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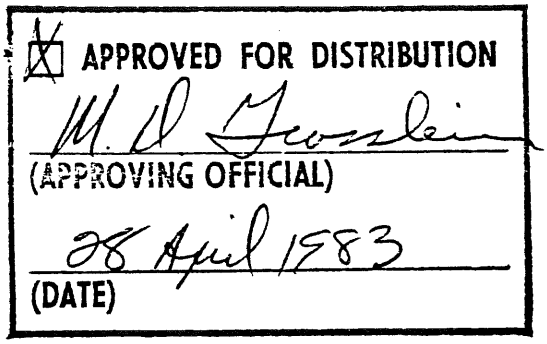
SURFACE AND BOTTOM TEMPERATURE AND BOTTOM SALINITY DISTRIBUTIONS ON THE CONTINENTAL SHELF, CAPE HATTERAS TO CAPE SABLE FROM MARMAP CRUISES, 1977-1982

by

Samuel R. Nickerson and David G. Mountain



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INTRODUCTION

This report presents surface temperature and bottom temperature and salinity distributions observed on twenty five cruises between 1977 and 1982 (see Table 1). These cruises were part of the Marine Resource Monitoring and Assessment Program (MARMAP) conducted by the Northeast Fisheries Center of the National Marine Fisheries Service. Sherman (1980) gives a full description of the MARMAP program. The area of observations extended over the continental shelf from Cape Hatteras to Nova Scotia (Figure 1), although complete coverage was not made on all cruises due to time and weather limitations. Generally the area was covered from south to north over a period of approximately six weeks.

Sampling on these cruises was done using Niskin bottles with reversing thermometers for hydrographic and chemical data and by bongo net tows for zooplankton and ichthyoplankton data. Chlorophyll and primary production measurements were also made on many of the cruises. This report complements reports by Patanjo et al. (1982) and Evans et al. (1979) which contain the hydrographic and chlorophyll data for eight cruises from 1977 to 1979.

Similar surface and bottom distributions from data obtained on spring and fall bottom trawl survey cruises for the period 1972-1979 were presented by Pawlowski et al. (1978) and by Wright and Nickerson (1980).

METHODS

Temperature values were obtained by deep-sea reversing thermometers mounted on Niskin bottles during routine hydrographic sampling. Surface temperature values were obtained from the shallowest bottle which was located as close to the surface as conditions permitted. Bottom temperatures used here were obtained from the deepest bottle, generally within 10 m of the bottom to a maximum depth of 300 m. Bottom salinity samples were drawn from the same bottle or from a separate bottom-trip bottle used in water depths of less than 75 m. The salinity samples were analyzed after each cruise using a Guildline AutoSal salinometer which has an accuracy of better than 0.01%.

DATA

The data are presented chronologically by cruise. The temperature distributions are contoured with a 1.0°C interval and the salinity with a 0.5°/oo interval. Although the specific values change from year to year a consistent annual cycle is evident throughout the area of coverage in all years.

Surface Temperature - The distributions indicate that in late winter (January-February) the surface temperatures are at their annual minimum. Nearshore values range from 2°C in the north to about 6°C in the south. The temperatures gradually increase across the shelf to values above 10°C at the outer edge

showing the influence of the Slope Water found further offshore. By April, the onset of spring warming has occurred with 6-8°C temperatures in the Gulf of Maine and up to 10°C across the southern parts of the shelf. Warming continues through the summer with maximum temperatures in August and September. The maximum values range from the mid-twenties over the southern parts of the shelf, to 18-20°C in the Middle Atlantic Bight and to 14-18°C in the Gulf of Maine and on Georges Bank. Cooling begins in the fall and the surface temperatures decrease to their winter minimum values as the annual cycle is completed.

Bottom Temperature - The bottom temperature distribution exhibits a seasonal cycle that has different characteristics in different areas. The range in values is considerably smaller than for the surface temperatures. In the deep Gulf of Maine the bottom temperature distribution reflects the inflow of the warm Slope Water through Northeast Channel that becomes cooler as it spreads across the gulf. The values range from 4-6°C at the winter minimum in the western gulf to above 10°C in the summer near Northeast Channel.

On the shallow portion of Georges Bank the water remains vertically well-mixed all year long due to strong tidal currents. The bottom temperature follows the same pattern as the surface values. Along the middle and outer portion of the shelf from Chesapeake Bay to Georges Bank, winter values are similar to the surface temperatures since the water column is again vertically uniform. From the onset of surface warming in spring

until the fall cooling, the bottom temperature distribution is characterized by a band of minimum values in the middle and outer portion of the shelf. This is the "cold pool" water whose minimum value, which ranges from less than 5°C in spring to about 8°C in fall (see Houghton et al., 1982).

Bottom Salinity - The bottom salinity distributions in the deep Gulf of Maine show the influence of the Slope Water flowing in through Northeast Channel. Values decrease from near 35°/oo in the channel to near 33.5°/oo in the western gulf with no distinct annual cycle being evident. In the shallow coastal region bottom salinities are generally less than 33°/oo with minimum values in the spring associated with increased local run off. On Georges Bank the bottom salinities are near uniform, ranging from 32.5 to 33.5°/oo. Minimum values are observed in the late summer (August-September). Along the southern edge of the bank a sharp gradient in salinity to values above 35°/oo represents the shelf/slope front and the transition to Slope Water.

Over the continental shelf from Cape Hatteras to Nantucket Shoals, the bottom salinity increases across the shelf from near 32°/oo at the coast to about 33.5°/oo at the beginning of the shelf/slope front. Minimum values of less than 32°/oo are observed near the mouths of Chesapeake Bay and Delaware Bay in summer where large amounts of coastal runoff enter the shelf system. South of Block Island, high bottom salinities of greater than 34°/oo occasionally encroach further up onto the shelf than is observed either to the east or to the west.

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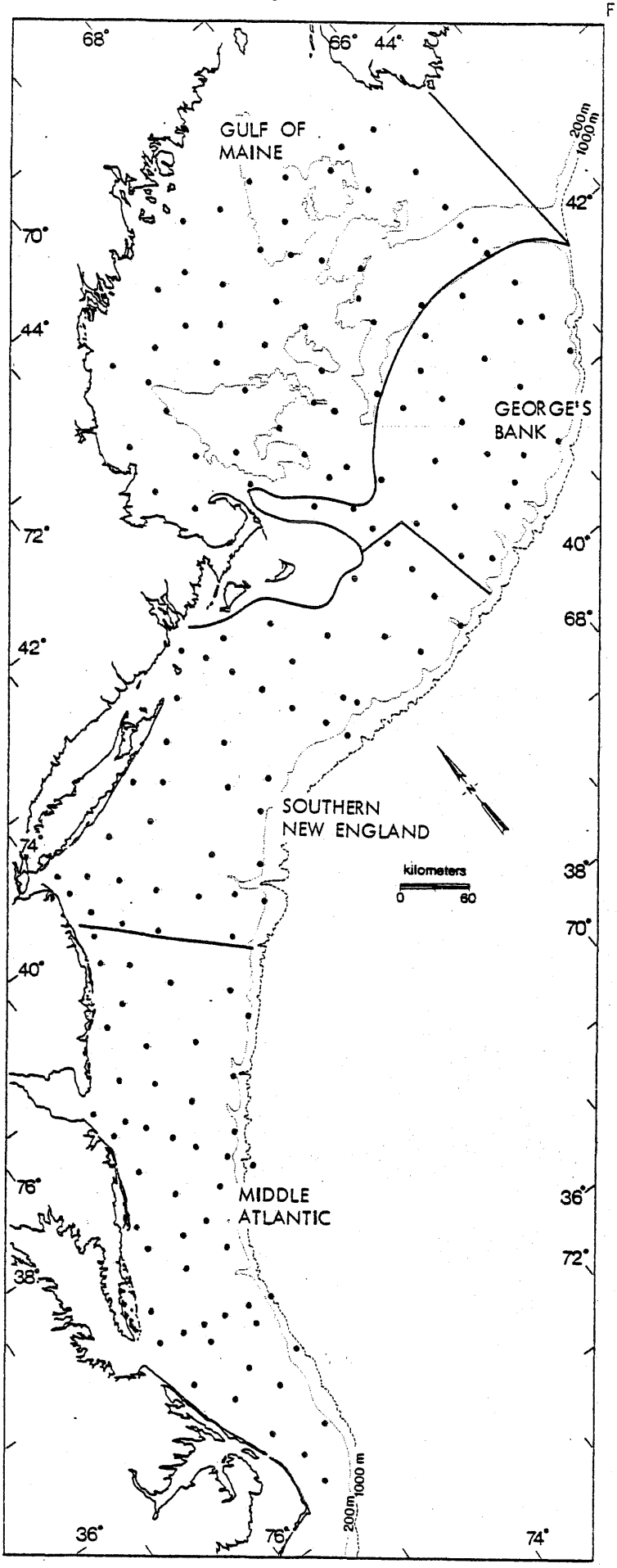
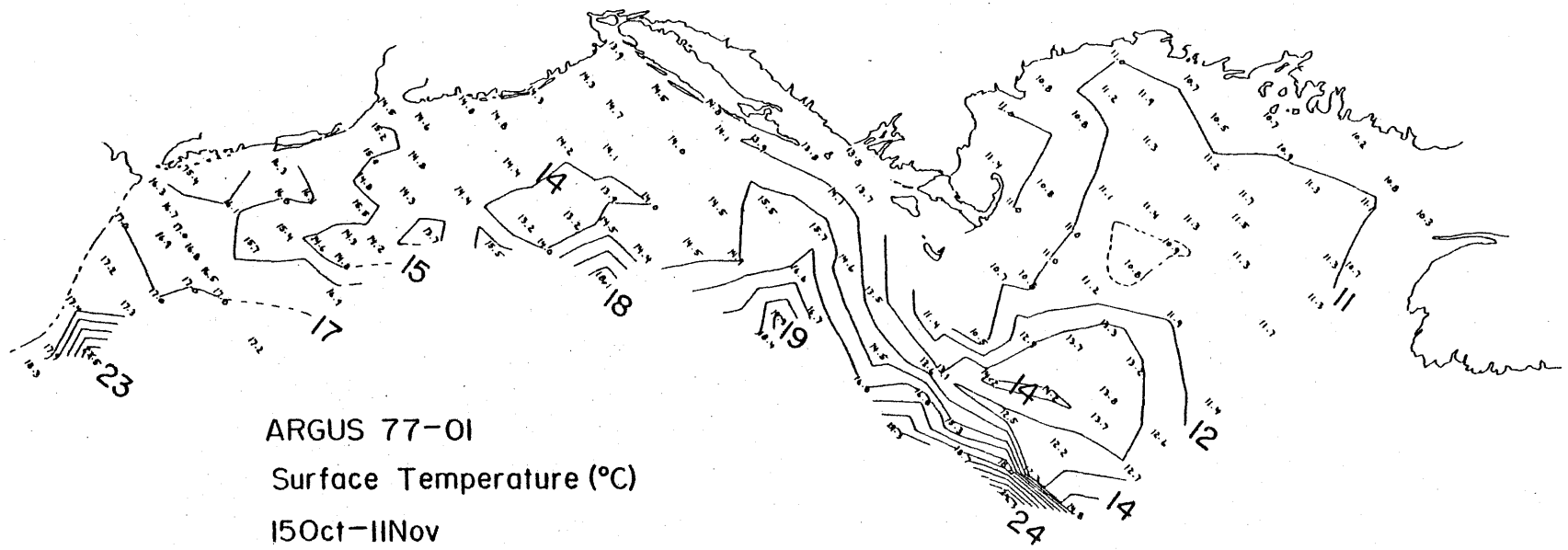
Wright, R.W. and S.R. Nickerson. 1980. Spring and fall bottom temperatures on the continental shelf, Cape Hatteras to Cape Sable, 1972 to 1979, with surface tempeature and salinity for 1978 and 1979. U.S. Dept. of Commerce, NOAA, NMFS, Northeast Fisheries Center, Woods Hole, MA, Lab. Ref. No. 80-01.

TABLE I

Year	Ship	Cruise No.	Dates
1977	ARGUS	77-01	15 Oct - 11 Nov
	MT. MITCHELL-KELEZ	77-11	12 Nov - 04 Dec
1978	DELAWARE II	78-02	14 Feb - 13 Mar
	ARGUS	78-04	13 Apr - 24 May
	ALBATROSS IV	78-07	22 Jun - 01 July
	BELOGORSK	78-01	09 Aug - 05 Sept
	BELOGORSK	78-03	05-20 Oct
	BELOGORSK	78-04	16-29 Nov
1979	DELAWARE II	79-03	23 Feb - 15 Mar
	DELAWARE II	79-05	06-29 May
	ALBATROSS IV	79-06	17 Jun - 12 July
	BELOGORSK	79-01	11 Aug - 02 Sept
	ALBATROSS IV	79-11	03 Sept - 29 Oct
	ALBATROSS IV	79-13	15 Nov - 20 Dec
1980	ALBATROSS IV	80-02	27 Feb - 04 Apr
	DELAWARE II	80-03	23 May - 12 Jun
	EVRIKA	80-04	25-29 Jun
	ALBATROSS IV	80-10	24 Sept - 30 Oct
	ALBATROSS IV	80-12	19 Nov - 21 Dec
1981	ALBATROSS IV	81-01	17 Feb - 24 Mar
	KELEZ	81-03, 04	18 Mar - 09 Apr
	DELAWARE II	81-03	20 May - 18 Jun
	ALBATROSS IV	81-14	16 Nov - 22 Dec
1982	ALBATROSS IV	82-02	16 Feb - 25 Mar
	DELAWARE II	82-03	17 May - 11 Jun
	DELAWARE II	82-09	15 Nov - 22 Dec

Figure 1


68°
66°
44°
GULF OF
MAINE
200m
1000m
42°
70°
44°
GEORGE'S
BANK
72°
40°
68°
42°
SOUTHERN
NEW ENGLAND
74°
kilometers
0
60
38°
70°
40°
76°
MIDDLE
ATLANTIC
36°
72°
38°
200m
1000 m
36°
76°
74°



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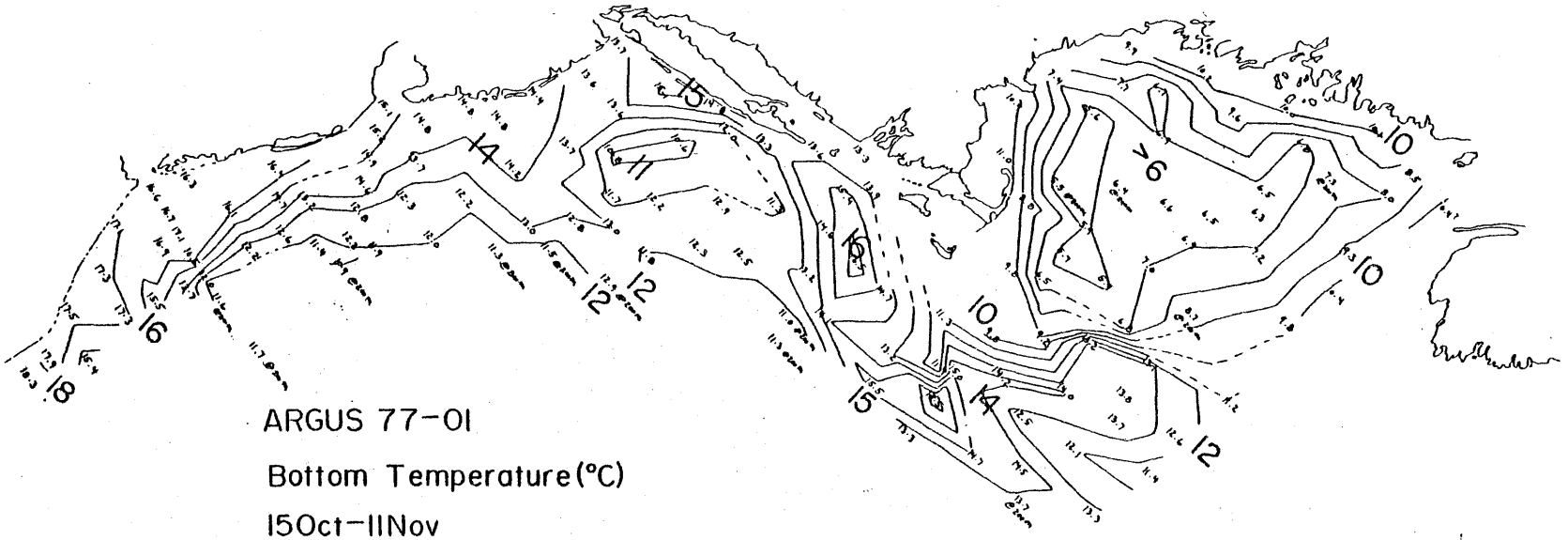

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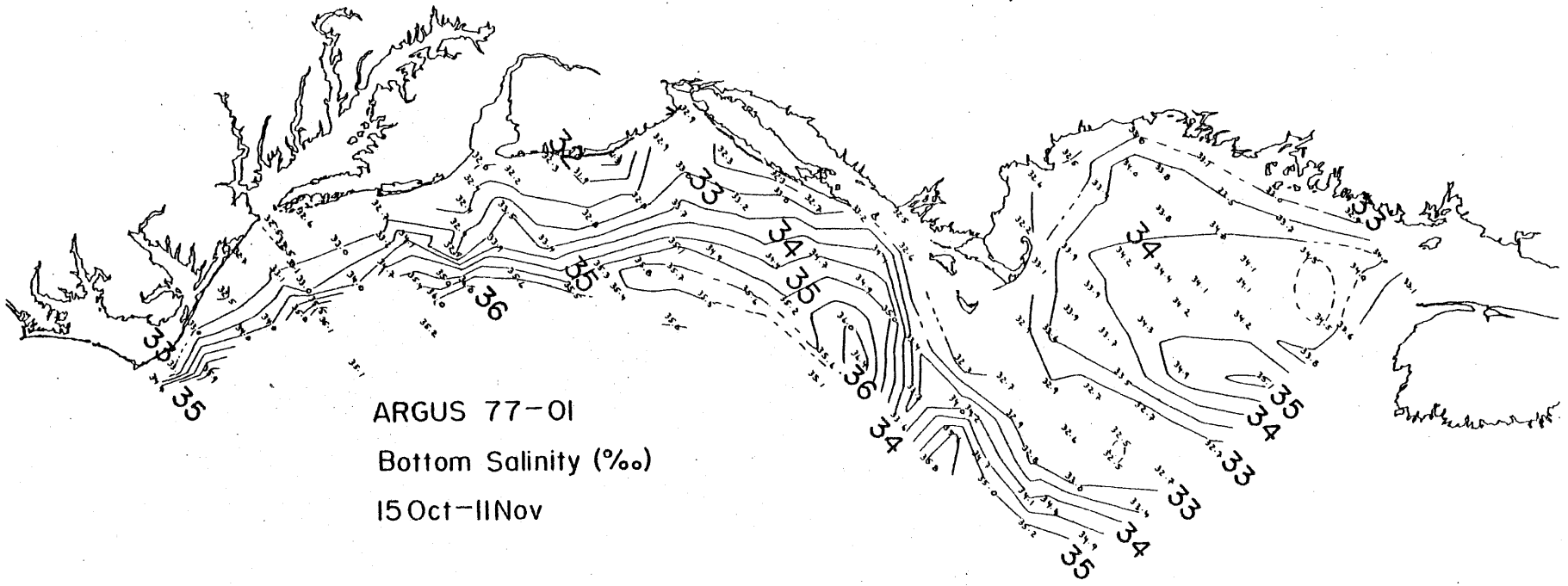

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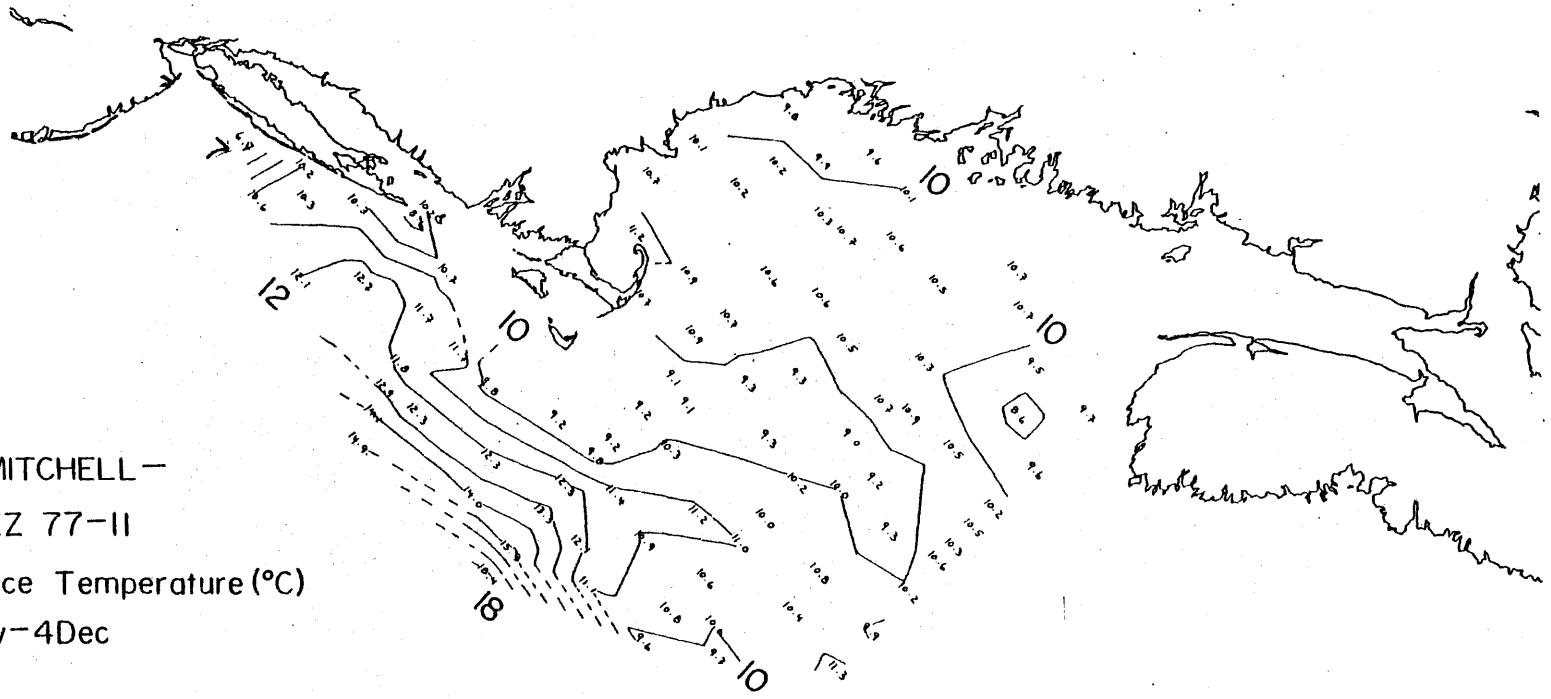

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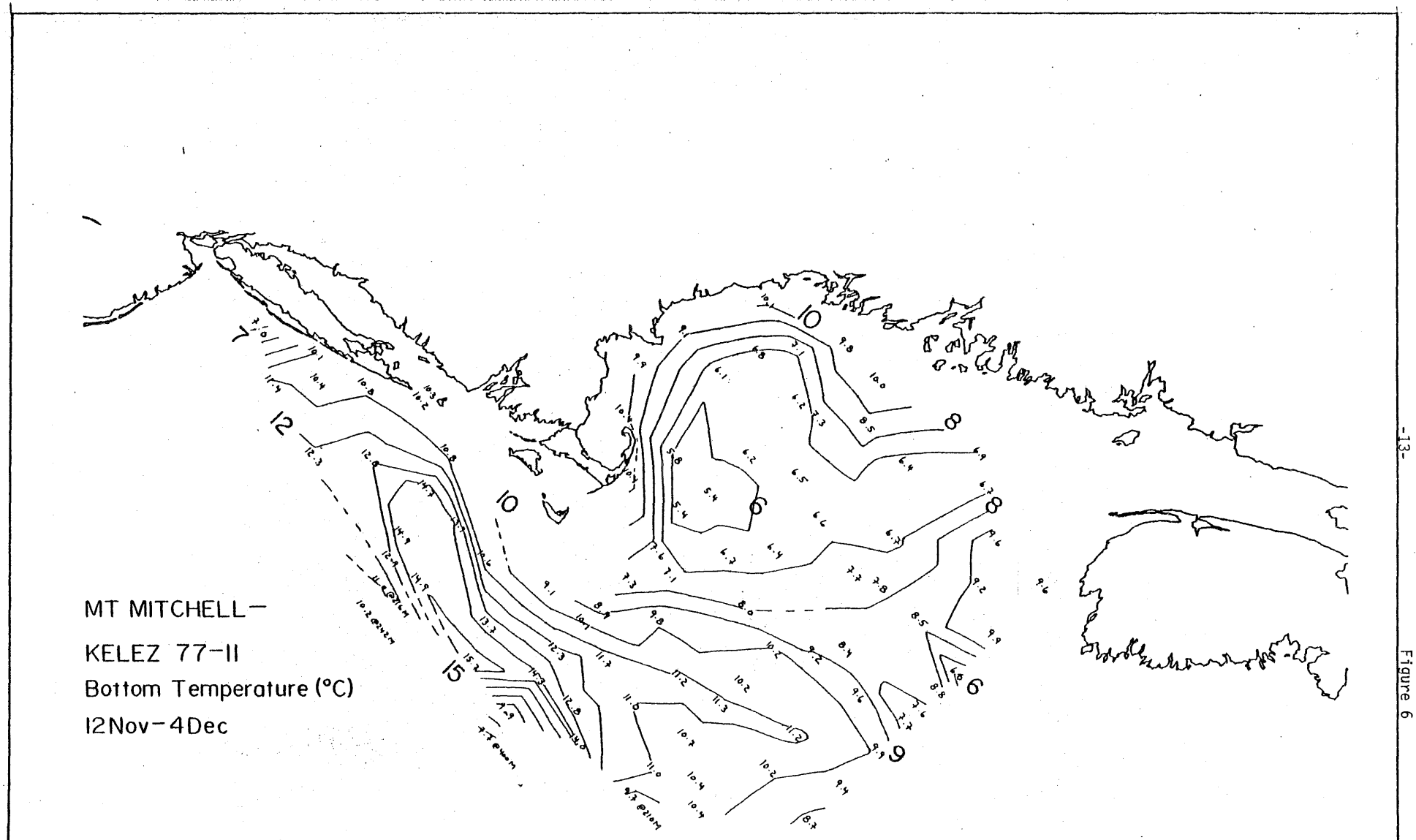

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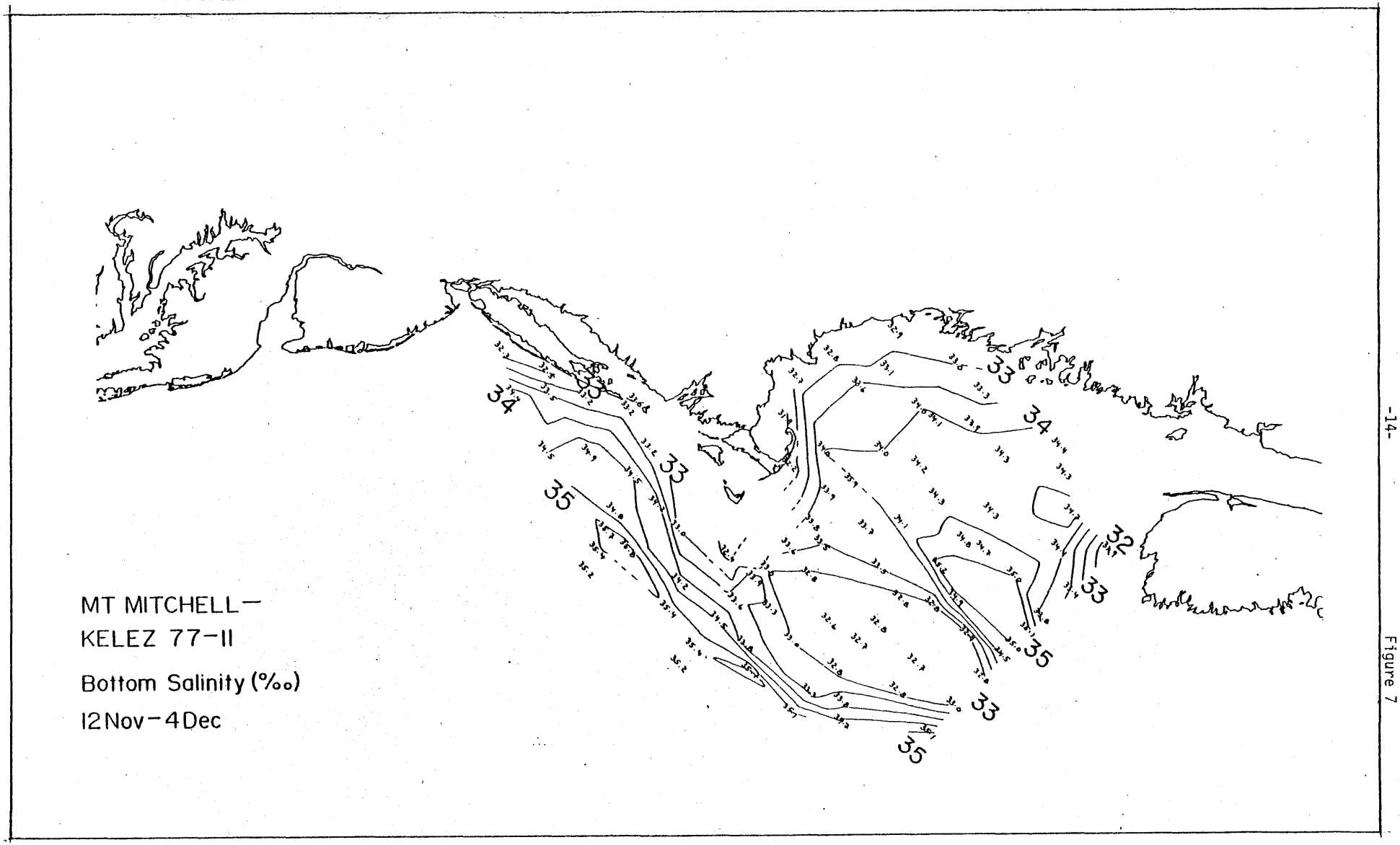

