Physical Oceanographic Measurements in St. Georges Bay, Nova Scotia 1976 and 1977

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PHYSICAL OCEANOGRAPHIC MEASUREMENTS IN ST. GEORGES BAY, NOVA SCOTIA, 1976 AND 1977

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ABSTRACT

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Physical oceanographic measurements taken during 1976 and 1977 in St. Georges Bay are presented and briefly discussed. Investigations in the nearshore zone (out to 9 km) revealed upwelling and downwelling events which were not always correlated with the local wind. Propagating internal Kelvin waves are suggested as a possible mechanism. Weekly current measurements did not indicate a consistent strong alongshore flow although such flows were observed on occasion. A short series of current measurements taken 6 km west of the Bay in Northumberland Strait showed strong eastward flow over the tidal cycle. Current intensity tended to be maximum at the surface and increased shorewards. Two current meter moorings in the Bay showed complex two-layered flow. The largest current events corresponded with the passage of low pressure systems but not the locally measured winds. Spring warming of the Bay was greater in 1976 but reached a lower peak temperature than in 1977. A lens of warm water in the middle of the Bay surrounded by cooler water was observed in 1977.

RESUME

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Des mesures d'océanographie physique réalisées dans la baie Saint-Georges en 1976 et 1977 font l'objet d'une brève analyse. L'étude de la zone proche de la côte (moins de 9 km) a révélé des phénomènes de remontée et de plongée des eaux qui n'étaient pas toujours liés au vent local. L'explication proposée est la propagation d'ondes de Kelvin internes. Les mesures pratiquées de façon hebdomadaire n'ont pas indiqué la présence suivie d'un fort écoulement en bordure de la côte, bien qu'un tel courant ait été observé à l'occasion. Une brève série de mesures du courant effectuées à 6 km à l'ouest de la baie dans le détroit de Northumberland a montré la présence d'un fort courant orienté vers l'est, en plus du cycle des marées. L'intensité du courant est maximale à la surface et augmente lorsqu'on se rapproche de la côte. Deux mouillages de courantomètres dans la baie ont révélé un écoulement complexe à deux couches. Les phénomènes les plus remarquables en ce qui concerne les courants correspondaient au passage de systèmes dépressionnaires mais pas aux vents mesurés sur place. En 1976, le réchauffement printanier a été plus marqué mais a atteint un maximum moins élevé que celui de 1977. Une lentille chaude entourée d'eau plus froide a été observée au milieu de la baie en 1977.

INTRODUCTION

Since 1973 the Marine Ecology Laboratory has been working in St. Georges Bay on various factors affecting biological production. Biological investigations have included abundance, growth and mortality of fish eggs and larvae, seasonal patterns of primary and secondary production, vertical migration and particle spectra. Coupled with these studies the physical oceanography has been investigated to provide a description of both the circulation pattern and the temperature and salinity structure within the Bay and, more importantly, to determine the role of the physical environment on the biological production. Data collected during 1974 and 1975 have been reported by Petrie and Drinkwater (1977a,b, 1978a) and a numerical model developed to explain the mean circulation pattern (Petrie and Drinkwater 1978b). The primary objectives of the 1976-77 program were:

(1) to describe temperature and salinity patterns within the Bay, both temporally and spatially;

(2) to examine nearshore currents within the Bay;

(3) to investigate currents in Northumberland Strait; and

(4) to measure and, if possible, to relate currents to sedimentation rates as measured by sediment traps at various depths throughout the water column.

To attain these goals the following data were gathered.

(1) Hydrographic data - Temperature data were collected weekly from May to August along 2 transects in 1976 with a bathythermograph. In 1977 temperature and salinity data were recorded on one transect between April and November. Bottles with reversing thermometers, an RS5 and/or a profiling Aanderaa current meter with temperature and conductivity sensors were used. Also during 1977 transects running both the length and breadth of the Bay and off Livingstone Cove in Northumberland Strait were occupied.

(2) Current meter data - Current profiles were measured weekly along the two offshore transects in 1976 using a Bendix or Endeco current meter. In 1977 the Bendix was used on two occasions prior to obtaining a modified Aanderaa current meter. Five conventional Aanderaa meters were moored in conjunction with sediment traps during a 28 day period in August 1977.

(3) Other data - Surface drift bottles were released at several locations on a weekly basis during 1977. Fifty bottles were released during the single occupation of a transect off Livingstone Cove in Northumberland Strait. Wind data and air temperature were recorded on a beach off Ogden Pond during 1976 while winds, air temperature and air pressure were measured in the same location during 1977.

SENSOR ACCURACY

The current meter accuracies are taken from the instrument specifications unless otherwise noted. For the remaining instruments accuracies have been based upon comparisons and in field repeatability.

(i) Current Meters

B	Aanderaa	Endeco	Bendix
Speed	±1 cm s^{-1}*	±8 cm s^{-1}	±3 cm s^{-1}
Direction	±10°	±10°	±15°
Temperature	±0.2°C	±0.5°C	
Salinity	±0.1°/oo		

* Lane (1970)

(ii) Industrial Instruments Model RS5-3

Temperature ±0.5°C

Salinity ±1.0°/oo

(iii) Bottles (Auto-lab salinometer) and reversing thermometers

Temperature ±0.05°C

Salinity ±0.01°/oo

(iv) Bathythermograph

Temperature ±0.5°C

HYDROGRAPHIC DATA

Between May and August 1976 bathythermograph data were collected approximately weekly along two transects running perpendicular to the western shore (indicated by solid lines in Fig. 1). Six stations, 1.25 km apart, were located off Ogden Pond and seven stations with similar spacing were located 3 km south of Ballantynes Cove. In 1977 the latter transect was occupied approximately weekly from April to

November. Temperature and salinity data were recorded at 4 stations using Nansen bottles while bathythermograph measurements were taken at all 7 stations. These data are available from the Marine Environmental Data Service (MEDS) in Ottawa.

Due to the large number of transects and the availability of the data from MEDS, only representative section plots of temperature for 1976 (Fig. 2a-d) and of temperature, salinity and density (σ_t) for 1977 (Fig. 3a-h) are presented. Stratification which had set in by April had broken down by October. The vertical gradients of temperature and salinity were similar to those previously measured (Petrie and Drinkwater 1977a, b). In general, under stratified conditions, horizontal gradients are weak (Figs. 2b, 3c) although upwelling (Fig. 2a and 3a) and less frequently, downwelling (Fig. 2c) do occur. These thermocline displacements may be an Ekman response where surface waters are transported at right angles to the wind. Such displacements may be generated locally, e.g. on July 16, 1976 (Fig. 2c), when northeast winds blow for approximately 12 hours prior to the measurements. They may also be effected by similar events occurring upstream in Northumberland Strait which then propagate as internal Kelvin waves along the coast and into the Bay. This might account for differences between expected thermocline displacements based on local wind conditions and the observations. An example was April 28, 1977 (Fig. 3a), when upwelling occurred although local winds were light.

Time series of temperature and salinity at the surface and near the bottom for stations 7 and 14 along the Ballantynes Cove transect are shown in Figures 4a and b respectively. Stations 7 and 14 are 9 and 1 km offshore respectively. Surface temperatures increased from 5°C in May to ∿20°C in mid August. Bottom temperatures at station 7 (30 m) increased from <0°C to 5 to 10°C during this same period. Bottom temperatures at station 14 (10 m) followed the surface trends but were typically 1 to 2°C cooler. A surface salinity maximum of ∿29.25°/oo occurred at both stations during the end of May to early June and decreased to a minimum of ∿28.25°/oo in August (station 14) or September (station 7). Salinities at station 7 (30 m) were >30°/oo, with the exception of one sample on May 30, until the fall when the water column became well mixed. At this time the bottom salinity was ∿28.75°/oo. The decrease in salinity through the late summer is likely due to the influence of St. Lawrence River discharge. The occasional sharp decrease in the vertical gradients of temperature and salinity in May and June may be due to increased local mixing or to horizontal or vertical advection of a more homogeneous water mass. The reestablishment of stratification suggests that if local mixing did occur it was over a small horizontal area and the resulting water mass was advected out of the region. Figure 4 also reveals year to year differences. Temperatures in 1976 were higher in spring and early summer but reached a lower maximum than in 1977.

Figure 5 shows time series of temperature from Aanderaa current meters moored at station 7 from July 19 to August 16, 1977. During this time the current meter at 21 m (Fig. 5a) lay within the thermocline which accounts for the larger amplitude of the high frequency fluctuations relative to the other meters. Over the period of the mooring, temperatures at 21 m ranged from about 10°C to 18°C and showed a gradual warming trend; at 26 m temperatures varied from about 6°C to 18°C with no clear trend; while at 30 m temperatures ranged from 4°C to 13°C and showed a gradual cooling trend. Sudden temperature changes beginning on July 27 (208) and August 10 (222) were observed at all depths but their magnitudes decreased with depth. The first event followed 2 to 3 days of increased velocities while the latter event occurred simultaneously with an increase in currents (see section 4). Salinity measurements (Fig. 5d) are available only at 30 m due to an instrument malfunction at 21 m. There was no conductivity cell on the meter moored at 26 m. Salinity increased slightly over the duration of the mooring with the largest salinity changes occurring during the two temperature events discussed above.

At 18 m at station 12, 4 km offshore and along the Ballantynes Cove transect, temperature fluctuations of ∿6°C over half a day are frequently observed (Fig. 5e). The temperature event of August 10 (222) at station 7 is also observed at station 12; however, the event of July 27 is not. Due to marine fouling the salinity signal deteriorated soon after mooring and is not plotted.

Temperature-depth profiles (Figs. 6 and 7) show the development of the mixed layer at station 7. In April and May a gradual but steady decrease in temperature with depth is observed. By June a mixed layer develops whose depth generally increases through the summer until October when isothermal conditions are well established. Comparison of 1976 and 1977 records reveal similar time evolution of the mixed layer despite differences in their temperatures. Salinity-depth profiles (Fig. 8) also show the depth of the upper layer to increase through the summer reaching isohaline conditions by October. Vertical gradients of salinity are not as pronounced at those of temperature.

During June and July of 1977 several transects were occupied to obtain further information on the spatial distribution of temperature and salinity. A latitudinal section along 45°50' (Figs. 1, 9) on July 7 using an RS5 showed a lens of warm water in the upper 10 m in the middle of the Bay, bordered on both sides by water 1°C cooler and warm water close to shore. A similar upper layer temperature structure existed along a longitudinal section (Figs. 1, 10) on July 28 using the profiling Aanderaa current meter but was not observed on the southern half of the longitudinal section on July 13 (Fig. 11) from RS5 measurements. Four transects in the vicinity of Cape George were occupied on June 23 using an RS5 (Fig. 12). The interesting feature is the warmer, fresher water found in the Bay compared to water off Livingstone Cove. The cause of these large horizontal gradients in temperature and salinity and how long they persist are unknown. This does suggest however that water from Northumberland Strait does not enter into the Bay immediately. On July 12 the horizontal gradients in temperature between the Bay and Livingstone Cove were weak (Figs. 3d and 15d).

CURRENTS

Coastal jets form when wind blowing parallel to shore accelerates water in a nearshore zone because an Ekman balance is prevented by the shoreline. Theoretical considerations (Csanady 1977) indicate the width of the coastal jet for a two layer ocean is in the order of the internal radius of deformation, R, where

$$R = \left(\frac{g \Delta\rho h_1 h_2}{f^2 \rho \ (h_1 + h_2)} \right)^{\frac{1}{2}}$$

and g is gravitational acceleration, f is the Coriolis parameter, ρ is the average density, Δρ is the density difference between layers and h_1 and h_2 are the depths of the upper and lower layers respectively. For St. Georges Bay, R is ∿3 km. Offshore of this zone Ekman dynamics results in the upper layer moving to the right of the wind and the possibility of upwelling or downwelling nearshore. To investigate the possibility of coastal jets within St. Georges Bay, weekly current profiles from June to August 1976 were taken on the Ballantynes Cove and Ogden Pond transects. Currents were measured using a Bendix or Endeco current meter and then corrected for ship's drift. Generally current speeds were less than 25 cm s^{-1} and the directions consistent with those predicted from tide tables (Anon. 1976). Data consistent with coastal jet theory (Csanady 1977) occurred only on August 11 when winds were recorded as southwesterly at 11 m s^{-1} during occupation of the transects. Unfortunately continual wind records to determine the duration or consistency of the winds were unavailable. However a northerly current of 30 to 40 cm s^{-1} was observed 2 to 4 km from shore (Fig. 13a) while further offshore the upper layer moved offshore and the bottom layer moved onshore (Fig. 13b). Temperature structure indicated upwelling (Fig. 13c).

Occasionally coastal currents of >40 cm s^{-1} were observed along the transects but these tended to be in narrow bands of less than 2 km in width (Fig. 14). No information was collected on the duration of these flows.

In 1977 current profiles were taken to further investigate wind effects in the near shore zone within the Bay. On July 6 currents were measured at two stations off North Lakevale (Fig. 1), one 3 km, the other 6.5 km offshore. The wind was blowing ∿10 m s^{-1} from the north to northeast. The previous evening the wind was from the northwest and had shifted to the northeast early in the morning. By mid-day the upper 10 to 15 m water layer was moving onshore while the bottom layer moved offshore (Fig. 15). The longshore velocity was to the south in the upper layer and to the north in the bottom layer. Four drogues were released on the same day, two at the current meter station and two ∿10 km to the north. The drogue and the current meter surface velocities (Fig. 15) show good agreement in amplitude and a discrepancy of only 20° in direction. The surface waters moved alongshore with a slight onshore component Its movement to the northeast against the wind suggested a small gyre formed behind the Cape.

Petrie and Drinkwater (1978b) have shown numerically that the observed clockwise gyre in the Bay could be driven by an alongshore current in Northumberland Strait. To investigate the flow in the strait a transect extending 9 km offshore was occupied off Livingstone Cove (Fig. 1) on July 12, 1977. Over a 14 hour period three current profiles were measured at each of 7 stations. Alongshore surface currents (u component) reached 50 cm s^{-1} to the northeast within 3 km of shore (Fig. 16b). The upper layer of water, whose depth generally decreased offshore, moved almost exclusively to the northeast during the entire period in spite of a rising tide during the latter two transects. The lower layer flow followed the predicted tidal pattern. The offshore velocities (v component) were generally <10 cm s^{-1} indicating the flow was primarily alongshore. Of the 50 drift bottles released during the second occupation of the transect, 11 were recovered, all in Cape Breton or Newfoundland (see section 6). From the 11 recoveries an average velocity of 8 cm s^{-1} to the northeast was inferred.

During mid-July to mid-August 1977, 4 Aanderaa current meters were moored at stations 7, 1, and 12 on the Ballantynes Cove transect. Their performance record is shown in Figure 17. Twenty-five percent data loss resulted from instrument failure and an additional 20% due to marine fouling. These instruments were moored in conjunction with and at the same depths as sediment traps in the hope of relating currents and sedimentation rates. Although this aspect will be discussed in a subsequent report, a description of the current meter data is presented here.

Plots of the rate and direction of the currents are shown in Figure 18. Upon recovery the rotor on the current meter at station 12 was found to be inoperative due to marine fouling. The gradual decrease in the rates at station 12 (Fig. 18d) suggests the marine growth began to affect the rotor early in the record. Periods of above average rates (events) are seen to occur simultaneously in all the records. The amplitude of the events decreased with depth at station 7. No similar events in the winds (Fig. 25) were detected, however the three largest events all occurred with the passage of a low pressure system (Fig. 28).

The progressive vector diagrams for station 7 (Fig. 19) reveal the high baroclinic nature of the flow (non-uniform in the vertical). Only during the event on days 222-223 did the currents appear barotropic (uniform in the vertical). The mean currents over the entire length of the records were 2 cm s^{-1} to the west-northwest at 21 m, 1 cm s^{-1} to northeast at 26 m and 0.4 cm s^{-1} to the west-southwest at 30 m.

The current meter data were filtered to remove the tidal components and are presented as stick diagrams (Fig. 20). The length is proportional to the amplitude of the current and the angle is the direction towards which the current is flowing. Dissimilarities in the records are notable. Current fluctuations of amplitude 5 to 10 times the mean and periods 1 to 2 days occur in all records.

To obtain a more complete picture of the vertical current structure at station 7 hourly current profiles were recorded every 2 to 3 m over a 13 hour period on July 27, 1977, using the over-the-side Aanderaa instrument. The time series of alongshore and offshore velocity components are shown in Figure 21. The 13 hour mean rates and directions throughout the water column are given in Table 1. A two layer system is evident. In the top 22 m, or upper layer, velocities decrease with depth and are moving to the southeast. The bottom layer velocities are almost 180° out of phase with the upper layer and the amplitude peaks at 31 m. Bottom friction is probably responsible for the decrease in amplitude at depths greater than the peak. The mean current profile (Table 1) appears to be in response to the southwest winds occurring immediately prior to the measurements. During July 26 (day 207) a mean wind stress of 3.4 dyn cm^{-2} from the southwest with a maximum of 9 dyn cm^{-2} was recorded (Fig. 25). The expected depth averaged Ekman transport is 90° to the right of the wind with an amplitude τ/f where τ is the wind stress and f the Coriolis parameter. Using the mean wind, the Ekman transport would be $3.4x10^4$ cm^2 s^{-1} to the southwest. Assuming an upper layer depth of 22 m, this transport requires a depth averaged current of 15.5 cm s^{-1} to the southeast. The measured depth averaged current over a 13 hr period on July 27, 1977, was 14.4 cm s^{-1} to the southeast.

