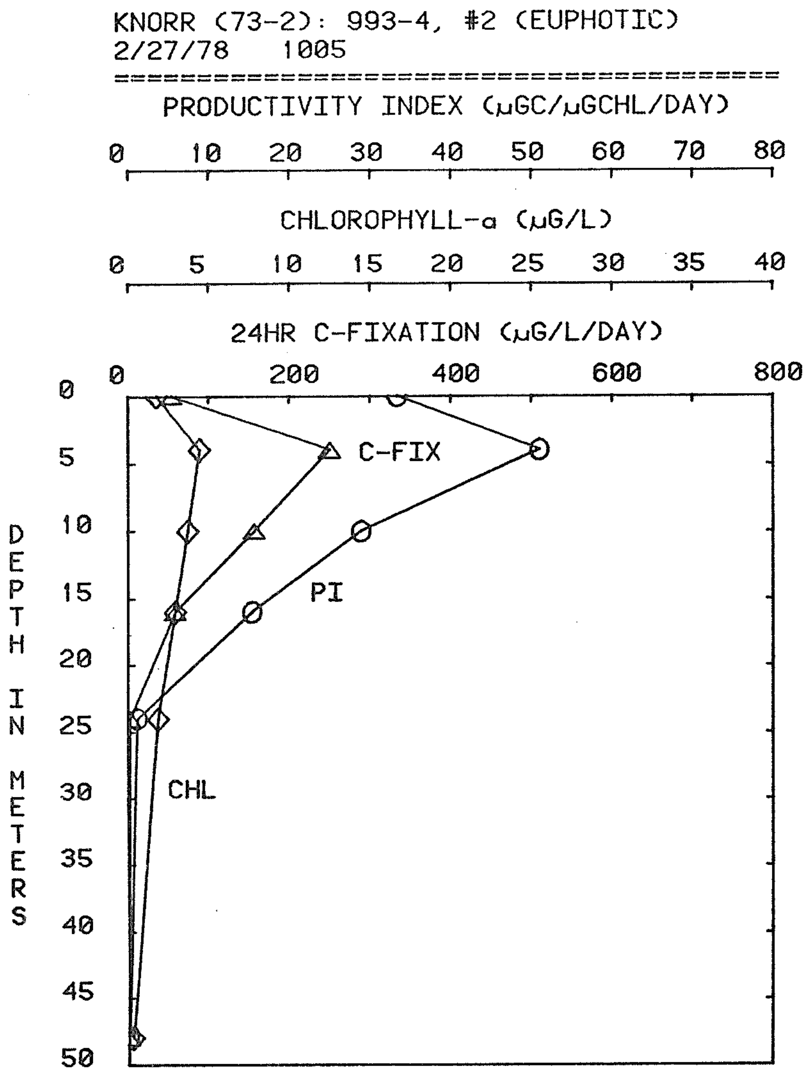


Fig. 9-2E

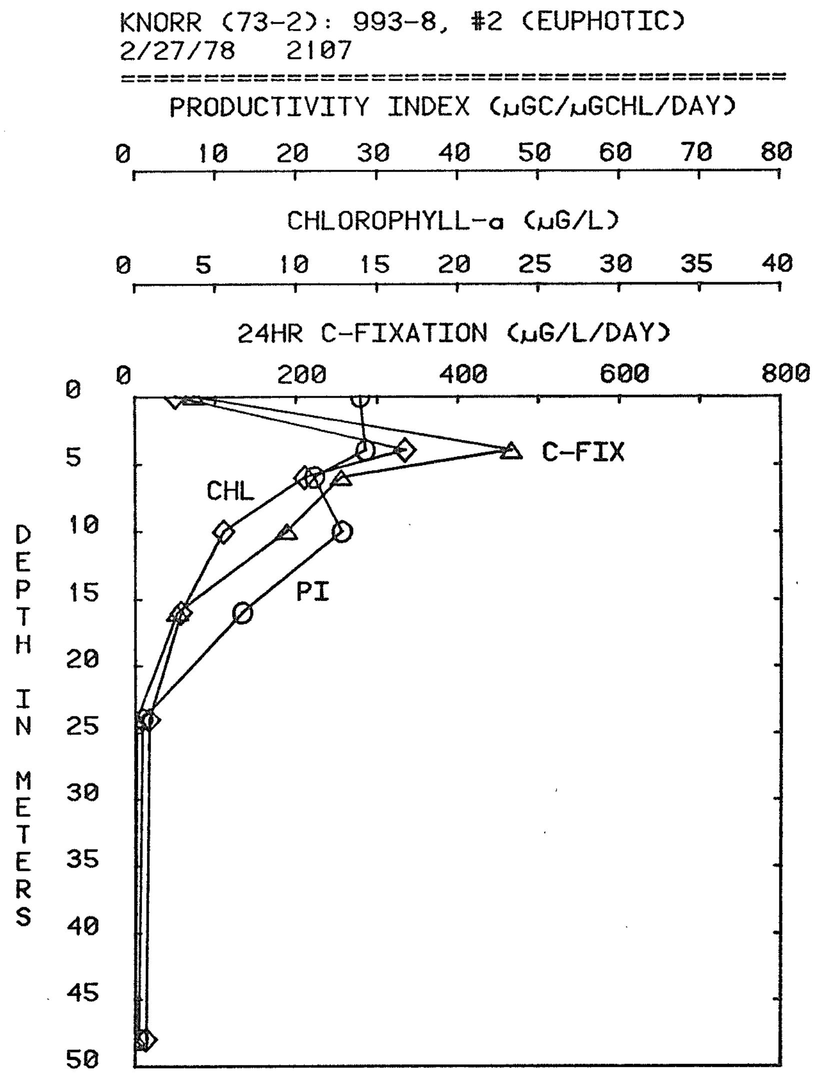


Fig. 10-2E

AM/PM euphotic data, Station 2: 2/27/78.

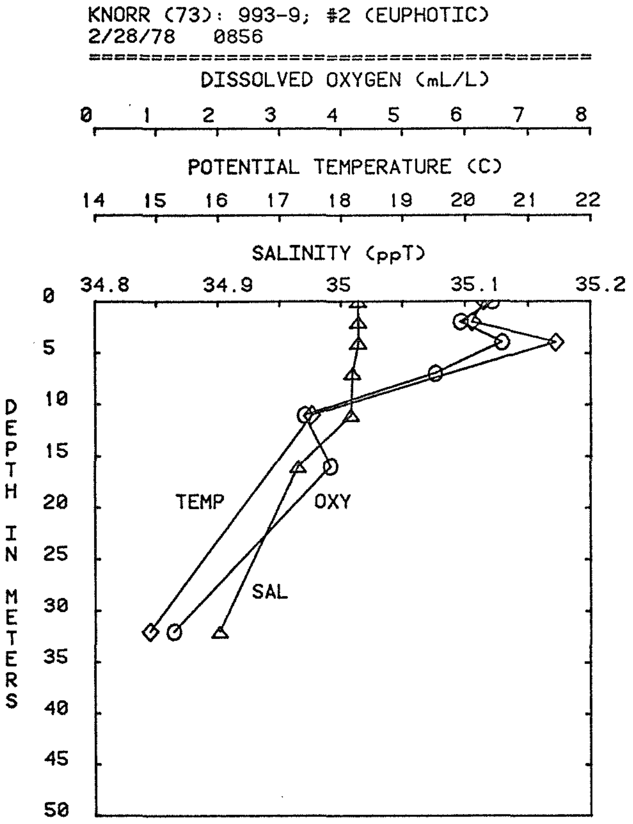


Fig. 11-2E

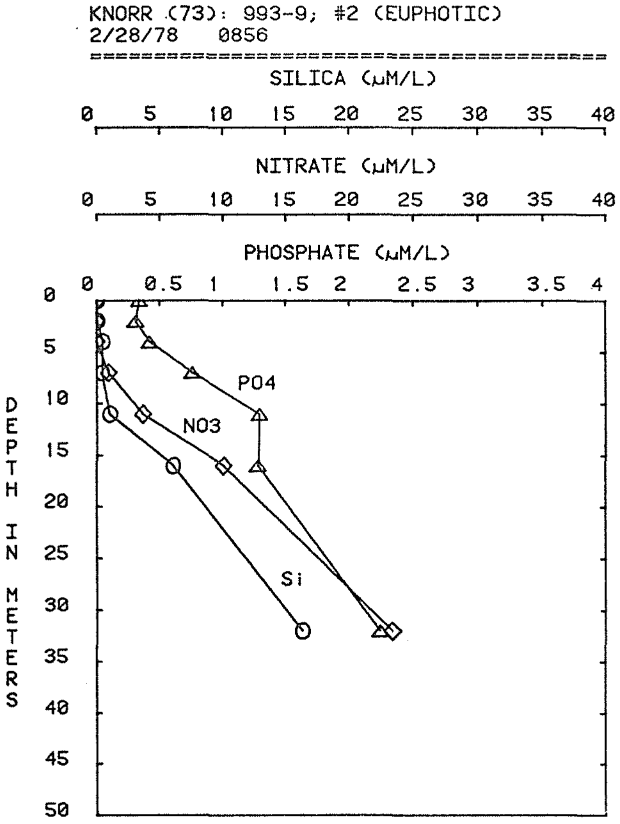


Fig. 12-2E

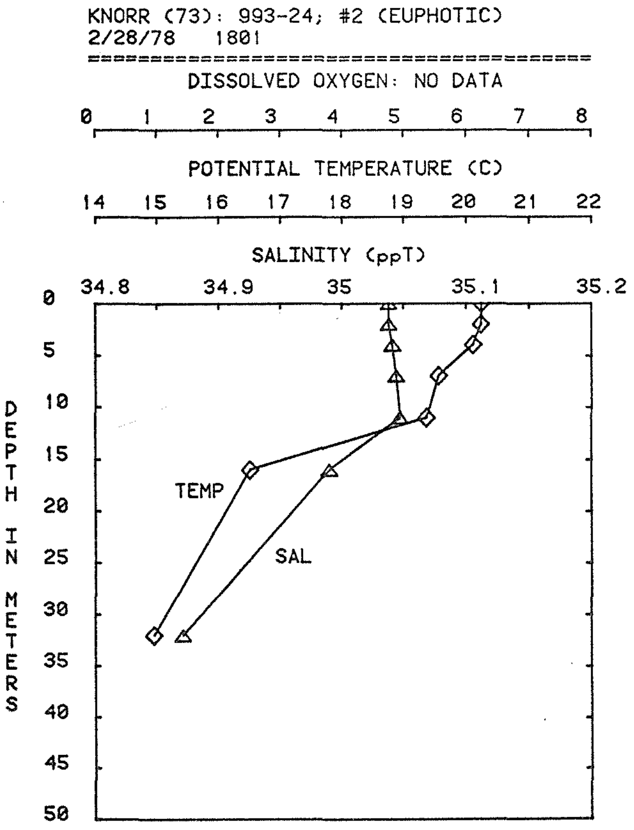


Fig. 13-2E

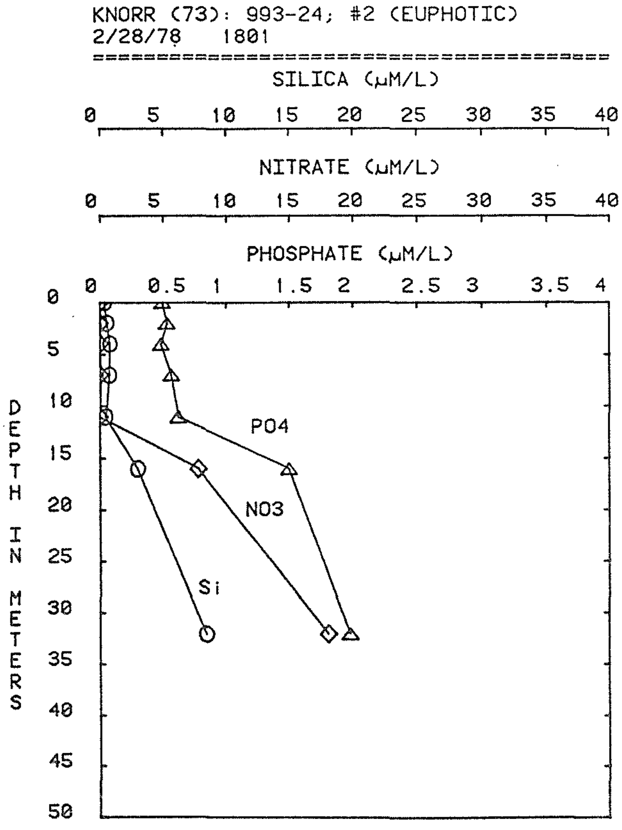


Fig. 14-2E

AM/PM euphotic data, Station 2: 2/28/78.

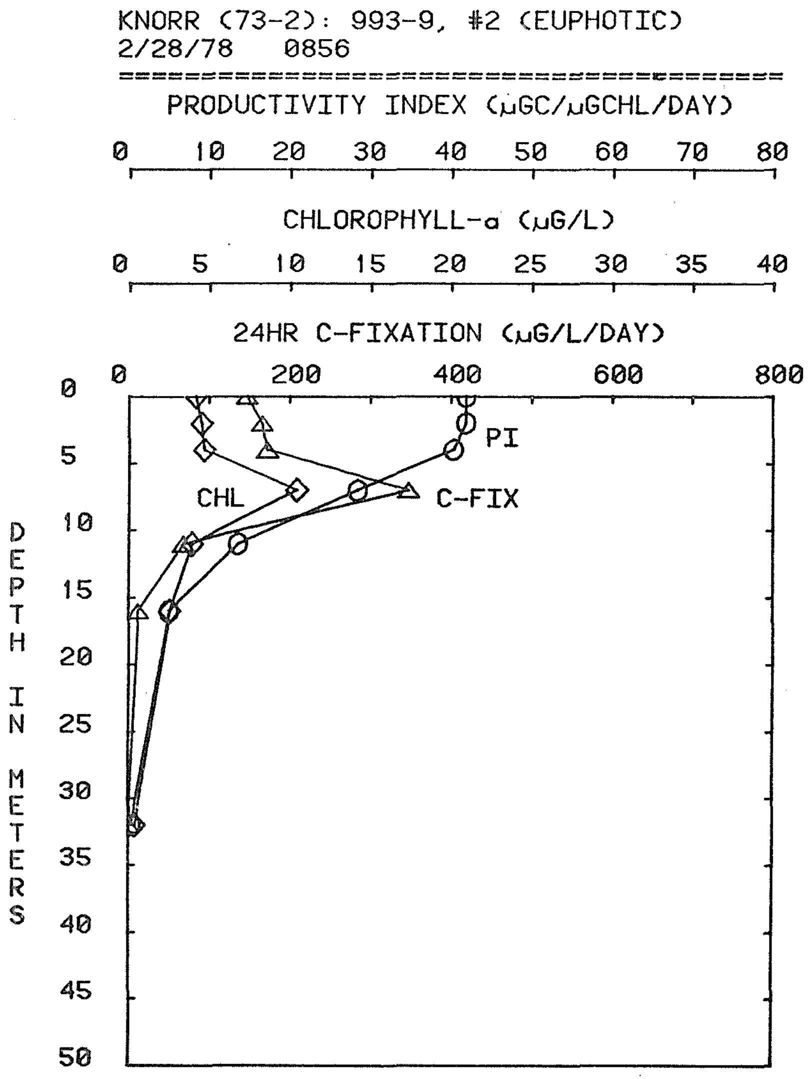


Fig. 15-2E

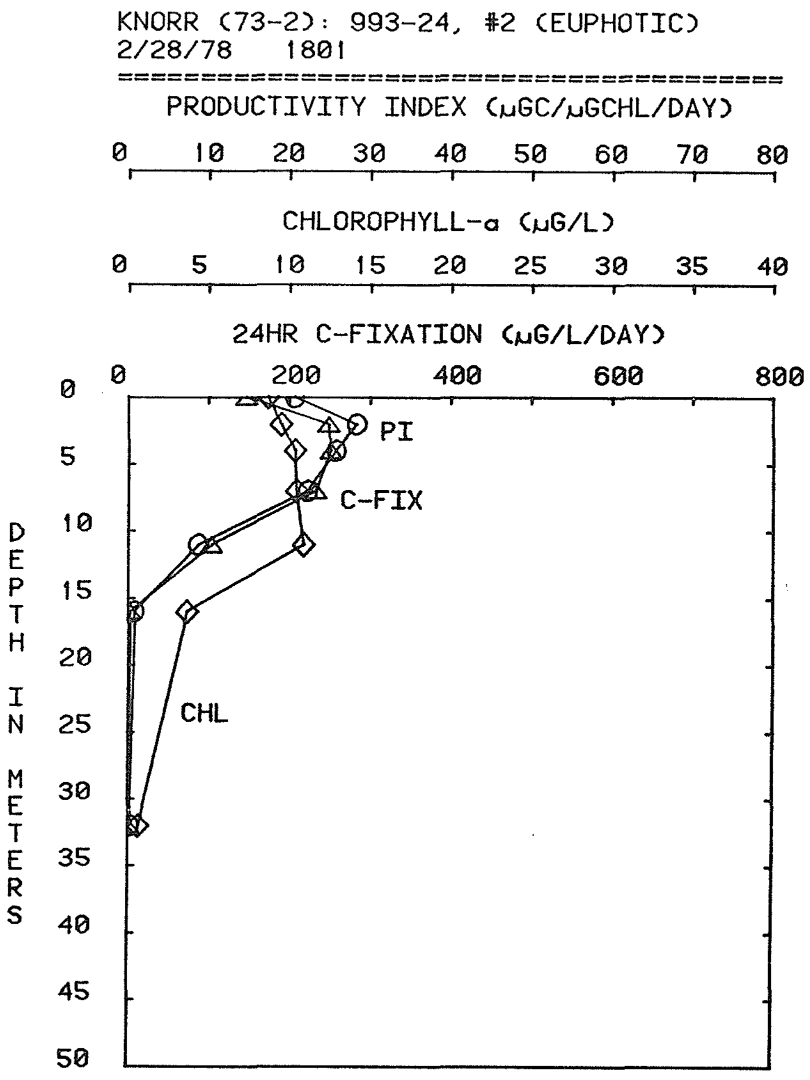


Fig. 16-2E

AM/PM euphotic data, Station 2: 2/28/78.

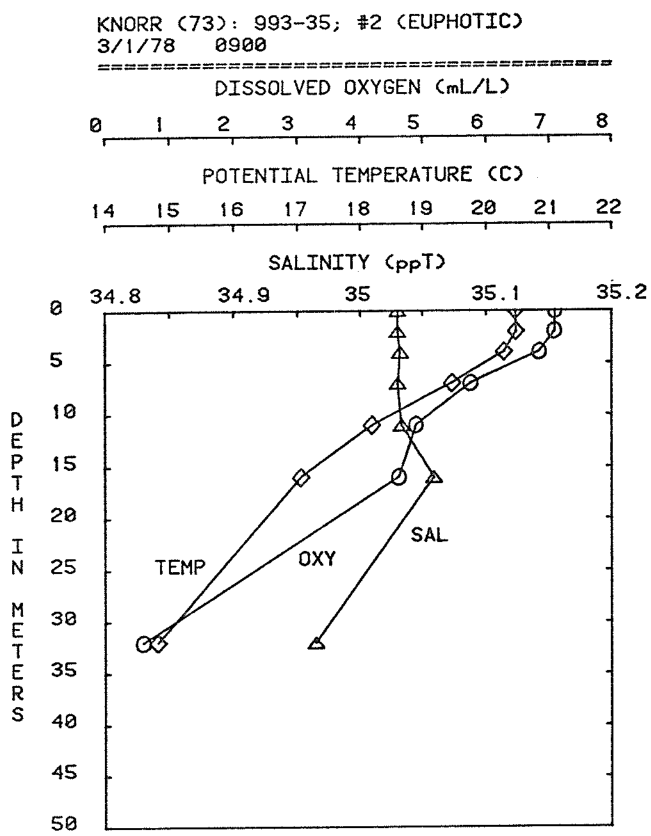


Fig. 17-2E

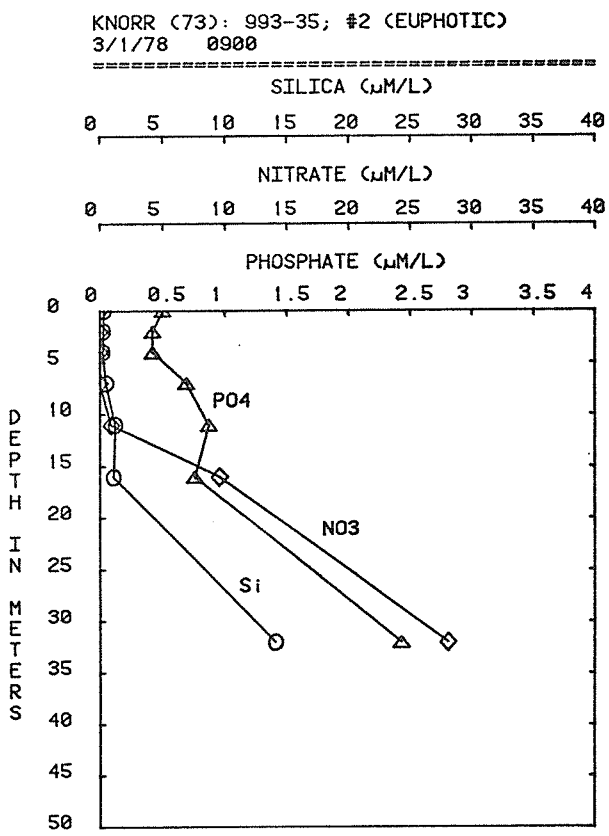


Fig. 18-2E

AM euphotic data, Station 2: 3/1/78.

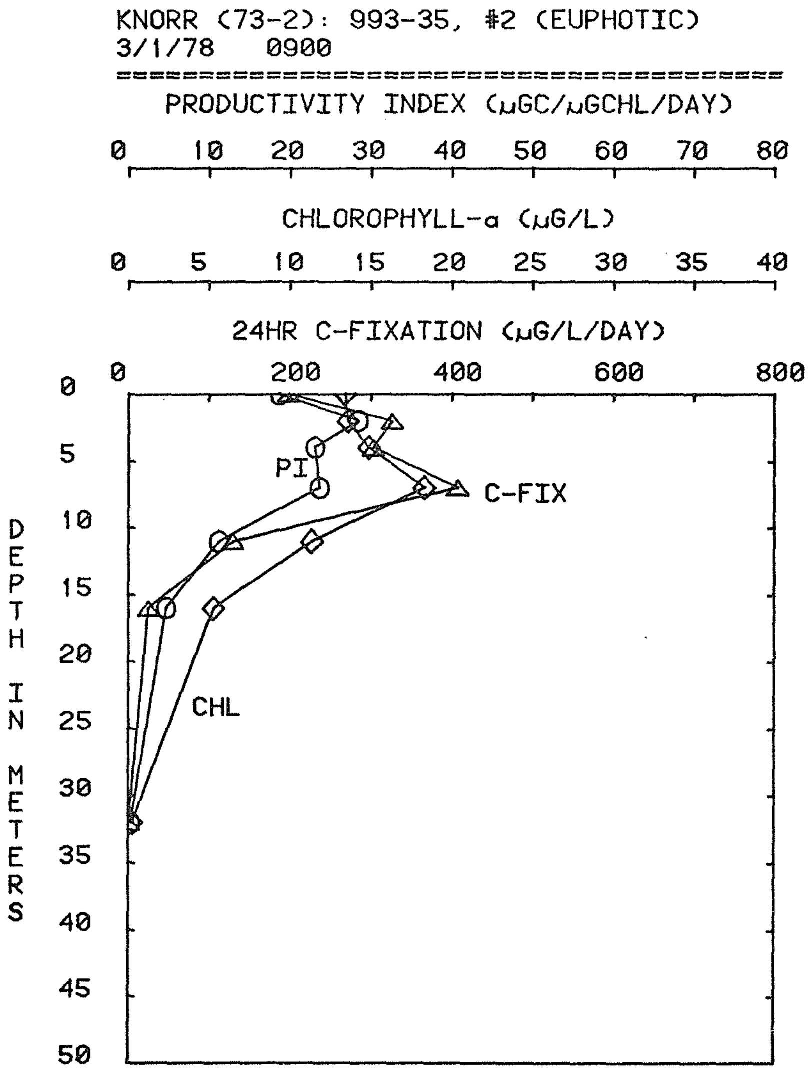


Fig. 19-2E

AM euphotic data, Station 2: 3/1/78.

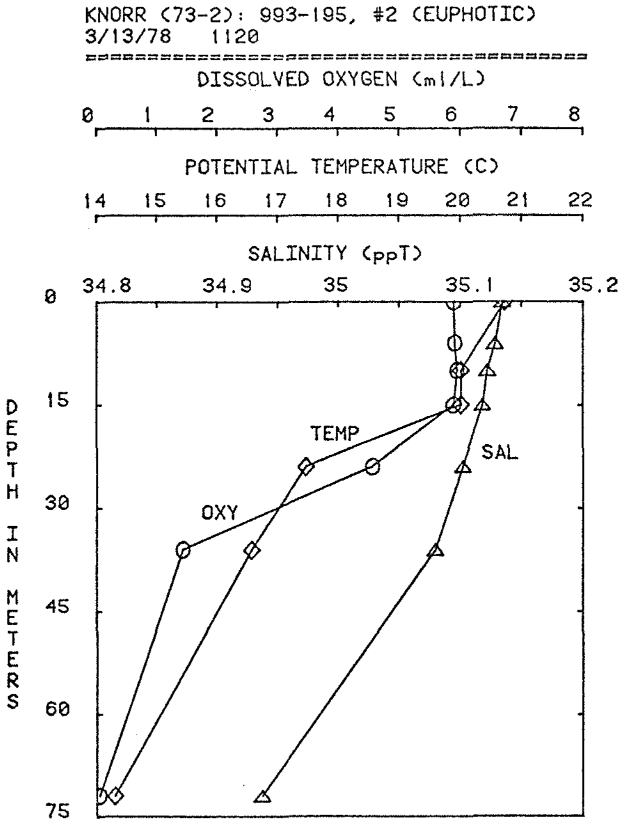


Fig. 20-2E

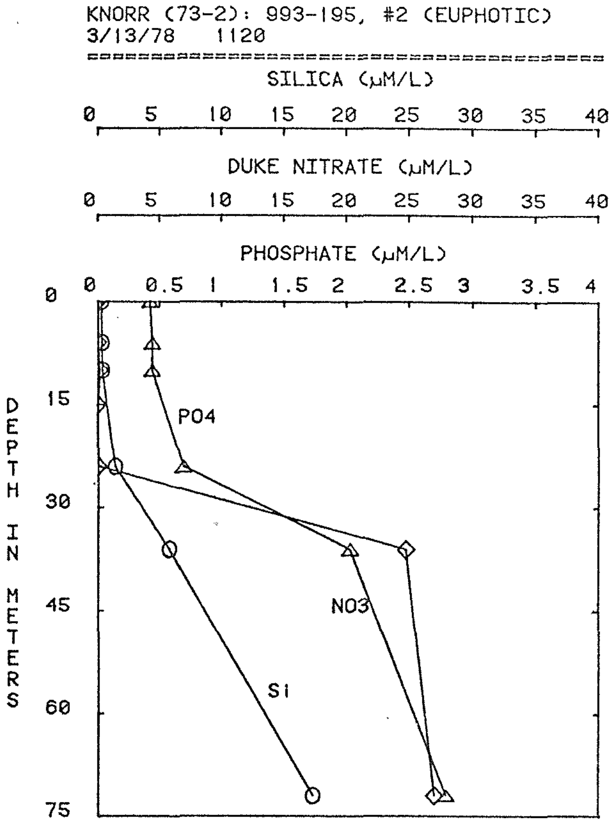


Fig. 21-2E

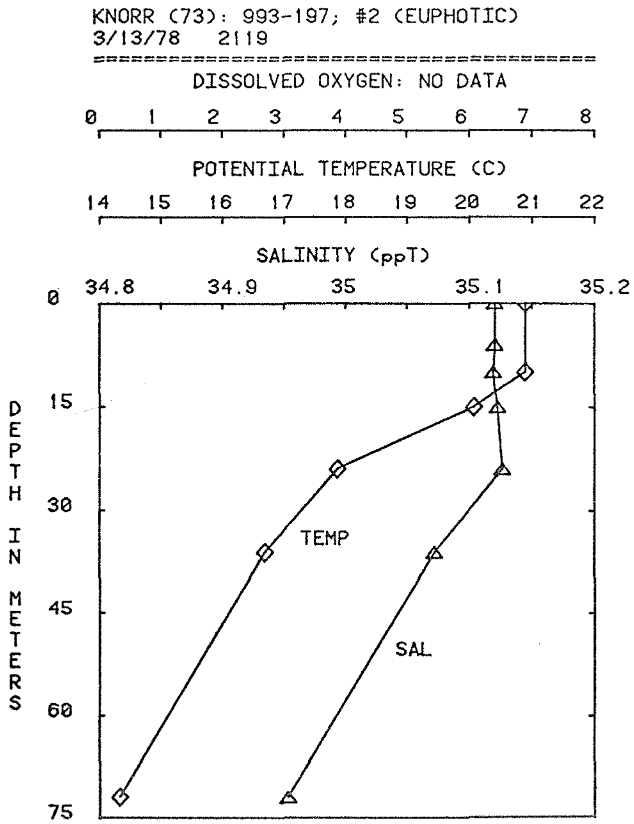


Fig. 22-2E

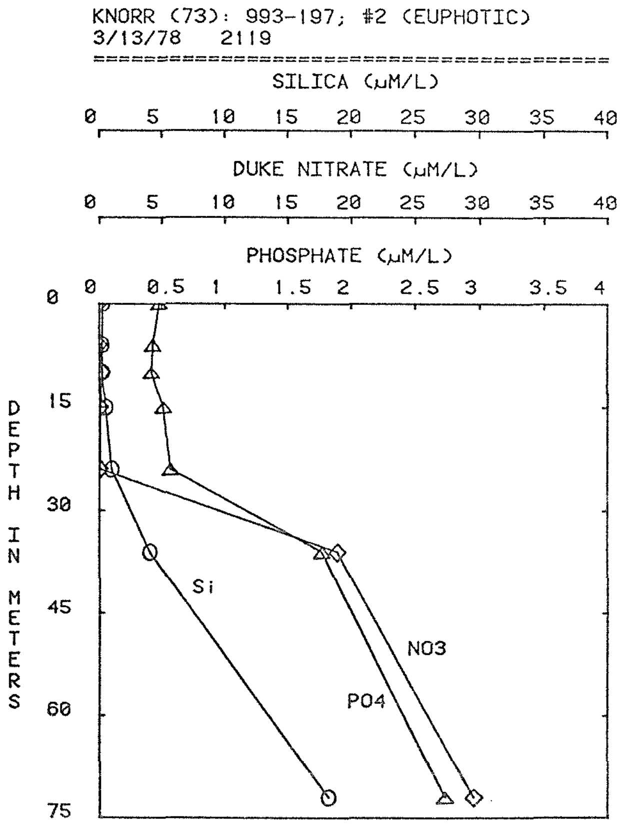


Fig. 23-2E

AM/PM euphotic data, Station 2: 3/13/78.

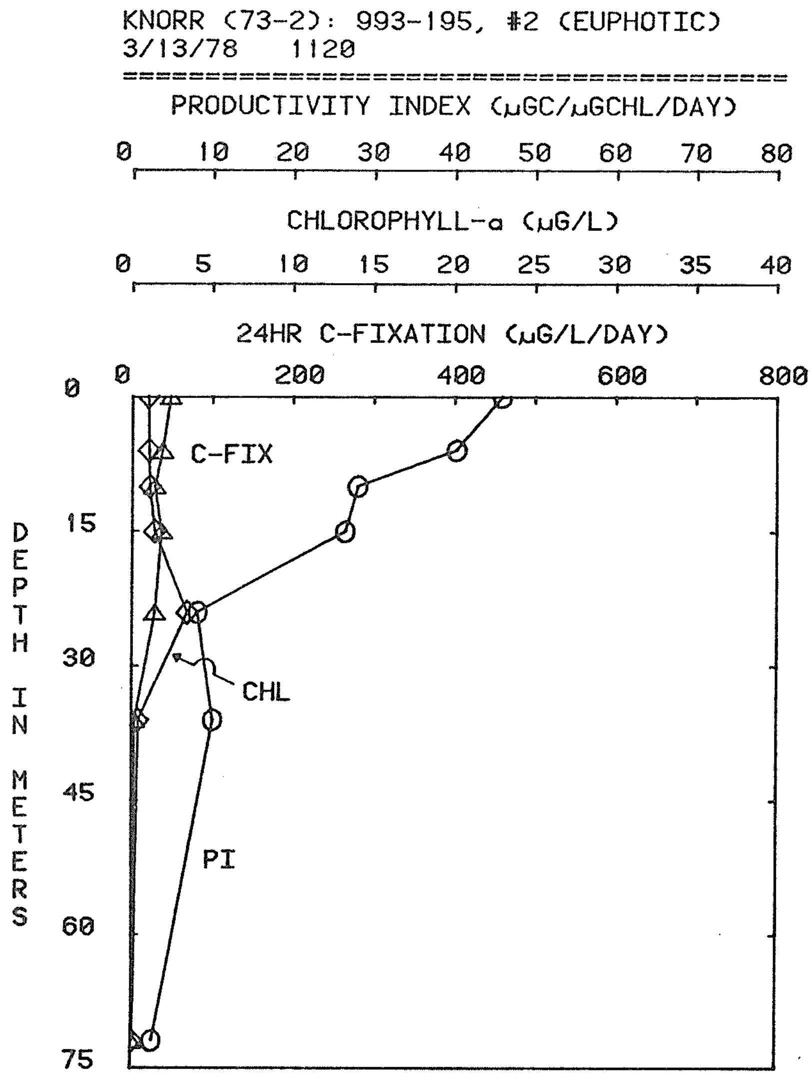


Fig. 24-2E

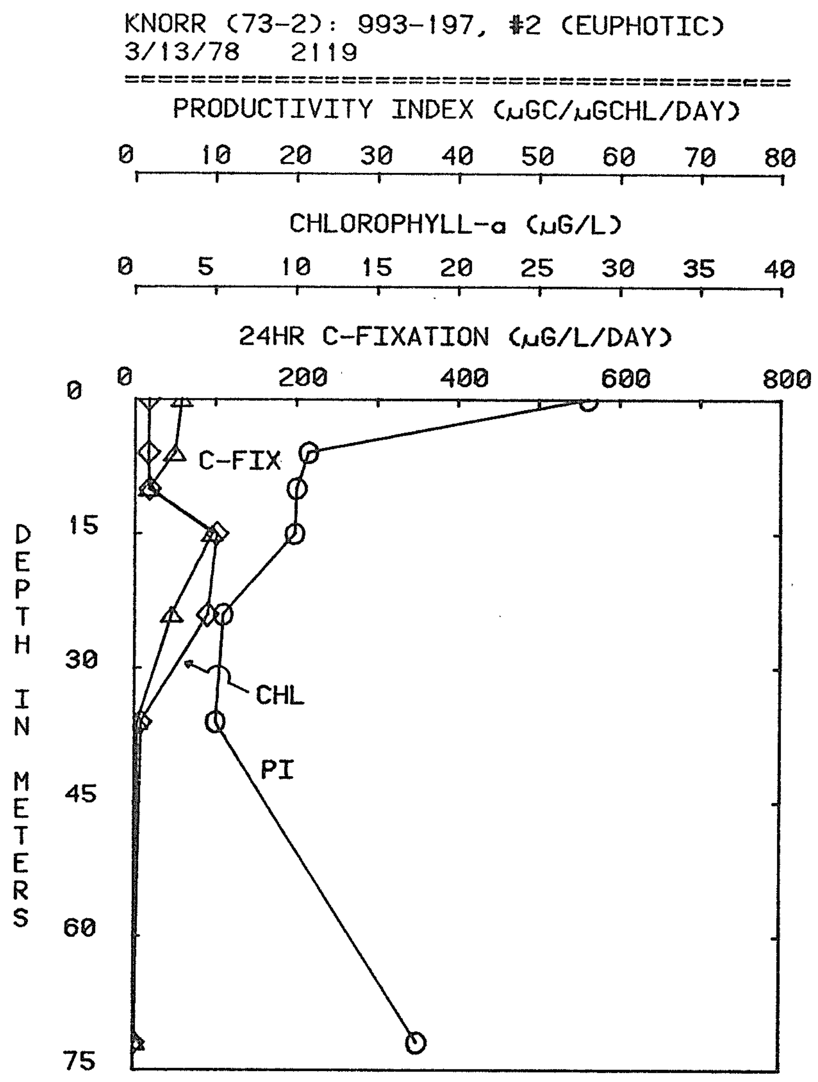


Fig. 25-2E

AM/PM euphotic data, Station 2: 3/13/78.

