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MEMORANDUM

Hydrographic measurements in the southern Iceland and Norwegian Seas during June and August, 1989

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G. Baldasserini, M. Zahorodny
and P. Zanasca

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Hydrographic measurements in the southern Iceland and Norwegian Seas during June and August, 1989

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Executive Summary: Environmental conditions near ocean fronts result in anomalous sound propagation and thus bear on acoustic detection of submarines. Frontal studies have therefore been a topic of continuing study at SACLANTCEN. This memorandum summarizes environmental conditions measured in and around the Iceland–Faeroe Front during June and August 1989. Specific cruise objectives were to illuminate the dynamics of the front, to establish initialization and validation fields for testing numerical environmental models, and to contribute to a regional environmental database. A series of such cruises have been conducted, each resulting in a substantial set of environmental data which is documented in a data report for research and archival purposes. When the series of cruises is complete, a synthesis document will be prepared, making use of all the data and referencing the individual memoranda.

This memorandum provides a basic presentation and reference for two hydrographic data sets now available in the Centre's database. Both include intensive measurements from the Iceland–Faeroe Ridge and eastward to the Norwegian coast, while the June survey also extended west, across the north of Iceland to the ice edge off Greenland, spanning the GIUK gap. The data are presented as vertical sections of temperature, salinity and sound speed, and as temperature-salinity diagrams. A brief guide to the main features seen in the figures is provided through an Oceanographic Summary. The data have already been used in several analyses referenced in the text. As a consequence, we know that, although showing substantial mesoscale variability in the form of eddies and meanders, the Iceland–Faeroe Front does not vary greatly on larger scales, and that structure is substantially as depicted here.

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Hydrographic measurements in the southern Iceland and Norwegian Seas during June and August, 1989

H. Perkins, W. Aicken, G. Baldasserini,
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Abstract: This memorandum documents an extensive collection of CTD data made during two cruises in the region between Greenland and Norway with emphasis on the Iceland–Faeroe Ridge. A summary of data collection and processing procedures is given, and some oceanographic features are noted. The main content of the memorandum, however, consists of appendices in which the data are displayed. A total of 25 sections, comprised of some 220 stations altogether, are presented as contours of temperature, salinity and sound speed, and as T-S diagrams.

Keywords: Iceland–Faeroe ridge ∘ salinity ∘ sound speed ∘ temperature

Contents

Acknowledgements: The contributions of our colleagues and the officers and crew on RV *Alliance* are gratefully acknowledged.

1
Introduction

Measurements from two CTD surveys on the Iceland–Faeroe Ridge and in adjacent waters are reported. The cruises, part of a series by SACLANTCEN were conducted to study the structure and evolution of the Iceland–Faeroe Front, together with inflow to the area from north of Iceland and outflow from the area north of the Faeroes and along the coast of Norway. Specific objectives were to illuminate the dynamics of the front, to establish initialization and validation fields for testing numerical environmental models, and to contribute to a regional environmental database. The cruises are identified as GIN89A and GIN89B; their respective CTD station locations are shown in Figs. 1 and 2a,b. Final versions of this data are stored in the Centre's database with 1 m vertical resolution. The data have already been used for testing techniques for data inversion (Peggion, 1991), in investigating the front itself (Perkins, 1992) and, together with other cruises in the area, for studies of seasonal variability (Arnal et al. 1993).

Included as part of the CTD sampling were measurements of light transmission and concentrations of dissolved oxygen, and in the case of cruise A, chlorophyll and nutrients. Between stations, XBT drops were sometimes made, especially near the front. The following operations were also carried out during the cruises:

1. Recovery and redeployment of currentmeter moorings along the northern side of the IFR from NE Iceland to the Faeroes during cruise A and recovery of all 9 moorings during cruise B.
2. Deployment of 6 neutrally buoyant (Swallow) floats at 600 m depth which were acoustically tracked by listening stations located on the currentmeter moorings during the interval between cruises.
3. Collection of air–sea exchange data through the extensive suite of sensors installed on *Alliance* (see Minnett, 1990 and 1991).
4. Reception and processing of satellite IR (sea-surface temperature) image data.
5. Collection of water samples for chemical and biological analysis through the cooperation of P. Povero of the University of Genova.

An independent but closely related program consisted of two AXBT surveys of the Iceland–Faeroe Ridge. These were conducted by the US Naval Research Laboratory (then known as NOARL) under contract to SACLANTCEN and have been reported by Boyd (1991). The first was on 7 and 8 June and the second on 19 June, corresponding respectively to intervals just before and at the end of the CTD measure-

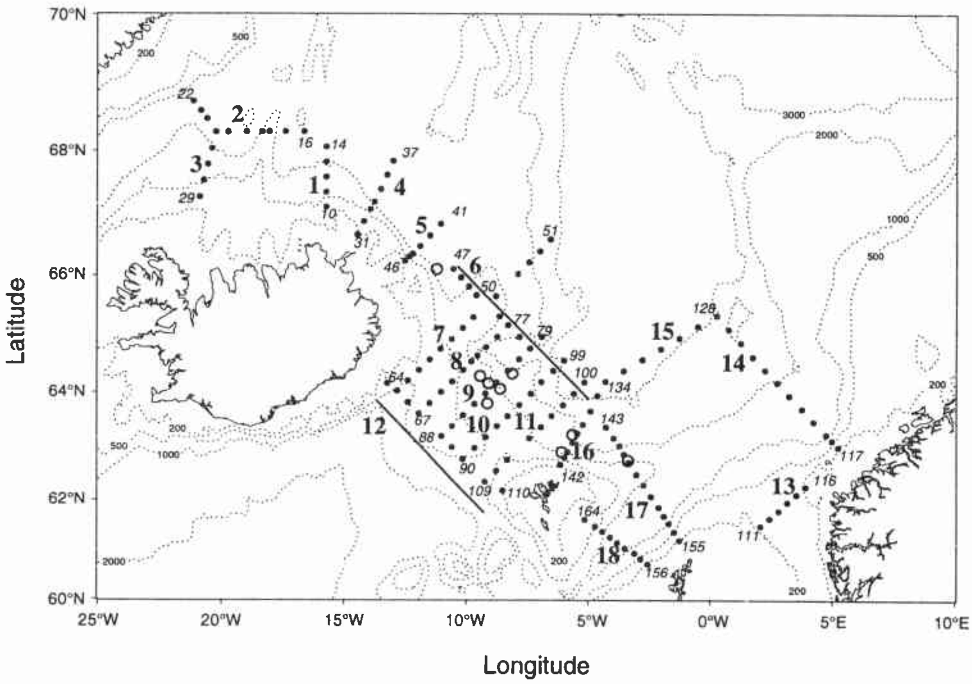

Figure 1 *Positions of CTD stations (solid dots) and station numbers (small numerals) during the June cruise, GIN89A. Section numbers are indicated by large numerals and hereafter denoted as 1A–18A. The two sections 6A and 12A, running roughly parallel to the ridge, have been constructed from collinear but non consecutive stations identified by line segments. Positions of 8 current meter moorings, left in place between the two cruises, are indicated by open circles. See Appendix A for a tabular description of all station positions and times.*

ments over the Ridge during cruise A. The AXBT and CTD data have been combined with satellite IR images to describe surface features of the front (Niiler et al., 1992).

A NASA aircraft was also operating in the area. Its flight on 25 May included 4 sections across the front while measuring surface characteristics at visible and IR frequencies and dropping AXBTs. This flight was organized by P. La Violette and R. Arnone at NOARL.

Coordinated measurements with overflights of the C-130 of the British Meteorological Research Flight were made for intercomparison of ship and aircraft radiation measurements.

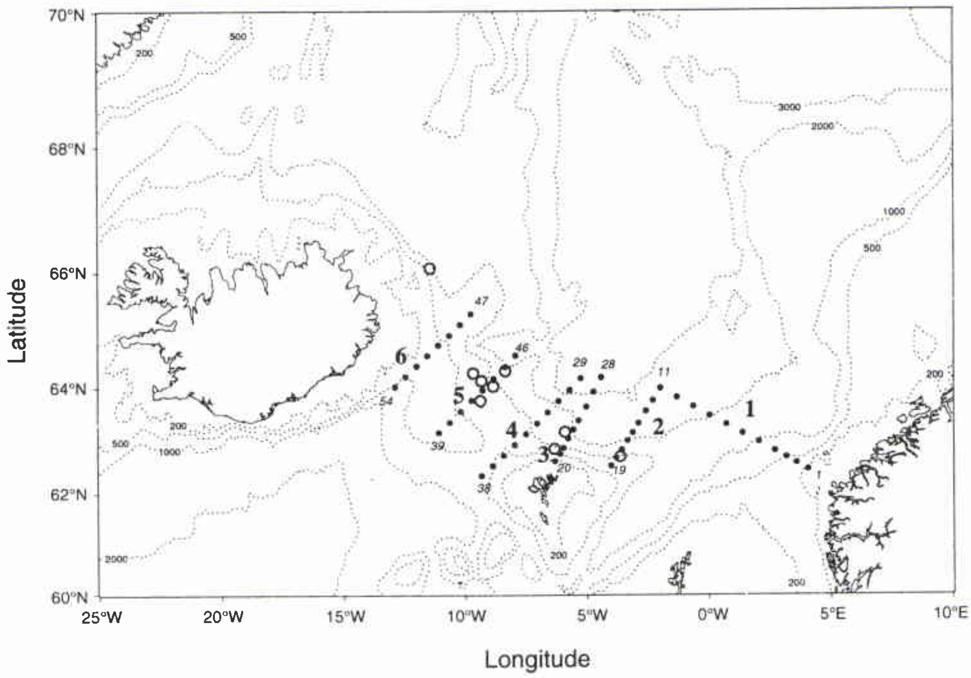

Figure 2a *As in Fig. 1, but for the August cruise, GIN89B. Sections 1B–6B.*

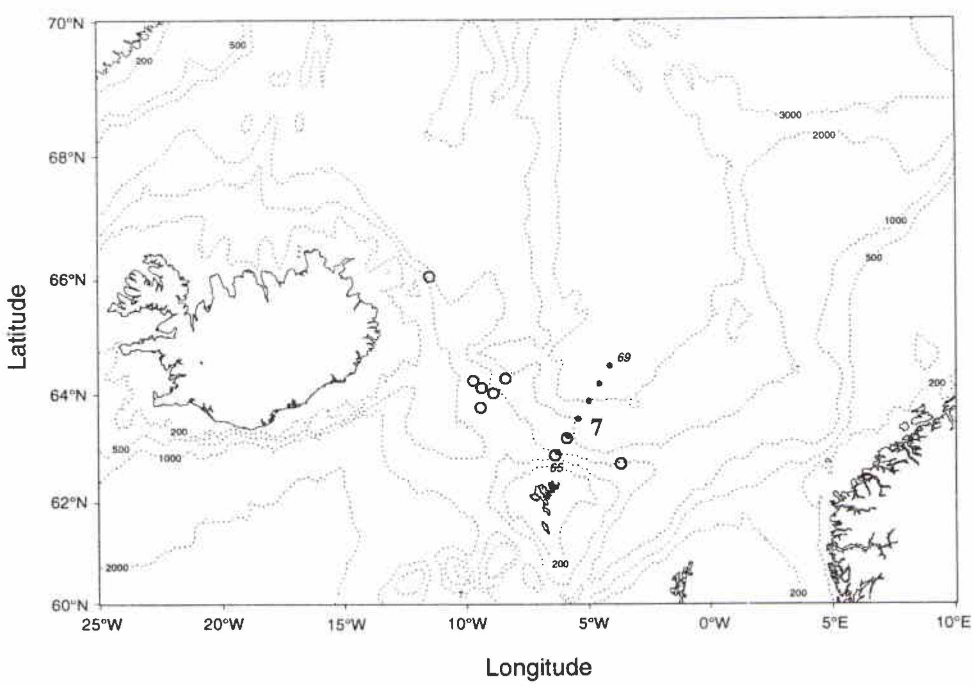

Figure 2b *As in Fig. 1, but for the August cruise, GIN89B. Section 7B, which is nearly coincident with section 3B.*

2
Data collection

CTD data were collected using either of two NBIS/EG&G Mark III instruments. Profiles extend as close as practical to the bottom, except in regions with water depth greater than about 1500 m, where measurements were not made below 1050 m in order to save time. See Appendix A for a listing of all stations.

Water sample bottles were collected regularly during cruise A, but only intermittently during cruise B. In the high sea-states encountered during most of cruise B, the CTD would not sink fast enough to keep tension on the lowering wire when the rosette sampler was attached. Instead, the known salinity stability of the Norwegian Sea intermediate water was used as a calibration check.

3
Data processing

Severe salinity spikes were encountered in these data. While this is well understood to result from the differing responses in temperature and conductivity sensors, it was a much greater problem than normal. Some of this is attributable to the sharp vertical gradients found in interleaving regions of the front, where rapid sensor response is most critical. This was accentuated during cruise B when high seas and the resulting ship motion resulted in the CTD plunging through these gradients at high speed. The problem was further compounded by the forward position of the winches on *Alliance* and the consequently exaggerated ship motion. However, two additional mechanisms leading to salinity spikes have been identified in these data. These are now discussed in some detail as they influence overall data quality.

The Mk III instruments used here have two temperature sensors, a slow but stable platinum standard and a fast but much less stable thermistor. They are joined through an analog filter network in the instrument to produce a single temperature output which should be both fast and stable. During the cruises, some evidence was found that the resulting temperature was not satisfactory and so the CTDs were later subjected to sudden immersion tests in a calibration bath to evaluate their response to a step change in temperature. Immediately after immersion, the output temperature nearly reached the bath temperature after a few tens of milliseconds, but then largely reverted to the original pre-immersion temperature, finally approaching the bath temperature again after several hundreds of milliseconds, a response time characteristic of the platinum sensor alone. It was thus conclusively shown that the temperatures were not being properly combined in either instrument, and we suspect that this may be a long-standing design problem with instruments of this type. (These instruments have since been modified so that the two temperatures are reported separately and combined under software control.) Temperature reported by the instruments was therefore very badly time-lagged relative to the measured conductivity.

A solution to this problem was devised in which the similarity between temperature and conductivity was exploited by replacing the erroneous high frequency component of temperature data with the high frequency component of suitably scaled conductivity. The objective of this procedure is to introduce high frequency fluctuations into the temperature so that, when it is used together with the measured conductivity to compute salinity, spikes in the salinity will be suppressed. In practice, conductivity was scaled by a constant α defined as a solution to the linear system

$$T_1 = \alpha C_1 + \beta \qquad T_2 = \alpha C_2 + \beta$$

where (T_1, C_1) and (T_2, C_2) are temperature and conductivity measurements made near the upper and lower extremes of the station. Scaled conductivity was high-pass filtered and added to the observed temperature which had been low-pass filtered with a complimentary filter. A more refined version of this procedure has since been shown to provide near-optimal removal of salinity spikes.

The second problem was associated with the high seas of cruise B where large salinity spikes occurred during certain phases of ship roll. The cause was diagnosed as water, entrained by the water sample bottles and rosette sampler, located above the CTD proper, forming a plume which washed down over the CTD when the instrument decelerated at the bottom of the ship roll. Some tests were made using a kinematic model to identify downwash, but these were not markedly successful. The procedure finally adopted was to admit data only when the instrument was descending more rapidly than a threshold speed (0.5 m/s) and so had accelerated out of the downwash. (In later cruises, this problem was much reduced by using a side-by-side configuration for the CTD and rosette in place of the conventional over-and-under arrangement used here.)

Water samples were collected at several depths for CTD calibration and for nutrient samples whenever possible, but as already noted, this was sometimes precluded by weather. They were omitted during one portion of cruise B which unfortunately coincided with introduction of a new CTD. This instrument proved to have a salinity offset compared with the known salinity of about 34.91 in the deeper water on the Norwegian Sea side of the ridge. Stations 36–45 (Figs. C.22 and C.23) of cruise B have therefore had 0.020 added to their salinity to bring them to the correct value.

4
Oceanographic summary

References cited above, together with citations contained in them, including especially the classic monograph by Stefánsson (1962) and the review by Hopkins (1991), provide a much fuller description of oceanographic features in the survey area than would be appropriate in this report. A few points are noted, however, as a guide to the figures in Appendices B and C.

For those sections crossing the Iceland–Faeroe Ridge, the strong contrast between the warmer, saltier, lighter water on the Atlantic side and the cooler, fresher, heavier water of the Nordic Seas is apparent, and defines the Iceland–Faeroe Front. Acoustically, the front marks the end of the sound velocity minimum found at 400–600 m in the Norwegian Sea. In both surveys, the front appeared to be in its normal state; its large-scale structure is similar to that reported in earlier work. Indeed, it might be characterized as a fixed feature perturbed by mesoscale fluctuations. It is striking that the front is so much more vertical in the west than in the east. Near Iceland the horizontal distance between top and bottom of the front is about 10 km, whereas toward the Faeroes the corresponding distance is nearer 50 km. In making these estimates, we take the top of the front to be where the 5 °C isotherm rises above 100 m, marking the northernmost penetration of Atlantic water, and the bottom to be where the 0 °C isotherm intersects the bottom, marking the southernmost penetration of water from the Nordic Seas.

Geostrophic currents are associated with the cross-frontal density contrast. The resulting current shear is the presumed cause of frontal instability which leads to the formation of detached eddies on both sides of the front which may be noted in some of the sections. Indirect evidence exists for strong near-bottom currents associated with the front, surely augmented by the strong tidal currents known to exist along the ridge (Perkins et al., 1993). The evidence consists of a few stations during cruise A where there is a bottom boundary layer 50–100 m thick which is well-mixed with respect to temperature and salinity and has uniformly reduced light transmission, such as might be associated with sediment resuspension.

Several distinct water types in the area can be identified from their characteristic values of temperature and salinity, and the classification can provide a sensitive method of tracing the flow and evolution of water from the region where its properties were determined. A summary of the water mass types around the Iceland–Faeroe Ridge are given in Appendix C following Reed and Pollard (1992).

Atlantic water enters the Norwegian Sea by flowing largely eastward north of the

Faeroes and eventually northward along the coast of Norway where it constitutes the Norwegian Current. It is represented by the sloping contours in Sections 14A, 16A, 1B and 3B. Nearer the Norwegian coast is water of very low salinity issuing from the Baltic (Section 13A), supplemented by fresh outflow from fjords.

