Natural Environment Research Council

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R.R.S. "Challenger" Cruise 105/93

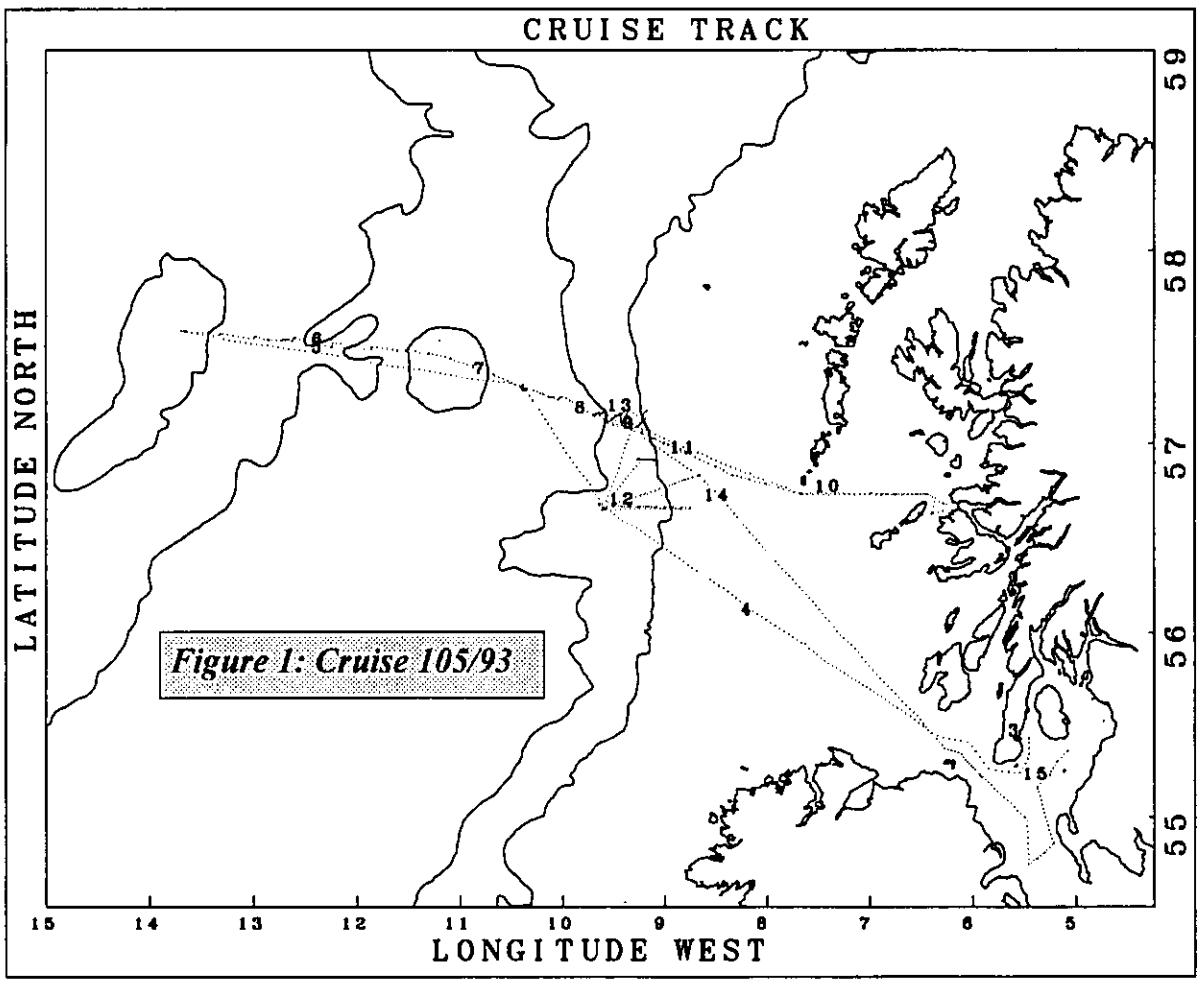

Figure 1: Cruise 105/93

Oban to Ardrossan

September 3rd to September 16th 1993

Cruise Report

Anton Edwards, 16th September 1993

Contents

Scientific Staff

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DML *Dunstaffnage Marine Laboratory, Oban*
IOSDL *Institute of Oceanographic Sciences Deacon Laboratory, Wormley*
SAMS *Scottish Association for Marine Science, Oban*
SURRC *Scottish Universities Research Reactor Centre, East Kilbride*

