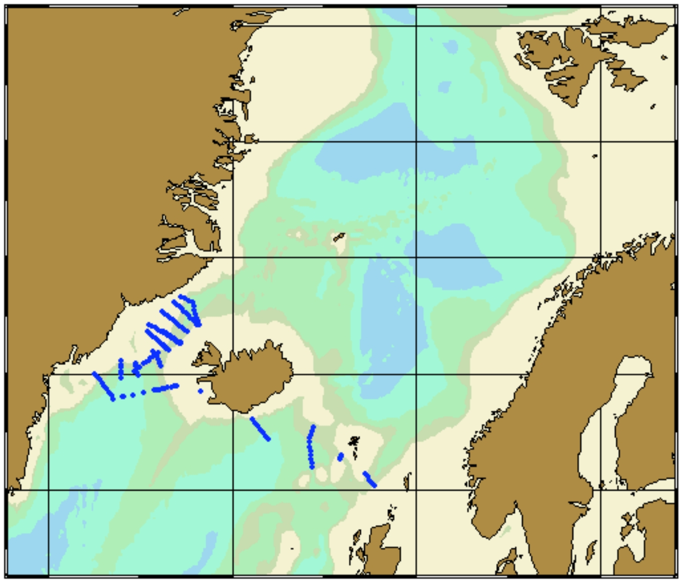
.CRUISE REPORT: AR18_1997

(Updated APR 2007)



A. HIGHLIGHTS

A.1. CRUISE SUMMARY INFORMATION

WOCE section designation	**AR18_1997**	
Expedition designation (ExpoCodes)	**34AR97_12**	
Chief Scientists	**Hannu Grönvall / FIMR** **Jouko Launiainen / FIMR**	Legs 1 & 2 Leg 3
Dates	9 Aug to 29 Aug 1997 1 Sept to 13 Sept 1997	Legs 1 & 2 Leg 3
Ship	*R/V Aranda*	
Ports of call	Gothenburg to Reykjavik, Island Reykjavik to Isafjordur, Island Isafjordur to Reykjavik	Leg 1 Leg 2 Leg 3
Station geographic boundaries	68.3162 N 34.8325 W 4.5 W 60.1845 N	
Stations	180 CTD stations, 168 Rosette stations	
Floats and drifters deployed	0	
Moorings deployed or recovered	0	

Chief Scientists:

Hannu Grönvall **Jouko Launiainen**

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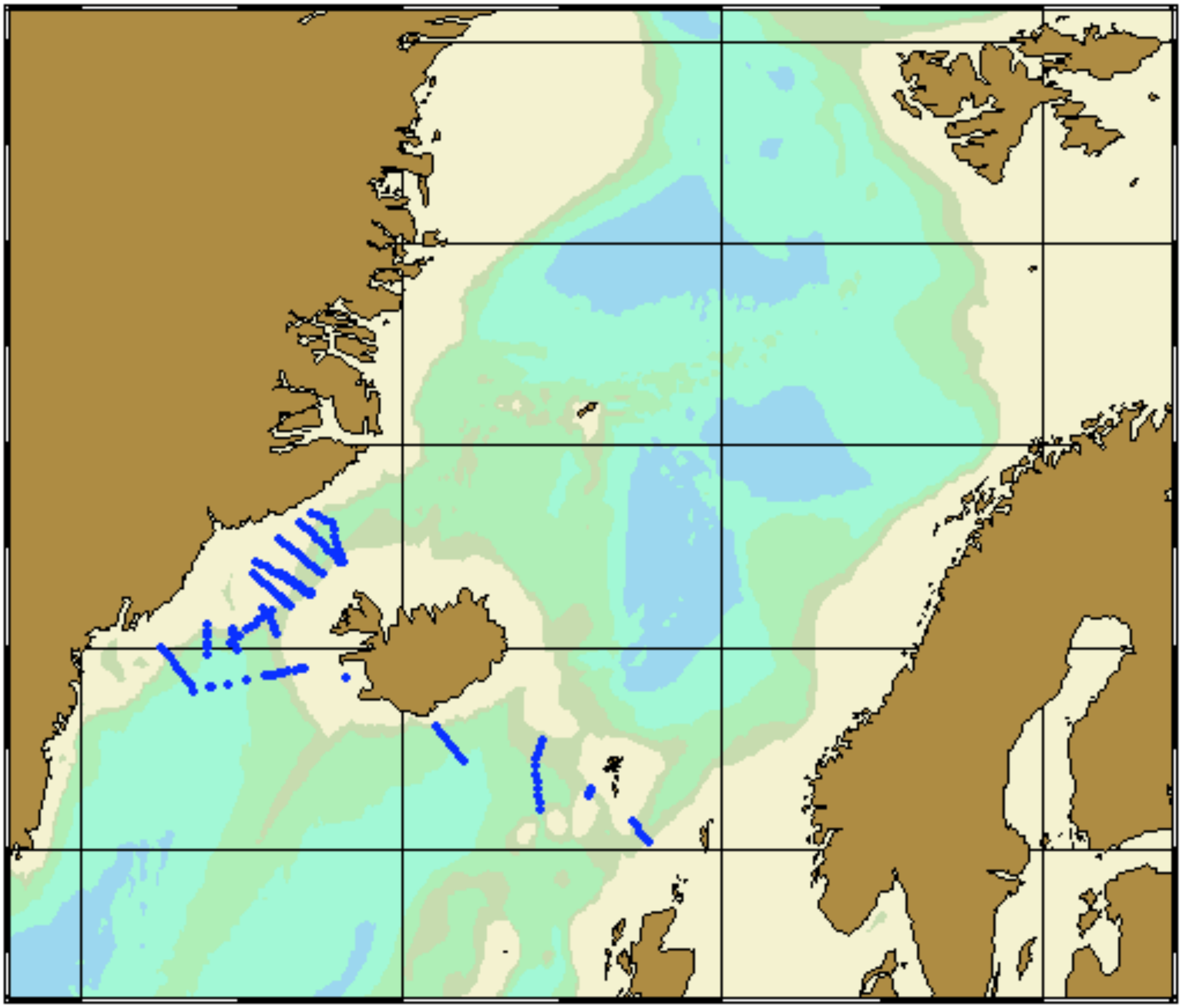
CRUISE AND DATA INFORMATION

Links to text locations. Shaded sections are not relevant to this cruise or were not available when this report was compiled

Station Locatons • AR18 • Grönvall • Launiainen • *RV/Aranda* • 1997



Finnish Institute of Marine Research

CRUISE REPORT

R/V Aranda

Cruise 12/1997

"VEINS - Nordic WOCE"

5 Aug. - 25 Sept. 1997

Ports of Call	Gothenburg, Sweden Leg 1: Gothenburg to Reykjavik, Island Leg 2: Reykjavik to Isafjordur, Island Leg 3: Isafjordur to Reykjavik Helsinki, Finland
Cruise Dates	Gothenburg, 5 Aug 1997 Leg 1: 9 Aug to 16 Aug 1997 Leg 2: 18 Aug to 29 Aug 1997 Leg 3: 1 Sept to 13 Sept 1997

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ICESCIEM
International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Scientific Personnel

Chief Scientists	H Groenvall, Legs 1 & 2 J Launiainen, Leg 3
Contact Persons	a: R Hietala, FIMR b: J Girton, APL, University of Washington, Seattle, Washington c: J Vainio, FIMR d: B Rudels, FIMR e: T Tanhua, Dept. of Analytical & Marine Chemistry, Univ. of Gothenburg

Station/ Underway Observations	**Number of stations, nm's, etc.,**	**Contact Person**	**Other Information**
Current profiler (eg ADCP)	3500km	R Hietala	underway current profiling in upper using RDI ADCP VEINS
Current profiler (eg ADCP)	23drops	J Girton	current & temperature profiling using Sippican XCP
Water bottle stations	168	T Tanhua	General Oceanic Rosette sampler, 12 x 10l bottles, on upcasts VEINS
CTD stations	28	J Vainio	28 at ICES(ENQ603x) CTD data collected on upcast Deeps casts using NBIS CTD
CTD stations	152	B Rudels	152 at ICES(ENQ603F) Incl. 1 test station. Deep casts using SBE S11+ CTD VEINS
Oxygen	168	T Tanhua	165 at ICES(ENQ603x) VEINS
Phosphate	168	T Tanhua	165 at ICES VEINS
Nitrate	168	T Tanhua	165 at ICES VEINS
Silicate	168	T Tanhua	165 at ICES VEINS
Freon - 11	168	T Tanhua	164 at ICES H73 Freon-11
Freon - 12	168	T Tanhua	164 at ICES H73 Freon-12
Freon - 113	168	T Tanhua	162 at ICES H73 Freon-113
Tetrachloromethane (CCl4)	168	T Tanhua	164 at ICES H73 Tetrachloromethane (CCl4)
Geochemical tracers (eg freons)	45	T Tanhua	SF6 VEINS

VEINS - NordicWOCE

Studies of the overflow across the Greenland -Scotland Ridge and the formation of the Denmark Strait Overflow Water

Chief scientists: Hannu Grönvall (9 Aug to 29 Aug 1997, LEGS 1 & 2)
Jouko Launiainen (1 Sept to 13 Sept 1997, LEG 3)

1. INTRODUCTION

Water transformation processes in the Nordic Seas, as well as in the Arctic Ocean, play an important role in the global thermohaline circulation and the exchange of water and heat between the Arctic Mediterranean Sea and the Atlantic Ocean is one of the key issues in the global oceanographic, climatological and environmental change. Dense water, formed north of the Greenland-Scotland Ridge, comprises a substantial fraction of the North Atlantic Deep Water (NADW). These waters cross the ridge between Shetland and the Faeroe Islands, between Iceland and the Faeroes and pass through Denmark Strait between Iceland and Greenland.

