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# Batfish Sections Near the Edge of the Scotian Shelf, 1976-1977

Peter C. Smith, Valerie Evans Champagne,  
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April 1983

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**Canadian Technical Report of  
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No. 1**



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BATFISH SECTIONS NEAR THE EDGE OF THE SCOTIAN SHELF, 1976-1977

by

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Can. Tech. Rep. Hydrogr. Ocean Sci. 1: iii + 159 p.

ABSTRACT

Smith, P.C., Evans Champagne, V., Bennett, A.S., and Herman, A.W. 1983.

Batfish sections near the edge of the Scotian Shelf, 1976-1977.

Can. Tech. Rep. Hydrogr. Ocean Sci. 1: iii + 159 p.

Temperature (T), salinity (S) and density ( $\sigma_t$ ) data collected using Batfish near the Scotian Shelf break during 1976-77 are presented as oceanographic sections. For individual tows of roughly constant ( $\pm 10\%$ ) speed and direction, five sections (T, S and  $\sigma_t$  vs. depth plus T, S vs.  $\sigma_t$ ) as well as selected traces of T vs. S are given. Smoothed data sets have been archived by the Marine Environmental Data Service (MEDS), Ottawa.

RESUME

Smith, P.C., Evans Champagne, V., Bennett, A.S., and Herman, A.W. 1983.

Batfish sections near the edge of the Scotian Shelf, 1976-1977.

Can. Tech. Rep. Hydrogr. Ocean Sci. 1: iii + 159 p.

Des données sur la température (T), la salinité (S) et la densité ( $\sigma_t$ ) recueillies au moyen du Batfish près du talus du plateau Néo-Écossais en 1976-1977 sont présentées sous forme de profils océanographiques. Pour des remorquages dans des directions et à des vitesses approximativement constantes ( $\pm 10\%$ ) on présente cinq profils (T, S et  $\sigma_t$  en fonction de la profondeur ainsi que T et S en fonction de  $\sigma_t$  ainsi que T en fonction de S pour des tracés choisis. Des ensembles lissés de données ont été versés aux archives de la Direction des services des données sur le milieu marin (SDMM) à Ottawa.

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## INTRODUCTION

The Batfish is a variable-depth towed body equipped with a CTD and various other sensors and used for rapid underway profiling of the upper layers of the ocean. Since 1971, various investigators at the Bedford Institute have used Batfish to sample hydrographic and some biological (e.g. fluorescence) properties of the waters near the shelf break south of Halifax (cruises tabulated in Stepanczak and Bennett, 1979). Much of this activity was coordinated with the Shelf Break Dynamics Experiment (Lively, 1979 a,b; Smith and Petrie, 1982) or carried out shortly afterward (1978-79). Some of the 1977 Batfish data have been used, in conjunction with the moored measurements, to study small-scale mixing processes associated with  $M_2$  semi-diurnal tide at the shelf/slope water boundary (Herman and Denman, 1979).

The sections contained in this atlas display all of the usable Batfish data (representing slightly less than 200 hrs of towing) collected near the shelf break during 1976-77. The remainder of the data is reserved for a later volume. Smoothed data sets from which the sections were drawn have been archived by the Marine Environmental Data Service (MEDS) in Ottawa.

## DATA REDUCTION

The 1976-77 Batfish data were collected at a rate of 10 sets/second (sampling interval,  $\Delta=0.1s$ ) and logged on magnetic tape via the HP2100/21MX - based data acquisition system. The raw data were scaled according to laboratory calibrations, corrected for compressibility and thermal expansion of the conductivity cell and for nonlinearity in the copper thermometer, and edited for spikes in any parameter. Next, because of mismatched time constants of the temperature and conductivity sensors, the

conductivity channel was "slowed down" using a recursive digital filter of the form,

$$\hat{C}_i = \hat{a} \hat{C}_{i-1} + (1-a) C_i = (1-a) \sum_{n=0}^{i-1} a^n C_{i-n} \quad (1)$$

which was initialized to the first good conductivity value in the set.

This formula is the digital equivalent of a single pole filter with a time-constant (rate of change of phase at zero frequency) of

$$\tau = \frac{a\Delta}{1-a}. \quad (2)$$

For each cruise, the value of the parameter,  $a$ , was selected by minimizing the magnitude of residual salinity and density spikes in a subset of vertical profiles and then applied to all the conductivity data from that cruise. The relevant values for the 1976-77 cruises are given in Table 1.

After applying all of the above corrections, the estimated overall accuracies, apart from dynamic errors in high gradient regions, for the variables ( $T$ ,  $S$ ,  $\sigma_t$ ) are  $\pm (0.01^\circ\text{C}, 0.02\text{‰}, 0.02)$  while the precisions are typically  $\pm (0.01^\circ\text{C}, 0.01\text{‰}, 0.01)$  before smoothing.

In high gradient regions, residual salinity spikes as large as  $\pm 0.3\text{‰}$  ( $\pm 0.25$  in  $\sigma_t$ ) may occur. The smoothing reduces the peak effect to about  $\pm 0.05\text{‰}$  or  $\pm 0.04$  in  $\sigma_t$ .

In order to plot the data as sections, the continuous records were split into segments over which the course and speed of the ship were roughly constant ( $\pm 10\%$  and  $\pm 5^\circ$  based on intermediate fixes). All the variables were then smoothed using the filter (1) with the value of  $a = 0.909$

so that  $\tau = 10\Delta = 1$ s. The response function for this filter is compared to that for a typical time constant correction  $a = .35$  in Figure 1. The half-power point for the low-pass version occurs at a period of 3.5 s. After smoothing, the data were contoured as described in the next section.

#### GRAPHICAL PRESENTATION

Five different sections were used to display the characteristics of each suitable segment of Batfish data:

- a)  $T(^{\circ}\text{C})$  on (time and distance) vs. depth, ( $\text{contour interval, } \Delta T = 2.0^{\circ}\text{C}$ )
- b)  $S(^{\circ}/\text{oo})$  on (time and distance) vs. depth, ( $\Delta S = 0.5^{\circ}/\text{oo}$ )
- c)  $\sigma_t$  on (time and distance) vs. depth, ( $\Delta \sigma_t = 0.5$ )
- d)  $T(^{\circ}\text{C})$  on (time and distance) vs.  $\sigma_t$ , ( $\Delta T = 1^{\circ}\text{C}$ )
- e)  $S(^{\circ}/\text{oo})$  on (time and distance) vs.  $\sigma_t$ , ( $\Delta S = 0.2^{\circ}/\text{oo}$ )

These plots along with a tow track and selected T-S traces appear on opposite pages in the report. On each section, the extremities of the Batfish cycles are indicated. The vertical profiles used for the T-S diagram are indicated by longer marks at the bottoms of the appropriate cycles on each section and are labelled on Section a). Note that one advantage of the procedure used to segment the tows is the equivalence of the time and distance axes via the constant ship speed, which may be calculated from the start- and end-fixes in Table 2 below. As a convenient reference, Table 2 also provides original tow number designations and locations (page numbers) for the 1976-77 sections presented in this report.

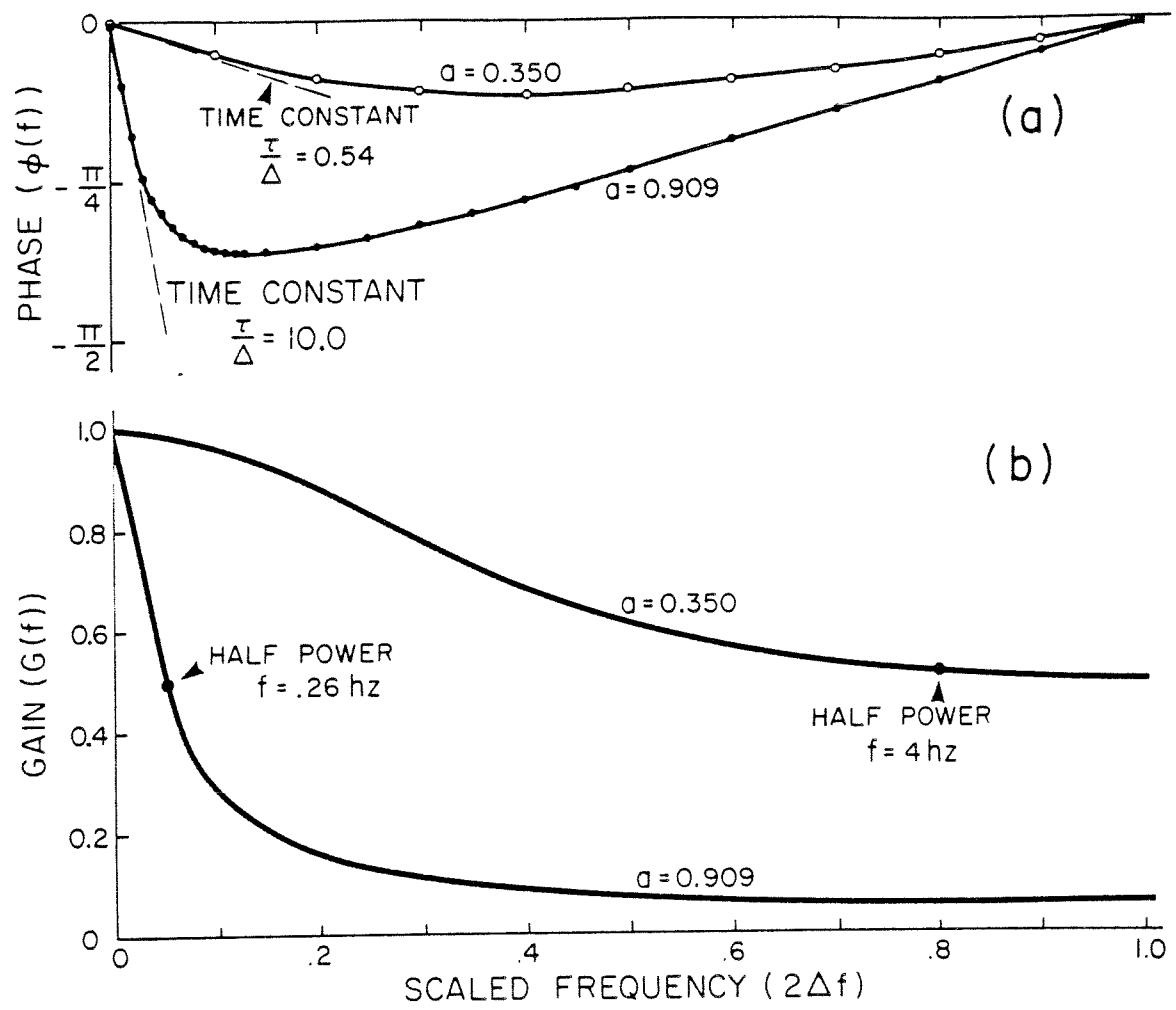


Figure 1 Response functions for typical time-constant corrections ( $a=0.35$ ) applied to conductivity channel and one second smoothing ( $a=0.909$ ) applied to all channels. (a) Phase, (b) Gain.

ACKNOWLEDGEMENTS

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TABLE 1

Parameters for Time Constant Correction Filters Applied to 1976-77 Batfish

Data

Cruise	a	$\tau/\Delta$
76013	.32	0.47
76020	.35	0.54
76033	"	"
77007	"	"
77017	.30	0.43

TABLE 2

## Batfish Sections Near the Scotian Shelf Break, 1976-1977

Cruise No.	Date	Year Day	GMT	Start - End Fixes		Page No.	Comments
				N. Lat.	W. Long.		
76013	May 23-24, 1976	144 -145	2221 0225	42° 22.5' 42° 56.0'	63° 22.1' 63° 31.0'	16	Tow 53, Leg 1
	May 24, 1976	145 -145	0225 0430	42° 56.0' 42° 39.0'	63° 31.0' 63° 26.0'	18	" , Leg 2
"		145 -145	0430 0645	42° 39.0' 42° 56.0'	63° 26.0' 63° 31.0'	20	" , Leg 3
"		145 -145	0645 1104	42° 56.0' 42° 23.7'	63° 31.0' 63° 24.2'	22	" , Leg 4
May 26-27, 1976	147 -147 -148	1804 2238 0300	43° 48.8' 43° 23.7' 42° 43.0'	63° 46.0' 63° 20.8' 63° 28.2'	24	Tow 77, Leg 1*	
May 27, 1976	148 -148 -148	0300 0738 1142	42° 43.0' 43° 23.7' 43° 48.8'	63° 28.2' 63° 20.8' 62° 46.0'	26	" , Leg 2*	
76020	July 3, 1976	185 -185	0143 0315	42° 24.5' 42° 24.3'	63° 25.5' 63° 07.8'	28	Tow 4 , Leg 1
"		185 -185	0315 0515	42° 24.3' 42° 40.6'	63° 07.8' 63° 00.0'	30	" , Leg 2
"		185 -185	0515 0731	42° 40.6' 42° 40.8'	63° 00.0' 63° 31.4'	32	" , Leg 3
July 6, 1976	188 -188	0315 0527	42° 39.6' 42° 59.7'	63° 19.8' 63° 20.0'	34	Tow 7 , Leg 1	

\* "dog leg" section consisting of two straight segments

Table 2 - Continued

Cruise No.	Date	Start - End Fixes				Page No.	Comments
		Year Day	GMT	N. Lat.	W. Long.		
76020	July 6, 1976	188 -188	0916 1020	42° 42.5' 42° 51.8'	63° 39.0' 63° 47.7'	36	Tow 7, Leg 2
	July 8, 1976	190 -190	1933 2212	42° 31.5' 42° 58.0'	63° 53.8' 63° 47.7'	38	Tow 8, Leg 1
	July 8-9, 1976	190 -191	2225 0145	42° 59.5' 42° 30.3'	63° 46.8' 63° 51.7'	40	" , Leg 2
	July 9, 1976	191 -191	0200 0515	42° 29.4' 42° 58.2'	63° 48.8' 63° 43.7'	42	" , Leg 3
		191 -191	0545 0845	42° 58.2' 42° 31.6'	63° 41.9' 63° 46.6'	44	" , Leg 4
"		191 -191	0915 1515	42° 31.2' 43° 28.3'	63° 43.5' 63° 35.0'	46	" , Leg 5
"		191 -191	1645 2300	43° 28.3' 42° 31.8'	63° 19.4' 63° 18.8'	48	Tow 9, Leg 6
	July 9-10, 1976	191 -192	2330 0245	42° 29.5' 42° 58.8'	63° 16.5' 63° 16.5'	50	" , Leg 7
	July 10, 1976	192 -192	0307 0615	43° 01.8' 42° 32.5'	63° 15.8' 63° 14.9'	52	" , Leg 8
	"	192 -192	0700 0945	42° 32.5' 42° 58.2'	63° 11.6' 63° 12.9'	54	" , Leg 9

Table 2 - Continued

Cruise No.	Date	Start Fixes				Page No.	Comments
		Year Day	GMT	- End Fixes	N. Lat.	W. Long.	
76020	July 10, 1976	192 -192	1015 1300	42° 58.9' 42° 32.3'	63° 10.8' 63° 09.2'	56	Tow 9, Leg 10
		192 -192	1330 1645	42° 29.4' 42° 58.5'	63° 06.8' 63° 09.0'	58	" , Leg 11
		192 -192	1715 2015	42° 58.3' 42° 30.0'	63° 07.0' 63° 04.5'	60	" , Leg 12
		193 -193	1442 1637	42° 41.0' 42° 58.9'	63° 20.0' 63° 20.2'	62	Tow 11
		193 -193	1822 2108	42° 57.7' 42° 36.9'	63° 20.2' 63° 20.2'	64	Tow 12
		193 -194	2310 0155	42° 39.6' 43° 03.7'	63° 19.4' 63° 19.5'	66	Tow 13
		195 -195	0340 0500	42° 40.0' 42° 40.7'	63° 19.1' 63° 02.6'	68	Tow 16, Leg 1
		195 -195	0500 0648	42° 40.7' 42° 42.8'	63° 02.6' 63° 25.9'	70	" , Leg 2
		195 -195	0648 0837	42° 42.8' 42° 45.2'	63° 25.9' 63° 03.7'	72	" , Leg 3
		195 -195	0837 1032	42° 45.2' 42° 47.4'	63° 03.7' 63° 26.7'	74	" , Leg 4

Table 2 - Continued

Cruise No.	Date	Start - End Fixes			Page No.	Comments	
		Year Day	GMT	N. Lat.			
76020	July 13, 1976	195 -195	1032 1147	42° 47.4' 42° 48.0'	63° 26.7' 63° 11.3'	76	Tow 16, Leg 5
"	"	195 -195	1232 1417	42° 49.8' 42° 50.8'	63° 04.4' 63° 26.3'	78	" , Leg 6
"	"	195 -195	1417 1558	42° 50.8' 42° 52.9'	63° 26.3' 63° 03.2'	80	" , Leg 7
"	"	195 -195	1558 1747	42° 52.9' 42° 54.5'	63° 03.2' 63° 27.0'	82	" , Leg 8
"	"	195 -195	1747 1932	42° 54.5' 42° 56.8'	63° 27.0' 63° 04.0'	84	" , Leg 9
"	"	195 -195	1932 2107	42° 56.8' 42° 57.2'	63° 04.0' 63° 26.5'	86	" , Leg 10
"	"	195 -195	2107 2253	42° 57.2' 43° 02.0'	63° 26.5' 63° 05.3'	88	" , Leg 11
July 13-14, 1976	195 -196	2253 0032	43° 02.0' 43° 02.7'	63° 05.3' 63° 24.6'	90	" , Leg 12	
July 14, 1976	196 -196	0032 1007	43° 02.7' 44° 09.3'	63° 24.6' 63° 57.2'	92	" , Leg 13	
76033	Oct. 13-14, 1976	287 -288	2301 0447	43° 29.1' 42° 30.3'	63° 24.6' 63° 24.9'	94	Tow 1

Table 2 - Continued

Cruise No.	Date	Start Fixes			Page No.	Comments	
		Year Day	GMT	N. Lat.			
76033	Oct. 15, 1976	289 -289	0012 0402	42° 54.8' 42° 21.0'	63° 25.5' 63° 24.4'	96	Tow 2
	Oct. 20, 1976	294 -284	0048 0212	42° 55.4' 42° 55.2'	63° 22.0' 63° 00.0'	98	Tow 4, Leg 1 Poor quality data start of section
	"	294 -294	0245 0417	42° 49.5' 42° 50.0'	63° 00.3' 63° 23.9'	100	Tow 4, Leg 2
	"	294 -294	0441 0558	42° 44.9' 42° 44.2'	63° 23.7' 63° 00.1'	102	" , Leg 3
	"	294 -294	0625 0812	42° 40.0' 42° 39.9'	63° 00.9' 63° 23.7'	104	" , Leg 4
77007	May 7, 1977	127 -127	1922 0037	42° 31.0' 43° 01.3'	63° 23.8' 63° 25.3'	106	Tow 66
	May 8, 1977	128 -128	0127 0439	42° 59.5' 42° 39.7'	63° 25.2' 63° 24.0'	108	Tow 67, Leg 1
	"	128 -128	0439 0805	42° 39.7' 43° 00.0'	63° 24.0' 63° 24.7'	110	" , Leg 2
	"	128 -128	0925 1240	42° 59.2' 42° 39.2'	63° 24.6' 63° 25.1'	112	Tow 68, Leg 1
	"	128 -128	1240 1544	42° 39.2' 43° 00.5'	63° 25.1' 63° 25.0'	114	" , Leg 2

Table 2 - Continued

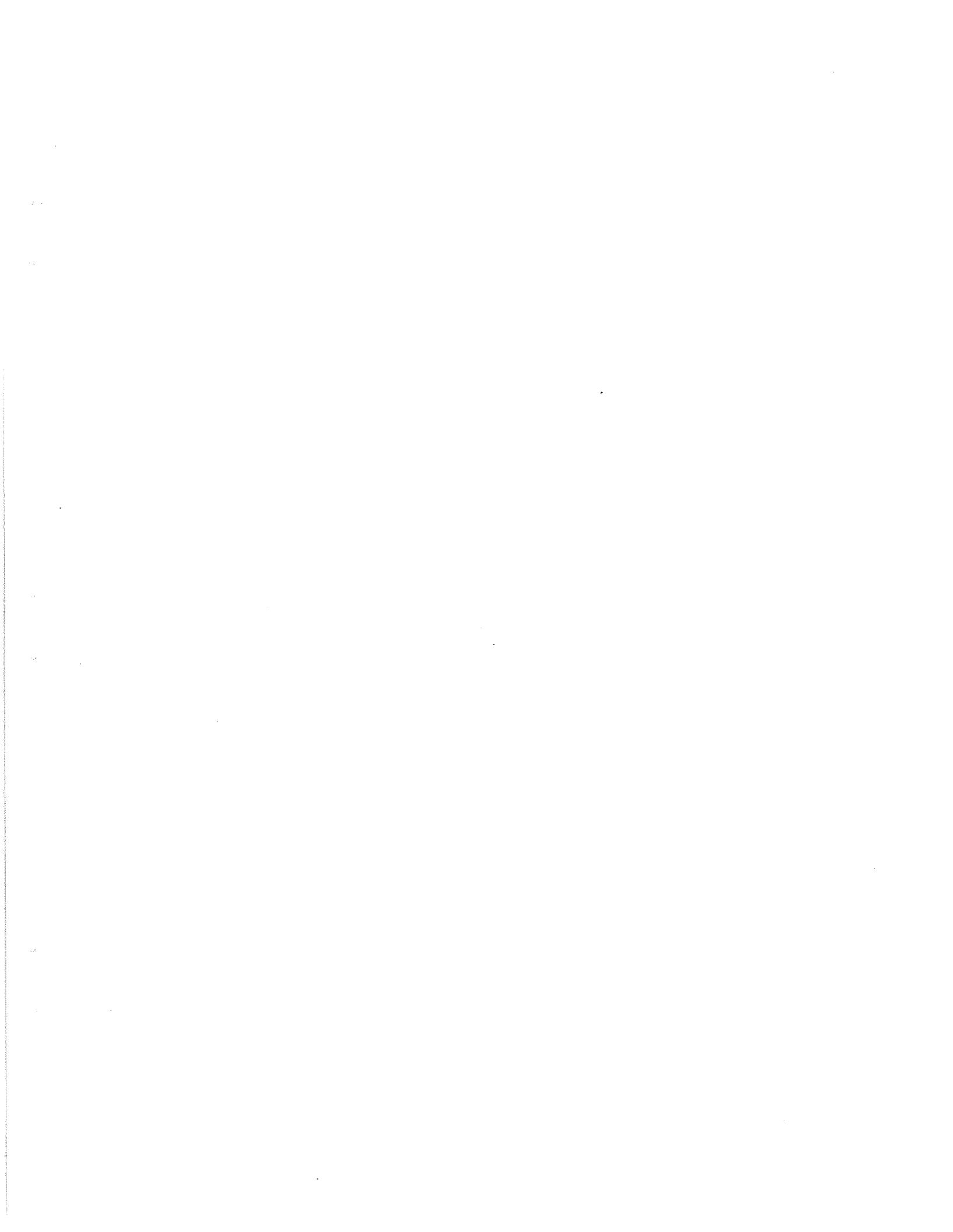
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77007	May 8, 1977	128	1628	42° 56.6'	63° 24.9'	116	Tow 69, Leg 1
		-128	1902	42° 39.9'	63° 25.1'		
" "		128	1917	42° 40.2'	63° 24.6'	118	Tow 70, Leg 1
		-128	2223	42° 59.3'	63° 24.5'		
May 8-9, 1977		128	2323	43° 02.3'	63° 24.0'	120	Tow 71, Leg 1
		-129	0241	42° 42.8'	63° 24.2'		
77017	July 8, 1977	189	0129	43° 58.3'	62° 50.8'	122	Tow 1003, Leg 1
		-189	0548	43° 16.6'	63° 26.3'		
"		189	0548	43° 16.6'	63° 26.3'	124	" , Leg 2
		-189	0847	42° 40.0'	63° 24.8'		
"		189	0847	42° 40.0'	63° 24.8'	126	" , Leg 3
		-189	0950	42° 50.7'	63° 25.5'		
July 9, 1977		190	0334	42° 42.6'	63° 24.4'	128	Tow 1006, Leg 1
		-190	0521	43° 00.0'	63° 25.0'		
"		190	0521	43° 00.0'	63° 25.0'	130	" , Leg 2
		-190	0710	42° 39.2'	63° 24.5'		
"		190	0710	42° 39.2'	63° 24.5'	132	" , Leg 3
		-190	0842	42° 58.6'	63° 24.6'		
July 10-11, 1977		191	2119	42° 10.6'	63° 25.2'	134	Tow 1007, Leg 1
		-192	0007	42° 45.0'	63° 25.0'		

Table 2 - Continued

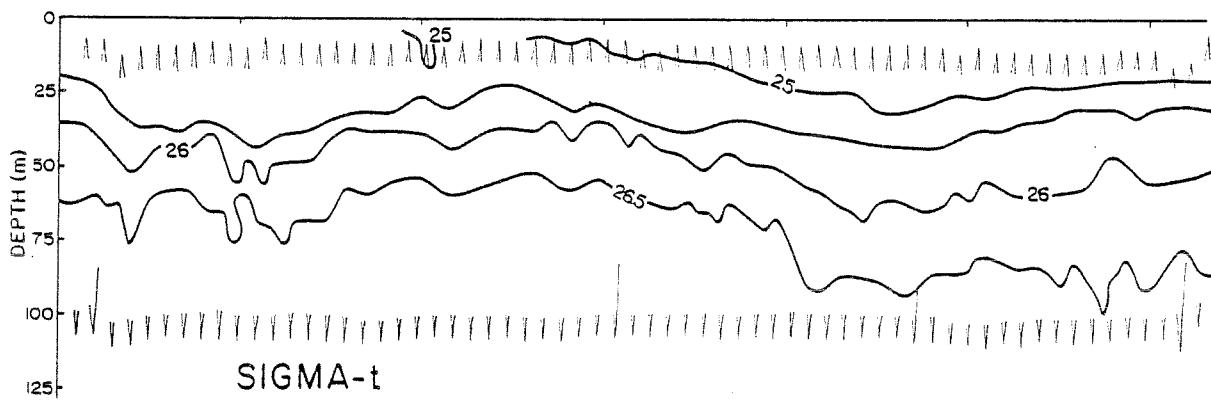
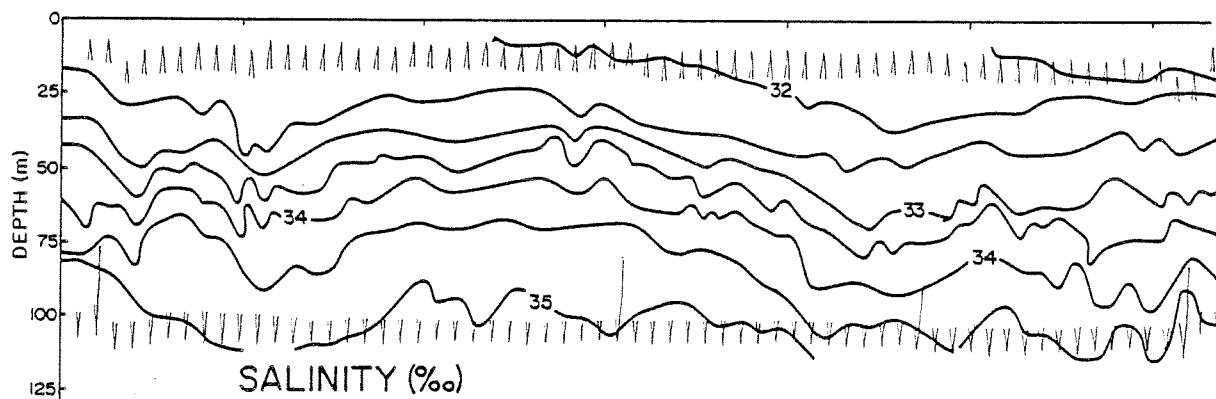
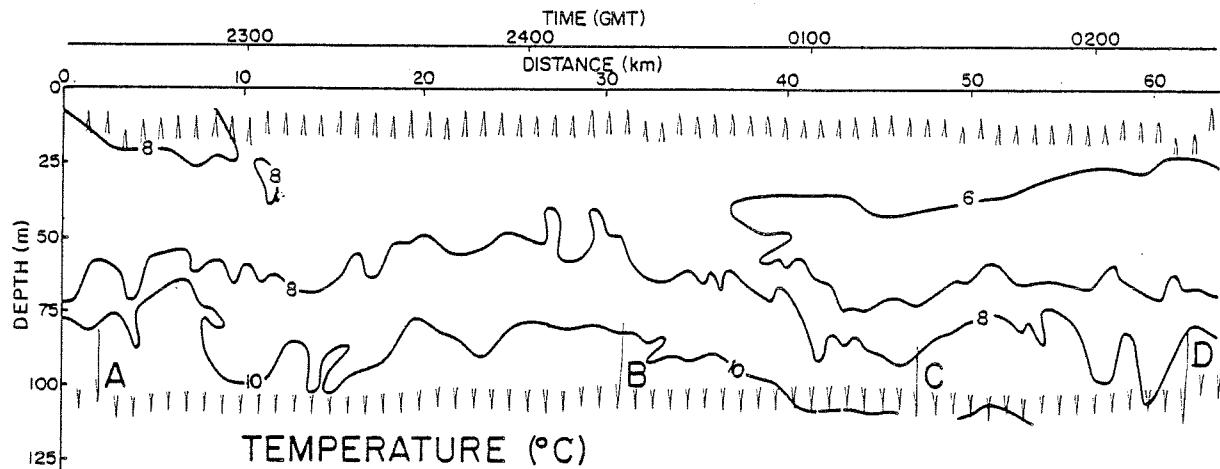
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77017	July 11, 1977	192 -192	0049 0249	42° 45.0' 42° 20.0'	63° 35.0' 63° 35.0'	136	Tow 1007, Leg 2
"	"	192 -192	0310 0520	42° 20.0' 42° 48.0'	63° 40.5' 63° 40.0'	138	" , Leg 3
"	"	192 -192	0535 0742	42° 48.0' 42° 19.3'	63° 45.0' 63° 44.5'	140	" , Leg 4
"	"	192 -192	0804 1012	42° 20.6' 42° 47.8'	63° 50.0' 63° 50.5'	142	" , Leg 5
"	"	192 -192	1028 1245	42° 47.3' 42° 20.0'	63° 54.5' 63° 55.0'	144	" , Leg 6
"	"	192 -192	1305 1507	42° 20.0' 42° 44.4'	64° 00.0' 64° 00.0'	146	" , Leg 7
July 11-12, 1977		192 -193	2328 0106	42° 33.1' 42° 15.4'	63° 35.6' 63° 35.1'	148	Tow 1009, Leg 1
July 12, 1977		193 -193	0433 0548	42° 19.0' 42° 36.6'	63° 28.0' 63° 28.0'	150	" , Leg 2
"	"	193 -193	0612 0740	42° 35.5' 42° 20.3'	63° 19.5' 63° 18.5'	152	" , Leg 3
"	"	193 -193	0753 0918	42° 21.8' 42° 39.3'	63° 15.0' 63° 14.3'	154	" , Leg 4

Table 2 - Continued

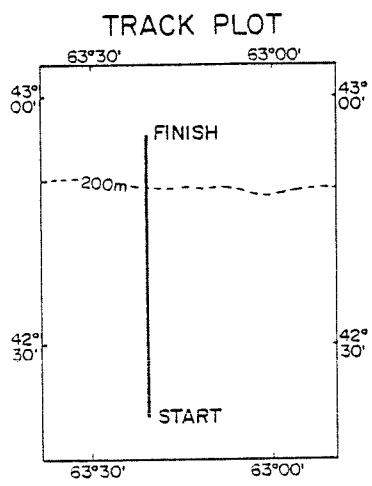
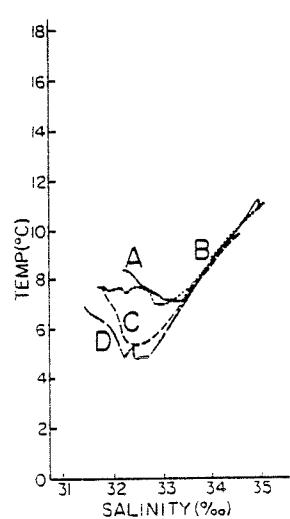
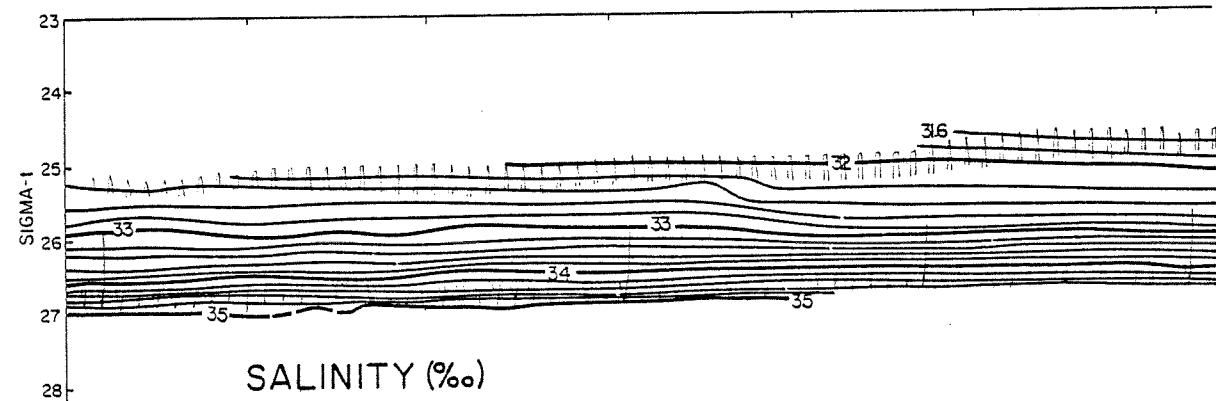
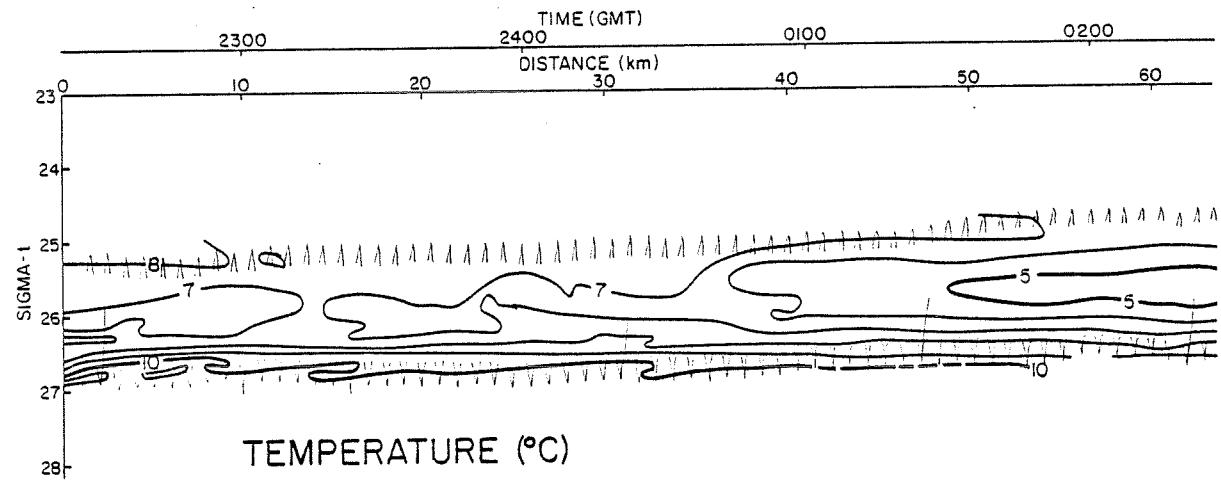
Cruise No.	Date	Start - End Fixes			Page No.	Comments	
		Year Day	GMT	N. Lat. W. Long.			
77017	July 12, 1977	193	0934	42° 38.6'	63° 09.7'	156	Tow 1009, Leg 5
		-193	1105	42° 20.0'	63° 09.7'		
		193	1123	42° 20.0'	63° 05.0'	158	" , Leg 6
		-193	1305	42° 40.0'	63° 04.0'		



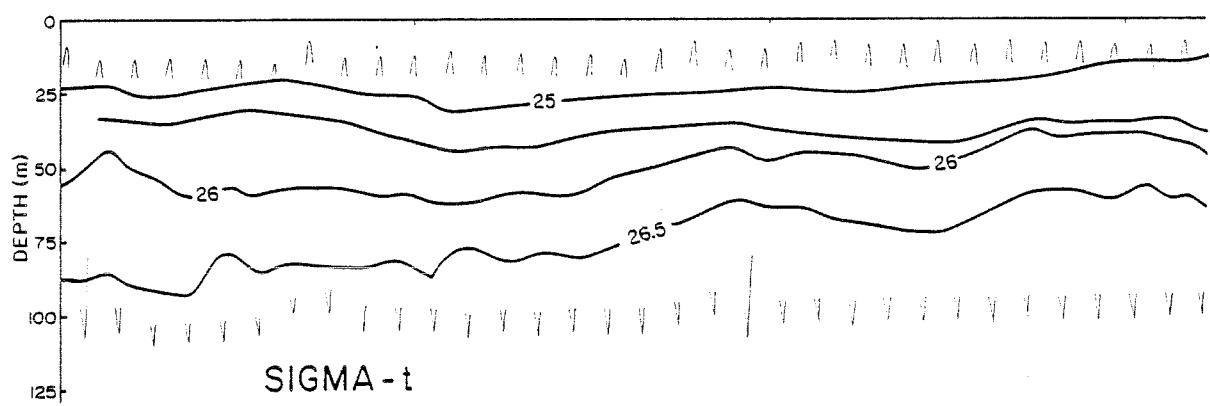
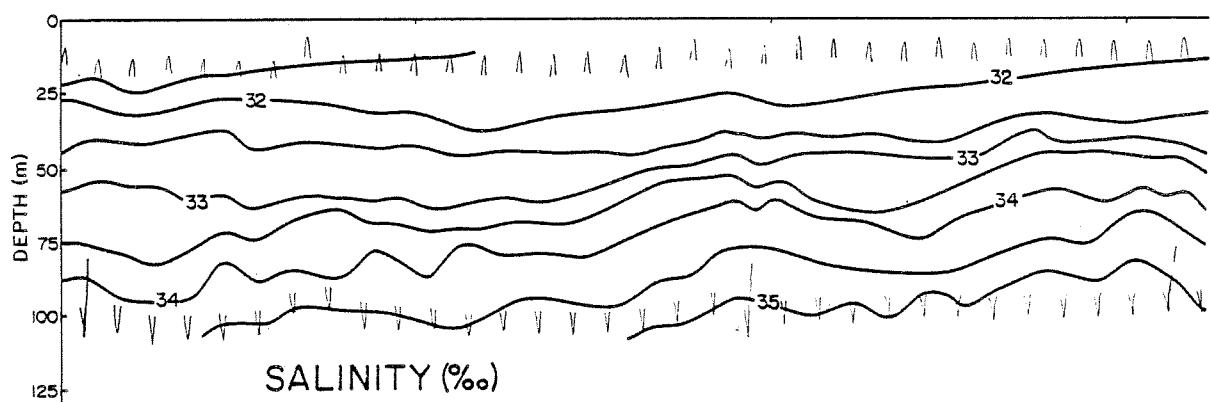
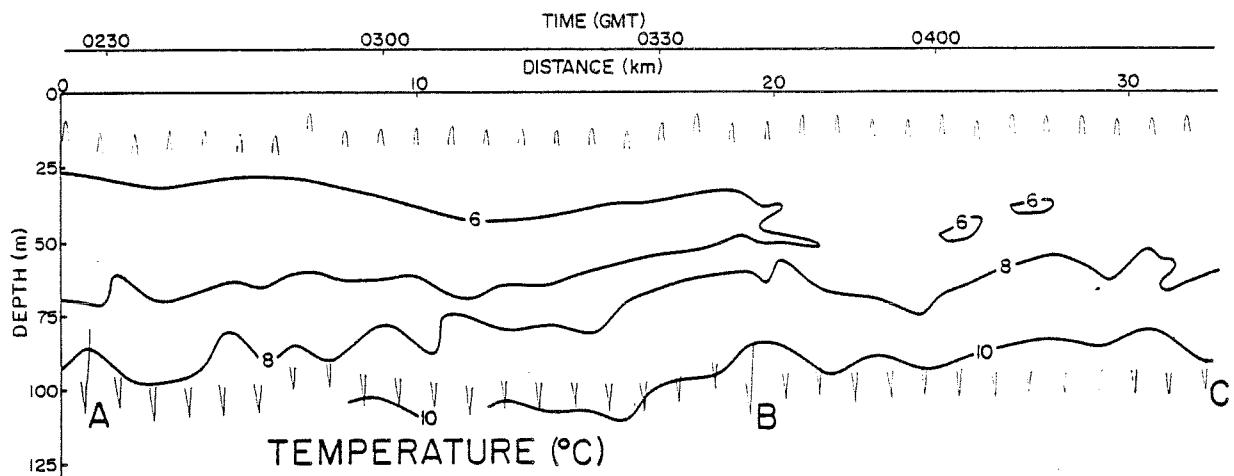
## CRUISE 76013 MAY 23-24, 1976



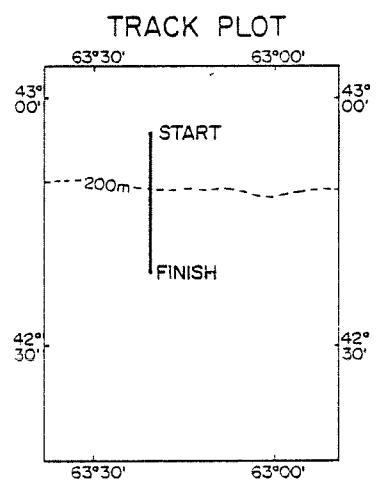
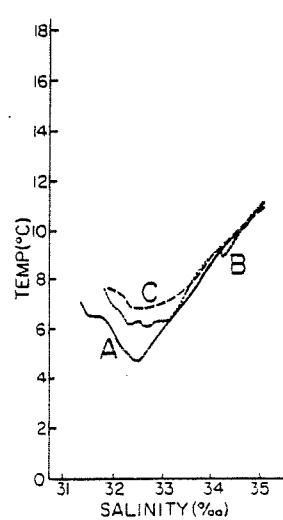
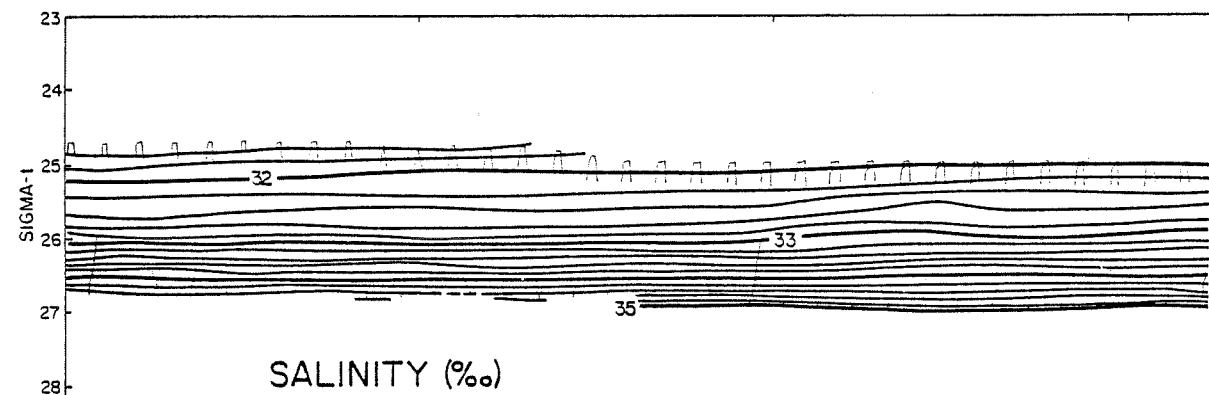
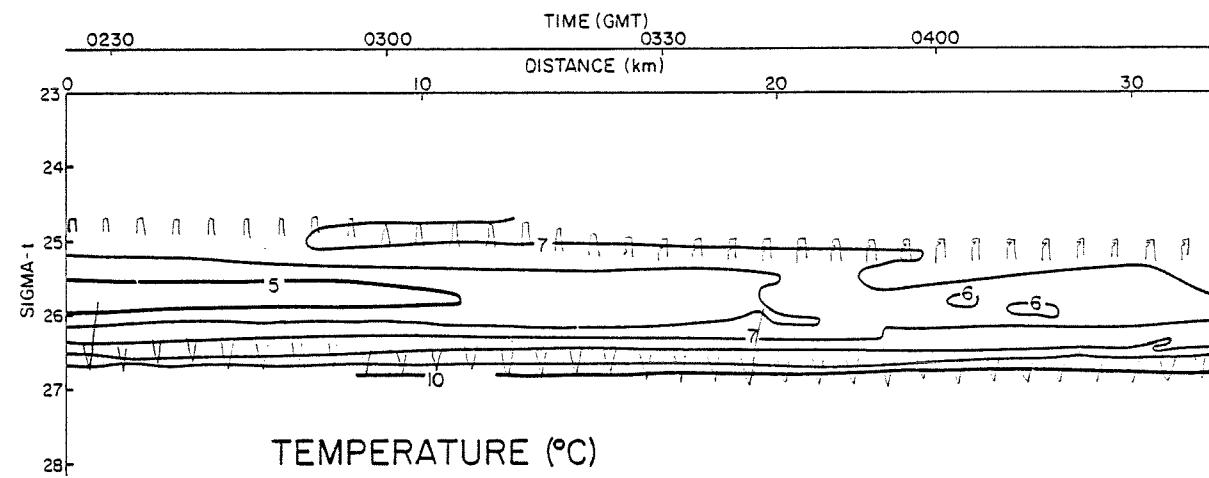
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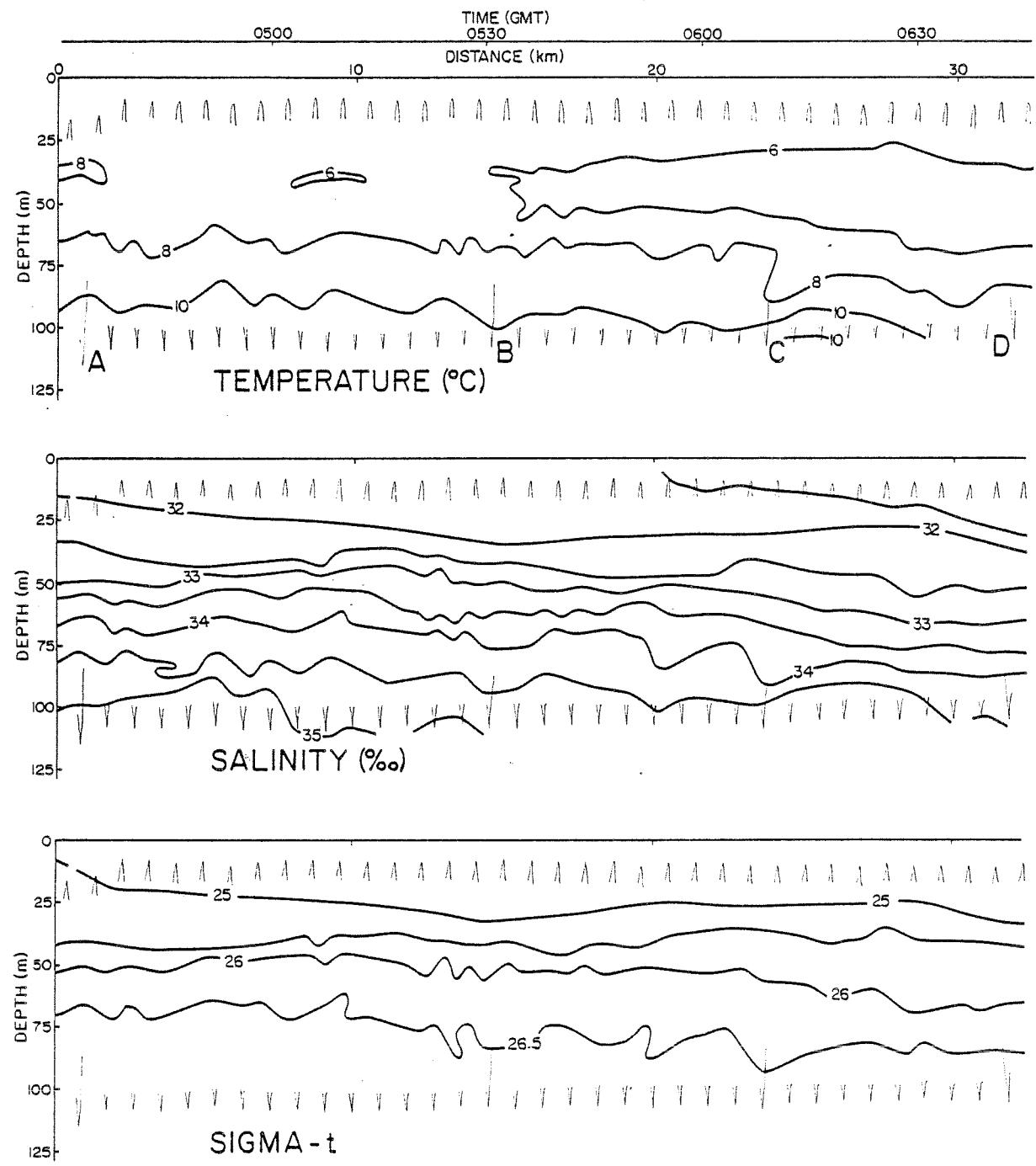
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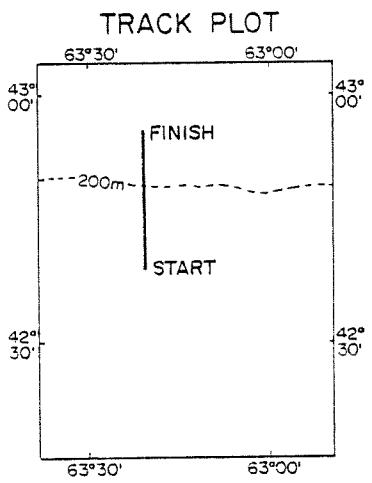
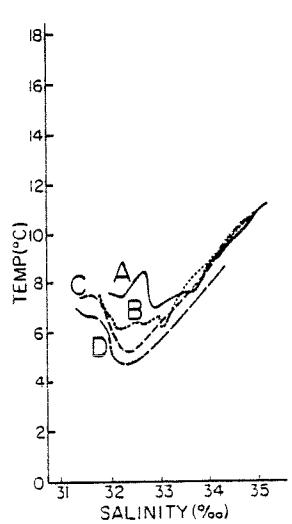
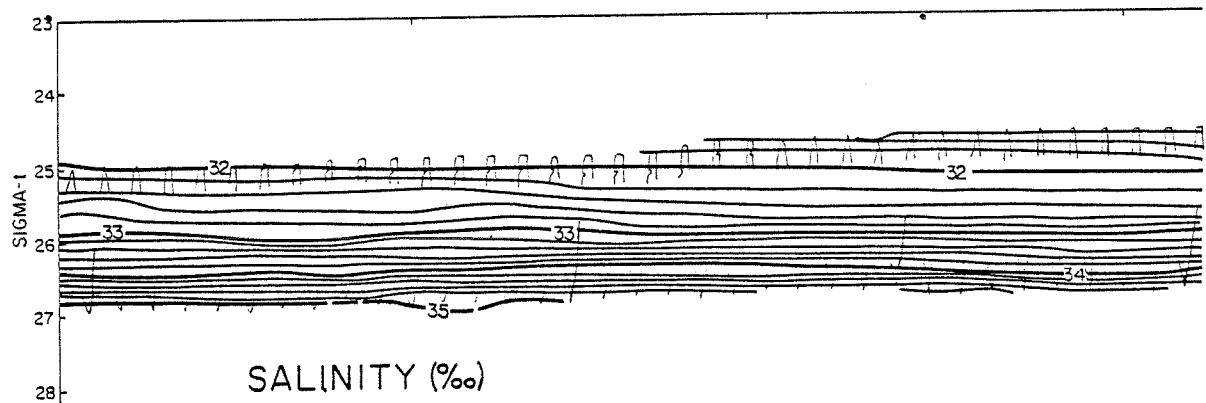
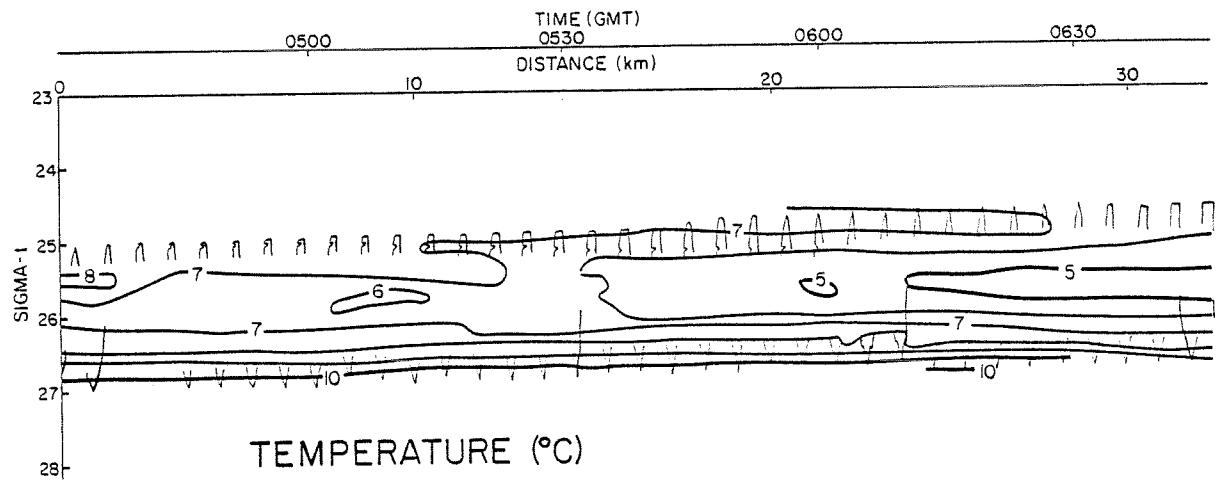
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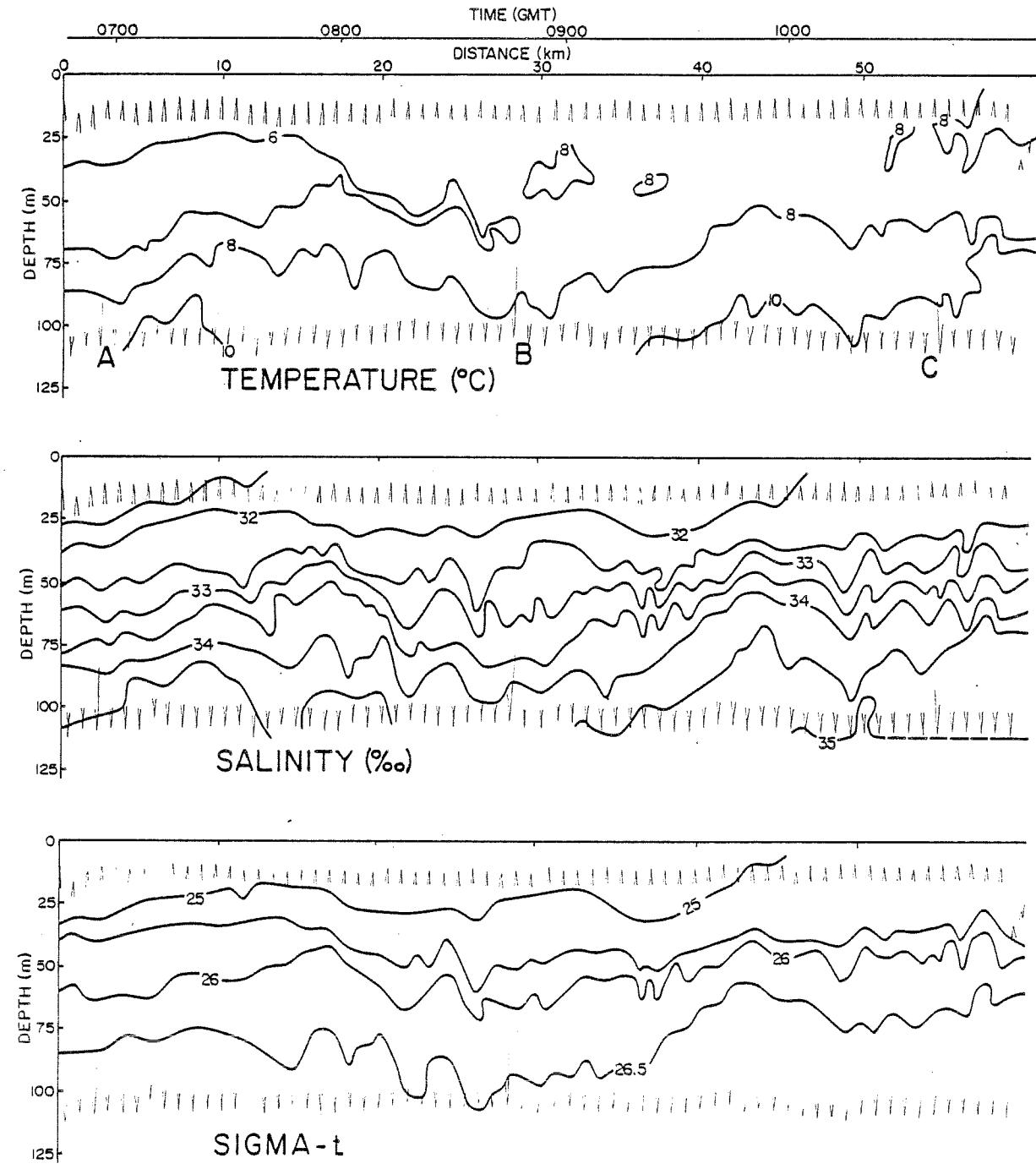
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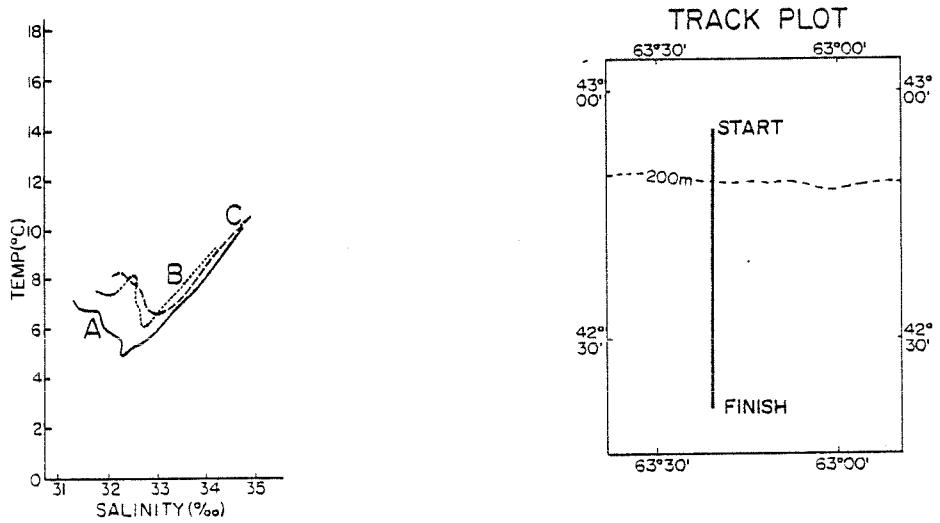
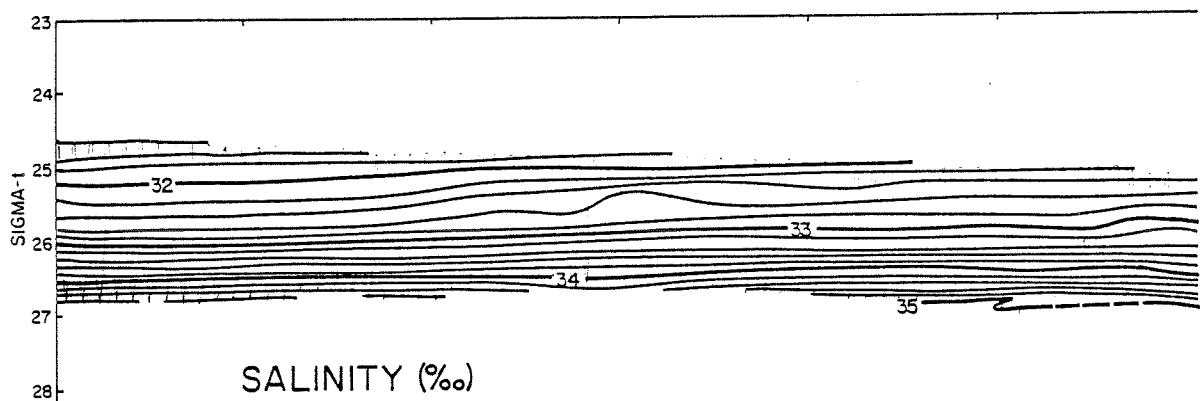
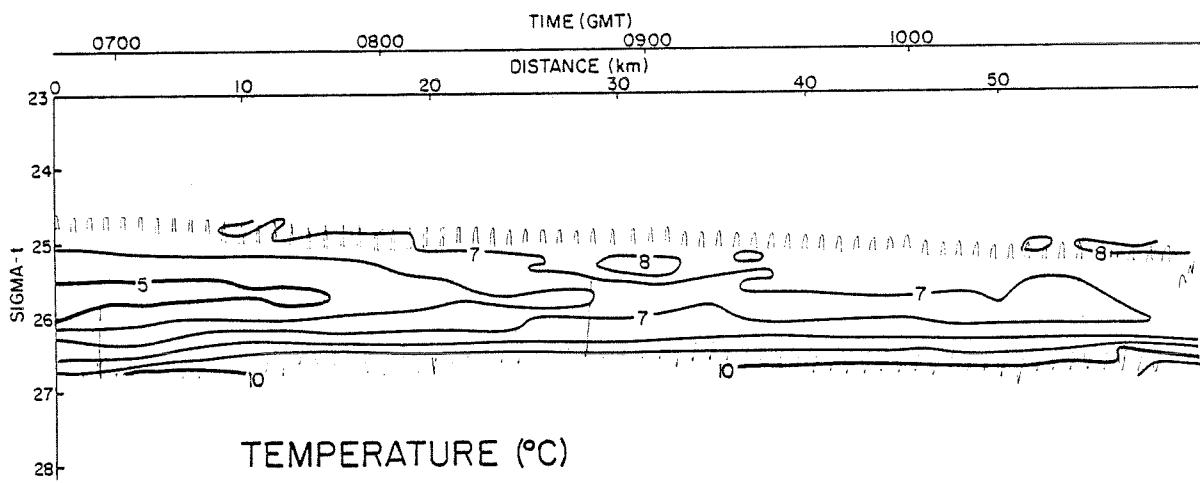
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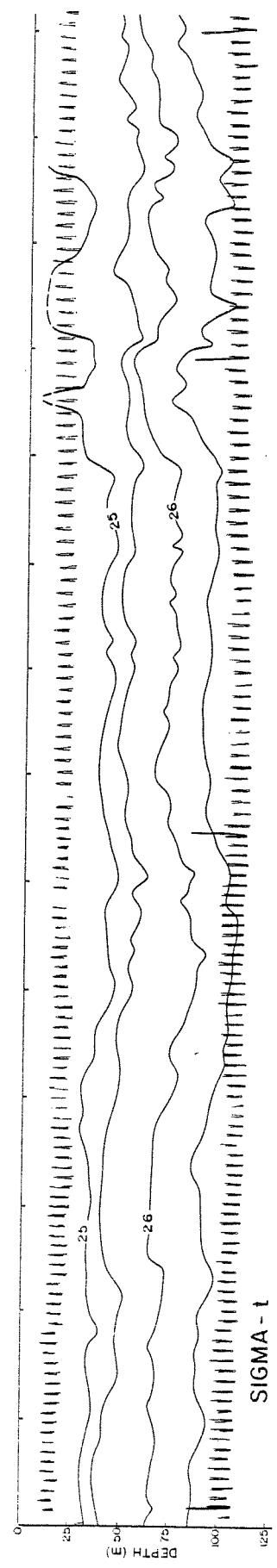
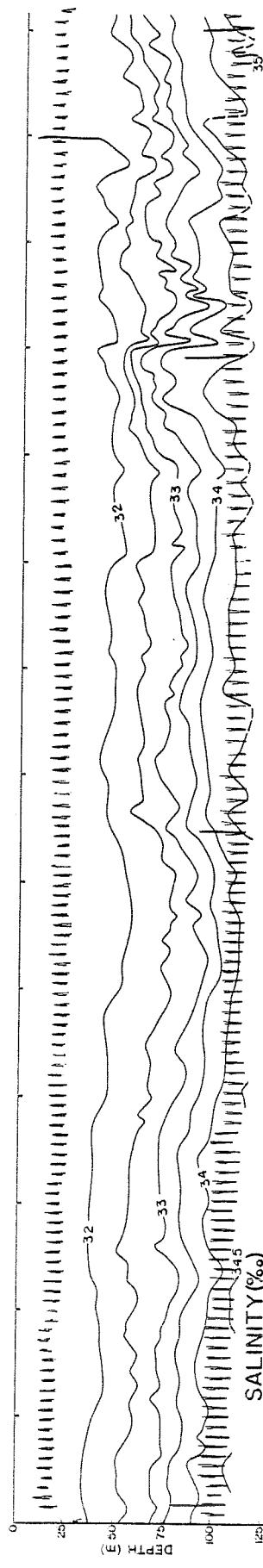
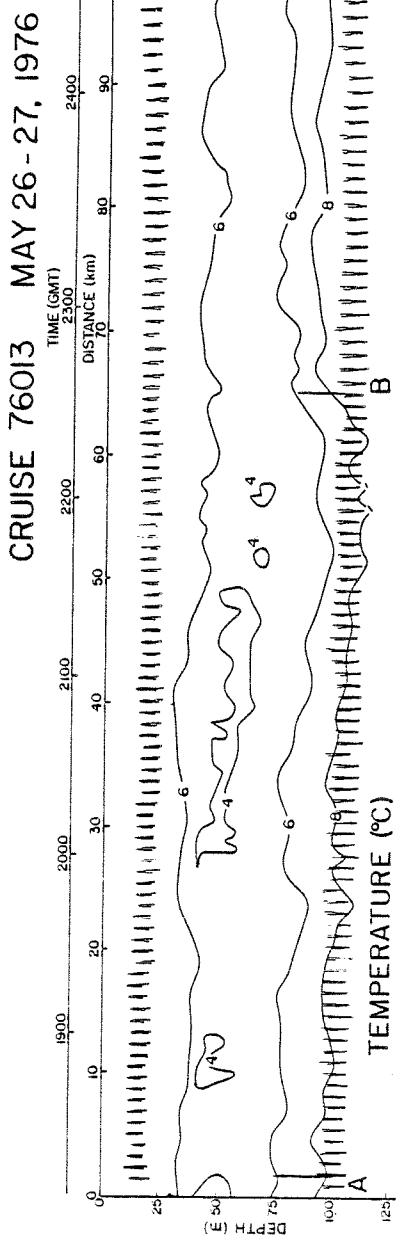


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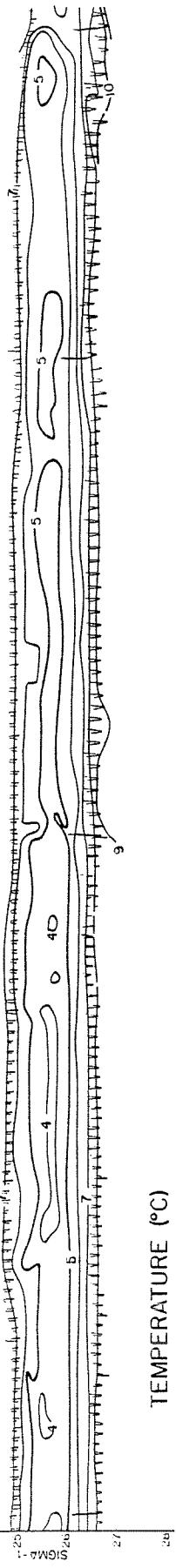


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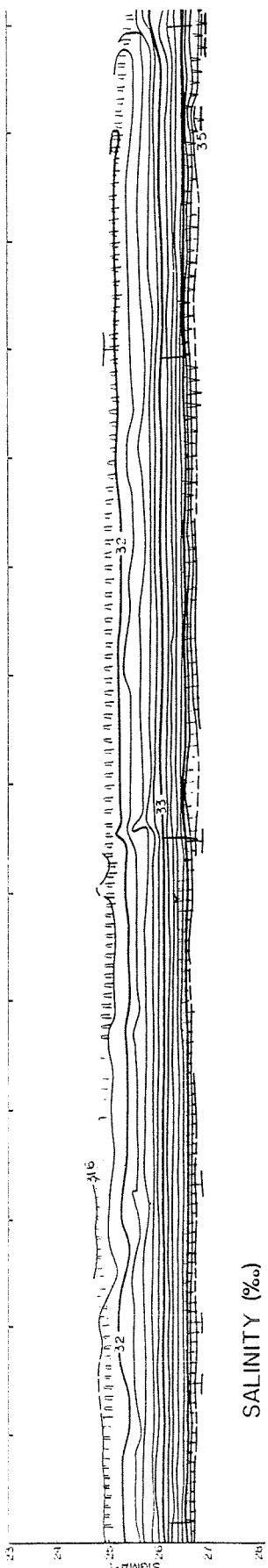


CRUISE 76013 MAY 26 - 27, 1976

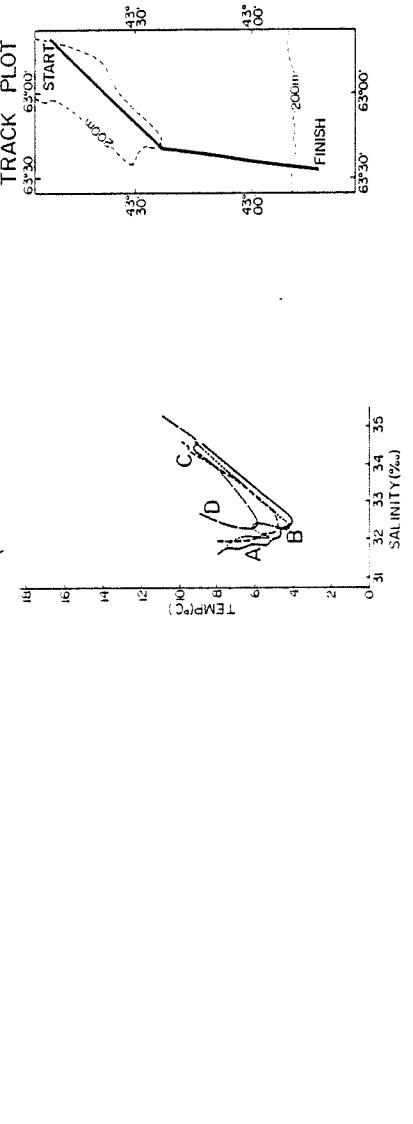


TEMPERATURE (°C)

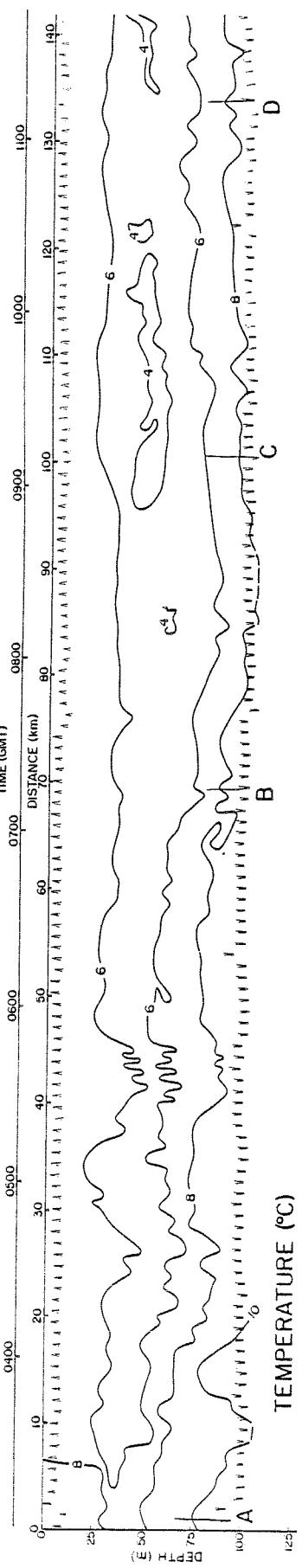
25



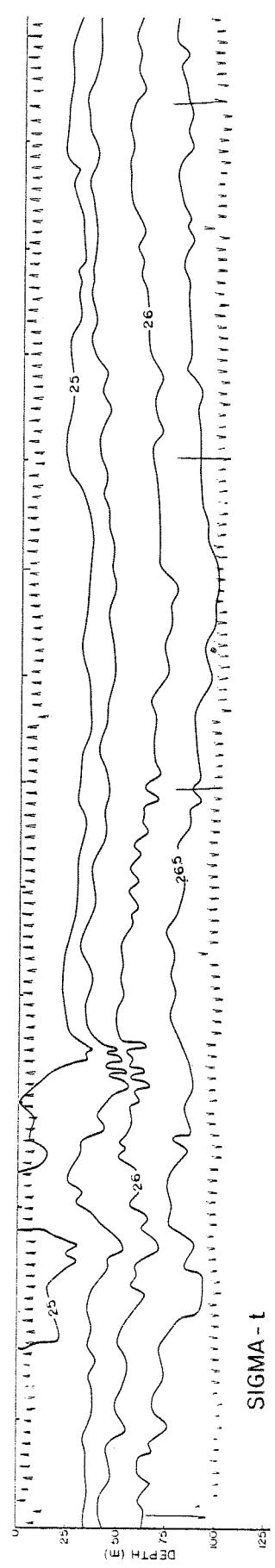
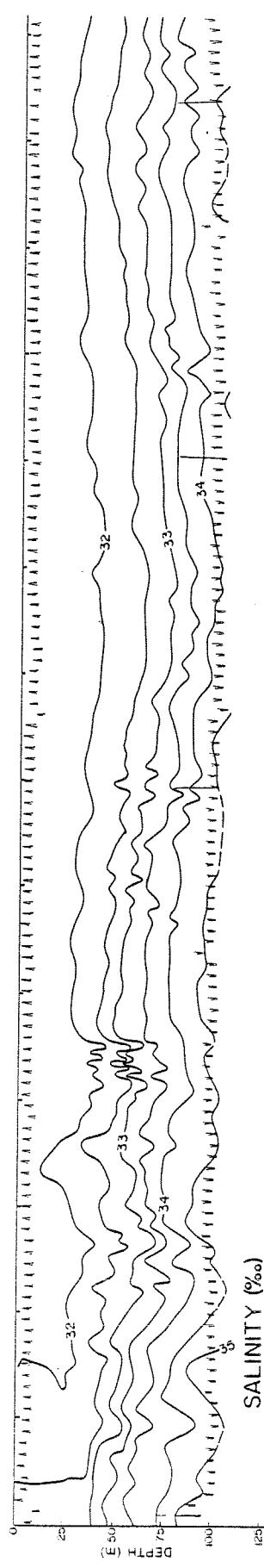
SALINITY (%)



