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North Atlantic Ship of Opportunity
XBT Programme, 1989

– Data Report –

Alexander Sy and Jürgen Ulrich



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NOAA-8-Aufnahme (AVHRR) vom 25. April 1984, 0730 UTC Pseudofarbdarstellung der relativen Oberflächentemperatur der Nordsee (Temperaturskala in Grad Kelvin)

Mit freundlicher Genehmigung der DLR, Oberpfaffenhofen

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- Data Report -

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and

Jürgen Ulrich

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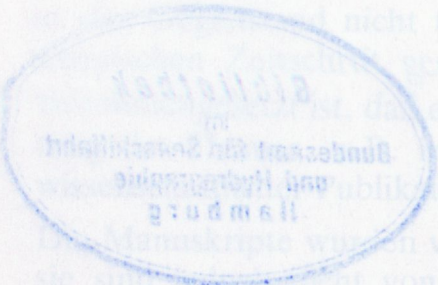
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Abstract

This report continues the presentation of temperature data acquired since 1988 within the framework of a Ship-of-Opportunity Programme between Europe and North America (IGOSS/WOCE line AX3) for the year 1989. The XBT measurements were carried out, during 12 voyages, by CMS "Köln Atlantic" of Hapag-Lloyd AG, Hamburg. In addition, this report contains some XBT data carried out by FRV "Walther Herwig" between Scotland and Greenland. The results are presented in terms of Tables, track plots, and profile plots and section plots of temperature. By means of laboratory and field measurements, problems concerning the accuracy of measurements are discussed. A scientific interpretation is not included in this report and will be given elsewhere.

Zusammenfassung

Dieser Bericht setzt die Präsentation der Temperaturdaten der seit 1988 im Rahmen eines Ship-of-Opportunity Programms zwischen Europa und Nordamerika (IGOSS/WOCE Linie AX3) durchgeführten Messungen für das Jahr 1989 fort. Die XBT-Messungen wurden von Bord des CMS "Köln Atlantic" der Hapag-Lloyd AG, Hamburg, auf 12 Reisen durchgeführt. Außerdem enthält dieser Bericht einige XBT-Daten, die von FFS "Walther Herwig" zwischen Schottland und Grönland gewonnen wurden. Alle Daten werden in Form von Tabellen, Stationskarten sowie Profilen und Schnitten der Temperatur dargestellt. Anhand von Labor- und Feldmessungen werden Fragen der Meßgenauigkeit diskutiert. Eine wissenschaftliche Interpretation beinhaltet dieser Bericht nicht. Sie wird an anderer Stelle erfolgen.

Introduction

This data report presents the temperature field across the North Atlantic Ocean between the English Channel and the Grand Banks in 1989 in the form of profiles and section plots. Owing to the kind support of the shipping company Hapag-Lloyd AG in Hamburg, F.R.Germany, and the willing co-operation of the crews of CMS "Köln Atlantic", the measurements have been carried out since May 1988, using expendable bathythermographs (XBT) launched from the bridge wing during the ship's bi-weekly passages across the North Atlantic.

In 1989, however, efforts were reduced to monthly measurements only. Due to the prevailing westerly winds, these were carried out during the eastbound passage of the North Atlantic - except for cruise No. 134. According to preliminary results of the 1988 measurements the temporal variability of the thermal field of the upper ocean should still be sufficiently resolved. As a compromise between an eddy resolving strategy and the workload put on the ship's officers during their highly automated single man watch on the bridge the spatial resolution of XBT drops was decided to be between 30 and 40 nautical miles.

This Ship-of-Opportunity Programme (SOOP) is a contribution to the Integrated Global Ocean Services System (IGOSS) as well as to the World Ocean Circulation Experiment (WOCE). The specific objectives of this programme, methods of measurement, flow and processing of data are described in Sy and Ulrich (1989) and Sy (1990) and thus need not to be repeated here. Except for some aspects concerning the data quality, which will be discussed in the next sections, the technical environment is kept unchanged.

The final data are archived in the Deutsches Ozeanographisches Datenzentrum (DOD) which is operated by DHI (recently renamed in "Bundesamt für Seeschifffahrt und Hydrographie" (BSH)). These data are available for personal use, in particular for WOCE. However, any use of these data should be agreed on with the originators prior to their publication. Special reservations are made concerning topics such as statistical analysis, heat content, wintertime convection, and North Atlantic Current, which are the primary reason of this SOOP.

The problem of reference measurements

In the past, the missing reference temperature turned out to be a serious problem concerning the quality control of single XBT profiles, in particular in the Western North Atlantic where eddies and meanders are frequent. To distinguish between data errors and thermal fronts CMS "Köln Atlantic", in June 1989, was equipped with an automatic sea surface temperature (SST) thermometer which has proved to be very helpful.

This SST thermometer was developed at DHI and is manufactured as "Mini-Medes" by Dittberner GmbH, F.R.Germany. The specification given by the manufacturer is as follows:

The unit consists of two parts (Fig. 1), the transducer for one or two Pt100 sensors (accuracy: $< \pm 0.1$ K) and data transmission (RS232), and the LED display (resolution: 0.1 K). "Mini-Medes" is equipped with zero, drift, and reference controls. Printer connection with time control and navigational data input is optional but not used in our SOOP yet.

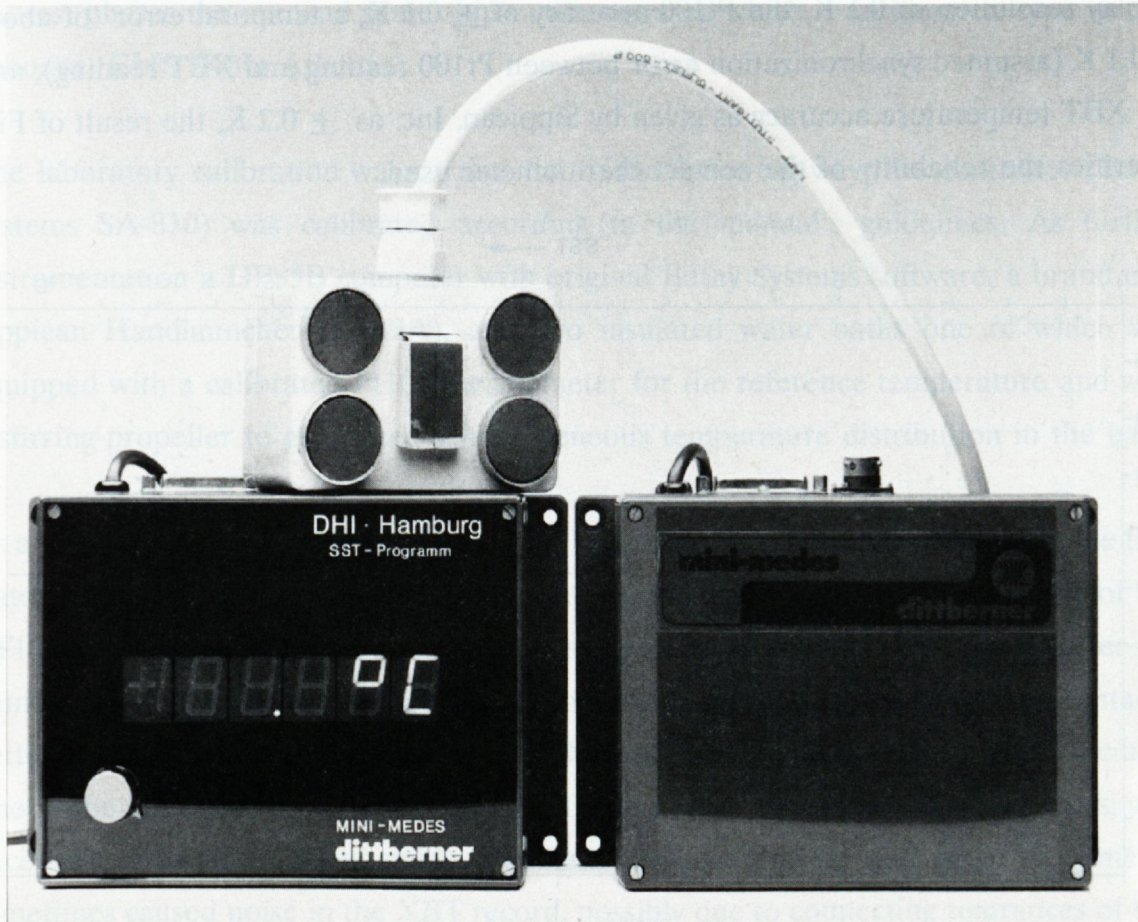


Fig. 1: The components of the contact thermometer "Mini Medes": measuring unit containing two Pt100 (top), data transmission unit (right), LED display (left)

The measuring unit used contains one Pt100 and is mounted at the inside of the ship's hull in the engine room about 2 m above the ship's bottom and good in front of the engine's radiator water outflow, thus working as a contact thermometer. The thermometer is insulated by thick layers of foam material against the warm engine room temperature. The values measured are telemetered by a two conductor cable to the navigation bridge where they are displayed continuously. These thermometers have proved to be reliable for years on several vessels used within the framework of the DHI SST programme (TRACKOB). As a matter of fact, instead of the real SST the temperature in about 6 to 7 m depth is measured - depending upon the ship's draught. For practical comparisons, however, this is an advantage due to the unreliable initial data cycles of each profile caused by the large time constant of the XBT thermistor. On the other hand, for the vast majority of profiles a homothermic top layer prevails.

Fig. 2 presents a scatter diagram of Pt100 SST versus XBT temperatures at the same depth. The linear fit calculated from 240 values produced from July through December shows an almost constant mean temperature difference $T(\text{SST}) - T(\text{XBT})$ of about + 0.15 K for the whole scale. Taking into account various error sources as the LED display resolution of 0.1 K, the Pt100 accuracy of ± 0.1 K, a temporal error of about ± 0.1 K (assumed synchronization error between Pt100 reading and XBT reading), and the XBT temperature accuracy as given by Sippican, Inc. as ± 0.2 K, the result of Fig. 2 verifies the reliability of the contact thermometer used.

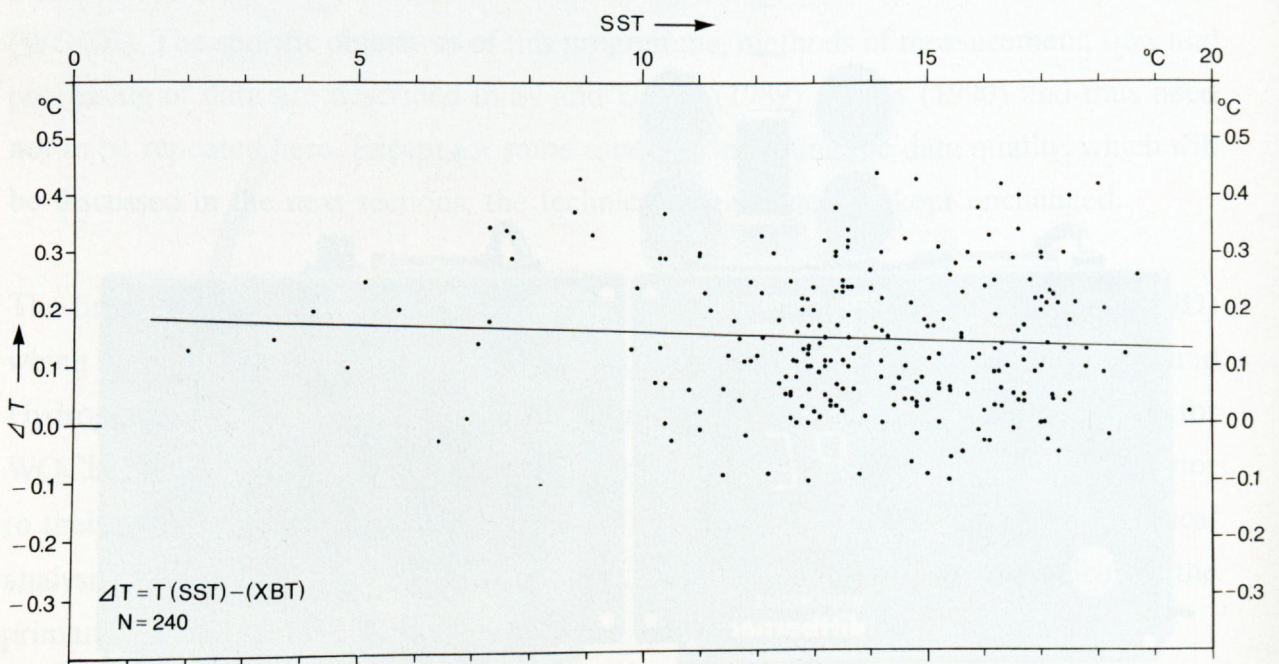


Fig. 2: SST as measured by "Mini Medes" versus XBT temperature readings at the same depth (6 to 7 m)

Evaluation of the depth fall rate error

The accuracy of Sippican's empirical XBT depth fall rate equation has been questioned in the literature over the last 10 years (e.g. Heinmiller et al., 1983). Thus, to obtain more insight into the data quality some laboratory and seagoing tests were carried out to evaluate the depth fall rate for "Deep Blue" probes. There is no other way than to compare XBT data against CTD data, and usually differences observed in simultaneous temperature readings are interpreted as errors in the depth fall rate. However, the depth fall rate error derived is a function of possibly two error sources; i.e. of the depth fall rate equation by which the time elapsed is converted into depth, and the temperature measured by the probe's thermistor. In addition, the specific XBT unit used may also be a source of error.

Consequently, the first step in our test was the calibration of those XBT thermistors which were to be used later for the *in-situ* comparison. The laboratory test should permit the elimination of one of the possibly two error sources. For both laboratory and *in-situ* test phases the one and same ship's unit was used which is an identical type to that onboard CMS "Köln Atlantic".

The laboratory calibration was carried out in the following way: the controller (Bathy Systems SA-810) was calibrated according to the manual's guidelines. As further instrumentation a HP85B computer with original Bathy Systems software, a brand new Sippican Handlauncher (LM-3A), and two insulated water baths one of which was equipped with a calibrated Pt100 thermometer for the reference temperature and with a stirring-propeller to guarantee a homogeneous temperature distribution in the bath.

As a first step, the probes were pre-cooled close to the reference temperature in the first water bath. The launch was simulated in the second water bath, and the reading of the PT100 temperature and the depth at the display were taken about one minute after the launch began. During the launch, the probe was moved up and down to guarantee a better water exchange through the hole of the zinc nose where the thermistor is located. The probe adaption, in particular that of the zinc nose with a great thermal mass, was necessary in order to allow stable readings. However, the up and down movements sometimes caused noise in the XBT record, possibly due to connecting tolerances of the

launcher. For each probe two measurements were carried out each in the range between 1 °C and 5 °C, 10 °C and 11 °C, and 19 °C and 20 °C, and were compared against the Pt100 readings recorded. 36 Sippican Deep-Blue probes were calibrated according to this procedure, one box in 1988 and two boxes in 1989. All probes were purchased about 6 months prior to the test. In addition, 6 probes XBT-7 manufactured by Sparton of Canada Ltd. were calibrated in 1989.

Except for three probes, all error functions ΔT calculated are significant within a 95 % confidence interval due to a linear fit and show a positive derivation (Fig. 3a-d). The considerable deviation of regression lines within each batch indicates a better thermistor accuracy than that given by Sippican as ± 0.2 K. The positive derivation, however, is assumed to be caused by the Bathy System controller. This assumption is supported by a study published by Roemmich and Cornuelle (1987) who calibrated 24 "Deep Blue" probes without finding a systematic derivation. For their study they used a self constructed XBT digitizer built in a PC-type microcomputer. According to the results presented a systematic error in the order of + 0.2 K can be expected for measurements in the tropical mixed layer. Fortunately, this bias is not relevant in the North Atlantic ($T < 20$ °C) and hence is no serious problem for the quality of our SOOP data.

A week after the laboratory tests in 1989, 12 calibrated probes were used for an *in-situ* comparison with two CTDs in the Norwegian Trench (water depth 700 m). An autonomous SIS CTD, with a self-adjusting high resolution pressure sensor, was mounted at a NB MkIII CTD. The sensor systems of both instruments were horizontally 30 cm apart. No significant deviation between the profiles of the two CTDs could be observed.

First results of this comparison are shown in Fig. 4a-c. The XBT traces are corrected according to the calibration results. The depth difference $\Delta z = z(\text{XBT}) - z(\text{CTD})$ of 8 XBT traces are negative, whereas that of 3 traces match the CTD trace (solid line). 1 probe seems to have failed (# 9). The clear positive temperature increase in the upper part of trace # 9 may be indicative of the so-called "bowing" (IOC, 1989). A gradual increase, or "bowing", in temperature was observed in the mixed layer only and first reported by Bailey et al. (1989). In the segment of the strongest gradient, which is located between 290 m and 440 m, the maximum negative depth difference to be found is about 14 m (# 10, # 12) at the lower end of this segment. The depth difference of

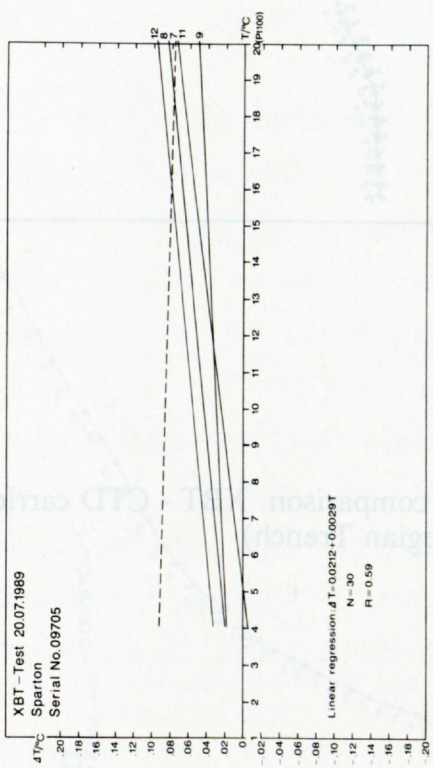
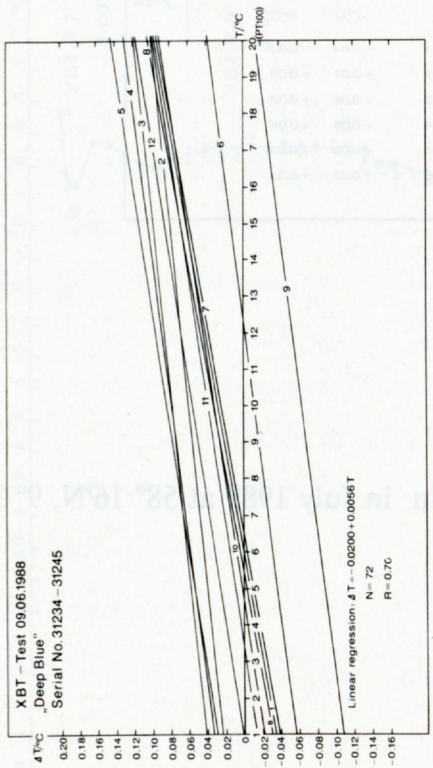
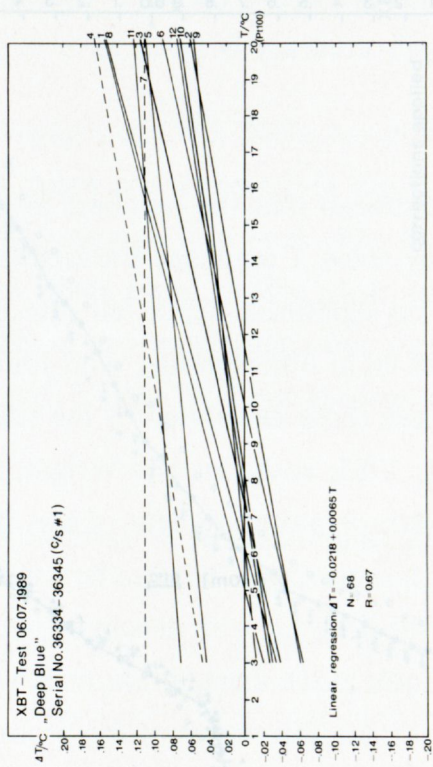
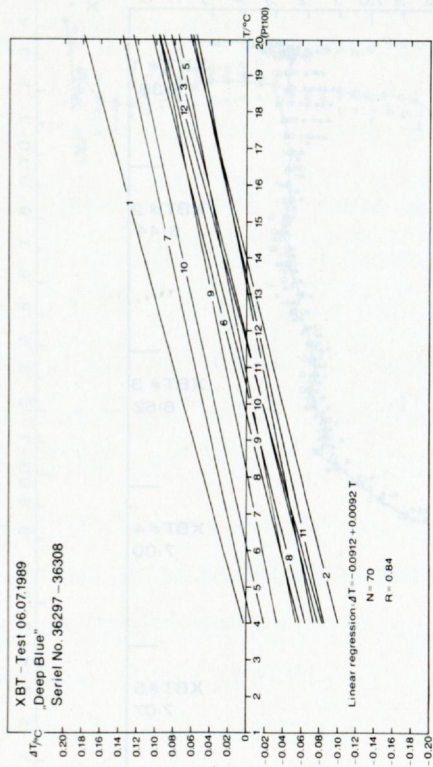


Fig. 3a-d: Result of the XBT thermistor calibration. The ordinate is temperature difference between XBT temperature and Pt100 reference temperature. Temperature differences are given as linear regressions as calculated for each probe calibrated. Significant results within a 95 % confidence interval are shown by solid lines

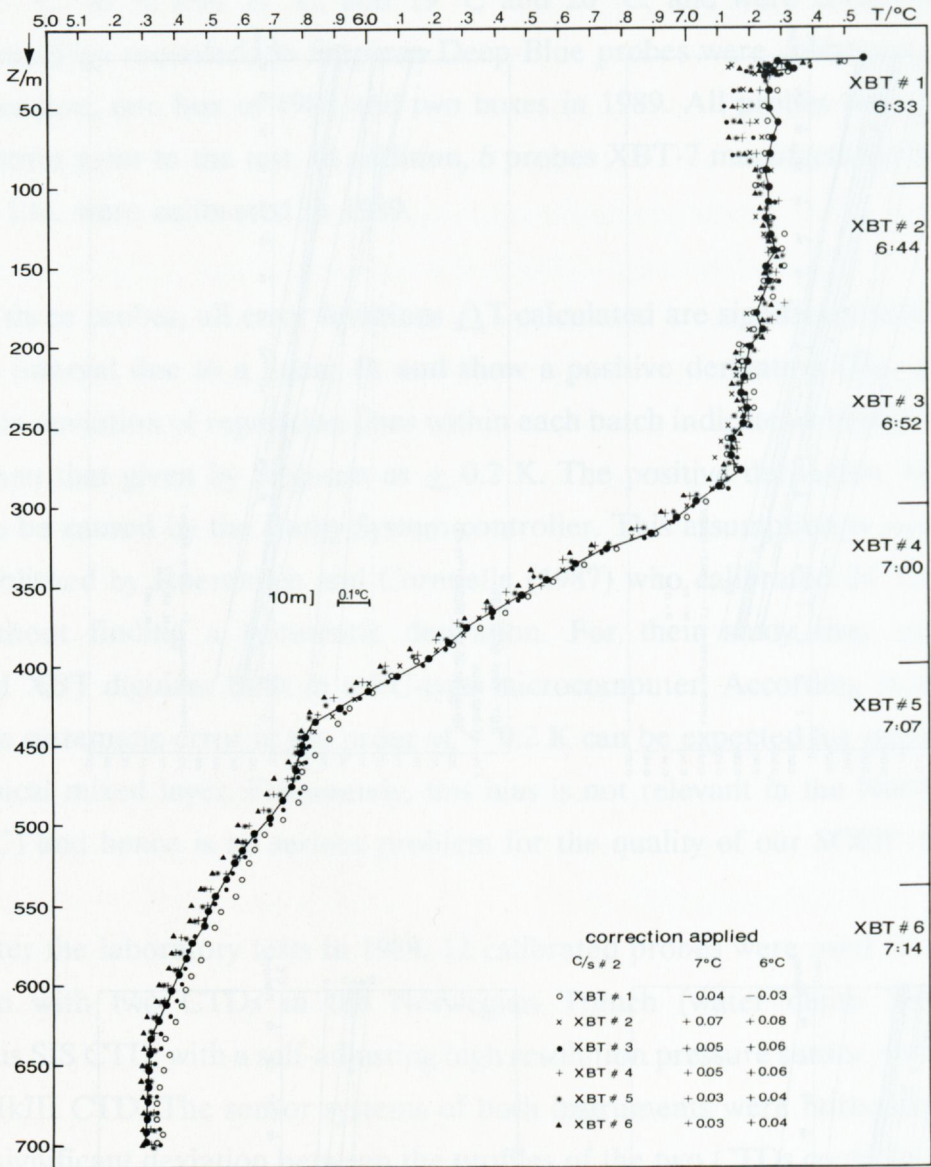
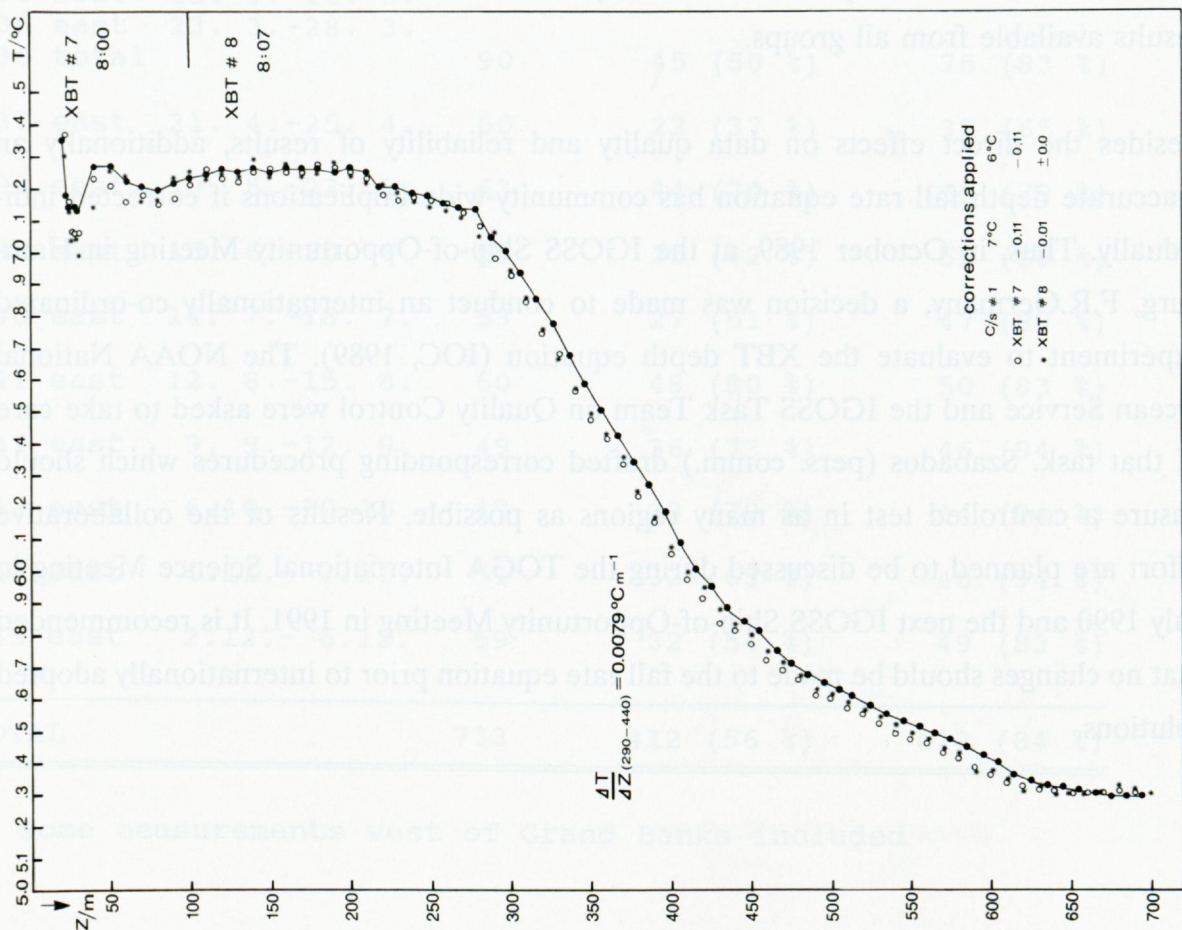
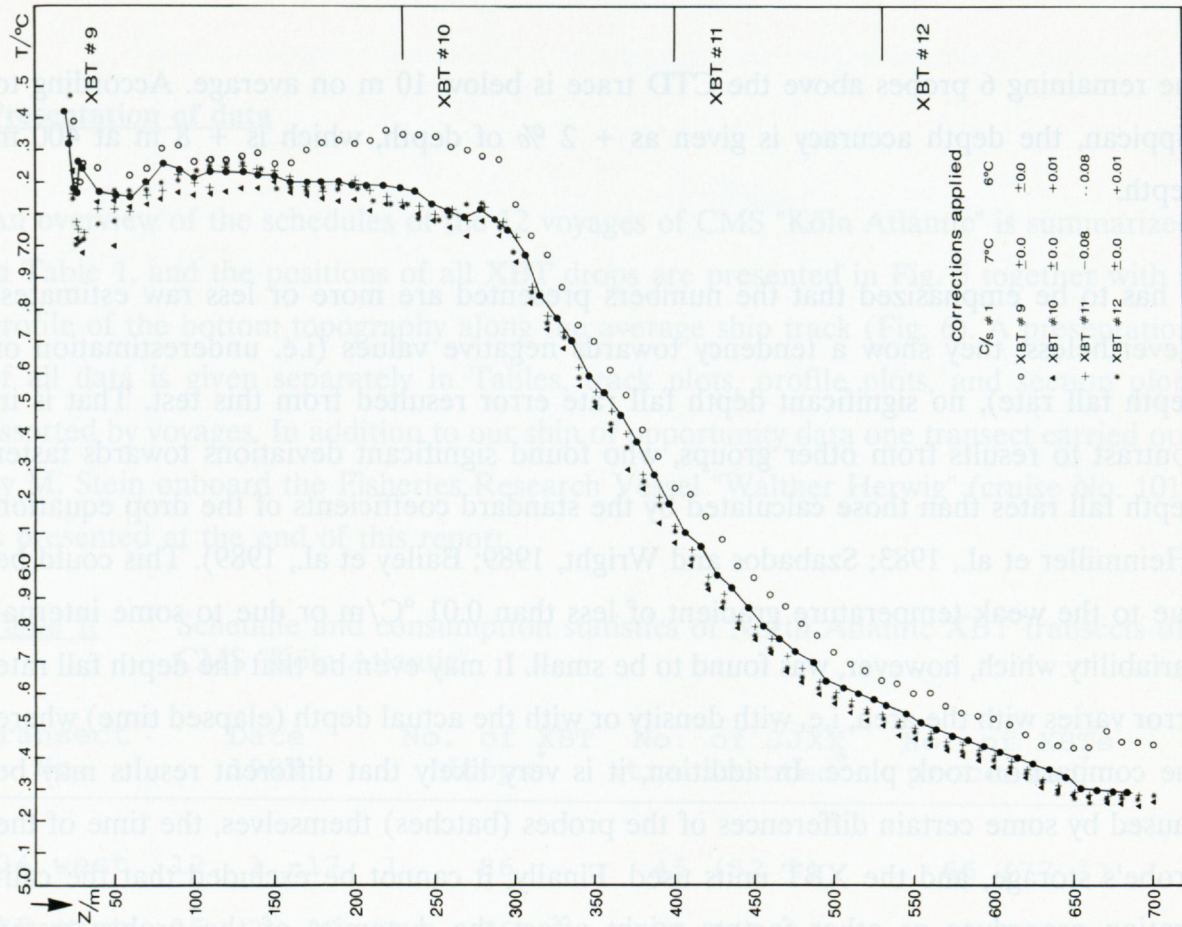


Fig. 4a-c:

In-situ comparison XBT - CTD carried out in in July 1989 at 58° 16'N, 9° 31'E (Norwegian Trench)



the remaining 6 probes above the CTD trace is below 10 m on average. According to Sippican, the depth accuracy is given as + 2 % of depth, which is + 8 m at 400 m depth.

It has to be emphasized that the numbers presented are more or less raw estimates. Nevertheless, they show a tendency towards negative values (i.e. underestimation of depth fall rate), no significant depth fall rate error resulted from this test. That is in contrast to results from other groups, who found significant deviations towards faster depth fall rates than those calculated by the standard coefficients of the drop equation (Heinmiller et al., 1983; Szabados and Wright, 1989; Bailey et al., 1989). This could be due to the weak temperature gradient of less than 0.01 °C/m or due to some internal variability which, however, was found to be small. It may even be that the depth fall rate error varies with the area, i.e. with density or with the actual depth (elapsed time) where the comparison took place. In addition, it is very likely that different results may be caused by some certain differences of the probes (batches) themselves, the time of the probe's storage, and the XBT units used. Finally, it cannot be excluded that the calibration procedure or other factors might affect the dynamics of the probes tested (Green, 1984). All these points have to be proved and discussed in context with all the results available from all groups.

Besides the direct effects on data quality and reliability of results, additionally an inaccurate depth fall rate equation has community-wide implications if corrected individually. Thus, in October 1989, at the IGOSS Ship-of-Opportunity Meeting in Hamburg, F.R.Germany, a decision was made to conduct an internationally co-ordinated experiment to evaluate the XBT depth equation (IOC, 1989). The NOAA National Ocean Service and the IGOSS Task Team on Quality Control were asked to take care of that task. Szabados (pers. comm.) drafted corresponding procedures which should ensure a controlled test in as many regions as possible. Results of the collaborative effort are planned to be discussed during the TOGA International Science Meeting in July 1990 and the next IGOSS Ship-of-Opportunity Meeting in 1991. It is recommended that no changes should be made to the fall rate equation prior to internationally adopted solutions.

Presentation of data

An overview of the schedules of the 12 voyages of CMS "Köln Atlantic" is summarized in Table 1, and the positions of all XBT drops are presented in Fig. 5 together with a profile of the bottom topography along the average ship track (Fig. 6). A presentation of all data is given separately in Tables, track plots, profile plots, and section plots assorted by voyages. In addition to our ship of opportunity data one transect carried out by M. Stein onboard the Fisheries Research Vessel "Walther Herwig" (cruise No. 101) is presented at the end of this report.