To determine if the hourly over-the-side current meter measurements provided realistic estimates of the flow a comparison was made with the moored Aanderaa meters. Progressive vector diagrams of hourly averages from the moored instruments are plotted together with the hourly values of the over-the-side instrument at corresponding depths (Fig. 22). The general shape of the progressive vectors as well as the overall means are in good agreement given the accuracies of the instruments and the different frequency of sampling. The mean rates and directions over the 13 hour period from the moored current meters are given in Table 1.

SURFACE DRIFTERS

A total of 396 sea surface drifters were released during 1977 along the Ballantynes Cove transect and 50 along the Livingstone Cove transect. Eighty-six drifters were recovered to date or 19% of the total releases. The numbers released per month together with the number and percent of those recovered are shown in Table 2. The distribution of recoveries made inside and outside the Bay is given in Table 3.

The pattern of recoveries during 1977 was similar to that of 1974 (Petrie and Drinkwater 1977a) and 1975 (Petrie and Drinkwater 1977b). Forty five (52%) were recovered within the Bay and the remaining 41 were recovered outside the Bay. Of those recovered within the Bay only 2 were located on the western shore while 14 were on the southern shore and 29 on the eastern shore. Drifters found outside the Bay landed along the Gulf of St. Lawrence side of Cape Breton Island (28), in Newfoundland (8), and in the southern sections of Canso Strait and Chedabucto Bay (5). These latter 5 drifters probably were carried through the lock at the Canso Causeway.

Using the fastest 1/3 (Bumpus and Lauzier 1965), the average speed within the Bay was 6 cm s^{-1} and the average time adrift was 7 days. The maximum speed was 24 cm s^{-1}. For recoveries outside the Bay the average speed was 12 cm s^{-1} and the bottle was adrift for 25 days. The maximum speed was 17 cm s^{-1}.

On July 12, 50 drifters were released on the Livingstone Cove transect and 24 along the transect south of Ballantynes Cove. Eleven of the Livingstone Cove drifters and 8 of the Ballantynes Cove drifters were recovered; all outside the Bay either along the shores of Cape Breton (15) or in Newfoundland (4). This suggests a coastal current flowing past St. Georges Bay entraining with it surface waters from the Bay. Although no drifters from Livingstone Cove entered the Bay at this time an exchange of surface waters might be expected. Figure 23 shows the inferred mean sea surface circulation based on the 1978 drifter data. It is in agreement with the drifter and surface current meter data collected in 1974 and 1975 (Petrie and Drinkwater 1977a,b).

WEATHER STATION

During 1976 and 1977 an Aanderaa weather station system was located on the beach side of Ogden Pond (Fig. 1). The wind speed and direction were measured at 3 m height in 1976 and at 8 m in 1977. The wind stress, which is proportional to the wind speed squared, has been plotted (Figs. 24, 25) rather than wind itself since the stress determines the force exerted on the surface of the ocean. The wind stress has been calculated using the relationship of Smith and Banke (1975). A wind of 18.5 mph corresponds to a wind stress of 1 dyn cm^2 s^{-1}.

Air temperature was recorded in 1976 (Fig. 26) and air temperature (Fig. 27) and pressure (Fig. 28) were recorded in 1977.

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LIST OF TABLES

Table 1. Mean currents at station 7 over a 13 hour period on July 27, 1977.

(a) over-the-side Aanderaa current meter

Depth (m)	Rate ($cm\ s^{-1}$)	Direction
1	19.5	139°
3	19.9	139°
5	18.3	146°
8	15.7	141°
10	13.7	133°
12	12.6	125°
15	11.5	122°
18	11.0	124°
20	12.4	125°
22	12.8	148°
25	5.7	144°
28	1.9	328°
29	6.2	358°
30	7.8	345°
31	8.5	339°
32	7.6	287°
33	6.3	286°

(b) moored Aanderaa current meters

Depth	Rate	Direction
21	15.6	124°
26	3.4	5°
30	8.4	320°

Table 2. Sea Surface Drifter Releases and Recoveries 1977.

Stn.	April			May			June			July			August			September			October			November			Totals		
No.	Rel.	Rec.	%	Rel.	Rec.	%	Rel.	Rec.	%	Rel.	Rec.	%	Rel.	Rec.	%	Rel.	Rec.	%	Rel.	Rec.	%	Rel.	Rec.	%	Rel.	Rec.	%
14	6	1	17	18	2	11	12	1	8	21	10	48	12	4	33	0	0	0	6	1	17	11	1	9	86	20	
12	6	0		24	4	17	24	1	4	22	2	9	11	7	64	6	0	0	6	0	0	12	0	0	111	14	
10	6	2	33	18	4	17	18	1	5	21	5	24	6	1	17	6	0	0	6	3	50	11	2	18	92	18	20
7	6	2	33	18	5	28	24	4	17	23	10	43	12	2	17	6	0	0	6	0	0	12	0	0	107	23	21
LCS																											
1										10	5	50													10	5	50
2										10	1	10													10	1	10
3										10	1	10													10	1	10
5										10	3	30													10	3	30
7										10	1	10													10	1	10
Total	24	5	21	78	15	19	78	7	9	137	38	28	41	14	34	18	0	0	24	4	17	46	3	7	446	86	19

Table 3. Recoveries of Surface Drifters - Comparison of Recoveries IN and OUT of Bay 1977

Stn.	April			May			June			July			August			September			October			November			Total		
No.	# Rec.	# In	# Out	# Rec.	# In	# Out	# Rec.	# In	# Out	# Rec.	# In	# Out	# Rec.	# In	# Out	# Rec.	# In	# Out	# Rec.	# In	# Out	# Rec.	# In	# Out	# Rec.	# In	# Out
14	1	0	1	2	0	2	1	0	1	10	4	6	4	4	0	0	0	0	1	0	1	1	0	1	20	8	12
12	0	0	0	4	3	1	1	1	0	2	1	1	7	7	0	0	0	0	0	0	0	0	0	0	14	12	2
10	2	2	0	4	1	3	1	0	1	5	2	3	1	1	0	0	0	0	3	3	0	2	2	0	18	11	7
7	2	1	1	5	5	0	4	2	2	10	4	6	2	2	0	0	0	0	0	0	0	0	0	0	23	14	9
LCS																											
1										5	0	5													5	0	5
2										1	0	1													1	0	1
3										1	0	1													1	0	1
5										3	0	3													3	0	3
7										1	0	1													1	0	1
Total	5	3	2	15	9	6	7	3	4	38	11	27	14	14	0	0	0	0	4	3	1	3	2	1	86	45	41
%		60	40		60	40		43	57		29	71		100						75	25		67	33		52	48

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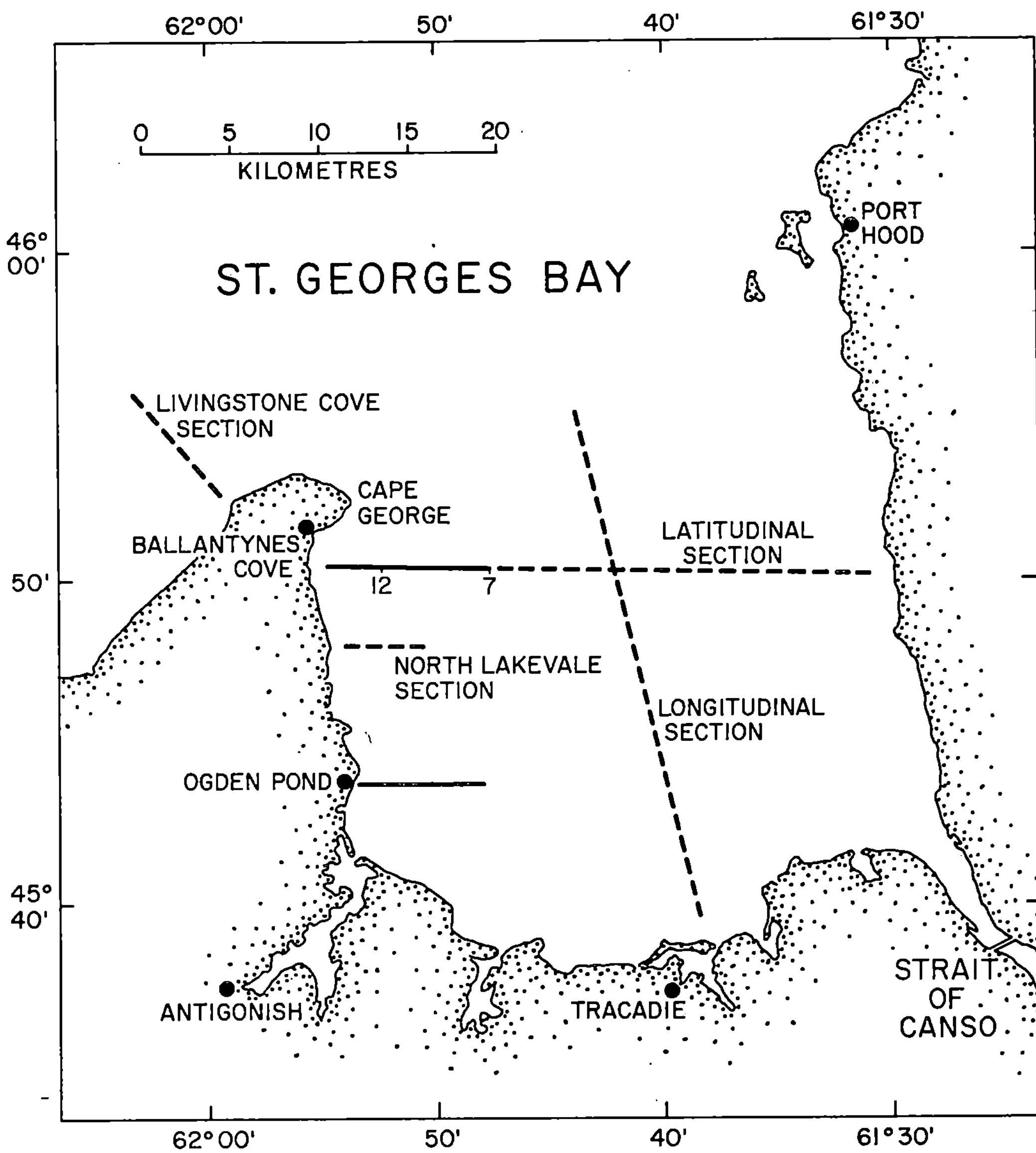
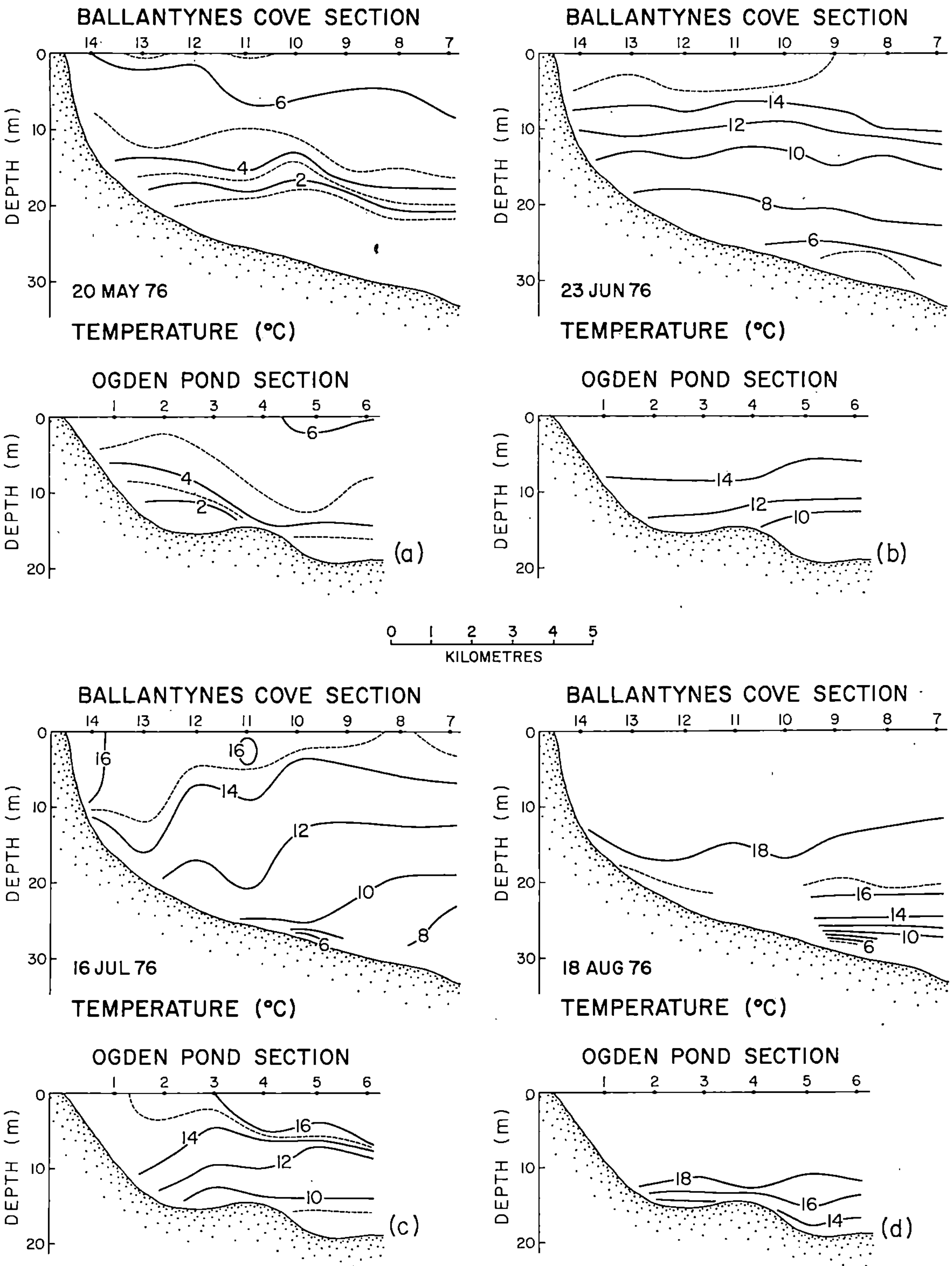


Fig. 1 St. Georges Bay, Nova Scotia. Transects occupied on a regular basis during 1976 or 1977 are indicated by solid lines.



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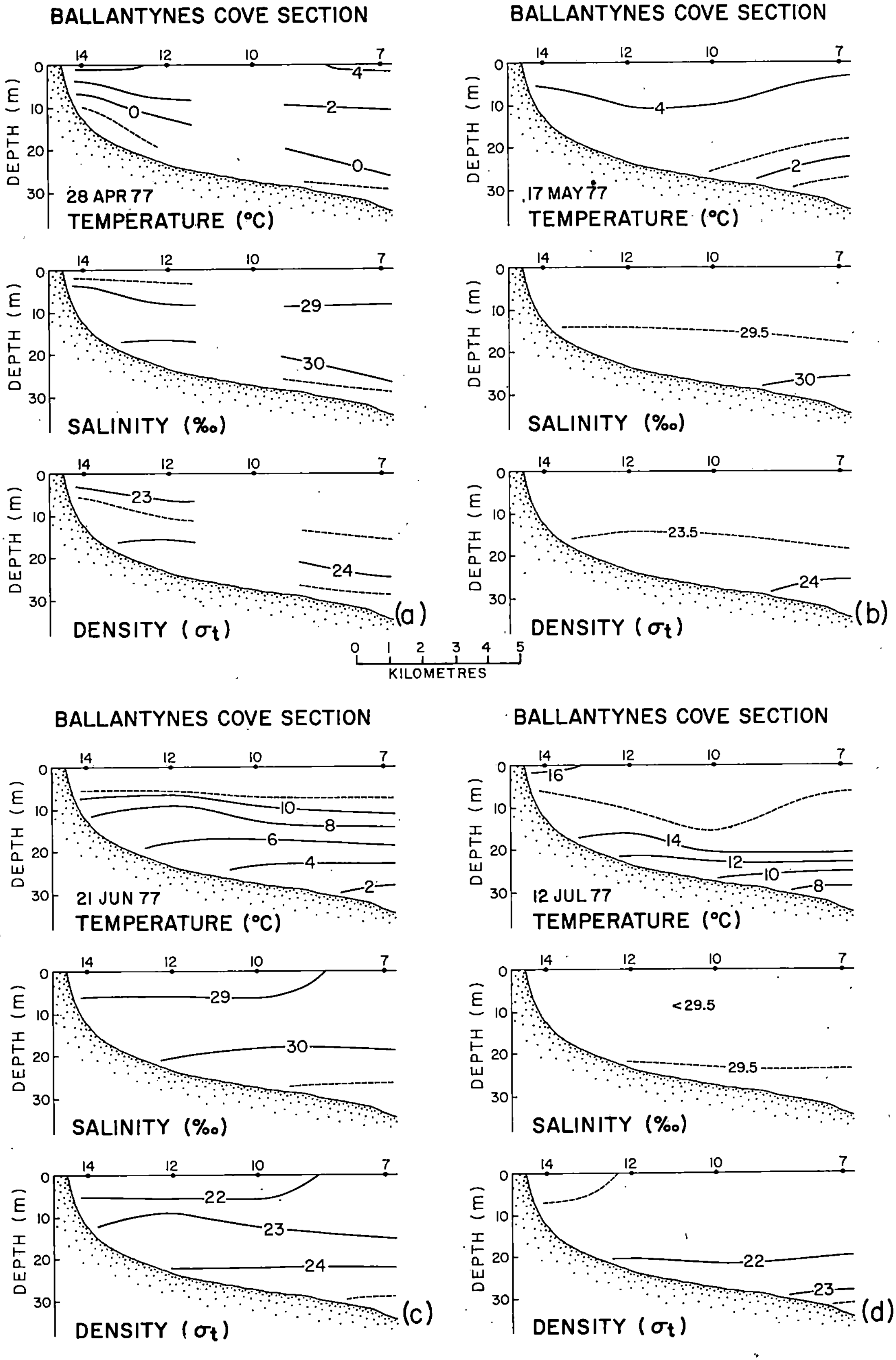

