Pacific Marine Science Report 78-24

OCEANOGRAPHIC DATA REPORT
KITIMAT ARM, PORPOISE HARBOUR
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ABSTRACT

Ocean Chemistry carried out sampling and analysis from the C.S.S. Parizeau from February 4-16, 1977. Data were obtained for salinity, temperature and nutrients (reactive silicate, nitrate and phosphate) and the results are reported here. The distribution of these water properties is interpreted in the light of the circulation occurring in Kitimat Arm and recommendations for chemical sampling are given. At one station an intercomparison of filtered and non-filtered nutrient samples was made. The results of analysis of variance show that while silicate and phosphate are unaffected by filtering, in non-turbid water, the nitrate levels are increased slightly (but statistically significantly). Lead-210 geochronology was carried out on one box core, and the apparent uniform sedimentation rate is about 0.47 cm y^{-1}. There was evidence, however, of turbidity flows which may increase the overall sedimentation rate. Sampling was also carried out for hydrocarbons in the water column, sediments, intertidal organisms and the plankton, and some sediment samples were obtained at Porpoise Harbour, the site of a recent PCB spill. The results of analysis on these materials are not reported here.

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INTRODUCTION

From February 4-16, 1977 Ocean Chemistry conducted a cruise to Kitimat Arm, a fjord located on the mainland coast of British Columbia at a latitude of about 53°N. At that time Kitimat was being considered as the location of an oil pipeline terminal, and in the event that a full scale survey would be required at a later date we conducted this cruise as an exploratory operation. Sampling was carried out for salinity, temperatures and nutrients (reactive silicate, phosphate and nitrate). In order to obtain baseline information on hydrocarbons, samples of the plankton were obtained by net hauls, bottom grabs were taken, mussels were collected at several beaches, and sea water was obtained for hydrocarbon analysis.

Because there had been a recent spill of polychlorinated biphenyls (PCBs) at Porpoise Harbour, which is located on the mainland coast of B. C. near Prince Rupert at a latitude of about 54°N, we also examined that area, taking a series of bottom grabs from the harbour entrance up to the spill area. We attempted to box core at the spill site, but fast currents and bottom debris prevented us from successfully doing so.

The detailed survey is now being undertaken and some of the samples obtained during this cruise (for hydrocarbon analysis) will be analyzed as part of this programme. This data report is intended to make the information obtained during the cruise, accessible.

SAMPLING

a) Net Hauls

Miller net hauls were run at approximately 5 knots for about a half hour. Since only small amounts of material were obtained, the samples from four Miller nets (#6 mesh) were pooled. Material was preserved for biological identification by storing it in buffered 5% formaldehyde solution. After the cruise, the samples were transferred to 95% ethanol through a series of increased concentrations and then shelved for about two weeks before analysis.

Neuston net hauls were also conducted at 5 knots for a half hour period. Only one tow contained tar balls and plastic material. Samples were preserved for biological identification as described above.

b) Water Sampling

Hydrocasts were carried out with 1.7 L Niskin P.V.C. bottles at standard depths (H.O. Publication #607, 1978). Samples were drawn for oxygen analysis, salinity and nutrients. Each bottle was equipped with two reversing protected thermometers, and all bottles at depths greater than or equal to 200 m had one unprotected thermometer. In all cases the depth calculated from the unprotected thermometer was within 3 m of the depth recorded on the meter block at the time of sampling.

Oxygen samples were drawn off first into calibrated 125 mL stoppered flasks which were immediately "pickled" with manganous chloride/alkali iodide solution in accordance with the method outlined in the Reference Manual for Ocean Chemistry Division Sampling Techniques (1976). Analysis was carried out within one day. Salinity samples were stored on deck in tightly stoppered salinity bottles with analysis being carried out after returning to the laboratory. Nutrients were sampled in duplicate (2 glass, 2 plastic) 20 mL screw cap test tubes.

These were filled about 3/4 full and frozen in the upright position immediately. At Station 8 samples for nutrients were drawn in triplicate both filtered and unfiltered to examine the influence of filtering on nutrient concentrations.

Sea water was obtained for hydrocarbon analysis by using the Clark-Blumer sampler (Clark et al, 1967) equipped with a rupture disc for the deep casts, and with an air activated valve for the shallow casts. Silk gloves were used to handle the 5 L glass inserts and during rupture disc installation. Each sample was immediately poisoned with $HgCl_2$ and stored in a cooler at 4°C but but frozen.

c) Sediment Sampling

Surface sediment was obtained where possible (soft bottom) with a Ponar grab sampler. Subsamples for hydrocarbon or PCB analysis were placed in a cleaned aluminum can, and the lids were wrapped with Teflon tape. The samples were then frozen and are stored frozen. Subsamples for mercury analysis were placed in Whirl-Pak bags and were immediately frozen.

Box coring was carried out with the Soutar-Bruland clear vented slow entry box coring device. Samples were obtained by inserting cut off plastic syringes through the specially machined holes on the side of the box corer. The sediment was extruded from the syringe with the exception of the last ½" of material which had been next to the wall and was likely disturbed during coring. Sediment was stored in plastic Whirl-Pak bags with a minimum of air space and was subsequently frozen. These samples were later subjected to ^{210}Pb, and organic carbon analysis.

ANALYTICAL METHODS

Oxygen was determined by the Micro-Winkler technique (Carpenter, 1965) in accordance with the procedure outlined in the Ocean Chemistry Division reference manual. The percent saturation was calculated by using the formula given by Weiss (1970) for oxygen solubility as a function of temperature and salinity.

Salinities were analyzed after the cruise with an Autolab inductive salinometer with duplicate determinations being within ± 0.003°/oo.

Analysis for reactive silicate, nitrate and phosphate was carried out on a Technicon II auto-analyzer using the methods outlined in the Reference Manual for Ocean Chemistry Division Sampling Techniques (1976). The basis of the technique for silicate involves reaction in acid medium with ammonium molybdate to form β-molybdosilicic acid which is subsequently reduced by ascorbic acid to form the characteristic molybdenum blue colour. Oxalic acid is used to prevent interference from phosphate. Nitrate is analyzed by reduction to nitrite in a copper-cadmium reductor column. The nitrite reacts with sulfanilamide in acid to form a diazo compound which on coupling with N-1-napthlethylenediamine dihydrochloride forms a red azo dye. Ortho phosphate is determined by forming molybdophosphoric acid which is reduced by ascorbic acid to give the molybdenum blue colour. In all three cases absorbance of the coloured complex is measured.

Lead-210 was measured by the method described in Matsumoto (1975). Sediment samples were thawed and dried at 110°C to determine moisture content. The residue was pulverized, leached with concentrated nitric acid, and the solid phase was filtered off. The lead was purified by electrodeposition on a platinum anode as PbO_2. The sulphate powder was dried and allowed to sit for at least 30 days to allow growth of the daughter ^{210}Bi to approach steady state. The radioactivity was measured by counting the β decay of the ^{210}Bi daughter.

Organic carbon was determined by the method of Gaudette et al (1974). Essentially the sediment was subjected to oxidation by an excess of $K_2Cr_2O_7$ solution in sulfuric acid for thirty minutes. After oxidation the solution was back titrated with ferrous ammonium solution.

Density of the solid material was determined by pycnometry, and salt corrections were applied by assuming that the salinity of the pore water was the same as that of the overlying water.

The preserved biological samples were split to 1/8th fractions and grouped according to phylum. Crustacea were separated by class and sometimes order. Sample MNT-1 was split into ¼ fractions and copepods were split to 1/16th fractions. A count was made of each group in the splits and each specimen was identified as far as possible. Each count was multiplied to "numbers in whole sample" and the percent of sample for each was computed.

The precision and accuracies of the various analyses used here are reported in Table 1. The 95% confidence, or 2 σ limits are given.

DISCUSSION

a) Water Properties

Previous cruises have been made to the Kitimat area and are reported on by Pickard (1961), and Waldichuk et al (1968). It would be premature to base too many conclusions on data obtained during this single cruise, however some interesting trends were observed with implications on conducting a baseline study for hydrocarbons.

The cruise was run in February, and since the main contributor to fresh water runoff in this mainland fjord is glacier and snow melt water, river input was at a seasonal low (Pickard, 1961). Furthermore this year was unusual in that a very low snowfall was evident. All beaches were clear of snow, as were the hills surrounding the channels investigated. The locations of the stations occupied during this cruise are shown in Figures 1 and 2 and are given in Table 2.

Pickard (1961) has classified Douglas Channel as belonging to group A.1 inlets; that is having low surface salinities at the head (0.1-2^o/oo) and about 5-20^o/oo surface salinity at the mouth. More explicitly the A.1 inlets are those with a relatively high runoff. Kitimat Arm can effectively be seen as a two layer system with a shallow pycnocline at the head gradually deepening from less than 10 m to about 50 m at the mouth (Figures 3 and 4). More uniform mixing down to 100 m on the shelf outside the sill is evident at Station 1. Temperature contours shown in Figure 5 follow a similar trend with uniform 8^{o}C water extending down to 100 m at Station 1, and a cold surface layer associated with the low salinity runoff. The cold surface layer deepens towards the mouth as expected. Both subsurface temperature minimums and maximums have been observed in many of the mainland inlets (Pickard, 1961). The data here show a subsurface maximum which can be seen quite clearly on Figure 5 when at Stations 7 to 11 the water from 100-150 m exceeds 8^{o}C in temperature. Only across the sill on the shelf are similar levels occurring. In conjunction with the temperature maximum, an oxygen maximum is also present (Figures 7 and 8). Oxygen levels also tend to be highest in the surface where both low temperature and low salinity lead to high gas solubility. At Stations 1 and 2 high dissolved oxygen levels (near saturation) extend down to 100 m. Inside the sill and deeper than it, the oxygen levels decrease with depth, but in no case do they approach anoxic conditions with the lowest levels being about 3.3 mL L^{-1}. It has been observed that significant seasonal variation of the deep water (that below the sill level) does not take place although apparently periods of deep water exchange take place due to inflow of deep water at irregular intervals. This must occur frequently enough to prevent anoxic conditions from taking place on a regular basis.

The distribution of nutrients (reactive silicate, phosphate and nitrate) are shown in Figures 9, 10 and 11. All three tend to increase with depth with the highest levels being found inside the sill below the depth of the sill. If the nutrients are plotted against salinity (Figures 12, 13 and 14) some deductions can be made about the water circulation. The silicate levels in Figure 12 appear to be more or less constant at the surface at about 30-37 µg at L^{-1} and salinities of 29-32^o/oo. Above a salinity of 31^o/oo two branches are seen. The high silicate branch includes all points below the sill where high salinity occurs. The low silicate branch includes at its extremity all points from outside the sill (Stations 1 and 2). The points between the low silicate extremity and the main cluster come from intermediate depths (75-200 m) at stations inside the sill, particularly from stations closer to the mouth such as 3, 4 and 6. The indication is that while some of the water inside the sill above 200 m is being replaced by water with lower silicate levels from outside the sill, water below the sill at depths greater than 200 m is not being affected. The nitrate-salinity diagram clearly shows the same trend except that nitrate appears to increase with salinity in low surface waters. Phosphate (Figure 13) again duplicates this picture. River water was not measured for nutrients during this cruise but the data reported here indicate that the river is probably a stronger source of silicate than for nitrate and phosphate relative to the levels occurring in the inlet. Looking back at the contour plots (Figures 5, 7, 9, 10, 11) one can see the intrusion of high salinity low nutrient water particularly on the silicate and nitrate diagrams. This circulation pattern probably also explains the subsurface temperature and oxygen maximums observed at the stations inside the sill. The S-T plots for all stations corroborate these conclusions and in general the maximum temperature of 8°C is found in the salinity range of 31.7°/oo - 32.0°/oo at a depth of 100-150 m with the notable exception of Station 1 where the maximum temperature is only 7.8°C and occurs at 50 m.

b) Sediments

At Station 10, one box core was obtained and has been subjected to ^{210}Pb geochronology. The core consisted of soft mud with a greenish brown appearance at the surface. The porosity decreased sharply with depth in the top 20 cm and more slowly below that. The dotted line on Figure 17 represents the data fitted to the theoretical curve given by Athy (1931). In order to compensate for the effect of compaction, the excess ^{210}Pb activity is plotted against Z', the depth corresponding to a non-compacted sediment. Examination of Figure 16 brings out several interesting features. The sedimentation rate both near the surface and at depth is about 0.47 cm y^{-1} (0.06 g $cm^{-2}y^{-1}$). Above the corrected depth of 20 cm (actual depth $\sim$ 10 cm) there is a slight flattening of the excess ^{210}Pb profile. This is probably due to bioturbation. At corrected depths of about 50 cm and 80-100 cm there are breaks in the uniform decay of excess ^{210}Pb with depth. These could arise as a result of turbidity flows as suggested by Pickard (1961). Similar disturbed profiles have been reported by Oldfield et al (1978) who interpreted these as an alteration of sedimentation rate. The effect of turbidity flows would be to increase sedimentation rate above that determined from a linear segment shown on Figure 16. It should be noted that the ^{210}Pb activities are relatively high at the surface allowing reduced counting times to achieve the necessary statistical confidence. This results in shorter analysis time and makes the area a good one for attempting geochronology. Turbidity flows will make interpretation more difficult, but not impossible. Based on the organic carbon content of this core, the flux rate of carbon to the sediment is about 1.4 mg $cm^{-2}y^{-1}$. Turbidity flows could increase this to about 2.2 mg $cm^{-2}y^{-1}$.

c) Filtering of Nutrients

At Station 8 nutrient samples were drawn in triplicate both filtered and unfiltered from all depths in order to test the effect of filtering. Data from the analysis was subjected to a two-way ANOVA (Model I) with replicates test (Zar, 1974). Factor A was depth and factor B was filtering with level one being no filter and level 2 filter. The null hypotheses are as follows:

1-Ho There is no effect of depth (Factor A) on nutrient concentration.