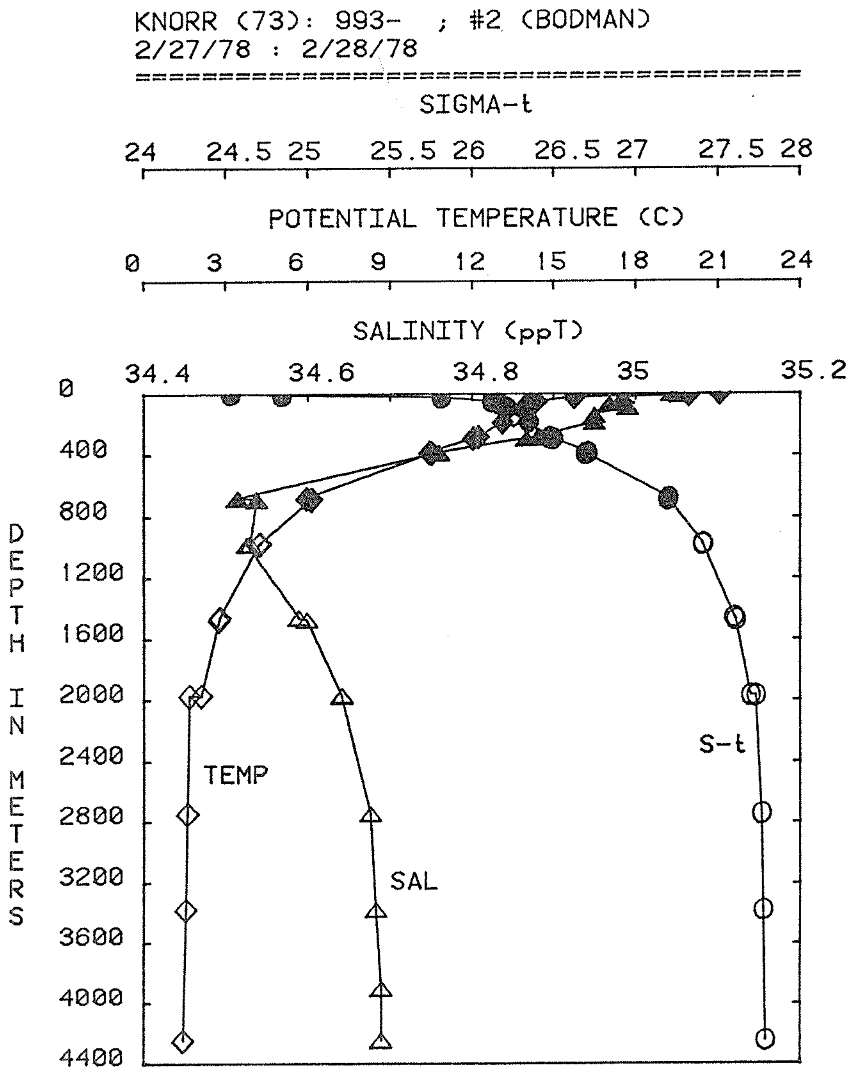


Fig. 26-2B

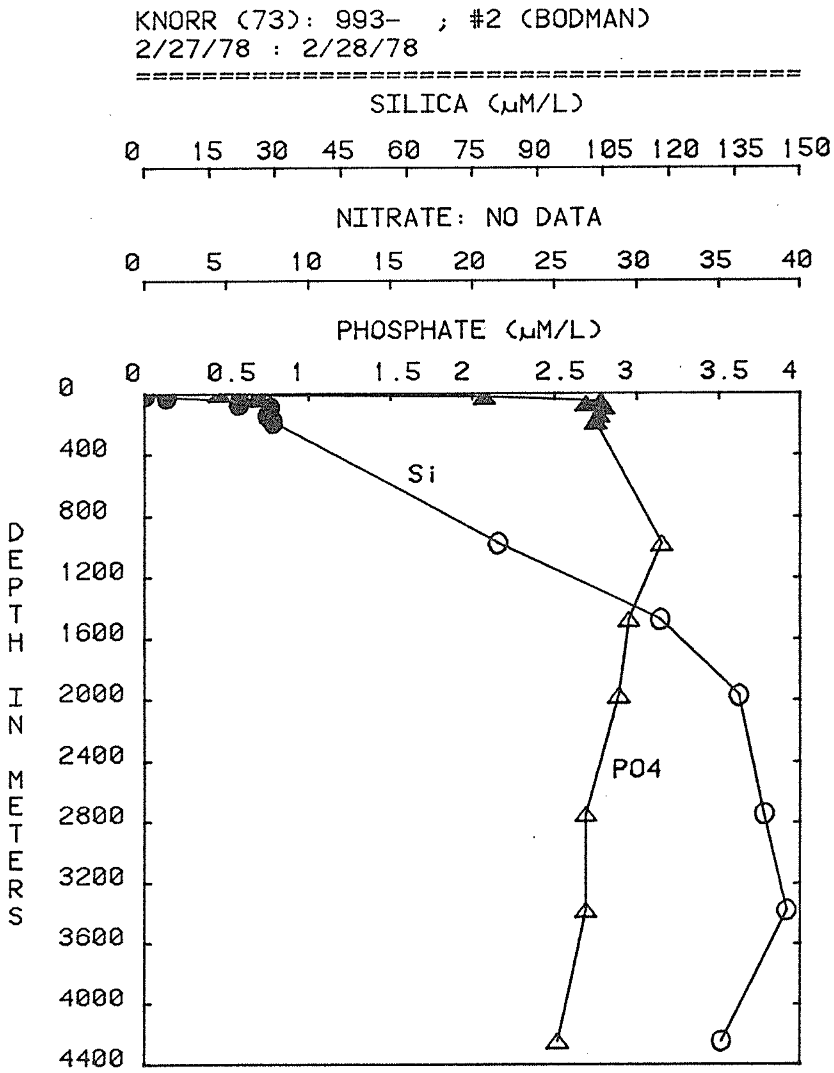


Fig. 27-2B

Bodman data, Station 2. Open symbols indicate data from 2/28/78, shaded symbols from 2/27/78.

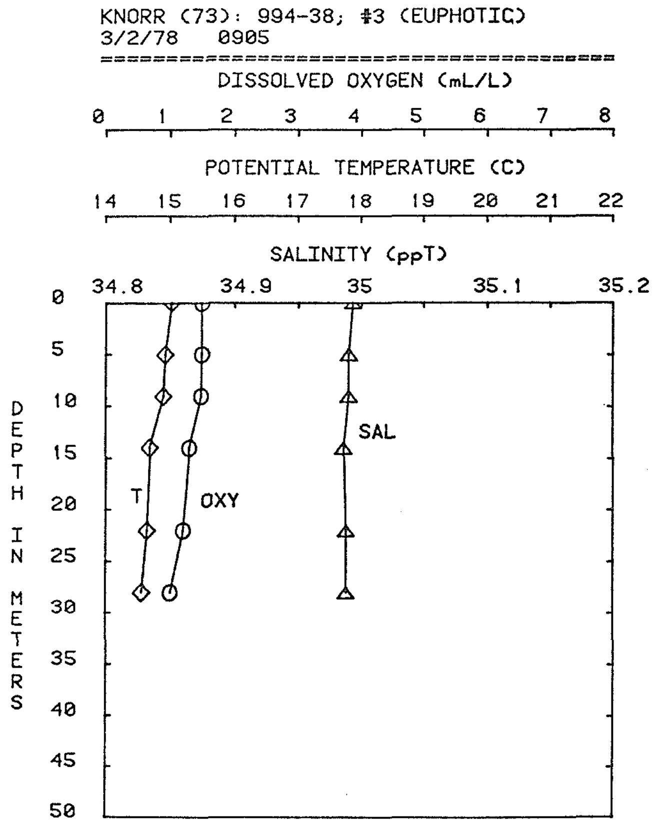


Fig. 28-3E

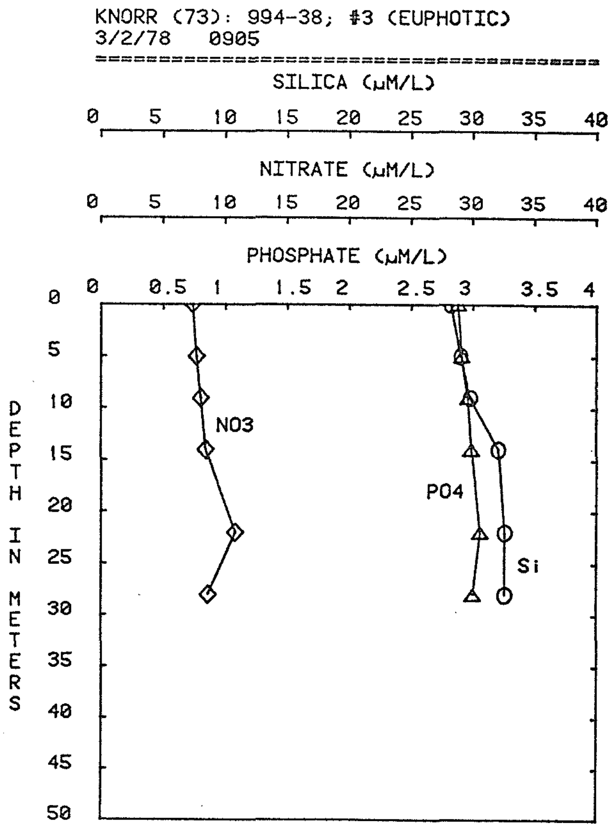


Fig. 29-3E

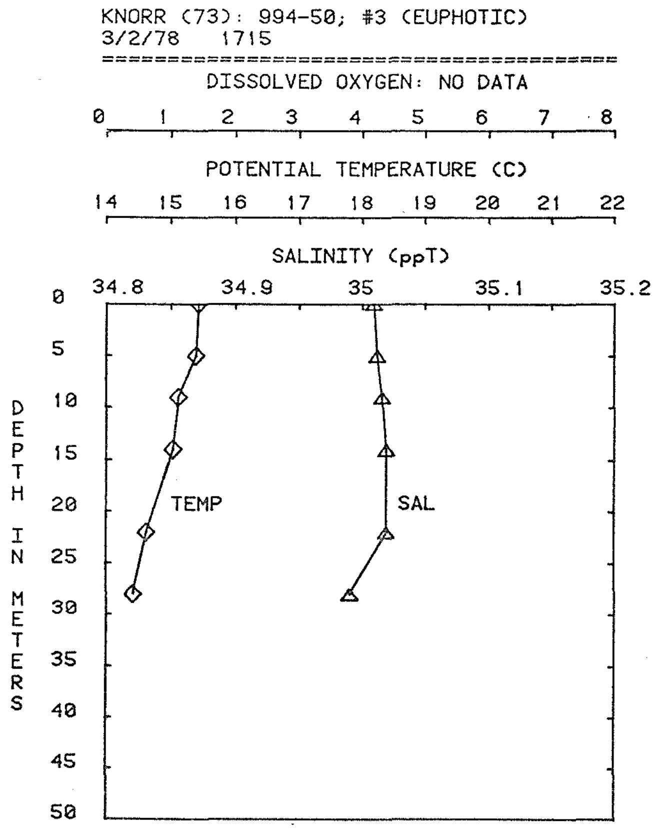


Fig. 30-3E

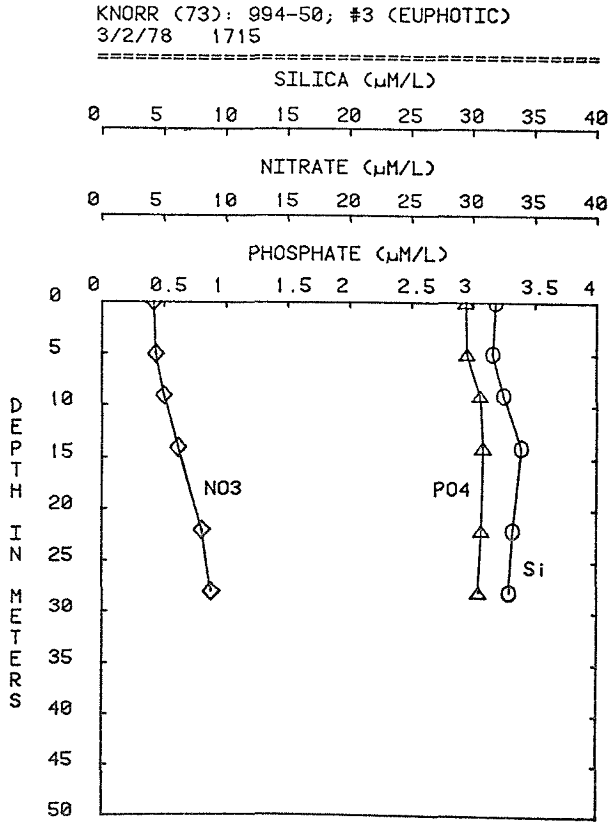


Fig. 31-3E

AM/PM euphotic data, Station 3: 3/2/78.

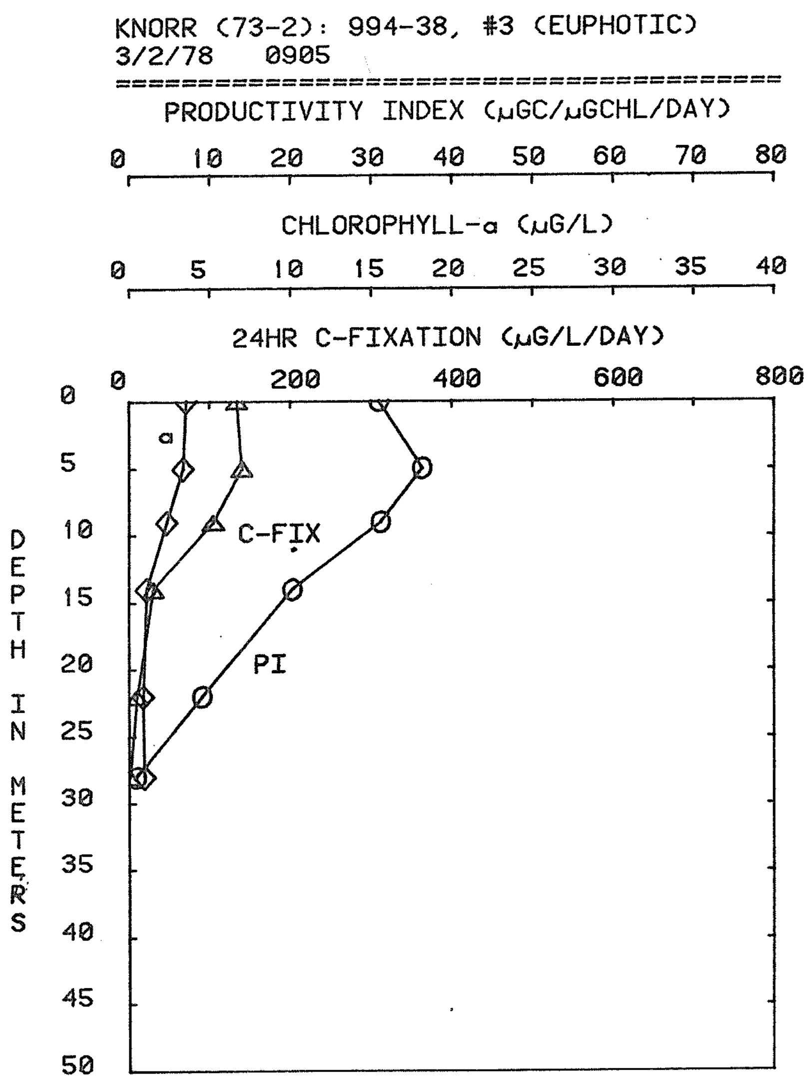


Fig. 32-3E

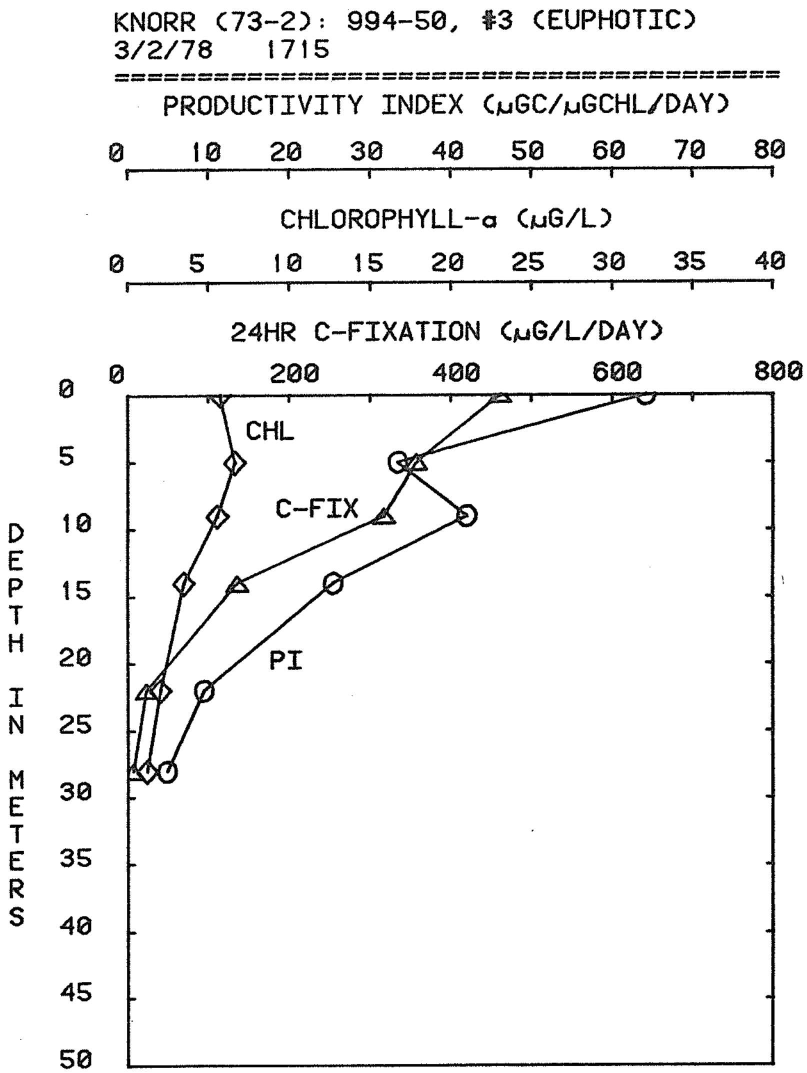


Fig. 33-3E

AM/PM euphotic data, Station 3: 3/2/78.

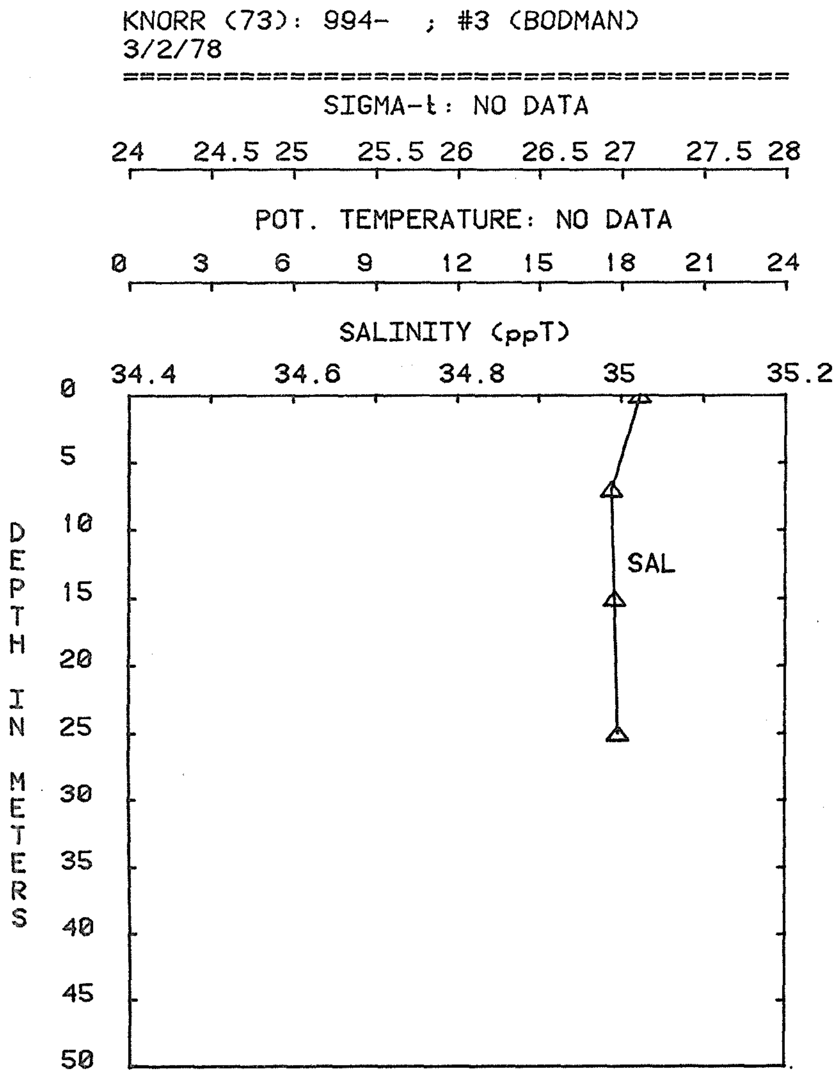


Fig. 34-3B

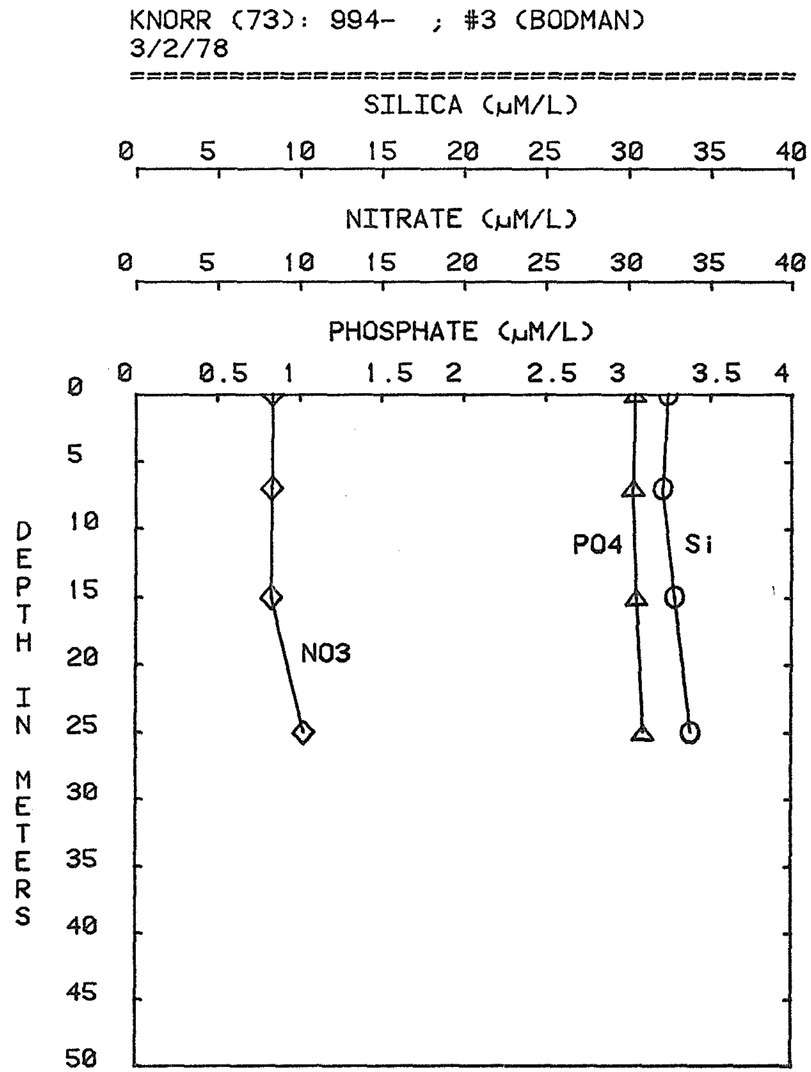


Fig. 35-3B

Bodman data, Station 3: 3/2/78.

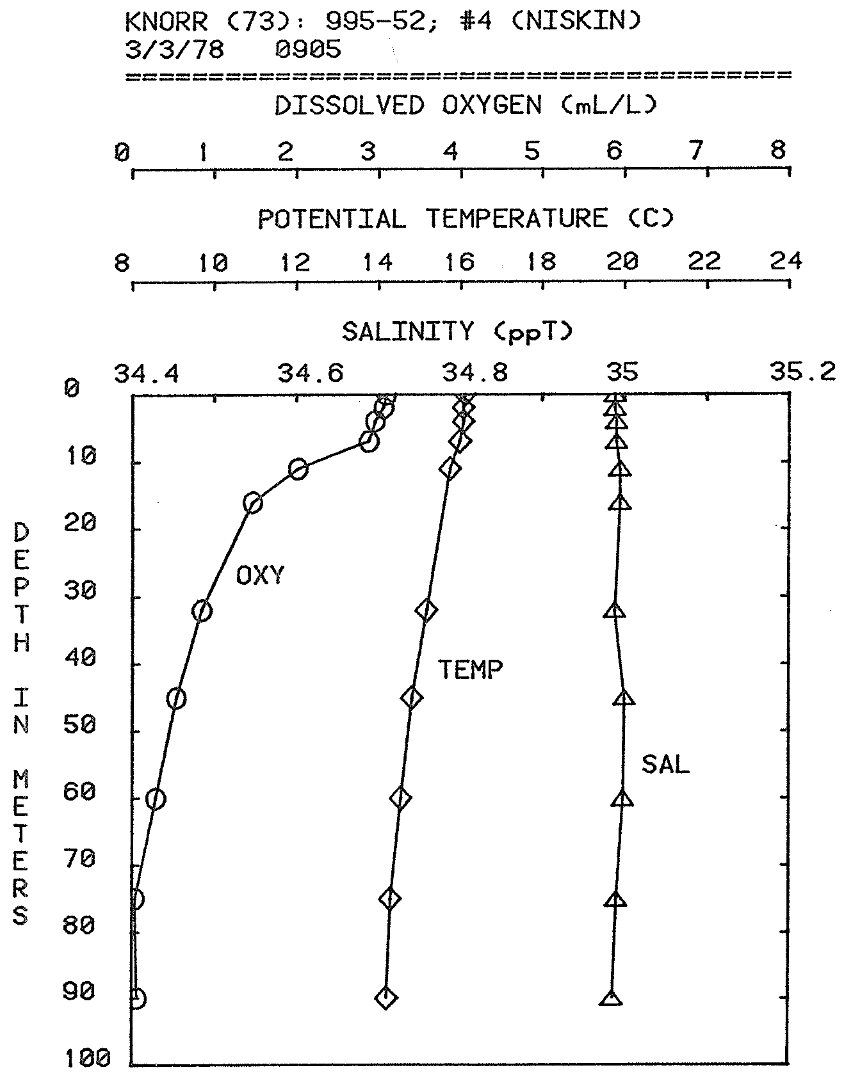


Fig. 36-4N

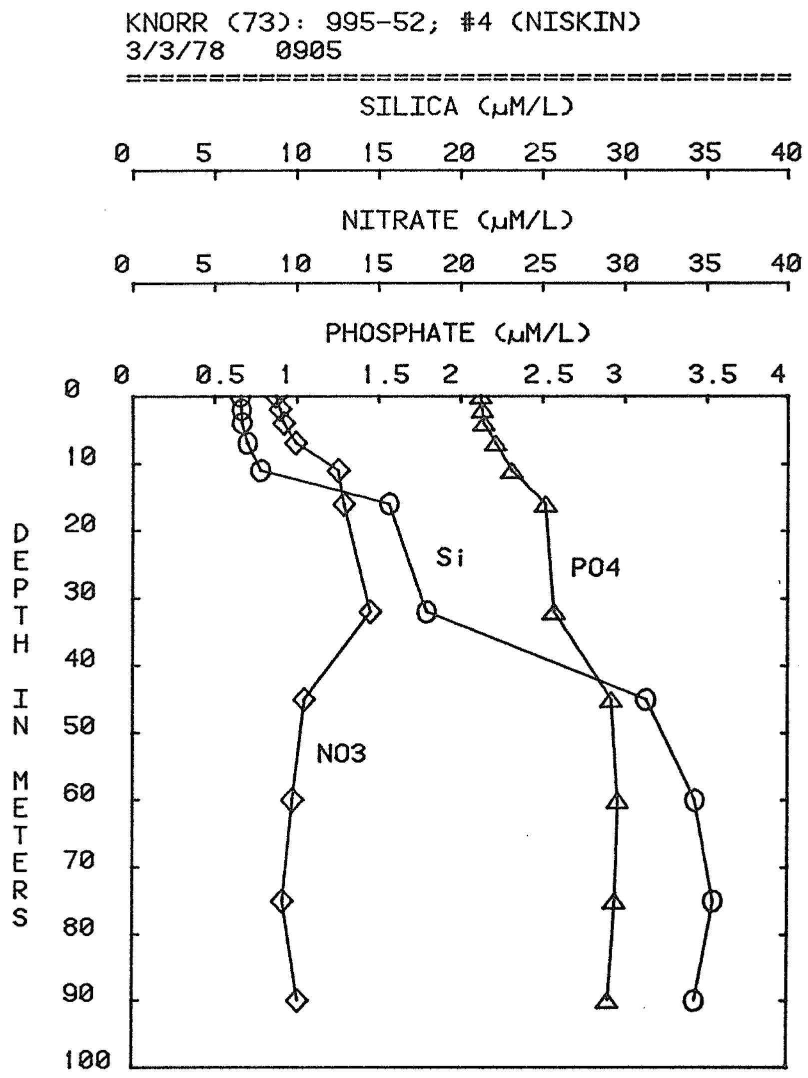


Fig. 37-4N

Niskin data, Station 4: 3/3/78.