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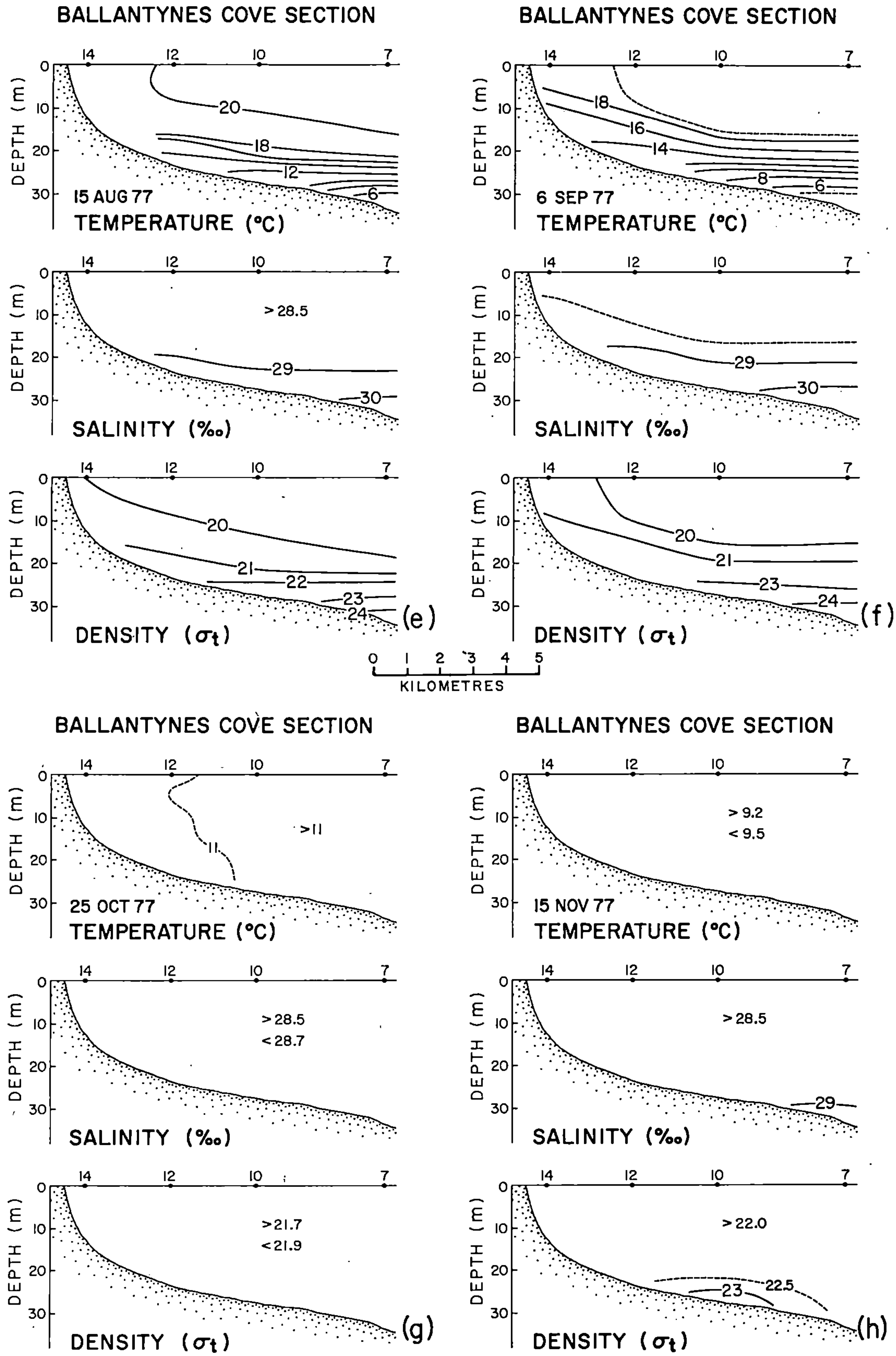

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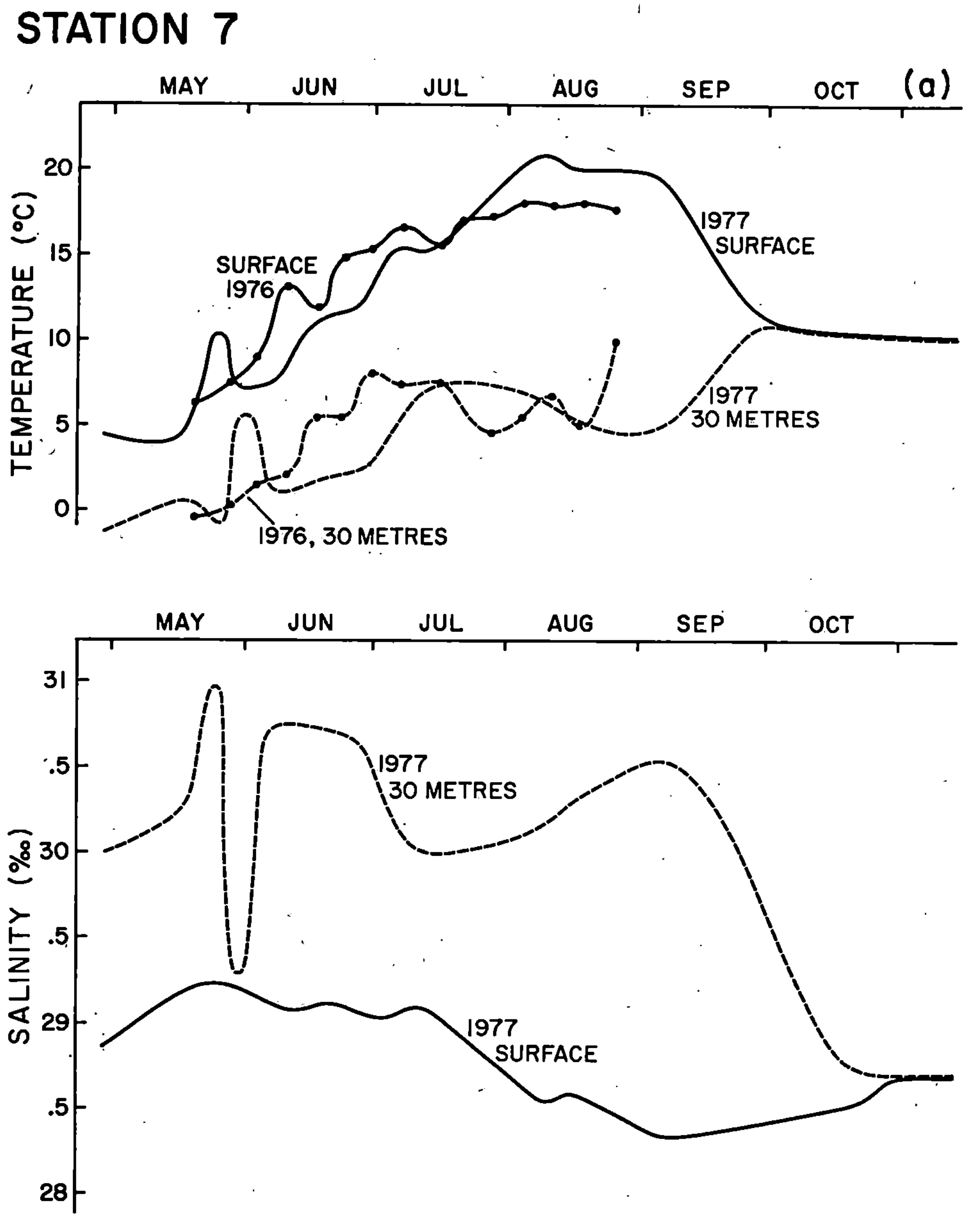

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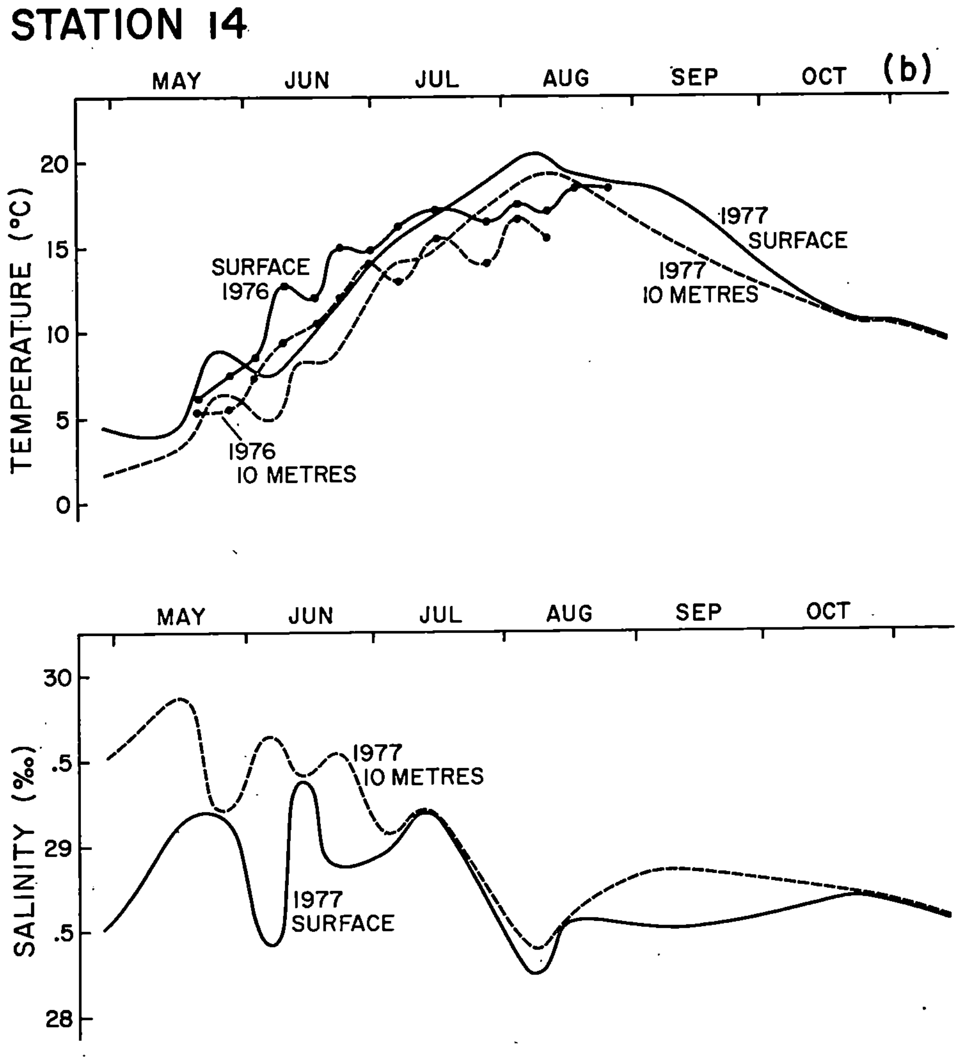

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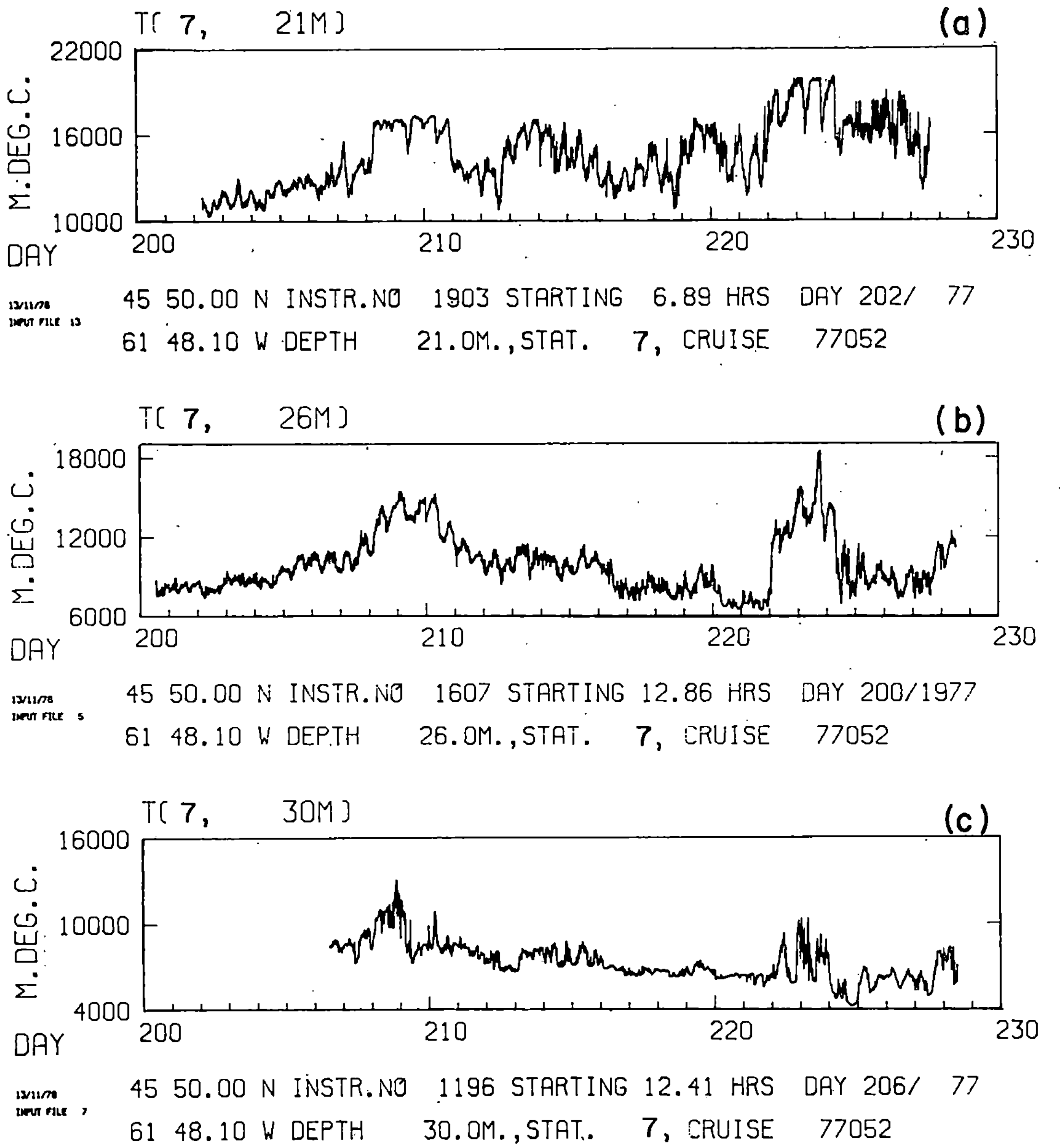

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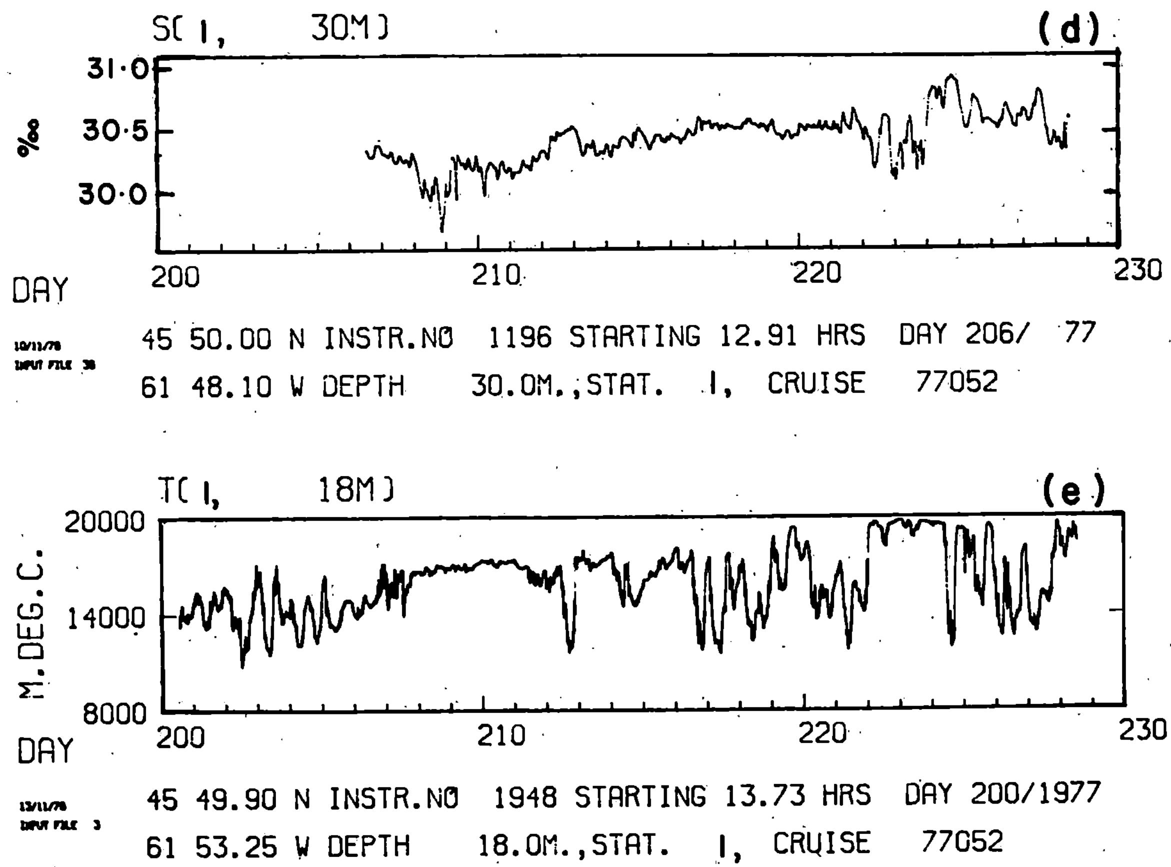