At the sill in the Denmark Strait, the northward flowing Irminger Current meets the East Greenland Current flowing south along the Greenland continental slope. The conditions at the sill become highly variable with eddy formation and intrusive mixing, and the overflow of the densest water is intermittent. The transformation of the overflow water partly takes place at the sill. The main changes are, however, expected to occur as the overflow water, entraining ambient water, sinks down to the continental slope. The volume of the overflow increases and the characteristics of the DSOW is formed.

In August-September 1997 the R/V Aranda of the Finnish Marine Research Institute (FIMR) completed a cruise covering all three overflow areas. The expedition was a continuation of the Nordic WOCE program and especially the hydrographic work was concentrated in the Denmark Strait. The cruise there formed a part of the EU MASTIII programme VEINS. Its goals include the identification of water masses contributing to the Denmark Strait Overflow Water (DSOW) and studies of the transformations of the waters, as they cross the sill and descend down the continental slope into the Irminger Sea forming the deep western boundary current. Several institutions participated the expedition: Stockholm University (SUMO), University of Gothenburg (GUMC), Plymouth Marine Laboratory, and University of Washington (UW).

The extensive CTD survey was complemented with measurements of chemical tracers - nutrients, oxygen and CFCs (GUMC) to better identify the initial water masses and to determine their relative abundance in the overflow waters. The CFCs also offer a possibility to estimate the time passed since the water last was in contact with the atmosphere and thus determine the "age" of a water mass. Sulphurhexaflouride (SF6) was also measured (by PML). SF6 has repeatedly been released as a tracer in the ocean and recently in the Greenland Sea as a part of the EU MAST III programme ESOP-2, which studies the convection and deep water formation in the Greenland Sea. Its presence in the Denmark Strait should give information of how rapidly water from the interior of the Greenland Sea reaches the overflow area, and the North Atlantic Deep Water.

The dynamical and variability aspects of the overflow, especially at the sill, are to be modelled using CTD and ADCP data (by SUMO & FIMR). In addition to the classical TS analysis (FIMR) the entrainment of water into the descending plumes will also be studied by the XCP observations (by UW). The northern and southernmost sections were planned to reach up onto the Iceland and Greenland continental slopes to form a closed volume. Geostrophic computations, continuity constraints and some minimisation scheme may then be used to assess the transports and the transformations of the overflow waters (FIMR).

The cruise track and the occupied sections are shown in Fig.1 and the station positions are given in table 4. In the Denmark Strait, icebergs were frequently in sight but no sea ice was encountered on the Greenland shelf. This was quite a different from conditions during the former R/V Aranda expedition in August-September 1993, when up to 3/4 parts of the Denmark Strait was covered by the drifting sea ice. These favourable conditions made it possible to extend all sections onto the Greenland shelf. Most of the sections in the Denmark Strait were taken perpendicular to the continental slope; only section J was taken along the slope and parallel to the assumed path of the overflow water. At sections J and E, XCP's were deployed. During the expedition, the sections E and S were visited twice and L was taken three times (Figs.1b and 1c), to study the short time variability of the circulation and an eddy-like characteristics, observed on the first crossings. In the end of the leg 3, a small scale square cruising was carried out in the northern end of the section E (Fig.1c), to study the air-sea interaction in a locality of a thermal marine front.

During the expedition, the weather was fairly good, and only two working days were missed, one during leg 2 and one during leg 3, although the winds were somewhat stronger during the 3rd leg. The CTD and water sampling could be done with wind velocities up to 16-17 m/s.

2. OBSERVATIONS AND ANALYSIS

2.1 Hydrography

The CTD observations were made during the first leg using a NBIS Mk-III CTD system. At stations 397-425 there was a gap in conductivity data from about 40 dbar to about 140 dbar. The reason of the gap was unknown. Otherwise the data seemed to be good according to the preliminary comparison with salinity samples analysed onboard. During the second and the third leg a SeaBird SBE-911plus CTD system was used. It performed well and appeared to remain stable during the cruise. In total 181 CTD stations were occupied. Salinity samples for control of the CTD were taken on each station. Some of the samples were measured onboard on a Guildline Autosal 8400 but the bulk of the samples will be analysed ashore.

2.2. Chemistry

Samples for the chemical measurements were drawn from 10 l Nisken bottles mounted on a 12-bottle rosette. The sampling order was CFCs, SF_6, oxygen, nutrient and salinity.

Four transient tracers (CFC-11, CFC-12, CFC-113 and CCl_4) were measured. The measurements were made with a purge and sample pre-treatment process followed by separation and detection on a gas chromatograph equipped with an electron capture detector. A total of 1444 water samples from 168 stations (Gothenburg - Reykjavik) were analysed. SF_6 was measured by a sparge technique followed by separation and detection on a gas chromatograph equipped with an electron capture detector. A total of 45 stations was analysed for SF_6 during the cruise. Oxygen was measured on all station (except section J) during the cruise. The analysis was performed onboard using Gran linearised potentiometric Winkler titration. Samples for nutrient analysis were also taken from all the stations. The analysis will be performed ashore after the cruise.

2.3 ADCP measurements

ADCP measurements were made during the cruise using a ship mounted 150 kHz unit (RD Instruments). The current profiles were recorded to 150-400m depth. Bottom tracking succeeded in areas where the water depth was less than 600m. During the second leg of the cruise R/V Aranda was equipped with Ashtech 3DF GPS attitude measuring system. The function of the system was to get a better heading accuracy for the ADCP measurements (than with the ship's gyrocompass).

2.4. XCP measurements

On 23 stations current and temperature profiles were measured using Sippican XCP probes. All launched probes appeared to have functioned properly. The reference velocity was obtained from the high precision positioning system introduced above.

2.5 Meteorological data

Extensive marine meteorological data from the ship's automatic weather station, were registered with 10 minutes interval throughout the expedition.

3. PRELIMINARY RESULTS

The main hydrographic sections, and some representative TS-plots and hydrographic vertical profiles for the Denmark Strait - Irminger Sea working area are given in Figures 2 to 10.

The conditions found on the sections north of the sill indicated that the East Greenland Current was predominantly baroclinic and that the motion in its deeper layers was considerably slower. The dense deep water was found higher in the water column on the Iceland side suggesting a recirculation towards Northeast along the Iceland continental slope (Fig. 2). The intermediate waters, characterised by a temperature maximum between 1 to 1.5 oC, were prominent along the Greenland slope but not present on the Iceland side (Fig. 3). This implies that the main water masses crossing the sill are intermediate waters originating from the Arctic Ocean, the Atlantic Return Current, the Greenland Sea and the Iceland Sea.

The repeated L sections at the sill showed large variability. At the first crossing East Greenland Current waters dominated and the warm Irminger Current was confined to the Iceland continental slope (Fig. 4). The second time, the Irminger Current water was present over almost the entire cross section and lenses of warm water were transferred into the East Greenland Current (Fig. 5). At the third crossing the Irminger Current water and the upper layers of the East Greenland Current, originating from the Arctic Ocean, were found to interact isopycnally forming intrusions and inversions in the water column (Fig. 6).

South of the sill the water column at the rim of the Irminger Sea was dominated by the recirculating branch of the Irminger Current (Fig. 7). The upper 800m in the central part of the Irminger Sea was filled with colder water of lower salinity. This water could be a remnant of the local winter convection. At station A3 the low salinity water extended to the sea surface showing a direct connection to the atmosphere (Fig. 8). Between 1000 and 2000 m colder and less saline Labrador Sea Water (LSW) was found as a salinity minimum (Fig. 7), lying above the North Eastern Atlantic Deep Water (NEADW), which enters the Irminger Sea from the east through the Gibbs Fracture Zone. DSOW was present at the deepest stations on sections A and N (Fig. 9). The layer was about 200m thick and observations from the other sections closer to the sill indicated that the width of the descending plume increased downstream.

The DSOW in the plume was stratified. Less saline, and often colder, water was present above the dense bottom water (Fig. 10). This suggests that the entrainment of ambient water into the plume is fairly small also at the early part of the descent. This is somewhat in conflict with that what is commonly assumed.