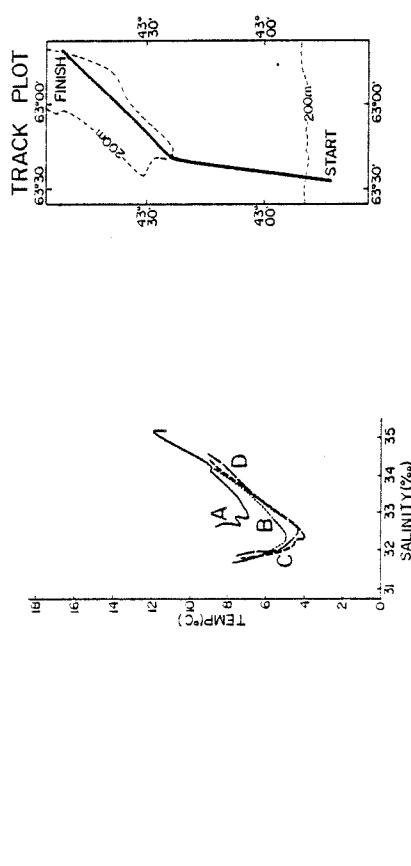
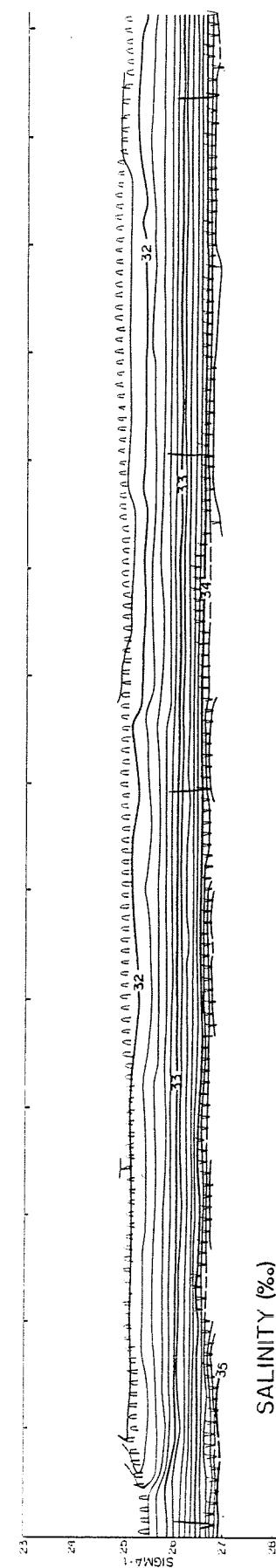
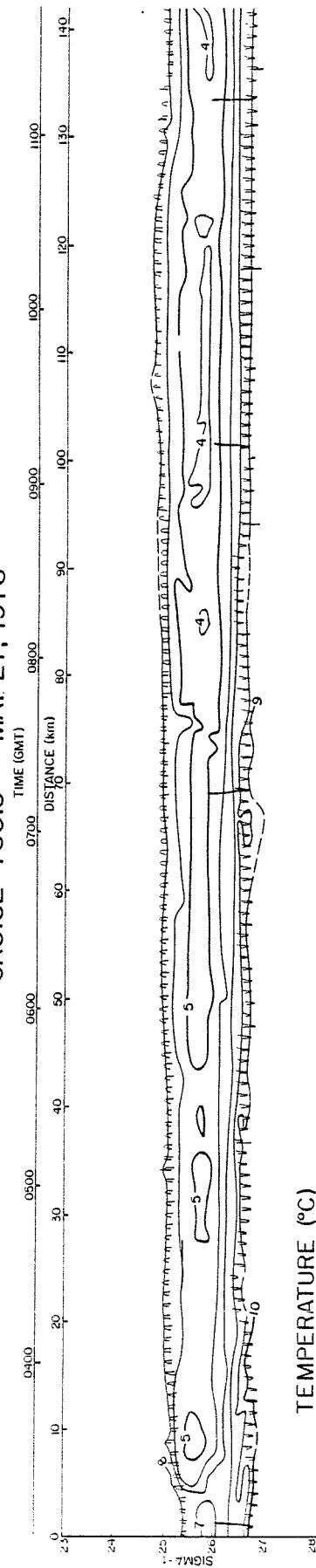
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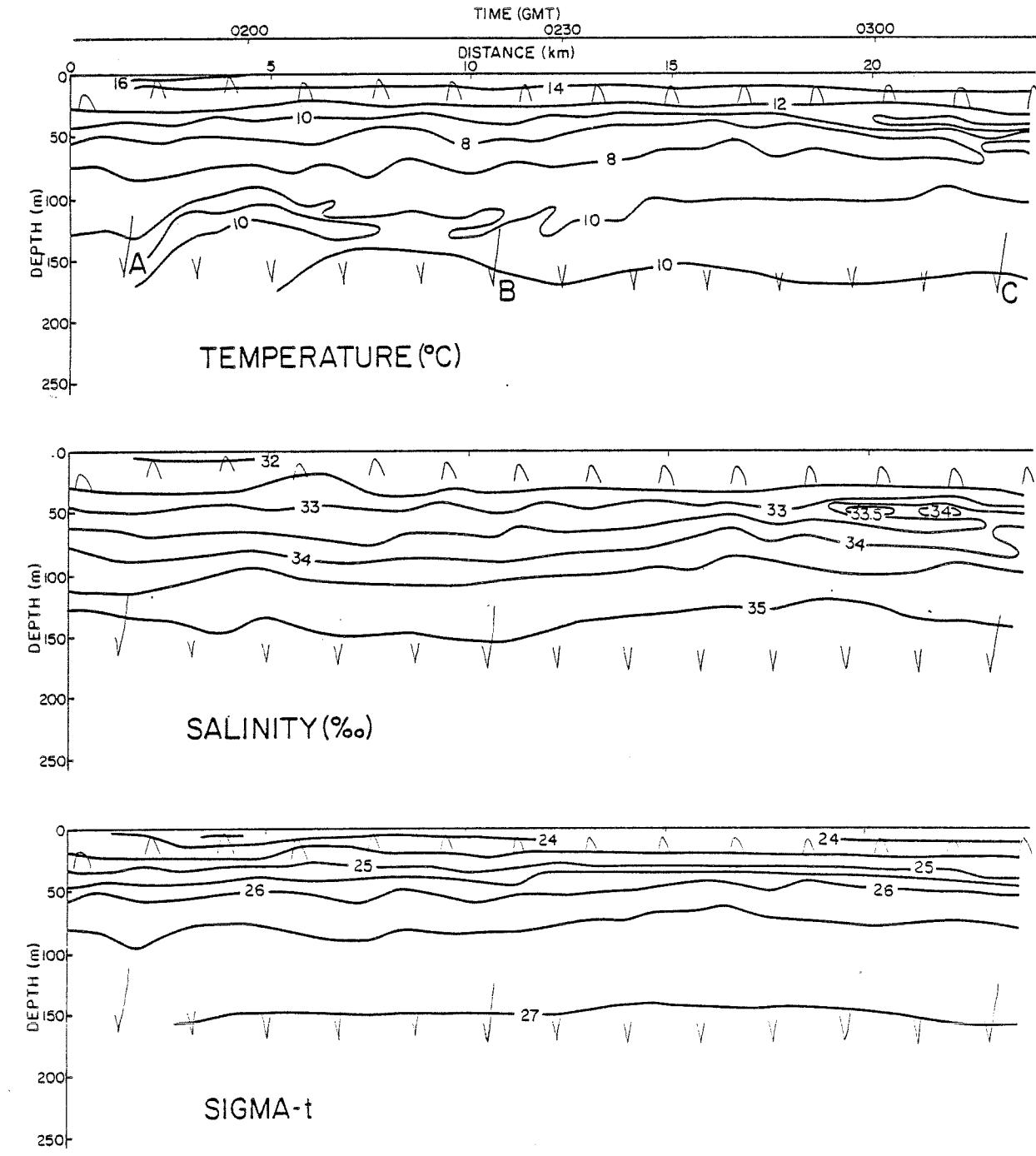
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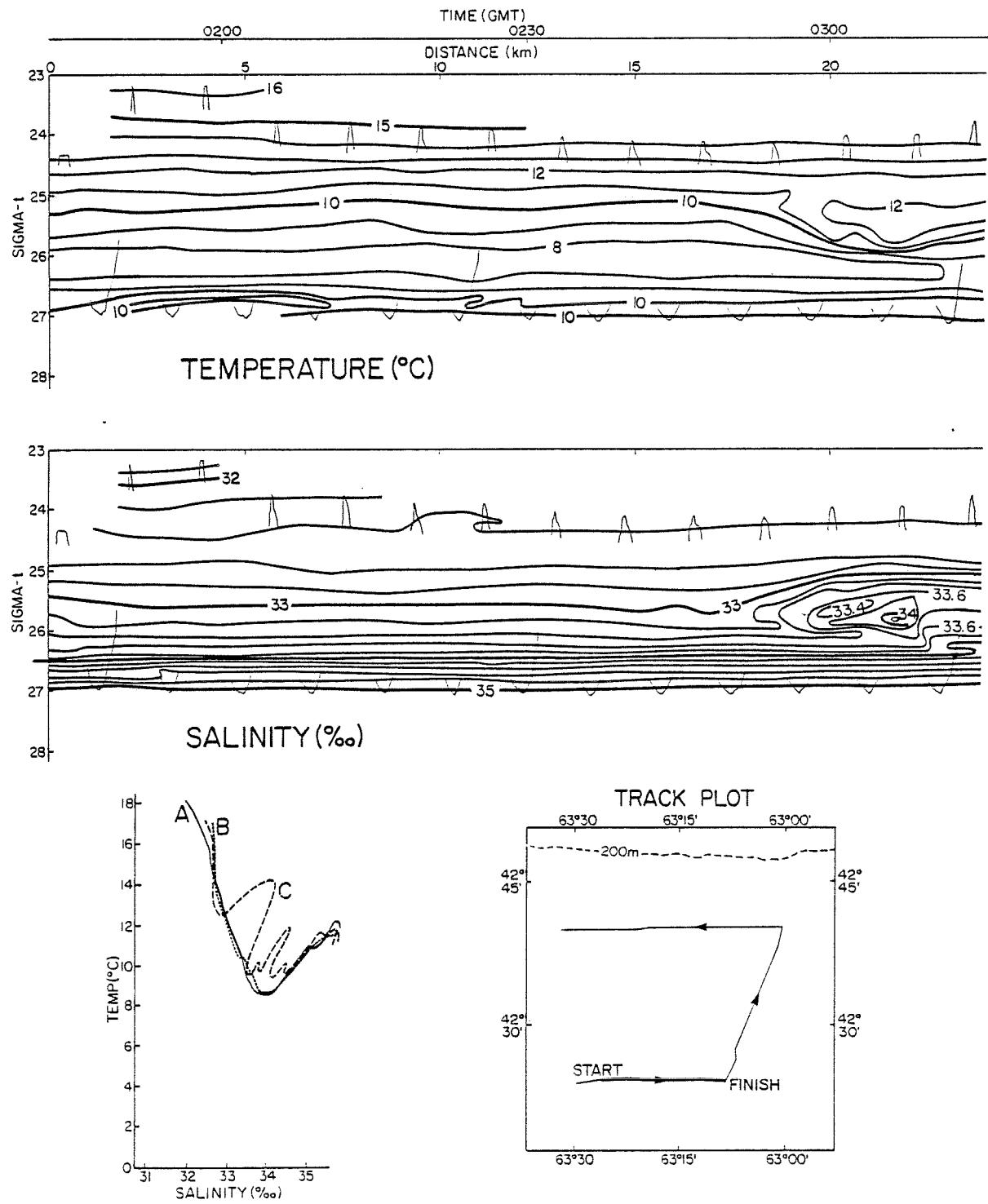
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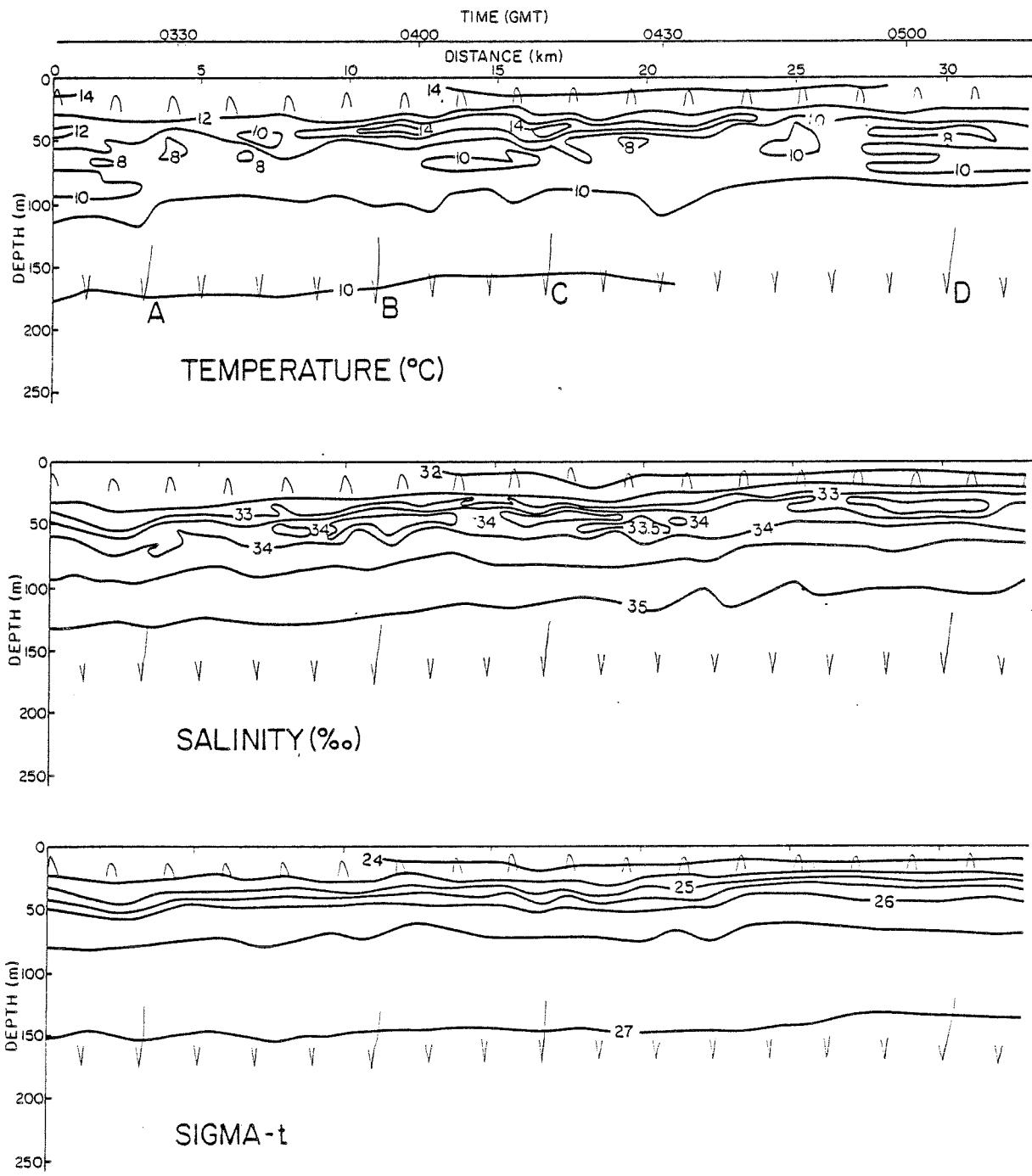
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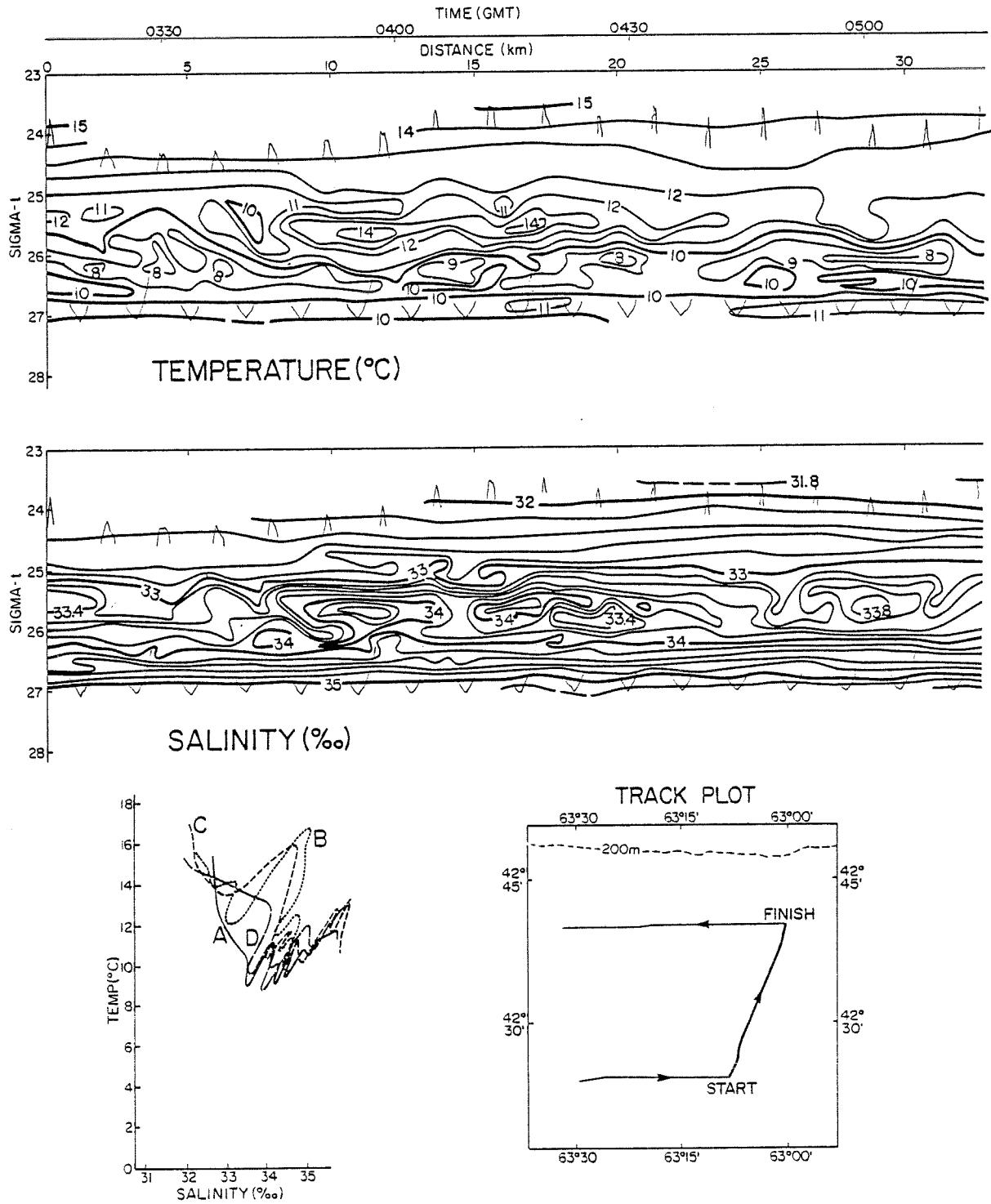
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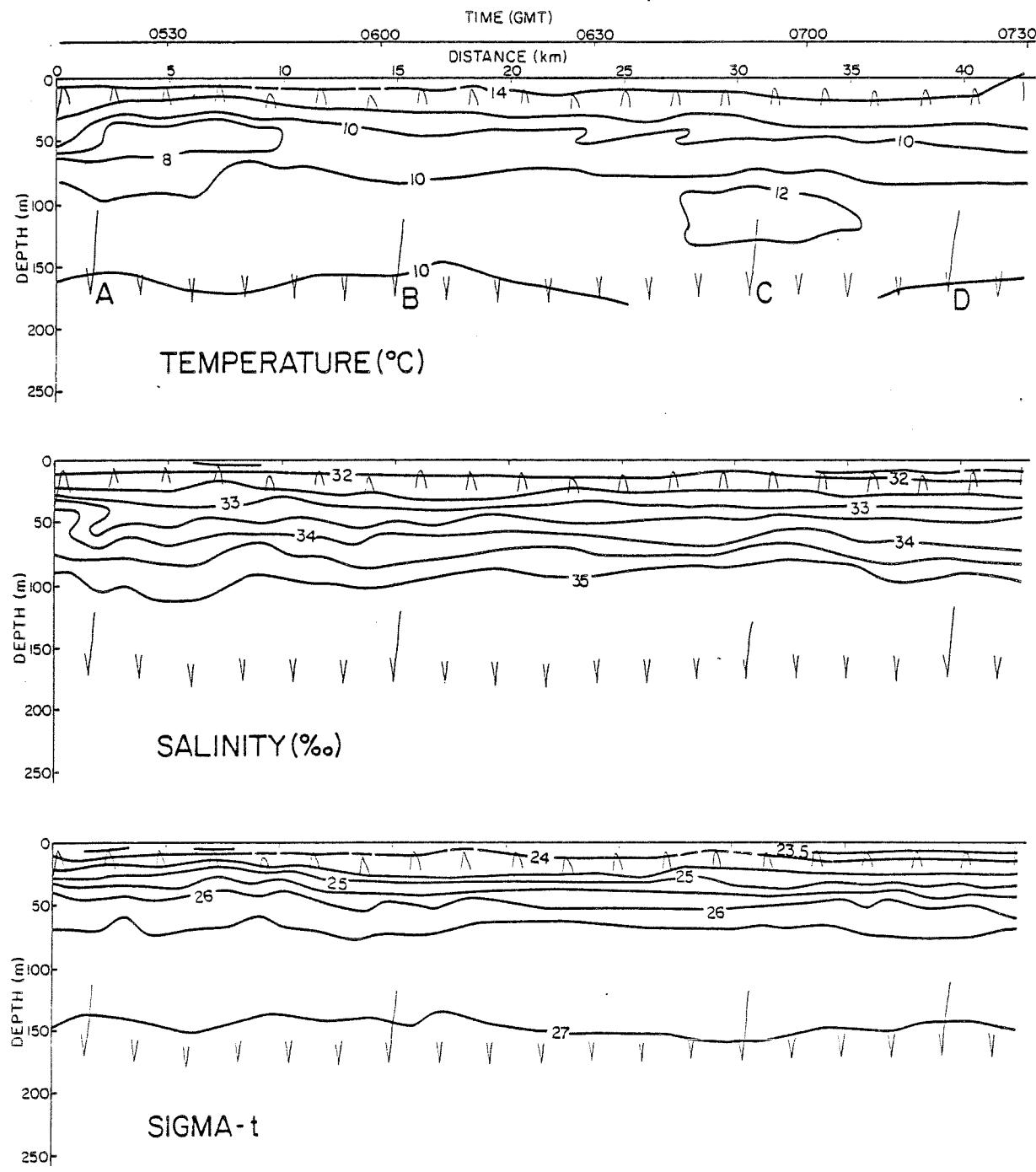
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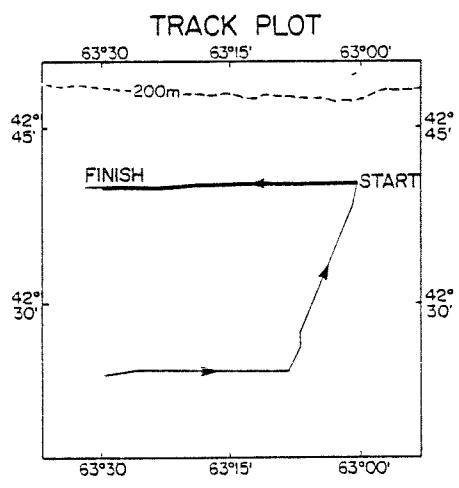
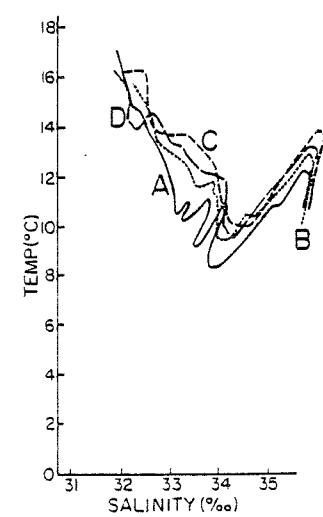
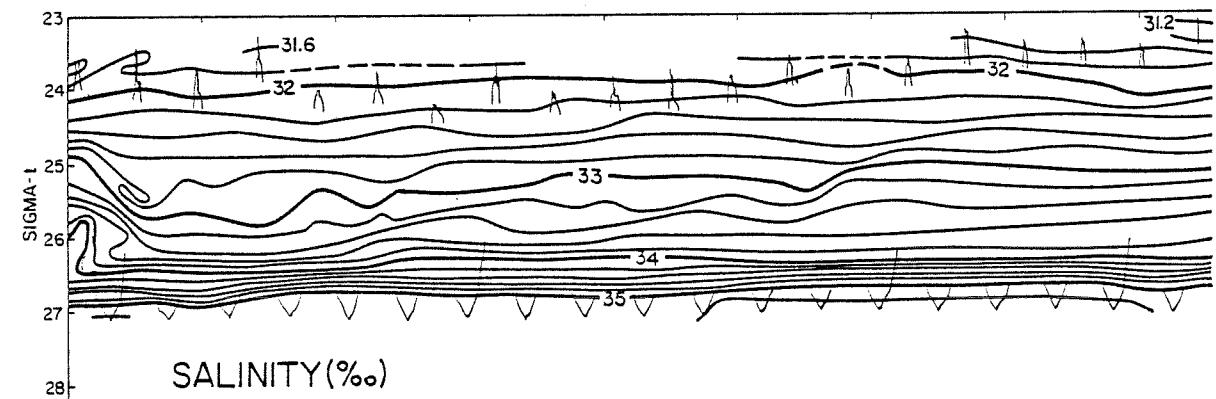
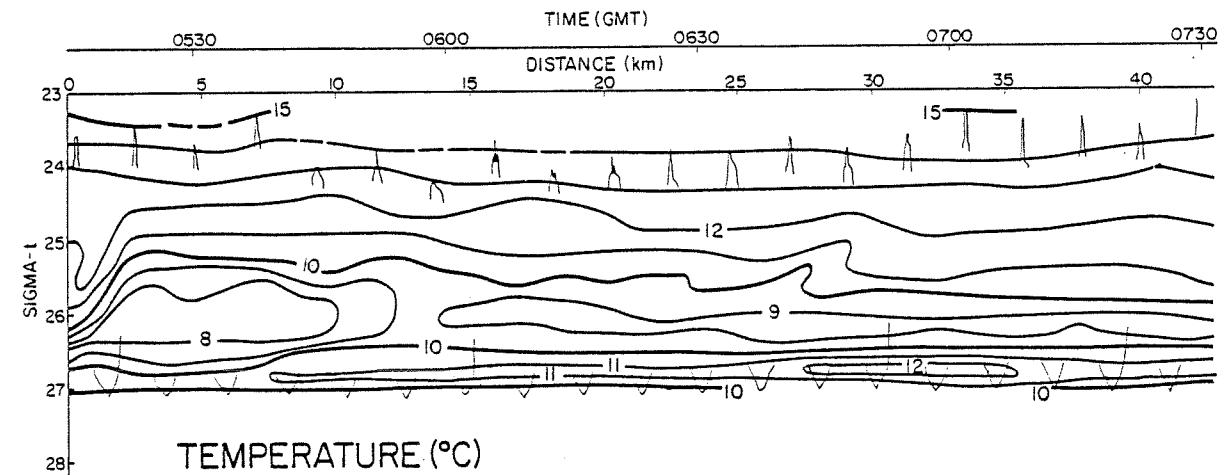
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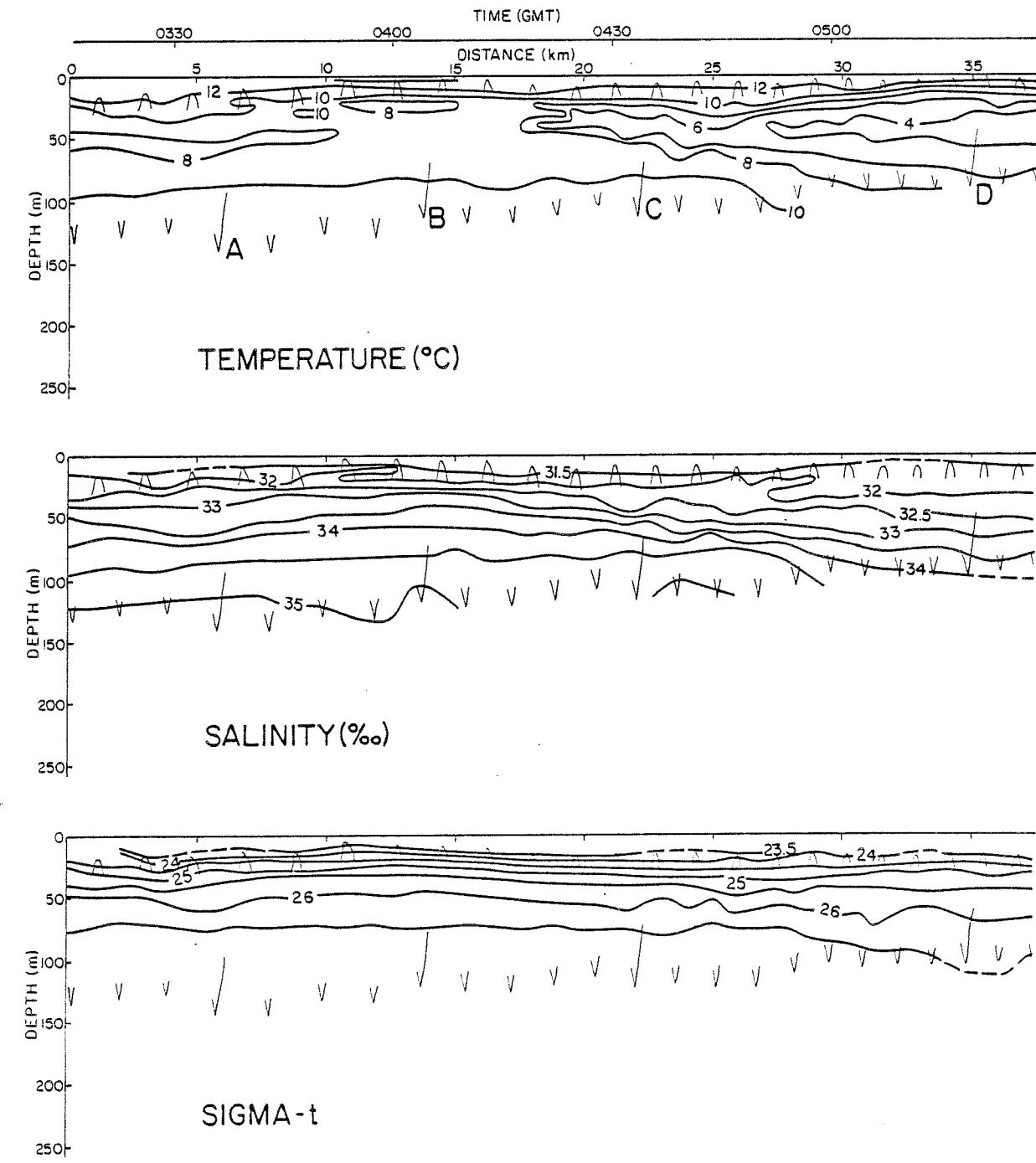
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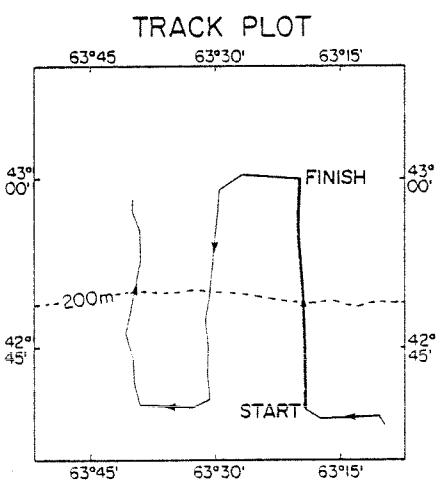
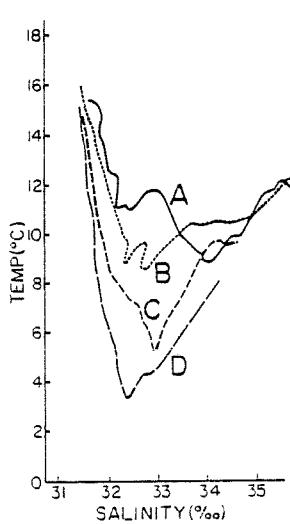
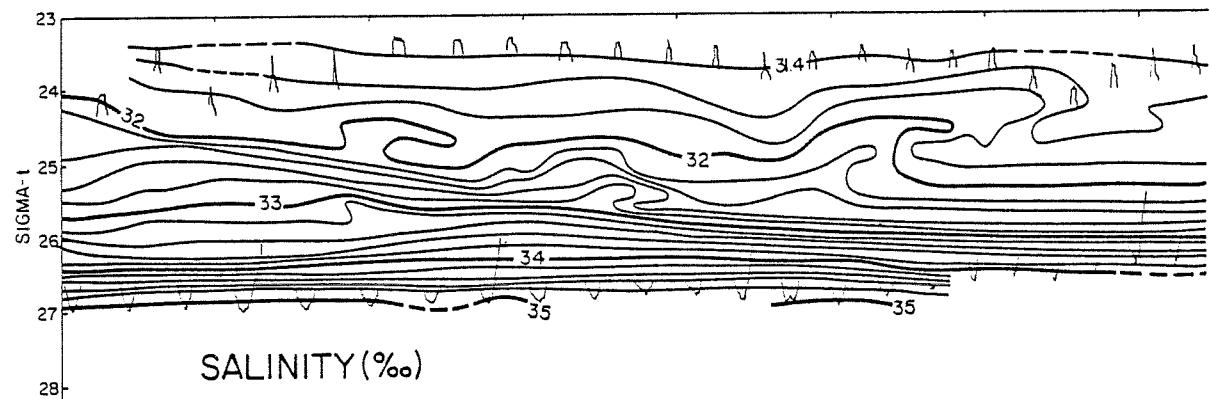
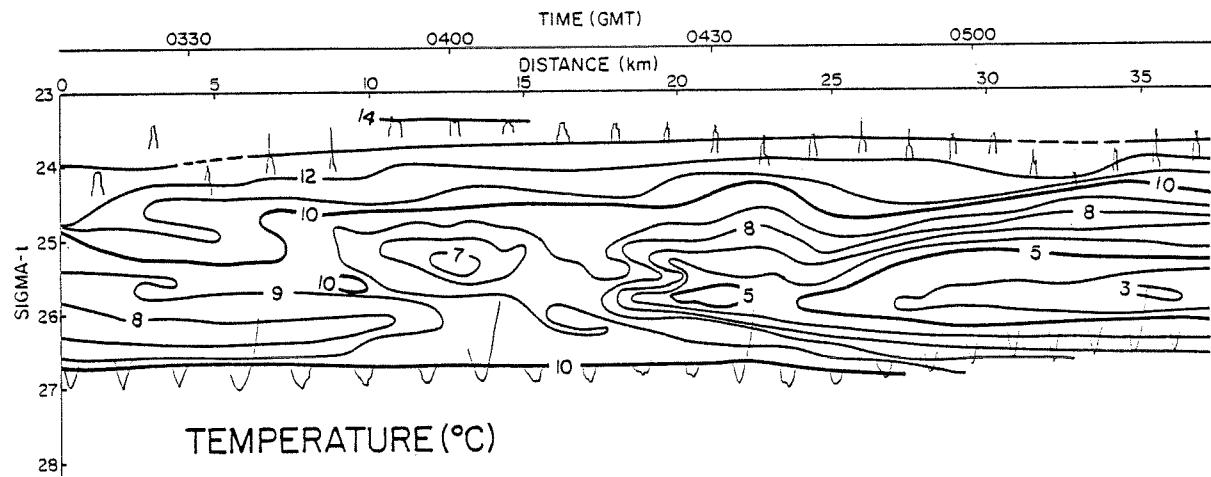
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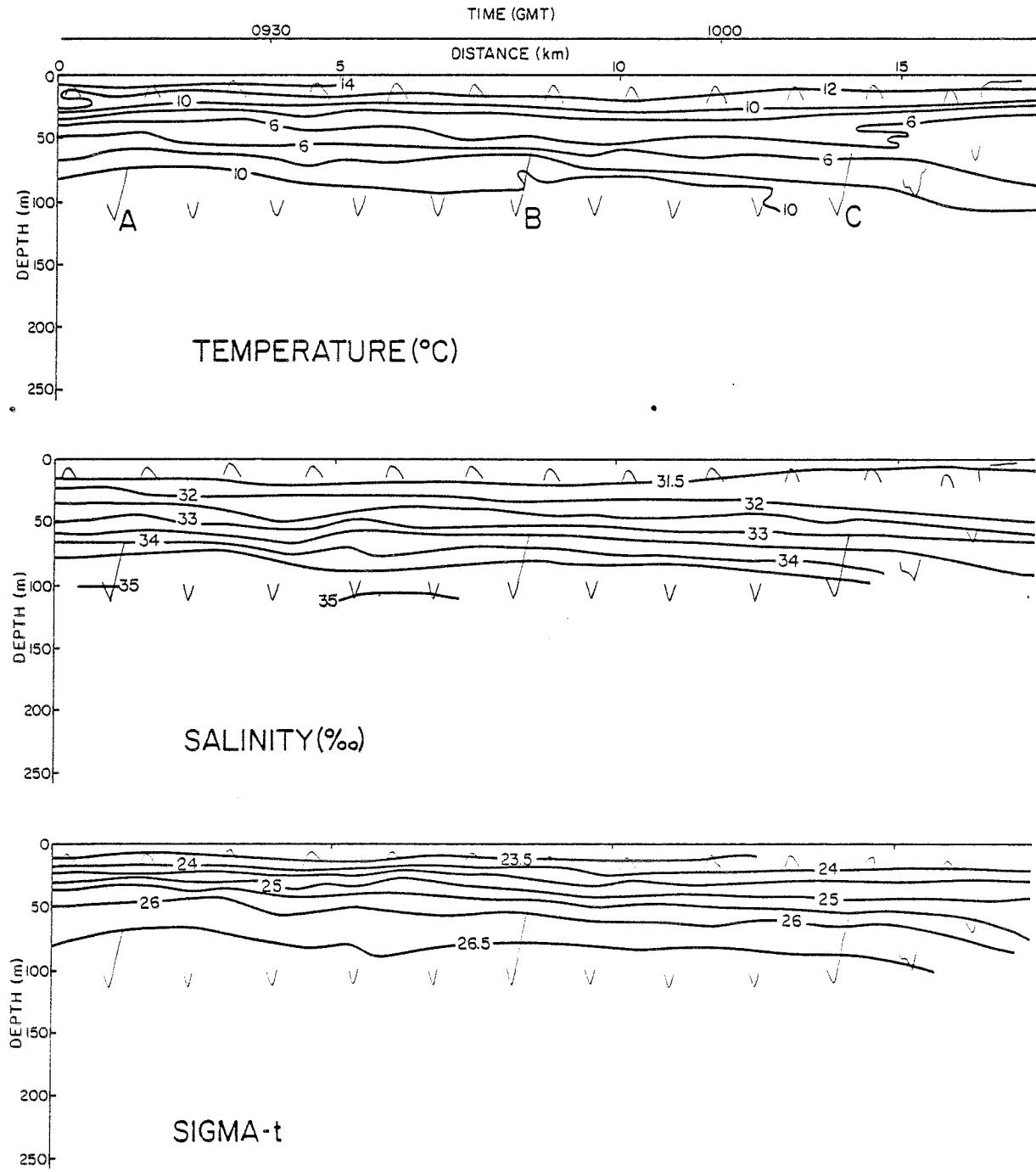
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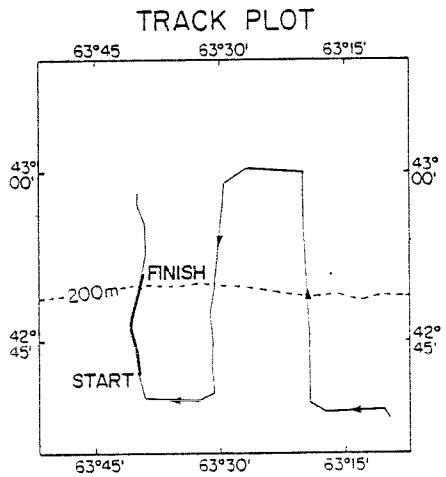
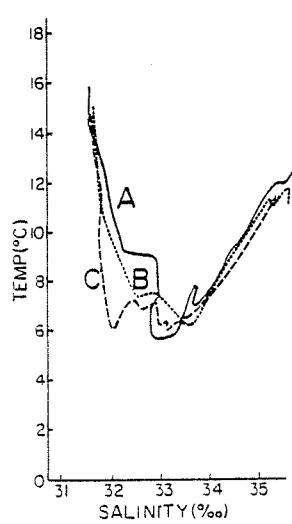
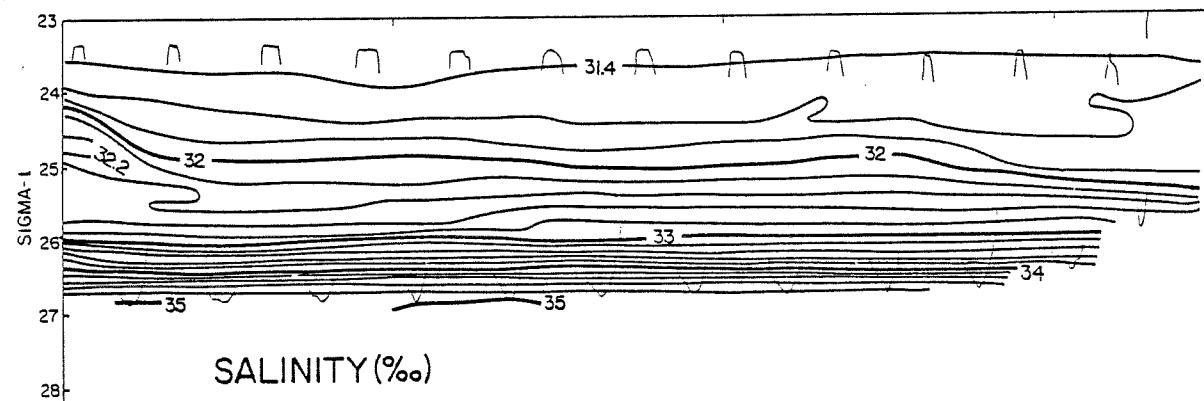
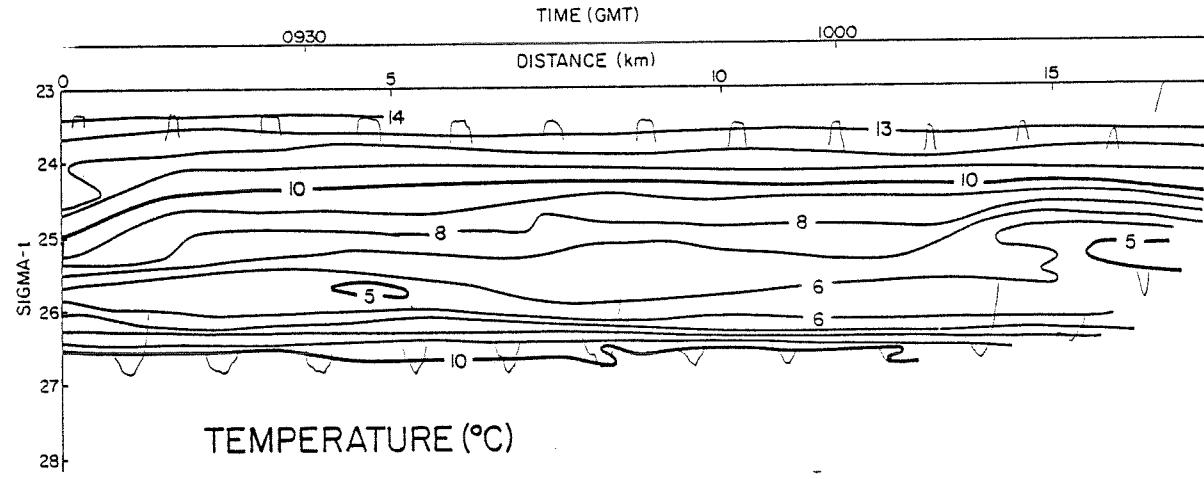
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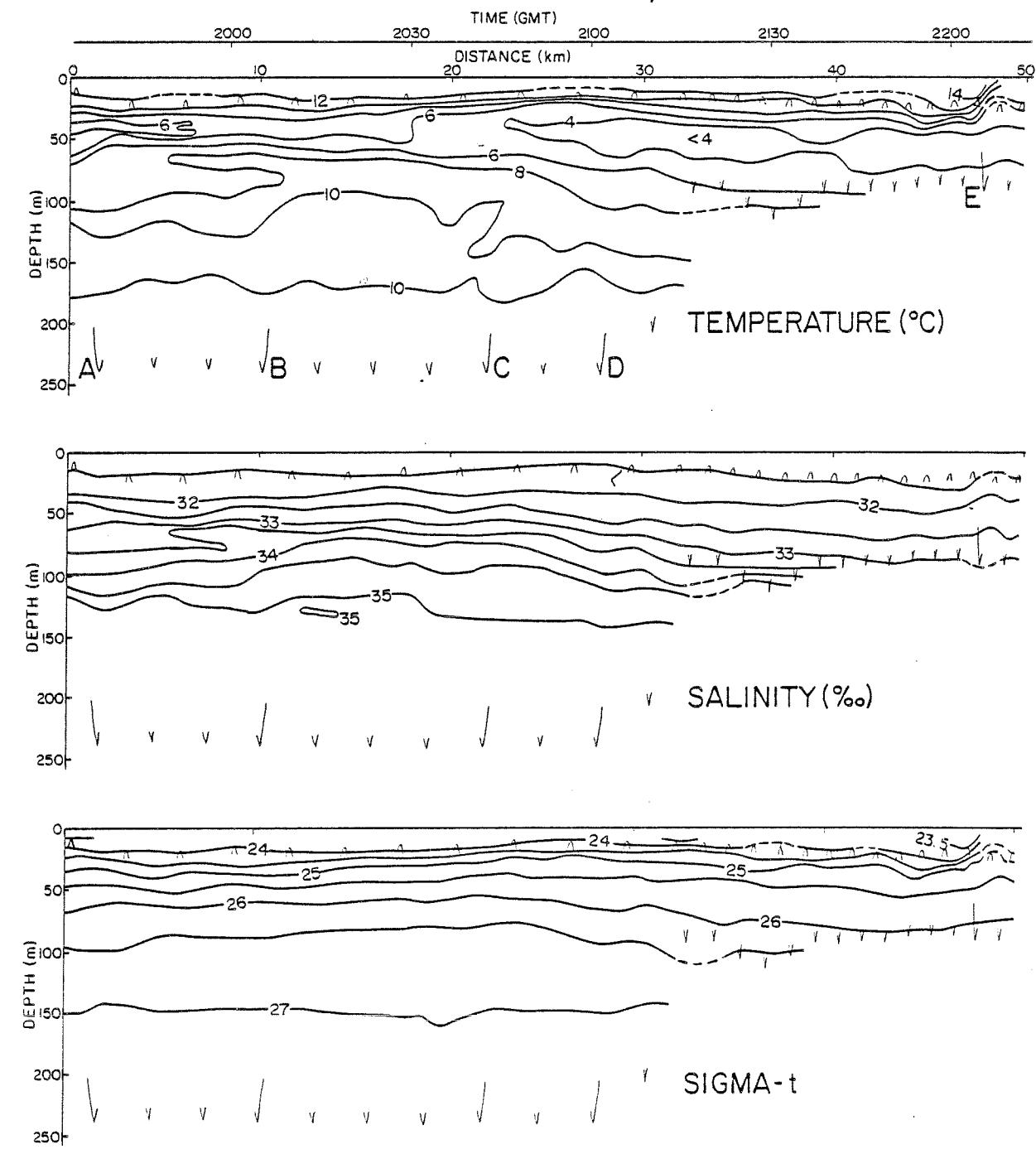
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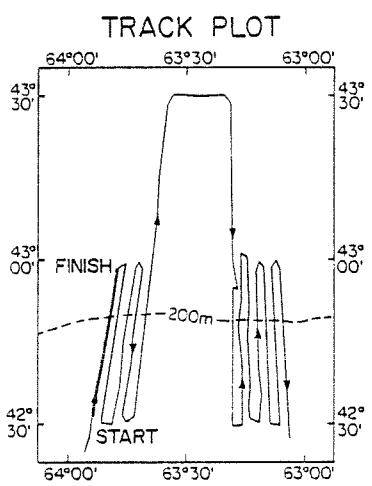
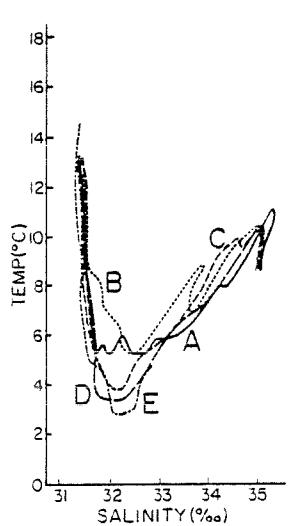
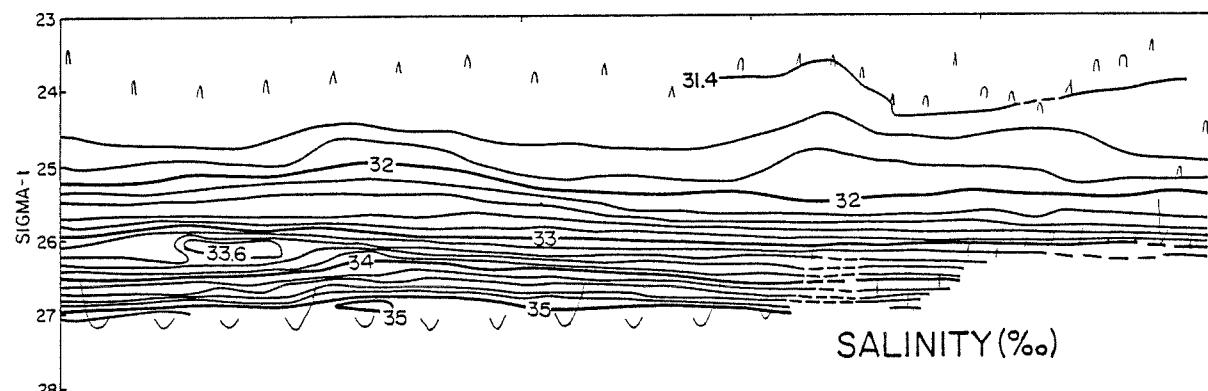
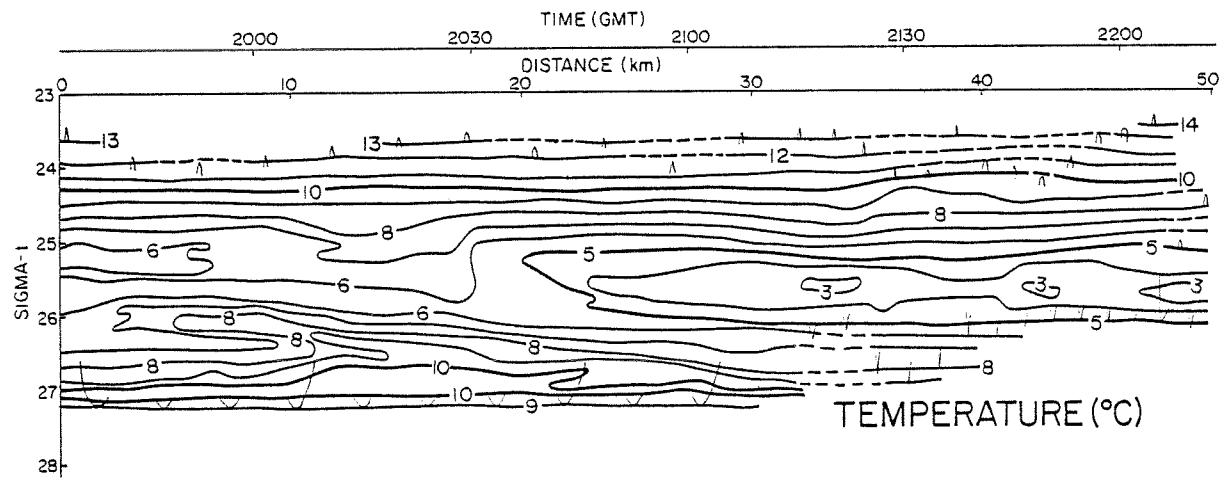
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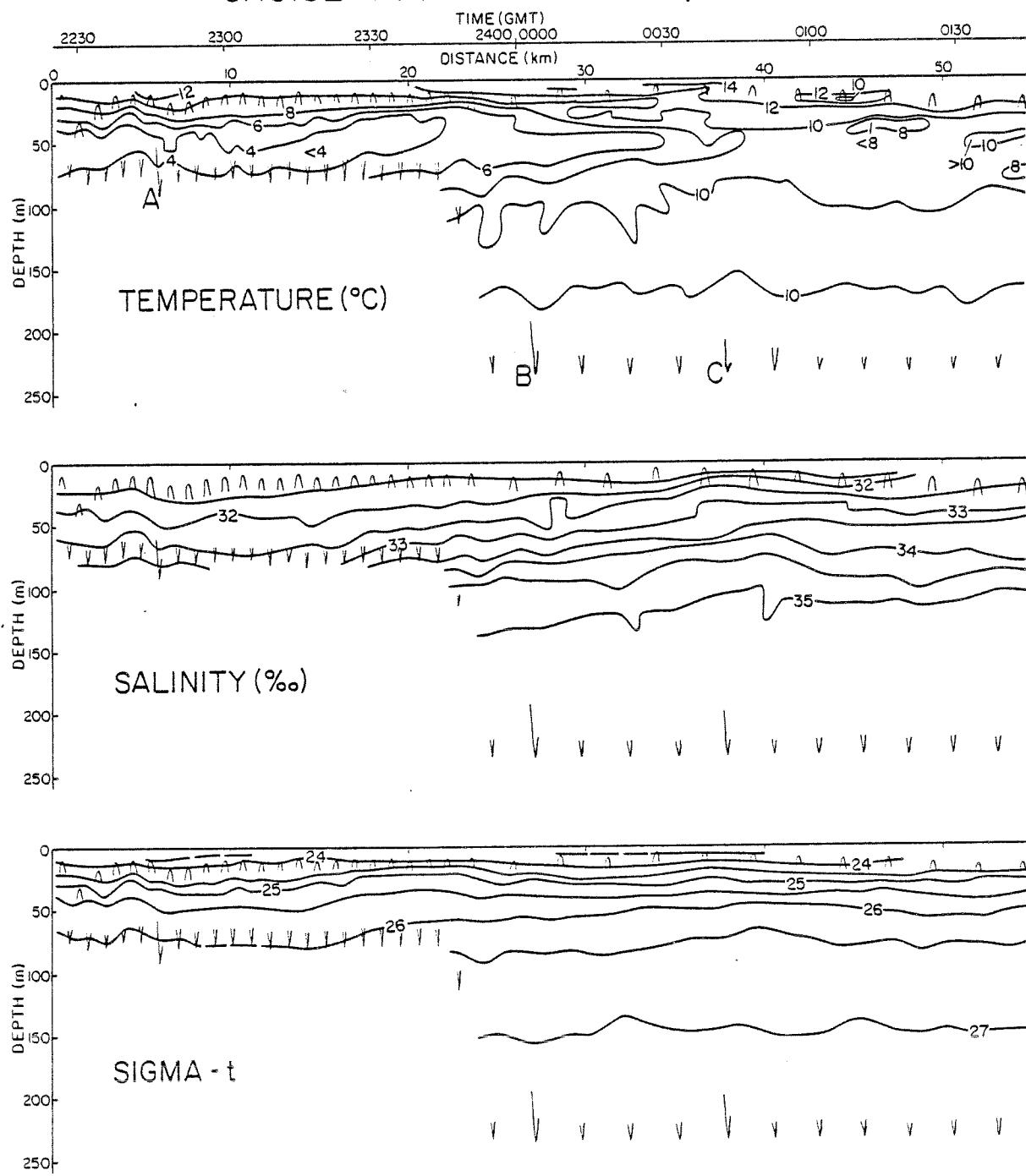
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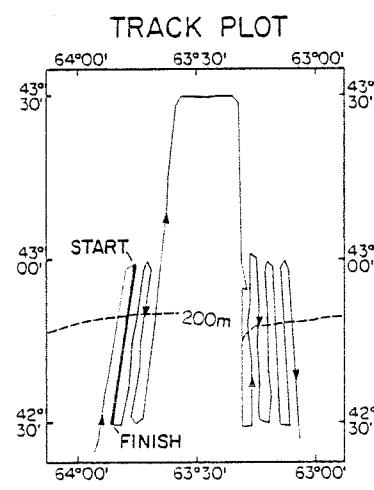
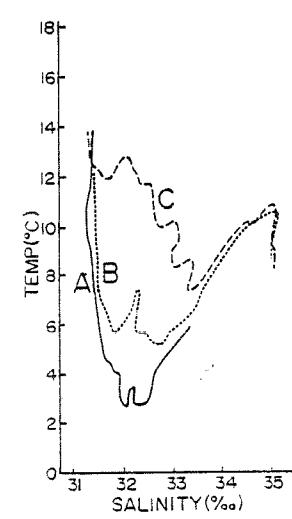
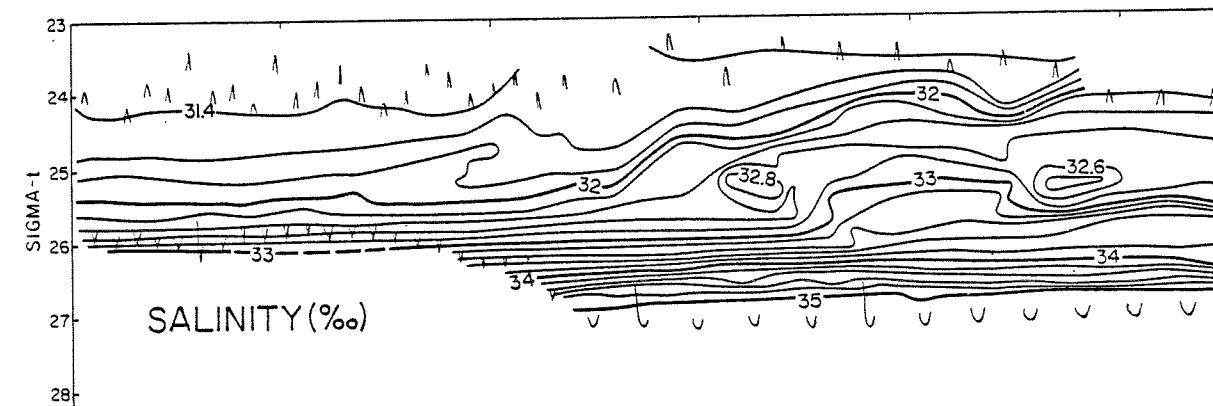
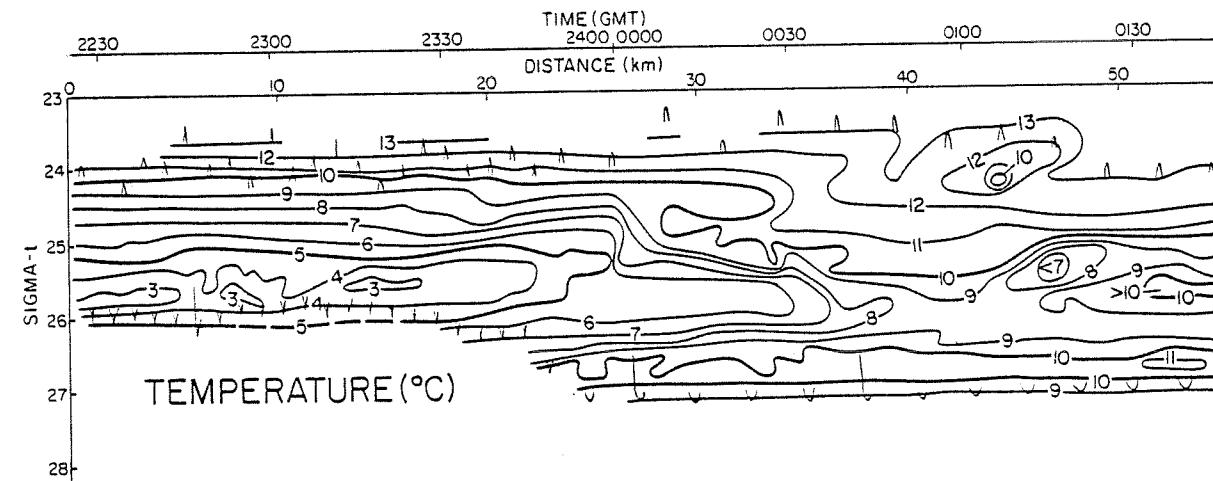
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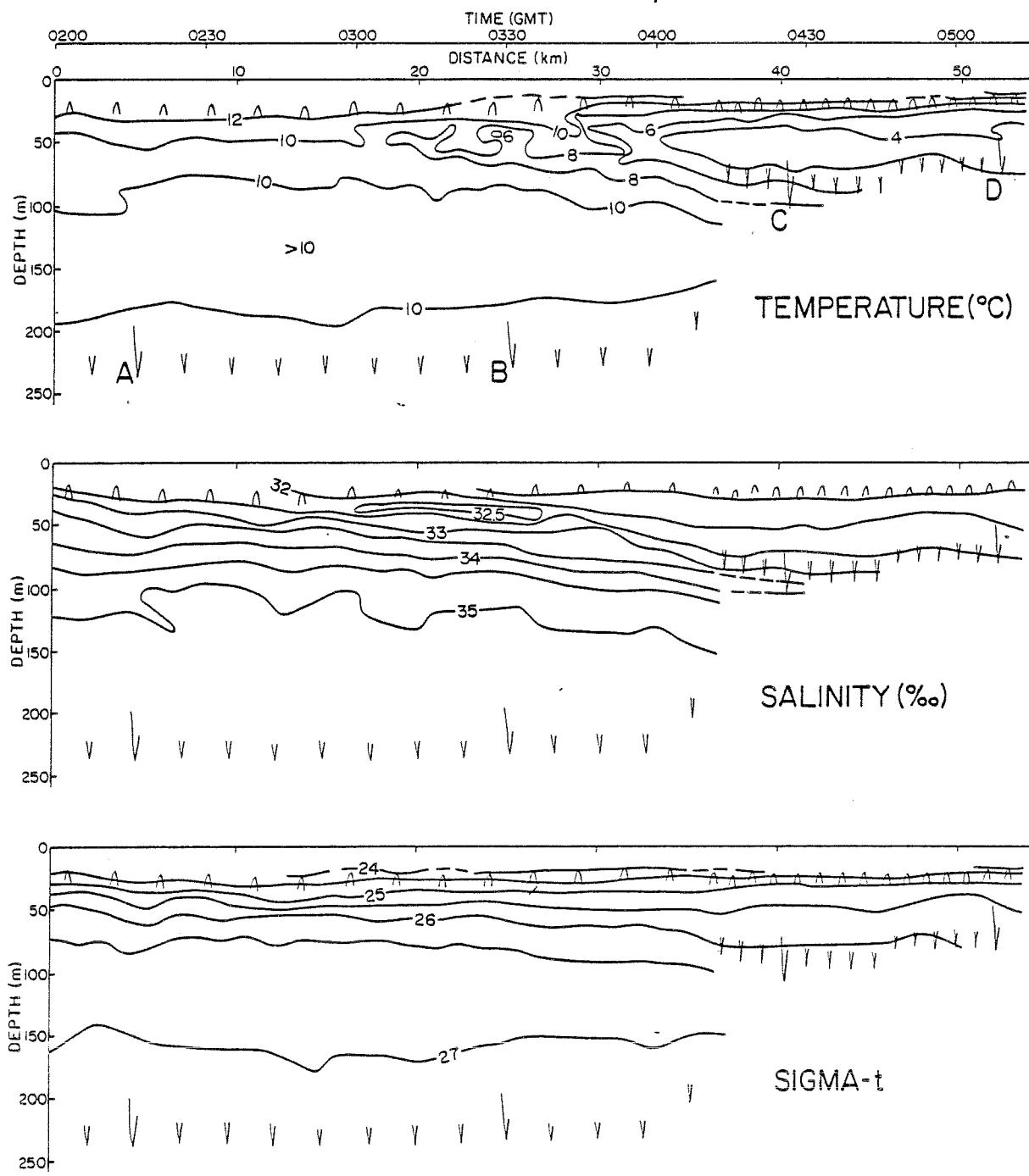
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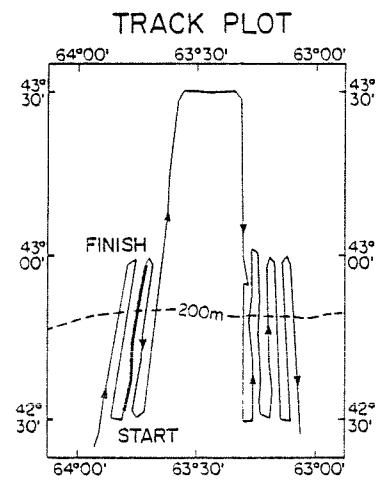
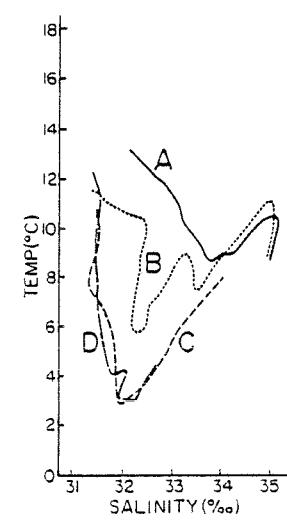
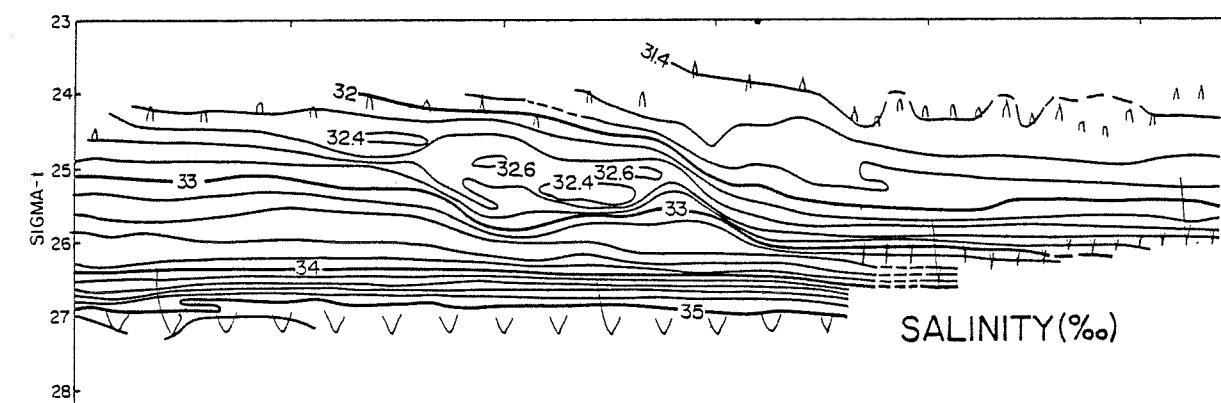
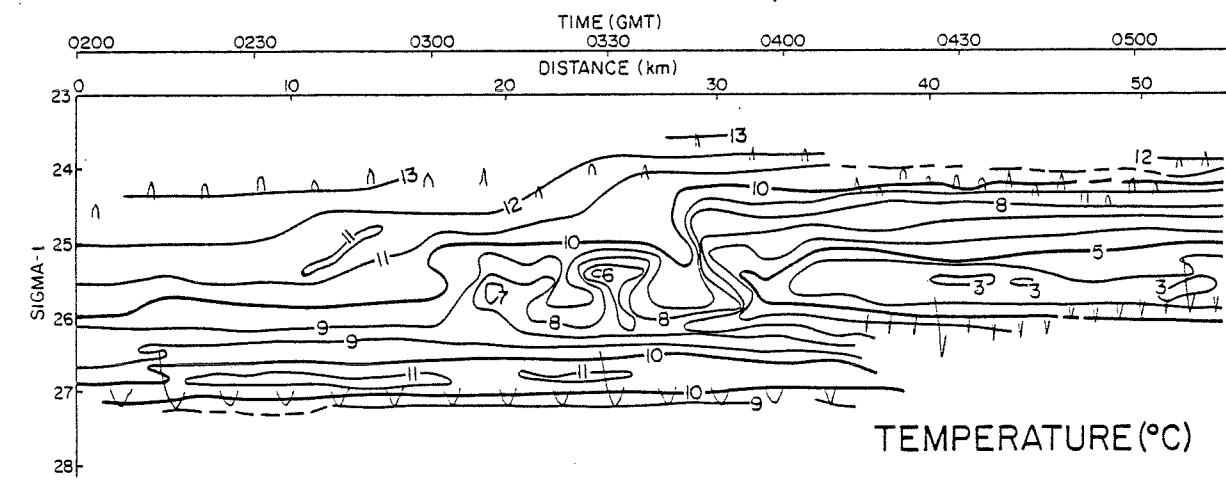
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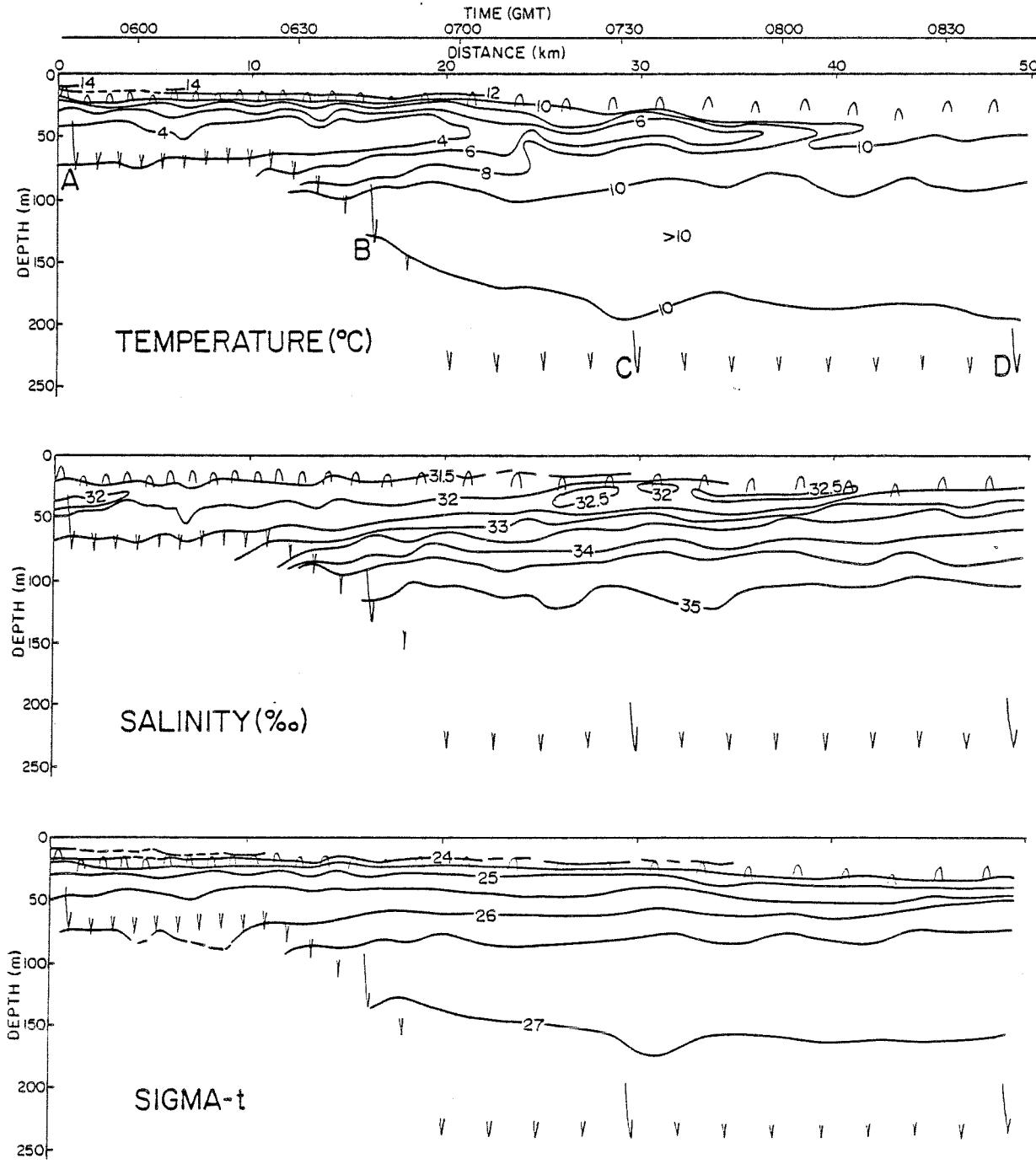
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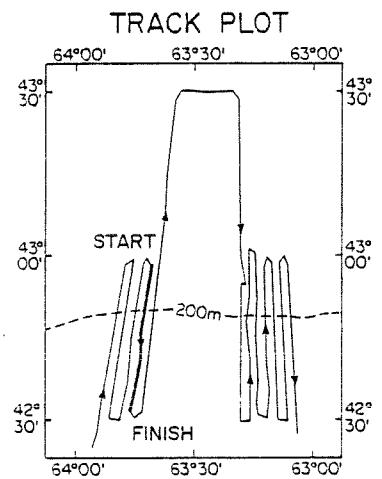
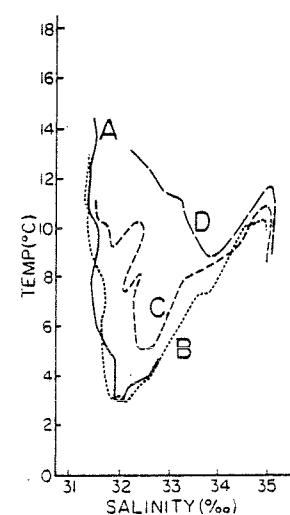
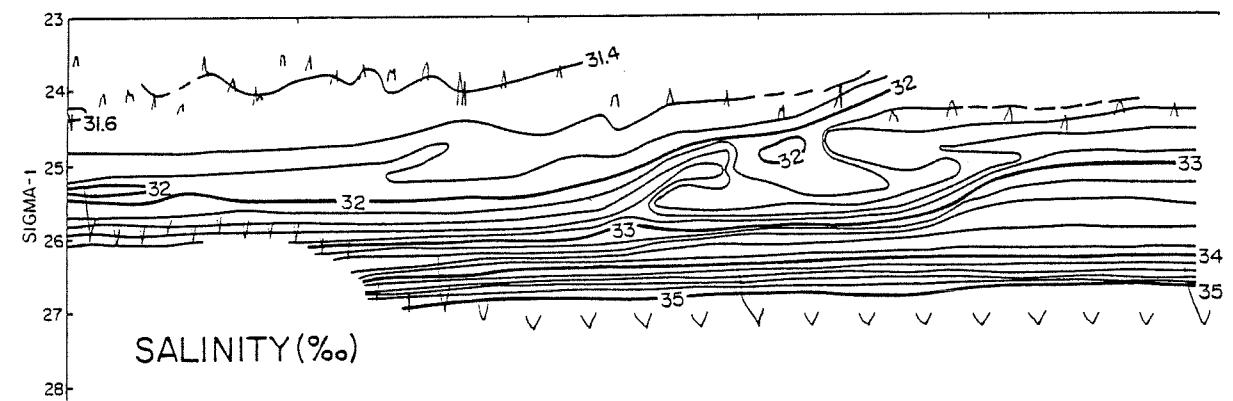
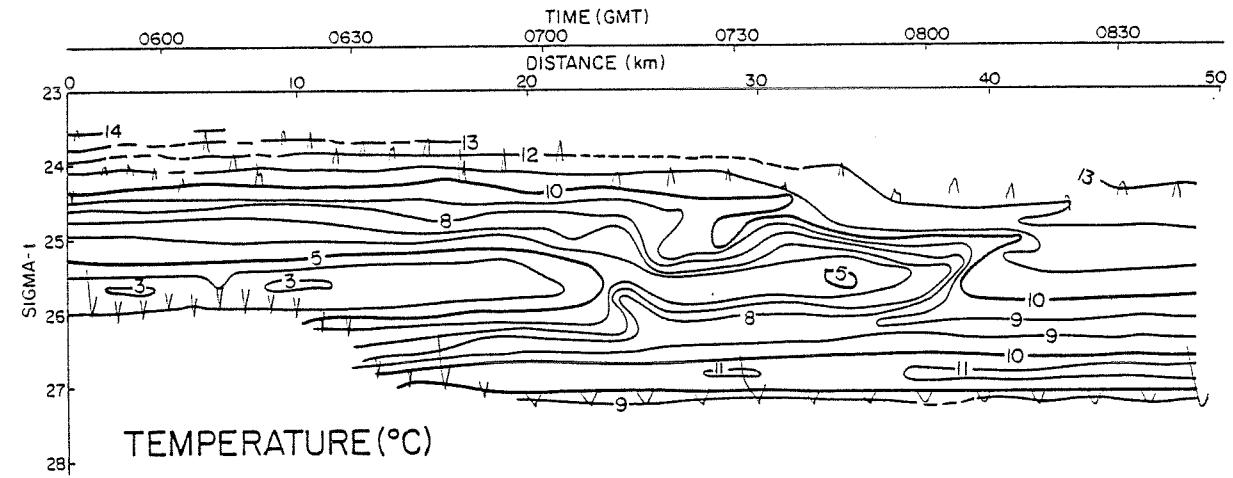
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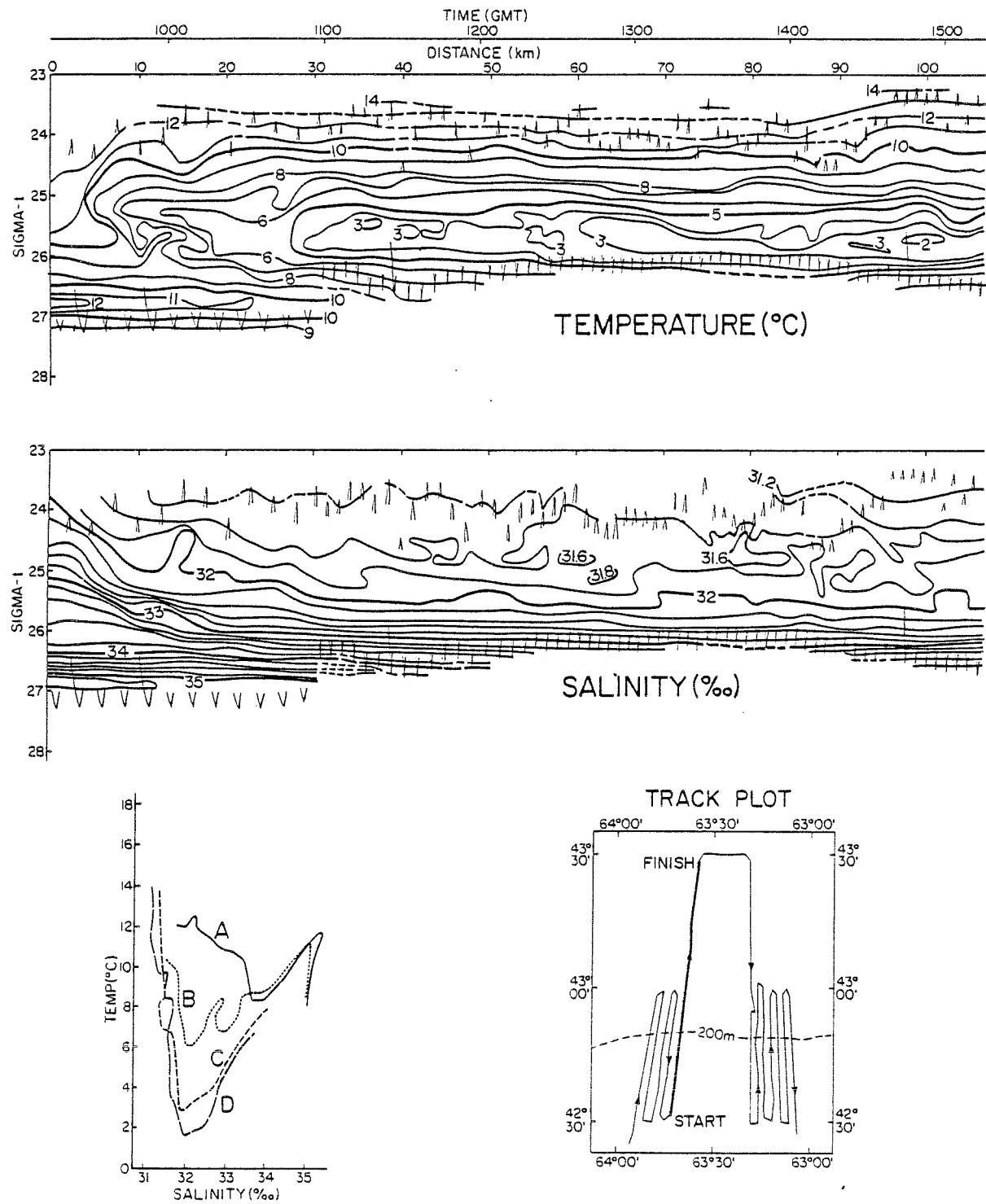
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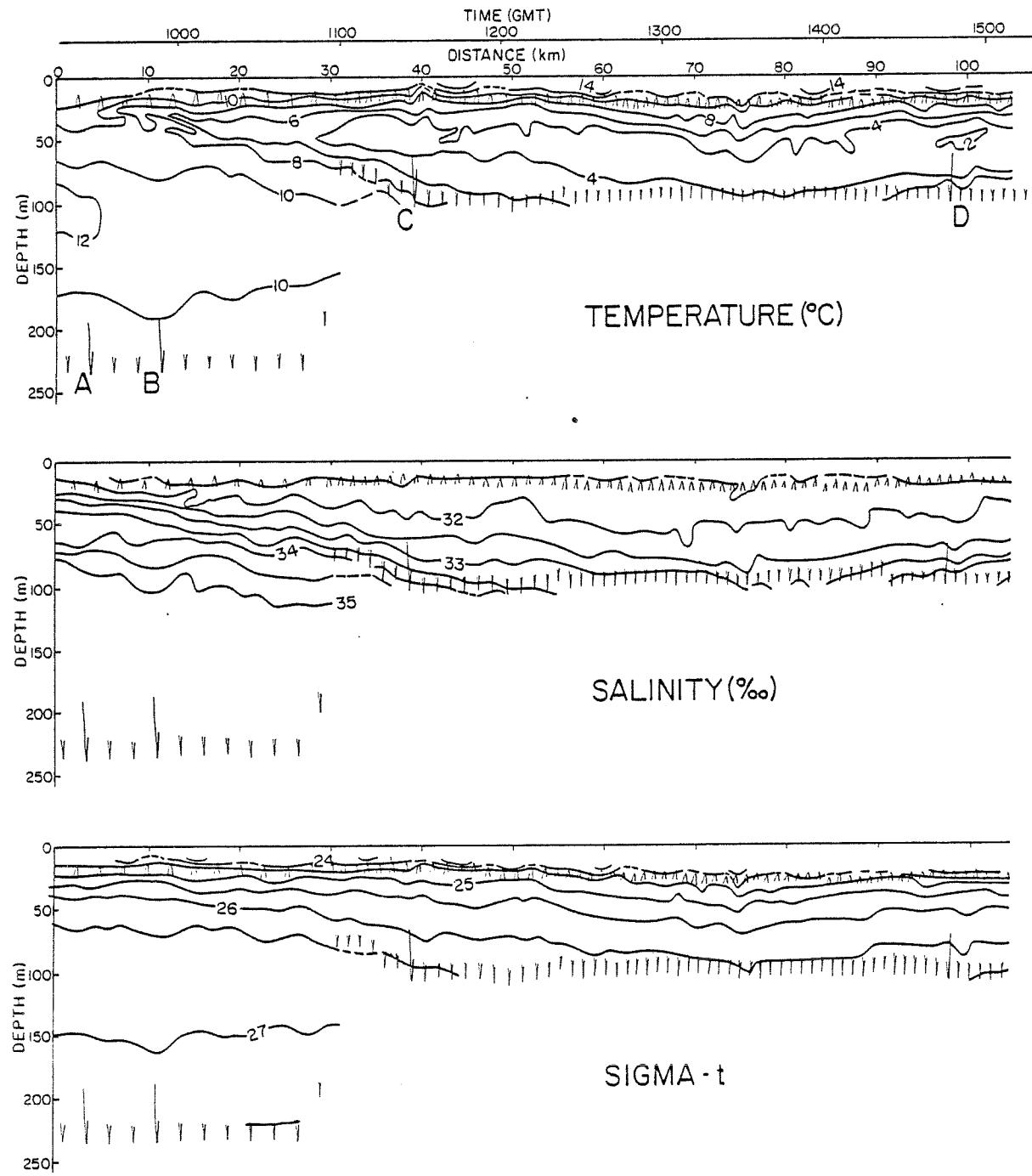
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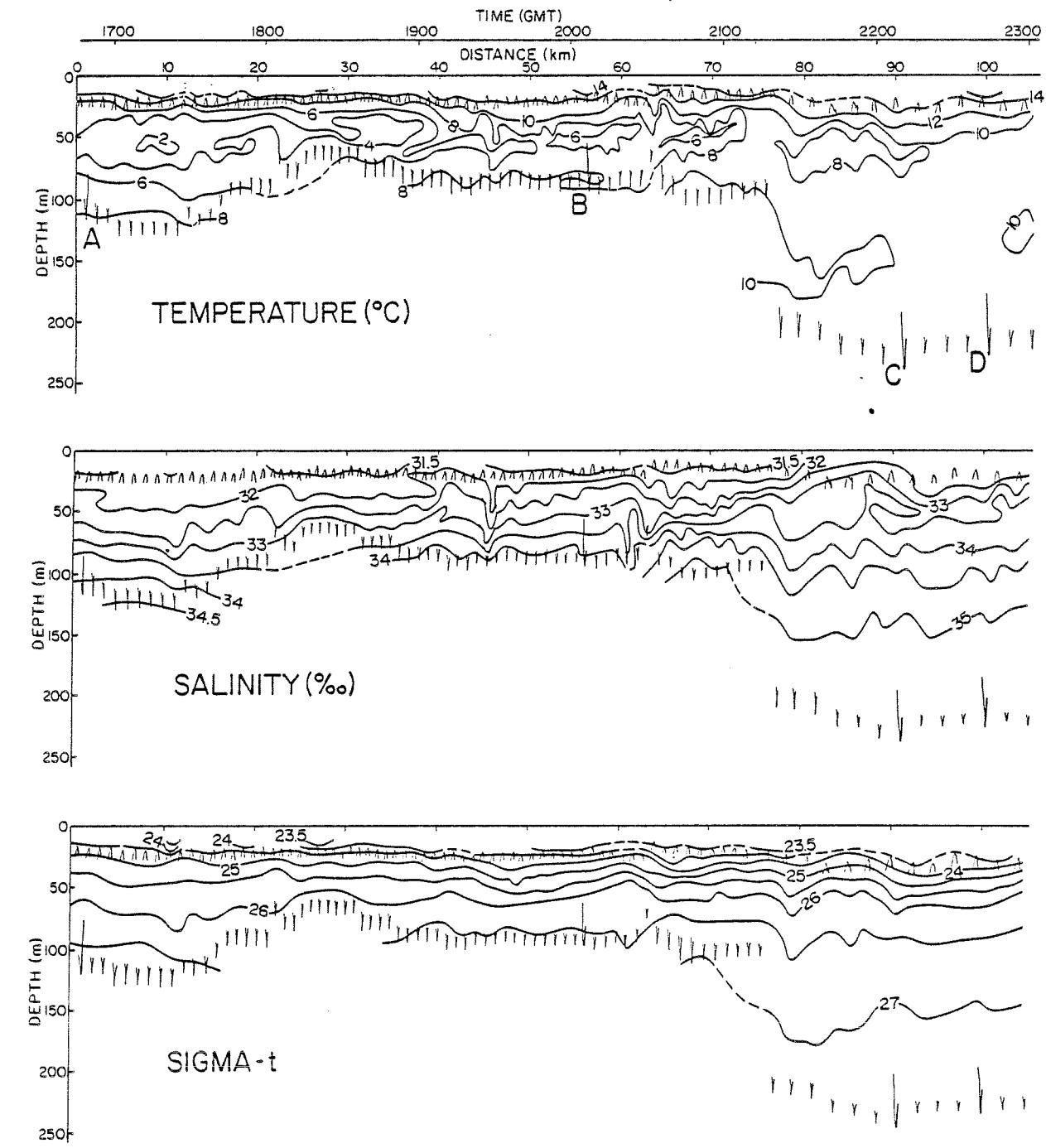
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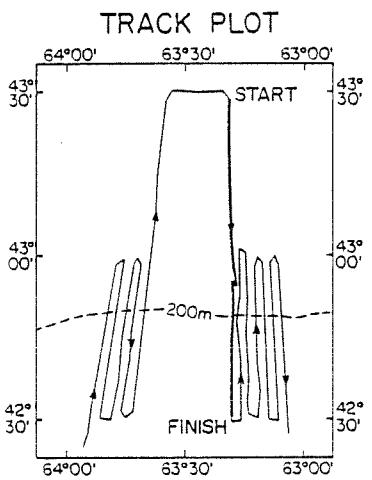
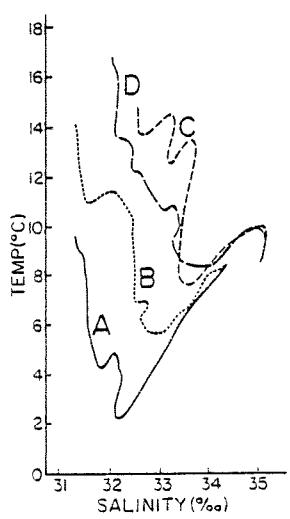
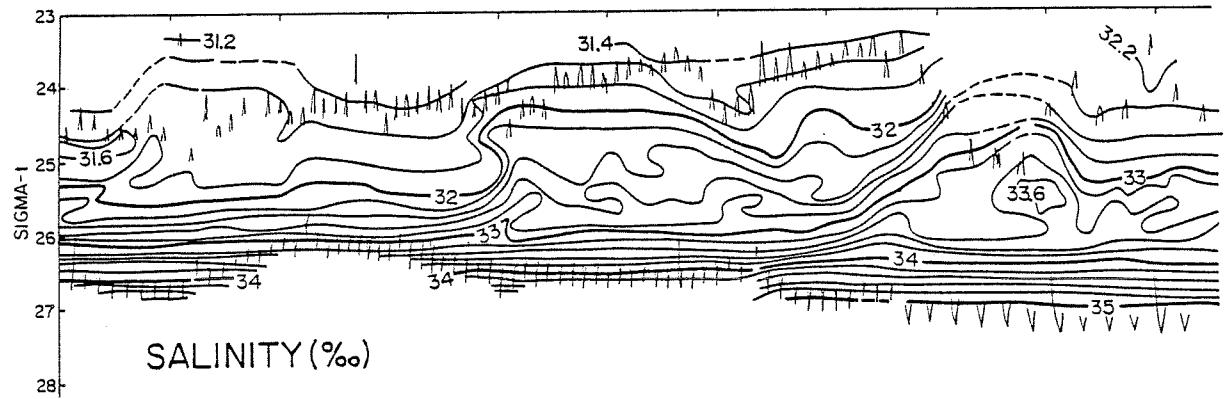
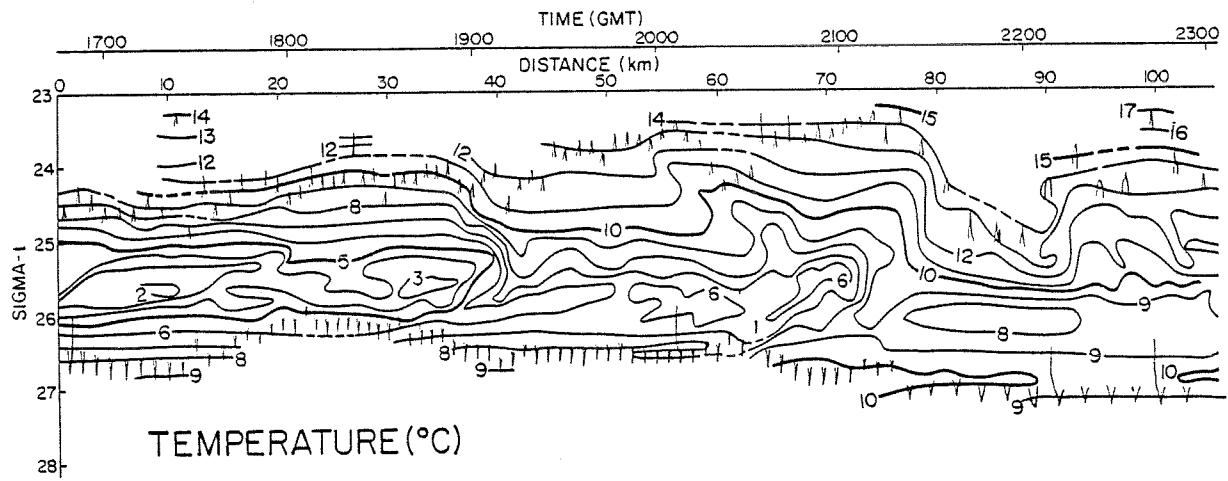
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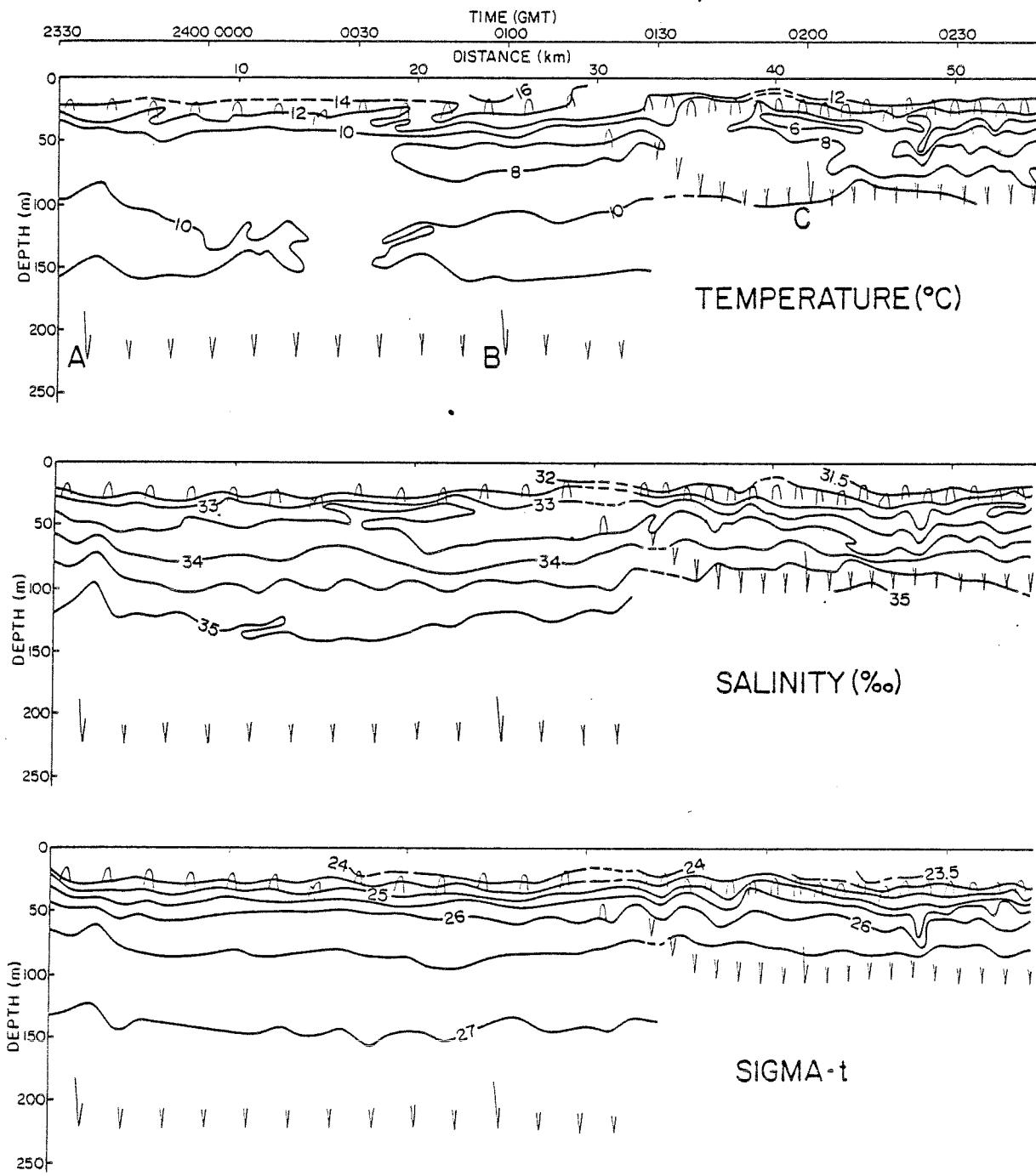
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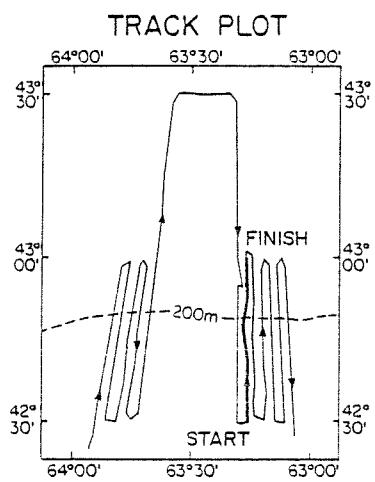
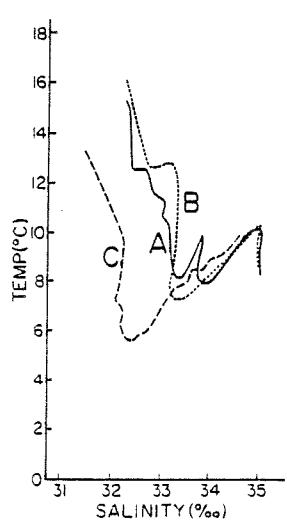
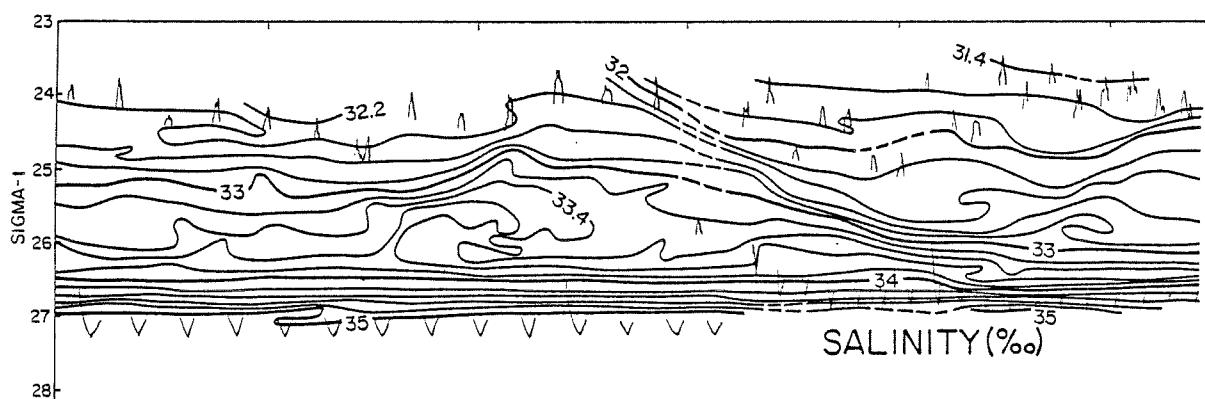
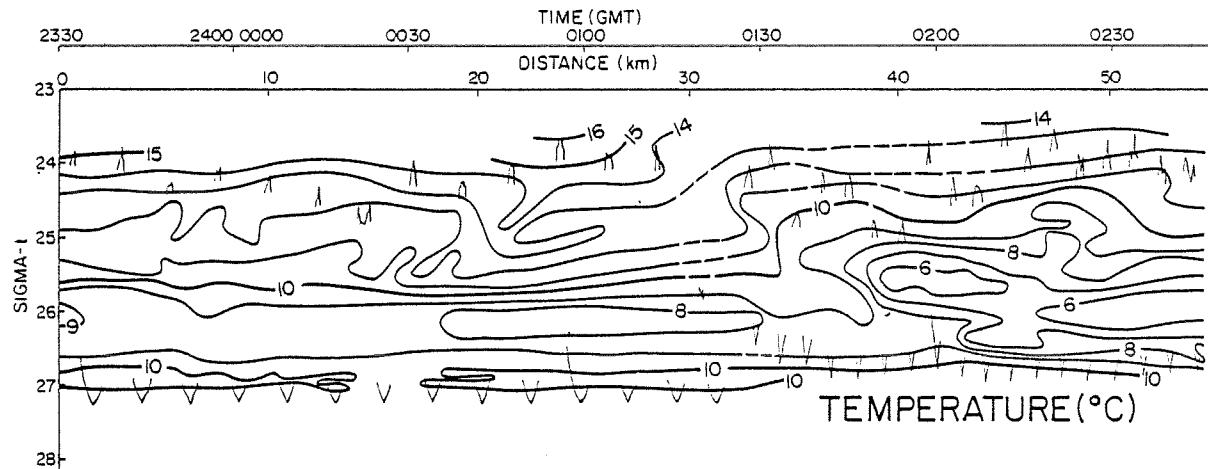
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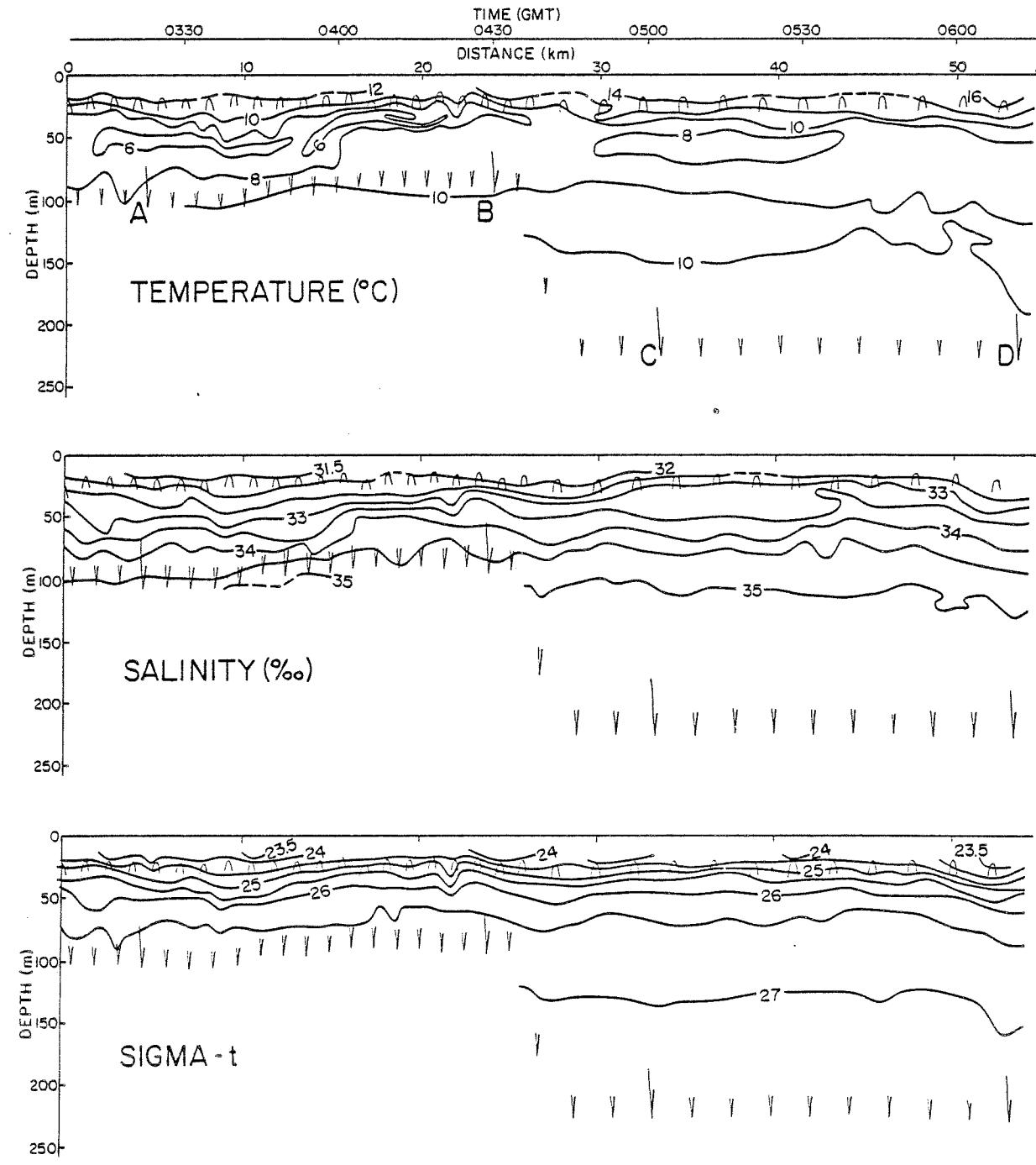
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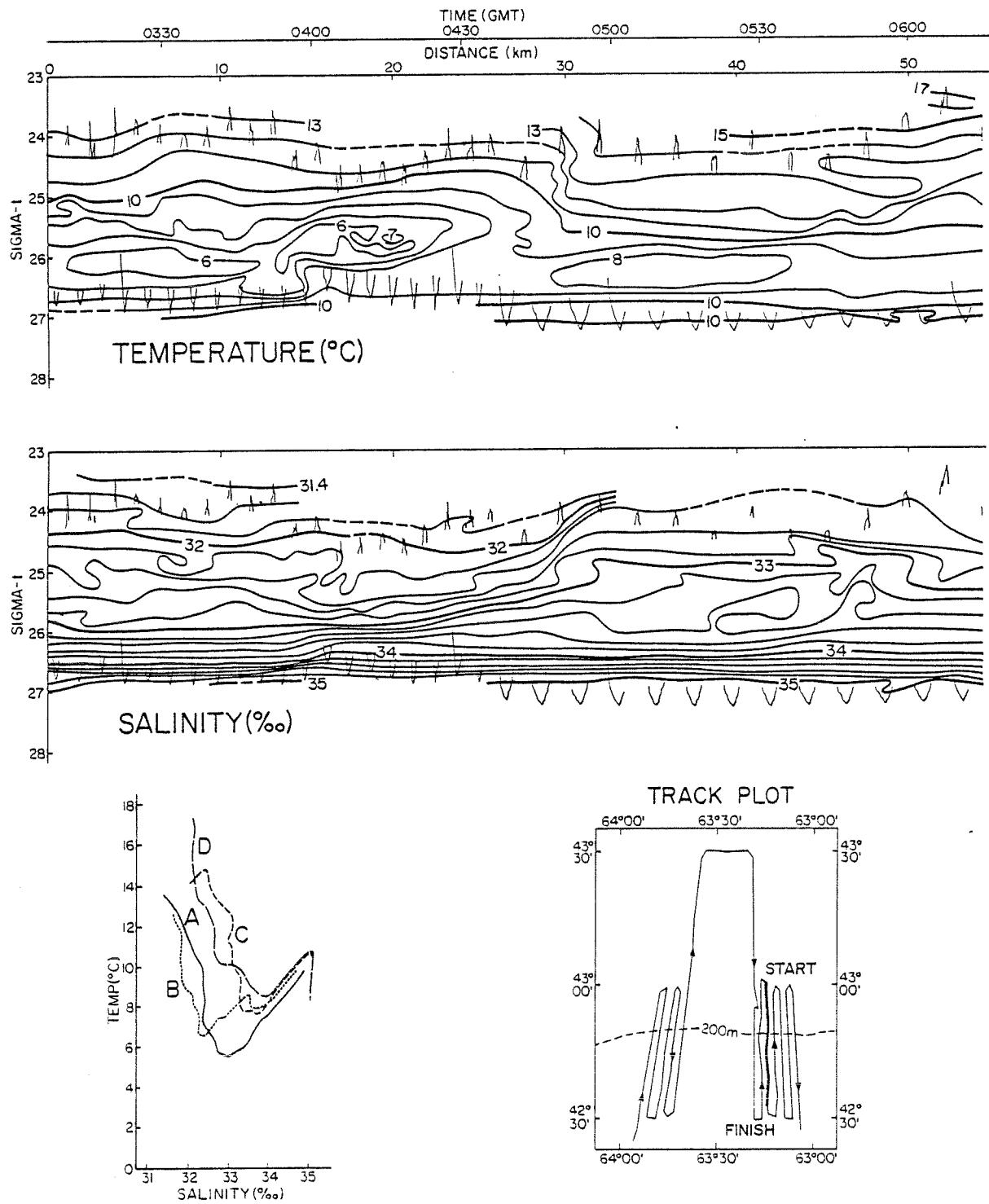
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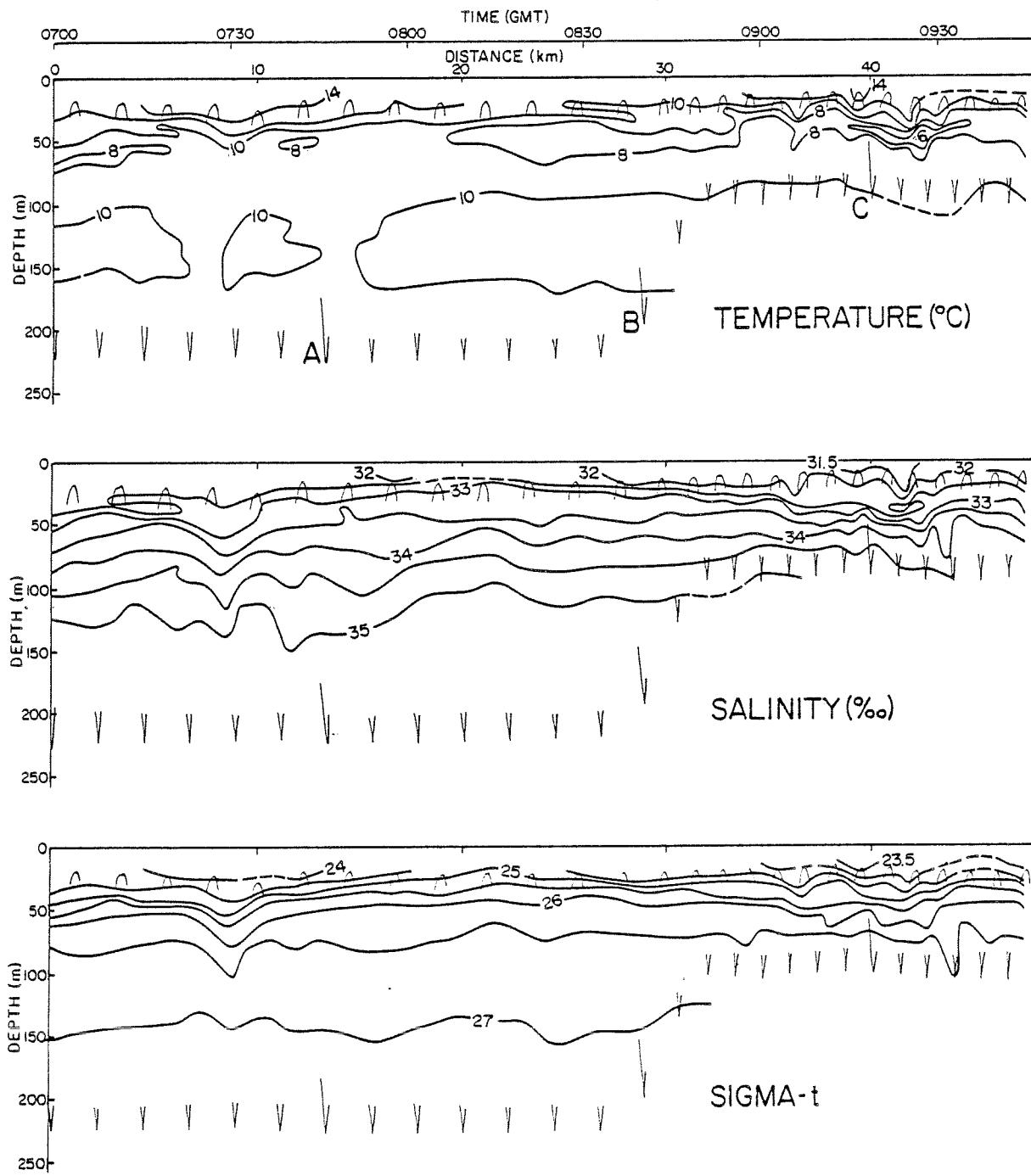
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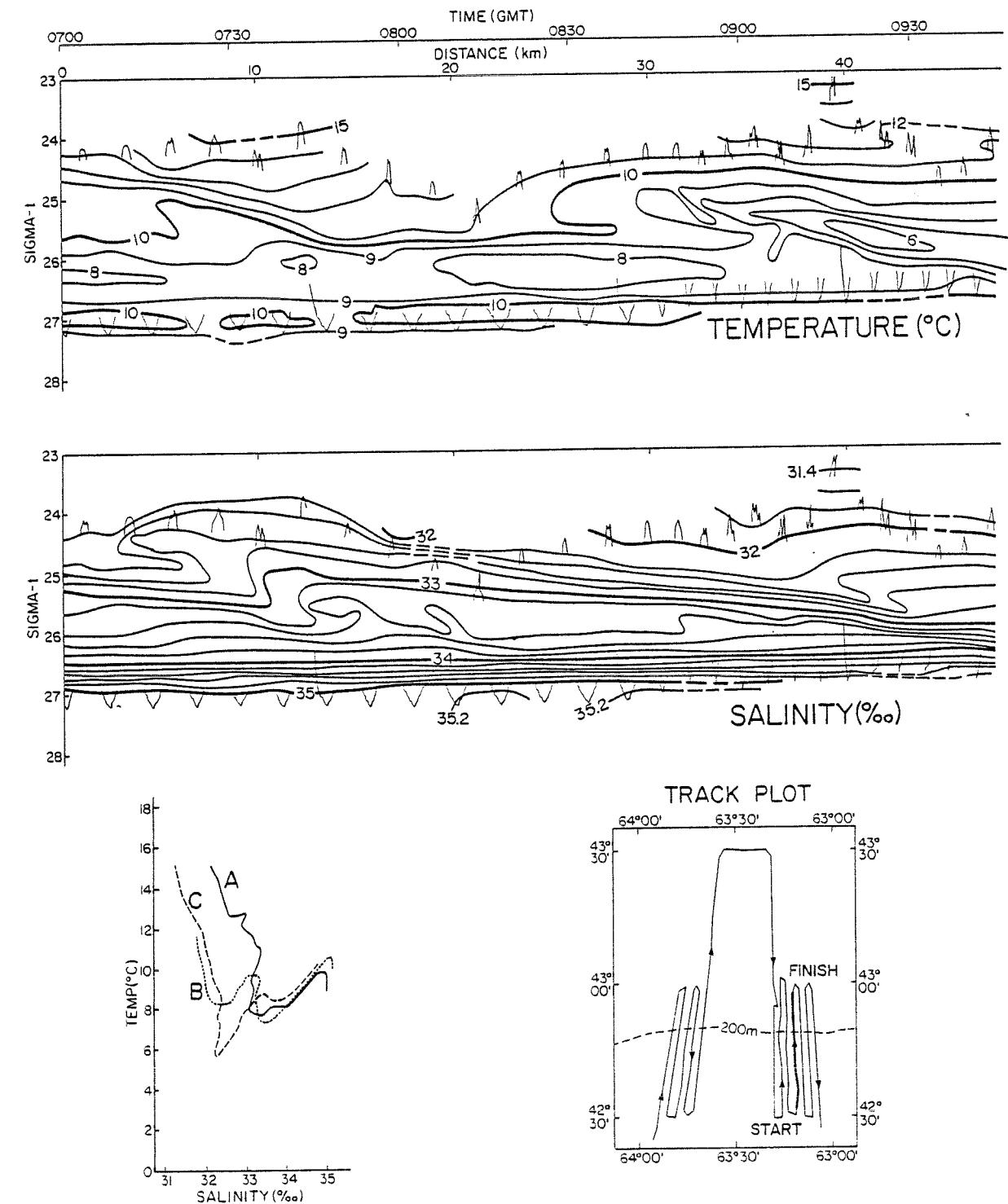
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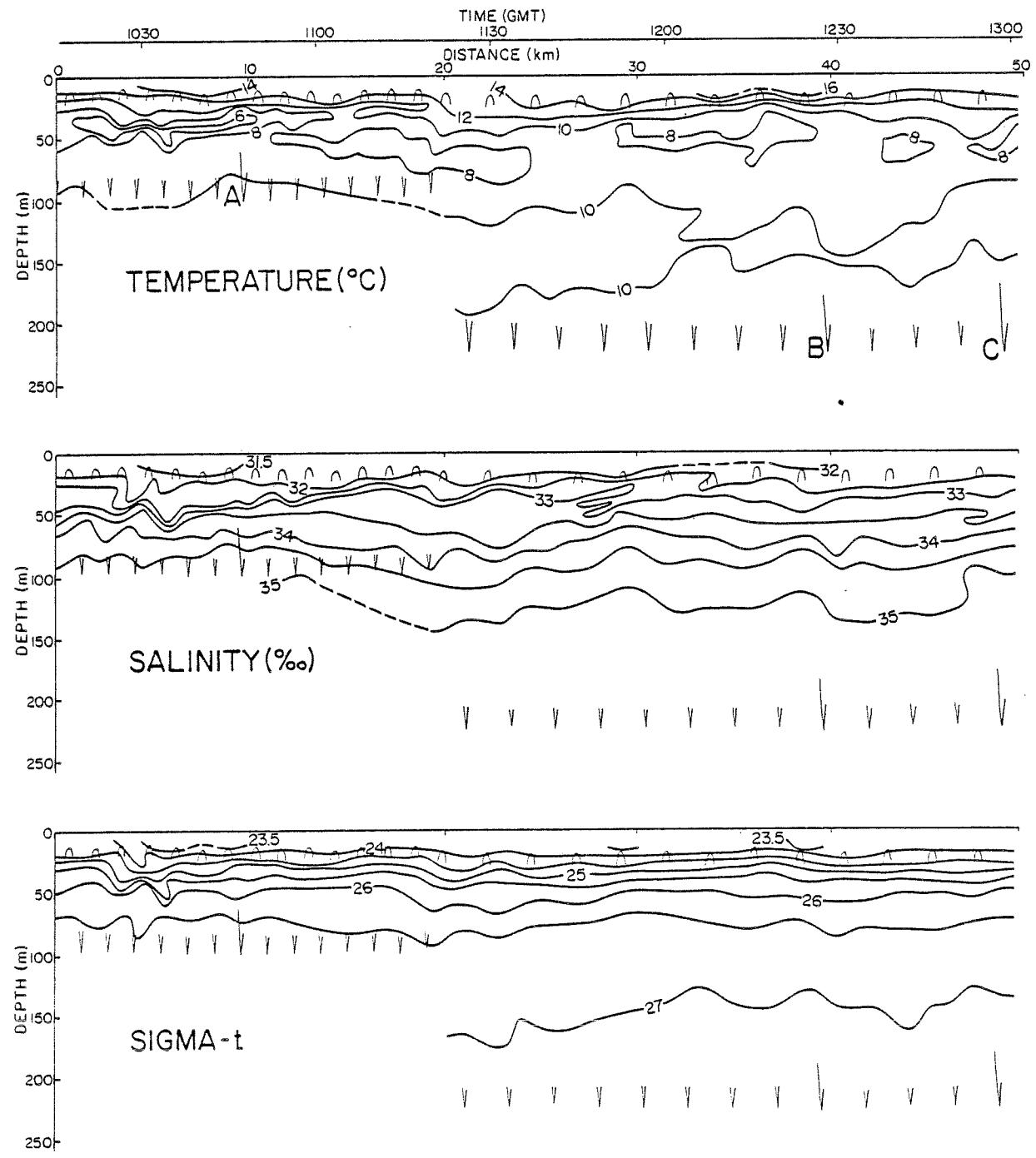
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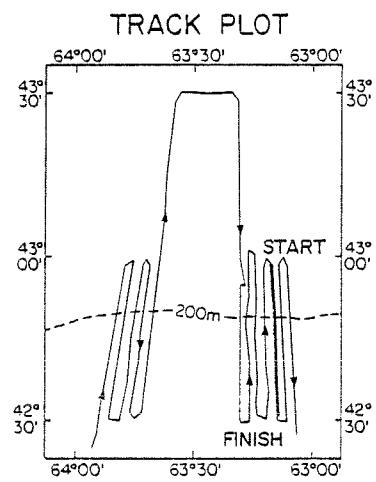
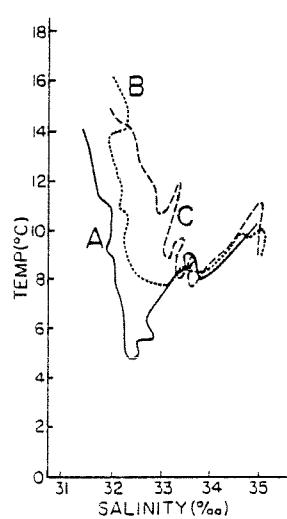
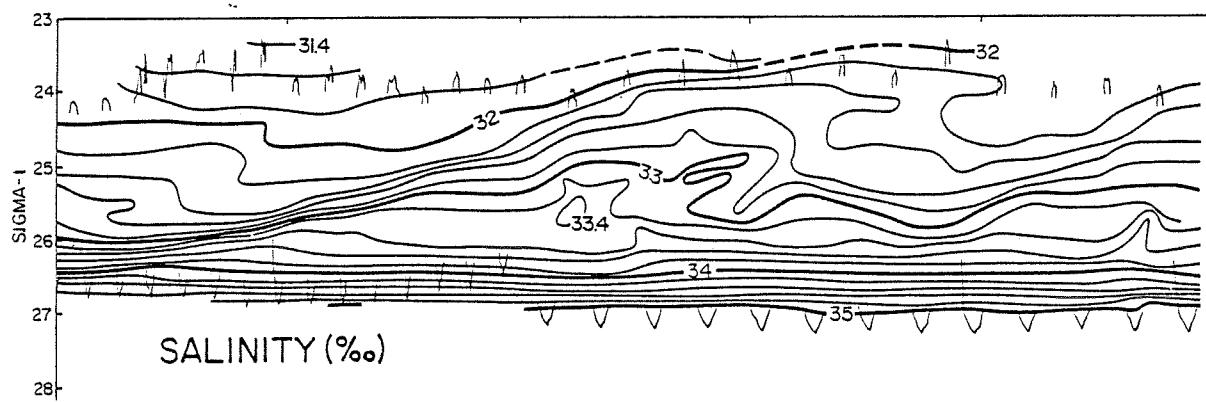
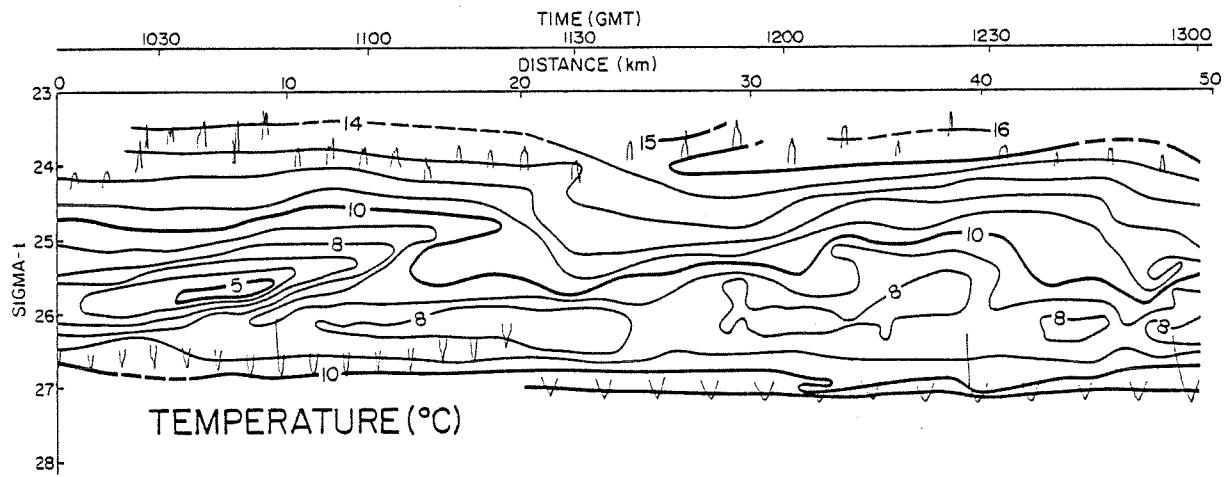
## CRUISE 76020 JULY 10, 1976