Section 3A extends to the ice edge off Greenland and crosses the very low salinity East-Greenland Current. This current flows south along the coast of Greenland, forming a conduit from the Arctic Ocean, where a surplus of near-surface fresh water arises from precipitation, river runoff and ice formation, to the Atlantic. It may also be the source of some of the low salinity on the shelf north of Iceland (Sections 1A–4A), although this is much affected by freshwater runoff from Iceland and by occasional excursions of high salinity Atlantic water proceeding northward through Denmark Strait and thence eastward along the northern Iceland coast.

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Appendix A

Station times and locations

The two tables below summarize CTD time, depth and position for the two cruises. Tabulated quantities are station number, time in decimal days (eg., 1200Z 01 Jan 89 = 1.50), latitude in decimal degrees, longitude in decimal degrees (east positive), maximum station depth, and water depth (m). Included are all stations used in preparing the sections. Missing station numbers correspond to stations taken near moorings for intercalibration checks (and hence not part of a section), to test stations, or to stations abandoned because of equipment or weather problems. Station 63 of Cruise B was cut short because it was not possible to keep tension on the CTD wire owing to severe pitching of the ship.

Table A1a *Station summary for GIN89A cruise (see also Fig. 1 for a chart of station positions)*

Station no.	Time	Lat.	Long.	Station depth	Water depth
10	153.03	67.08	−15.70	151	186
11	153.10	67.32	−15.70	435	482
12	153.18	67.55	−15.70	761	816
13	153.27	67.78	−15.70	979	1033
14	153.36	68.02	−15.70	1138	1236
16	153.59	68.25	−16.60	1097	1193
17	153.70	68.25	−17.35	1234	1305
18	153.80	68.25	−18.00	793	969
19	153.87	68.25	−18.30	793	916
20	153.97	68.25	−18.92	1088	1199
21	154.08	68.25	−19.66	980	1063
22	154.36	68.70	−21.05	1089	1263
23	154.44	68.57	−20.75	990	1104
24	154.52	68.45	−20.50	987	1110
25	154.63	68.25	−20.15	1038	1101
26	154.73	68.00	−20.30	939	1010
27	154.83	67.75	−20.47	645	650
28	154.93	67.50	−20.63	320	378
29	155.02	67.25	−20.80	238	275
31	160.73	66.63	−14.45	142	150
32	160.81	66.84	−14.19	190	190
33	160.90	67.04	−13.92	450	457
34	160.96	67.16	−13.75	853	860
35	161.07	67.36	−13.50	659	1623
36	161.19	67.58	−13.25	1577	1726
37	161.29	67.80	−13.00	1728	1820
41	162.10	66.80	−11.08	1412	1467
42	162.23	66.62	−11.51	1350	1429
43	162.36	66.45	−11.91	1164	1226
44	162.43	66.33	−12.21	868	923
45	162.48	66.29	−12.35	526	579
46	162.53	66.22	−12.52	146	197
47	162.78	66.08	−10.56	1201	1275
48	162.90	65.94	−10.25	1084	1170
49	163.01	65.81	− 9.93	790	858
50	163.10	65.66	− 9.63	737	804
51	163.55	66.56	− 6.63	2510	2649
52	163.69	66.37	− 7.06	2052	2197
53	164.12	66.19	− 7.50	1848	1964
54	164.26	66.00	− 7.95	1528	1619
55	164.64	65.65	− 8.84	745	814
57	164.88	65.29	− 9.75	773	810
58	164.99	65.10	−10.18	524	575
59	165.09	64.92	−10.62	373	430
60	165.18	64.75	−11.07	375	436
61	165.27	64.57	−11.52	392	444
62	165.36	64.38	−11.95	396	426
63	165.45	64.20	−12.40	444	480

Table A1b *Station summary for GIN89A cruise (see also Fig. 1 for a chart of station positions)*

Station no.	Time	Lat.	Long.	Station depth	Water depth
64	165.56	64.15	−13.24	114	152
65	165.64	64.02	−12.83	561	620
66	165.72	63.82	−12.40	395	442
67	165.80	63.62	−11.96	335	379
68	165.88	63.80	−11.52	347	377
69	165.96	64.00	−11.05	354	392
70	166.03	64.18	−10.60	397	450
71	166.13	64.39	−10.15	485	534
72	166.20	64.53	− 9.83	486	546
73	166.27	64.64	− 9.58	721	776
74	166.36	64.78	− 9.23	1921	2042
75	166.62	64.96	− 8.79	1775	1912
76	166.84	65.30	− 8.69	936	995
77	166.93	65.15	− 8.35	1067	1124
78	167.06	64.95	− 7.88	2358	2588
79	167.23	64.95	− 7.00	1829	1954
80	167.37	64.76	− 7.45	2413	2535
81	167.61	64.57	− 7.90	2109	2275
82	167.86	64.37	− 8.35	1871	1977
83	168.00	64.17	− 8.80	1232	1312
84	168.11	63.97	− 9.25	712	773
85	168.20	63.79	− 9.70	592	644
86	168.30	63.58	−10.16	476	528
87	168.39	63.39	−10.60	355	411
88	168.49	63.20	−11.06	377	421
89	168.57	63.00	−10.63	394	448
90	168.66	62.78	−10.20	417	482
91	168.75	62.98	− 9.72	443	491
92	168.83	63.18	− 9.27	453	509
93	168.92	63.39	− 8.81	533	579
94	169.00	63.57	− 8.35	681	740
95	169.09	63.77	− 7.90	1064	1140
96	169.22	63.97	− 7.43	1673	1816
97	169.40	64.17	− 7.01	2369	2463
98	169.61	64.37	− 6.53	2609	2765
99	169.75	64.55	− 6.10	2950	3246
100	169.95	64.17	− 5.26	2943	3470
101	170.11	63.97	− 5.69	2953	3421
102	170.26	63.77	− 6.14	2264	2398
103	170.41	63.57	− 6.59	1498	1577
104	170.54	63.37	− 7.03	1217	1298
105	170.65	63.16	− 7.50	932	996
107	170.87	62.77	− 8.40	403	453

Table A1c *Station summary for GIN89A cruise (see also Fig. 1 for a chart of station positions)*

Station no.	Time	Lat.	Long.	Station depth	Water depth
108	170.96	62.57	– 8.84	461	524
109	171.06	62.37	– 9.30	506	558
110	171.15	62.20	– 8.59	118	180
111	173.76	61.50	1.87	236	285
112	173.84	61.65	2.24	334	377
113	173.92	61.80	2.60	333	386
114	174.01	61.97	2.95	362	405
115	174.09	62.12	3.32	317	364
116	174.17	62.27	3.69	176	206
117	174.48	63.00	5.01	248	305
118	174.56	63.12	4.76	670	794
119	174.63	63.23	4.53	993	1068
120	174.76	63.47	4.02	1134	1305
121	174.90	63.70	3.55	1381	1466
122	175.04	63.93	3.03	1482	1583
123	175.17	64.17	2.56	1432	1963
124	175.30	64.39	2.07	1575	2374
125	175.43	64.62	1.57	1578	2773
126	175.57	64.86	1.08	1477	2768
127	175.69	65.08	0.59	1478	2693
128	175.84	65.32	0.10	2715	2890
129	175.98	65.13	– 0.67	1478	2924
130	176.11	64.93	– 1.41	1479	2938
131	176.26	64.75	– 2.17	2850	3011
132	176.40	64.56	– 2.91	1481	3052
133	176.53	64.37	– 3.67	1462	3102
134	176.67	64.18	– 4.41	2933	3284
135	176.80	63.93	– 4.74	1478	3036
136	176.91	63.66	– 5.02	1478	2671
137	177.03	63.41	– 5.33	1968	2146
138	177.14	63.25	– 5.55	1968	2128
139	177.28	63.08	– 5.76	1771	1914
140	177.35	62.91	– 5.96	897	1011
141	177.41	62.81	– 6.08	396	475
142	177.47	62.68	– 6.25	100	155
143	177.80	63.36	– 4.39	2361	2510
144	177.90	63.17	– 4.08	1478	2474
145	178.00	63.02	– 3.84	1872	2006
146	178.09	62.87	– 3.66	1202	1285
147	178.17	62.72	– 3.47	850	921
148	178.26	62.50	– 3.16	570	642
149	178.37	62.31	– 2.87	840	910
150	178.49	62.08	– 2.57	1587	1664

Table A1d *Station summary for GIN89A cruise (see also Fig. 1 for a chart of station positions)*

Station no.	Time	Lat.	Long.	Station depth	Water depth
151	178.59	61.87	– 2.26	1517	1583
152	178.66	61.70	– 2.05	1411	1492
153	178.76	61.55	– 1.85	937	1031
154	178.83	61.38	– 1.63	472	521
155	178.89	61.22	– 1.42	146	194
156	179.08	60.75	– 2.70	137	176
157	179.14	60.85	– 2.99	441	515
158	179.22	60.97	– 3.23	840	898
159	179.30	61.06	– 3.62	1038	1132
160	179.30	61.06	– 3.62	988	1132
161	179.47	61.28	– 4.22	997	1098
162	179.55	61.40	– 4.53	841	889
163	179.63	61.50	– 4.83	193	242
164	179.71	61.63	– 5.26	185	245

Table A2a *Station summary for GIN89B cruise (see also Figs. 2a,b for a chart of station positions)*

Station no.	Time	Lat.	Long.	Station depth	Water depth
1	260.69	62.50	4.01	119	173
2	260.78	62.62	3.54	254	340
3	260.86	62.74	3.13	500	500
4	260.94	62.86	2.67	677	730
5	261.05	63.02	2.00	896	979
6	261.18	63.19	1.35	1202	1285
7	261.32	63.35	0.69	1631	1695
8	261.45	63.51	0.00	1970	2070
9	261.57	63.67	−0.65	1479	2307
10	261.68	63.83	−1.32	1480	2587
11	261.80	64.00	−2.00	2658	2700
12	261.89	63.78	−2.30	1483	2816
13	261.98	63.59	−2.58	1481	2838
14	262.08	63.37	−2.89	2440	2544
15	262.17	63.20	−3.12	1482	2483
16	262.24	63.05	−3.34	1904	1978
17	262.32	62.88	−3.58	1185	1293
18	262.39	62.72	−3.80	838	917
19	262.46	62.57	−4.02	676	724
20	264.31	62.66	−6.30	118	155
21	264.50	62.80	−6.09	396	457
22	264.43	62.91	−5.96	917	983
23	264.51	63.09	−5.77	1825	1977
24	264.59	63.25	−5.55	1480	2150
25	264.68	63.42	−5.34	2069	2169
26	264.76	63.67	−5.02	1479	2708
27	264.85	63.93	−4.73	1480	3000
28	264.94	64.18	−4.42	2947	3000
29	265.19	64.17	−5.25	1478	3514
30	265.28	63.97	−5.70	1480	3467
31	265.37	63.77	−6.15	2263	2420
32	265.46	63.57	−6.60	1479	1603
33	265.55	63.37	−7.03	1185	1337
34	265.73	63.17	−7.48	955	1028
35	265.82	62.97	−7.95	573	630
36	265.90	62.77	−8.40	455	517
37	265.97	62.57	−8.85	483	526
38	266.06	62.38	−9.30	501	560
39	266.28	63.20	11.05	361	425
40	266.35	63.38	10.60	353	410
41	266.42	63.58	10.15	473	534
42	266.49	63.78	−9.69	590	651
43	266.56	63.97	−9.26	710	771

Table A2b *Station summary for GIN89B cruise (see also Figs. 2a,b for a chart of station positions)*

Station no.	Time	Lat.	Long.	Station depth	Water depth
44	266.64	64.17	−8.80	1181	1314
45	266.74	64.37	−8.34	1873	2075
46	266.87	64.57	−7.91	1971	2300
47	267.14	65.28	−9.73	740	827
48	267.24	65.10	10.18	533	580
49	267.33	64.92	10.62	378	435
50	267.40	64.75	11.07	396	447
51	267.49	64.57	11.52	387	451
52	267.58	64.38	11.95	367	429
53	267.68	64.20	12.40	441	490
54	267.85	64.02	12.83	574	630
55	271.25	64.07	−8.74	938	950
56	271.49	63.82	−9.27	642	692
57	271.70	64.18	−9.19	941	1012
58	271.82	63.88	−9.46	660	715
59	271.90	64.07	−9.03	823	887
60	272.00	64.26	−8.58	1529	1619
61	272.09	64.47	−8.12	2072	1221
62	274.20	66.03	11.73	198	273
63	274.32	66.12	11.29	147	1000
64	275.15	63.25	−5.79	1921	2021
65	275.46	62.95	−6.21	984	1069
66	275.82	63.57	−5.36	1478	2255
67	275.97	63.88	−4.93	1477	3010
68	276.09	64.20	−4.50	1479	3280
69	276.21	64.52	−4.07	1478	3240

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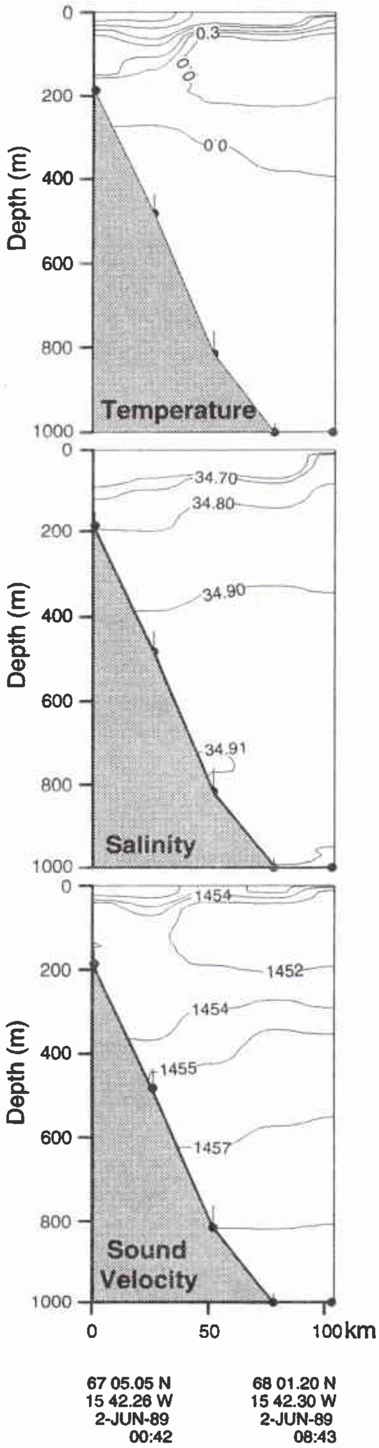
Appendix B

Contoured data along sections

Contoured values of temperature, salinity, and sound speed are given for each section. Section locations are plotted in Figs. 1 and 2a,b. Figures here correspond, section by section, with those of Appendix C.

Station positions are shown at the bottom by solid circles. At each station, a line extends from the bottom symbol to the maximum depth of the station, thus indicating absence of data in that part of the water column. At the bottom are given positions and times for the first and last stations of the section. Individual stations may be identified by referencing Figs. 1 or 2a,b. Because of missing data near the bottom, contours sometimes show an abrupt change (e.g., Figs. B7, B11) which is clearly an artifact of the contouring algorithm.



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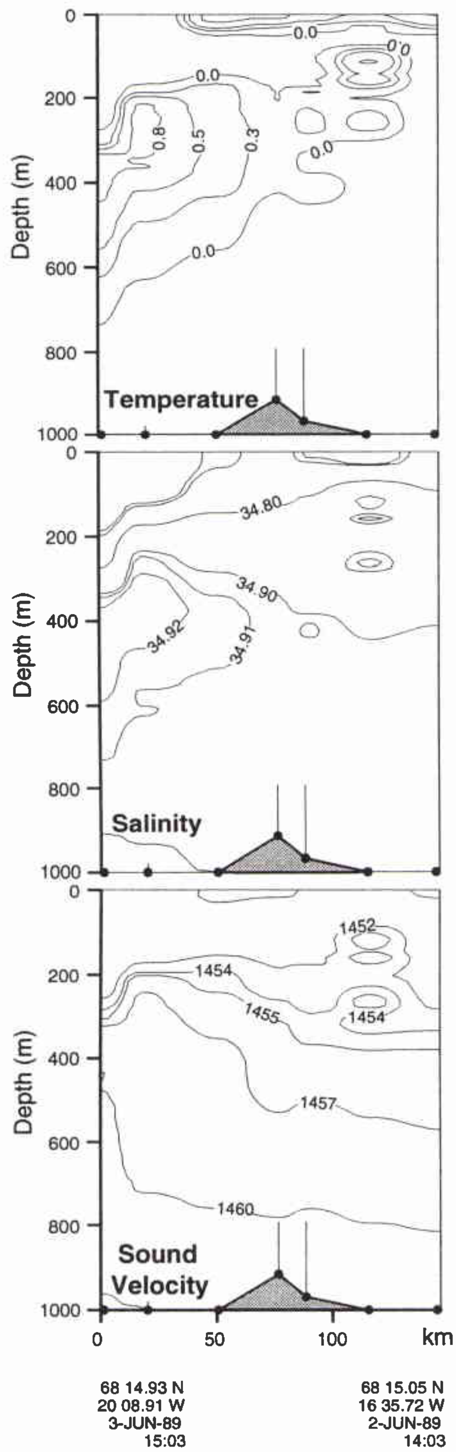