Participating Institutions:

Finnish Institute of Marine Research	(FIMR)
Department of Analytical and Marine Chemistry, Gothenburg University	(GUMC)
Department of Meteorology and Oceanography, Stockholm Univesity	(SUMO)
Applied Physics Laboratory, University of Washington	(UW)
Plymouth Marine Laboratory	(PML)

Responsible Investigators:

Leg 1: Gothenburg-Reykjavik	Chief Scientist	Hannu Grönvall
Leg 2: Reykjavik-Isafjördur	Chief Scientist	Hannu Grönvall
Leg 3: Isafjördur-Reykjavik	Chief Scientist	Jouko Launiainen

CTD:	Bert Rudels	(FIMR)	bert.rudels@fimr.fi
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Chemical tracers:	Toste Tanhua	(GUMC)	toste@alpha.amc.chalmers.se
XCP:	James Girton	(UW)	girton@ocean.washington.edu
Air- sea meteorology:	Jouko Launiainen	(FIMR)	jouko.launi @ fimr.fi

Participants

Leg 1. 9-16.8.1997 Gothenburg – Reykjavik		**Leg 2. 18-29.8.1997 Reykjavik –Isafjördur**		**Leg 3. 1-13.9.1997 Isafjördur-Reykjavik**	
Hannu Grönvall	FIMR	Hannu Grönvall	FIMR	Jouko Launiainen	FIMR
Kimmo Kahma	FIMR	Riikka Hietala	FIMR	Riikka Hietala	FIMR
Henry Söderman	FIMR	Tero Purokoski	FIMR	Juha Kivimäki	FIMR
Jouni Vainio	FIMR	Bert Rudels	FIMR	Tero Purokoski	FIMR
Hannu Vuori	FIMR	Henry Söderman	FIMR	Bert Rudels	FIMR
Klas Lindblad	SUMO	Hannu Vuori	FIMR	Hannu Vuori	FIMR
Peter Sigray	SUMO	Peter Lundberg	SUMO	Peter Lundberg	SUMO
Toste Tanhua	GUMC	Tim Fristedt	SUMO	Tim Fristedt	SUMO
Anders Olsson	GUMC	Irene Lake	SUMO	Irene Lake	SUMO
Kristina Olsson	GUMC	Anna Nikolopolos	SUMO	Anna Nikopolos	SUMO
Malcolm Liddicoat	PML	Toste Tanhua	GUMC	Johan Nilsson	SUMO
		Anders Olsson	GUMC	Toste Tanhua	GUMC
		Ingrid Kubista	GUMC	Anders Olsson	GUMC
		Marie Persson	GUMC	Lars Johansson	GUMC
		Malcolm Liddicoat	PML	Malcolm Liddicoat	PML
		James Girton	UW		

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Leg 1:	Gothenburg-Reykjavik		9.-16.8.1997			
Index	**Station name**	**Latitude**	**Longitude**	**Depth**	**Date**	**Time**
397	VEINS_TEST	N57.4406	E007.2178	358	19970809	0743
398	VEINS-I_1	N60.1106	W004.3001	389	19970810	2035
399	VEINS-I_2	N60.1838	W004.4598	851	19970810	2256
400	VEINS-I_3	N60.2548	W005.0236	919	19970811	0155
401	VEINS-I_4	N60.3276	W005.1869	789	19970811	0444
402	VEINS-I_5	N60.3998	W005.3503	732	19970811	0723
403	VEINS-II_1	N61.2001	W008.1599	552	19970811	1653
404	VEINS-II_2	N61.2242	W008.1331	796	19970811	1826
405	VEINS-II_3	N61.2485	W008.1064	719	19970811	2052
406	VEINS-II_4	N61.2742	W008.0784	409	19970811	2243
407	VEINS-II_5	N61.3000	W008.0497	207	19970811	2358
408	VEINS-IV_1	N62.4000	W011.0703	607	19970812	1045
409	VEINS-IV_2	N62.3102	W011.1746	719	19970812	1307
410	VEINS-IV_3	N62.2199	W011.2771	833	19970812	1543
411	VEINS-IV_4	N62.1300	W011.3802	980	19970812	1823
412	VEINS-IV_5	N62.0219	W011.3511	1118	19970812	2109
413	VEINS-IV_6	N61.5128	W011.3178	1103	19970813	0026
414	VEINS-IV_7	N61.4041	W011.2876	1212	19970813	0343
415	VEINS-IV_8	N61.2956	W011.2587	980	19970813	0645
416	VEINS-IV_9	N61.1869	W011.2284	1438	19970813	0940
417	VEINS-IV_10	N61.0785	W011.2005	1262	19970813	1317
418	VEINS-IV_11	N60.5703	W011.1695	677	19970813	1650
419	VEINS-V_1	N62.0900	W016.0000	2199	19970814	0802
420	VEINS-V_2	N62.1778	W016.1729	2139	19970814	1213
421	VEINS-V_3	N62.2662	W016.3491	2070	19970814	1642
422	VEINS-V_4	N62.3549	W016.5258	1925	19970814	2011
423	VEINS-V_5	N62.4429	W017.1030	1795	19970814	2343
424	VEINS-V_6	N62.5316	W017.2814	1481	19970815	0318
425	VEINS-V_7	N63.0201	W017.4604	1115	19970815	0629

Leg 2:	Reykjavik-Isafjördur		18.-29.8.1997			
Index	**Station name**	**Latitude**	**Longitude**	**Depth**	**Date**	**Time**
426	VE_TEST1	N64.1420	W023.2242	106	19970818	1623
427	VEINS_N1	N64.2801	W026.0005	273	19970818	2322
428	VEINS_N2	N64.2658	W026.1834	284	19970819	0102
429	VEINS_N3	N64.2507	W026.3647	325	19970819	0249
430	VEINS_N4	N64.2363	W026.5477	342	19970819	0432
431	VEINS_N5	N64.2219	W027.1291	644	19970819	0617
432	VEINS_N6	N64.2074	W027.3108	862	19970819	0823
433	VEINS_N7	N64.1927	W027.4923	962	19970819	1051
434	VEINS_N8	N64.1782	W028.0737	1243	19970819	1334
435	VEINS_N9	N64.1638	W028.2547	1341	19970819	1618
436	VEINS_N10	N64.1092	W029.3337	1939	19970819	2114
437	VEINS_N11	N64.0544	W030.4097	2611	19970820	0252
438	VEINS_N12	N64.0000	W031.4838	2725	19970820	0900
439	VEINS_N12	N63.5996	W031.4813	2724	19970820	1326
440	VEINS_A1	N63.5492	W032.4943	2609	19970822	0810
441	VEINS_A2	N64.0312	W033.0461	2412	19970822	1318
442	VEINS_A3	N64.1126	W033.1958	2216	19970822	1726
443	VEINS_A4	N64.1940	W033.3469	1985	19970822	2224
444	VEINS_A5	N64.2747	W033.4943	1697	19970823	0237
445	VEINS_A6	N64.3563	W034.0455	1400	19970823	0636
446	VEINS_A7	N64.4377	W034.1952	1152	19970823	1017
447	VEINS_A8	N64.5187	W034.3478	1000	19970823	1319
448	VEINS_A9	N64.5998	W034.4994	341	19970823	1604
449	VEINS_B1	N64.4999	W032.0018	2164	19970824	0033
450	VEINS_B2	N64.5859	W032.0004	1991	19970824	0459
451	VEINS_B3	N65.0721	W032.0002	1750	19970824	0849
452	VEINS_B4	N65.1580	W031.5998	1441	19970824	1221
453	VEINS_B5	N65.2442	W032.0002	1025	19970824	1538
454	VEINS_B6	N65.3301	W032.0002	450	19970824	1821
455	VEINS_D6	N65.2799	W030.2724	409	19970824	2317
456	VEINS_D5	N65.1943	W030.2272	1022	19970825	0144
457	VEINS_D4	N65.1118	W030.1830	1464	19970825	0501
458	VEINS_D3	N65.0250	W030.1384	1820	19970825	0822
459	VEINS_D2	N64.5405	W030.0957	2056	19970825	1202
460	VEINS_J11	N65.0680	W030.3370	1639	19970825	1645
461	VEINS_J10	N65.1163	W030.1695	1447	19970825	1935
462	VEINS_J9	N65.1603	W030.0247	1306	19970825	2209
463	VEINS_J7	N65.2521	W029.3205	1126	19970826	0155
464	VEINS_J6	N65.2977	W029.1676	1122	19970826	0428
465	VEINS_J5	N65.3433	W029.0202	1082	19970826	0640
466	VEINS_J4	N65.3896	W028.4717	1066	19970826	0840
467	VEINS_J3	N65.4355	W028.3200	935	19970826	1039
468	VEINS_J2	N65.4800	W028.1698	762	19970826	1237
469	VEINS_J1	N65.5260	W028.0188	616	19970826	1440
470	VEINS_E1	N65.5900	W028.3200	455	19970826	1747
471	VEINS_E2	N65.5322	W028.2449	548	19970826	1920
472	VEINS_E3	N65.4768	W028.1736	768	19970826	2105
473	VEINS_E4	N65.4215	W028.0979	906	19970826	2306

Leg 2:	Reykjavik-Isafjördur		18.-29.8.1997			
Index	**Station name**	**Latitude**	**Longitude**	**Depth**	**Date**	**Time**
474	VEINS_E5	N65.3671	W028.0195	835	19970827	0120
475	VEINS_E6	N65.3116	W027.5446	816	19970827	0344
476	VEINS_E7	N65.2557	W027.4721	800	19970827	0543
477	VEINS_E8	N65.1994	W027.3994	729	19970827	0746
478	VEINS_L9	N66.1902	W027.4507	381	19970827	1527
479	VEINS_L8	N66.1501	W027.3293	497	19970827	1714
480	VEINS_L7	N66.1298	W027.2703	496	19970827	1840
481	VEINS_L6	N66.1098	W027.2099	496	19970827	1958
482	VEINS_L5	N66.0898	W027.1495	537	19970827	2114
483	VEINS_L4	N66.0699	W027.0894	625	19970827	2242
484	ADCP_ICE	N66.0457	W027.0413	677	19970828	0030
485	VEINS_L2	N66.0296	W026.5512	597	19970828	0237
486	VEINS_L1	N66.0102	W026.4800	452	19970828	0437
487	ADCP_ICE	N66.0459	W027.0415	681	19970828	0646
488	VEINS_S10	N66.4793	W027.2303	370	19970828	1201
489	VEINS_S9	N66.4482	W027.1037	408	19970828	1329
490	VEINS_S8	N66.4175	W026.5753	476	19970828	1457
491	VEINS_S7	N66.3864	W026.4503	540	19970828	1637
492	VEINS_S6	N66.3548	W026.3229	567	19970828	1826
493	VEINS_S5	N66.3236	W026.1970	629	19970828	2005
494	VEINS_S4	N66.2924	W026.0711	677	19970828	2153
495	VEINS_S3	N66.2612	W025.5467	656	19970829	0014
496	VEINS_S2	N66.2298	W025.4199	450	19970829	0259
497	VEINS_S1	N66.2143	W025.3573	331	19970829	0436

