FRAM III

Chemical and biochemical data obtained by Bigelow Laboratory Investigators

edited by

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ACKNOWLEDGMENTS

Technical assistance preparing equipment for the project was provided by G. Friederich and P. Garfield. Mary Silver provided the methodology for collecting and preparing samples for electron microscopy. In addition, G. Friederich analyzed the frozen nutrient samples, P. Garfield analyzed the particulate organic carbon and particulate organic nitrogen samples and M. Keller processed samples for the electron microscope. Andy Heiberg was in charge of logistics, and logistical support for FRAM III was provided by the 612th QM Company (U.S. Army) and the 317th and 62nd Tactical Airwings (U.S. Air Force). Pat Oathout typed this manuscript.

Particular thanks are due to the "seasoned" FRAM colleagues, led by chief scientist Ken Hunkins and camp manager Allen Hilscher, who provided advice and assistance at the FRAM III site.

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INTRODUCTION

Drifting ice station FRAM-III was one of a series of scientific investigations conducted from camps located on the pack ice of the Arctic Ocean (Figure 1). Manley *et al.* (1982) present a summary of the FRAM scientific program.

During the first half of the experiment (3-16 April 1981), two investigators (L.A. Codispoti and T.T. Packard) from the Bigelow Laboratory studied the chemical and biochemical properties of the water column in the Eurasian Basin. Their observations included on-site analysis of samples collected from just beneath the ice cover to a depth of 4,100 m for dissolved oxygen, ammonium, dissolved silicon, nitrate, nitrite, and reactive phosphorus. On-site determinations of the activity of of the respiratory electron transport system (ETS) were also made on eight samples taken from depths as great as 2,000 m. Preserved samples were returned to the Bigelow Laboratory for examination with a scanning electron microscope and for the determination of their nutrient, chlorophyll, phaeophytin, particulate organic nitrogen and particulate organic carbon contents.

All of the laboratory work has been completed, and our initial analysis shows that metabolic rates in the FRAM III water column are extremely low. Nitrite and ammonium concentrations were zero or very close to zero throughout the water column, and ETS activities were low in the upper 125 m and undetectable below that depth. This was the first time that ETS activity could not be detected in deep-sea samples. These data showing low metabolic rates will prove useful (when combined with data from other regions) in clarifying the relative importance of

the processes that feed the "deep metabolism", and in constructing an inorganic nitrogen budget for the Arctic Ocean.

Some weak maxima and minima in the vertical dissolved silicon, reactive phosphorus, and nitrate distributions were observed, however there was no evidence for the presence of substantial amounts of the high nutrient waters that enter the Arctic via Bering Strait. In addition, these data do not suggest a large contribution to the subsurface layers from waters formed over the continental shelf during the ice formation season.

METHODS

Hydrographic Sampling

Hydrographic casts were made with a Neil Brown Instrument Systems CTD combined with a rosette sampler equipped with twelve 1.7 ℓ Niskin bottles. From six CTD casts, samples were drawn from the Niskin bottles for chemical (nutrients and dissolved oxygen) analyses.

Water samples for biochemical and chemical analyses were collected using 30 ℓ Niskin bottles equipped with protected and unprotected reversing thermometers. Only two 30 ℓ sampling bottles were placed on the hydro-wire at a time and samples drawn from the bottles were analyzed before obtaining more samples. Therefore, the biochemical station reported in this report is comprised of eight separate lowerings of the bottles spaced over a 56 hour time span (Table 1).

Dissolved Oxygen

Oxygen concentrations were determined using the Chesapeake Bay Institute modification of the Winkler method (Carpenter, 1965).

Inorganic Nutrients

Nutrient analyses were made using Technicon AutoAnalyzer procedures based on the manual method of Murphy and Riley (1962) for reactive phosphorus and the methods of Armstrong, Stearns and Strickland (1967) for dissolved silicon, nitrite, and nitrate. Ammonium was measured by the phenol-hypochlorite method of Koroleff (1970), as adapted to the AutoAnalyzer by Slawyk and MacIsaac (1972). The automated methods used have been described by Friederich and Whitledge (1972). At the first three stations, two sets of samples were collected; one set was analyzed immediately and the second set was frozen and returned to Bigelow for analysis. Samples from succeeding stations were frozen for later laboratory analysis. Figures 3 and 4 compare samples analyzed on site with those frozen and returned to the laboratory.

Particulate Organic Carbon and Nitrogen

Particulate organic carbon (POC) and particulate organic nitrogen (PON) were determined using the procedure of Sharp (1973). POC and PON were measured on samples filtered through pre-combusted Whatman GF/F glass fiber filters using a CHN analyzer (Hewlett-Packard FSM 185) interfaced with a Hewlett Packard (3380A) integrator. The frozen filters were stored for several weeks before analysis.

Chlorophyll a and Phaeopigments

Chlorophyll *a* was determined by the fluorometric technique (Yentsch and Menzel, 1963; Holm-Hansen *et al.* 1965) using a Turner Design model 10-005 R fluorometer, standardized with a chlorophyll *a* solution (Sigma Chemical Co.).

Respiratory Enzyme Activity

ETS activity was determined by a modification (Kenner and Ahmed, 1975a) of the tetrazolium reduction technique of Packard (1971). Seawater, in 20-44 ℓ samples, was filtered through 47 mm glass fiber filters (Whatman GF/F) at < ½ atm of pressure. The seawater samples were never stored for longer than 3 hours at 0 to 4°C before being filtered. The filters were ground with 3 ml of a phosphate grinding buffer at 0-4°C for 2 min in a teflon-glass tissue grinder (A.H. Thomas Company, Phila., PA).

After homogenization, the assay was run immediately on 1 ml of the crude homogenate, 1 ml of a tetrazolium (INT) solution, and 3 ml of a pyridine nucleotide enriched substrate solution. The reaction proceeded at pH 8.0, 0°C for 20 min, after which time it was quenched with the addition of 1 ml of a phosphoric acid-formalin quench solution. The color of the reaction mixture changes during the incubation period from a clear solution to a pink or red solution depending on the activity of the ETS in plankton. Reacted samples were stored at 0°C for less than one hour and then were centrifuged for ½ hour at 3000 rpm. After recording the volume (∿ 6.0 ml), the absorbance at 490 nm and 750 nm was read in a 10 cm cell in a spectrophotometer. Absorbances were read within one hour after centrifugation.

The 490 nm peak is proportional to INT-formazan production; the 760 reading serves as a turbidity blank. Pigment blanks, consisting of an assay run without pyridine nucleotides or succinate on the clarified homogenate were run with every assay. In addition, a reagent blank was run daily by filtering 1 ml of prefiltered seawater and assaying the filter. A_{490}^{1cm} exceeding 0.05 in the reagent blank indicates bacterial

contamination or low quality reagents. The ETS activity was calculated by the equation:

$$\text{ETS } (\mu l\ O_2\ h^{-1}\ \ell^{-1}) = 60 \times S \times H \times (COD-RB) / 1.42 \times f \times V \times t$$

where H is the crude homogenate volume in milliter (∿ 5.5 ml), S is the volume of the quenched reaction mixture (∿ 6.0 ml), COD is the corrected absorbance (absorbance of the assay minus the pigment blank), RB is the reagent blank, V is the volume of the seawater filtered, f is the volume of the homogenate used in the assay (∿ 1 ml), and t is the reaction time (∿ 20 minutes). The two constants, 60 and 1.42, convert the measurements to units of hours and oxygen volume (µl). The result was then corrected for temperature by the equation:

$$\text{ETS } (\textit{in situ} \text{ temp}) = \text{ETS (incubation temp)} \times e^{Ea \{\frac{1}{T_1} - \frac{1}{T_2}\}} \times R^{-1}$$

where Ea = 15,000 Kcal mole^{-1}, R = 1.98 Kcal mole^{-1} degree^{-1}, and T_1 and T_2 are the incubation and *in situ* temperatures in degrees Kelvin.

Respiration rates were calculated from ETS activities using an experimentally derived R/ETS ratio of 0.43 for stationary phase (Christensen *et al.*, 1980). Since this ratio was determined using a less sensitive ETS assay technique (no Triton X-100), the ETS activities reported in this study were first divided by 4.44 (Christensen and Packard, 1979) then multiplied by 0.43 to obtain *in situ* respiration rates.

Light Transmission

On 6 April 1981, 4 casts were made to measure the percent light transmission from just below the ice to 135 m. A Hydro-products transmissometer (Model 9125) was used to make the observations. Unfortunately, voltage fluctuations in the Fram III AC power supply

contaminated the data. One cast, corrected for the voltage fluctuations, showed a monotonic increase in percent light transmission with depth.

Scanning Electron Microscope

Dr. Mary Silver (Univ. California - Santa Cruz) provided the methodology for collection and preparation of S.E.M. samples.

During Fram III, one liter of seawater was filtered through a .2 μm Nuclepore filter. The organisms were then rinsed into a vial using a syringe and fixed using one part 5% gluteraldehyde solution to one part sample. Sample preparation was done at Bigelow Laboratory and scanning was done on the scanning electron microscope at the Darling Center (Univ. of Maine Marine Laboratory - Walpole). These data are still being analyzed and are not presented in this report.

Station Location

Station locations and depth soundings used in this data report were taken from Hunkins *et al.* (1981). Station locations were determined using satellite navigation (Figure 2). Depth soundings were recorded continuously with an eco-sounder system. Numbering of chemical stations corresponds to CTD casts by participants from Lamont-Doherty Geological Observatory.

Accepted Depths

Depths (decibars) for chemical samples taken from the rosette mounted 1.7 ℓ Niskin bottles were determined using the Neil Brown CTD system. Depths were corrected using calibration information supplied by T. Manley (personal communication). Depths (decibars) of the biochemical and chemical samples collected with 30 ℓ Niskin bottles were determined using meter wheel data and thermometric depths determined from protected and unprotected reversing thermometers.

Temperature and Salinity

Temperature and salinity values reported for chemical stations are the raw values from the CTD manually corrected using calibration information supplied by T. Manley (personal communication). Some of the deep salinity values are higher by approximately 0.1 $^{o}/oo$ than historical salinity values. All salinity values obtained from the CTD should be regarded as preliminary until final editing by the Fram-III physical oceanographers has been completed. Temperatures for the biochemical casts were obtained from the protected reversing thermometers.

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Bigelow Laboratory Participants

Investigator

Louis A. Codispoti	Chemical parameters
Theodore T. Packard	Biochemical parameters

Inquiries

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Explanation of Data Units

Station number	CTD hydrocast number
Latitude	In degrees, minutes and decimal minutes for each cast
Longitude	In degrees, minutes and decimal minutes for each cast
Date	Greenwich date
Time	Greenwich mean time of start of each cast
Sonic depth	Depth of water in meters as determined by the eco-sounding system
Sampling depth	Depth of water samples in decibars determined from CTD data, meter wheel or thermometric depths
Temperature	In degrees celsius
Salinity	In 1978 practical salinity scale
Oxygen	Observed dissolved O_2 concentration in ml/ℓ
Fluorometric chlorophyll	In nanograms per liter
Phosphate	Reactive phosphorous in microgram atoms per liter
Dissolved Silicon	In microgram atoms per liter
Nitrate	In micromoles per liter
Nitrite	In micromoles per liter
Ammonium	In micromoles per liter
ETS	Electron transport system activity measured in micro-liters of oxygen per hour per liter
Respiration	In nanoliters of oxygen per hour per liter
Phaeopigments	In nanograms per liter
Phaeopigments & chlorophyll	In nanograms per liter
Carbon	Particulate organic carbon in micrograms carbon per liter
Nitrogen	Particulate organic nitrogen in micrograms nitrogen per liter

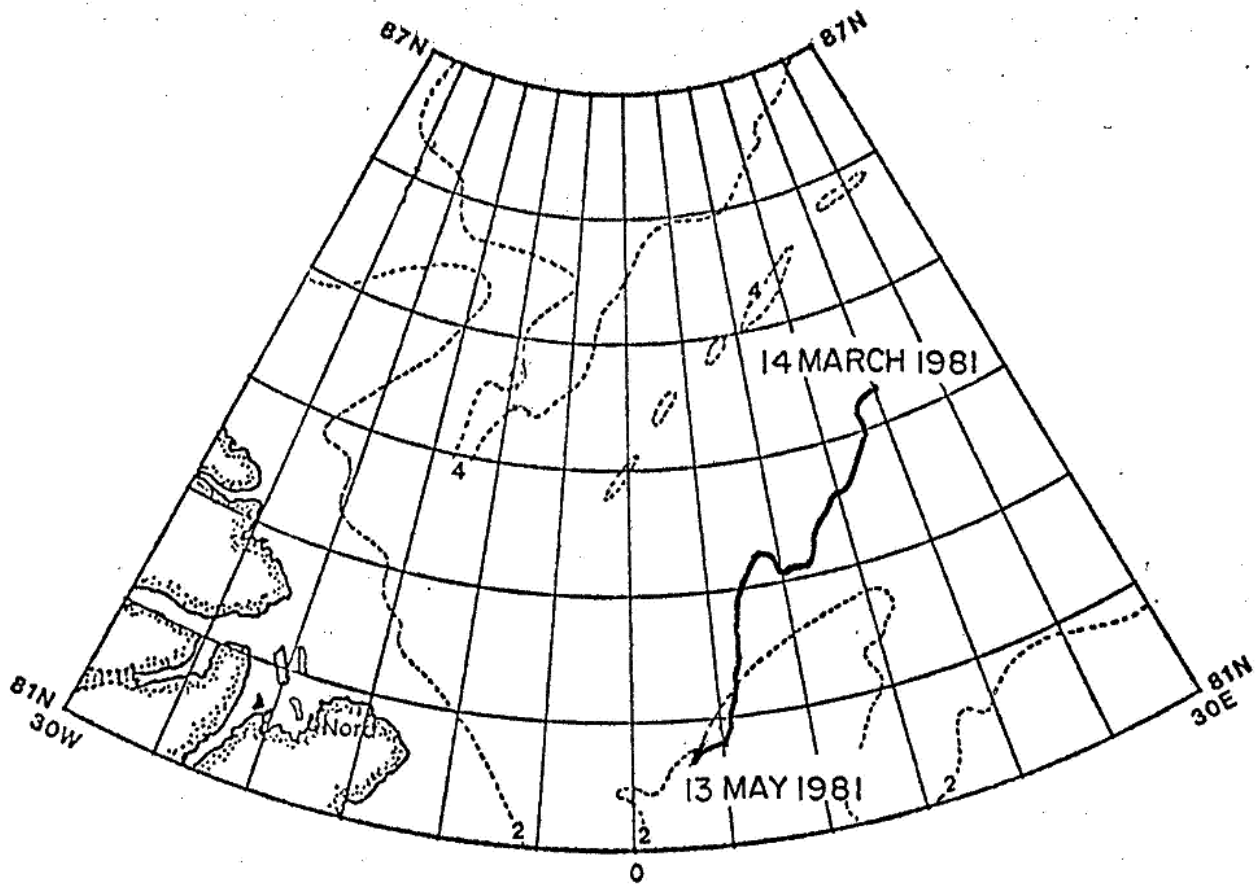


Figure 1. Drift track of Fram III in relation to the northeast coast of Greenland and local bottom topography. Dashed lines are depth contours, depths are given in km. Adapted from Hunkins et al. (1981).

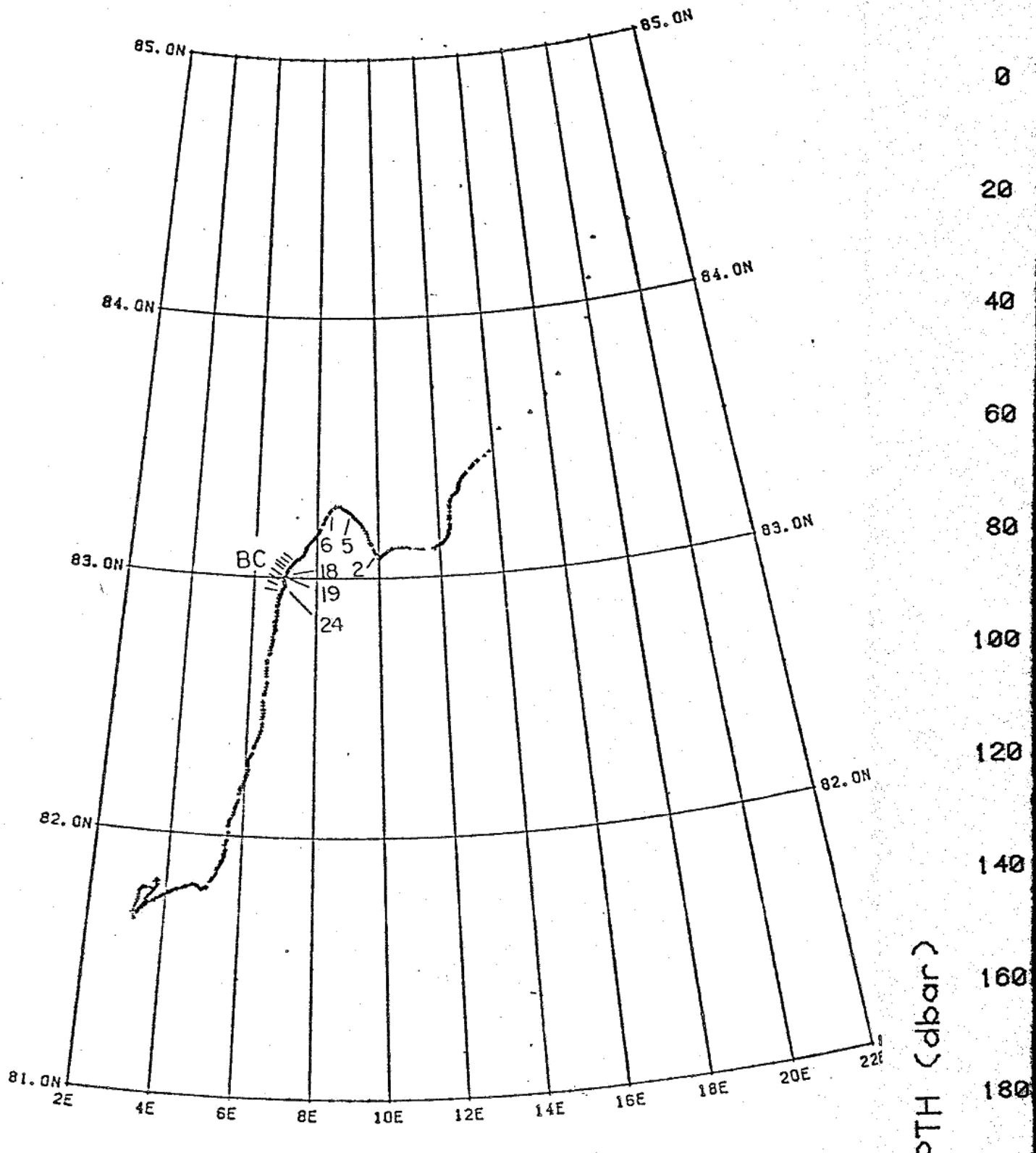


Figure 2. Drift track of Fram III based on original fixes. Positions of chemical stations (numbers) and biochemical (bc) casts are indicated. Adapted from Hunkins et al. (1981).