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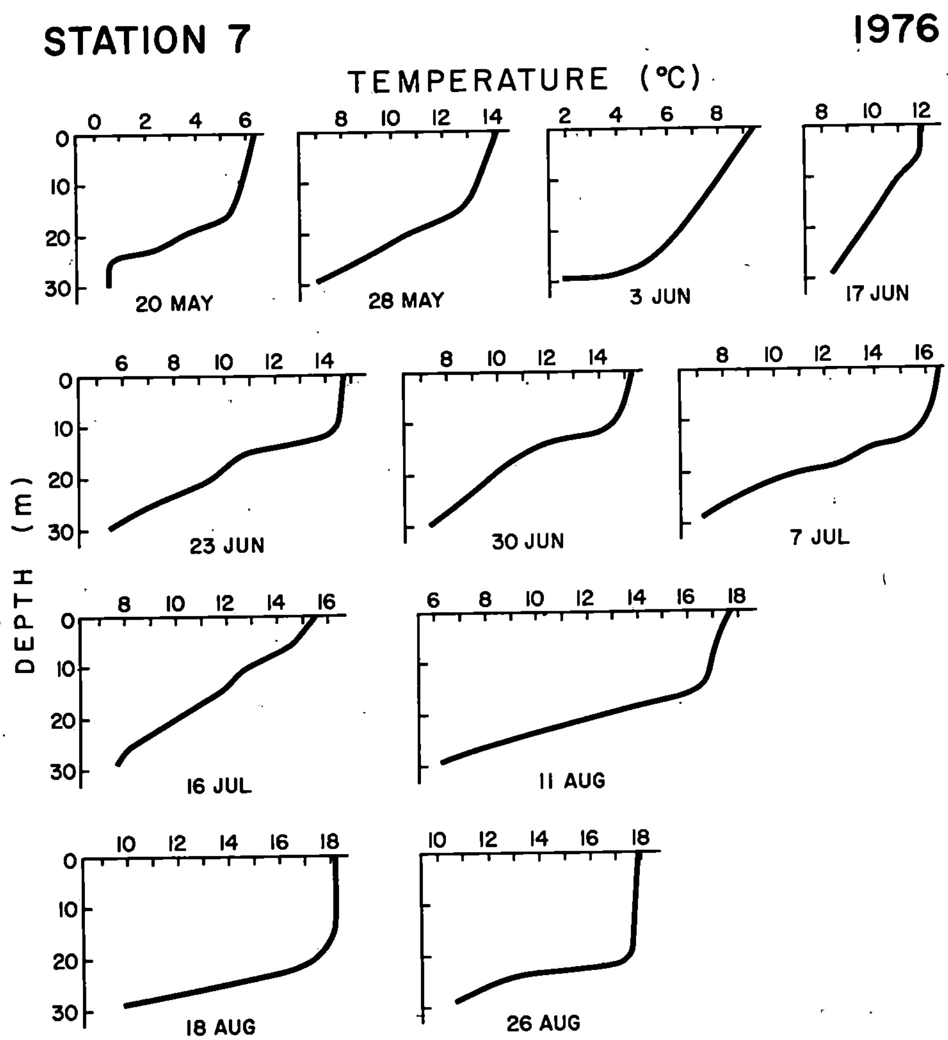

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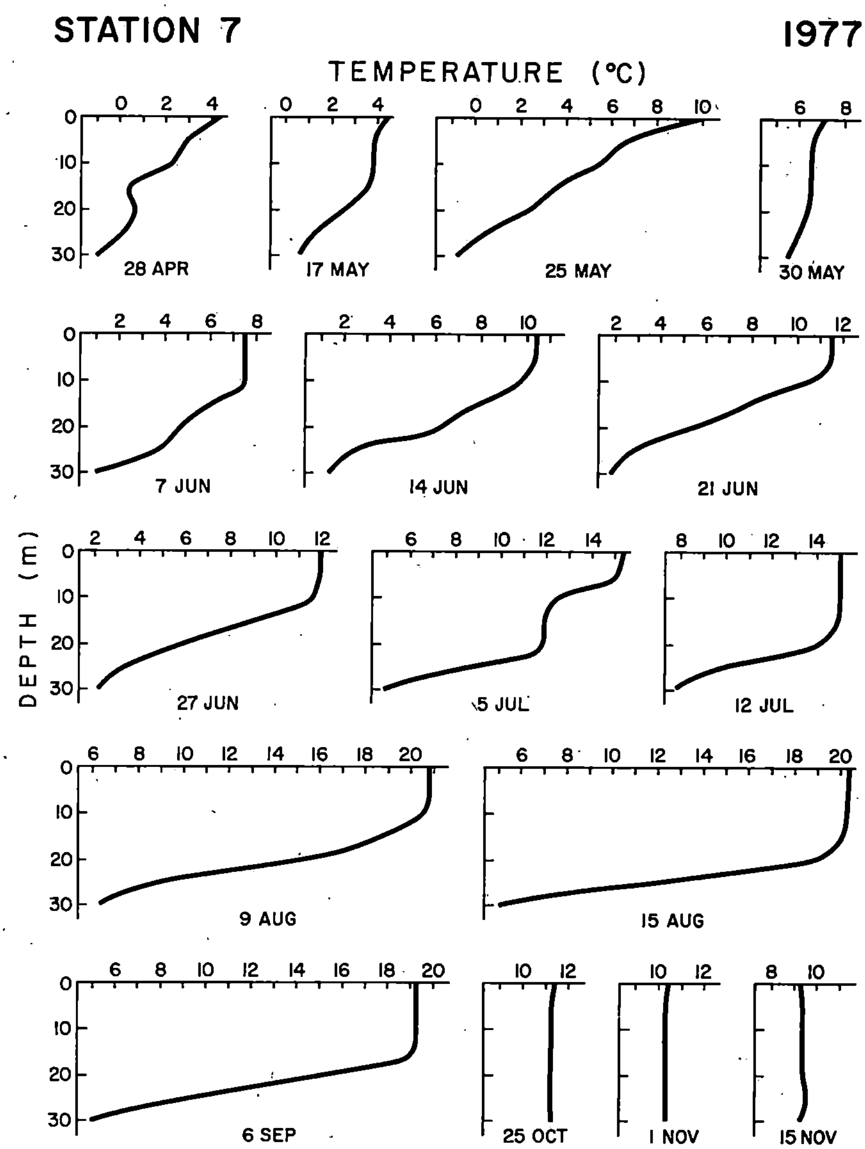

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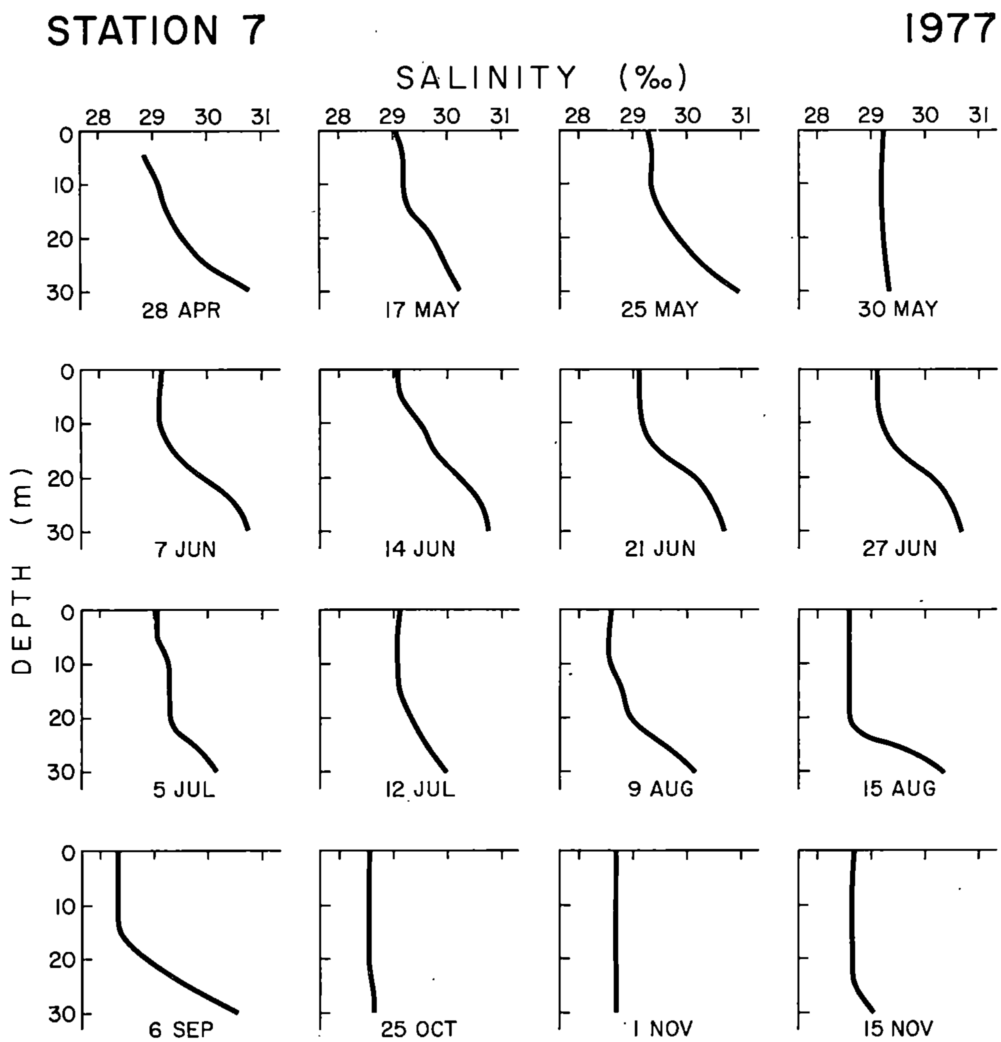

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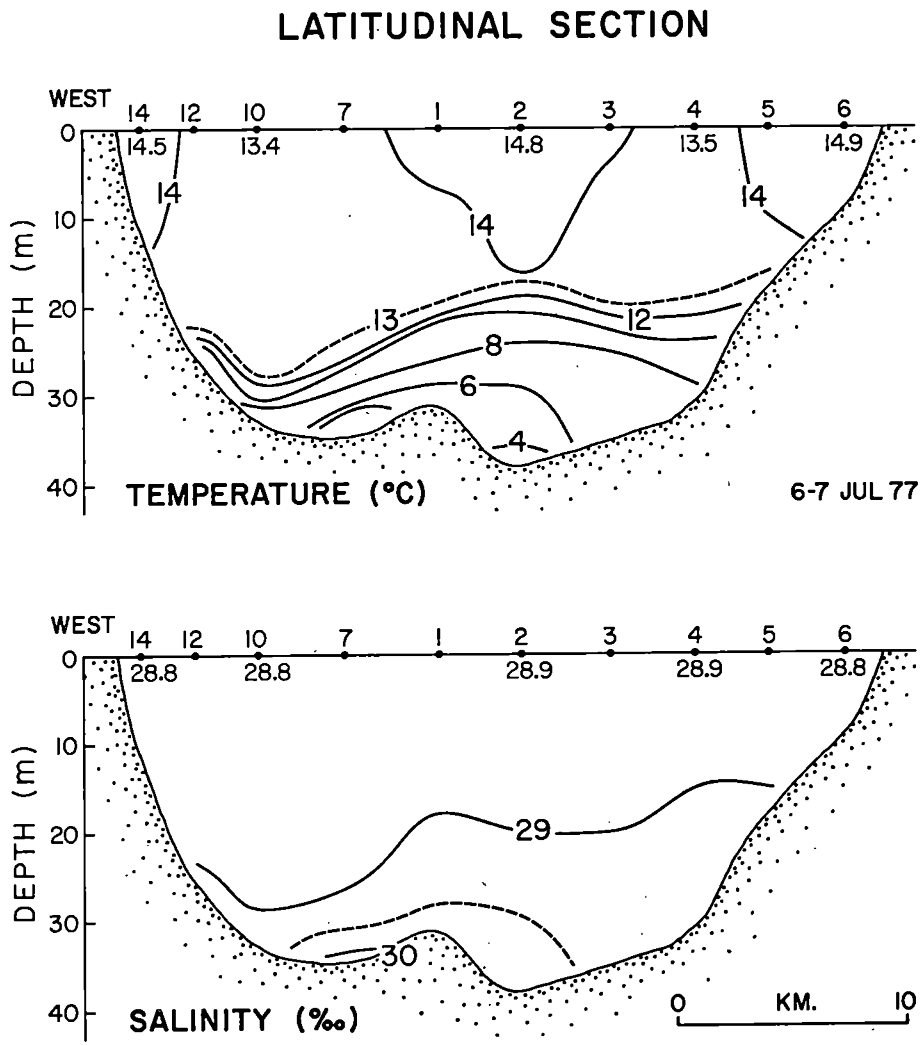

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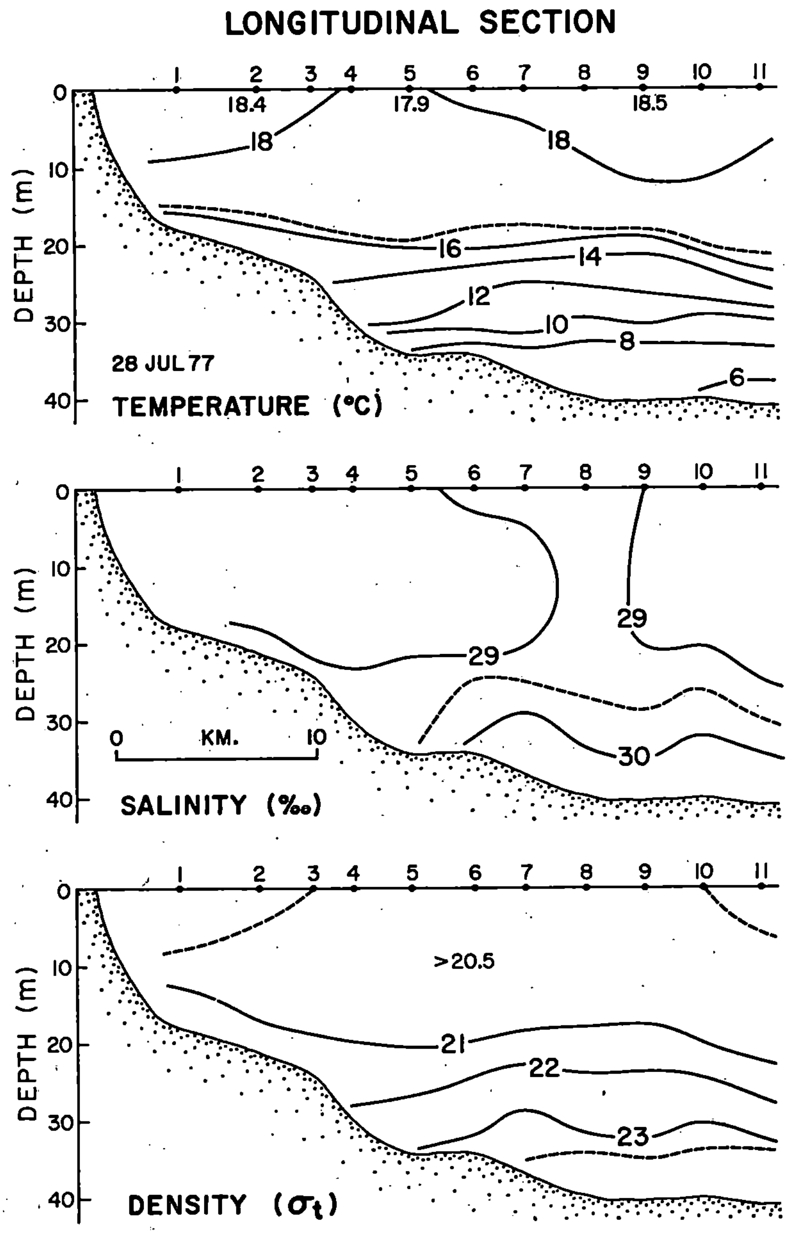