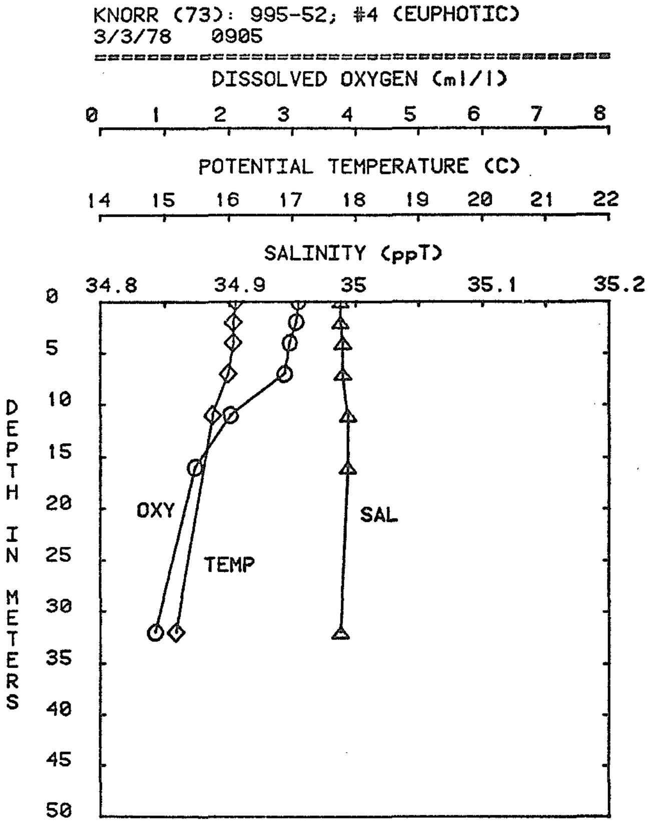


Fig. 38-4E

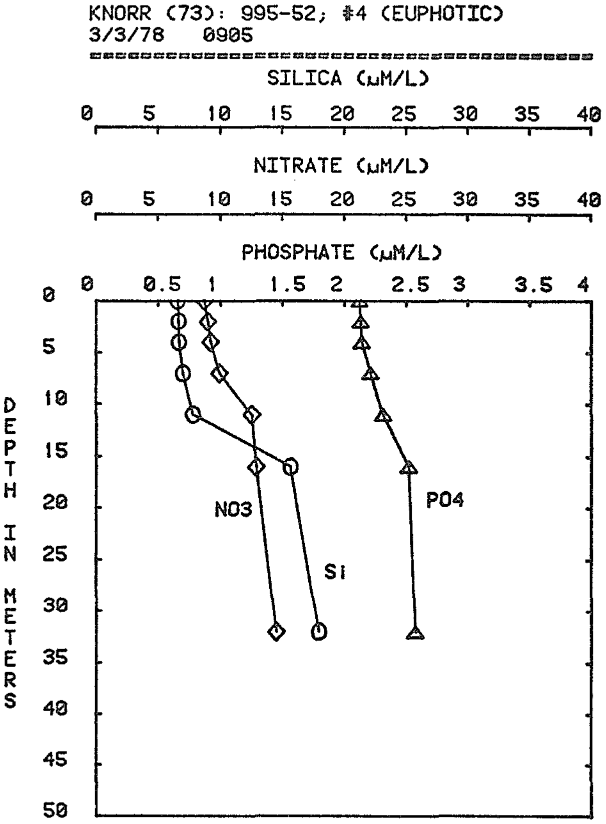


Fig. 39-4E

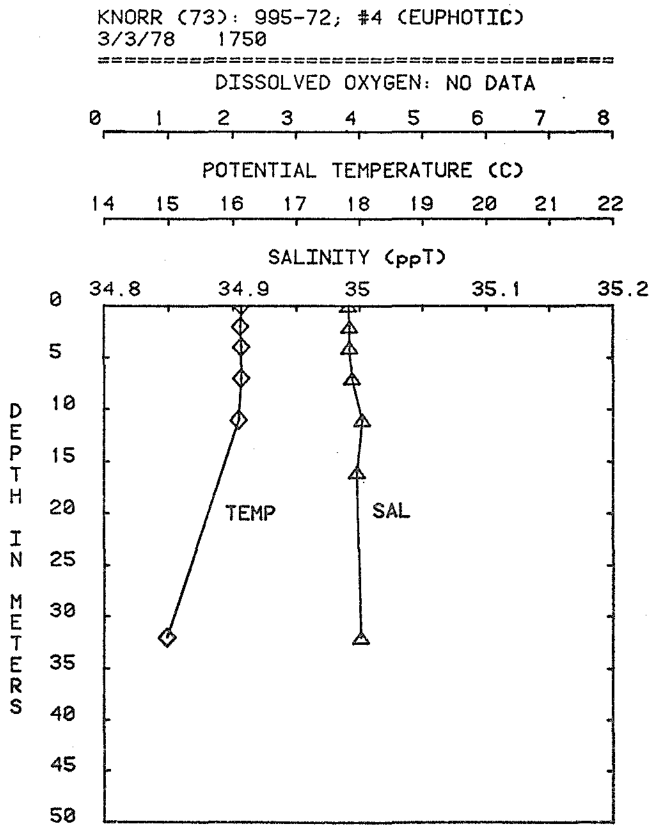


Fig. 40-4E

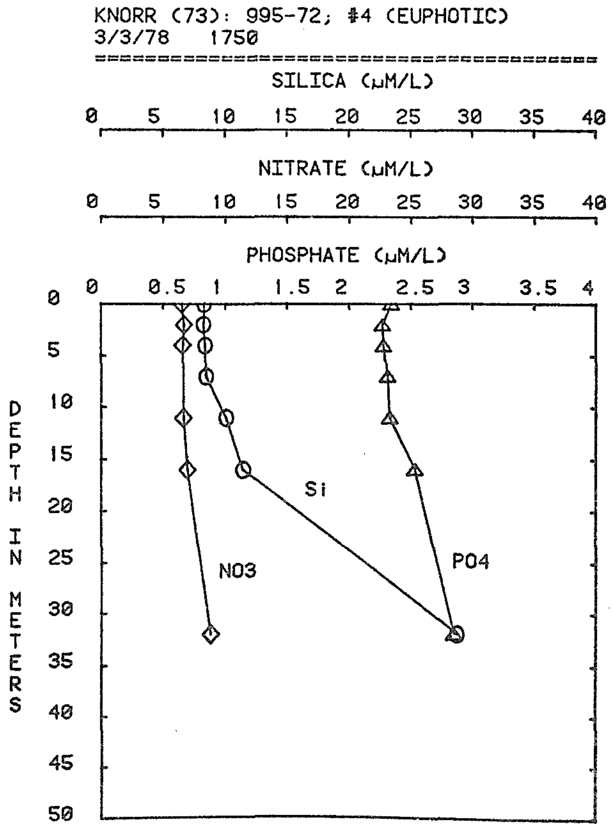


Fig. 41-4E

AM/PM euphotic data, Station 4: 3/3/78.

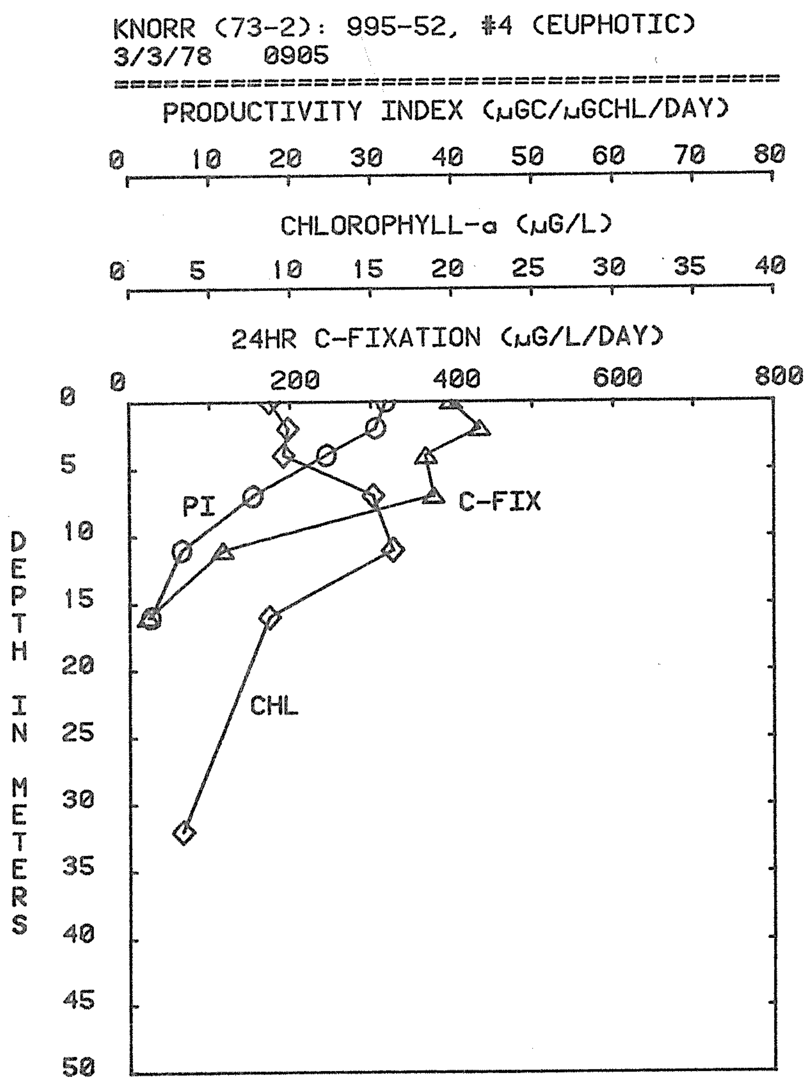


Fig. 42-4E

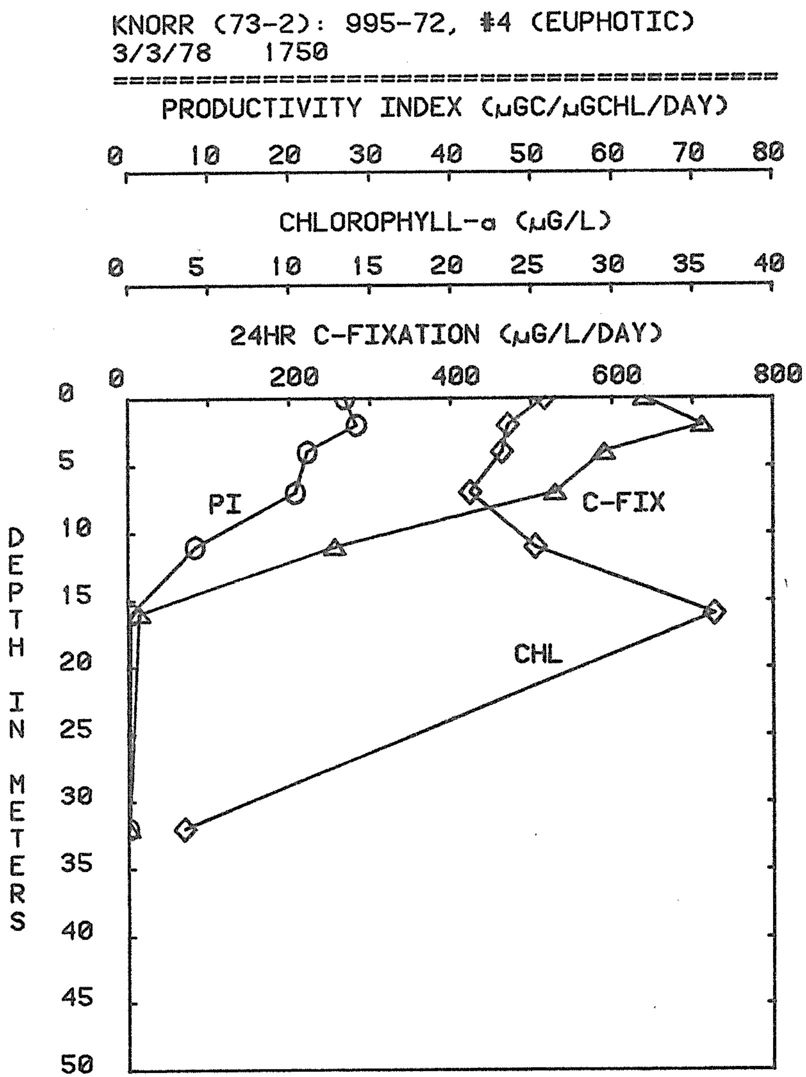


Fig. 43-4E

AM/PM euphotic data, Station 4: 3/3/78.

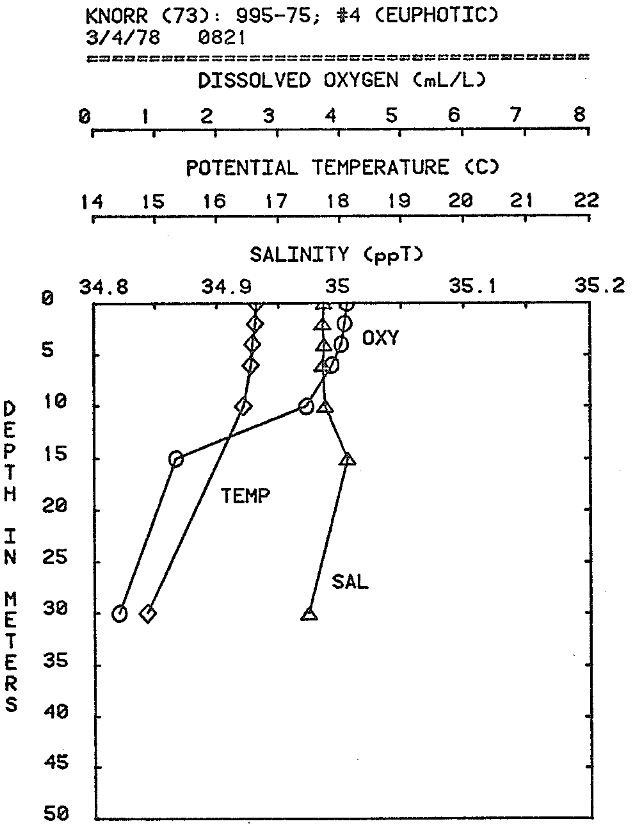


Fig. 44-4E

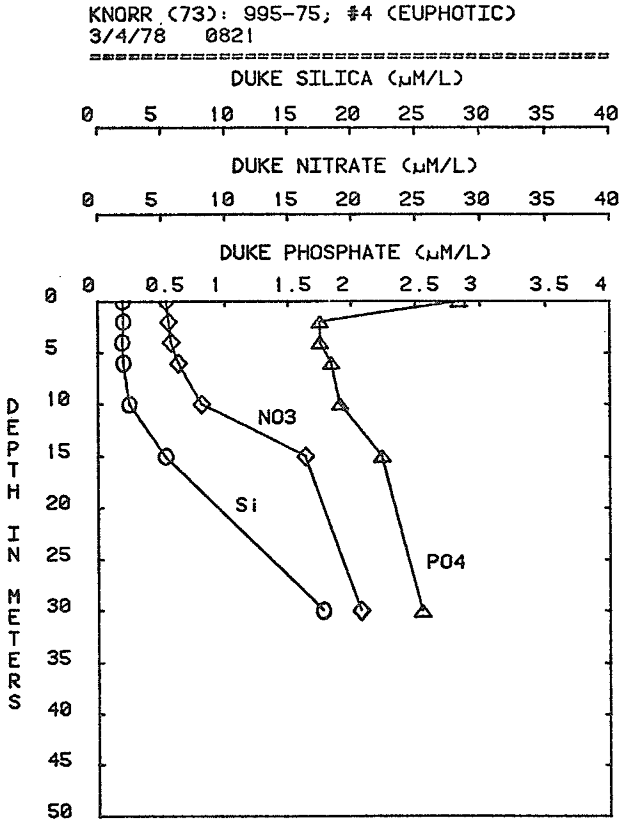


Fig. 45-4E

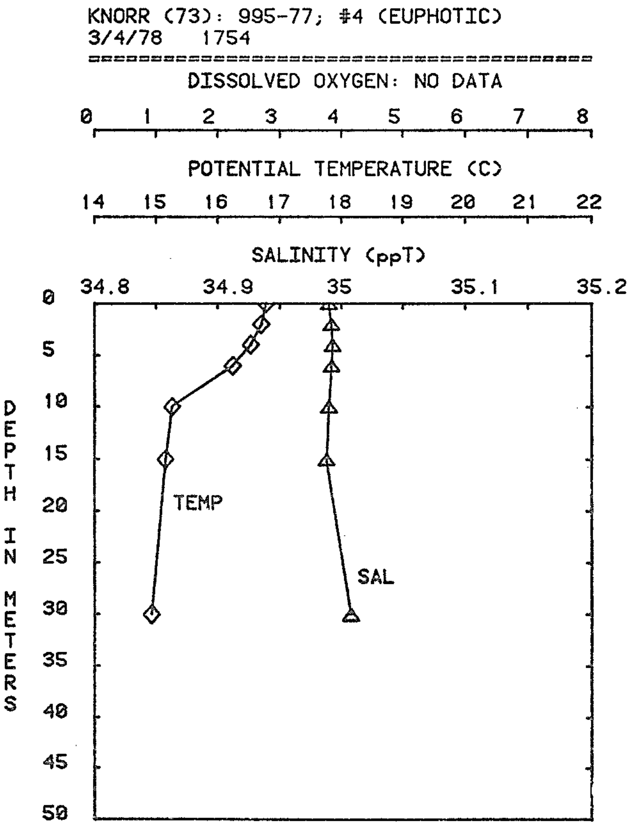


Fig. 46-4E

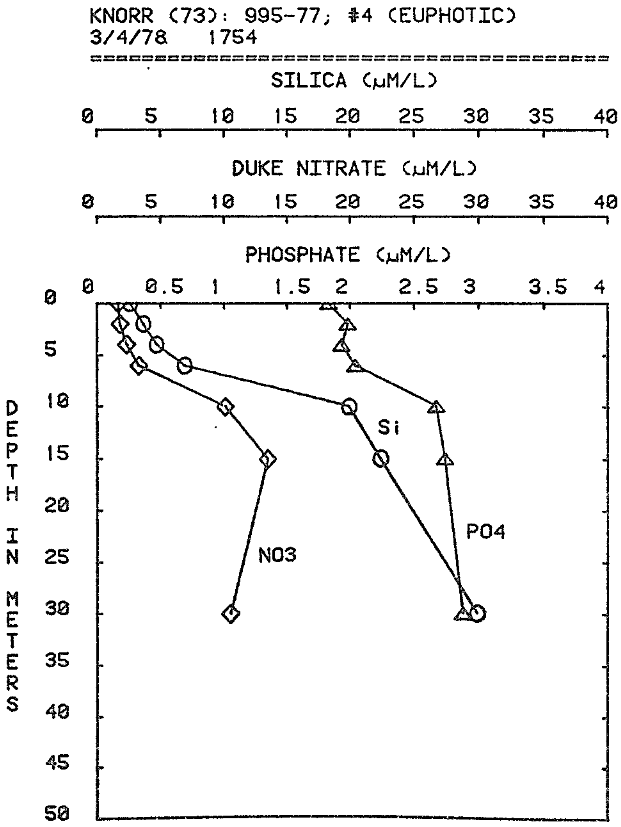


Fig. 47-4E

AM/PM euphotic data, Station 4: 3/4/78.

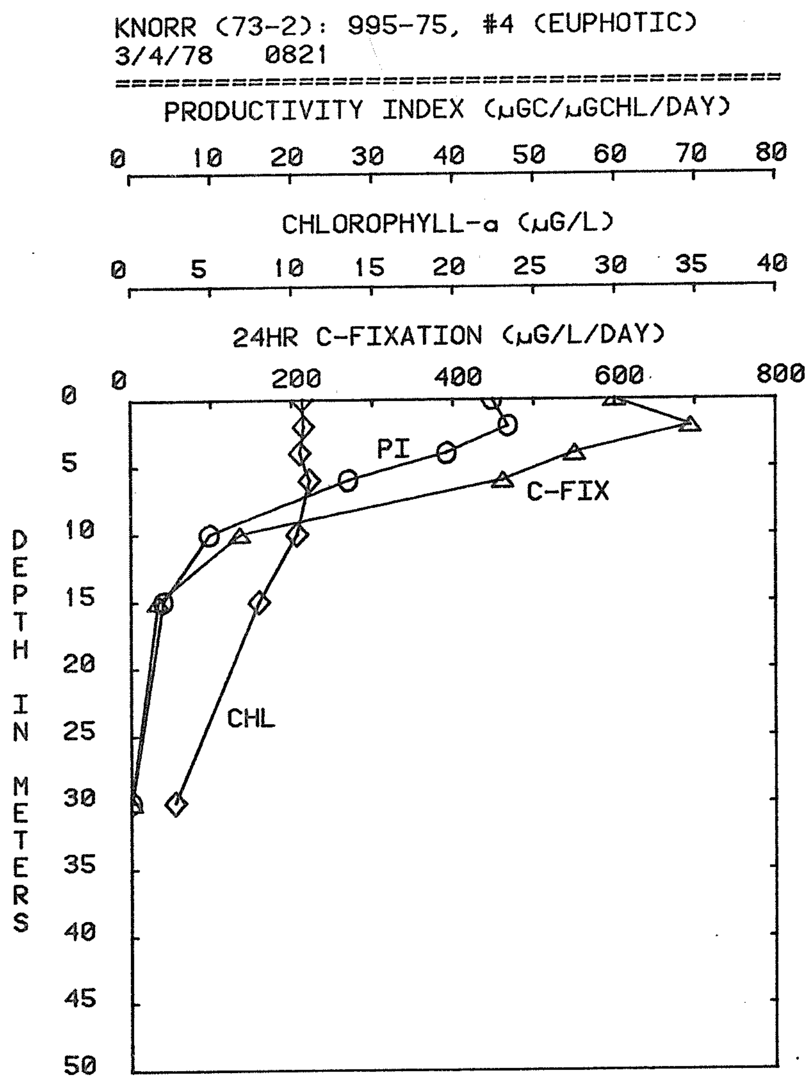


Fig. 48-4E

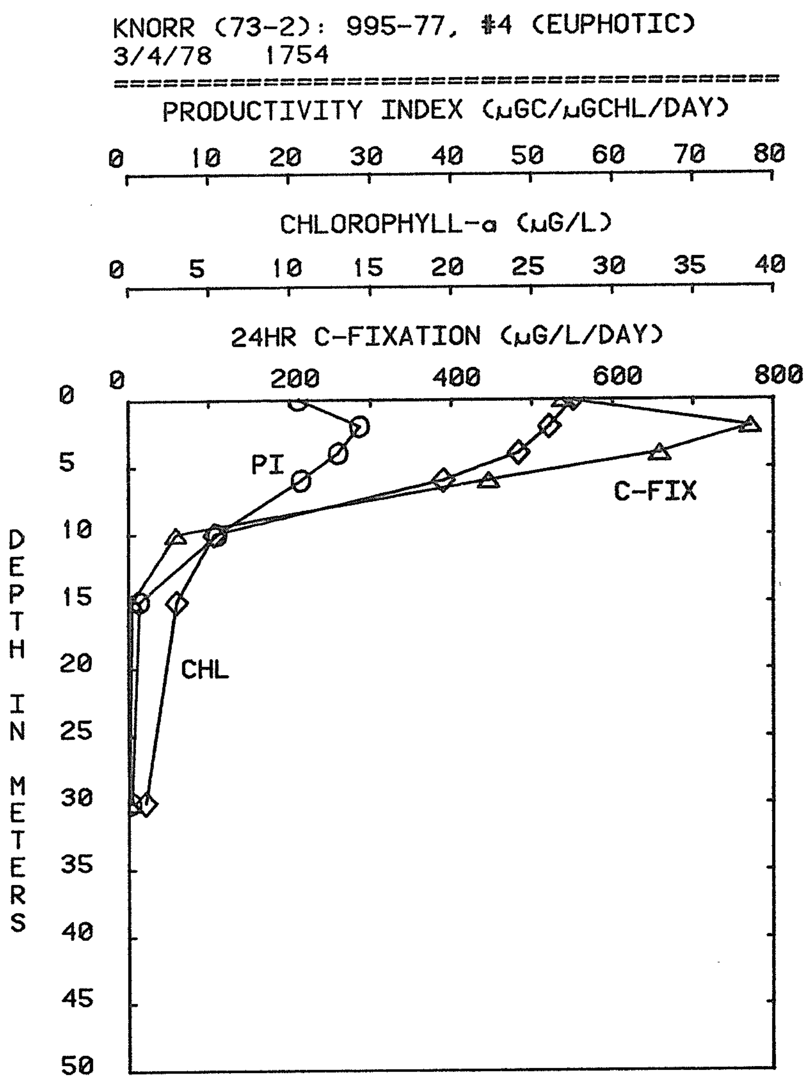


Fig. 49-4E

AM/PM euphotic data, Station 4: 3/4/78.

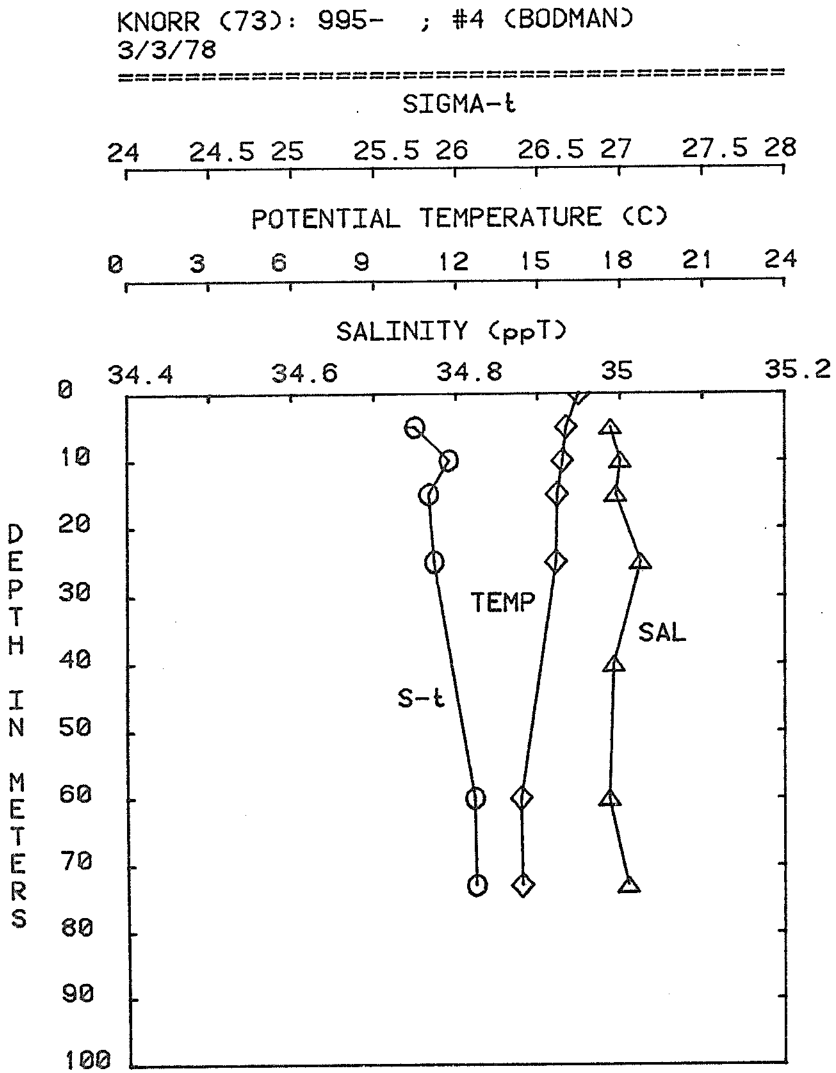


Fig. 50-4B

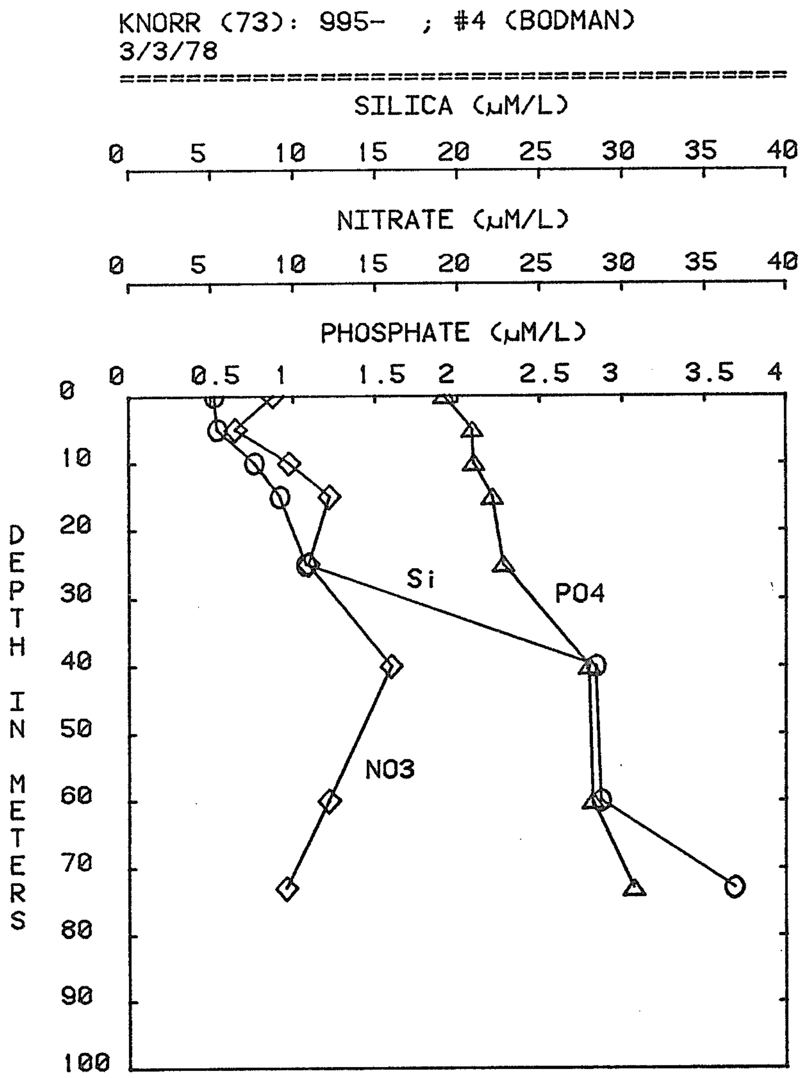


Fig. 51-4B

Bodman data, Station 4: 3/3/78.

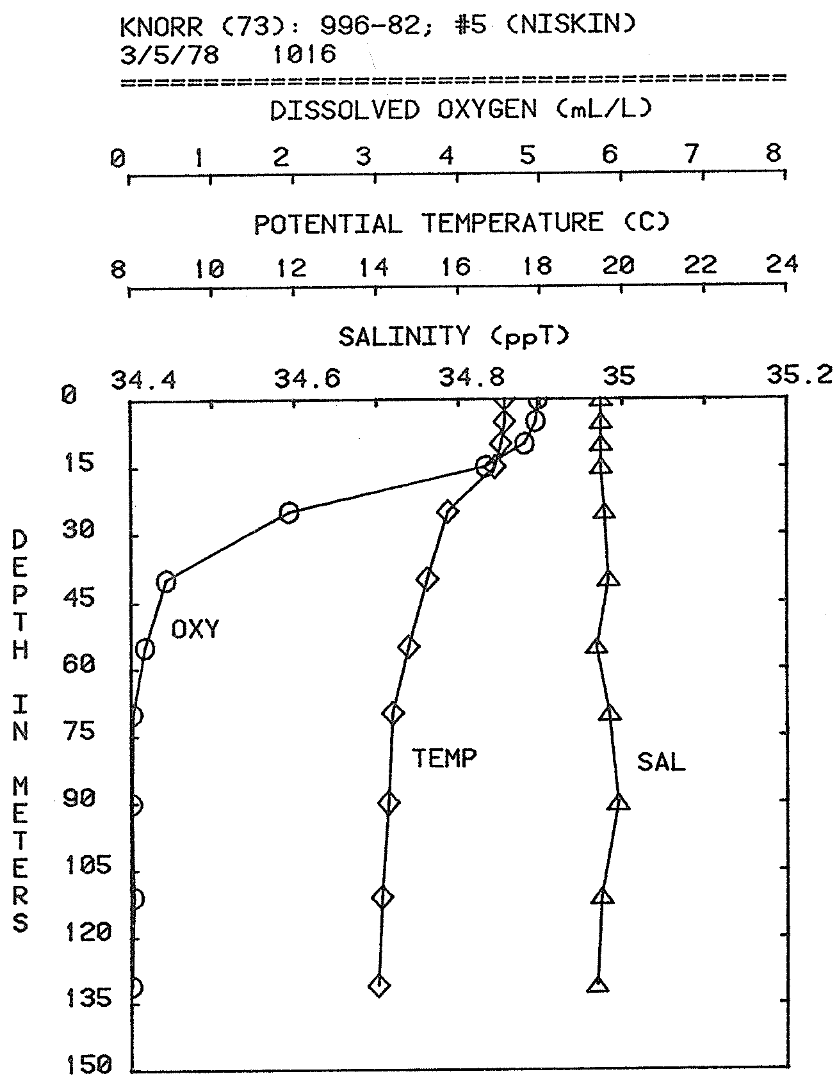


Fig. 52-5N

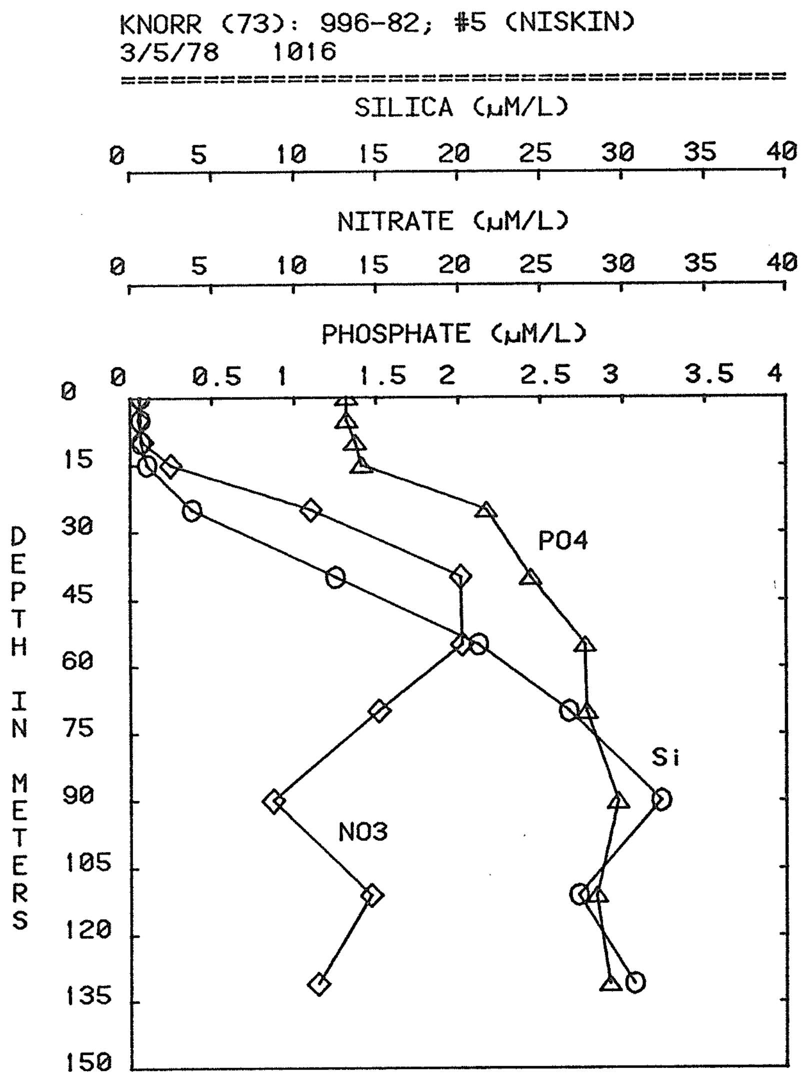


Fig. 53-5N

Niskin data, Station 5: 3/5/78.