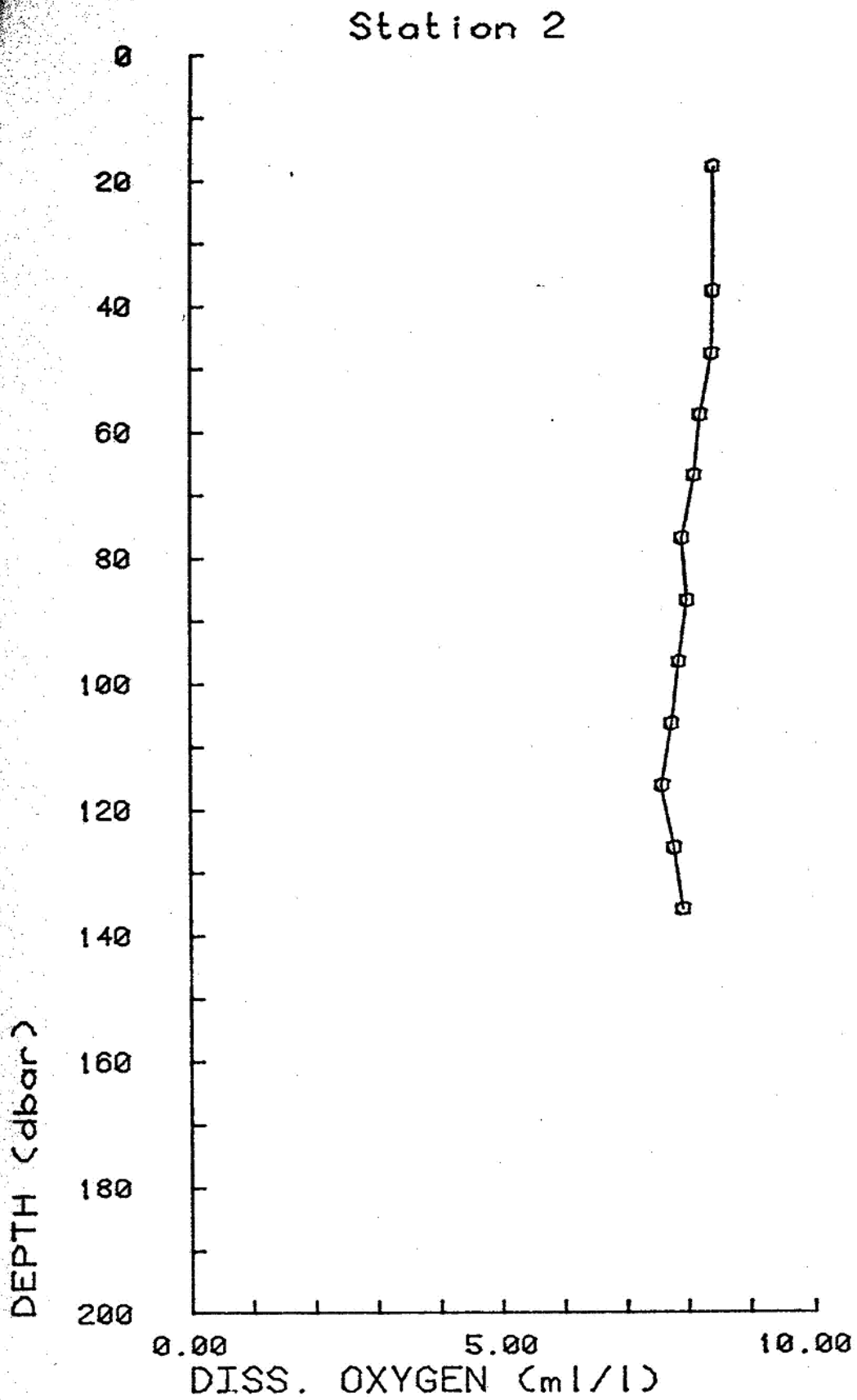


Figure 3a. Dissolved oxygen data for station 2.

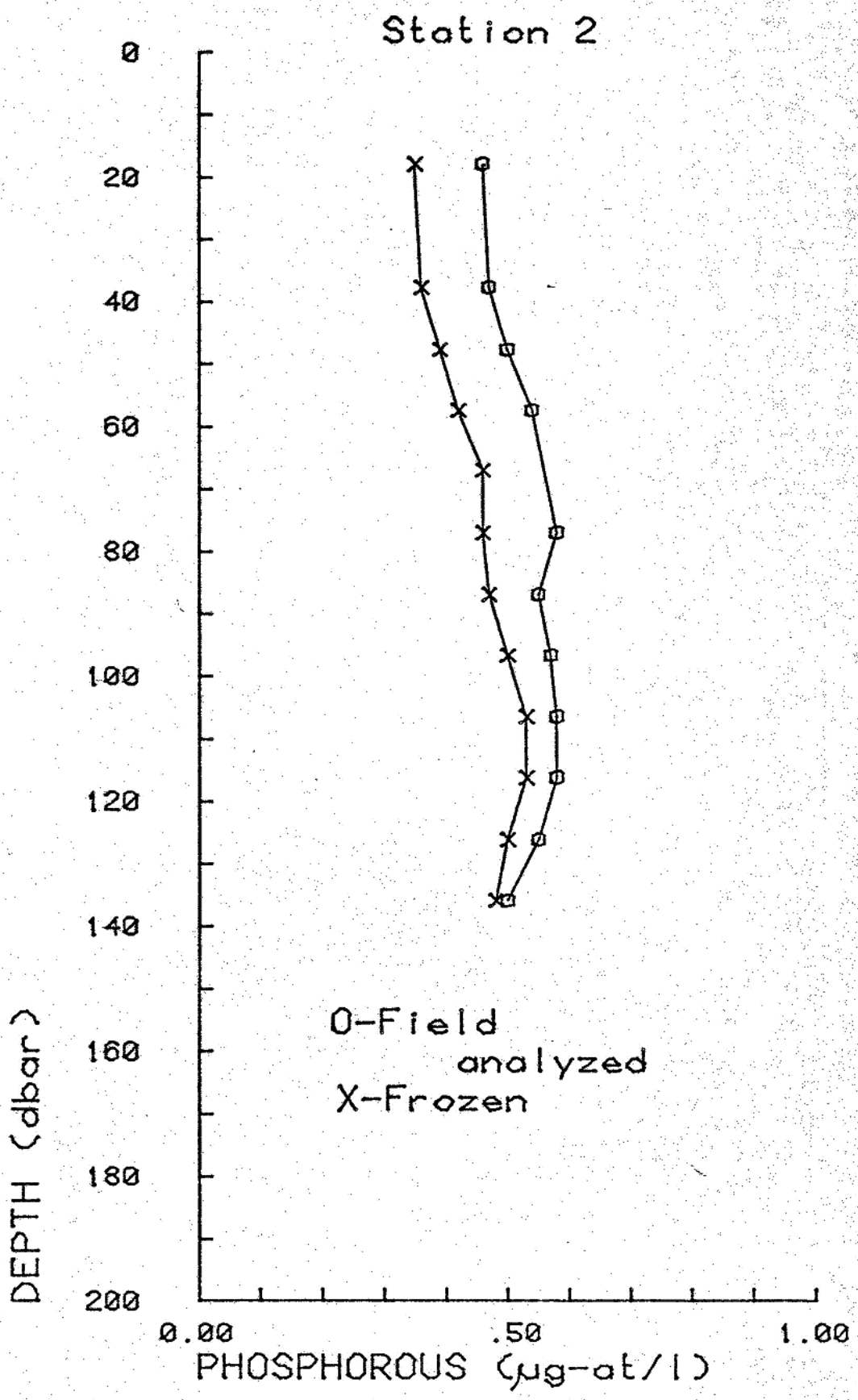


Figure 3b. Reactive phosphorus for station 2.

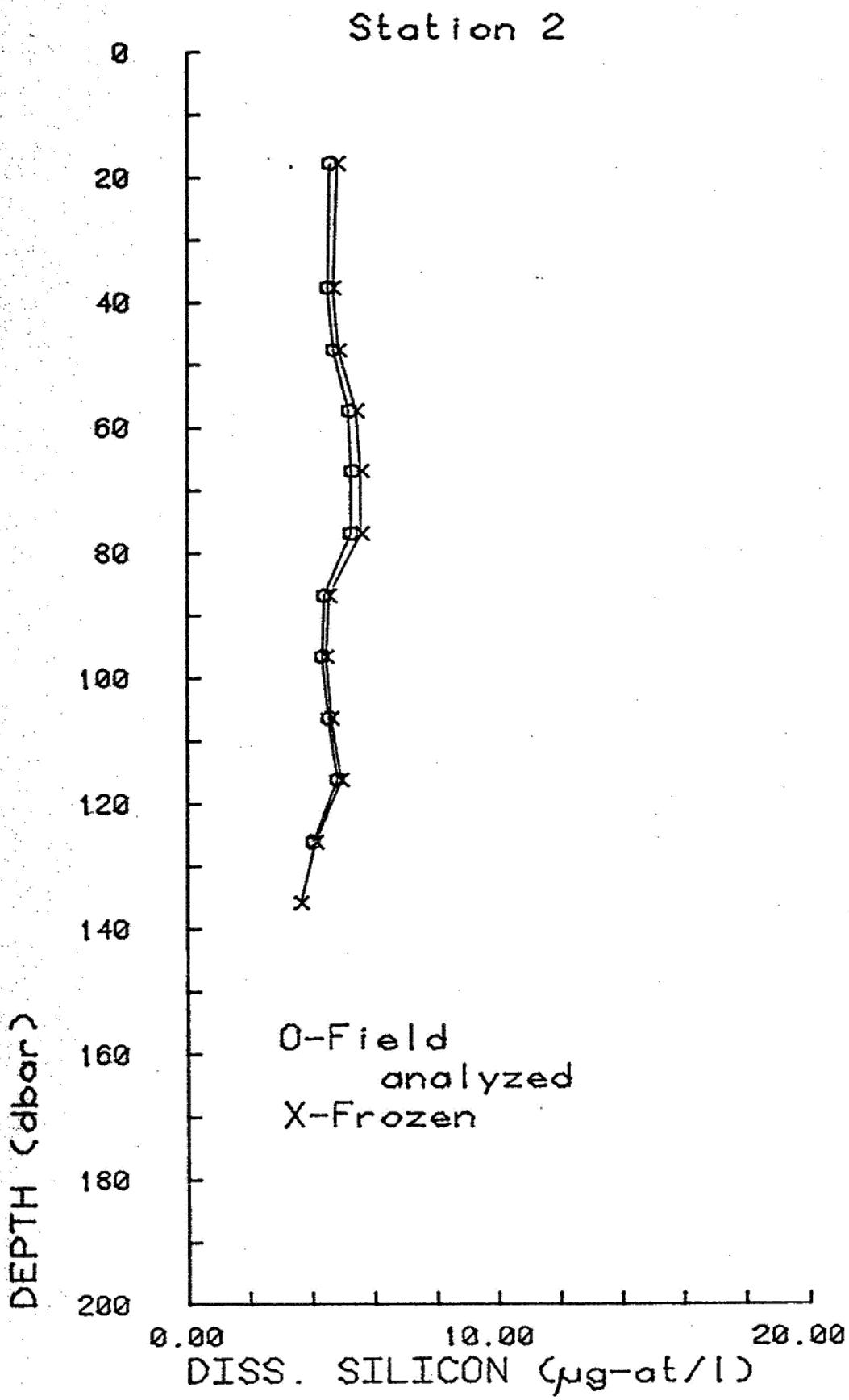


Figure 3c. Dissolved silicon for station 2.

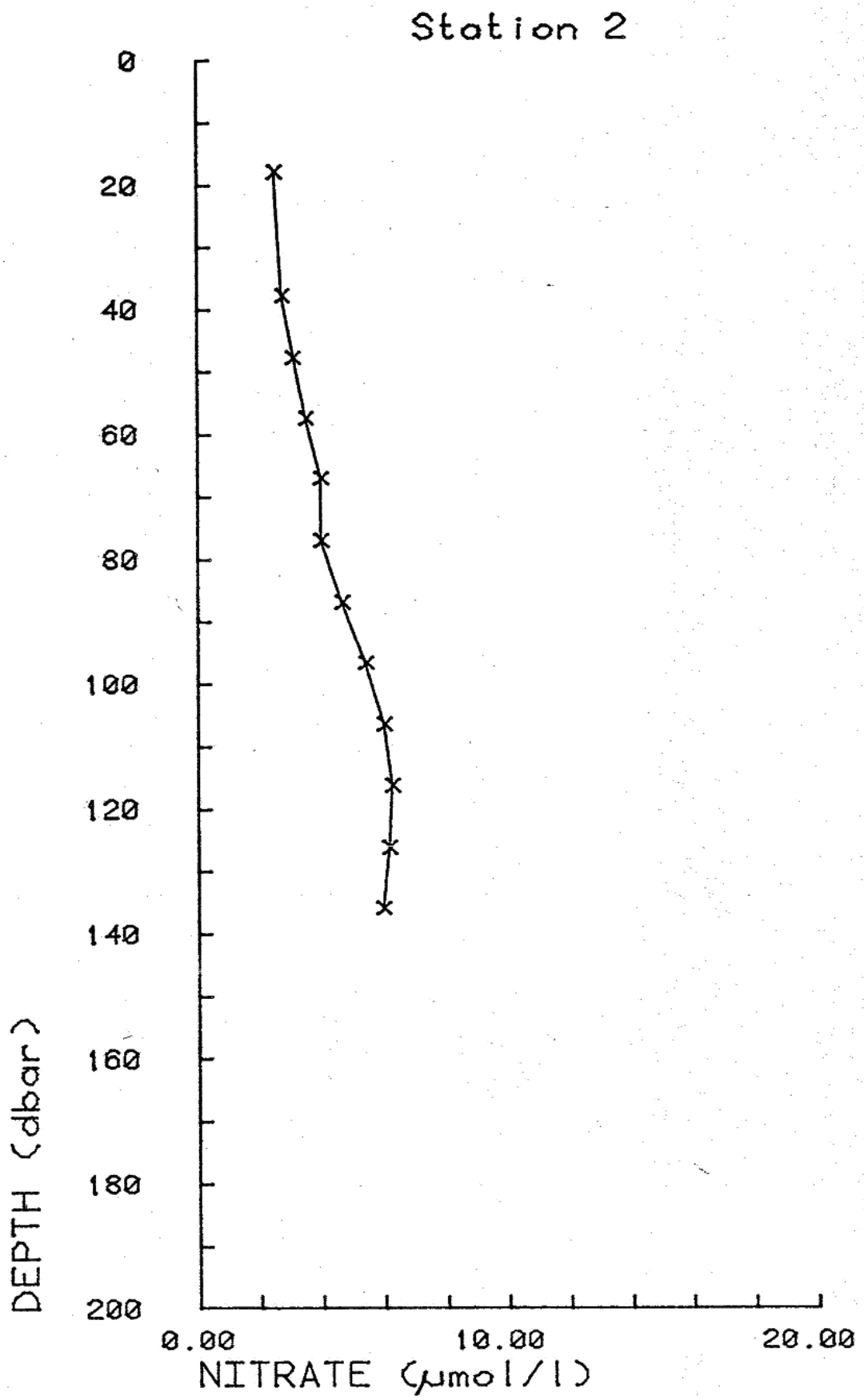


Figure 3d. Nitrate data for station 2. Field analyses of nitrate we lost due to equipment malfunction.

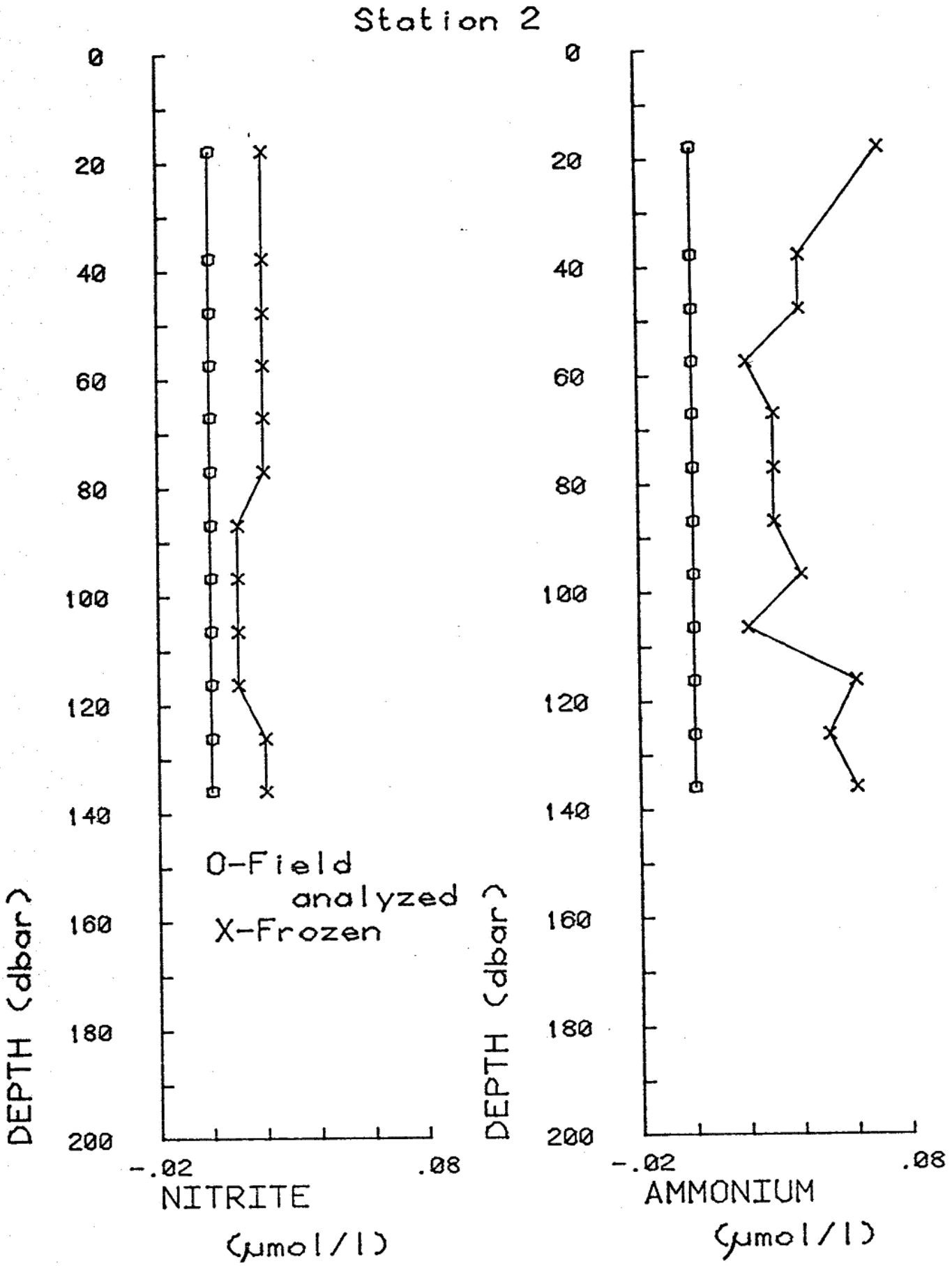


Figure 3e. Nitrite and ammonium data for station 2. Note ∅ offset in diagrams.