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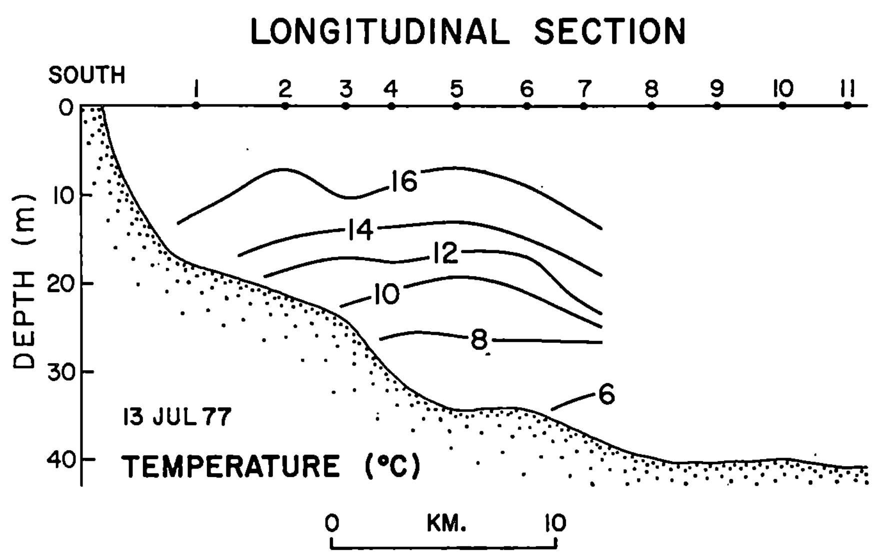

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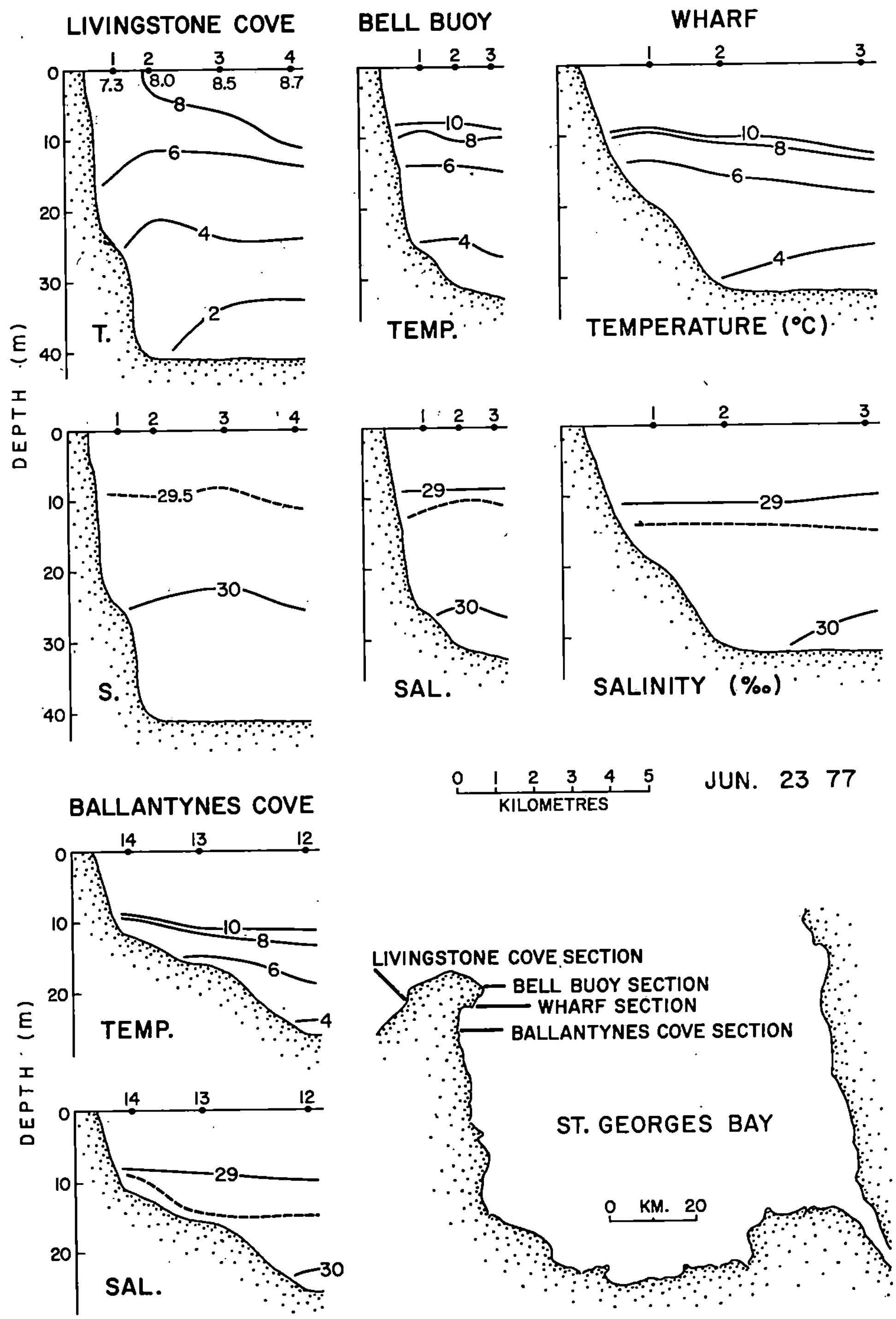

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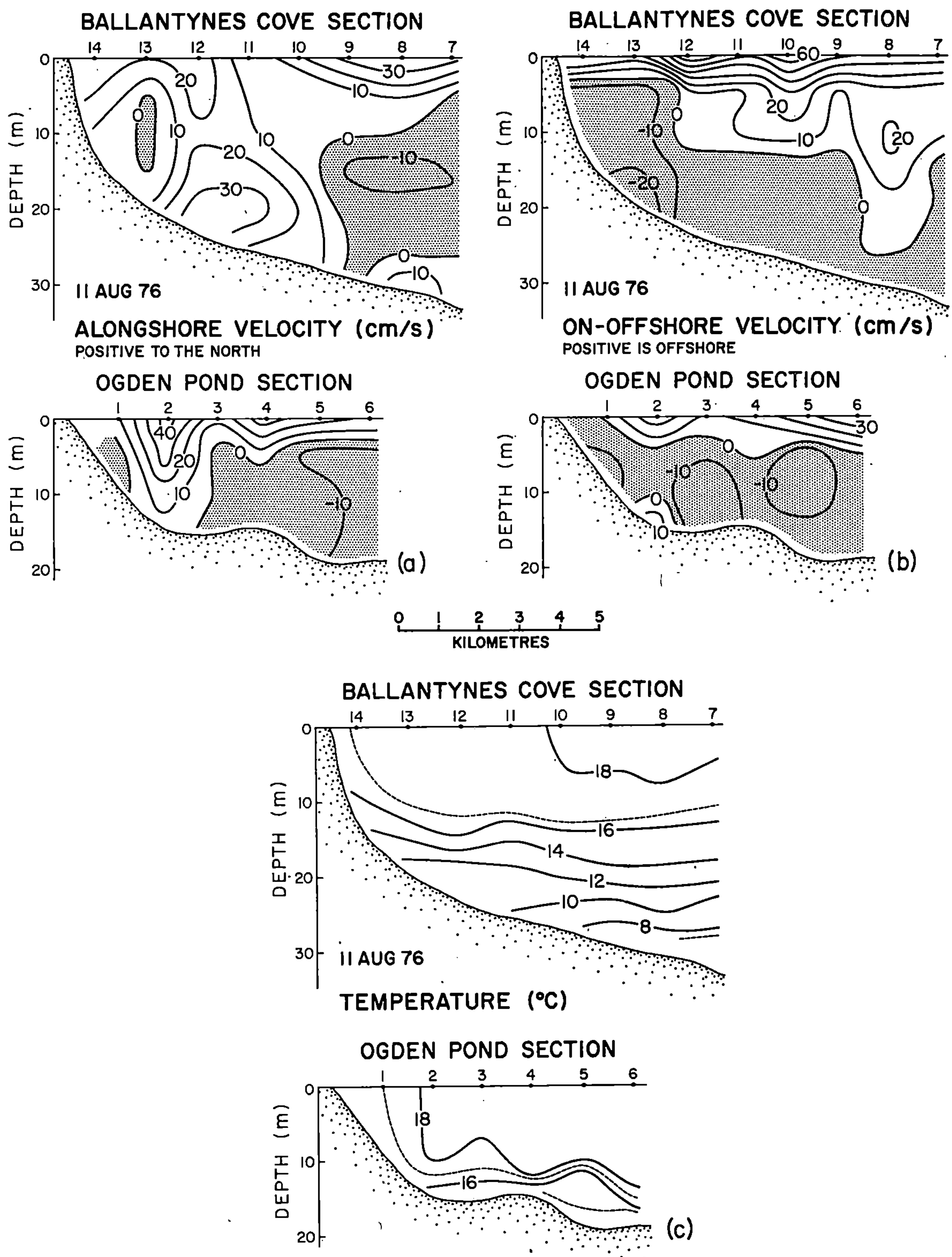

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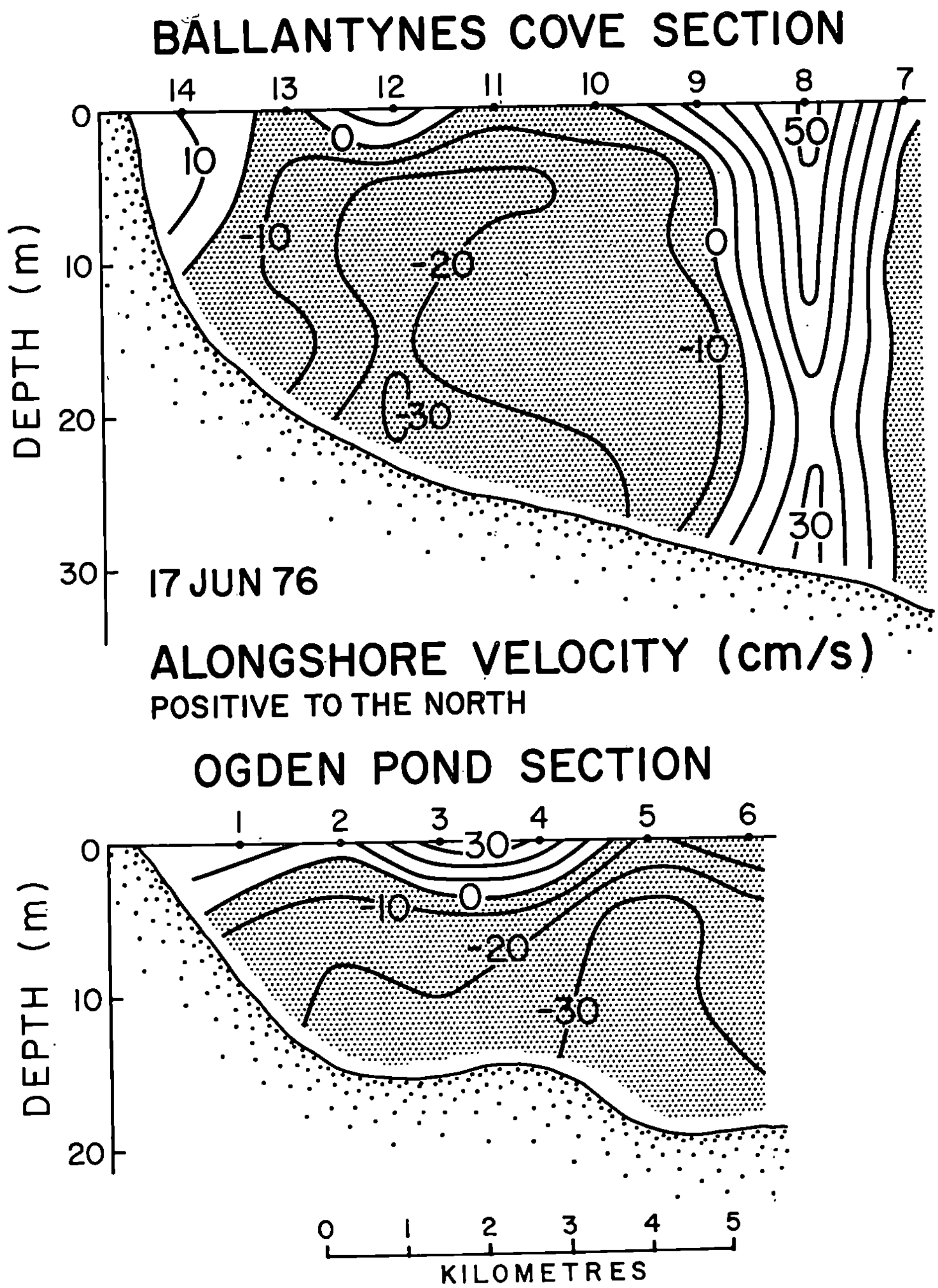

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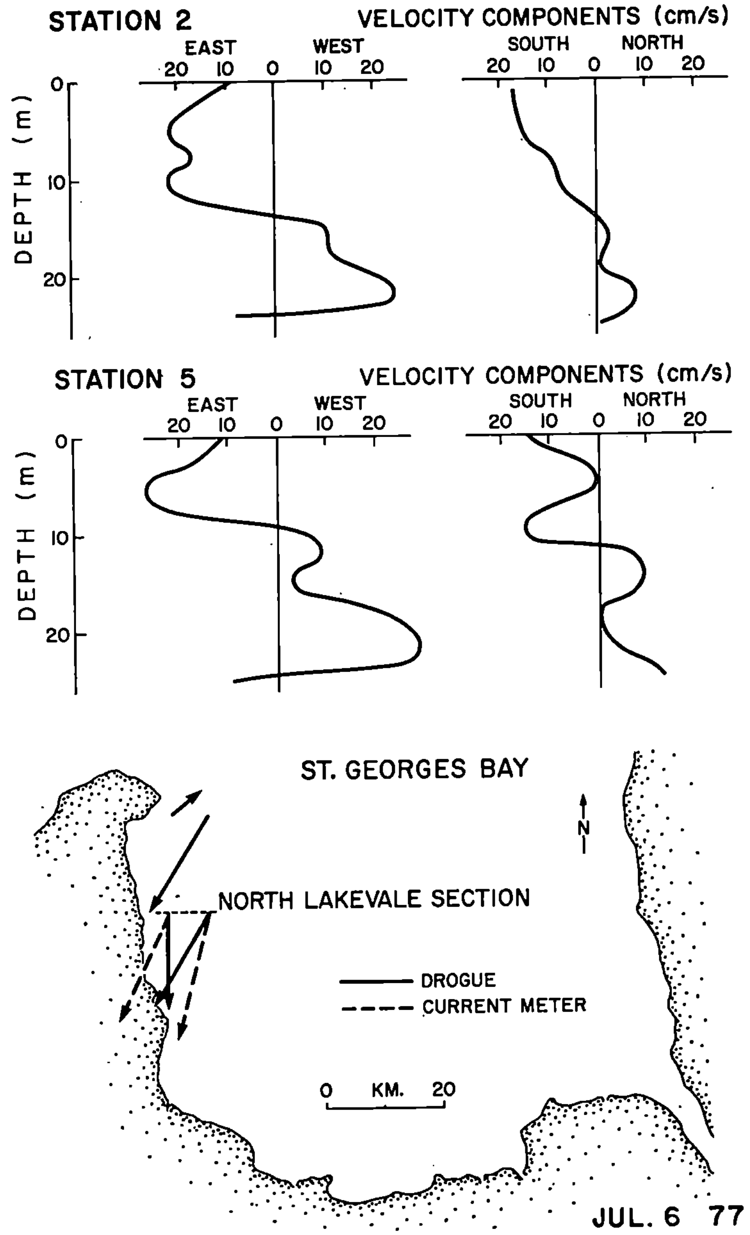

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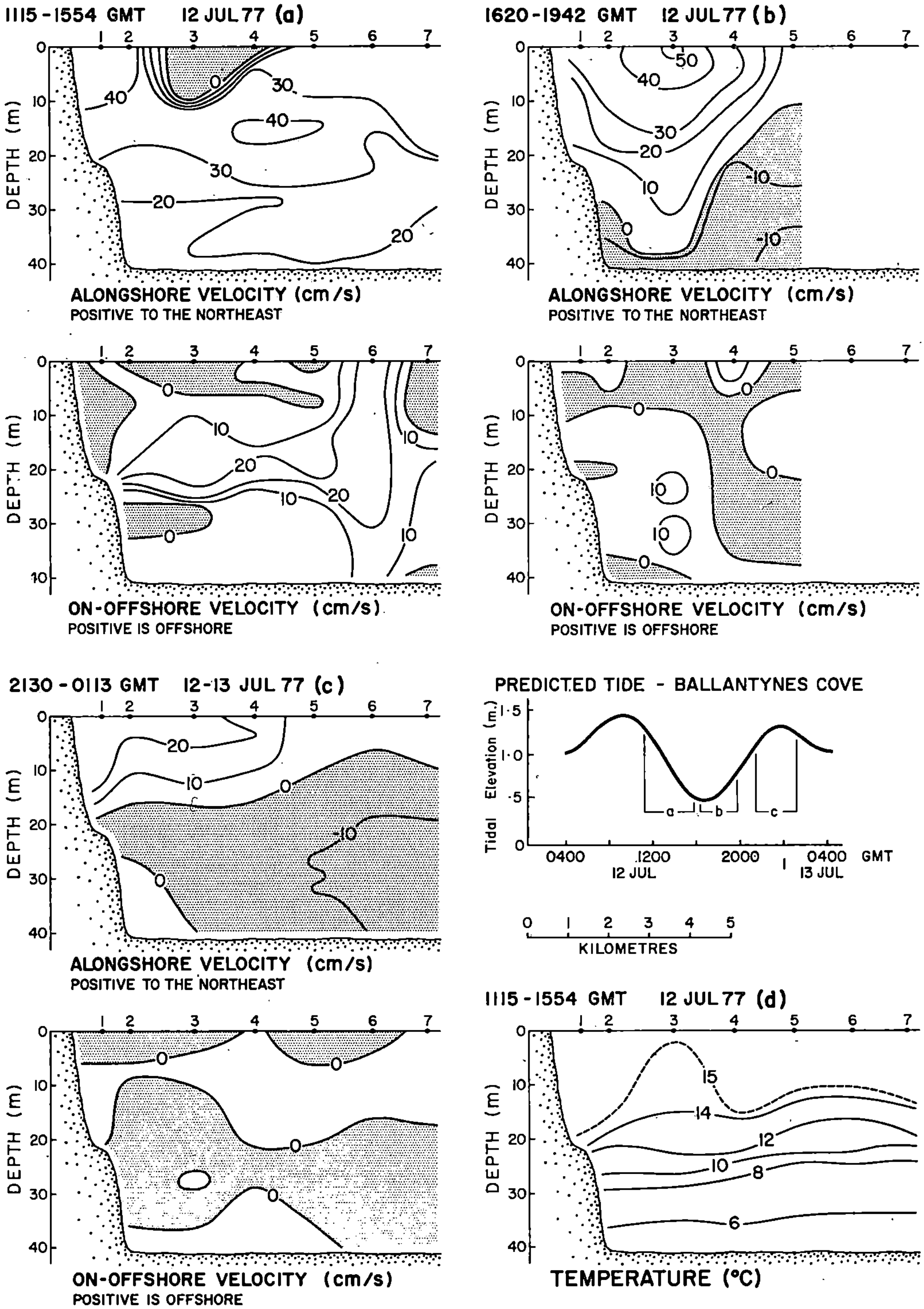
LIVINGSTONE COVE SECTION