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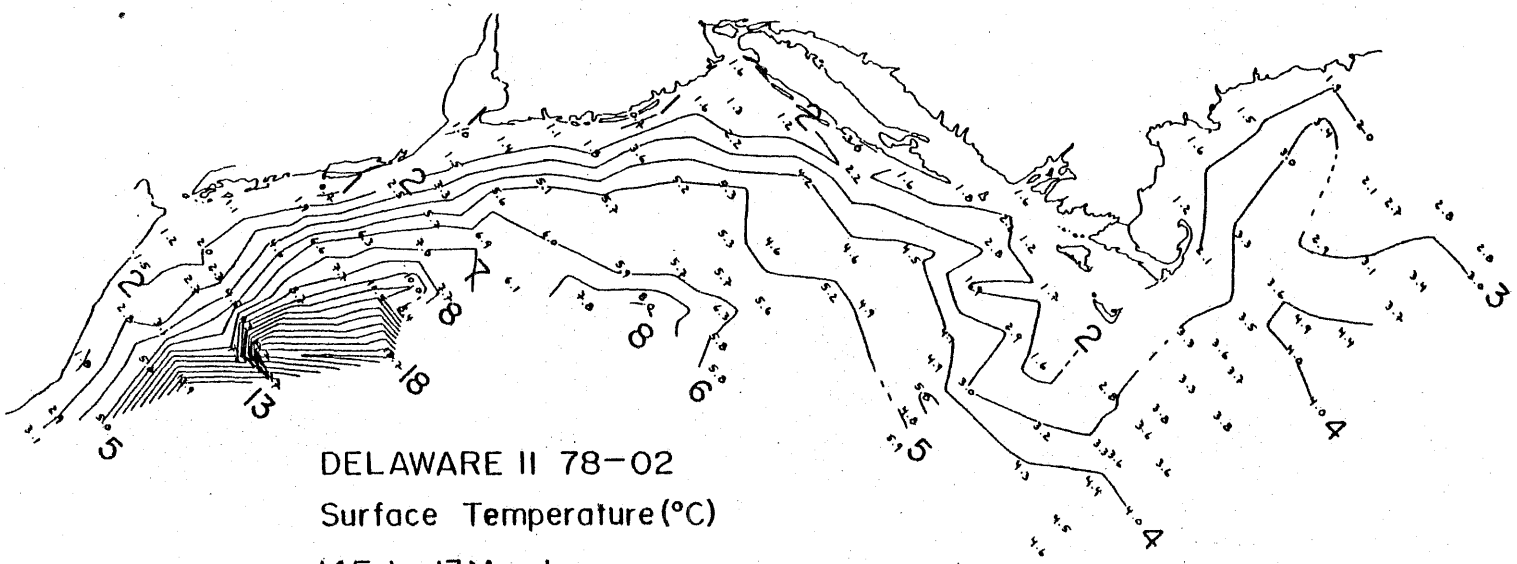
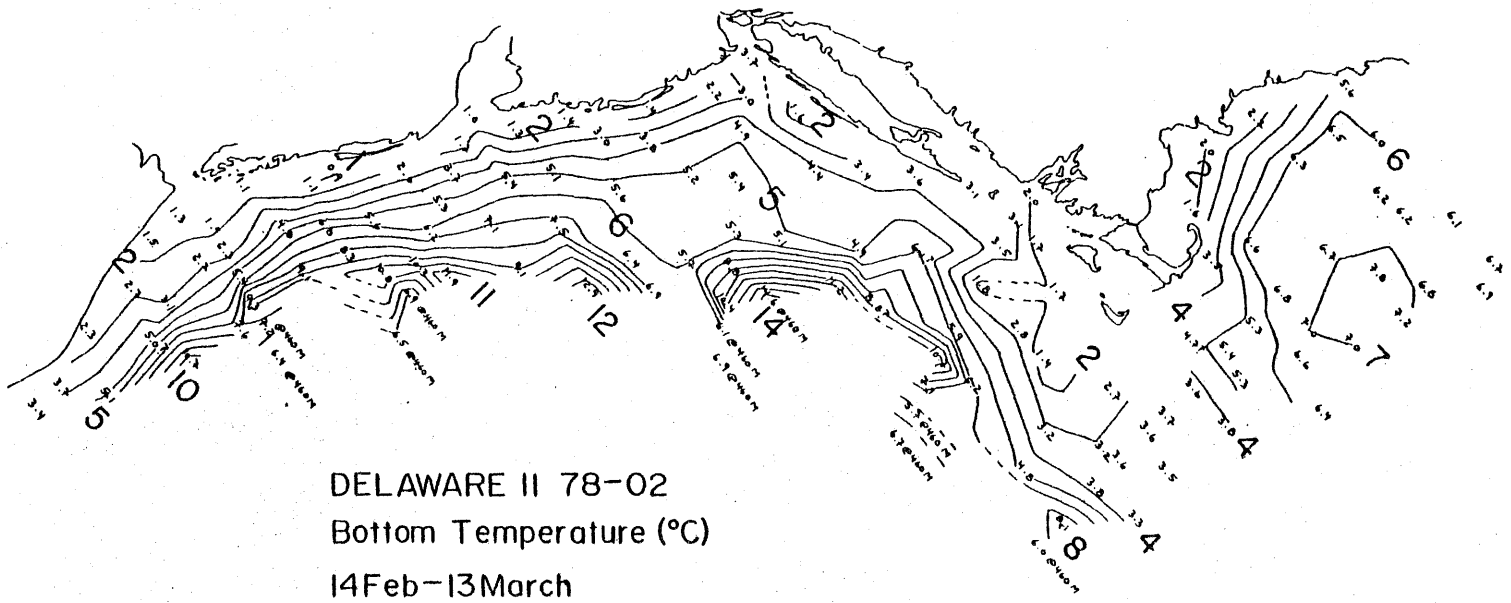


DELAWARE II 78-02

Surface Temperature (°C)

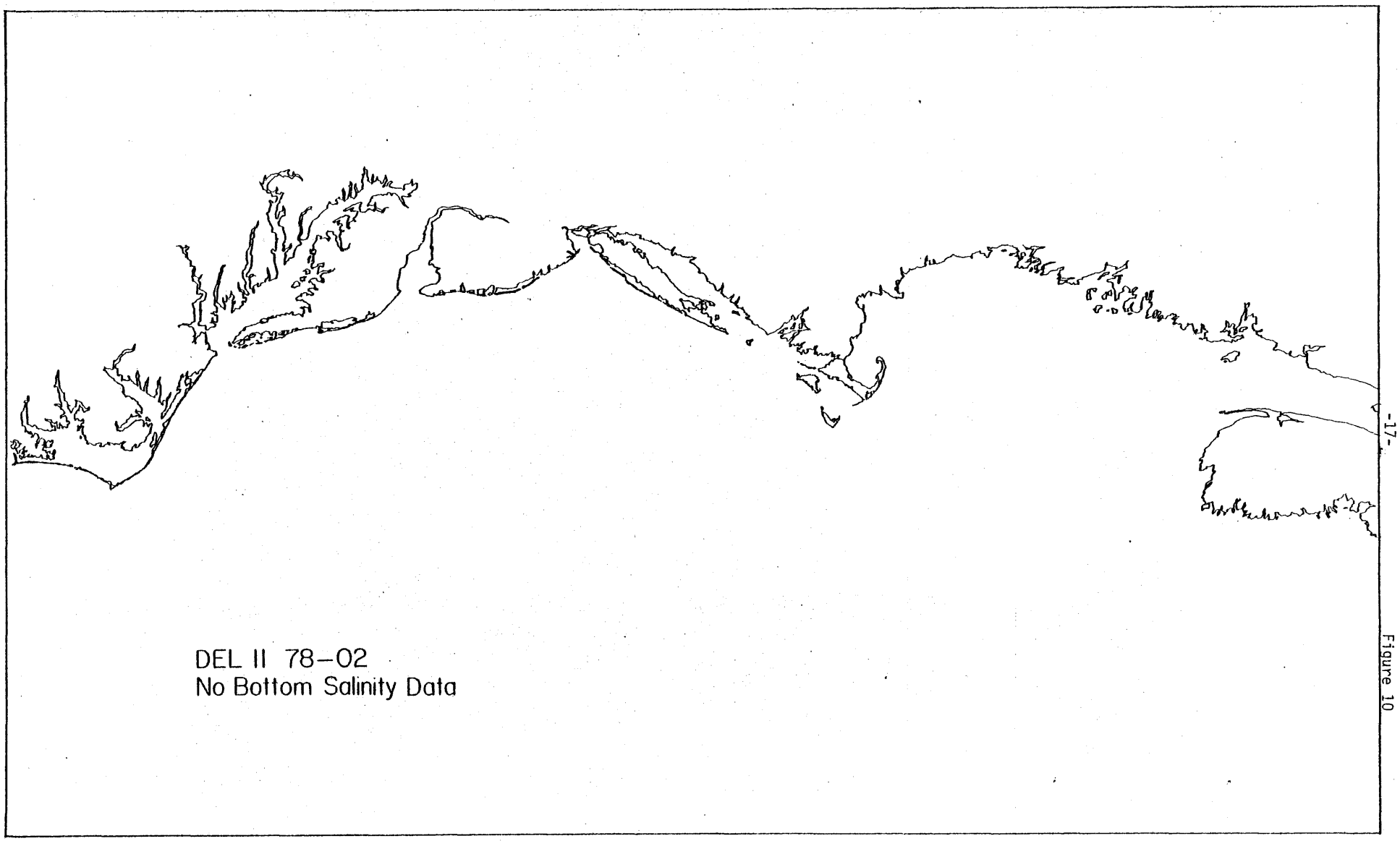
14 Feb - 13 March

Figure 8



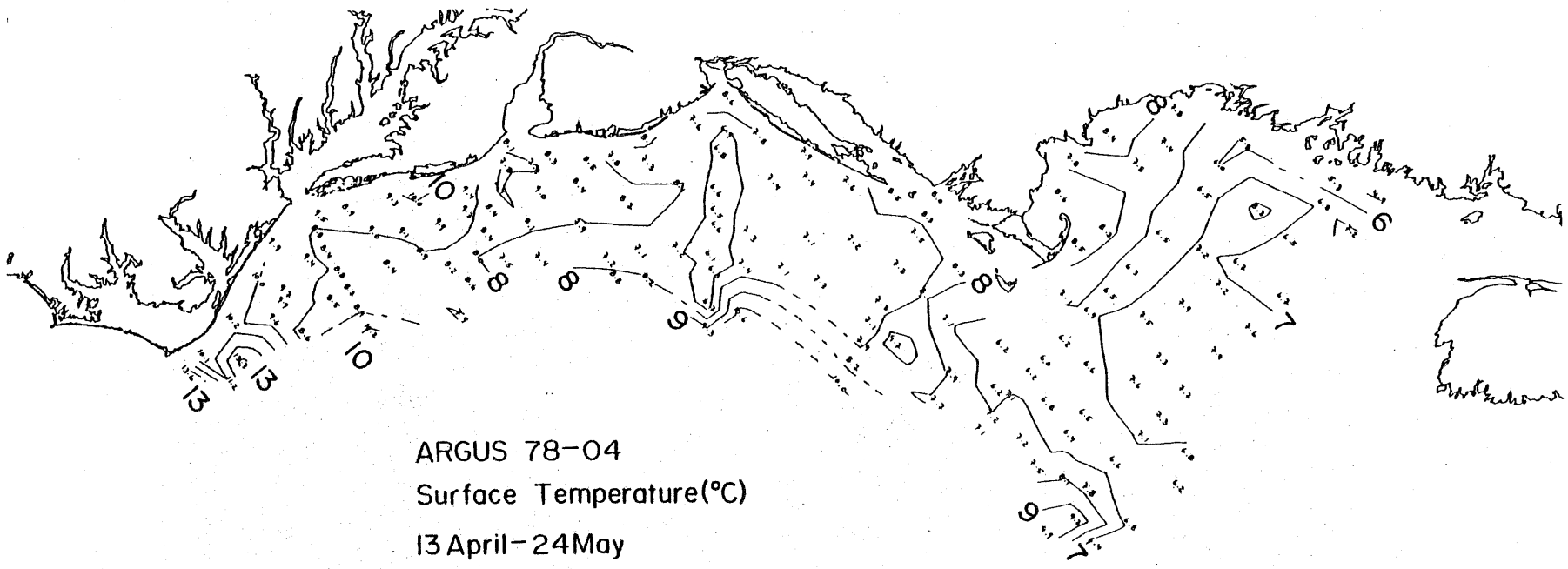
DELAWARE II 78-02
Bottom Temperature (°C)
14Feb–13March

Figure 9



DEL II 78-02
No Bottom Salinity Data

Figure 10



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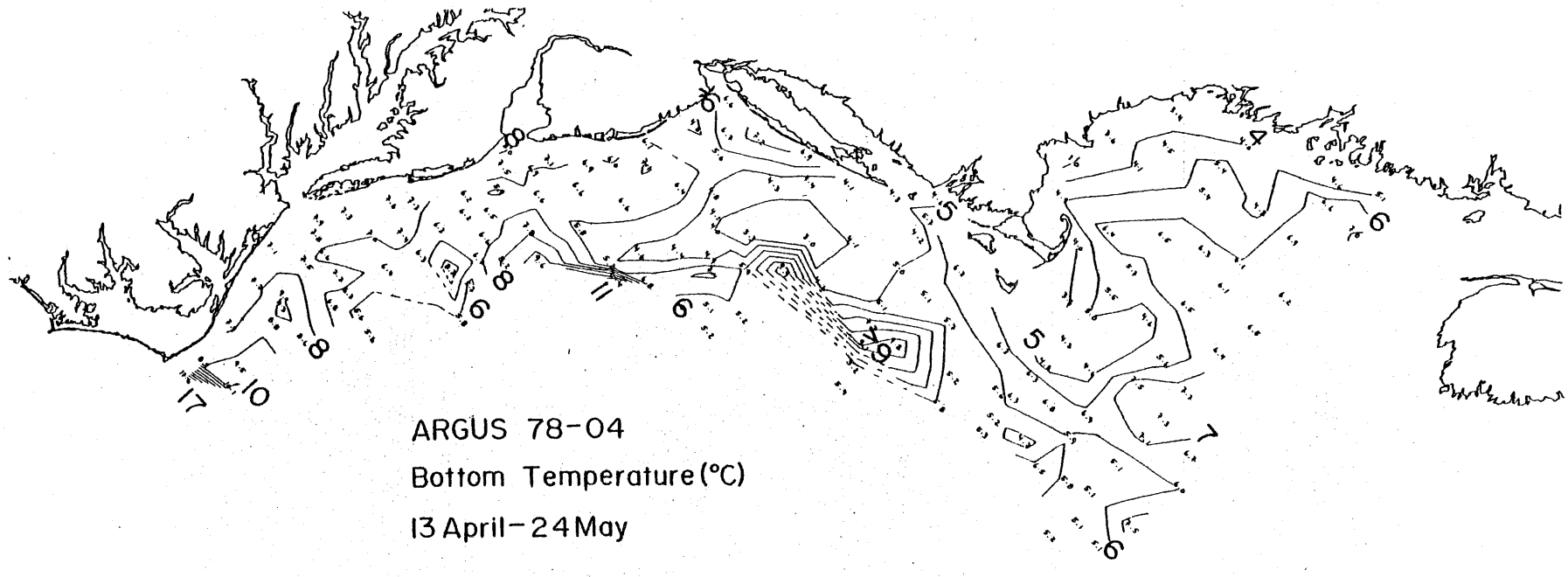

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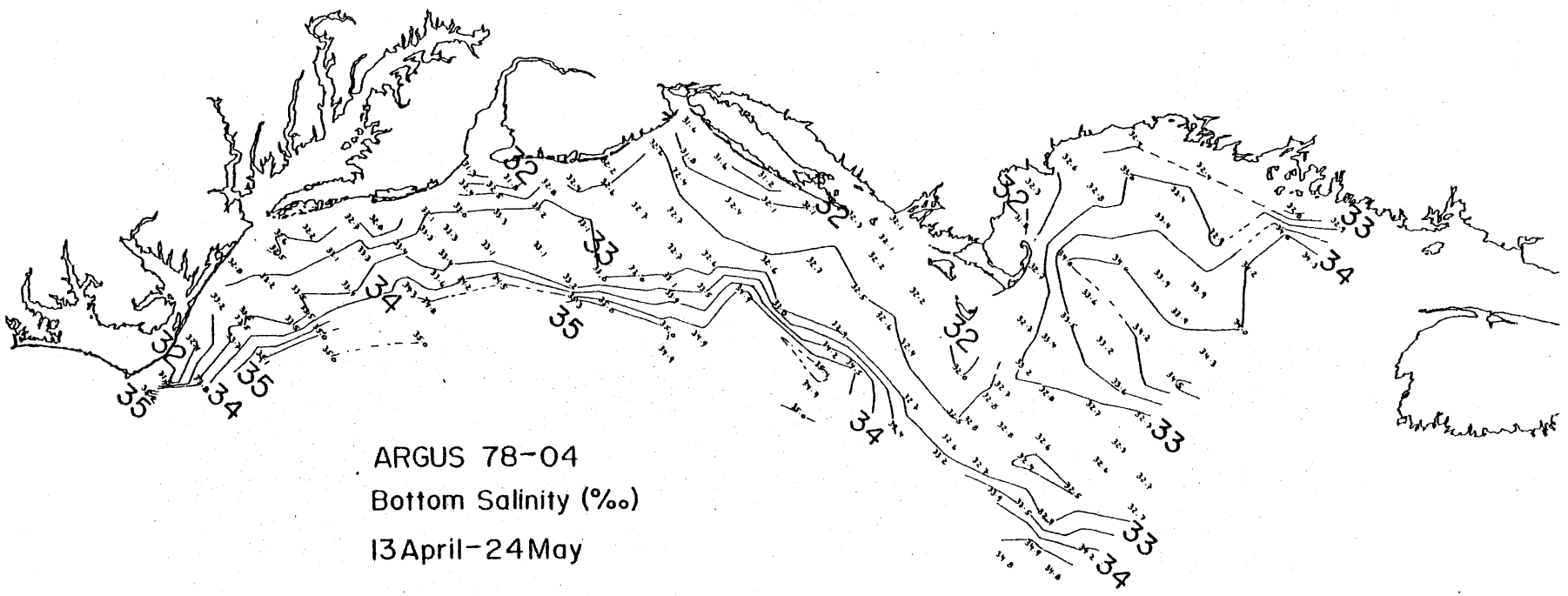

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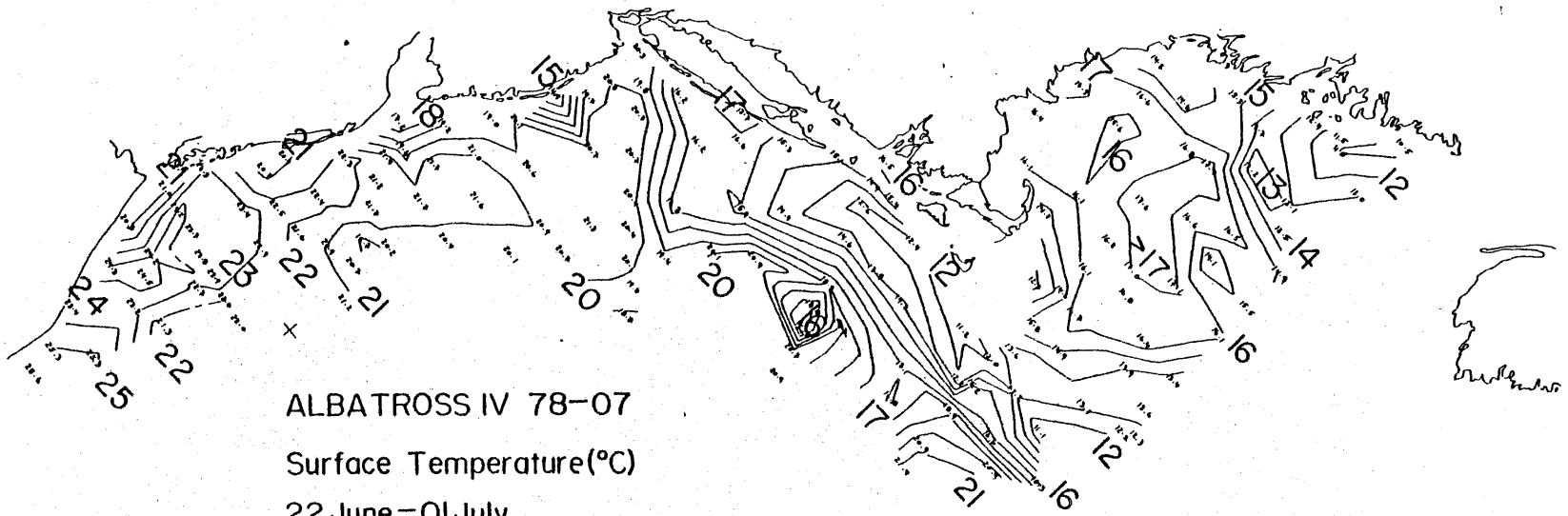

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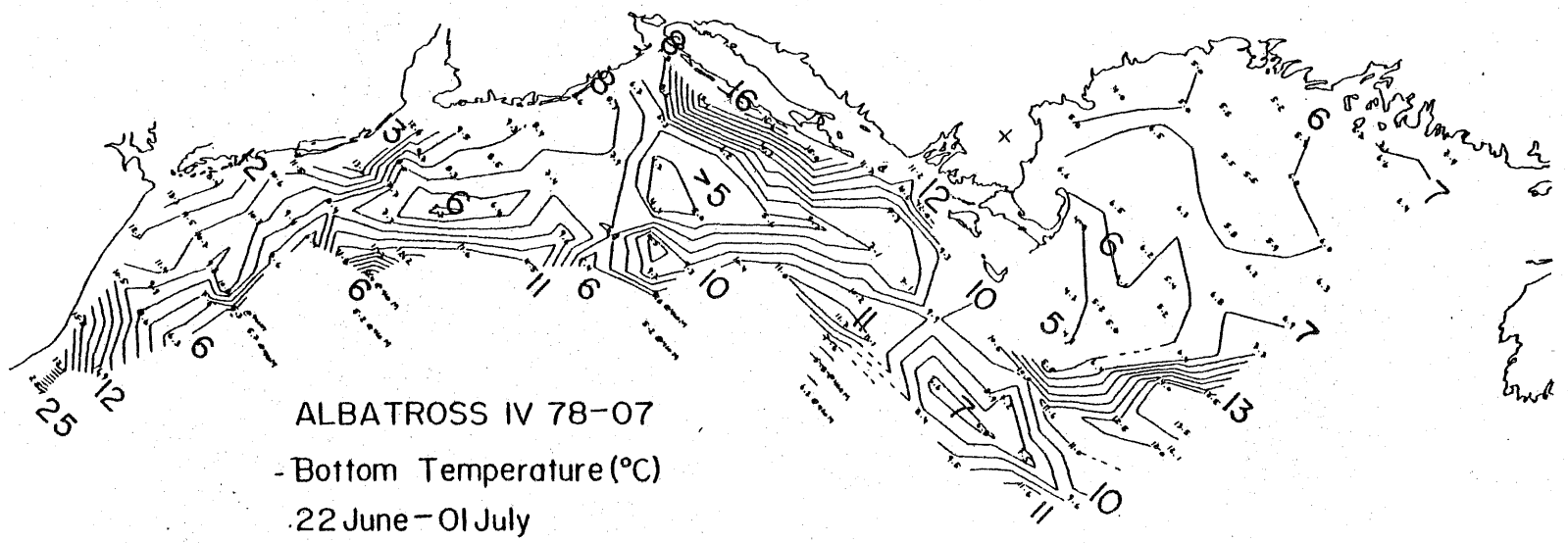

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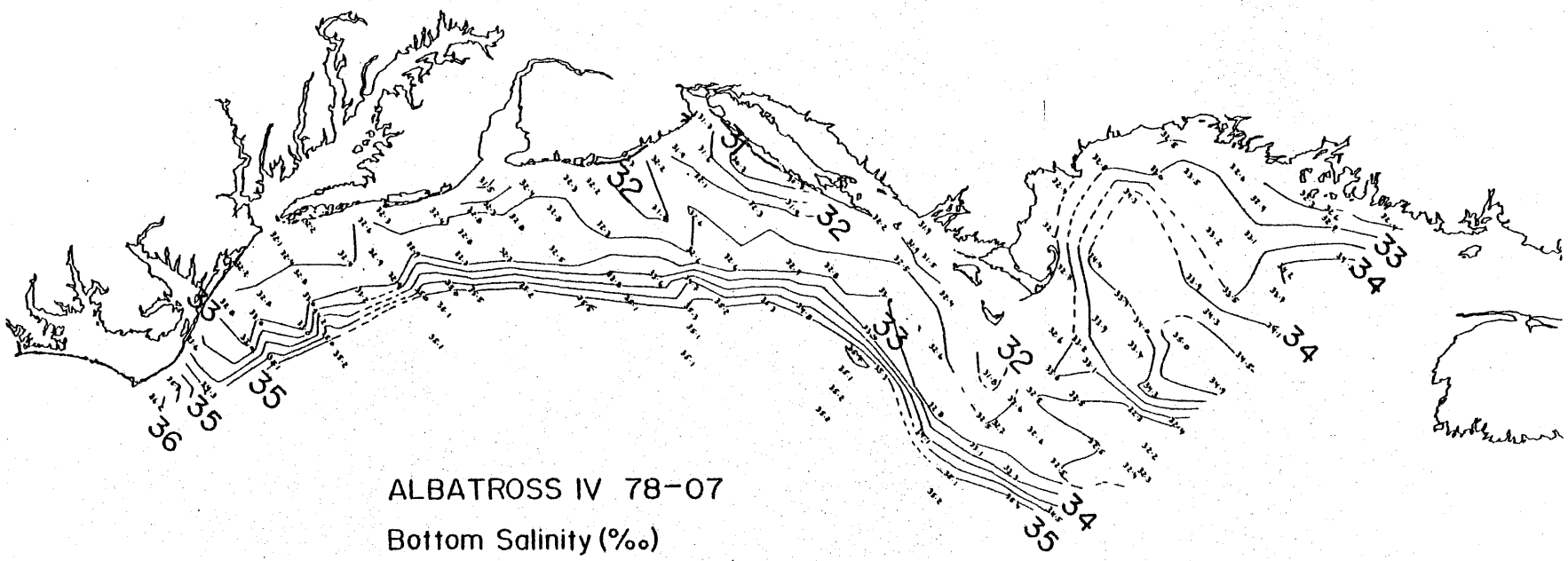

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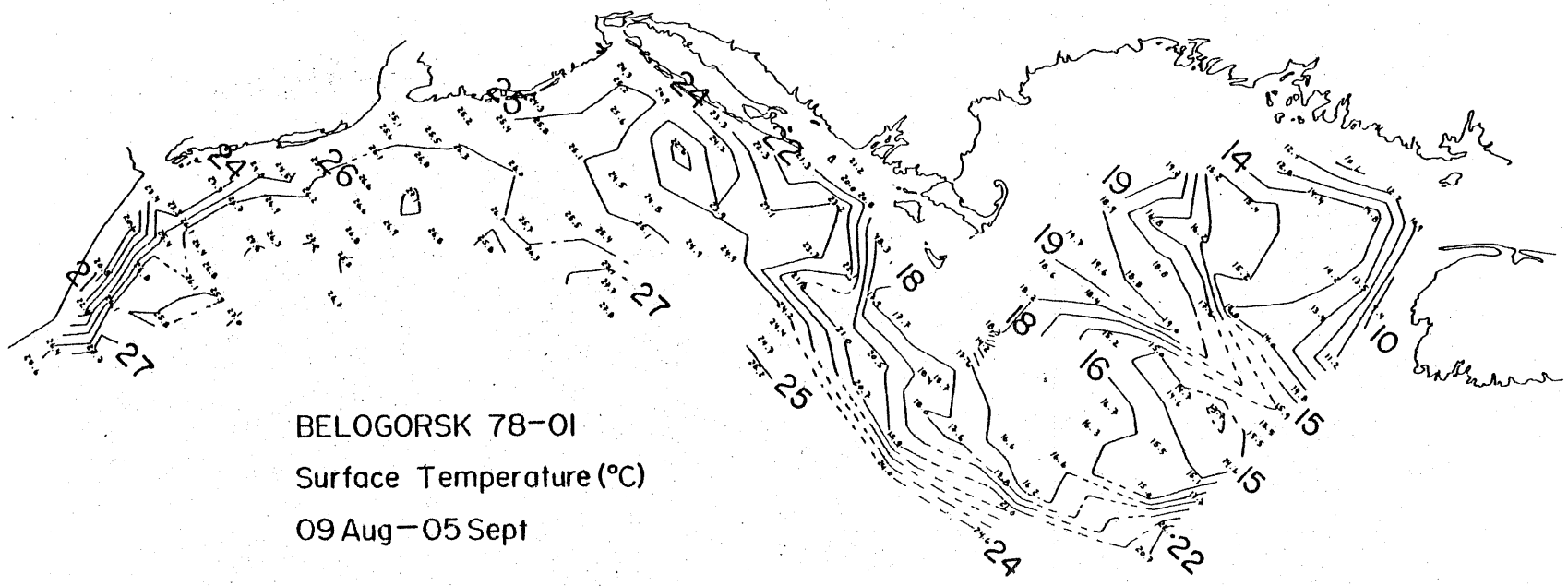

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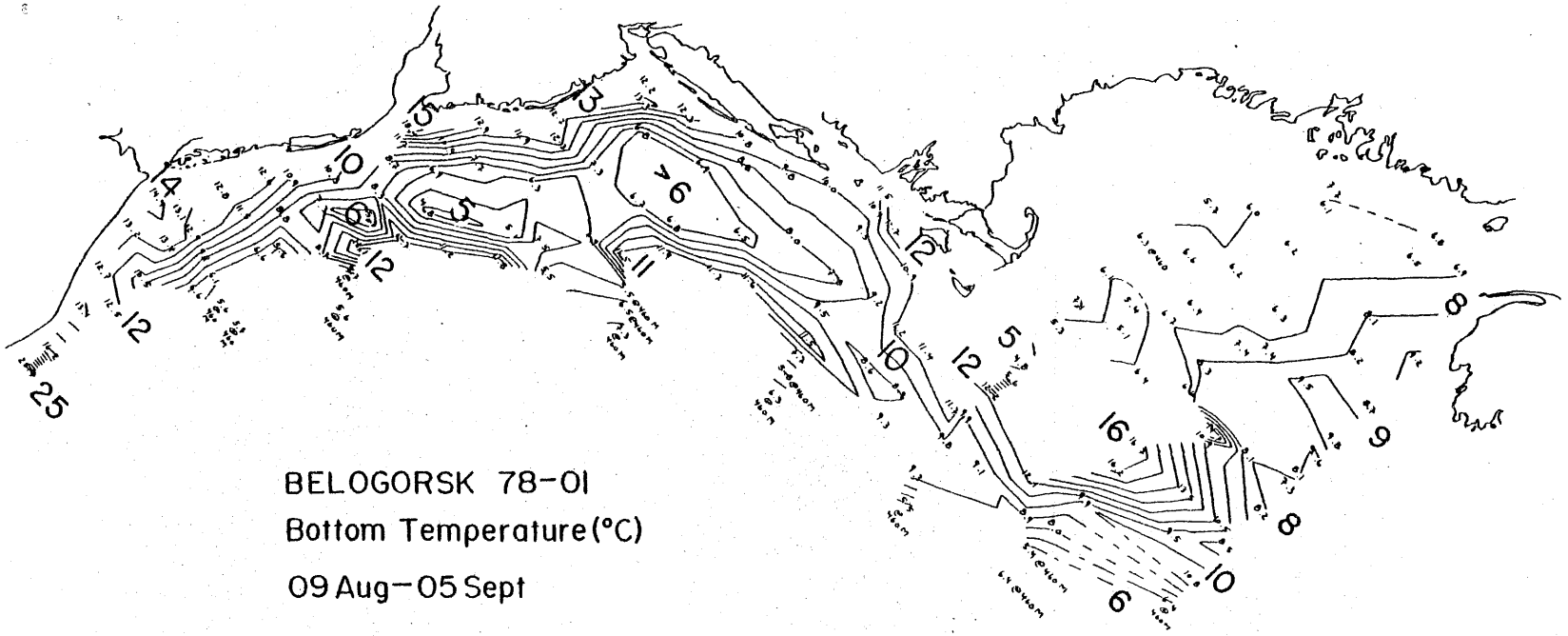

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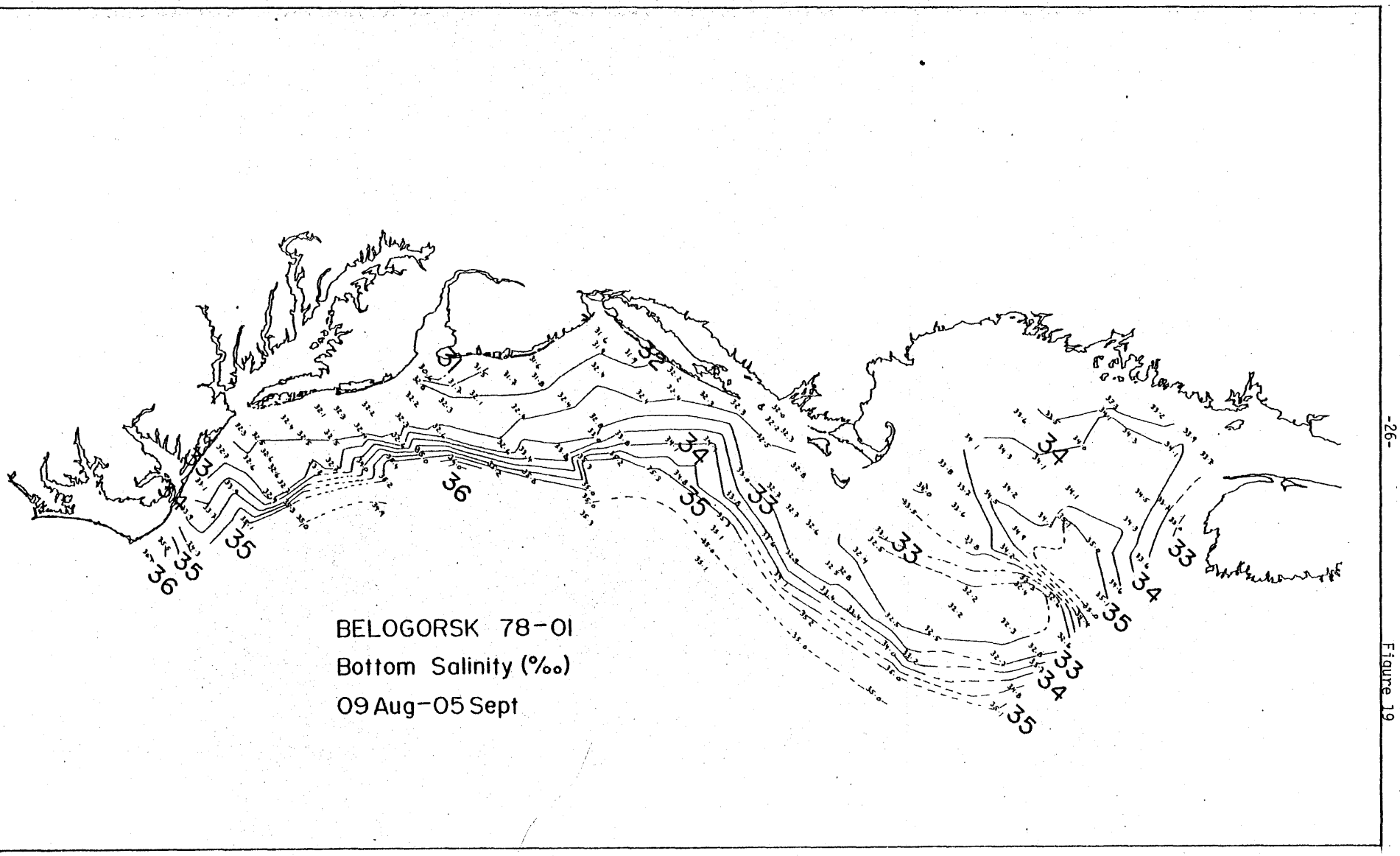