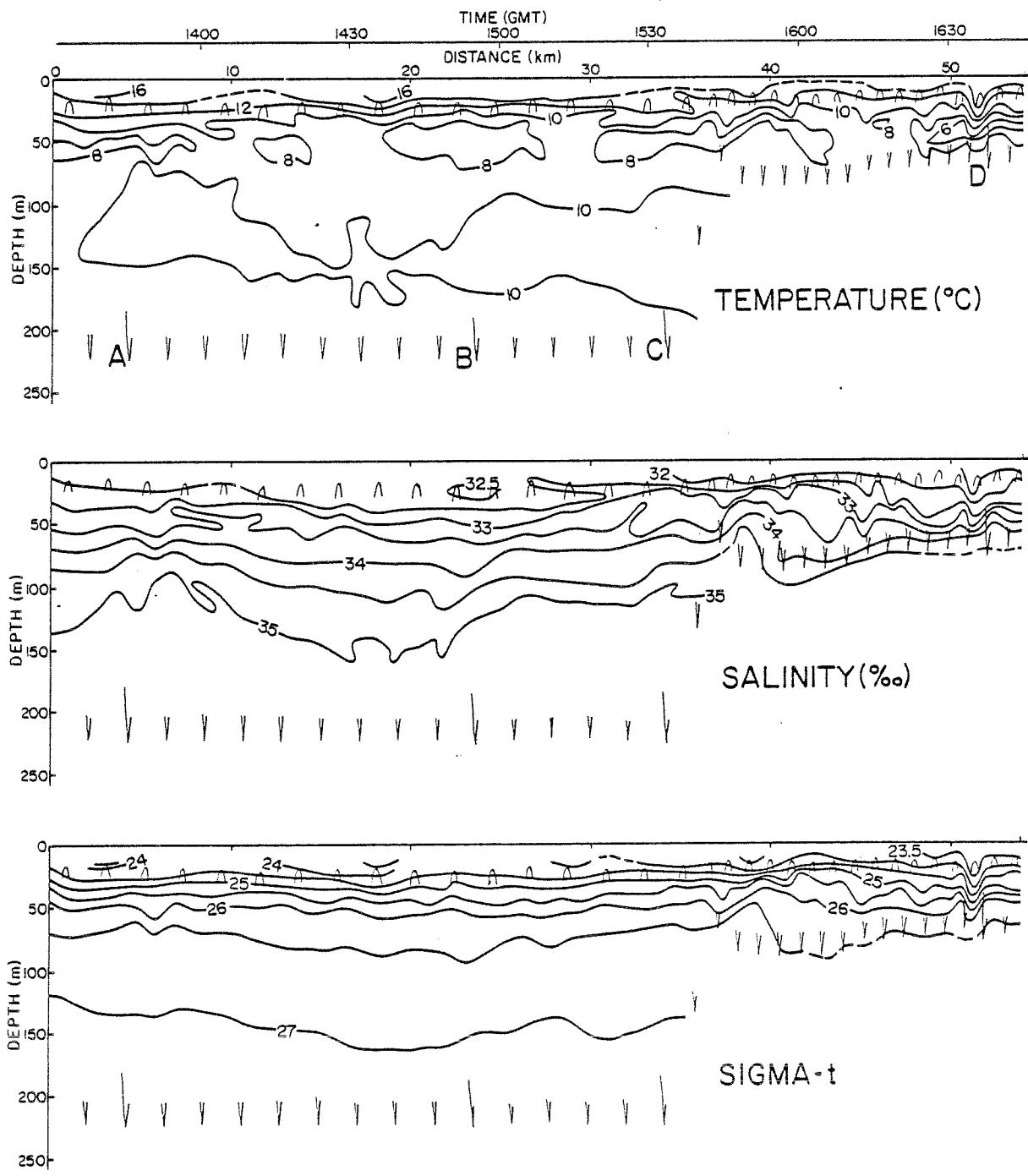
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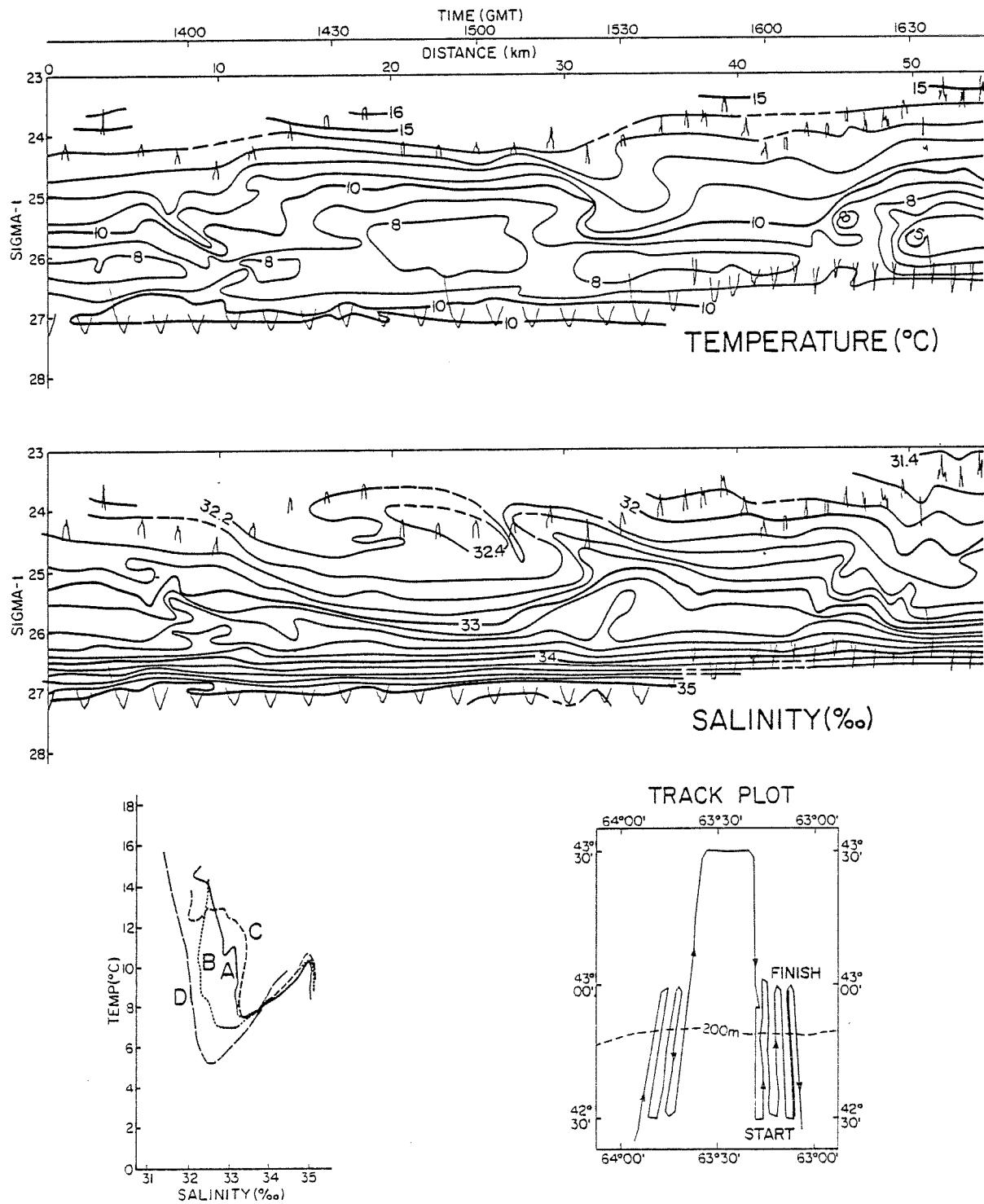
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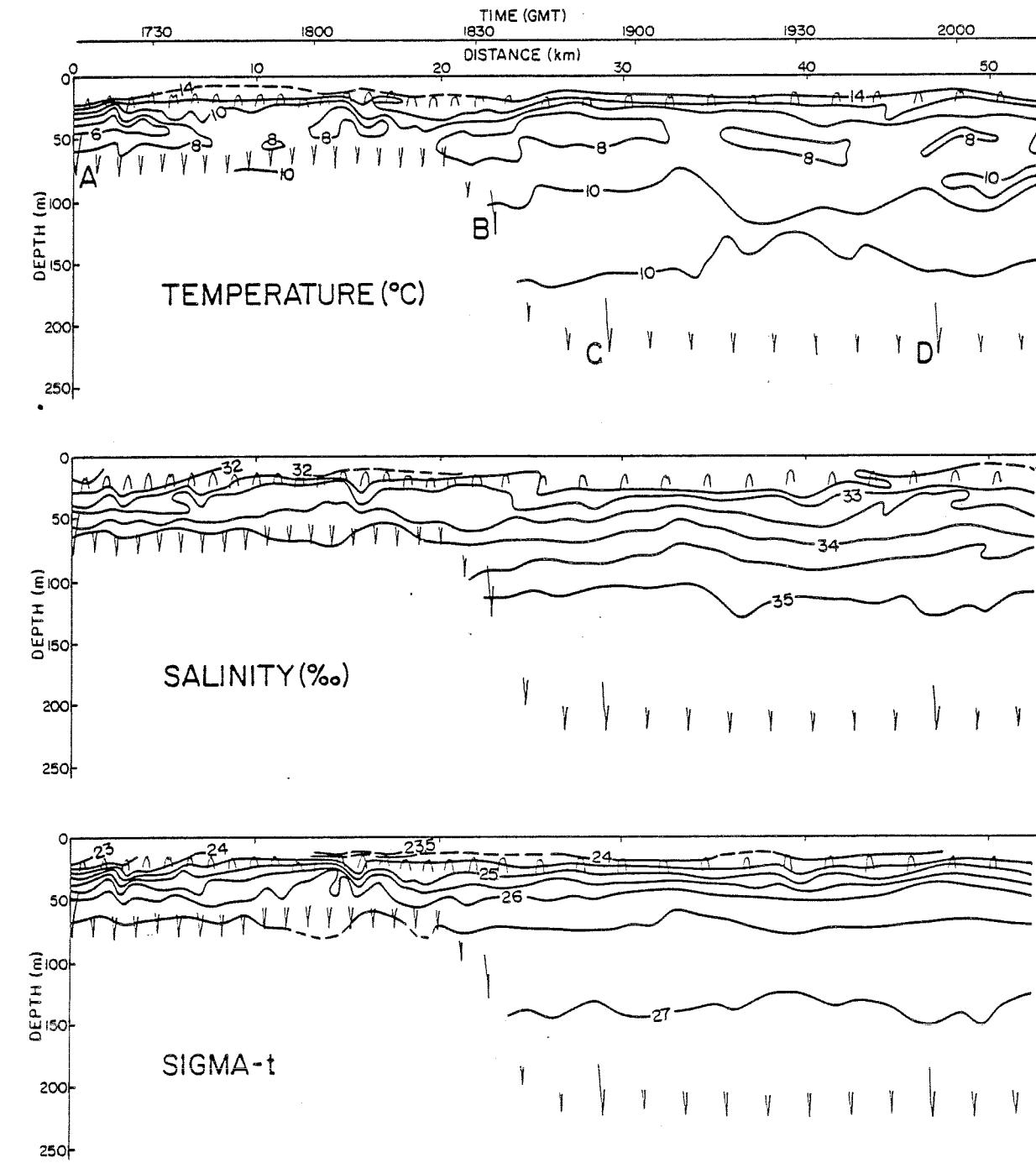
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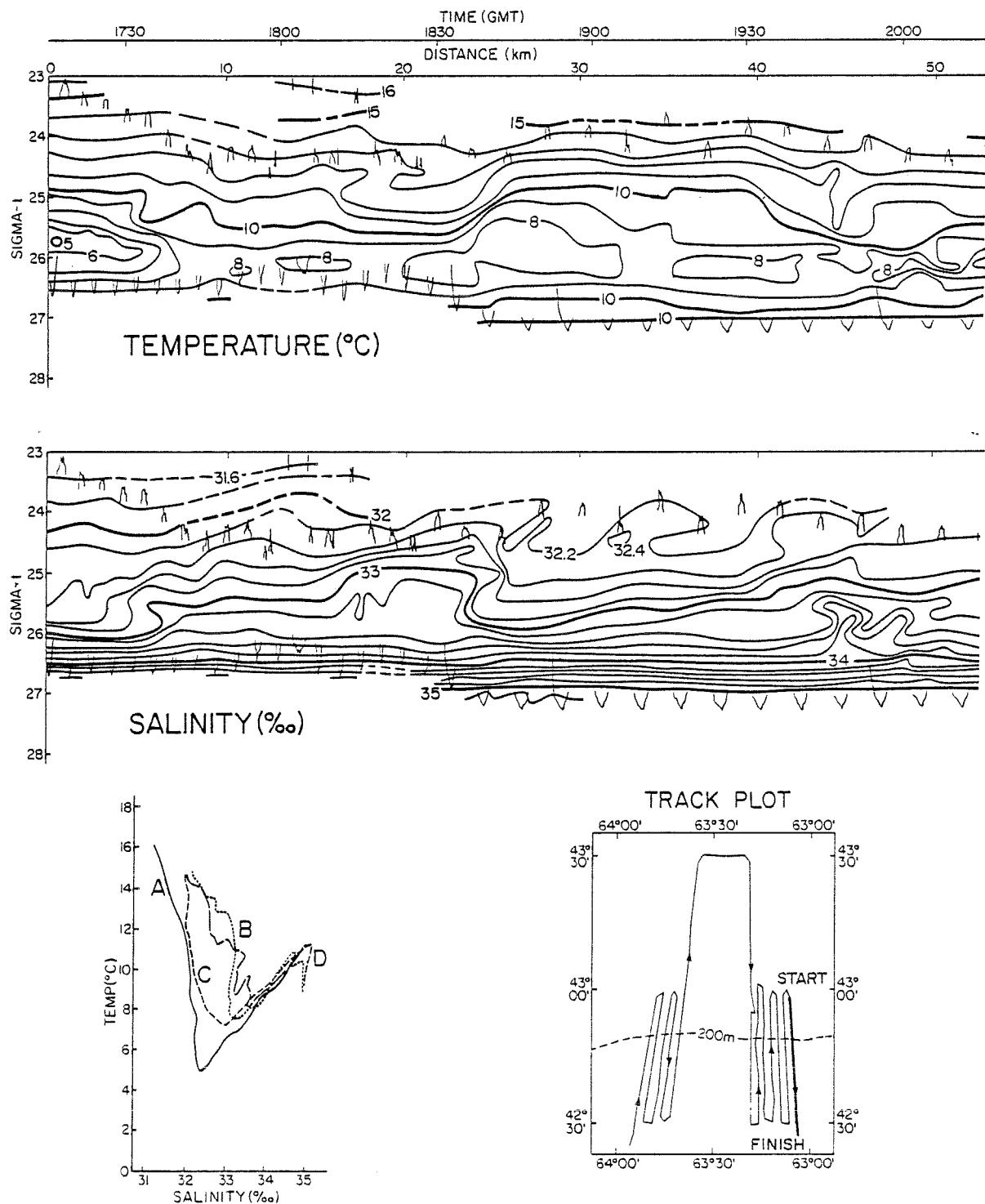
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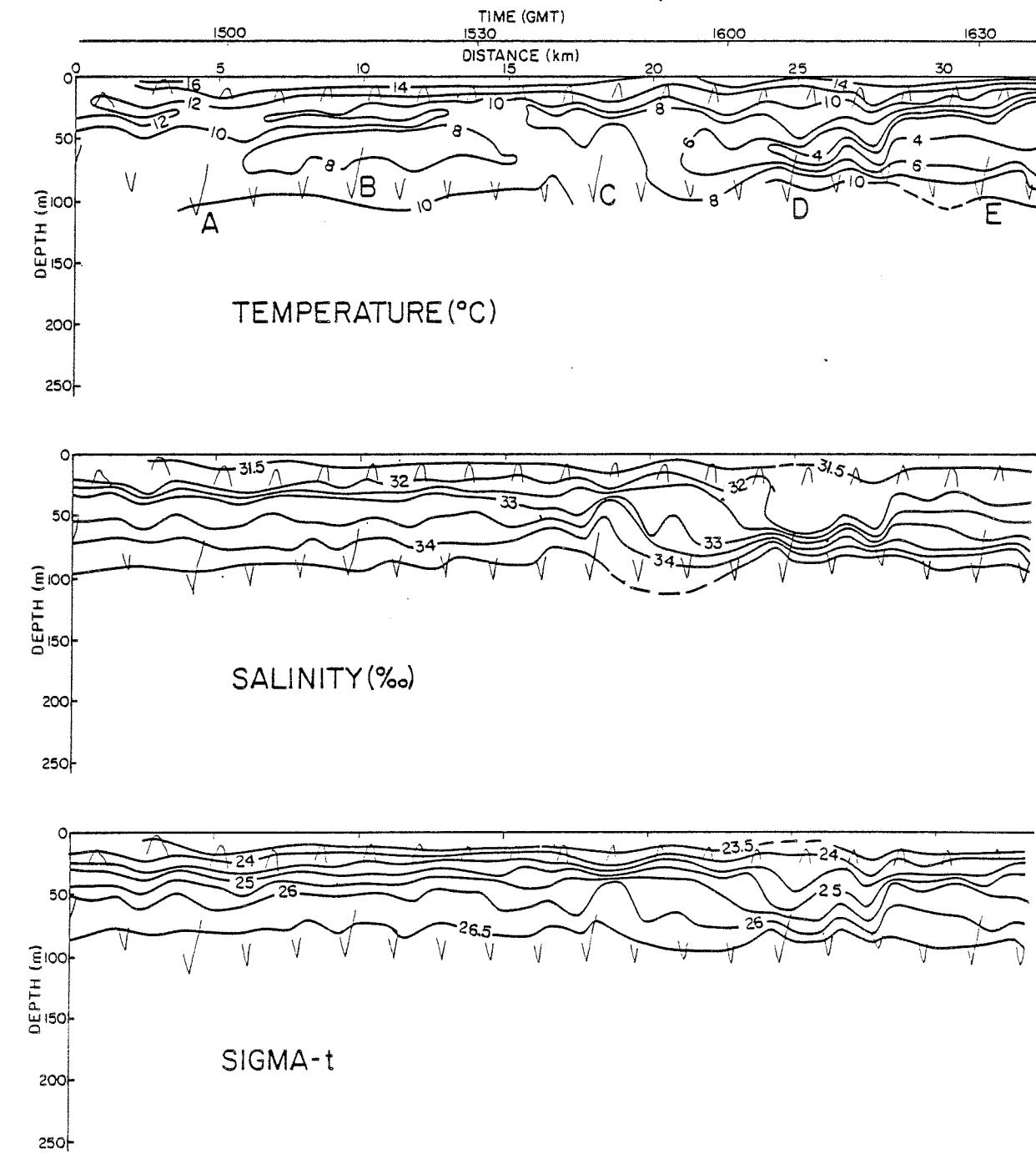
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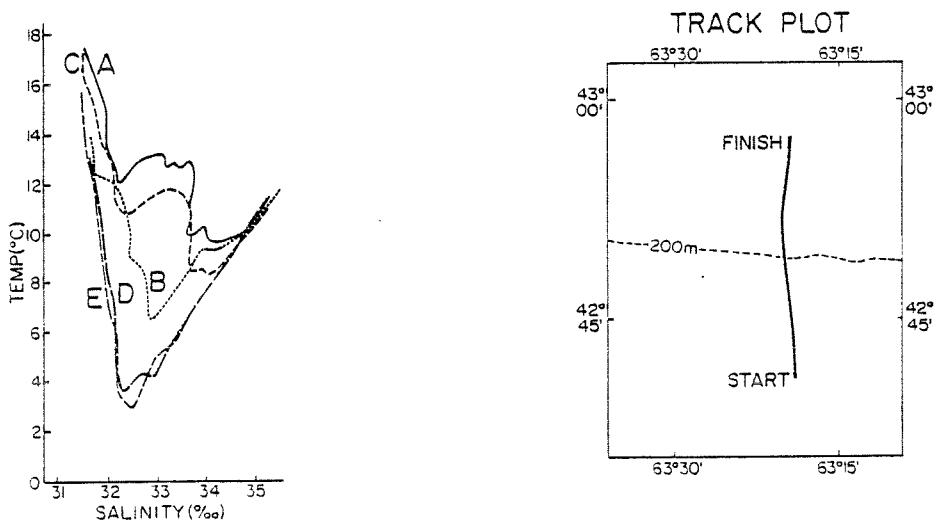
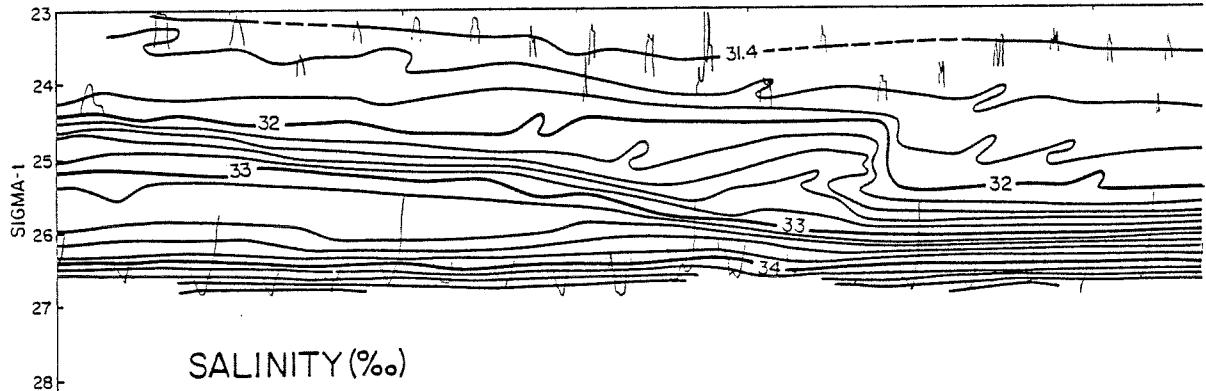
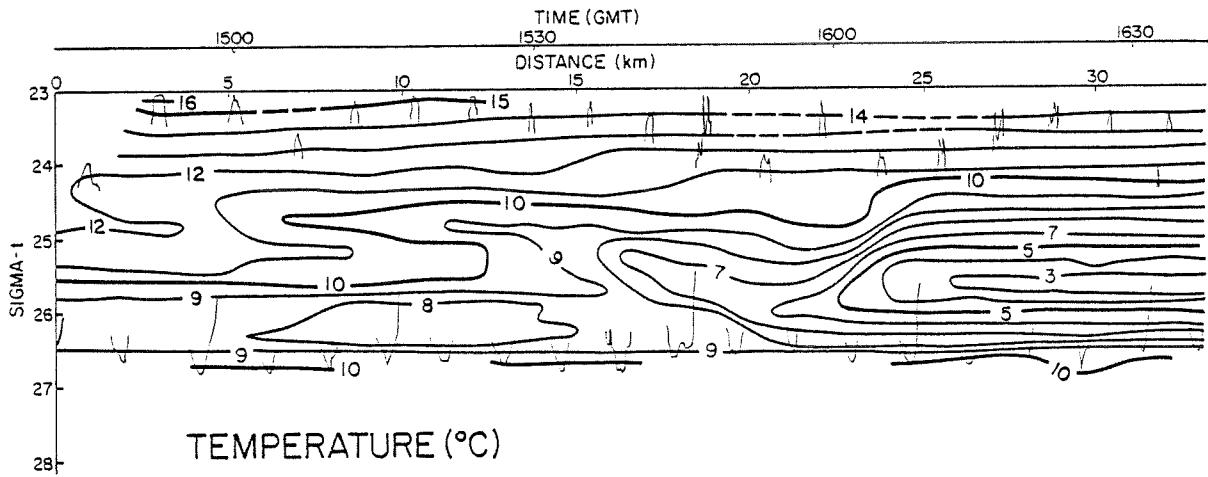
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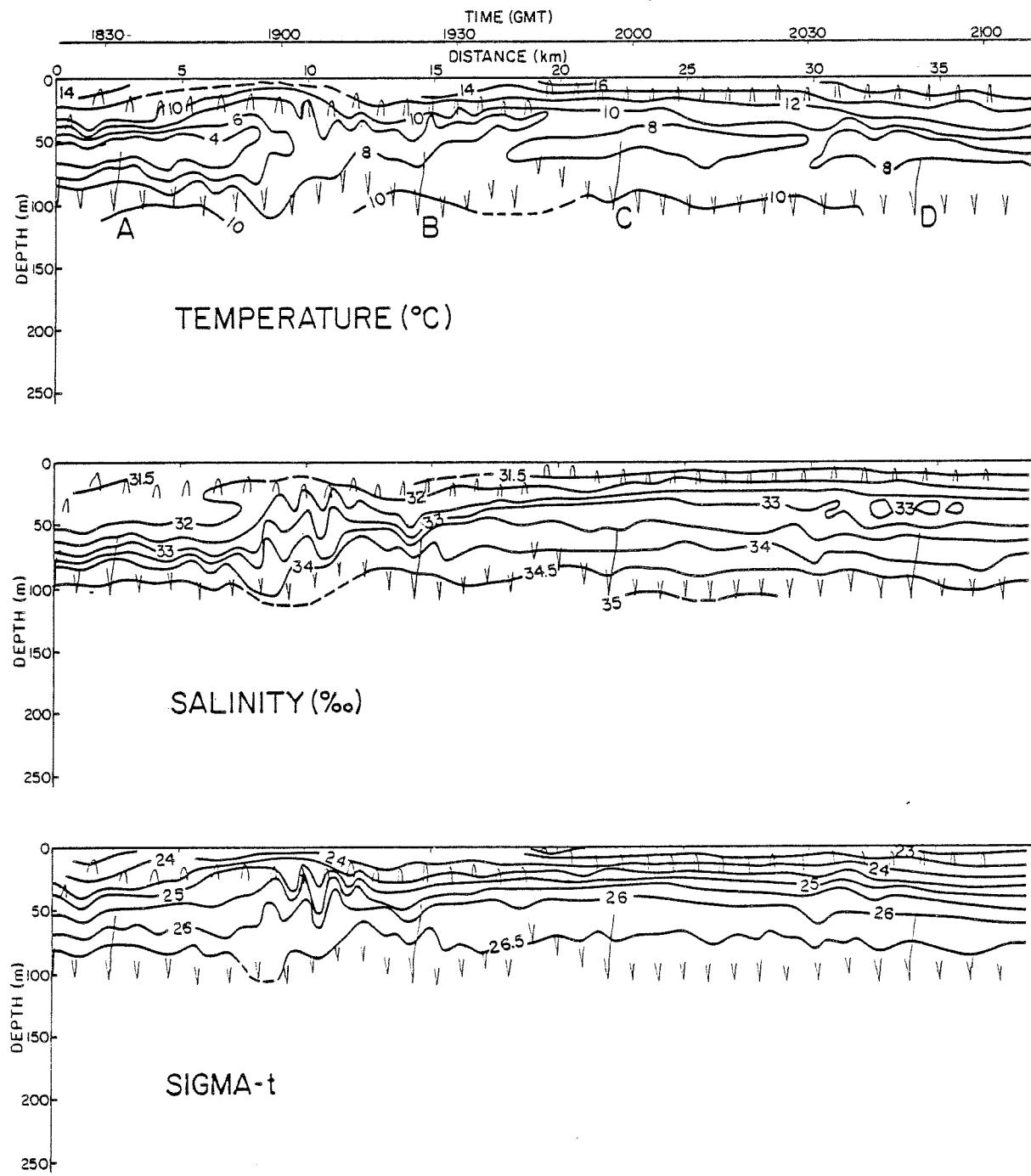
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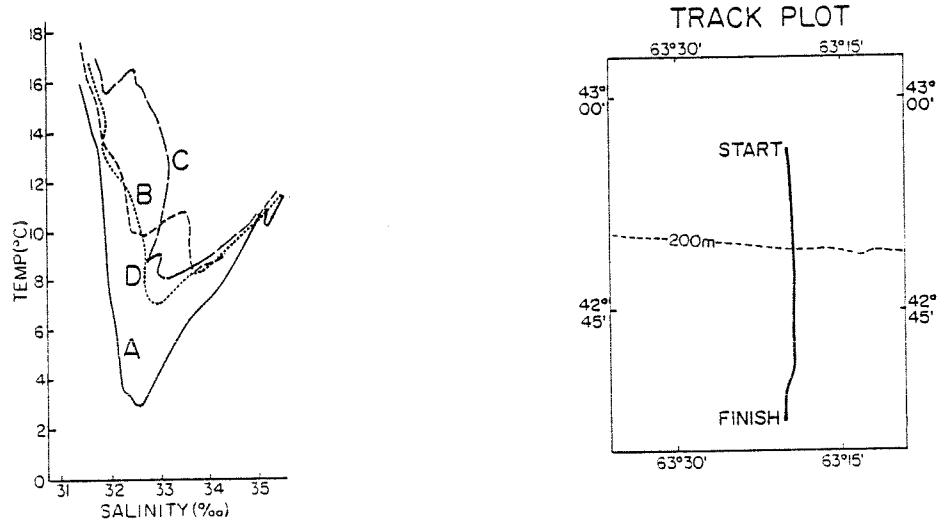
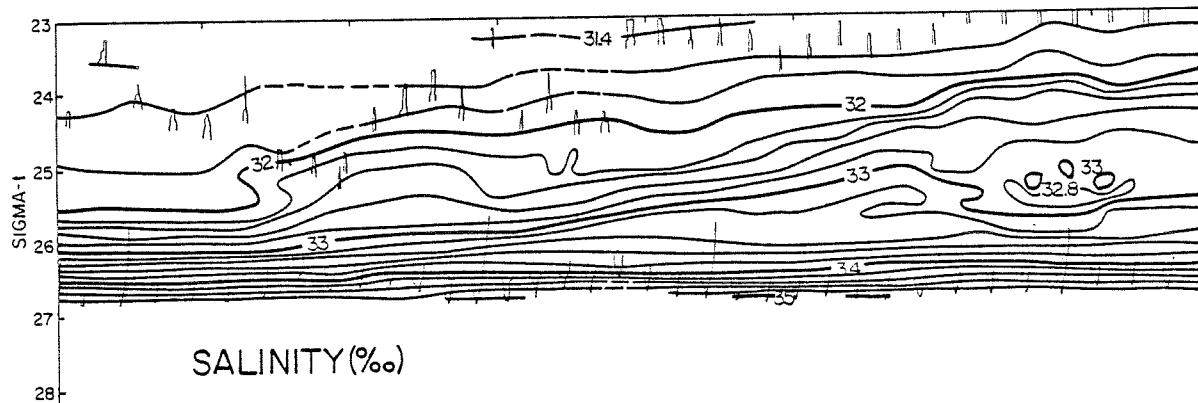
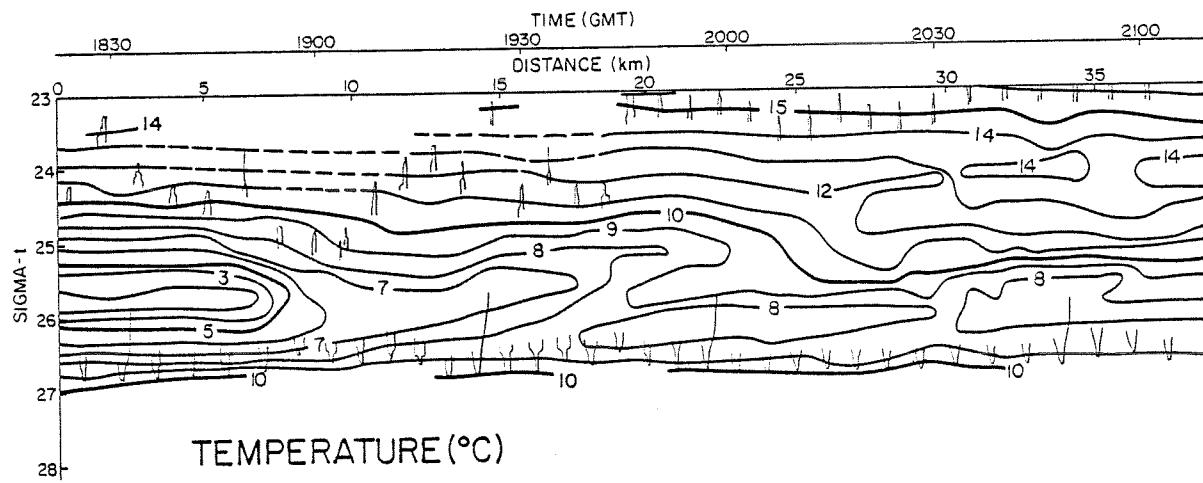
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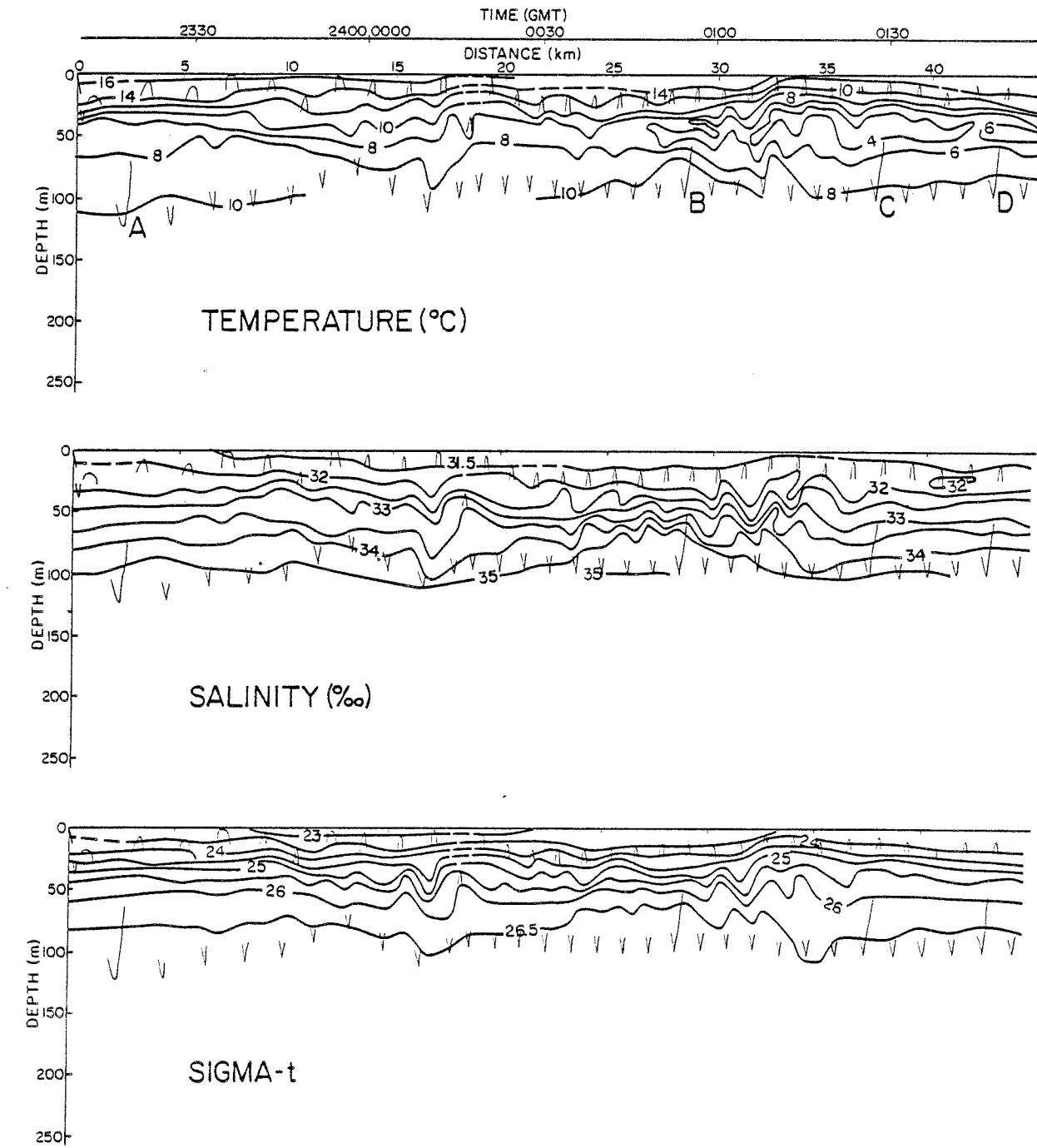
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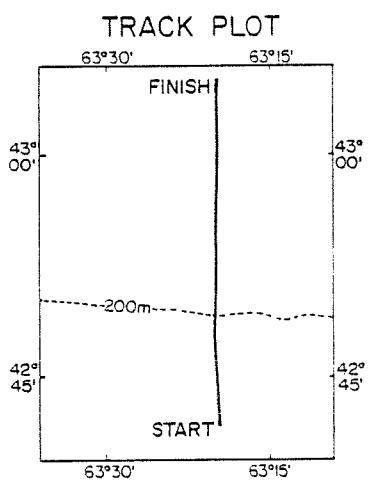
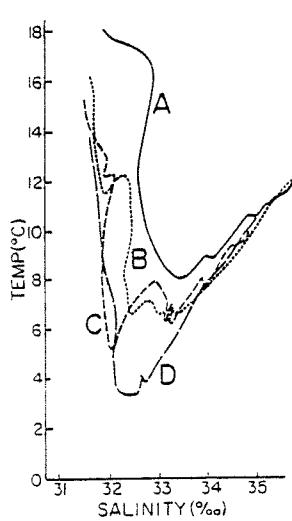
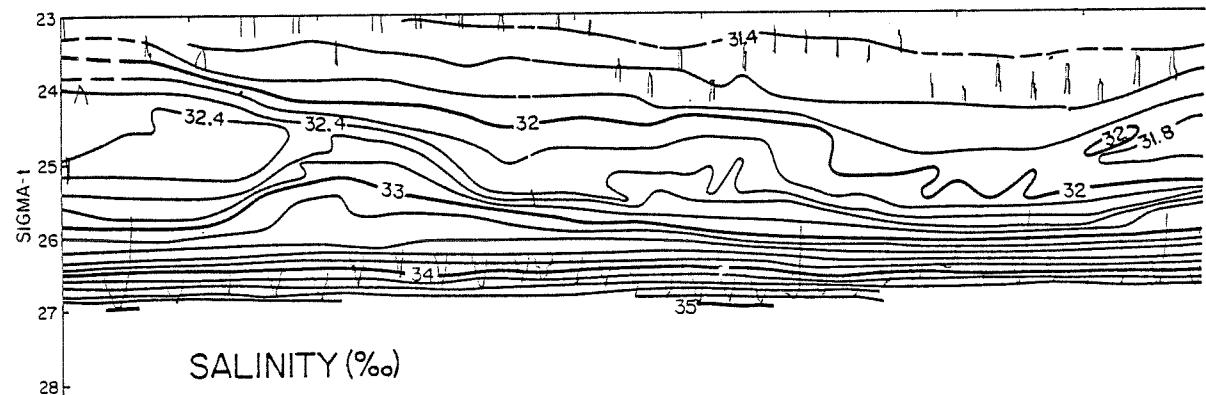
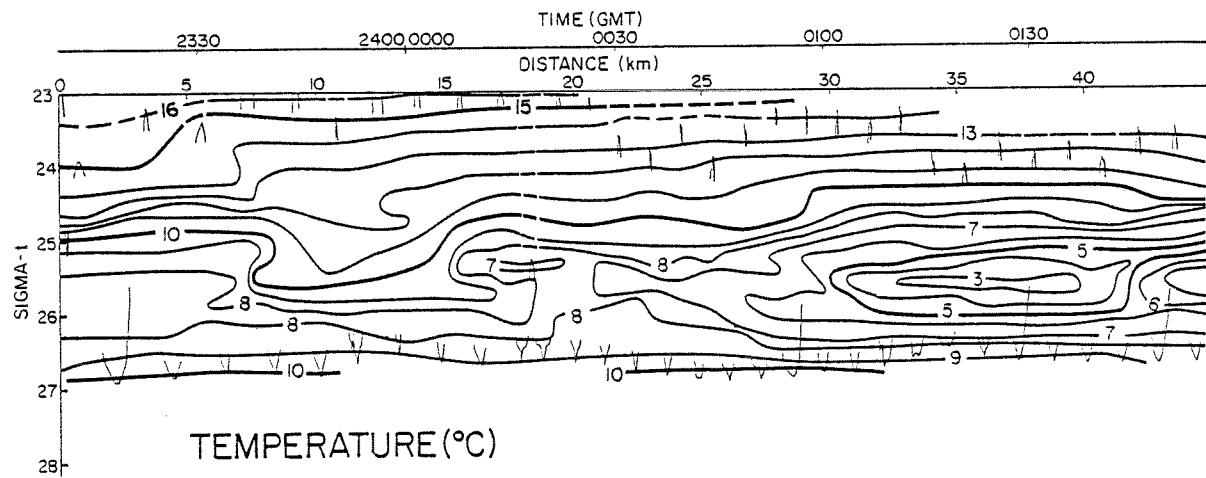
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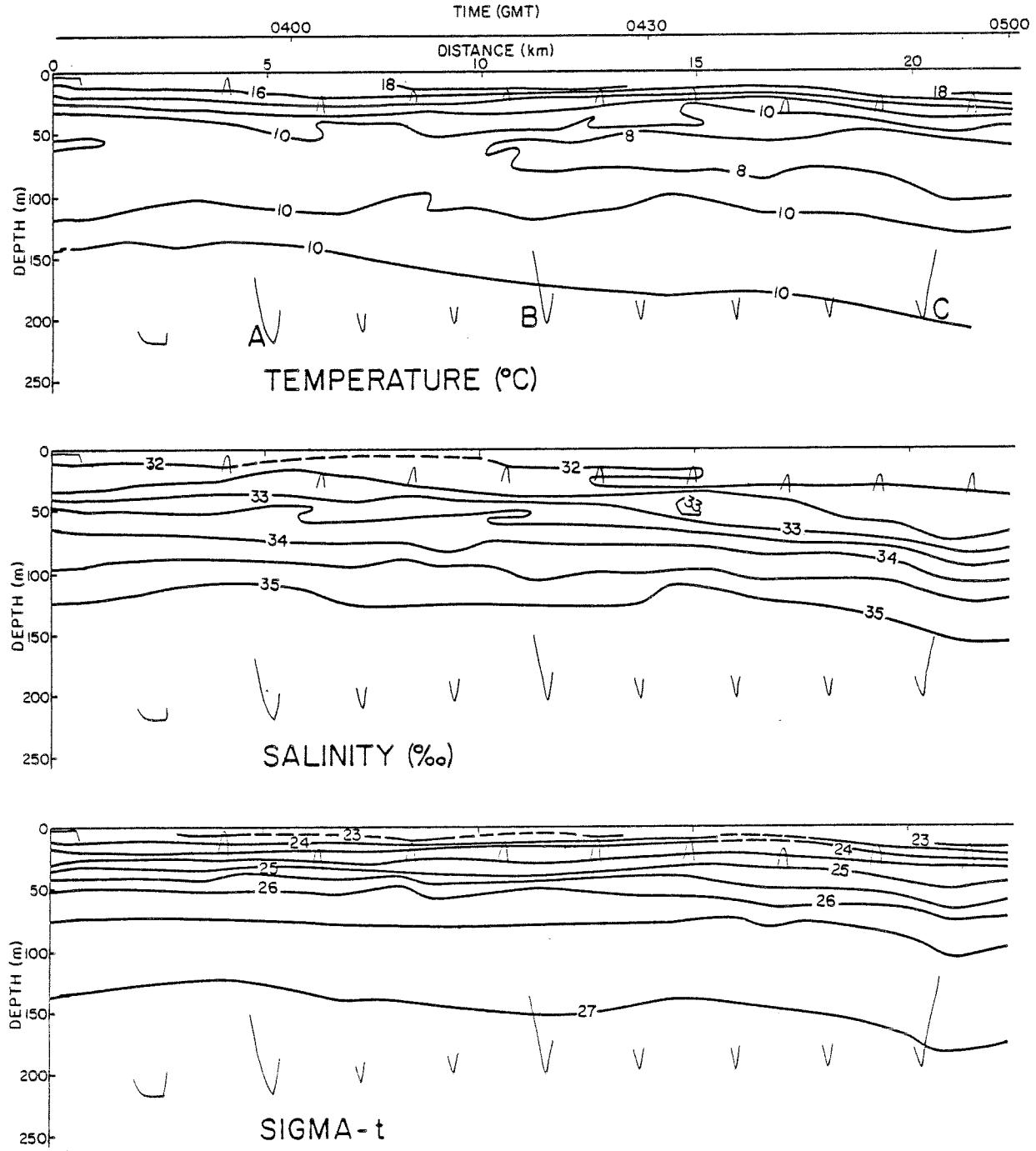
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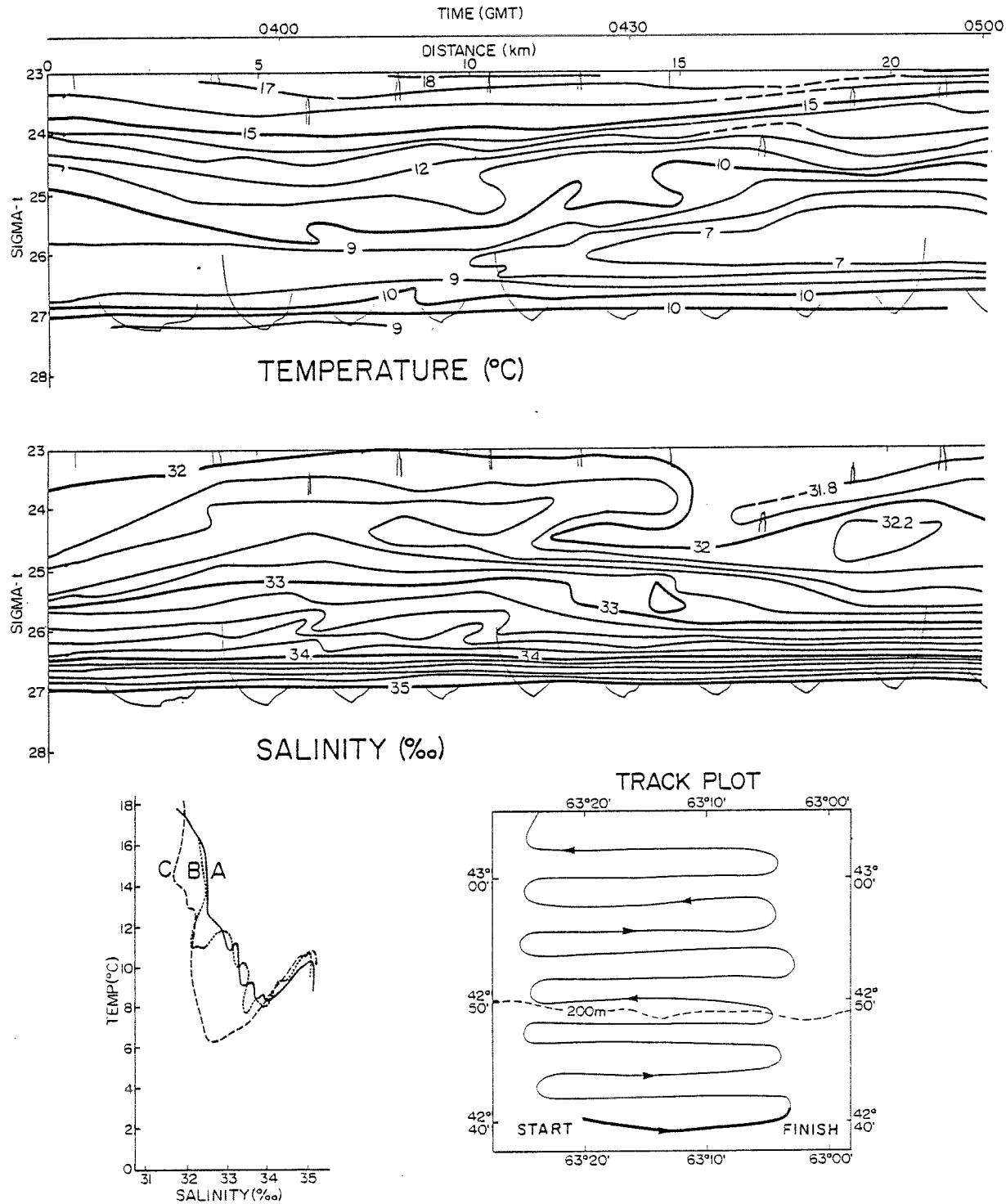
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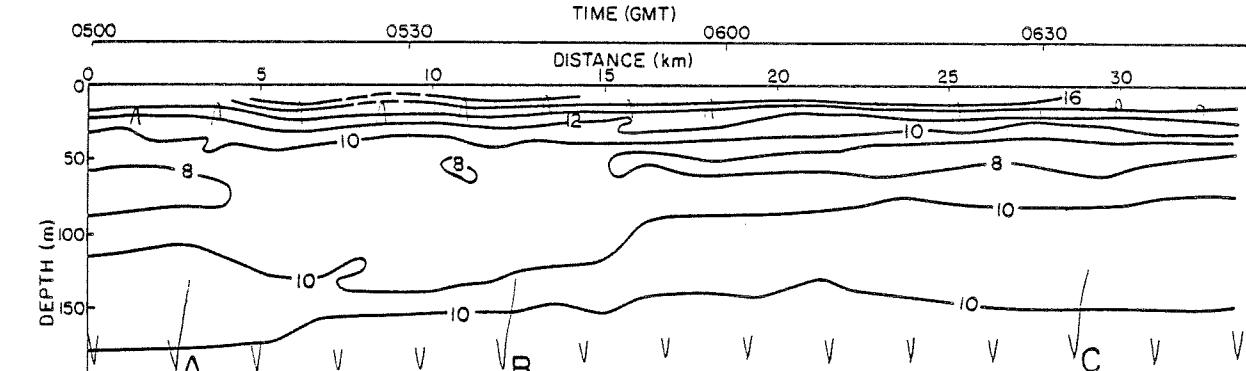
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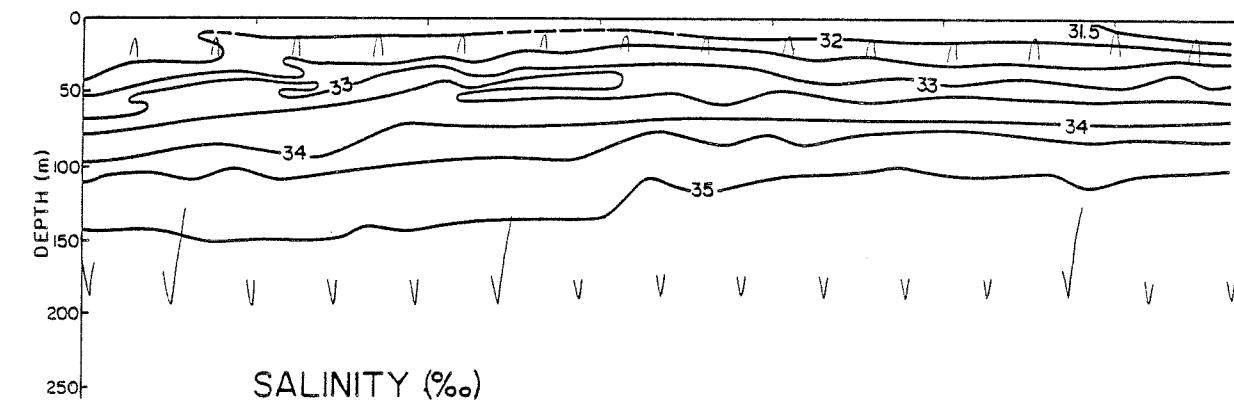
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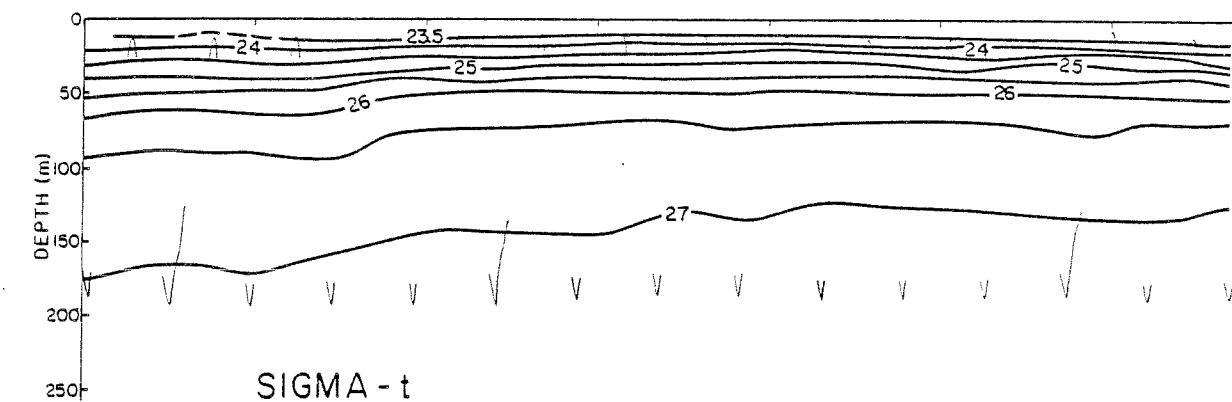
CRUISE 76020 JULY 13, 1976