Table 1: Schedule and consumption statistics of North Atlantic XBT transects of CMS "Köln Atlantic"

Transect No.	Date 1989	No. of XBT drops*	No. of JJXX transmitted*	No. of XBTs processed
134 west	12. 1.-17. 1.	86	45 (52 %)	66 (77 %)
135 east	25. 2.-28. 2.	56	23 (41 %)	46 (82 %)
136 west	11. 3.-12. 3.			
136 east	23. 3.-28. 3.			
136 total		90	45 (50 %)	75 (83 %)
137 east	21. 4.-25. 4.	60	22 (37 %)	39 (65 %)
138 east	19. 5.-23. 5.	63	44 (70 %)	50 (79 %)
139 east	16. 6.-20. 6.	59	25 (42 %)	52 (88 %)
140 east	14. 7.-18. 7.	53	27 (51 %)	47 (89 %)
141 east	12. 8.-15. 8.	60	48 (80 %)	50 (83 %)
142 east	9. 9.-12. 9.	49	36 (73 %)	46 (94 %)
143 east	6.10.-10.10.	47	33 (70 %)	44 (94 %)
144 east	4.11.- 7.11.	51	32 (63 %)	48 (94 %)
145 east	2.12.- 6.12.	59	32 (54 %)	49 (83 %)
TOTAL		733	412 (56 %)	612 (84 %)

* some measurements west of Grand Banks included

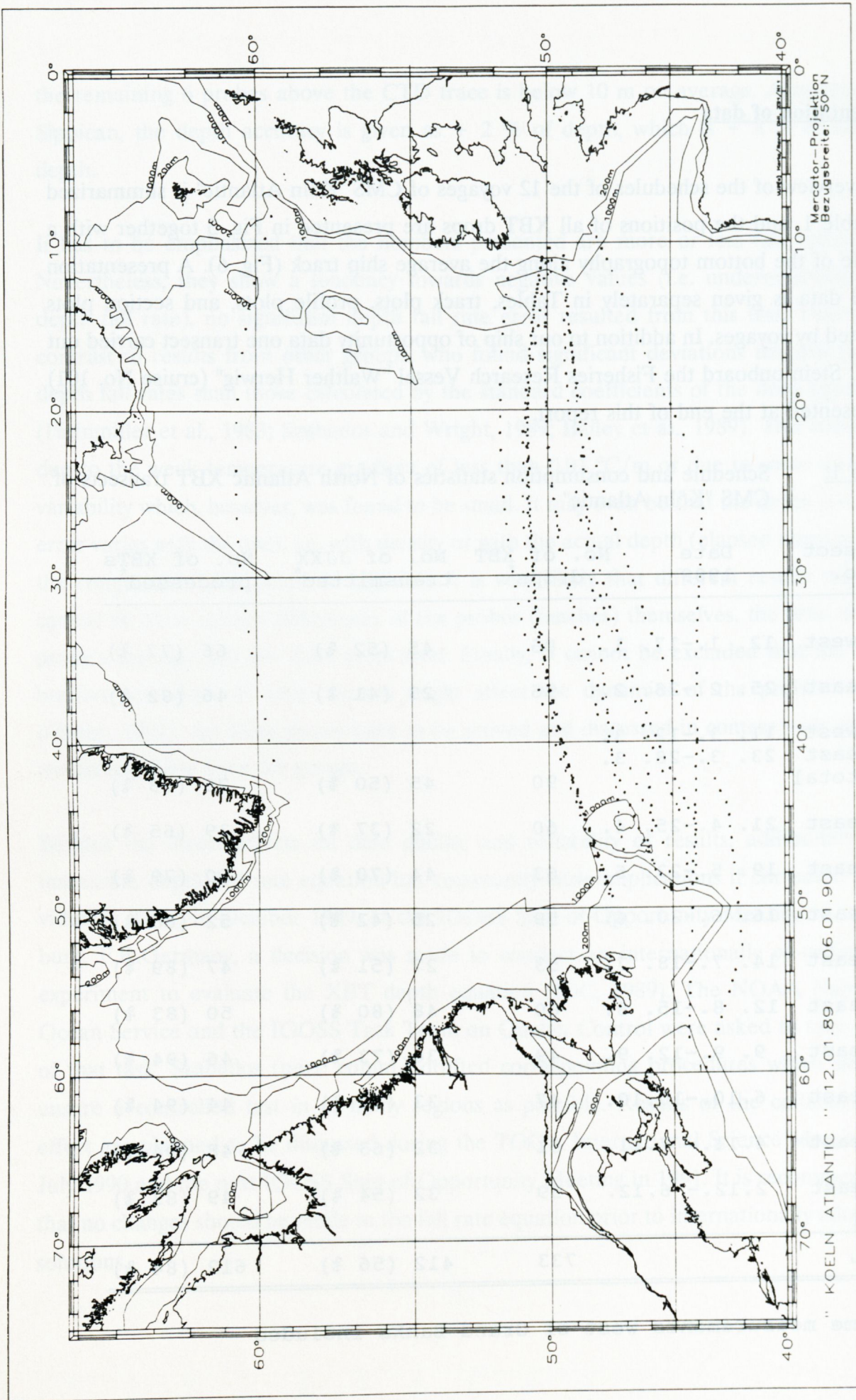


Fig. 5: Track plot of all XBT drops shown in this data report. The section along 60°N was carried out by FRV "Walther Herwig"

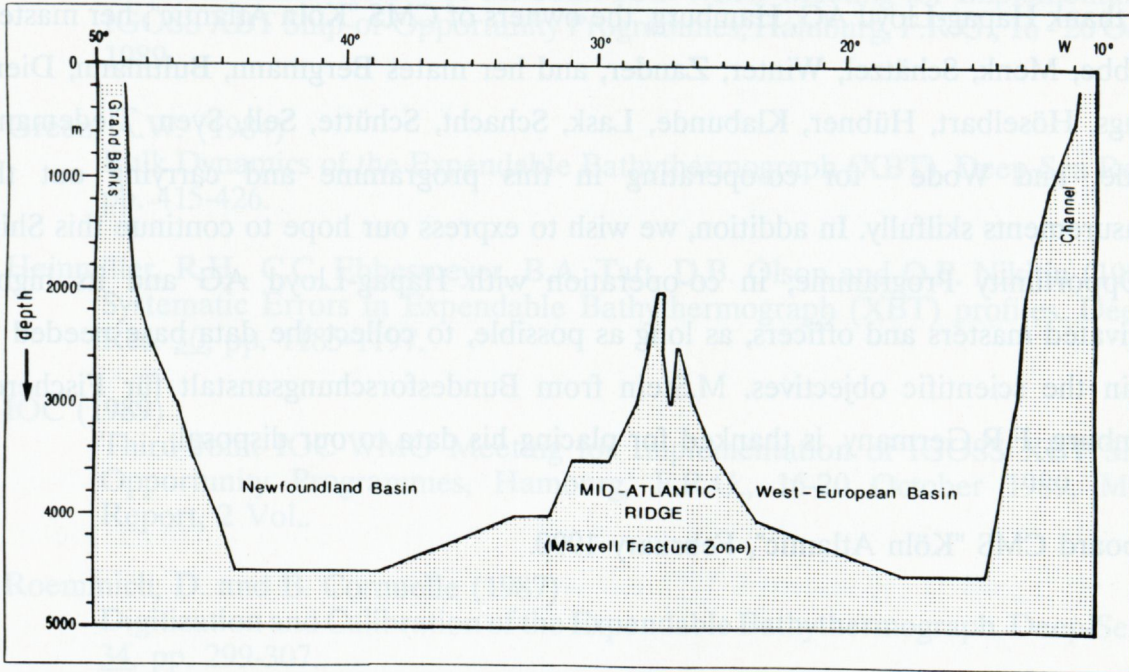


Fig. 6: Bottom topography along the average track of CMS "Köln Atlantic" between Europe and Grand Banks

Acknowledgement

We thank Hapag-Lloyd AG, Hamburg, the owners of CMS "Köln Atlantic", her masters Krabbe, Menk, Schätzel, Winter, Zander, and her mates Bergmann, Bultmann, Diers, Frings, Höselbart, Hübner, Klabunde, Lask, Schacht, Schütte, Sell, Sven, Tiedemann, Wilde, and Wode for co-operating in this programme and carrying out the measurements skilfully. In addition, we wish to express our hope to continue this Ship-of-Opportunity Programme, in co-operation with Hapag-Lloyd AG and its highly motivated masters and officers, as long as possible, to collect the data base needed to attain the scientific objectives. M.Stein from Bundesforschungsanstalt für Fischerei, Hamburg, F.R.Germany, is thanked for placing his data to our disposal.

Onboard CMS "Köln Atlantic", February 1990.

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Field Evaluation of Real-Time XBT Systems. Unpublished manuscript presented at Third Session of the Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes, Hamburg, F.R.G., 16 - 20 October 1989.

In the following, and assorted by voyage numbers, the measurements are presented in

1. Tables containing header information and remarks of each XBT drop,
2. track plots of each transect,
3. section plots showing the vertical temperature field of each transect,
4. and profile plots of final temperature data (the profiles are offset according to the tick marks, the temperature at tick mark is 6 °C).

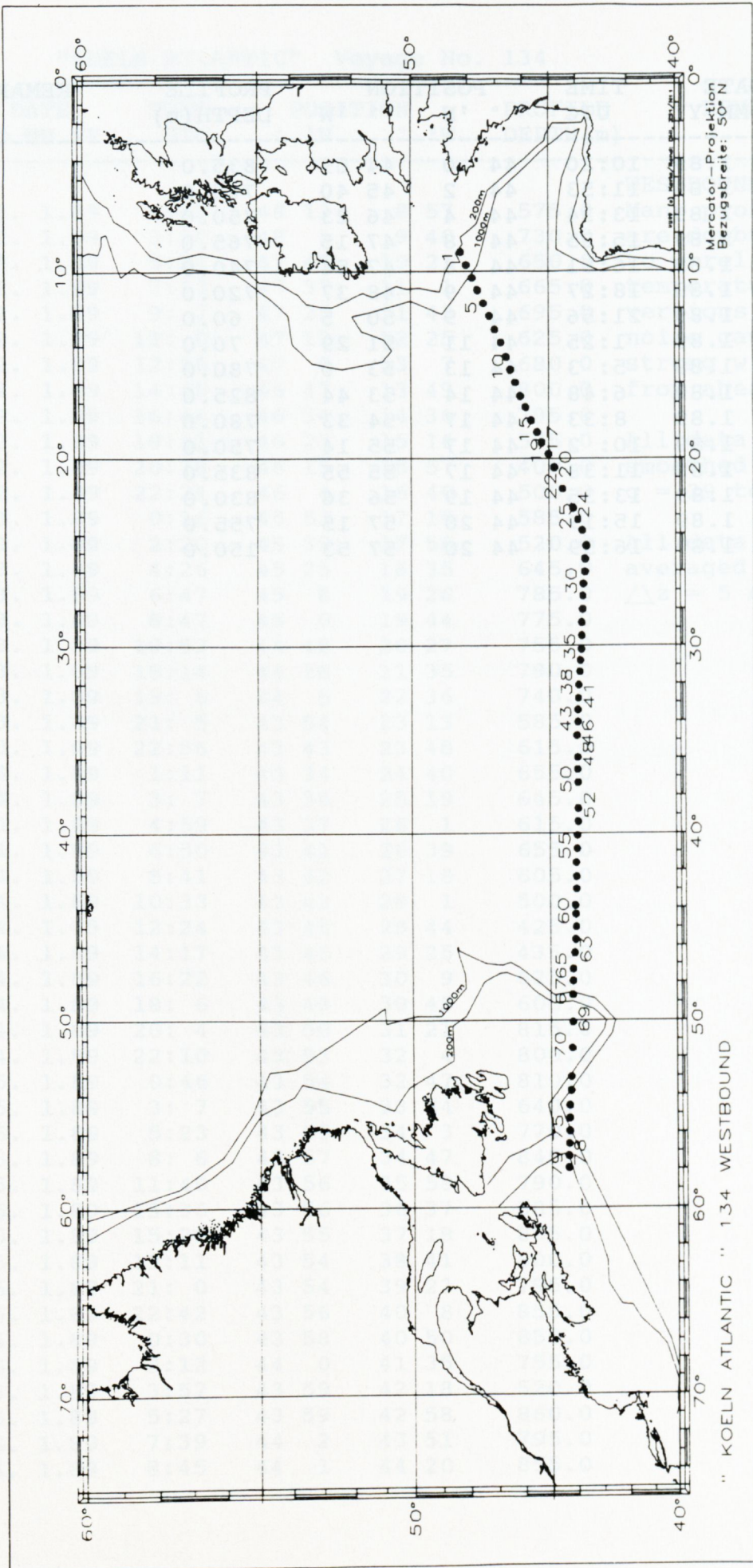
The different numeration may give rise to some confusion. The complete XBT drop number consists of 6 digits as shown in the profile plots. The leading 2 digits denote the year of measurement, the next 3 digits give the XBT drop number ranging from 001 to 999, and the last digit marks the repetition, if necessary. In the Tables and section plots the leading zero of the XBT drop number is omitted whereas in the track plots the repetition digit is omitted, as well.

"KOELN ATLANTIC" Voyage No. 134

XBT NO.	DATE			TIME UTC	POSITION		PROFILE DEPTH(m)	REMARKS	
	DD	MM	YY		° 'N	° 'W			

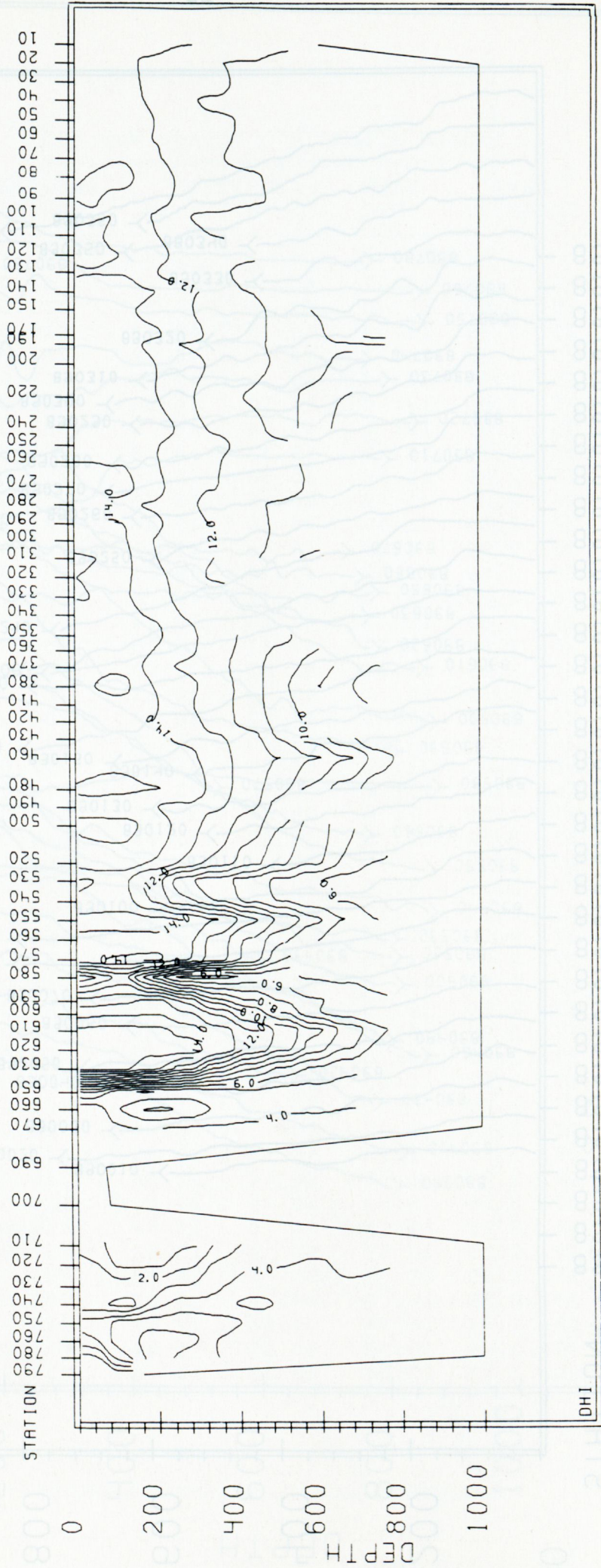
	WESTBOUND								
10	12.	1.89		1:42	48 13	8 57	575.0	Many profiles are doubtful due to unreliable temperature inversions, and noise caused by strong wind from ahead.	
20	12.	1.89		3:30	48 1	9 40	730.0		
30	12.	1.89		5:21	47 49	10 21	650.0		
40	12.	1.89		7:13	47 37	11 1	665.0		
50	12.	1.89		9: 7	47 25	11 43	695.0		
60	12.	1.89		11: 0	47 12	12 25	625.0		
70	12.	1.89		12:56	47 0	13 7	680.0		
80	12.	1.89		14:49	46 47	13 49	800.0		
90	12.	1.89		16:46	46 34	14 36	795.0		
100	12.	1.89		18:31	46 25	15 16	575.0		All data are smoothed with q = 29 to 41.
110	12.	1.89		20:18	46 15	15 57	400.0		
120	12.	1.89		22:21	46 4	16 40	500.0		
130	13.	1.89		0:16	45 52	17 15	585.0		
140	13.	1.89		2:20	45 39	17 56	520.0	All data are averaged to $\Delta z = 5$ m.	
150	13.	1.89		4:26	45 25	18 35	645.0		
170	13.	1.89		6:47	45 8	19 26	785.0		
190	13.	1.89		8:47	45 0	19 44	775.0		
200	13.	1.89		10:53	44 48	20 27	755.0		
220	13.	1.89		15:14	44 28	21 35	790.0		
240	13.	1.89		19: 6	44 5	22 36	740.0		
250	13.	1.89		21: 5	43 54	23 13	585.0		
260	13.	1.89		22:56	43 43	23 48	615.0		
270	14.	1.89		1:11	43 34	24 40	655.0		
280	14.	1.89		3: 7	43 36	25 19	645.0		
290	14.	1.89		4:59	43 37	26 1	615.0		
300	14.	1.89		6:50	43 41	26 39	655.0		
310	14.	1.89		8:41	43 42	27 18	605.0		
320	14.	1.89		10:33	43 43	28 1	500.0		
330	14.	1.89		12:24	43 45	28 44	425.0		
340	14.	1.89		14:17	43 45	29 25	435.0		
350	14.	1.89		16:22	43 46	30 9	625.0		
360	14.	1.89		18: 6	43 49	30 45	605.0		
370	14.	1.89		20: 4	43 50	31 21	815.0		
380	14.	1.89		22:10	43 53	32 4	800.0		
410	15.	1.89		0:46	43 54	32 47	810.0		
420	15.	1.89		3: 7	43 55	33 24	640.0		
430	15.	1.89		5:23	43 55	34 3	770.0		
460	15.	1.89		8: 6	43 57	34 47	845.0		
480	15.	1.89		11:40	43 56	35 58	790.0		
490	15.	1.89		13:36	43 56	36 37	585.0		
500	15.	1.89		15:29	43 55	37 18	805.0		
520	15.	1.89		19:11	43 54	38 41	800.0		
530	15.	1.89		21: 0	43 54	39 23	795.0		
540	15.	1.89		22:42	43 56	40 8	855.0		
550	16.	1.89		0:30	43 58	40 50	850.0		
560	16.	1.89		2:12	44 0	41 35	755.0		
570	16.	1.89		3:57	43 59	42 18	520.0		
580	16.	1.89		5:27	43 59	42 58	860.0		
590	16.	1.89		7:39	44 2	43 51	795.0		
600	16.	1.89		8:45	44 1	44 20	855.0		

XBT NO.	DATE			TIME UTC	POSITION		PROFILE DEPTH (m)	REMARKS
	DD	MM	YY		'N	'W		
610	16.	1.89	10:20	44	0	44 59	835.0	
620	16.	1.89	11:53	44	2	45 40	765.0	
630	16.	1.89	13:34	44	4	46 23	750.0	
650	16.	1.89	15:25	44	8	47 15	765.0	
660	16.	1.89	16:51	44	8	47 54	740.0	
670	16.	1.89	18:27	44	9	48 37	720.0	
690	16.	1.89	21:56	44	9	50 5	60.0	
700	17.	1.89	1:25	44	11	51 29	70.0	
710	17.	1.89	5: 3	44	13	53 0	780.0	
720	17.	1.89	6:48	44	14	53 44	825.0	
730	17.	1.89	8:33	44	17	54 33	780.0	
740	17.	1.89	10: 2	44	17	55 14	750.0	
750	17.	1.89	11:38	44	17	55 55	835.0	
760	17.	1.89	13:35	44	19	56 36	830.0	
780	17.	1.89	15:19	44	20	57 15	755.0	
790	17.	1.89	16:59	44	20	57 53	150.0	

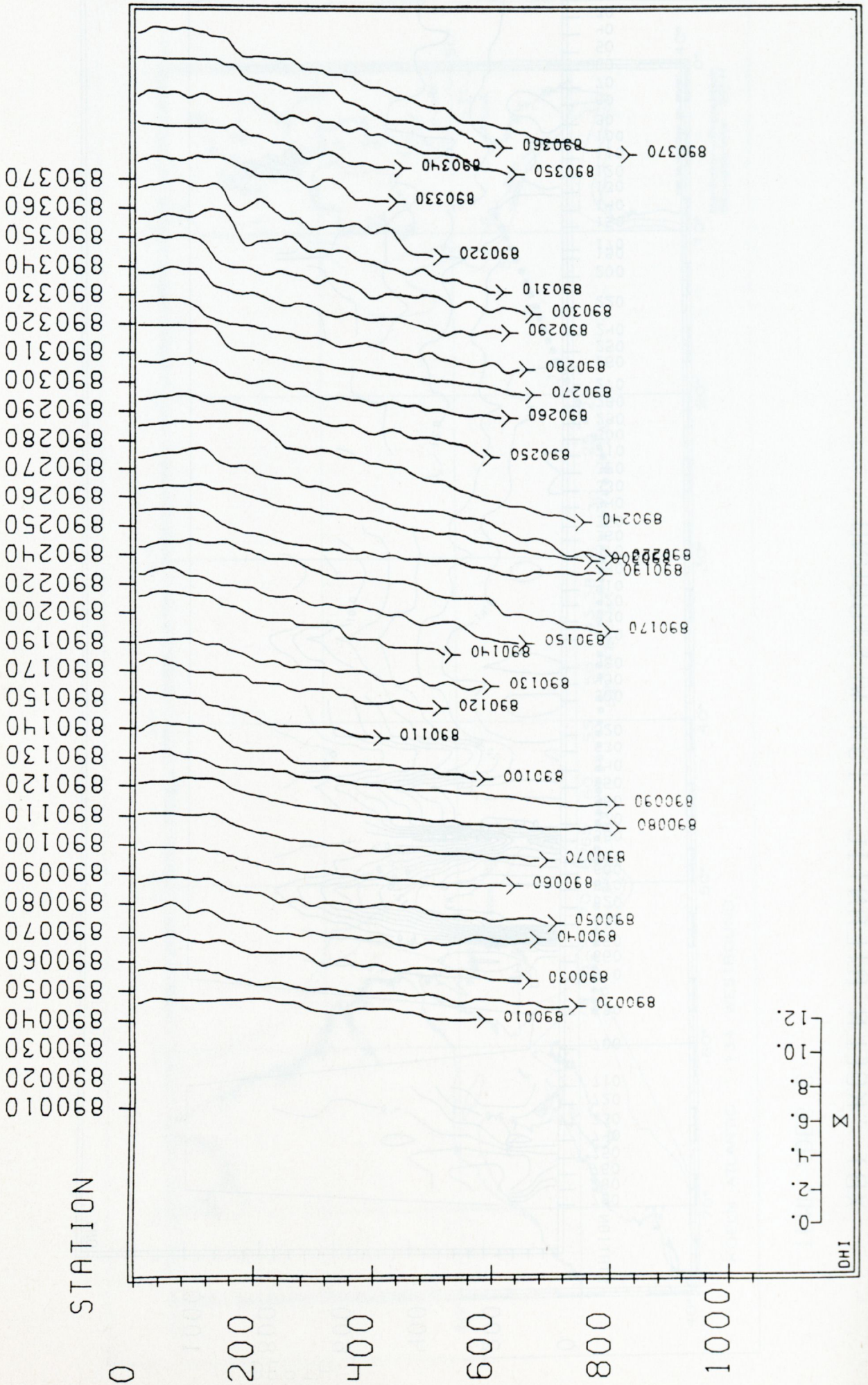


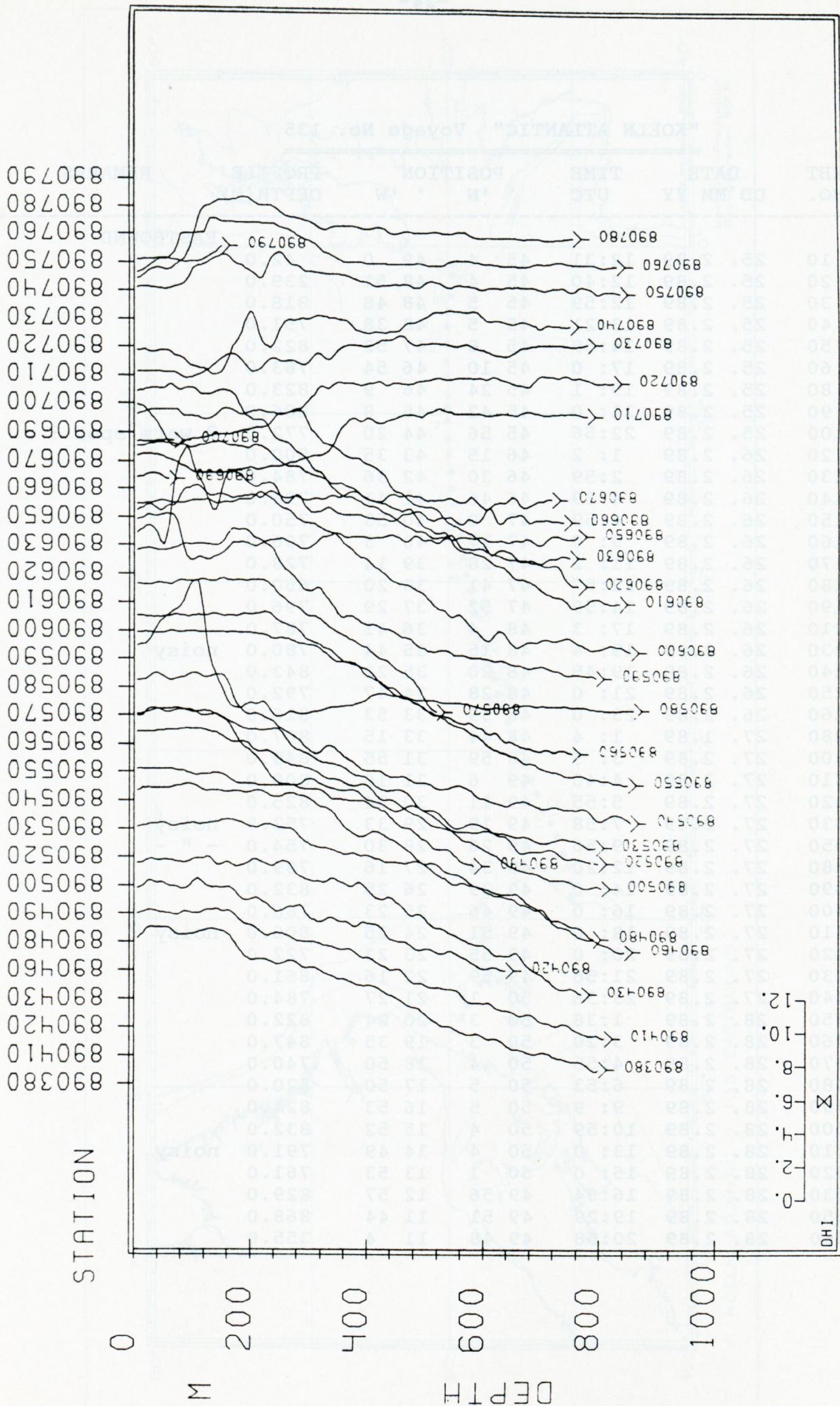
XBT "KOELN ATLANTIC" 134 WESTBOUND

TEMP /DEG C



DHI

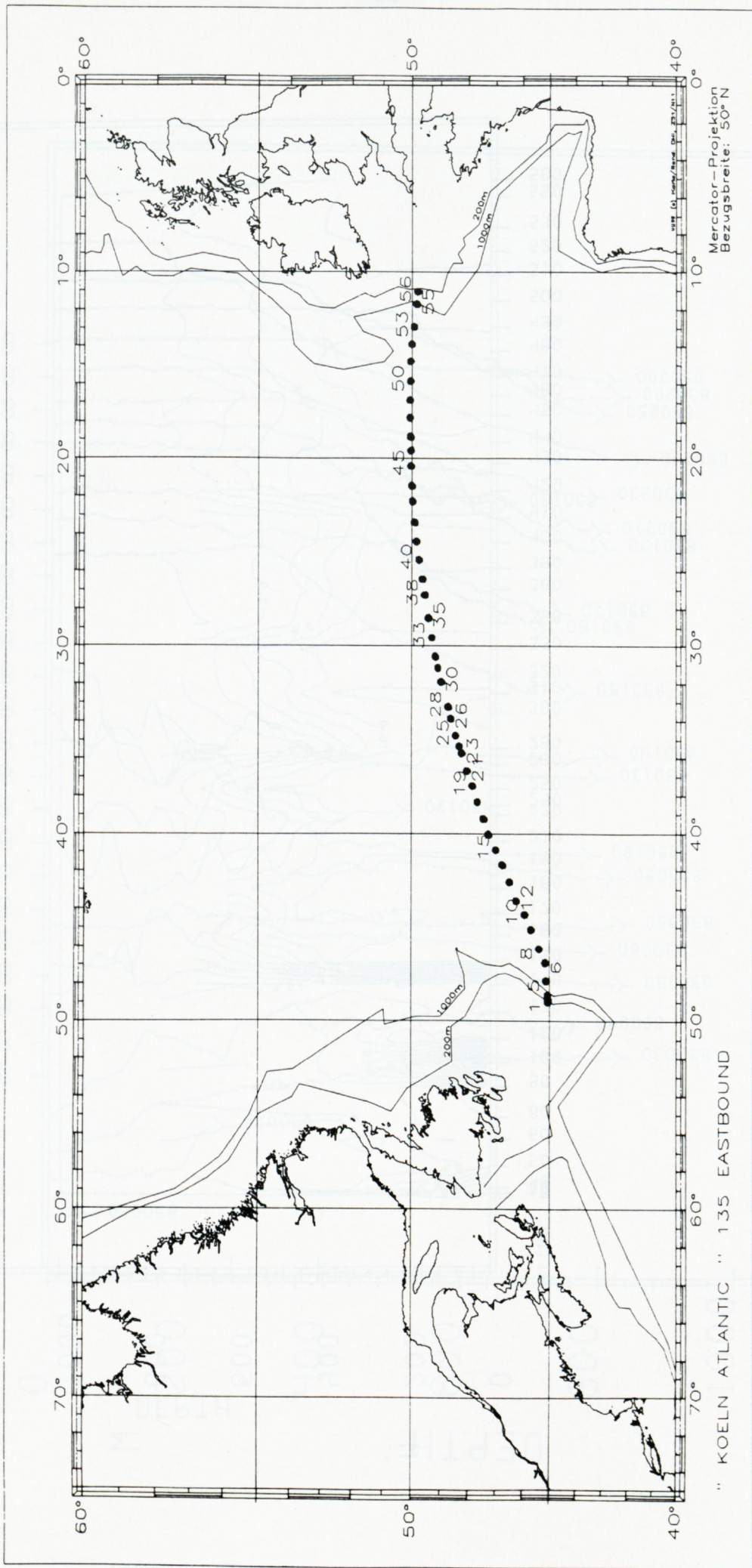




"KOELN ATLANTIC" Voyage No. 135

XBT NO.	DATE			TIME		POSITION		PROFILE	REMARKS
	DD	MM	YY	UTC	'N	'W	DEPTH (m)		
	=====								

	EASTBOUND								
10	25.	2.89		12:31	45 4	49 0		42.0	
20	25.	2.89		12:40	45 4	48 51		239.0	
30	25.	2.89		12:59	45 5	48 48		818.0	
40	25.	2.89		13:21	45 5	48 38		751.0	
50	25.	2.89		14:59	45 8	47 52		822.0	
60	25.	2.89		17: 0	45 10	46 54		783.0	
80	25.	2.89		19: 1	45 24	46 9		823.0	
90	25.	2.89		21: 0	45 42	45 8		806.0	
100	25.	2.89		22:56	45 56	44 20		772.0	? warm spot ?
120	26.	2.89		1: 2	46 15	43 35		500.0	
130	26.	2.89		2:59	46 30	42 36		784.0	
140	26.	2.89		4:59	46 46	41 41		798.0	
150	26.	2.89		6:59	47 0	40 53		750.0	
160	26.	2.89		9: 0	47 17	40 3		706.0	
170	26.	2.89		11: 2	47 28	39 14		728.0	
180	26.	2.89		12:57	47 41	38 20		650.0	
190	26.	2.89		14:59	47 52	37 29		796.0	
210	26.	2.89		17: 3	48 4	36 41		787.0	
230	26.	2.89		19: 4	48 15	35 44		780.0	noisy
240	26.	2.89		19:45	48 20	35 22		843.0	
250	26.	2.89		21: 0	48 28	34 47		792.0	
260	26.	2.89		23: 0	48 39	33 53		816.0	
280	27.	1.89		1: 4	48 44	33 15		807.0	
300	27.	2.89		3: 5	48 59	31 55		849.0	
310	27.	2.89		4:40	49 6	31 10		808.0	
320	27.	2.89		5:55	49 11	30 34		825.0	
330	27.	2.89		7:58	49 19	29 33		753.0	noisy
350	27.	2.89		9:56	49 26	28 30		754.0	- " -
380	27.	2.89		12:20	49 34	27 16		789.0	
390	27.	2.89		14: 0	49 39	26 25		832.0	
400	27.	2.89		16: 0	49 46	25 23		786.0	
410	27.	2.89		18: 0	49 51	24 25		800.0	noisy
420	27.	2.89		20: 0	49 55	23 23		722.0	
430	27.	2.89		21:56	49 59	22 16		861.0	
440	27.	2.89		23:36	50 1	21 27		784.0	
450	28.	2.89		1:38	50 3	20 24		822.0	
460	28.	2.89		3:20	50 3	19 35		847.0	
470	28.	2.89		4:55	50 4	18 50		740.0	
480	28.	2.89		6:53	50 5	17 50		820.0	
490	28.	2.89		9: 9	50 5	16 53		824.0	
500	28.	2.89		10:59	50 4	15 52		832.0	
510	28.	2.89		13: 0	50 4	14 49		791.0	noisy
520	28.	2.89		15: 0	50 1	13 53		761.0	
530	28.	2.89		16:54	49 56	12 57		829.0	
550	28.	2.89		19:29	49 51	11 44		868.0	
560	28.	2.89		20:58	49 48	11 4		355.0	

