Report no. changed (Mar 2006): SM-262-UU

124

SACLANTCEN MEMORANDUM
serial no.: SM-262

SACLANT UNDERSEA RESEARCH CENTRE

MEMORANDUM

Hydrography of the Iceland–Faeroe Ridge during March 1992: Environmental data during NORDIC 92

H. Perkins, J. Sellschopp, A. Warn-Varnas, M. Zahorodny and G. Baldasserini

December 1992

The SACLANT Undersea Research Centre provides the Supreme Allied Commander Atlantic (SACLANT) with scientific and technical assistance under the terms of its NATO charter, which entered into force on 1 February 1963. Without prejudice to this main task – and under the policy direction of SACLANT – the Centre also renders scientific and technical assistance to the individual NATO nations.

Report no. changed (Mar 2006): SM-262-UU

This document is released to a NATO Government at the direction of SACLANT Undersea Research Centre subject to the following conditions:

- The recipient NATO Government agrees to use its best endeavours to ensure that the information herein disclosed, whether or not it bears a security classification, is not dealt with in any manner (a) contrary to the intent of the provisions of the Charter of the Centre, or (b) prejudicial to the rights of the owner thereof to obtain patent, copyright, or other like statutory protection therefor.
- If the technical information was originally released to the Centre by a NATO Government subject to restrictions clearly marked on this document the recipient NATO Government agrees to use its best endeavours to abide by the terms of the restrictions so imposed by the releasing Government.

Page count for SM-262
(excluding Covers
and Data Sheet)

Pages	Total
i–vi	6
1–50	50
	56

SACLANT Undersea Research Centre
Viale San Bartolomeo 400
19138 San Bartolomeo (SP), Italy

tel: 0187 540 111
fax: 0187 524 600
telex: 271148 SACENT I

NORTH ATLANTIC TREATY ORGANIZATION

Report no. changed (Mar 2006): SM-262-UU

Hydrography of the Iceland–Faeroe Ridge during March 1992: Environmental data during NORDIC 92

H. Perkins, J. Sellschopp, A. Warn-Varnas,
M. Zahorodny and G. Baldasserini

The content of this document pertains to work performed under Project 04 of the SACLANTCEN Programme of Work. The document has been approved for release by The Director, SACLANTCEN.

Issued by:
Underwater Research Division

H. Urban
Division Chief

intentionally blank page

Report no. changed (Mar 2006): SM-262-UU

Hydrography of the Iceland–Faeroe Ridge during March 1992: Environmental data during NORDIC 92

H. Perkins, J. Sellschopp, A. Warn-Varnas,
M. Zahorodny and G. Baldasserini

Executive Summary: Acoustic propagation forecasting in the vicinity of and across ocean fronts continues to be a problem of naval as well as scientific interest. In order to improve the capability of acoustic propagation forecasting in the vicinity of an ocean front, it is necessary to improve the understanding of front evolution and dynamics.

In a series of oceanographic surveys, SACLANTCEN has explored the environmental and acoustical conditions associated with ocean fronts. This memorandum provides the environmental data from the large-scale survey of one such trial in the vicinity of the Iceland–Faeroe front. It details the results of CTD and XBT measurements made during the multi-national (Germany, United States, and SACLANTCEN) trial NORDIC 92, an integrated trial of measurement and modeling of the physical and acoustic environment. The data is stored at SACLANTCEN and FWG, Germany, and are readily available for processing or display.

The environmental data, in addition to supporting the follow-on acoustic experiments conducted in the area, will be used to validate hypotheses of the dynamics of the front and to initialize and validate numerical ocean forecasting models.

Report no. changed (Mar 2006): SM-262-UU

intentionally blank page

Report no. changed (Mar 2006): SM-262-UU

Hydrography of the Iceland–Faeroe Ridge during March 1992: Environmental data during NORDIC 92

H. Perkins, J. Sellschopp, A. Warn-Varnas,
M. Zahorodny and G. Baldasserini

Abstract: This memorandum documents an extensive collection of CTD and XBT data made on the Iceland–Faeroe Ridge in March, 1992 by the SACLANTCEN vessel *Alliance* and the FWG vessel *Planet* as part of a larger operation called NORDIC 92. A summary of data collection and processing procedures is given, and some of the more striking oceanographic features are noted. The main content of the report, however, consists of a series of appendices in which the data is displayed in various ways. XBTs were used to provide increased resolution between CTD stations or in place of them when weather conditions precluded CTD work. In the data displays, CTD and XBT measurements have been merged by assigning to the XBTs salinities derived from nearby CTD stations.

Keywords: CTD ○ NORDIC 92 ○ XBT

Report no. changed (Mar 2006): SM-262-UU

Contents

Acknowledgements: The contributions of our colleagues and the officers and crews on both vessels are gratefully acknowledged. Our thanks go to Will Aicken for preparing the figures. This work was supported by SACLANTCEN Project 04 and by the FWG through Project 1.2.4.

1
Introduction

The first leg for both *Alliance* and *Planet* was primarily devoted to a large scale survey of the Iceland–Faeroe Front (IFF), part of an effort to understand its evolution and dynamics. The survey plan is shown in Fig. 1. Other measurements made during the cruise, although not described here, also supported this objective. Moored current meters recovered early in the leg were planned to monitor inflow conditions to the region and to detect any deep overflow events, which are thought to influence development of the front. Towed instruments – SeaSoar and a temperature–conductivity chain – provided small-scale structures in the front, which are related to mixing processes. High-resolution AXBT surveys provided three-dimensional views of the front over a limited area north of the Faeroes.

Leg 2 was an acoustic experiment, positioned according to the results of Leg 1 so that transmission paths were in deep water and crossed the front. In the selected area north of the Faeroes, acoustic measurements were made between *Helmsand*, the source ship, and *Alliance*, the receiving ship, while *Planet* made CTD and towed instrument sections nearby.

This report is intended to document CTD and XBT measurements made from the SACLANTCEN ship *Alliance* and the FWG ship *Planet* during the program NORDIC 92. The data itself is archived at SACLANTCEN and FWG, and is available to project participants on request. The purpose of the data collection was to provide environmental support for acoustic operations, to evaluate hypotheses concerning dynamics of the region, and to provide initialization and validation of numerical models. Here we provide a description of the data with these purposes in mind. An overall view of the program is provided by the Operation Order for NORDIC 92.

Report no. changed (Mar 2006): SM-262-UU

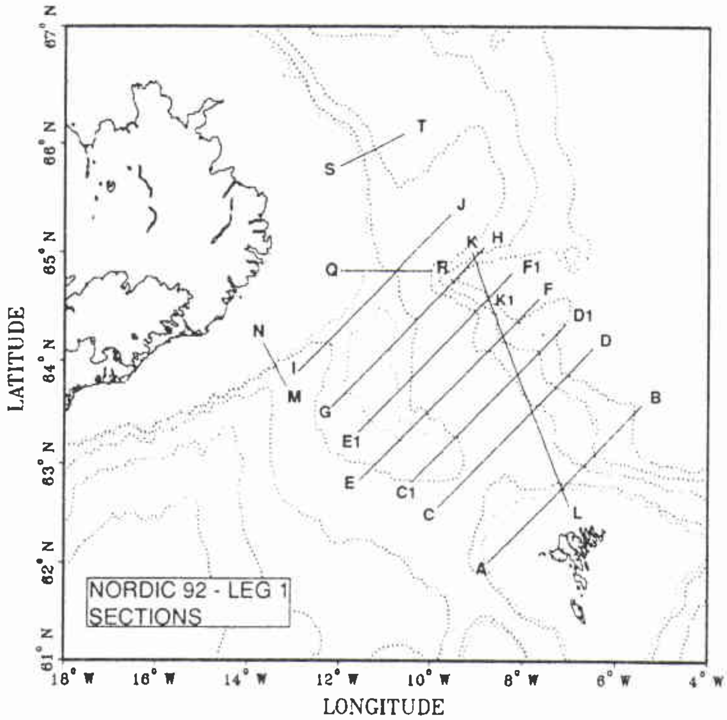

Figure 1 *Area map and identification of sections. Appendix A gives a more detailed description of station positions and times, including those for Leg 2. See also Figs. A1 (a,b) for an overall view of station positions and Figs. A2–A5 for maps of CTD and XBT positions and station numbers.*

2
Data Collection

Alliance CTD data were collected using an NBIS/EGG Mk-V instrument. Profiles extend to within 20 m of 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. *Planet* CTD data were collected with a Salzgitter Elektronik Bathysonde 2000 LS and usually extended to within 3 m of the bottom.

Both ships used water sample bottles only on a few stations. In the high sea-states encountered during most of the cruise, the CTD would not sink fast enough during lowering 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.

XBT data was collected between CTD stations during the Leg 1 survey to improve spatial resolution. Failure rate of these was higher than normal, presumably because high winds blew the wire against the ship. All drops reported here have been edited. Many that remain do not extend to full depth. XBTs from *Alliance* have their surface value replaced by a bucket thermometer reading.

3
Data Processing

Planet CTD and XBT data was transferred to *Alliance* during the stop in Tórshavn following Leg 1. During Leg 2, CTD stations 58–67 and 72–76 were transferred to *Alliance* by radio link and modems connected to PCs. Preliminary data editing and processing was done at sea on *Alliance*. Copies of the processed data were transferred back to *Planet* in Tórshavn following Leg 2. Post-cruise processing has been carried out at SACLANTCEN.

Both ships suffered from instrument problems which affected the quality of salinity data. This was easily apparent in the values measured in the deeper water north of the Iceland–Faeroe Ridge (IFR) where the deep salinity is very stable at about 34.91. It has been necessary to correct the measured salinities to force an agreement with this value, as described below. High seas prevented routine collection of water samples – if the rosette sampler was included, the free-fall speed of the CTD package was not high enough to keep tension on the lowering cable during extremes of ship motion. In consequence, the deep salinities reported here are not suitable for such demanding applications as water mass analysis of water below the thermocline.

Alliance salinities were affected by a problem in the Mk-V CTD which caused occasional small jumps during each cast in fast temperature and, not always at the same time, in conductivity. The effect of these was an increasing salinity bias with depth which occurred in small steps of 0.005 to 0.010. These steps were not removed, but the salinities were subjected to a linear correction with respect to pressure to a depth of 1000 m and assumed constant for the limited amount of data below that depth; i.e.

$$S = \begin{cases} S_m + aP, & \text{for } P < 1000 \text{ dbar} \\ S(1000), & \text{for } P > 1000 \text{ dbar}, \end{cases}$$

where S is the final salinity, S_m the measured salinity, P the pressure, and a is determined by the condition

$$S_{av} = 34.91 \text{ at } 1000 \text{ dbar}$$

with S_{av} being the average salinity over all *Alliance* stations with data at 1000 dbar. The same value for a was applied to all the stations, whether or not they extend to 1000 dbar. For the few stations extending deeper than 1000 dbar, salinity was fixed at its cast-dependent value at 1000 dbar. The rationale here is that deep *Alliance* salinities show an apparently consistent offset, so that differences between stations may be significant even for deep salinities. However, no objective test of this has been made.

Planet deep salinities were erratic from one cast to another, but appeared somewhat stable in the deep water within each cast. We have therefore applied a constant offset to each station so that the deep values were reasonable:

$$S = S_{\text{m}} + S_{\text{off}},$$

where S_{off} is determined cast-by-cast so that

$$S = 34.91 \text{ at } 1000 \text{ dbar}$$

for stations with data at 1000 dbar and otherwise with S_{off} as the average of the offsets for all deep stations.

XBT profiles have values of corrected salinity attached to them based on a CTD trace believed to have T-S relation representative of the XBT position. This does not, of course, make them equivalent to CTD profiles, but does provide salinities useful for some purposes, especially considering the ease in recognizing the two water types of the area by their temperature profile alone (see Appendix D). In particular, such salinities seem adequate for determining sound-speed profiles and dynamic height (see Appendix E).

First, each XBT was associated with a nearby CTD having temperature structure most closely resembling that of the XBT. Then for each point (Z, T) of the XBT, the distance d to every point (Z', T') of the CTD profile was calculated as

$$d^2 = (Z - Z')^2/Z_0^2 + (T - T')^2/T_0^2,$$

where Z_0 and T_0 are scaling parameters. Salinity of the CTD point having minimum distance was then associated with the XBT point; or, in the usual case of multiple minima with comparable distances, a mean salinity was computed from them, weighted by the inverse square of their respective distances. After some tests, (Z_0, T_0) were taken to be $(1000, 7)$, corresponding to the observed range of variables. Thus d was nearly proportional to distance as measured with a ruler on a full-range plot.

4

Oceanographic Summary

There is little previous data from this area during March. However, based on other SACLANTCEN surveys adjusted for expected seasonal effects, it appears that the IFF was in a normal state during NORDIC 92. This section gives a brief description of a few less well-known features noted during the cruise.

Deep mixed layers were sometimes found on both sides of the front, but were extremely variable. They are apparent in the contoured sections (e.g. Figs. B2, B7, B14) or in the individual station profile plots, and are the expected result of winter surface cooling and convection to intermediate depths. In the Atlantic water south of the center of the front (e.g. *Alliance* CTDs 12, 13, 24; *Planet* CTDs 19, 21, 25 – see Table A2 or Figs. A2–A5 for their positions) surface mixed layers of 200 to over 300 m thick were found. North of the front, mixed layers were most pronounced directly north of the Faeroes, with mixed layers to over 300 m in places (e.g. *Planet* CTD 65).

An eddy of Atlantic water was found near 65°N,10°W, somewhat north of the front at *Alliance* CTD 05. It can be seen at the eastern end of Section Q-R (Fig. B12) and in the near-surface constant-depth maps in Appendix C. Such a pool has been found very close to this position during most cruises to this area, suggesting it is a quasi-permanent feature. It is thought to be initially part of a northward loop in the front which is pinched off but remains nearly in place.

CTD stations north of the front sometimes showed a well stratified surface layer which was nevertheless isopycnal; e.g. see Figs. D4, D10 and D12. The phenomenon invites conjecture about near-surface mixing processes.

Appendix A

Details of sections and stations

A directory of when and where data were collected is given by the following tables and figures. In addition to Fig. 1, which gives the positions and identifications of the various sections, Table A1 provides a tabular listing of the section end points. Figures A1–A5 give details of the positions, data types and station numbers. By referencing these against Table A2, the appoximate time of each measurement can be determined.

Table A1 *End points of sections occupied during Leg 1 (see also Fig. 1)*

Section	End points			
	N	W	N	W
A–B	62.000°	08.750°	63.583°	05.417°
C–D	62.567°	09.833°	64.117°	06.500°
C1–D1	62.813°	10.417°	64.350°	07.084°
E–F	62.833°	11.556°	64.583°	07.667°
E1–F1	63.304°	11.584°	64.817°	08.250°
G–H	63.550°	12.167°	65.050°	08.833°
I–J	63.895°	12.900°	65.353°	09.570°
K–L	65.000°	09.110°	62.580°	07.000°
K1–L	64.699°	08.862°	62.580°	07.000°
M–N	63.750°	13.167°	64.167°	13.667°
Q–R	64.833°	12.000°	64.833°	10.000°
S–T	65.790°	12.000°	66.080°	10.600°

Table A2 *Start and stop times of sections and station numbers*[1]

Section	CTDs	XBTs	Start	Stop
Alliance				
N–M	none	1–6	06.25	06.32
Q–R	1–5	7–10	06.93	07.20
T–S	6–8	11–17	07.77	08.08
J–I	9–10	18–26	11.67	12.42
G–H	none	27–36	12.54	13.59
E1–F1	11–16	37–39	14.99	15.63
H–G	17–22	40–44	15.78	16.48
C1–D1	23–25	45–52	16.74	17.29
K1–L	26–30	53–59	17.54	18.20
Planet				
A–B	1–11	2–10	13.33	14.18
D–C	13–23	14–22	14.53	15.20
E–F	25–37	26–36	15.43	16.13
K–L	39–57	50–56	16.34	17.66
X–Y	58–67	none	21.25	21.88

[1] *Alliance* CTDs and XBTs are numbered as independent, sequential series. *Planet* used odd numbers for CTDs and even numbers for XBTs. Times are given as decimal day during March (e.g. 9.50 = 09 Mar 1200Z). Entries are ordered first by ship, second by time. Section identification indicates the direction in which it was made. Section G–H and most of section K–L were occupied twice.