Aims

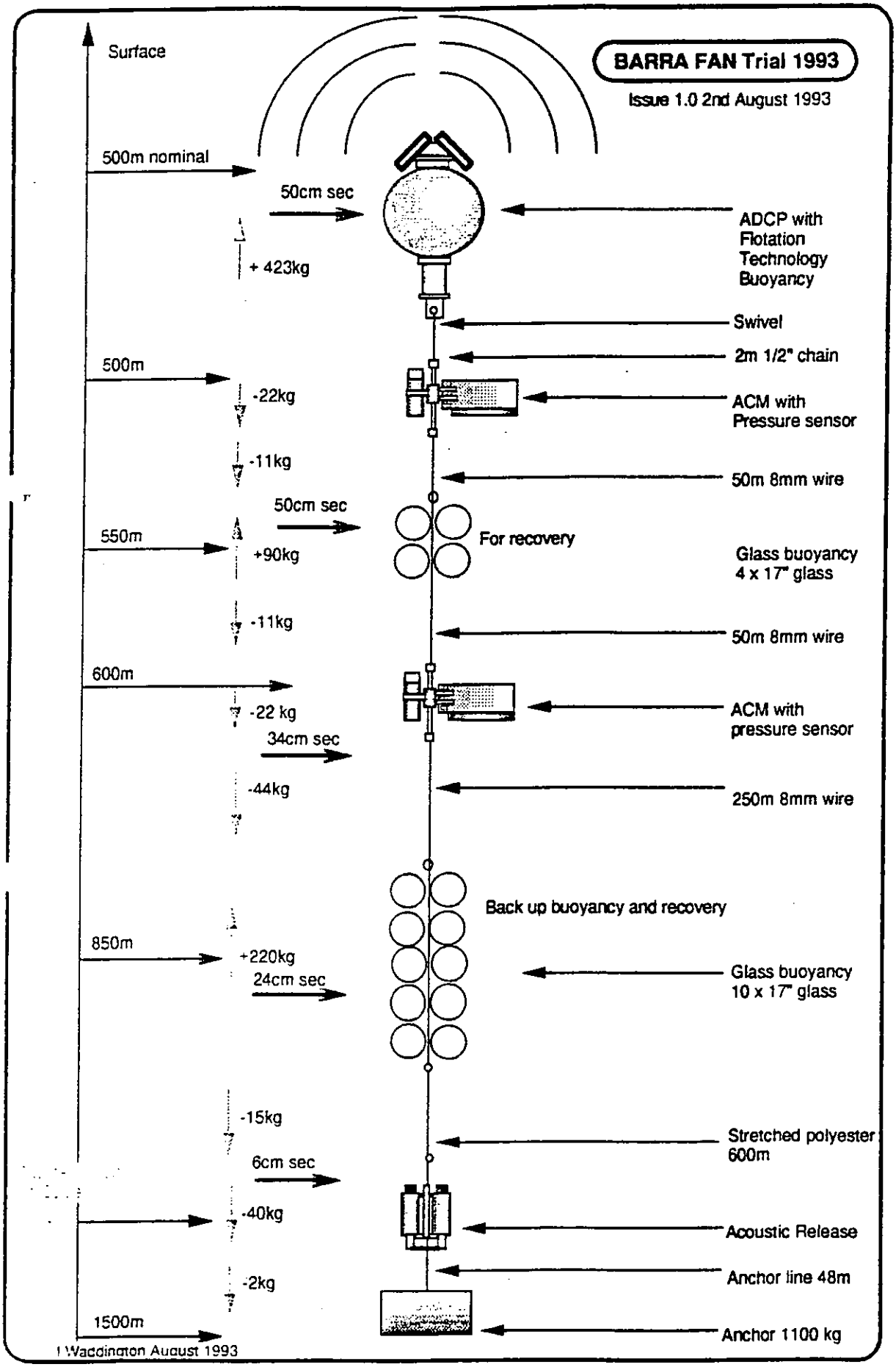
1) To make Conductivity - Temperature - Depth (CTD) profiles and to collect water samples for nutrient and phytoplanktonic analysis at standard positions between the Sound of Mull and the shelf edge West of Barra.
2) To maintain the DML current meter mooring in the Tiree Passage.
3) To deploy an RDI broadband acoustic Doppler profiler (ADCP) on a trial mooring prior to its eventual deployment in the Agulhas Current as part of WOCE[1].
4) To collect a suite of physical, biological and chemical profiles and sea-bed samples (multicorer and Craib corers) at the shelf edge as part of the LOIS[2] studies.
5) To recover and redeploy a temperature and salinity recorder with thermistor chain at station M of the Anton Dohrn section.
6) To work the CTD stations of the Anton Dohrn seamount section between the shelf-edge and Rockall to continue the Rockall Trough time series as a UK contribution to WOCE goal 2. To collect nutrient and phytoplankton samples along this line.
7). To work CTD, nutrient and phytoplankton sections in the Clyde Sea area as a part of the MAST 2 "PROFILE" project.
8) To launch POL[3] satellite tracked drogues in the North Channel in preparation for "Challenger" cruise 106.
9) To measure water column and sea surface conditions on the continental shelf in the swath of ERS-1 satellite overpasses on the 12th and 13th of September.
10) To collect material from the core of the Scottish Continental Slope Current, adjacent shelf waters and the Rockall Trough to study zooplankton indicator species there.
11) To collect live copepods, *Pleuromamma robusta* (Giesbrecht, 1889).