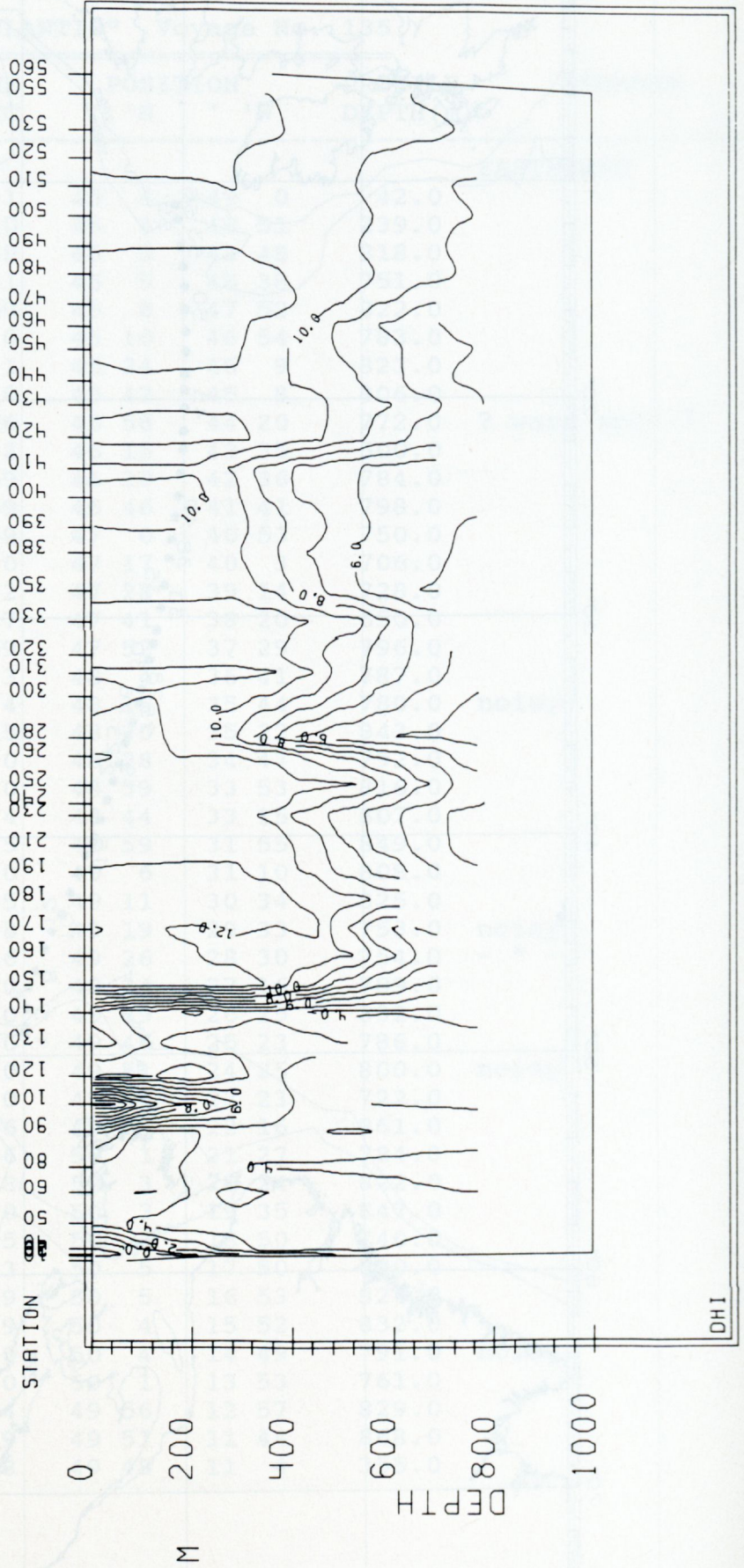


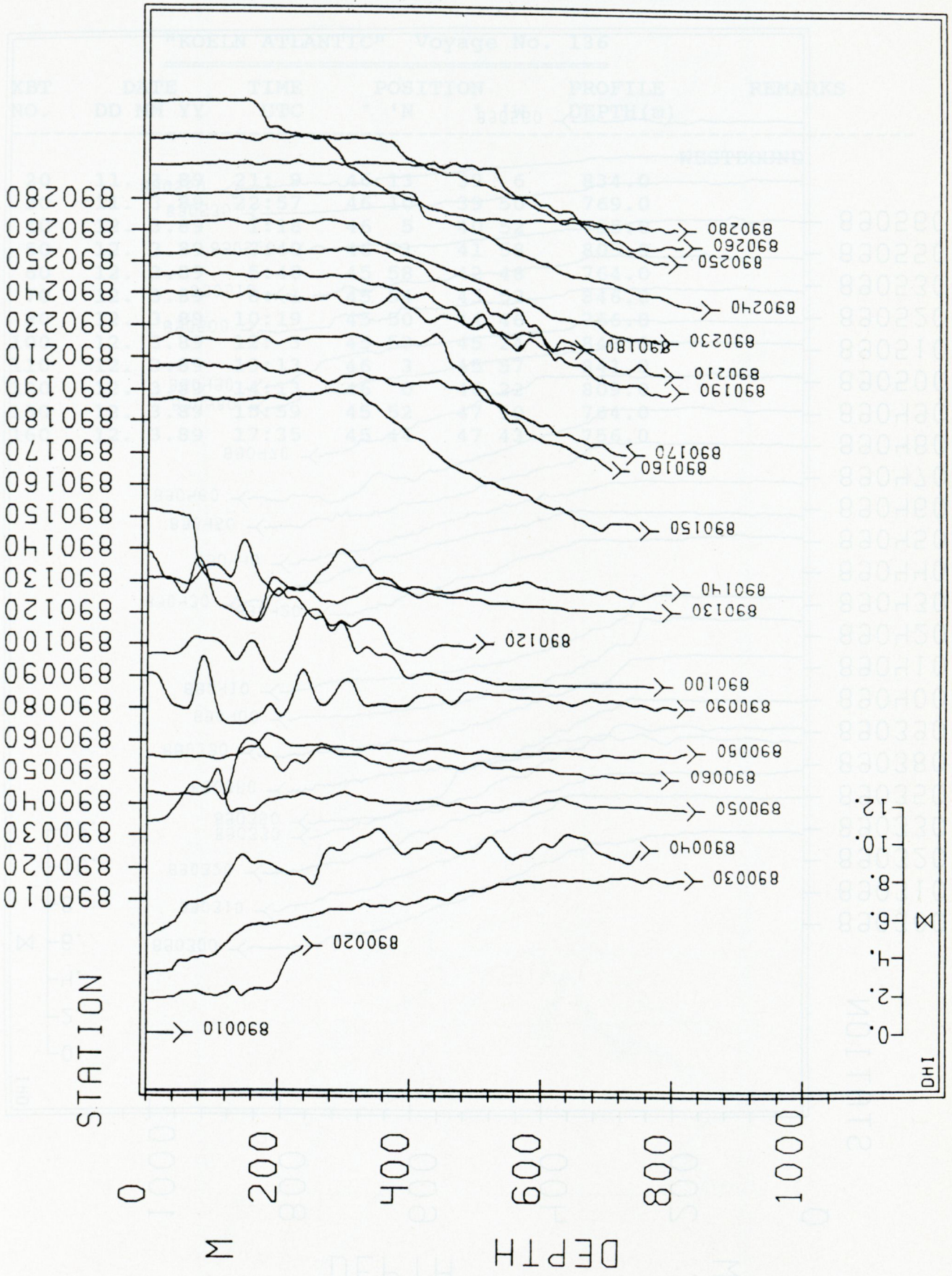
.. KOELN ATLANTIC .. 135 EASTBOUND

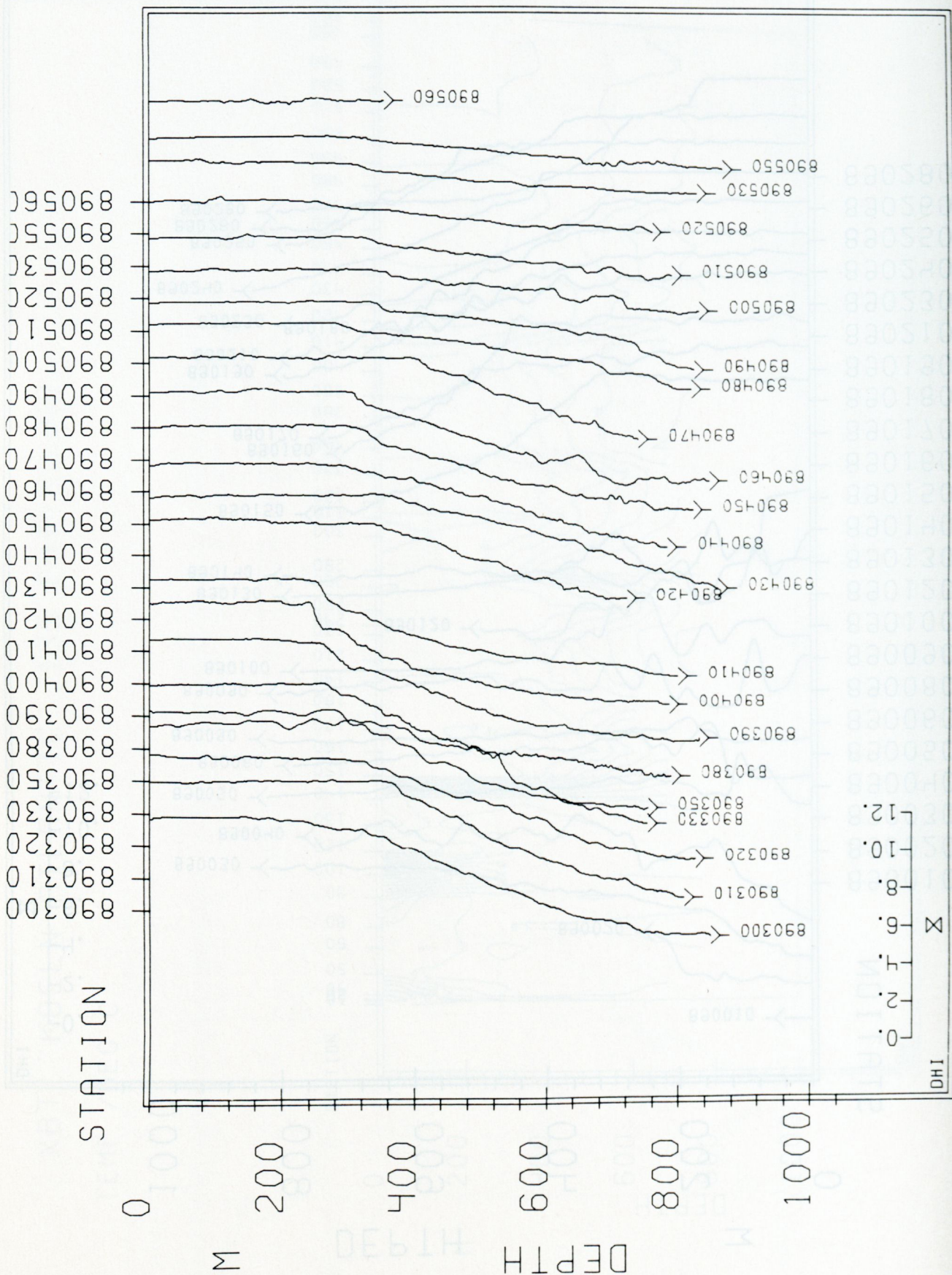
Mercator-Projektion
Bezugsbreite: 50° N

XBT "KOELN ATLANTIC" 135 EASTBOUND

TEMP / DEG C







"KOELN ATLANTIC" Voyage No. 136

XBT NO.	DATE DD MM YY	TIME UTC	POSITION ° 'N ° 'W	PROFILE DEPTH (m)	REMARKS
					WESTBOUND
20	11. 3.89	21: 9	46 13 39 6	834.0	
30	11. 3.89	22:57	46 10 39 50	769.0	
40	12. 3.89	1:18	46 5 40 52	755.0	
50	12. 3.89	3:40	46 1 41 58	805.0	
60	12. 3.89	5:40	45 58 42 48	764.0	
70	12. 3.89	8: 1	45 54 43 52	846.0	
80	12. 3.89	10:19	45 50 44 46	756.0	
100	12. 3.89	12: 3	45 53 45 24	849.0	
110	12. 3.89	13:13	46 3 45 57	841.0	
120	12. 3.89	14:13	46 0 46 22	809.0	
130	12. 3.89	15:59	45 52 47 10	764.0	
160	12. 3.89	17:35	45 44 47 43	756.0	

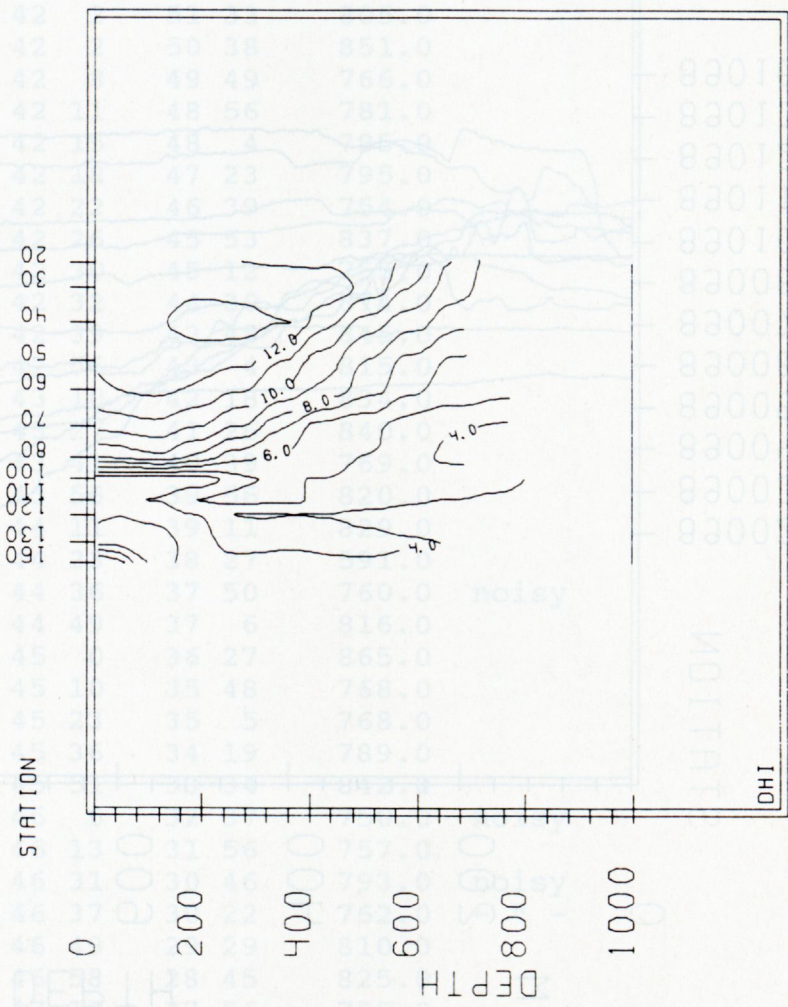
XBT NO. DATE TIME POSITION PROFILE REMARKS
 DD MM YY UTC 'N 'W DEPTH (m)

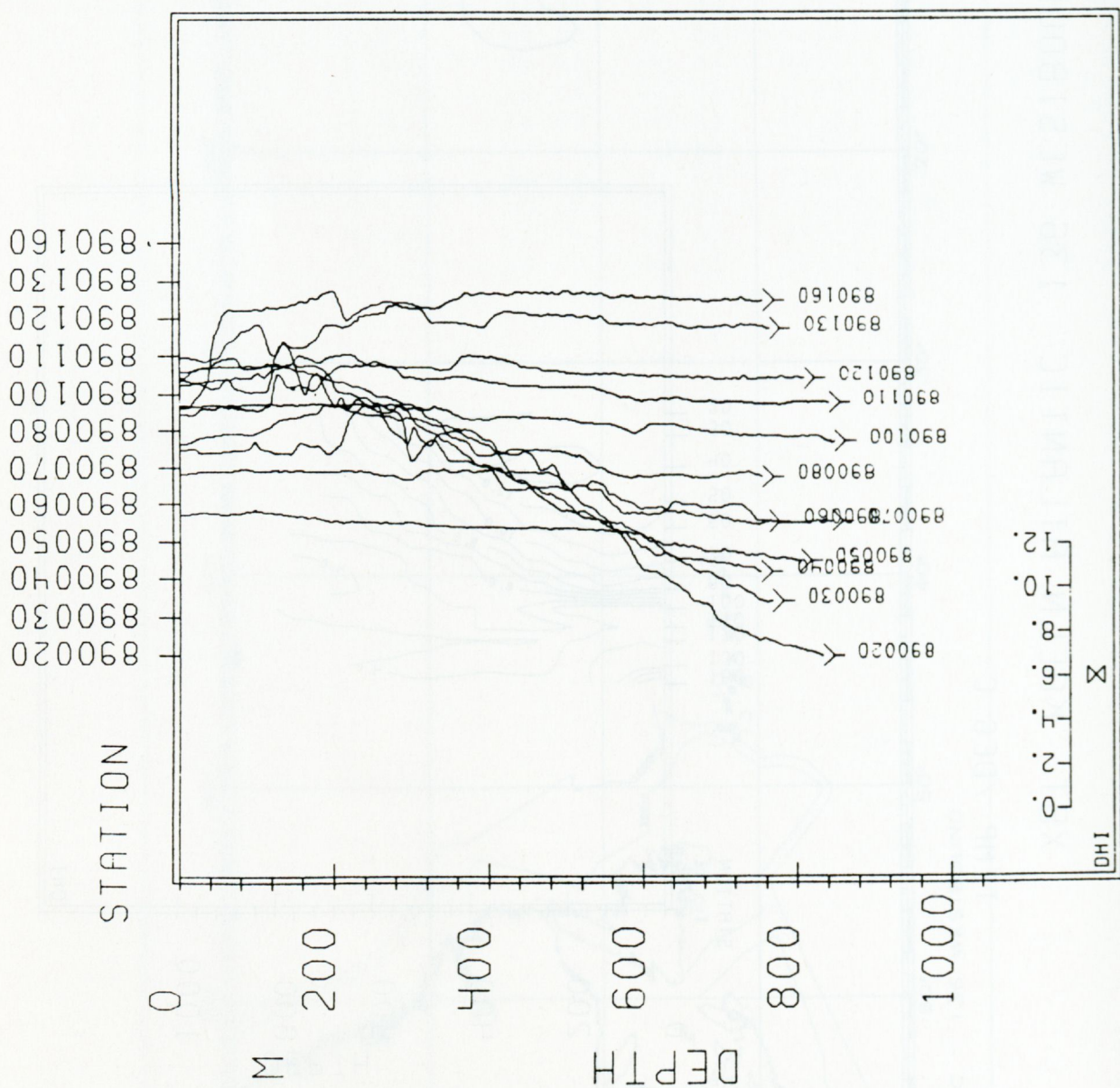
XBT "KOELN ATLANTIC" 136 WESTBOUND

TEMP /DEG C

EASTBOUND

XBT NO.	DATE	TIME	POSITION	PROFILE	REMARKS
DD MM YY	UTC	'N	'W	DEPTH (m)	
170	23	3:89	43 37	59 43	193.0
180	23	3:89	43 29	59 5	772.0
190	23	3:89	43 12	58 2	816.0
200	3:89	23: 0	43 5	57 26	826.0
210	3:89	1: 0	42 56	56 42	773.0
220	3:89	2:38	42 58	56 2	819.0
230	3:89	4:40	42 34	55 10	823.0
240	3:89	6:19	42 25	54 31	769.0
250	3:89	8: 0	42 16	53 51	827.0
260	3:89	9:59	42 2	53 4	834.0
270	3:89	11:59	41 57	52 20	762.0
280	3:89	14: 1	42		
290	3:89	15:59	42	50 38	851.0
300	3:89	18: 1	42	49 49	766.0
310	3:89	19:59	42	48 56	801.0
320	3:89	21:59	42	48 4	785.0
330	3:89	23:19	42	47 23	795.0
340	3:89	01:19	42	46 39	754.0
350	3:89	03:19	42	45 23	817.0
360	3:89	05:20	42		
370	3:89	07:20	42		
380	3:89	09:20	42		
390	3:89	11:20	42		
400	3:89	13:20	42		
410	3:89	15:20	42		
420	3:89	17:20	42		
430	3:89	19:20	42		
440	3:89	21:20	42		
450	3:89	23:20	42		
460	3:89	01:44	43	17 50	760.0 noisy
470	3:89	2:40	43	17 6	816.0
480	3:89	4:20	43	16 27	865.0
490	3:89	6: 0	43	15 48	768.0
500	3:89	7:50	43	15 5	768.0
510	3:89	9:54	43	14 19	789.0
520	3:89	11:59	43		
530	3:89	14: 0	43		
540	3:89	16: 0	43		
550	3:89	18:40	43	17 58	757.0
560	3:89	20:40	43	17 29	757.0
570	3:89	22:40	43	16 45	825.0
580	3:89	1:40	43	15 56	755.0
590	3:89	3:20	43	15 16	795.0
600	3:89	5: 0	43	26 35	771.0 noisy
610	3:89	7: 0	43	25 43	826.0
620	3:89	9: 0	43	24 57	777.0 noisy
630	3:89	10:57	43	24 10	719.0
640	3:89	13: 0	43	23 25	743.0
650	3:89	15: 1	43	22 32	750.0

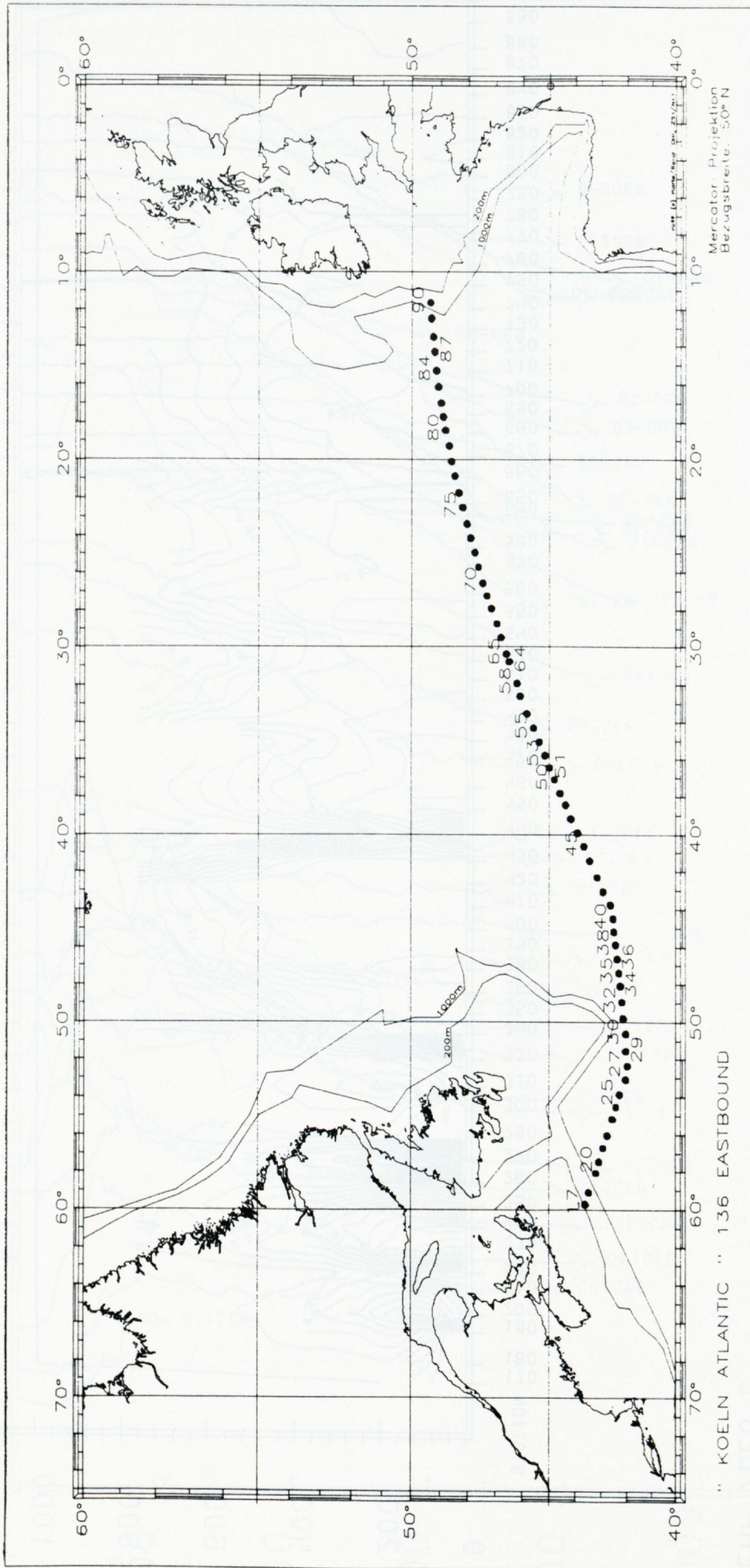




XBT NO.	DATE			TIME UTC	POSITION		PROFILE DEPTH(m)	REMARKS
	DD	MM	YY		'N	'W		

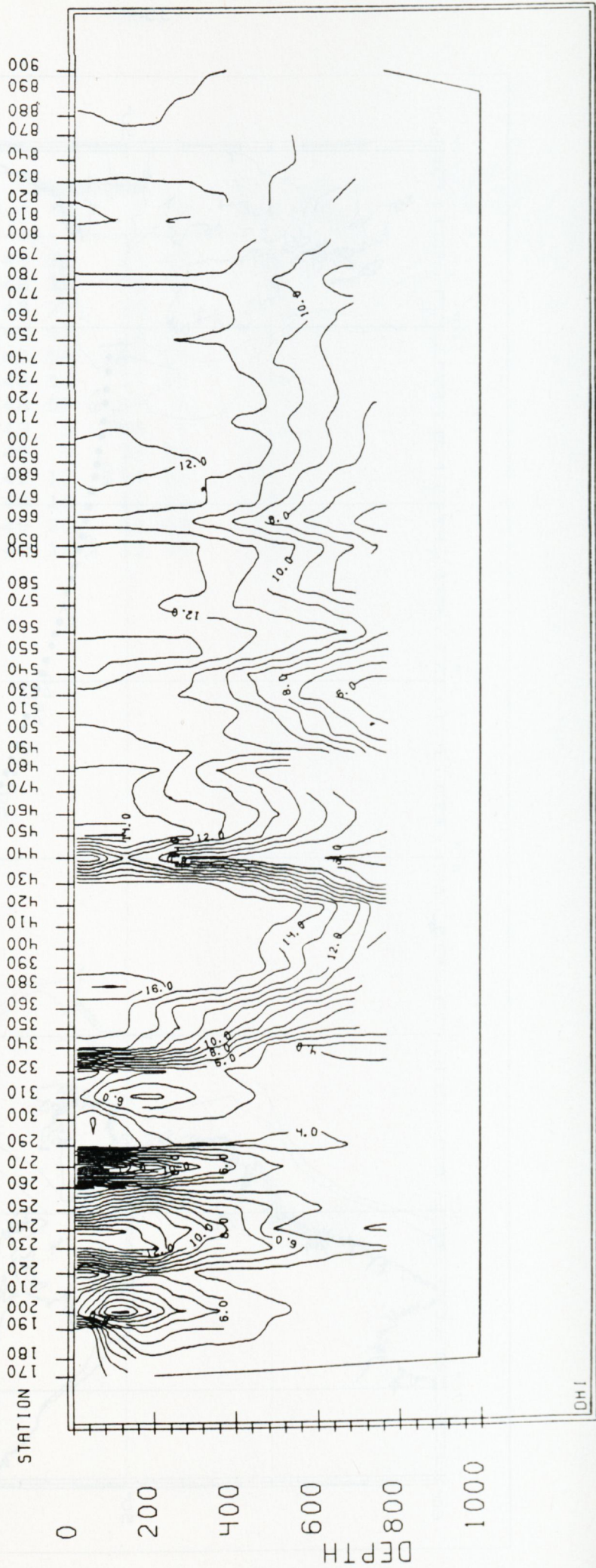
EASTBOUND								
170	23.	3.89	17:30	43 37	59 43	193.0		
180	23.	3.89	18:59	43 29	59 5	772.0		
190	23.	3.89	20:59	43 12	58 2	816.0		
200	23.	3.89	23: 0	43 5	57 26	826.0		
210	24.	3.89	1: 0	42 56	56 42	773.0		
220	24.	3.89	2:46	42 46	56 2	840.0		
230	24.	3.89	4:40	42 34	55 10	823.0		
240	24.	3.89	6:19	42 25	54 31	769.0		
250	24.	3.89	8: 0	42 16	53 51	827.0		
260	24.	3.89	9:59	42 2	53 4	834.0		
270	24.	3.89	11:58	41 57	52 20	762.0		
290	24.	3.89	14: 1	42 2	51 33	805.0		
300	24.	3.89	15:59	42 2	50 38	851.0		
310	24.	3.89	18: 1	42 8	49 49	766.0		
320	24.	3.89	19:58	42 11	48 56	781.0		
340	24.	3.89	22: 8	42 15	48 4	785.0		
350	25.	3.89	0: 1	42 18	47 23	795.0		
360	25.	3.89	1:42	42 22	46 39	754.0		
380	25.	3.89	3:44	42 26	45 53	837.0		
390	25.	3.89	5:20	42 30	45 12	755.0		
400	25.	3.89	6:59	42 32	44 30	874.0		
410	25.	3.89	8:59	42 39	43 45	845.0		
420	25.	3.89	11: 6	42 56	43 4	815.0		
430	25.	3.89	13: 3	43 10	42 18	834.0		
440	25.	3.89	15: 0	43 27	41 26	840.0		
450	25.	3.89	17: 0	43 41	40 39	769.0		
460	25.	3.89	19: 0	43 56	39 56	820.0		
470	25.	3.89	21: 0	44 11	39 11	829.0		
480	25.	3.89	23: 0	44 23	38 27	591.0		
490	26.	3.89	0:44	44 36	37 50	760.0	noisy	
500	26.	3.89	2:40	44 49	37 6	816.0		
510	26.	3.89	4:20	45 0	36 27	865.0		
530	26.	3.89	6: 8	45 10	35 48	768.0		
540	26.	3.89	7:59	45 23	35 5	768.0		
550	26.	3.89	9:54	45 36	34 19	789.0		
560	26.	3.89	12: 2	45 51	33 34	842.0		
570	26.	3.89	14: 9	46 6	32 37	750.0	noisy	
580	26.	3.89	16: 0	46 13	31 56	757.0		
640	26.	3.89	18:48	46 31	30 46	793.0	noisy	
650	26.	3.89	19:50	46 37	30 22	762.0	- " -	
660	26.	3.89	22: 0	46 49	29 29	810.0		
670	26.	3.89	23:40	46 58	28 45	825.0		
680	26.	3.89	1:40	47 10	27 56	755.0		
690	26.	3.89	3:20	47 20	27 16	795.0		
700	27.	3.89	5: 0	47 29	26 35	771.0	noisy	
710	27.	3.89	7: 0	47 39	25 43	826.0		
720	27.	3.89	9: 0	47 47	24 57	777.0	noisy	
730	27.	3.89	10:57	47 56	24 10	719.0		
740	27.	3.89	13: 0	48 4	23 25	743.0		
750	27.	3.89	15: 1	48 13	22 32	750.0		

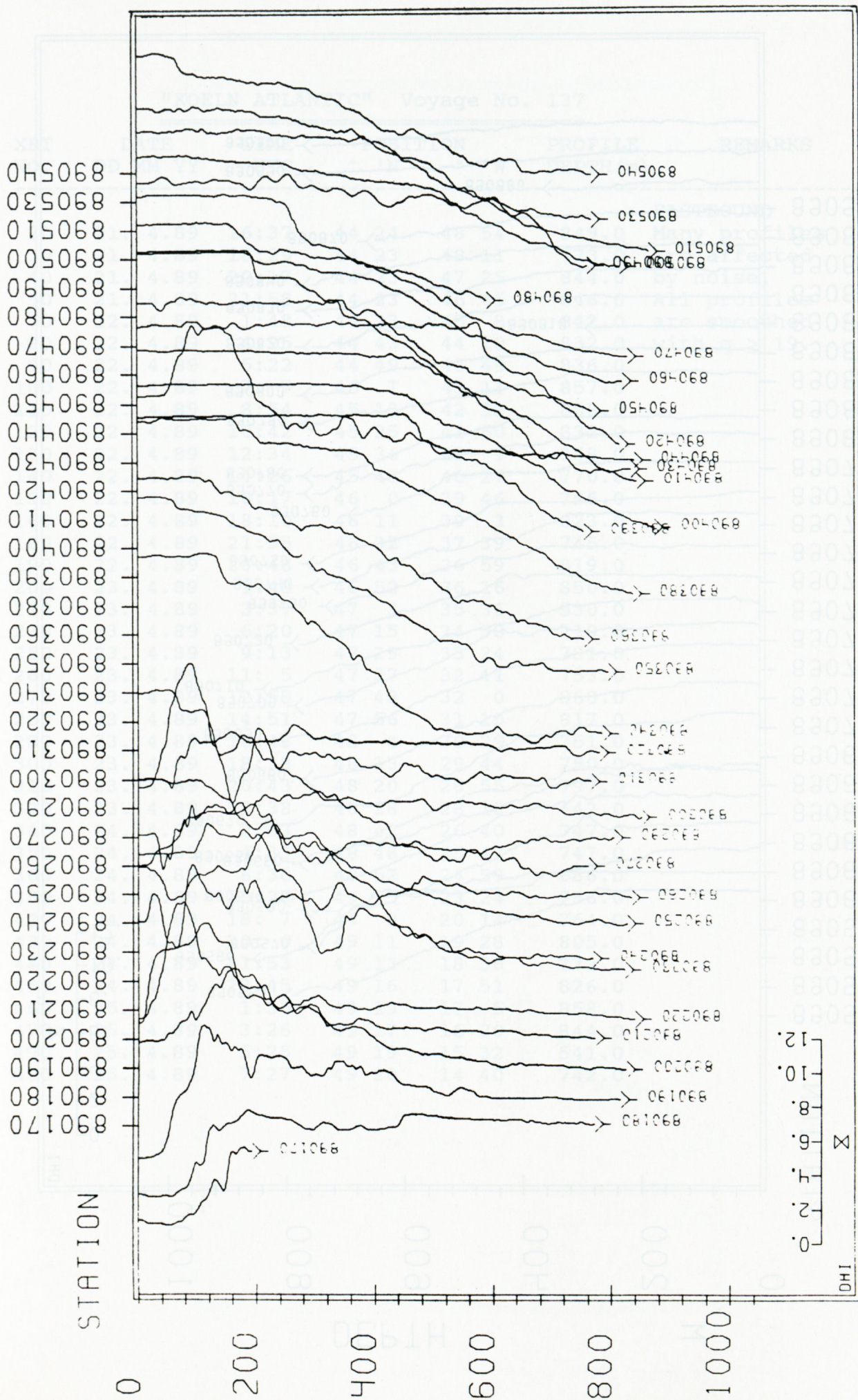
XBT NO.	DATE			TIME UTC	POSITION		PROFILE DEPTH (m)	REMARKS
	DD	MM	YY		'N	'W		
760	27.	3.	89	16:59	48 21	21 45	680.0	
770	27.	3.	89	18:59	48 30	20 52	755.0	
780	27.	3.	89	20:59	48 37	20 6	755.0	
790	27.	3.	89	22:42	48 42	19 16	754.0	
800	28.	3.	89	0:40	48 50	18 26	756.0	
810	28.	3.	89	2:20	48 55	17 43	280.0	
820	28.	3.	89	4: 0	48 59	17 0	755.0	
830	28.	3.	89	6: 0	49 5	16 9	755.0	
840	28.	3.	89	7:58	49 9	15 17	756.0	
870	28.	3.	89	10:17	49 13	14 16	650.0	
880	28.	3.	89	12: 0	49 16	13 29	351.0	
890	28.	3.	89	14: 0	49 20	12 29	755.0	
900	28.	3.	89	16: 0	49 22	11 39	755.0	