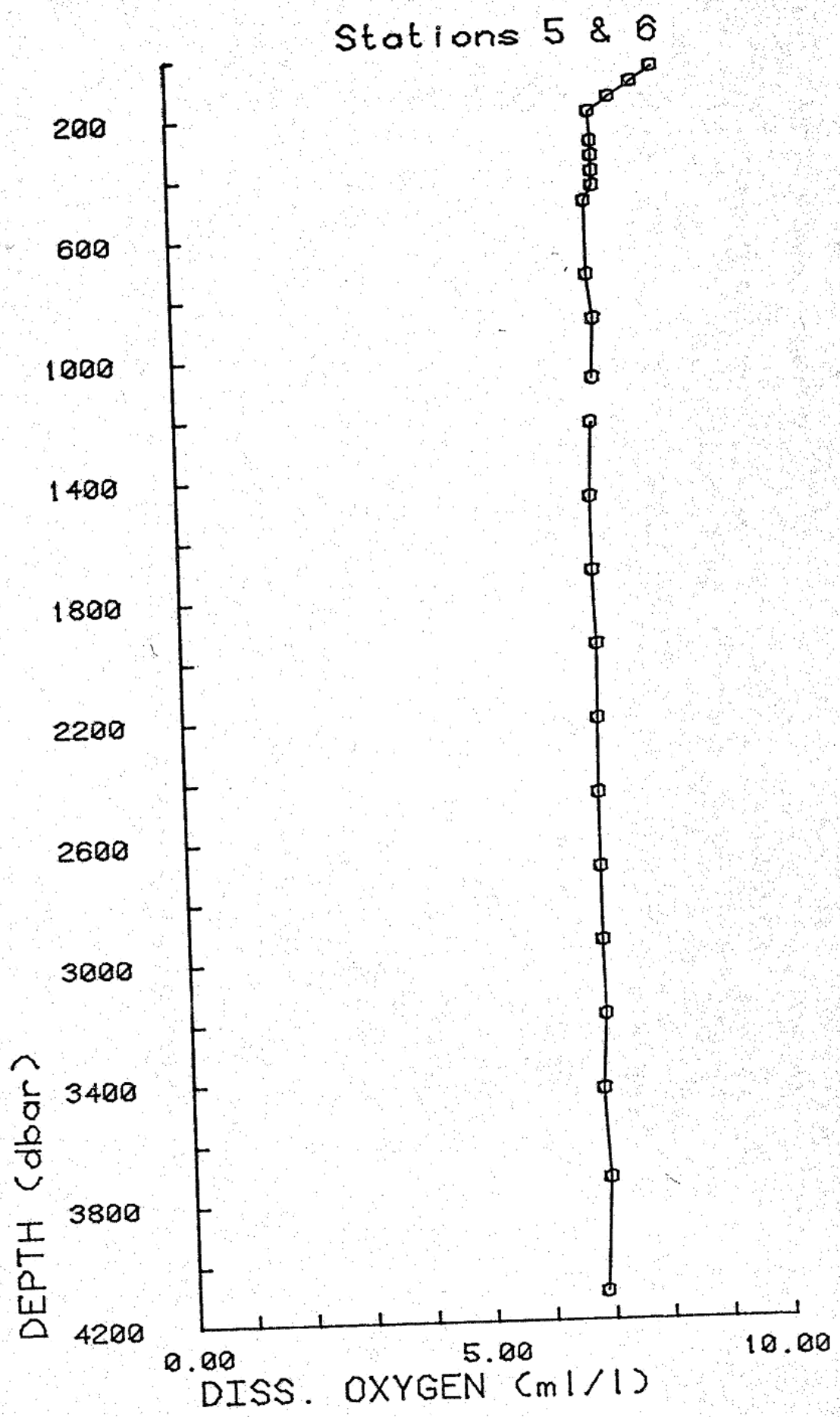


Figure 4a. Dissolved oxygen data for station 5 and 6.

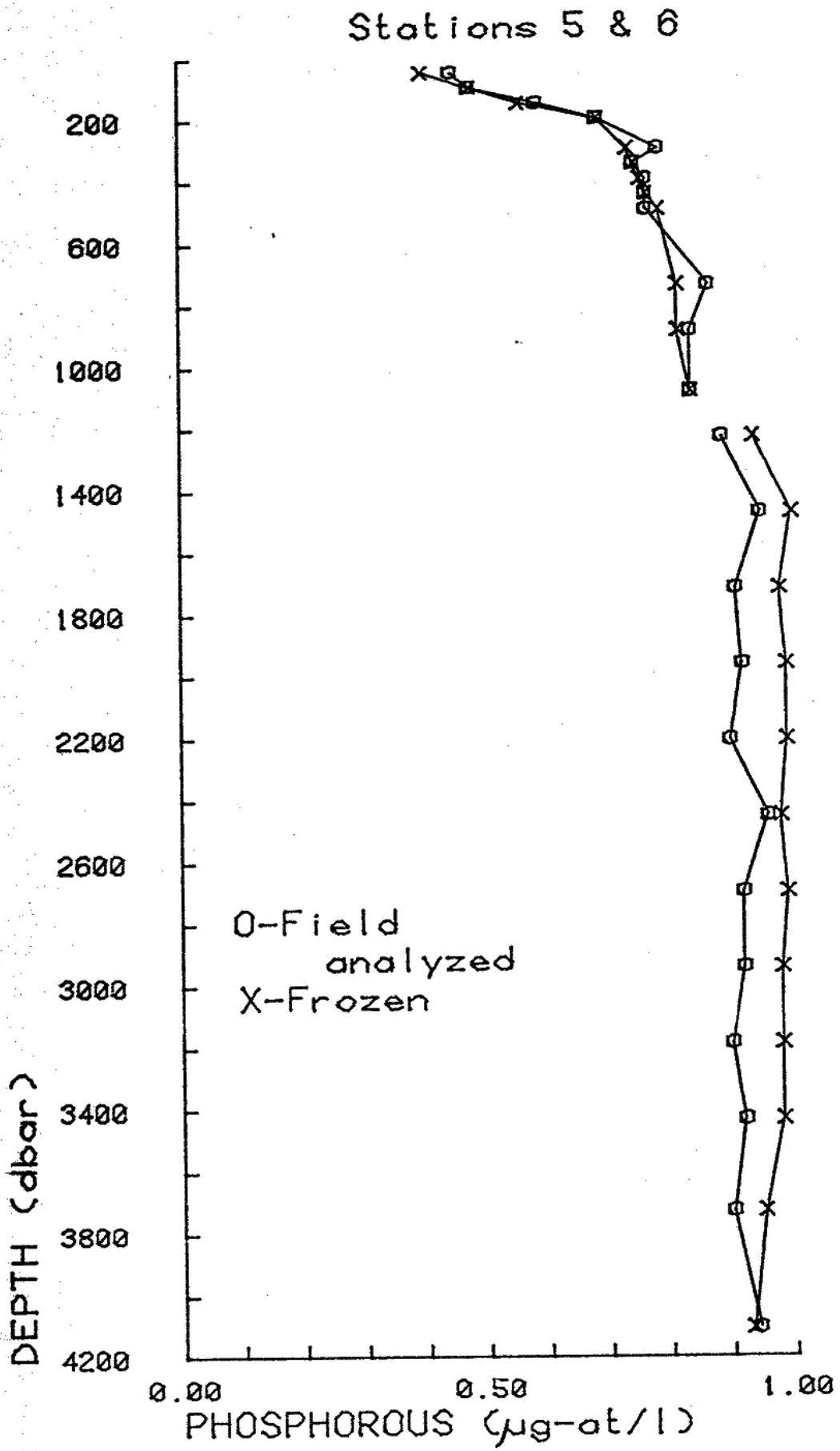


Figure 4b. Reactive phosphorus for stations 5 and 6.

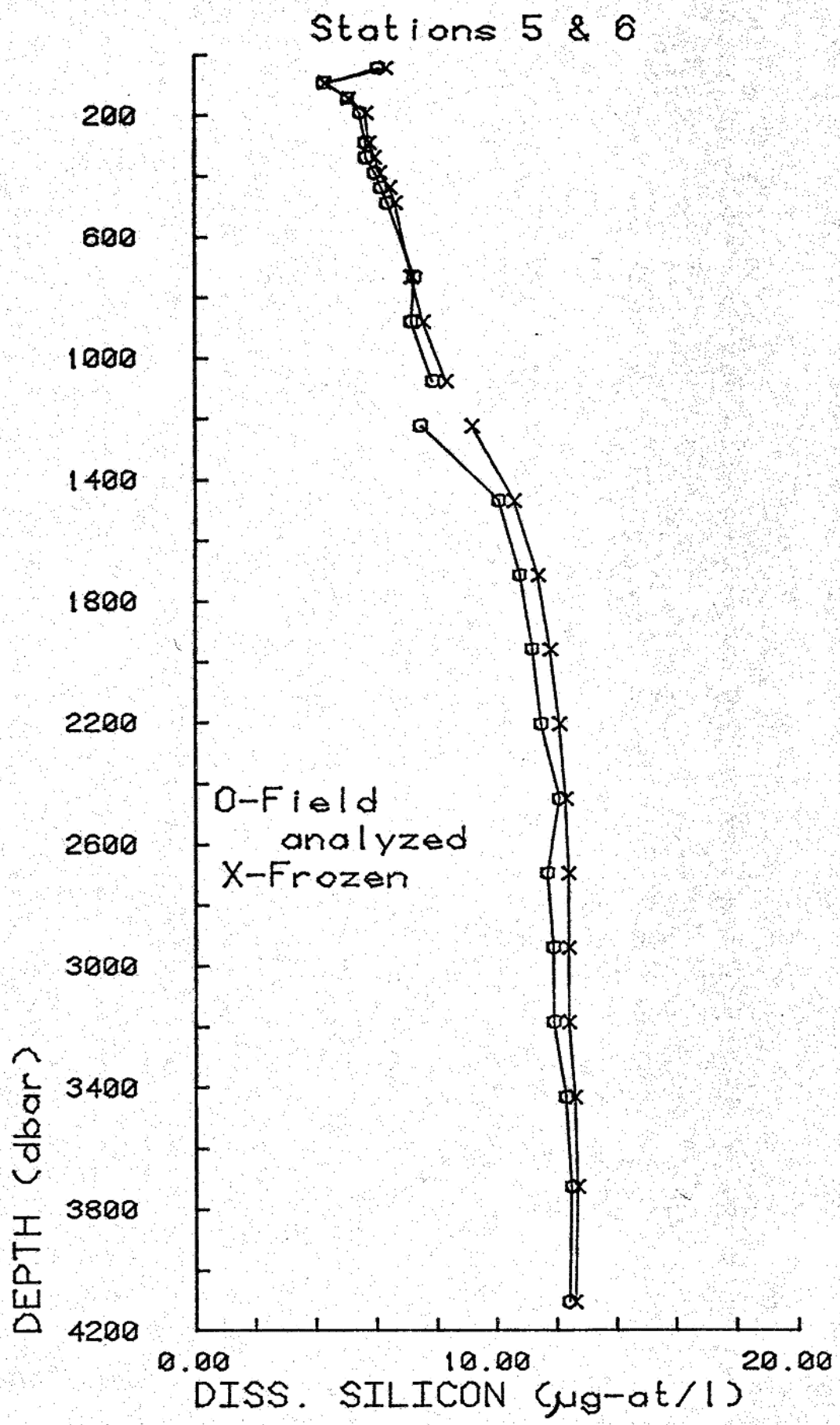


Figure 4c. Dissolved silicon data for stations 5 and 6.

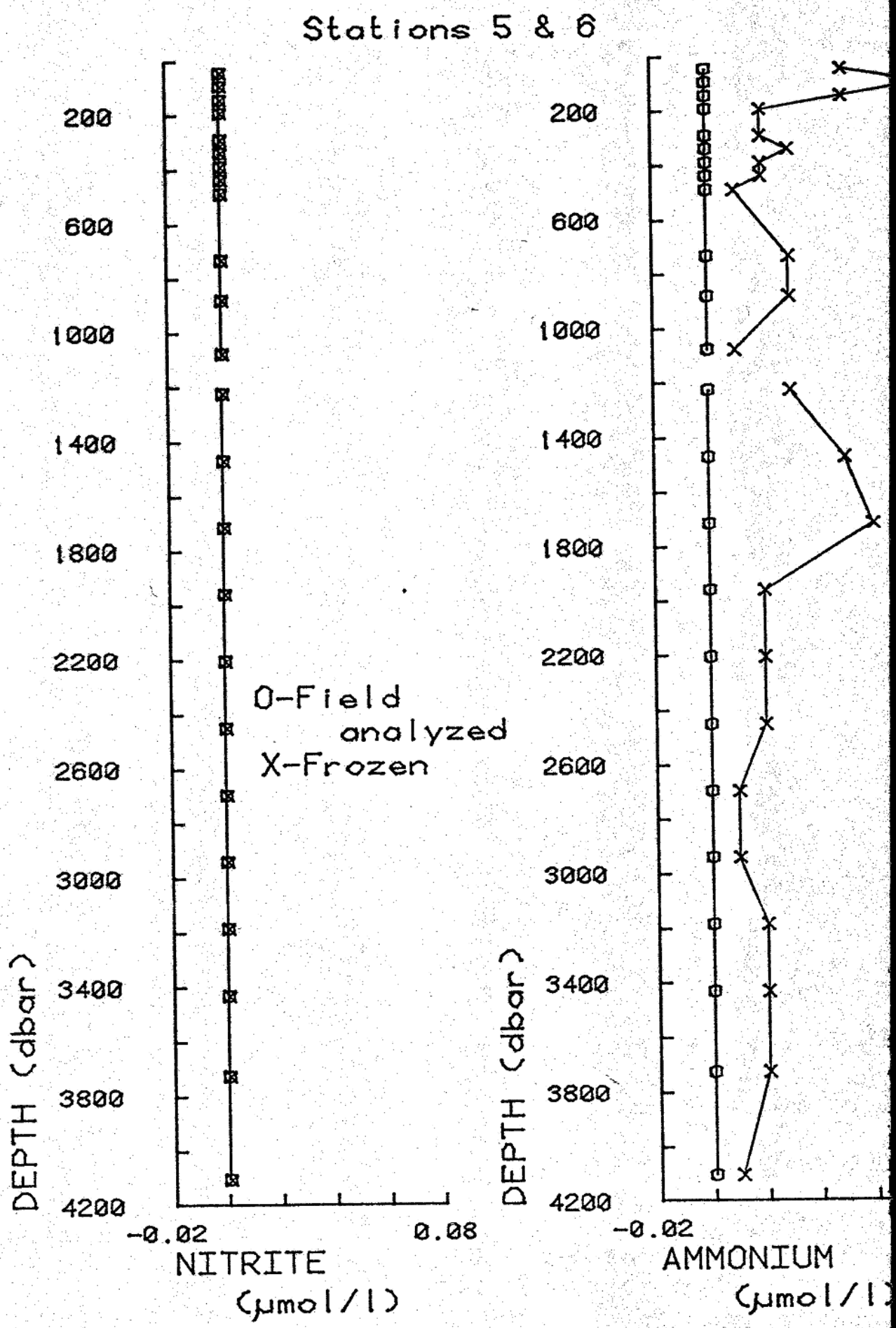


Figure 4e. Nitrite and ammonium data for stations 5 and 6. No
offset in diagrams. Field analyzed and frozen nitrite samples

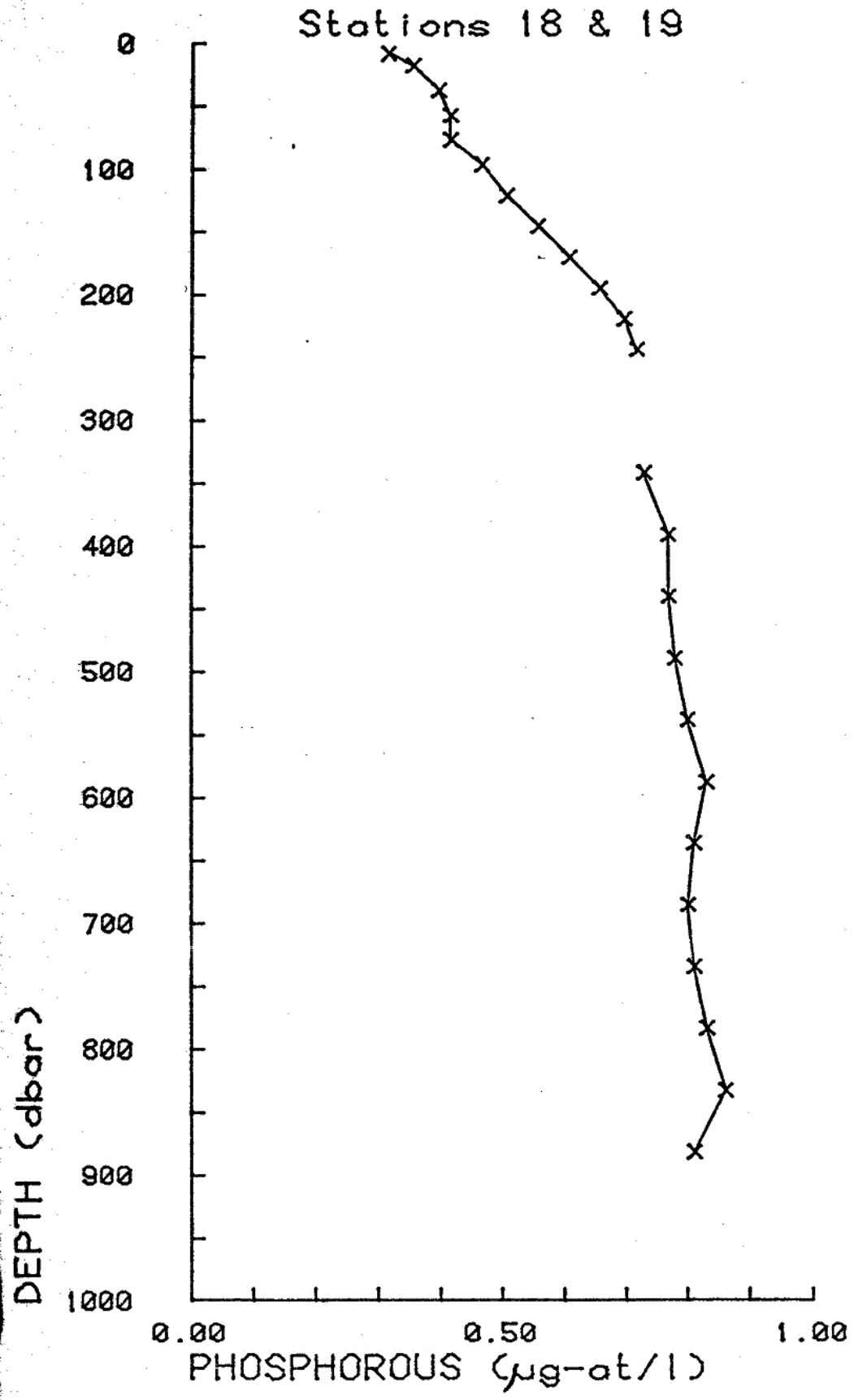


Figure 5a. Reactive phosphorus data for stations 18 and 19.