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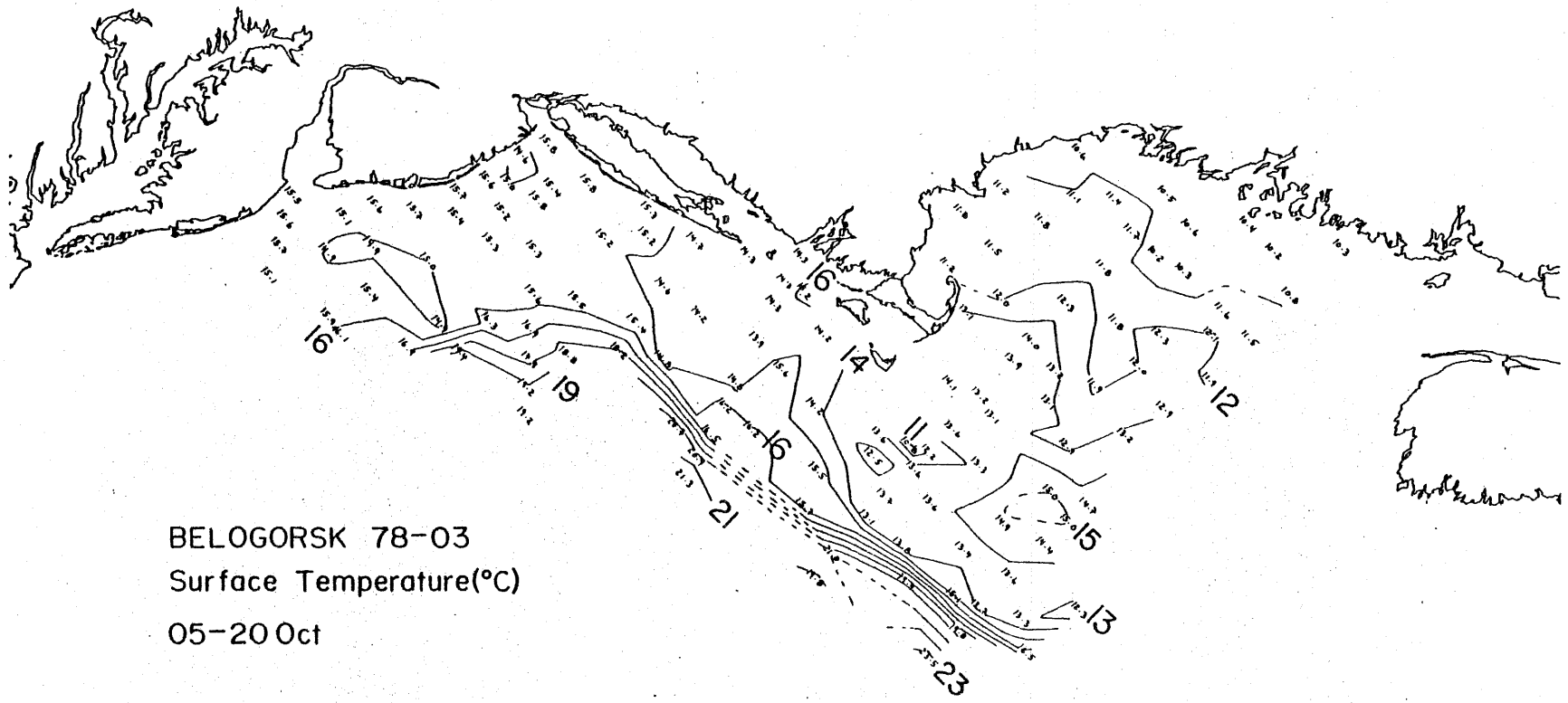

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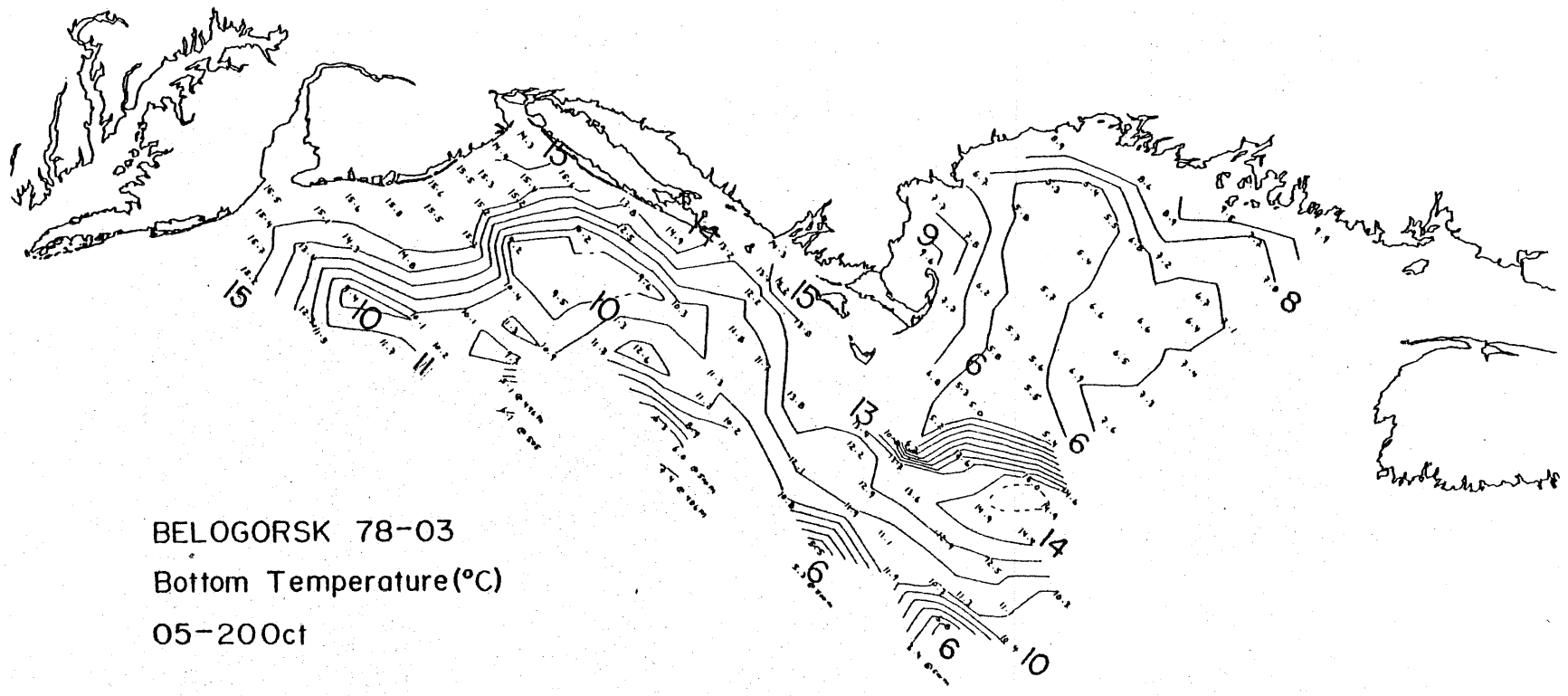

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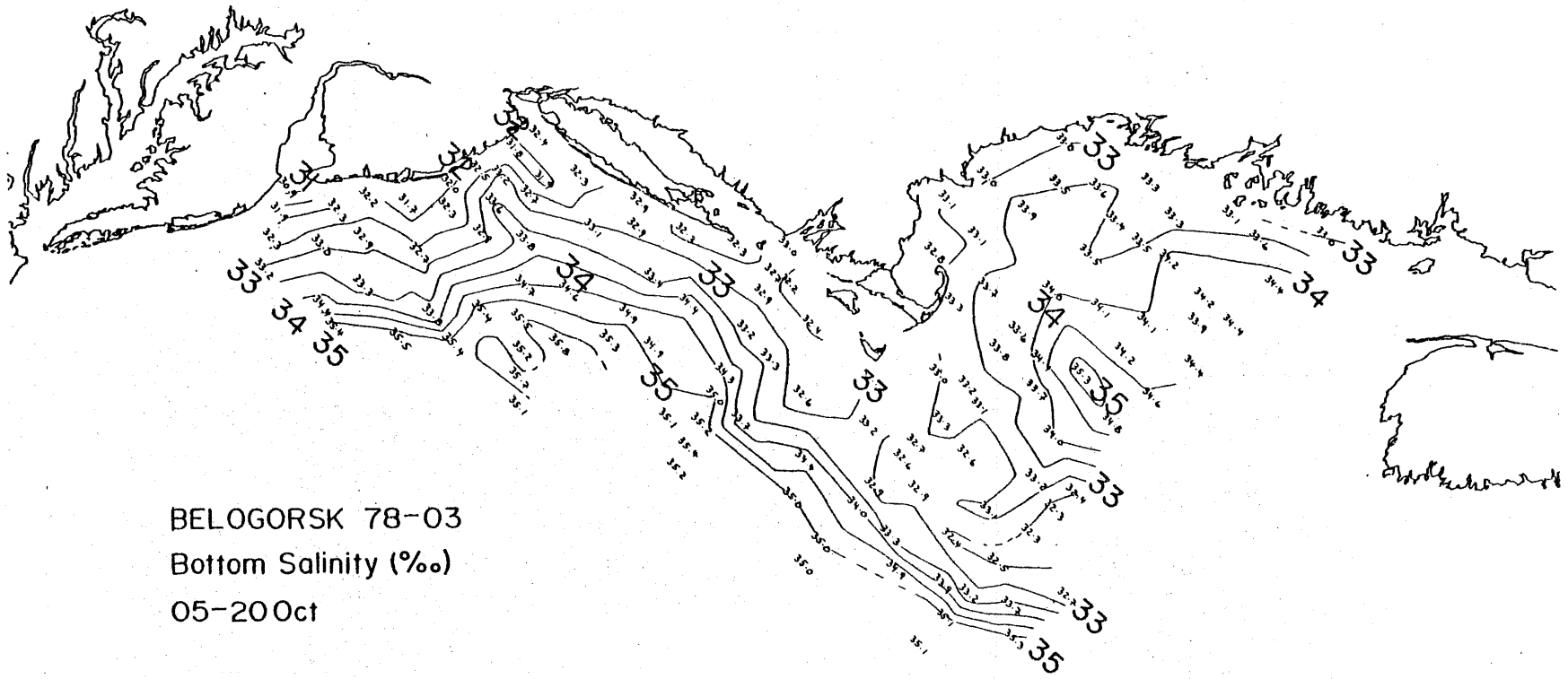

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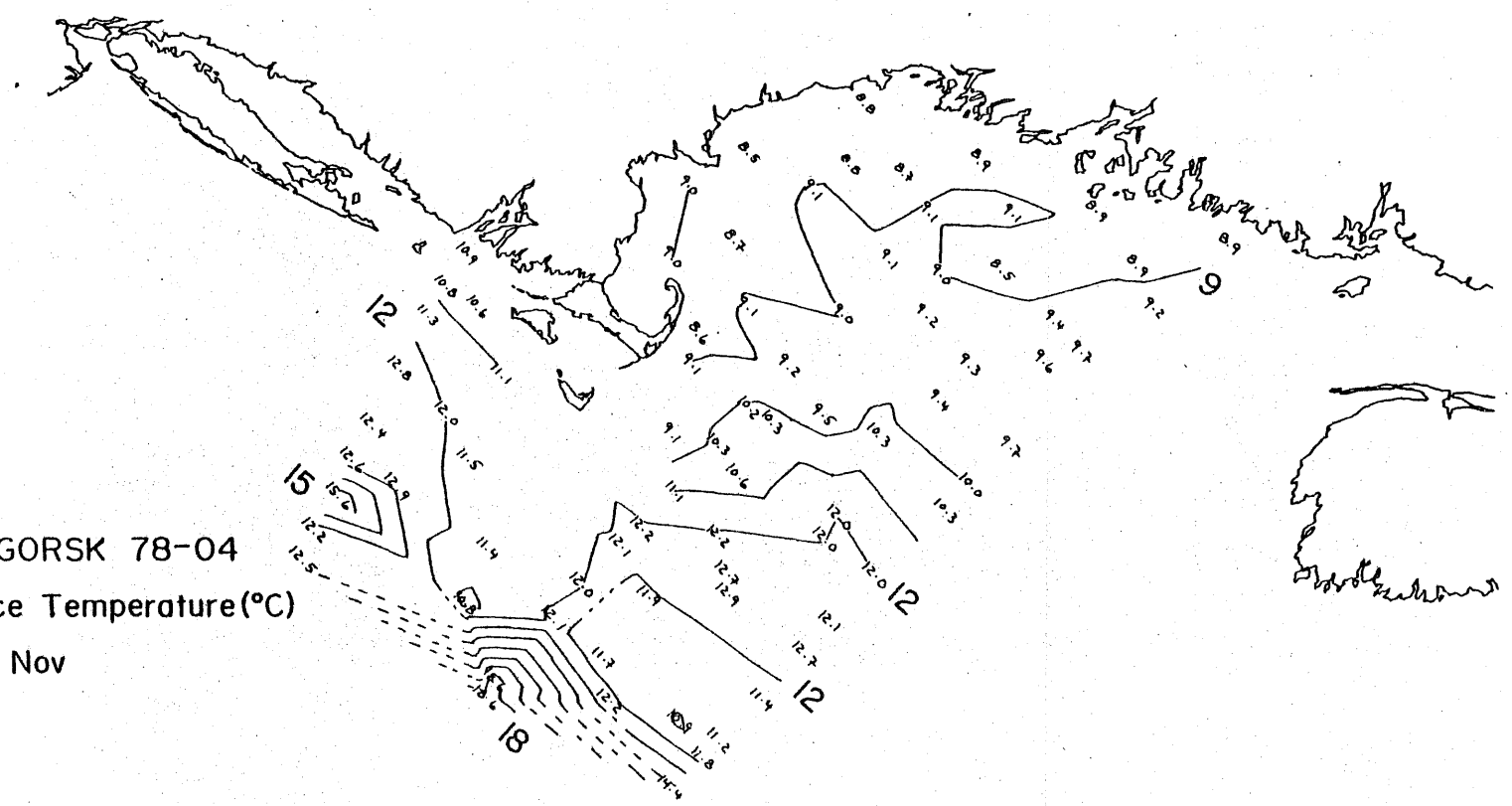

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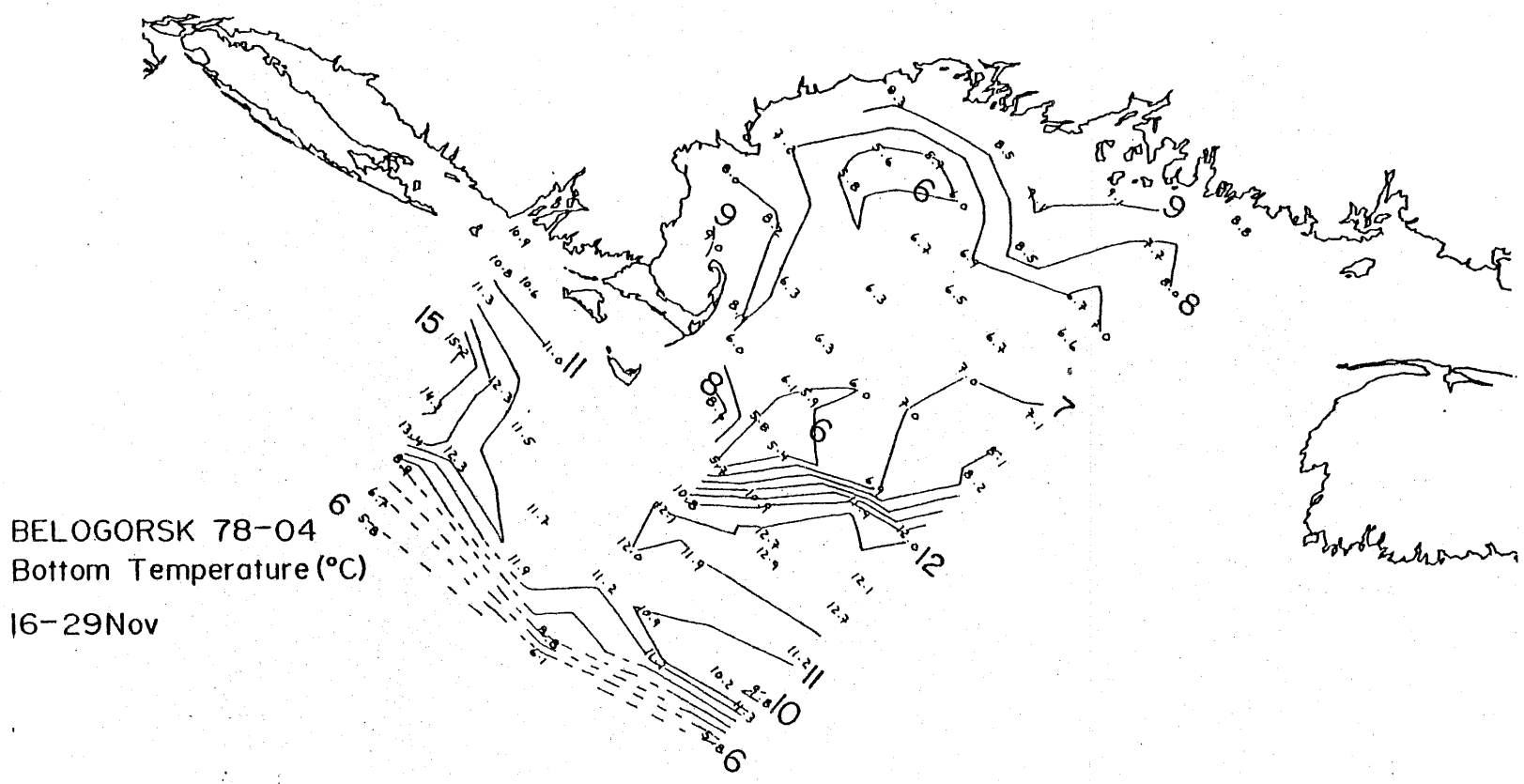

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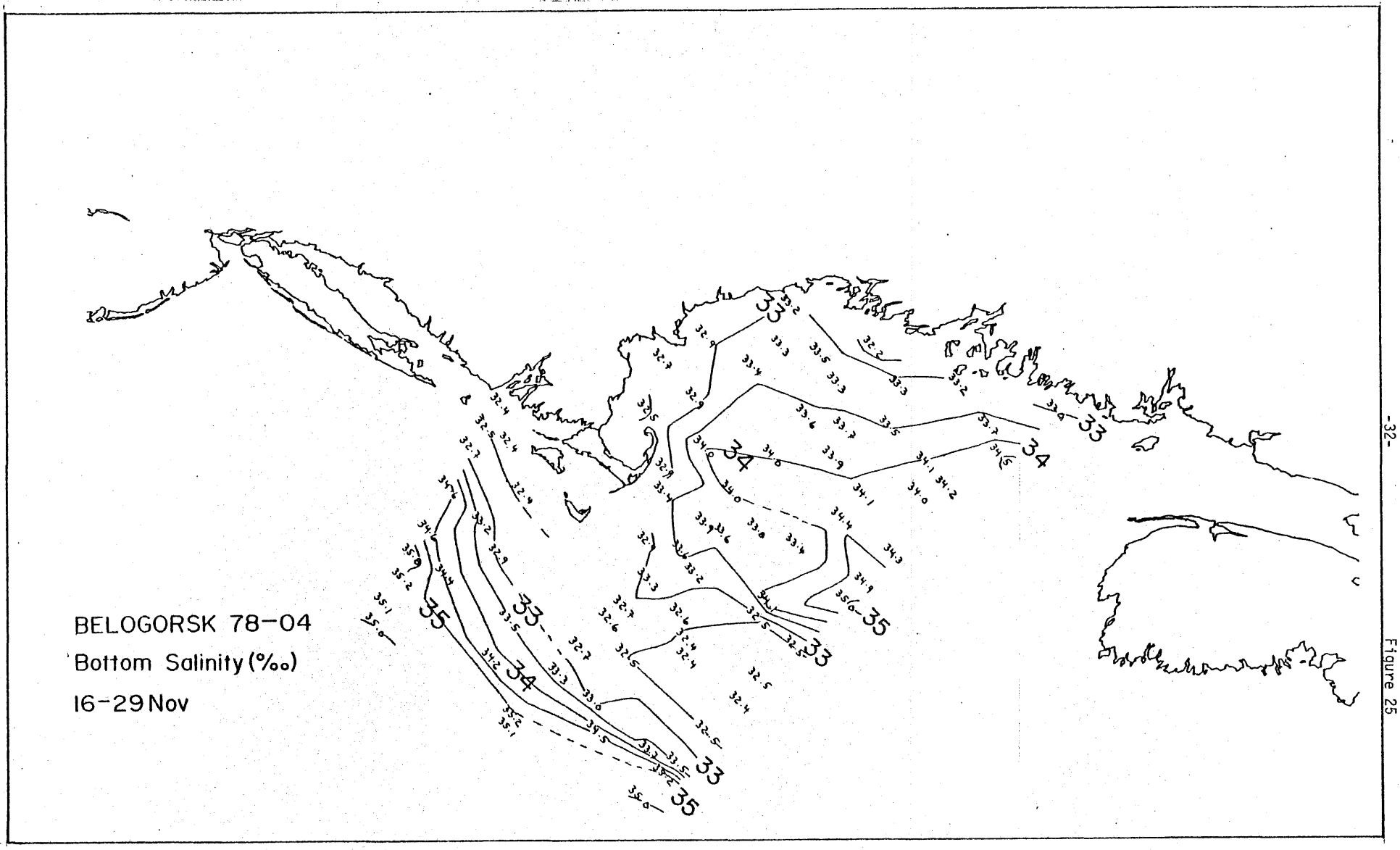

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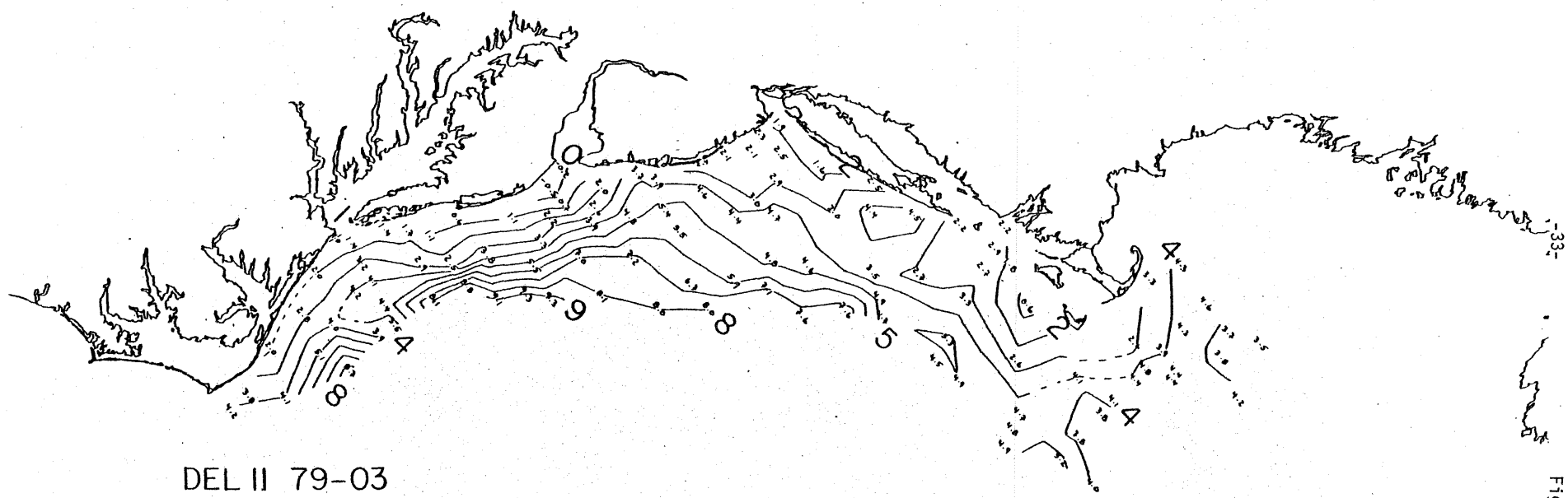
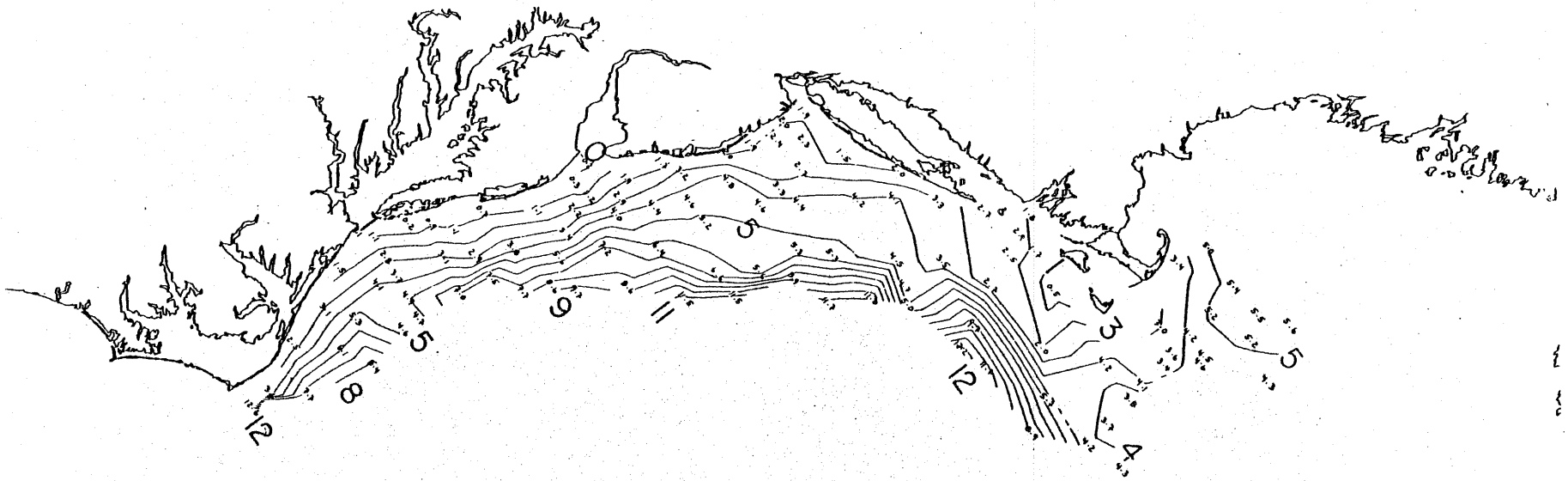


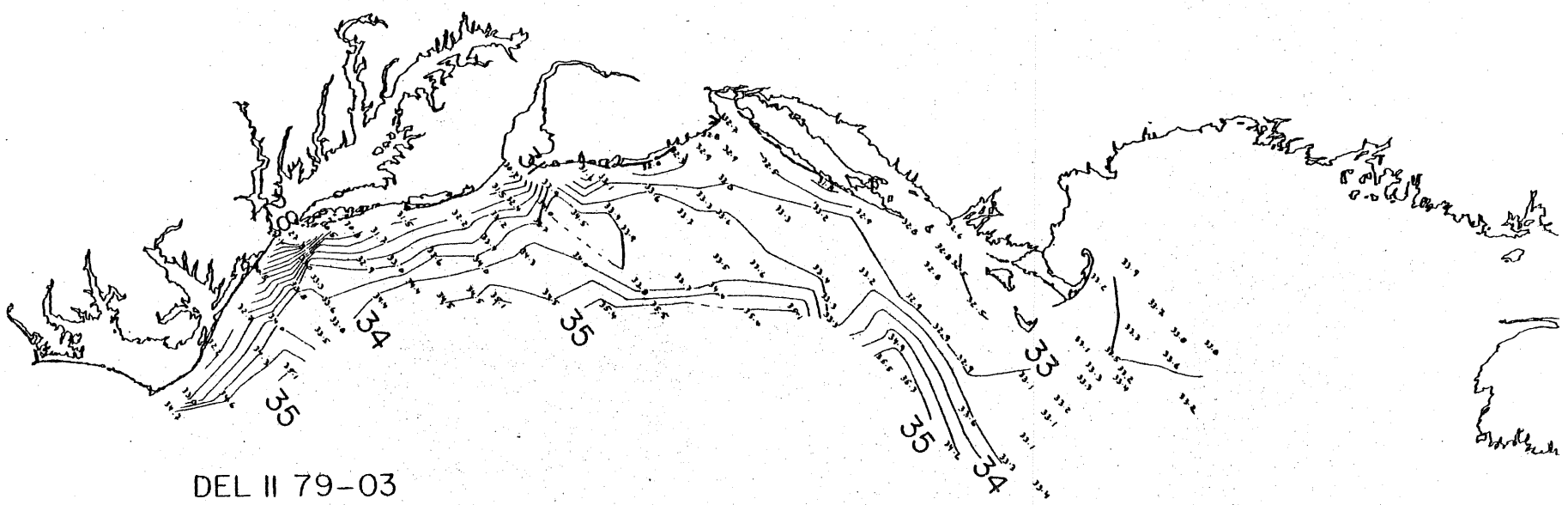
DEL II 79-03
Surface Temperature (°C)
23 FEB – 15 MAR