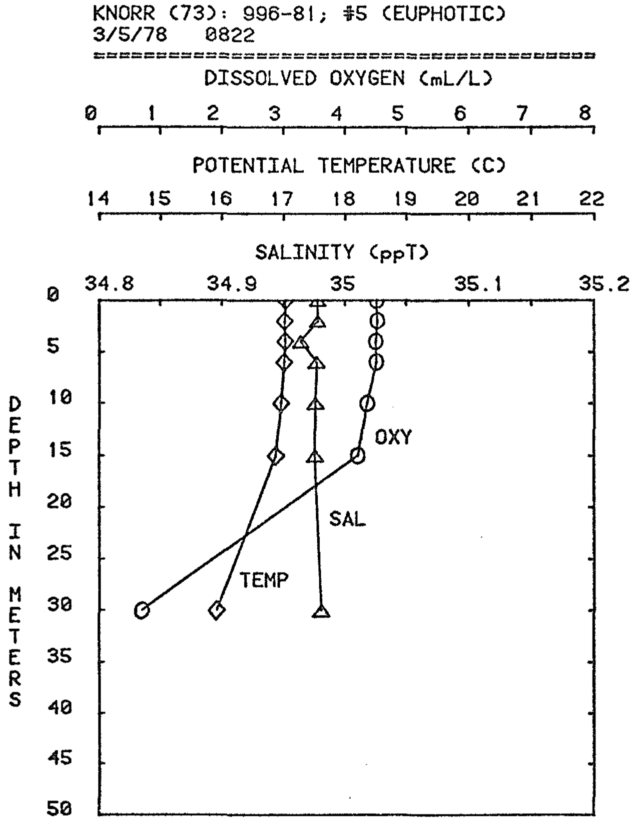


Fig. 54-5E

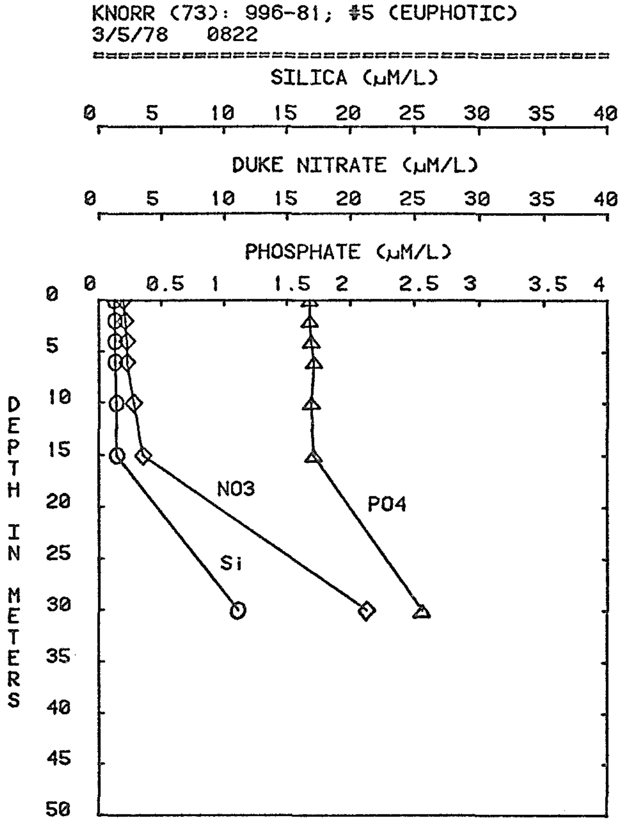


Fig. 55-5E

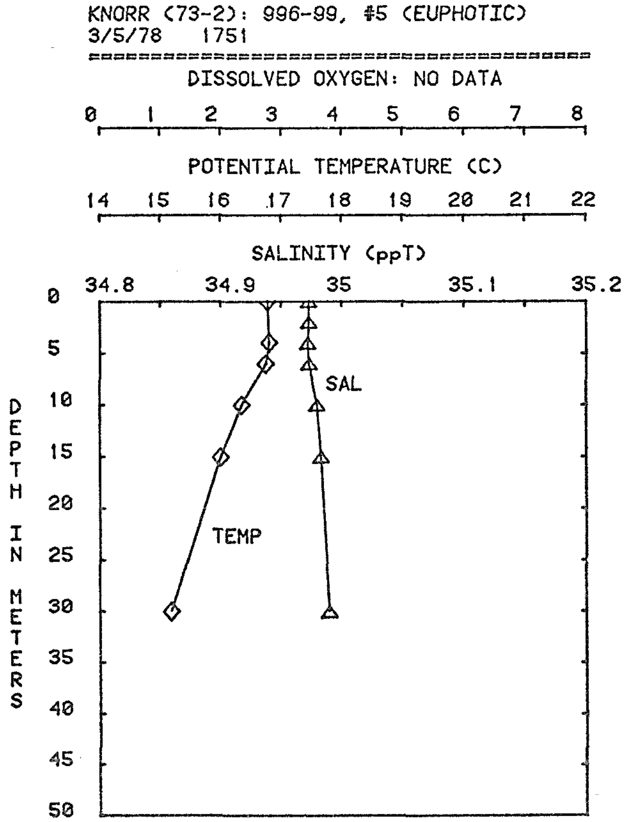


Fig. 56-5E

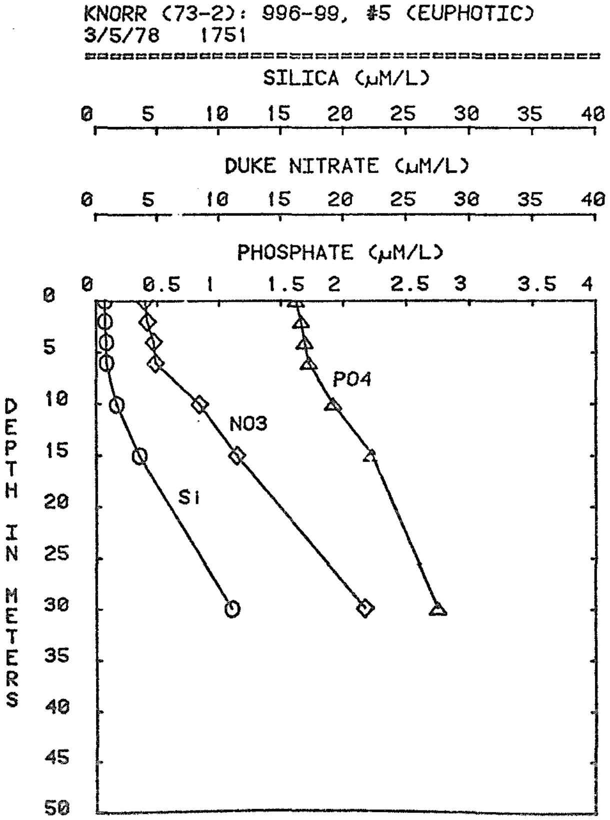


Fig. 57-5E

Am/PM euphotic data, Station 5: 3/5/78.

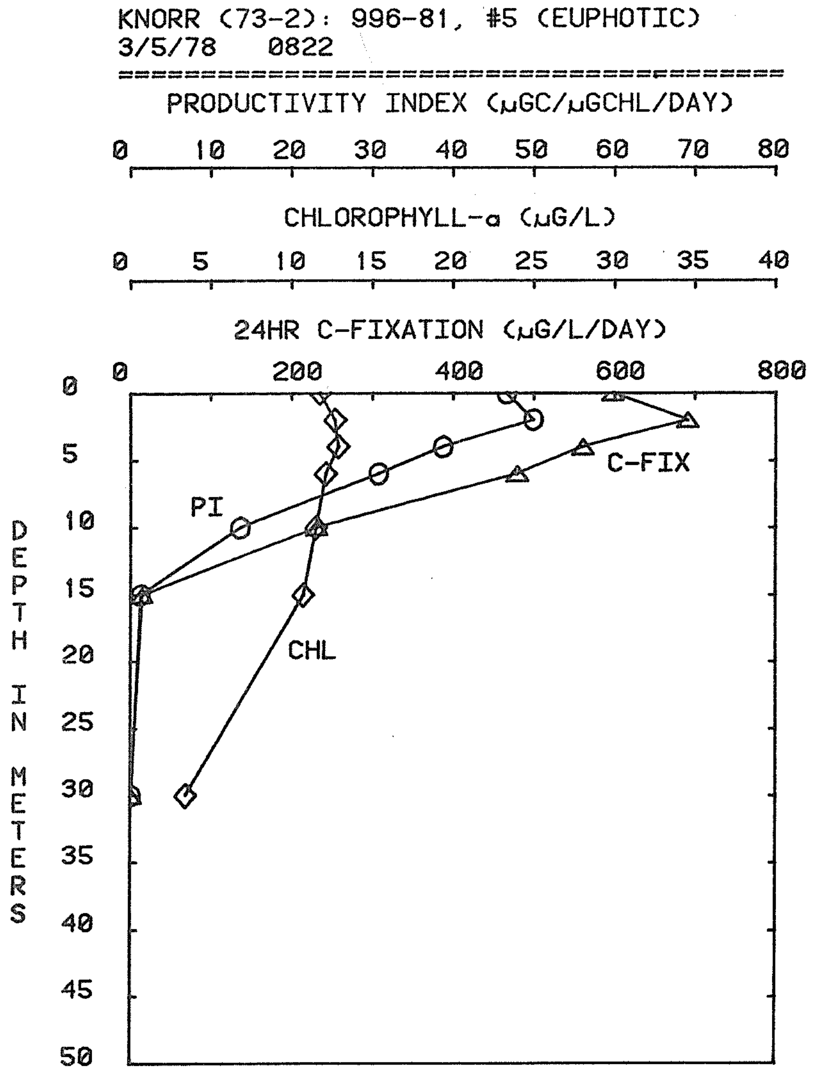


Fig. 58-5E

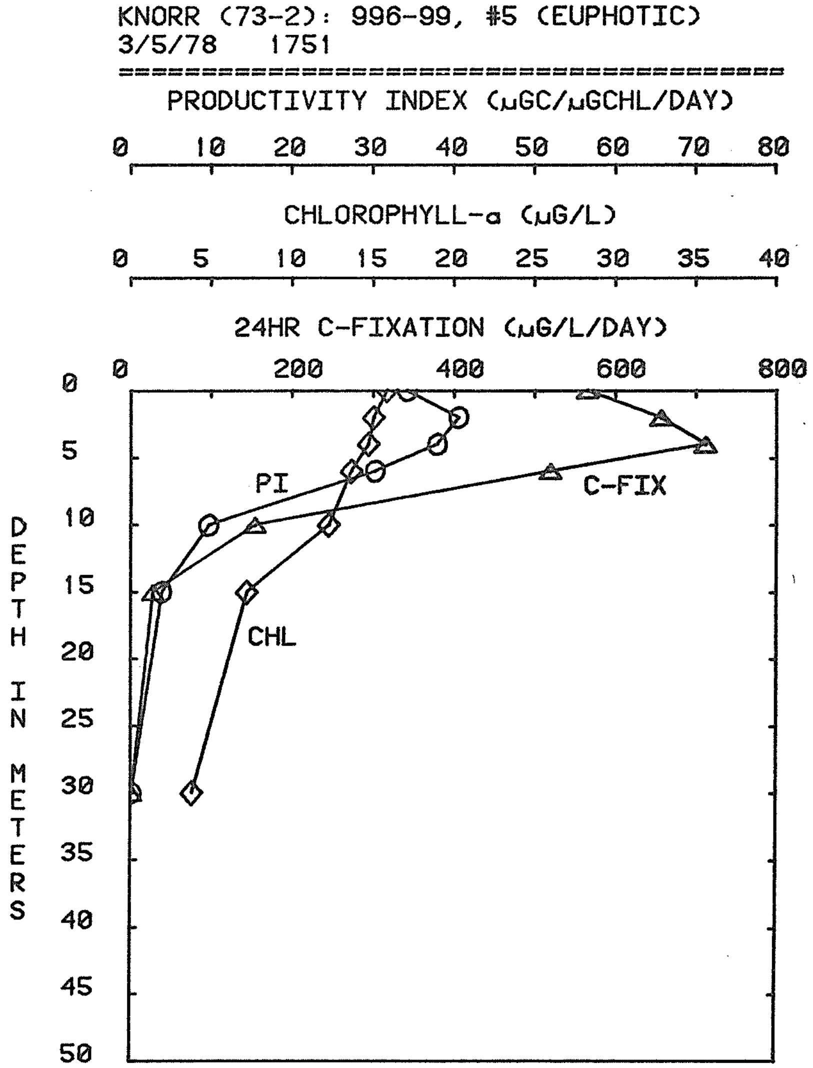


Fig. 59-5E

AM/PM euphotic data, Station 5: 3/5/78.

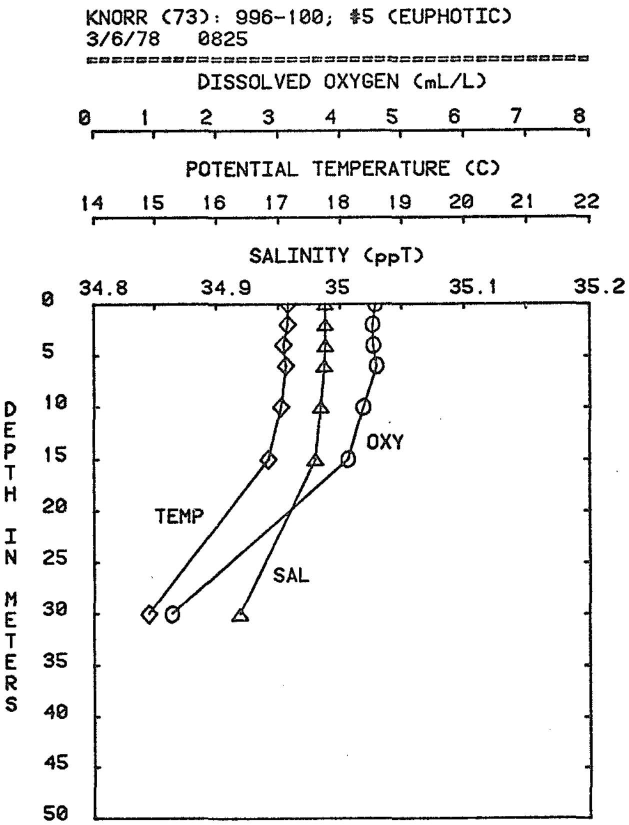


Fig. 60-5E

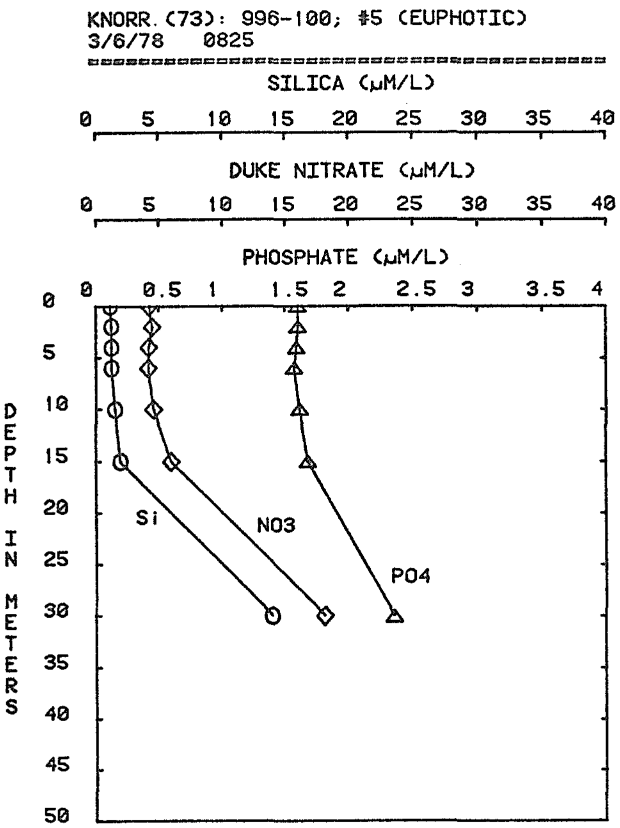


Fig. 61-5E

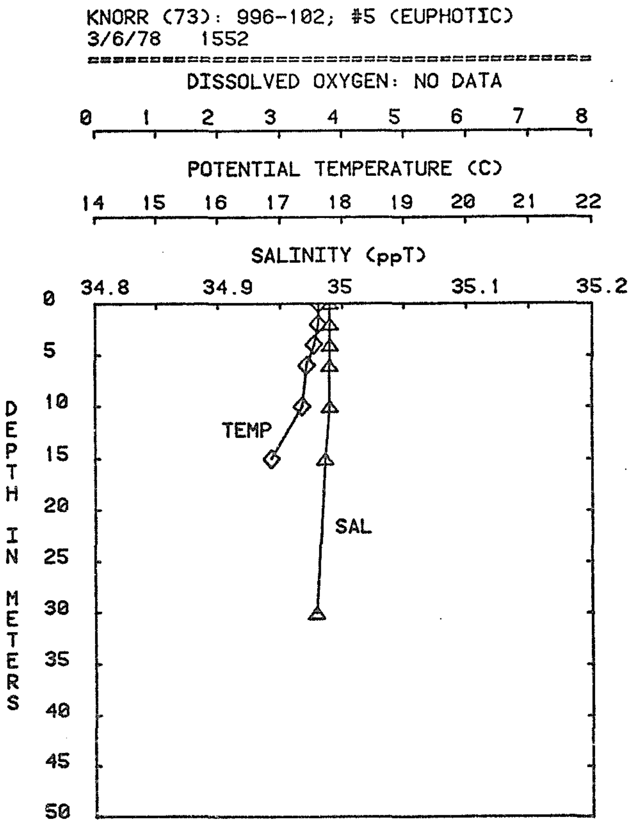


Fig. 62-5E

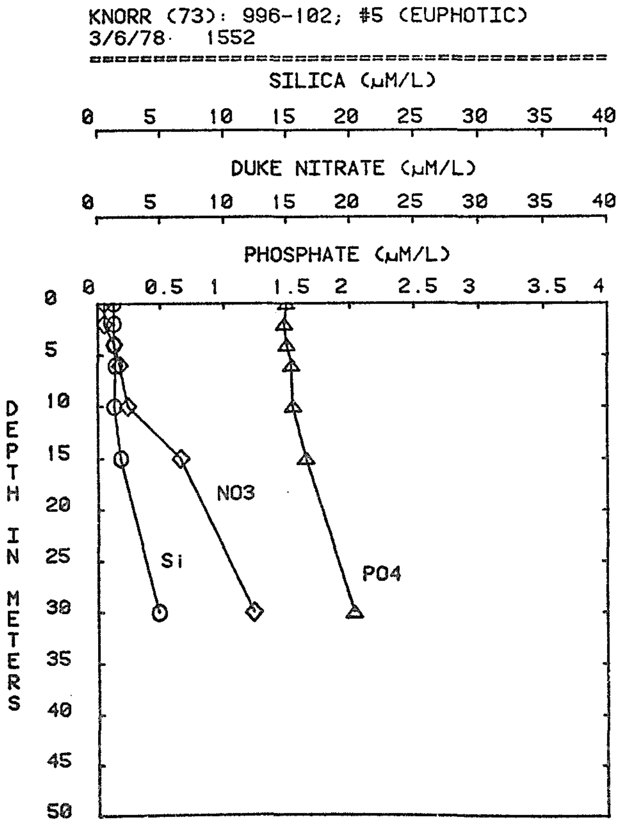


Fig. 63-5E

AM/PM euphotic data, Station 5: 3/6/78.

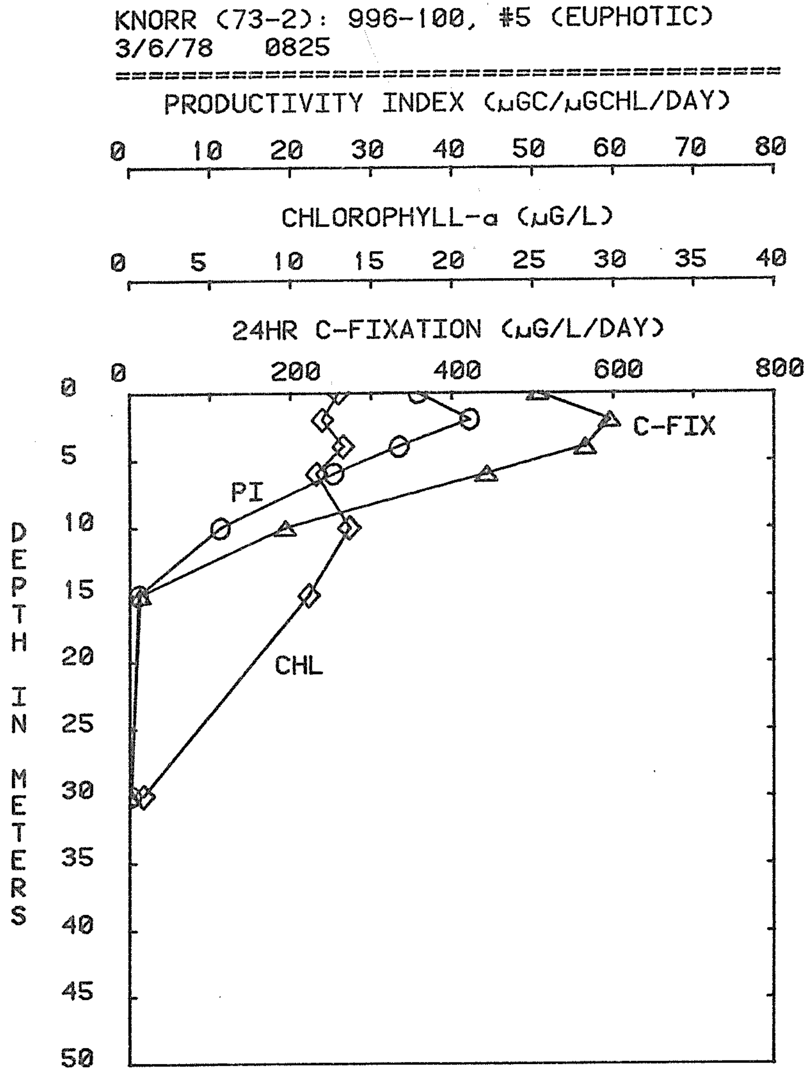


Fig. 64-5E

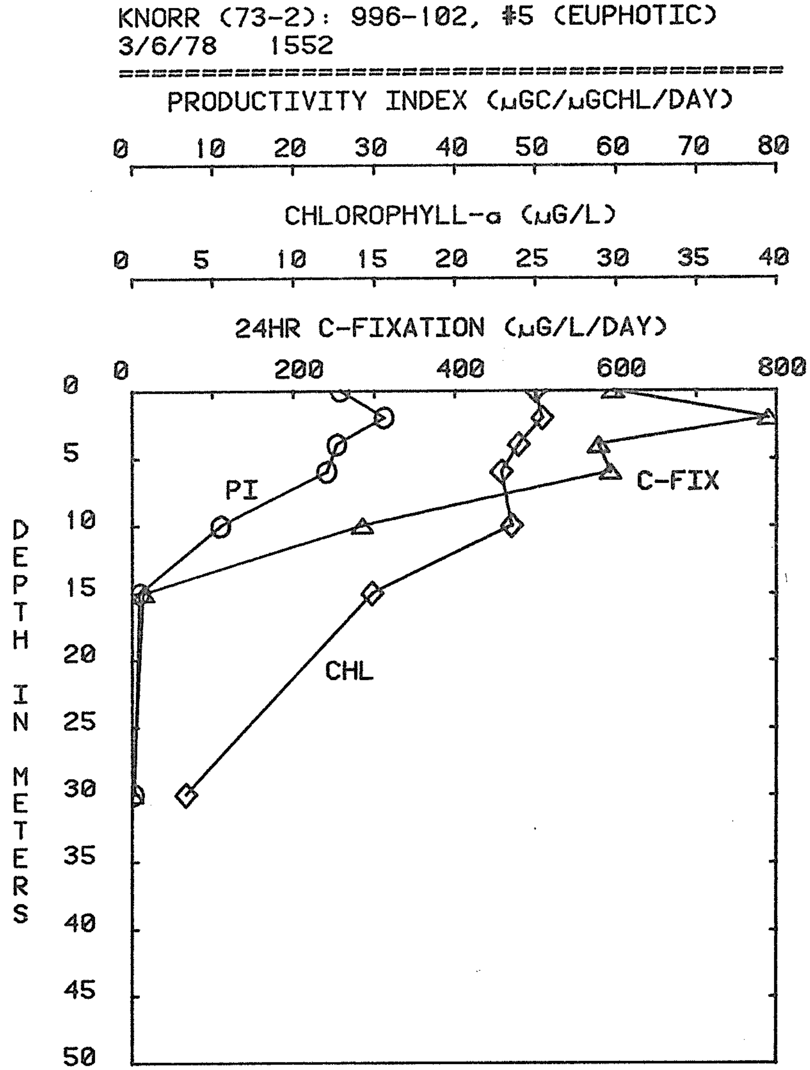


Fig. 65-5E

AM/PM euphotic data, Station 5: 3/6/78.

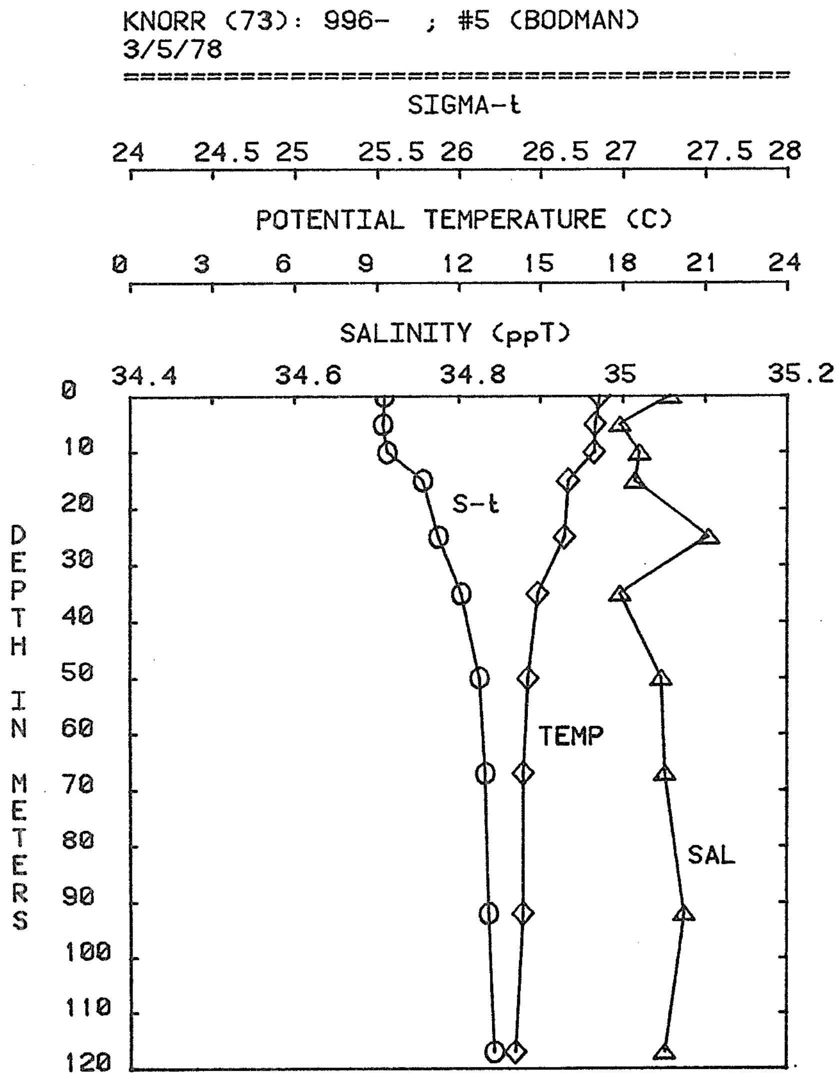


Fig. 66-5B

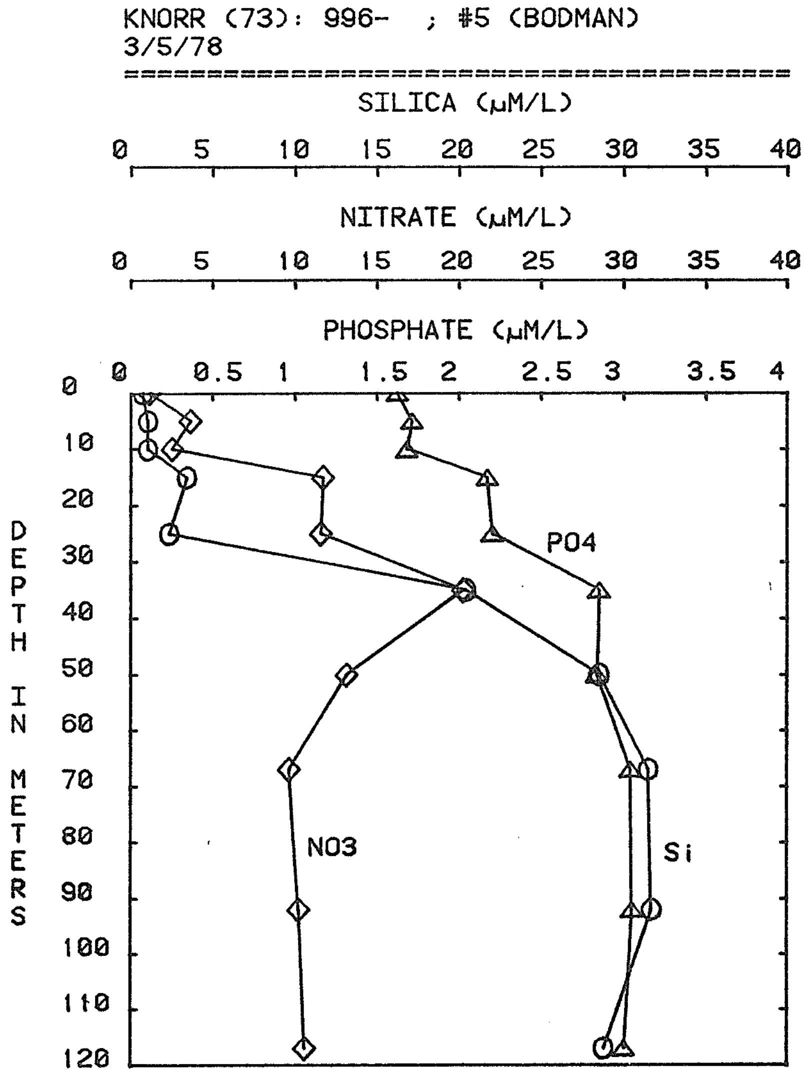


Fig. 67-5B

Bodman data, Station 5: 3/5/78.

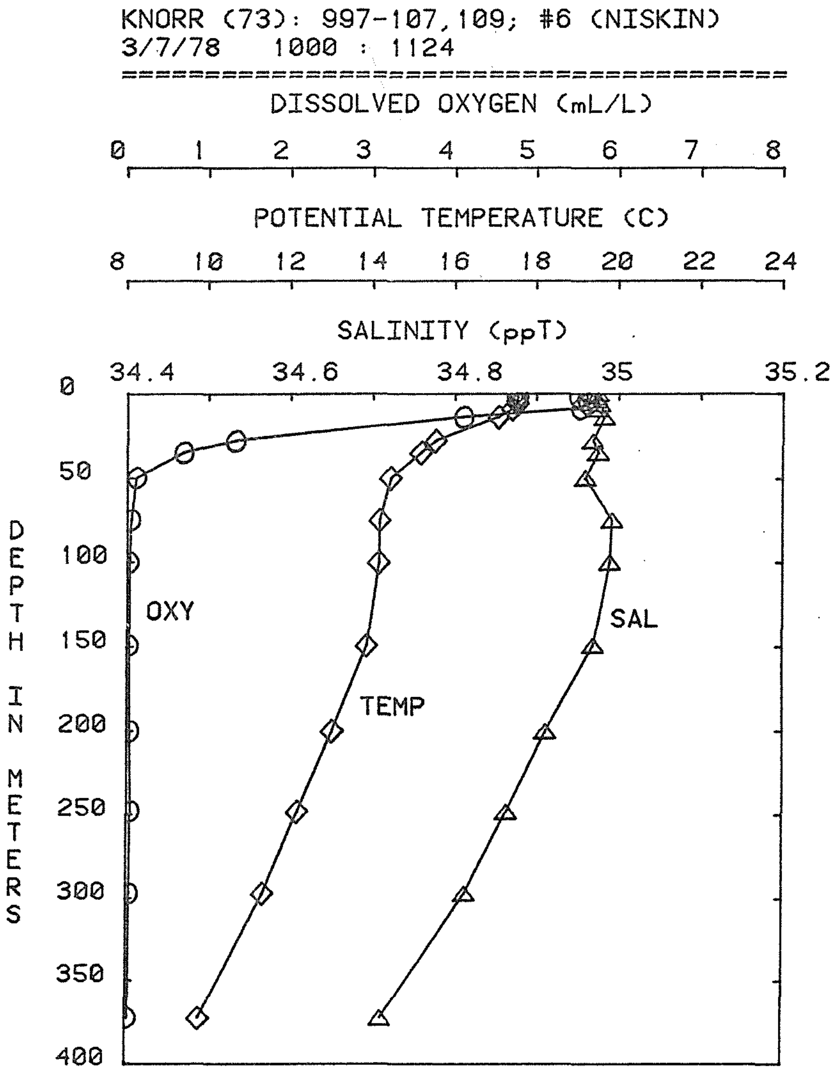


Fig. 68-6N

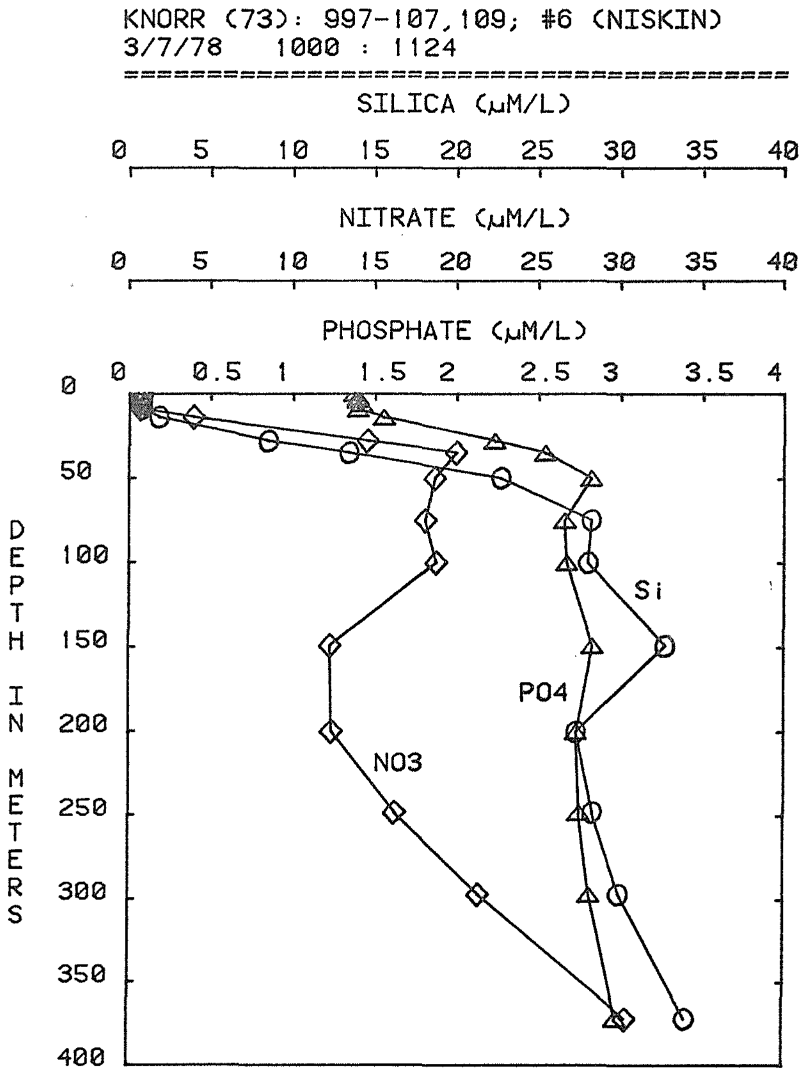


Fig. 69-6N

Niskin data, Station 6: 3/7/78.