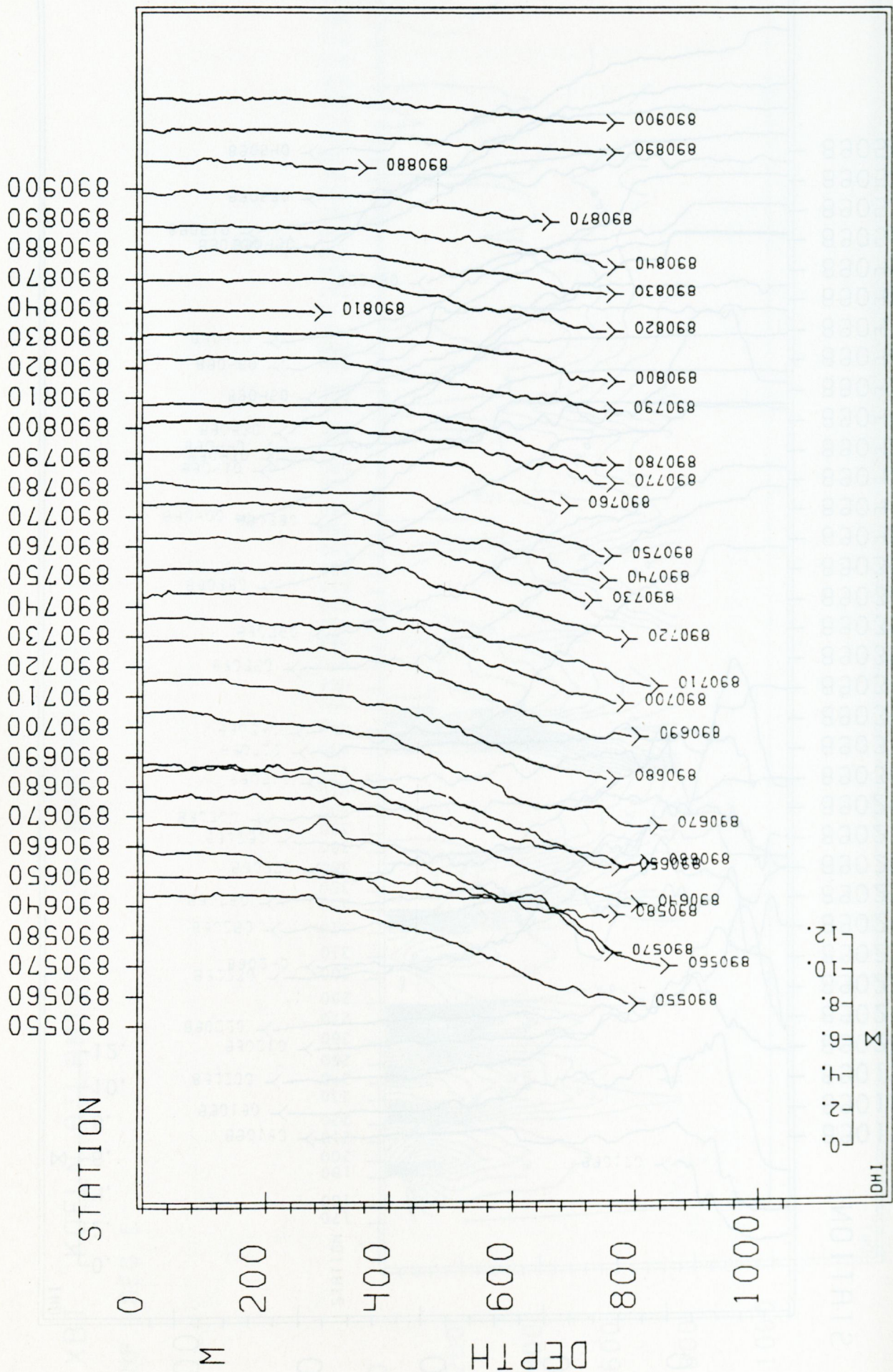


XBT "KOELN ATLANTIC" 136 EASTBOUND

TEMP / DEG C

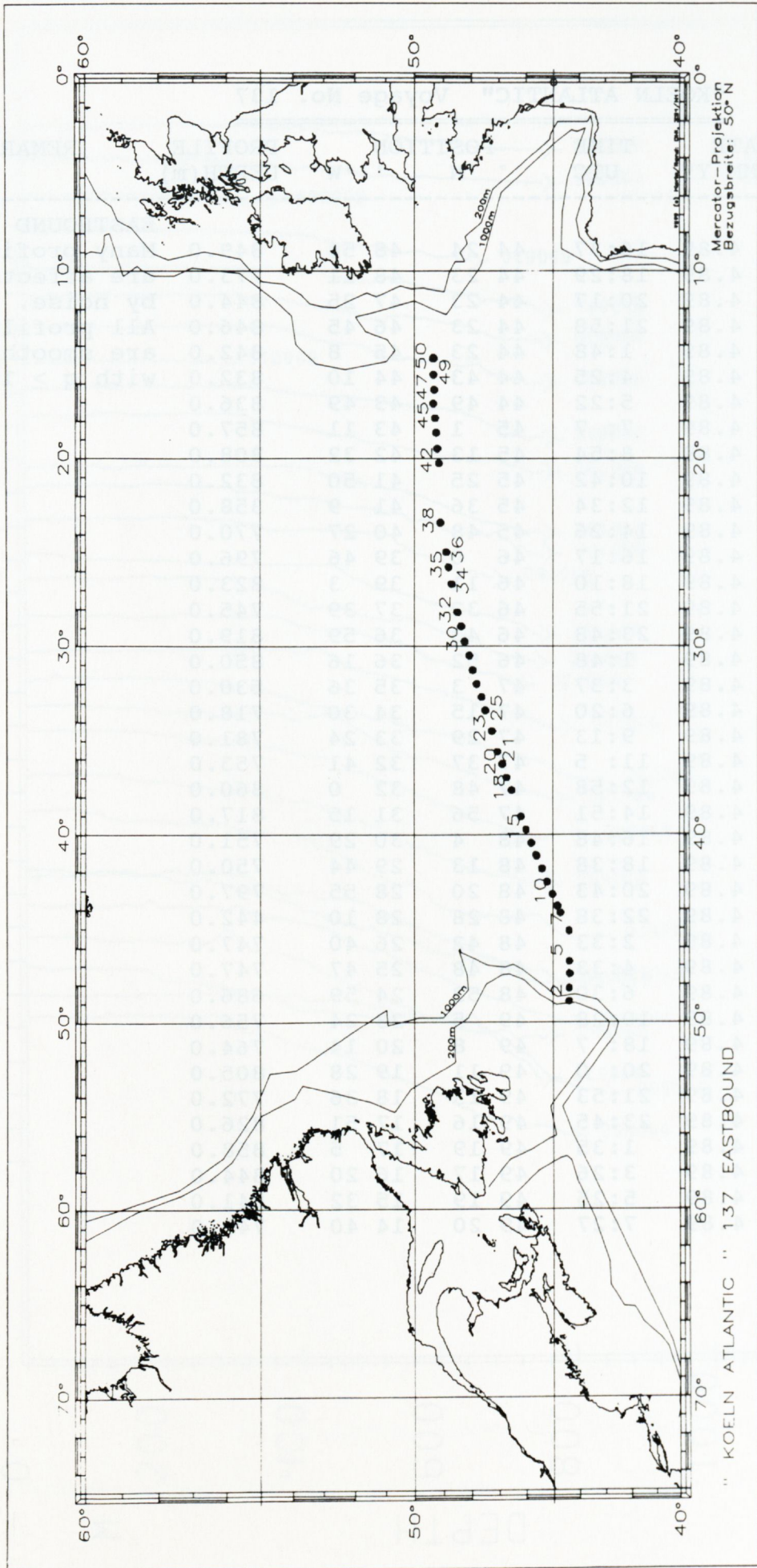






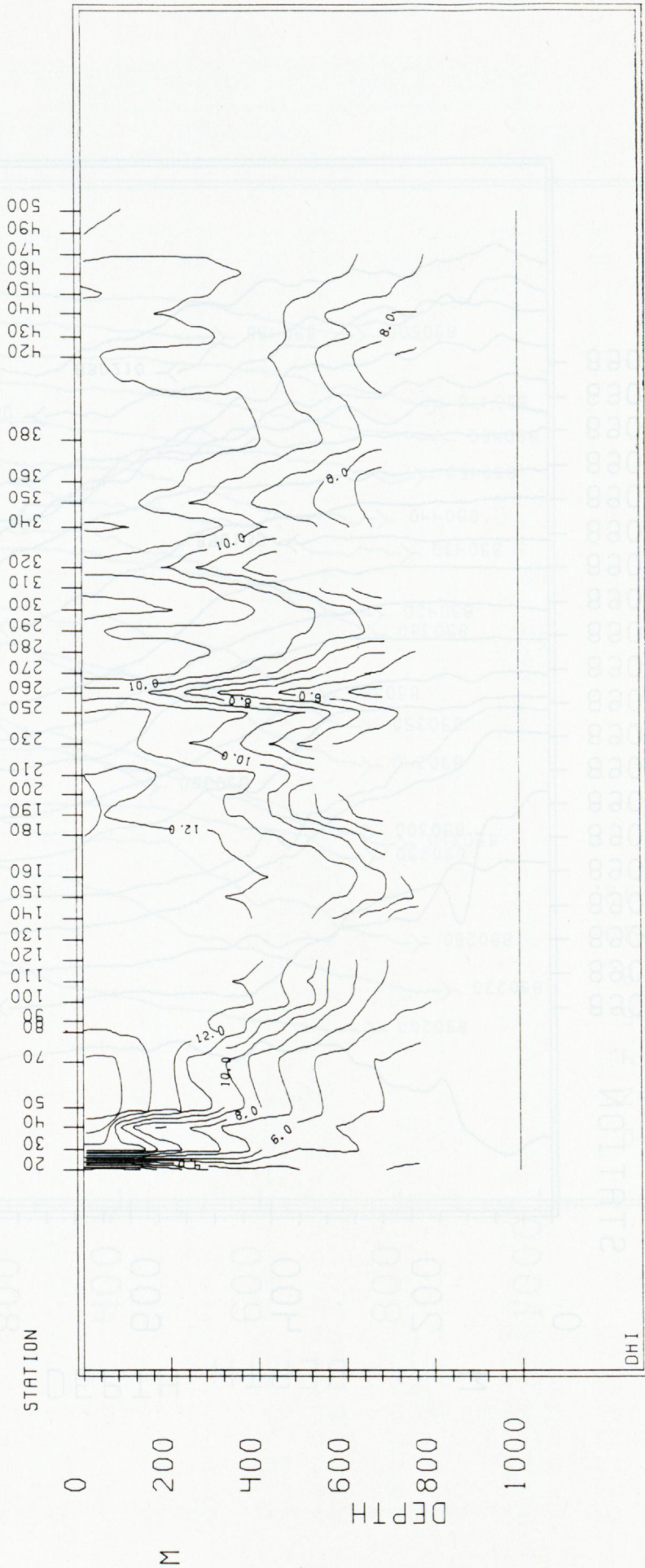
"KOELN ATLANTIC" Voyage No. 137

XBT NO.	DATE			TIME UTC	POSITION		PROFILE DEPTH(m)	REMARKS
	DD	MM	YY		'N	'W		
	EASTBOUND							
20	21.	4.	89	16:37	44 24	48 54	849.0	Many profiles are affected by noise. All profiles are smoothed with $q \geq 19$.
30	21.	4.	89	18:29	44 23	48 11	773.0	
40	21.	4.	89	20:17	44 23	47 25	844.0	
50	21.	4.	89	21:58	44 23	46 45	846.0	
70	22.	4.	89	1:48	44 23	45 8	842.0	
80	22.	4.	89	4:25	44 43	44 10	832.0	
90	22.	4.	89	5:22	44 49	43 49	836.0	
100	22.	4.	89	7: 7	45 1	43 11	857.0	
110	22.	4.	89	8:54	45 13	42 32	808.0	
120	22.	4.	89	10:42	45 25	41 50	832.0	
130	22.	4.	89	12:34	45 36	41 9	358.0	
140	22.	4.	89	14:26	45 48	40 27	770.0	
150	22.	4.	89	16:17	46 0	39 46	796.0	
160	22.	4.	89	18:10	46 11	39 3	823.0	
180	22.	4.	89	21:55	46 32	37 39	745.0	
190	22.	4.	89	23:48	46 43	36 59	819.0	
200	23.	4.	89	1:48	46 52	36 16	850.0	
210	23.	4.	89	3:37	47 3	35 36	530.0	
230	23.	4.	89	6:20	47 15	34 30	718.0	
250	23.	4.	89	9:13	47 29	33 24	781.0	
260	23.	4.	89	11: 5	47 37	32 41	753.0	
270	23.	4.	89	12:58	47 48	32 0	860.0	
280	23.	4.	89	14:51	47 56	31 15	817.0	
290	23.	4.	89	16:48	48 4	30 29	751.0	
300	23.	4.	89	18:38	48 13	29 44	750.0	
310	23.	4.	89	20:43	48 20	28 55	797.0	
320	23.	4.	89	22:38	48 28	28 10	442.0	
340	24.	4.	89	2:33	48 42	26 40	747.0	
350	24.	4.	89	4:33	48 48	25 47	747.0	
360	24.	4.	89	6:30	48 52	24 59	686.0	
380	24.	4.	89	10:28	49 5	23 24	756.0	
420	24.	4.	89	18: 7	49 8	20 14	764.0	
430	24.	4.	89	20: 0	49 11	19 28	805.0	
440	24.	4.	89	21:53	49 13	18 36	772.0	
450	24.	4.	89	23:45	49 16	17 51	826.0	
460	25.	4.	89	1:35	49 19	17 5	858.0	
470	25.	4.	89	3:26	49 17	16 20	844.0	
490	25.	4.	89	5:25	49 19	15 32	541.0	
500	25.	4.	89	7:27	49 20	14 40	742.0	

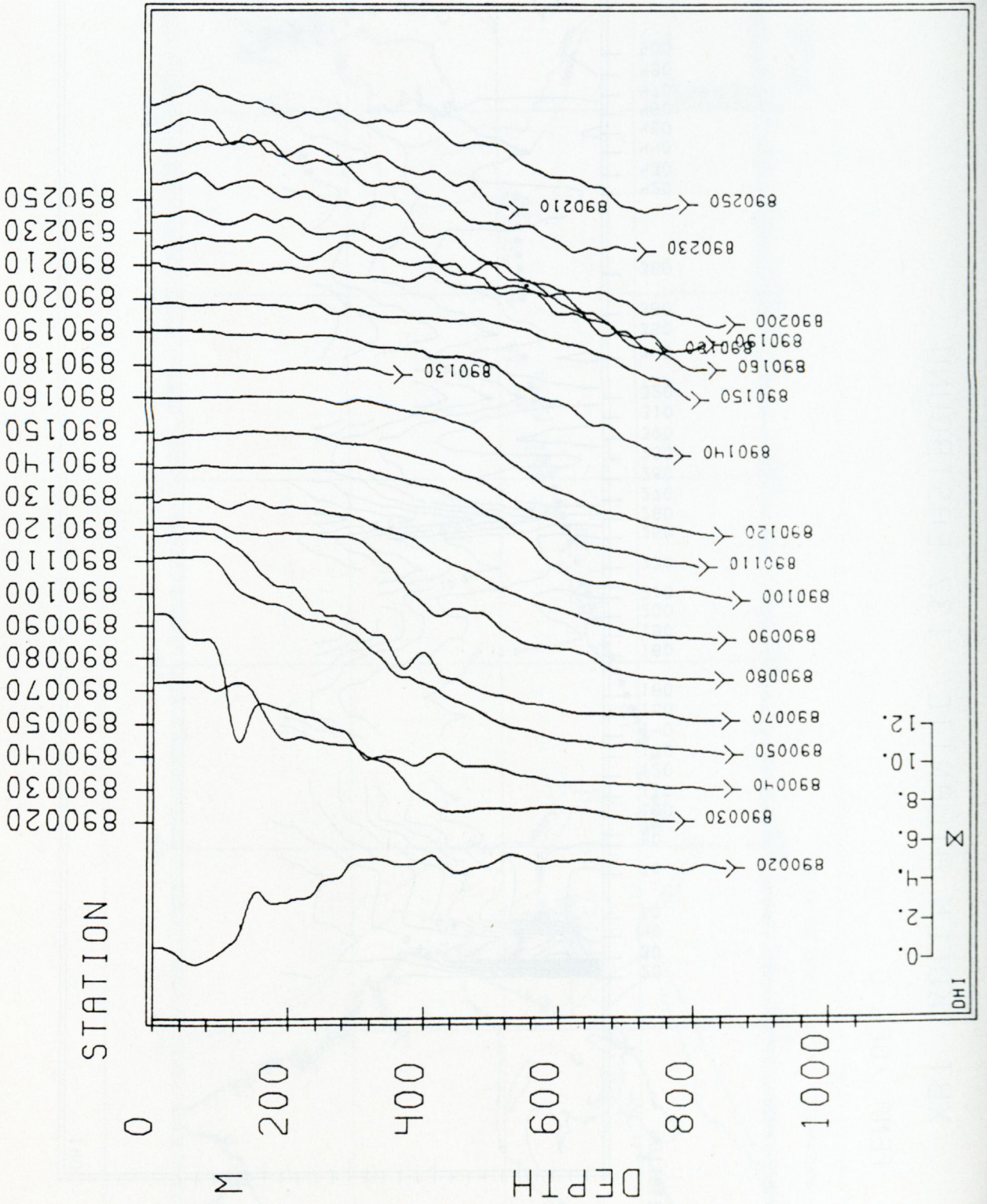


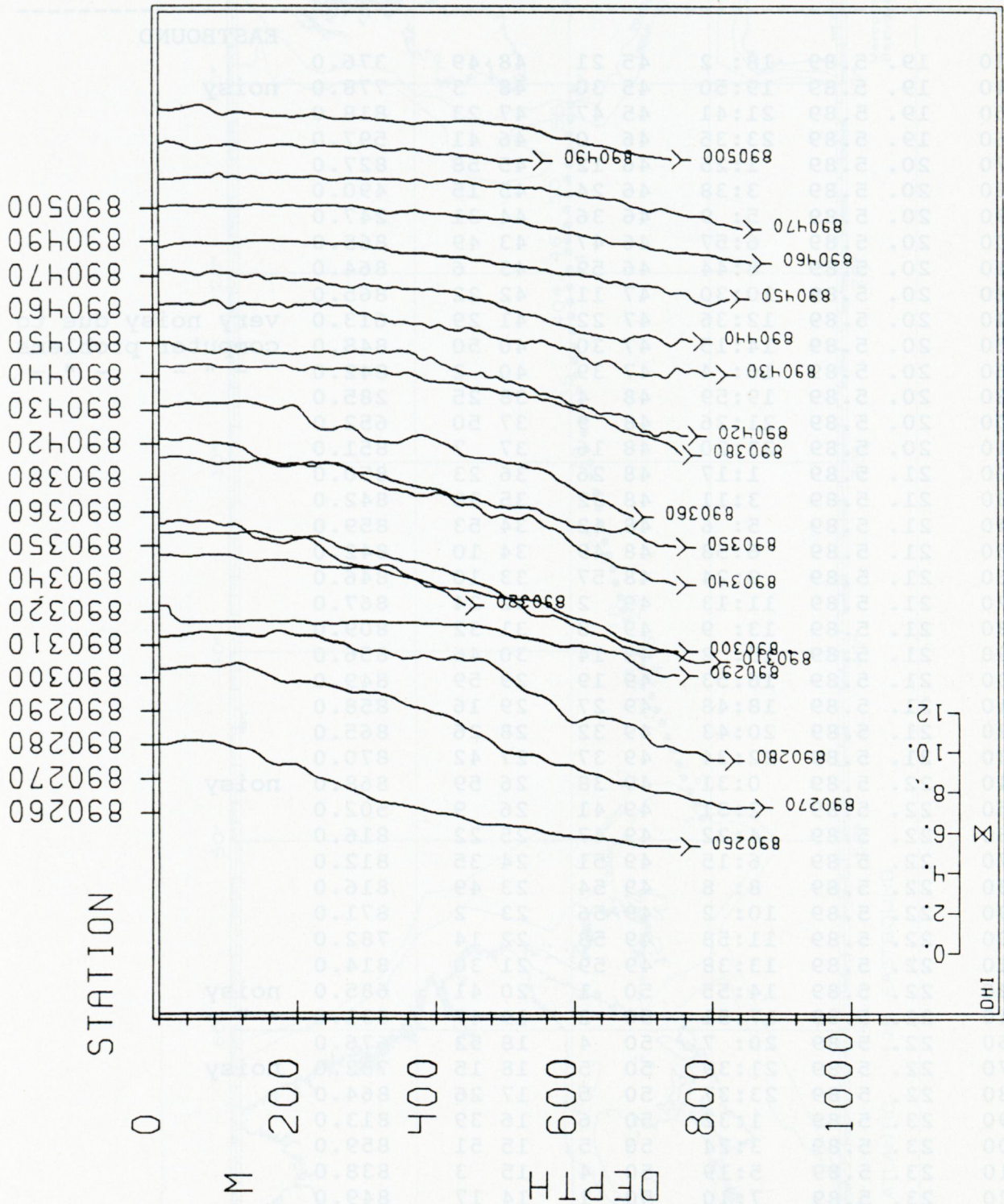
XBT "KOELN ATLANTIC" 137 EASTBOUND

TEMP / DEG C



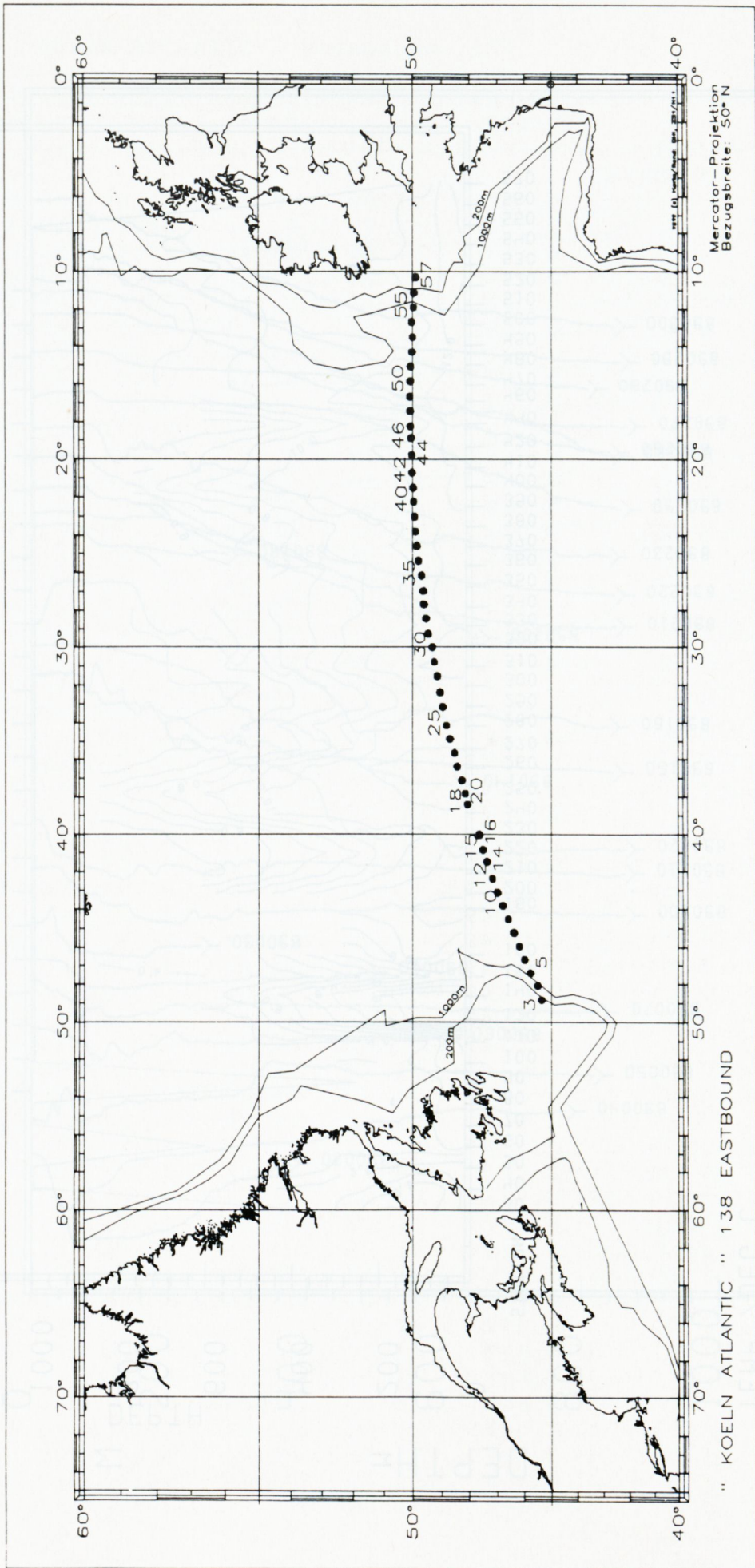
DHT





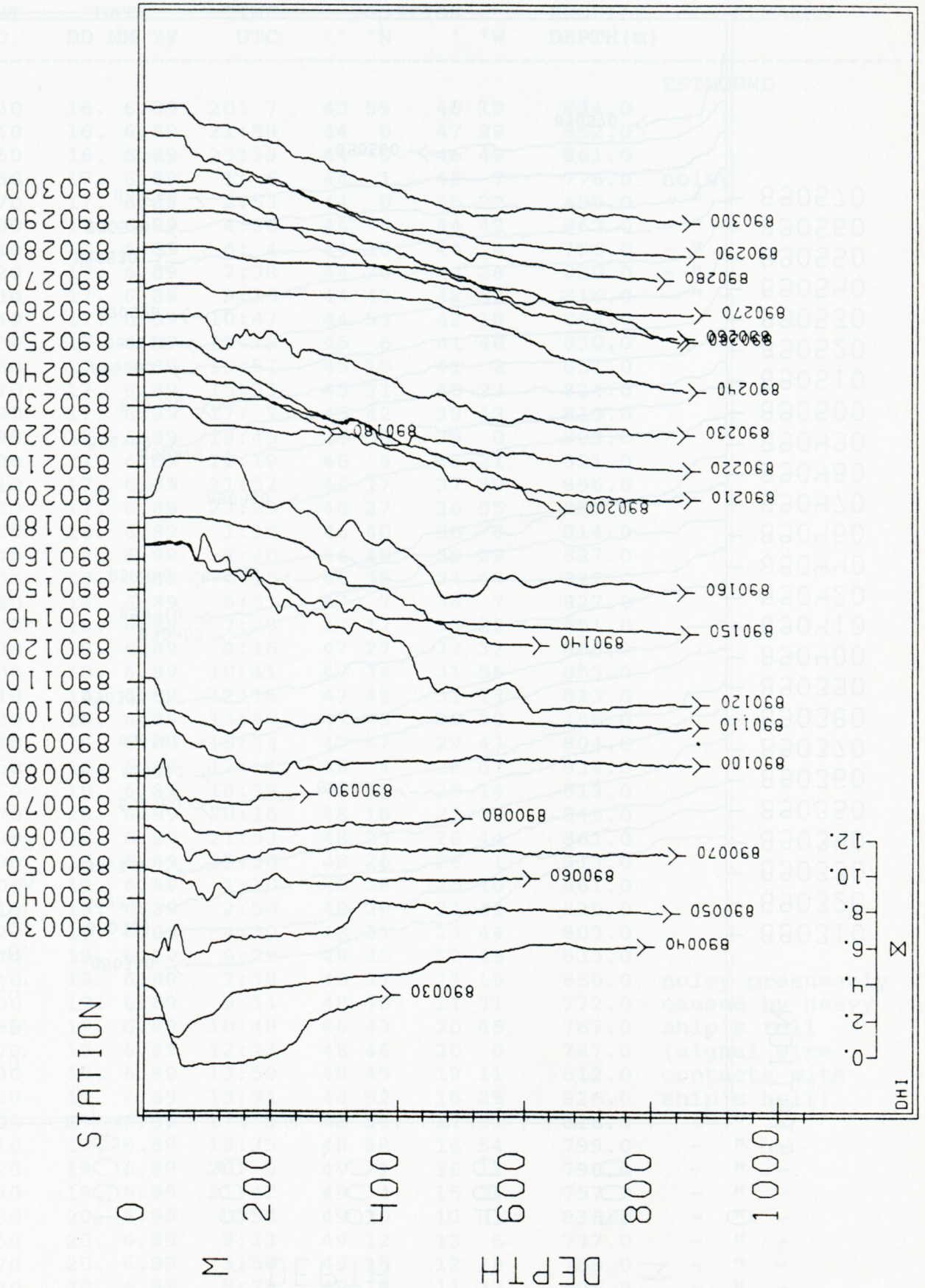
"KOELN ATLANTIC" Voyage No. 138

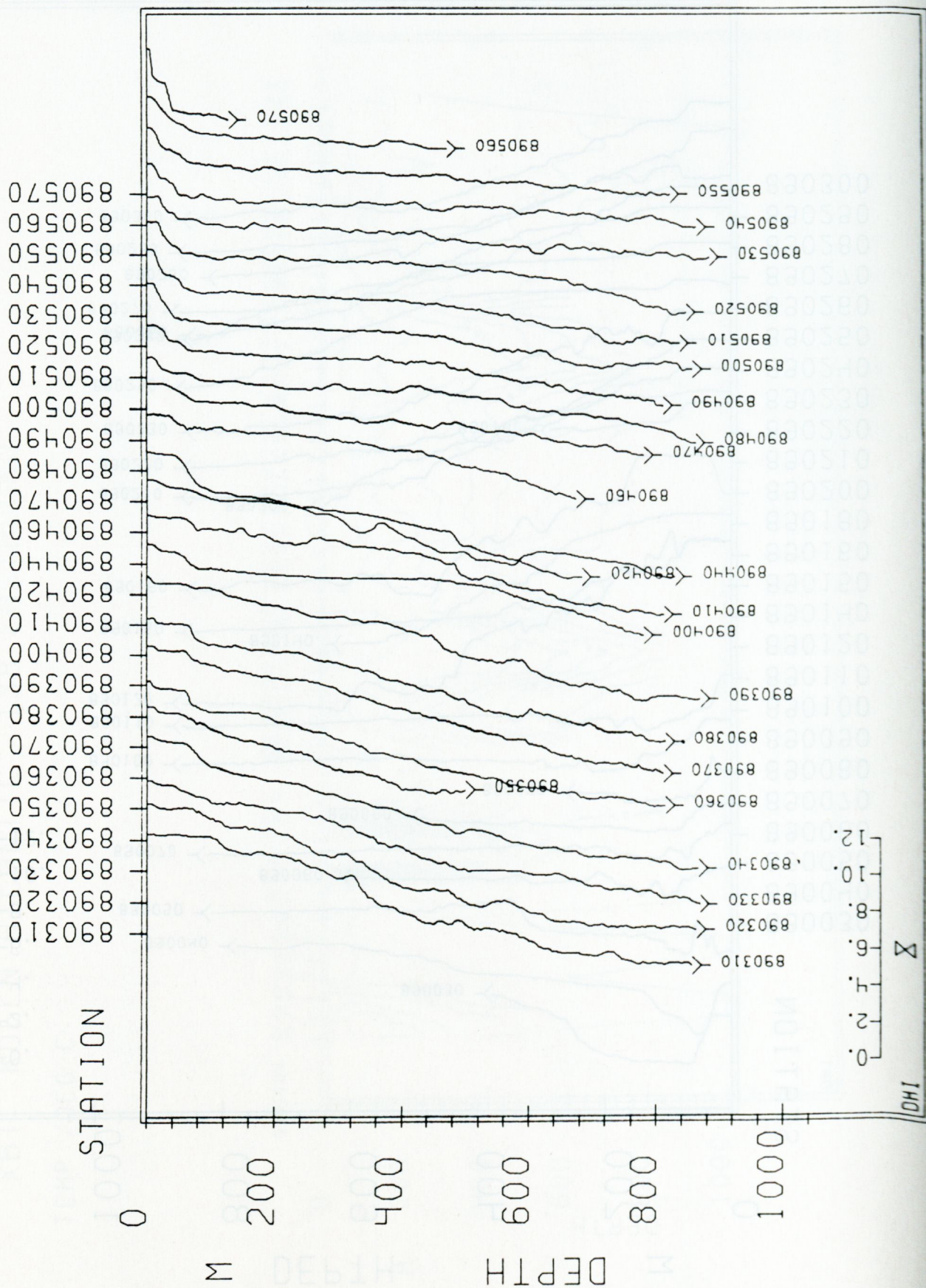
XBT NO.	DATE			TIME	POSITION		PROFILE	REMARKS
	DD	MM	YY	UTC	° 'N	° 'W	DEPTH (m)	
								EASTBOUND
30	19.	5.89		18: 2	45 21	48 49	376.0	
40	19.	5.89		19:50	45 30	48 3	778.0	noisy
50	19.	5.89		21:41	45 47	47 23	818.0	
60	19.	5.89		23:35	46 0	46 41	597.0	
70	20.	5.89		1:25	46 12	45 58	827.0	
80	20.	5.89		3:38	46 24	45 15	490.0	
90	20.	5.89		5: 9	46 36	44 31	247.0	
100	20.	5.89		6:57	46 47	43 49	865.0	
110	20.	5.89		8:44	46 59	43 6	864.0	
120	20.	5.89		10:30	47 11	42 22	865.0	
140	20.	5.89		12:36	47 22	41 29	613.0	very noisy due to
150	20.	5.89		14:15	47 30	40 50	848.0	computer problems
160	20.	5.89		16: 4	47 39	40 2	842.0	- " - - " -
180	20.	5.89		19:59	48 4	38 25	285.0	
200	20.	5.89		21:26	48 9	37 50	652.0	
210	20.	5.89		23:20	48 16	37 7	851.0	
220	21.	5.89		1:17	48 26	36 23	850.0	
230	21.	5.89		3:11	48 32	35 38	842.0	
240	21.	5.89		5: 6	48 42	34 53	859.0	
250	21.	5.89		6:58	48 49	34 10	842.0	
260	21.	5.89		9:24	48 57	33 10	846.0	
270	21.	5.89		11:13	49 2	32 24	867.0	
280	21.	5.89		13: 9	49 8	31 32	809.0	
290	21.	5.89		15: 2	49 14	30 46	856.0	
300	21.	5.89		16:53	49 19	29 59	849.0	
310	21.	5.89		18:48	49 27	29 16	858.0	
320	21.	5.89		20:43	49 32	28 26	865.0	
330	21.	5.89		22:34	49 37	27 42	870.0	
340	22.	5.89		0:31	49 38	26 59	868.0	noisy
350	22.	5.89		2:31	49 41	26 9	502.0	
360	22.	5.89		4:22	49 47	25 22	816.0	
370	22.	5.89		6:15	49 51	24 35	812.0	
380	22.	5.89		8: 8	49 54	23 49	816.0	
390	22.	5.89		10: 2	49 56	23 2	871.0	
400	22.	5.89		11:58	49 58	22 14	782.0	
410	22.	5.89		13:38	49 59	21 30	814.0	
420	22.	5.89		14:55	50 1	20 41	685.0	noisy
440	22.	5.89		17:51	50 2	19 47	831.0	- " -
460	22.	5.89		20: 7	50 4	18 52	676.0	
470	22.	5.89		21:39	50 5	18 15	782.0	noisy
480	22.	5.89		23:37	50 5	17 26	864.0	
490	23.	5.89		1:32	50 6	16 39	813.0	
500	23.	5.89		3:24	50 5	15 51	859.0	
510	23.	5.89		5:19	50 4	15 3	838.0	
520	23.	5.89		7:10	50 1	14 17	849.0	
530	23.	5.89		9: 5	50 0	13 30	885.0	
540	23.	5.89		11:10	50 2	12 41	865.0	
550	23.	5.89		13: 9	49 58	11 54	822.0	
560	23.	5.89		15: 3	49 57	11 7	472.0	noisy
570	23.	5.89		17: 4	49 53	10 18	127.0	