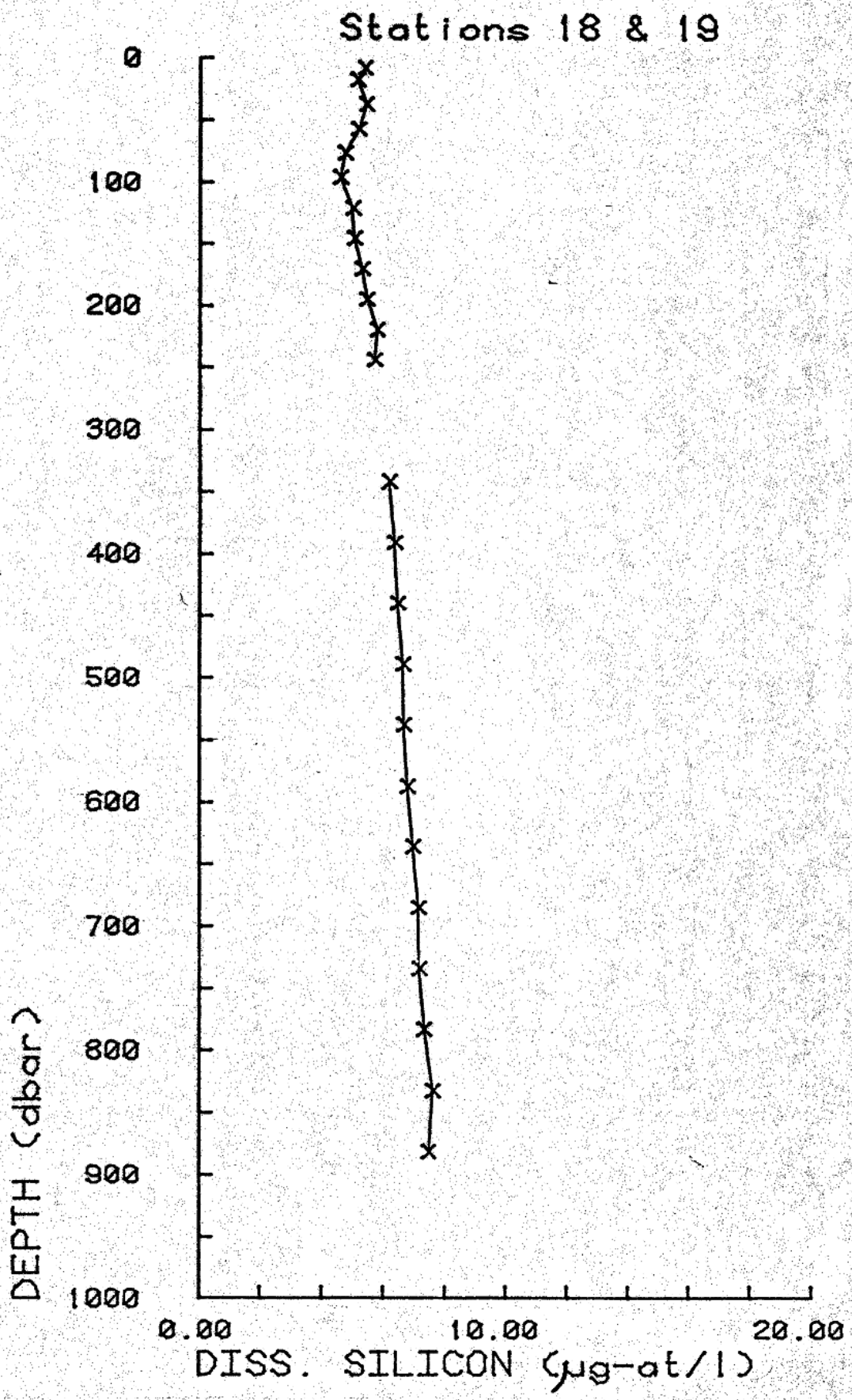


Figure 5b. Dissolved silicon for stations 18 and 19.

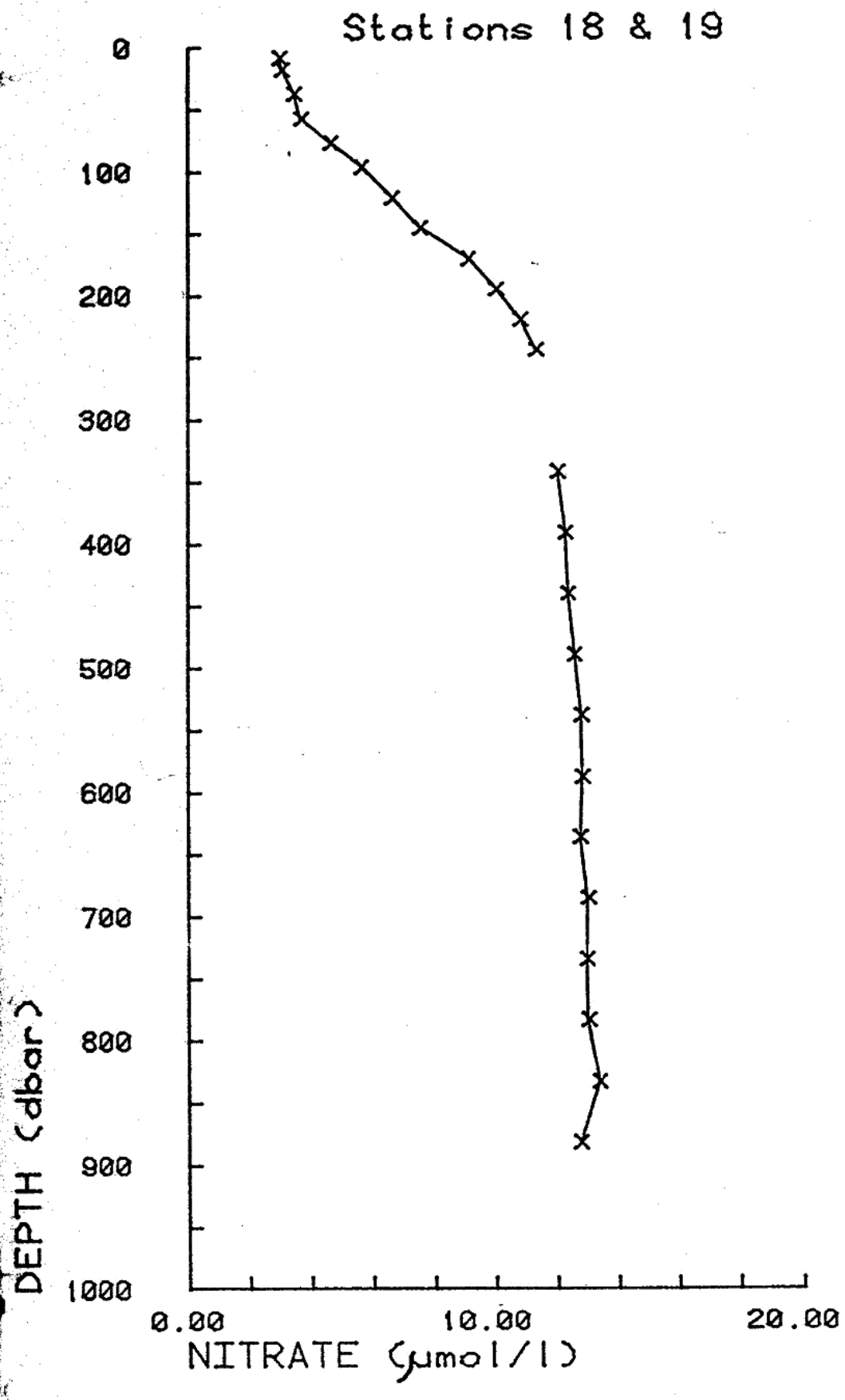


Figure 5c. Nitrate data for stations 18 and 19.

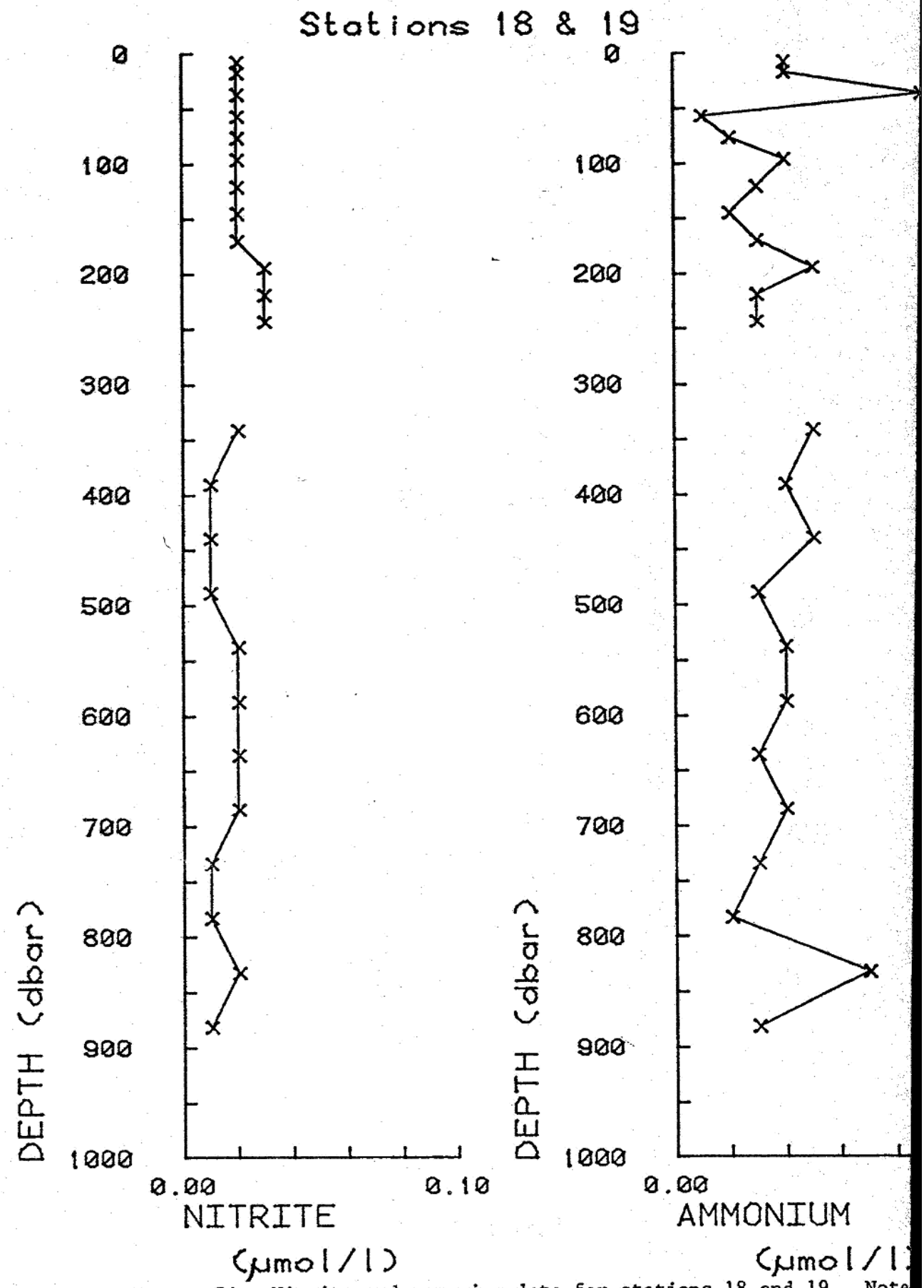


Figure 5d. Nitrite and ammonium data for stations 18 and 19. Note the comparison between field analyzed and frozen samples in figures and 4 suggests that the vertical structure could be an artifact introduced during storage of these frozen samples.

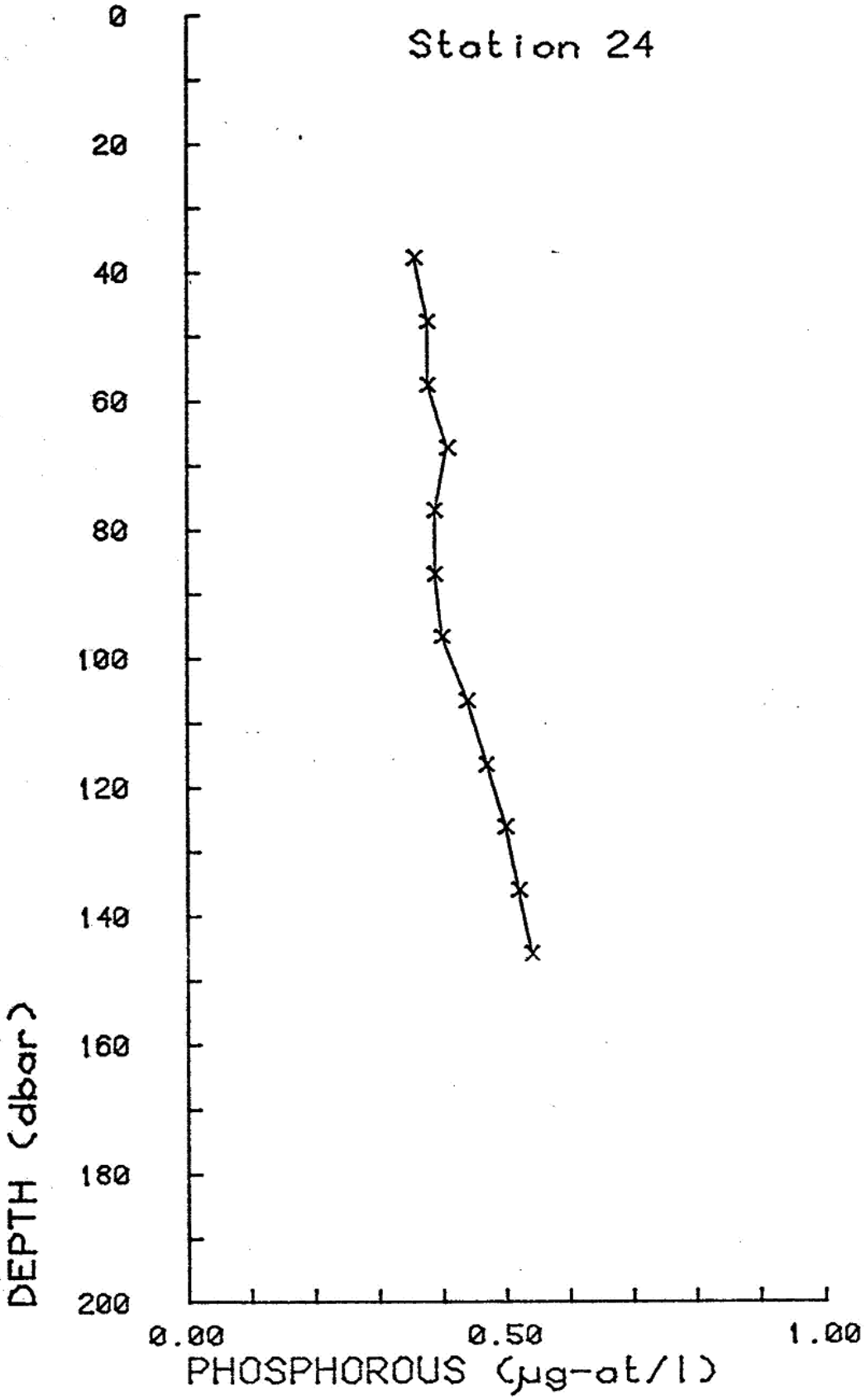


Figure 6a. Reactive phosphorus data for station 24.