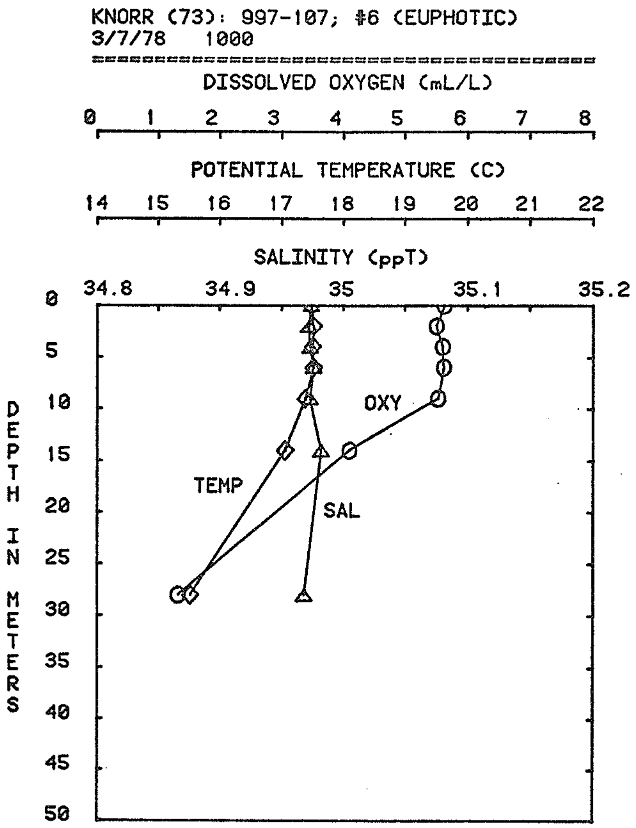


Fig. 70-6E

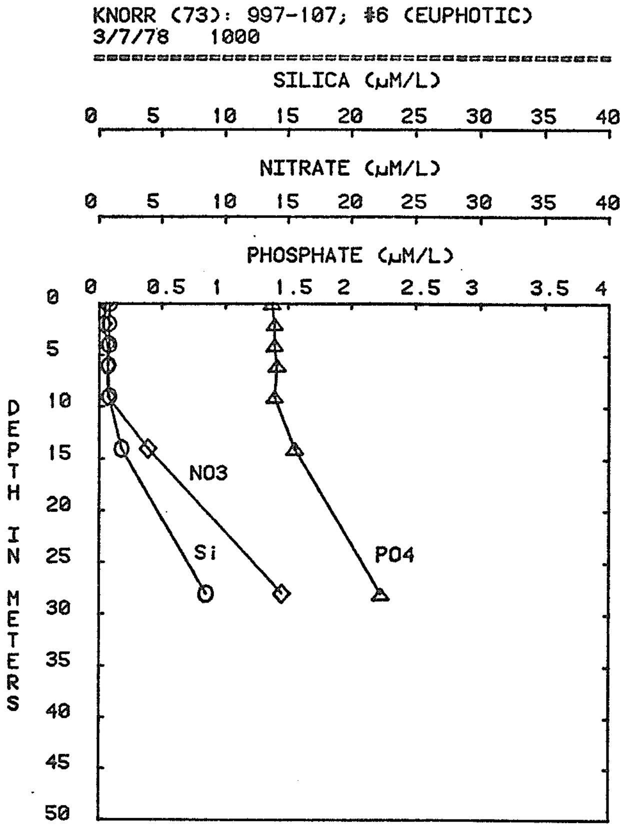


Fig. 71-6E

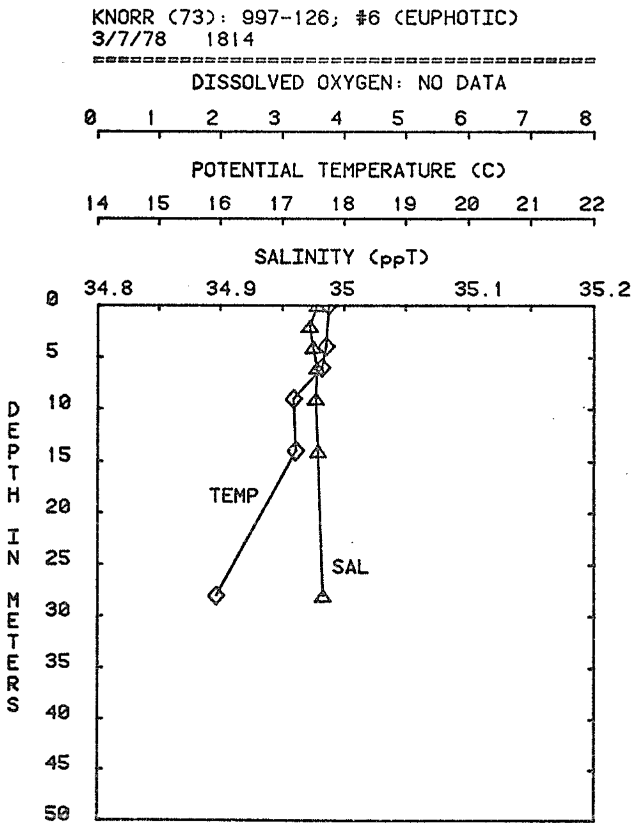


Fig. 72-6E

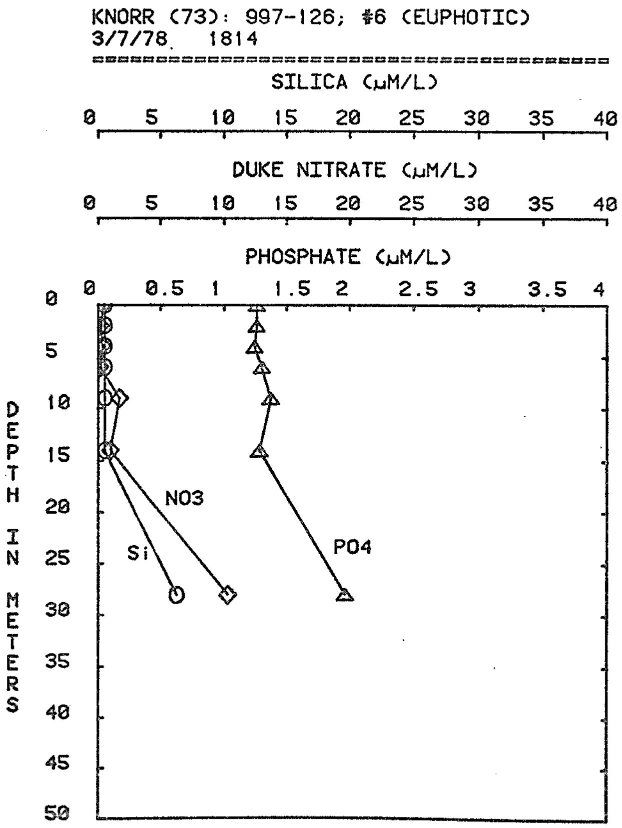


Fig. 73-6E

AM/PM euphotic data, Station 6: 3/7/78.

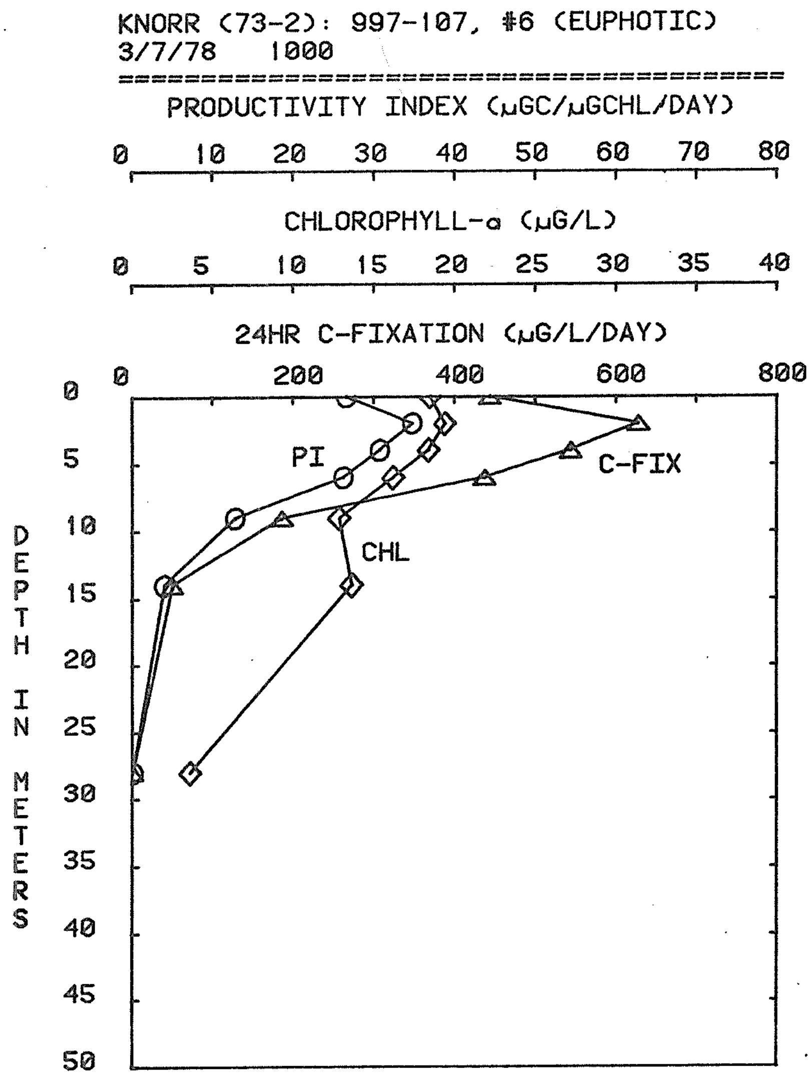


Fig. 74-6E

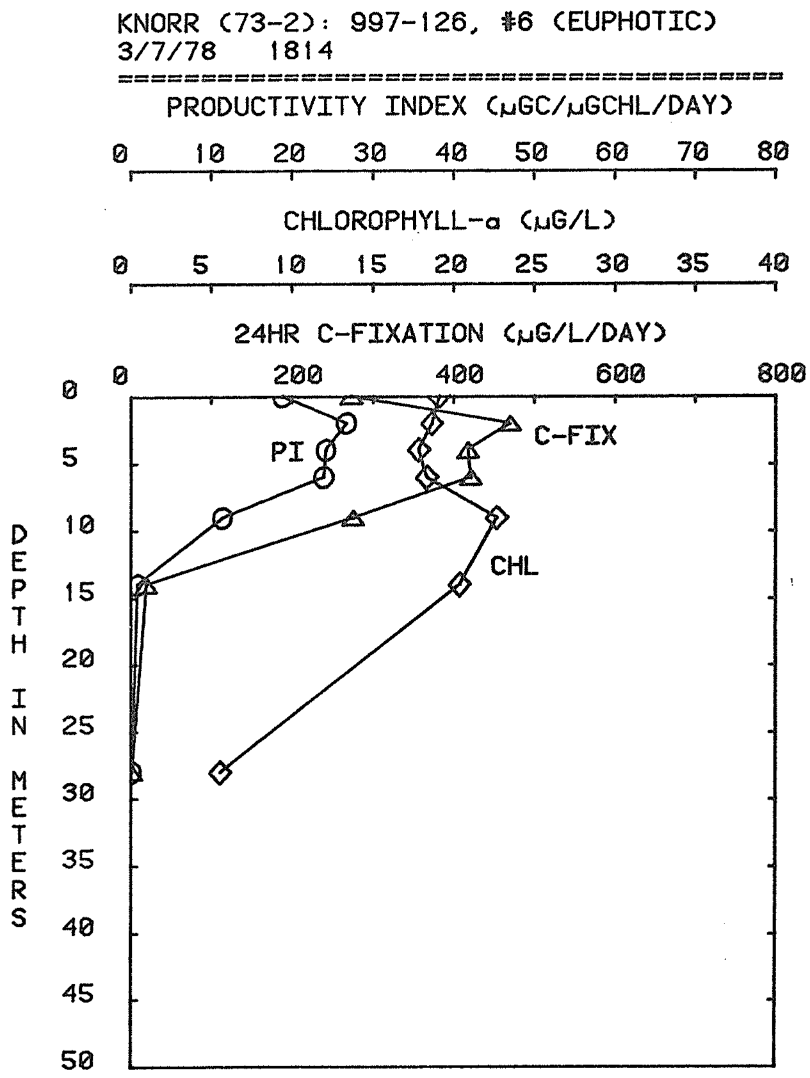


Fig. 75-6E

AM/PM euphotic data, Station 6: 3/7/78.

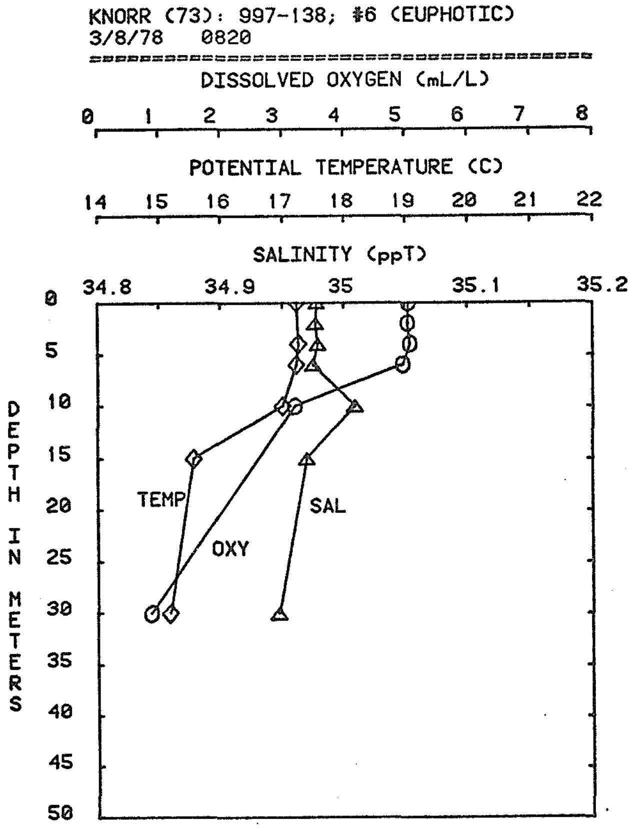


Fig. 76-6E

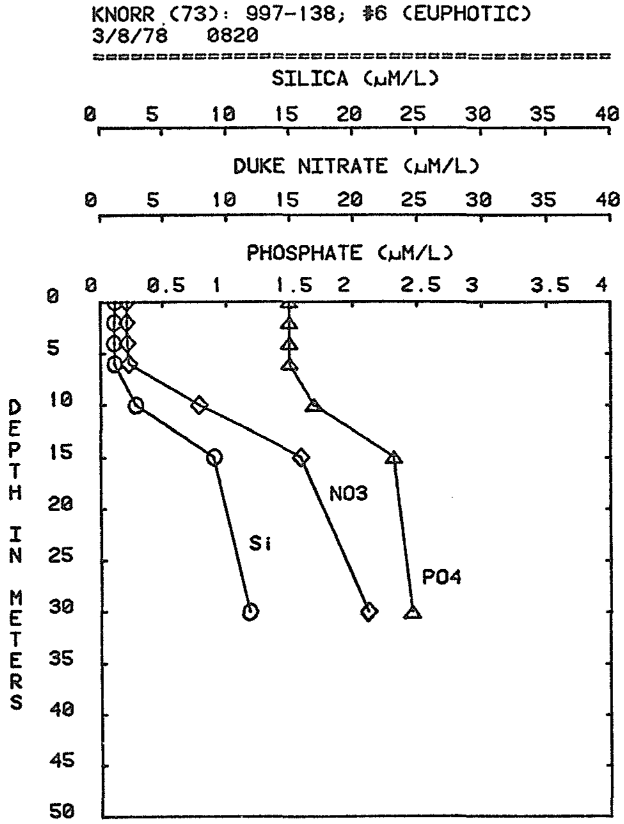


Fig. 77-6E

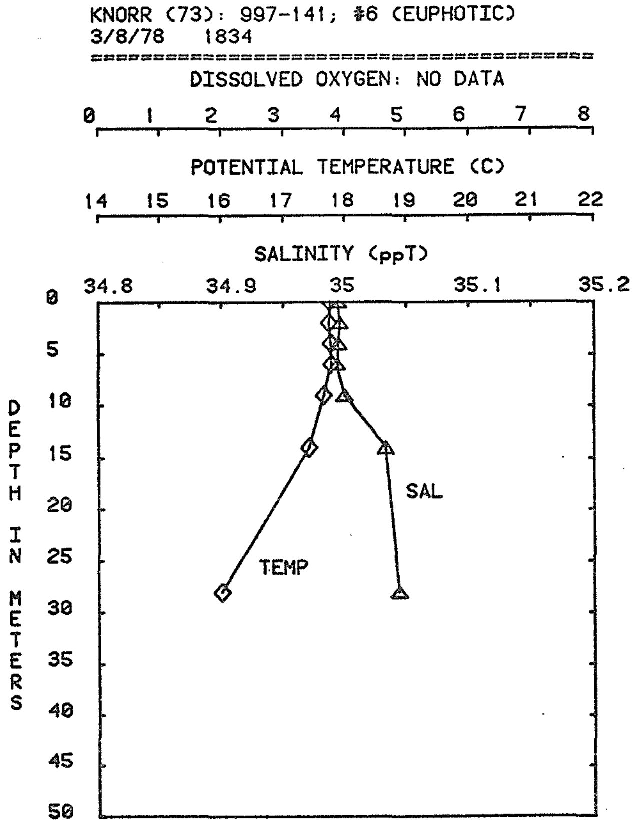


Fig. 78-6E

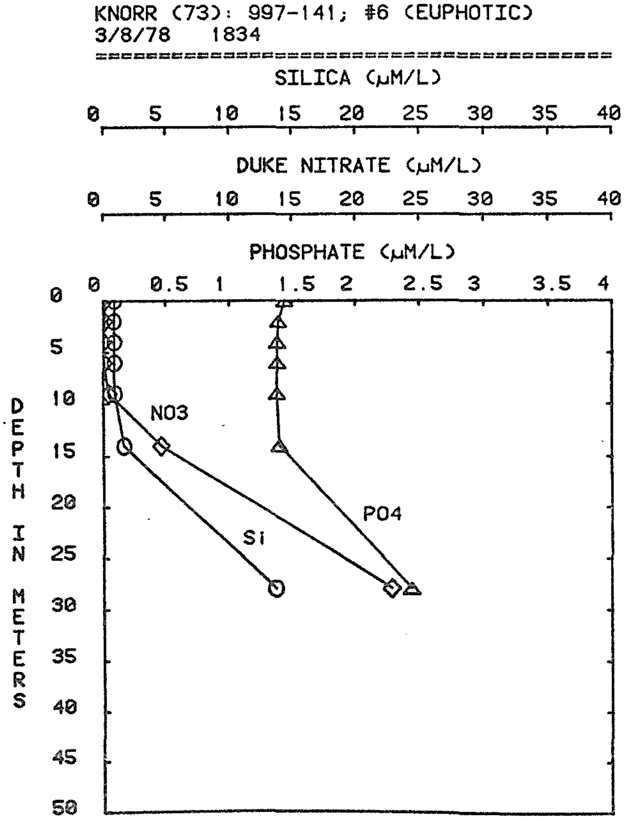


Fig. 79-6E

AM/PM euphotic data, Station 6: 3/8/78.

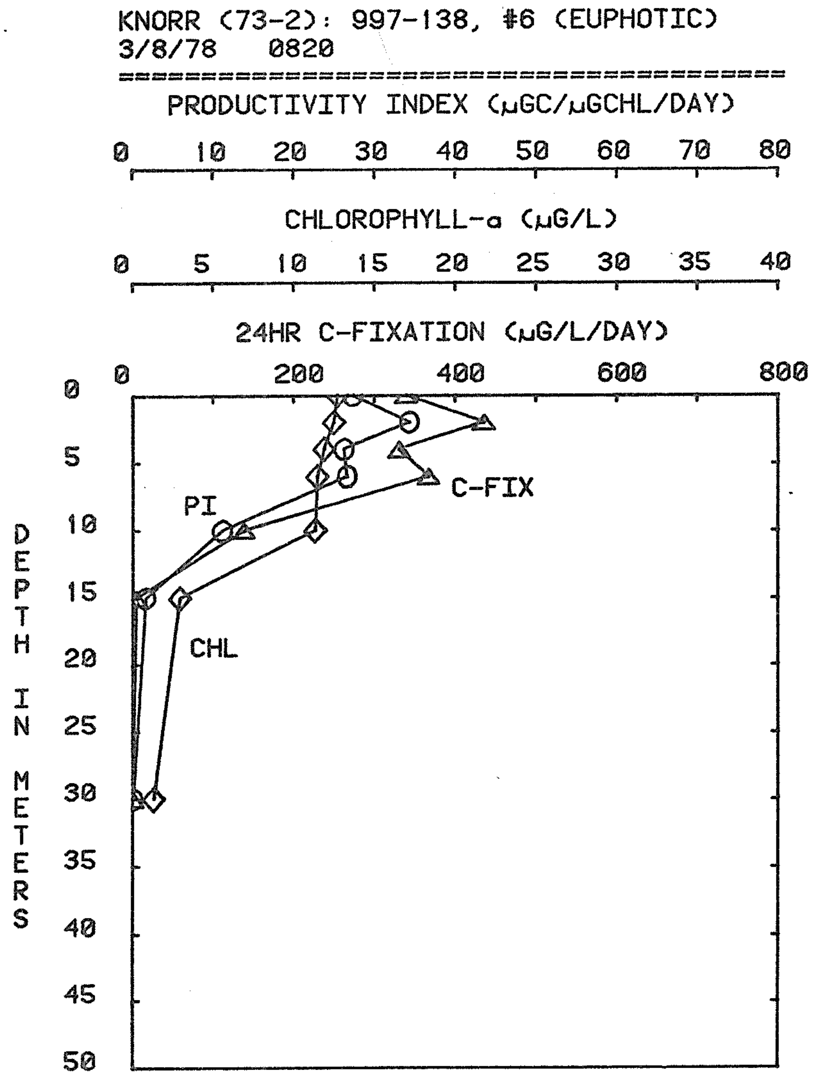


Fig. 80-6E

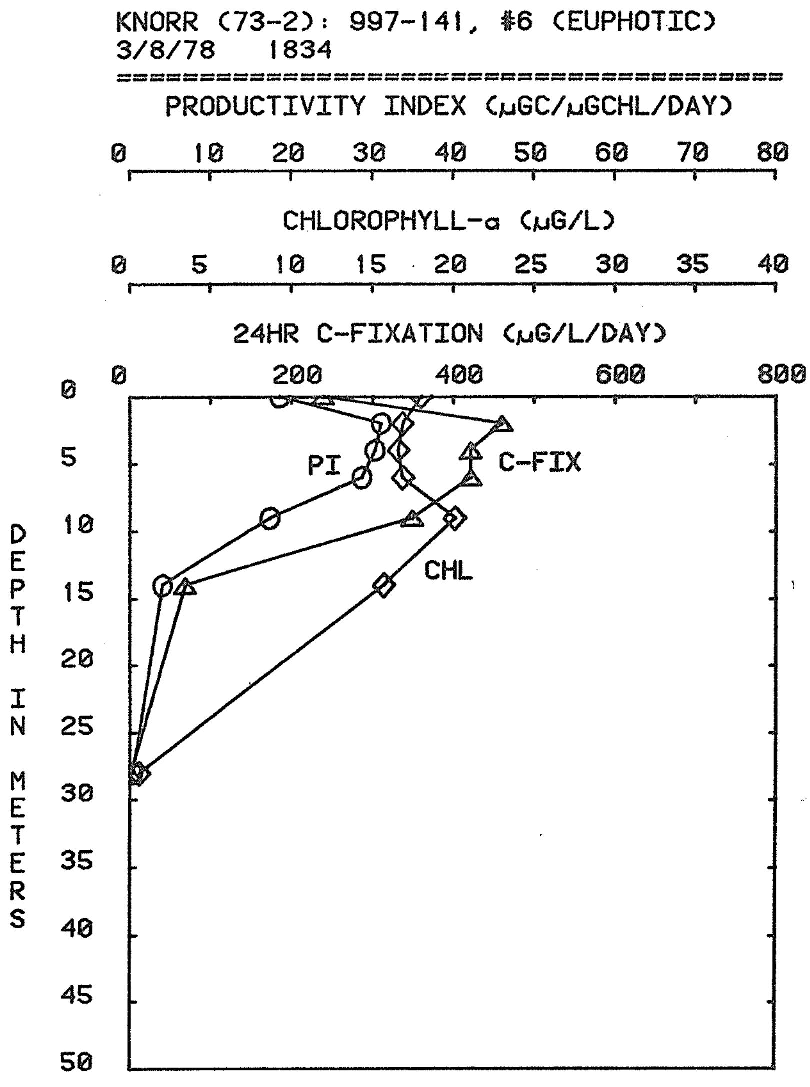


Fig. 81-6E

AM/PM euphotic data, Station 6: 3/8/78.

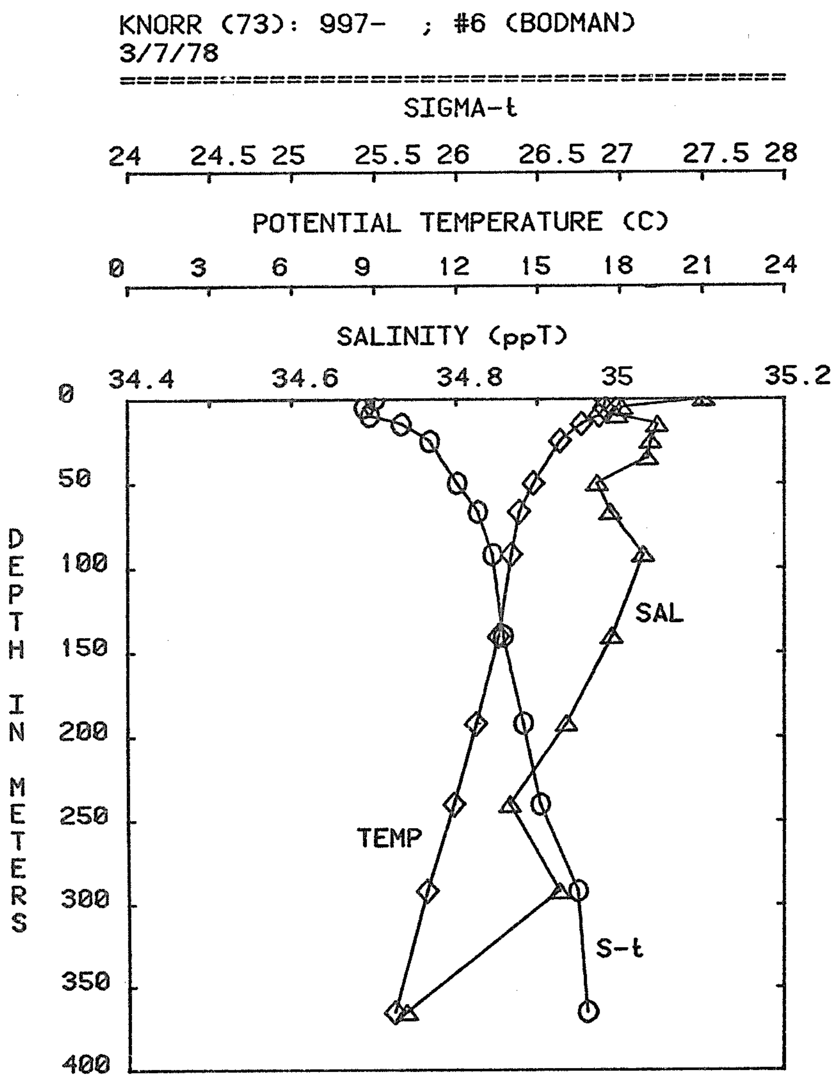


Fig. 82-6B

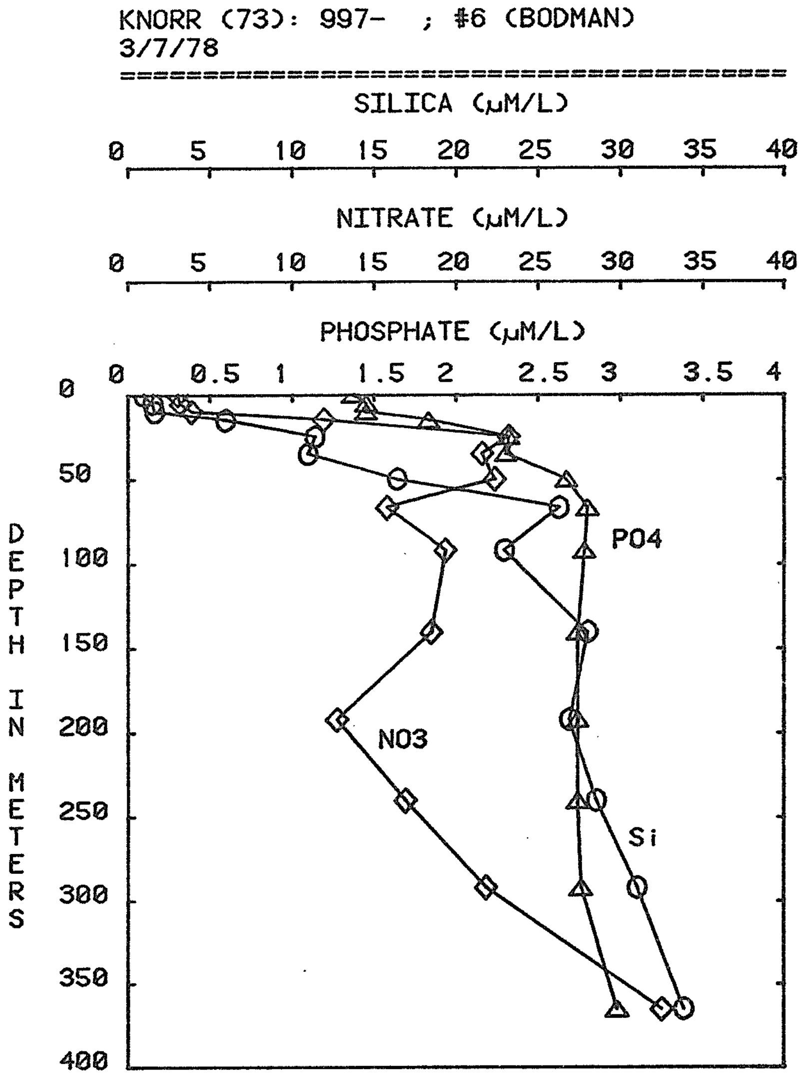


Fig. 83-6B

Bodman data, Station 6: 3/7/78.

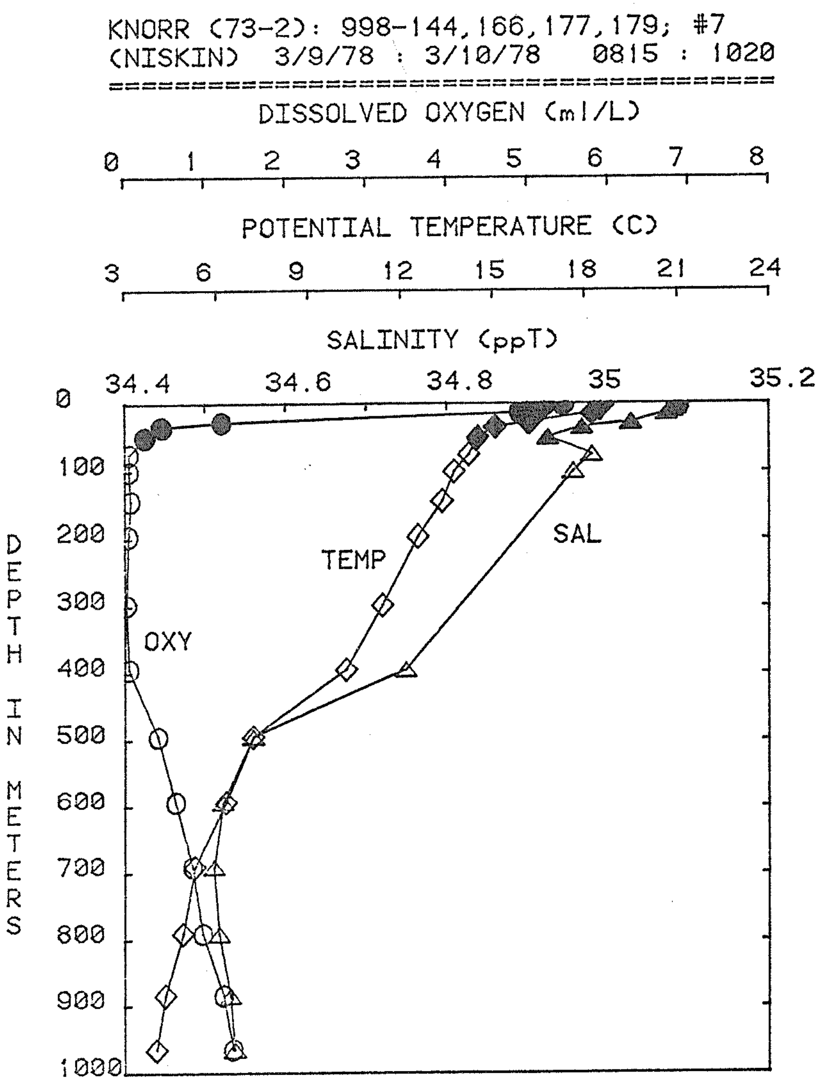


Fig. 84-7N

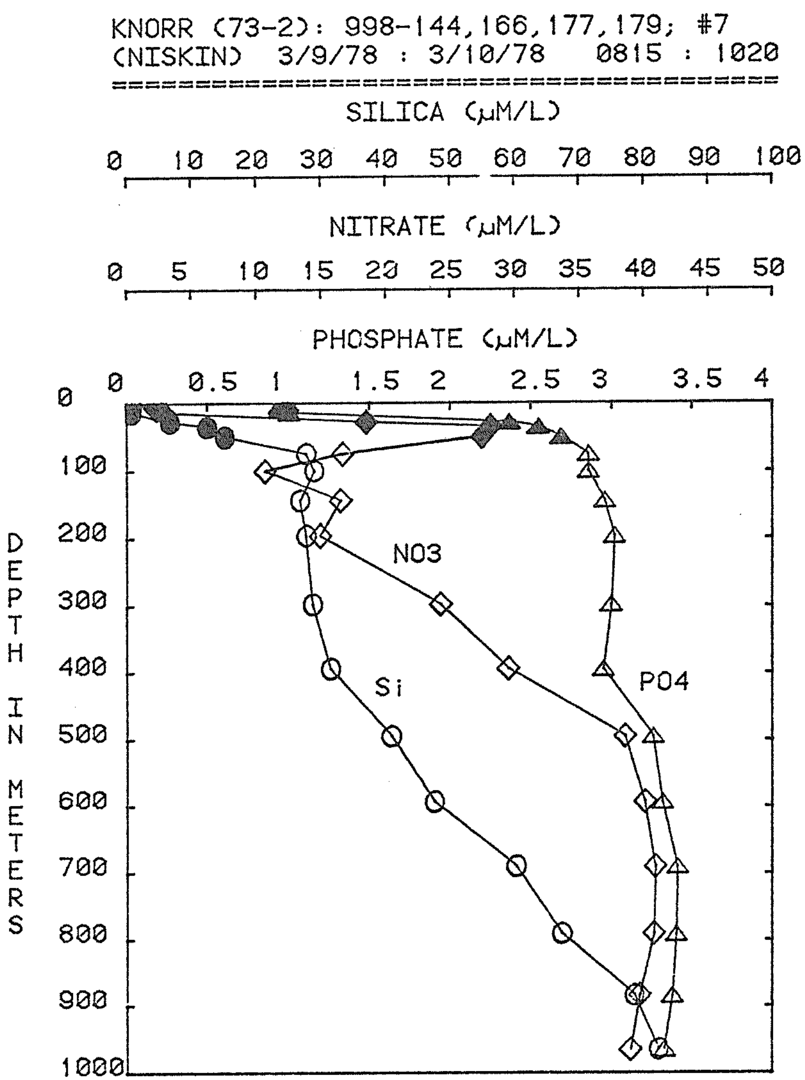


Fig. 85-7N

Niskin data, Station 7. Open symbols indicate data from 3/10/78, shaded symbols from 3/9/78.