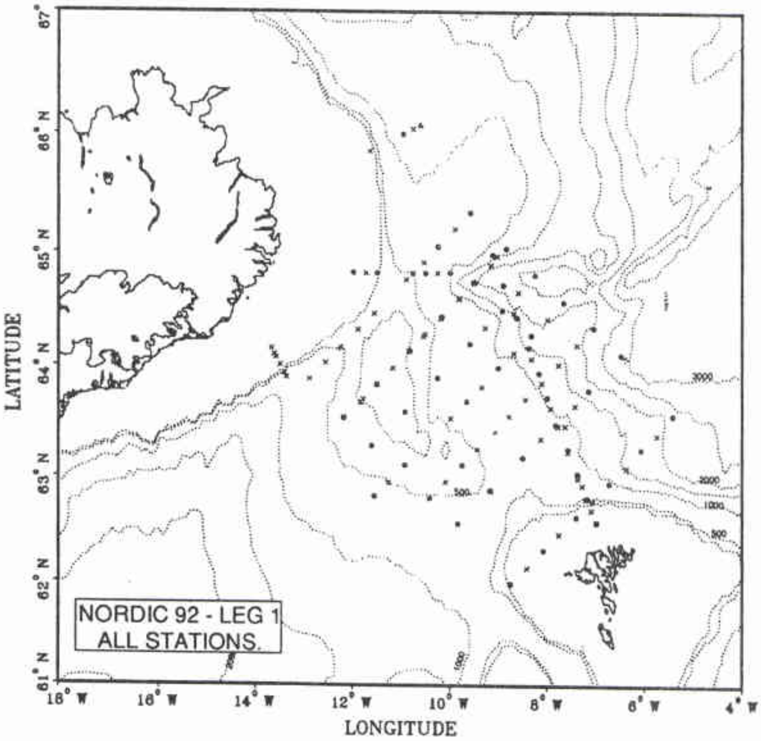

Figure A1a *Station locations for both Alliance and Planet for Leg 1. CTD stations are indicated by a dot, XBTs by a cross.*

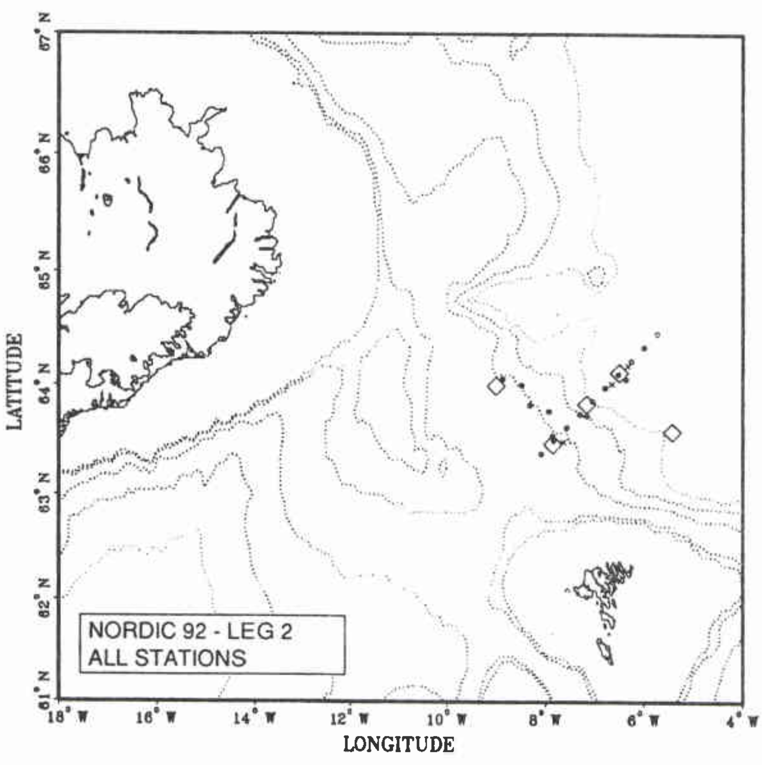

Figure A1b *Station locations for both Alliance and Planet for Leg 2. CTD stations are indicated by a dot, XBTs by a cross. The five sites marked by diamonds are related to the acoustic program.*

Report no. changed (Mar 2006): SM-262-UU

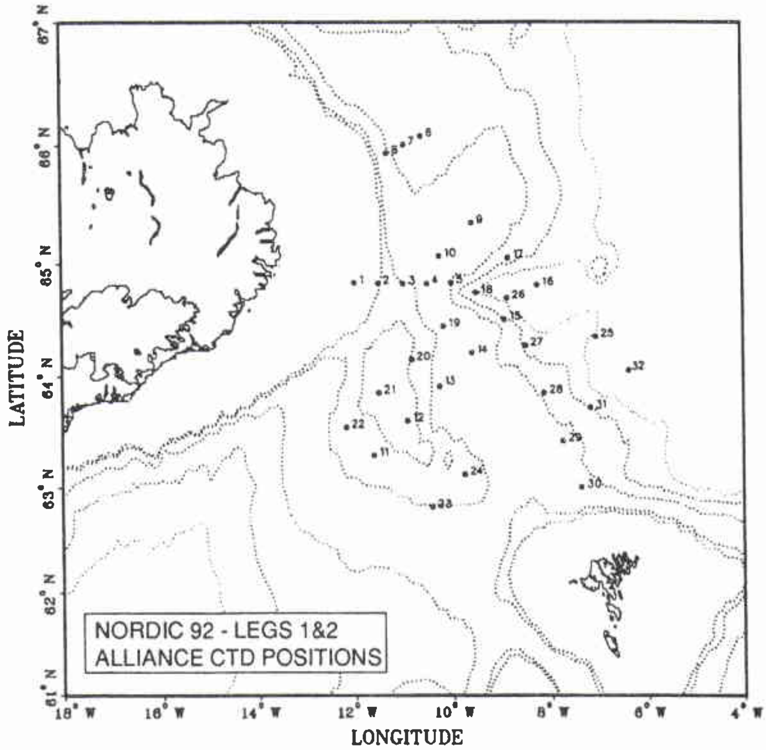

Figure A2 *Alliance CTD positions and station numbers. Stations 31 and 32 are from Leg 2; all others are from Leg 1.*

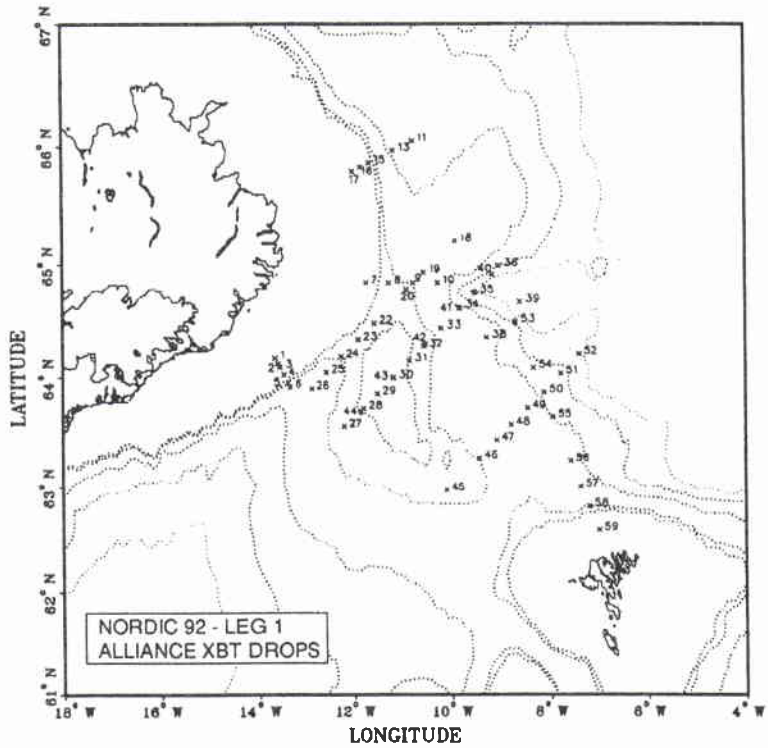

Figure A3 *Alliance XBT positions and drop numbers. Section G–H was occupied twice: during the first (drops 27–36) XBTs alone were used; during the second (40–44) the XBTs were between CTD stations.*

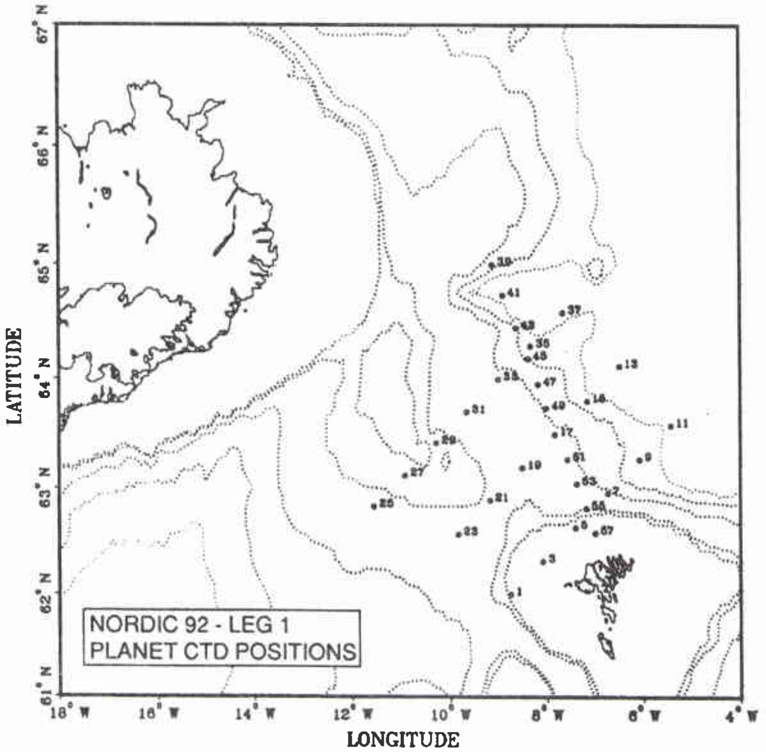

Figure A4a *Planet CTD positions and station numbers for Leg 1.*

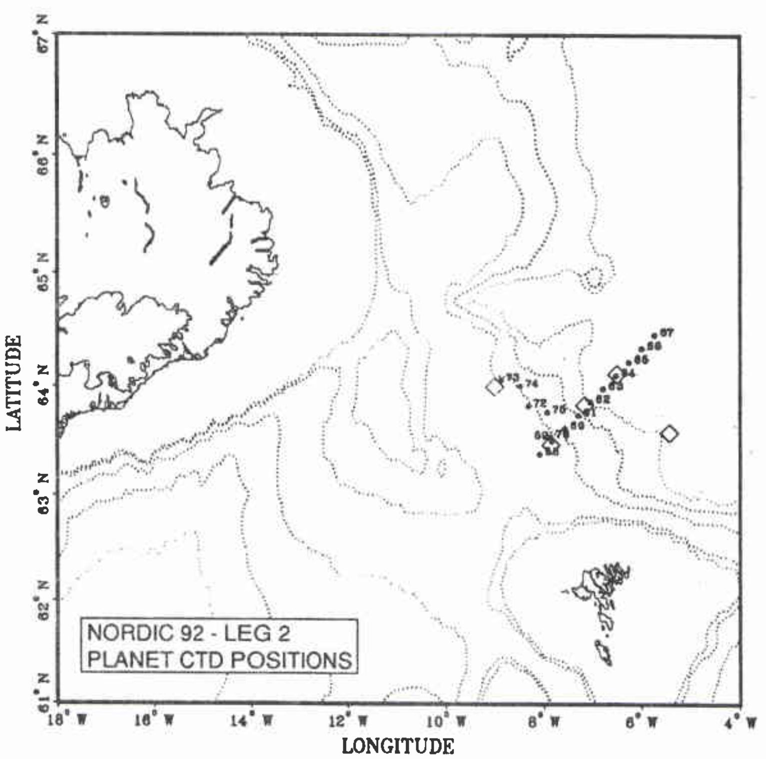

Figure A4b *Planet CTD positions and station numbers for Leg 2.*

Report no. changed (Mar 2006): SM-262-UU

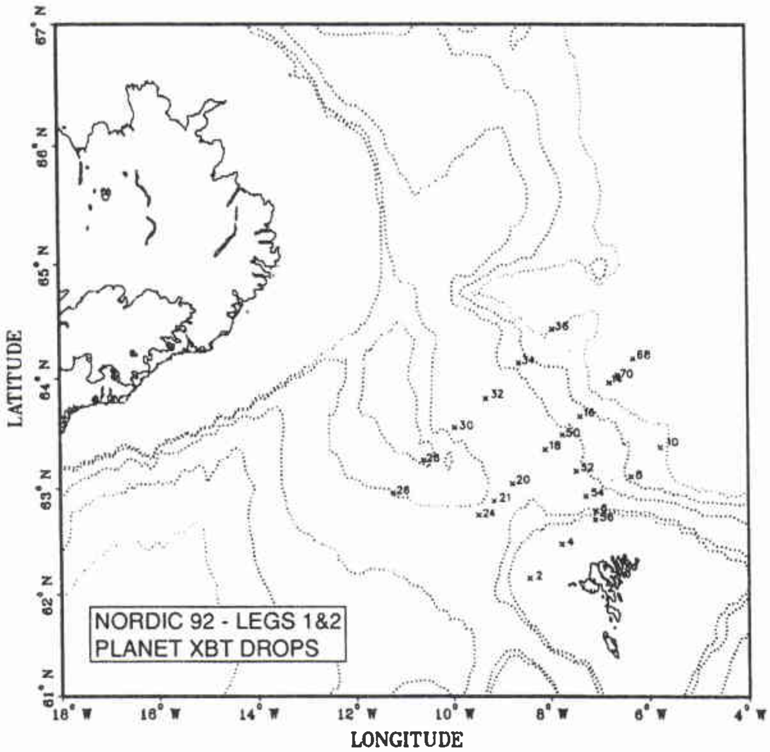

Figure A5 *Planet XBT positions and drop numbers. Drops 68 and 70 are from Leg 2; all others are from Leg 1.*

Appendix B
Data along sections

Contoured values of temperature, salinity, and sound speed are given for each section. Positions of the stations are shown at bottom, with CTDs denoted by solid circles and XBTs by open 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 bottom are given positions and times for the first and last stations of the section. Individual stations may be identified by referencing Table A2 or Figs. A2–A5. Because of missing data in some parts of the water column – a common problem with the XBT data – the contours sometimes show an abrupt change (e.g. Fig. B1), and in one extreme case, Fig. B6, the contours have been omitted.