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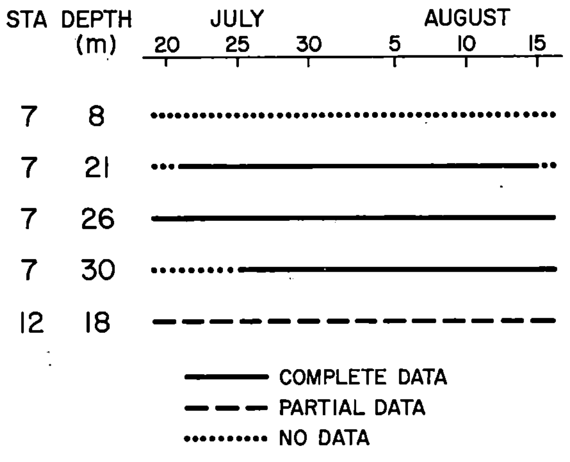

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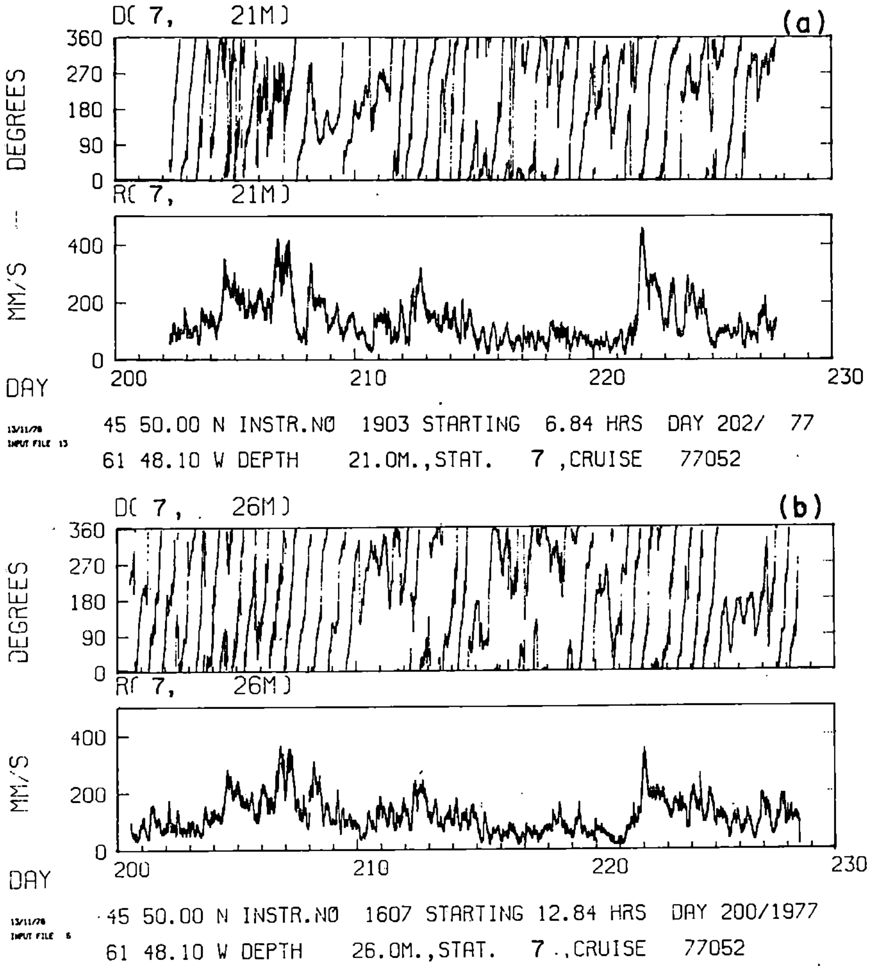

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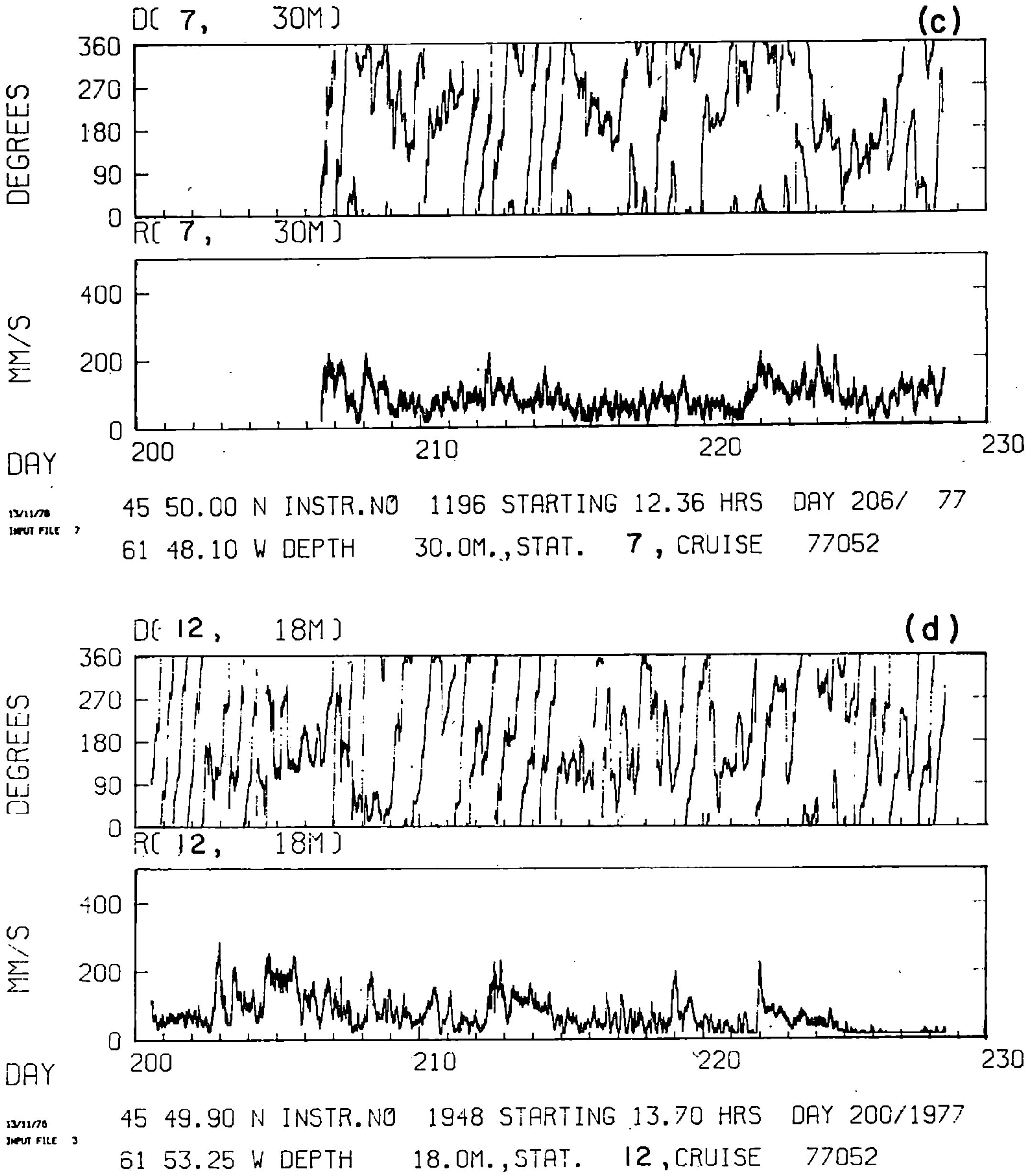

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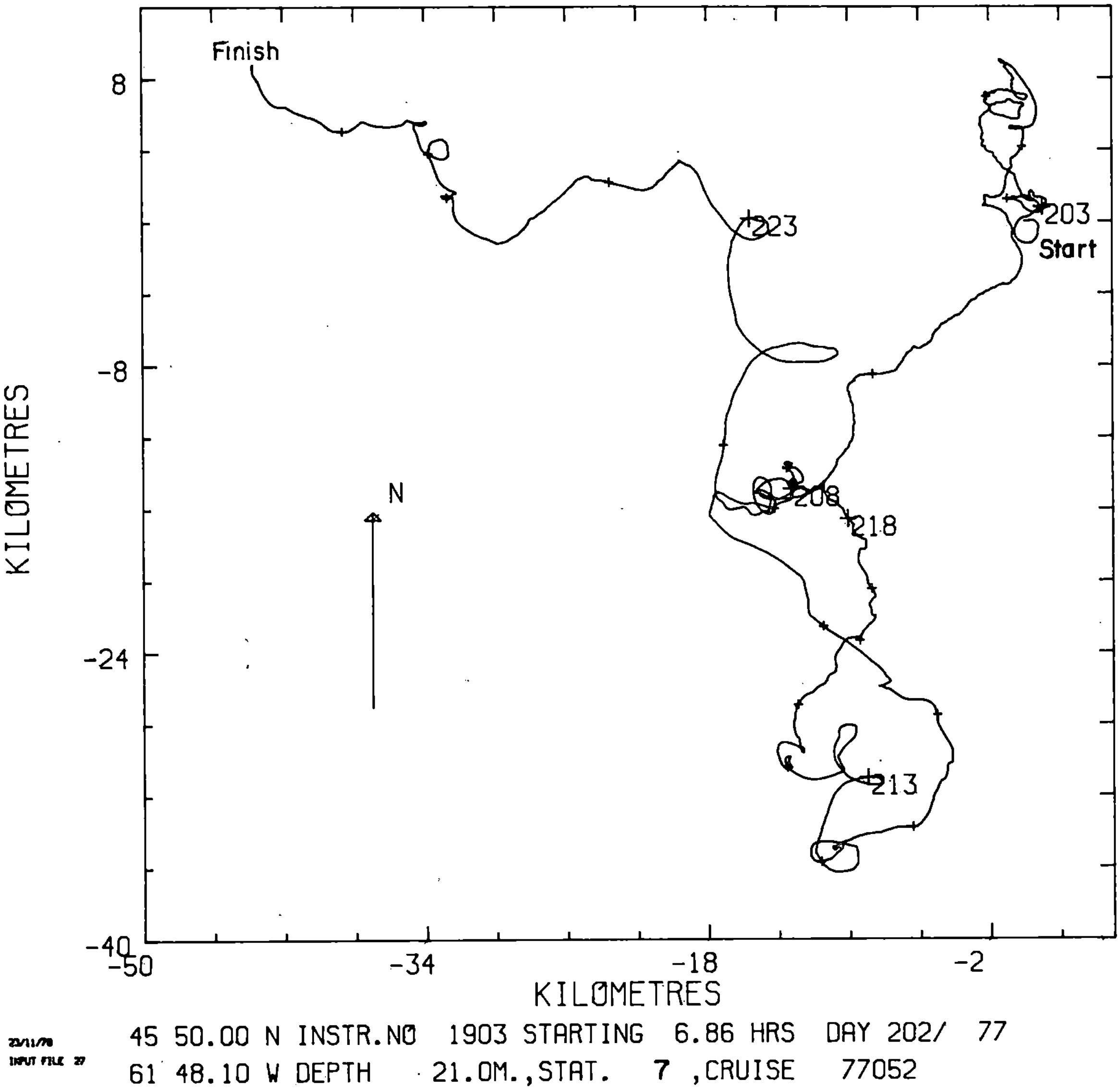

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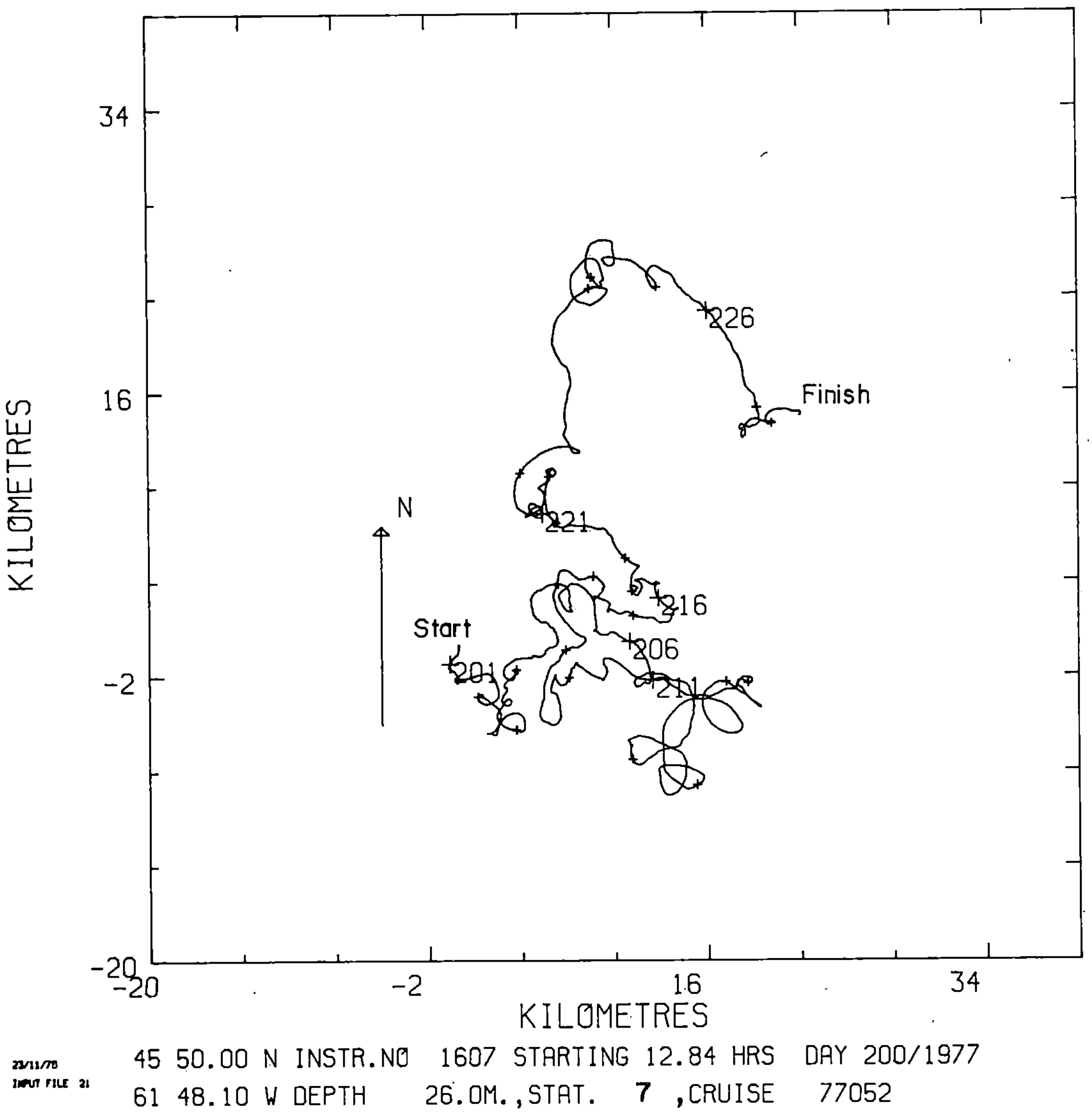