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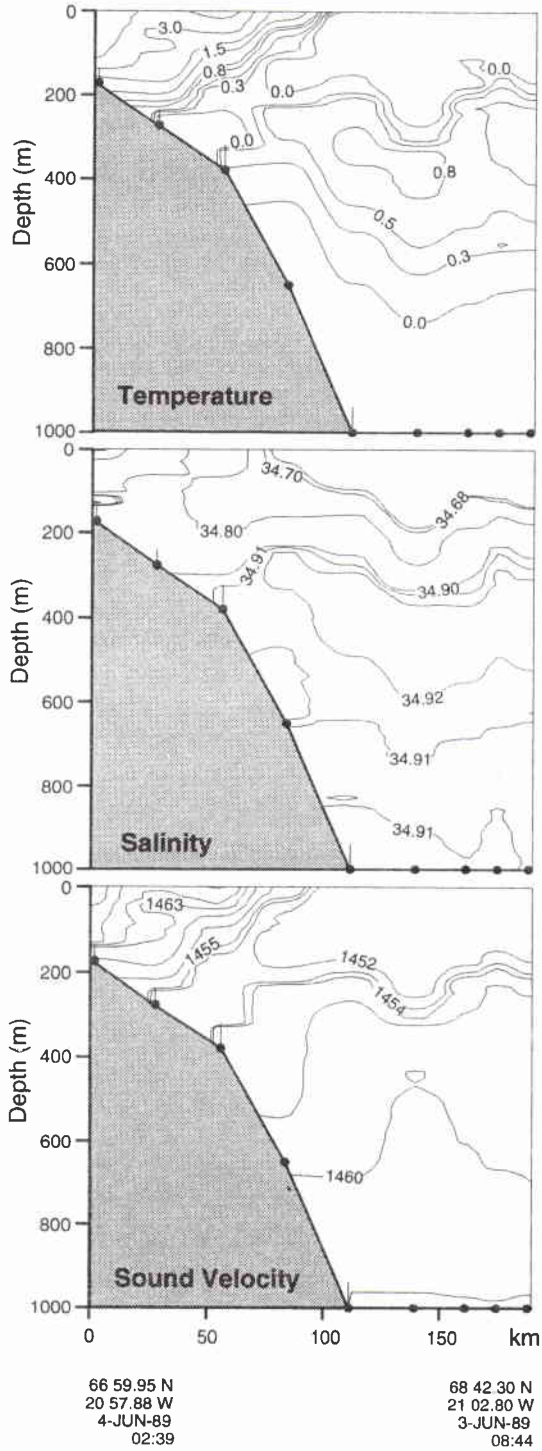

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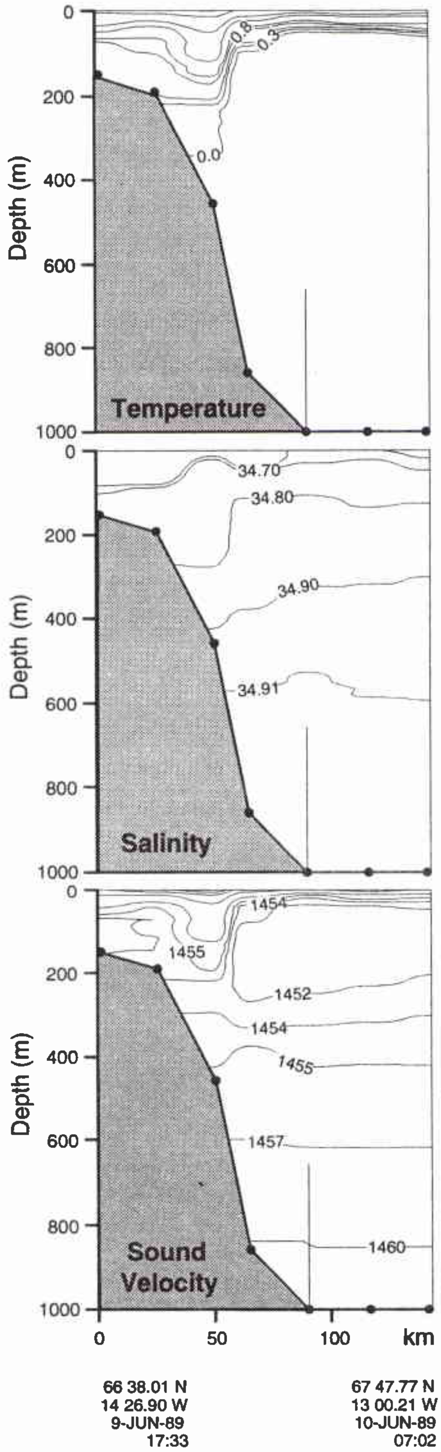

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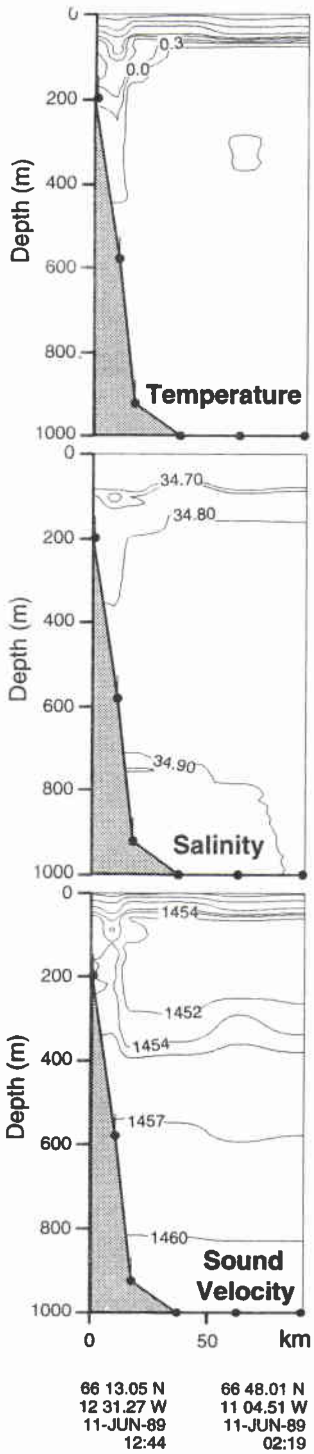

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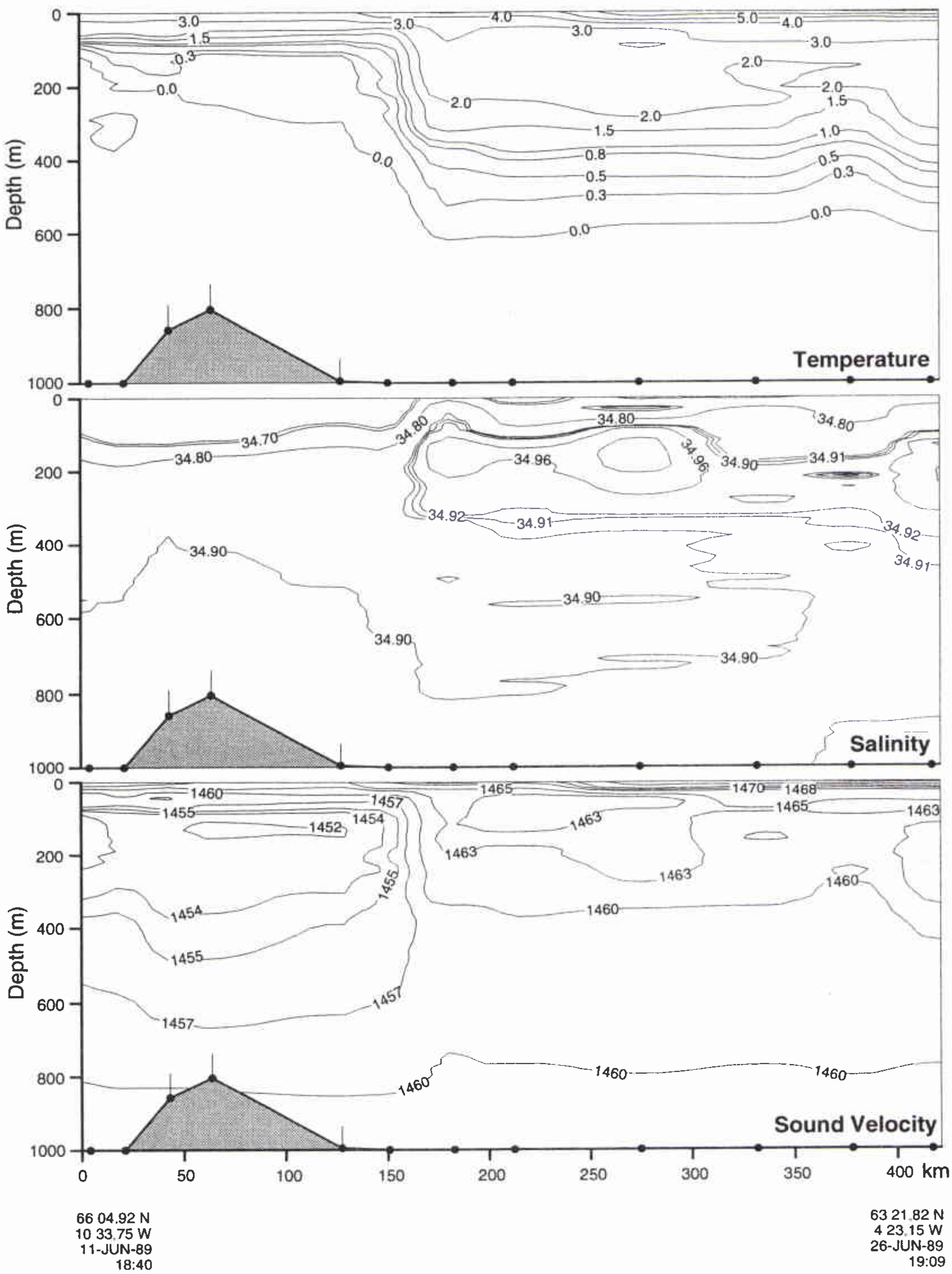

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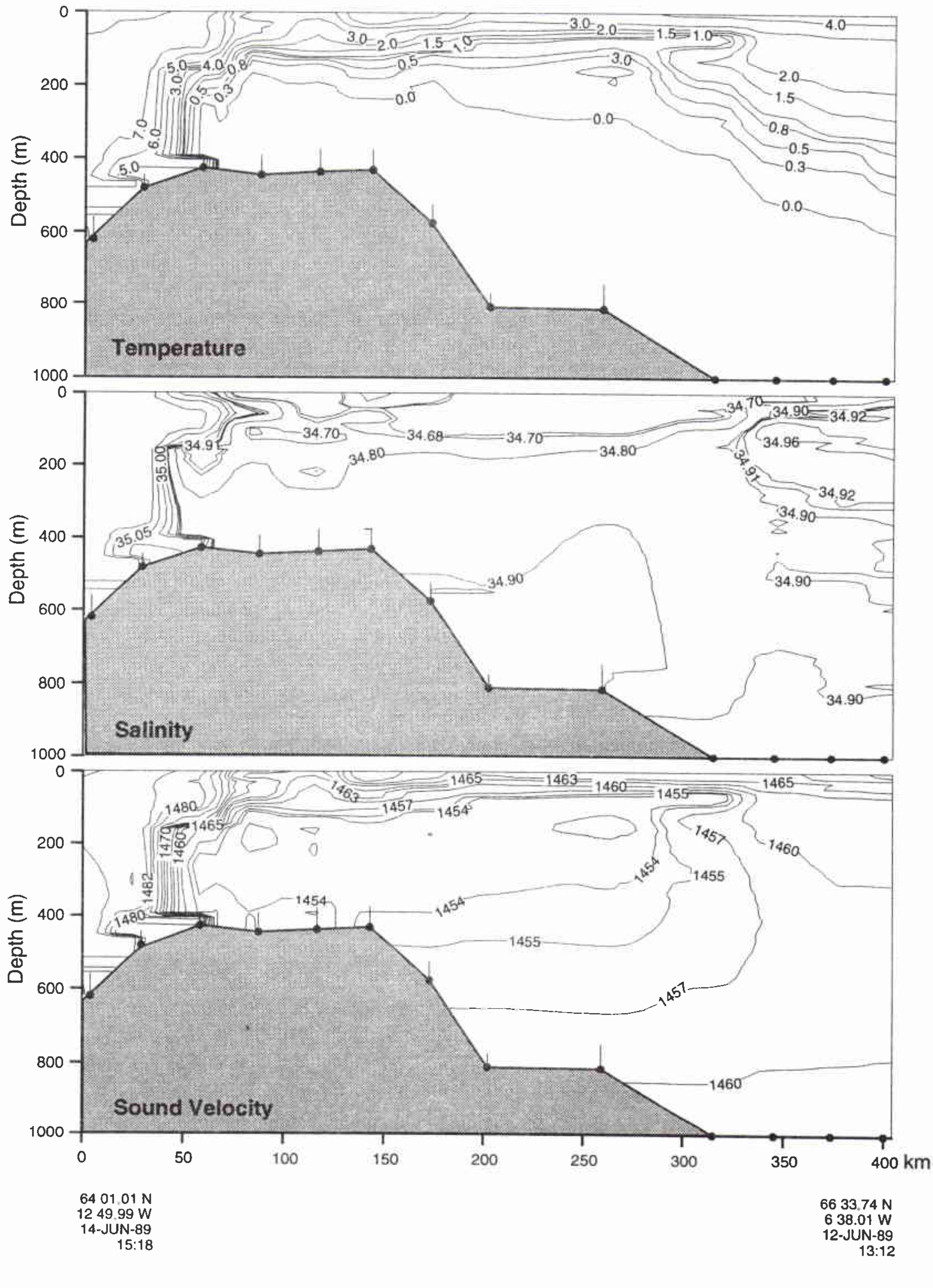

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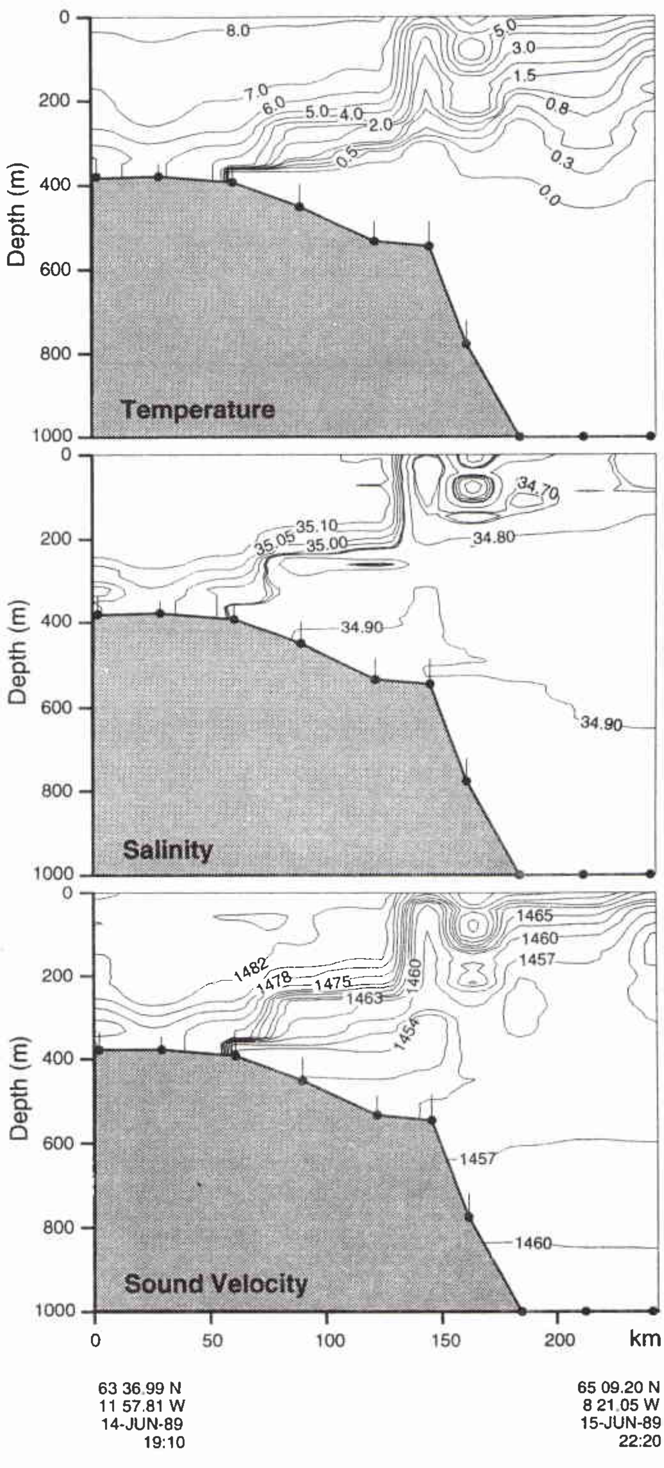

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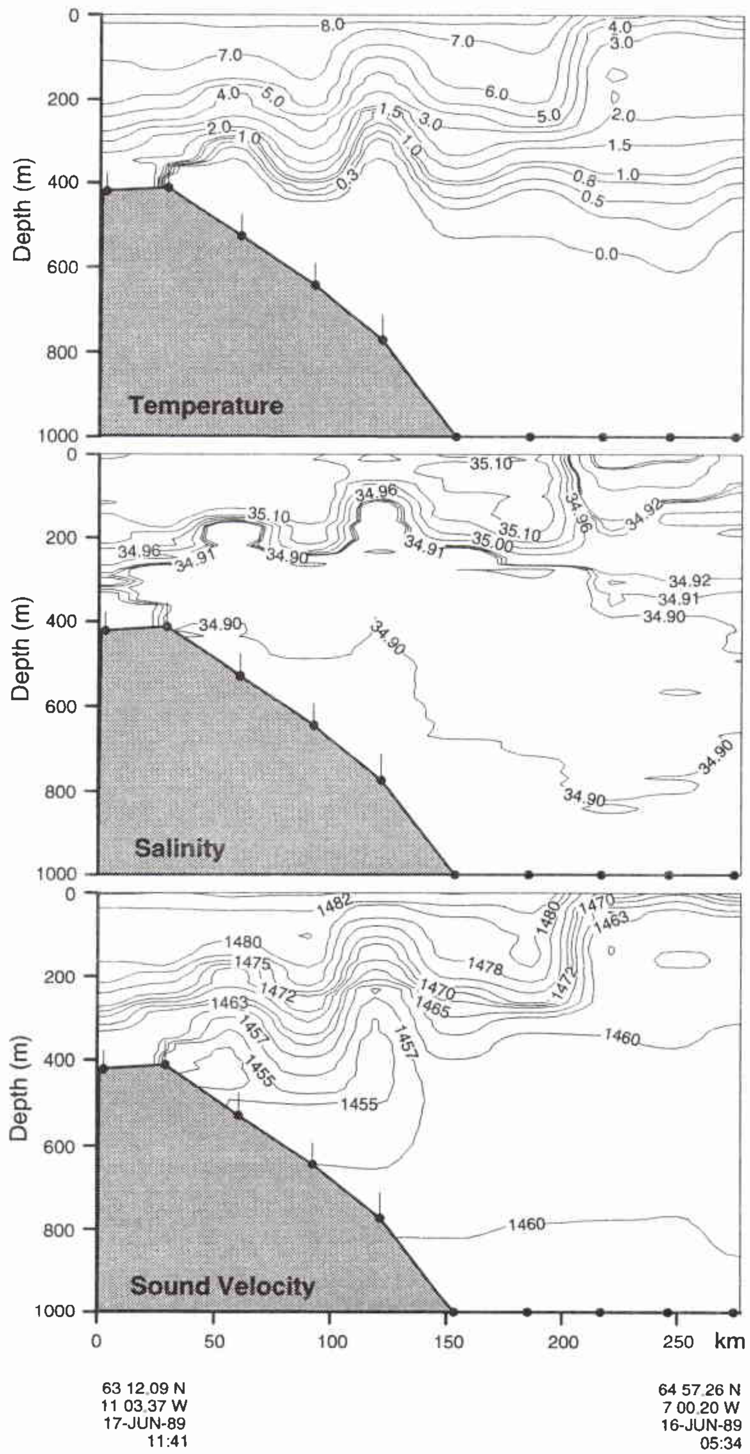