2-Ho There is no effect of filtering (Factor B) on nutrient concentration.

3-Ho There is no interaction of depth and filtering (AXB) on the nutrient concentration.

For all three nutrients the Fmax test was used to check for equality of variance where

$$\mathrm{Fmax} = \frac{\sigma^2 \max}{\sigma^2 \min}$$

Two of the phosphate measurements were deleted because of an obviously erroneous measurement. The calculated test statistic along with the critical statistic (95%) is shown in column 2 of Table 5. In all three cases the variances may be assumed to be homogeneous. Factor A, the influence of depth need not be tested for our present purposes, but for the sake of interest the result of the test is shown in column 3 of Table 5. Obviously depth is an important consideration for all of the nutrients as expected. Factor B, the influence of filtering, was tested and the results are summarized in column 4. Both silicate and phosphate are unaffected by filtering, and there is no interaction between filtering and depth. However nitrate shows a statistically significant (95%) filtering effect and an examination of the original data reveals that the filtered samples have about a 1% increase in their nitrate concentration at the 20 μg at L^{-1} level. This effect is not particularly large considering the reported precision and accuracy of the method in Table 1. Millipore (MF) filters were used with the reported composition: mixed esters of cellulose, cellulose acetate and cellulose nitrate. Prior to filtering the sea water sample the filter was rinsed with 400 mL of distilled water and rinsed at least once with a small amount of the sea water to be sampled. In spite of this it appears that small amounts of nitrate were leached into the sea water during filtering. It has previously been reported that cellulose filters can add nitrate to nutrient samples (Maynard and Hopkins, 1971) and polycarbonate appears to be a better filtering material. On the whole, for non-turbid water, filtering appears to be an unnecessary step during which contamination could take place.

d) Biological Samples

The locations at which net hauls were performed are listed in Table 6, and stored material not yet analyzed is given in Table 6. Identification of material caught in the Neuston and Miller net hauls is summarized in Table 8.

CONCLUSIONS

In a physical sense the water in Kitimat Arm can be considered as a two layer system. From the point of view of the chemistry, however, at least three bodies of water appear to be important during this cruise, and other water bodies might become apparent from a longer, in-depth survey. First there is the fresh water input which is highly variable and affects the top 10-20 m directly. Sampling both in this layer and of the river proper should be attempted if a complete chemical picture is to be obtained. Second there is a subsurface layer from about 20 m down to about 200 m which appears to be subject to exchange from outside the sill at this time of year. It is also indirectly affected by the river inflow both by particulate fall-out and because inflow is driven to some extent by estuarine flow at the surface. Chemical properties of this water will be a superposition of processes going on within the inlet on water which is of relatively recent origin from outside the inlet. Particles falling through this layer as well as biological processes going on within it could produce obvious effects on the original water. Third, there is a body of deep water below the sill which does not exchange as readily and could be affected by interaction with sediments and particulates over a longer period. Use of particle size distribution should be an excellent approach in examining the chemistry of the water, and has been used to look at trace metal interactions in the Saguenay Fjord (Chanut et al, 1977).

Geochronology of the sediments should be a valuable tool in determining horizons in sediments where anthropogenic inputs have taken place. Flux rates of natural and anthropogenic materials can both be determined, as can the rate of burying these below a depth at which bioturbation is important. High surface activity of ^{210}Pb makes it a natural choice for dating the sediments for at least the last 100 years.

A small test of the effect of filtering during sampling shows that both silicate and phosphate are unaffected in non-turbid waters. Nitrate is increased by about 1% at the 20 μg at L^{-1} level. Use of a polycarbonate filter should eliminate this effect.

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TABLES

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TABLE 1

PRECISION AND ACCURACIES OF THE METHODS

Measurement	Precision	Accuracy (± 2σ Limits)
T°C	<.01C°	± .02C°
O_2 mL L^{-1}	± .005 mL L^{-1}	± .02 mL L^{-1}
Salinity °/oo	± .003 °/oo	± .02 °/oo
Organic Carbon	± 0.25%	± 3.0%
Nitrate μg at L^{-1}	± 0.4%	± 4%
Silicate μg at L^{-1}	± 0.3%	± 5%
Phosphate μg at L^{-1}	± 2% (high turbidity not filtered)	±10%
Phosphate μg at L^{-1}	± 0.3% (low turbidity or filtered)	± 5%

TABLE 2

STATION LOCATIONS

STATION	DATE	TIME:GMT	LOCATION N	LOCATION W	SAMPLING*
1	13.2.77	2016	52°46.8'	129°51.3'	S,T,N,O_2, XBT
2	13.2.77	1807	52°53.0'	129°30.0'	S,T,N,O_2, XBT
3	8.2.77	1827	52°57.5'	129°15.0'	S,T,N,O_2, XBT B (S)
4	8.2.77	2221	53°06.8'	129°21.8'	S,T,N,O_2, XBT
5	9.2.77	0038	53°16.5'	129°17.0'	S,T,N,O_2, XBT, B(S,D)
6	9.2.77	1650	53°00.65'	129°00.72'	S,T,N,O_2, XBT G
7	9.2.77	0332	53°16.7'	129°08.0'	S,T,N,O_2, XBT
8	9.2.77	1936	53°26.3'	129°12.6'	S,T,N,O_2, XBT G
9	9.2.77	2328	53°36.3'	129°12.7'	S,T,N,O_2
10	10.2.77	0222	53°44.0'	129°01.7'	S,T,N,O_2, B(S) G
10A	11.2.77	0038	53°46.3'	128°49.8'	XBT
10B	11.2.77	0106	53°47.0'	128°54.5'	XBT
11	10.2.77	1707	53°50.0'	128°48.0'	S,T,N,O,G
11A	10.2.77	1815	53°53.7'	128°44.7'	XBT
12	10.2.77	1932	53°58.75'	128°40.5'	S,T,N,O_2,G,B(S+D) XBT

TABLE 2 (CONTINUED)

STATION	DATE	TIME:GMT	LOCATION N	W	SAMPLING
Anchor Stn	9.2.77	0725	53°04.2'	129°06.0'	G
10	11.2.77	1653	53°44.0'	129°01.7'	Box Core
BW-1	11.2.77	2330	53°04.1'	129°35.6'	Mussel Collection
BW-2	10.2.77	2050	53°58.75'	128°40.5'	" "
BW-3	10.2.77	2225	53°52.6'	128°42.6'	" "
BW-4	12.2.77	1840	54°02.2'	130°15.5'	" "
BW-5	9.2.77	2115	53°26.3'	129°10.7'	" "
BG-1	12.2.77	2100	54°12.25'	130°21.8'	G
BG-2	12.2.77	2127	54°12.17'	130°19.5'	G
BG-3	12.2.77	2147	54°13.18'	130°17.62'	G
BG-4	12.2.77	2201	54°13.9'	130°18.05'	G
BG-5	12.2.77	2213	54°13.9'	130°18.05'	G
BG-6	12.2.77	2229	54°14.3'	130°18.22'	G
BG-7	12.2.77	2236	54°14.37'	130°18.22'	G
BG-8	12.2.77	2241	54°14.44'	130°18.26'	G
BG-9	12.2.77	2247	54°14.55'	130°18.36'	G

TABLE 2 (CONTINUED)

STATION	DATE	TIME:GMT	LOCATION		SAMPLING
			N	W	
Pump Station-1	15.2.77	0015	49°26.5'	123°59.6'	Sea water for Hg mobilization study (Howe Sound)
Pump Station-2	15.2.77	0500	49°40.9'	123°10.6'	

*B - Blumer Sampler for Hydrocarbons S - Shallow D - Deep
G - Bottom Grab
N - Nutrients - Silicate, Nitrate, Phosphate
O_2 - Oxygen
S - Salinity
T - Temperature
XBT - Expendable Bathythermograph

Stations 1 - 12 and BW1 - BW5 - Kitimat Arm
Stations BG1 - BG9 - Porpoise Harbour
Pump Stations 1, 2 - Howe Sound

TABLE 3

CHEMICAL DATA

STATION #1 13/2/77 2016 GMT DEPTH 240 m

DEPTH	TEMP. (°C)	SALINITY $^{o}/_{oo}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (µg at L^{-1})	SILICATE (µg at L^{-1})	NITRATE (µg at L^{-1})
0	8.37	31.711	24.66	6.70	100.2	1.49	20.6	13.1
10	-	31.696	-	6.72	-	1.45	20.6	13.1
20	8.41	31.700	24.65	6.71	100.3	1.41	20.7	13.1
30	8.41	31.716	24.66	6.68	100.0	1.38	20.5	13.1
50	8.45	31.716	24.65	6.67	99.8	1.35	20.5	13.1
75	8.22	31.716	24.69	6.68	99.5	1.36	20.2	13.0
100	8.32	31.810	24.75	6.62	98.8	1.36	18.8	12.3
150	8.34	32.174	25.03	5.69	85.1	1.44	19.8	13.2
200	7.39	33.038	25.85	4.53	66.8	2.09	37.4	23.6

TABLE 3 (CONTINUED)

STATION #2 13/2/77 1807 GMT DEPTH 180m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (μg at L^{-1})	SILICATE (μg at L^{-1})	NITRATE (μg at L^{-1})
0	7.85	31.425	24.52	6.61	97.5	1.62	25.9	16.2
10	7.85	31.425	24.52	6.62	97.5	1.62	25.9	16.3
20	7.86	31.424	24.52	6.65	98.0	1.57	25.9	16.3
30	7.87	31.441	24.53	6.64	97.8	1.58	25.6	16.0
50	7.87	31.448	24.53	6.65	98.1	1.57	25.6	16.0
75	7.95	31.505	24.57	6.64	98.2	1.46	24.7	15.6
100	8.00	31.611	24.64	6.58	97.4	1.55	23.8	15.3
150	8.09	31.939	24.88	6.16	91.6	1.54	24.0	15.5
165	8.08	32.006	24.94	6.01	89.4	1.55	24.9	15.7

TABLE 3 (CONTINUED)

STATION #3 8/2/77 1827 GMT DEPTH 225 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (µg at L^{-1})	SILICATE (µg at L^{-1})	NITRATE (µg at L^{-1})
0	7.18	30.550	23.92	6.34	91.5	1.65	33.9	20.8
10	7.18	30.551	23.92	6.34	91.5	1.71	33.3	20.9
20	7.19	30.558	23.93	6.34	91.5	1.60	33.5	20.7
30	7.18	30.612	23.97	6.31	91.1	1.61	32.9	20.4
50	7.29	30.789	24.10	6.20	89.9	1.67	32.3	20.1
75	7.41	30.993	24.24	6.13	89.1	1.72	31.9	19.9
100	-	31.504	-	5.88	-	1.66	30.7	19.1
150	7.86	32.192	25.12	5.27	78.0	1.73	32.1	19.8
200	7.46	32.580	25.48	4.11	60.5	2.11	43.0	25.1
215	7.32	32.680	25.57	3.77	55.3	2.22	44.2	25.1

TABLE 3 (CONTINUED)

STATION #4 8/2/77 2221 GMT DEPTH 660 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (μg at L^{-1})	SILICATE (μg at L^{-1})	NITRATE (μg at L^{-1})
0	7.07	30.270	23.72	6.53	93.9	1.61	33.8	20.4
10	7.07	30.260	23.71	6.53	93.7	1.64	34.1	20.7
20	7.11	30.516	23.90	6.36	91.7	1.73	34.0	20.6
30	7.34	30.885	24.16	6.13	89.0	1.74	33.1	20.2
50	7.59	31.259	24.42	6.04	88.3	1.74	30.5	18.7
75	8.01	31.711	24.72	6.06	89.9	1.63	27.5	17.5
100	8.04	31.799	24.78	5.98	88.8	1.59	27.3	17.3
150	7.96	32.112	25.04	5.43	80.6	1.72	30.8	19.3
200	7.62	32.388	25.30	4.59	67.7	1.97	38.8	23.1
300	7.30	32.694	25.59	3.71	54.4	2.15	48.2	27.1
400	7.23	32.780	25.66	3.46	50.7	2.20	50.1	28.1
500	7.24	32.798	25.67	3.40	49.2	2.27	50.7	28.6
600	7.22	32.813	25.69	3.34	49.0	2.05	51.2	28.7

TABLE 3 (CONTINUED)

STATION #5 9/2/77 0388 GMT DEPTH 530 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (μg at L^{-1})	SILICATE (μg at L^{-1})	NITRATE (μg at L^{-1})
0	6.92	29.893	23.44	6.66	95.1	1.72	34.3	20.2
10	6.92	29.913	23.46	6.60	94.2	1.70	34.6	20.4
20	7.00	30.355	23.79	6.37	91.4	1.75	34.8	20.6
30	7.06	30.468	23.87	6.33	91.0	1.71	33.4	20.5
50	7.38	30.969	24.22	6.10	88.6	1.74	33.4	20.1
75	7.82	31.476	24.56	5.96	87.8	1.65	30.6	18.8
100	8.02	31.807	24.79	5.89	87.3	1.59	28.3	17.8
150	7.99	32.107	25.03	5.38	79.9	1.65	32.0	19.6
200	7.83	32.308	25.21	4.90	72.6	1.81	35.9	21.4
300	7.49	32.578	25.47	3.95	58.1	2.06	44.7	26.0
400	7.26	32.751	25.64	3.47	50.9	2.78	50.0	28.0
500	7.13	32.787	25.68	3.37	49.3	2.33	52.5	28.6

TABLE 3 (CONTINUED)

