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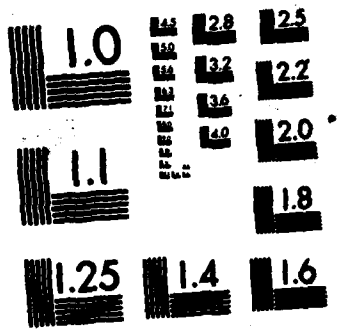

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Naval Ocean Research and Development Activity
NSTL, Mississippi 39529 NORDA Report 92 April 1985

Atlas of Sognefjord Sections
1900-1970
Final Report

K.D. Saunders
D.A. Burns
Oceanography Division
Ocean Science Directorate

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86-11-18-010

Forword

The systematic study of the physical of the Norwegian Sea effectively began with the work of Helland-Hansen and Nansen. During the years 1900-1905, they repeatedly took hydrographic measurements along a section running in a northwesterly direction from the mouth of Sognefjord. This section, which spans the Norwegian Atlantic Current, is commonly known as the "Sognefjord Section." Since the initial study of Helland-Hansem and Nansen, other investigators have repeated the section at irregular intervals.

This data, collected along and in the vicinity of the Sognefjord section during 1900-1970, were assembled and edited. This report presents these data in a useful format.

R. P. Onorati, Captain, USN
Commanding Officer, NORDA

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19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

A hydrographic section in the southern Norwegian Sea, which extends in a northwesterly direction from the entrance to Sognefjord (the "Sognefjord Section"), has been repeated at irregular intervals from 1900 to 1970. This atlas presents the temperature and salinity data obtained during that period. For each of 55 sections, the station positions, the temperature-salinity diagrams, and the contour plots of temperature and salinity are presented.

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Executive summary

A hydrographic section in the southern Norwegian Sea, which extends in a northwesterly direction from the entrance to Sognefjord (the "Sognefjord Section"), has been repeated at irregular intervals from 1900 to 1970. This atlas presents the temperature and salinity data obtained during that period. For each of 55 sections, the station positions, the temperature-salinity diagrams, and the contour plots of temperature and salinity are presented.

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86-11-18-010

Acknowledgments

I would like to thank my colleagues at the University in Bergen for their kindness and support during the initial stages in preparing this atlas, especially Professors Mosby and Mork. Herr Leinebø of the Fiskeridirektorat/Havforskningsinstitutt was most helpful in providing a large quantity of the data used in this report. Numerous conversations with Dr. A. W. Green of NORDA contributed greatly to the approach taken in the data presentation. I would also like to thank Pat Carter, who plotted the data. This work was begun while one of the authors was supported by a NATO Fellowship and continued under the support of an NTNF Fellowship. We also wish to acknowledge the support of the Non-Acoustic ASW Oceanography Program (formerly the Ocean Measurement Program), Program Element 63704N, Dr. Rudolph Hollman, manager.

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Atlas of Sognefjord Sections 1900-1970

Introduction

Between 1900 and 1905, Helland-Hansen and Nansen (1909) conducted one of the most extensive studies of the physical oceanography of the Norwegian Sea. During this period they performed hydrographic measurements along a section that began near the entrance to Sognefjord and ran northwestward every May from 1901 to 1905. This section was named the "Sognefjord Section."

Since then, this section (or sections near it) has been repeated at irregular intervals. After the first intensive field study, from 1900 to 1905, no further sections were made until 1914. World War I prevented further studies, and no more sections were made until 1925. The Sognefjord section was repeated in 1925, 1927, 1928, 1929, 1932, 1934, 1935, and 1936. An 11-year hiatus was partly due to World War II. The sections were continued in 1947 and were made annually until 1953. They were continued annually from 1957 to 1962 but have since been sporadic.

These data have never been assembled and presented in a systematic manner. Most of the data from these repeated sections have been assembled and are presented in this atlas. The period covered is from 1900 to 1970.

Data sources

The early data from 1900 to 1904 were copied from Helland-Hansen and Nansen (1909), where they are listed in an appendix, and from the *Bulletin des resultats aquis pendant les courses periodiques*, Copenhagen, 1902 to 1904 (this later became the *Bulletin Trimesteral* and the earlier data may be found under that title), published by the ICES. The data from 1914 to 1953 came from the original data sheets of the Geofysisk Institutt, Univeristetet i Bergen, with the exception of the 1935 and 1936 data, which had already been punched on computer cards and published (Mosby, 1966a, 1966b). The data from 1957 to 1962 has been published in the ICES Data Lists for those years, and these and other data were obtained in punched card format with the assistance of Herr Reidar Leinebø of the Norsk Fiskeridirektorat/Havforsknings-institutt in Bergen.

Helland-Hansen (1934) described in great detail the Sognefjord sections from 1925 to 1929. These and the sections made between 1932 and 1949 were discussed by Scheldrup (1954). The data from 1935 and 1936 were discussed in detail by Mosby (1970), and the data from 1947-1953 were discussed in detail by Saelen (1959).

Data quality

All the data were taken by Nansen bottle casts. As such, the data quality is similar to other data taken during the early to mid-twentieth century. The temperatures are probably accurate to 0.01° to 0.02°C, and the salinities are estimated to have systematic errors of less than 0.02 ppt (Helland-Hansen, 1934). Between 1949 and 1963, the 95% confidence limit on titrations for salinity was 0.015 ppt (Leinebø, 1971). In August 1961, Mohr's method (titration) was replaced by an NIO salinometer at the Geofysisk Institutt (Mosby, 1964).

The depths of Nansen bottles were determined by comparing the reading of protected and unprotected reversing thermometers. Often, the depths were determined by reading the wire-out indicator on the winch. The wire angle was not often taken nor was the depth corrected by means of the unprotected thermometer. The usual practice was to use an unprotected thermometer only on the deepest bottle. Therefore, errors up to 20 m may be encountered. The only statement that can be made conservatively is that when errors do occur, they will appear as reported depths deeper than the true depths.

By far, the greatest source of error in these measurements is the ship's position. Until recently, the ship's position was determined by celestial navigation and dead-reckoning. Under good conditions (e.g., a calm sea, anchored ship, and clear weather), the accuracy of a sun fix taken by an experienced observer was on the same order as the LORAN-C fixes (Biskopshavn, private communication). However, in the Norwegian Sea, it is not uncommon to have the sky obscured by clouds for long periods. The following illustrates the amount of error that can occur under the conditions present during the collection of Sognefjord section data:

The lack of observations in the winter is mainly due to the very bad weather at sea, which generally makes it impossible to obtain trustworthy observations, and in any case makes the work very difficult. Moreover, when it is dark and stormy, the determination of one's position will in most instances be very doubtful. This was especially the case during the February cruise in 1903, when, one occasion it was impossible to decide whether Jan Mayen was actually visible from the ship (in the ice), or, according to the ship's journal was more than one hundred miles to the north. In November, 1903, when the investigations were being made on board the fishery steamboat ASK, the Faeroes were suddenly seen through the dark atmosphere: but according to our dead reckoning, the islands at the time were supposed to be some sixty miles to the south. As this November cruise, however, only occupied 10 days with the touch at the Faeroes to keep our bearings right, the positions of the stations on this cruise may be considered to be fairly trustworthy, the probable error not exceeding 20 miles at the most (Helland-Hansen and Nansen, 1909, p. 24).

After the summer of 1957, LORAN-C was used. The accuracy was assumed to be between 300 and 500 meters (Biskopshavn, private communication). From 1961 until at least 1974, Decca navigation was used, which provided 6 m accuracy along the baseline.

Data processing, interpolation, and plotting methods

The data were transcribed from the punched cards to disk and tape on the UNIVAC 1110 at the University of Bergen. The obvious errors in temperature and salinity were edited from the data set. The data were written to tape, and final processing was done on a VAX 11-750 at NORDA.

The sections were plotted using the contouring routine from the DISPLA plotting package. Before this routine could be employed, the data had to be registered to a uniform grid. The stations were first sorted for increasing longitude. The variable to be plotted was then interpolated at each station to a uniform grid in the vertical, and the variable at each standard vertical level was then interpolated to a uniform horizontal grid. Where no data were available for the deeper layers, a constant value of −1.0°C and 34.90 ppt was set at 1500 m. The bottom contour was obtained from the values punched on the cards if present, or estimated from bottom charts if not present on the original data cards. The interpolation method used was a local cubic fit (Akima, 1972).

Because of the use of a historical value for the deeper waters, some of the contours in the very deep water are not representative of what we believe to be the true situation. Also, some of the bottom contours do not appear to be representative of the actual bottom. The data used were the best available, but the user of this atlas should be aware that errors may have been made in collecting or transcribing the data, and the deep temperature and salinity contours and the bottom contours should be used with caution.

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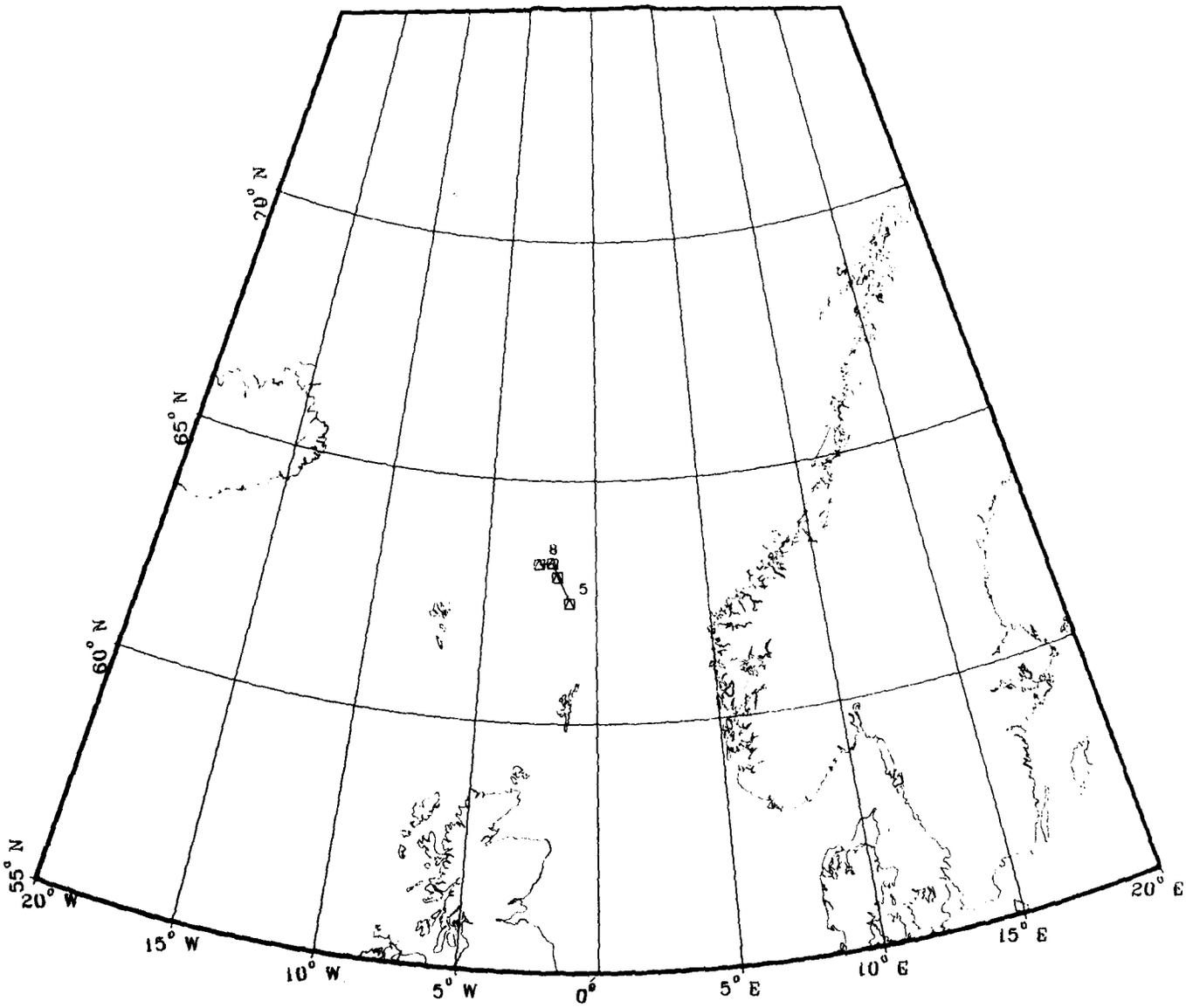

Figure 1. May 1900 station positions.

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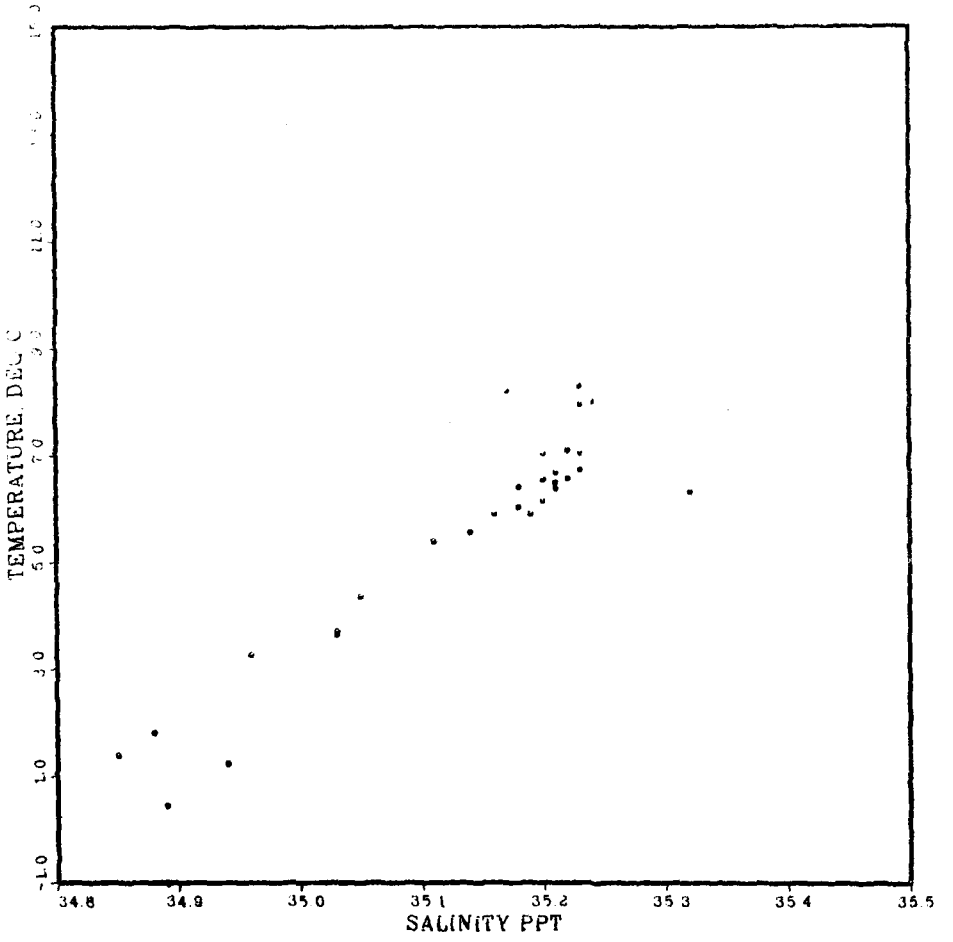

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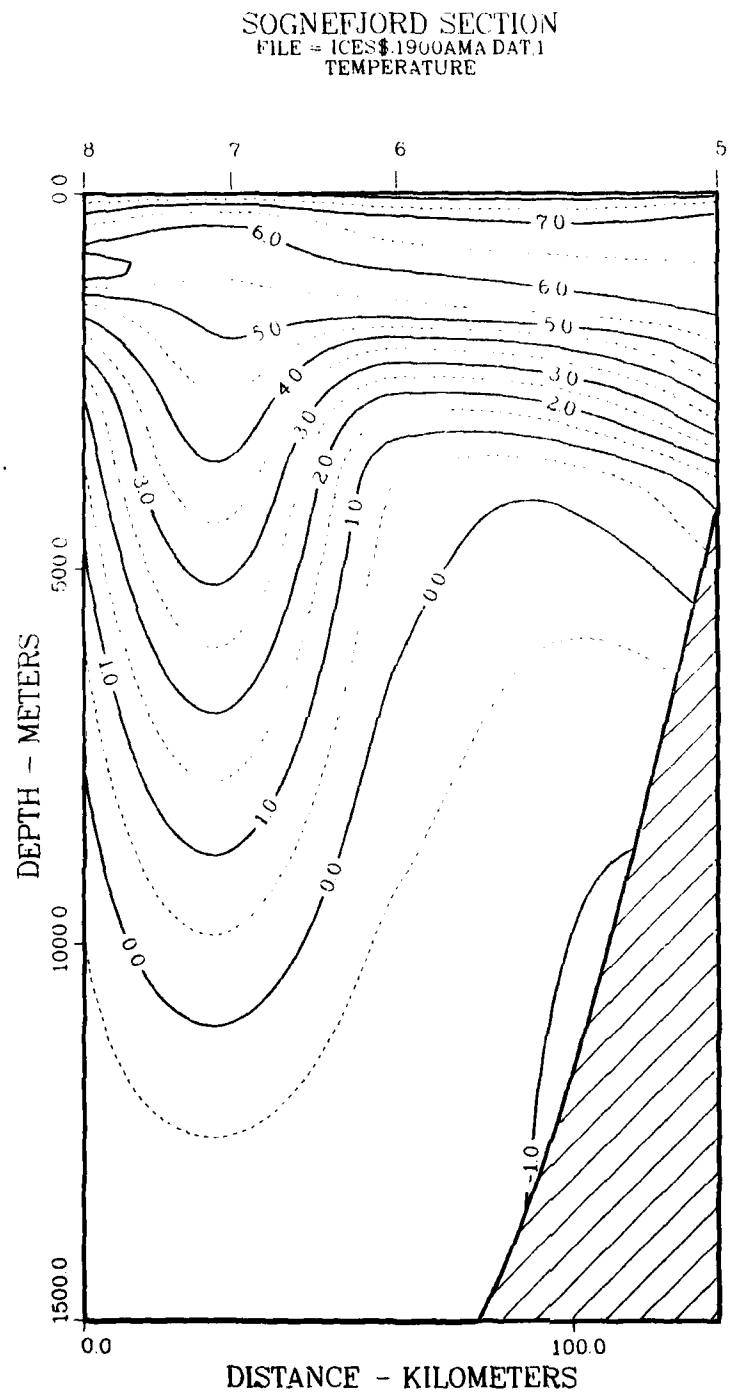

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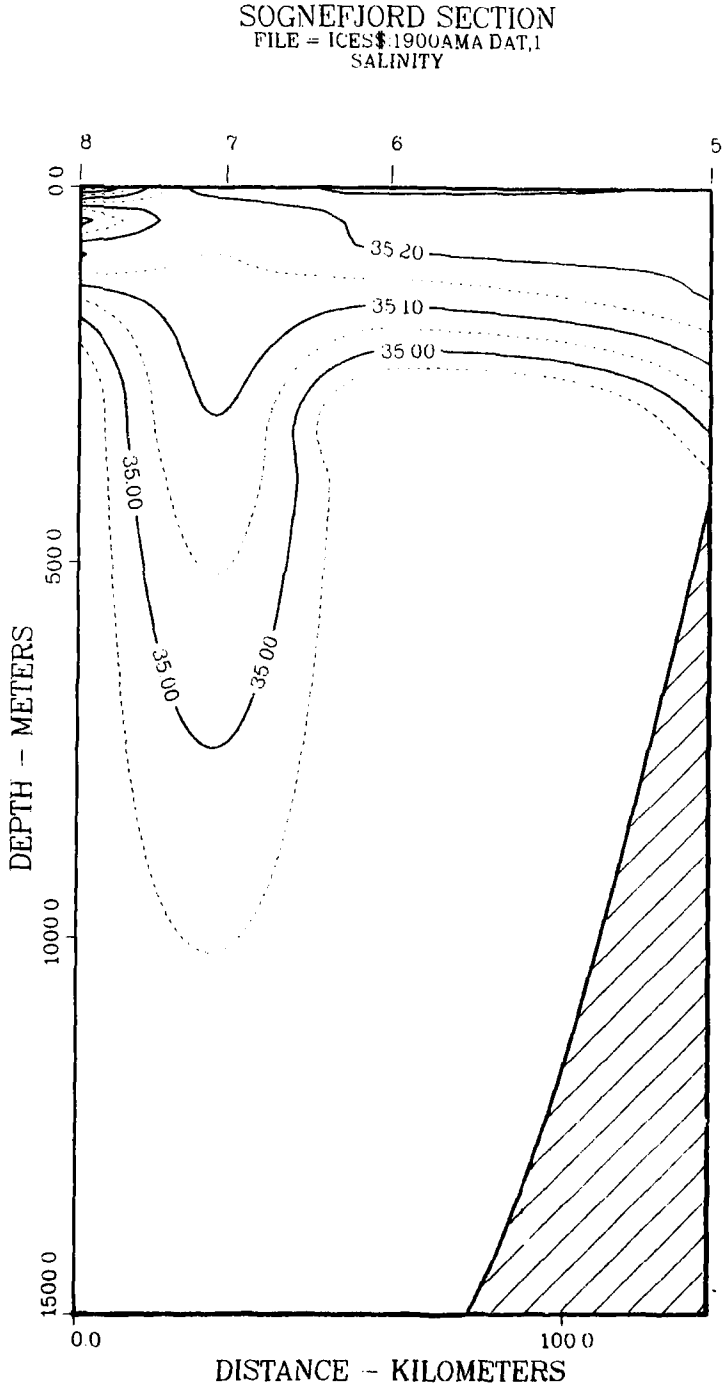

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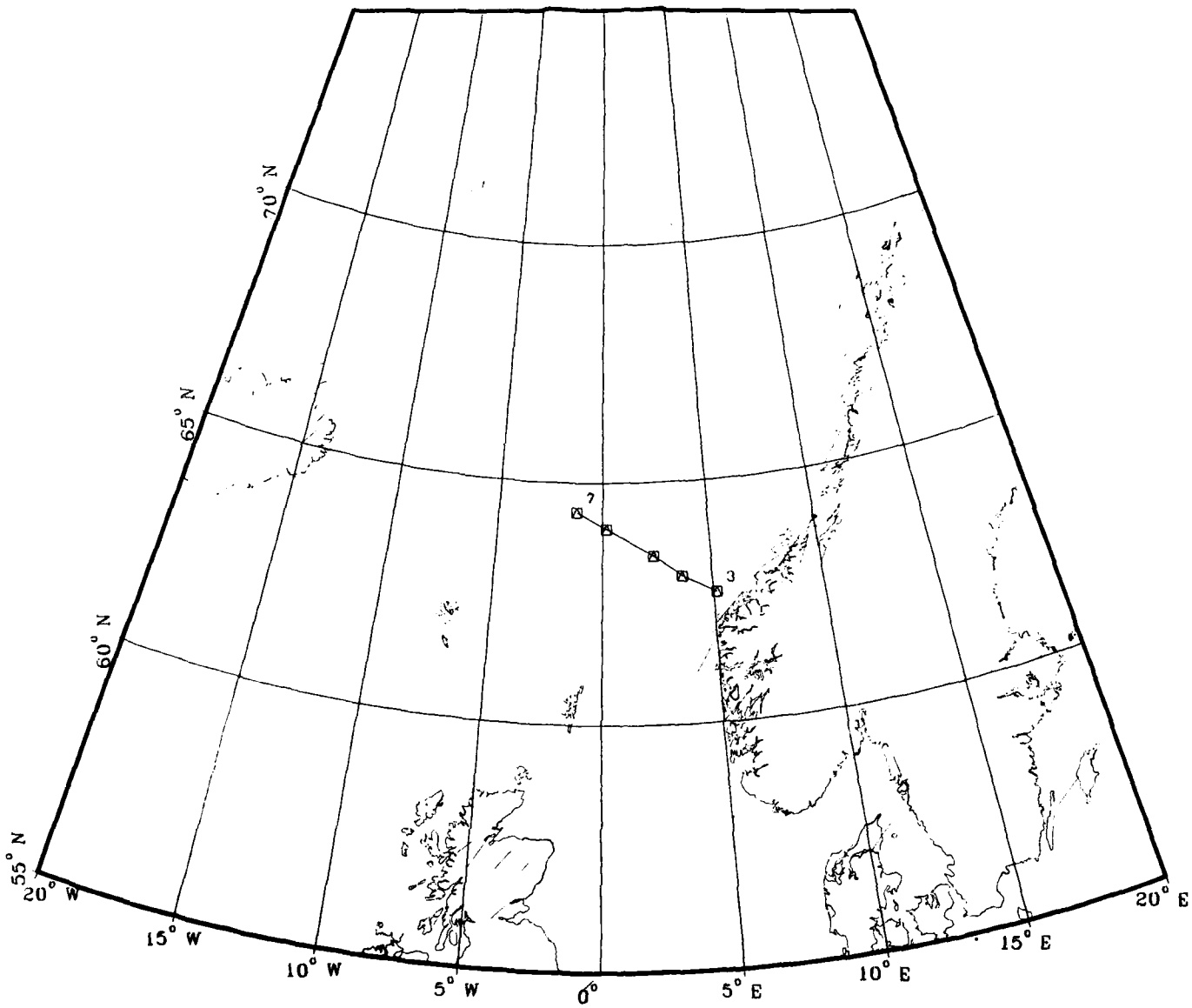

Figure 5. January 1901 station positions.

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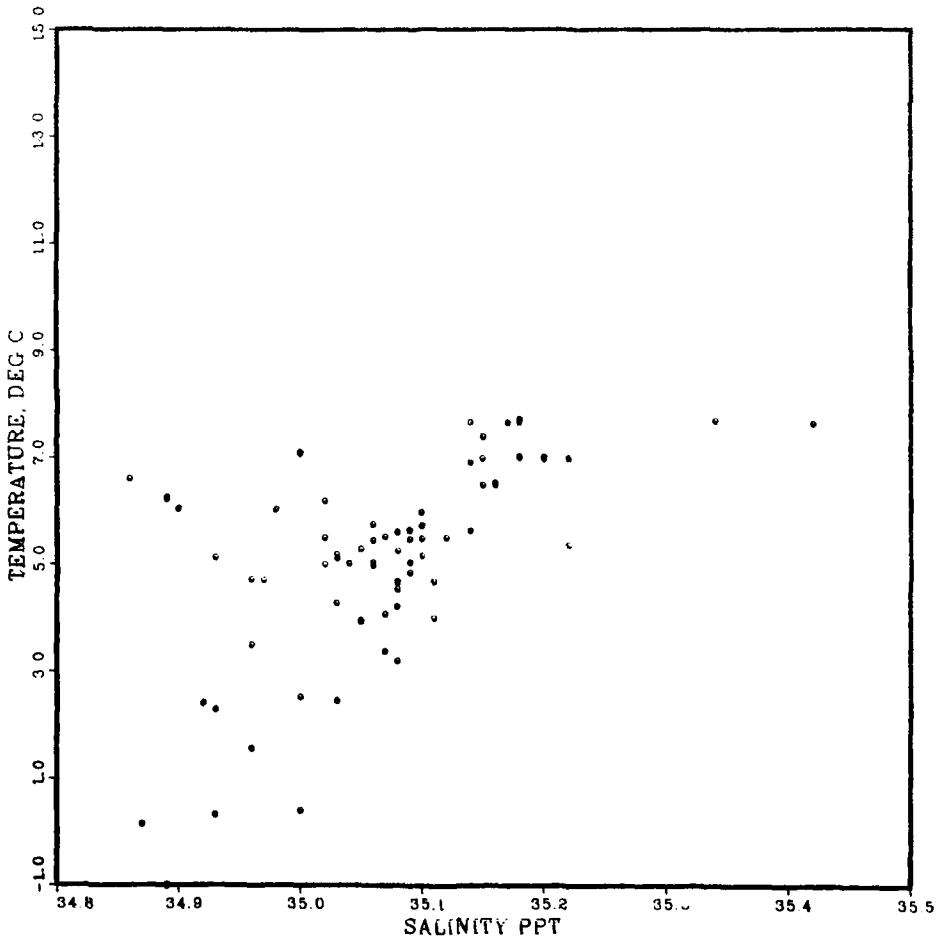

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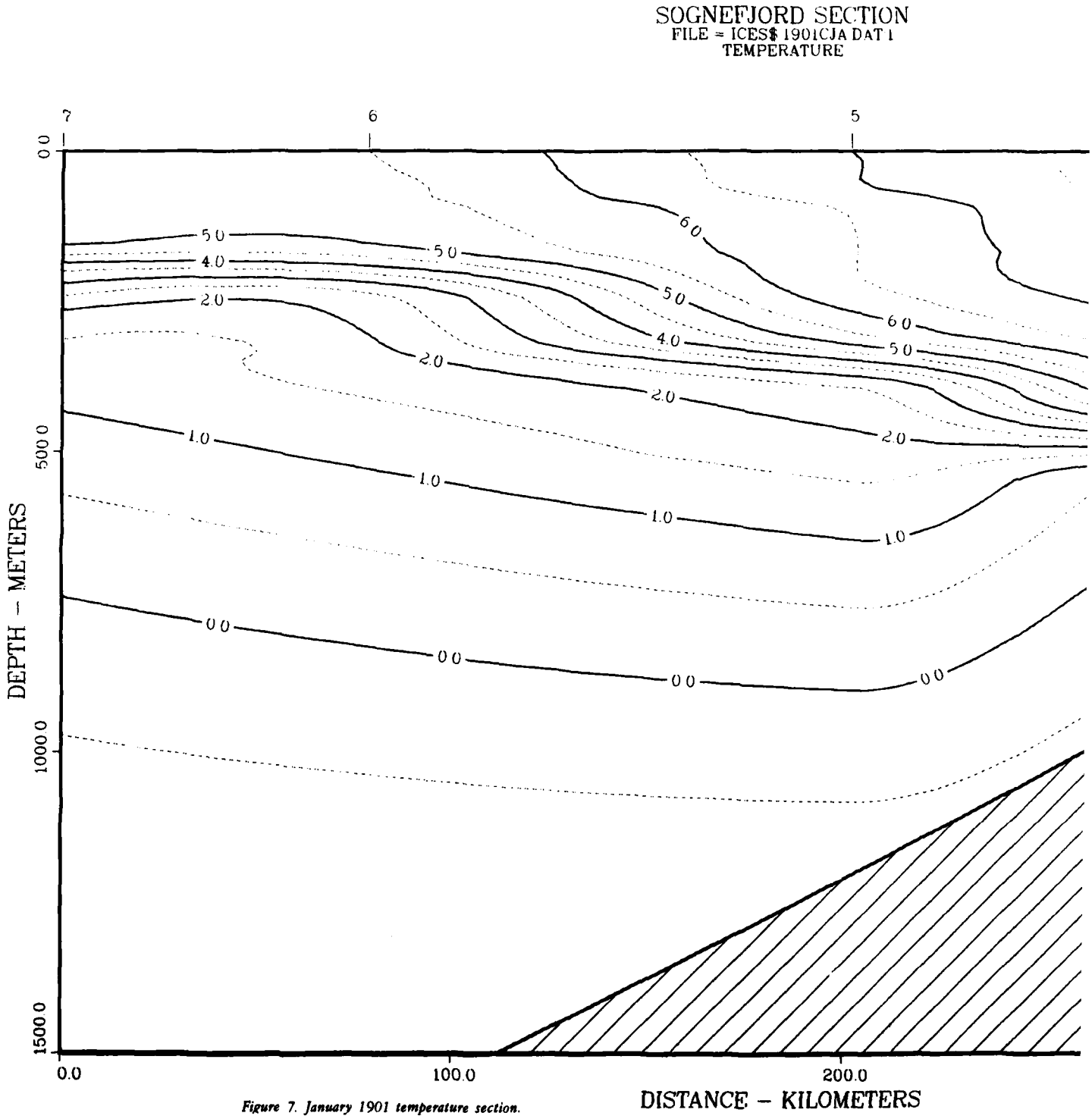

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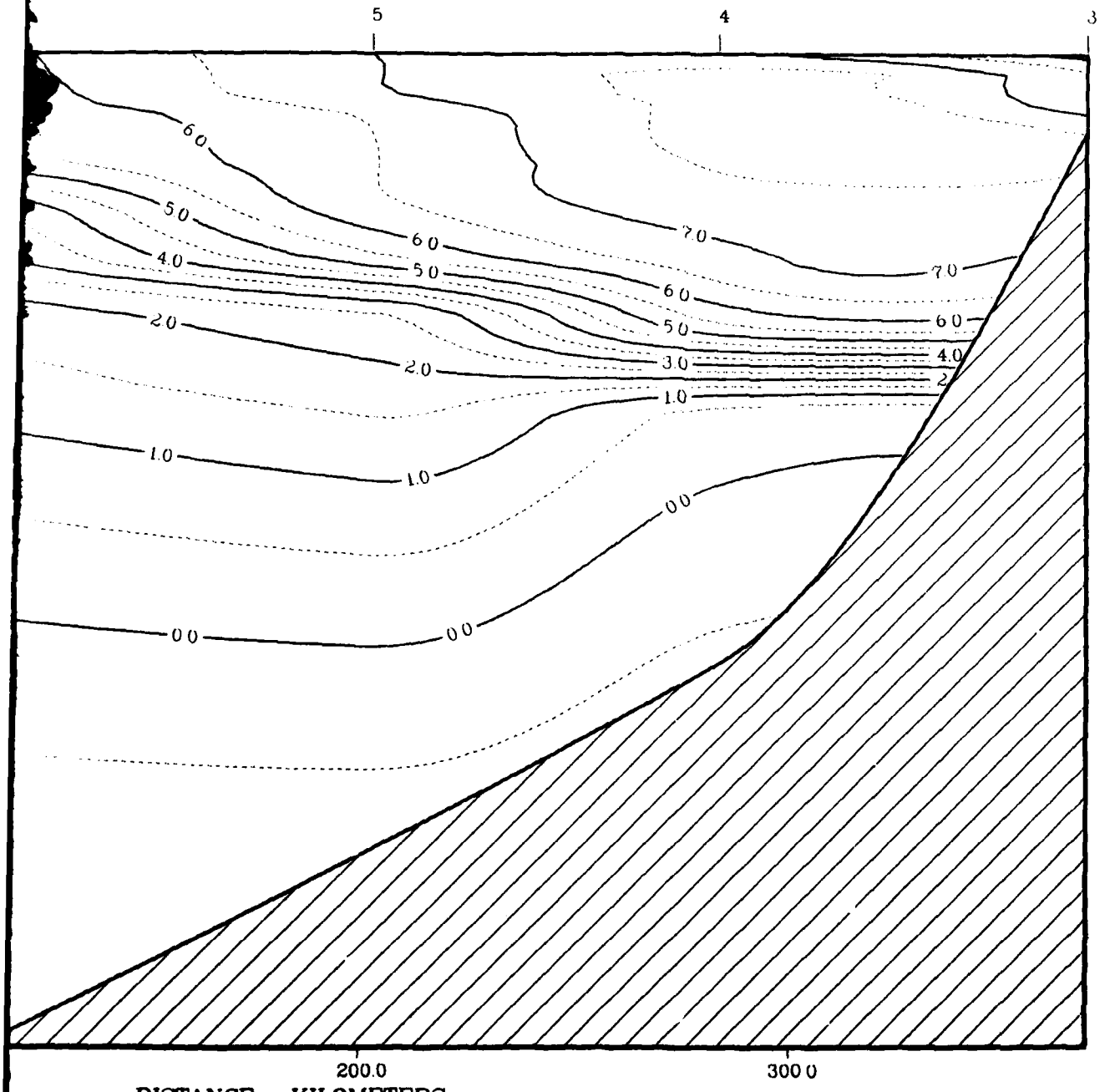

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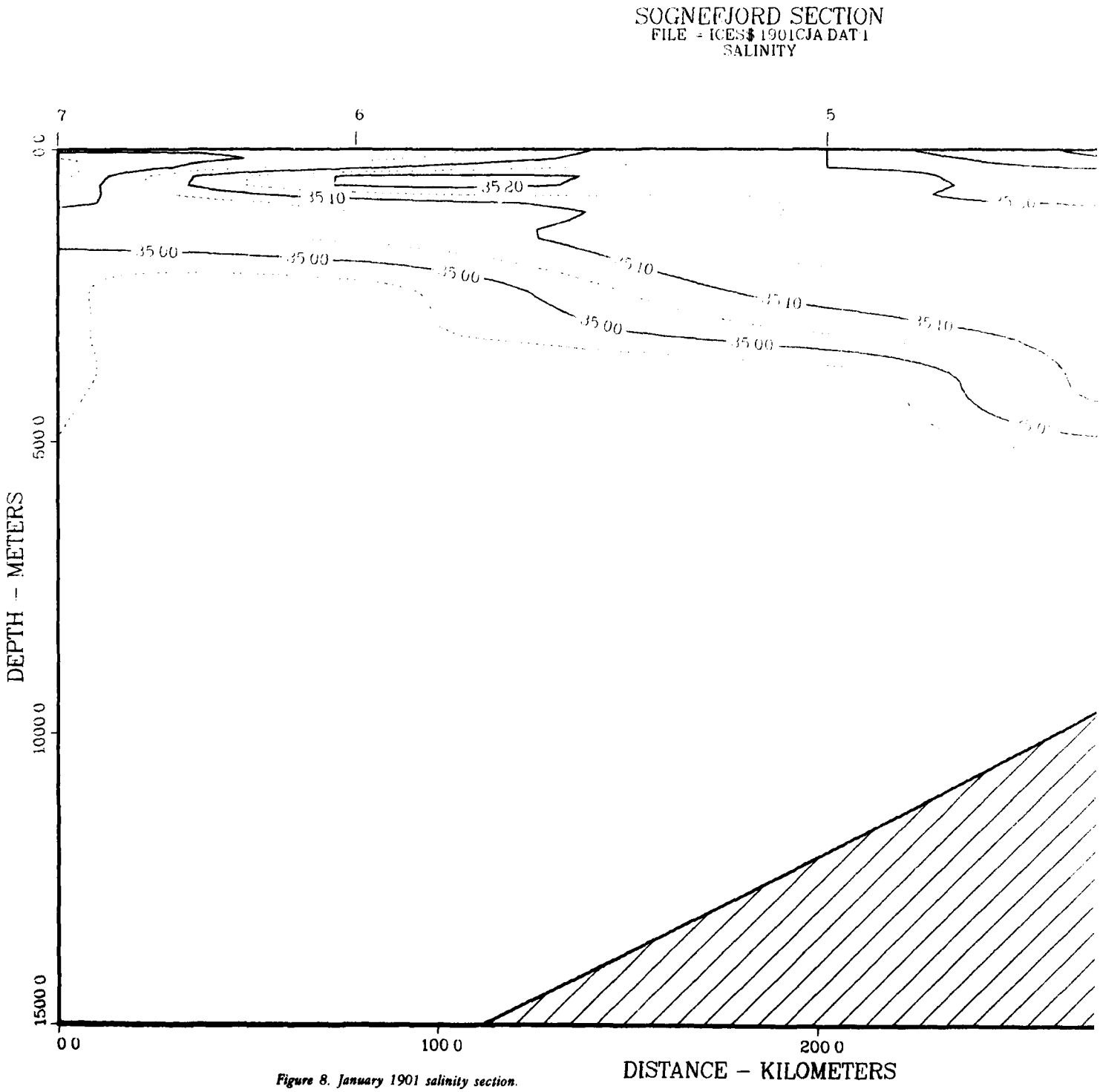

Figure 8. January 1901 salinity section.

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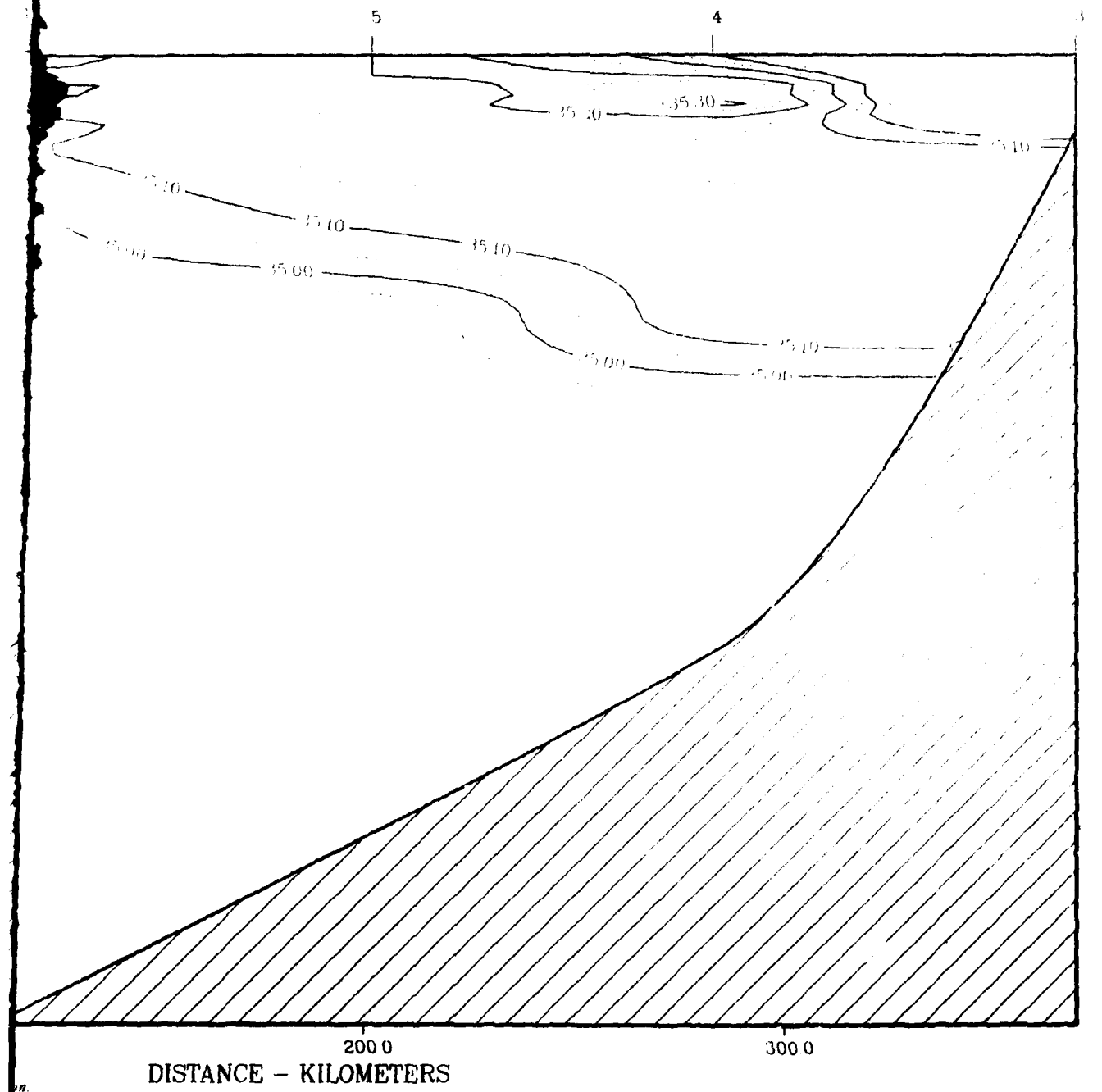

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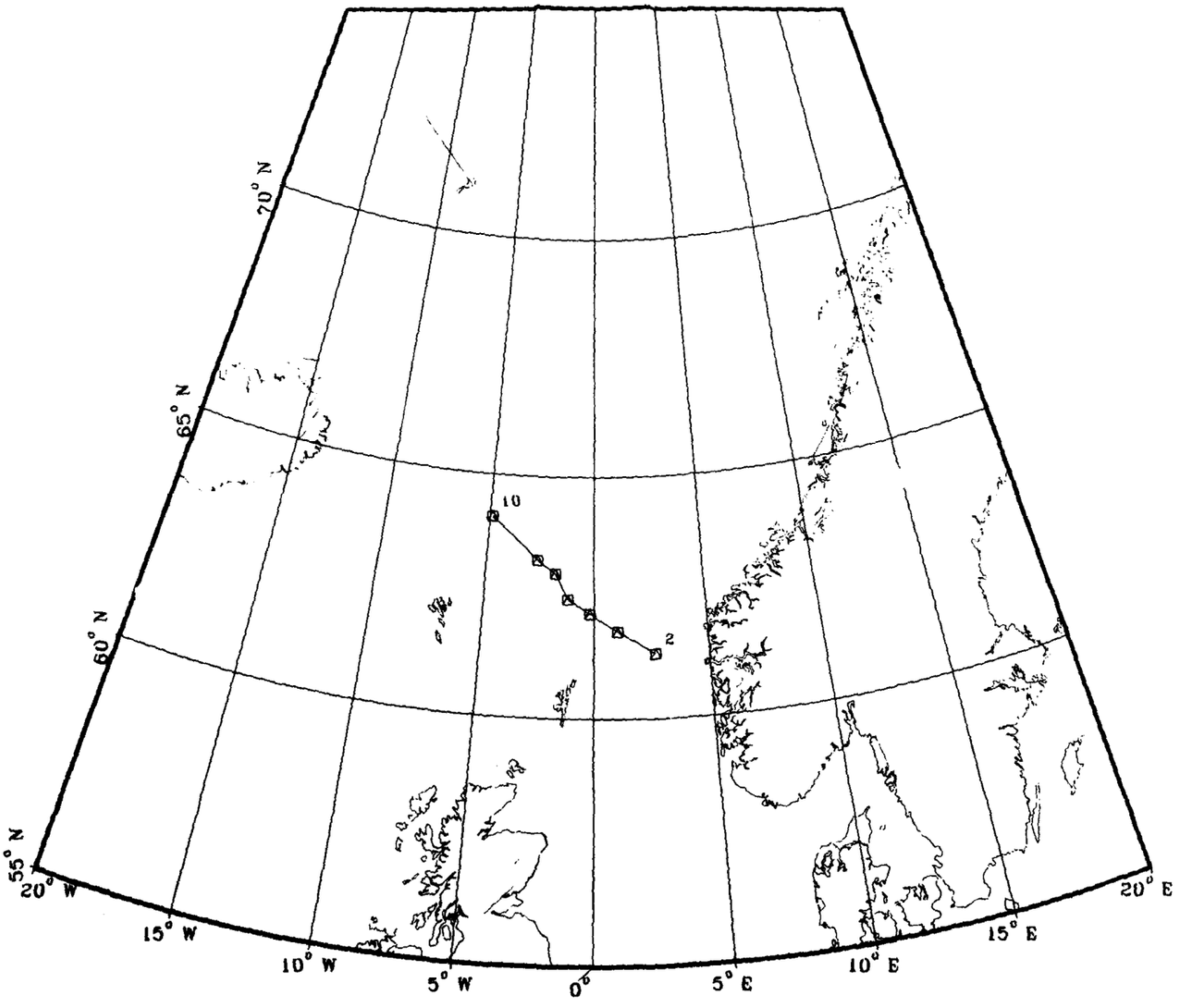

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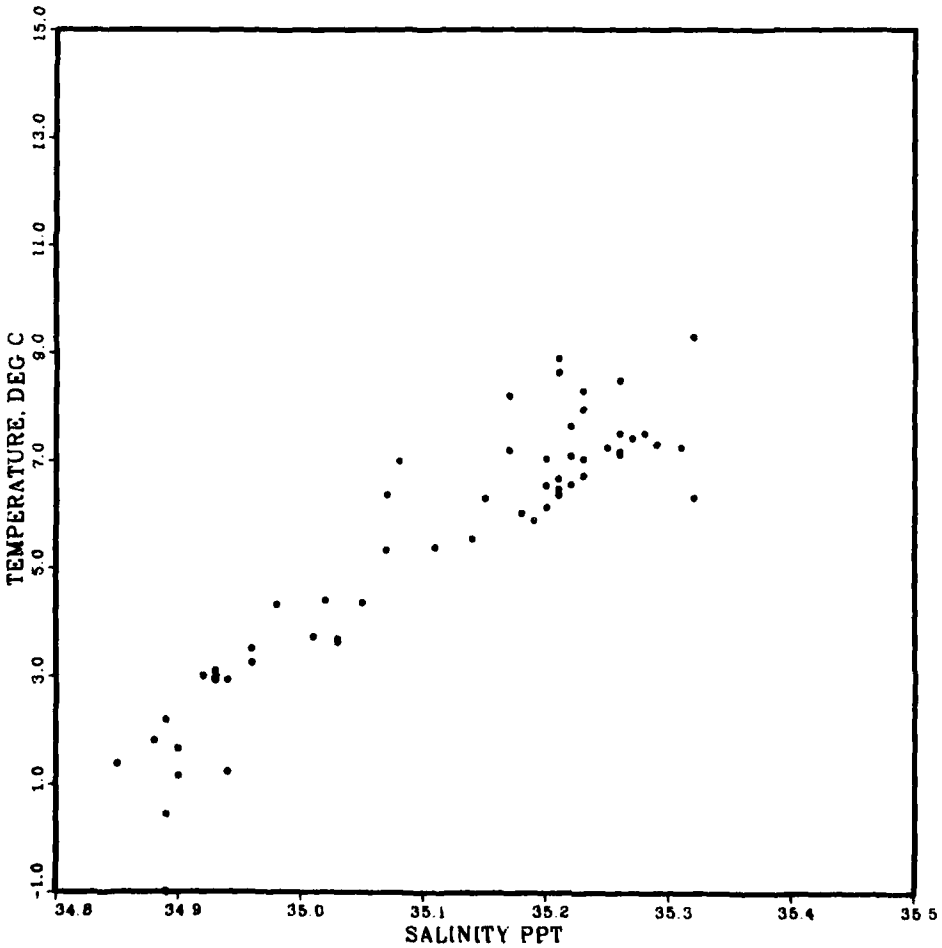

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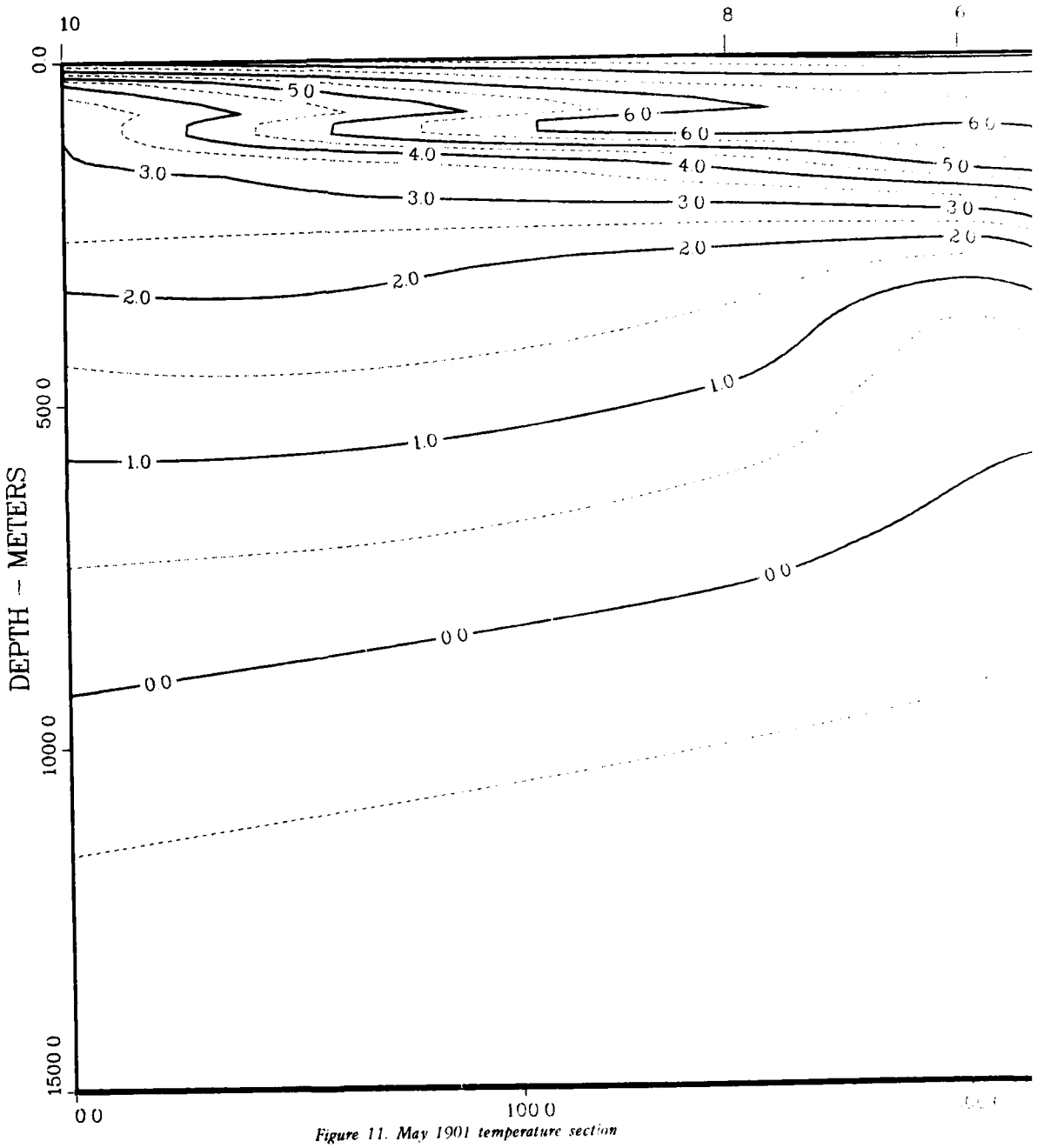

Figure 11. May 1901 temperature section

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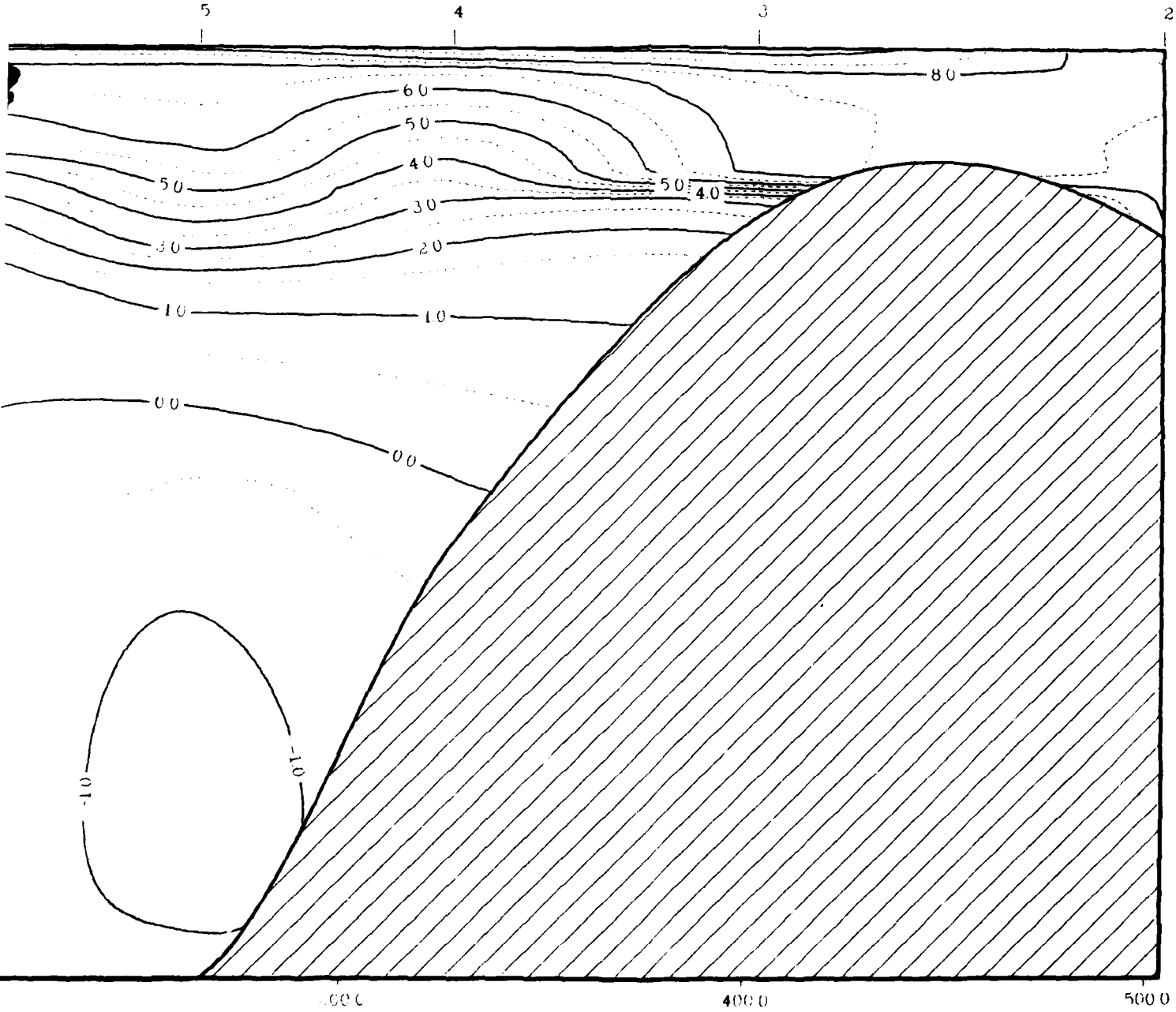

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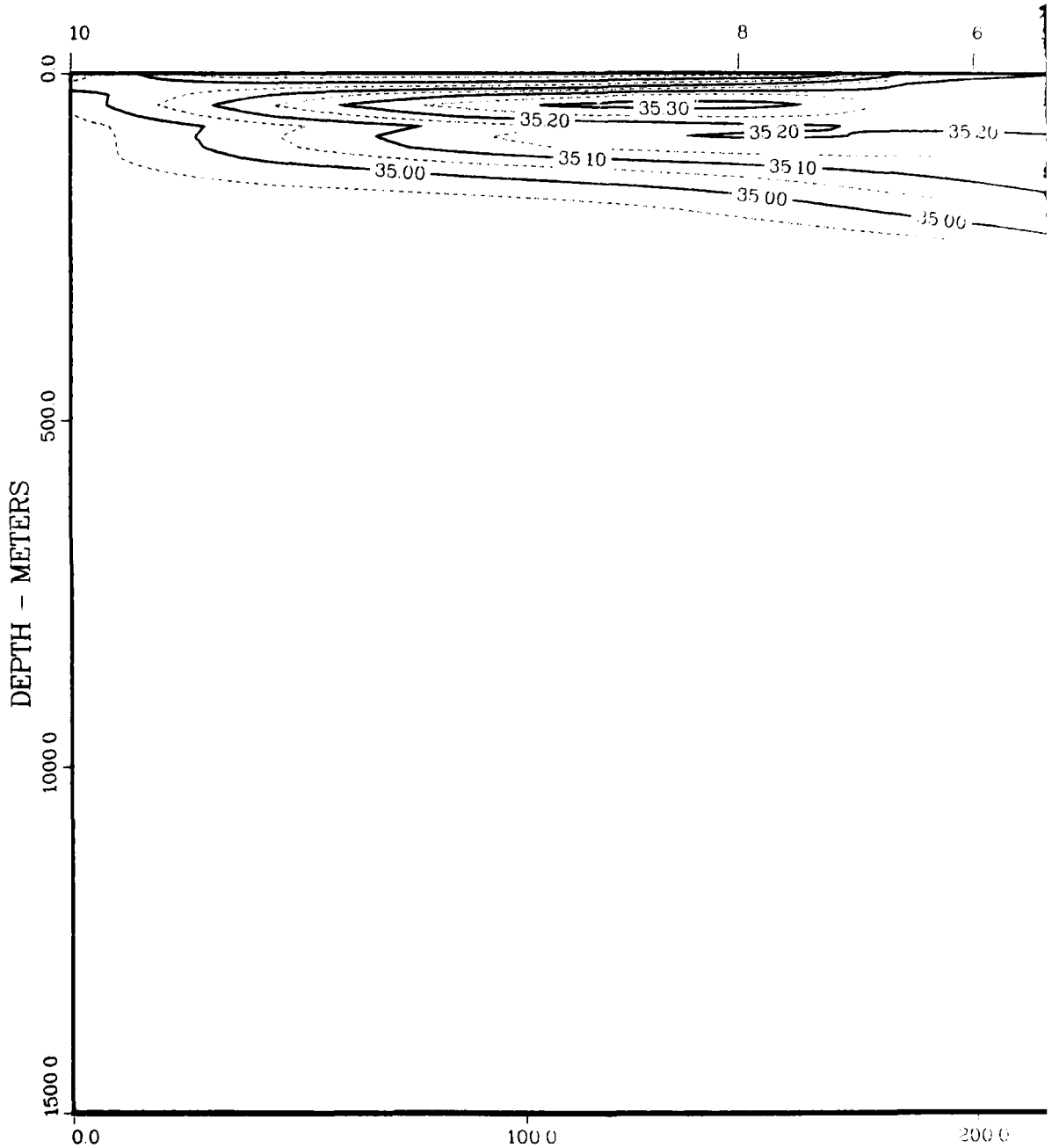

Figure 12. May 1901 salinity section.

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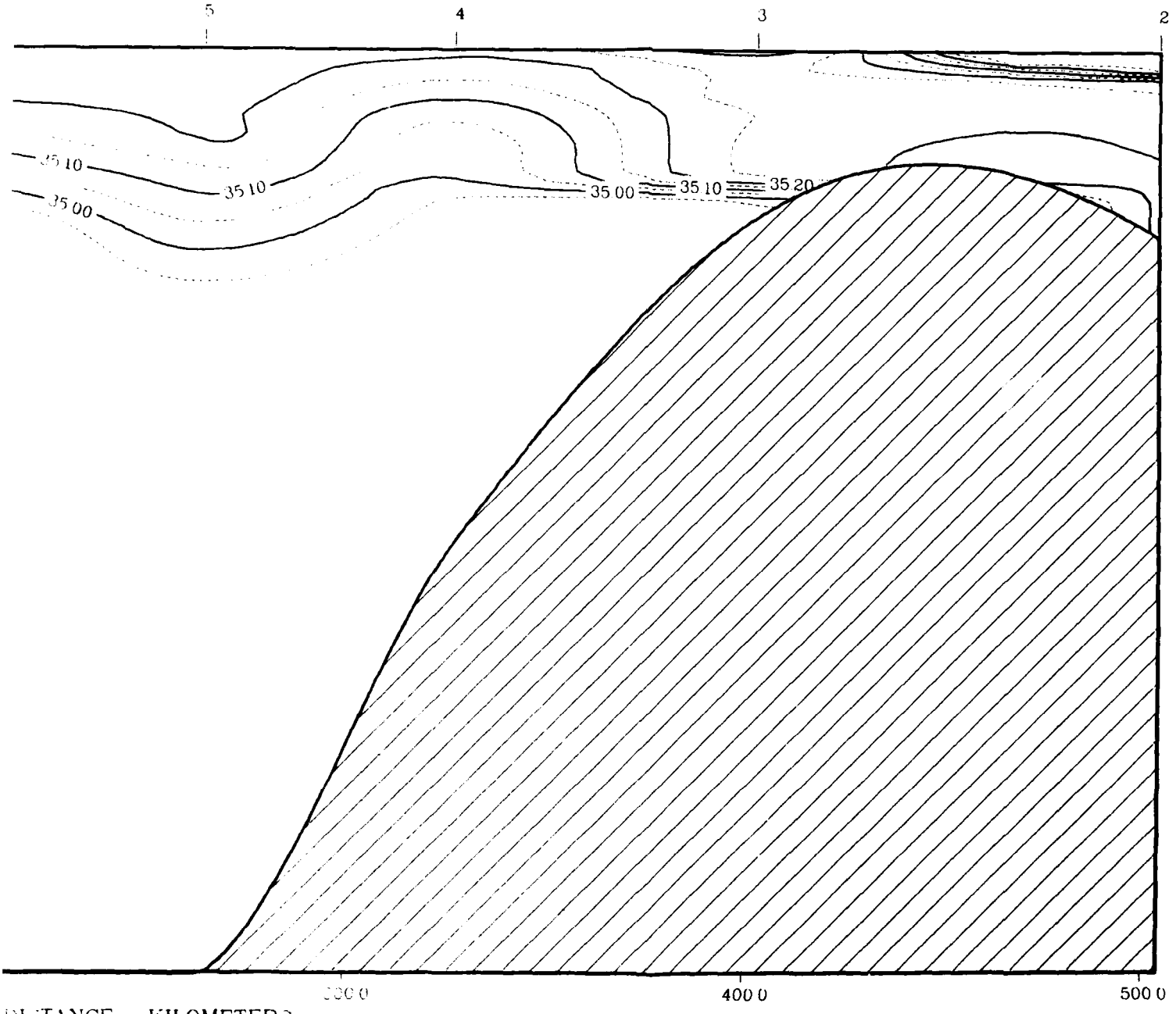

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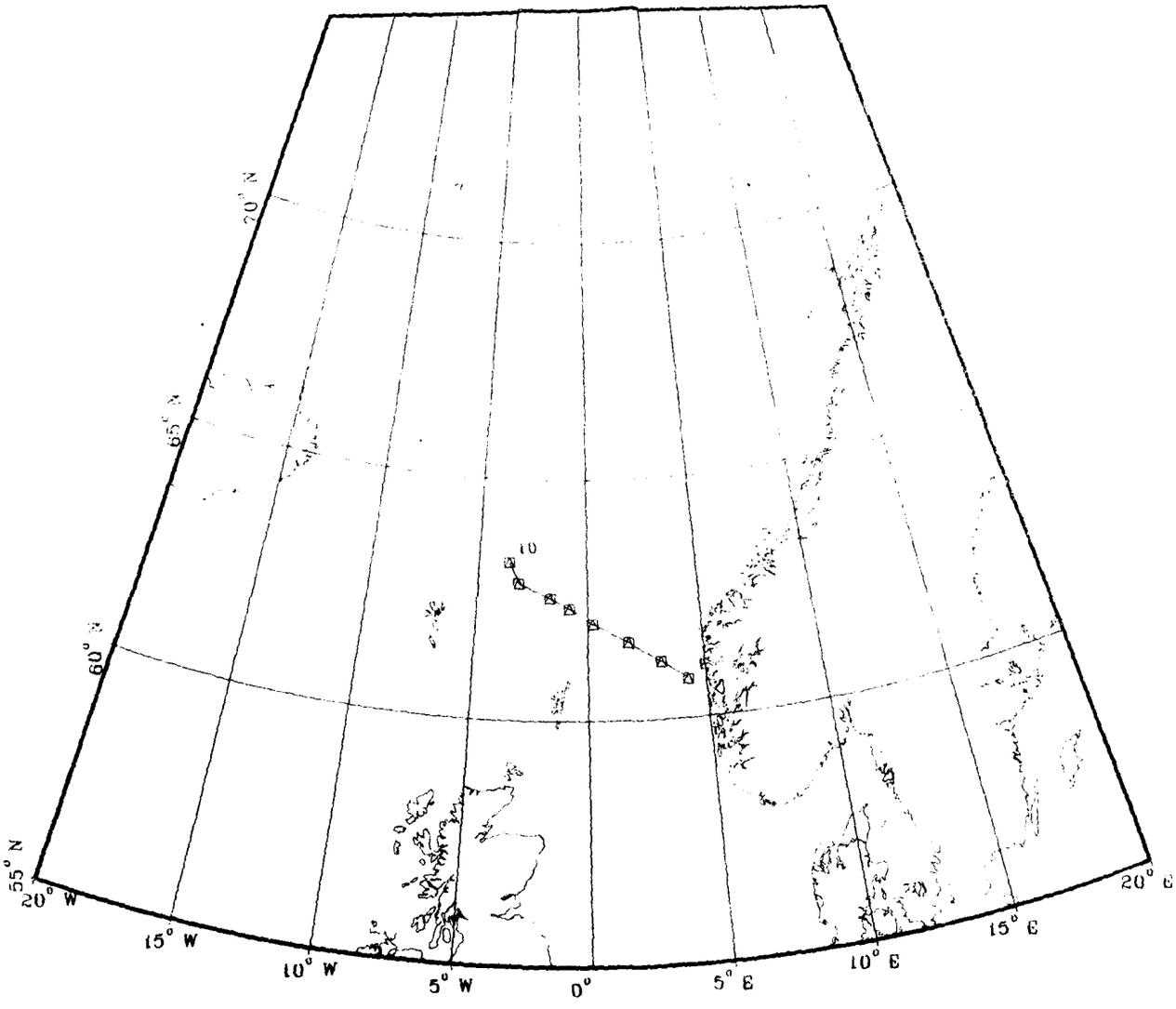

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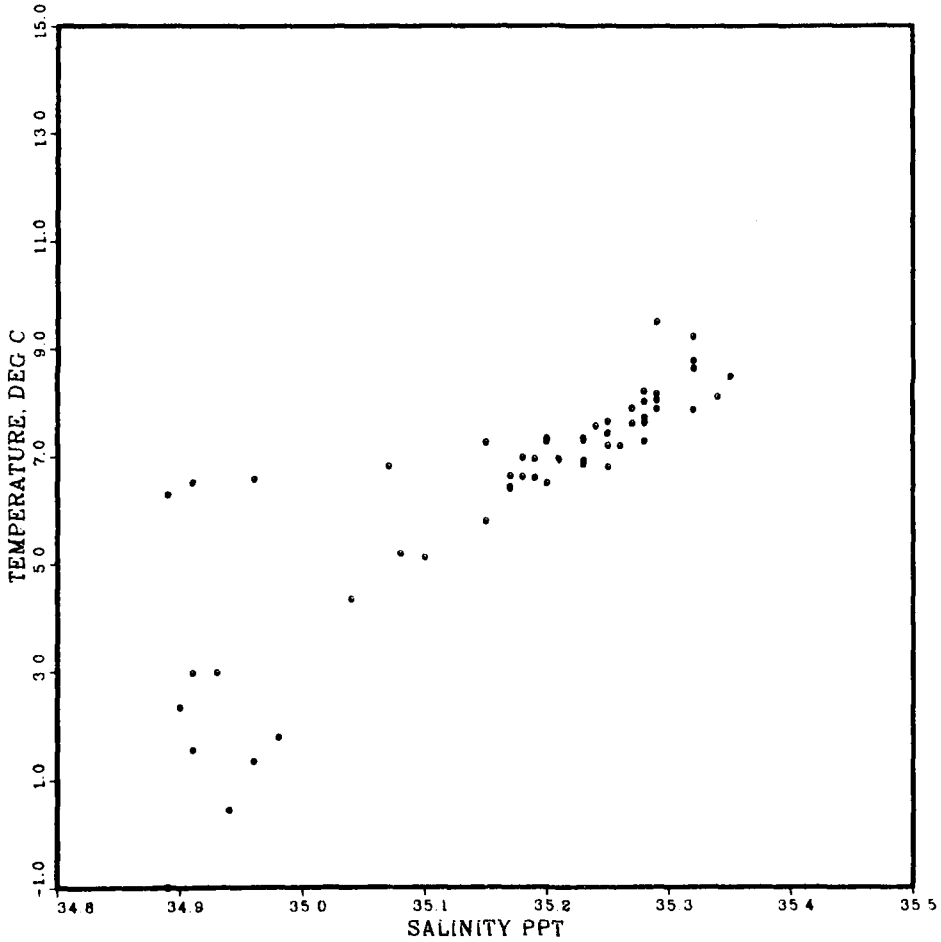

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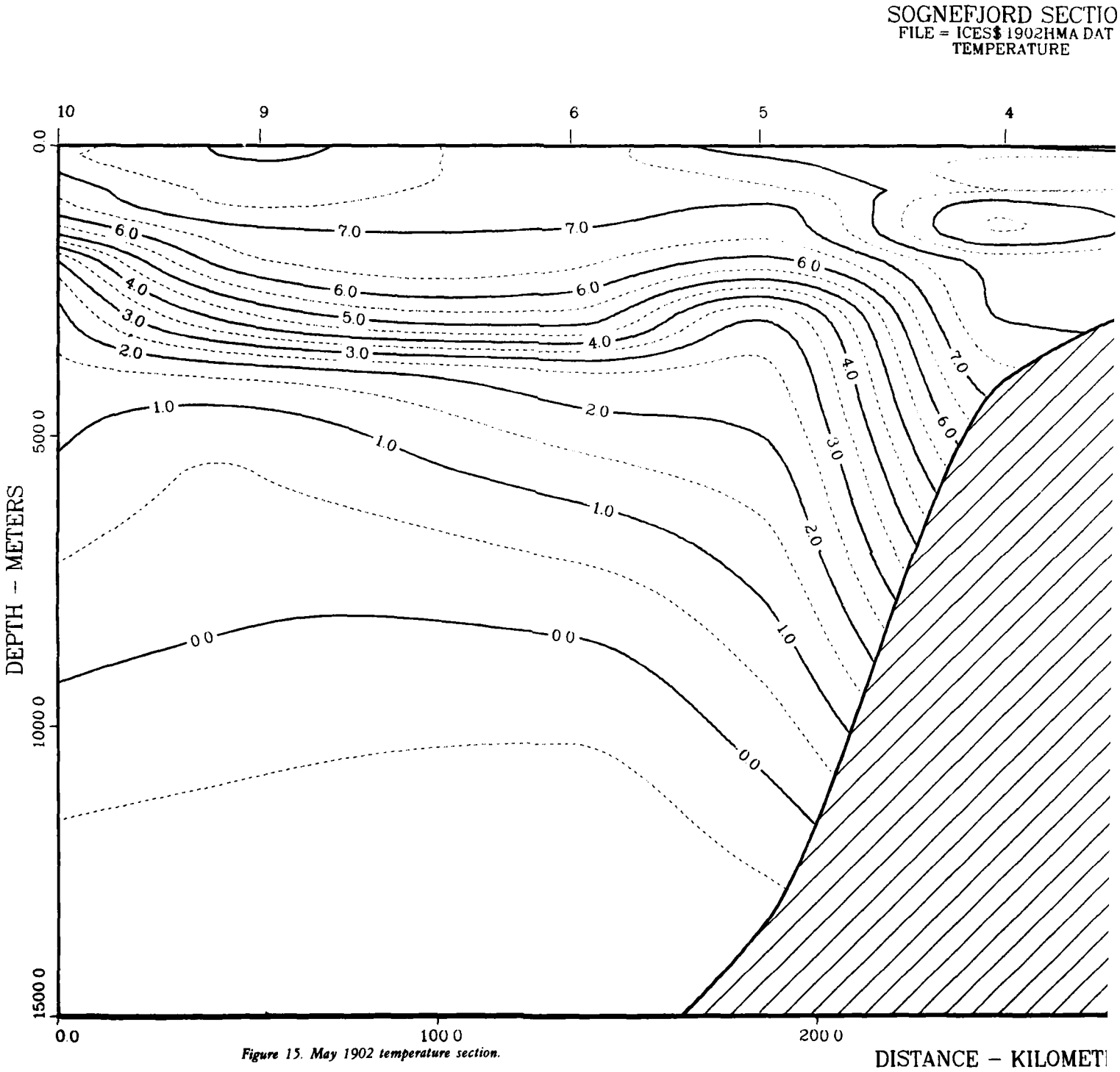

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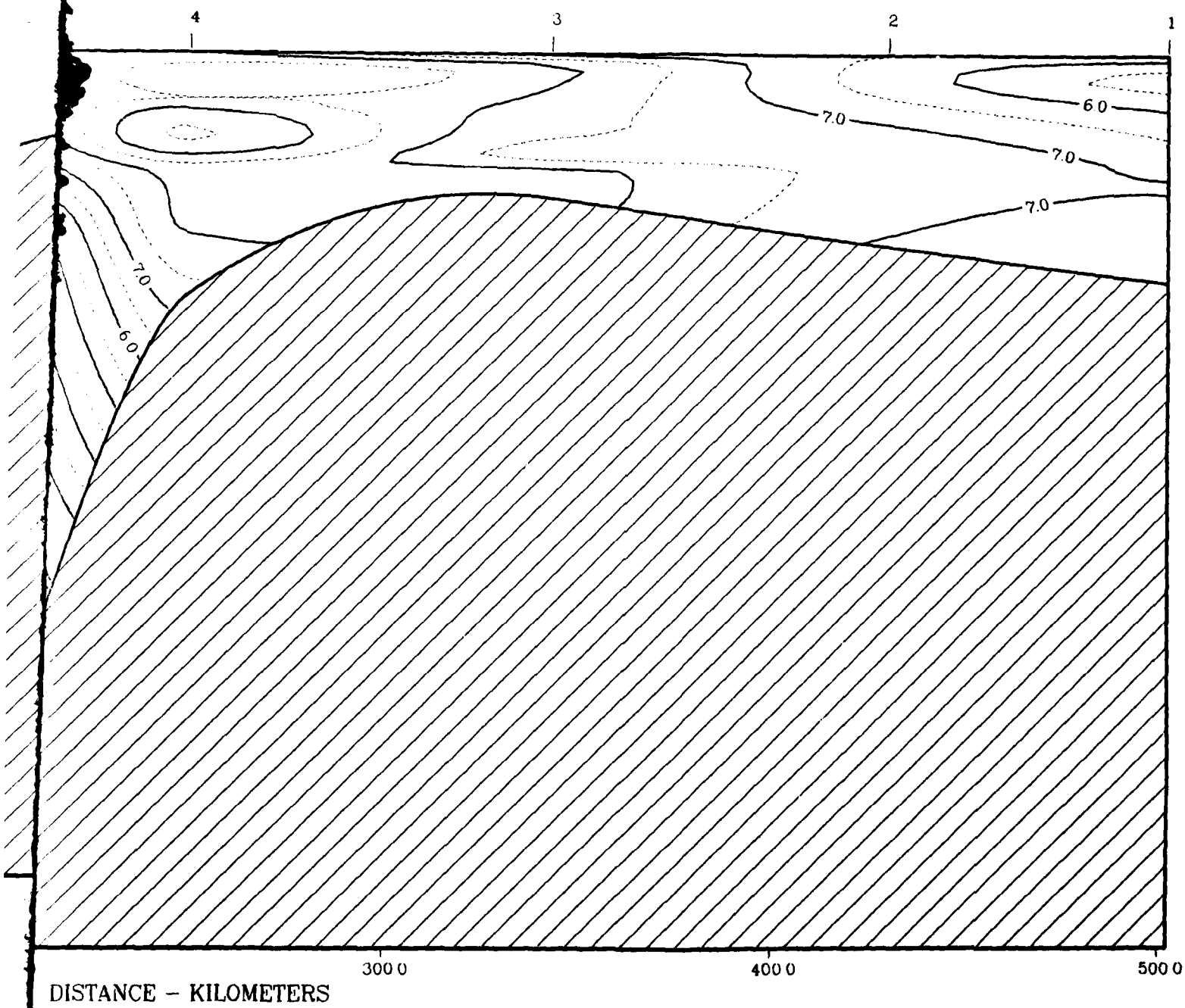

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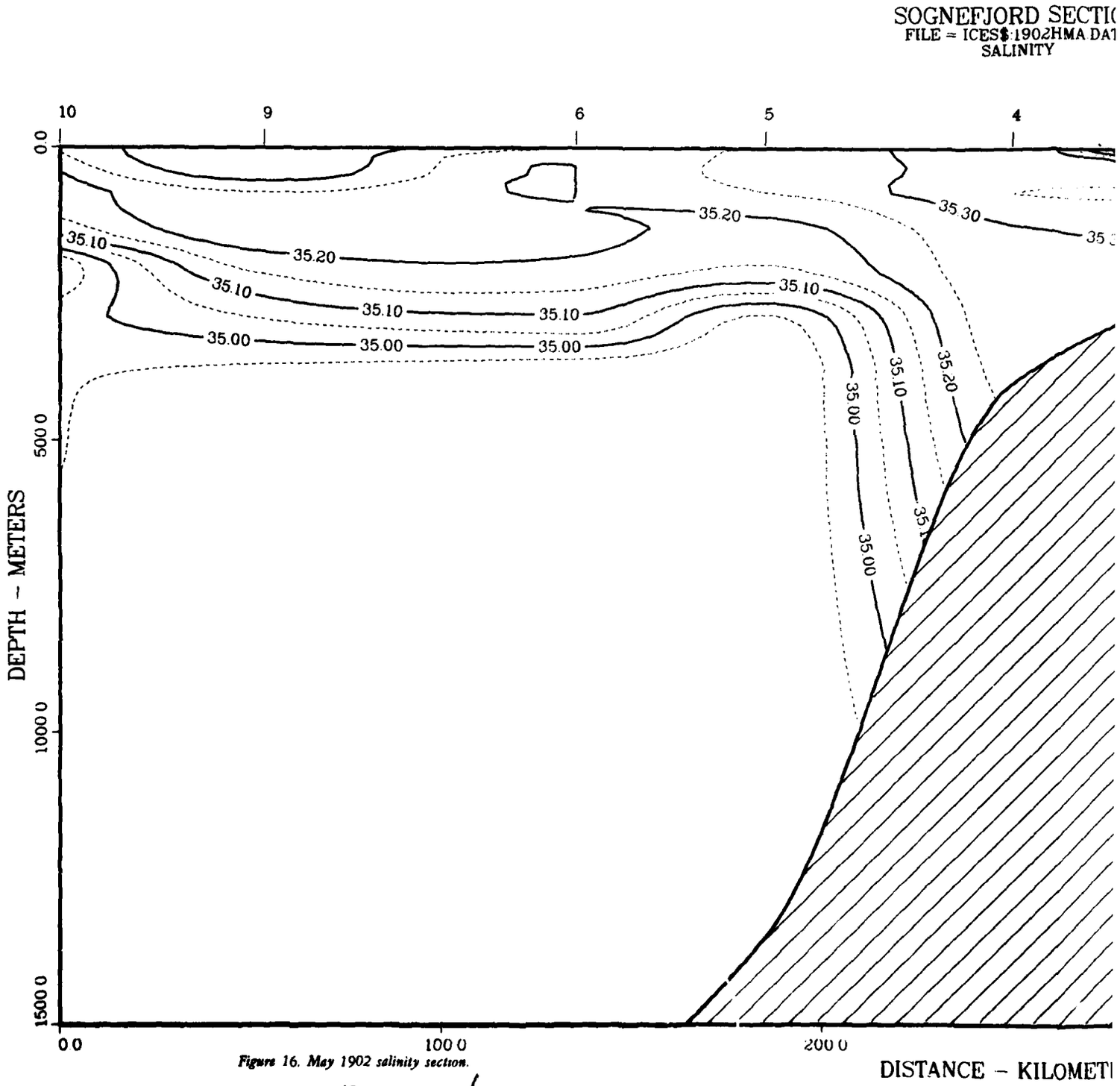

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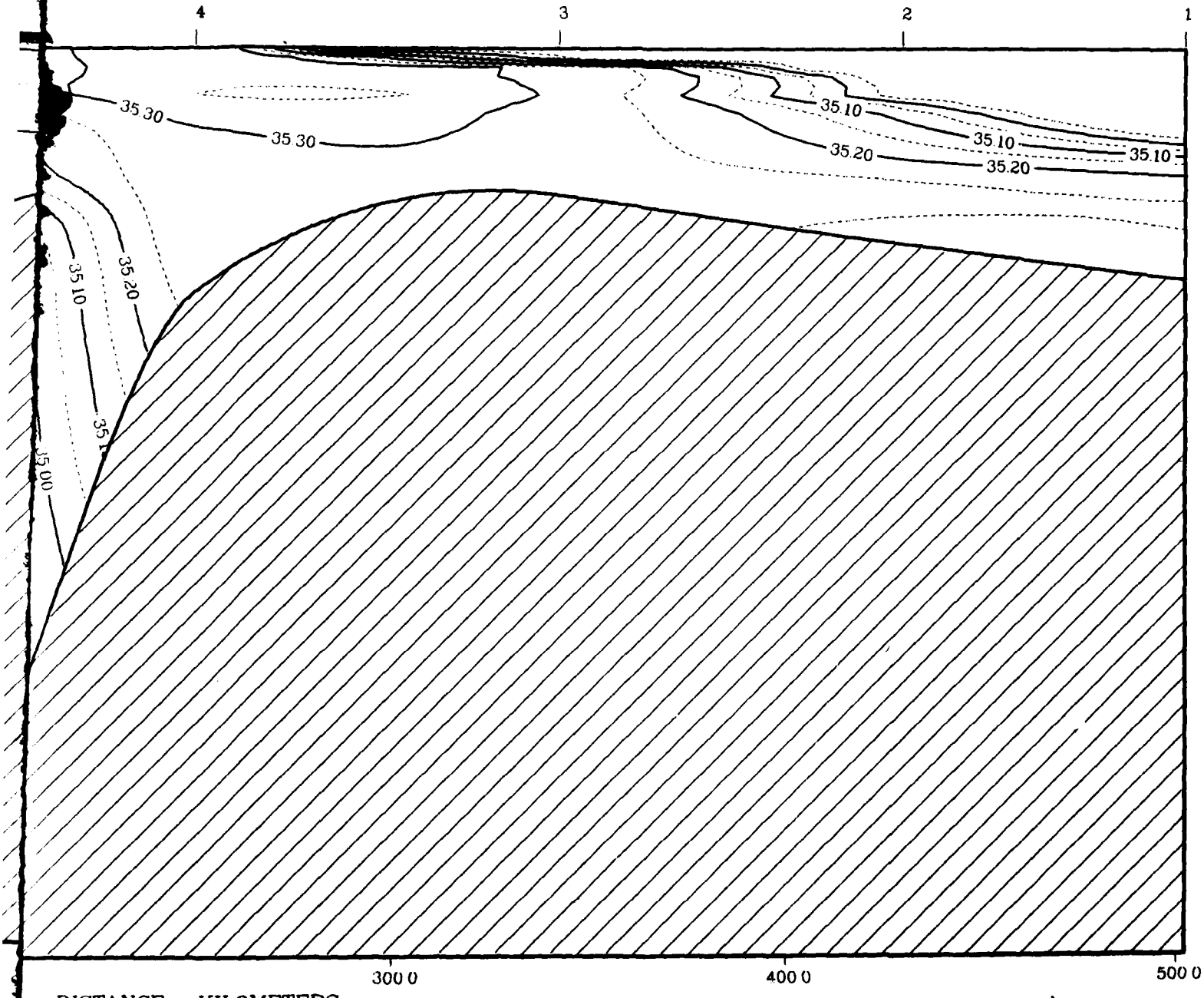

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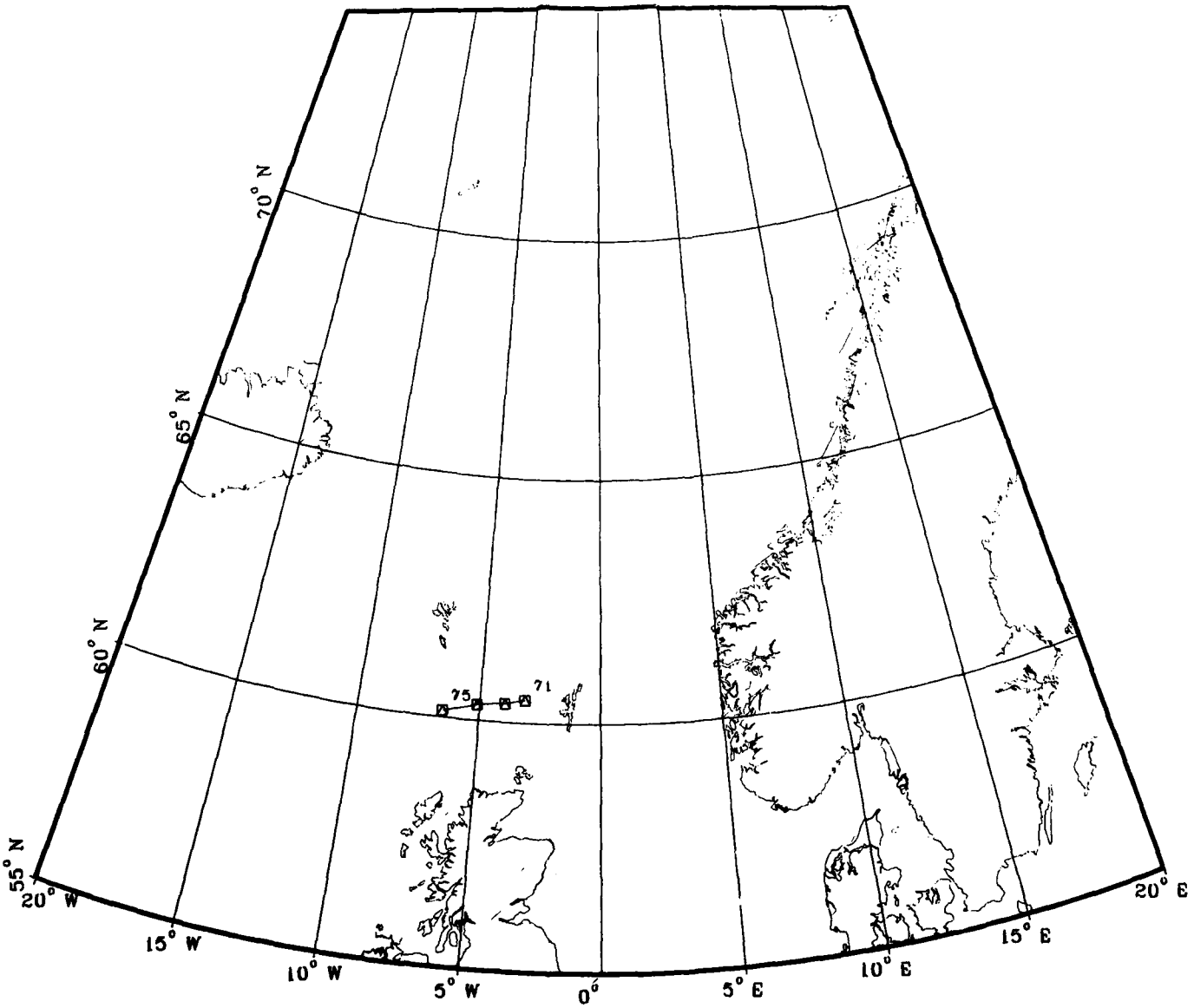

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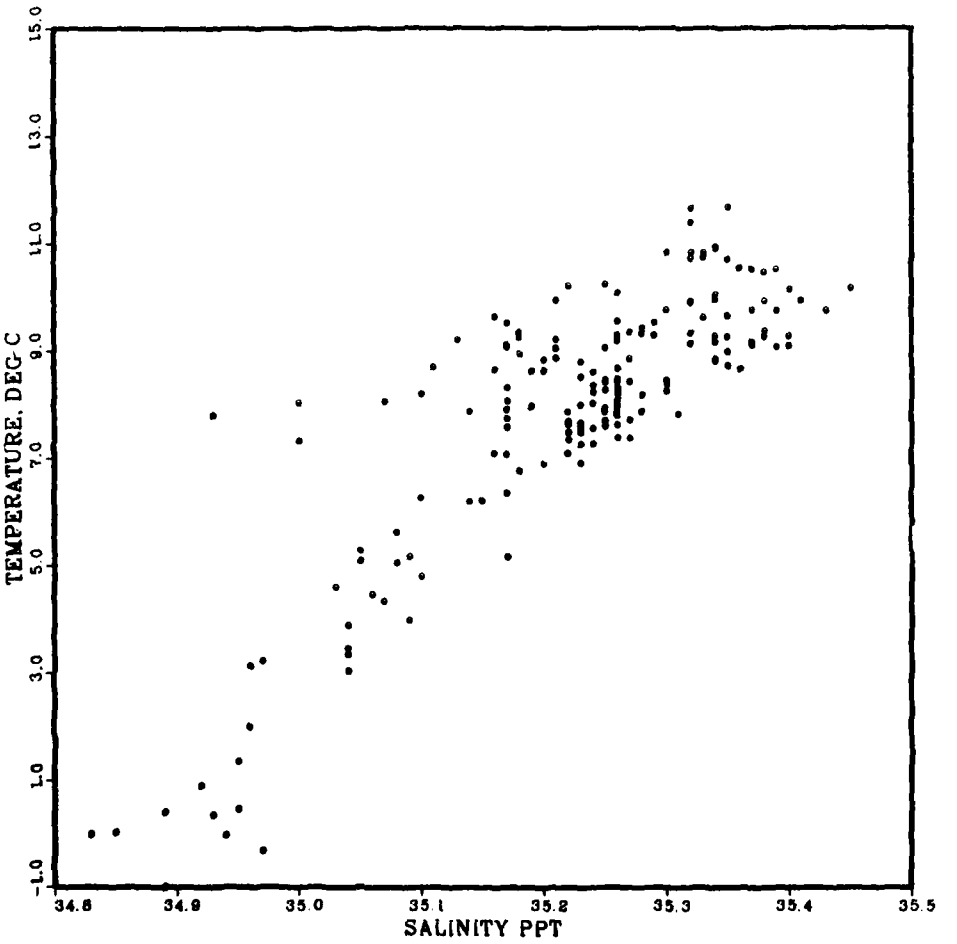

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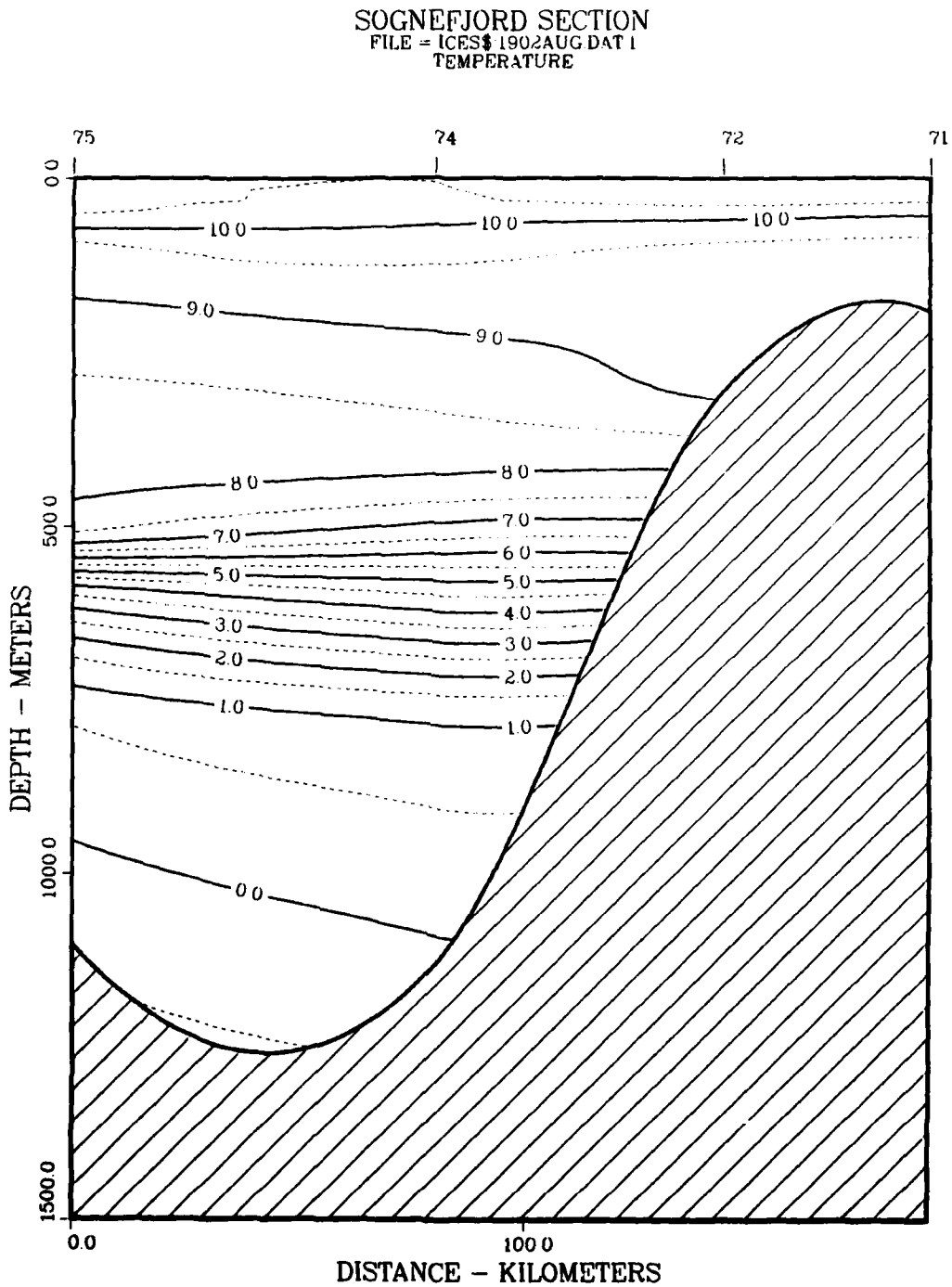

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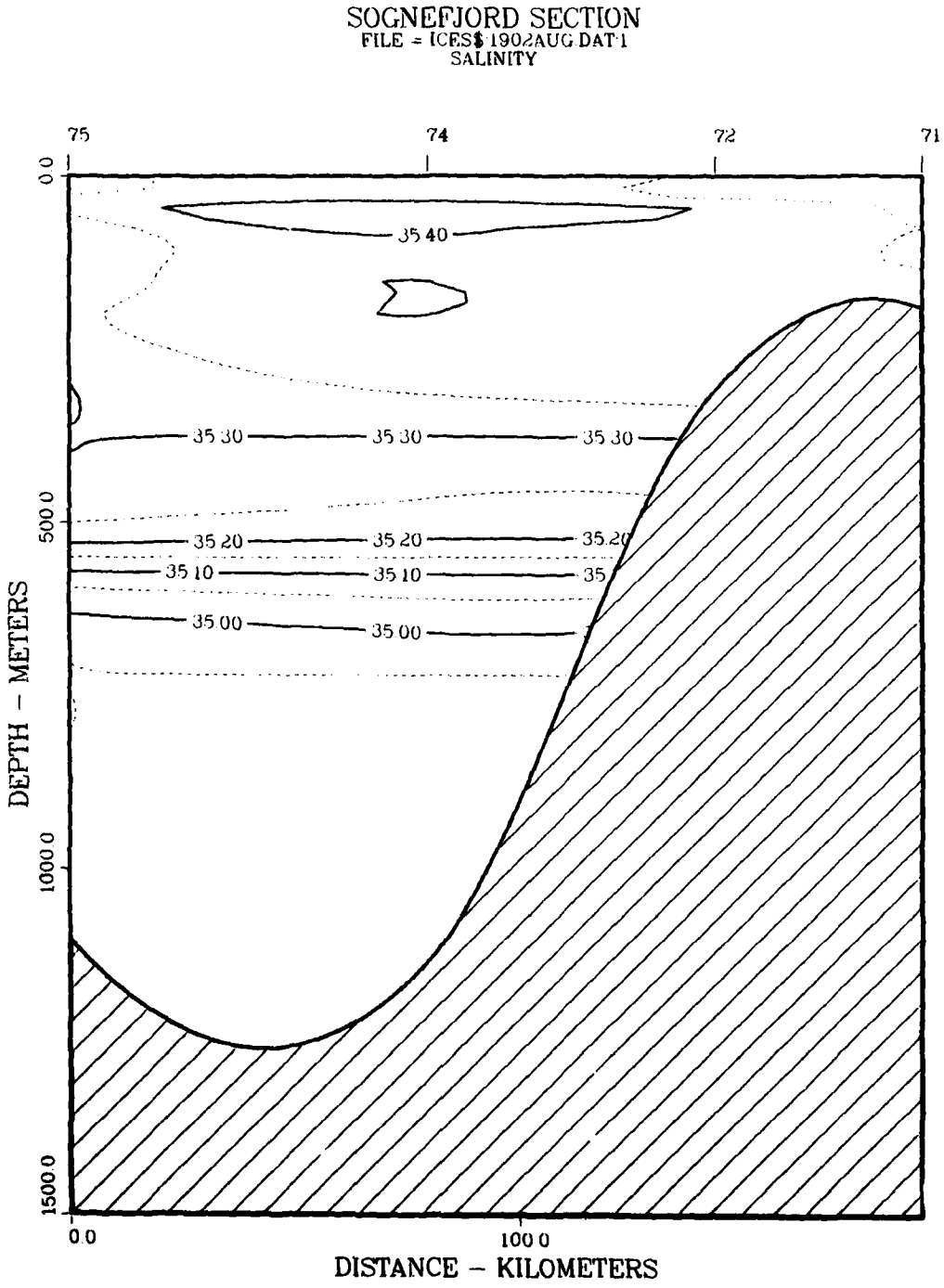

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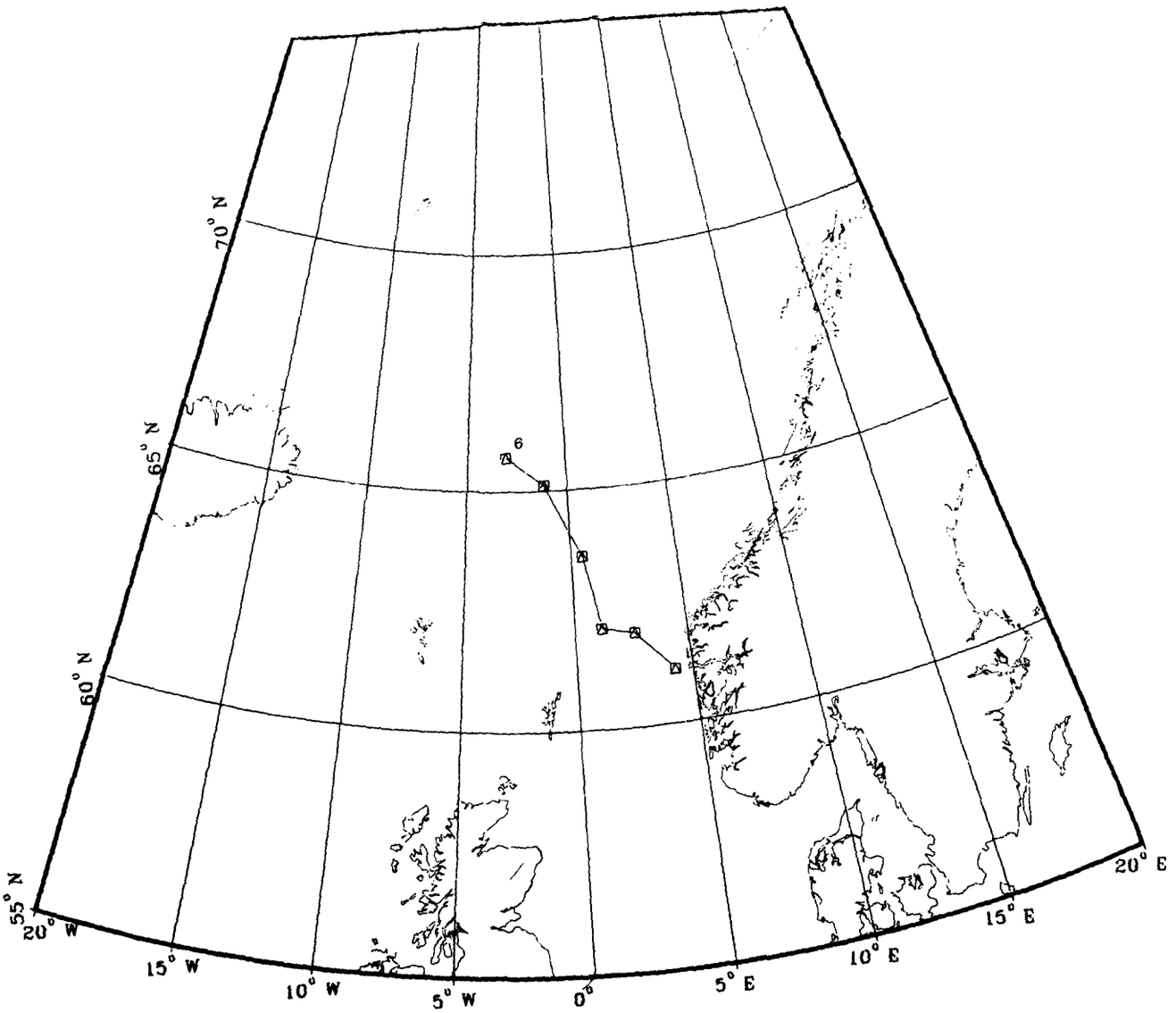

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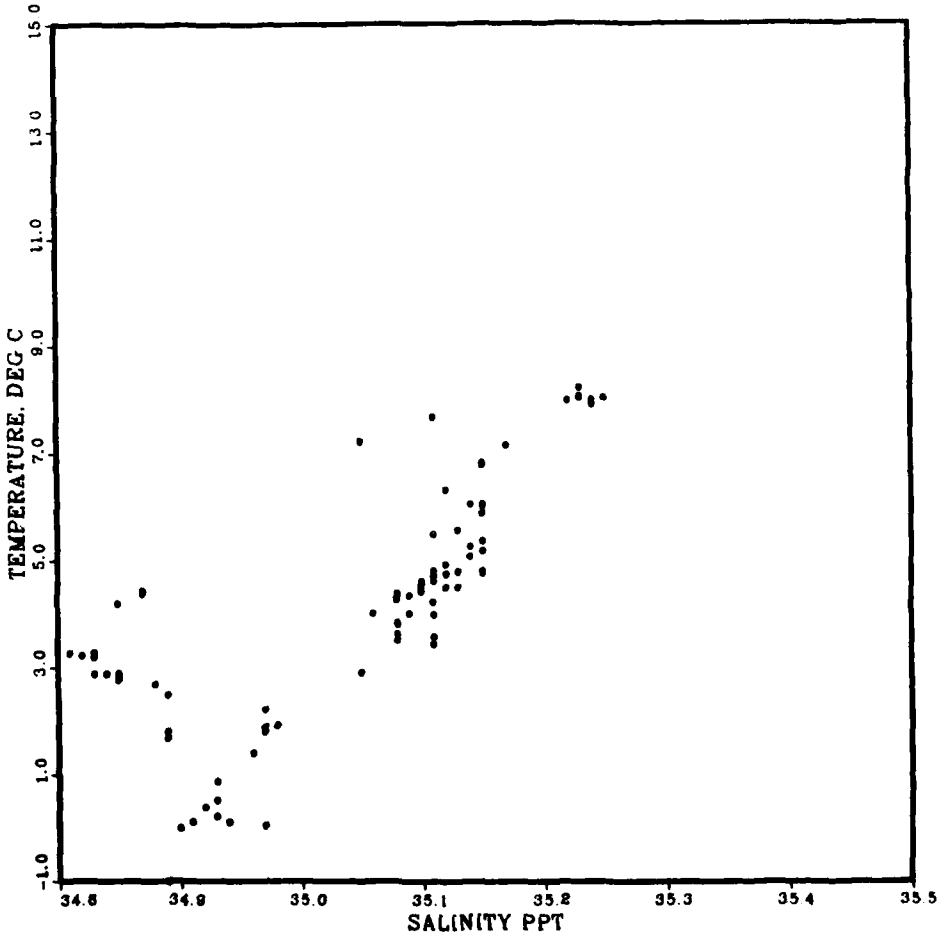

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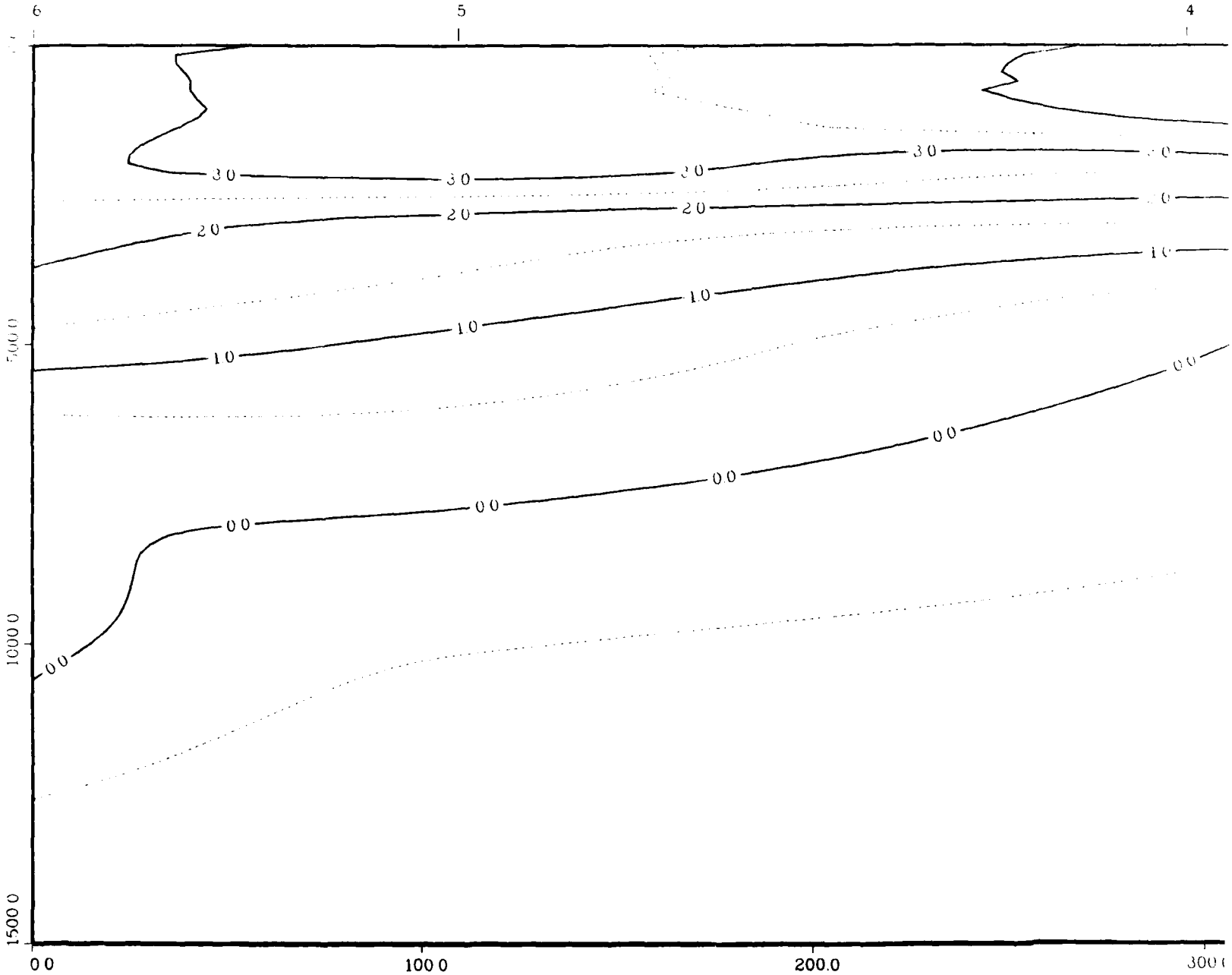
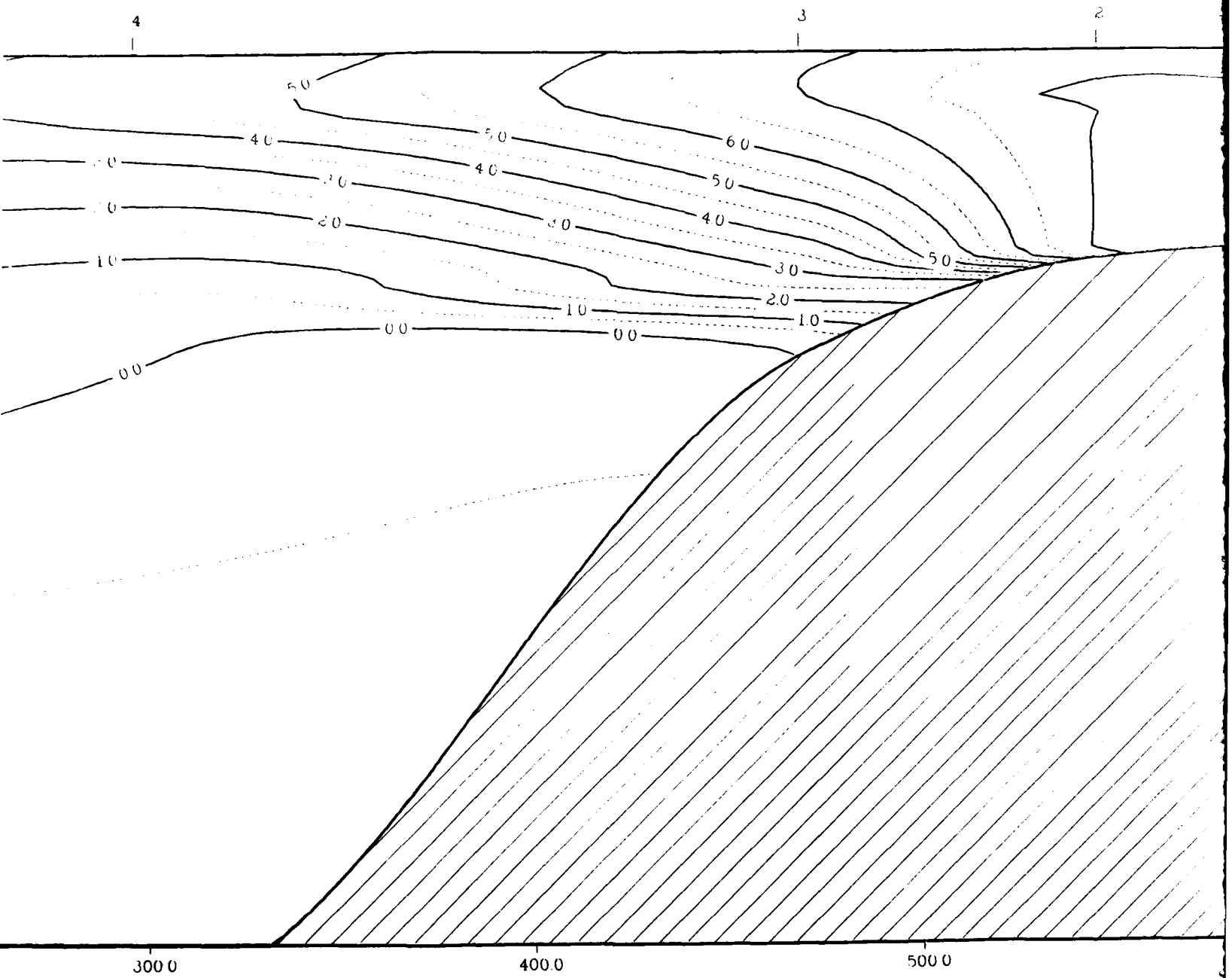


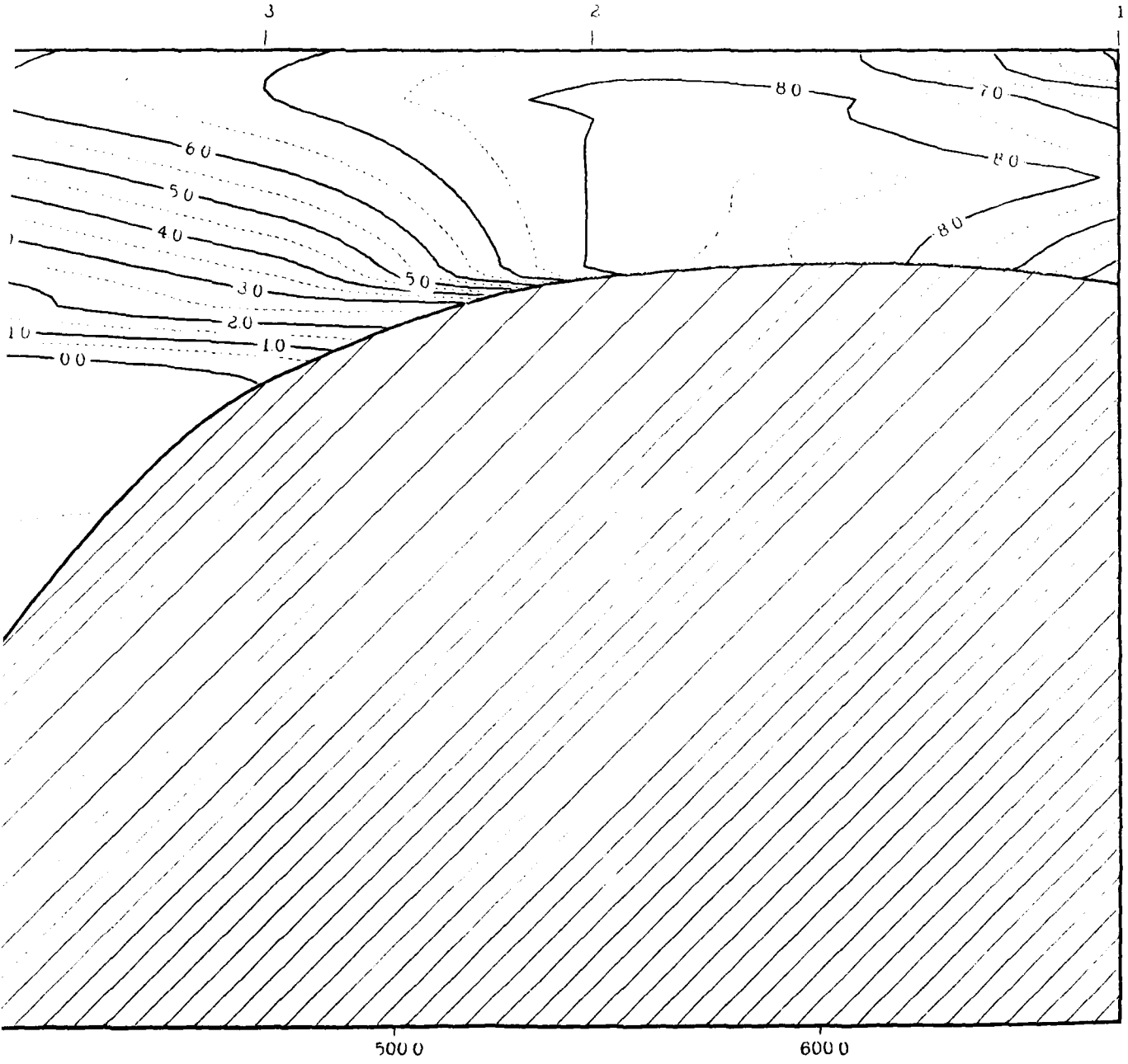
Figure 23. February 1903 temperature section.

SOGNEFJORD SECTION
FILE = ICES# 190.FEB DAT 1
TEMPERATURE



DISTANCE - KILOMETERS

2


3
2
1
8 0
7 0
6 0
8 0
5 0
4 0
8 0
5 0
3 0
2.0
1.0
0 0
500 0
600 0

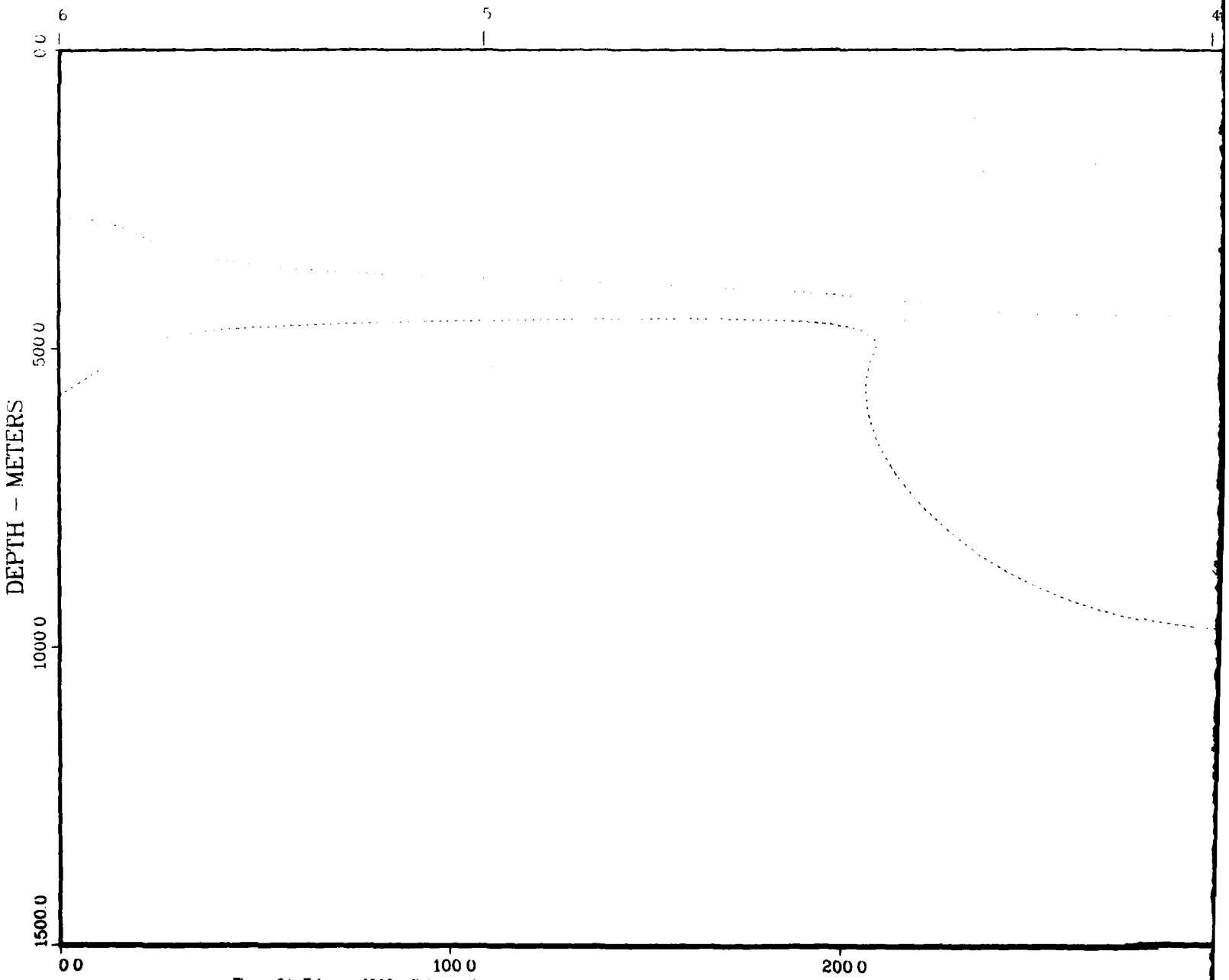
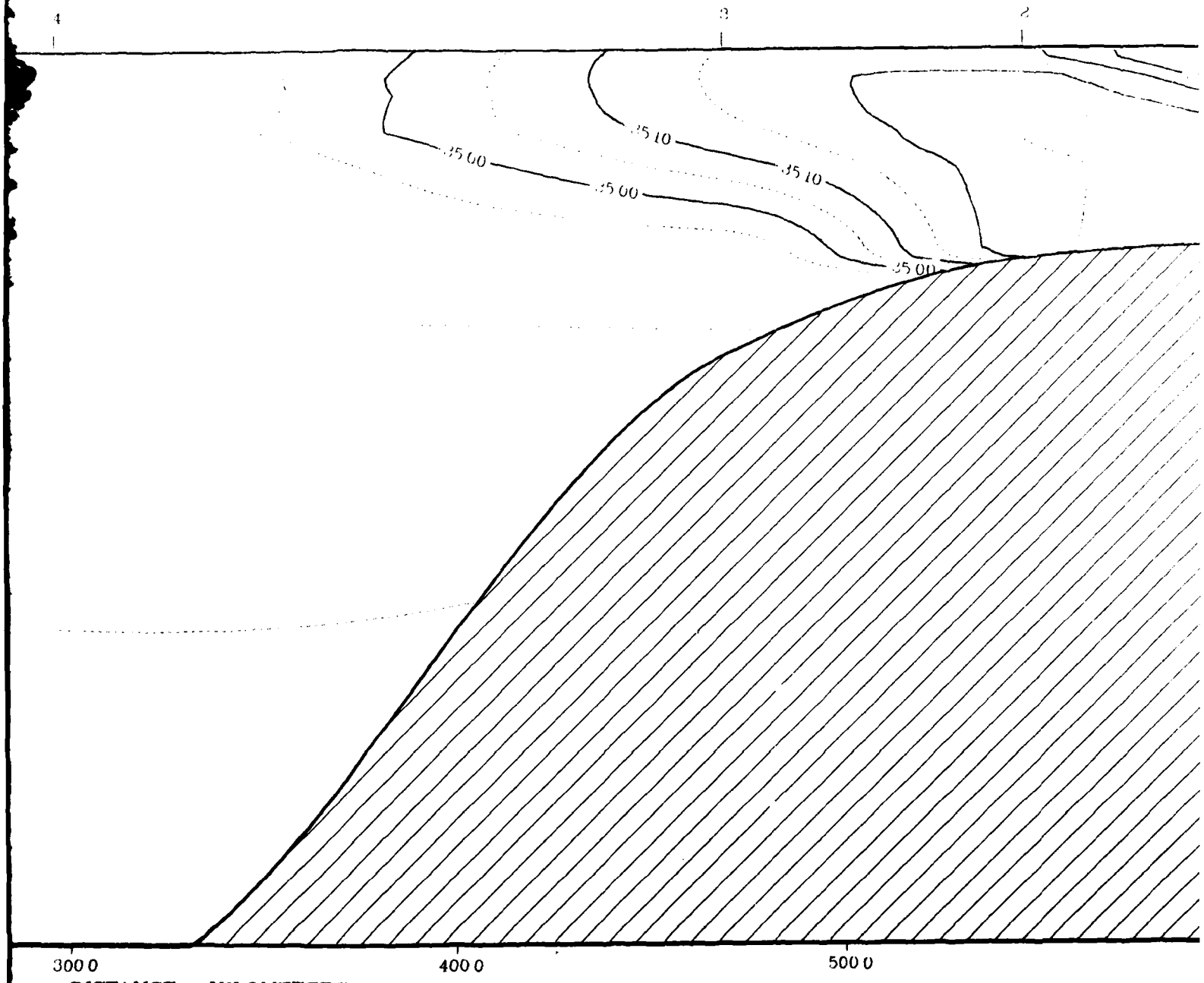


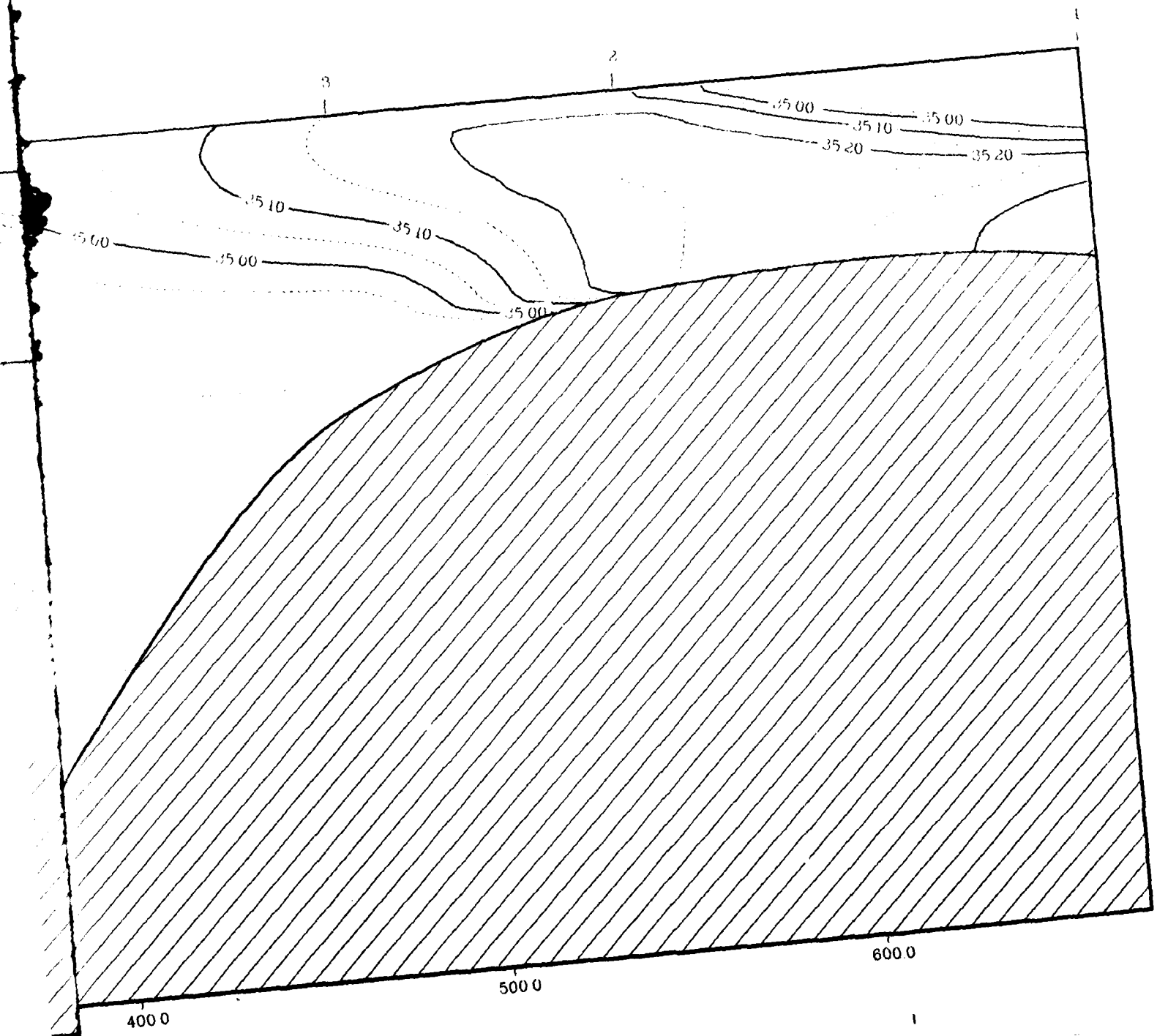
Figure 24. February 1903 salinity section.

SOGNEFJORD SECTION
FILE = ICES$190.FEB DAT1
SALINITY



DISTANCE – KILOMETERS

2


35.00
35.10
35.00
35.20
35.20
35.10
35.10
35.00
35.00
35.00
400.0
500.0
600.0

2

3

ICES$:1903LMA.DAT

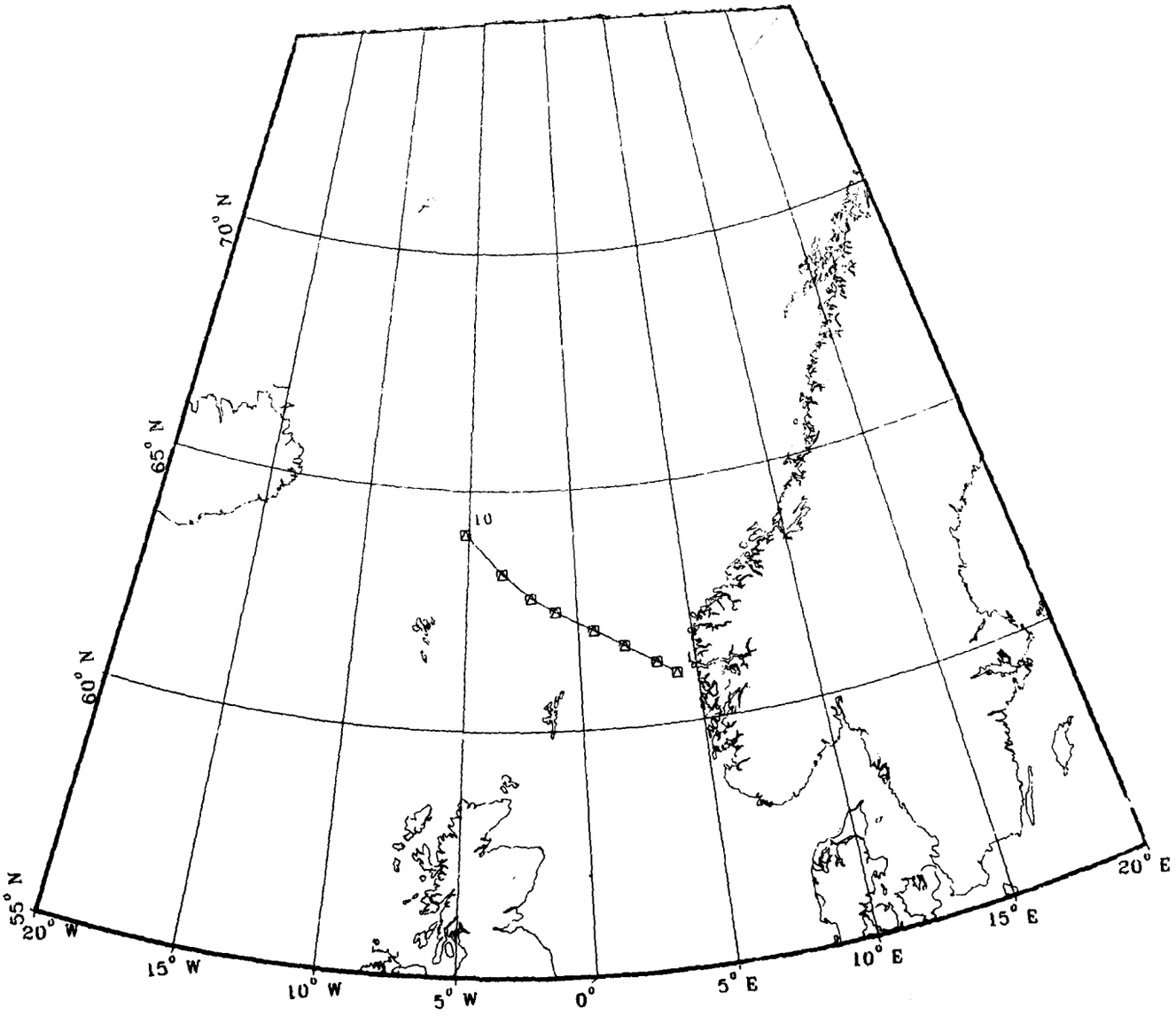


Figure 25. May 1903 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1903LMA.DAT
T/S PLOT

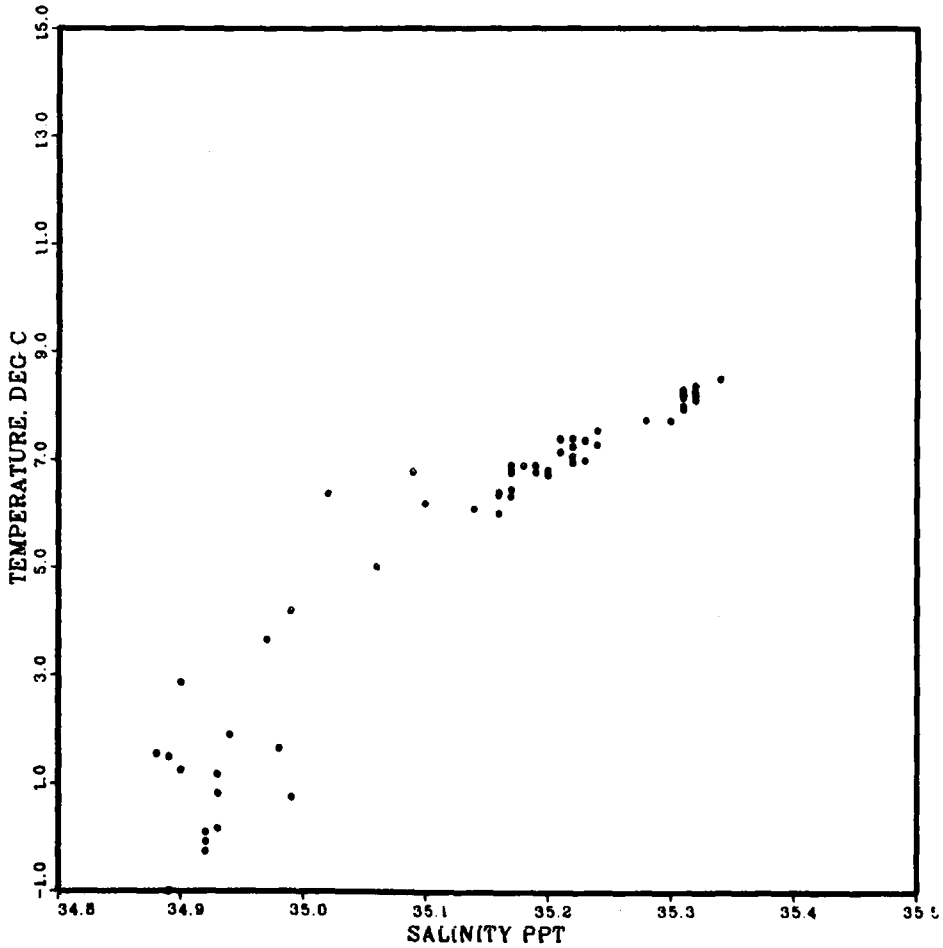


Figure 26. May 1903 temperature/salinity diagram.

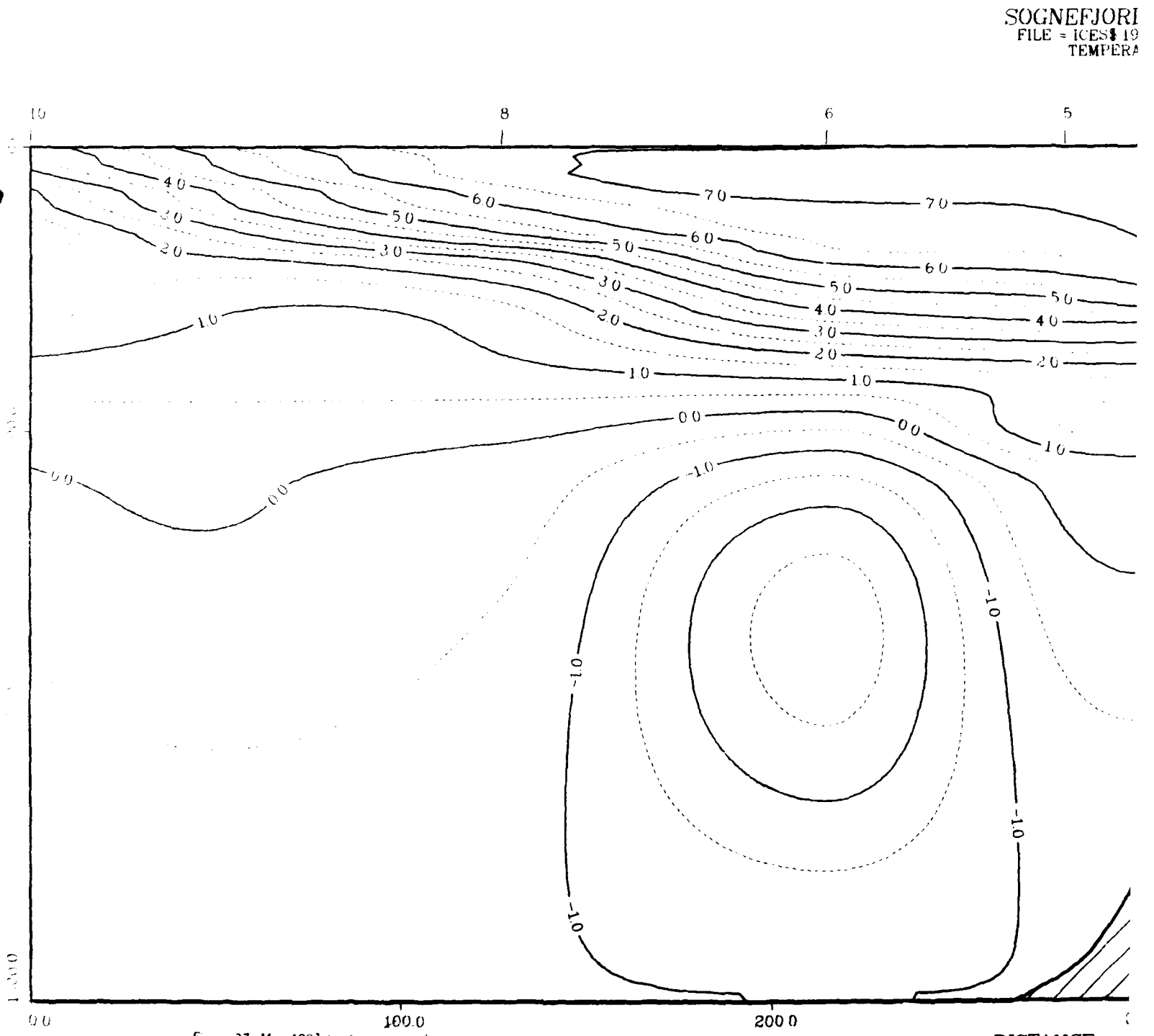
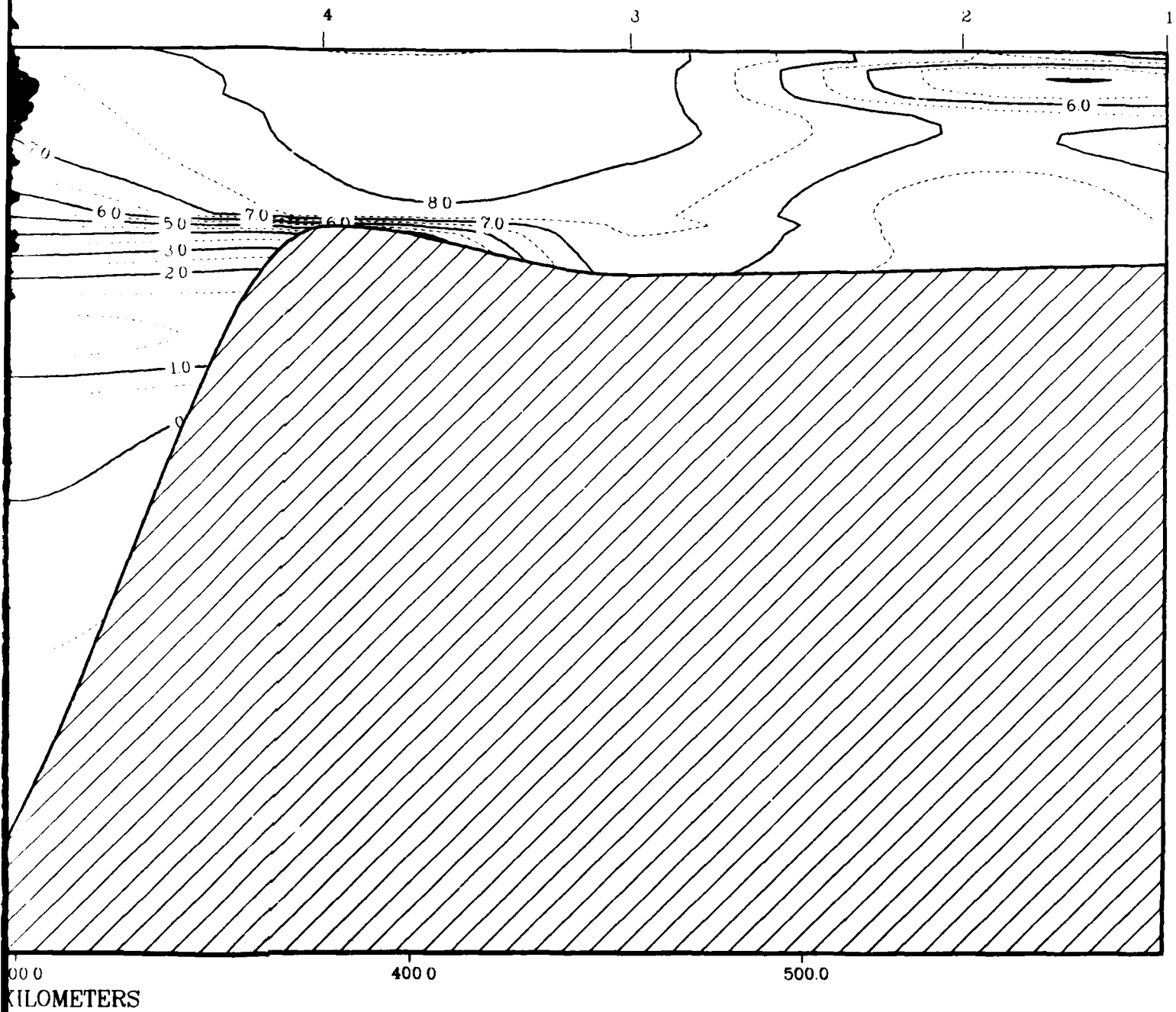


Figure 27 May 1903 temperature section

RD SECTION
90.3LMA DAT 1
ATURE



2

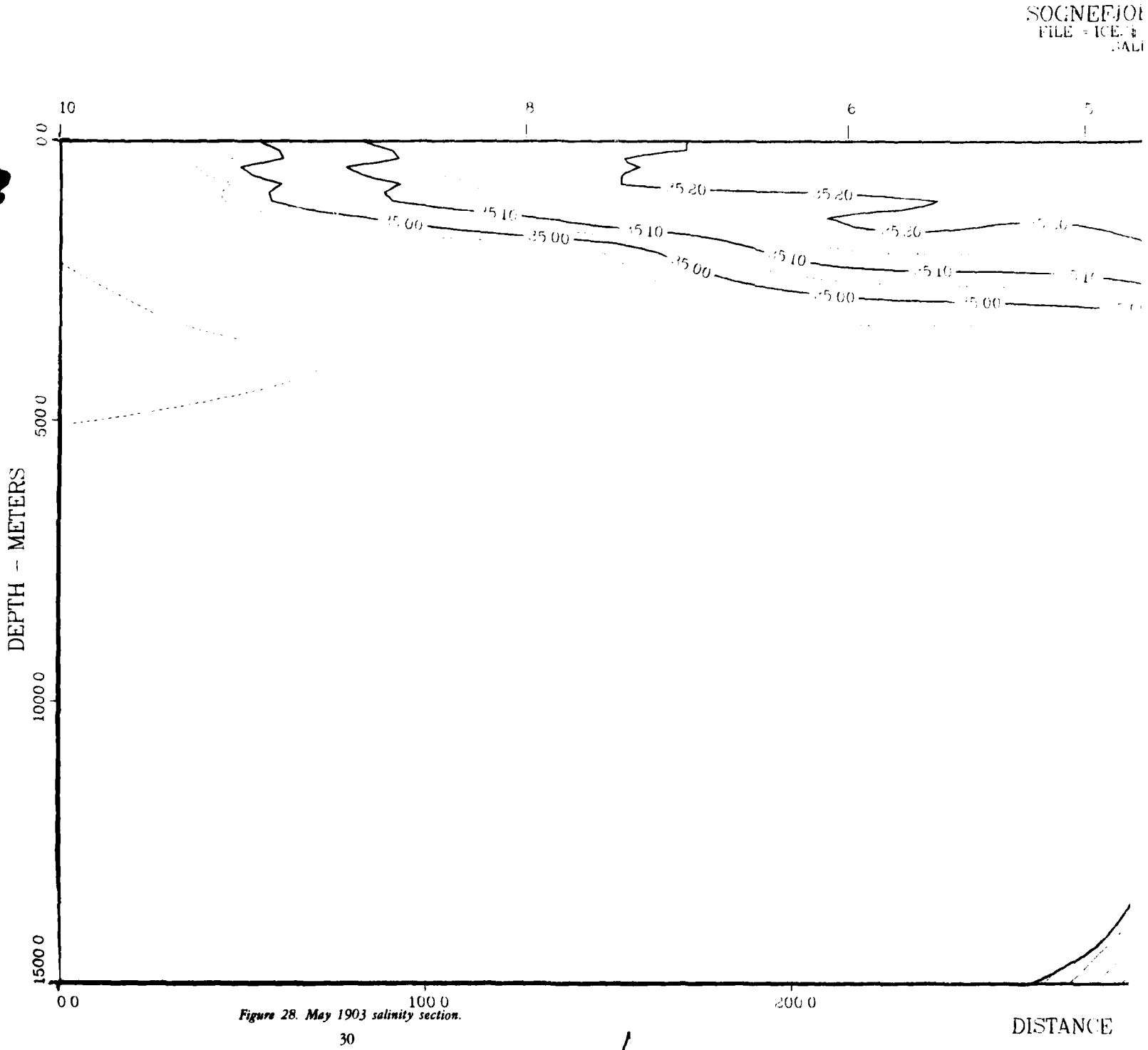
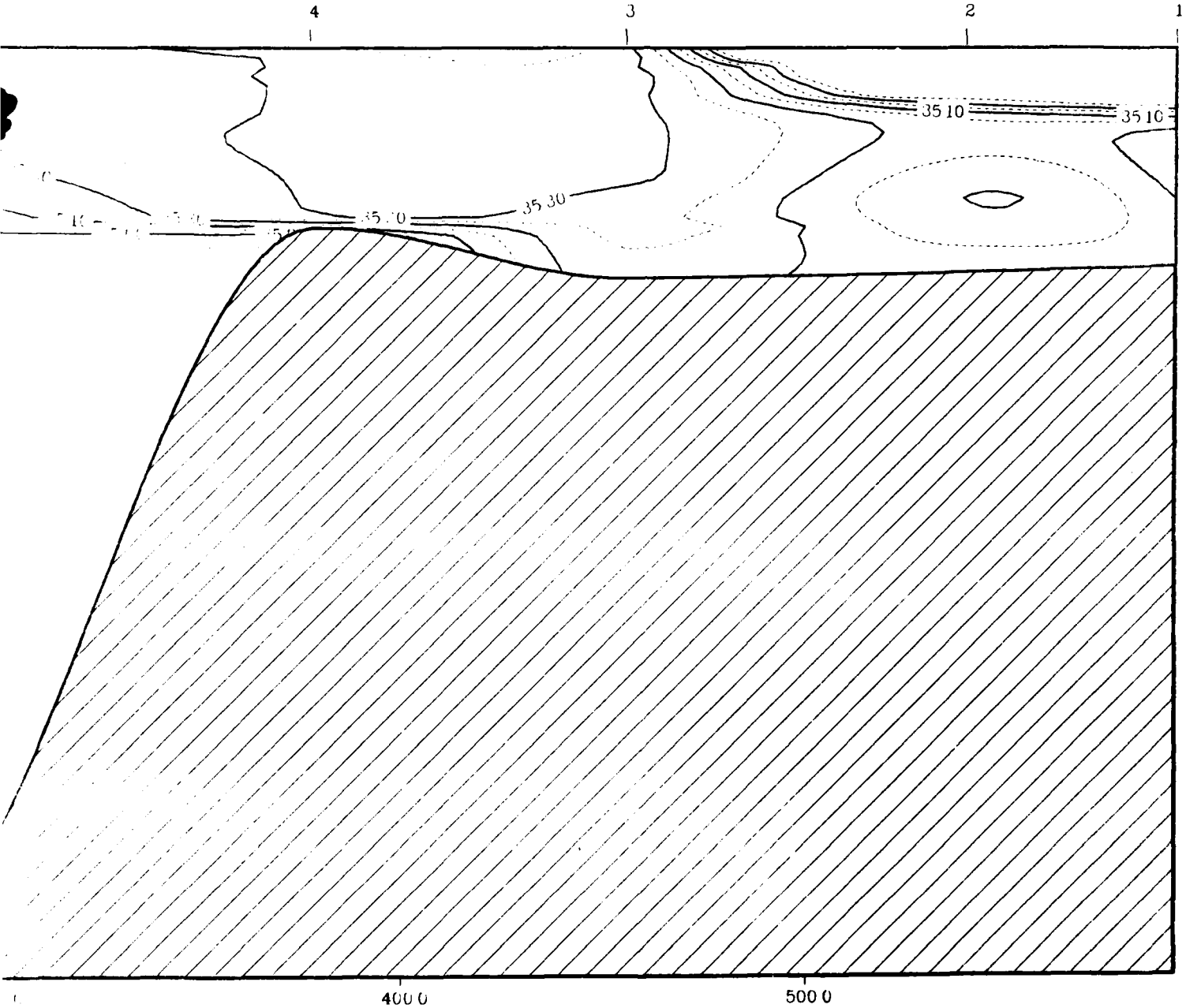


Figure 28. May 1903 salinity section.