" KOELN ATLANTIC " 138 EASTBOUND

"KOELEN ATLANTIC" Voyage No. 139

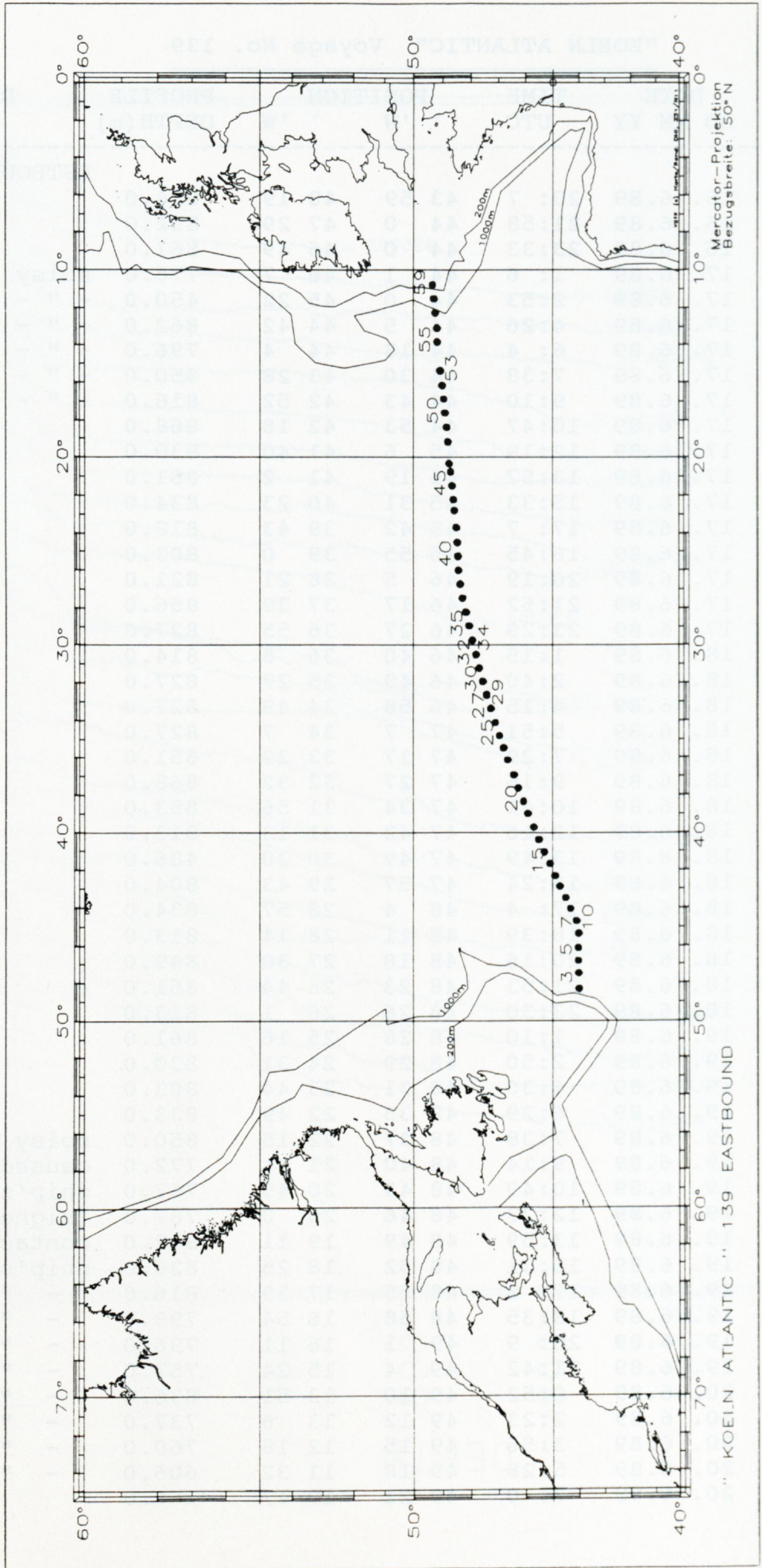




"KOELN ATLANTIC" Voyage No. 139

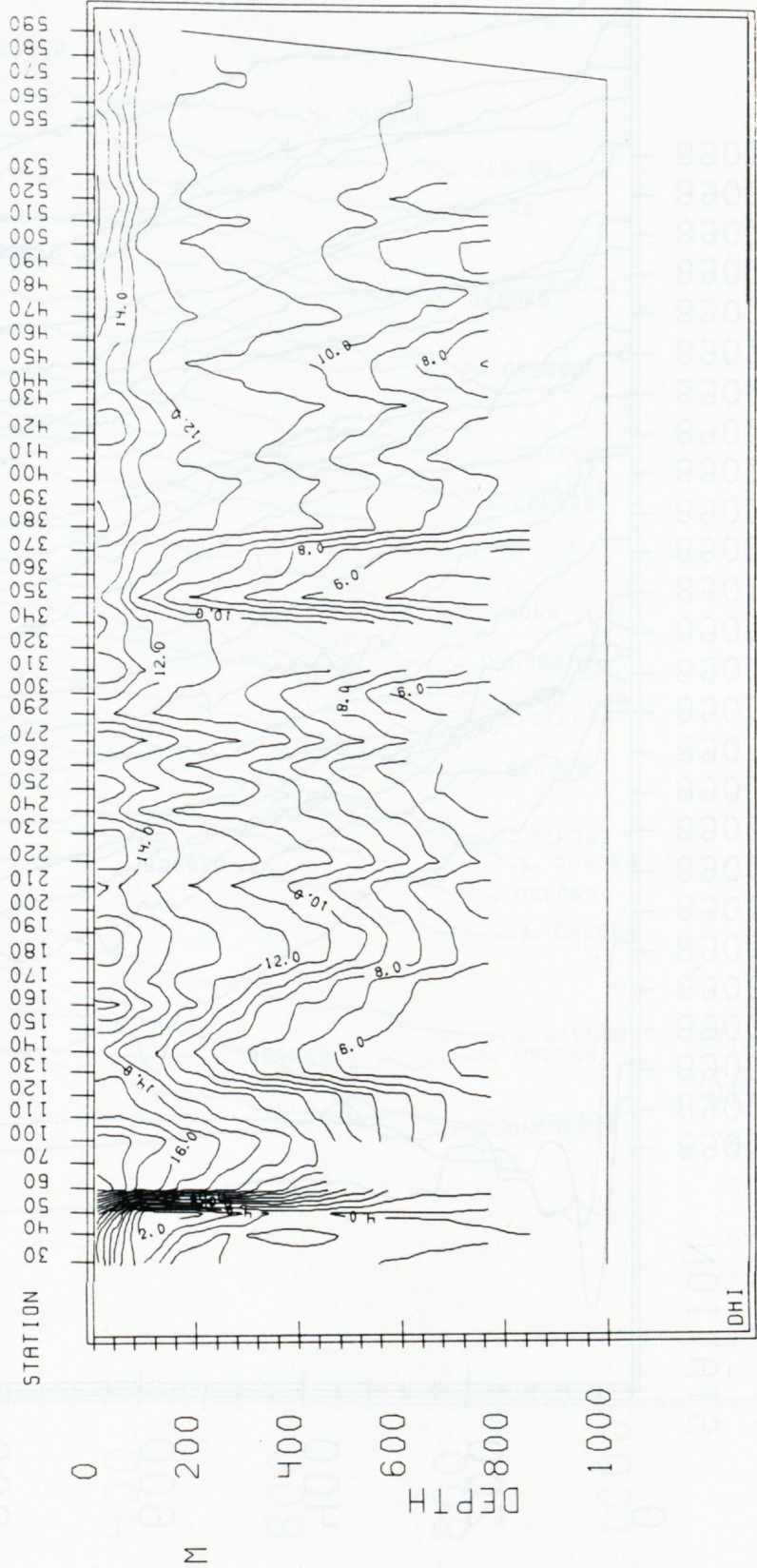
XBT NO.	DATE			TIME	POSITION		PROFILE	REMARKS
	DD	MM	YY	UTC	'N	'W	DEPTH(m)	

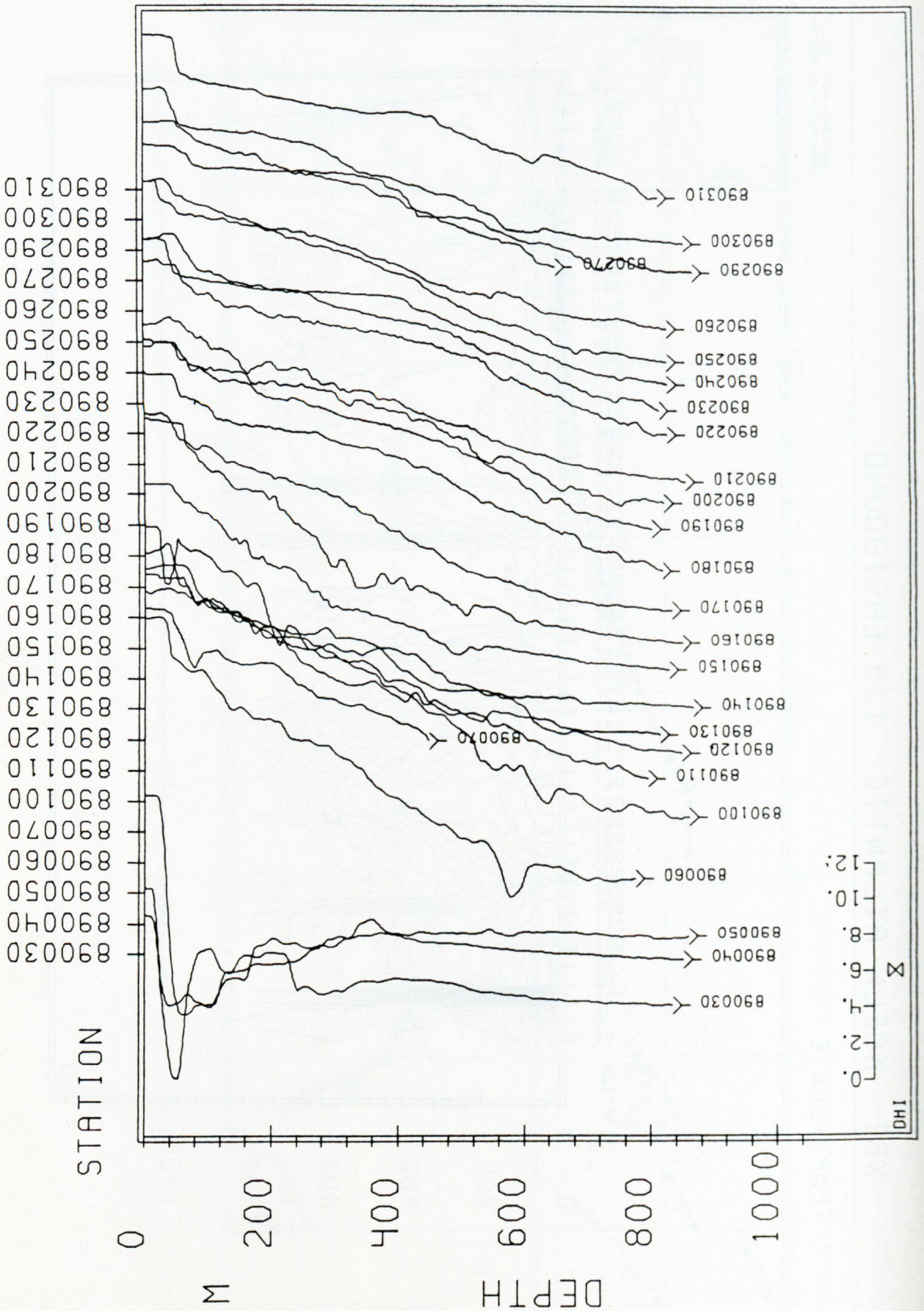
	ESTBOUND							
30	16.	6.89	20: 7	43 59	48 19	834.0		
40	16.	6.89	21:58	44 0	47 29	852.0		
50	16.	6.89	23:33	44 0	46 49	861.0		
60	17.	6.89	1: 6	44 1	46 7	776.0	noisy	
70	17.	6.89	2:53	44 0	45 22	450.0	- " -	
100	17.	6.89	4:26	44 5	44 42	862.0	- " -	
110	17.	6.89	6: 4	44 18	44 4	796.0	- " -	
120	17.	6.89	7:38	44 30	43 28	850.0	- " -	
130	17.	6.89	9:10	44 43	42 52	816.0	- " -	
140	17.	6.89	10:47	44 53	42 18	868.0		
150	17.	6.89	12:19	45 6	41 40	830.0		
160	17.	6.89	13:57	45 19	41 2	851.0		
170	17.	6.89	15:33	45 31	40 23	834.0		
180	17.	6.89	17: 7	45 42	39 43	819.0		
190	17.	6.89	18:45	45 55	39 0	803.0		
200	17.	6.89	20:19	46 5	38 21	821.0		
210	17.	6.89	21:52	46 17	37 39	856.0		
220	17.	6.89	23:29	46 27	36 55	827.0		
230	18.	6.89	1:15	46 40	36 8	814.0		
240	18.	6.89	2:40	46 49	35 29	827.0		
250	18.	6.89	4:15	46 58	34 49	827.0		
260	18.	6.89	5:51	47 7	34 7	827.0		
270	18.	6.89	7:29	47 17	33 22	651.0		
290	18.	6.89	9:16	47 27	32 32	868.0		
300	18.	6.89	10:41	47 34	31 56	853.0		
310	18.	6.89	12:16	47 42	31 13	813.0		
320	18.	6.89	13:49	47 49	30 30	486.0		
340	18.	6.89	15:24	47 57	29 43	804.0		
350	18.	6.89	17: 4	48 4	28 57	834.0		
360	18.	6.89	18:39	48 11	28 14	813.0		
370	18.	6.89	20:16	48 18	27 30	849.0		
380	18.	6.89	21:53	48 23	26 44	861.0		
390	18.	6.89	23:30	48 26	26 1	813.0		
400	19.	6.89	1:10	48 28	25 16	861.0		
410	19.	6.89	2:50	48 29	24 31	830.0		
420	19.	6.89	4:30	48 31	23 44	803.0		
430	19.	6.89	6:29	48 35	22 49	833.0		
440	19.	6.89	7:38	48 37	22 15	850.0	noisy presumably	
450	19.	6.89	9:14	48 40	21 31	772.0	caused by heavy	
460	19.	6.89	10:49	48 43	20 45	767.0	ship's roll	
470	19.	6.89	12:23	48 46	20 0	787.0	(signal wire	
480	19.	6.89	13:59	48 49	19 11	812.0	contacts with	
490	19.	6.89	15:31	48 52	18 25	826.0	ship's hull).	
500	19.	6.89	17: 8	48 55	17 39	816.0	- " -	
510	19.	6.89	18:35	48 58	16 54	799.0	- " -	
520	19.	6.89	20: 9	49 1	16 11	796.0	- " -	
530	19.	6.89	21:42	49 4	15 24	757.0	- " -	
550	20.	6.89	0:52	49 10	13 51	836.0	- " -	
560	20.	6.89	2:23	49 12	13 6	737.0	- " -	
570	20.	6.89	3:56	49 15	12 18	760.0	- " -	
580	20.	6.89	5:28	49 18	11 32	606.0	- " -	
590	20.	6.89	7: 0	49 21	10 47	166.0		

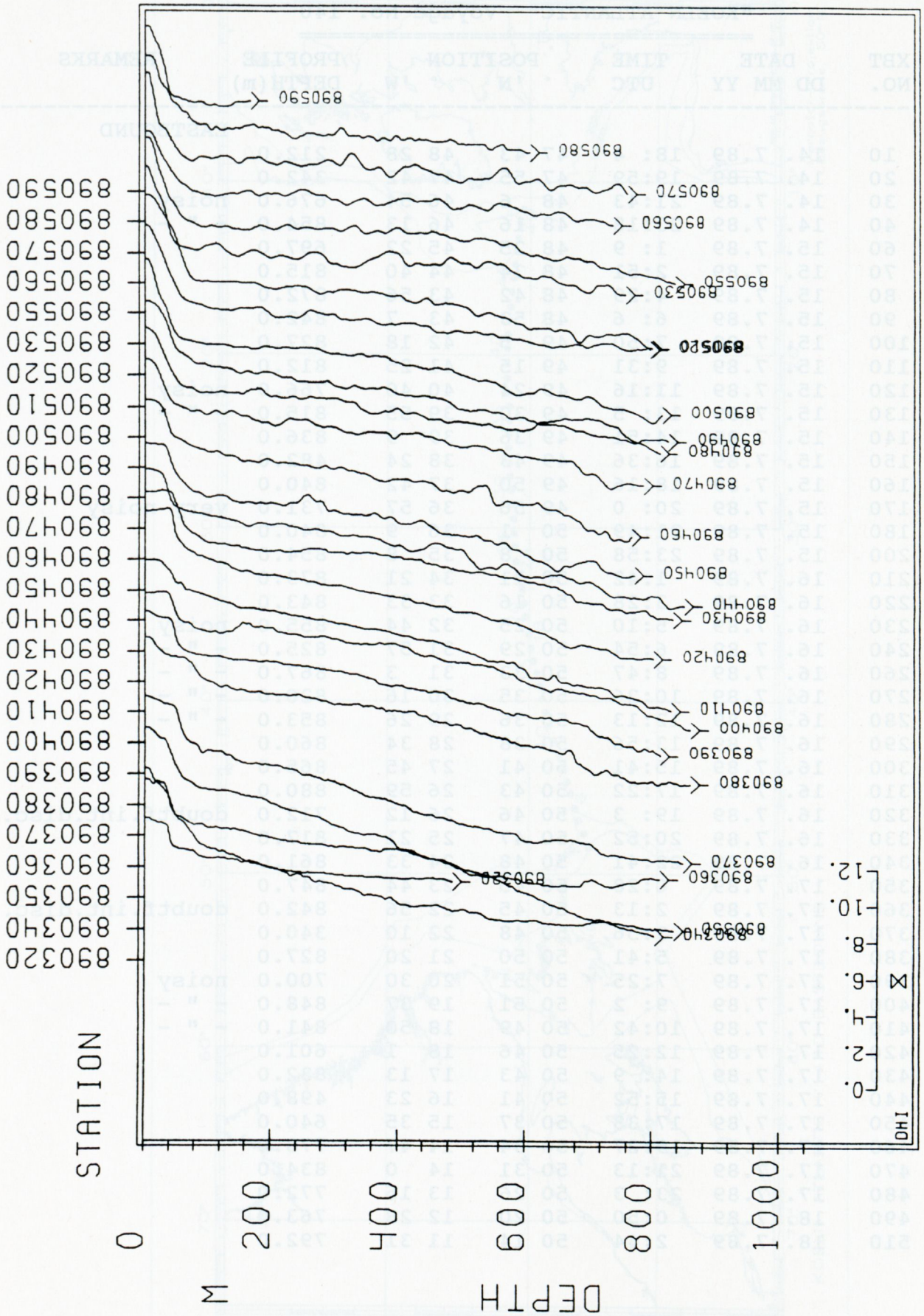


XBT "KOELN ATLANTIC" 139 EASTBOUND

TEMP /DEG C

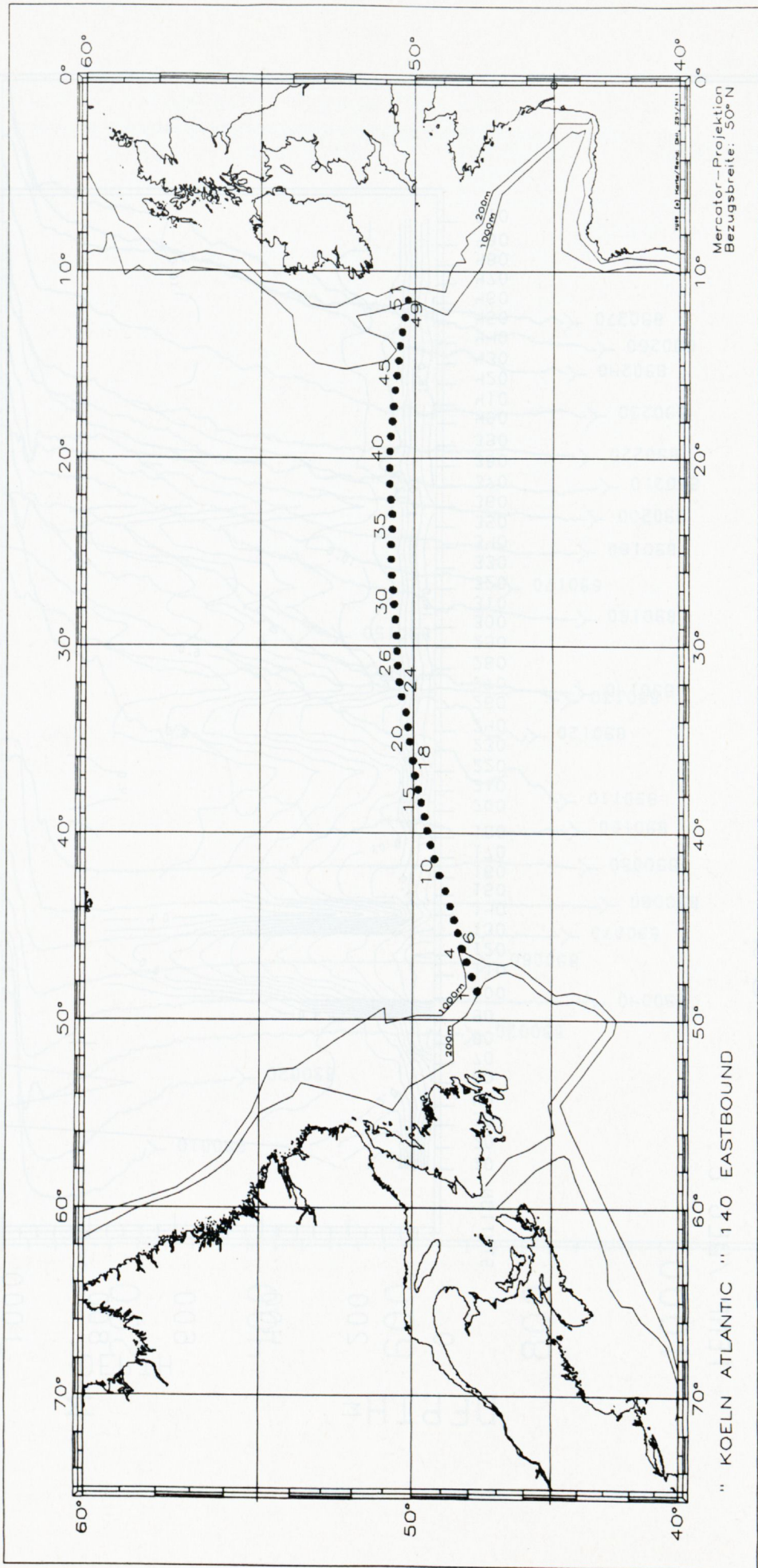






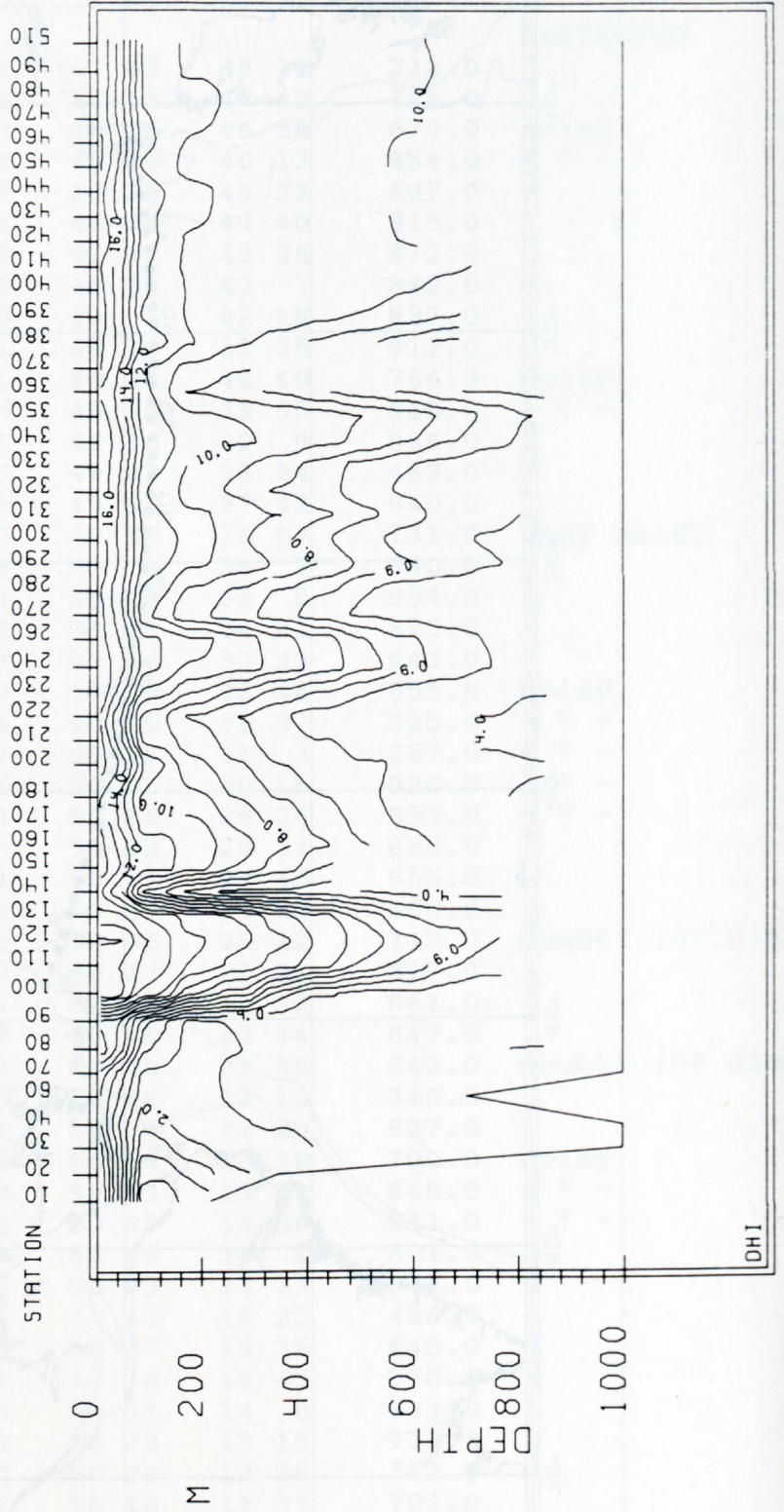
"KOELN ATLANTIC" Voyage No. 140

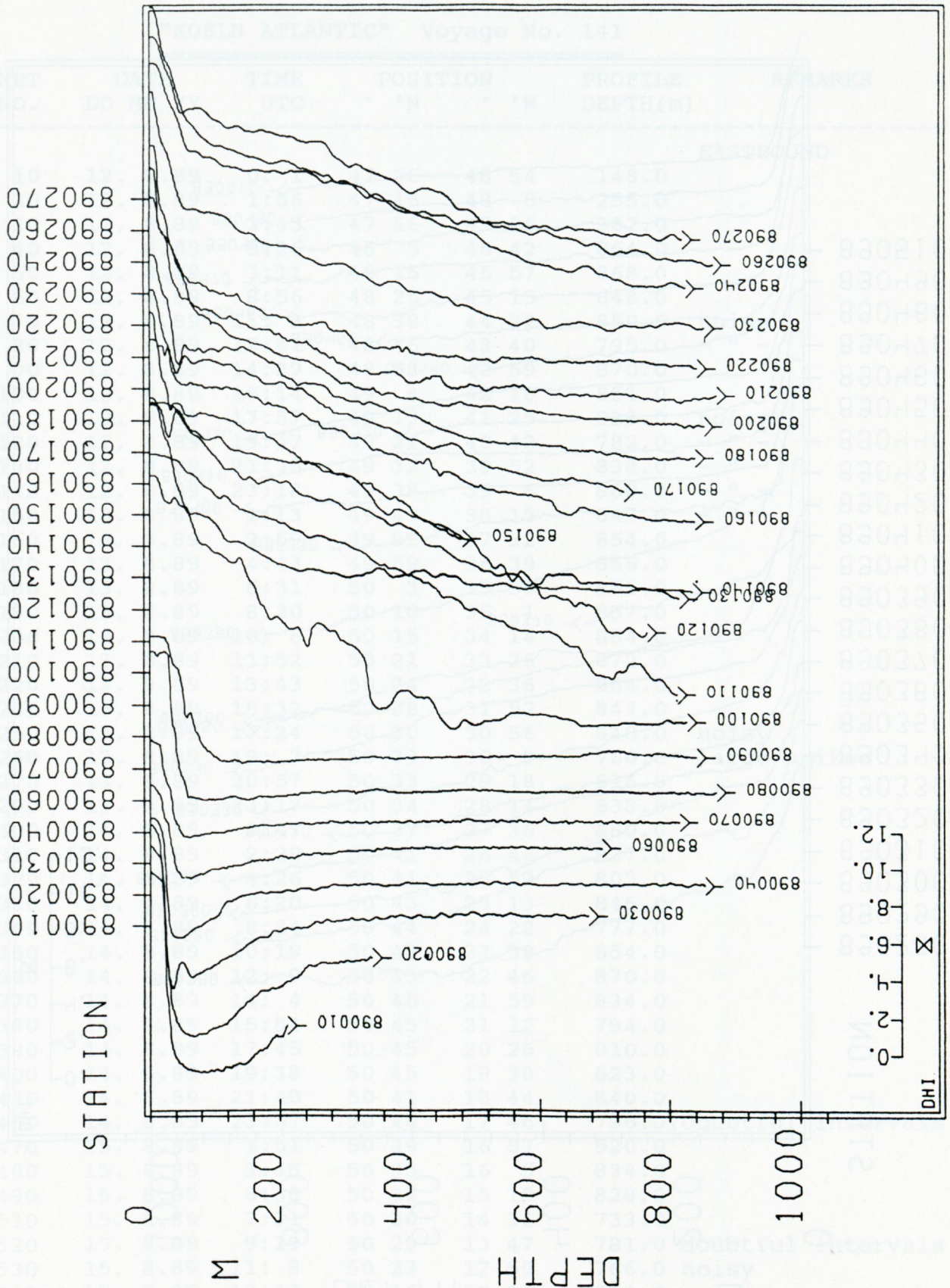
XBT NO.	DATE			TIME UTC	POSITION			PROFILE DEPTH(m)	REMARKS
	DD	MM	YY		° 'N	° 'W			
	EASTBOUND								
10	14.	7.89		18: 4	47 43	48 28		212.0	
20	14.	7.89		19:59	47 55	47 42		342.0	
30	14.	7.89		21:43	48 6	46 54		676.0	noisy
40	14.	7.89		23:18	48 16	46 13		854.0	- " -
60	15.	7.89		1: 9	48 25	45 22		697.0	
70	15.	7.89		2:51	48 34	44 40		815.0	
80	15.	7.89		4:29	48 42	43 56		872.0	
90	15.	7.89		6: 6	48 53	43 7		842.0	
100	15.	7.89		7:50	49 5	42 18		827.0	
110	15.	7.89		9:31	49 15	41 25		812.0	
120	15.	7.89		11:16	49 24	40 40		766.0	noisy
130	15.	7.89		13: 5	49 30	39 55		815.0	- " -
140	15.	7.89		14:51	49 36	39 9		836.0	
150	15.	7.89		16:36	49 43	38 24		482.0	
160	15.	7.89		18:16	49 50	37 42		840.0	
170	15.	7.89		20: 0	49 56	36 57		731.0	very noisy
180	15.	7.89		21:49	50 1	36 9		840.0	
200	15.	7.89		23:58	50 8	35 8		854.0	
210	16.	7.89		1:42	50 11	34 21		873.0	
220	16.	7.89		3:28	50 16	33 33		843.0	
230	16.	7.89		5:10	50 25	32 44		855.0	noisy
240	16.	7.89		6:54	50 29	31 57		825.0	- " -
260	16.	7.89		8:47	50 33	31 3		867.0	- " -
270	16.	7.89		10:26	50 35	30 16		820.0	- " -
280	16.	7.89		12:13	50 36	29 26		853.0	- " -
290	16.	7.89		13:56	50 38	28 34		860.0	
300	16.	7.89		15:41	50 41	27 45		865.0	
310	16.	7.89		17:22	50 43	26 59		880.0	
320	16.	7.89		19: 3	50 46	26 12		712.0	doubtf.int.disc.
330	16.	7.89		20:52	50 47	25 21		817.0	
340	16.	7.89		22:41	50 48	24 33		861.0	
350	17.	7.89		0:28	50 45	23 44		847.0	
360	17.	7.89		2:13	50 45	22 56		842.0	doubtf.int.disc.
370	17.	7.89		3:56	50 48	22 10		340.0	
380	17.	7.89		5:41	50 50	21 20		827.0	
390	17.	7.89		7:25	50 51	20 30		700.0	noisy
400	17.	7.89		9: 2	50 51	19 37		848.0	- " -
410	17.	7.89		10:42	50 49	18 50		841.0	- " -
420	17.	7.89		12:25	50 46	18 1		601.0	
430	17.	7.89		14: 9	50 43	17 13		832.0	
440	17.	7.89		15:52	50 41	16 23		498.0	
450	17.	7.89		17:38	50 37	15 35		640.0	
460	17.	7.89		19:27	50 34	14 47		778.0	
470	17.	7.89		21:13	50 31	14 0		834.0	
480	17.	7.89		23: 3	50 26	13 15		772.0	
490	18.	7.89		0:50	50 20	12 28		763.0	
510	18.	7.89		2:44	50 14	11 31		792.0	