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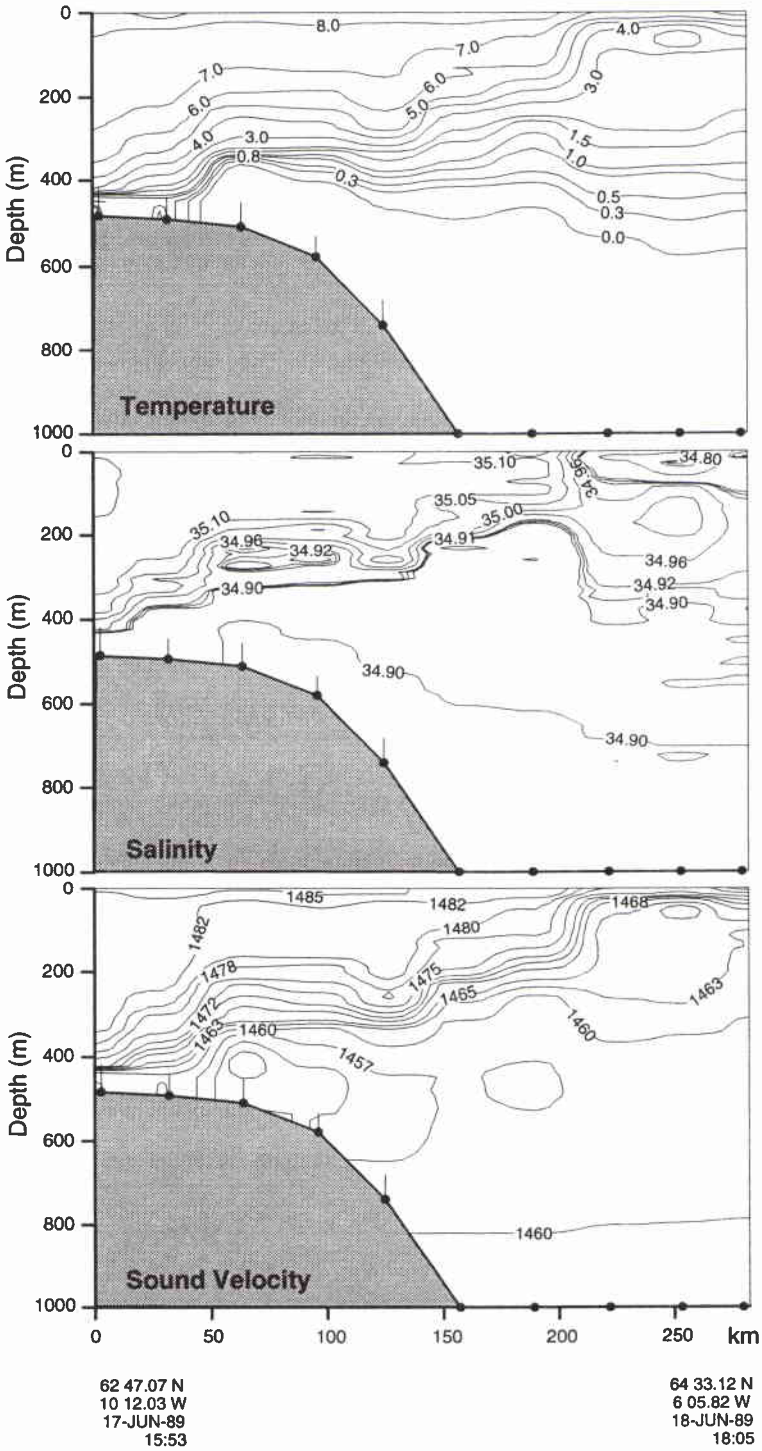

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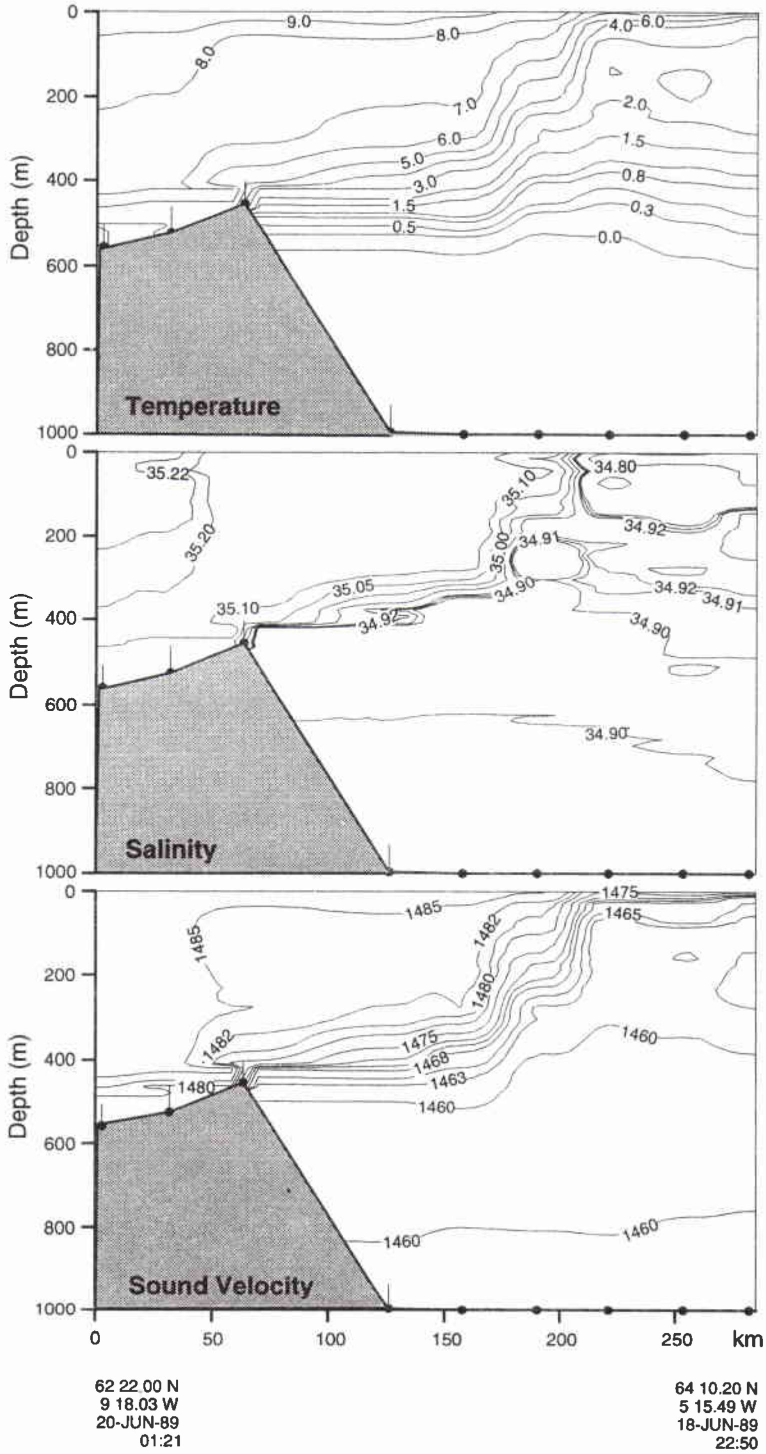

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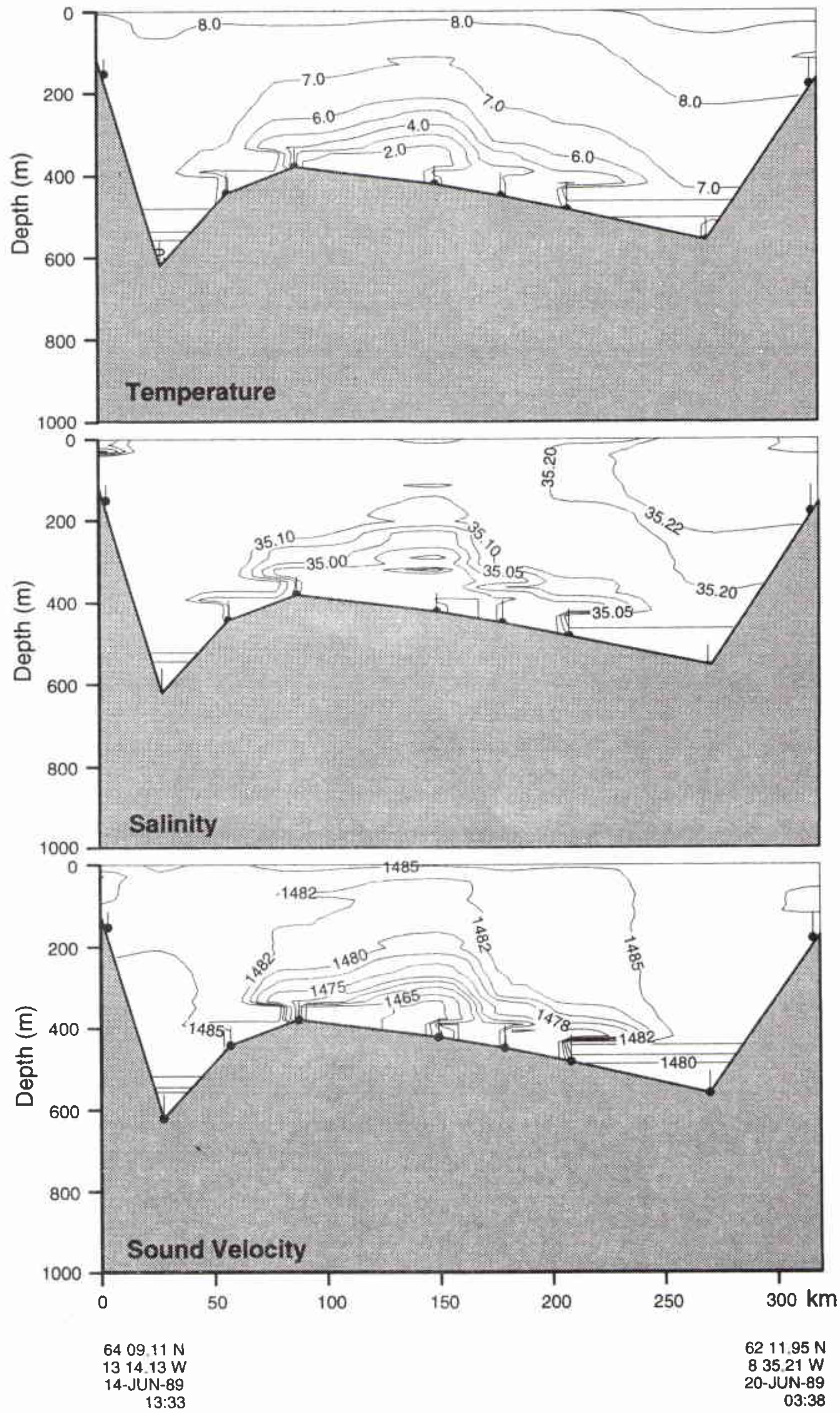

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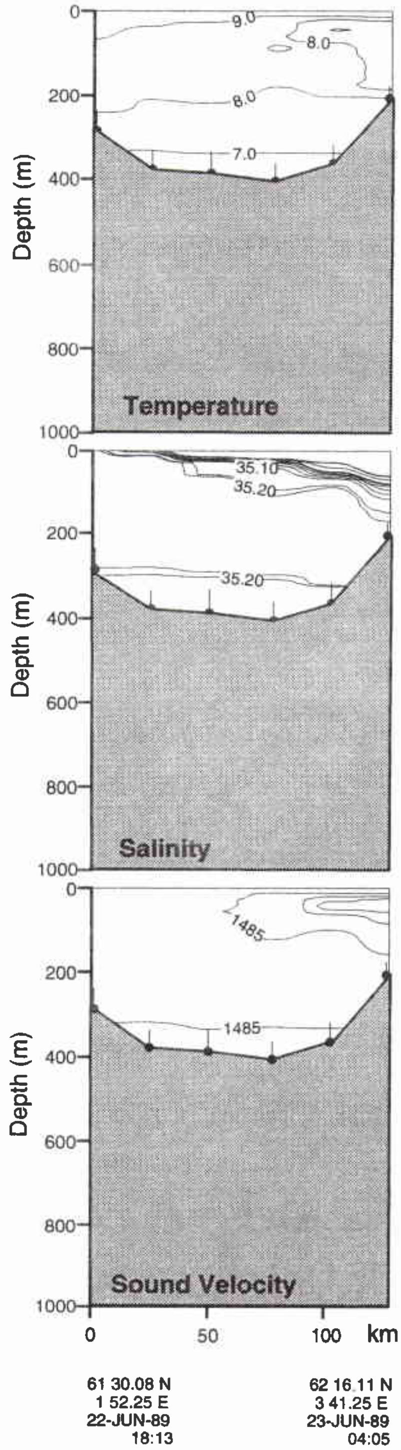

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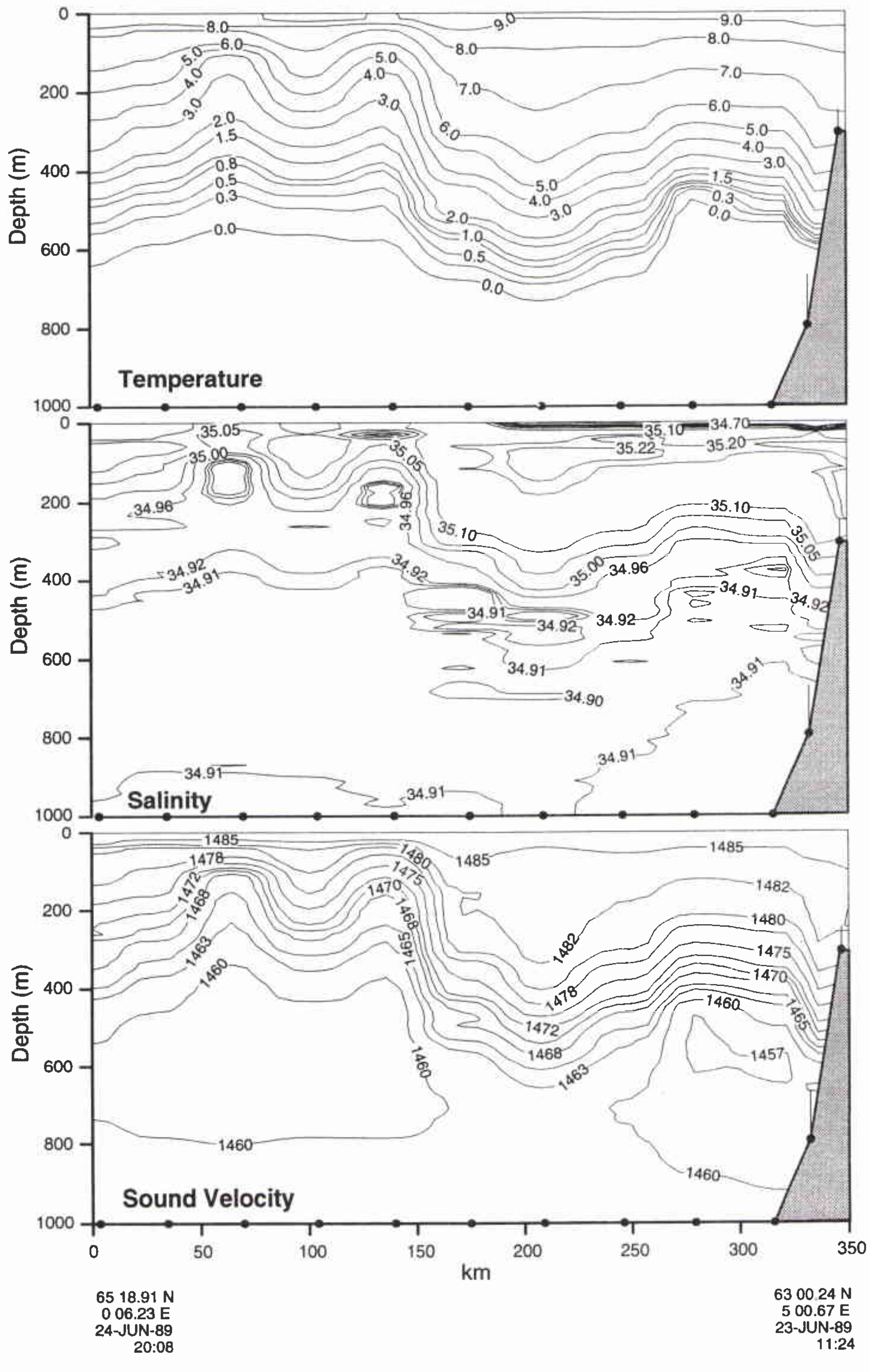