Report no. changed (Mar 2006): SM-262-UU

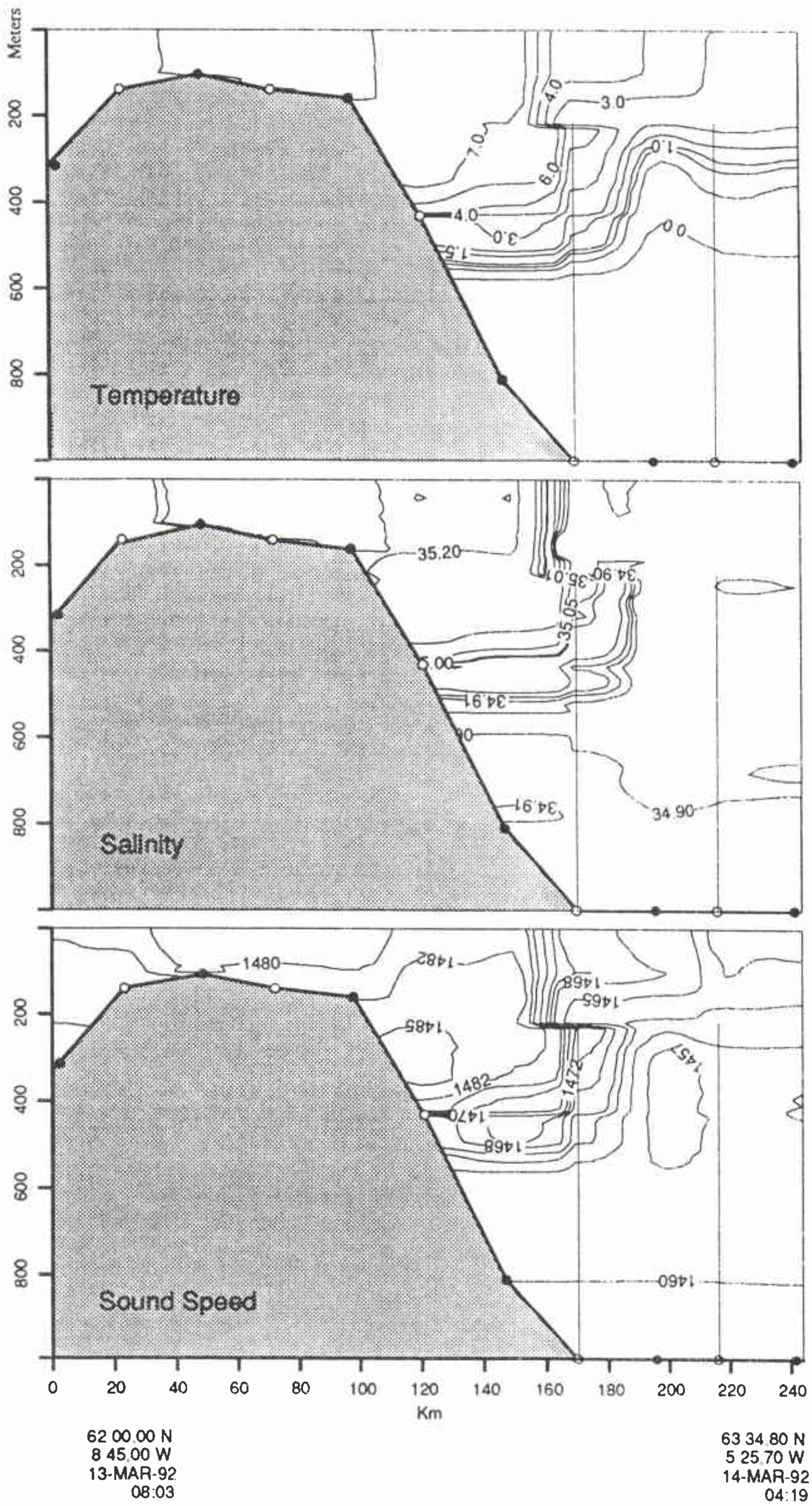

Figure B1 *Section A–B.*

Report no. changed (Mar 2006): SM-262-UU

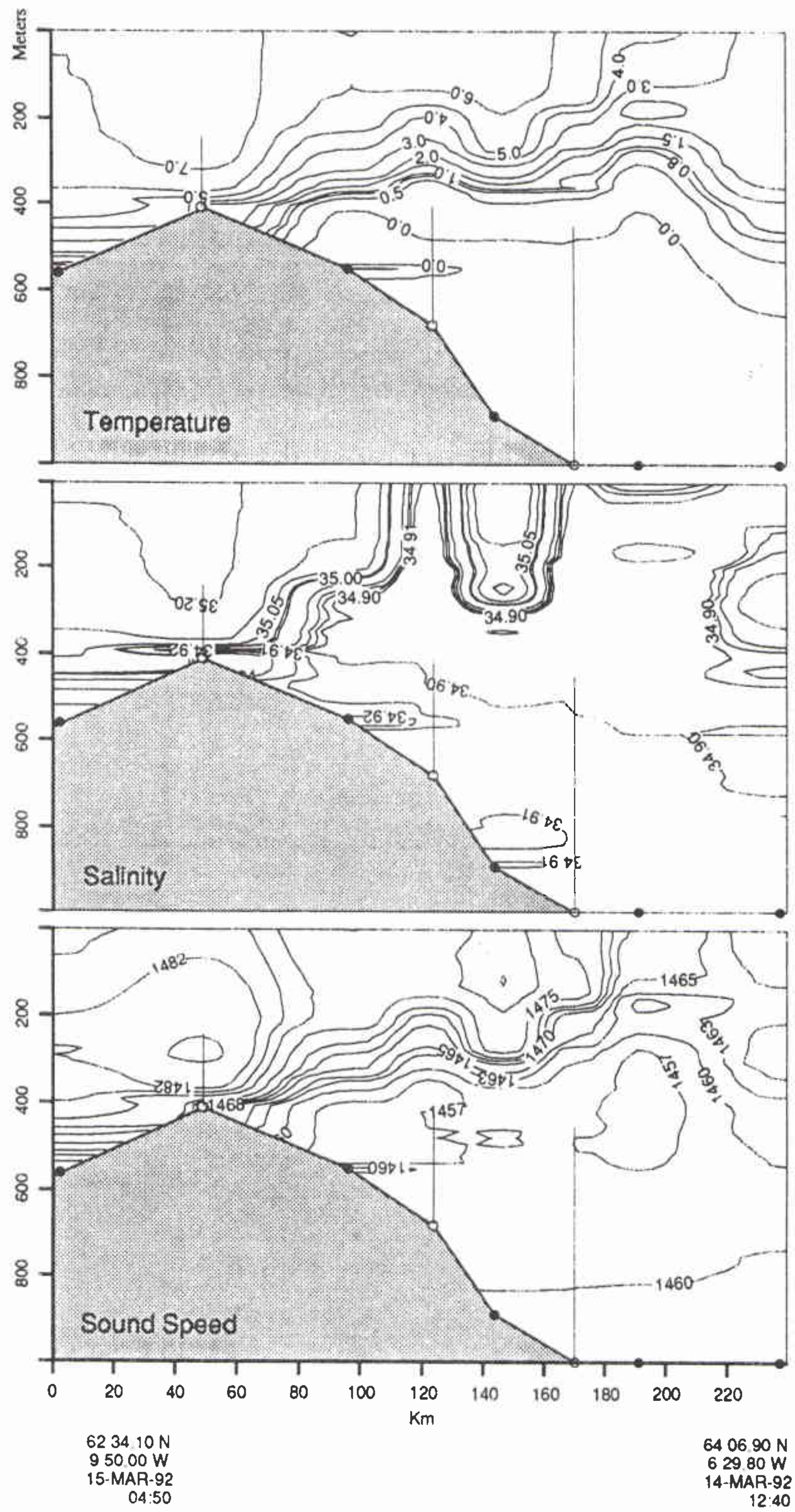

Figure B2 *Section C–D.*

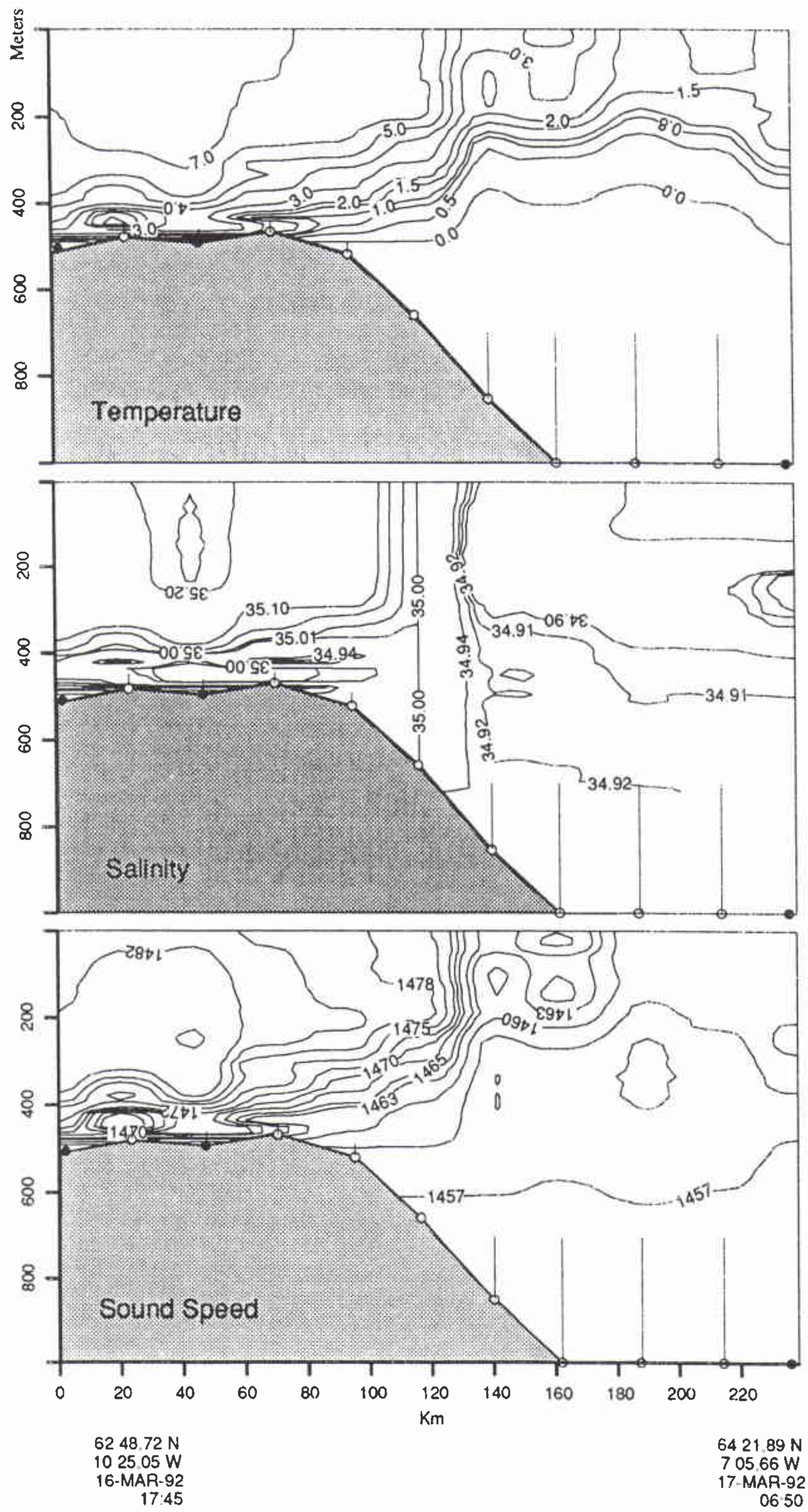

Figure B3 *Section C1–D1.*

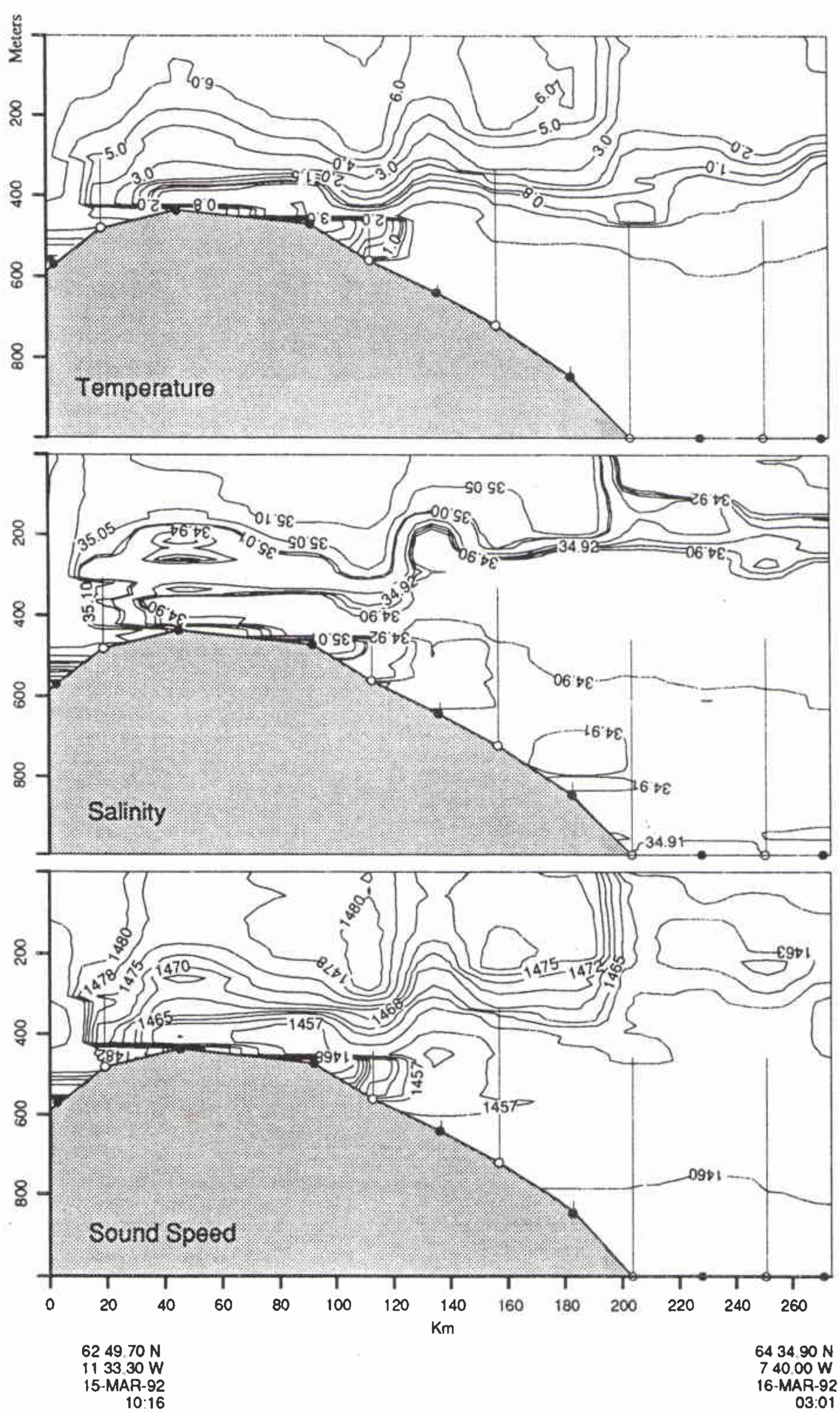

Figure B4 *Section E–F.*

Report no. changed (Mar 2006): SM-262-UU

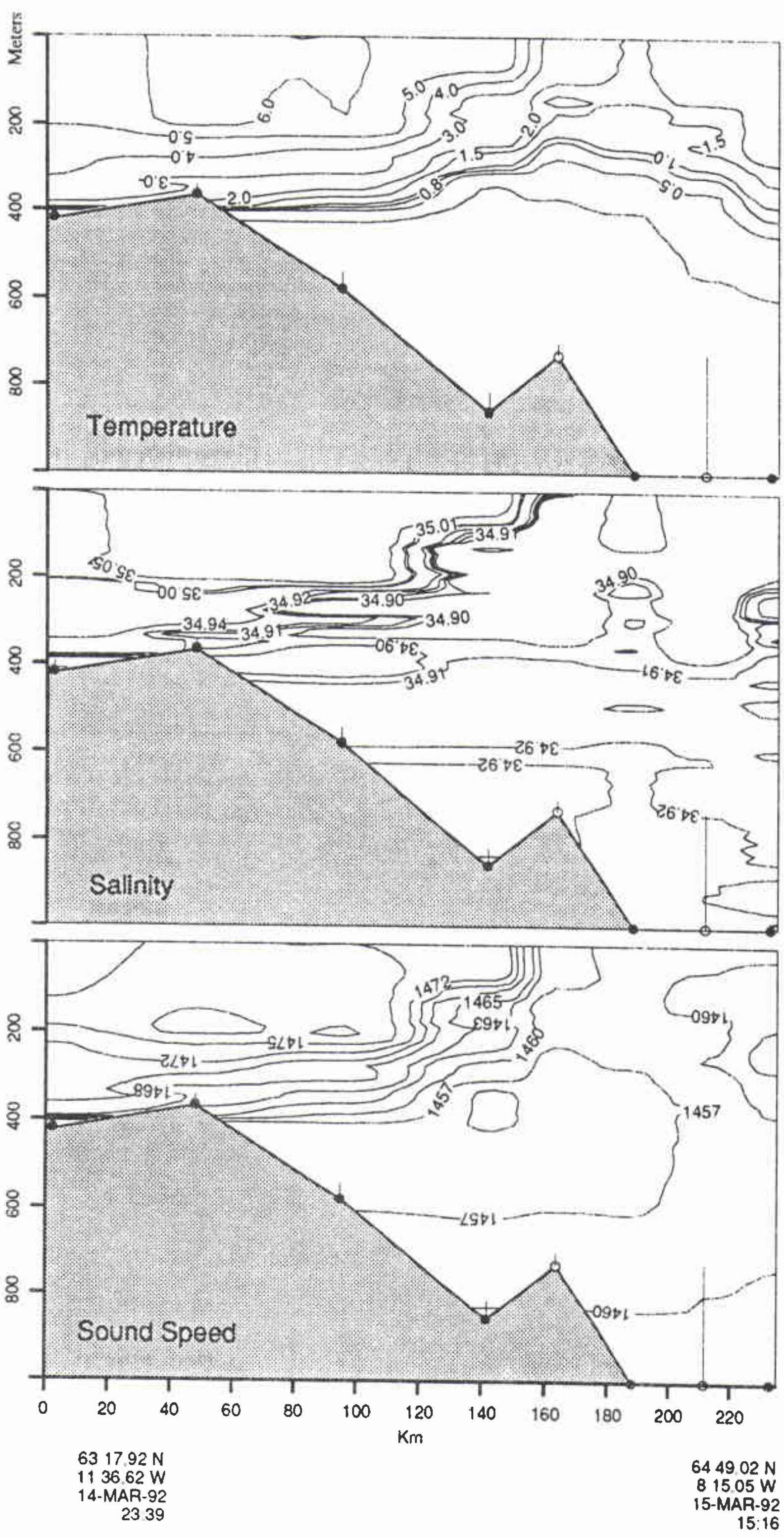

Figure B5 *Section E1-F1.*

Report no. changed (Mar 2006): SM-262-UU

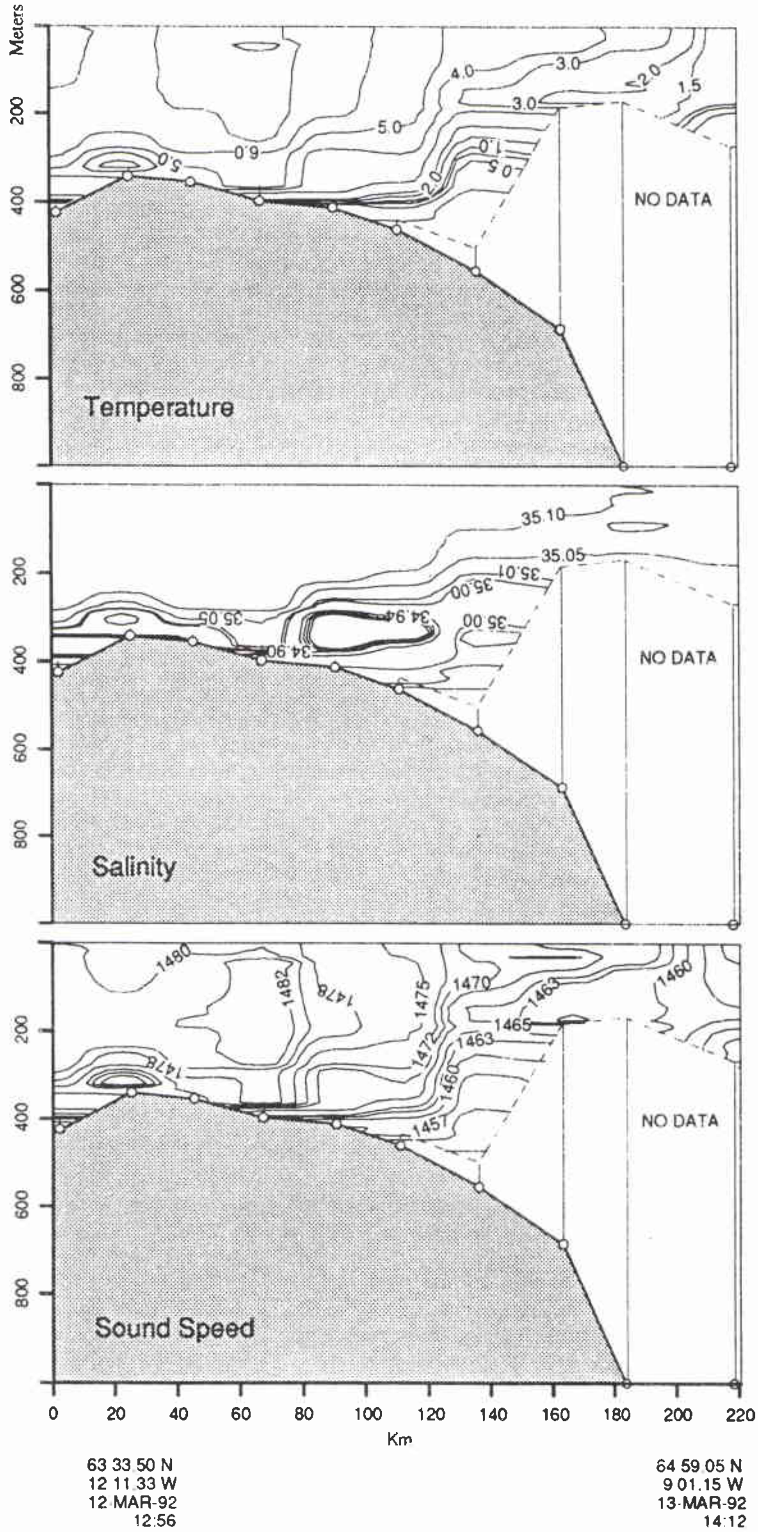

Figure B6 *Section G–H. First transit, XBTs only.*