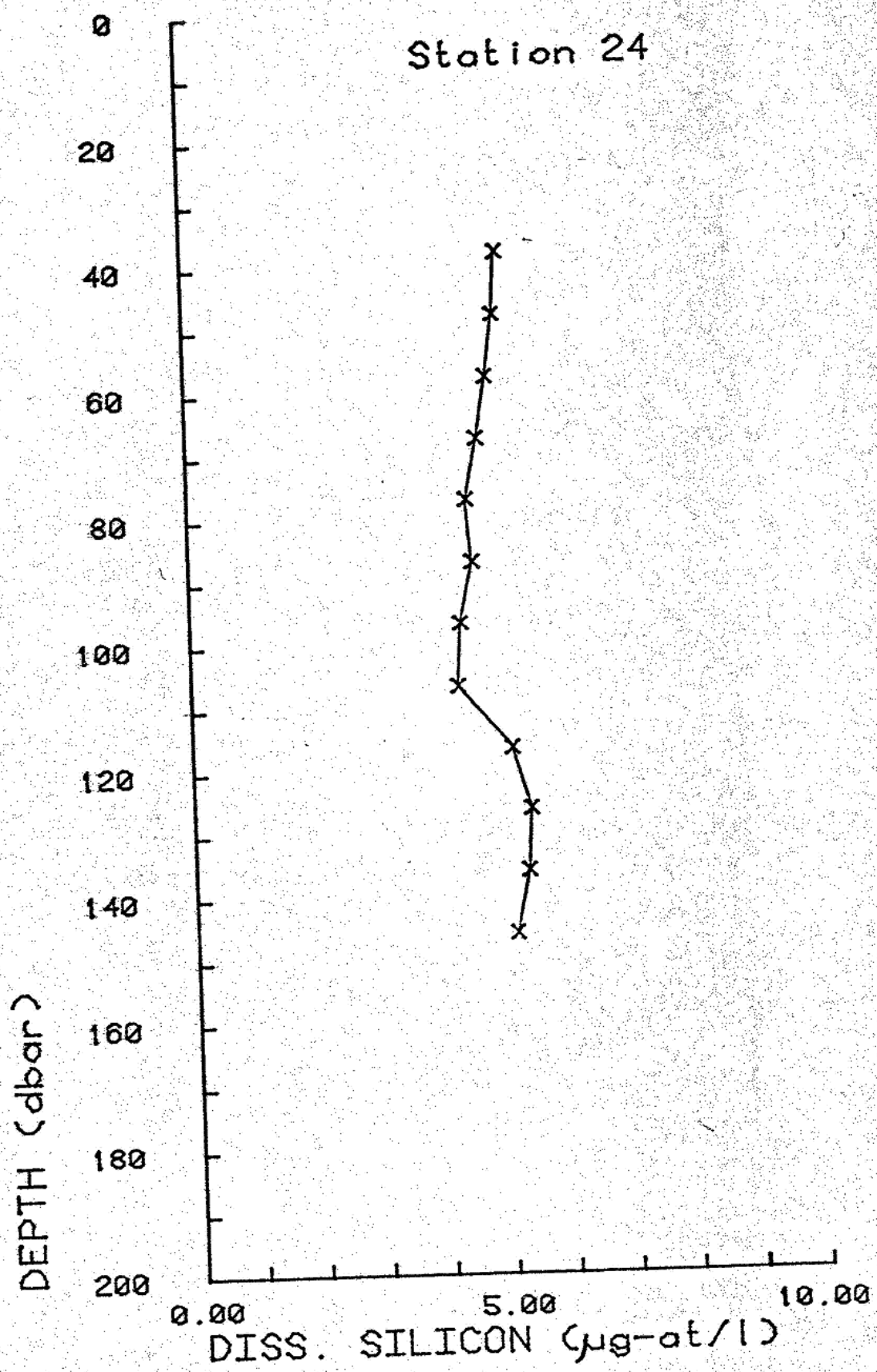


Figure 6b. Dissolved silicon data for station 24.

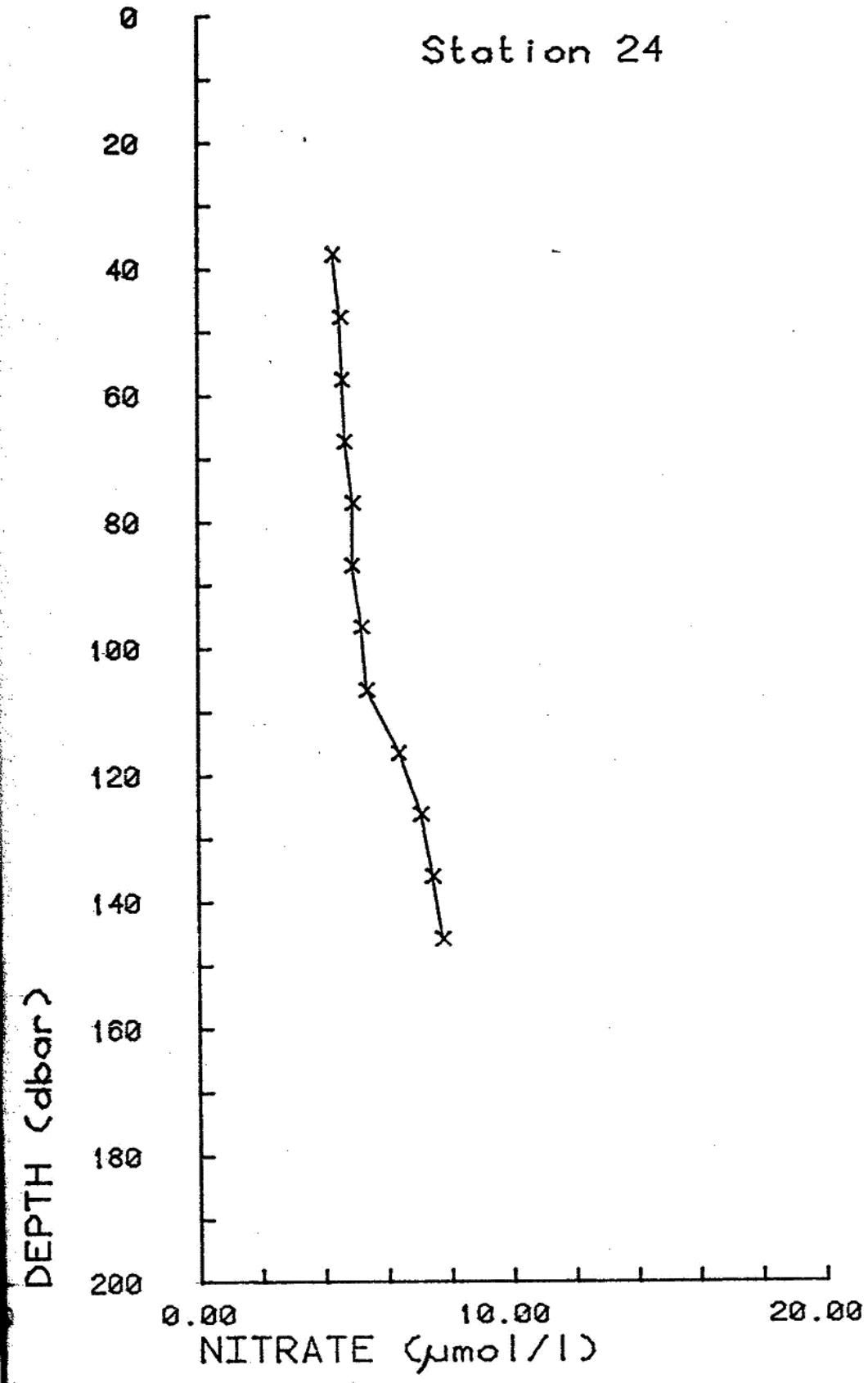
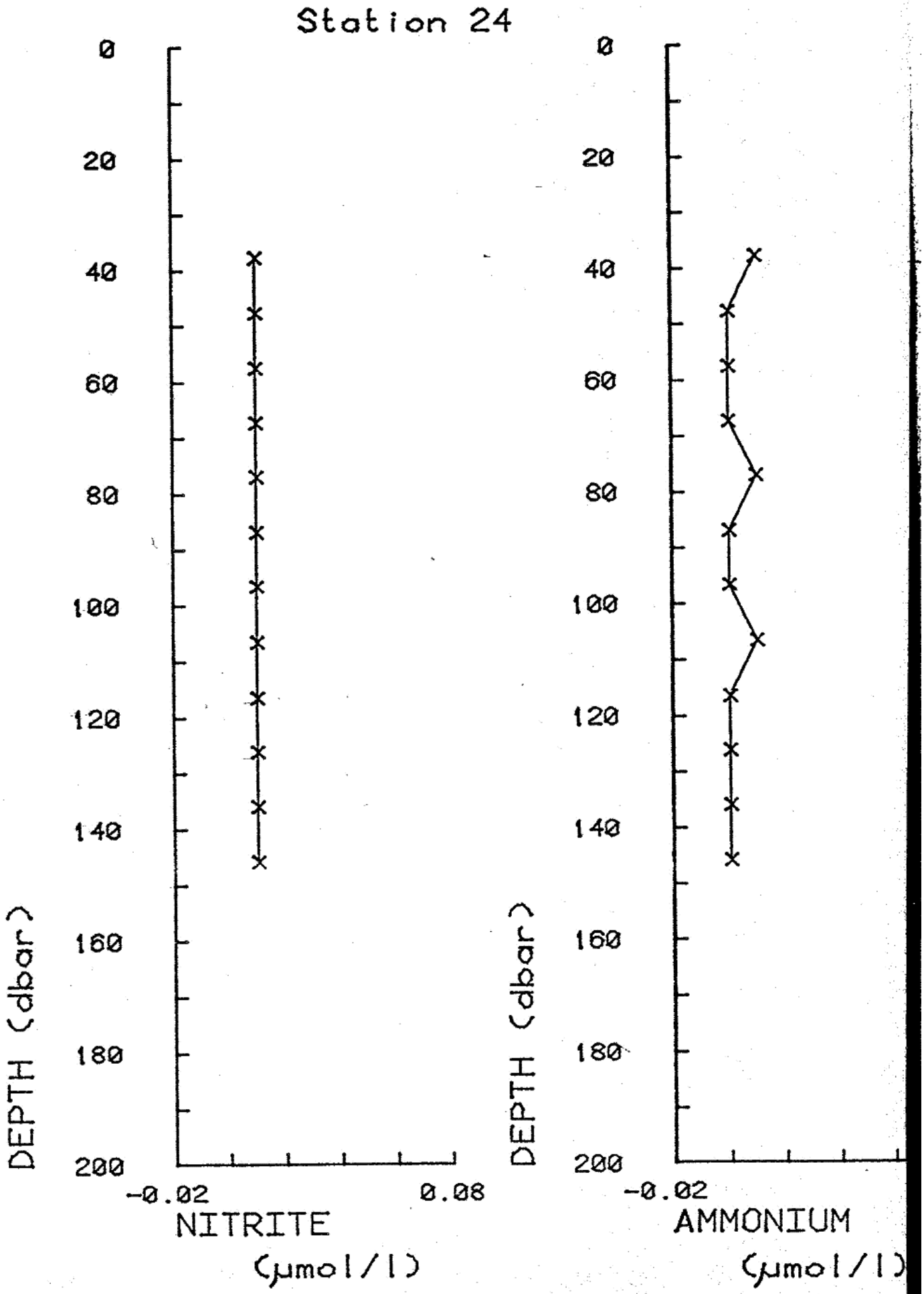


Figure 6c. Nitrate data for station 24.


Station 24
DEPTH (dbar)
0
20
40
60
80
100
120
140
160
180
200
-0.02
0.08
NITRITE
(µmol/l)
DEPTH (dbar)
0
20
40
60
80
100
120
140
160
180
200
-0.02
AMMONIUM
(µmol/l)

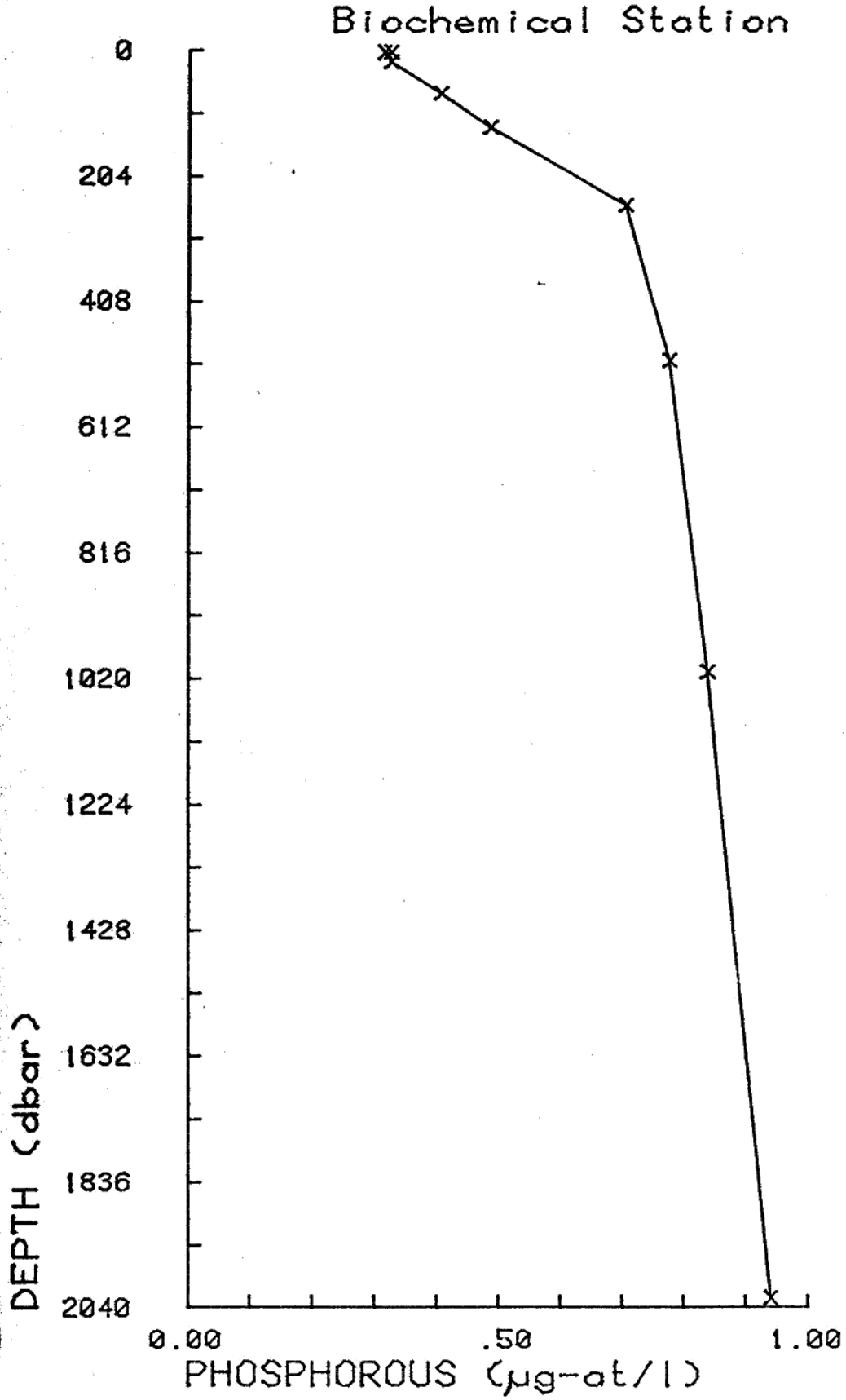


Figure 7a. Reactive phosphorus data for the biochemical station.

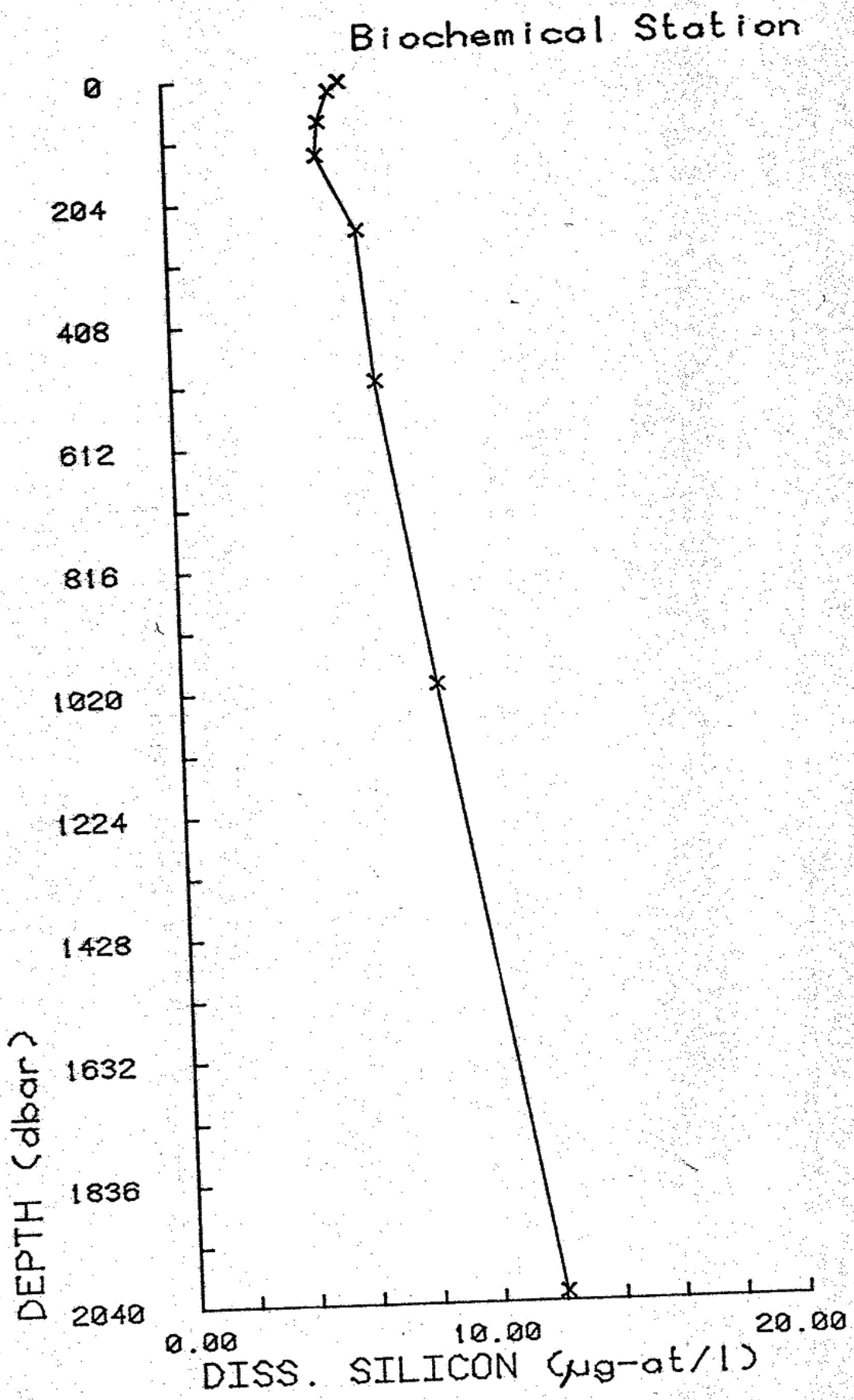


Figure 7b. Dissolved silicon data for the biochemical station.