**TEMPERATURE (°C)**

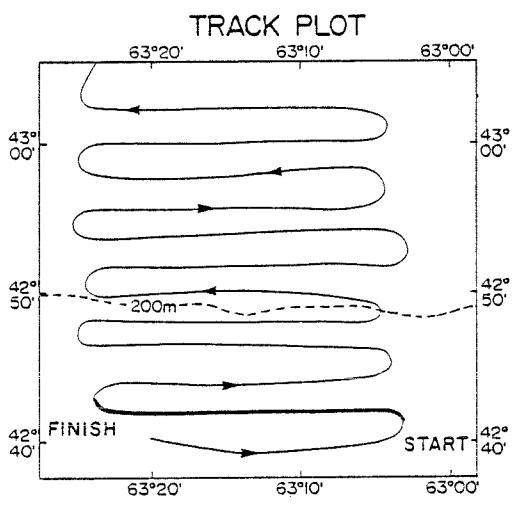
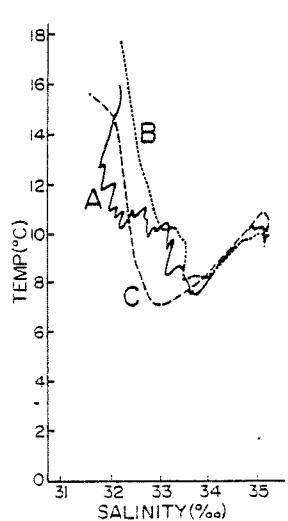
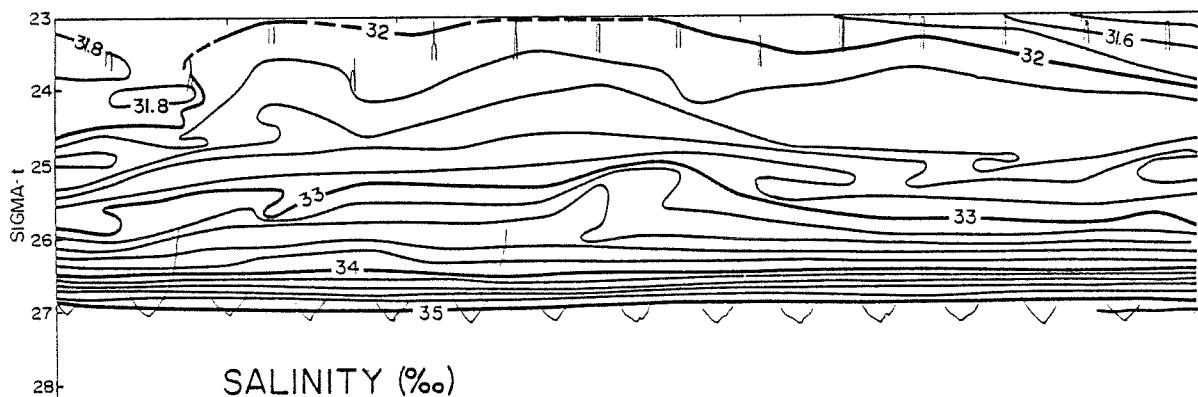
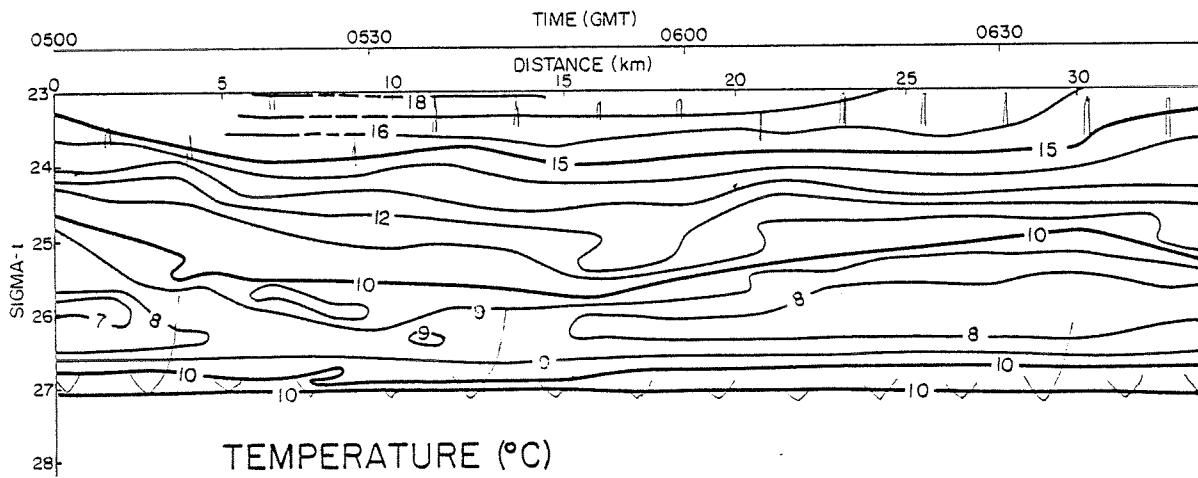


### SALINITY (%)

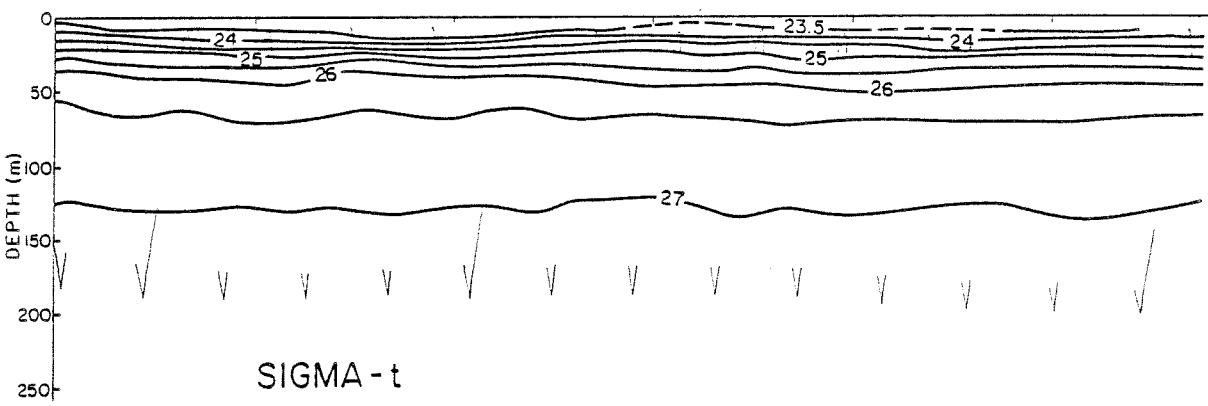
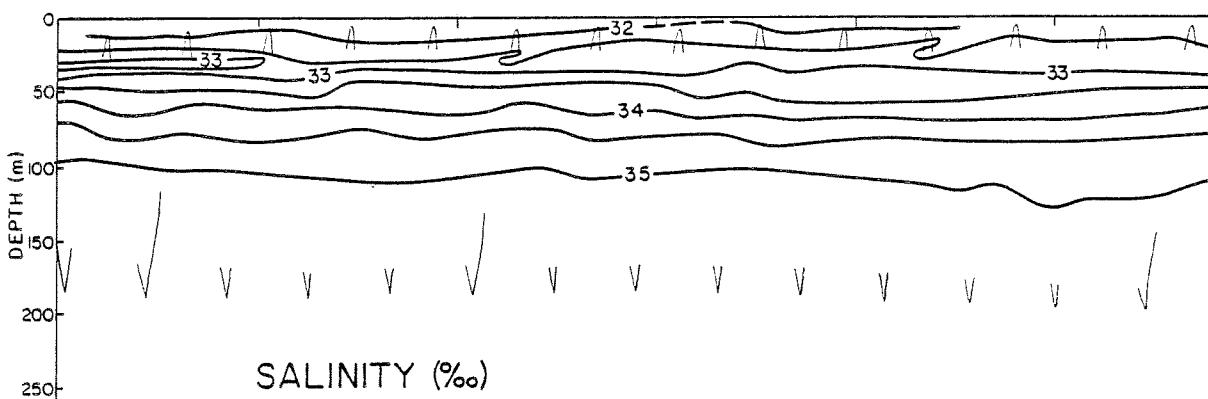
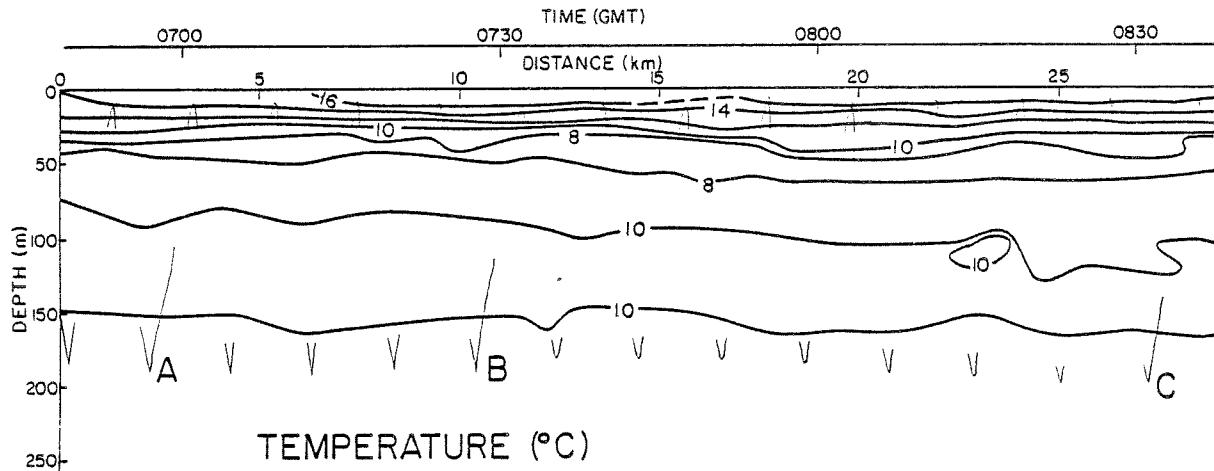


SIGMA -

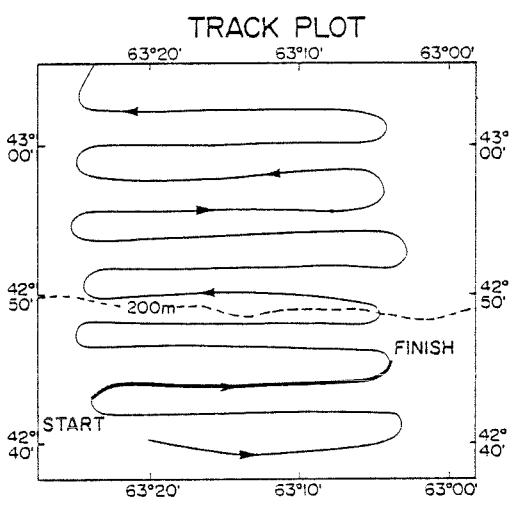
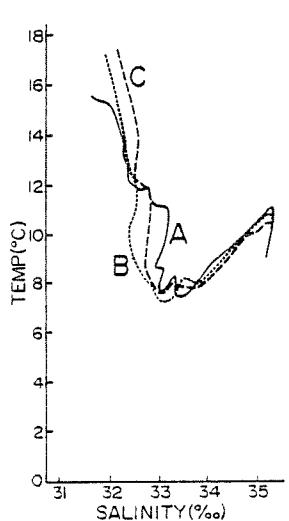
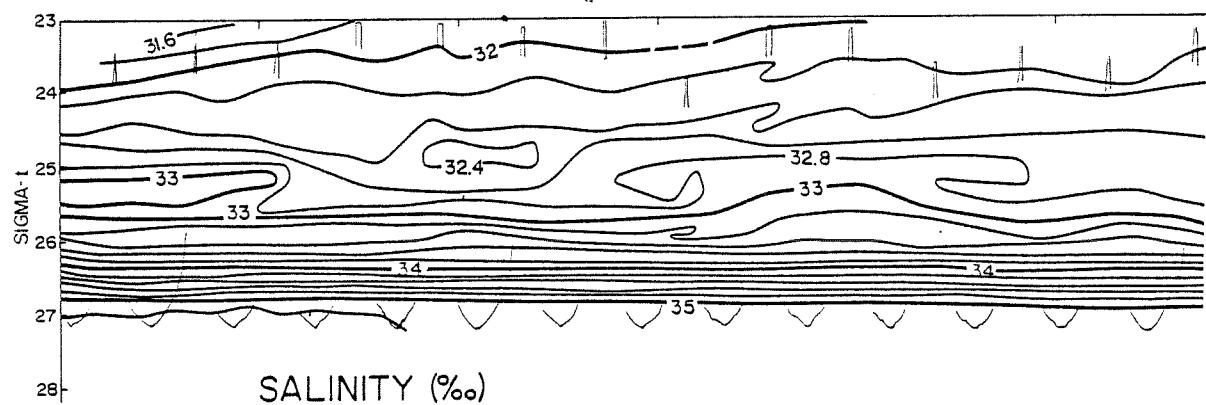
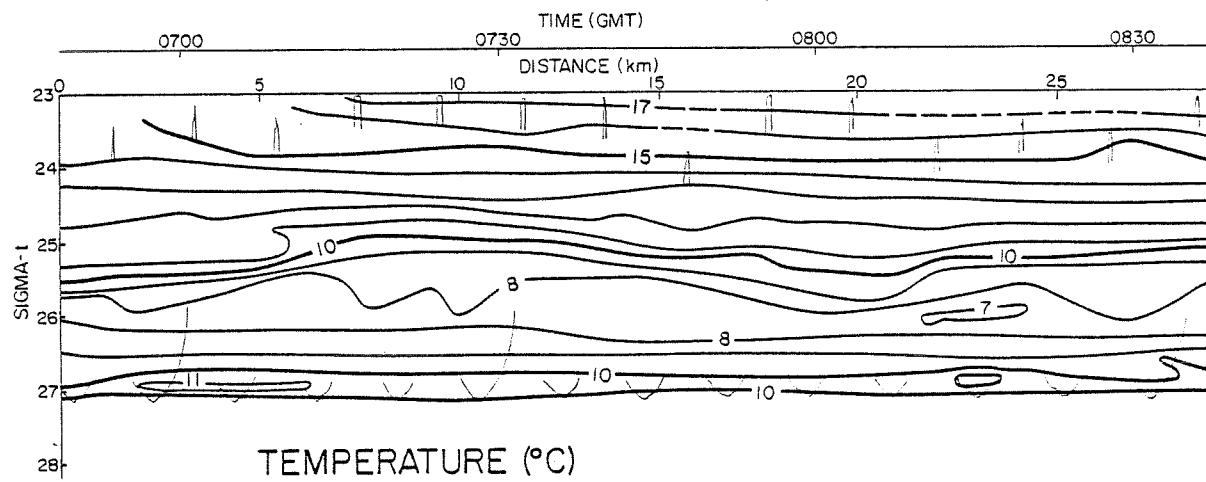
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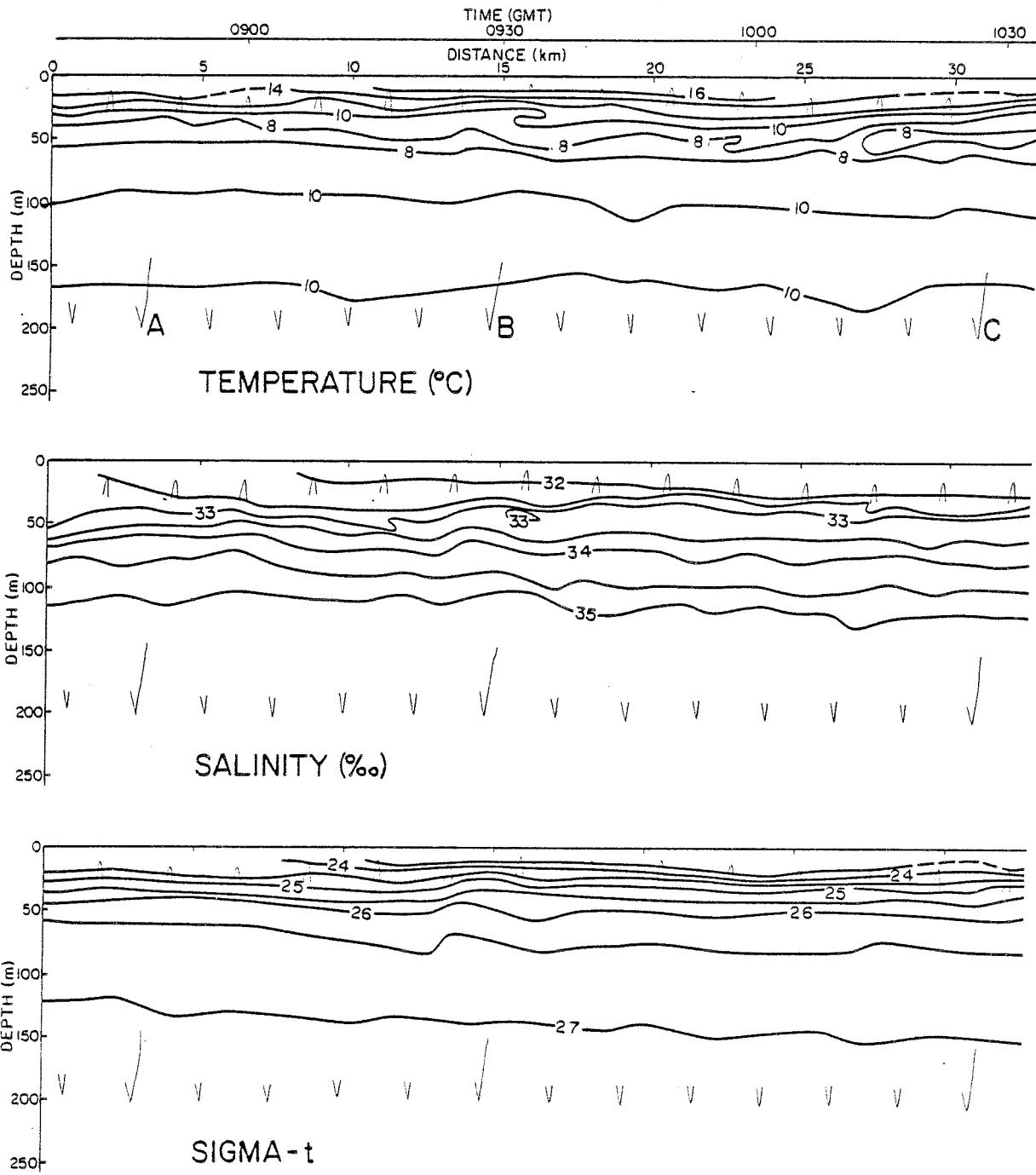
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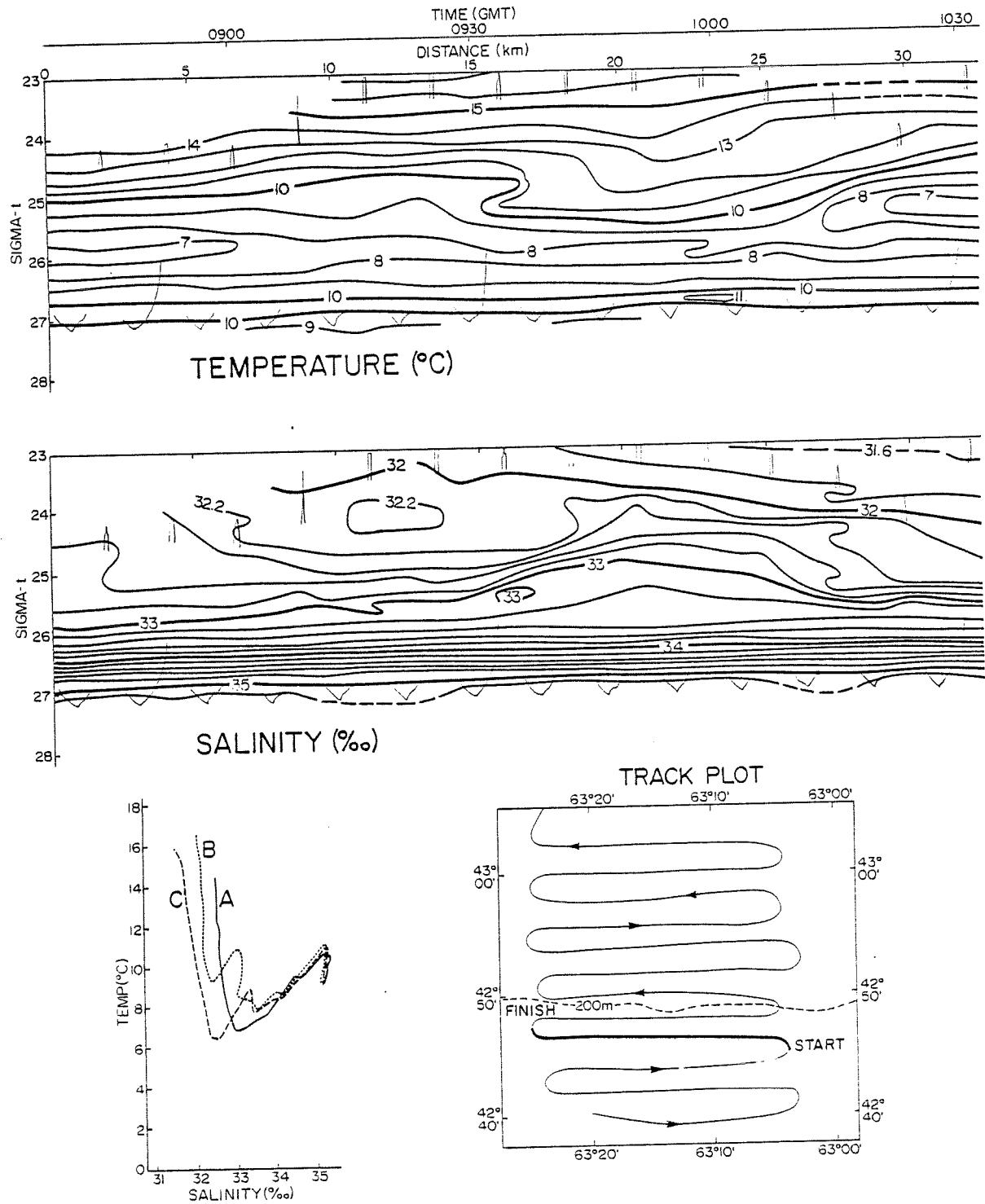
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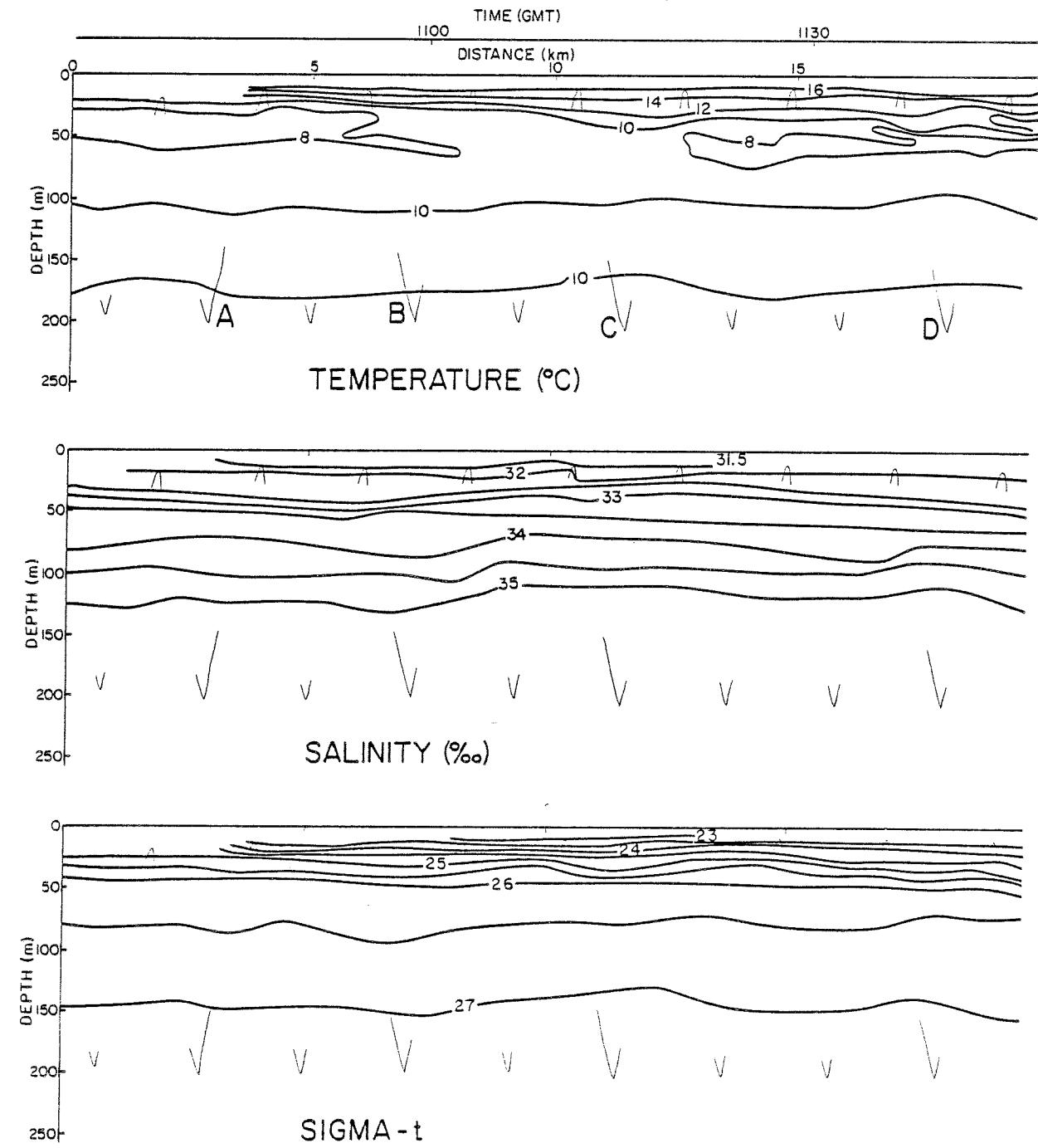
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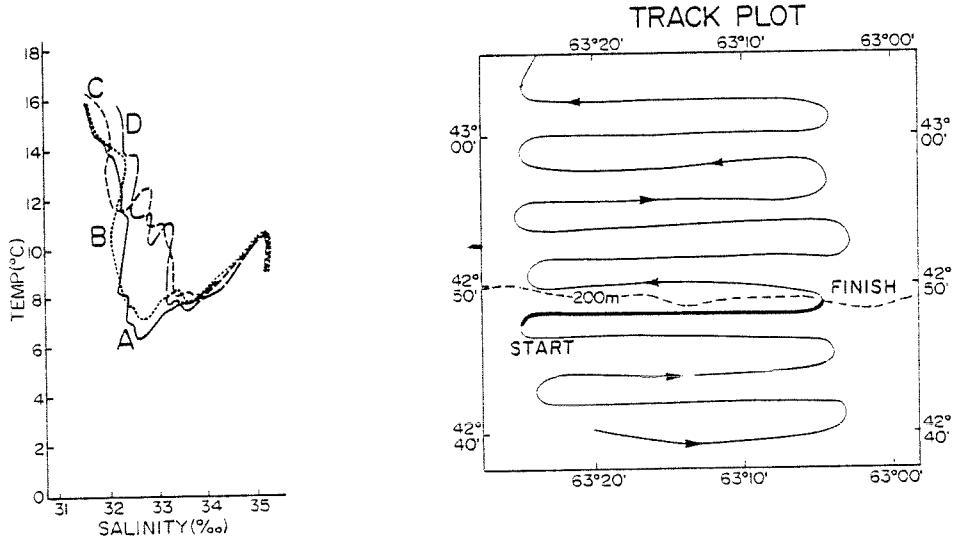
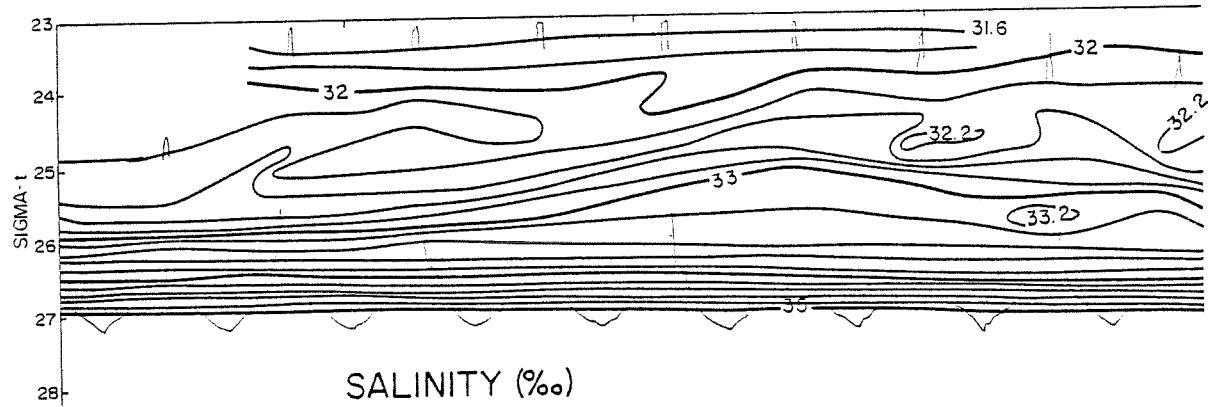
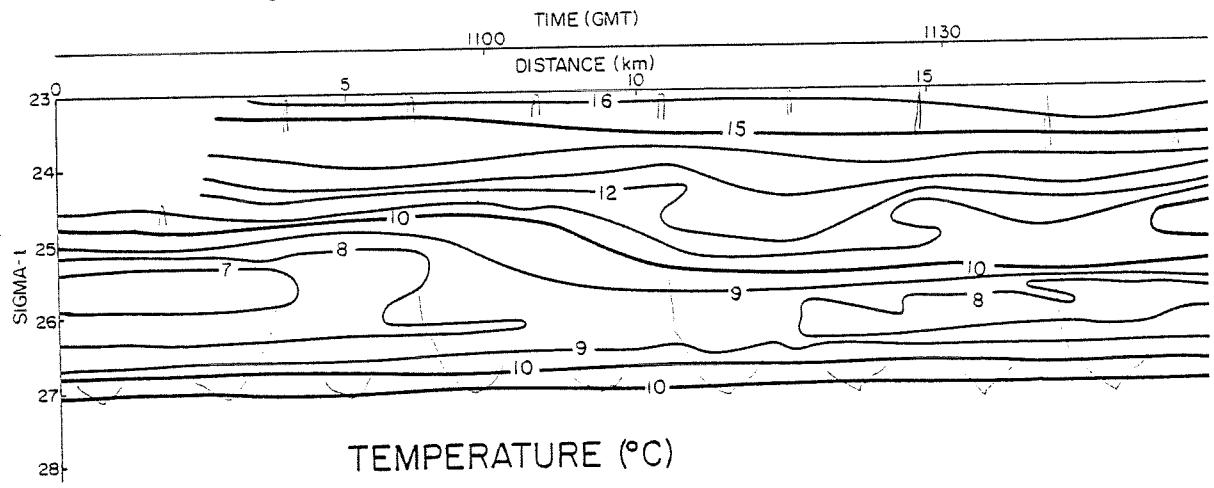
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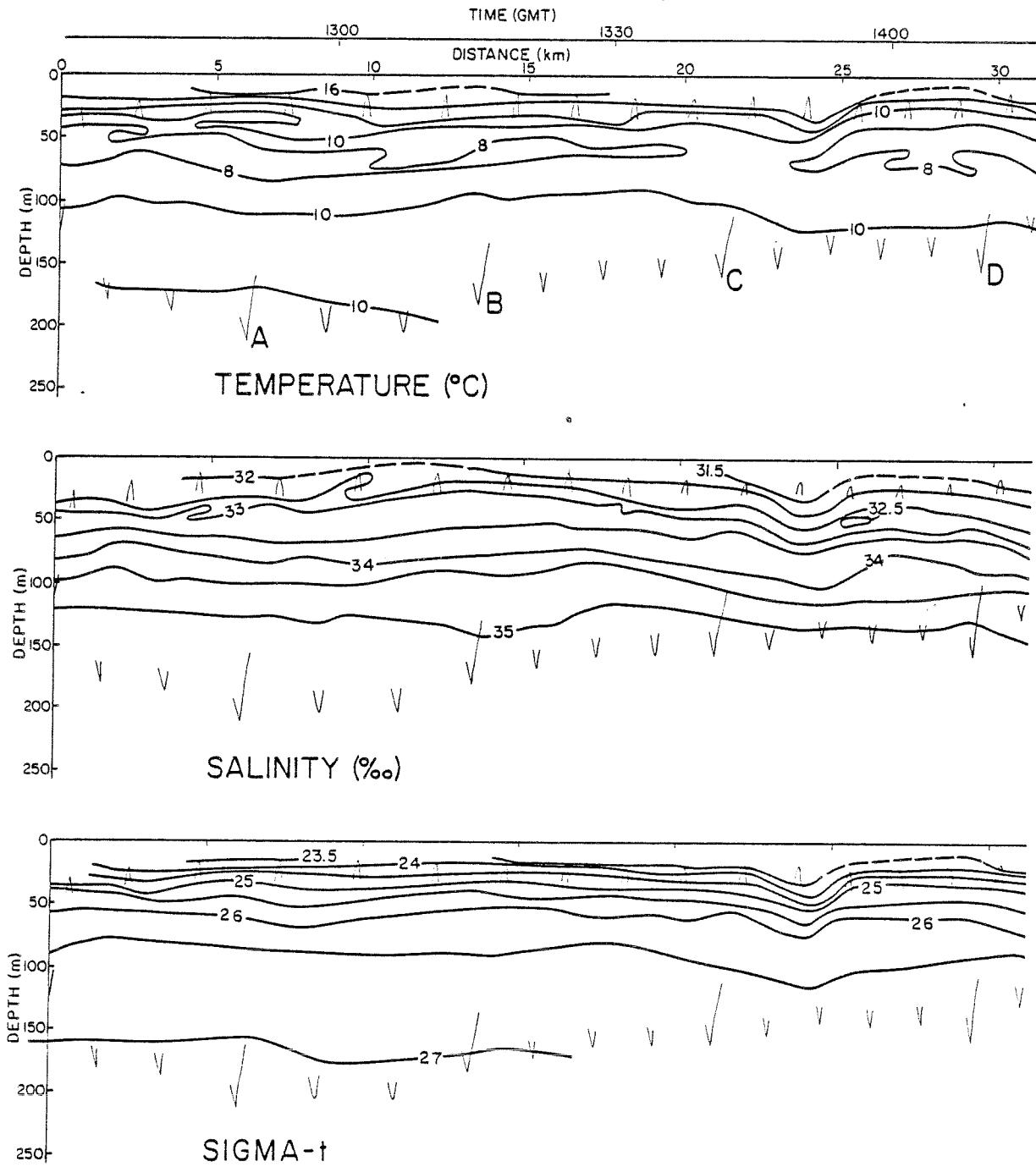
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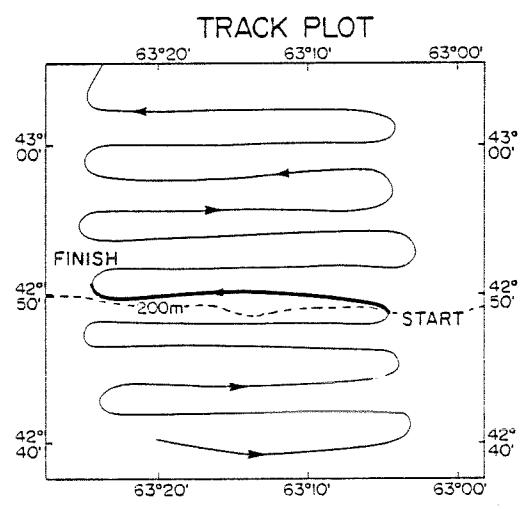
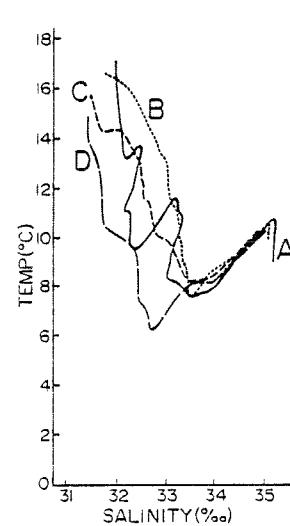
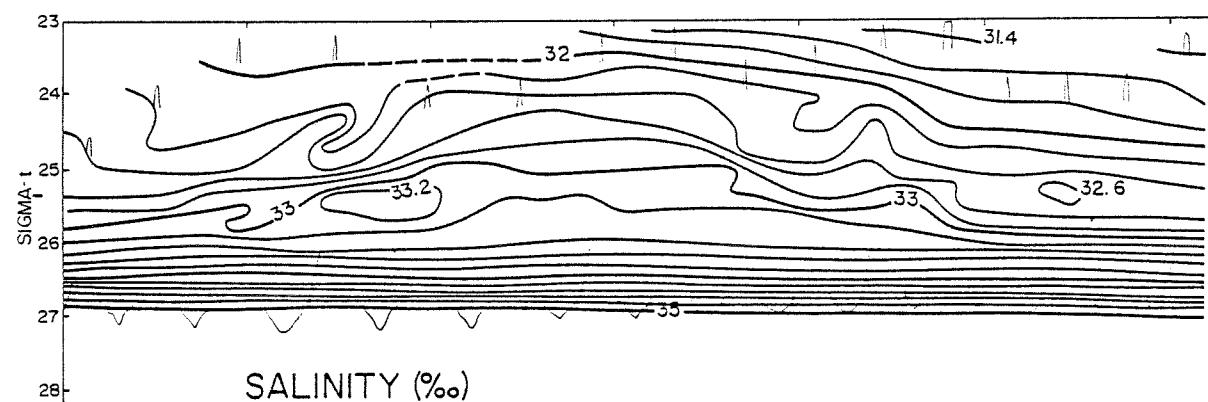
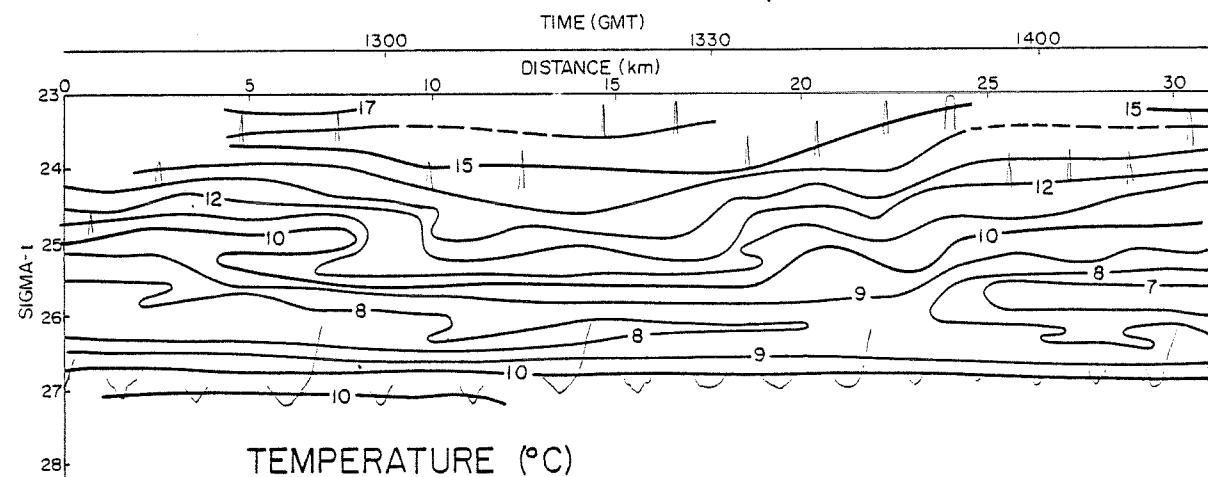
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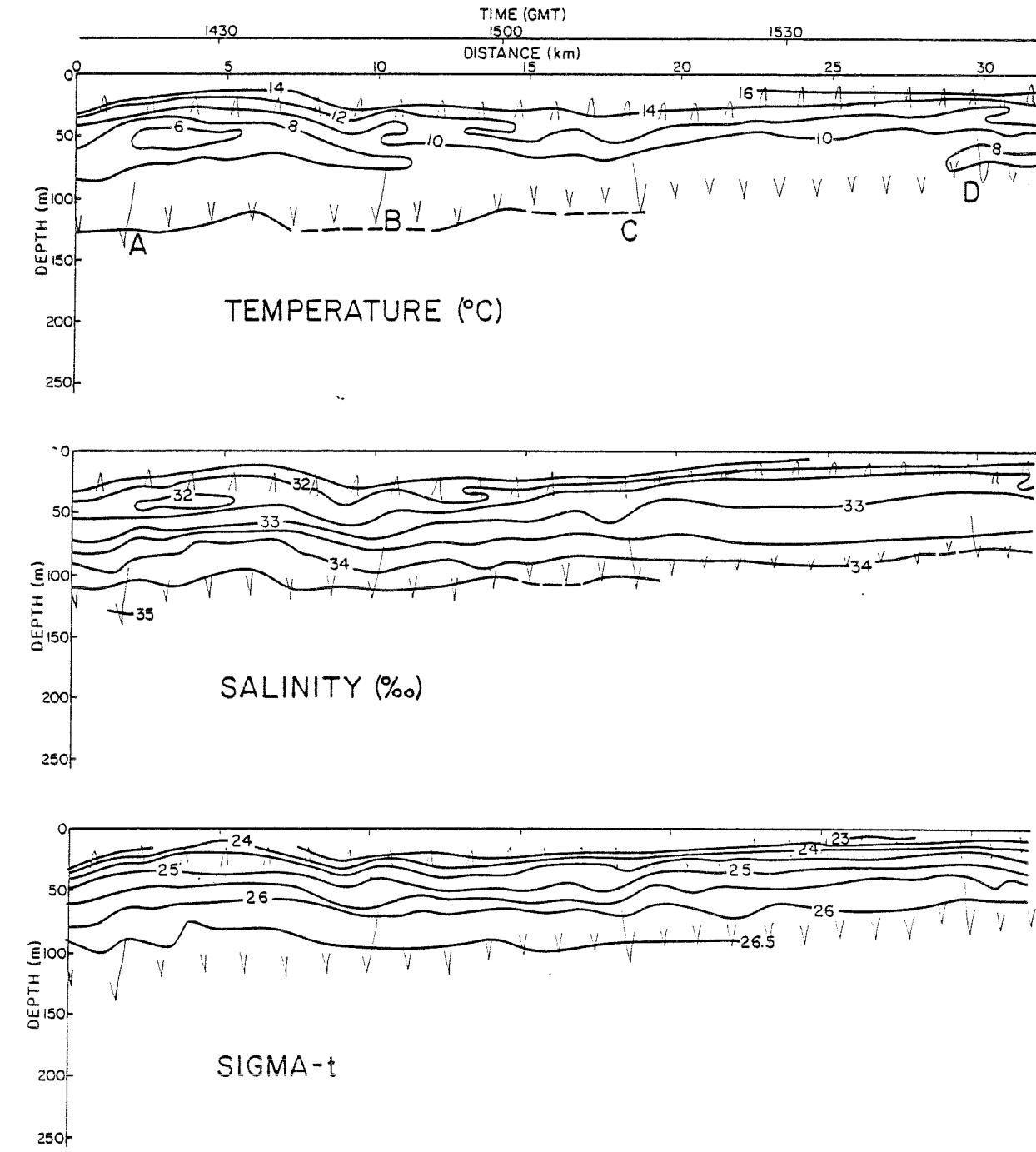
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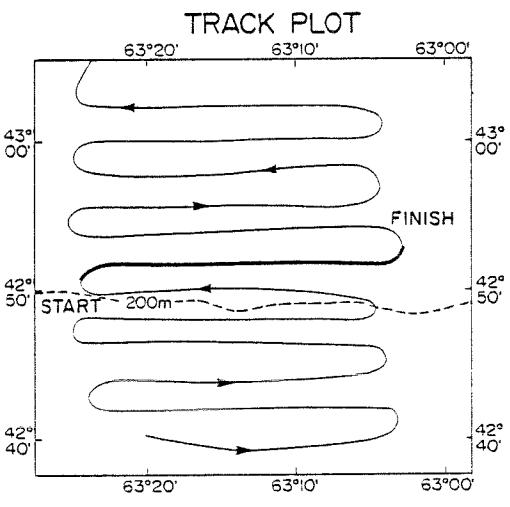
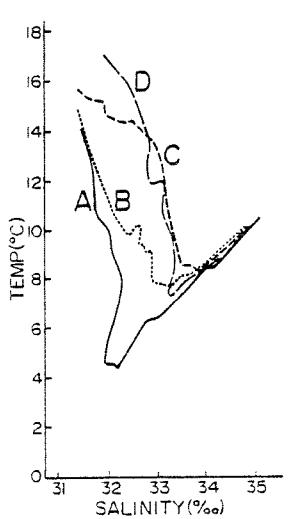
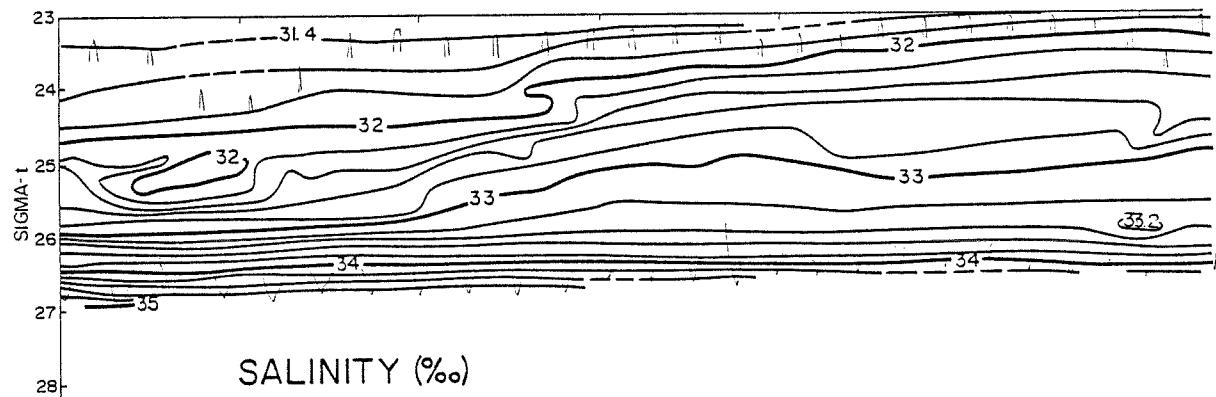
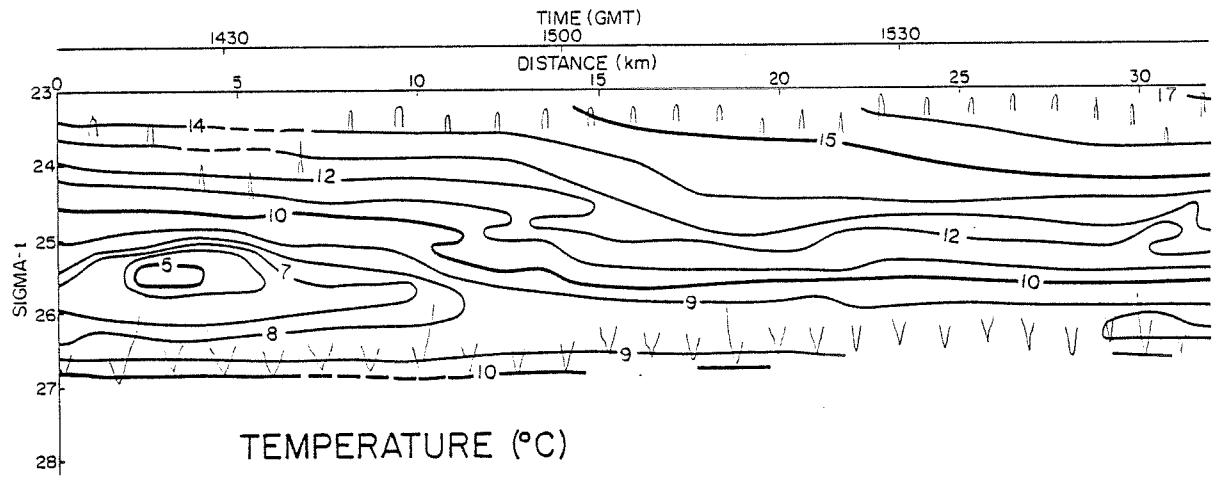
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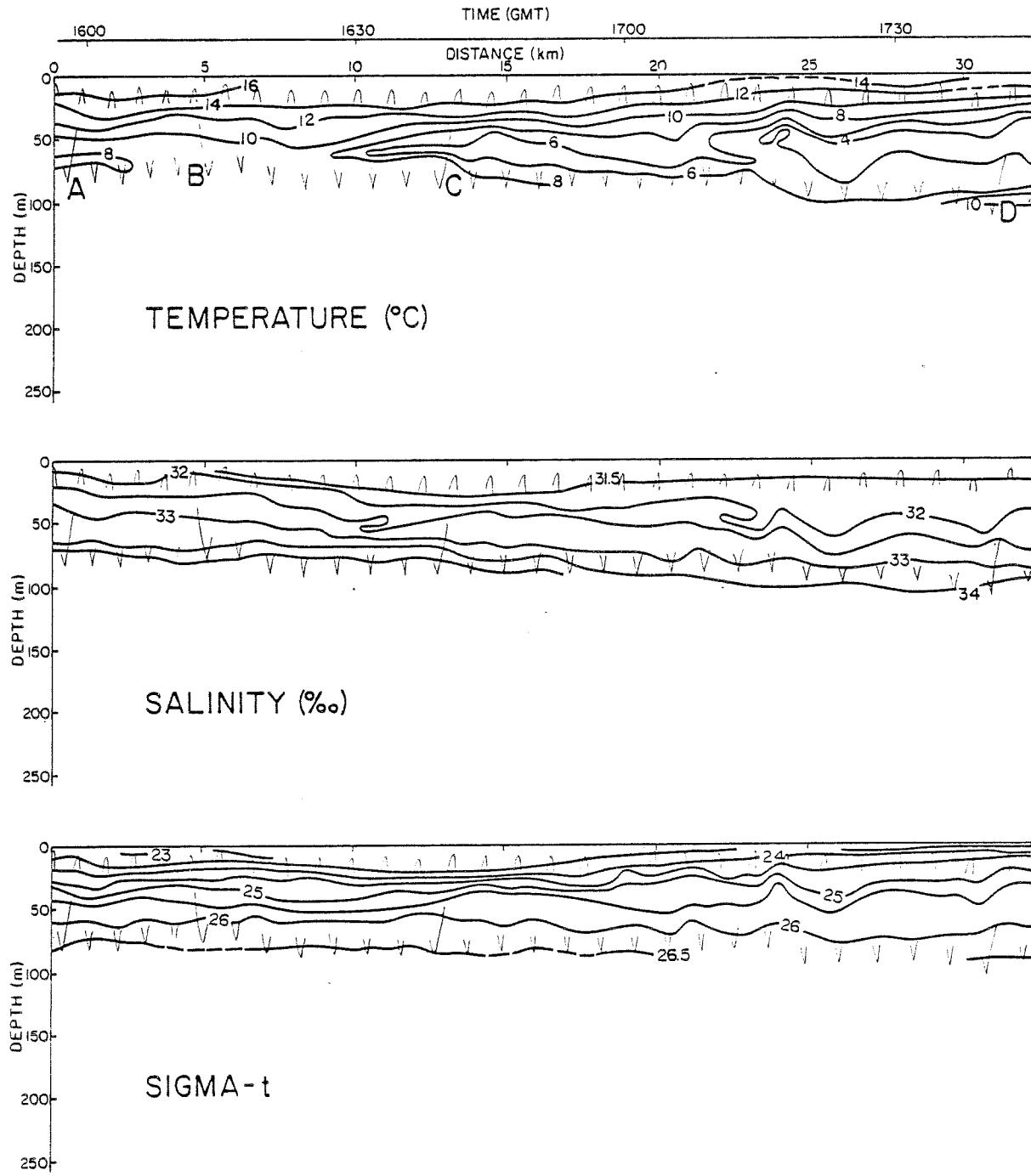
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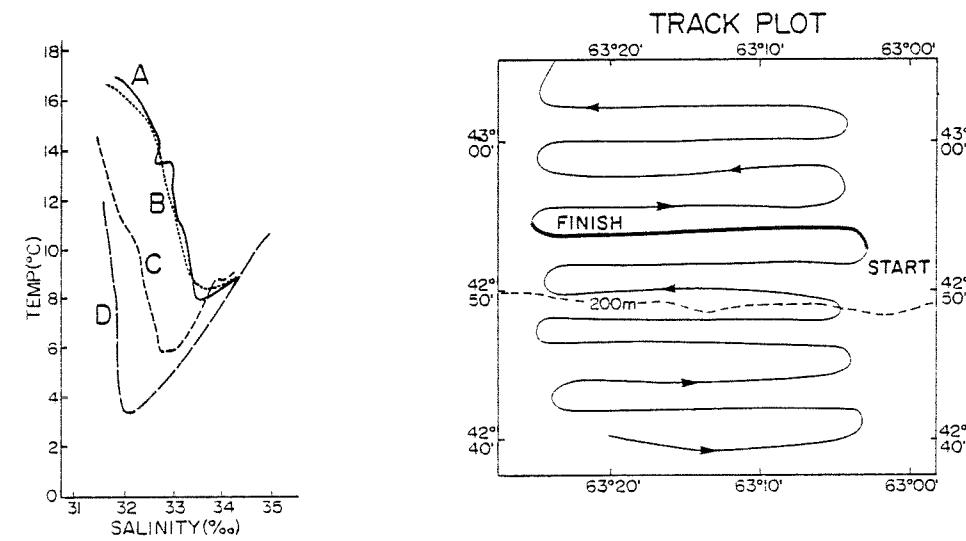
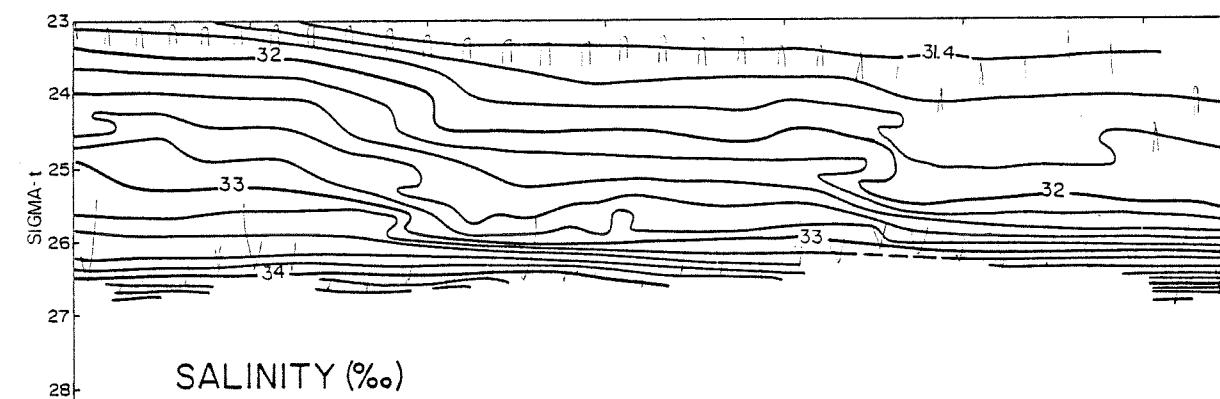
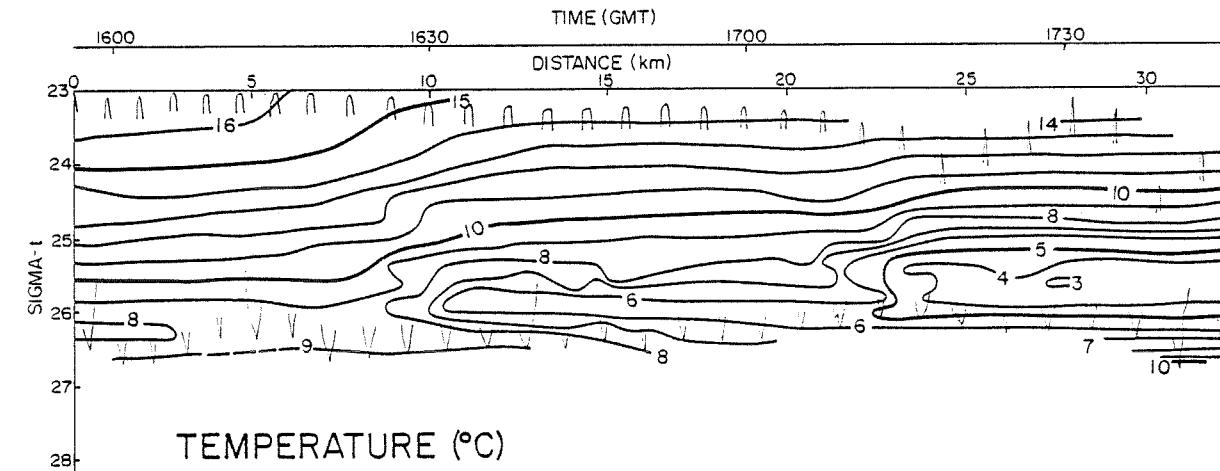
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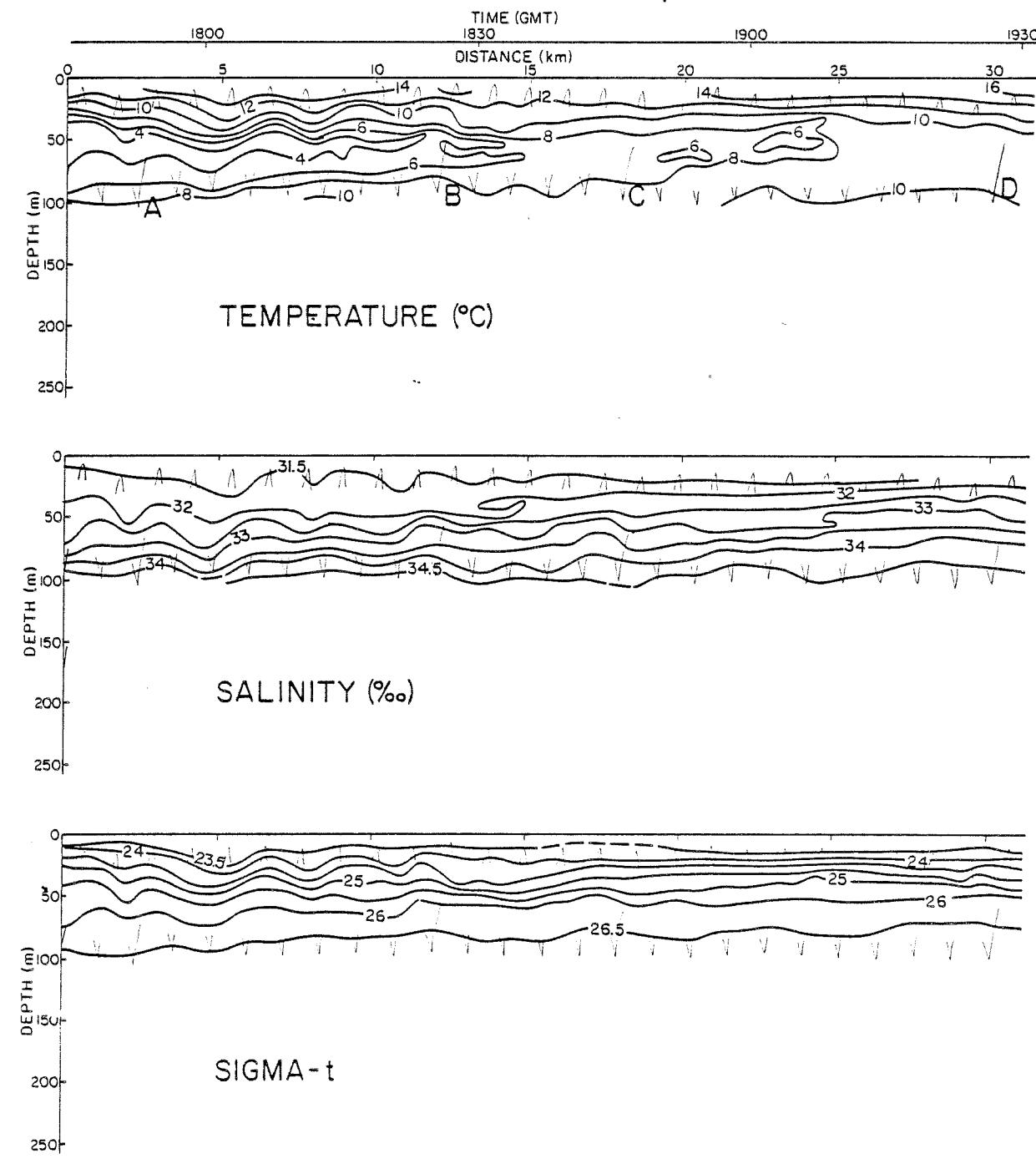
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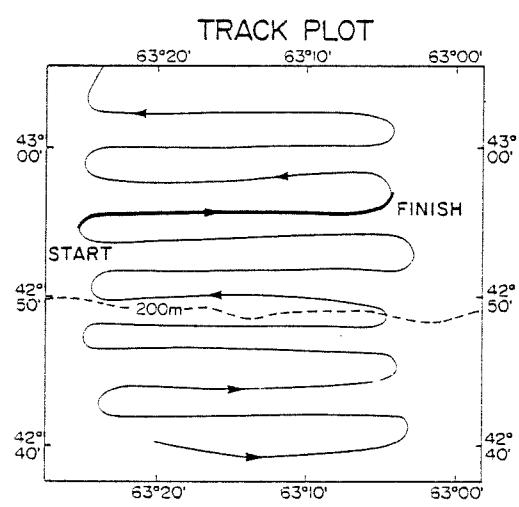
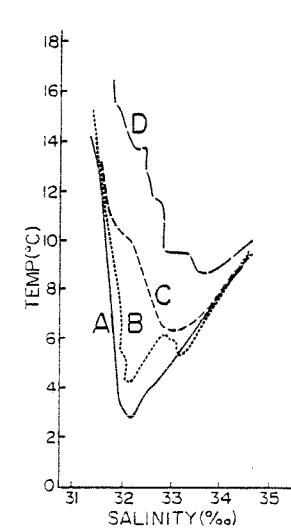
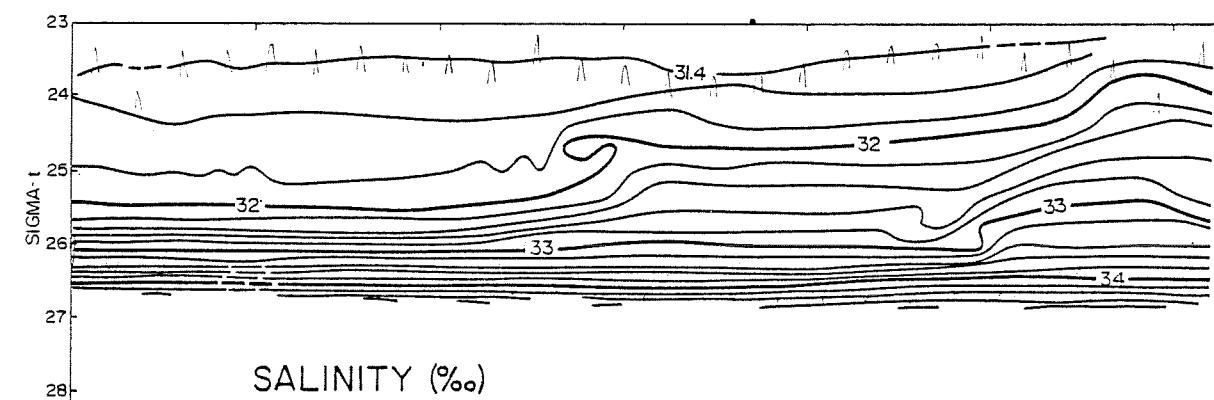
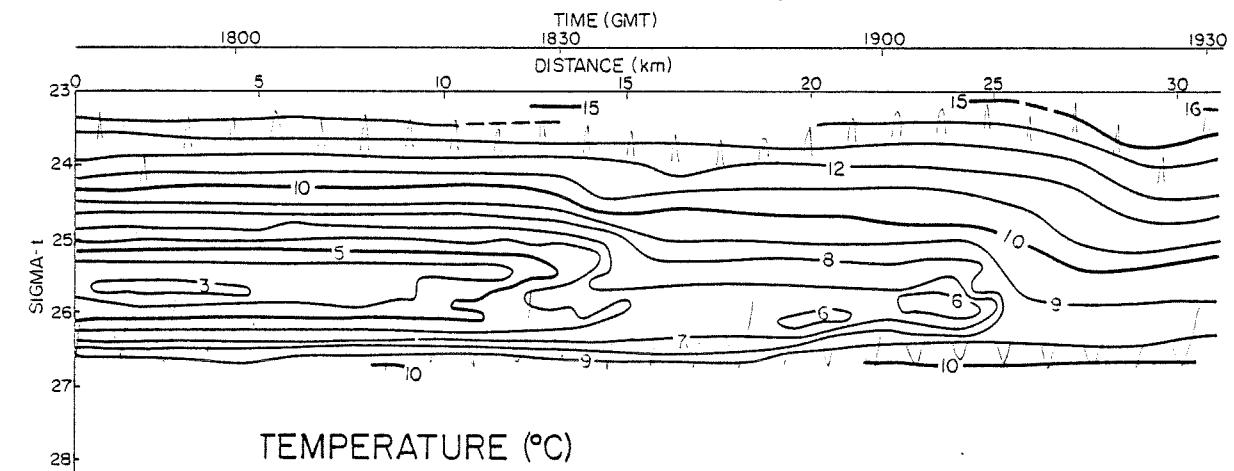
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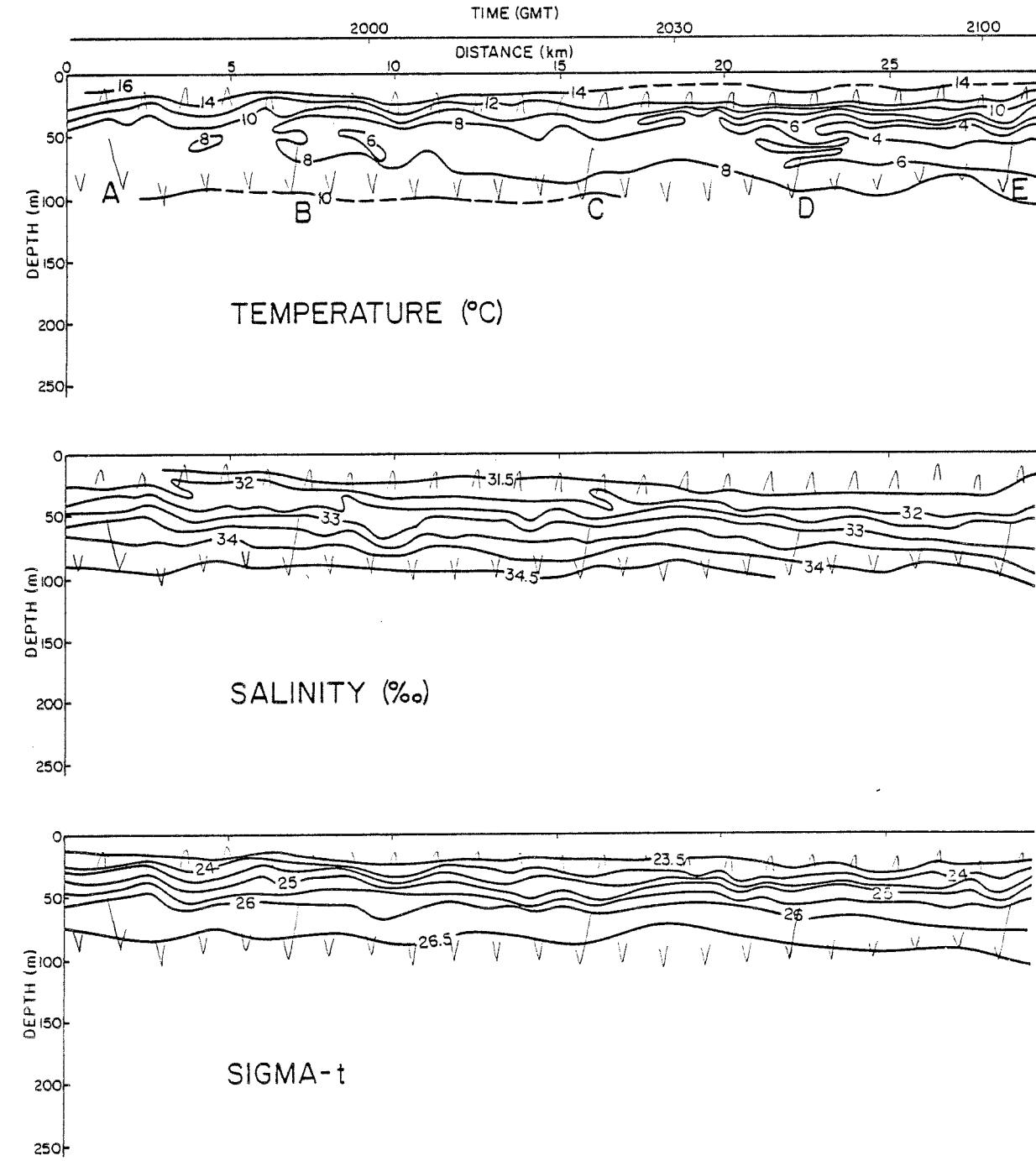
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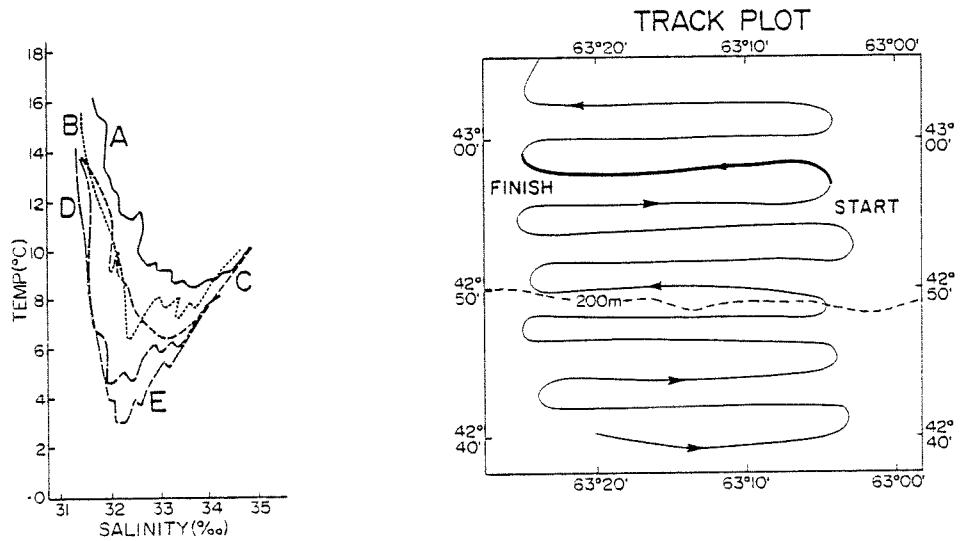
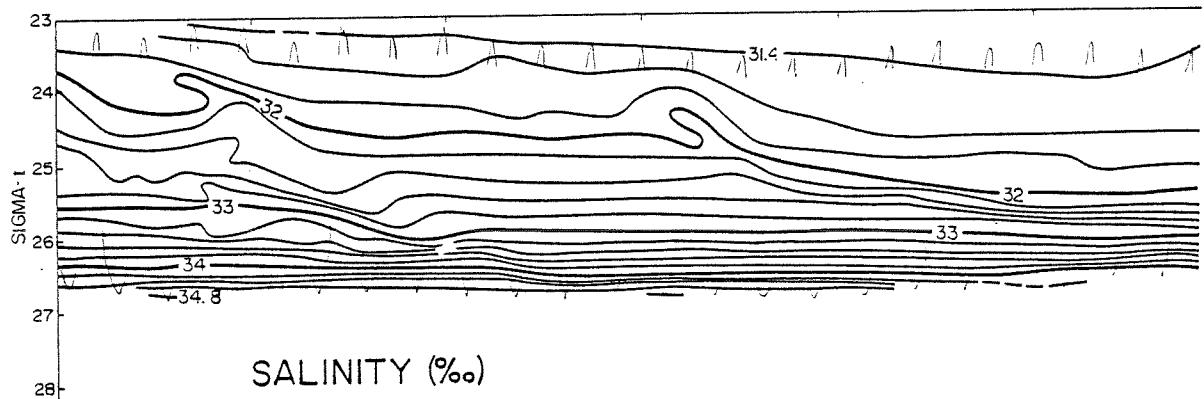
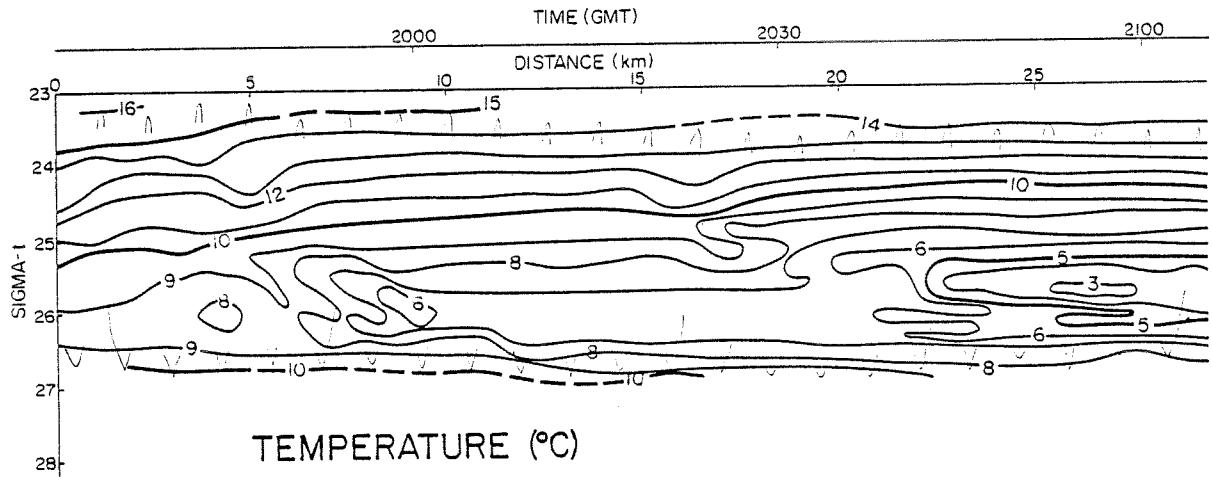
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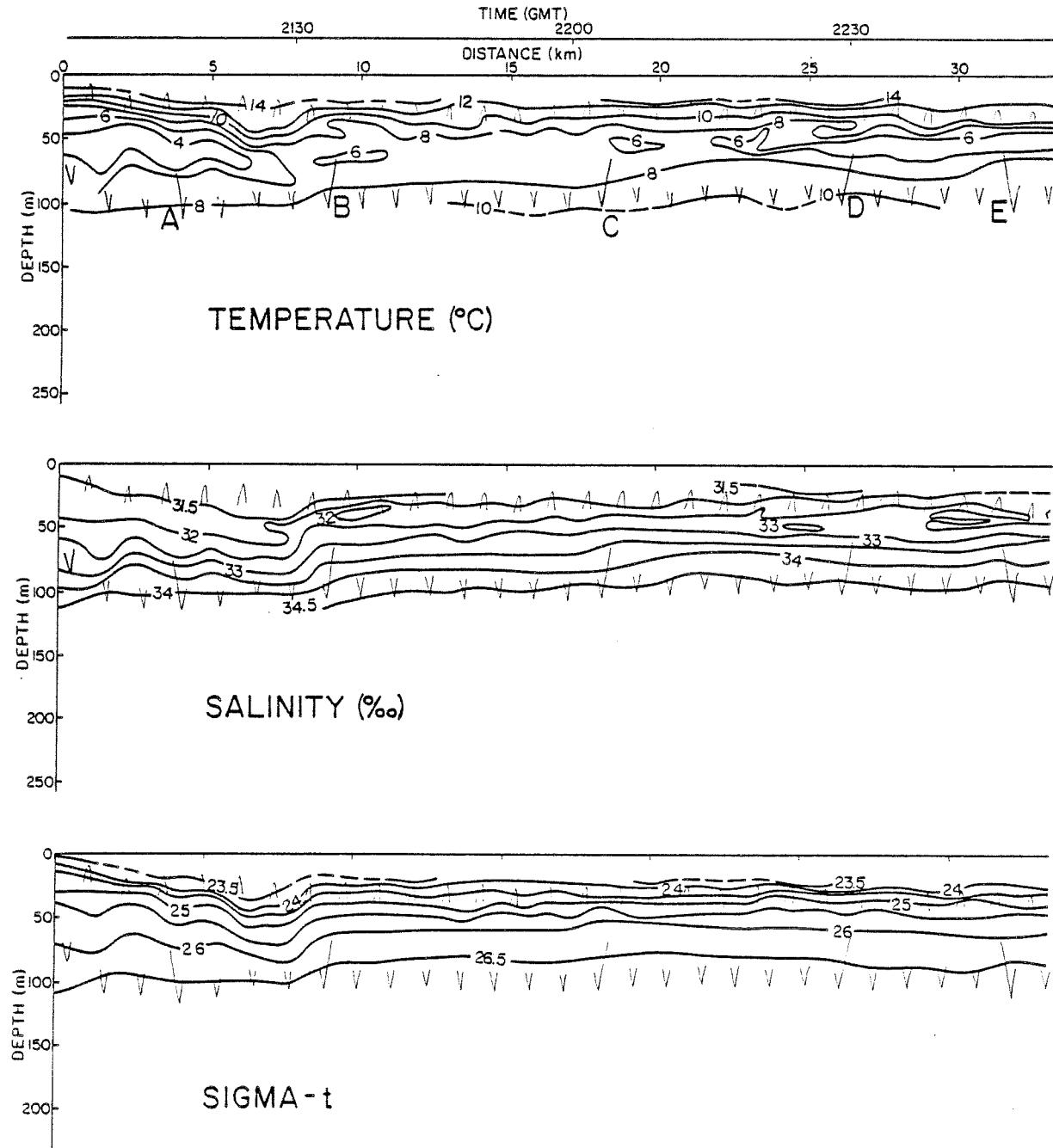
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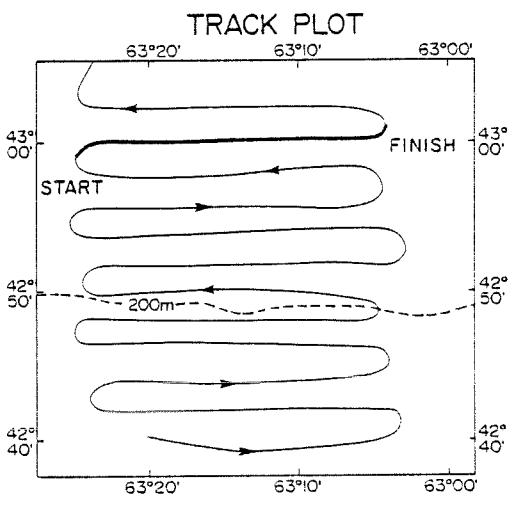
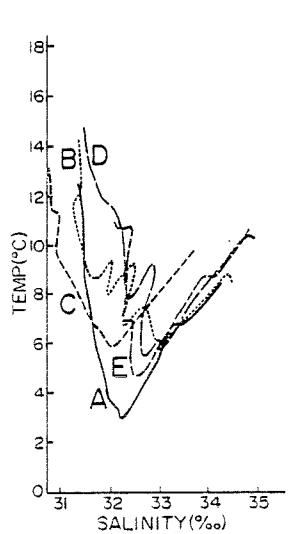
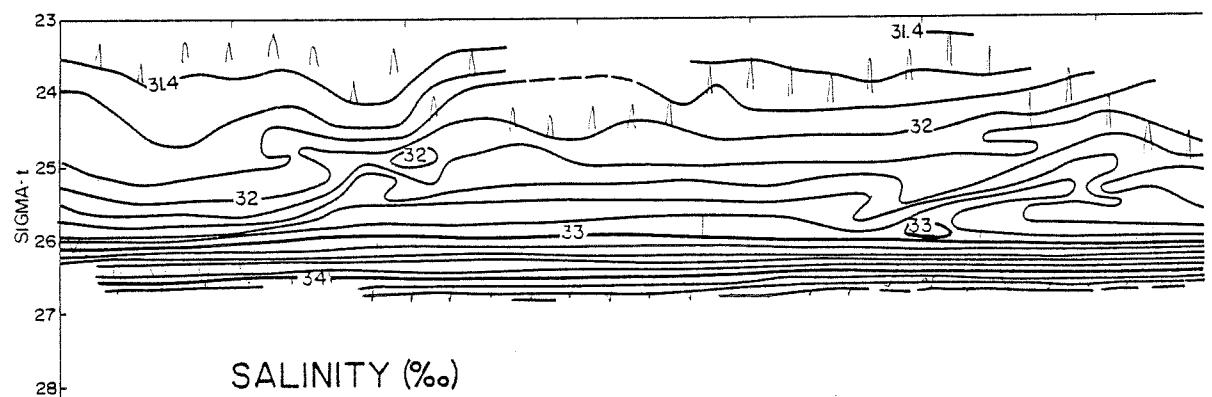
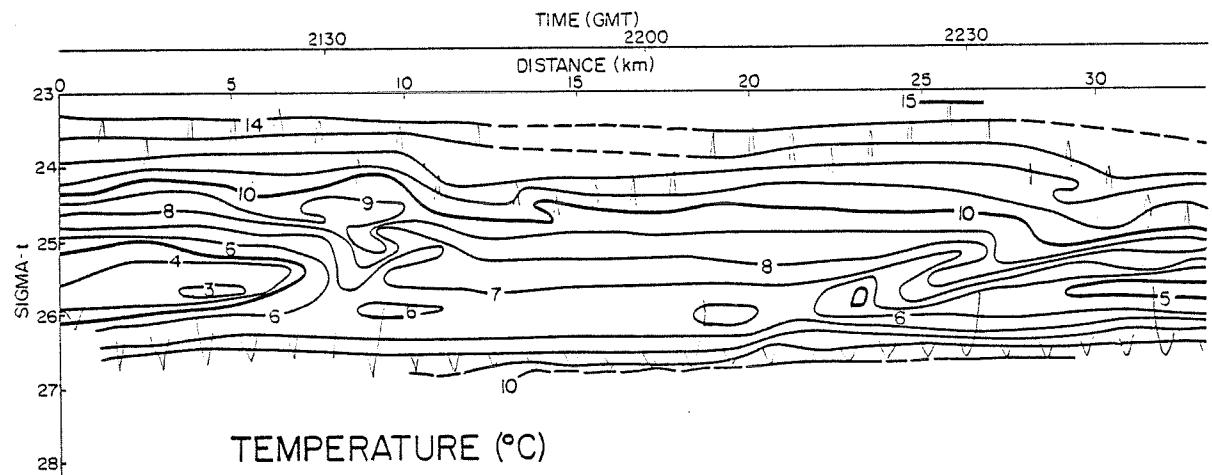
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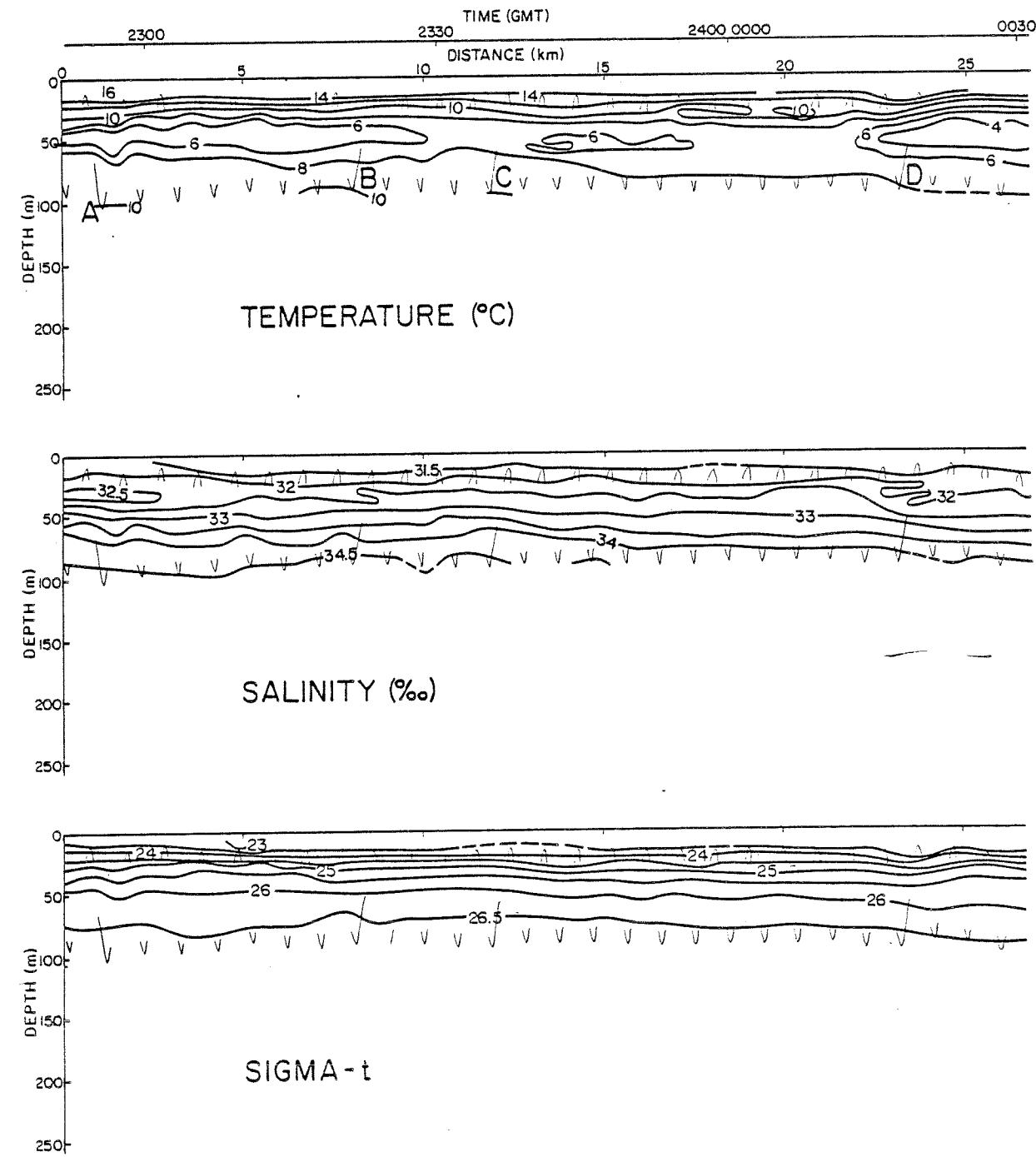
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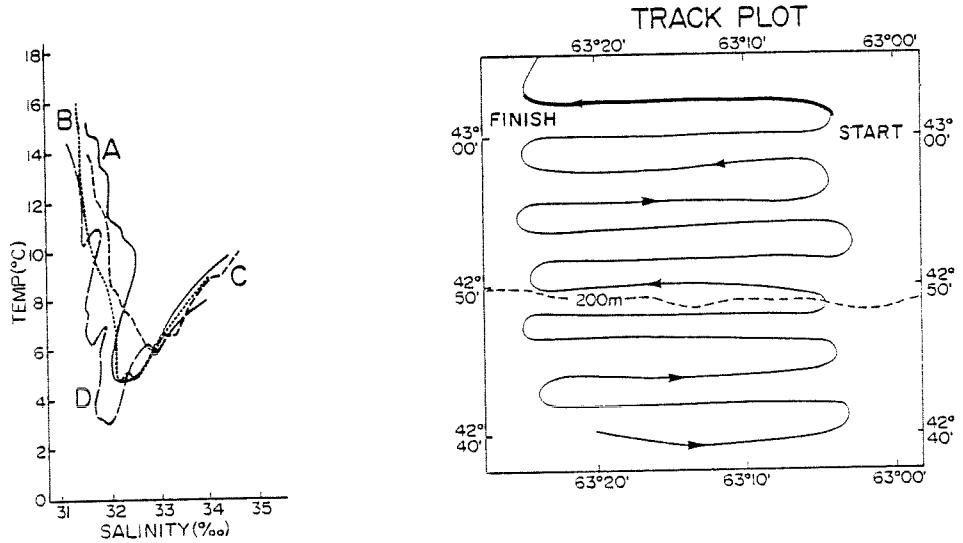
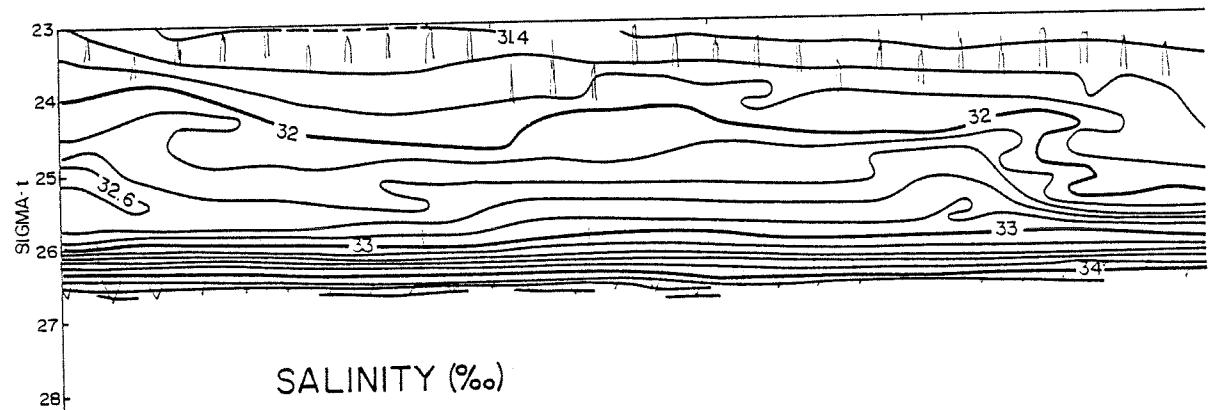
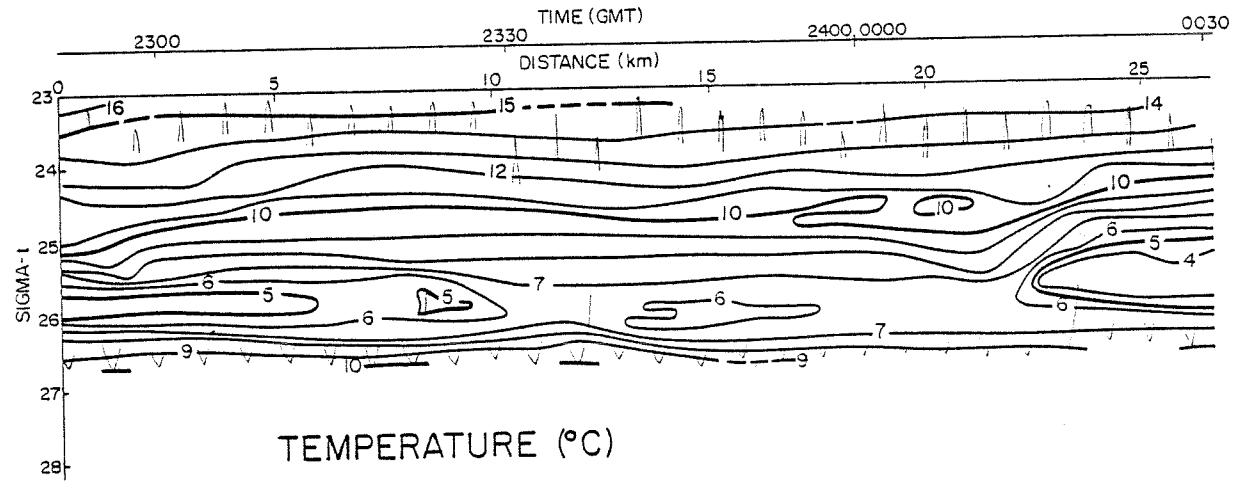
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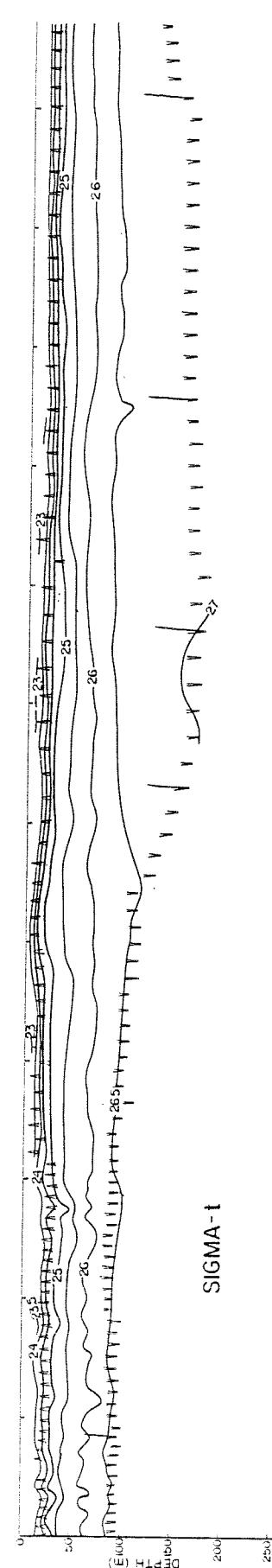
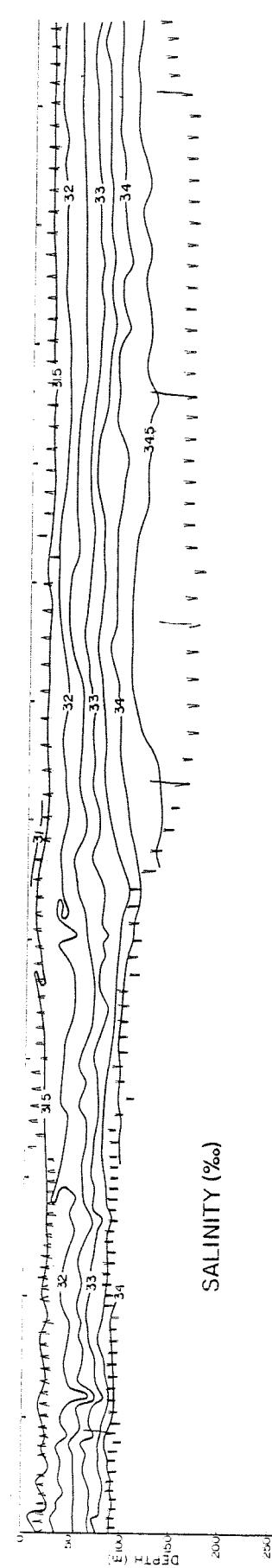
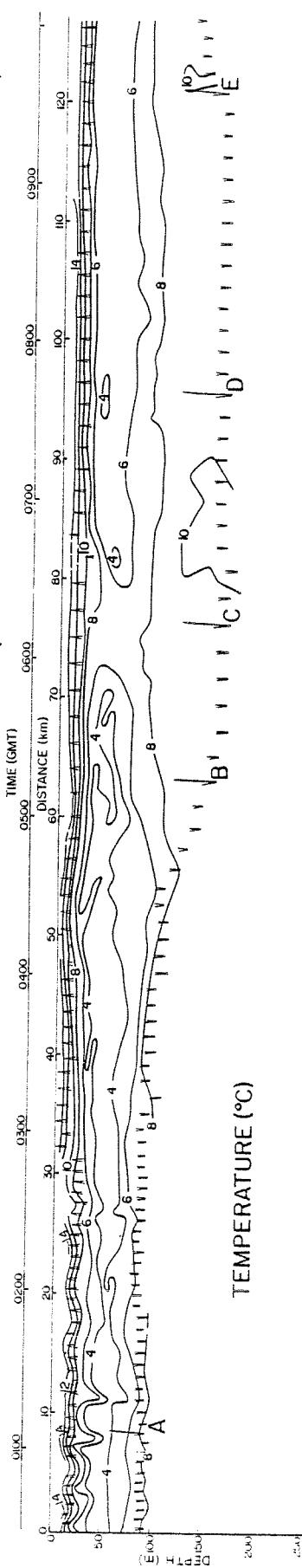
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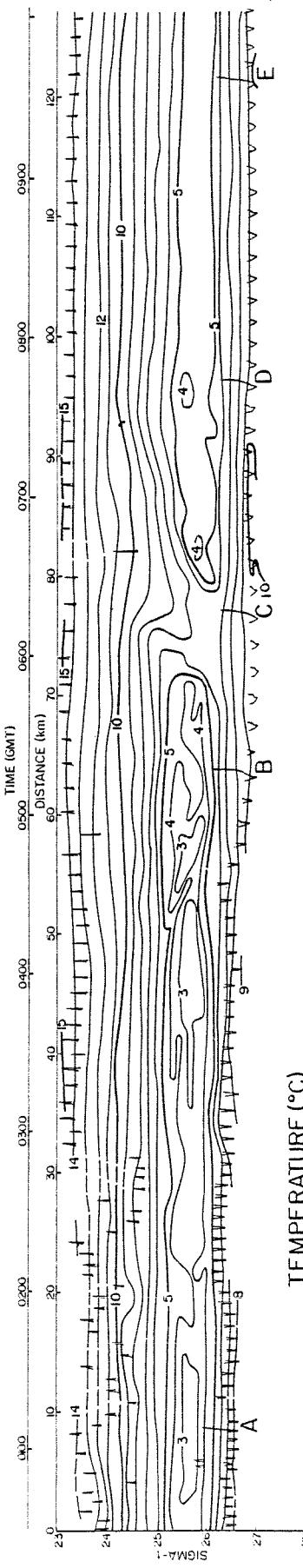
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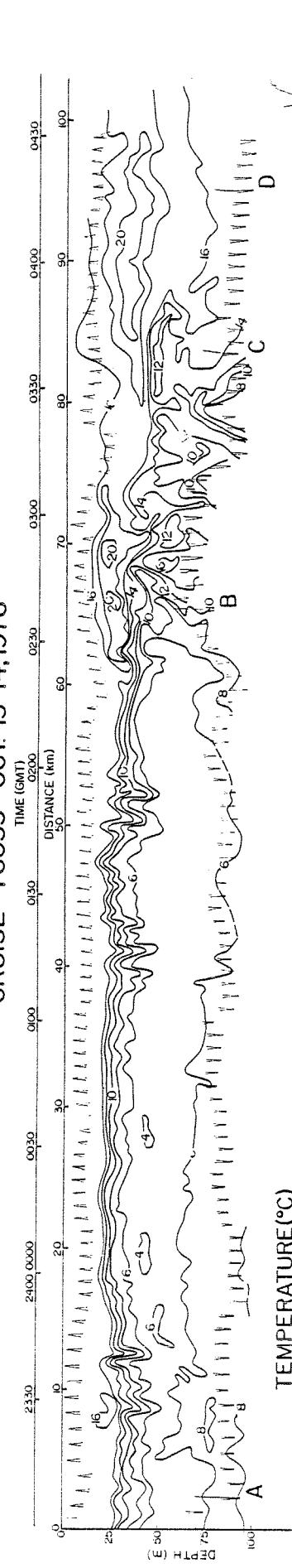
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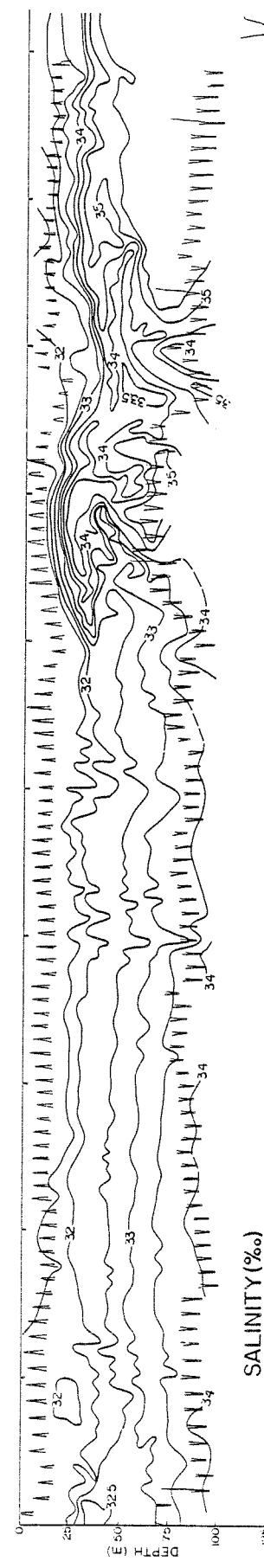
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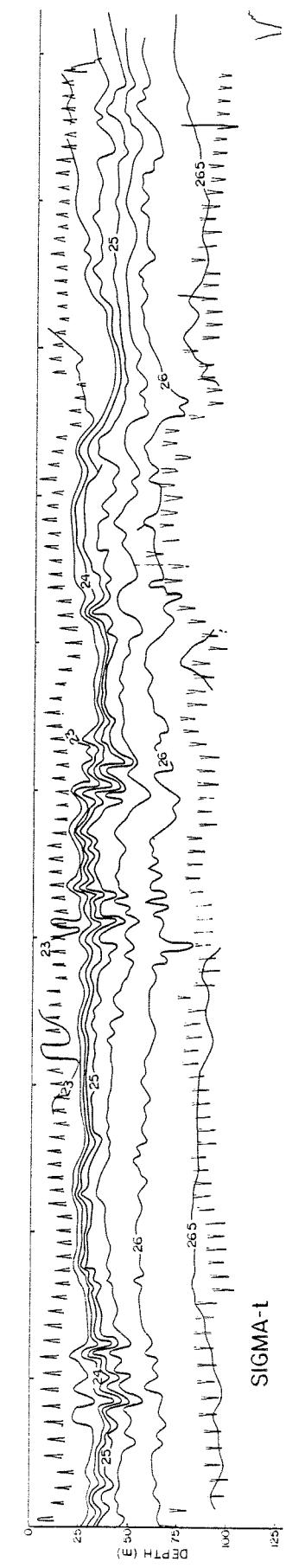
CRUISE 76033 OCT. 13-14, 1976