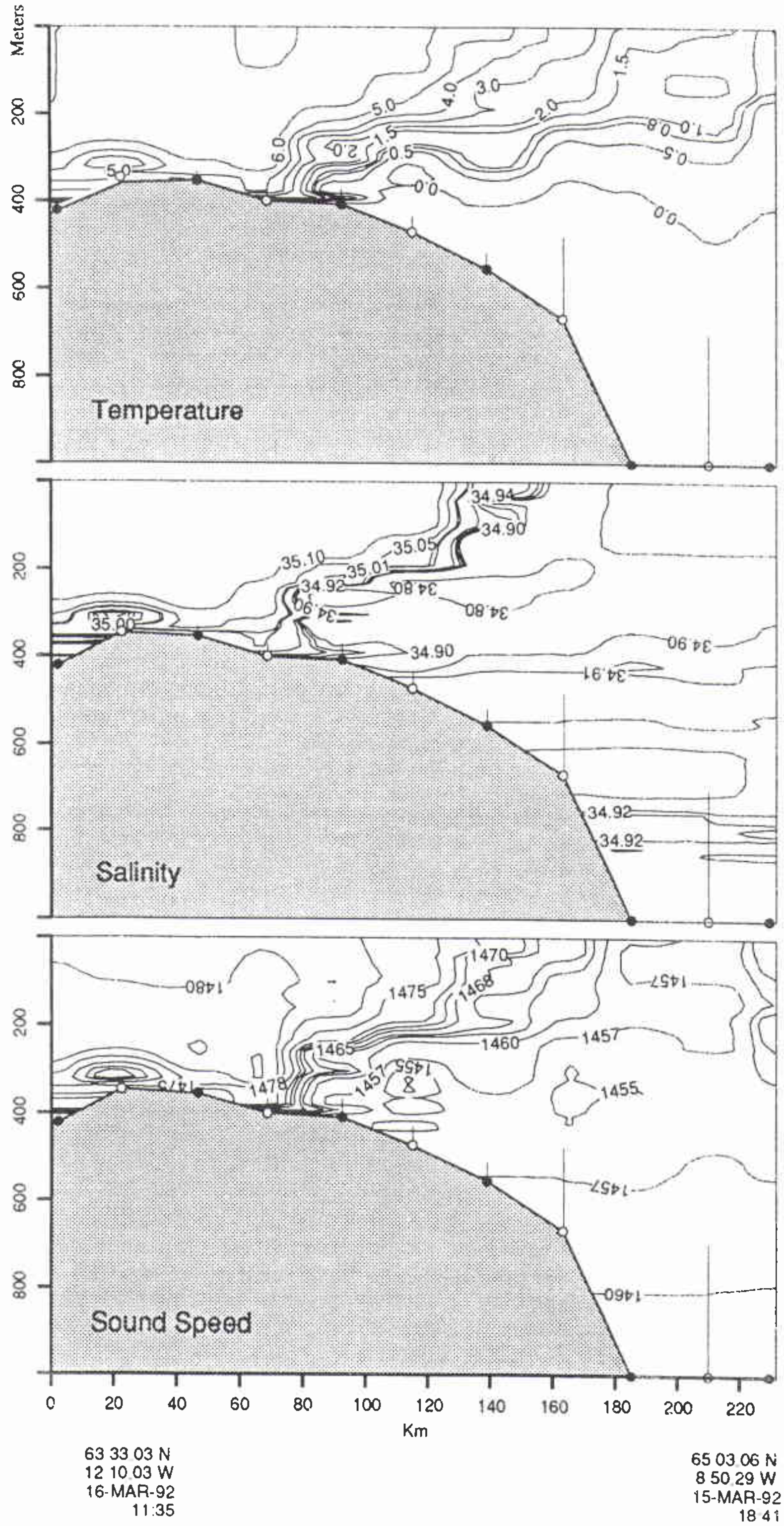

Figure B7 *Section G–H. Second transit.*

Report no. changed (Mar 2006): SM-262-UU

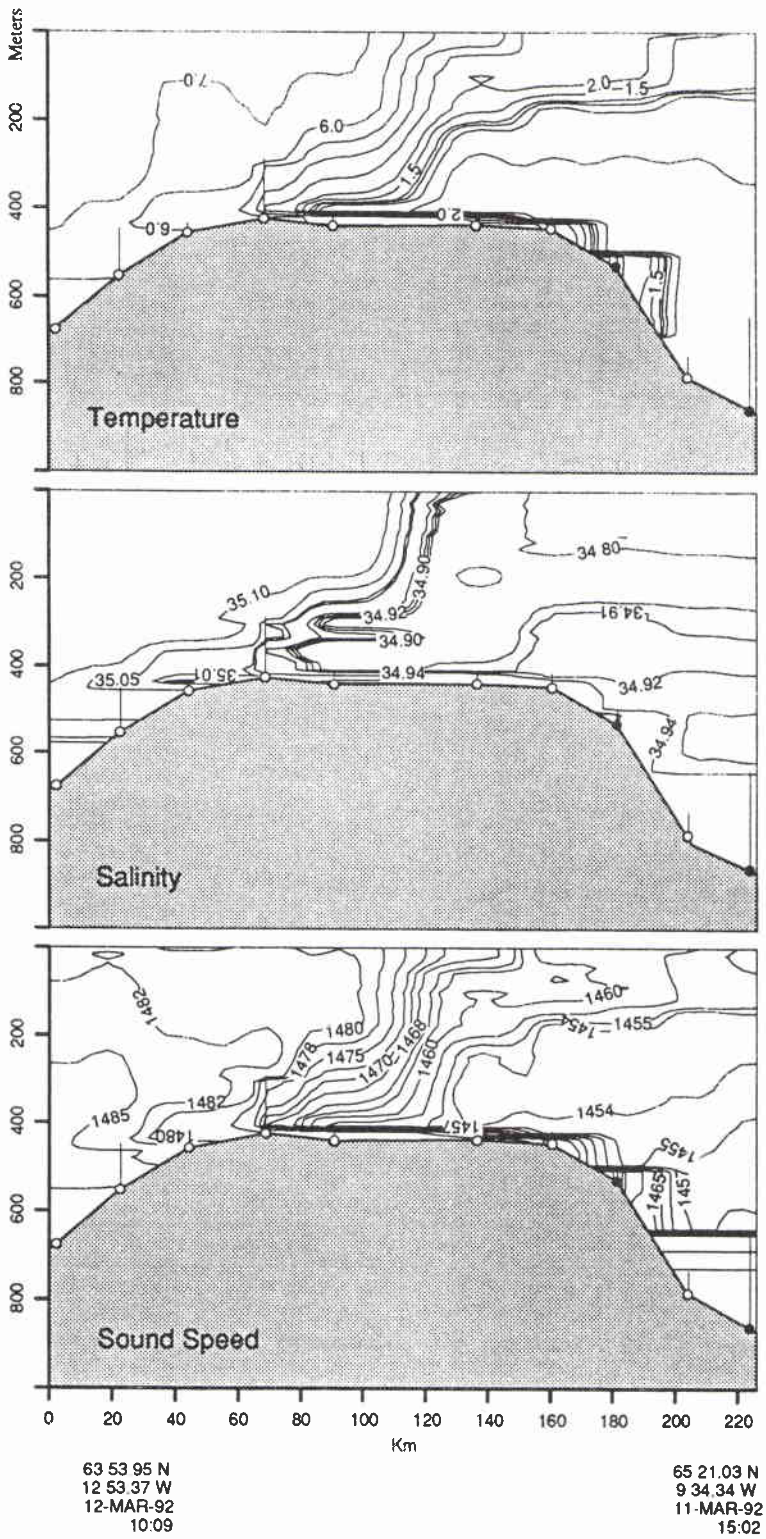

Figure B8 *Section I–J.*

Report no. changed (Mar 2006): SM-262-UU

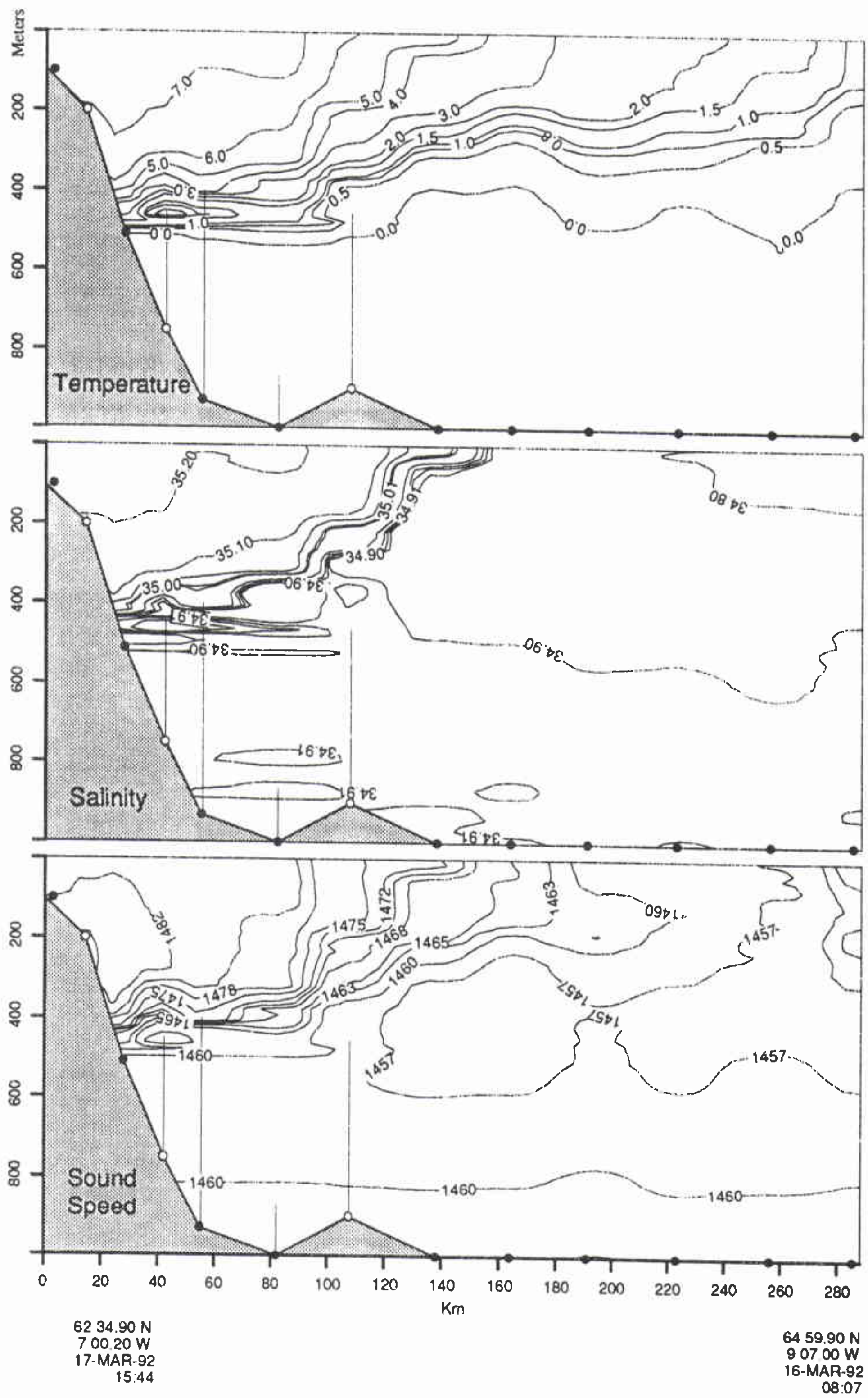

Figure B9 *Section K–L. First transit, Planet data.*

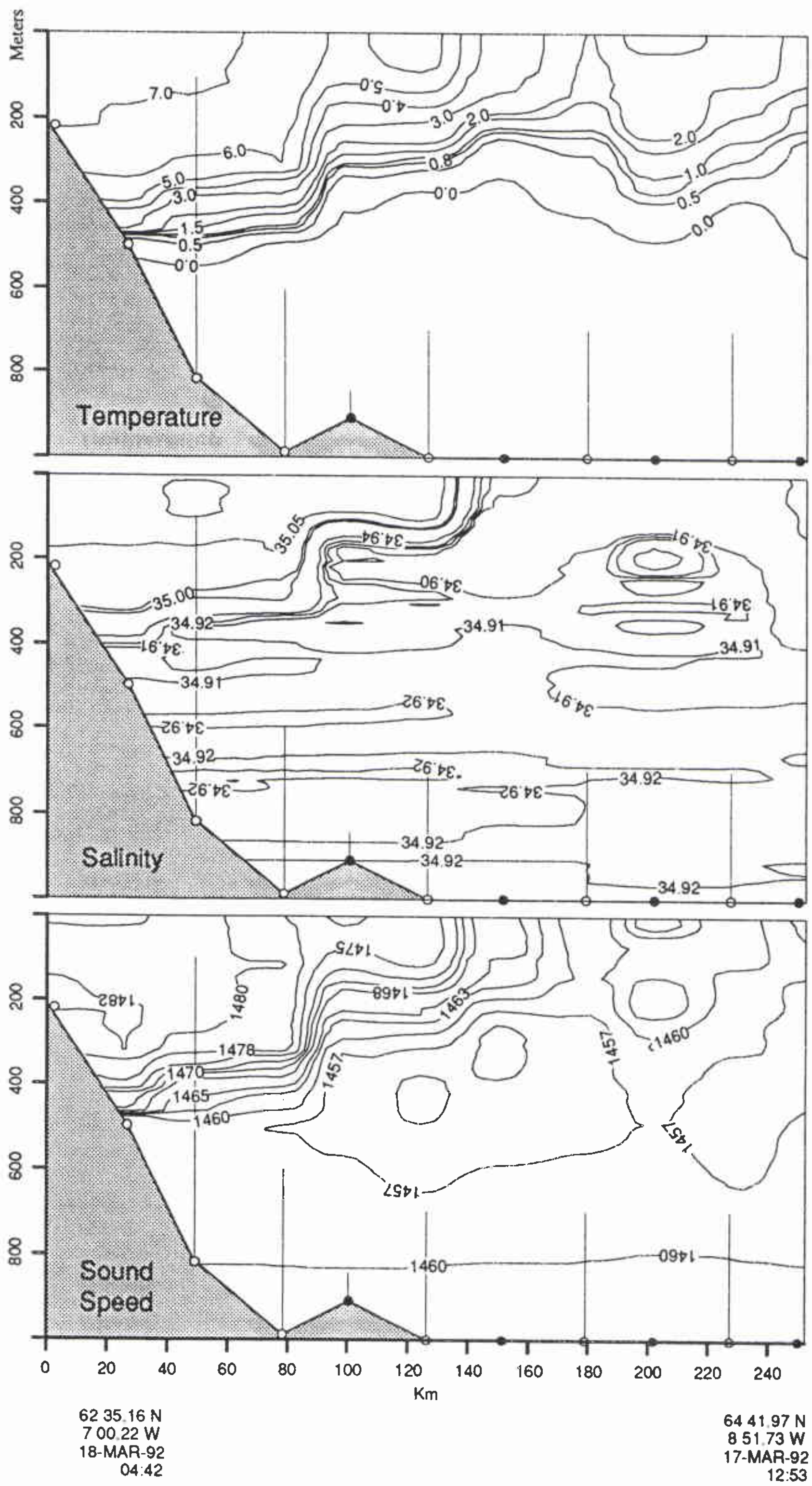

Figure B10 *Section K1–L. Second transit, Alliance data.*

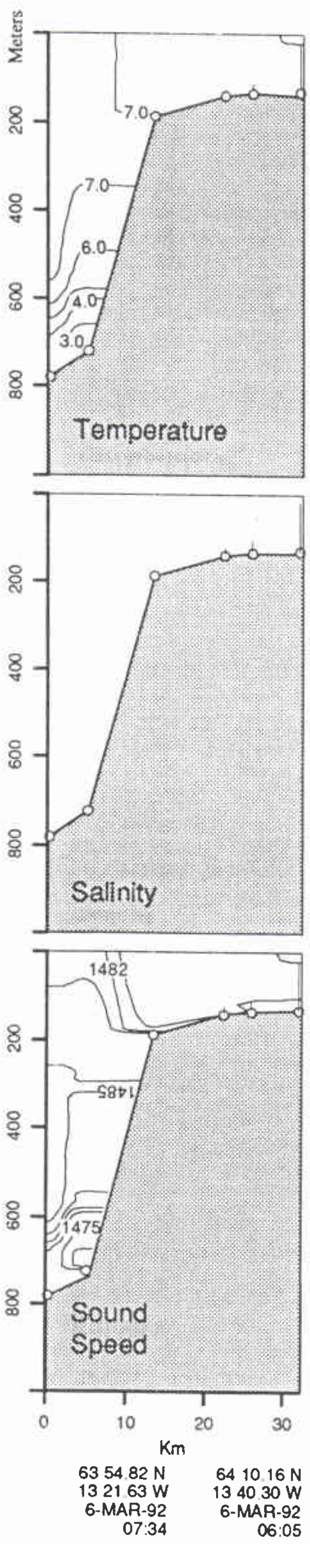

Figure B11 *Section M–N. XBTs only. Sound speed is based on a constant salinity of 35.*