Narrative

Scientific staff joined "Challenger" at 0900Z on 3rd of September. The ship sailed in calm conditions at 1100Z and, after heading for the North Channel, entered Kilbrannan Sound for engine tests relating to a hunting problem. By mid afternoon these difficulties were overcome and the vessel sailed via the North Channel to the IOSDL mooring site GOY1 on the continental slope north of the Barra Fan, at the south-west corner of the LOIS(SES[4]) box. After a brief bathymetric survey and a 1200 metre wire test of the acoustic release, a mooring to test two Aanderaa current meters and an acoustic release (Figure 2) was laid by 1106Z on the 4th. Course was set for DML station M in the eastern Rockall Trough so as to recover a thermistor chain and Seacat logger laid there in May 1993. On arrival at M in the afternoon of the 4th, it was found that the mooring's acoustic release would not reply. Because conditions were calm and the GPS was working well the release signal was nevertheless sent and the mooring came to the surface in the vicinity of the ship. It was recovered by 1800Z and the ship then proceeded in calm conditions to station A on Rockall Bank.

Work now started on the WOCE line. At each station we planned a CTD cast, water sampling for nutrient and chlorophyll analysis, and a surface neuston net tow. Around first

1 *WOCE - World Ocean Circulation Experiment*
2 *LOIS - the NERC's Land Ocean Interaction Study*
3 *POL - Proudman Oceanographic Laboratory, Bidston*
4 *SES - Shelf Edge Study*



Design of the IOSDL Mooring on the Barra Fan, September 1993

Challenger 105/93 Figure 2

light on the 5th at 0440Z, we reached station A and photographed Rockall for public relations. The WOCE line was resumed at station B at 0820Z. Between Stations D and E a Rectangular Mid-water Trawl (RMT) was towed for zooplankton at depths to 1000m. When recovered, the trawl had fouled the trawl wire, was twisted and had suffered minor abrasion. Pending repair of the trawl nets, we resumed work on the line of stations. The Seacat logger from site M was tested on the CTD wire at station E to check performance of its pressure sensor. Stations G,H,I,K and L were worked on the 6th in gradually freshening conditions.

CTD and water bottle casts at Station M commenced early on the 7th and at first light the WOCE Seacat and thermistor chain mooring went out. We collected three sets of multiple cores and sailed for a ten minute RMT trawl at 250 metres depth (500 metres wire out at 2 knots). This trawl fouled itself and had to be repaired during the next two days. The ship steamed in light swell and good weather along the WOCE line towards the continental slope. Station P was complete by 1000Z on the 8th, when we turned for O, coring there in calm conditions in the afternoon. With coring finished, we headed east along the WOCE line for CTD and bottles during the night. We reached station S early on the 9th, then turned west once more to arrive in the vicinity of P1 at 0700Z for a RMT. With wind force 4 from the North-northeast, the trawl was towards that direction, heading for the continental slope. We tried to monitor the depth of the trawl with a pinger and were successful only in finding the pinger echo but not the simultaneous bottom echo. This at least let us check for approach to the bottom as we neared the continental slope.

We successfully won three sets of cores from station P in the afternoon of the 9th and then steamed directly for Barra Head. We completed a line of CTD and water bottle stations across the southern end of the Minch, ending at 1G at 0900Z on the 10th. We retrieved the DML mooring in the Tiree Passage, serviced it and relaid it in calm seas by 1200Z. "Challenger then steamed for Barra Head for the Hebridean shelf section out to the shelf edge at station R, investigated during the night. A trawl with the RMT followed at 0300Z 11th over the continental slope. During our passage to the IOSDL mooring at GOY1, the light to moderate winds with which we had been favoured since the start of the cruise were increasing to strong winds from the North West. By the time that we reached the mooring, conditions were unfavourable for its recovery, so we merely interrogated it succesfully and steamed to M1 on the southern edge of the LOIS box so as to work westwards before the easterly gale and seas that now prevailed. We worked section M during the remainder of the 11th and early in the 12th in improving conditions.