SECTION
ELMA DATI
TY



LOMETERS

2

ICES$:1903NOV.DAT

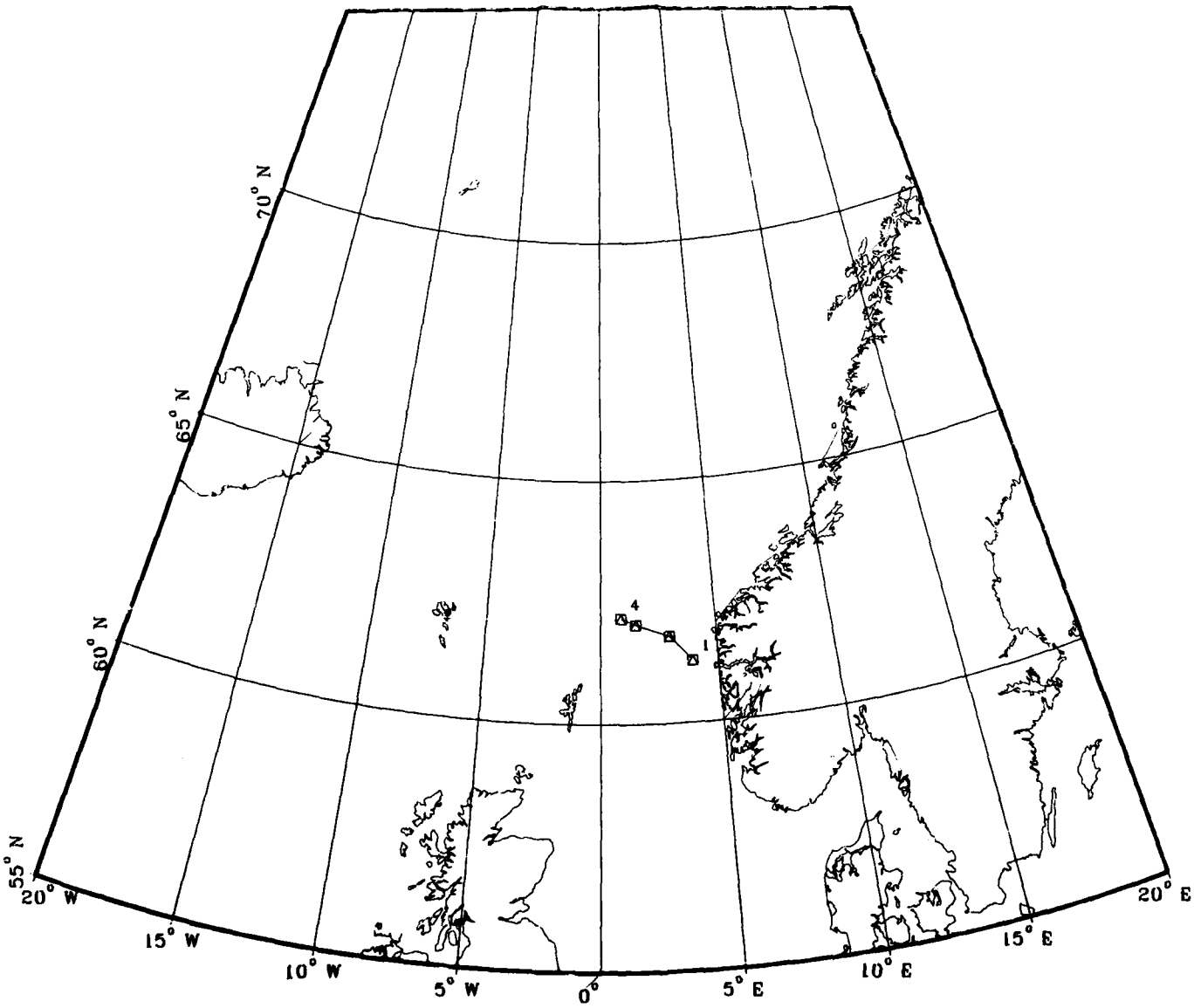


Figure 29. November 1903 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1903NOV.DAT
T/S PLOT

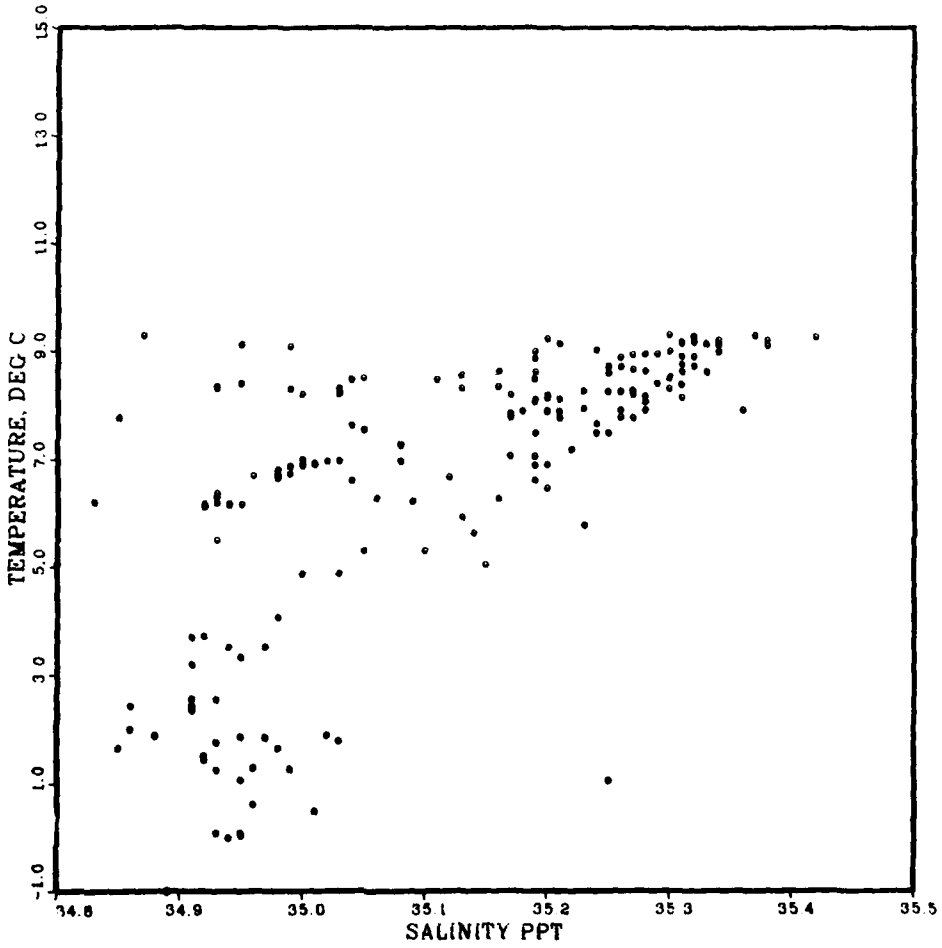


Figure 30. November 1903 temperature/salinity diagram.

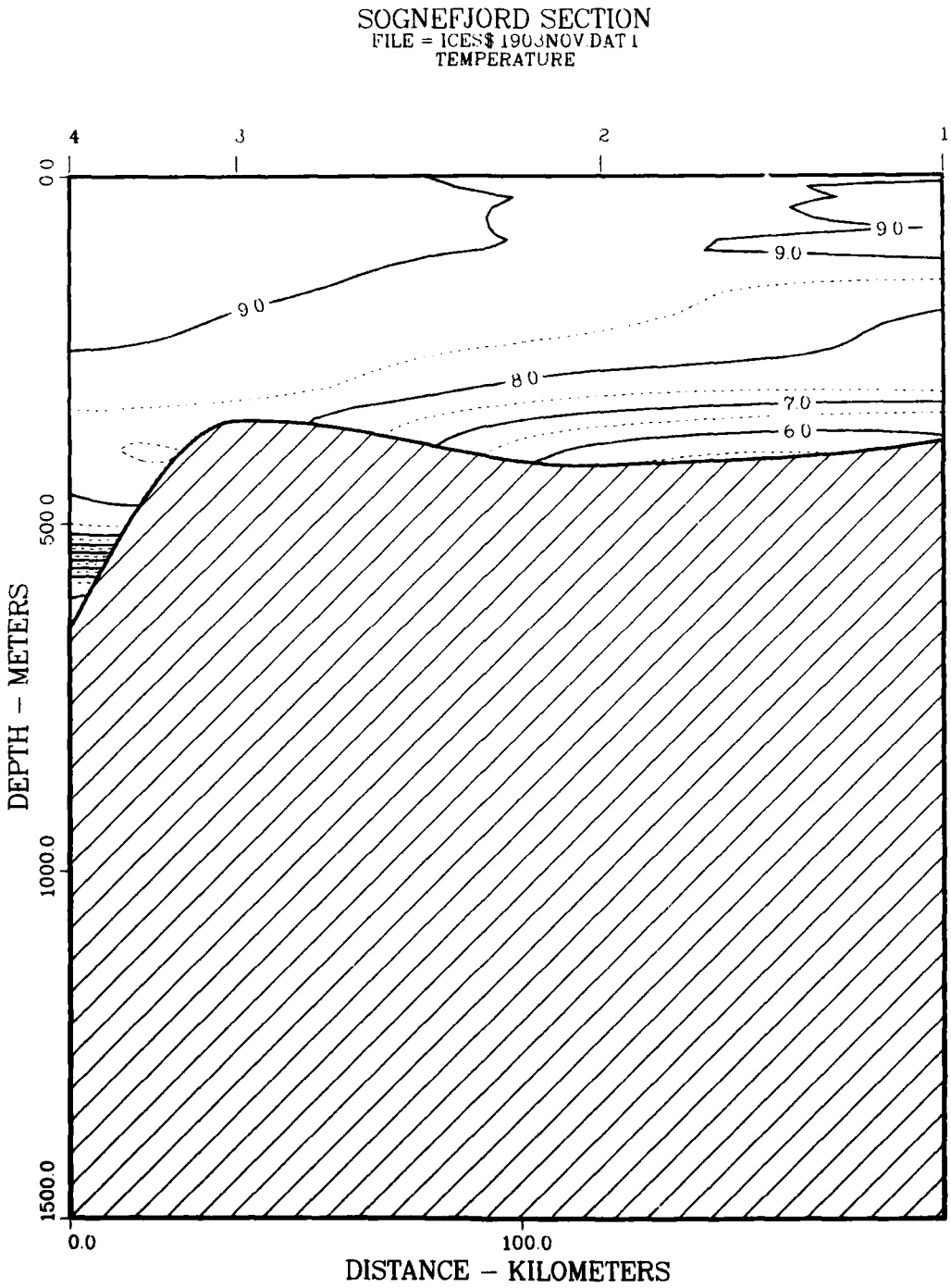


Figure 31. November 1903 temperature section.

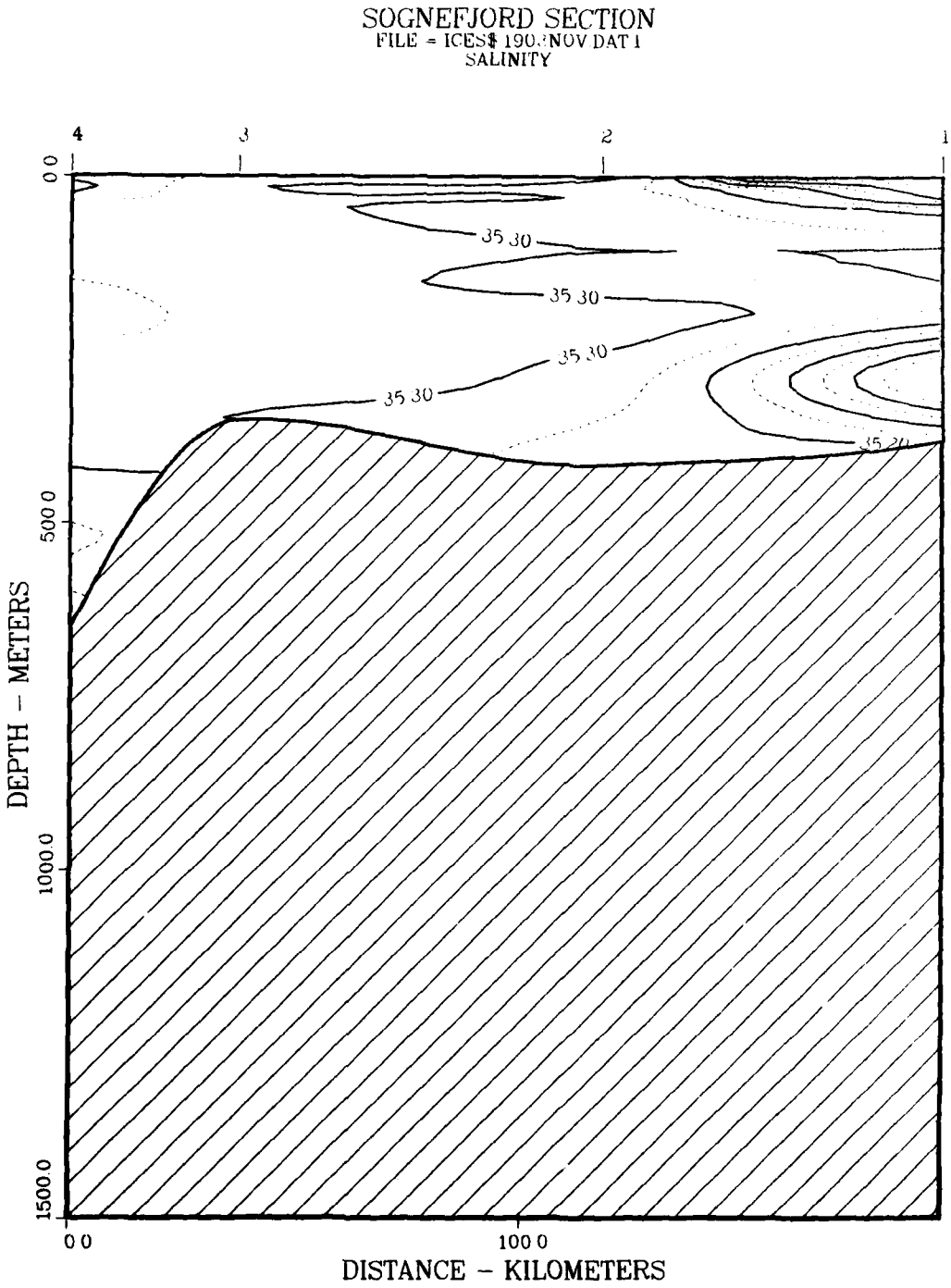


Figure 32. November 1903 salinity section.

ICES$:1904BMA.DAT

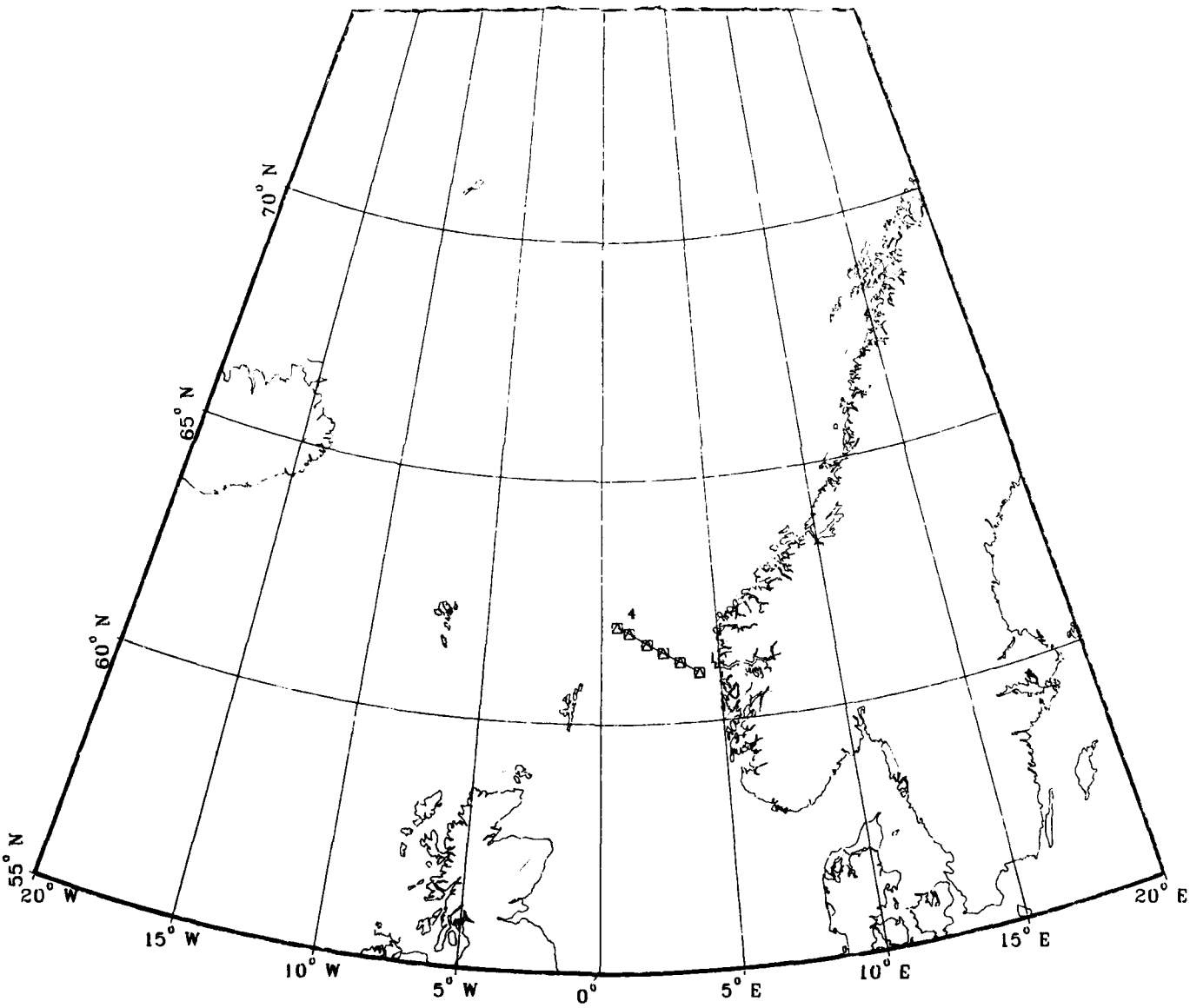


Figure 33. May 1904 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1904BMA.DAT
T/S PLOT

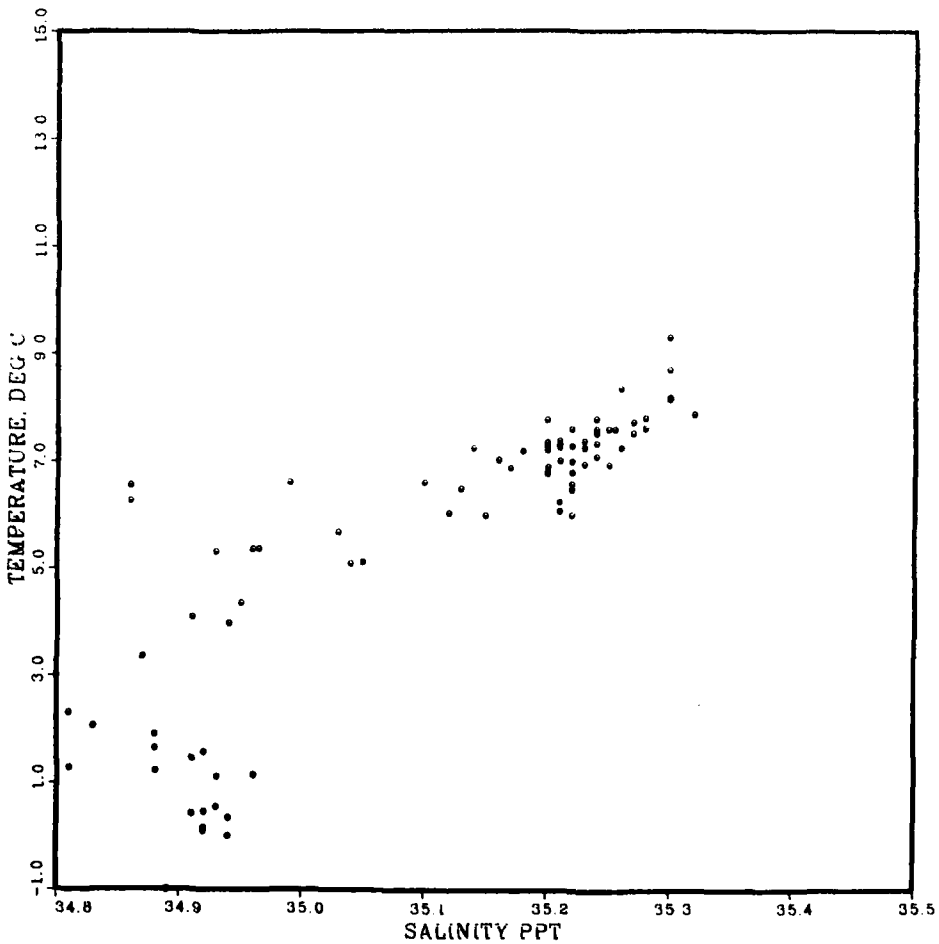


Figure 34. May 1904 temperature/salinity diagram.

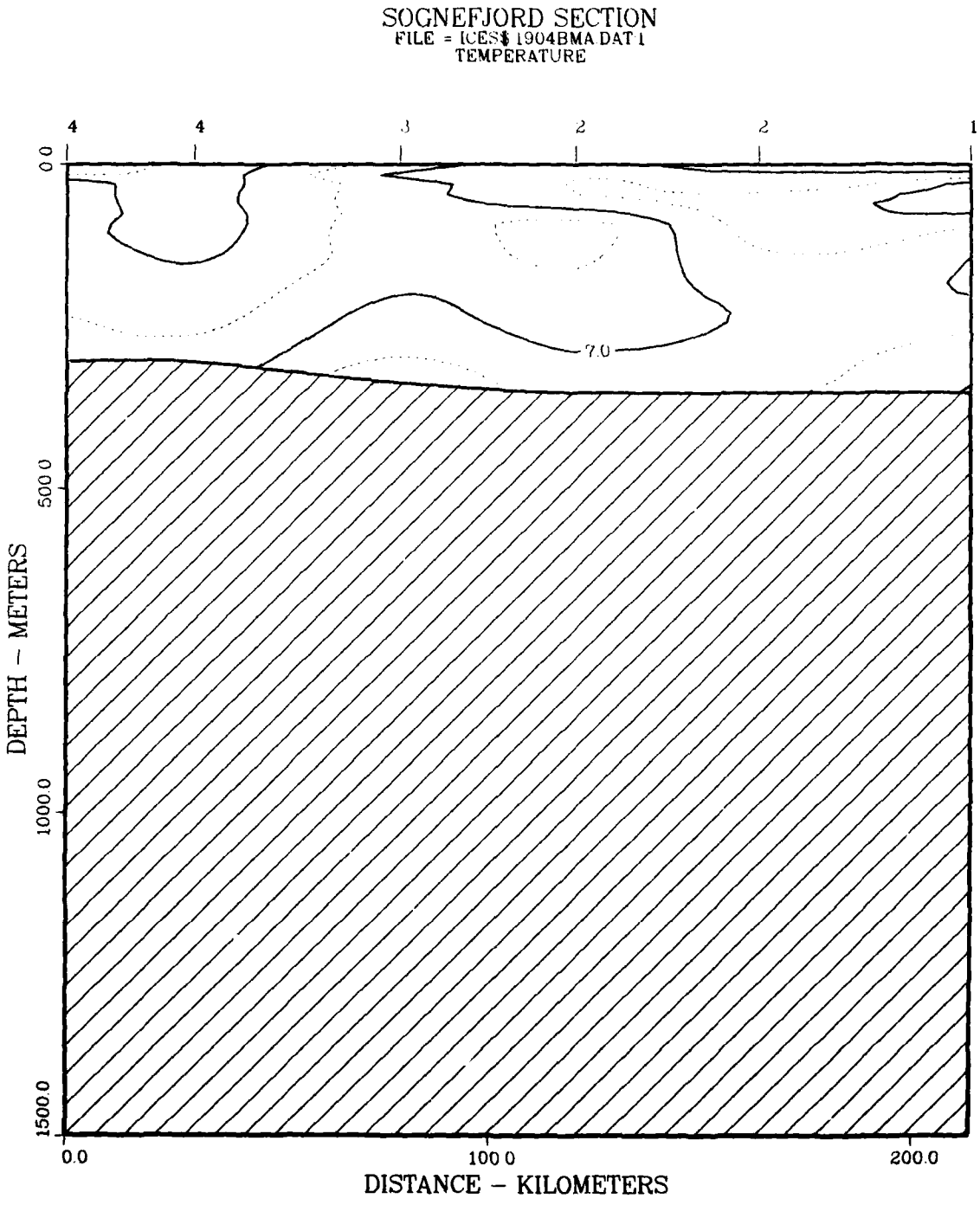


Figure 35. May 1904 temperature section.

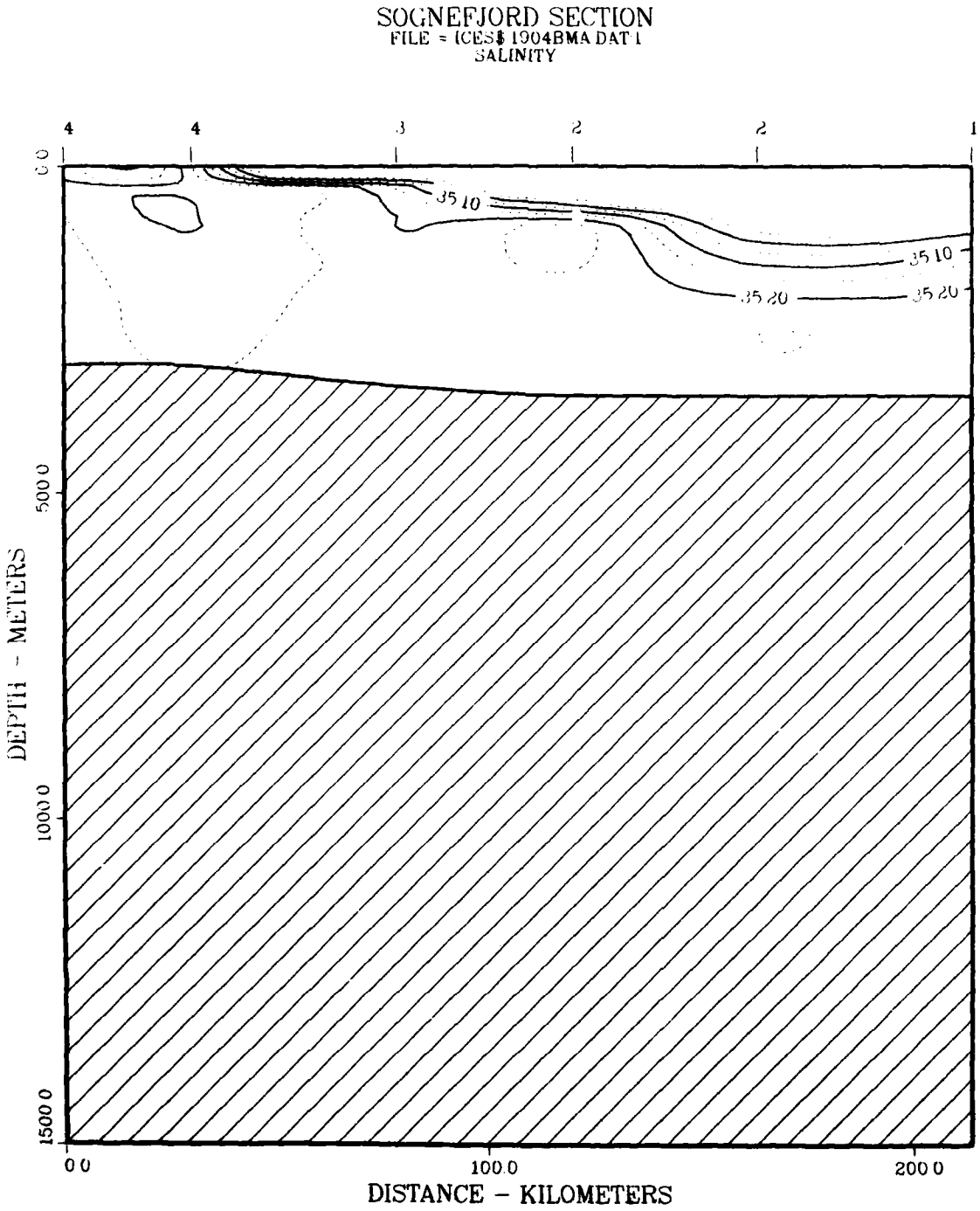


Figure 36. May 1904 salinity section.

ICES$:1914MAY.DAT

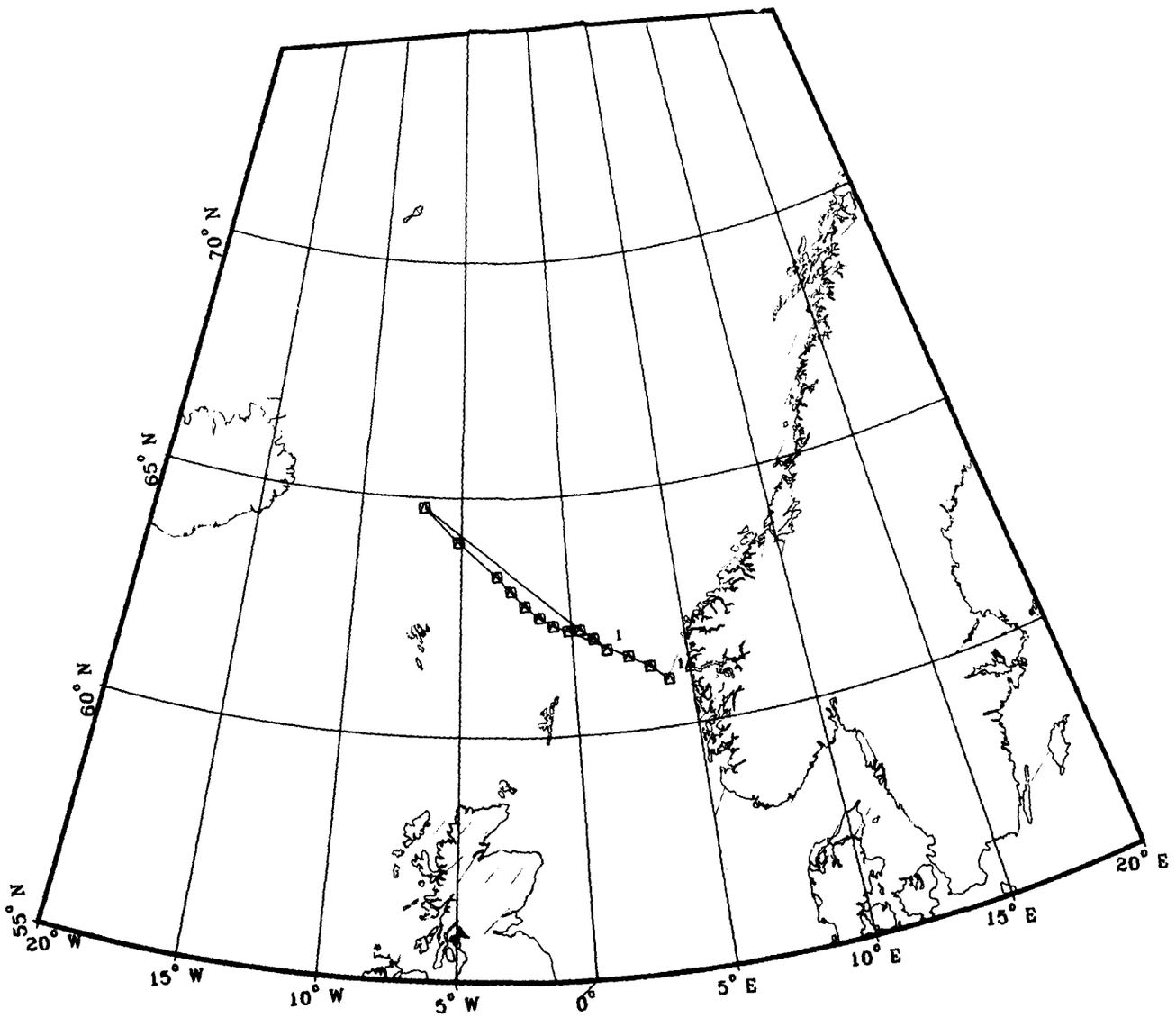


Figure 37. May 1914 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1914MAY.DAT
T/S PLOT

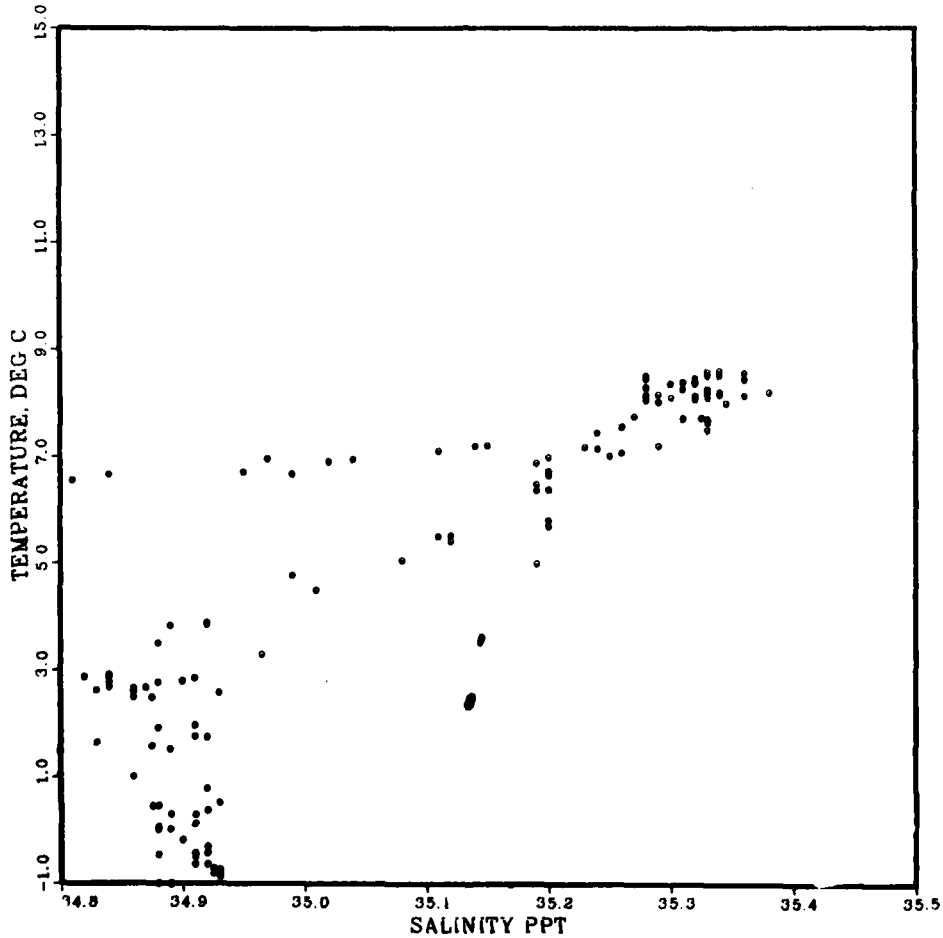


Figure 38. May 1914 temperature/salinity diagram.

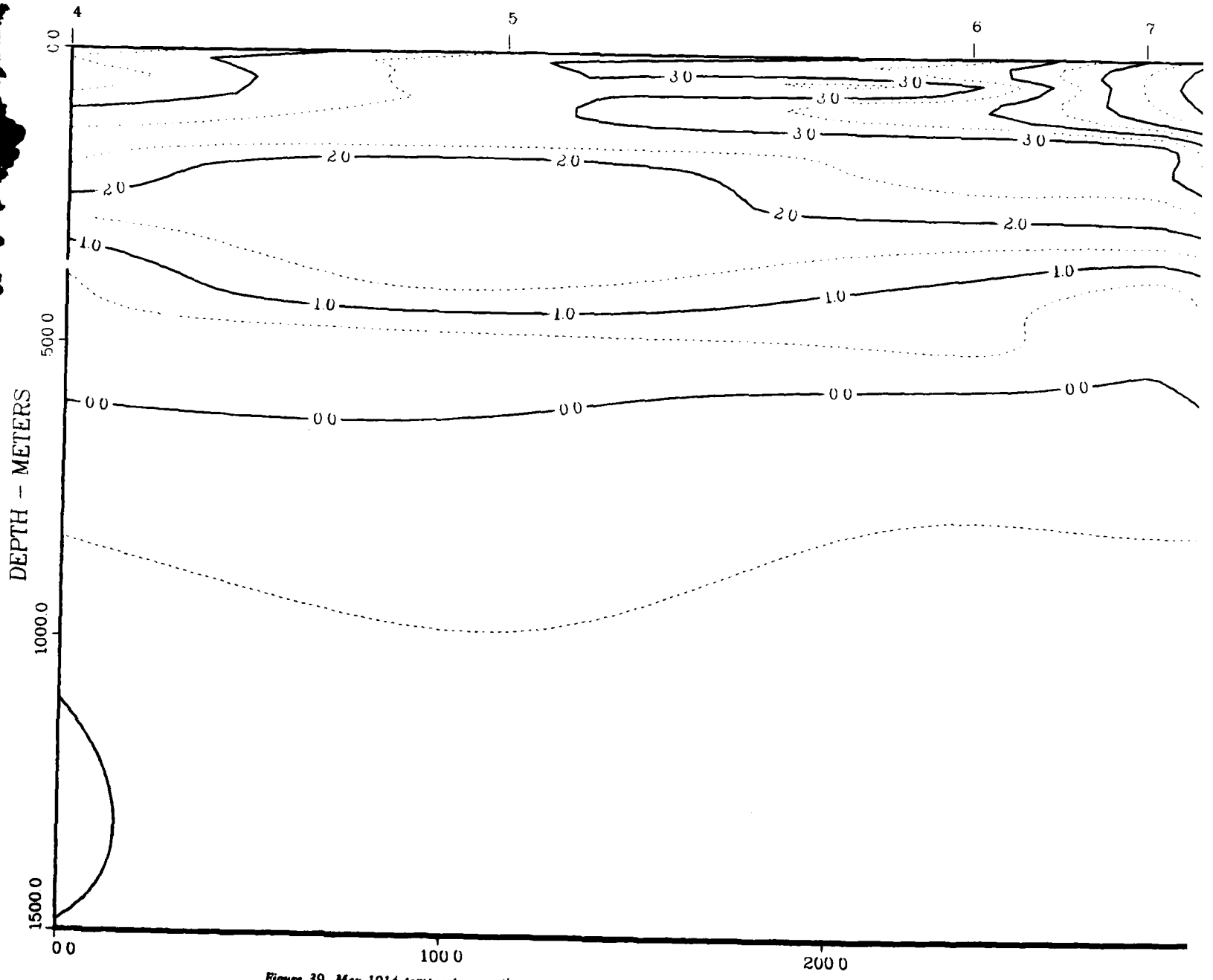
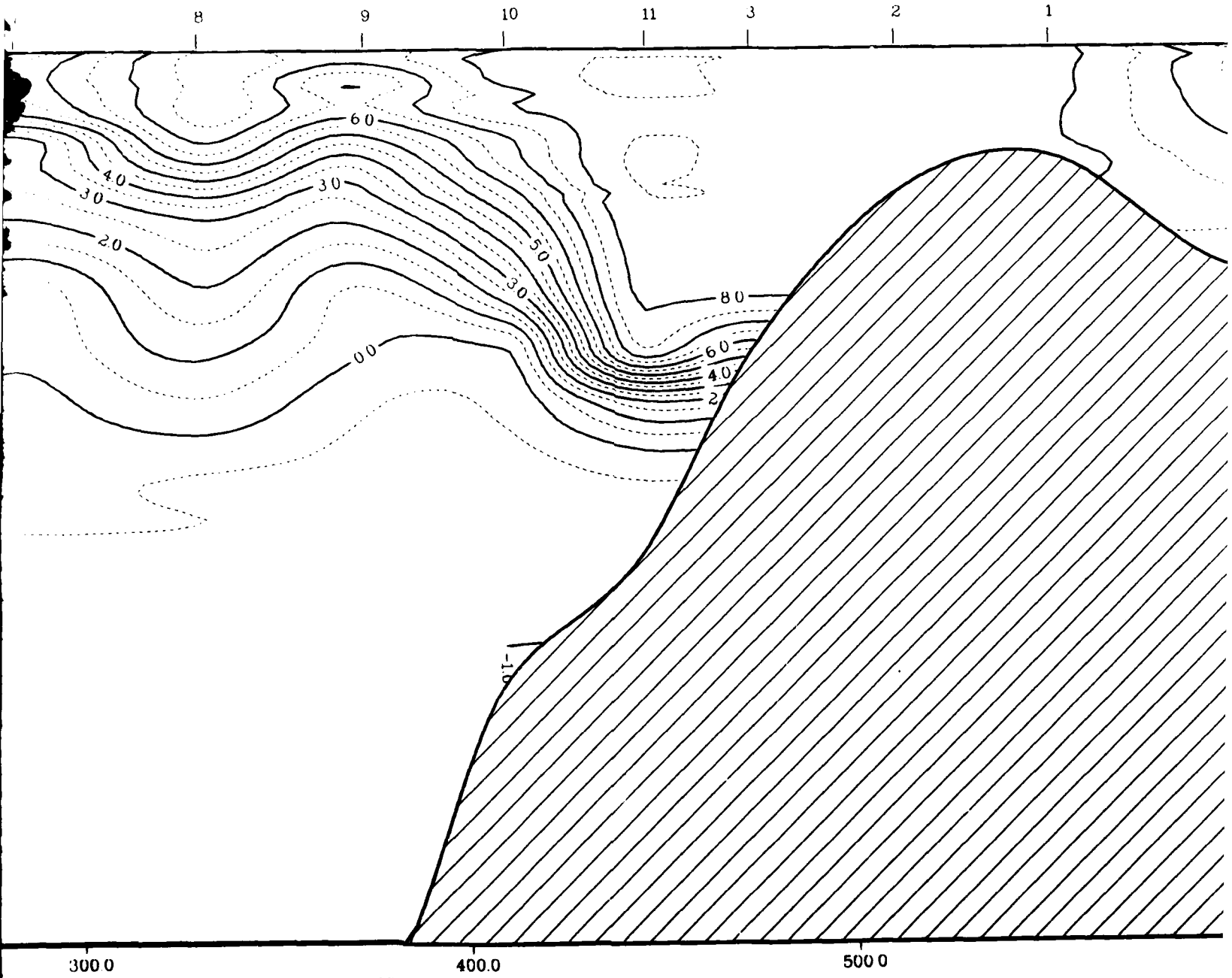


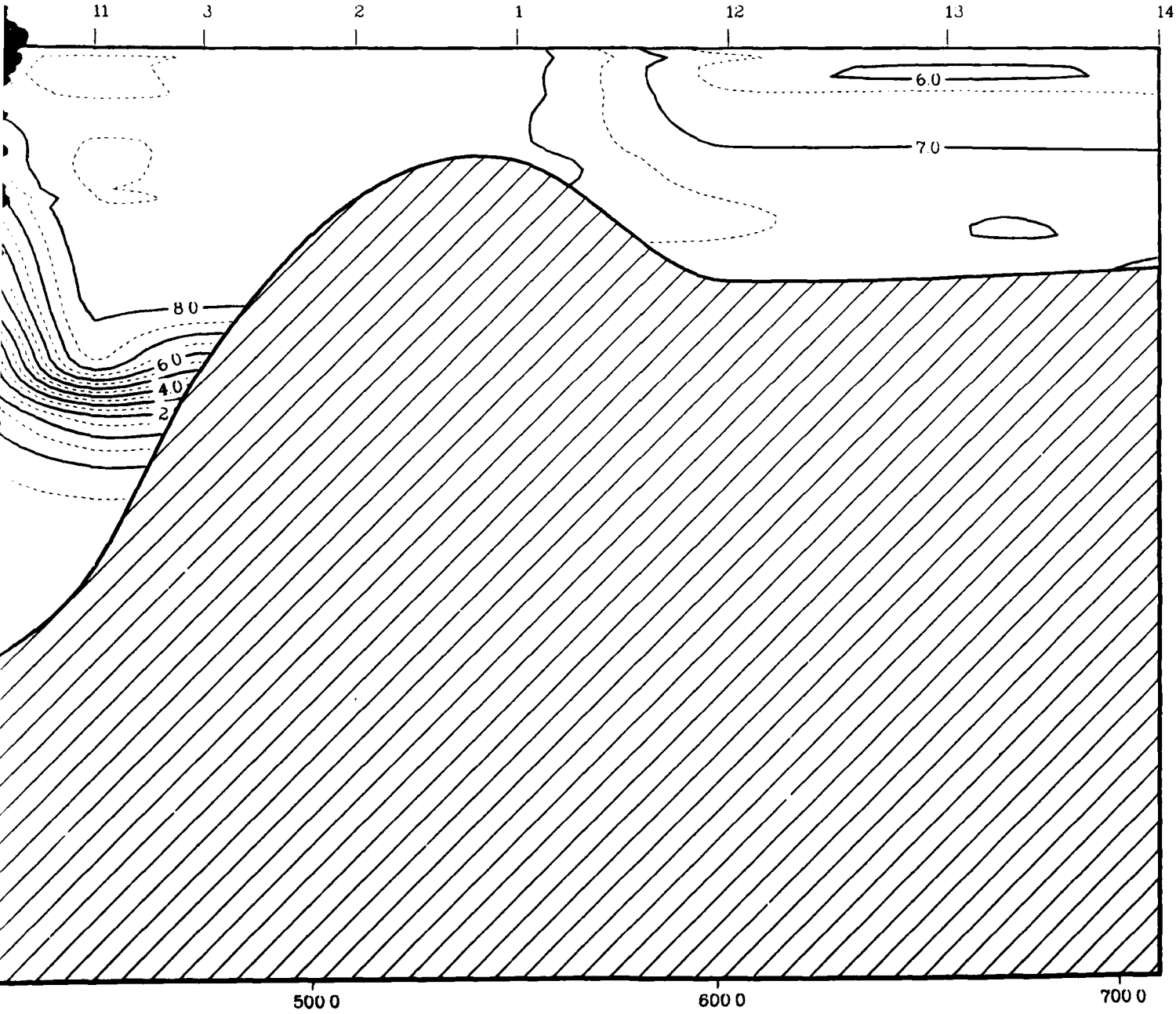
Figure 39. May 1914 temperature section.

SOGNEFJORD SECTION
FILE = ICES$ 1914MAY DAT 1
TEMPERATURE



DISTANCE – KILOMETERS

2


11
3
2
1
12
13
14
6.0
7.0
8 0
6 0
4.0
2
500 0
600 0
700 0

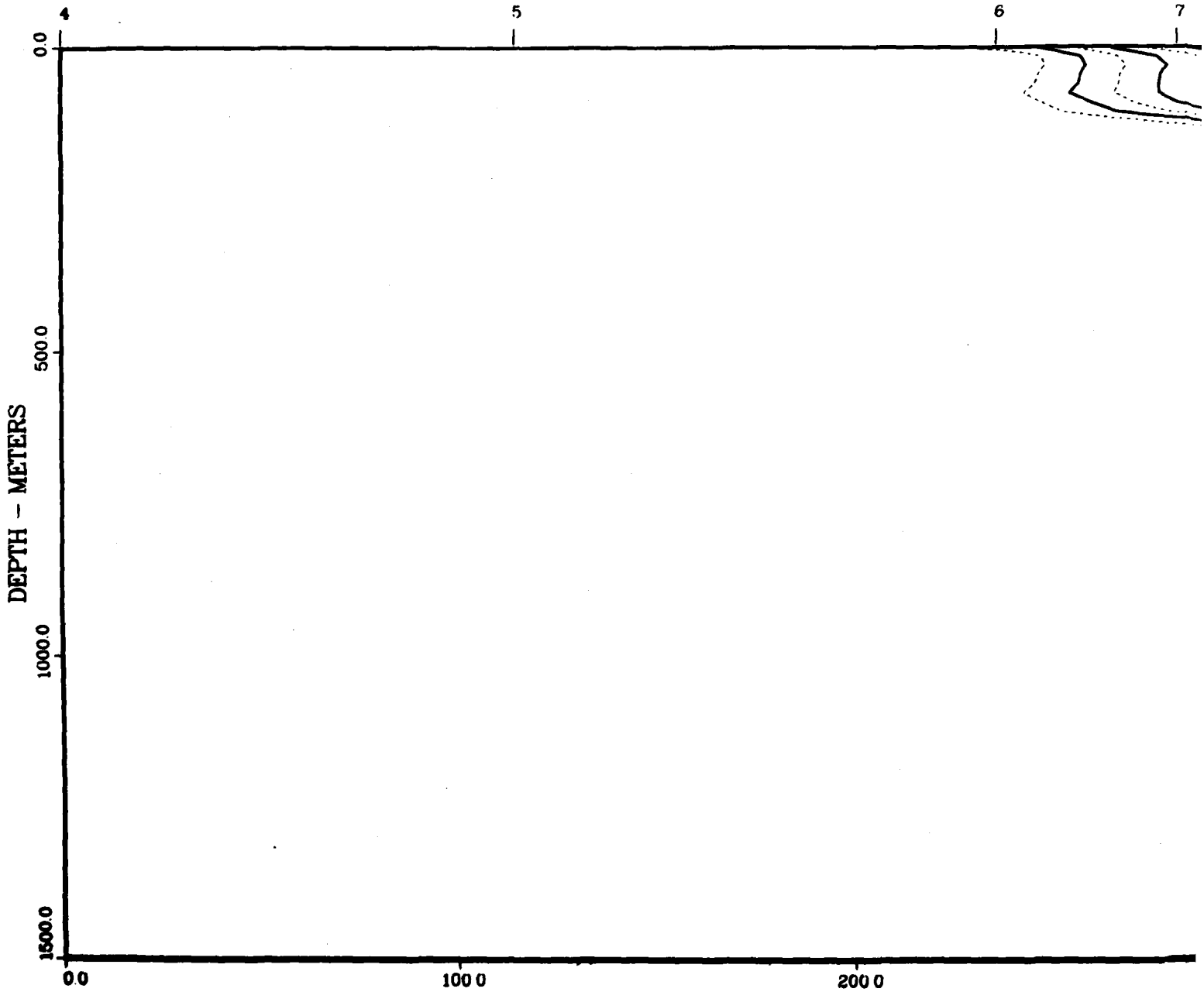
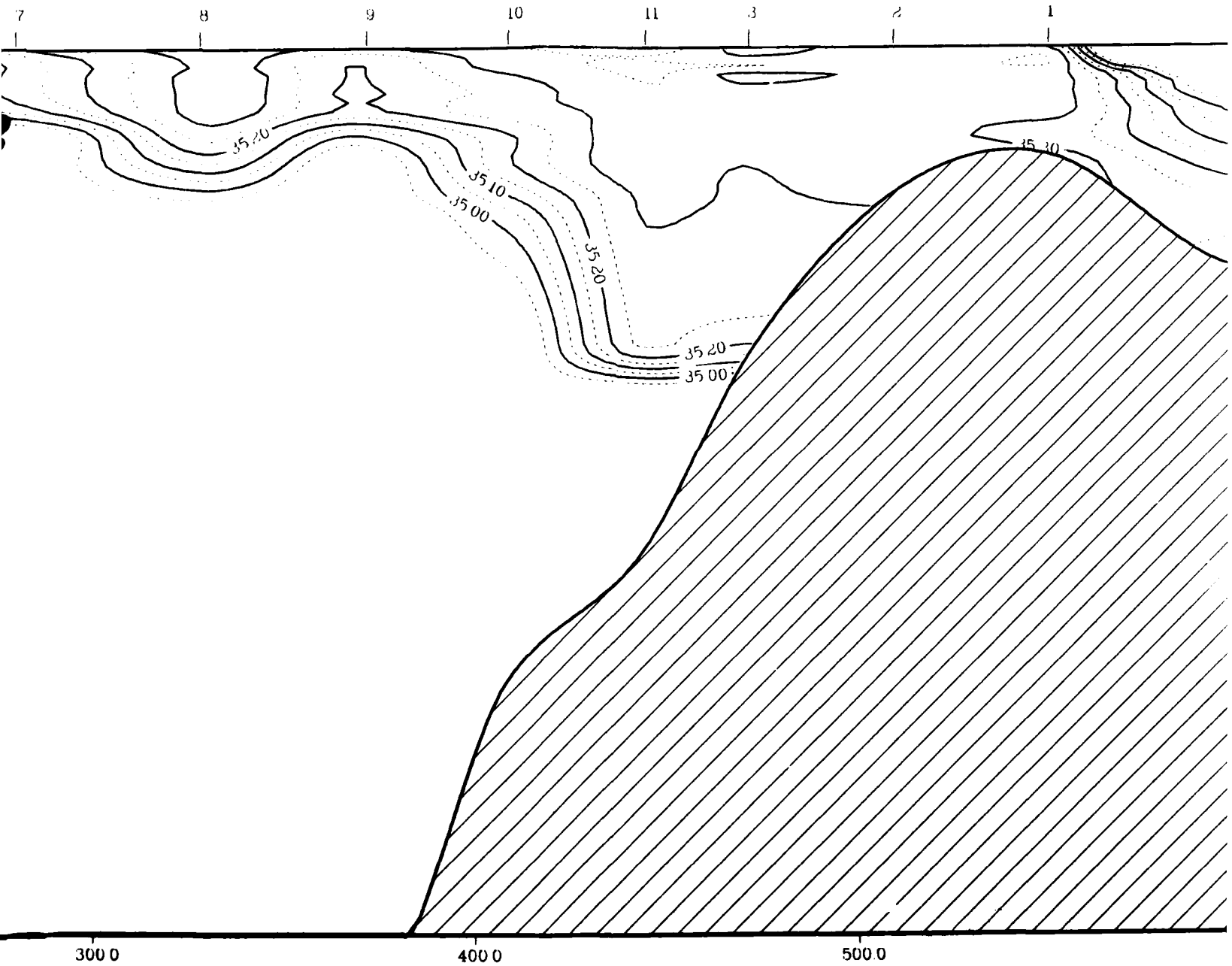


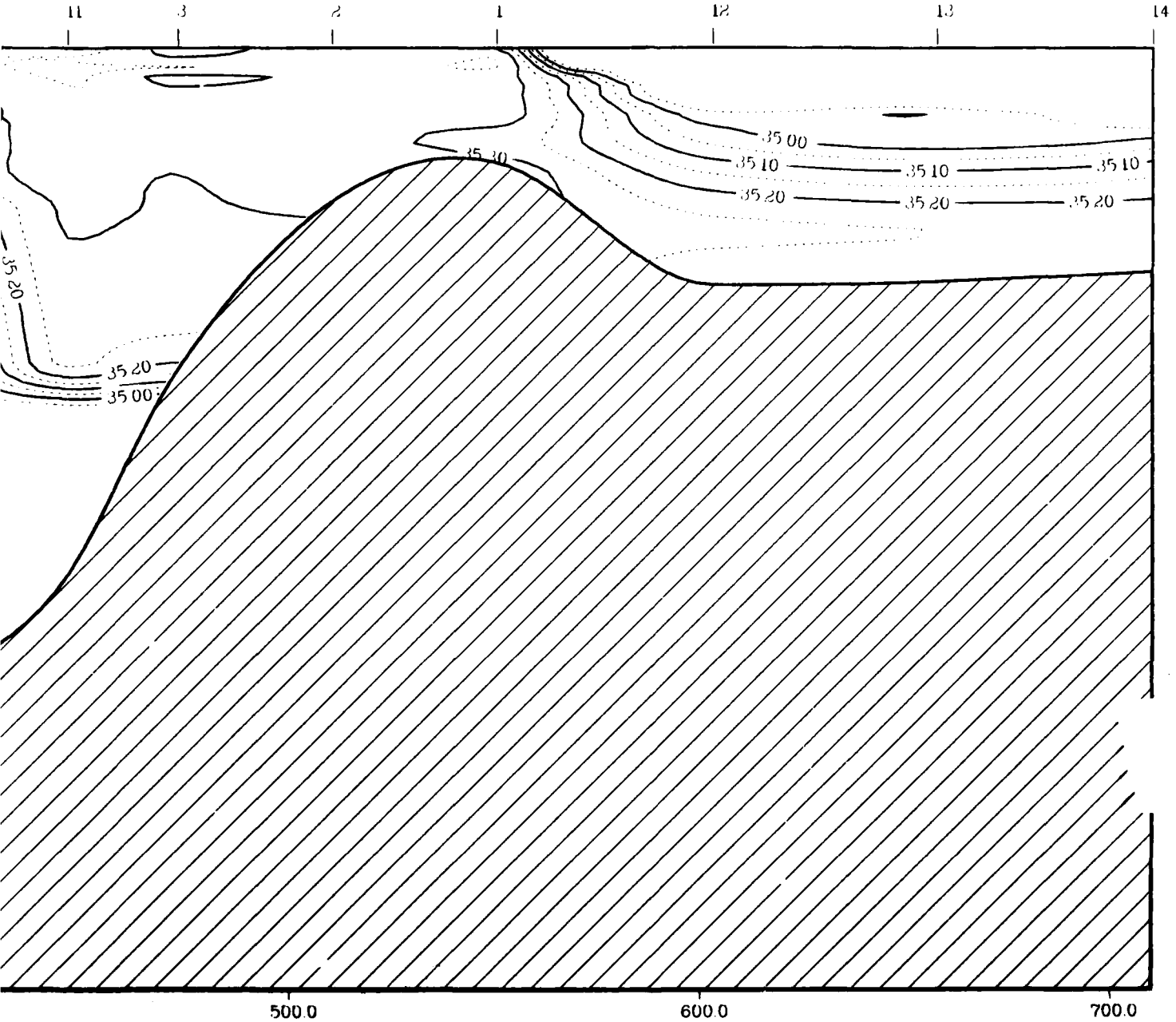
Figure 40. May 1914 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1914MAY DAT 1
SALINITY



DISTANCE – KILOMETERS

2


11
3
2
1
12
13
14
35.00
35.10
35.10
35.10
35.20
35.20
35.20
35.30
35.20
35.20
35.00
500.0
600.0
700.0

ICES$:1925JUN.DAT

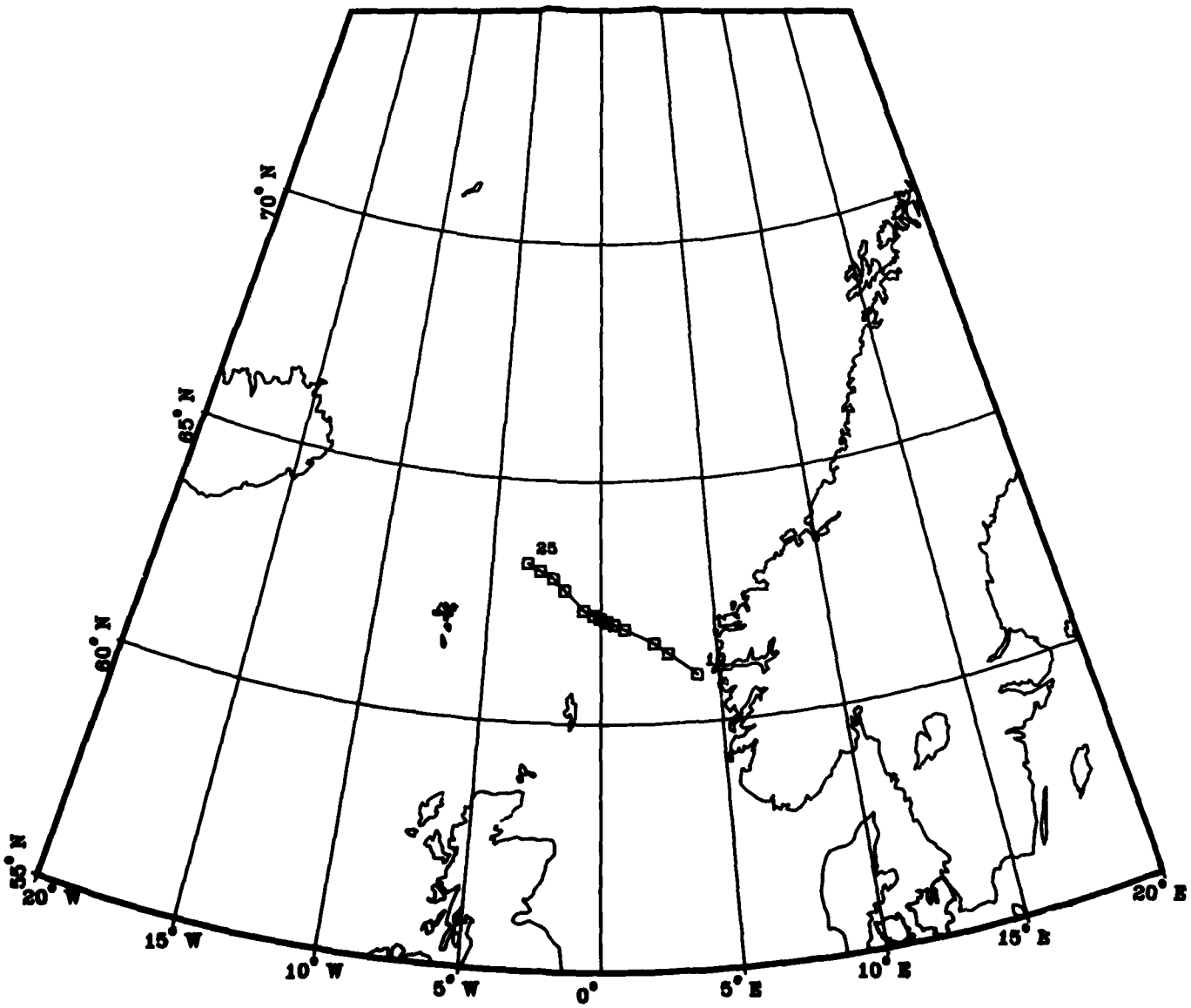


Figure 41. June 1925 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1925JUN.DAT
T/S PLOT

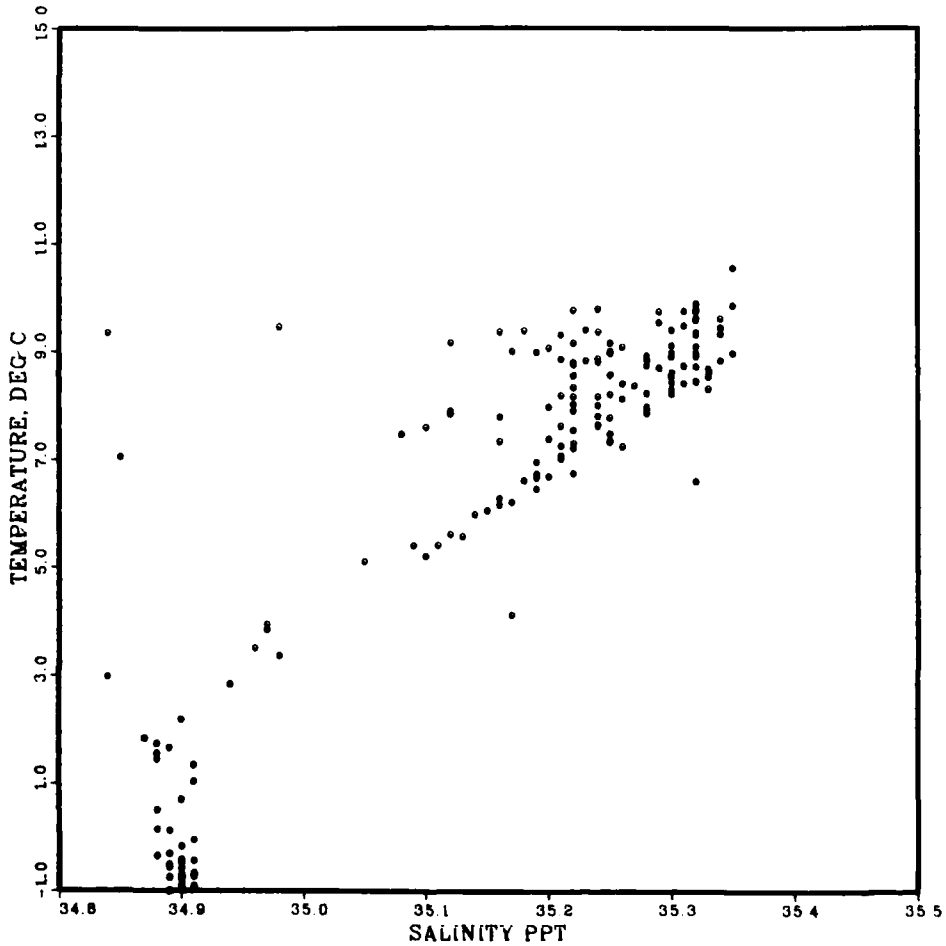


Figure 42. June 1925 temperature/salinity diagram.

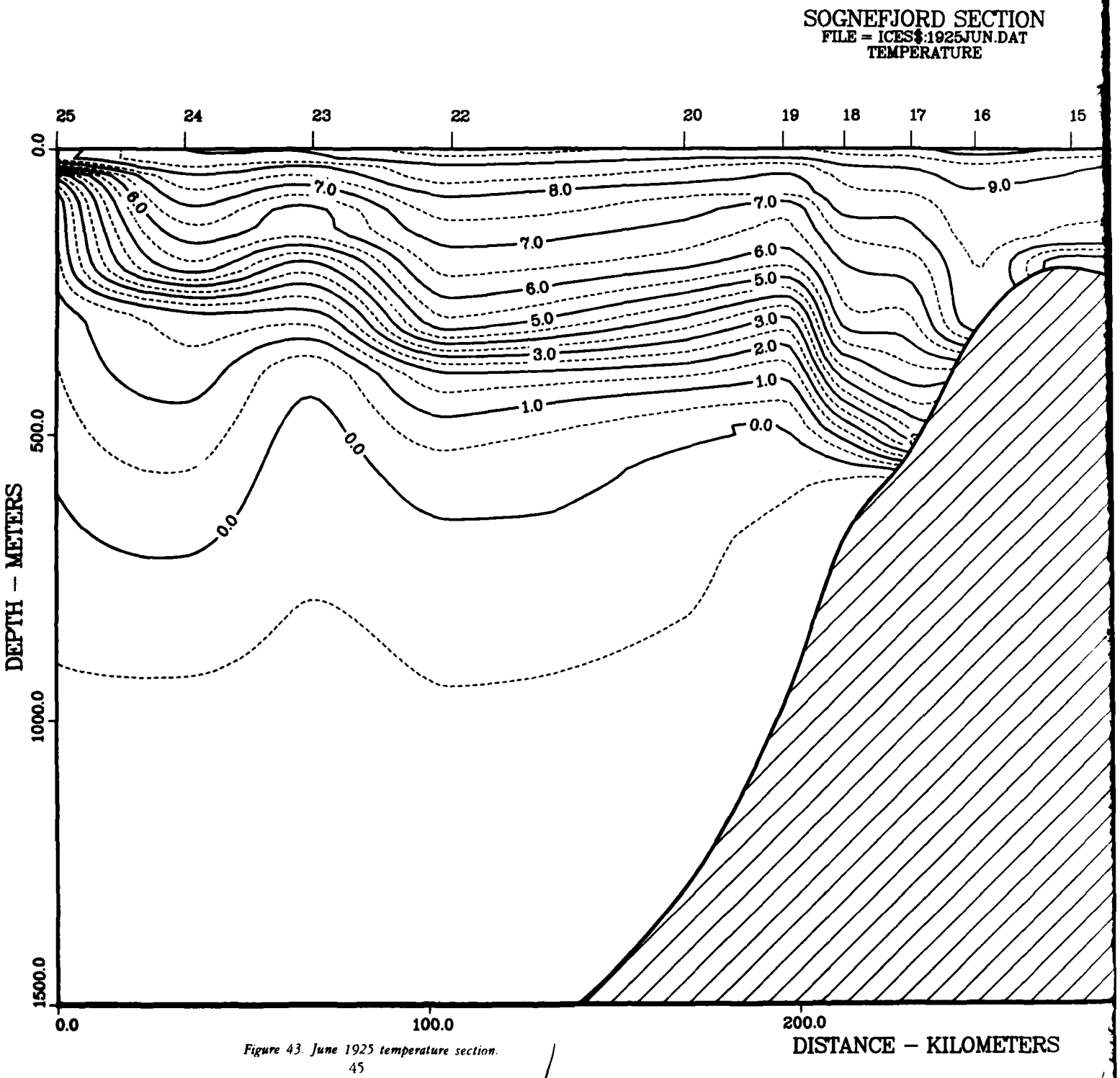
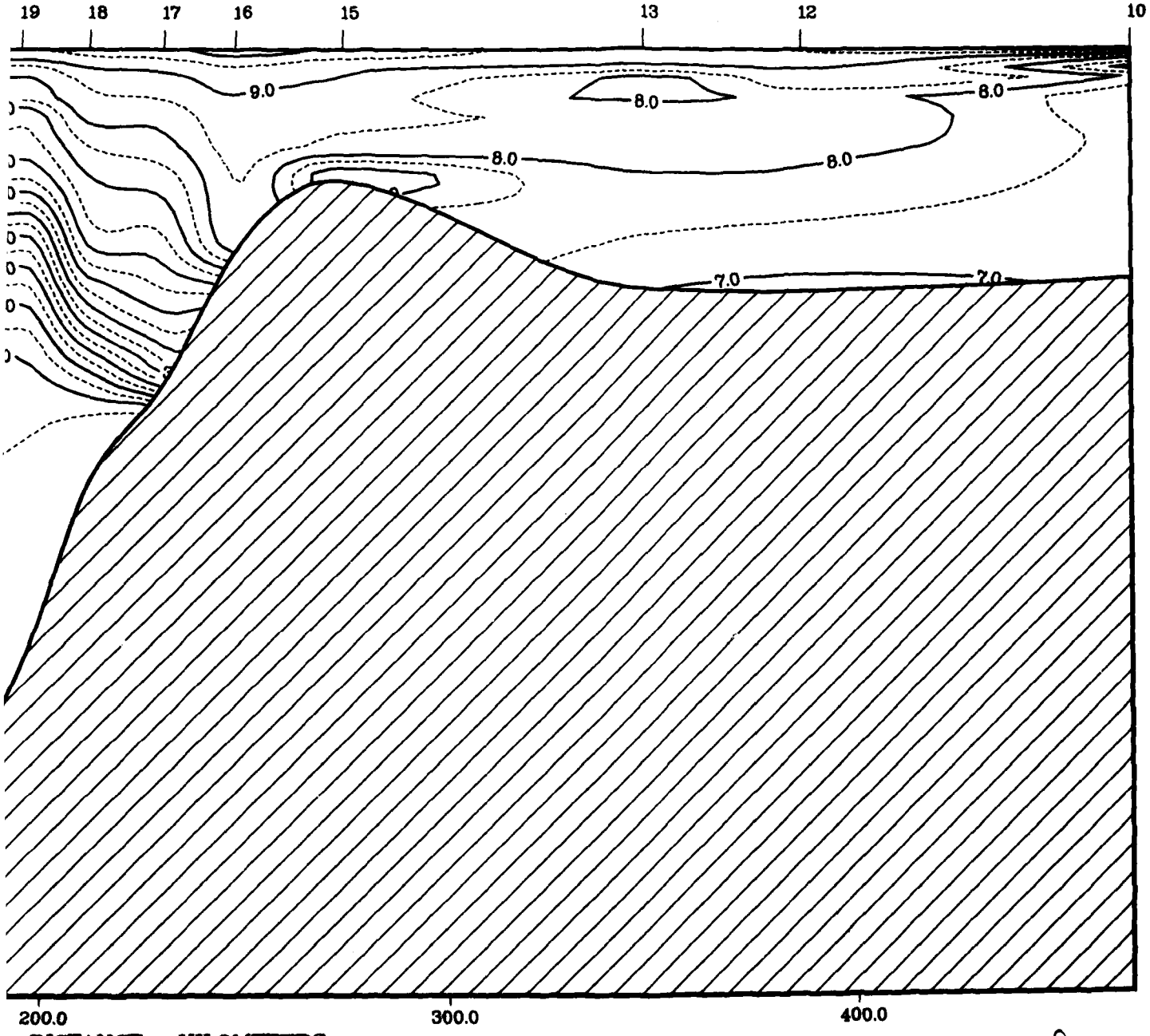


Figure 43. June 1925 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1925JUN.DAT
TEMPERATURE



DISTANCE – KILOMETERS

2

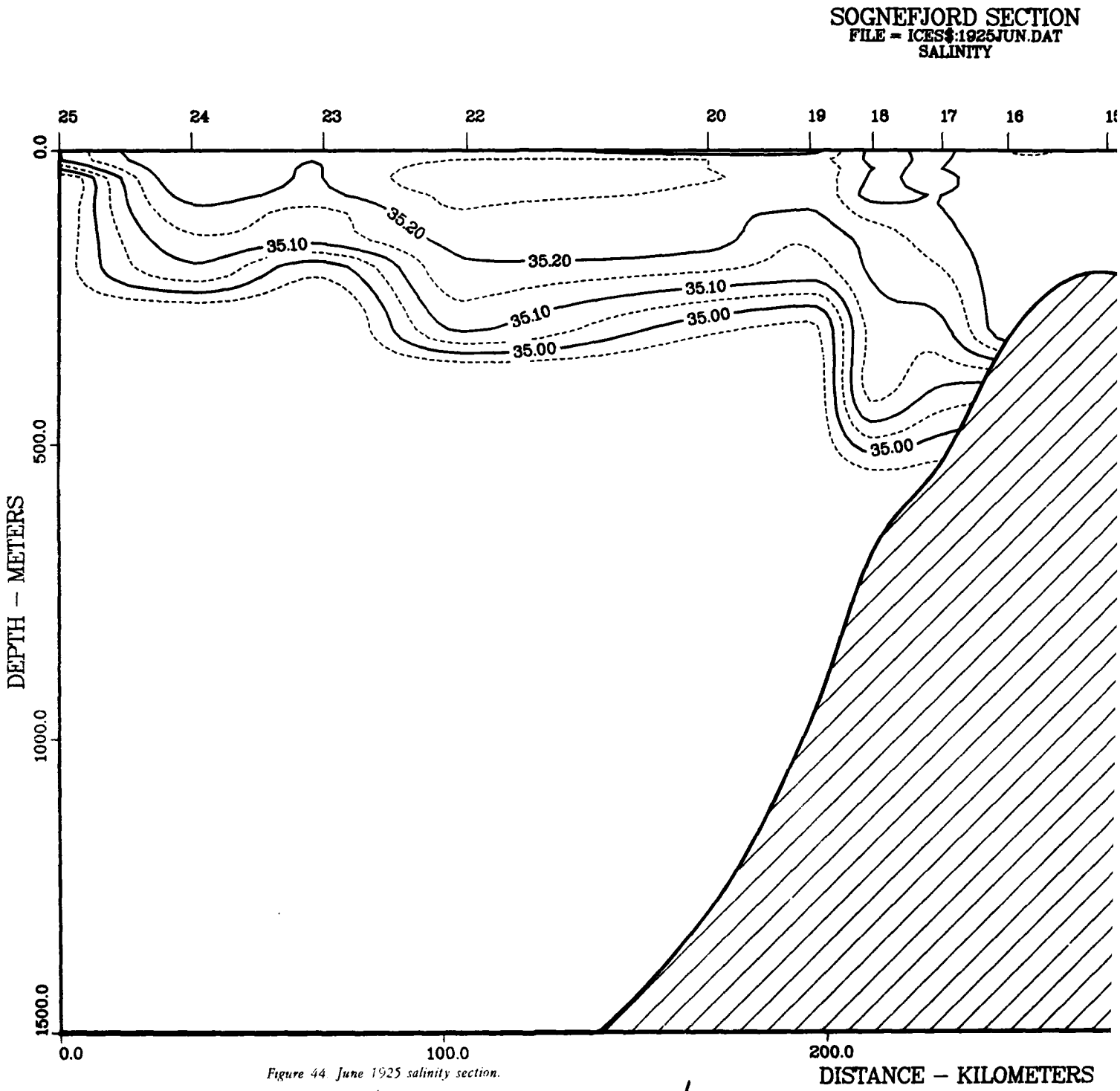
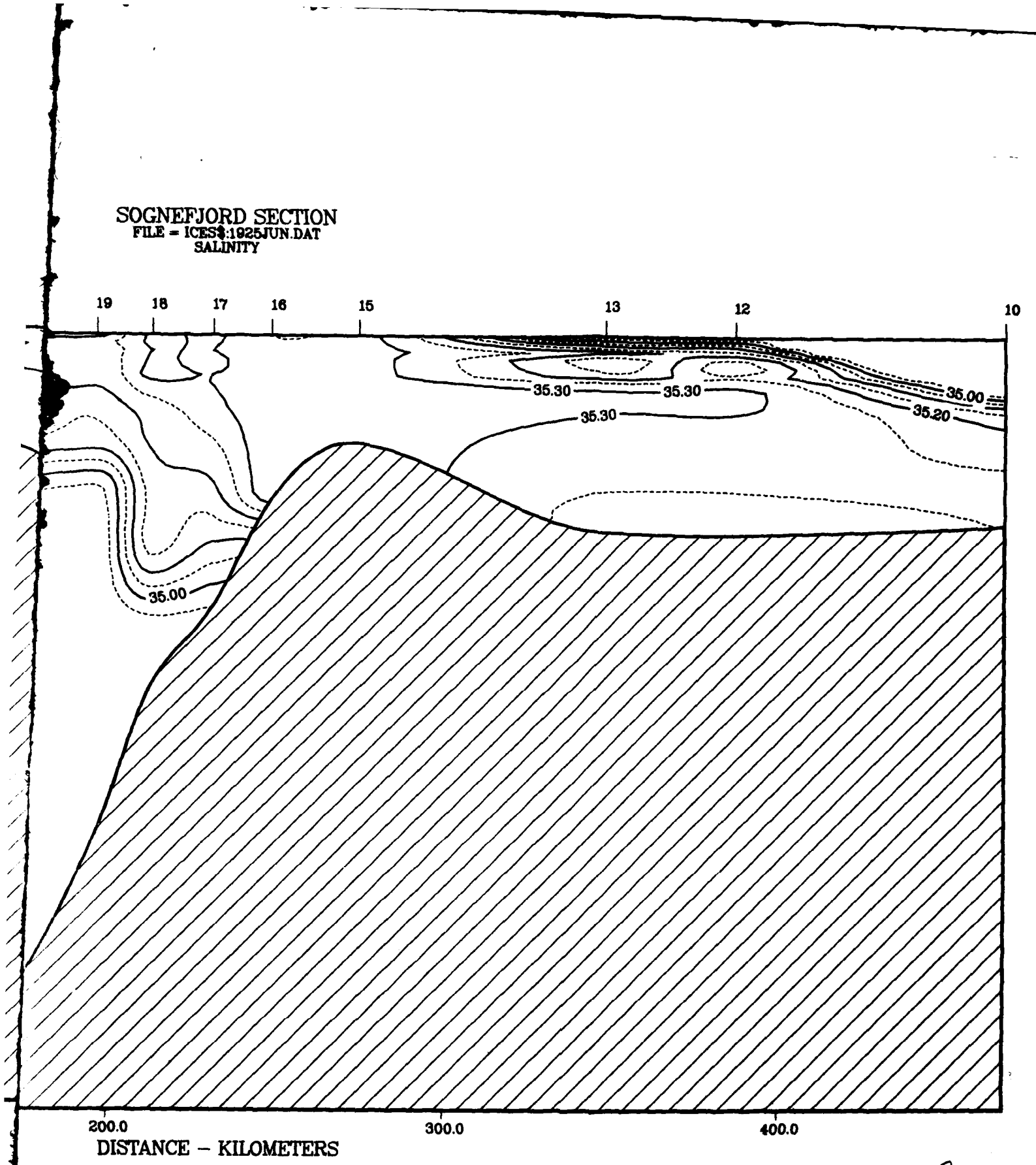


Figure 44. June 1925 salinity section.


SOGNEFJORD SECTION
FILE = ICES$:1925JUN.DAT
SALINITY
19
18
17
16
15
13
12
10
35.30
35.30
35.30
35.00
35.20
35.00
200.0
300.0
400.0
DISTANCE – KILOMETERS

2

ICES$:1927MAY.DAT

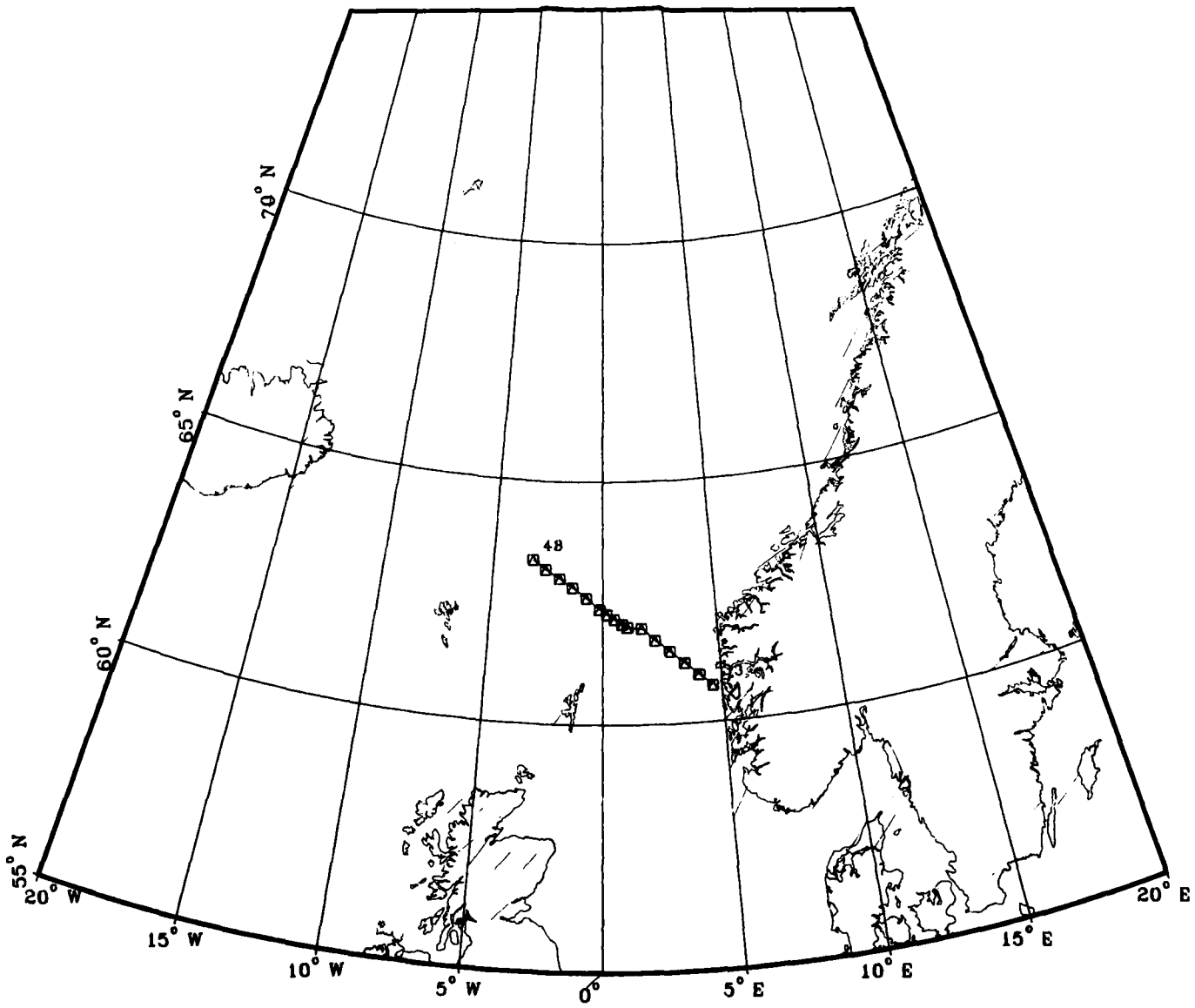


Figure 45. May 1927 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1927MAY.DAT
T/S PLOT

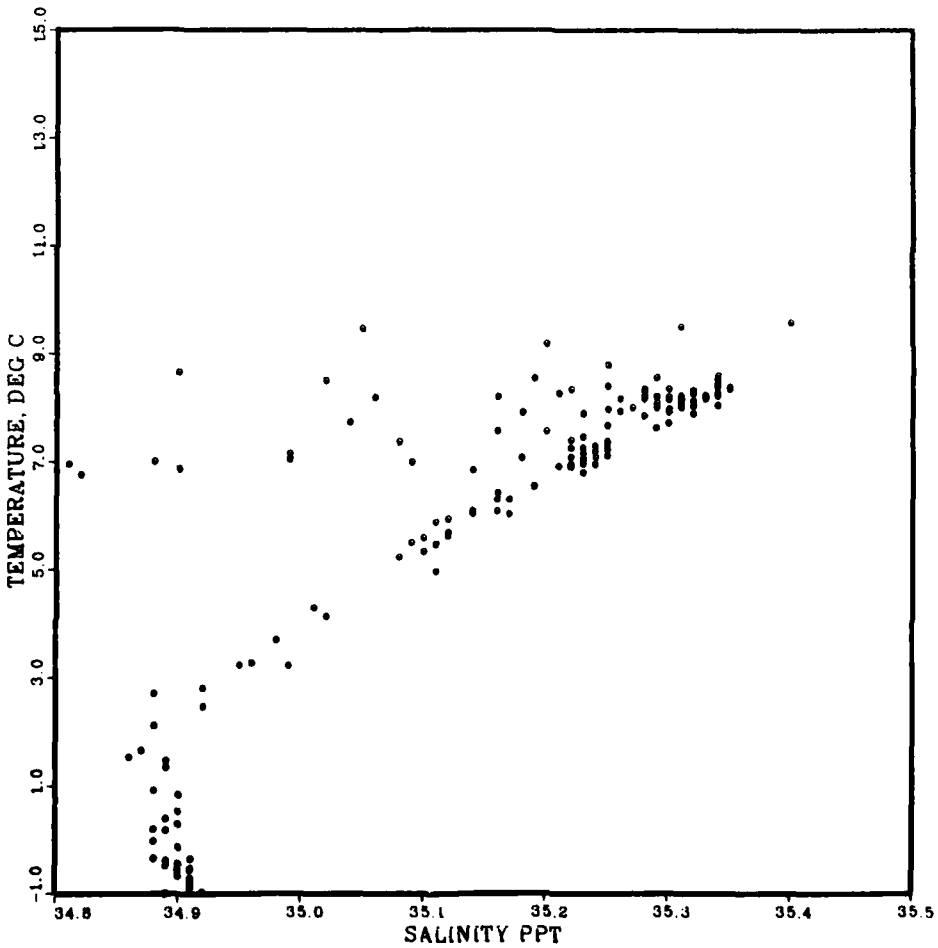


Figure 46. May 1927 temperature/salinity diagram.

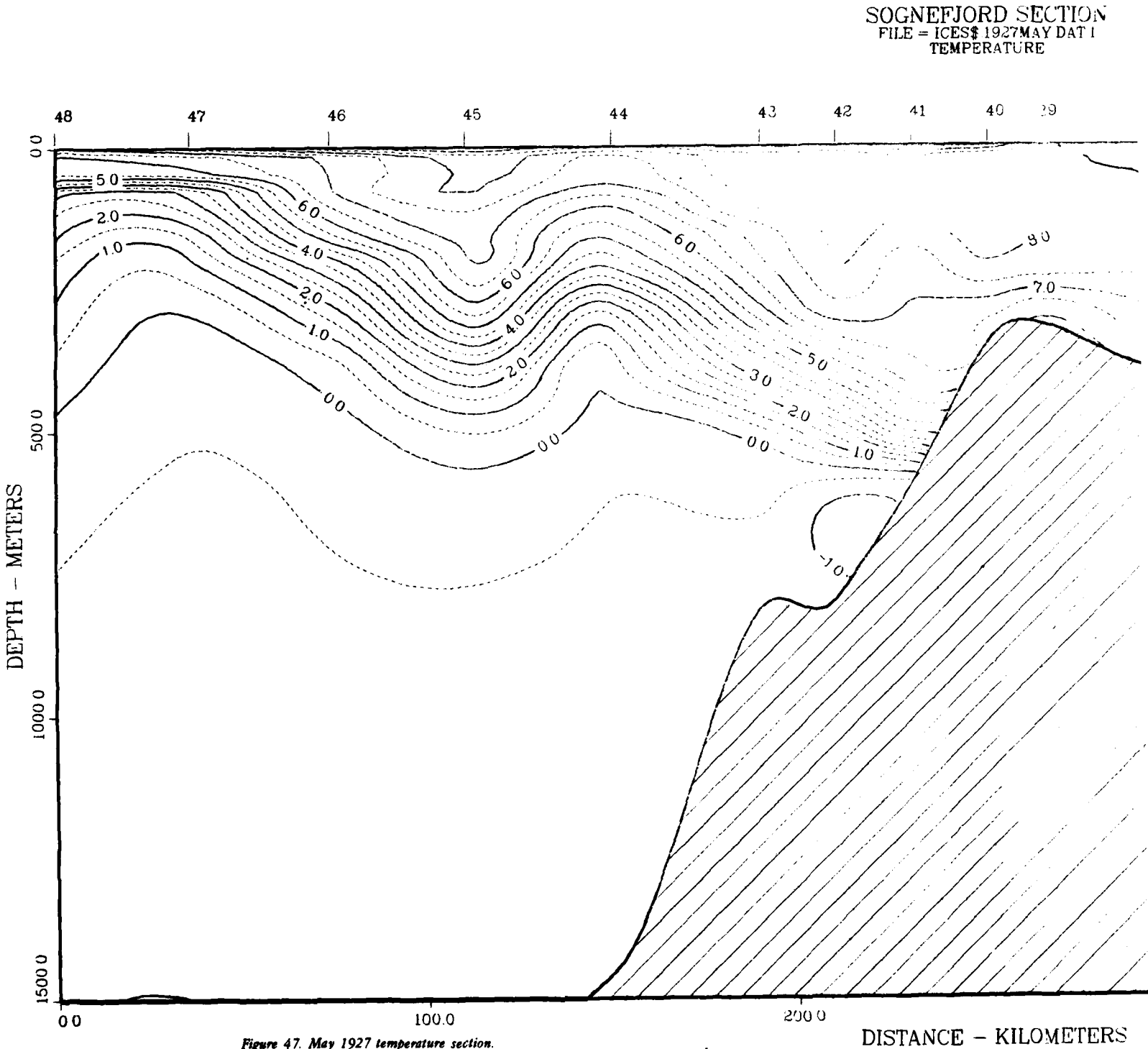


Figure 47. May 1927 temperature section.

SOGNEFJORD SECTION
FILE = ICES$ 1927MAY DAT 1
TEMPERATURE

DISTANCE – KILOMETERS

2

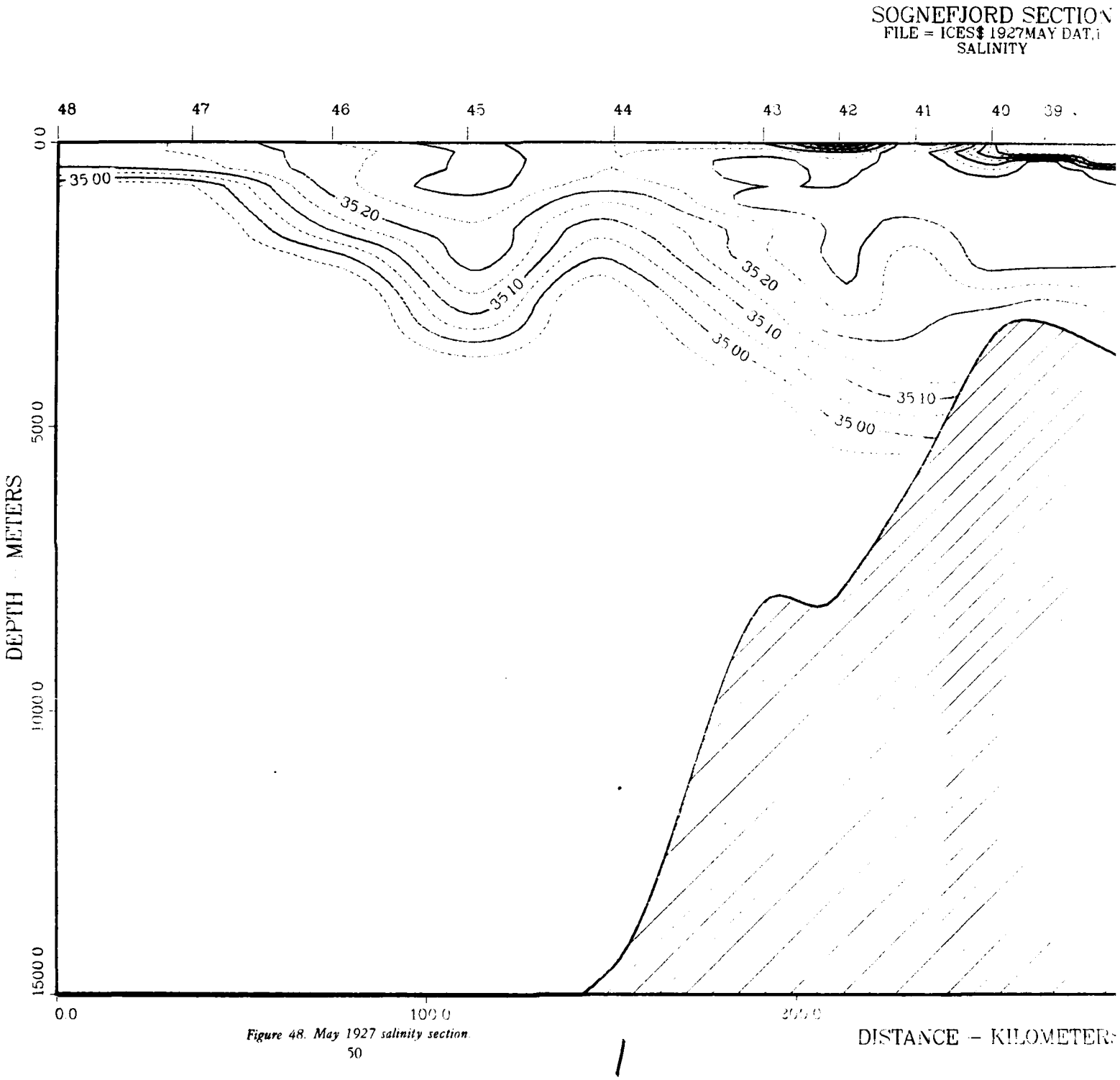
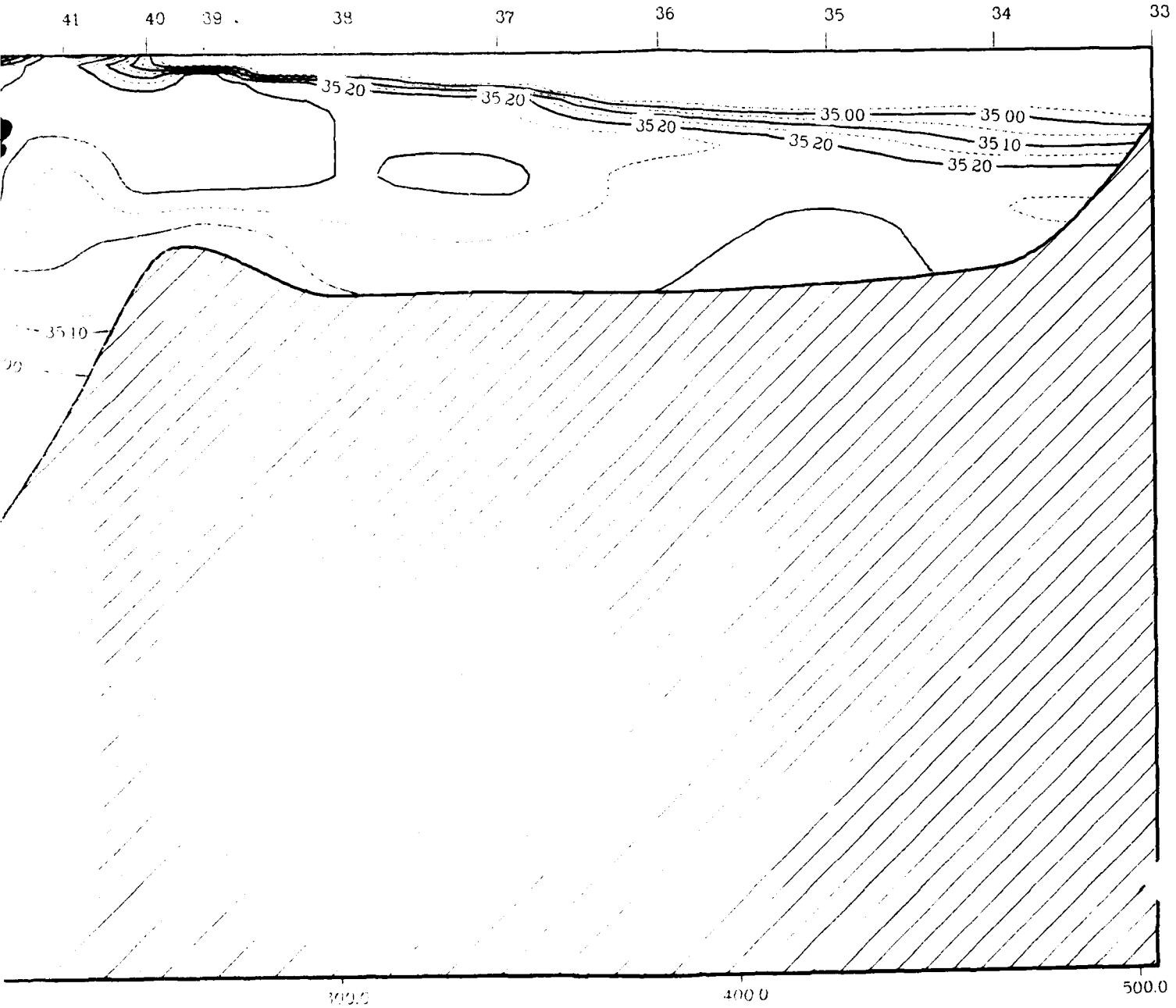


Figure 48. May 1927 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1927MAY DAT;1
SALINITY



DISTANCE - KILOMETERS

ICES$:1928AUG.DAT

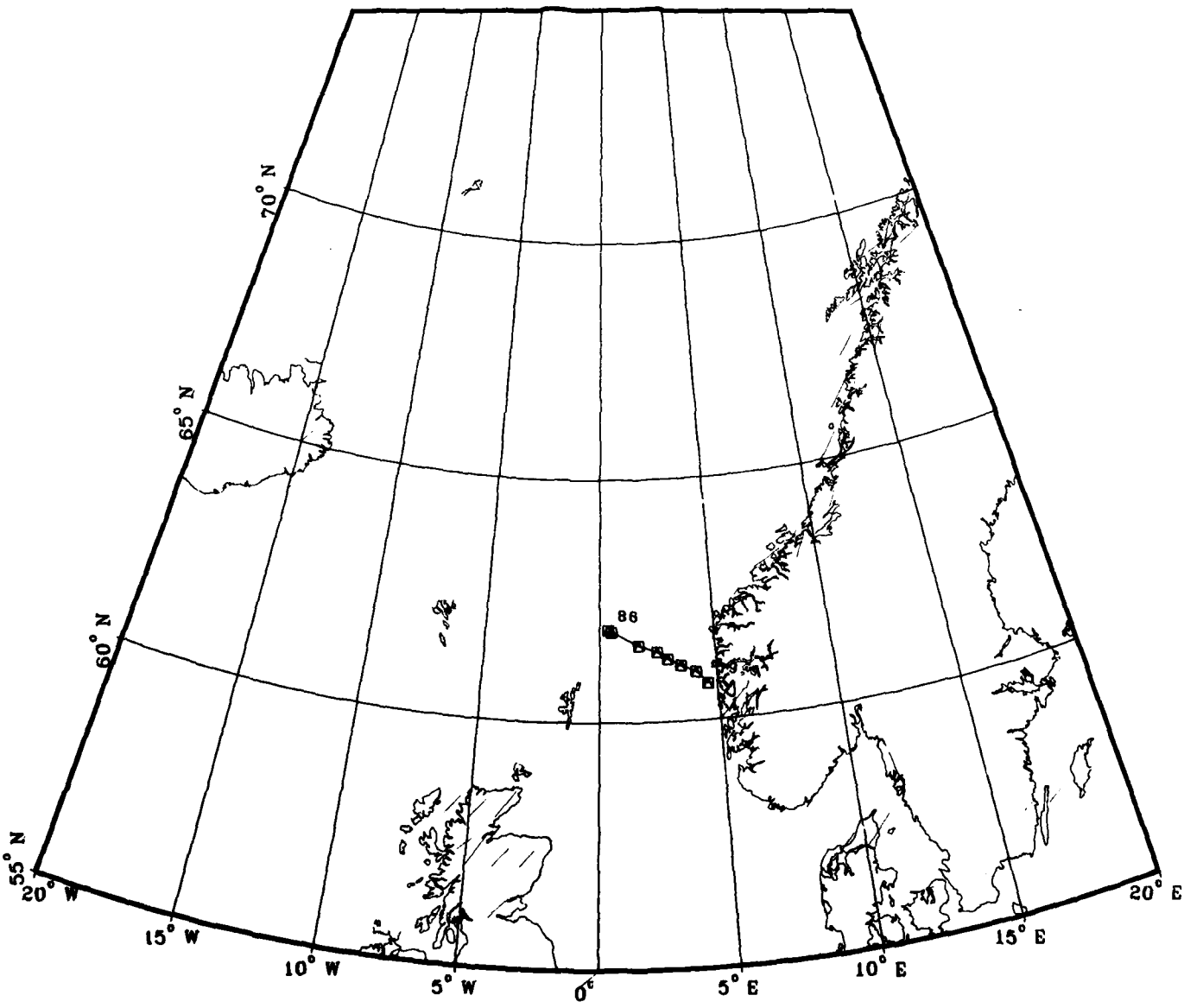


Figure 49. August 1928 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1928AUG.DAT
T/S PLOT

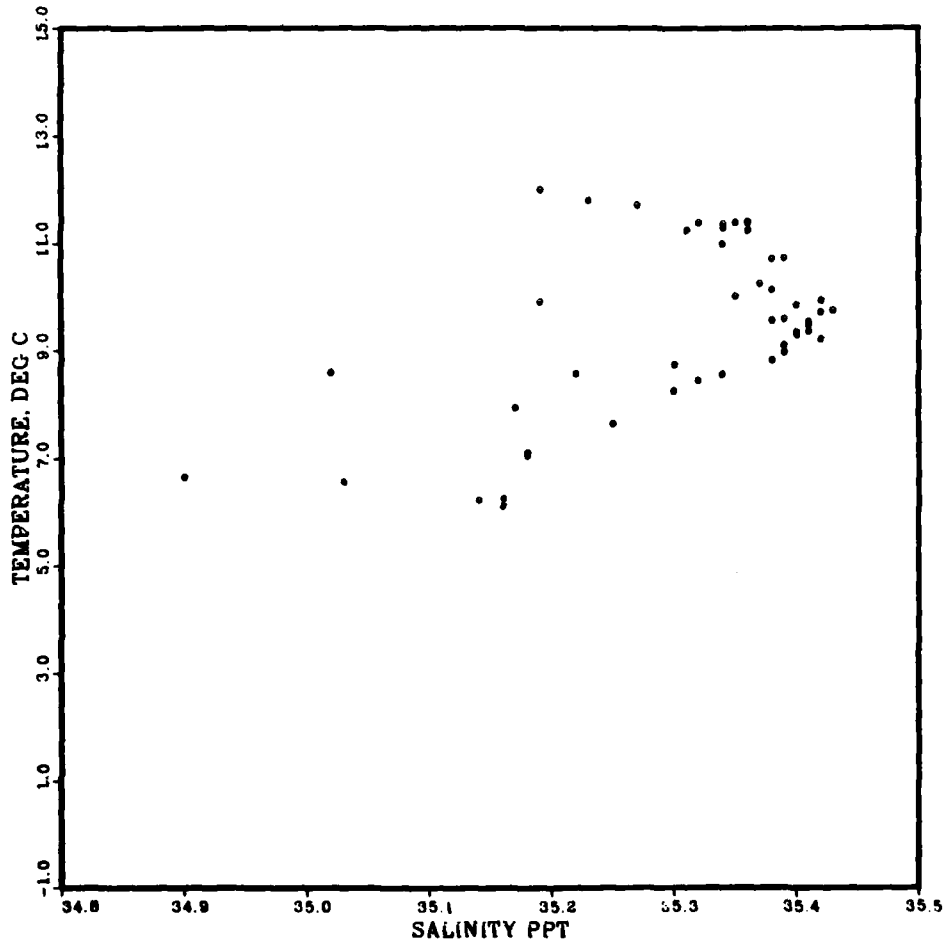


Figure 50. August 1928 temperature/salinity diagram.

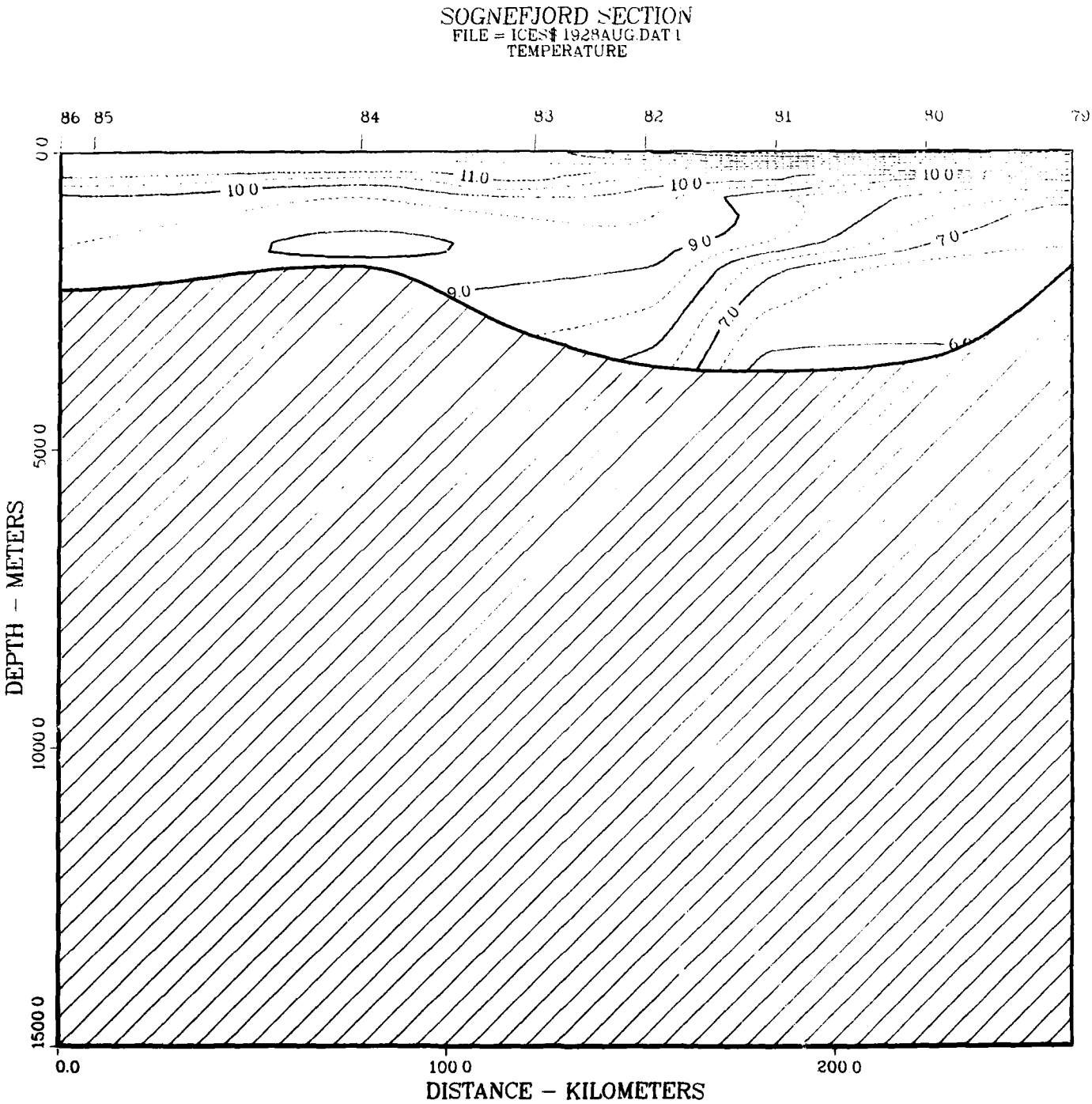


Figure 51. August 1928 temperature section.

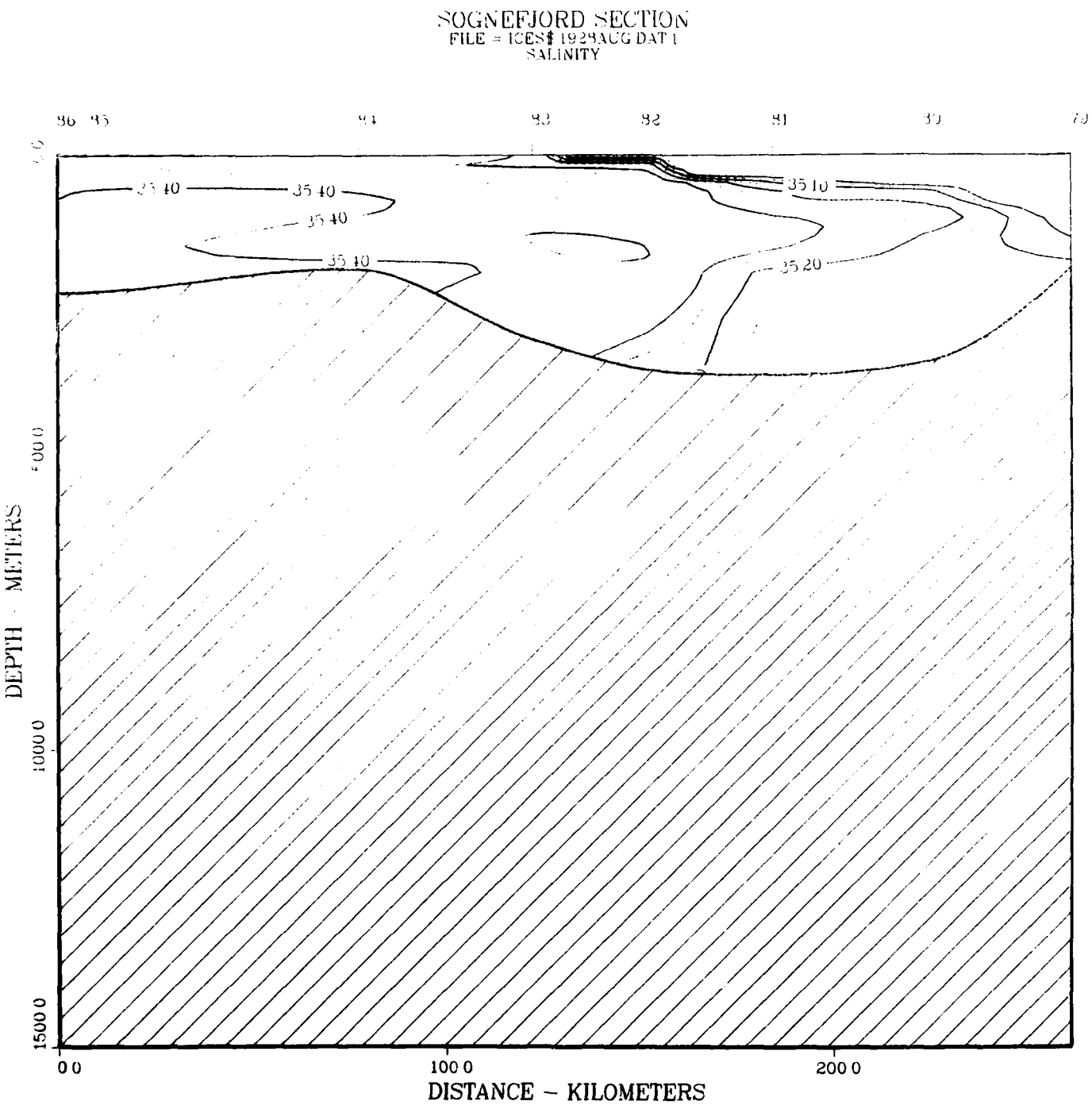


Figure 52. August 1928 salinity section.

ICES$:1929MAY.DAT

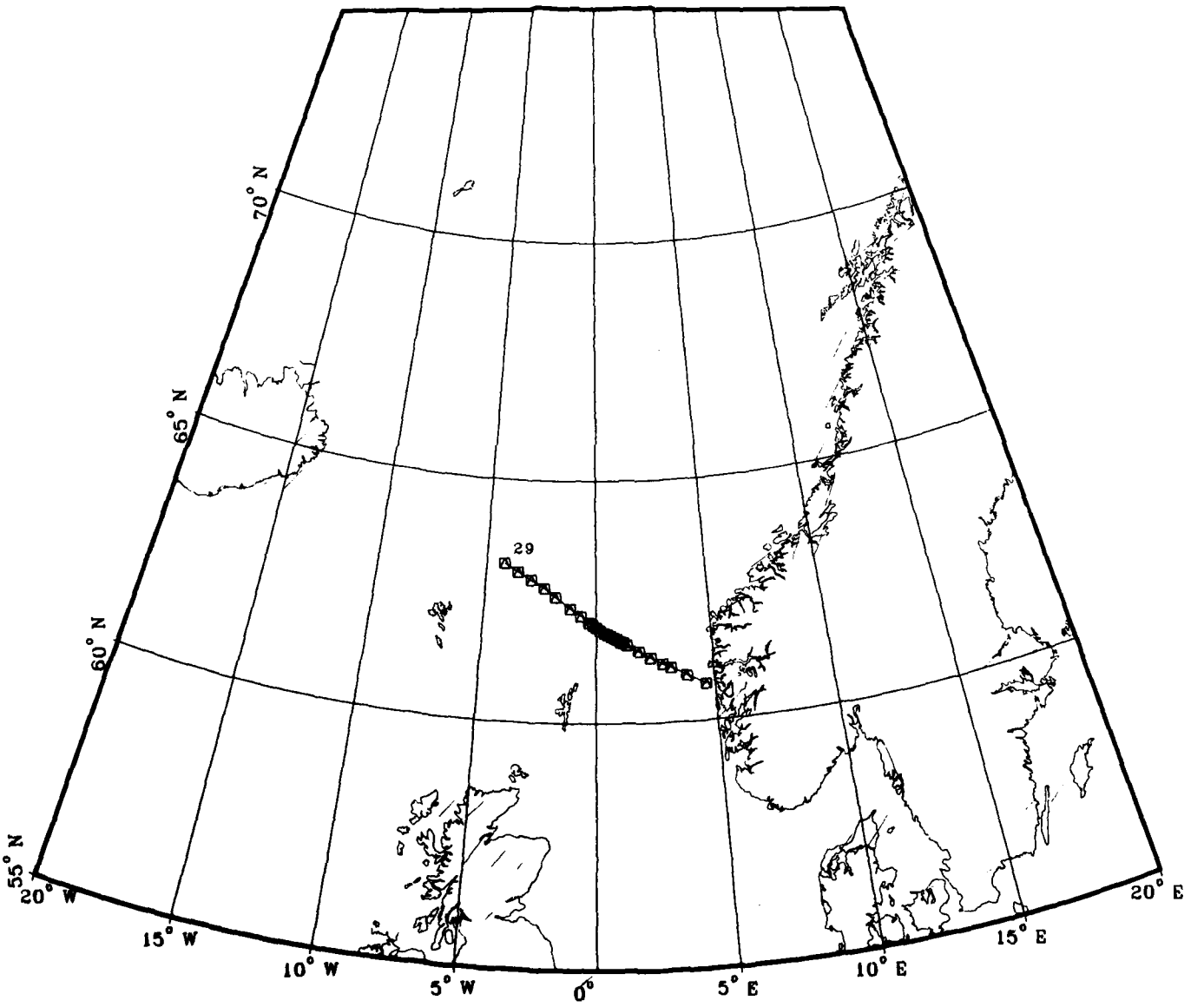


Figure 53. May 1929 station positions.

SOGNEFJORD SECTION
FILE = ICE8$:1929MAY.DAT
T/S PLOT

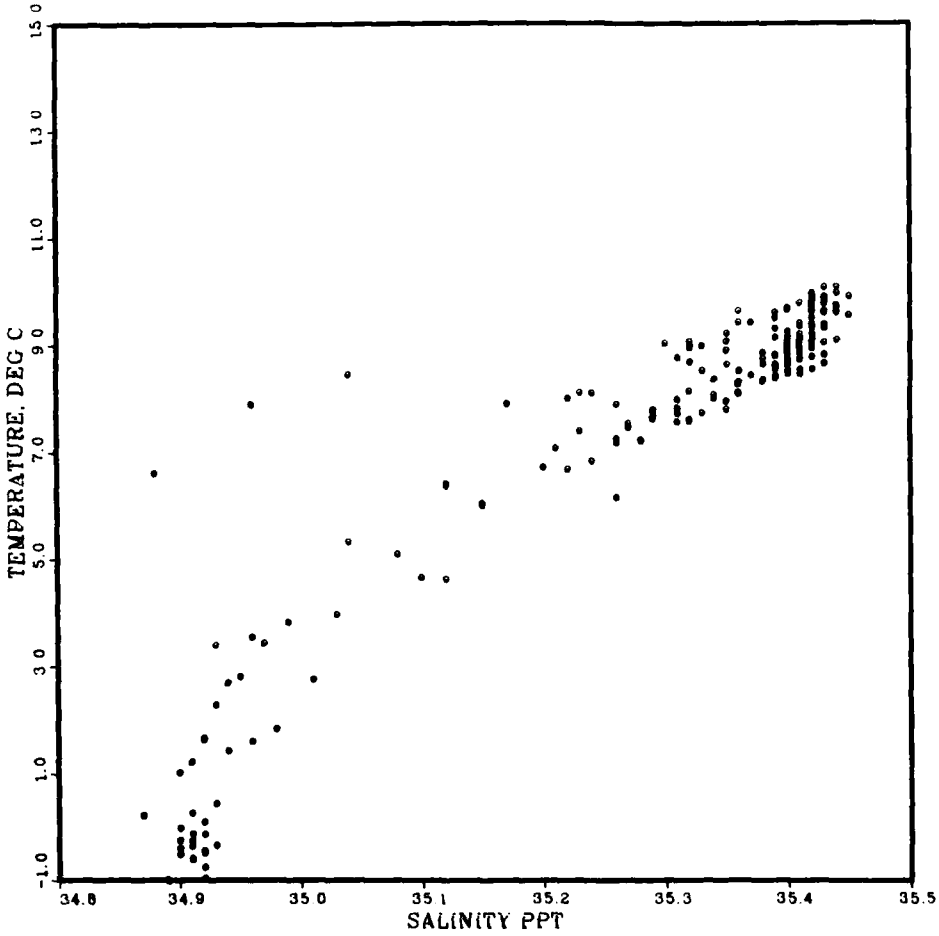


Figure 54. May 1929 temperature/salinity diagram.

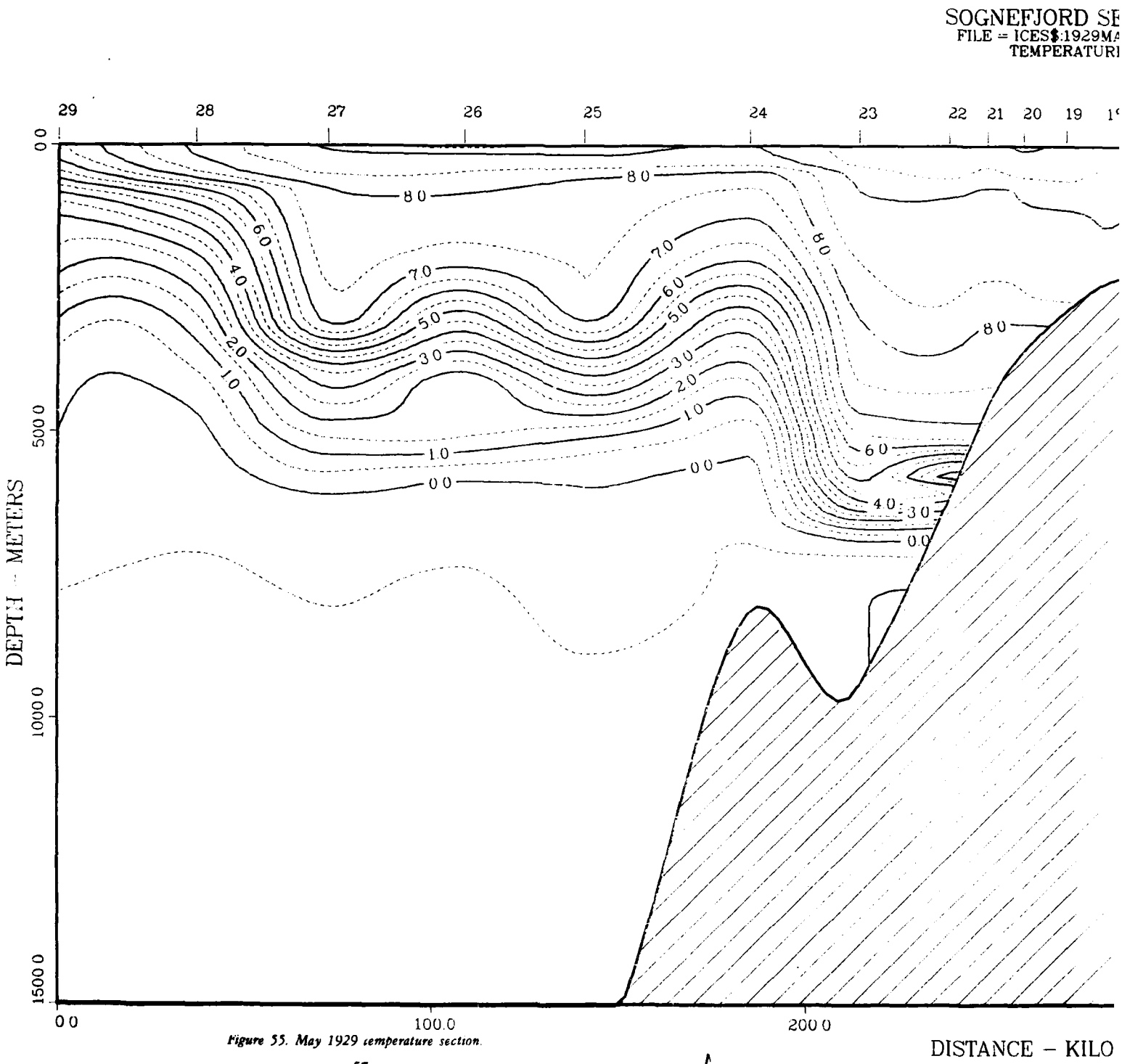
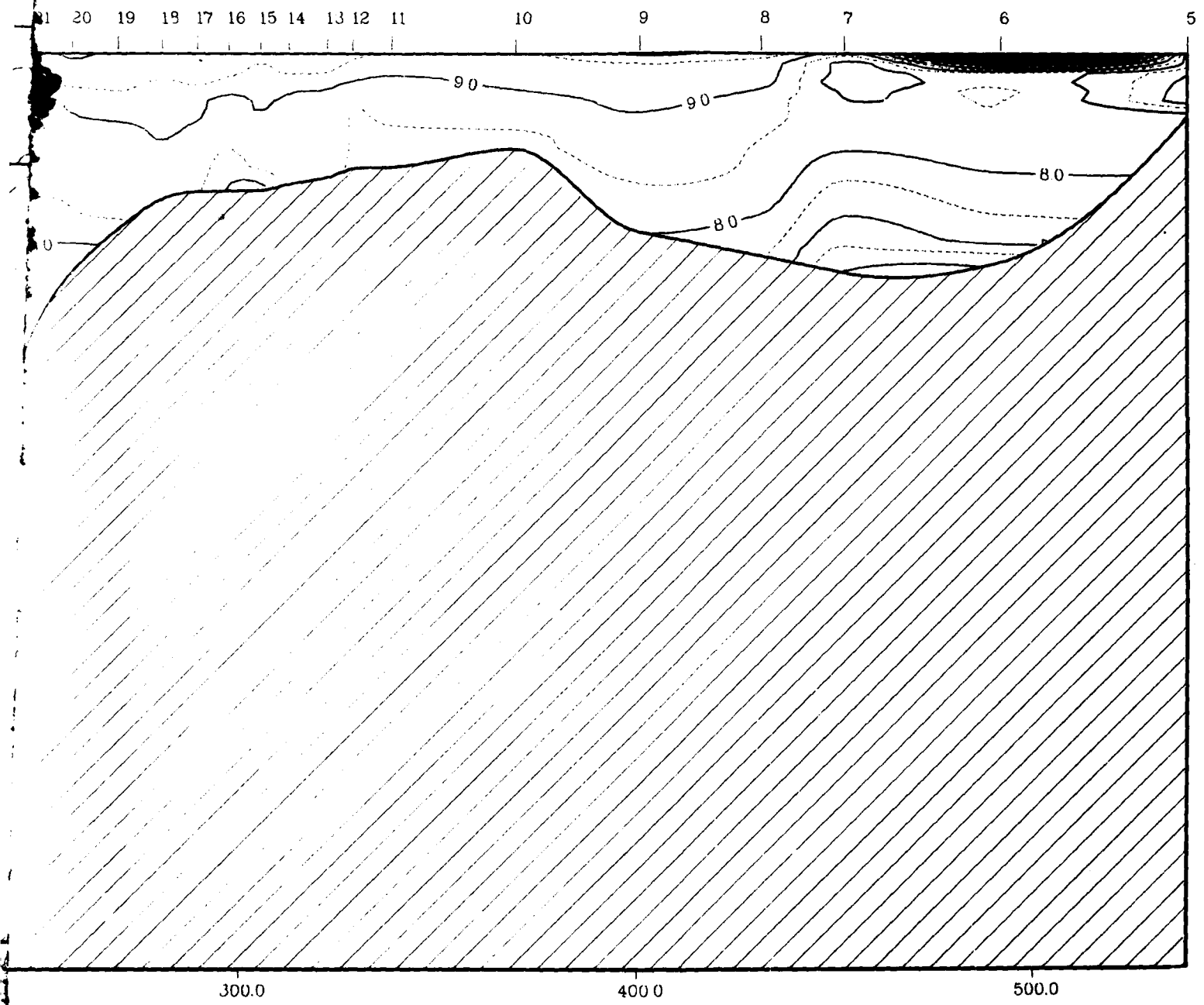


Figure 55. May 1929 temperature section.

NEFJORD SECTION
= ICES$:1929MAY.DAT:1
TEMPERATURE



TANCE – KILOMETERS

2

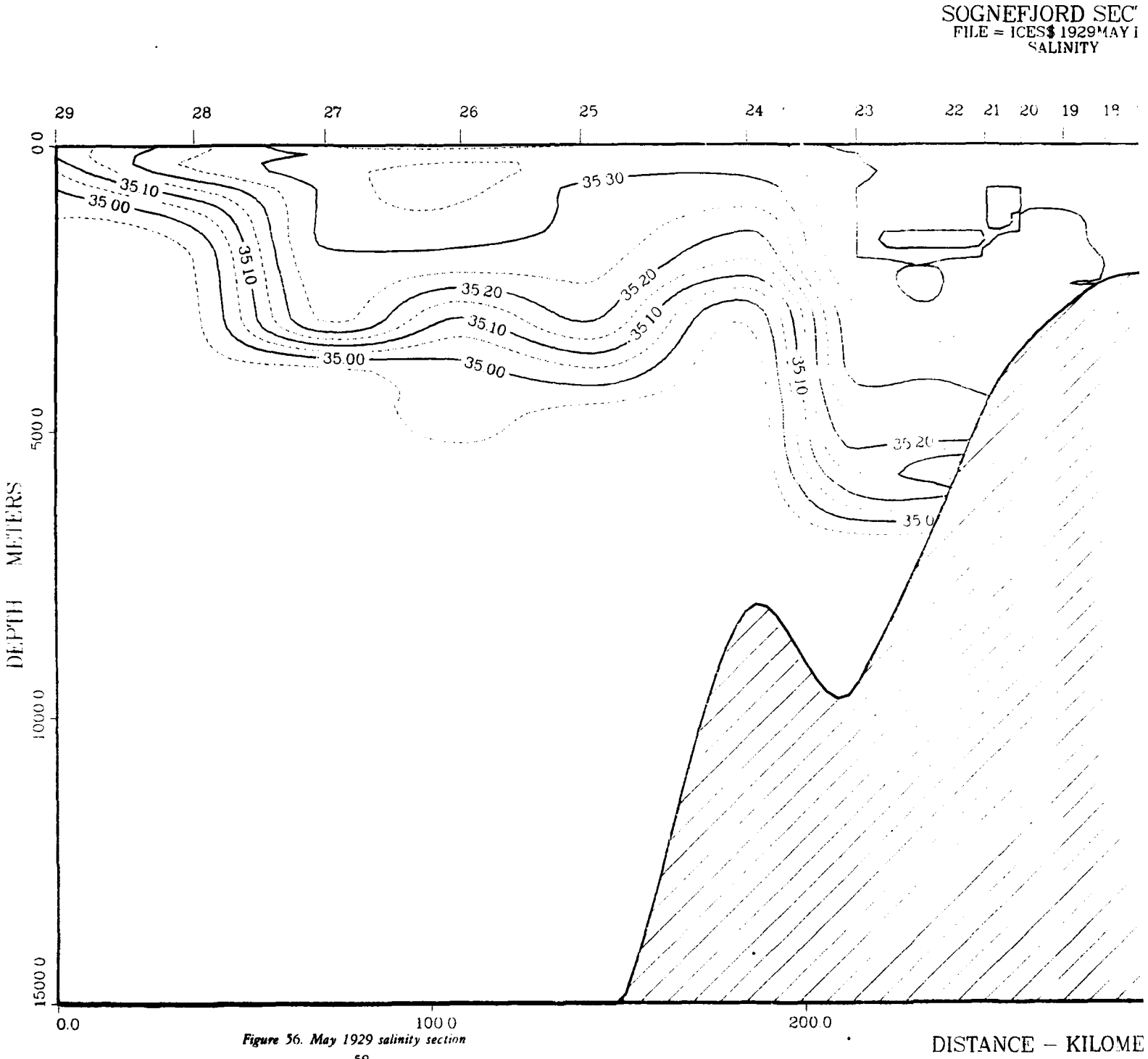
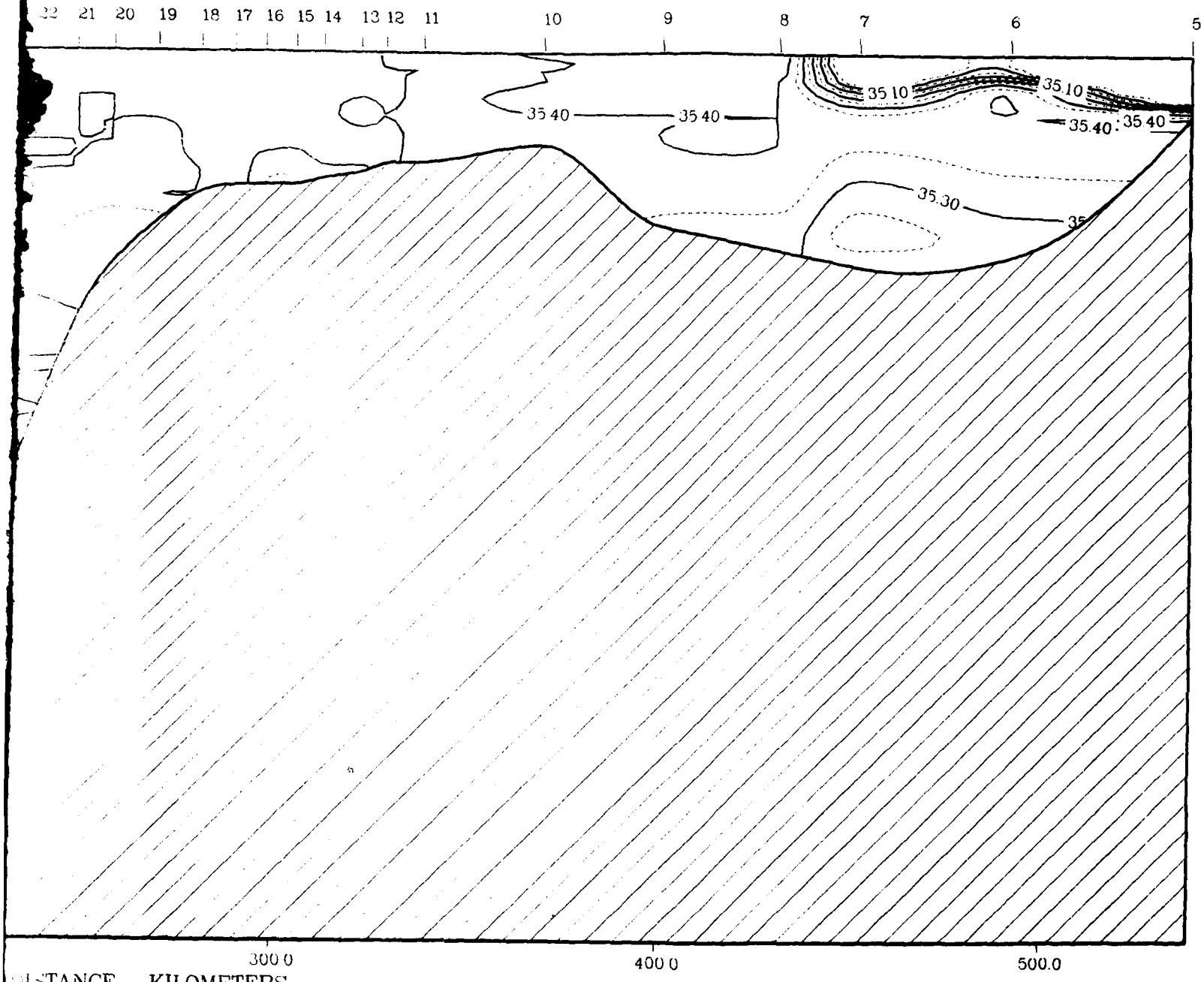


Figure 56. May 1929 salinity section

SOGNEFJORD SECTION
FILE = ICES$ 1929MAY DAT 1
SALINITY



DISTANCE – KILOMETERS

2

ICES$:1932AUG.DAT

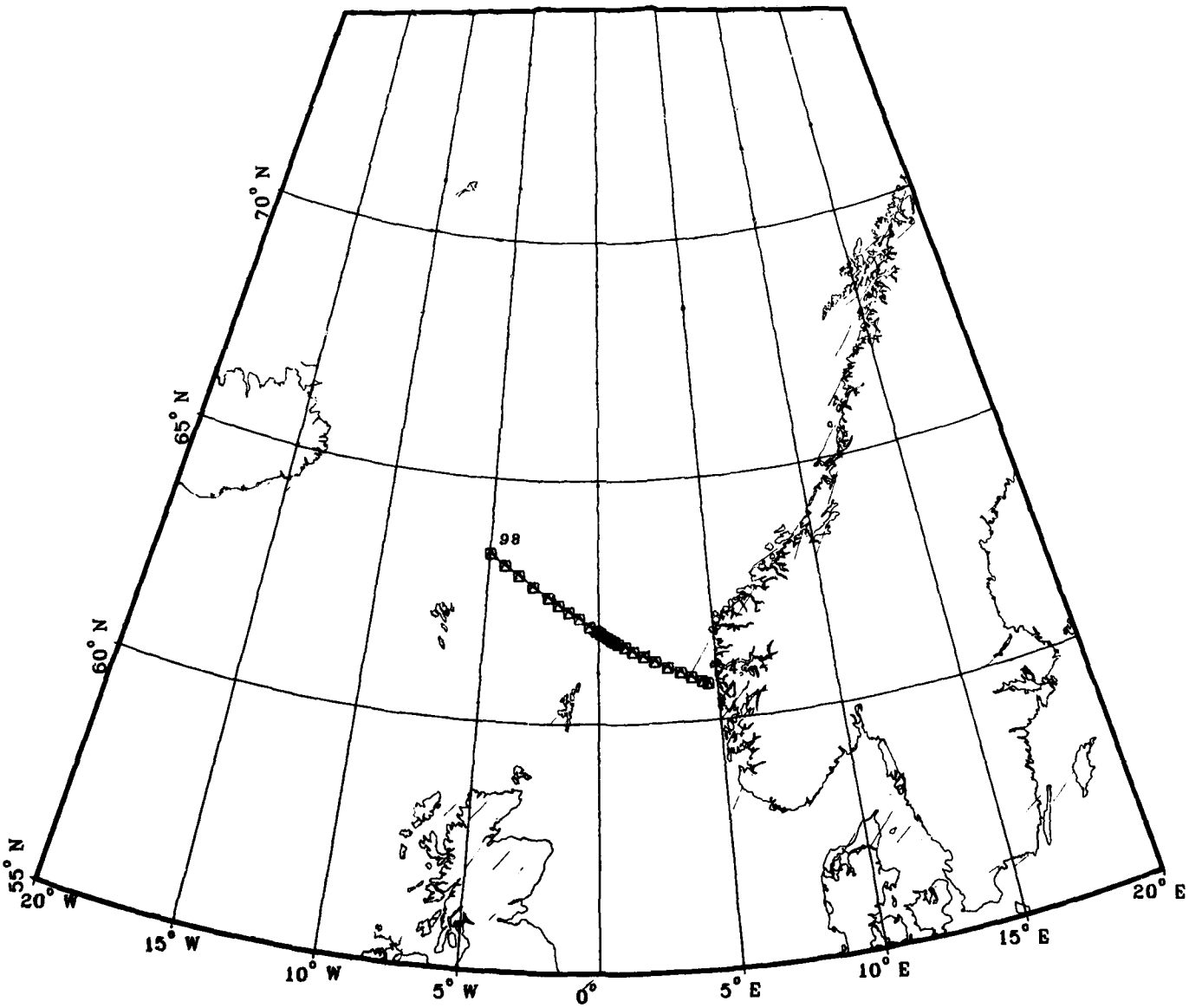


Figure 57. August 1932 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1932AUG.DAT
T/S PLOT

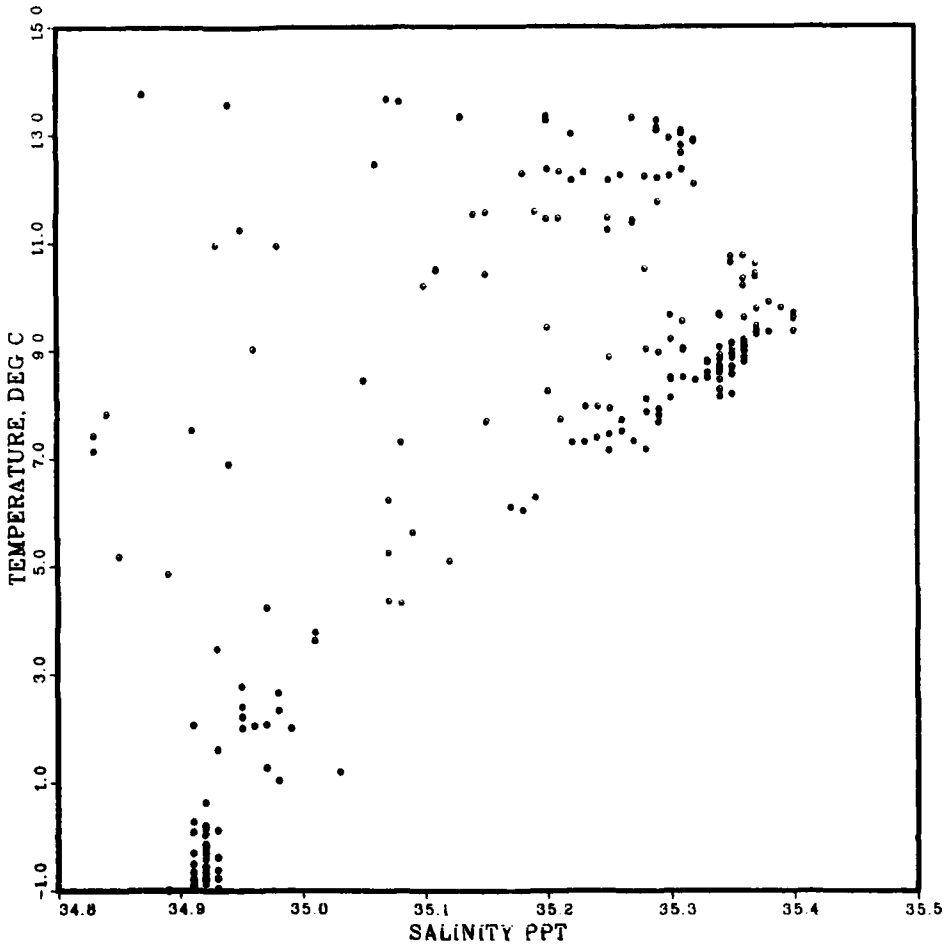


Figure 58. August 1932 temperature/salinity diagram.

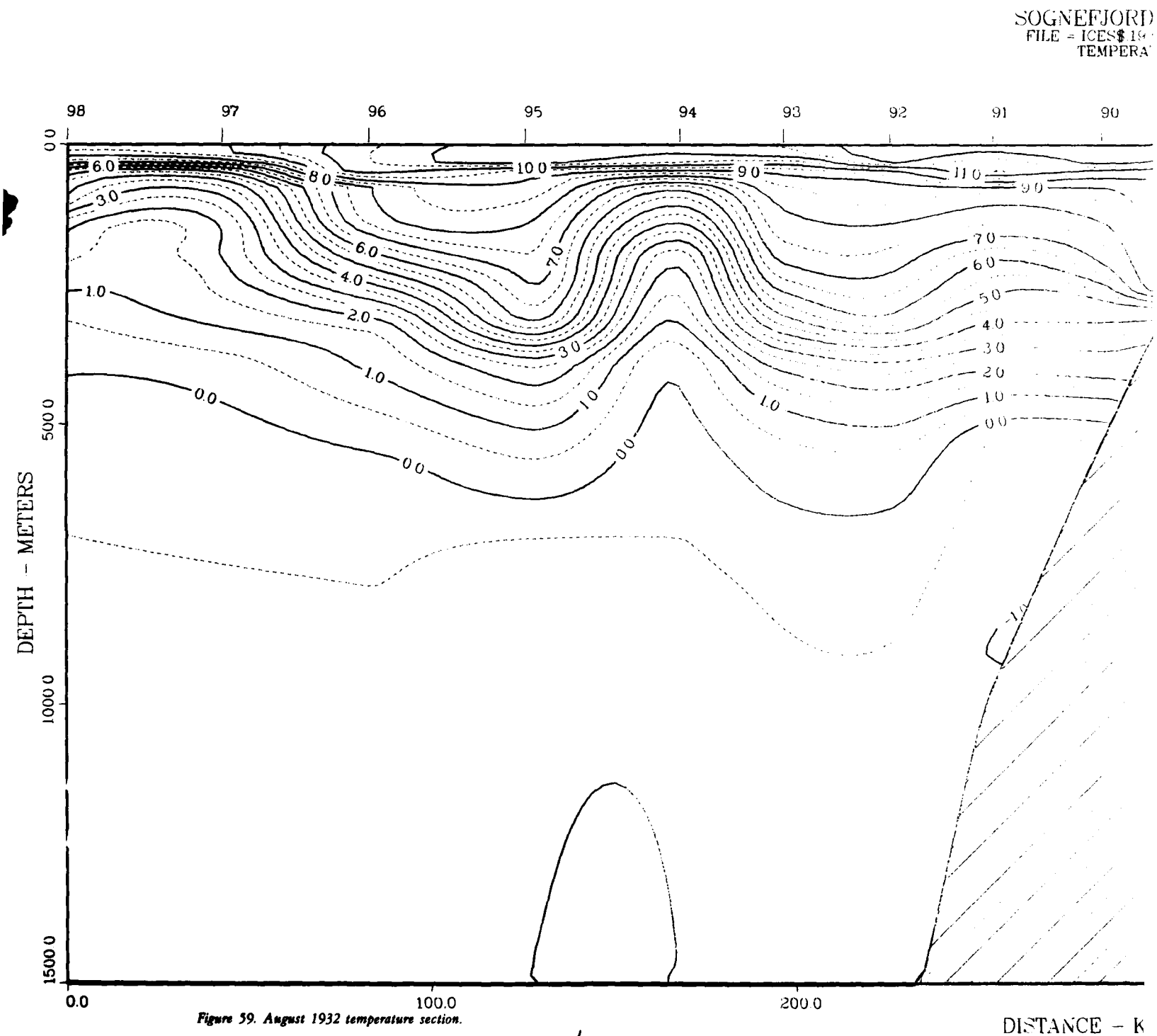
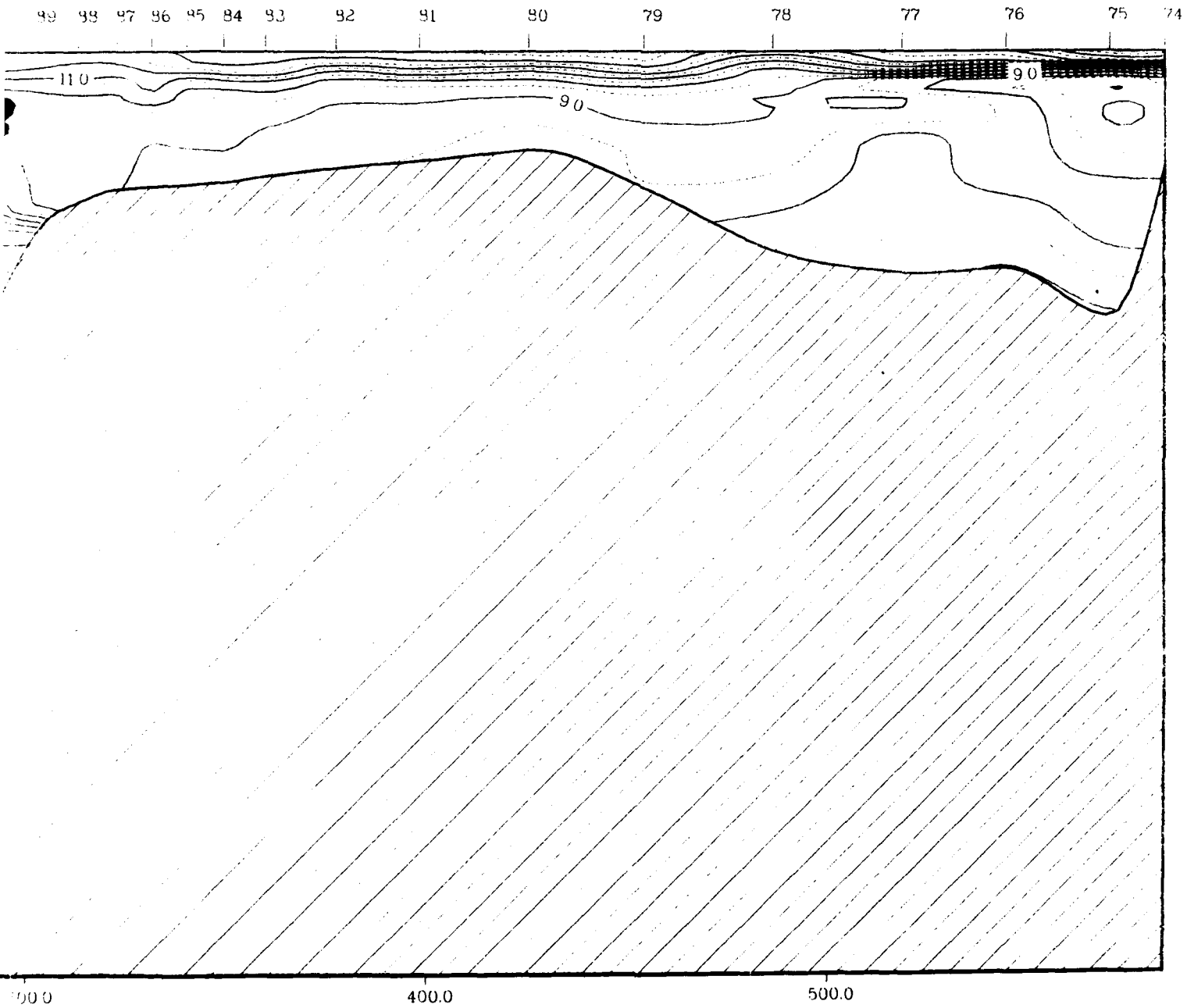


Figure 59. August 1932 temperature section.

D SECTION
[illegible] DAT 1
ATURE



KILOMETERS

2

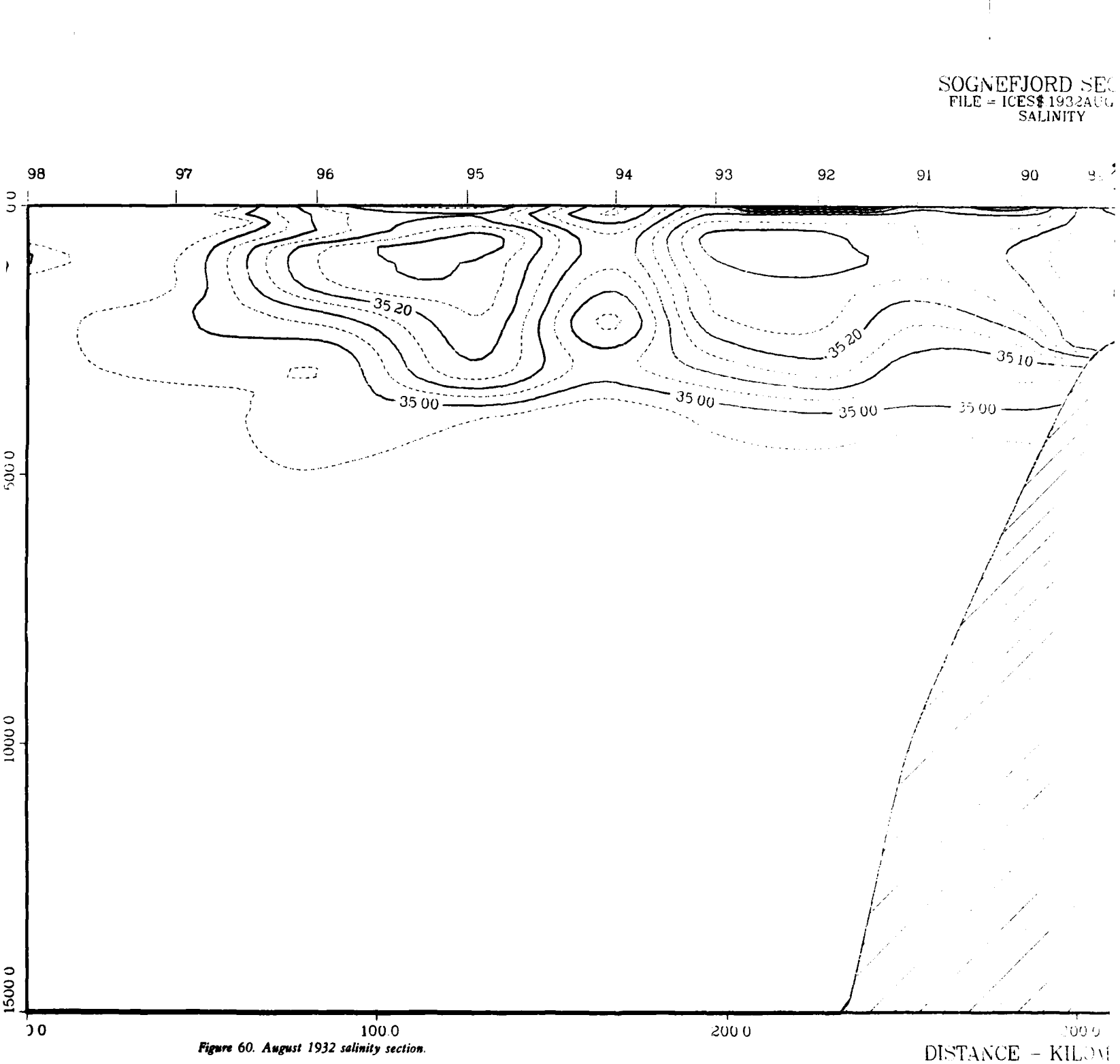


Figure 60. August 1932 salinity section.