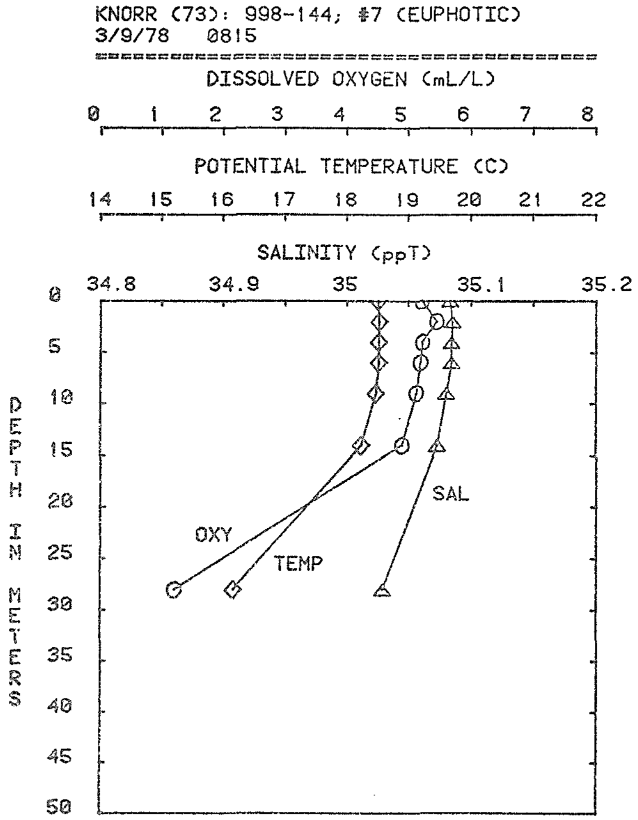


Fig. 86-7E

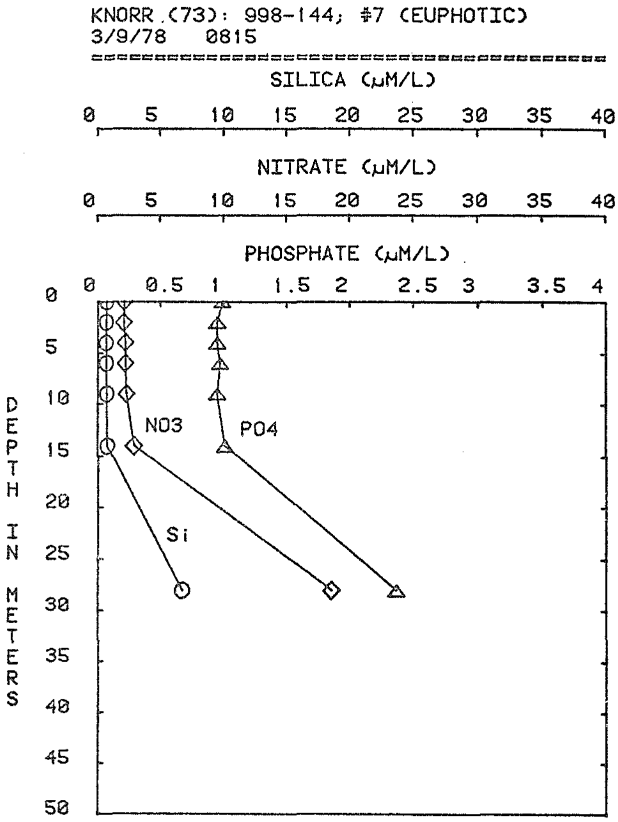


Fig. 87-7E

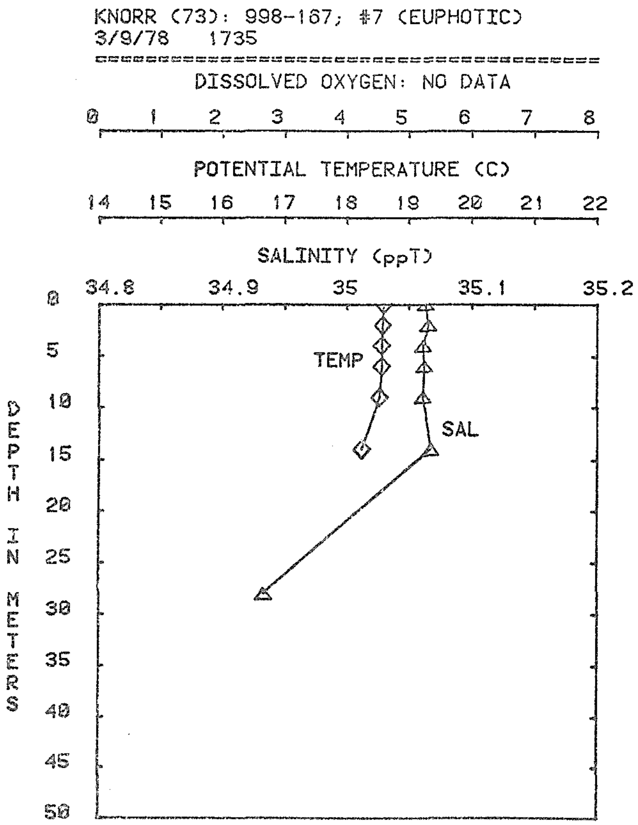


Fig. 88-7E

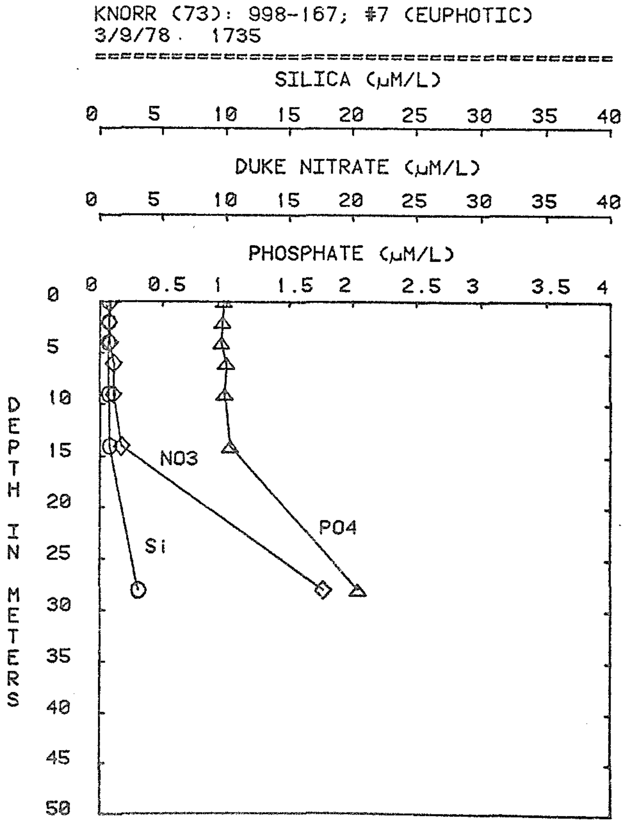


Fig. 89-7E

AM/PM euphotic data, Station 7: 3/9/78.

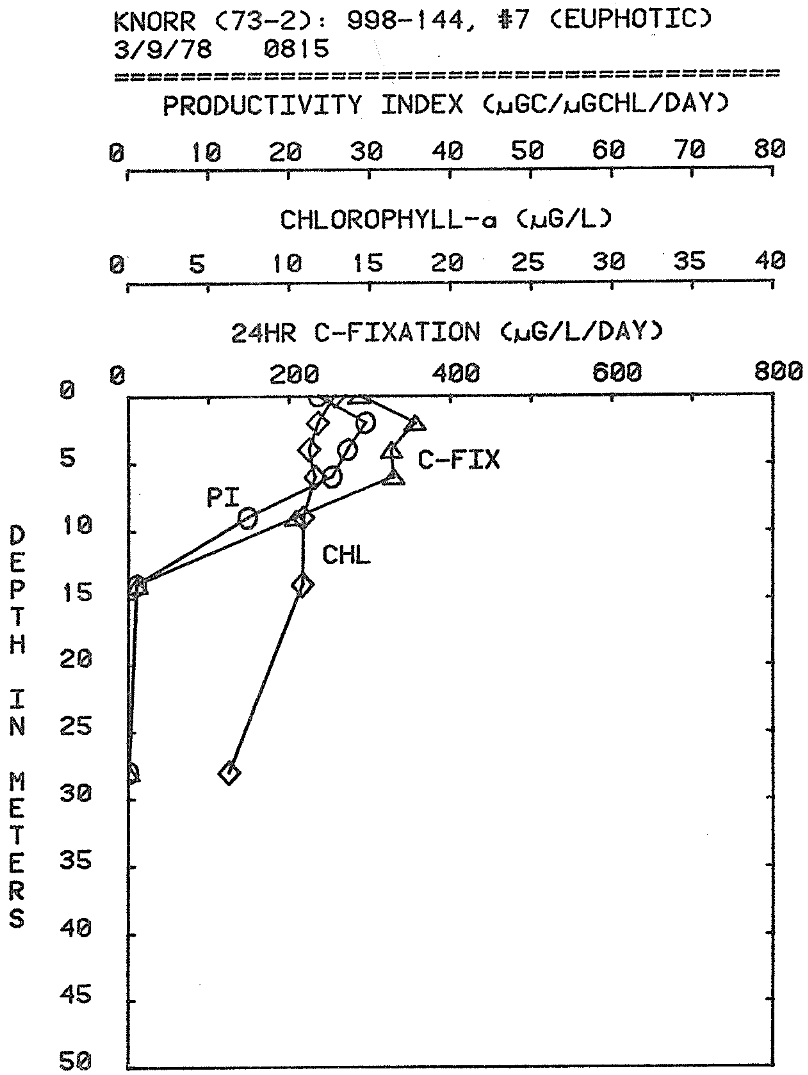


Fig. 90-7E

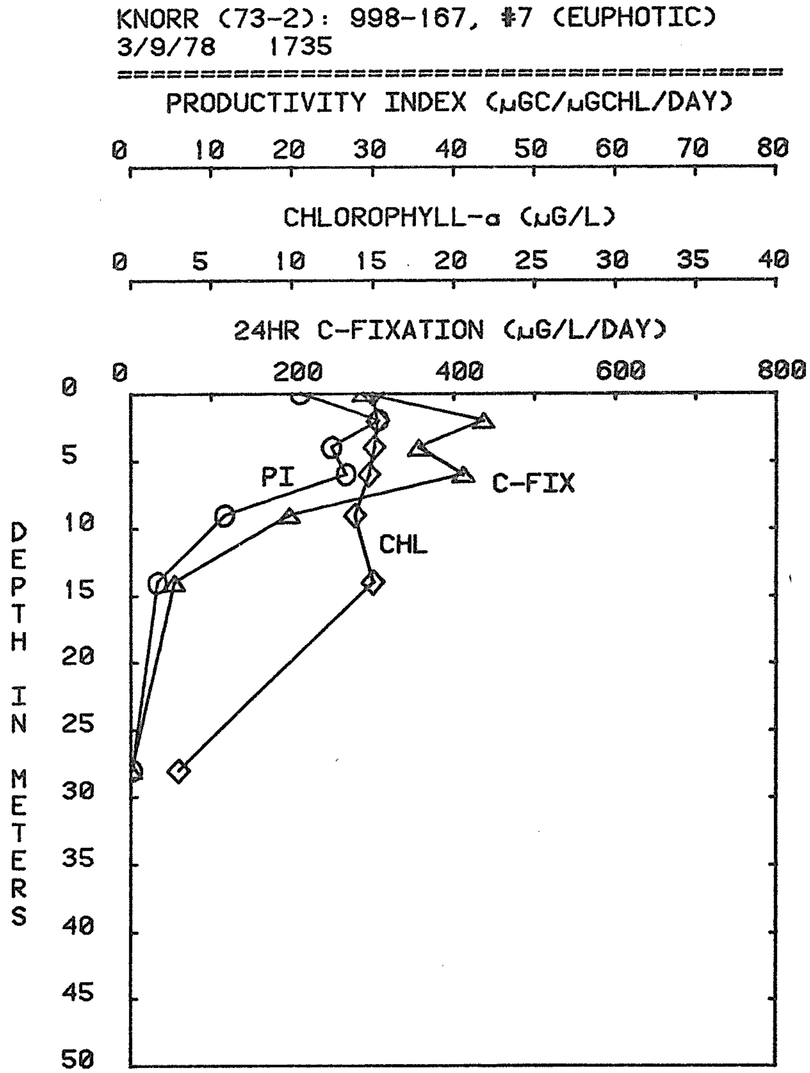


Fig. 91-7E

AM/PM euphotic data, Station 7: 3/9/78.

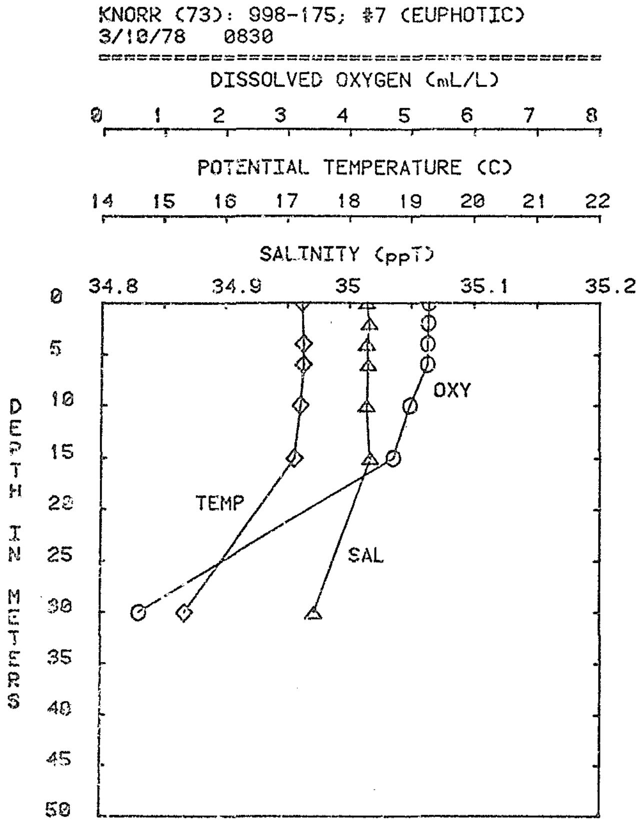


Fig. 92-7E

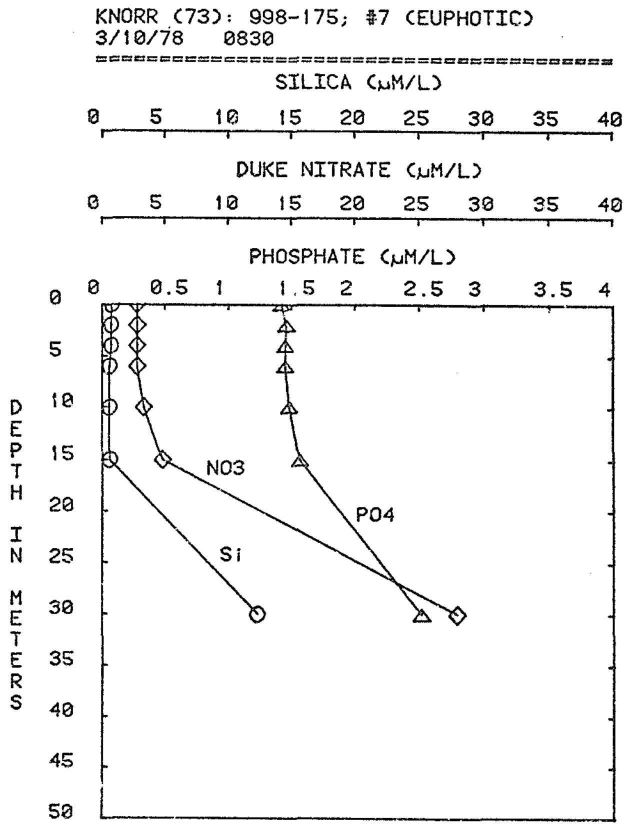


Fig. 93-7E

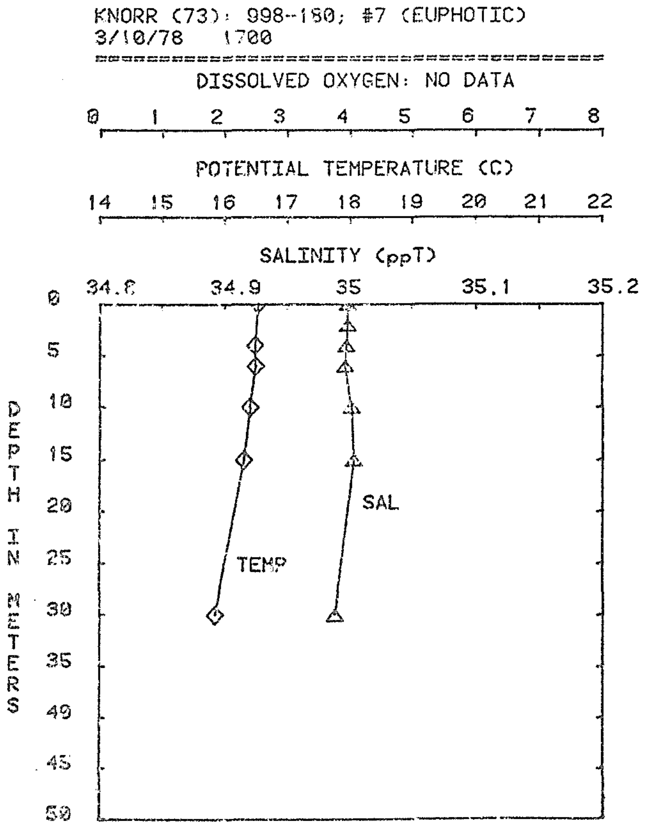


Fig. 94-7E

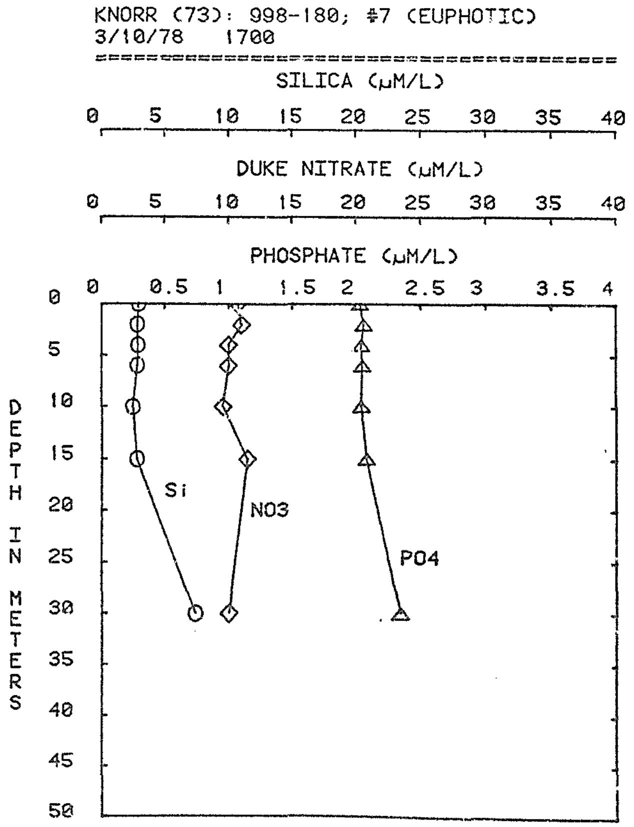


Fig. 95-7E

AM/PM euphotic data, Station 7: 3/10/78.

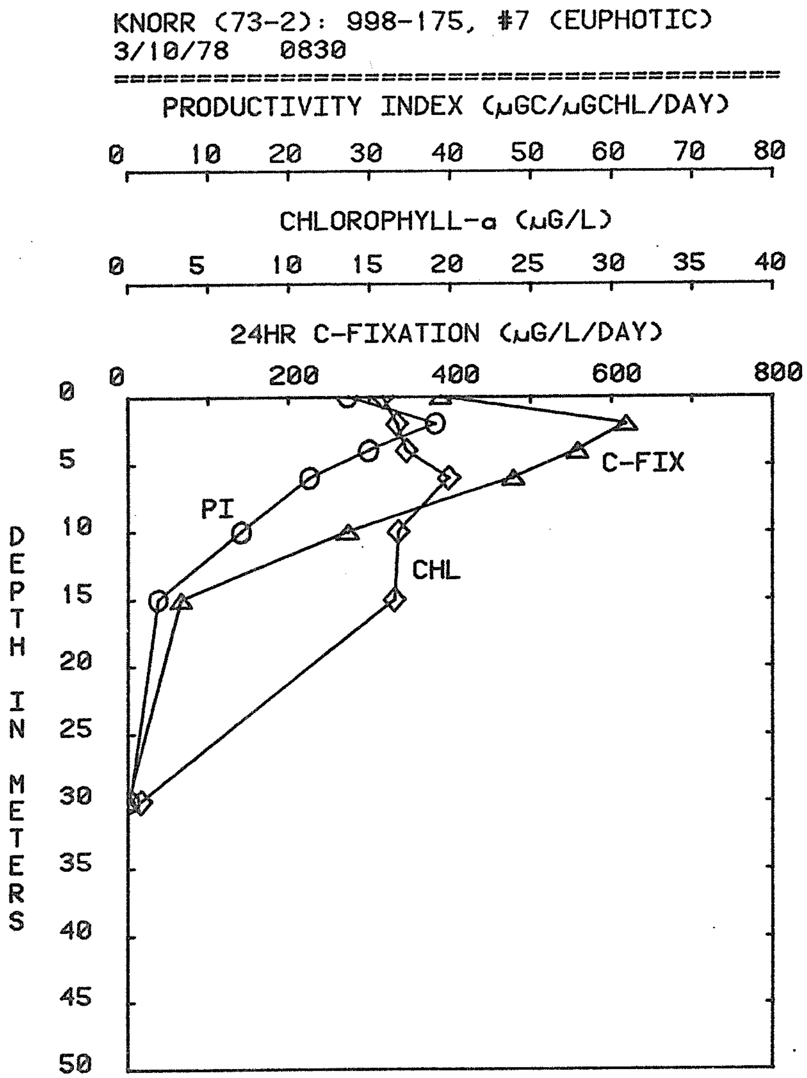


Fig. 96-7E

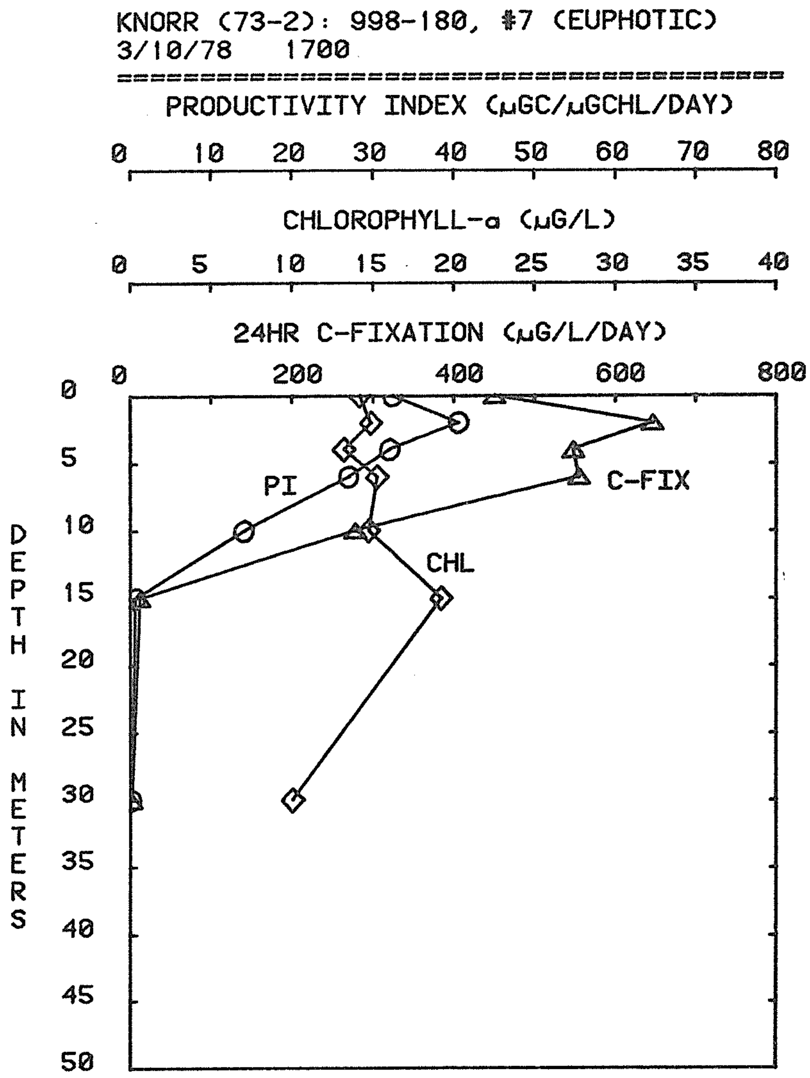


Fig. 97-7E

AM/PM euphotic data, Station 7: 3/10/78.

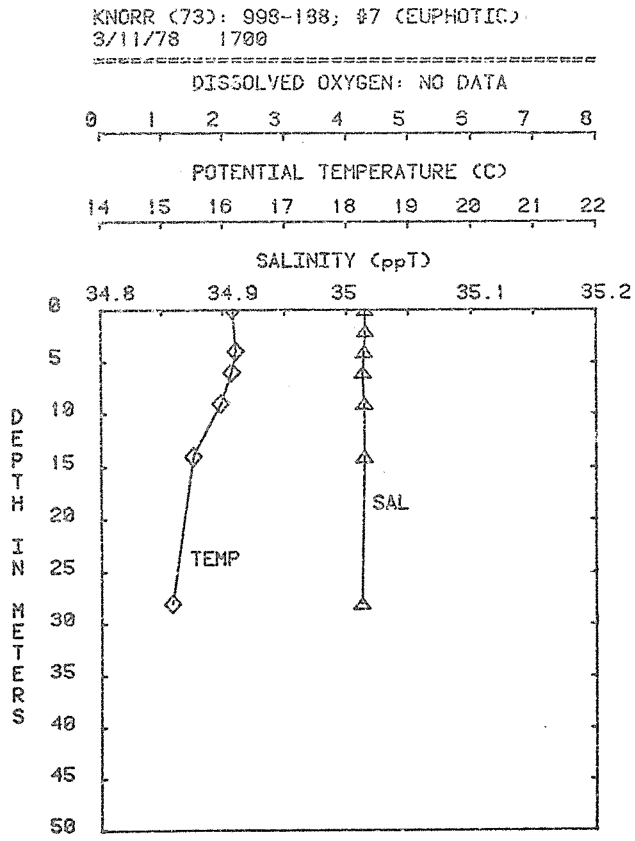


Fig. 98-7E

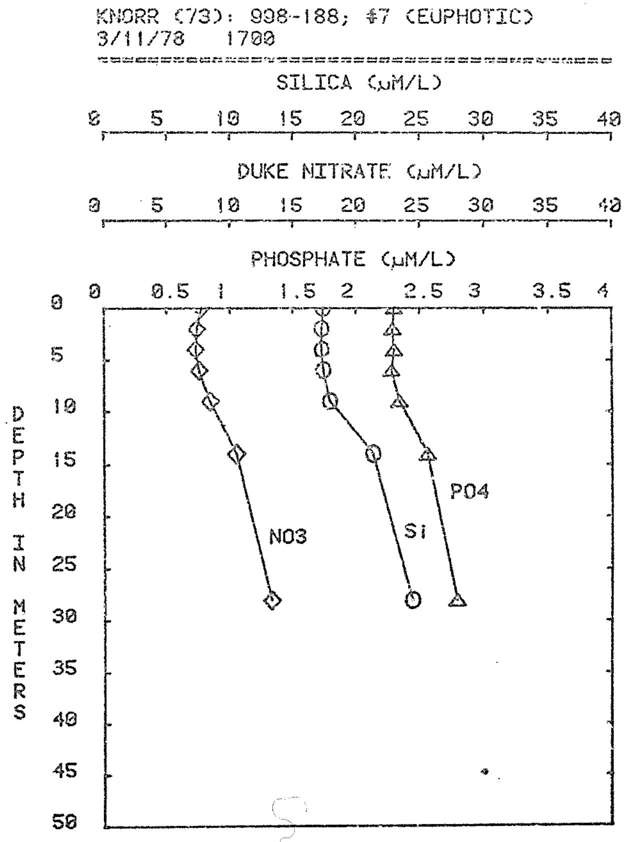


Fig. 99-7E

PM euphotic data, Station 7: 3/11/78.

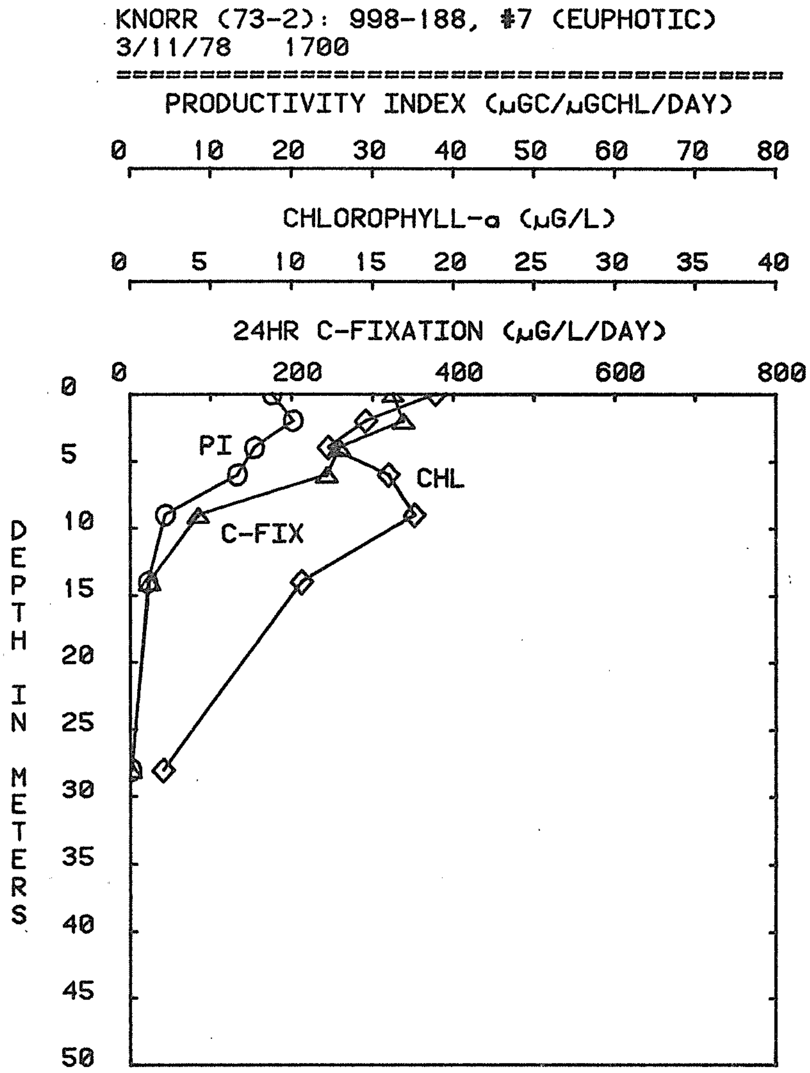


Fig. 100-7E

PM euphotic data, Station 7: 3/11/78.