Report no. changed (Mar 2006): SM-262-UU

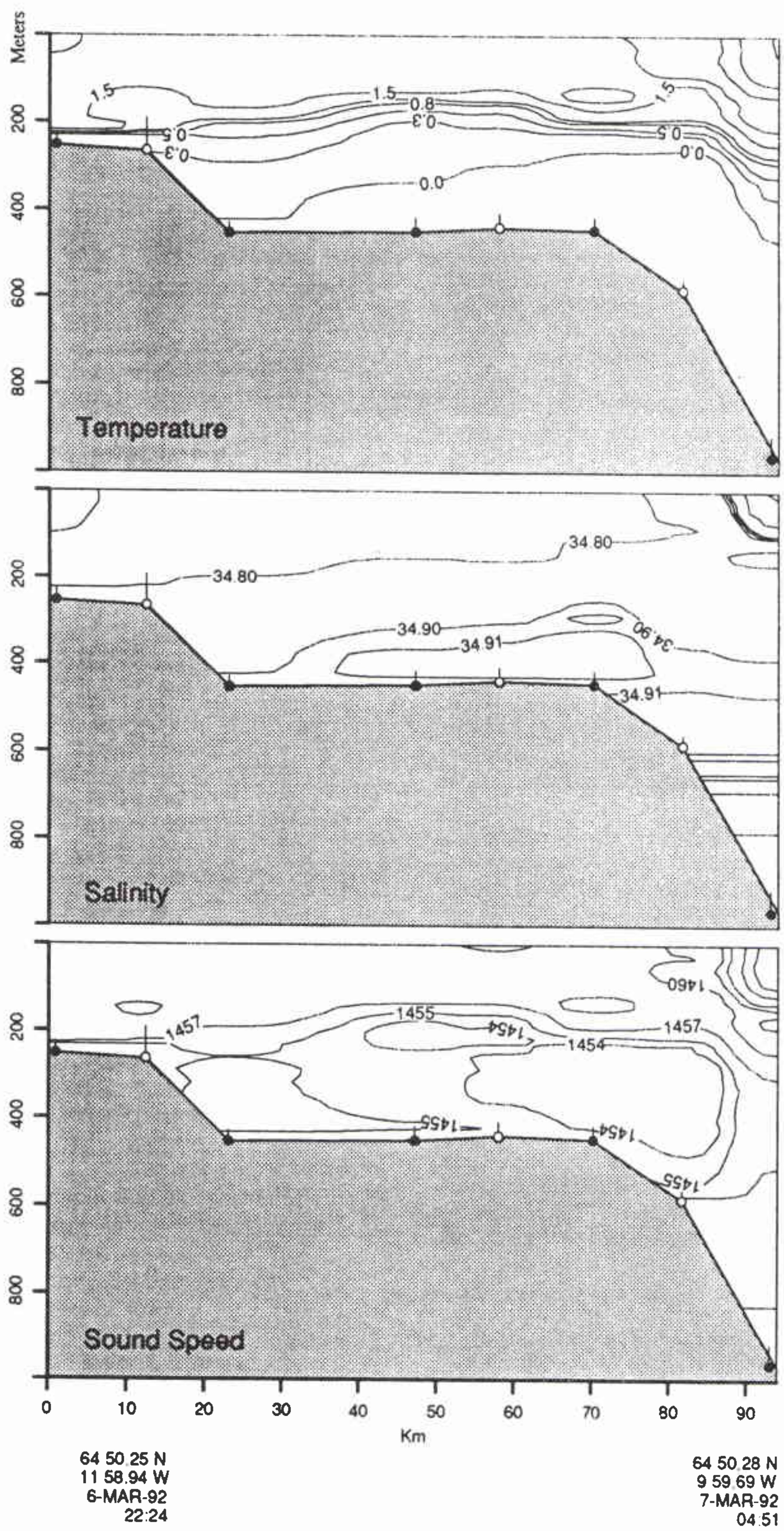

Figure B12 *Section Q–R.*

Report no. changed (Mar 2006): SM-262-UU

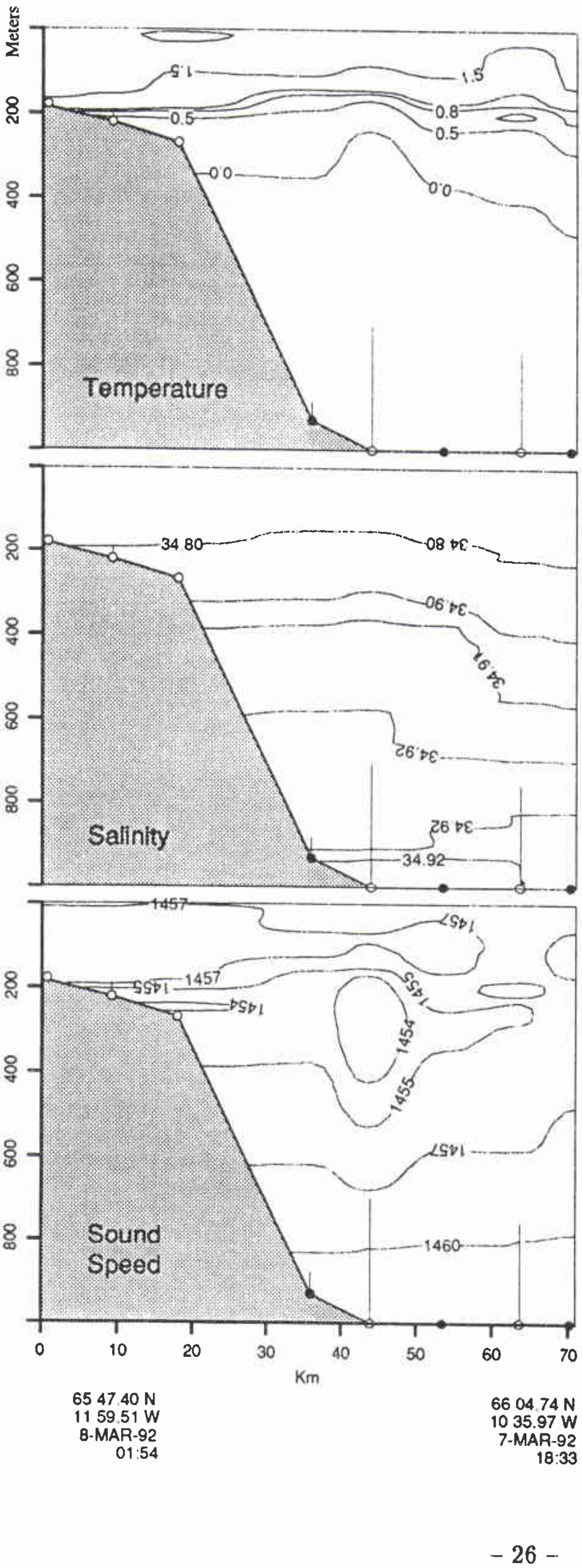

Figure B13 *Section S–T.*

Report no. changed (Mar 2006): SM-262-UU

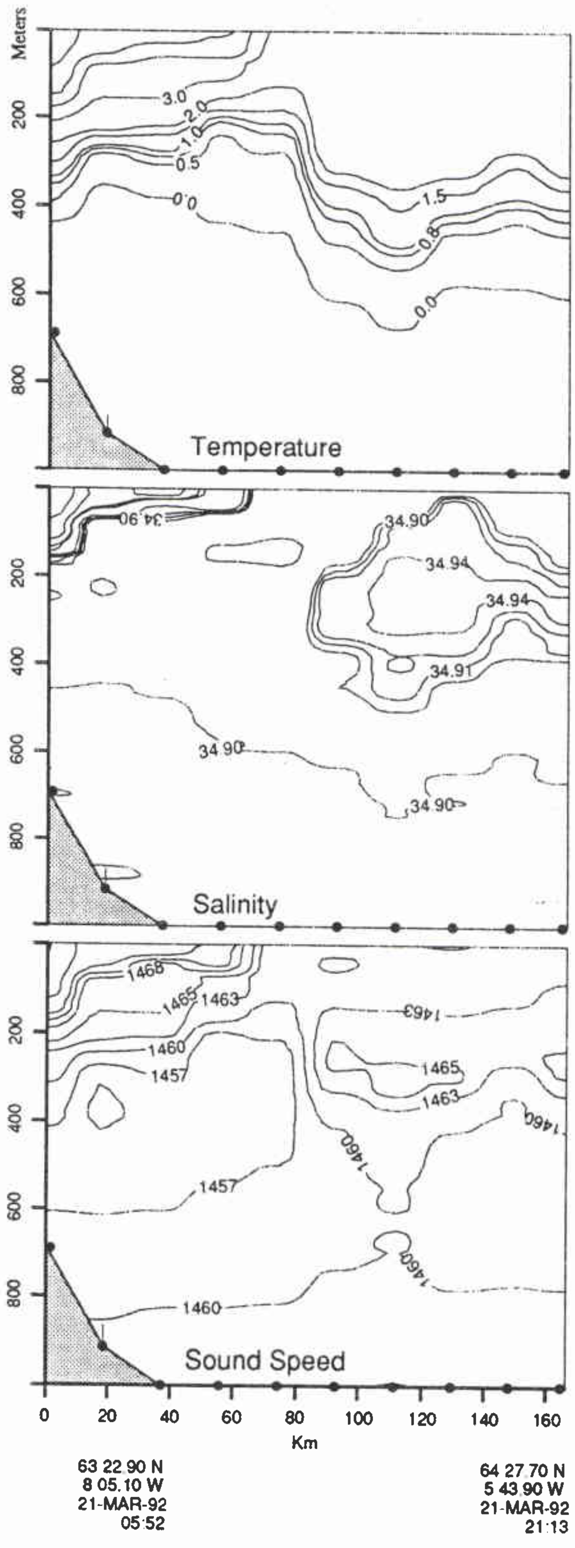

Figure B14 *Section X–Y.*

intentionally blank page

Report no. changed (Mar 2006): SM-262-UU

Appendix C

Data on depth surfaces

The figures of this appendix have been contoured using data from both CTD (dot) and XBT (cross) stations. The symbols indicate positions where data was available on each depth surface. Bathymetric contours are given as dotted lines at 400 m, thus helping define the shelf break and ridge crest, and at every 500 m. Since some sections were occupied twice, there are inevitable contouring ambiguities, resolved by choosing those stations which formed the most nearly synoptic picture. XBTs are weighted equally with CTDs in temperature and sound speed contours, but have only a minor role in salinity contours. Because of the need to identify specific features and other operational constraints, the data spacing is irregular. Hence, the contouring was done by hand.