STATION #6 9/2/77 1650 GMT DEPTH 567 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (µg at L^{-1})	SILICATE (µg at L^{-1})	NITRATE (µg at L^{-1})
0	6.88	29.572	23.19	6.43	91.6	1.78	35.9	21.3
10	6.98	29.831	23.38	6.34	90.6	1.80	36.2	21.4
20	7.08	30.311	23.75	6.01	86.4	1.79	36.3	21.6
30	7.23	30.666	24.01	6.09	88.1	1.79	34.5	20.8
50	7.38	30.996	24.24	5.97	86.8	1.77	33.8	20.4
75	7.71	31.568	24.64	5.66	83.3	1.79	32.2	19.8
100	7.82	31.801	24.82	5.58	82.3	1.76	31.8	19.7
150	7.69	32.182	25.10	4.91	72.0	1.77	36.9	22.1
200	7.51	32.385	25.32	4.29	63.1	1.78	41.6	24.2
300	7.25	32.652	23.56	3.68	53.9	2.18	48.3	27.3
400	7.11	32.745	25.65	3.41	49.8	2.36	50.8	28.3
500	7.08	32.772	25.68	3.35	48.9	2.39	52.0	28.6
550	7.07	32.777	25.69	3.31	48.3	2.37	52.1	28.7

TABLE 3 (CONTINUED)

STATION #7 9/2/77 0332 GMT DEPTH 520 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (μg at L^{-1})	SILICATE (μg at L^{-1})	NITRATE (μg at L^{-1})
0	6.85	29.533	23.17	6.55	93.1	1.69	35.2	20.7
10	6.86	29.639	23.25	6.49	92.4	1.74	35.3	20.7
20	6.88	29.816	23.39	6.43	91.7	1.71	35.3	21.0
30	7.06	30.244	23.70	6.05	86.9	1.72	34.9	21.0
50	7.26	30.666	24.00	5.65	81.8	1.83	34.2	21.1
75	7.68	31.334	24.47	4.78	70.9	1.76	34.2	20.8
100	7.92	31.686	24.71	3.27 ?	48.4	1.72	29.2	19.3
150	8.01	31.971	24.92	5.18	77.0	1.76	31.2	19.5
200	7.81	32.259	25.26	4.63	67.6	1.88	36.7	22.2
300	7.32	32.615	25.52	3.13	46.0	2.21	48.0	27.4
400	7.08	32.746	25.66	3.40	49.6	2.33	51.5	28.3
500	7.03	32.798	25.71	3.31	48.2	2.41	53.2	28.7

TABLE 3 (CONTINUED)

STATION #8 9/2/77 1936 GMT DEPTH 400 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (µg at L^{-1})	SILICATE (µg at L^{-1})	NITRATE (µg at L^{-1})
0	6.31	27.186	21.39	6.76	93.4	1.65	31.5	19.8
10	6.75	29.067	22.81	6.37	90.1	1.77	33.6	20.6
20	6.90	29.662	23.26	6.20	88.3	1.80	34.6	21.3
30	7.13	30.316	23.74	5.91	85.0	1.89	35.2	21.5
50	7.62	31.108	24.30	5.19	75.9	1.88	36.5	22.1
75	7.77	31.303	24.43	5.09	74.9	1.91	35.6	21.5
100	7.84	31.529	24.60	5.49	80.9	1.84	33.6	20.7
150	8.01	31.979	24.93	5.39	80.0	1.83	32.3	19.8
200	7.76	32.199	25.14	4.45	65.7	2.04	40.7	23.8
300	7.10	32.591	25.53	3.54	51.7	2.28	47.9	27.5
380	6.96	32.696	25.64	3.37	49.0	2.31	51.7	28.3

TABLE 3 (CONTINUED)

STATION #9 9/2/77 2328 GMT DEPTH 242 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (μg at L^{-1})	SILICATE (μg at L^{-1})	NITRATE (μg at L^{-1})
0	5.79	23.194	18.31	7.10	94.5	1.43	30.9	17.6
10	6.91	29.378	23.04	6.04	85.9	1.74	36.8	21.5
20	7.20	30.347	23.76	5.68	81.9	1.80	37.1	21.9
30	7.37	30.715	24.03	5.42	78.7	1.84	37.1	21.9
50	7.73	31.328	24.46	5.41	79.5	1.83	35.3	21.3
75	7.86	31.497	24.57	5.59	82.4	1.75	32.9	20.1
100	7.96	31.690	24.71	5.58	82.7	1.73	31.8	19.6
150	7.91	31.977	24.94	5.12	75.8	1.85	35.0	21.1
200	7.68	32.192	25.14	4.48	66.1	2.05	40.7	24.2
230	7.58	32.260	25.21	4.32	63.5	2.10	42.0	24.5

TABLE 3 (CONTINUED)

STATION # 10   10/2/77   0222 GMT   DEPTH 380 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	$^{\sigma}T$	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (μg at L^{-1})	SILICATE (μg at L^{-1})	NITRATE (μg at L^{-1})
0	5.94	24.668	19.45	6.99	94.3	1.49	32.6	18.8
10	6.84	28.769	22.57	5.92	83.7	1.75	36.5	21.3
20	7.25	30.138	23.59	5.51	79.4	1.82	37.1	22.0
30	7.49	30.858	24.12	5.33	77.6	1.84	37.1	22.2
50	7.64	31.176	24.35	5.23	76.5	1.87	36.9	22.2
75	7.87	31.489	24.56	5.41	79.8	1.81	33.9	20.7
100	8.01	31.813	24.80	5.28	78.2	1.77	33.9	20.8
150	7.78	32.091	25.05	4.33	64.0	2.01	35.3	24.5
200	7.28	32.328	25.30	3.77	55.1	2.18	46.6	26.7
300	6.77	32.661	25.63	3.37	48.9	2.42	53.2	28.5
360	6.74	32.700	25.67	3.32	48.1	2.40	55.0	28.9

TABLE #3 (CONTINUED)

STATION #11 10/2/77 1707 GMT DEPTH 336 m

DEPTH	TEMP (^{0}C)	SALINITY $^0/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (μg at L^{-1})	SILICATE (μg at L^{-1})	NITRATE (μg at L^{-1})
0	4.72	20.560	16.32	7.34	93.5	1.25	37.8	17.6
10	6.99	29.740	23.31	5.54	79.2	1.83	38.4	22.3
20	7.35	30.459	23.83	5.29	76.5	1.88	38.2	22.8
30	7.46	30.784	24.07	5.23	76.0	1.88	37.9	22.8
50	7.69	31.113	24.30	5.17	75.7	1.87	37.3	22.5
75	7.93	31.438	24.52	5.13	75.8	1.86	37.5	22.8
100	8.07	31.727	24.72	4.74	70.4	1.86	36.5	22.0
150	7.70	32.033	25.01	3.95	58.2	2.25	46.4	26.4
200	7.27	32.186	25.19	3.59	52.5	2.13	43.1	25.8
300	6.72	32.655	25.64	3.40	49.1	2.28	52.8	28.5
320	6.72	32.712	25.68	3.35	48.5	2.42	53.8	28.4

TABLE #3 (CONTINUED)

STATION # 12 10/2/77 1932 GMT DEPTH 178 m

DEPTH	TEMP (^{0}C)	SALINITY $^{0}/_{00}$	σ_T	OXYGEN (mL L^{-1})	OXYGEN % SAT'N	PHOSPHATE (µg at L^{-1})	SILICATE (µg at L^{-1})	NITRATE (µg at L^{-1})
0	4.41	17.466	13.90	7.31	90.5	1.12	29.7	15.7
10	6.90	30.236	23.71	5.35	76.5	1.90	36.2	23.0
20	7.02	30.556	23.95	5.20	74.8	2.01	37.2	23.3
30	7.29	30.802	24.11	5.00	72.4	2.02	37.3	23.7
50	7.78	31.141	24.30	4.63	68.0	2.04	37.7	23.5
75	7.76	31.441	24.54	4.29	63.1	2.01	37.1	24.2
100	7.63	31.724	24.78	3.94	57.8	2.03	41.2	25.7
150	7.44	31.991	25.02	3.74	54.7	2.09	43.5	26.6
160	7.31	32.010	24.27	3.58	52.0	2.07	44.9	27.3

TABLE 4

^{210}Pb Data

OC-77-IS-002

Station Location: Kitimat

Water Depth:

Date Feb. 11, 1977

Corer Type: Box

Core Length: 94.5 cm

S = 32.7 °/oo
T = 6.74°C
ρw = 1.02567
ρs = 2.58 ± .04

Depth (cm)	Corrected Depth (cm)	Total ^{210}Pb (dpm/g-salt free)	Excess ^{210}Pb (dpm/g-salt free)	Water Content (weight %)	Porosity	% Organic Carbon
0- 1.5	0 - 1.73	52.457 ± 0.392	51.047 ± 0.395	83.80	0.942	2.26
1.5- 4.5	1.73 - 6.34	49.821 ± 0.403	48.411 ± 0.406	79.50	0.920	
4.5- 7.5	6.34 - 12.1	45.034 ± 0.437	43.624 ± 0.440	77.58	0.910	
7.5-10.5	12.1 - 18.6	37.023 ± 0.336	35.613 ± 0.339	74.27	0.892	
10.5-13.5	18.6 - 25.6	29.575 ± 0.249	28.165 ± 0.254	71.67	0.877	
13.5-16.5	25.6 - 33.1	20.537 ± 0.179	19.127 ± 0.185	69.71	0.866	
16.5-19.5	33.1 - 40.7	13.332 ± 0.096	11.922 ± 0.107	70.54	0.871	
19.5-22.5	40.7 - 48.6	15.292 ± 0.162	13.882 ± 0.169	69.34	0.863	1.67
22.5-25.5	48.6 - 56.5	5.519 ± 0.071	4.109 ± 0.071	71.10	0.874	
25.5-28.5	56.5 - 64.6			70.31	0.869	
28.5-31.5	64.6 - 72.7	3.843 ± 0.069	2.433 ± 0.084	71.01	0.873	1.69
31.5-34.5	72.7 - 80.8	3.781 ± 0.068	2.311 ± 0.083	70.49	0.870	1.80
34.5-37.5	80.8 - 88.9	5.806 ± 0.049	4.396 ± 0.069	70.45	0.870	
40.5-43.5	97.1 - 105.3	3.773 ± 0.068	2.363 ± 0.083	69.99	0.867	
46.5-49.5	113.5 - 121.7	1.931 ± 0.052	0.521 ± 0.071	68.83	0.860	

TABLE 4 (CONTINUED)

Depth (cm)	Corrected Depth (cm)	Total ^{210}Pb (dpm/g-salt free)	Excess ^{210}Pb (dpm/g-salt free)	Water Content (weight %)	Porosity	% Organic Carbon
52.5-55.5	129.9 - 138.2	1.588 ± 0.037	0.178 ± 0.061	70.67	0.871	
64.5-67.5	162.8 - 171.0	1.820 ± 0.028	0.410 ± 0.056	68.58	0.859	
76.5-79.5	195.7 - 203.9			67.84	0.854	
88.5-91.5	228.6 - 236.8			67.66	0.853	
91.5-94.5	236.8 - 245.0	1.410 ± 0.048		67.67	0.853	1.74

TABLE 5

ANOVA NUTRIENT RESULTS (F FACTORS)

Nutrient	Homogeneity of Variance	Factor A Depth	Factor B Filtering	Interaction AXB
Silicate	419.5/1412	123/2.06	0.44/4.06	0.27/2.06
Nitrate	6.7/1412	300/2.06	4.8/4.1	0.36/2.06
Phosphate	45/1011	94/2.32	0.8/4.1	0.12/2.3

TABLE 6

NET HAULS

#	DEPTH(m)	DATE	START	FINISH	DISTANCE NAUT. MILES	COMMENTS
*MNT-1	7,13,19,25	9.2.77	53°16.7'N 129°08.0'W 0522 GMT	53°06.5'N 129°07.2'W 0556 GMT	2.5	Combined
MNT-2	7,13,19,25	10.2.77	53°44.0'N 129°01.7W 0452 GMT	53°47.0'N 128°54.5'W 0552 GMT	2.5	Combined
NNT-1	Surface	8.2.77	51°10.0'N 128°26.0'W 0600 GMT	51°08.3'N 128°23.0'W 0630 GMT	2.5	Tar Balls + Plastic
NNT-2	Surface	12.2.77	53°05.0'N 129°33.7'W 0007 GMT	53°07.3'N 129°36.0'W 0037 GMT	2.5	No Tar
NNT-3	Surface	10.2.77	53°55.2'N 128°44.7'W 2305 GMT	53°56.9'N 128°41.15'W 2338 GMT	2.5	No Tar
NNT-4	Surface	12.2.77	54°11.52'N 130°25.25'W 2014 GMT	54°11.7'N 130°23.6'W 2045 GMT	2.5	No Tar

*MNT - Miller Net Tow

NNT - Neuston Net Tow

TABLE 7

PRESERVED MATERIAL

IDENTIFICATION	SAMPLER	SAMPLE		METHOD OF PRESERVING
BW-1	Manual Collection	Mussels (Mytilus edulis)		Frozen in Aluminum Foil
BW-2	" "	Mytilus edulis Mytilus californianus		" " " "
BW-3	" "	Mussels (Mytilus edulis)		" " " "
BW-4	" "	" "		" " " "
BW-5	" "	" "		" " " "
MNT-1	Miller Net #6 mesh	Plankton		5% Formaldehyde (Biological Identification)
MNT-2	Miller Net #6 mesh	Plankton		Frozen in Al Can Subsample for Biological ID
NNT-1	Neuston Net	Neuston		5% Buffered Formaldehyde (Biological Identification)
NNT-2	"	"		" " " "
1 5L Glass	Blumer	Sea Water	5 m	$HgCl_2$ (Hydrocarbon Analysis)
2 " "	"	" "	150 m	" " " "
3 " "	"	" "	5 m	" " " "
4 " "	"	" "	5 m	" " " "
5 " "	"	" "	150 m	" " " "
6 " "	"	" "	5 m	" " " "
7 " "	"	" "	150 m	" " " "
Anchor Stn	Ponar Grab	Mud		Al Can Frozen Whirl-Pak Bag Frozen
STD-6	"	"		" " "
STD-8	"	"		" " "