The 12th dawned fine and calm and we took up position at station ERS1 for four hours to await the overpass of ERS-1[1]. The ADCP[2] ran continuously on this station and the CTD was lowered hourly. The weather remained calm and clear throughout, with only occasional light airs. The sea surface was roughened by a wide spectrum of decaying waves and a swell from the west about 2-3 metres high of period, when discernible, about 8 seconds.

During the 12th, the POL drifting buoys were assembled and their Argos transmitters started. All seven devices were checked satisfactorily with the IOSDL Argos receiver. After the ERS-1 overpass we hastened to recover the IOSDL mooring at GOY1. When interrogated, the acoustic release gave no bottom echo although, on firing, we received the "released"

1 *ERS-1 Earth Resources Satellite - 1*

2 *ADCP - Acoustic Doppler Current Profiler*

signal. Repeated attempts to release the mooring produced no change. Nothing was seen on the surface. The ARGOS database in Toulouse was questioned twice during the ensuing three hours but was empty. There was no signal to be received by the portable ARGOS. We concluded that Fortune had once more vomited on our duvet covers and reluctantly left the site at dusk in gradually deteriorating conditions.

Time was now pressing if all our objectives were to be achieved and we headed for the neighbourhood of Q1 to trawl twice with the RMT in the night - over the upper slope and the shelf. The ship hove to near Q1 for a brief period until 0700Z, when we took three multicorer sediment samples and then left for our second appointment with ERS-1, arriving at ERS1 at 1200Z in time to run a ten hour CTD and ADCP time series until midnight on the 13th. The wind blew at about 25 knots from Northeast and was accompanied by a rough sea and moderate swell of guessed height about 5 metres, period about 8 seconds. The ship then steamed for the North Channel. On passage, minor battery replacements were made to the POL warning beacons that had been tested overnight.

After noon on the 14th, we worked a pair of CTD stations in the North Channel and laid seven POL Argos drogues at requested positions. The cruise ended with a set of CTD, water bottle and CTD stations worked anticlockwise around Arran on the 15th. After picking up the pilot, the "Challenger" docked in Ardrossan in the mid morning of the 16th September.

Results

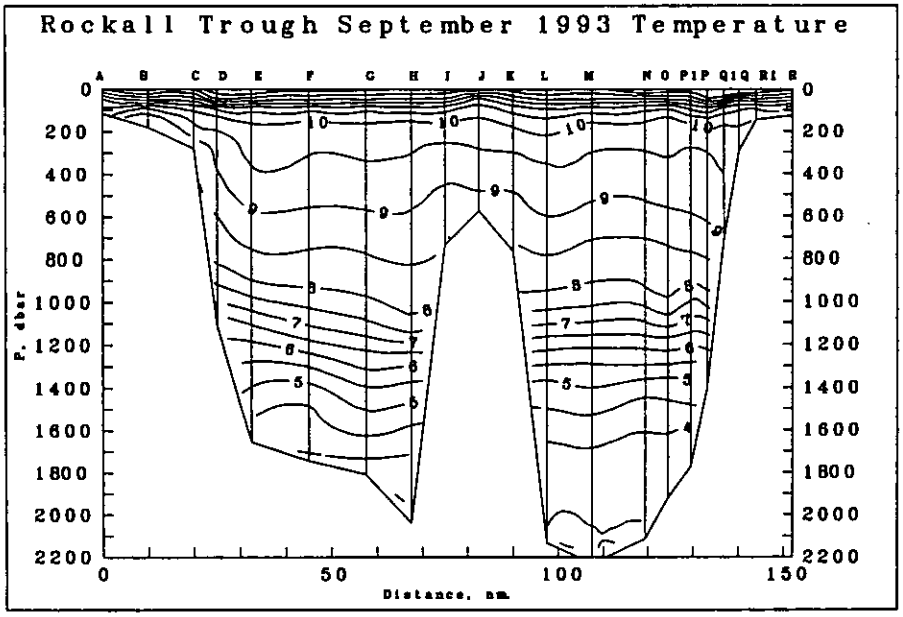
The cruise was almost entirely successful, clouded only by our inability to retrieve the IOSDL mooring on the Barra Fan. We achieved our main aims and those of our collaborators for whom some of the work was done. Apart from an easterly gale on the 13th and a strong easterly wind on the afternoon of the 11th, we were favoured with weather much better than is commonly experienced in these waters. The following figures and tables summarise results.