Leg 3:	Isafjördur-Reykjavik		1.-13.9.1997			
Index	**Station name**	**Latitude**	**Longitude**	**Depth**	**Date**	**Time**
498	VEINS_K2	N67.1498	W023.3643	397	19970902	1153
499	VEINS_K3	N67.2500	W023.4474	654	19970902	1430
500	VEINS_K4	N67.3495	W023.5315	975	19970902	1813
501	VEINS_K5	N67.4507	W024.0180	1287	19970903	0718
502	VEINS_K6	N67.5506	W024.1016	1481	19970903	1127
503	VEINS_K7	N68.0499	W024.1880	1500	19970903	1459
504	VEINS_K10	N68.1891	W025.2846	300	19970903	1935
505	VEINS_K9	N68.1418	W025.0512	729	19970903	2149
506	VEINS_K8	N68.0962	W024.4199	1279	19970904	0134
507	VEINS_H11	N68.0498	W026.1265	312	19970904	0731
508	VEINS_H10	N67.5903	W025.5602	404	19970904	0925
509	VEINS_H9	N67.5296	W025.3993	641	19970904	1128
510	VEINS_H8	N67.4723	W025.2557	1079	19970904	1329
511	VEINS_H7	N67.4149	W025.1136	1343	19970904	1600
512	VEINS_H6	N67.3565	W024.5694	1449	19970904	1851
513	VEINS_H5	N67.2999	W024.4265	1354	19970904	2210
514	VEINS_H4	N67.2426	W024.2838	1152	19970905	0208
515	VEINS_H3	N67.1854	W024.1423	877	19970905	0512
516	VEINS_H2	N67.1272	W023.5989	568	19970905	0730
517	VEINS_H1	N67.0698	W023.4574	280	19970905	0929
518	VEINS_K1	N67.0496	W023.2737	241	19970905	1100
519	VEINS_R1	N66.4800	W024.5309	579	19970905	1519
520	VEINS_R2	N66.5319	W025.0846	925	19970905	1714
521	VEINS_R2	N66.5270	W025.0955	929	19970905	1820
522	VEINS_R3	N66.5838	W025.2403	1083	19970905	2048
523	VEINS_R4	N67.0359	W025.3947	945	19970906	0009
524	VEINS_R5	N67.0877	W025.5501	835	19970906	0316
525	VEINS_R6	N67.1399	W026.1078	739	19970906	0657
526	VEINS_R7	N67.1924	W026.2628	591	19970906	0905
527	VEINS_R8	N67.2434	W026.4211	293	19970906	1147
528	VEINS_R9	N67.2962	W026.5815	298	19970906	1355
529	VEINS_R10	N67.3482	W027.1417	239	19970906	1703
530	VEINS_R11	N67.3997	W027.3022	290	19970906	1935
531	VEINS_S12A	N66.5308	W028.0182	356	19970907	0906
532	VEINS_S11A	N66.4813	W027.3971	357	19970907	1202
533	VEINS_S10A	N66.4396	W027.2279	371	19970907	1350
534	VEINS_S9A	N66.4093	W027.1014	416	19970907	1528
535	VEINS_S8A	N66.3786	W026.5730	485	19970907	1716
536	VEINS_S7A	N66.3478	W026.4533	525	19970907	1926
537	VEINS_S6A	N66.3157	W026.3183	563	19970907	2147
538	VEINS_S5A	N66.2830	W026.1933	643	19970907	2357
539	VEINS_S4A	N66.2520	W026.0717	657	19970908	0240
540	VEINS_S3A	N66.2221	W025.5474	583	19970908	0506
541	VEINS_S2A	N66.1901	W025.4185	338	19970908	0704
542	VEINS_S1A	N66.1747	W025.3627	188	19970908	0822
543	VEINS_L1	N66.0096	W026.4791	446	19970908	1428
544	VEINS_L2	N66.0302	W026.5488	584	19970908	1602
545	ADCP_ICE	N66.0460	W027.0412	669	19970908	1802

Leg 3:	Isafjördur-Reykjavik		1.-13.9.1997			
Index	**Station name**	**Latitude**	**Longitude**	**Depth**	**Date**	**Time**
546	VEINS_L4	N66.0700	W027.0896	618	19970908	1952
547	VEINS_L5	N66.0909	W027.1484	529	19970908	2135
548	VEINS_L6	N66.1106	W027.2091	493	19970908	2306
549	VEINS_L7	N66.1304	W027.2698	494	19970909	0048
550	VEINS_L8	N66.1498	W027.3280	498	19970909	0232
551	VEINS_L9	N66.1891	W027.4484	383	19970909	0444
552	VEINS_L10	N66.2472	W028.0232	340	19970909	0644
553	VEINS_L11	N66.3046	W028.1964	317	19970909	0838
554	VEINS_L12	N66.3623	W028.3718	327	19970909	1031
555	VEINS_L13	N66.4197	W028.5469	345	19970909	1220
556	VEINS_L14	N66.4772	W029.1226	364	19970909	1406
557	VEINS_S15A	N67.0723	W028.5888	323	19970909	1656
558	VEINS_S14A	N67.0256	W028.3928	322	19970909	1849
559	VEINS_S13A	N66.5783	W028.1966	343	19970909	2044
560	VEINS_S12A	N66.5316	W028.0006	360	19970909	2333
561	VEINS_L11	N66.3046	W028.1963	315	19970910	0652
562	VEINS_L10	N66.2472	W028.0236	342	19970910	0905
563	VEINS_L9	N66.1898	W027.4505	381	19970910	1116
564	VEINS_L8	N66.1500	W027.3303	496	19970910	1256
565	VEINS_L7	N66.1298	W027.2691	498	19970910	1432
566	VEINS_L6	N66.1098	W027.2097	497	19970910	1608
567	VEINS_L5	N66.0895	W027.1492	537	19970910	1732
568	VEINS_L4	N66.0693	W027.0914	622	19970910	1913
569	ADCP_ICE	N66.0457	W027.0415	672	19970910	2056
570	VEINS_L2	N66.0315	W026.5533	600	19970910	2314
571	VEINS_E8	N65.2000	W027.3988	731	19970911	1238
572	VEINS_E7	N65.2553	W027.4729	802	19970911	1437
573	VEINS_E6	N65.3113	W027.5474	818	19970911	1635
574	VEINS_E5	N65.3670	W028.0214	835	19970911	1847
575	VEINS_E4	N65.4230	W028.0963	902	19970911	2049
576	VEINS_E3	N65.4776	W028.1717	766	19970911	2333
577	VEINS_E2	N65.5340	W028.2445	543	19970912	0223
578	VEINS_E1	N65.5898	W028.3204	459	19970912	0455