TABLE 7 (CONTINUED)

PRESERVED MATERIAL

IDENTIFICATION	SAMPLER	SAMPLE	METHOD OF PRESERVING
STD-10	Ponar Grab	Mud	Al Can Frozen Whirl-Pak Bag Frozen
STD-11	"	"	" " "
STD-12	"	"	" " "
BG-1	"	Green-Brown Mud	Al Can (Frozen for PCB Analysis
BG-2	"	Blackish Mud	" " "
BG-4	"	Black Mud (H_2S)	" " "
BG-5	"	" " "	" " "
BG-6	"	" " "	" " "
BG-7	"	" " "	" " "
Box Core STD-10	Sutar Bruland Box Corer	Mud	Subsampled into Whirl-Pak Bags, Frozen
Carboy 24	Pump	Sea Water (13m) S ≃ 28 $^{o}/oo$	Stored in Polyethylene Barrel (200 L)
Carboy 20	"	Sea Water 1.5 m S ≃ 20 $^{o}/oo$	" " "
Carboy 21	"	" " "	" " "
Carboy 22	"	" " "	" " "
Carboy 23	"	" " "	" " "

TABLE 8

BIOLOGICAL IDENTIFICATION

SAMPLE NO. OC-77-IS-002-NNT-1

PHYLUM	CLASS	ORDER	SPECIES	COUNT	PERCENT OF TOTAL
Chaetognatha			*Saggita elegans*	8	0.3
Chordata	Pisces		all larvae	152	6.0
Arthropoda	Crustacea-Copepoda-Calanoida		*Metridia lucens* *Calanus pacifica* *Paracalanus parvus* *Oithona helgolandica* Others (<2mm)	1880	74.6
			Epilabidocera amphitrites	184	7.3
			Others (>2mm)	232	9.2
		Amphipoda-Gammaridea	(juvenile stages)	40	1.6
	Malacostraca	Euphausiacea	*Thysanoessa spinifera*	24	0.9
			TOTAL ORGANISMS PER SAMPLE	2520	

miscellaneous material

nemertean worm
fish scales
fir leaves
Macrocystis bulb and stipe
insect pupa

TABLE 8 (CONTINUED)

SAMPLE NO. OC-77-IS-002-MNT-2
2052 9/2/77

PHYLUM	CLASS	ORDER	SPECIES	COUNT	PERCENT OF TOTAL
Chaetognatha			*Saggita elegans*	8	0.2
Chordata	Pisces		all larvae	8	0.2
Arthropoda	Crustacea	Ostracods	*Conchoecia elegans*	120	3.7
	Malacostraca	Euphausacea	*Euphausia pacifica*	72	2.2
			Thysanoessa raschii	8	0.2
	Crustacea	Amphipoda-Hyperiidae	*Parathemisto sp.*	16	0.5
		Gammaridae	*Cyphocaris sp.*	24	0.7
	Crustacea-Copepoda-Calanoida		*Metridia lucens*	1416	43.3
			Metridia okhotensis	592	18.1
			Candacia bipinnata	16	0.5
			Others (<2mm)	992	30.3
			TOTAL ORGANISMS PER SAMPLE	3272	

SAMPLE NO. OC-77-IS-002-NNT-2
1607 11/2/77

PHYLUM	CLASS	ORDER	SPECIES	COUNT	PERCENT OF TOTAL
Chordata	Pisces		all larvae	152	3.1
Arthropoda	Crustacea	Amphipoda-Gammaridae	*Parathemisto sp.*	1232	24.9
	Crustacea-Copepoda-Calanoida		all <2mm	3512	71.0
			Epilabidocera amphitrites	48	
			TOTAL ORGANISMS PER SAMPLE	4944	

miscellaneous material

polychaete worm tubes
grass
algae blade
cedar leaves
feathers
fir leaves

TABLE 8 (CONTINUED)

SAMPLE NO. OC-77-IS-002-MNT-1
2122 8/2/77

PHYLUM	CLASS	ORDER	SPECIES	COUNT	PERCENT OF TOTAL
Chaetognatha			*Saggita elegans*	4	0.1
Arthropoda-Crustacea-Ostracoda-Myodocopoda			*Conchoecia elegans*	80	1.5
	Malacostraca	Euphausiacea	*Euphausia pacifica*	52	1.0
			Thysanoessa raschii	4	0.1
			Thysanoessa spinifera	4	0.1
	Crustacea	Amphipoda-Hyperiidae	*Parathemisto sp.*	8	0.2
		Mysidacea		12	0.2
	Crustacea-Copepoda-Calanoida		*Metridia lucens*	3152	57.5
			Metridia okhotensis	160	2.9
			Candacia bipinnata	48	0.8
			Calanus pacificus	80	1.5
			Others (<2mm)	1872	34.1
			TOTAL ORGANISMS PER SAMPLE	5312	

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FIGURES

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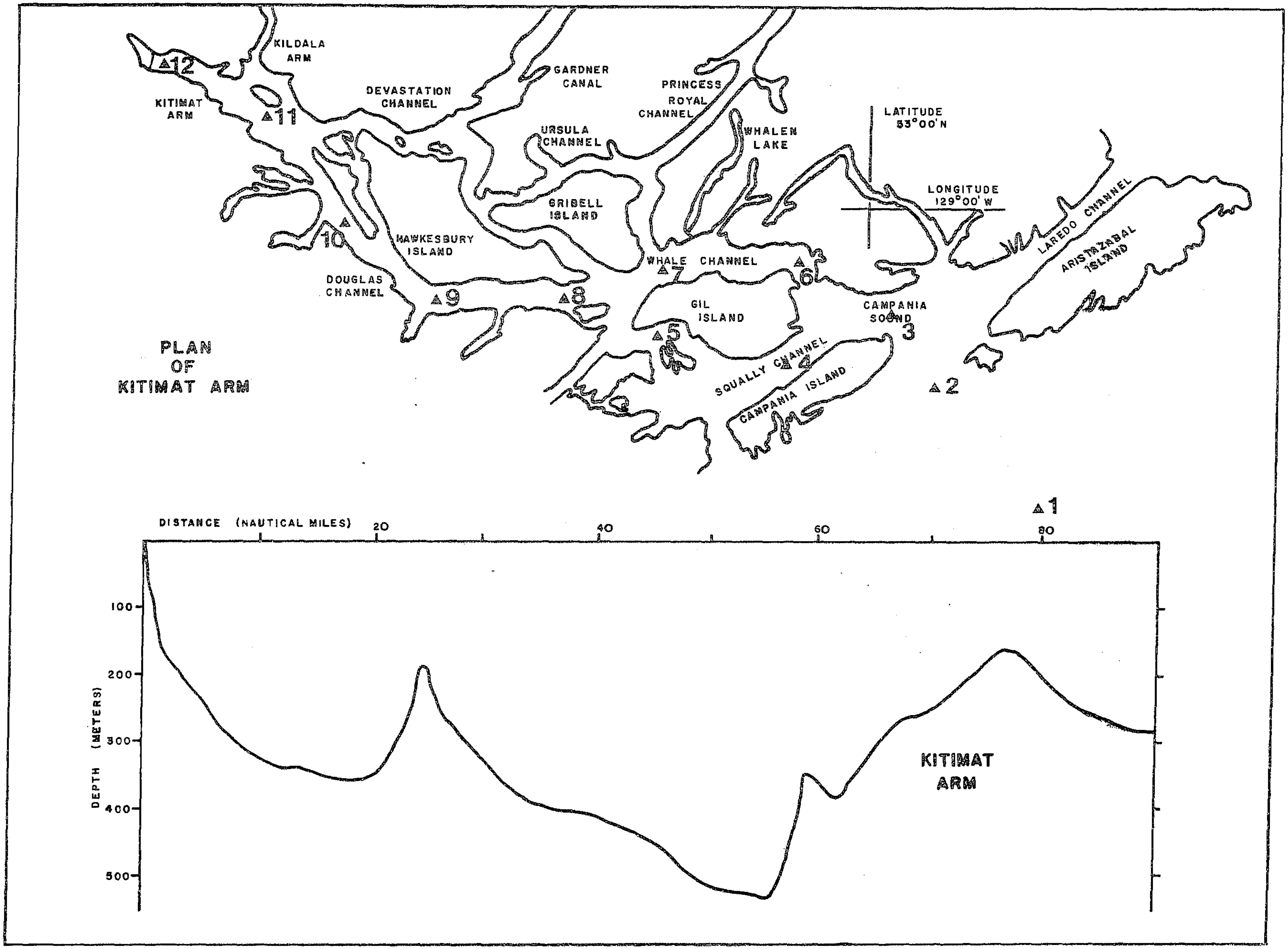

KILDALA ARM
12
KITIMAT ARM
11
DEVASTATION CHANNEL
GARDNER CANAL
PRINCESS ROYAL CHANNEL
URSULA CHANNEL
WHALEN LAKE
LATITUDE 53°00'N
LONGITUDE 129°00'W
GRIBELL ISLAND
HAWKESBURY ISLAND
10
LAREDO CHANNEL
ARISTAZABAL ISLAND
WHALE CHANNEL
7
6
DOUGLAS CHANNEL
9
8
GIL ISLAND
CAMPANIA SOUND
3
5
SQUALLY CHANNEL
4
CAMPANIA ISLAND
2
PLAN OF KITIMAT ARM
1
DISTANCE (NAUTICAL MILES)
20
40
60
80
100
200
300
400
500
DEPTH (METERS)
KITIMAT ARM