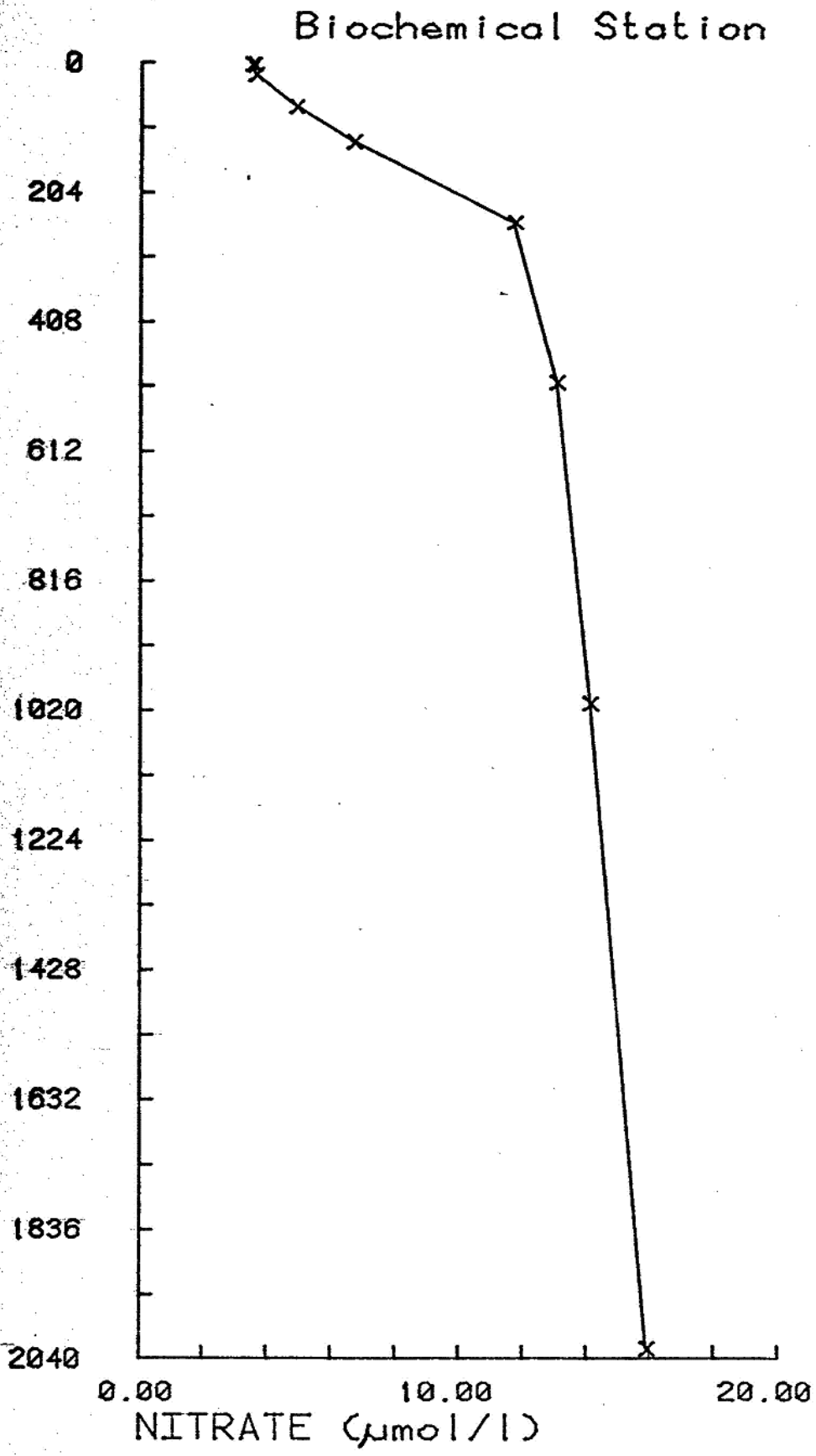


Figure 7c. Nitrate data for the biochemical station.

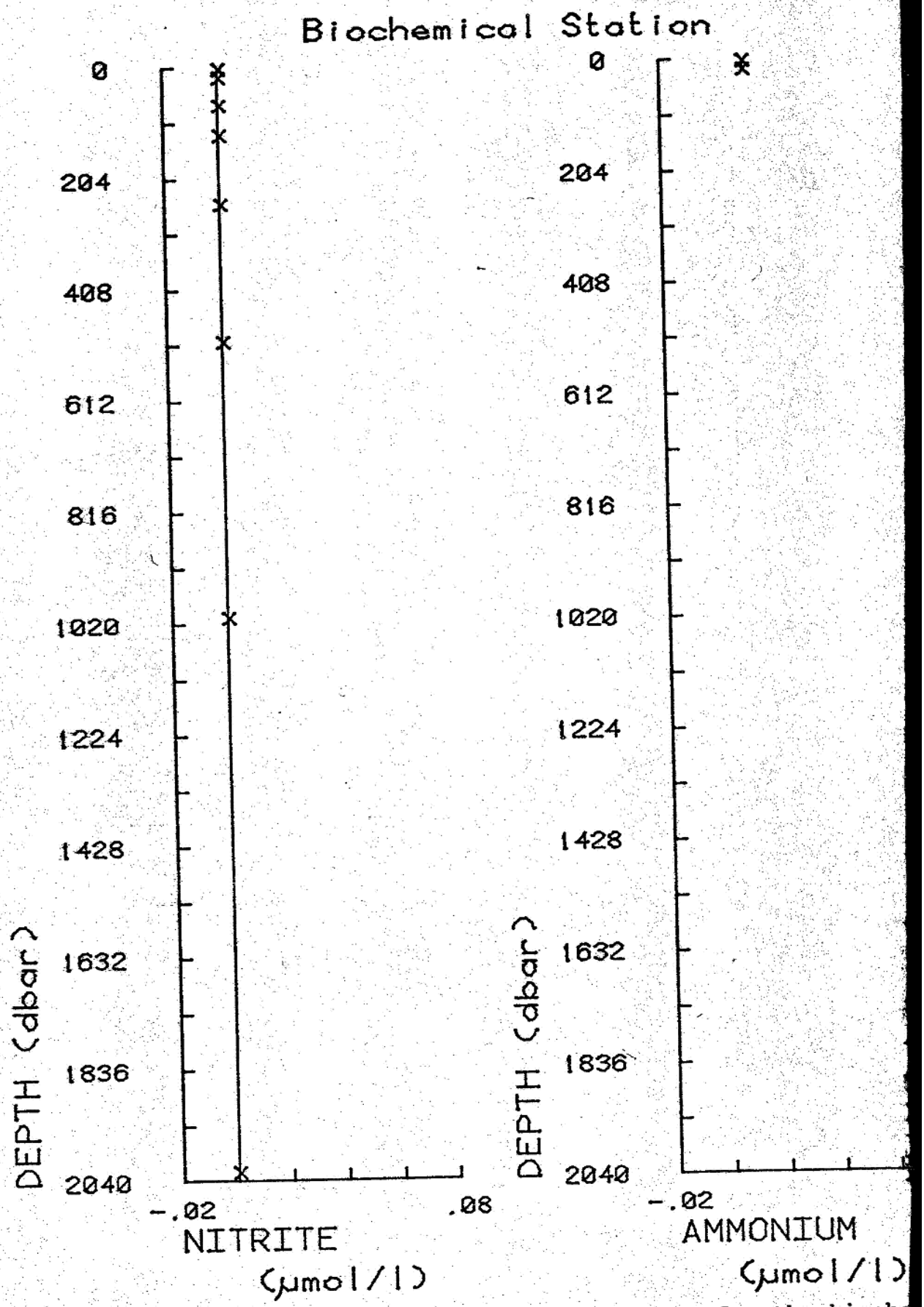


Figure 7d. Nitrite and ammonium data for the bioche
station. Note the ø offset in the diagrams.

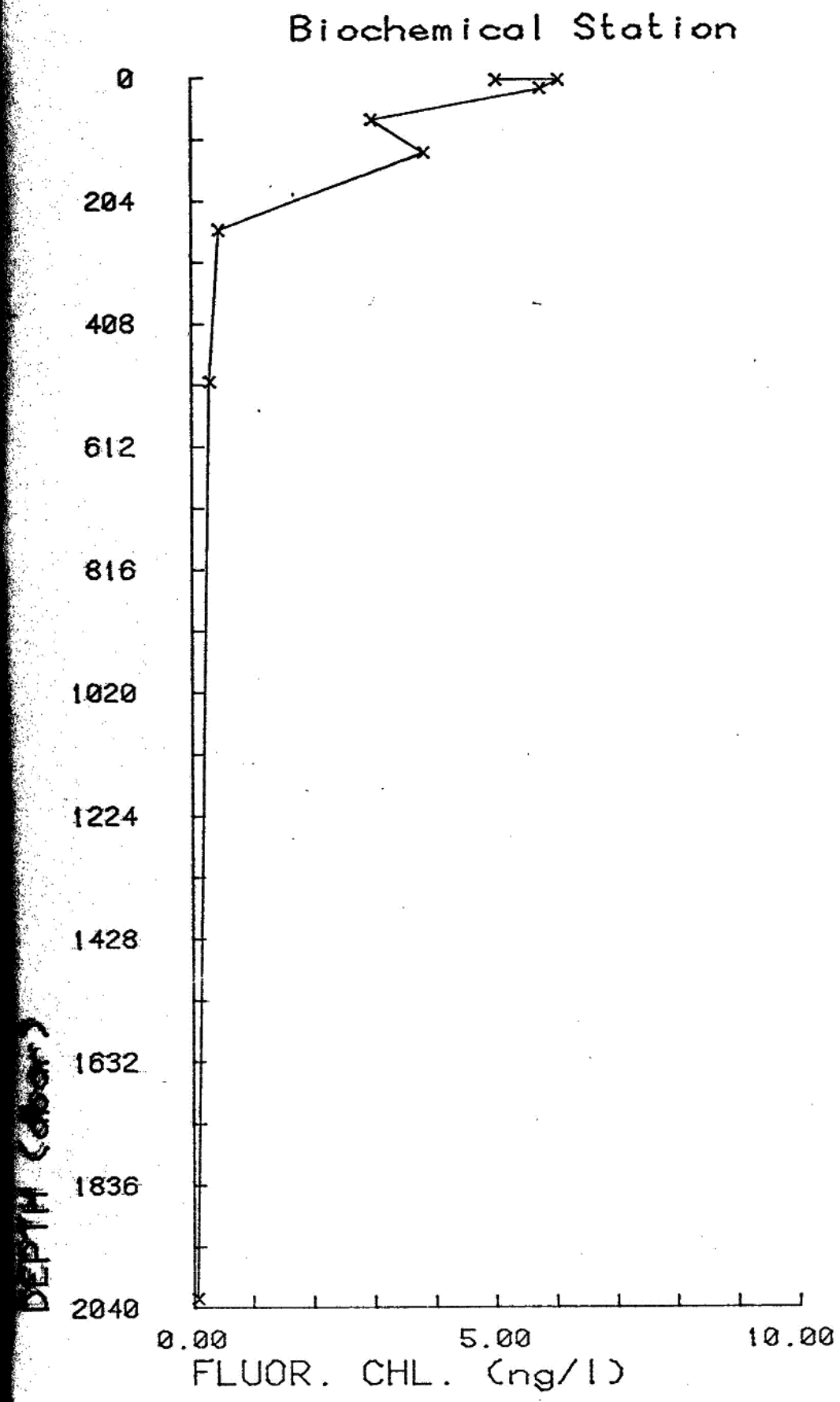


Figure 7e. Fluorometric chlorophyll a data for the biochemical station.

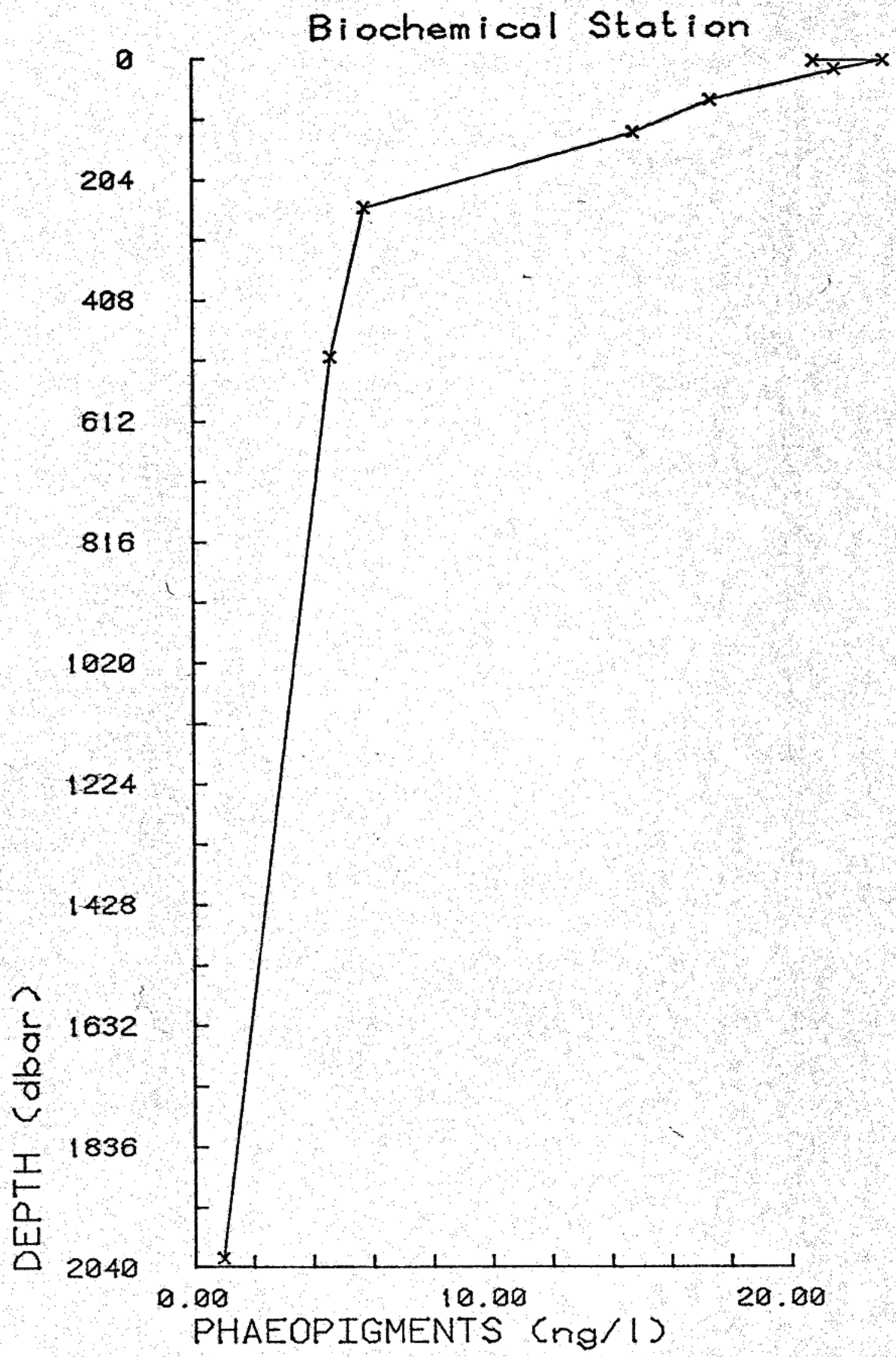


Figure 7f. Phaeopigment data for the biochemical sta

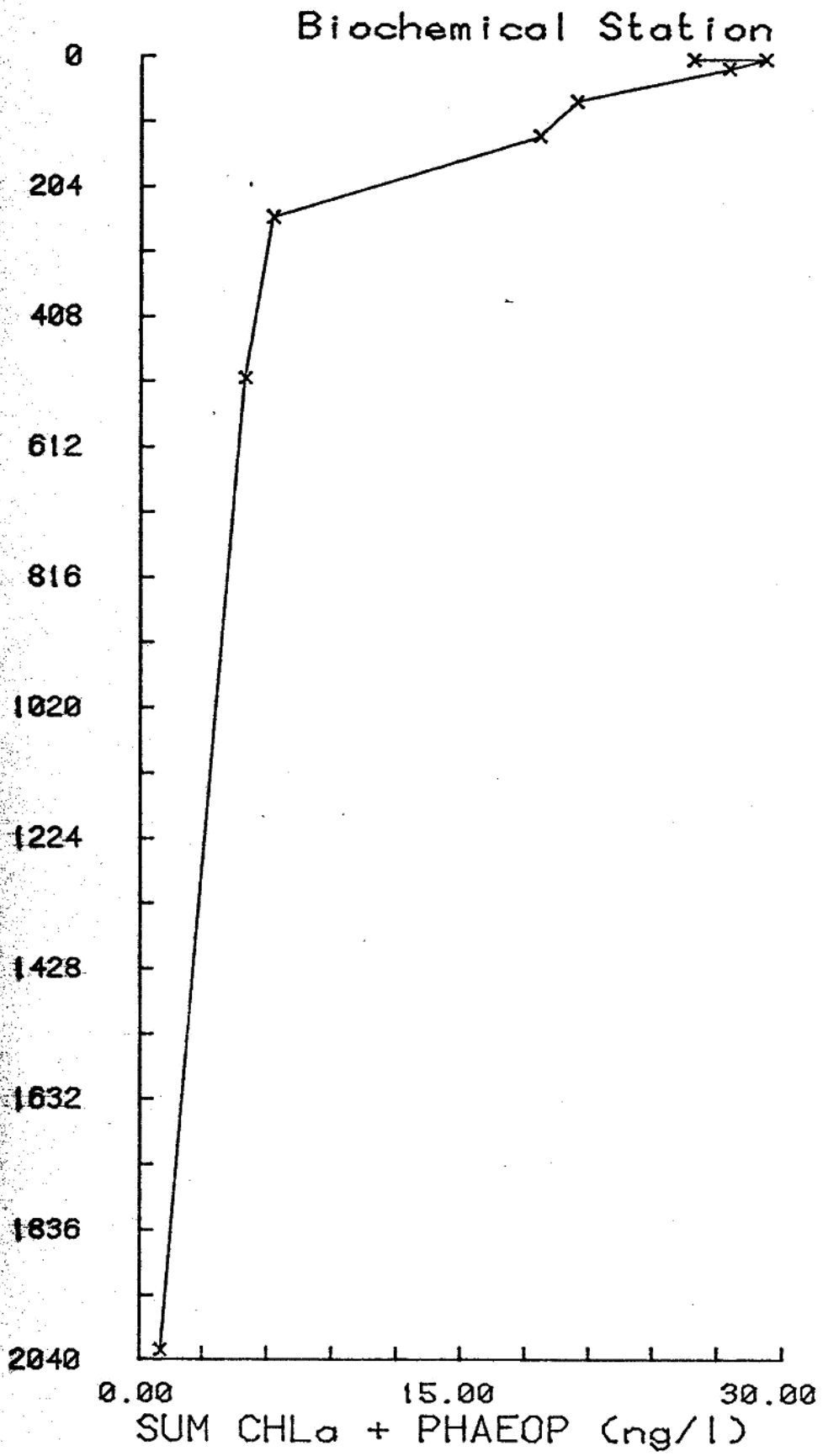


Figure 7g. The sum of chlorophyll-a and phaeopigment data for the biochemical station.