Report no. changed (Mar 2006): SM-262-UU

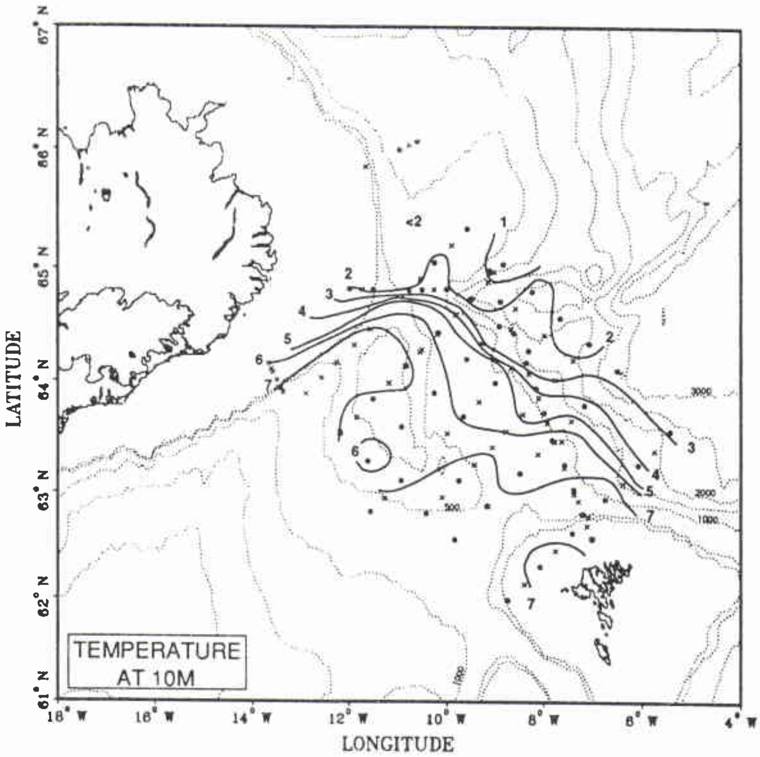

Figure C1a *Temperature at 10 m depth.*

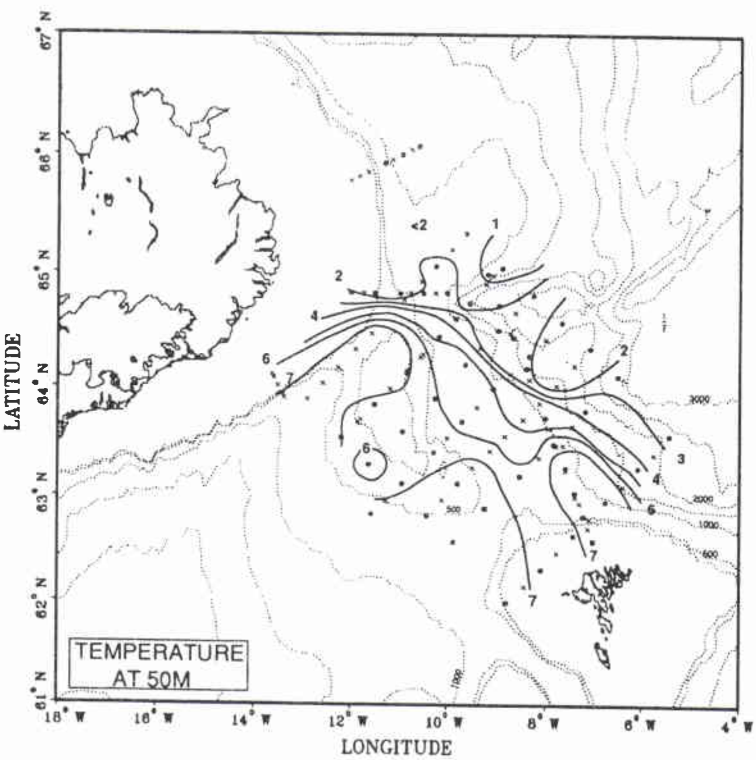

Figure C1b *Temperature at 50 m depth.*

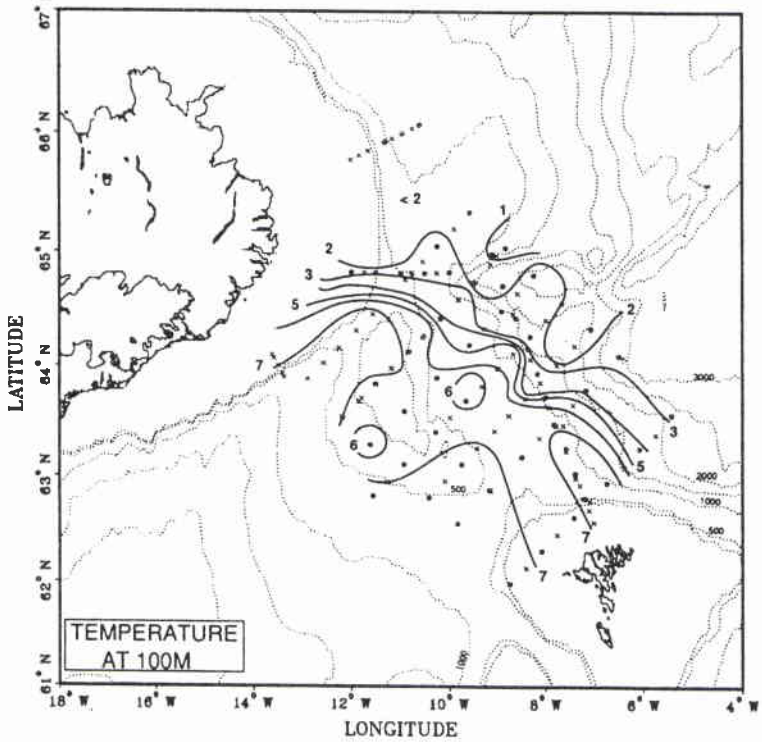

Figure C1c *Temperature at 100 m depth.*

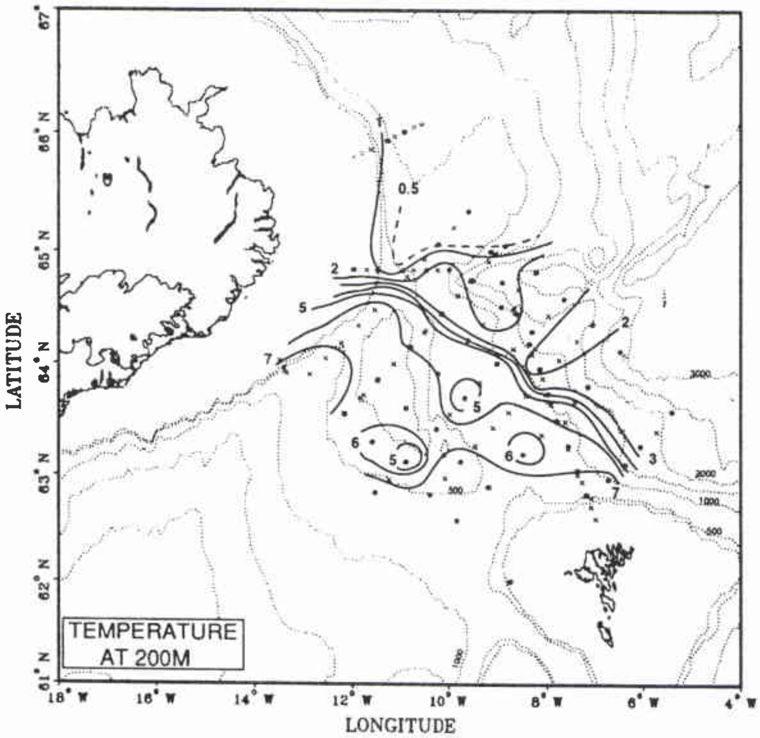

Figure C1d *Temperature at 200 m depth.*

Report no. changed (Mar 2006): SM-262-UU

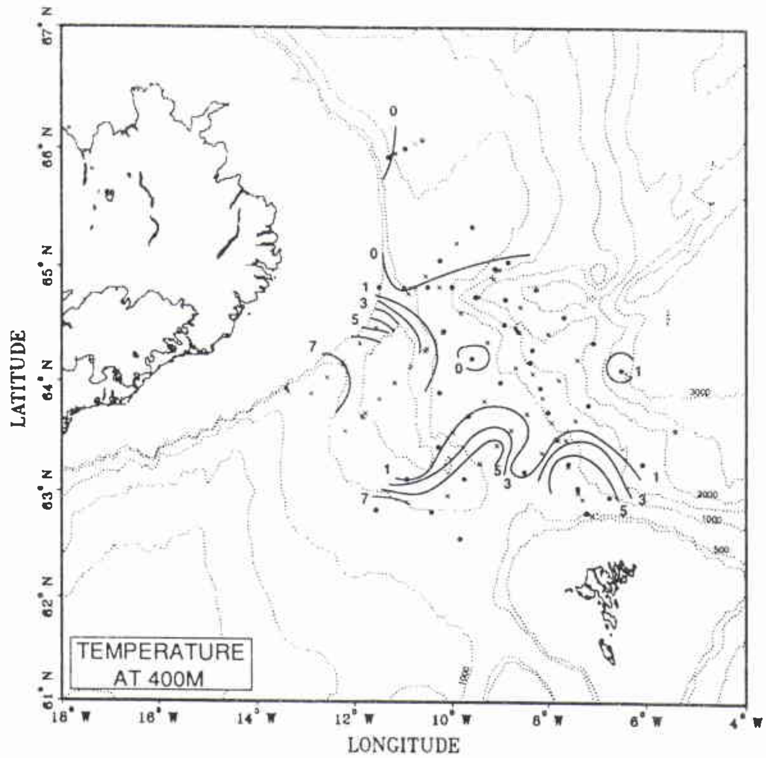

Figure C1e *Temperature at 400 m depth.*

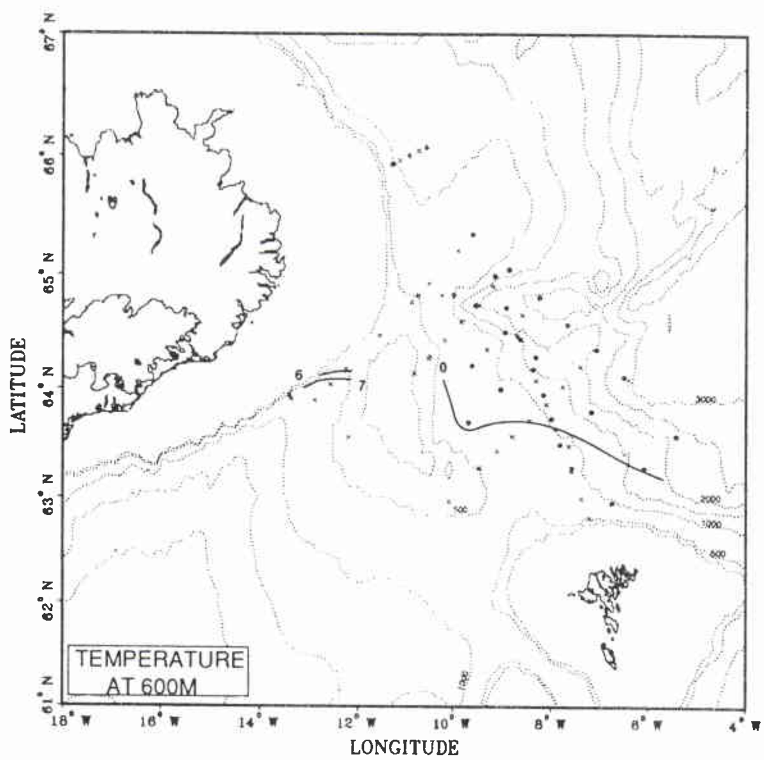

Figure C1f *Temperature at 600 m depth.*

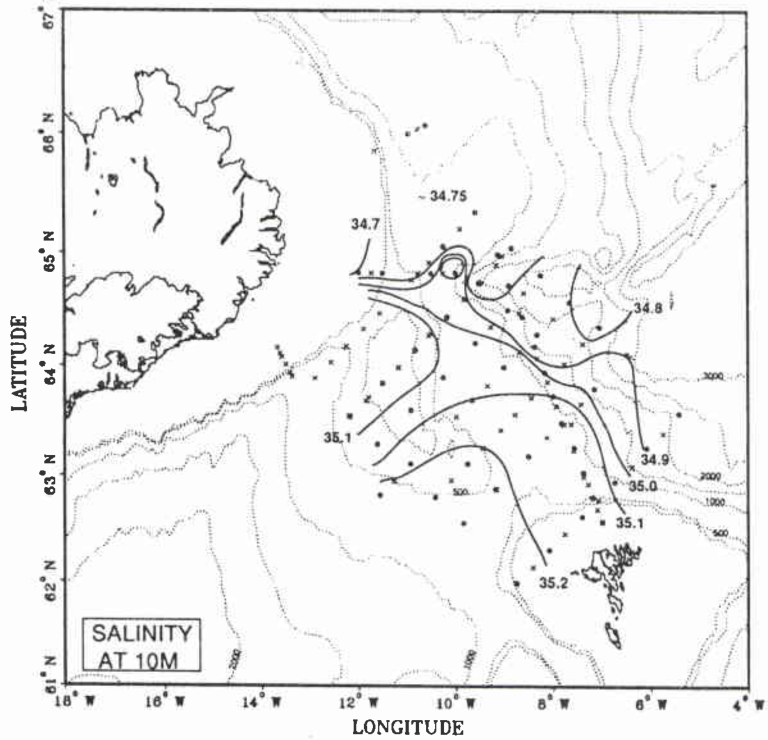

Figure C2a *Salinity at 10 m depth. Contours are at intervals of 0.10 except at 400 m, where dashed lines give additional contours at intervals of 0.05.*

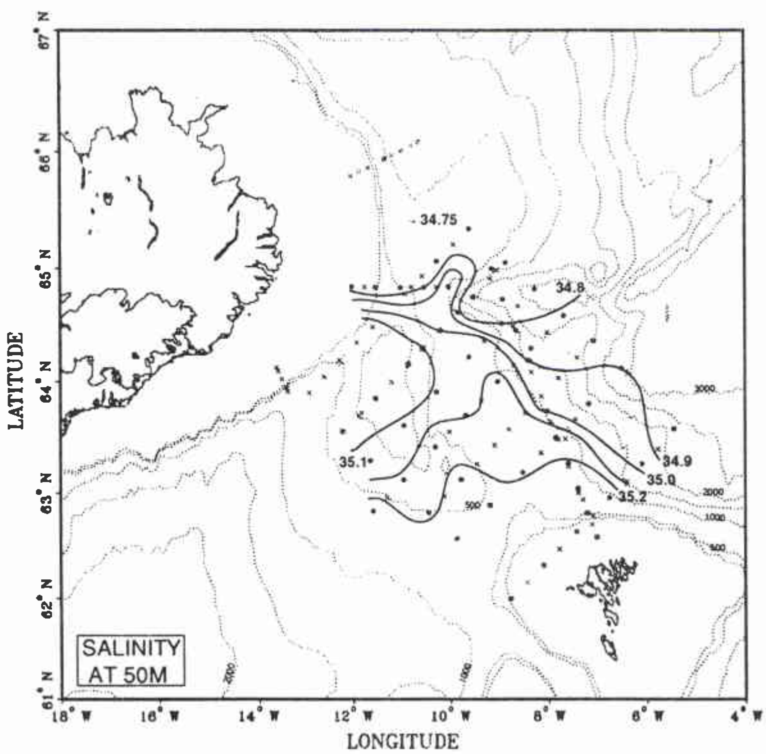

Figure C2b *Salinity at 50 m depth. Contours are at intervals of 0.10 except at 400 m, where dashed lines give additional contours at intervals of 0.05.*

Report no. changed (Mar 2006): SM-262-UU

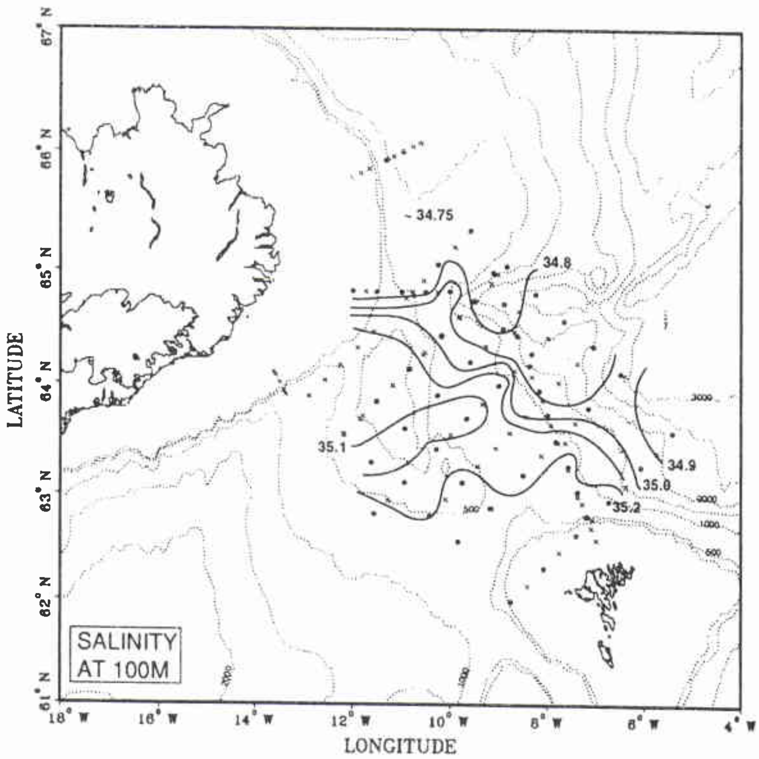

Figure C2c *Salinity at 100 m depth. Contours are at intervals of 0.10 except at 400 m, where dashed lines give additional contours at intervals of 0.05.*

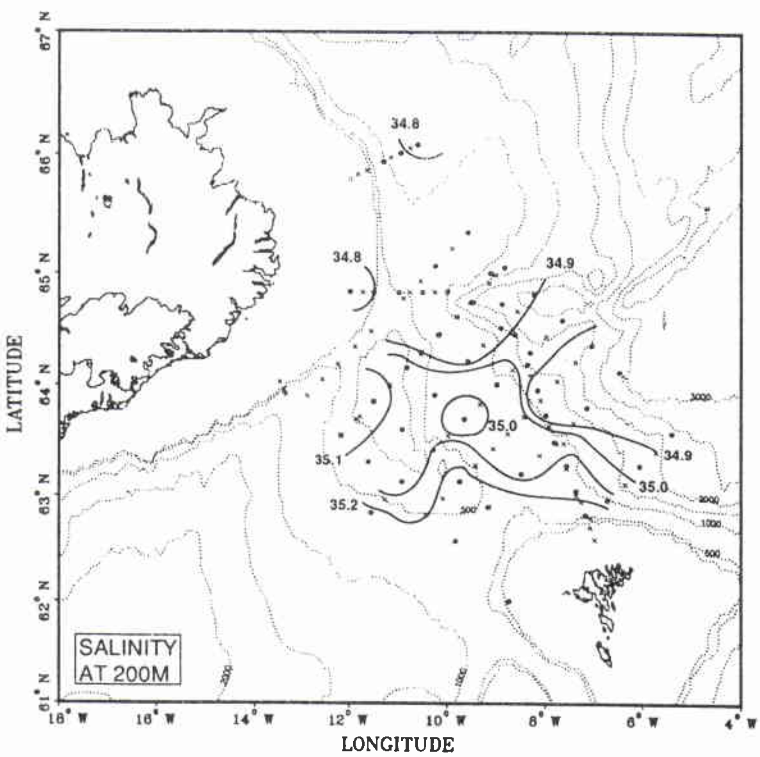

Figure C2d *Salinity at 200 m depth. Contours are at intervals of 0.10 except at 400 m, where dashed lines give additional contours at intervals of 0.05.*

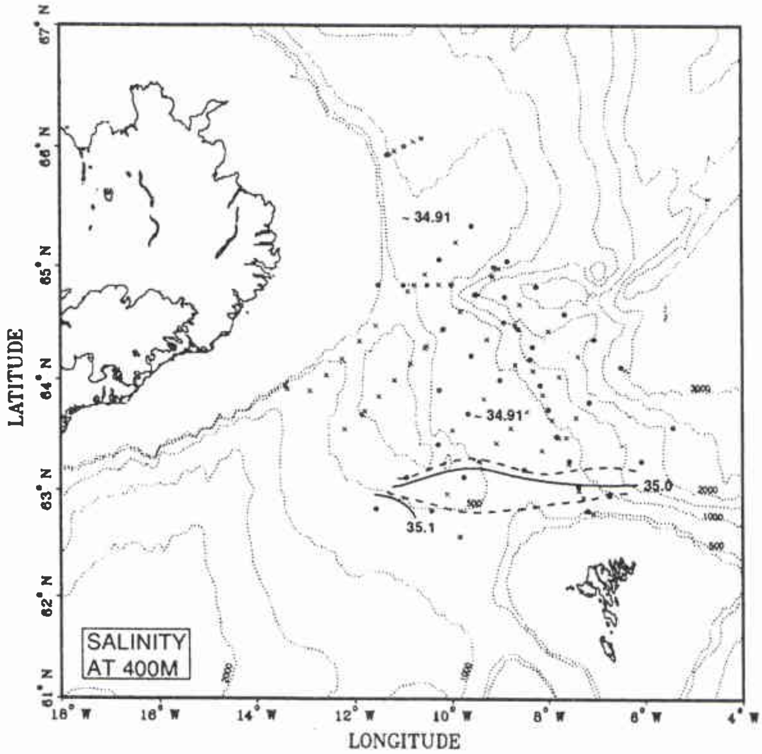

Figure C2e *Salinity at 400 m depth. Contours are at intervals of 0.10 except at 400 m, where dashed lines give additional contours at intervals of 0.05.*

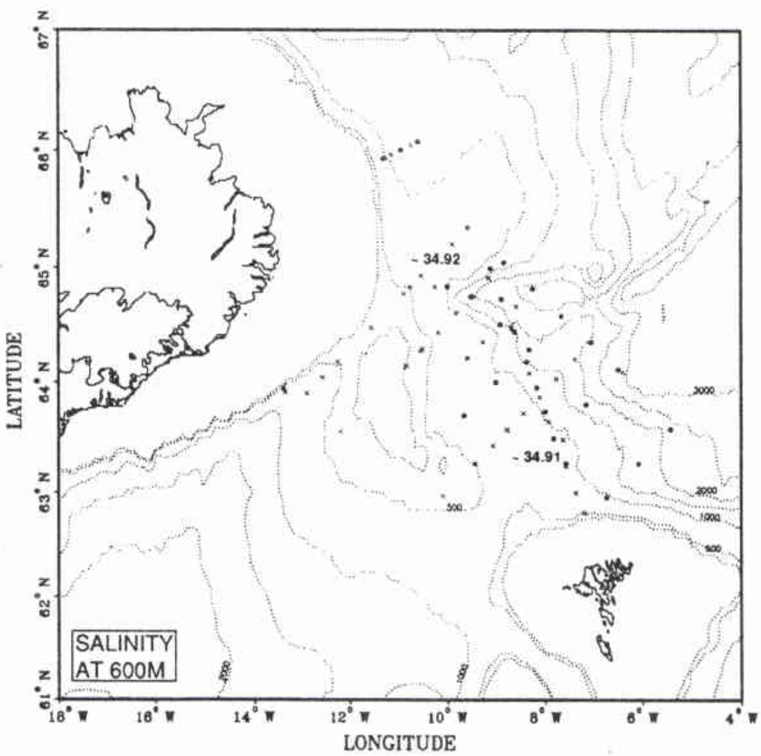

Figure C2f *Salinity at 600 m depth. Contours are at intervals of 0.10 except at 400 m, where dashed lines give additional contours at intervals of 0.05.*

Report no. changed (Mar 2006): SM-262-UU

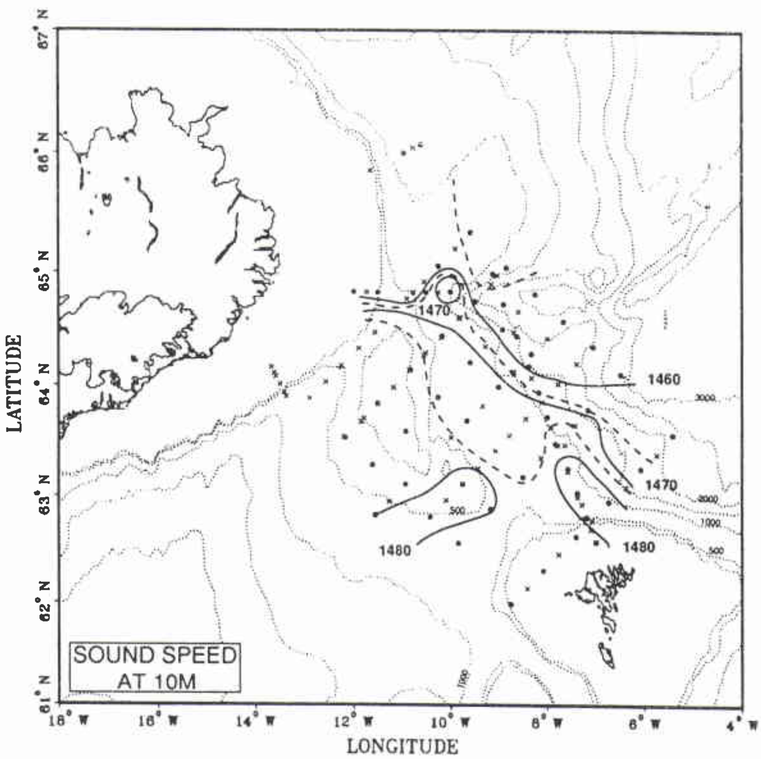

Figure C3a *Sound speed at 10 m depth. Solid contours are at intervals of 10 ms^{-2}, dashed contours at 5 ms^{-2}.*

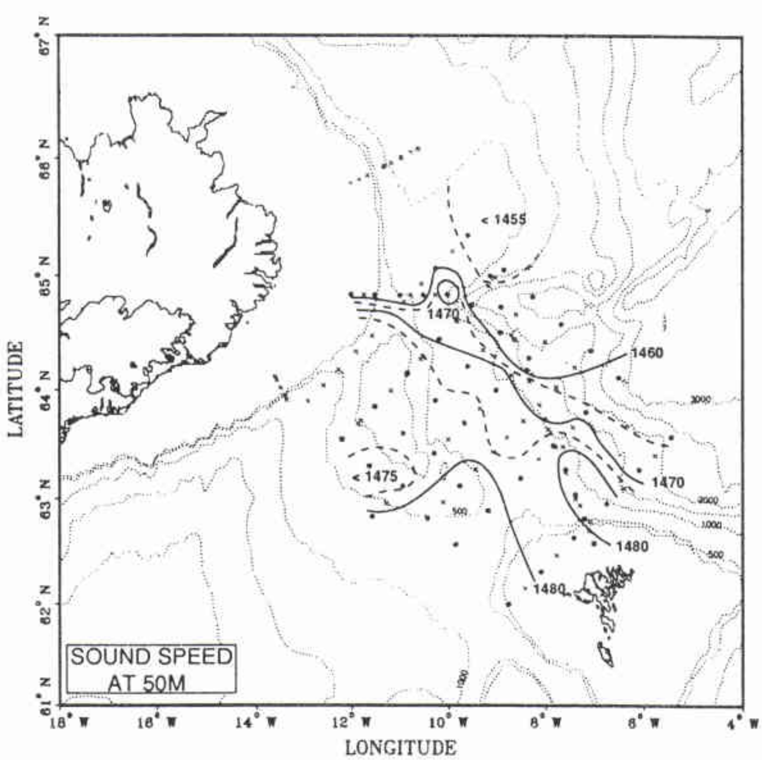

Figure C3b *Sound speed at 50 m depth. Solid contours are at intervals of 10 ms^{-2}, dashed contours at 5 ms^{-2}.*

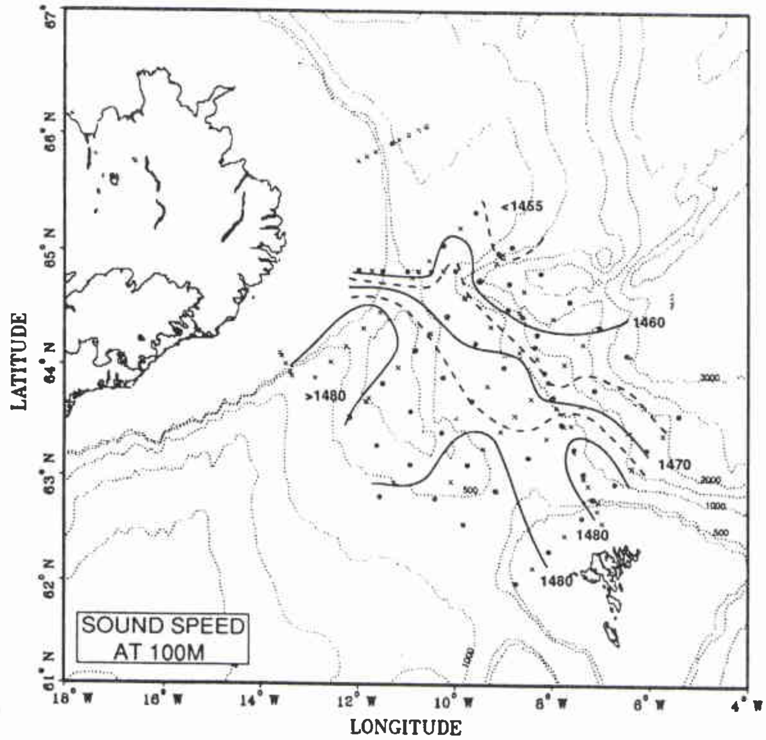

Figure C3c *Sound speed at 100 m depth. Solid contours are at intervals of 10 ms^{-2}, dashed contours at 5 ms^{-2}.*