Figure 26



DEL II 79-03
Bottom Temperature (°C)
23 FEB–15 MAR

Figure 27

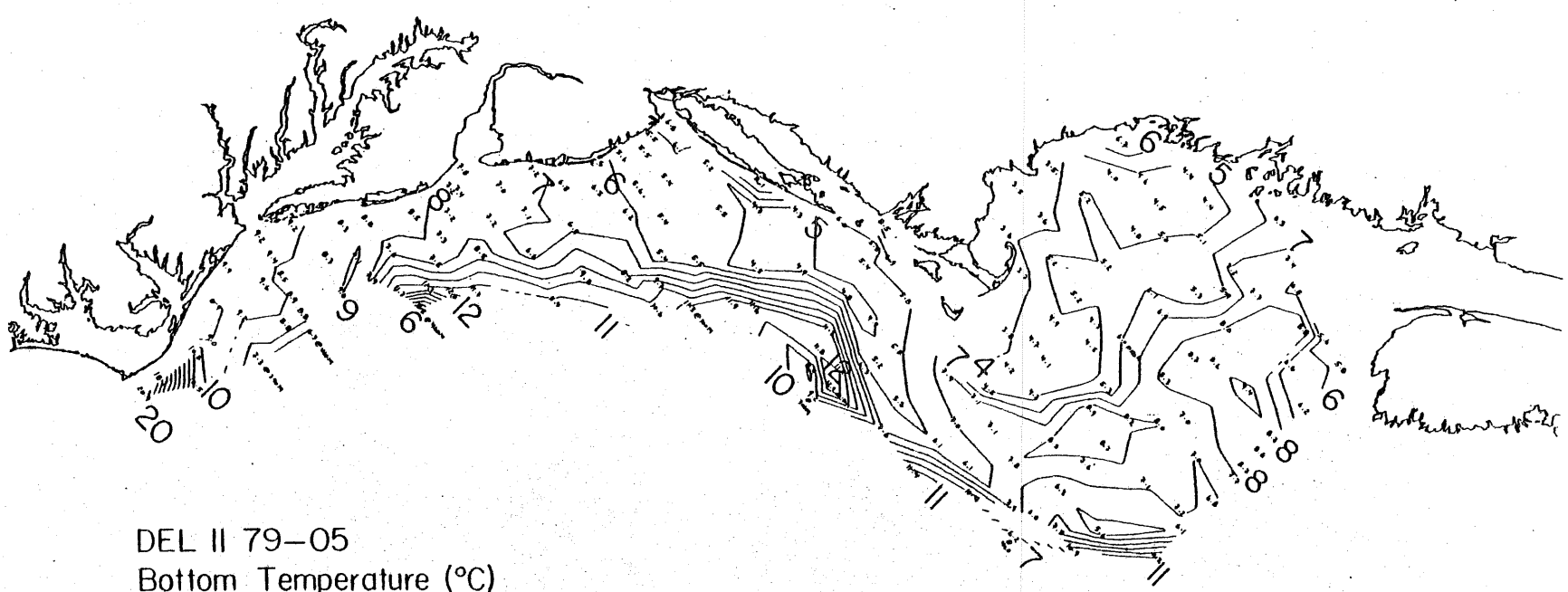


DEL II 79-03
Bottom Salinity (‰)
23 FEB–15MAR

Figure 28

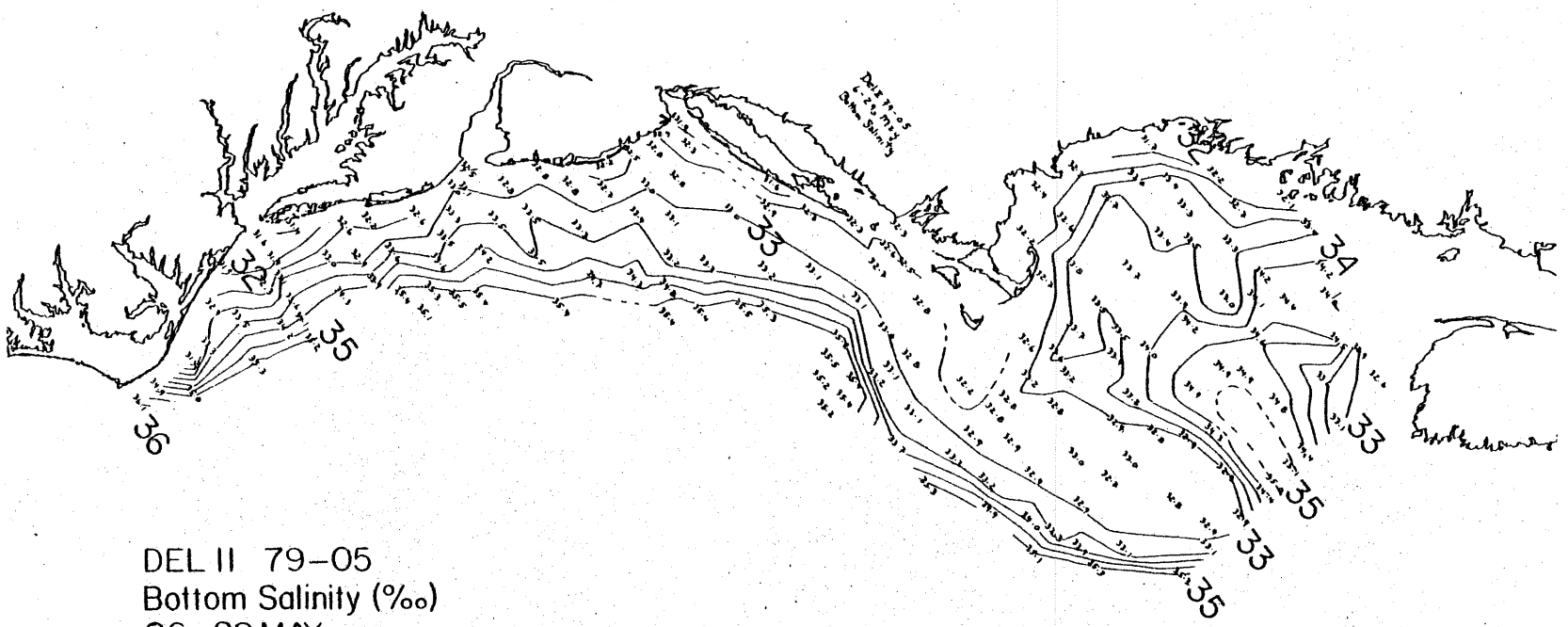
DEL II 79-05
Surface Temperature (°C)
06-29 May

Figure 29



DEL II 79–05
Bottom Temperature (°C)
06–29MAY

Figure 30



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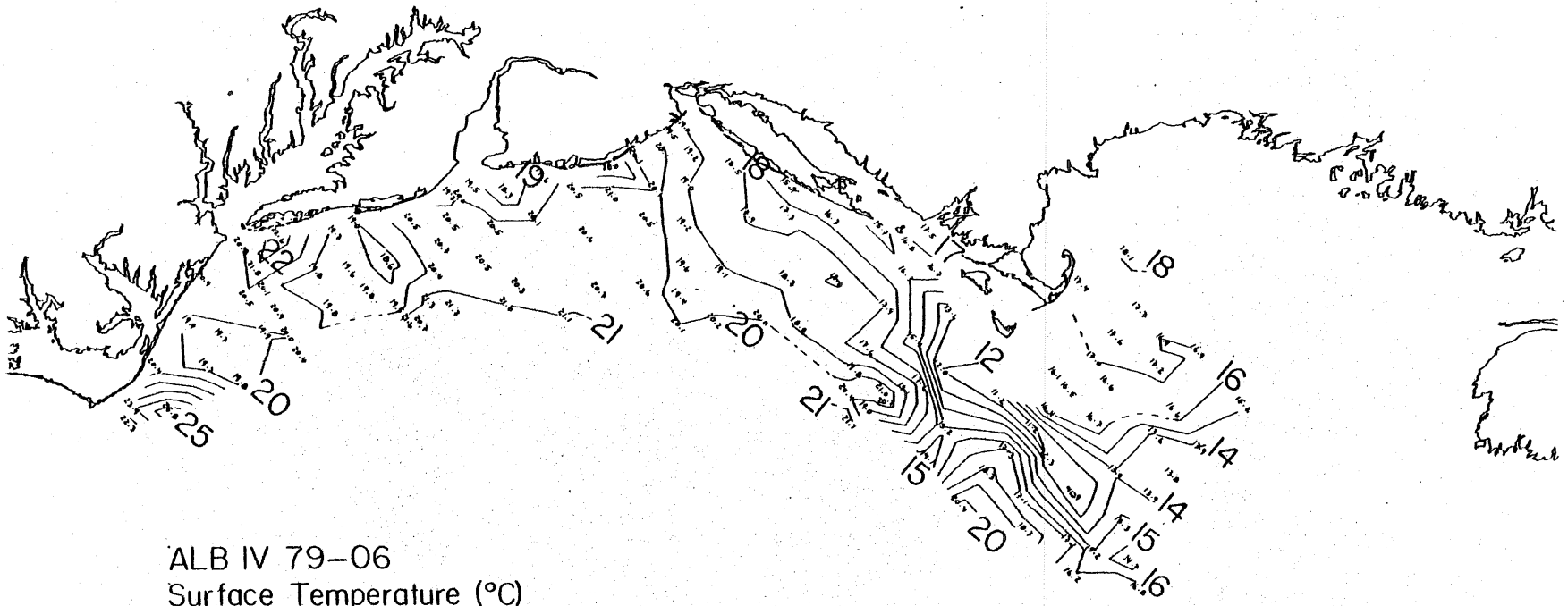

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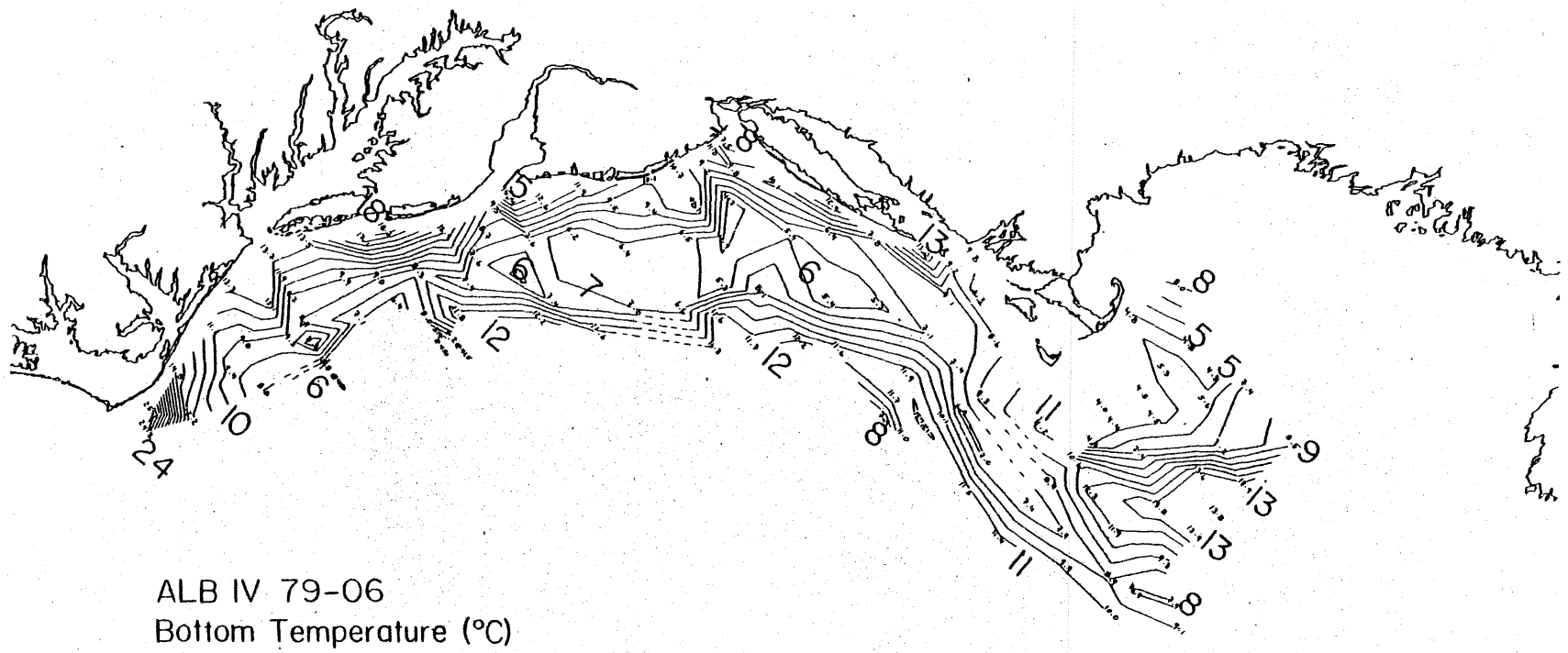

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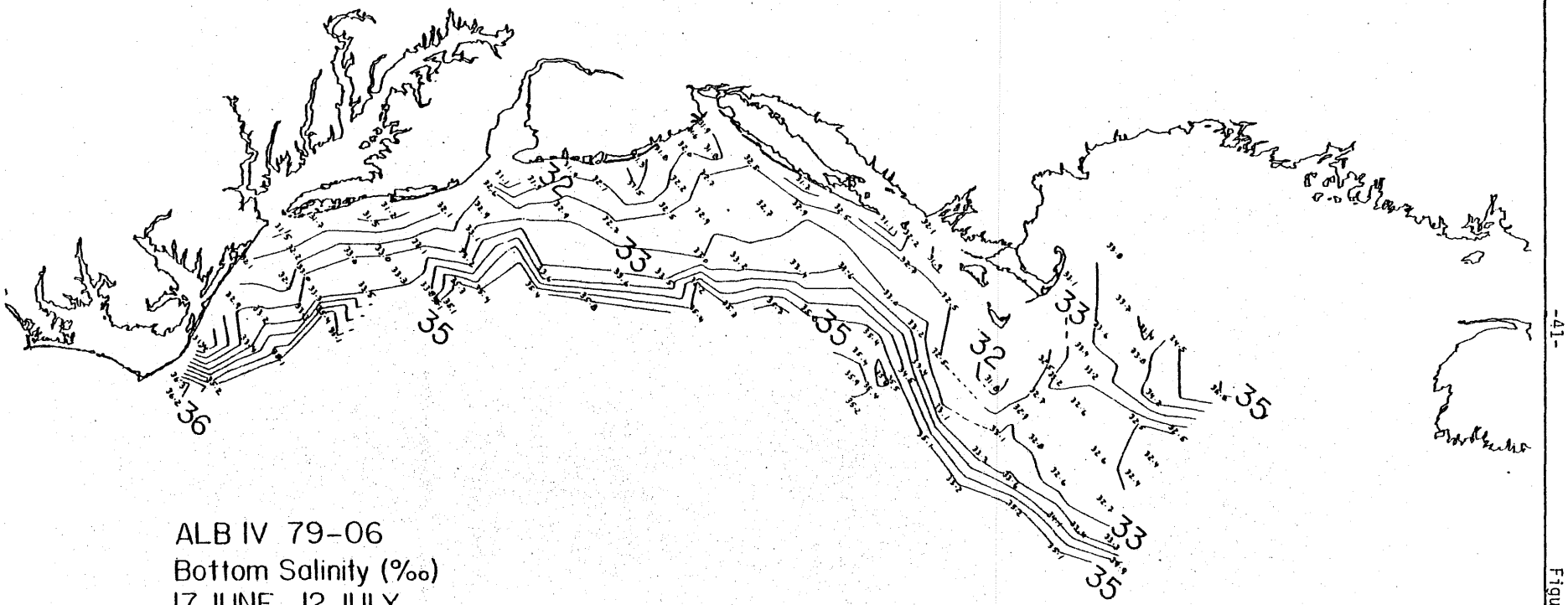

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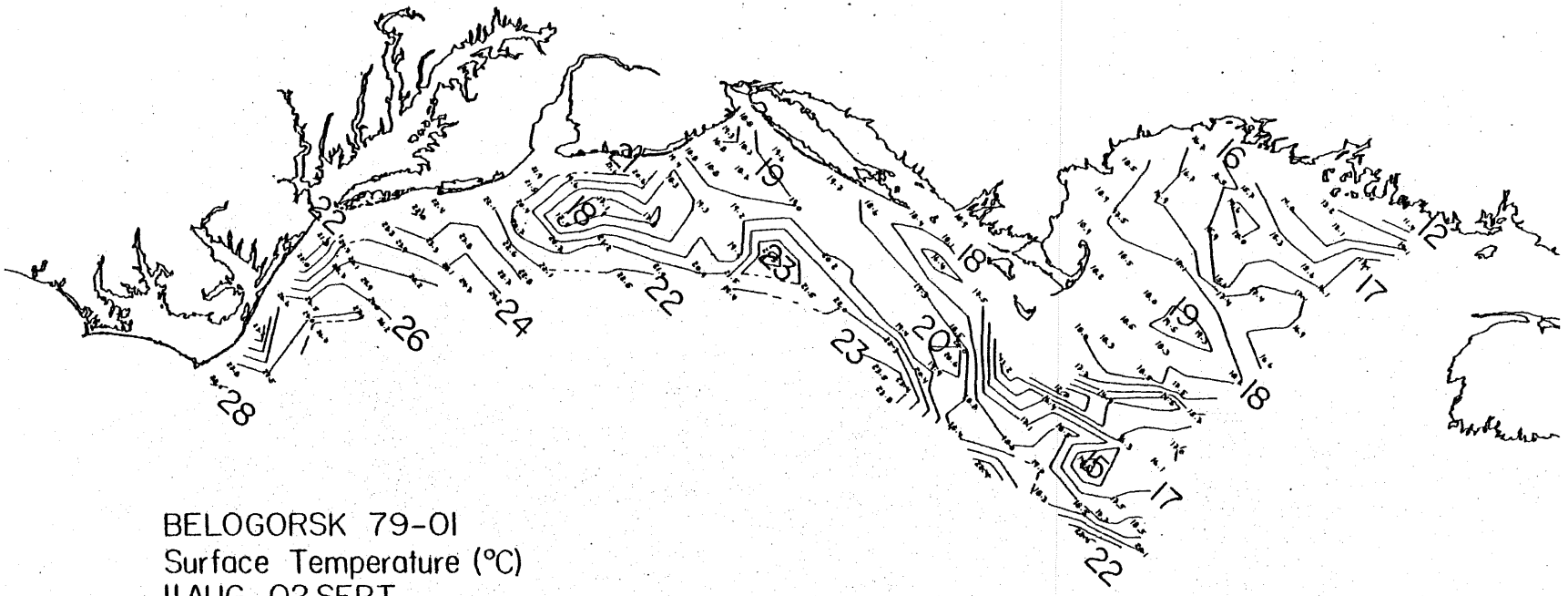

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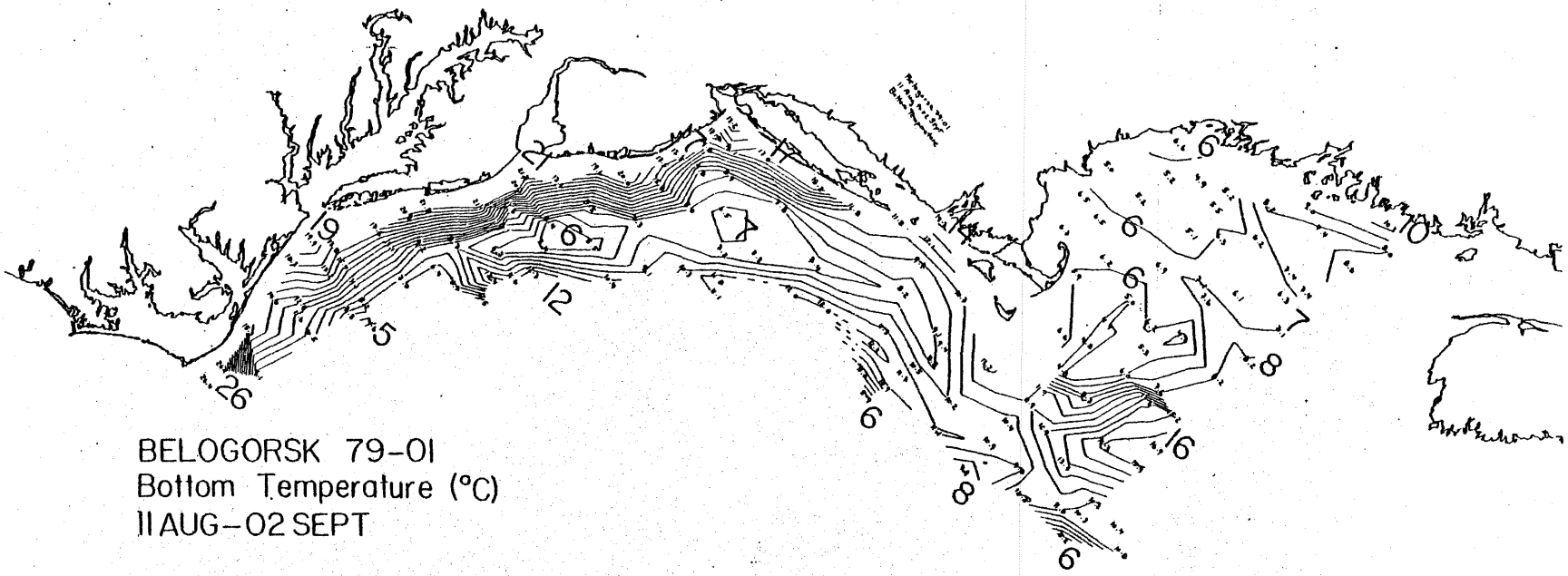

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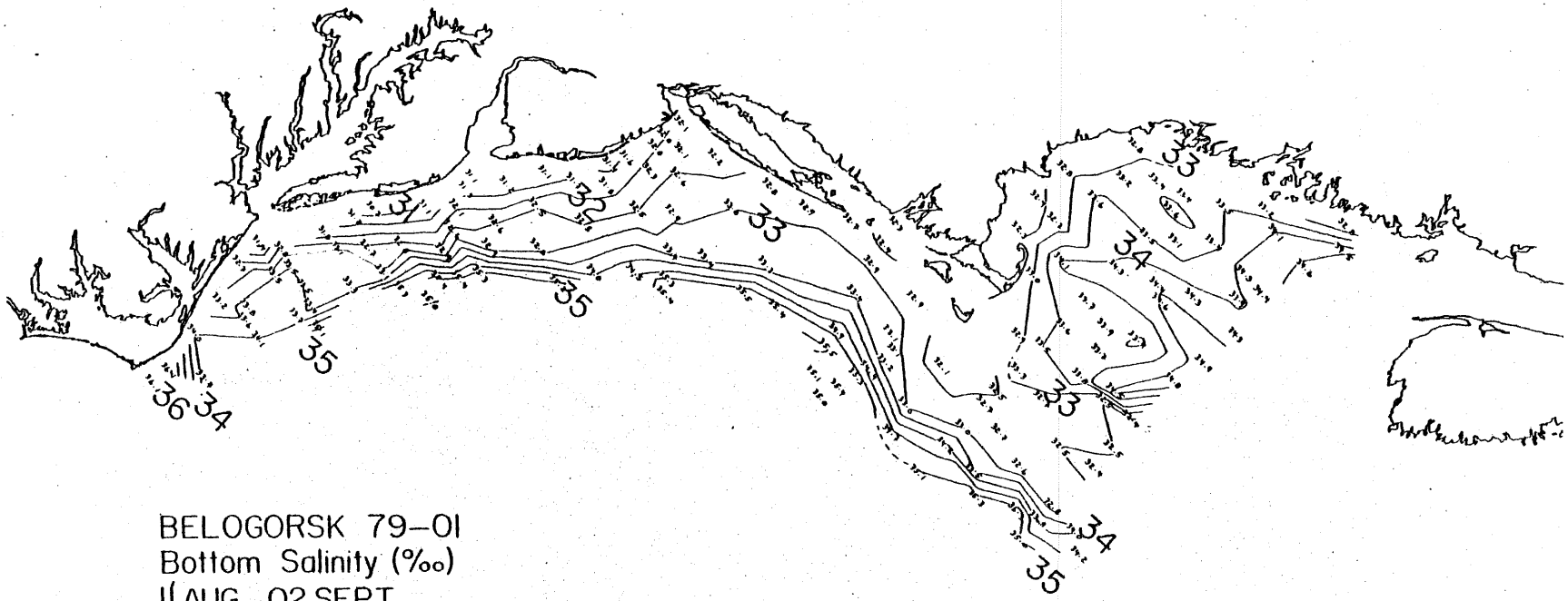

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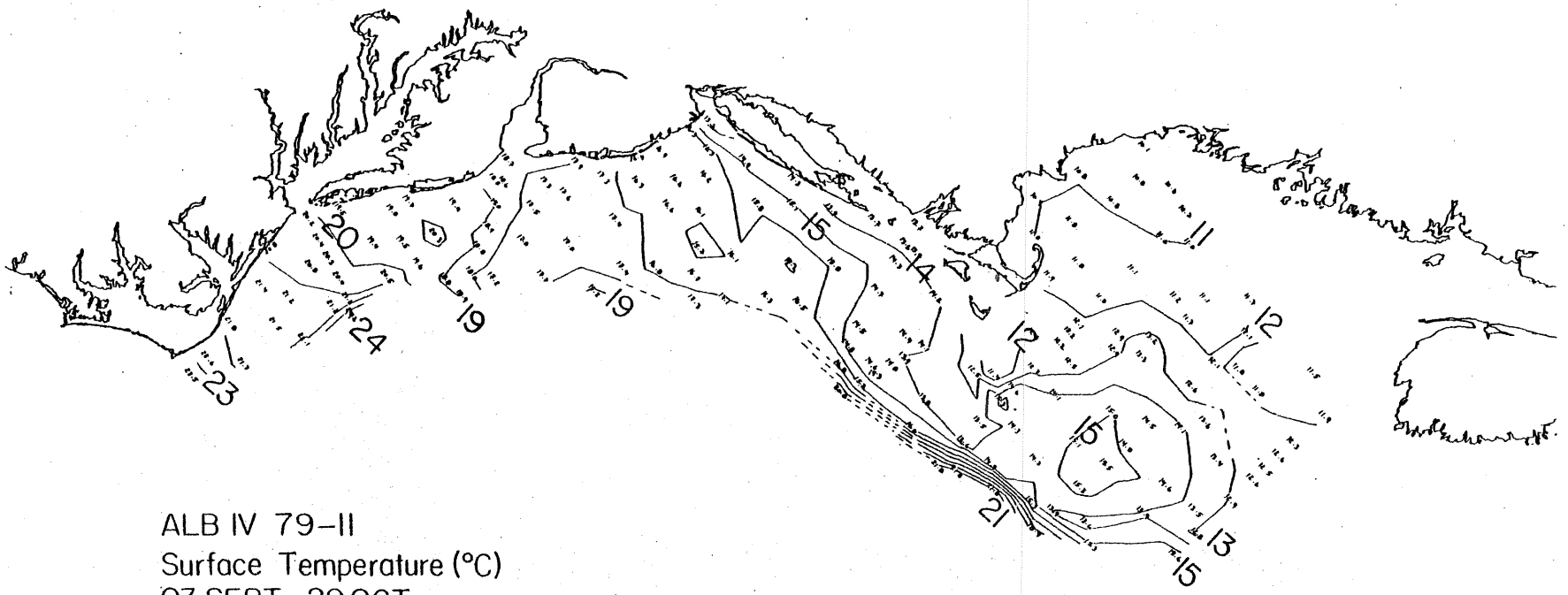
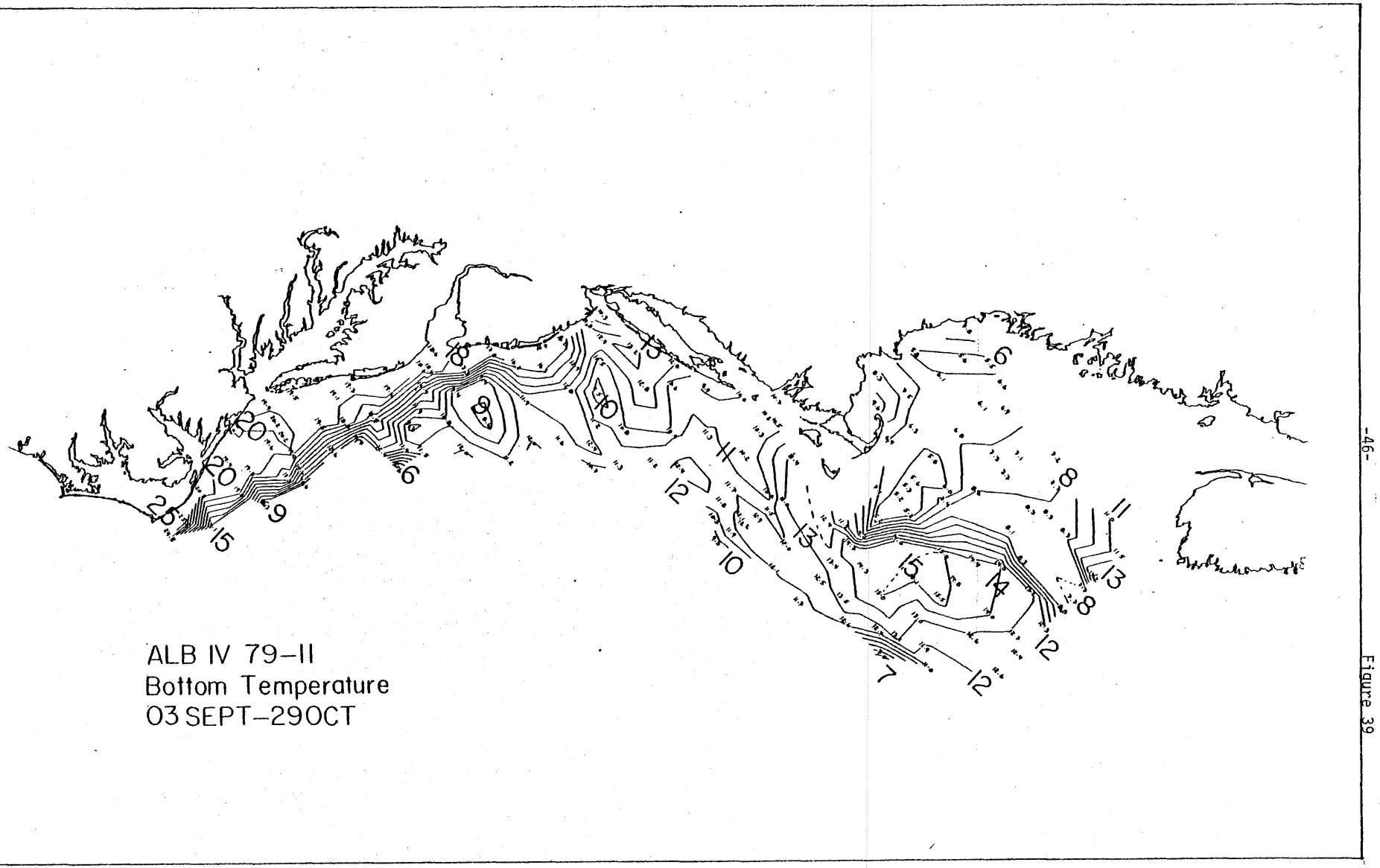


ALB IV 79-II
Surface Temperature (°C)
03 SEPT–29 OCT

Figure 38



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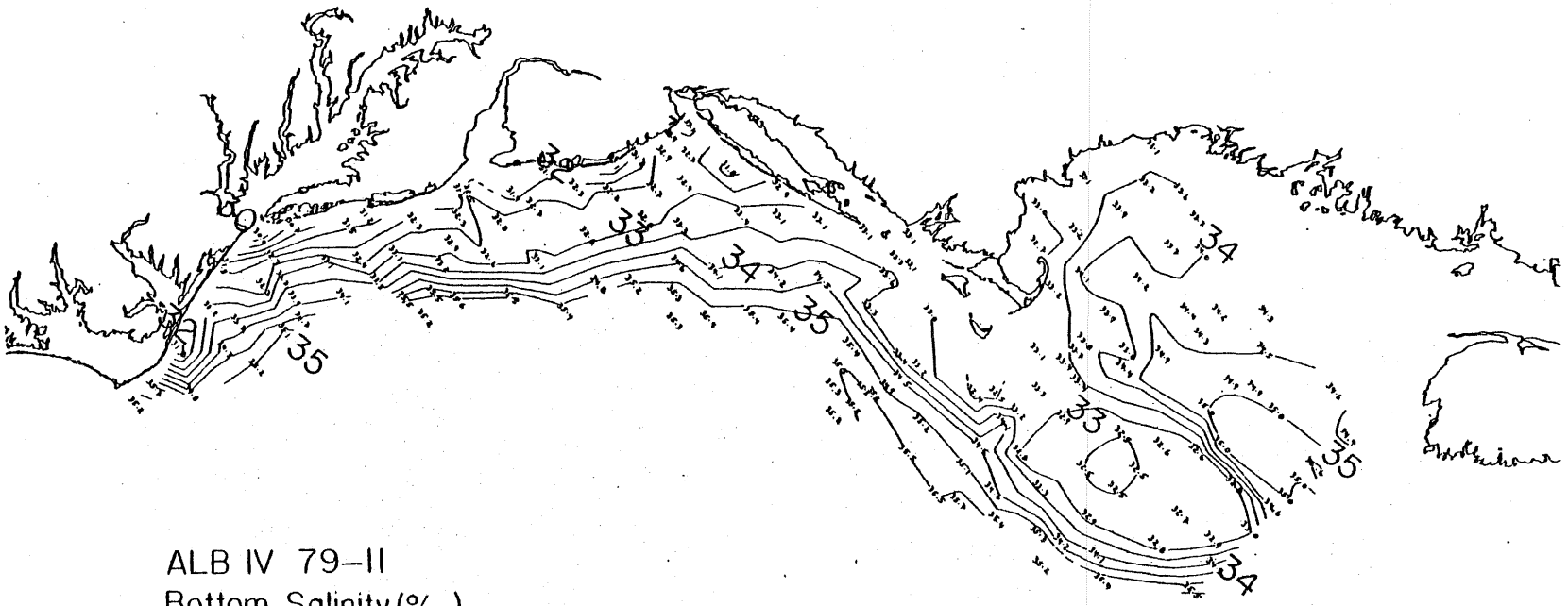