SECTION
AUG DAT 1

LOMETERS

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ICES$:1933AUG.DAT

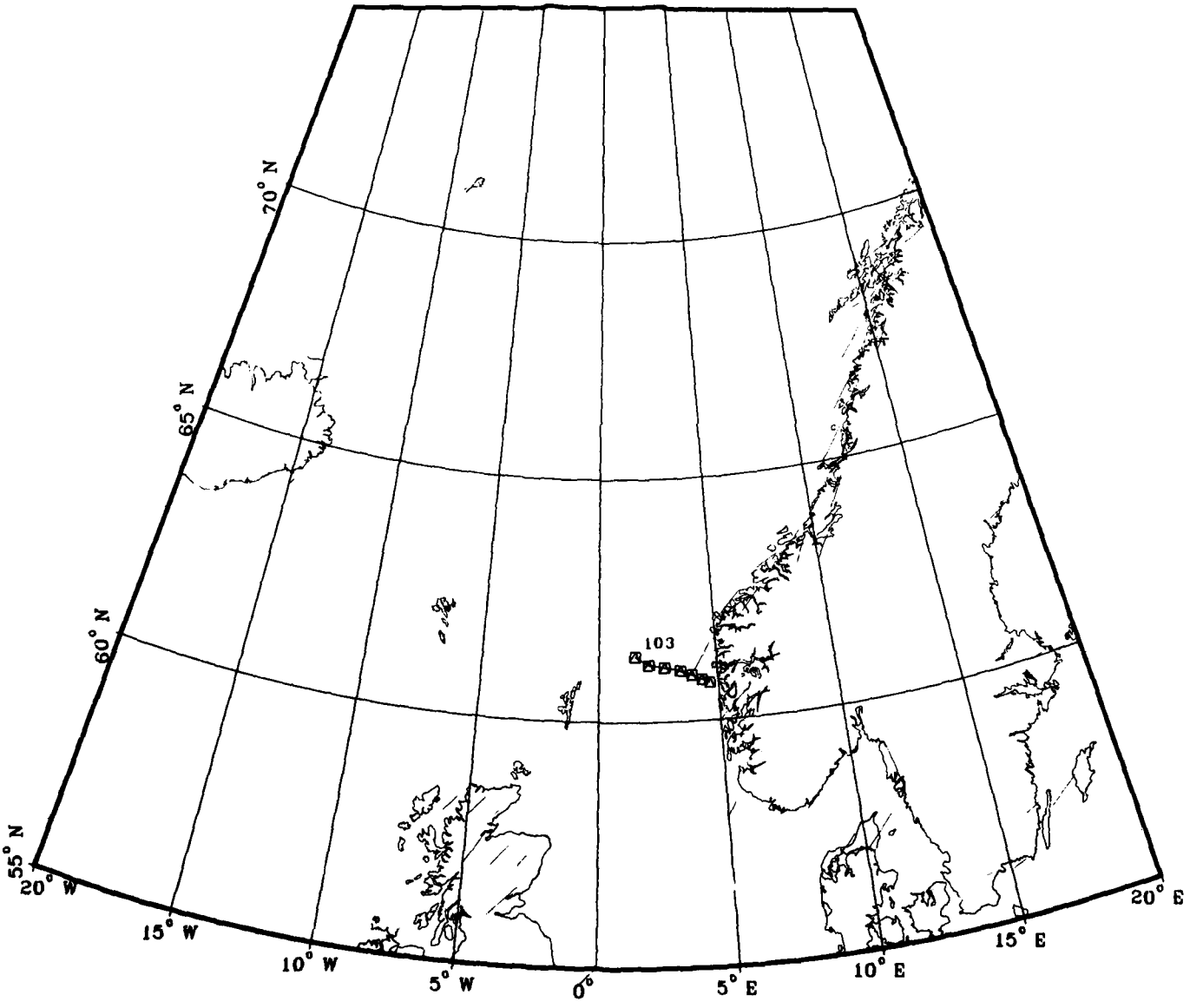


Figure 61. August 1933 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1933AUG.DAT
T/S PLOT

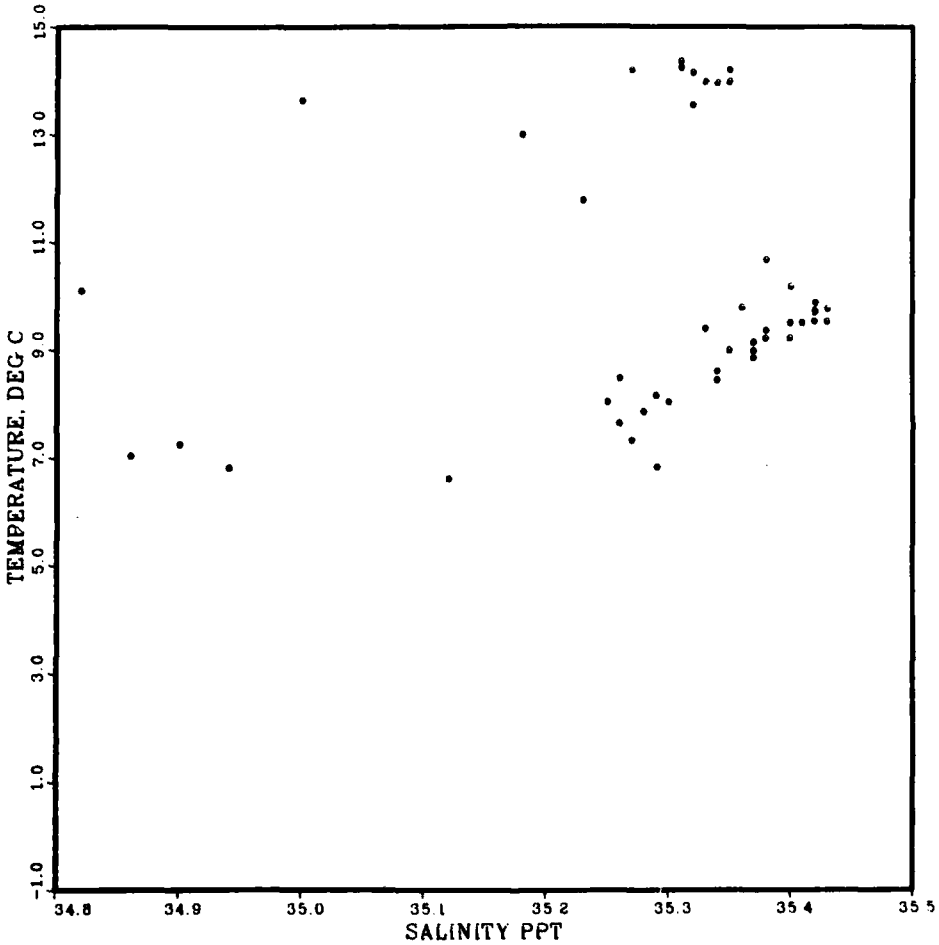


Figure 62. August 1933 temperature/salinity diagram.

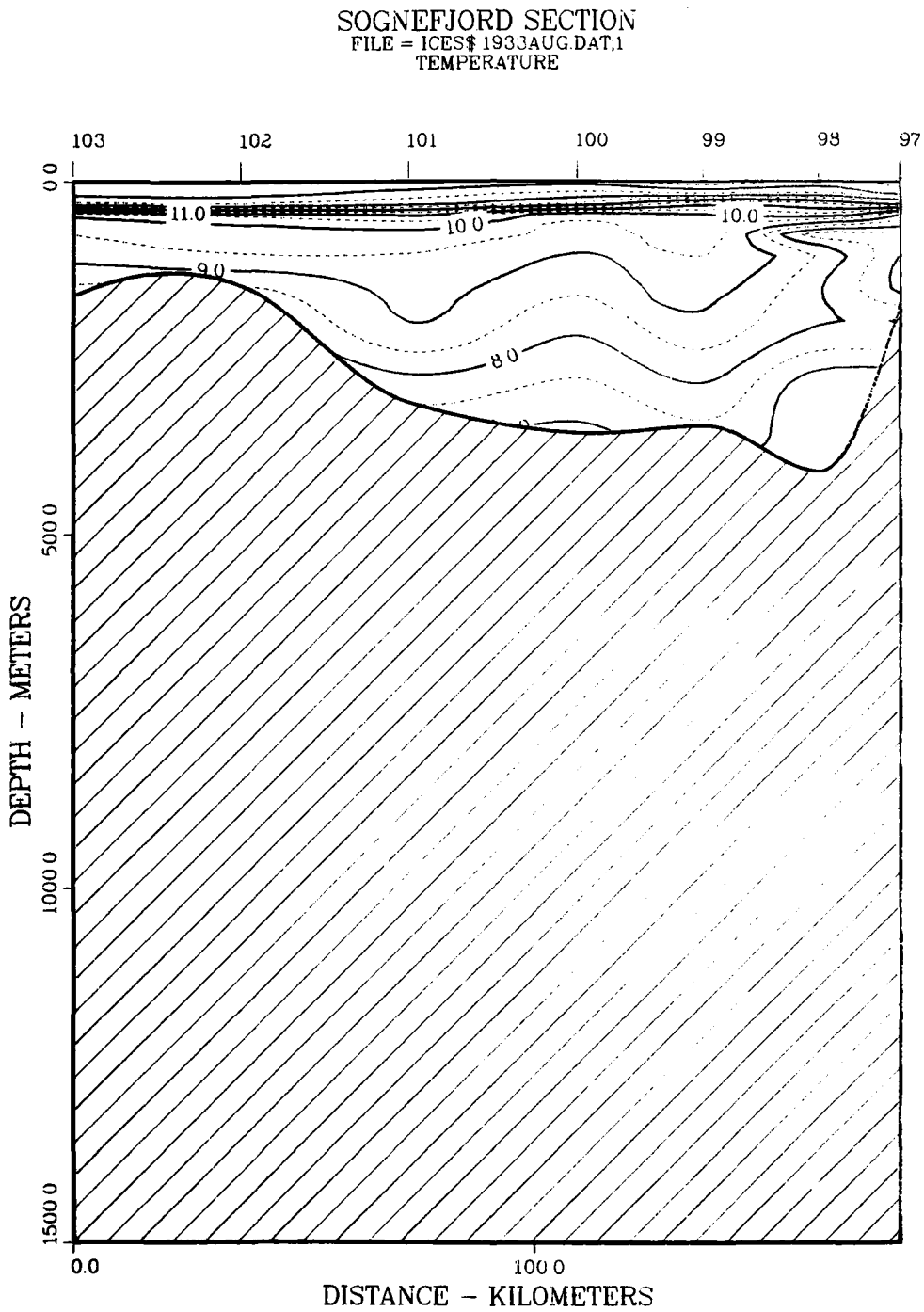


Figure 63. August 1933 temperature section.

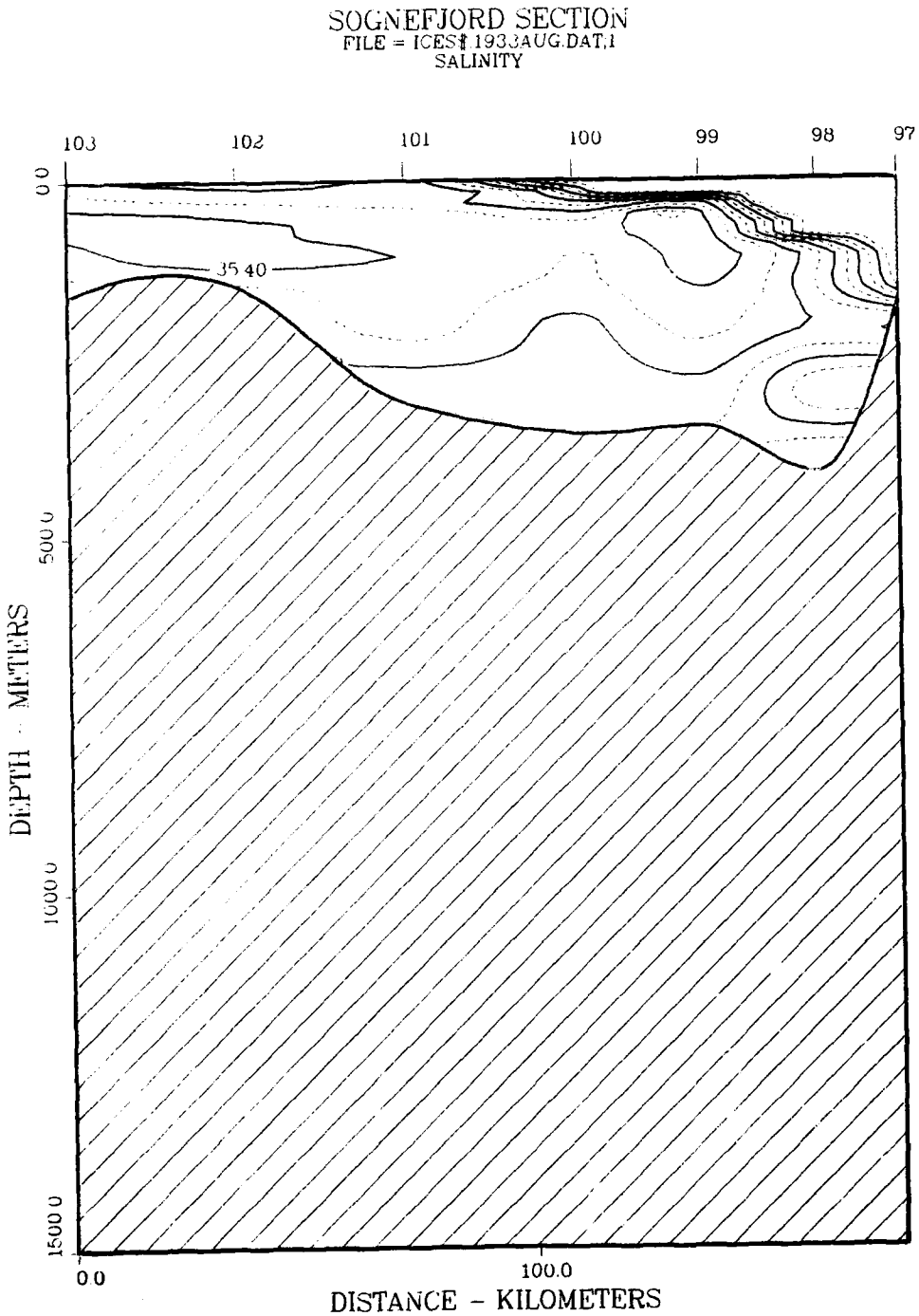
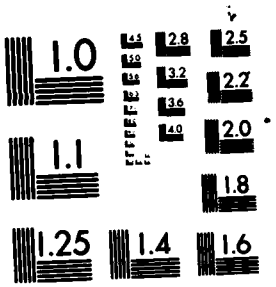


Figure 64. August 1933 salinity section.

AD-A169 098 ATLAS OF SOGNEFJORD SECTIONS 1900-1979(U) NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY NSTL STATION MS K D SAUNDERS ET AL. APR 85 NORDA-42 2/4

UNCLASSIFIED F/G 8/10 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

ICES$:1934AUG.DAT

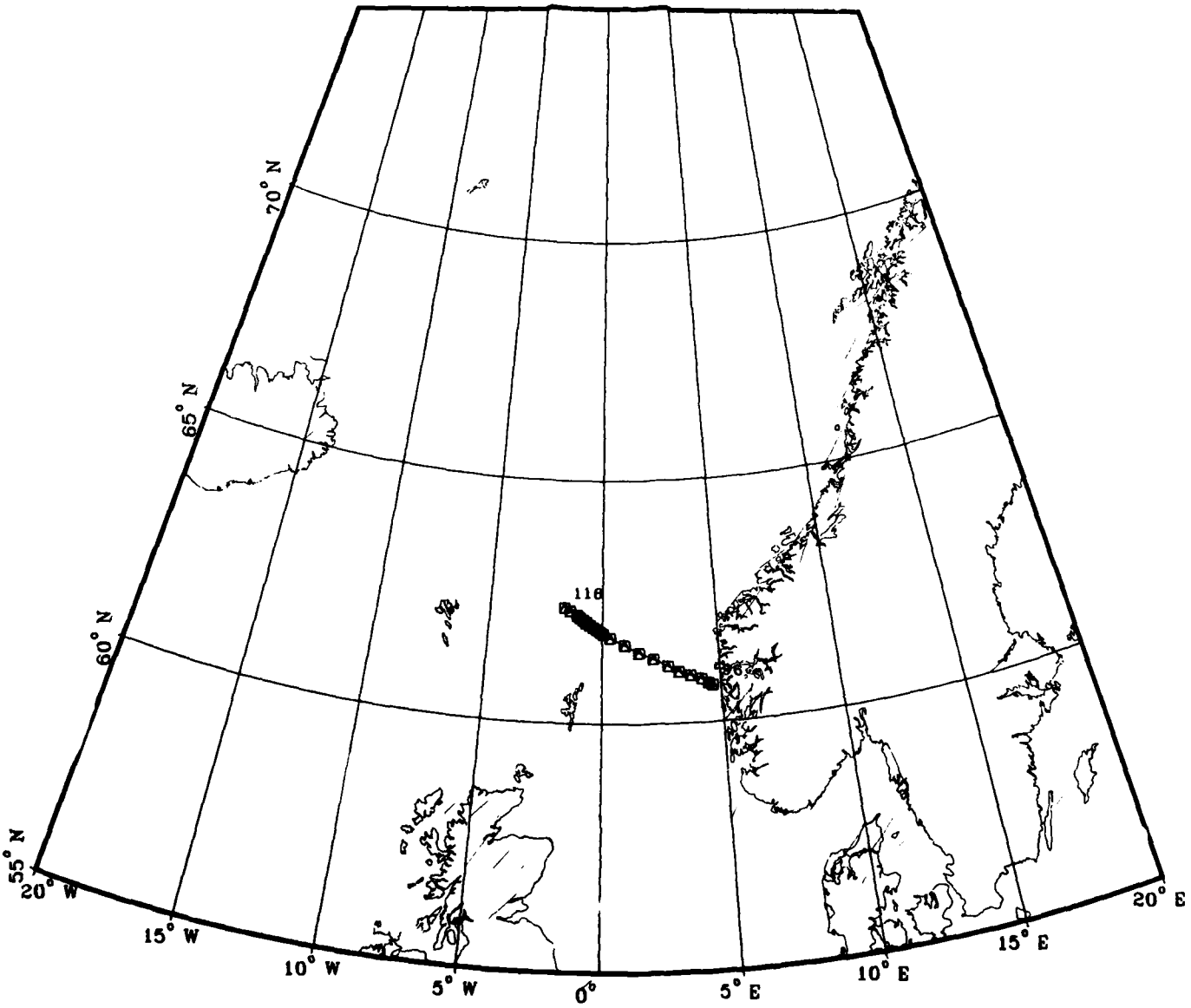


Figure 65. August 1934 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1934AUG.DAT
T/S PLOT

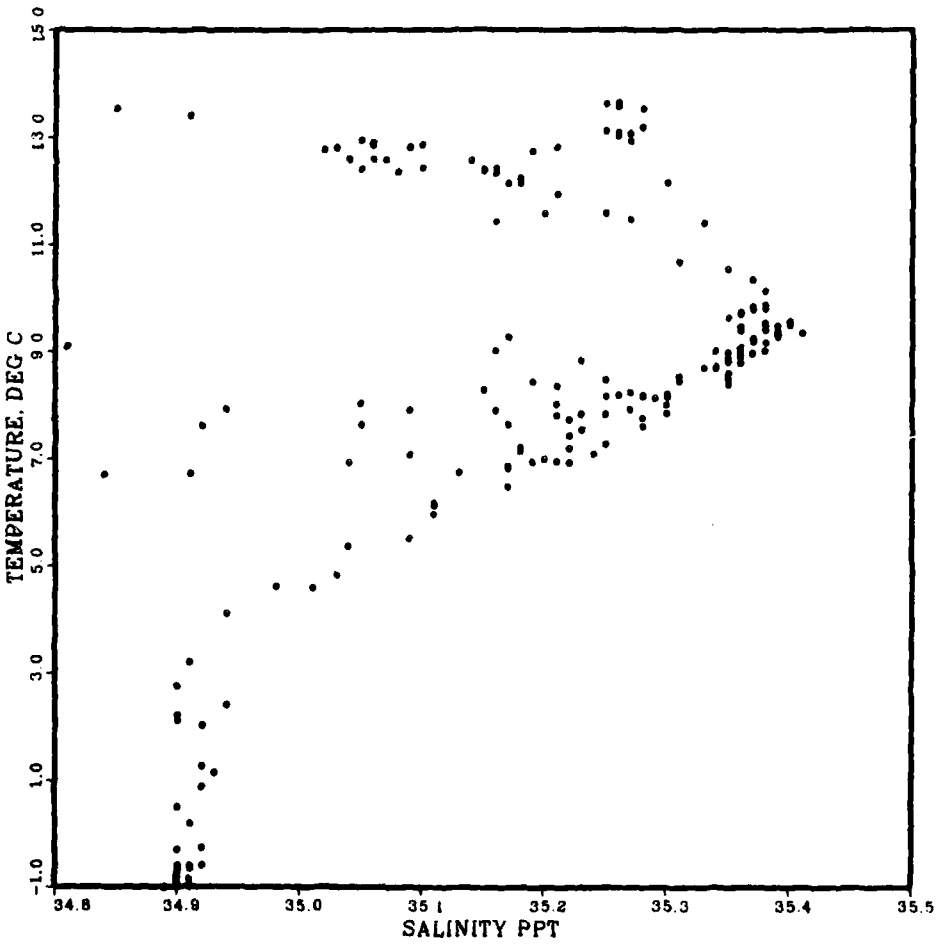


Figure 66. August 1934 temperature/salinity diagram.

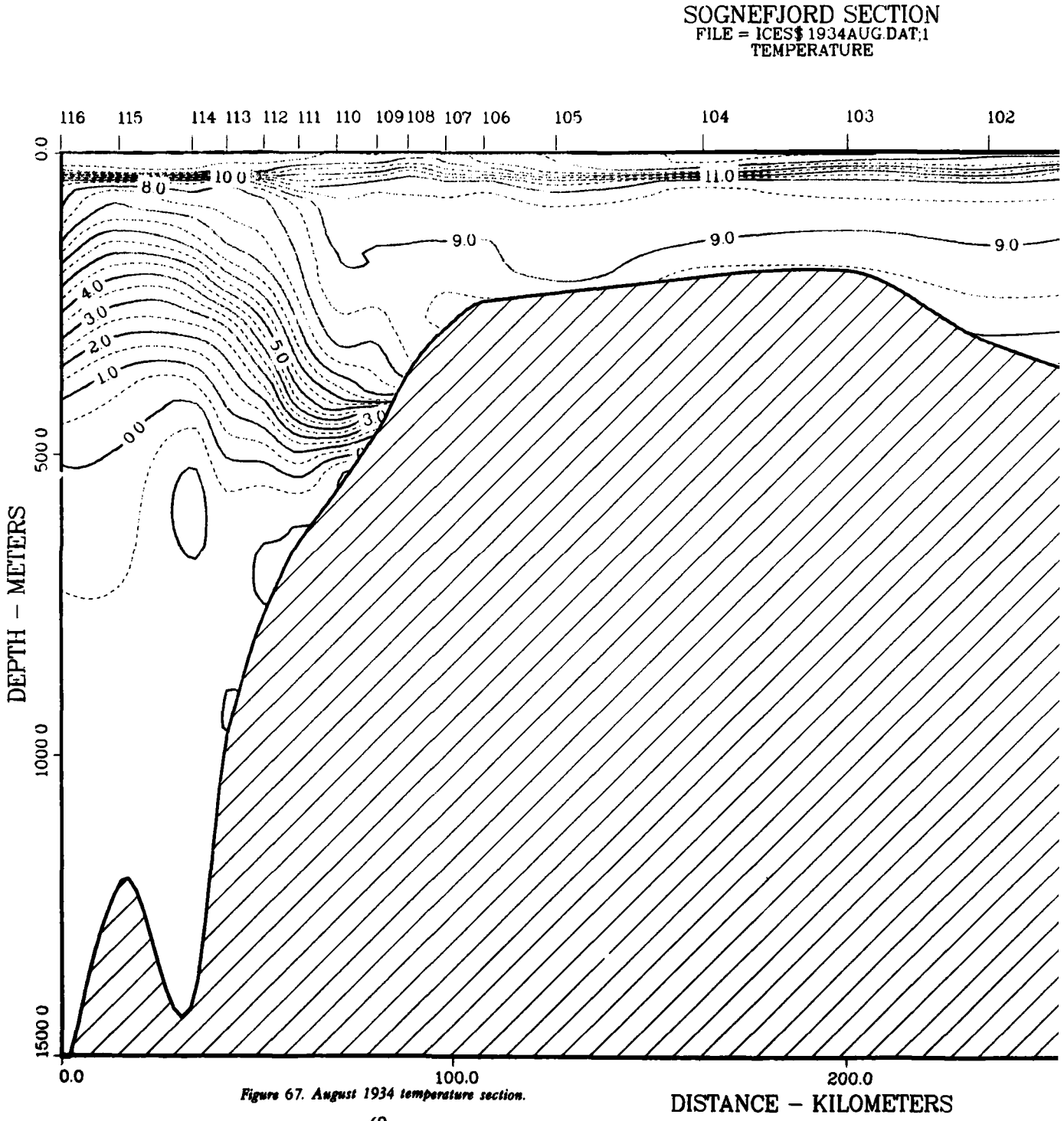
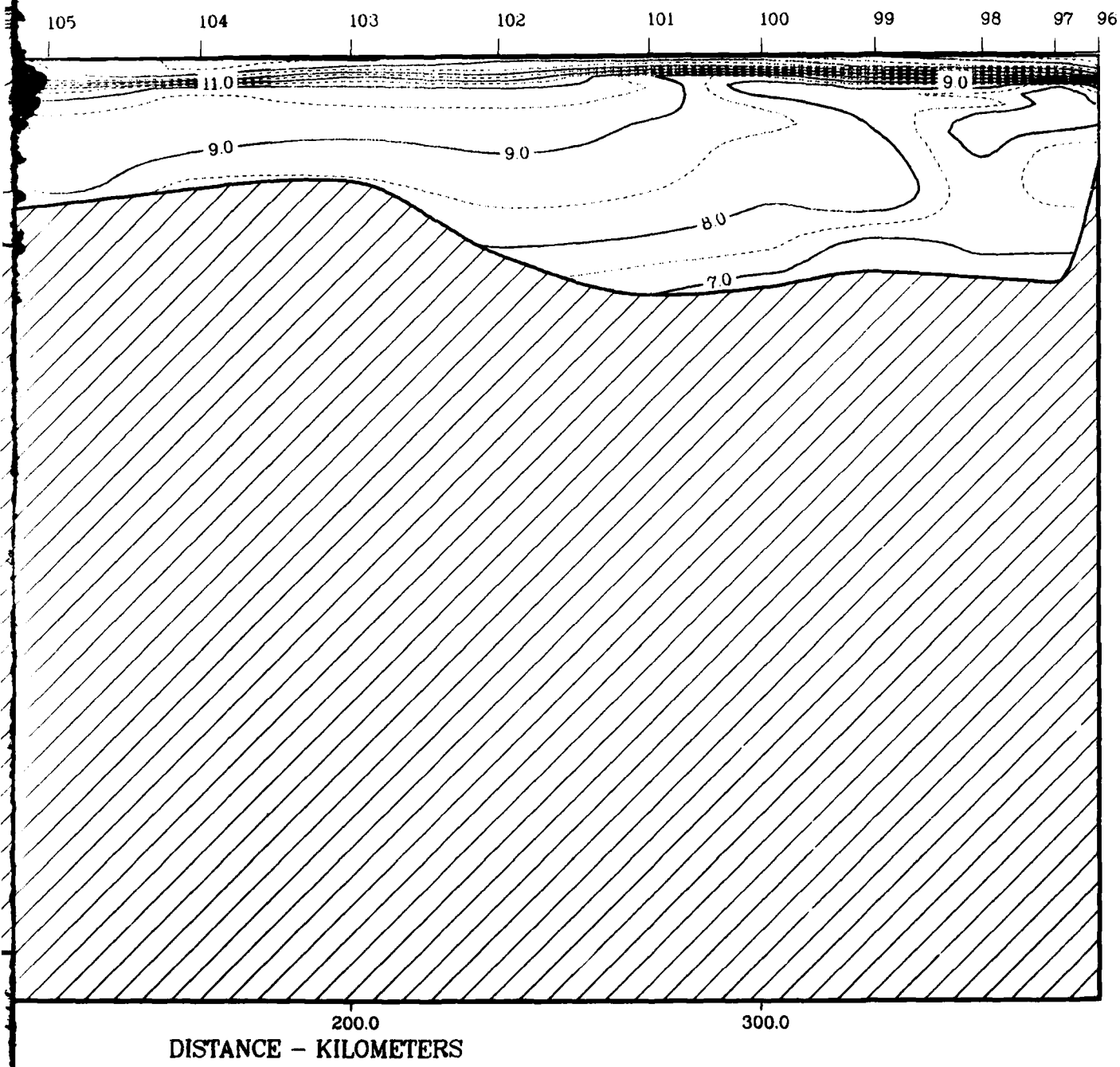


Figure 67. August 1934 temperature section.

SOGNEFJORD SECTION
FILE = ICES$1934AUG.DAT;1
TEMPERATURE



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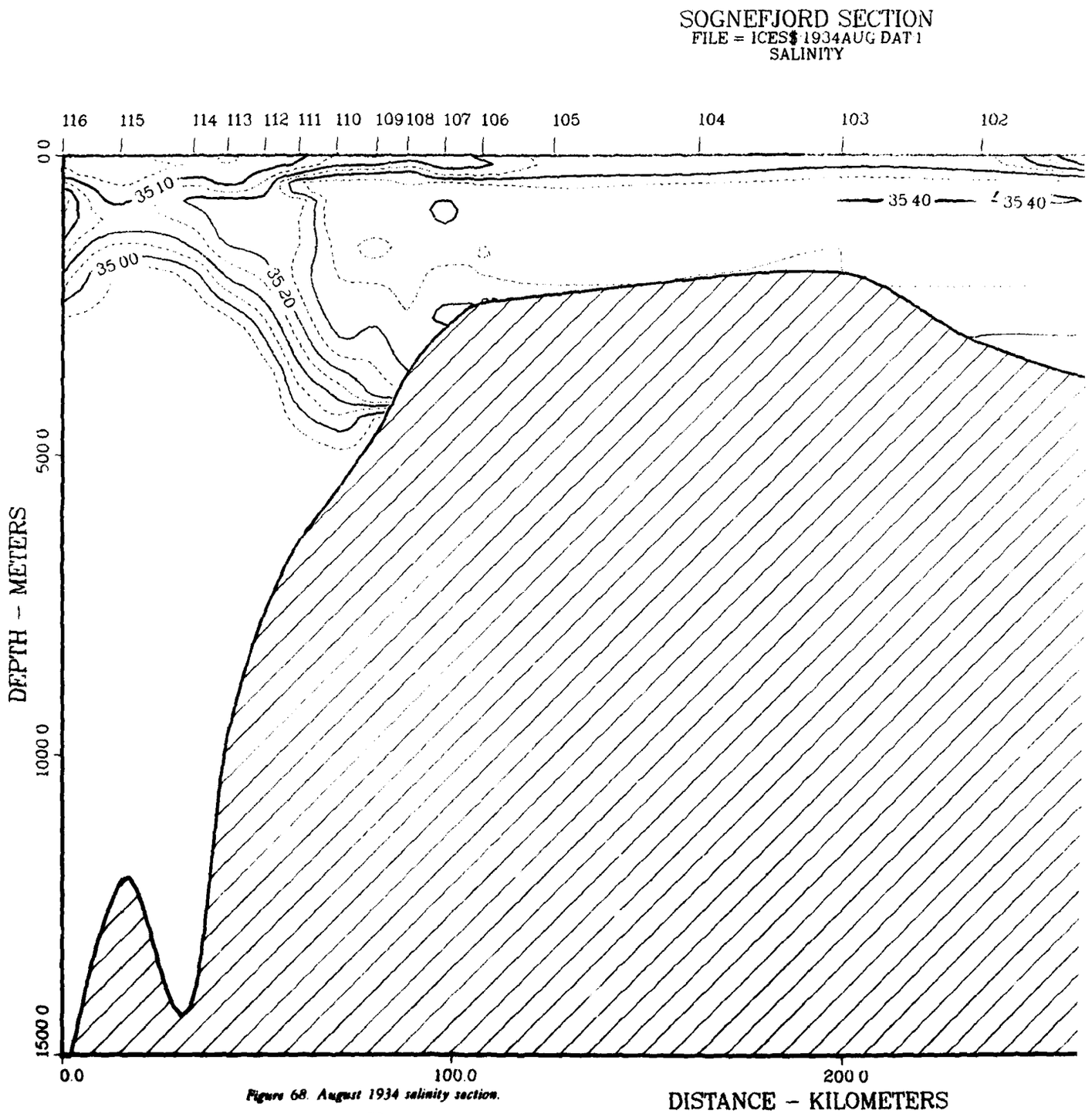
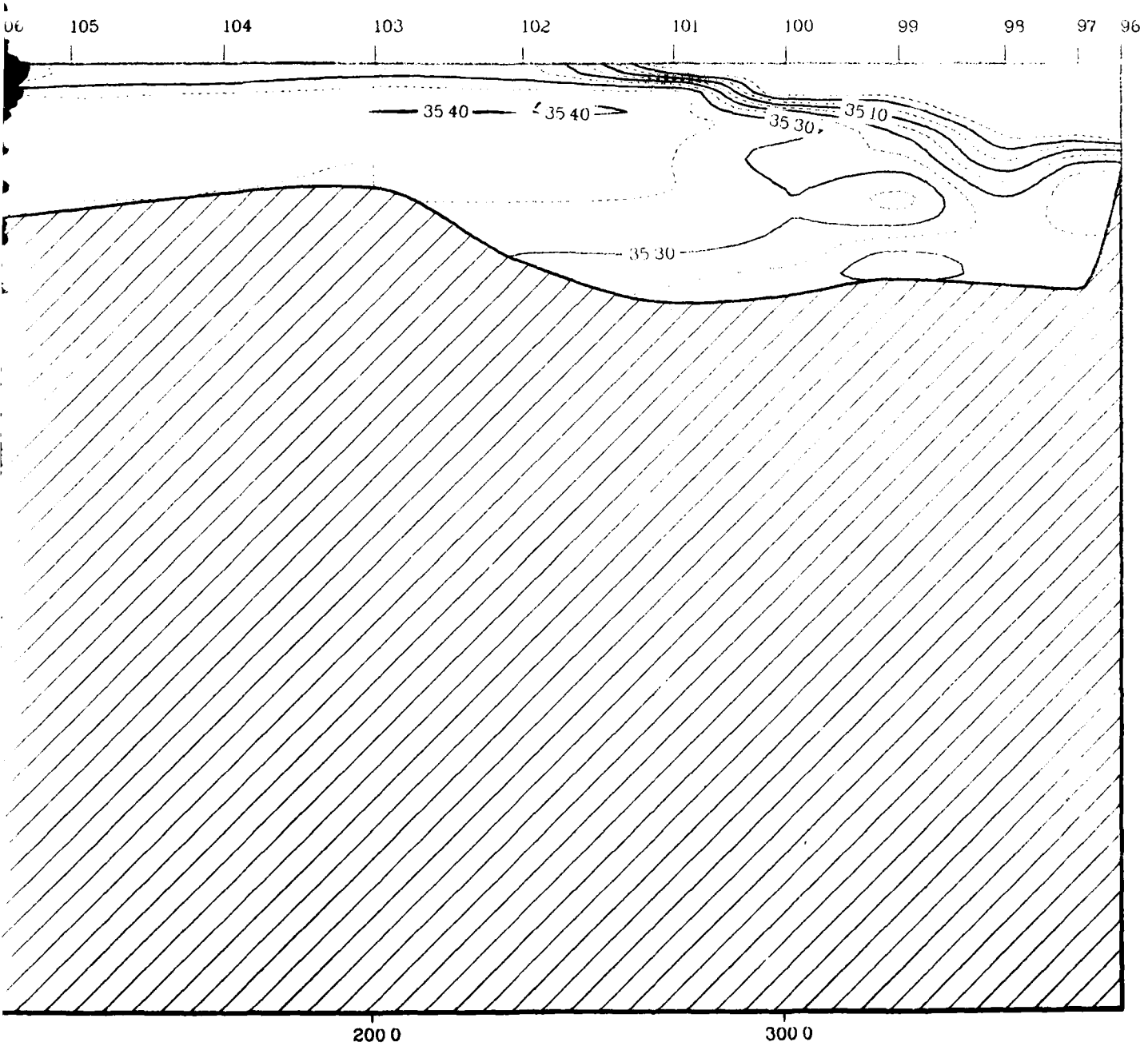


Figure 68. August 1934 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1934AUG DAT 1
SALINITY



DISTANCE – KILOMETERS

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2

ICES$:193501.DAT

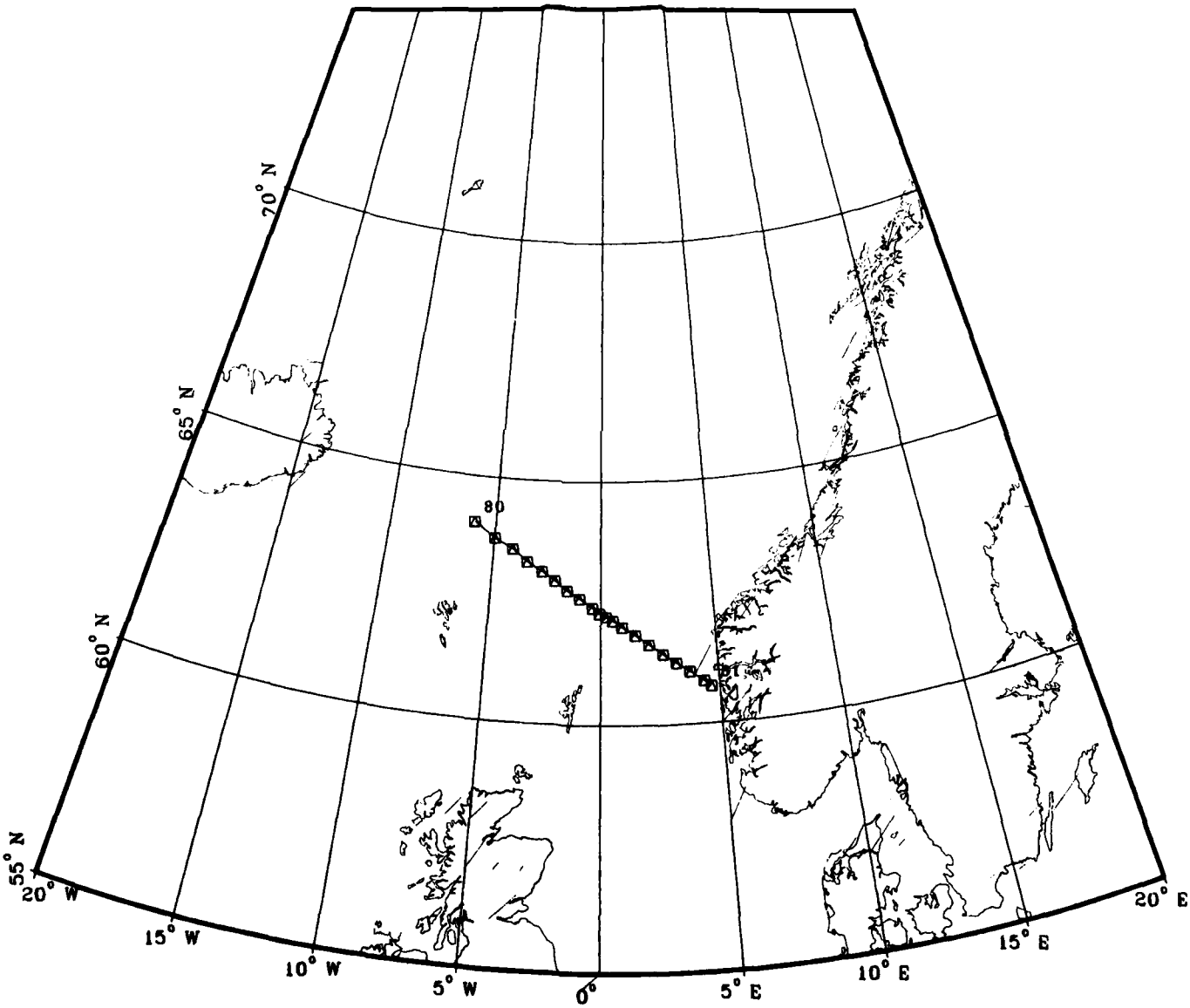


Figure 69. May 1935 (data set #1) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 193501.DAT
T/S PLOT

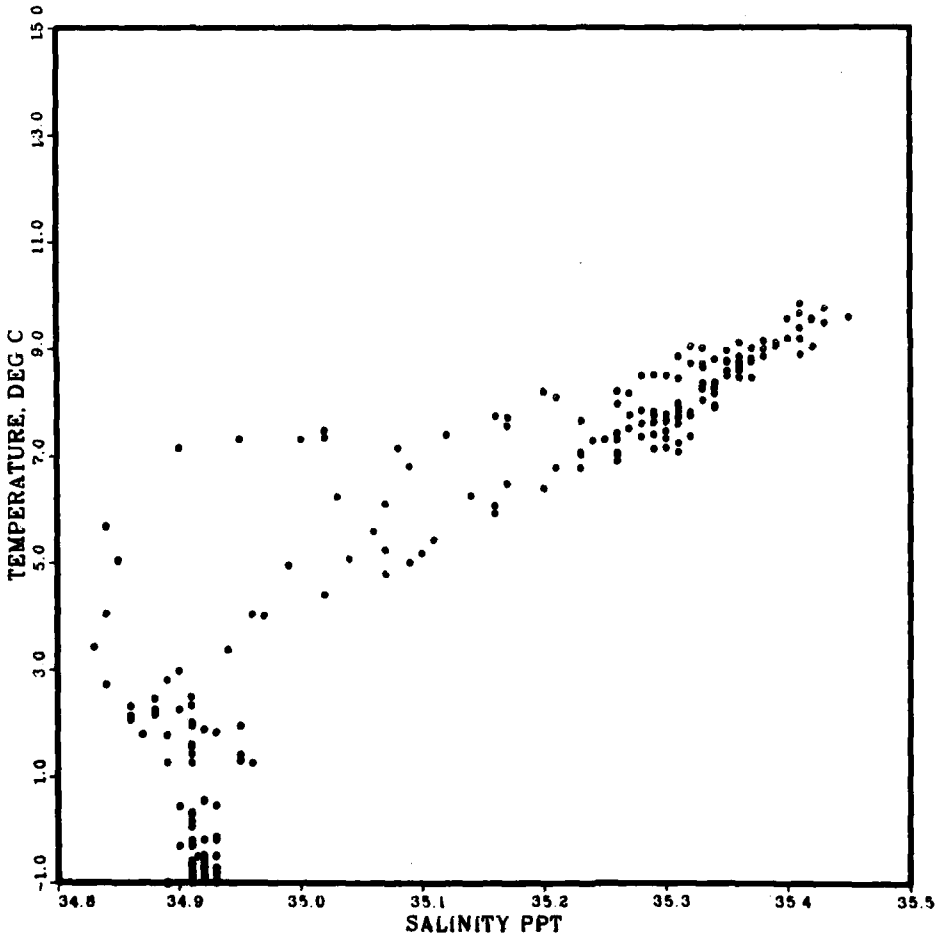


Figure 70. May 1935 (data set #1) temperature/salinity diagram.

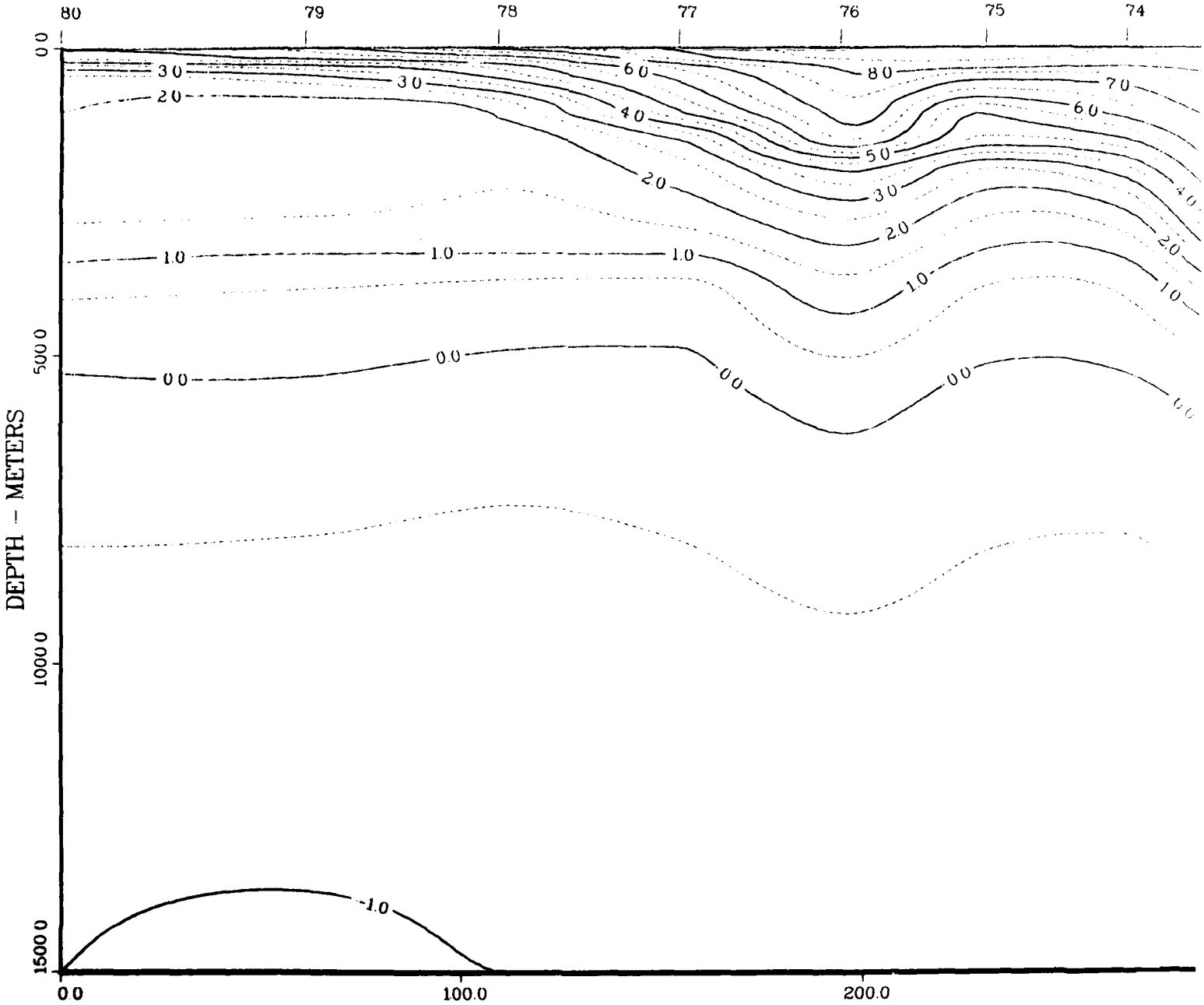
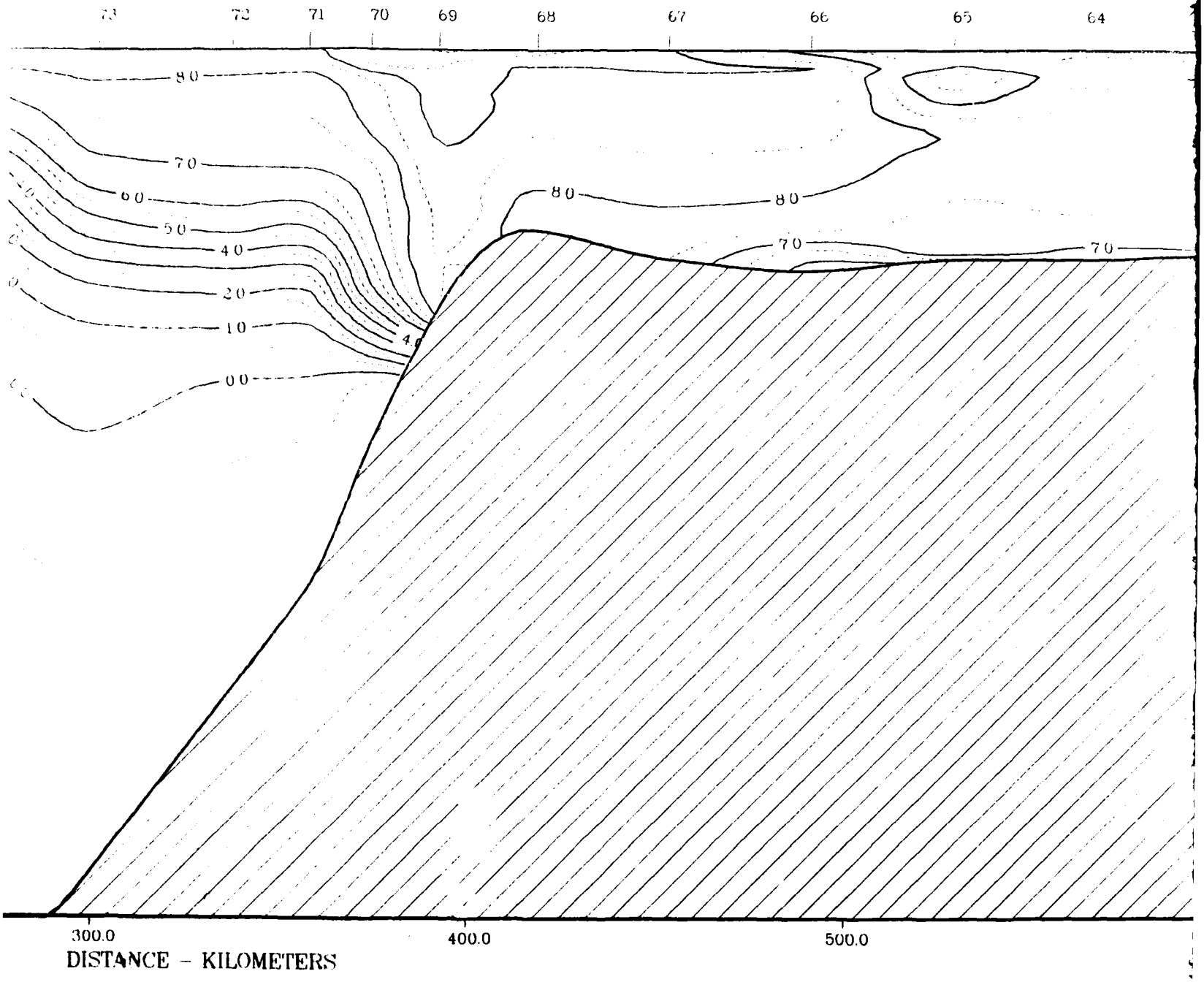


Figure 71. May 1935 (data set #1) temperature section.

SOGNEFJORD SECTION
FILE = ICES$ 193501 DAT,1
TEMPERATURE



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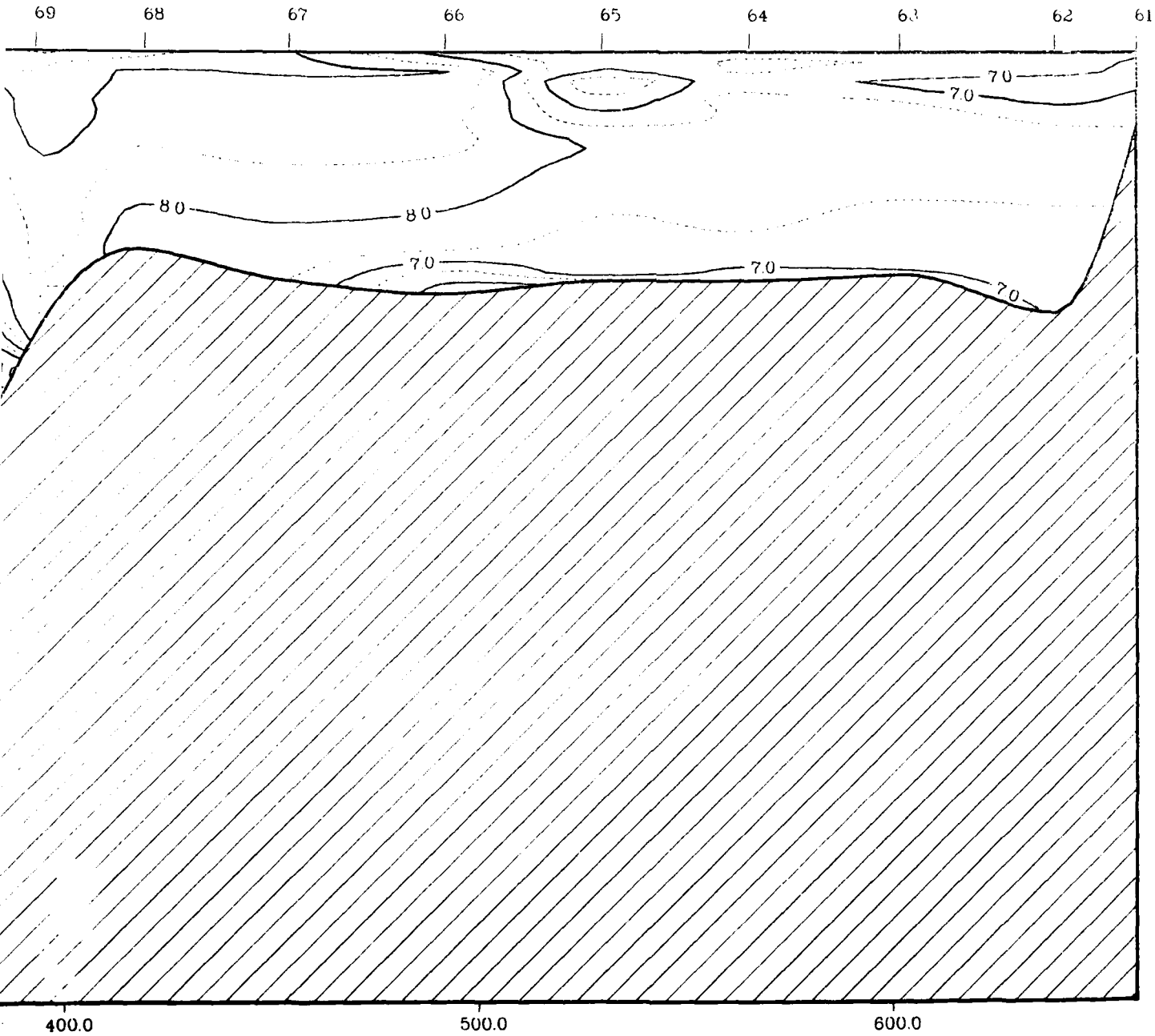


2

1

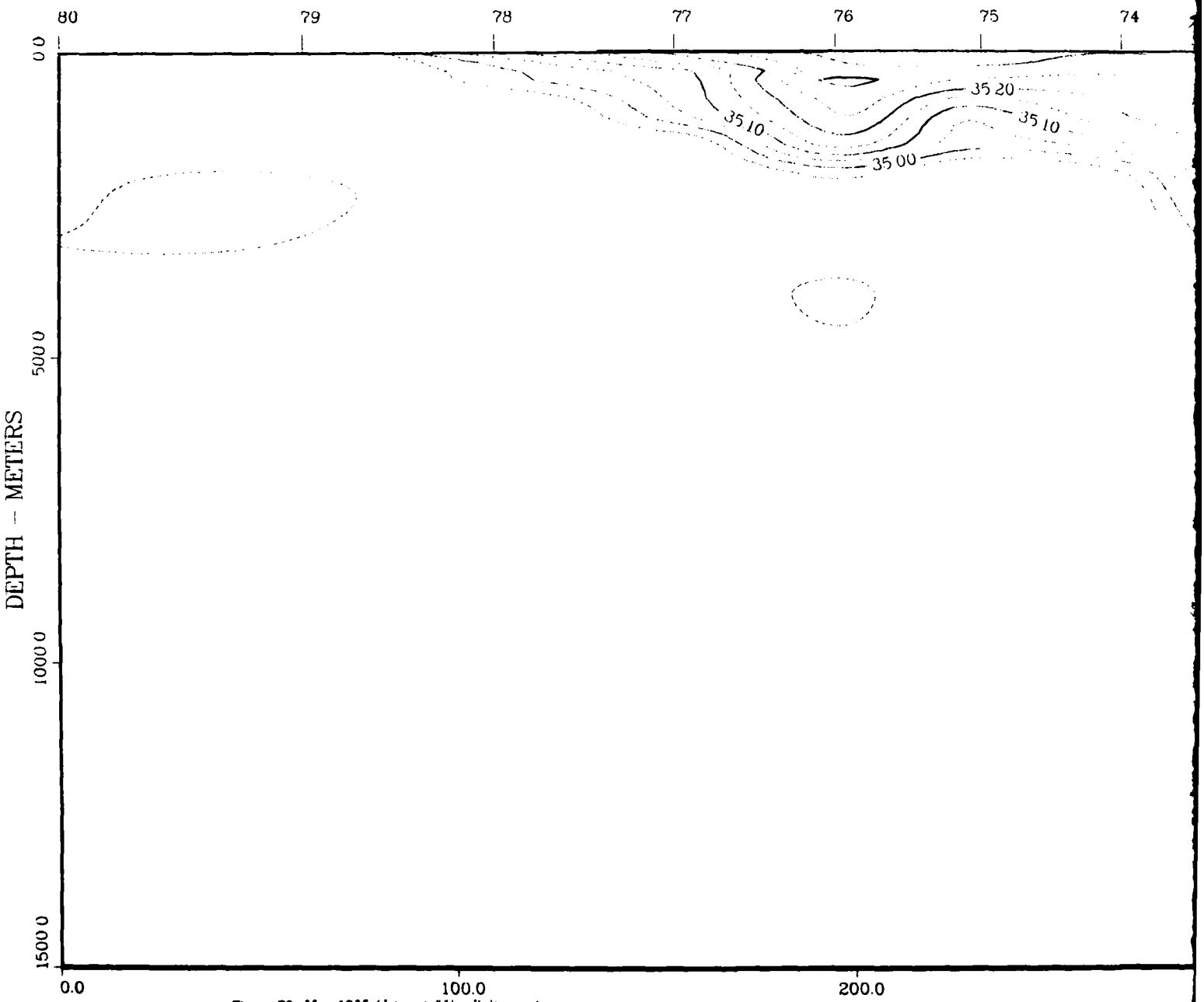
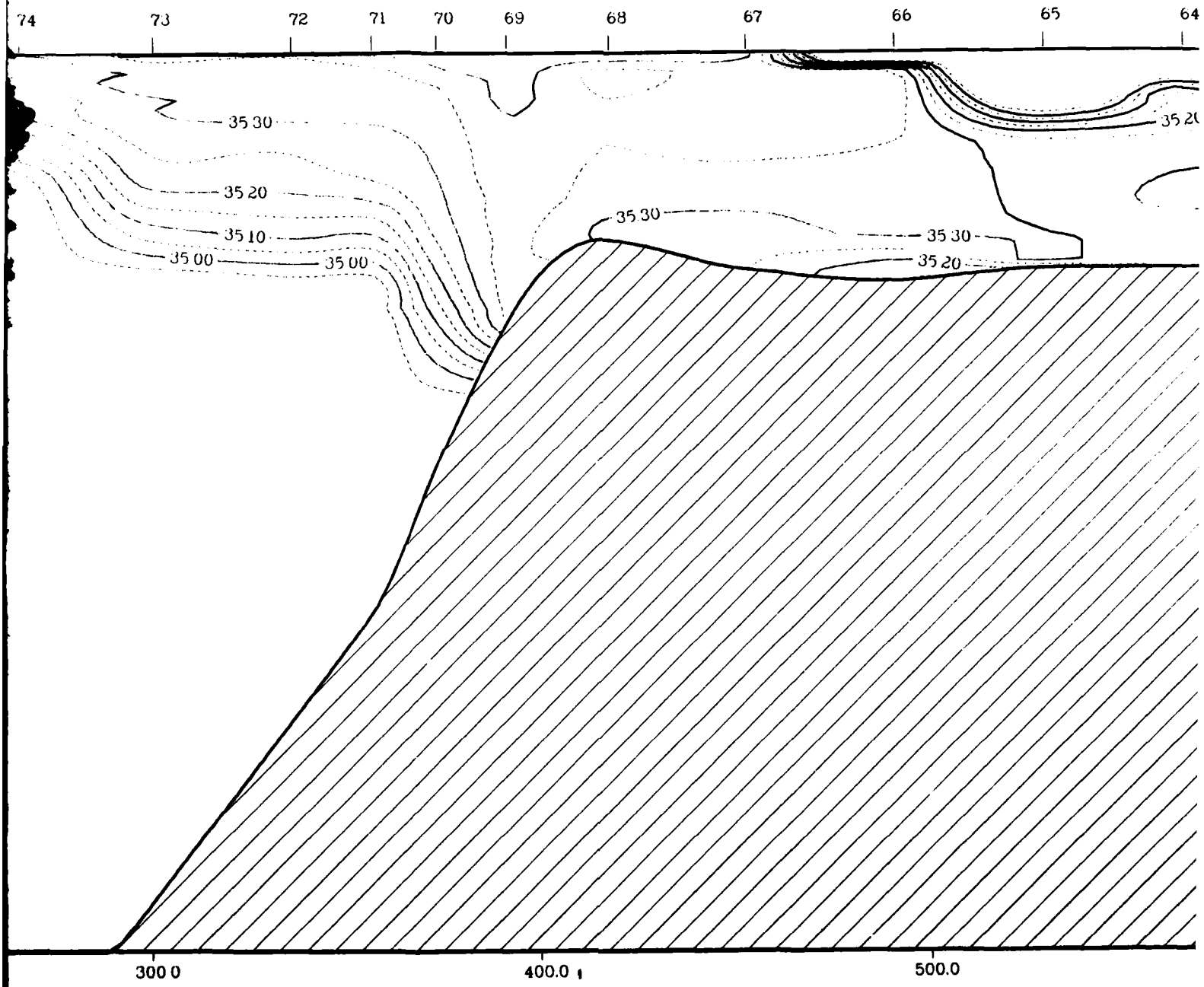


Figure 72. May 1935 (data set #1) salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 193501 DAT:1
SALINITY



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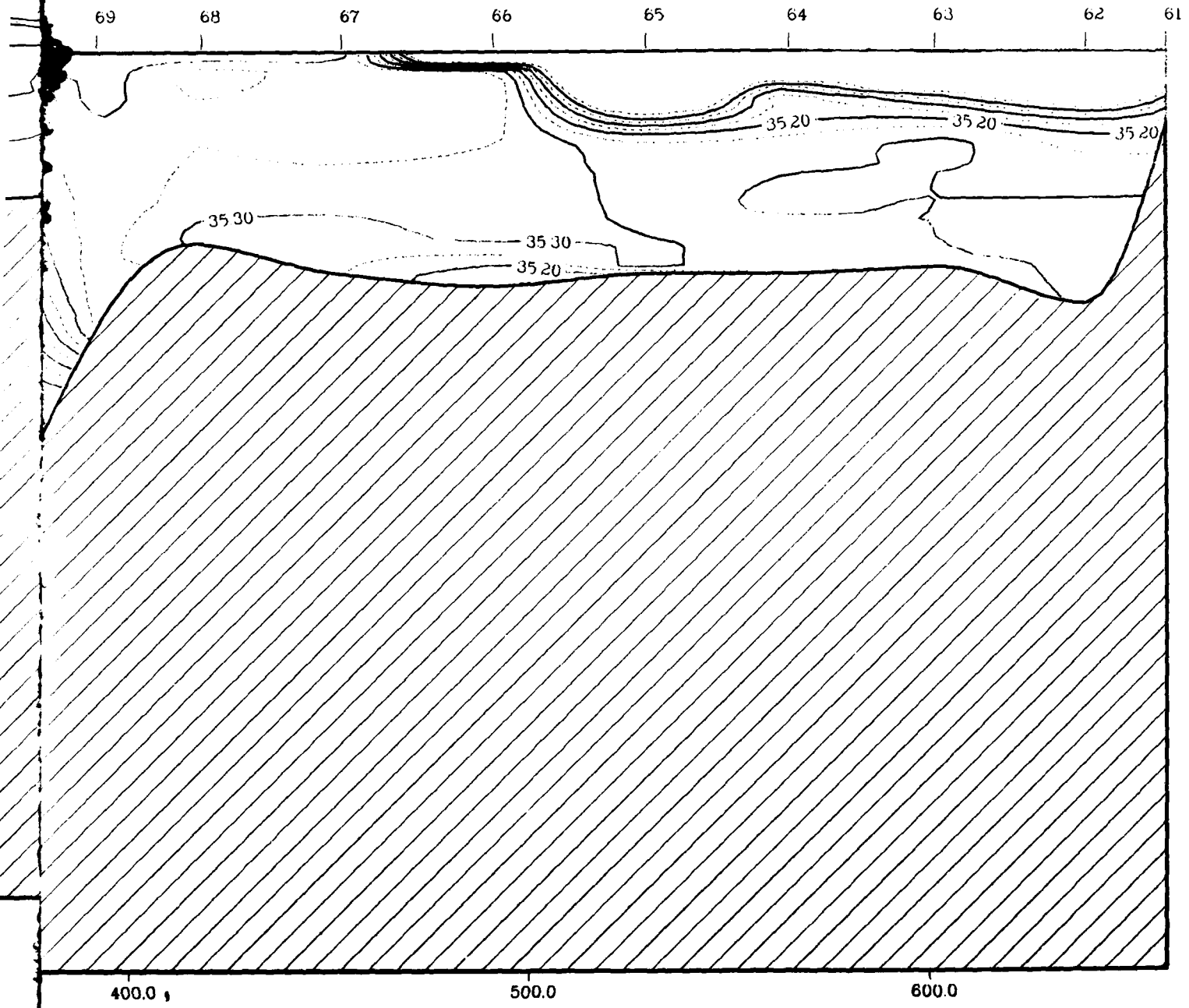
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600.0

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3

ICES$:1935R3.DAT

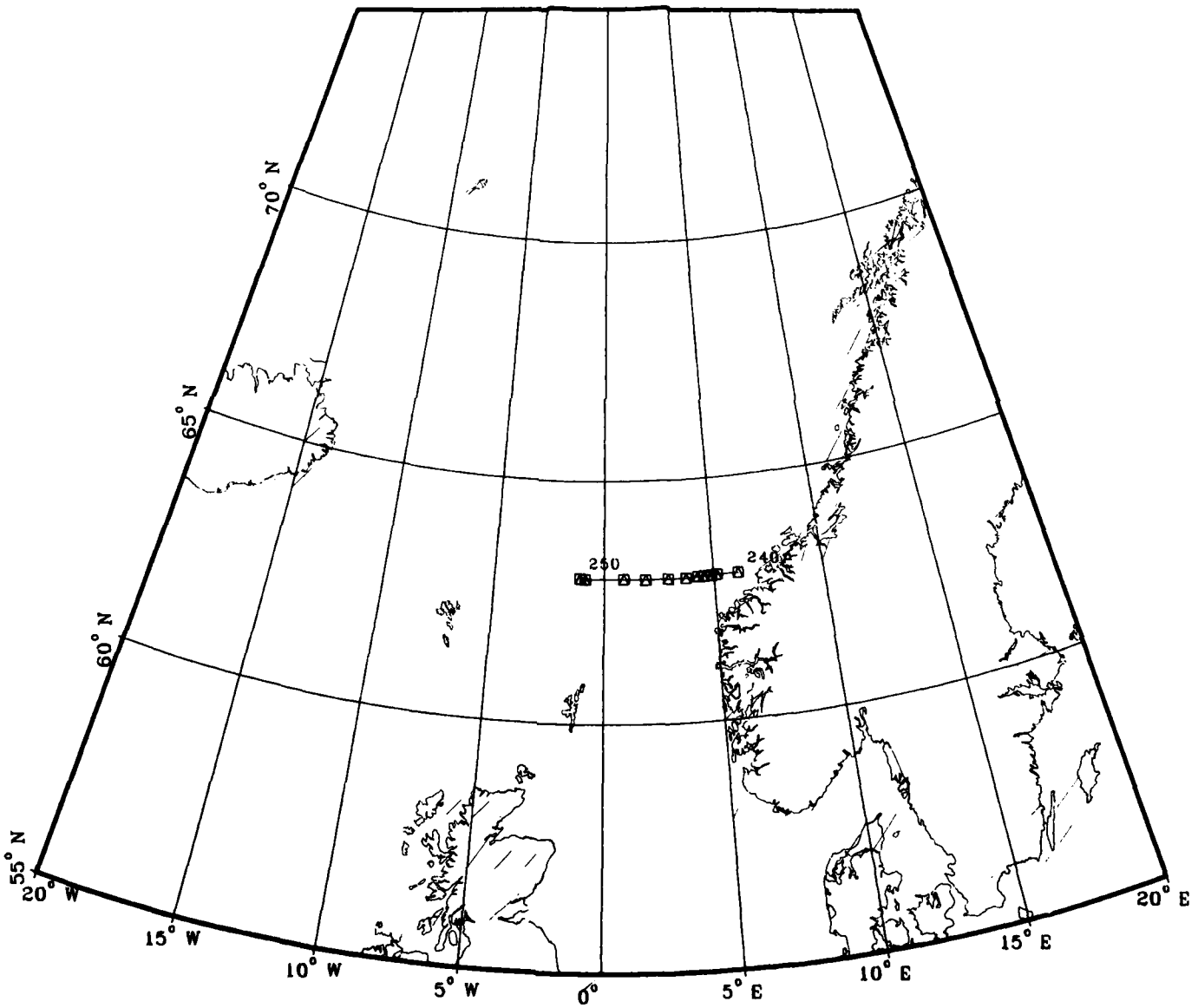


Figure 73. July 1935 (data set #3) station positions.

SOGNEFJORD SECTION
FILE = ICES$:1935R3.DAT
T/S PLOT

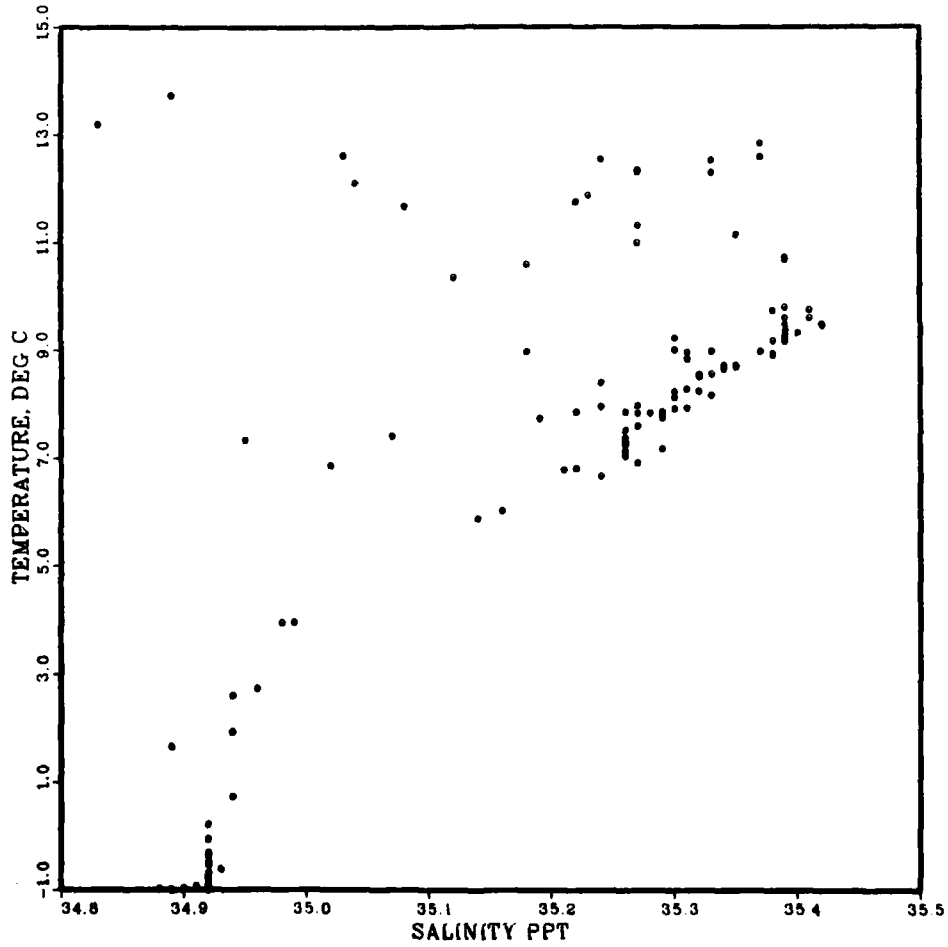


Figure 74. July 1935 (data set #3) temperature/salinity diagram.

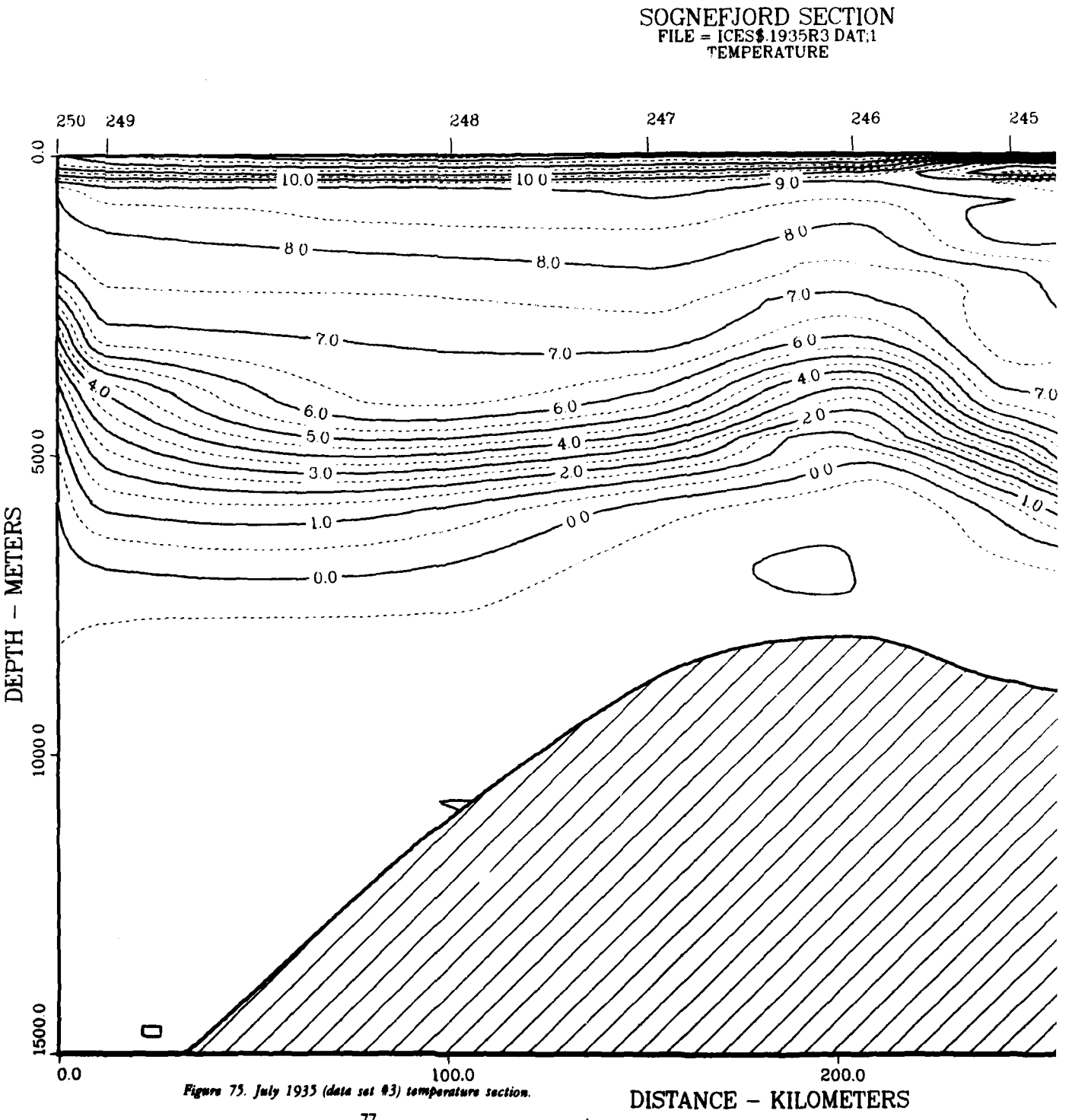
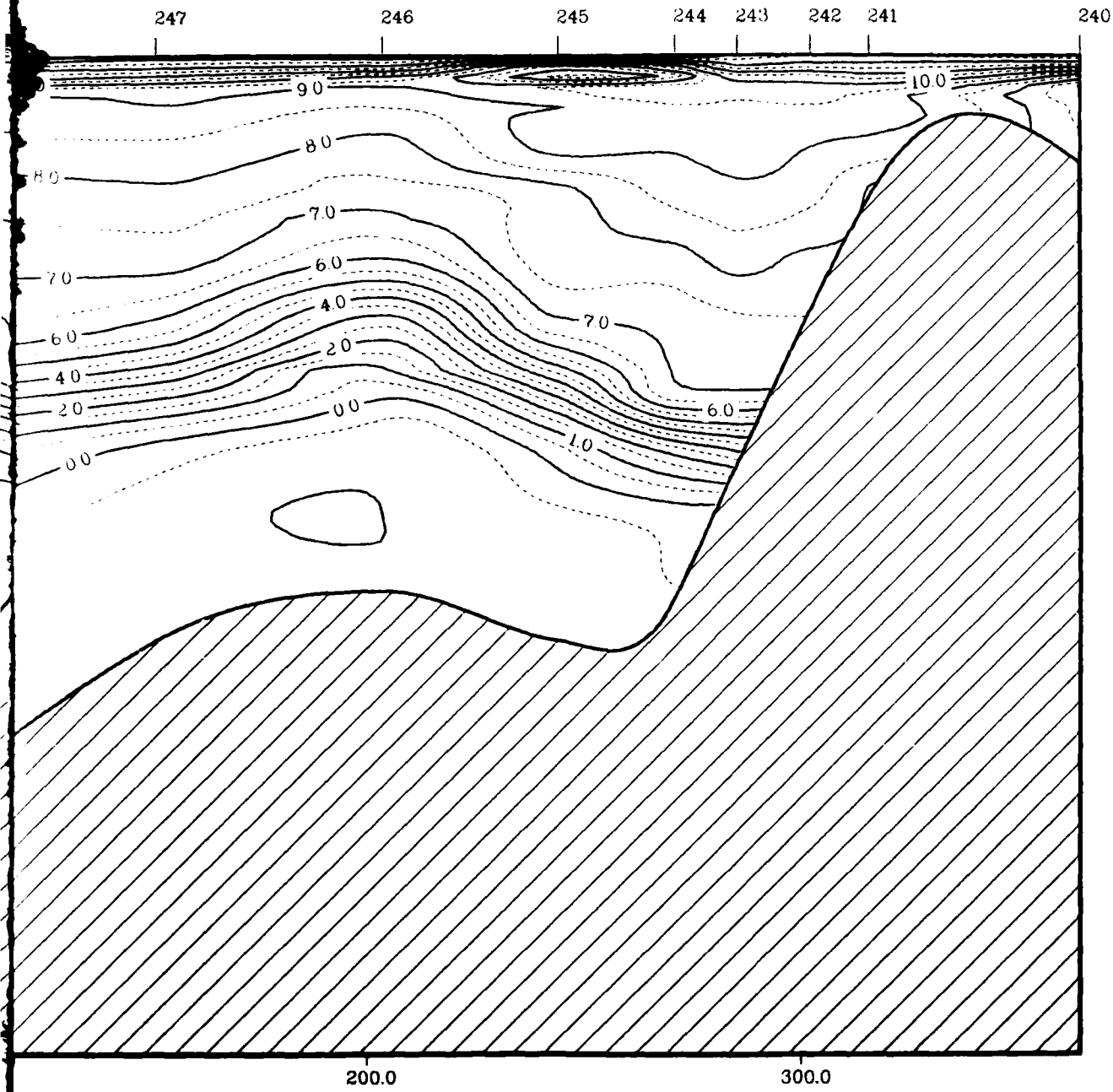


Figure 75. July 1935 (data set #3) temperature section.

SOGNEFJORD SECTION
FILE = ICES$.1935R3 DAT;1
TEMPERATURE



DISTANCE – KILOMETERS

1

2

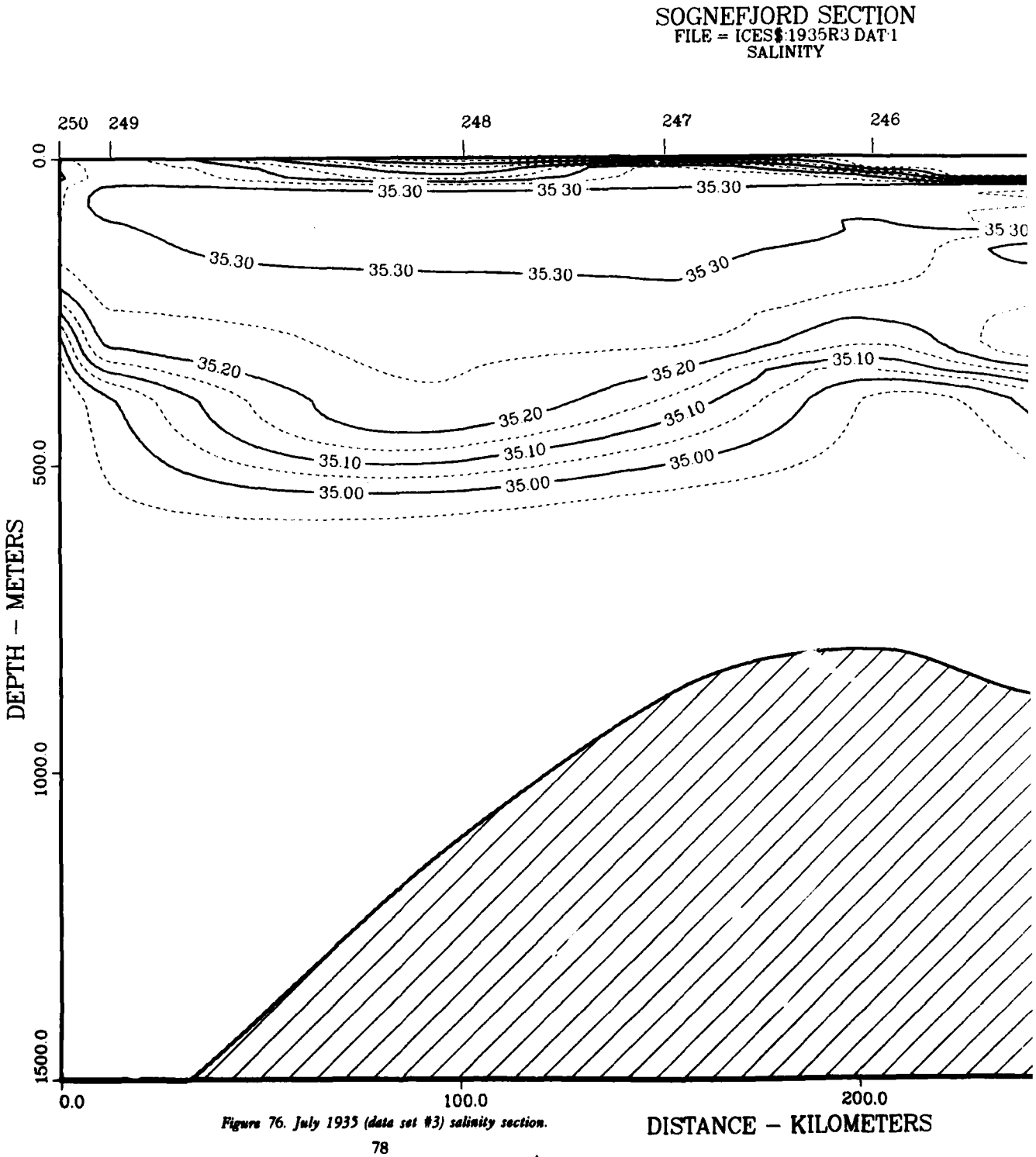
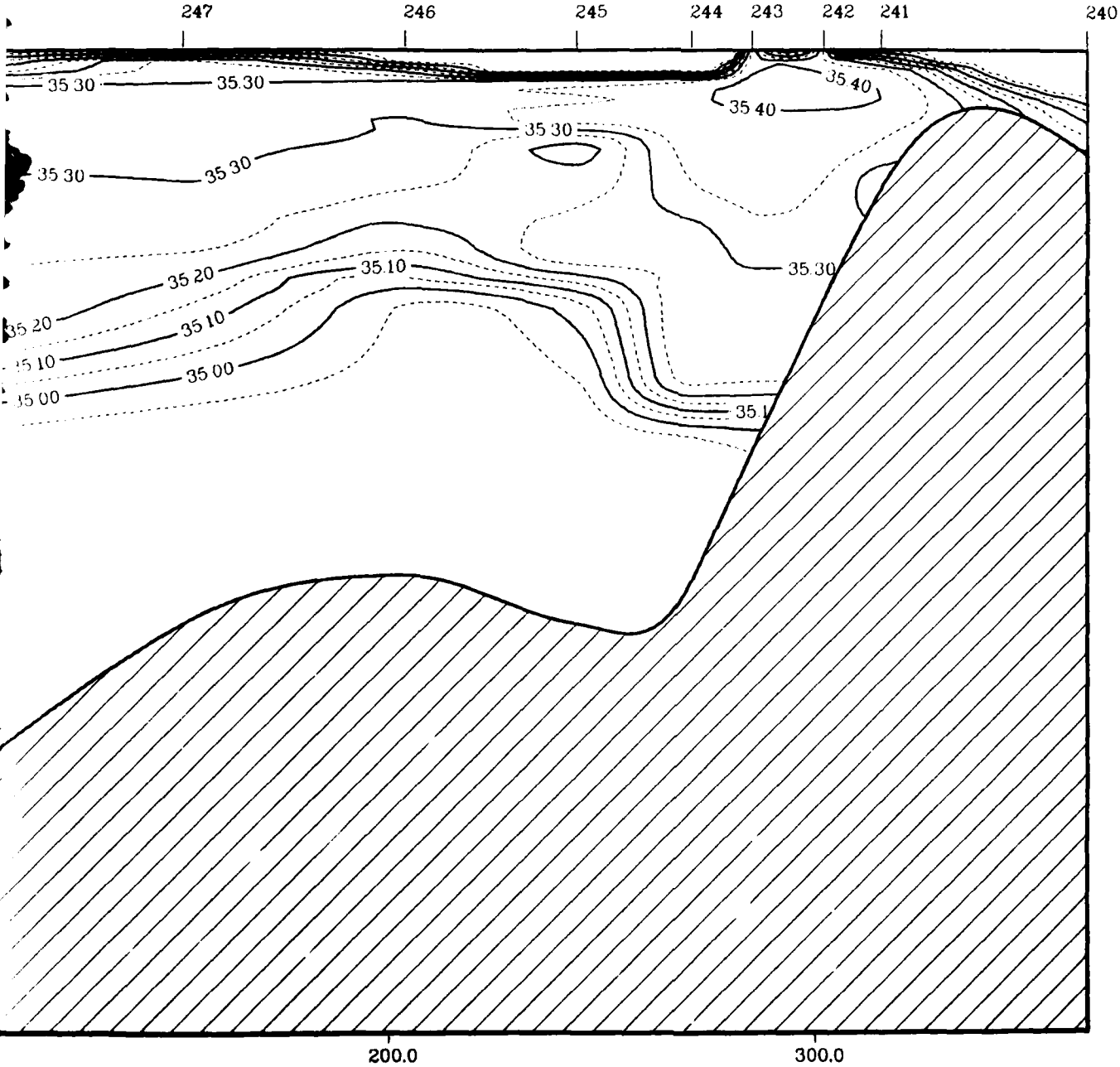


Figure 76. July 1935 (data set #3) salinity section.

SOGNEFJORD SECTION
FILE = ICES$1935R3 DAT 1
SALINITY



section.

DISTANCE – KILOMETERS

ICES$:1935S4.DAT

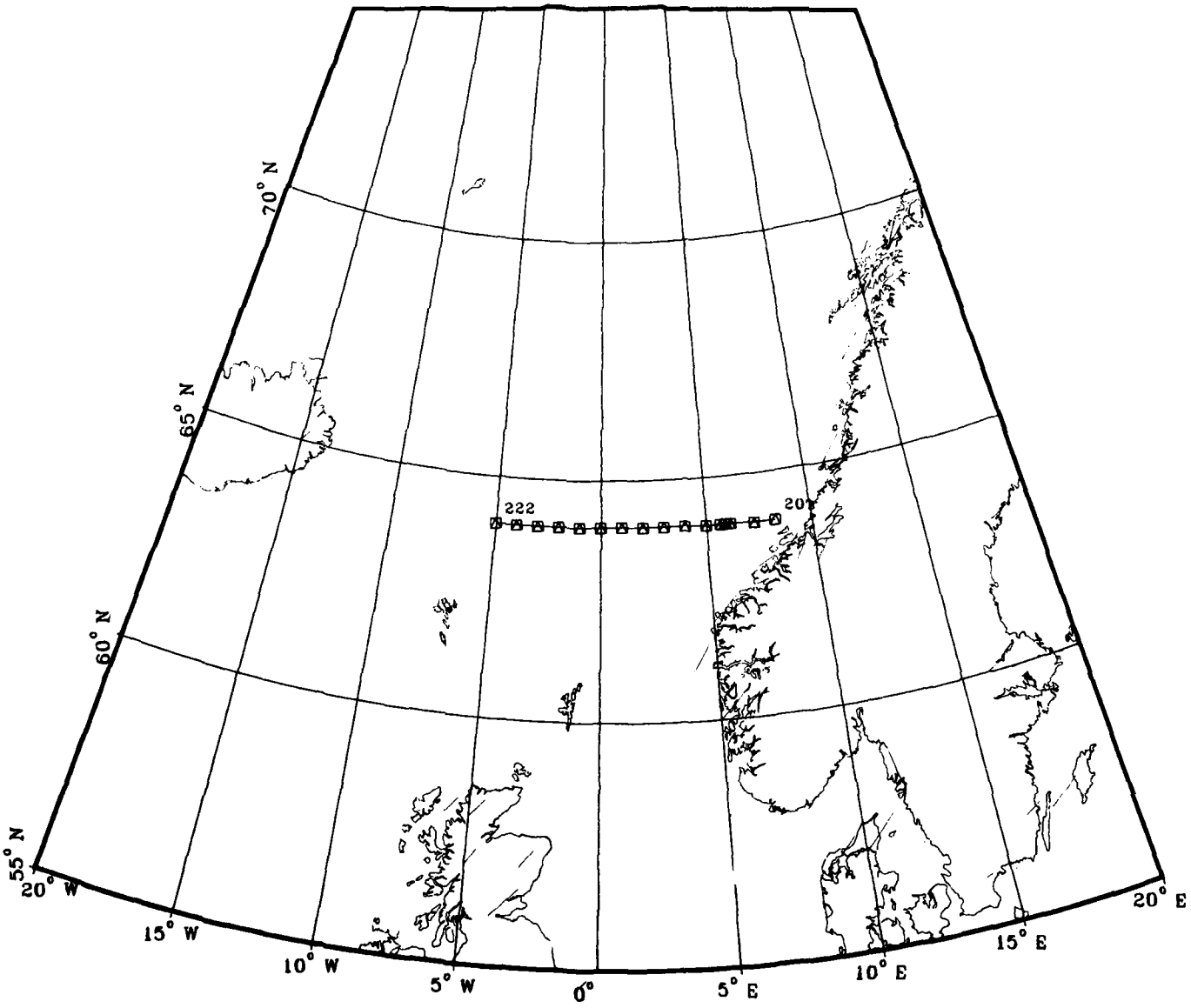


Figure 77. July 1935 (data set #4) station positions.

SOGNEFJORD SECTION
FILE = ICES$:1935S4.DAT
T/S PLOT

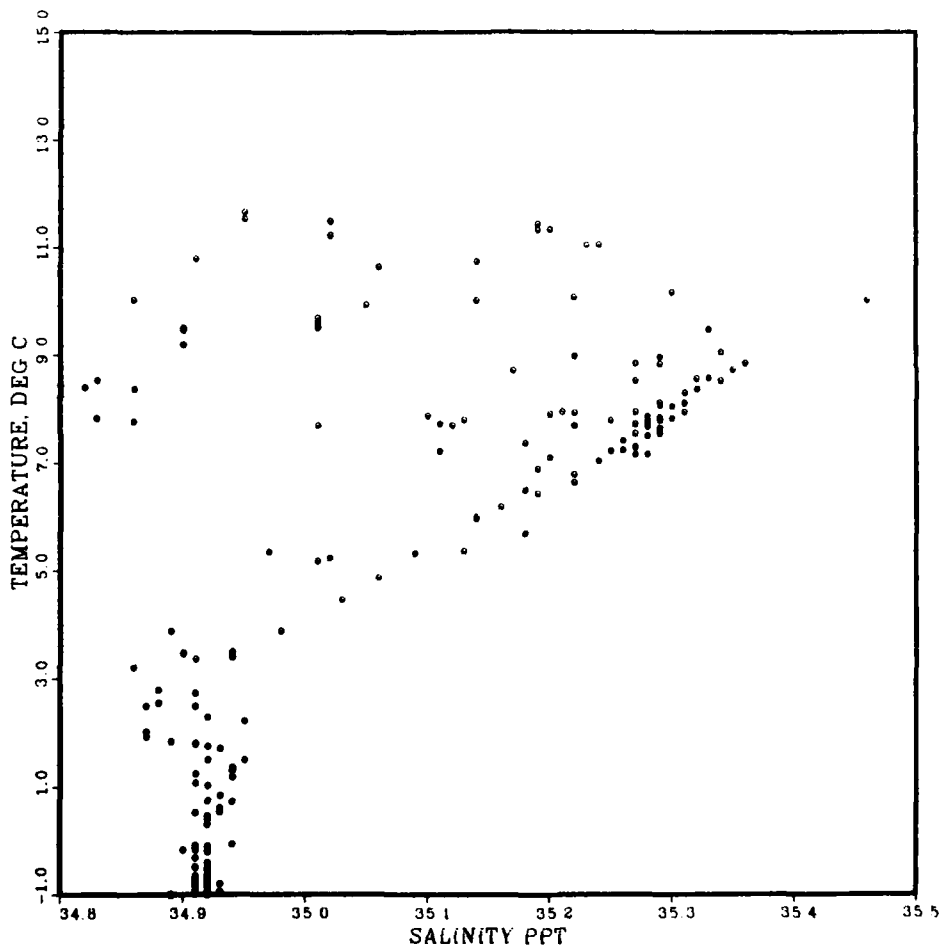


Figure 78. July 1935 (data set #4) temperature/salinity diagram.

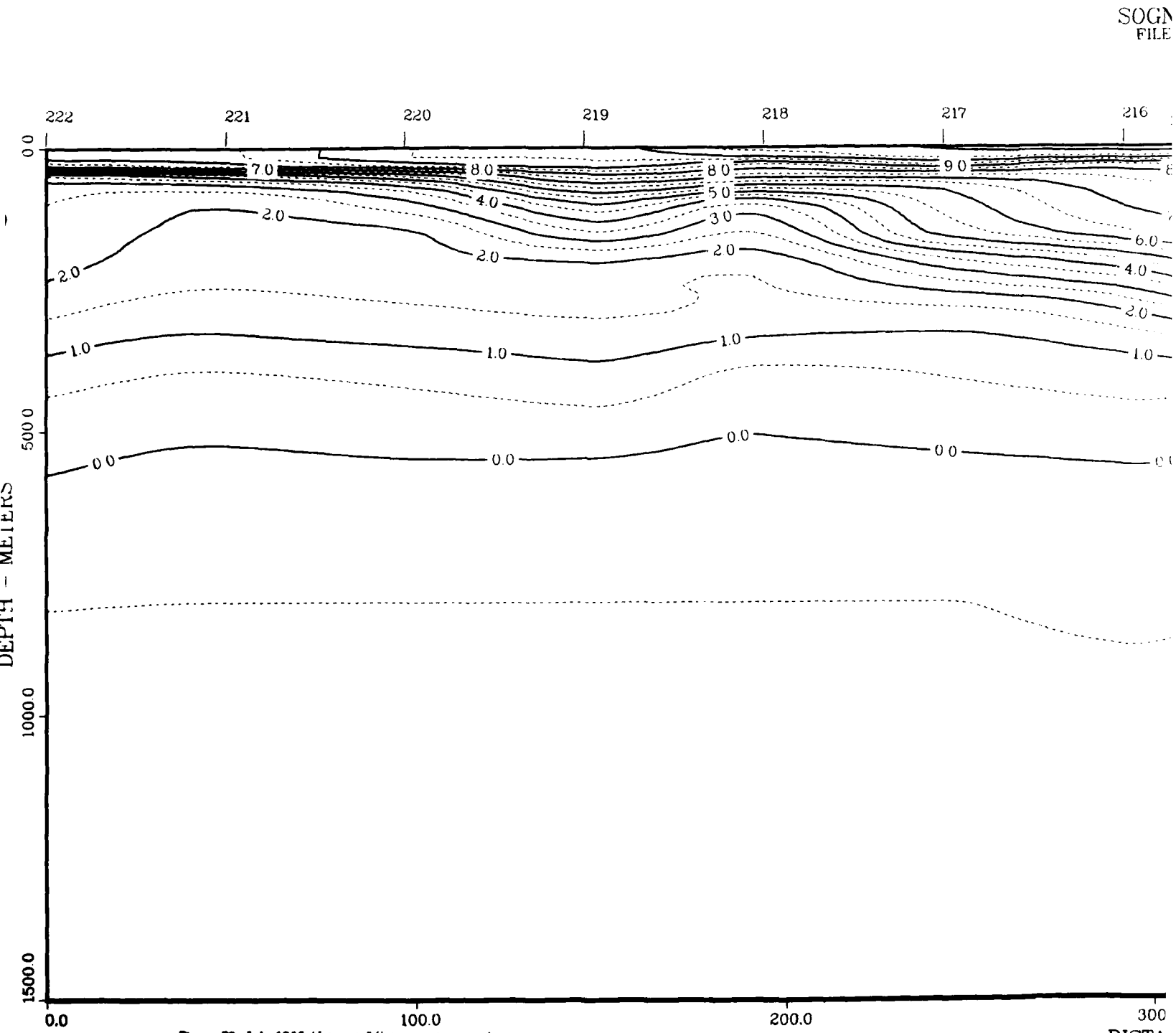
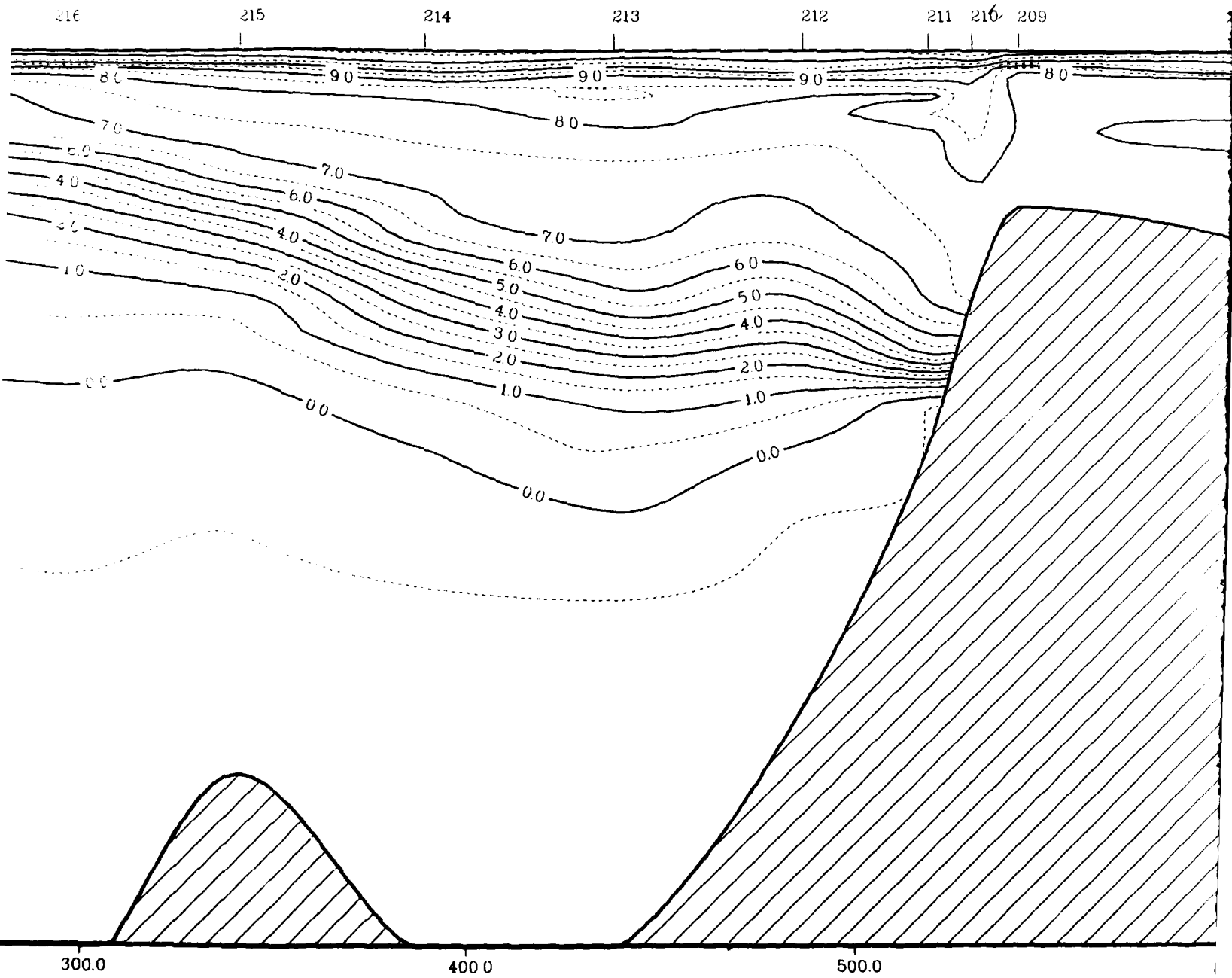
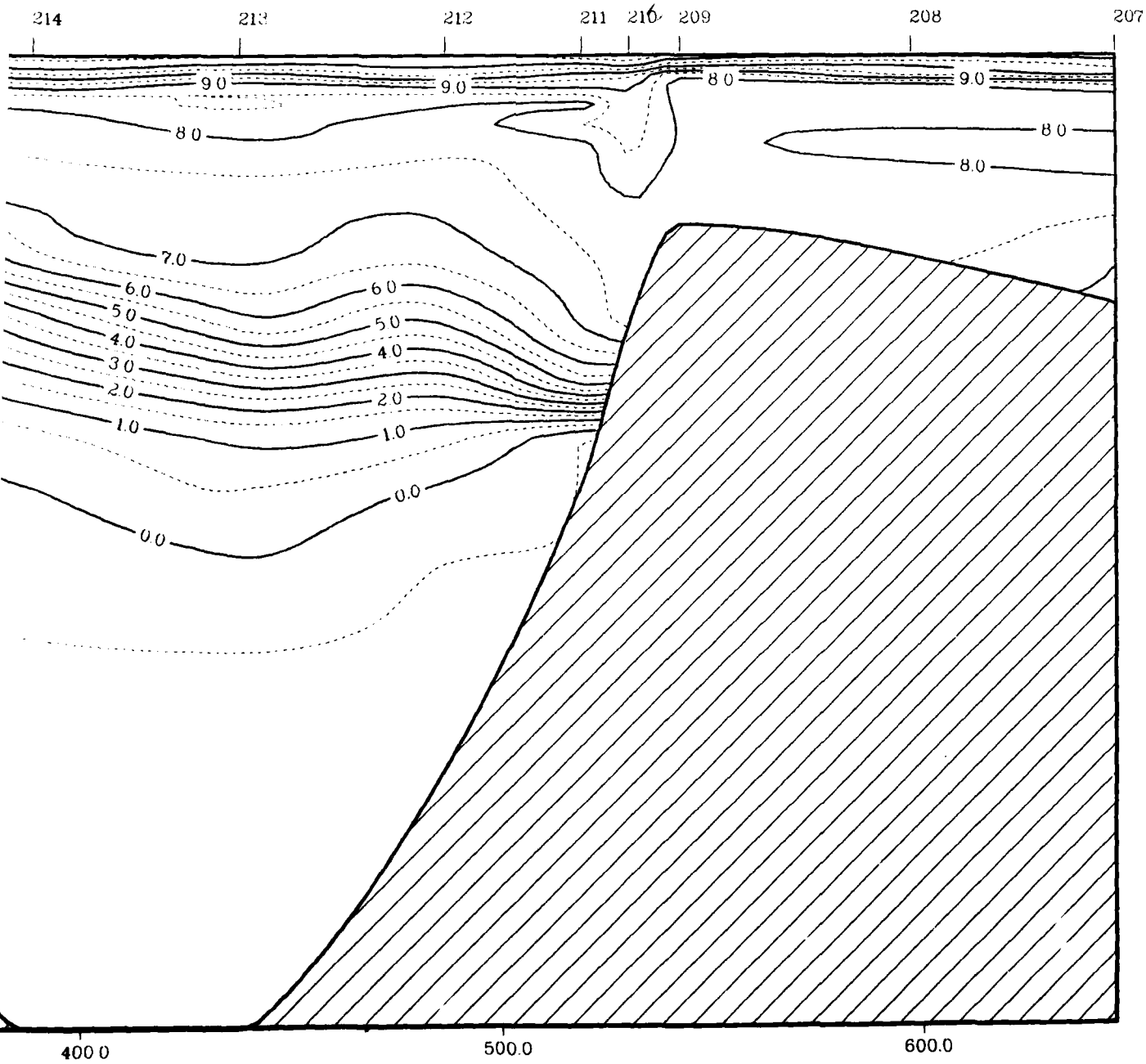


Figure 79. July 1935 (data set #4) temperature section.

SOGNEFJORD SECTION
FILE = ICES$ 1935S4 DAT;1
TEMPERATURE



2


214
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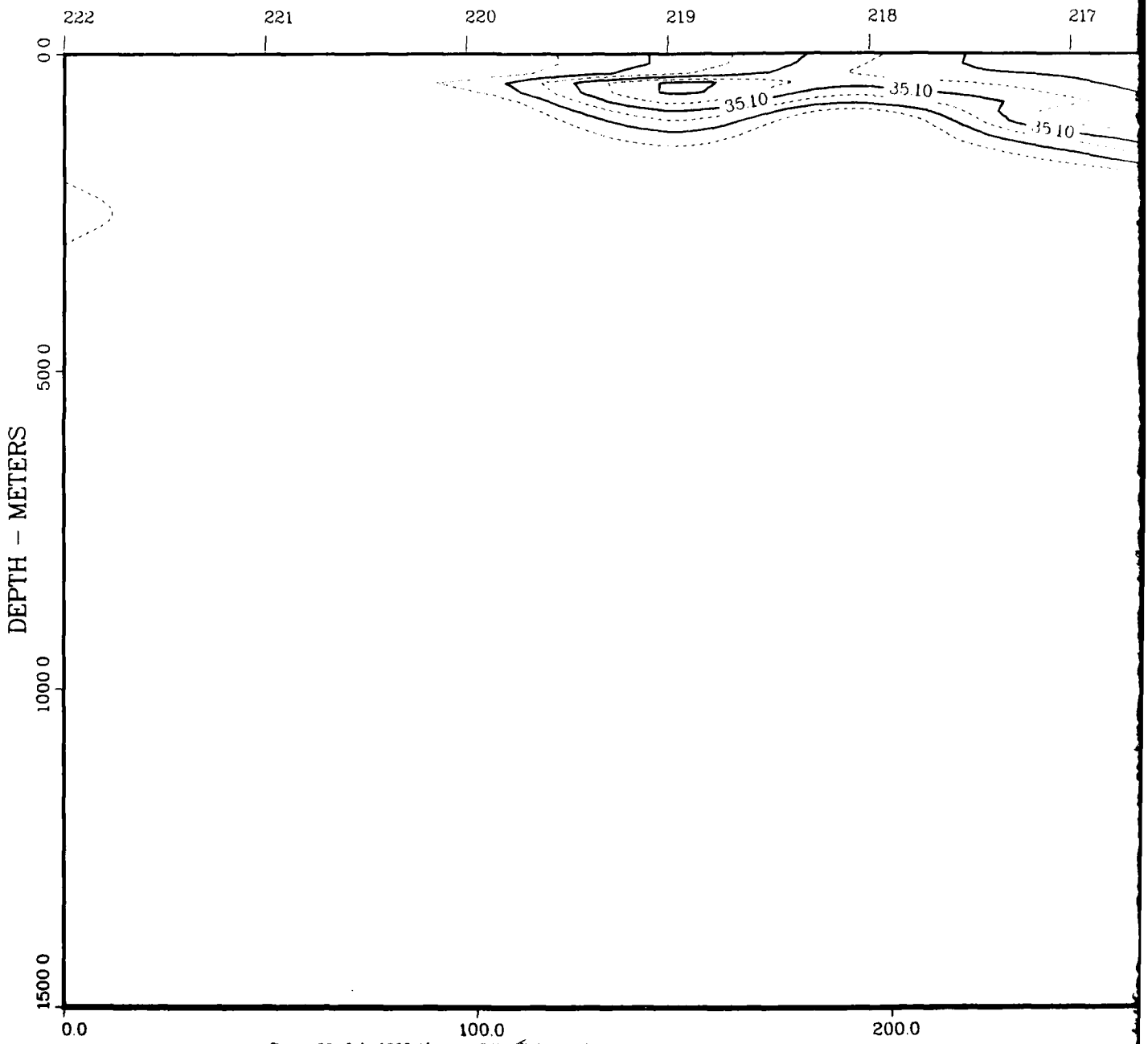
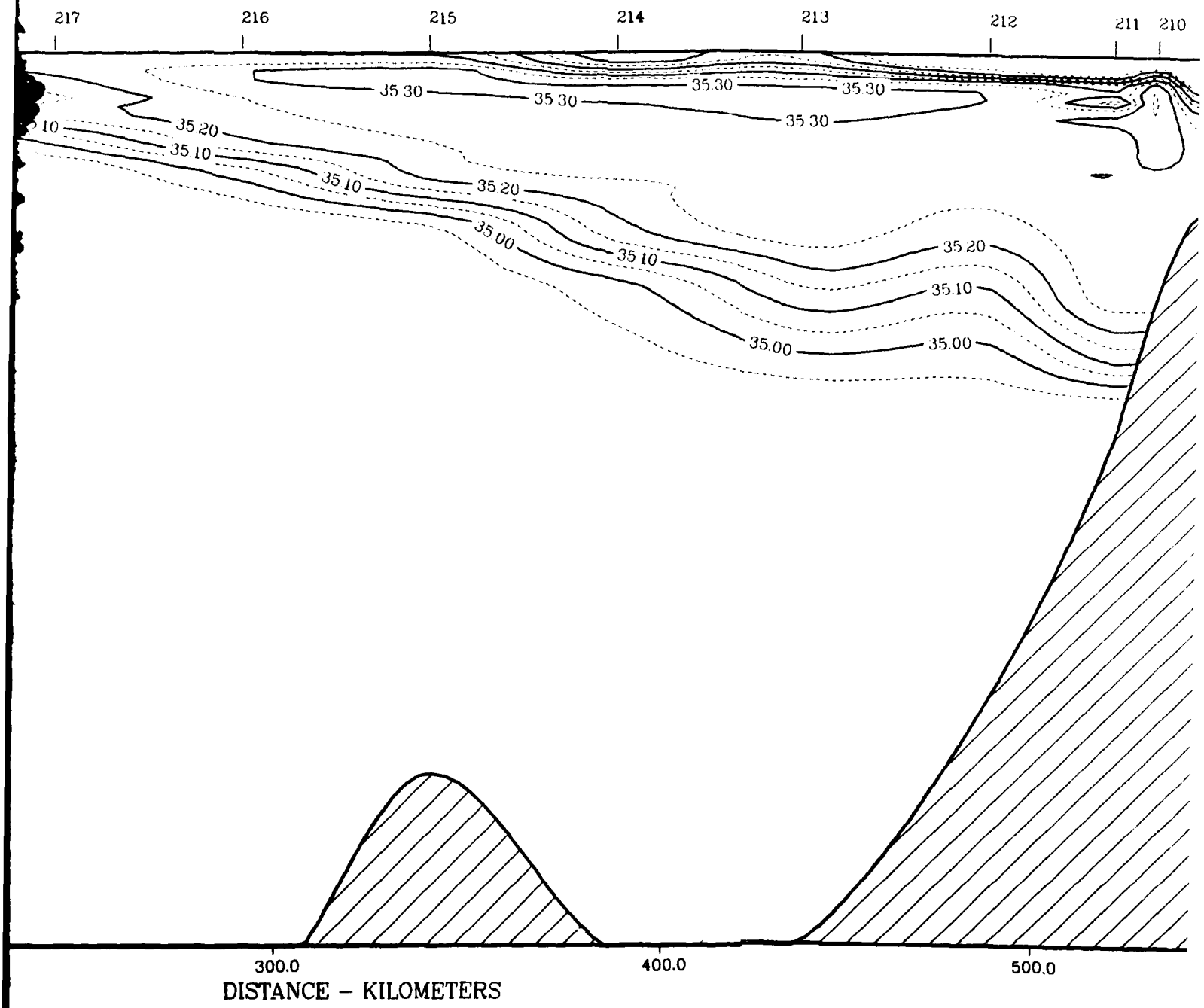
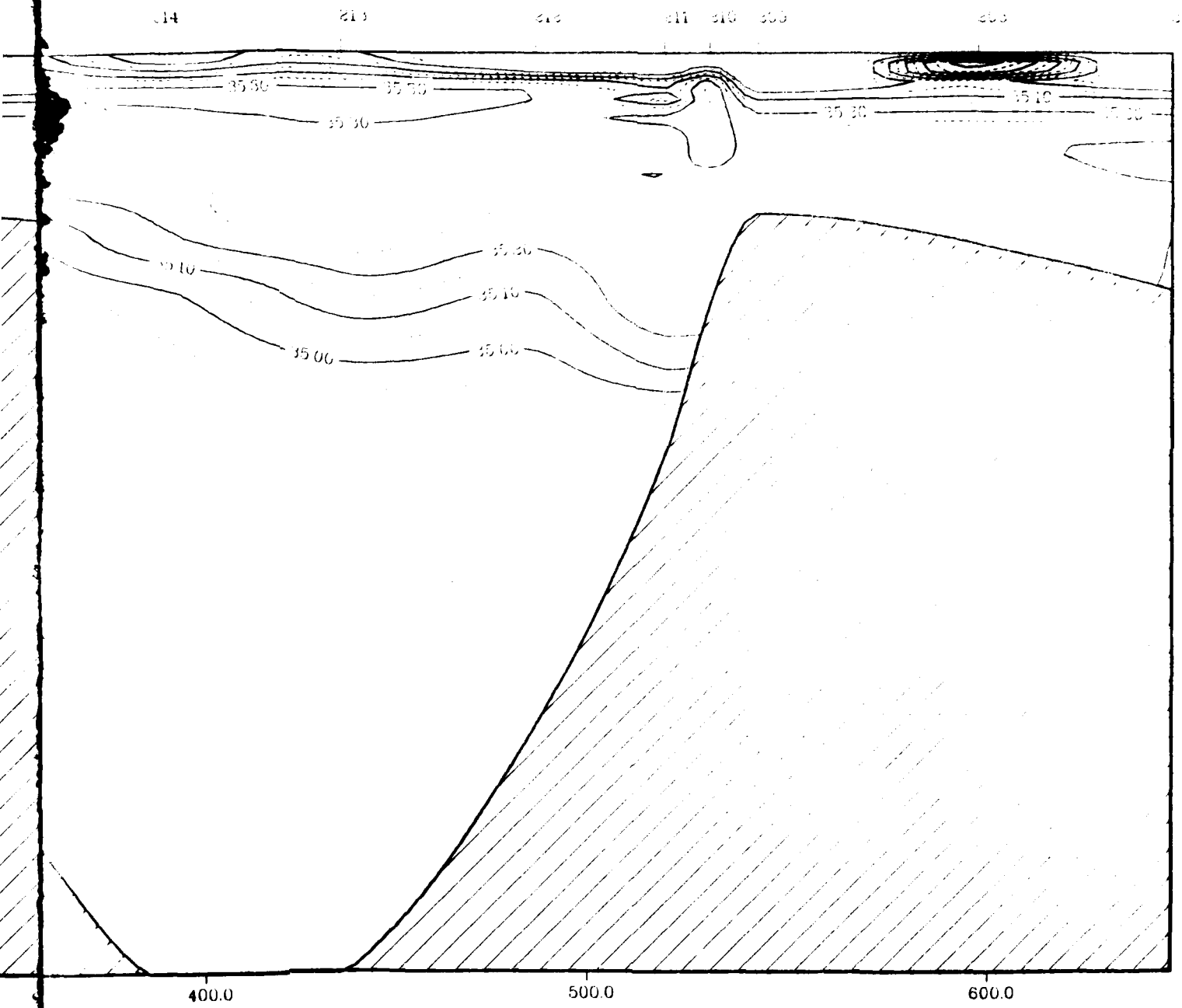


Figure 80. July 1935 (data set #4) salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1935S4.DAT-1
SALINITY

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ICES$:1935T5.DAT

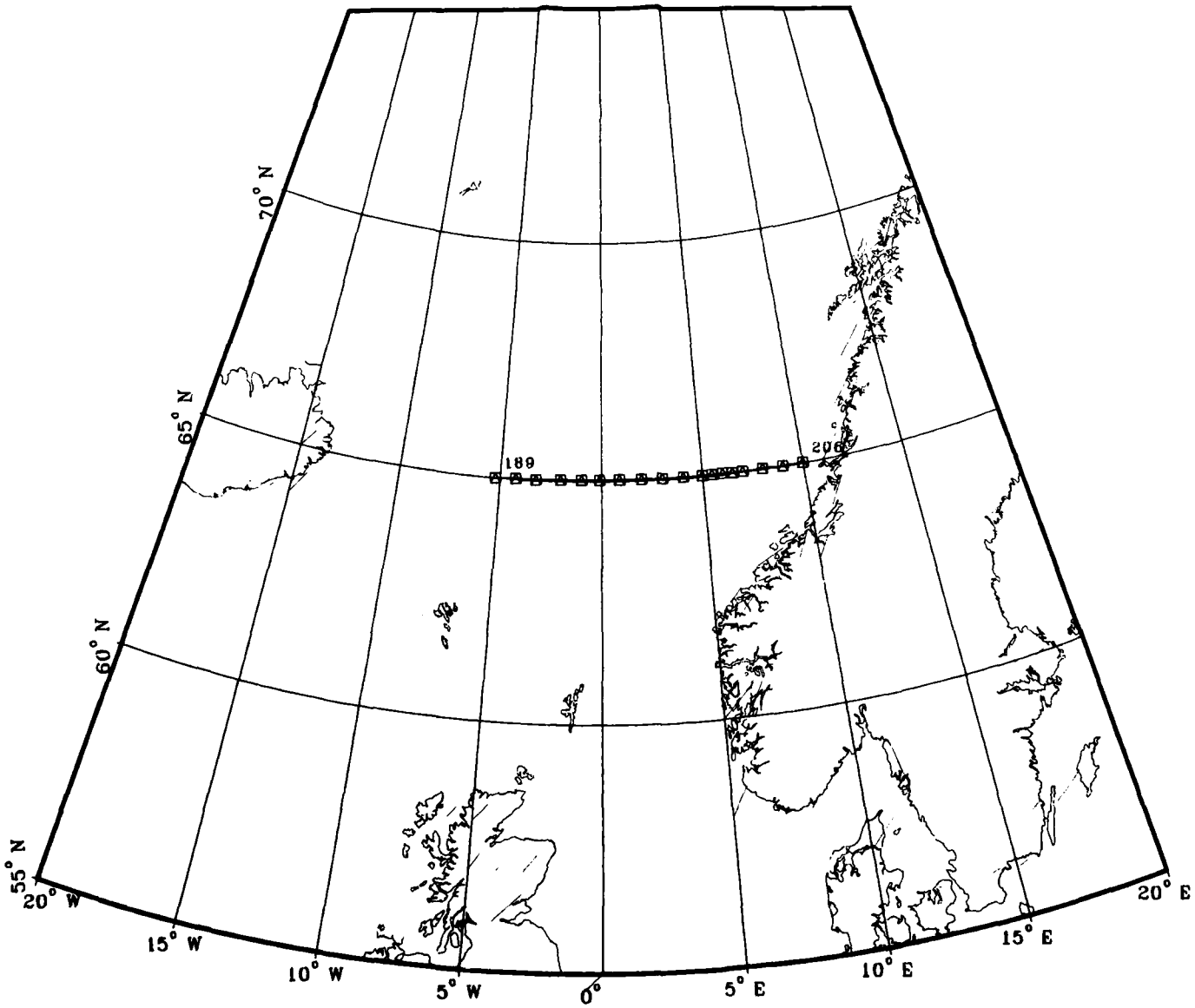


Figure 81. July 1935 (data set #5) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1935T5 DAT
T/S PLOT

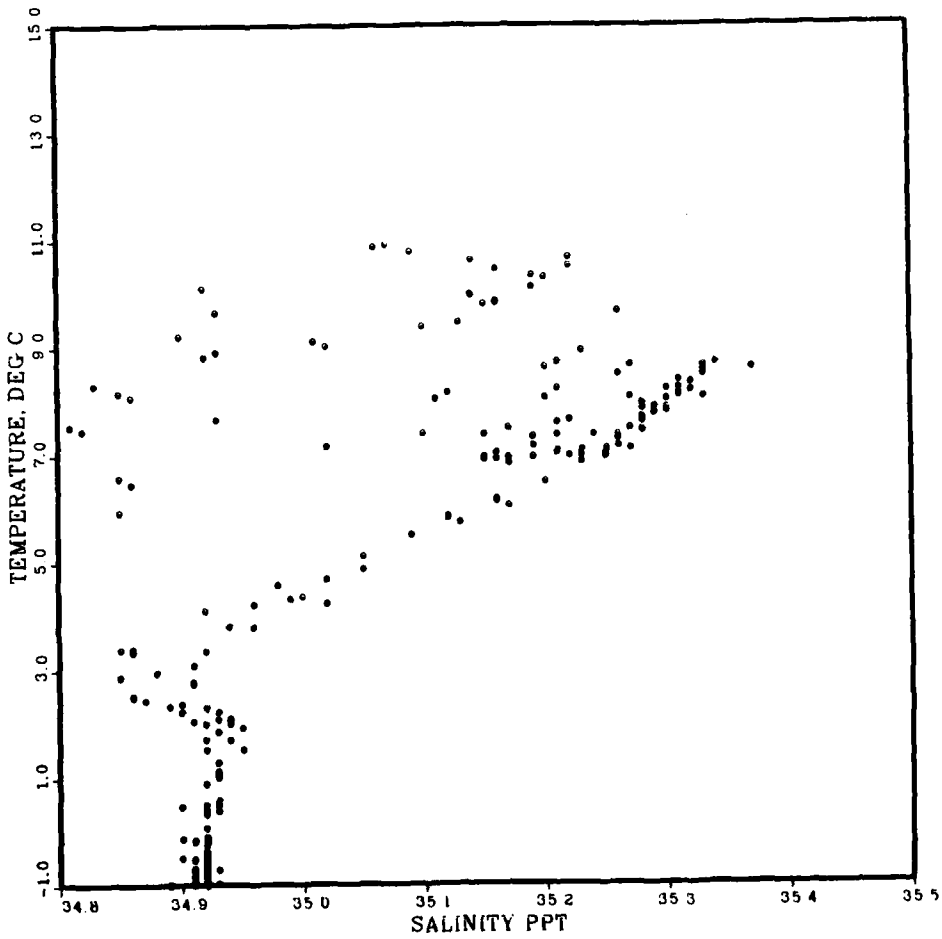


Figure 82. July 1935 (data set #5) temperature/salinity diagram.

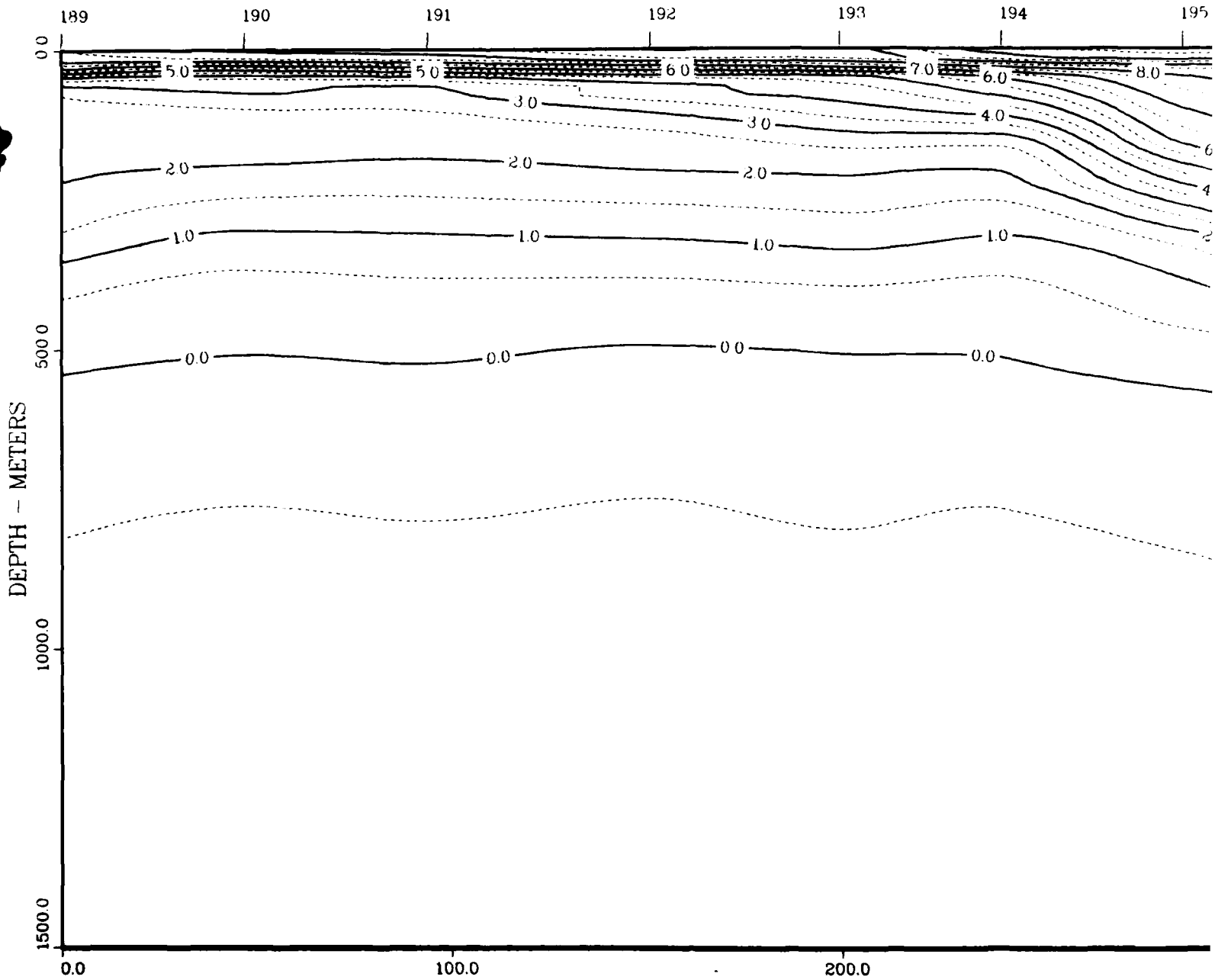
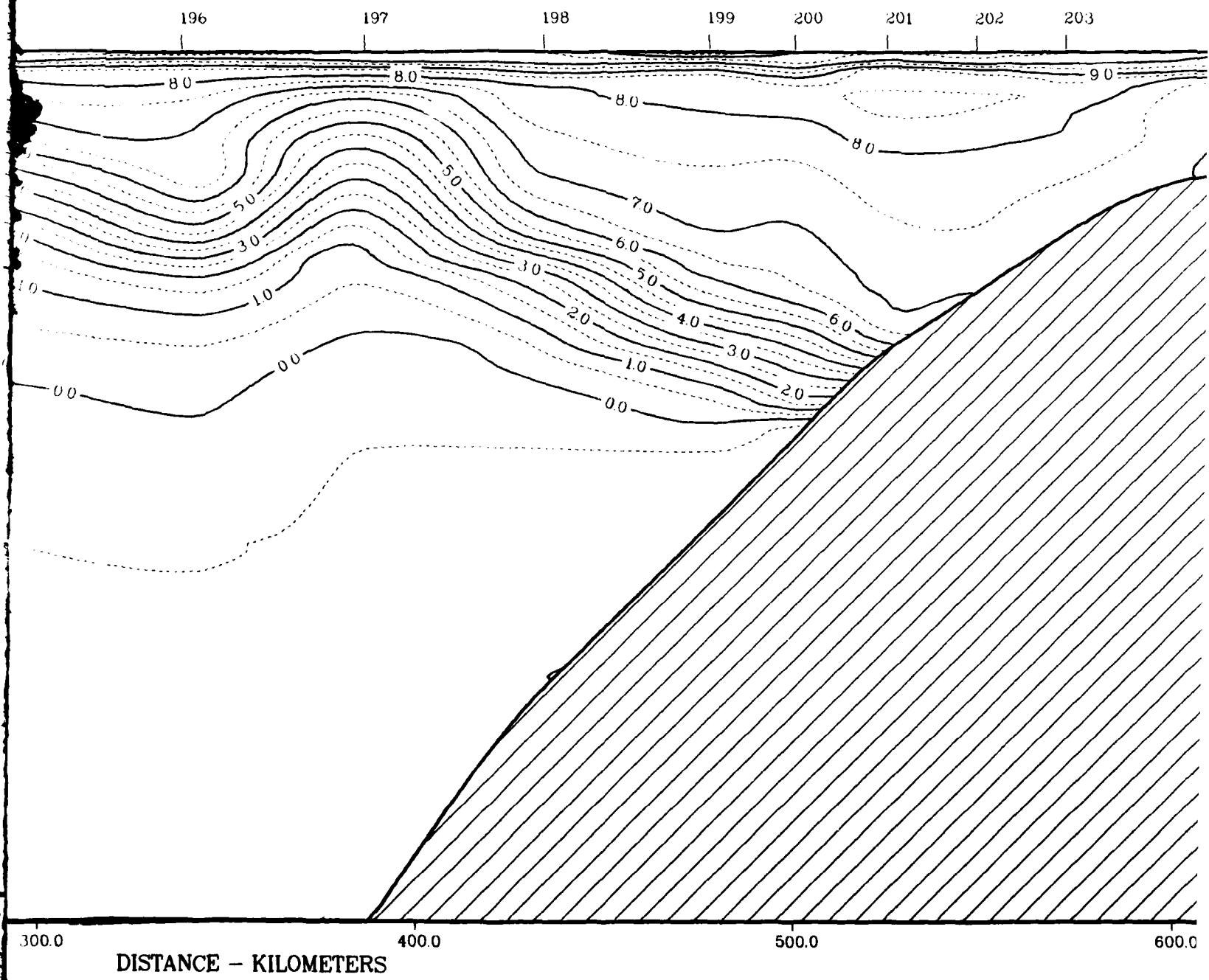


Figure 83. July 1935 (data set #5) temperature section.

SOGNEFJORD SECTION
FILE = ICES$.19.35T5 DAT.1
TEMPERATURE



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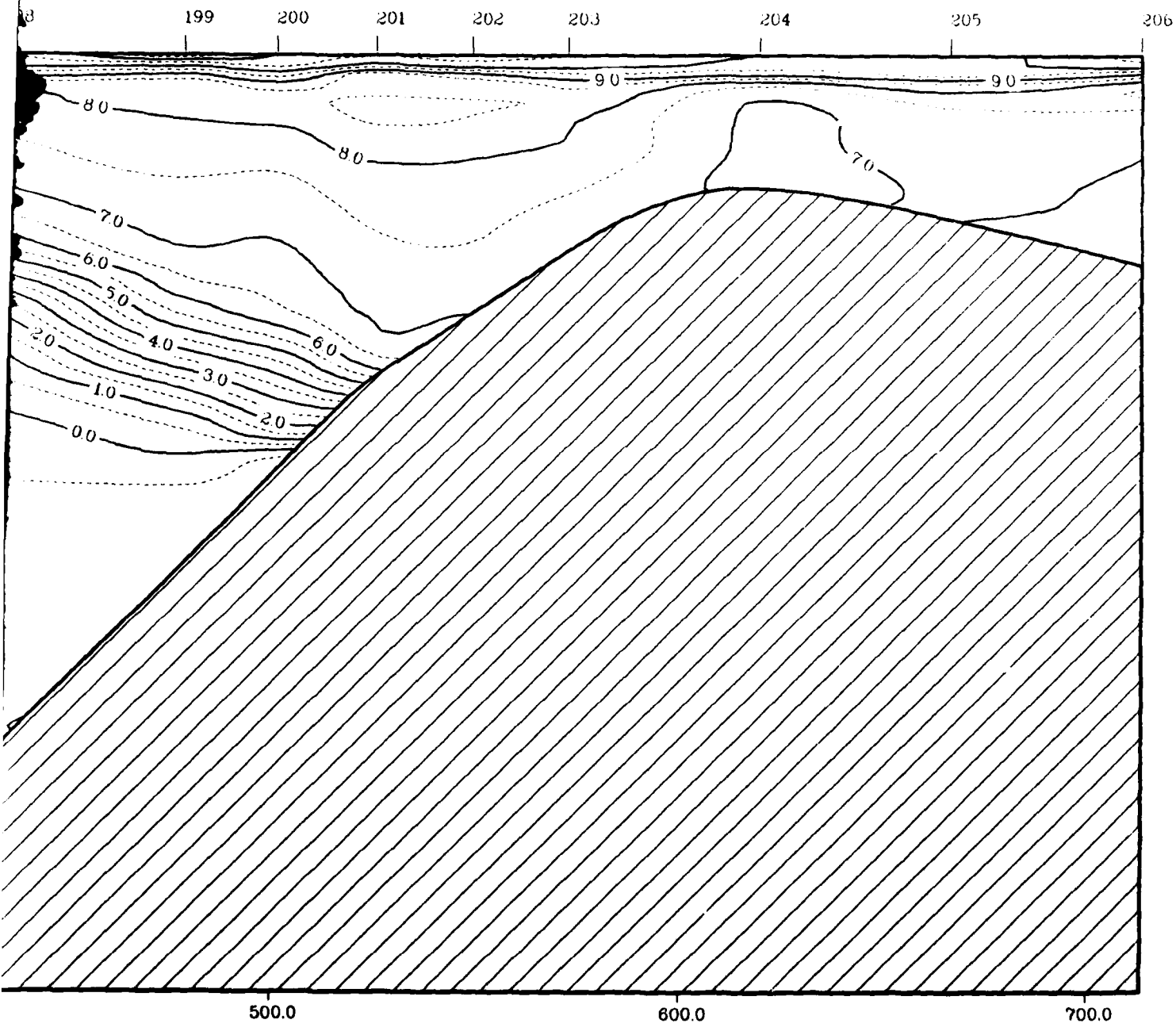
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600.0
700.0

2 1 3

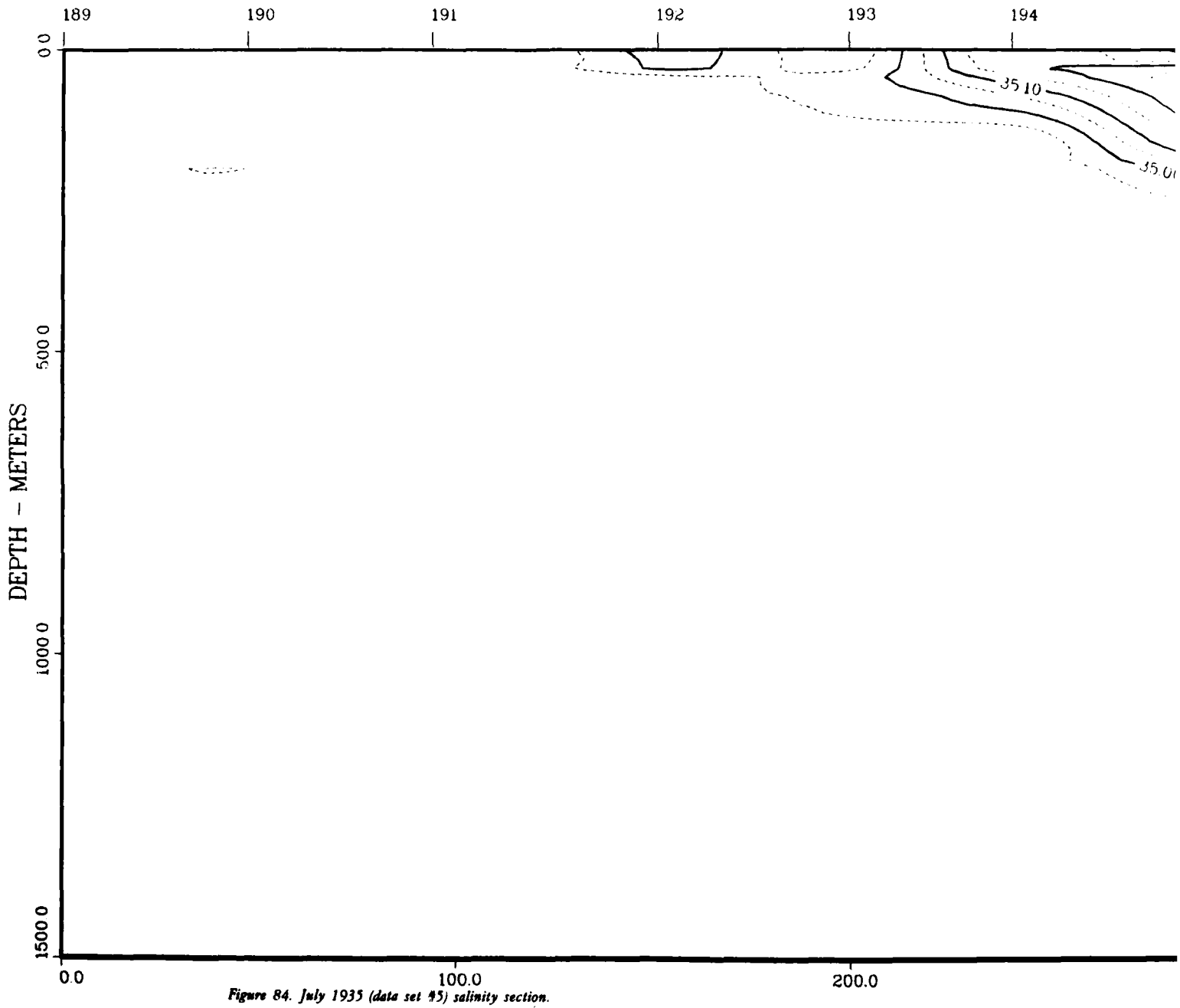
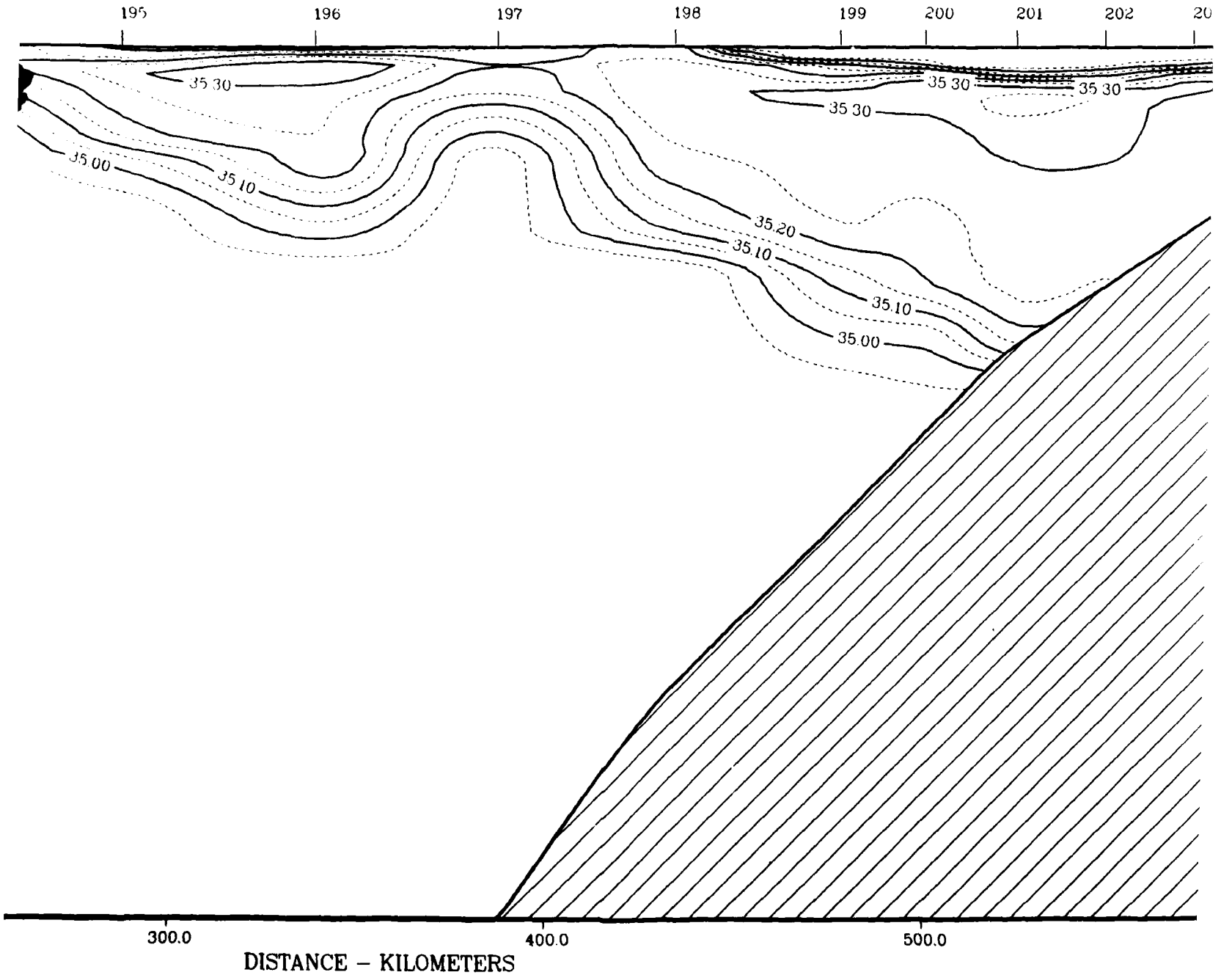


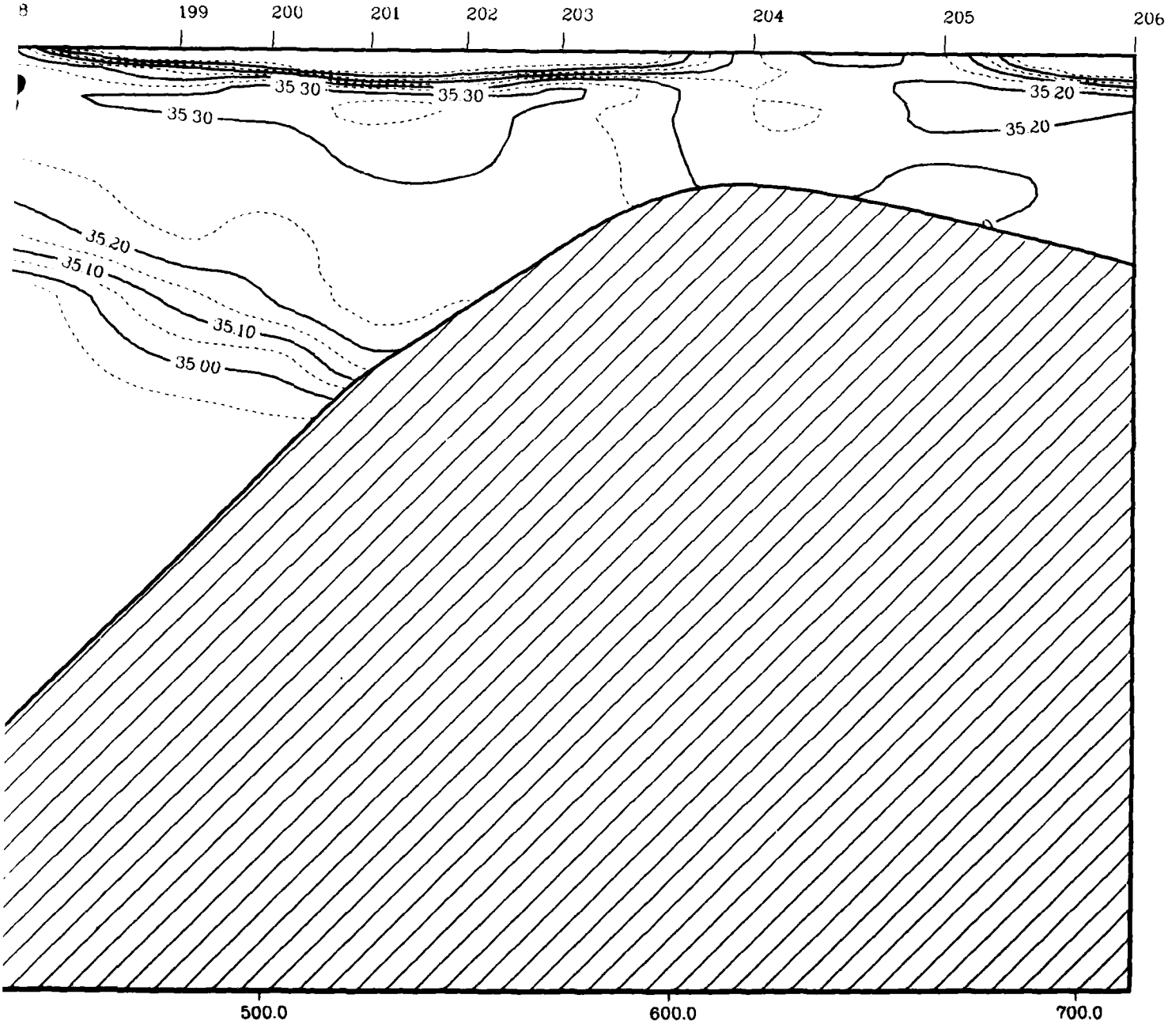
Figure 84. July 1935 (data set #5) salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1935T5.DAT;1
SALINITY



1

2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35.00
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600.0
700.0

3

ICES$:1935U6.DAT

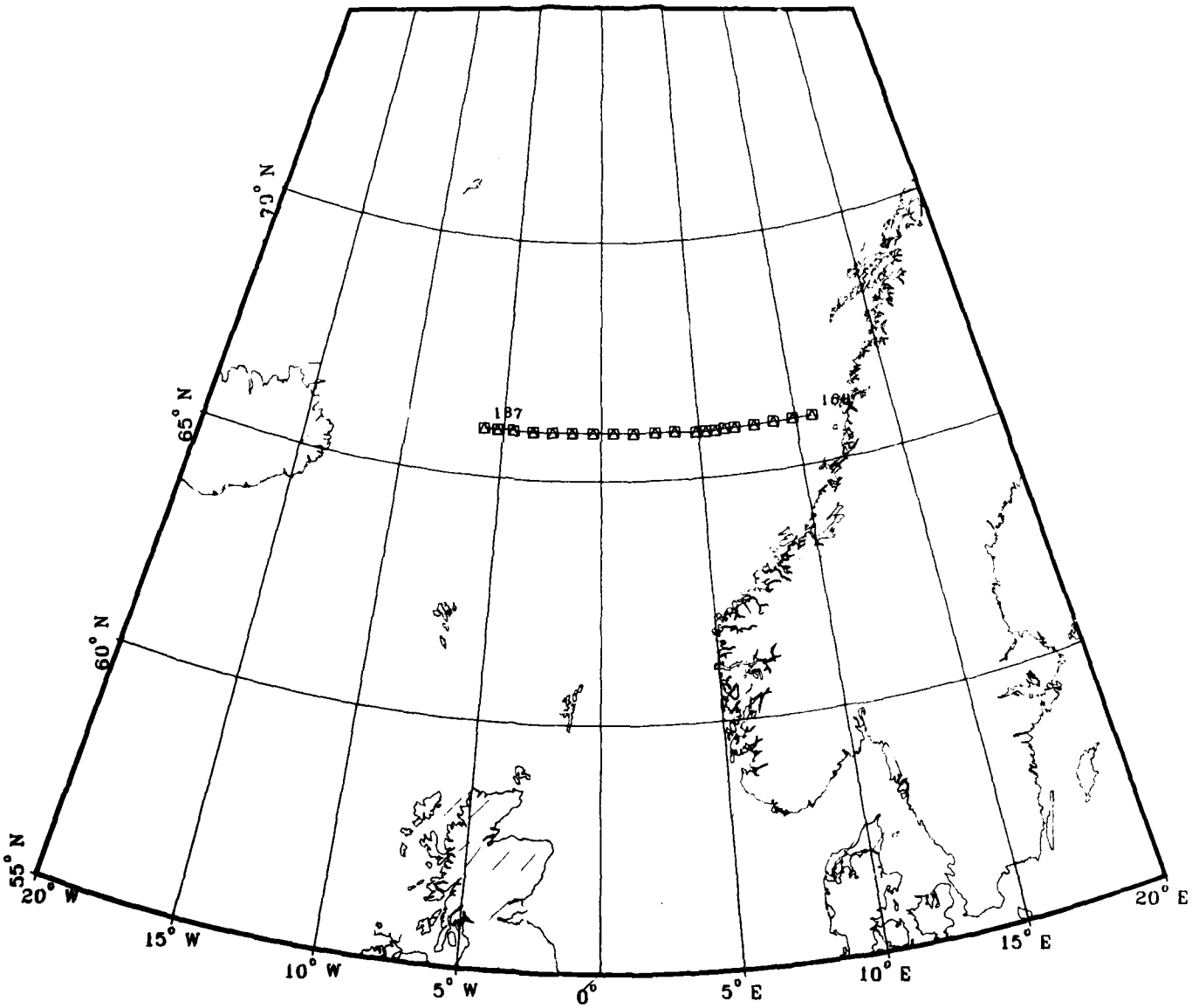


Figure 85. July 1935 (data set #6) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1935U6.DAT
T/S PLOT

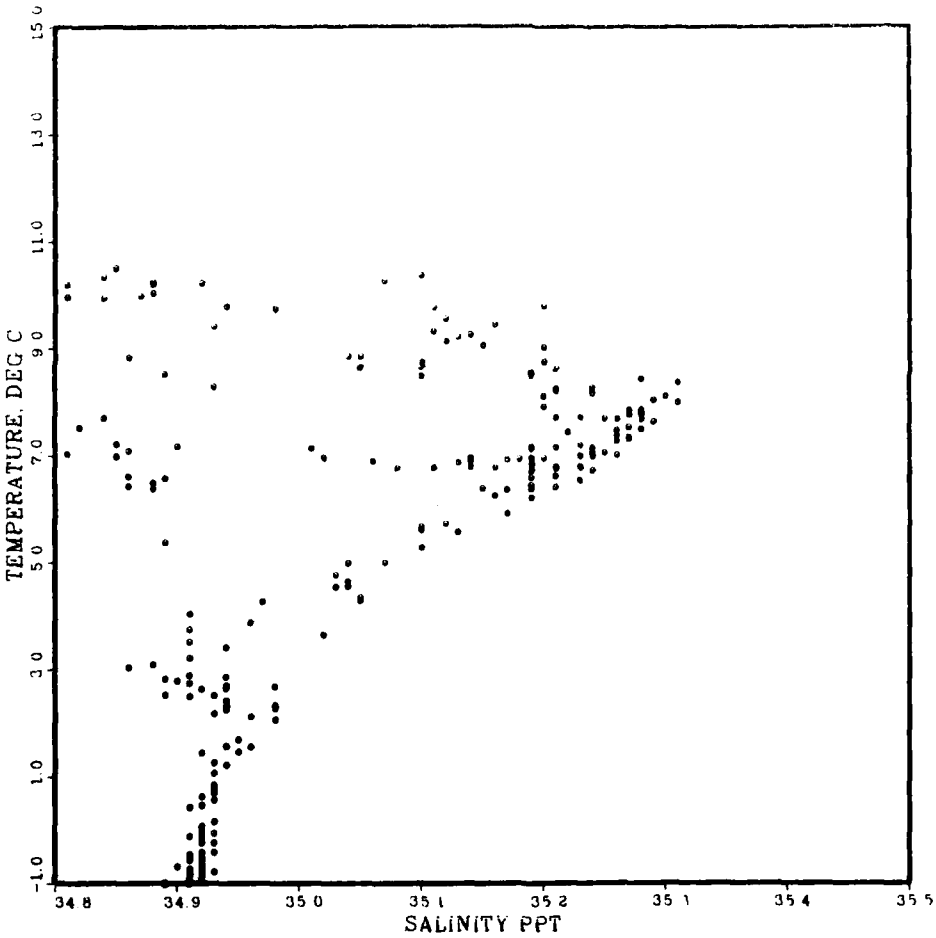


Figure 86. July 1935 (data set #6) temperature/salinity diagram.