TEMPERATURE (°C)

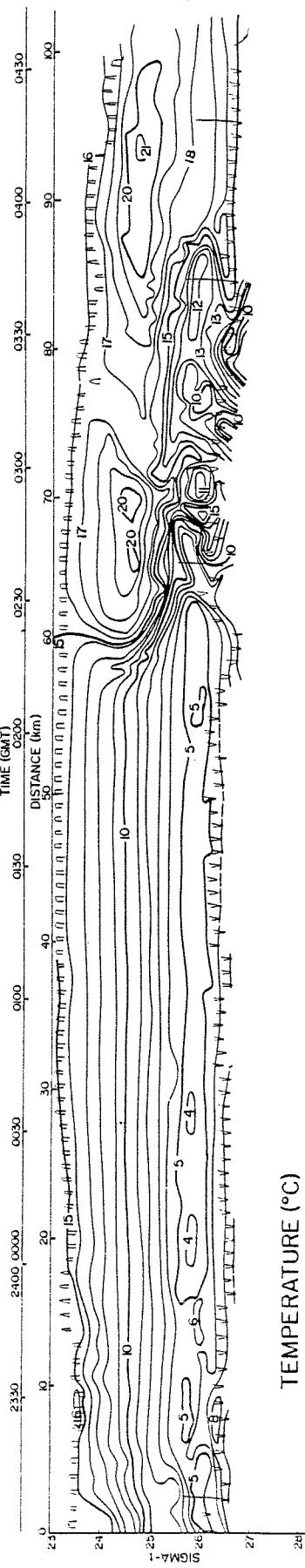


SALINITY (‰)

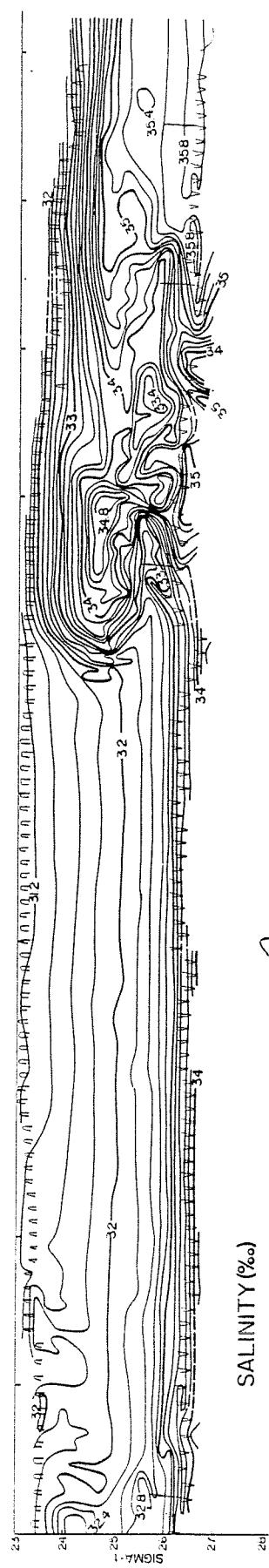


SIGMA-t

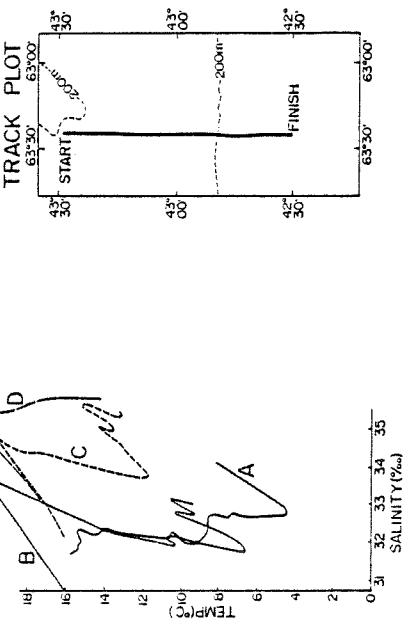
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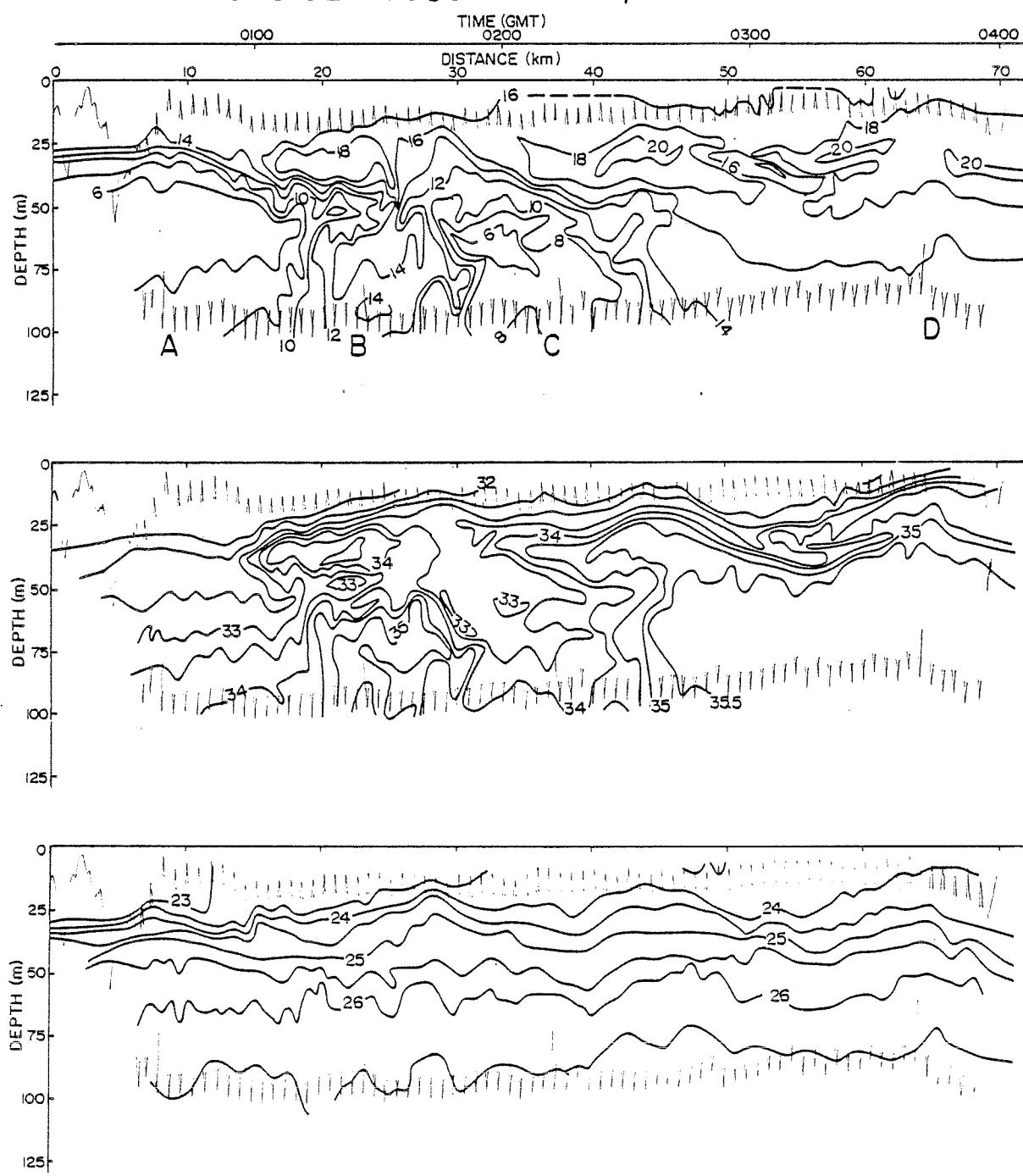
TEMPERATURE ( $^{\circ}\text{C}$ )



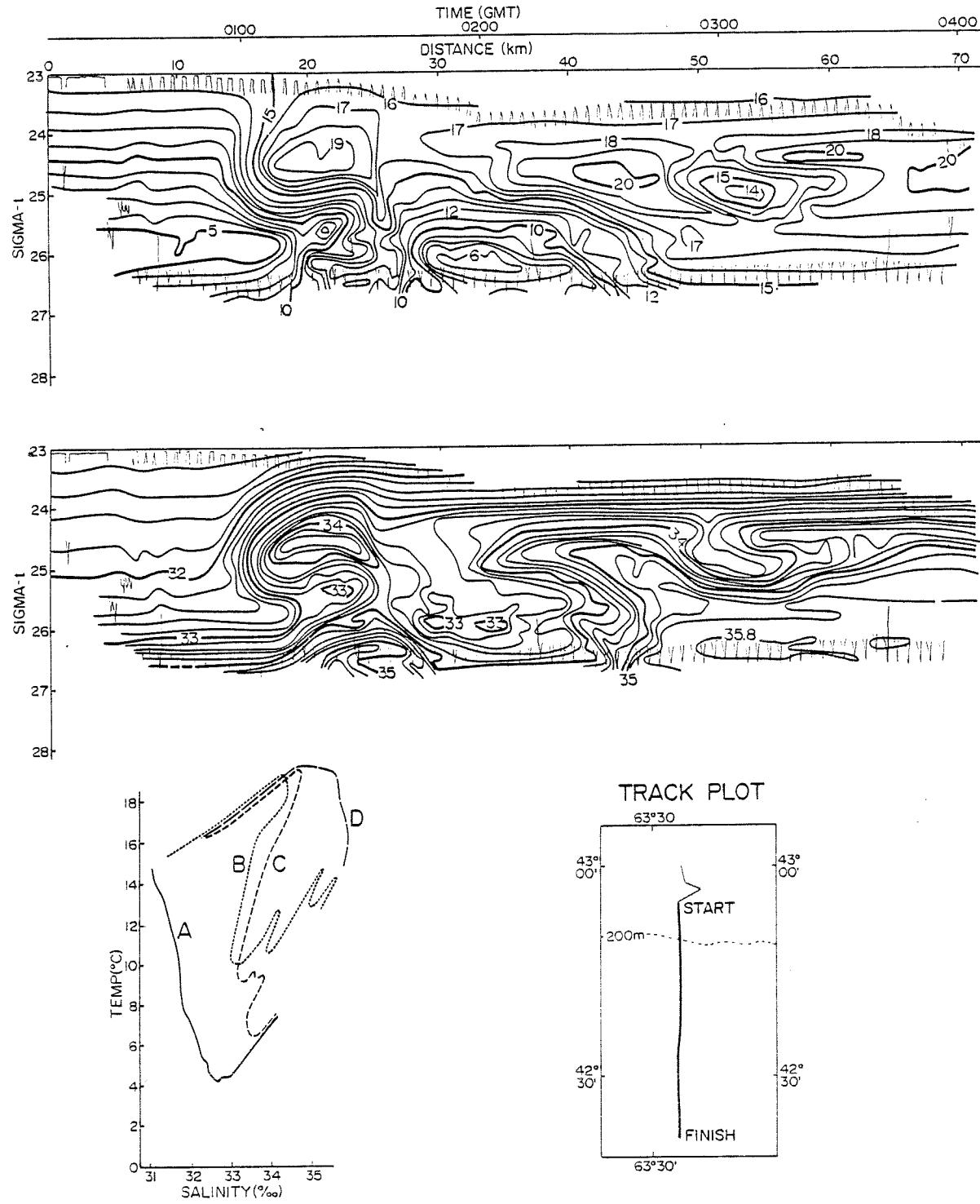
SALINITY ( $\text{\textperthousand}$ )



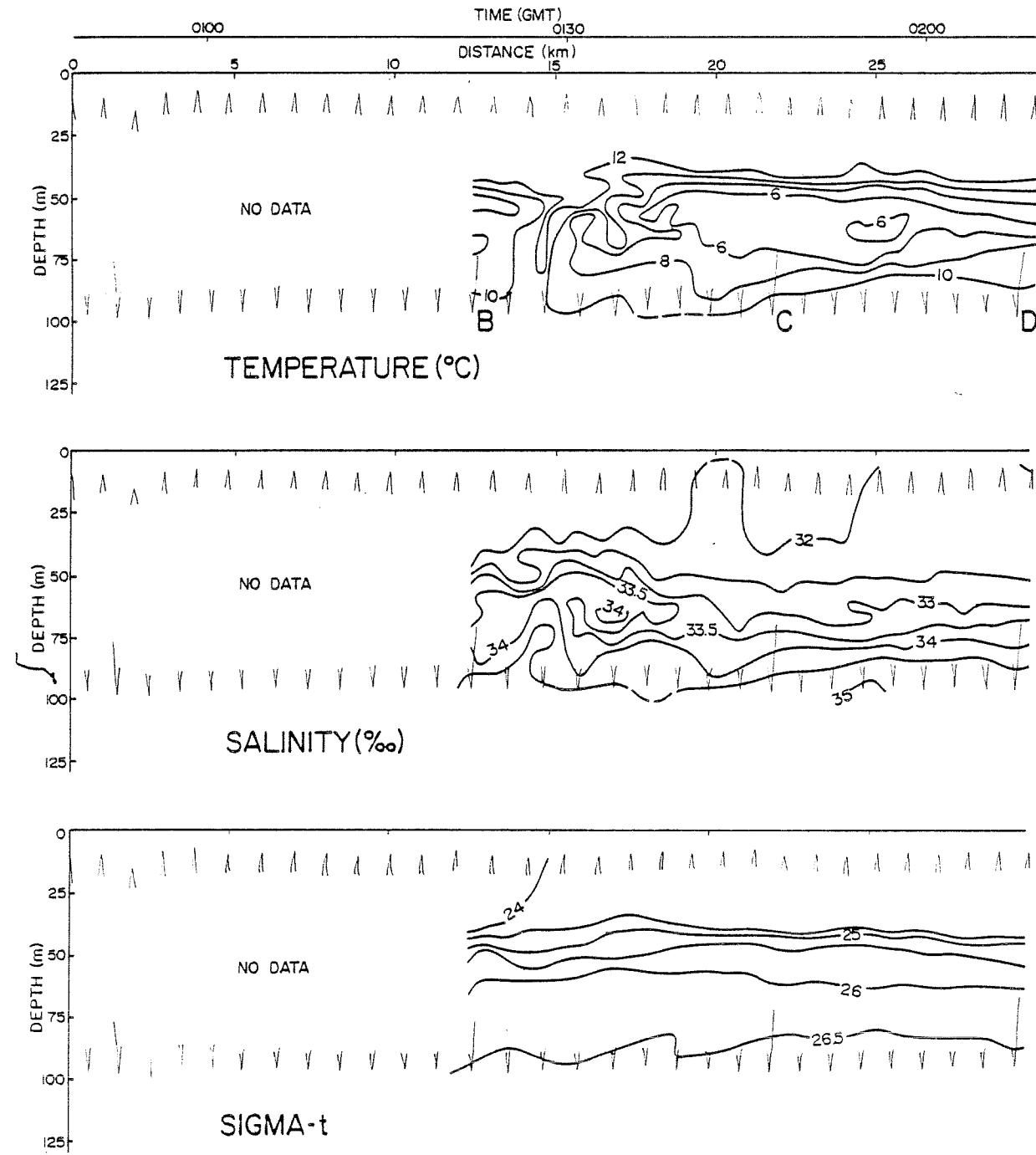
## CRUISE 76033 OCT. 15, 1976



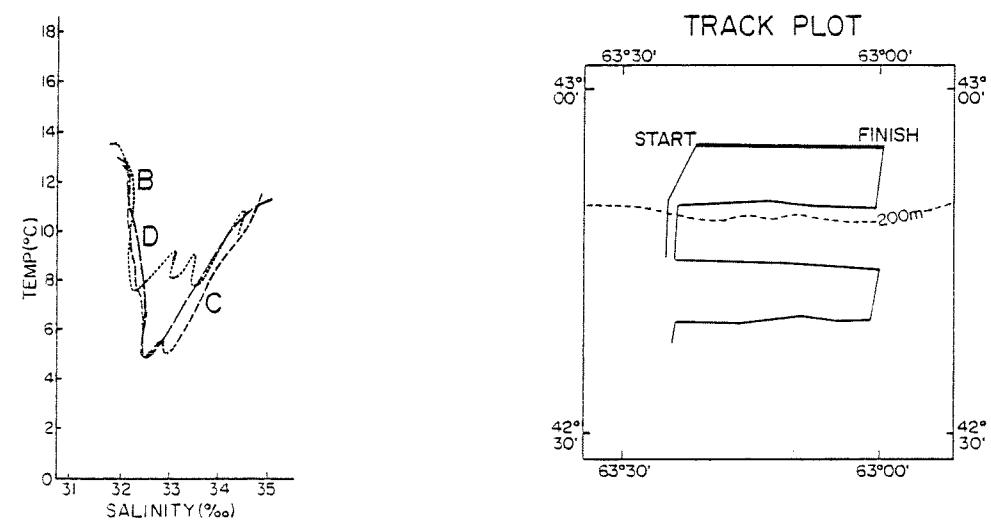
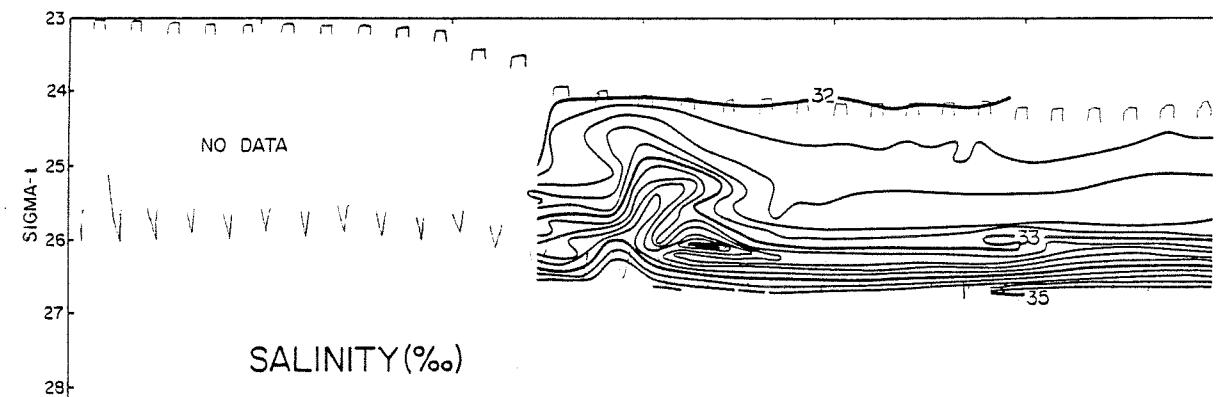
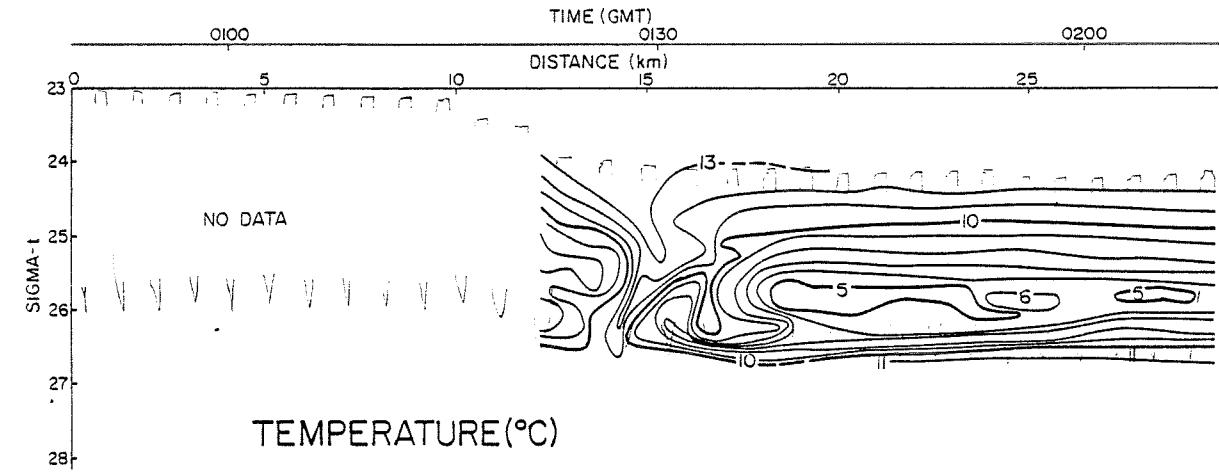
## CRUISE 76033 OCT. 15, 1976



## CRUISE 76033 OCT. 20, 1976

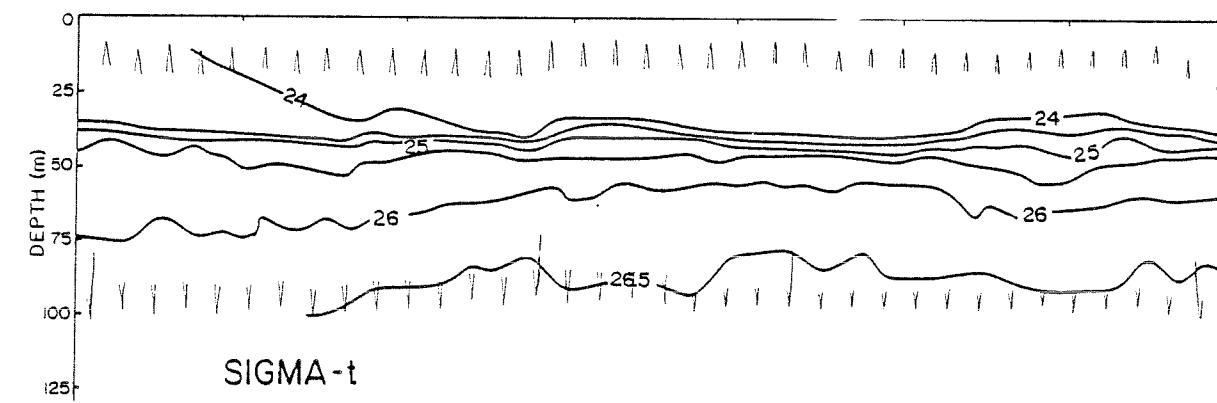
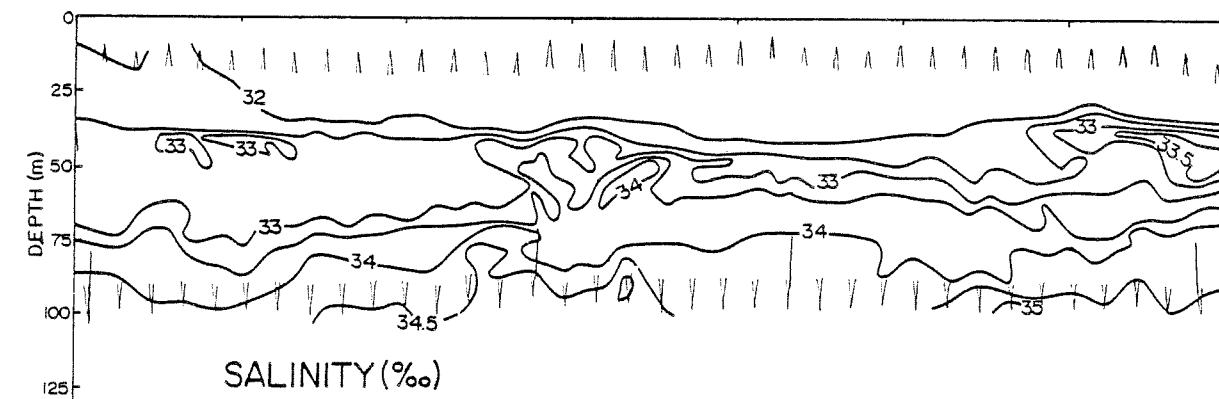
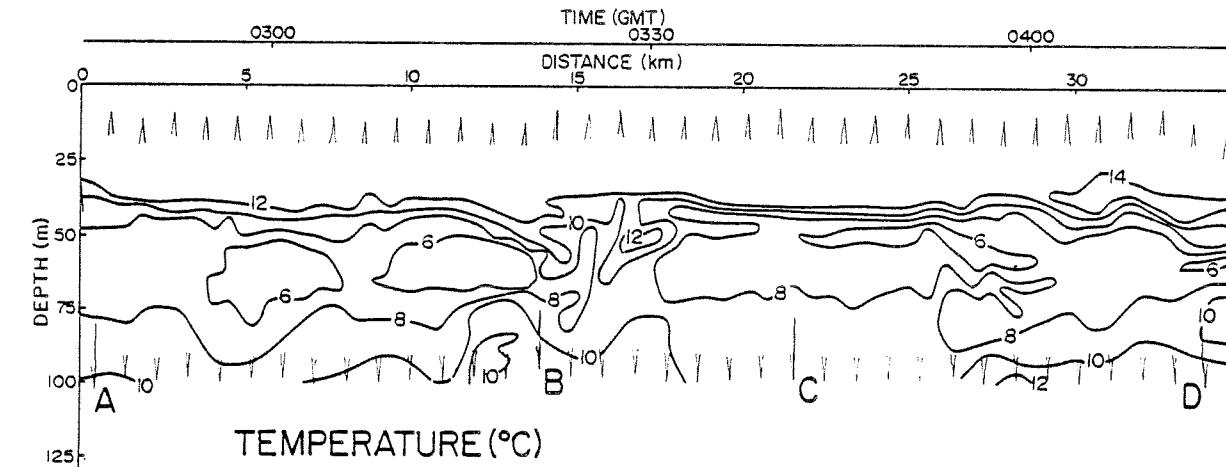


## CRUISE 76033 OCT. 20, 1976

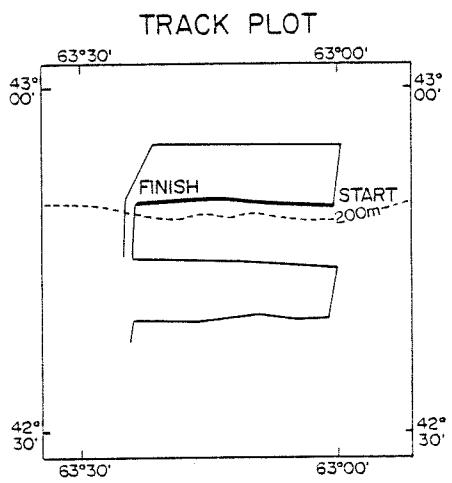
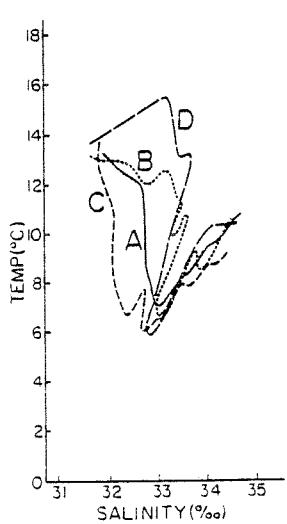
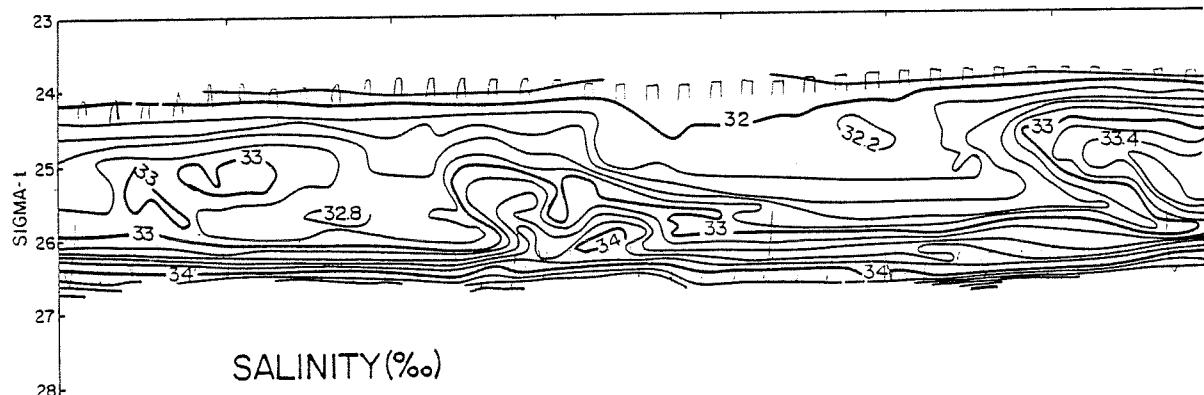
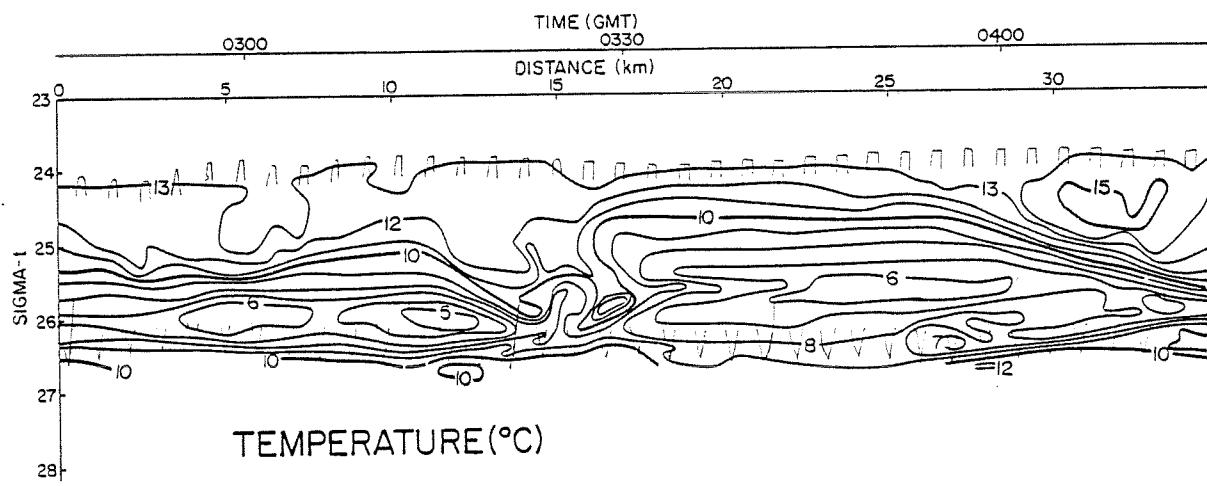


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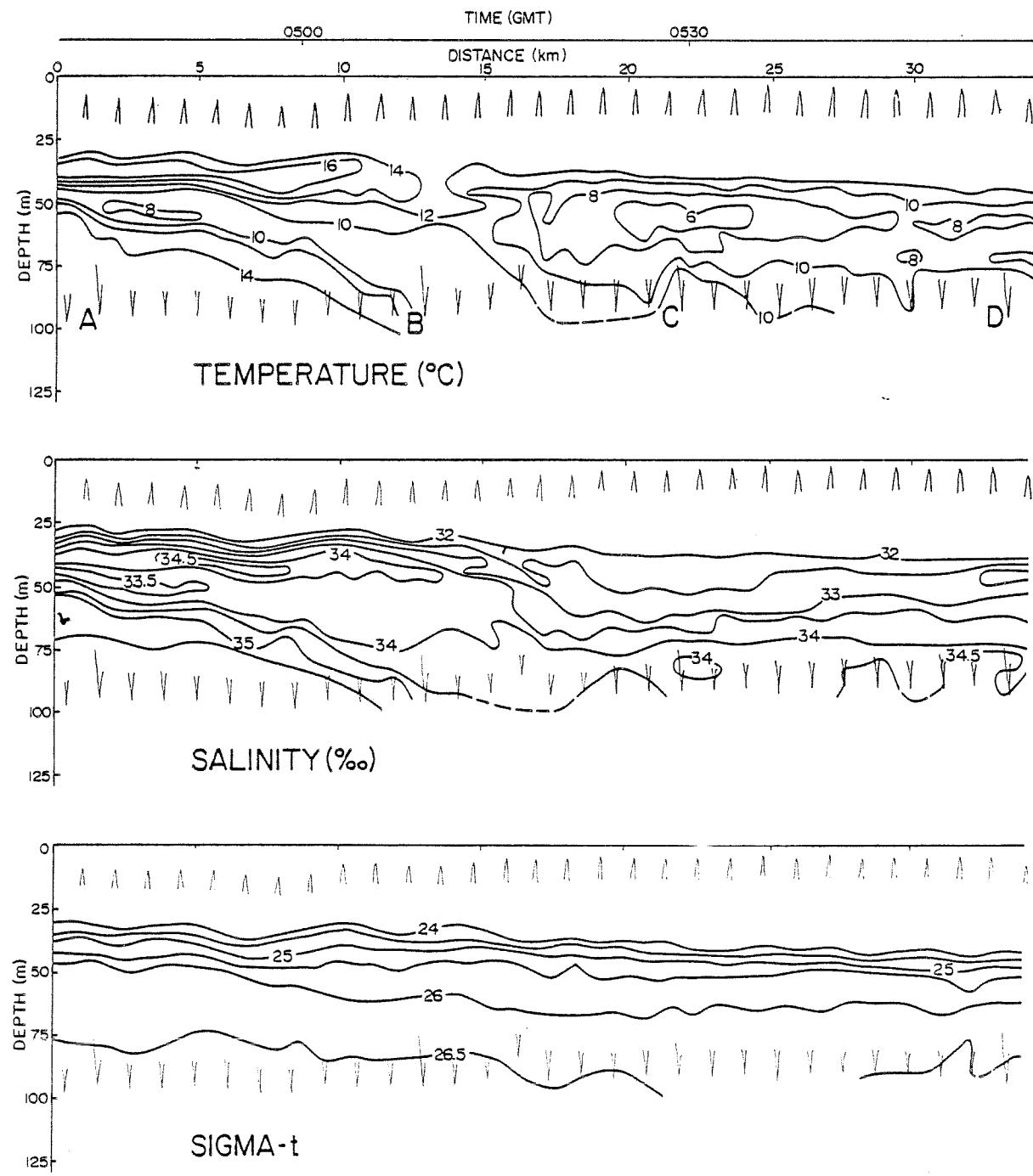
## CRUISE 76033 OCT. 20, 1976