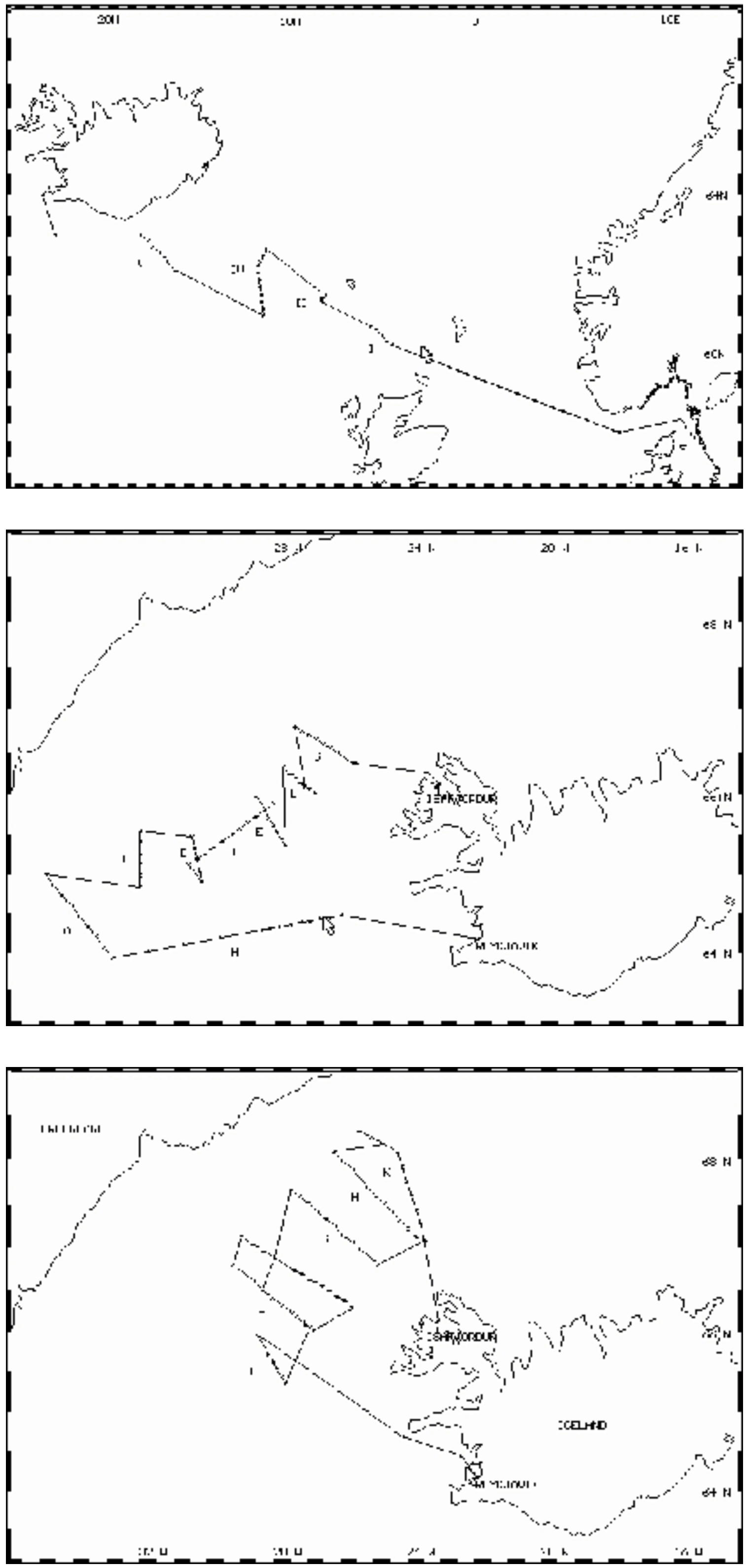

Figure 1: Cruise tracks for legs 1 to 3.

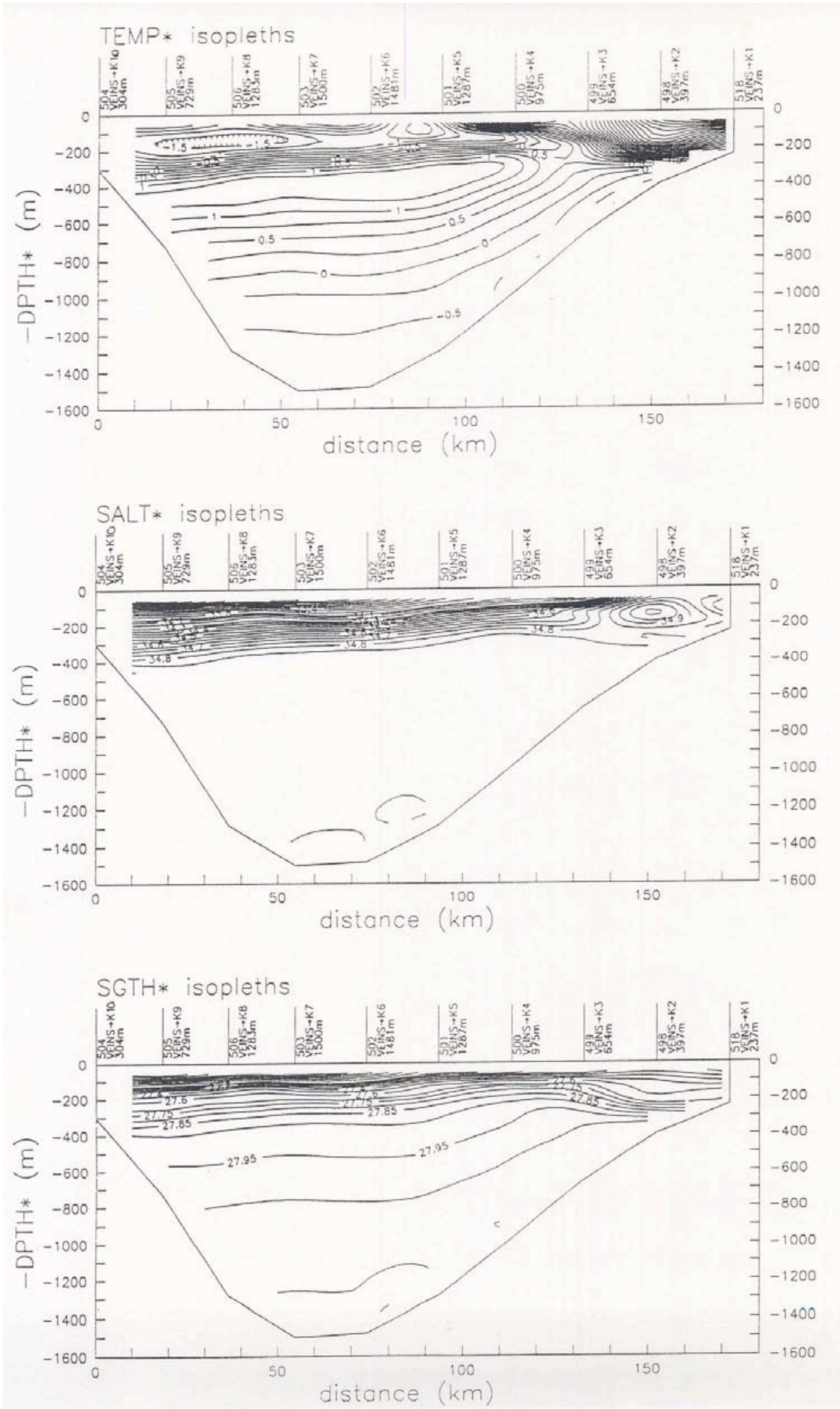

Figure 2: Potential temperature, salinity, and potential density sections for the of the density range 27.85-28 at the Iceland continental slope.

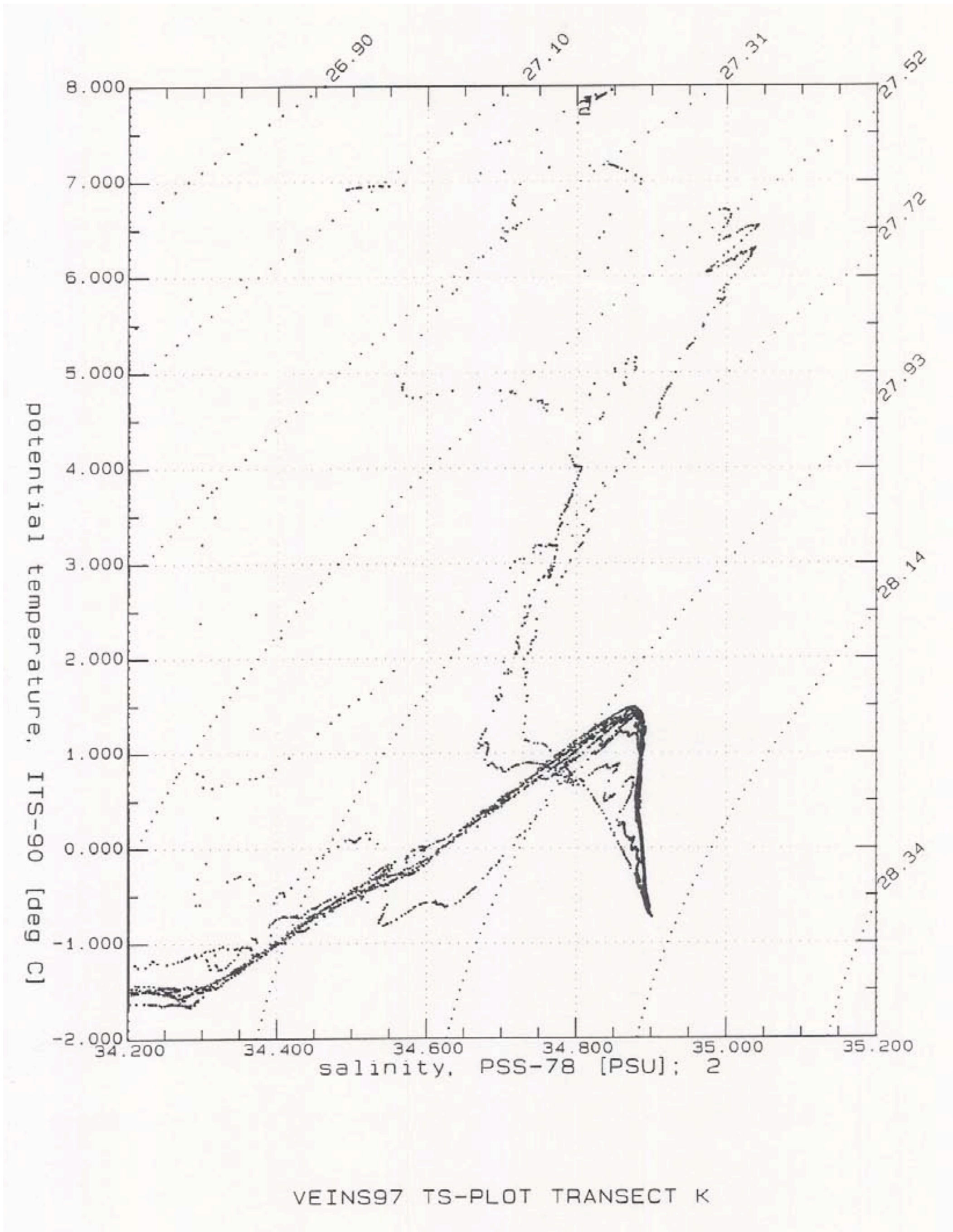

Figure 3: TS northernmost transect K. Notice the shallowing of the isopycnals and the weak representation diagram for transect K showing the close TS relation of the warm intermediate waters.