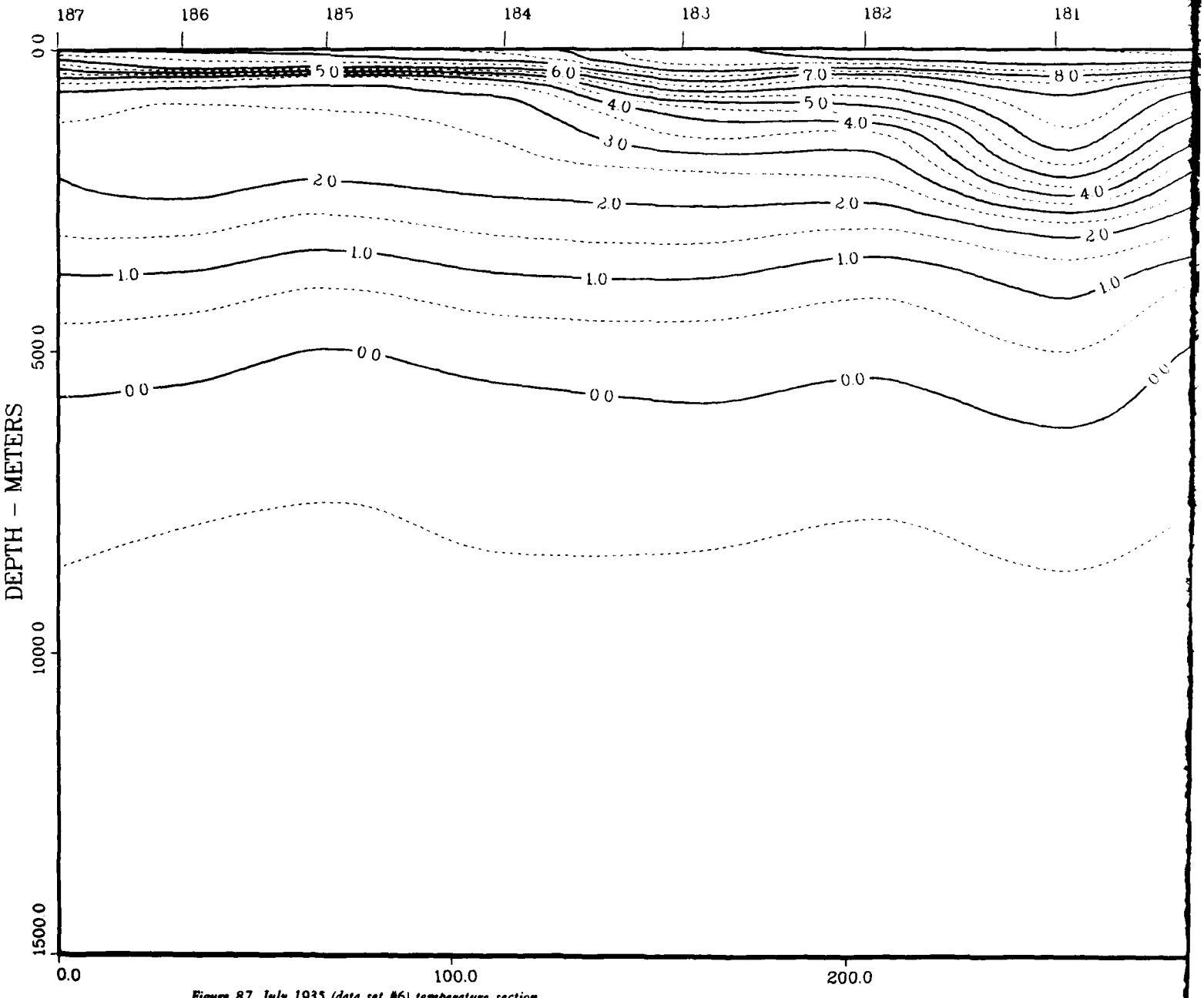
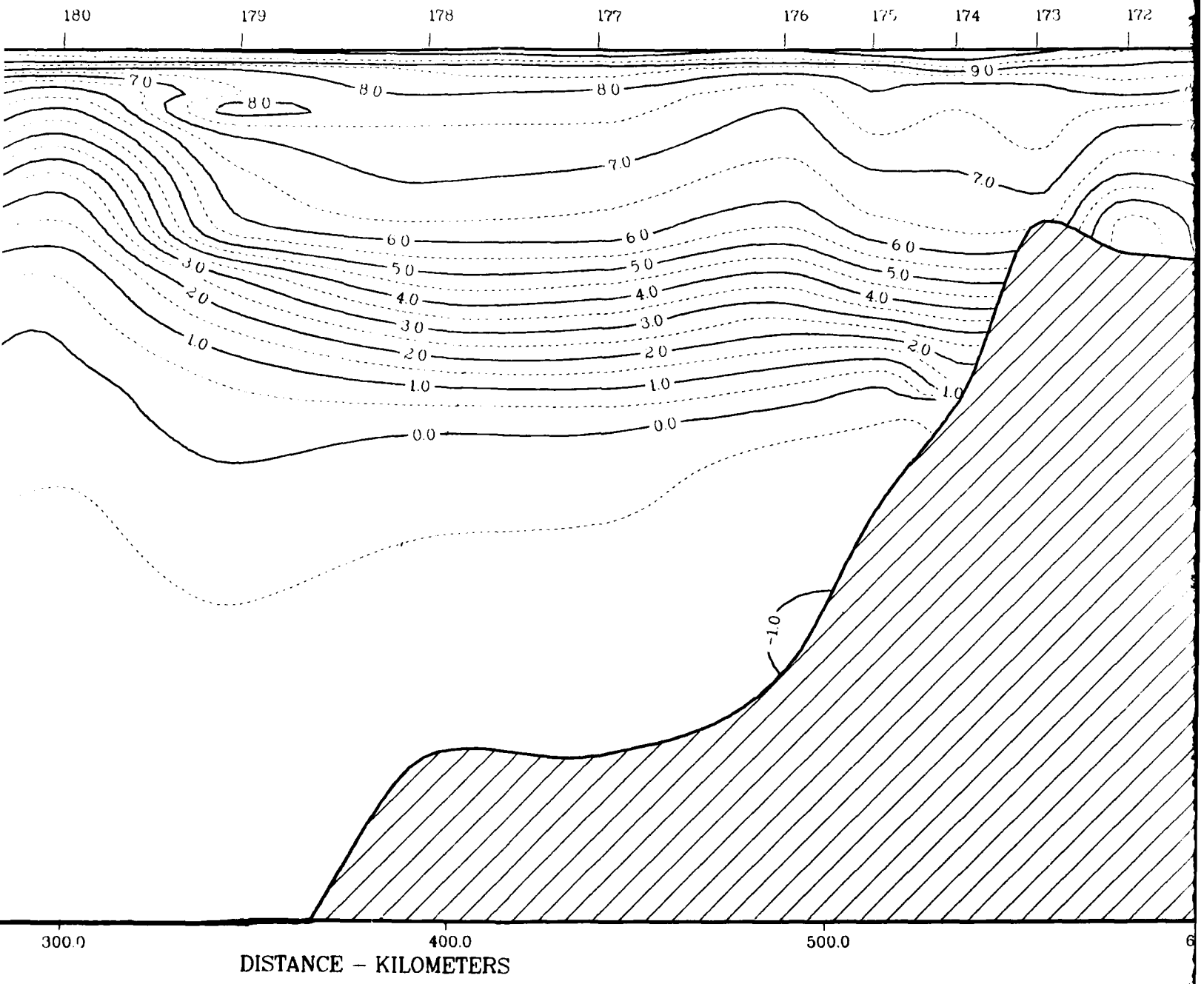
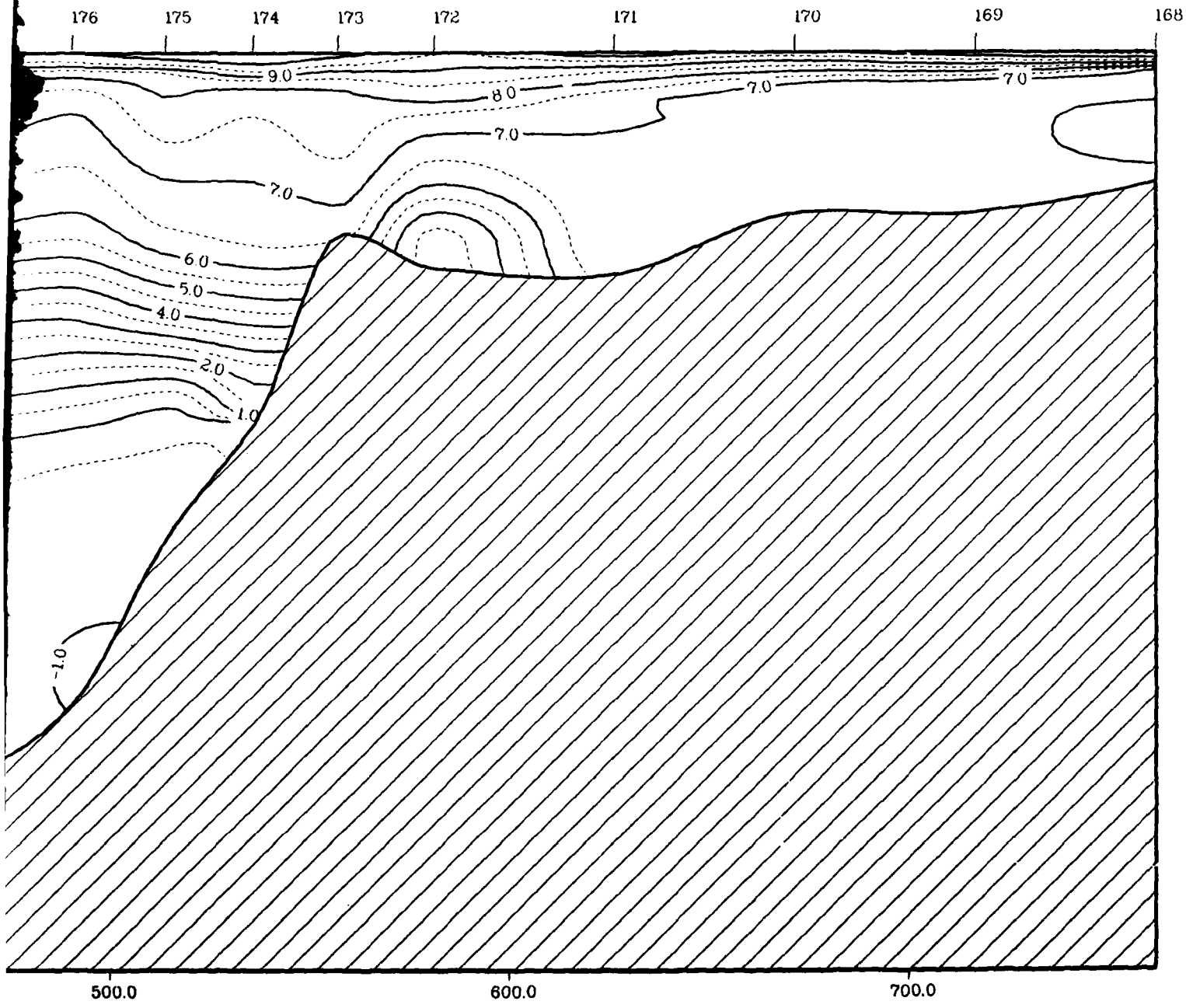


Figure 87. July 1935 (data set #6) temperature section.

SOGNEFJORD SECTION
FILE = ICES$1935U6 DAT1
TEMPERATURE



2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2 3

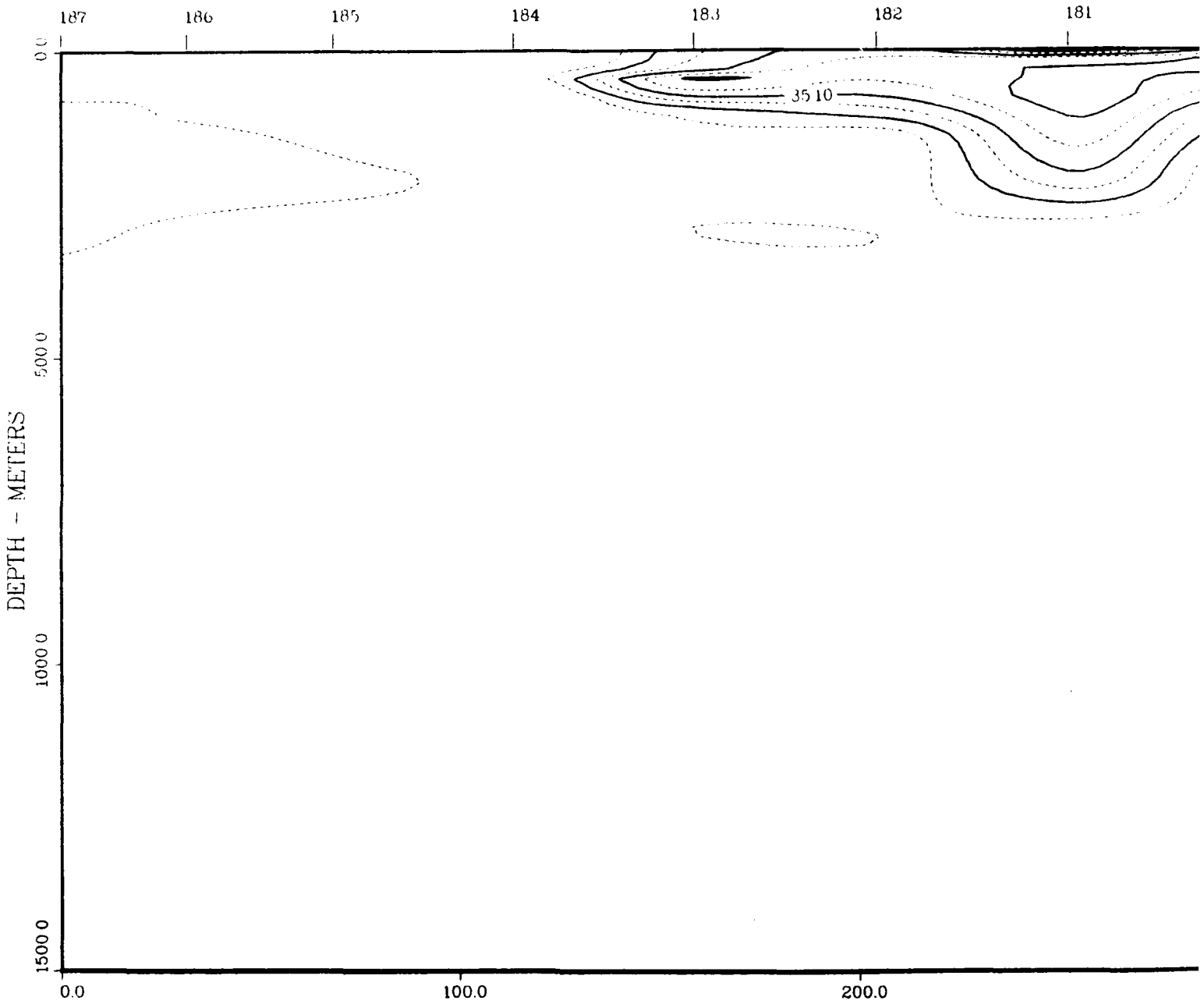
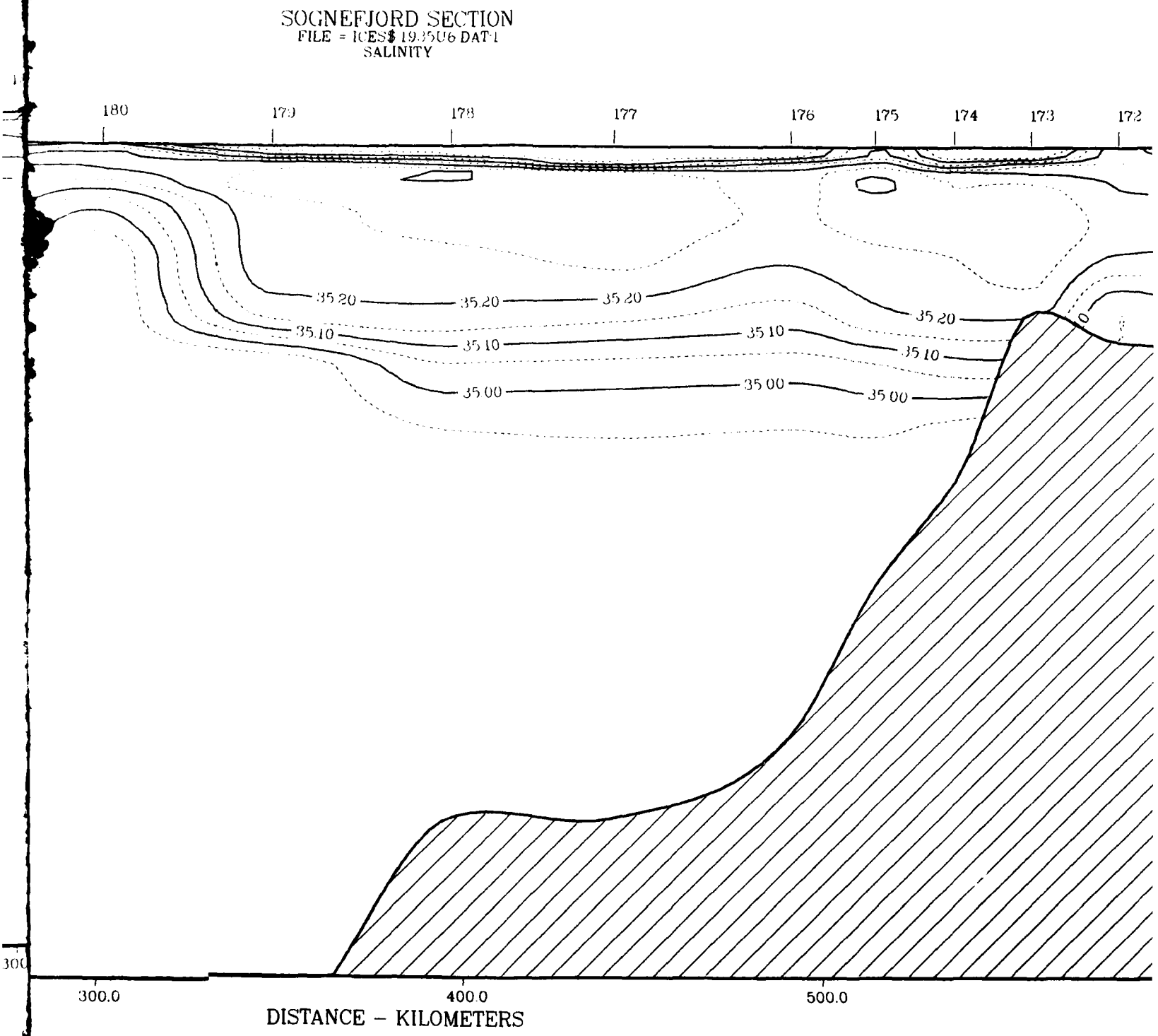
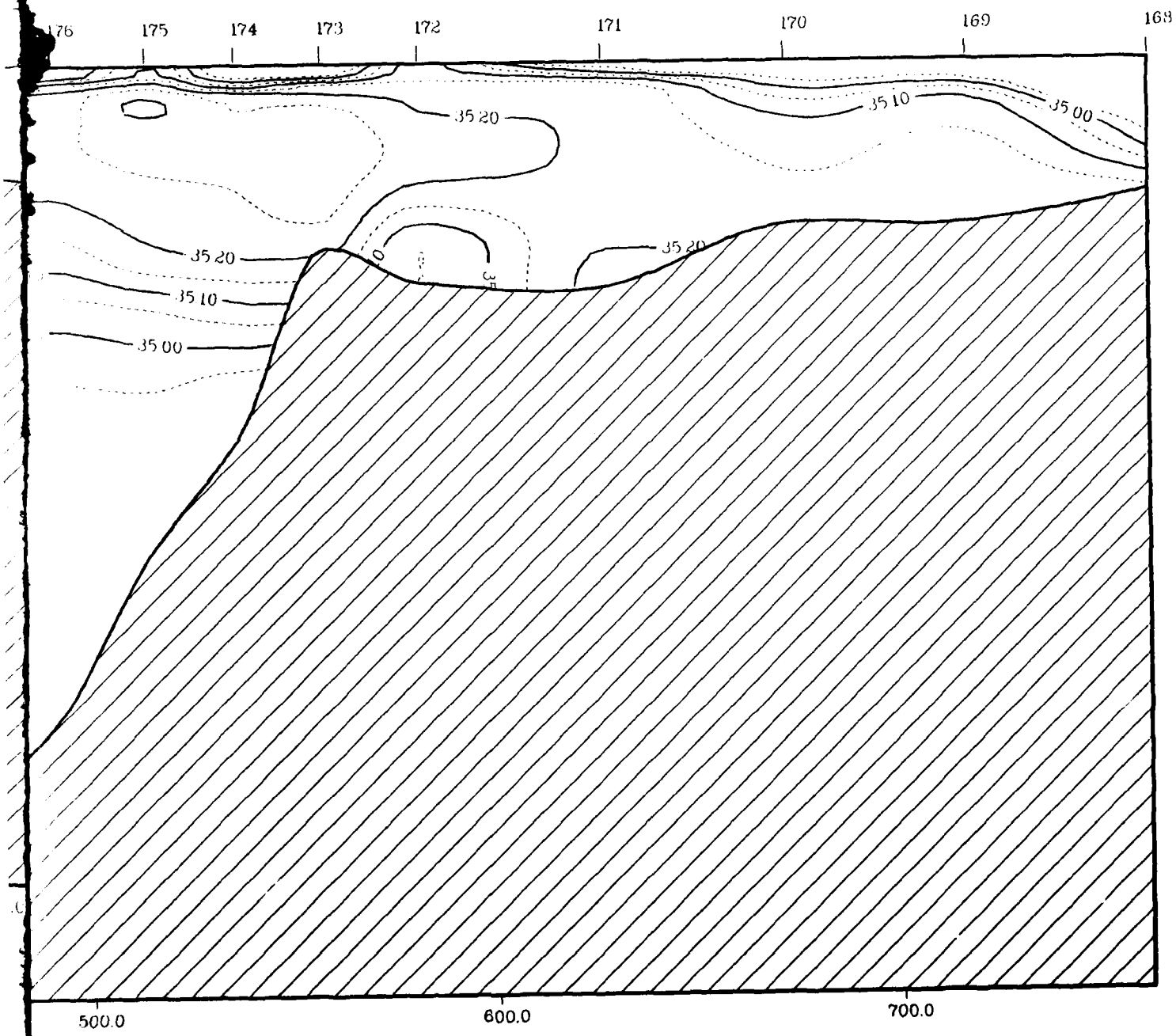


Figure 88. July 1935 (data set #6) salinity section.


SOGNEFJORD SECTION
FILE = ICES$ 19.35U6 DAT-1
SALINITY
180
179
178
177
176
175
174
173
172
35.20
35.20
35.20
35.20
35.10
35.10
35.10
35.10
35.00
35.00
35.00
300.0
400.0
500.0
DISTANCE – KILOMETERS

2


176
175
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173
172
171
170
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168
35 20
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35 00
35 20
35 10
35 00
35 20
500.0
600.0
700.0

3

ICES$:1935V7.DAT

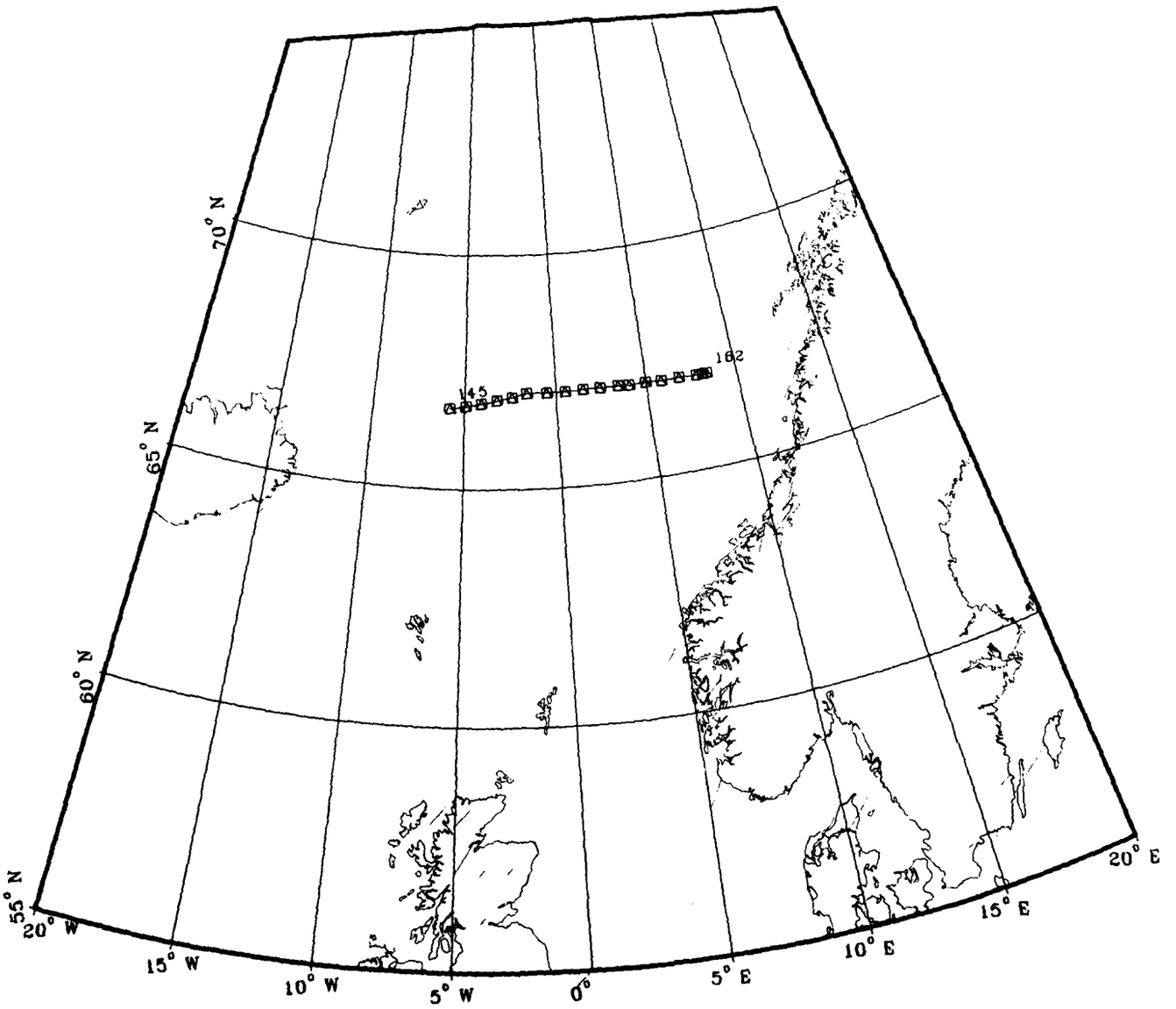


Figure 89. June 1935 (data set #7) station positions.

SOGNEFJORD SECTION
FILE = ICES$:1935V7.DAT
T/S PLOT

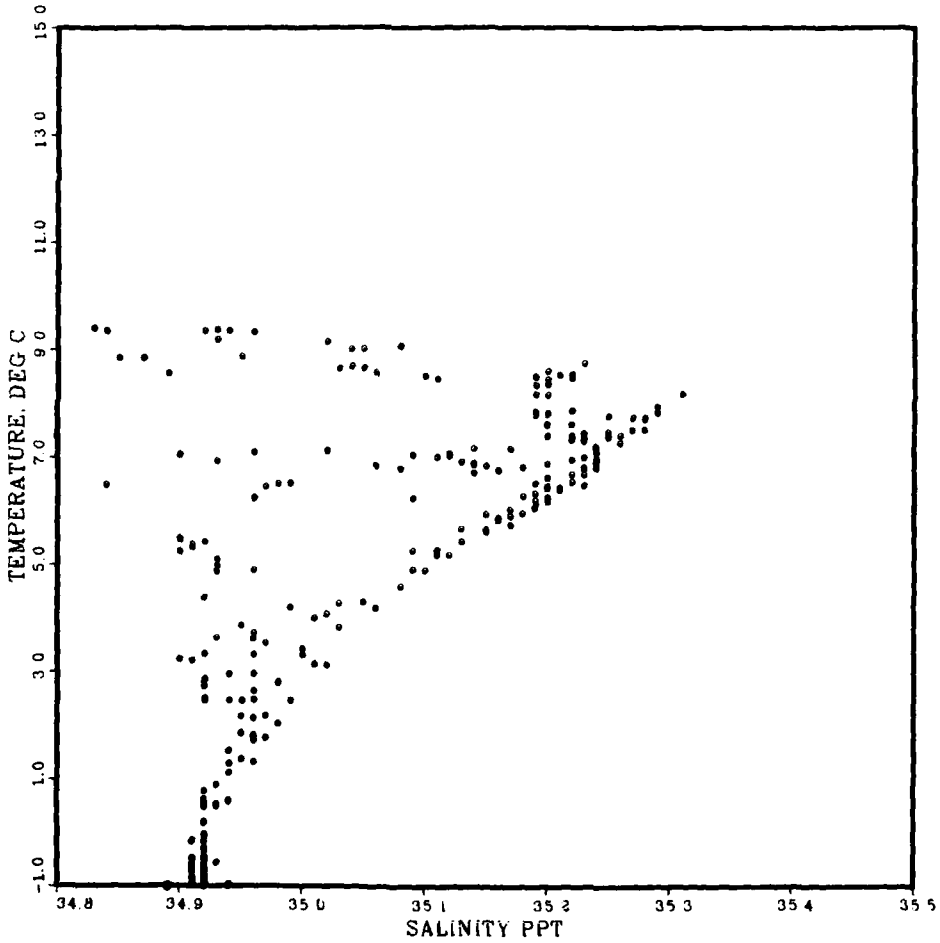


Figure 90. June 1935 (data set #7) temperature/salinity diagram.

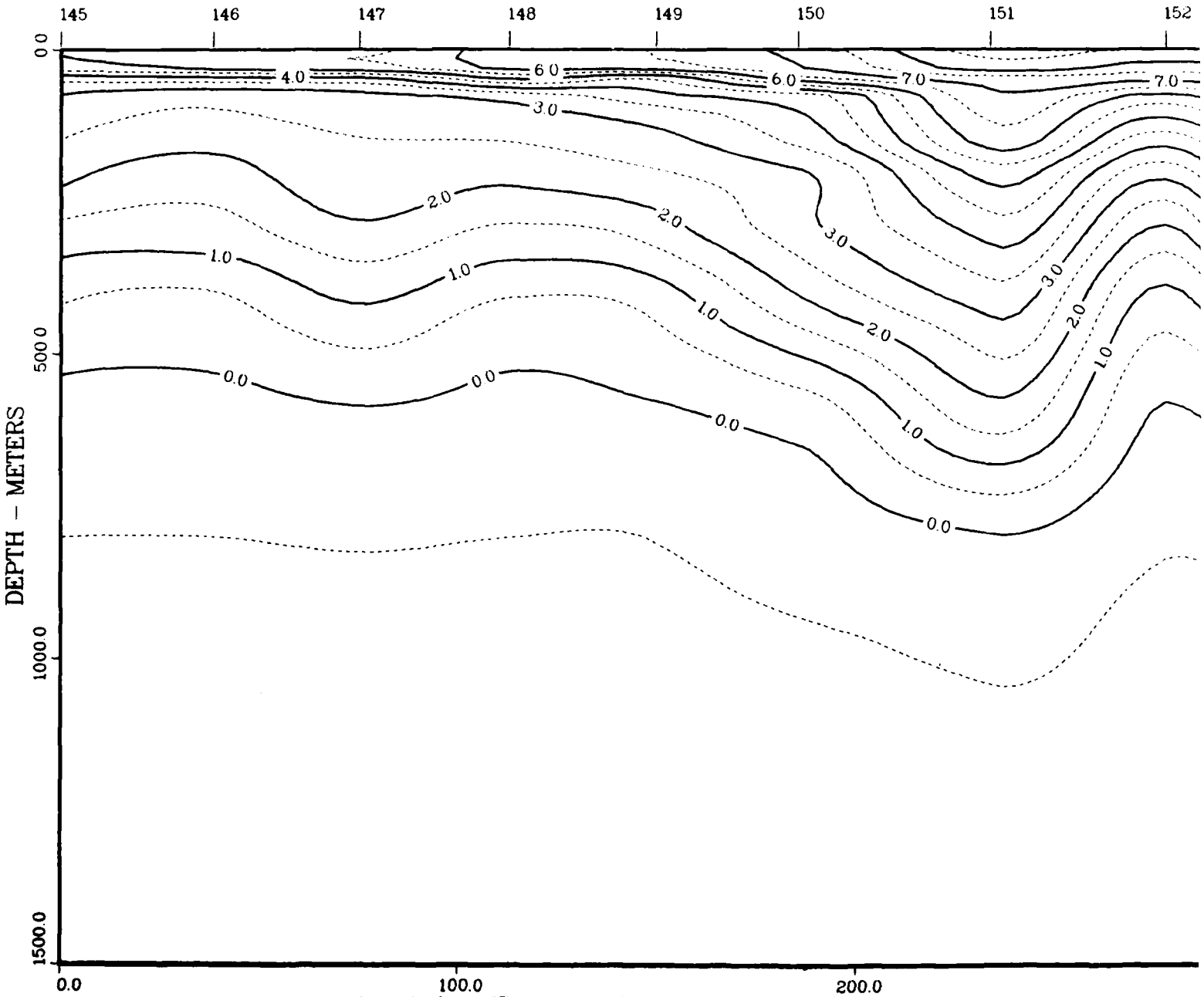
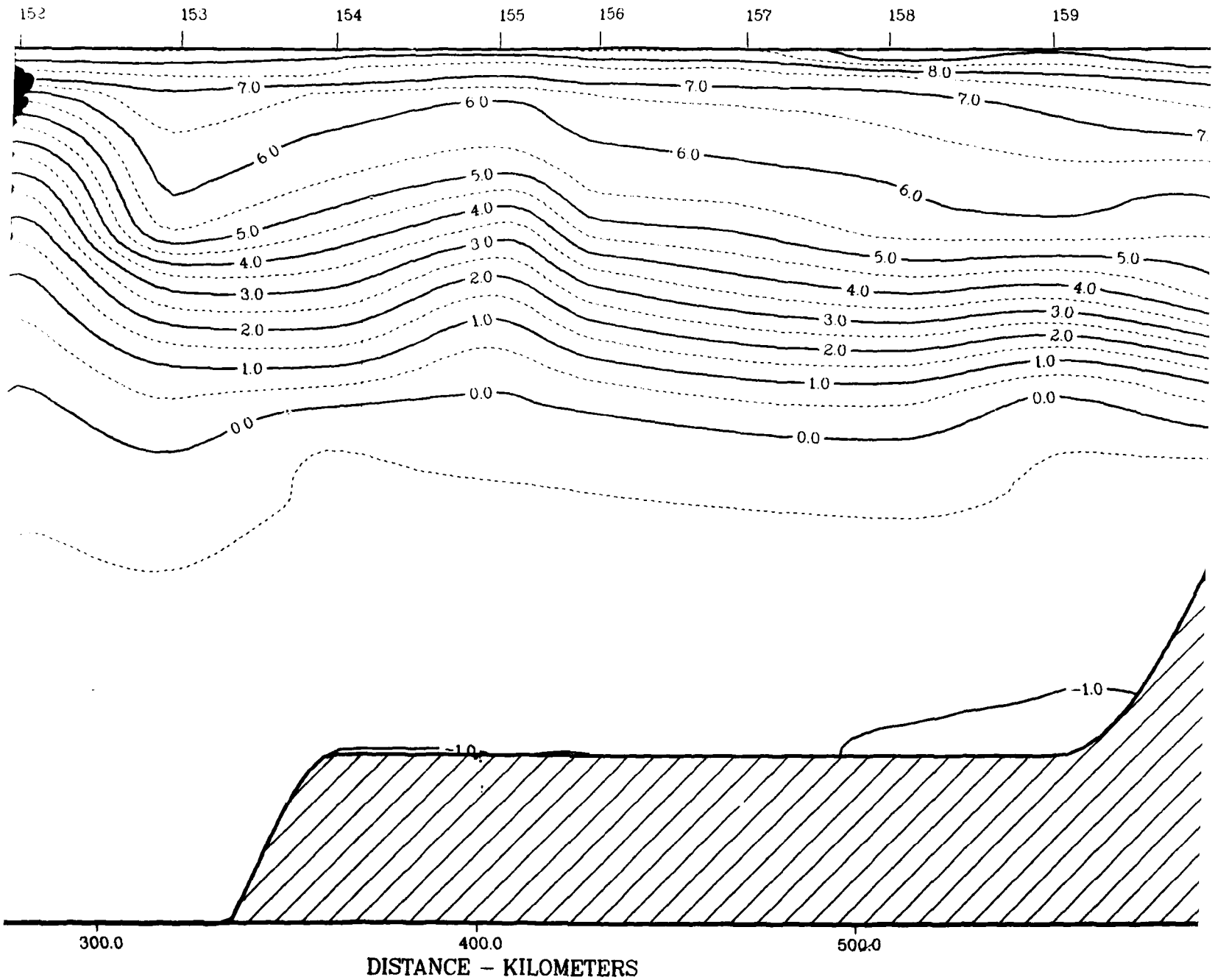
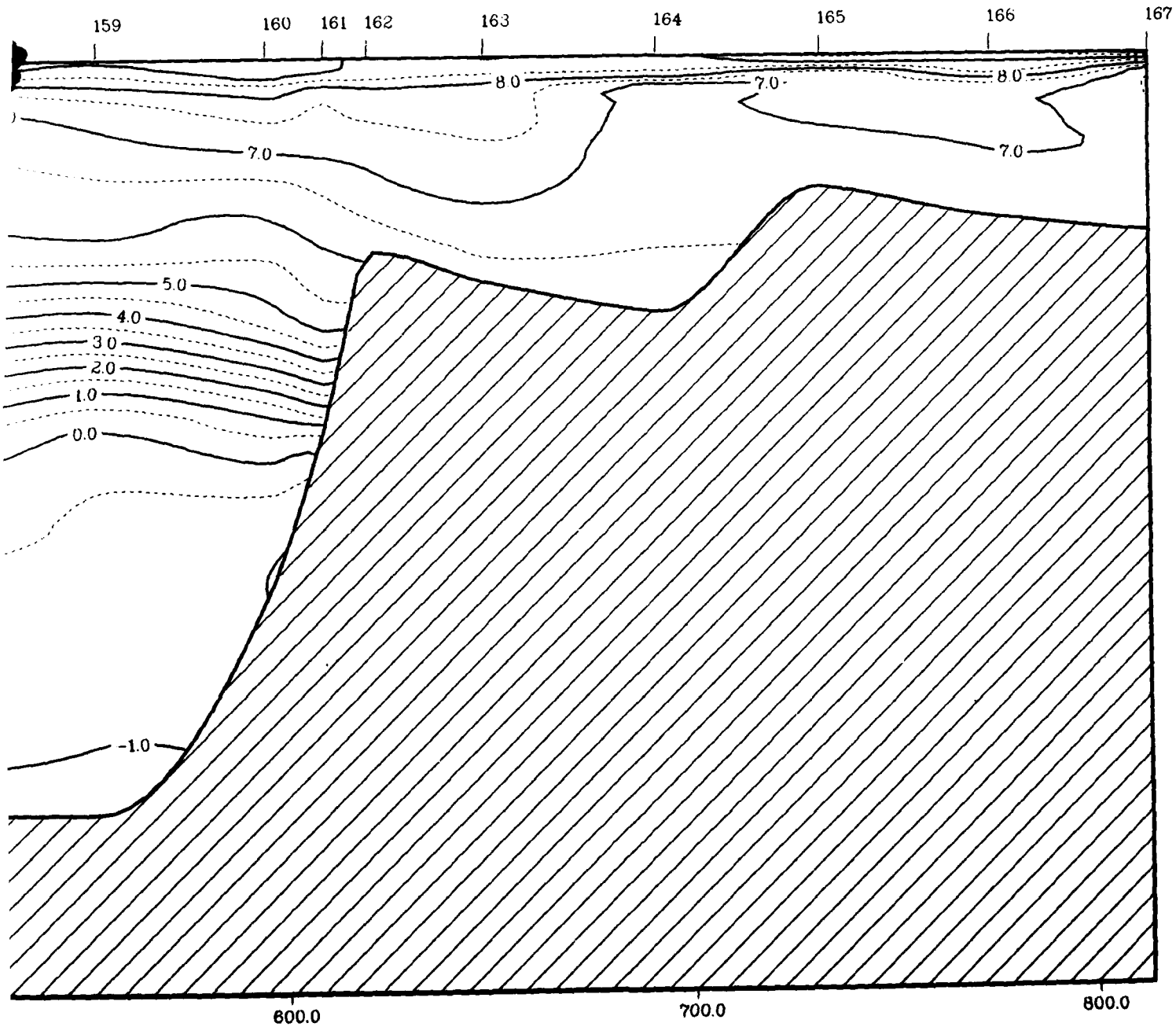


Figure 91. June 1935 (data set #7) temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1935V7.DAT:1
TEMPERATURE




159
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164
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167
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7.0
8.0
7.0
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3.0
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-1.0
600.0
700.0
800.0

3

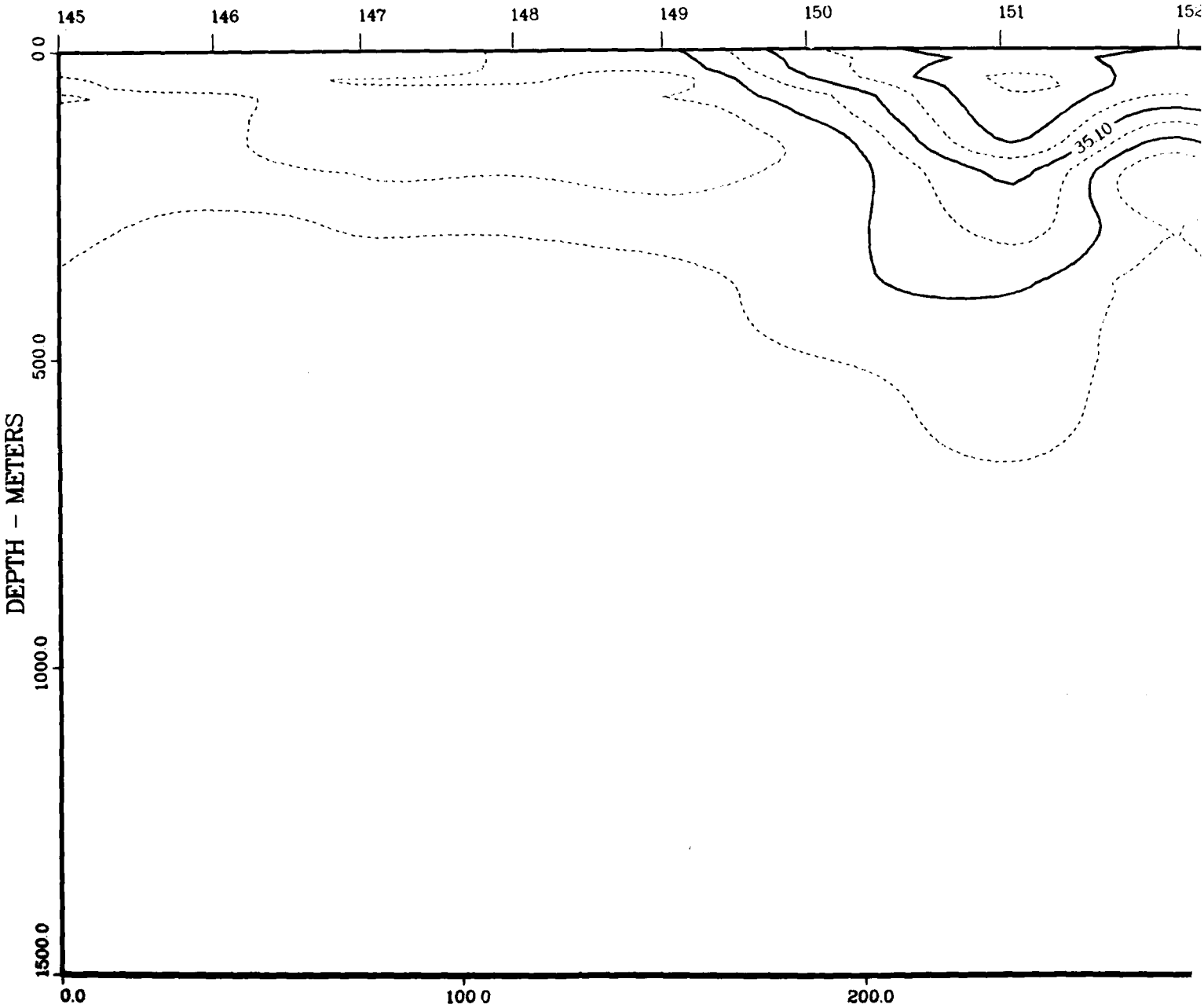
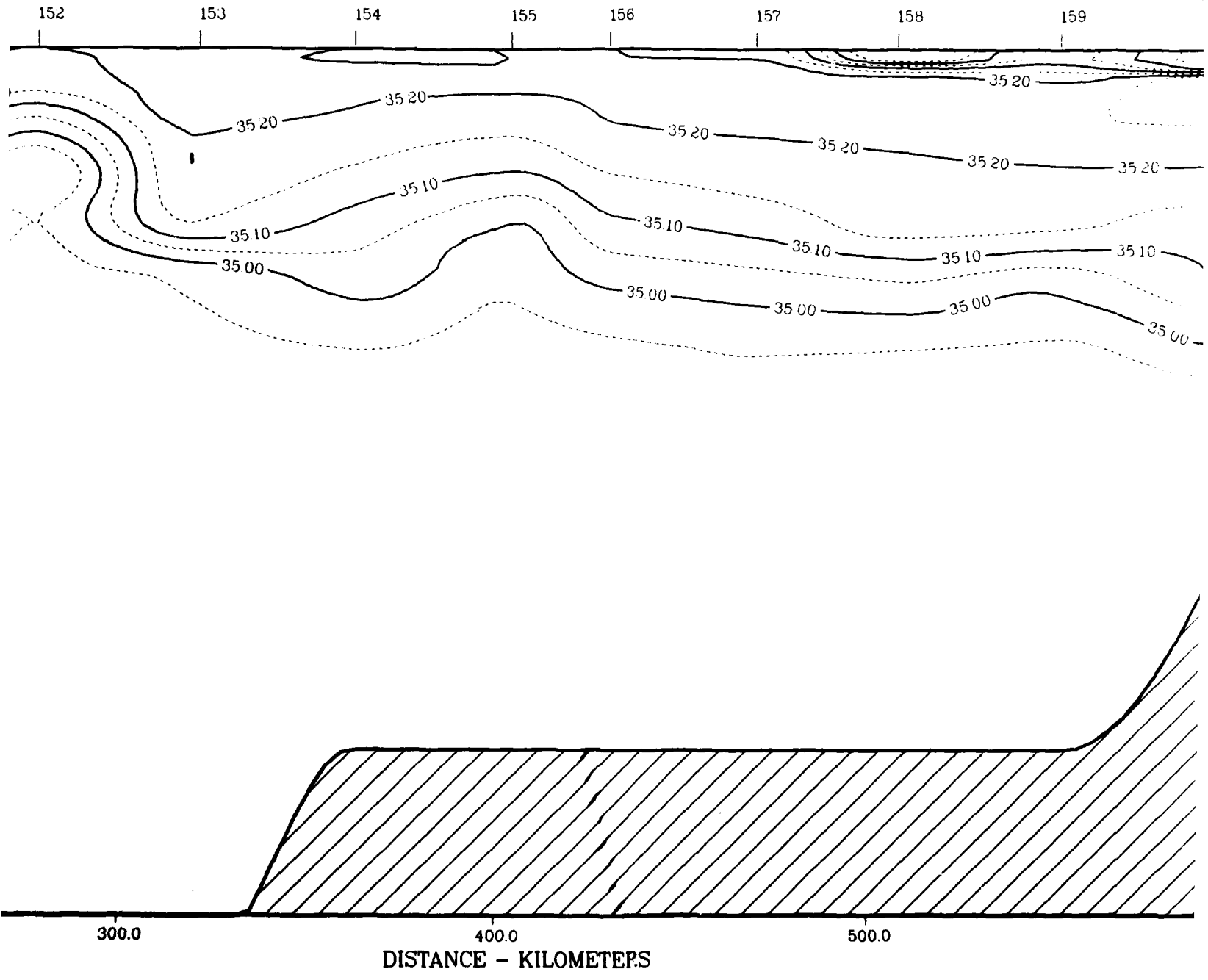
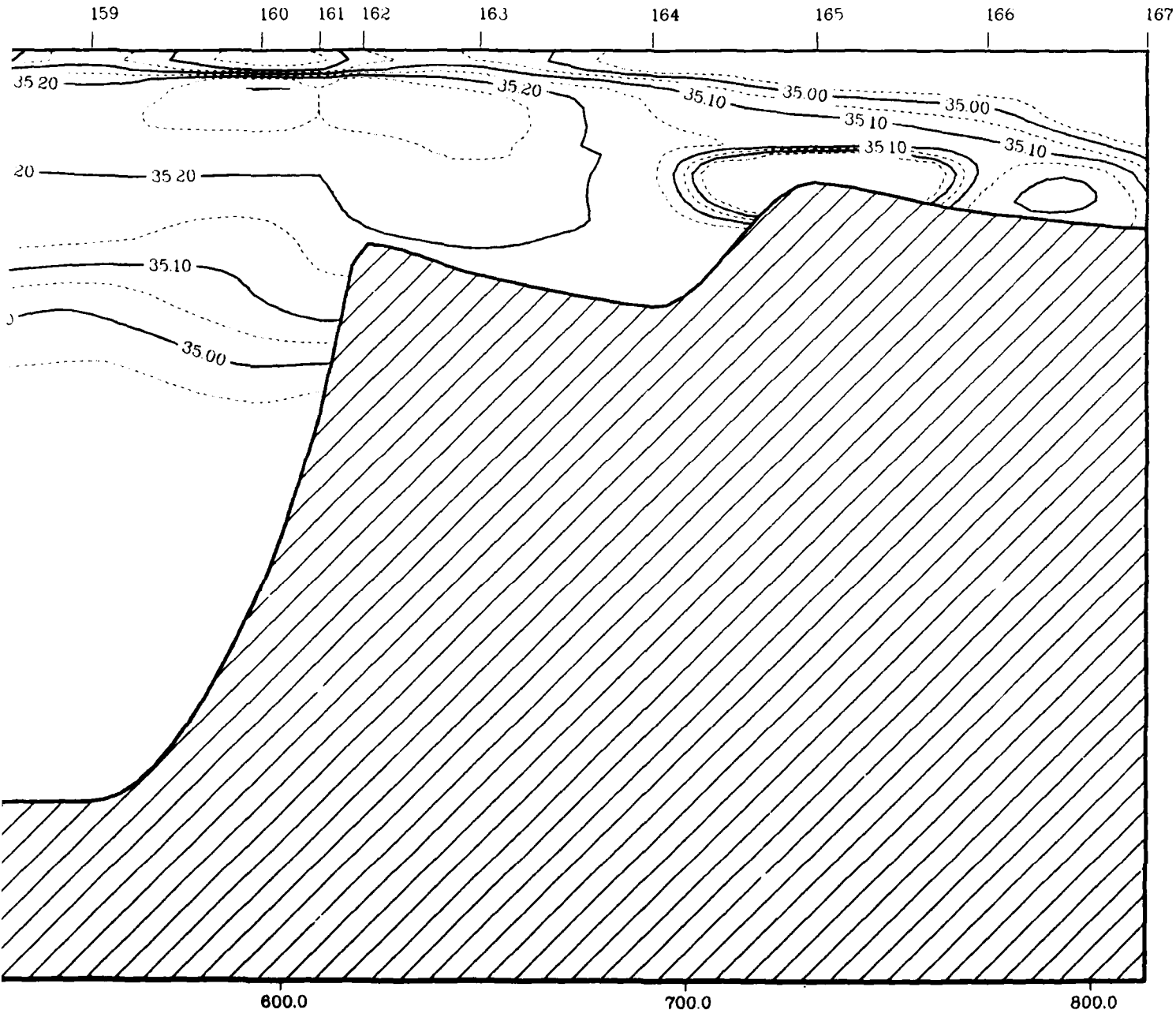


Figure 92. June 1935 (data set #7) salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1935V7.DAT;1
SALINITY



2


159
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35.20
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35.10
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35.20
35.10
35.00
600.0
700.0
800.0

3

ICES$:1935X9.DAT

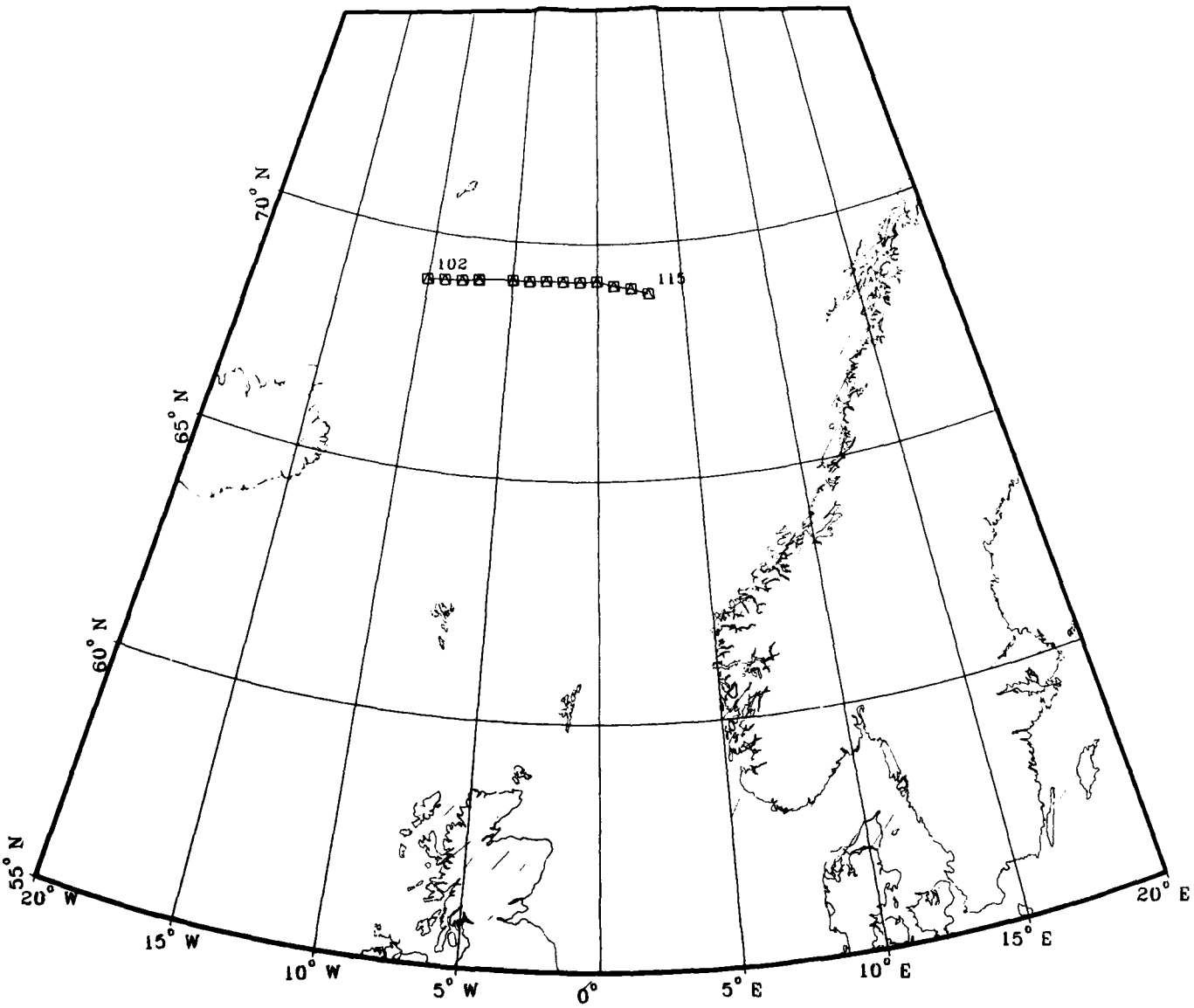


Figure 93. June 1935 (data set #9) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1935X9 DAT
T/S PLOT

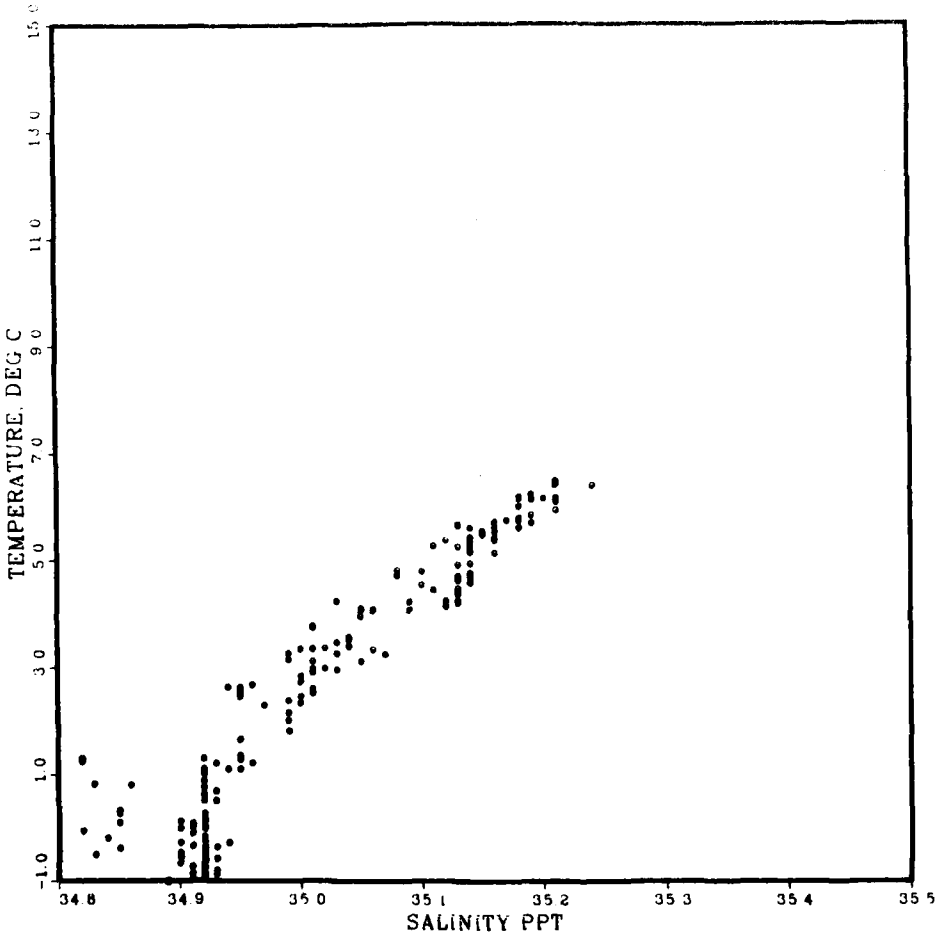


Figure 94. June 1935 (data set #9) temperature/salinity diagram.

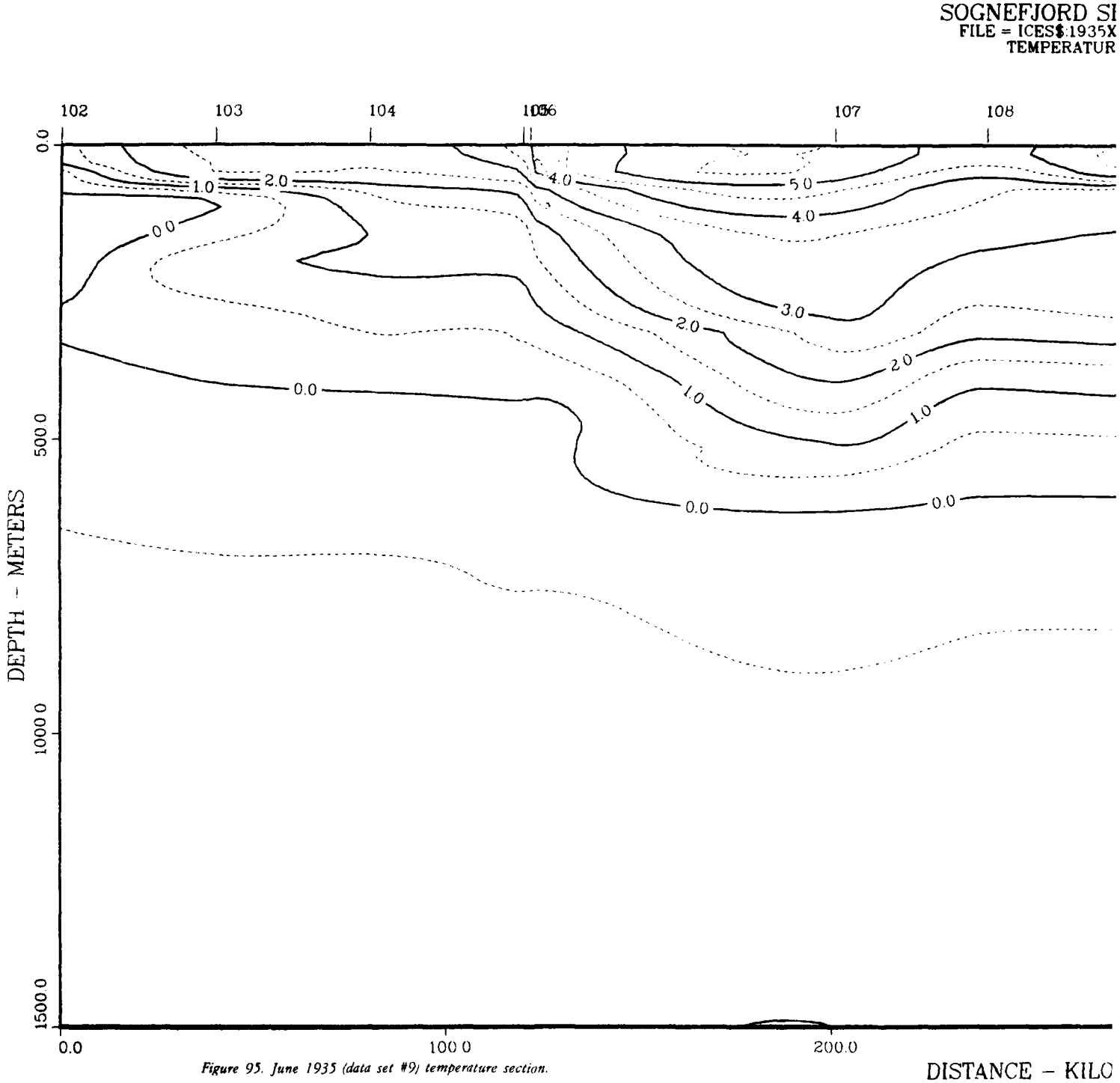
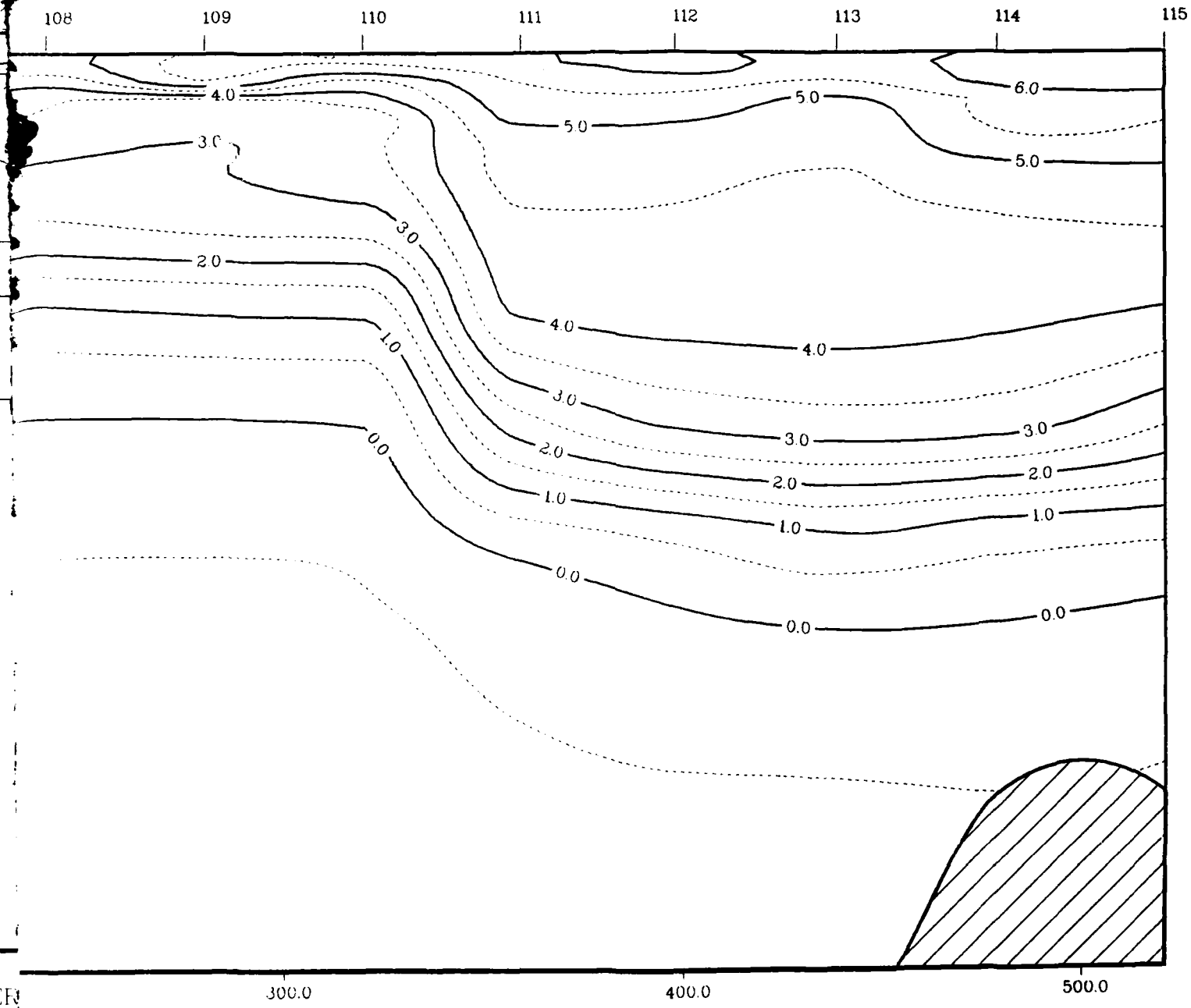


Figure 95. June 1935 (data set #9) temperature section.

OGNEFJORD SECTION
FILE = ICES$:1935X9 DAT 1
TEMPERATURE



TANCE – KILOMETERS

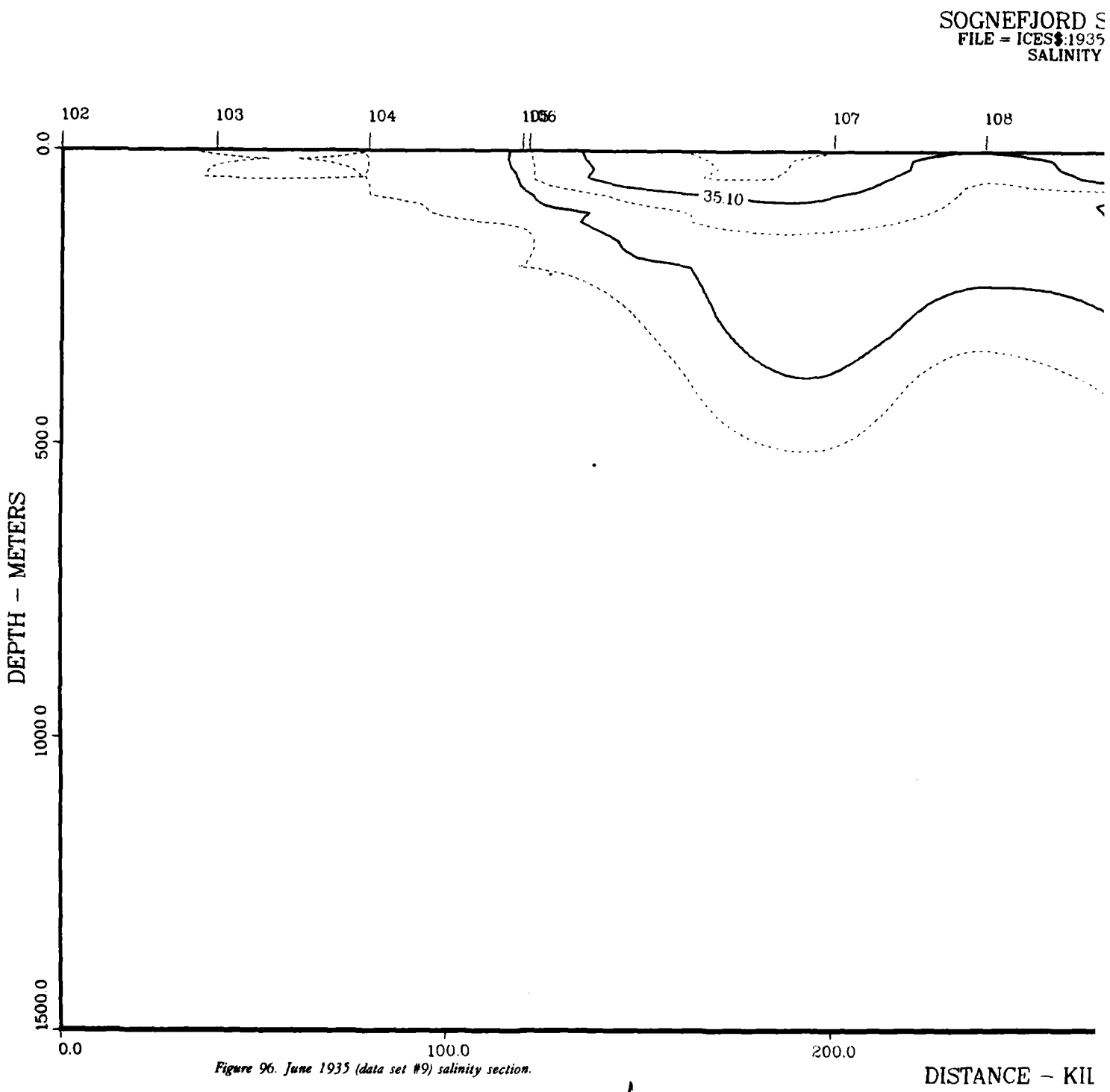
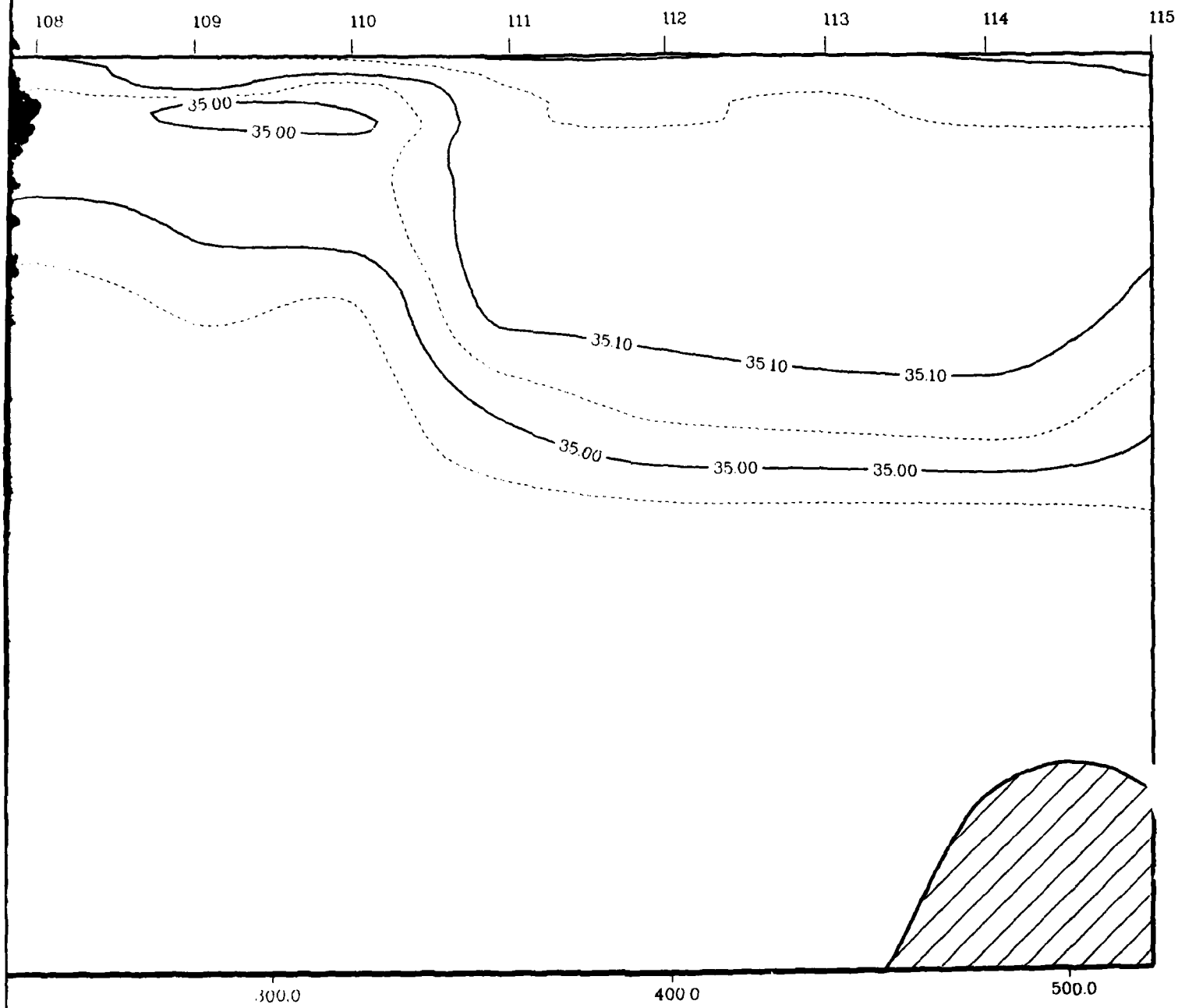


Figure 96. June 1935 (data set #9) salinity section.

GNEFJORD SECTION
ILE = ICES$:1935X9 DAT:1
SALINITY



TANCE – KILOMETERS

2

ICES$:1935P10.DAT

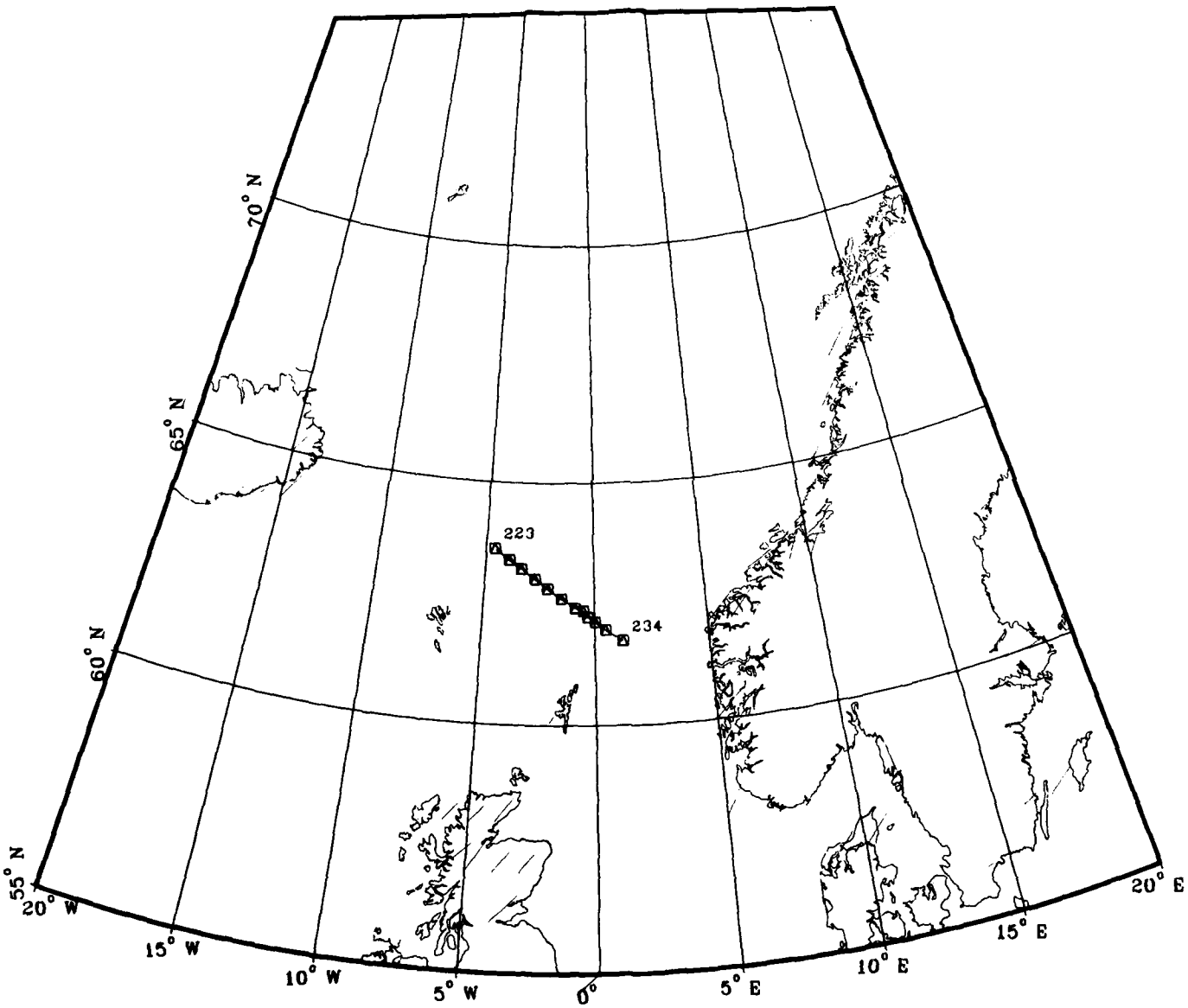


Figure 97. July 1935 (data set #10) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1935P10.DAT
T/S PLOT

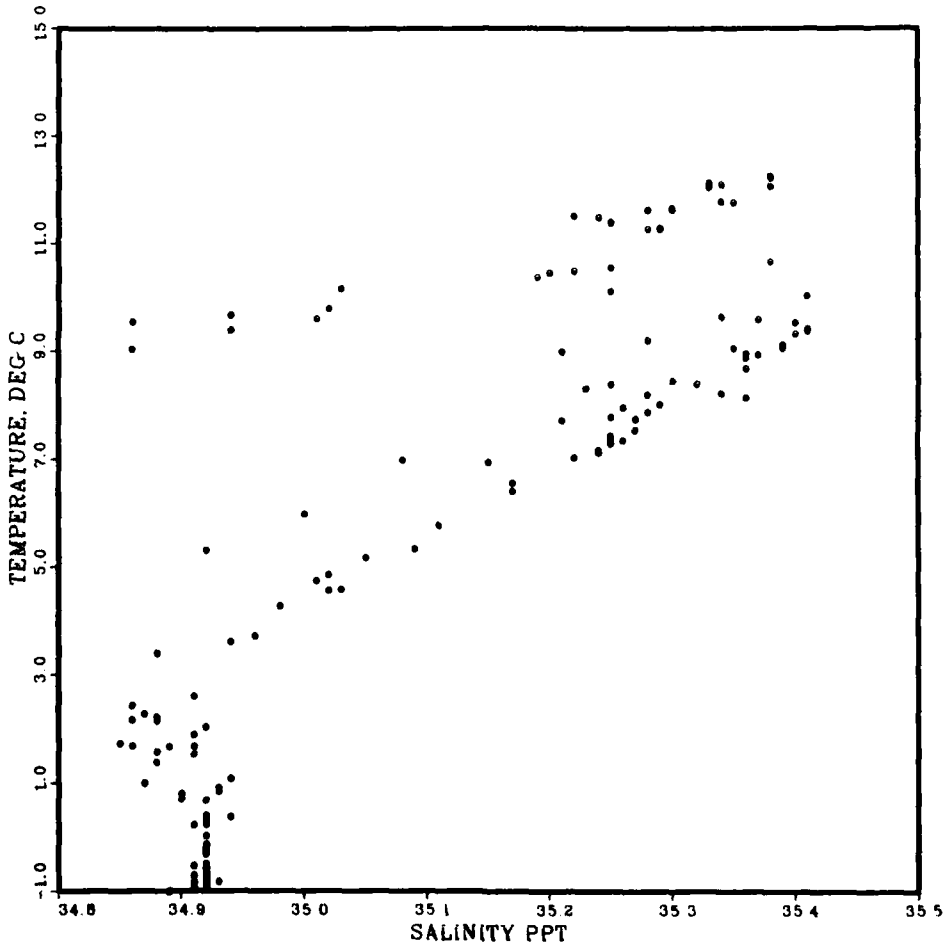


Figure 98. July 1935 (data set #10) temperature/salinity diagram.

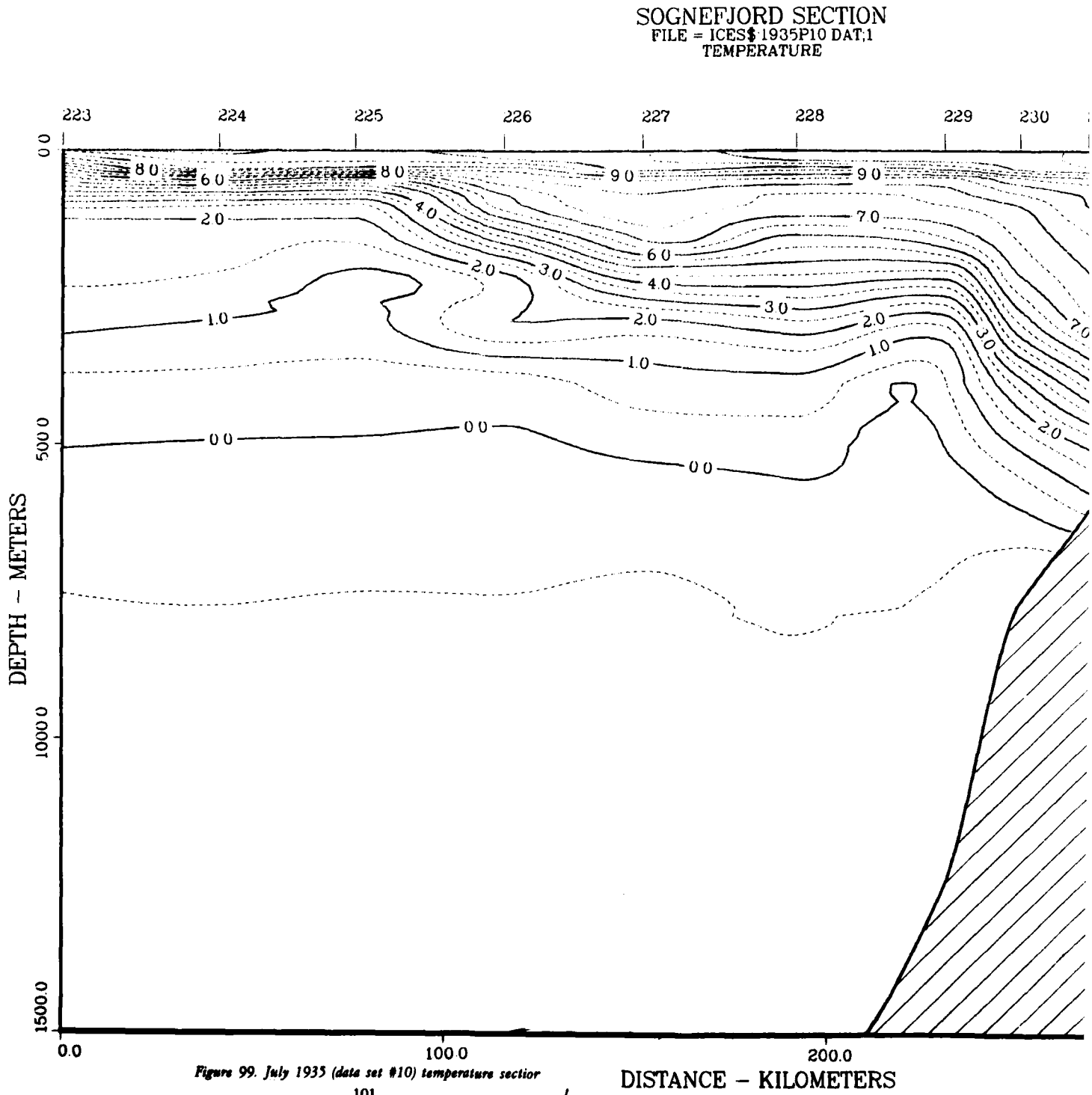
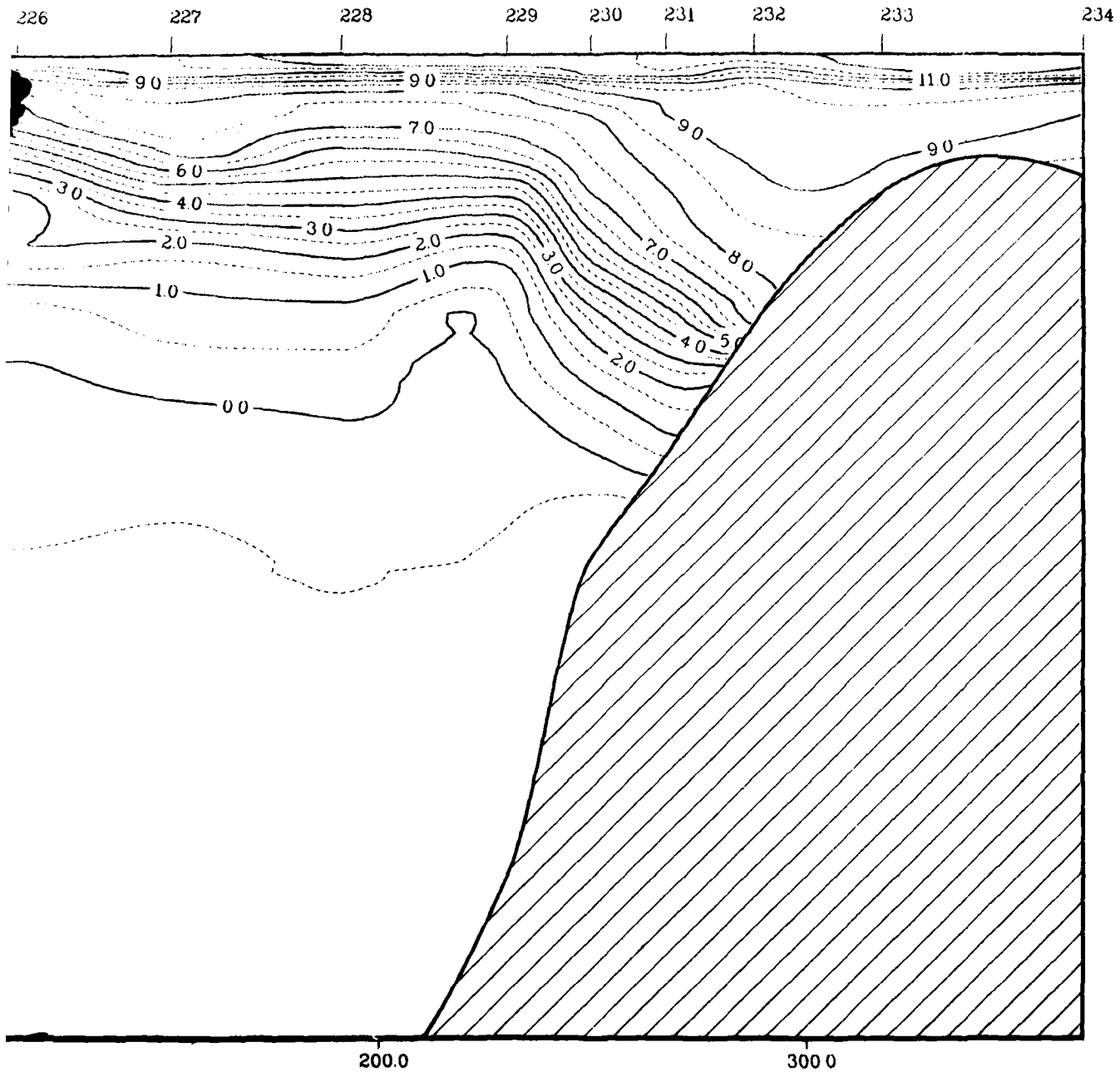


Figure 99. July 1935 (data set #10) temperature section

SOGNEFJORD SECTION
FILE = ICES$ 1935P10 DAT;1
TEMPERATURE



DISTANCE – KILOMETERS

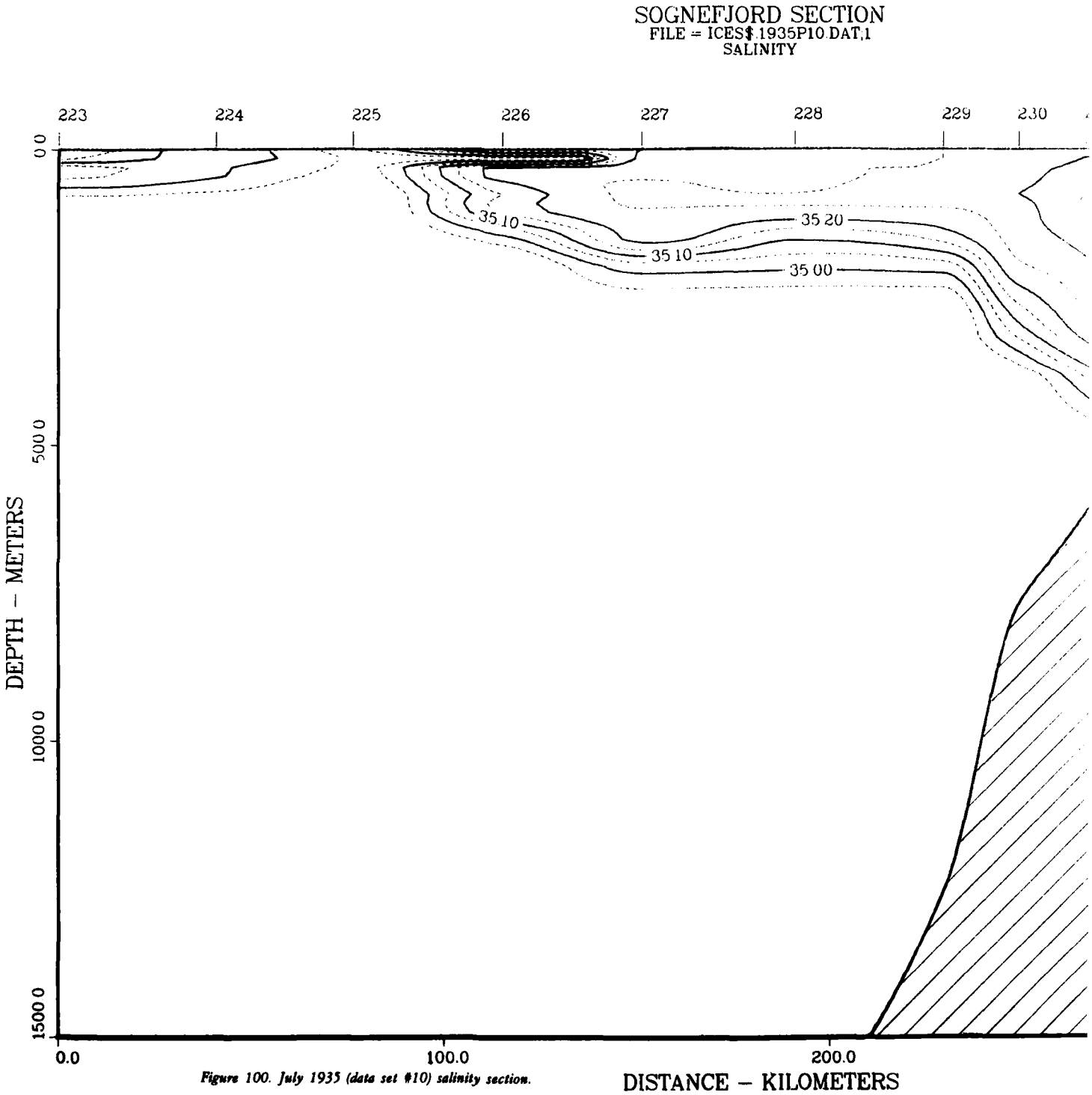
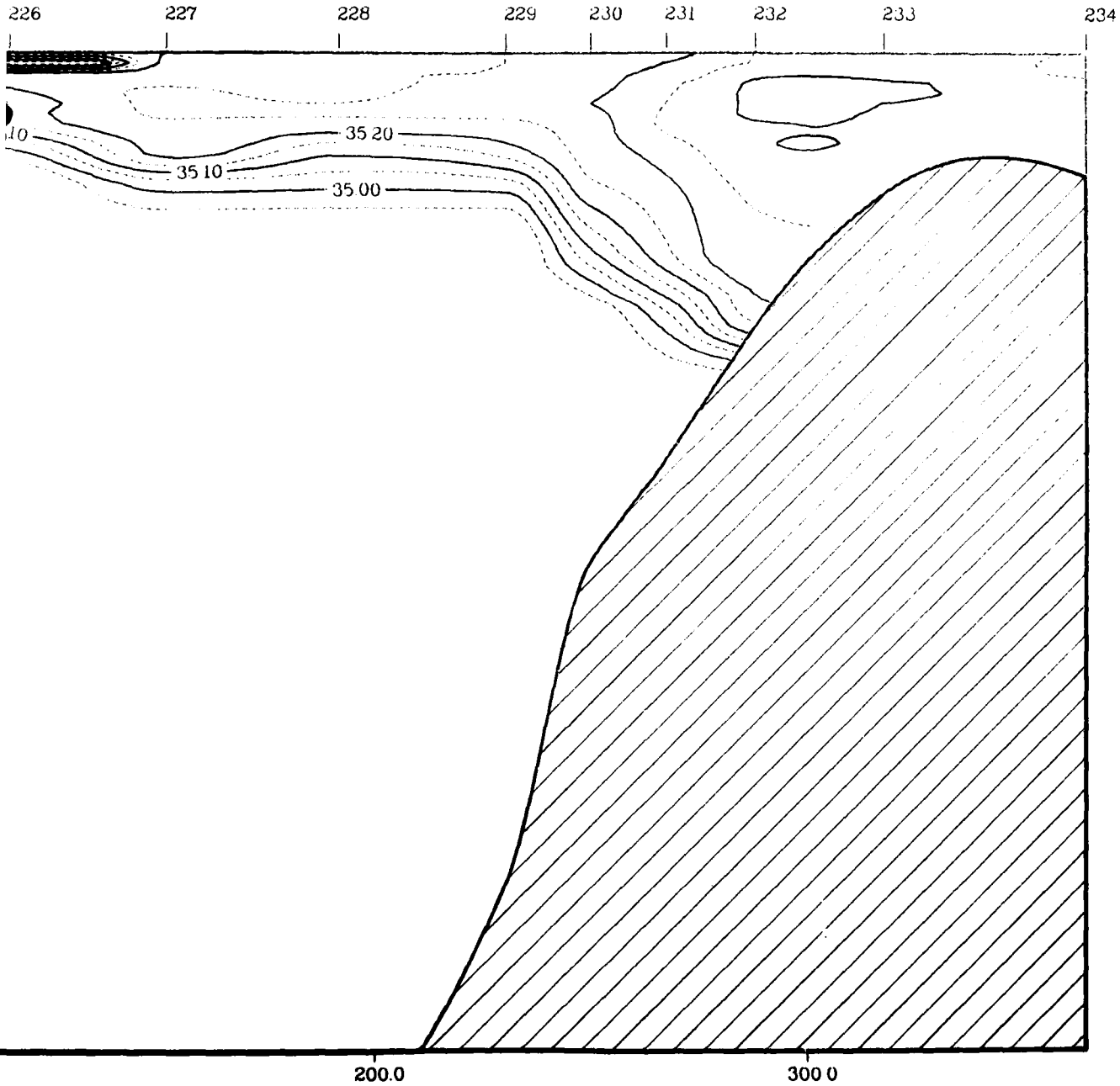


Figure 100. July 1935 (data set #10) salinity section.

SOGNEFJORD SECTION
FILE = ICES$.1935P10.DAT,1
SALINITY



DISTANCE – KILOMETERS

ICES$:1936Y1.DAT

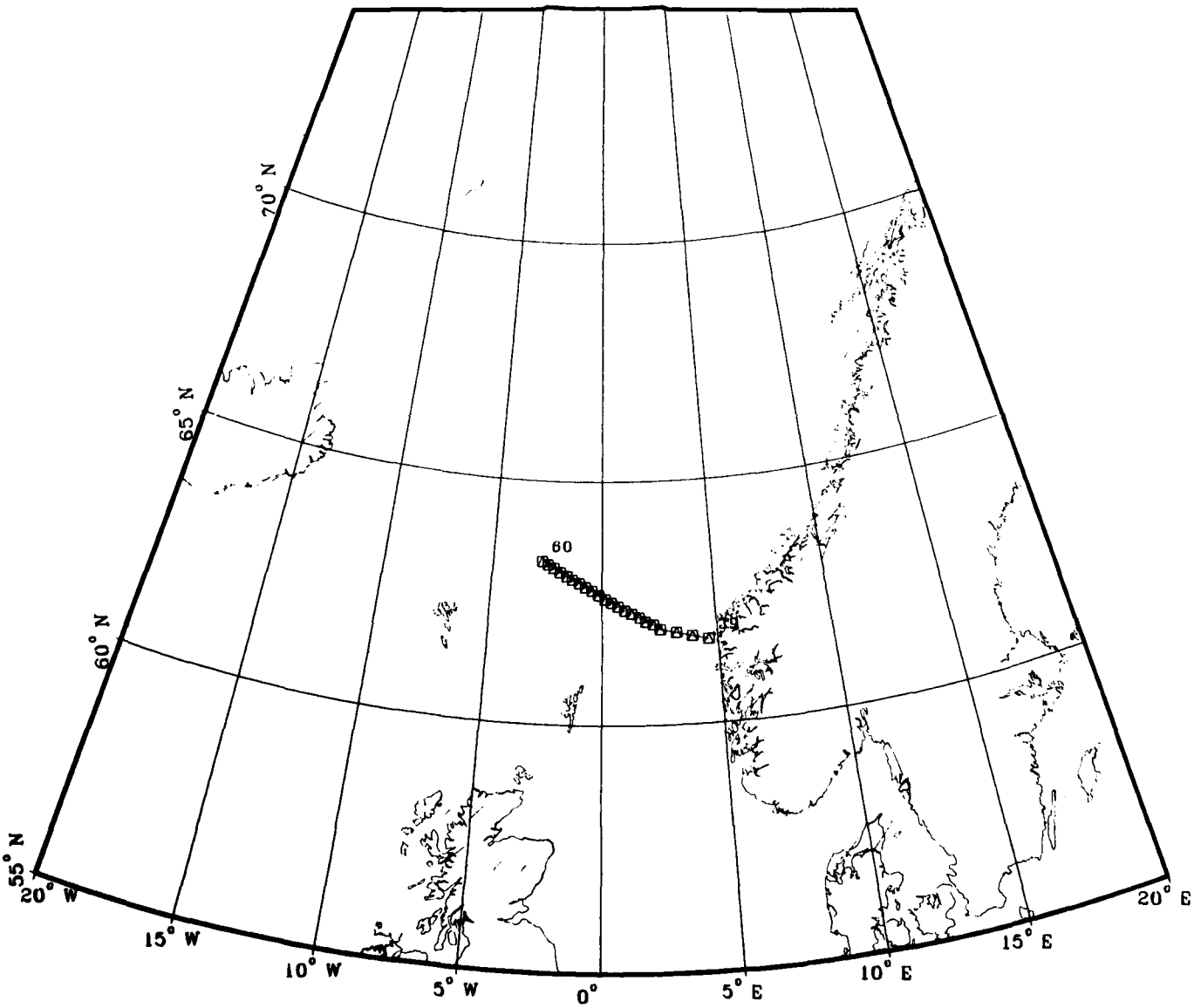


Figure 101. June 1936 (data set #1) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1936Y1.DAT
T/S PLOT

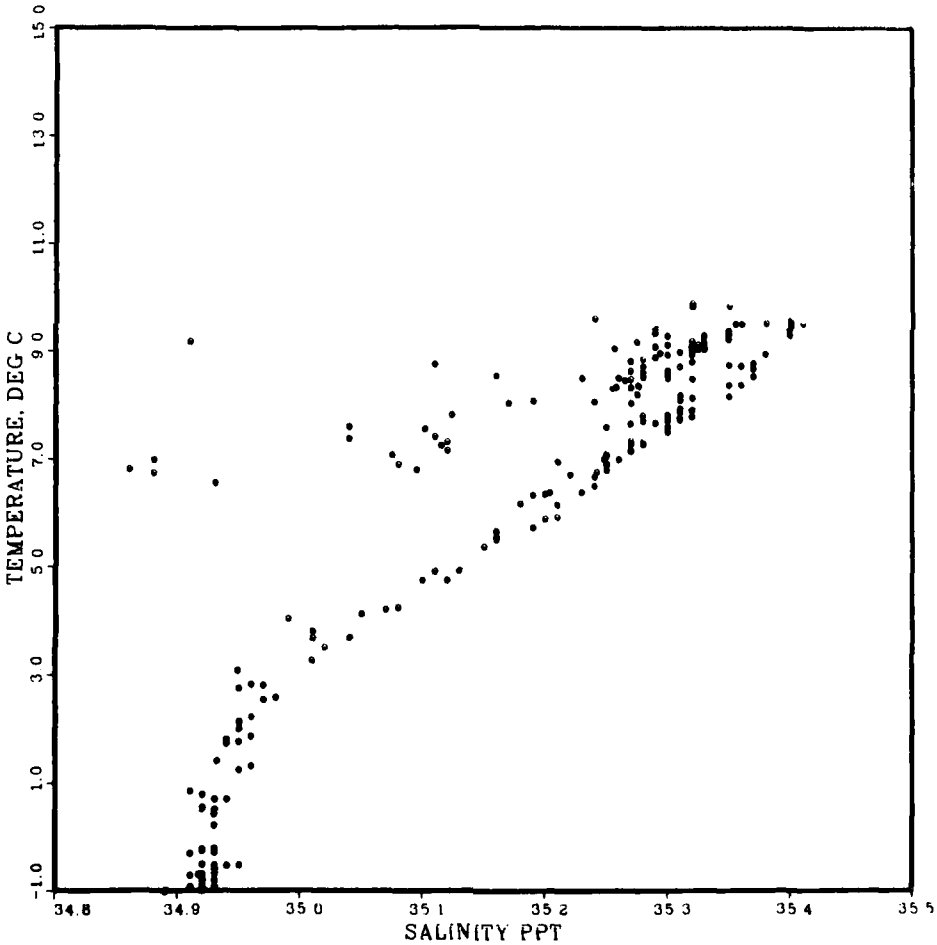


Figure 102. June 1936 (data set #1) temperature/salinity diagram.

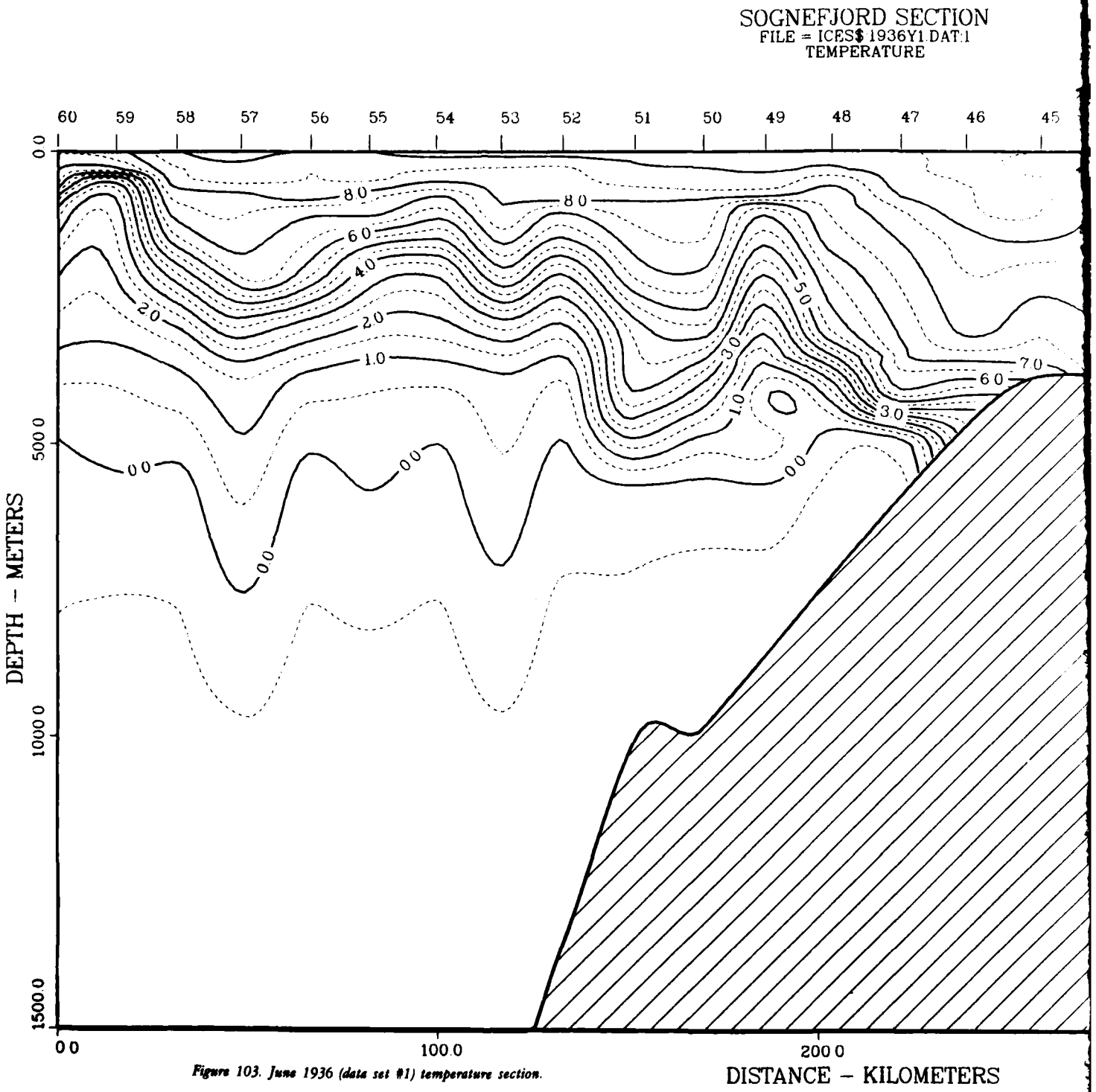
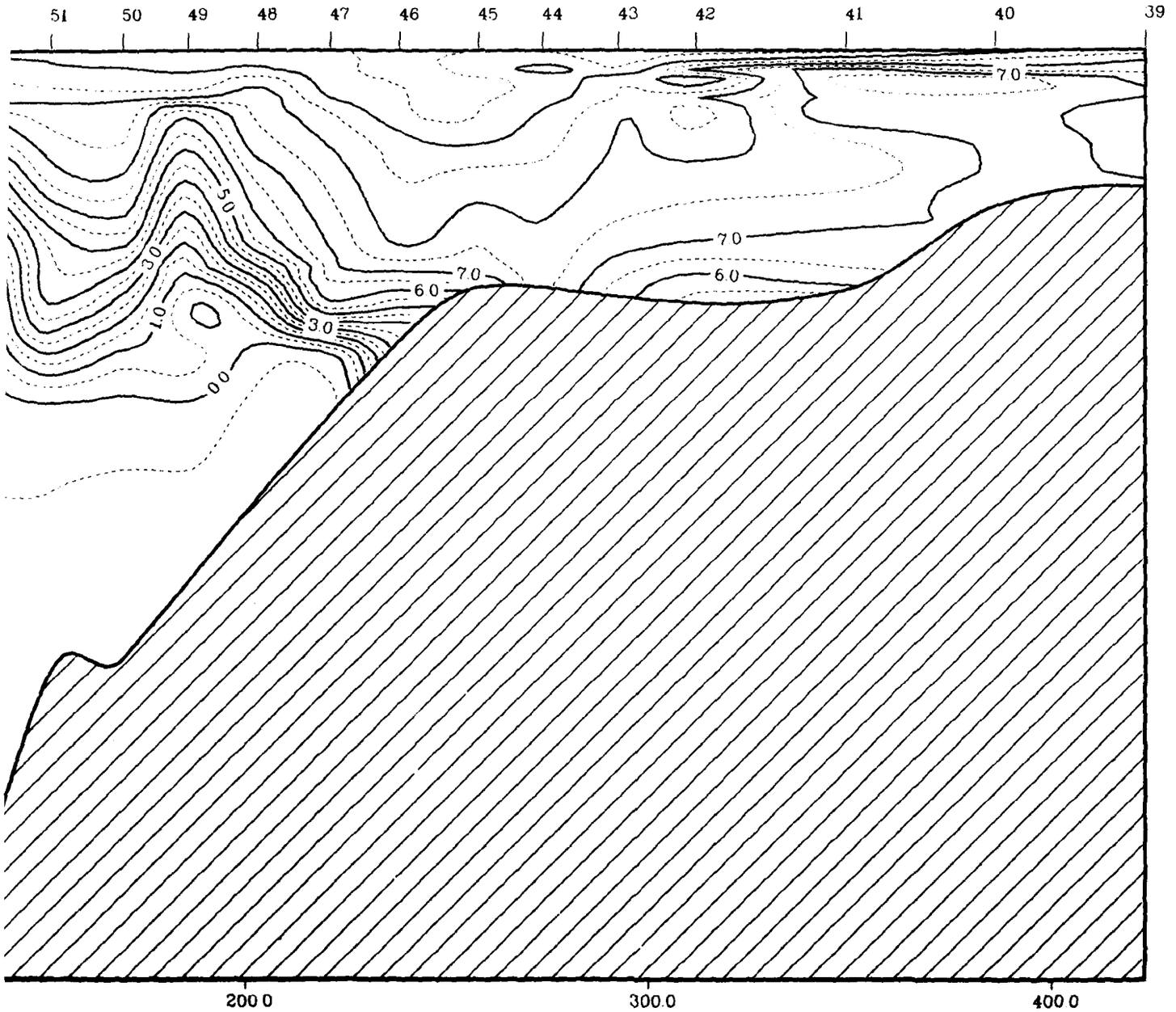


Figure 103. June 1936 (data set #1) temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1936Y1.DAT;1
TEMPERATURE



DISTANCE – KILOMETERS

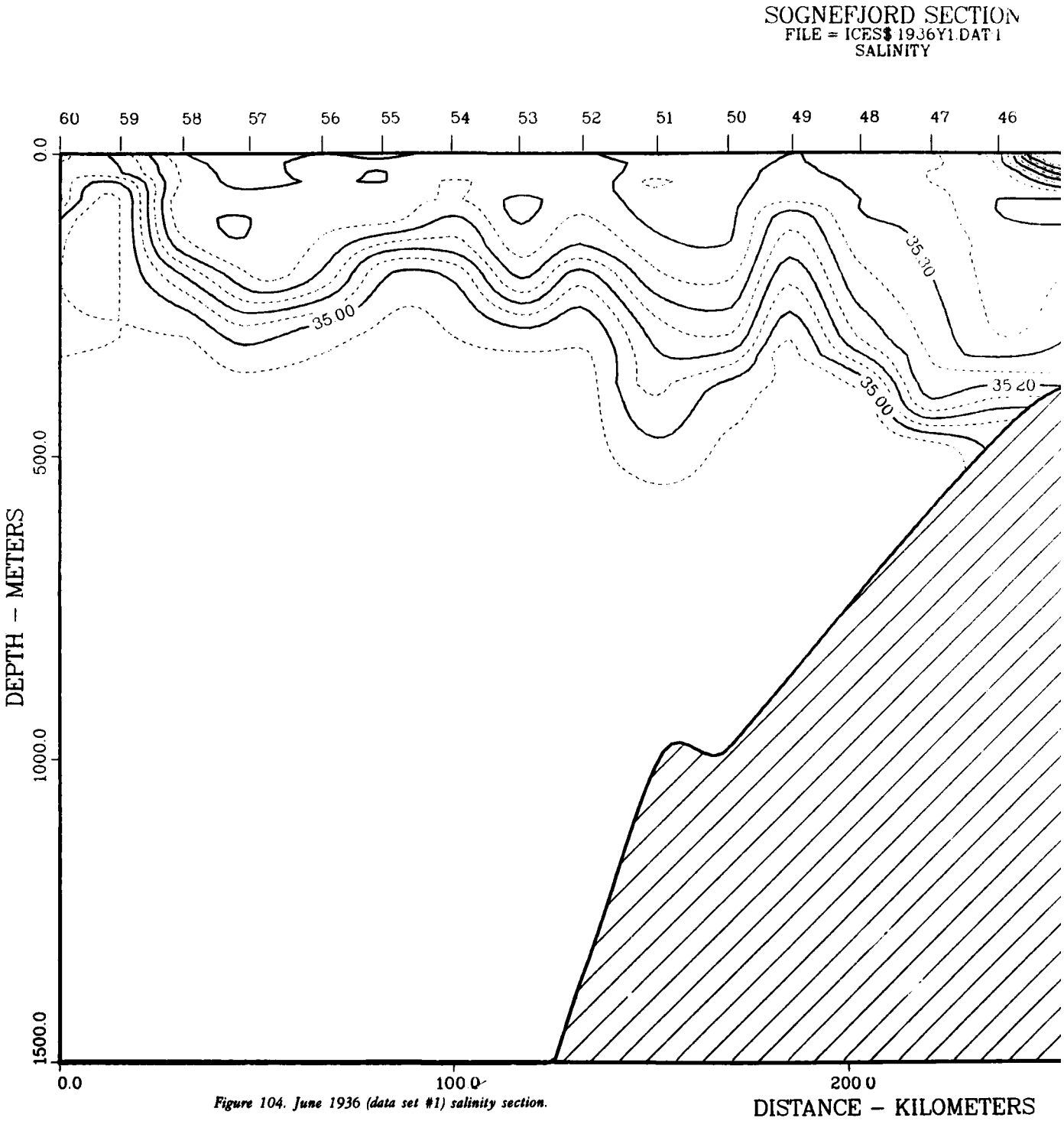
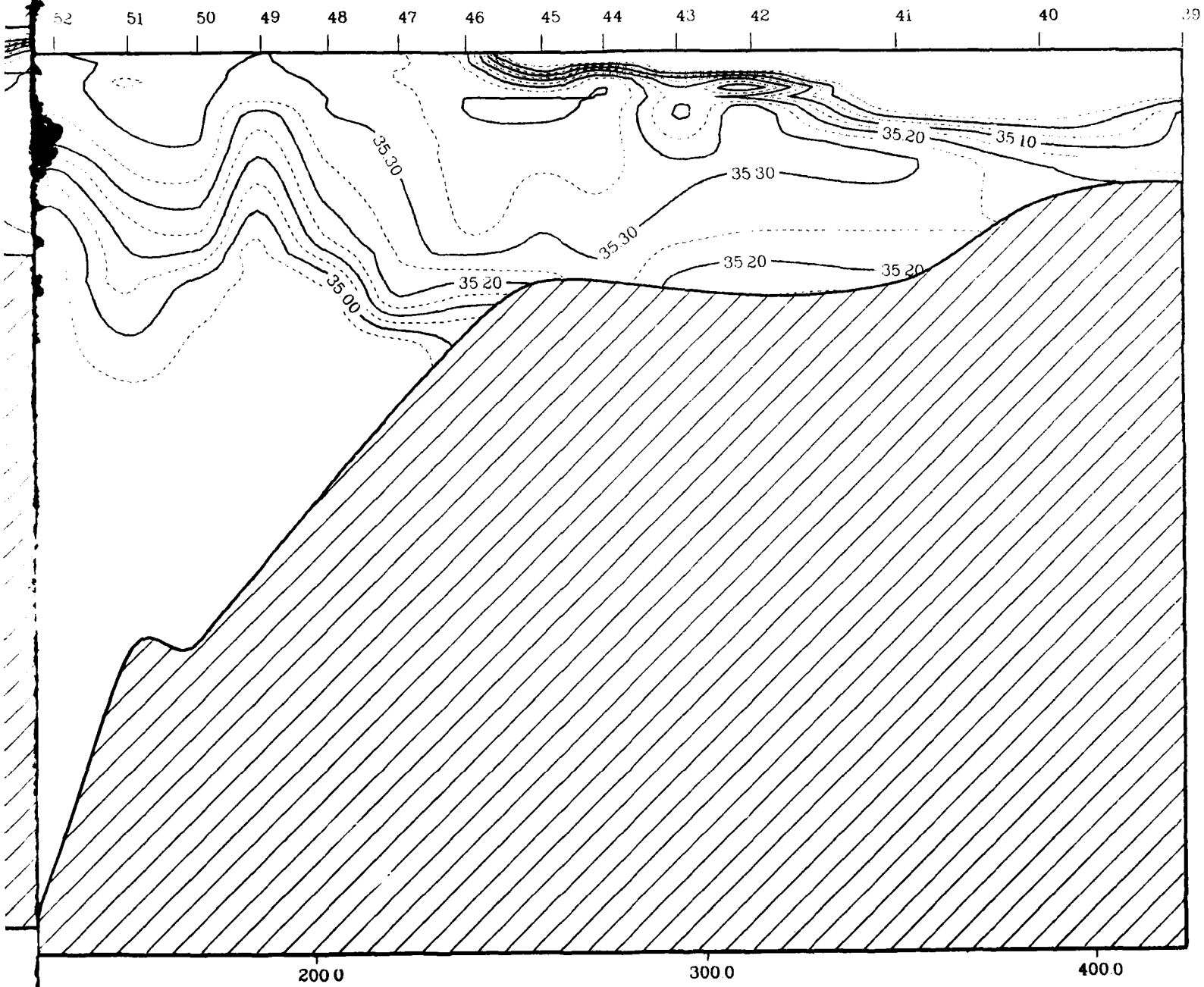


Figure 104. June 1936 (data set #1) salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1936Y1.DAT 1
SALINITY



DISTANCE – KILOMETERS

ICES$:1936A3.DAT

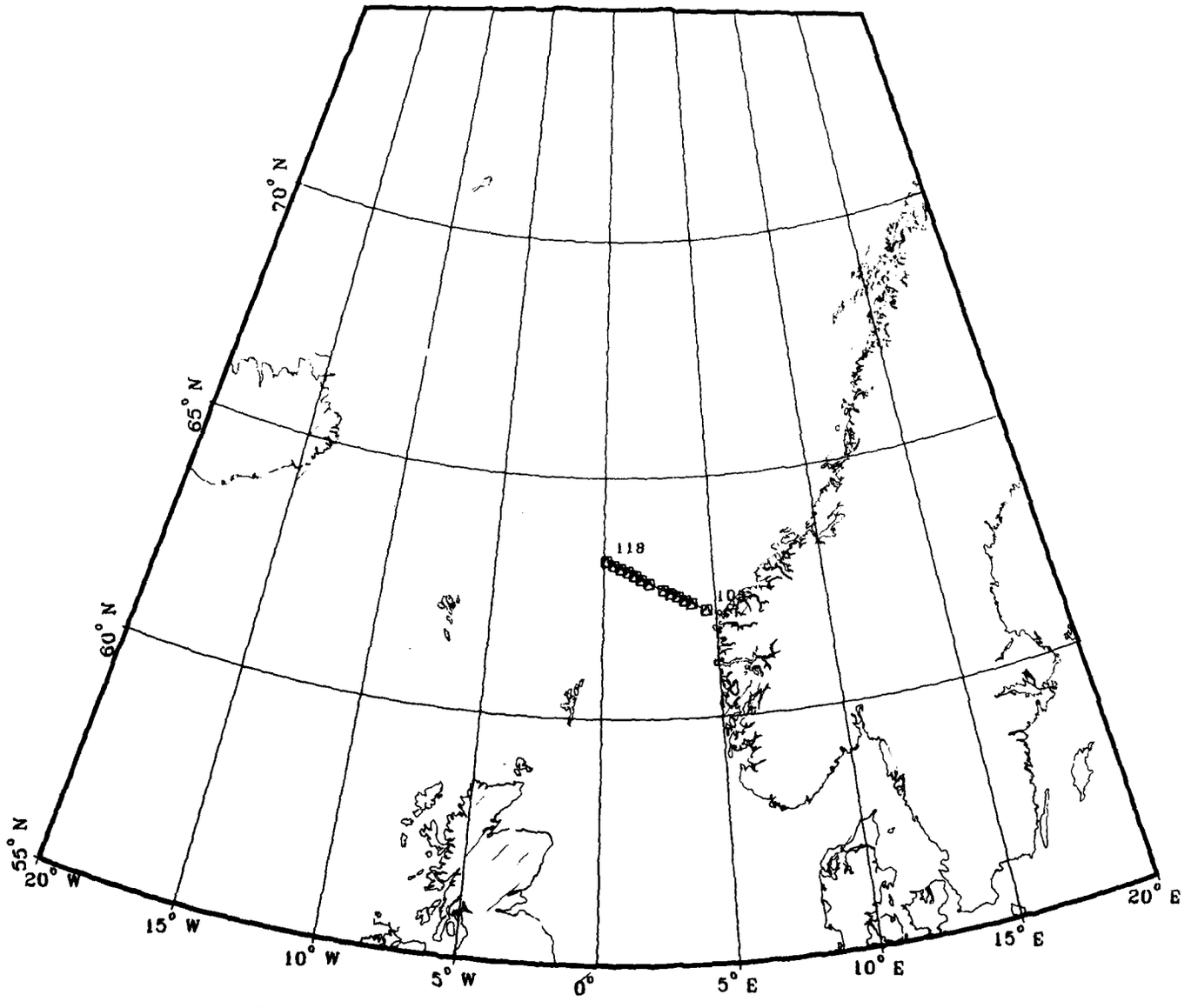


Figure 105. June 1936 (data set #3) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1936A3.DAT
T/S PLOT

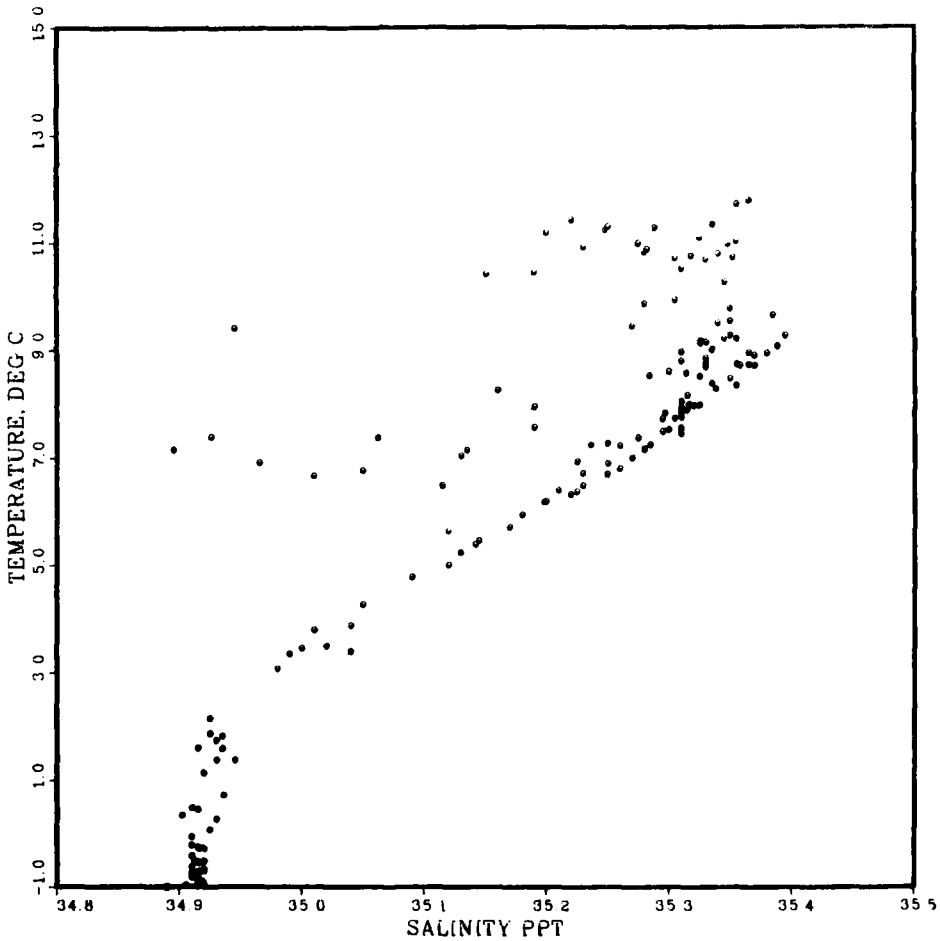


Figure 106. June 1936 (data set #3) temperature/salinity diagram.

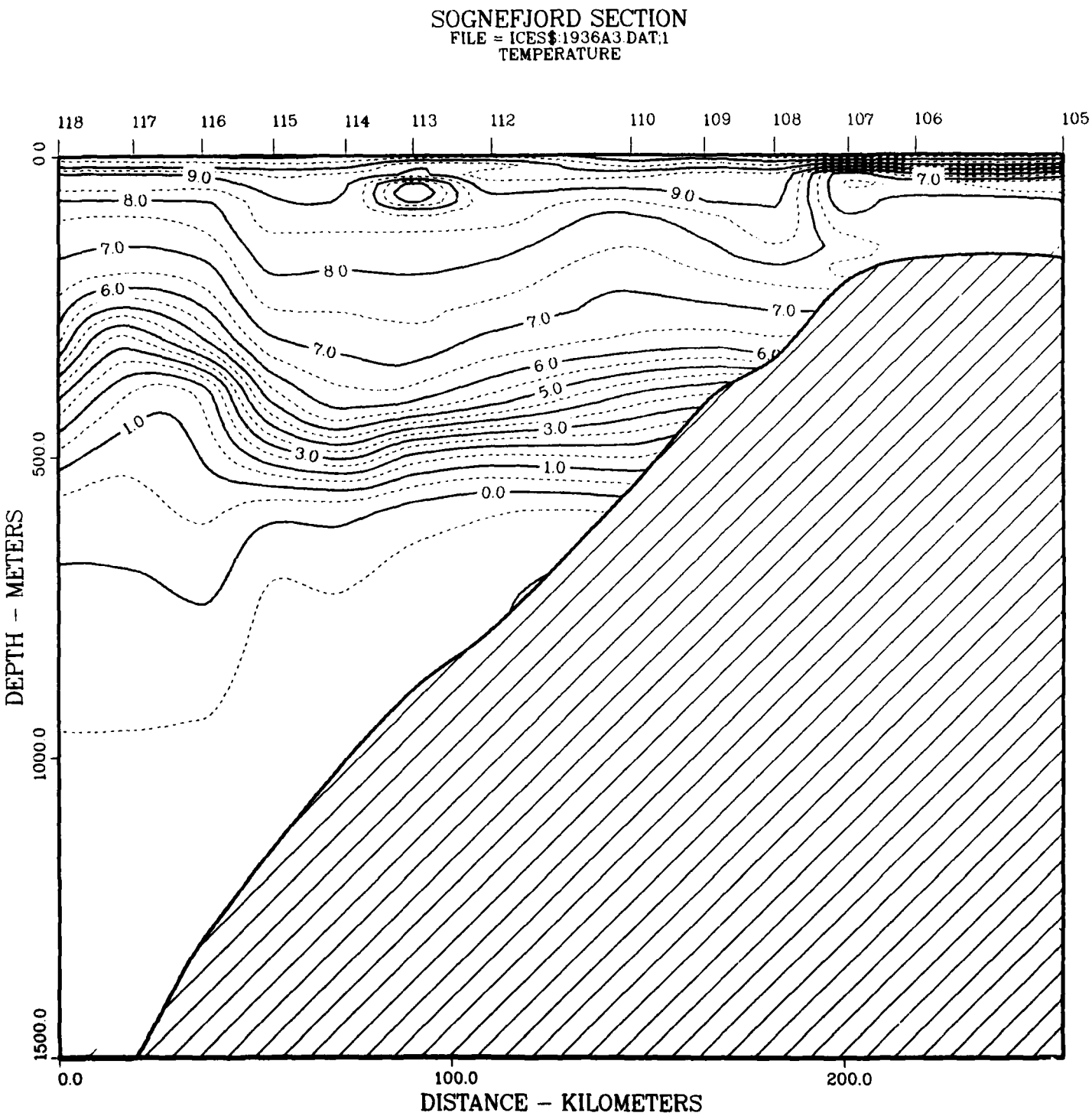


Figure 107. June 1936 (data set #3) temperature section.

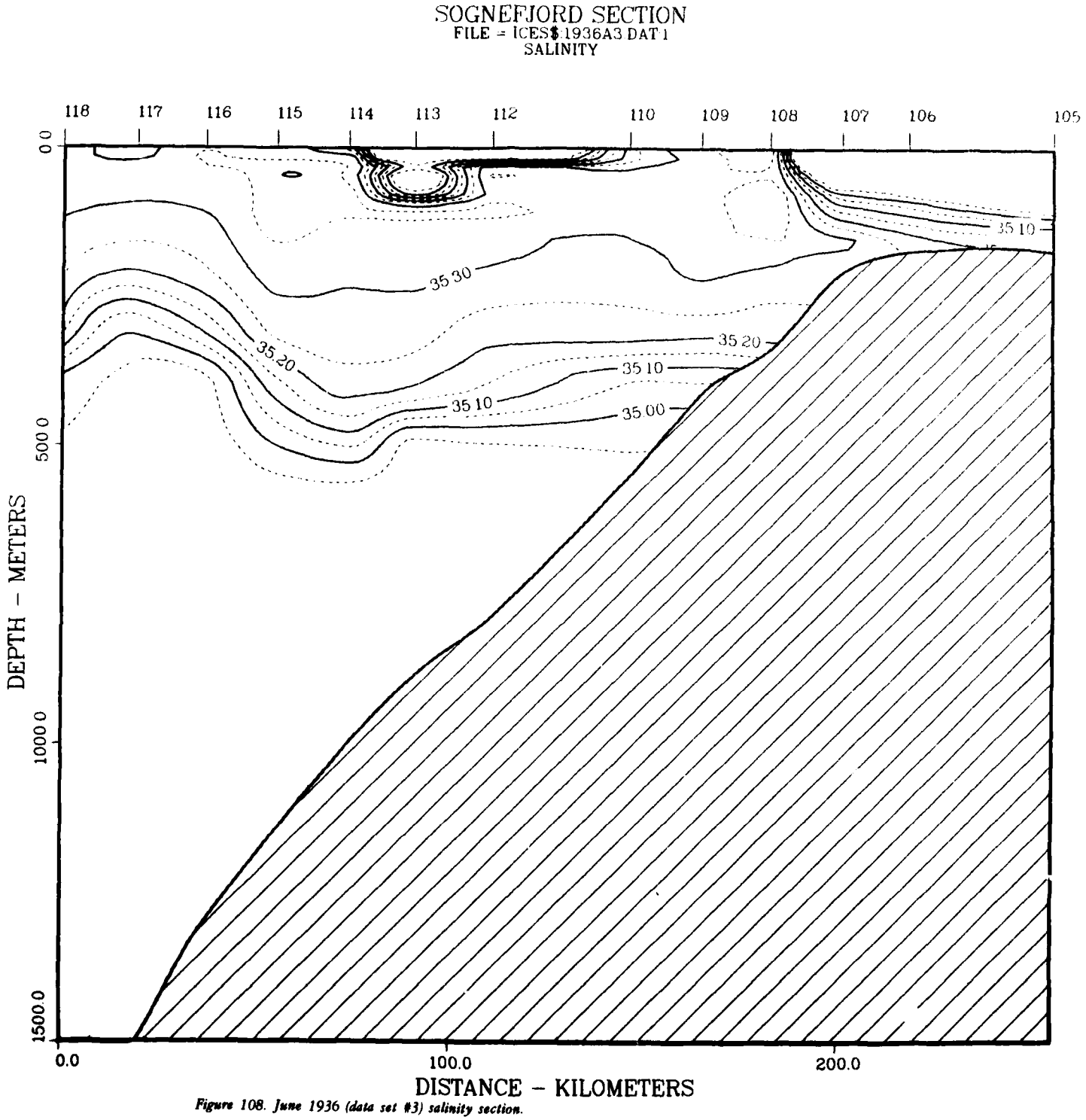


Figure 108. June 1936 (data set #3) salinity section.

ICES$:1936B5.DAT

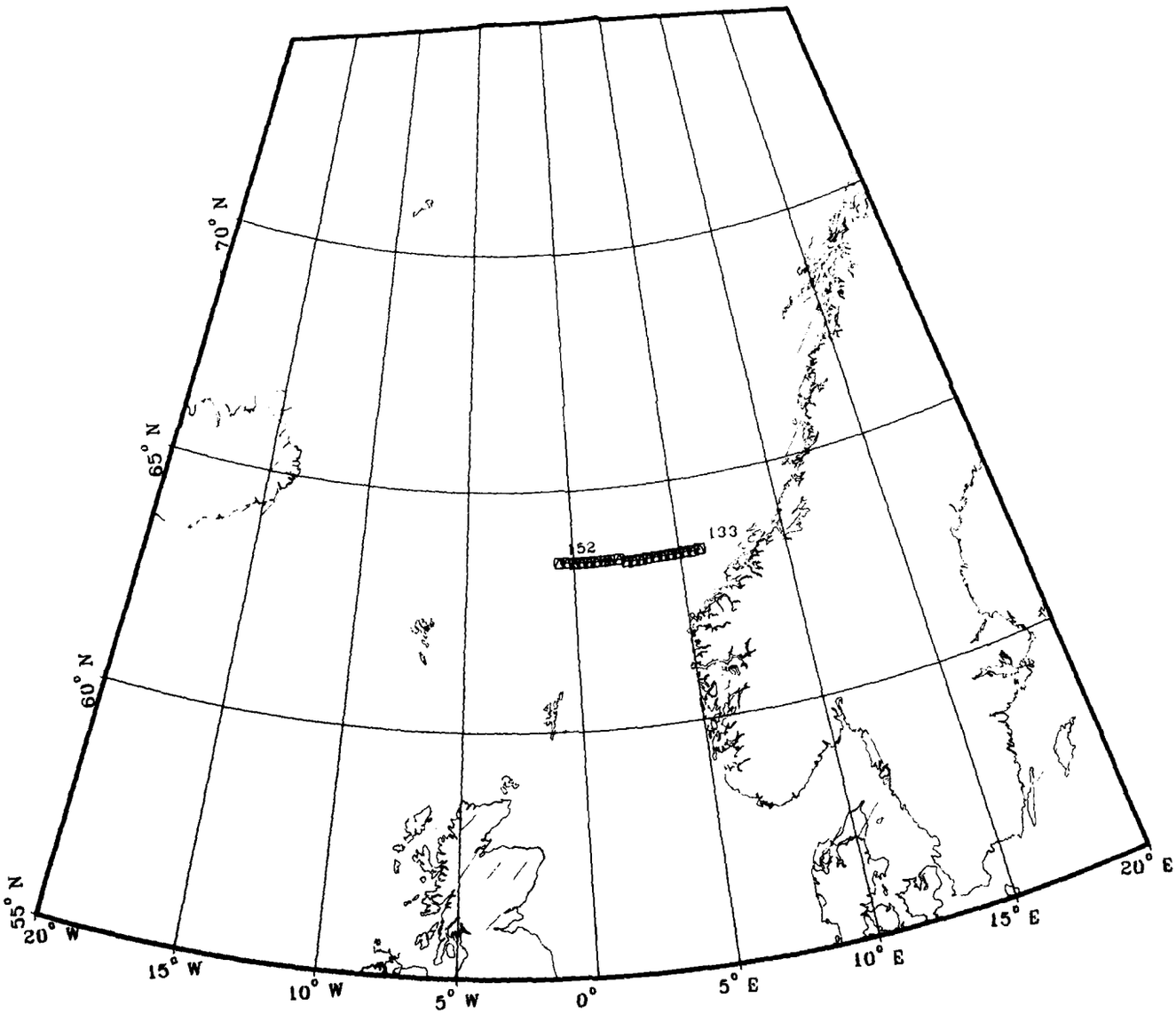


Figure 109. June 1936 (data set #5) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1936B5.DAT
T/S PLOT

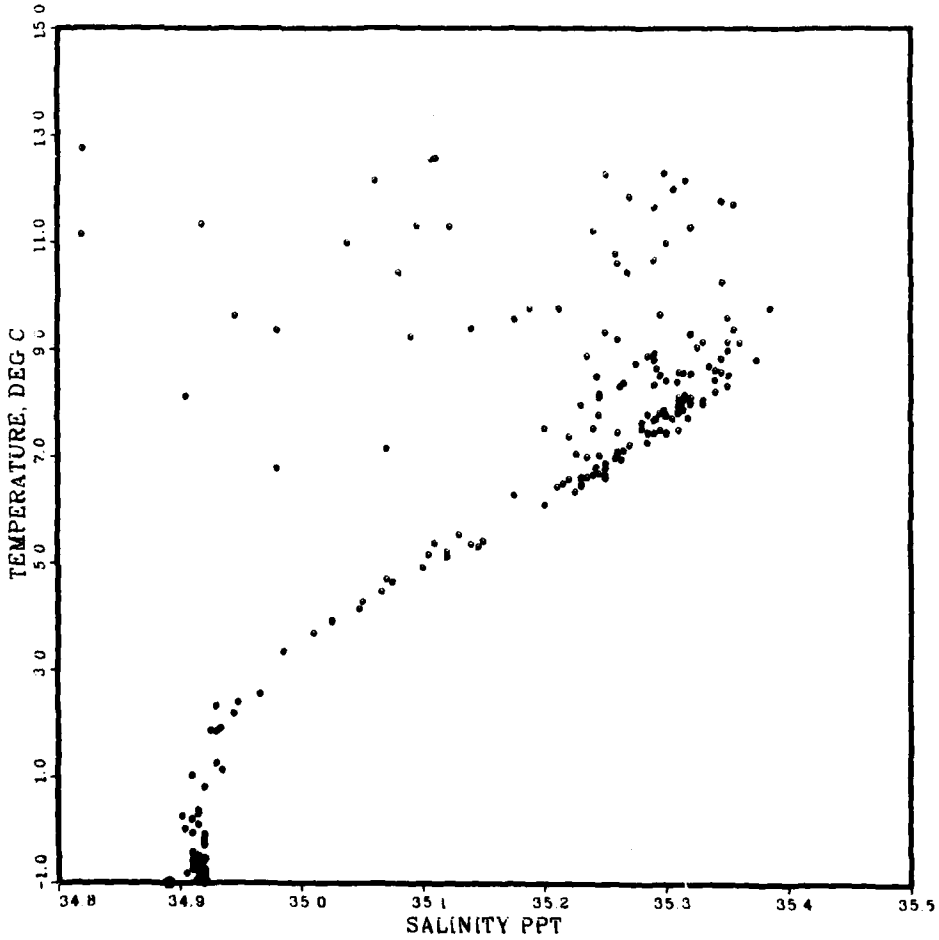


Figure 110. June 1936 (data set #5) temperature/salinity diagram.

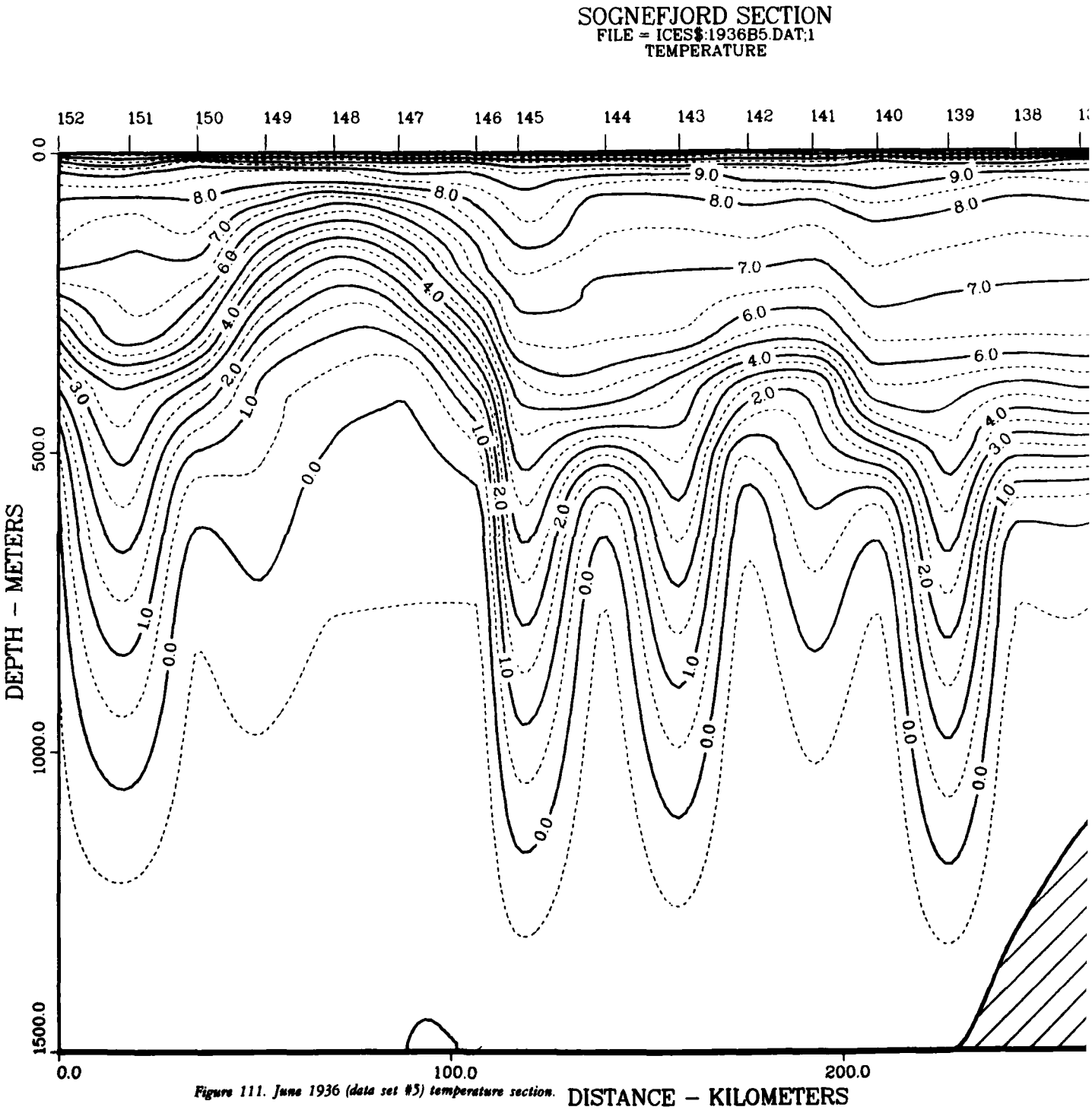
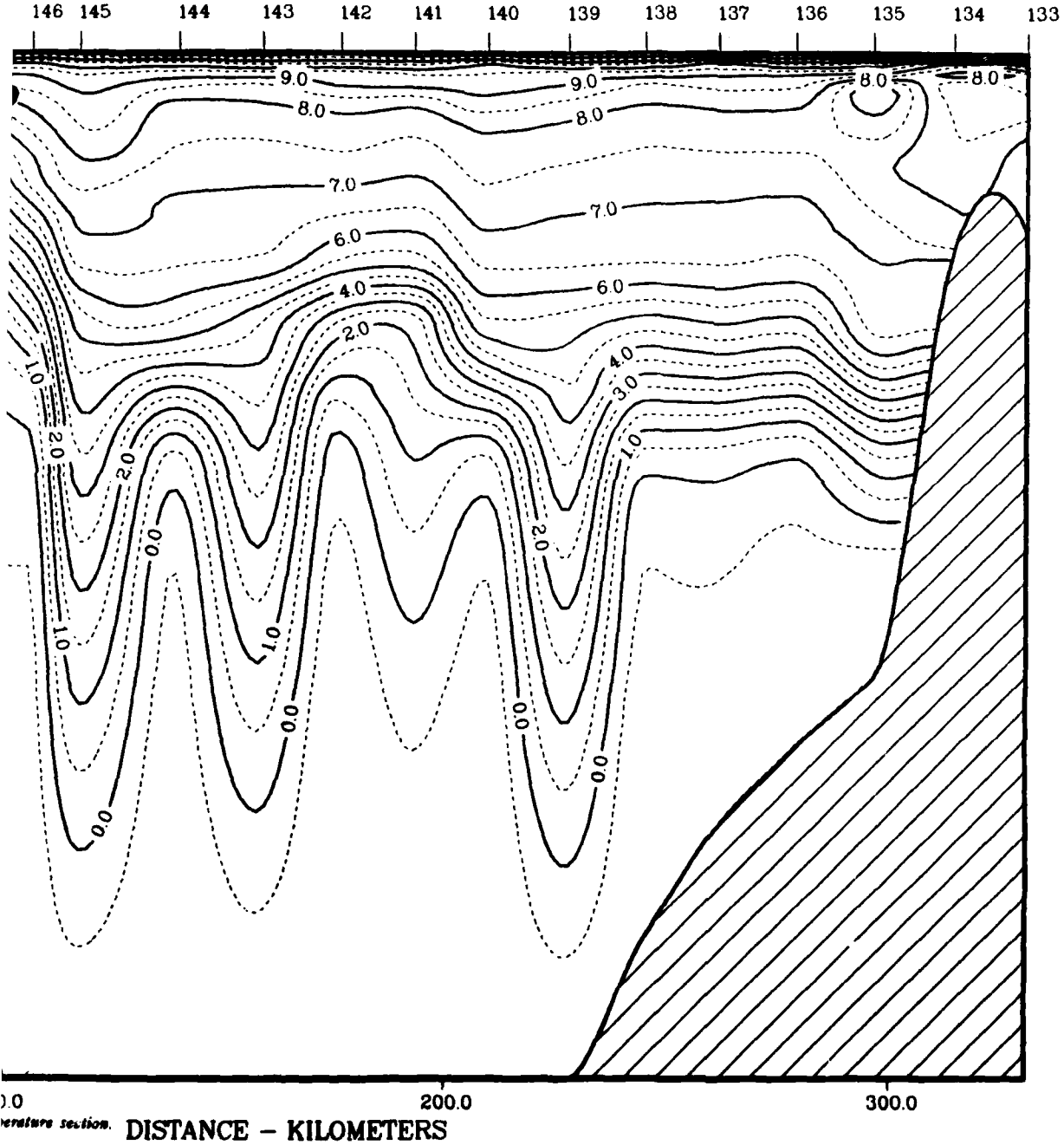


Figure 111. June 1936 (data set #5) temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1936B5.DAT;1
TEMPERATURE



...perature section. DISTANCE – KILOMETERS

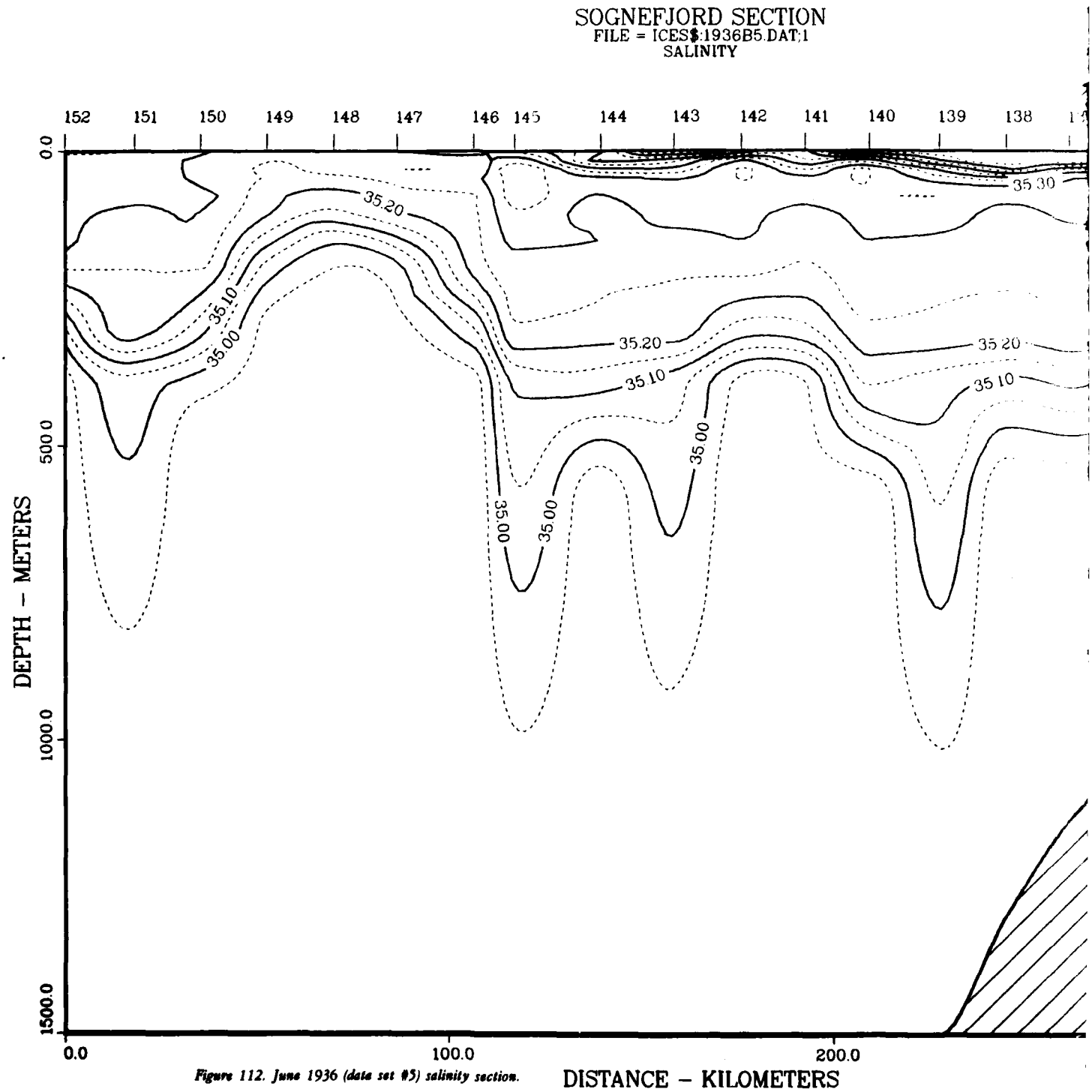
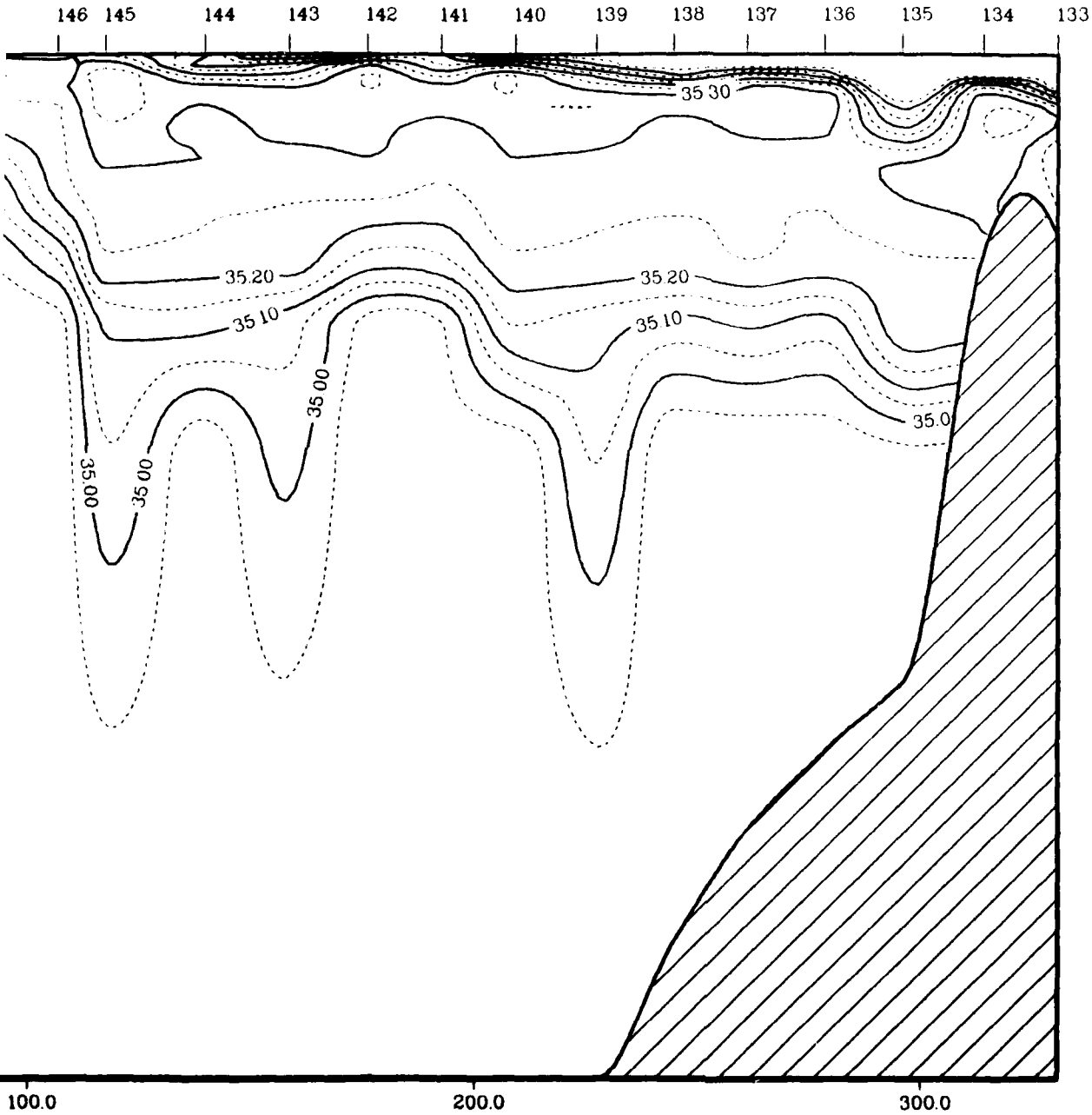


Figure 112. June 1936 (data set #5) salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1936B5 DAT;1
SALINITY



salinity section.