ALB IV 79–11
Bottom Salinity (‰)
03 SEPT – 29 OCT

Figure 40

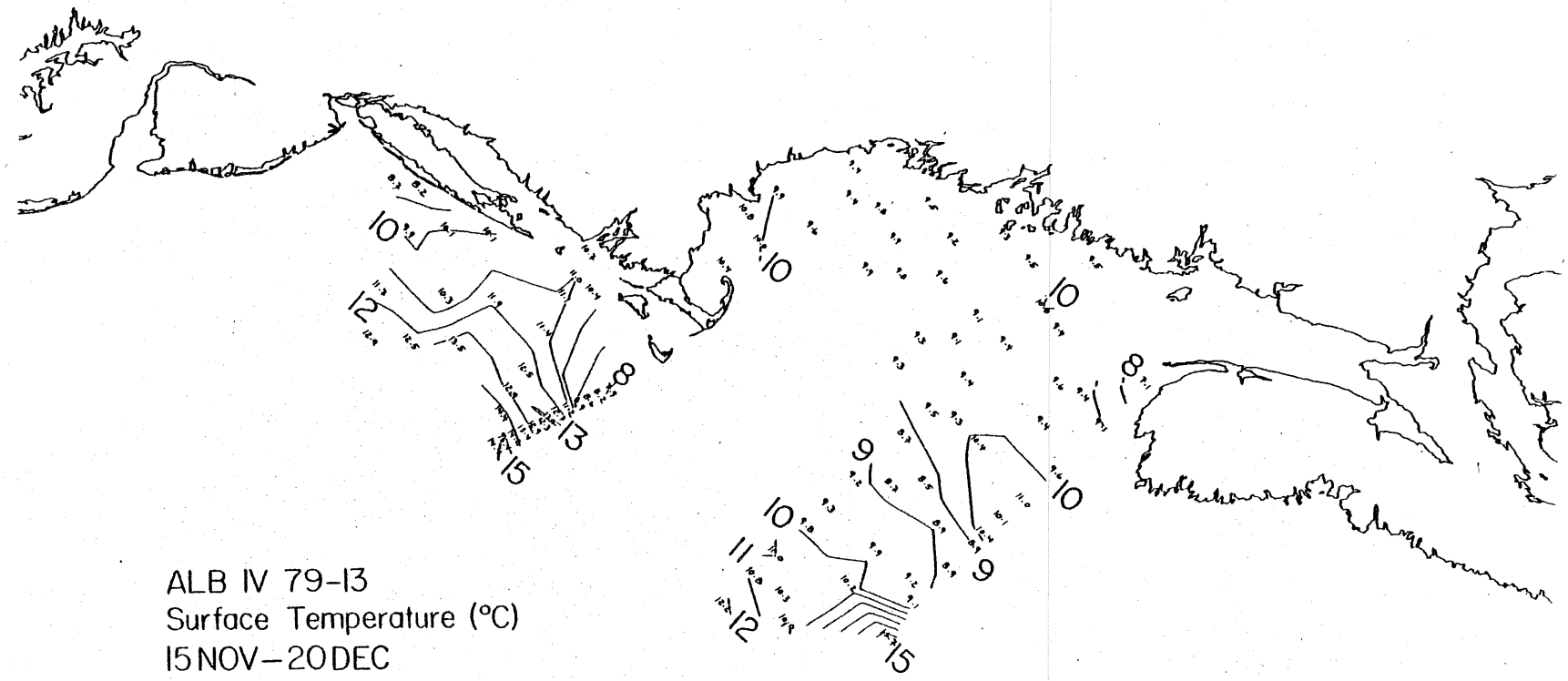


Figure 41

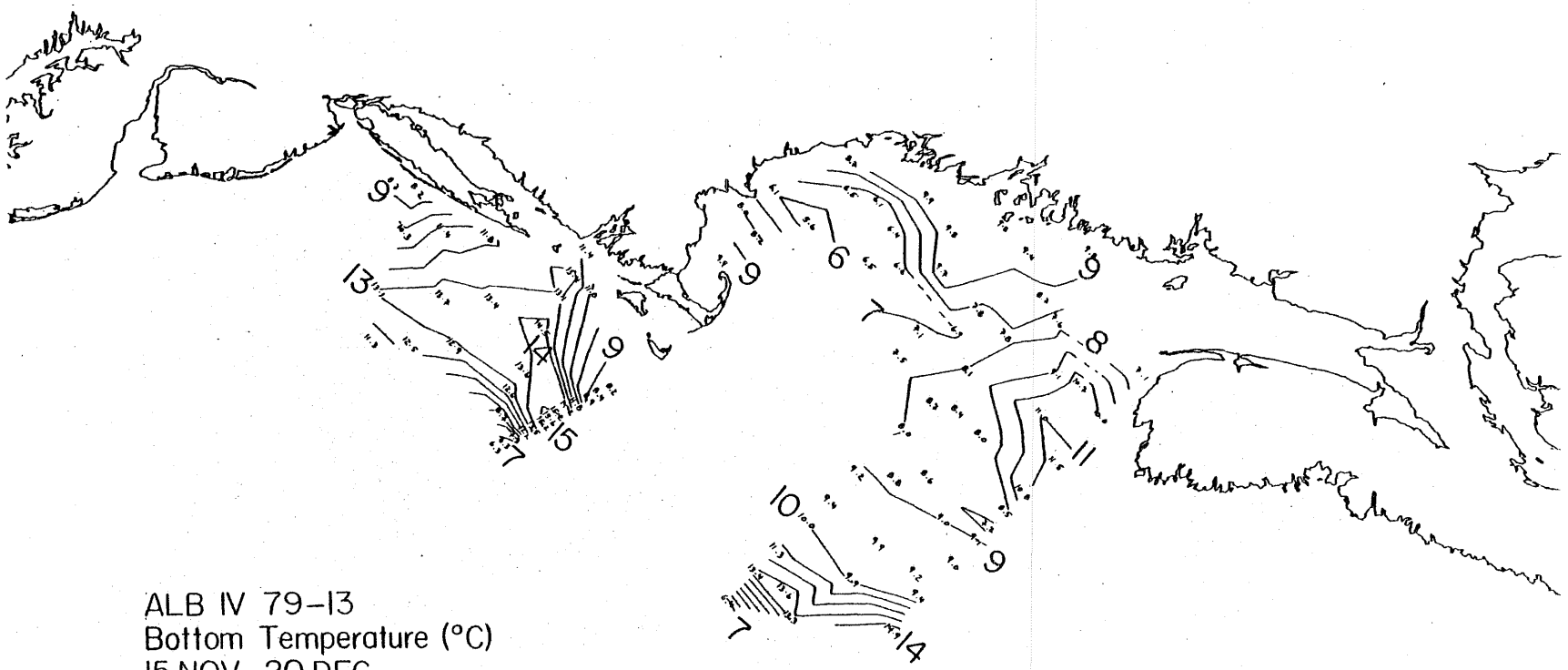


Figure 42

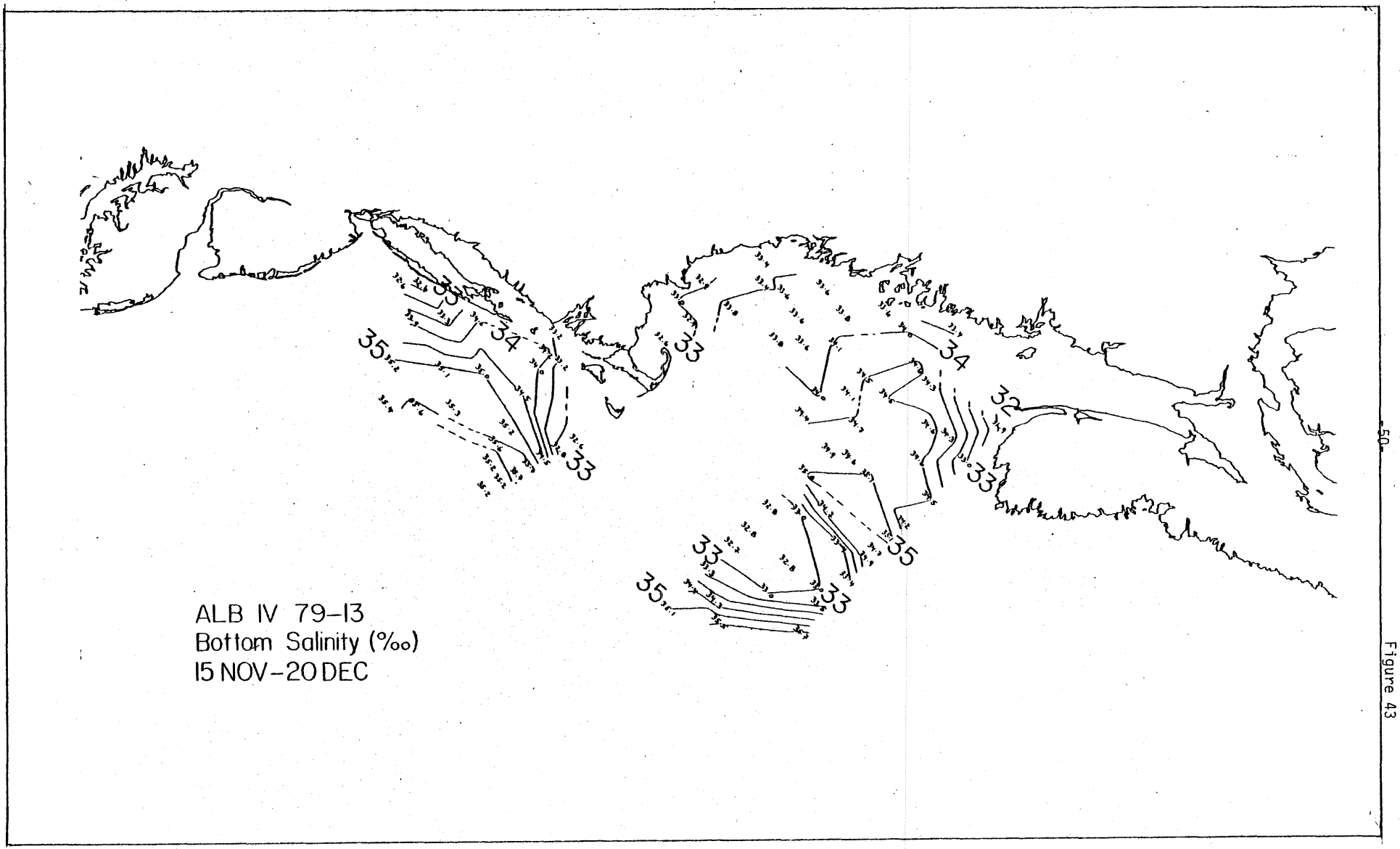
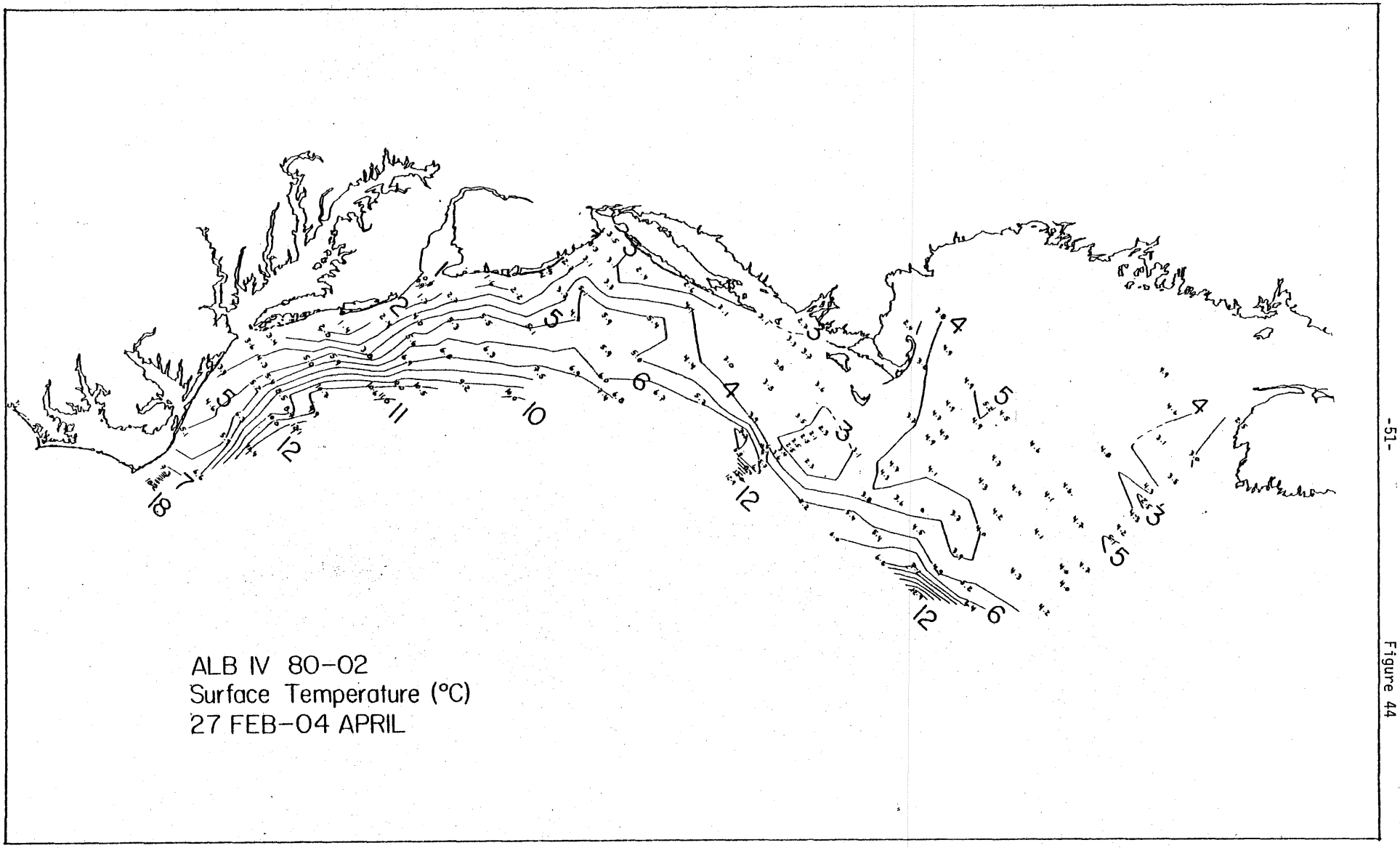


Figure 43



ALB IV 80-02
Surface Temperature (°C)
27 FEB-04 APRIL

Figure 44

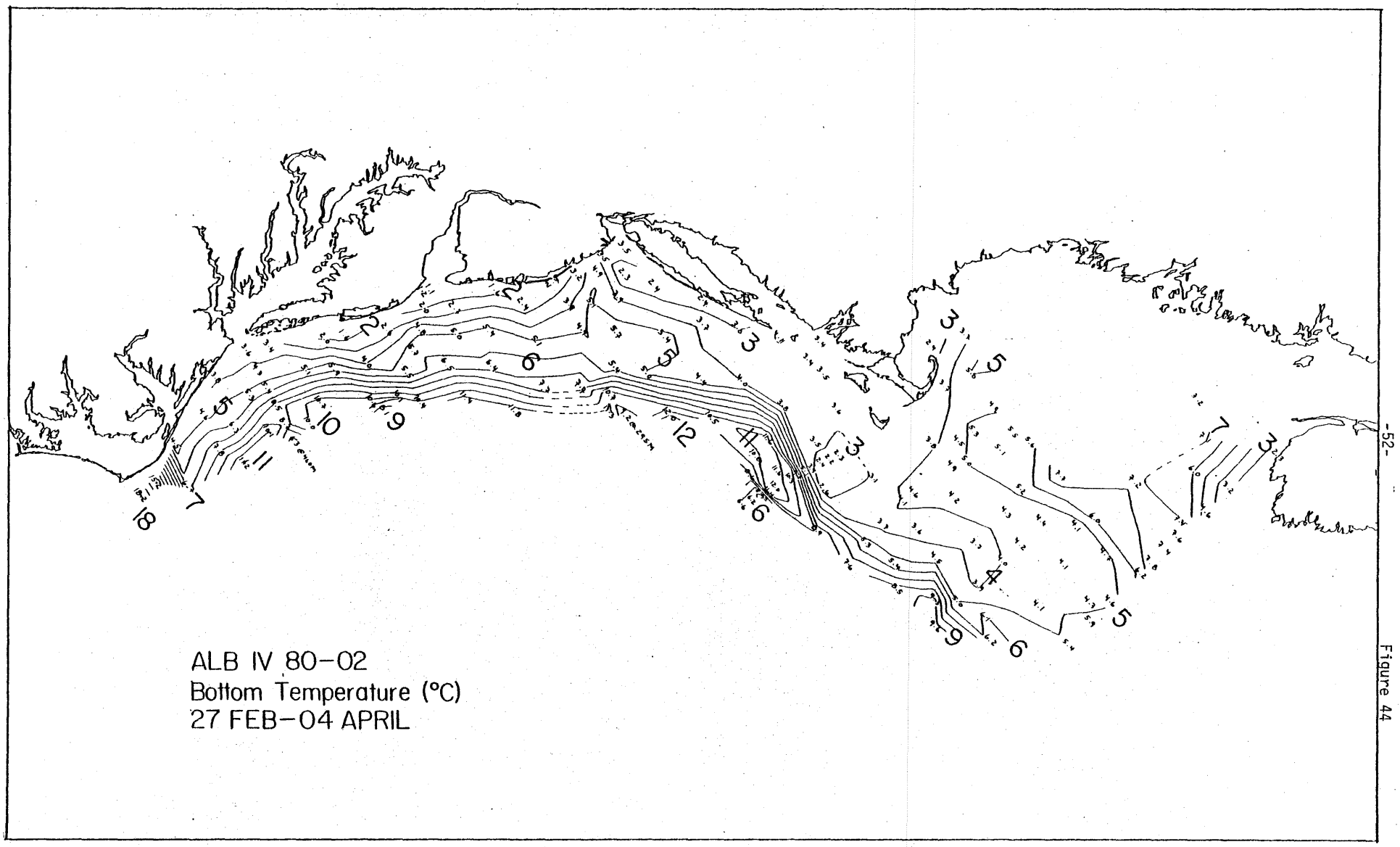


Figure 44

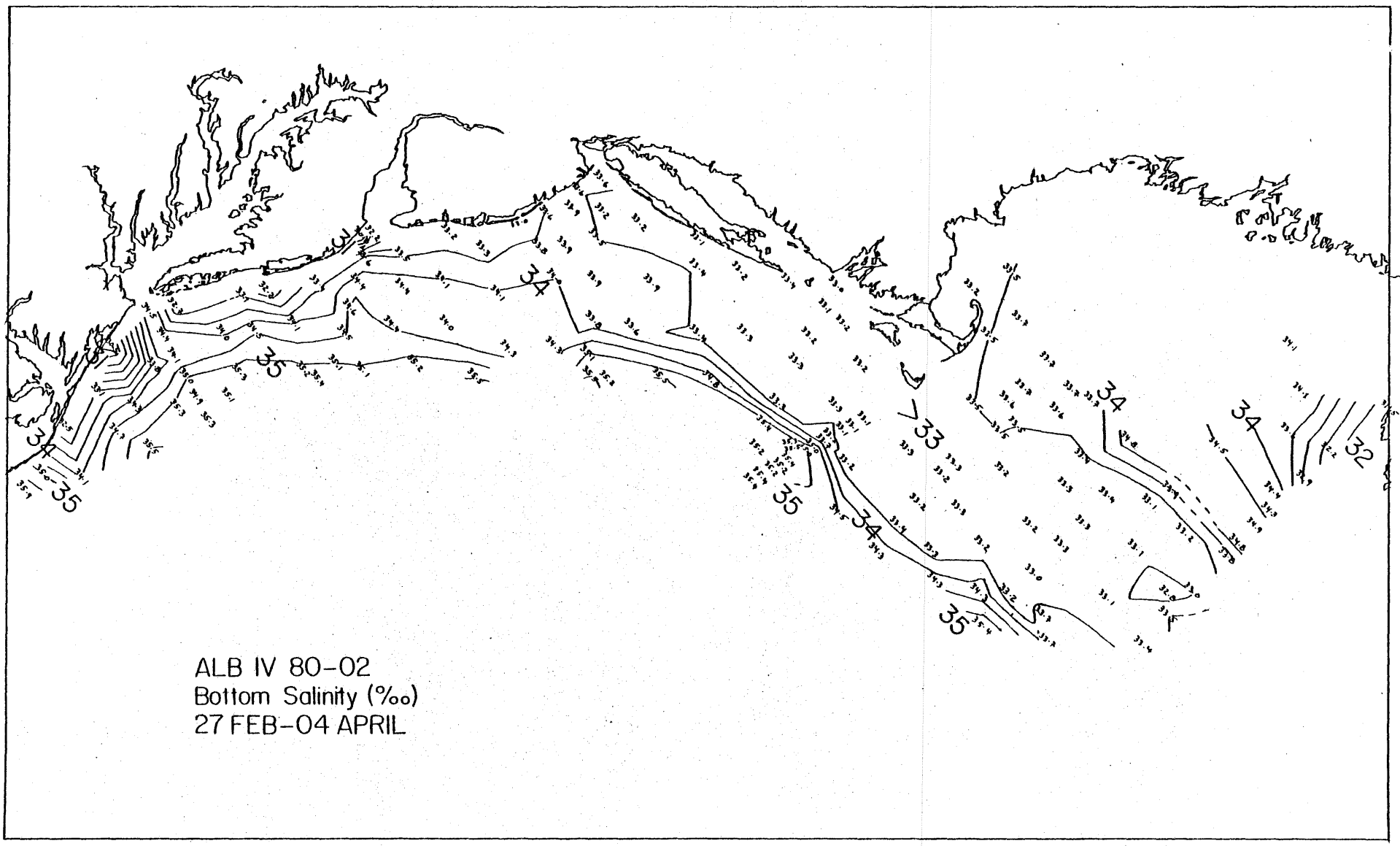


Figure 45

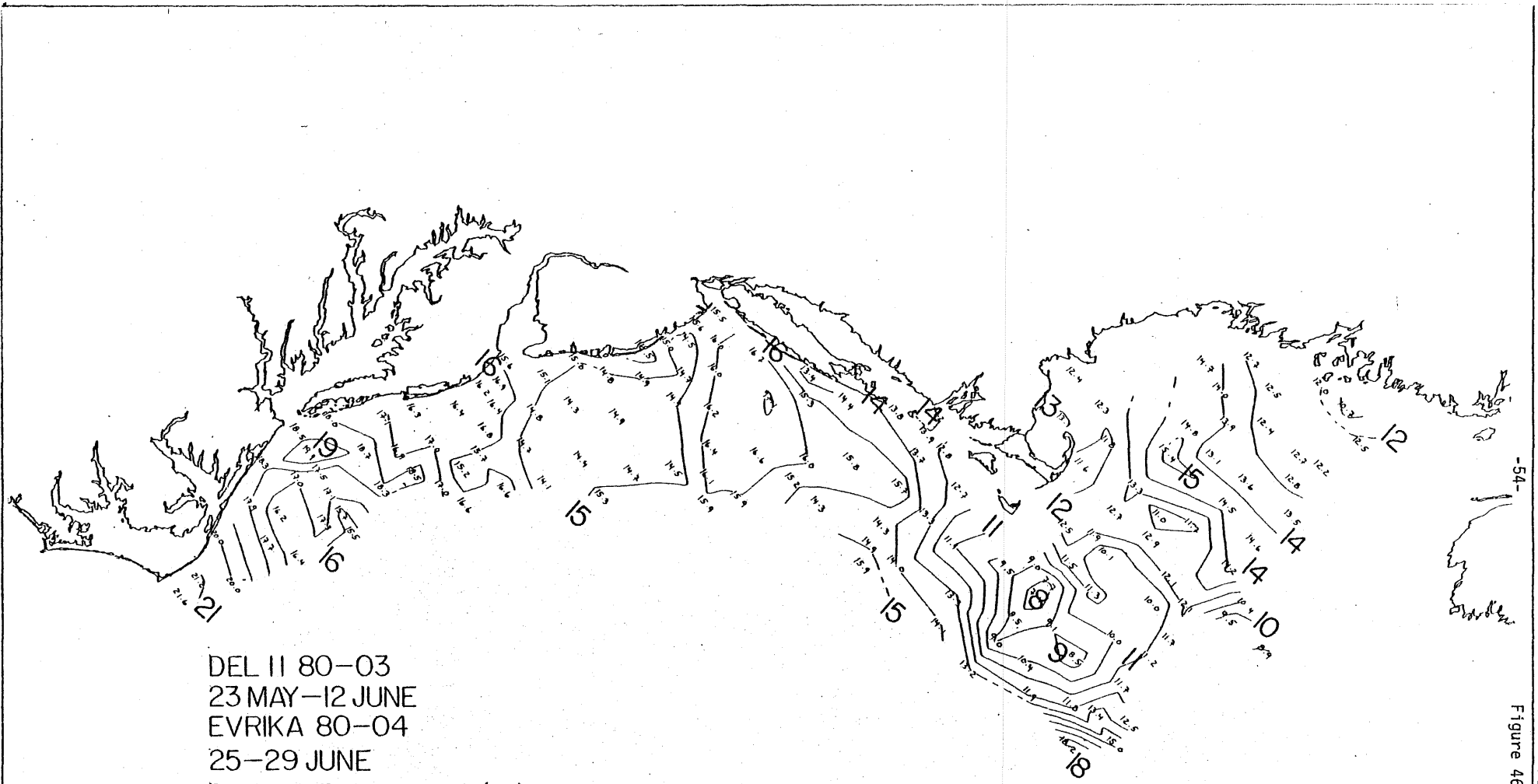

DEL 11 80-03
23 MAY-12 JUNE
EVRIKA 80-04
25-29 JUNE
Surface Temperature (°C)

Figure 46

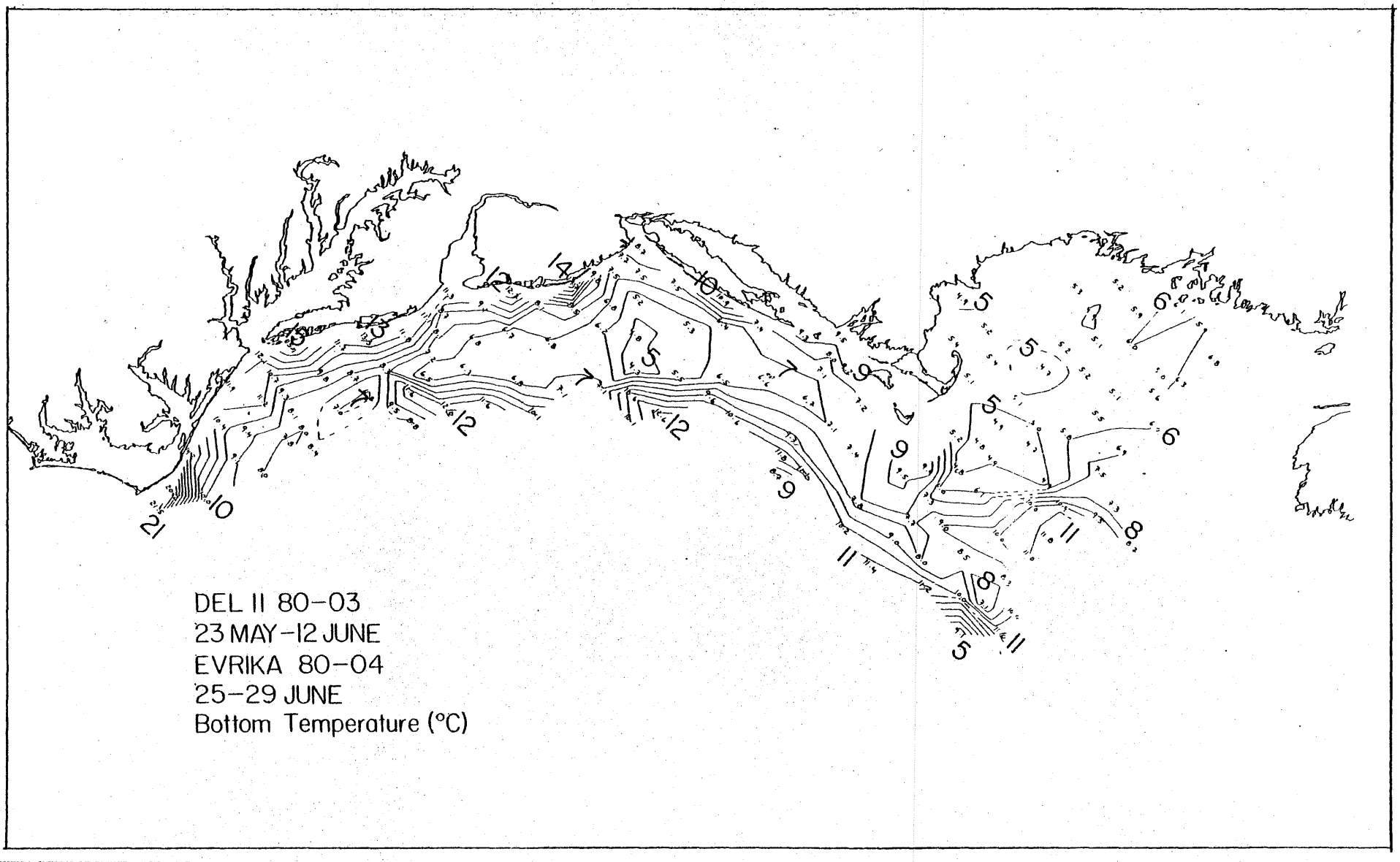

DEL II 80-03
23 MAY-12 JUNE
EVRIKA 80-04
25-29 JUNE
Bottom Temperature (°C)