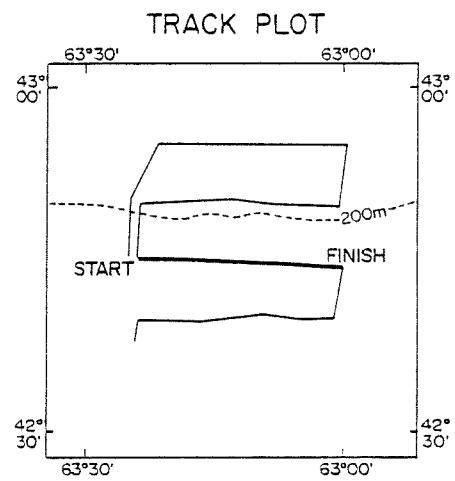
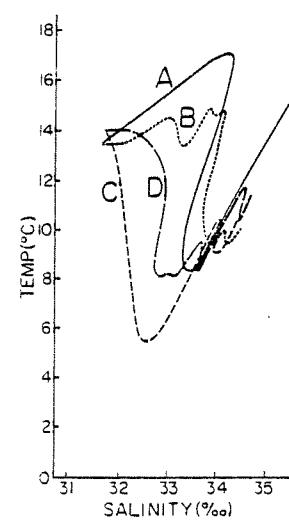
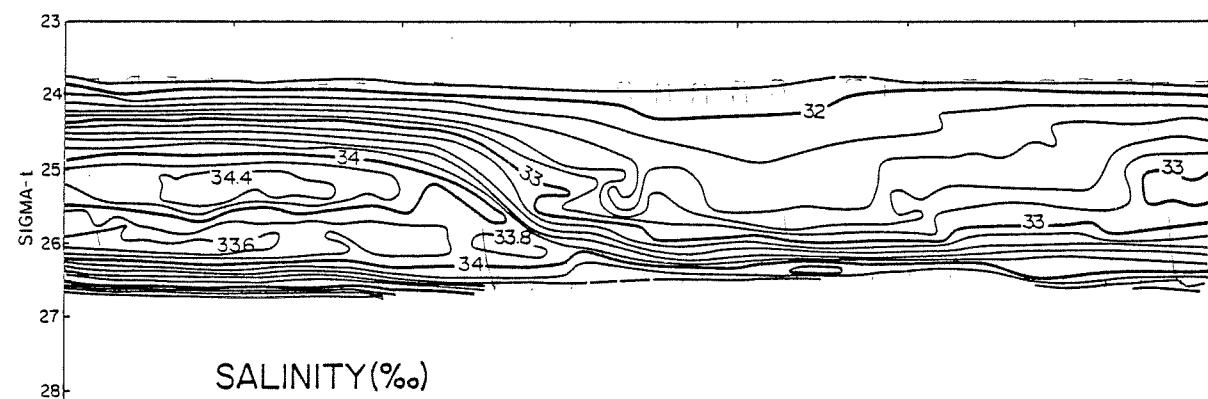
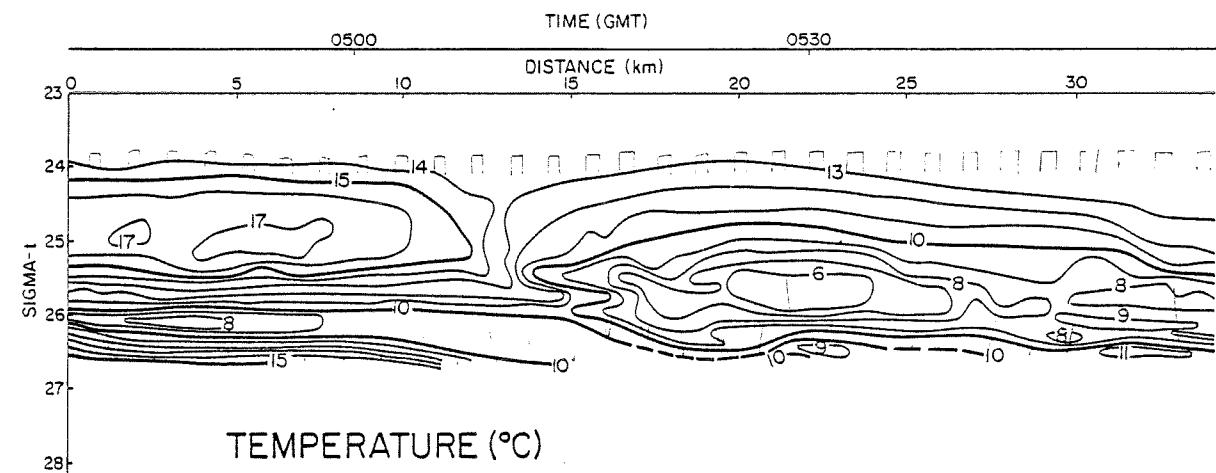
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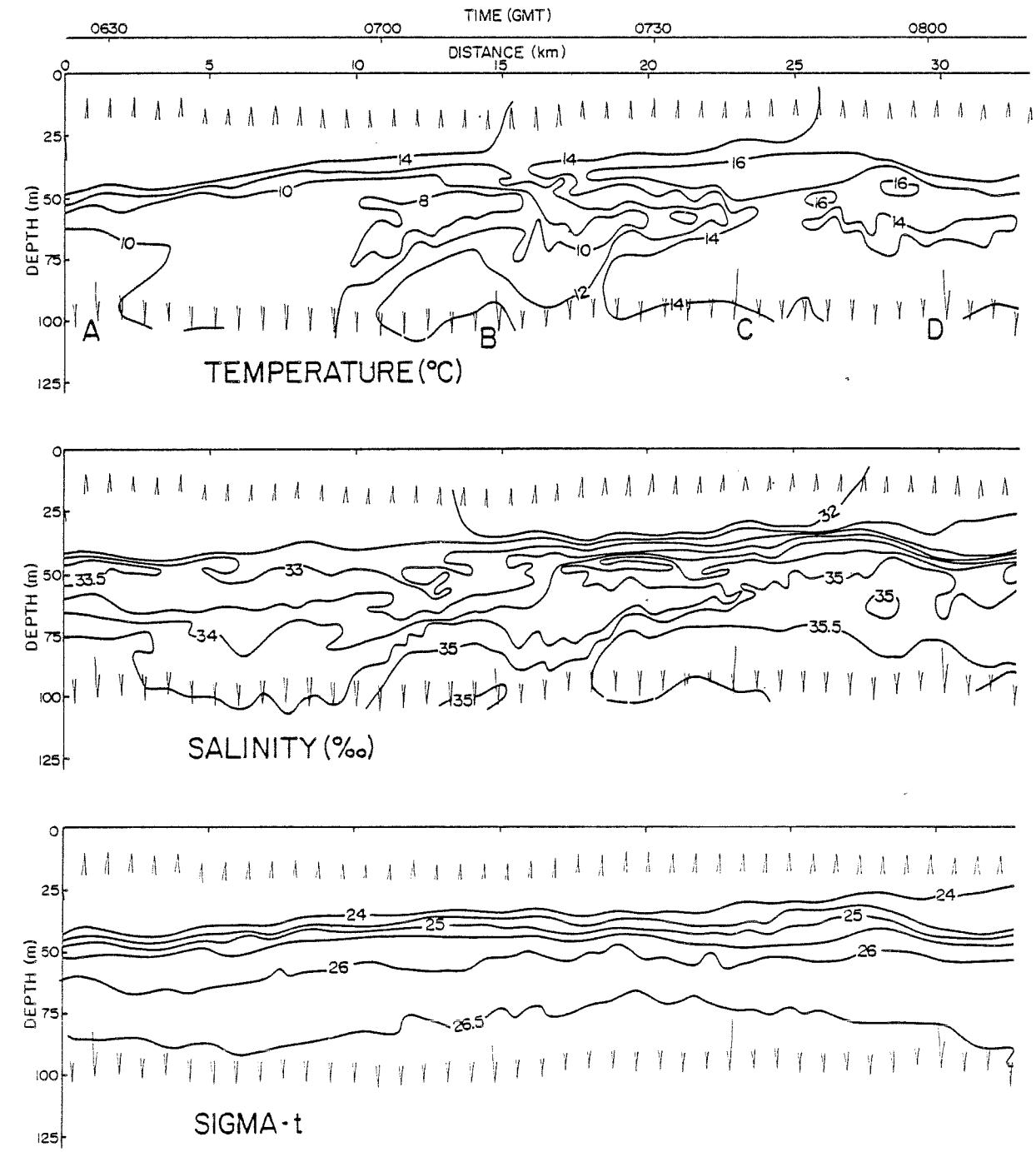
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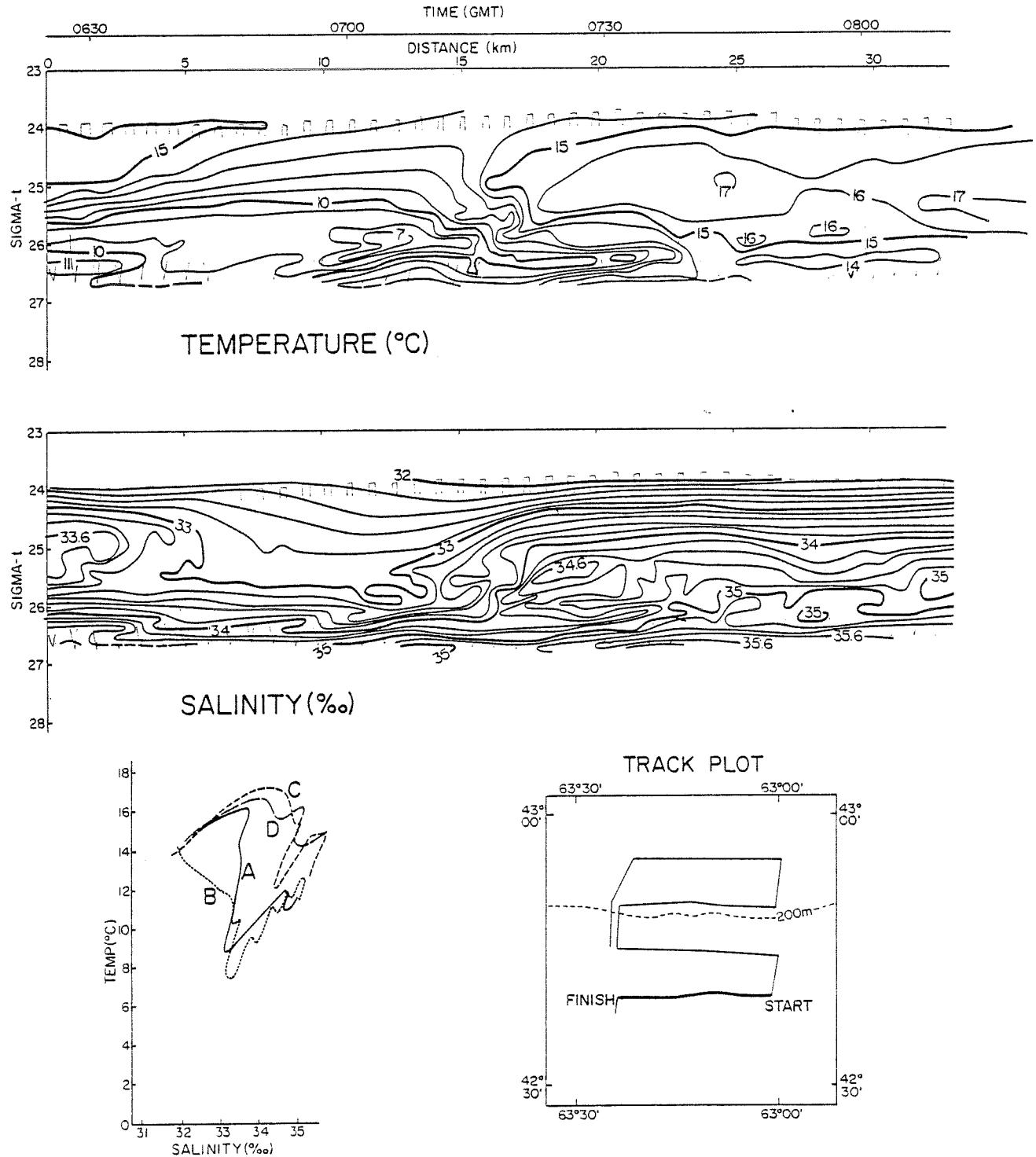
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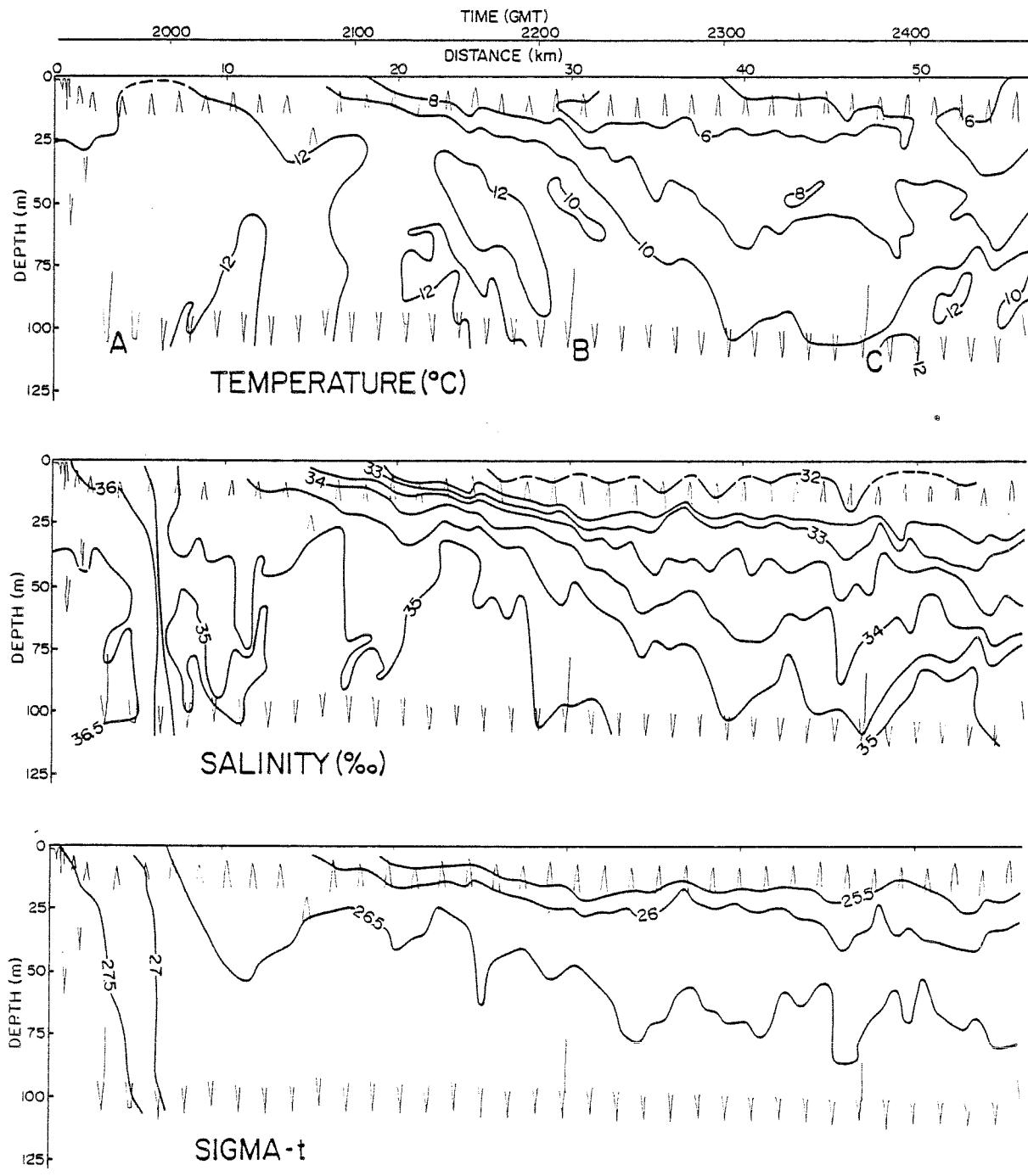
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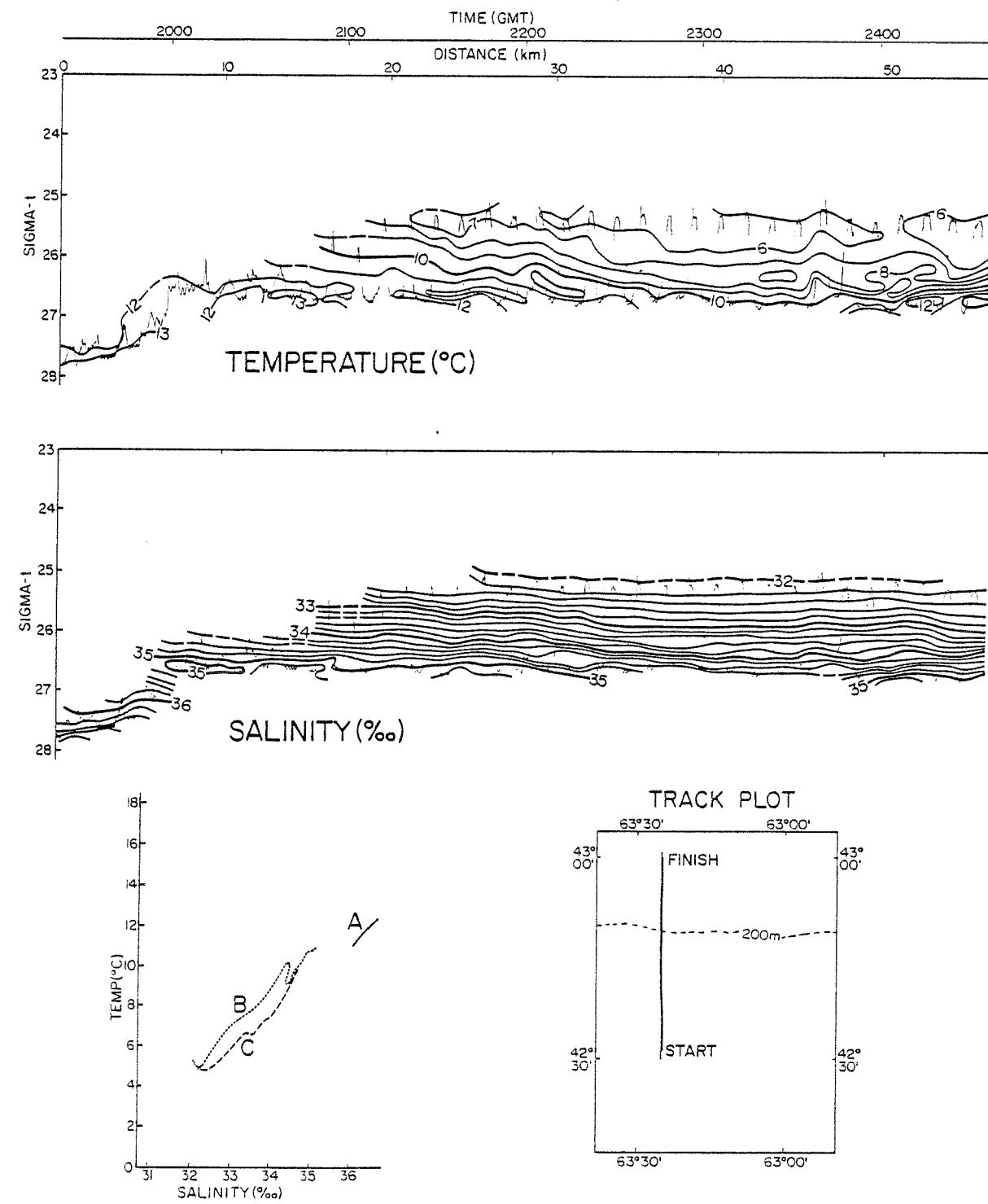
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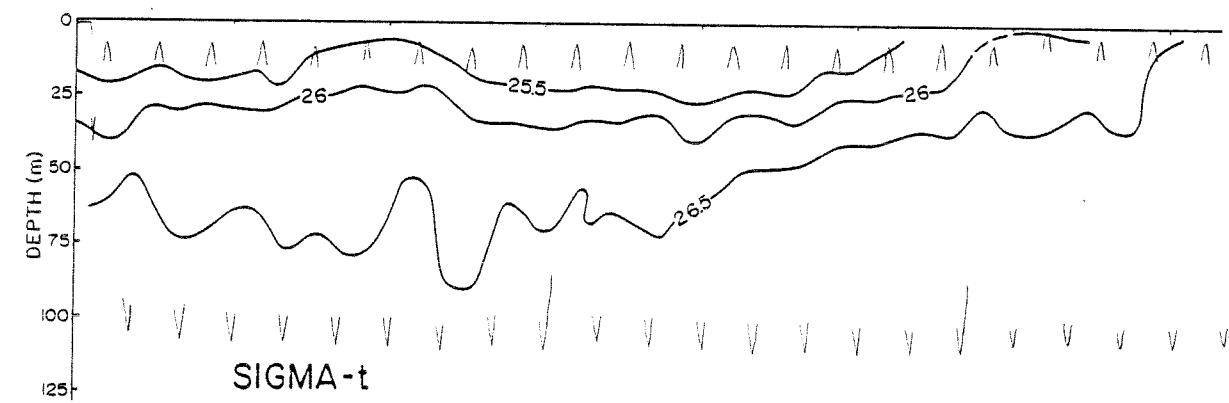
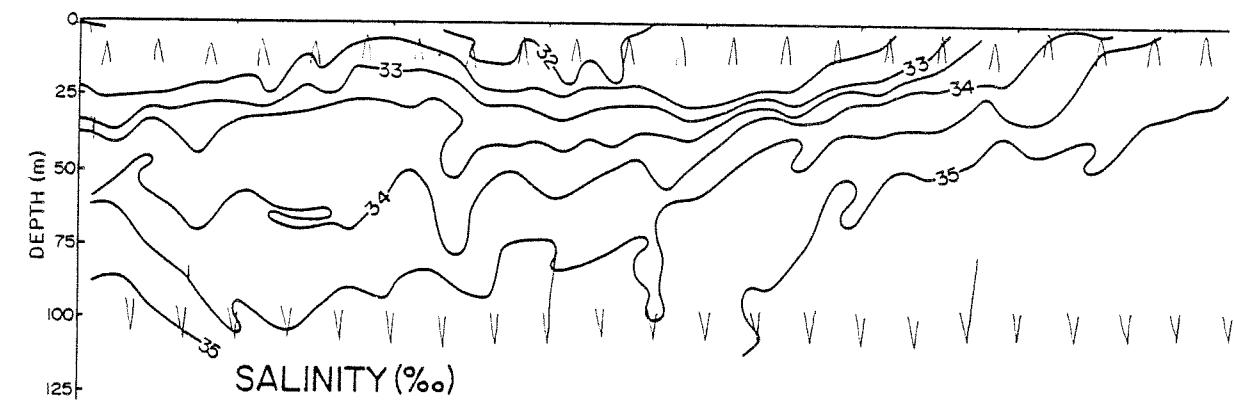
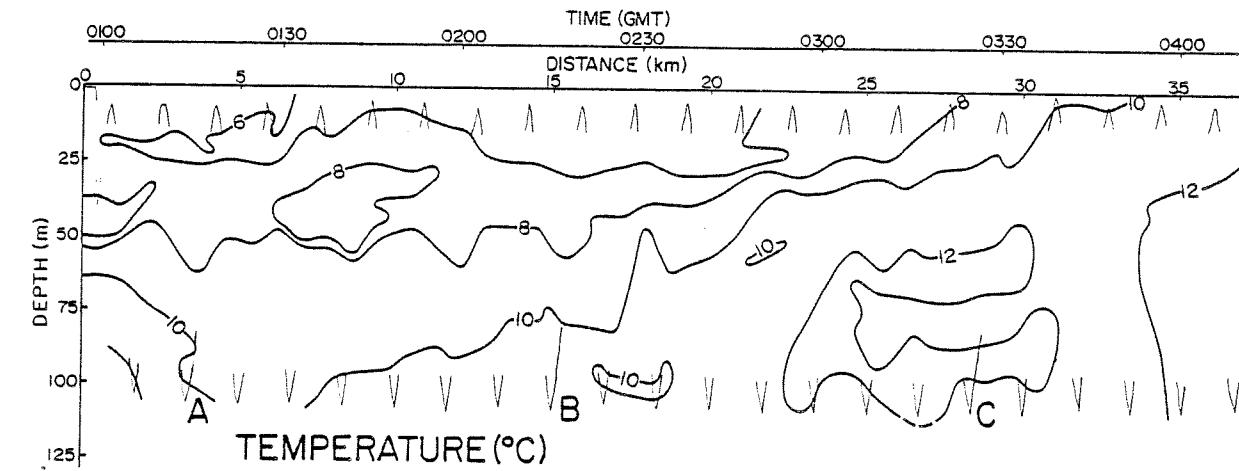
## CRUISE 77007 MAY 7, 1977



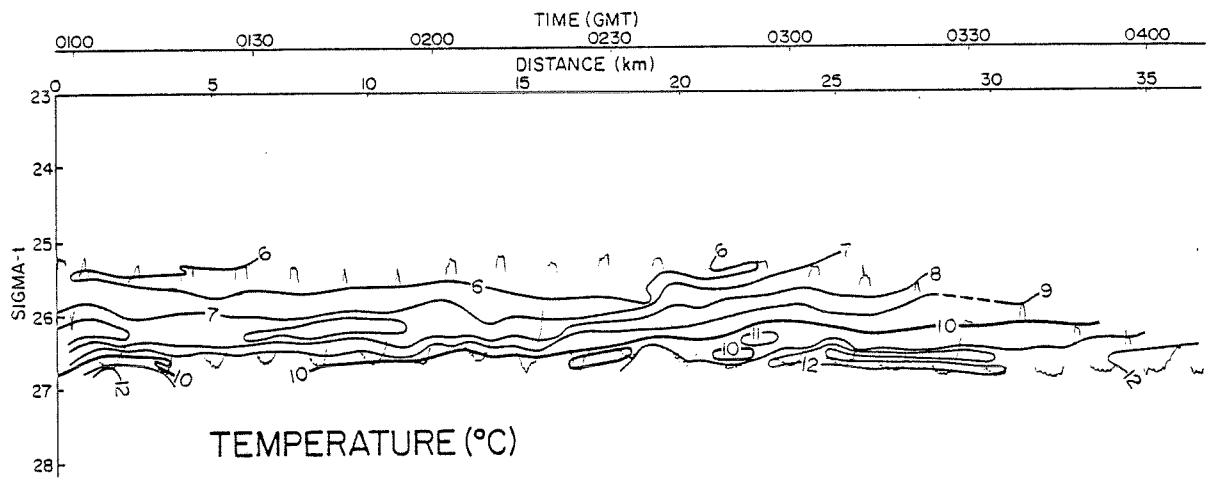
## CRUISE 77007 MAY 7, 1977



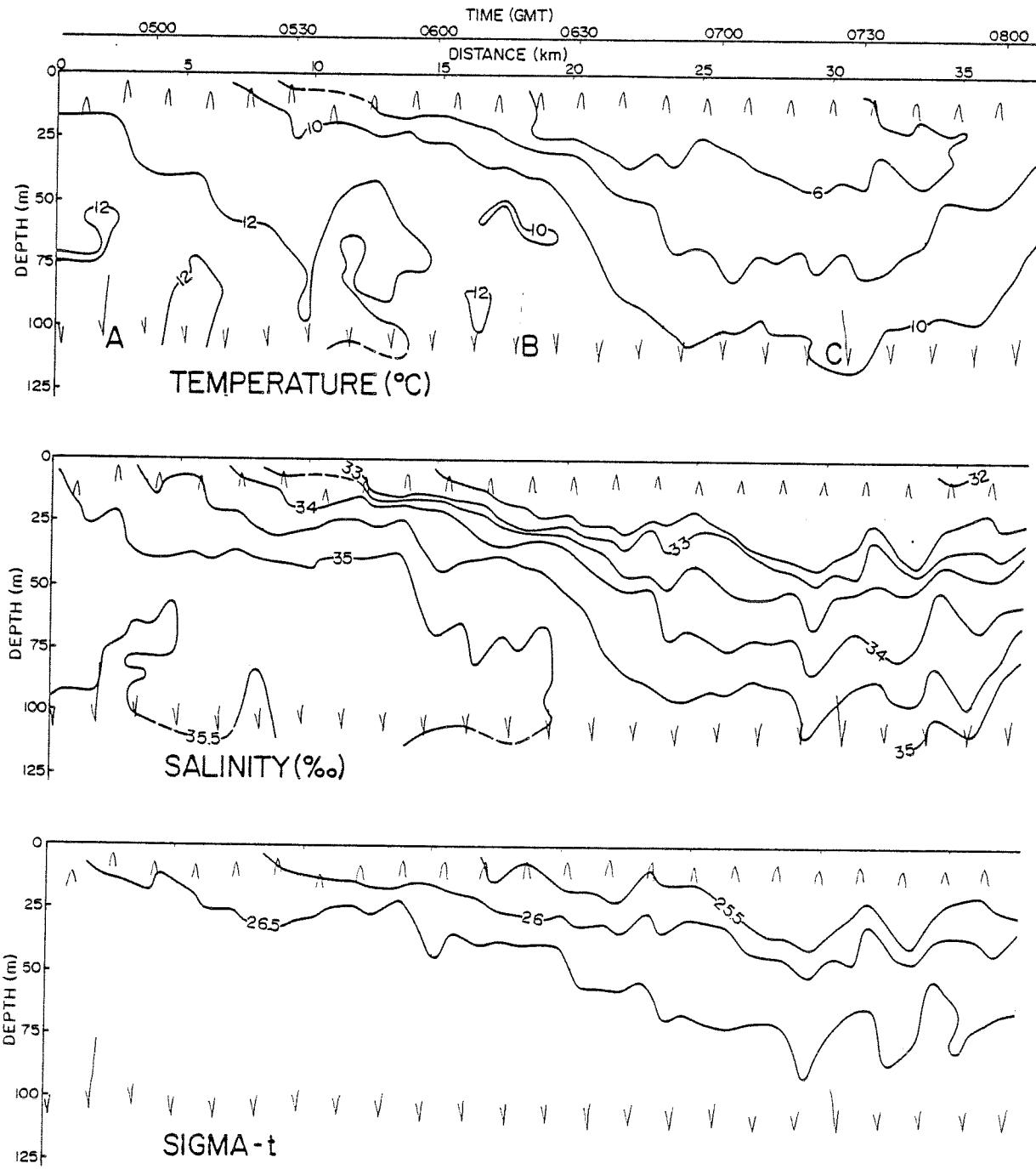
## CRUISE 77007 MAY 8, 1977



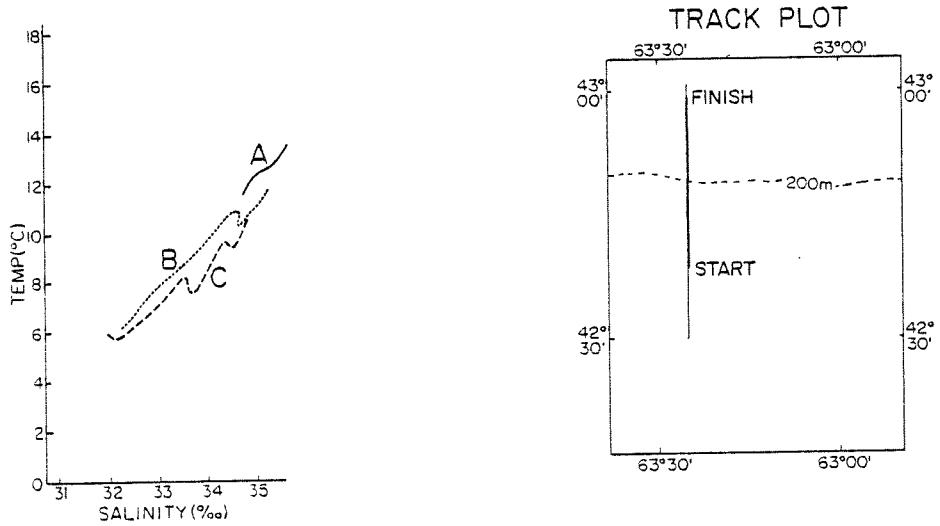
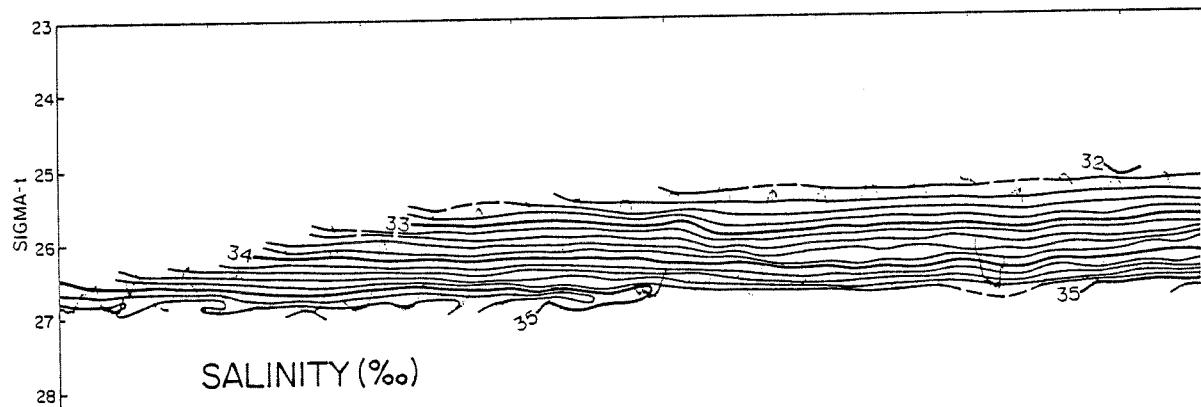
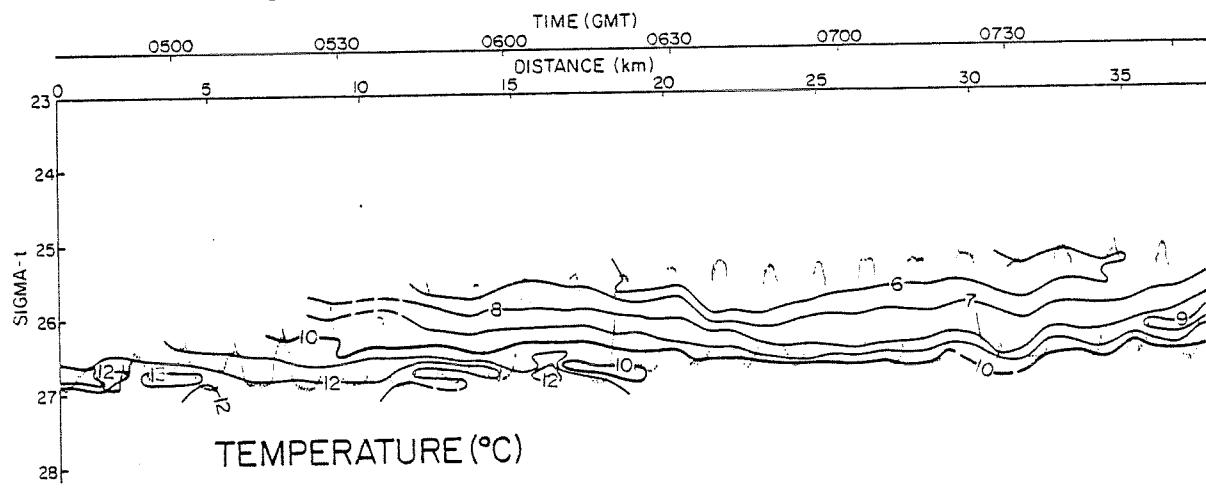
## CRUISE 77007      MAY 8, 1977



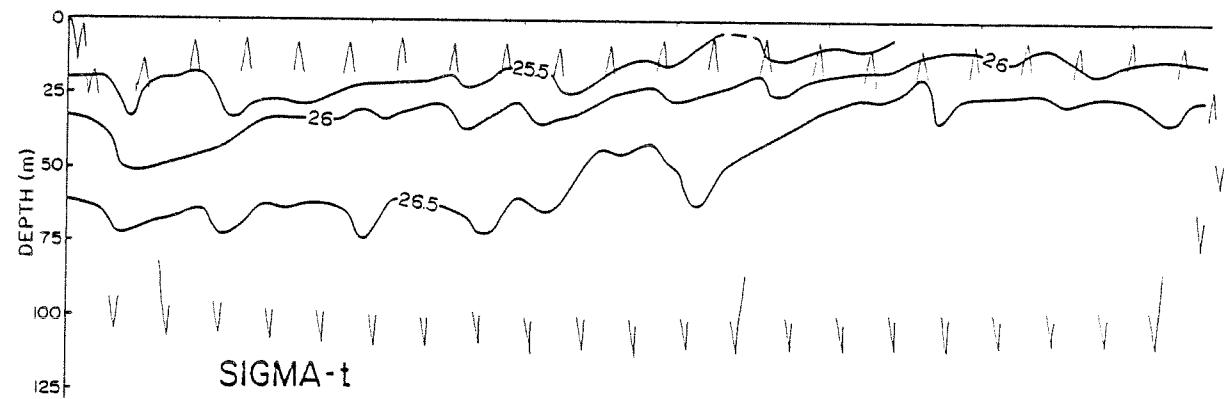
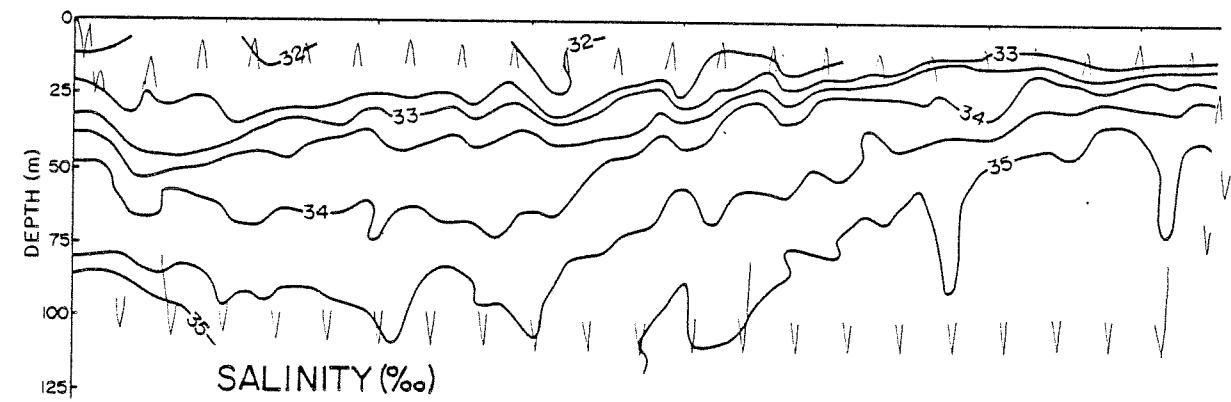
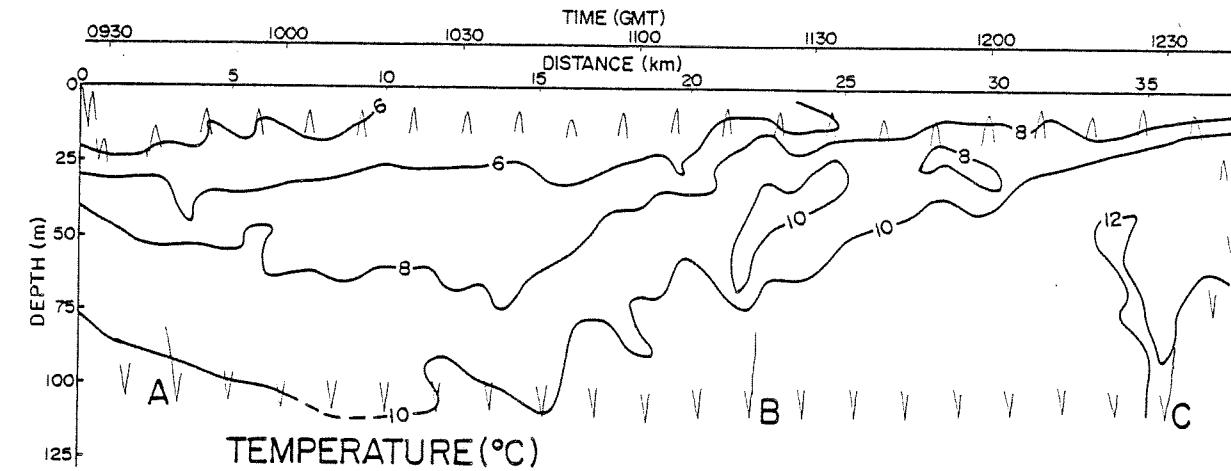
## CRUISE 77007 MAY 8, 1977



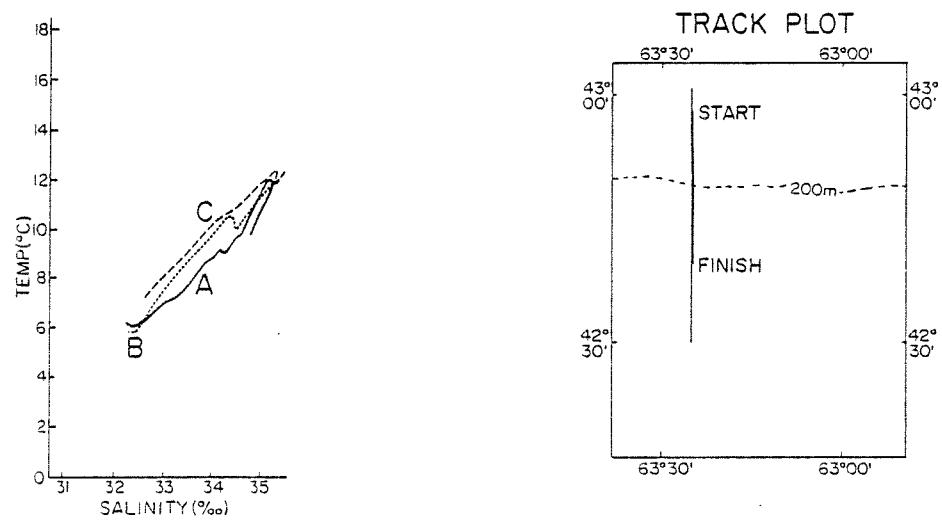
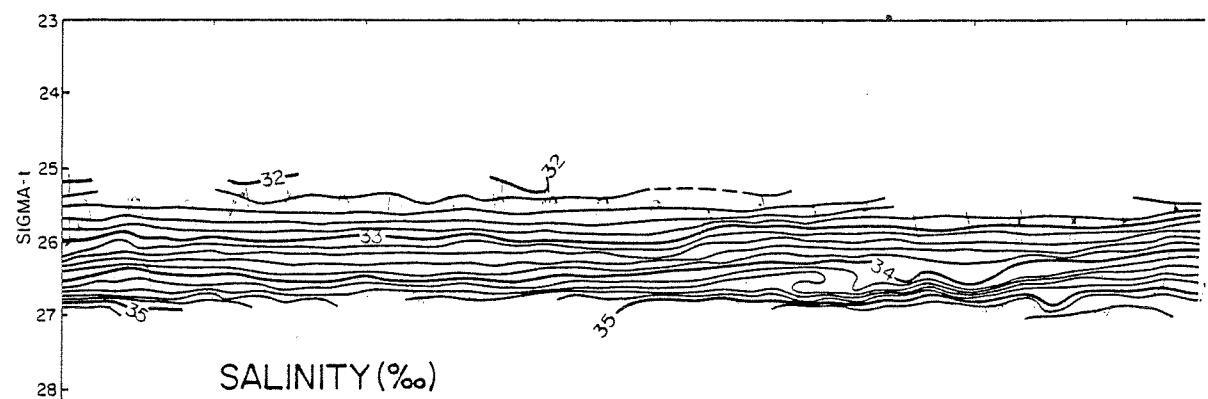
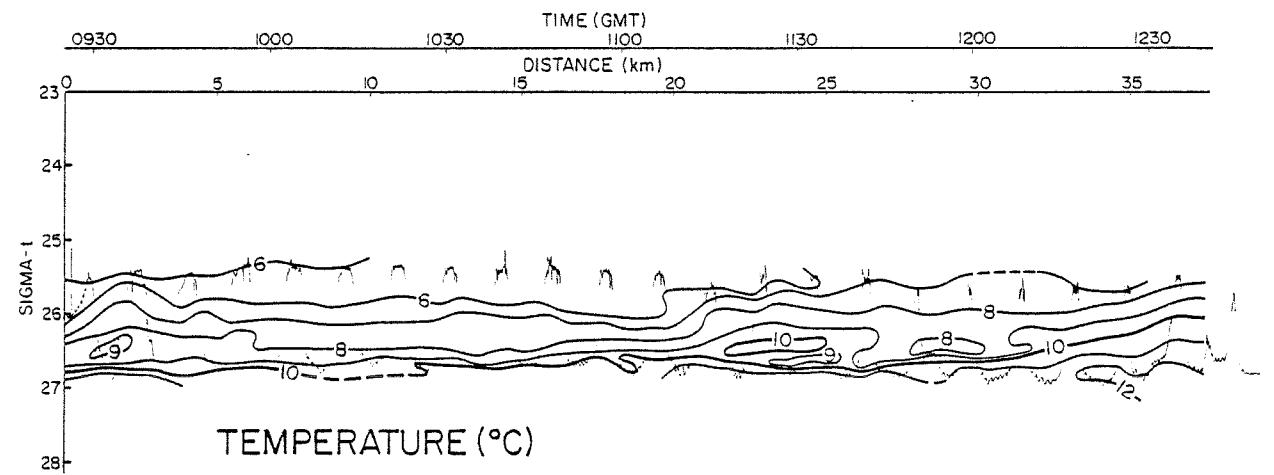
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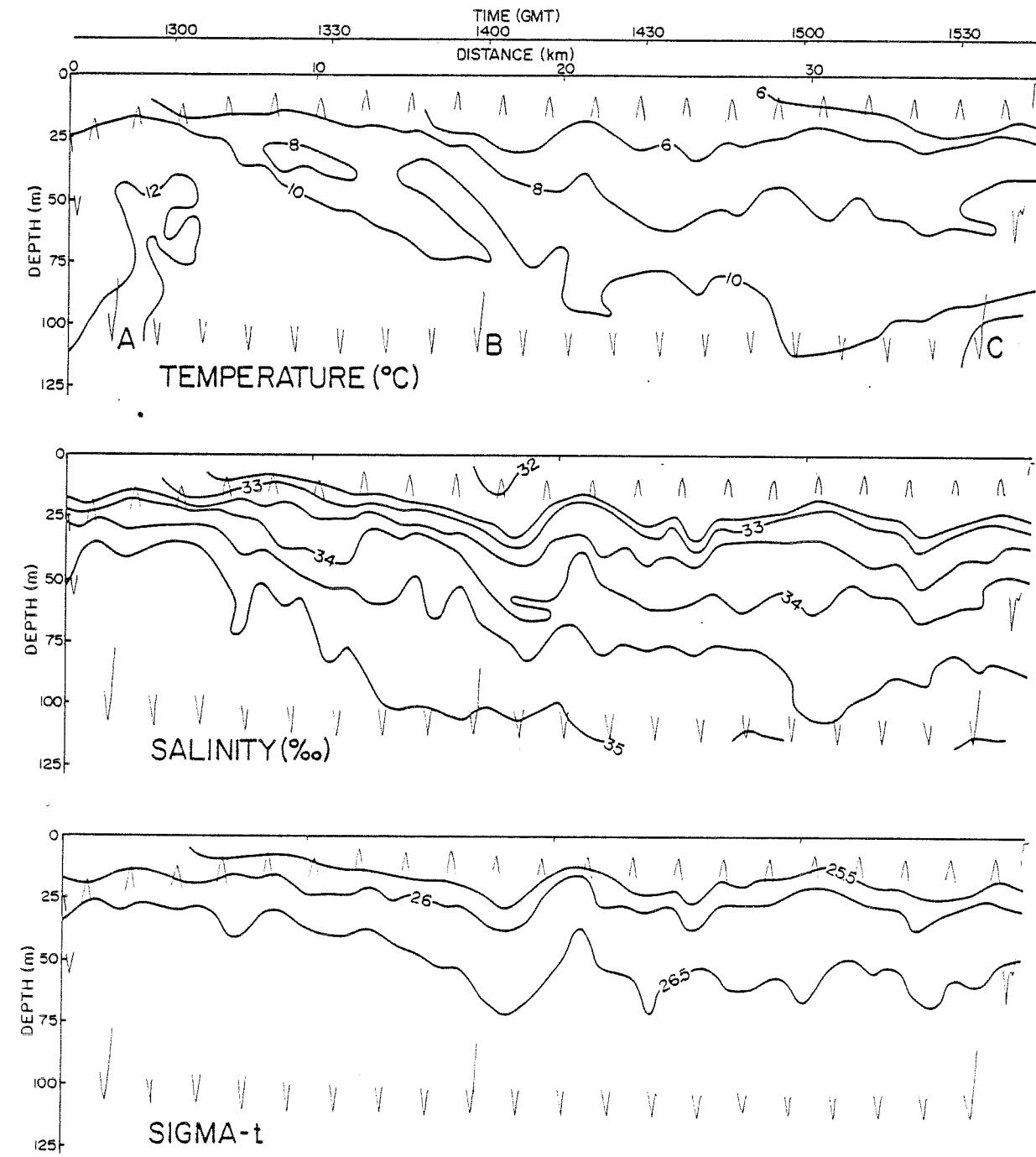
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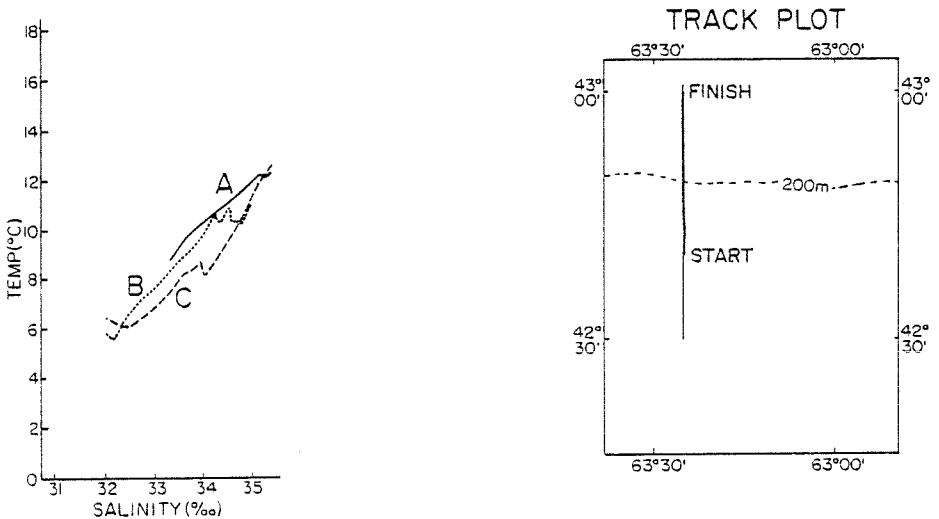
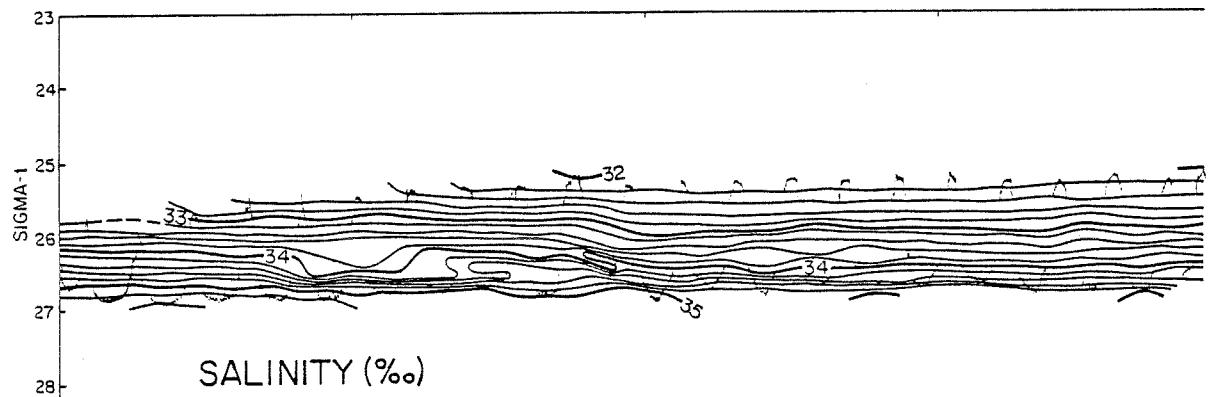
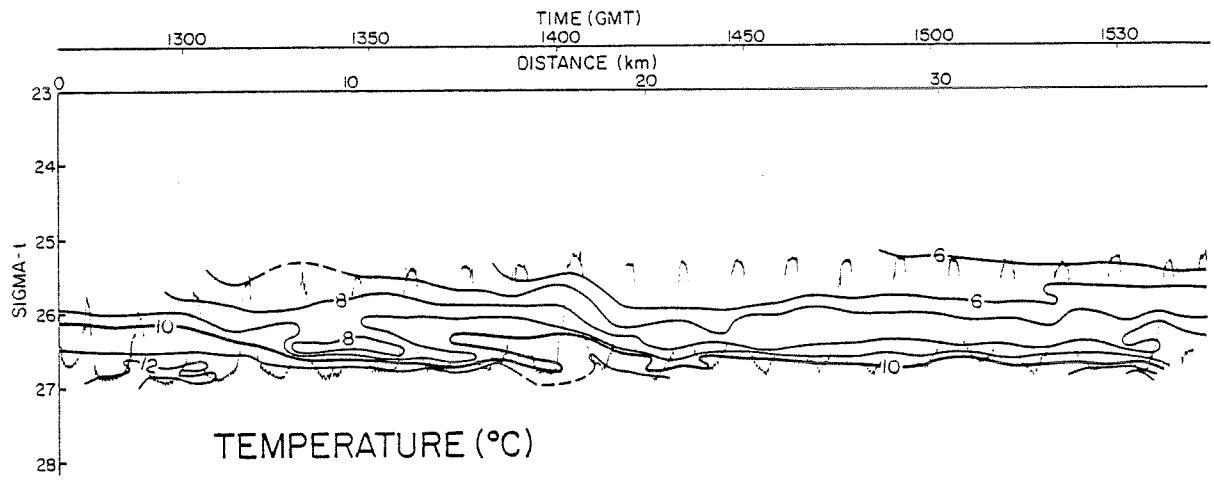
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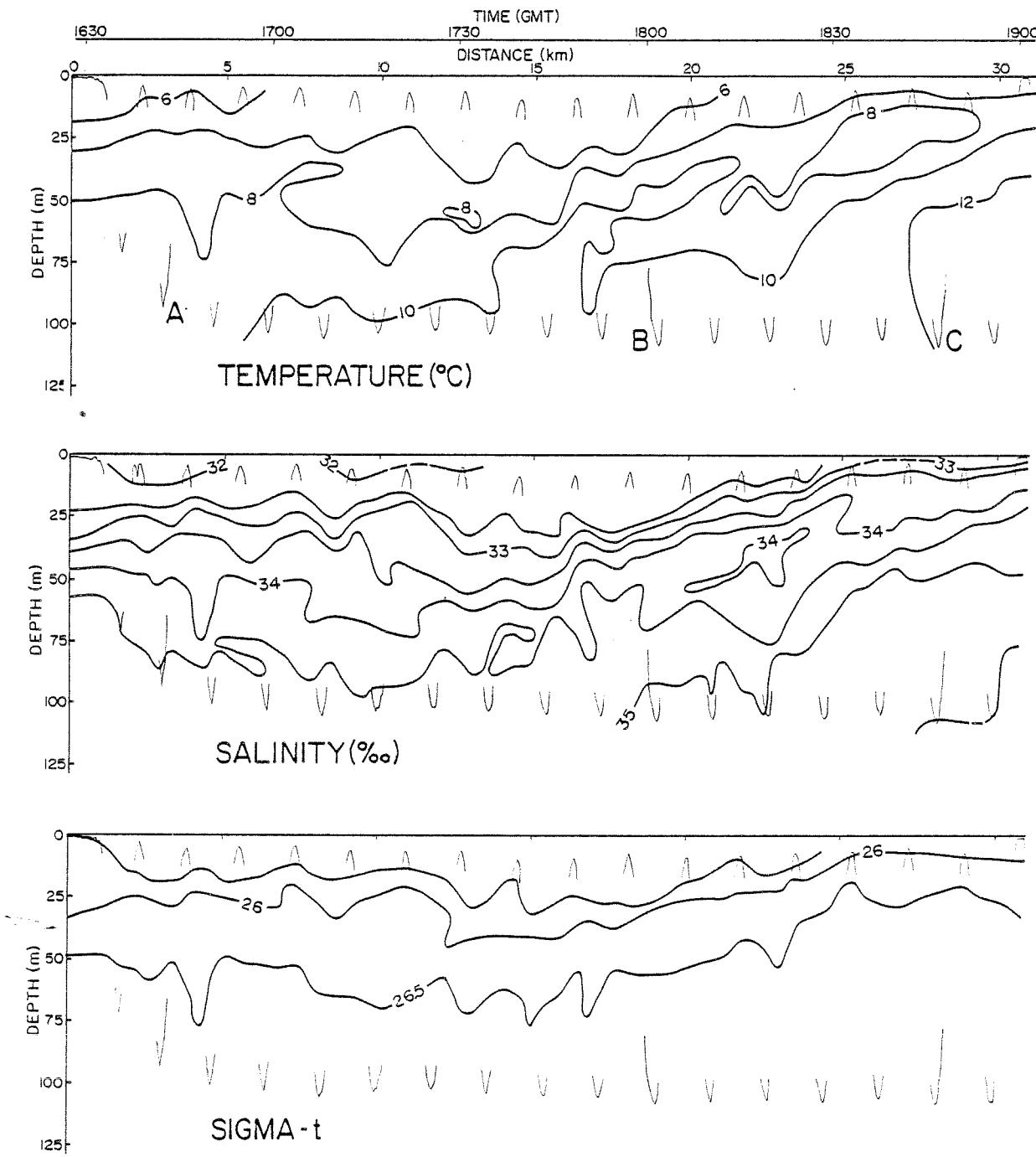
## CRUISE 77007 MAY 8, 1977



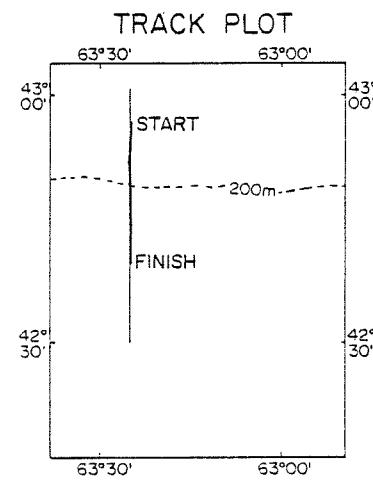
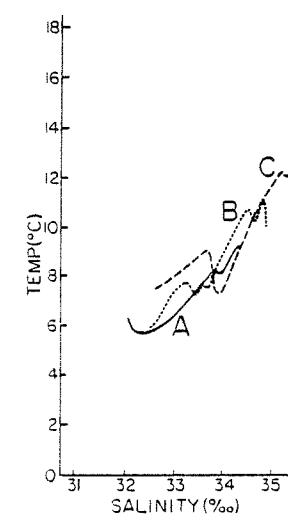
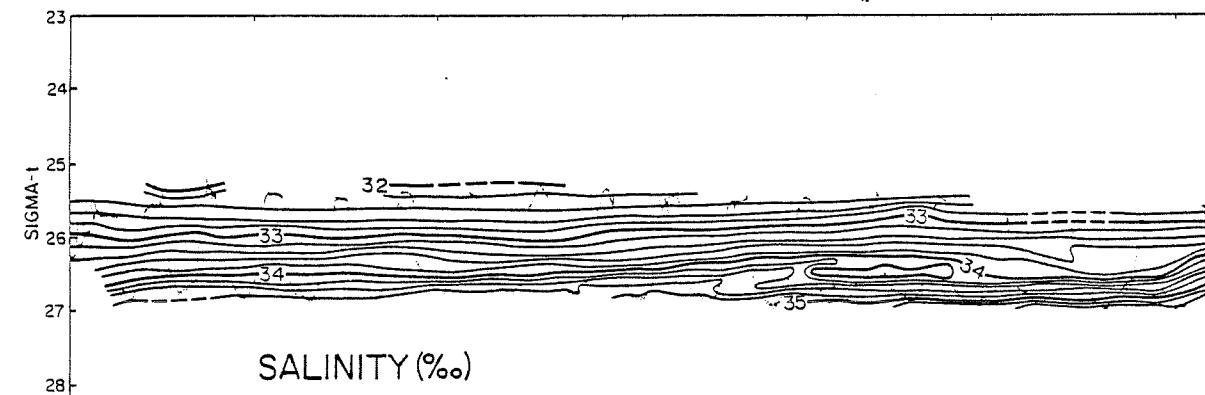
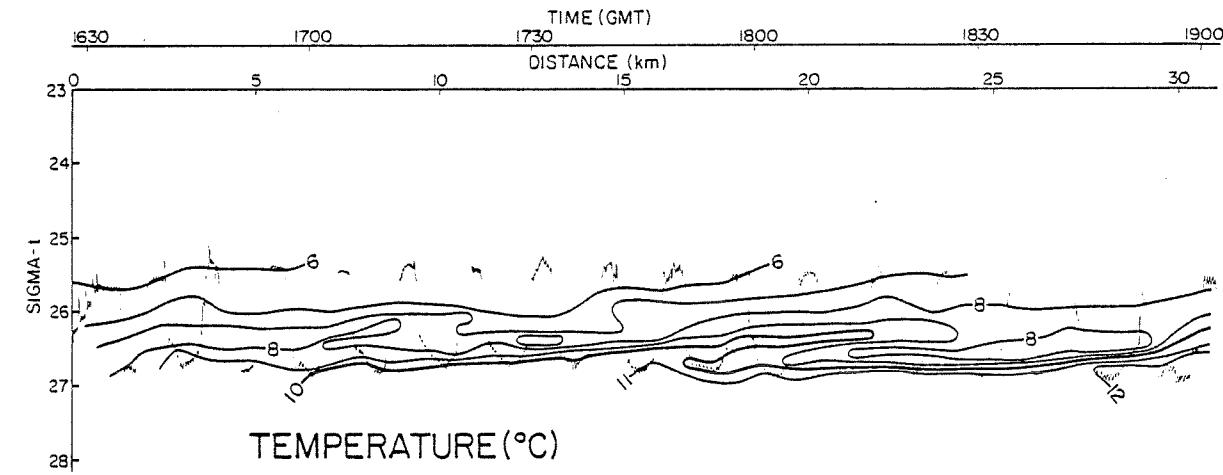
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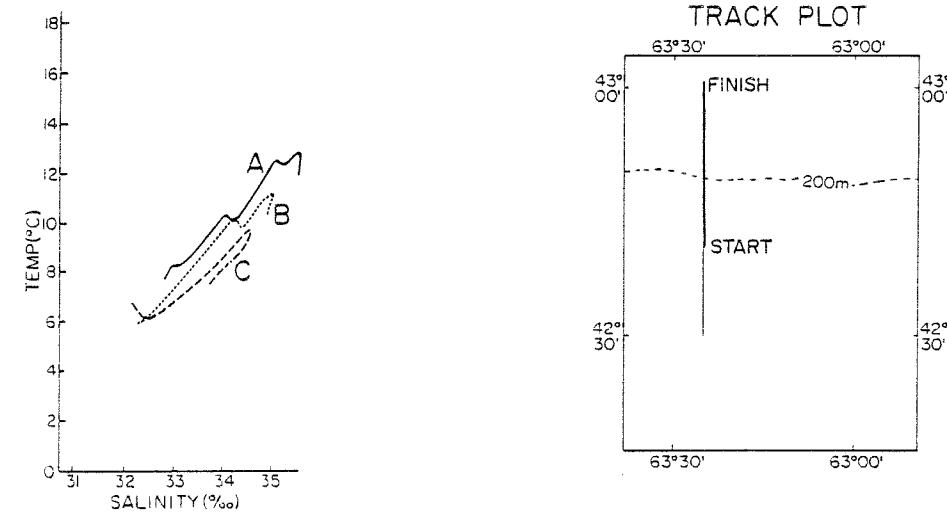
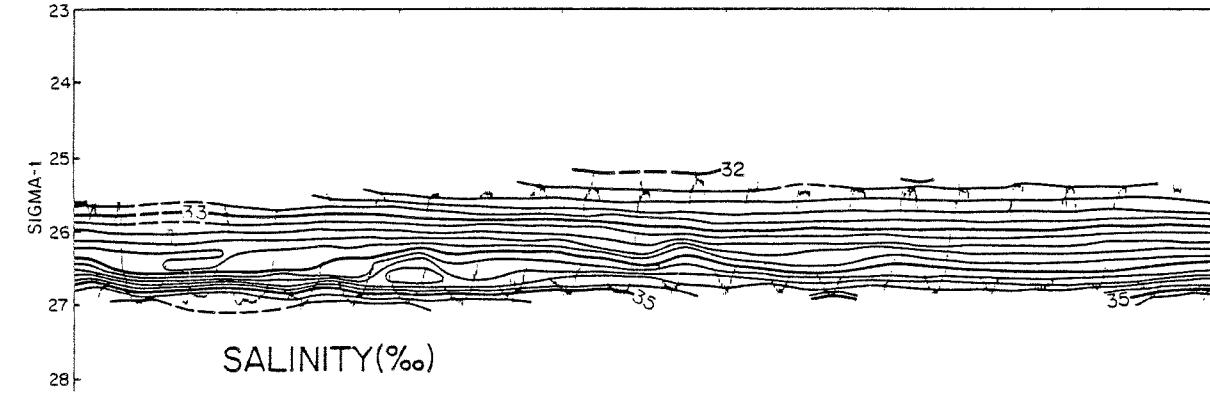
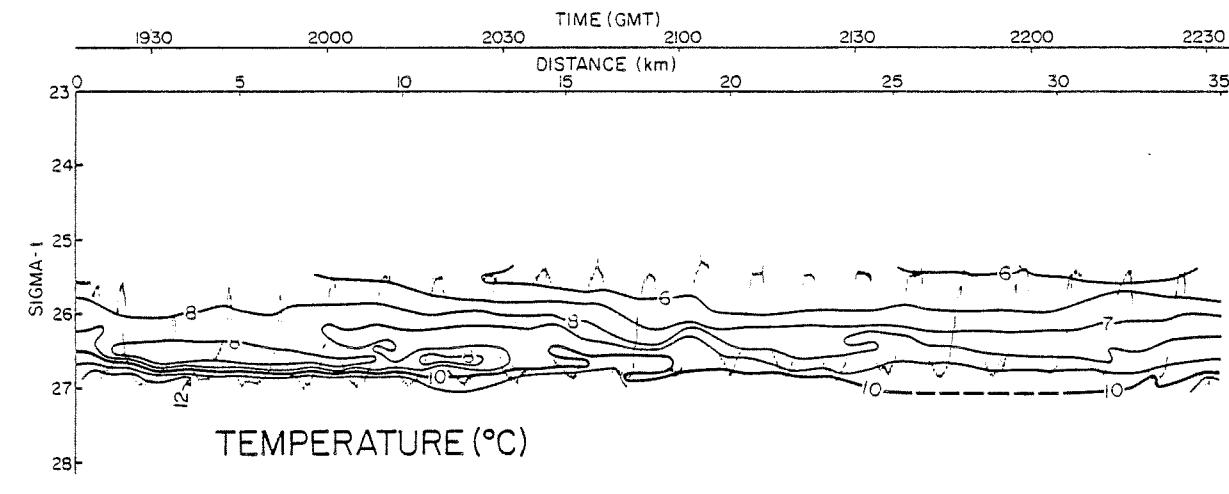
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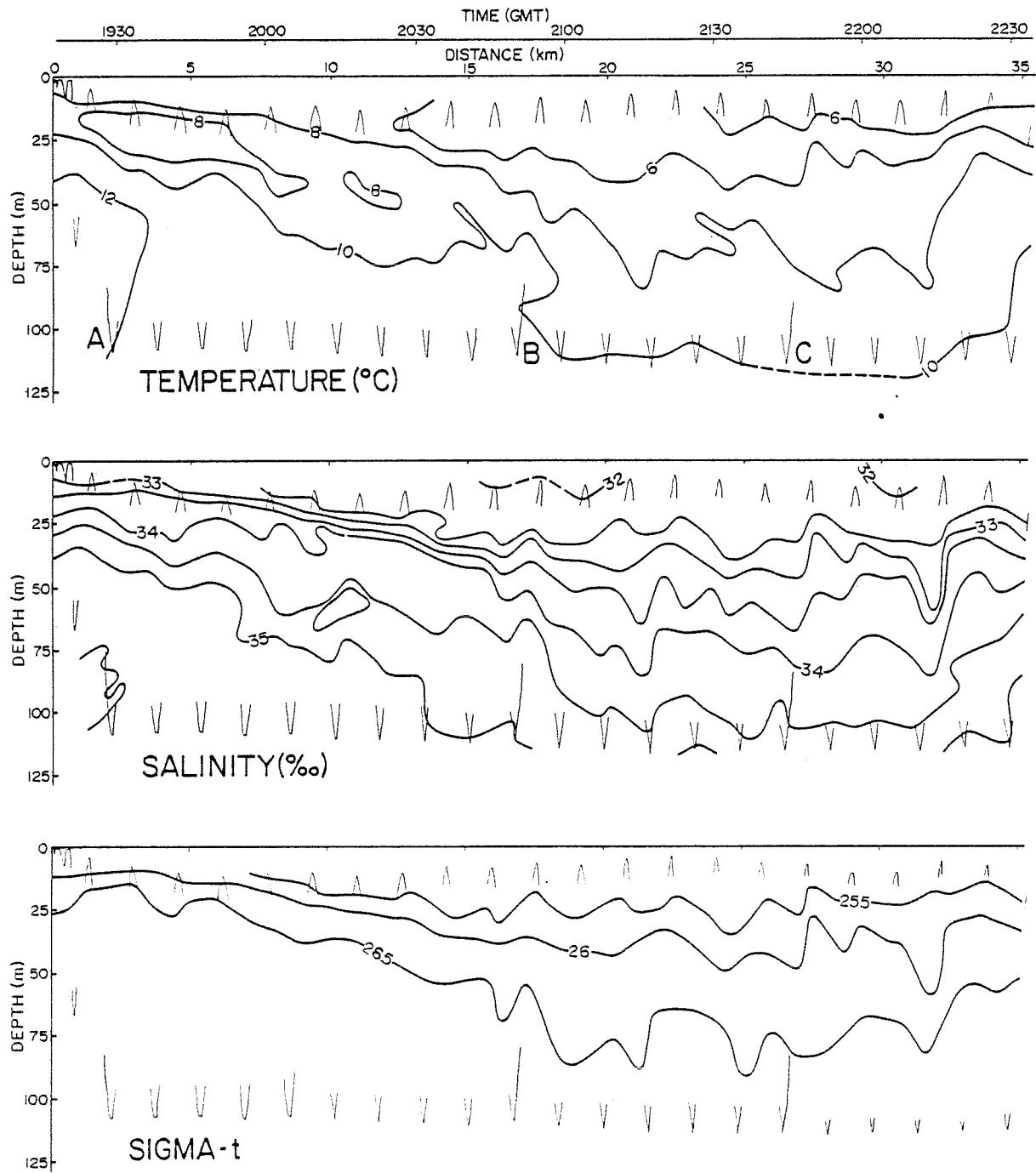
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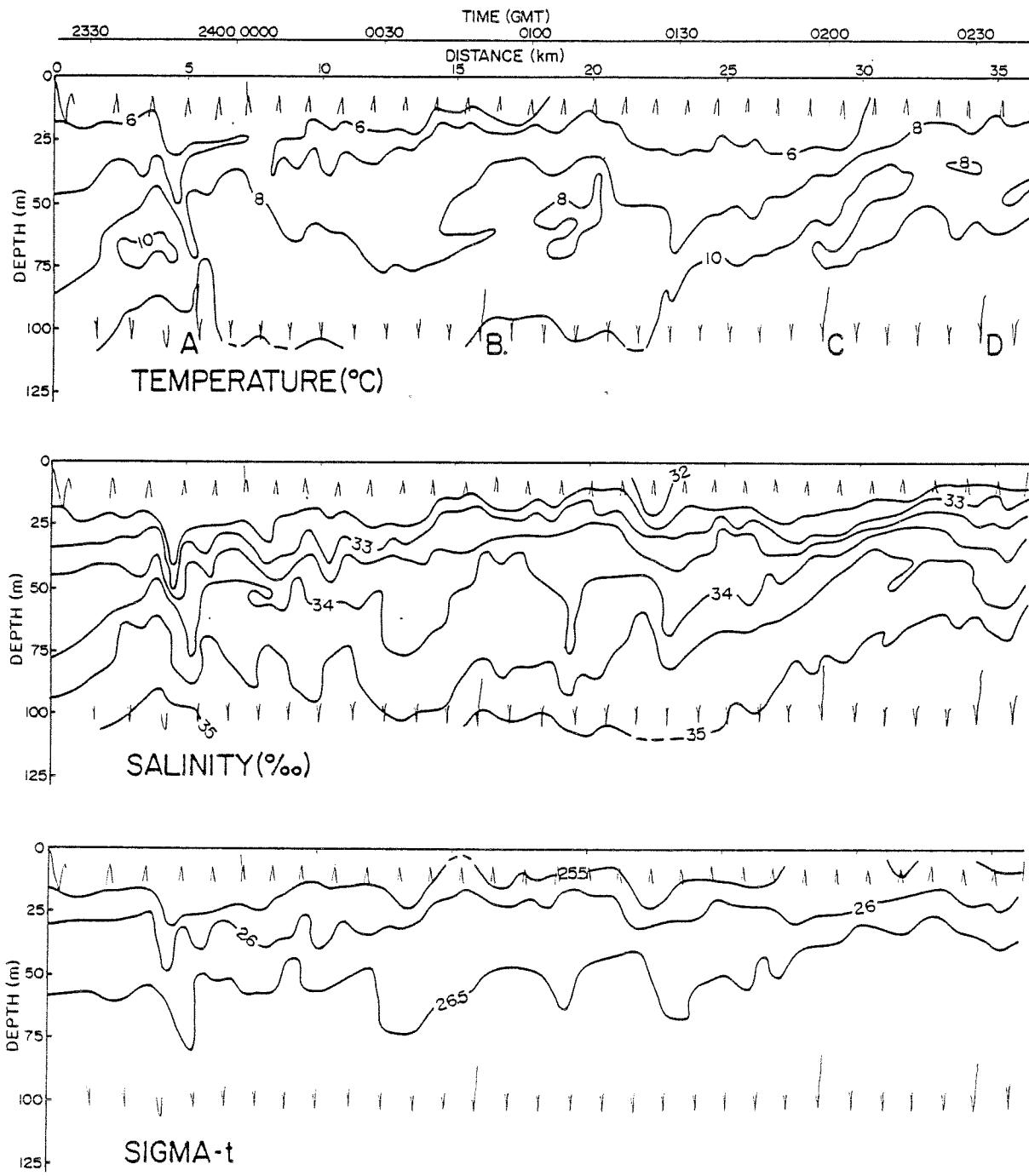
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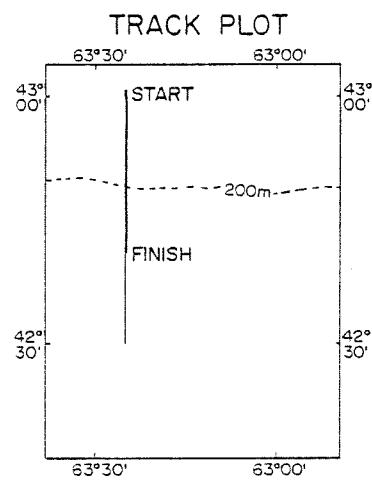
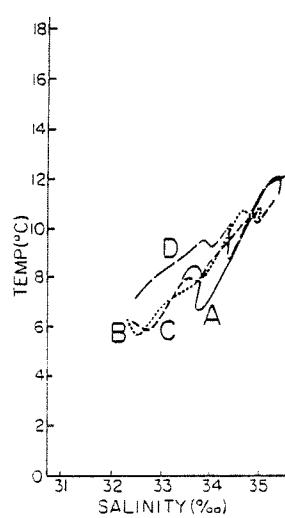
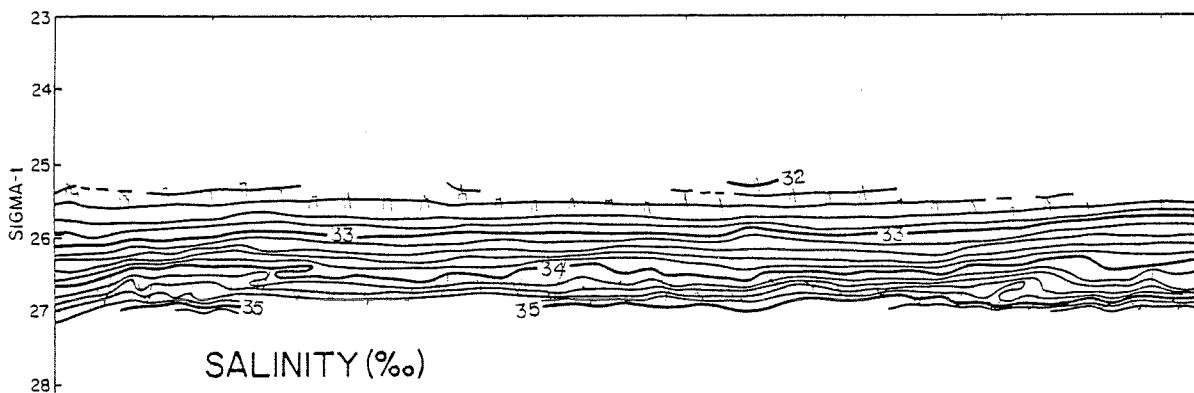
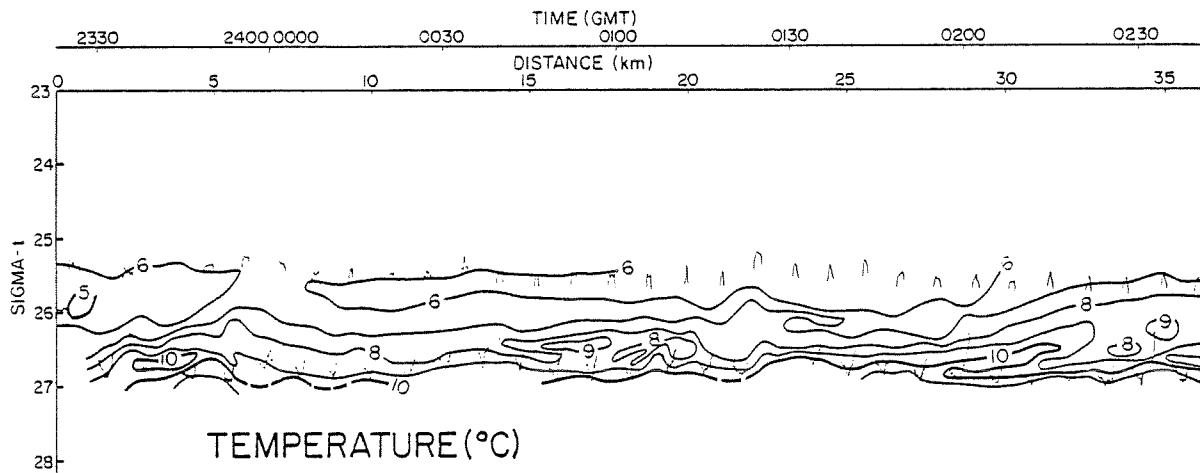
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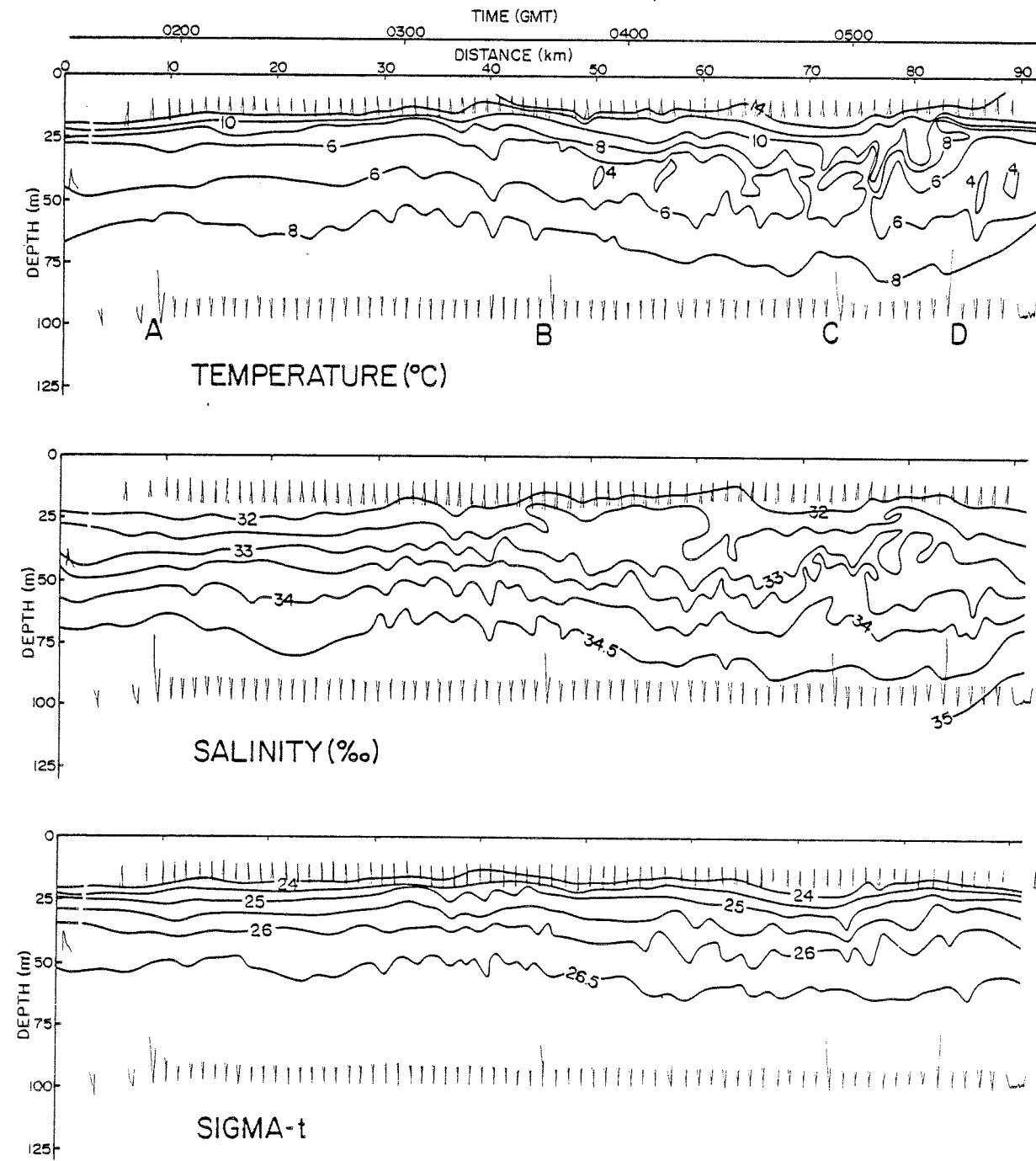
## CRUISE 77007 MAY 8-9, 1977