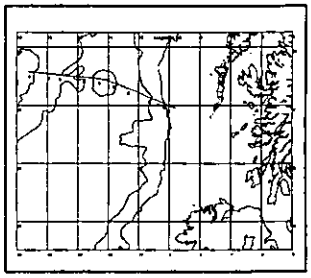
WOCE and LOIS and Clyde Sea Sections

The track of the WOCE and shelf section is shown in figure 1. Figures 3 to 6 show the uncalibrated oceanographic sections of temperature, salinity and density from these measurements in the Rockall Trough, over the continental slope and shelf. Figure 7 shows the uncalibrated oceanographic sections of temperature, salinity and density from measurements around the Isle of Arran. On these sections, many samples were taken at discrete depths with NIO water bottles. These samples were destined for analysis of nutrients, chlorophyll, and photosynthetic activity after inhibition of photosystem II with DCMU. At all stations less than 500 metres, the Seabird CTD was fitted with a fluorimeter. Figure 11 shows these associated fluorescence measurements. Greater depths could not be investigated because of the pressure limit on this instrument.

Tiree Passage Mooring

The DML current meter mooring in the Tiree Passage was retrieved and relaid successfully on the 10th (Figure 8). The mooring was recovered by 1024Z with good data in the Data Storage Units and relaid at 56° 37.53'N 6° 24.11'W at 1159Z with two Aanderaa meters recording at 60 minute intervals.. The depth at this position was about 46m.





Track in the Rockall Trough

Figure 3a: Temperature Distribution (°C). (uncalibrated) , 5-9 September 1993.

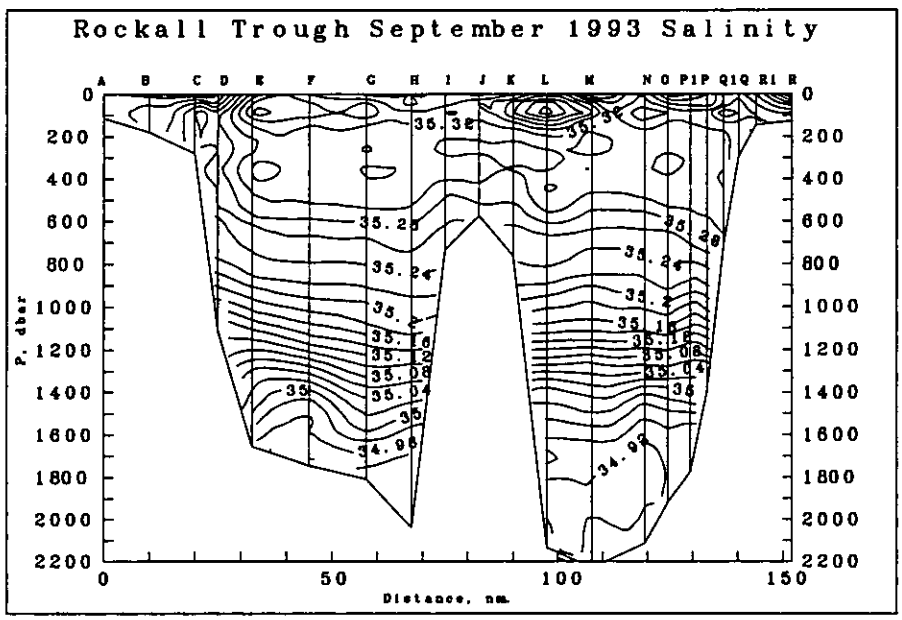


Figure 3b : Salinity Distribution (psu). (uncalibrated) in the Rockall Trough, 5-9 September 1993