ICES$:1936C6.DAT

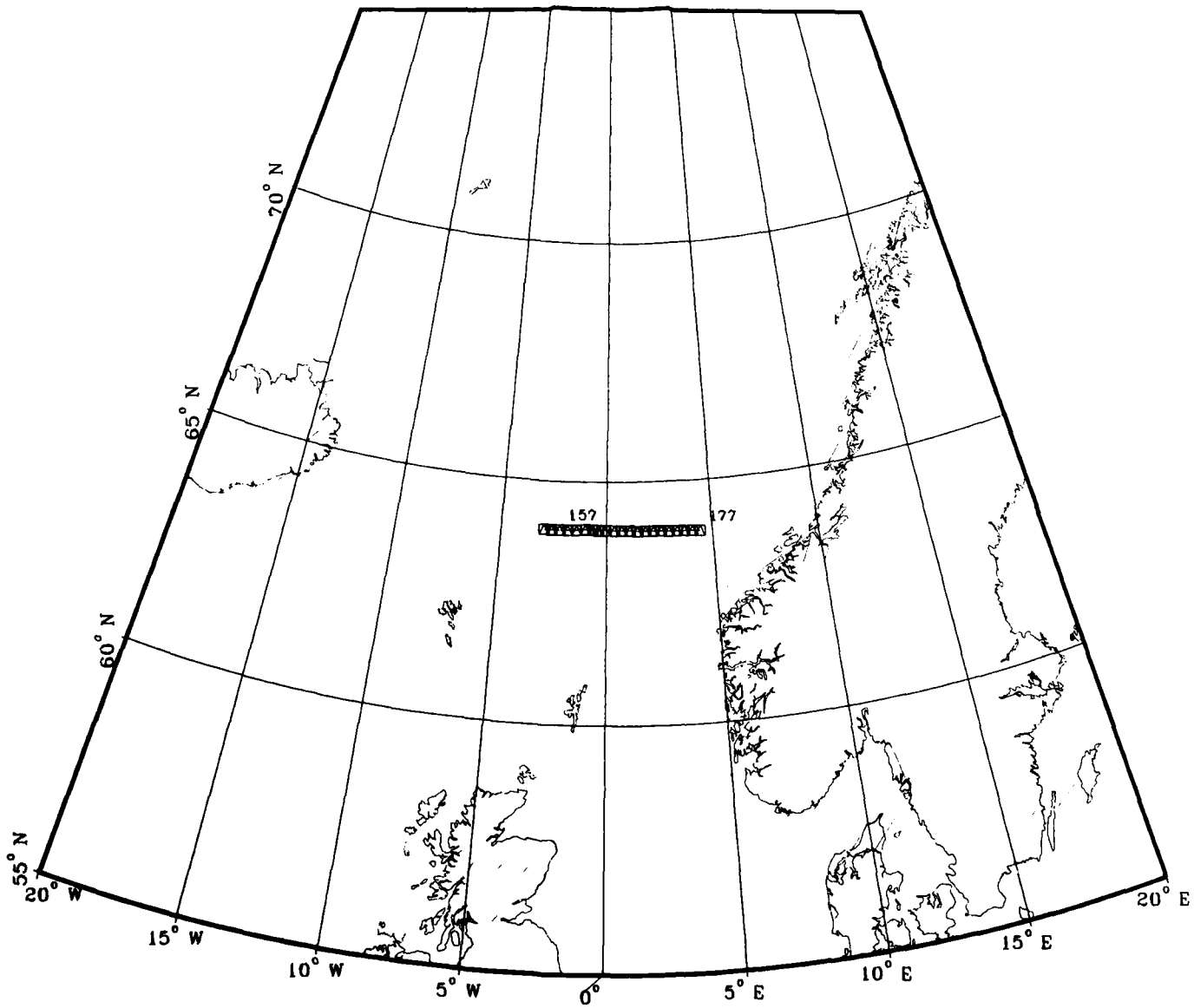


Figure 113. June 1936 (data set #6) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1936C6 DAT
T/S PLOT

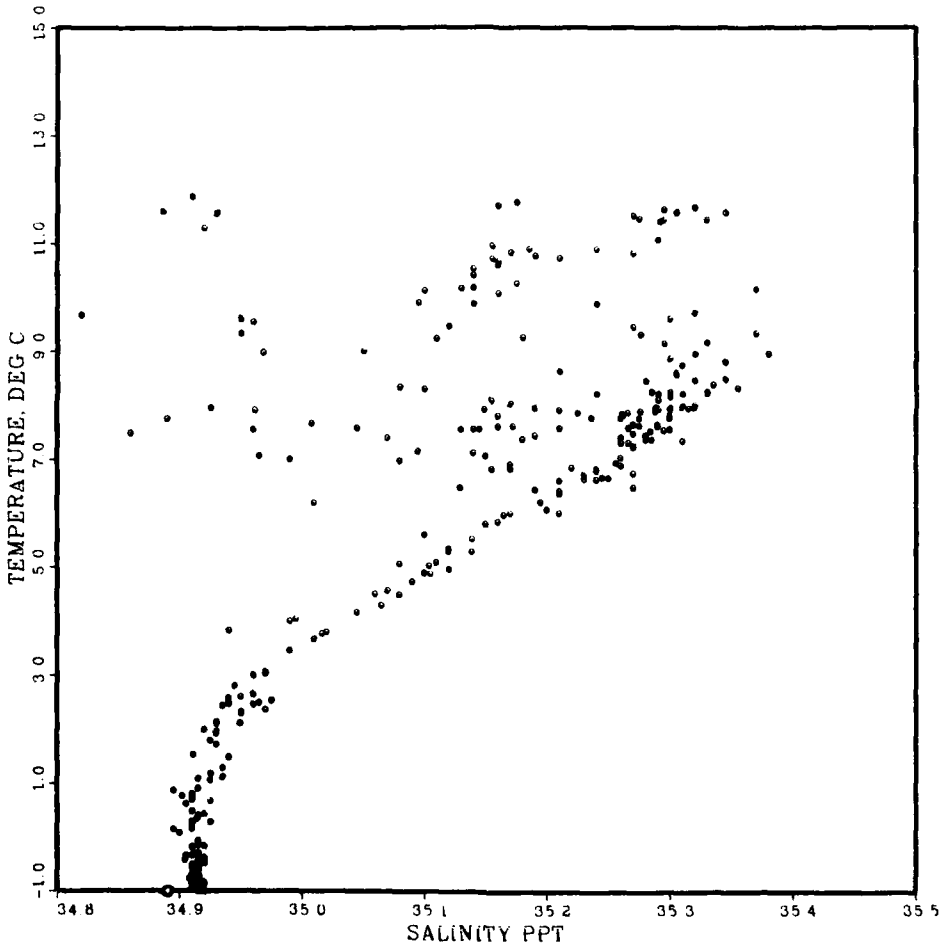


Figure 114. June 1936 (data set #6) temperature/salinity diagram.

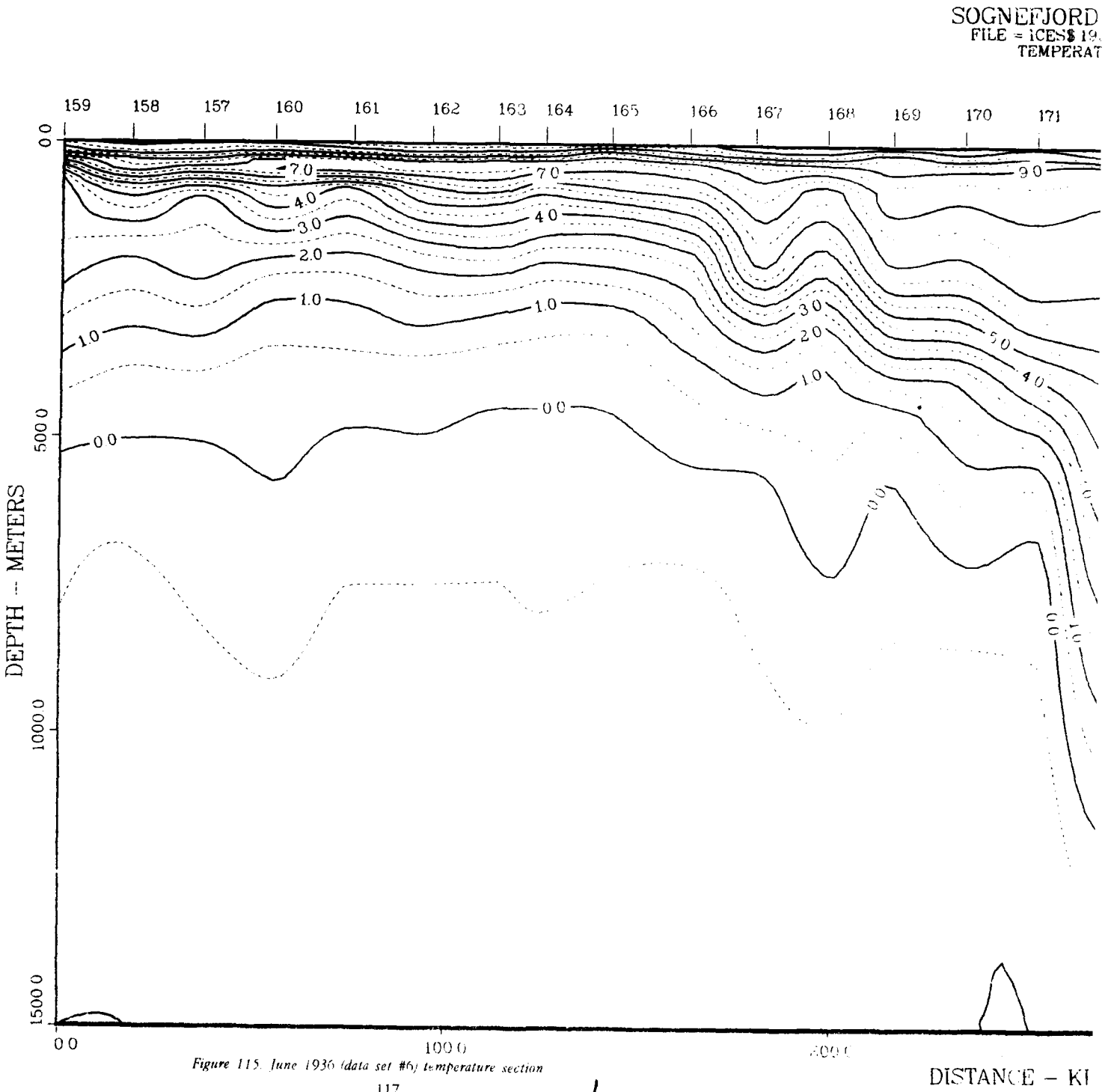
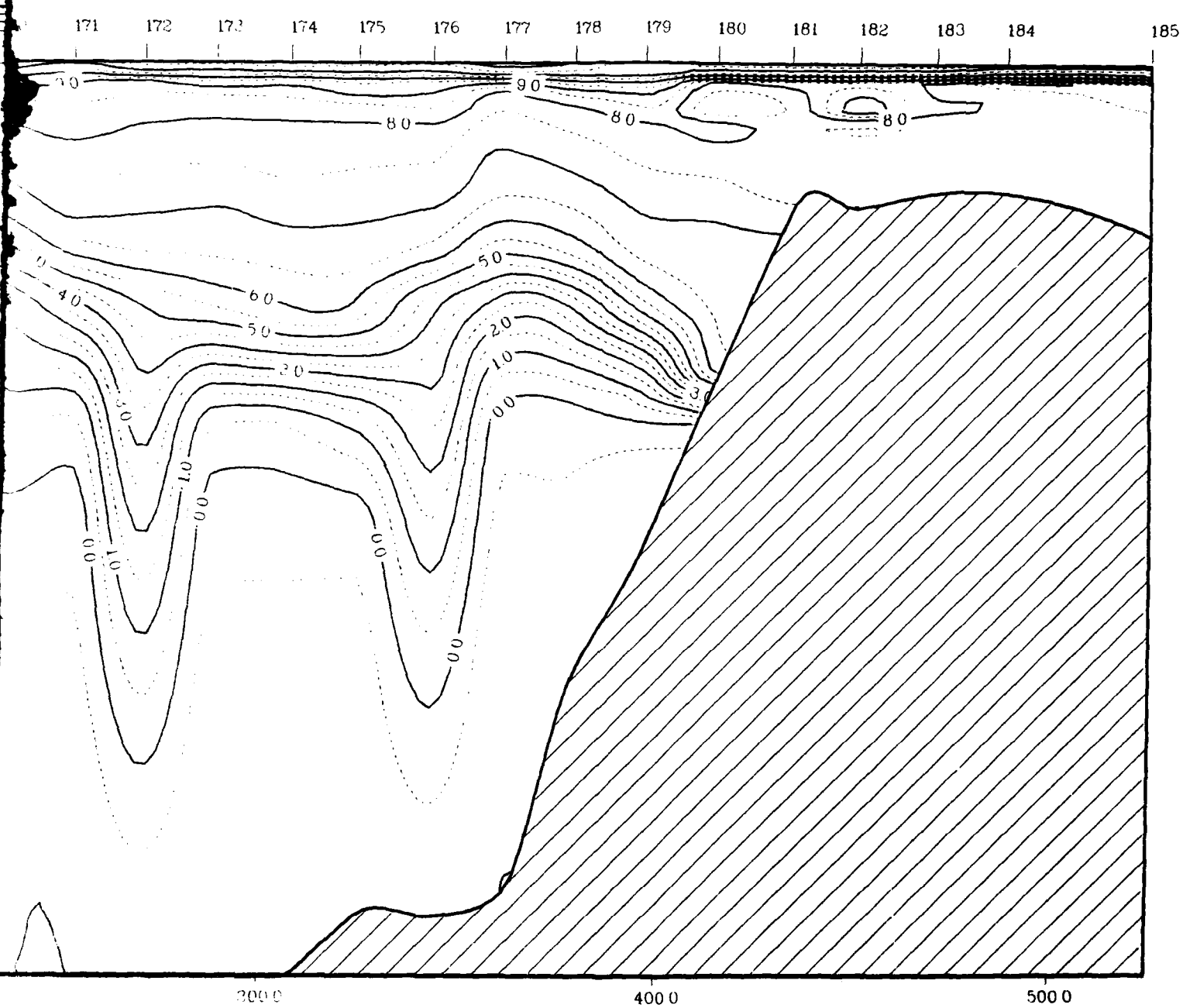


Figure 115. June 1936 (data set #6) temperature section

GNEFJORD SECTION
ILE = ICES$ 1936C6 DAT 1
TEMPERATURE



ANCE – KILOMETERS

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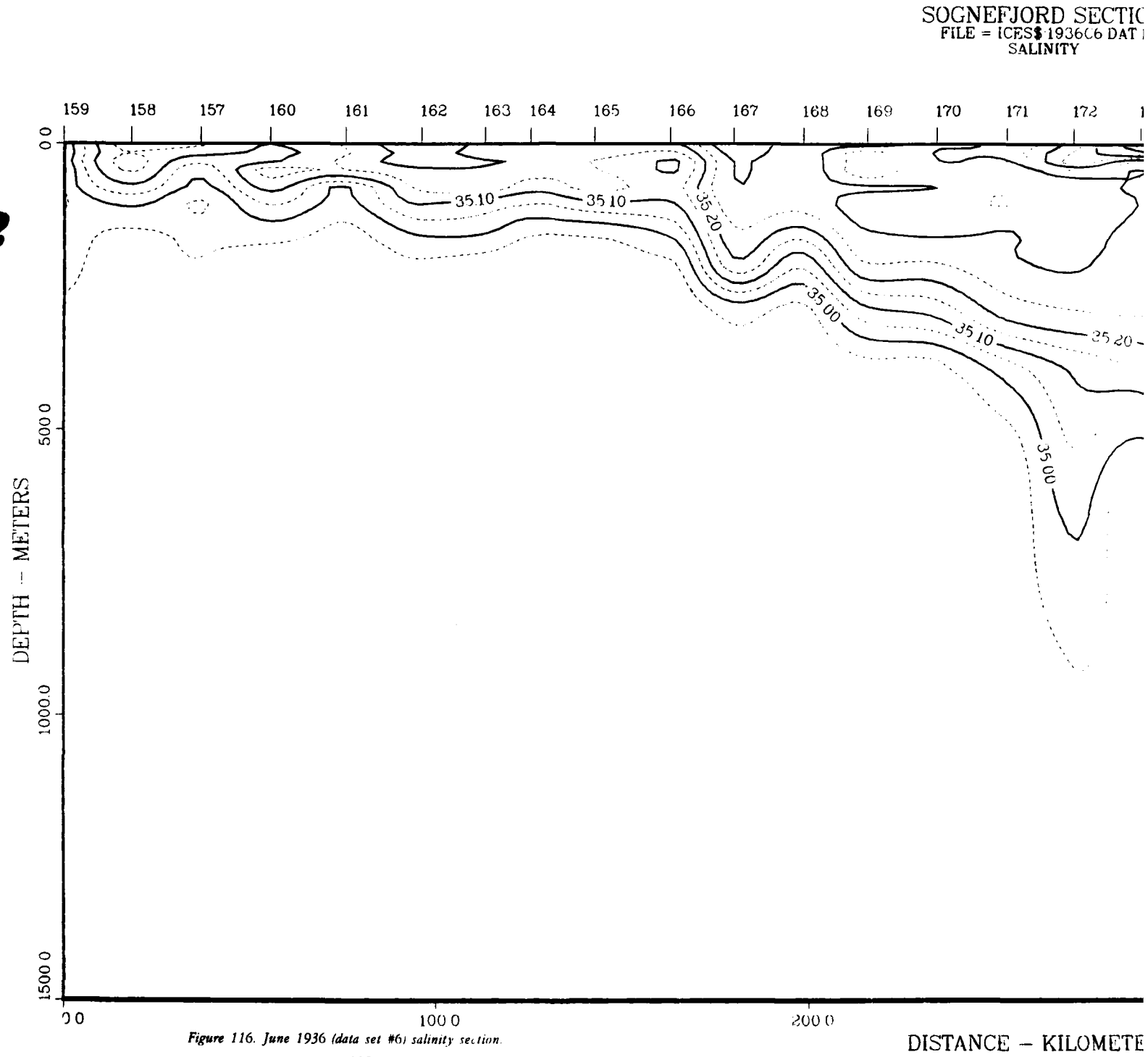
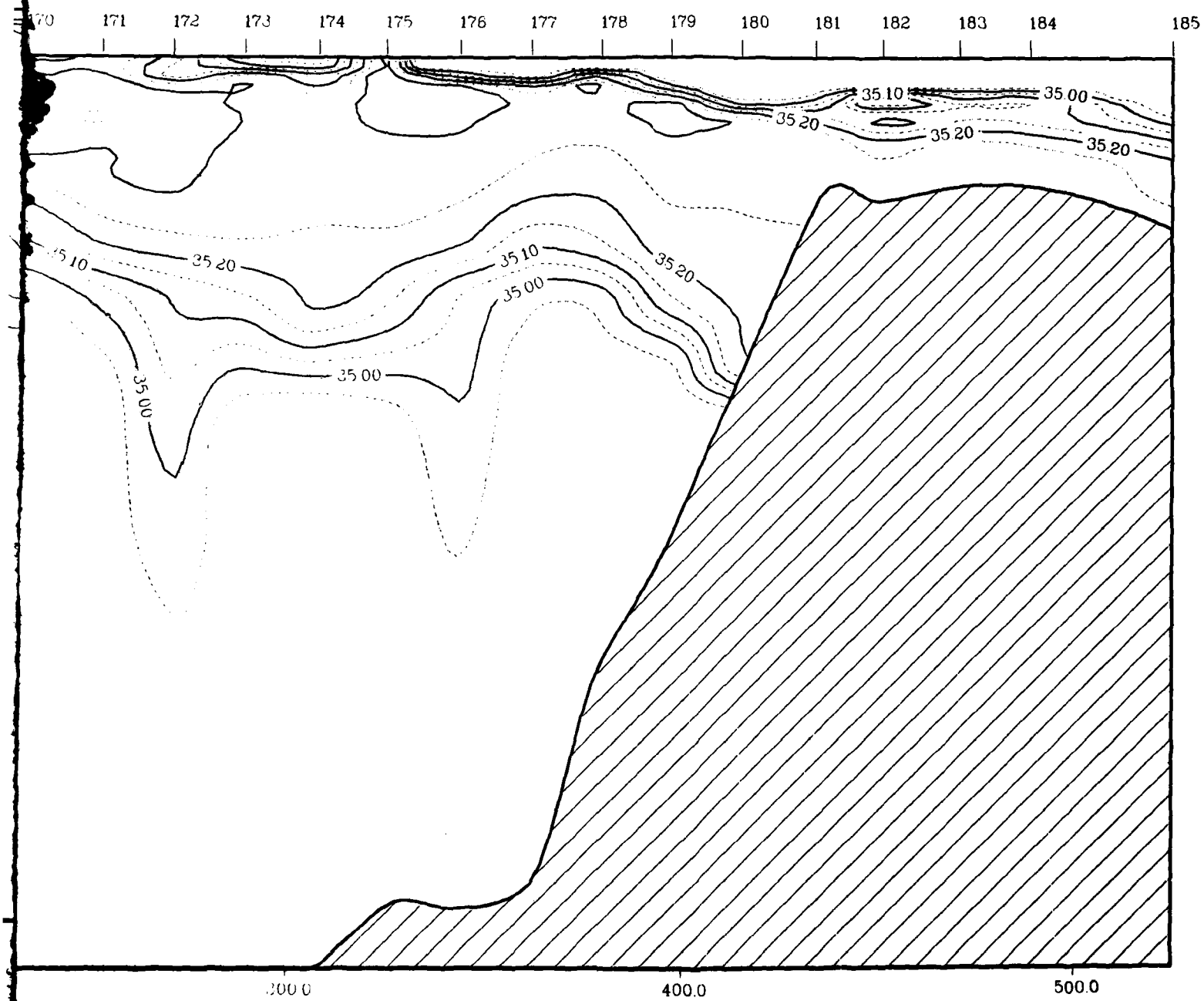


Figure 116. June 1936 (data set #6) salinity section.

OGNEFJORD SECTION
FILE = ICES$ 1936C6 DAT 1
SALINITY



STANCE – KILOMETERS

ICES$:1936D7.DAT

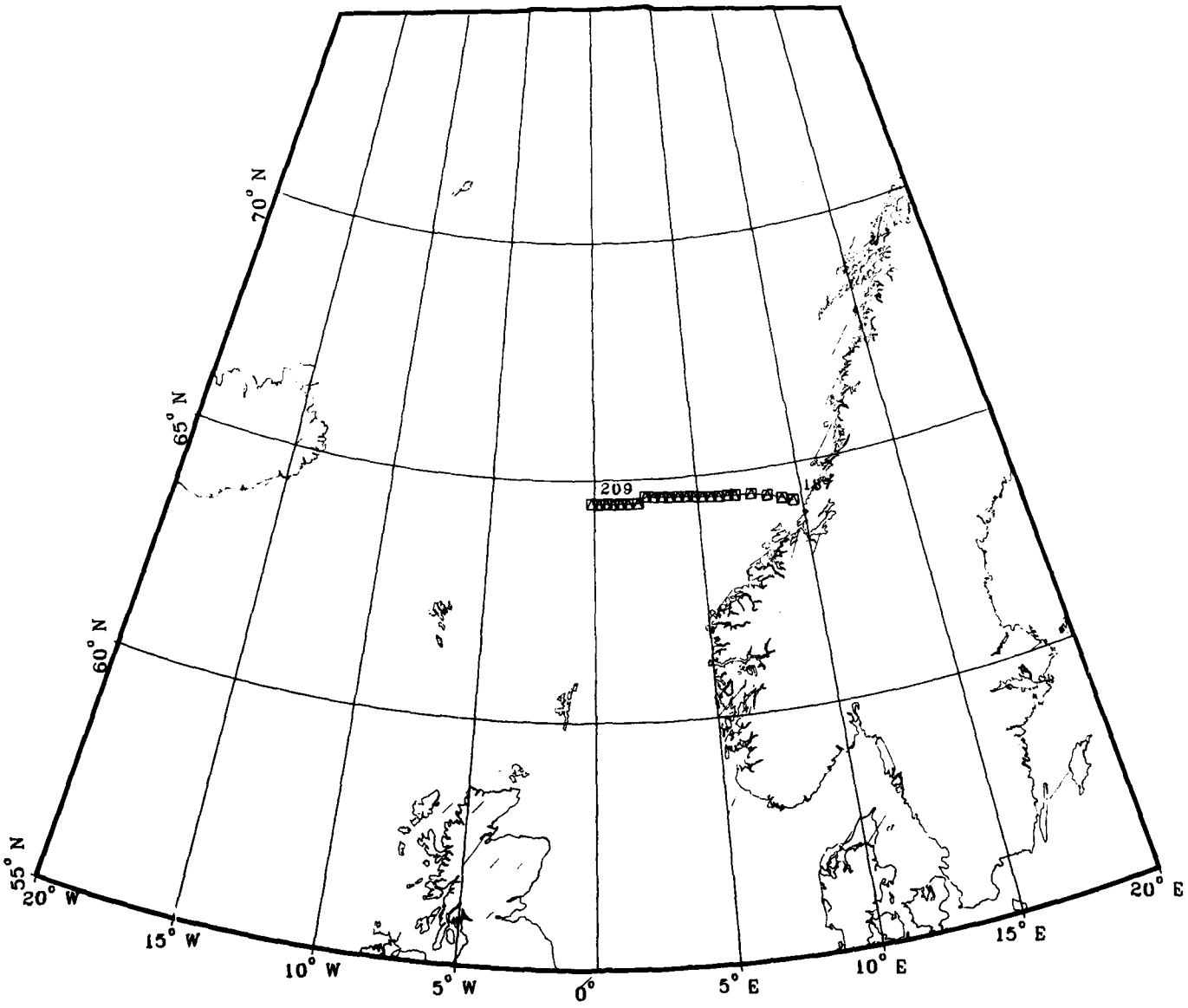


Figure 117. June 1936 (data set #7) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1936D7.DAT
T/S PLOT

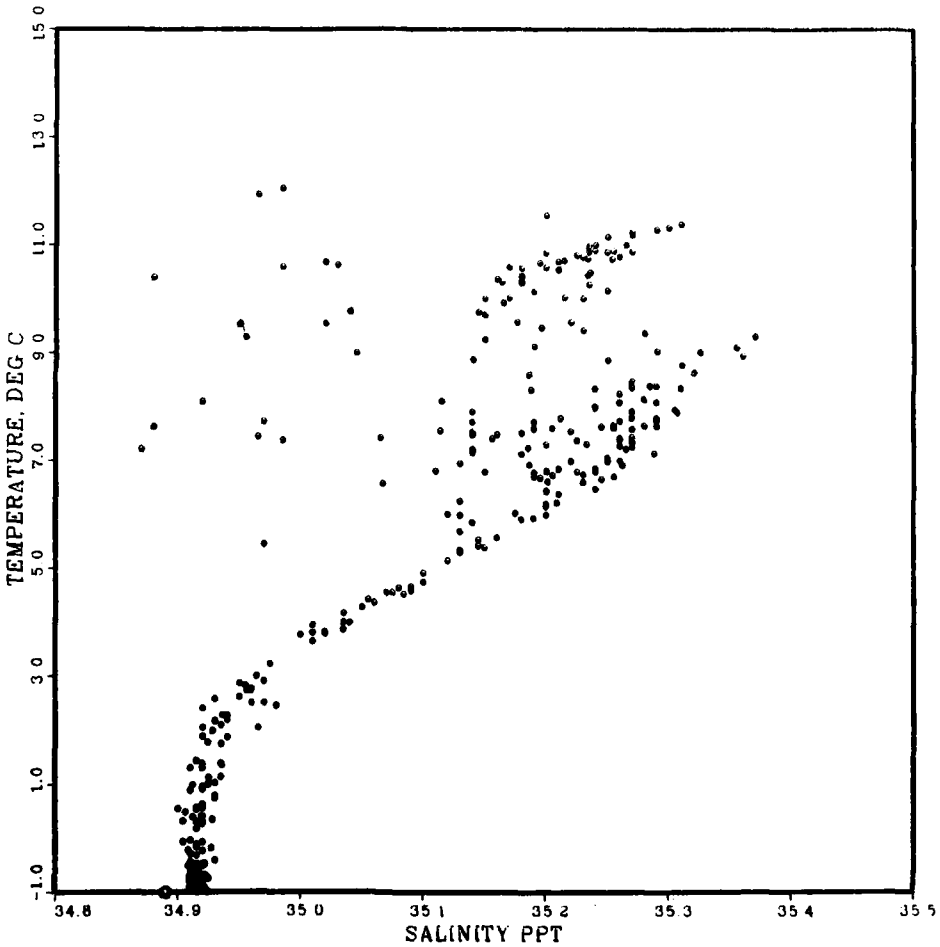


Figure 118. June 1936 (data set #7) temperature/salinity diagram.

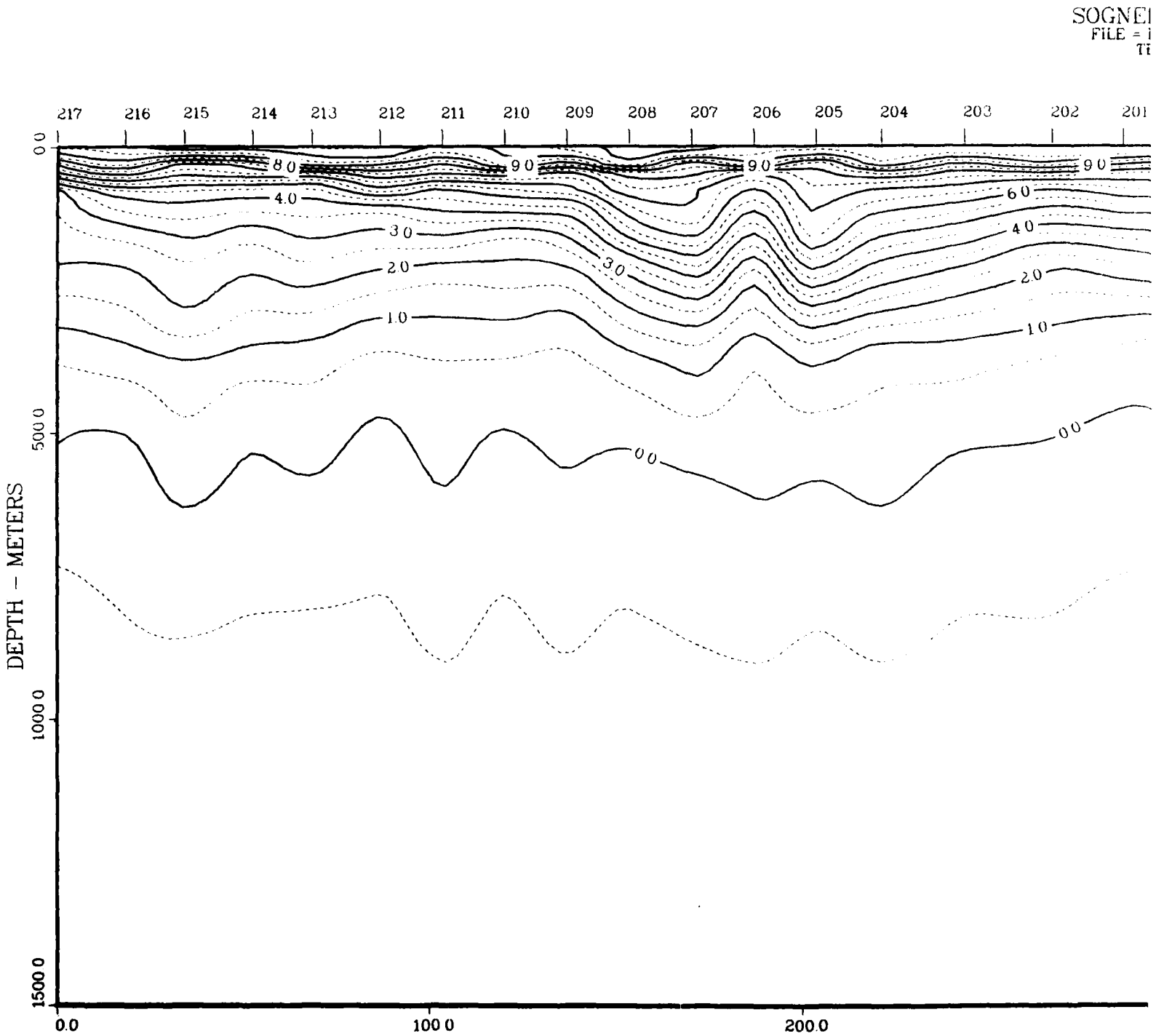
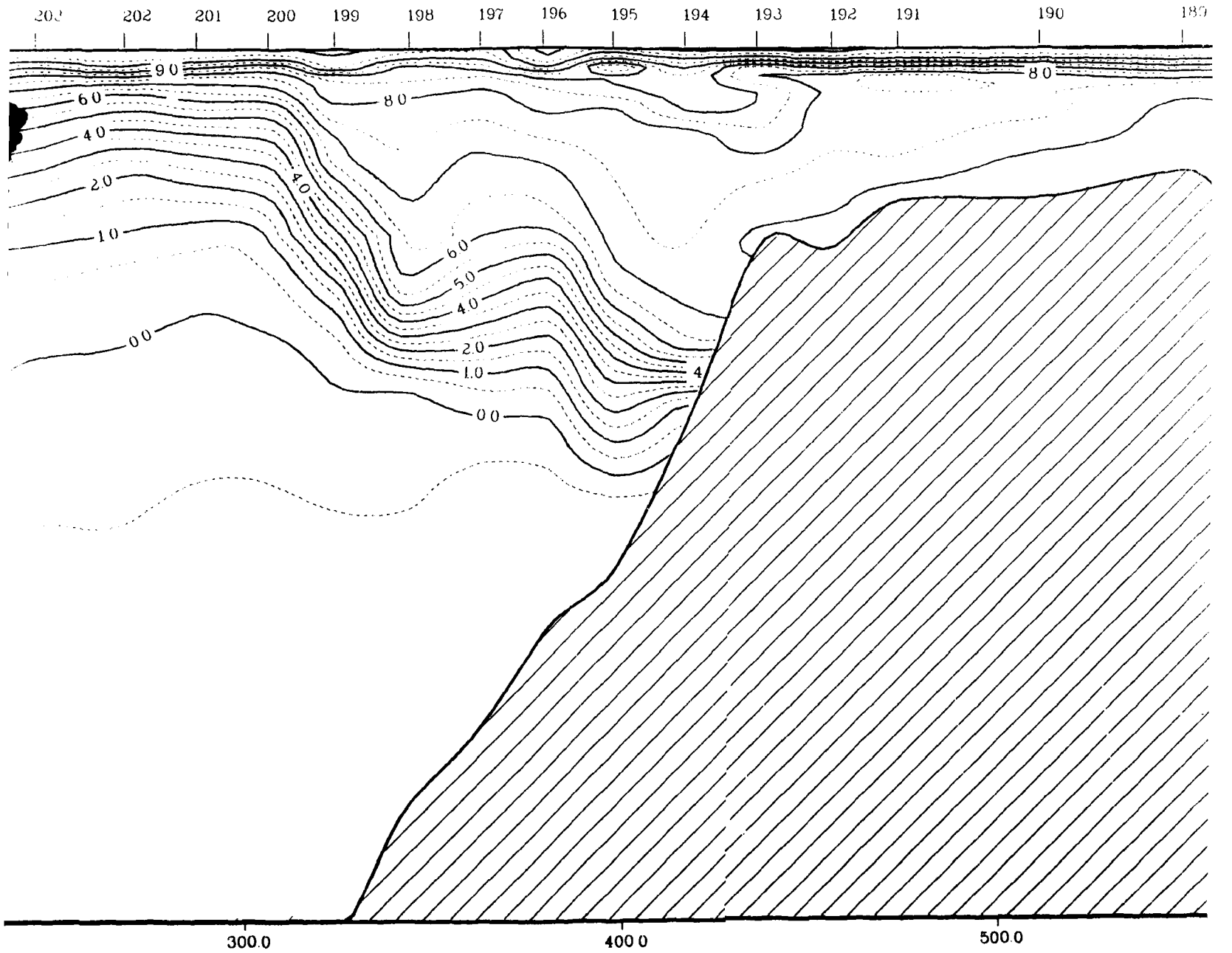


Figure 119. June 1936 (data set #7) temperature section.

SOGNEFJORD SECTION
FILE = ICES$.1936D7.DAT.1
TEMPERATURE



DISTANCE – KILOMETERS

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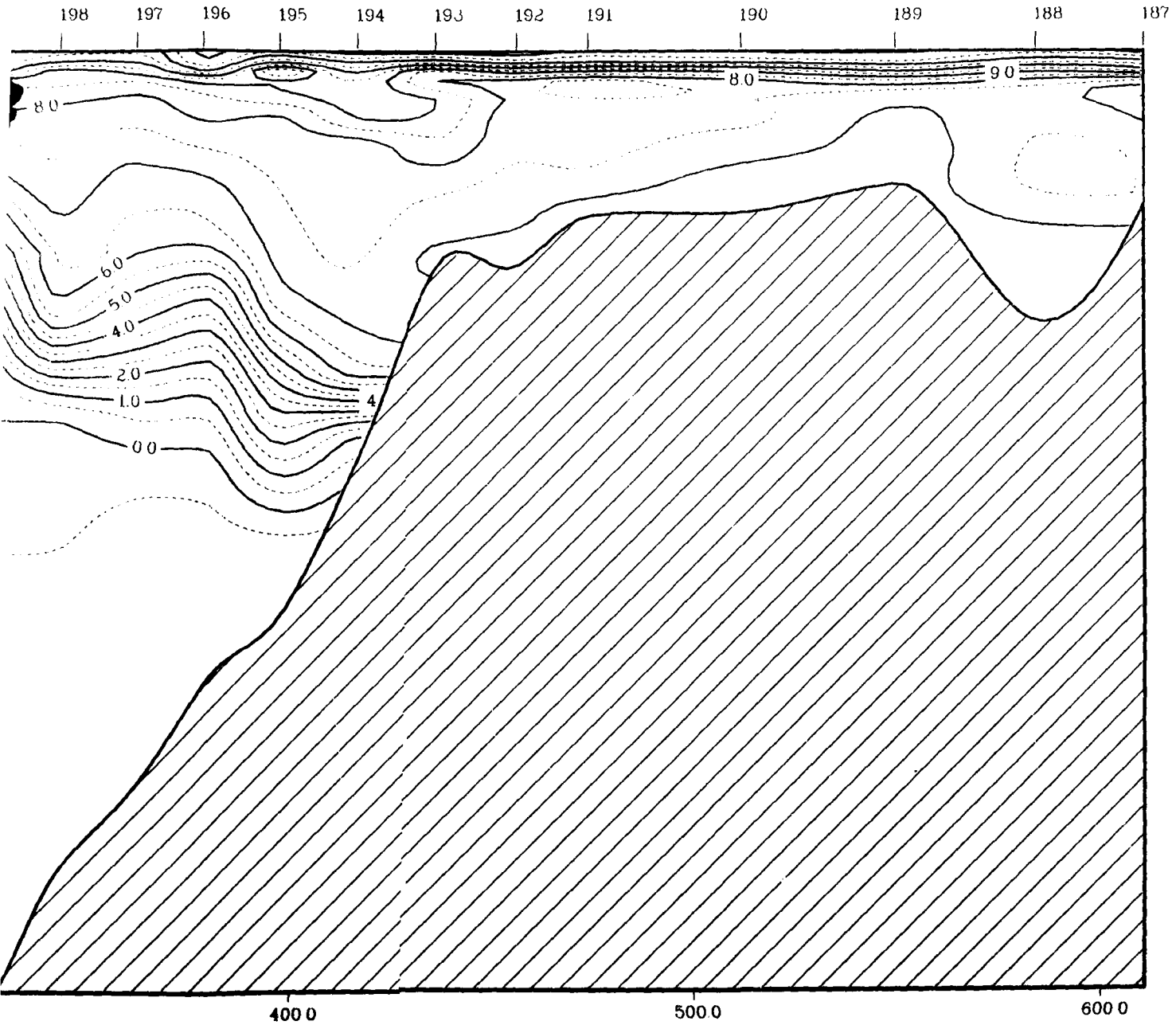
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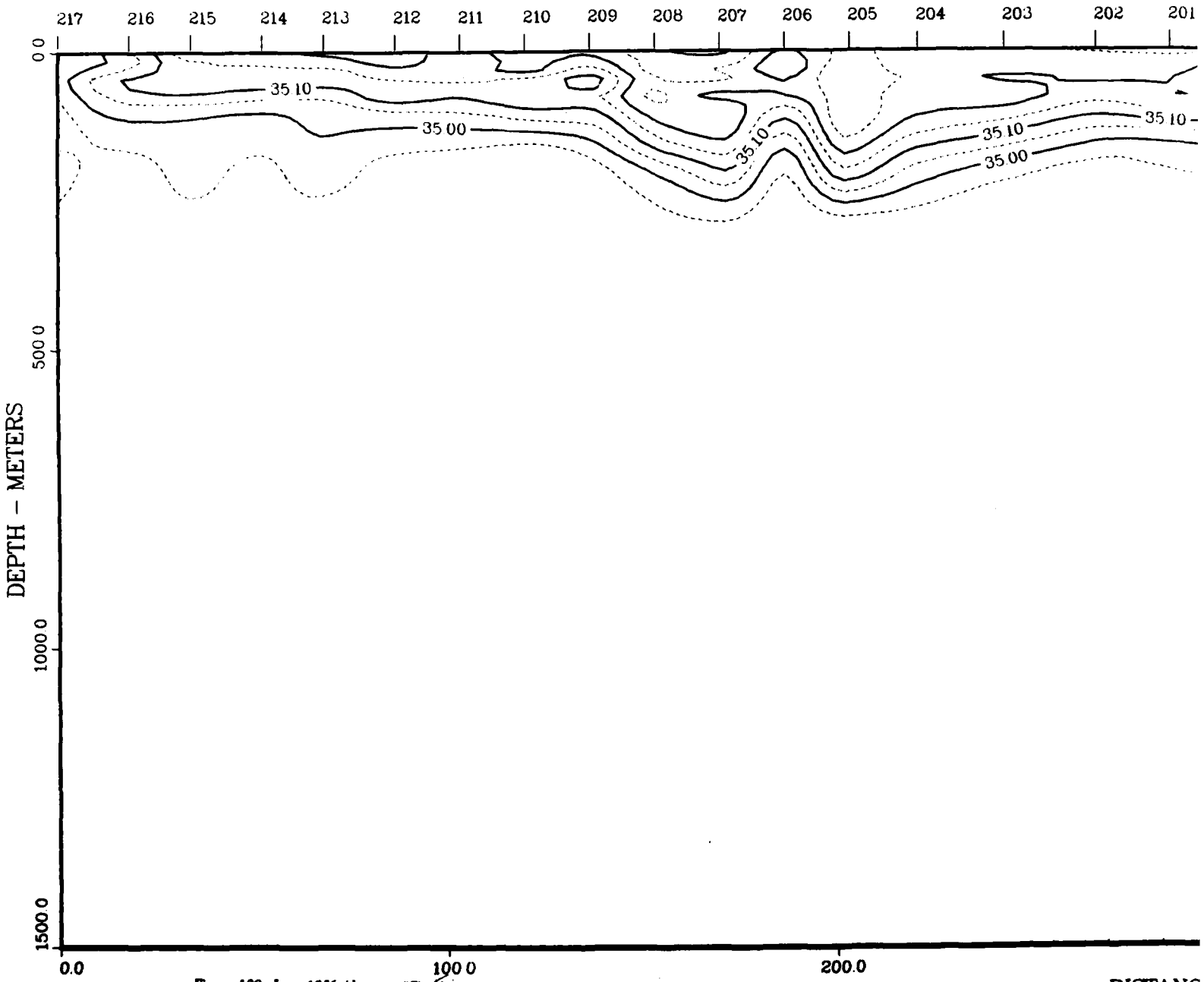
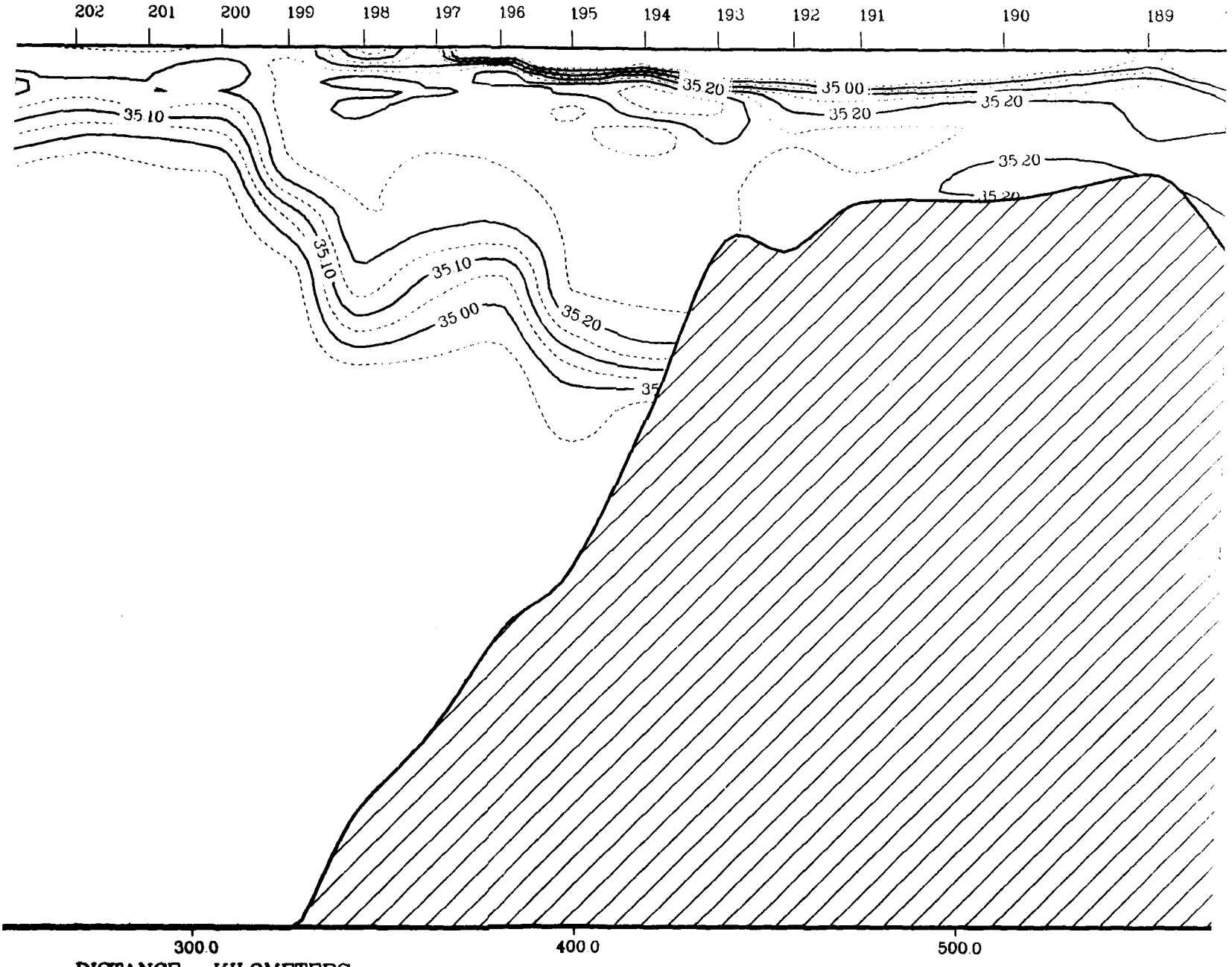
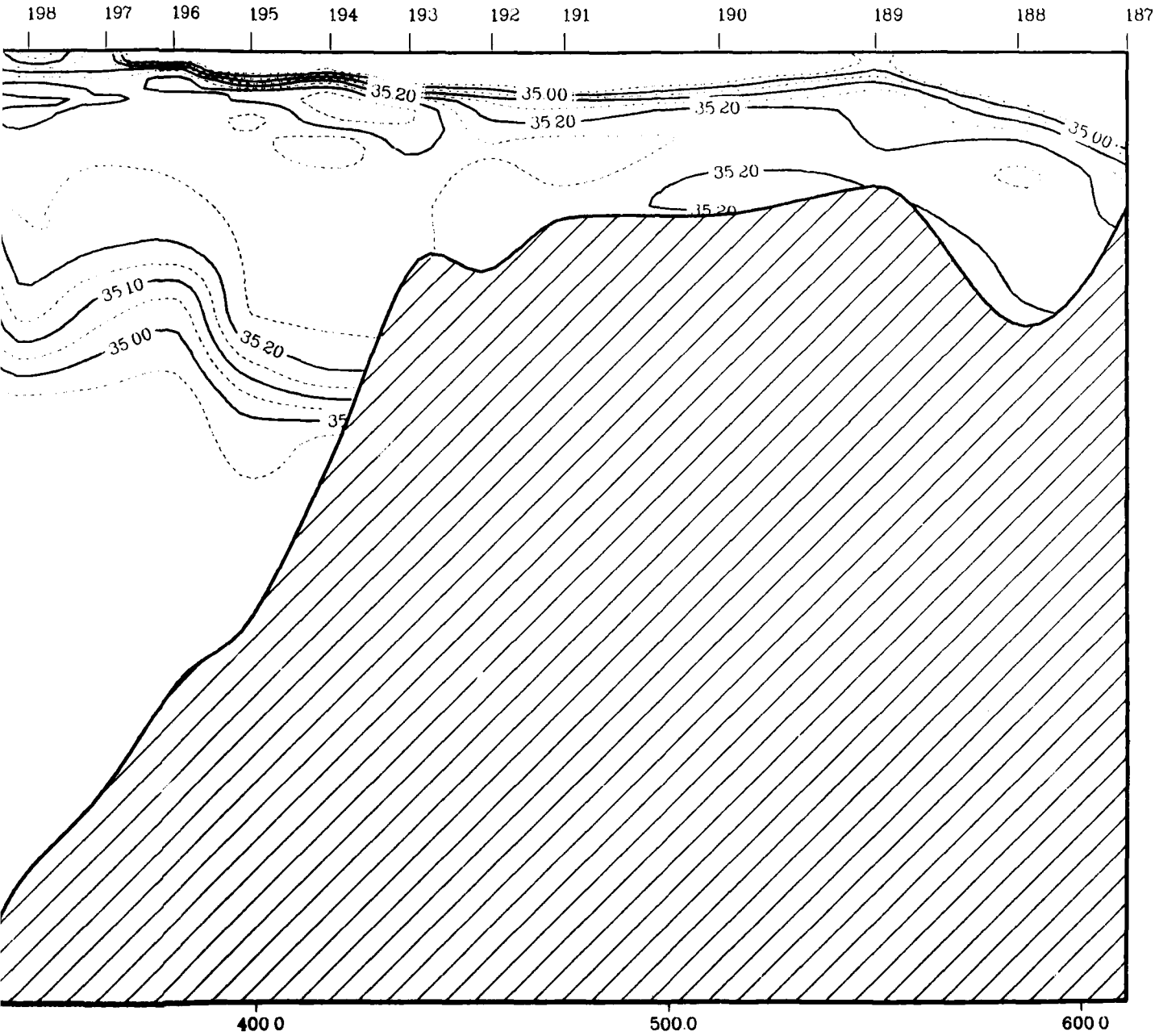


Figure 120. June 1936 (data set #7) salinity section.

SOGNEFJORD SECTION
FILE = ICES$19.36D7.DAT·1
SALINITY



DISTANCE – KILOMETERS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ICES$:1936E8.DAT

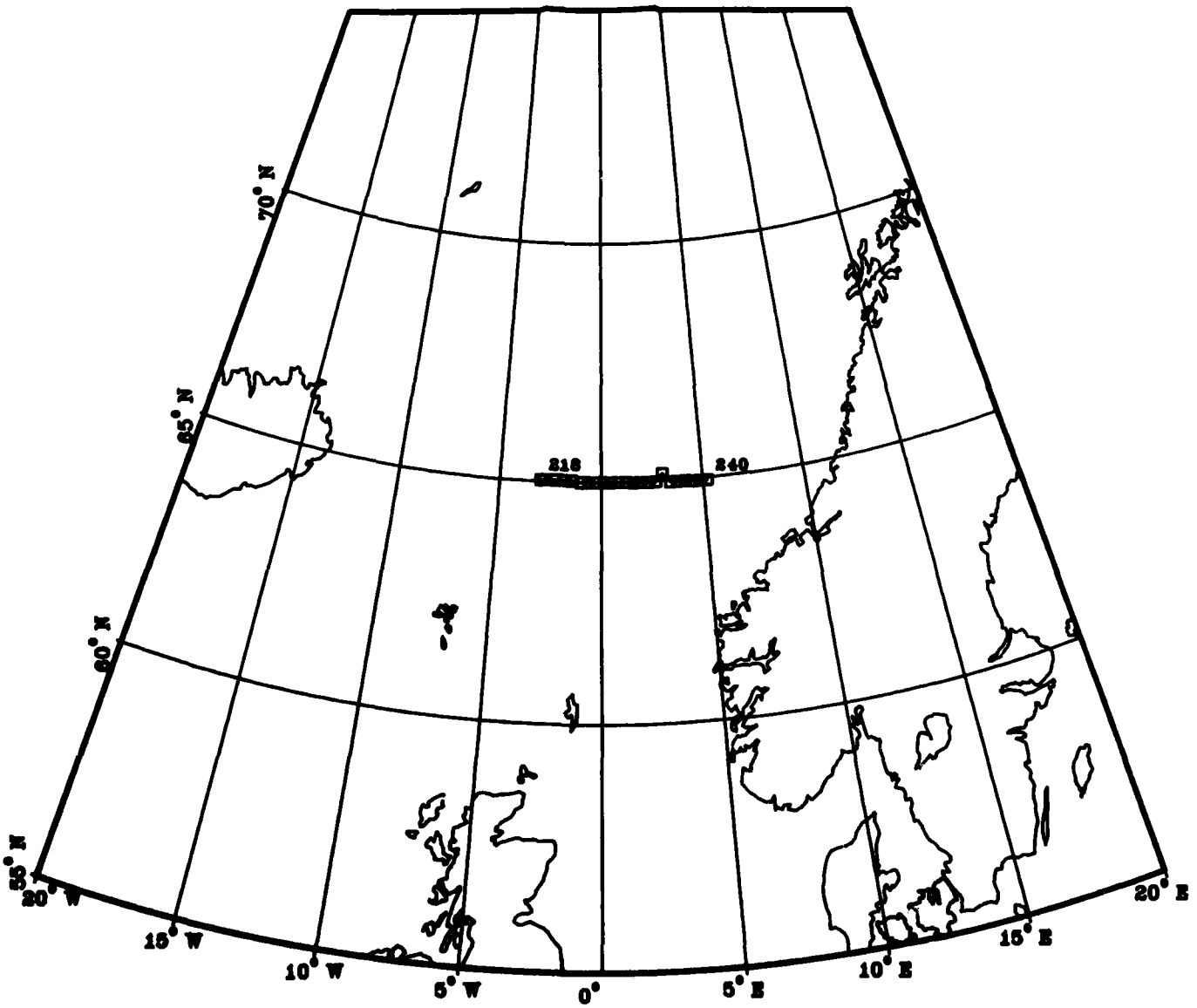

Figure 121. June 1936 (data set #8) station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1936E8 DAT
T/S PLOT

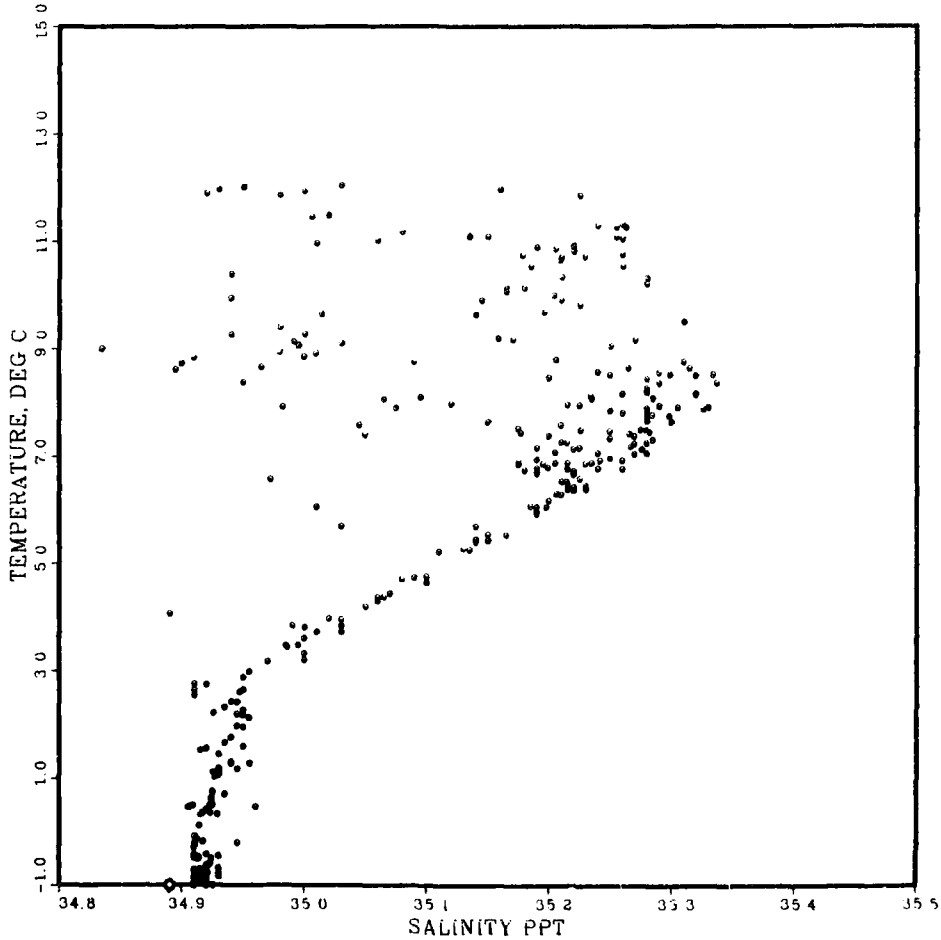

Figure 122. July 1936 (data set #8) temperature/salinity diagram.

AD-A169 098 ATLAS OF SOGNEFJORD SECTIONS 1969-1970(U) NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY NSTL STATION MS K D SAUNDERS ET AL. APR 85 NORDA-42 3/4

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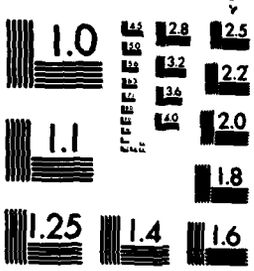

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NATIONAL BUREAU OF STANDARDS-1963-A

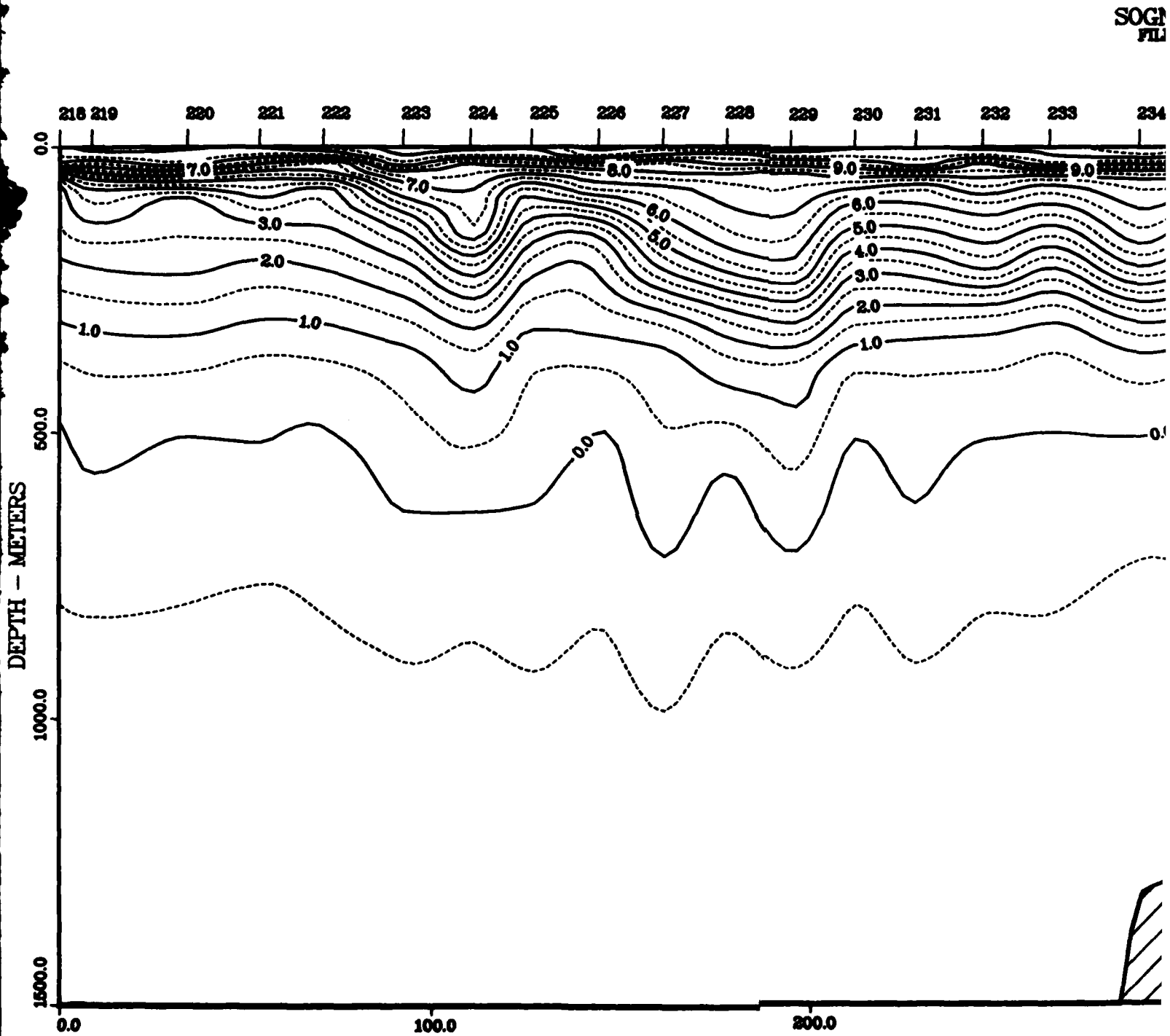
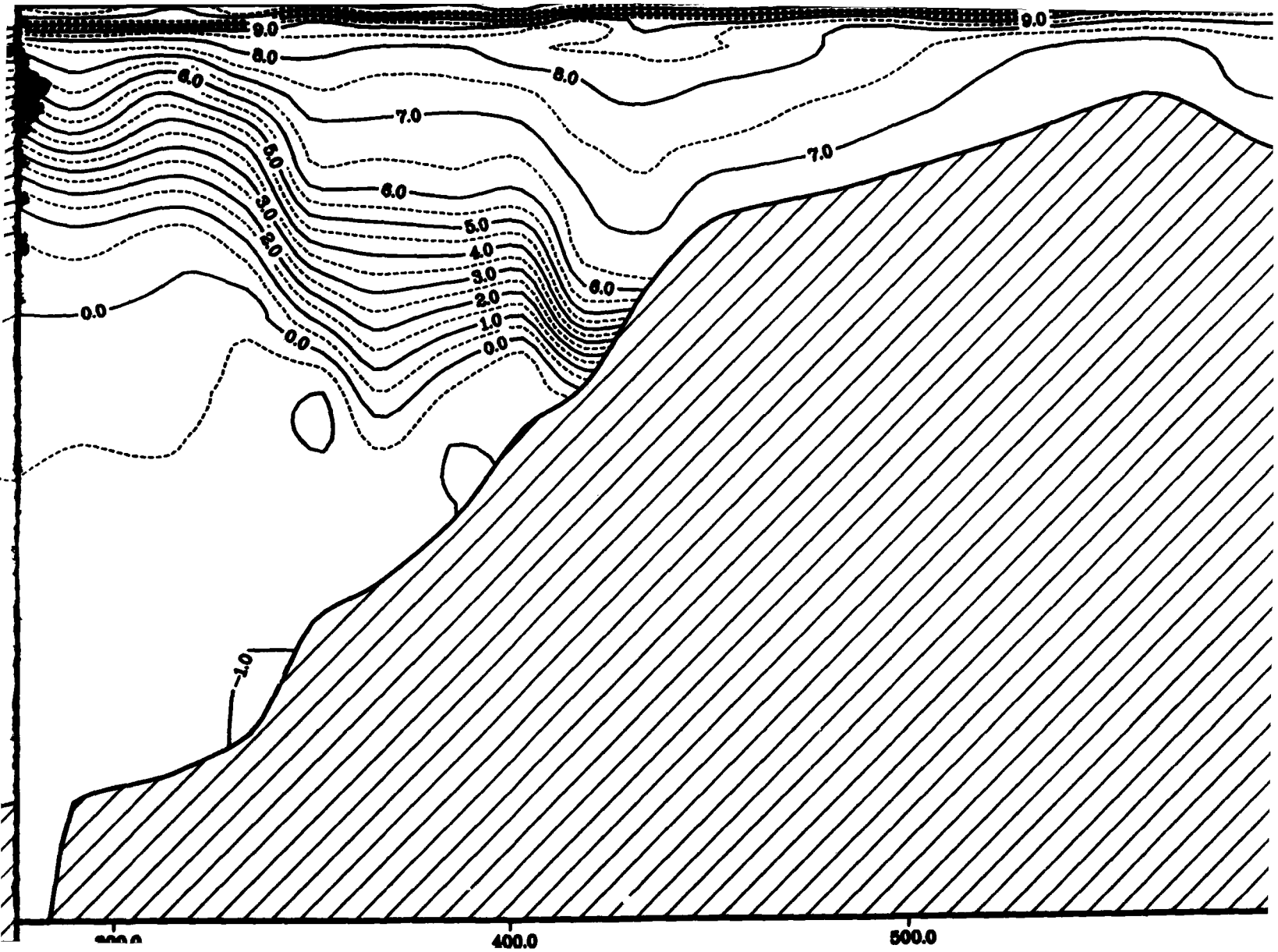


Figure 123. July 1936 (data set #8) temperature section.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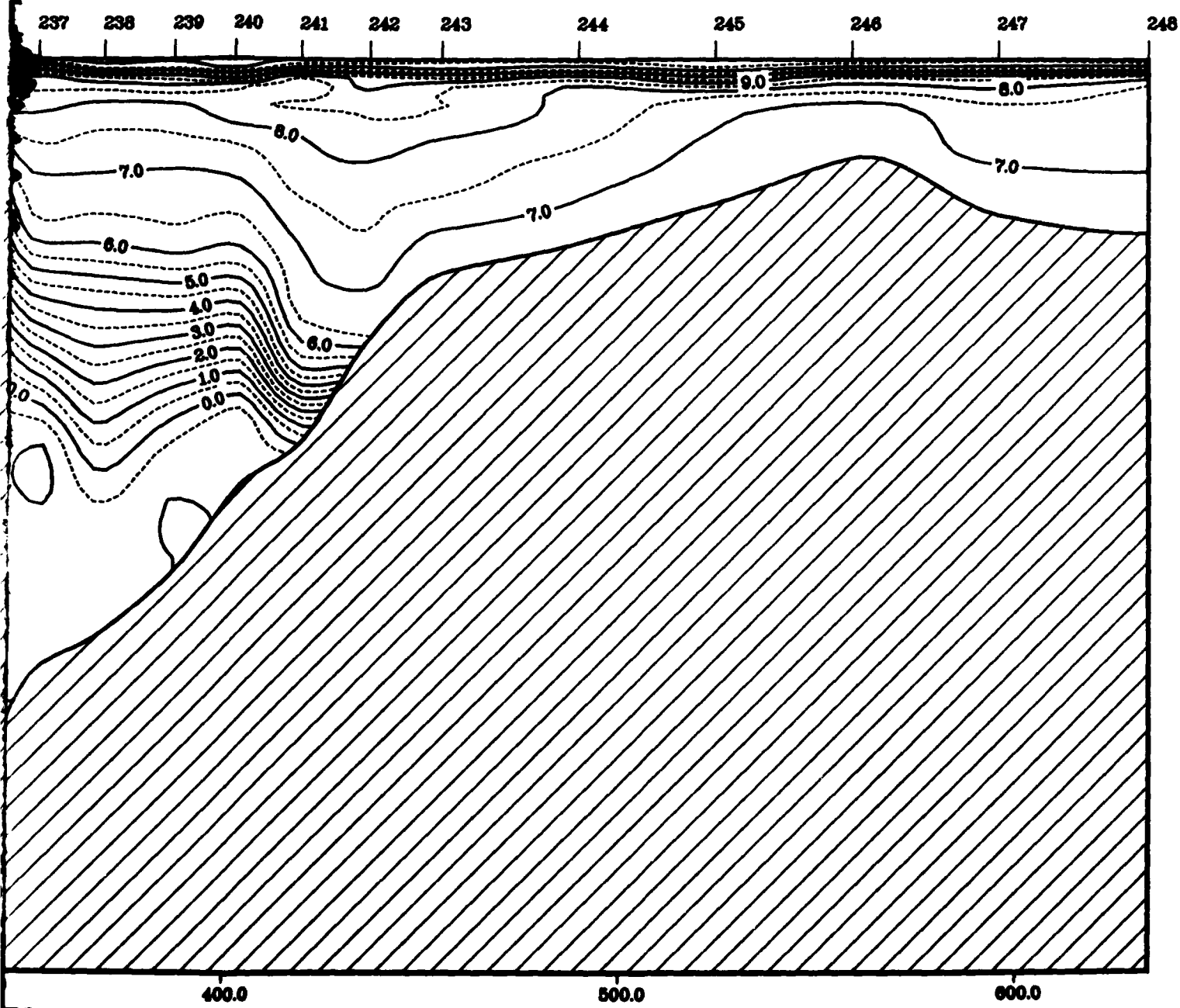
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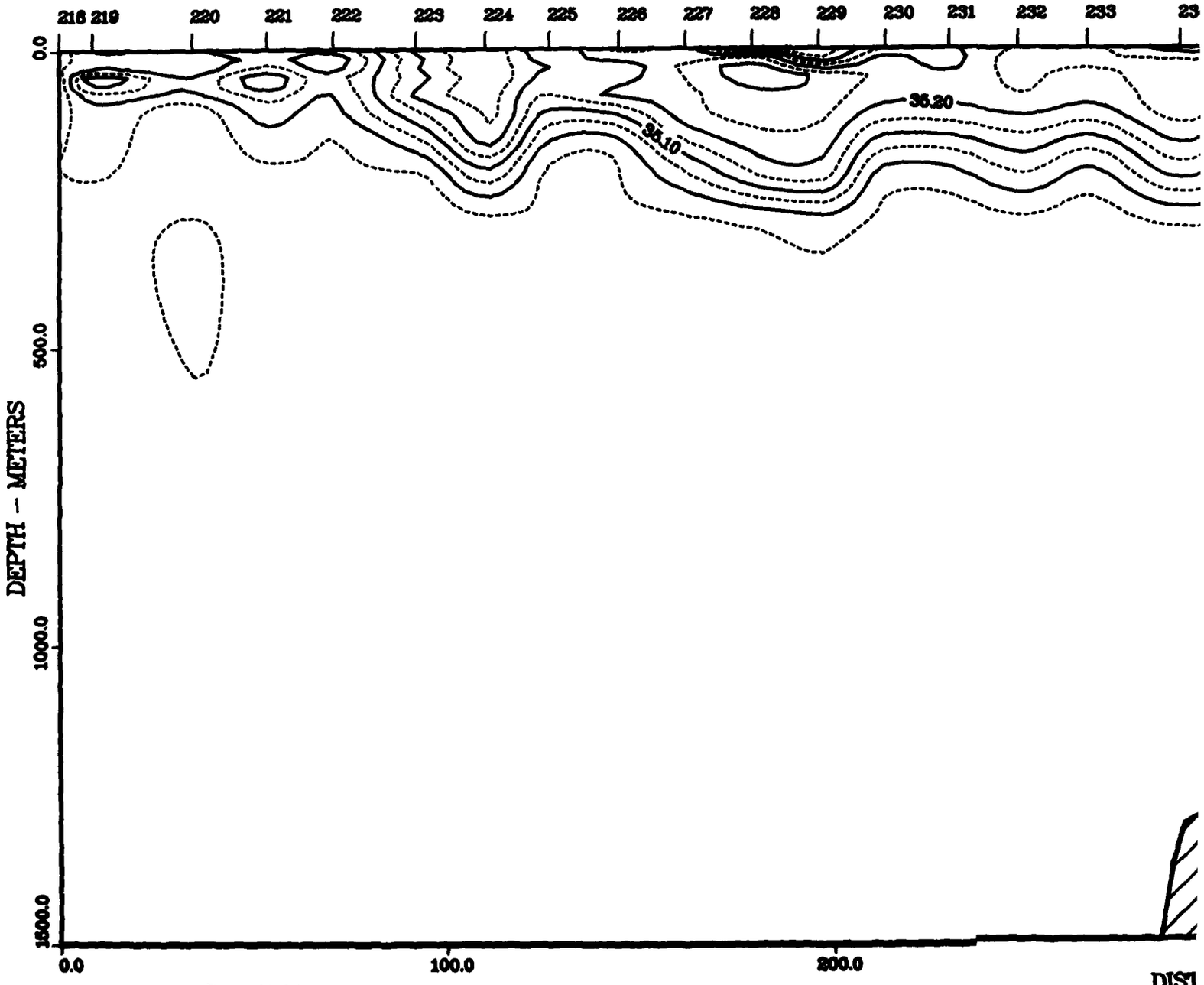
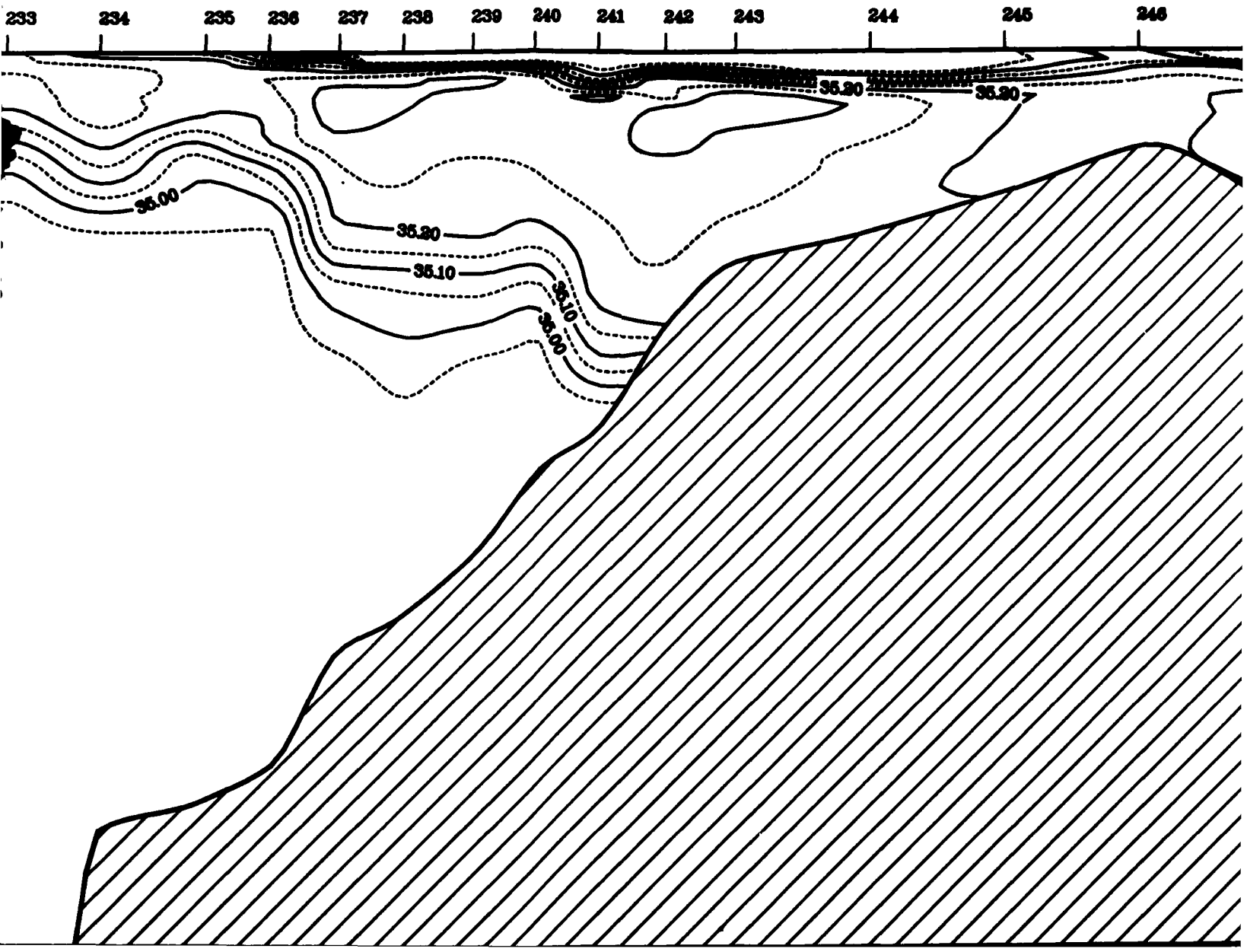
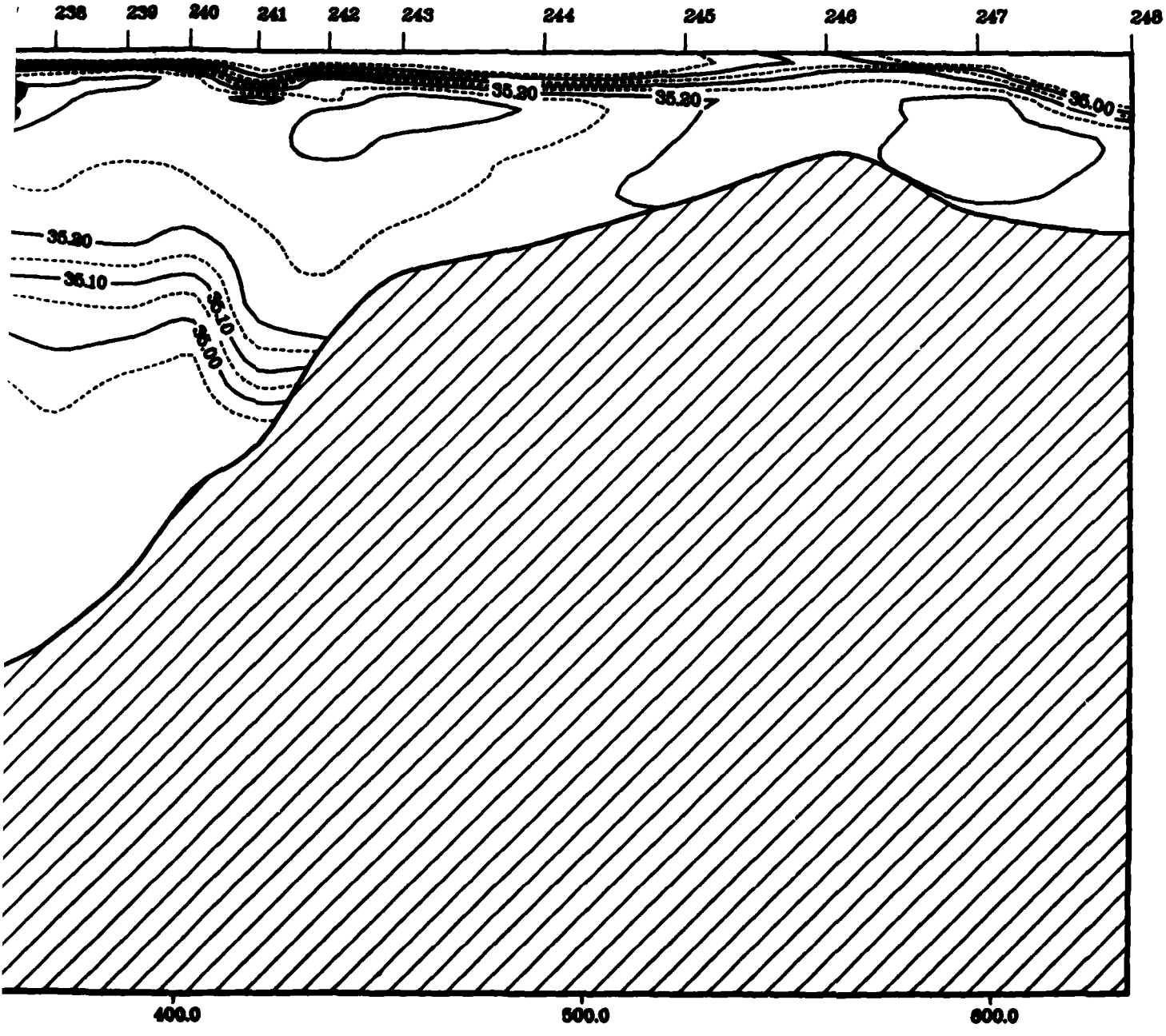


Figure 124. July 1936 (data set #8) salinity section.

SOGNEFJORD SECTION
FILE = ICES8:1936E8.DAT
SALINITY

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ICES$:1936D9.DAT

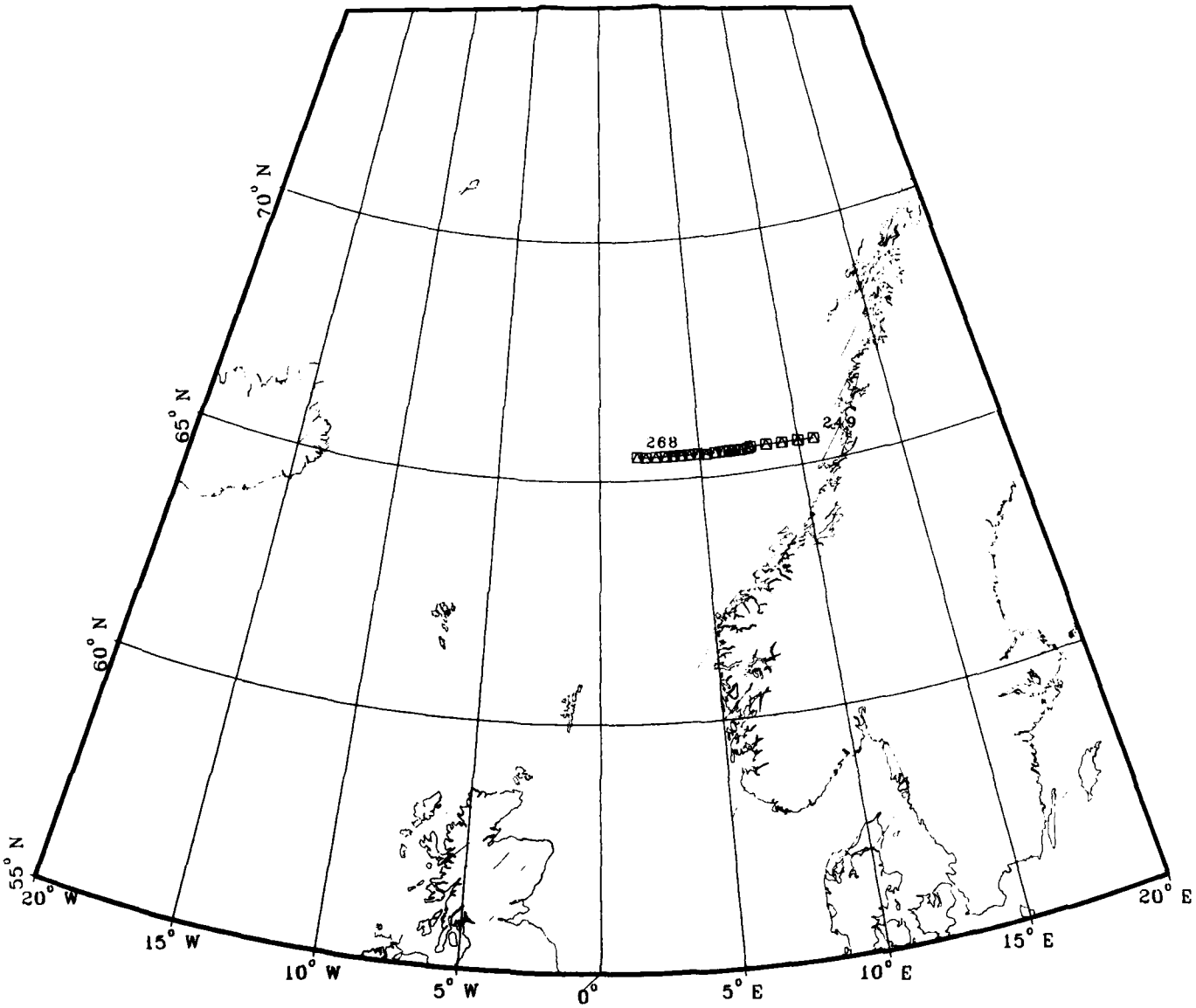


Figure 125. July 1936 (data set #9) station positions.

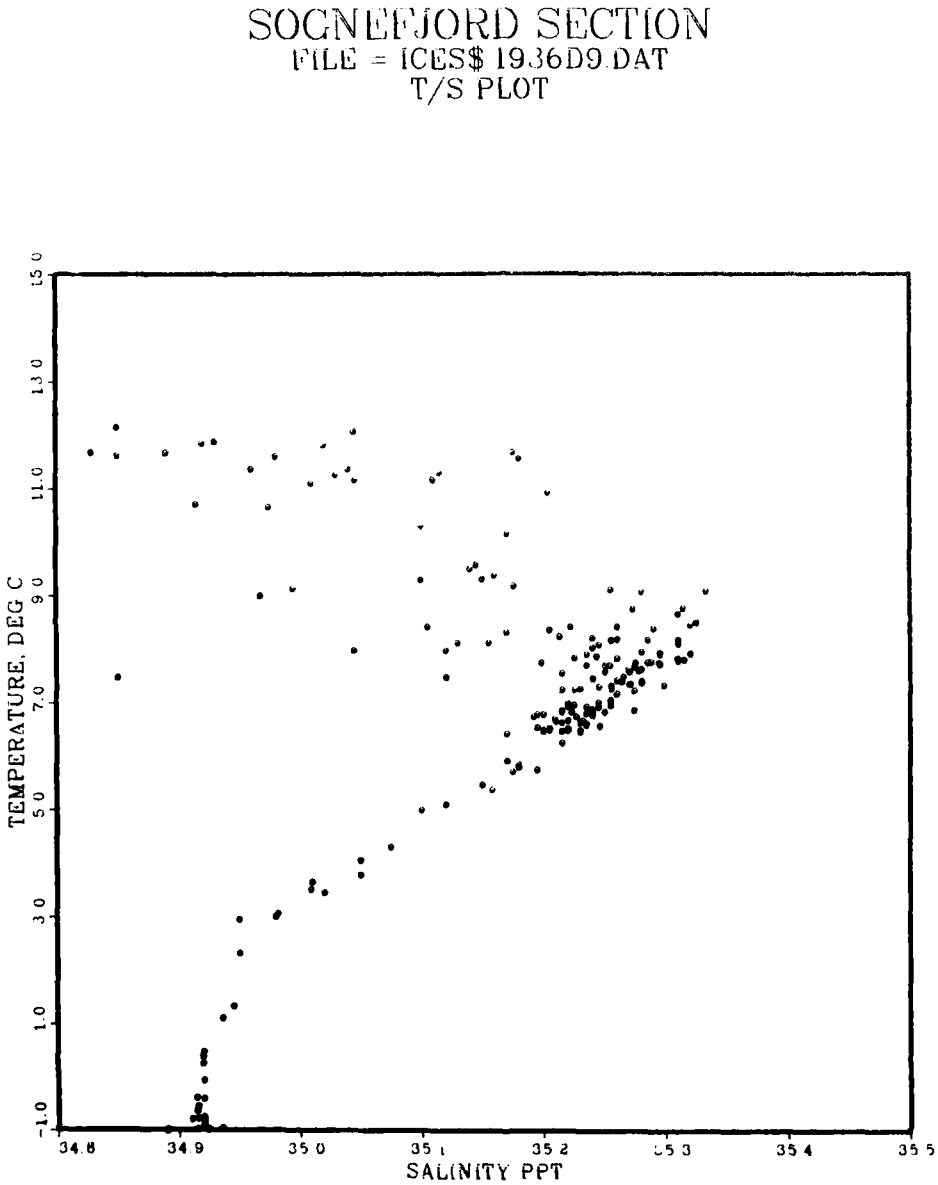


Figure 126. July 1936 (data set #9) temperature/salinity diagram.

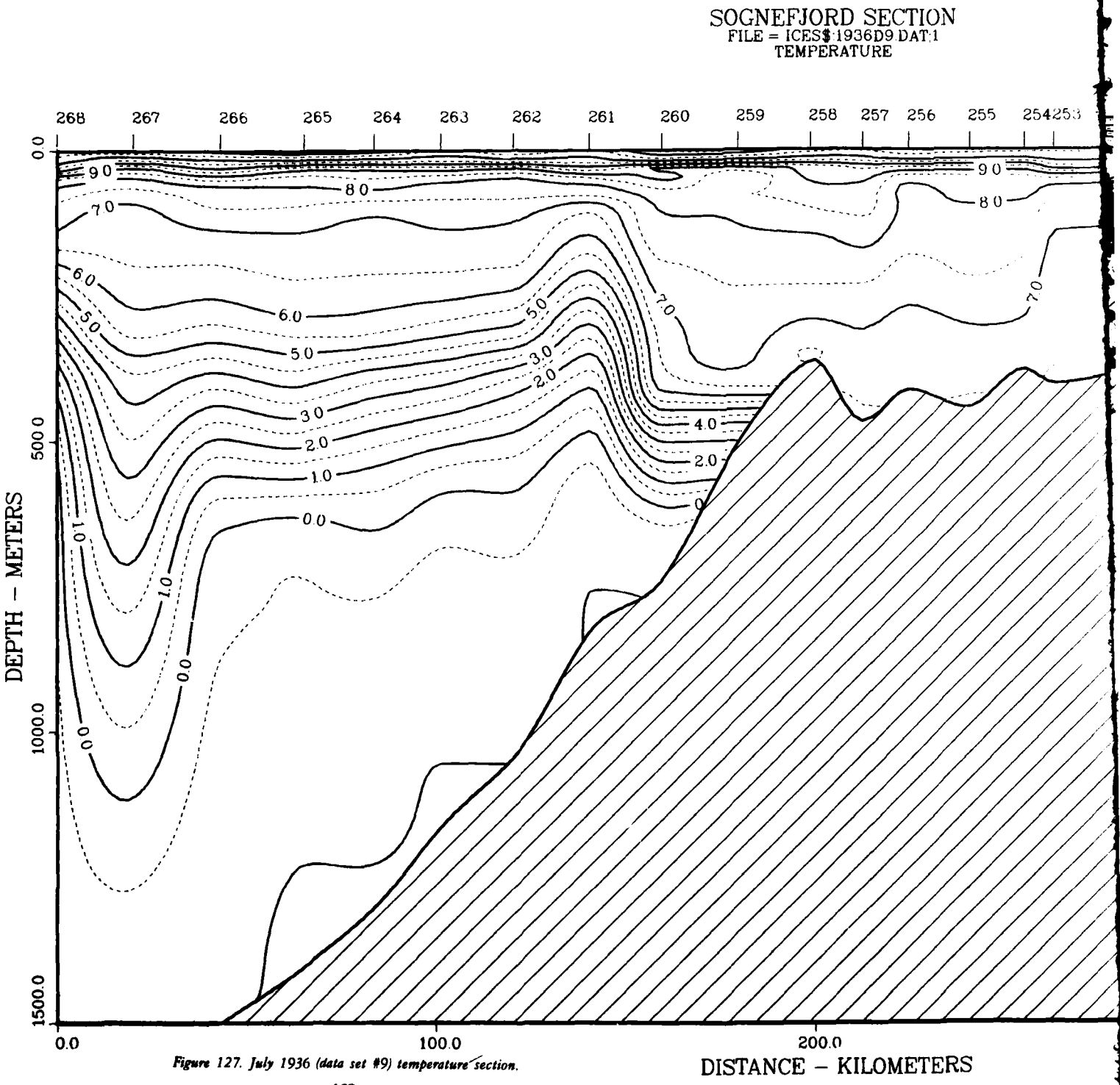
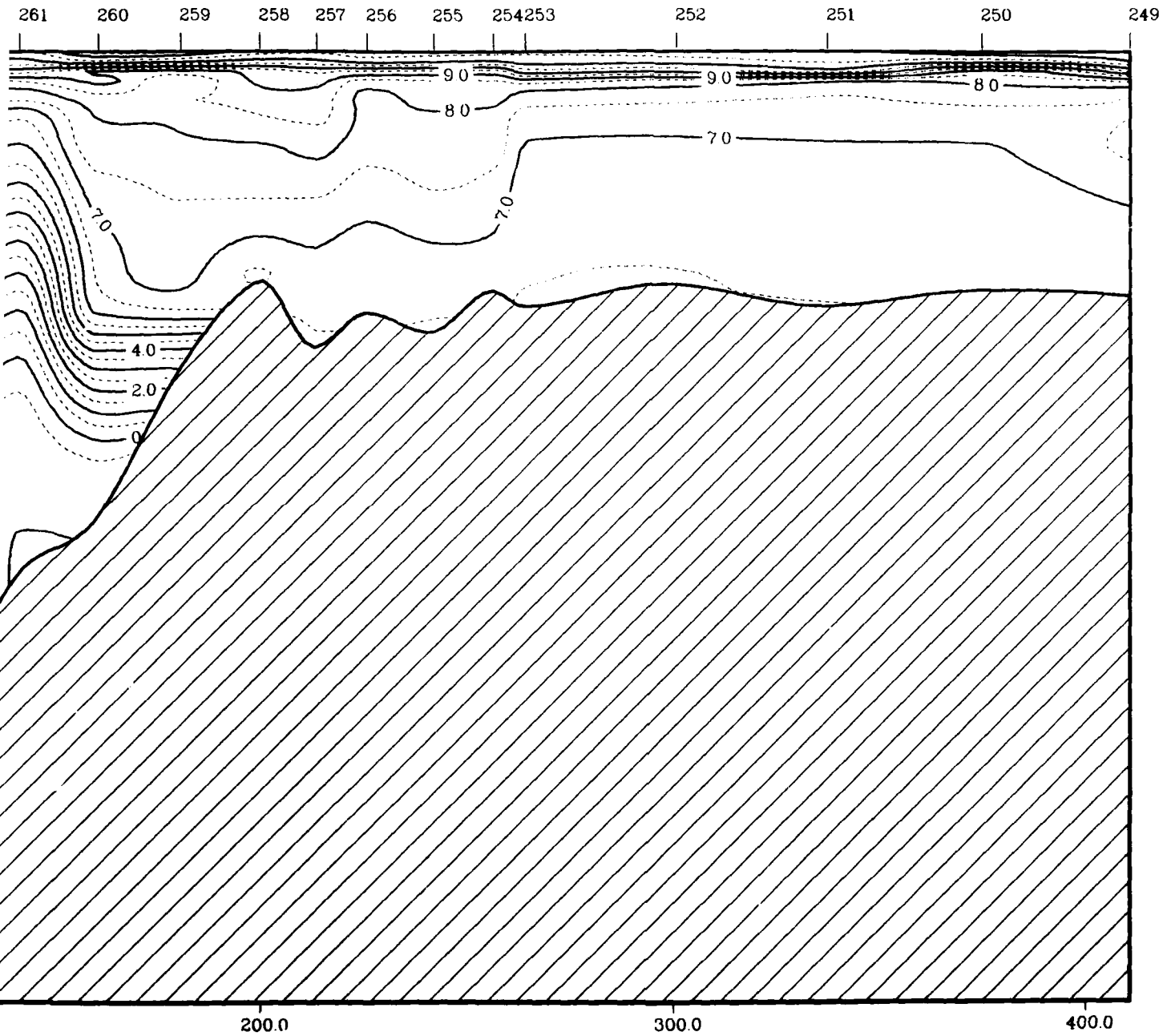


Figure 127. July 1936 (data set #9) temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1936D9.DAT;1
TEMPERATURE



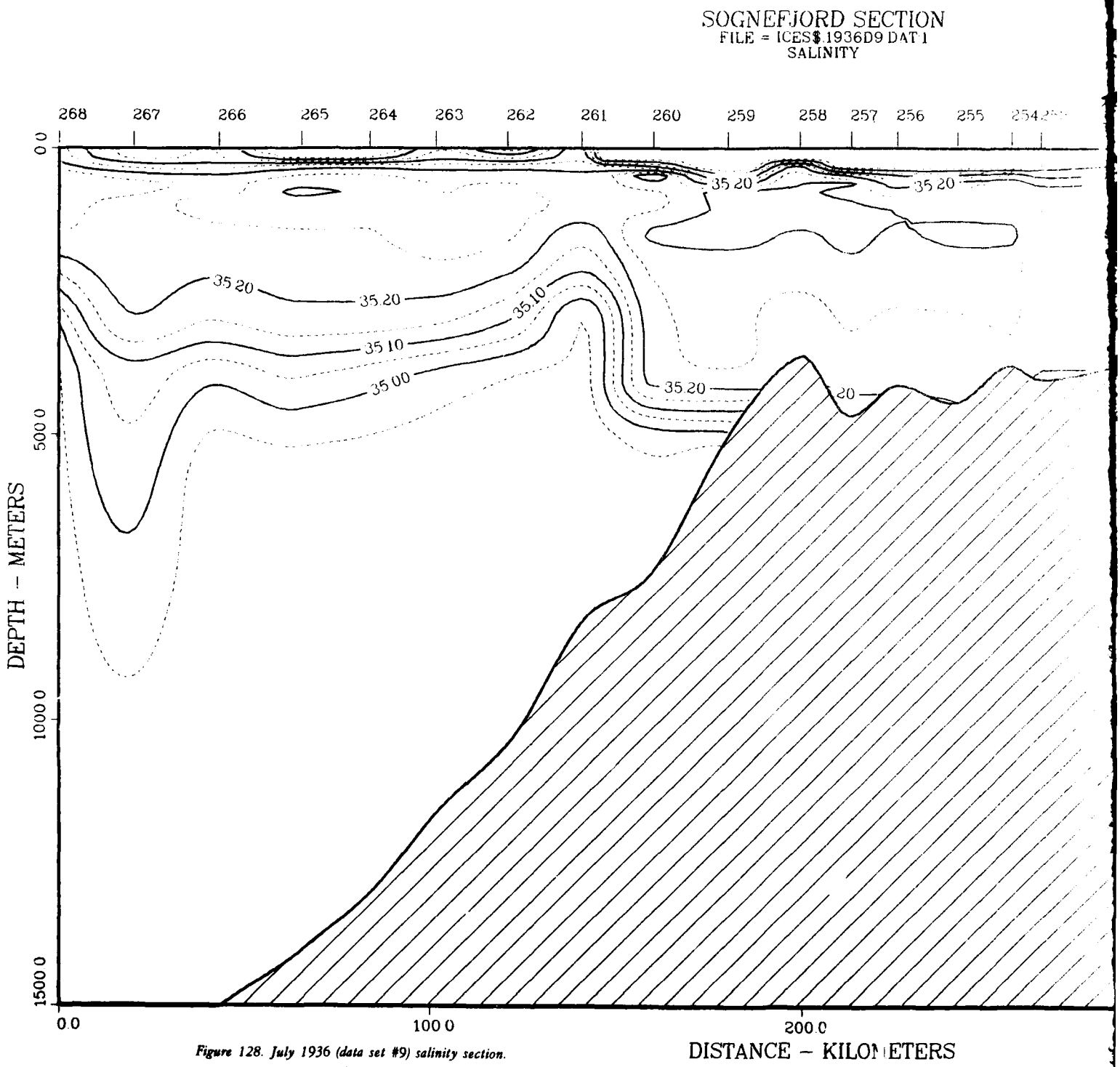
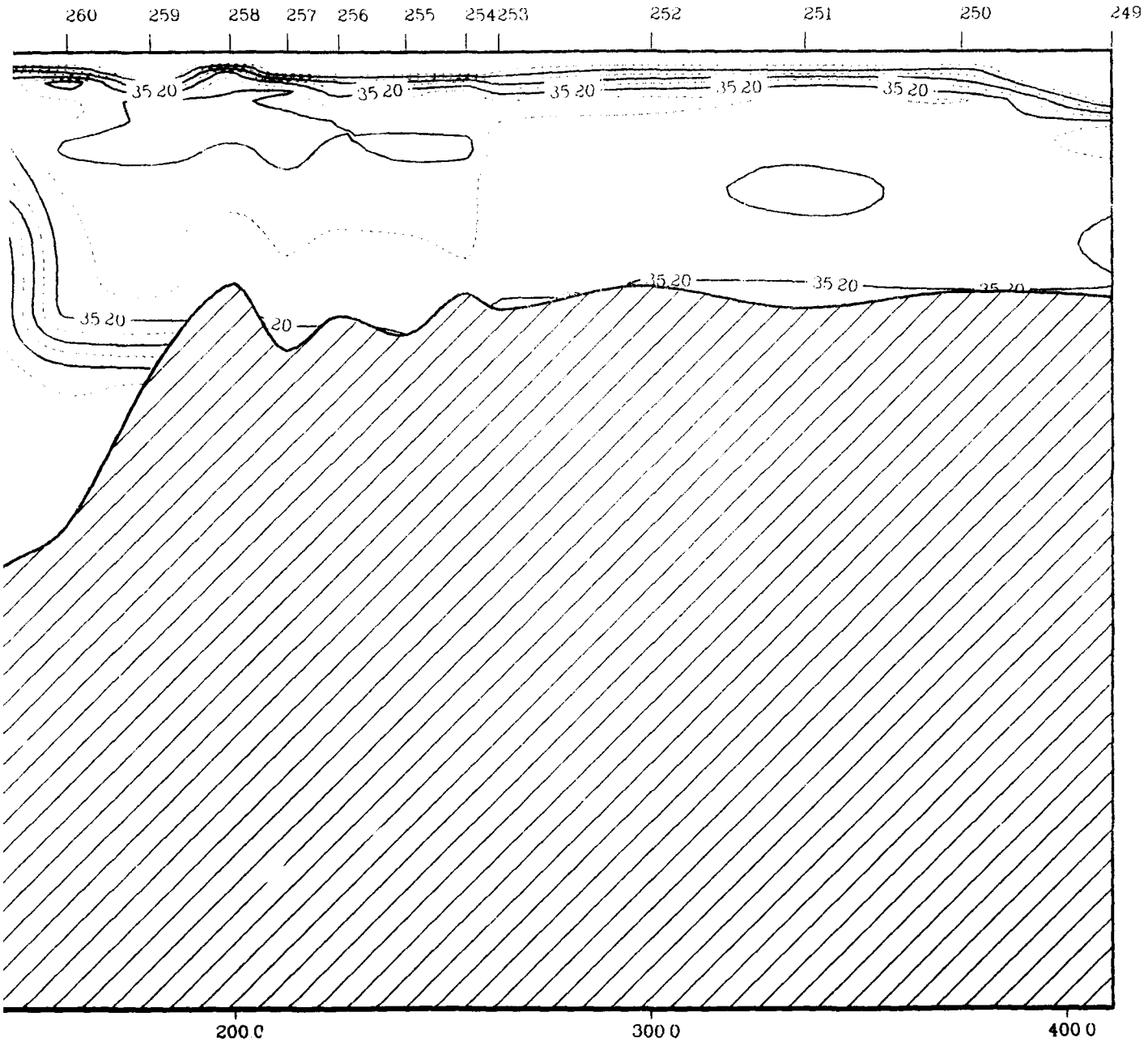


Figure 128. July 1936 (data set #9) salinity section.

SOGNEFJORD SECTION
FILE = ICES$.1936D9 DAT 1
SALINITY



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ICES$:1947MAY.DAT

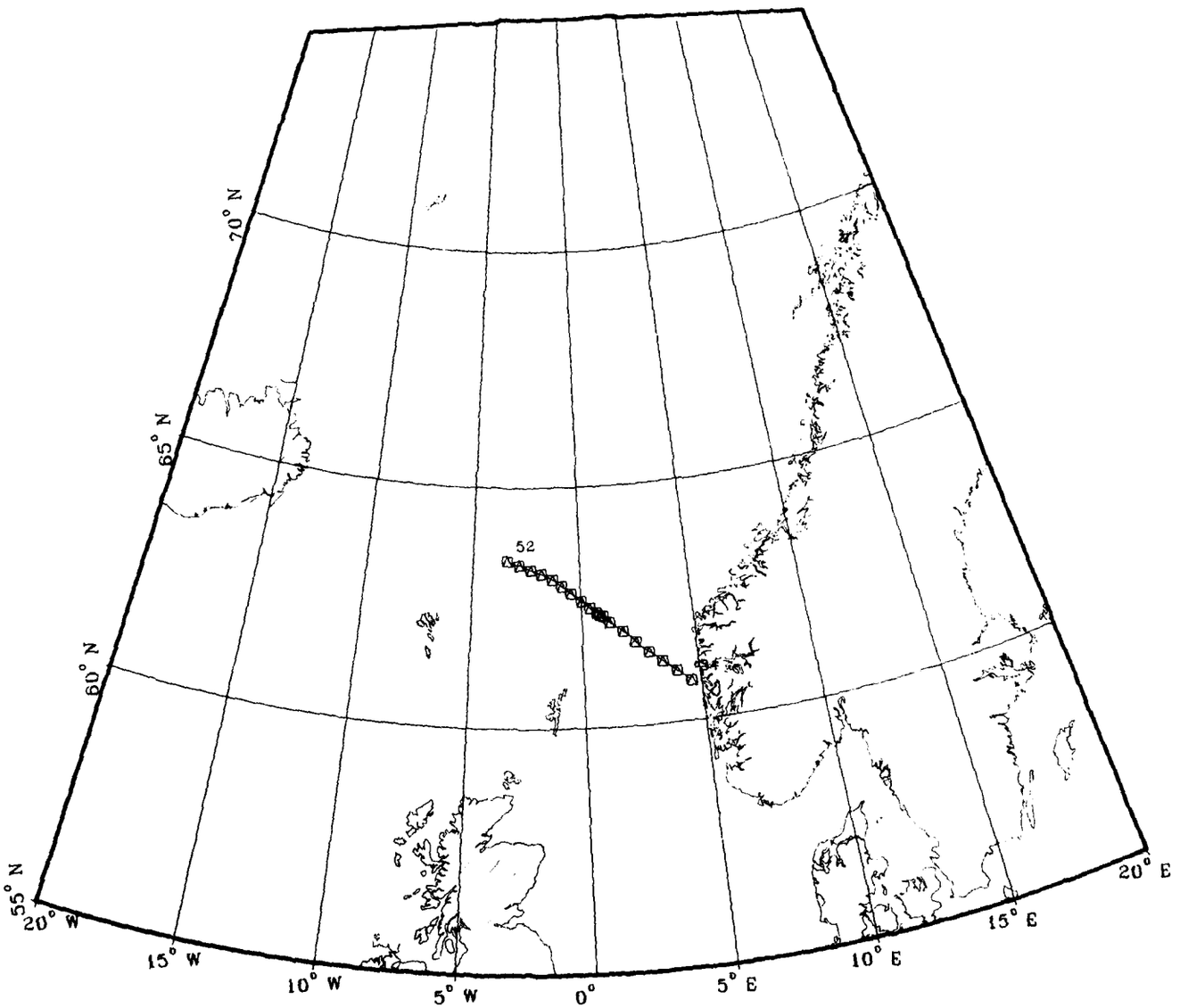


Figure 129. May 1947 station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1947MAY.DAT
T/S PLOT

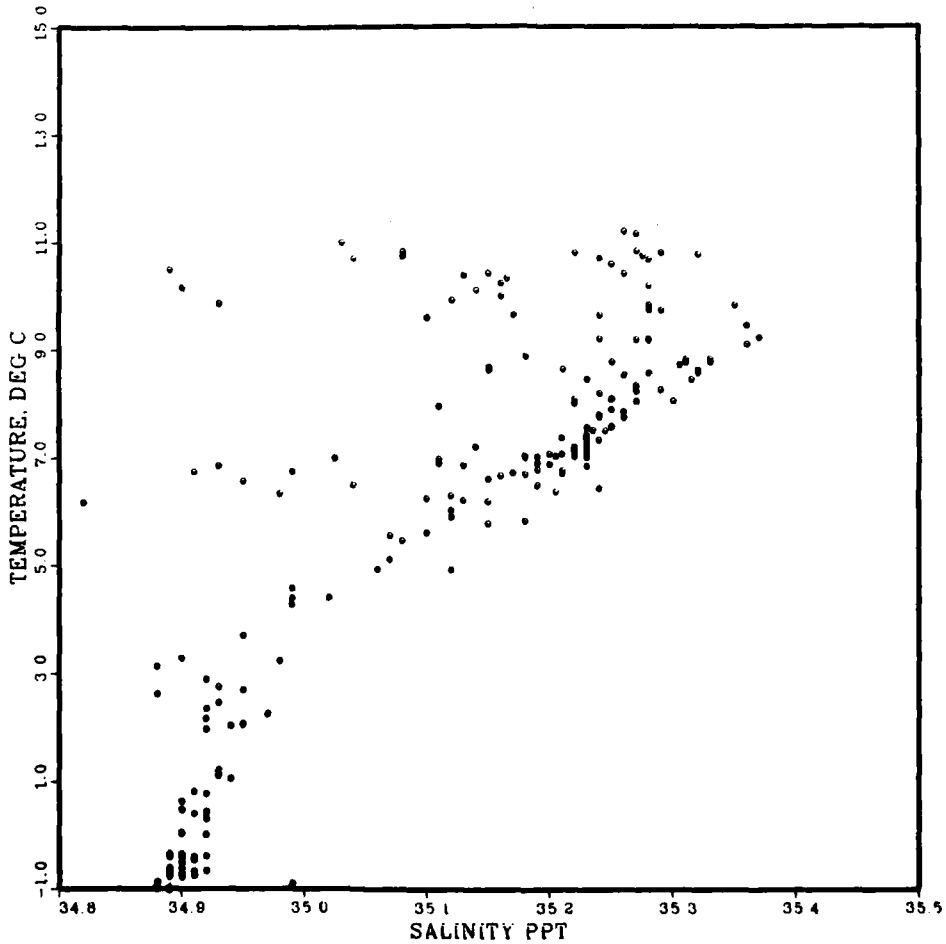


Figure 130. May 1947 temperature/salinity diagram.

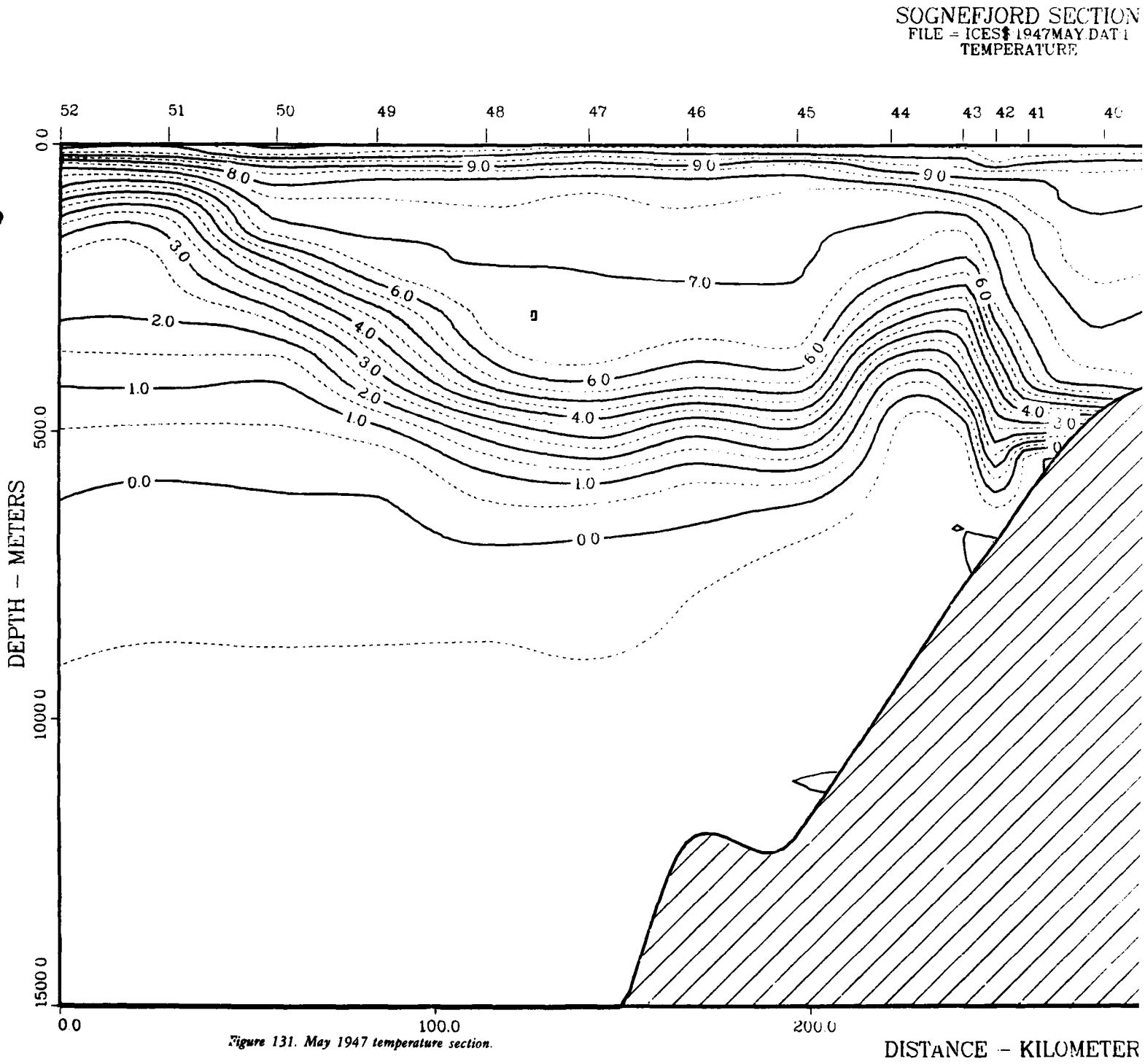
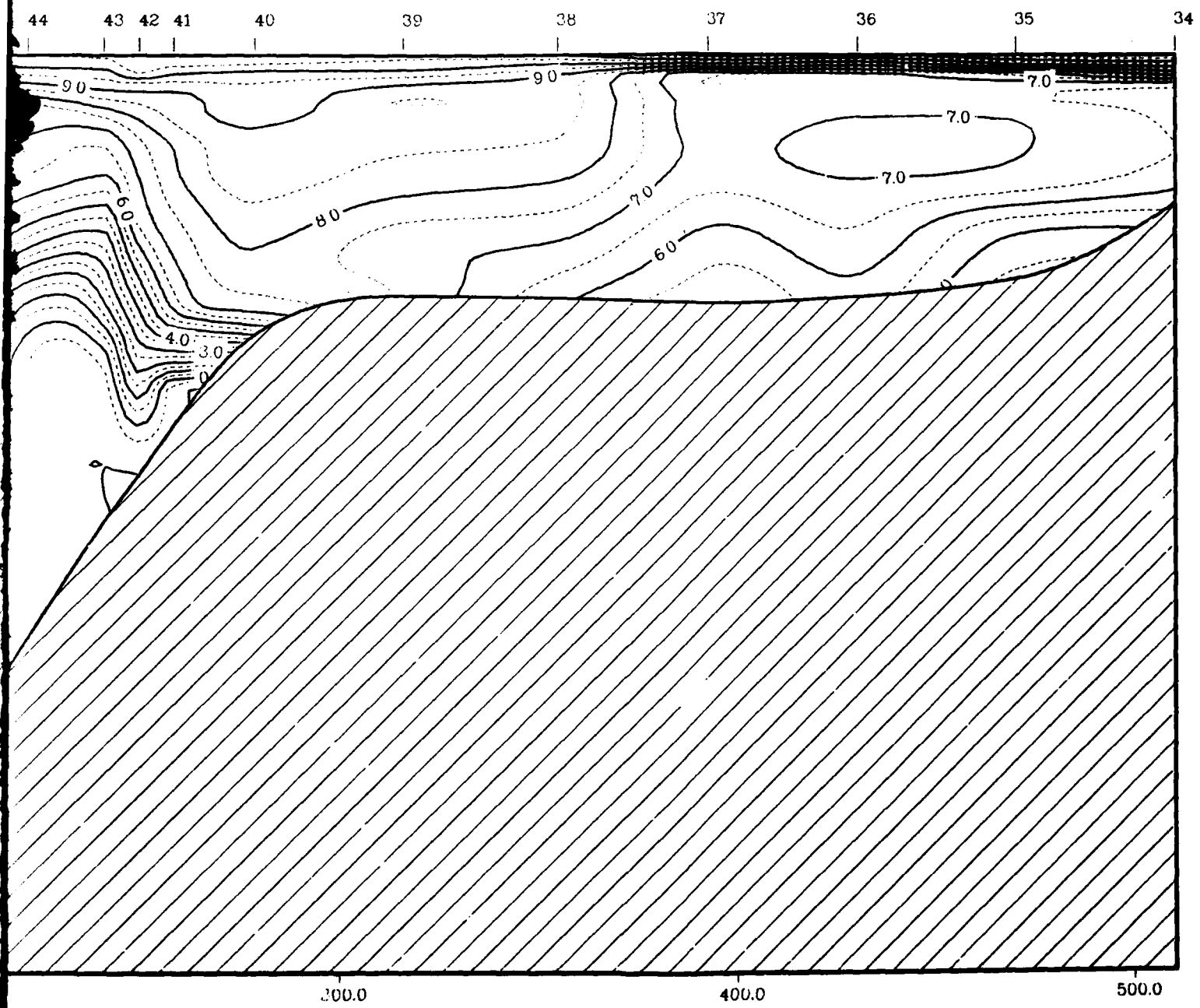


Figure 131. May 1947 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1947MAY.DAT;1
TEMPERATURE



DISTANCE - KILOMETERS

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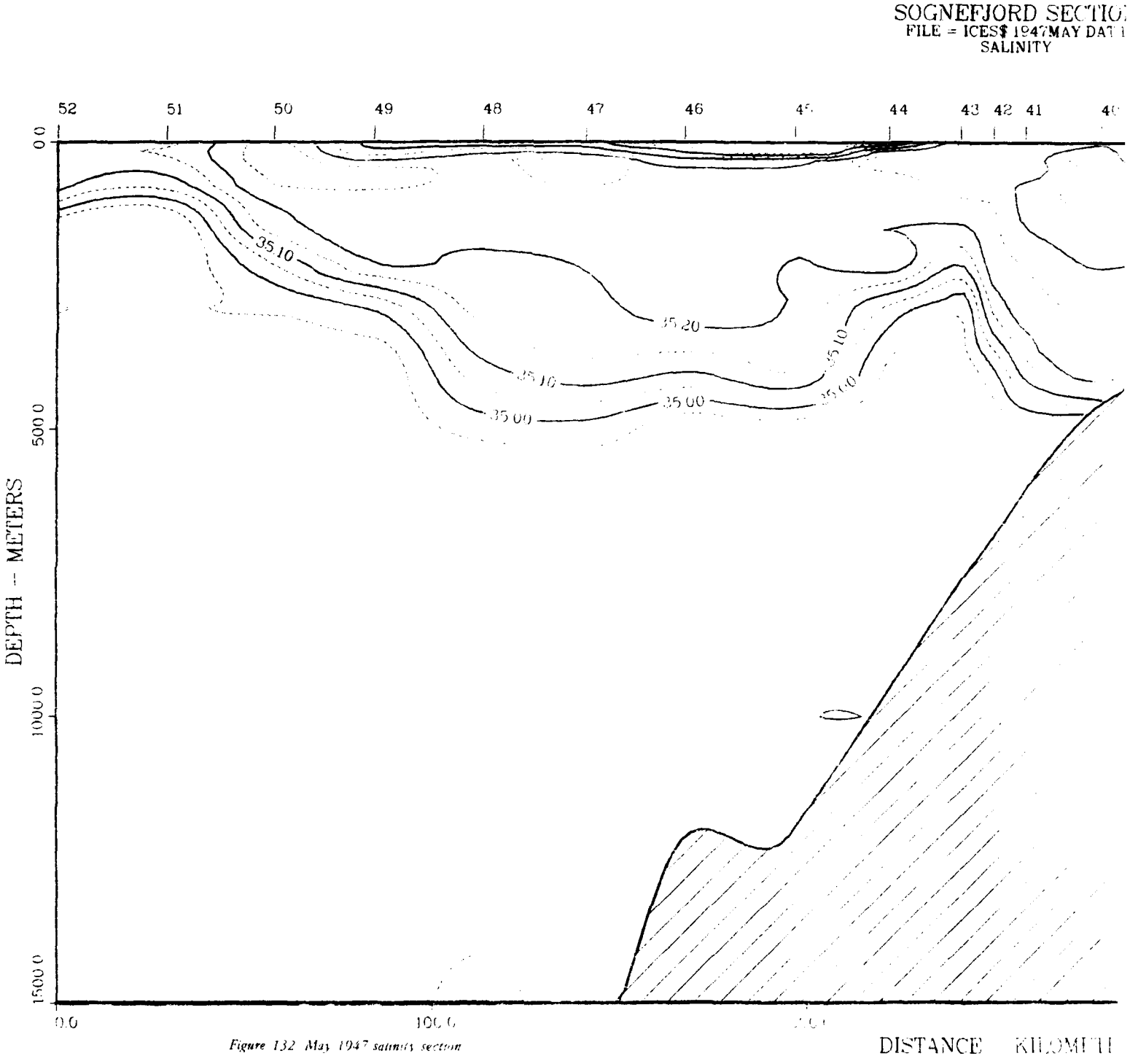
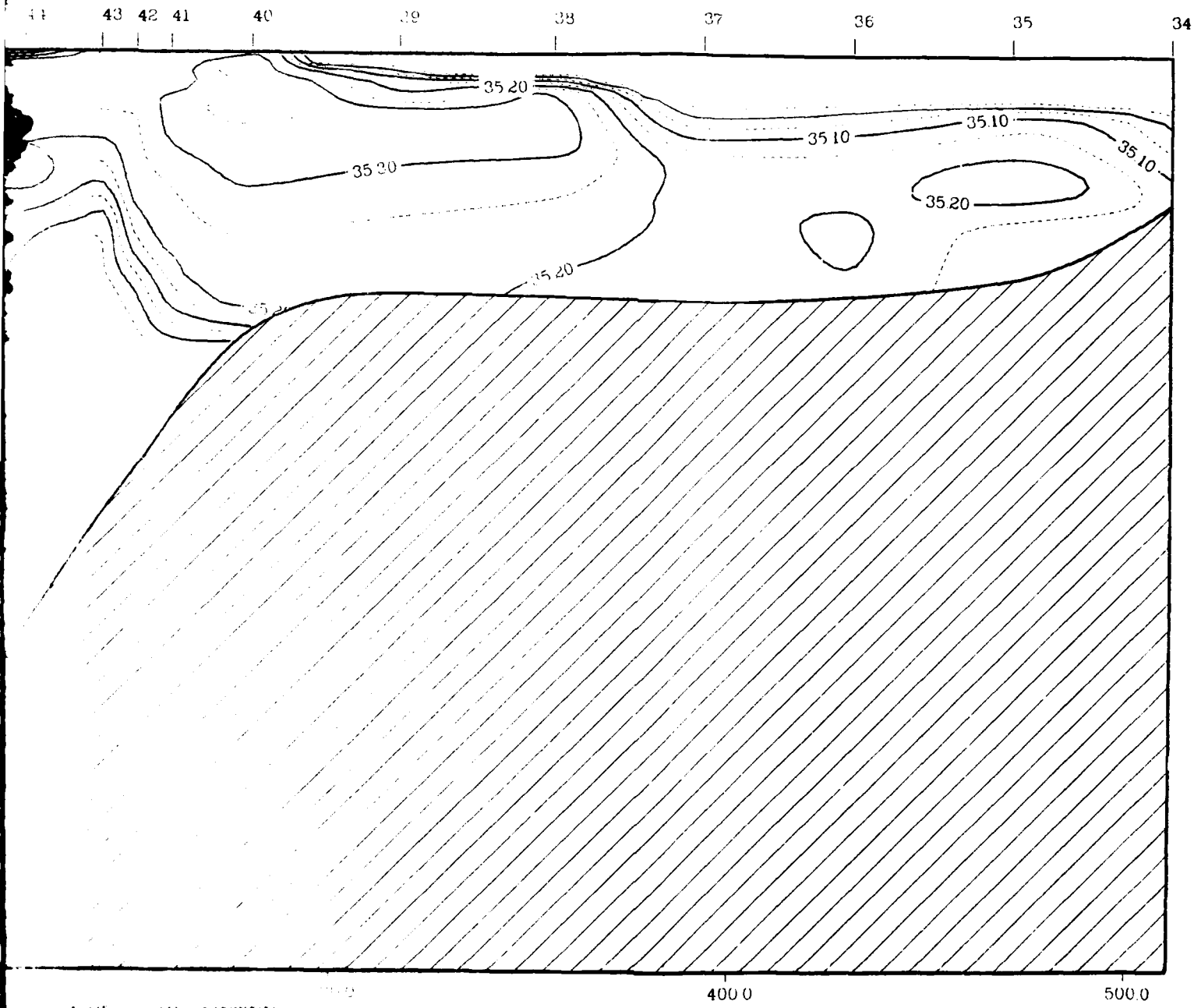


Figure 132 May 1947 salinity section

SOGNEFJORD SECTION
FILE = ICES$ 1947MAY DAT.1
SALINITY



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ICES$:1947AUG.DAT

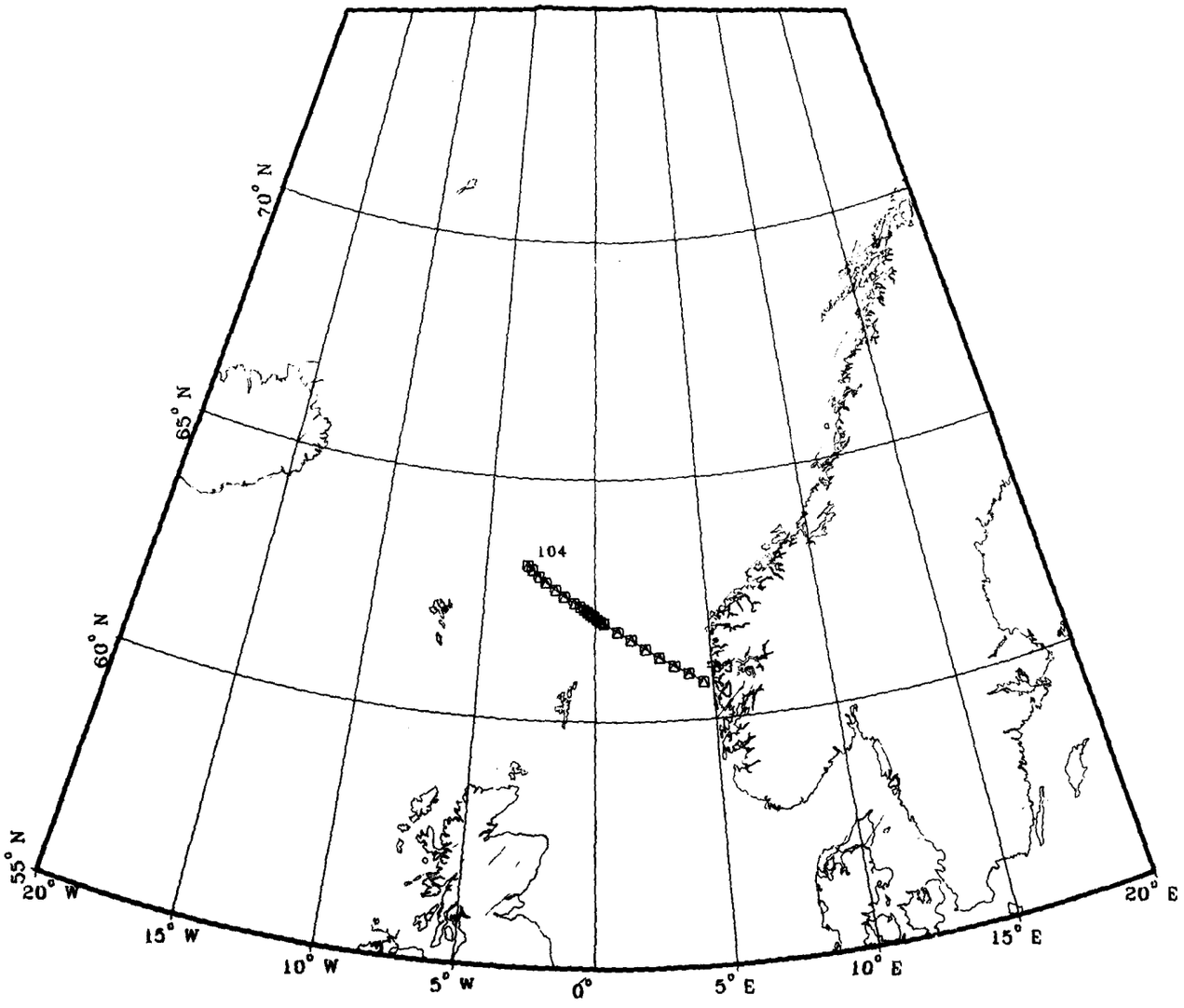


Figure 133. August 1947 station positions

SOGNEFJORD SECTION
FILE = ICES$ 1947AUG.DAT
T/S PLOT

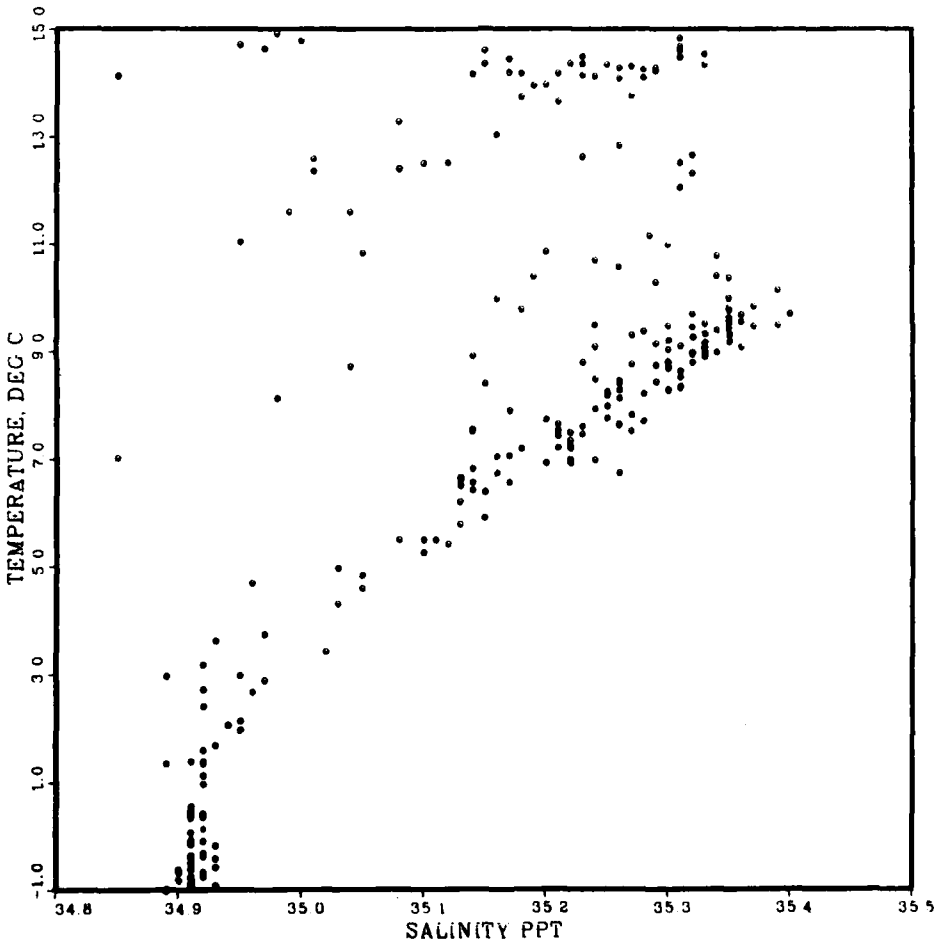


Figure 134. August 1947 temperature/salinity diagram.

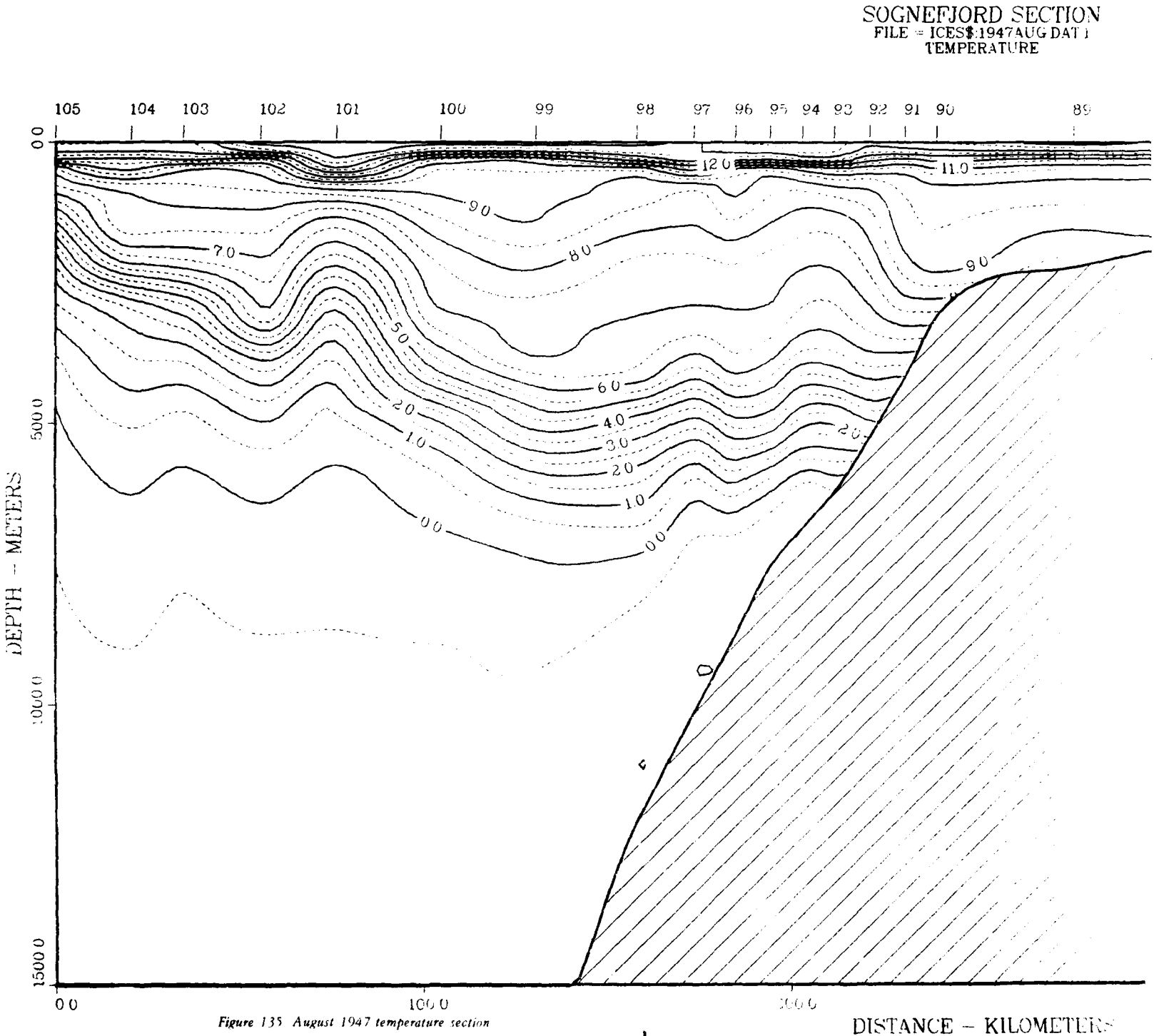
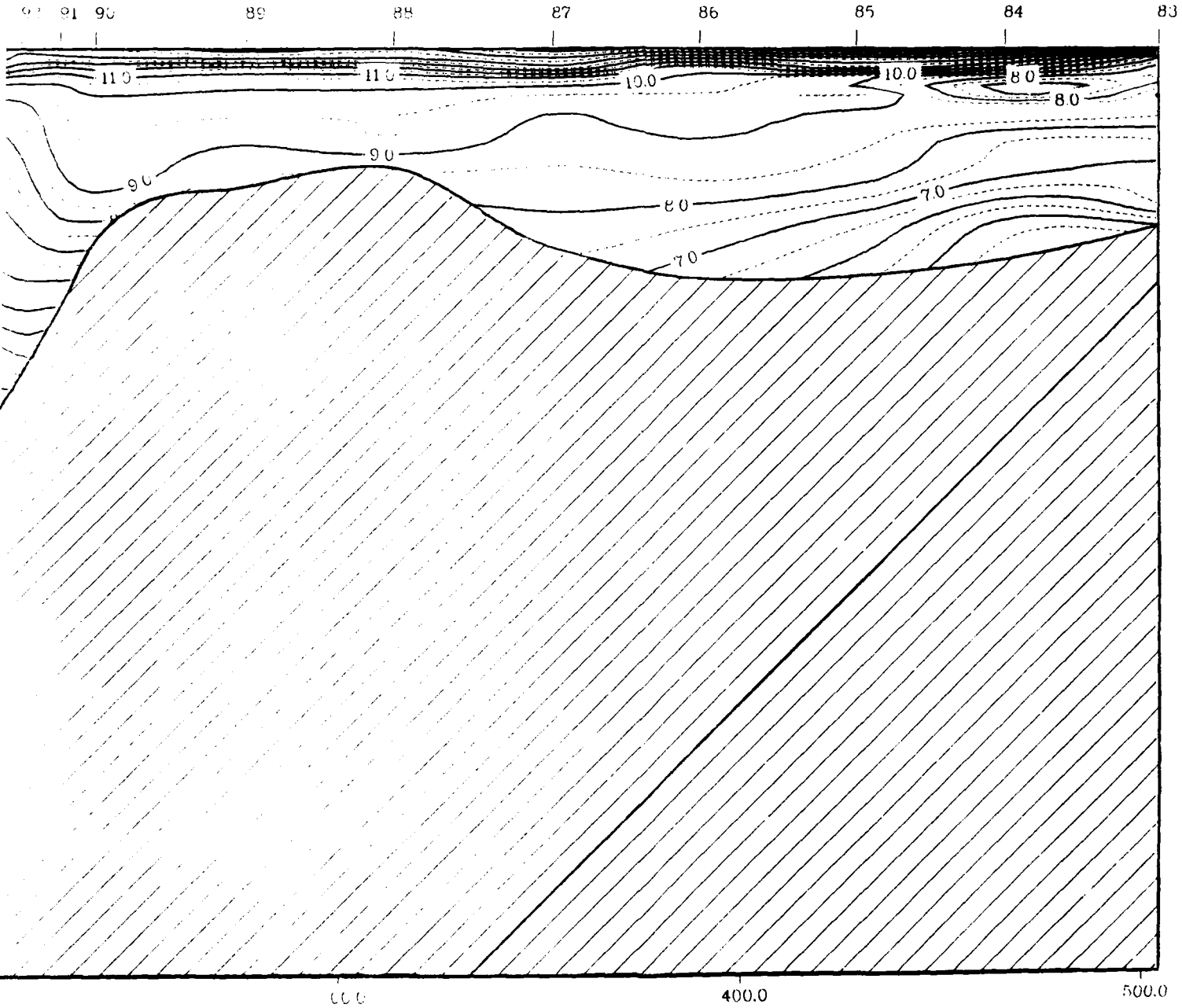


Figure 135 August 1947 temperature section

SOGNEFJORD SECTION
FILE = ICES$:1947AUG.DAT 1
TEMPERATURE



DISTANCE - KILOMETERS

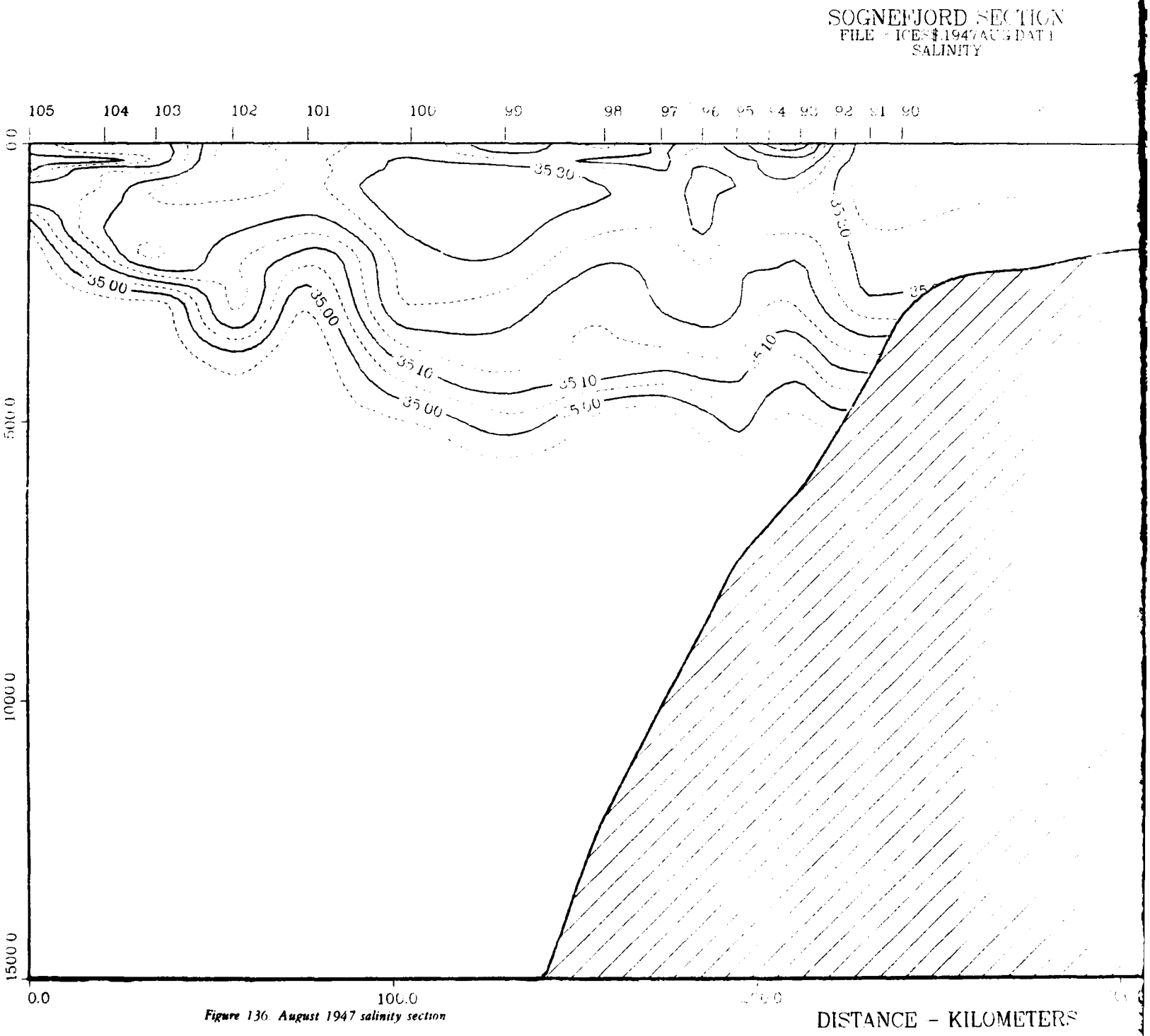
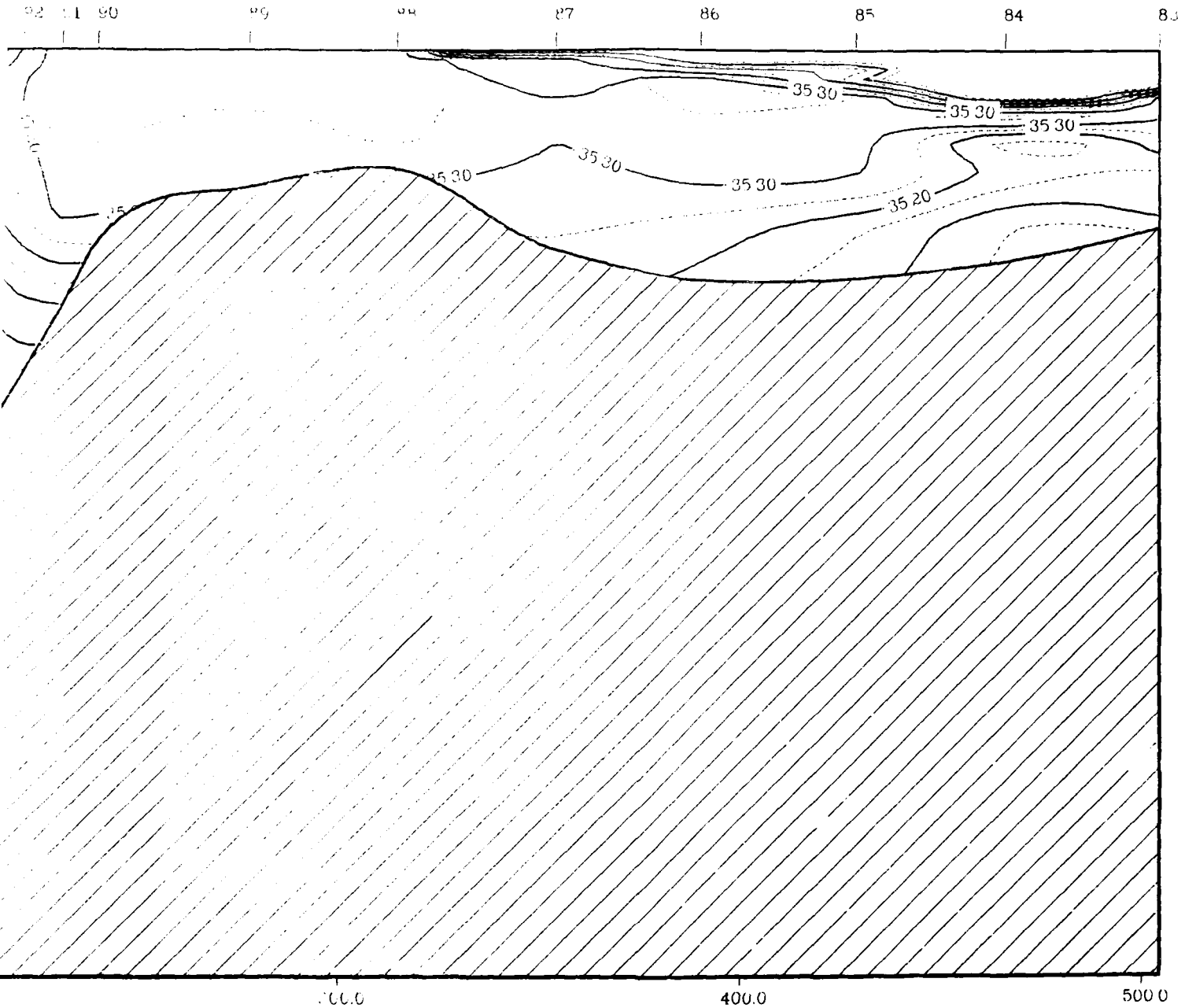


Figure 136. August 1947 salinity section

SOGNEFJORD SECTION
FILE = ICES$1947AUG.DAT1
SALINITY



DISTANCE - KILOMETERS

2

ICES$:1948MAY.DAT

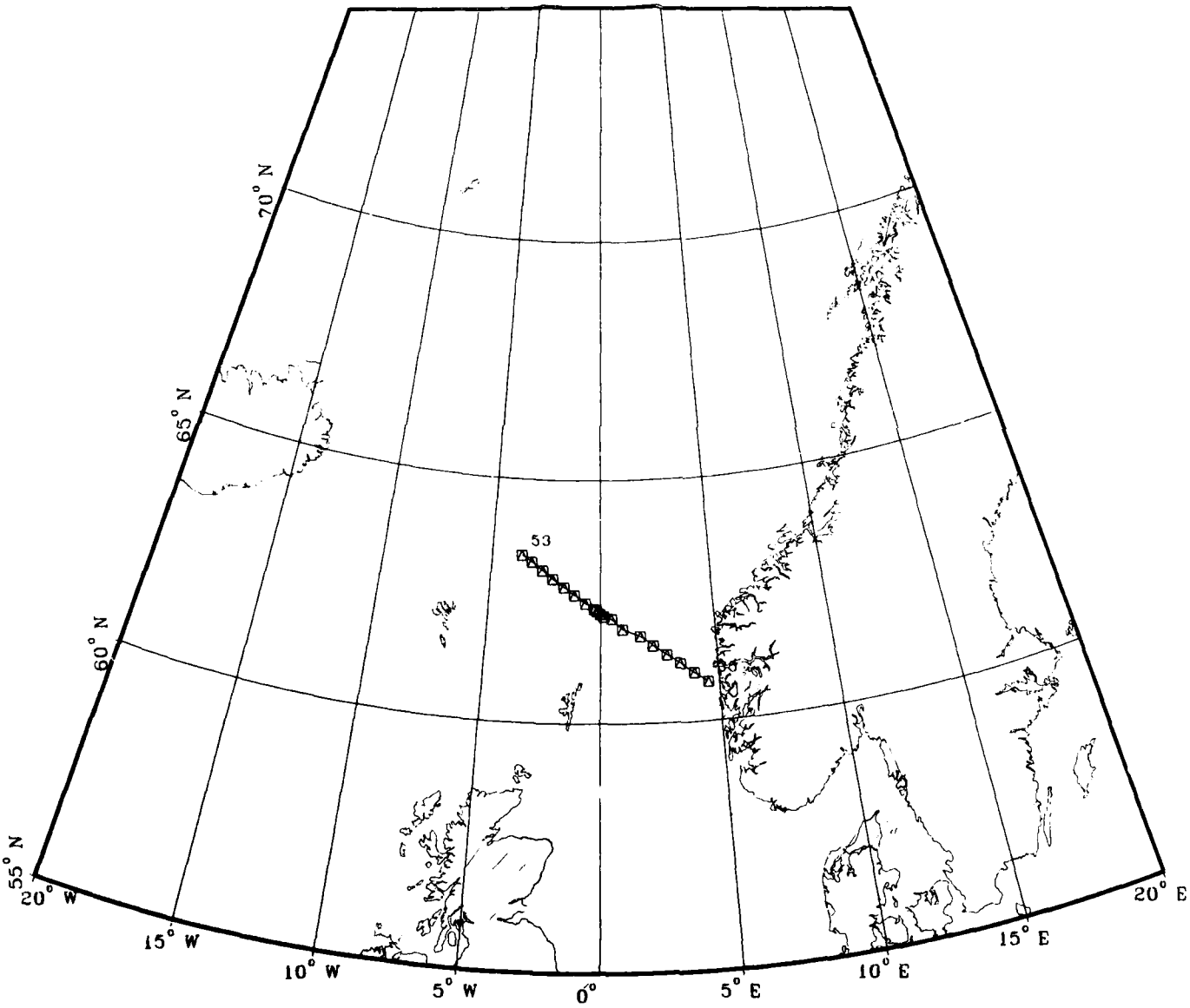


Figure 137. May 1948 station positions.

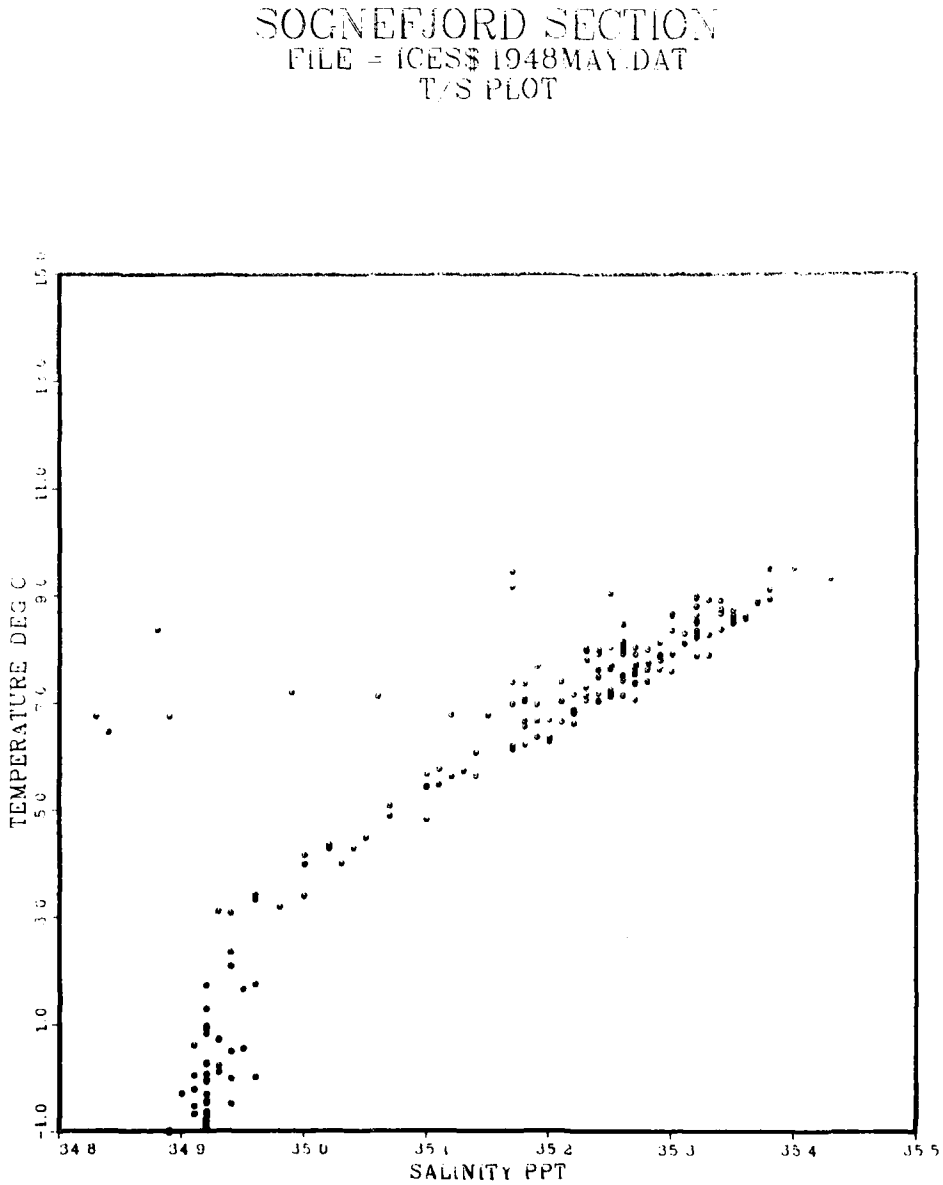


Figure 138. May 1948 temperature/salinity diagram.