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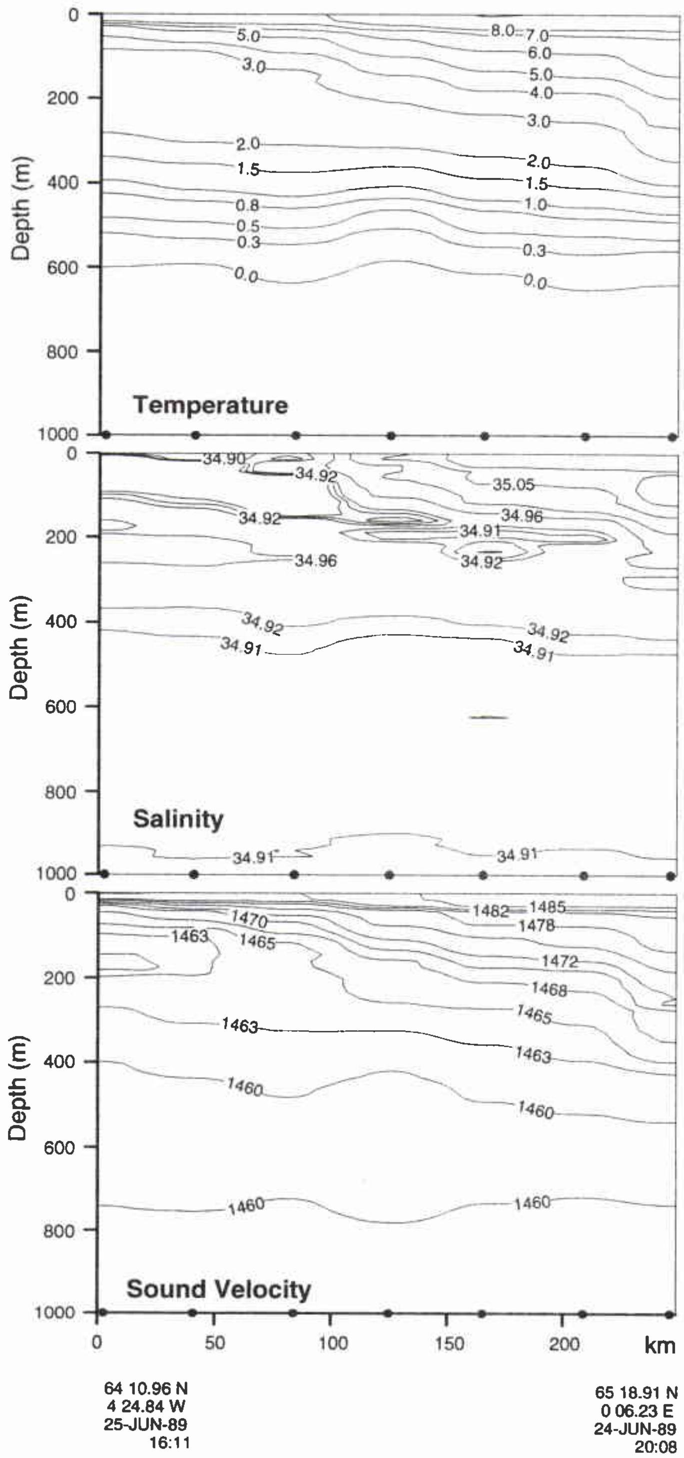

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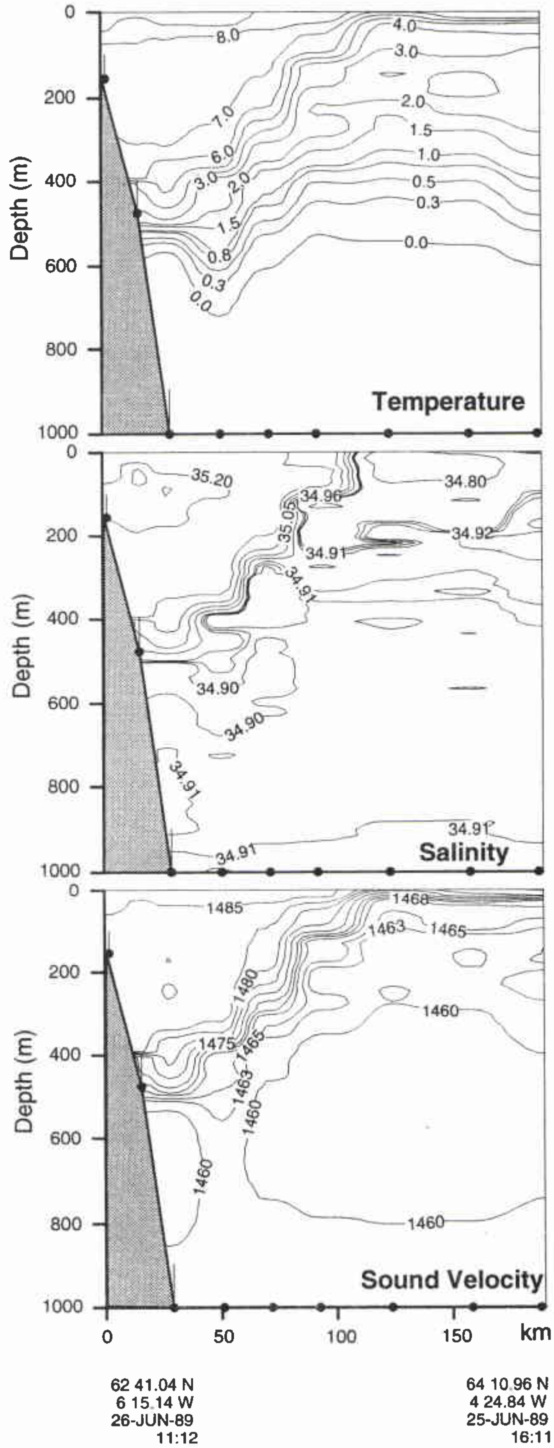

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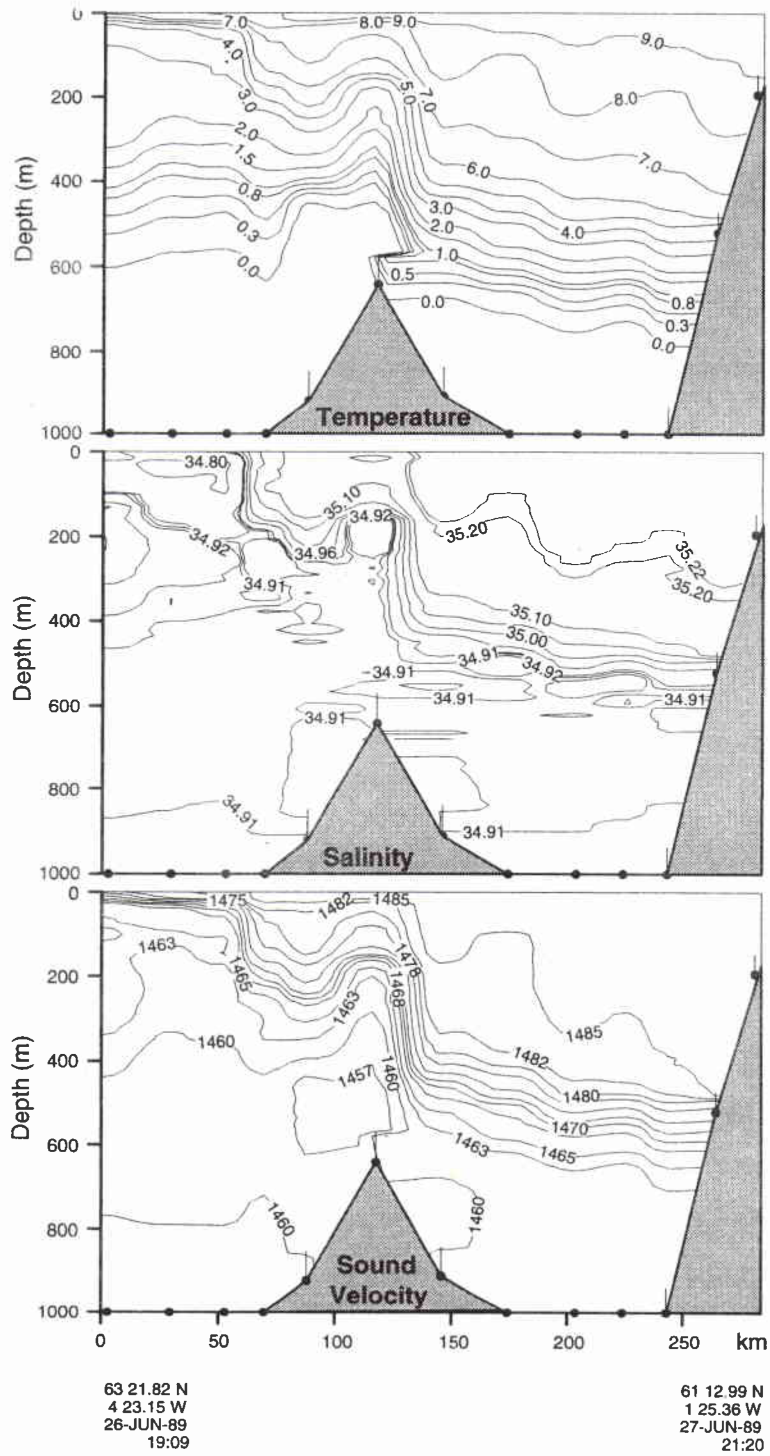

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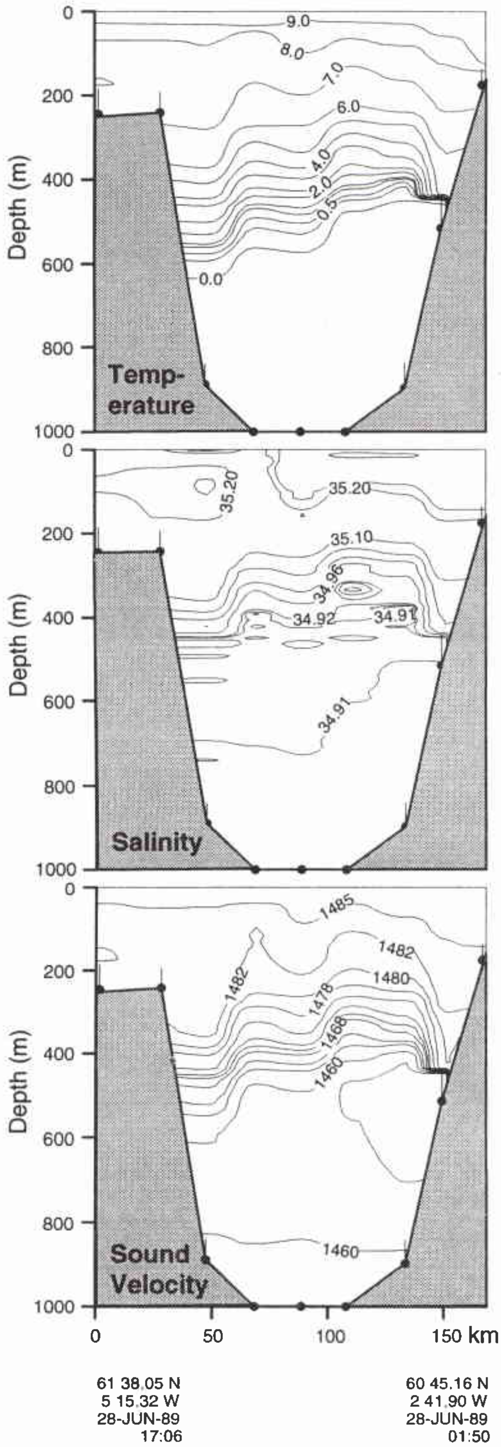

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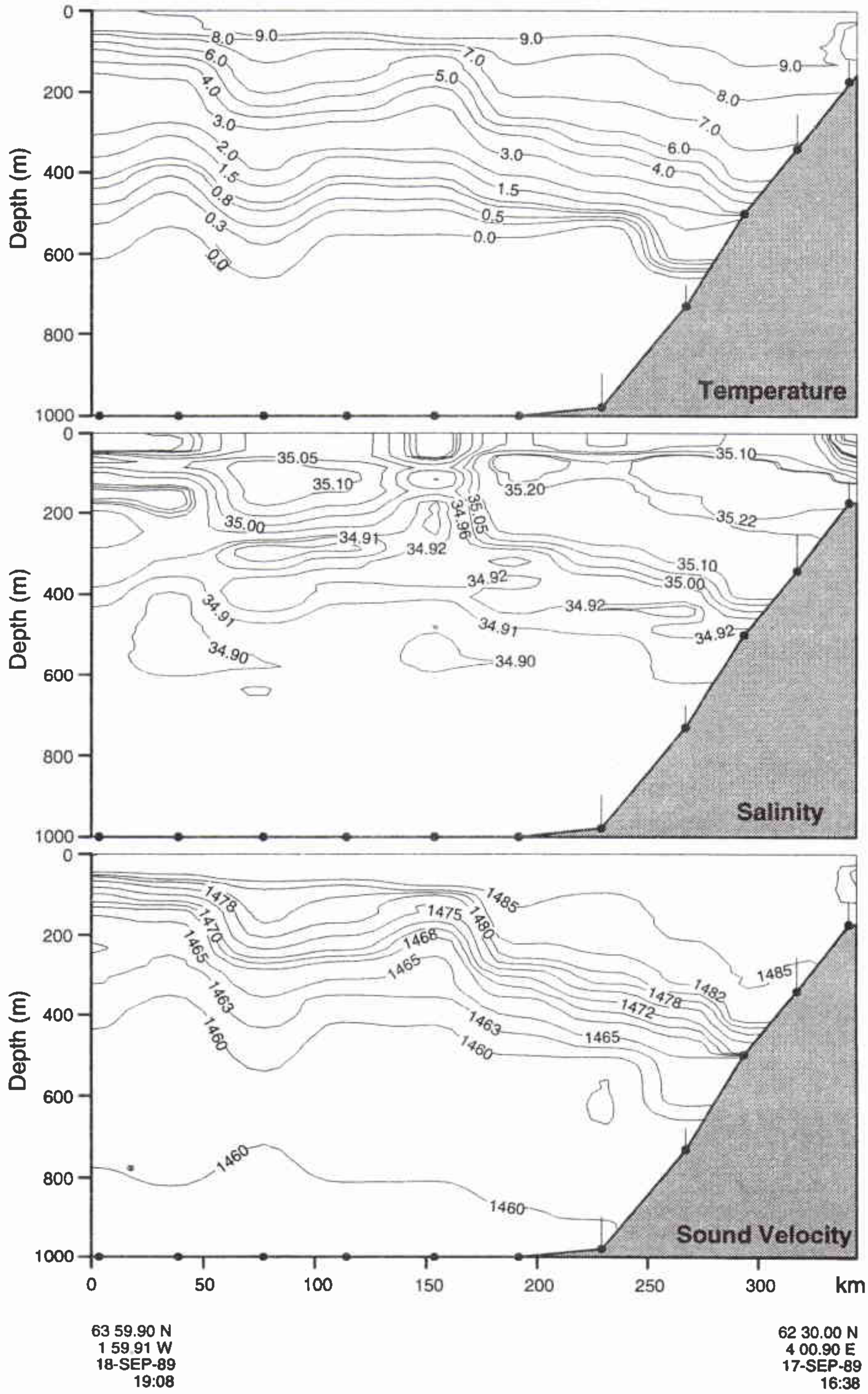

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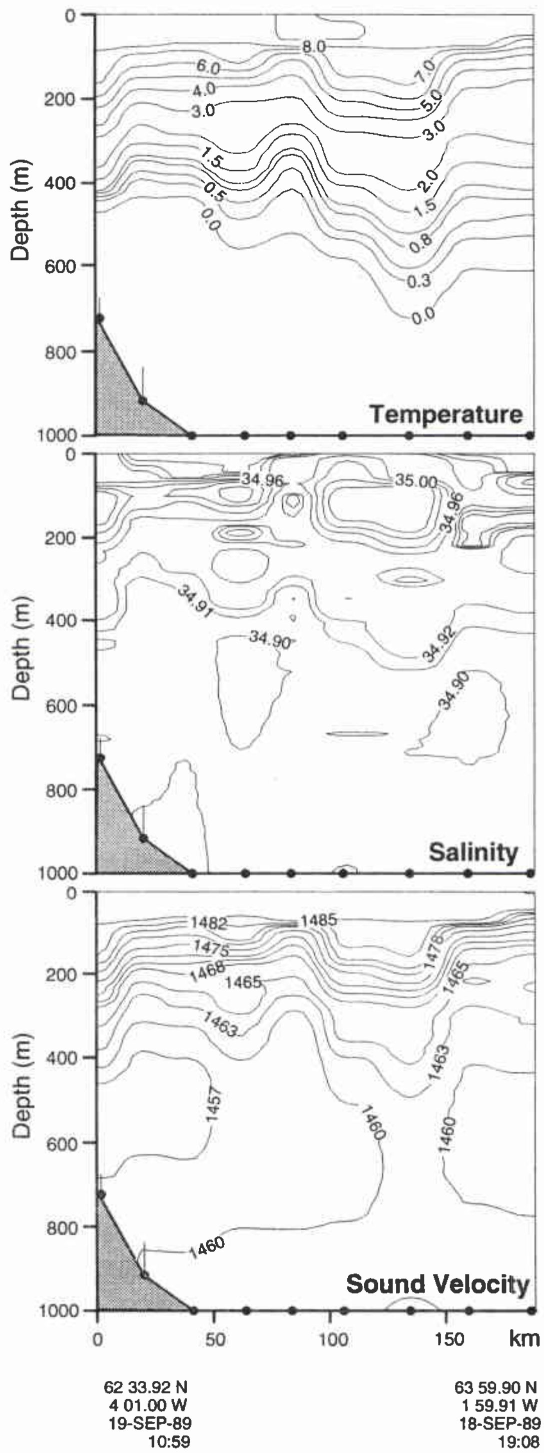