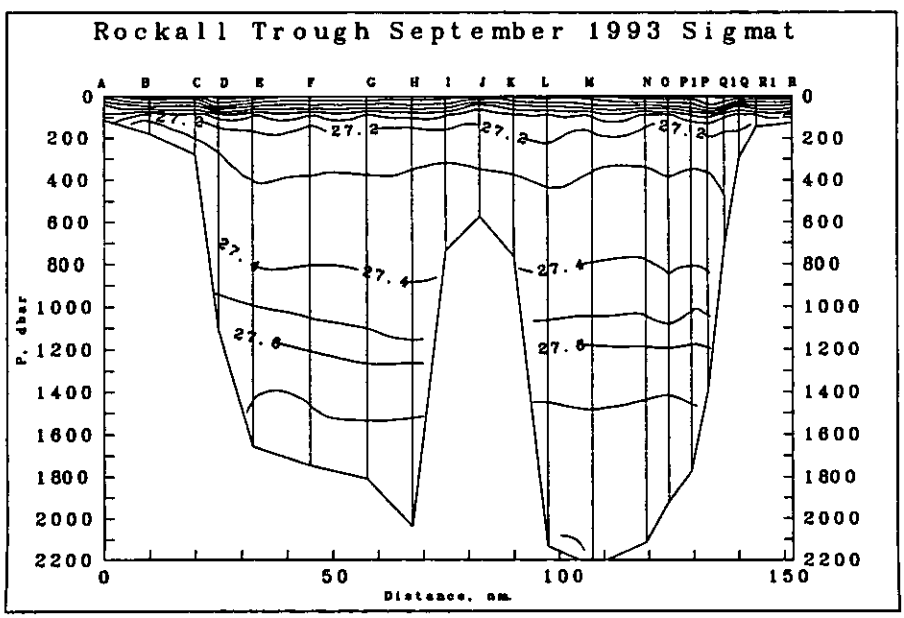
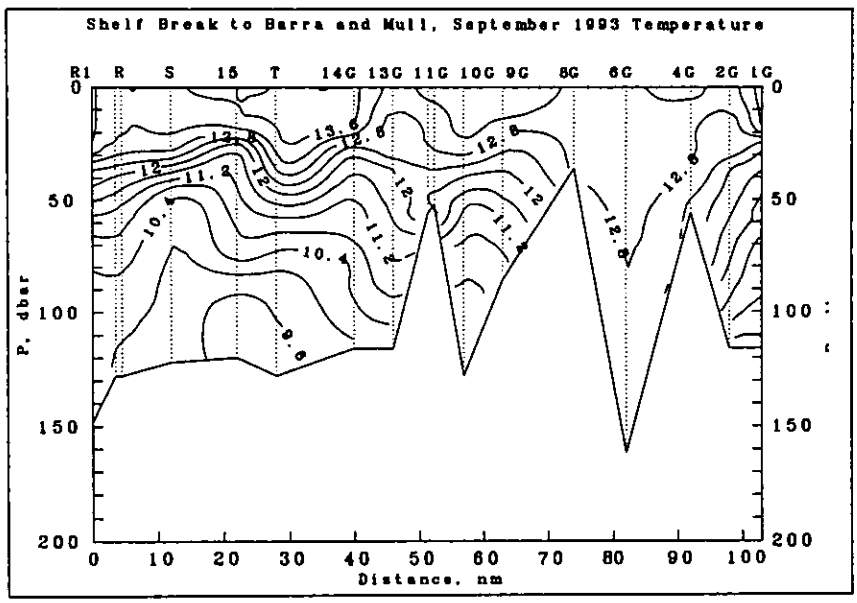
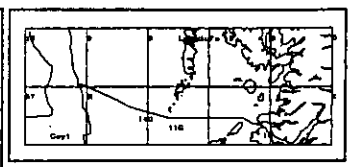


Figure 3c : Sigma-t Distribution (kgm^{-3}) (uncalibrated) in the Rockall Trough, 5-9 September 1993





Track on the shelf

Figure 4a: Temperature Distribution (°C) on the shelf (uncalibrated), 9-10 September 1993.

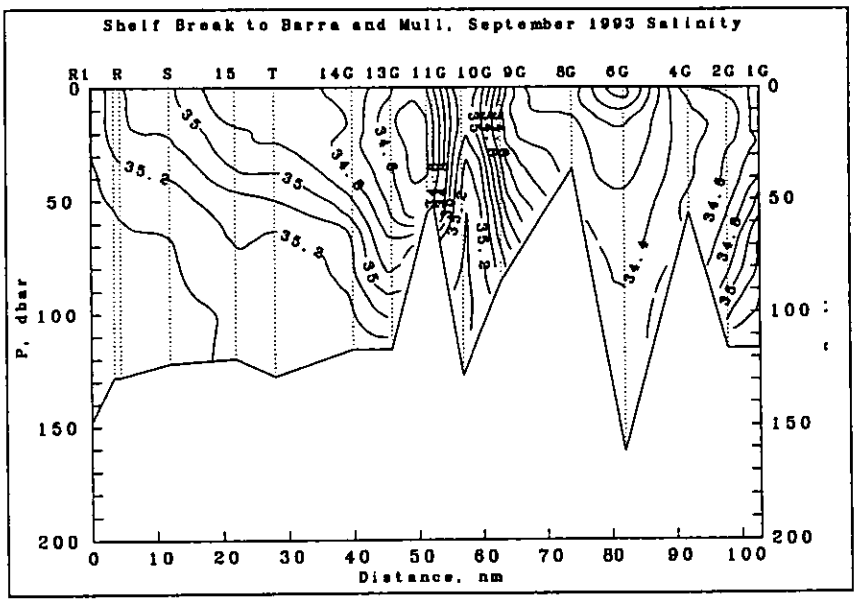


Figure 4b : Salinity Distribution (psu). on the shelf, (uncalibrated) 9-10 September 1993