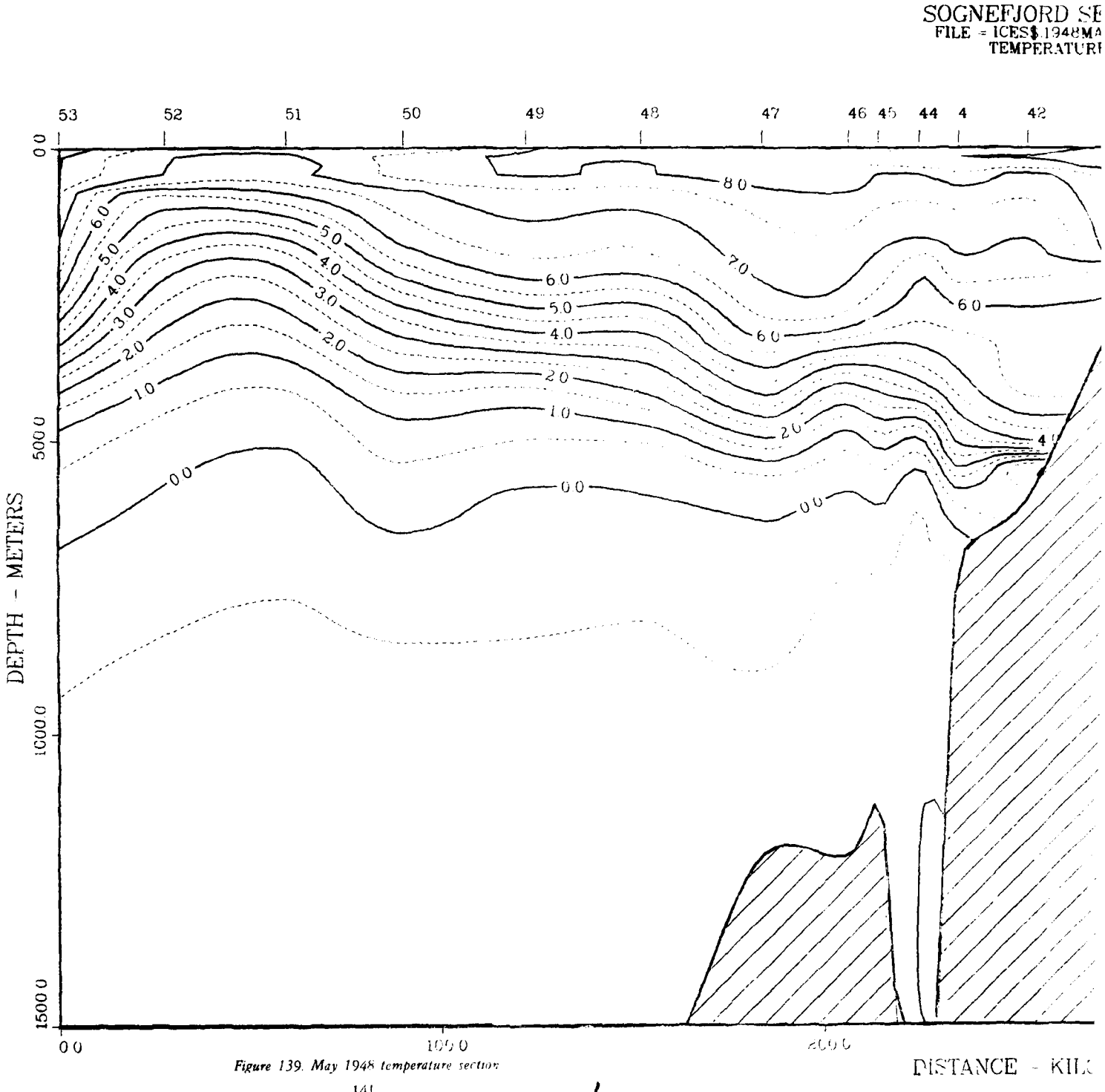
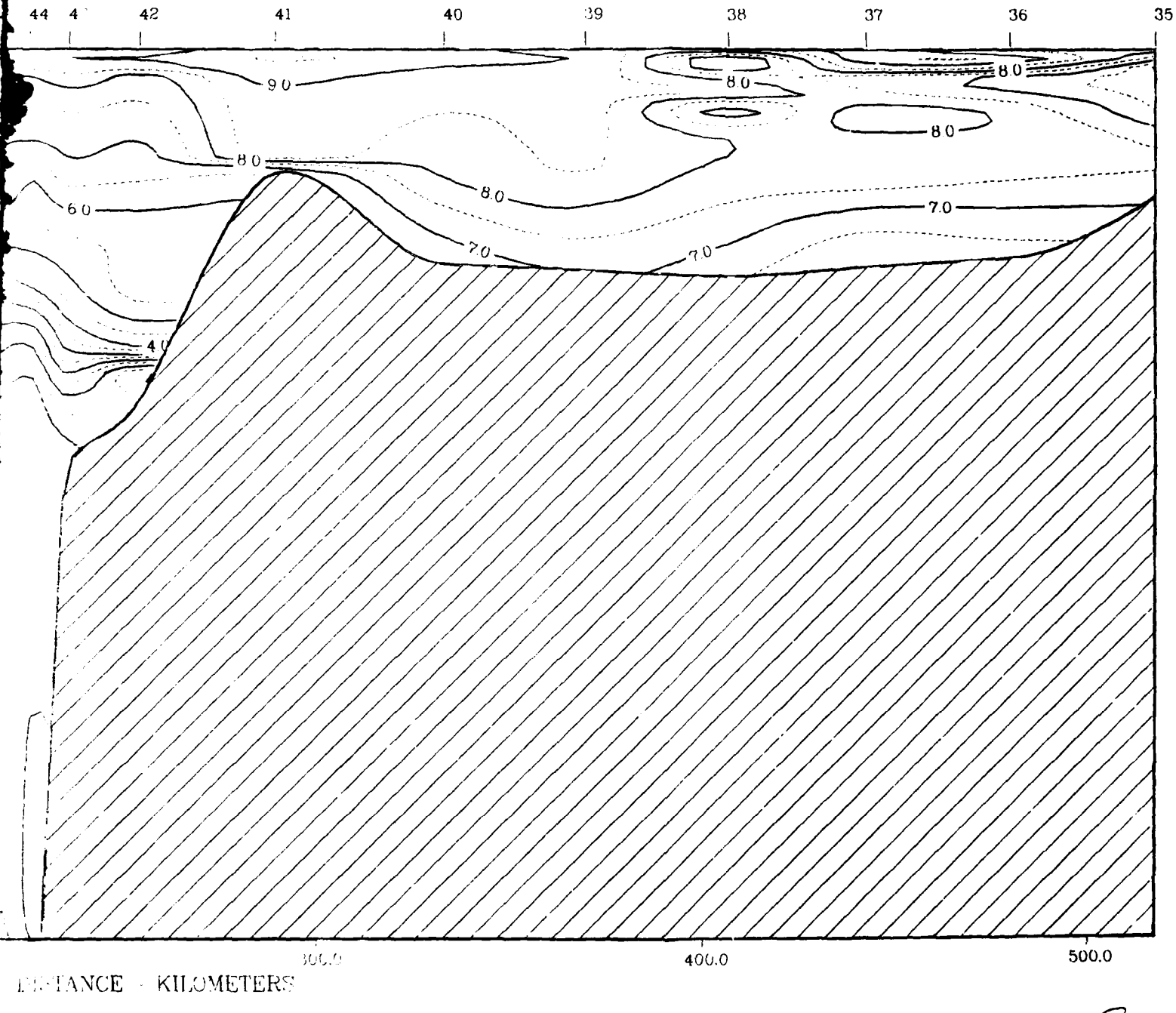


Figure 139. May 1948 temperature section

SOGNEFJORD SECTION
FILE = ICES$.1948MAY.DAT,1
TEMPERATURE



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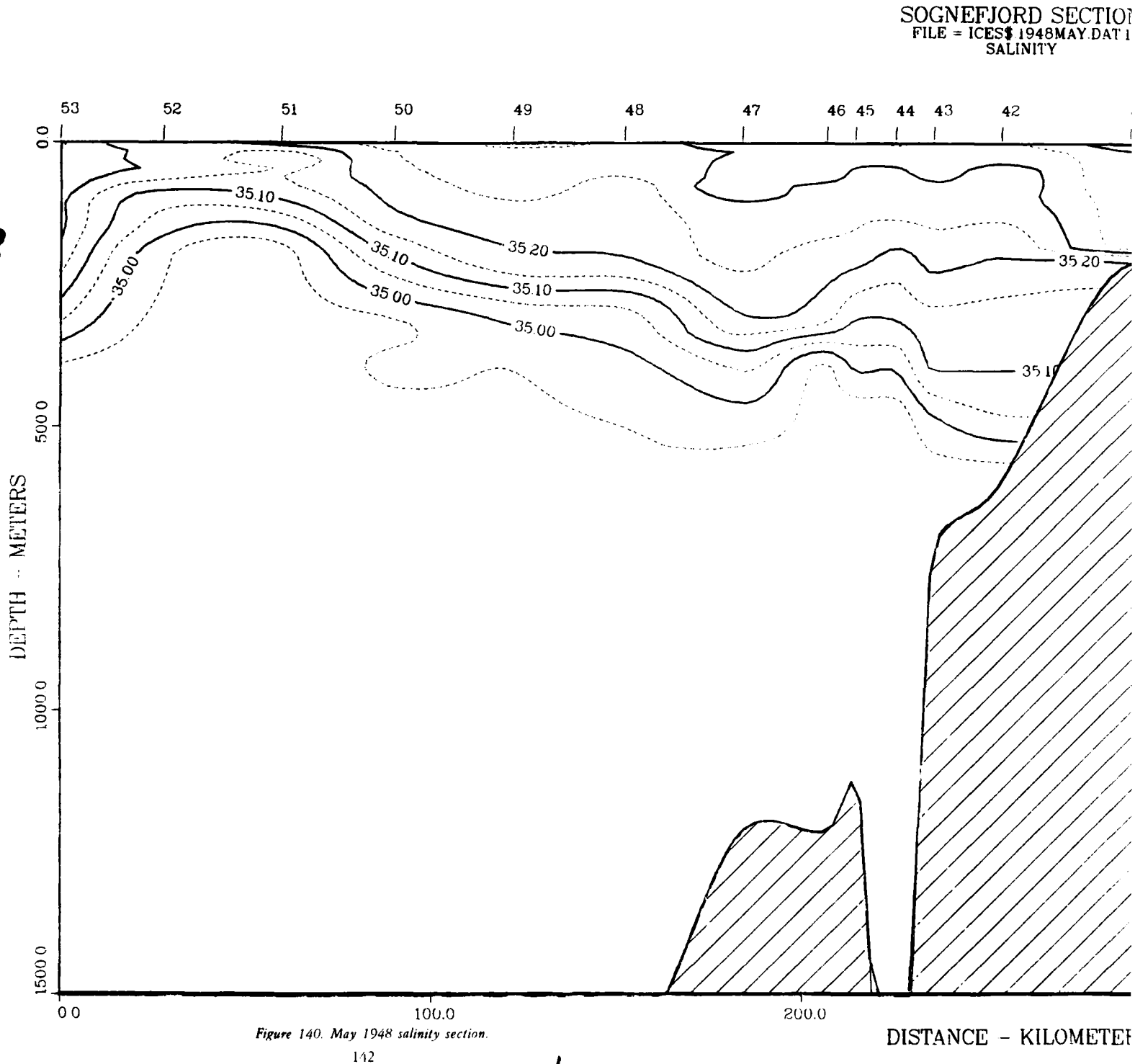
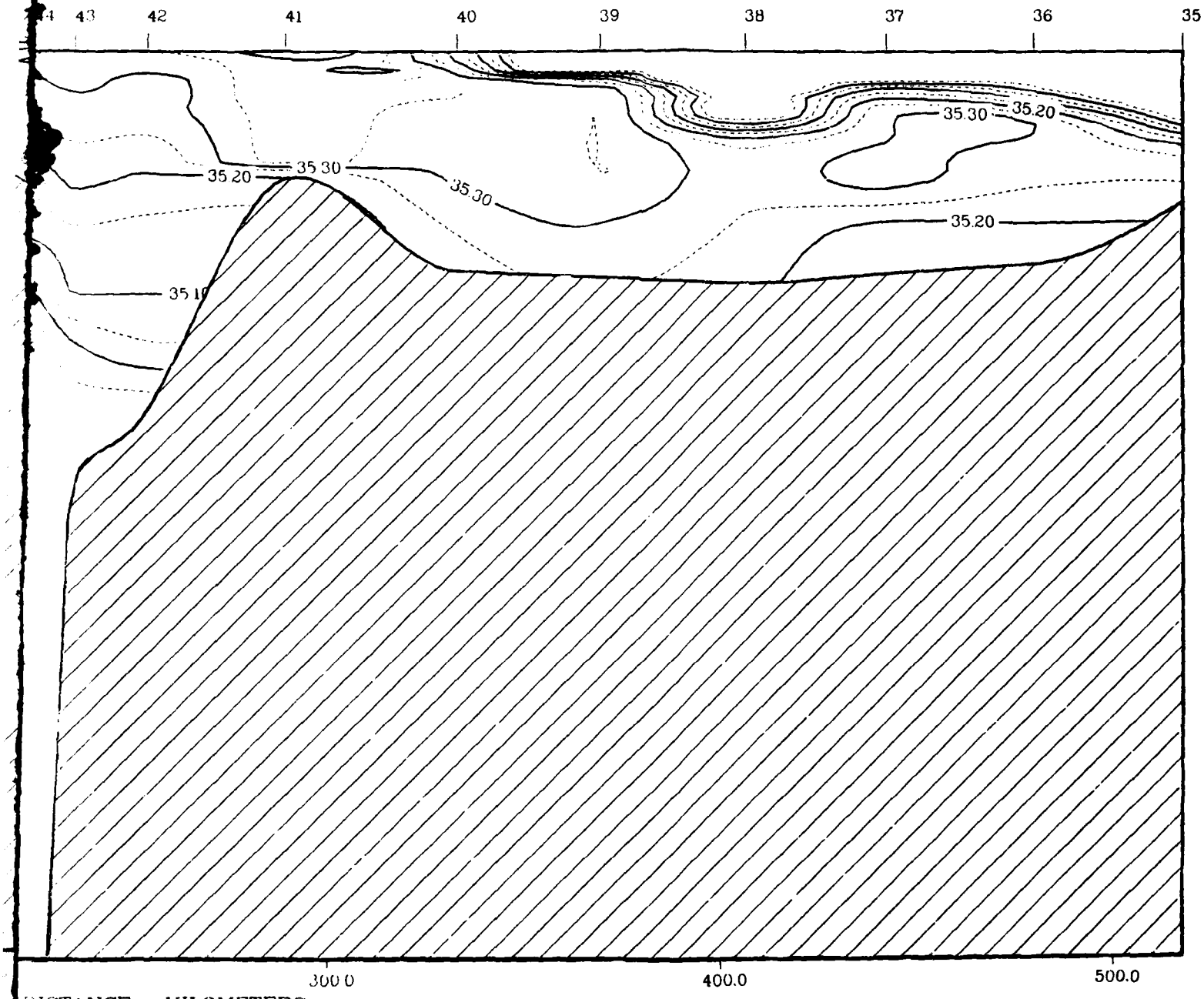


Figure 140. May 1948 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1948MAY.DAT 1
SALINITY



DISTANCE - KILOMETERS

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ICES$.1948JUN.DAT

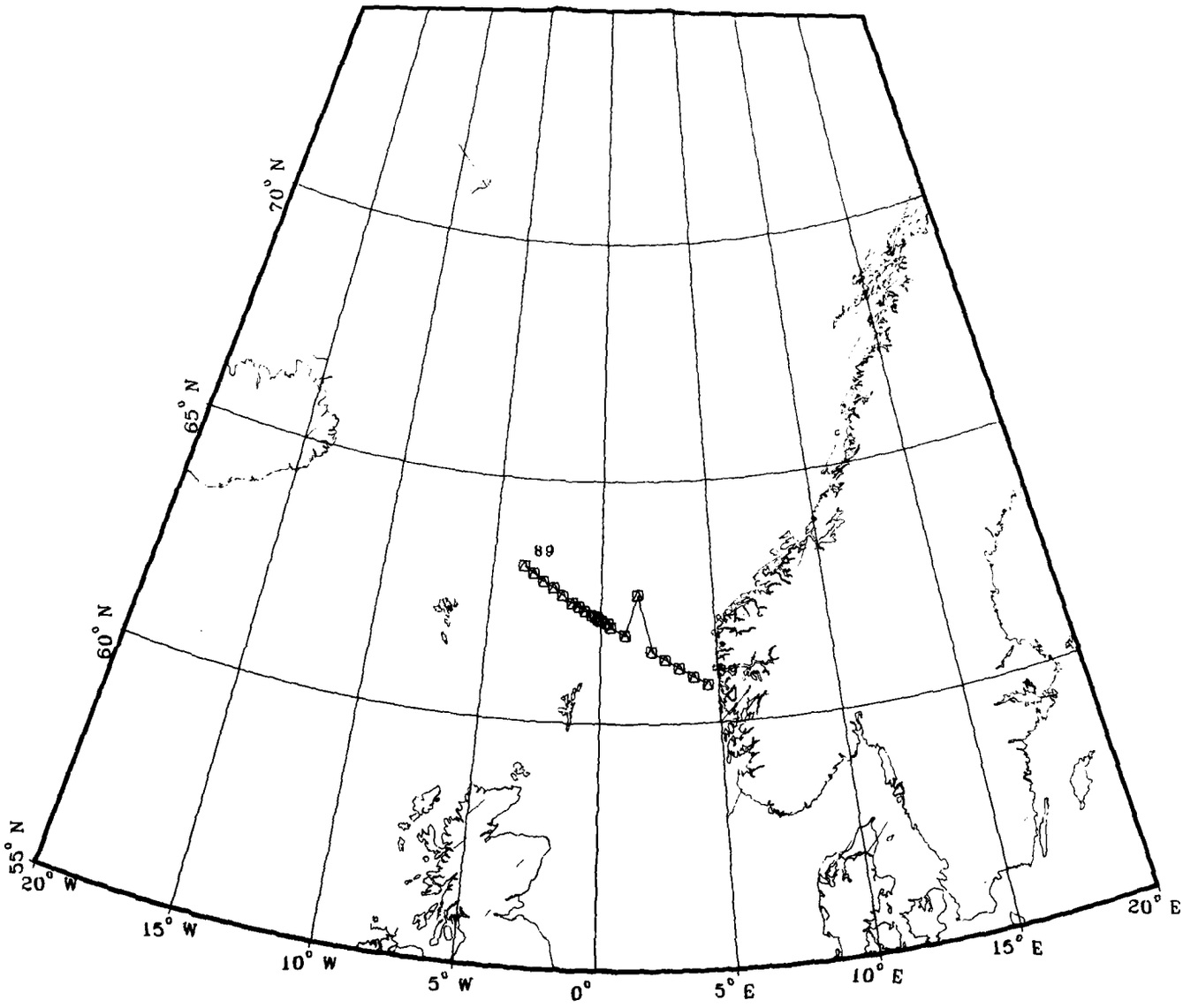


Figure 141. June 1948 station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1948JUN.DAT
T/S PLOT

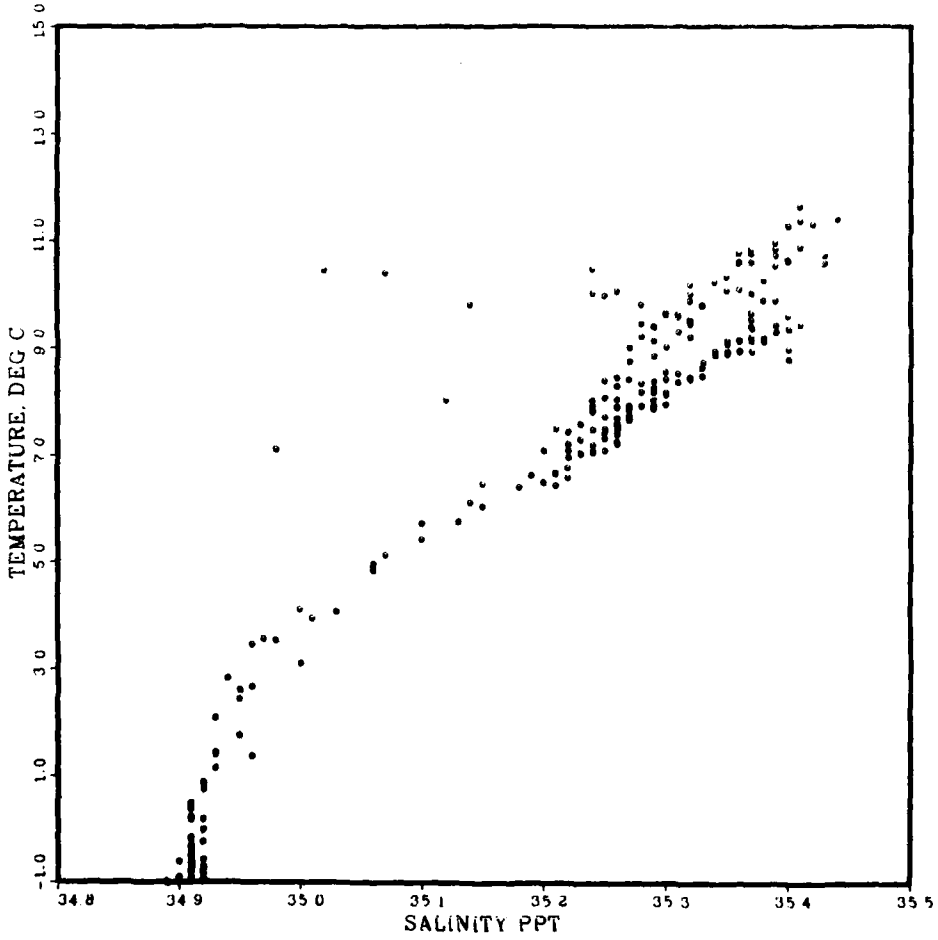


Figure 142. June 1948 temperature/salinity diagram.

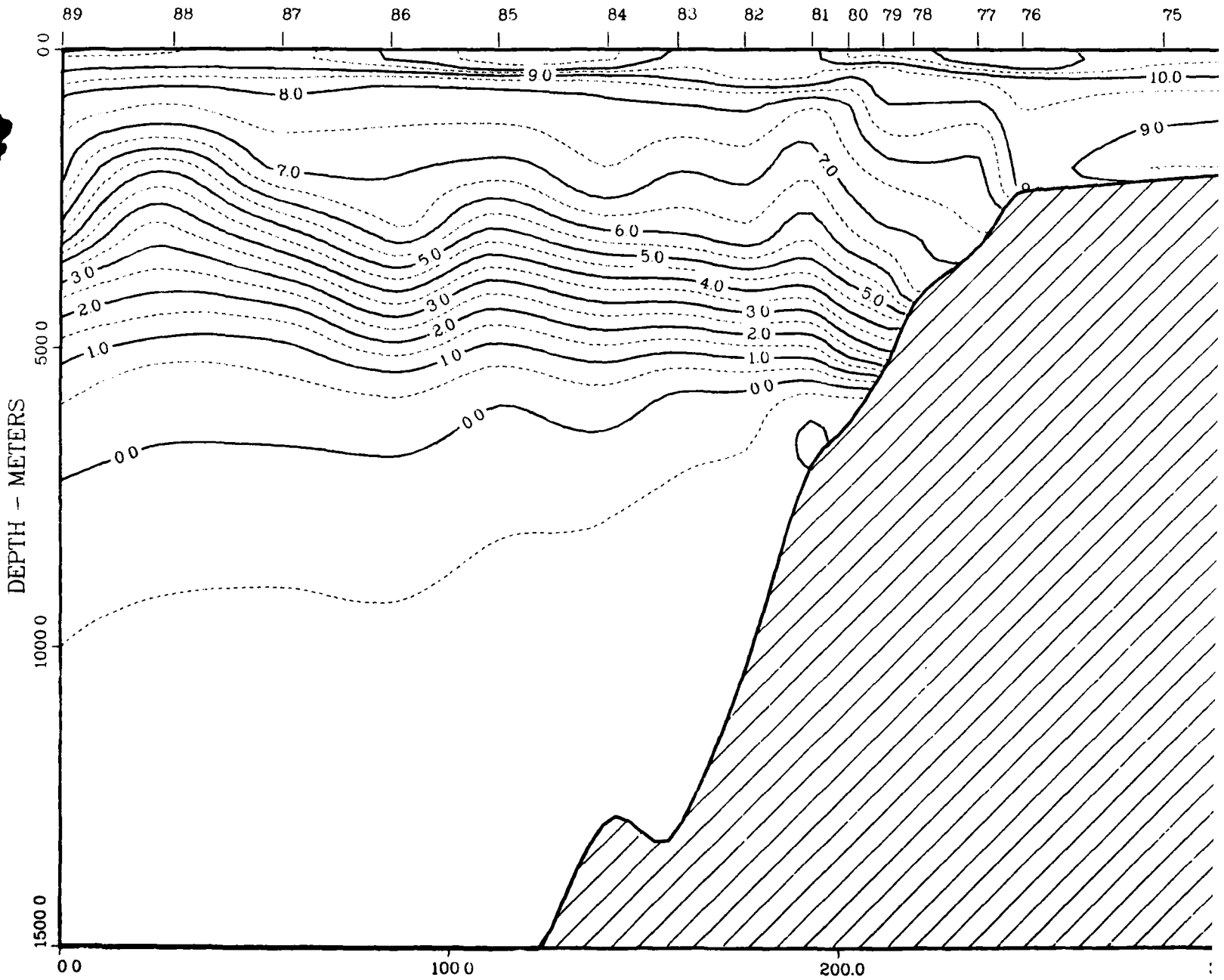
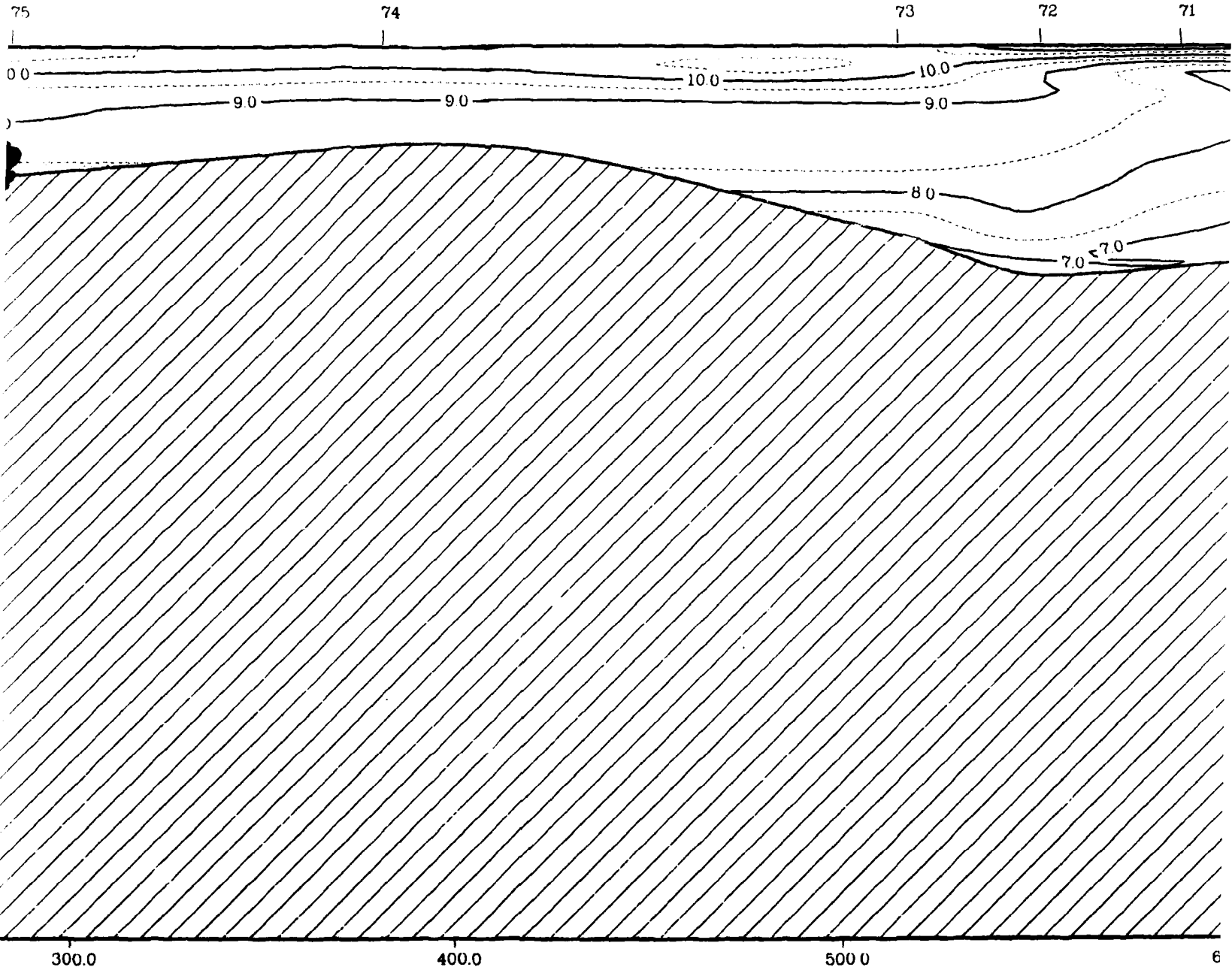
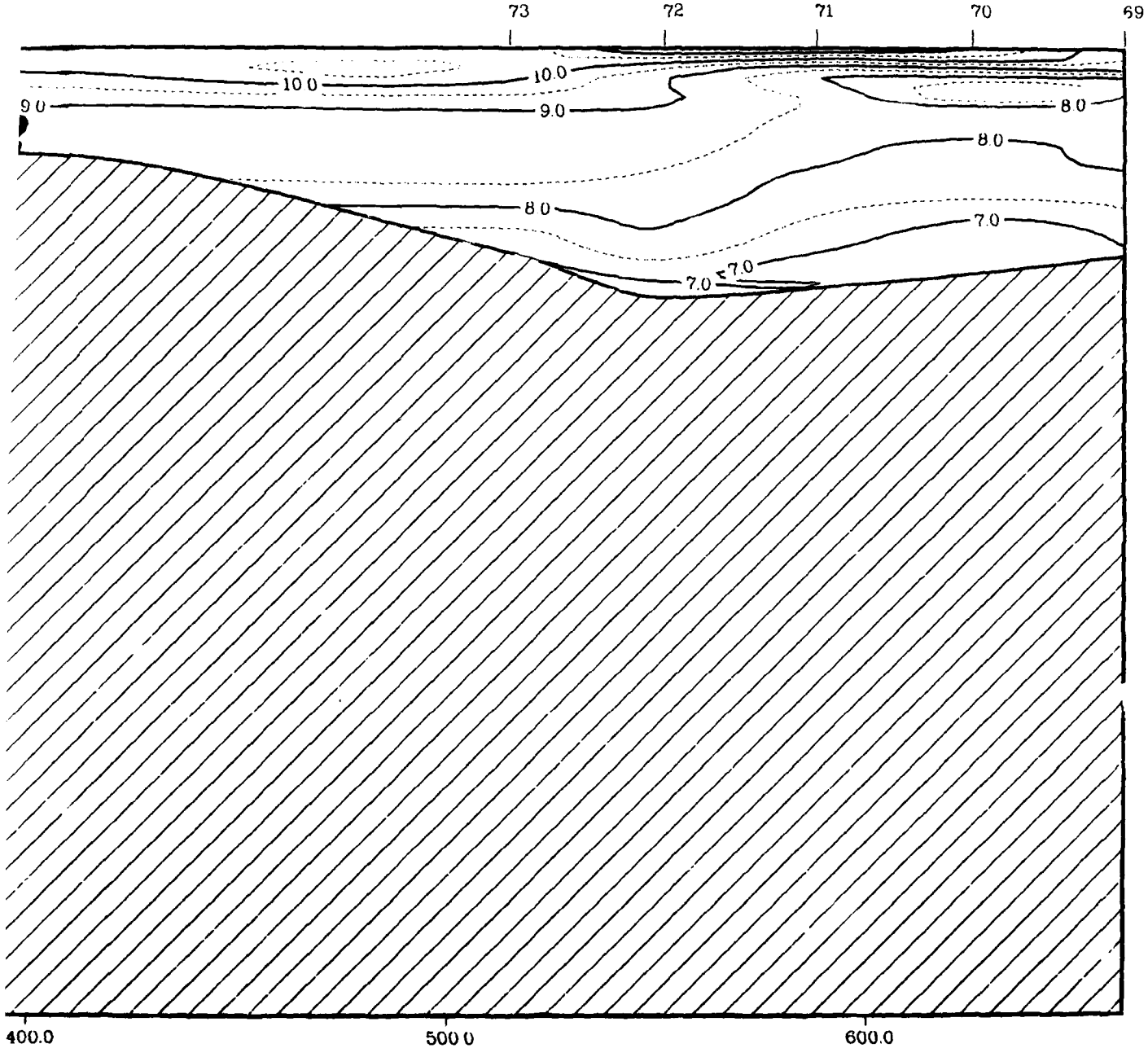


Figure 143. June 1948 temperature section.

SOGNEFJORD SECTION
FILE = ICES$.1948JUN.DAT;1
TEMPERATURE



DISTANCE – KILOMETERS



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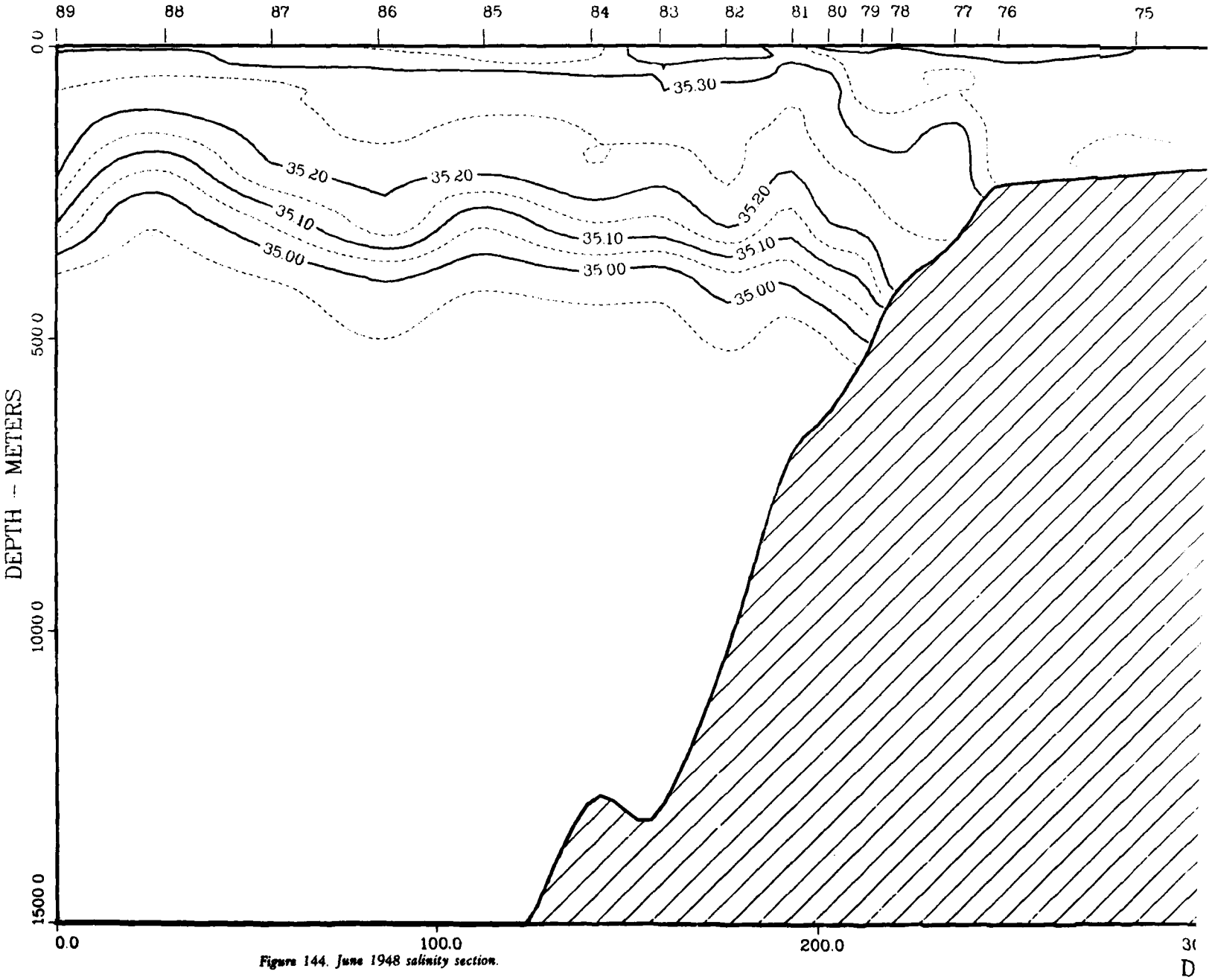
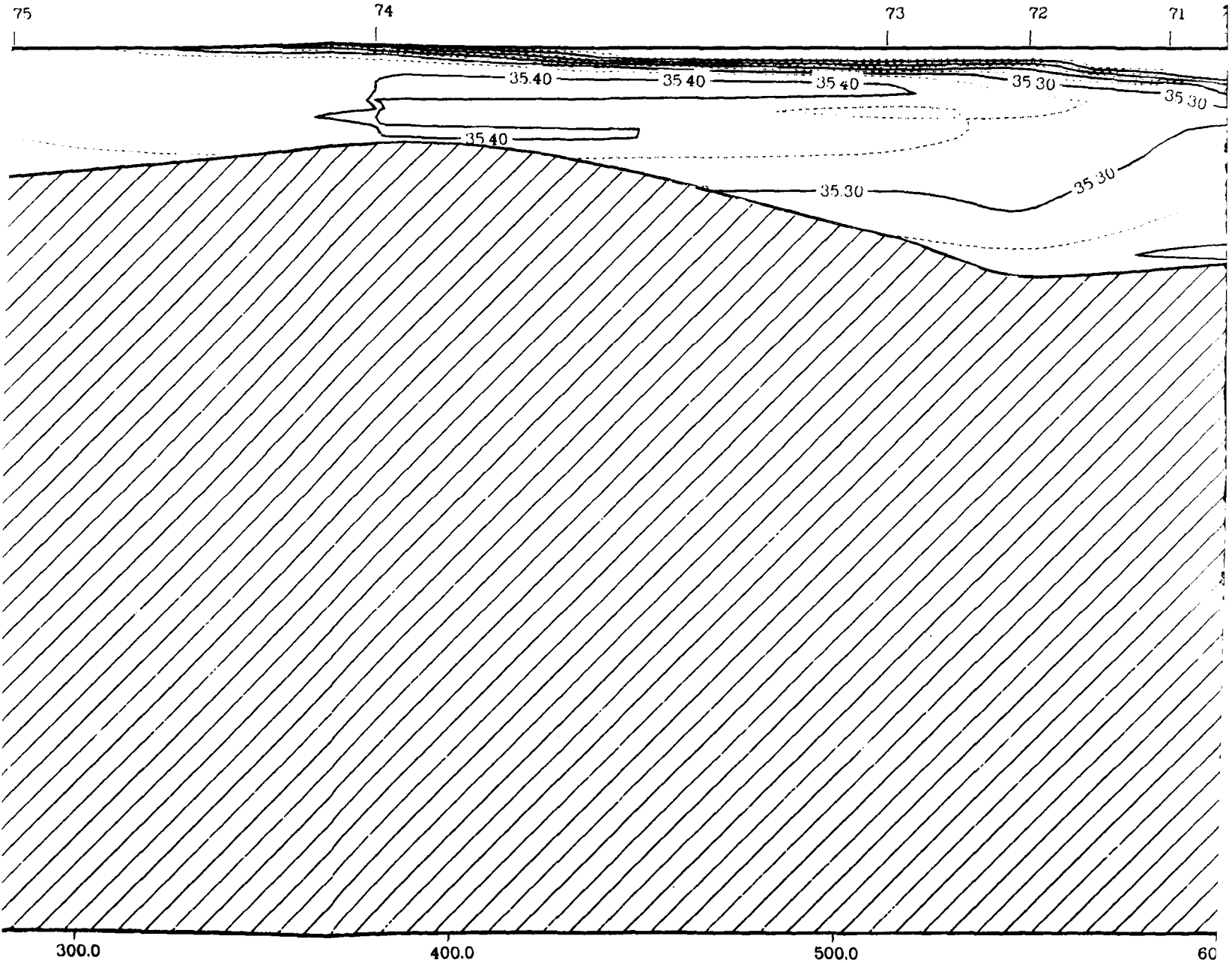


Figure 144. June 1948 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1948JUN.DAT:1
SALINITY



DISTANCE – KILOMETERS

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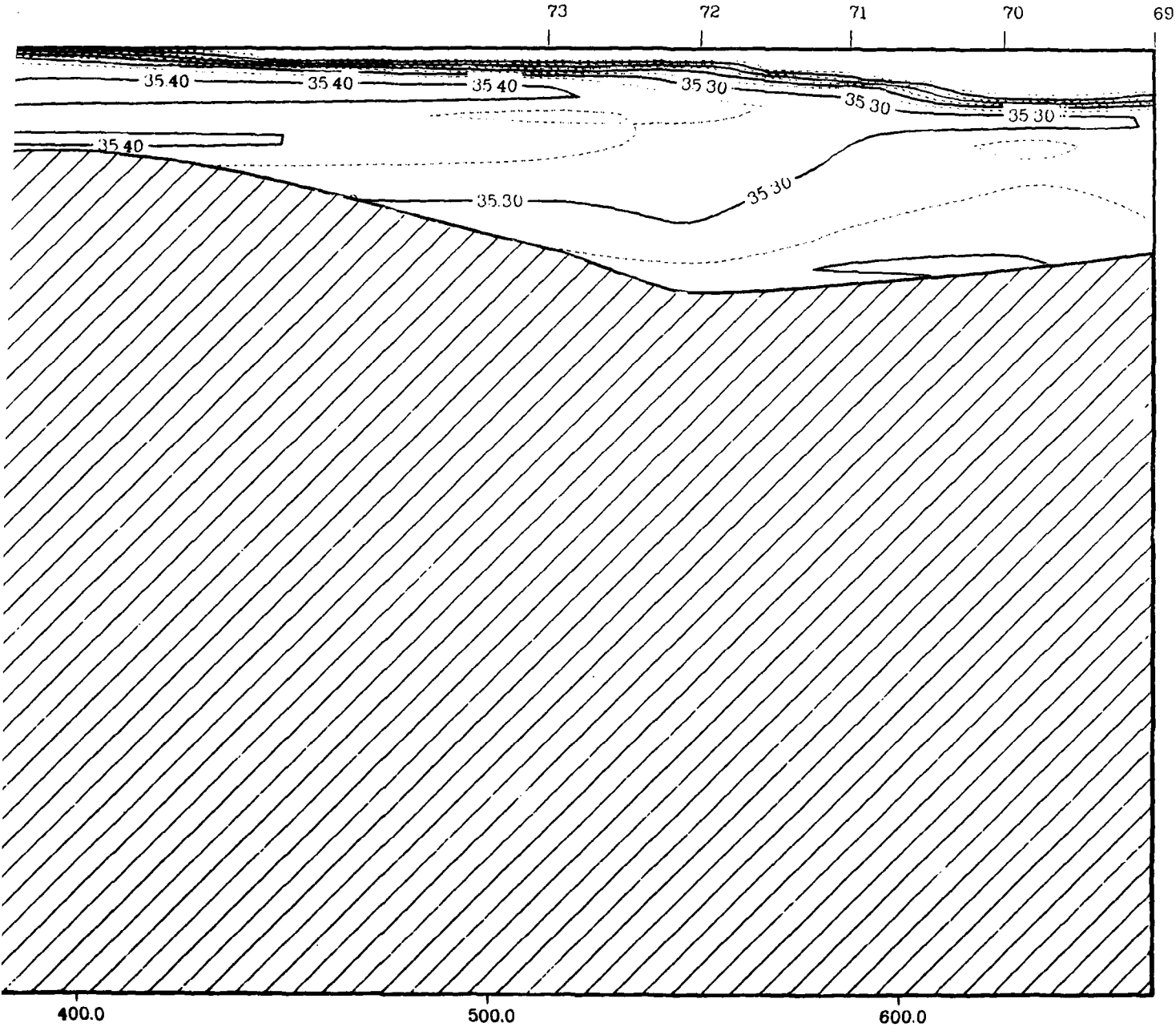
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ICES$.1948AUG.DAT

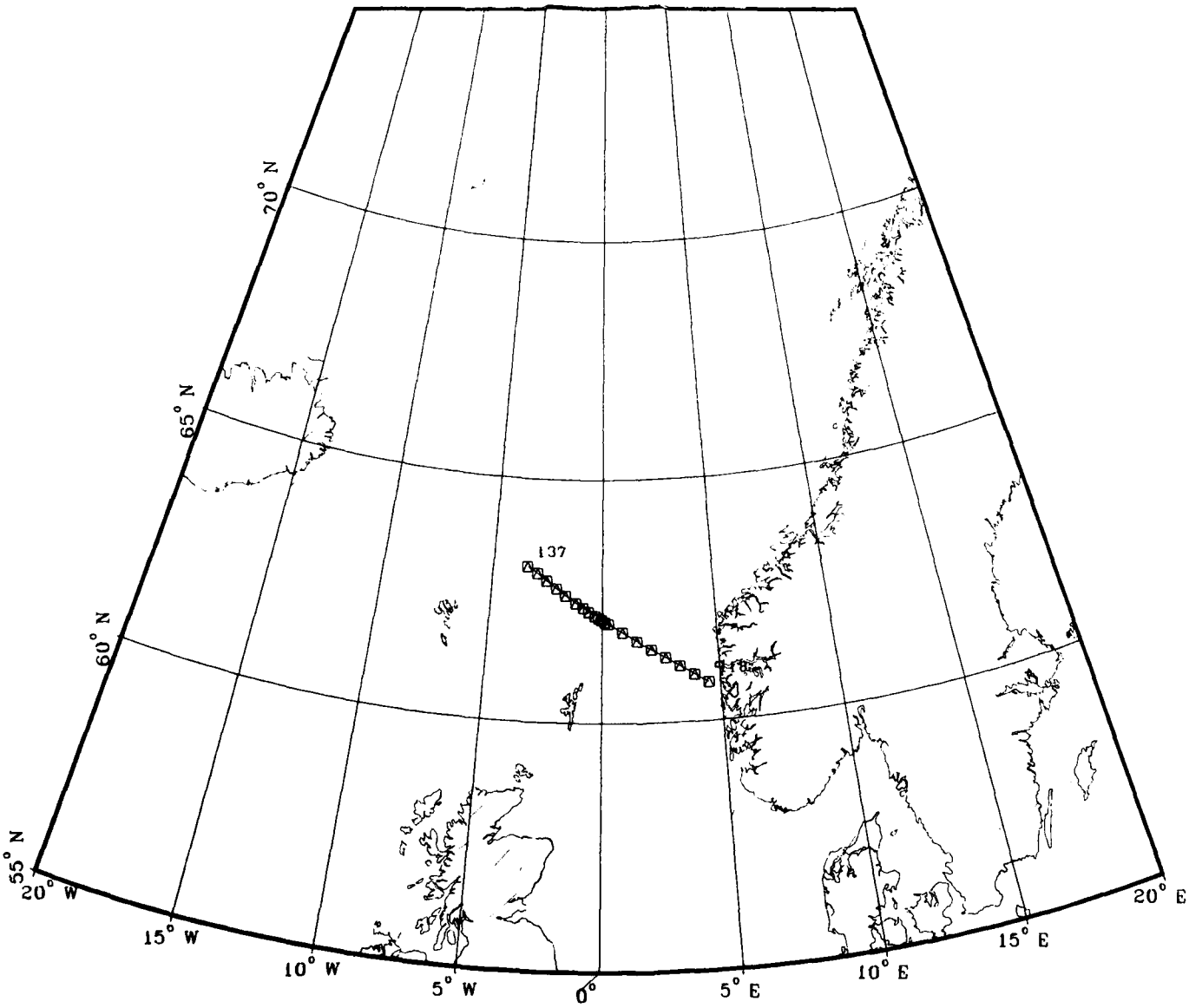


Figure 145. August 1948 station possisons.

SOGNEFJORD SECTION
FILE = ICES$ 1948AUG DAT
T/S PLOT

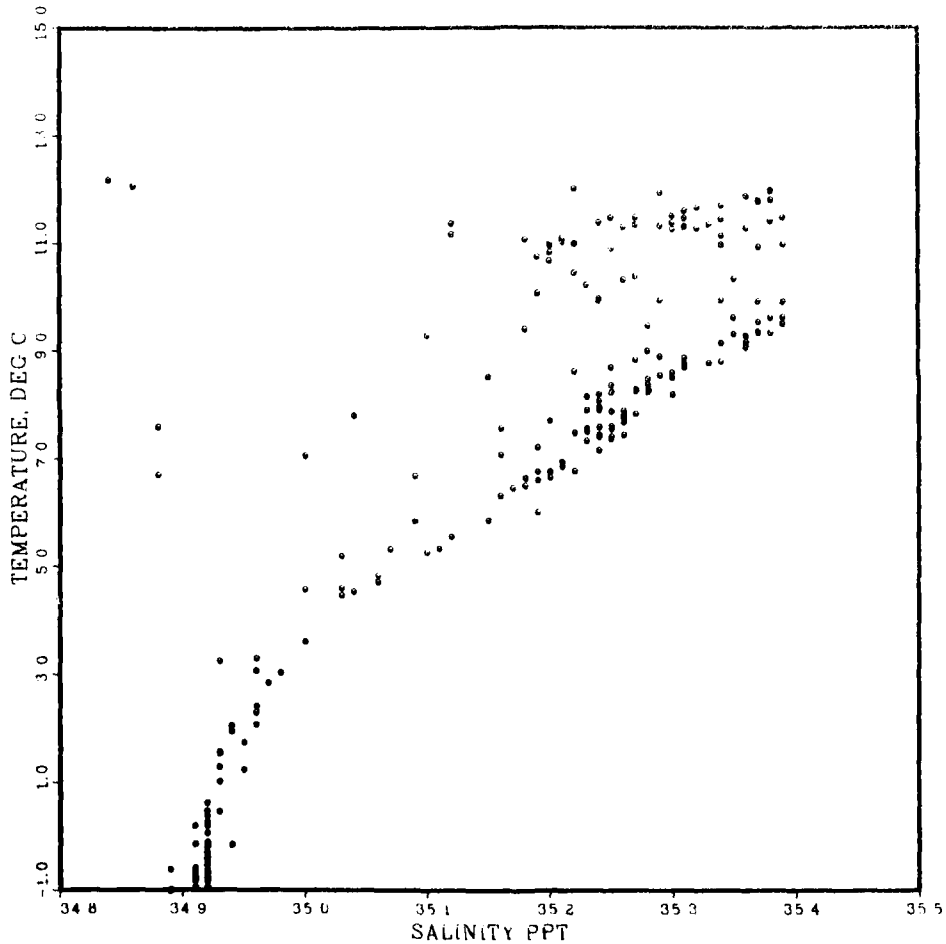


Figure 146. August 1948 temperature/salinity diagram.

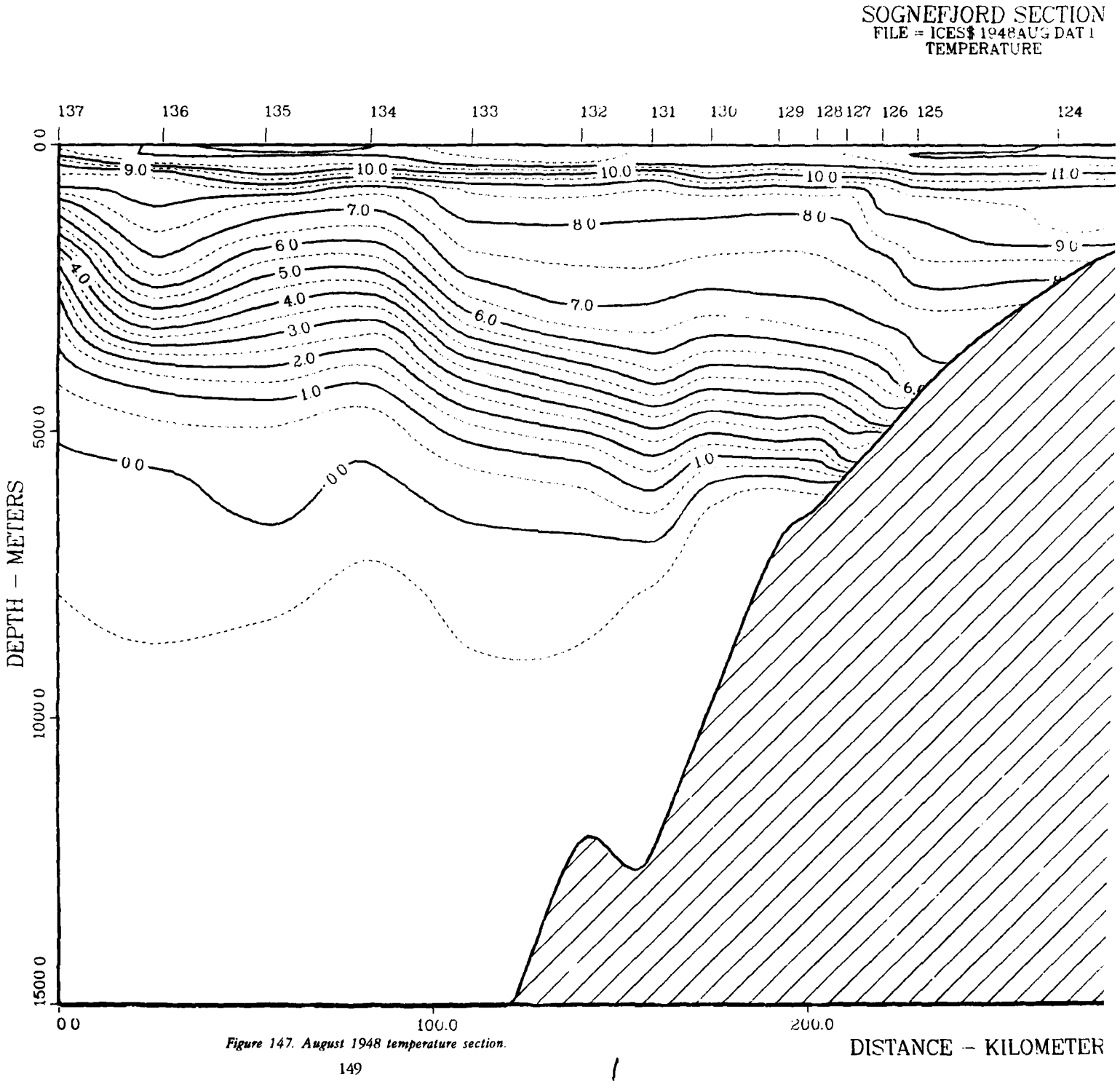
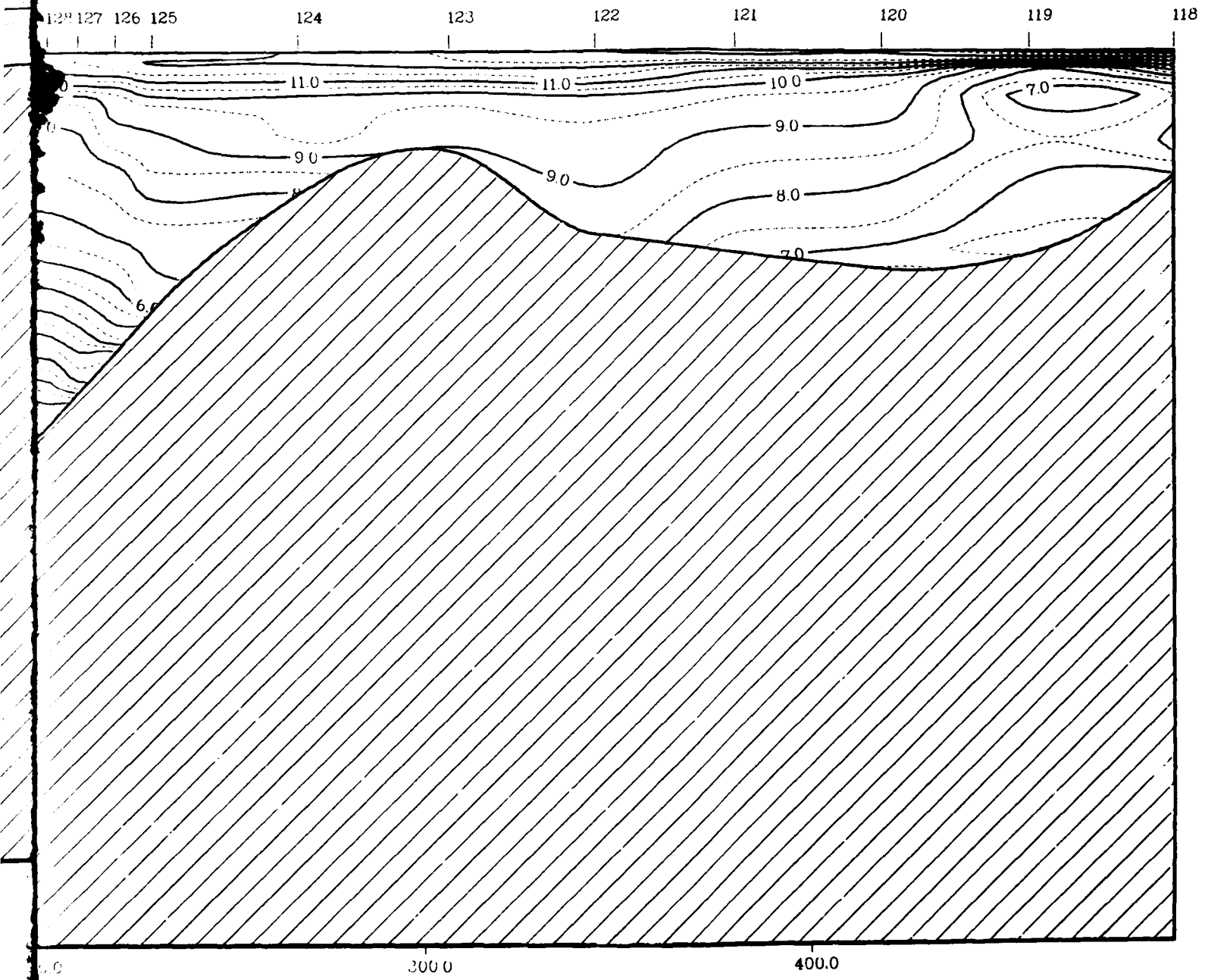


Figure 147. August 1948 temperature section.

SOGNEFJORD SECTION
FILE = ICES$ 1948AUG DAT 1
TEMPERATURE



DISTANCE – KILOMETERS

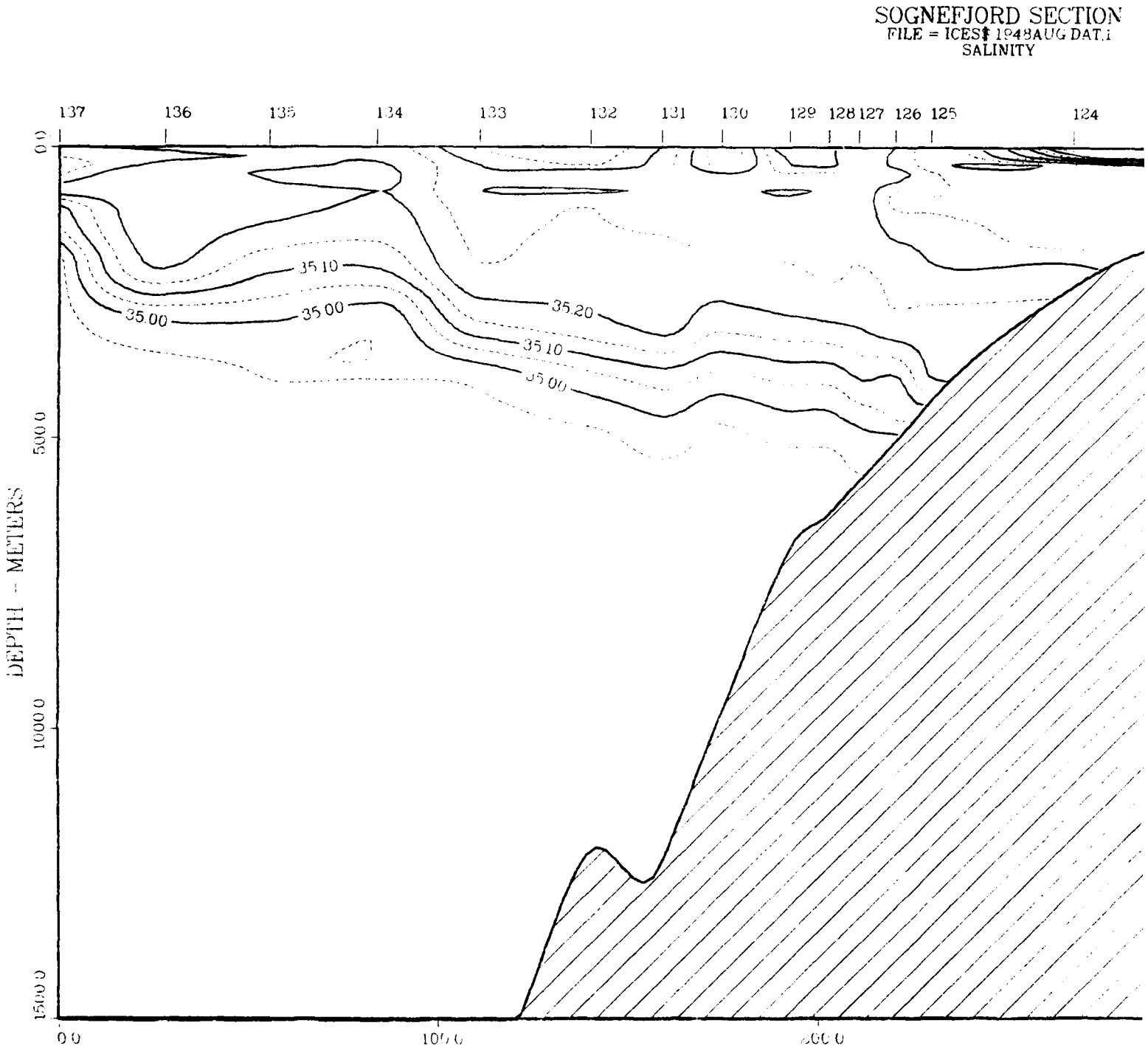
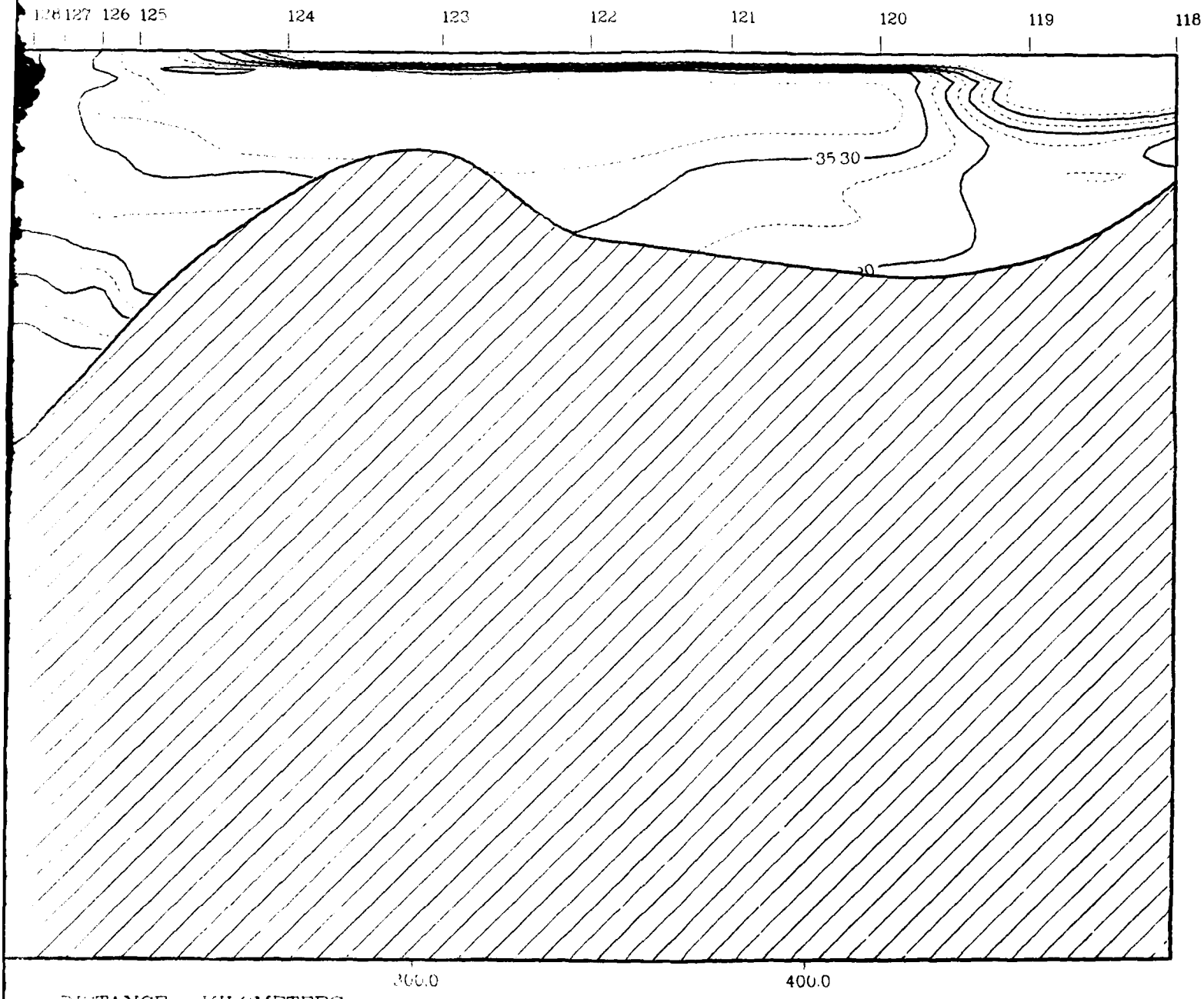


Figure 148. August 1948 salinity section

SOGNEFJORD SECTION
FILE = ICES$ 1948AUG DAT;1
SALINITY



DISTANCE – KILOMETERS

2

ICES$:1949MAY.DAT

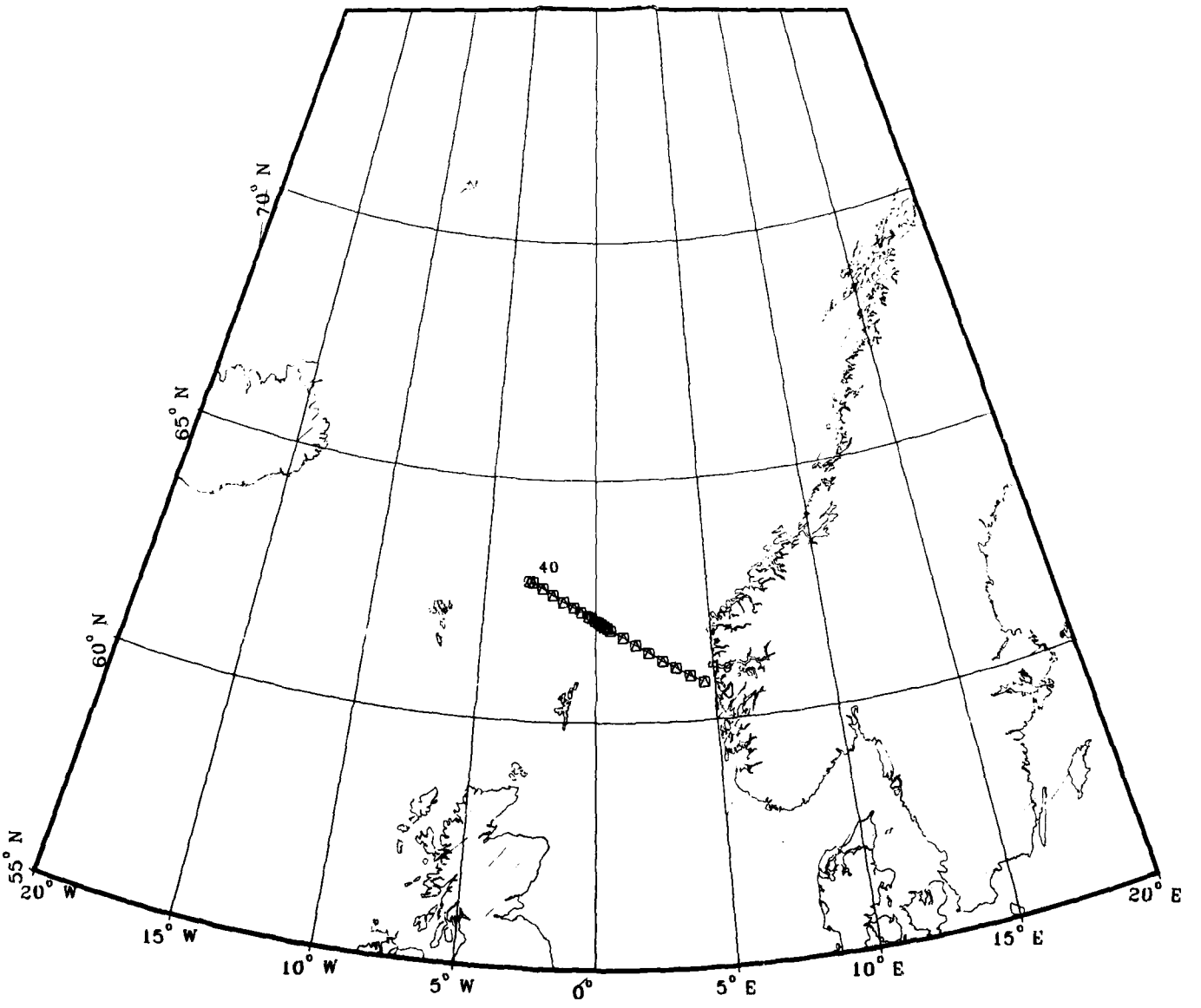


Figure 149. May 1949 station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1949MAY.DAT
T/S PLOT

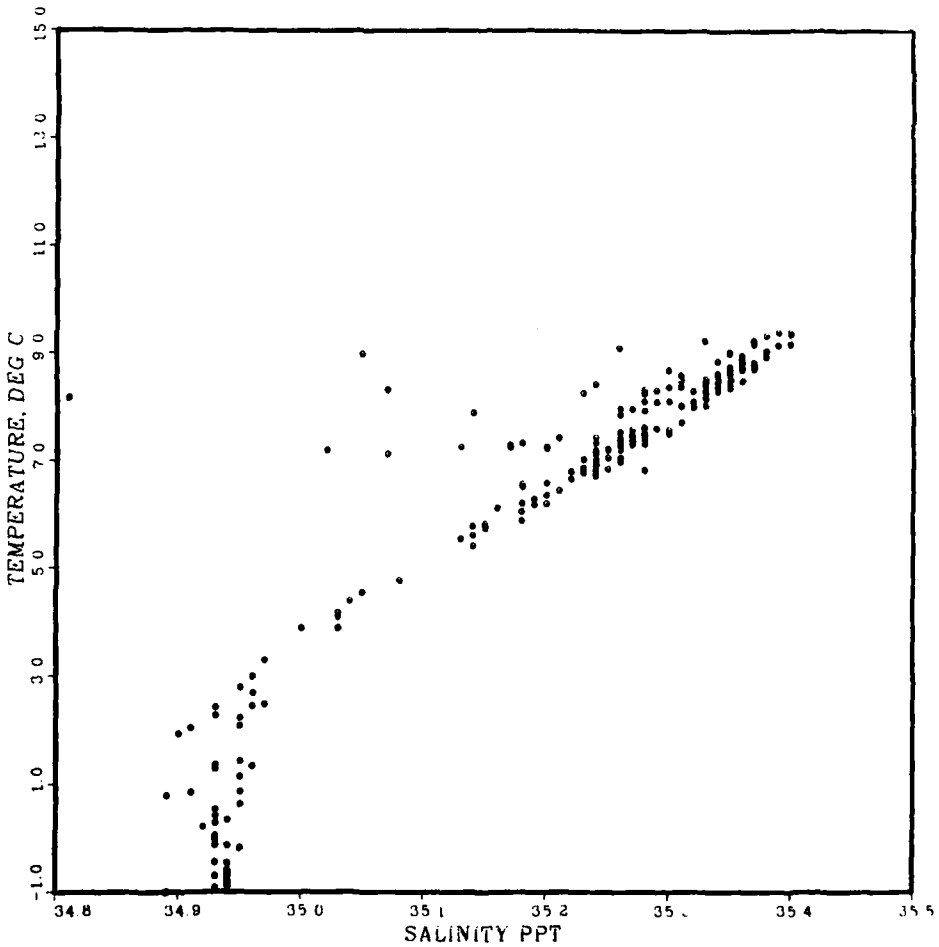


Figure 150. May 1949 temperature/salinity diagram.

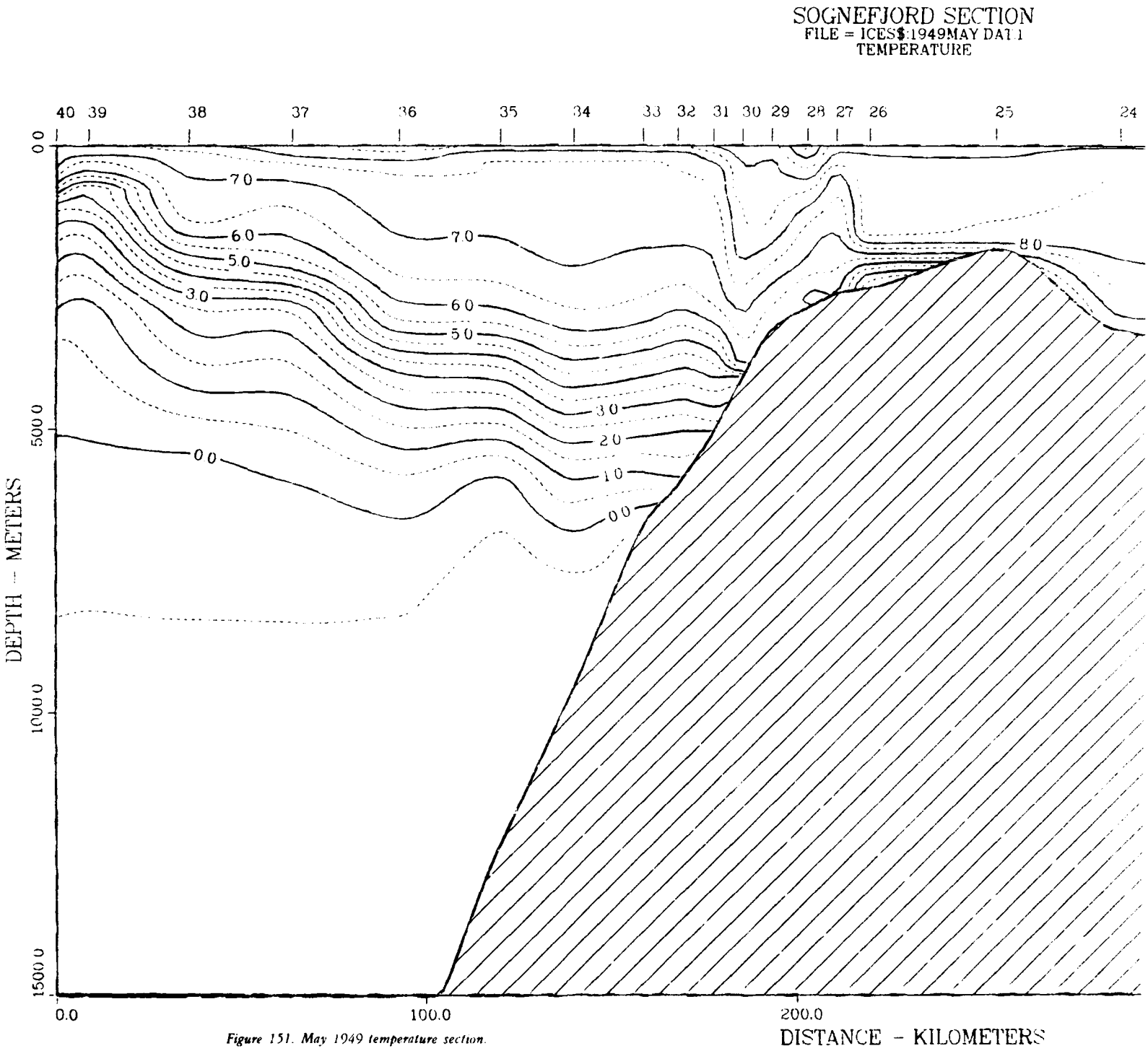
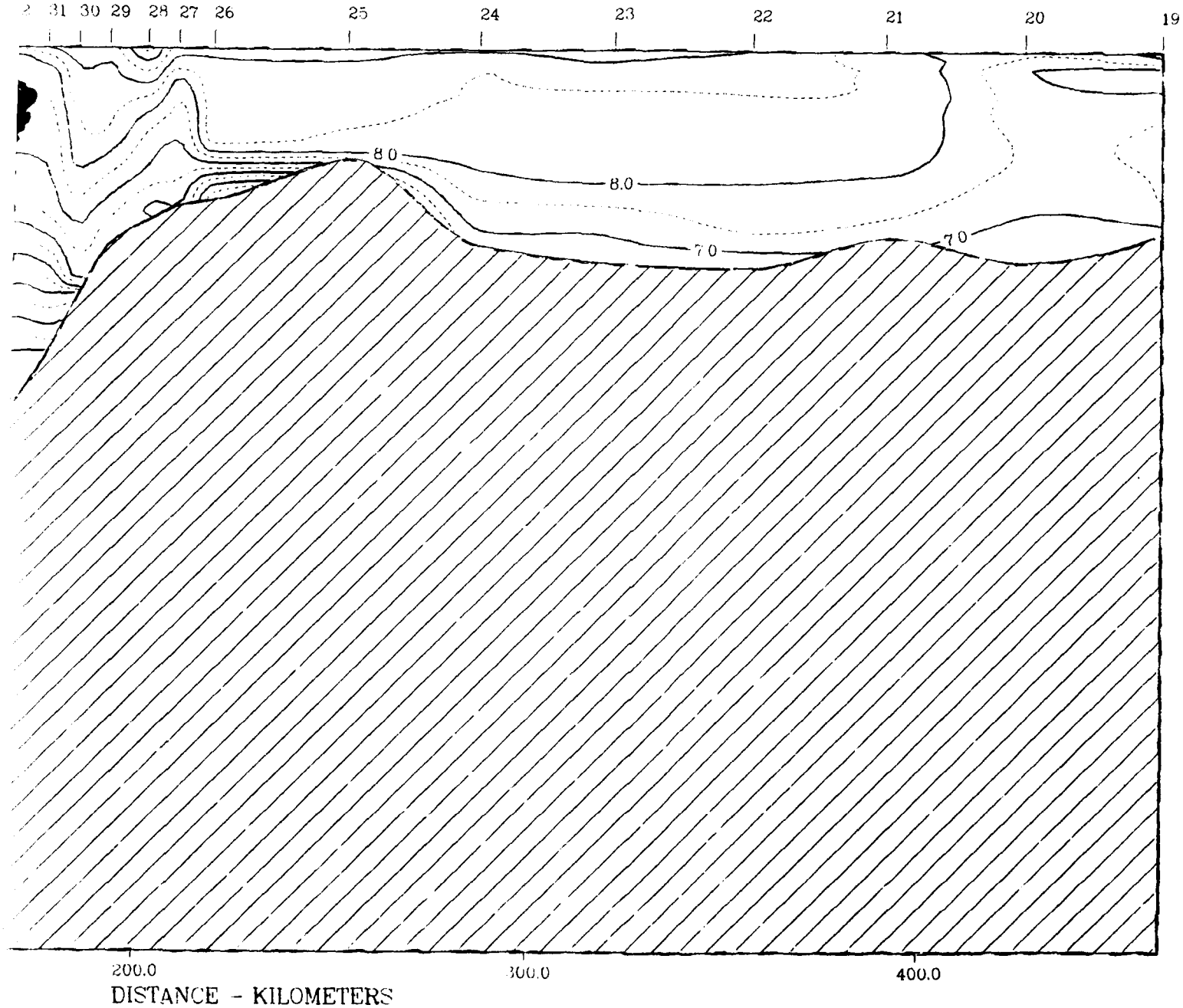


Figure 151. May 1949 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1949MAY DAT:1
TEMPERATURE



DISTANCE - KILOMETERS

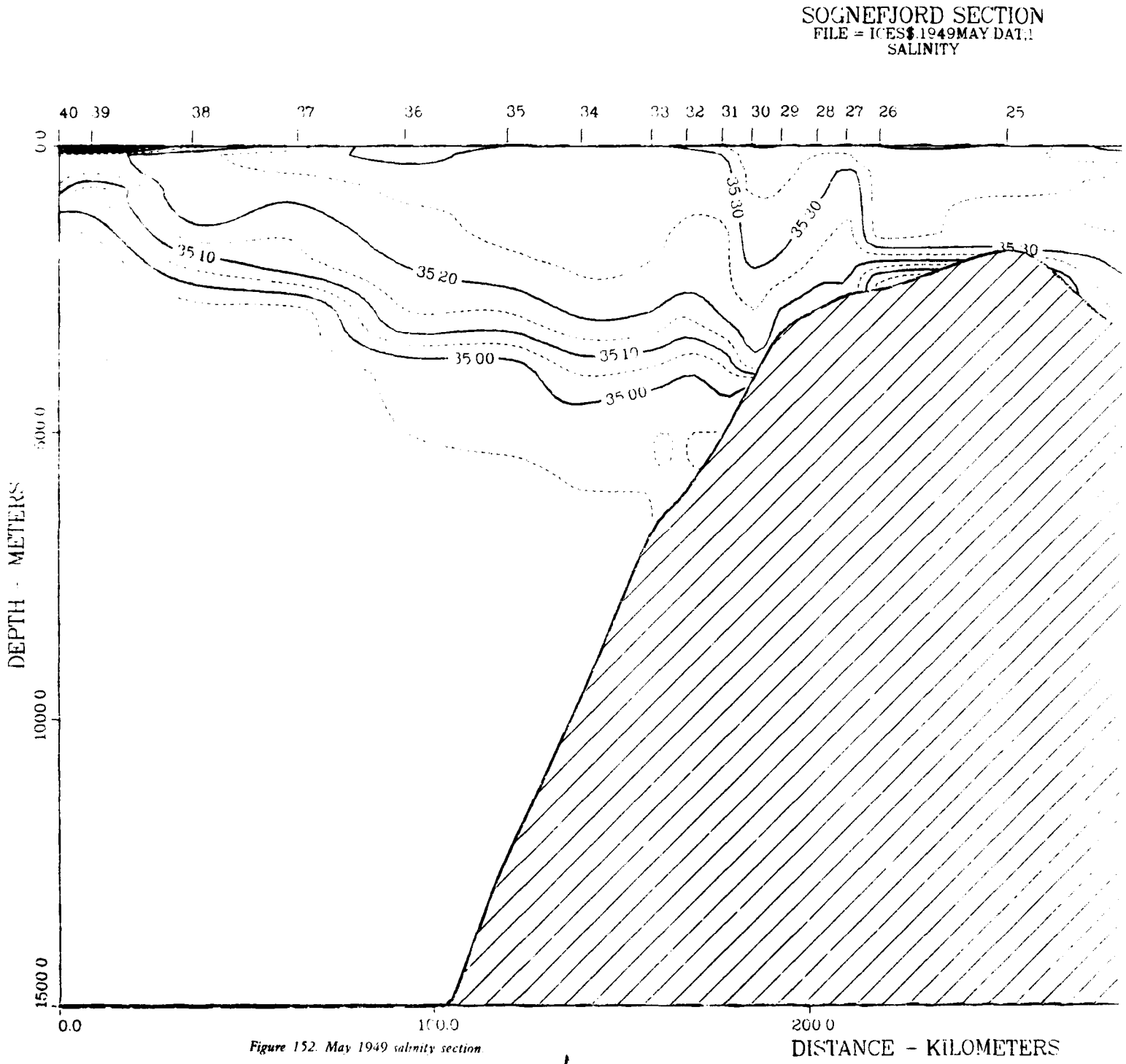
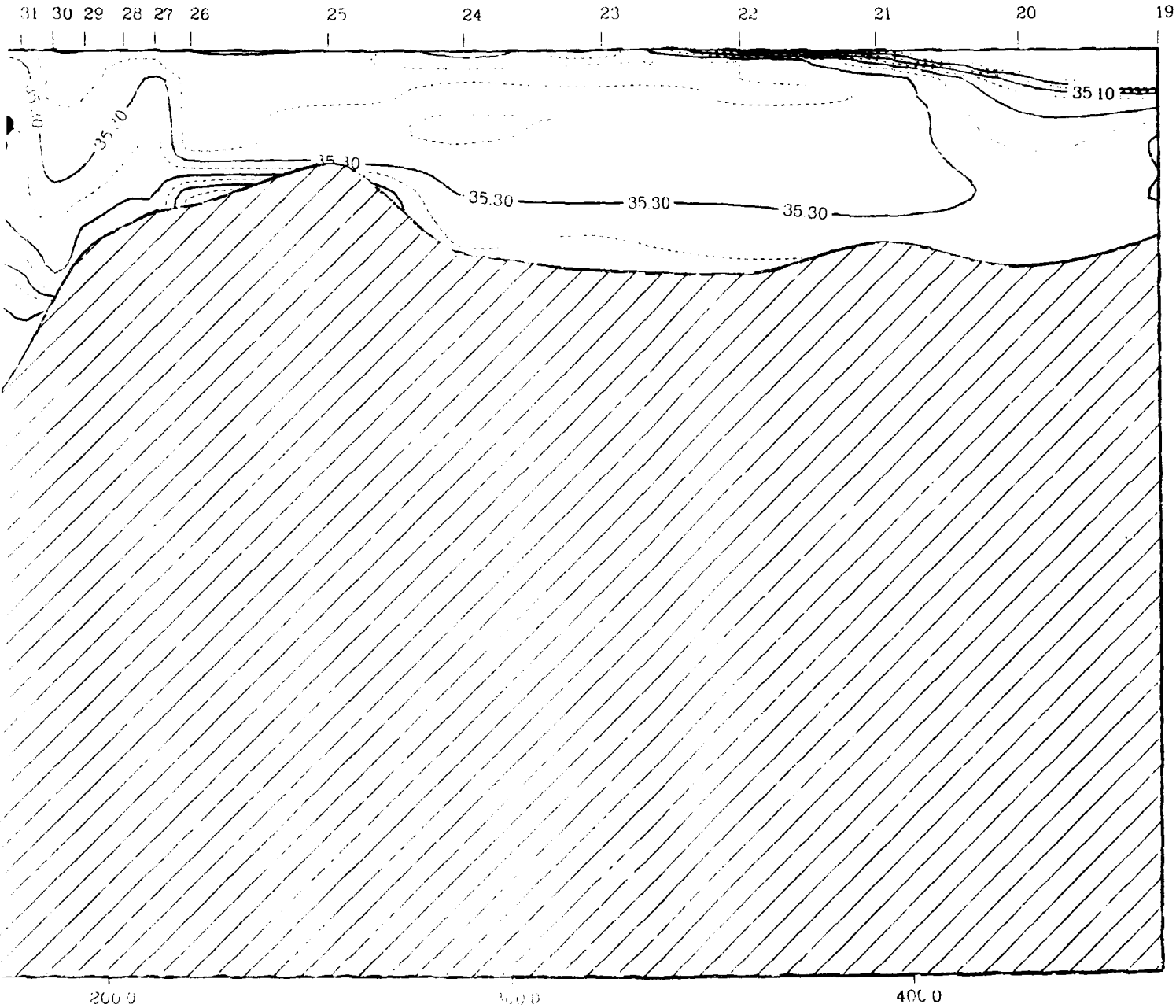


Figure 152. May 1949 salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1949MAY.DAT;1
SALINITY



DISTANCE - KILOMETERS

2

SOGNEFJORD SECTION
FILE = ICES$ 1949JUL.DAT
T/S PLOT

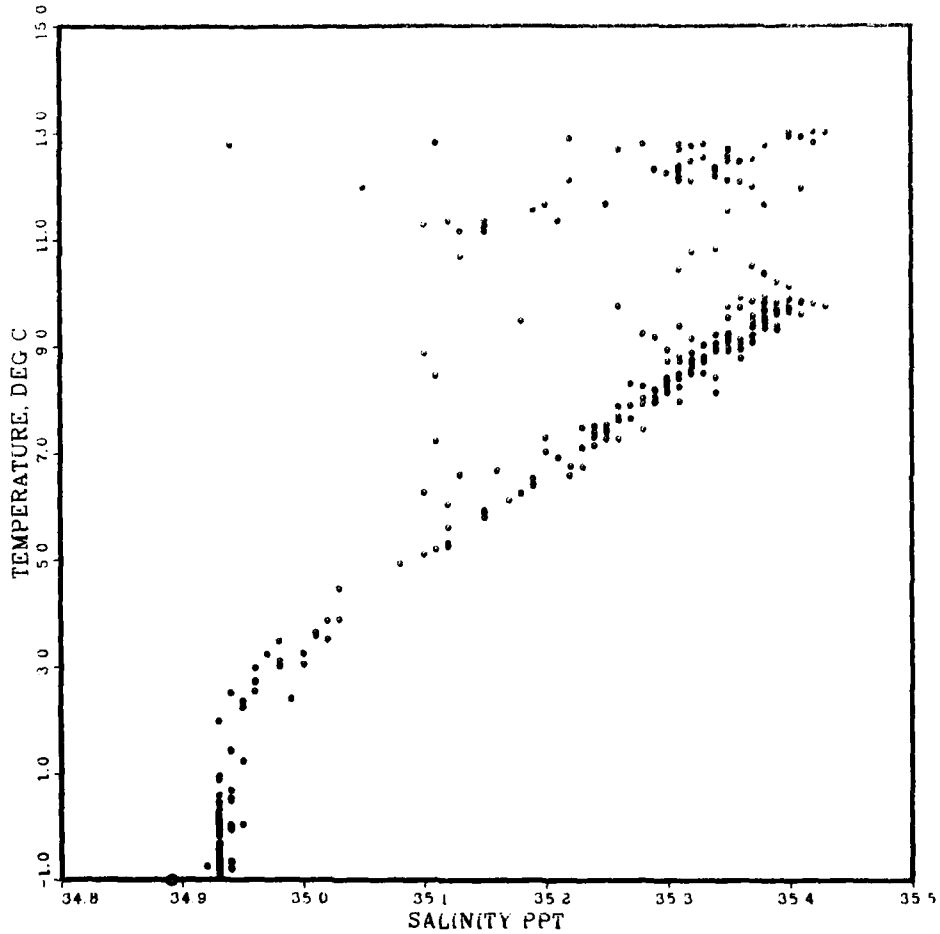


Figure 154. July 1949 temperature/salinity diagram.

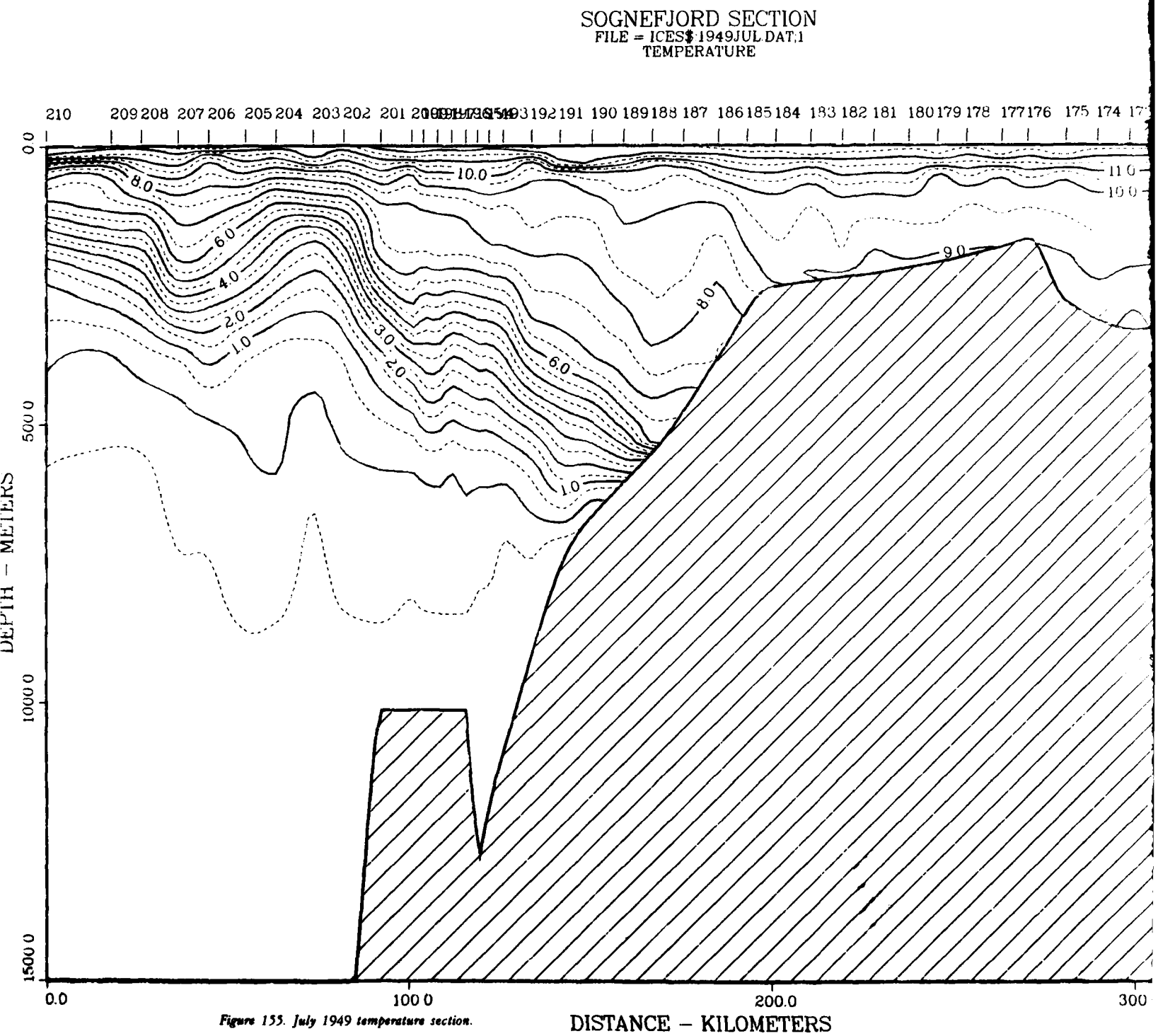
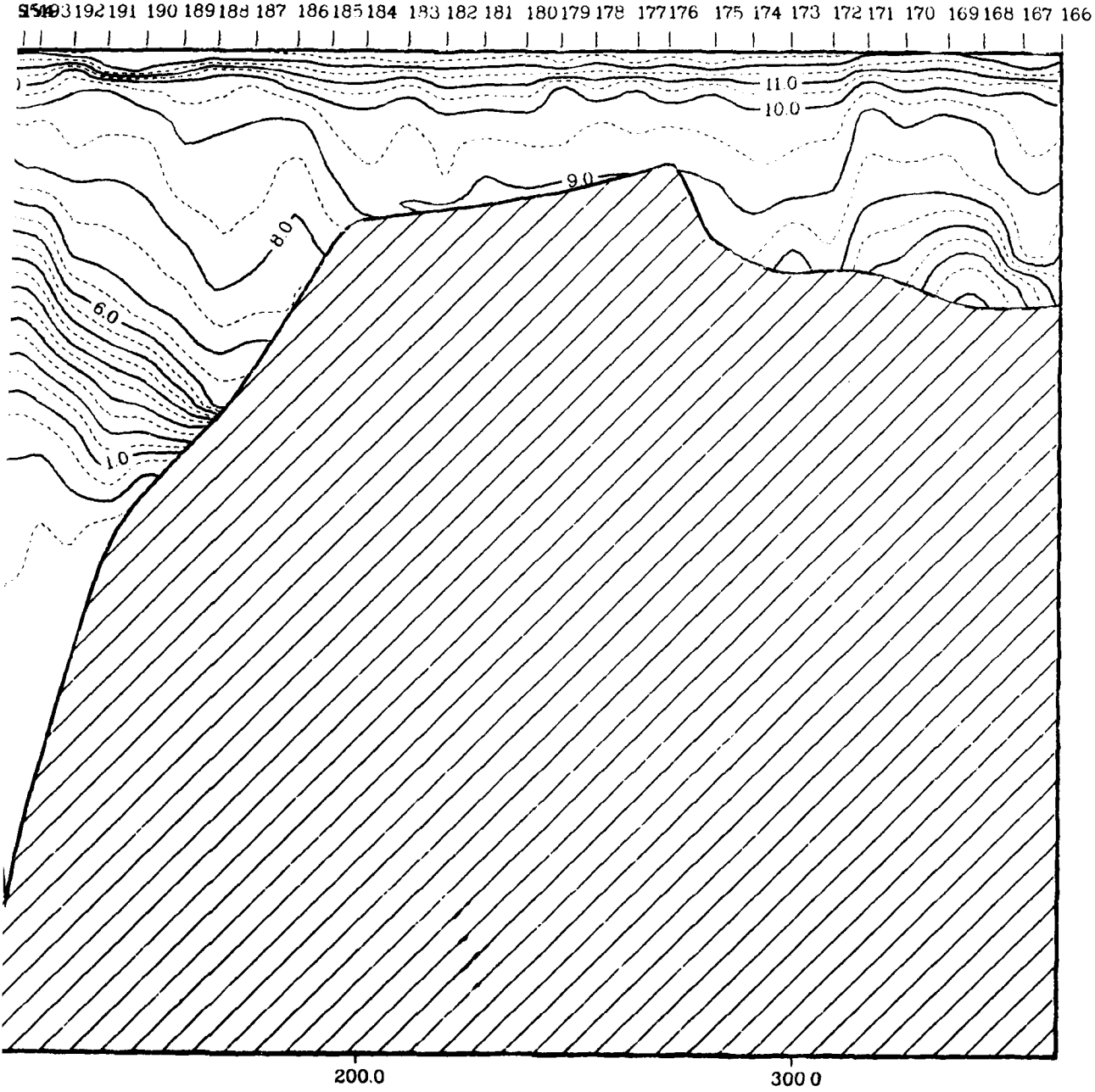


Figure 155. July 1949 temperature section.

SOGNEFJORD SECTION
FILE = ICES$1949JUL.DAT.1
TEMPERATURE



DISTANCE – KILOMETERS

1

1

2

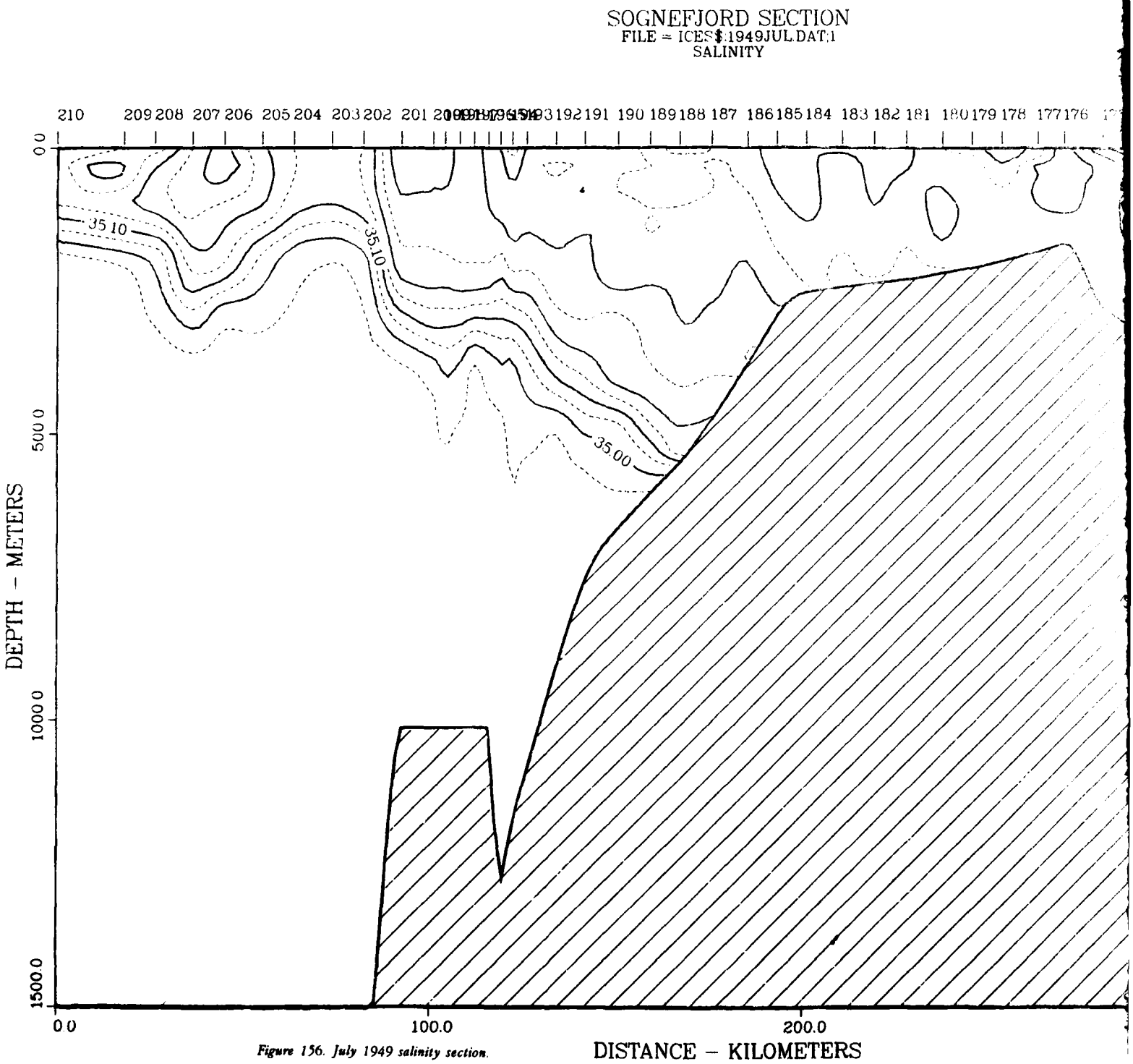
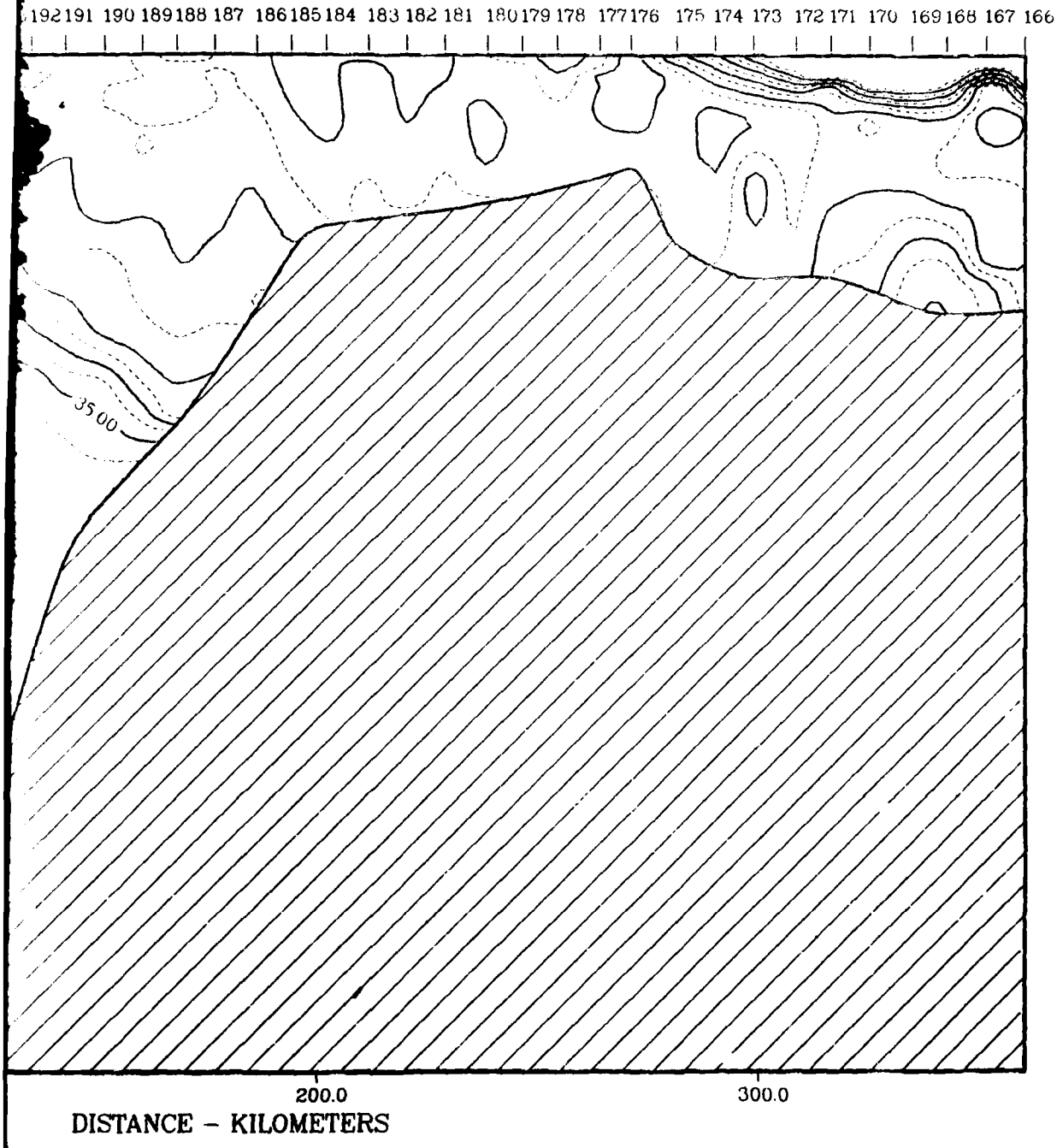


Figure 156. July 1949 salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1949JUL.DAT;1
SALINITY



2

ICES$:1950PMA.DAT

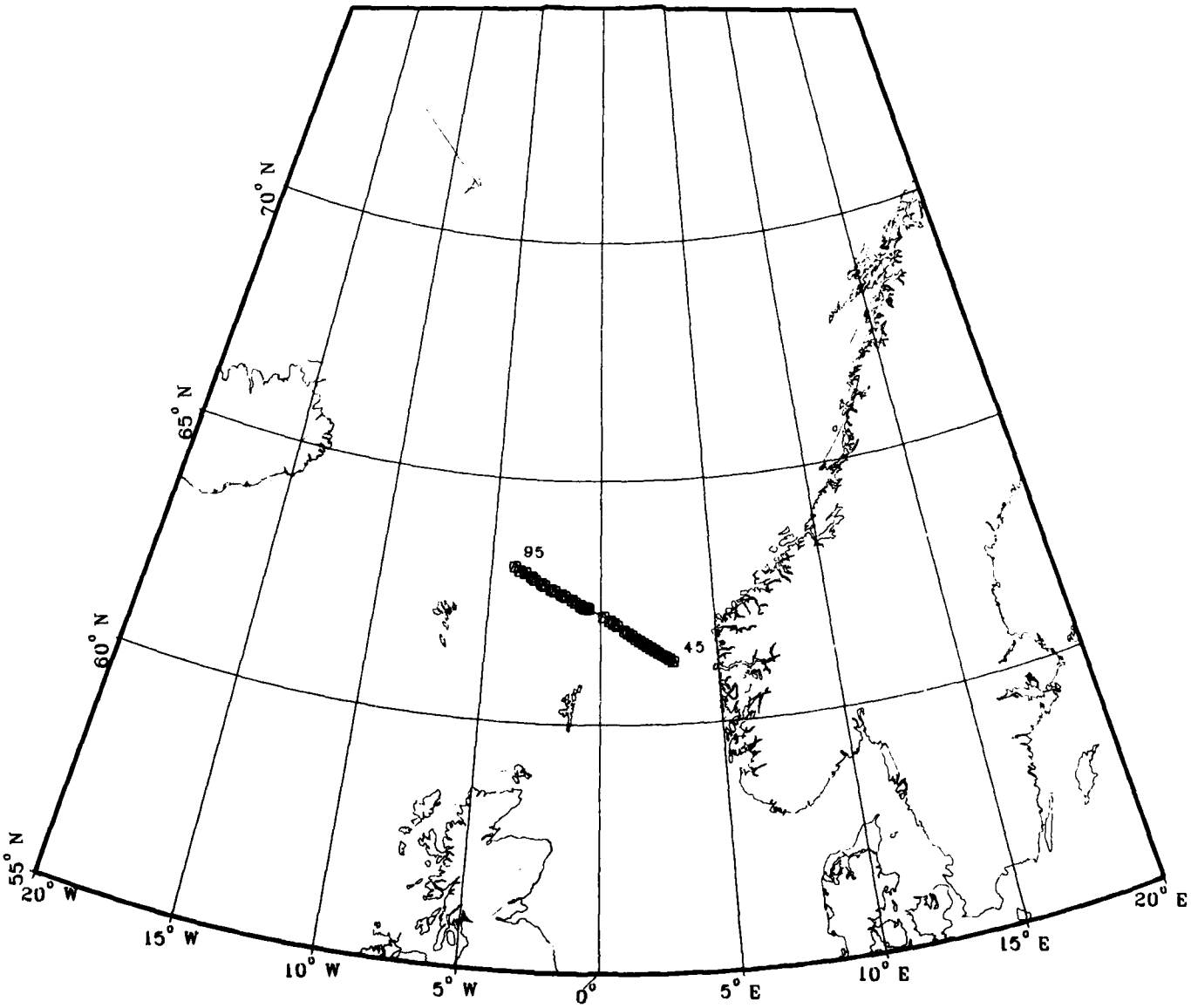


Figure 157. May 1950 station positions.

SOGNEFJORD SECTION
FILE - ICES$ 1950PMA DAT
T/S PLOT

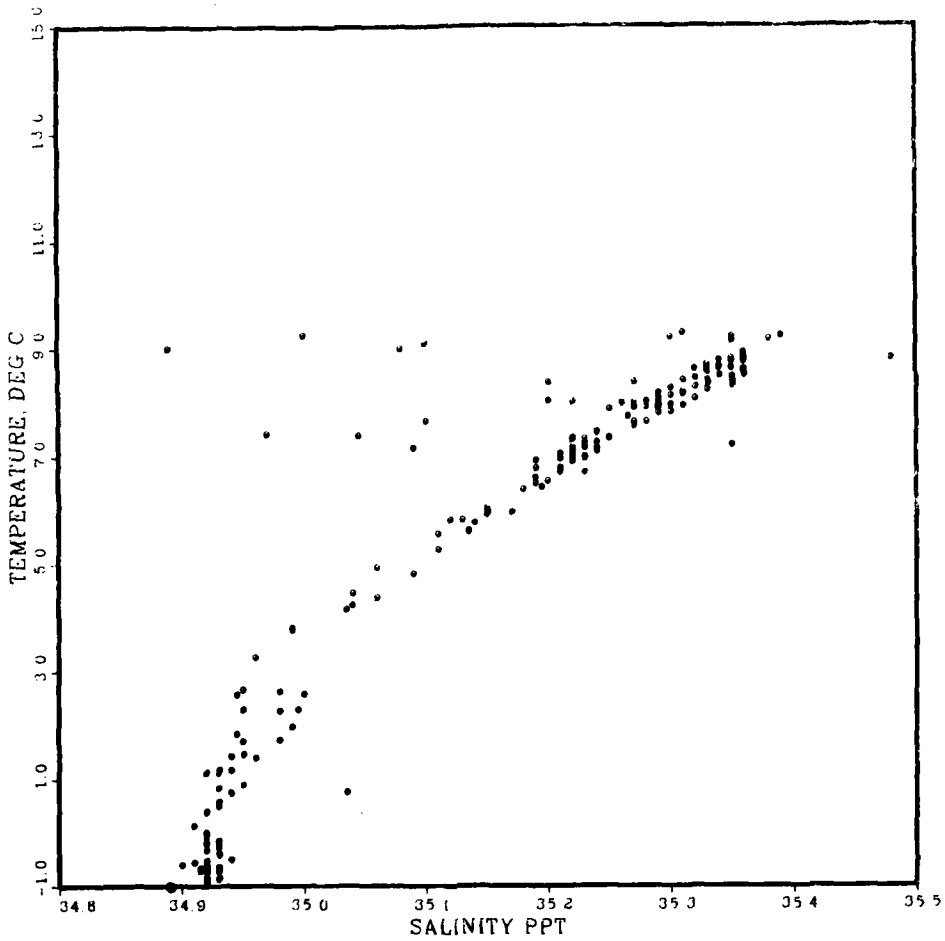


Figure 158. May 1950 temperature/salinity diagram.

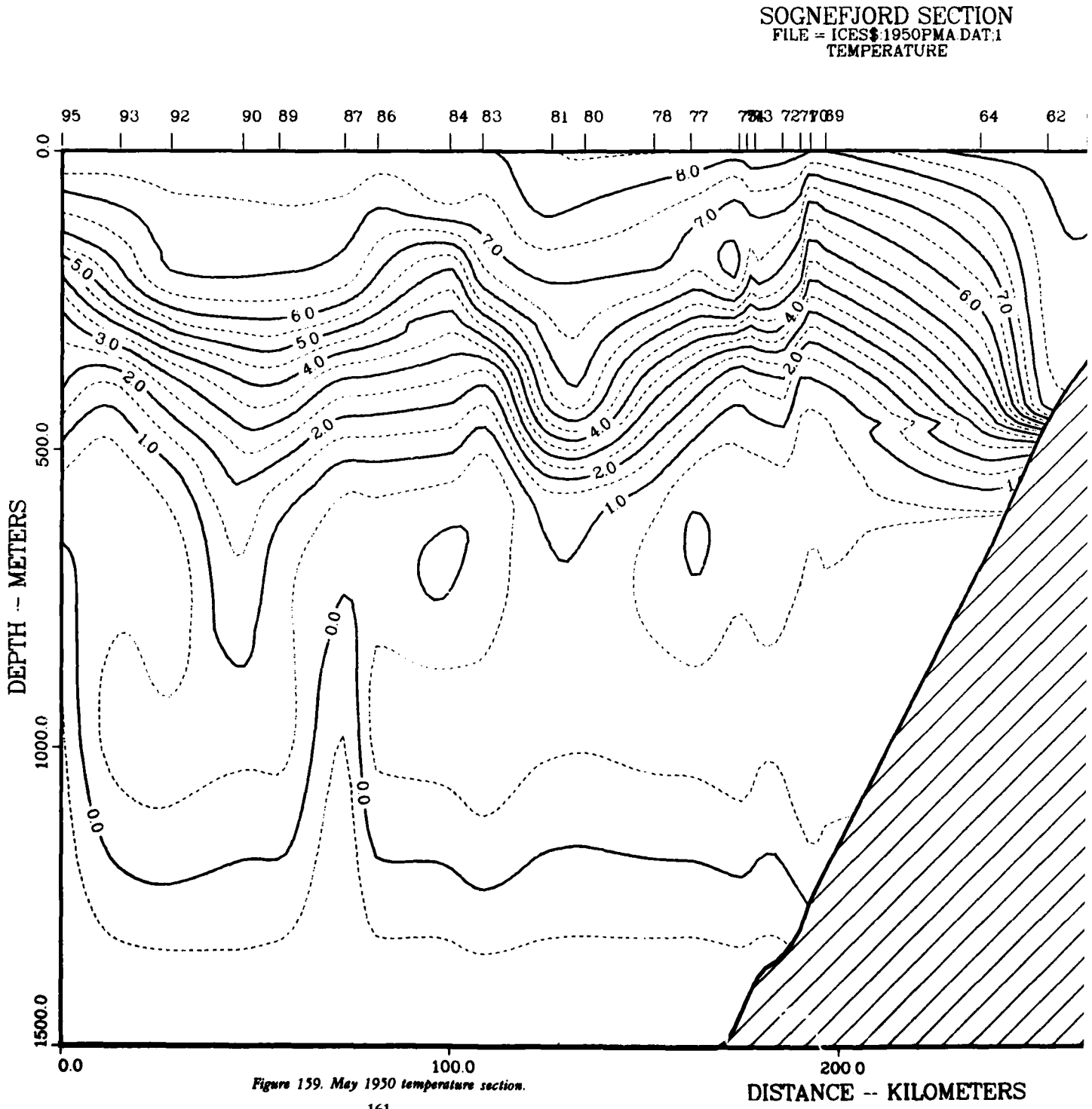
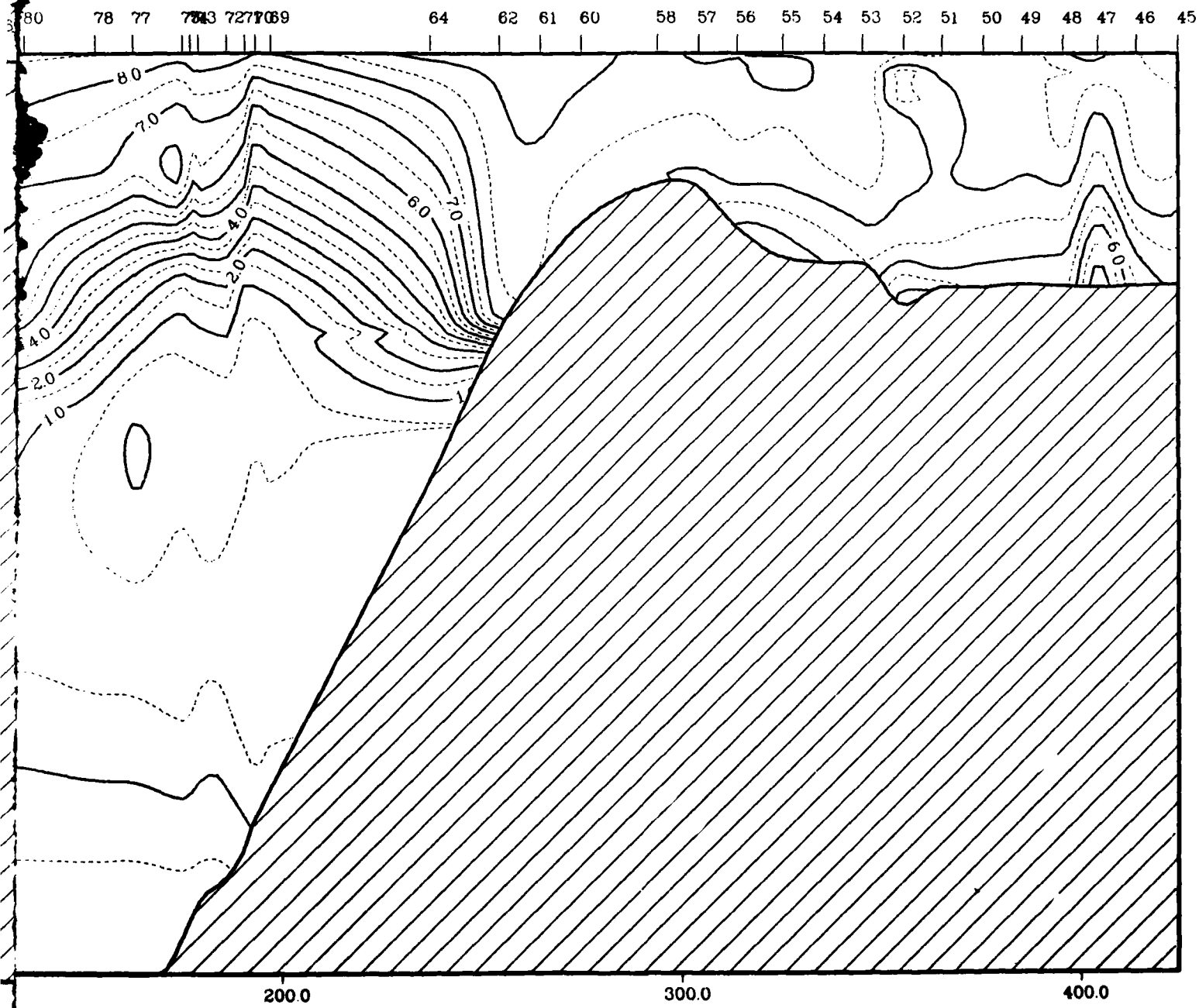


Figure 159. May 1950 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1950PMA.DAT;1
TEMPERATURE



DISTANCE – KILOMETERS

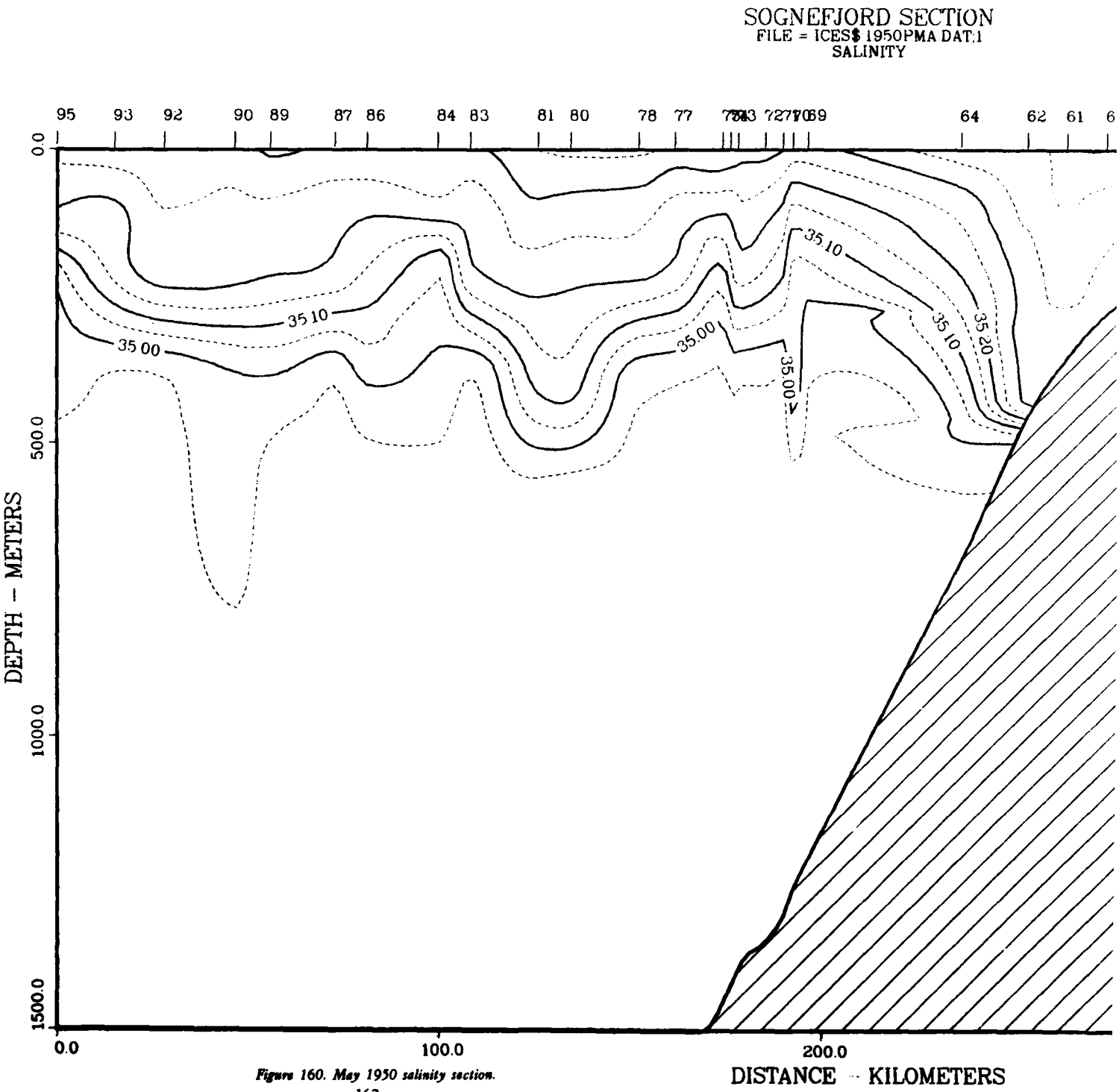
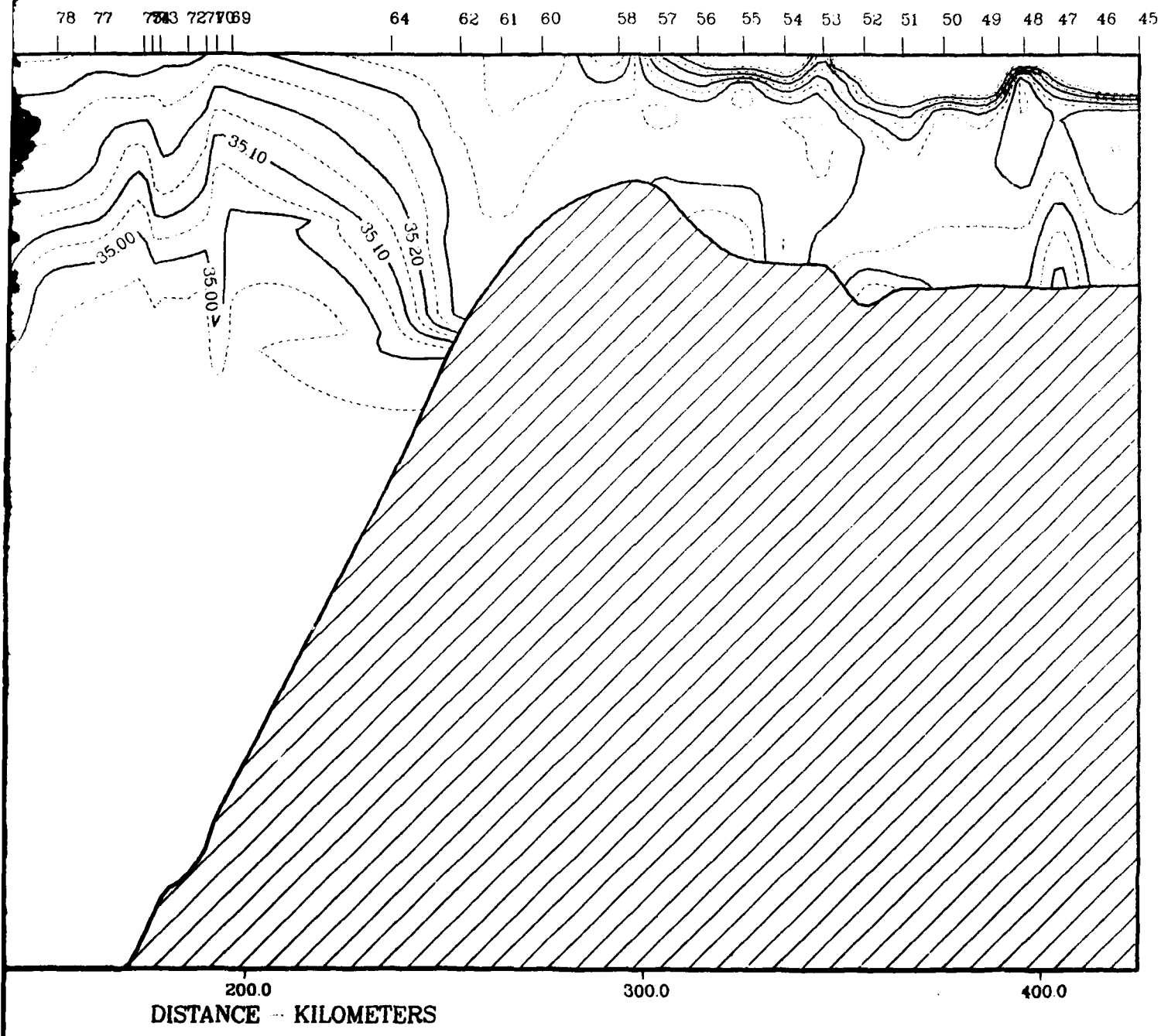


Figure 160. May 1950 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1950PMA DAT.1
SALINITY



ICES$:1950GJU.DAT

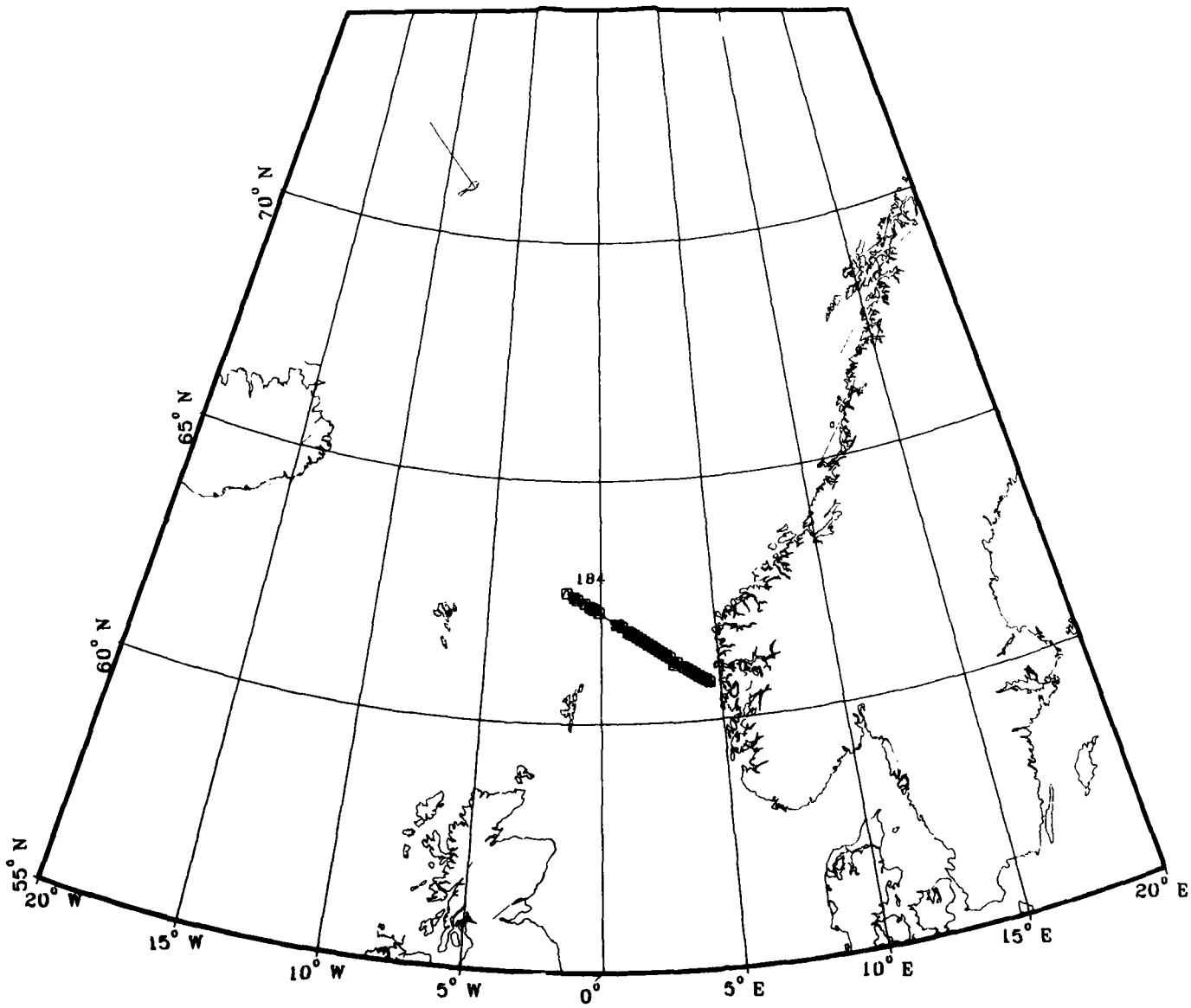


Figure 161. July 1950 station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1950GJU DAT
T/S PLOT

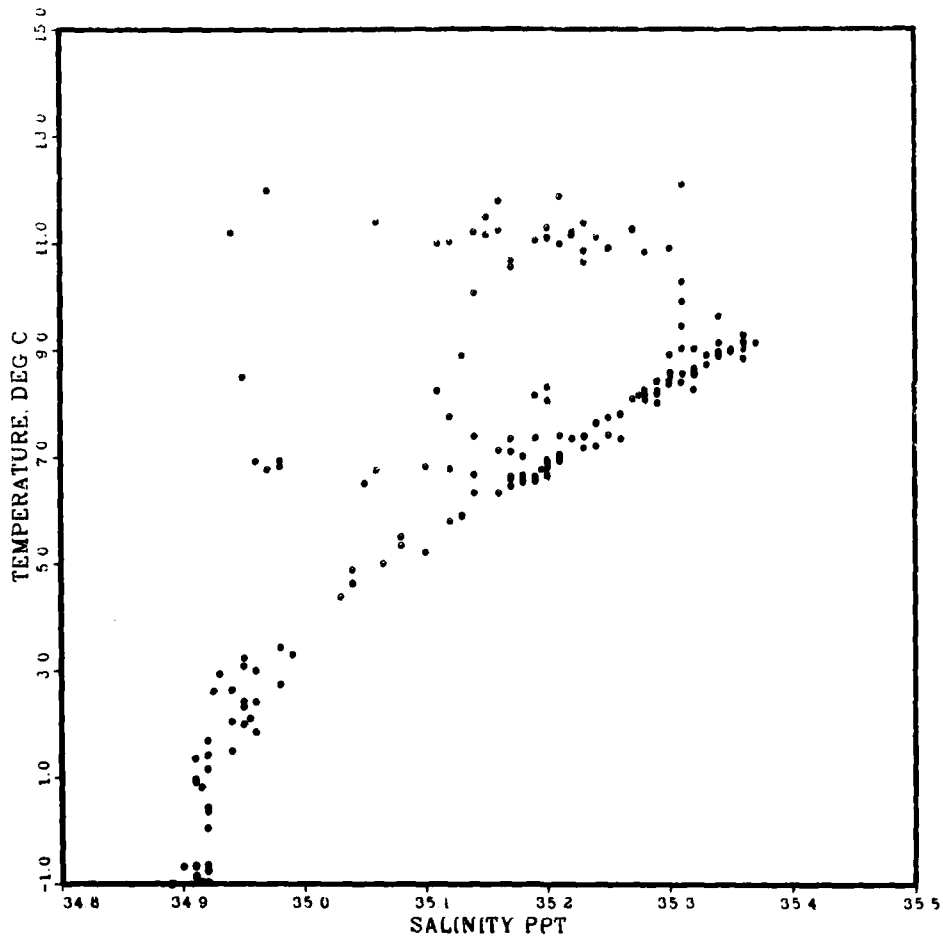


Figure 162. July 1950 temperature/salinity diagram.

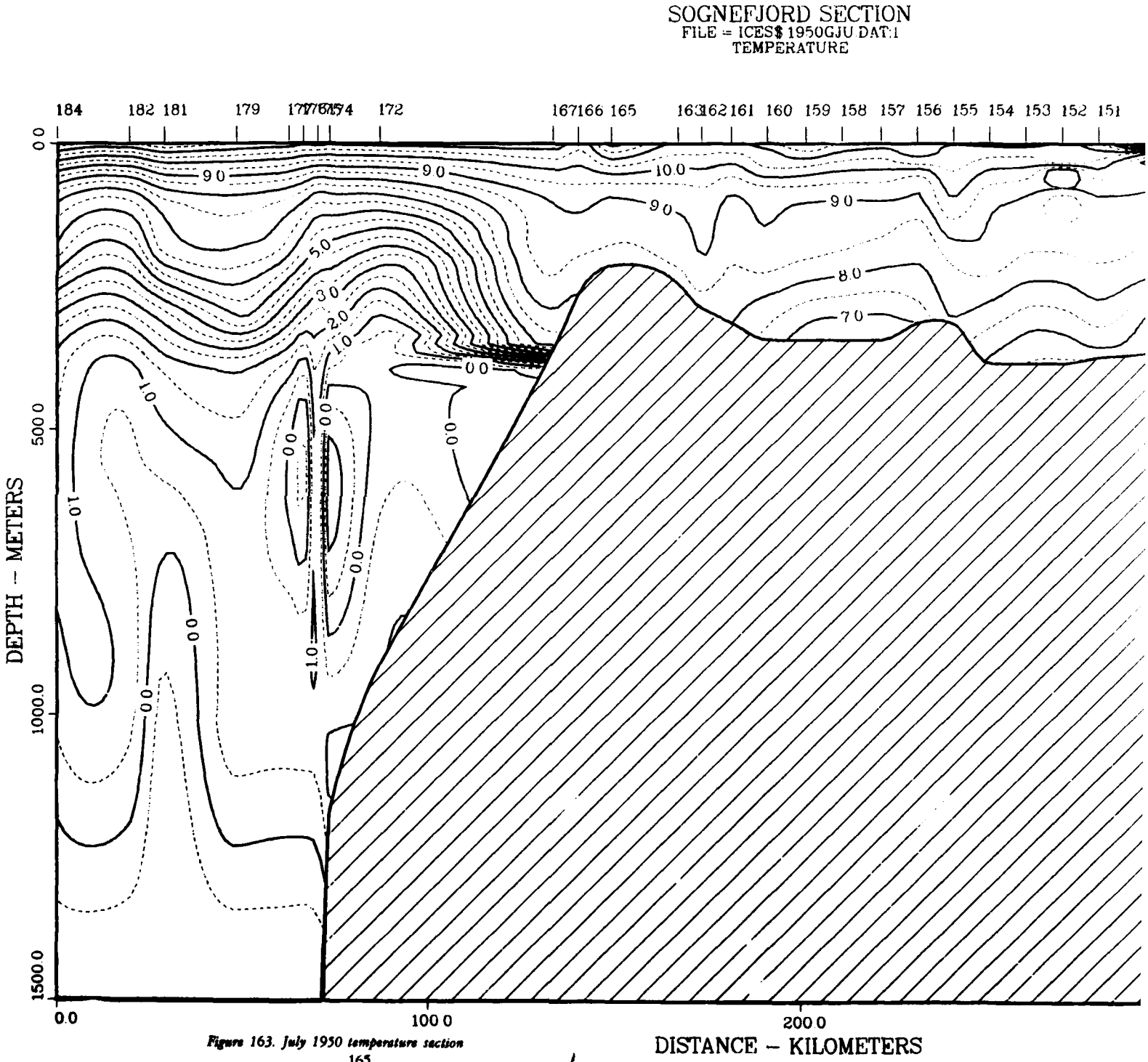
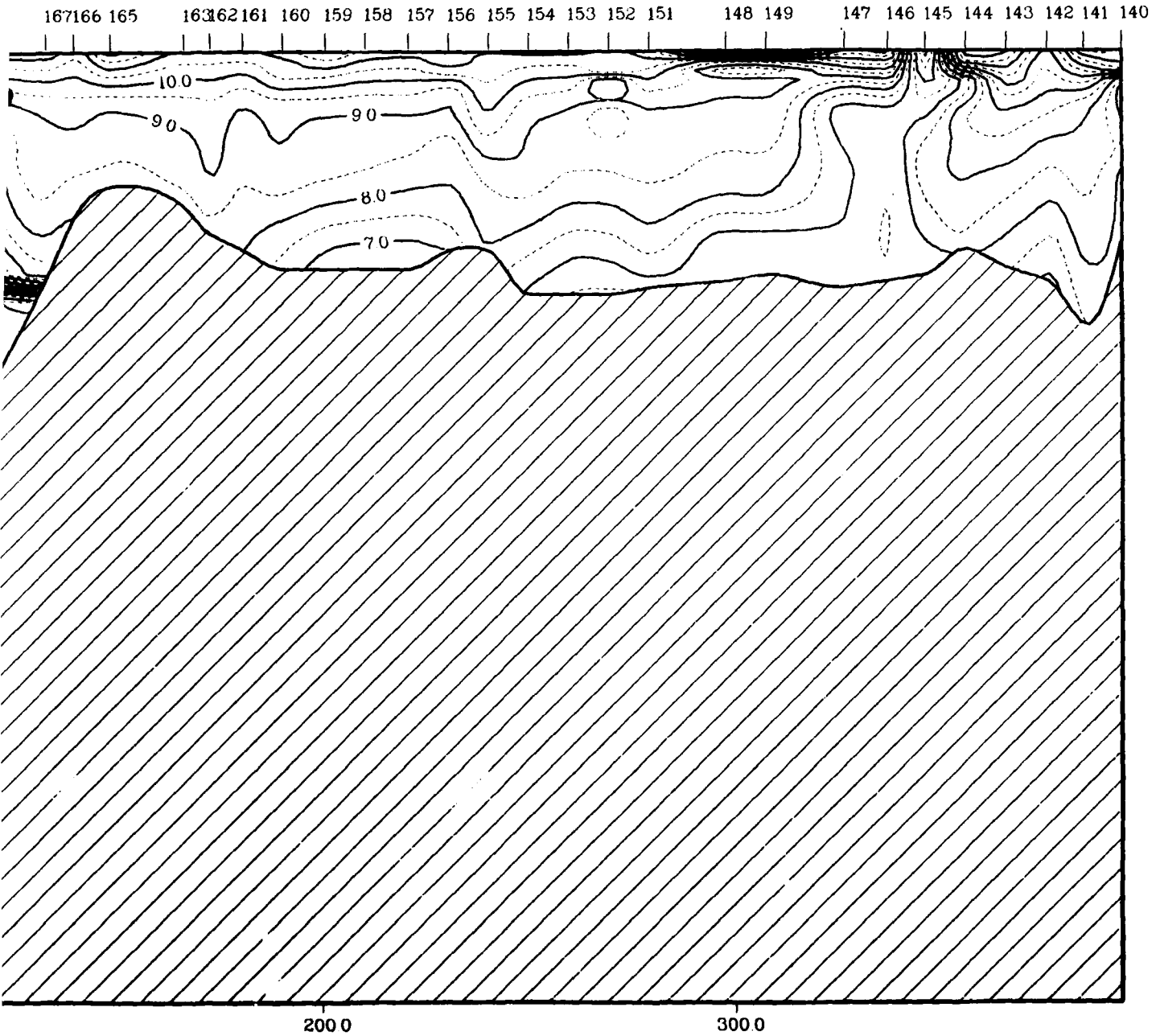


Figure 163. July 1950 temperature section

SOGNEFJORD SECTION
FILE = ICES$ 1950GJU DAT:1
TEMPERATURE



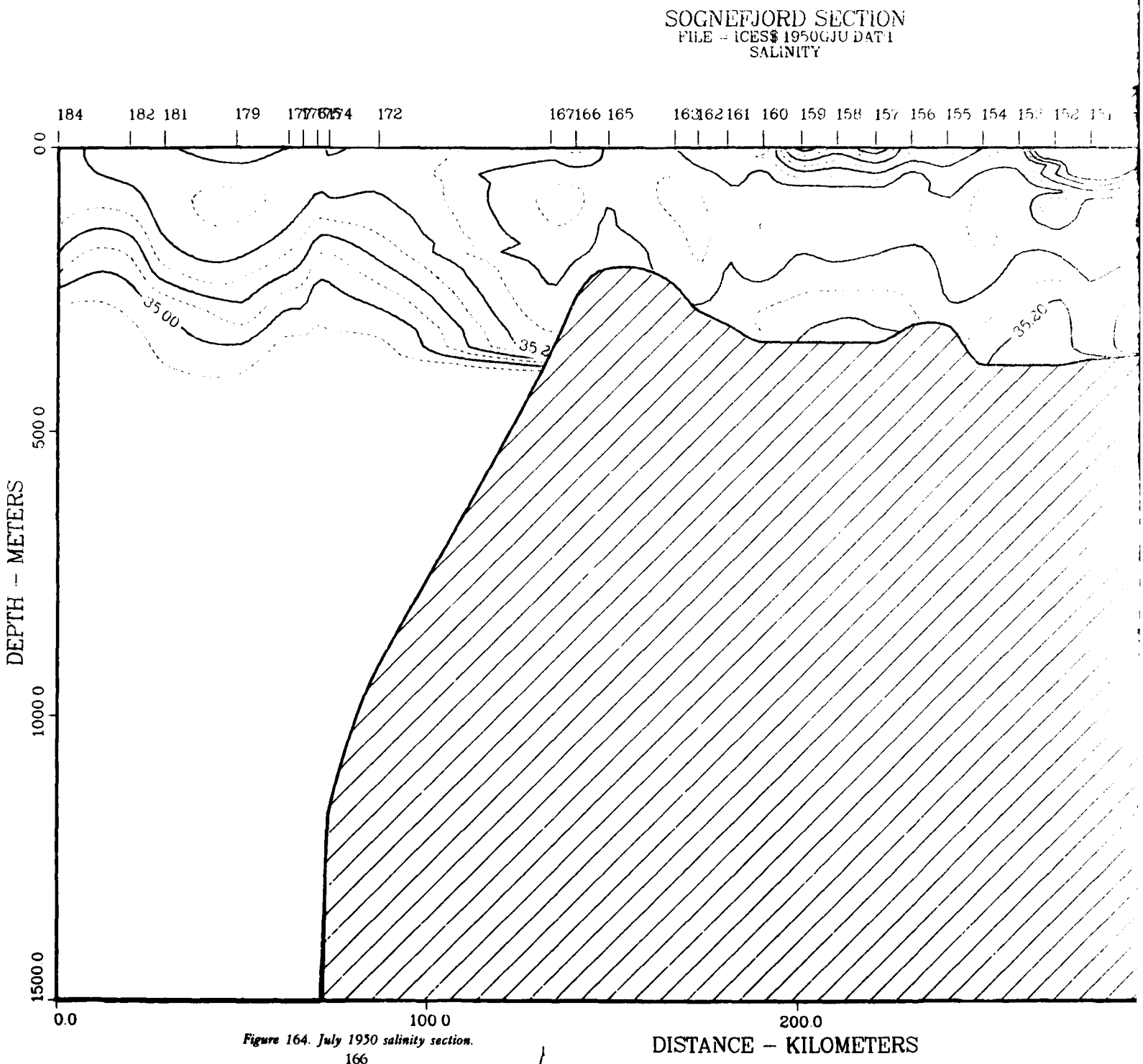
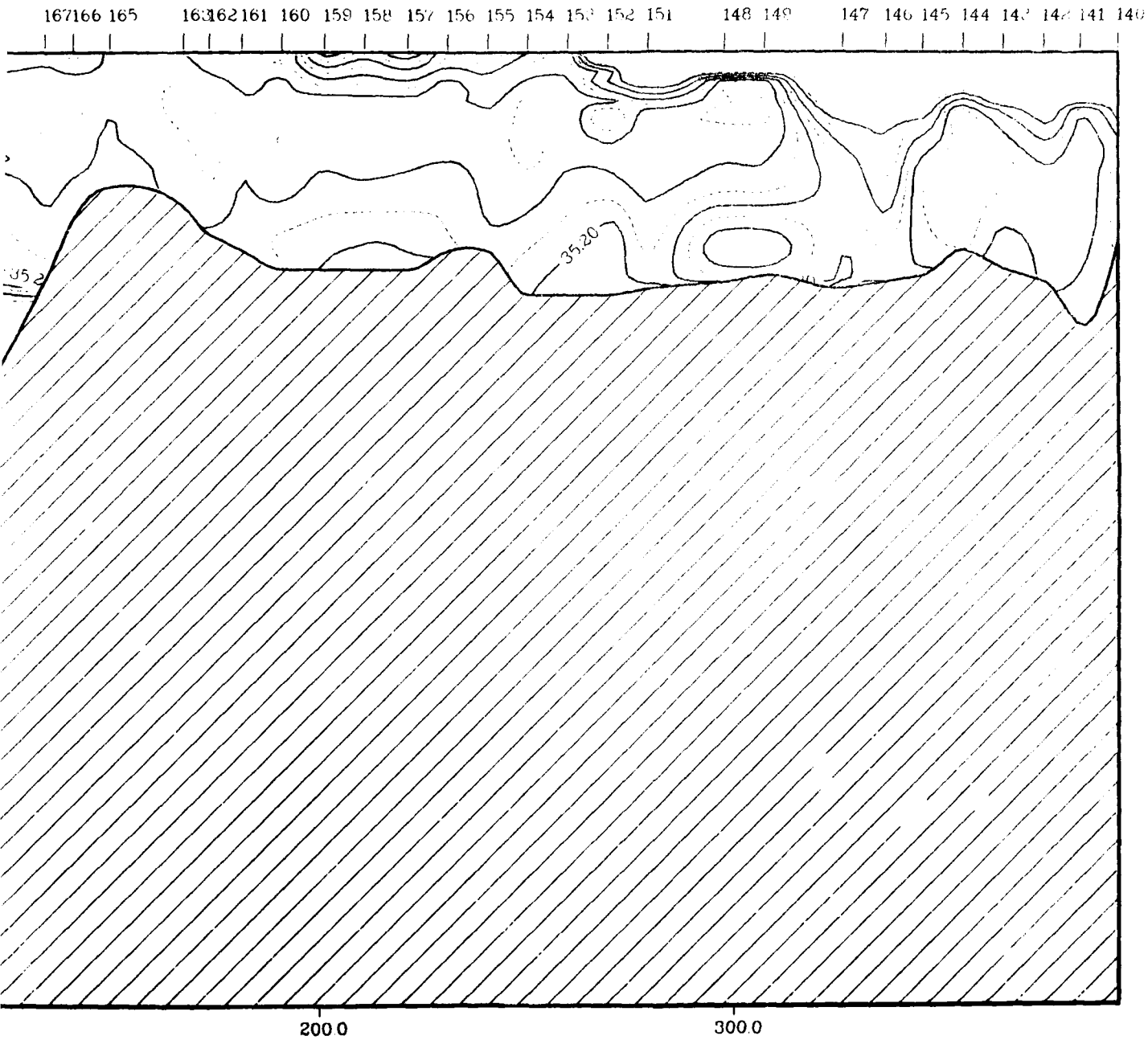


Figure 164. July 1950 salinity section.