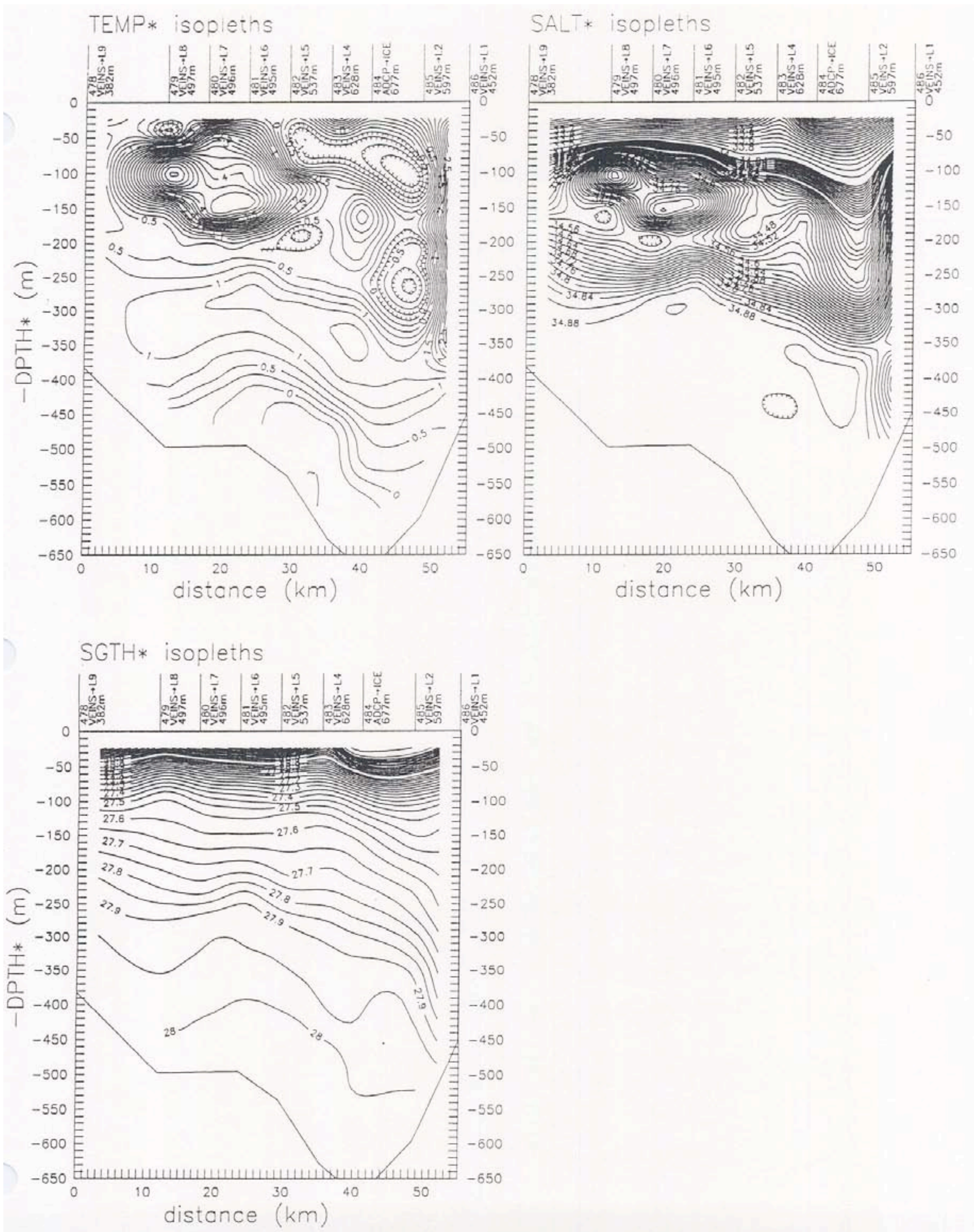

Figure 4: Potential temperature, salinity and potential density sections for the first transect L along the Denmark Strait sill. Cold water from the East Greenland Current is observed close to the Iceland shelf and a detached volume of Irminger Current water is seen far to the west.

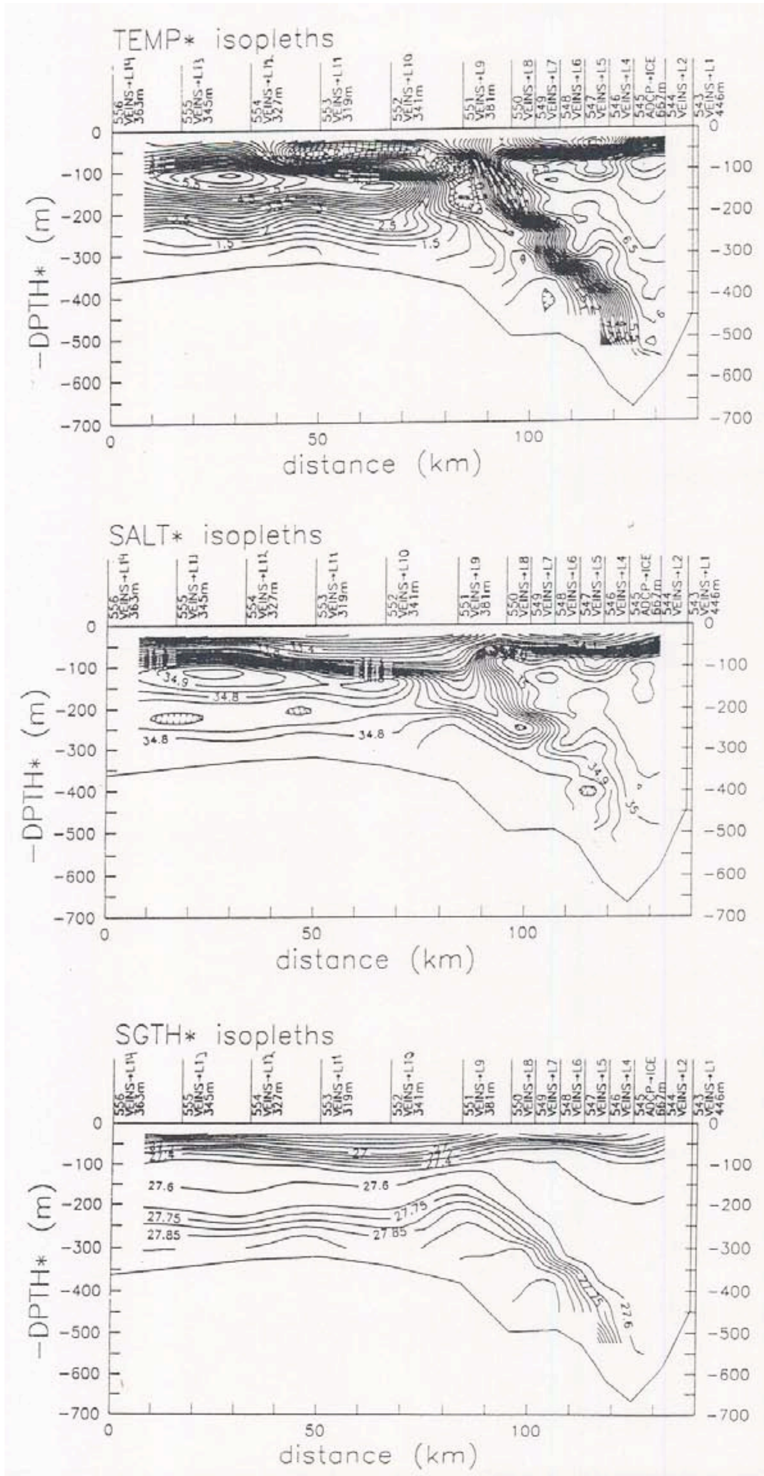

Figure 5: Potential temperature, salinity, and potential density sections for the second transect L along the sill. Irminger Current water dominates the main area of the passage and the warm water is present far to the west on the Greenland continental shelf.