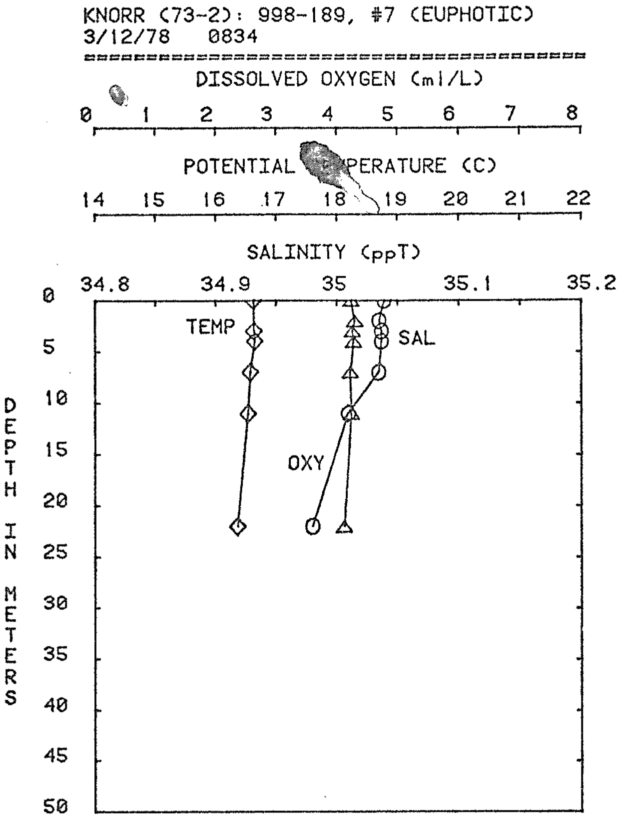


Fig. 101-7E

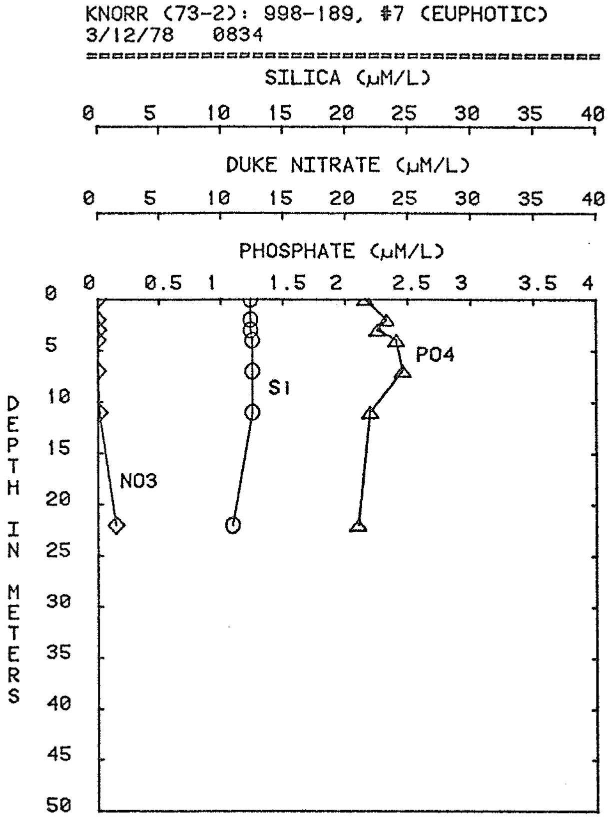


Fig. 102-7E

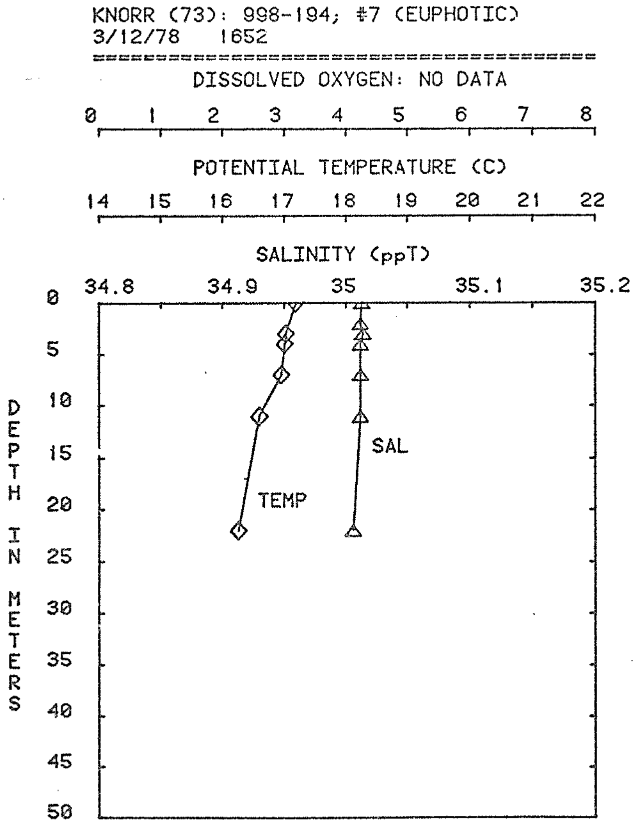


Fig. 103-7E

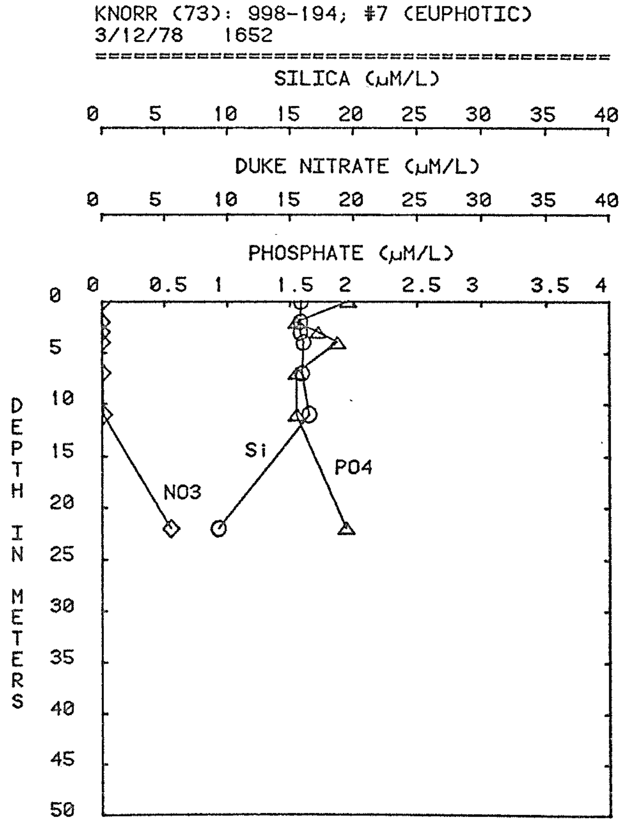


Fig. 104-7E

AM/PM euphotic data, Station 7: 3/12/78.

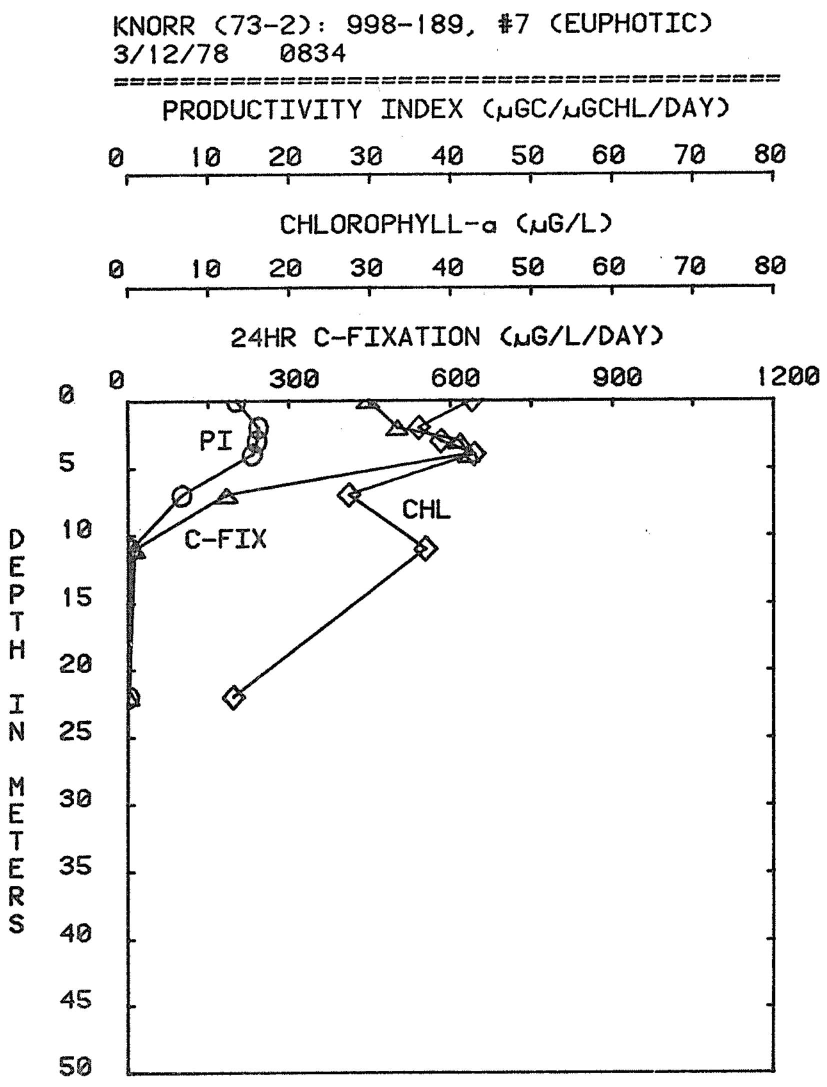


Fig. 105-7E

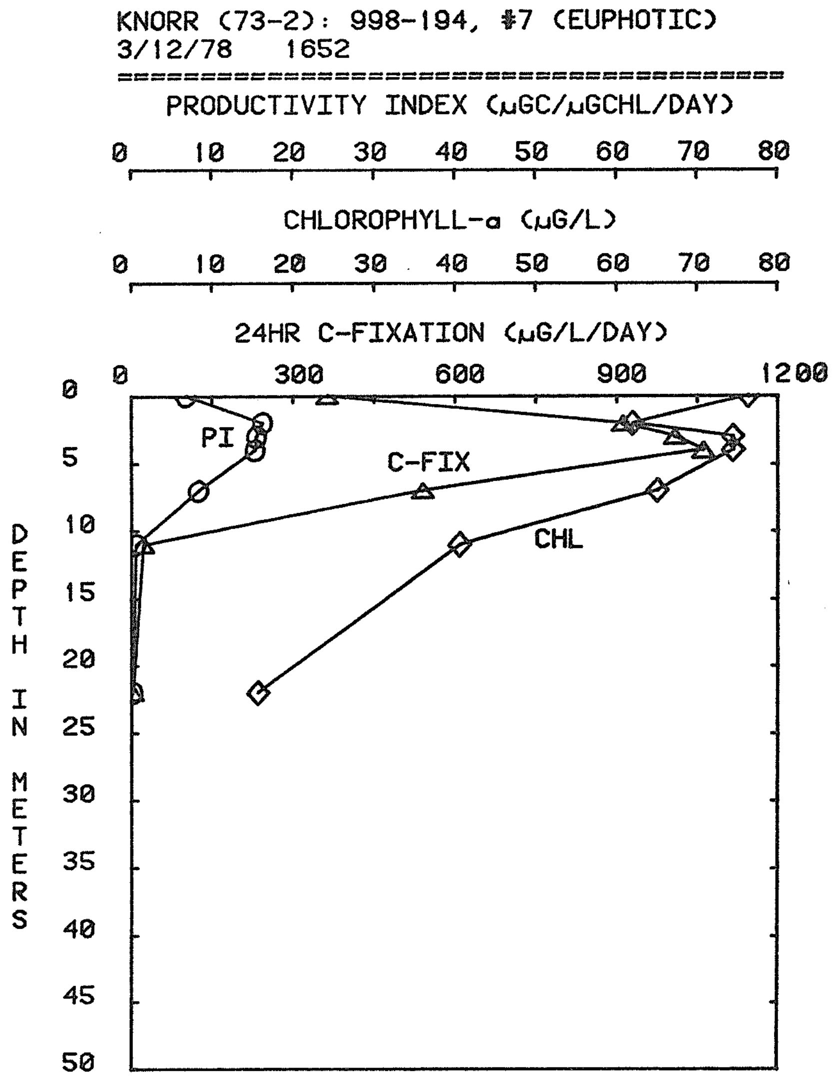


Fig. 106-7E

AM/PM euphotic data, Station 7: 3/12/78.

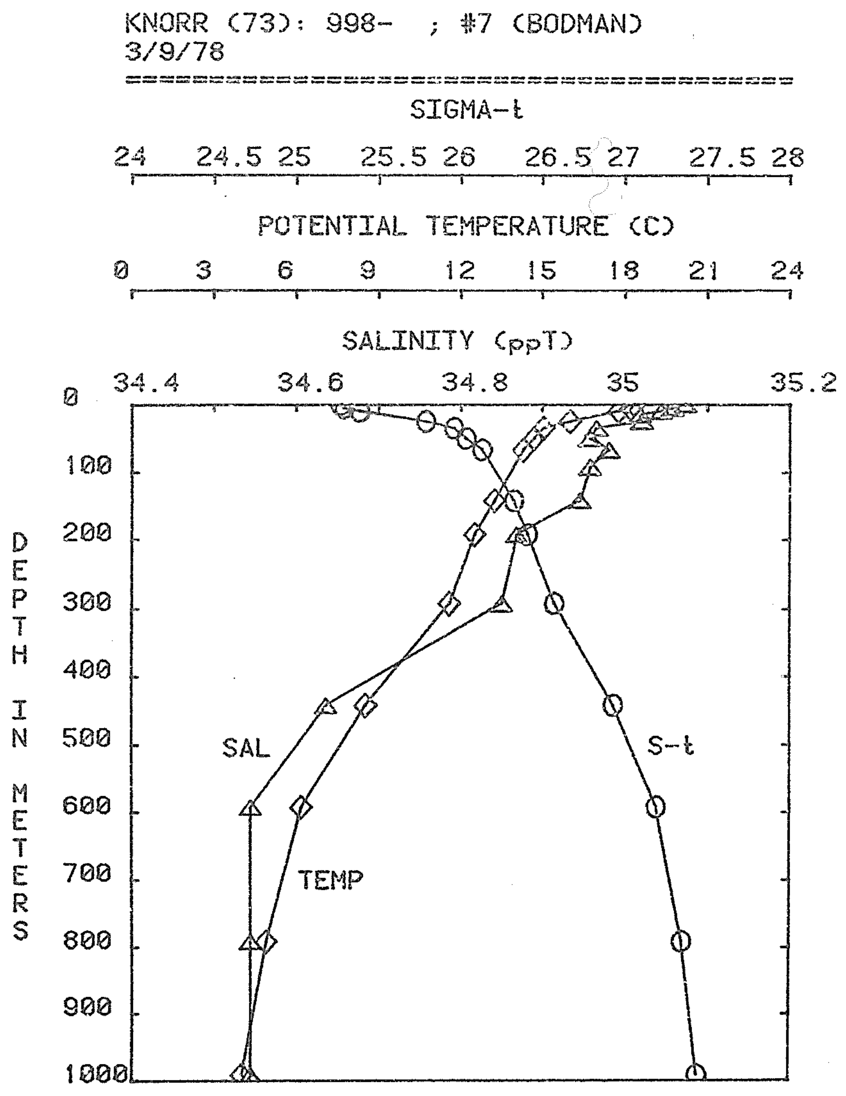


Fig. 107-7B

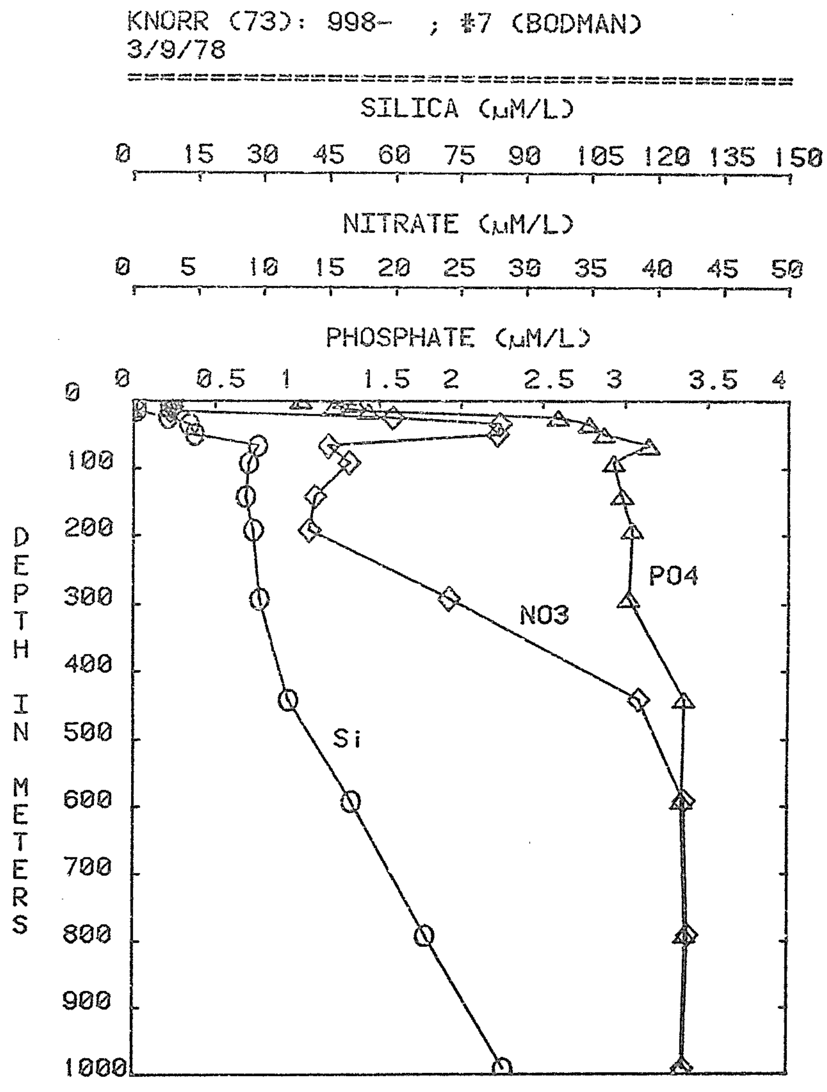


Fig. 108-7B

Bodman data, Station 7: 3/9/78.

TEMPERATURE DEPTH, SALINITY, DENSITY, DISSOLVED OXYGEN, NITRATE, NITRITE AMMONIUM, PHOSPHATE, AND SILICATE DATA FOR NISKIN, EUPHOTIC ZONE AND BODMAN CASTS FOR STATIONS 2-7

(TABLE 1).

R/V Knorr Cruise No. 73, Leg 2
Station No. 993(2)
Water Column Depth: 3850 - 4269 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity (‰)	Dissolved oxygen (ml O_2/ℓ.)	% Light	Chlorophyll (μg/ℓ)	Phaeopigment (μg/ℓ)	Nitrate (Micromoles/liter)	Nitrite (Micromoles/liter)	Ammonium (Micromoles/liter)	Phosphate (Micromoles/liter)	Silicate (Micromoles/liter)
2/27	1005	15°26.2'	4	21.31	0	35.037	7.59	100	1.78	0.37	0.89	0.00	0.0	0.48	0.01
		75°54.4'		21.03	4	35.027	6.58	50	4.45	0.98	1.83	0.09	0.0	0.64	0.33
				-----	6	------	3.89	30	-	-	-	-	-	-	-
				20.94	10	34.994	2.83	15	3.72	1.08	12.96	0.82	0.20	1.62	6.34
				-----	16	34.983	2.53	5	2.93	1.77	15.21	0.89	0.0	1.67	6.38
				15.66	24	34.997	1.28	1	1.87	0.87	20.07	1.21	1.20	2.34	9.38
				14.87	48	34.952	0.40	.01	0.27	0.85	28.79	0.10	2.09	2.46	15.90
2/27	2107	15°27.0'	8	20.88	0	35.031	----	100	2.51	0.60	0.19	0.0	0.0	0.41	0.06
		75°53.5'		17.54	4	35.031	----	50	16.70	4.73	4.24	0.15	1.19	0.90	0.54
				17.22	6	35.009	----	30	10.49	3.93	7.84	0.6	0.96	1.24	1.28
				16.85	10	34.999	----	15	5.49	2.42	10.52	0.72	2.18	1.53	2.74
				16.12	16	35.008	----	5	2.82	1.83	13.67	1.03	1.47	2.22	3.88
				15.02	24	34.953	----	1	0.86	1.78	24.58	0.33	0.0	2.66	12.7
				14.79	48	34.988	----	.01	0.66	0.60	12.44	0.15	0.0	2.90	24.7
2/28	0856	15°27.3'	9	20.223	0	35.014	6.43	100	4.17	1.03	0.0	0.0	0.0	0.39	0.20
		75°51.8'		20.11	2	35.014	5.93	50	4.52	1.08	0.0	0.0	0.0	0.40	0.20
				21.44	4	35.014	6.58	30	4.66	1.42	0.0	0.0	0.0	0.42	0.49
				-----	7	35.009	5.52	15	10.43	1.48	0.94	0.6	0.44	0.76	0.44
				17.52	11	35.008	3.40	5	3.92	1.16	3.66	1.66	0.53	1.32	1.06
				-----	16	34.965	3.83	1	2.57	0.92	10.08	1.12	0.0	1.28	6.10
				14.89	32	34.901	1.28	.01	0.40	0.38	23.35	0.56	0.0	2.24	16.3
2/28	1801	15°27.6	24	20.24	0	35.038	----	100	8.67	1.00	0.0	0.0	0.0	0.58	0.20
		75°57.0		20.23	2	35.038	----	50	9.47	1.21	0.0	0.0	0.0	0.63	0.15
				20.11	4	35.041	----	30	10.31	1.60	0.0	0.0	0.0	0.63	0.15
				19.56	7	35.044	----	15	10.43	1.60	0.0	0.27	0.0	0.73	0.45
				19.37	11	35.047	----	5	10.86	1.65	0.0	0.26	0.07	0.81	0.55
				16.51	16	34.990	----	1	3.68	1.20	7.82	1.81	0.0	1.43	3.65
				14.95	32	34.871	----	.01	0.61	0.45	18.09	1.03	0.0	1.73	9.85

R/V Knorr Cruise No. 73, Leg 2
Station No. 993(2)

Water Column Depth: 3850 - 4269 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity (‰)	Dissolved oxygen (ml O2/l)	% Light	Chlorophyll (μg/ℓ)	Phaeopigment (μg/ℓ)	Nitrate (Micromoles/liter)	Nitrite	Ammonium	Phosphate	Silicate
3/1	0900	15°23.9'	35	20.46	0	35.030	7.09	100	13.39	1.12	0.0	0.0	0.0	0.49	0.31
		75°58.3'		20.47	2	35.030	7.08	50	13.58	0.92	0.0	0.0	0.0	0.42	0.26
				20.28	4	35.032	6.84	30	14.85	1.26	0.0	0.0	0.0	0.42	0.24
				19.46	7	35.030	5.75	15	18.29	2.27	0.0	0.0	0.0	0.69	0.52
				18.19	11	35.033	4.89	5	11.35	1.60	0.92	0.14	0.08	0.87	1.23
				17.06	16	35.059	4.62	1	5.26	1.71	9.59	0.45	0.0	0.76	1.10
				14.82	32	34.965	0.59	0.01	0.23	0.29	28.07	0.07	0.0	2.43	14.1
3/13	1120	15°27.3'	195[1]	20.72	0	35.134	5.89	100	1.01	0.19	0.0	0.0	----	0.42	0.24
		75°51.3'		-----	6	35.128	5.91	50	1.02	0.10	0.0	0.01	----	0.44	0.30
				20.01	10	35.122	5.95	30	1.09	0.25	0.14	0.01	----	0.44	0.36
				20.01	15	35.118	5.89	15	1.39	0.23	0.0	0.0	----	----	----
				17.46	24	35.102	4.56	5	3.44	0.62	0.0	0.02	----	0.69	1.36
				16.57	36	35.080	1.43	1	0.39	0.33	24.76	0.44	----	2.03	5.78
				14.30	72	34.937	0.04	0.01	0.04	0.18	26.98	0.14	----	2.79	17.3
3/13	2119	15°24.3'	197[1]	20.89	0	35.120	----	100	0.84	0.23	0.0	0.02	----	0.48	0.26
		75°55.6'		-----	6	35.120	----	50	0.83	0.24	0.0	0.01	----	0.43	0.24
				20.89	10	35.119	----	30	0.90	0.22	0.24	0.02	----	0.42	0.29
				20.06	15	35.122	----	15	5.10	0.51	0.03	0.02	----	0.51	0.51
				17.87	24	35.126	----	5	4.52	0.59	0.05	0.03	----	0.57	1.00
				16.69	36	35.072	----	1	0.41	0.53	18.9	0.90	----	1.77	4.07
				14.32	72	34.953	----	0.01	0.04	0.22	29.53	0.01	----	2.73	18.2

1. Nitrate and nitrite data are Duke values.

R/V Knorr Cruise No. 73, Leg 2
Station No. 993(2)

15°26.8'S, 75°53.3'W
Water Column Depth: 3850 - 4269 m.
Niskin Casts

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m.)	°C. in situ Tω	Niskin Accepted Depth (m)	Salinity (°/..)	Pot. Temp. (°C.)	σ_o	σ_t	Dissolved oxygen (ml O_2/1.)	Nitrate	Nitrite	Ammonium	Phosphate	Silicate
											(Micromoles/liter)				
2/27/78	1400	5	0	21.59	0	35.018	21.59	24.140	24.365	7.33	0.30	----	0.0	0.45	0.0
			10	16.13	10	34.980	16.13	28.110	25.720	2.29	14.85	0.87	0.96	1.75	6.99
			25	15.60	25	34.989	15.60	28.117	25.848	1.15	19.03	1.15	1.29	2.38	9.78
			50	14.62	50	34.951	14.62	28.086	26.035	0.36	27.75	0.11	0.0	2.56	16.2
			75	14.16	75	34.943	14.14	28.080	26.131	0.03	12.76	7.51	0.0	2.75	23.1
			100	13.71	100	34.962	13.70	28.095	26.238	0.02	3.95	9.74	0.0	2.84	32.2
			150	13.32	151	34.948	13.30	28.084	26.310	----	8.24	9.69	0.0	2.68	29.2
			200	12.99	198	34.919	12.96	28.061	26.356	0.02	11.69	9.59	0.0	2.70	28.9
			300	11.46	305	34.825	11.42	27.985	26.581	0.01	22.55	6.55	0.0	2.71	29.5
			400	9.75	390	34.703	9.70	27.886	26.790	0.02	35.03	0.10	0.0	2.81	31.6
3/1/78	0410	33	0	20.51	0	35.019	20.51	28.141	24.659	5.43	0.45	0.0	---	----	----
			150	13.51	151	34.951	13.49	28.086	26.273	0.03	8.61	9.08	---	----	----
			250	12.72	243	34.905	12.68	28.049	26.401	0.04	11.88	9.19	---	----	----
			500	8.22	490	34.604	8.17	27.807	26.957	0.24	40.04	0.0	---	3.01	35.6
			1000	3.99	991	35.541	3.91	28.562	27.247	1.46	42.28	0.0	---	3.19	87.6
			1100	3.75	1115	35.551	3.67	27.764	27.484	1.67	41.92	0.0	---	3.15	93.4
			1500	2.81	1479	34.606	2.70	27.808	27.619	2.13	40.02	0.0	---	3.02	125.5
			2000	2.18	1975	34.649	2.03	27.841	27.708	2.49	38.23	0.0	---	2.84	138.9
			2500	1.86	2459	34.672	1.68	27.862	27.755	3.19	35.90	0.0	---	----	----
			3000	1.78	2961	34.679	1.56	27.867	27.769	2.90	36.36	0.0	---	2.68	146.5
			3500	1.82	3450	34.682	1.54	27.870	27.773	2.83	35.91	0.0	---	2.65	147.7
			3800	1.83	3747	34.685	1.52	27.872	27.777	3.33	35.31	0.0	---	2.57	137.4

R/V Knorr Cruise No. 73, Leg 2 - continued
Station No. 993(2)

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m.)	°C. *in situ* T_ω	Niskin Accepted Depth (m)	Salinity (°/..)	Pot. Temp. (°C.)	σ_o	σ_t
3/11/78	0650	181	300	11.08	293	------	------	------	------
			400	9.43	399	------	------	------	------
			700	5.42	690	------	------	------	------
			1000	4.17	987	------	------	------	------
			1500	2.81	1484	------	------	------	------
			2000	2.23	1979	------	------	------	------
			2800	1.82	2772	------	------	------	------
			3700	1.80	3663	------	------	------	------
	0948	182	0	23.37	0	------	------	------	------
			10	23.46	10	------	------	------	------
			25	17.83	25	------	------	------	------
			50	14.50	50	------	------	------	------
			75	14.02	75	------	------	------	------
			100	13.44	100	------	------	------	------
			150	12.64	152	------	------	------	------
			200	12.24	195	------	------	------	------

R/V Knorr Cruise No. 73, Leg 2
Station No. 993(2)
2/26/78 - 3/1/78
15°26.8'S, 75°53.3'W
Water Column Depth: 3850 - 4269 m
Bodman Casts

Date (Local)	Time (Local)	Cast No.	Niskin[4] wire out (m.)	°C. in situ Tω	Niskin[4] Accepted Depth (m)	Salinity (°/₀₀)	Pot. Temp. (°C.)	σ_0	σ_t	Nitrate	Nitrite	Ammonium	Phosphate	Silicate
										(Micromoles/liter)				
2/26/78	2340	1-1	2792	1.80	2748	34.677	1.60	27.866	27.765	----	----	----	2.69	141.7
	2340	1-2	1992	2.24	1970	34.642	2.10	27.837	27.698	----	----	----	----	----
2/27/78	0451	2-3	4254	1.80	4246[3]	34.689	1.43	27.875	27.787	----	----	----	2.52	131.8
	0451	2-4	3392	1.80	3379[2]	34.683	1.53	27.870	27.775	----	----	----	2.69	146.8
	0810	3-5	1992	1.81	1972	34.642	1.67	27.837	27.731	----	----	----	2.89	135.8
	0810	3-6	1492	2.86	1476	34.599	2.75	27.803	27.609	----	----	----	2.95	117.8
	1549	6-7	1492	2.90	1460	34.589	2.79	27.795	27.597	----	----	----	----	----
	1753	6-8	992	4.34	977	34.530	4.26	27.747	27.406	----	----	----	3.15	80.8
	1835	7-9	992	4.30	981	34.526	4.22	27.744	27.407	----	----	----	----	----
	1835	7-10	692	6.01	682	34.514	5.95	27.734	27.196	----	----	----	----	----
2/28/78	1038	11-11	692	6.19	689	34.538	6.13	27.754	27.192	----	----	----	----	----
	1038	11-12	392	10.56	388	34.758	10.52	27.931	26.692	----	----	----	----	----
	1215	12-13	392	10.50	386	34.760	10.45	27.932	26.705	----	----	----	----	----
	1215	12-14	292	12.08	292	34.866	12.04	28.018	26.496	----	----	----	----	----
	1325	13-15	0	21.05[1]	0	35.043	21.05	28.161	24.532	----	----	----	0.46	0.0
	1430	14-16	0	-----	0	------	-----	------	------	----	----	----	----	----
	1510	15-17	10	19.92	10	35.053	19.91	28.169	24.844	----	----	----	0.69	0.15
	1530	16-18	10	-----	10	------	-----	------	------	----	----	----	----	----
	1543	17-19	25	15.74	25	34.984	15.74	28.113	25.812	----	----	----	2.07	5.05
	1600	18-20	25	-----	25	------	-----	------	------	----	----	----	----	----
	1647	20-21	50	14.36	50	34.984	14.35	28.113	26.118	----	----	----	2.78	21.8
	1700	21-22	50	-----	50	------	-----	------	------	----	----	----	----	----
	1719	22-23	67	14.07	67	34.967	14.06	28.099	26.167	----	----	----	2.69	21.6
	1730	23-24	67	-----	67	------	-----	------	------	----	----	----	----	----
	1840	25-25	92	13.92	92	34.990	13.91	28.118	26.216	----	----	----	2.80	28.8
	1905	26-26	92	-----	92	------	-----	------	------	----	----	----	----	----
	1921	27-27	142	13.55	141	34.949	13.53	28.085	26.263	----	----	----	2.77	28.1
	1940	28-28	142	-----	141	------	-----	------	------	----	----	----	----	----
	2130	29-29	192	13.15	186	34.949	13.12	28.085	26.347	----	----	----	2.75	29.4
	2150	30-30	192	-----	186	------	-----	------	------	----	----	----	----	----

R/V Knorr Cruise No. 73, Leg 2 (Contd)
Station No. 993(2)

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m)	°C in situ Tω	Niskin Accepted Depth (m)	Salinity (‰)	Pot. Temp. (°C)	σ_o	σ_t	Nitrate (Micromoles/liter)	Nitrite	Ammonium	Phosphate	Silicate
2/28/78	2210	31-31	300	12.27	285	34.880	12.23	28.029	26.470	----	----	----	----	----
3/1/78	0011	32-32	3903	-----	3903	34.689	-----	------	------	----	----	----	----	----

[1]Protected thermometer malfunctioned; since depth = 0-10 m, unprotected temperature used for Tω and θ.

[2]Unprotected thermometer malfunctioned; therefore, depth = wire out × depth factor.

[3]Pinger used to determine depth.

[4]Hydrographic and nutrient data refer to the Niskin which was placed 8 m above the Bodman.