SOGNEFJORD SECTION
FILE – ICES$ 1950GJU DAT 1
SALINITY



DISTANCE – KILOMETERS

2

ICES$:1951QMA.DAT

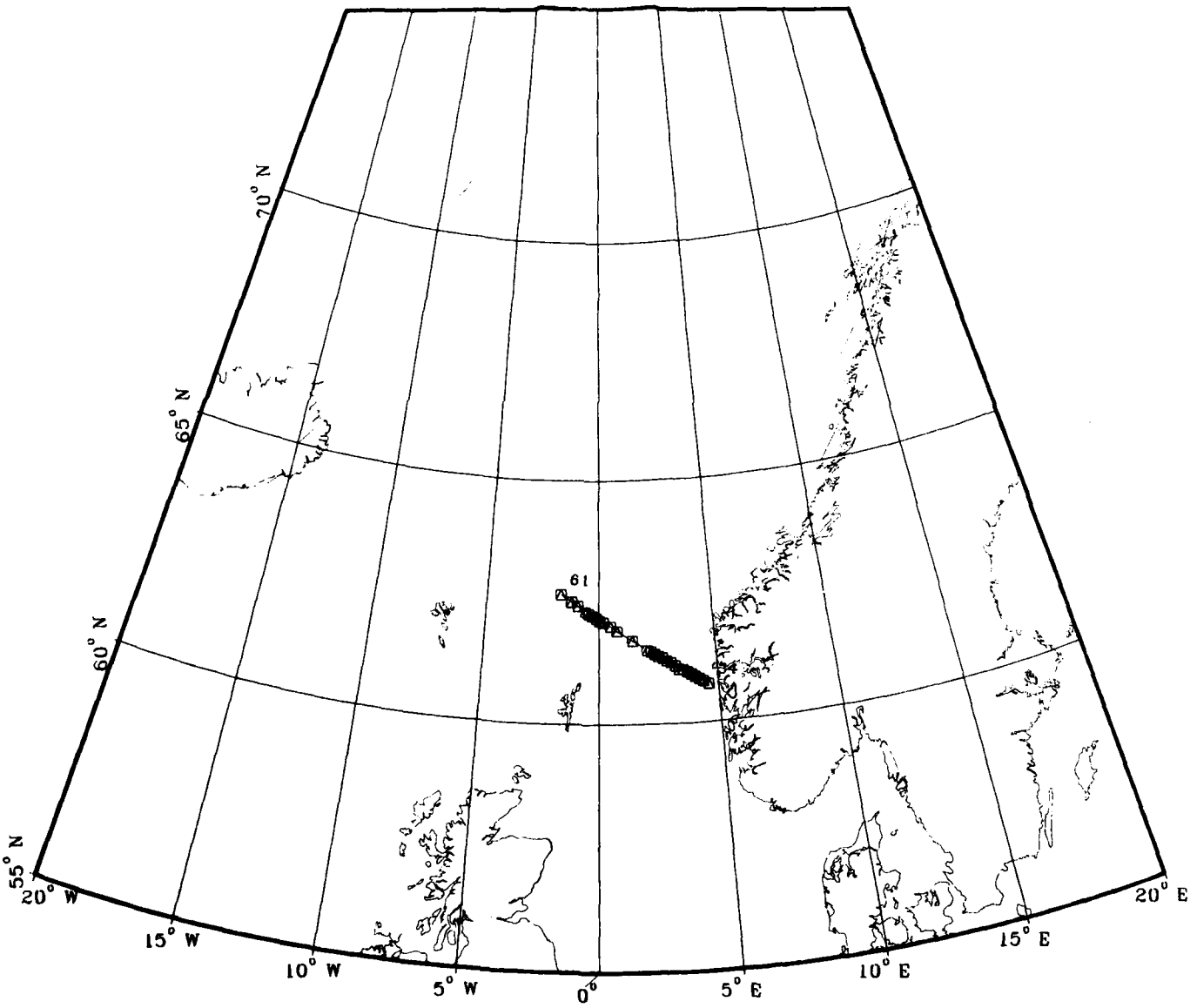


Figure 165. May 1951 station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1951QMA.DAT
T/S PLOT

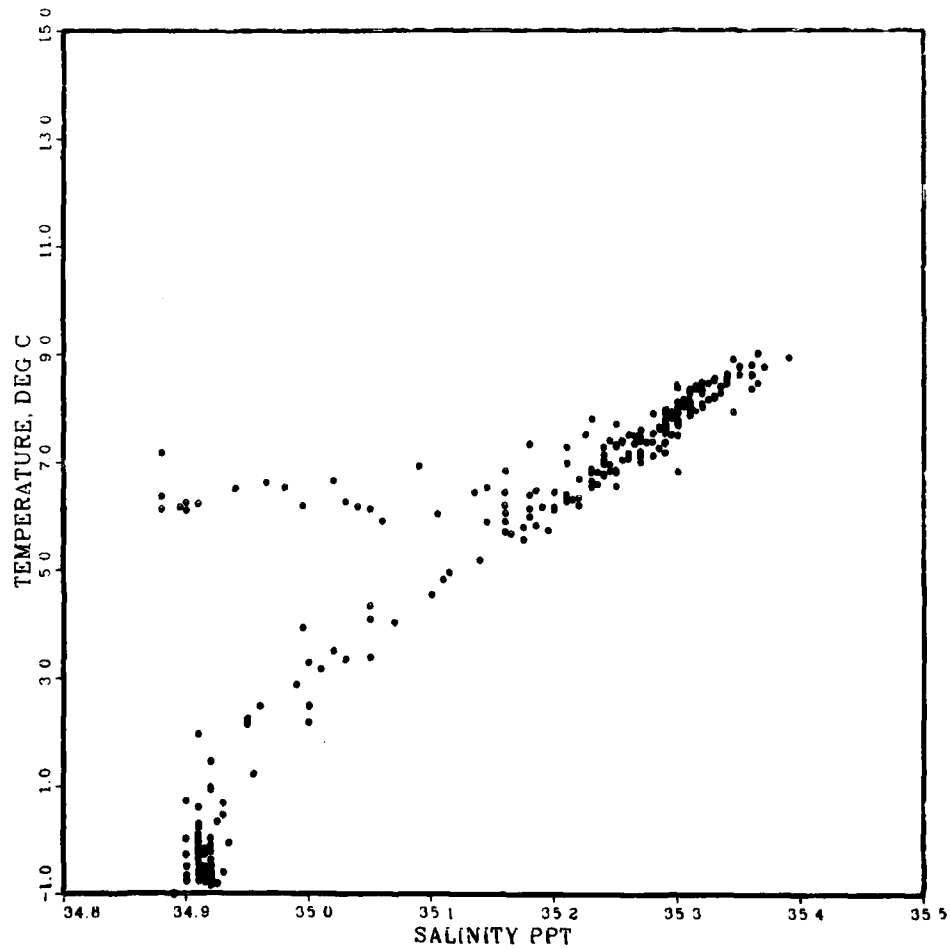


Figure 166. May 1951 temperature/salinity diagram.

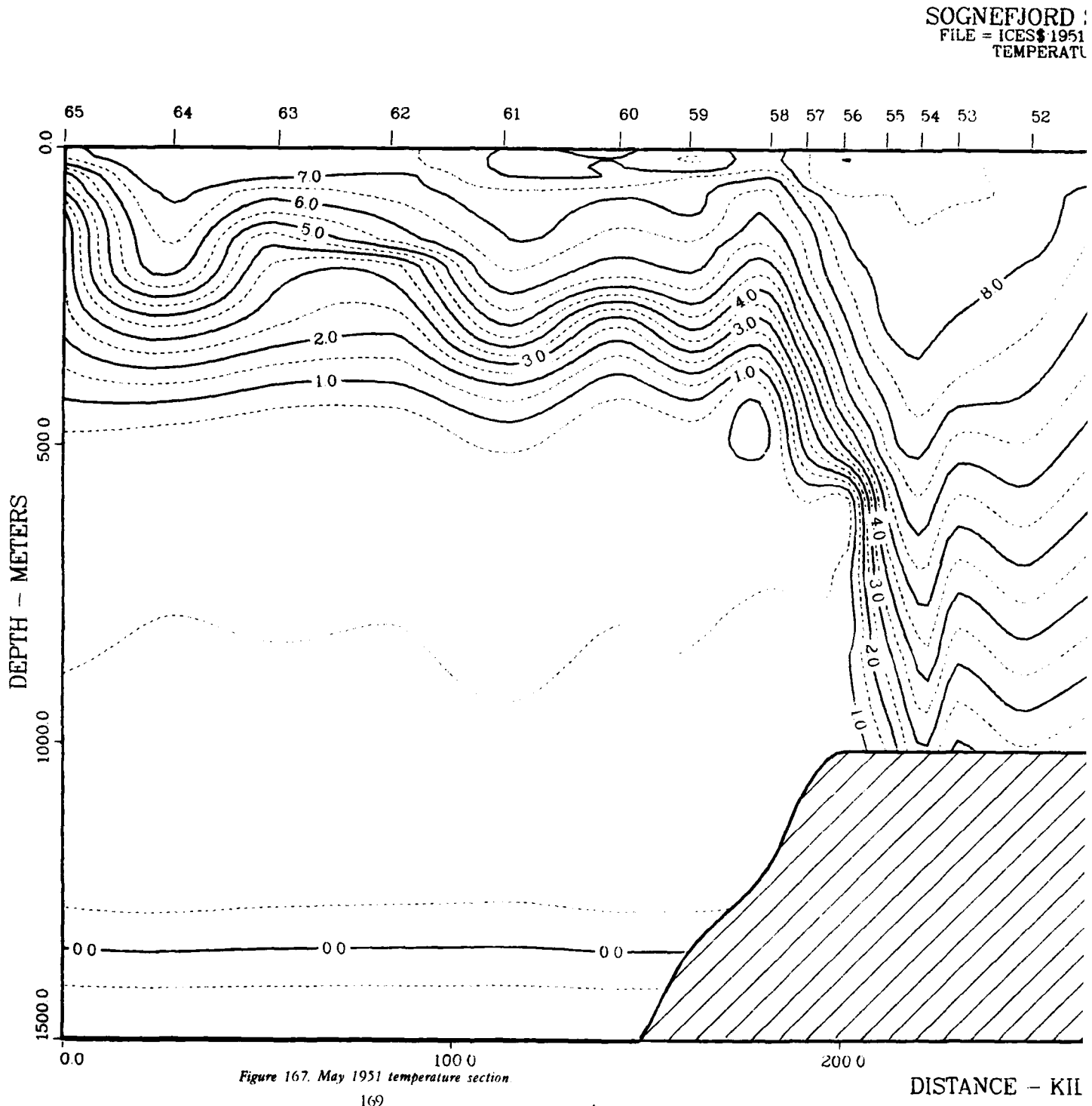
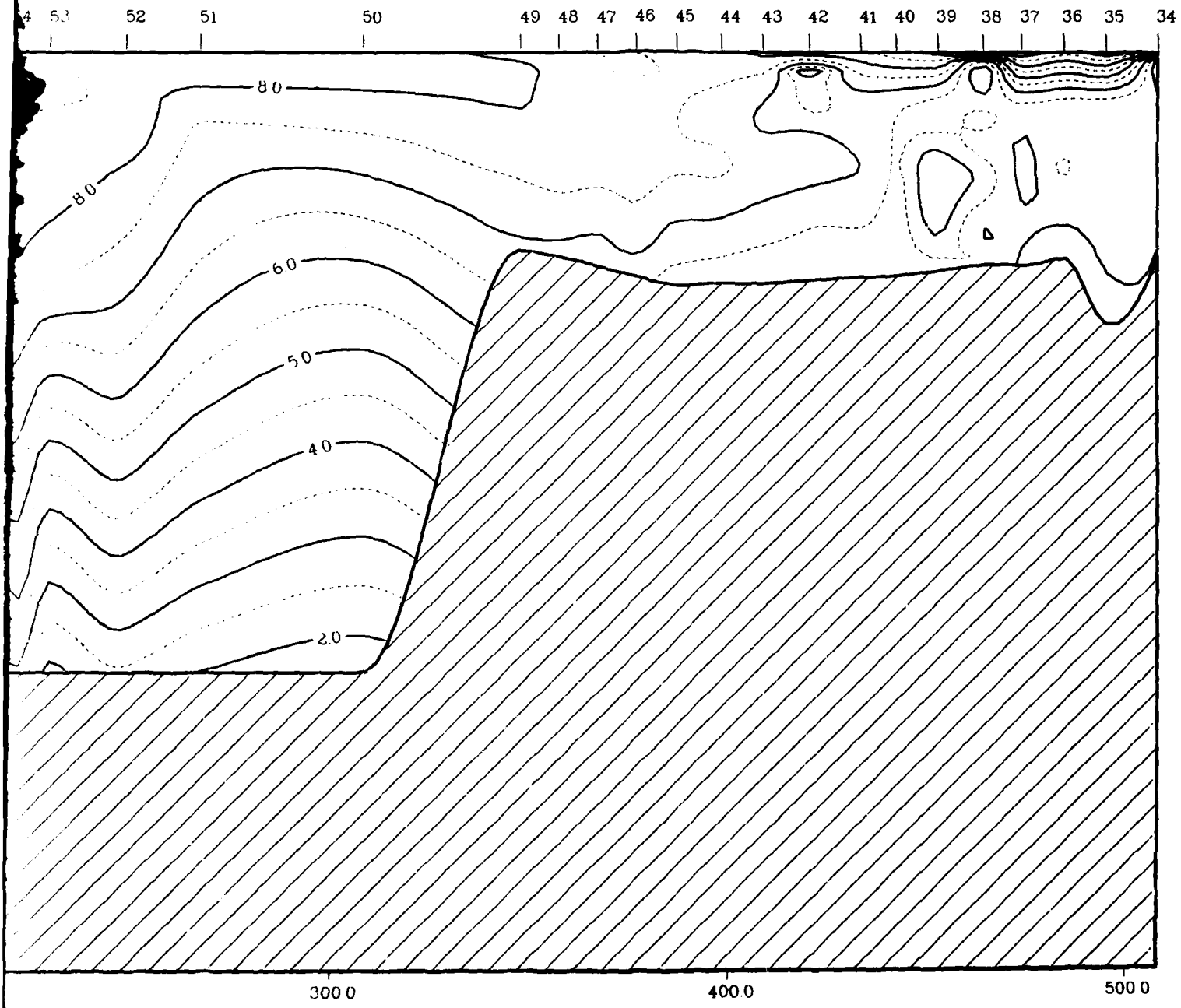


Figure 167. May 1951 temperature section

SOGNEFJORD SECTION
FILE = ICES$ 1951QMA DAT 1
TEMPERATURE



DISTANCE - KILOMETERS

2

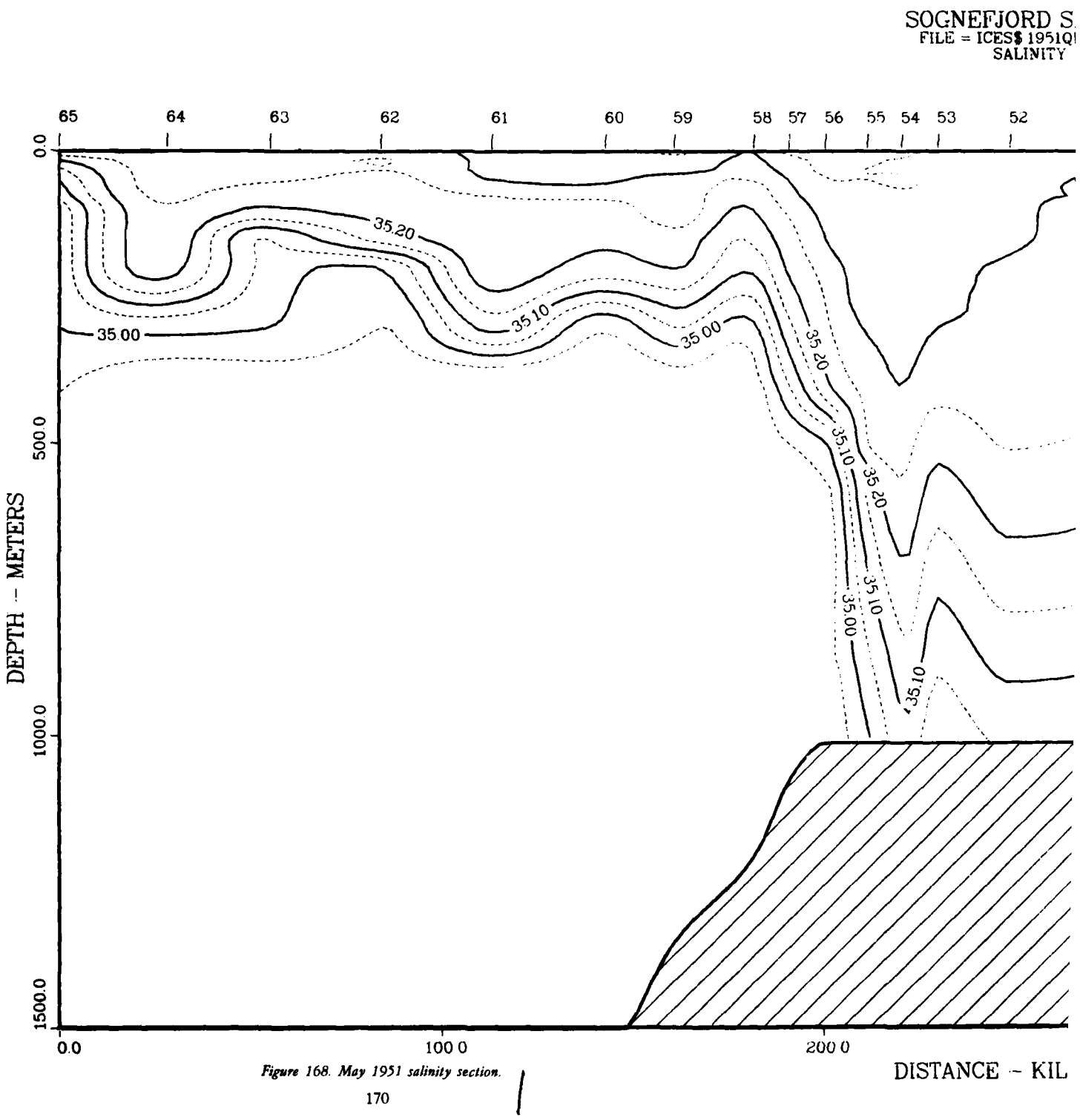
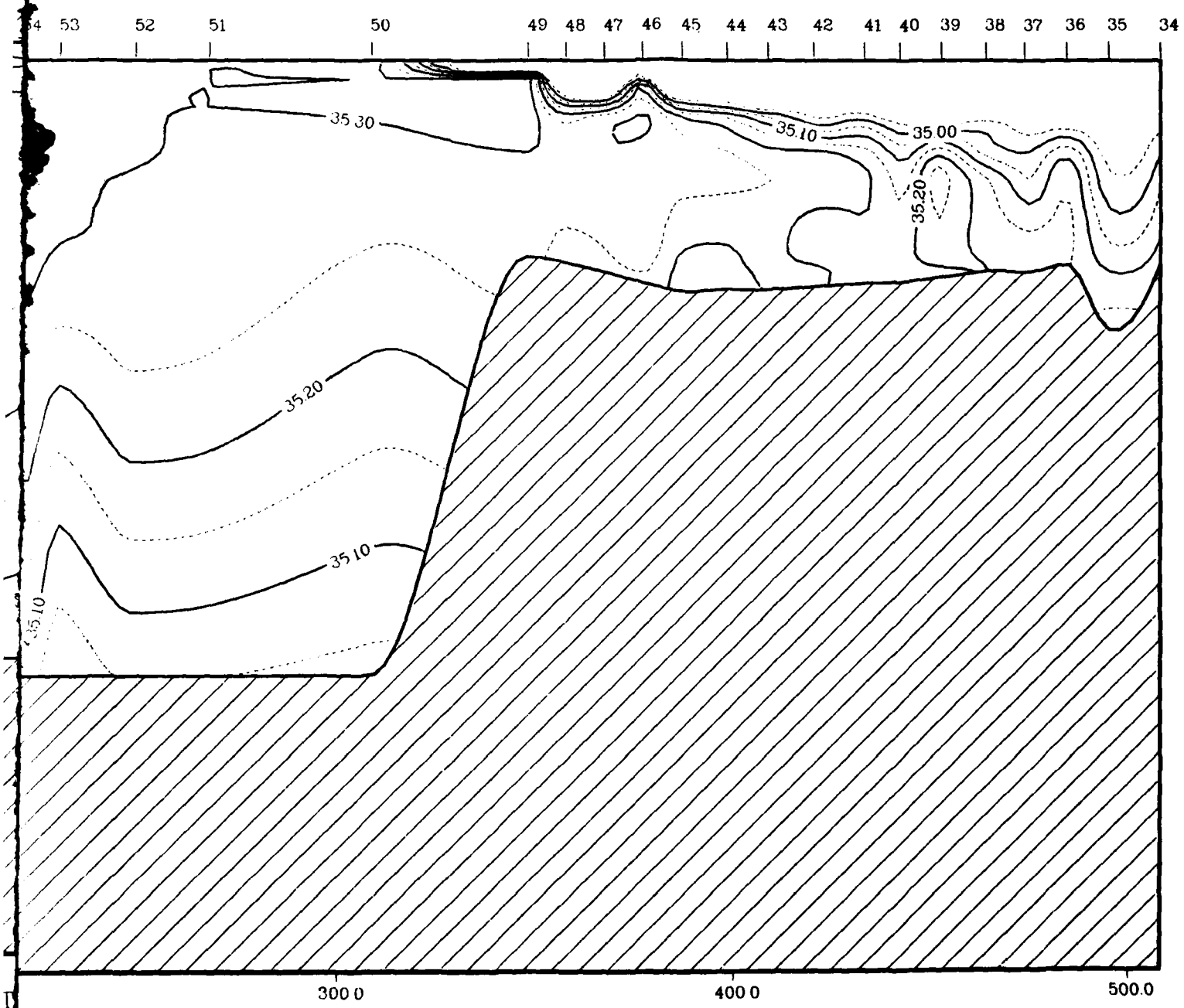


Figure 168. May 1951 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1951QMA DAT 1
SALINITY



DISTANCE - KILOMETERS

2

ICES$:1952VMA.DAT

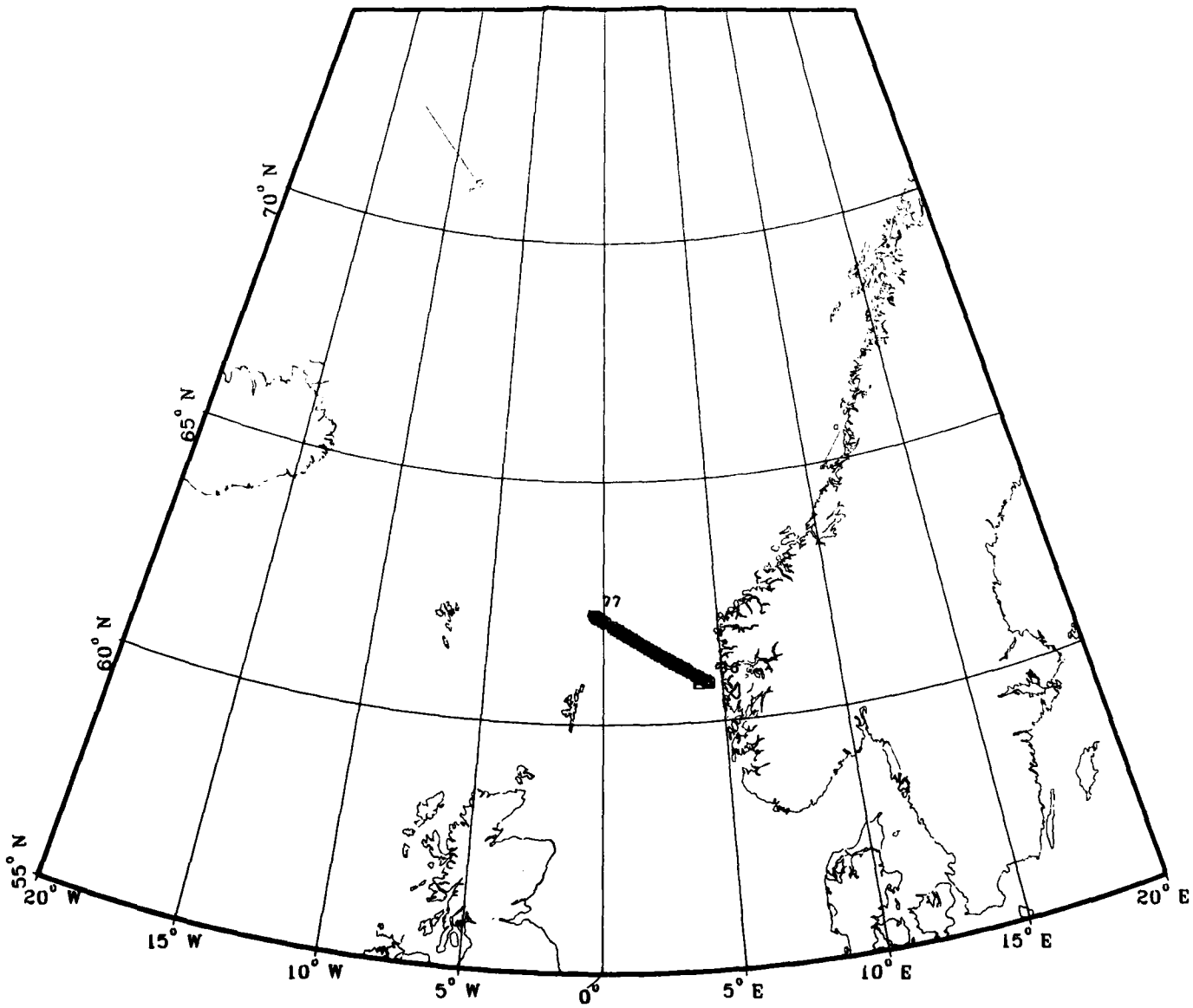


Figure 169. May 1952 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1952VMA.DAT
T/S PLOT

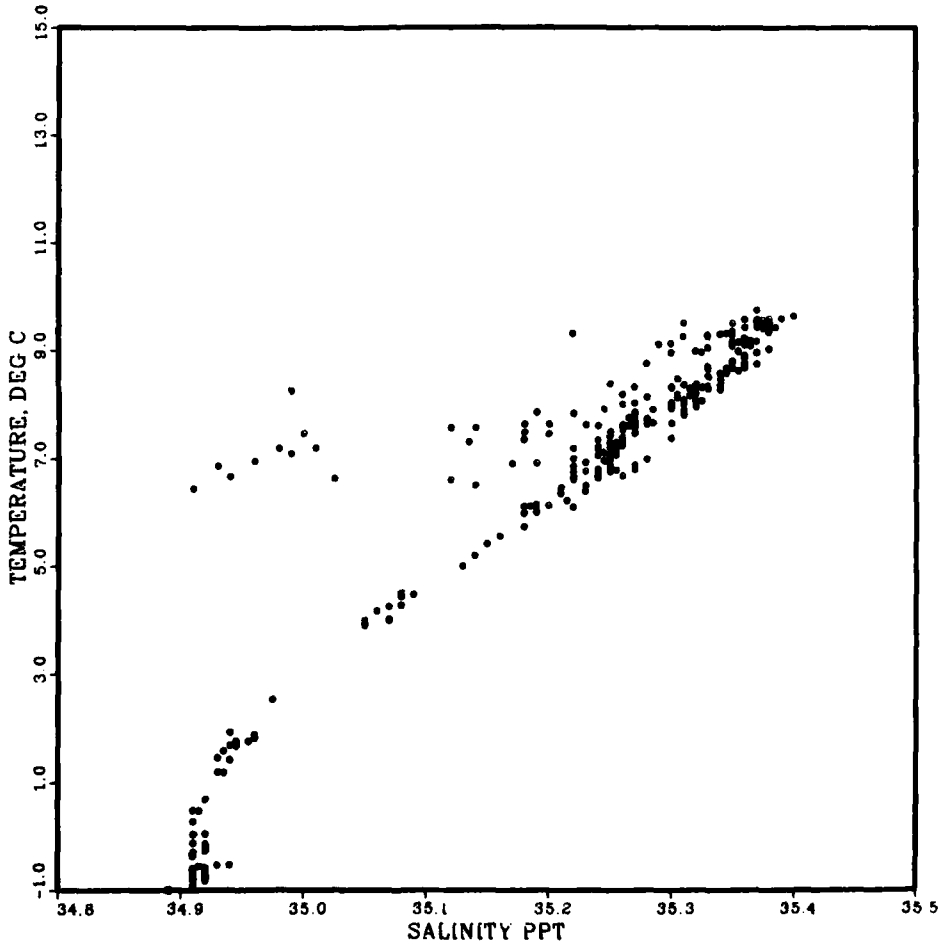


Figure 170. May 1952 temperature/salinity diagram.

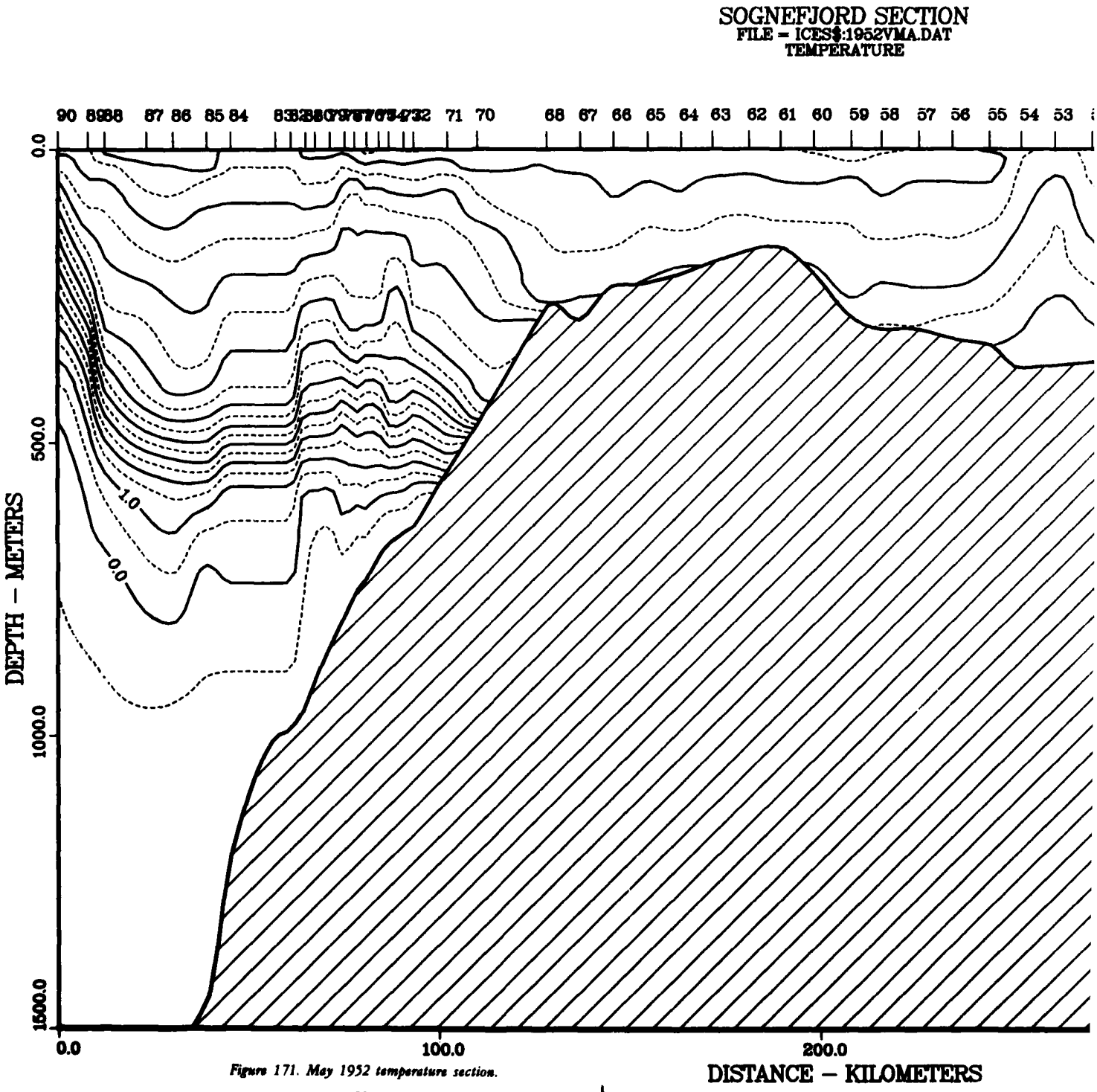
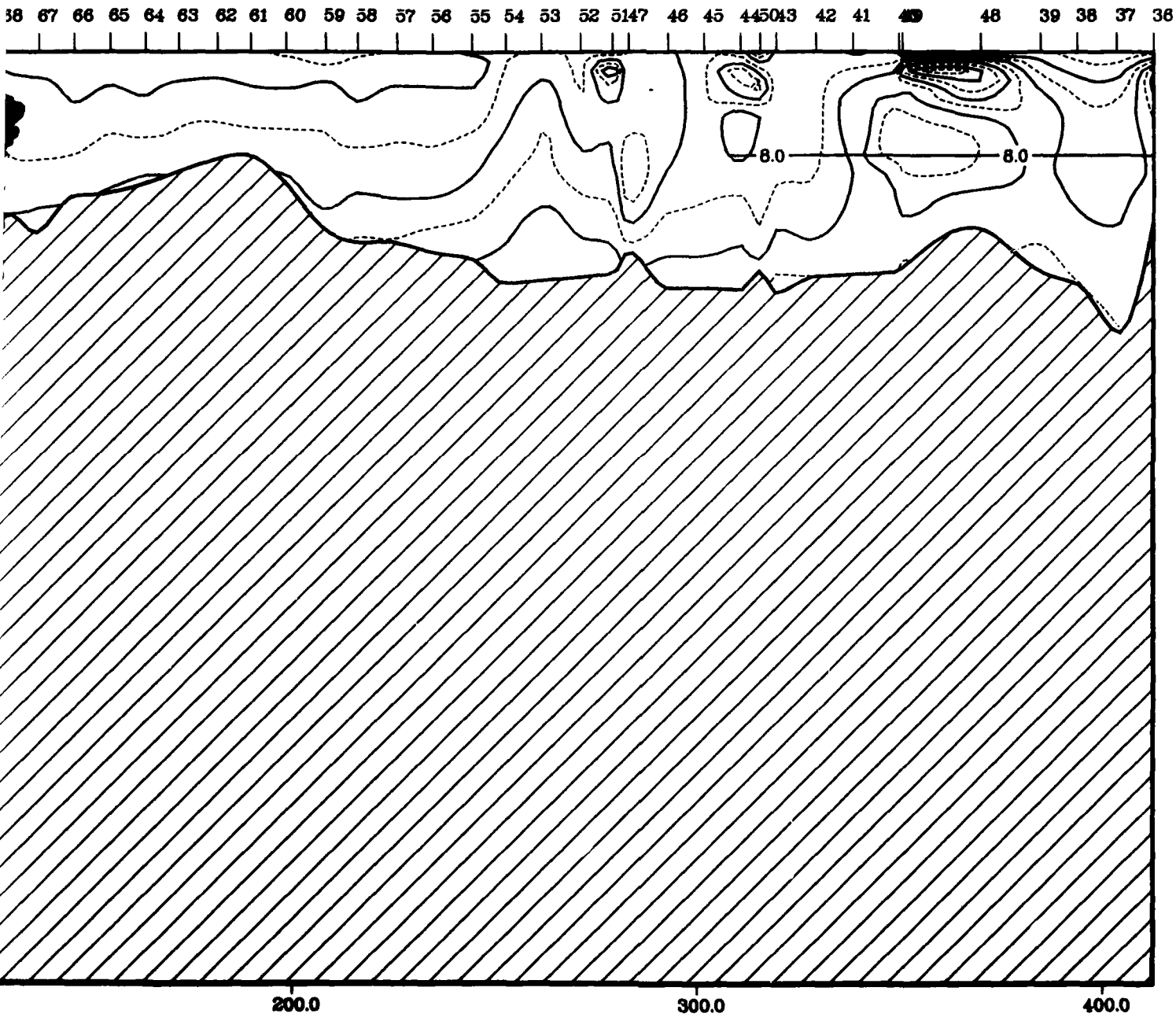


Figure 171. May 1952 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1952VMA.DAT
TEMPERATURE



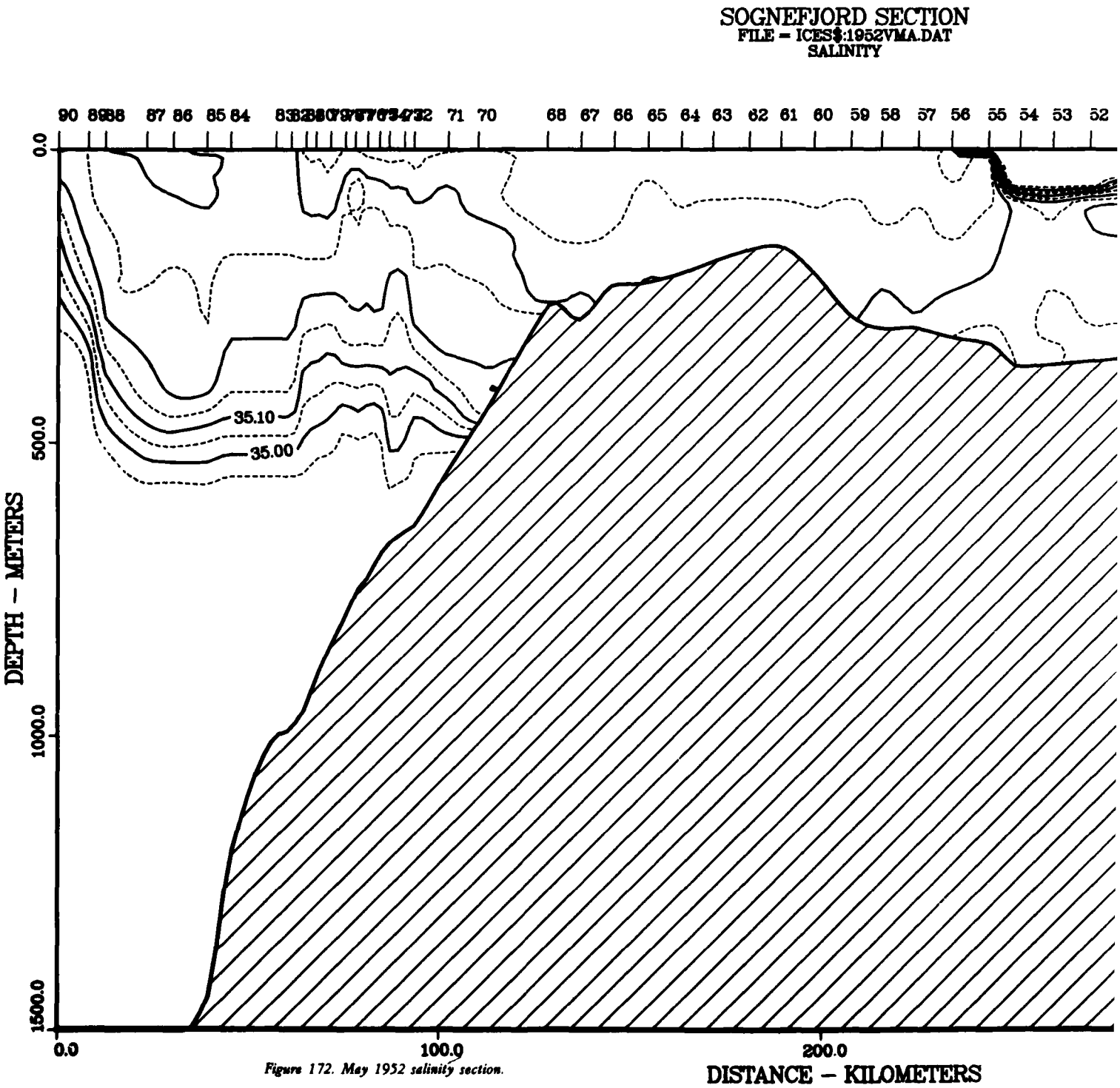
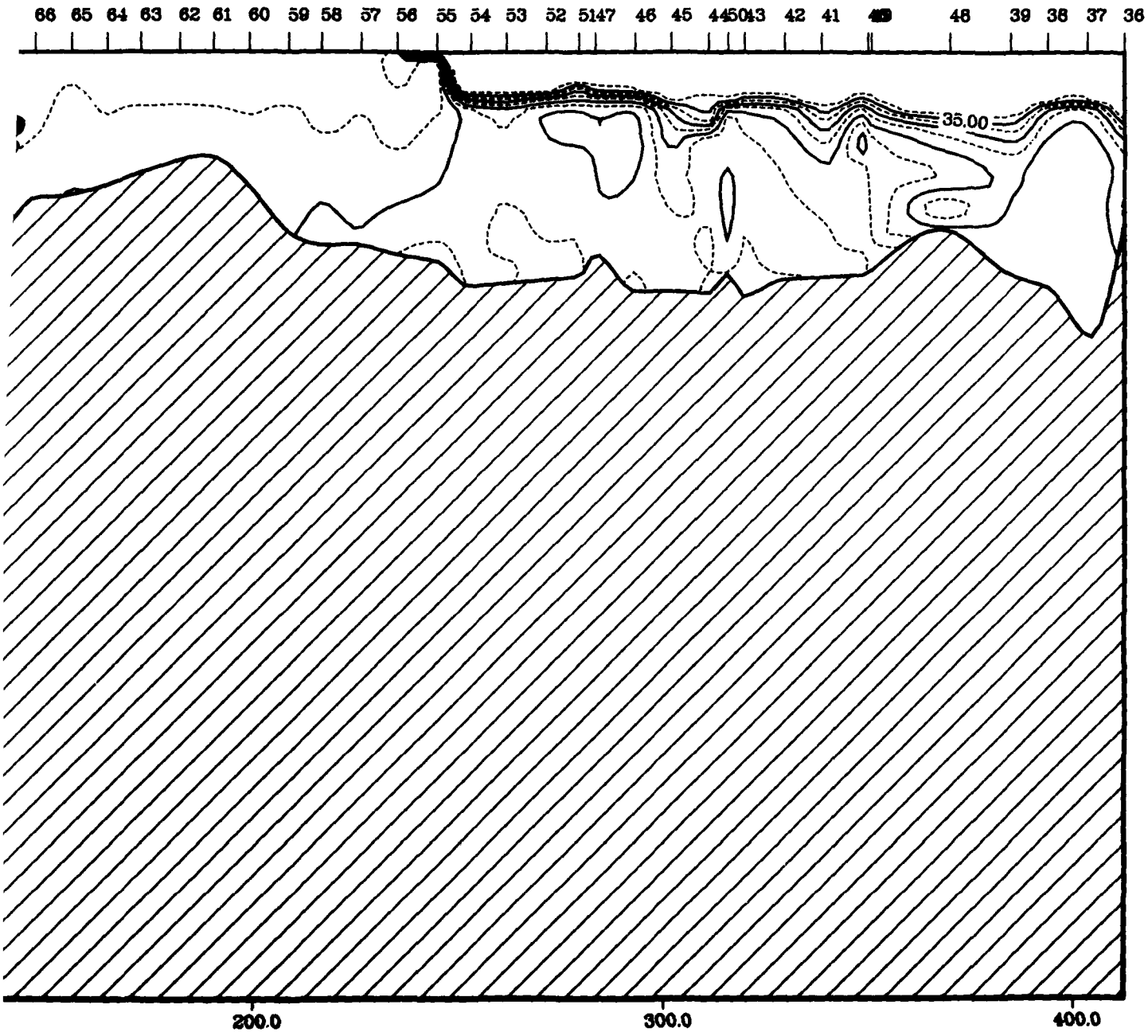


Figure 172. May 1952 salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1952VMA.DAT
SALINITY



DISTANCE – KILOMETERS

1 1 2

ICES$:1952SJU.DAT

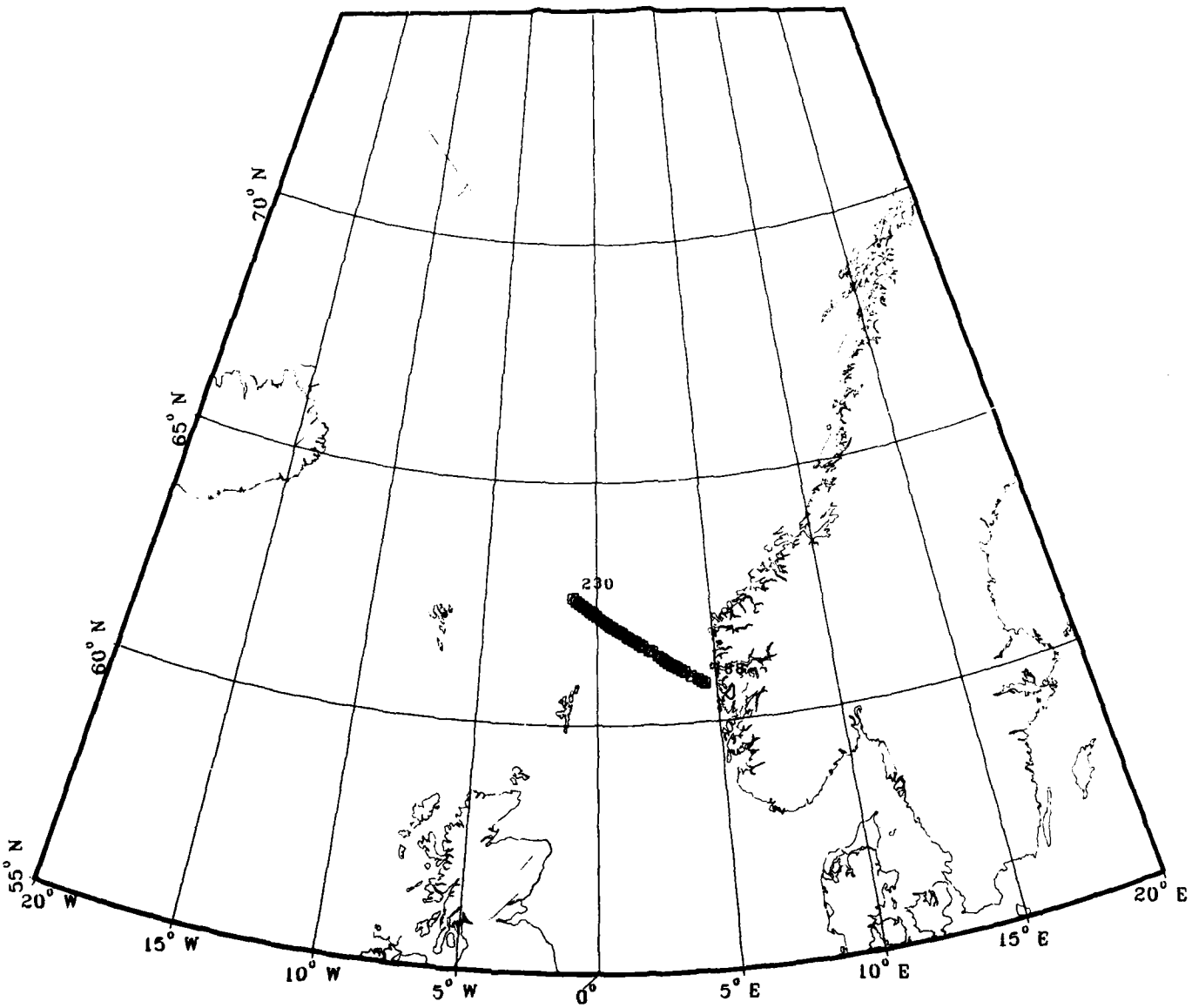


Figure 173. July 1952 station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1952SJU.DAT
T/S PLOT

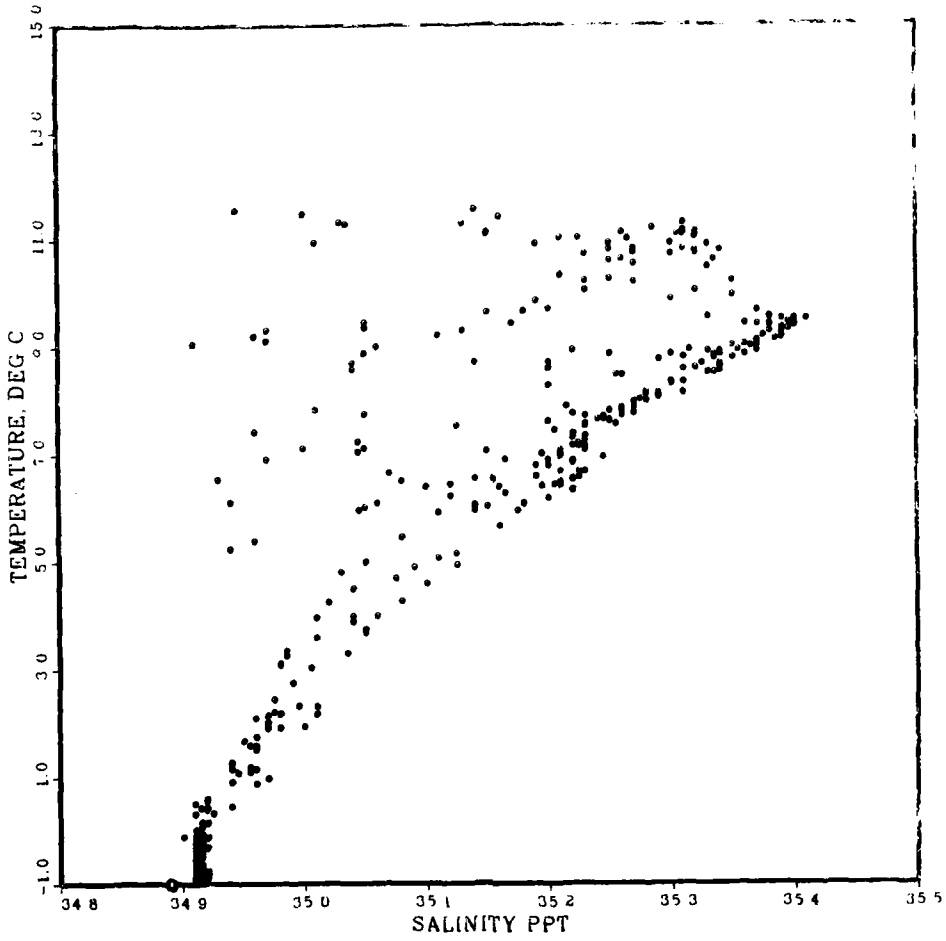


Figure 174. July 1952 temperature/salinity diagram.

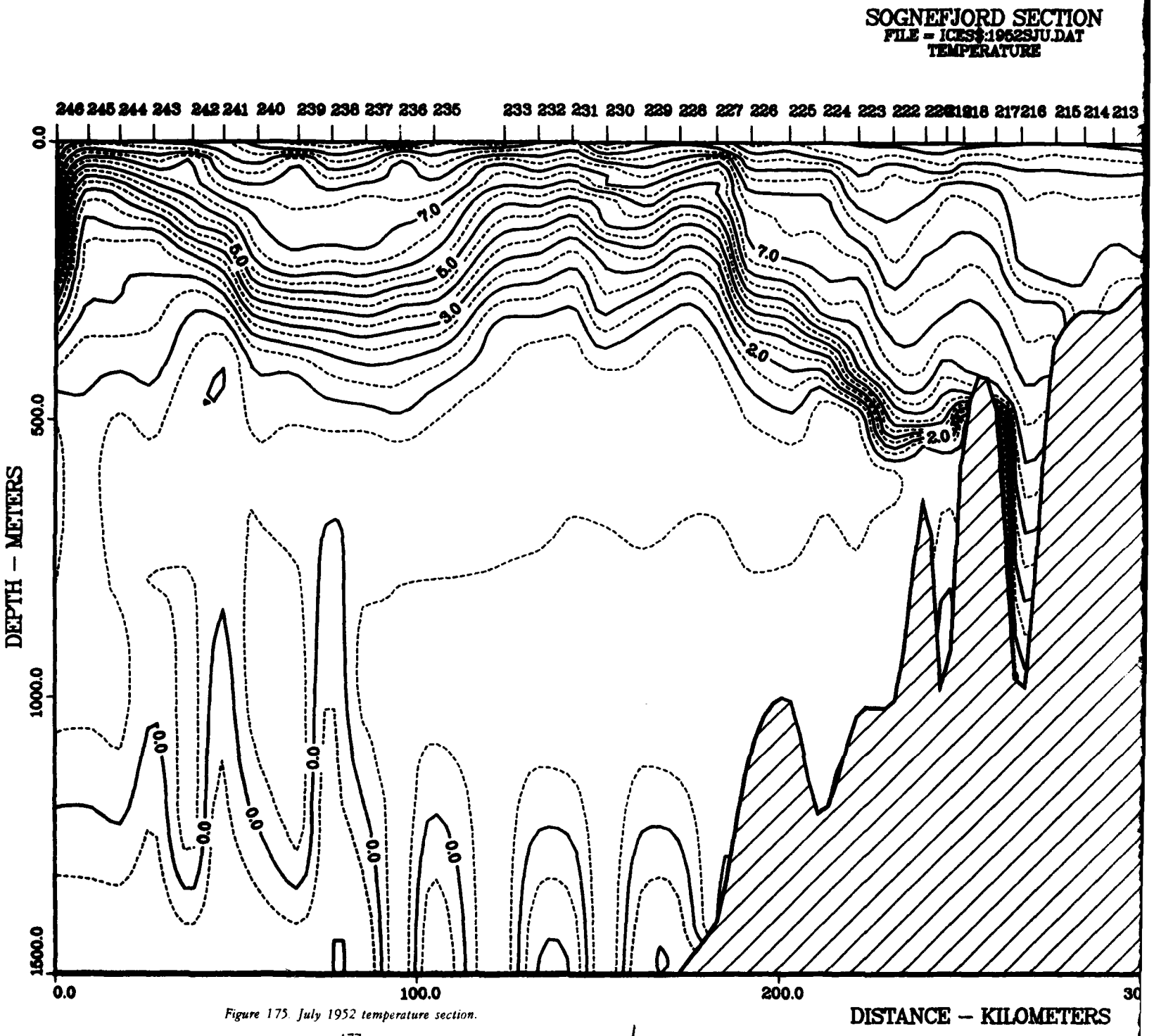
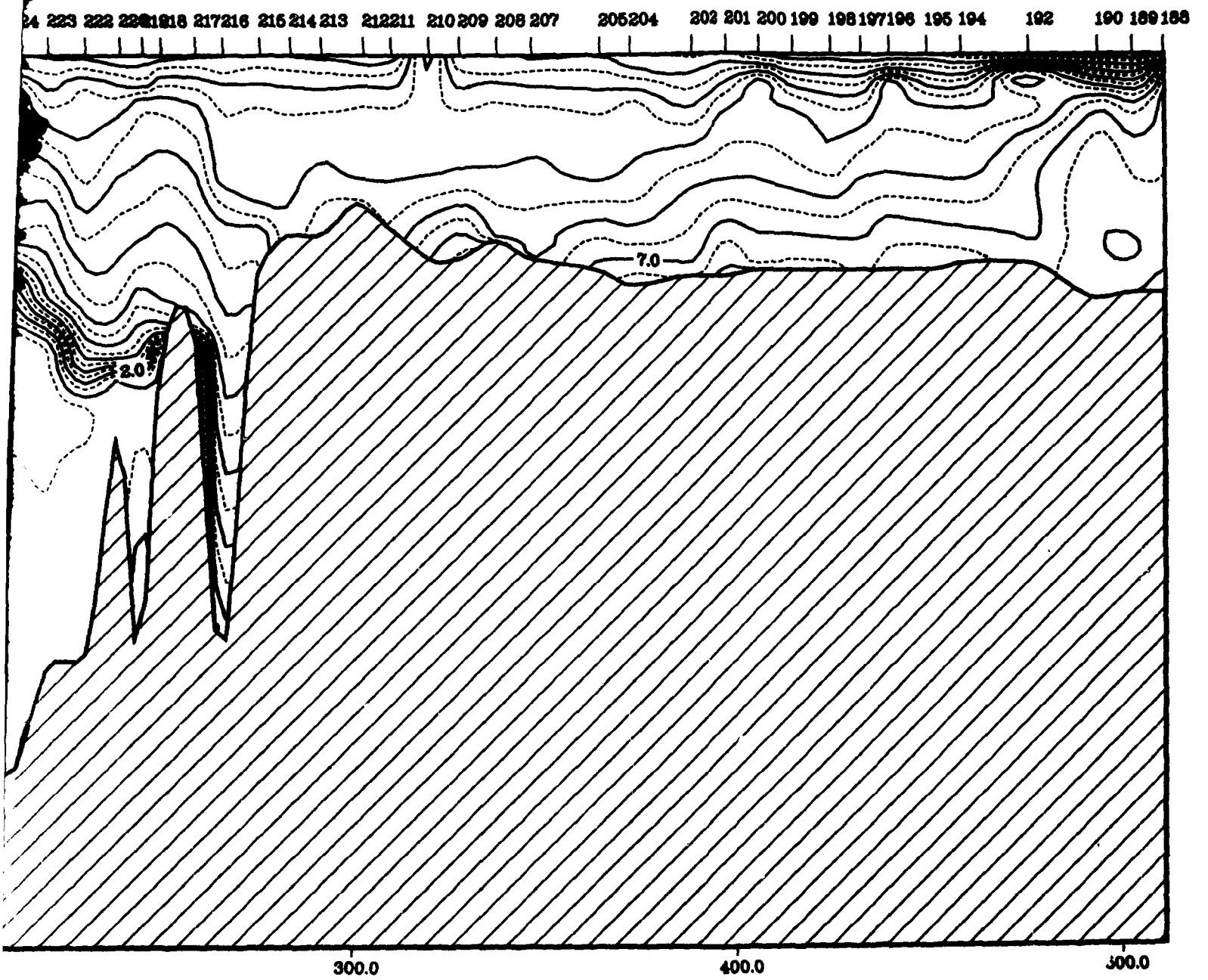


Figure 175. July 1952 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1952SJU.DAT
TEMPERATURE



DISTANCE – KILOMETERS

2

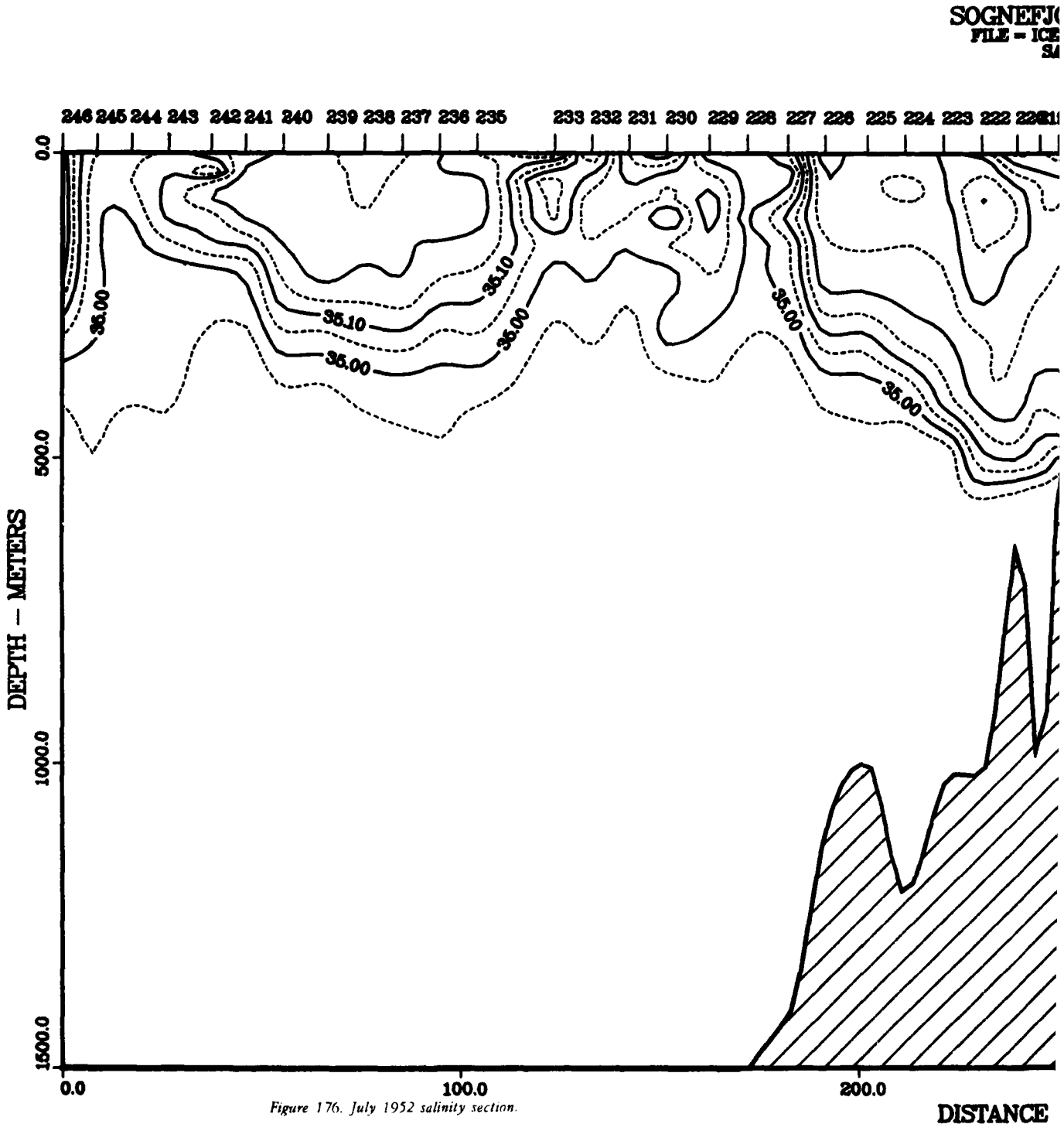
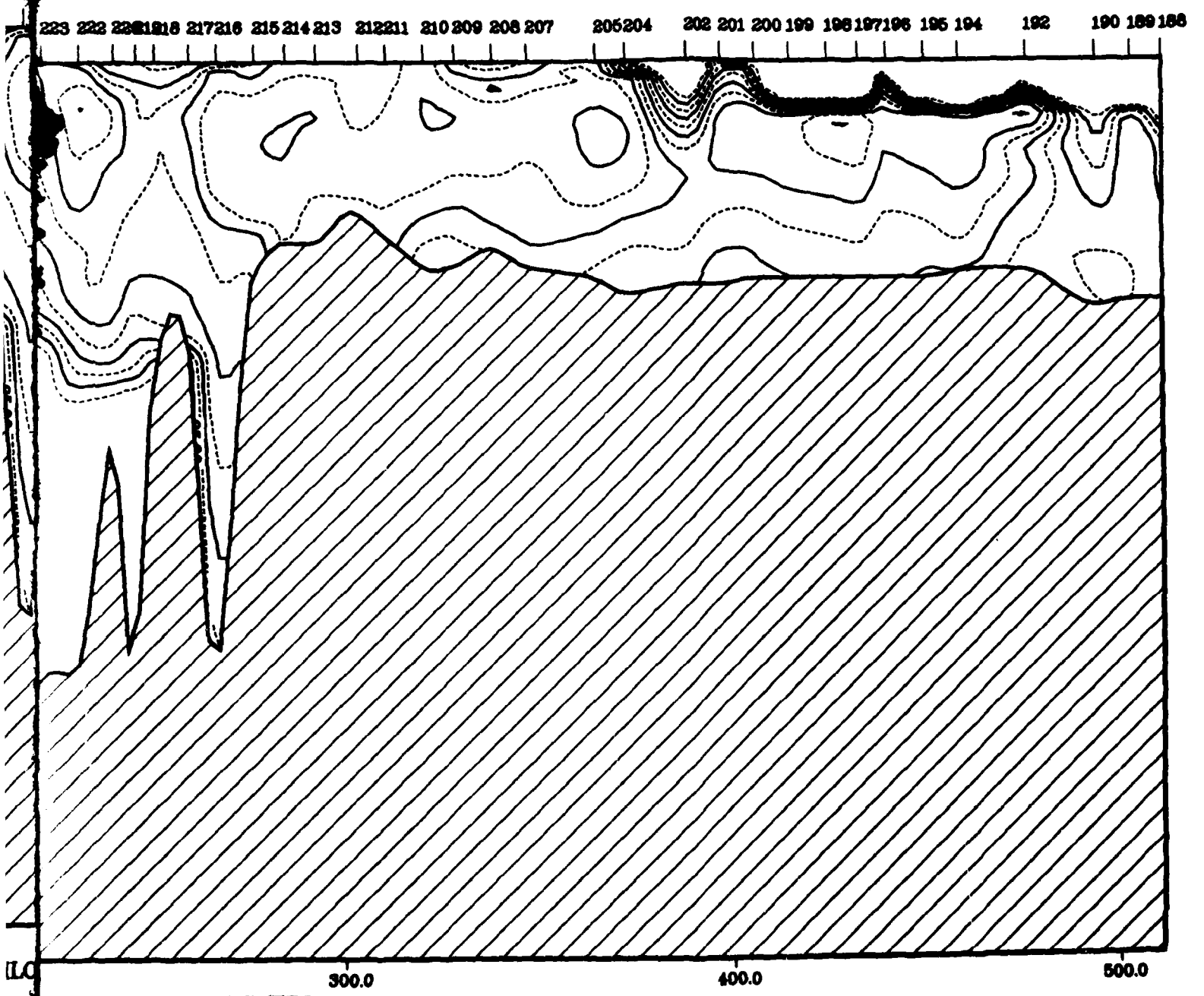


Figure 176. July 1952 salinity section.

SOGNEFJORD SECTION
FILE = ICES:1962SJU.DAT
SALINITY



DISTANCE – KILOMETERS

ICES$:1952RAU.DAT

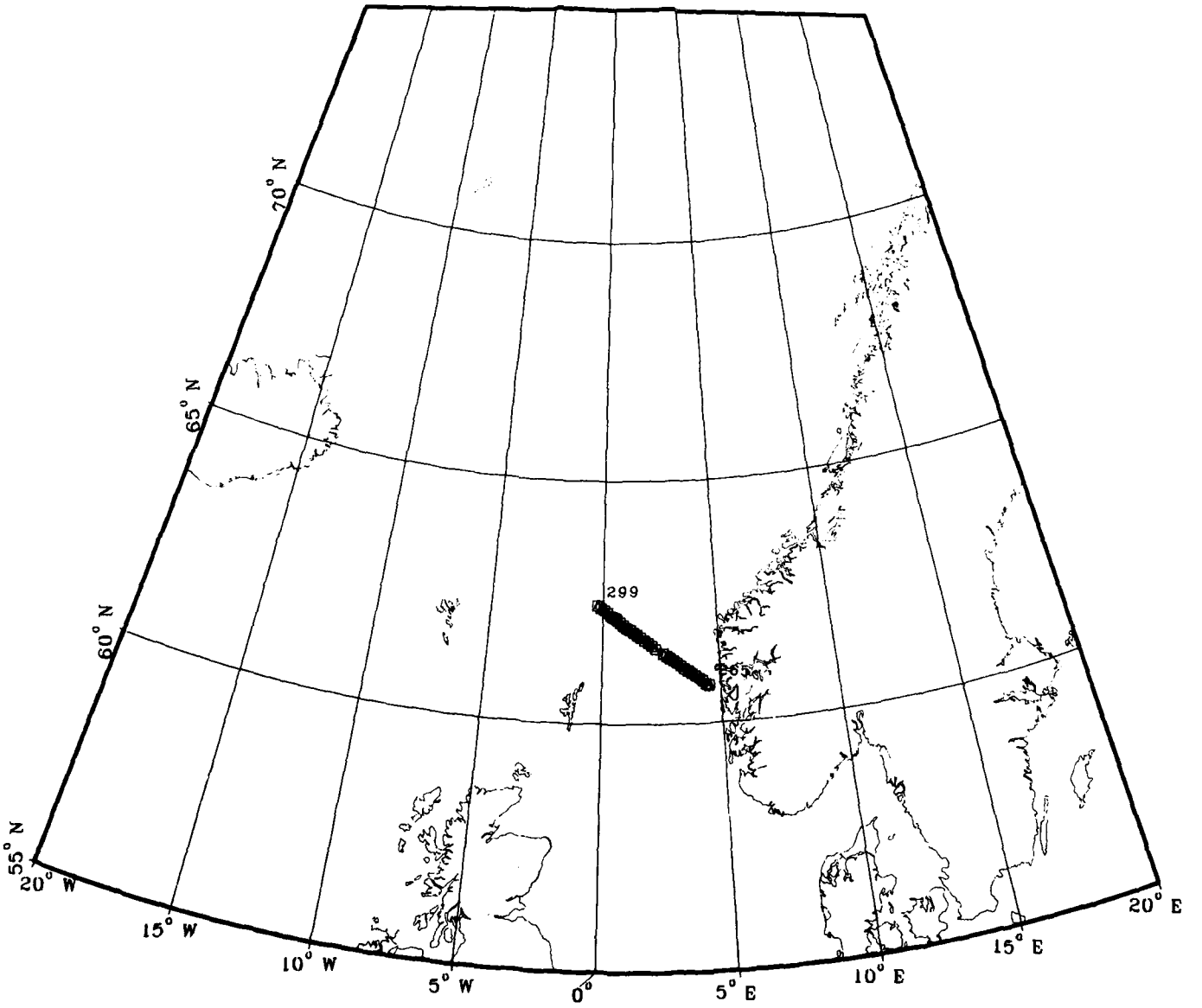


Figure 177. August 1952 station positions.

SOGNEFJORD SECTION
FILE = ICES$ 1952RAU DAT
T/S PLOT

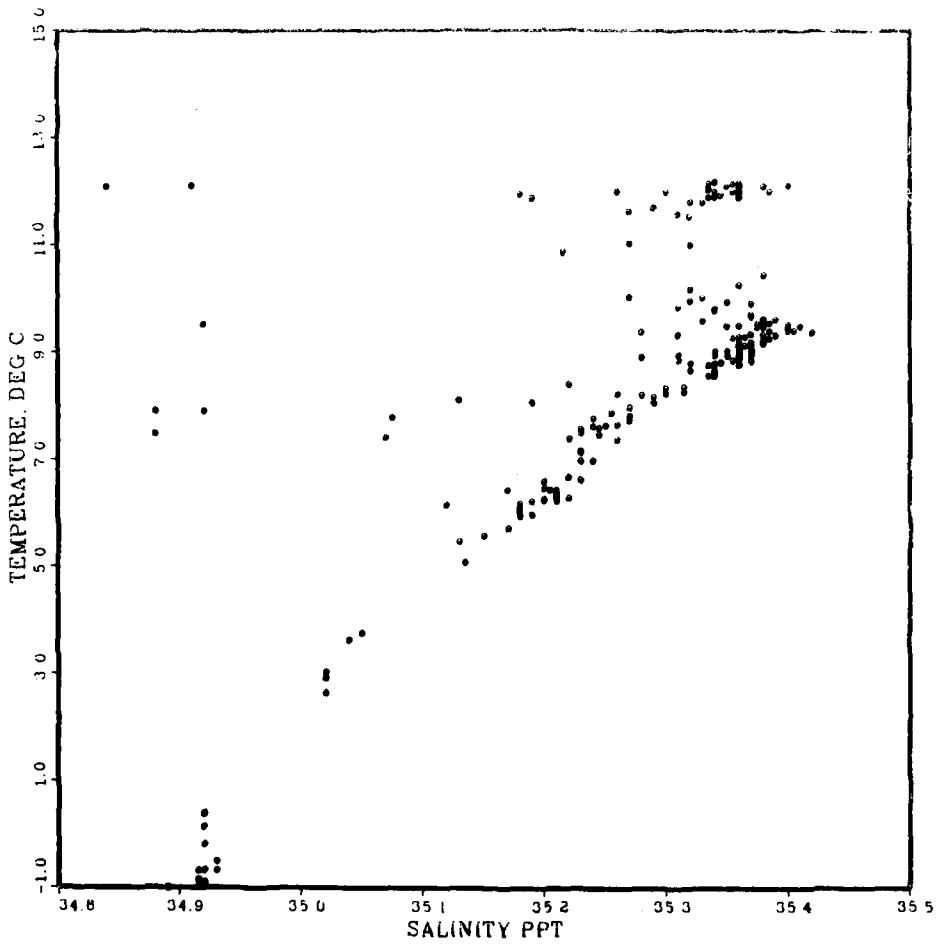


Figure 178. August 1952 temperature/salinity diagram.

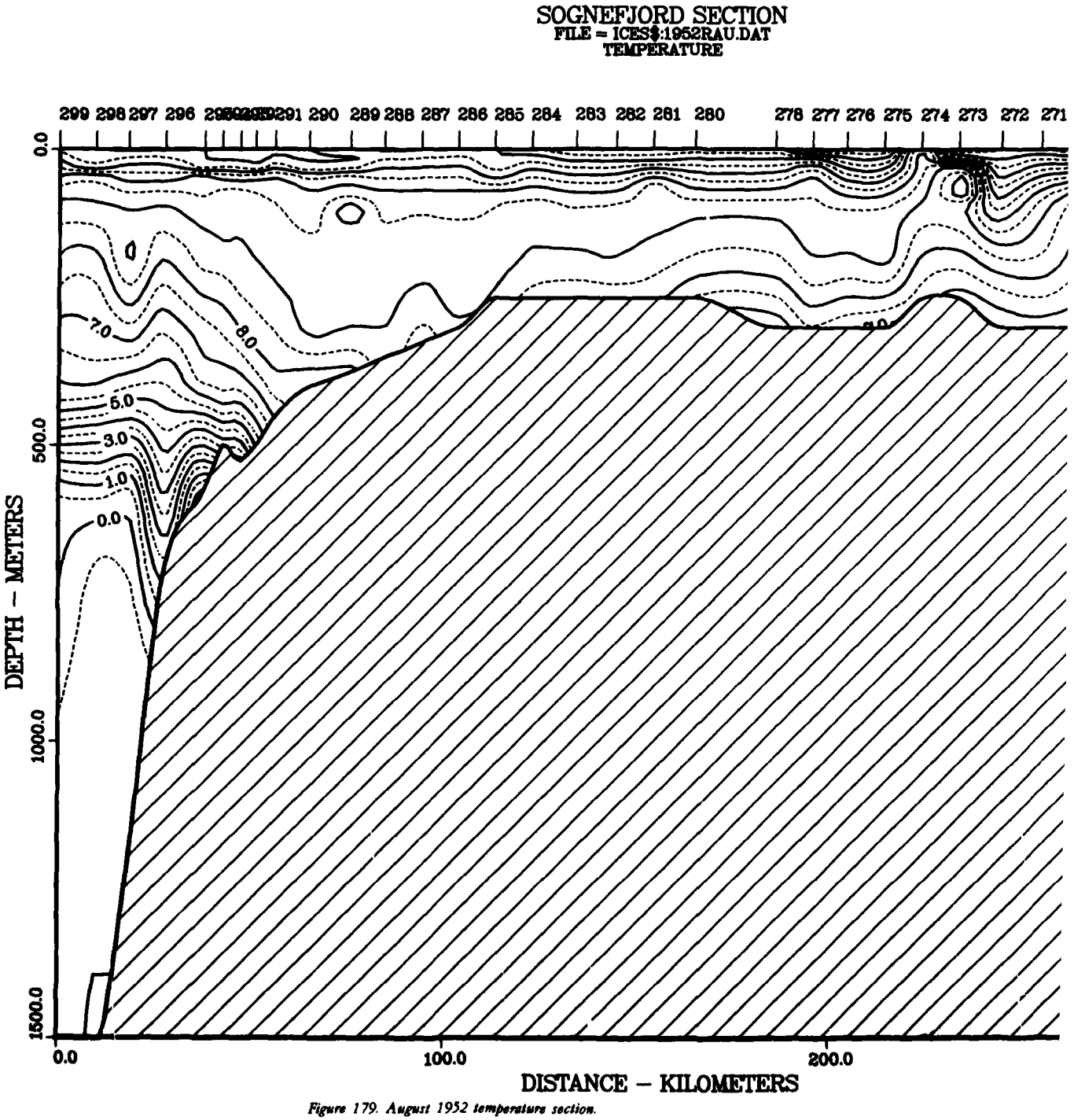
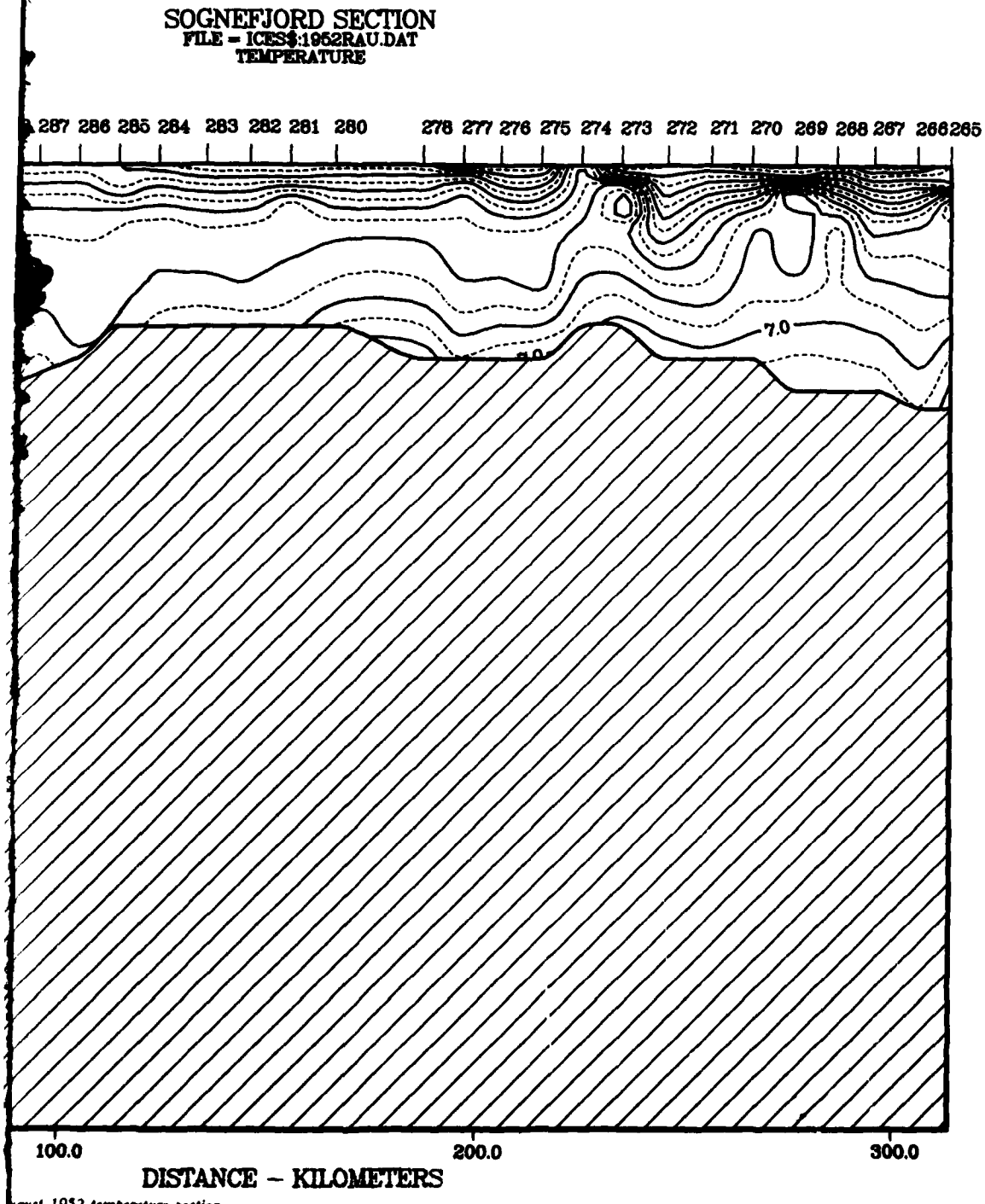


Figure 179. August 1952 temperature section.



gust 1952 temperature section.

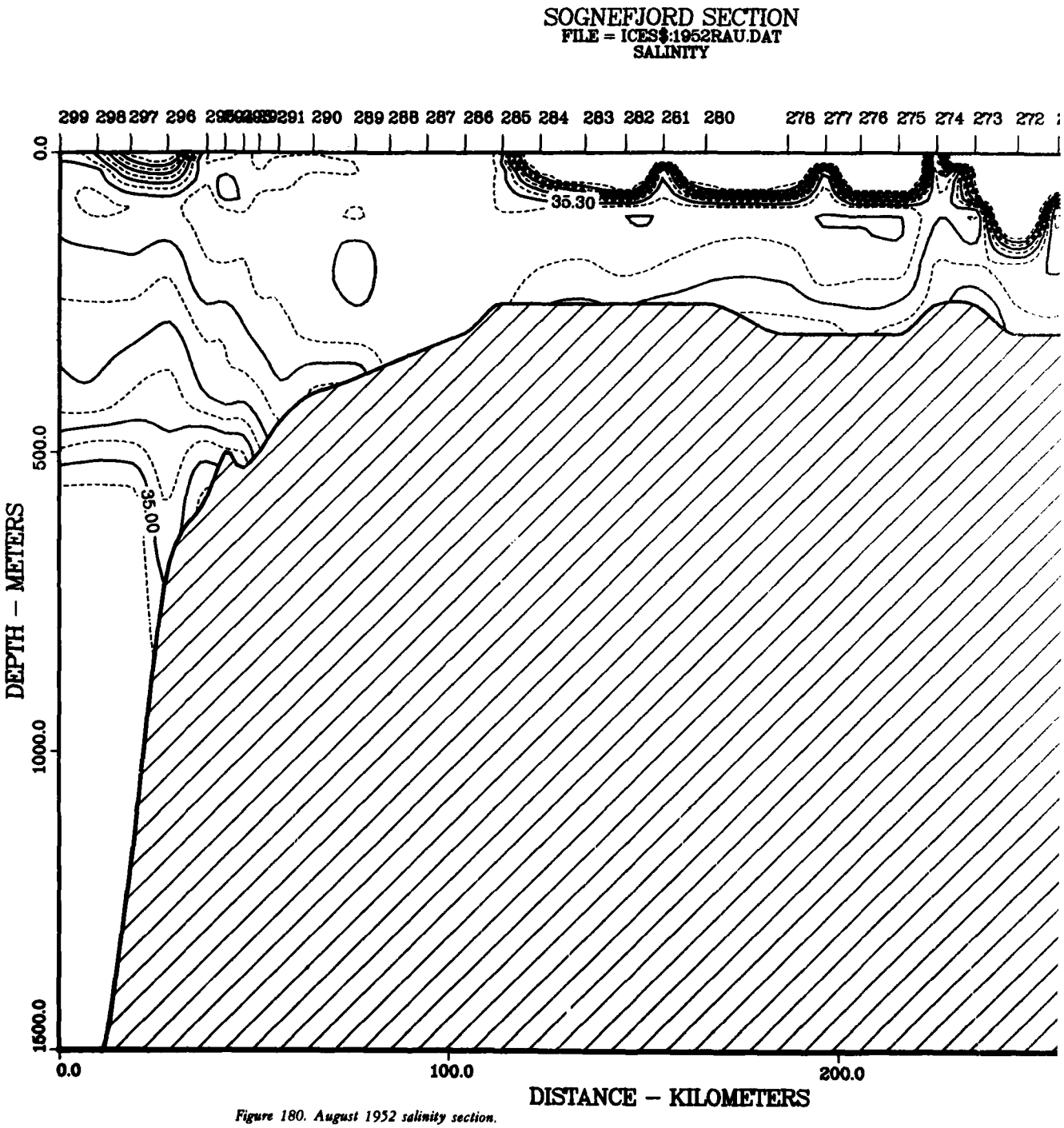
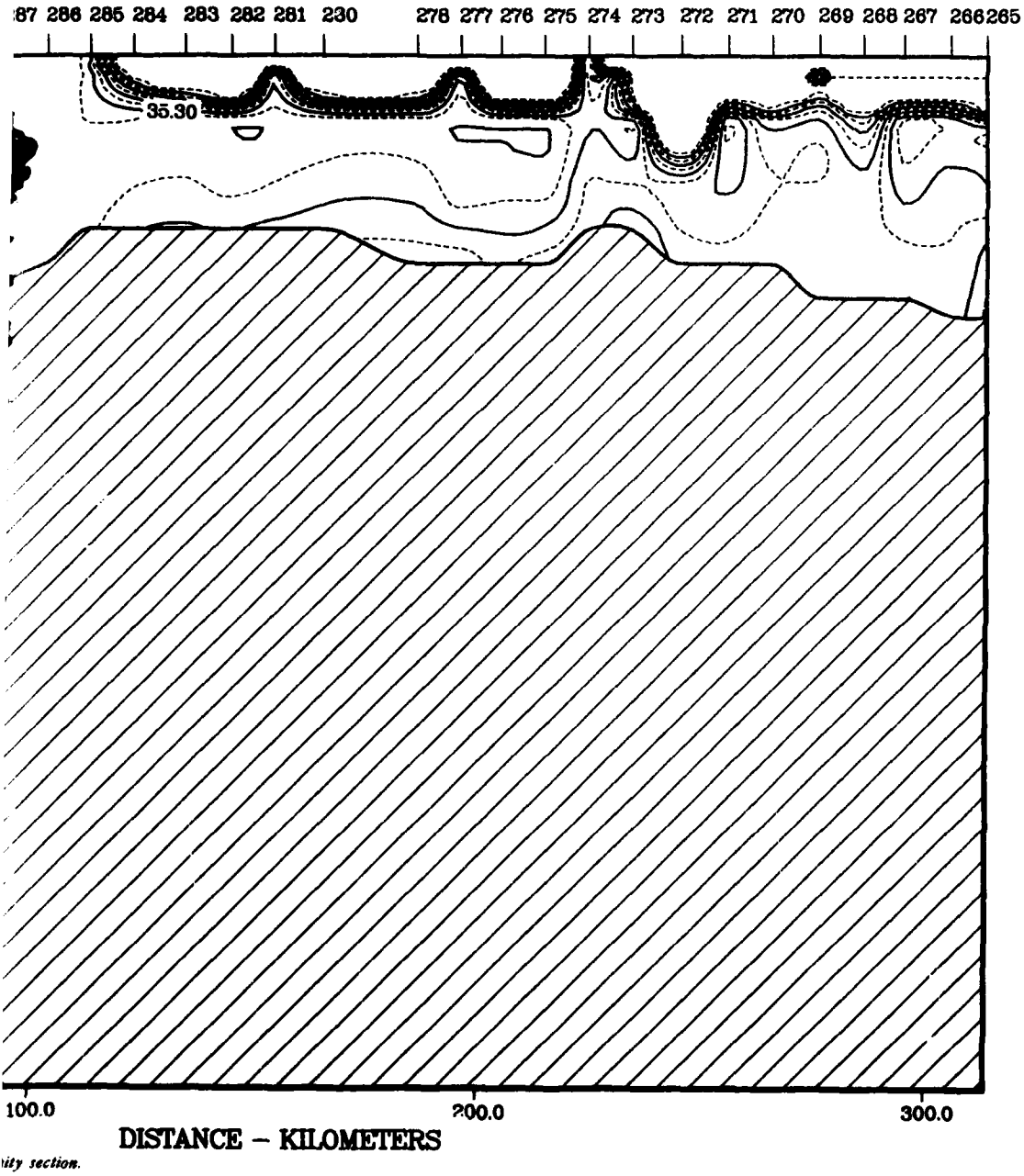


Figure 180. August 1952 salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1952RAU.DAT
SALINITY



ity section.

ICES$:1953YMA.DAT

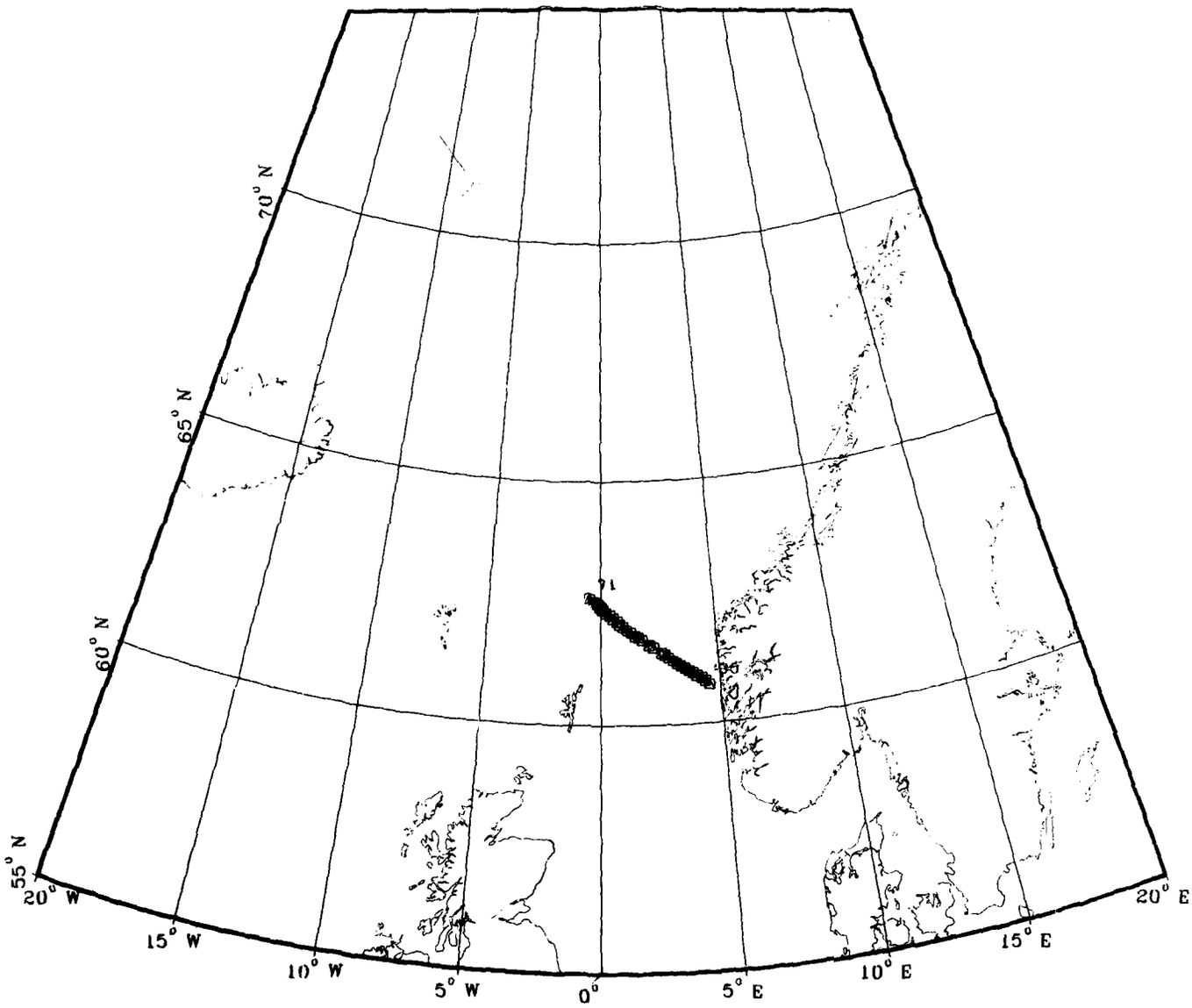


Figure 181. May 1953 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1953YMA.DAT
T/S PLOT

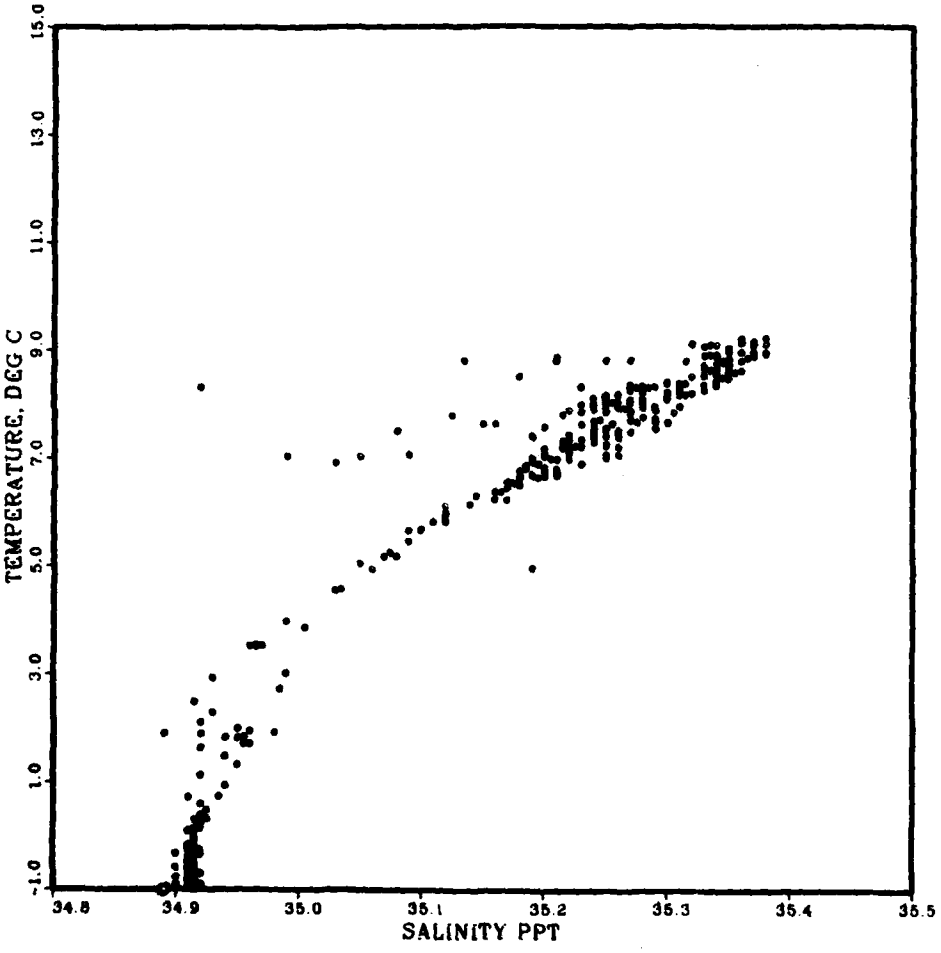


Figure 182. May 1953 temperature/salinity diagram.

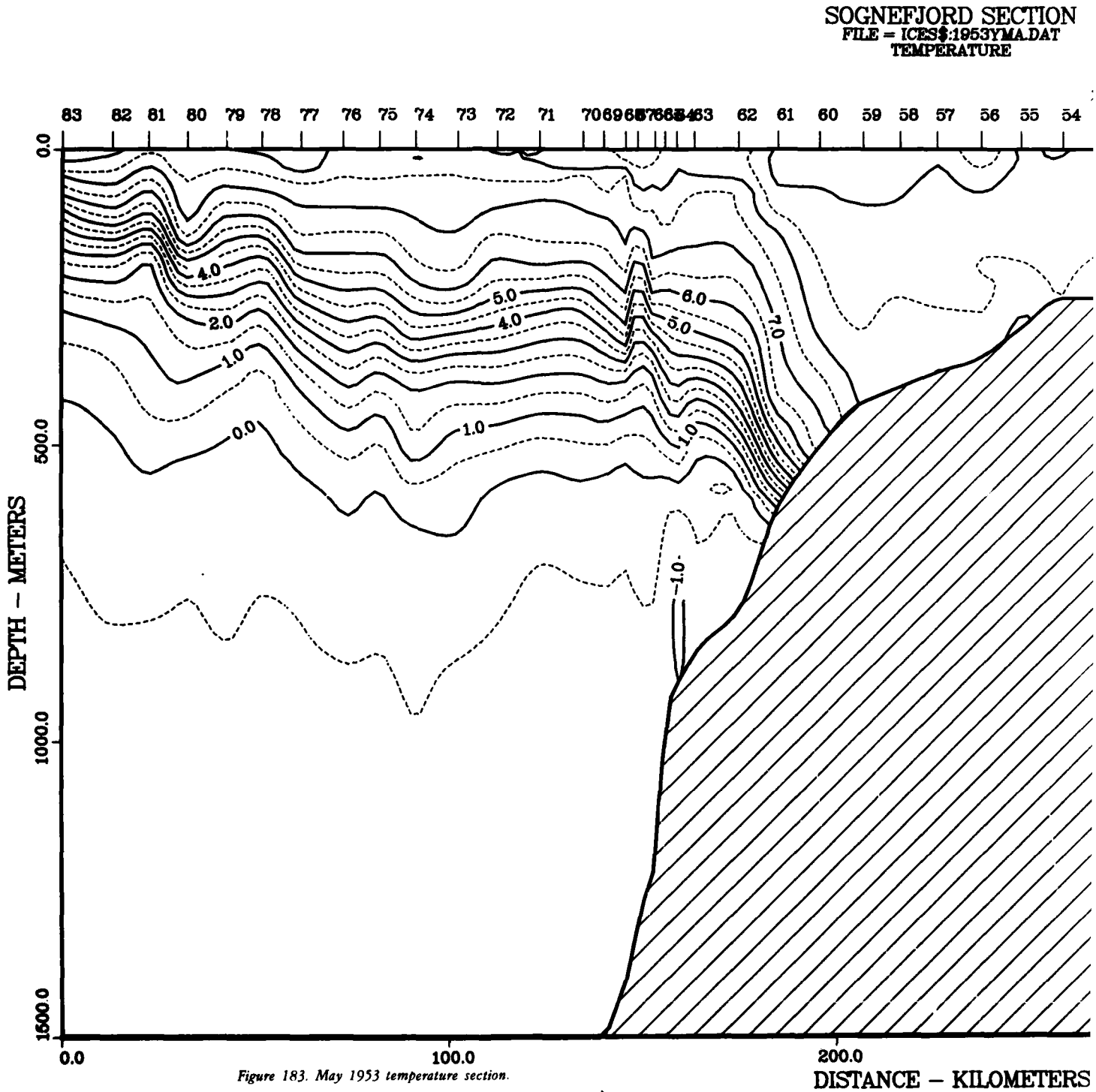
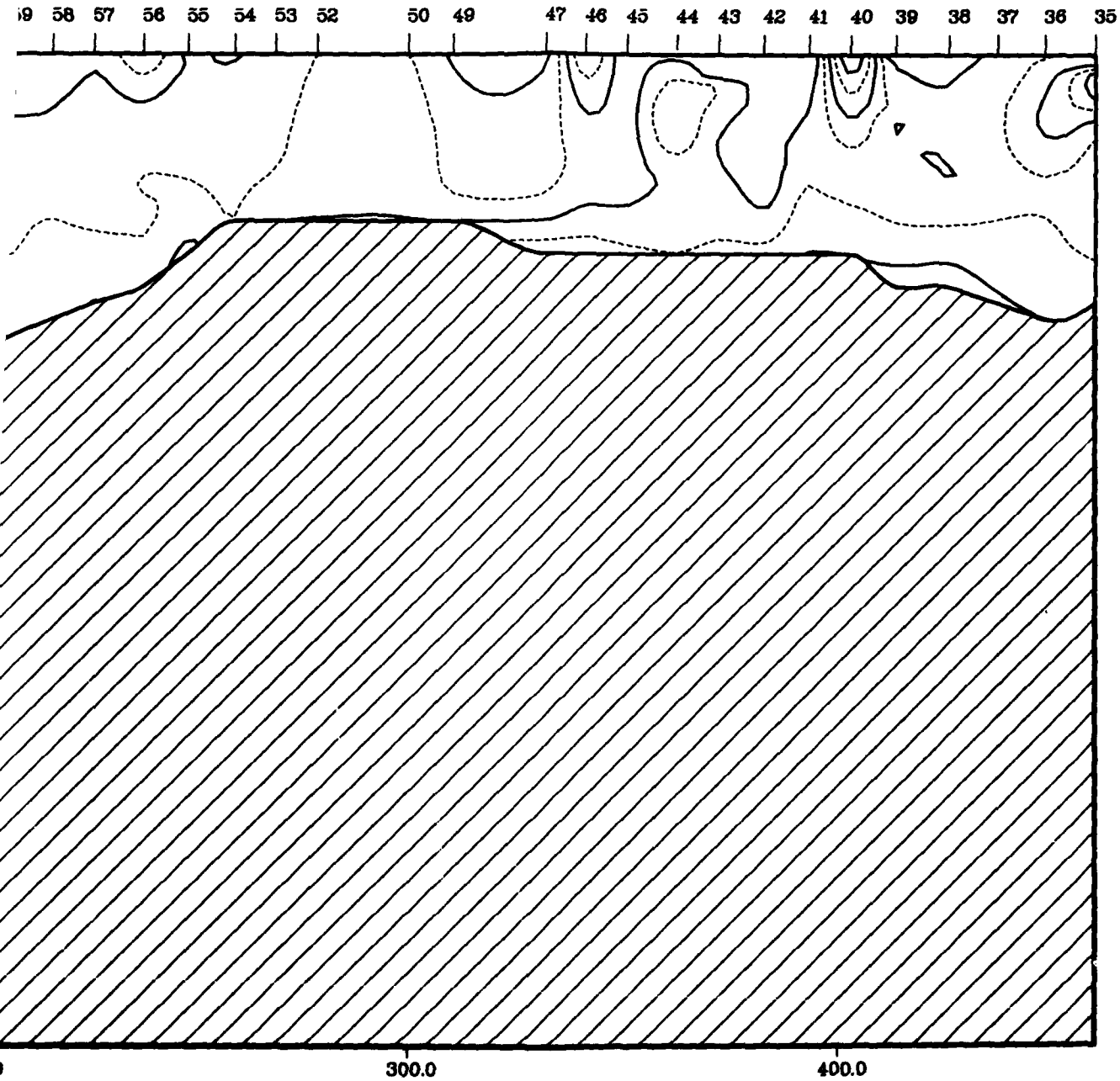


Figure 183. May 1953 temperature section.

NEFJORD SECTION
E = ICES$:1953YMA.DAT
TEMPERATURE



ANCE – KILOMETERS

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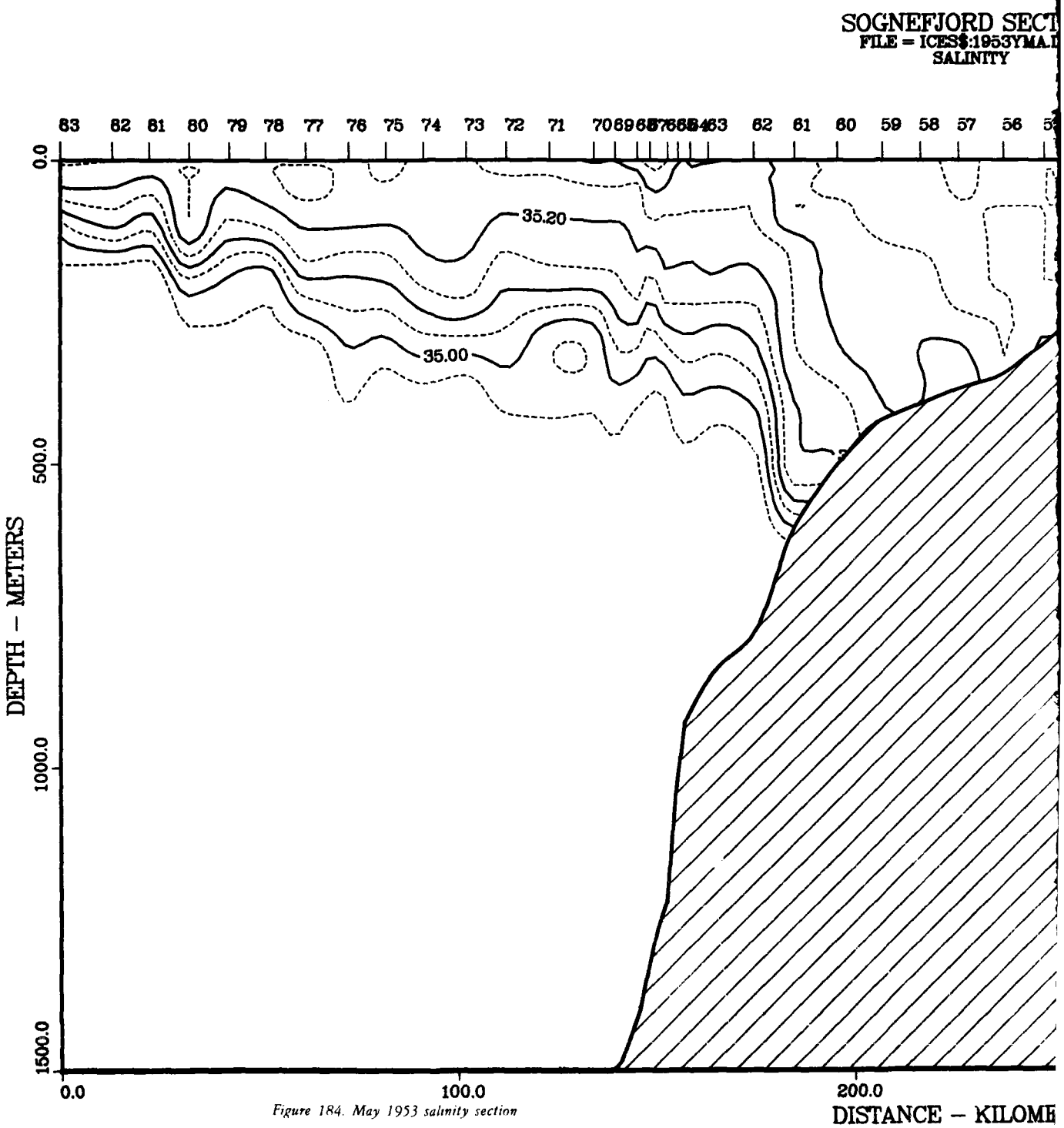

Figure 184. May 1953 salinity section

AD-A169 098 ATLAS OF SOGNEFJORD SECTIONS 1900-1979(U) NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY NSTL STATION MS K D SAUNDERS ET AL. APR 85 NORDA-42 4/4

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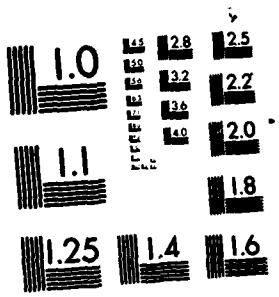
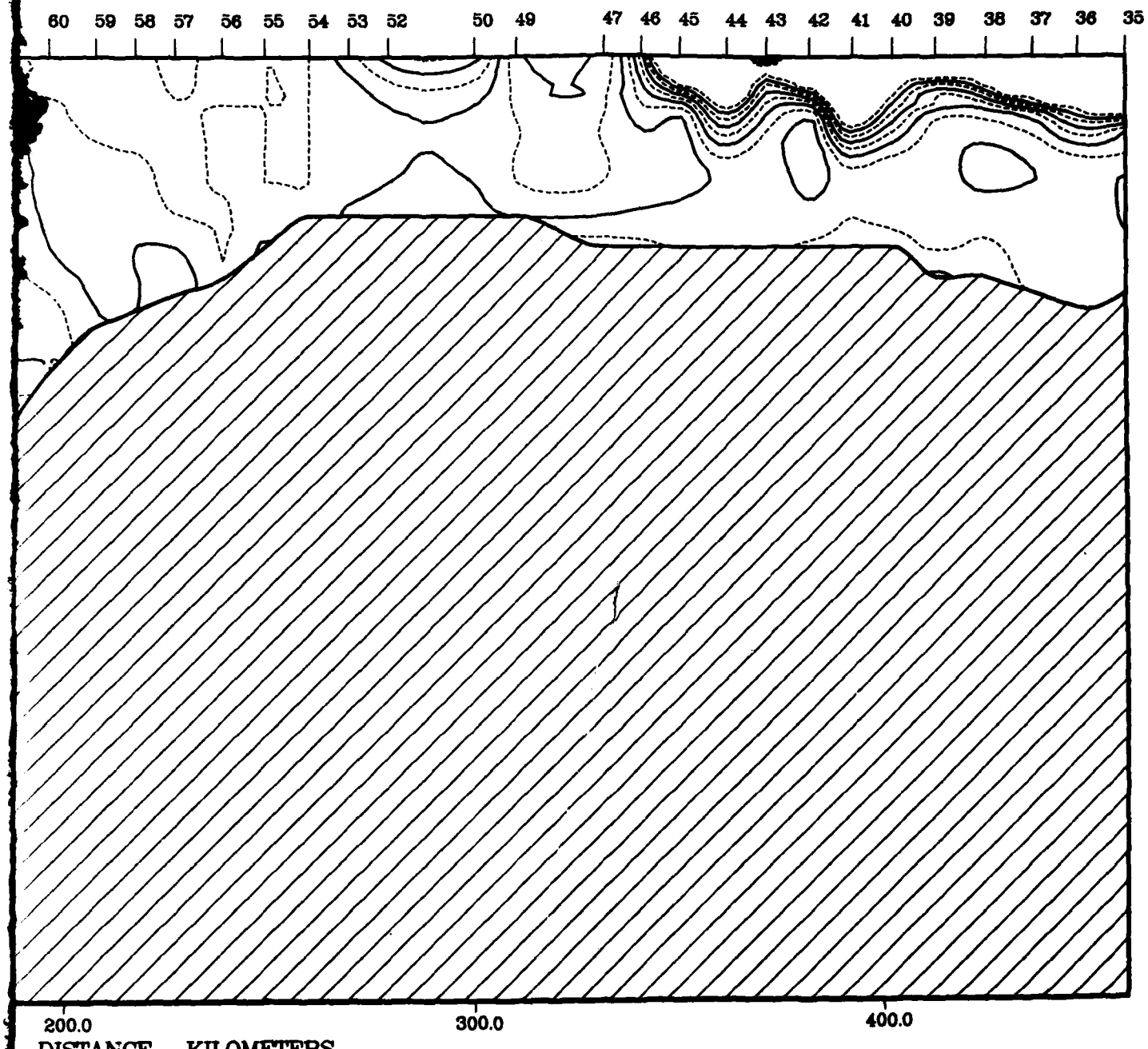


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SOGNEFJORD SECTION
FILE = ICES$:1953YMA.DAT
SALINITY



DISTANCE – KILOMETERS

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ICES$:1953XJU.DAT

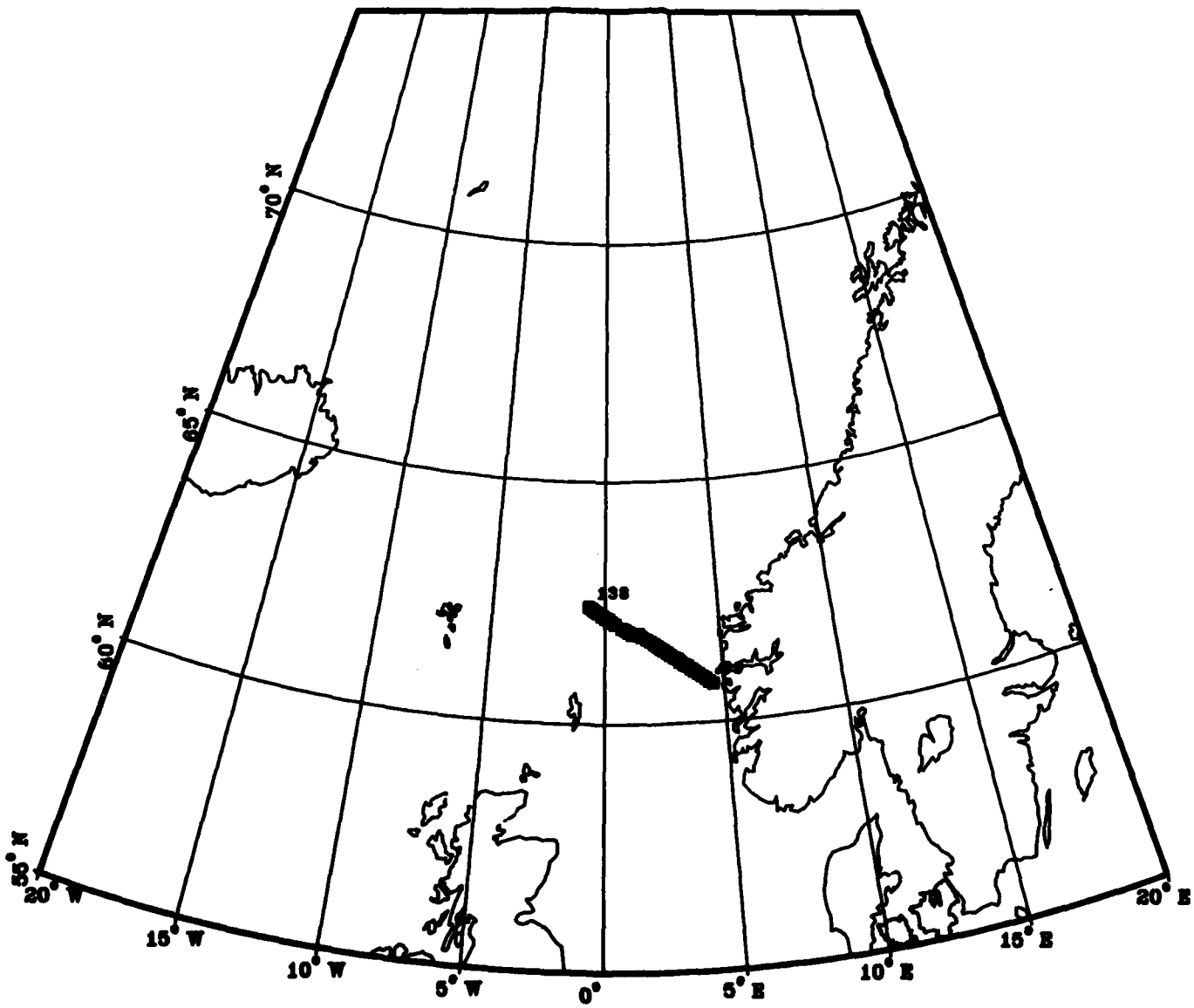


Figure 185. June 1953 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1953XJU.DAT
T/S PLOT

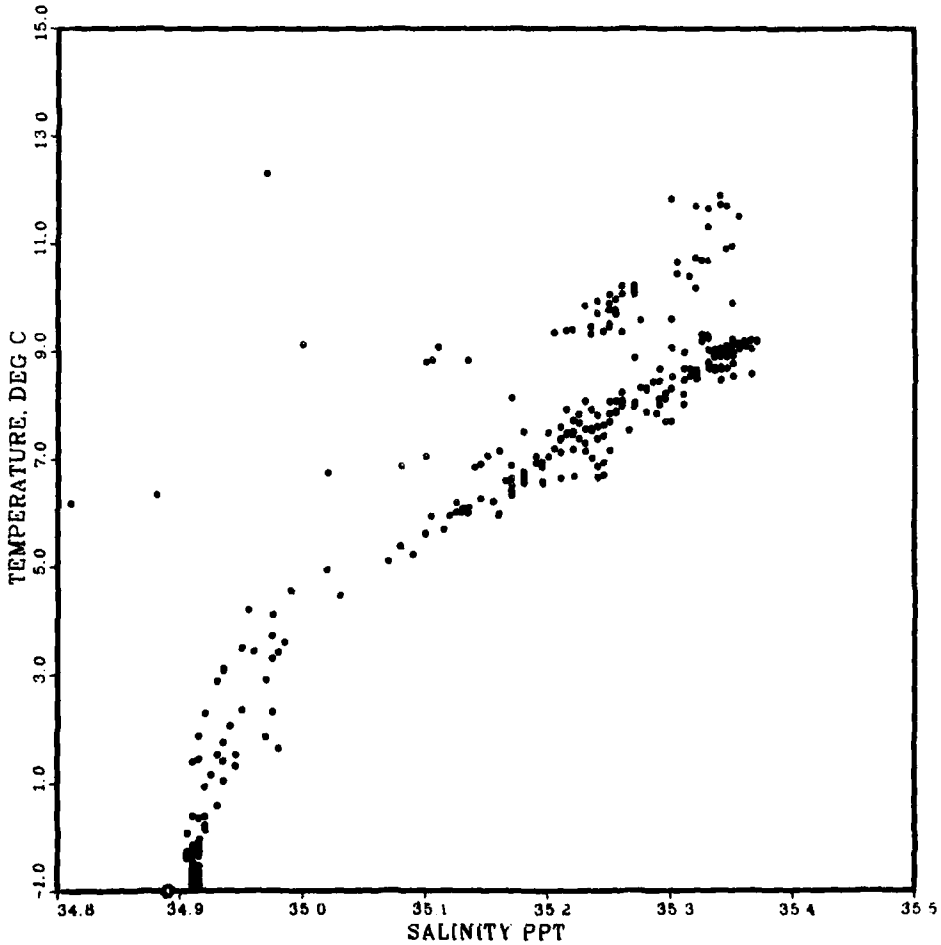


Figure 186. June 1953 temperature/salinity diagram.

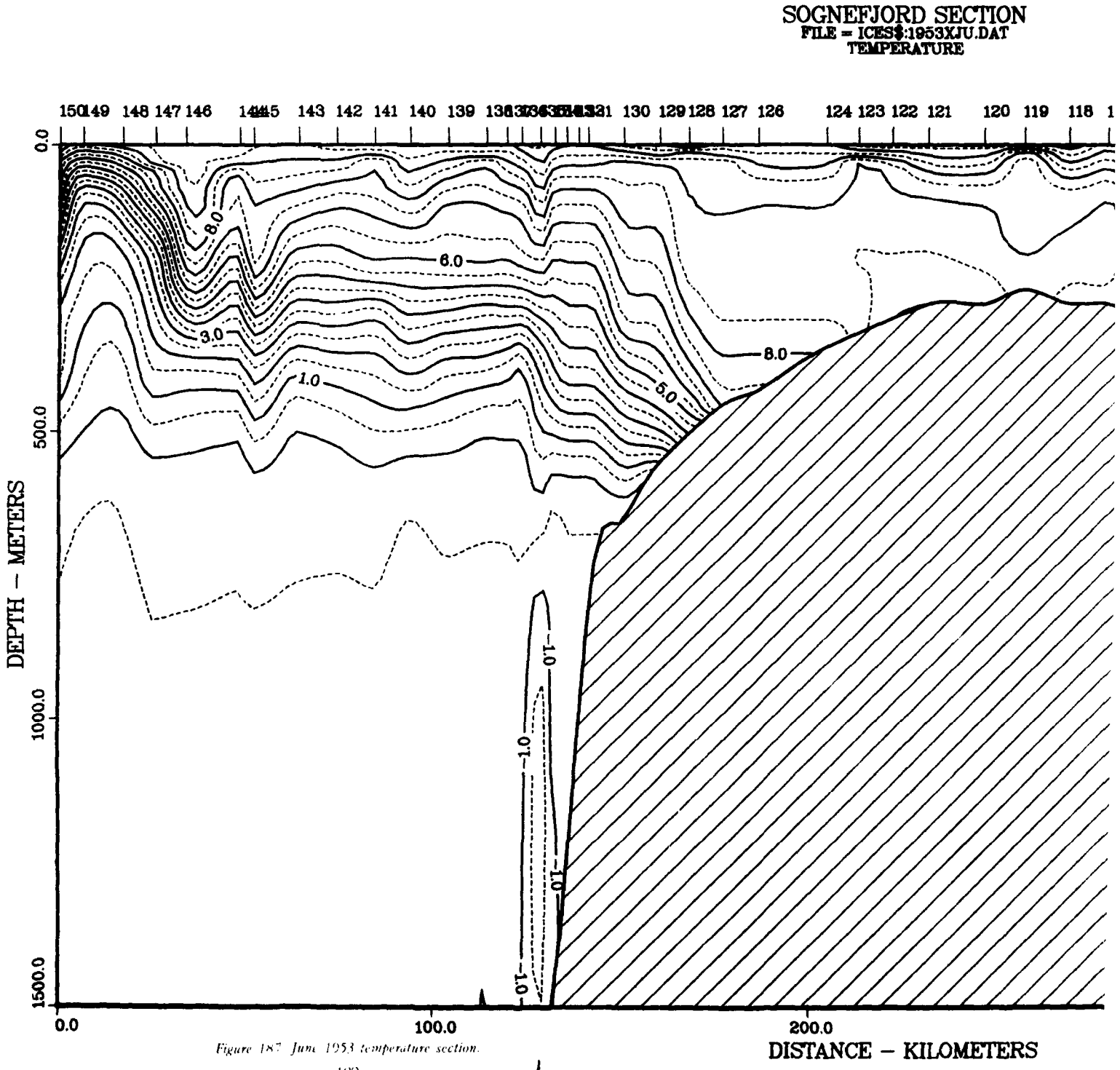
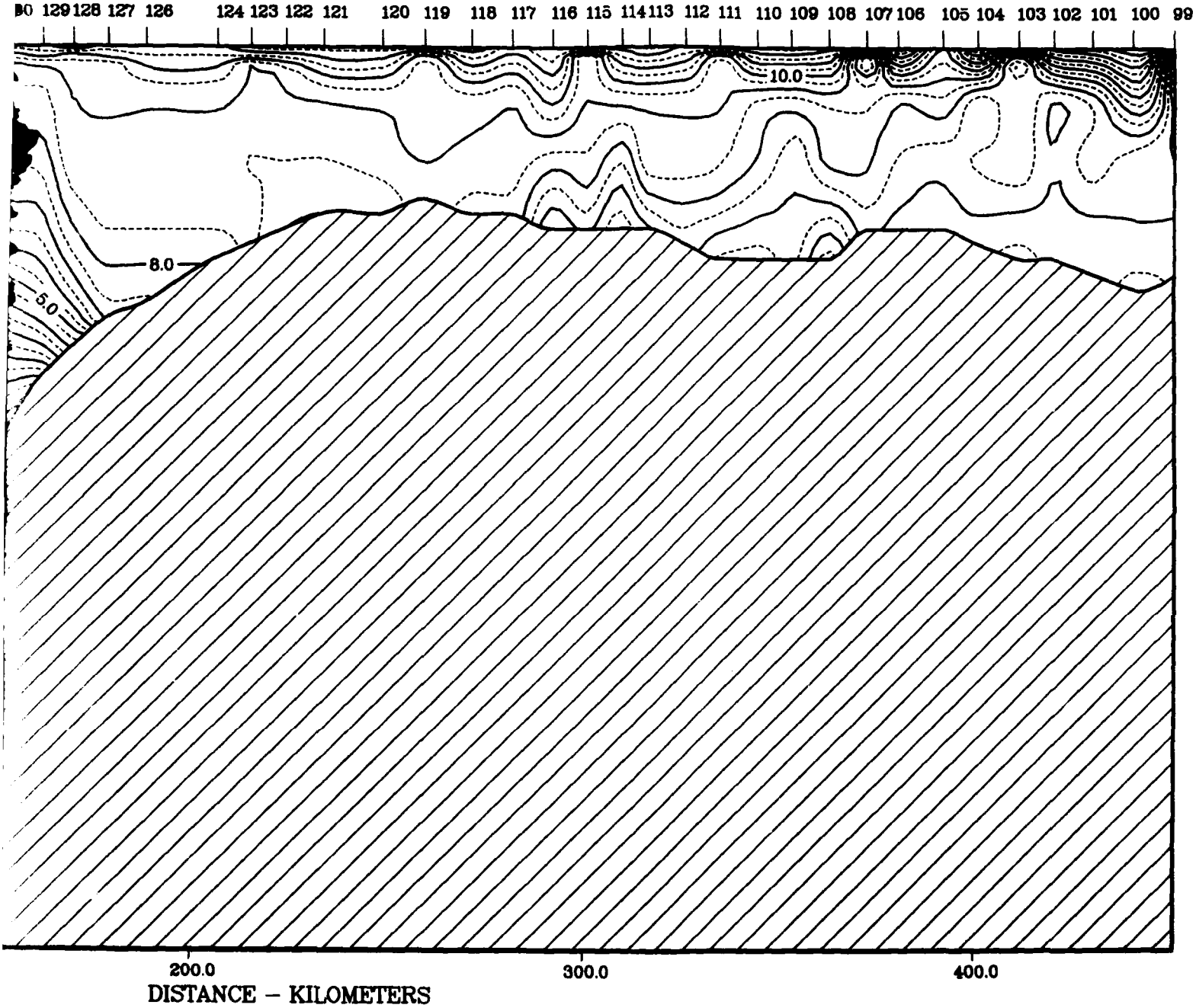


Figure 187. June 1953 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1953XJU.DAT
TEMPERATURE



DISTANCE – KILOMETERS

2

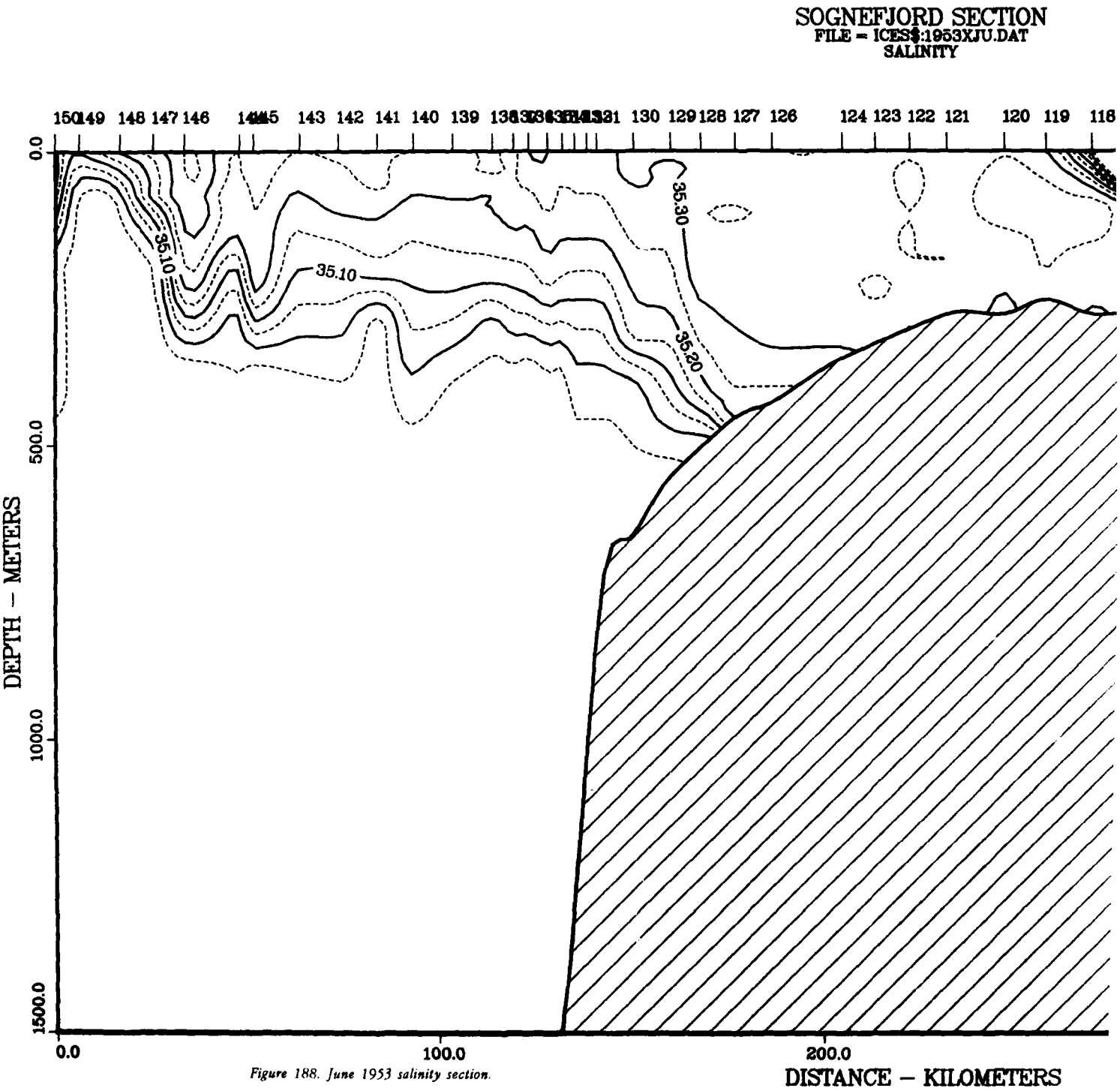
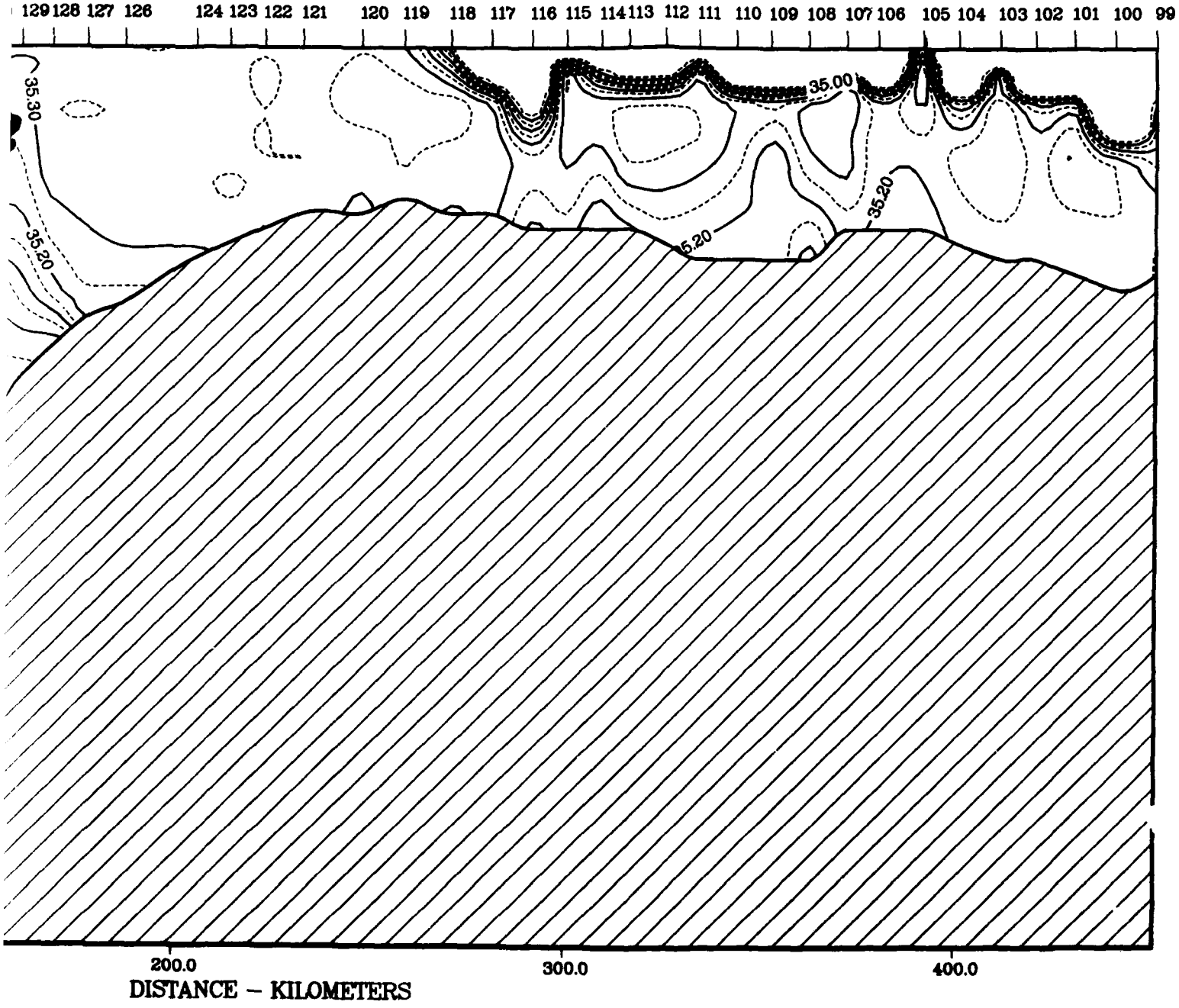


Figure 188. June 1953 salinity section.

SOGNEFJORD SECTION
FILE = ICES$:1953XJU.DAT
SALINITY



1

2

ICES$:1953WAU.DAT

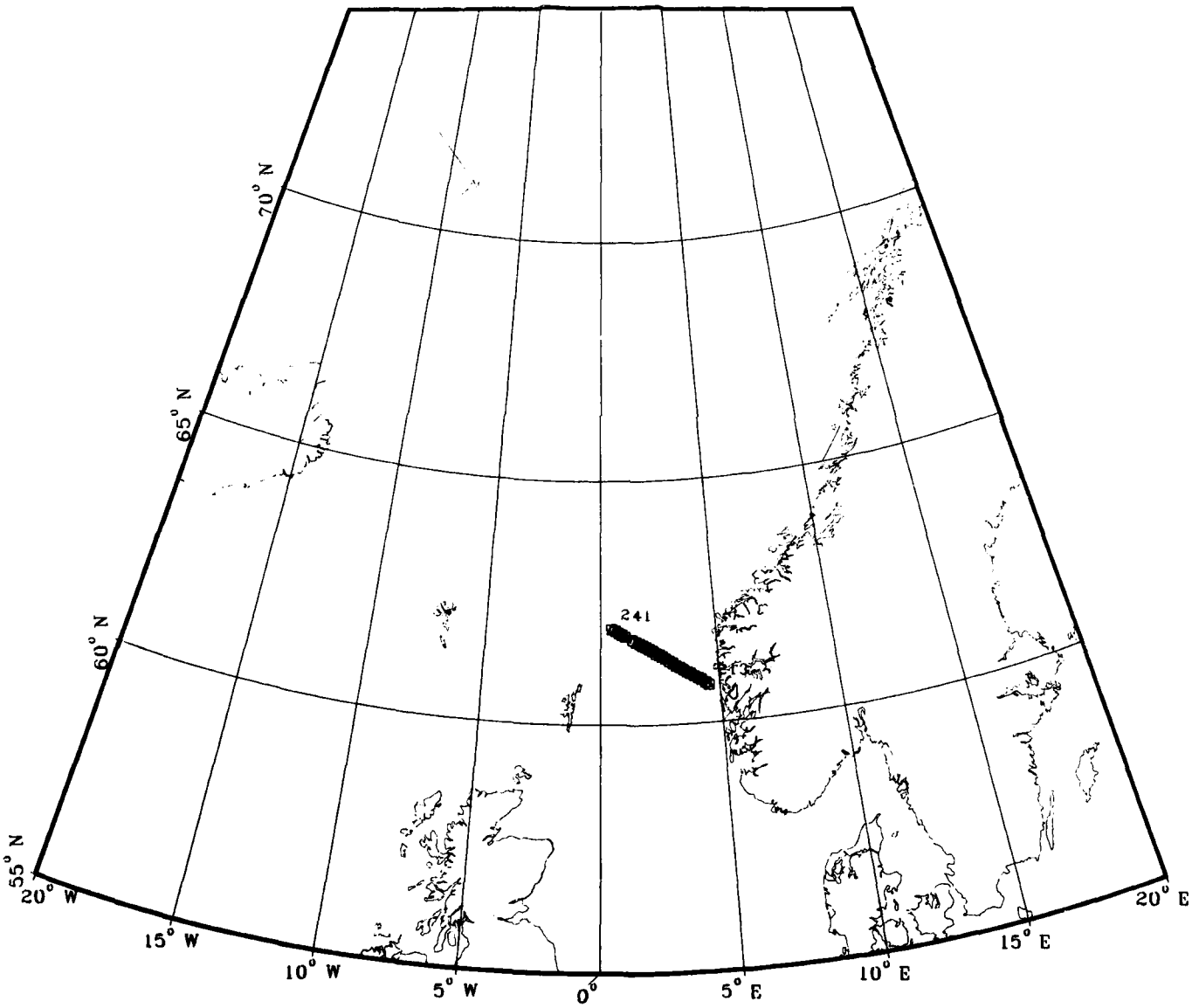


Figure 189. August 1953 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1953WAU.DAT
T/S PLOT

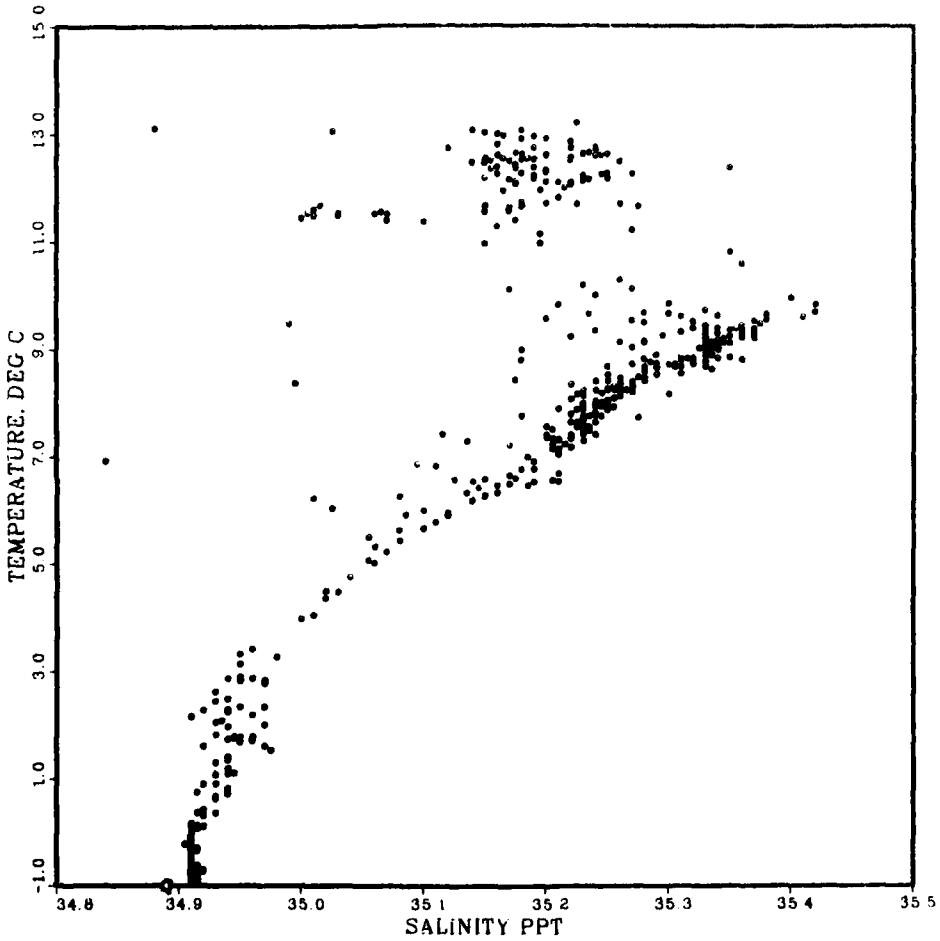


Figure 190. August 1953 temperature/salinity diagram.

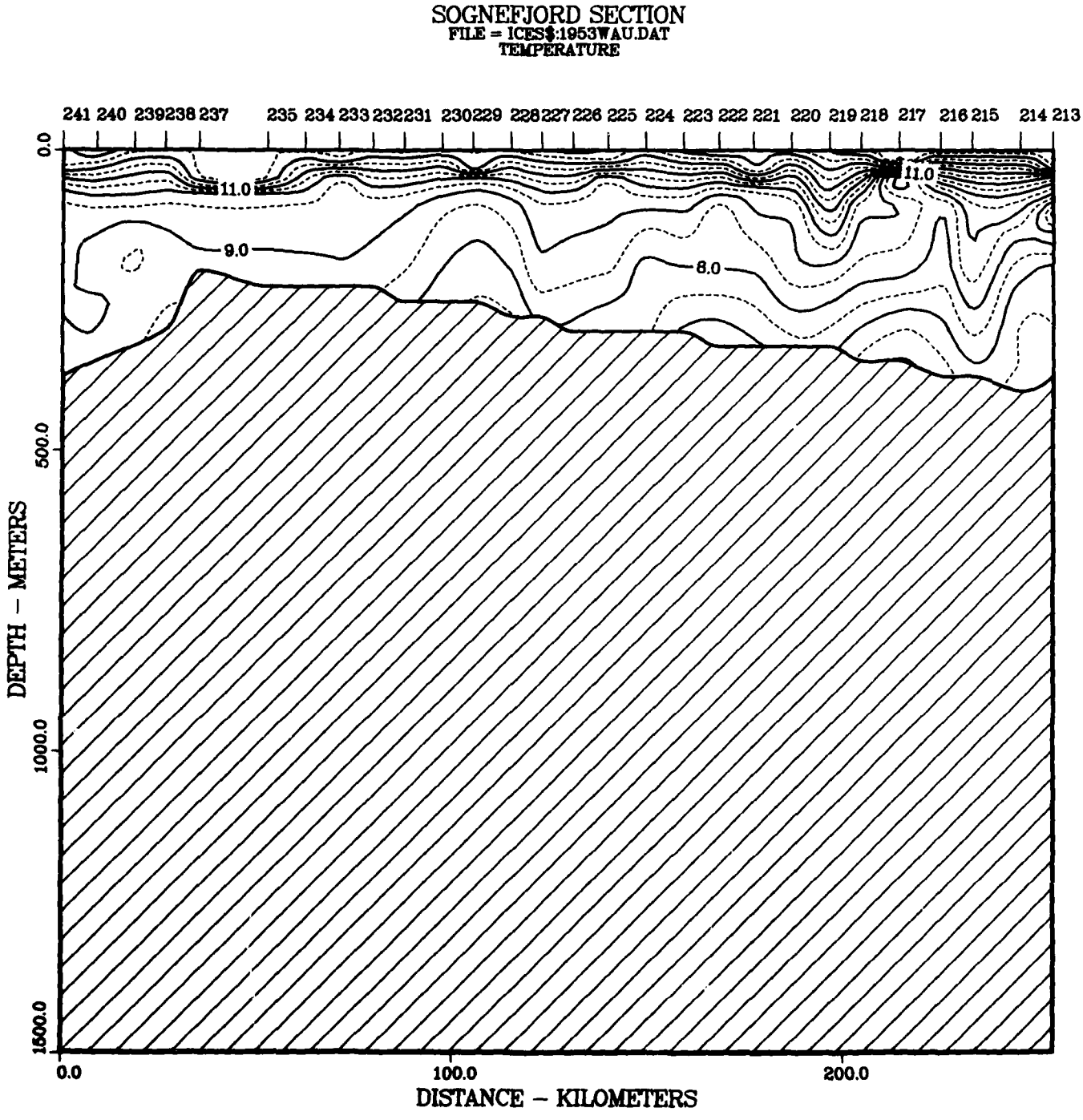


Figure 191. August 1953 temperature section.

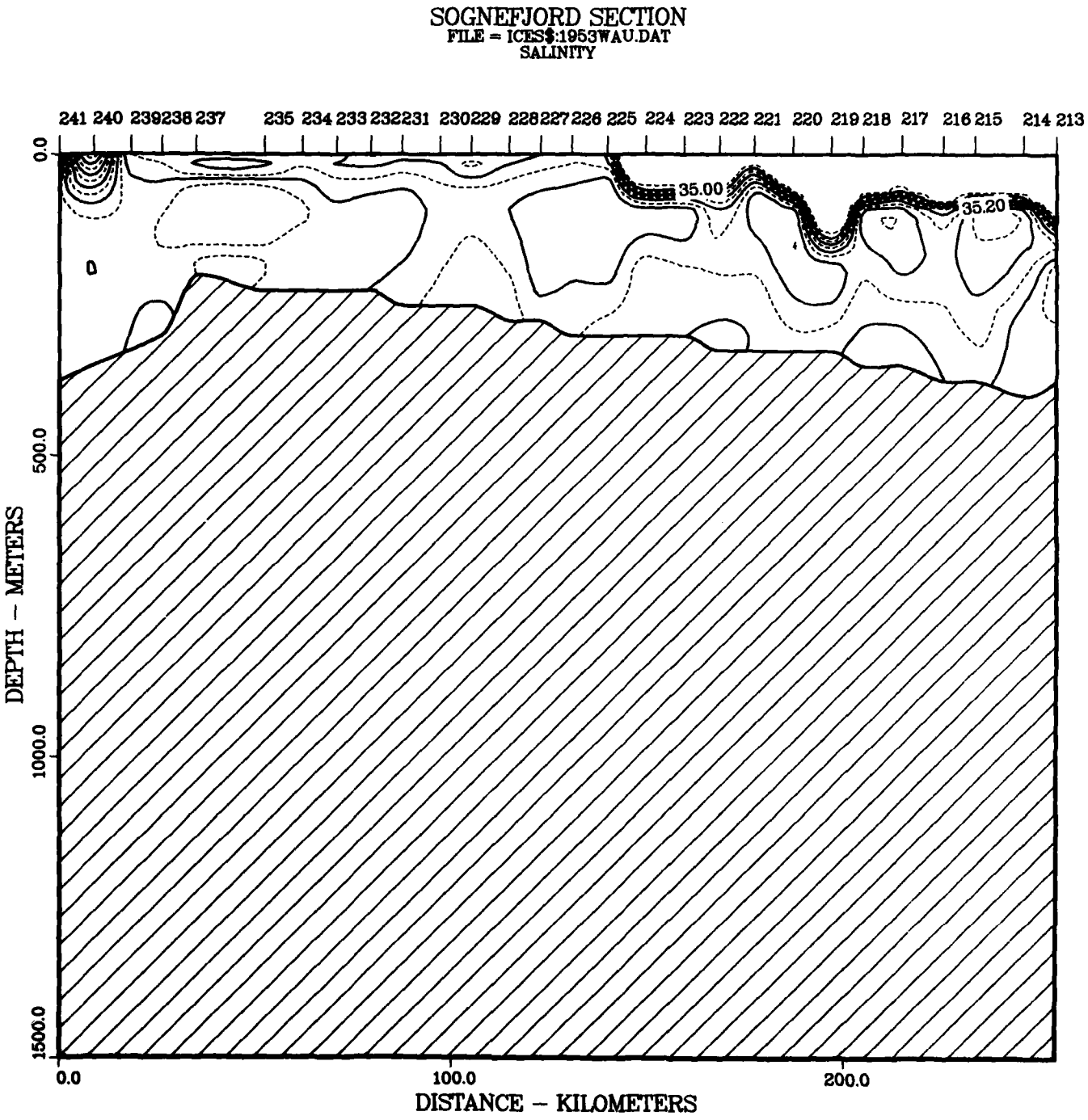


Figure 192. August 1953 salinity section.

ICES$:1959.DAT

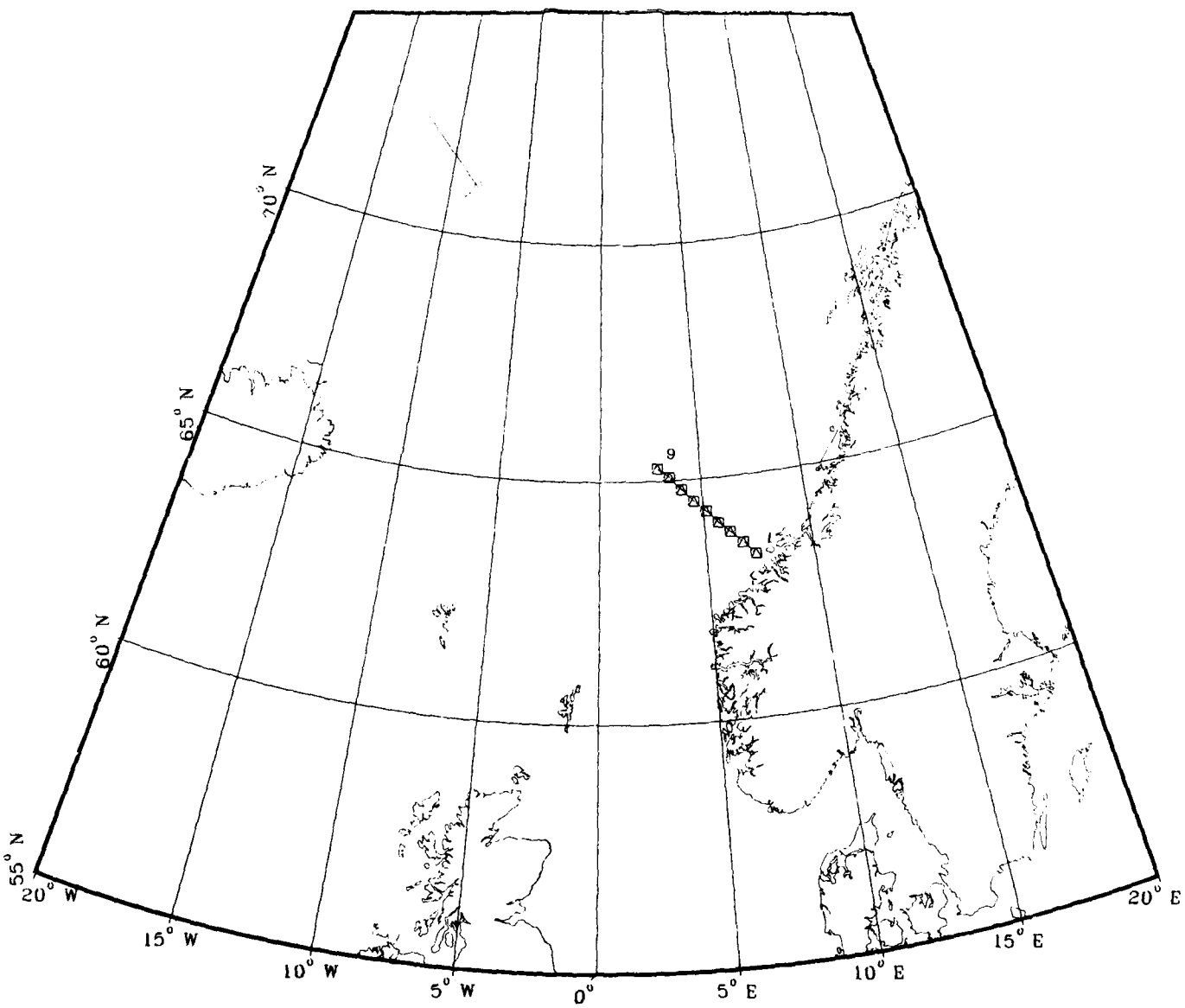


Figure 193. January 1959 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1959.DAT
T/S PLOT

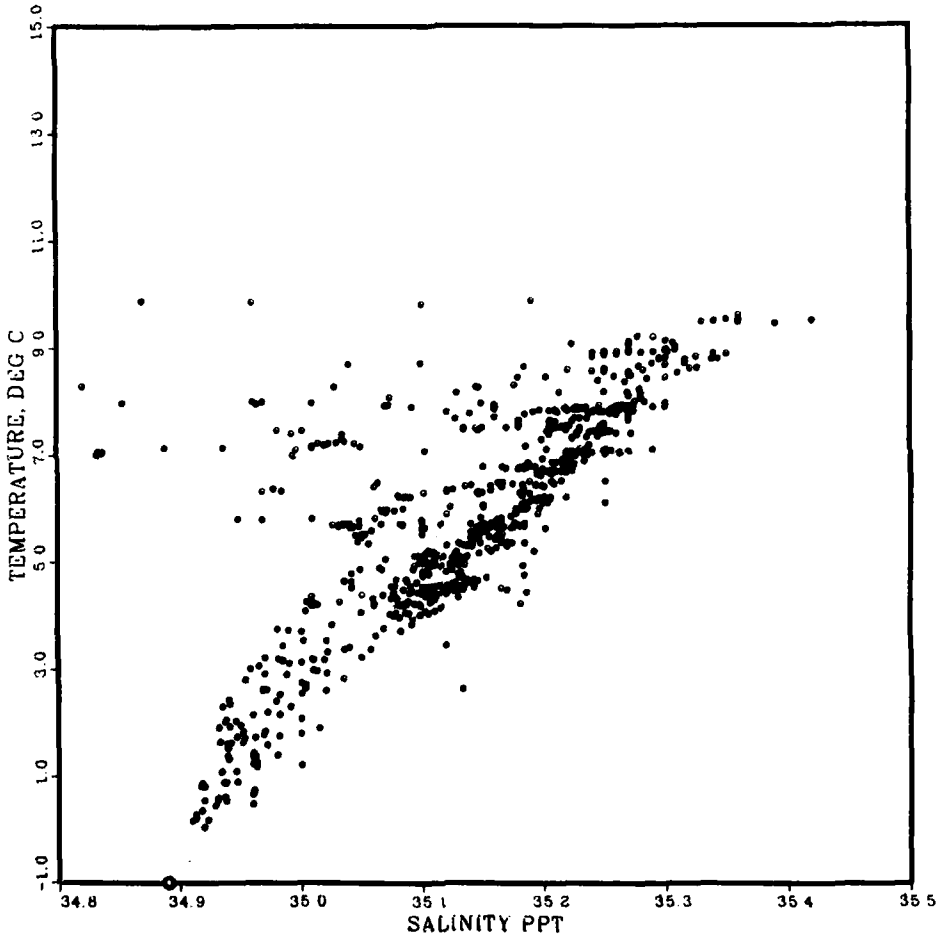


Figure 194. January 1959 temperature/salinity diagram.