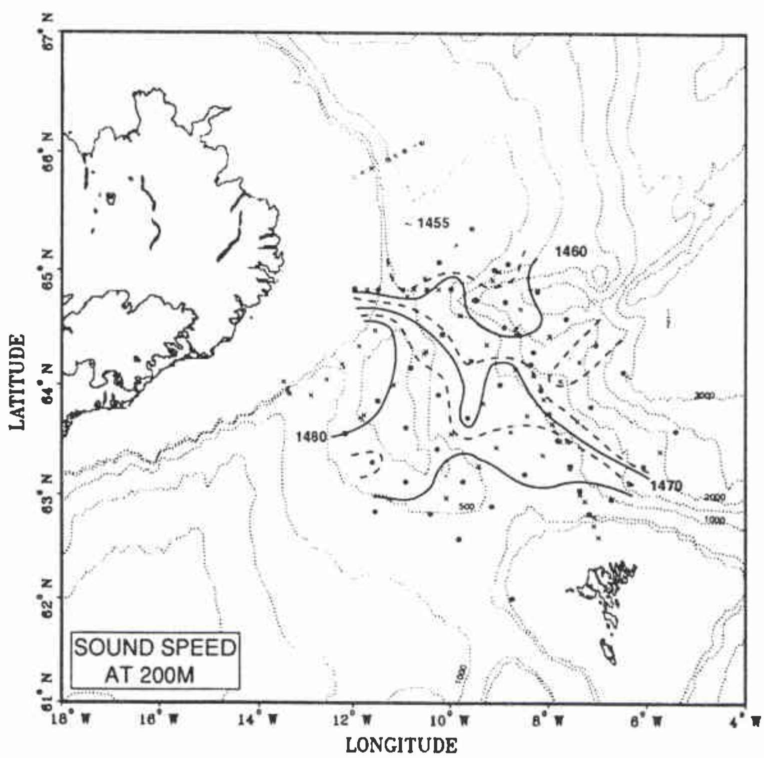

Figure C3d *Sound speed at 200 m depth. Solid contours are at intervals of 10 ms^{-2}, dashed contours at 5 ms^{-2}.*

Report no. changed (Mar 2006): SM-262-UU

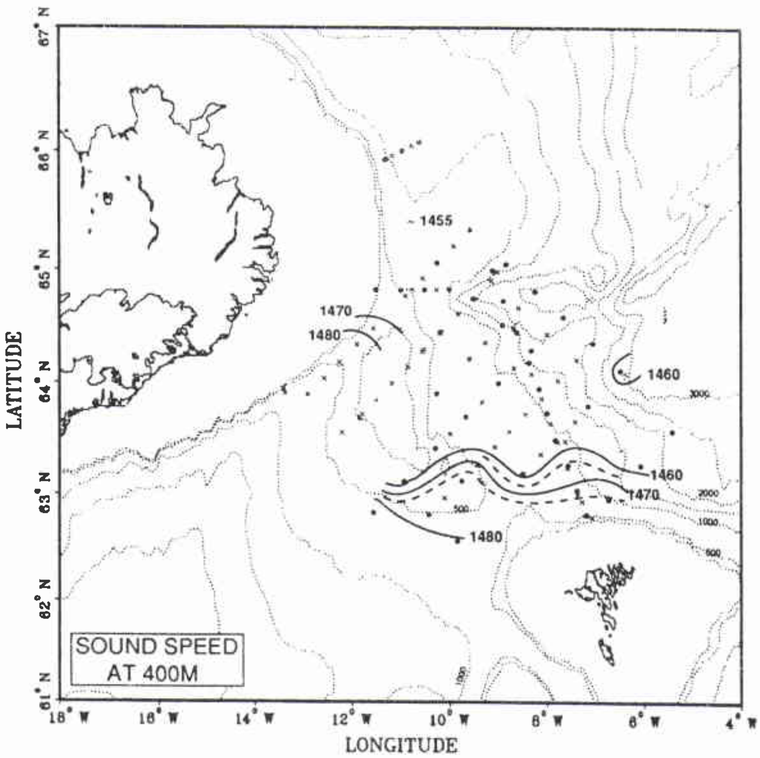

Figure C3e *Sound speed at 400 m depth. Solid contours are at intervals of 10 ms^{-2}, dashed contours at 5 ms^{-2}.*

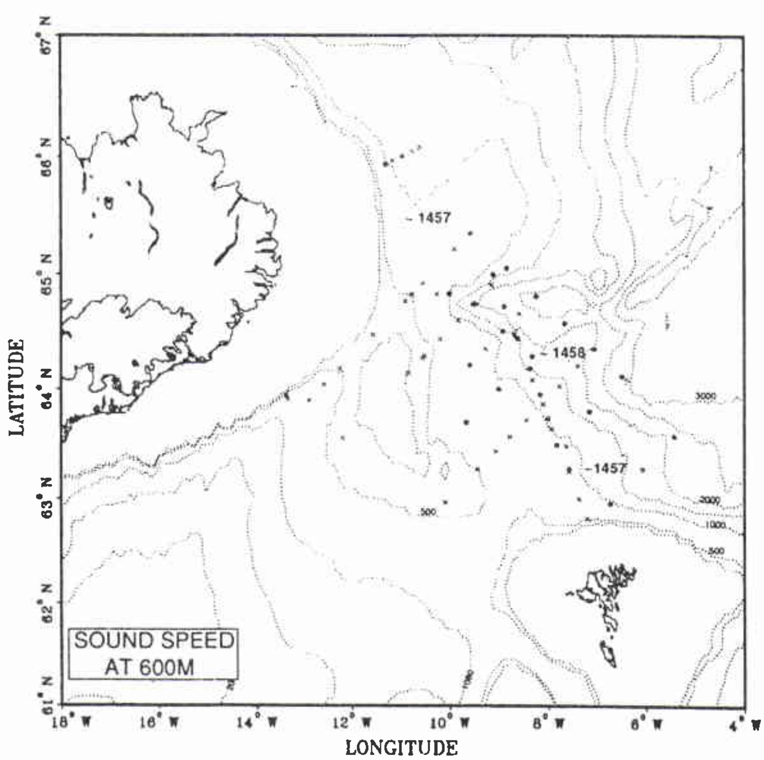

Figure C3f *Sound speed at 600 m depth. Solid contours are at intervals of 10 ms^{-2}, dashed contours at 5 ms^{-2}.*

Report no. changed (Mar 2006): SM-262-UU

Appendix D
T-S relations

The characterization of different water types is often made through the relation between temperature and salinity. Shown here are temperature-salinity diagrams with contours of density superimposed, making apparent the strong contrast between the warmer, saltier, lighter water on one side of the front and the cooler, fresher, heavier water of the Nordic seas. For stations made north of the front, water colder than 1°C has a nearly constant salinity of ~ 34.91.