R/V Knorr Cruise No. 73, Leg 2
Station No. 994(3)

Water Column Depth: 35 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity (‰)	Dissolved oxygen (ml O2/l)	% Light	Chlorophyll (µg/ℓ)	Phaeopigment (µg/ℓ)	Nitrate (Micromoles/liter)	Nitrite	Ammonium	Phosphate	Silicate
3/2	0905	15°04.5'	38	15.02	0	34.993	1.49	100	3.52	0.58	7.37	1.69	0.0	2.88	28.2
		75°28.8'		14.92	5	34.990	1.49	50	3.33	0.81	7.69	1.84	0.0	2.91	29.0
				14.89	9	34.990	1.48	30	2.34	0.69	8.04	1.91	0.07	2.96	29.8
				14.68	14	34.986	1.30	15	1.07	0.78	8.43	2.07	0.0	2.99	32.1
				14.64	22	34.988	1.20	5	0.86	0.79	10.8	1.58	0.0	3.06	32.6
				14.56	28	34.988	1.00	1	0.96	0.70	8.63	2.2	0.0	3.00	32.6
3/2	1715	15°04.5'	50	15.42	0	35.009	----	100	5.73	0.98	4.17	1.48	0.0	2.94	31.8
		75°28.8'		15.39	5	35.012	----	50	6.63	0.45	4.32	1.49	0.0	2.95	31.6
				15.12	9	35.016	----	30	5.56	1.08	5.00	1.65	0.0	3.06	32.5
				15.03	14	35.019	----	15	3.48	0.76	6.13	1.98	0.0	3.08	33.9
				14.62	22	35.019	----	5	1.99	0.97	8.10	1.99	0.0	3.07	33.2
				14.41	28	34.990	----	1	1.17	0.80	8.82	1.91	0.0	3.04	32.9

R/V Knorr Cruise No. 73, Leg 2
Station No. 994(3)
15°04.8'S, 75°25.1'W
Bodman Casts

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m.)	°C *in situ* Tω	Niskin Accepted Depth (m)	Salinity (°/..)	Pot. Temp. (°C.)	σ_0	σ_t	Nitrate (Micromoles/liter)	Nitrite (Micromoles/liter)	Ammonium (Micromoles/liter)	Phosphate (Micromoles/liter)	Silicate (Micromoles/liter)
3/2/78	1020	40-33	0	------	0	35.022	-----	------	------	8.36	1.98	0.0	3.04	32.4
		41-34	0	------	0	------	-----	------	------	----	----	---	----	----
	1100	42-35	7	------	7	34.988	-----	------	------	8.32	2.05	0.0	3.03	32.1
		43-36	7	------	7	------	-----	------	------	----	----	---	----	----
	1120	44-37	15	------	15	34.992	-----	------	------	8.26	2.05	0.0	3.05	32.8
		45-38	15	------	15	------	-----	------	------	----	----	---	----	----
	1159	46-39	25	------	25	34.996	-----	------	------	10.26	1.62	0.0	3.09	33.8
		47-40	25	------	25	------	-----	------	------	----	----	---	----	----

R/V Knorr Cruise No. 73, Leg 2
Station No. 995(4)

Water Column Depth; 90 m
Euphotic Casts

(Date) (Local)	(Time) (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity (‰)	Dissolved oxygen (ml O2/l)	% Light	Chlorophyll (μg/ℓ)	Phaeopigment (μg/ℓ)	Nitrate (Micromoles/liter)	Nitrite (Micromoles/liter)	Ammonium (Micromoles/liter)	Phosphate (Micromoles/liter)	Silicate (Micromoles/liter)
3/3	1750	15°04.0'	72	16.13	0	34.991	----	100	25.85	2.17	6.48	0.38	0.0	2.34	8.30
		75°28.6'		16.11	2	34.992	----	50	23.55	1.93	6.69	0.39	0.0	2.27	8.27
				16.13	4	34.992	----	30	23.17	1.89	6.57	0.35	0.0	2.28	8.41
				16.12	7	34.994	----	15	21.20	1.72	----	----	0.0	2.31	8.45
				16.08	11	35.002	----	5	25.23	1.68	6.62	0.38	0.0	2.33	10.1
				-----	16	34.998	----	1	36.32	3.21	6.94	0.37	0.0	2.53	11.4
				14.97	32	35.001	----	0.01	3.48	1.10	8.81	0.54	0.0	2.85	28.8
3/4	0821	15°04.5'	75[1,2]	16.64	0	34.987	4.12	100	10.63	1.77	5.41	0.34	---	2.84	2.00
		75°30.8'		16.62	2	34.986	4.08	50	10.74	1.88	5.60	0.34	---	1.75	2.05
				16.58	4	34.987	4.02	30	10.50	1.90	5.80	0.35	---	1.75	1.95
				16.55	6	34.986	3.87	15	11.09	1.97	6.38	0.34	---	1.84	2.05
				16.43	10	34.988	3.45	5	10.34	1.74	8.17	0.36	---	1.91	2.50
				-----	15	35.006	1.33	1	7.97	1.67	16.35	0.62	---	2.24	5.35
				14.86	30	34.974	0.40	0.01	2.73	1.10	20.70	0.23	---	2.55	17.8
3/4	1754	15°04.1'	77[1]	16.78	0	34.990	----	100	27.58	2.29	1.69	0.22	---	1.83	2.63
		75°28.2'		16.70	2	34.992	----	50	26.09	2.17	1.83	0.23	---	1.98	3.66
				16.53	4	34.993	----	30	24.19	2.42	2.33	0.27	---	1.93	4.69
				16.24	6	34.992	----	15	19.48	2.38	3.30	0.44	---	2.04	6.90
				15.26	10	34.990	----	5	5.33	1.18	10.12	0.73	---	2.67	19.9
				15.15	15	34.988	----	1	2.99	1.34	13.45	0.76	---	2.74	22.4
				14.93	30	35.008	----	0.01	1.05	0.73	10.50	0.35	---	2.88	29.9

1. Nitrate, nitrite are Duke values.

2. Phosphate and silicate are Duke values.

R/V Knorr Cruise No. 73, Leg 2
Station No. 995(4)
3/3/78
15°02.9'S, 75°30.2'W
Water Column Depth: 90 m
Niskin Cast

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m)	°C in situ Tw	Niskin Accepted Depth (m)	Salinity (‰)	Pot. Temp. (°C)	σ_o	σ_t	Dissolved oxygen (ml O_2/l)	Nitrate	Nitrite	Ammonium	Phosphate	Silicate
											(Micromoles/liter)				
3/3/78	0905	52	0	16.10	0	34.988	16.10	28.116	25.733	3.09	8.73	0.31	0.0	2.12	6.57
			2	16.06	2	34.988	16.06	28.116	25.742	3.06	8.97	0.34	0.0	2.13	6.64
			4	16.06	4	34.990	16.06	28.118	25.744	2.96	9.20	0.38	0.0	2.14	6.66
			7	15.98	7	34.990	15.98	28.118	25.762	2.88	9.94	0.44	0.0	2.21	7.01
			11	15.74	11	34.994	15.74	28.121	25.820	2.02	12.52	0.44	0.0	2.31	7.79
			16	-----	16	34.994	-----	-----	-----	1.47	12.85	0.46	0.0	2.52	15.6
			32	15.18	32	34.988	15.17	28.116	25.943	0.85	14.50	0.35	0.0	2.57	17.9
			45	14.82	45	35.000	14.82	28.126	26.030	0.54	10.48	0.98	0.0	2.92	31.3
			60	14.55	60	34.998	14.54	28.124	26.088	0.29	9.77	1.50	0.0	2.96	34.3
			75	14.31	75	34.990	14.29	28.118	26.136	0.03	9.16	1.42	0.0	2.94	35.4
			90	14.23	90	34.985	14.21	28.114	26.149	0.06	10.11	1.58	0.0	2.90	34.3

R/V Knorr Cruise No. 73, Leg 2
Station No. 995(4)
3/3/78
15°02.9'S, 75°30.2'W
Water Column Depth: 90 m
Bodman Casts

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m.)	°C. in situ Tω	Niskin Accepted Depth (m)	Salinity (°/₀₀)	Pot. Temp. (°C.)	σo	σt	Nitrate	Nitrite	Ammonium	Phosphate	Silicate
										(Micromoles/liter)				
3/3/78	1039	54-41	0	16.49[1]	0	------	16.49	------	------	8.78	0.45	0.0	1.92	5.23
	1050	55-42	0	-----	0	------	-----	------	------	----	----	---	----	----
	1109	56-43	5	16.02	5	34.988	16.02	28.116	25.751	6.52	0.33	0.0	2.09	5.44
	1120	57-44	5	-----	5	------	-----	------	------	----	----	---	----	----
	1135	58-45	10	15.89[1]	10	35.000	15.89[1]	28.126	25.957	9.77	0.42	0.0	2.10	7.68
	1150	59-46	10	-----	10	------	-----	------	------	----	----	---	----	----
	1306	60-47	15	15.69	15	34.994	15.68	28.121	25.833	12.19	0.46	0.0	2.21	9.20
	1319	62-48	15	-----	15	------	-----	------	------	----	----	---	----	----
	1339	63-49	25	15.64	25	35.024	15.63	28.145	25.868	10.93	0.42	0.0	2.28	10.8
	----	64-50	25	-----	25	------	-----	------	------	----	----	---	----	----
	1407	65-51	40	-----[2]	40	34.992	-----	------	------	15.93	0.99	0.0	2.80	28.4
	----	66-52	40	-----	40	------	-----	------	------	----	----	---	----	----
	1447	67-53	60	14.38	60	34.986	14.37	28.115	26.115	12.16	0.45	0.0	2.82	28.7
	1520	68-54	60	-----	60	------	-----	------	------	----	----	---	----	----
	1536	69-55	73	14.43	73	35.010	14.41	28.134	26.125	9.58	1.11	0.6	3.07	36.8
	1655	70-56	73	-----	73	------	-----	------	------	----	----	---	----	----

[1] Protected thermometer malfunctioned; since depth = 0 to 10 m, unprotected temperature used for Tω and θ.

[2] Offscale.

R/V Knorr Cruise No. 73, Leg 2
Station No. 996(5)
Water Column Depth: 136 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity (‰)	Dissolved oxygen (ml 02/1)	% Light	Chlorophyll (µg/ℓ)	Phaeopigment (µg/ℓ)	Nitrite (Micromoles/liter)	Nitrate (Micromoles/liter)	Ammonium (Micromoles/liter)	Phosphate (Micromoles/liter)	Silicate (Micromoles/liter)
3/5/78	0822	15°10.3'	81[1]	17.04	0	34.978	4.52	100	11.74	2.07	1.99	0.18	---	1.68	1.26
		75°30.5'		17.02	2	34.978	4.53	50	12.68	1.72	2.12	0.21	---	1.68	1.30
				17.03	4	34.964	4.50	30	12.87	1.72	2.27	0.20	---	1.69	1.31
				17.01	6	34.977	4.51	15	12.09	1.21	2.25	0.20	---	1.71	1.31
				16.96	10	34.976	4.36	5	11.50	2.29	2.78	0.22	---	1.69	1.39
				16.88	15	34.976	4.21	1	10.72	2.16	3.57	0.24	---	1.71	1.47
				15.91	30	34.981	0.69	0.01	3.42	1.60	21.26	0.45	---	2.56	11.1
3/5/78	1751	15°10.4'	99[1]	16.78	0	34.973	----	100	15.84	2.06	3.98	0.29	---	1.62	0.73
		75°29.2'		-----	2	34.973	----	50	14.99	2.84	4.18	0.30	---	1.66	0.72
				16.80	4	34.972	----	30	14.67	3.17	4.66	0.32	---	1.69	0.80
				16.74	6	34.973	----	15	13.63	3.30	4.81	0.33	---	1.72	0.80
				16.35	10	34.980	----	5	12.26	2.95	8.41	0.52	---	1.92	1.69
				16.00	15	34.983	----	1	7.18	2.18	11.43	0.70	---	2.23	3.51
				15.18	30	34.990	----	0.01	3.78	1.67	21.70	0.45	---	2.75	11.0
3/6/78	0825	15°08.3'	100[1]	17.16	0	34.988	4.57	100	12.97	2.19	4.30	0.44	---	1.60	1.19
		75°36.2'		17.15	2	34.988	4.53	50	11.98	2.40	4.51	0.44	---	1.60	1.27
				17.08	4	34.988	4.54	30	13.26	1.32	4.24	0.44	---	1.59	1.28
				17.12	6	34.987	4.59	15	11.61	2.31	4.21	0.44	---	1.57	1.28
				17.04	10	34.984	4.37	5	13.65	1.36	4.59	0.44	---	1.61	1.52
				16.84	15	34.980	4.13	1	11.14	1.82	6.00	0.49	---	1.68	1.99
				14.90	30	34.919	1.28	0.01	0.85	0.76	18.15	0.46	---	2.36	14.0
3/6/78	1552	15°09.0'	102[1]	17.62	0	34.990	----	100	25.02	2.00	0.54	0.07	---	1.50	1.31
		75°35.1'		17.61	2	34.990	----	50	25.42	2.54	0.54	0.08	---	1.48	1.32
				17.54	4	34.990	----	30	23.97	2.40	1.31	0.15	---	1.50	1.32
				17.43	6	34.990	----	15	22.88	1.85	1.79	0.17	---	1.54	1.45
				17.35	10	34.990	----	5	23.53	2.81	2.44	0.26	---	1.55	1.34
				16.86	15	34.986	----	1	14.86	2.39	6.61	0.52	---	1.65	1.85
				-----	30	34.979	----	0.01	3.33	1.62	12.35	1.04	---	2.03	4.87

1. Nitrate and nitrite data are Duke values.

R/V Knorr Cruise No. 73, Leg 2
Station No. 996(5)
15°09.4'S, 75°30.5'W
Water Column Depth: 136 m
Niskin Cast

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m)	°C in situ Tω	Niskin Accepted Depth (m)	Salinity (‰)	Pot. Temp. (°C)	σ_o	σ_t	Dissolved oxygen (ml O2/l)	Nitrate	Nitrite	Ammonium (Micromoles/liter)	Phosphate	Silicate
3/5/78	1016	82	0	17.13	0	34.974	17.13	28.105	25.481	4.97	0.55	0.57	0.0	1.32	0.64
			5	17.13	5	34.974	17.13	28.105	25.481	4.94	0.52	0.61	0.0	1.32	0.62
			10	17.04	10	34.974	17.04	28.105	25.503	4.81	0.77	0.52	0.0	1.37	0.67
			15	16.89	15	34.974	16.89	28.105	25.538	4.33	2.47	0.66	0.0	1.41	1.03
			25	15.75	25	34.978	15.74	28.108	25.808	1.94	11.00	1.91	0.0	2.17	3.80
			40	15.25	40	34.983	15.24	28.112	25.924	0.43	20.12	0.65	0.0	2.44	12.5
			55	14.79	55	34.968	14.78	------	26.014	0.17	20.20	0.51	0.0	2.77	21.2
			70	14.40	70	34.984	14.39	28.113	26.110	0.02	15.14	2.17	0.0	2.78	26.7
			90	14.29	90	34.994	14.28	28.121	26.141	0.01	8.69	1.80	0.0	2.97	32.3
			110	14.13	111	34.974	14.11	28.105	26.162	0.03	14.64	2.38	0.0	2.84	27.3
			132	14.04	131	34.968	14.02	28.100	26.176	0.01	11.40	3.79	0.15	2.92	30.7

R/V Knorr Cruise No. 73, Leg 2
Station No. 996(5)
15°09.4'S, 75°30.5'W
Water Column Depth: 136 m
Bodman Casts

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m.)	°C. *in situ* Tω	Niskin Accepted Depth (m)	Salinity (°/₀₀)	Pot. Temp. (°C.)	σ_o	σ_t	Nitrate	Nitrite	Ammonium (Micromoles/liter)	Phosphate	Silicate
3/5/78	1139	83-57	0	17.13	0	35.057	17.13	28.172	25.545	1.12	0.78	0.04	1.62	0.72
	1159	84-58	0	-----	0	------	-----	------	------	----	----	----	----	----
	1250	85-59	5	16.97	5	34.996	16.97	28.123	25.536	3.64	0.88	0.06	1.71	1.03
	1303	86-60	5	-----	5	------	-----	------	------	----	----	----	----	----
	1317	87-61	10	16.93	10	35.020	16.93	28.142	25.564	2.53	0.82	0.0	1.68	1.03
	1327	88-62	10	-----	10	------	-----	------	------	----	----	----	----	----
	1345	89-63	15	15.98	15	35.014	15.98	28.137	25.781	11.7	1.08	0.81	2.17	3.43
	1430	90-64	15	-----	15	------	-----	------	------	----	----	----	----	----
	1503	91-65	25	15.86	25	35.104	15.86	28.210	25.877	11.55	1.41	0.47	2.20	2.34
	1518	92-66	25	-----	25	------	-----	------	------	----	----	----	----	----
	1528	93-67	35	14.88	35	34.996	14.87	28.123	26.015	20.21	0.72	0.0	2.85	20.4
	1549	94-68	50	14.54	50	35.047	14.53	28.164	26.128	13.14	3.61	0.0	2.84	28.5
	1610	95-69	67	14.38	67	35.051	14.37	28.167	26.166	9.66	2.81	0.0	3.03	31.5
	1632	96-70	92	14.38	92	35.075	14.36	28.186	26.186	10.25	2.14	0.0	3.05	31.7
	1641	97-71	117	14.11	117	35.051	14.09	28.167	26.225	10.61	3.31	0.0	3.00	28.8

R/V Knorr Cruise No. 73, Leg 2
Station No. 997(6)
Water Column Depth: 400 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity (‰)	Dissolved oxygen (ml O2/l)	% Light	Chlorophyll (µg/ℓ)	Phaeopigment (µg/ℓ)	Nitrate (Micromoles/liter)	Nitrite	Ammonium	Phosphate	Silicate
3/7/78	1814	15°10.0'	126[1]	17.75	0	34.978	---	100	19.07	2.39	0.42	0.05	---	1.26	0.54
		75°34.8'		-----	2	34.972	---	50	18.02	2.84	0.21	0.05	---	1.26	0.54
				17.71	4	34.975	---	30	17.82	2.72	0.36	0.05	---	1.24	0.55
				17.64	6	34.978	---	15	18.33	2.69	0.17	0.06	---	1.30	0.55
				17.18	9	34.977	---	5	22.69	2.74	1.74	0.23	---	1.37	0.55
				17.22	14	34.979	---	1	20.39	3.26	0.98	0.14	---	1.28	0.56
				15.94	28	34.983	---	0.01	5.55	1.30	10.29	0.61	---	1.96	6.29
3/8/78	0820	15°07.0'	138[1]	17.24	0	34.978	5.05	100	12.72	2.24	2.18	0.26	---	1.50	1.20
		75°37.5'		-----	2	34.971	5.04	50	12.50	2.47	2.14	0.26	---	1.50	1.15
				17.26	4	34.979	5.08	30	11.89	2.04	2.17	0.32	---	1.50	1.11
				17.23	6	34.975	4.96	15	11.45	2.10	2.32	0.28	---	1.50	1.15
				17.00	10	35.009	3.20	5	11.35	2.74	7.85	0.60	---	1.69	2.83
				15.57	15	34.970	1.50	1	2.92	1.11	15.9	0.70	---	2.32	9.05
				15.18	30	34.947	0.87	0.01	1.30	1.11	21.18	0.34	---	2.46	11.08

1. Nitrate and nitrite data are Duke values.

R/V Knorr Cruise No. 73, Leg 2
Station No. 997(6)
Water Column Depth: 400 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tw	Depth (m)	Salinity (‰)	Dissolved oxygen (ml 02/1)	% Light	Chlorophyll (µg/ℓ)	Phaeopigments (µg/ℓ)	Nitrate (Micromoles/liter)	Nitrite	Ammonium	Phosphate	Silicate
3/8/78	1834	15°09.7'	141 [1]	17.76	0	34.995	----	100	18.00	2.25	0.14	0.03	----	1.44	0.92
		75°35.9'		17.74	2	34.996	----	50	16.85	2.64	0.08	0.02	----	1.39	0.87
				17.77	4	34.995	----	30	16.55	2.59	0.01	0.02	----	1.38	0.88
				17.78	6	34.994	----	15	16.86	2.13	0.04	0.02	----	1.38	0.88
				17.66	9	35.000	----	5	20.08	2.87	0.44	0.06	----	1.38	0.95
				17.42	14	35.033	----	1	15.69	2.48	4.64	0.44	----	1.40	1.68
				16.01	28	35.044	----	0.01	0.59	1.00	22.86	0.22	----	2.44	13.7

1. Nitrate and nitrite data are Duke values.

R/V Knorr Cruise No. 73, Leg 2
Station No. 997(6)
3/7/78
15°09.9'S, 75°36.0'W
Water Column Depth: 400 m
Niskin Cast

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m)	°C in situ Tω	Niskin Accepted Depth (m)	Salinity (‰)	Pot. Temp. (°C)	σ_o	σ_t	Dissolved oxygen (ml 02/1)	Nitrate (Micromoles/liter)	Nitrite (Micromoles/liter)	Ammonium (Micromoles/liter)	Phosphate (Micromoles/liter)	Silicate (Micromoles/liter)
3/7/78	1000	107	0	17.49	0	34.974	17.49	28.105	25.395	5.63	0.54	0.0	0.0	1.37	0.86
			2	17.53	2	34.972	17.52	28.103	25.386	5.50	0.35	0.0	0.0	1.39	0.79
			4	17.51	4	34.973	17.51	28.104	25.389	5.60	0.63	0.0	0.0	1.39	0.83
			6	17.52	6	34.976	17.52	28.107	25.389	5.62	0.68	0.0	0.0	1.41	0.72
			9	17.39	9	34.973	17.39	28.104	25.418	5.53	0.67	0.0	0.0	1.39	0.80
			14	17.07	14	34.982	17.06	28.111	25.504	4.10	3.94	0.03	0.95	1.55	1.81
			28	15.53	28	34.968	15.52	28.100	25.849	1.32	14.50	0.47	0.96	2.23	8.47
	1124	109	35	15.17	35	34.975	15.17	28.106	25.933	0.69	19.95	0.25	0.04	2.54	13.4
			50	14.44	50	34.959	14.43	28.093	26.082	0.11	18.65	0.01	0.03	2.82	22.7
			75	14.18	75	34.992	14.17	28.119	26.163	0.04	18.07	0.89	0.0	2.66	28.2
			100	14.15	100	34.989	14.14	28.117	26.167	0.02	18.72	0.95	0.0	2.67	28.0
			150	13.88	149	34.969	13.86	28.101	26.210	0.02	12.27	3.94	0.36	2.83	32.7
			200	13.05	200	34.911	13.02	28.054	26.338	0.03	12.35	7.28	0.04	2.73	27.3
			250	12.20	248	34.864	12.17	28.016	26.469	0.04	16.22	6.76	0.0	2.75	28.3
			300	11.37	297	34.813	11.33	27.975	26.588	0.03	21.33	5.01	0.04	2.81	29.9
			375	9.83	372	34.711	9.79	27.893	26.781	0.02	30.35	1.02	0.03	2.98	34.0

R/V Knorr Cruise No. 73, Leg 2
Station No. 997(6)
3/7/78
15°09.9'S, 75°36.0'W
Water Column Depth: 400 m
Bodman Casts

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m)	°C in situ Tw	Niskin Accepted Depth (m)	Salinity (‰)	Pot. Temp. (°C)	σ_o	σ_t	Nitrate (Micromoles/liter)	Nitrite (Micromoles/liter)	Ammonium (Micromoles/liter)	Phosphate (Micromoles/liter)	Silicate (Micromoles/liter)
3/7/78	1330	112-75	0	17.44	0	35.102	17.44	28.208	25.505	3.02	0.0	0.15	1.37	0.97
	1352	113-76	0	-----	0	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1358	114-77	5	17.39	5	35.002	17.39	28.127	25.440	3.21	0.0	0.16	1.45	1.51
	1412	115-78	5	-----	5	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1418	116-79	10	17.23	10	34.996	17.23	28.123	25.474	3.89	0.0	0.24	1.45	1.62
	1473	117-80	10	-----	10	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1437	118-81	15	16.58	15	35.045	16.58	28.162	25.666	11.93	0.0	0.87	1.83	5.97
	1455	119-82	15	-----	15	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1458	120-83	25	15.81	25	35.037	15.80	28.156	25.839	23.19	0.0	0.0	2.32	11.4
	1520	121-84	25	-----	25	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1534	122-85	35	-----	35	35.033	-----	-----	-----	21.56	0.79	0.0	2.30	11.0
	1546	123-86	35	-----	35	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1555	124-87	50	14.84	50	34.972	14.83	28.103	26.005	22.34	0.09	0.0	2.67	16.4
	1620	125-88	50	-----	50	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1919	128-89	67	14.31	67	34.988	14.30	28.116	26.132	15.75	0.19	0.0	2.80	26.3
	1928	129-90	67	-----	67	-----	-----	-----	-----	-----	-----	-----	-----	-----
	2039	130-91	92	14.04	92	35.028	14.02	28.148	26.222	19.32	0.38	0.0	2.78	22.9
	2105	131-92	142	13.576	140	34.990	13.56	28.118	26.289	18.45	0.88	0.0	2.74	28.0
	2129	132-93	192	12.753	192	34.935	12.73	28.073	26.414	12.71	7.90	0.0	2.74	26.9
	2152	133-94	242	11.967	240	34.866	11.93	28.018	26.517	16.87	6.91	0.0	2.74	28.5
	2228	134-95	292	10.988	292	34.927	10.95	28.067	26.746	21.79	2.94	0.0	2.76	31.0
	2245	135-96	367	9.816	365	34.740	9.77	27.916	26.807	32.51	0.35	0.0	2.98	33.9

R/V Knorr Cruise No. 73, Leg 2
Station No. 998(7)
Water Column Depth: 1025 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity ‰	Dissolved oxygen (ml O_2/ℓ)	% Light	Chlorophyll (μg/ℓ)	Phaeopigments (μg/ℓ)	Nitrate (Micromoles/liter)	Nitrite	Ammonium	Phosphate	Silicate
3/9/78	1735	15°14.8'	167[1]	18.59	0	35.063	----	100	14.95	1.98	0.87	0.14	----	0.98	0.73
		75°42.8'		18.57	2	35.065	----	50	15.25	2.41	0.74	0.14	-----	0.97	0.73
				18.56	4	35.061	----	30	15.05	1.91	0.83	0.13	-----	0.96	0.69
				18.56	6	35.062	----	15	14.72	1.92	1.11	0.11	-----	1.00	----
				18.53	9	35.061	----	5	13.86	2.17	1.10	0.13	-----	0.99	0.73
				18.24	14	35.067	----	1	14.98	1.97	1.71	0.13	-----	1.03	0.76
				-----	28	34.933	----	0.01	2.95	1.96	17.64	0.66	-----	2.04	3.09
3/10/78	0830	15°15.8'	175[1]	17.24	0	35.014	5.28	100	15.83	1.58	2.79	0.23	-----	1.42	0.79
		75°39.6'		-----	2	35.016	5.27	50	16.70	2.15	2.82	0.23	-----	1.46	0.72
				17.26	4	35.014	5.26	30	17.29	1.73	2.79	0.22	-----	1.45	0.72
				17.26	6	35.015	5.26	15	19.94	1.53	2.82	0.22	-----	1.45	0.61
				17.22	10	35.014	4.98	5	16.79	0.65	3.33	0.22	-----	1.48	0.61
				17.12	15	35.017	4.71	1	16.55	2.15	4.82	0.28	-----	1.56	0.61
				15.36	30	34.972	0.62	0.01	0.79	1.09	27.94	0.26	-----	2.52	12.3
3/10/78	1700	15°10.5'	180[1]	16.53	0	34.998	----	100	14.17	1.42	10.74	0.36	-----	2.03	2.95
		75°35.3'		-----	2	34.998	----	50	14.85	1.04	11.03	0.37	-----	2.06	2.86
				16.49	4	34.997	----	30	13.19	1.80	----	0.38	-----	2.04	2.88
				16.50	6	34.996	----	15	15.25	0.57	----	0.37	-----	2.05	2.84
				16.41	10	35.001	----	5	14.72	1.47	9.58	0.40	-----	2.04	2.49
				16.31	15	35.003	----	1	19.22	1.92	11.48	0.42	-----	2.08	2.80
				15.85	30	34.988	----	0.01	10.06	2.63	----	0.47	-----	2.34	7.41
3/11/78	1700	15°04.1'	188[1]	16.16	0	35.015	----	100	18.92	0.04	7.78	0.34	-----	2.30	17.3
		75°32.3'		-----	2	35.015	----	50	14.56	1.46	7.39	0.29	-----	2.29	17.3
				16.21	4	35.014	----	30	12.24	1.22	7.32	0.30	-----	2.30	17.3
				16.14	6	35.013	----	15	15.95	0.70	7.60	0.31	-----	2.28	17.4
				15.96	9	35.014	----	5	17.58	2.24	8.46	0.32	-----	2.34	17.9
				15.51	14	35.014	----	1	10.60	1.36	10.50	0.51	-----	2.56	21.3
				15.16	28	35.012	----	0.01	2.03	0.56	13.27	0.20	-----	2.79	24.4

1. Nitrate and nitrite data are Duke values.

R/V Knorr Cruise No. 73, Leg 2
Station No. 998(7)
Water Column Depth: 1025 m
Euphotic Casts

Date (Local)	Time (Local)	Lat. S Long. W	Cast No.	°C in situ Tω	Depth (m)	Salinity (‰)	Dissolved oxygen (ml O_2/ℓ)	% Light	Chlorophyll (μg/ℓ)	Phaeopigments (μg/ℓ)	Nitrate (Micromoles/liter)	Nitrite	Ammonium	Phosphate	Silicate
3/12/78	0834	15°09.4'	189[1]	16.62	0	35.012	4.78	100	42.65	0.00	0.03	0.0	---	2.16	12.4
		75°35.1'		-----	2	35.015	4.70	50	36.09	1.62	0.0	0.01	---	2.33	12.4
				16.63	3	35.013	4.74	30	38.87	0.76	0.04	0.01	---	2.26	12.4
				16.64	4	35.014	4.74	15	42.94	2.82	0.0	0.01	---	2.41	12.5
				16.57	7	35.011	4.69	5	27.40	0.94	0.0	0.01	---	2.46	12.5
				16.53	11	35.012	4.19	1	36.93	2.37	0.11	0.01	---	2.20	12.5
				16.36	22	35.006	3.60	0.01	13.10	1.31	1.45	0.11	---	2.10	10.9
3/12/78	1652	15°11.4'	194[1]	17.19	0	35.013	----	100	76.32	1.41	0.07	0.03	---	2.36	13.4
		75°32.8'		-----	2	35.012	----	50	61.97	0.14	0.0	0.03	---	2.31	13.3
				17.03	3	35.014	----	30	74.36	3.13	0.0	0.04	---	2.25	13.2
				17.01	4	35.012	----	15	74.41	4.52	0.01	0.05	---	2.36	14.3
				16.96	7	35.012	----	5	65.01	1.84	0.03	0.02	---	2.35	13.8
				16.60	11	35.012	----	1	40.53	3.57	0.14	0.02	---	2.13	15.3
				16.26	22	35.006	----	0.01	15.69	1.57	5.52	0.3	---	2.05	11.4

1. Nitrate and nitrite phosphate and silicate data are Duke values.

R/V Knorr Cruise No. 73, Leg 2
Station No. 998(7)
15°12.9'S, 75°38.7'W
3/9/78 - 3/10/78
Water Column Depth: 1025 m
Niskin Casts

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m.)	°C. in situ Tω	Niskin Accepted Depth (m)	Salinity (°/..)	Pot. Temp. (°C.)	σo	σt	Dissolved oxygen (ml O2/l.)	Nitrate	Nitrite	Ammonium	Phosphate	Silicate
											(Micromoles/liter)				
3/9/78	0815	144	0	18.51	0	35.083	18.51	28.193	25.227	5.21	2.12	0.32	0.34	1.00	0.72
			2	18.53	2	35.085	18.53	28.194	25.223	5.45	2.07	0.33	0.51	0.95	0.69
			4	18.52	4	35.084	18.52	28.194	25.225	5.22	2.22	0.32	0.27	0.95	0.66
			6	18.53	6	35.084	18.52	28.194	25.225	5.19	2.23	0.32	0.64	0.97	0.69
			9	18.47	9	35.080	18.47	28.190	25.234	5.12	2.32	0.33	0.43	0.95	0.73
			14	18.25	14	35.073	18.24	28.185	25.286	4.90	2.92	0.37	0.56	1.01	0.79
			28	16.16	28	35.029	16.16	28.149	25.751	1.21	18.54	0.99	0.81	2.37	6.75
	1535	166	35	15.09	35	34.968	15.09	28.100	25.945	0.47	28.16	0.25	0.0	2.55	12.5
			50	14.52	50	34.926	14.51	28.066	26.039	0.25	27.49	0.19	0.0	2.69	15.2
3/10/78	1020	177	75	14.23	75	34.980	14.22	28.110	26.143	0.05	16.69	2.00	0.13	2.86	27.8
			100	13.77	100	34.957	13.75	28.091	26.224	0.05	10.72	7.07	0.0	2.86	29.0
			400	10.26	394	34.750	10.22	27.924	26.738	0.05	29.52	1.66	0.0	2.95	31.5
			500	7.22	495	34.560	7.18	27.771	27.068	0.41	38.54	0.11	0.0	3.26	40.9
			600	6.35	593	34.522	6.29	27.741	27.158	0.63	40.13	0.01	0.0	3.32	47.6
			700	5.34	690	34.511	5.28	27.732	27.276	0.84	40.93	0.00	0.0	3.41	60.3
			800	4.97	791	34.517	4.90	27.737	27.325	0.97	40.80	0.0	0.0	3.40	67.4
			900	4.39	884	34.531	4.32	27.748	27.401	1.23	39.70	0.0	0.0	3.38	78.6
			1000	4.11	965	34.537	4.03	27.753	27.436	1.35	38.99	0.0	0.0	3.33	82.4
		179	150	13.37	144	------	13.34	------	------	0.07	16.54	5.47	0.0	2.96	26.8
			200	12.60	196	------	12.58	------	------	0.04	14.98	7.10	0.0	3.02	27.8
			300	11.44	298	------	11.40	------	------	0.02	24.29	3.64	0.0	3.00	28.8

R/V Knorr Cruise No. 73, Leg 2
Station No. 998(7)
3/9/78
15°12.9'S, 75°38.7'W
Water Column Depth: 1025 m.
Bodman Casts

Date (Local)	Time (Local)	Cast No.	Niskin wire out (m.)	°C. in situ Tw	Niskin Accepted Depth (m)	Salinity (°/oo)	Pot. Temp. (°C.)	σ_o	σ_t	Nitrate	Nitrite	Ammonium	Phosphate	Silicate
										(Micromoles/liter)				
3/9/78	0950	145-97	0	18.31	0	35.073	18.31	28.185	25.269	2.96	0.24	0.16	1.02	0.61
	0953	146-98	0	-----	0	------	-----	------	------	----	----	----	----	-----
	1013	147-99	5	18.18	5	35.057	18.18	28.172	25.289	2.88	0.25	0.0	1.35	0.62
	1027	148-100	5	-----	5	------	-----	------	------	----	----	----	----	-----
	1040	149-101	10	17.77	10	35.043	17.76	28.161	25.382	2.93	0.28	0.53	1.22	0.66
	1055	150-102	10	-----	10	------	-----	------	------	----	----	----	----	-----
	1106	151-103	15	-----	15	35.018	-----	------	------	2.84	0.23	0.97	1.43	0.65
	1114	152-104	15	-----	15	------	-----	------	------	----	----	----	----	-----
	1126	153-105	25	15.98	25	35.020	15.98	28.142	25.785	19.76	0.85	0.40	2.59	8.01
	1136	154-106	25	-----	25	------	-----	------	------	----	----	----	----	-----
	1148	155-107	35	15.03	35	34.965	15.02	28.098	25.958	27.95	0.0	0.0	2.78	12.8
	1152	156-108	35	-----	35	------	-----	------	------	----	----	----	----	-----
	1315	158-109	50	14.67	50	34.957	14.66	28.091	26.031	27.74	0.0	0.0	2.87	14.1
	1322	159-110	50	-----	50	------	-----	------	------	----	----	----	----	-----
	1340	160-111	67	14.29	67	34.980	14.28	28.110	26.130	14.82	2.18	0.0	3.14	28.4
	1350	161-112	67	-----	67	------	-----	------	------	----	----	----	----	-----
	1415	162-113	92	-----	92	34.957	-----	------	------	16.43	2.72	0.0	2.93	26.4
	1423	163-114	142	13.25	142	34.945	13.23	28.082	26.322	13.82	6.13	0.0	2.98	25.7
	1440	164-115	192	12.53	192	34.868	12.50	28.019	26.408	13.40	6.77	0.0	3.04	27.5
	1505	165-116	292	11.61	292	34.850	11.58	28.005	26.570	24.05	4.01	0.0	3.02	29.0
	1925	169-117	442	8.58	442	34.636	8.53	27.833	26.927	38.51	0.15	0.0	3.36	35.6
	1955	170-118	592	6.24	592	34.545	6.19	27.759	27.190	42.05	0.05	0.0	3.35	49.9
	2036	171-119	792	4.99	792	34.545	4.92	27.759	27.345	42.31	0.0	0.0	3.37	66.8
	2132	172-120	992	4.11	992	34.545	4.03	27.759	27.443	41.96	0.0	0.0	3.35	85.0
	2225	173-121	592	6.23	592	------	-----	------	------	----	----	----	----	-----

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In February and March of 1978, a major cruise was undertaken on the R/V KNORR off the Peruvian coast near 15°S in order to investigate the organic biogeochemical processes associated with upwelling areas. The purpose of this report is to collate the large amount of hydrographic, nutrient, and plankton data generated from various investigators on this cruise and use the report as a standard for the cruise participants. Data for temperature, salinity, oxygen, nitrate, nitrite, ammonium, phosphate, silicate, chlorophyll a, productivity indices, and carbon fixation rates are given.

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