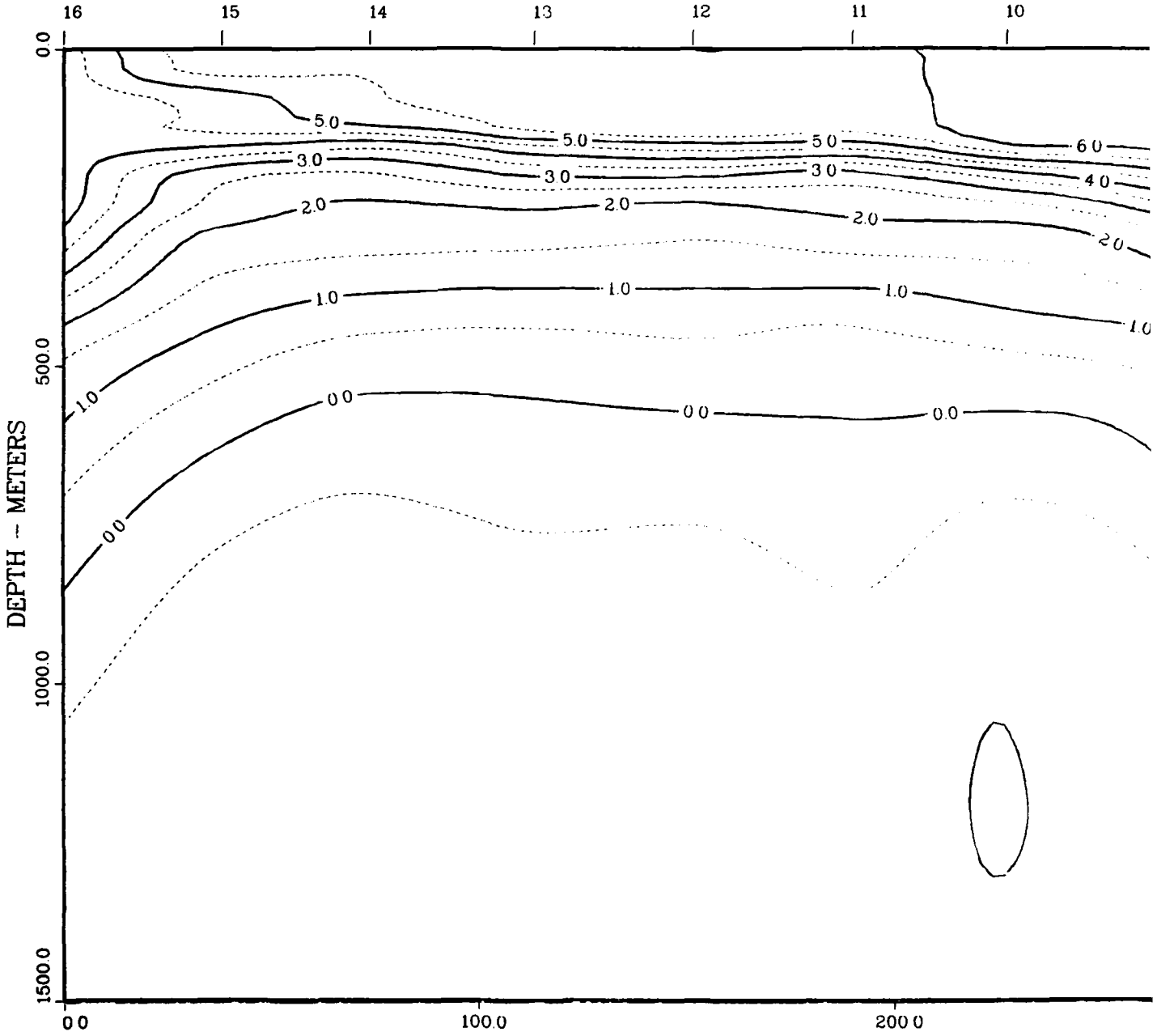
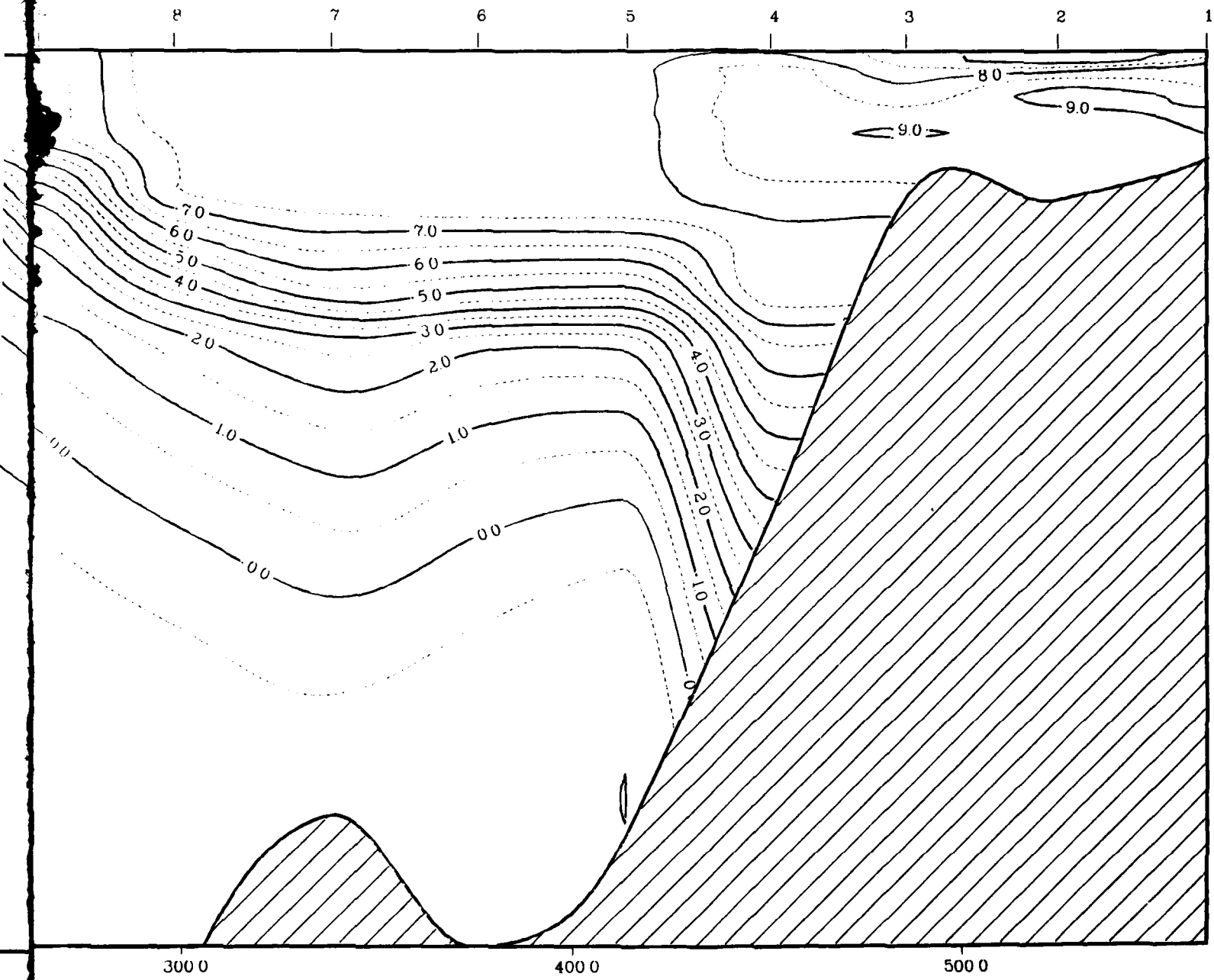


Figure 195. January 1959 temperature section.

JONEFJORD SECTION
ICHE = ICES$ 1959 DAT 1
MP TEMPERATURE



NCE - KILOMETERS

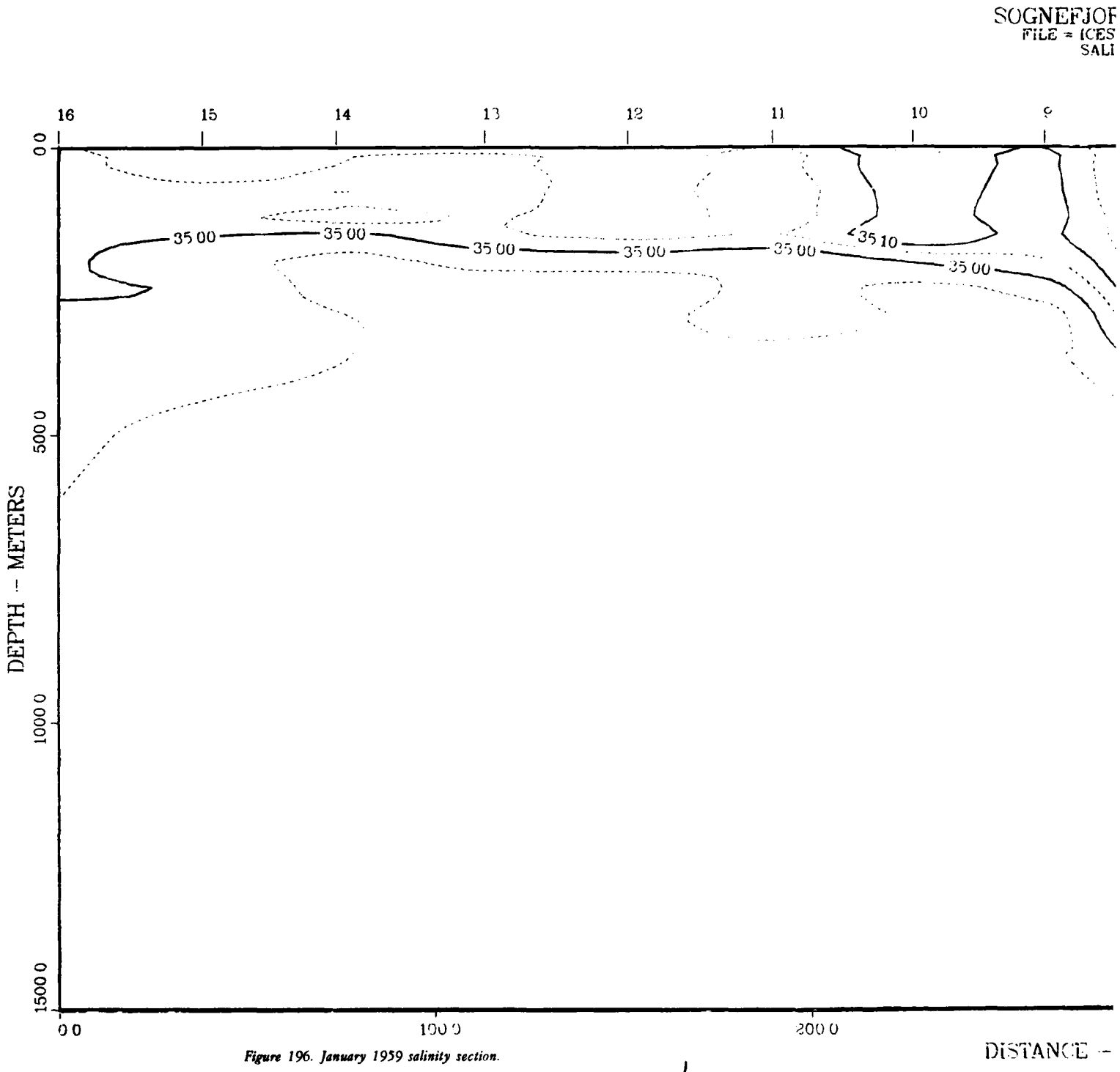
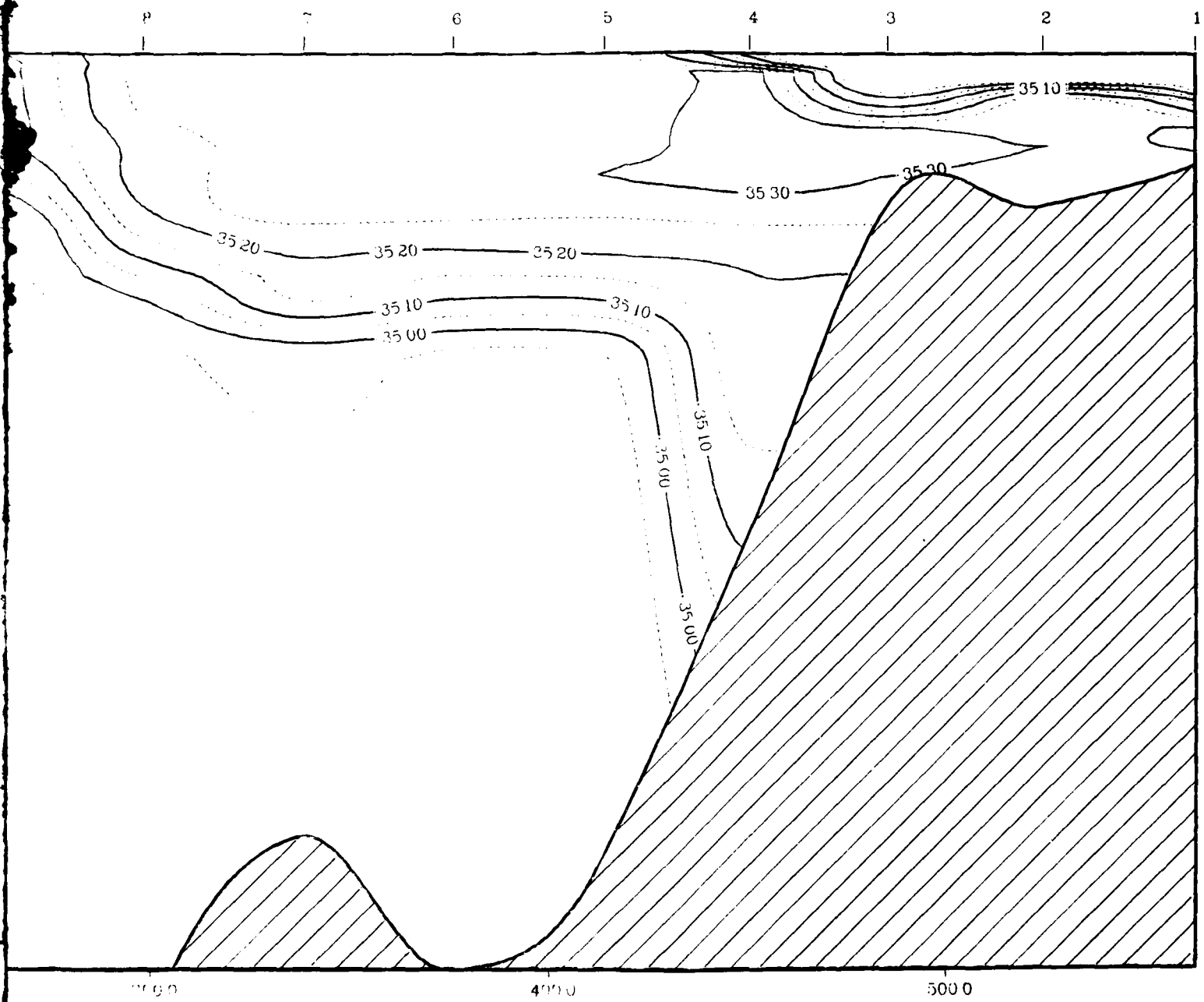


Figure 196. January 1959 salinity section.

EFJORD SECTION
= ICES# 1959 DAT 1
SALINITY



- KILOMETERS

2

ICES$:1960.DAT

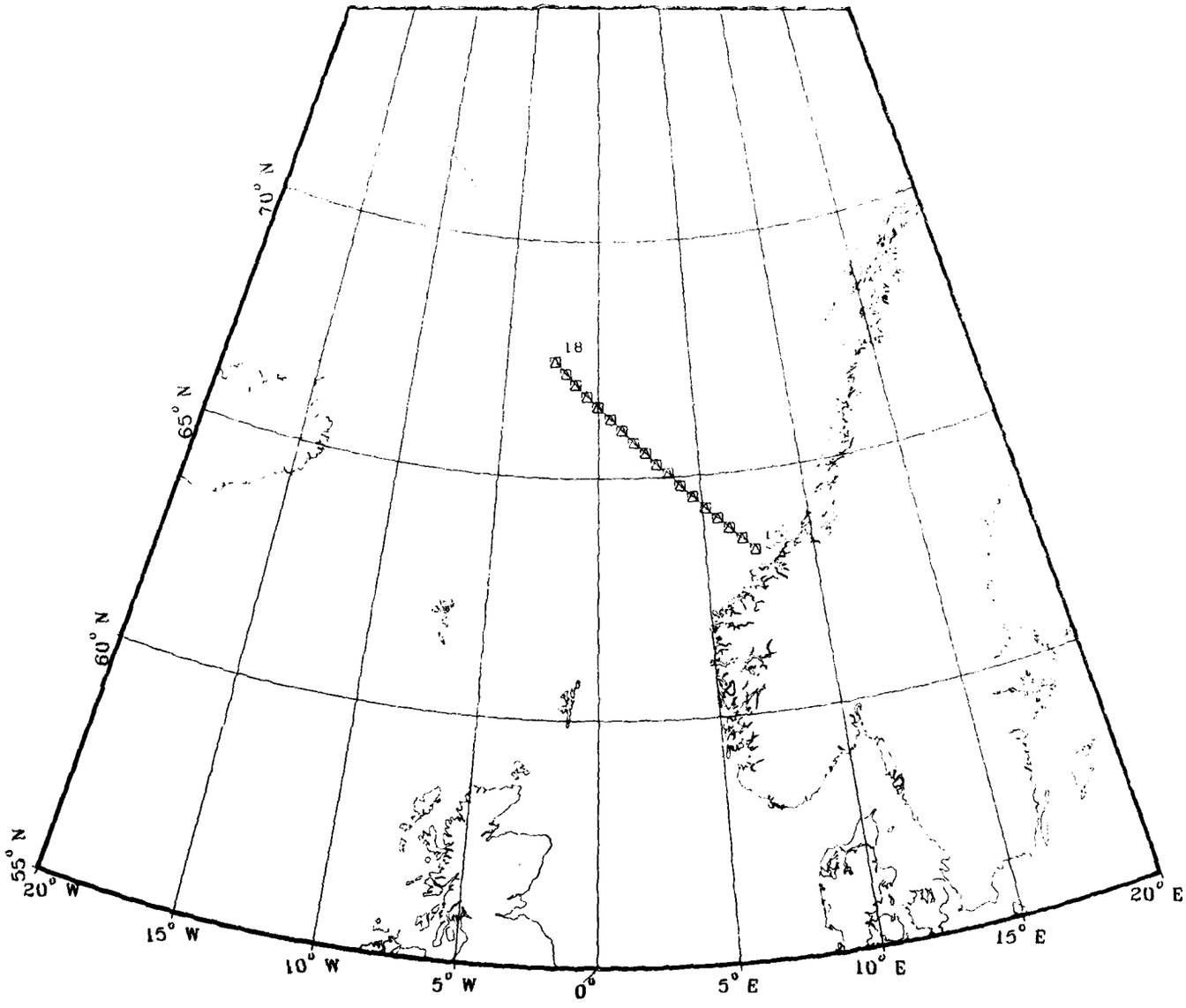


Figure 197. January 1960 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1960.DAT
T/S PLOT

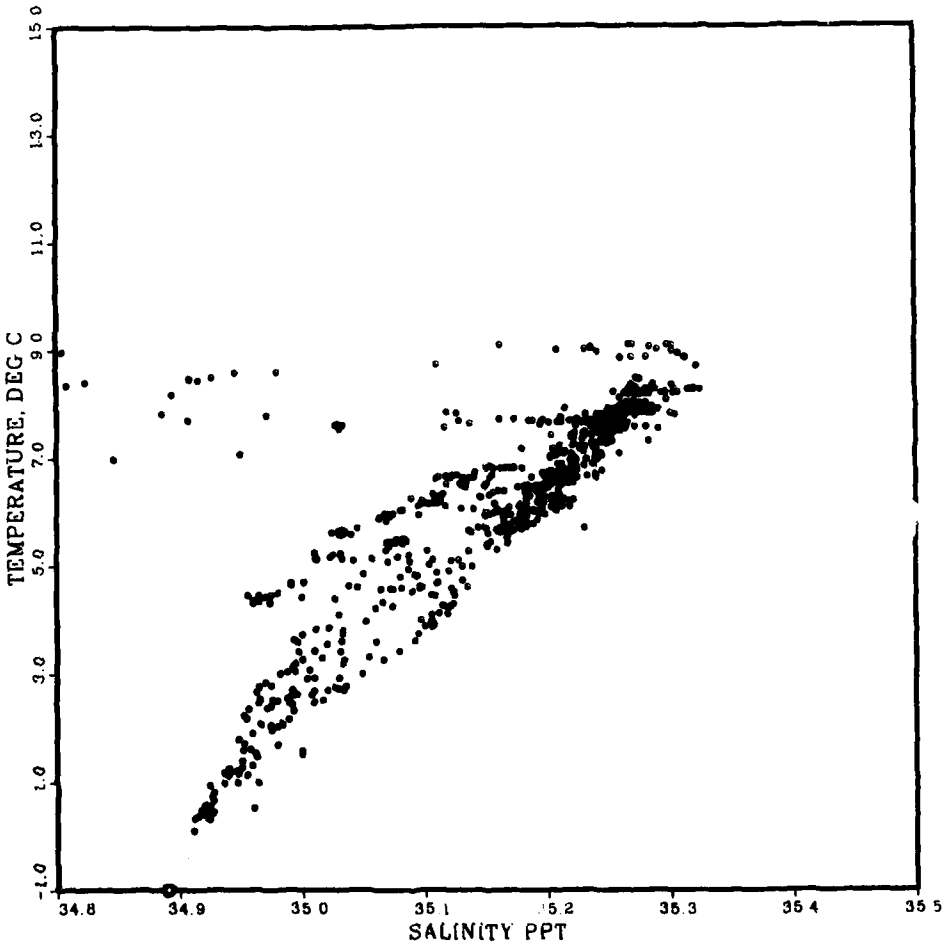


Figure 198. January 1960 temperature/salinity diagram.

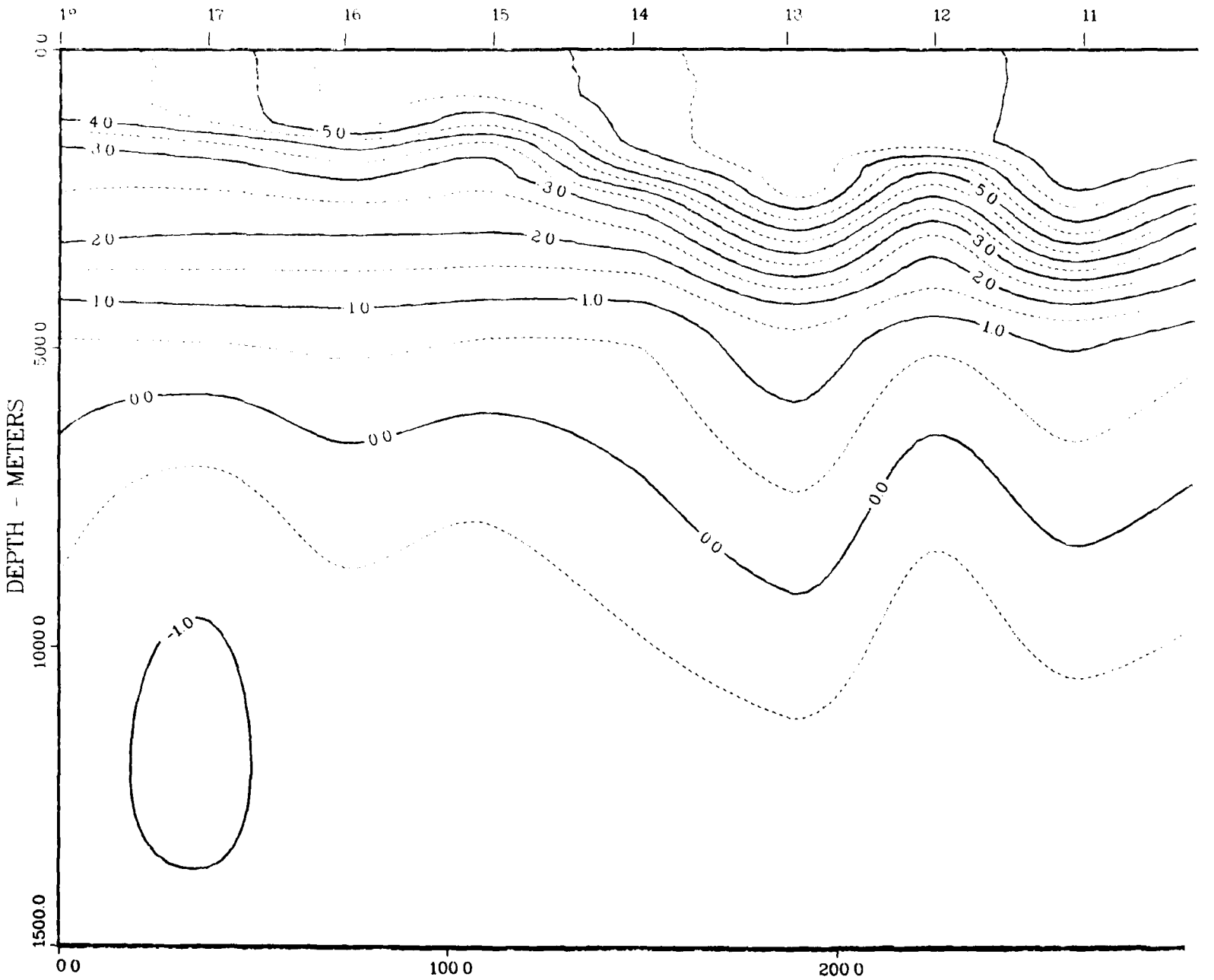
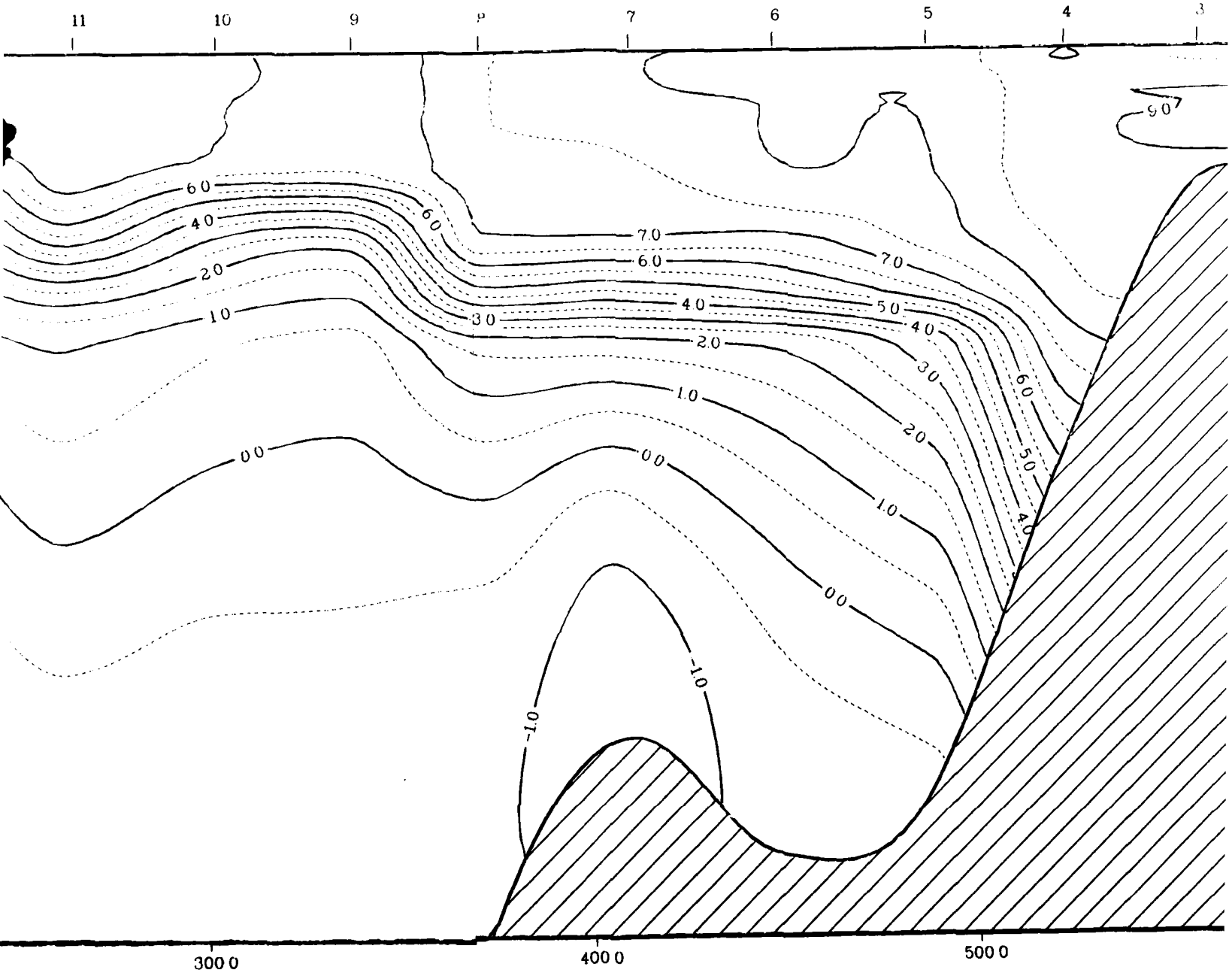
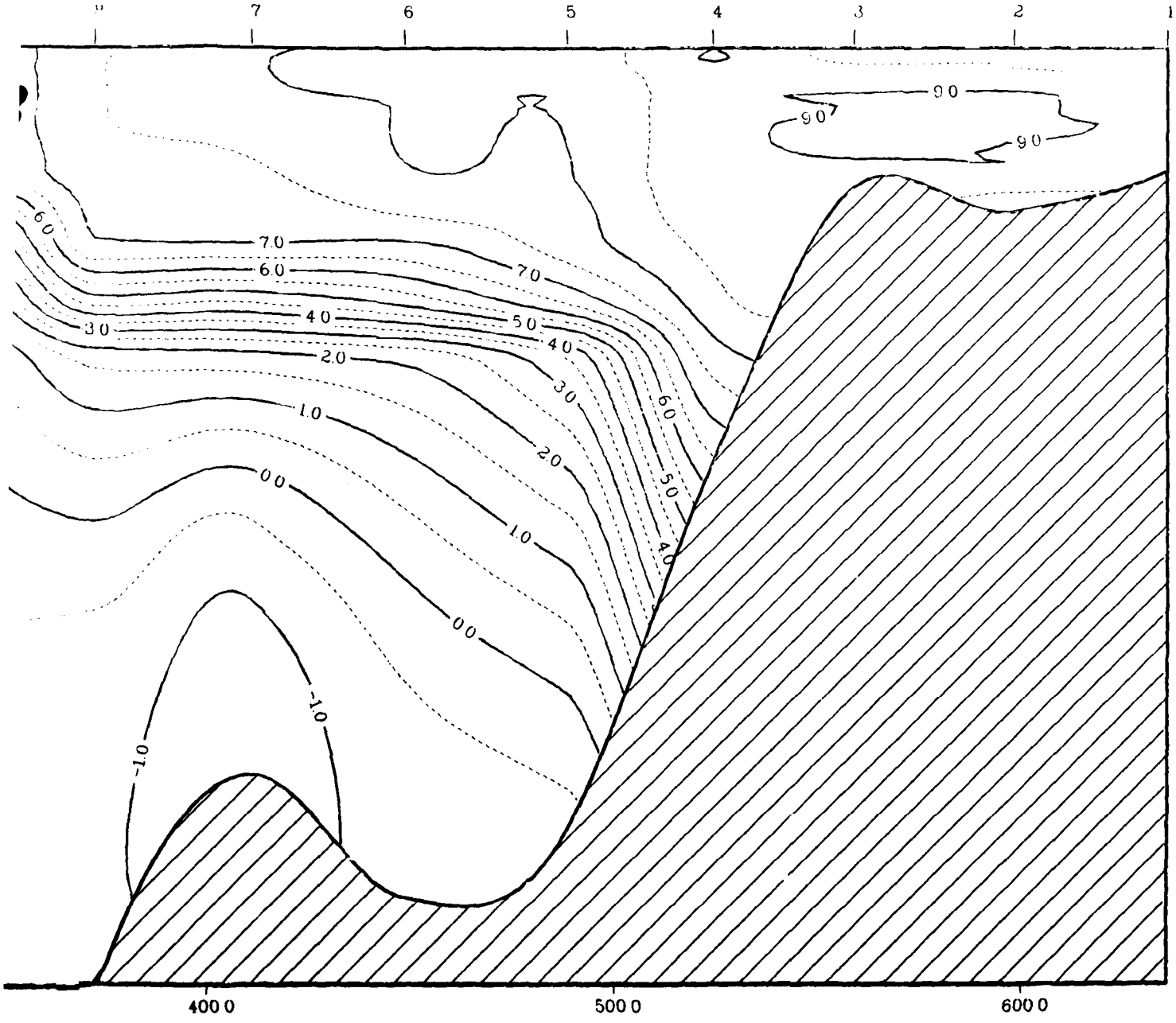


Figure 199. January 1960 temperature section.

SOGNEFJORD SECTION
FILE = ICES$ 1960 DAT 1
TEMPERATURE



2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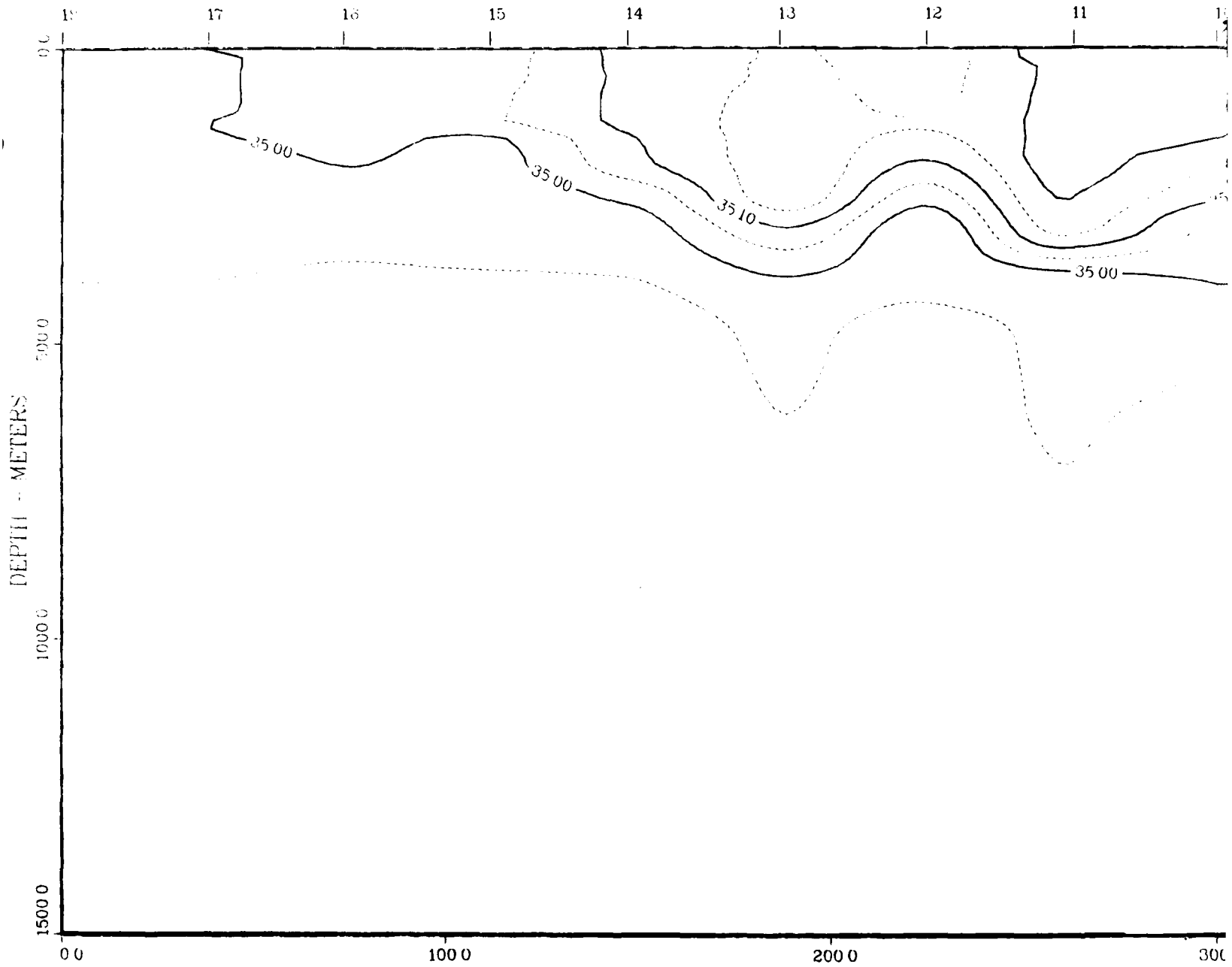
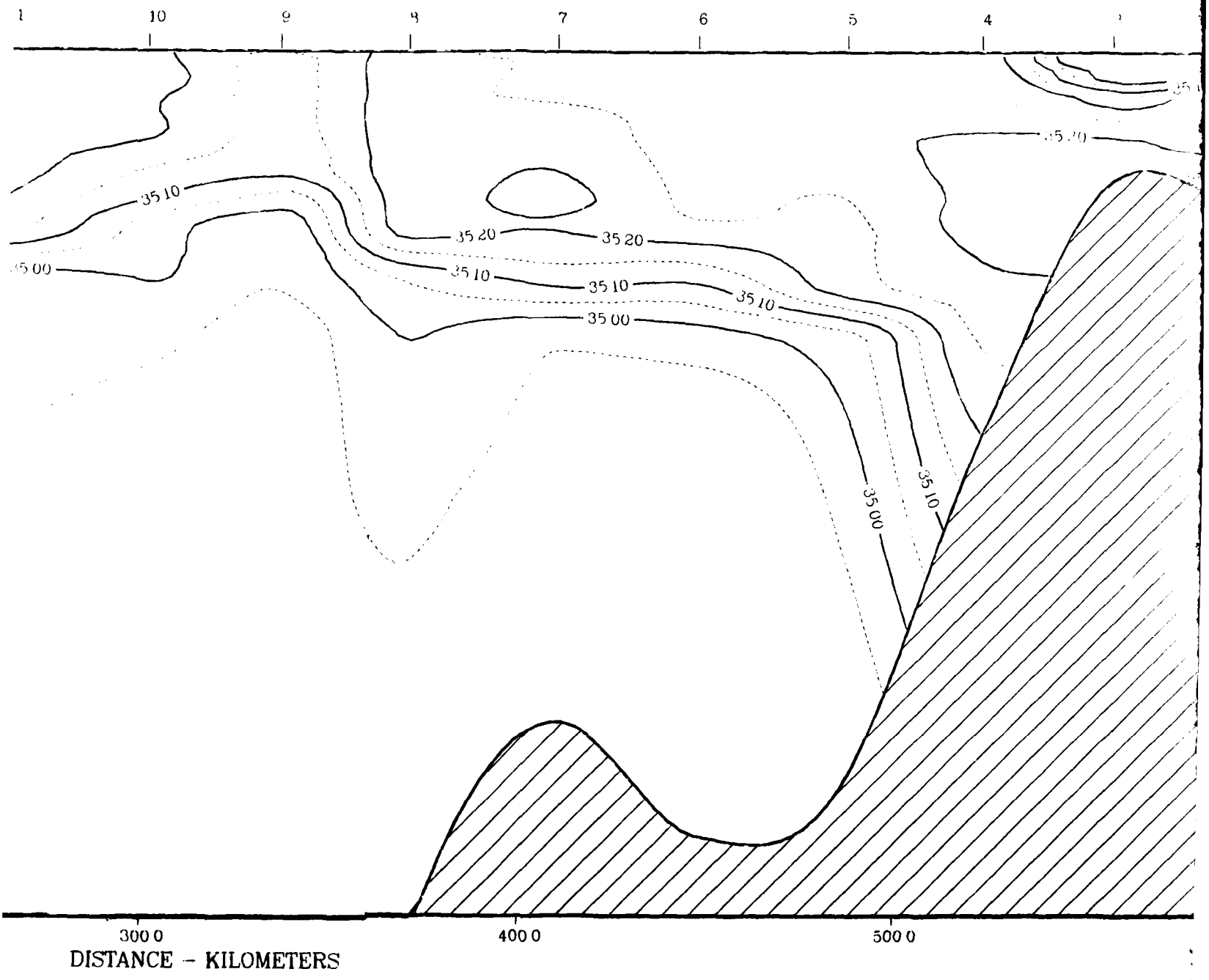
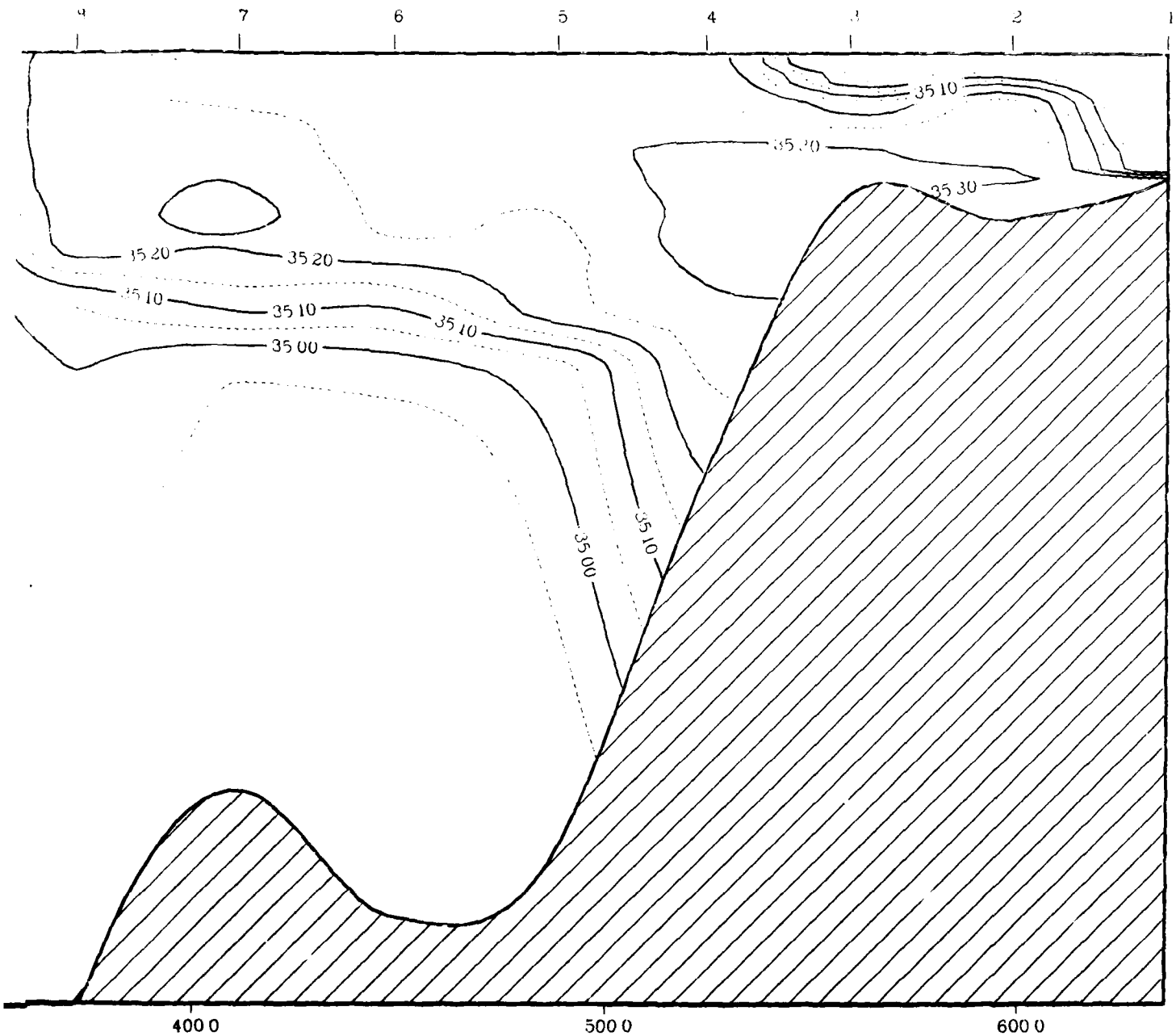


Figure 200. January 1960 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1960 DAT 1
SALINITY

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600 0

ICES$:1961.DAT

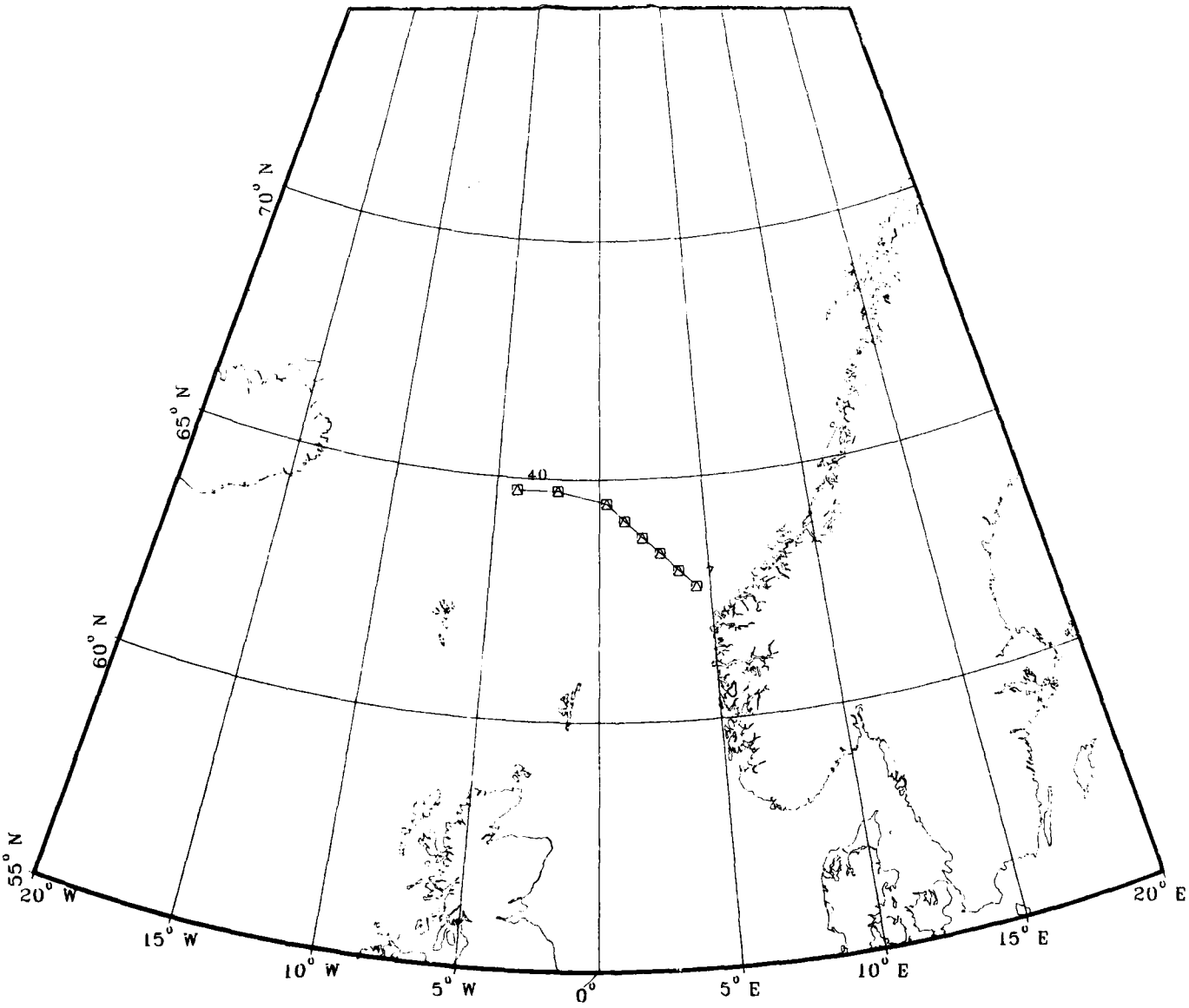


Figure 201. January 1961 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1961.DAT
T/S PLOT

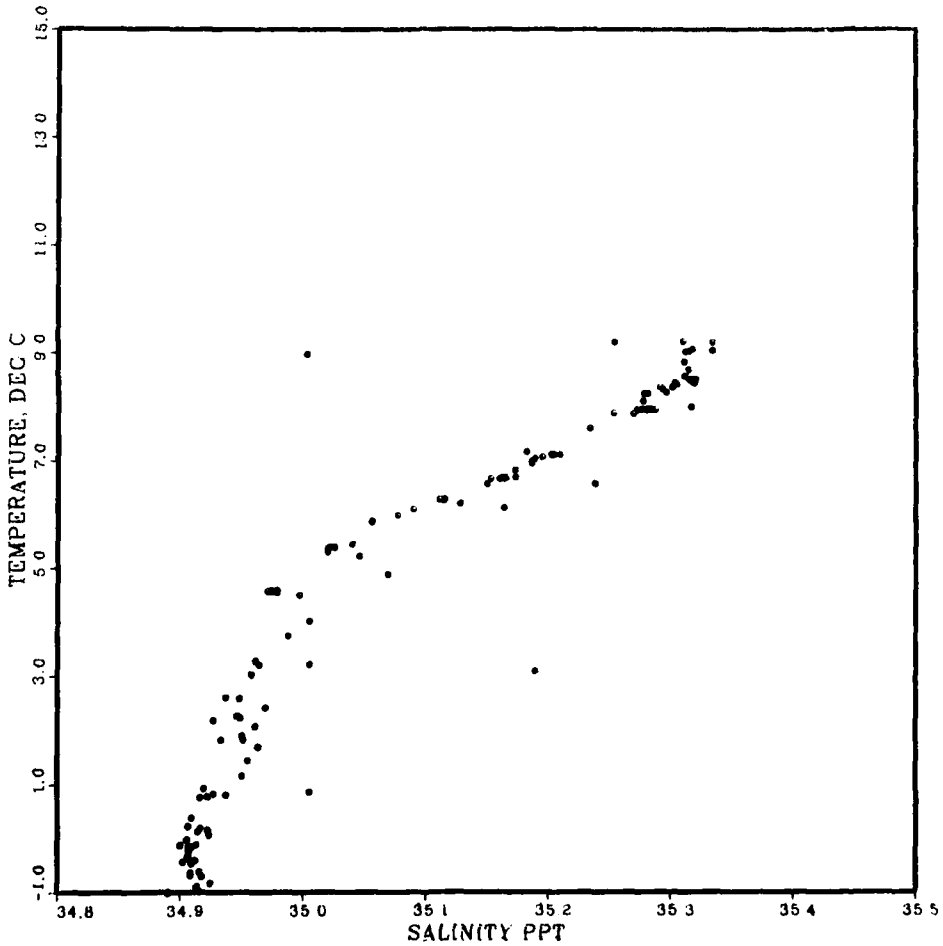


Figure 202. January 1961 temperature/salinity diagram.

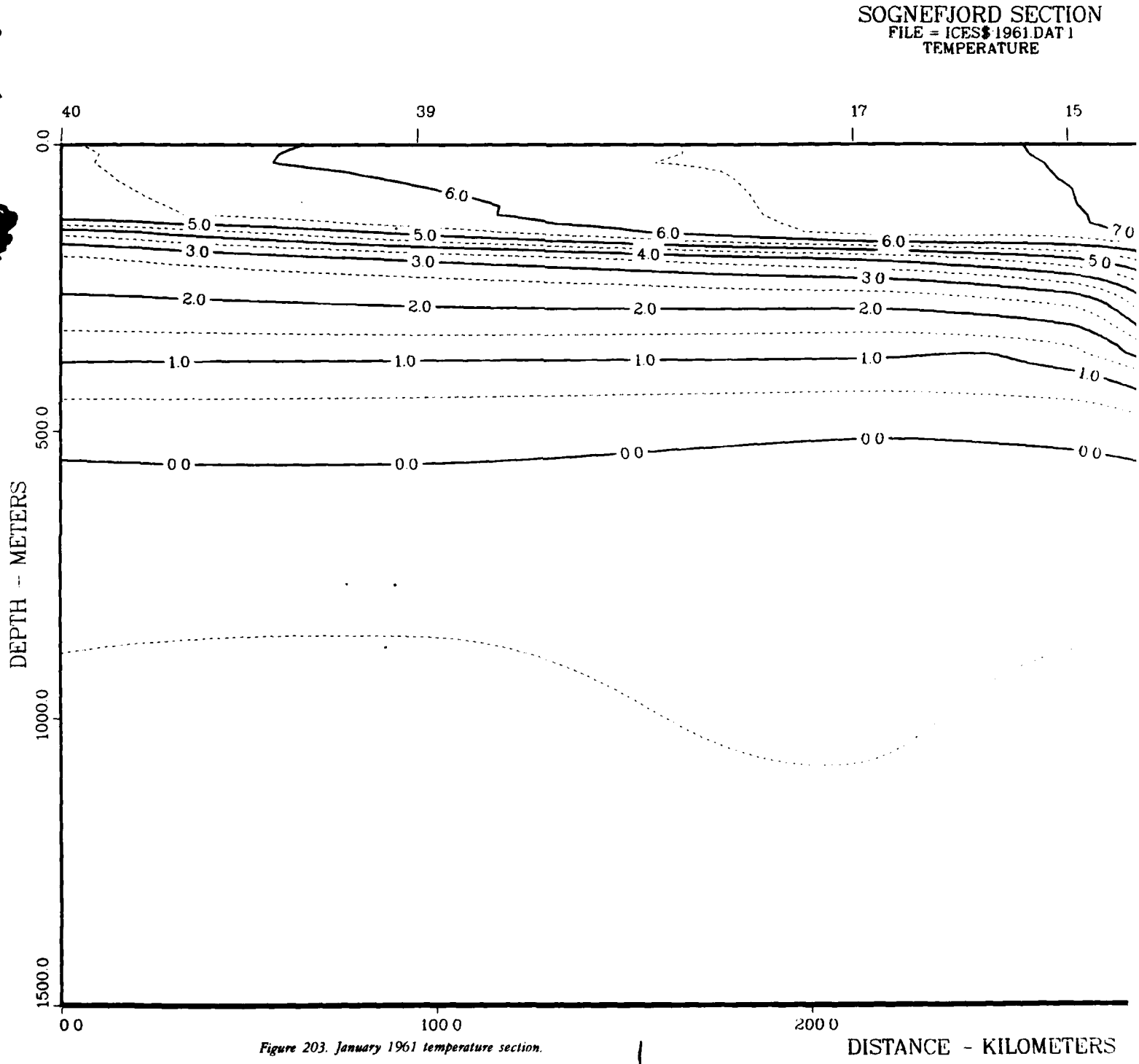
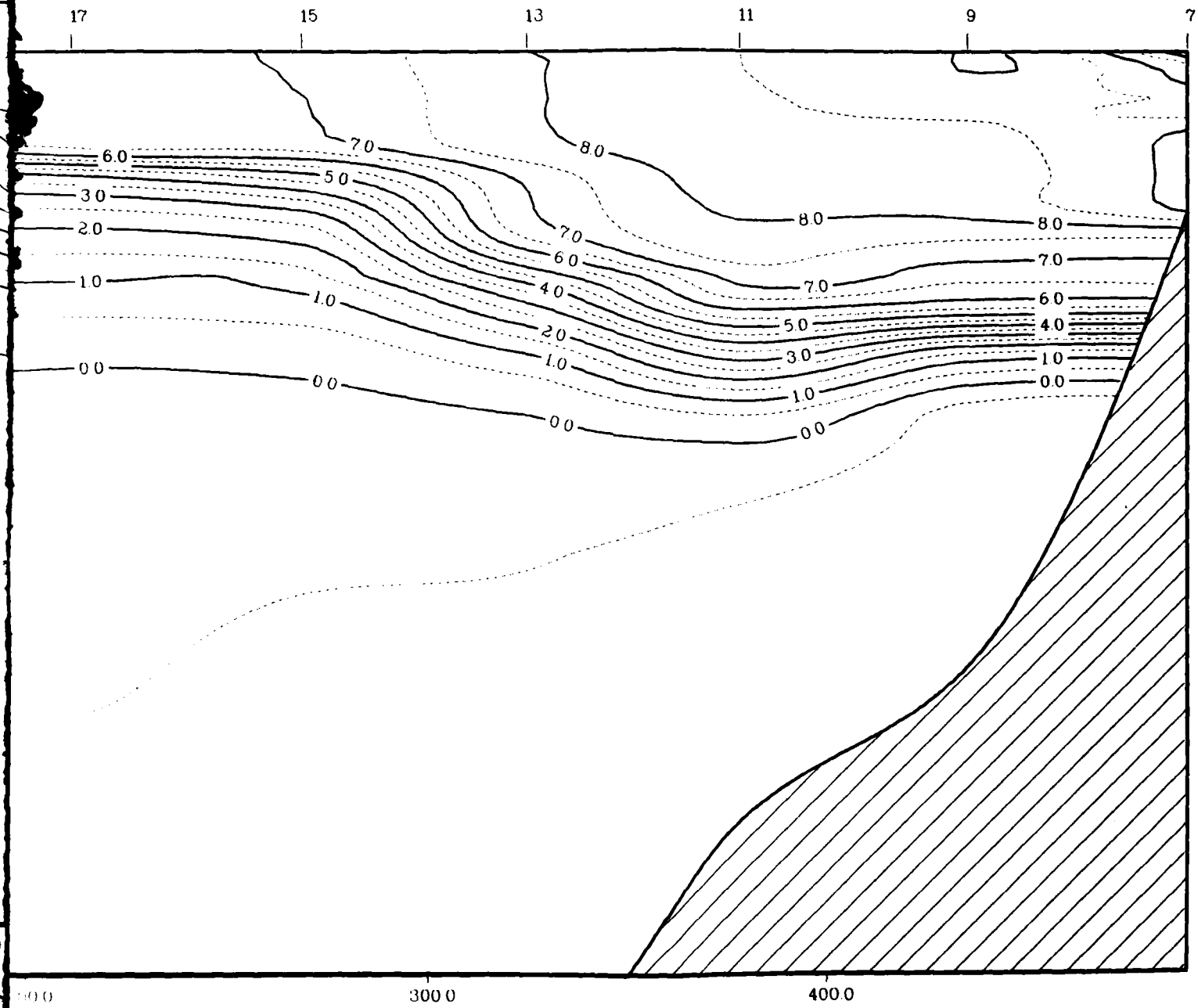


Figure 203. January 1961 temperature section.

SOGNEFJORD SECTION
FILE = ICES$:1961.DAT:1
TEMPERATURE



DISTANCE - KILOMETERS

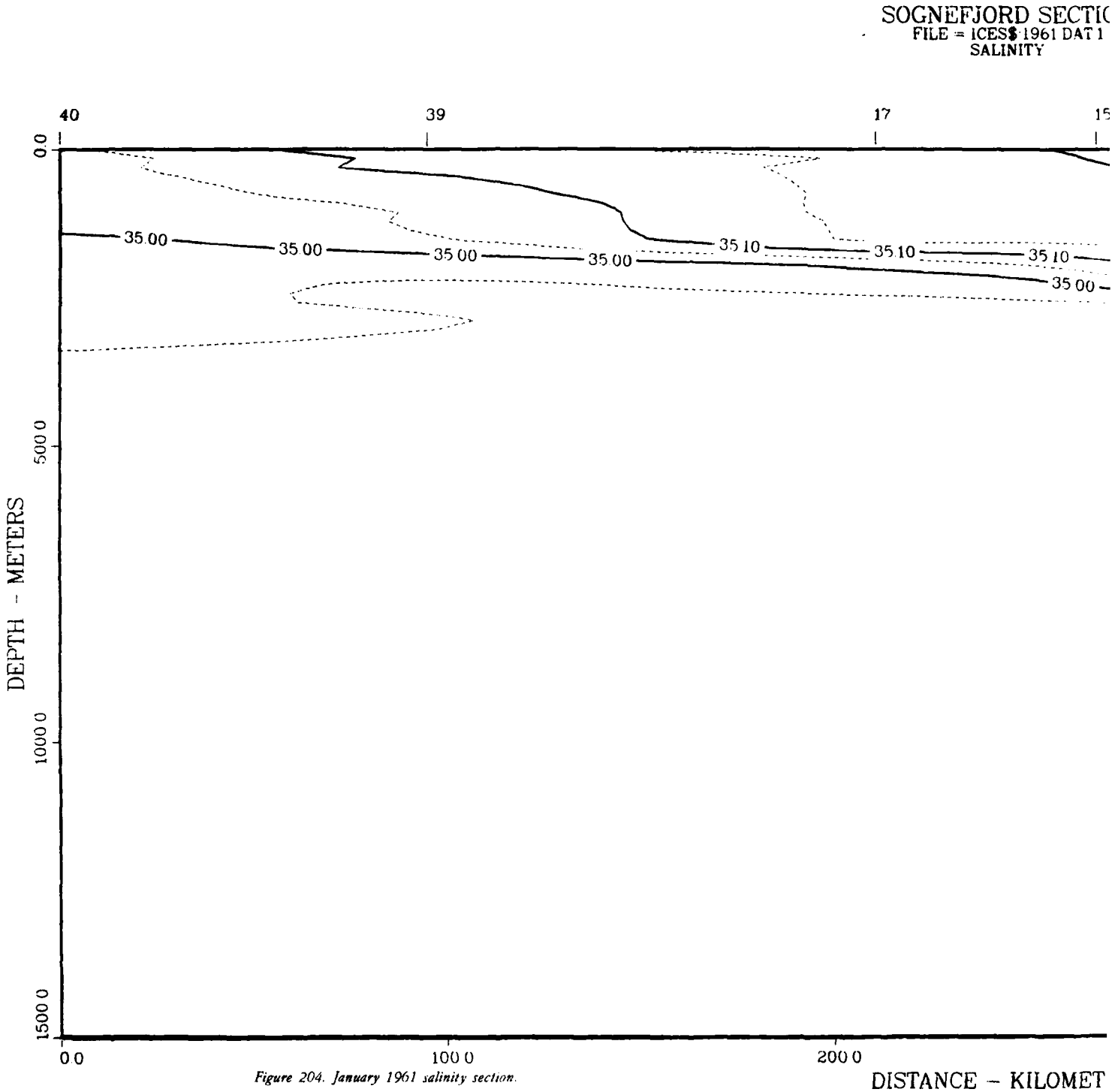
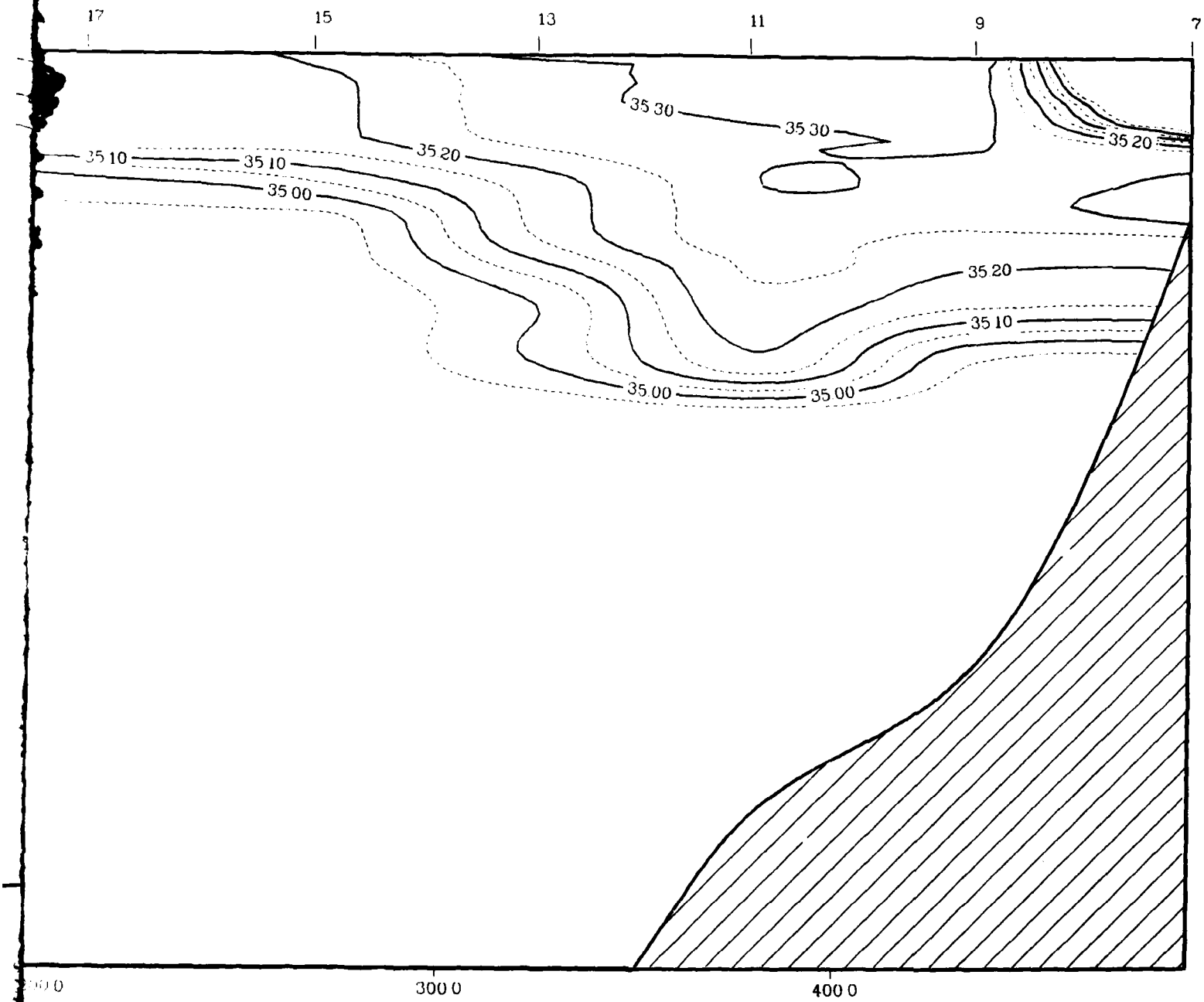


Figure 204. January 1961 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1961 DAT 1
SALINITY



DISTANCE – KILOMETERS

ICES$:1962.DAT

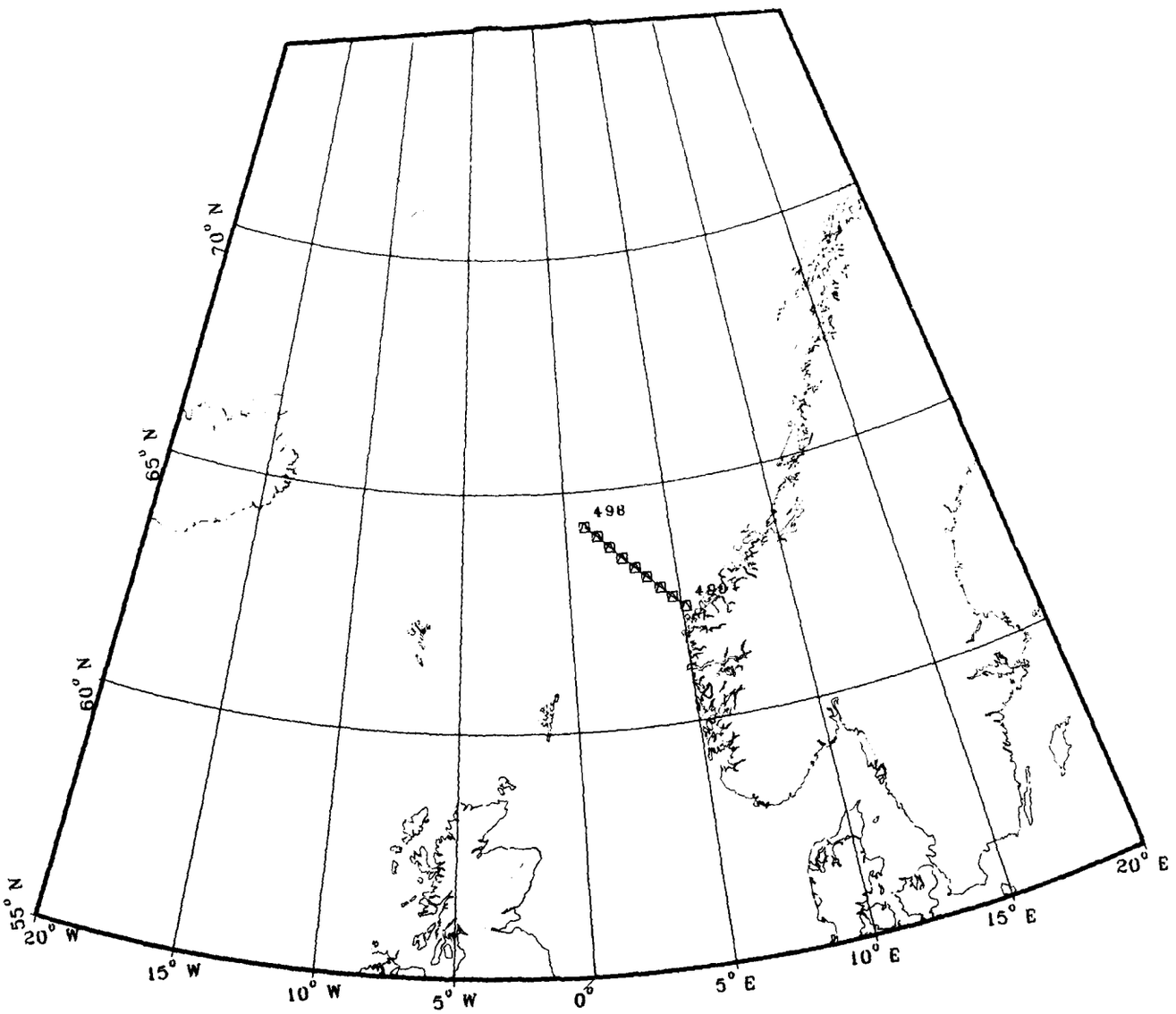


Figure 205. January 1962 station positions.

SOGNEFJORD SECTION
FILE = ICES$:1962.DAT
T/S PLOT

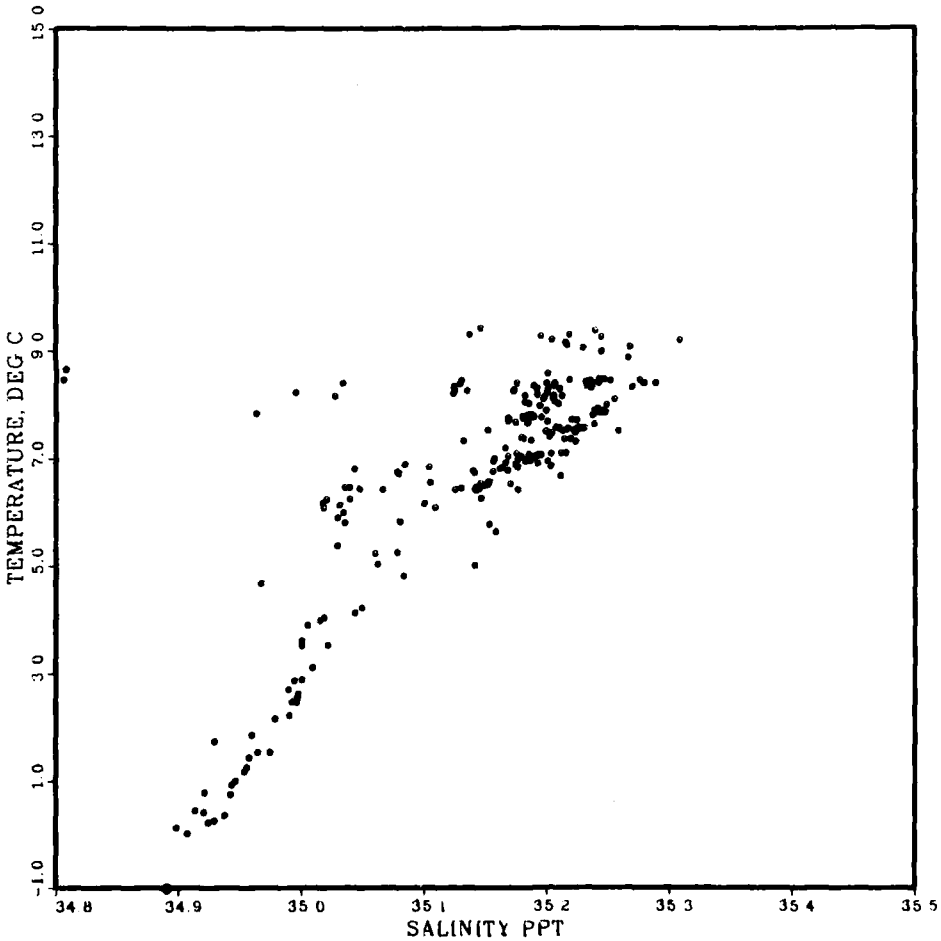


Figure 206. January 1962 temperature/salinity diagram

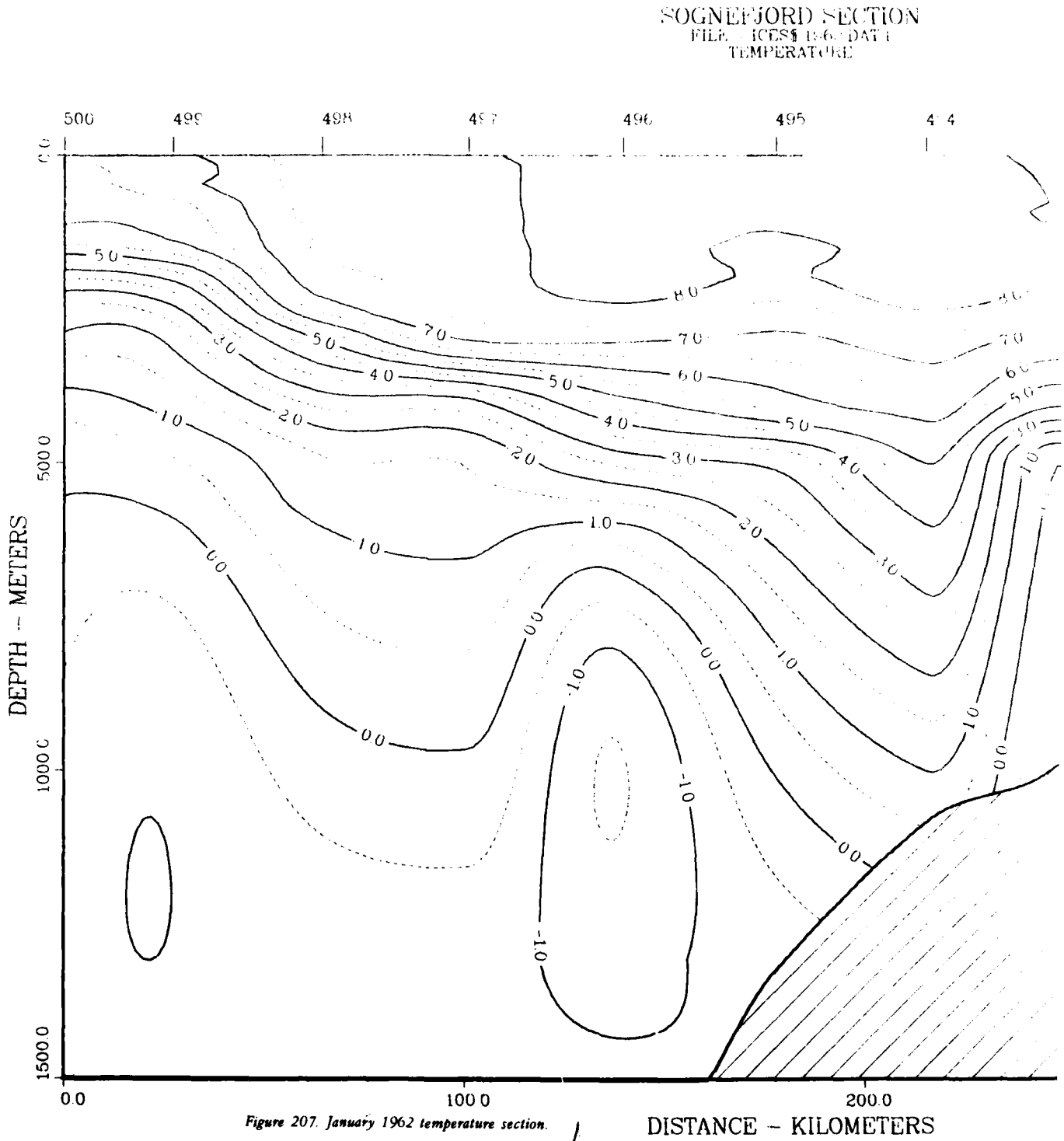
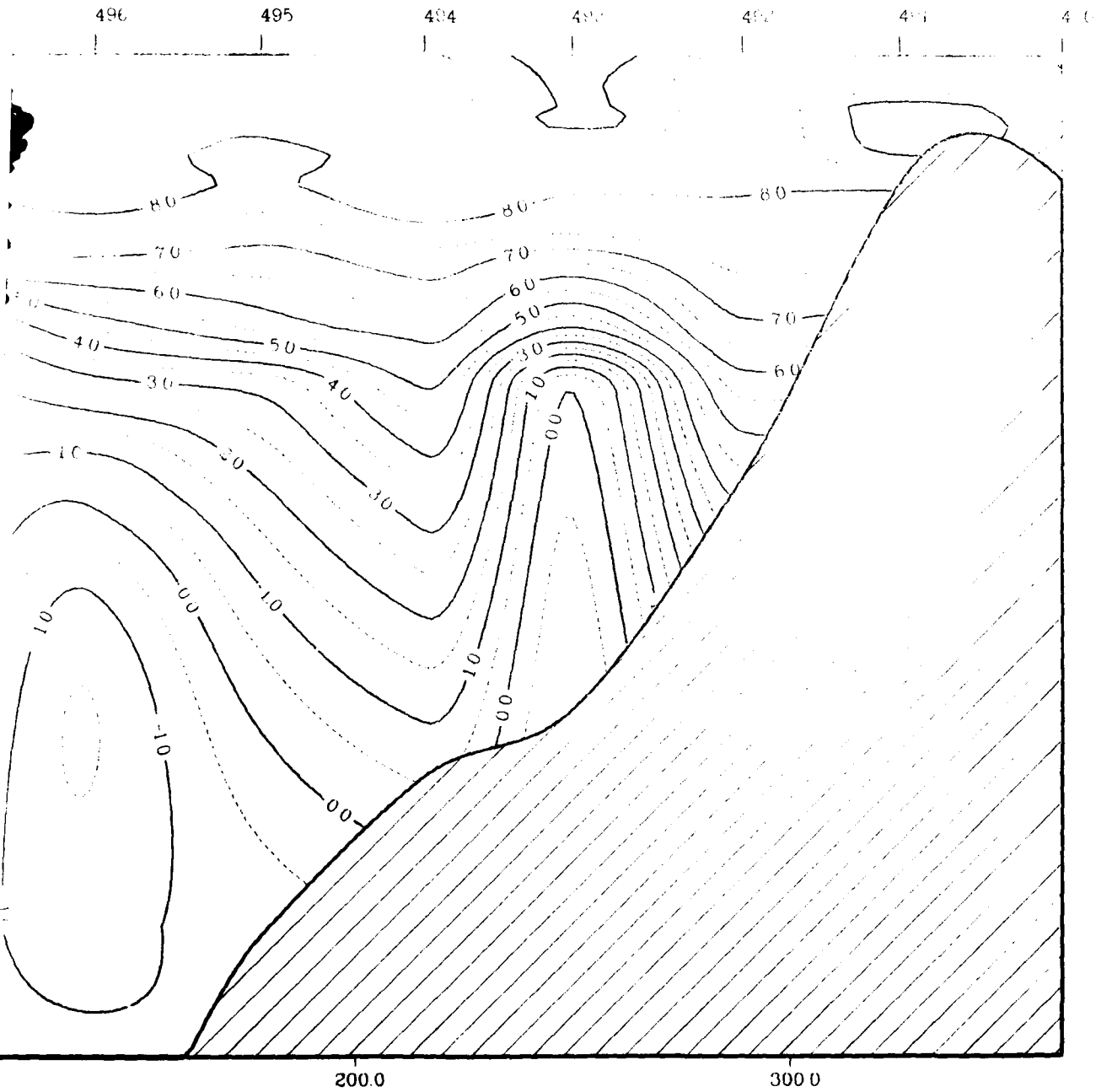


Figure 207. January 1962 temperature section.

SOGNEFJORD SECTION
FILE = ICES$ 1962 DAT 1
TEMPERATURE



DISTANCE – KILOMETERS

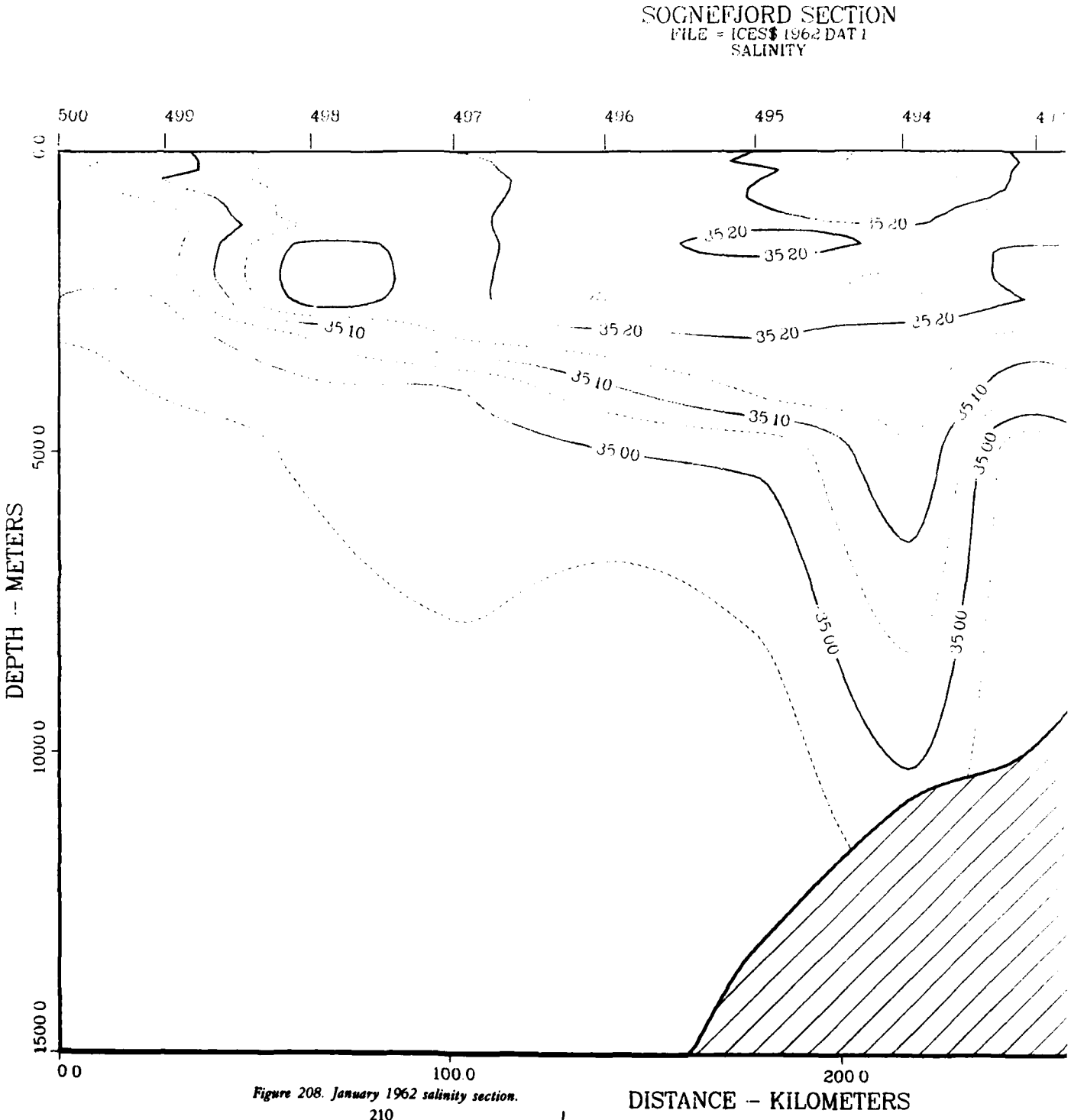
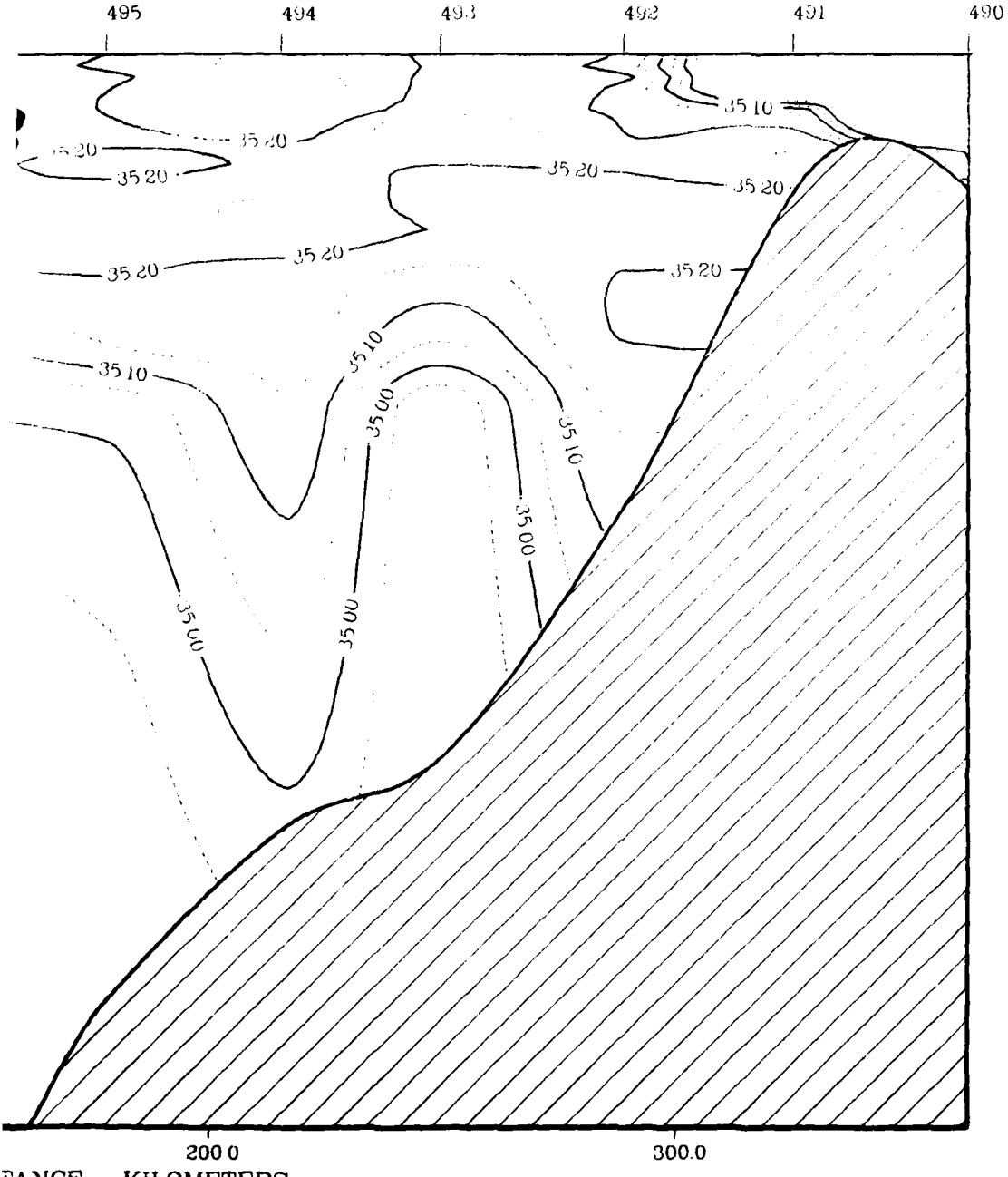


Figure 208. January 1962 salinity section.

NEFJORD SECTION
ILE = ICES$ 1962 DAT 1
SALINITY



TANCE – KILOMETERS

ICES$:1967GOS.DAT

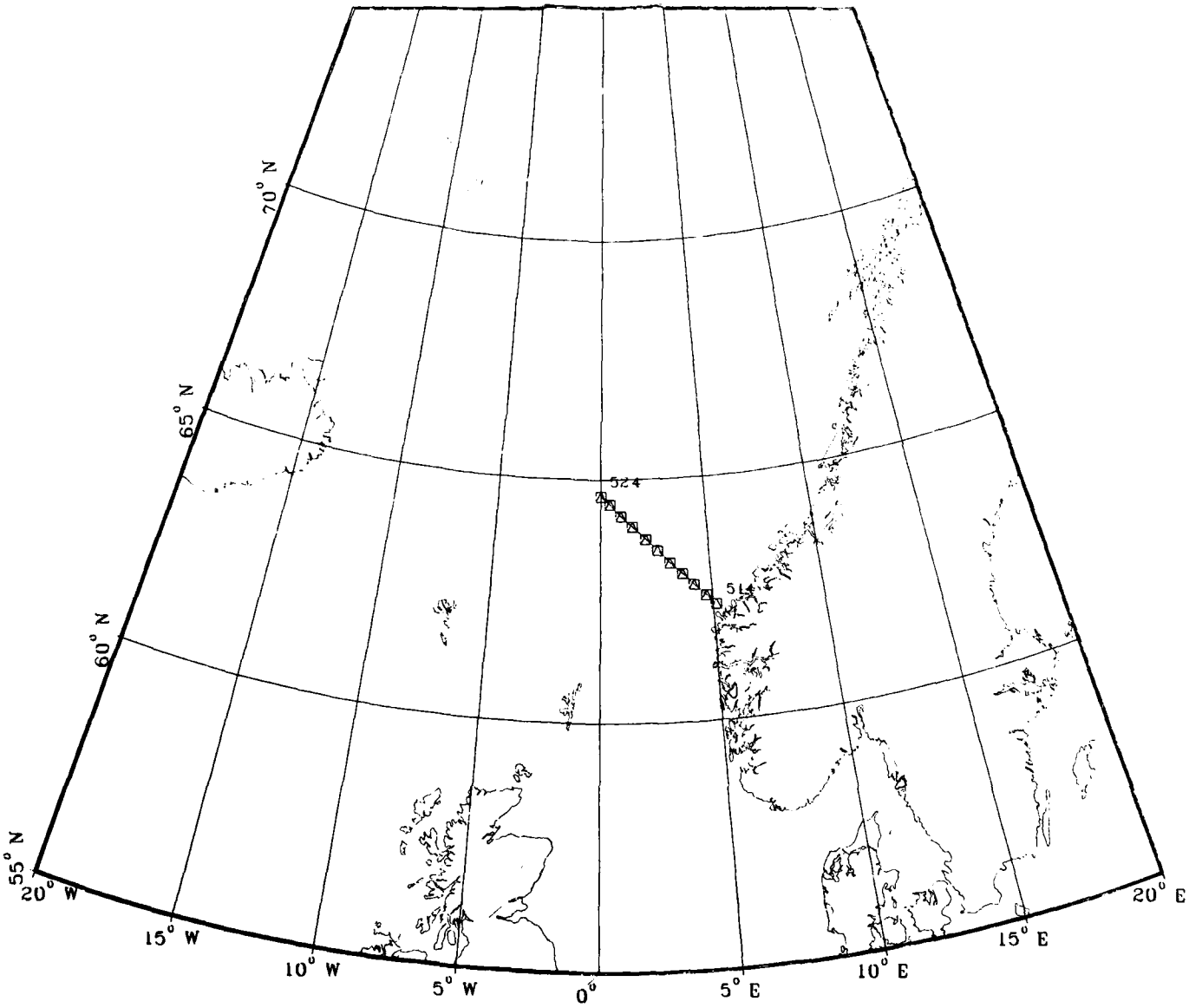


Figure 209. November 1967 (G.O. SARS) station positions.

SOGNEFJORD SECTION
FILE = ICES$:1967GOS.DAT
T/S PLOT

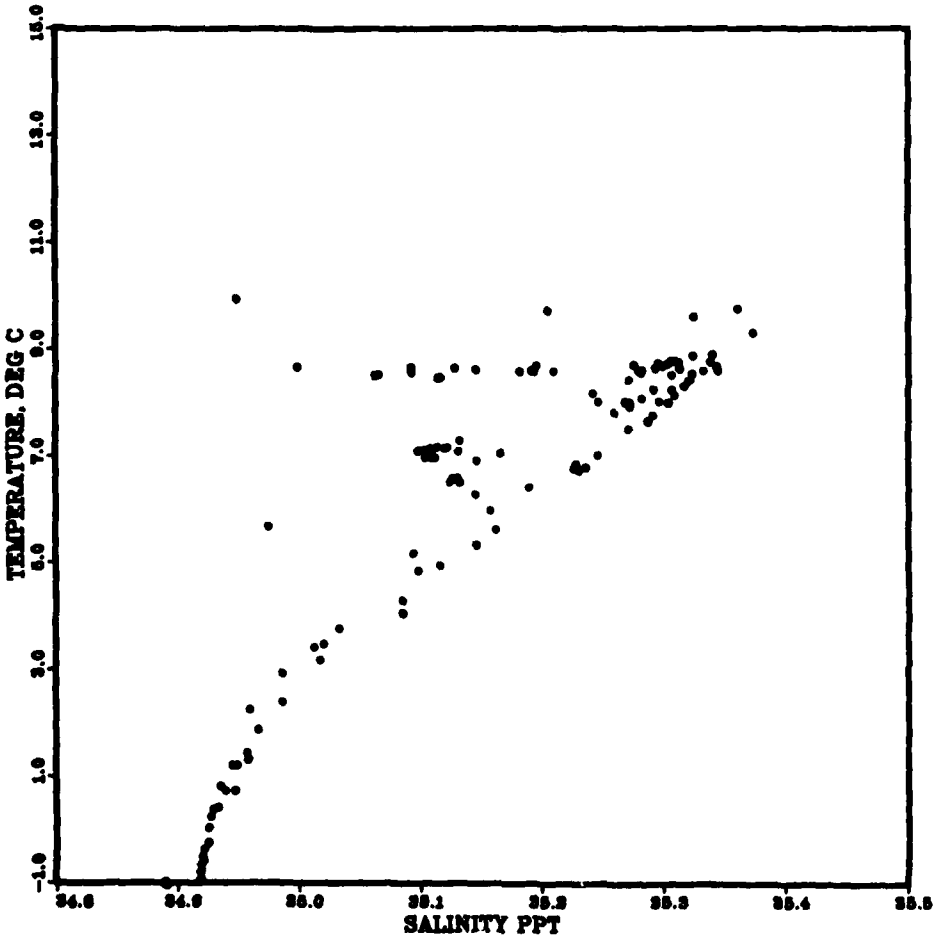


Figure 210. November 1967 (G.O. SARS) temperature/salinity diagram.

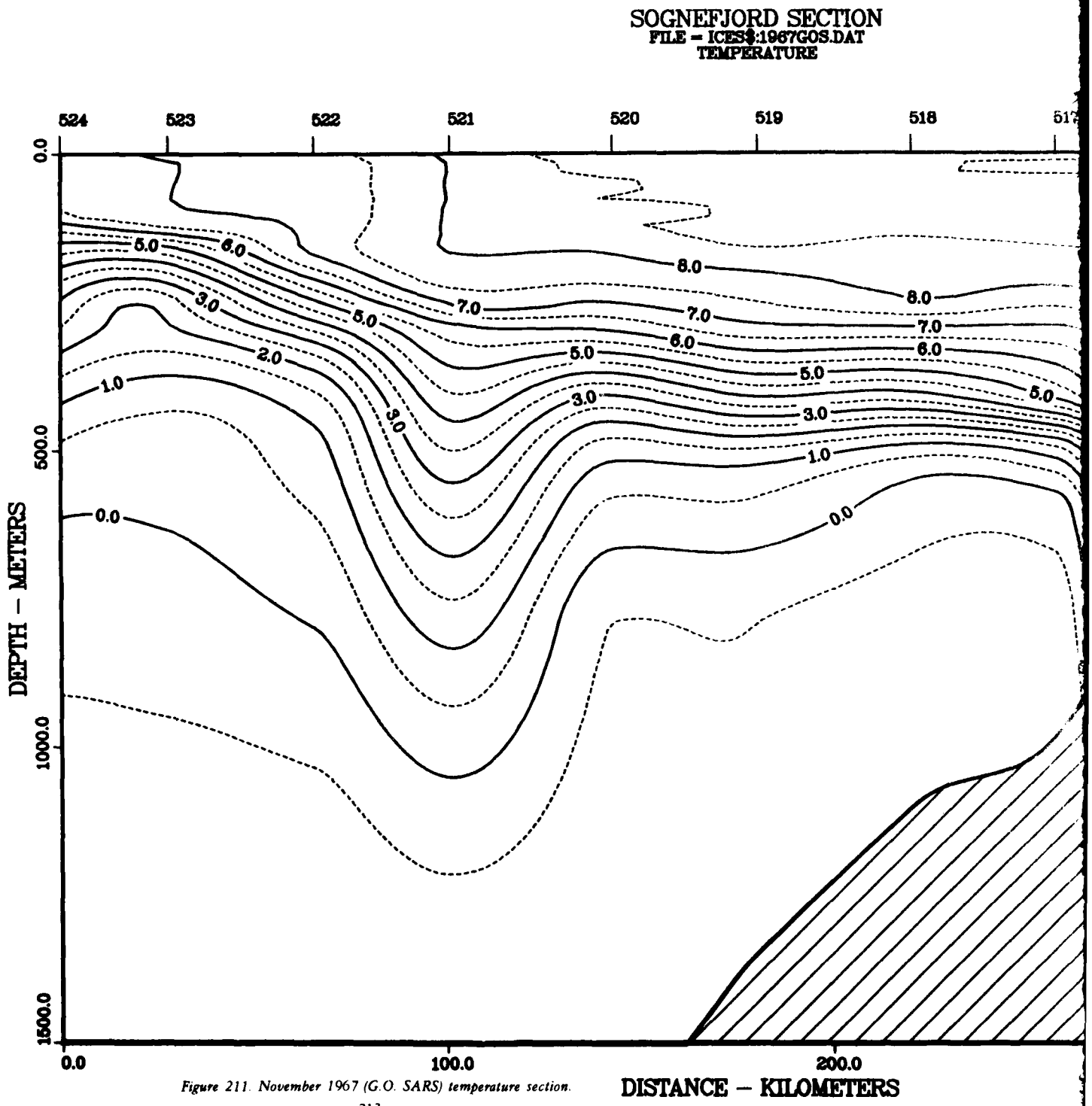
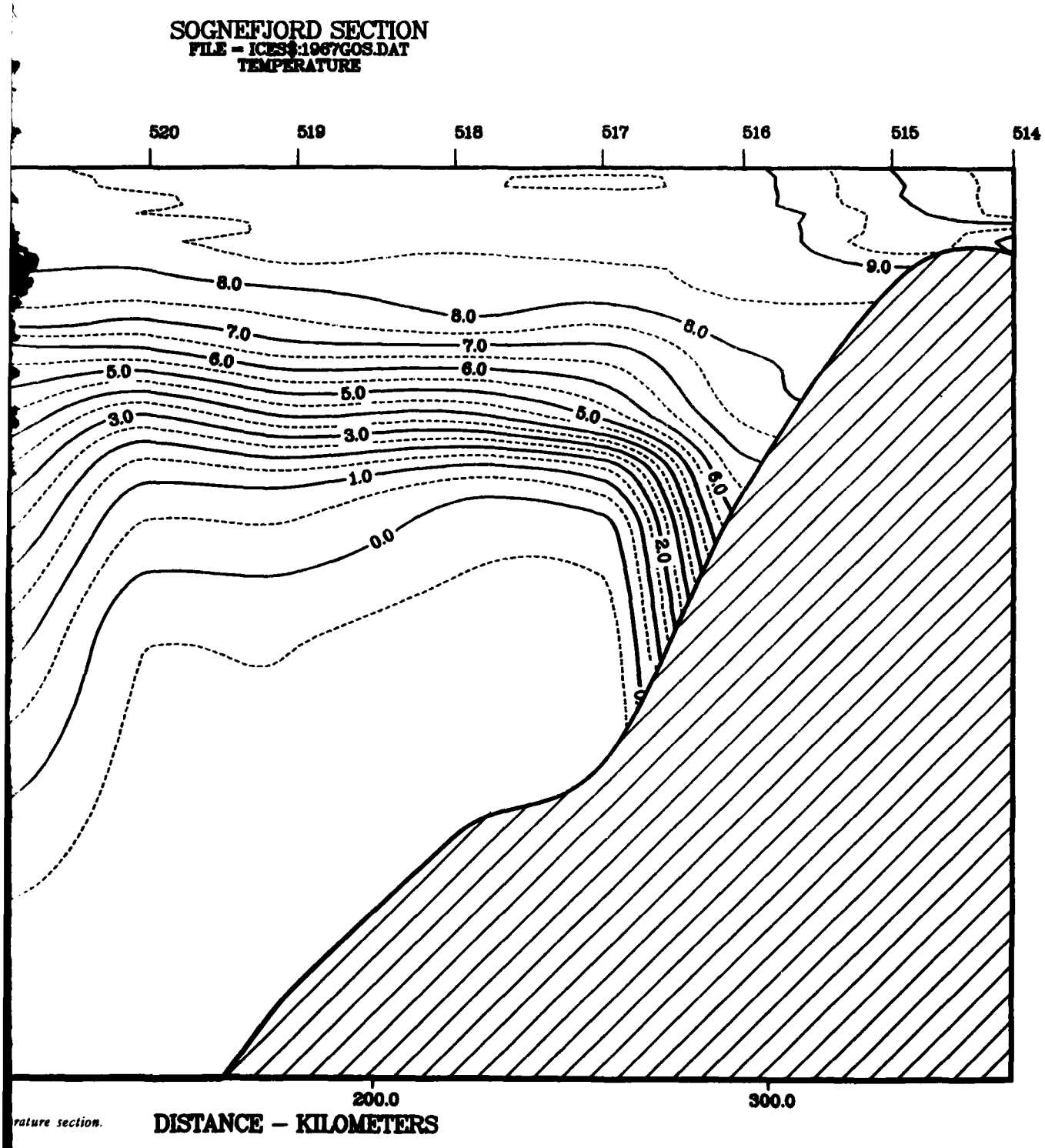


Figure 211. November 1967 (G.O. SARS) temperature section.



rature section.

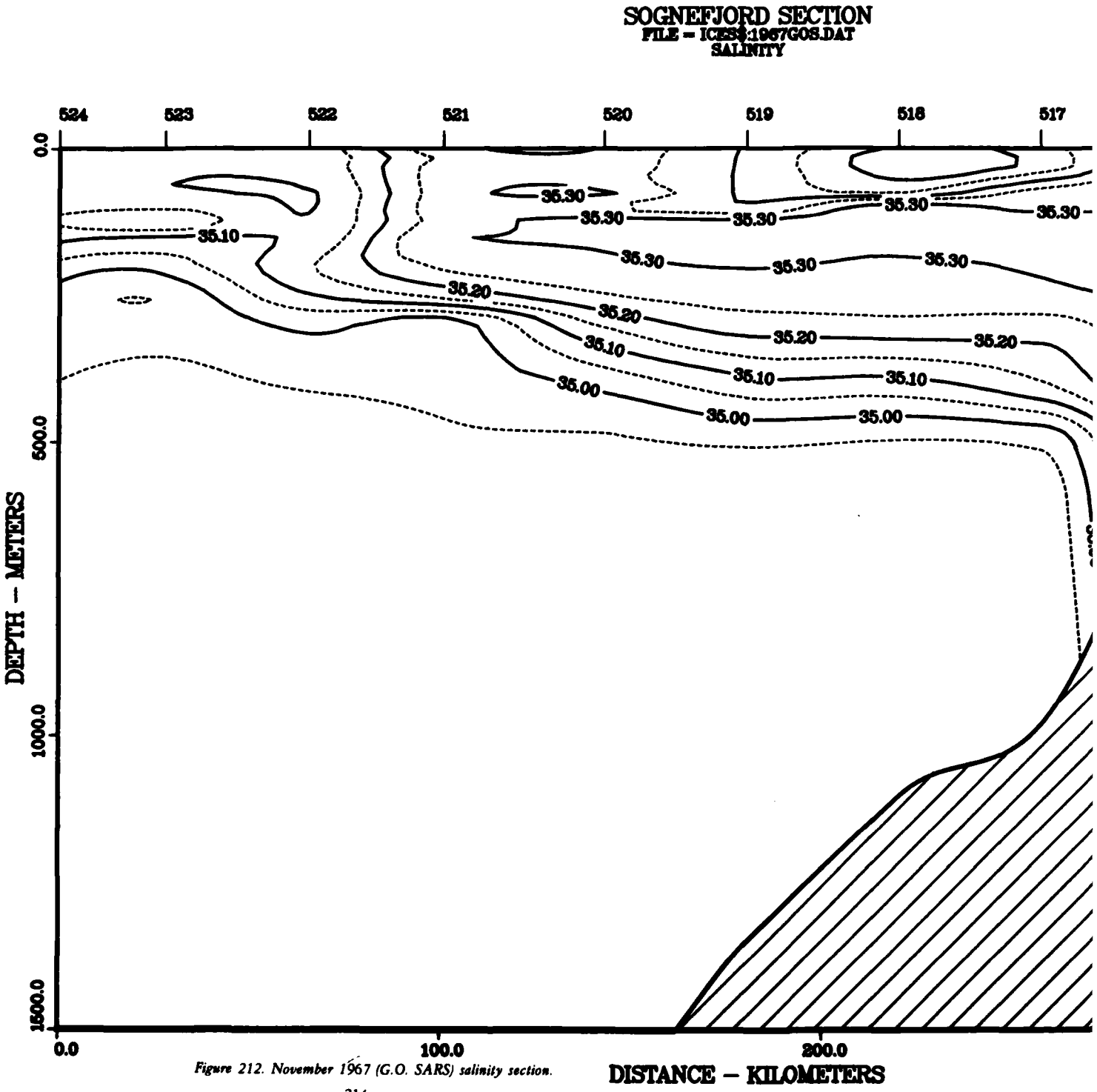
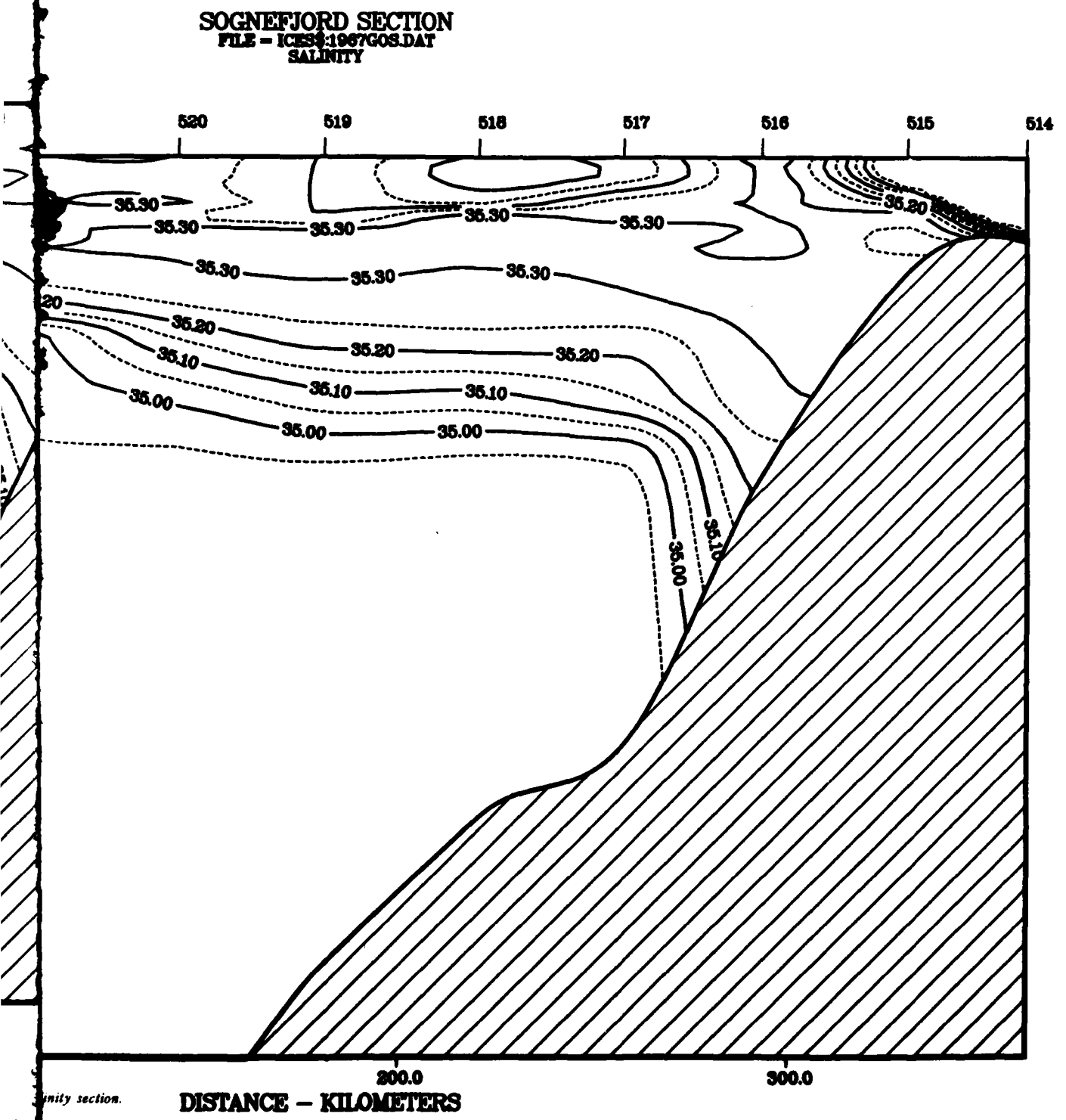


Figure 212. November 1967 (G.O. SARS) salinity section.



nity section.

ICES$:1967JH.DAT

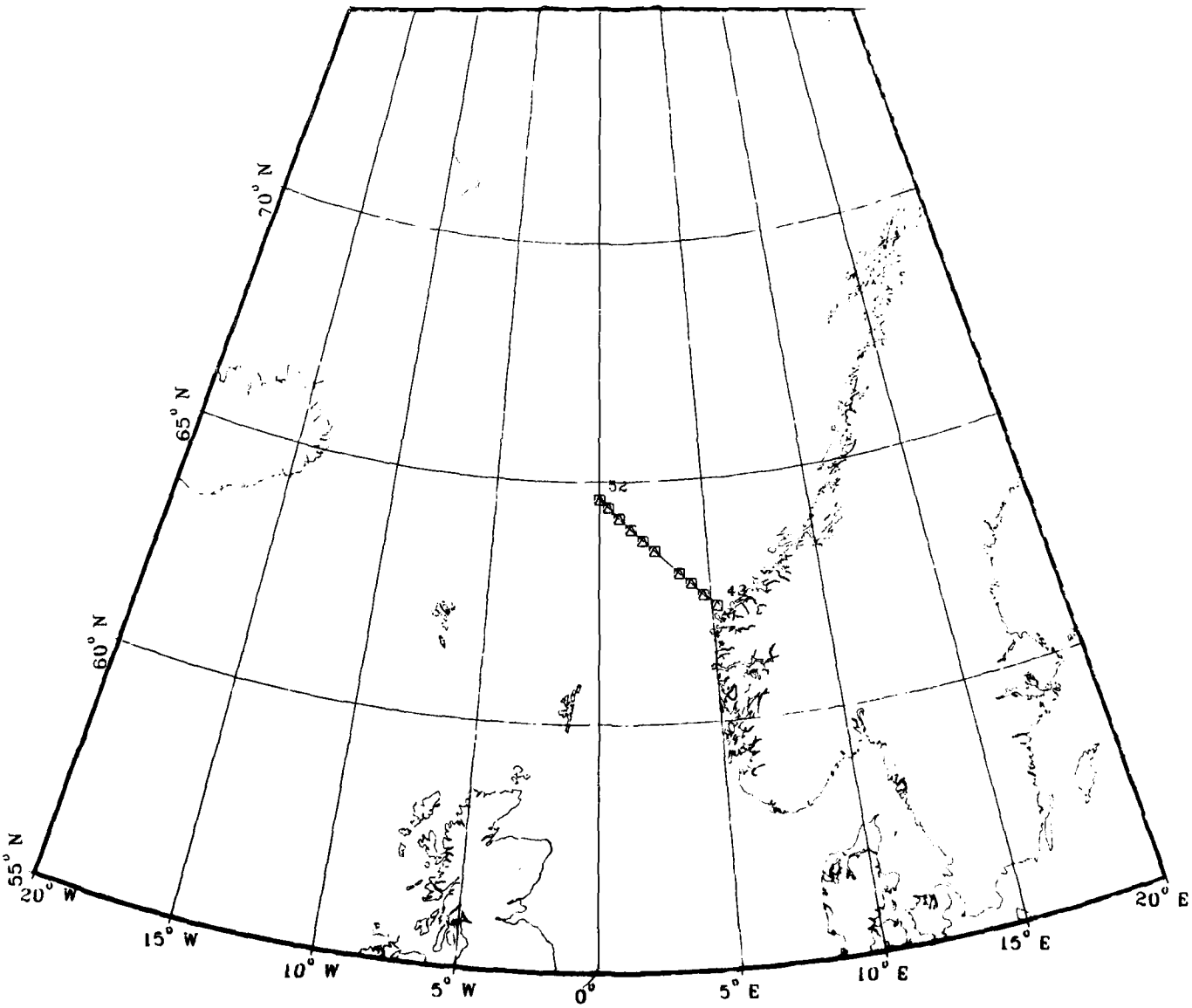


Figure 213. November 1967 (J. HJORT) station positions.

# SOGNEFJORD SECTION
FILE = ICES$:1967JH.DAT
T/S PLOT

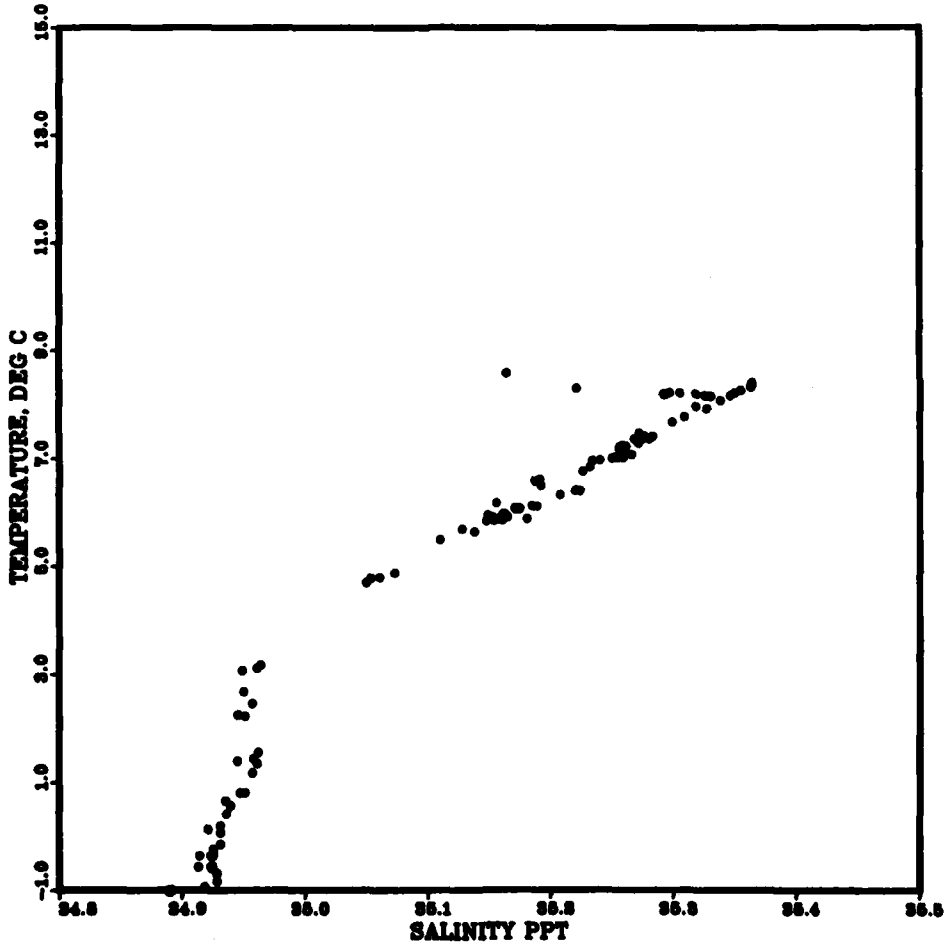


Figure 214. November 1967 (J. HJORT) temperature/salinity diagram.

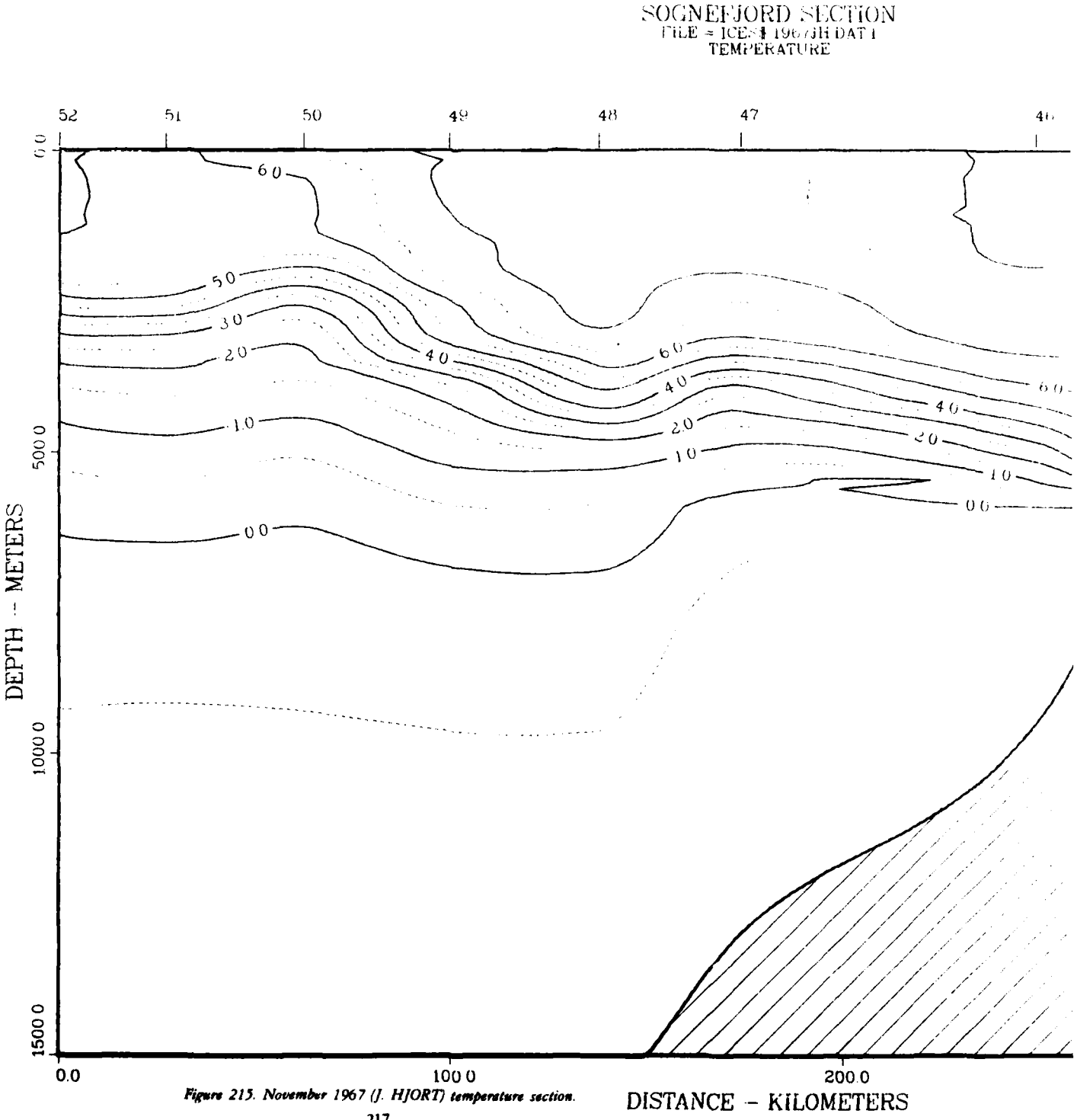
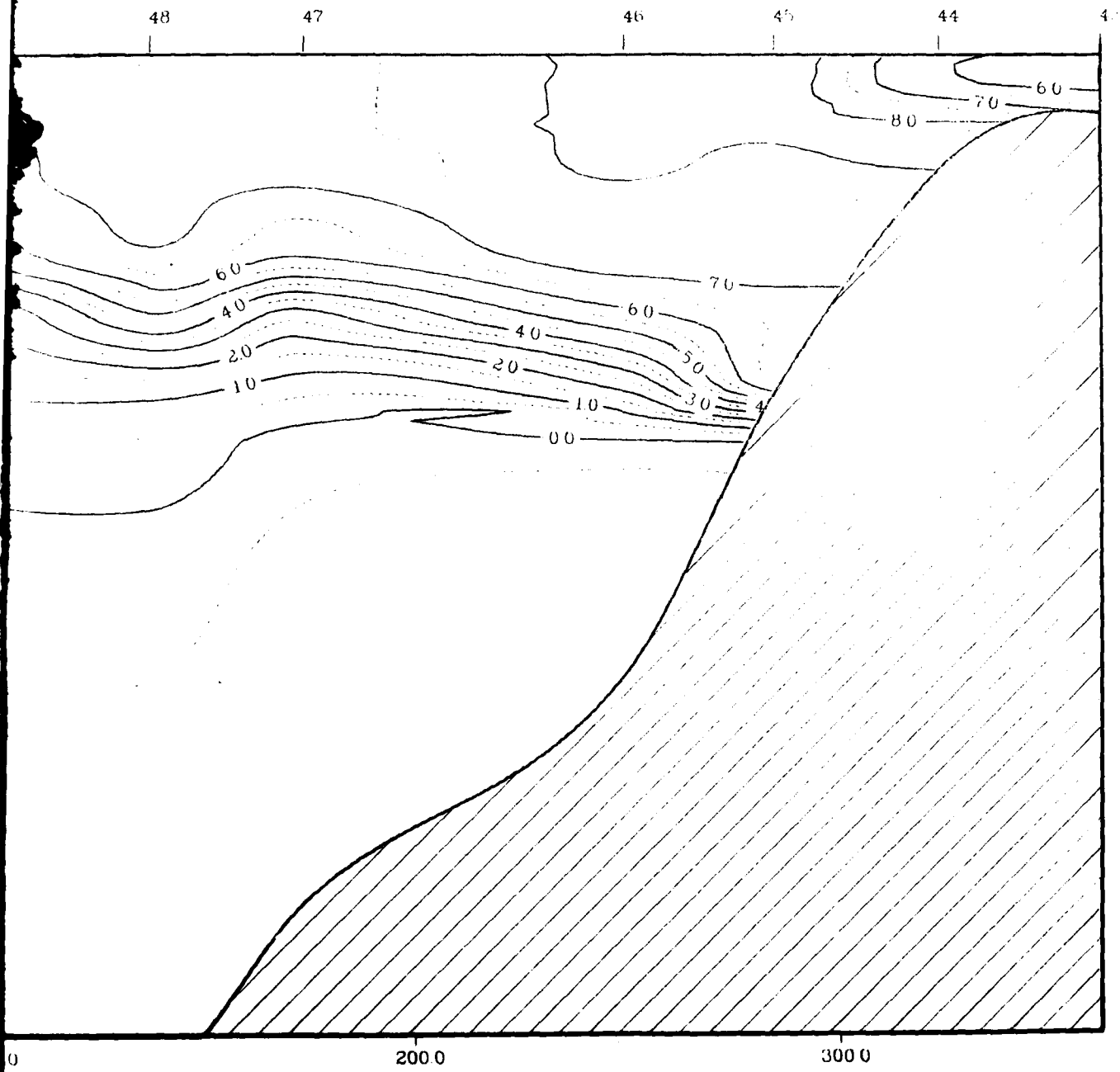


Figure 215. November 1967 (J. HJORT) temperature section.

SOGNEFJORD SECTION
FILE = ICES# 1967JH DAT 1
TEMPERATURE



mperature section.

DISTANCE – KILOMETERS

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2

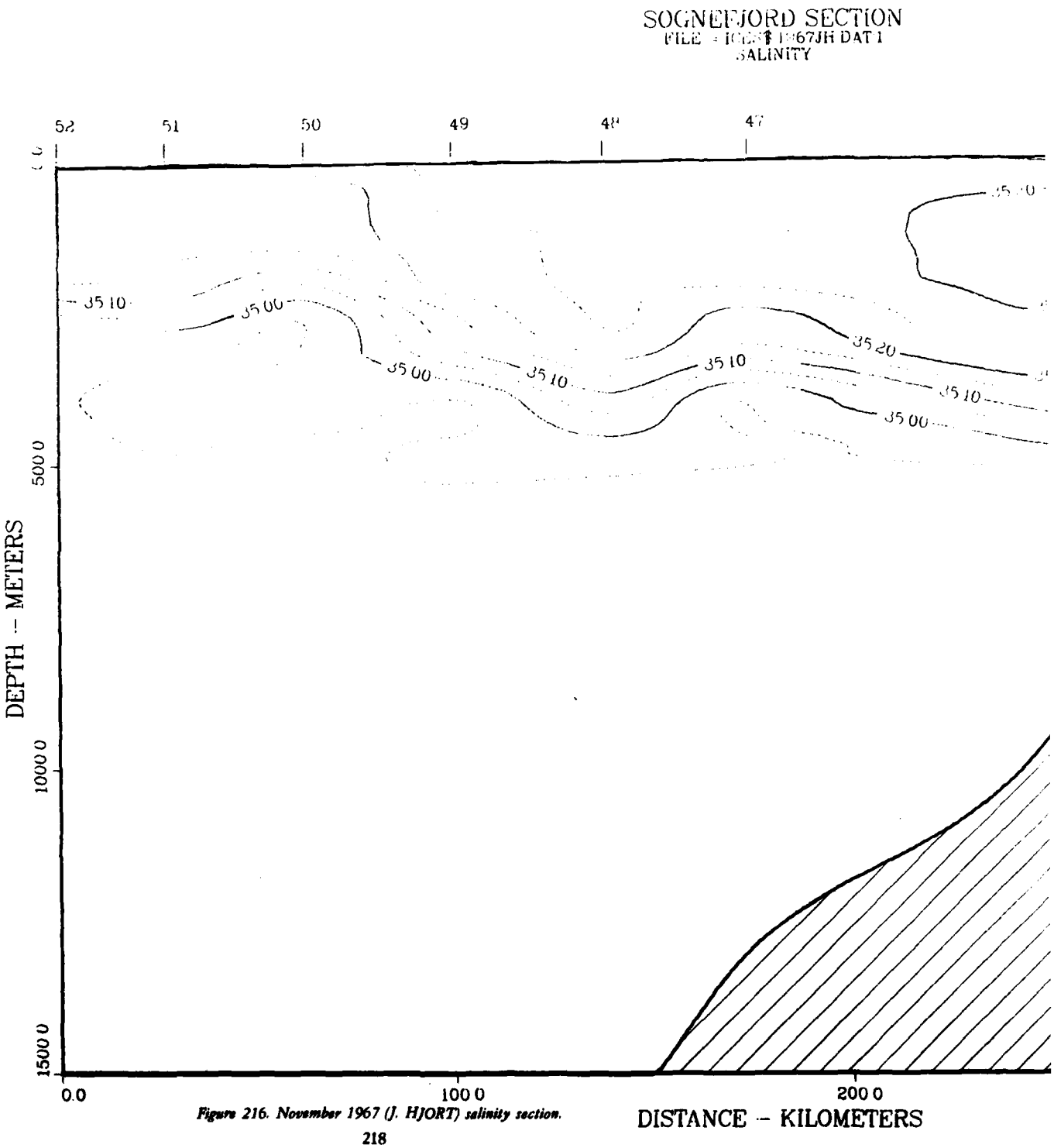
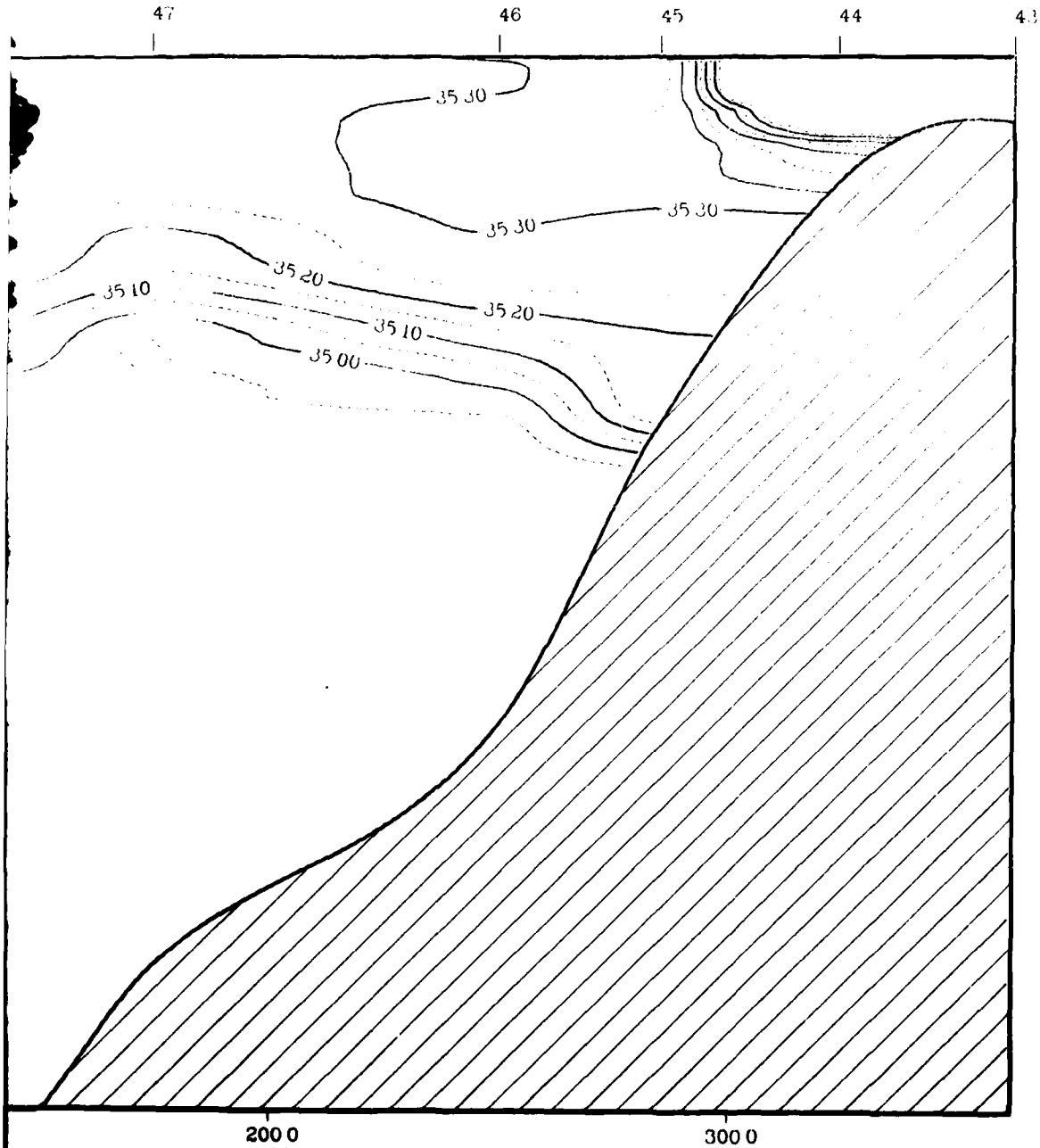


Figure 216. November 1967 (J. HJORT) salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1967JH DAT 1
SALINITY



DISTANCE - KILOMETERS

ICES$:1970JH.DAT

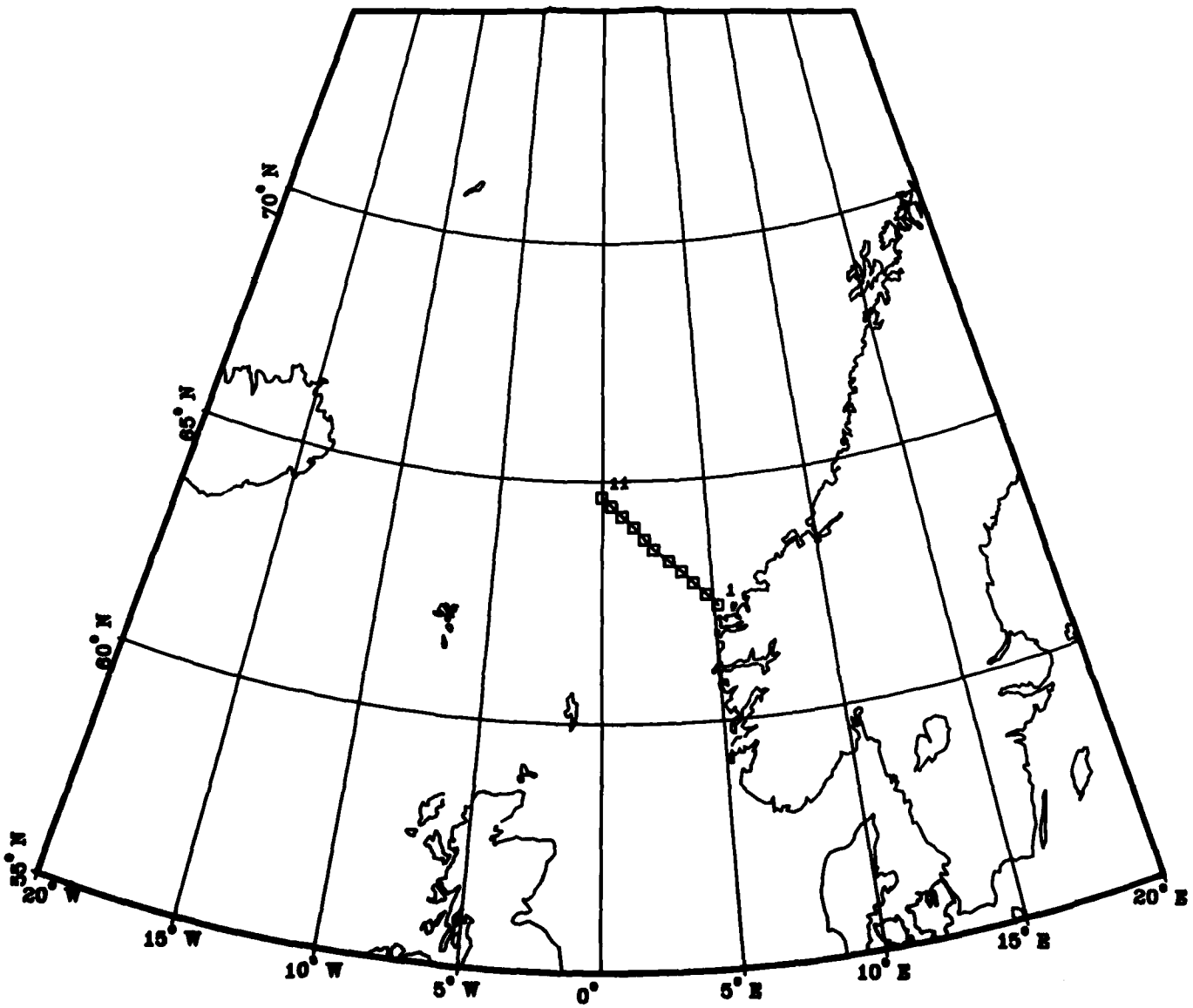


Figure 217. January 1970 station positions.

# SOGNEFJORD SECTION
FILE = ICES$:1970JH.DAT
T/S PLOT

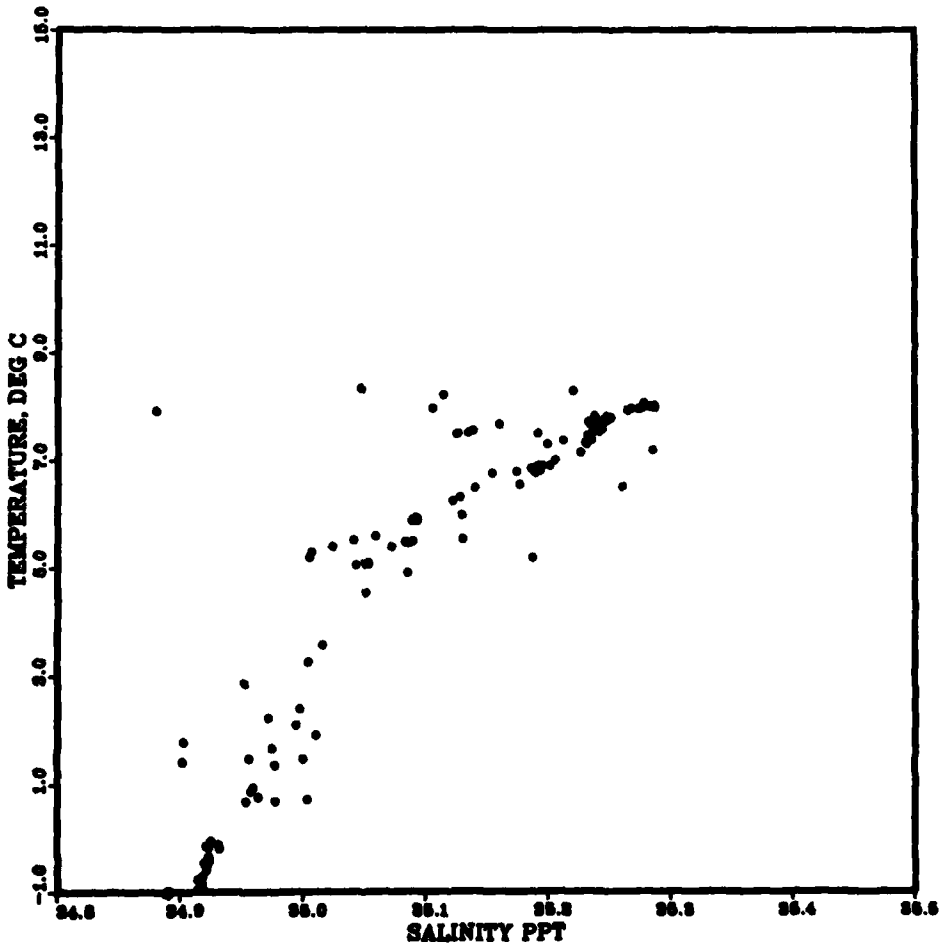


Figure 218. January 1970 temperature/salinity diagram.

*U.S. GOVERNMENT PRINTING OFFICE: 1985-631-626 Region 4.

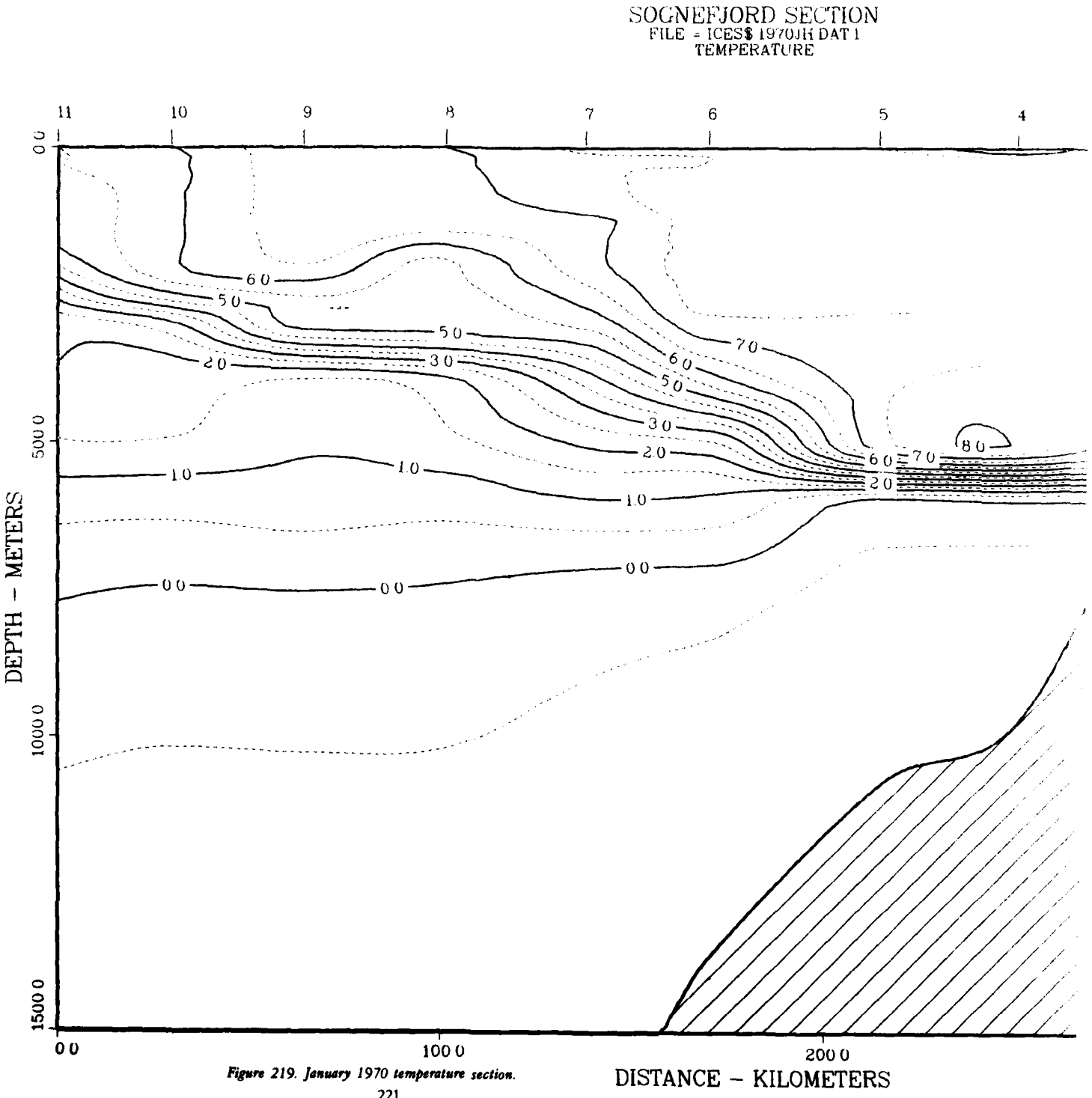
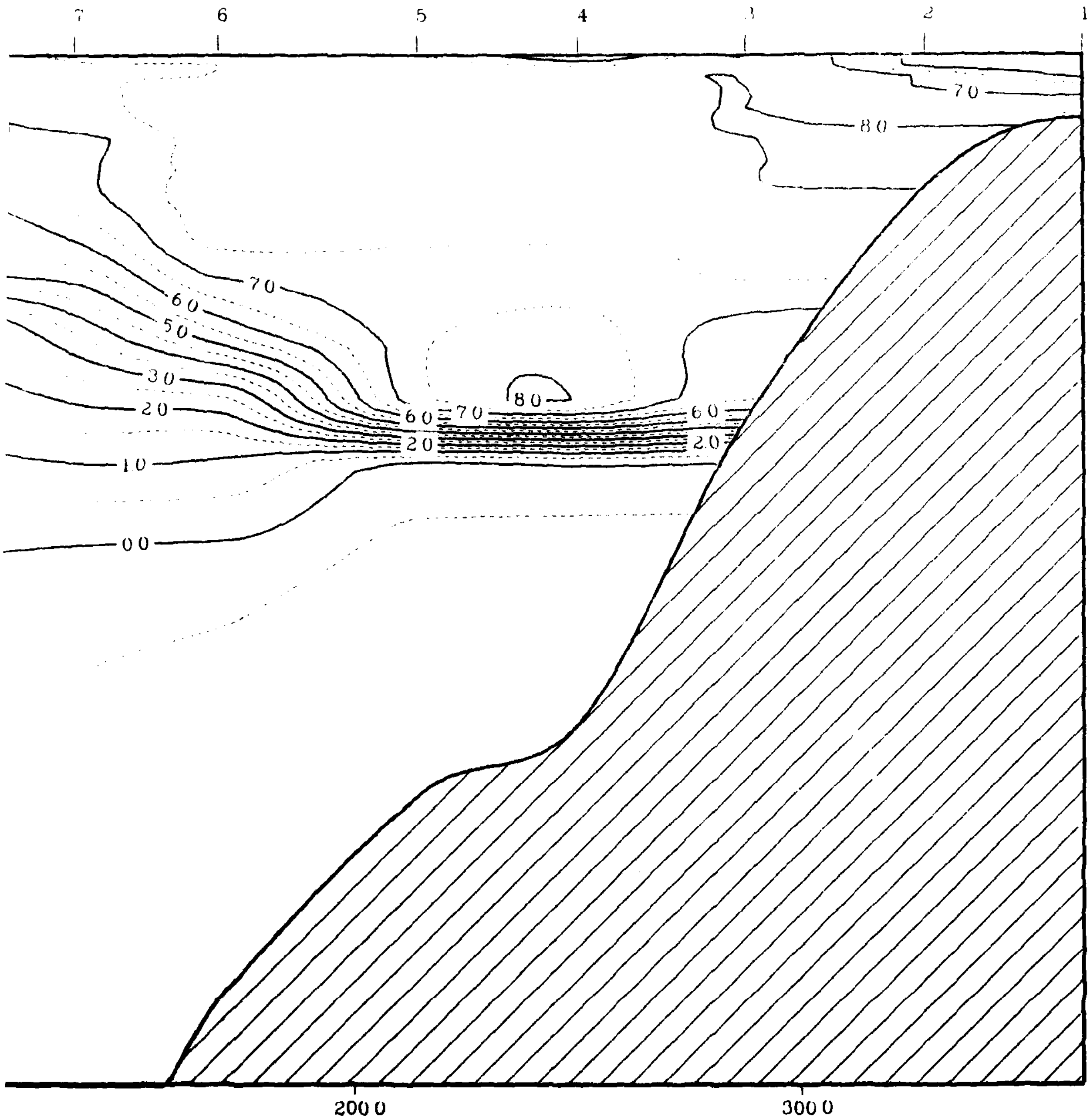


Figure 219. January 1970 temperature section.

SOGNEFJORD SECTION
FILE - ICES$ 1970JH DAT 1
TEMPERATURE



DISTANCE - KILOMETERS

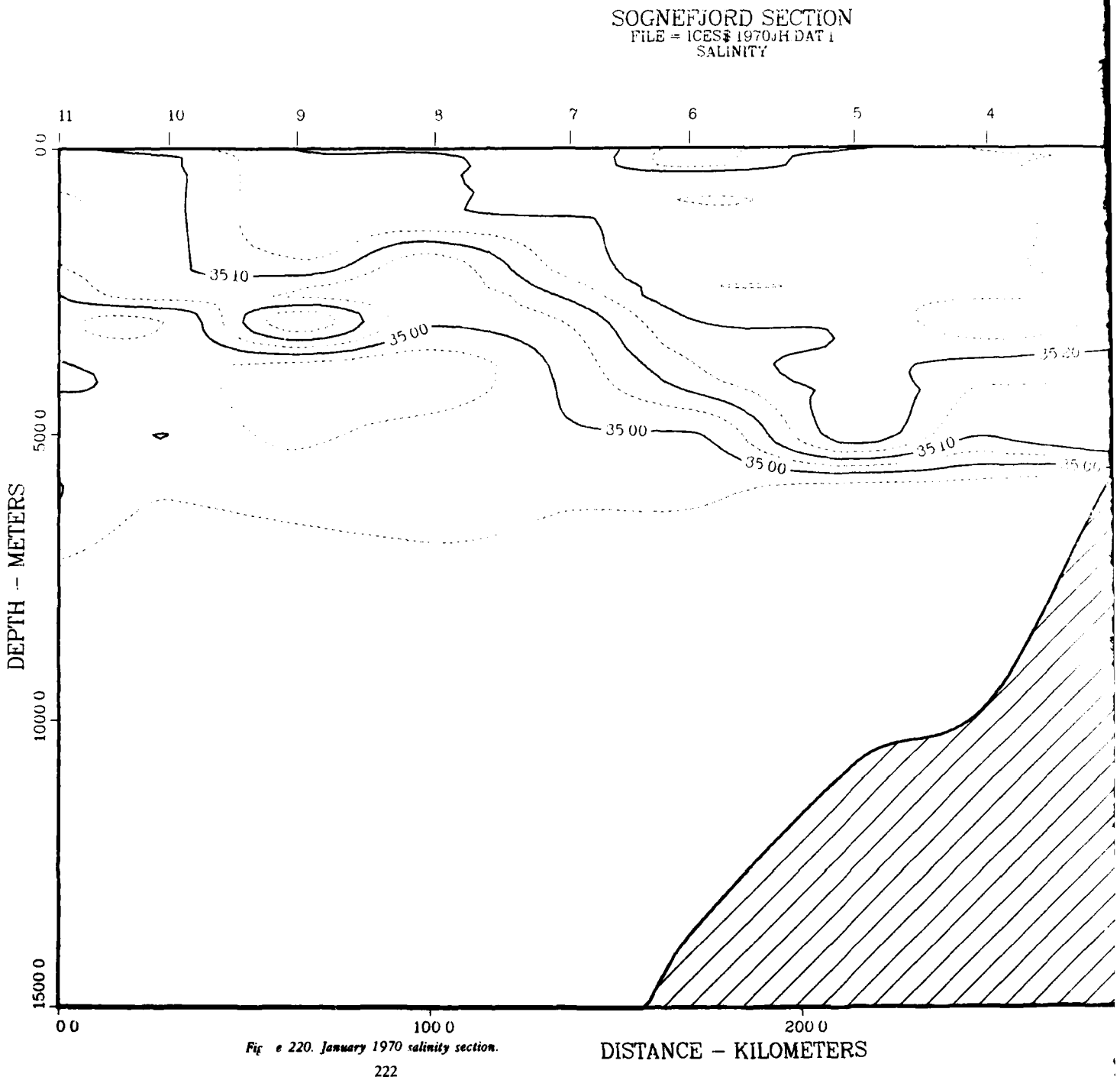
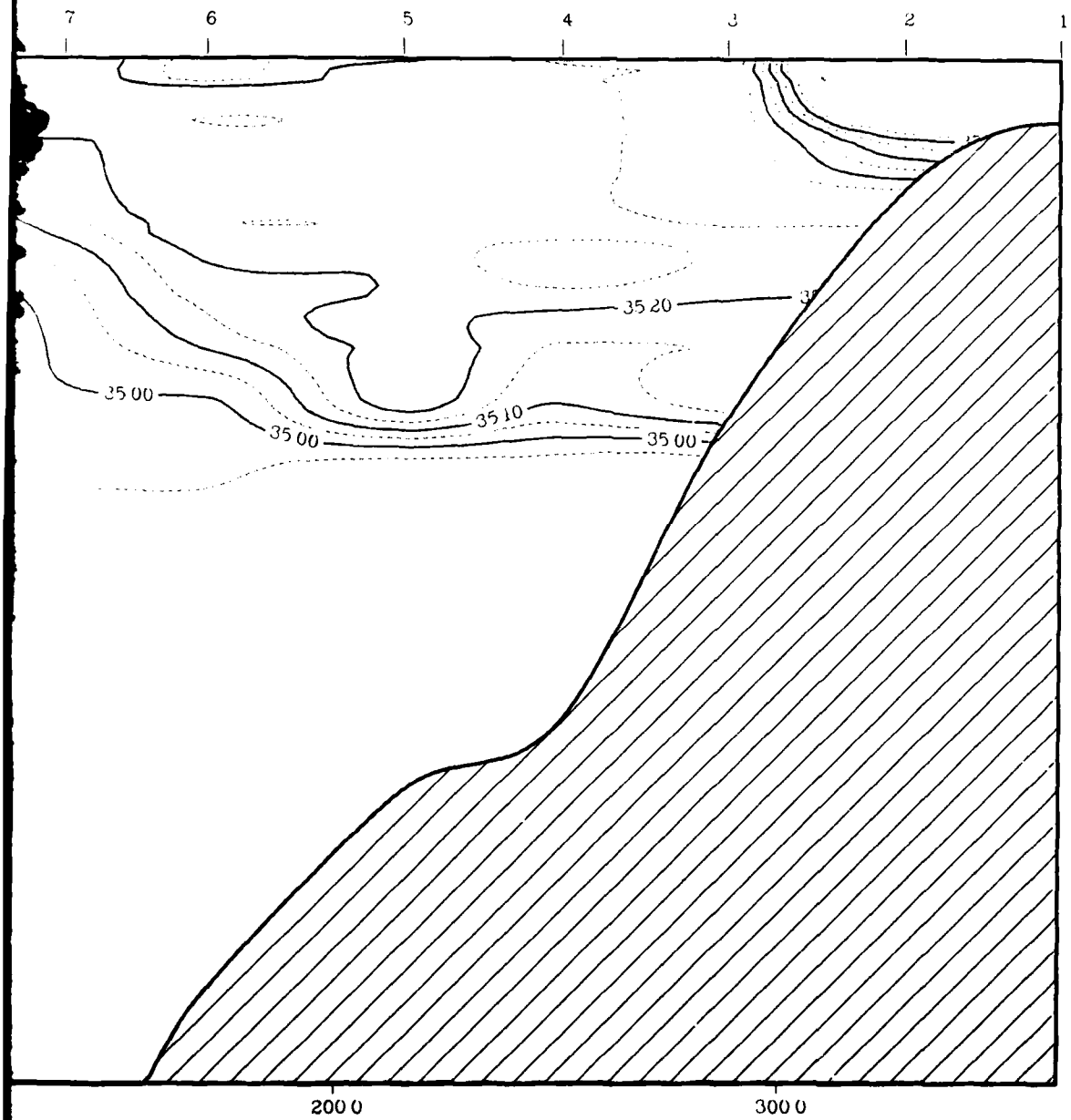


Fig e 220. January 1970 salinity section.

SOGNEFJORD SECTION
FILE = ICES$ 1970JH DAT 1
SALINITY



DISTANCE – KILOMETERS

END

DATE
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