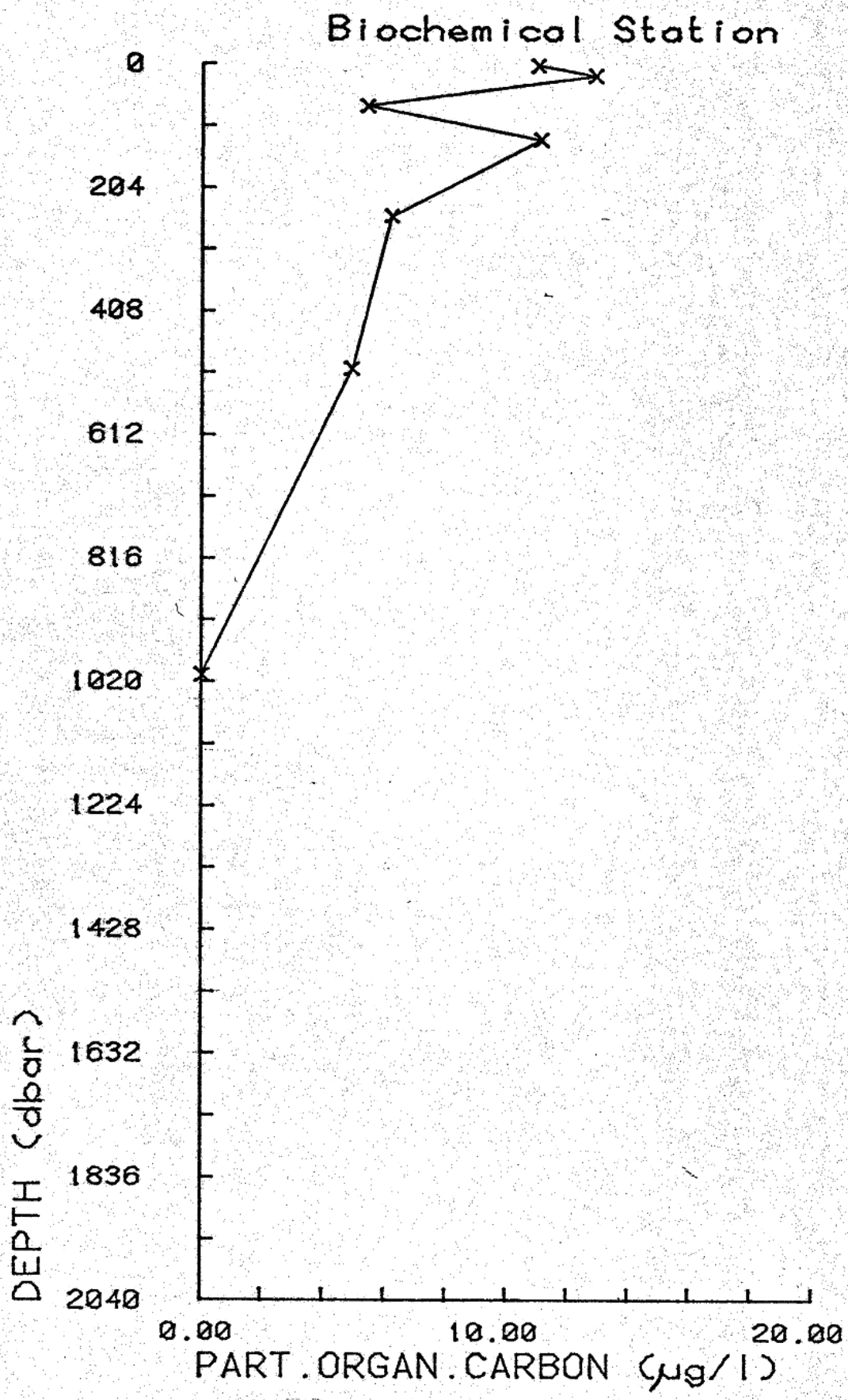


Figure 7h. Particulate organic carbon data for the bio
station.

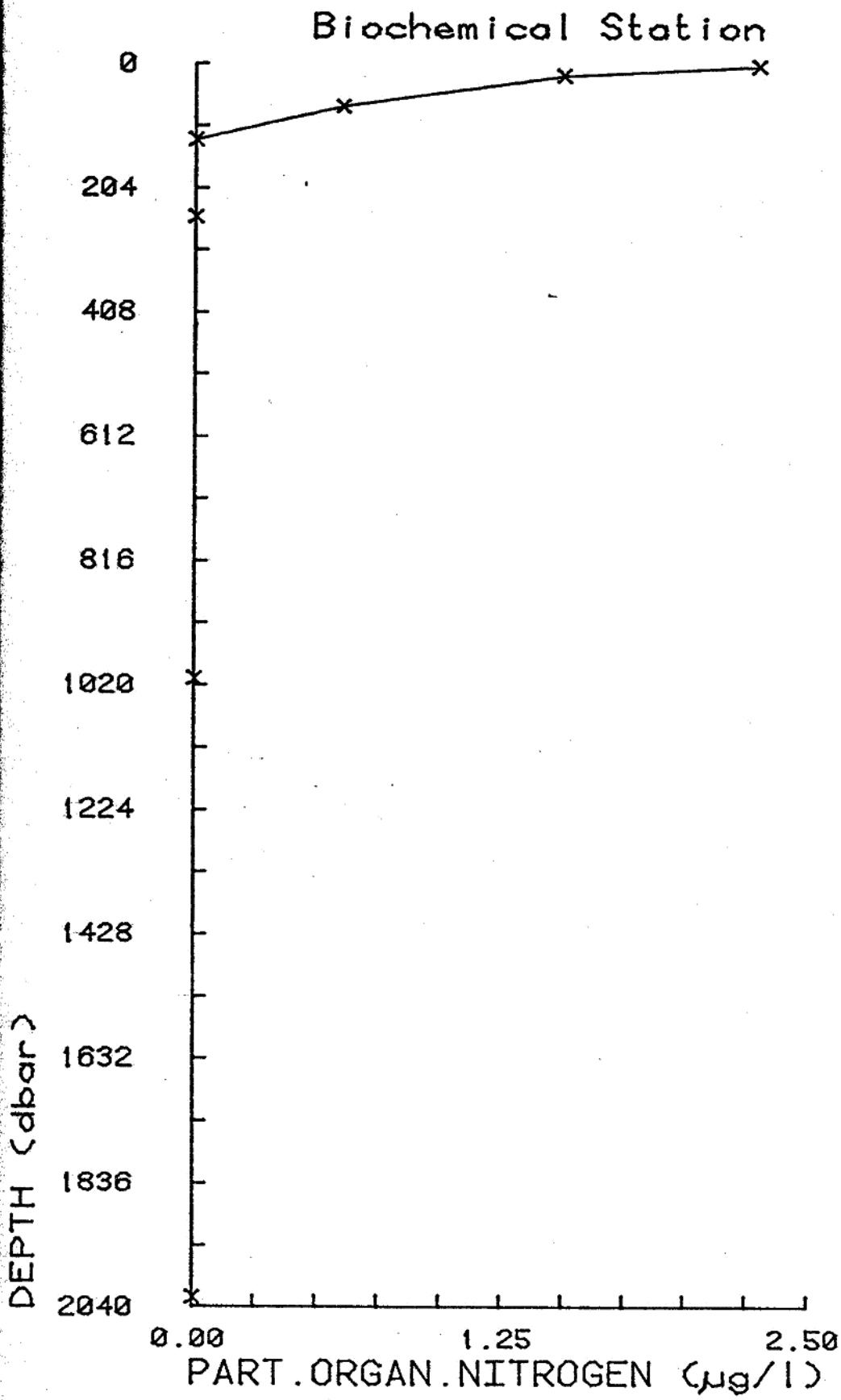


Figure 7i. Particulate organic nitrogen data for the biochemical station.

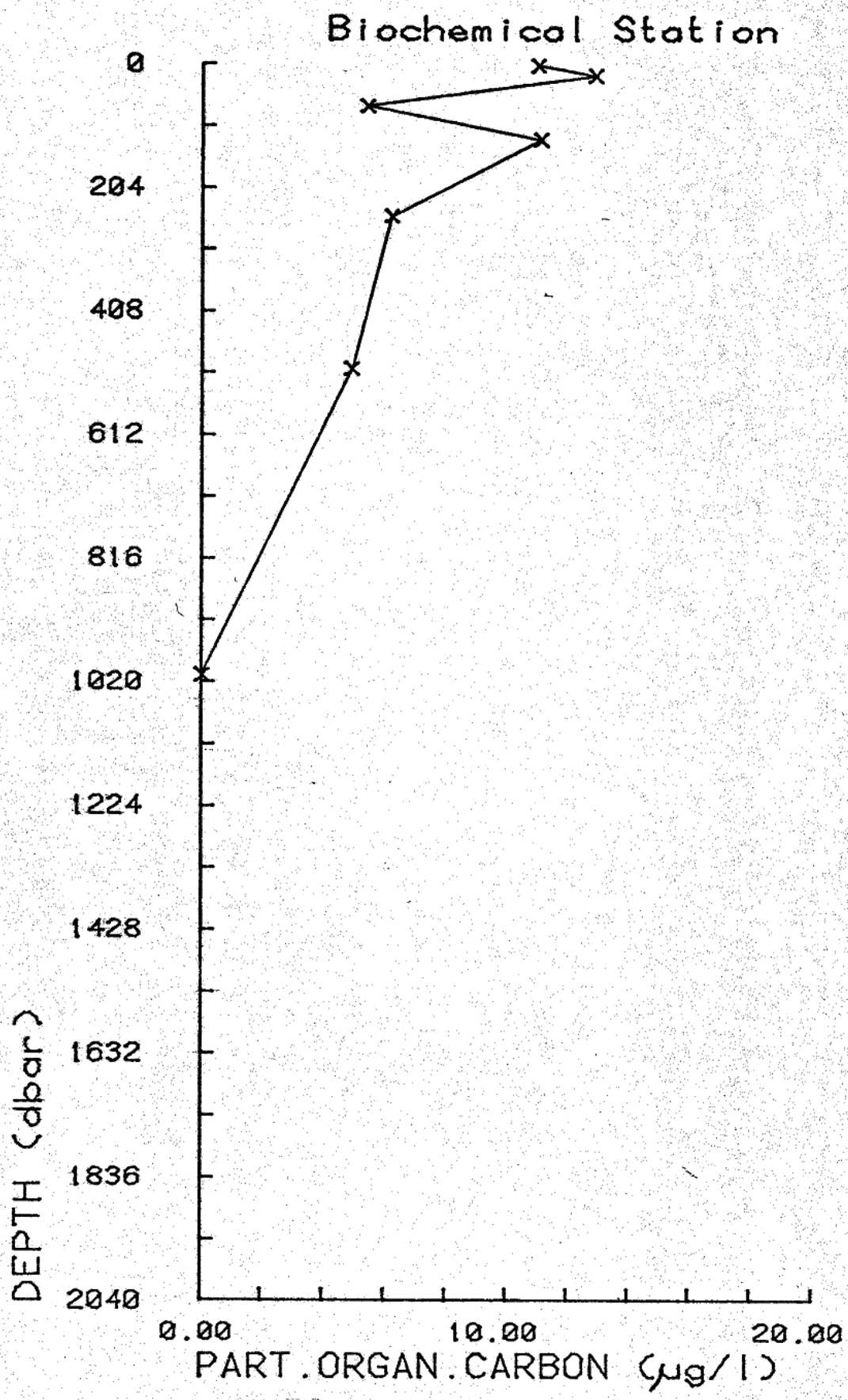


Figure 7h. Particulate organic carbon data for the bio
station.

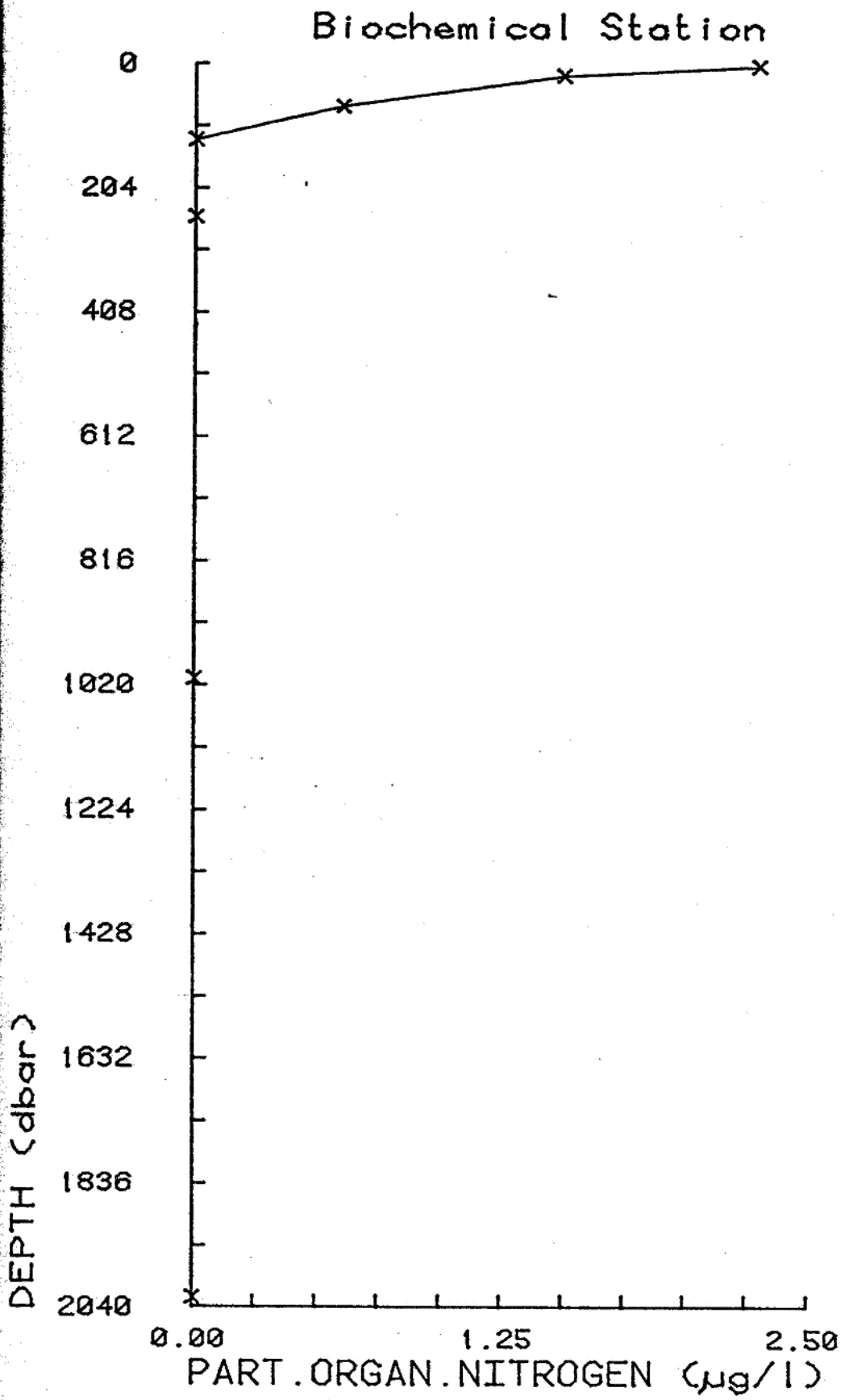


Figure 7i. Particulate organic nitrogen data for the biochemical station.

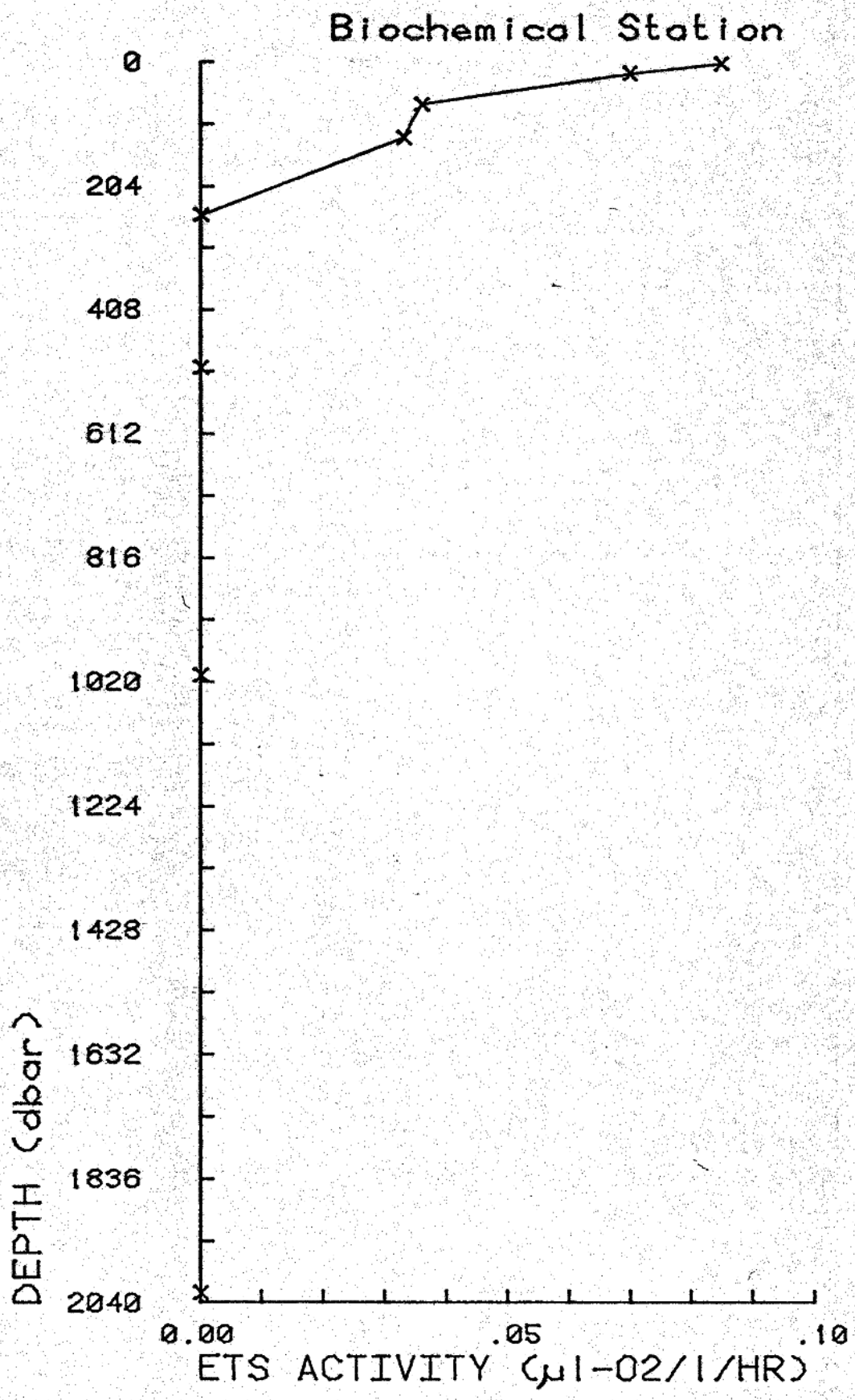


Figure 7j. Electron transport system activity data the biochemical station.