Figure 1

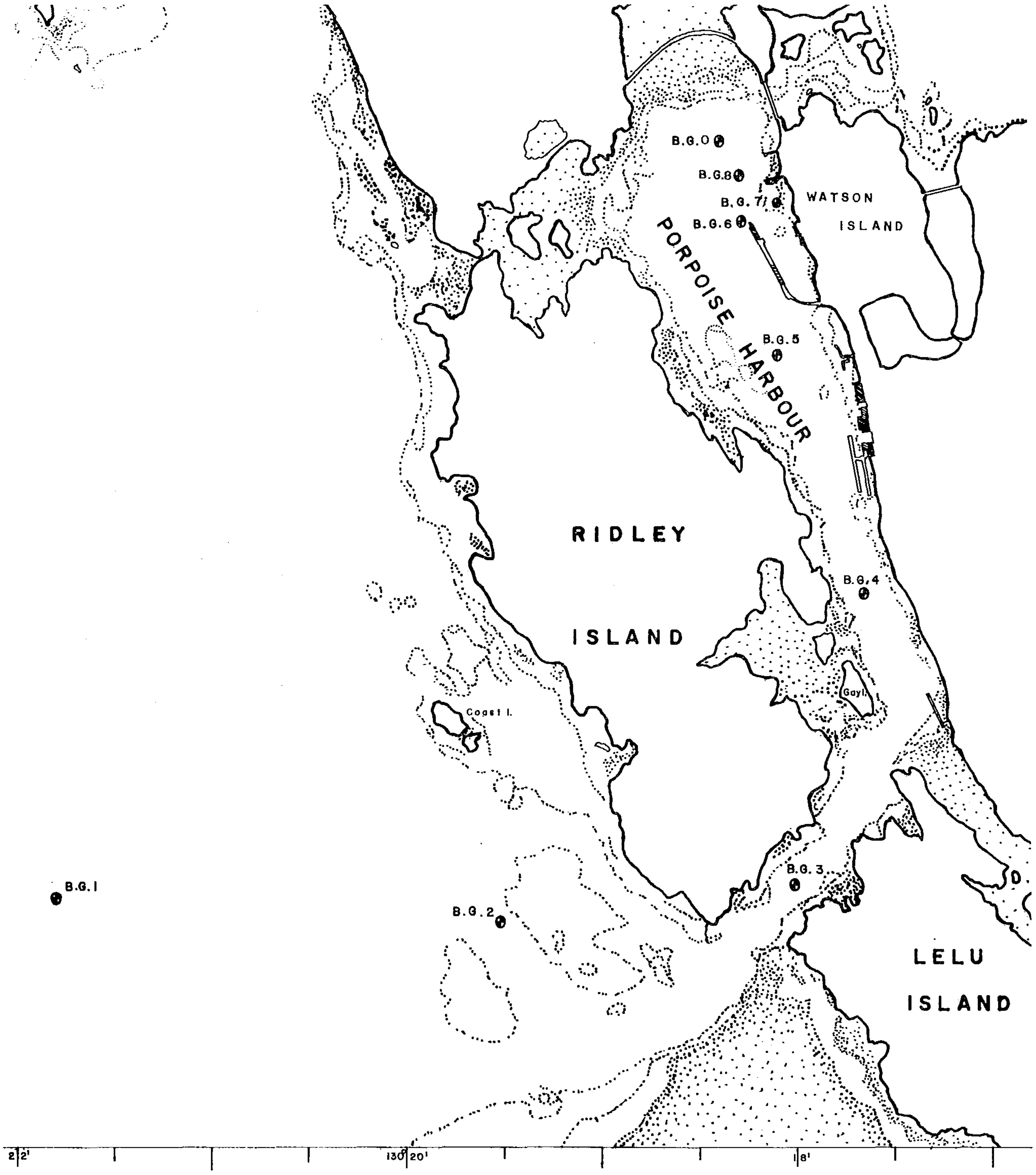
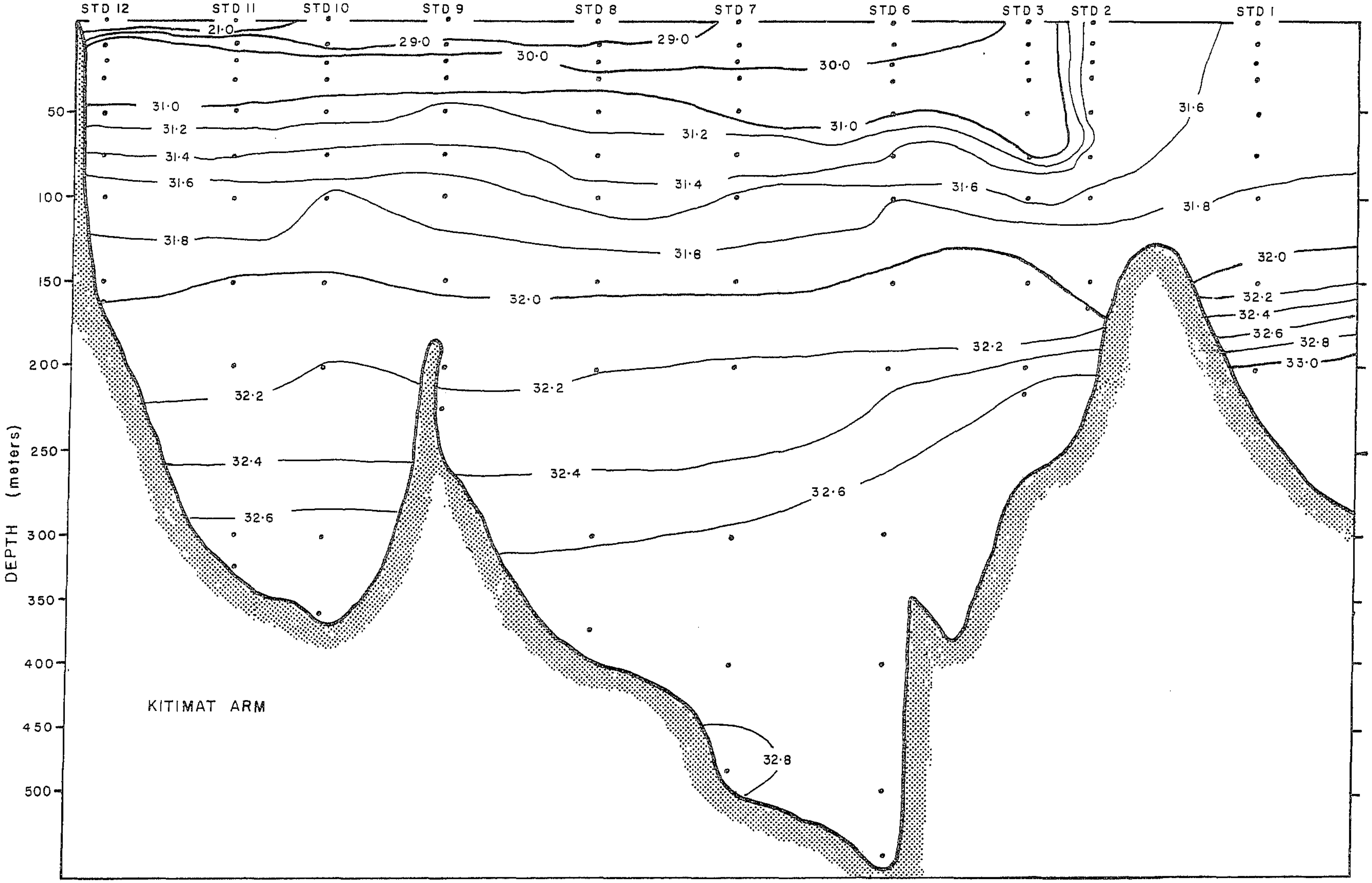
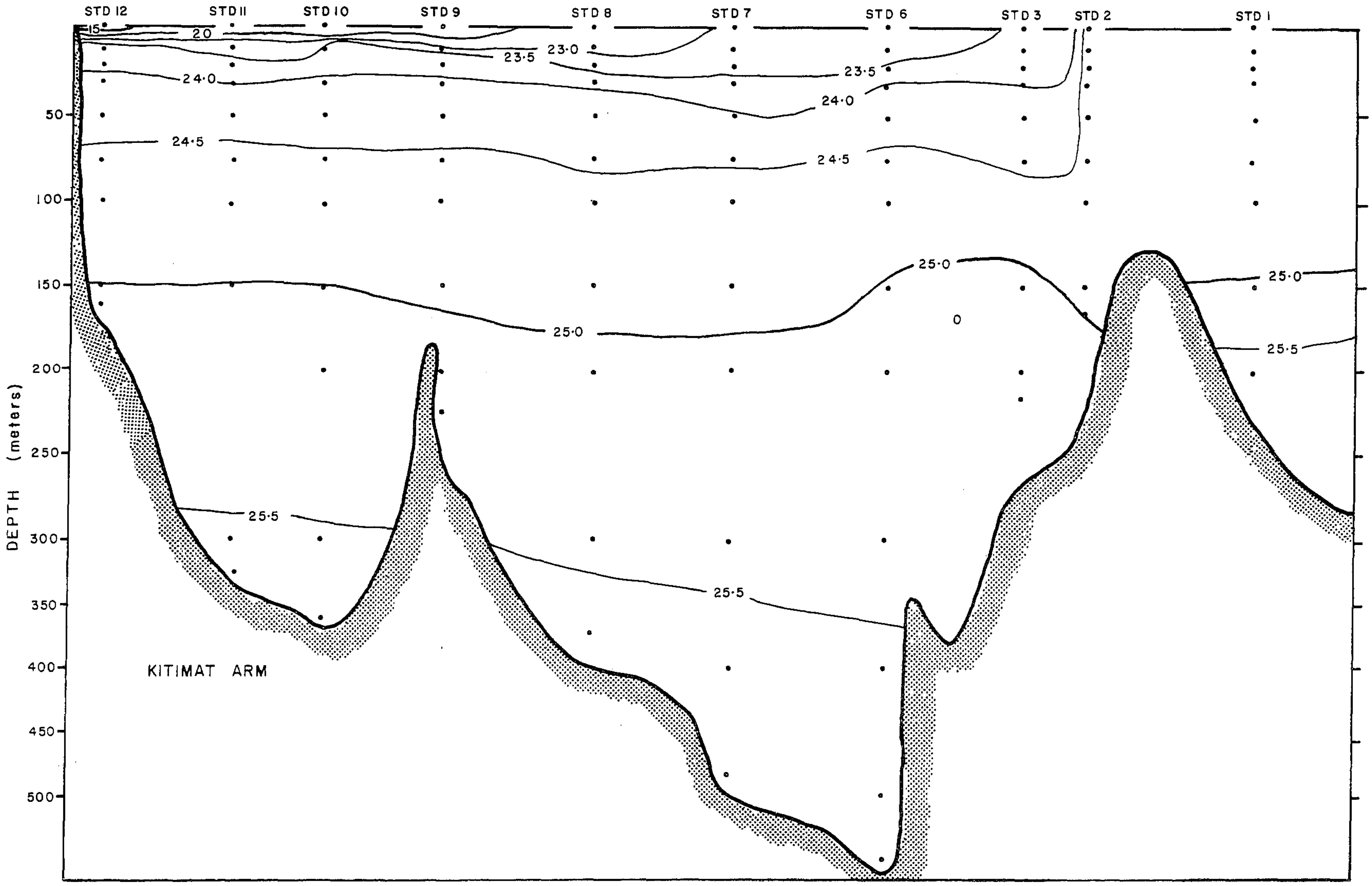

B.G.0
B.G.8
B.G.7
B.G.6
WATSON
ISLAND
PORPOISE
HARBOUR
B.G.5
RIDLEY
ISLAND
B.G.4
Gay I.
Coast I.
B.G.1
B.G.2
B.G.3
LELU
ISLAND
22'
130°20'
18'

Figure 2



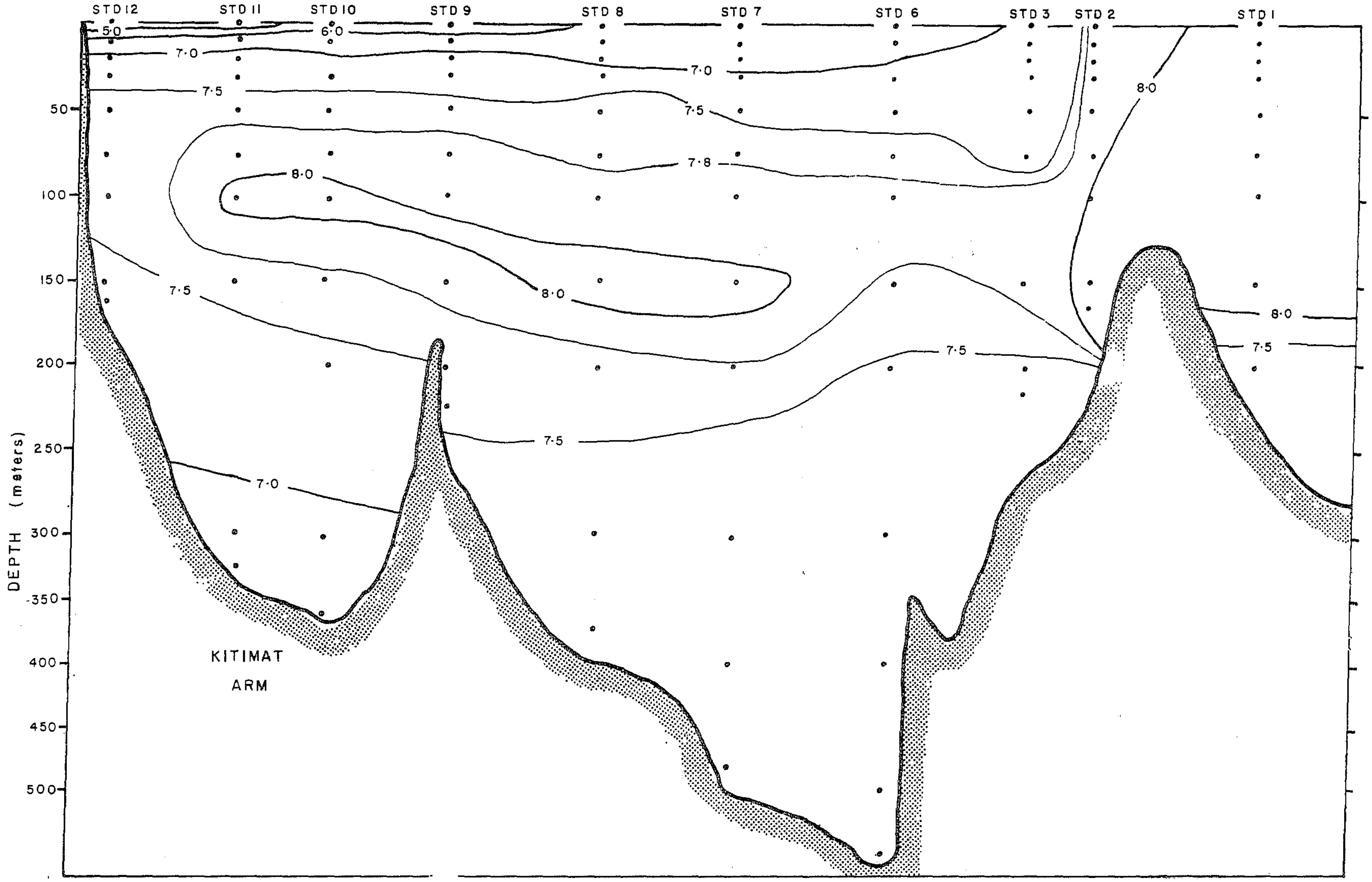
KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR SALINITY (‰)

Figure 3



KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR DENSITY (Sigma T)

Figure 4



KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR TEMPERATURE (C)