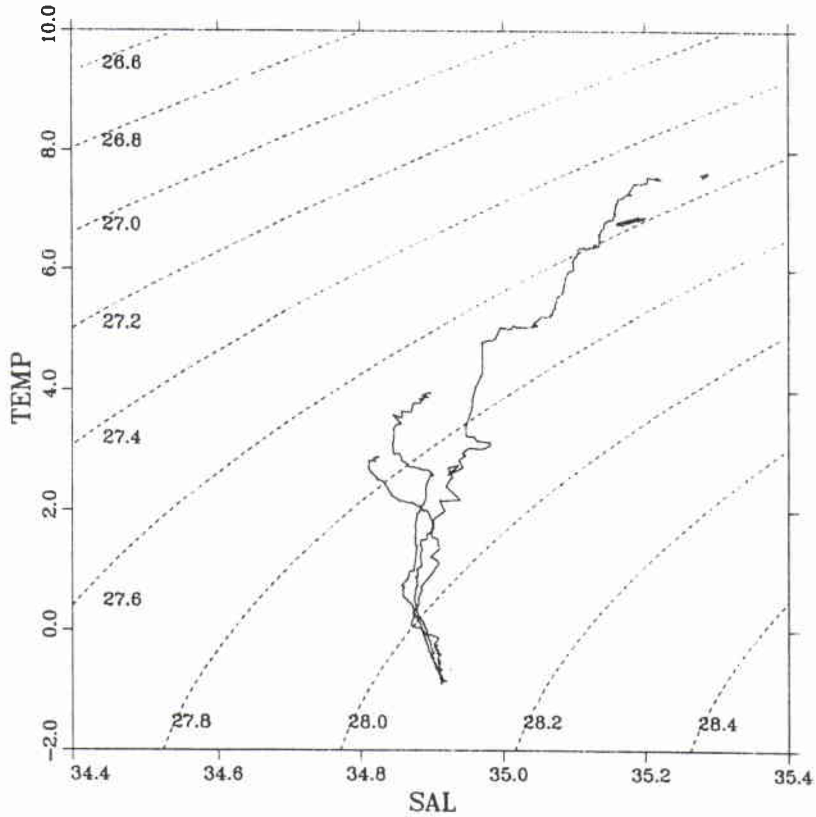

Figure D1 *Section A–B.*

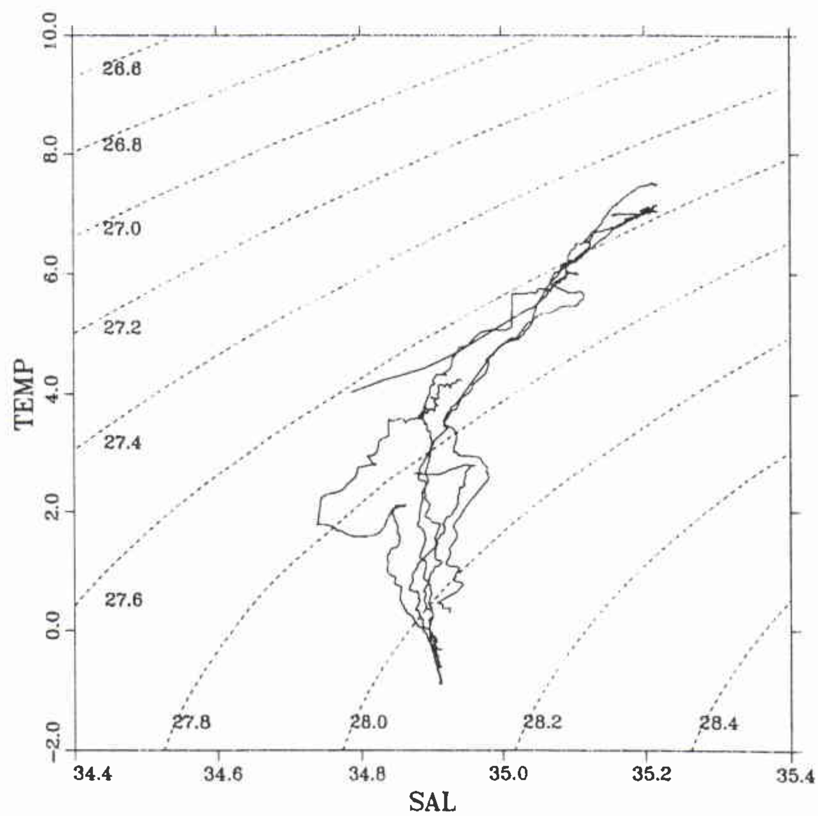

Figure D2 *Section C–D.*

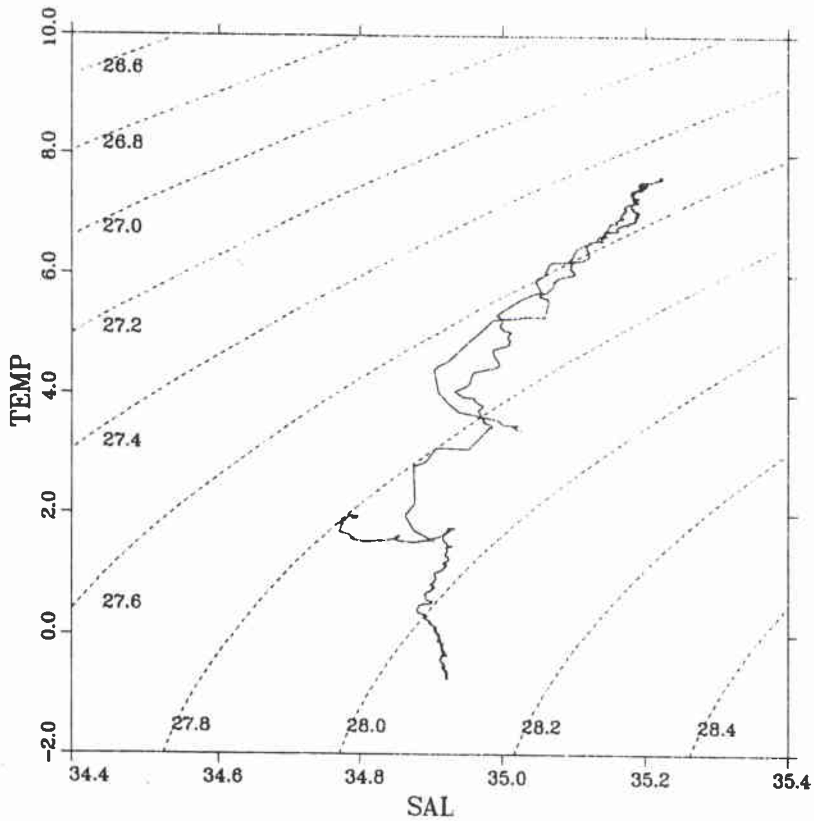

Figure D3 *Section C1–D1.*

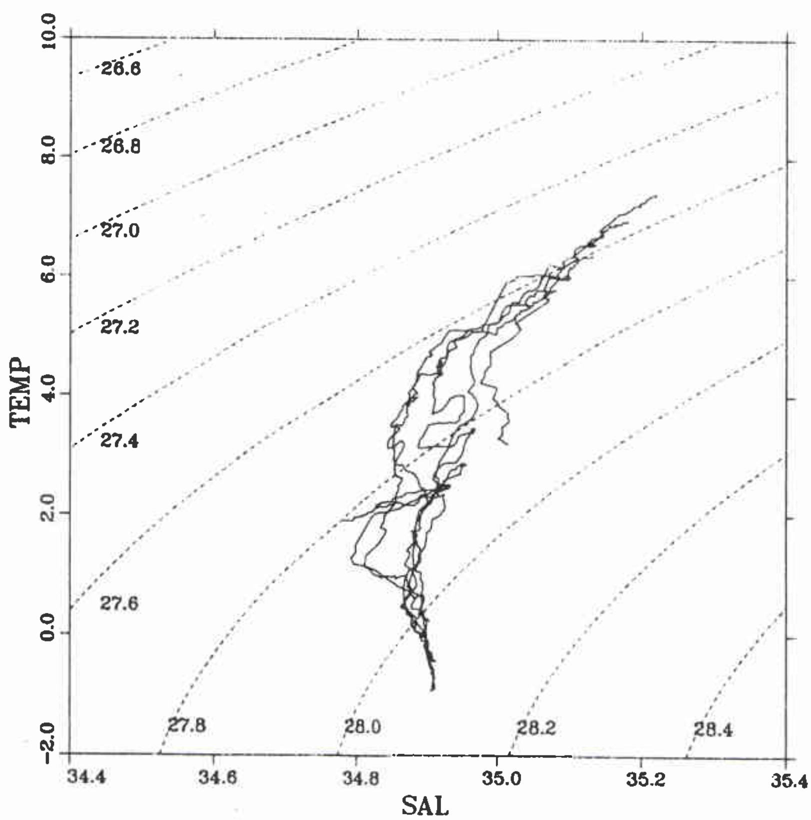

Figure D4 *Section E–F.*

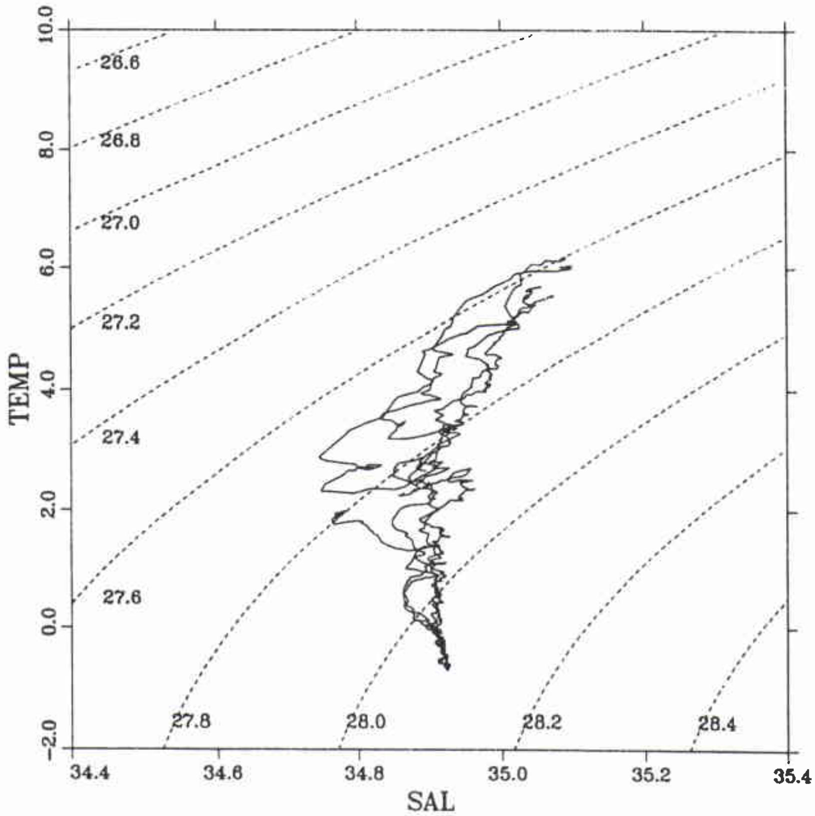

Figure D5 *Section E1–F1.*

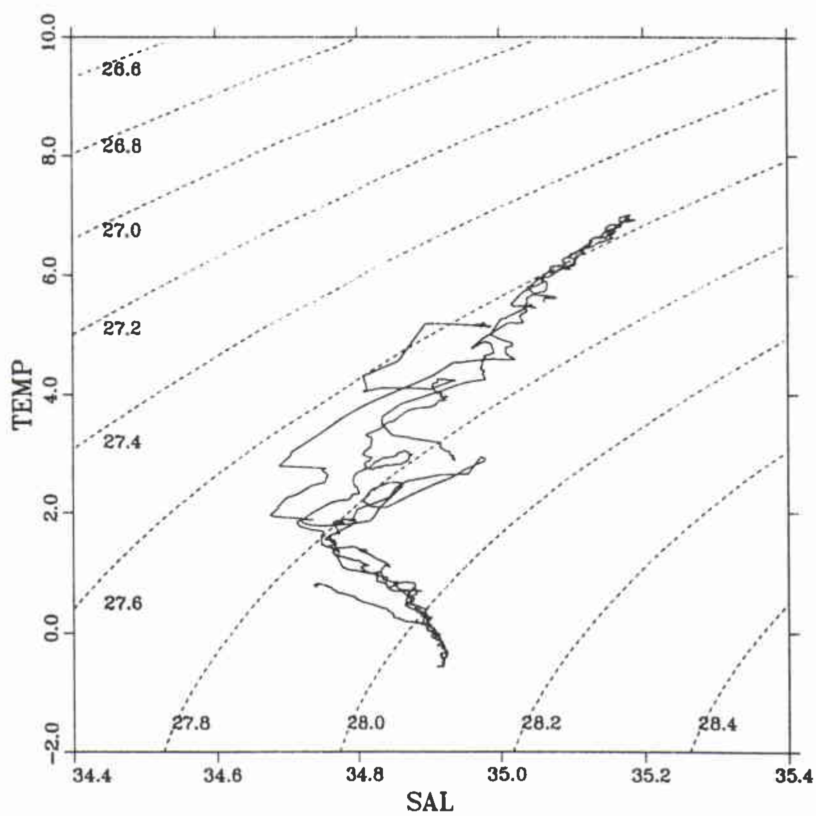

Figure D6 *Section G–H. Second transit.*

Report no. changed (Mar 2006): SM-262-UU

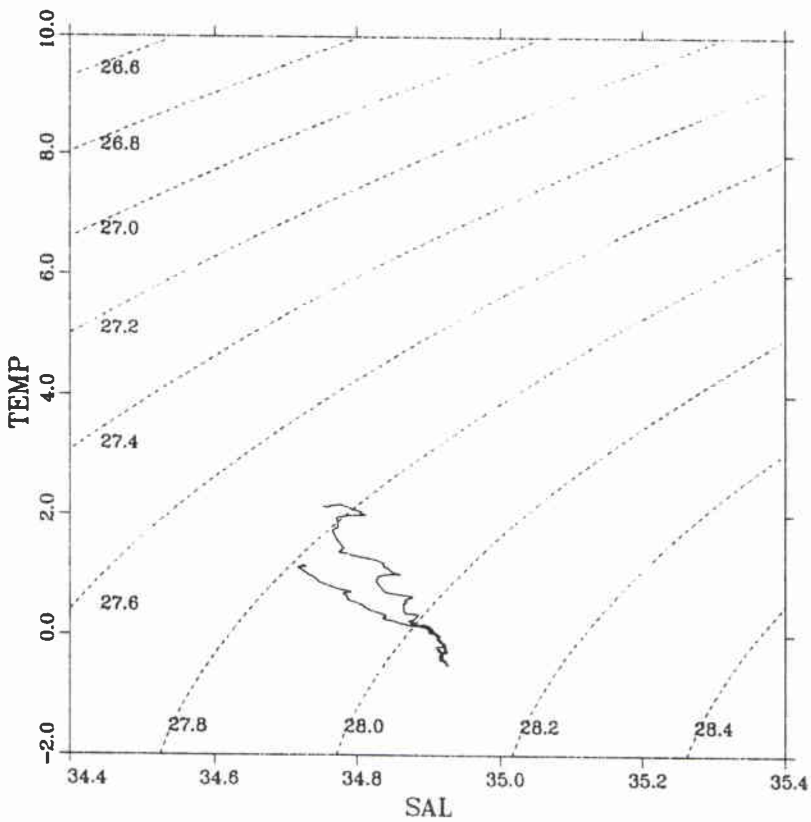

Figure D7 *Section I–J.*

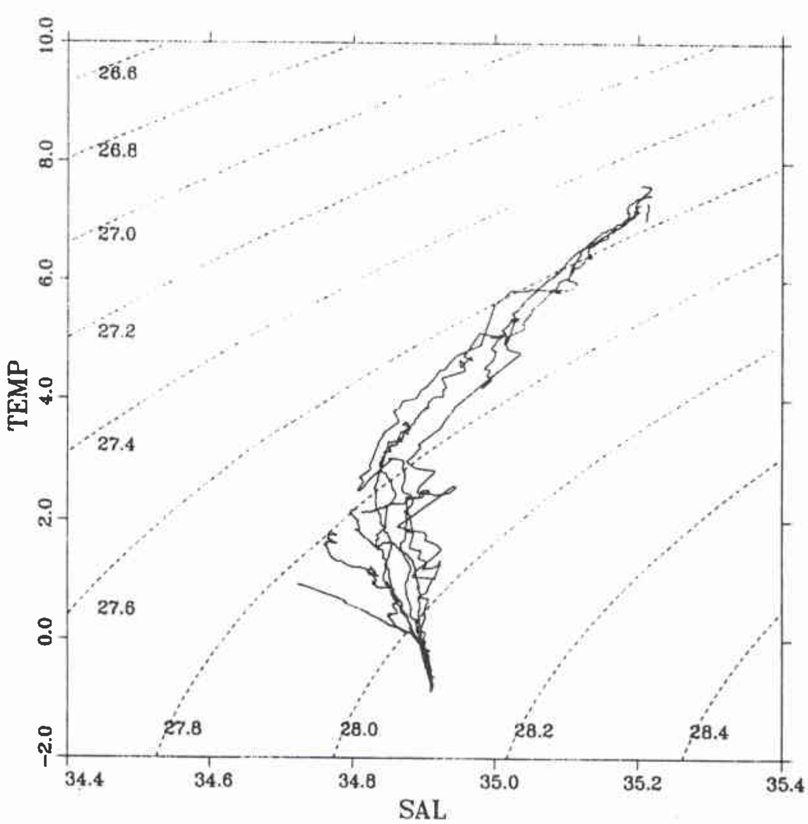

Figure D8 *Section K–L. First transit, Planet data.*

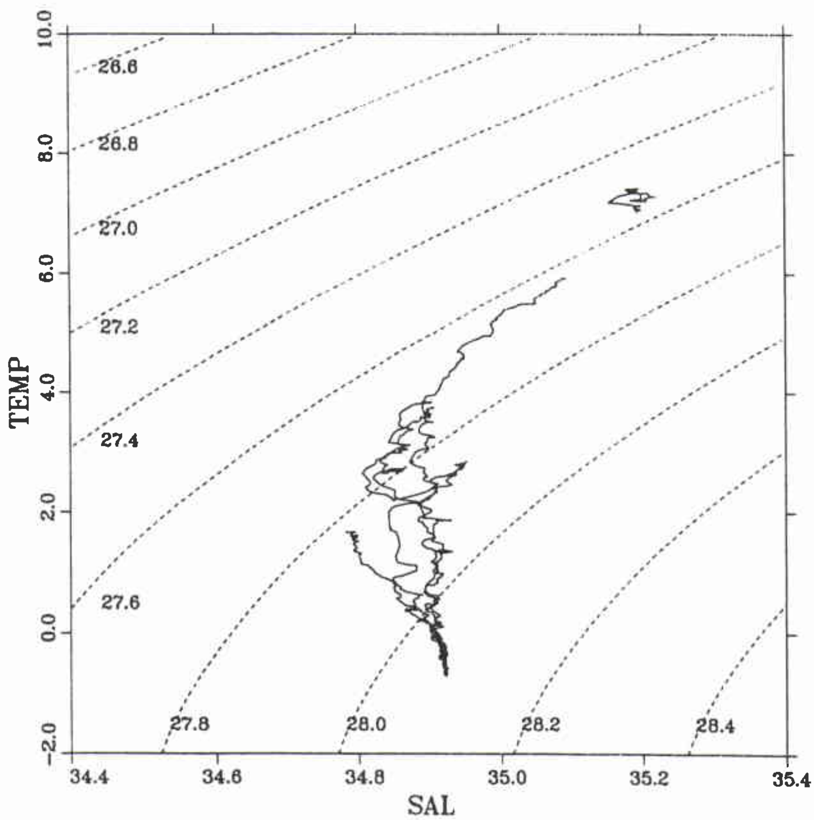

Figure D9 *Section K1–L. Second transit, Alliance data.*

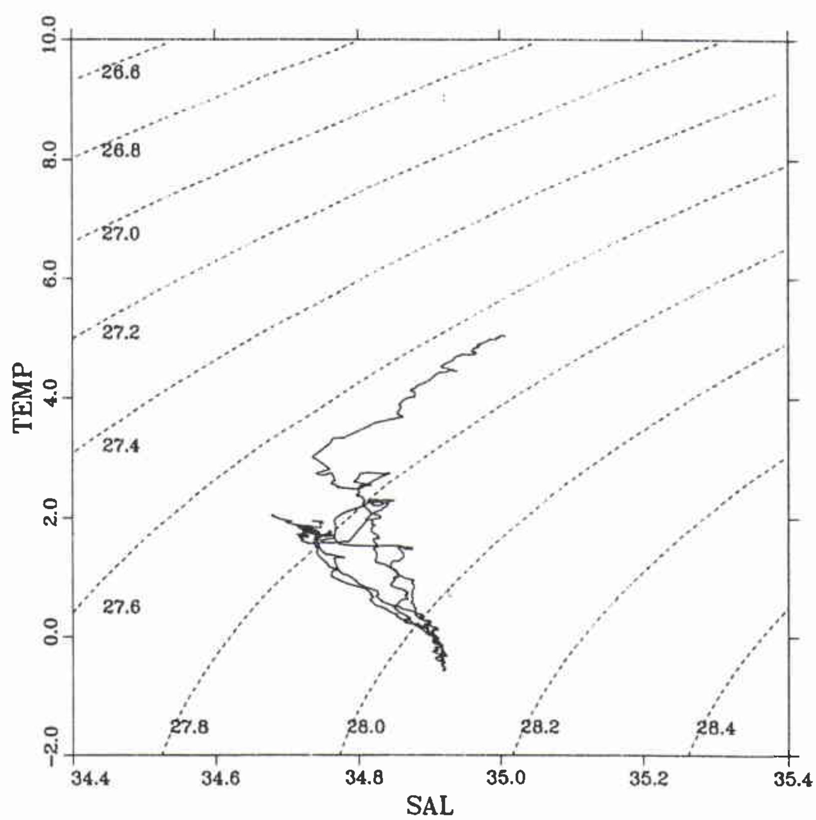

Figure D10 *Section Q–R.*

Report no. changed (Mar 2006): SM-262-UU

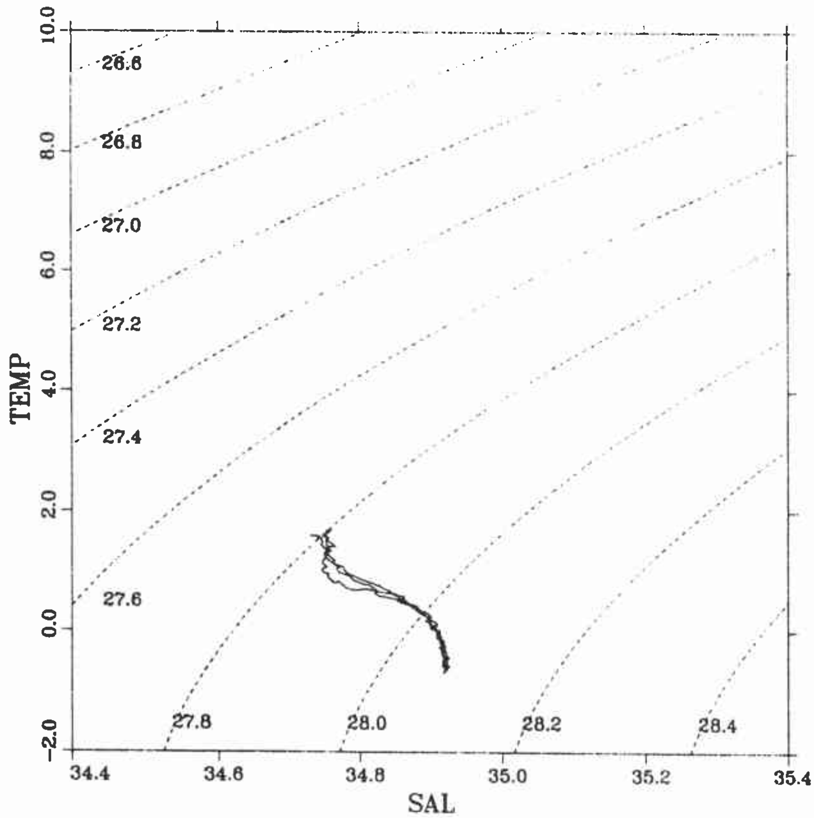

Figure D11 *Section S–T.*

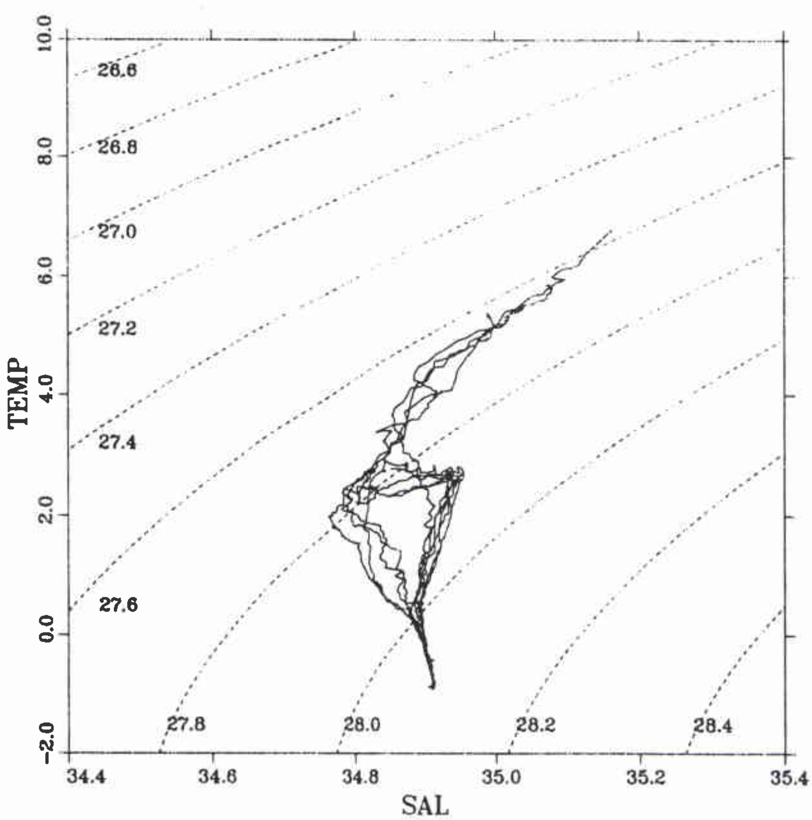

Figure D12 *Section X–Y.*

intentionally blank page

Appendix E

Effects of XBT errors on calculation of sound speed and dynamic height

XBT data must be treated with considerable scepticism: the probes are subject to several common types of failure, they undergo no on-site calibration checks, nor are they intended to be used as research tools. However, some failures are gross and easily spotted. The profiles reported here have been carefully inspected and those appearing suspicious either discarded or truncated. Assuming this subjective culling to have been effective, this appendix investigates the errors associated with normally functioning XBTs. Errors in interpreting XBT data are related to errors in temperature and depth, and also to salinity errors in case salinity values have been assigned. Here we estimate the size of these errors and compute their effect on sound speed and dynamic height for two representative sites. The analysis does not take into account any malfunction of the probe, which may be hard to detect near the IFF where numerous temperature inversions are common. The problem of how to determine a reference level for dynamic height in the shallow water of the IFR is not addressed.

Temperature error is represented as a constant offset of 0.1°C, the specified accuracy for T-7 probes. This is a worst case for dynamic height calculations, since their main application is to derive geostrophic currents which depend on height differences between probes. It is less so for sound-speed profiles since vertical gradients are largely unaffected. XBT depth is computed from an empirically determined quadratic function of fall time. Here we assume an error of 5%, which is the manufacturer's specified maximum error.

Salinity error depends on the availability of nearby CTD stations and on the quality of the regional T-S relationship. In the present context, use can be made of a nearly constant salinity north of the IFR below 600 m, assumed here to be of 34.91. In contrast, in the IFF there is mixing between Atlantic waters and those of the Nordic Seas, creating relatively large uncertainty in the T-S relationship. Based on observed scatter in the cumulative T-S curve for the present cruise, we assume the salinity error to decrease linearly from 0.2 PSU at the surface to 0.02 at 600 m, and to be constant below that depth.

As representative cases, two CTD profiles have been selected, one north of the IFF and one north of the Faeroes where Atlantic water overlays the Norwegian Sea intermediate water. For each CTD sound speed and dynamic height have been computed for four cases: from the original 'exact' data; from temperature with an offset of 0.1°C; from depths with a linearly increasing error of 5%; and from a salinity

Report no. changed (Mar 2006): SM-262-UU

Initial Distribution for SM-262

SCNR for SACLANTCEN	
SCNR Belgium	1
SCNR Canada	1
SCNR Denmark	1
SCNR Germany	1
SCNR Greece	1
SCNR Italy	1
SCNR Netherlands	1
SCNR Norway	1
SCNR Portugal	1
SCNR Spain	1
SCNR Turkey	1
SCNR UK	1
SCNR US	2
French Delegate	1
SECGEN Rep. SCNR	1
NAMILCOM Rep. SCNR	1

National Liaison Officers	
NLO Canada	1
NLO Denmark	1
NLO Germany	1
NLO Italy	1
NLO Netherlands	1
NLO UK	1
NLO US	4

Total external distribution	27
SACLANTCEN Library	10
Stock	23
Total number of copies	60