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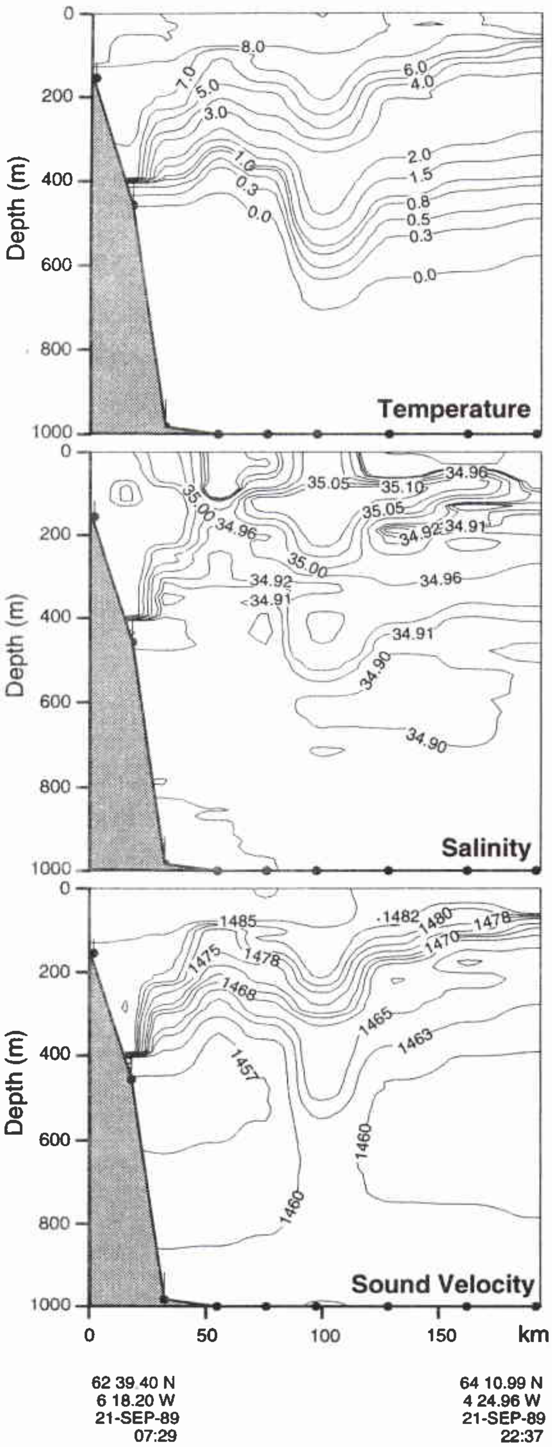

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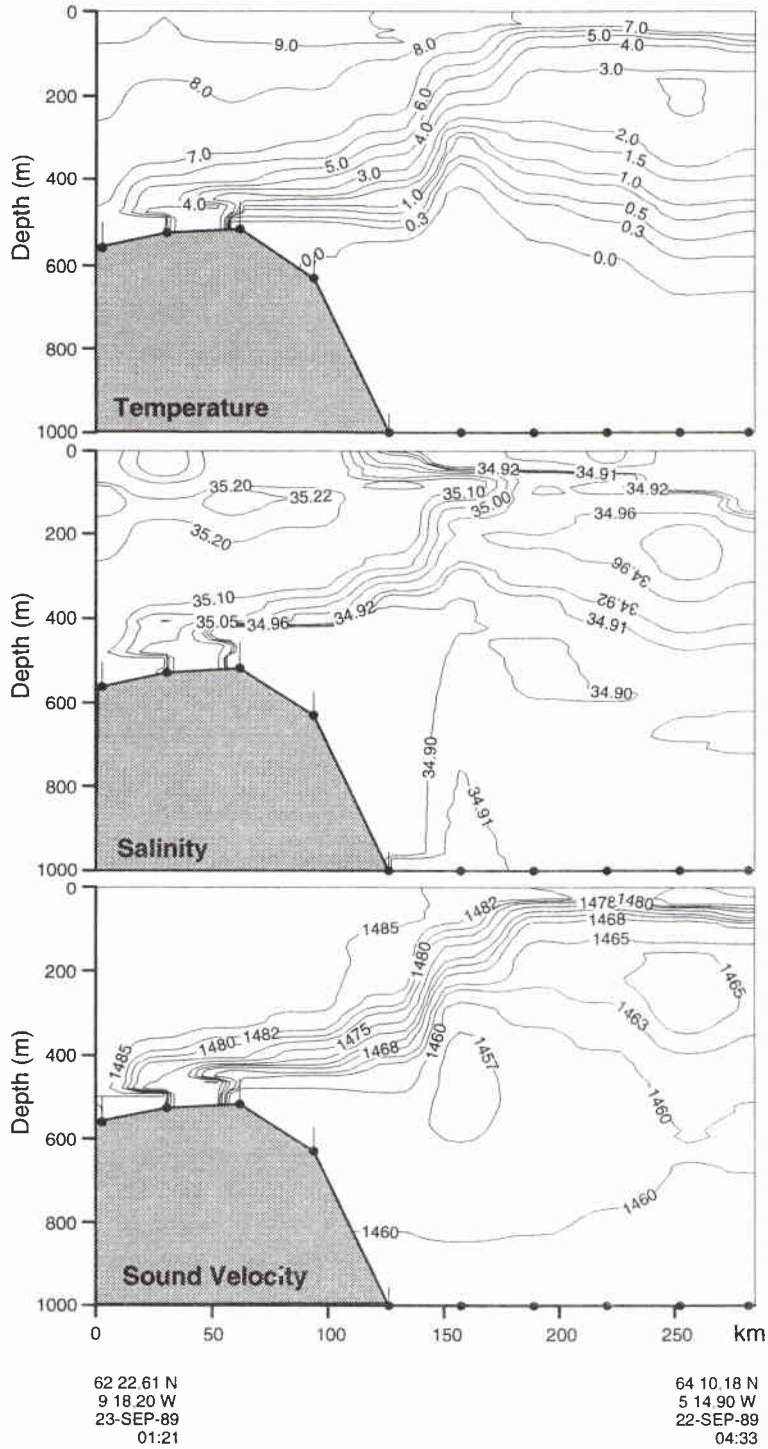

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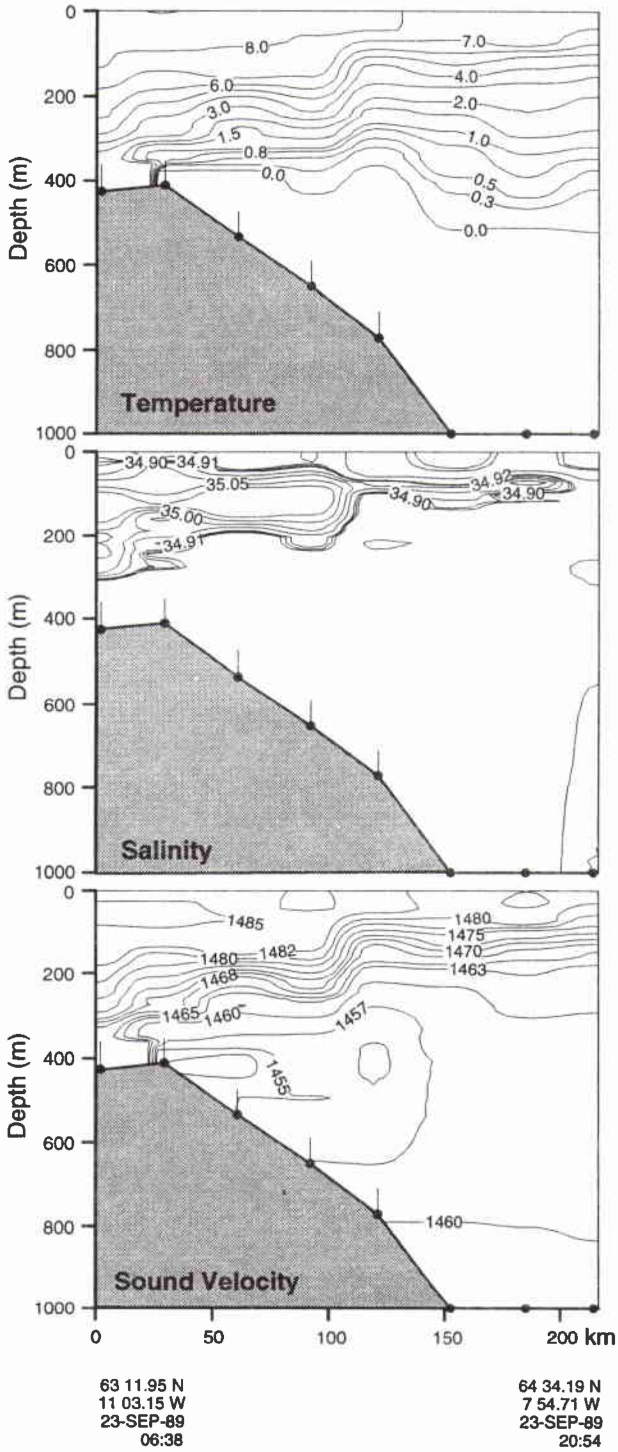

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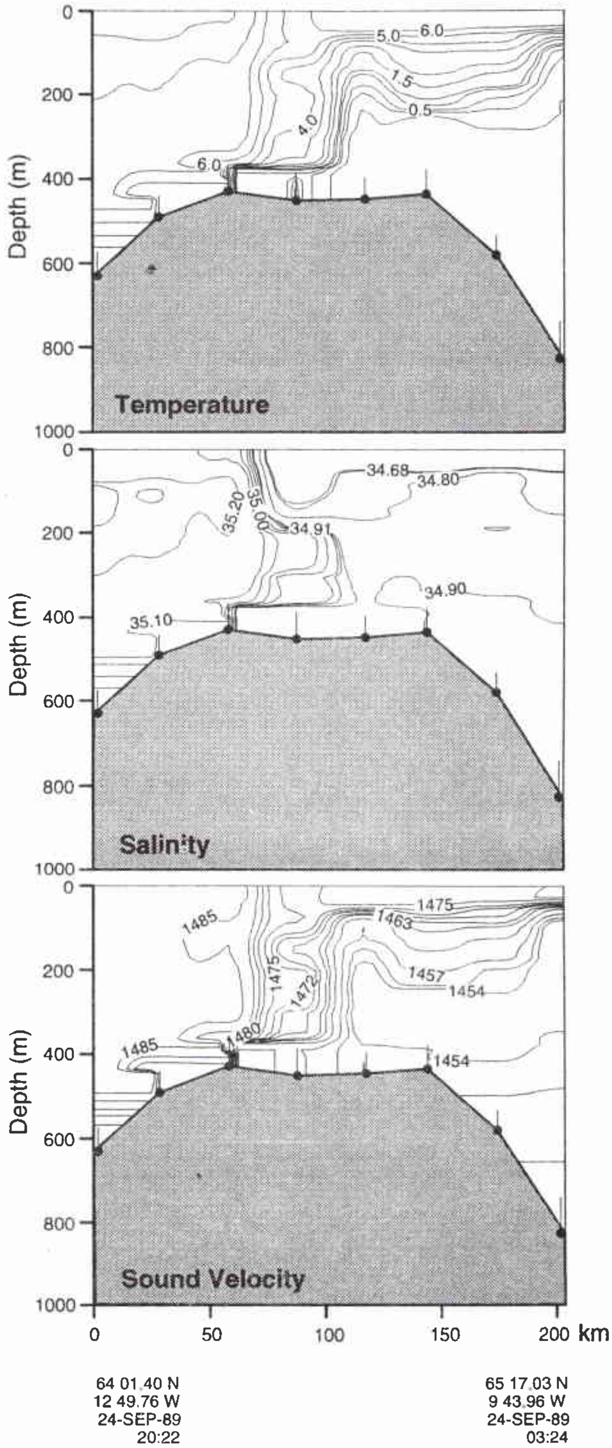

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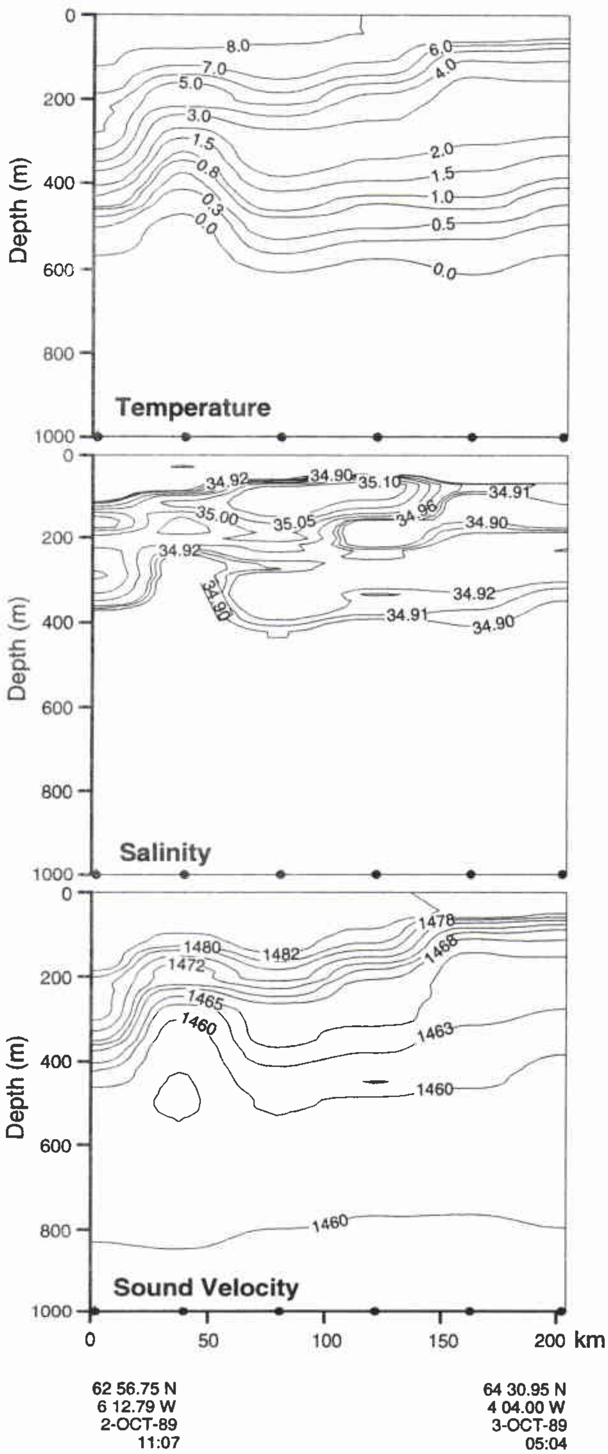


Figure B25 *Section 7B.*

Appendix C

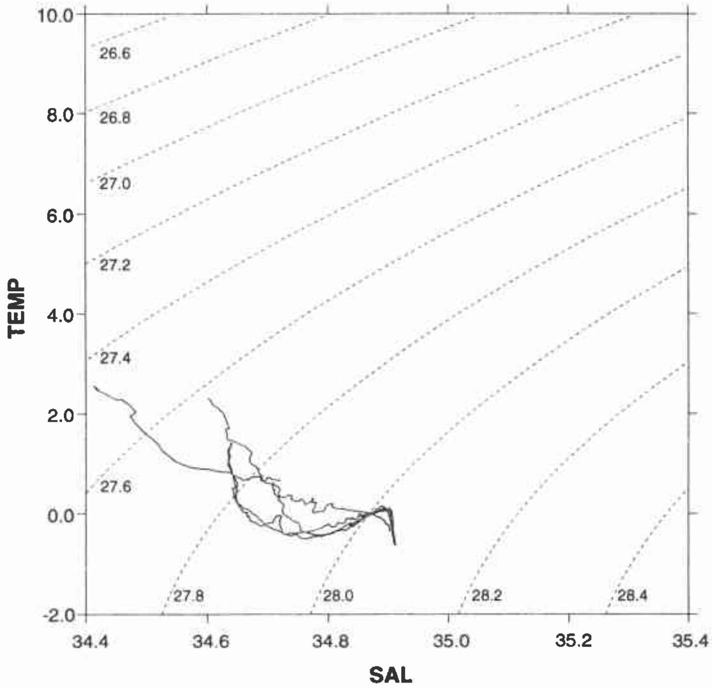
T-S relations along sections

The relation between temperature and salinity provides a useful characterization of water type. Shown here are temperature-salinity diagrams for stations grouped by sections with superimposed density contours. Section locations are plotted in Figs. 1 and 2a,b. Figure numbers here correspond, section by section, with those of Appendix B.

A guide to the origin of the various water massed is given in Table C1. It is as given by Reed and Pollard (1992) except that one additional type, East Greenland Current, has been added.

Table C1 *Water mass characteristics*

Water mass	Temperature	Salinity
North Atlantic water	>8.0	>35.00
Modified North Atlantic water	7.5–8.0	35.20–35.25
Norwegian North Atlantic water	3.0	34.98
Arctic Intermediate water	0.0	34.90
Norwegian Sea deep water	−0.5	34.92
East Icelandic current	8.0	34.30
East Icelandic water	0.4	34.74
East Greenland current	<0.0	<34.6



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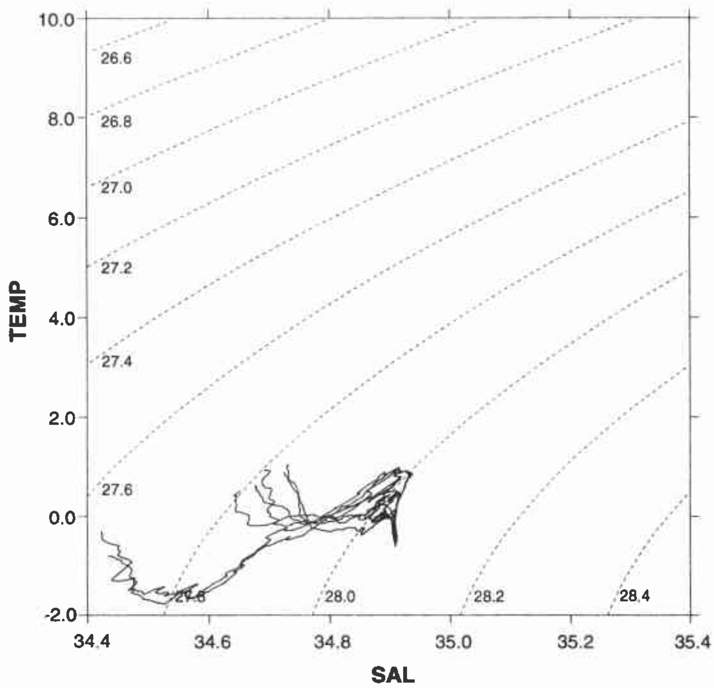