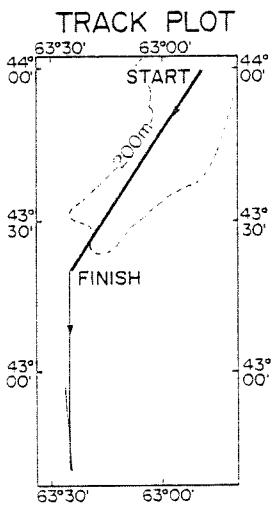
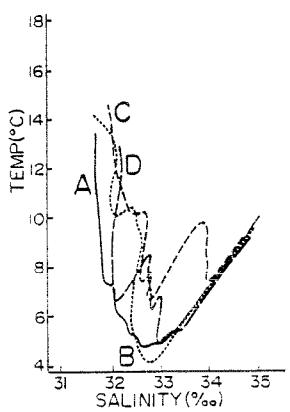
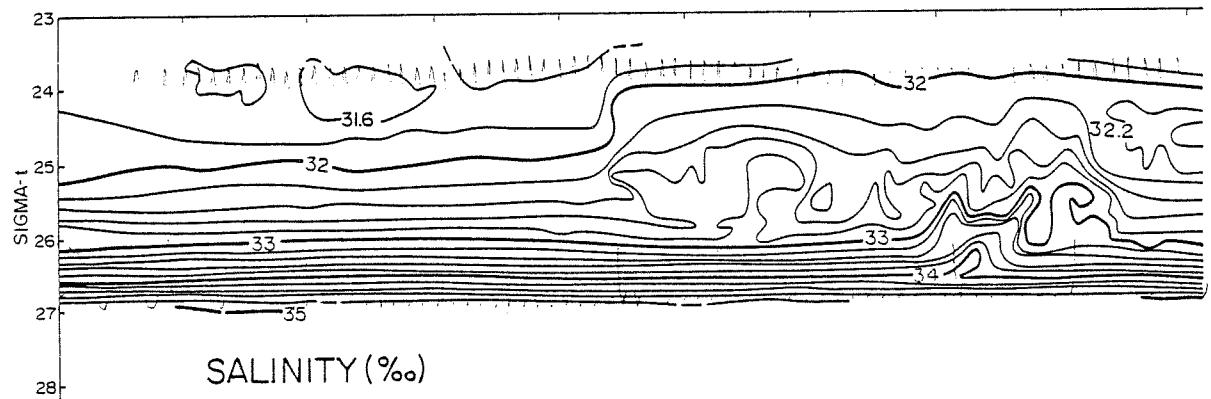
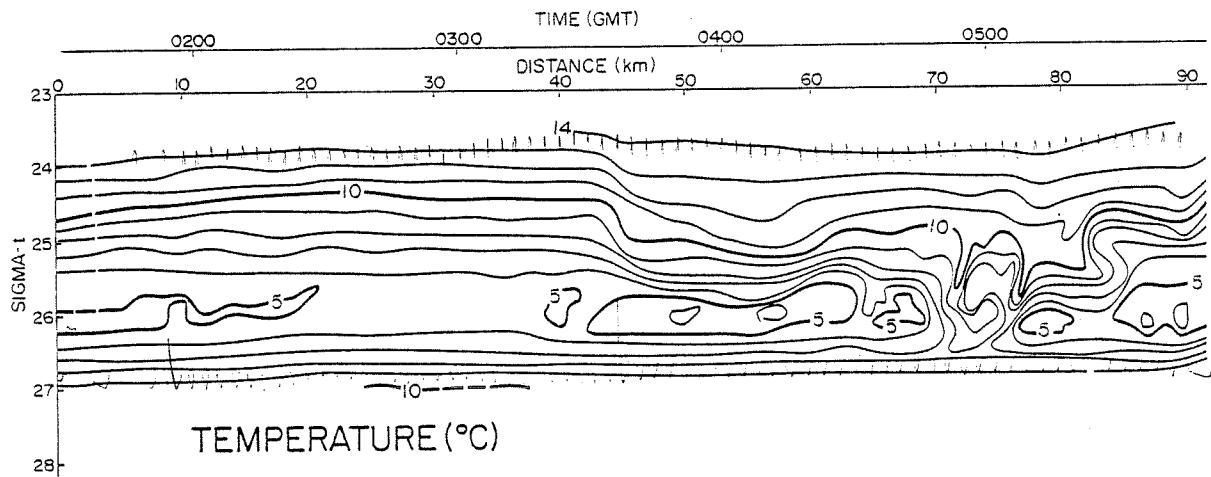
## CRUISE 77007      MAY 8 - 9, 1977



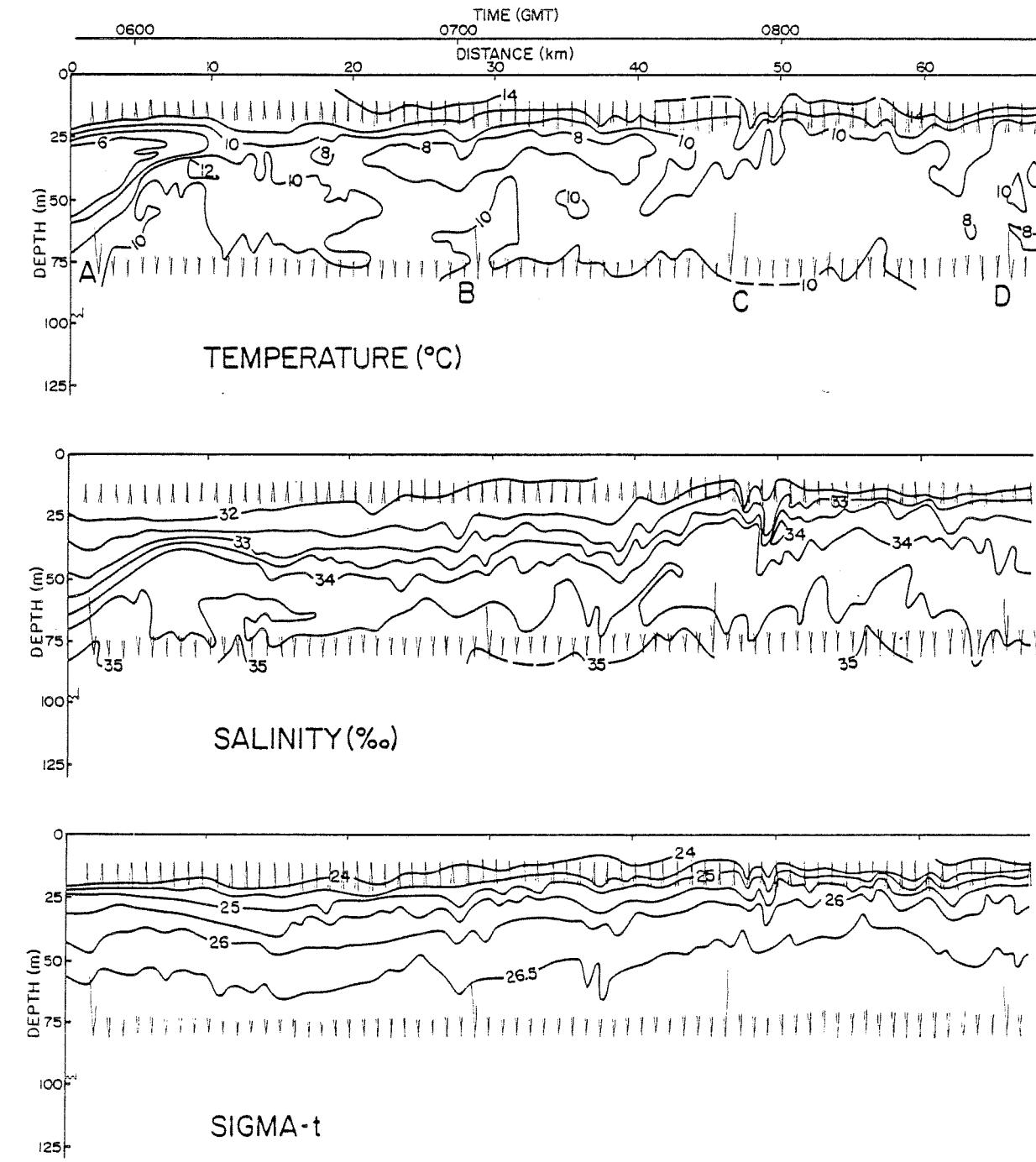
## CRUISE 77017 JULY 6, 1977



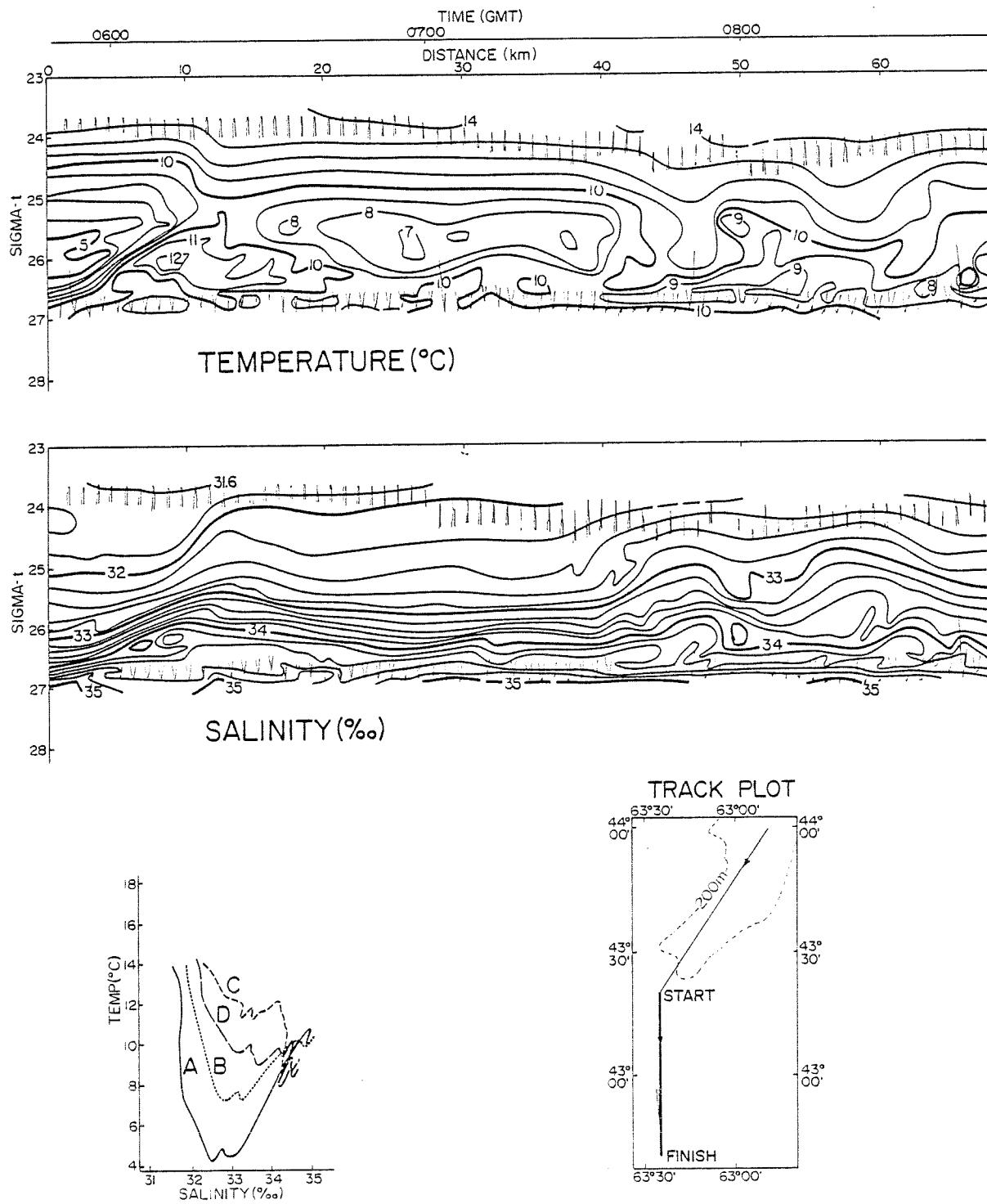
## CRUISE 77017 JULY 6, 1977



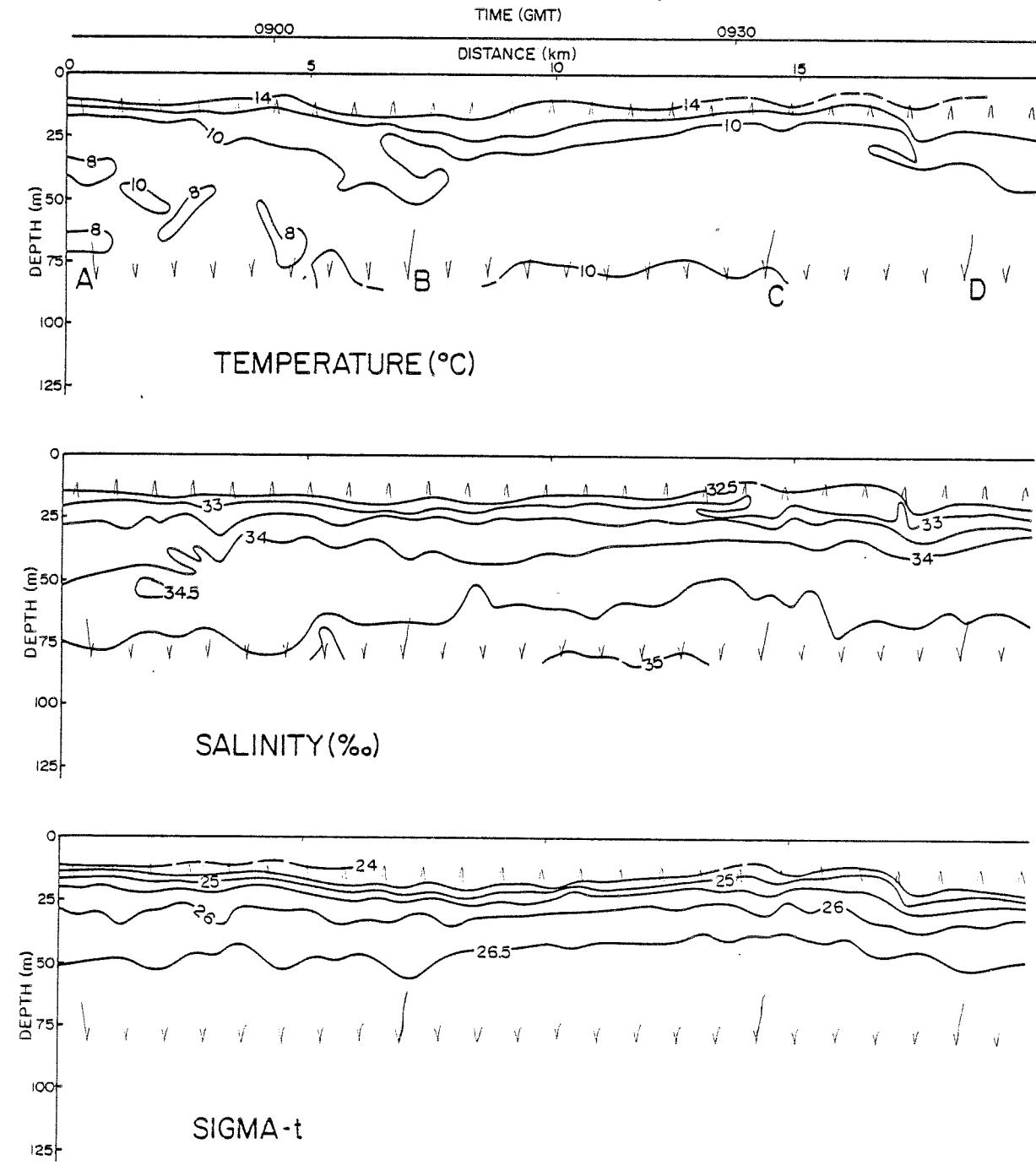
## CRUISE 77017 JULY 6, 1977



CRUISE 77017 JULY 6, 1977



## CRUISE 77017 JULY 6, 1977



## CRUISE 77017 JULY 6, 1977

TIME (GMT)

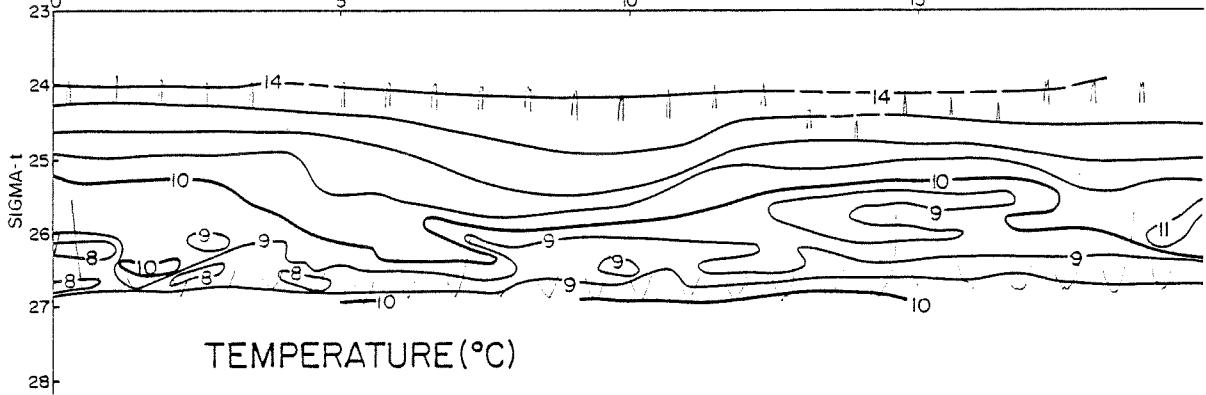
0900

0930

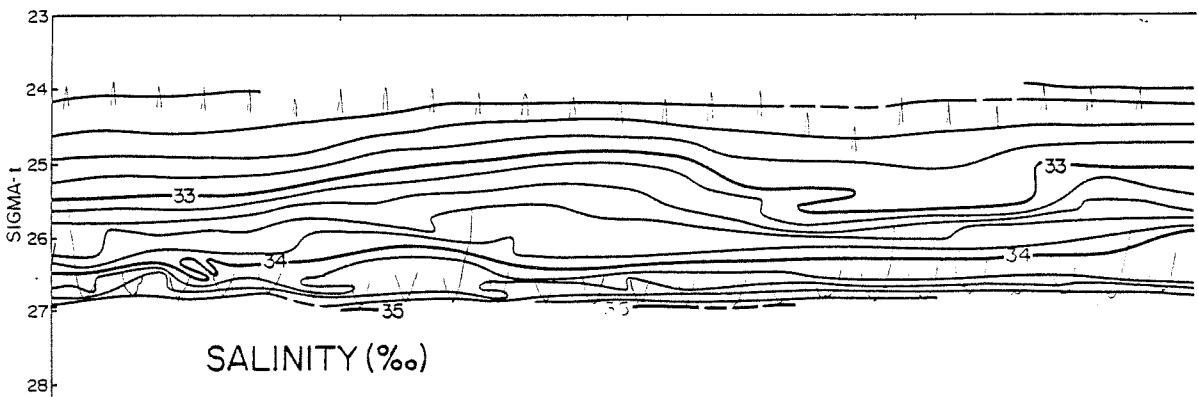
DISTANCE (km)

5

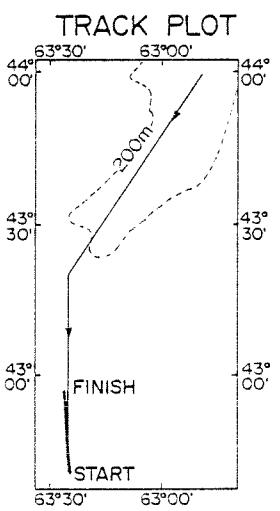
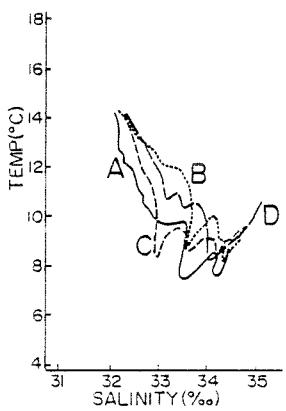
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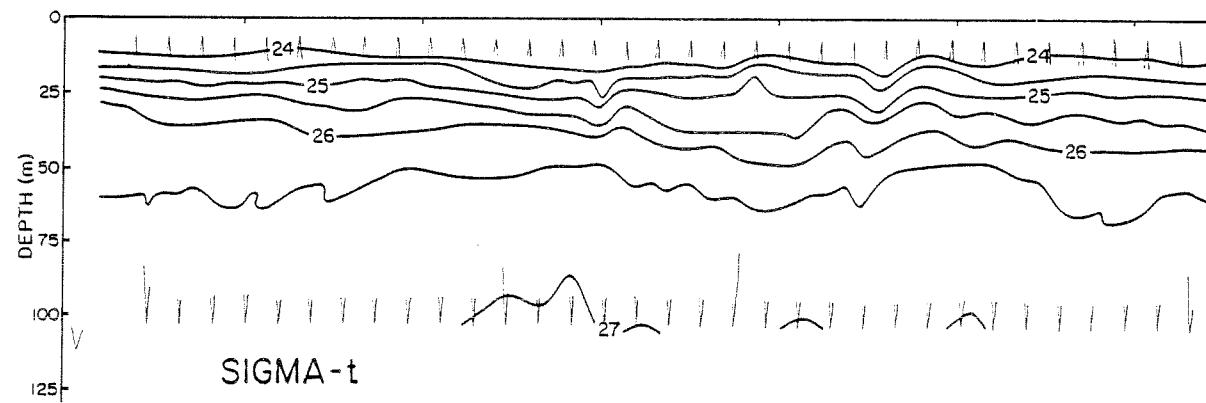
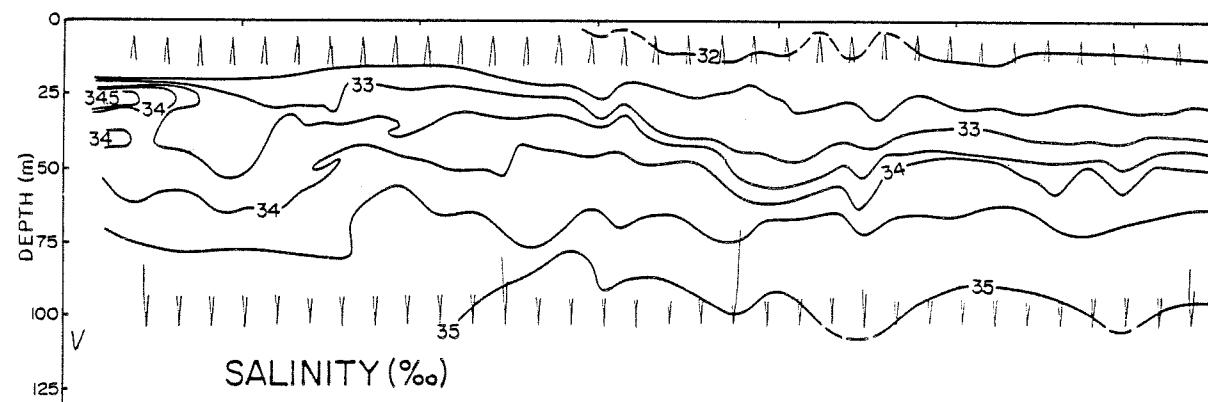
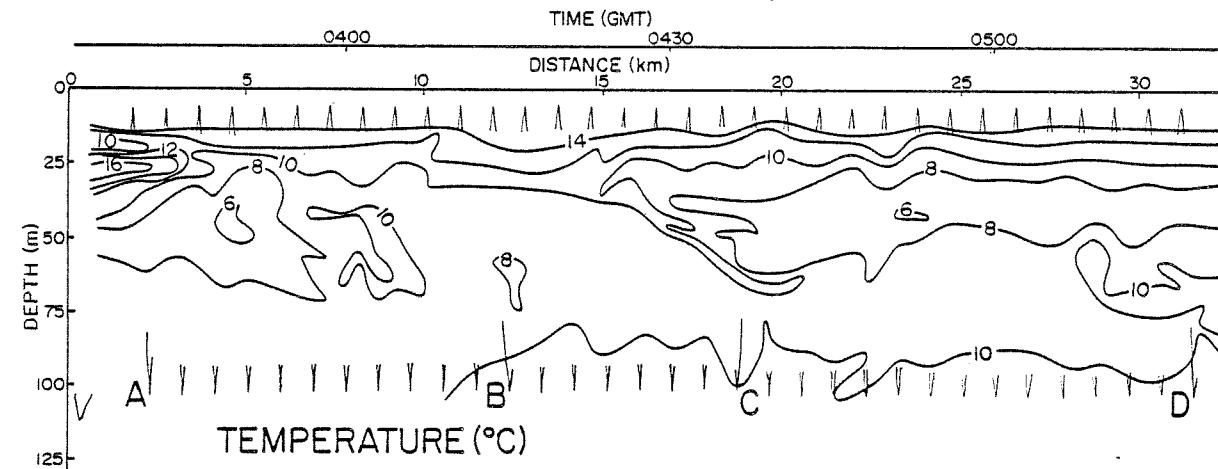
TEMPERATURE (°C)



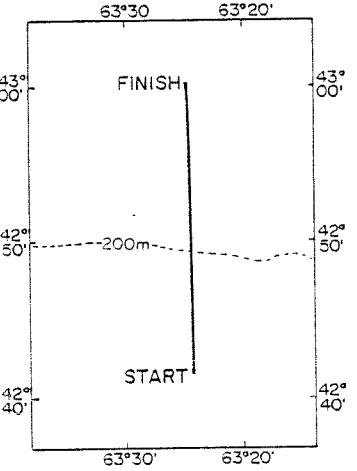
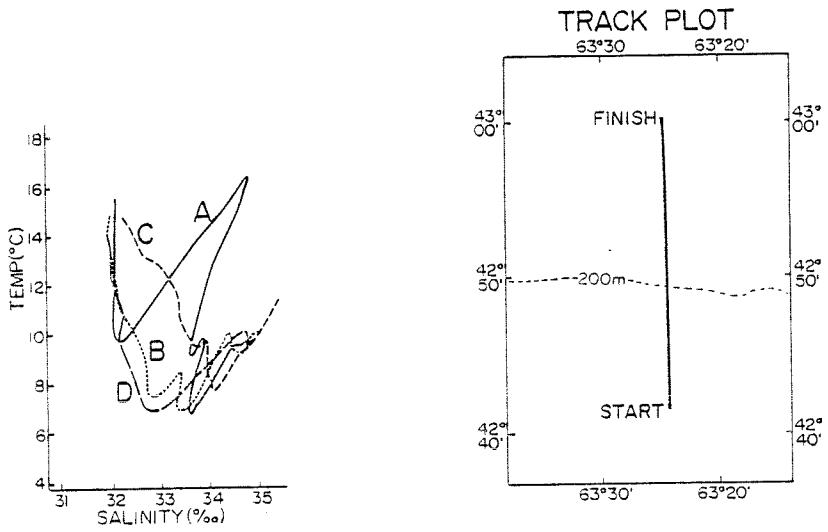
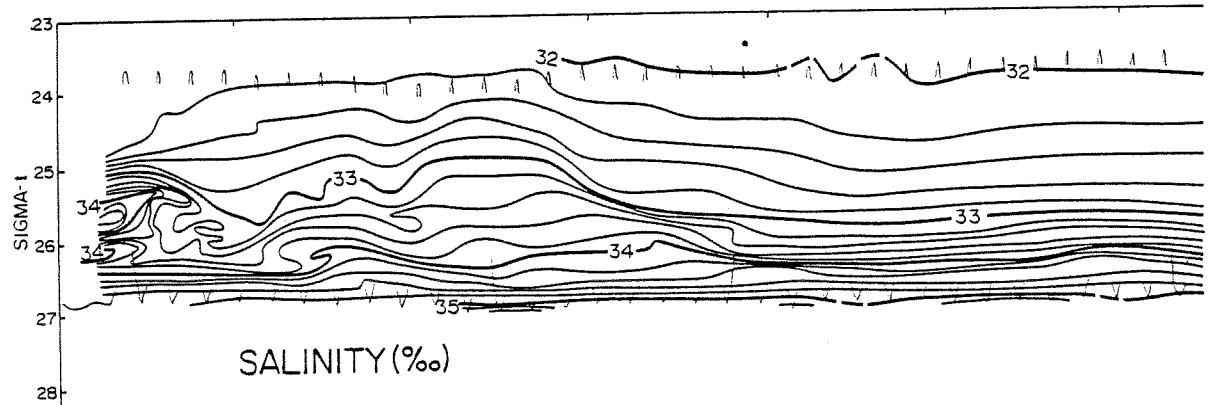
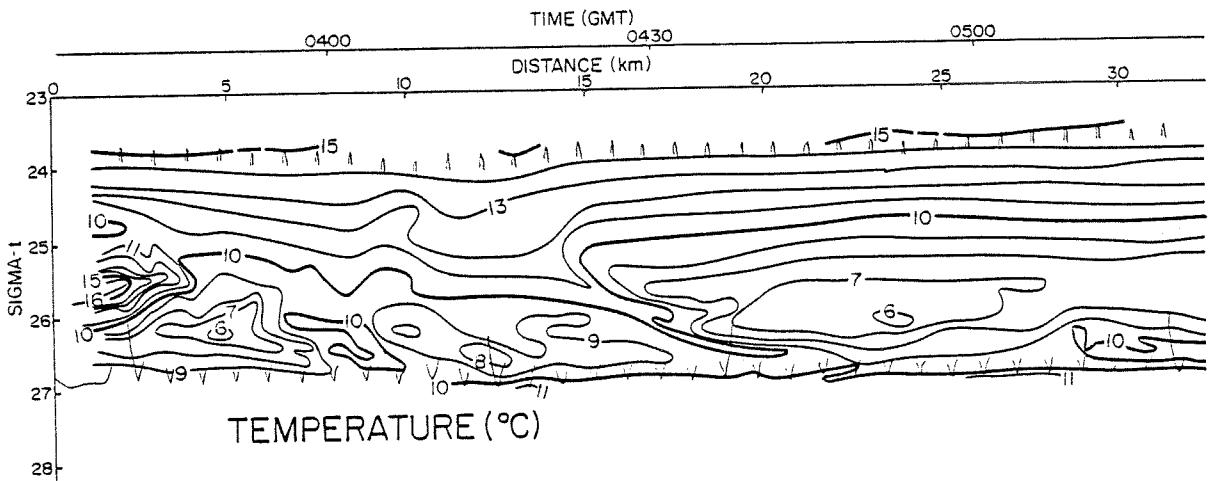
SALINITY (‰)



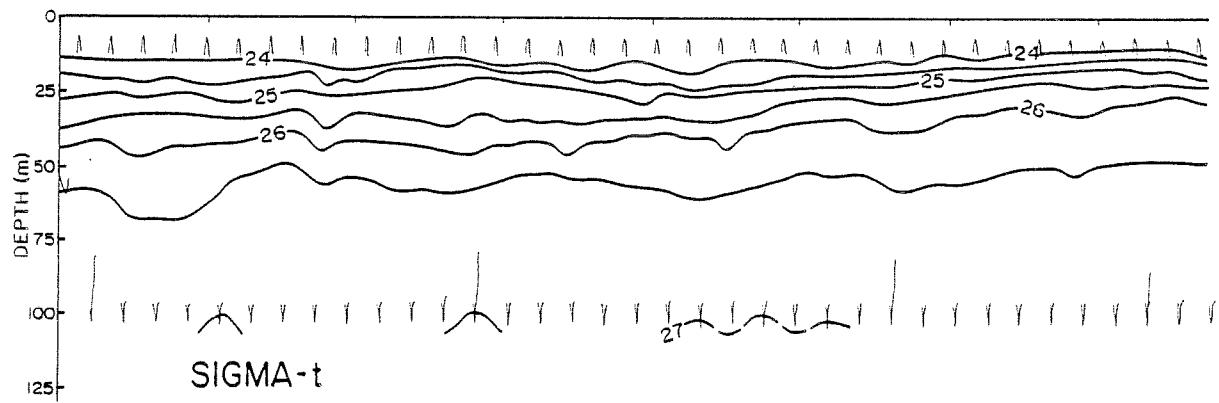
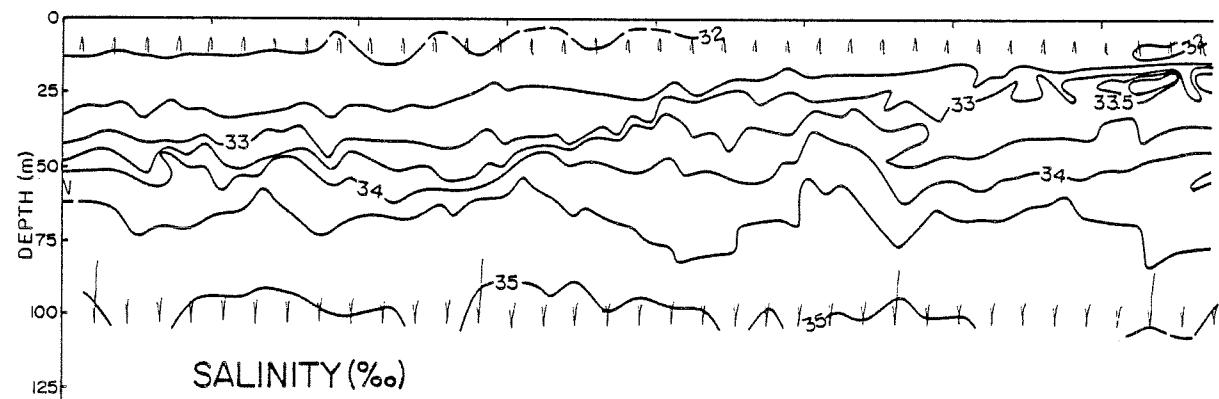
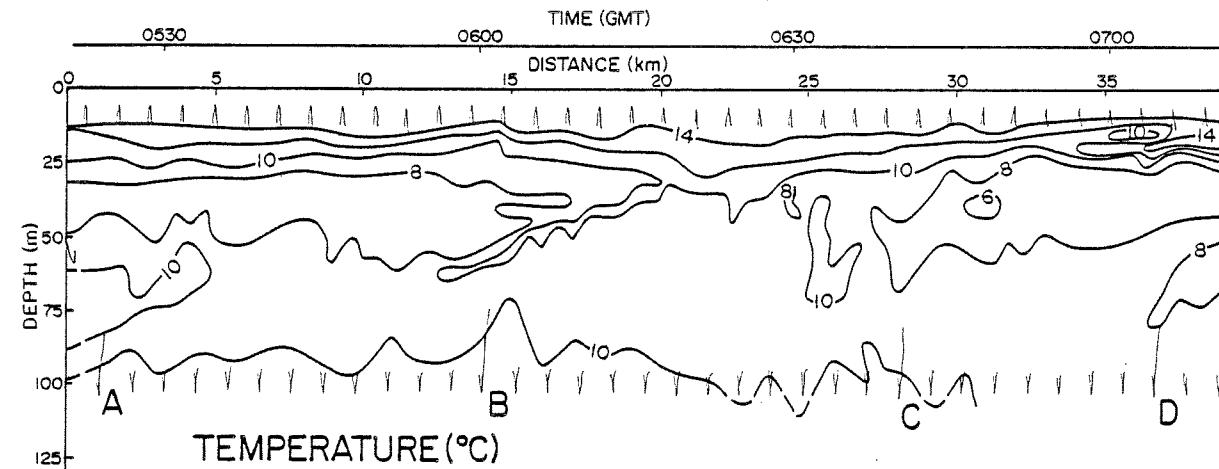
## CRUISE 77017 JULY 9, 1977



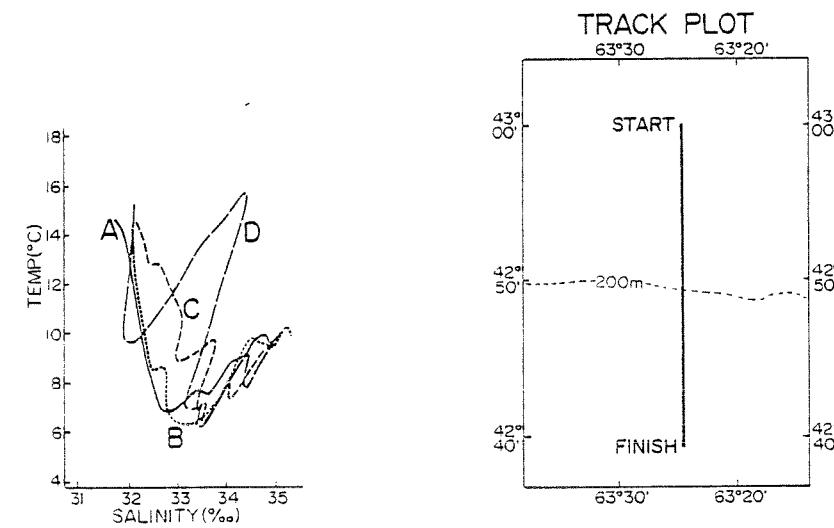
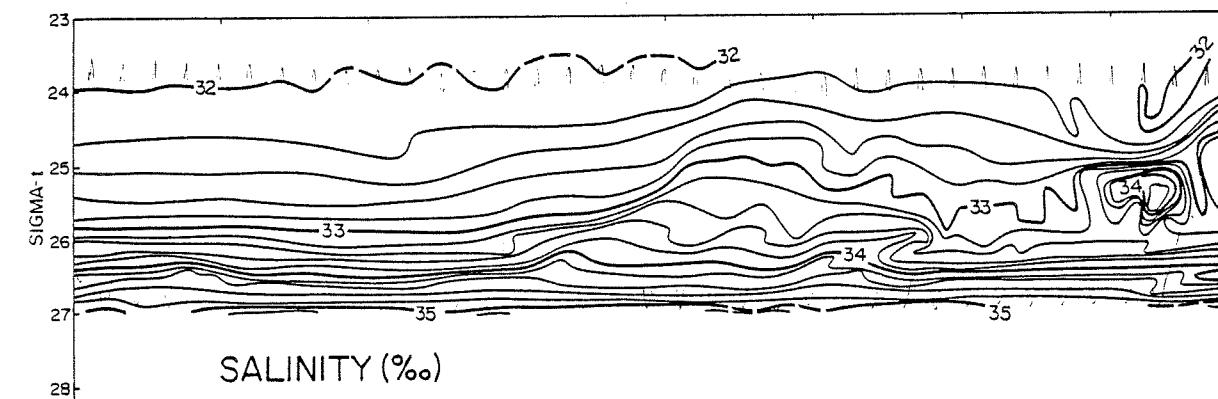
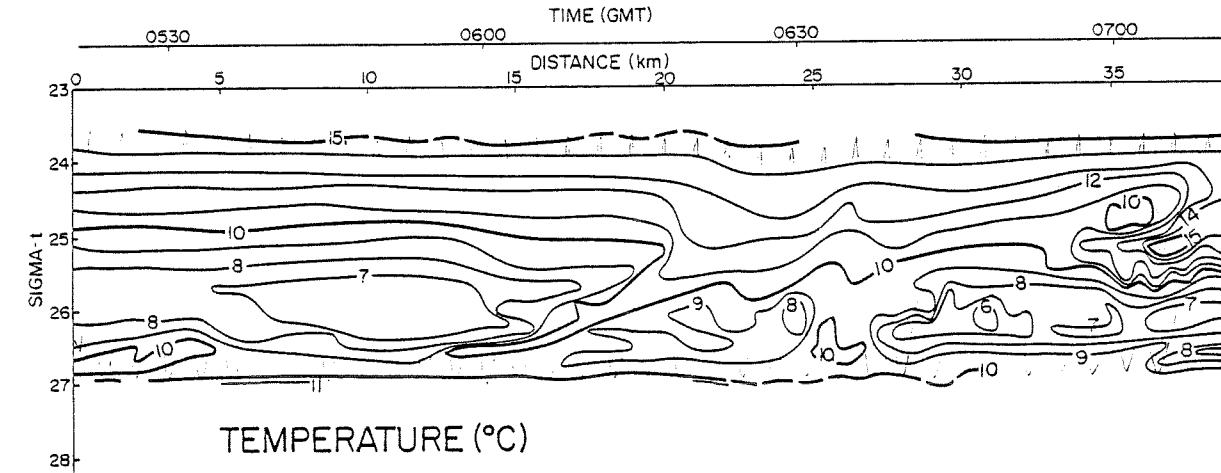
## CRUISE 77017 JULY 9, 1977



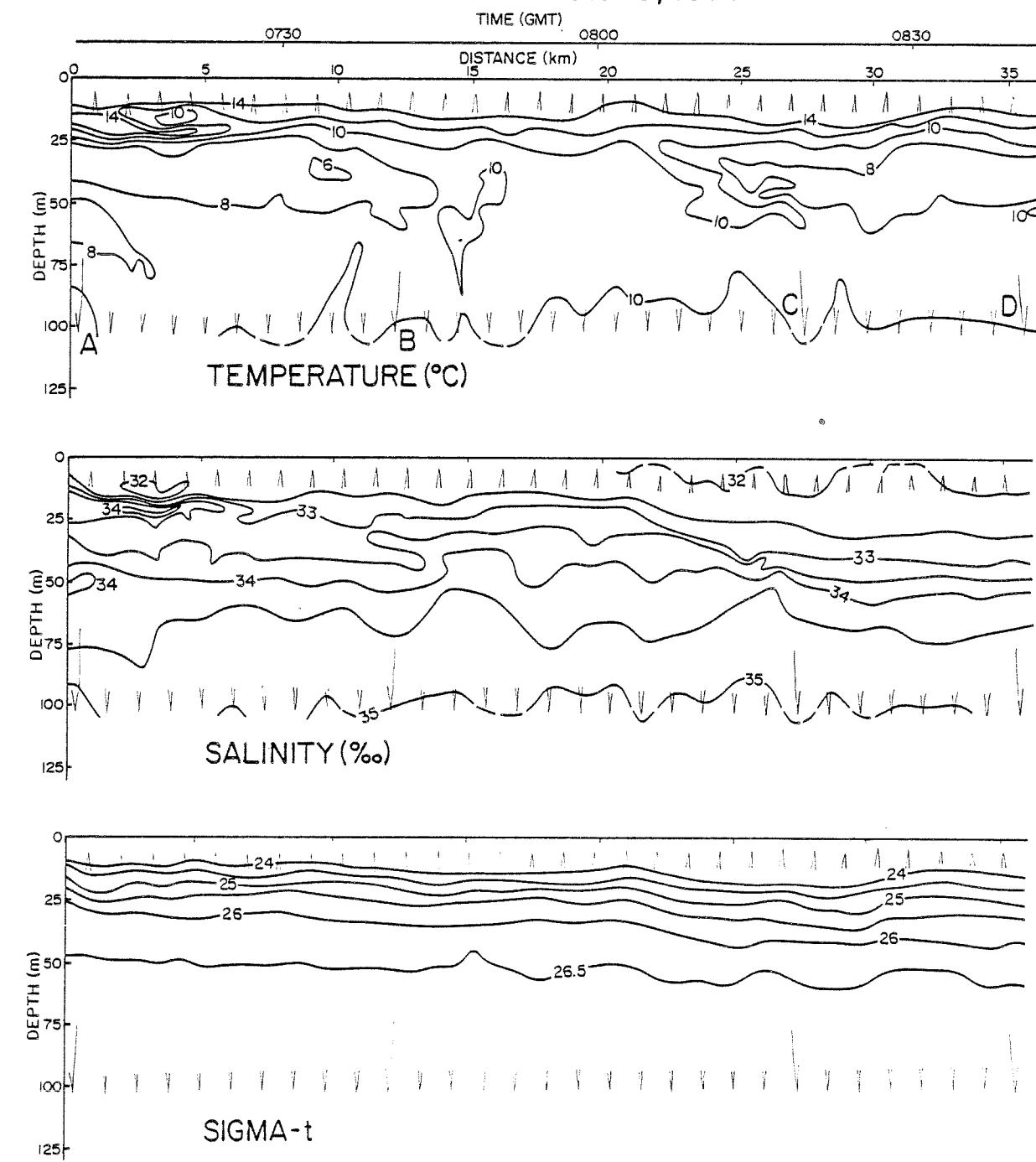
## CRUISE 77017 JULY 9, 1977



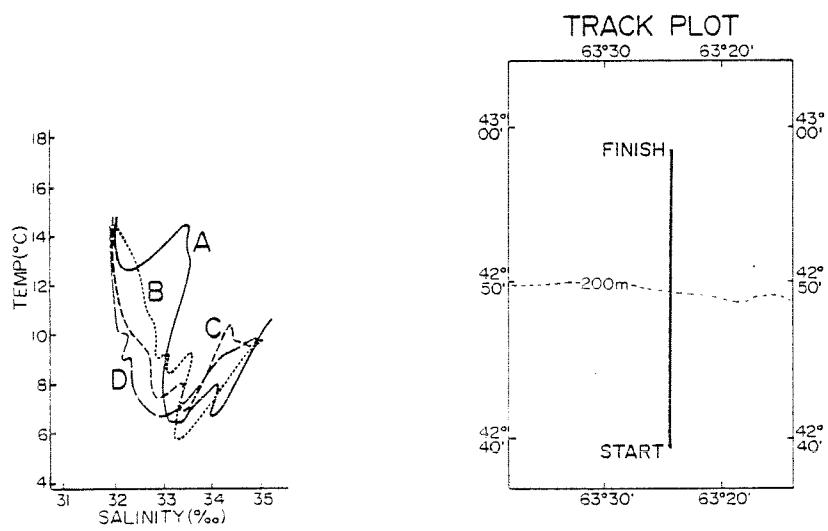
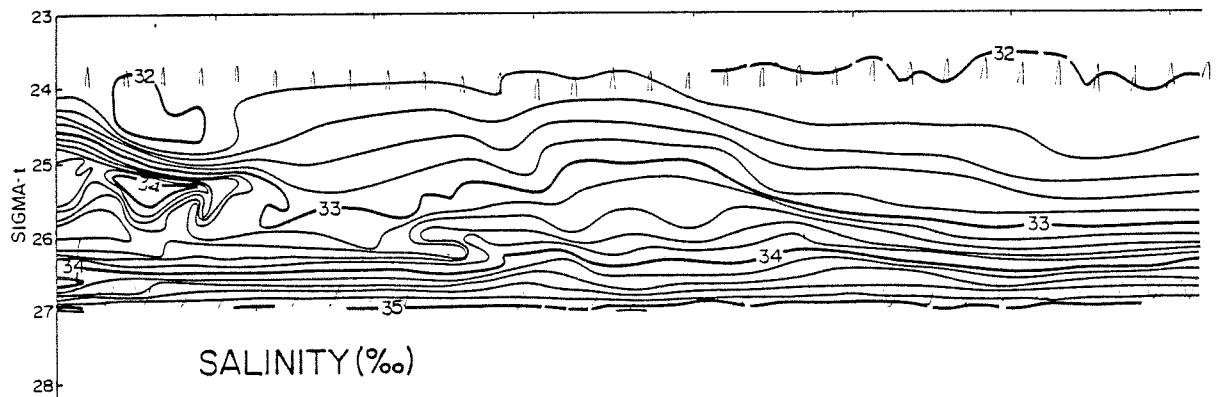
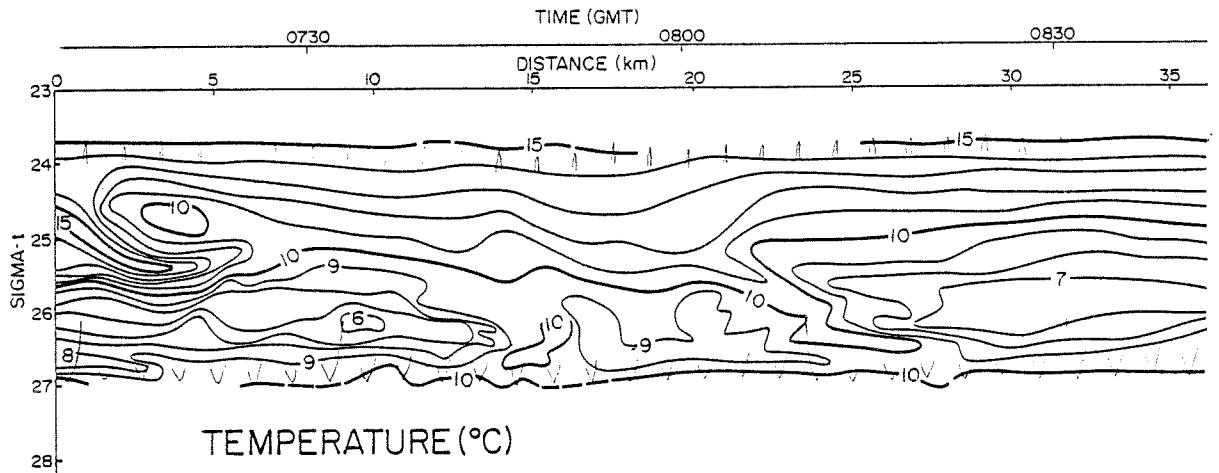
CRUISE 77017 JULY 9, 1977



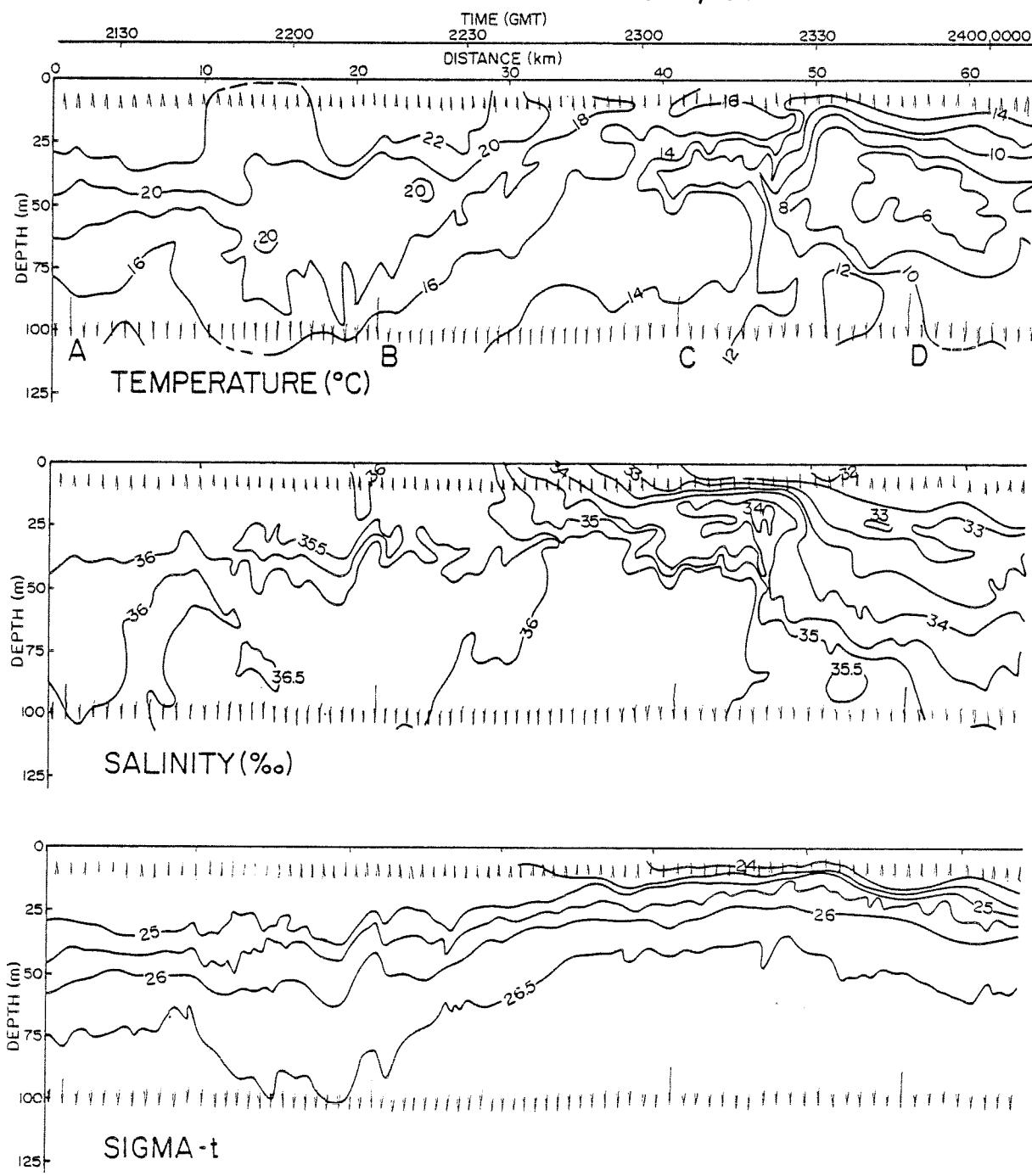
## CRUISE 77017 JULY 9, 1977



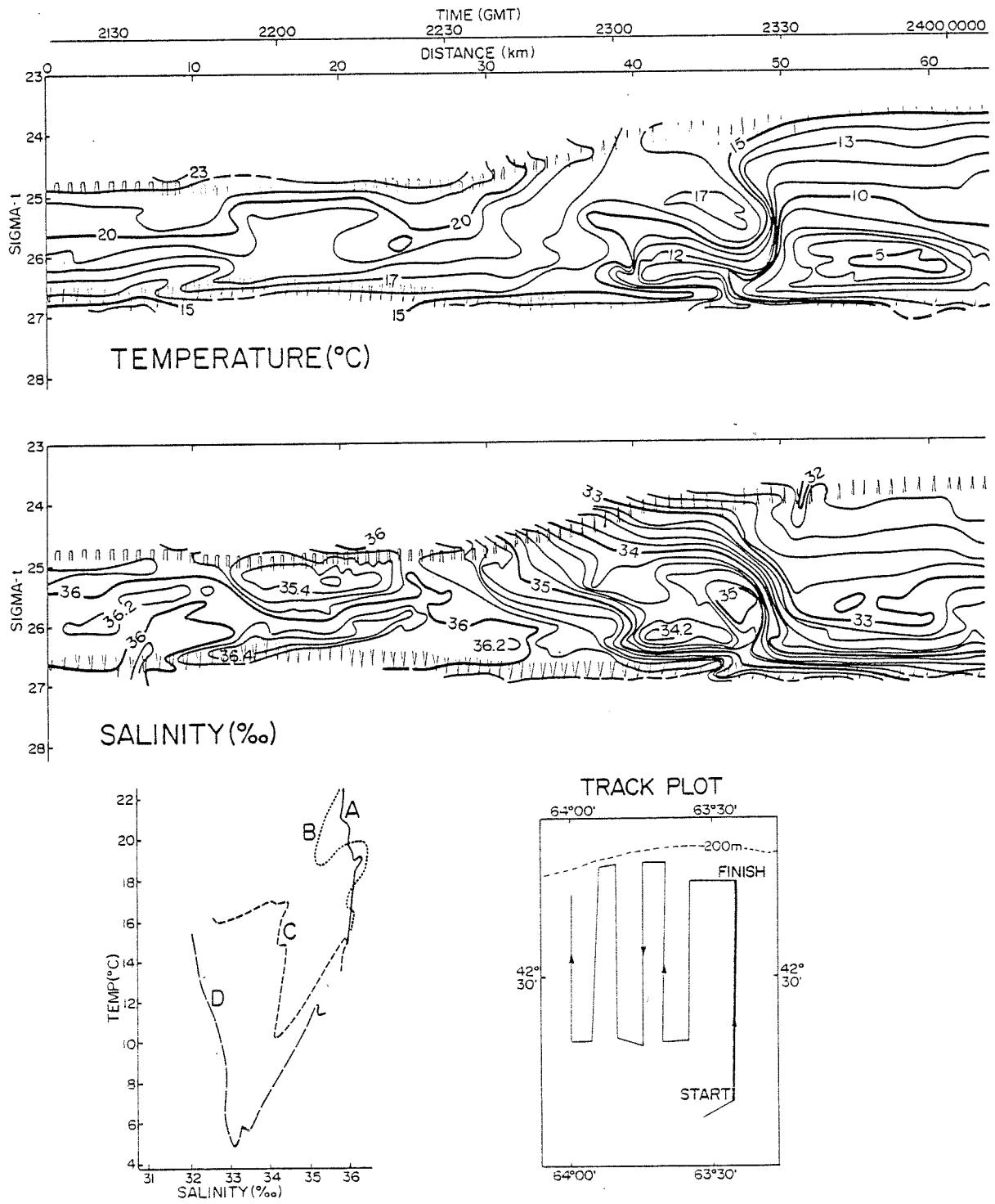
CRUISE 77017 JULY 9, 1977



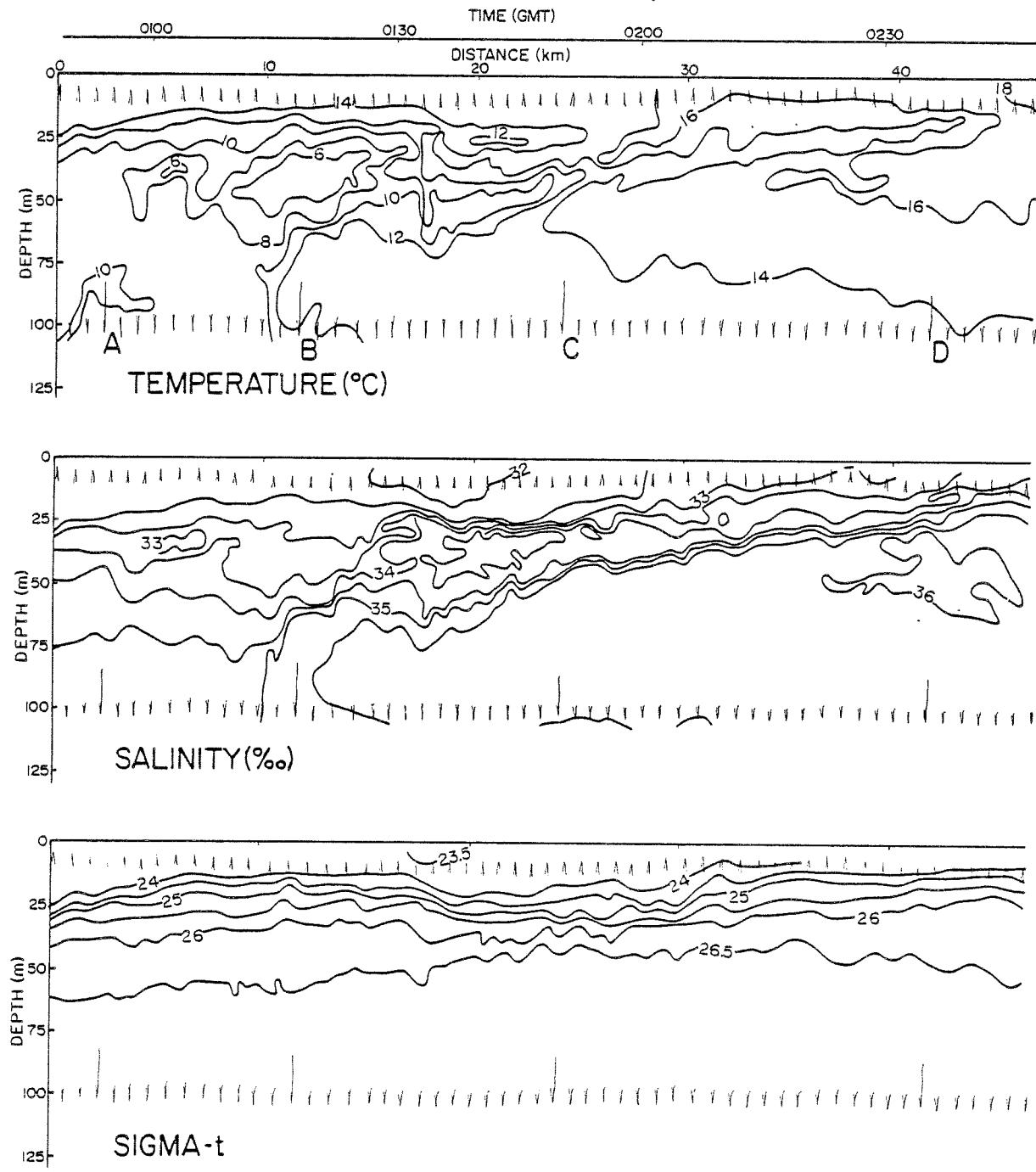
## CRUISE 77017 JULY 10-11, 1977



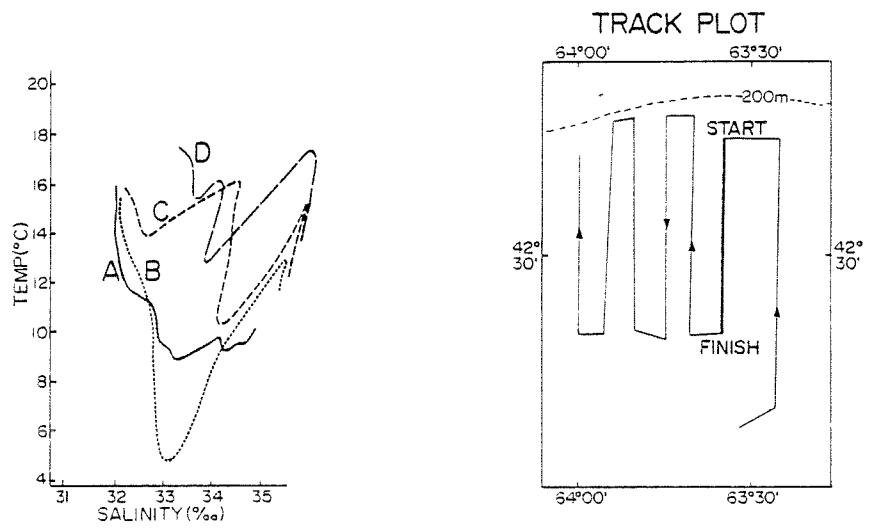
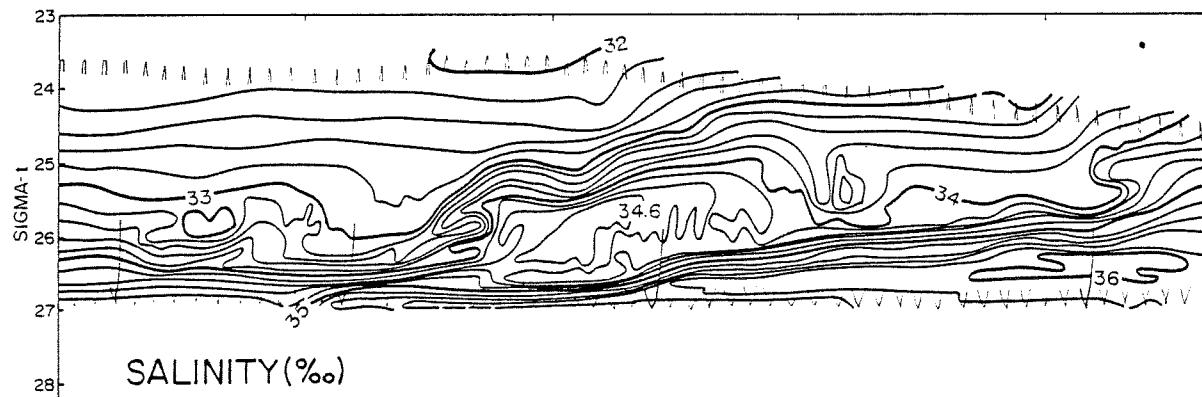
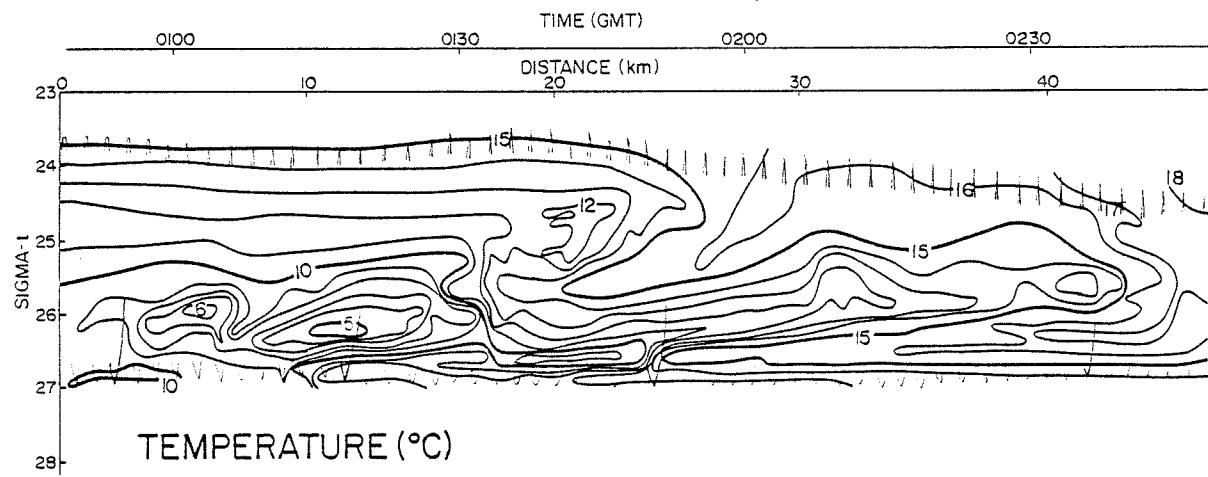
## CRUISE 77017 JULY 10-11, 1977



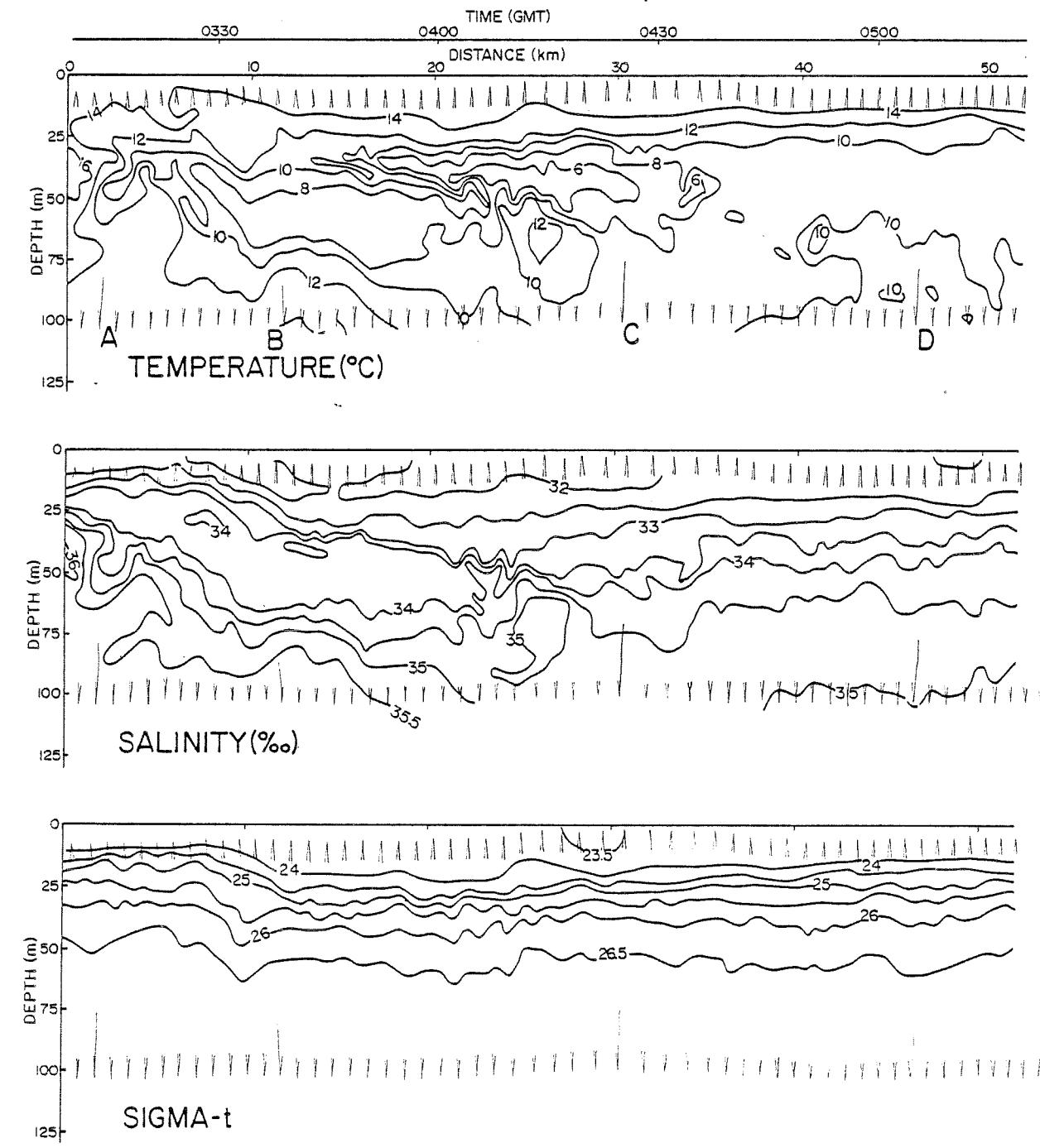
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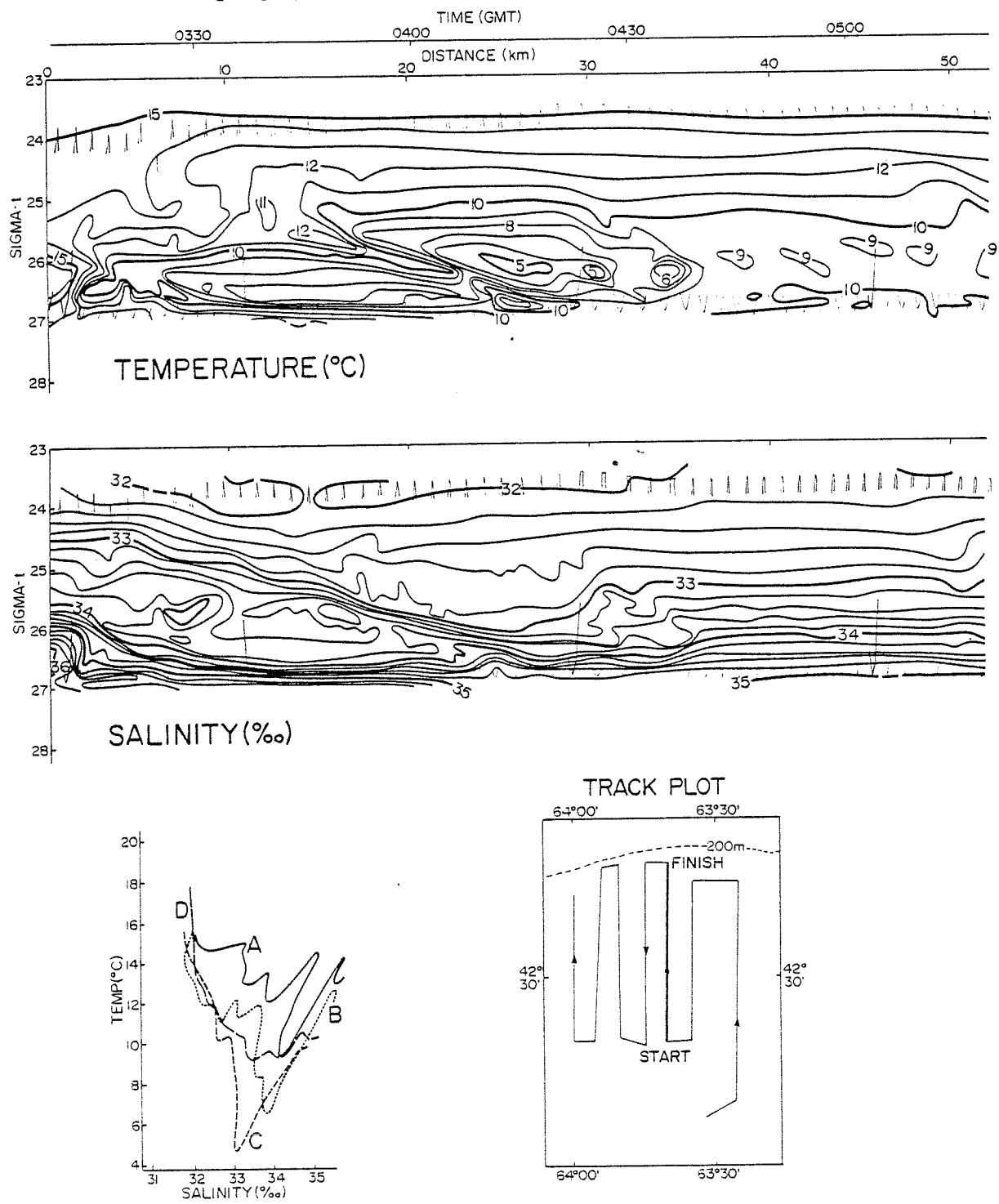
## CRUISE 77017 JULY 11, 1977