Figure 5

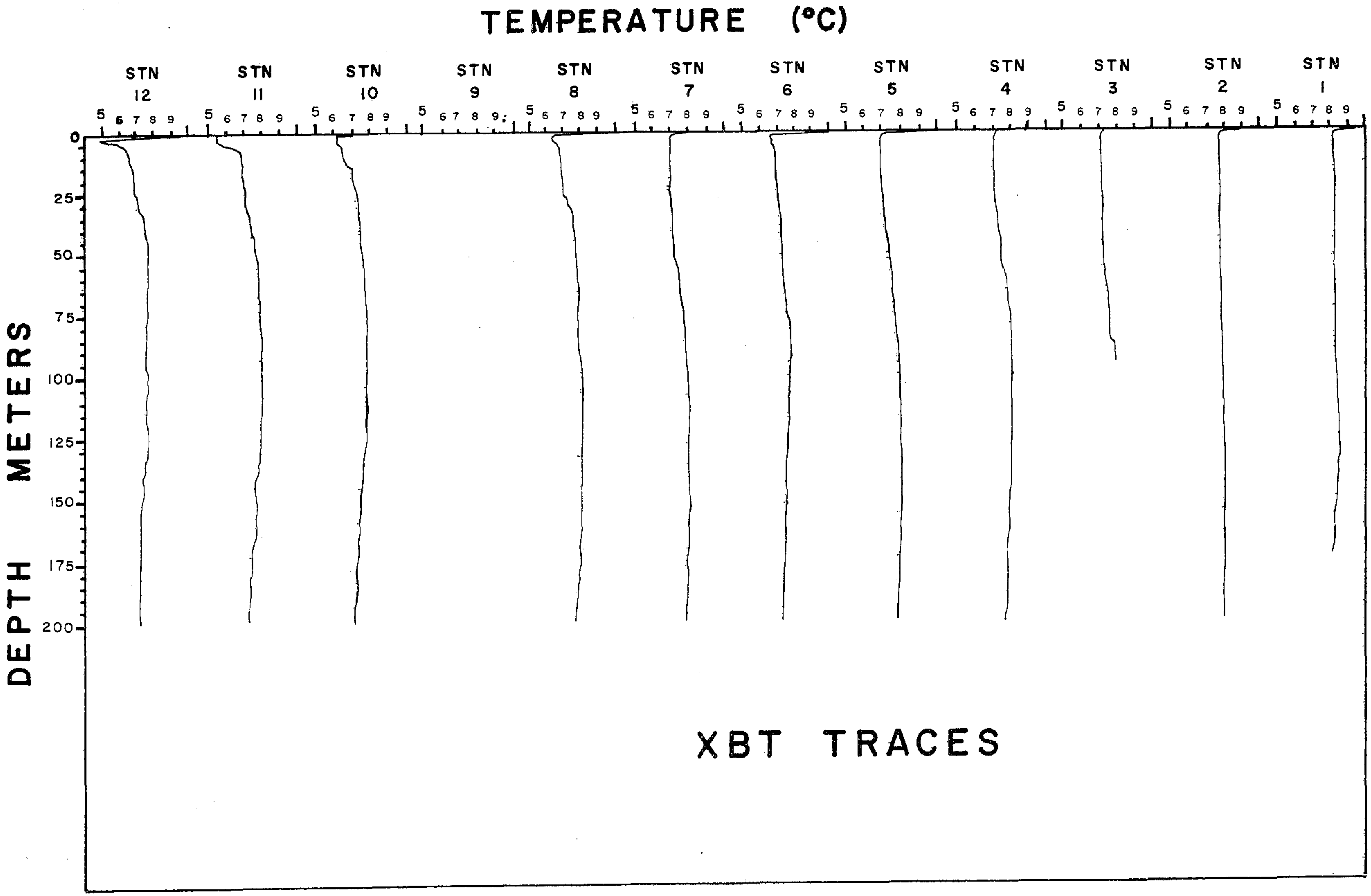
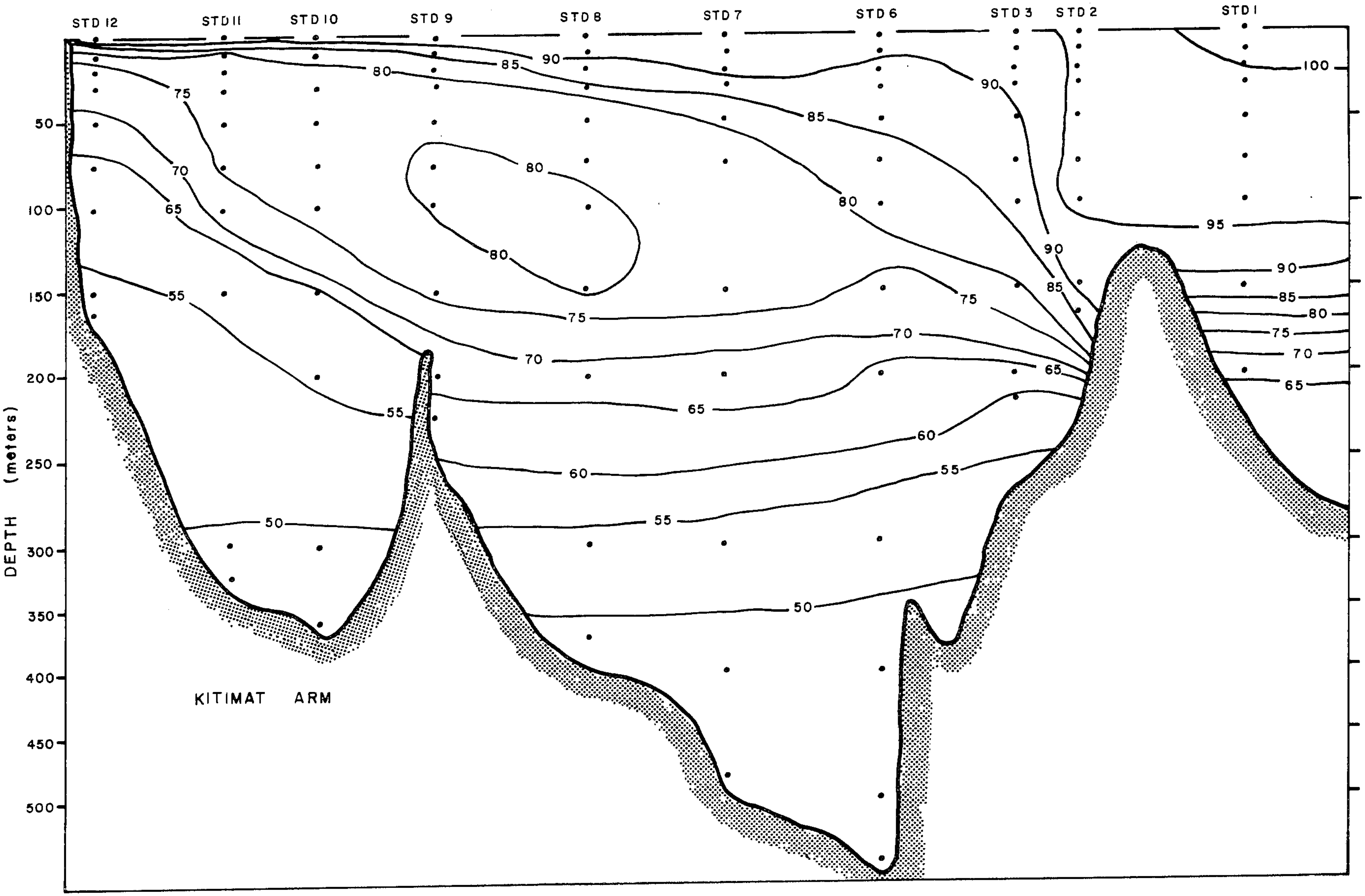

TEMPERATURE (°C)
STN 12
STN 11
STN 10
STN 9
STN 8
STN 7
STN 6
STN 5
STN 4
STN 3
STN 2
STN 1
5 6 7 8 9
0
25
50
75
100
125
150
175
200
DEPTH METERS
XBT TRACES

Figure 6

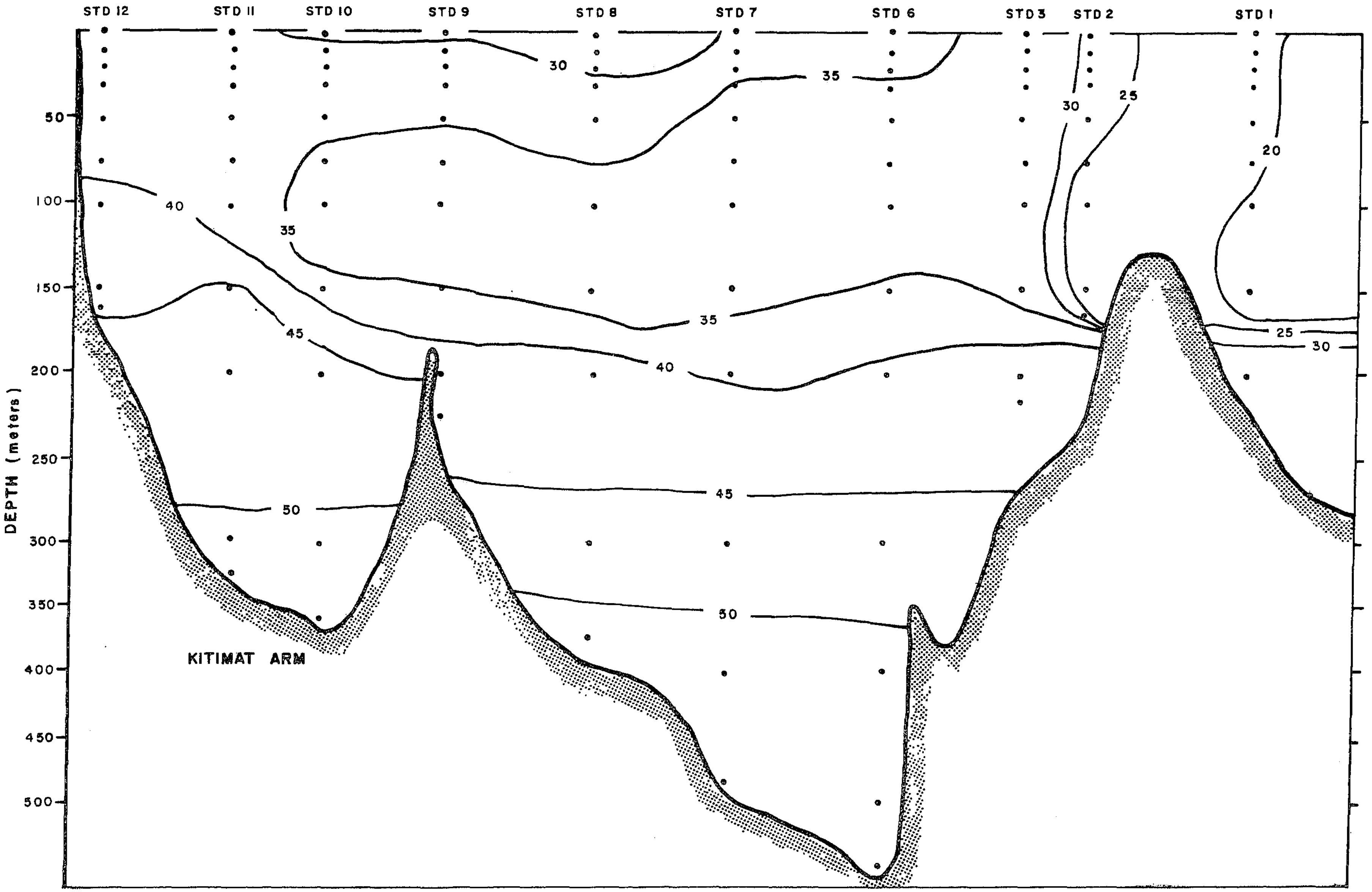
KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR OXYGEN (ml/l)

Figure 7



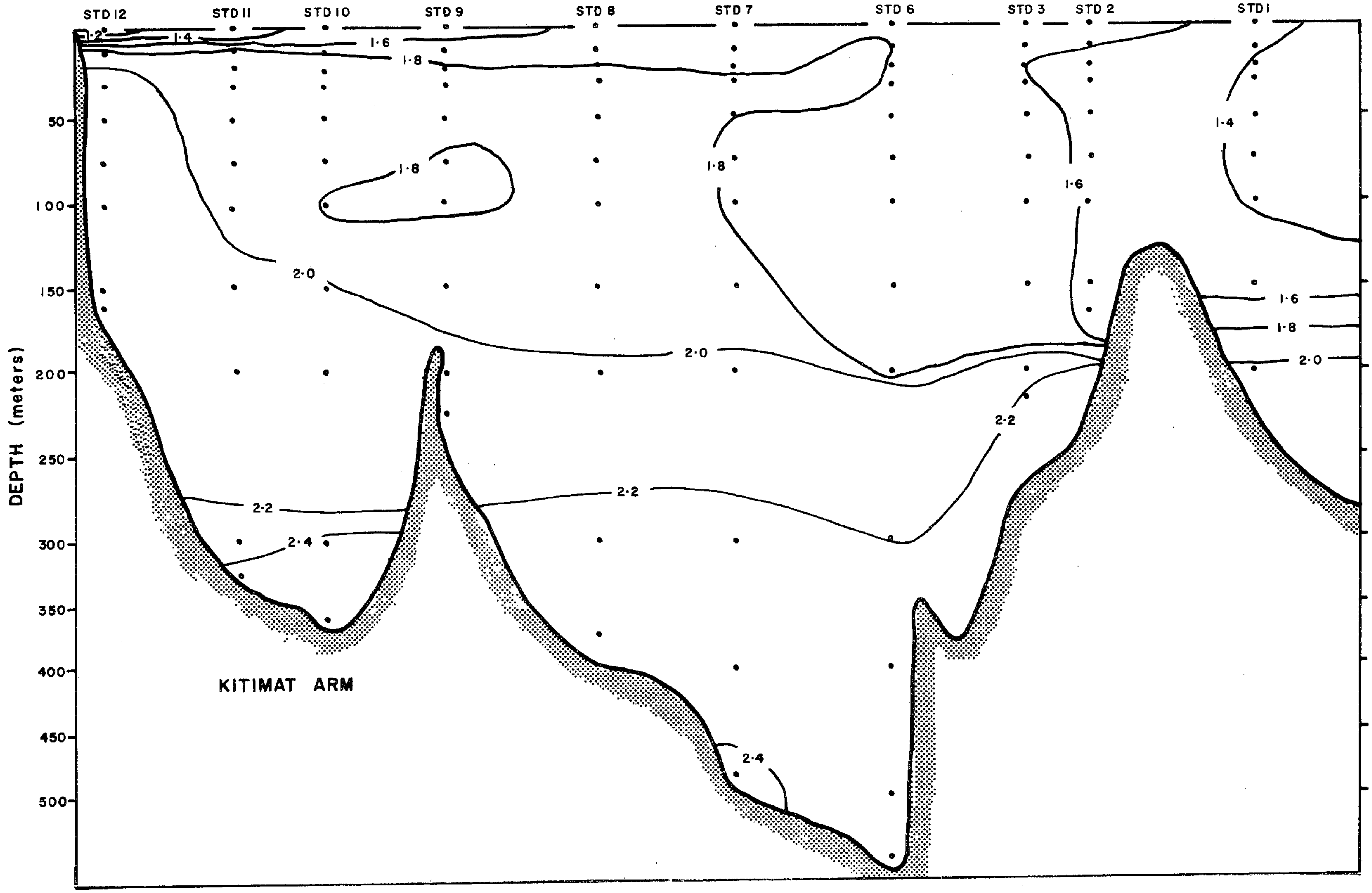
KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR OXYGEN (% Sat.)