Figure 47

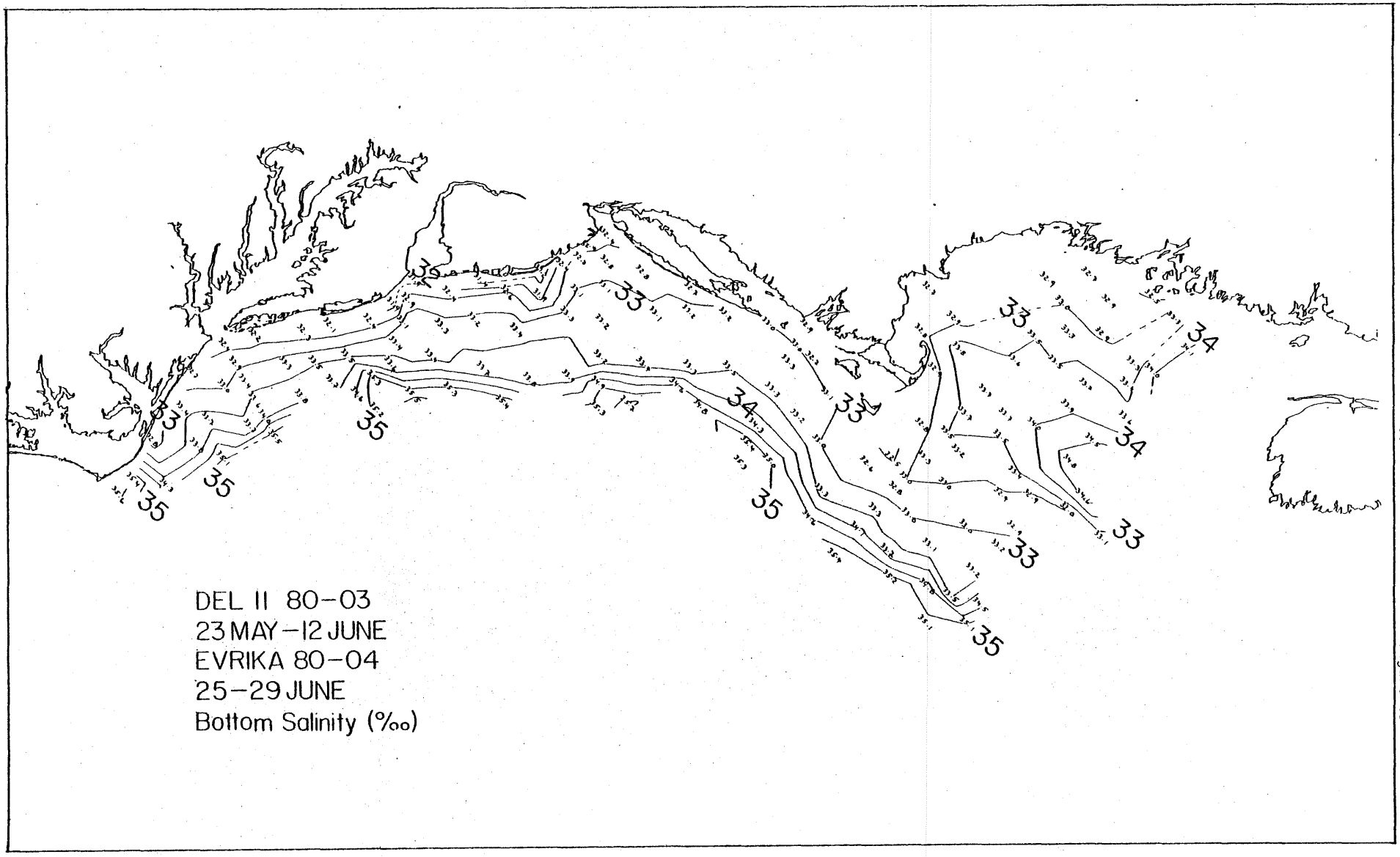
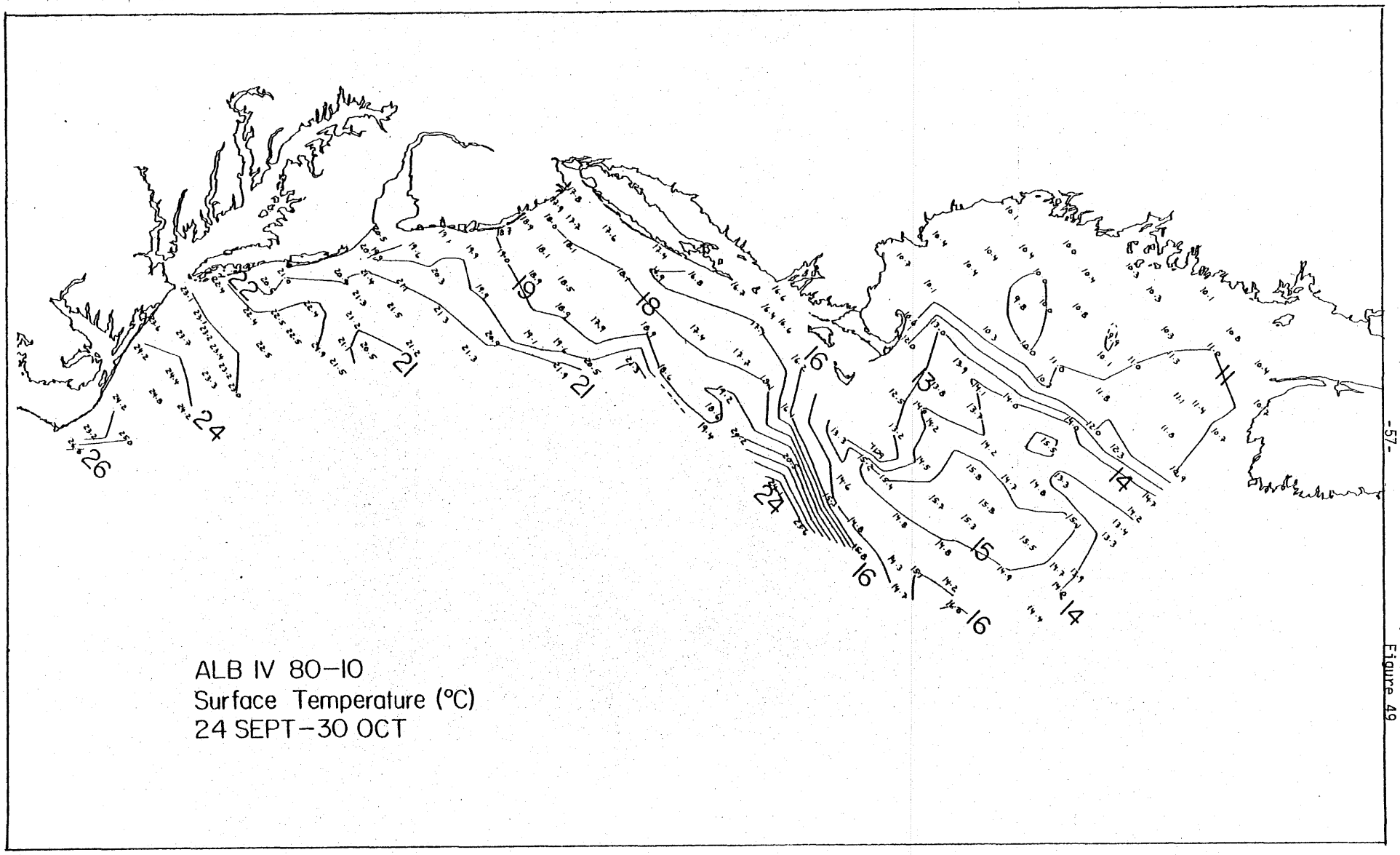
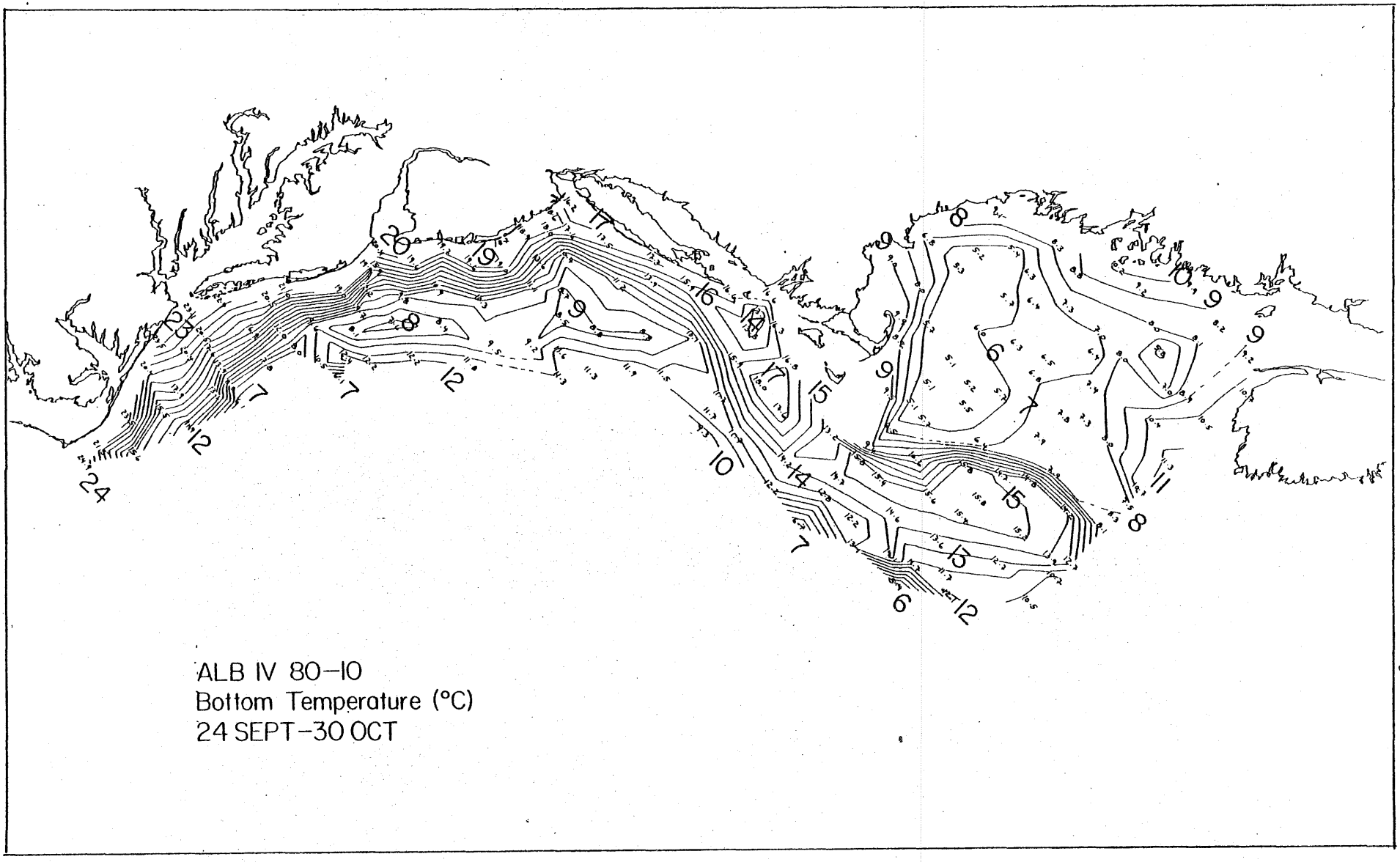

DEL 11 80-03
23 MAY - 12 JUNE
EVRIKA 80-04
25-29 JUNE
Bottom Salinity (‰)

Figure 48



ALB IV 80-10
Surface Temperature (°C)
24 SEPT-30 OCT

Figure 49



ALB IV 80–10
Bottom Temperature (°C)
24 SEPT–30 OCT

Figure 50

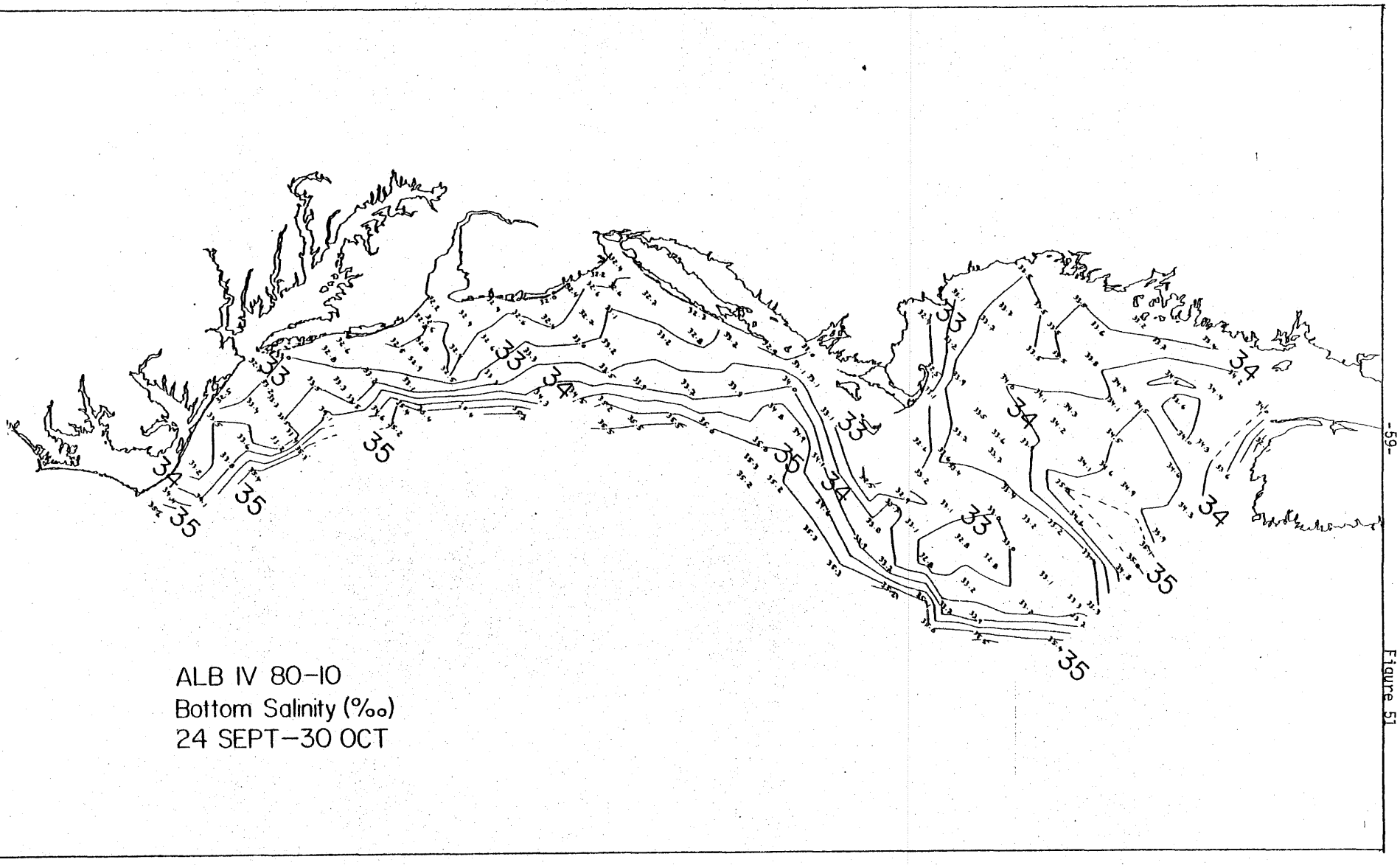
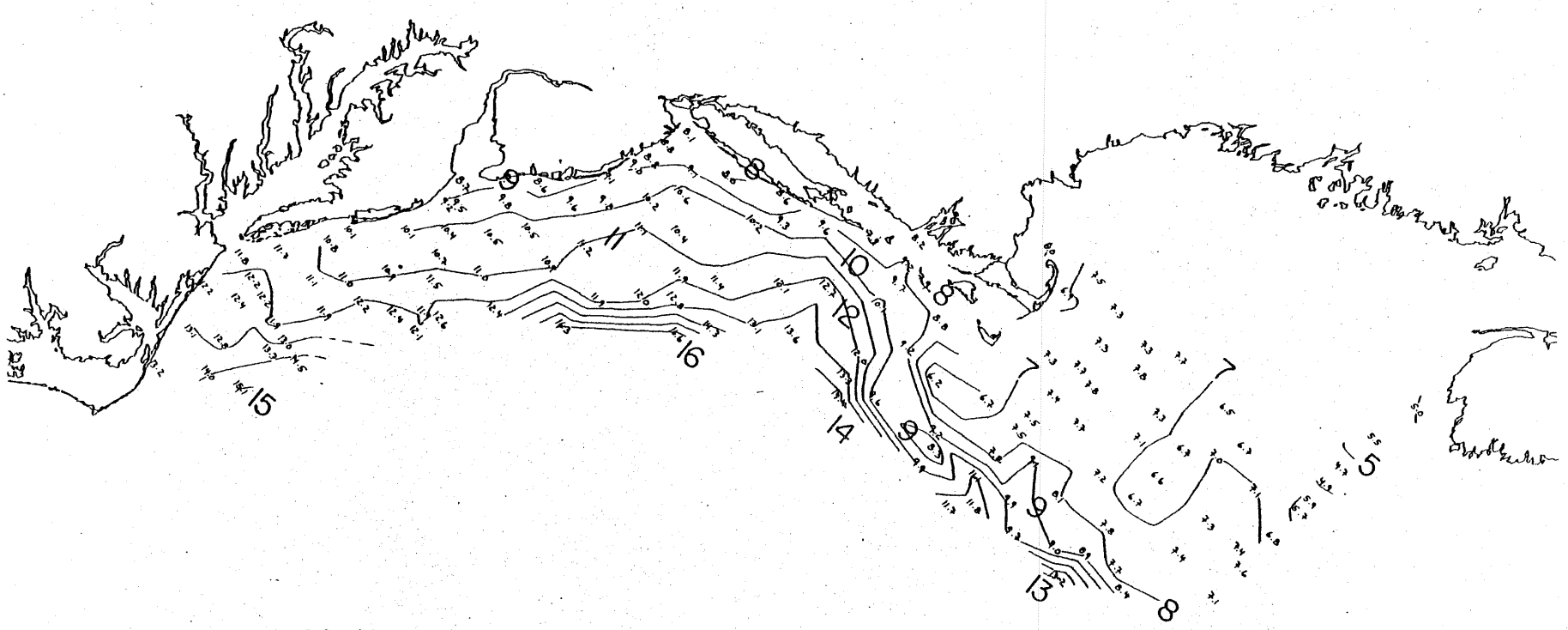