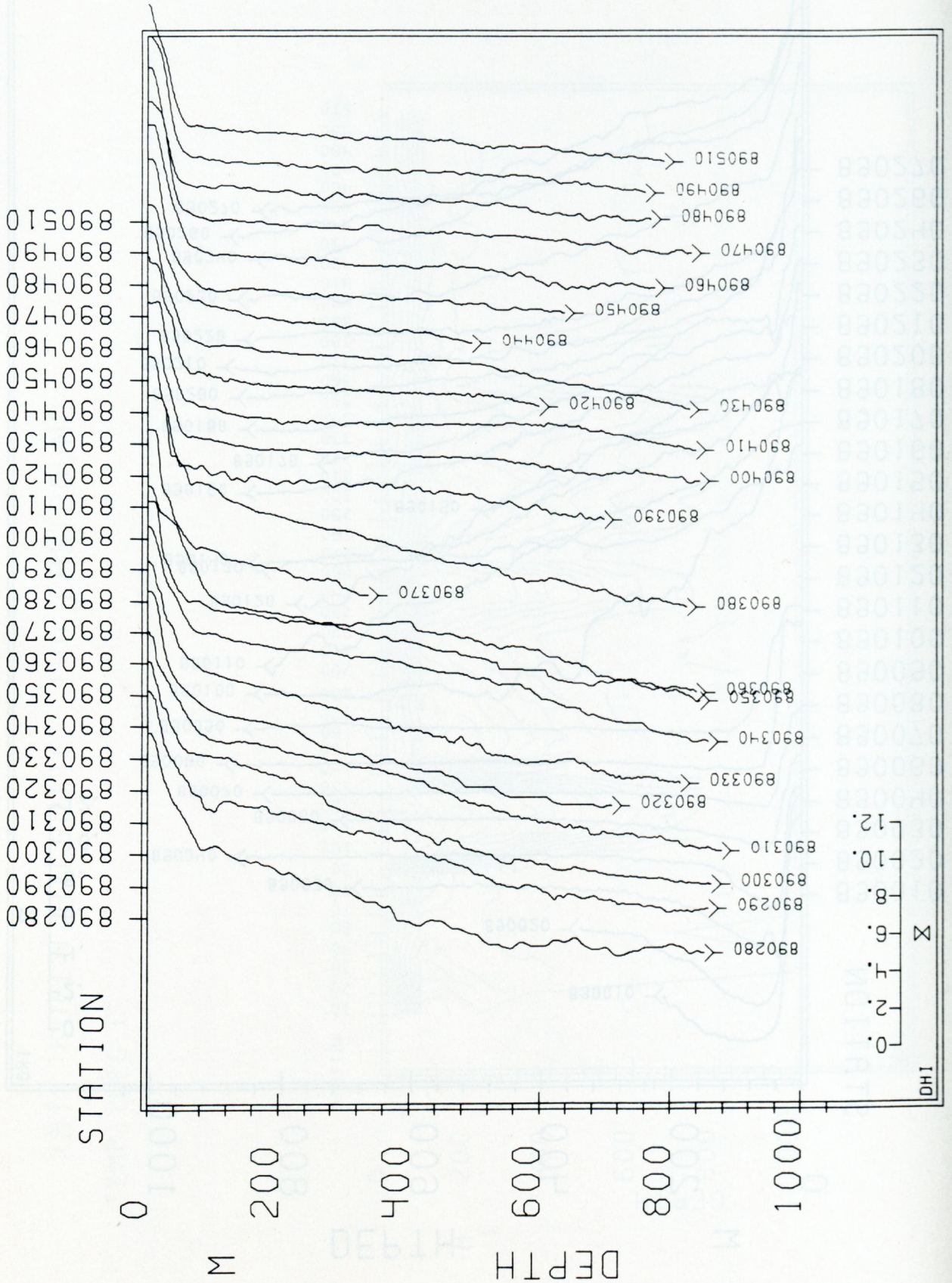


XBT "KOELN ATLANTIC" 140 EASTBOUND

TEMP / DEG C

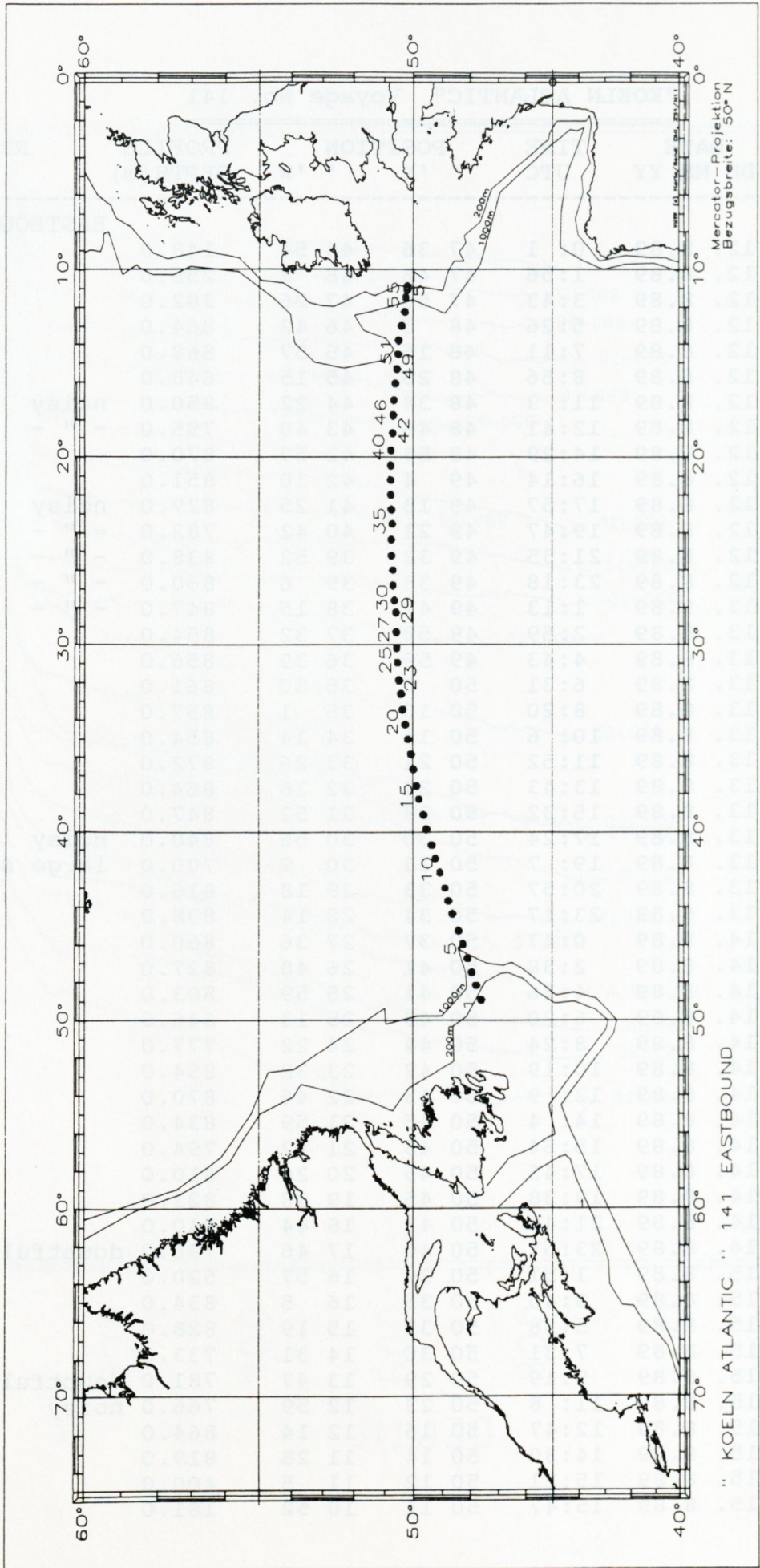






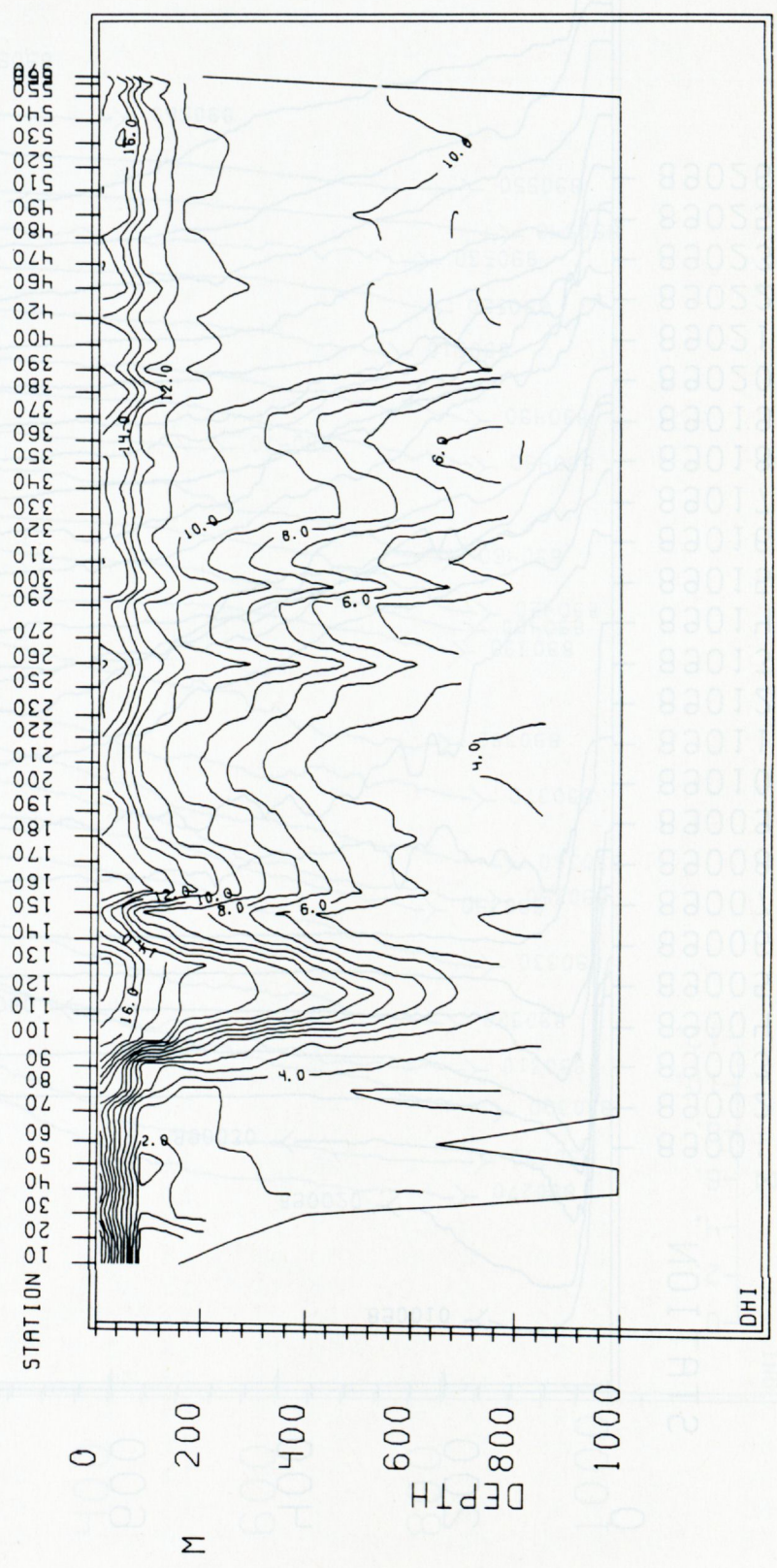
"KOELN ATLANTIC" Voyage No. 141

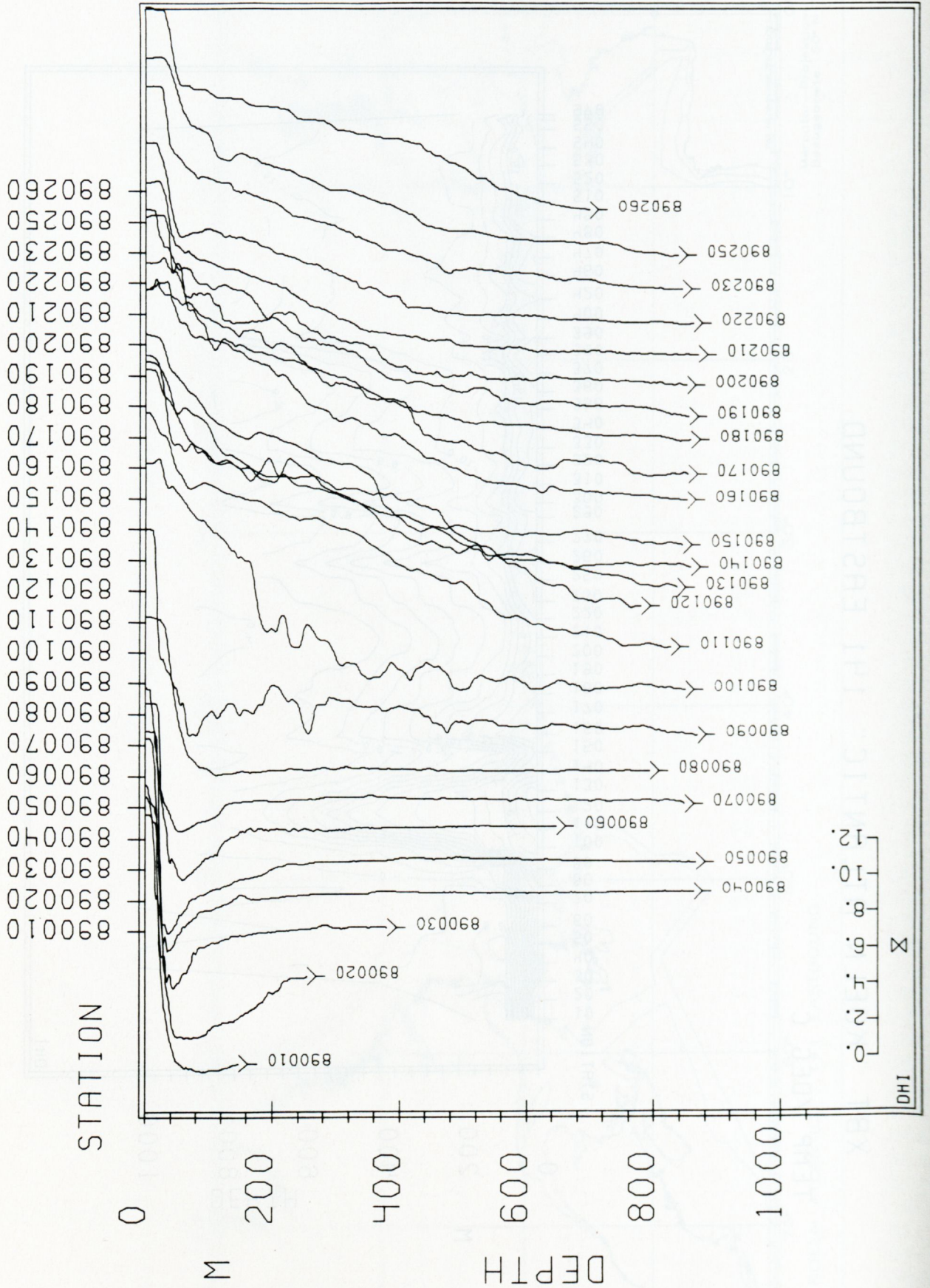
XBT NO.	DATE			TIME	POSITION			PROFILE	REMARKS
	DD	MM	YY	UTC	'N	'W	DEPTH(m)		
EASTBOUND									
10	12.	8.	89	0: 1	47 36	48 54	148.0		
20	12.	8.	89	1:56	47 46	48 8	255.0		
30	12.	8.	89	3:43	47 56	47 26	382.0		
40	12.	8.	89	5:26	48 5	46 42	864.0		
50	12.	8.	89	7:11	48 15	45 57	868.0		
60	12.	8.	89	8:56	48 25	45 15	648.0		
70	12.	8.	89	11: 3	48 38	44 22	850.0	noisy	
80	12.	8.	89	12:41	48 46	43 40	795.0	- " -	
90	12.	8.	89	14:29	48 53	42 59	870.0		
100	12.	8.	89	16:14	49 4	42 10	851.0		
110	12.	8.	89	17:57	49 13	41 25	829.0	noisy	
120	12.	8.	89	19:47	49 21	40 42	782.0	- " -	
130	12.	8.	89	21:35	49 32	39 52	838.0	- " -	
140	12.	8.	89	23:18	49 38	39 6	860.0	- " -	
150	13.	8.	89	1:13	49 47	38 15	847.0	- " -	
160	13.	8.	89	2:59	49 52	37 32	854.0		
170	13.	8.	89	4:43	49 59	36 39	856.0		
180	13.	8.	89	6:31	50 3	35 50	861.0		
190	13.	8.	89	8:20	50 10	35 1	857.0		
200	13.	8.	89	10: 6	50 15	34 14	854.0		
210	13.	8.	89	11:52	50 21	33 26	872.0		
220	13.	8.	89	13:43	50 24	32 36	864.0		
230	13.	8.	89	15:32	50 28	31 52	847.0		
250	13.	8.	89	17:24	50 30	30 56	840.0	noisy	
260	13.	8.	89	19: 7	50 33	30 9	700.0	large spikes	
270	13.	8.	89	20:57	50 33	29 18	816.0		
290	13.	8.	89	23:17	50 34	28 14	838.0		
300	14.	8.	89	0:47	50 37	27 36	860.0		
310	14.	8.	89	2:38	50 41	26 48	827.0		
320	14.	8.	89	4:26	50 41	25 59	803.0		
330	14.	8.	89	6:20	50 43	25 13	846.0		
340	14.	8.	89	8:24	50 44	24 22	777.0		
350	14.	8.	89	10:19	50 42	23 32	854.0		
360	14.	8.	89	12: 9	50 43	22 46	870.0		
370	14.	8.	89	14: 4	50 45	21 59	834.0		
380	14.	8.	89	15:54	50 45	21 12	794.0		
390	14.	8.	89	17:45	50 45	20 26	810.0		
400	14.	8.	89	19:38	50 45	19 38	823.0		
420	14.	8.	89	21:40	50 41	18 44	840.0		
460	14.	8.	89	23:57	50 40	17 46	796.0	doubtful intervals	
470	15.	8.	89	1:51	50 39	16 57	520.0		
480	15.	8.	89	3:45	50 35	16 5	834.0		
490	15.	8.	89	5:38	50 32	15 19	828.0		
510	15.	8.	89	7:31	50 30	14 31	733.0		
520	15.	8.	89	9:19	50 29	13 47	781.0	doubtful intervals	
530	15.	8.	89	11: 8	50 23	12 59	766.0	noisy	
540	15.	8.	89	12:47	50 16	12 14	864.0		
550	15.	8.	89	14:30	50 14	11 28	819.0		
560	15.	8.	89	15:21	50 12	11 5	400.0		
570	15.	8.	89	15:47	50 11	10 52	181.0		