Figure 8



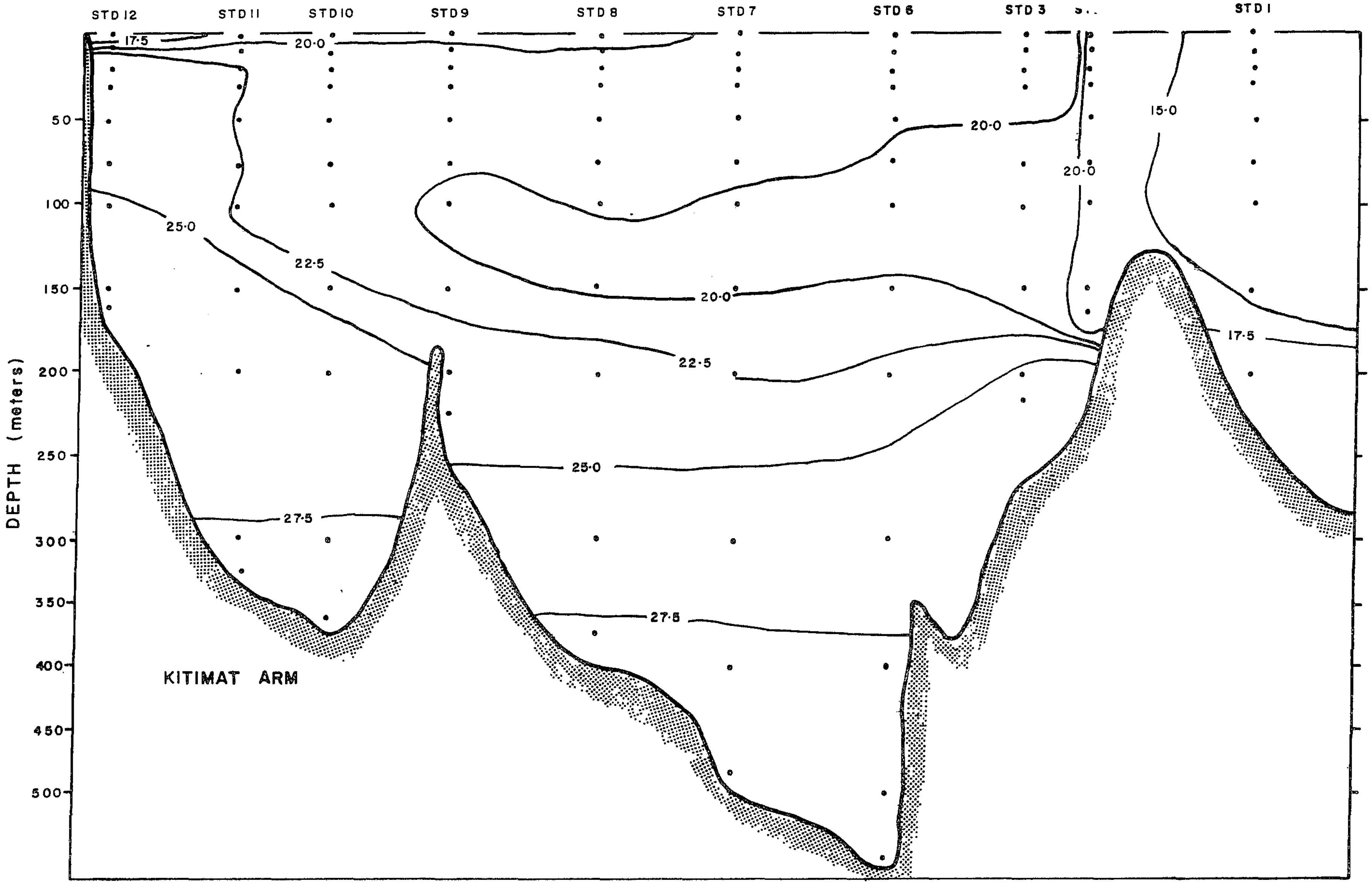
KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR SILICATE (µg At/l)

Figure 9



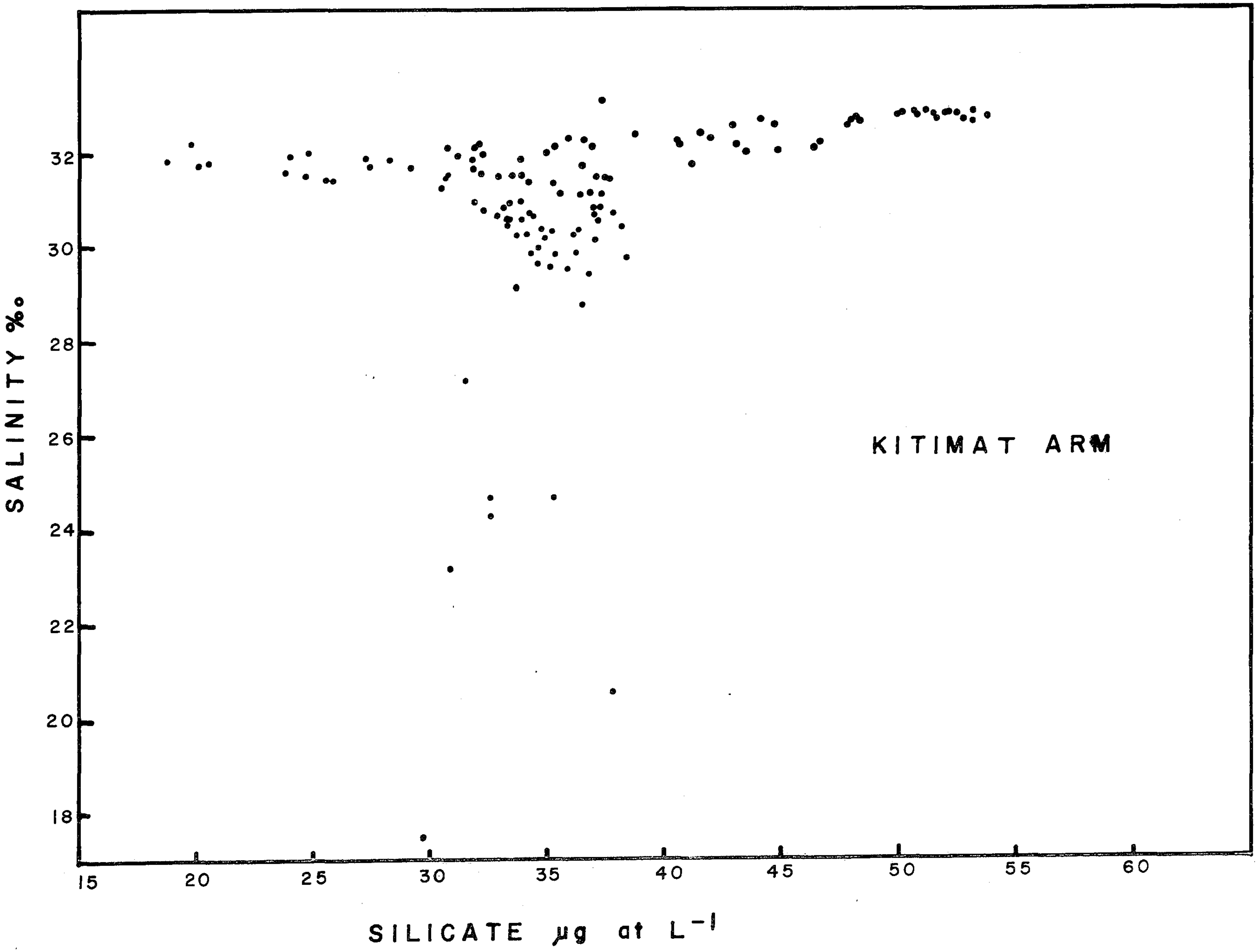
KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR PHOSPHATE (μg.At./l)

Figure 10



KITIMAT ARM FEBRUARY 1977
VERTICAL PROFILE FOR NITRATE (µg At/l)