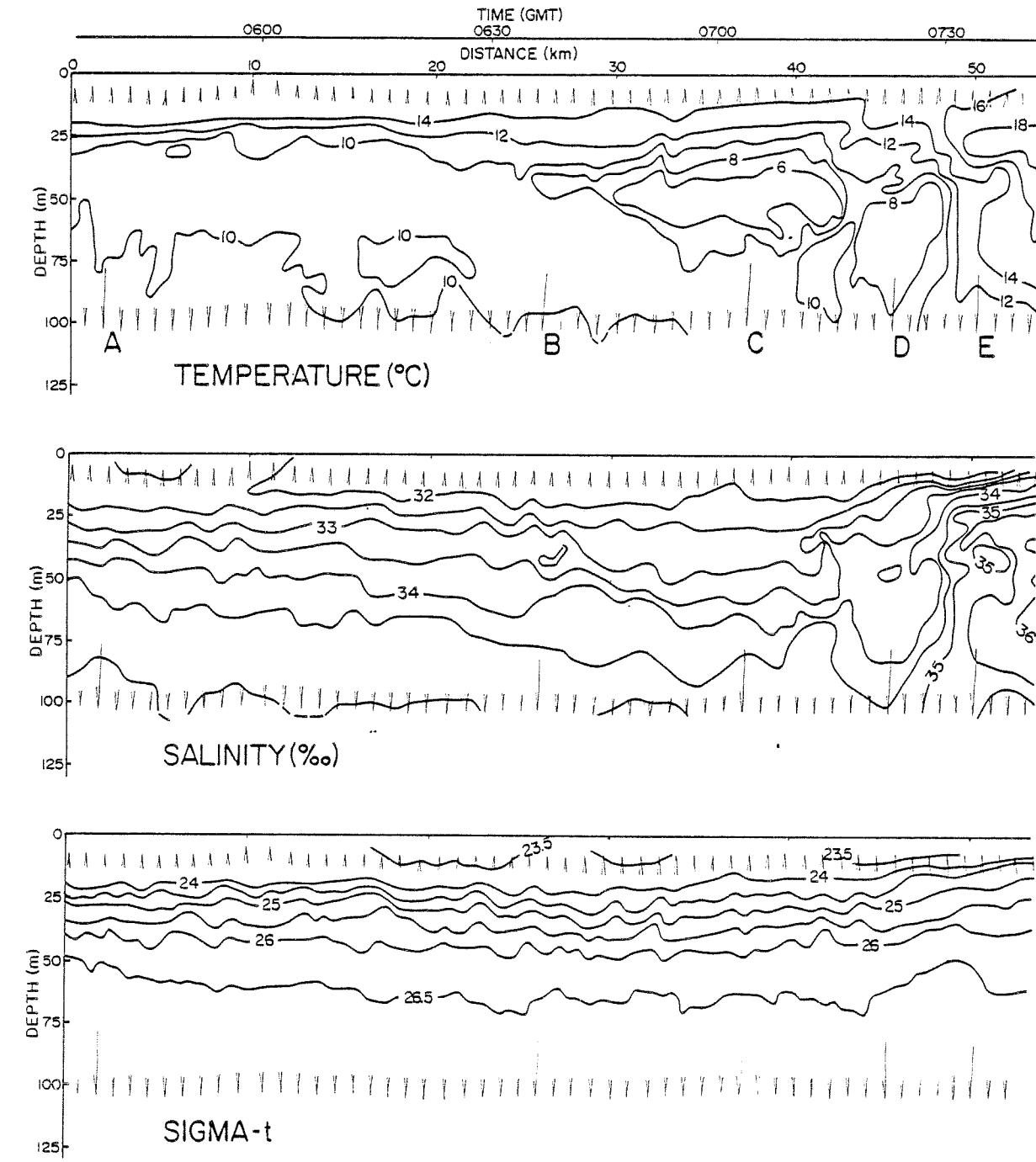
## CRUISE 77017 JULY 11, 1977



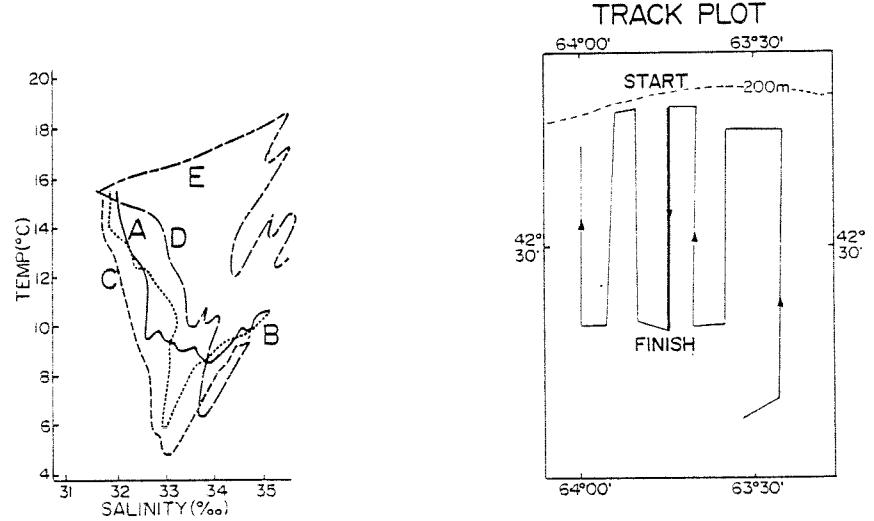
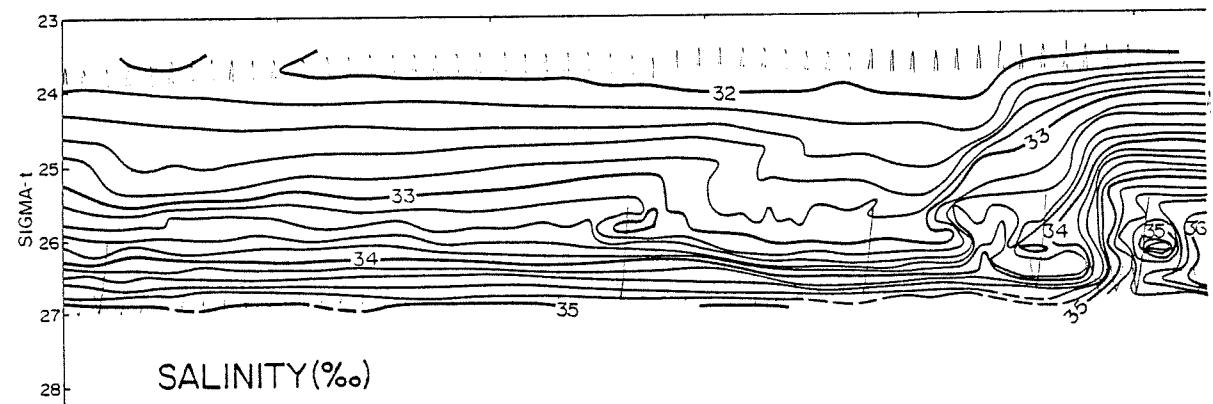
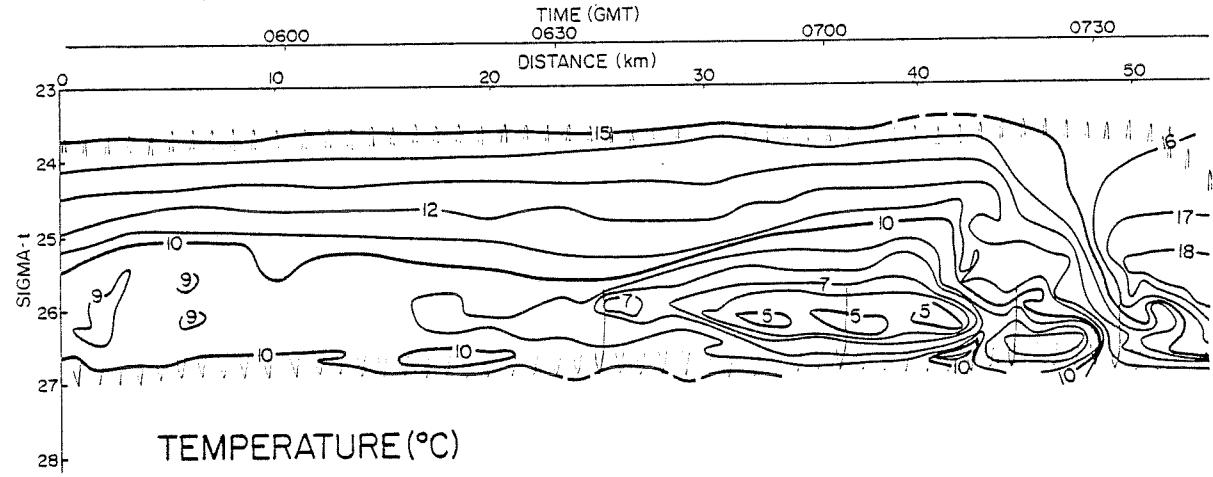
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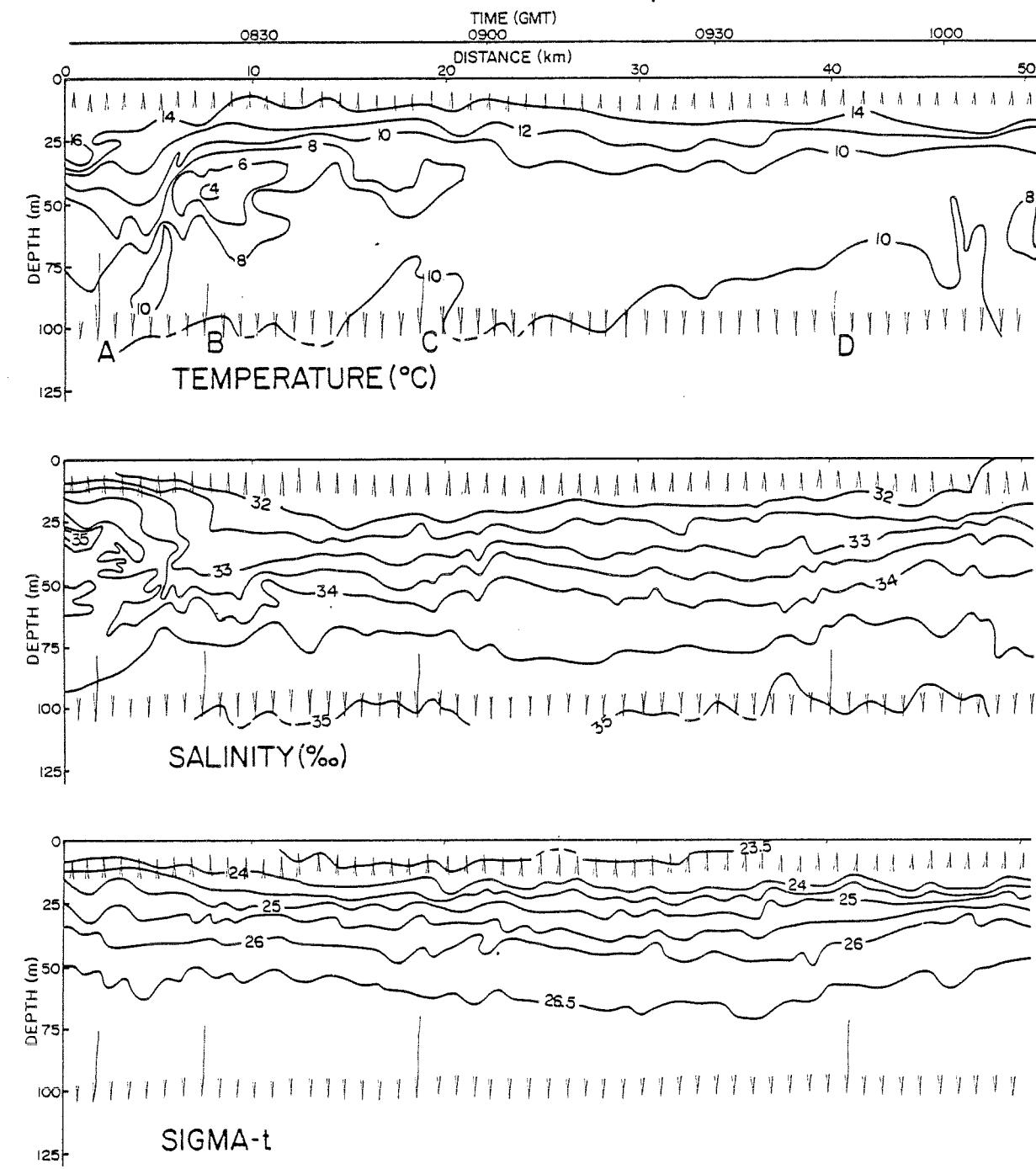
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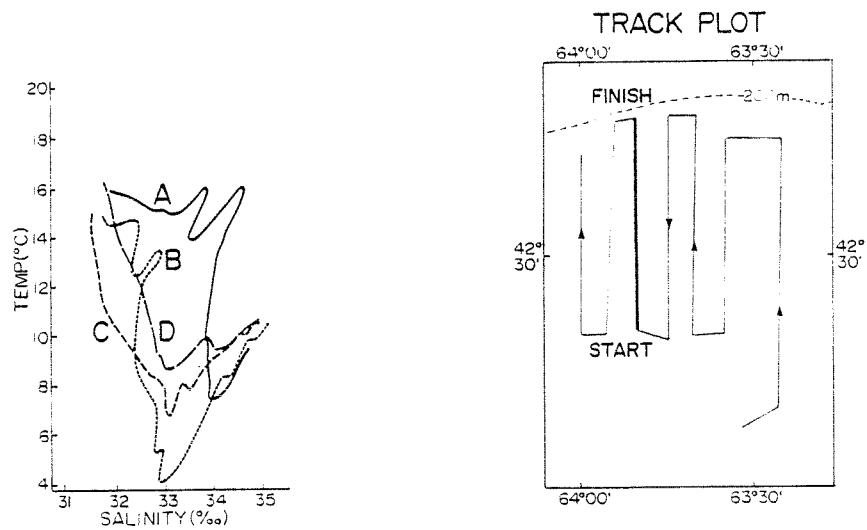
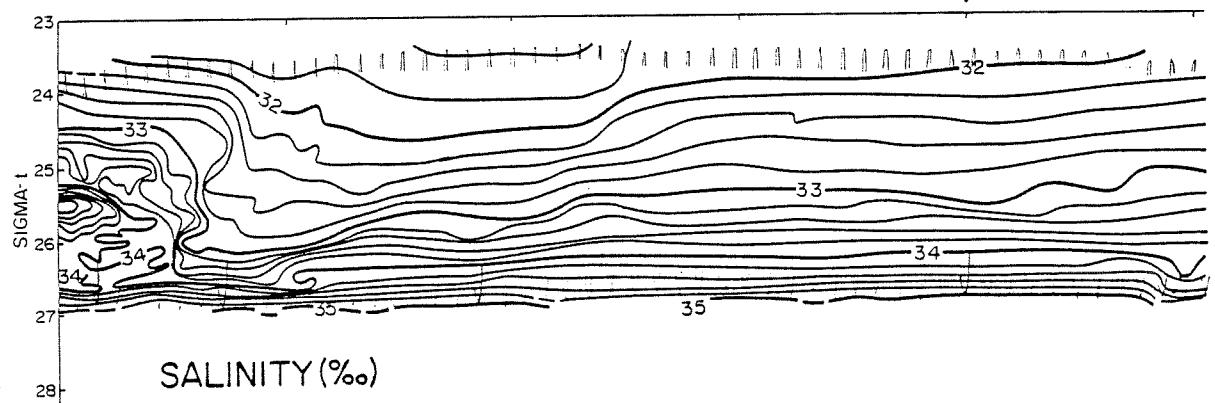
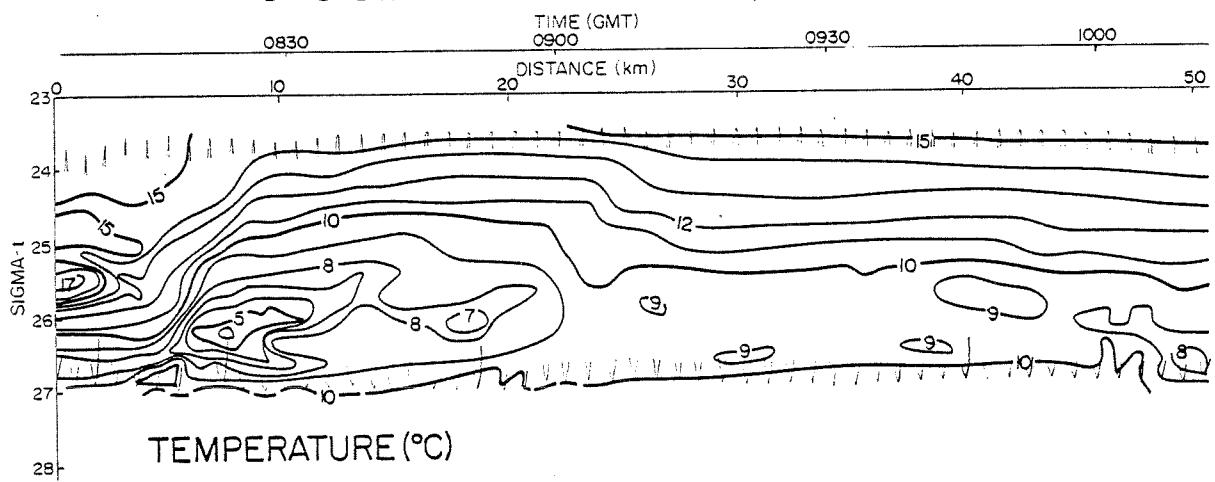
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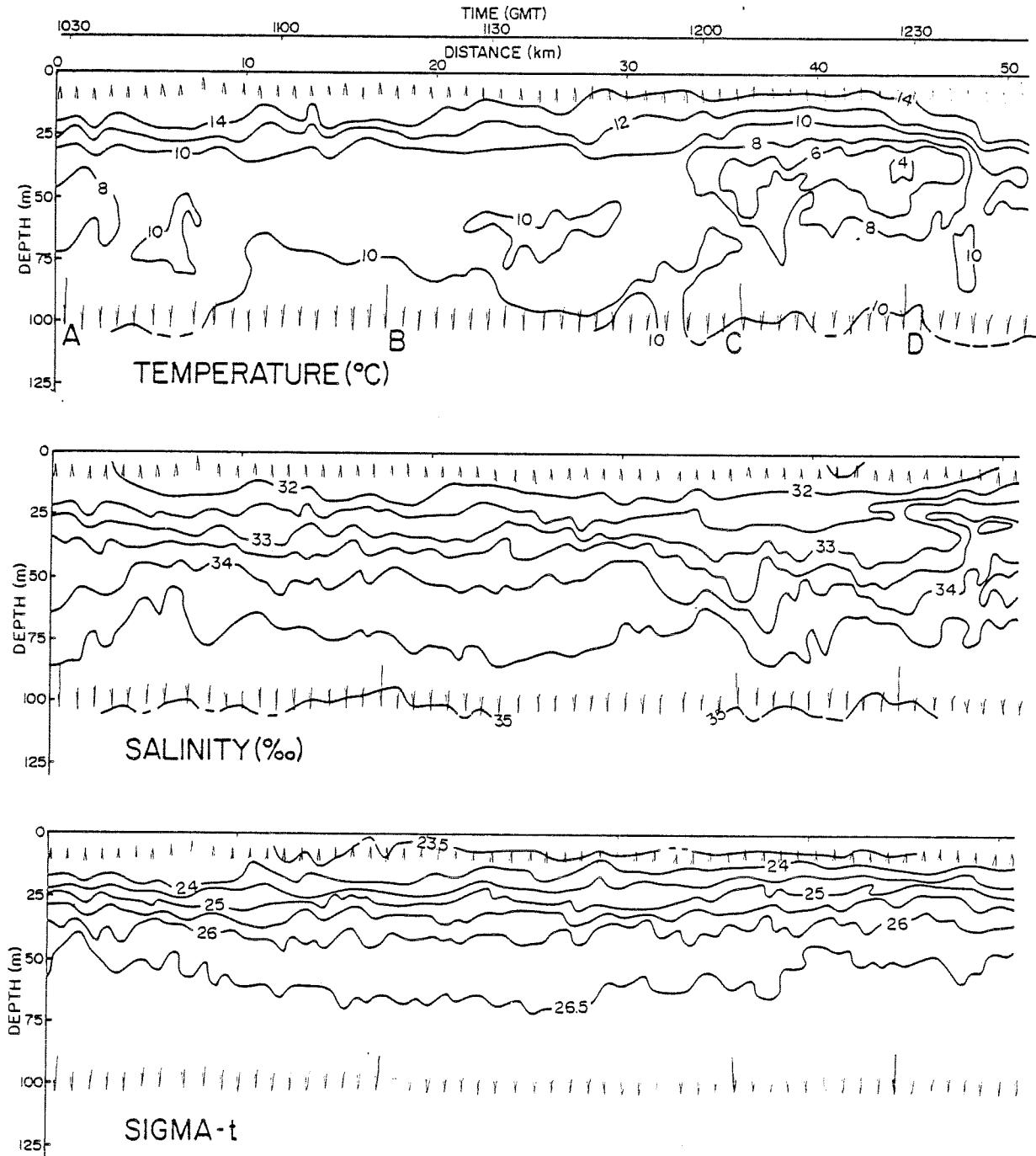
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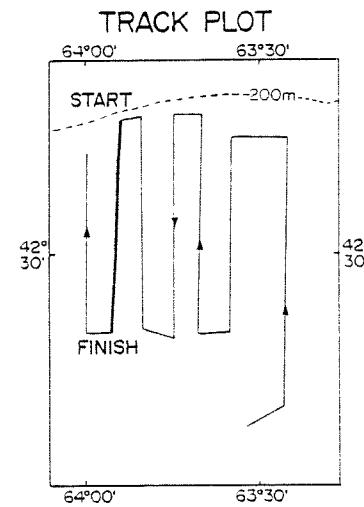
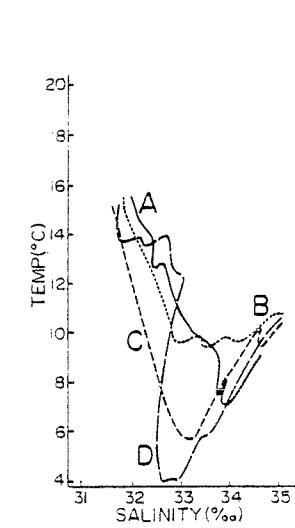
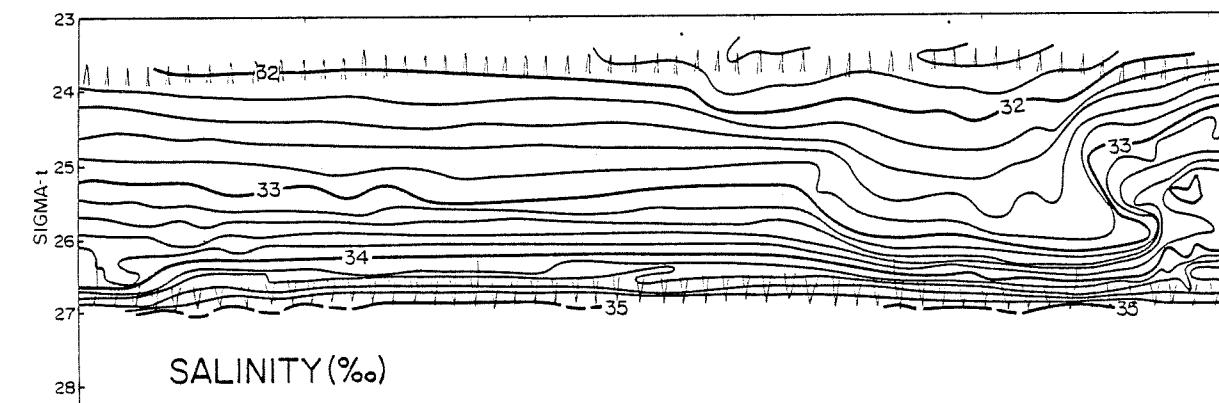
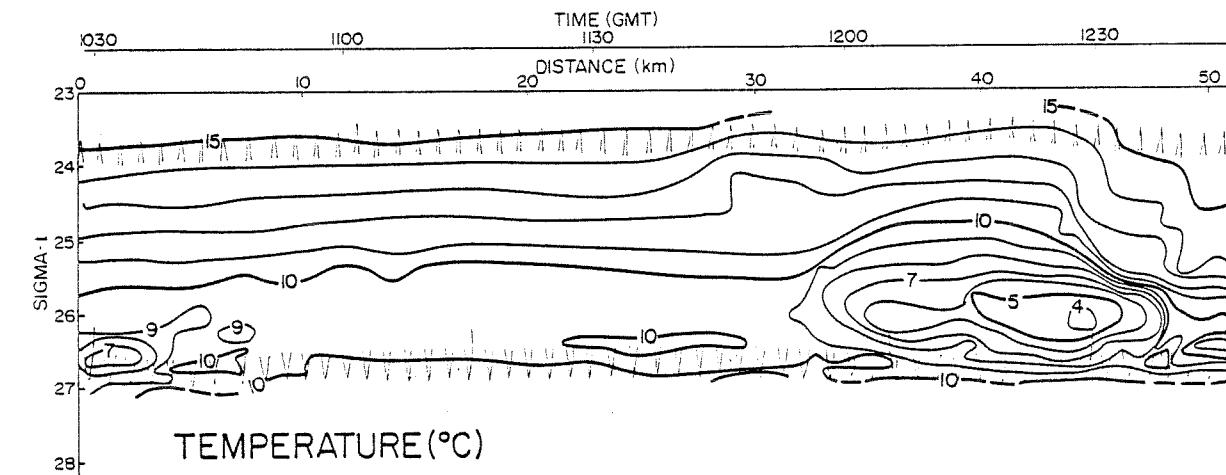
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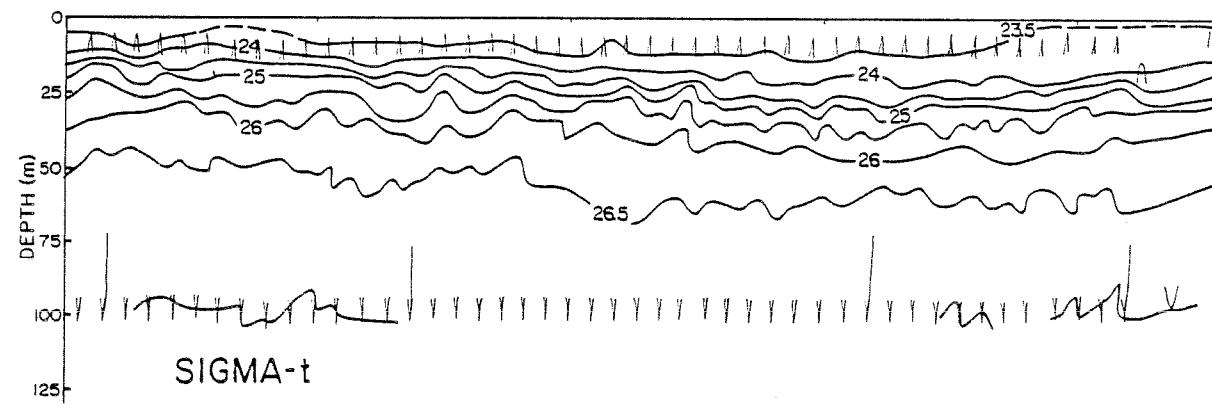
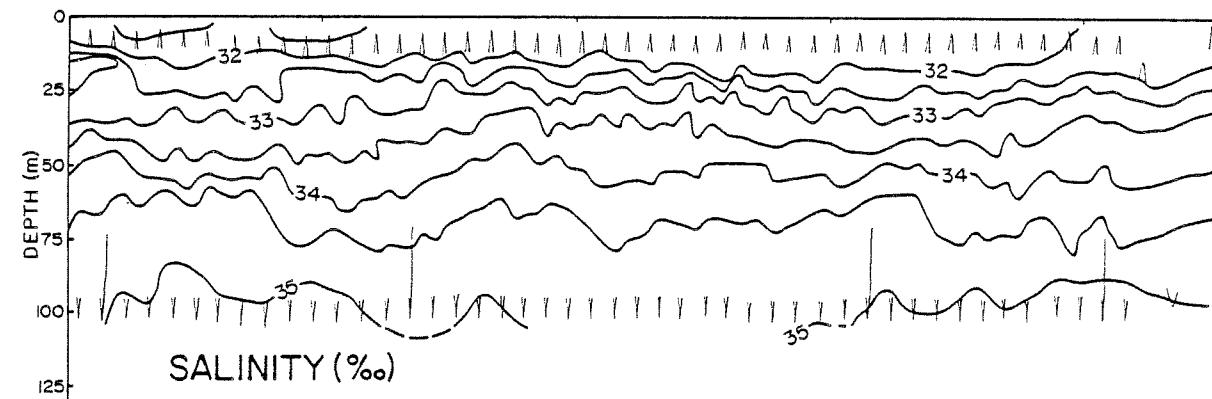
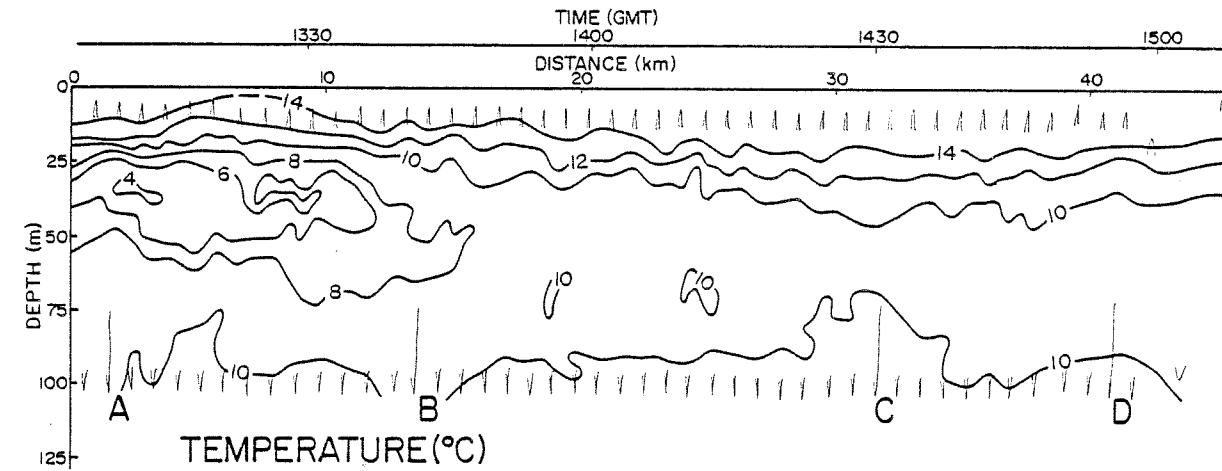
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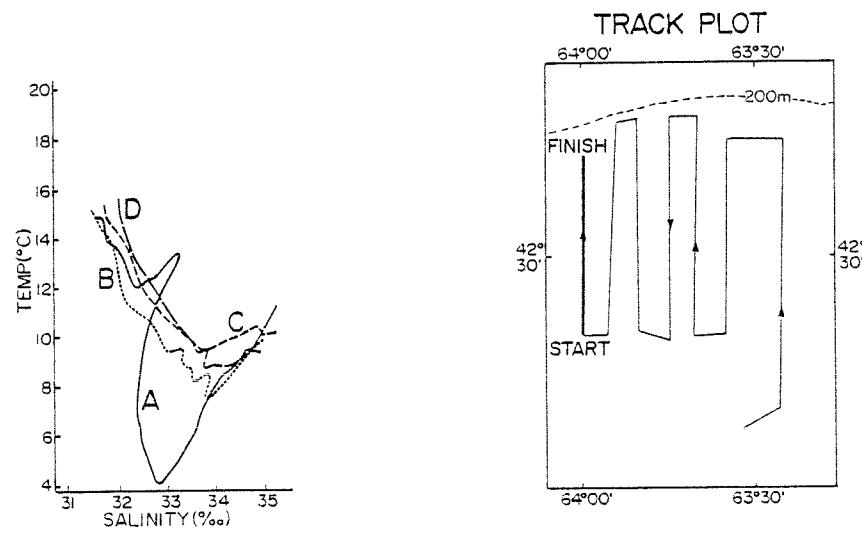
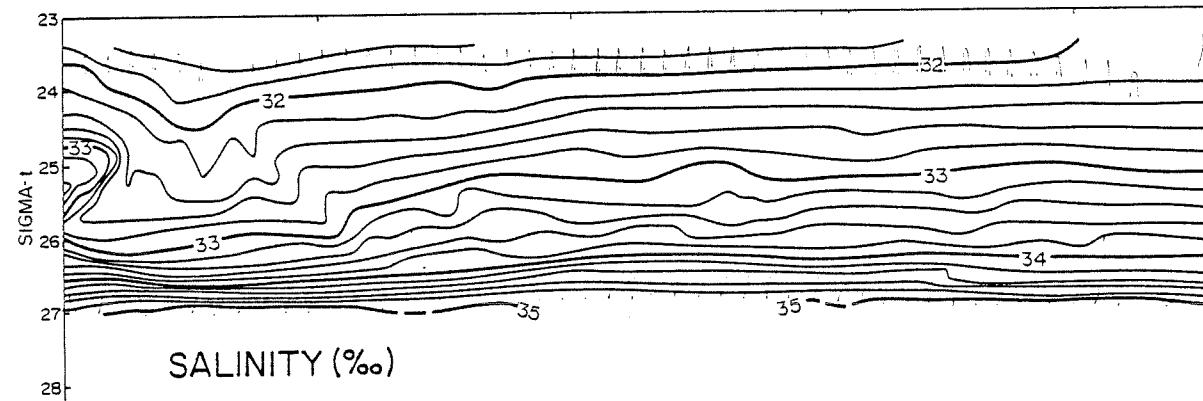
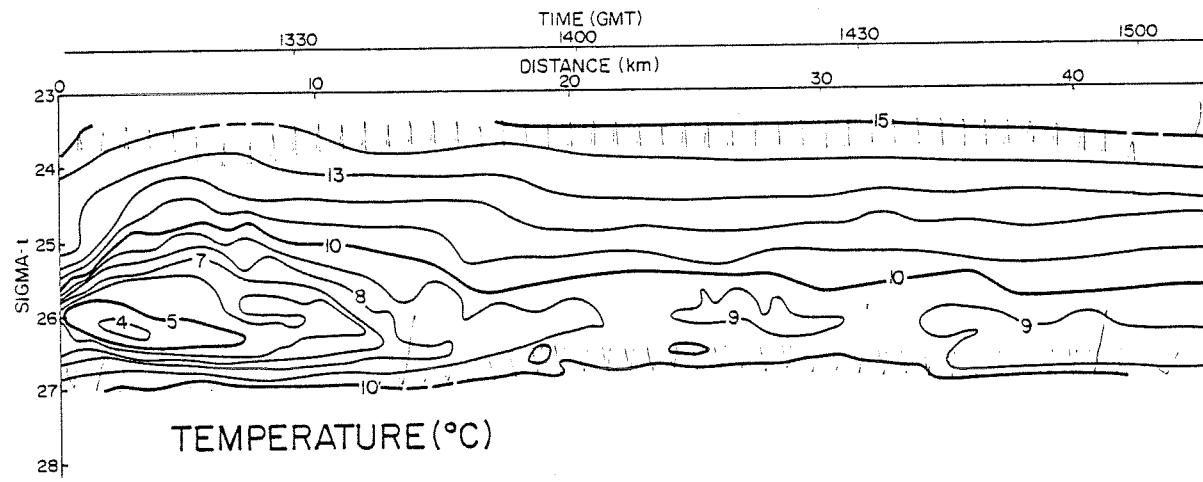
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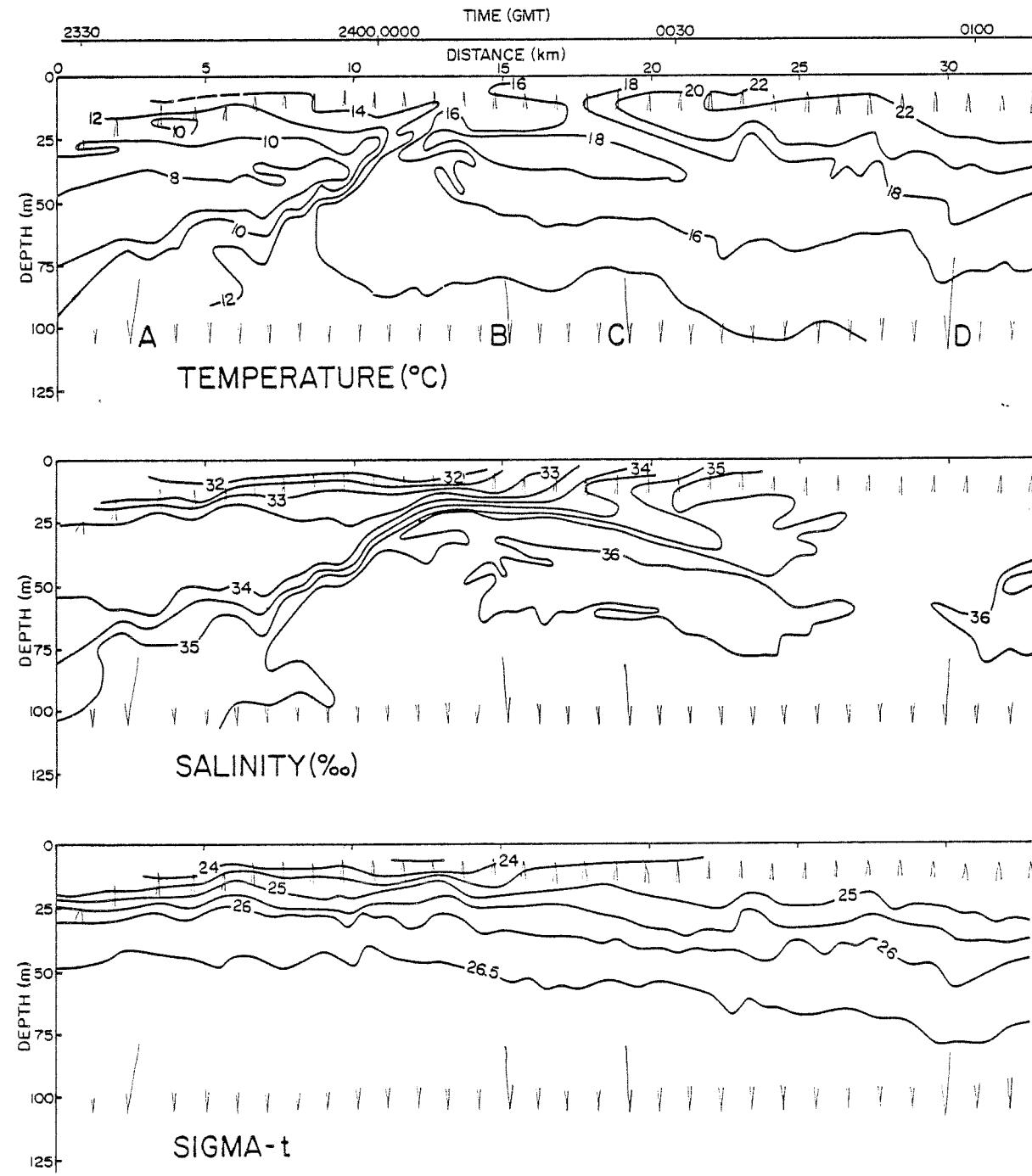
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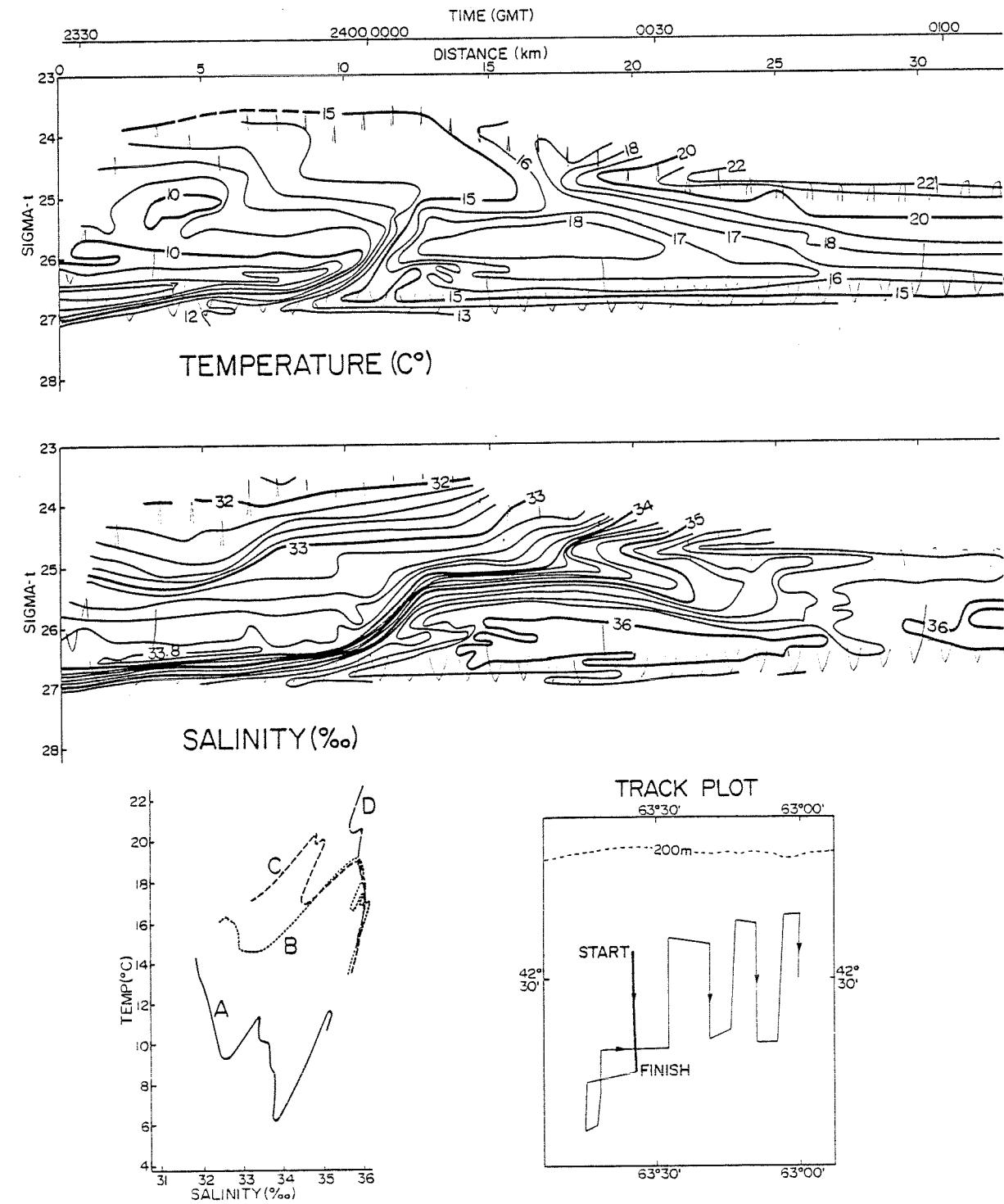
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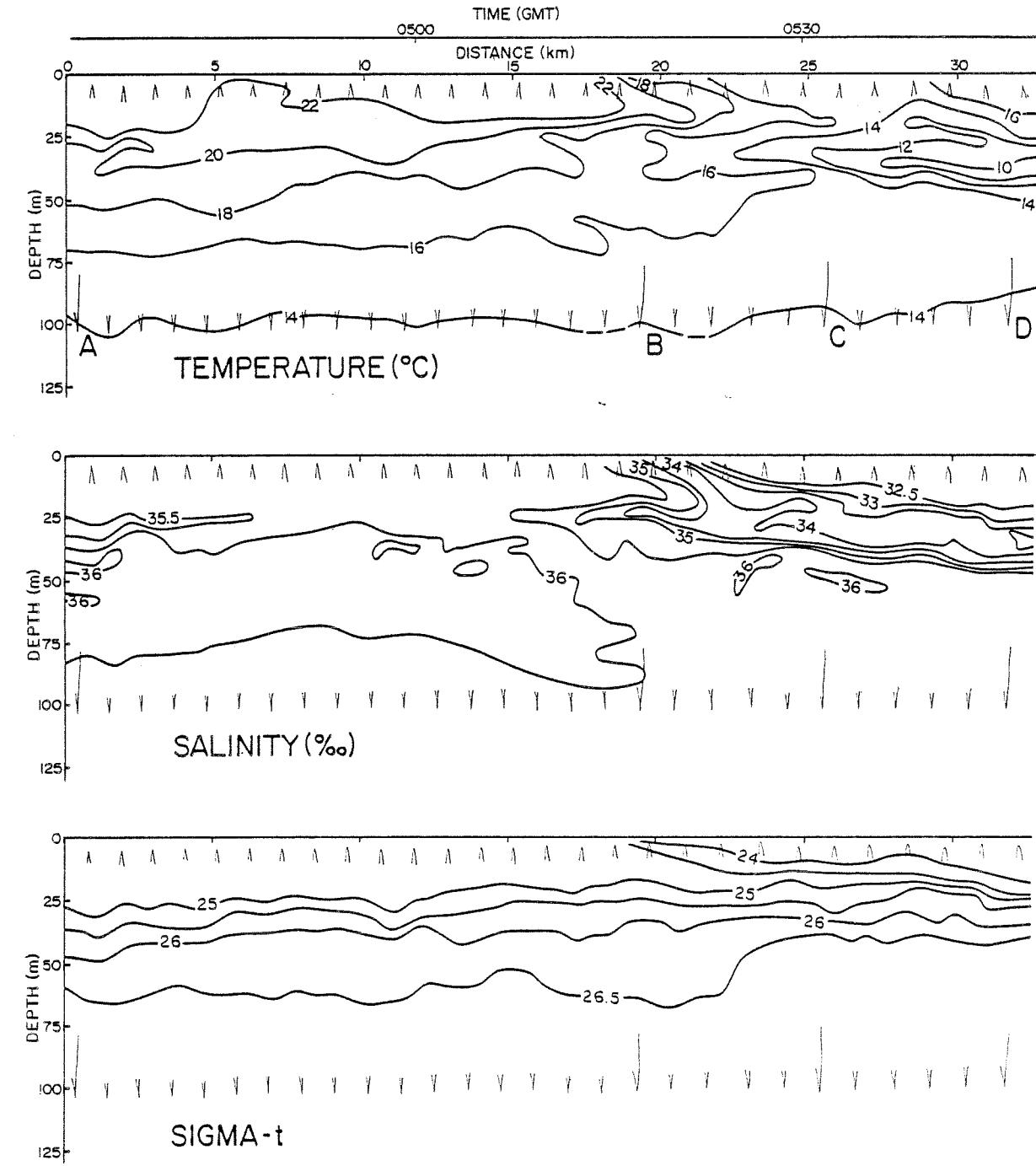
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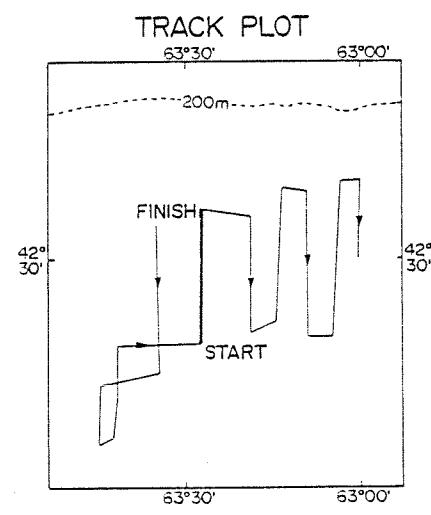
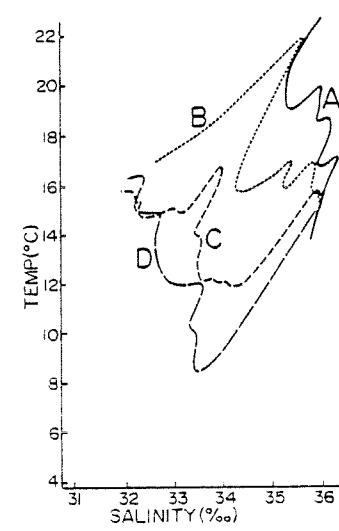
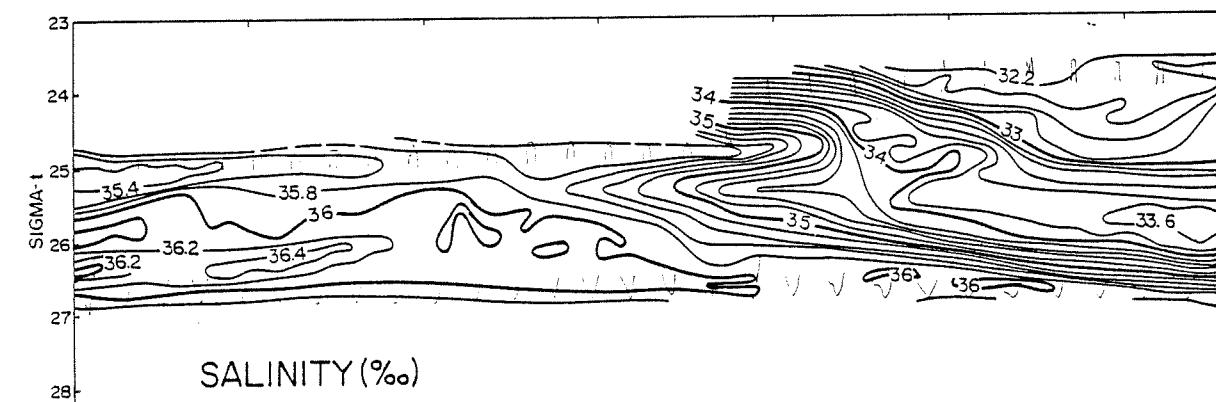
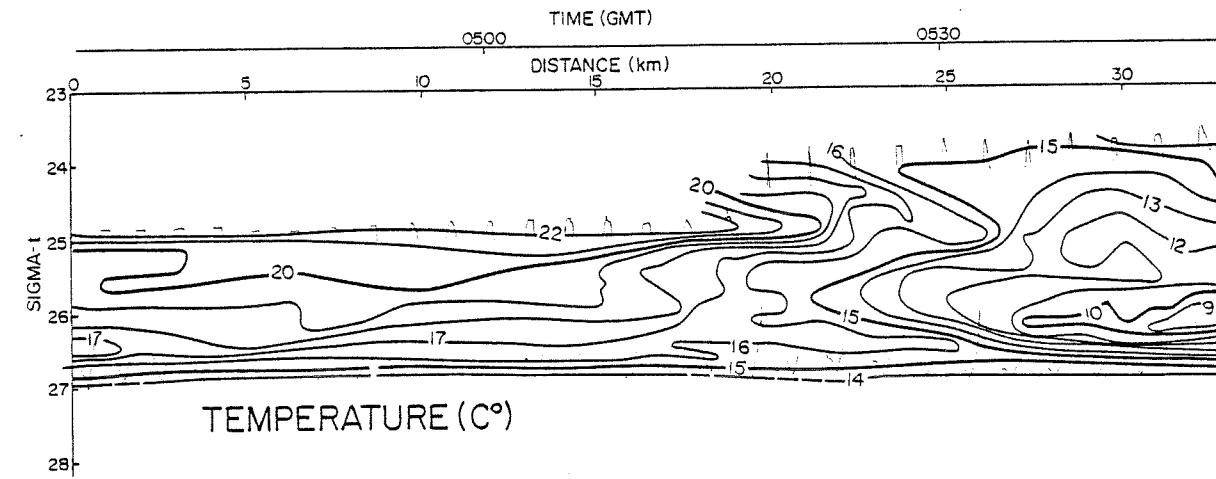
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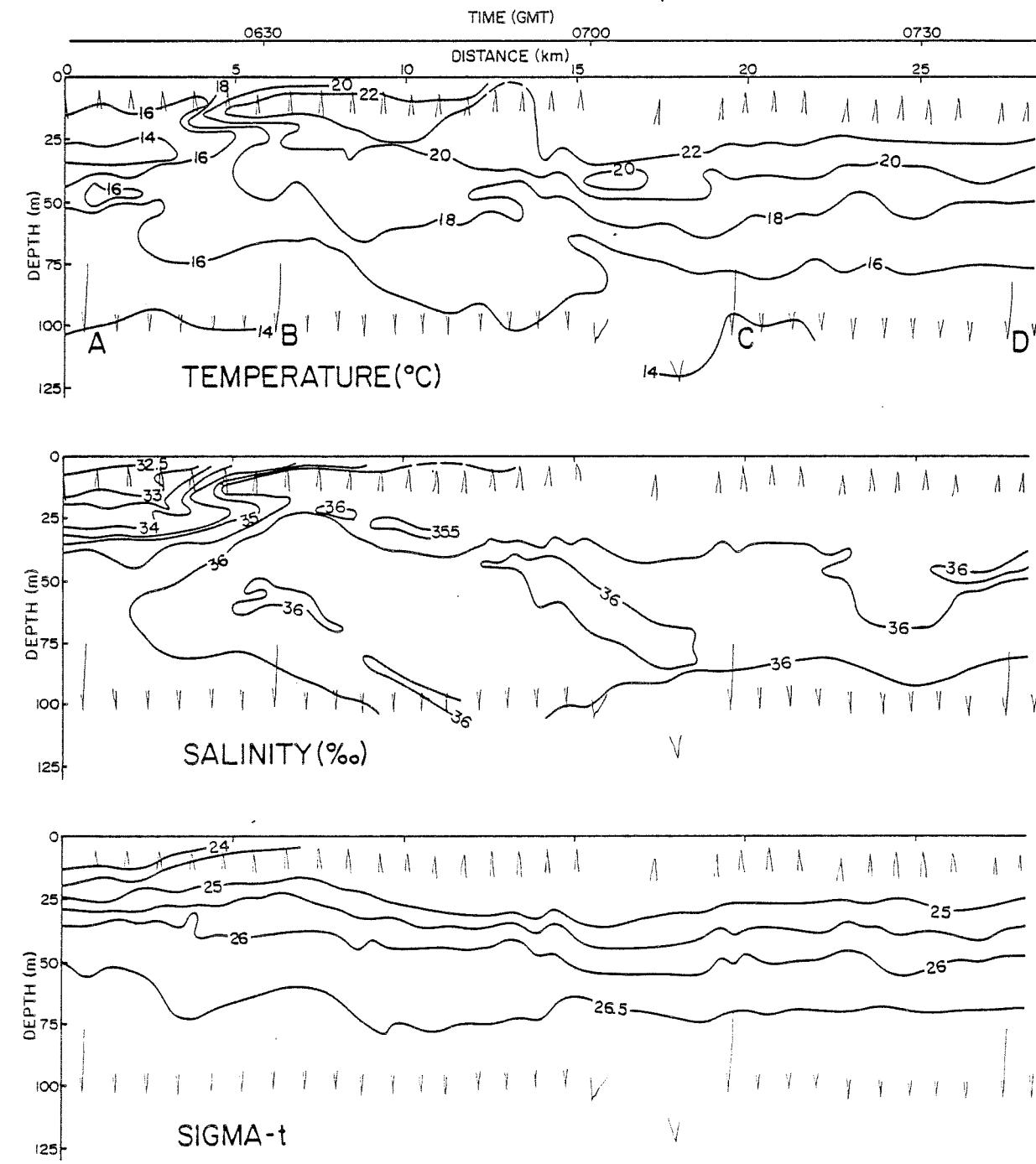
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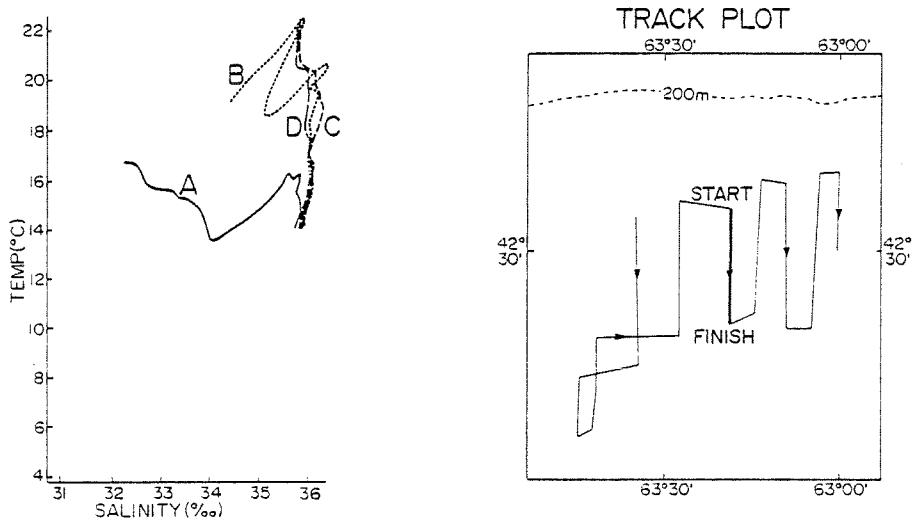
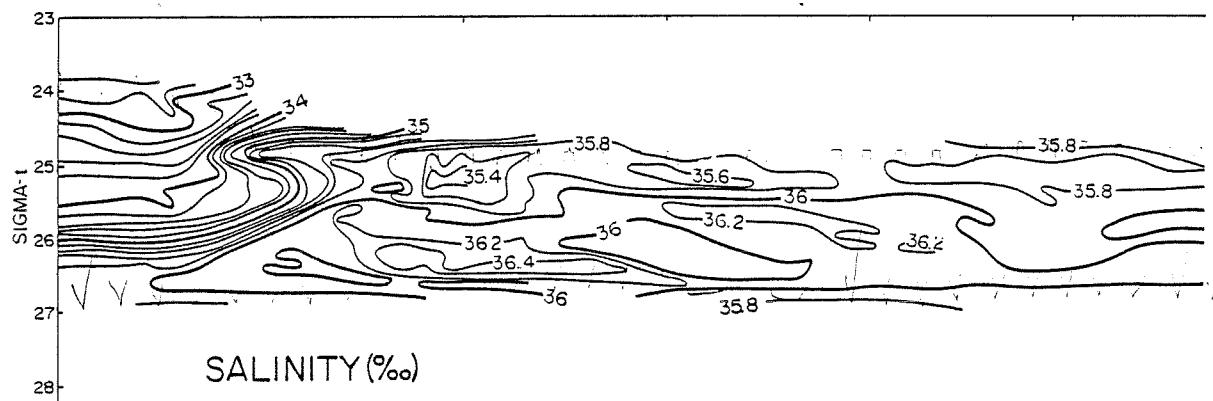
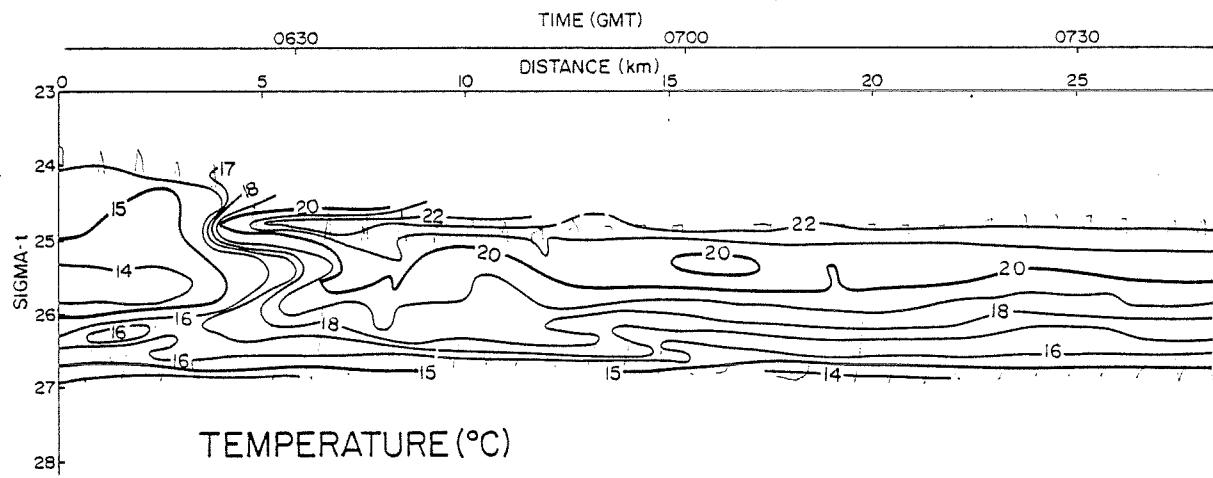
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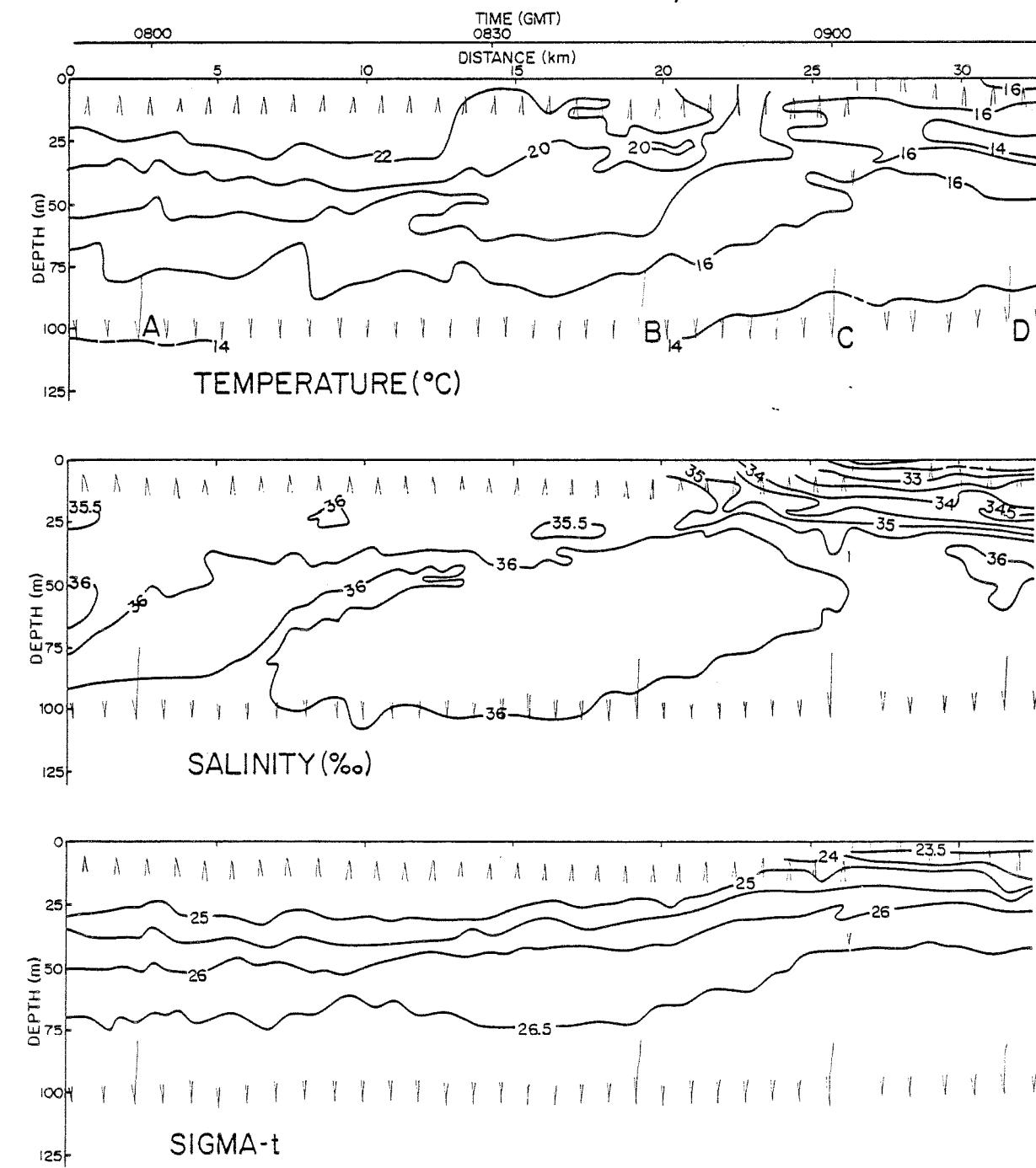
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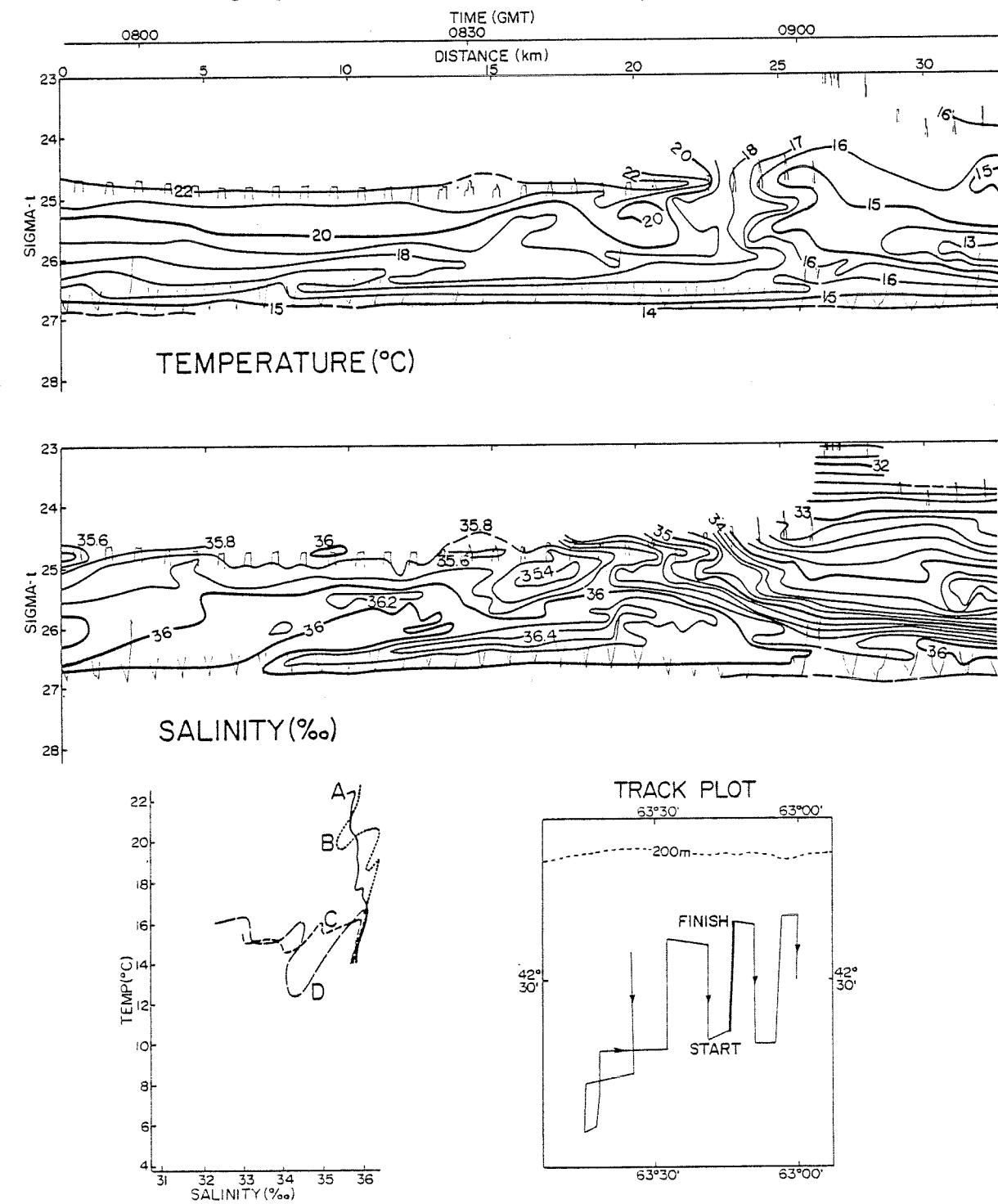
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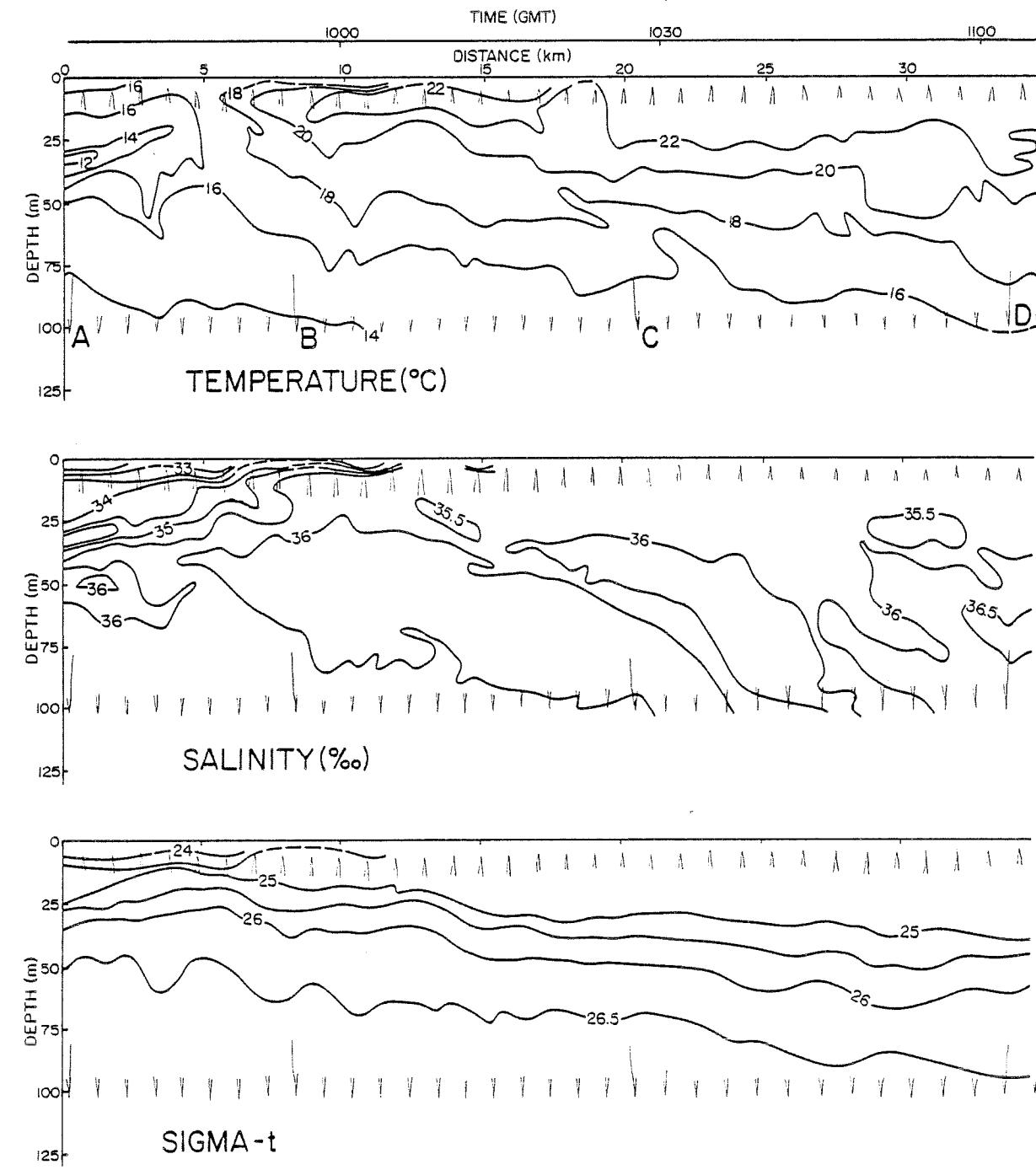
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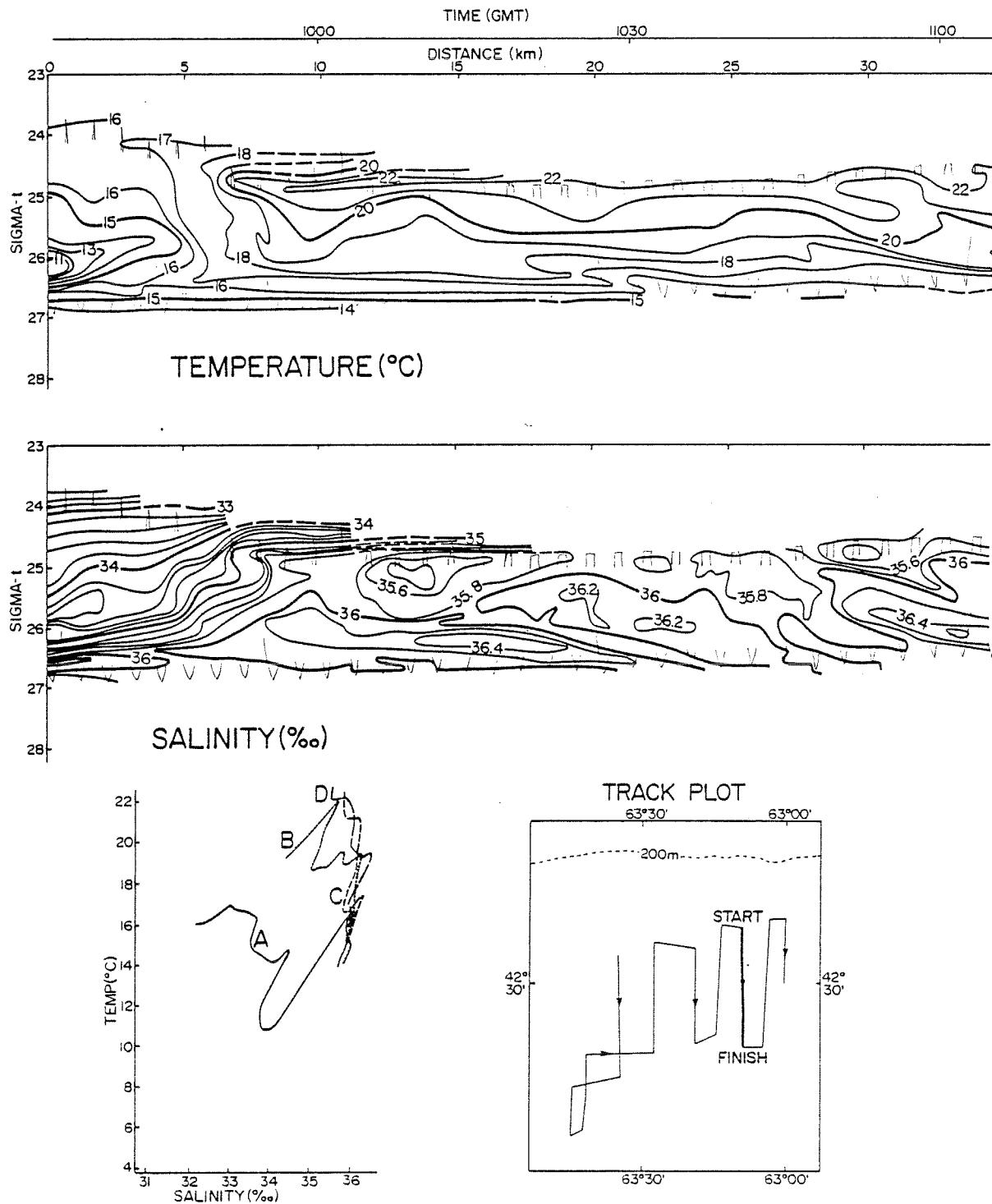
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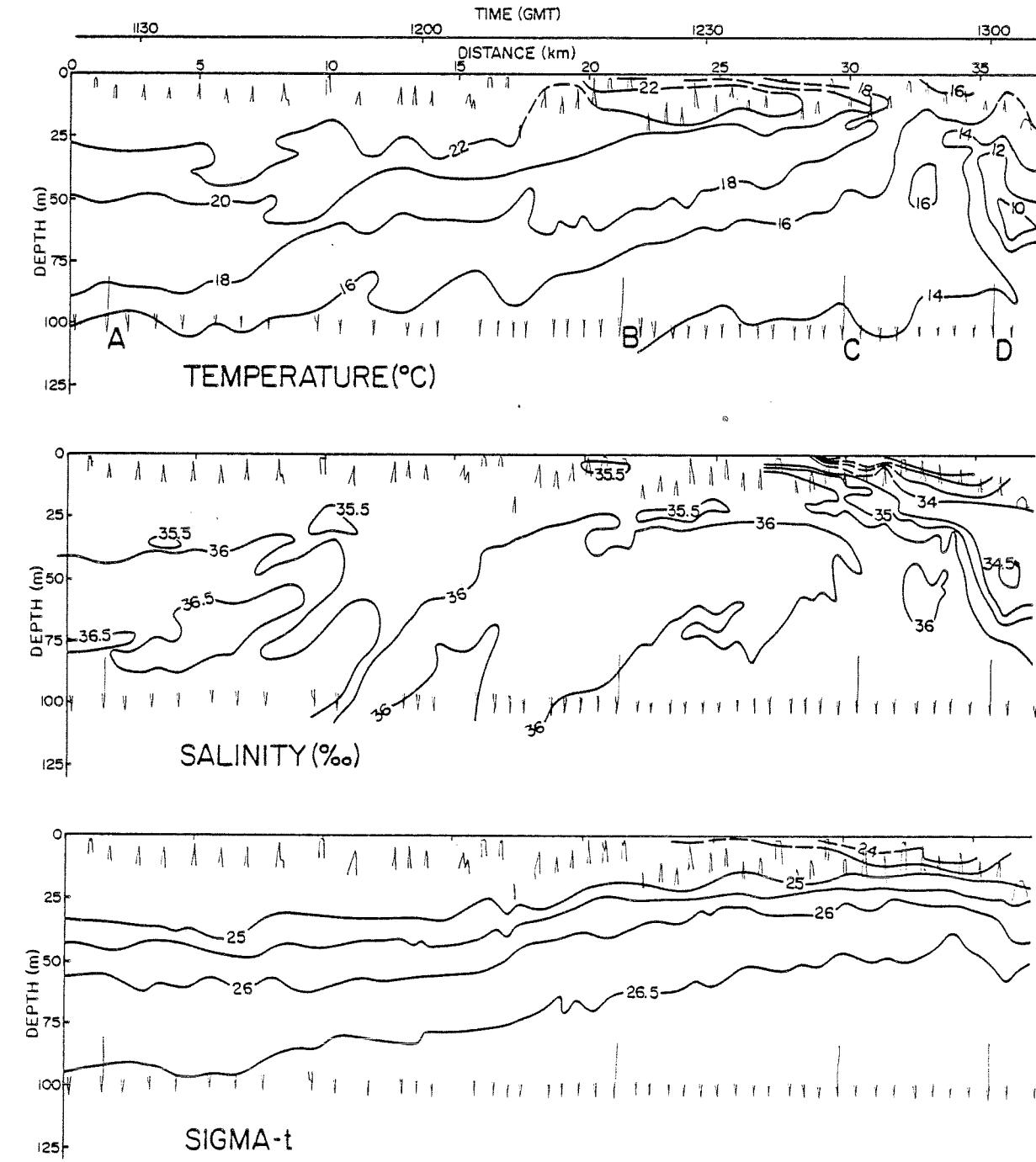
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## CRUISE 77017 JULY 12, 1977