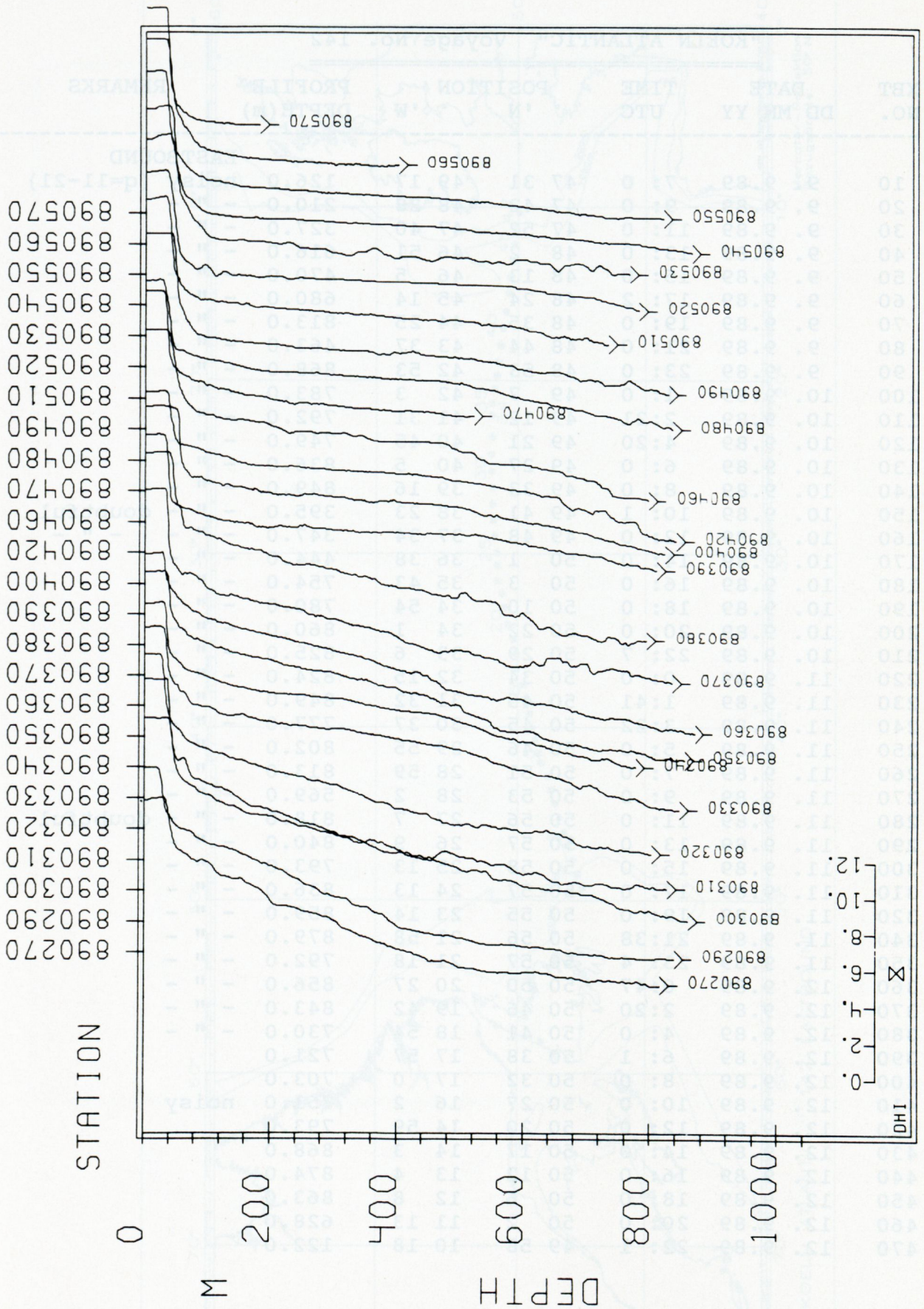


XBT "KOELEN ATLANTIC" 141 EASTBOUND

TEMP /DEG C

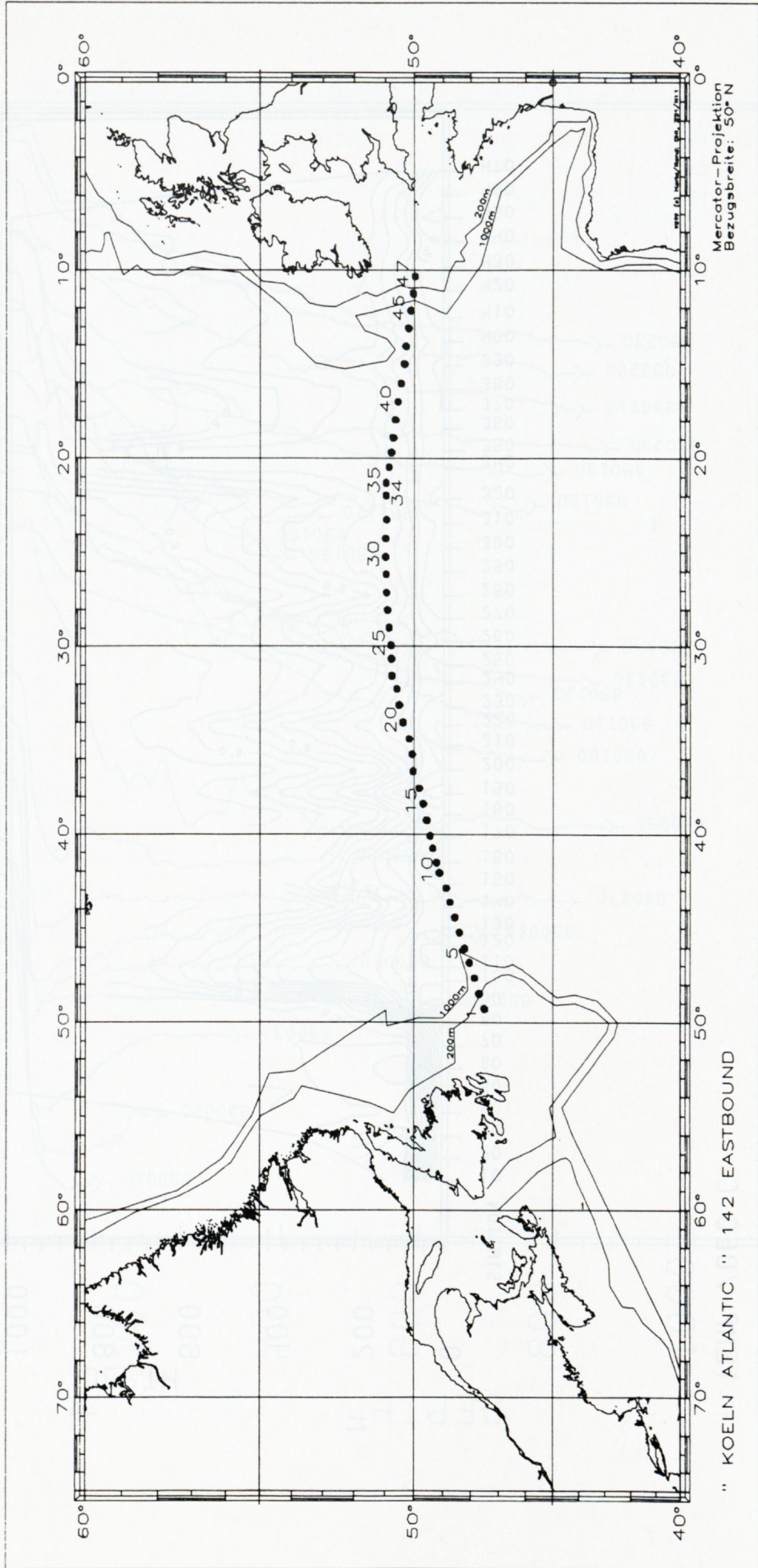


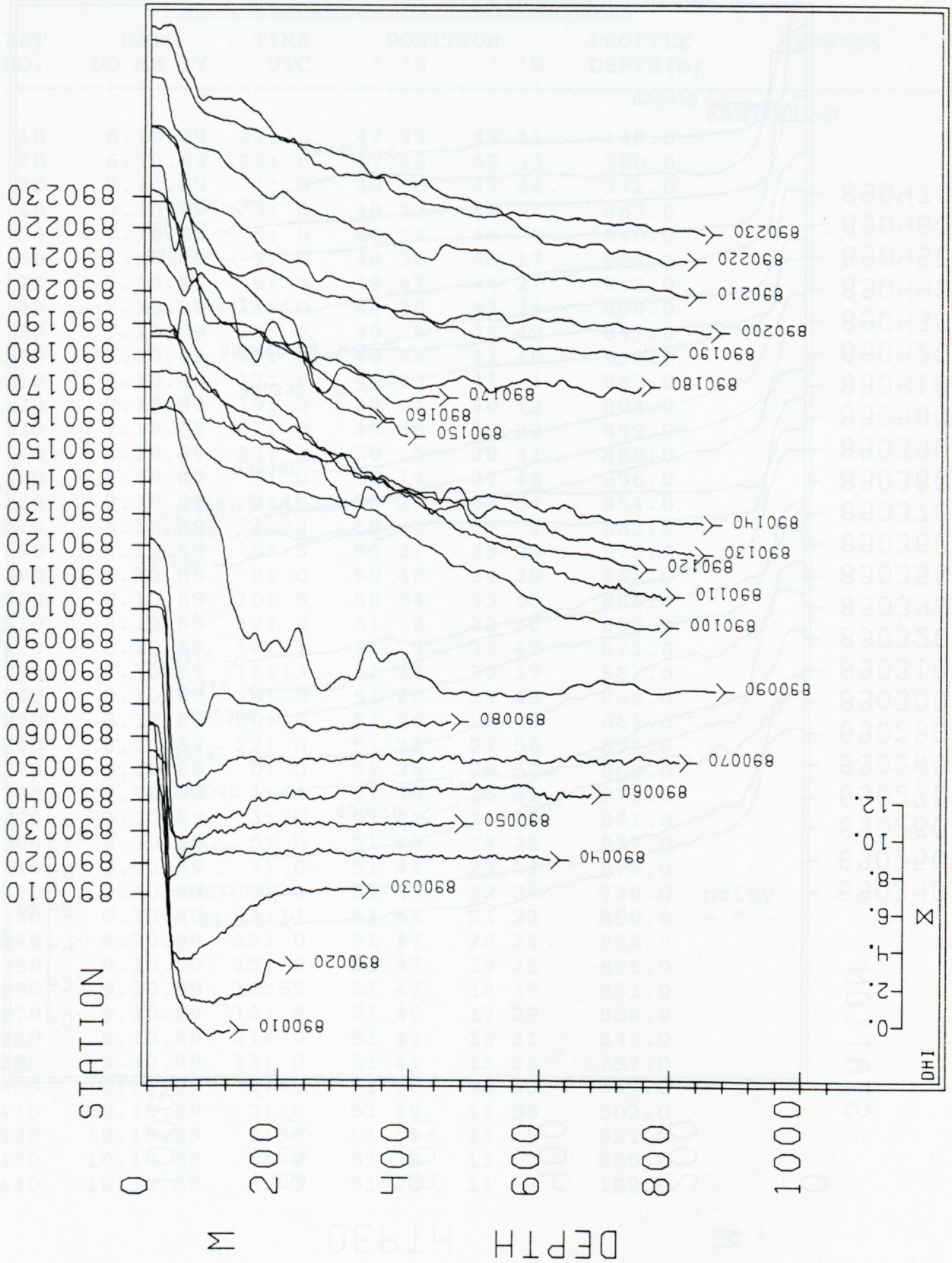


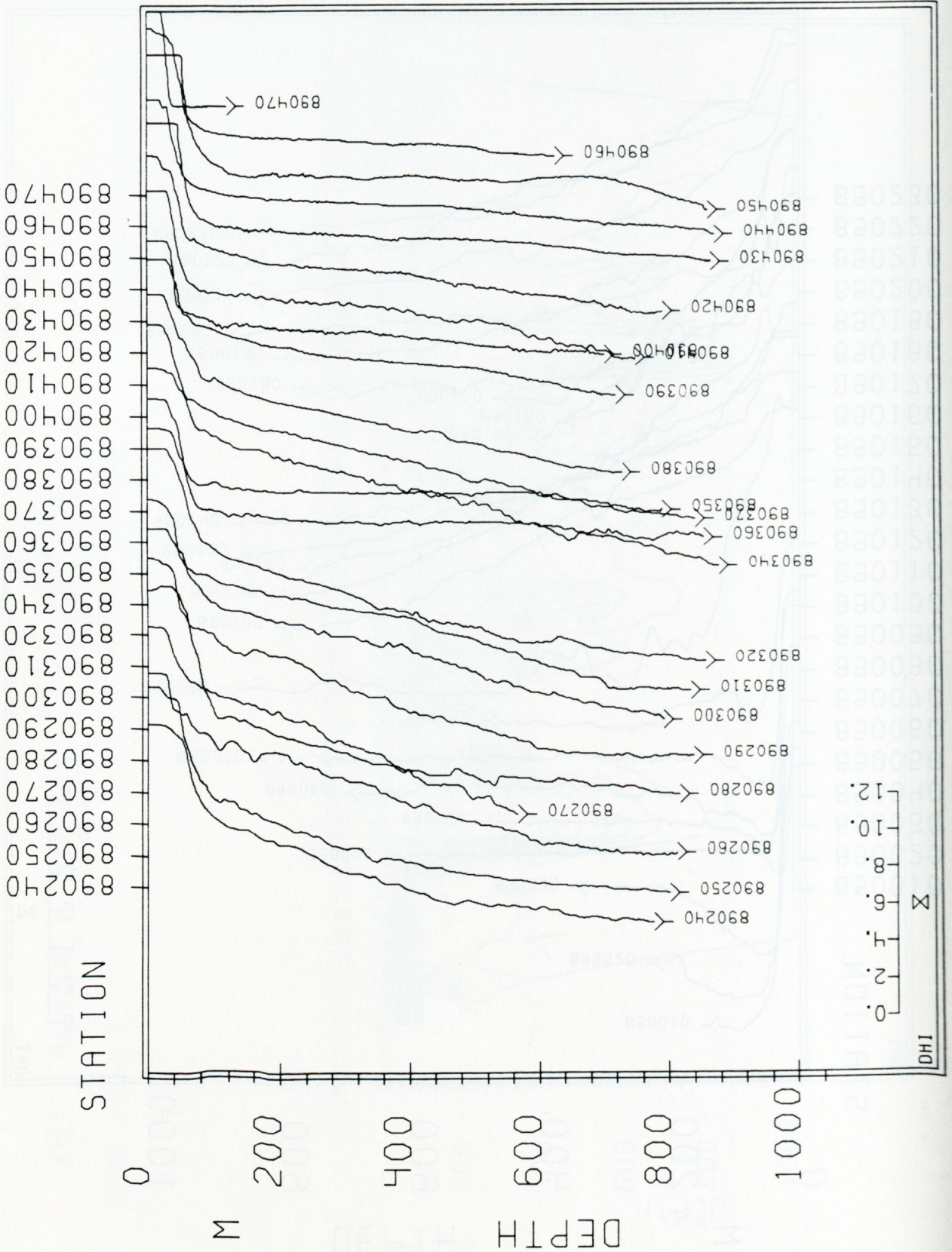


"KOELN ATLANTIC" Voyage No. 142

XBT NO.	DATE			TIME	POSITION		PROFILE	REMARKS
	DD	MM	YY	UTC	'N	'W	DEPTH (m)	
								EASTBOUND
10	9.	9.	89	7: 0	47 31	49 17	126.0	noisy (q=11-21)
20	9.	9.	89	9: 0	47 42	48 28	210.0	- " -
30	9.	9.	89	11: 0	47 52	47 40	327.0	- " -
40	9.	9.	89	13: 0	48 2	46 51	616.0	- " -
50	9.	9.	89	15: 0	48 13	46 5	470.0	- " -
60	9.	9.	89	17: 2	48 24	45 14	680.0	- " -
70	9.	9.	89	19: 0	48 35	44 25	813.0	- " -
80	9.	9.	89	21: 0	48 44	43 37	463.0	- " -
90	9.	9.	89	23: 0	48 53	42 53	868.0	- " -
100	10.	9.	89	1: 0	49 7	42 3	783.0	- " -
110	10.	9.	89	2:21	49 12	41 31	792.0	- " -
120	10.	9.	89	4:20	49 21	40 45	749.0	- " -
130	10.	9.	89	6: 0	49 27	40 5	836.0	- " -
140	10.	9.	89	8: 0	49 33	39 16	849.0	- " -
150	10.	9.	89	10: 1	49 41	38 23	395.0	- " - doubtful
160	10.	9.	89	12: 0	49 48	37 34	347.0	- " -
170	10.	9.	89	14: 0	50 1	36 38	444.0	- " -
180	10.	9.	89	16: 0	50 3	35 43	754.0	- " -
190	10.	9.	89	18: 0	50 10	34 54	780.0	- " -
200	10.	9.	89	20: 0	50 22	34 1	860.0	- " -
210	10.	9.	89	22: 7	50 29	33 6	825.0	- " -
220	11.	9.	89	0: 0	50 34	32 15	824.0	- " -
230	11.	9.	89	1:41	50 45	31 32	849.0	- " -
240	11.	9.	89	3:22	50 45	30 37	777.0	- " -
250	11.	9.	89	5: 0	50 46	29 55	802.0	- " -
260	11.	9.	89	7: 0	50 51	28 59	813.0	- " -
270	11.	9.	89	9: 0	50 53	28 2	569.0	- " -
280	11.	9.	89	11: 0	50 56	27 7	818.0	- " - doubtful
290	11.	9.	89	13: 0	50 57	26 9	840.0	- " -
300	11.	9.	89	15: 0	50 58	25 13	793.0	- " -
310	11.	9.	89	17: 0	50 57	24 13	836.0	- " -
320	11.	9.	89	19: 0	50 55	23 14	859.0	- " -
340	11.	9.	89	21:38	50 56	21 58	879.0	- " -
350	11.	9.	89	23: 4	50 57	21 18	792.0	- " -
360	12.	9.	89	0:47	50 50	20 27	856.0	- " -
370	12.	9.	89	2:20	50 46	19 42	843.0	- " -
380	12.	9.	89	4: 0	50 41	18 54	730.0	- " -
390	12.	9.	89	6: 1	50 38	17 57	721.0	- " -
400	12.	9.	89	8: 0	50 32	17 0	703.0	- " -
410	12.	9.	89	10: 0	50 27	16 2	751.0	noisy
420	12.	9.	89	12: 0	50 20	14 59	793.0	- " -
430	12.	9.	89	14: 0	50 17	14 3	868.0	- " -
440	12.	9.	89	16: 0	50 12	13 4	874.0	- " -
450	12.	9.	89	18: 0	50 6	12 8	863.0	- " -
460	12.	9.	89	20: 0	50 2	11 13	628.0	- " -
470	12.	9.	89	22: 1	49 58	10 18	122.0	- " -

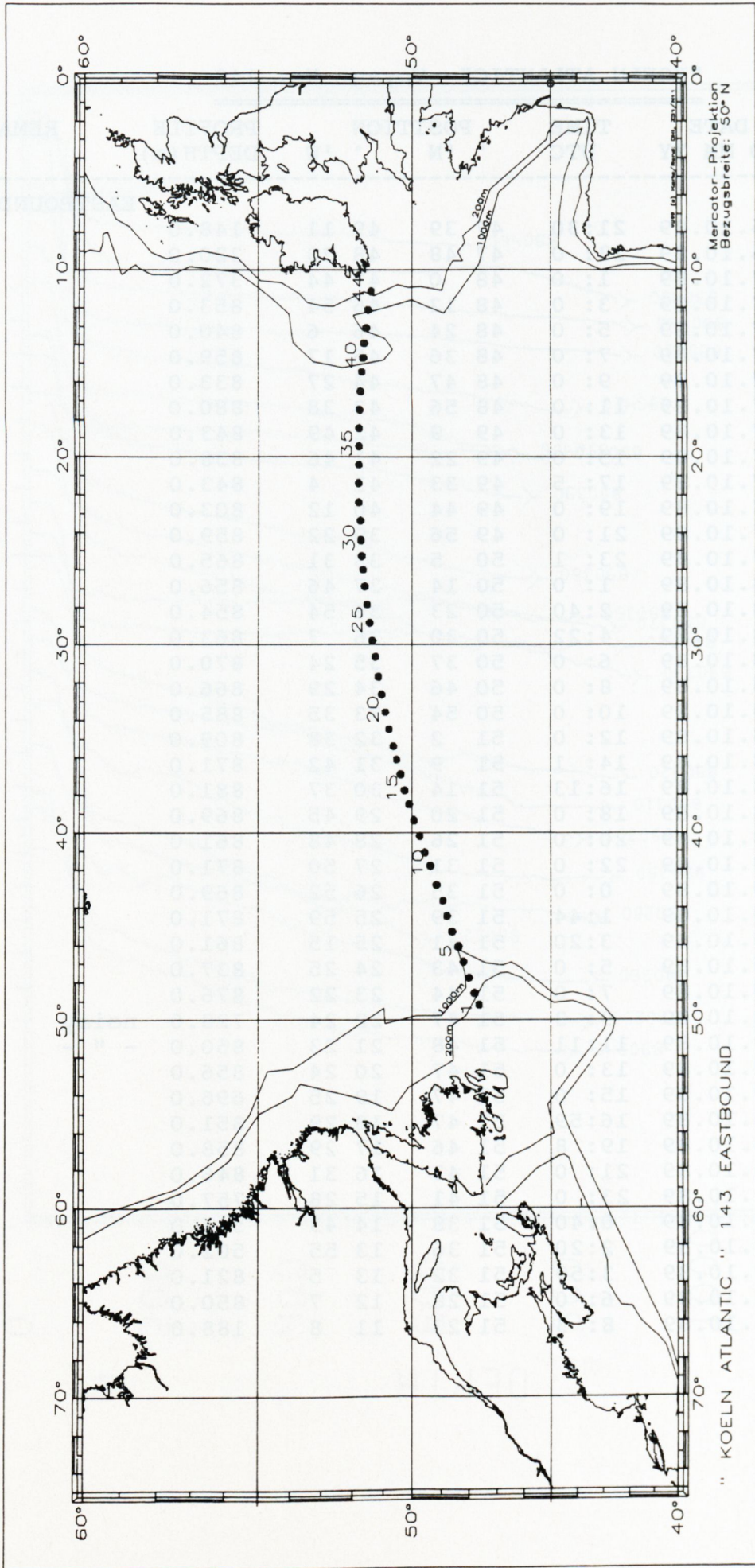






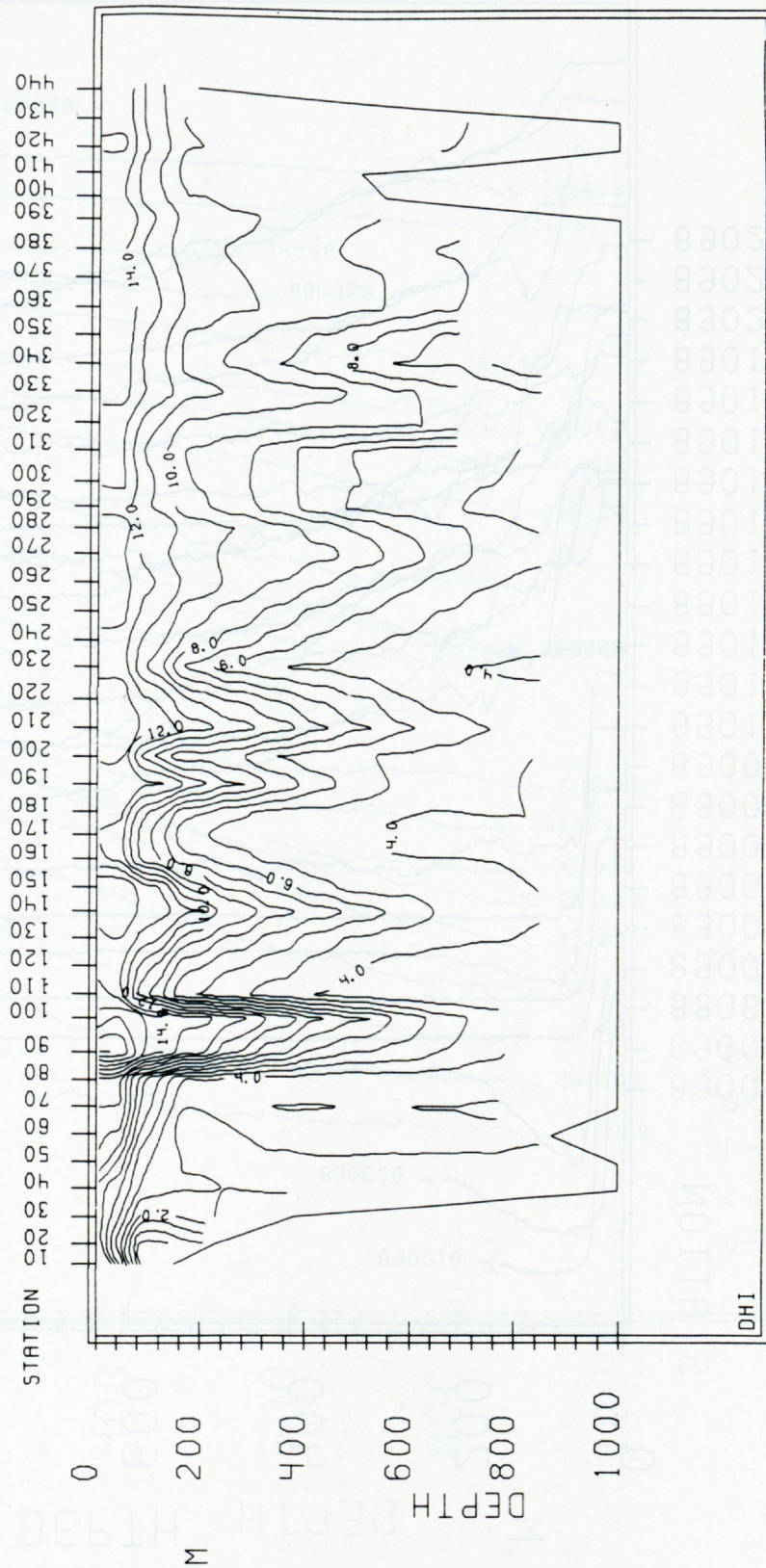
"KOELN ATLANTIC" Voyage No. 143

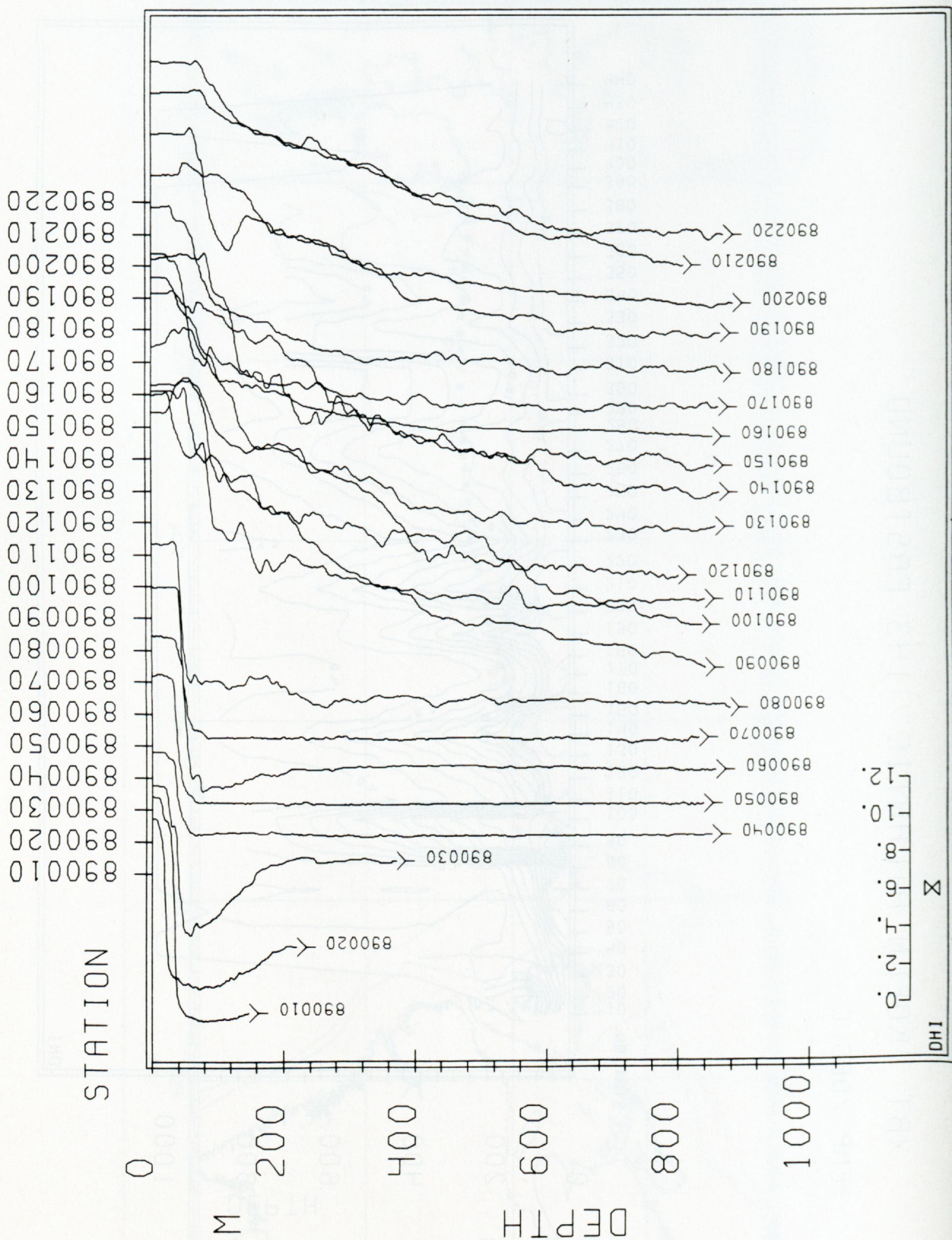
XBT NO.	DATE			TIME		POSITION		PROFILE DEPTH (m)	REMARKS
	DD	MM	YY	UTC	'N	'W			
	EASTBOUND								
10	6	10	89	21:30	47 39	49 11	148.0		
20	6	10	89	23: 0	47 48	48 33	220.0		
30	7	10	89	1: 0	48 0	47 44	372.0		
40	7	10	89	3: 0	48 12	46 54	853.0		
50	7	10	89	5: 0	48 24	46 6	840.0		
60	7	10	89	7: 0	48 36	45 17	859.0		
70	7	10	89	9: 0	48 47	44 27	833.0		
80	7	10	89	11: 0	48 56	43 38	880.0		
90	7	10	89	13: 0	49 9	42 49	843.0		
100	7	10	89	15: 0	49 22	41 46	838.0		
110	7	10	89	17: 5	49 33	41 4	843.0		
120	7	10	89	19: 0	49 44	40 12	803.0		
130	7	10	89	21: 0	49 56	39 22	859.0		
140	7	10	89	23: 1	50 5	38 31	865.0		
150	8	10	89	1: 0	50 14	37 46	856.0		
160	8	10	89	2:40	50 23	36 54	854.0		
170	8	10	89	4:22	50 30	36 7	863.0		
180	8	10	89	6: 0	50 37	35 24	870.0		
190	8	10	89	8: 0	50 46	34 29	866.0		
200	8	10	89	10: 0	50 54	33 35	885.0		
210	8	10	89	12: 0	51 2	32 38	809.0		
220	8	10	89	14: 1	51 9	31 42	871.0		
230	8	10	89	16:13	51 14	30 37	881.0		
240	8	10	89	18: 0	51 20	29 45	869.0		
250	8	10	89	20: 0	51 26	28 48	861.0		
260	8	10	89	22: 0	51 31	27 50	871.0		
270	9	10	89	0: 0	51 35	26 52	869.0		
280	9	10	89	1:44	51 39	25 59	871.0		
290	9	10	89	3:20	51 41	25 15	861.0		
300	9	10	89	5: 0	51 43	24 25	837.0		
310	9	10	89	7: 0	51 44	23 22	876.0		
320	9	10	89	9: 3	51 47	22 24	728.0	noisy	
330	9	10	89	11:11	51 48	21 23	850.0	- " -	
340	9	10	89	13: 0	51 47	20 24	856.0		
350	9	10	89	15: 0	51 47	19 25	696.0		
360	9	10	89	16:59	51 47	18 29	851.0		
370	9	10	89	19: 8	51 46	17 29	858.0		
380	9	10	89	21: 0	51 43	16 31	846.0		
390	9	10	89	23: 0	51 41	15 28	757.0		
400	10	10	89	0:40	51 38	14 43	547.0		
410	10	10	89	2:20	51 36	13 55	502.0		
420	10	10	89	3:59	51 32	13 5	821.0		
430	10	10	89	6: 0	51 28	12 7	850.0		
440	10	10	89	8: 3	51 23	11 8	188.0		

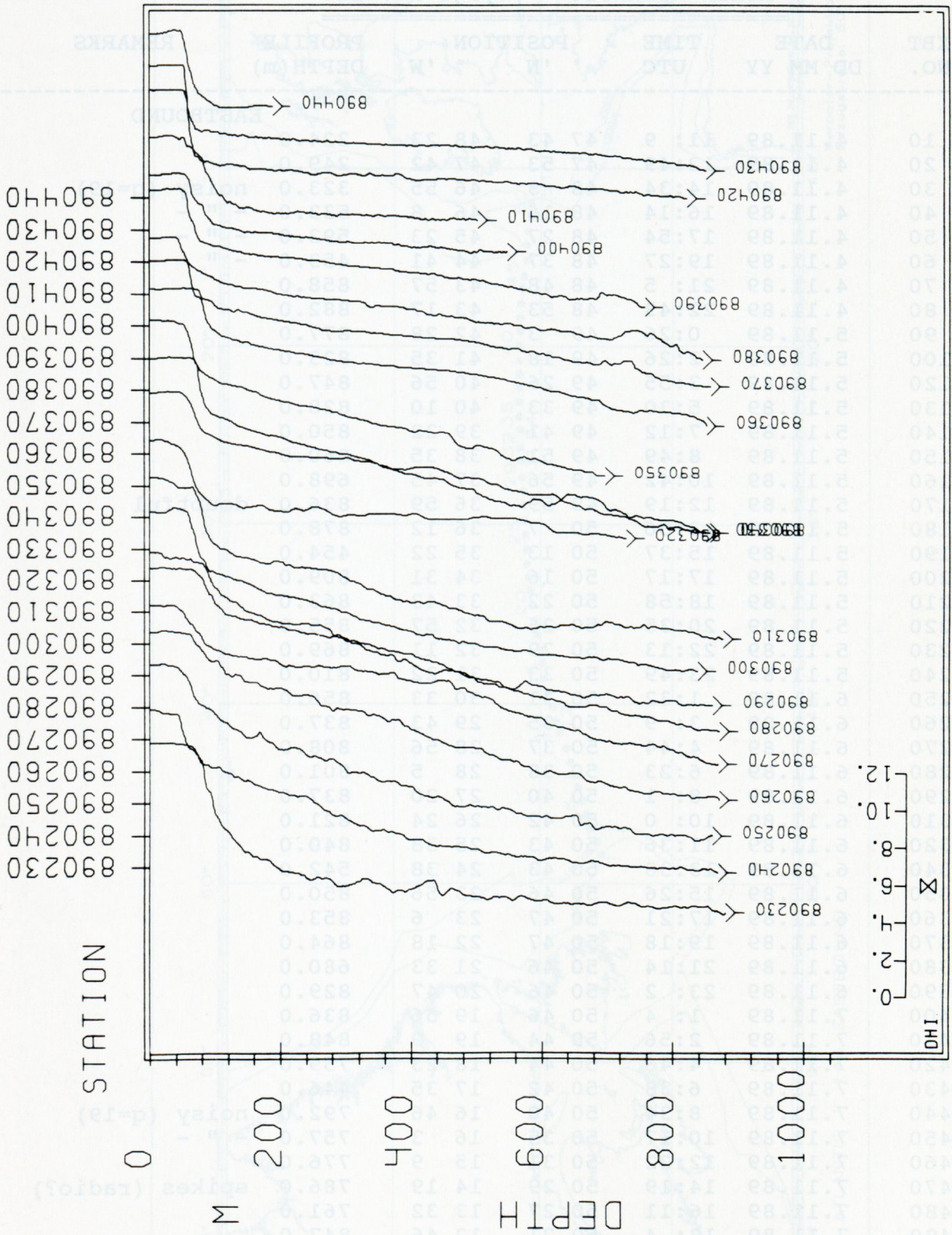


XBT "KOELN ATLANTIC" 143 EASTBOUND

TEMP /DEG C

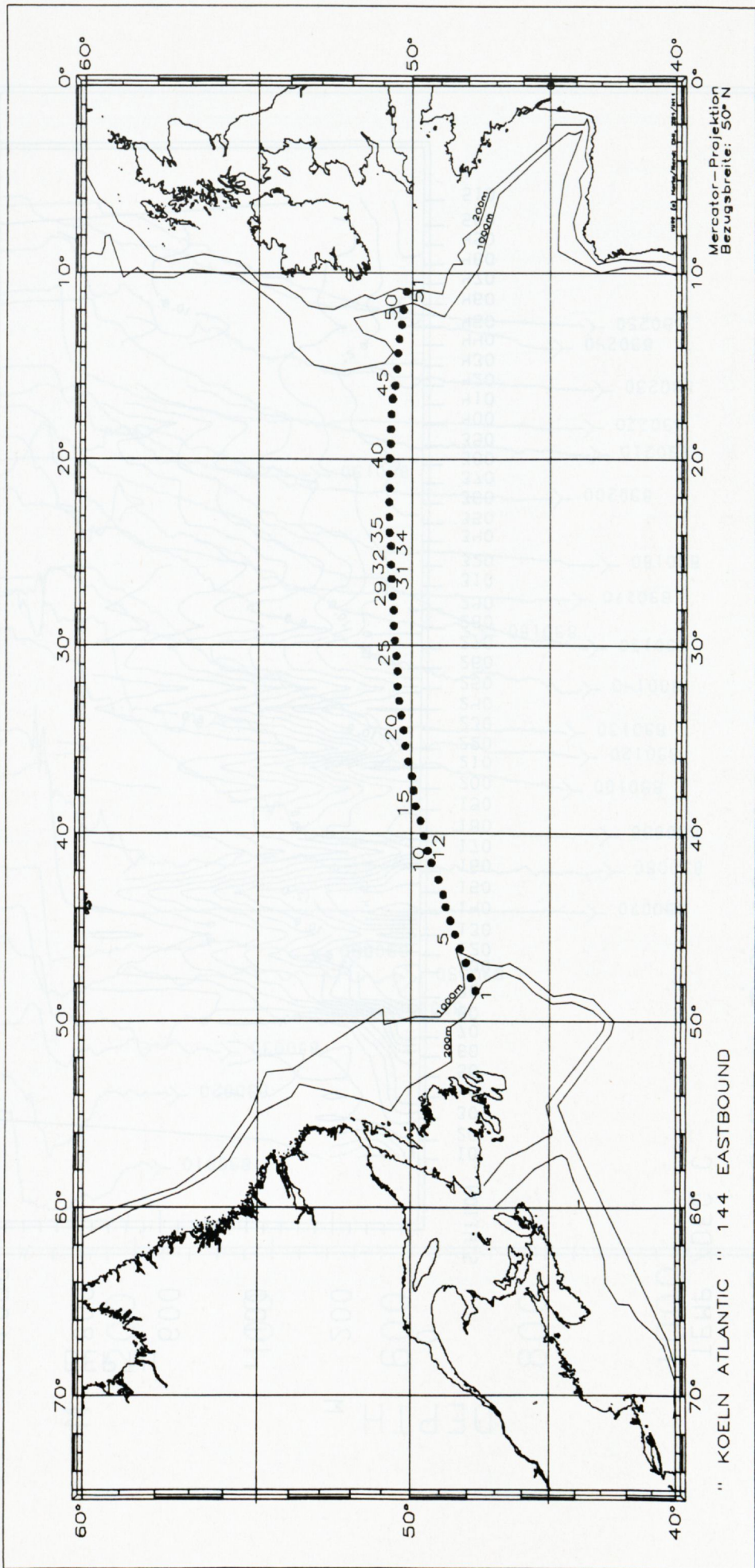






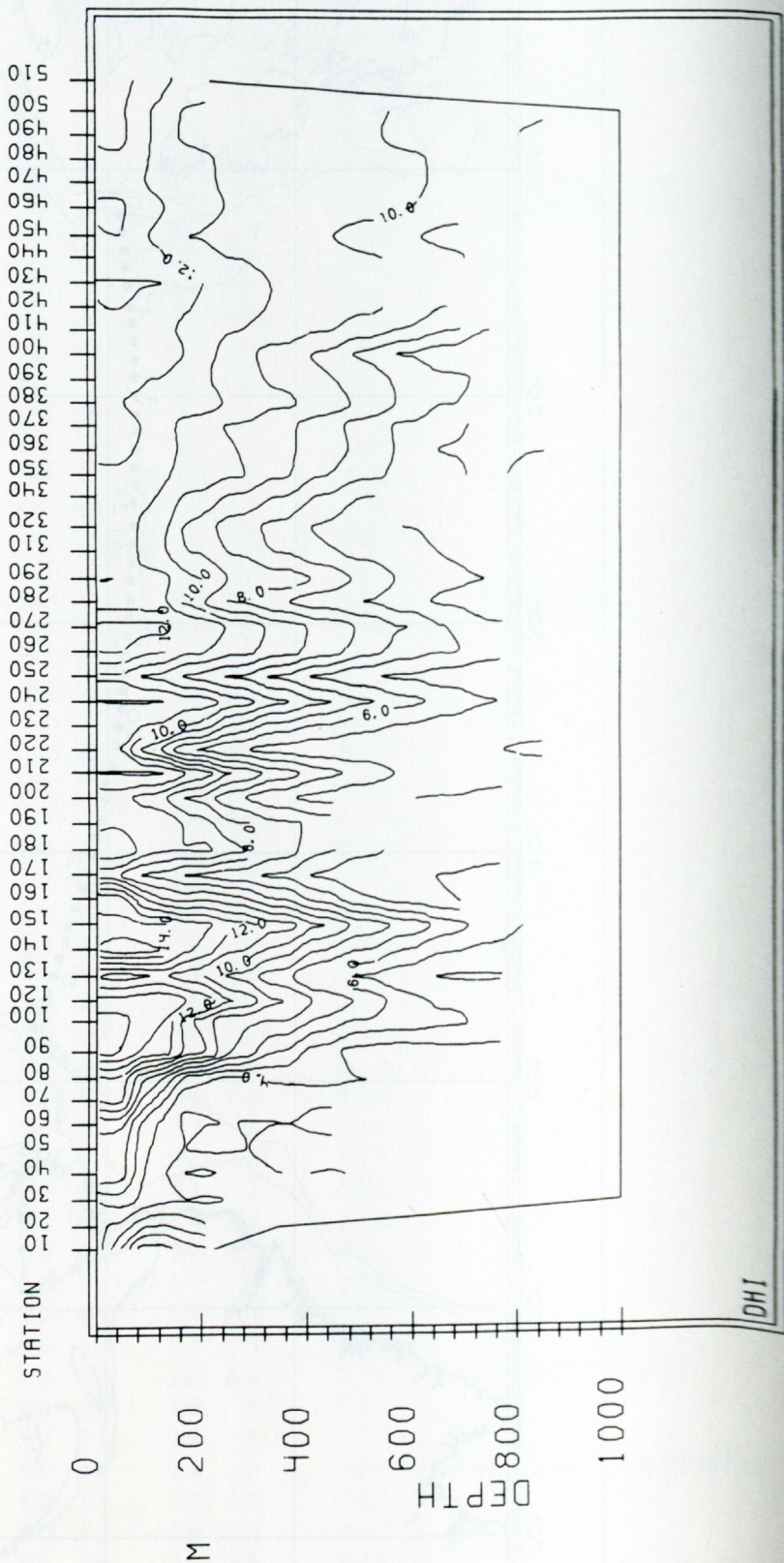
"KOELN ATLANTIC" Voyage No. 144

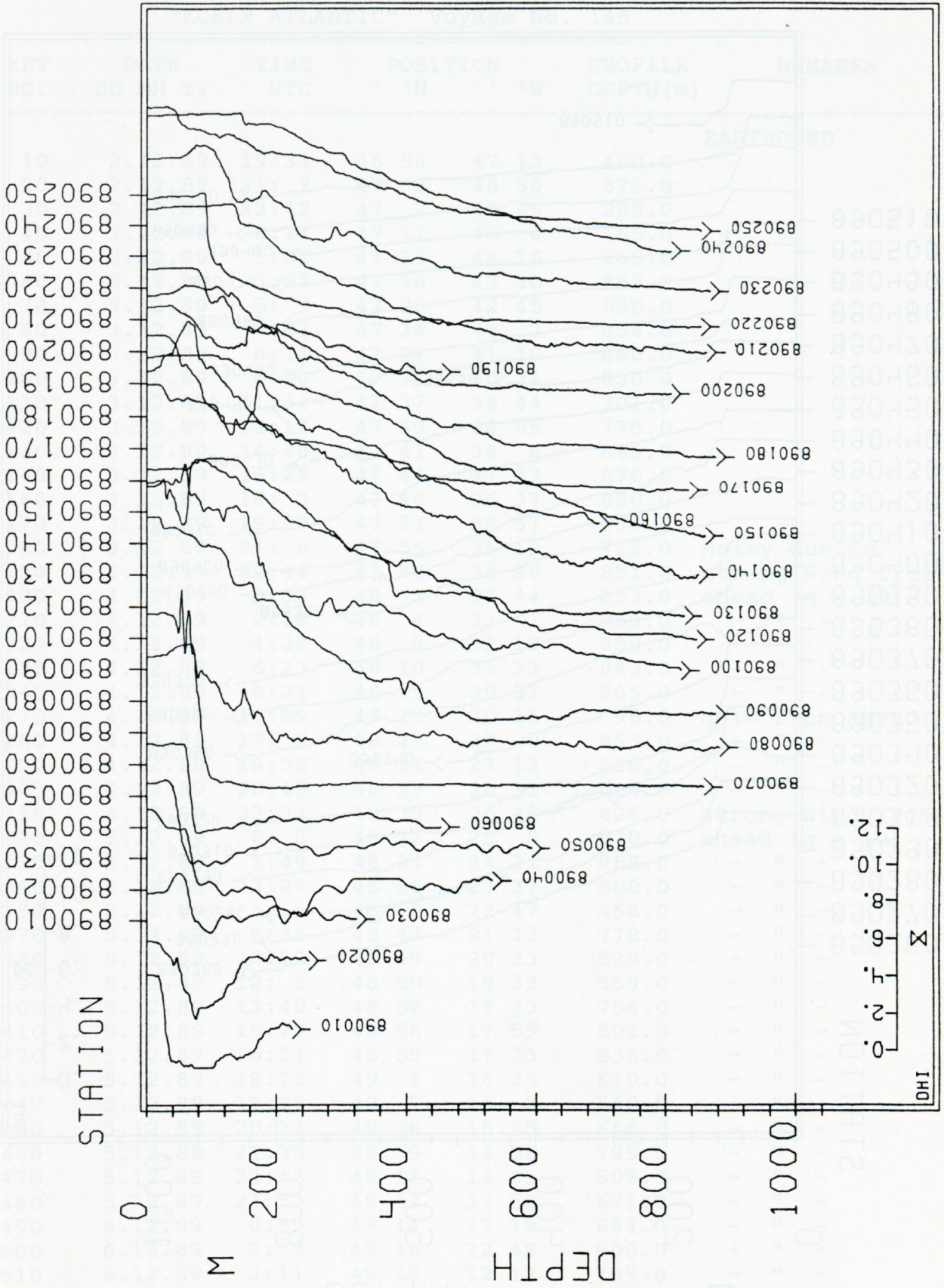
XBT NO.	DATE			TIME		POSITION		PROFILE DEPTH(m)	REMARKS
	DD	MM	YY	UTC	'N	'W			
	EASTBOUND								
10	4.11.89			11: 9	47 43	48 23		224.0	
20	4.11.89			12:49	47 53	47 42		249.0	
30	4.11.89			14:34	48 3	46 55		323.0	noisy (q=19)
40	4.11.89			16:14	48 16	46 8		533.0	- " -
50	4.11.89			17:54	48 27	45 23		593.0	- " -
60	4.11.89			19:27	48 37	44 41		453.0	- " -
70	4.11.89			21: 5	48 48	43 57		858.0	
80	4.11.89			22:43	48 53	43 17		882.0	
90	5.11.89			0:26	49 3	42 28		877.0	
100	5.11.89			2:26	49 18	41 35		823.0	
120	5.11.89			3:55	49 26	40 56		847.0	
130	5.11.89			5:30	49 33	40 10		828.0	
140	5.11.89			7:12	49 41	39 22		850.0	
150	5.11.89			8:49	49 51	38 35		860.0	
160	5.11.89			10:42	49 56	37 45		698.0	
170	5.11.89			12:19	49 59	36 59		836.0	doubtful
180	5.11.89			13:56	50 7	36 12		878.0	
190	5.11.89			15:37	50 13	35 22		454.0	
200	5.11.89			17:17	50 16	34 31		809.0	
210	5.11.89			18:58	50 22	33 43		863.0	
220	5.11.89			20:35	50 26	32 57		855.0	
230	5.11.89			22:13	50 29	32 11		869.0	
240	5.11.89			23:49	50 33	31 22		810.0	
250	6.11.89			1:32	50 31	30 33		856.0	
260	6.11.89			3: 9	50 35	29 43		837.0	
270	6.11.89			4:44	50 37	28 56		808.0	
280	6.11.89			6:23	50 38	28 5		801.0	
290	6.11.89			8: 1	50 40	27 20		837.0	
310	6.11.89			10: 0	50 42	26 24		821.0	
320	6.11.89			11:36	50 43	25 38		840.0	
340	6.11.89			13:38	50 43	24 38		542.0	
350	6.11.89			15:26	50 46	23 56		850.0	
360	6.11.89			17:21	50 47	23 6		853.0	
370	6.11.89			19:18	50 47	22 18		864.0	
380	6.11.89			21:14	50 46	21 33		680.0	
390	6.11.89			23: 2	50 46	20 47		829.0	
400	7.11.89			1: 4	50 46	19 56		836.0	
410	7.11.89			2:56	50 44	19 9		848.0	
420	7.11.89			4:46	50 44	18 23		759.0	
430	7.11.89			6:38	50 42	17 35		446.0	
440	7.11.89			8:34	50 40	16 46		792.0	noisy (q=19)
450	7.11.89			10:17	50 35	16 3		757.0	- " -
460	7.11.89			12:22	50 31	15 9		776.0	
470	7.11.89			14:19	50 29	14 19		786.0	spikes (radio?)
480	7.11.89			16:11	50 27	13 32		761.0	
490	7.11.89			18: 4	50 21	12 46		847.0	
500	7.11.89			19:54	50 18	11 58		845.0	
510	7.11.89			22:21	50 11	11 0		220.0	