Figure 51



ALB IV 80-12
Surface Temperature (°C)
19 NOV–21 DEC

Figure 52

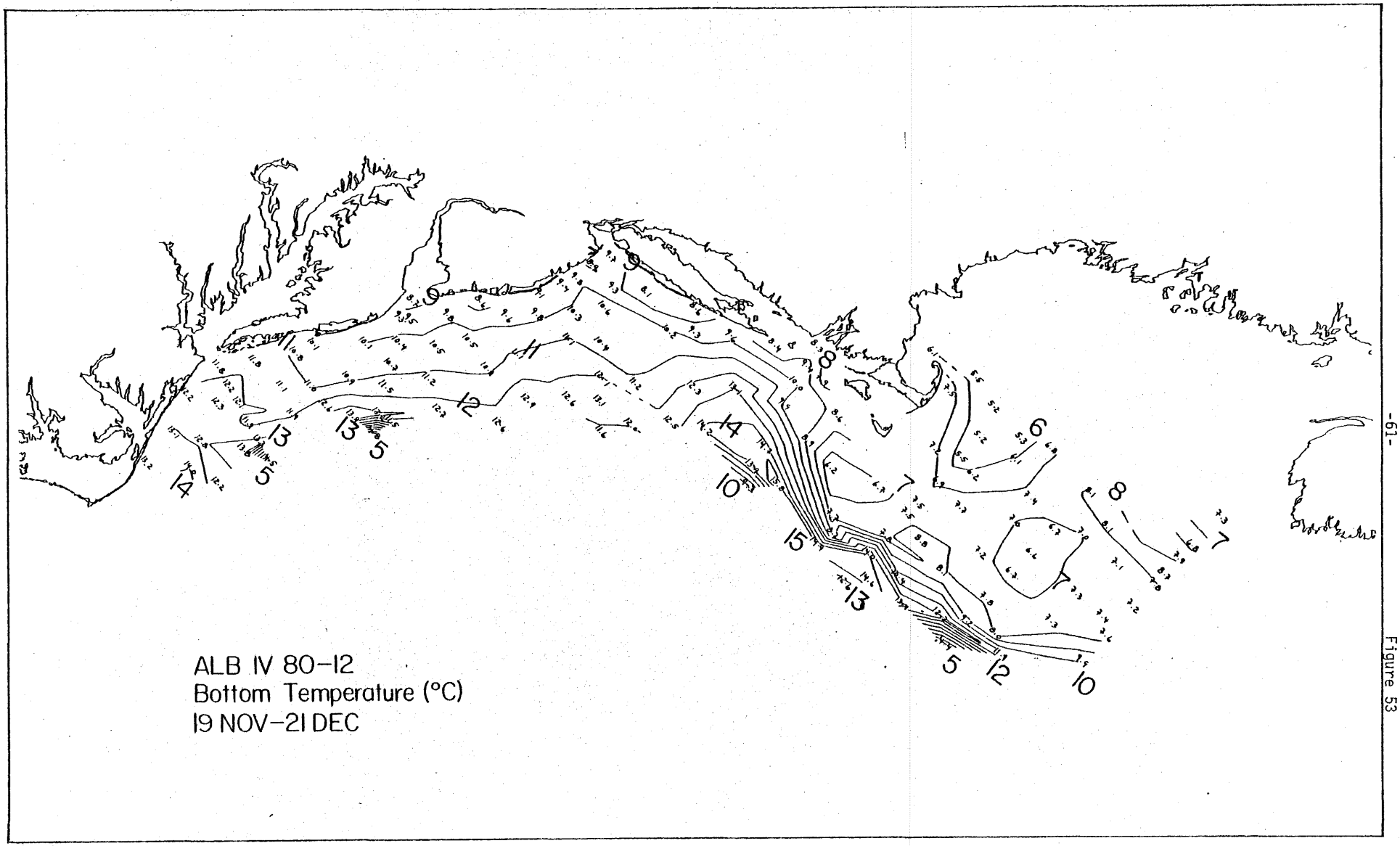


Figure 53

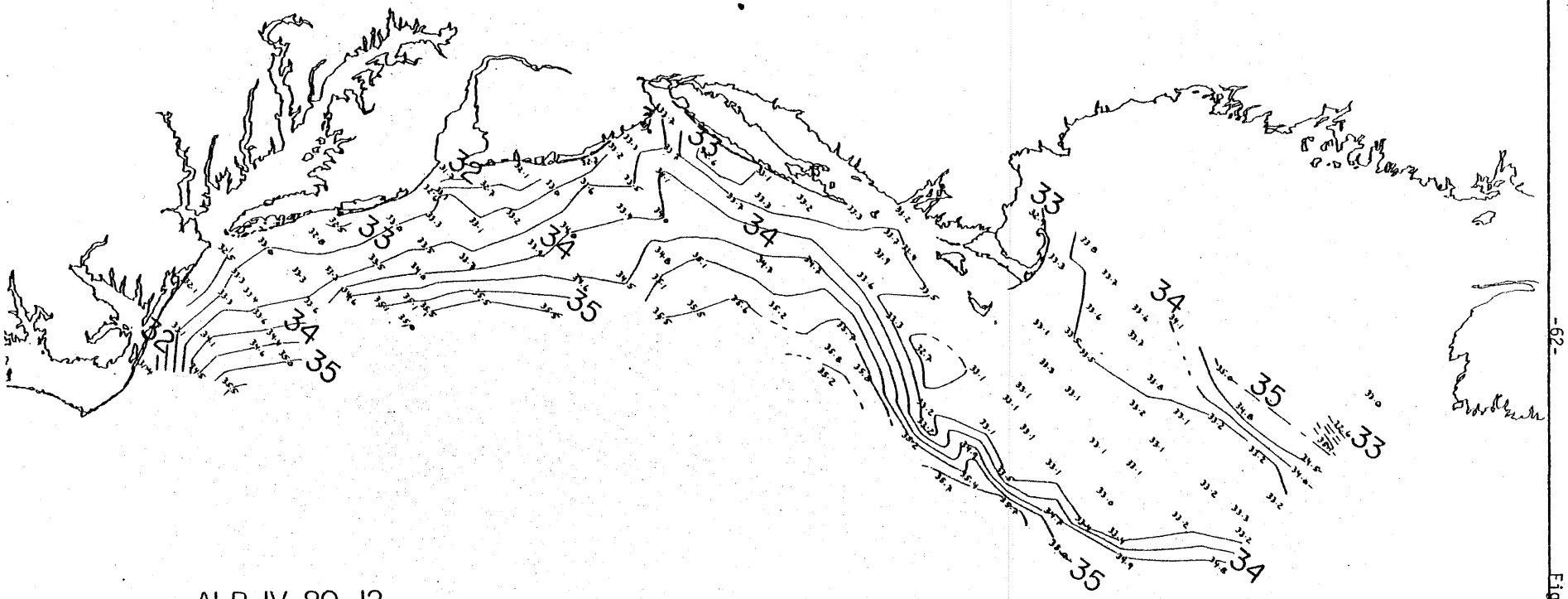


Figure 54

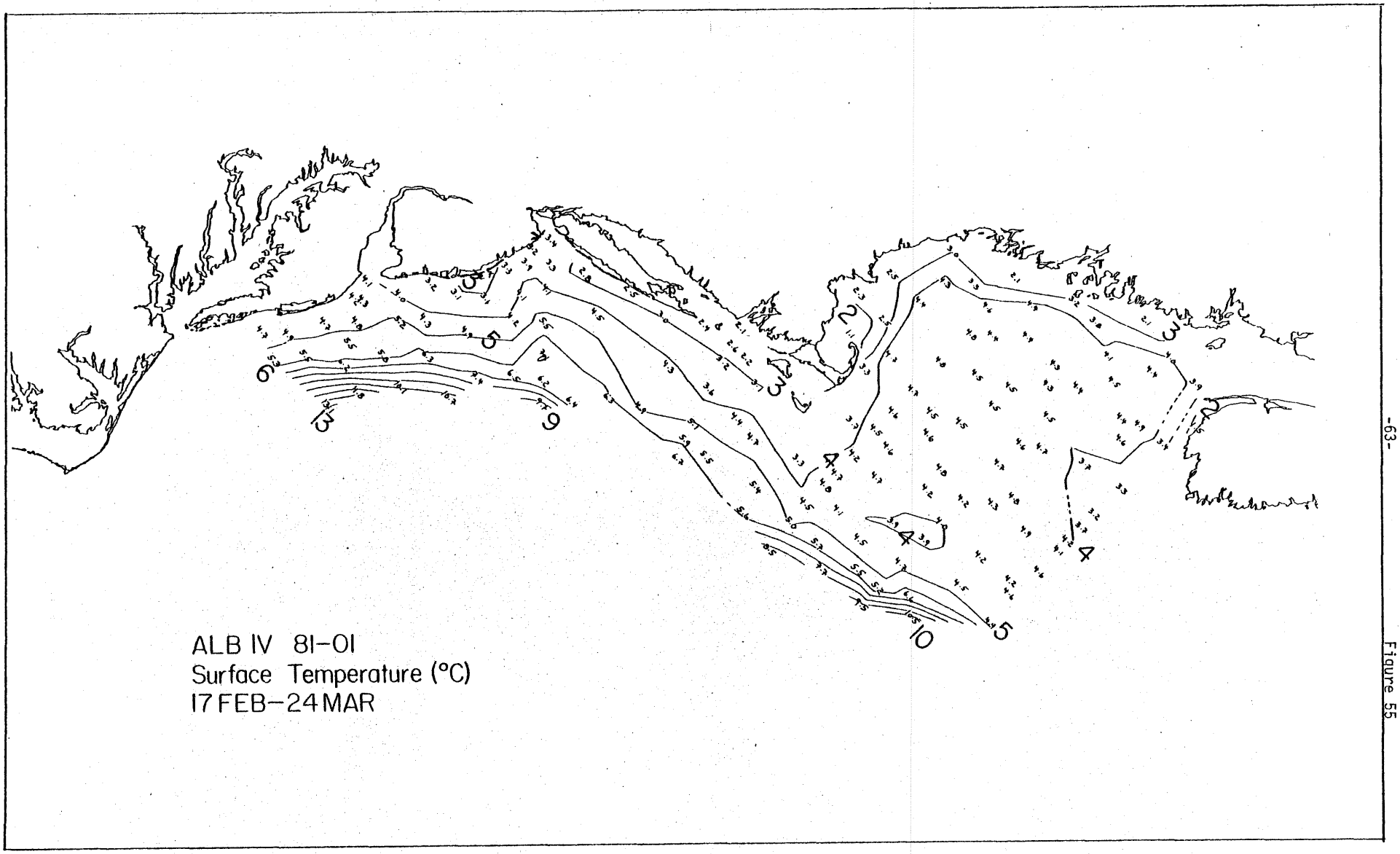


Figure 55

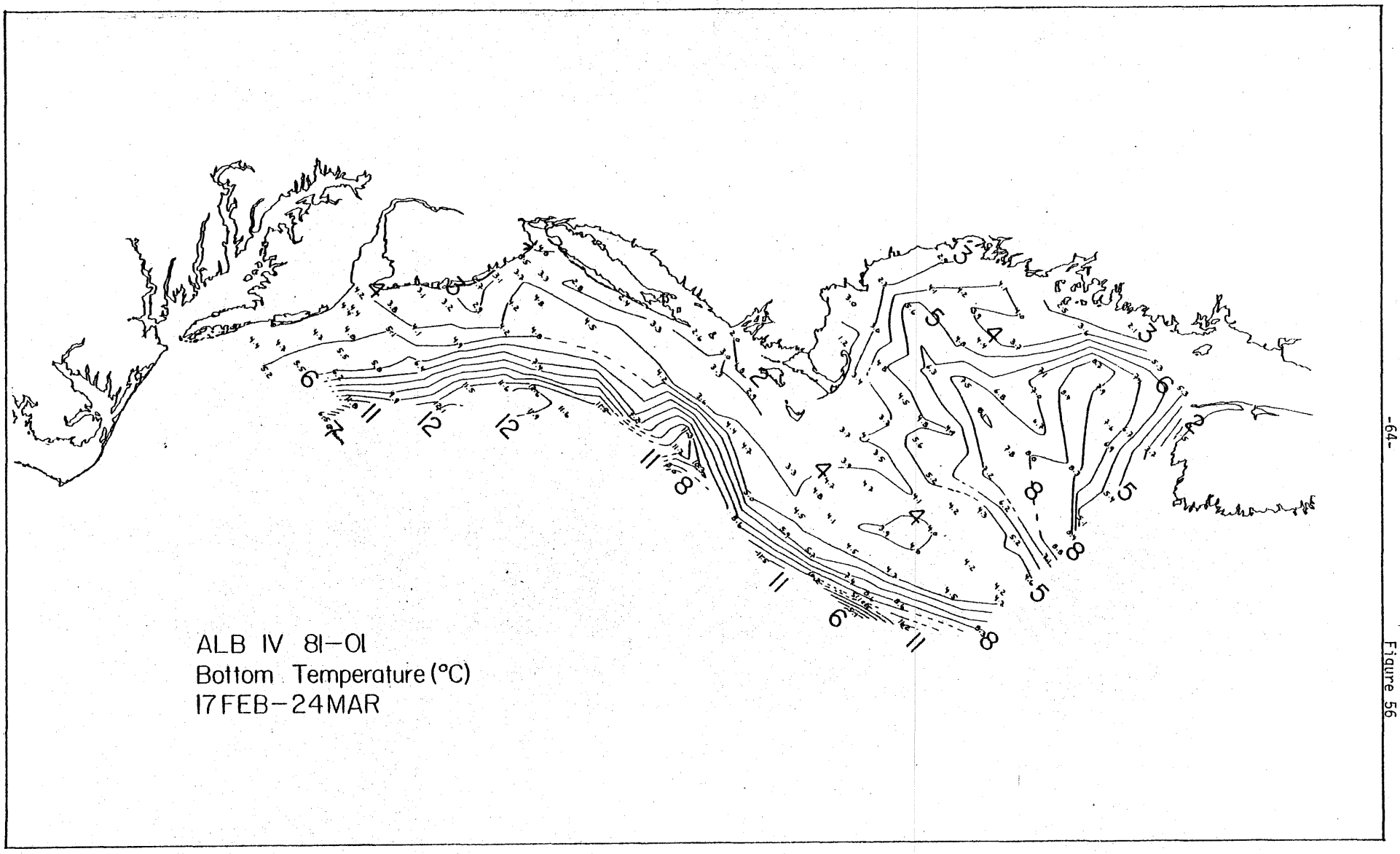


Figure 56

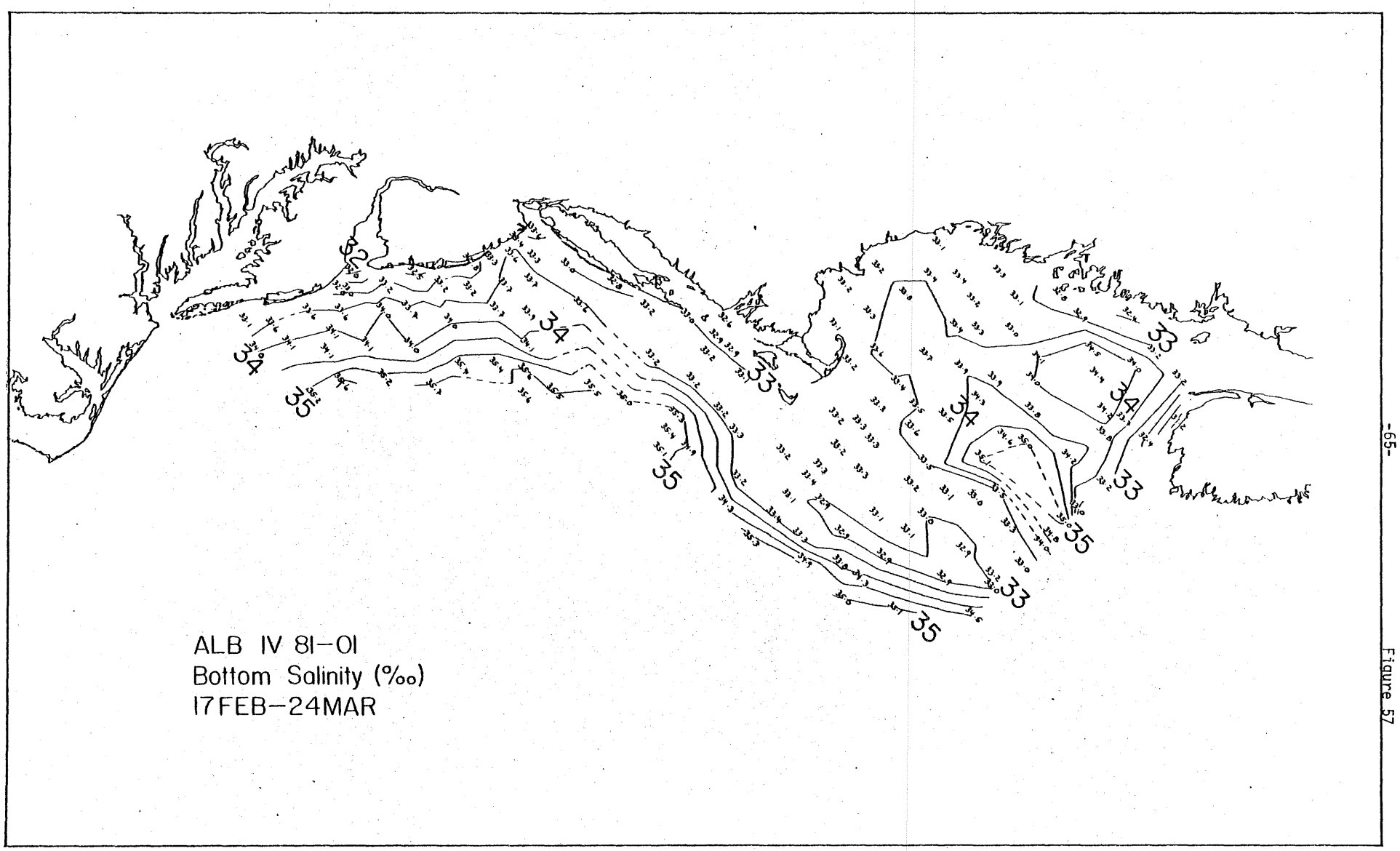


Figure 57

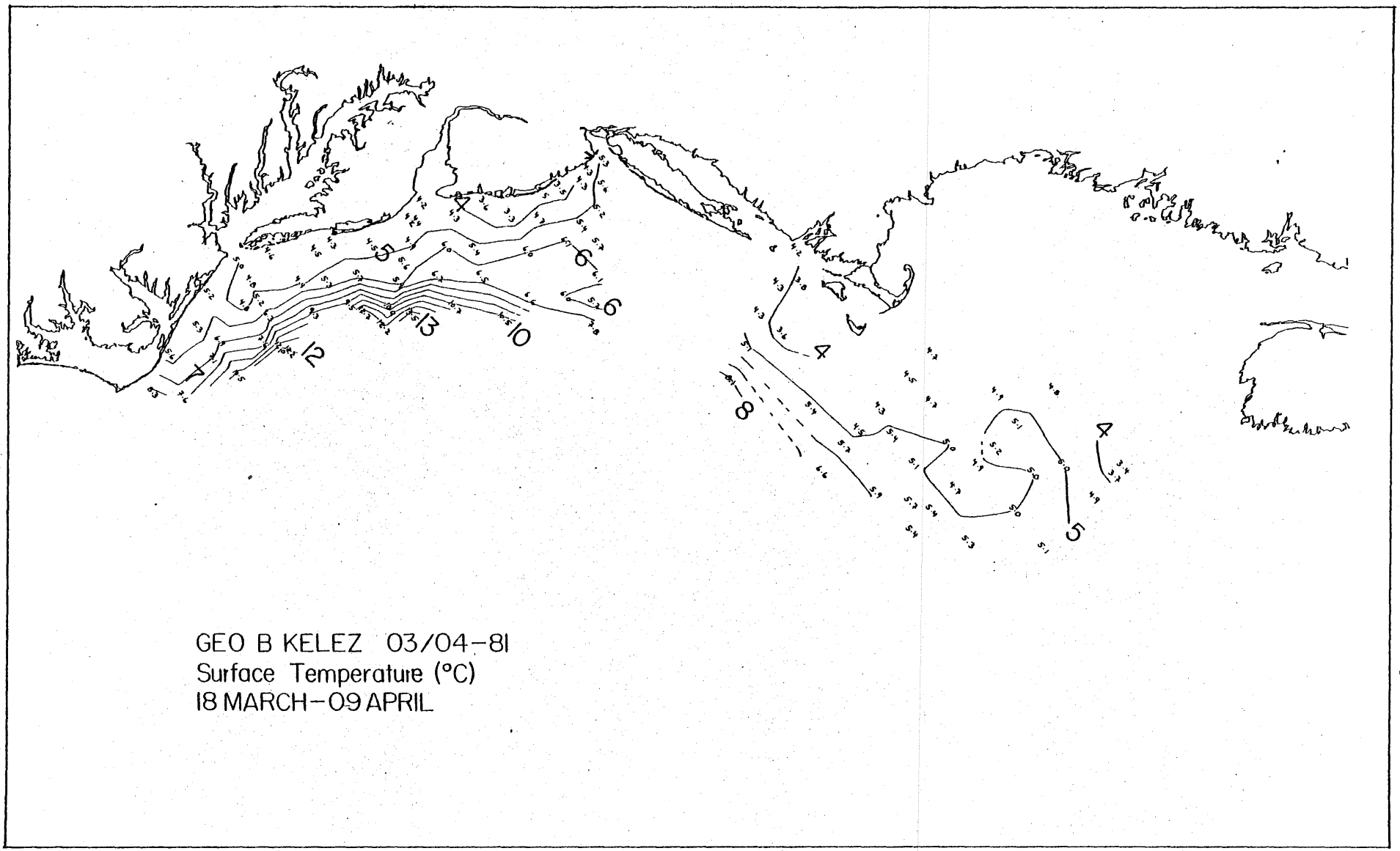
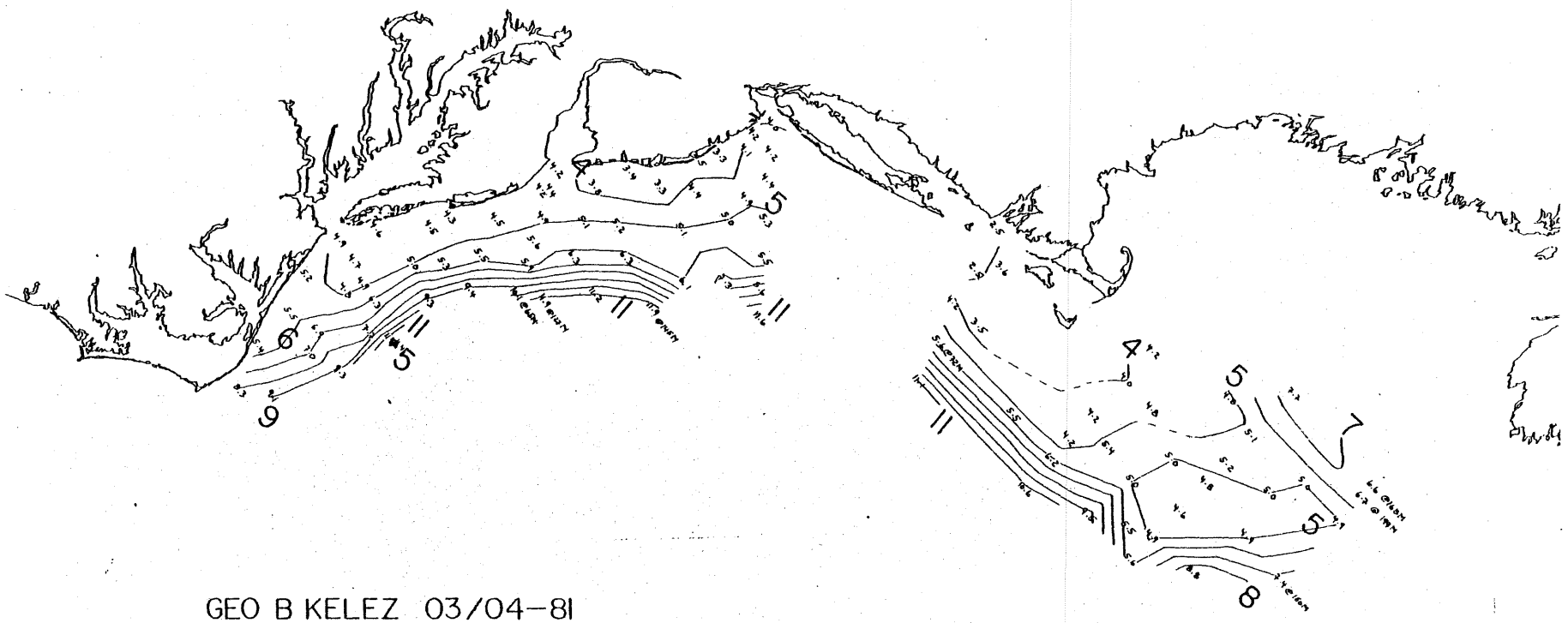


Figure 58



GEO B KELEZ 03/04–81
Bottom Temperature (°C)
18 MARCH–09 APRIL

Figure 59

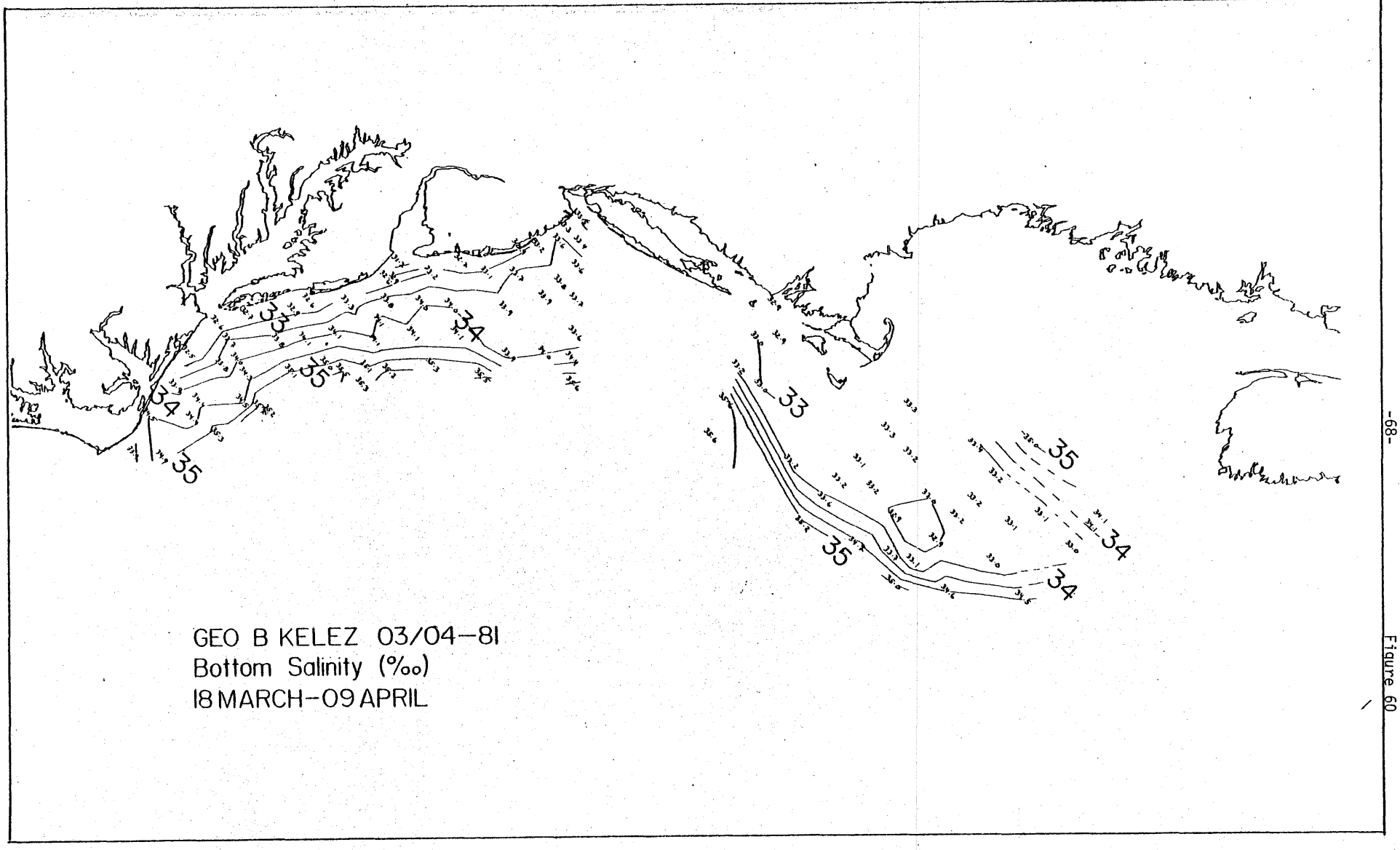
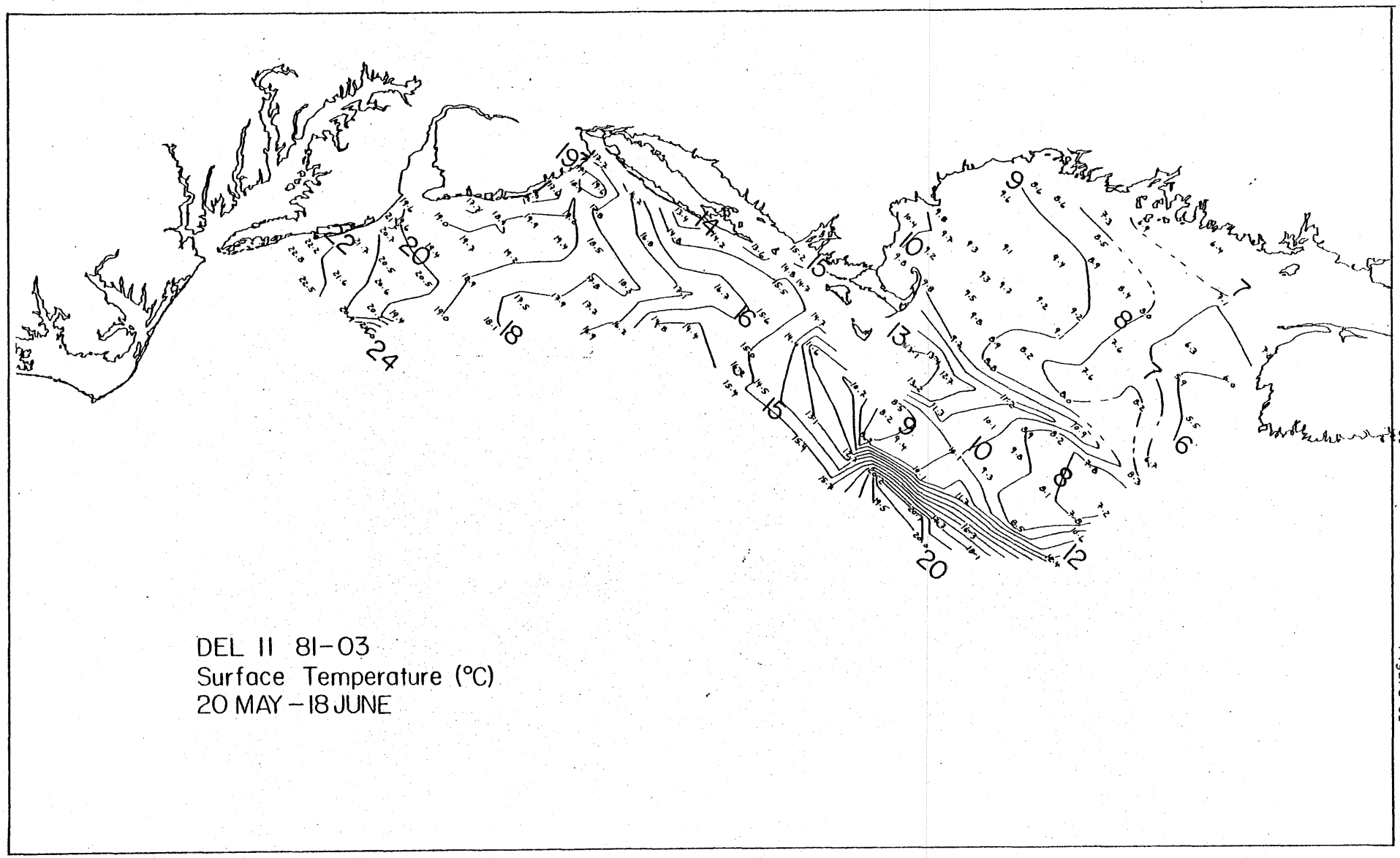
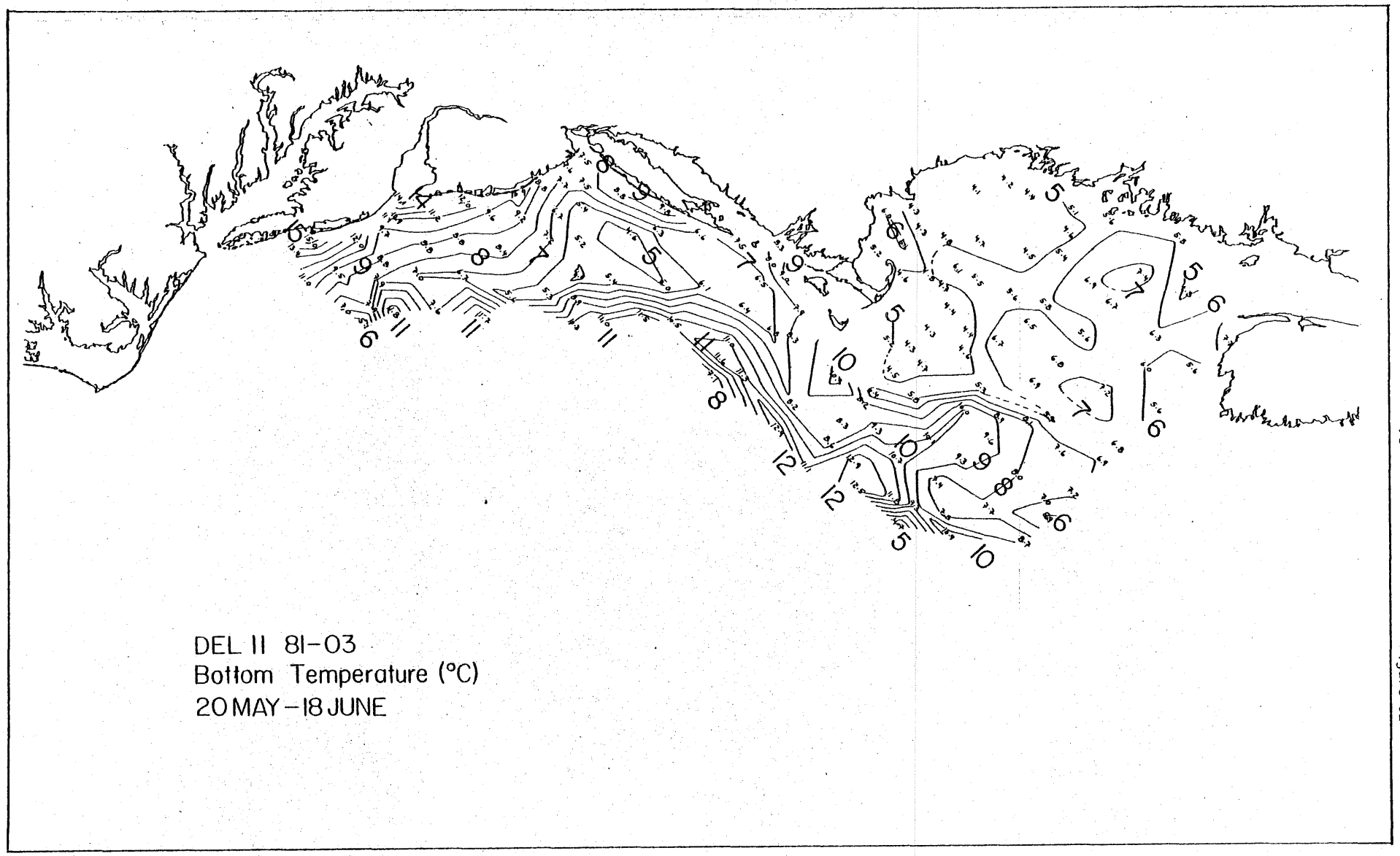


Figure 60



DEL 11 81-03
Surface Temperature (°C)
20 MAY – 18 JUNE

Figure 61



DEL 11 81-03
Bottom Temperature (°C)
20 MAY – 18 JUNE

Figure 62

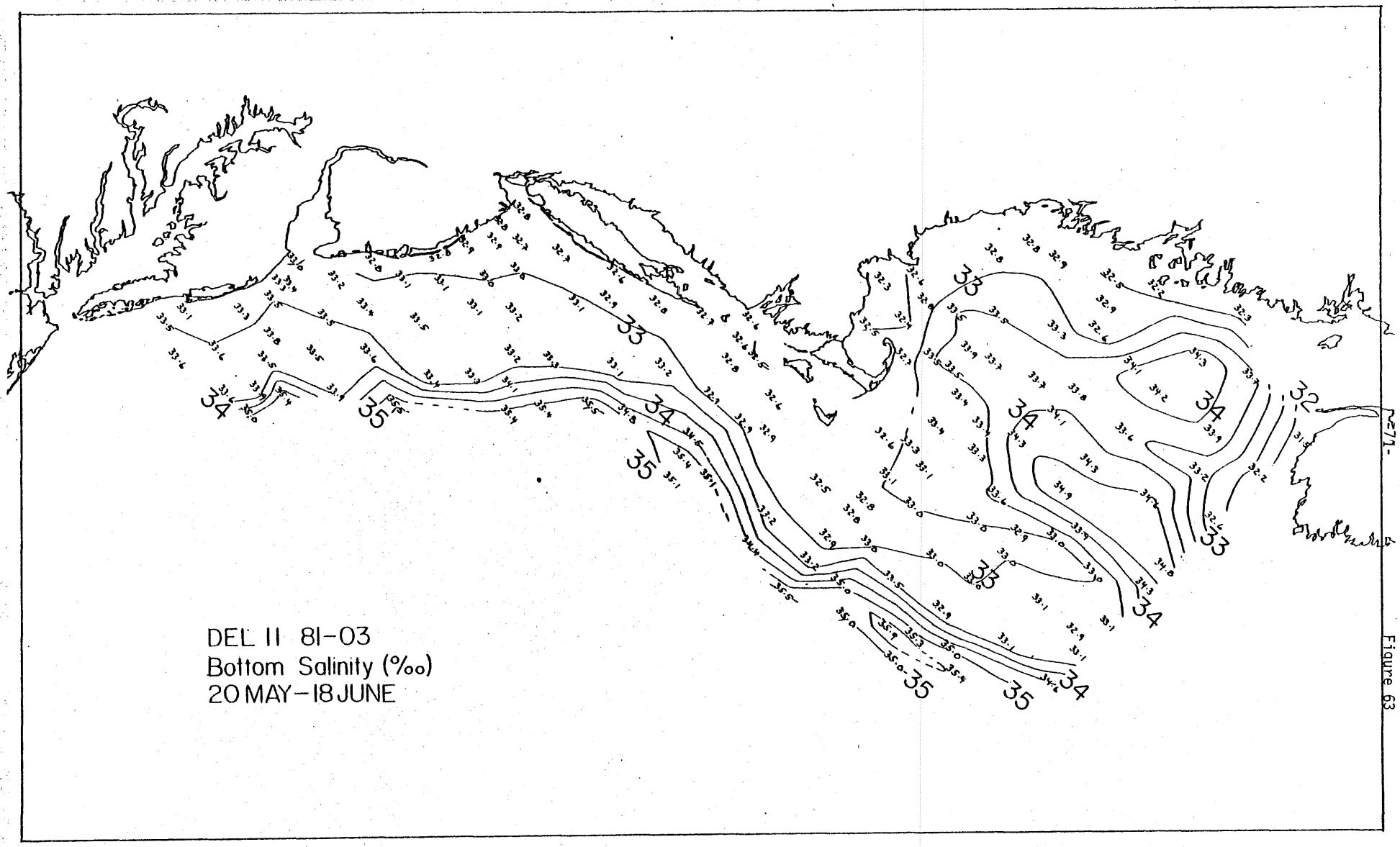
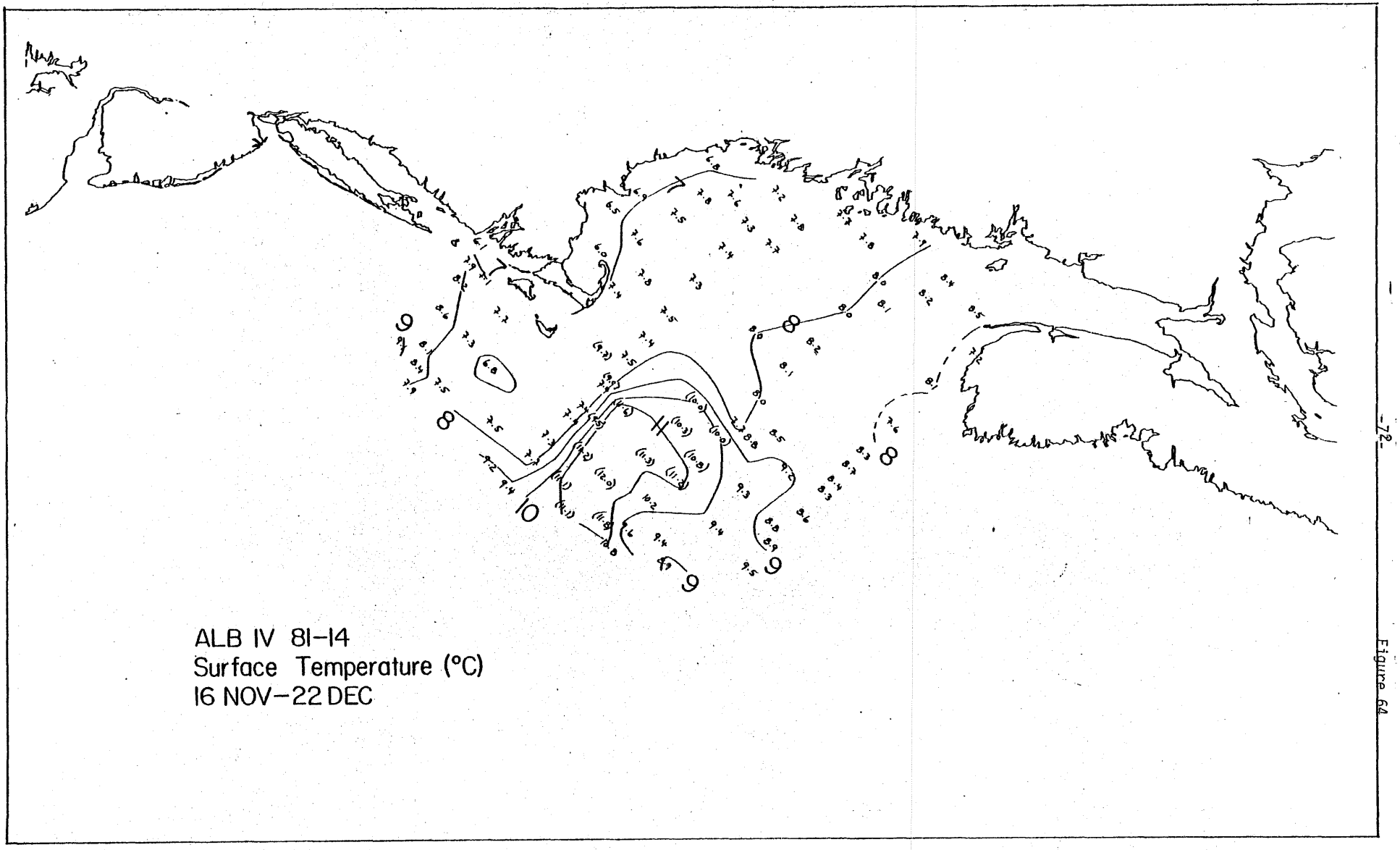