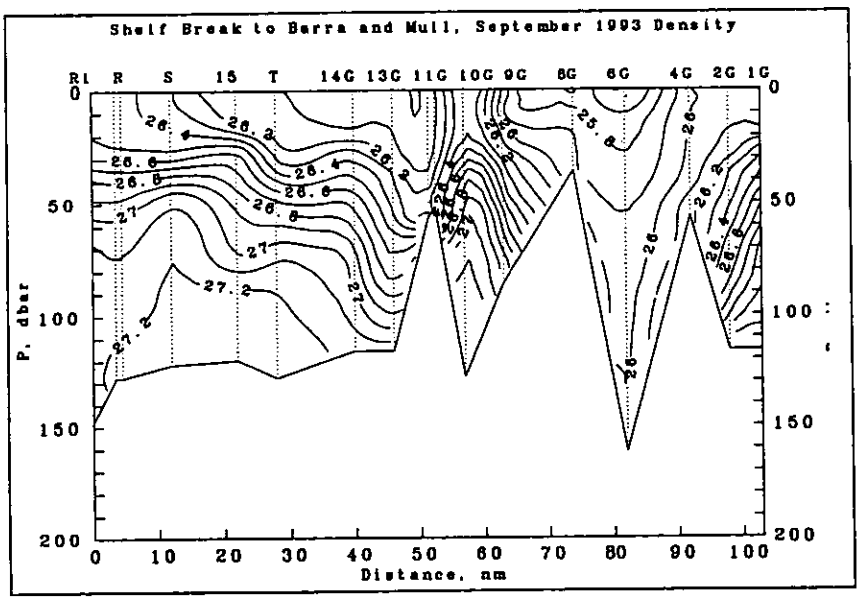
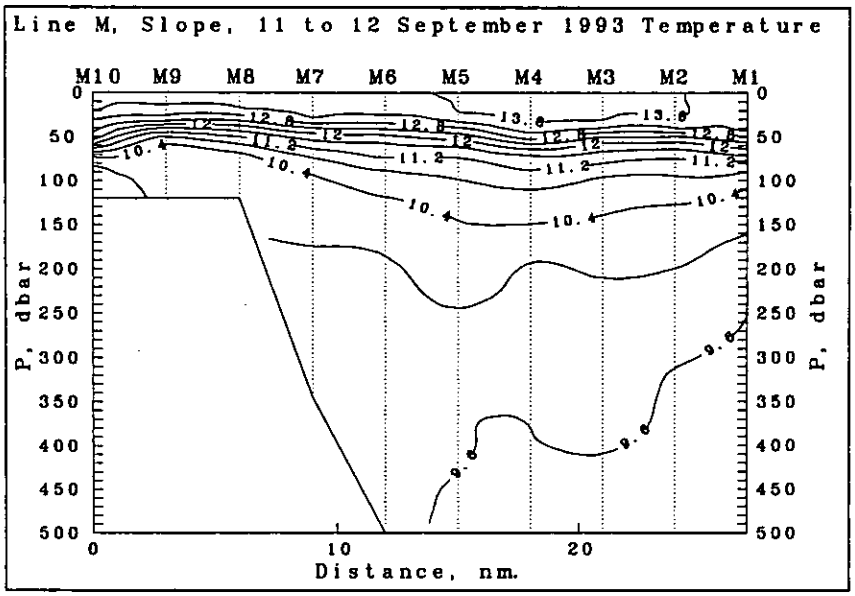
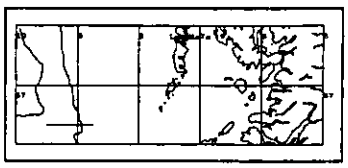


Figure 4c : Sigma-t Distribution (kgm^{-3}) on the shelf, (uncalibrated) 9-10 September 1993





Track on the shelf

Figure 5a: Temperature Distribution (°C) on the slope (uncalibrated), 11-12 September 1993.