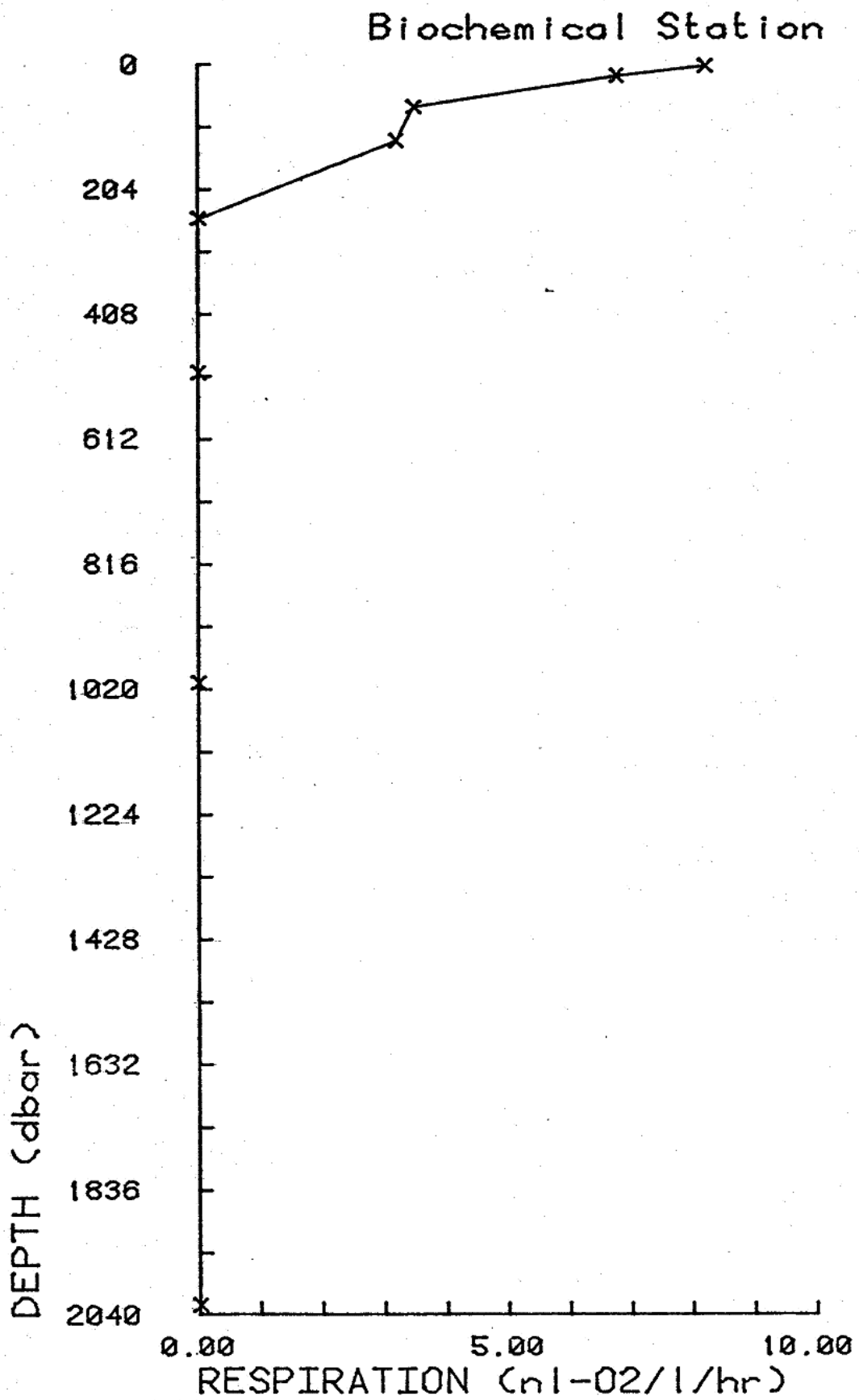


Figure 7k. Respiration rates determined from ETS activity for the biochemical station.

Table 1. Fram III chemical and biochemical stations for Bigelow Laboratory component.

STA	DAY GMT	TIME GMT	LATITUDE N	LONGITUDE E	WATER DEPTH METERS
Chemical Stations					
2	8 April '81	1100	83° 05.28'	09° 55.35'	4009
5	10 April '81	1400	83° 15.95'	08° 29.97'	4017
6	10 April '81	1730	83° 15.30'	08° 24.23'	4025
18	14 April '81	1449	83° 01.57'	07° 04.00'	4018
19	14 April '81	2000	83° 00.80'	07° 01.26'	4012
24	16 April '81	0900	82° 57.62'	06° 56.88'	4007
Biochemical and Chemical Samples Comprising Station BC					
DEPTH					
5	13 April '81	1225	83° 03.85'	07° 14.40'	4024
20	13 April '81	2325	83° 03.02'	07° 10.77'	4024
70	14 April '81	1125	83° 02.00'	07° 06.05'	4021
500	14 April '81	1615	83° 01.40'	07° 03.22'	4016
1000	14 April '81	2250	83° 00.37'	06° 59.47'	3982
2000	15 April '81	0330	82° 59.80'	06° 57.97'	4004
250	15 April '81	0830	82° 59.13'	06° 56.67'	4006
125	15 April '81	2050	82° 57.93'	06° 58.97'	4007

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
2	83° 05.28'N	09° 55.35'E	8 April 1981	1100	4009

DEPTH	TEMPERATURE	SALINITY	OXYGEN	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
18.0	-1.83	33.215	8.46	.35	4.91	2.49	.02	.07
37.8	-1.84	33.328	8.44	.36	4.76	2.73	.02	.04
47.7	-1.84	33.338	8.41	.39	4.93	3.09	.02	.04
57.5	-1.81	33.466	8.23	.42	5.49	3.49	.02	.02
67.1	-1.78	33.707	8.12	.46	5.63	3.97	.02	.03
77.1	-1.78	33.925	7.92	.46	5.63	3.97	.02	.03
86.9	-1.73	34.040	8.00	.47	4.59	4.65	.01	.03
96.7	-1.68	34.170	7.86	.50	4.49	5.41	.01	.04
106.6	-1.64*	34.220	7.74	.53	4.66	6.01	.01	.02
116.3	-1.54*	34.263	7.58	.53	4.96	6.25	.01	.06
126.2	-1.63	34.304	7.78	.50	4.13	6.16	.02	.05
136.0	-1.66	34.307	7.92	.48	3.64	5.96	.02	.06

FIELD ANALYZED SAMPLES

DEPTH	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
18.0	.46	4.65	-	0.00	0.00
37.8	.47	4.58	-	0.00	0.00
47.7	.50	4.75	-	0.00	0.00
57.5	.54	5.26	-	0.00	0.00
67.1	-	5.33	-	0.00	0.00
77.1	.58	5.28	-	0.00	0.00
86.9	.55	4.42	-	0.00	0.00
96.7	.57	4.36	-	0.00	0.00
106.6	.58	4.56	-	0.00	0.00
116.3	.58	4.83	-	0.00	0.00
126.2	.55	4.05	-	0.00	0.00
136.0	.50	-	-	0.00	0.00

- Data not available
* Questionable

1981 FRAM III - BIGELOW LABORATORY COMPONENT

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
5	83° 15.95'N	08° 29.97'E	10 April 1981	1400	4017

DEPTH	TEMPERATURE	SALINITY	OXYGEN	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
1225.6	-0.37	34.962	7.00	.94	9.21	14.4	0.00	.03
1471.0	-0.57	34.966	6.95	1.00	10.6	15.0	0.00	.05
1716.1	-0.68	34.969	6.95	.98	11.4	15.5	0.00	.06
1961.7	-0.77	34.978	6.99	.99	11.8	15.5	0.00	.02
2207.1	-0.81	34.981	6.97	.99	12.1	15.7	0.00	.02
2452.8	-0.83	34.989	6.94	.98	12.3	15.7	0.00	.02
2697.5	-0.86	35.043	6.94	.99	12.4	15.5	0.00	.01
2942.7	-0.80	35.012	6.94	.98	12.4	15.5	0.00	.01
3188.4	-0.78	35.025	6.95	.98	12.4	15.5	0.00	.02
3433.6	-0.76	35.041	6.89	.98	12.6	15.4	0.00	.02
3728.3	-0.73	35.058	6.97	.95	12.7	15.4	0.00	.02
4107.3	-0.69	35.100	6.86	.93	12.6	15.4	0.00	.01

FIELD ANALYZED SAMPLES

DEPTH	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
1225.6	.89	7.50	13.6	0.00	0.00
1471.0	.95	10.1	14.2	0.00	0.00
1716.1	.91	10.8	14.5	0.00	0.00
1961.7	.92	11.2	14.8	0.00	0.00
2207.1	.90	11.5	15.0	0.00	0.00
2452.8	.96	12.1	15.7	0.00	0.00
2697.5	.92	11.7	15.0	0.00	0.00
2942.7	.92	11.9	15.1	0.00	0.00
3188.4	.90	11.9	15.0	0.00	0.00
3433.6	.92	12.3	15.1	0.00	0.00
3728.3	.90	12.5	15.1	0.00	0.00
4107.3	.94	12.4	15.1	0.00	0.00

1981 FRAM III - BIGELOW LABORATORY COMPONENT

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
5	83° 15.95'N	08° 29.97'E	10 April 1981	1400	4017

DEPTH	TEMPERATURE	SALINITY	OXYGEN	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
1225.6	-0.37	34.962	7.00	.94	9.21	14.4	0.00	.03
1471.0	-0.57	34.966	6.95	1.00	10.6	15.0	0.00	.05
1716.1	-0.68	34.969	6.95	.98	11.4	15.5	0.00	.06
1961.7	-0.77	34.978	6.99	.99	11.8	15.5	0.00	.02
2207.1	-0.81	34.981	6.97	.99	12.1	15.7	0.00	.02
2452.8	-0.83	34.989	6.94	.98	12.3	15.7	0.00	.02
2697.5	-0.86	35.043	6.94	.99	12.4	15.5	0.00	.01
2942.7	-0.80	35.012	6.94	.98	12.4	15.5	0.00	.01
3188.4	-0.78	35.025	6.95	.98	12.4	15.5	0.00	.02
3433.6	-0.76	35.041	6.89	.98	12.6	15.4	0.00	.02
3728.3	-0.73	35.058	6.97	.95	12.7	15.4	0.00	.02
4107.3	-0.69	35.100	6.86	.93	12.6	15.4	0.00	.01

FIELD ANALYZED SAMPLES

DEPTH	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
1225.6	.89	7.50	13.6	0.00	0.00
1471.0	.95	10.1	14.2	0.00	0.00
1716.1	.91	10.8	14.5	0.00	0.00
1961.7	.92	11.2	14.8	0.00	0.00
2207.1	.90	11.5	15.0	0.00	0.00
2452.8	.96	12.1	15.7	0.00	0.00
2697.5	.92	11.7	15.0	0.00	0.00
2942.7	.92	11.9	15.1	0.00	0.00
3188.4	.90	11.9	15.0	0.00	0.00
3433.6	.92	12.3	15.1	0.00	0.00
3728.3	.90	12.5	15.1	0.00	0.00
4107.3	.94	12.4	15.1	0.00	0.00

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
6	83° 15.30'N	08° 24.23'E	10 April 1981	1730	4025

DEPTH	TEMPERATURE	SALINITY	OXYGEN	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
47.1	-1.78	33.381	8.20	.40	6.37	4.71	0.00	.05
96.6	-1.67	34.156	7.84	.48	4.32	6.57	0.00	.08
145.5	-0.91	34.399	7.46	.56	5.12	8.71	0.00	.05
195.1	1.04	34.733	7.12	.69	5.69	11.3	0.00	.02
293.0	1.86	34.918	7.14	.74	5.81	12.8	0.00	.02
342.2	1.70	34.966	7.15	.75	5.99	12.9	0.00	.03
391.4	1.51	34.940	7.15	.76	6.16	13.1	0.00	.02
440.4	1.23	34.933	7.15	.77	6.49	13.2	0.00	.02
489.5	1.00	34.935	7.00	.79	6.66	13.3	0.00	.01
734.5	0.48	34.957	7.01	.82	7.20	13.7	0.00	.03
882.0	0.10	34.951	7.09	.82	7.58	13.8	0.00	.03
1078.6	-0.20	34.953	7.05	.84	8.35	14.2	0.00	.01

FIELD ANALYZED SAMPLES

DEPTH	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
47.1	.45	6.10	5.23	0.00	0.00
96.6	.48	4.30	7.02	0.00	0.00
145.5	.59	5.10	8.94	0.00	0.00
195.1	.69	5.50	11.3	0.00	0.00
293.0	.79	5.70	12.3	0.00	0.00
342.2	.75	5.70	12.3	0.00	0.00
391.4	.77	6.00	12.7	0.00	0.00
440.4	.77	6.20	12.7	0.00	0.00
489.5	.77	6.40	12.9	0.00	0.00
734.5	.87	7.30	13.3	0.00	0.00
882.0	.84	7.20	13.2	0.00	0.00
1078.6	.84	7.90	13.6	0.00	0.00

1981 FRAM III - BIGELOW LABORATORY COMPONENT

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
18	83° 01.57'N	07° 04.00'E	14 April 1981	1449	4018

DEPTH	TEMPERATURE	SALINITY	OXYGEN	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
8.4	-1.83	33.104	-	.32	5.38	3.02	.02	.04
18.1	-1.83	33.190	-	.36	5.14	3.11	.02	.04
37.8	-1.84	33.439	-	.40	5.44	3.52	.02	.09
57.5	-1.84	33.692	-	.42	5.18	3.73	.02	.01
77.2	-1.84	33.851	-	.42	4.73	4.70	.02	.02
96.8	-1.73	34.068	-	.47	4.58	5.71	.03	.04
121.4	-1.49	34.221	-	.51	4.98	6.73	.02	.03
145.8	-1.13	34.325	-	.56	5.04	7.62	.02	.02
170.4	-0.02	34.514	-	.61	5.28	9.20	.02	.03
195.0	0.88	34.670	-	.66	5.46	10.1	.03	.05
219.5	1.18	34.781	-	.70	5.79	10.9	.03	.03
244.0	1.71	34.871	-	.72	5.69	11.4	.03	.03

- Data not available

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
19	83° 00.80'N	07° 01.43'E	14 April 1981	2000	4012

DEPTH	TEMPERATURE	SALINITY	OXYGEN	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
342.1	1.23	34.918	-	.73	6.18	12.1	.02	.05
391.2	1.18	34.935	-	.77	6.36	12.3	.01	.04
440.3	1.01	34.935	-	.77	6.46	12.4	.01	.05
489.7	0.94	34.947	-	.78	6.64	12.6	.01	.03
538.5	0.80	34.951	-	.80	6.66	12.8	.02	.04
587.5	0.65	34.949	-	.83	6.80	12.8	.02	.04
636.2	0.59	34.961	-	.81	6.98	12.8	.02	.03
685.6	0.42	34.961	-	.80	7.15	13.0	.02	.04
734.9	0.31	34.961	-	.81	7.17	13.0	.01	.03
783.6	0.19	34.964	-	.83	7.33	13.0	.01	.02
833.1	0.10	34.962	-	.86	7.61	13.4	.02	.07
882.1	0.01	34.961	-	.81	7.46	12.7	.01	.03

- Data not available

1981 FRAM III - BIGELOW LABORATORY COMPONENT

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
24	82° 57.62'N	06° 56.88'E	16 April 1981	0900	4007

DEPTH	TEMPERATURE	SALINITY	OXYGEN	PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM
37.8	-1.85	33.592	-	.36	5.05	4.39	.01	.01
47.7	-1.85	33.653	-	.38	4.98	4.63	.01	.00
57.6	-1.86	33.770	-	.38	4.84	4.68	.01	.00
67.4	-1.86	33.826	-	.41	4.67	4.75	.01	.00
77.1	-1.86	33.869	-	.39	4.48	4.99	.01	.01
87.0	-1.85	33.903	-	.39	4.55	4.95	.01	.00
96.7	-1.85	33.935	-	.40	4.34	5.24	.01	.00
106.7	-1.81	33.983	-	.44	4.27	5.39	.01	.01
116.5	-1.68	34.085	-	.47	5.12	6.40	.01	.00
126.2	-1.60	34.158	-	.50	5.40	7.09	.01	.00
136.1	-1.51	34.231	-	.52	5.33	7.45	.01	.00
145.9	-1.40	34.303	-	.54	5.12	7.77	.01	.00

- Data not available

STATION	LATITUDE	LONGITUDE	DATE (GMT)	TIME (GMT)	SONIC DEPTH (M)
BC[1]	83° 03.85- 82° 57.93'N	07° 14.40- 06° 58.97'E	13-15 April 1981		4024-3982

DEPTH	TEMPERATURE**	SALINITY	OXYGEN	DISSOLVED PHOSPHATE	DISSOLVED SILICON	NITRATE	NITRITE	AMMONIUM	CHLOROPHYLL	PHAEOPIGMENT
5.	-1.76	-	-	.32	5.80	3.63	0.00	.01	5.05	20.83
5.	-1.76	-	-	.33	5.77	3.54	0.00	.01	6.09	23.13
20.	-1.41	-	-	.33	5.44	3.66	0.00	.01	5.78	21.52
71.	-1.90	-	-	.41	5.06	4.95	0.00	-	3.00	17.38
126.	-1.64	-	-	.49	4.96	6.76	0.00	-	3.85	14.78
253.	.80	-	-	.71	6.23	11.8	0.00	-	.46	5.73
505.	.97	-	-	.78	6.69	13.1	0.00	-	.30	4.60
1010.	-.18	-	-	.84	8.39	14.2	0.00	-	-	-
2025.	-.78	-	-	.94	12.0	15.9	0.00	-	.06	.93

DEPTH	SUM CHL & PHAE	CARBON	NITROGEN	ETS	RESPIRATION
5.	25.88	11.0	2.3	.085	8.2
5.	29.22	-	-	-	-
20.	27.50	12.9	1.5	.070	6.8
71.	20.38	5.4	.6	.036	3.5
126.	18.63	11.1	0.0	.033	3.2
253.	6.19	6.2	0.0*	0.000	0.0
505.	4.90	4.9	1.4*	0.000	0.0
1010.	-	0.0*	0.0	0.000	0.0
2025	.99	4.8*	0.0	0.000	0.0

\- Data not available

1 See text and Table 1 for sampling locations

* Questionable data

** These temperatures are from protected reversing thermometers