Figure 63



ALB IV 81-14
Surface Temperature (°C)
16 NOV–22 DEC

Figure 64

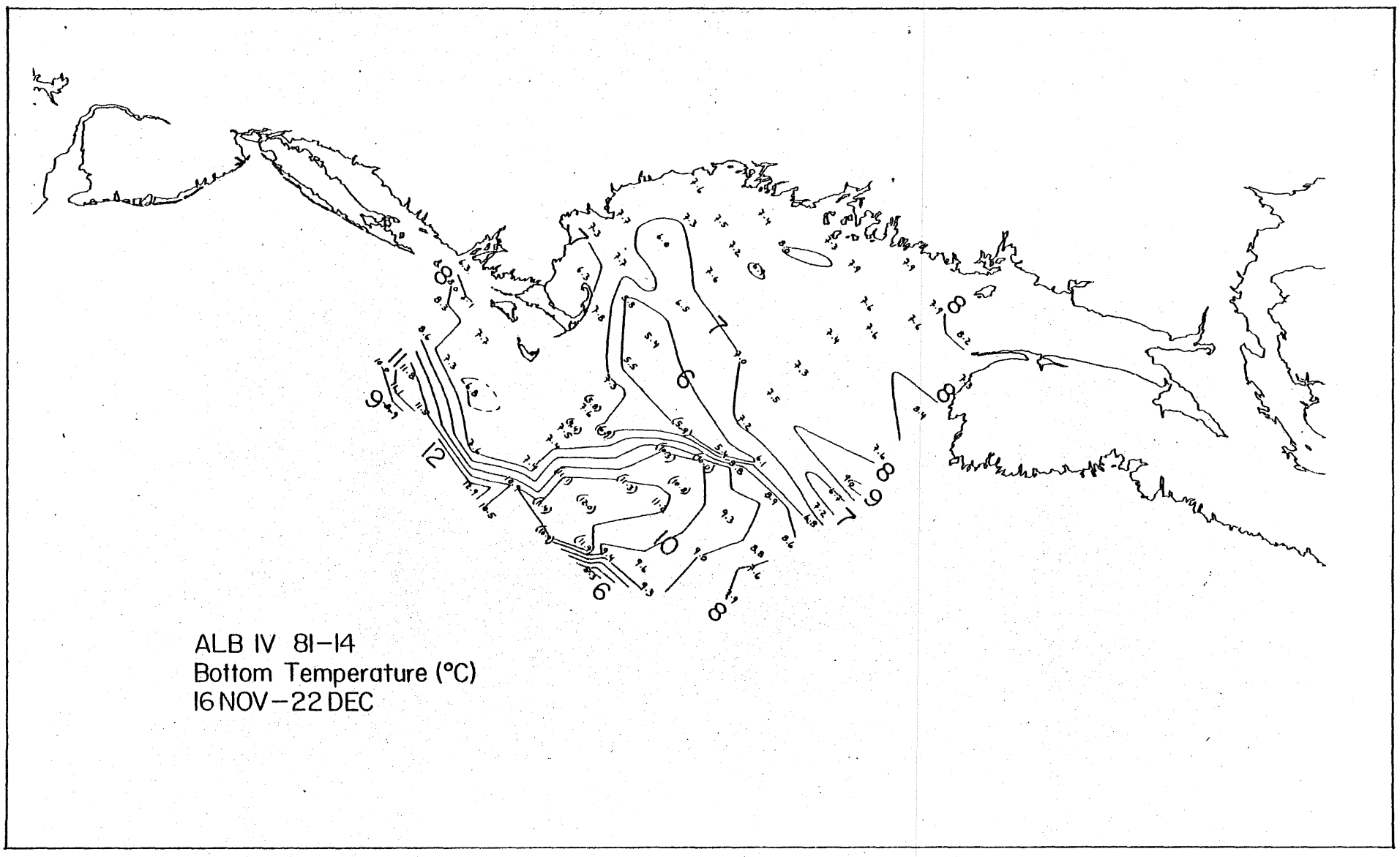


Figure 63

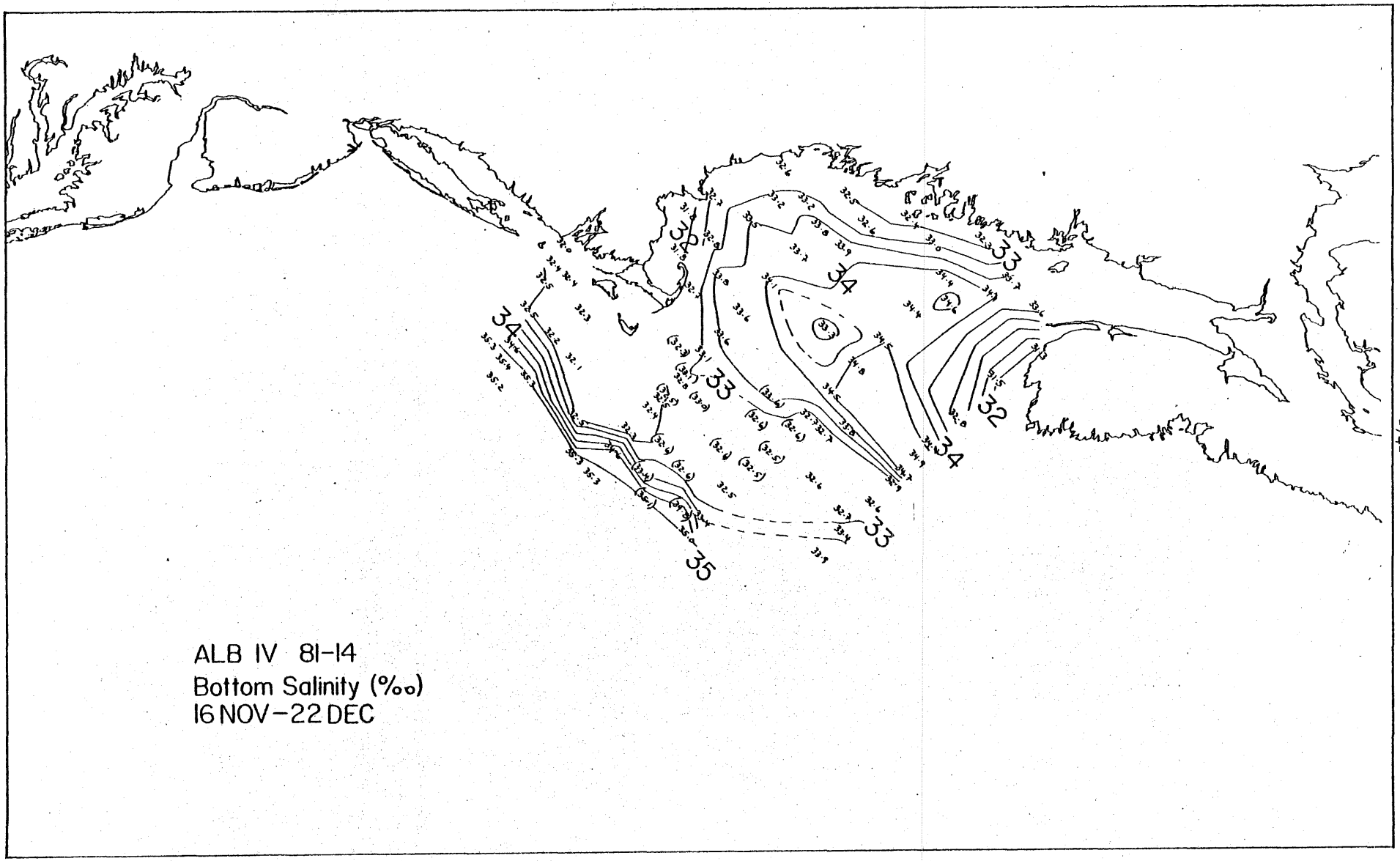


Figure 64

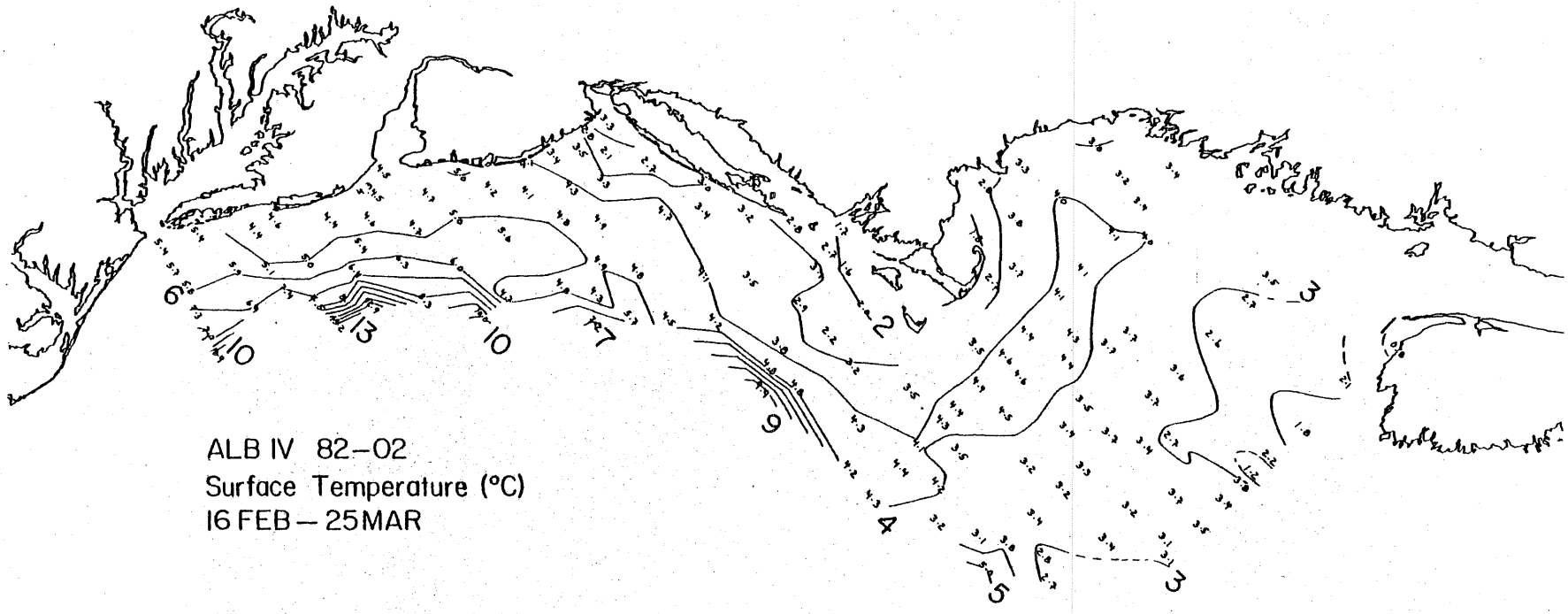


Figure 65

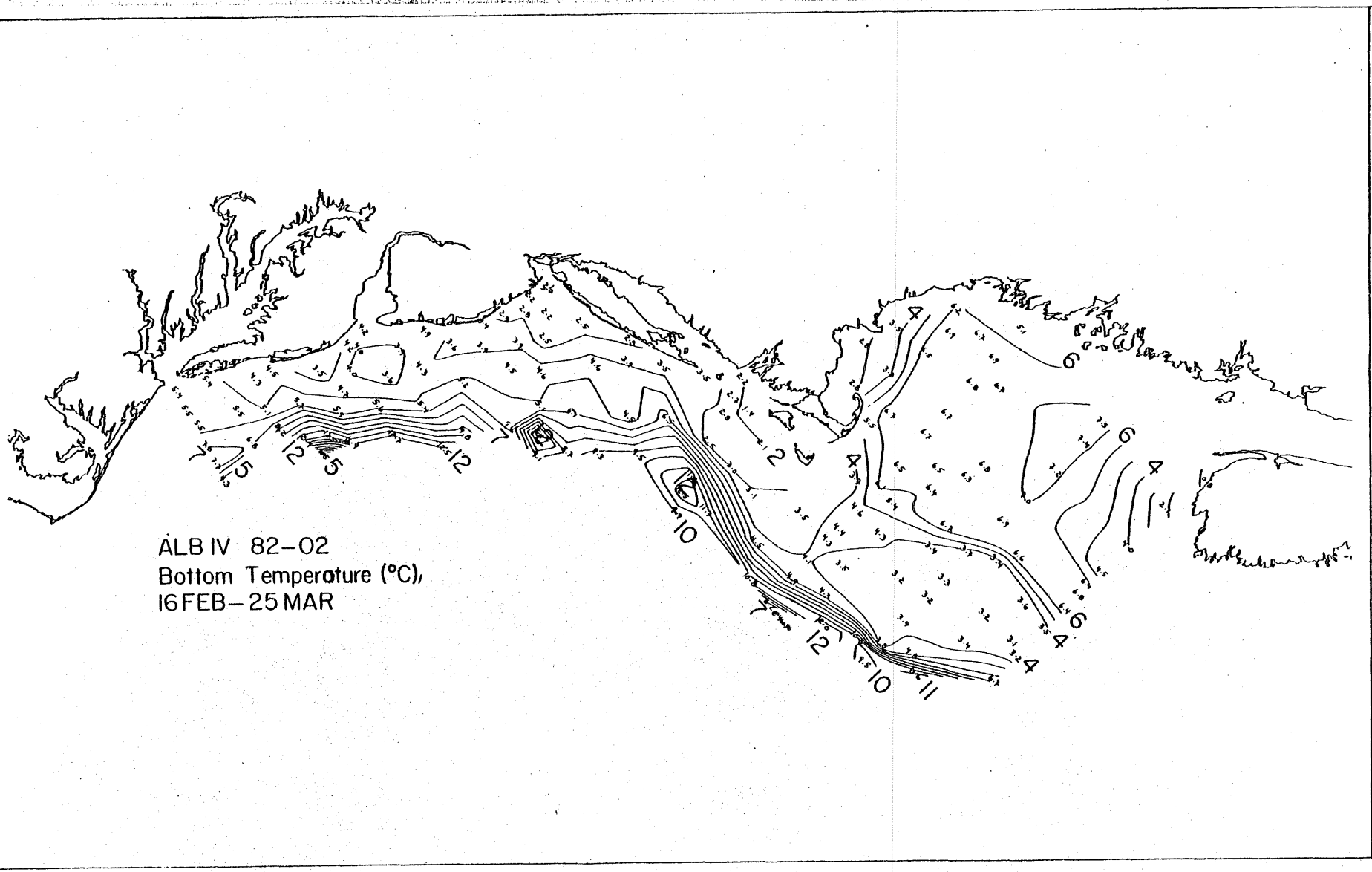


Figure 66

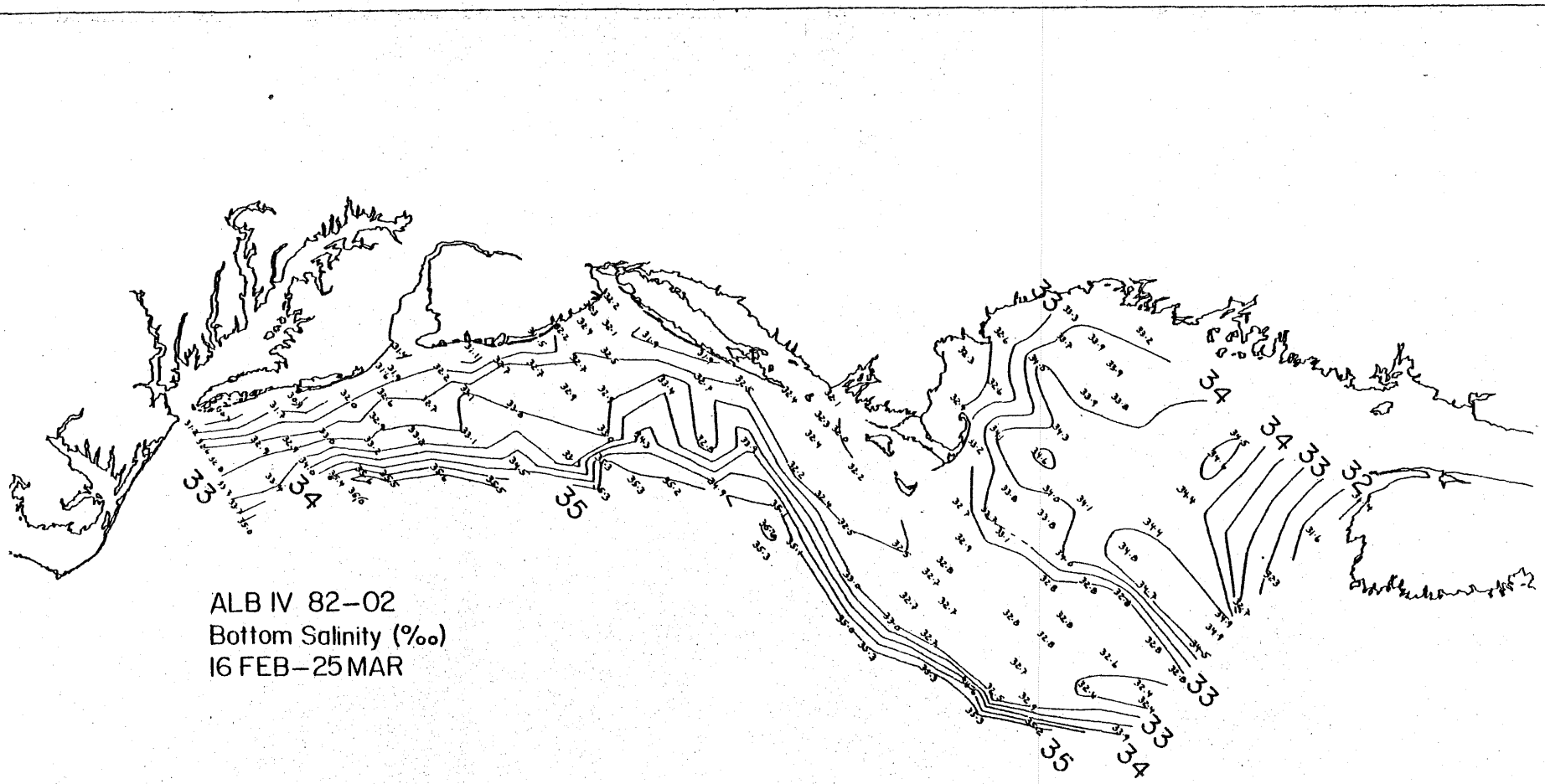


Figure 67

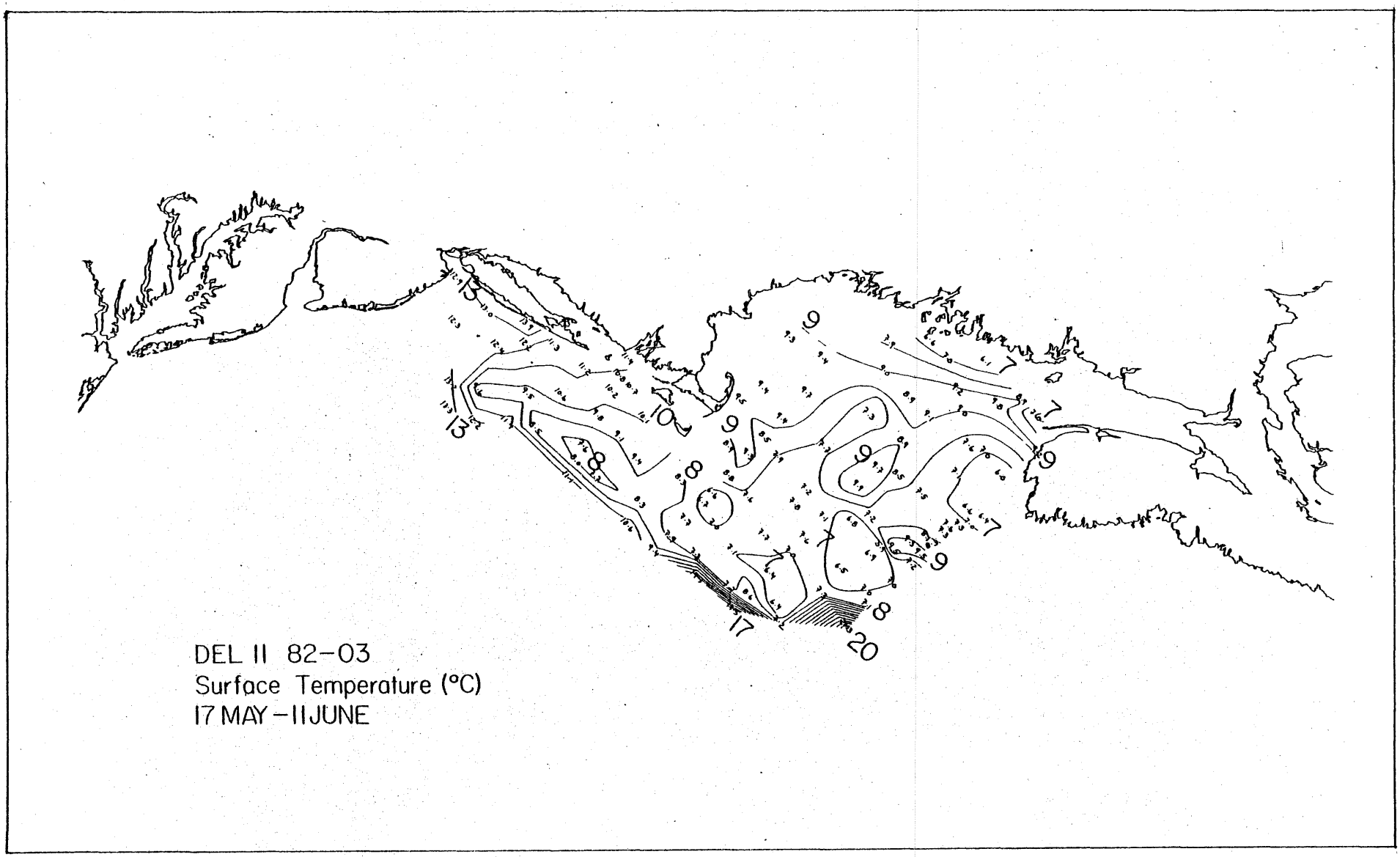


Figure 68

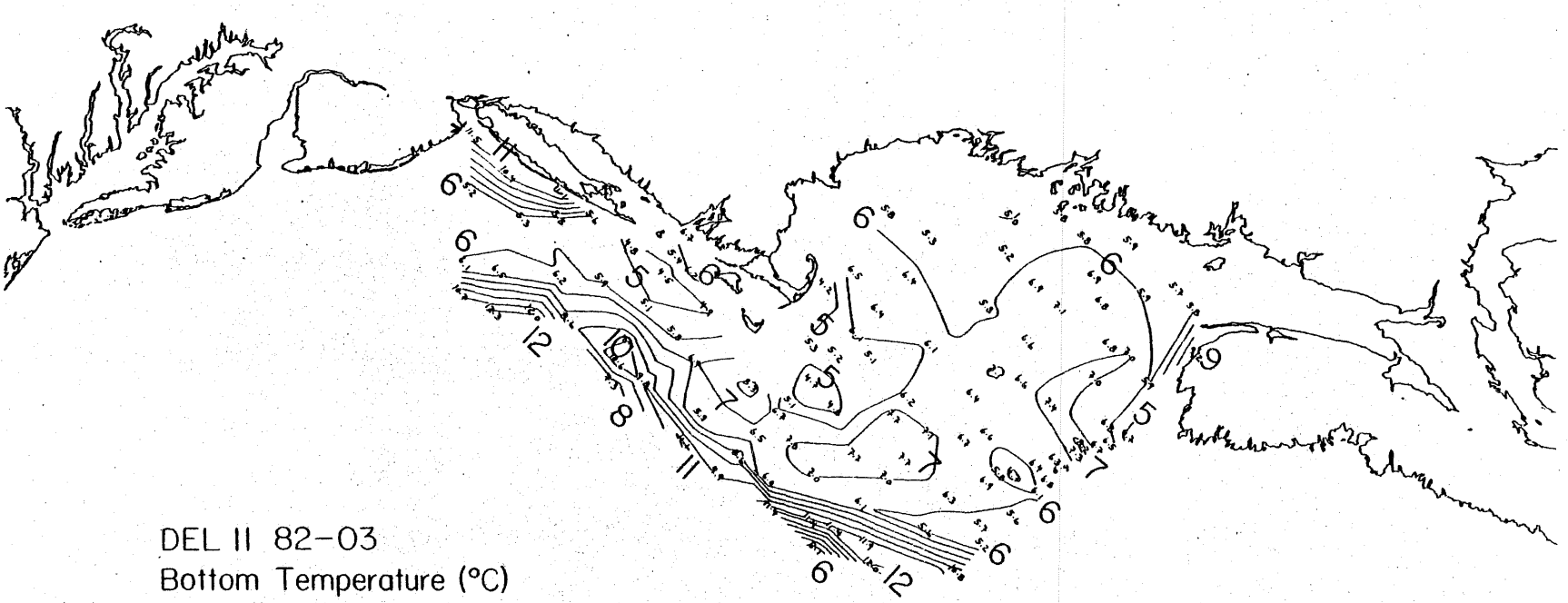


Figure 69

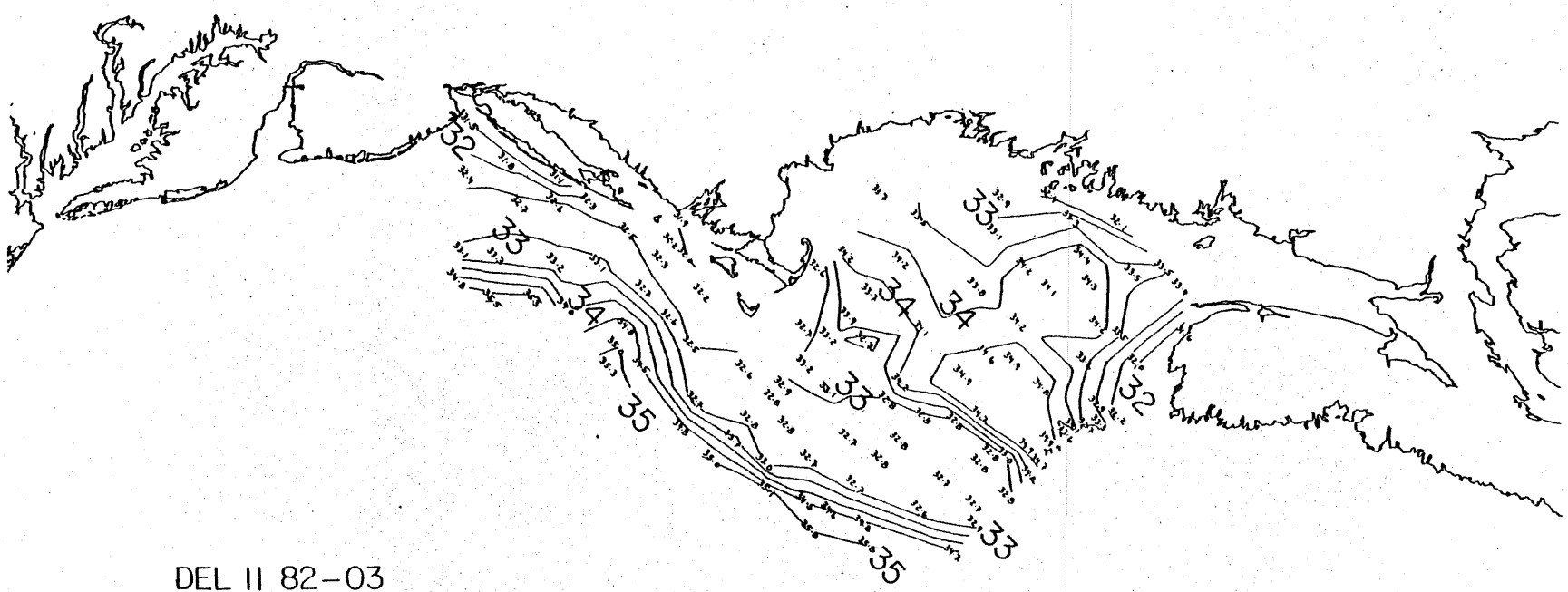


Figure 70

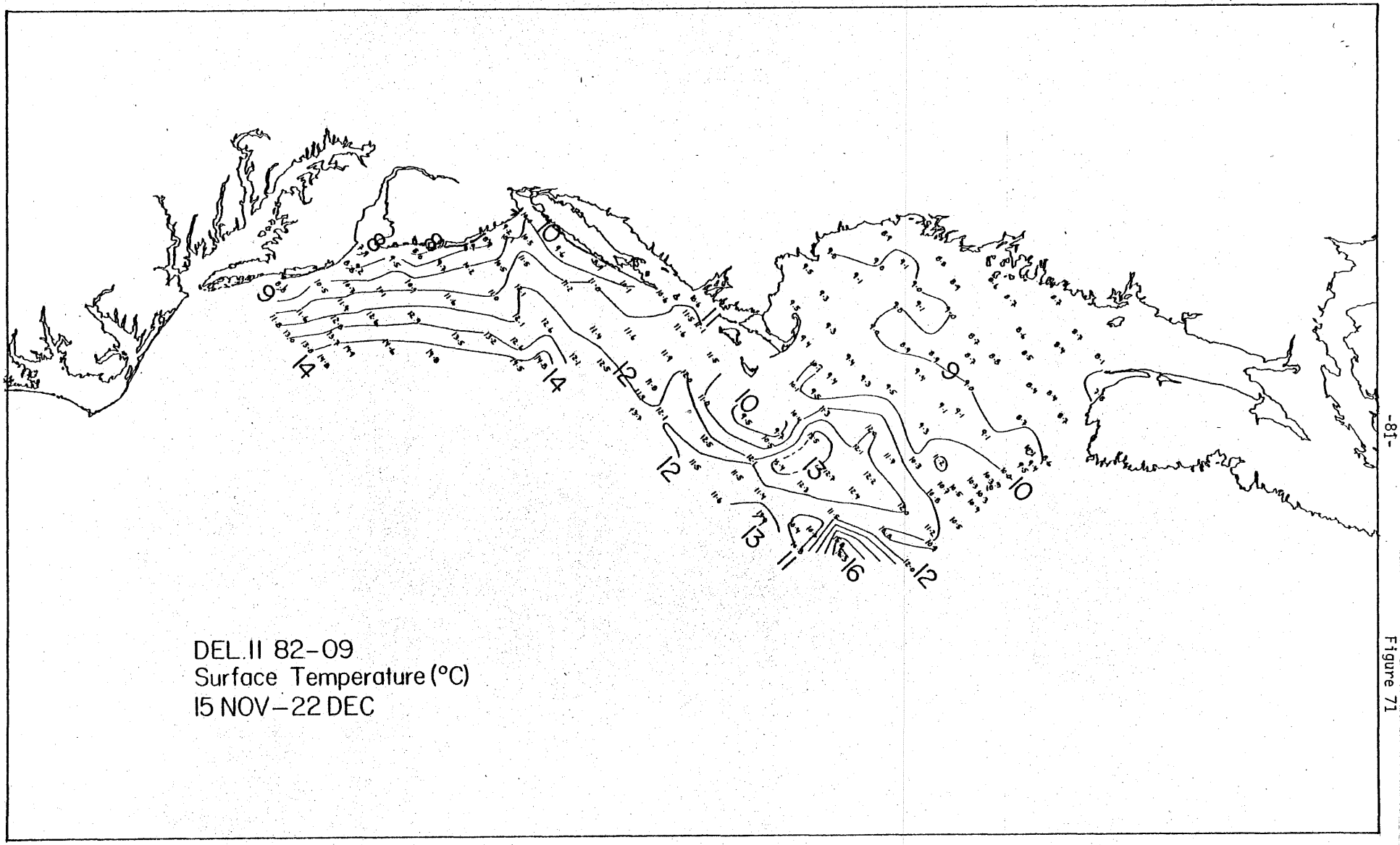


Figure 71

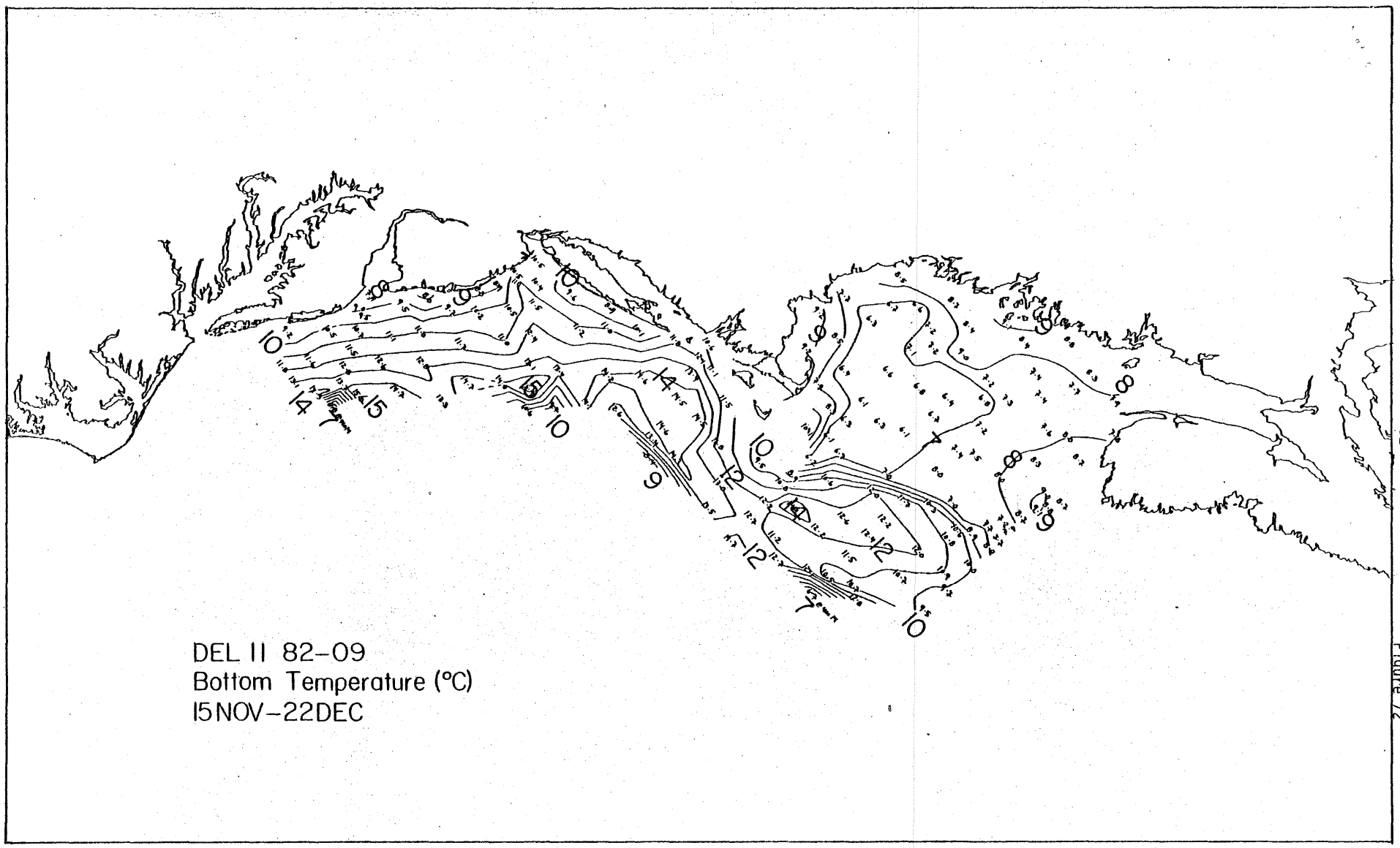


Figure 72

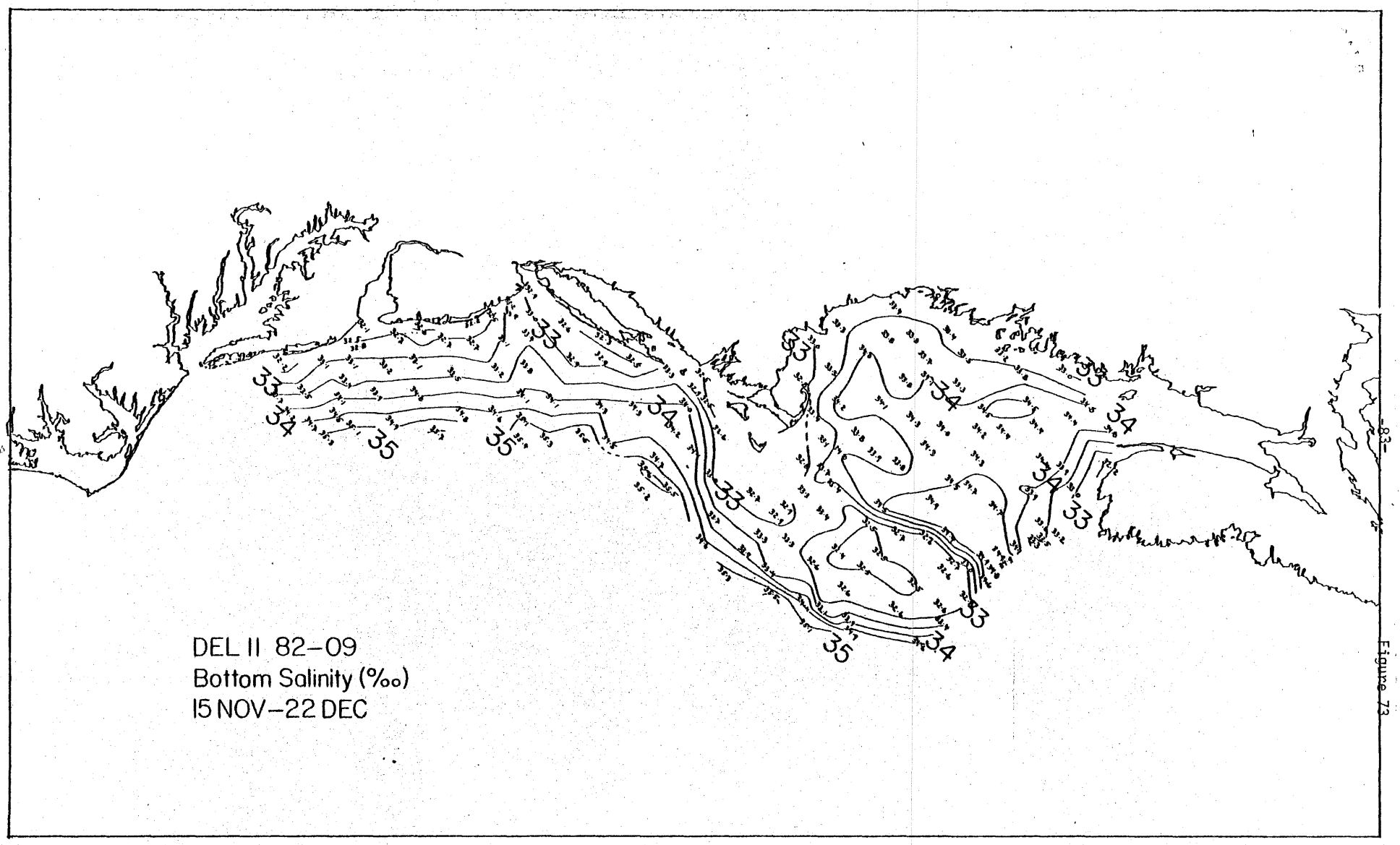


Figure 73