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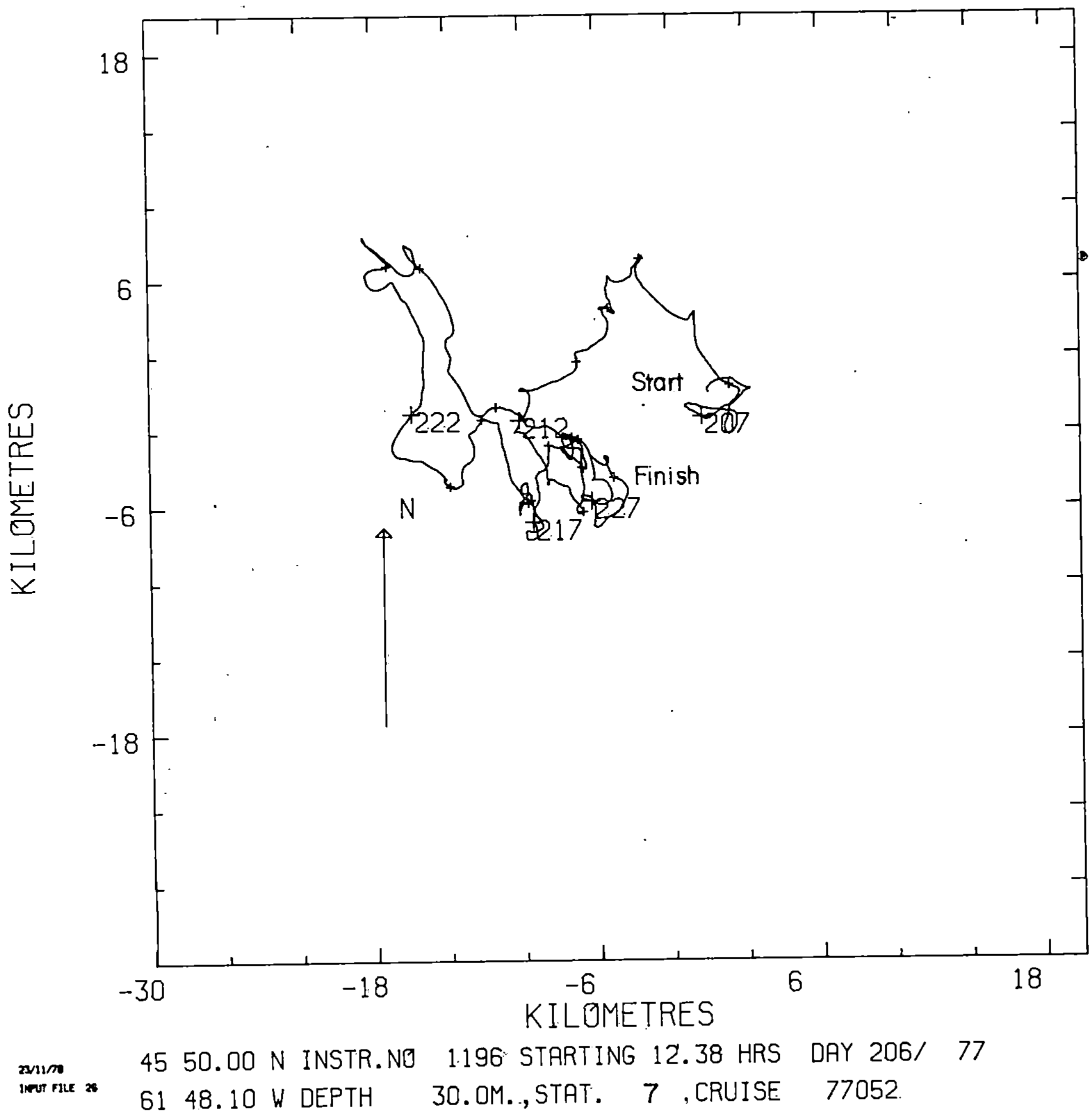

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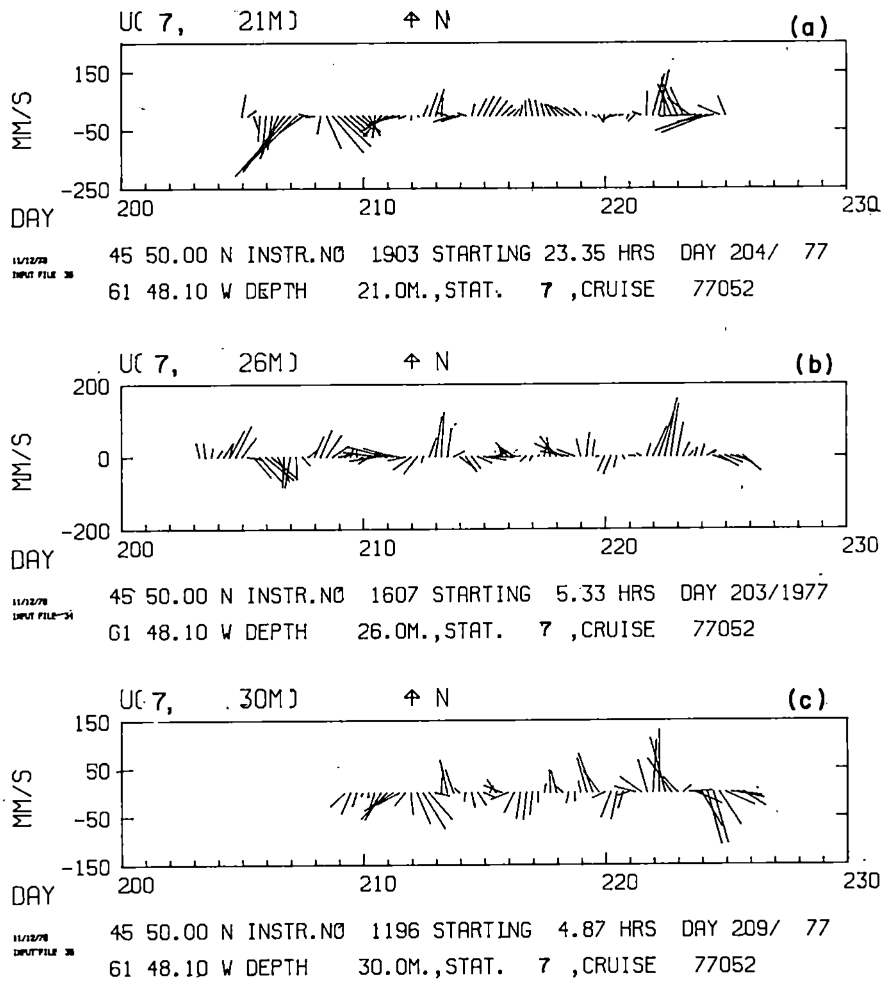

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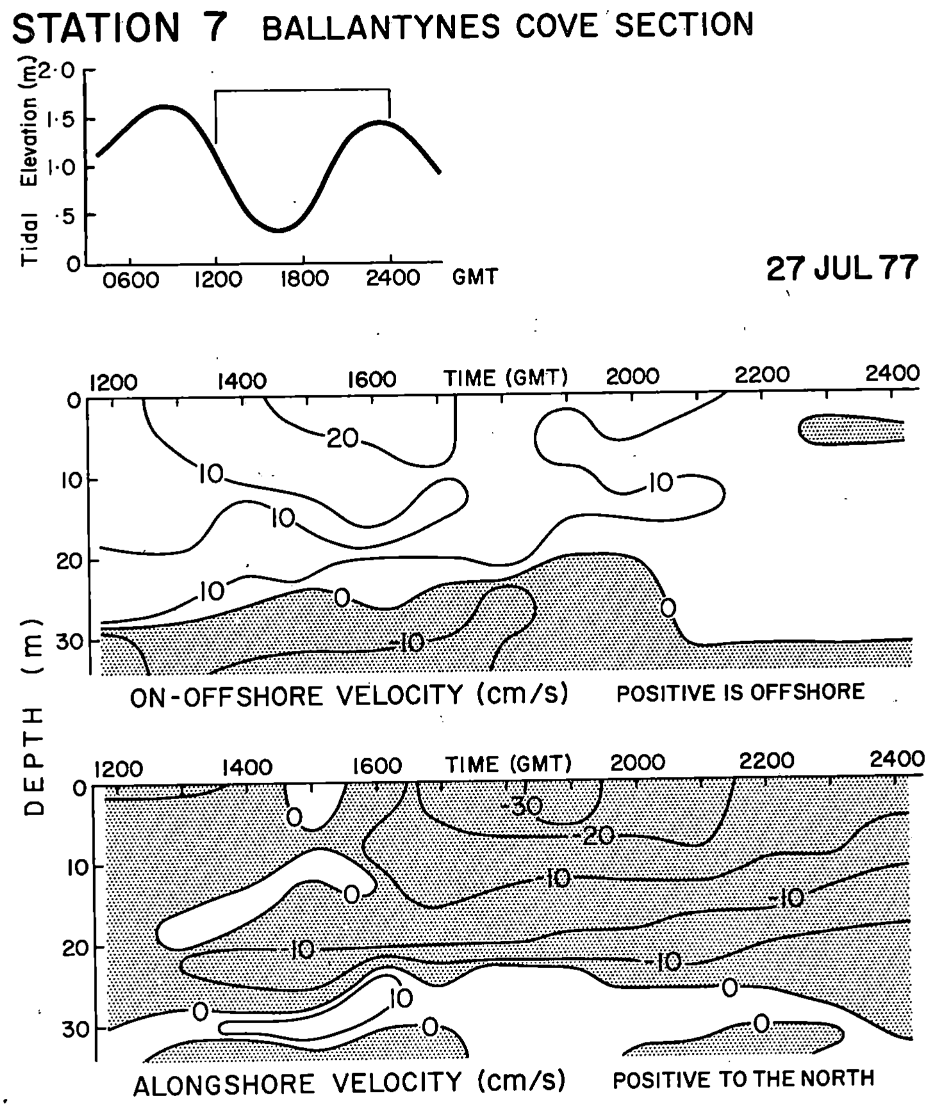

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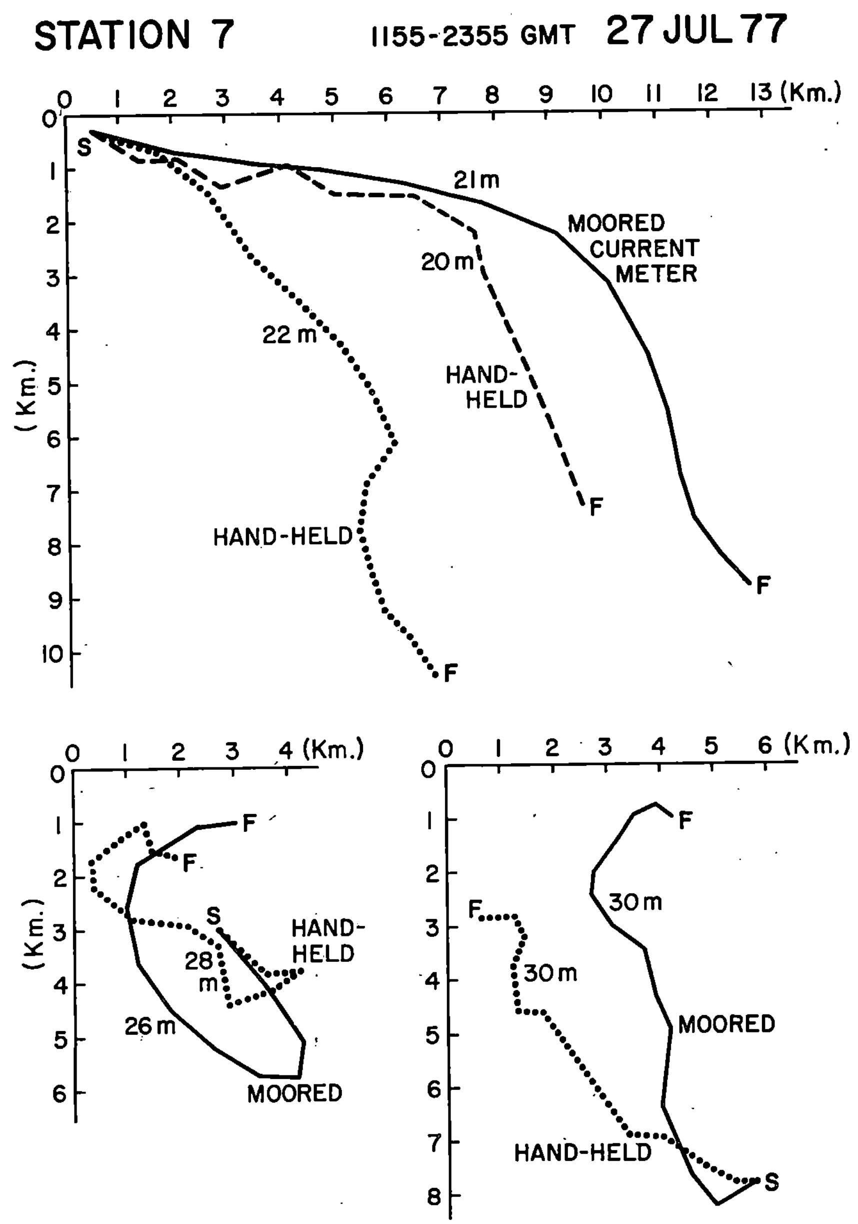

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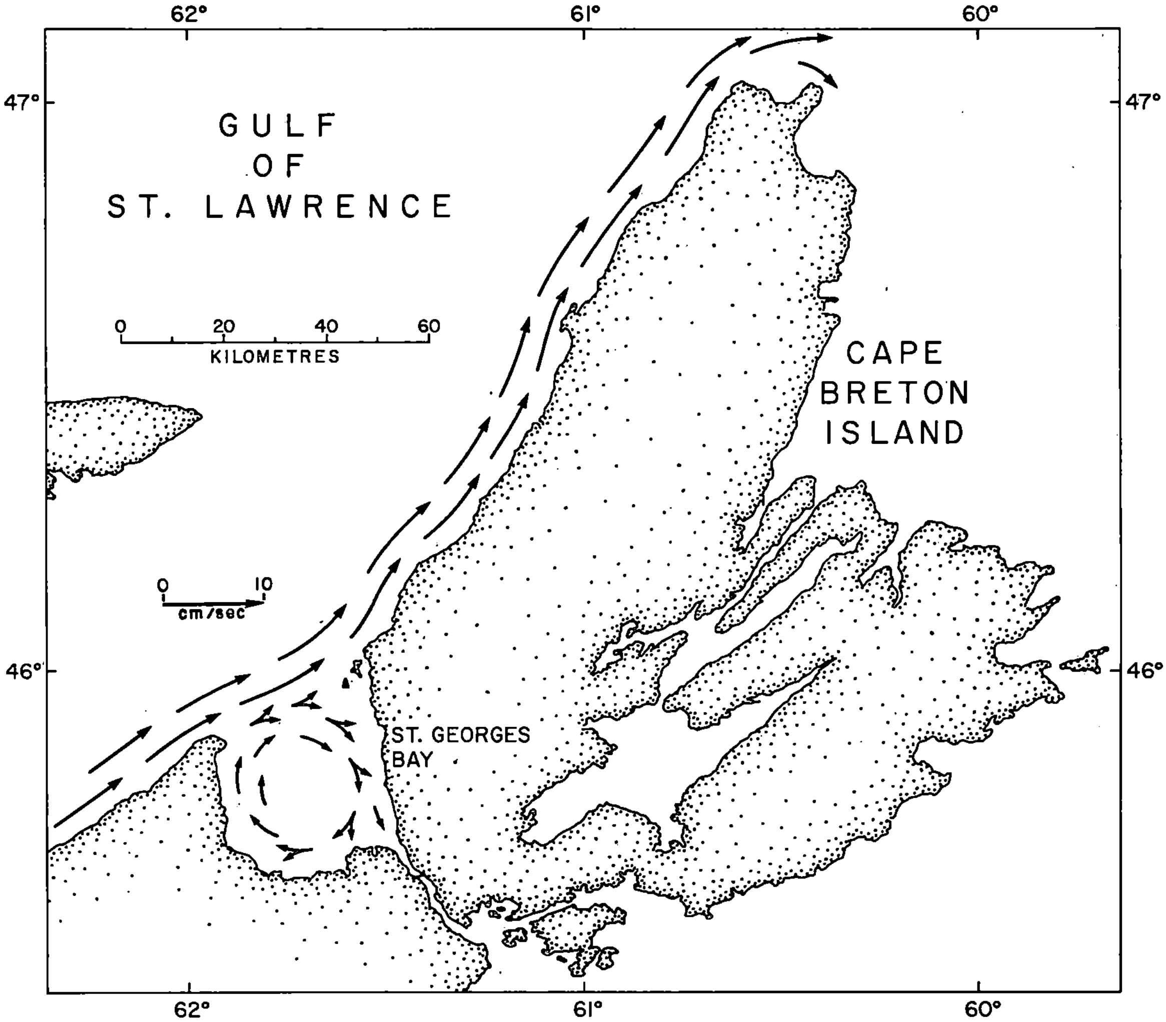