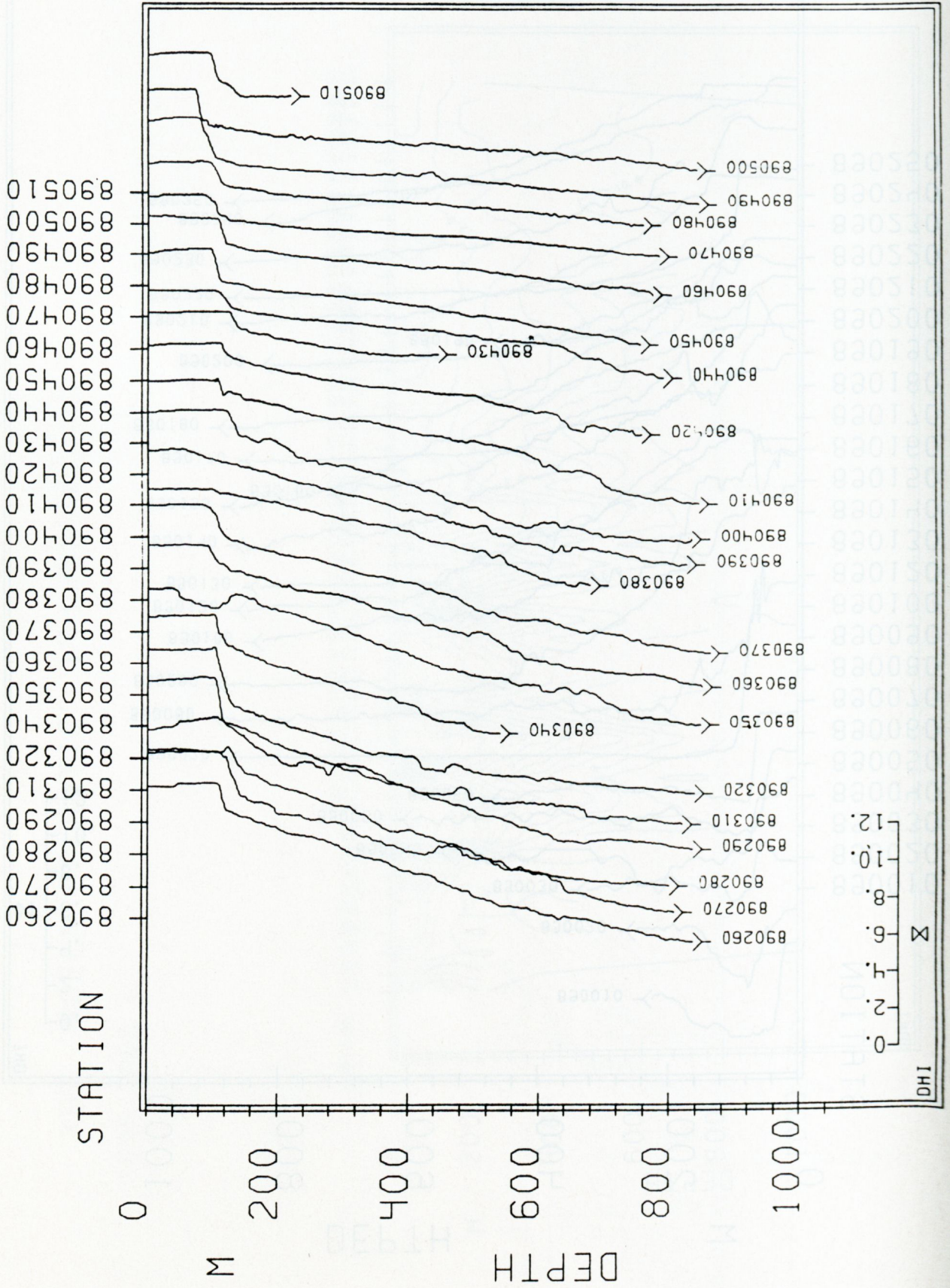


XBT "KOELN ATLANTIC" 144 EASTBOUND

TEMP / DEG C

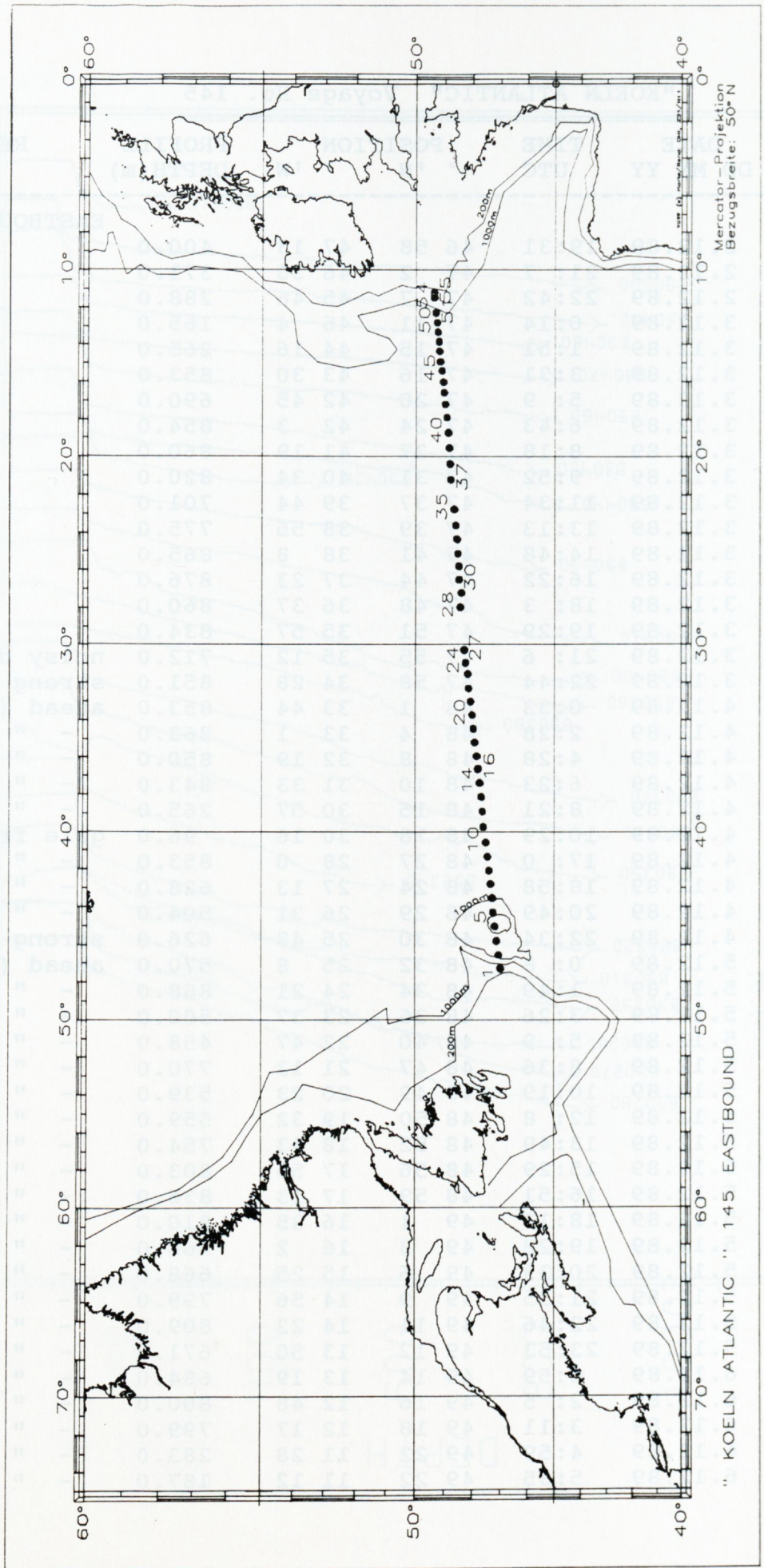






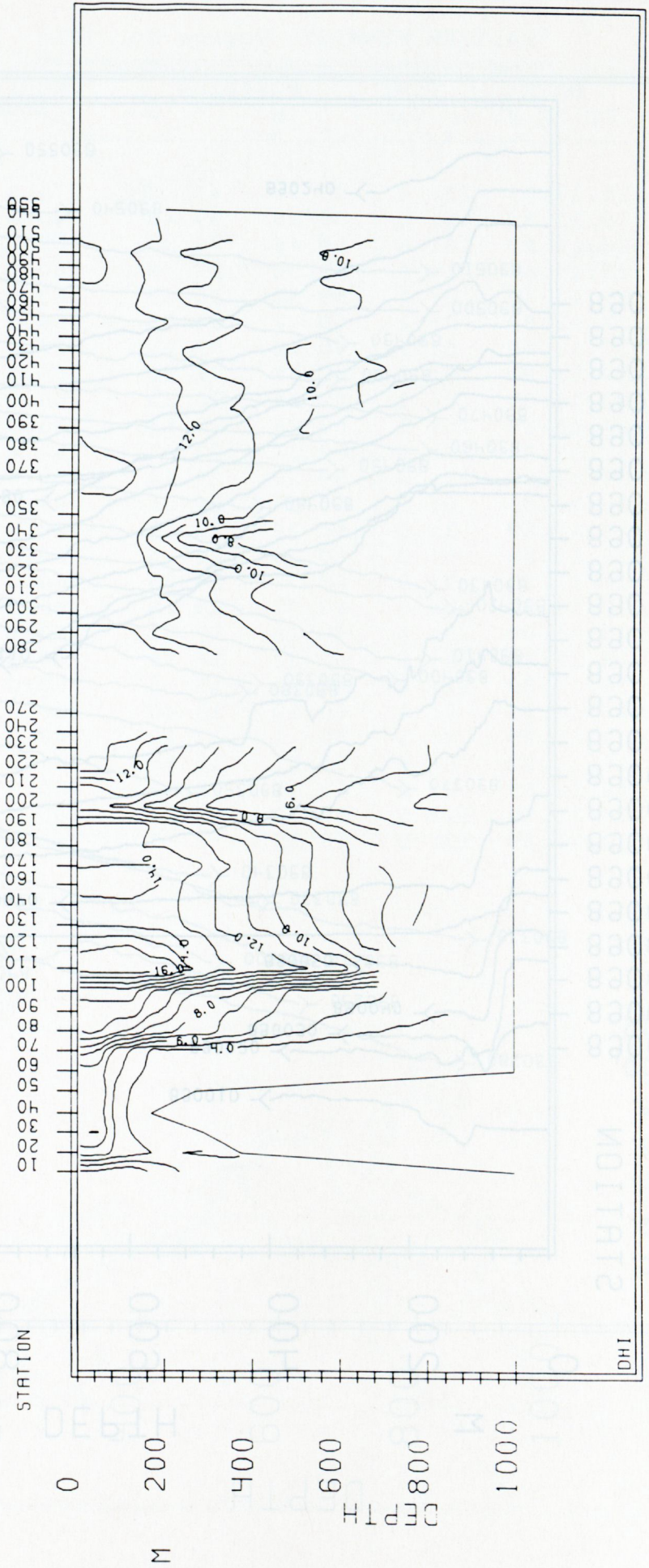
"KOELN ATLANTIC" Voyage No. 145

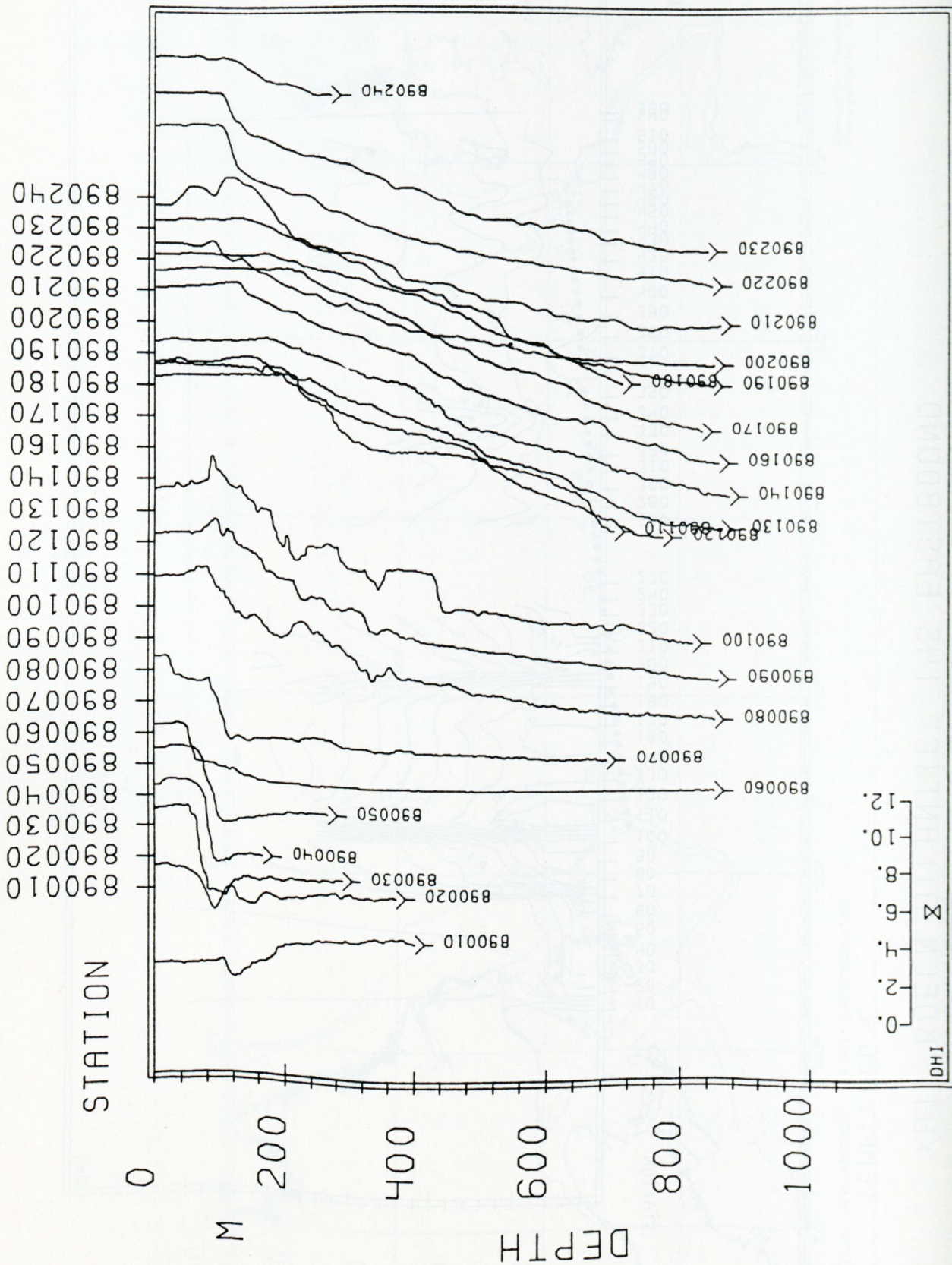
XBT NO.	DATE			TIME		POSITION		PROFILE DEPTH(m)	REMARKS
	DD	MM	YY	UTC	'N	'W			
EASTBOUND									
10	2	12	89	19:31	46 58	47 13		400.0	
20	2	12	89	21: 7	47 2	46 30		371.0	
30	2	12	89	22:42	47 7	45 46		288.0	
40	3	12	89	0:14	47 11	45 4		165.0	
50	3	12	89	1:51	47 15	44 16		265.0	
60	3	12	89	3:31	47 16	43 30		853.0	
70	3	12	89	5: 9	47 20	42 45		690.0	
80	3	12	89	6:43	47 24	42 3		854.0	
90	3	12	89	8:18	47 27	41 19		860.0	
100	3	12	89	9:52	47 31	40 34		820.0	
110	3	12	89	11:34	47 37	39 44		701.0	
120	3	12	89	13:13	47 39	38 55		775.0	
130	3	12	89	14:48	47 41	38 8		865.0	
140	3	12	89	16:22	47 44	37 23		876.0	
160	3	12	89	18: 3	47 48	36 37		860.0	
170	3	12	89	19:29	47 51	35 57		834.0	
180	3	12	89	21: 6	47 55	35 12		712.0	noisy due to
190	3	12	89	22:44	47 58	34 28		851.0	strong wind from
200	4	12	89	0:33	48 1	33 44		853.0	ahead (q = 19)
210	4	12	89	2:28	48 4	33 1		863.0	- " -
220	4	12	89	4:28	48 8	32 19		850.0	- " -
230	4	12	89	6:23	48 10	31 33		843.0	- " -
240	4	12	89	8:21	48 15	30 57		265.0	- " -
270	4	12	89	10:29	48 18	30 16		96.0	gale from ahead
280	4	12	89	17: 0	48 27	28 0		853.0	- " -
290	4	12	89	18:58	48 24	27 13		628.0	- " -
300	4	12	89	20:49	48 29	26 31		504.0	- " -
310	4	12	89	22:34	48 30	25 48		626.0	strong wind from
320	5	12	89	0: 8	48 32	25 8		570.0	ahead (q = 19)
330	5	12	89	1:49	48 34	24 21		868.0	- " -
340	5	12	89	3:26	48 36	23 37		500.0	- " -
350	5	12	89	5: 9	48 40	22 47		458.0	- " -
370	5	12	89	8:36	48 47	21 13		770.0	- " -
380	5	12	89	10:19	48 49	20 23		539.0	- " -
390	5	12	89	12: 8	48 50	19 32		559.0	- " -
400	5	12	89	13:49	48 52	18 43		754.0	- " -
410	5	12	89	15:29	48 56	17 55		803.0	- " -
420	5	12	89	16:51	48 59	17 13		836.0	- " -
430	5	12	89	18:13	49 1	16 35		810.0	- " -
440	5	12	89	19:22	49 3	16 2		560.0	- " -
450	5	12	89	20:33	49 6	15 25		668.0	- " -
460	5	12	89	21:35	49 9	14 56		799.0	- " -
470	5	12	89	22:46	49 11	14 22		809.0	- " -
480	5	12	89	23:53	49 12	13 50		671.0	- " -
490	6	12	89	0:59	49 14	13 19		684.0	- " -
500	6	12	89	2: 5	49 16	12 48		800.0	- " -
510	6	12	89	3:11	49 18	12 17		799.0	- " -
540	6	12	89	4:59	49 22	11 28		283.0	- " -
550	6	12	89	5:35	49 22	11 12		187.0	- " -

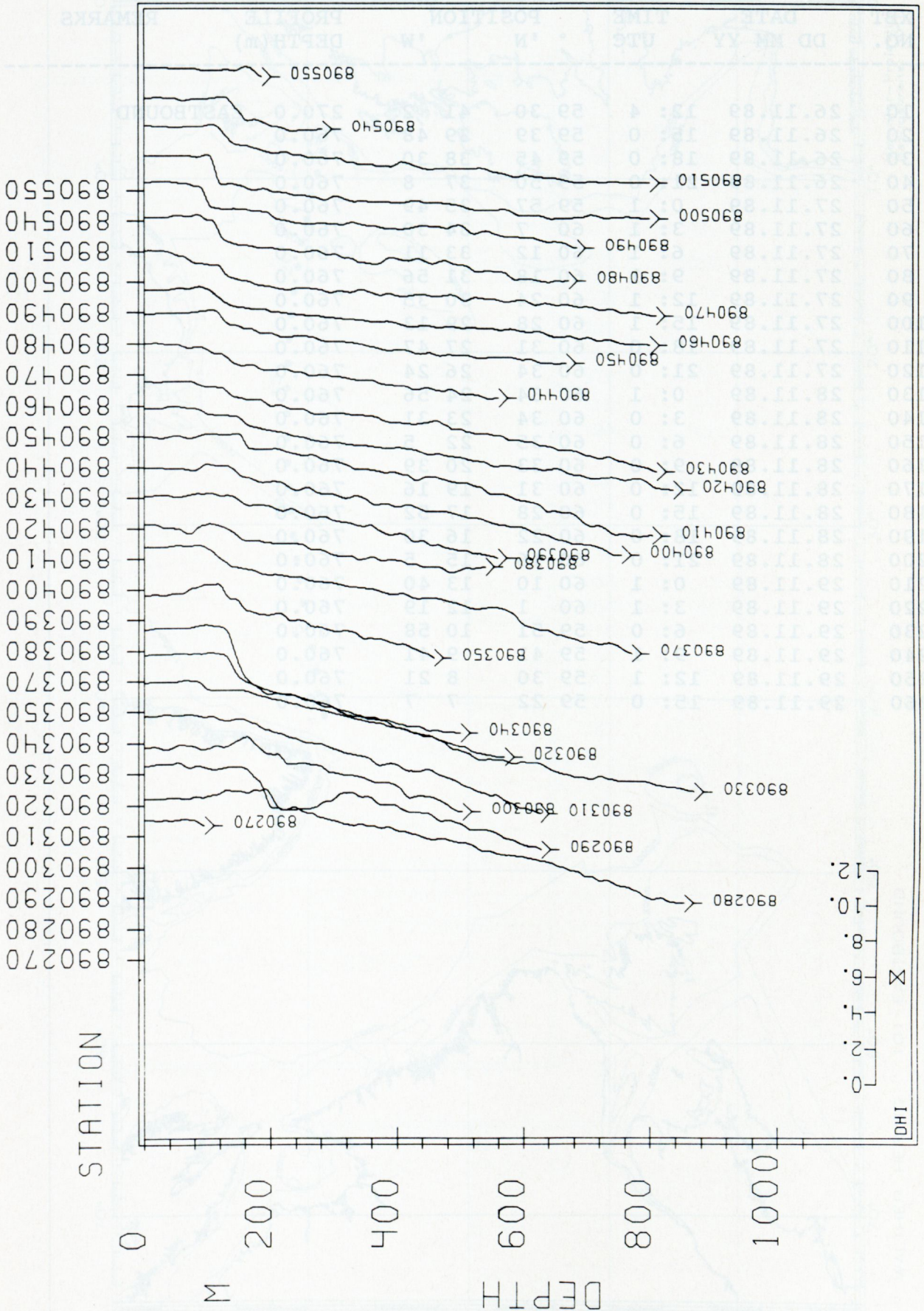


XBT "KOELN ATLANTIC" 145 EASTBOUND

TEMP / DEG C





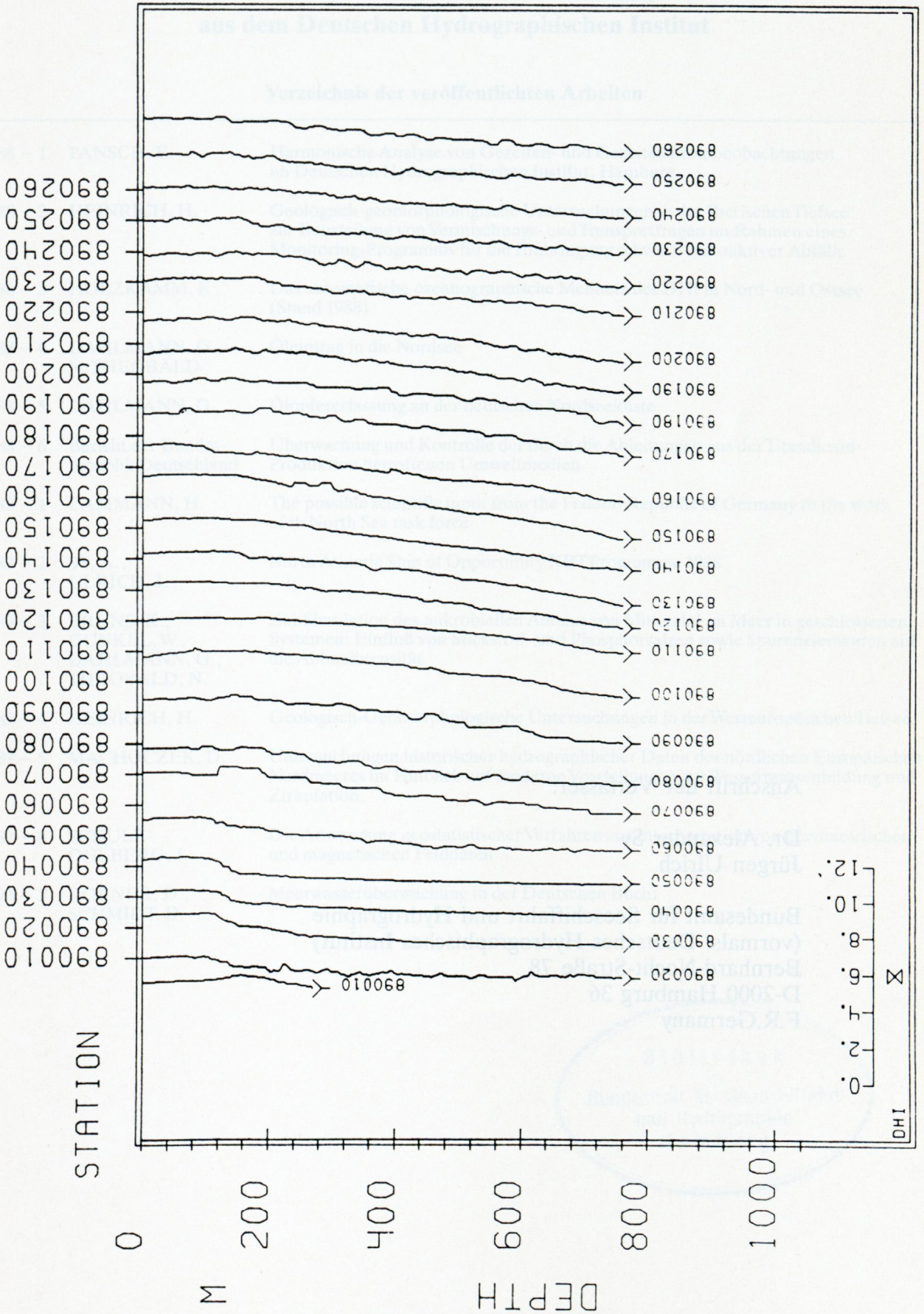


"WALTHER HERWIG" Voyage No. 101

XBT NO.	DATE			TIME		POSITION		PROFILE	REMARKS
	DD	MM	YY	UTC	'N	'W	DEPTH (m)		
10	26	11	89	12: 4	59 30	41 2	270.0	EASTBOUND	
20	26	11	89	15: 0	59 39	39 48	760.0		
30	26	11	89	18: 0	59 45	38 30	760.0		
40	26	11	89	21: 0	59 50	37 8	760.0		
50	27	11	89	0: 1	59 57	35 49	760.0		
60	27	11	89	3: 1	60 7	34 30	760.0		
70	27	11	89	6: 1	60 12	33 11	760.0		
80	27	11	89	9: 1	60 18	31 56	760.0		
90	27	11	89	12: 1	60 24	30 35	760.0		
100	27	11	89	15: 1	60 28	29 13	760.0		
110	27	11	89	18: 0	60 31	27 47	760.0		
120	27	11	89	21: 0	60 34	26 24	760.0		
130	28	11	89	0: 1	60 34	24 56	760.0		
140	28	11	89	3: 0	60 34	23 31	760.0		
150	28	11	89	6: 0	60 35	22 5	760.0		
160	28	11	89	9: 0	60 33	20 39	760.0		
170	28	11	89	12: 0	60 31	19 16	760.0		
180	28	11	89	15: 0	60 28	17 52	760.0		
190	28	11	89	18: 0	60 22	16 30	760.0		
200	28	11	89	21: 0	60 16	15 5	760.0		
210	29	11	89	0: 1	60 10	13 40	760.0		
220	29	11	89	3: 1	60 1	12 19	760.0		
230	29	11	89	6: 0	59 51	10 58	760.0		
240	29	11	89	9: 1	59 41	9 41	760.0		
250	29	11	89	12: 1	59 30	8 21	760.0		
260	29	11	89	15: 0	59 22	7 7	760.0		

Wissenschaftlich-Technische Berichte
aus dem Deutschen Hydrographischen Institut

Verzeichnis der veröffentlichten Arbeiten



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Wissenschaftlich-Technische Berichte aus dem Deutschen Hydrographischen Institut

Verzeichnis der veröffentlichten Arbeiten

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- | | | |
|----------|--|---|
| 1988 - 1 | PANSCH, E. | Harmonische Analyse von Gezeiten- und Gezeitenstrombeobachtungen im Deutschen Hydrographischen Institut, Hamburg |
| 1988 - 2 | HEINRICH, H. | Geologisch-geomorphologische Untersuchungen in der Iberischen Tiefsee zur Beurteilung von Vermischungs- und Transportfragen im Rahmen eines Monitoring-Programms für die Einbringung schwach radioaktiver Abfälle |
| 1988 - 3 | HOLZKAMM, F. | Das automatische ozeanographische Meßnetz des DHI in Nord- und Ostsee (Stand 1988) |
| 1988 - 4 | DAHLMANN, G.,
N. THEOBALD | Öleintrag in die Nordsee |
| 1988 - 5 | DAHLMANN, G. | Ölopferrerfassung an der deutschen Nordseeküste |
| 1988 - 6 | Bericht der Bundes-
republik Deutschland | Überwachung und Kontrolle der durch die Ableitungen aus der Titandioxid-Produktion betroffenen Umweltmedien |
| 1989 - 1 | CAMMANN, H. | The possible scientific input from the Federal Republic of Germany to the work of th North Sea task force |
| 1989 - 2 | SY, A.,
ULRICH, J. | North Atlantic Ship of Opportunity XBT Programme 1988 |
| 1989 - 3 | BRUNS, K.,
GUNKEL, W.,
DAHLMANN, G.,
THEOBALD, N. | Zur Simulation des mikrobiellen Abbaus von Mineralöl im Meer in geschlossenen Systemen: Einfluß von Stickstoff- und Phosphorsalzen sowie Spurenelementen auf die Abbauintensität |
| 1989 - 4 | HEINRICH, H. | Geologisch-Geomorphologische Untersuchungen in der Westeuropäischen Tiefsee |
| 1989 - 5 | MACHOCZEK, D. | Untersuchungen historischer hydrographischer Daten des nördlichen Europäischen Nordmeeres im Hinblick auf moderne Vorstellungen zur Wassermassenbildung und Zirkulation. |
| 1989 - 6 | SCHULZ-
OHLBERG, J. | Die Anwendung geostatistischer Verfahren zur Interpretation von gravimetrischen und magnetischen Felddaten |
| 1990 - 1 | KÖRNER, D.,
SCHMIDT, D. | Meerwasserüberwachung in der Deutschen Bucht |