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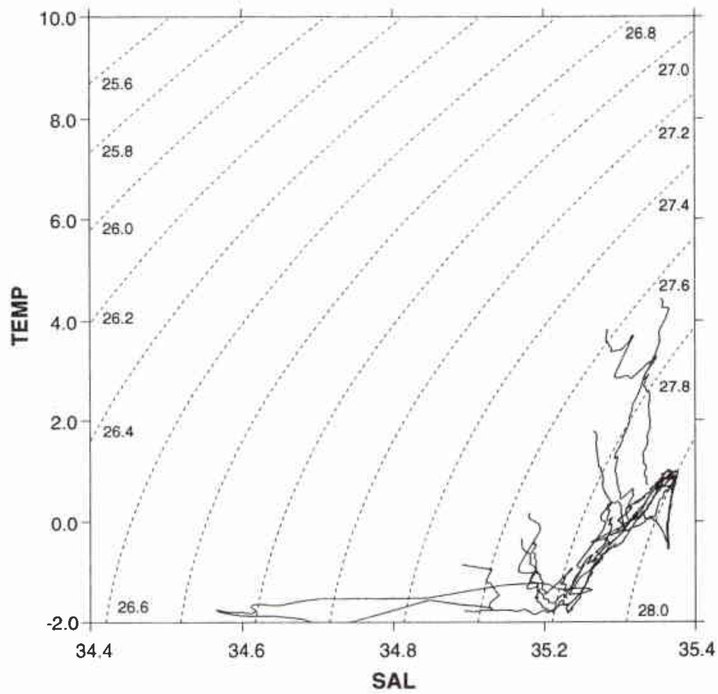

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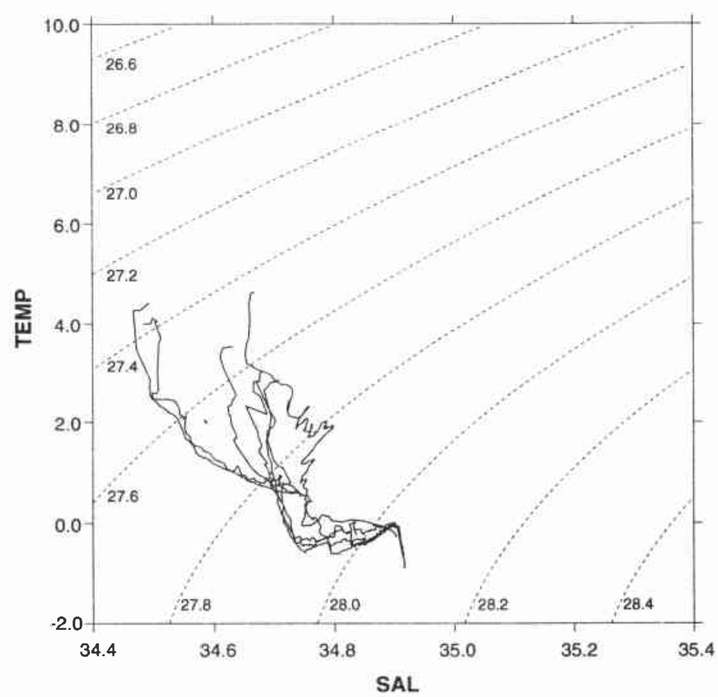

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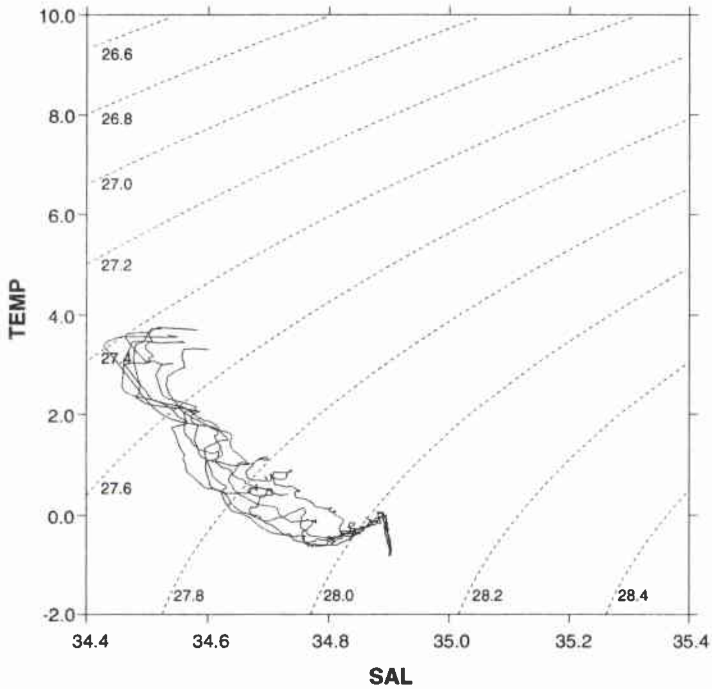

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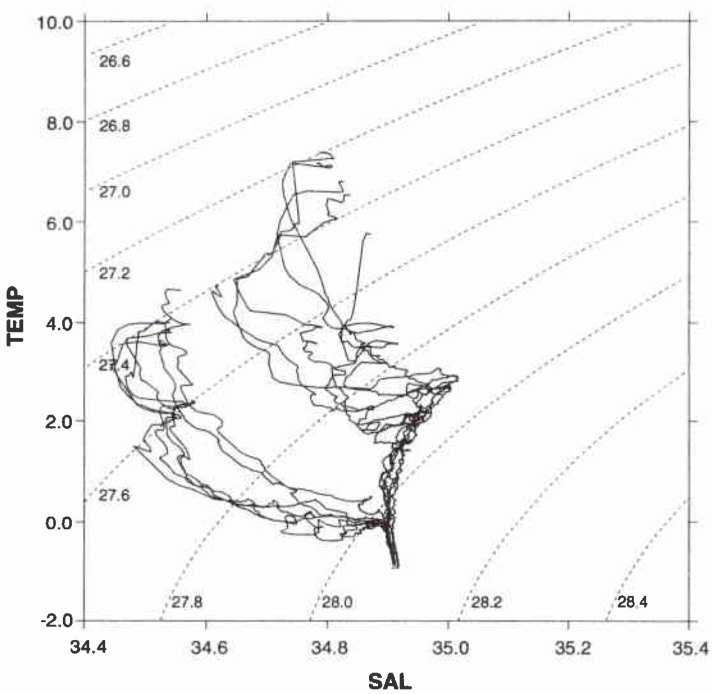

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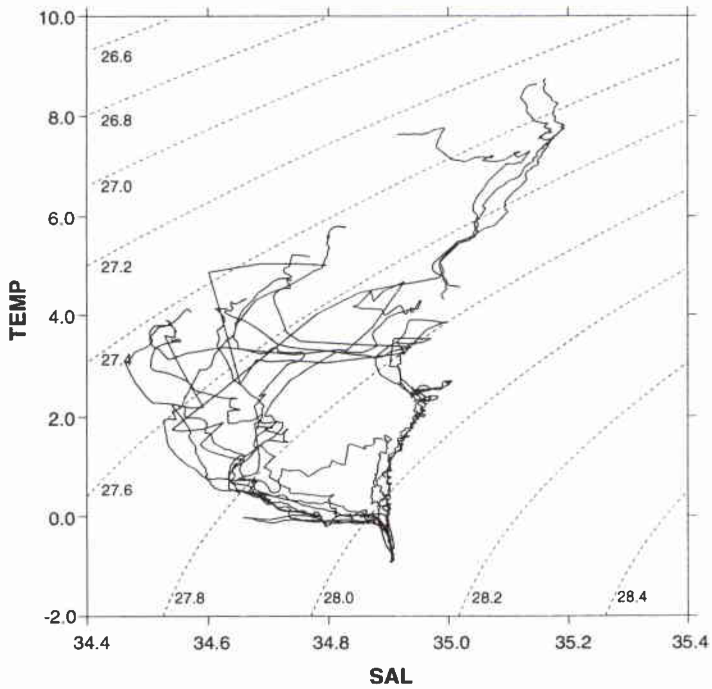

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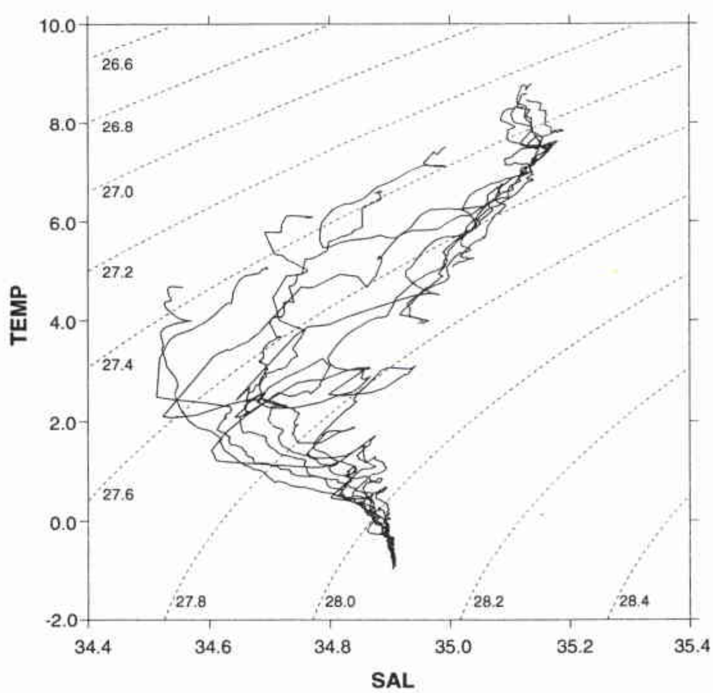

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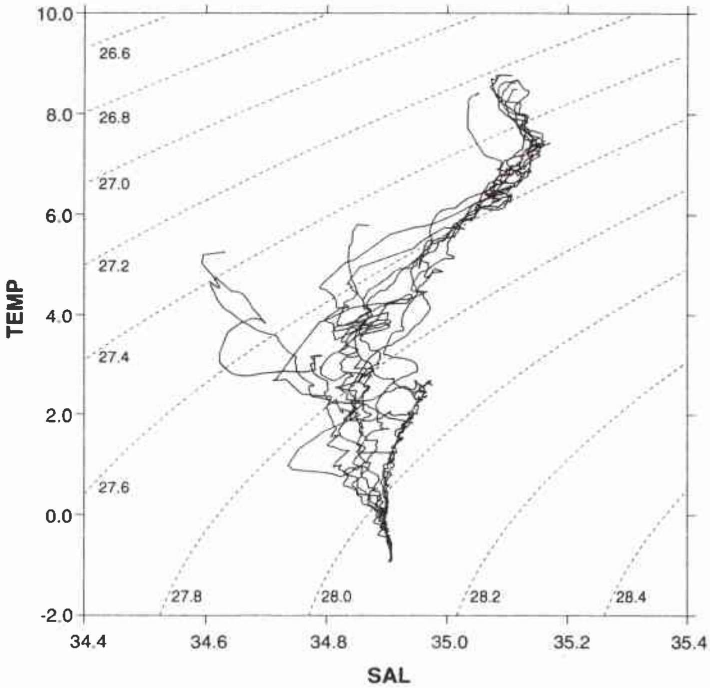

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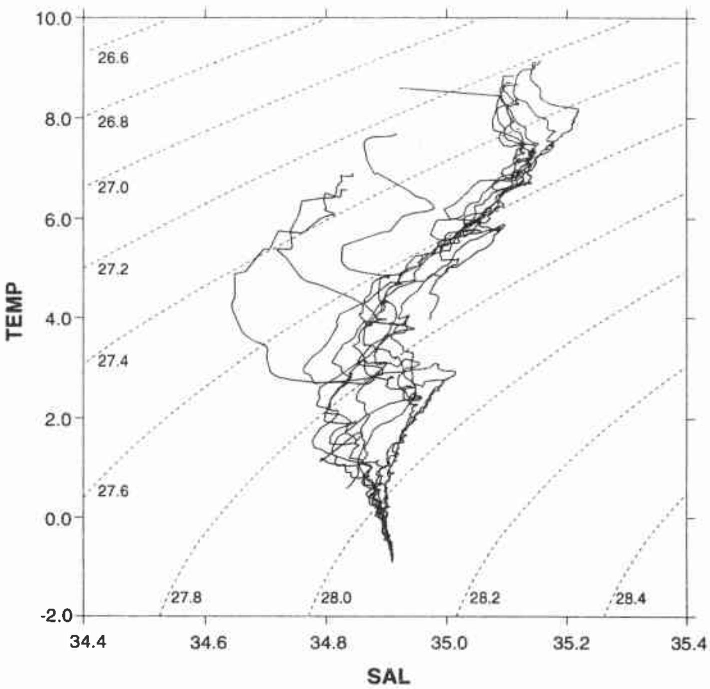

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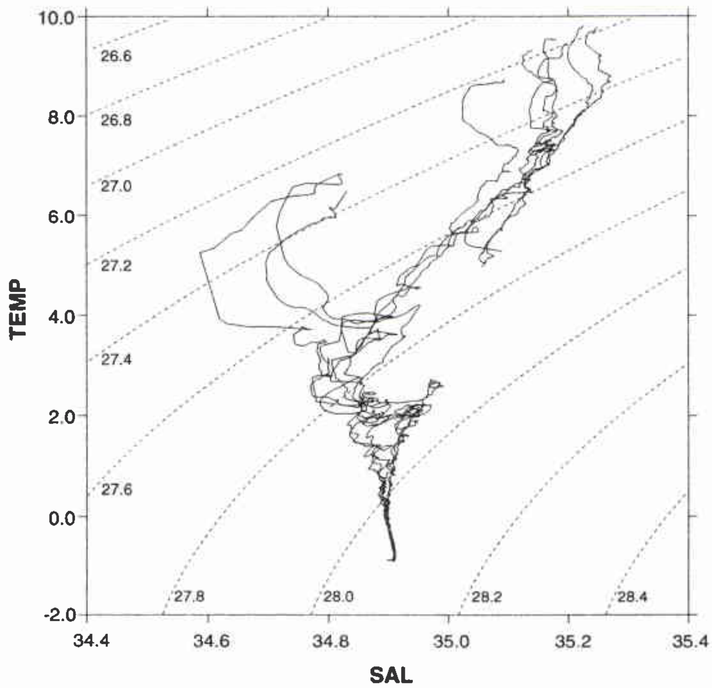

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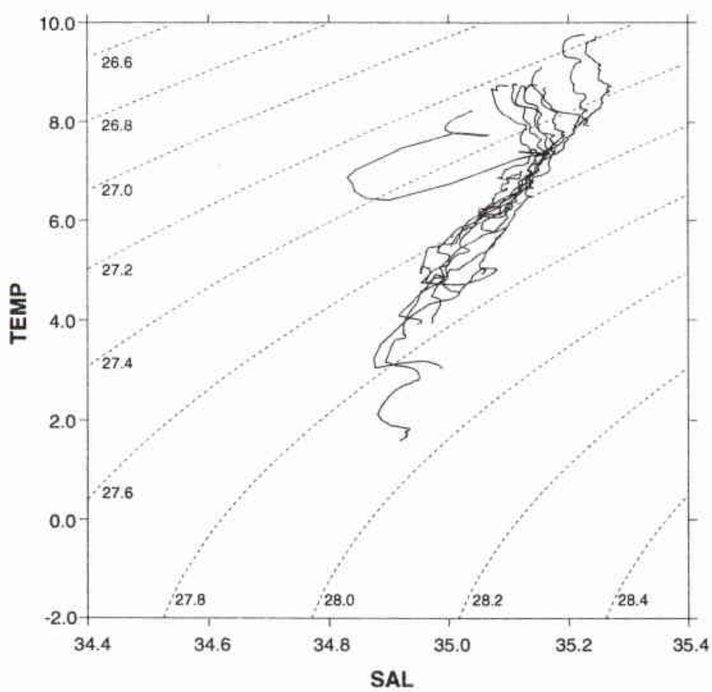

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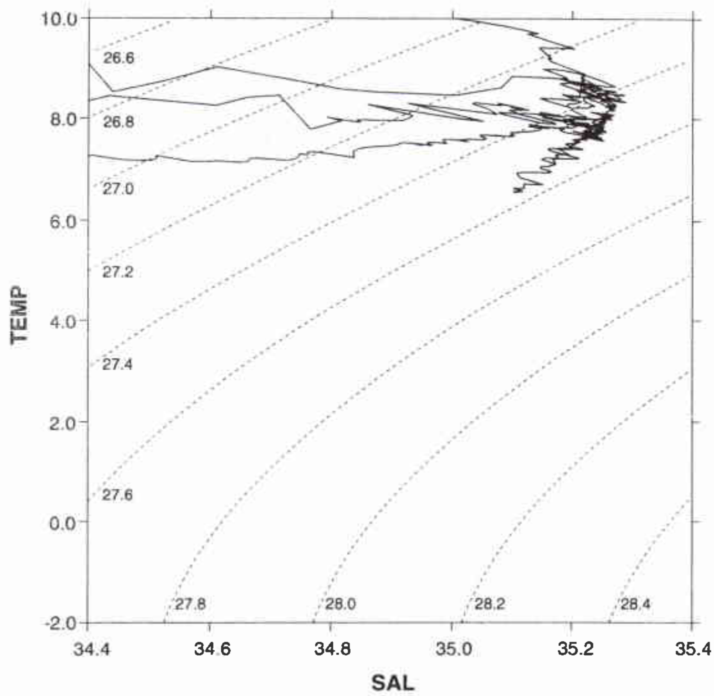

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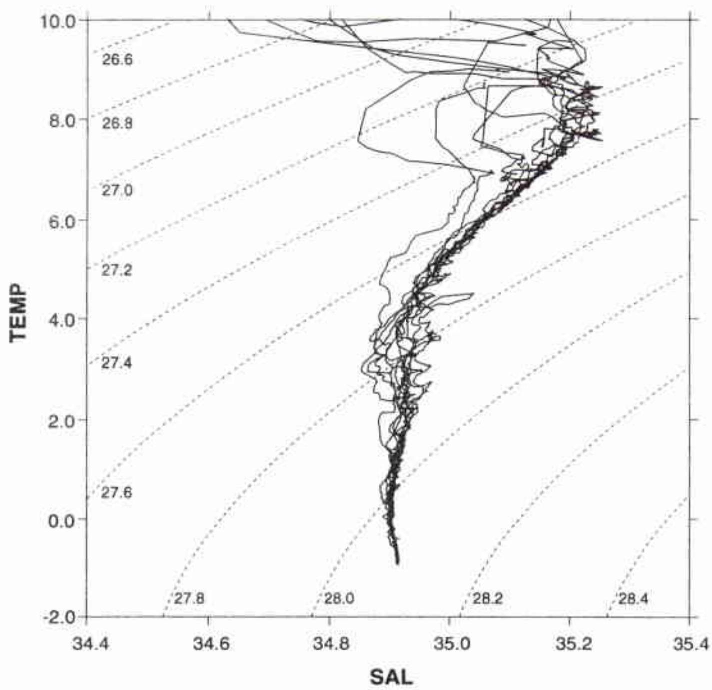