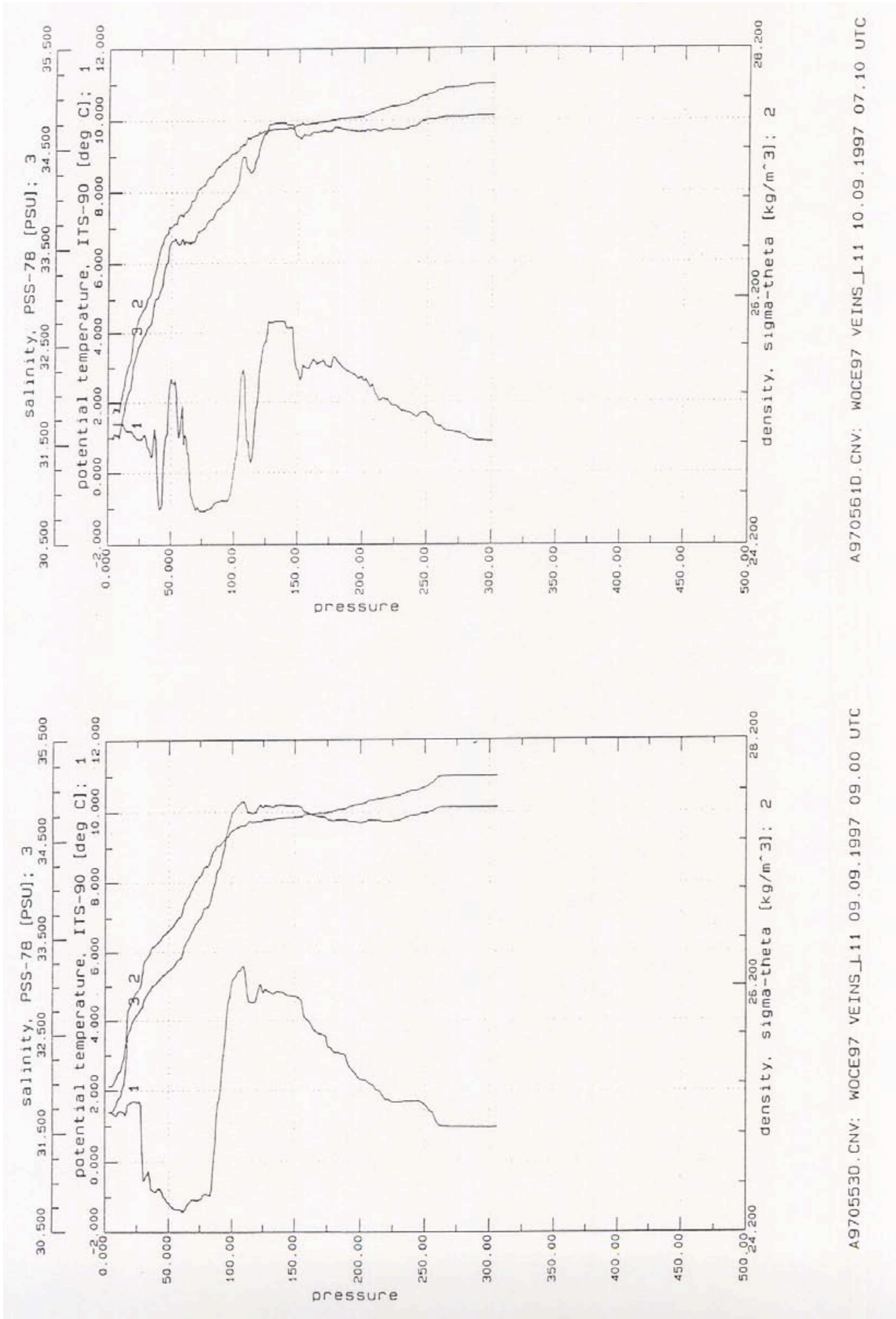

Figure 6: Potential temperature, salinity, and potential density profiles for station L11 on the second (left) and third (right) transect taken along the sill.

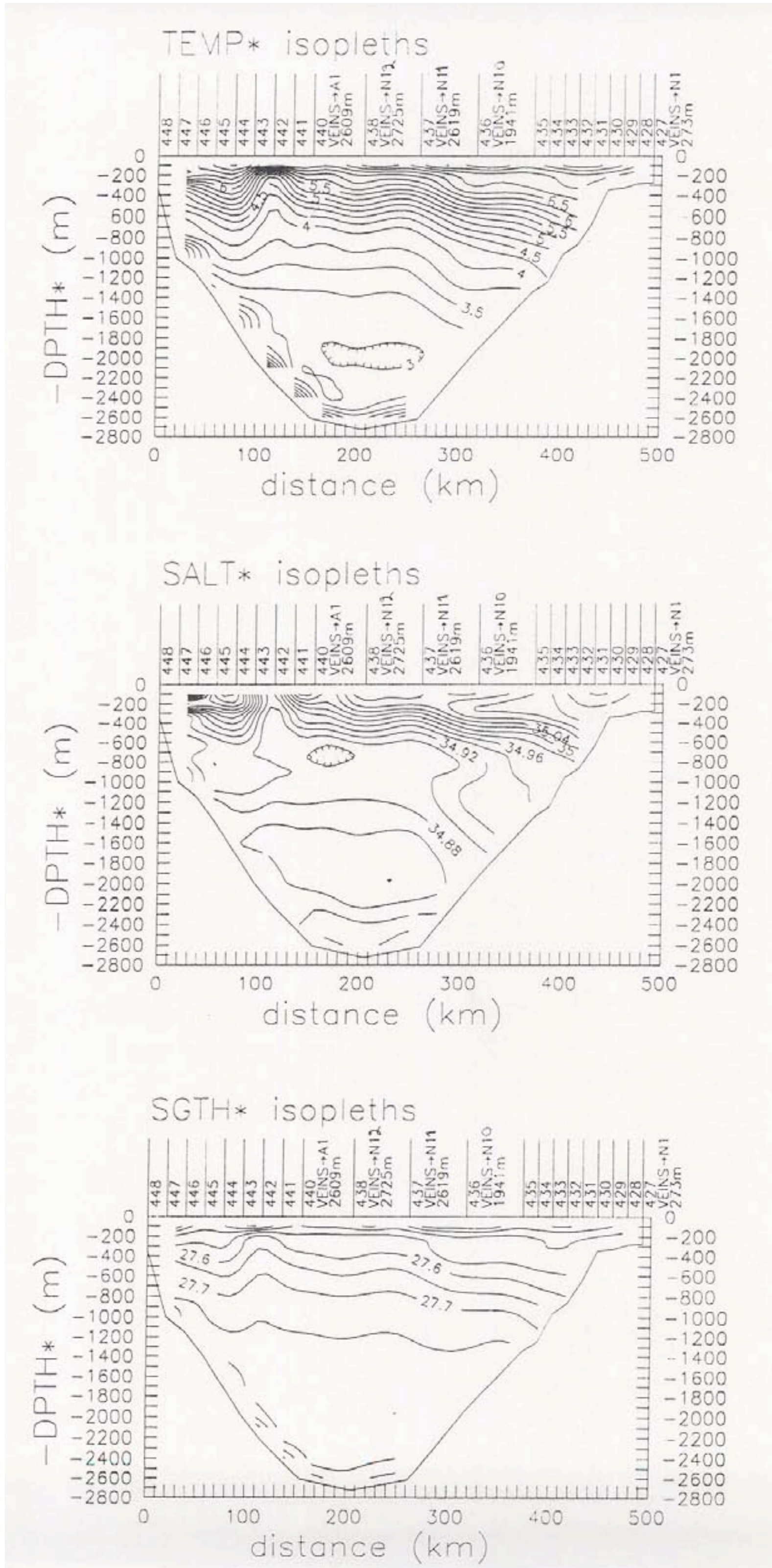

Figure 7: The southernmost transect N+A across the Irminger Basin. The warm, and saline Irminger Current is seen at the rim and the Labrador Sea Water forming a salinity minimum between 1000 and 2000m. The Denmark Strait Overflow Water is present in the deepest layer at the centre and at the western slope.

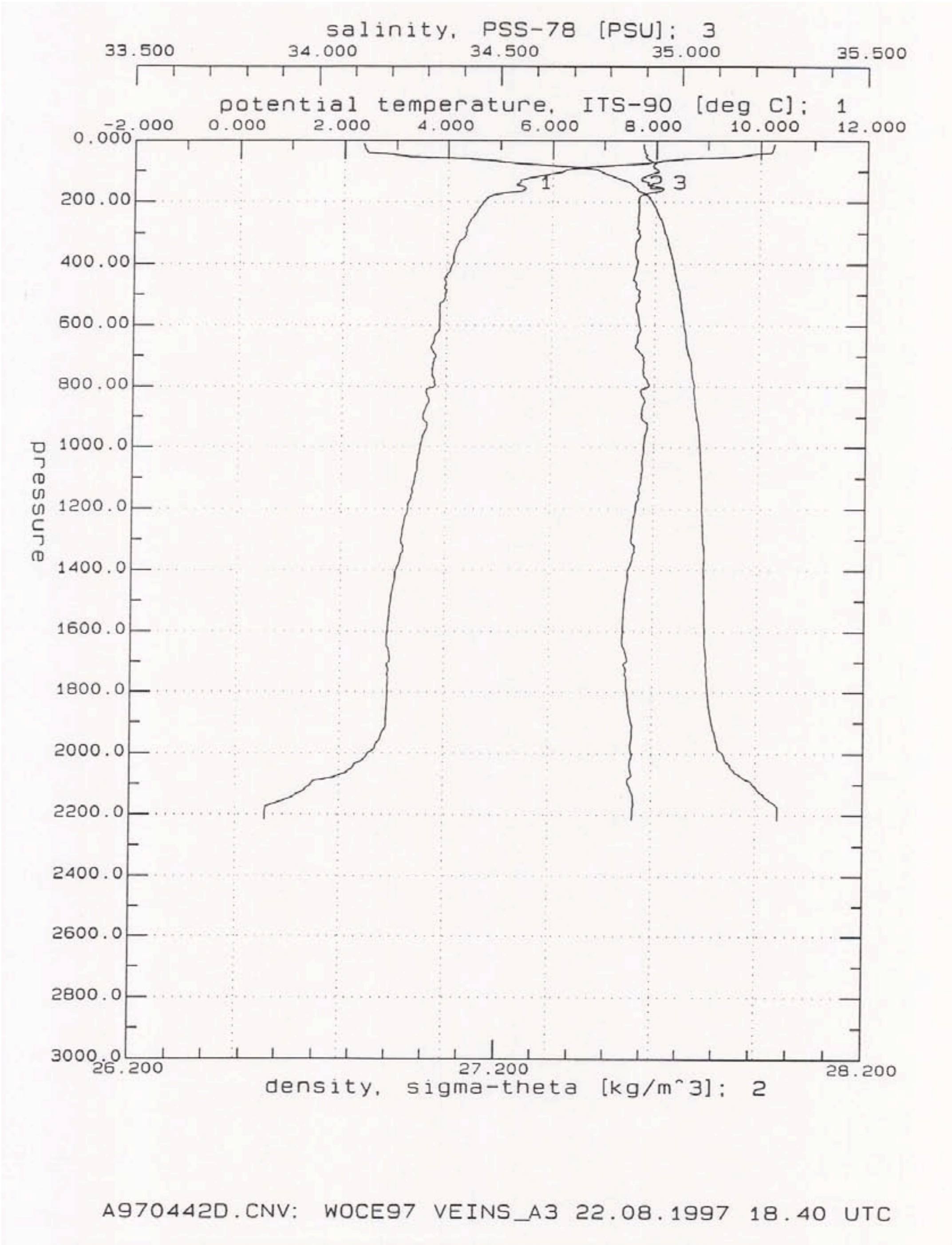

Figure 8: Potential temperature, salinity, and potential density profiles for station A3 showing the absence of warm, saline water in the central part of the Irminger basin. This station is seen in Figure 7 as a low salinity funnel extending toward the surface.