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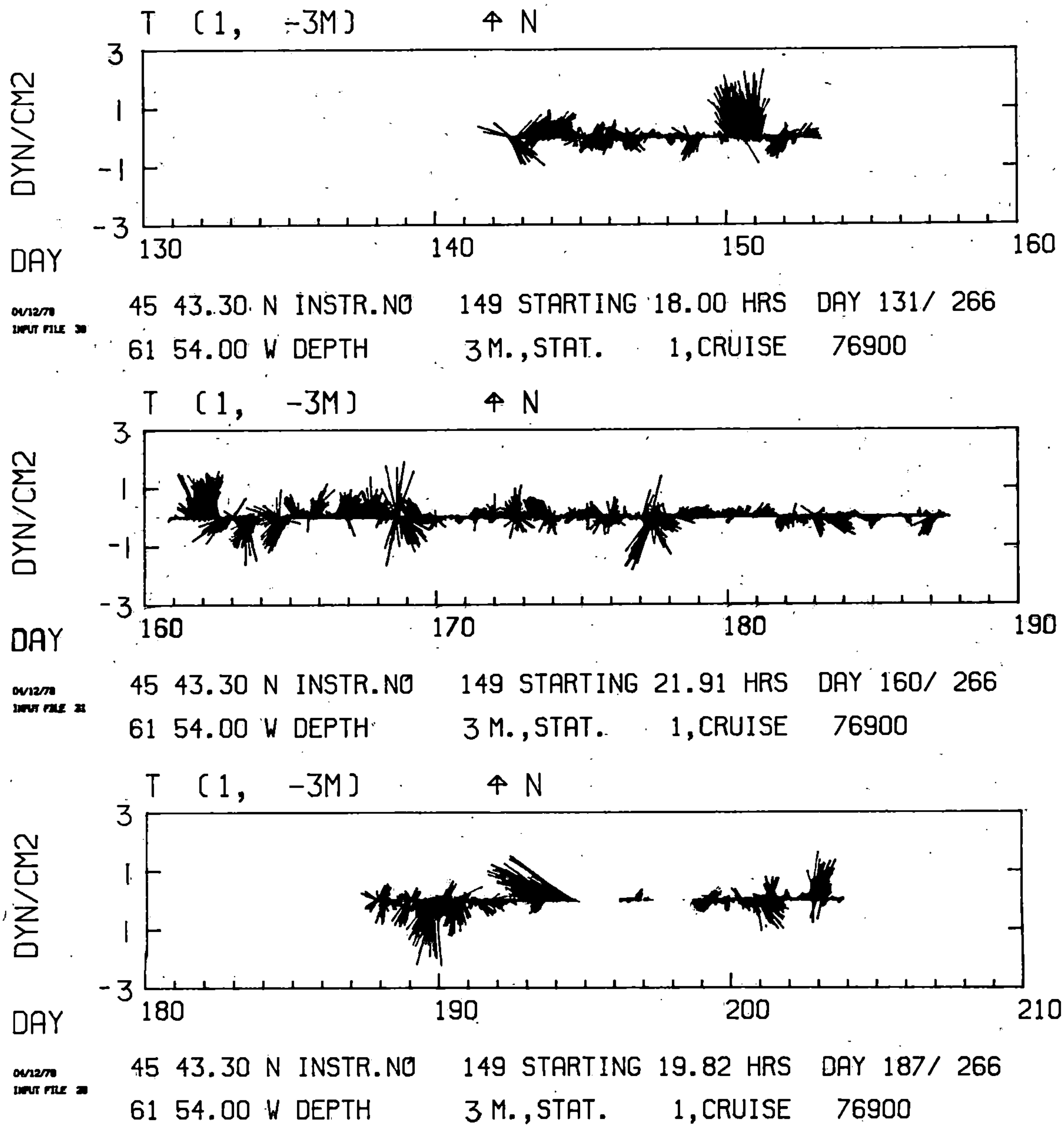

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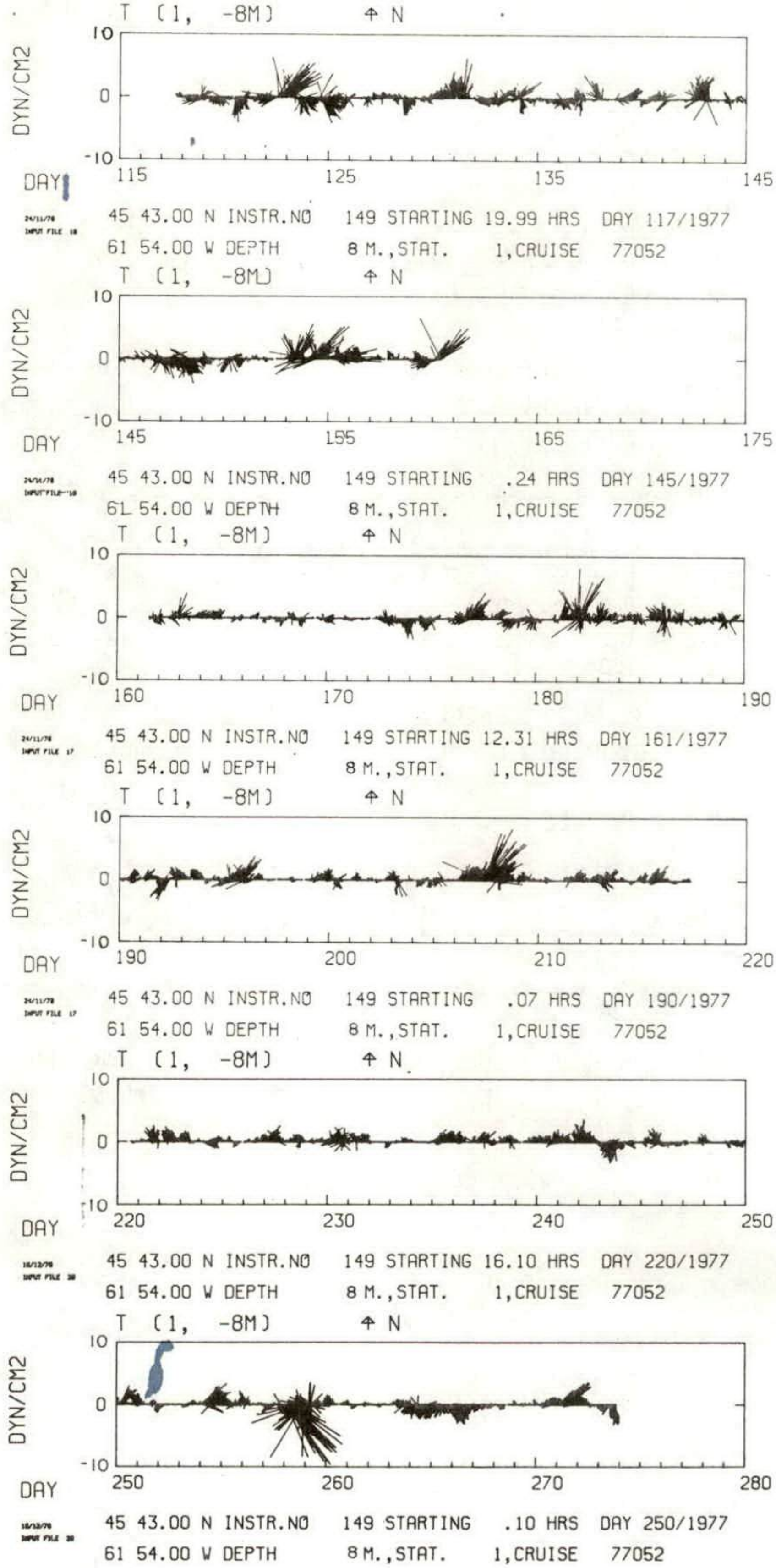

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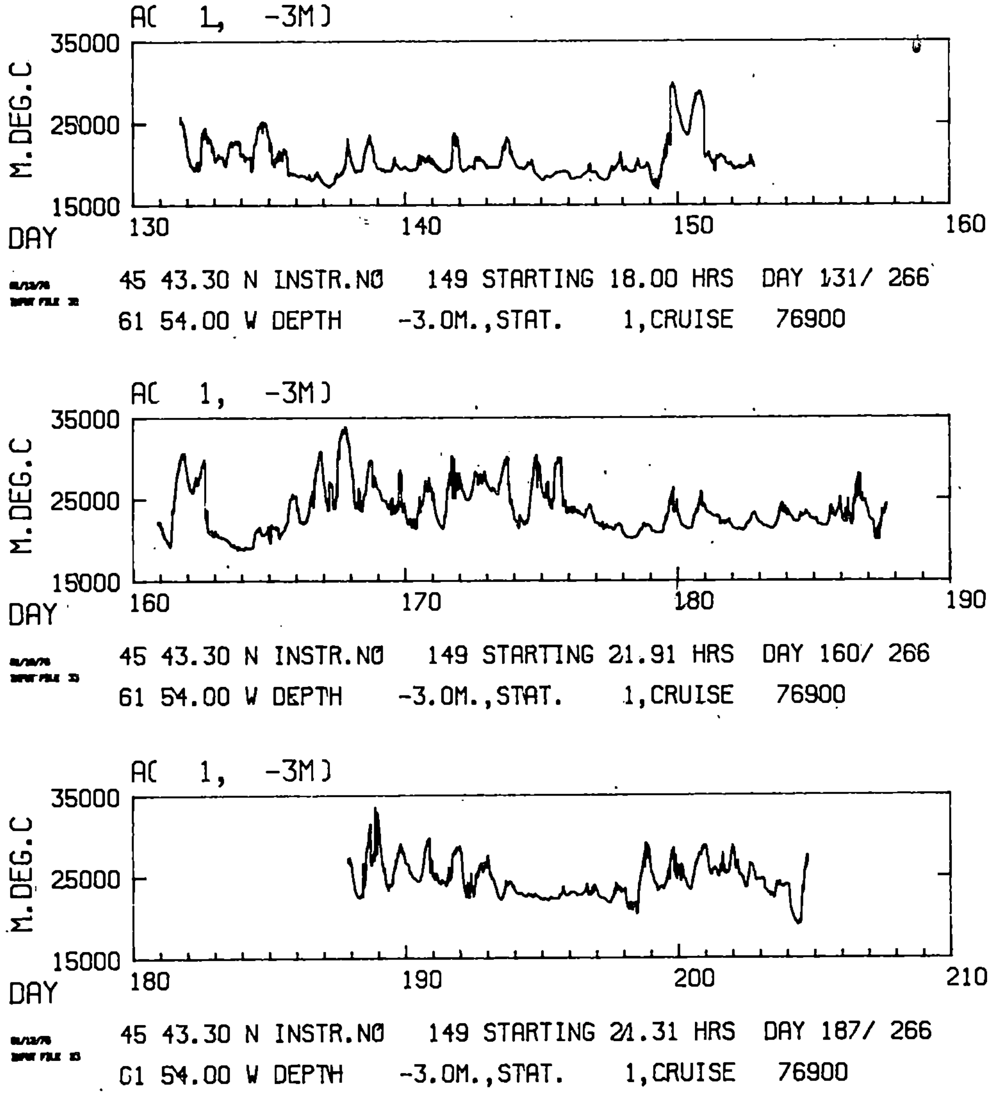

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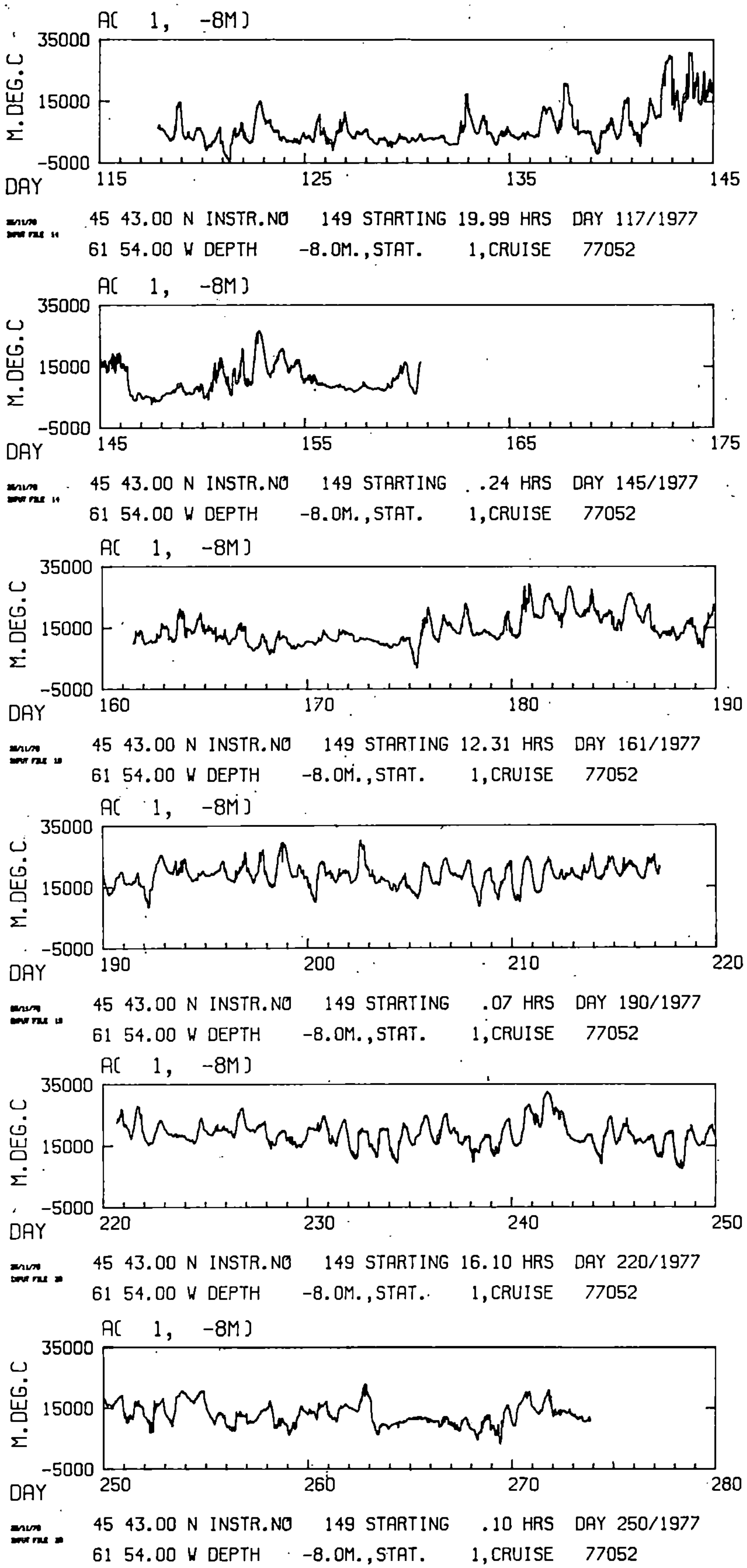

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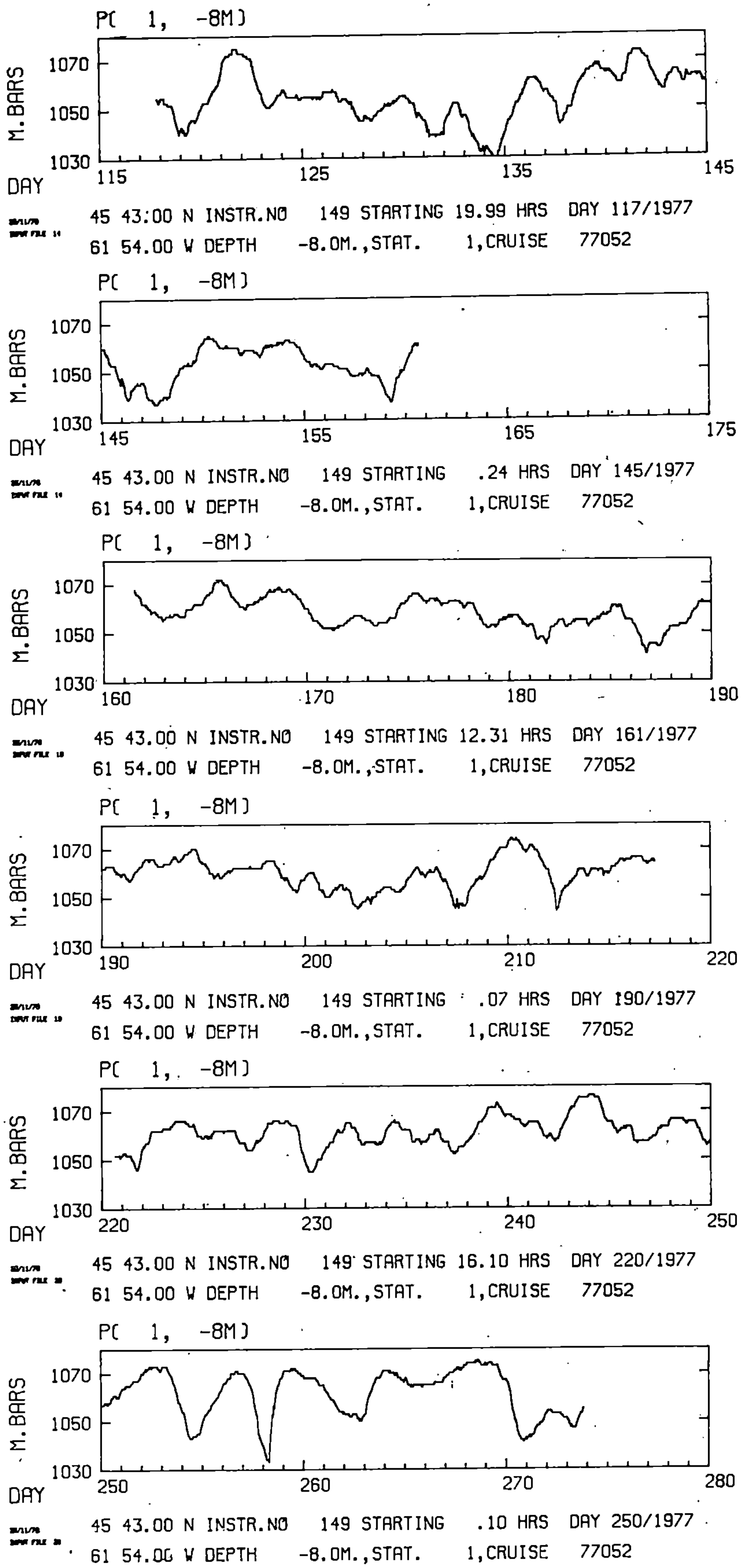

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