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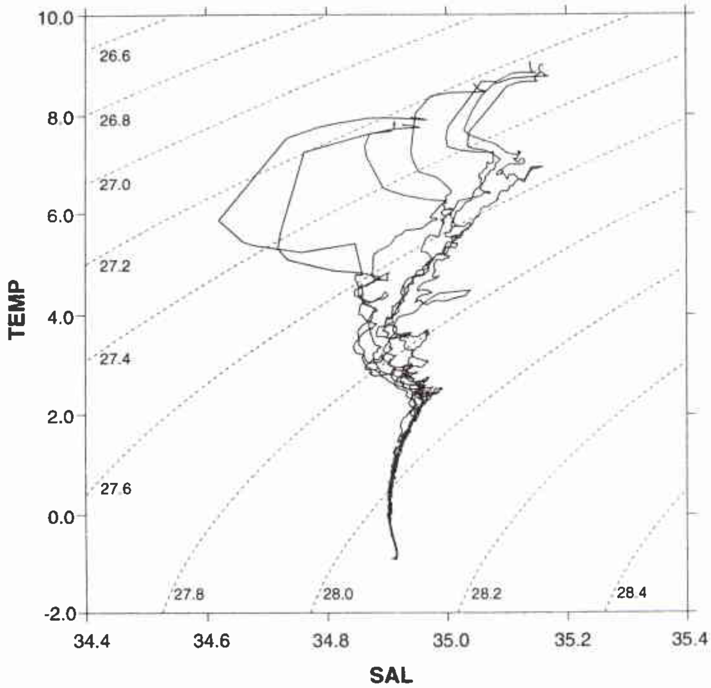

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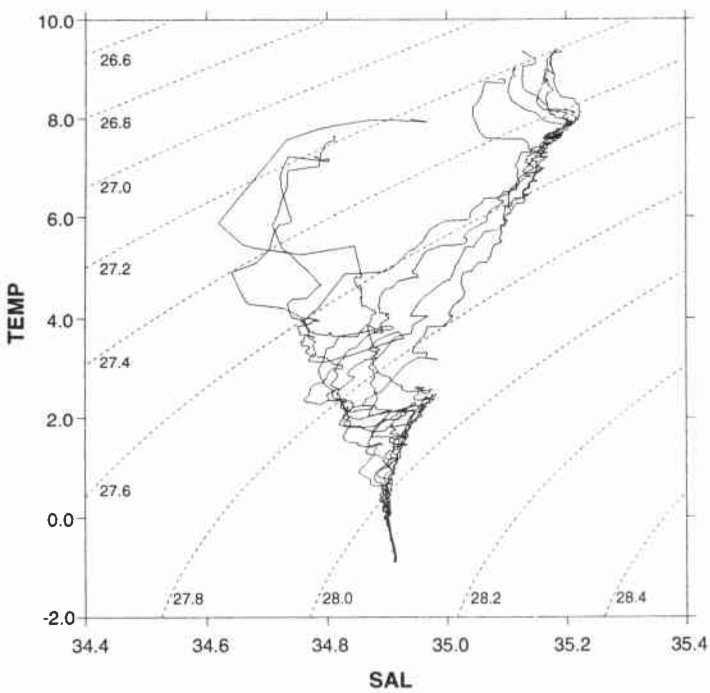

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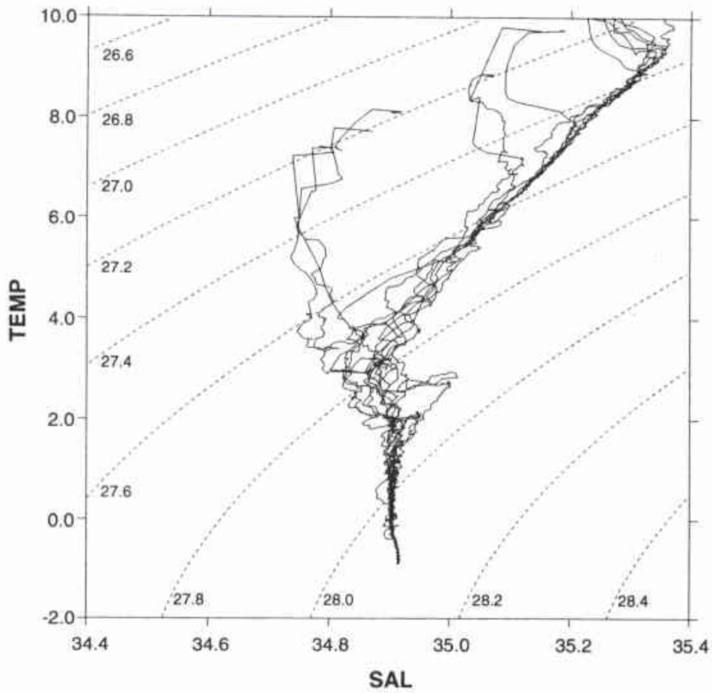

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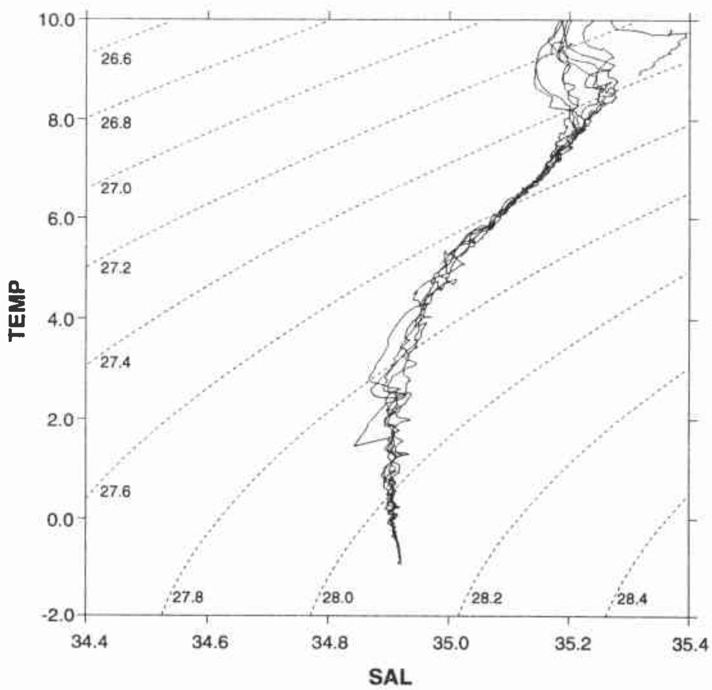

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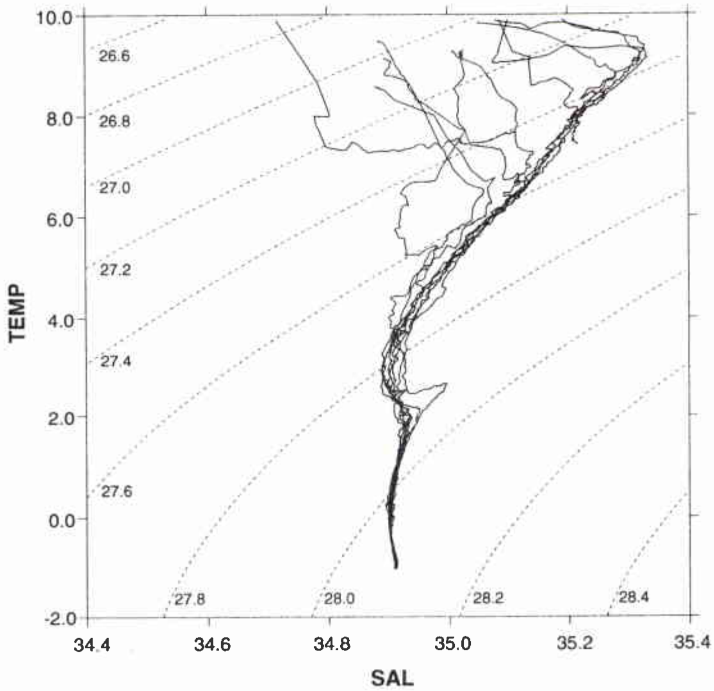

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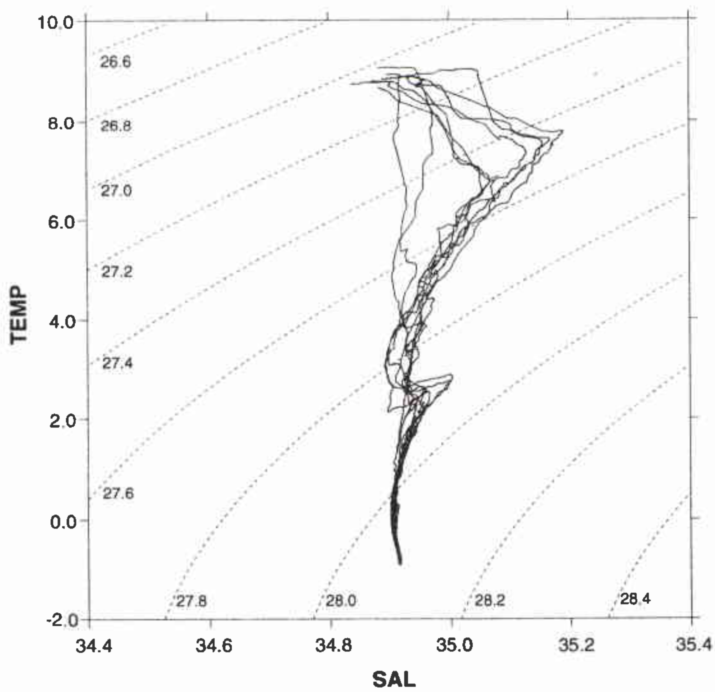

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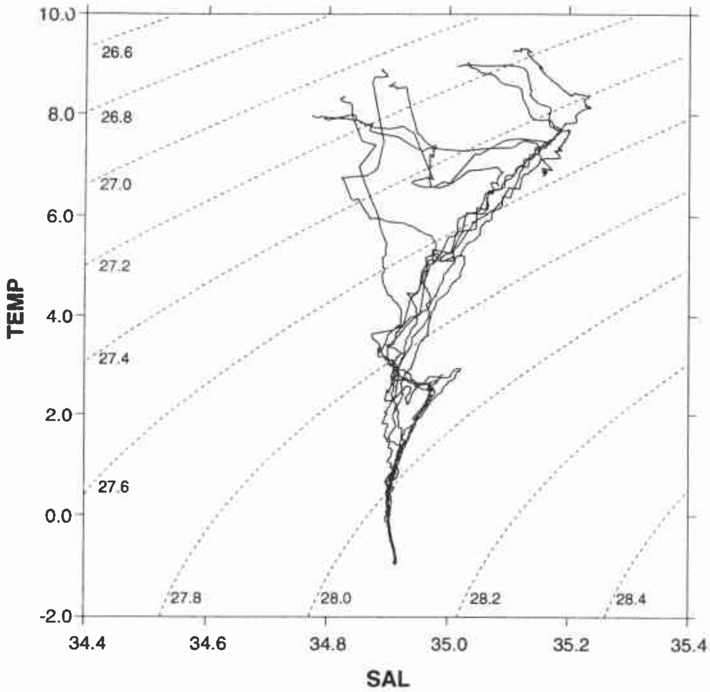

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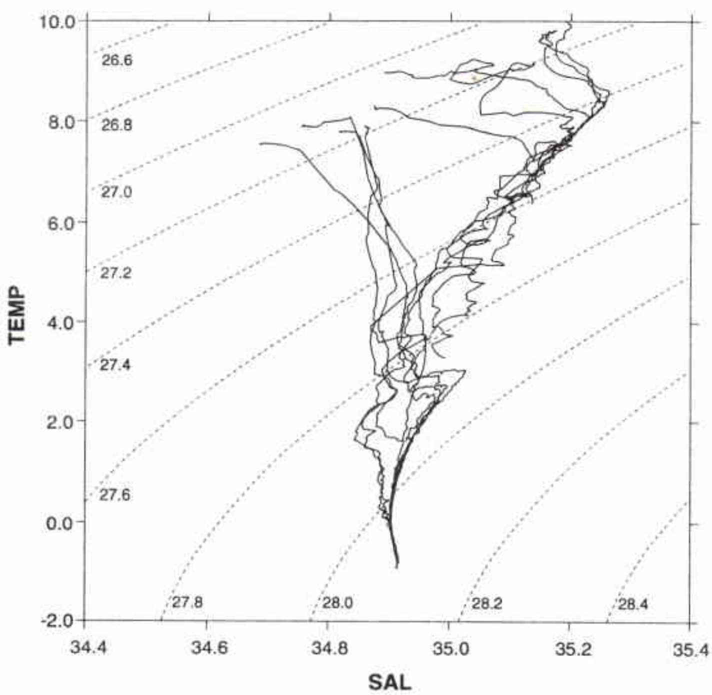

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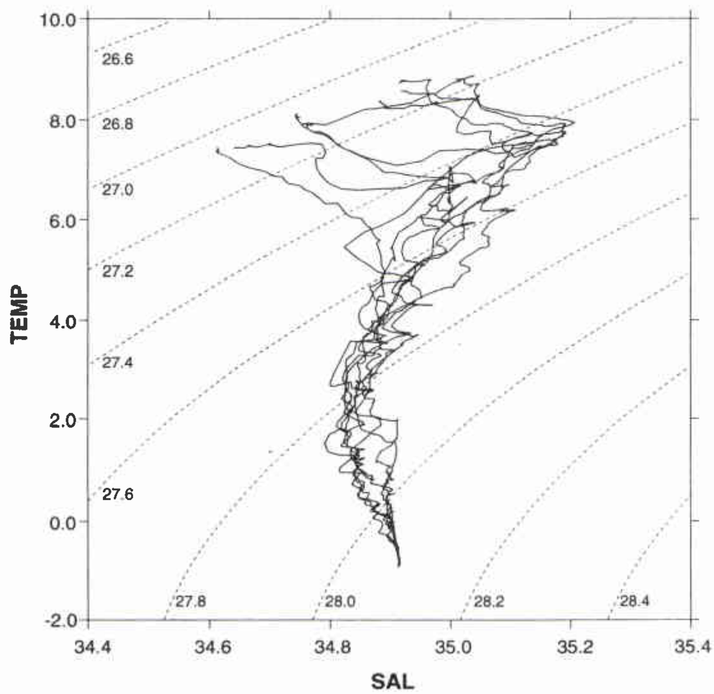

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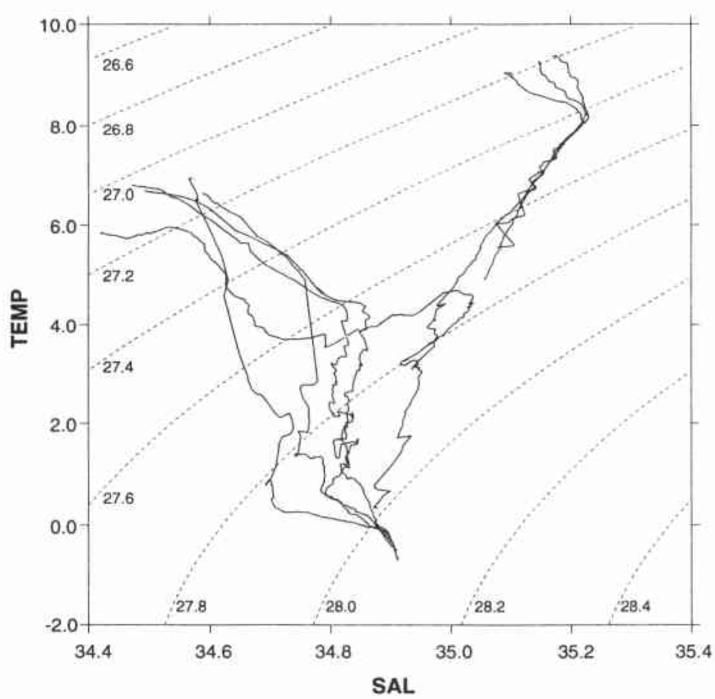

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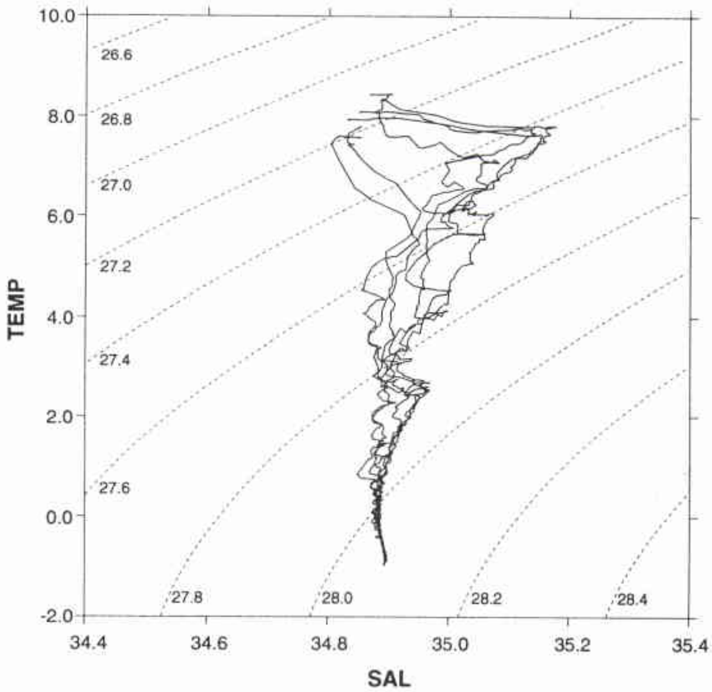

Figure C25 *Section 7B.*

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Author(s)

H. Perkins, W. Aicken, G. Baldasserini, M. Zahorodny and P. Zanasca

Title

Hydrographic measurements in the southern Iceland and Norwegian Seas during June and August, 1989

Abstract

This memorandum documents an extensive collection of CTD data made during two cruises in the region between Greenland and Norway with emphasis on the Iceland–Faeroe Ridge. A summary of data collection and processing procedures is given, and some oceanographic features are noted. The main content of the memorandum, however, consists of appendices in which the data are displayed. A total of 25 sections, comprised of some 220 stations altogether, are presented as contours of temperature, salinity and sound speed, and as T-S diagrams.

Keywords

Iceland–Faeroe ridge, salinity, sound speed, temperature

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