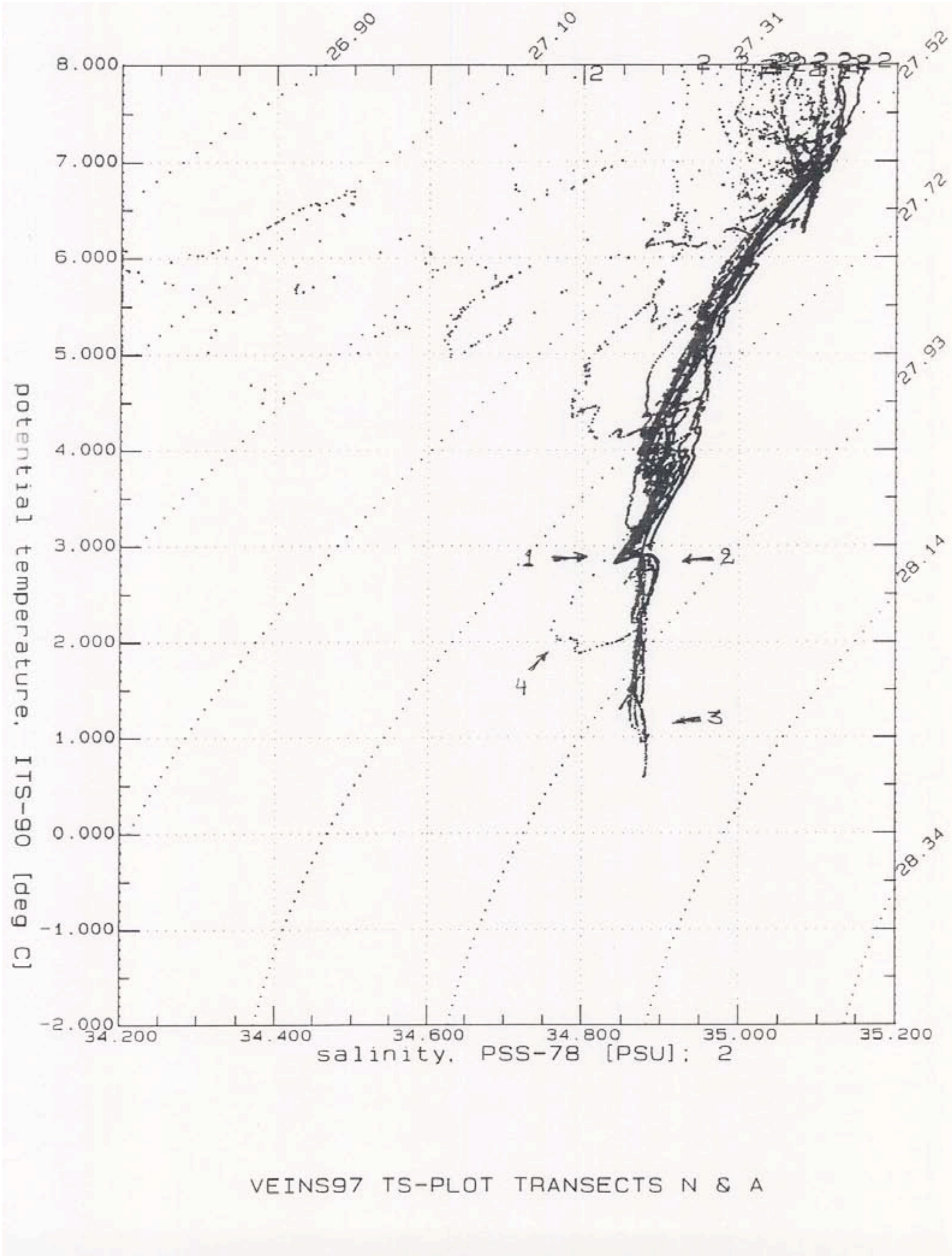

Figure 9: TS diagram for transects N and A. No 1 indicates the sharp salinity and temperature minimum of the Labrador Sea Water, No 2 the deep salinity and temperature maximum of the North-eastern Atlantic Deep Water, No 3 Denmark Strait Overflow Water, No 4 shows a salinity and temperature minimum present above the densest part of the overflow water at station A8, at the slope (1000m).

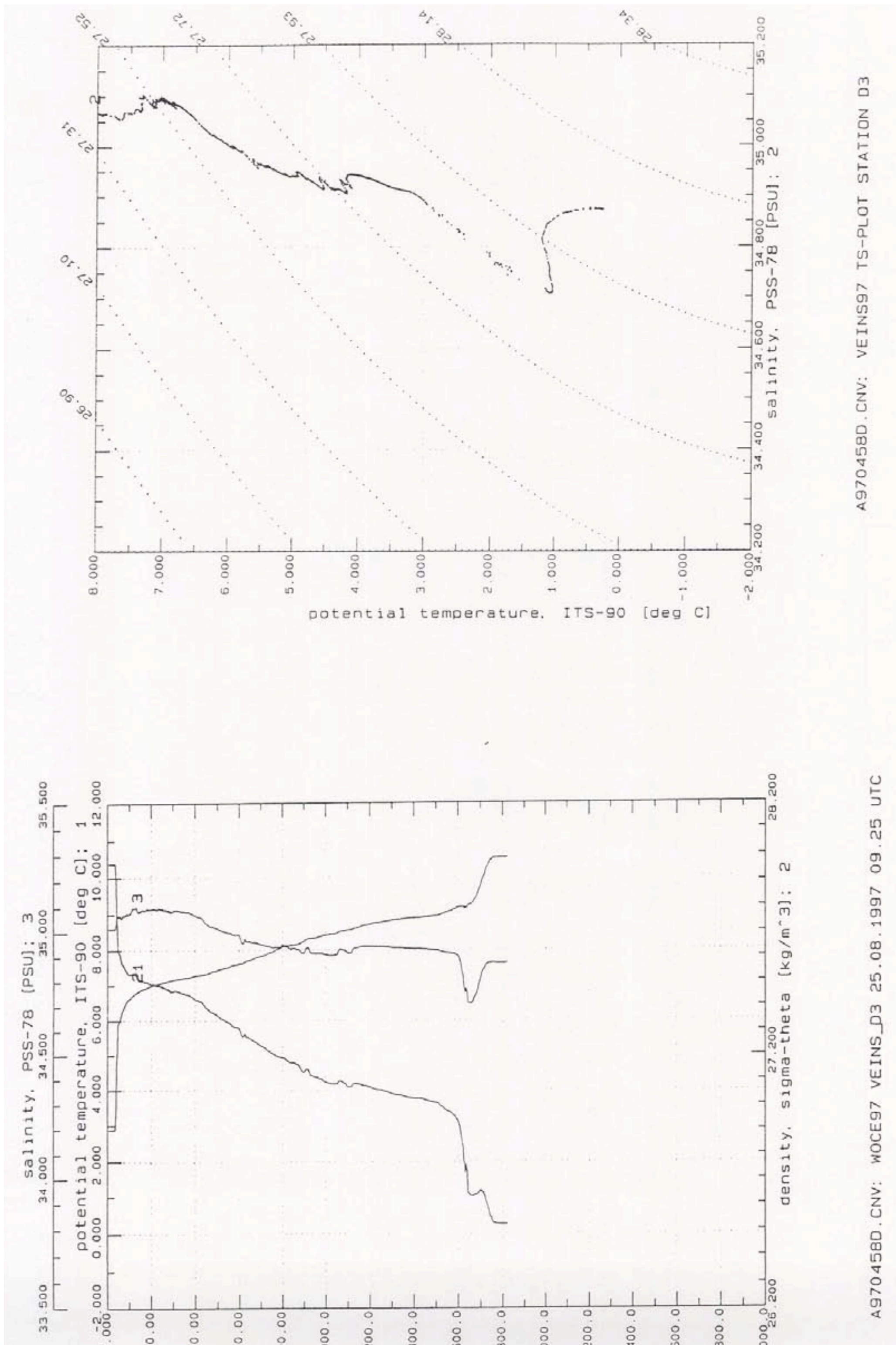

Figure 10: Potential temperature, salinity, and potential density profiles and TS diagram for station D3. The boundary plume is seen to be strongly stratified, and the salinity and temperature minima show that the less dense part also originates from north of the Denmark Strait.