Figure 11



SALINITY ‰
32
30
28
26
24
22
20
18
15
20
25
30
35
40
45
50
55
60
SILICATE µg at L⁻¹
KITIMAT ARM

Figure 12

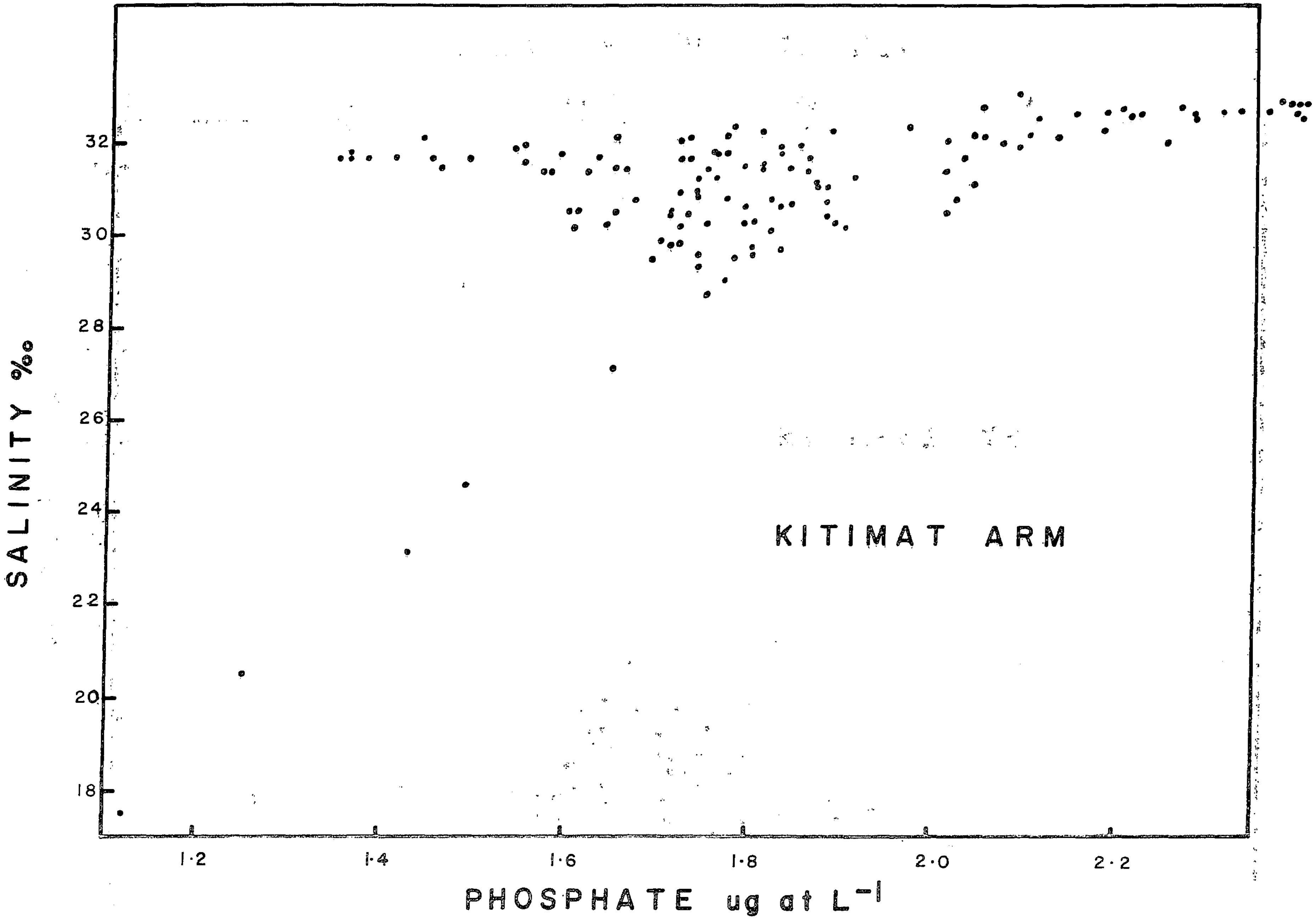

SALINITY ‰
32
30
28
26
24
22
20
18
1·2
1·4
1·6
1·8
2·0
2·2
PHOSPHATE ug at L⁻¹
KITIMAT ARM

Figure 13

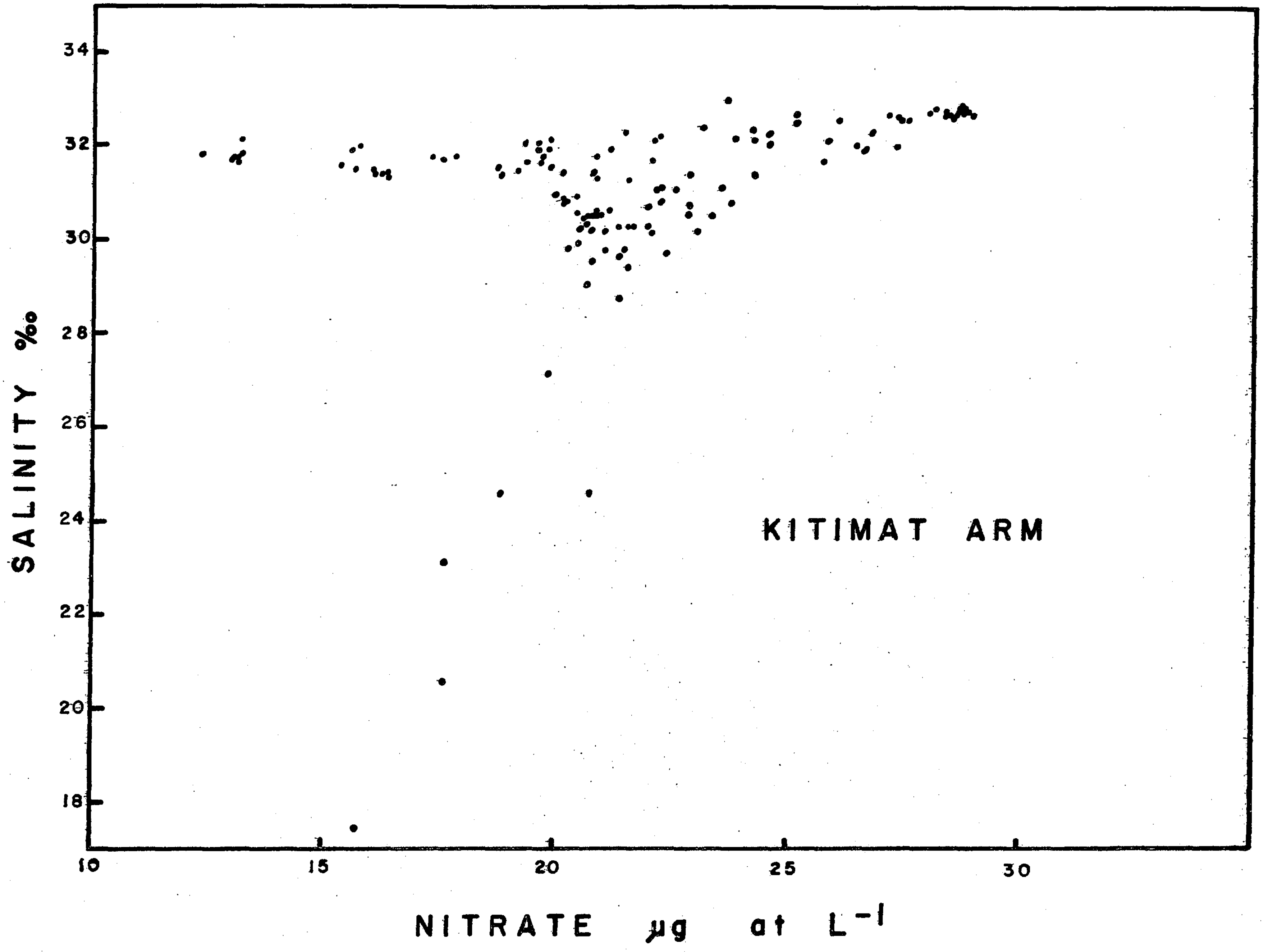

KITIMAT ARM
SALINITY ‰
34
32
30
28
26
24
22
20
18
NITRATE µg at L⁻¹
10
15
20
25
30

Figure 14

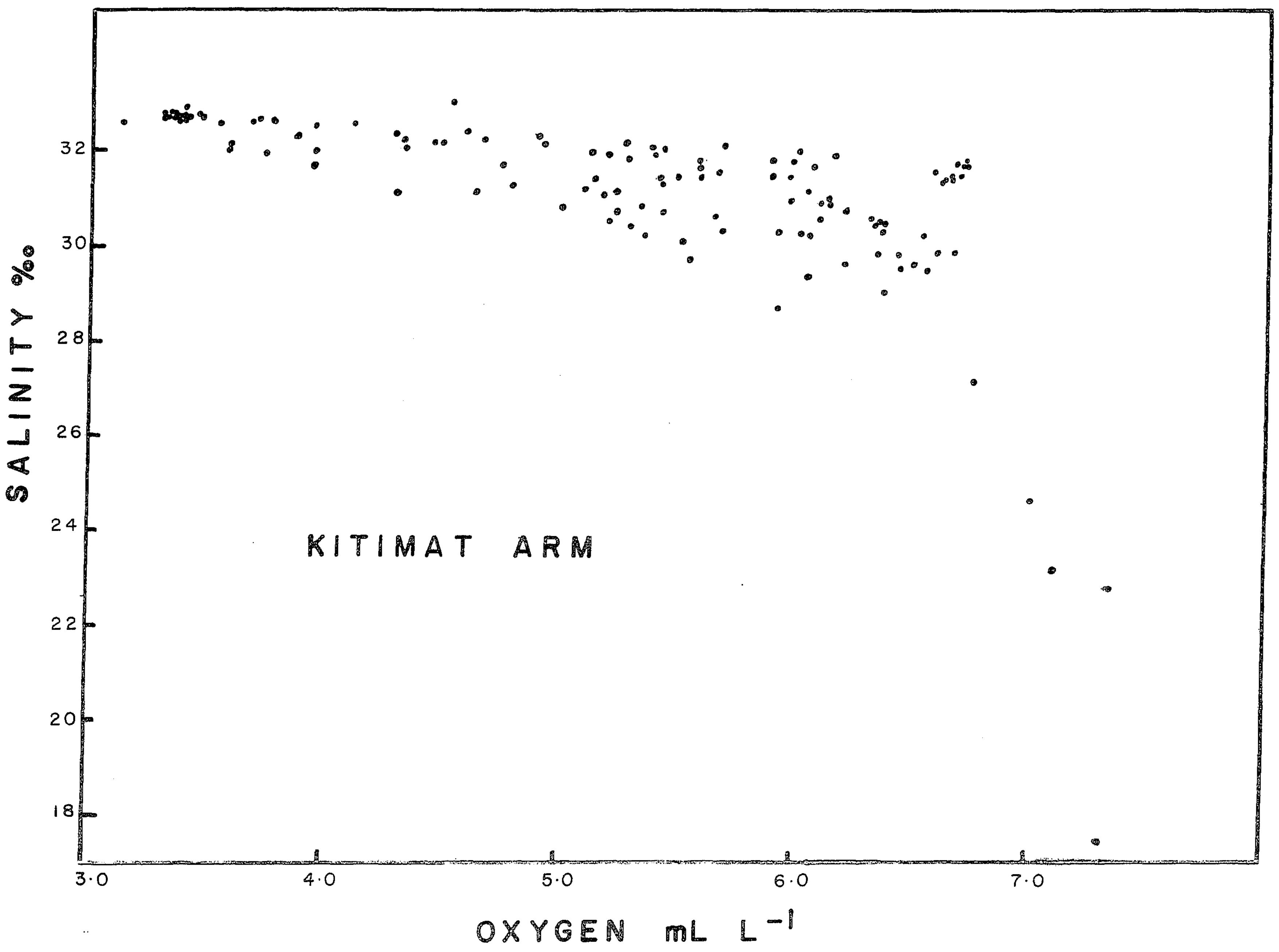

SALINITY ‰
32
30
28
26
24
22
20
18
KITIMAT ARM
3·0
4·0
5·0
6·0
7·0
OXYGEN mL L⁻¹

Figure 15

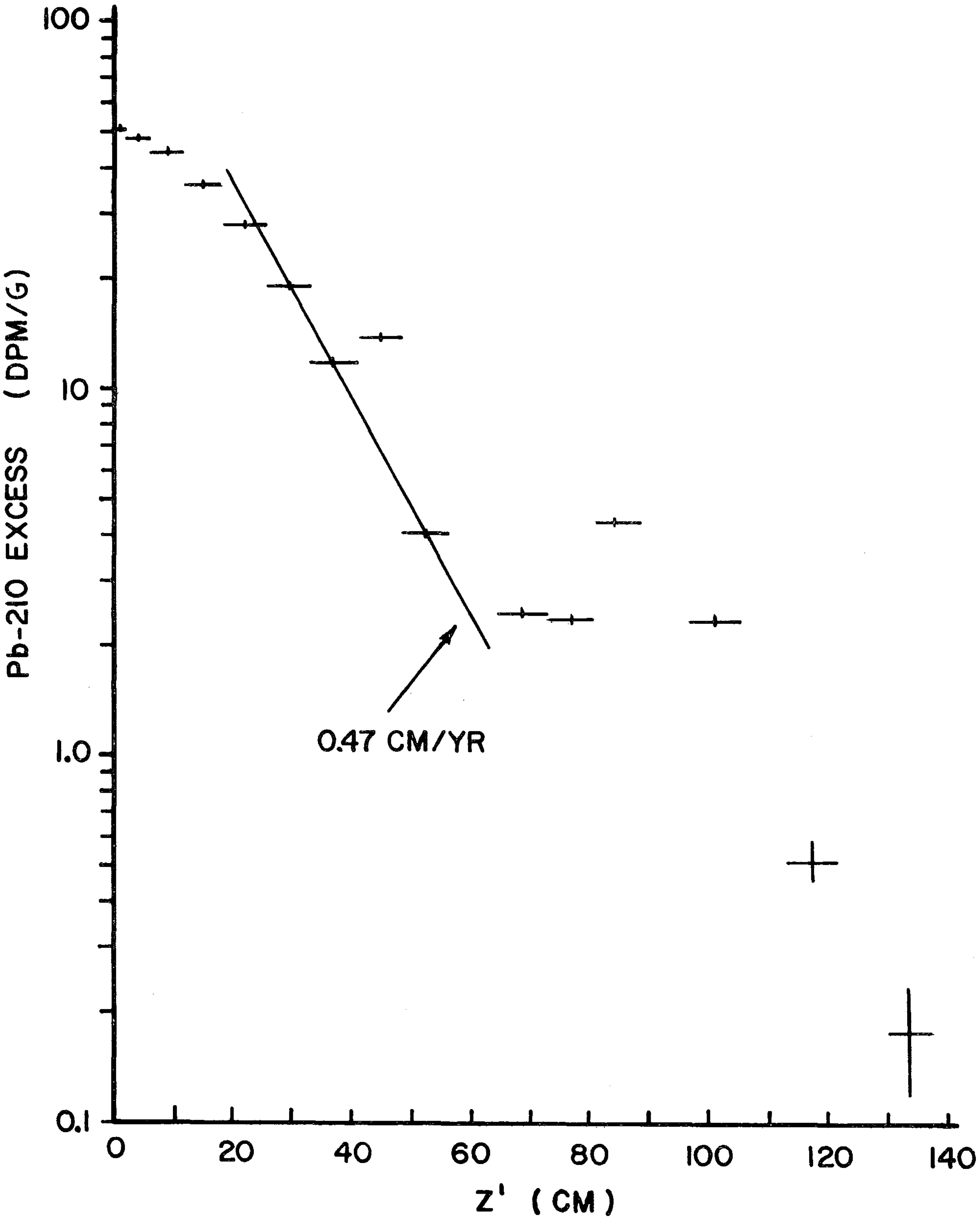

100
10
1.0
0.1
Pb-210 EXCESS (DPM/G)
0
20
40
60
80
100
120
140
Z' (CM)
0.47 CM/YR

Figure 16

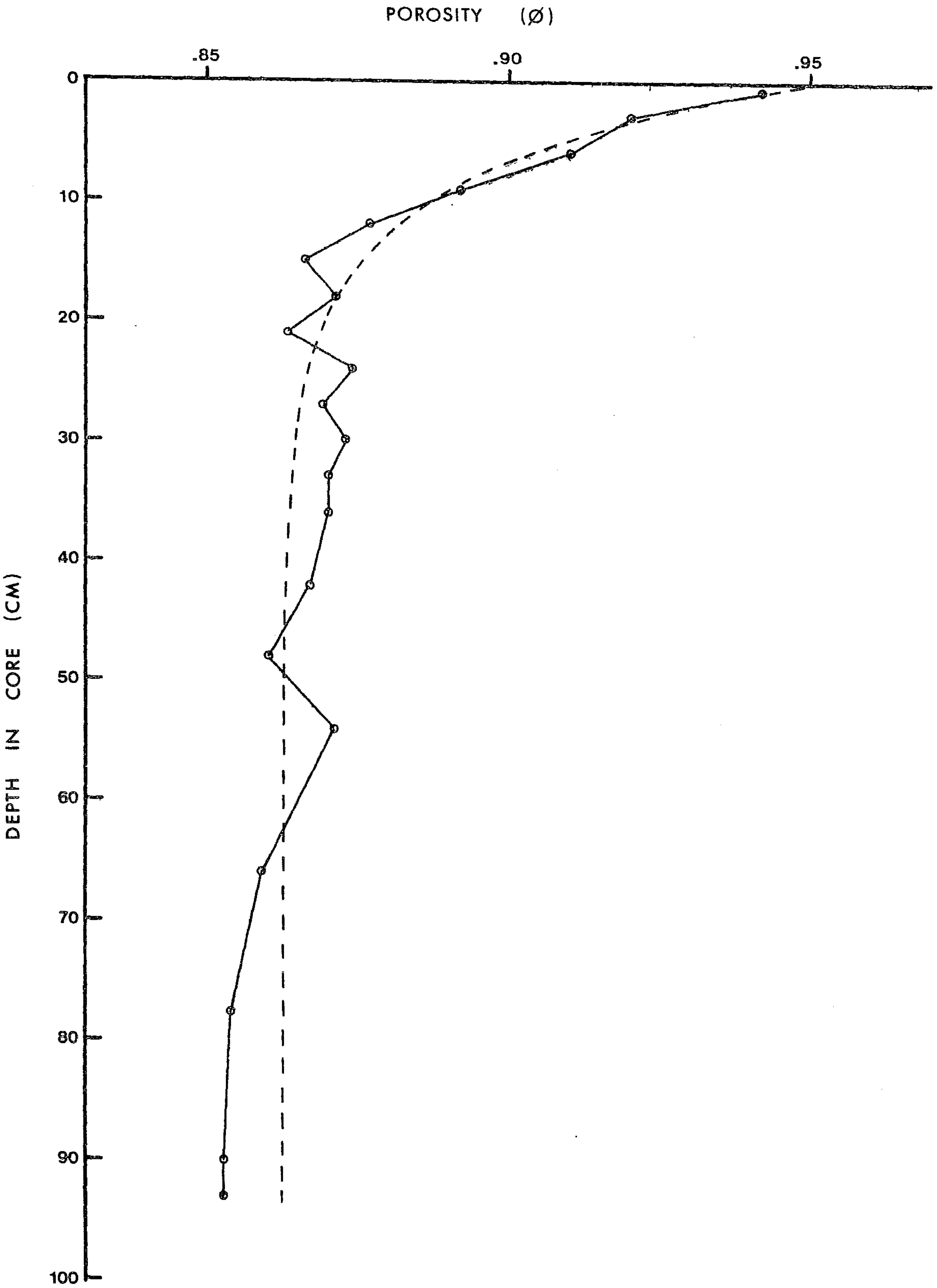

POROSITY (Ø)
.85
.90
.95
0
10
20
30
40
50
60
70
80
90
100
DEPTH IN CORE (CM)

Figure 17