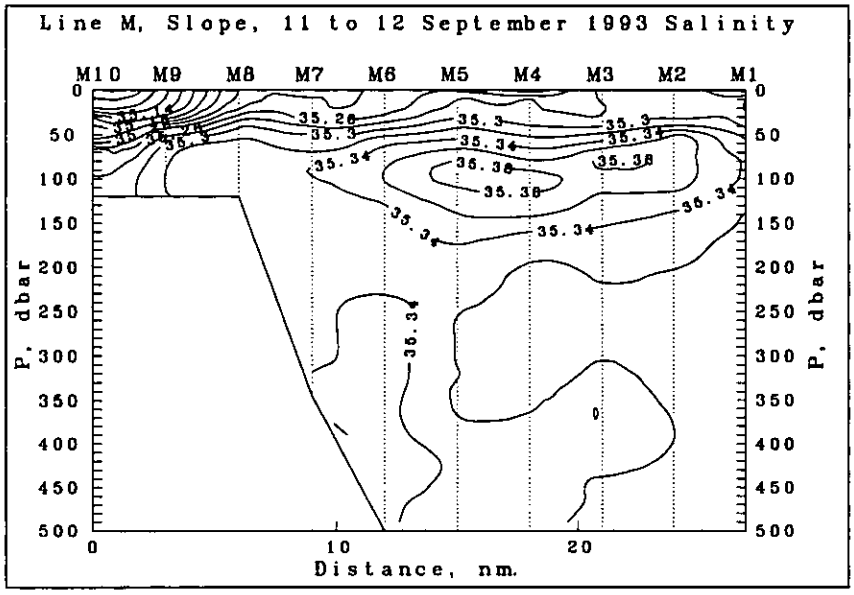


Figure 5b : Salinity Distribution (psu). on the slope, (uncalibrated) 11-12 September 1993

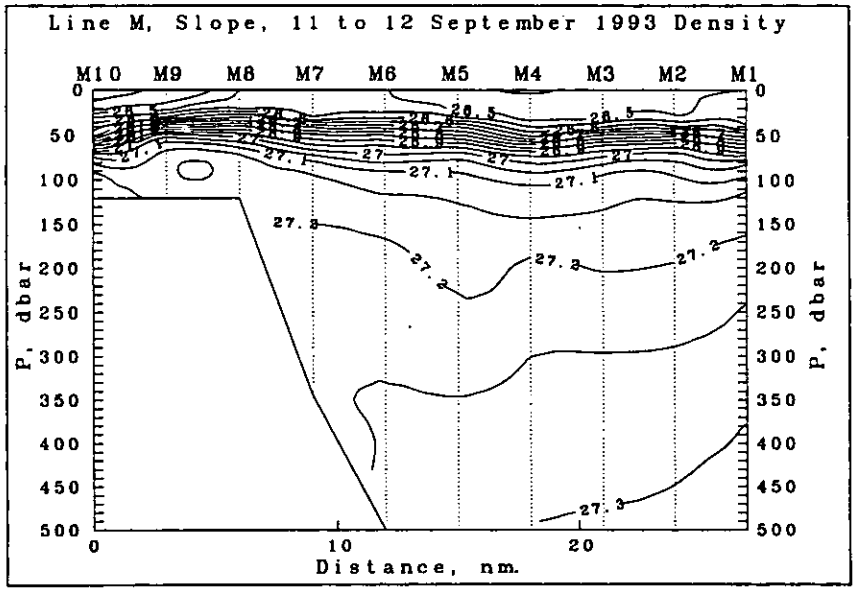


Figure 5c : Sigma-t Distribution (kgm^{-3}) on the slope, (uncalibrated) 11-12 September 1993

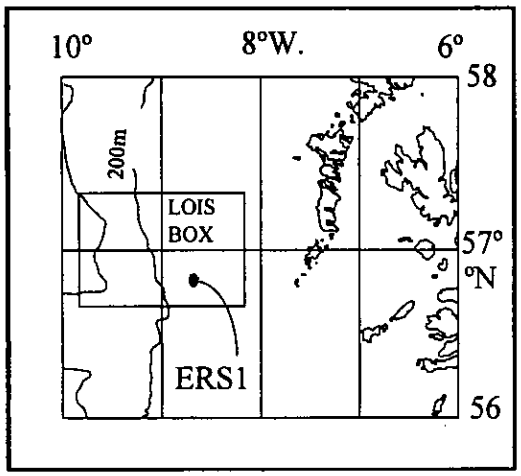


Figure 6a: The LOIS Box and Station ERS1, September 1993

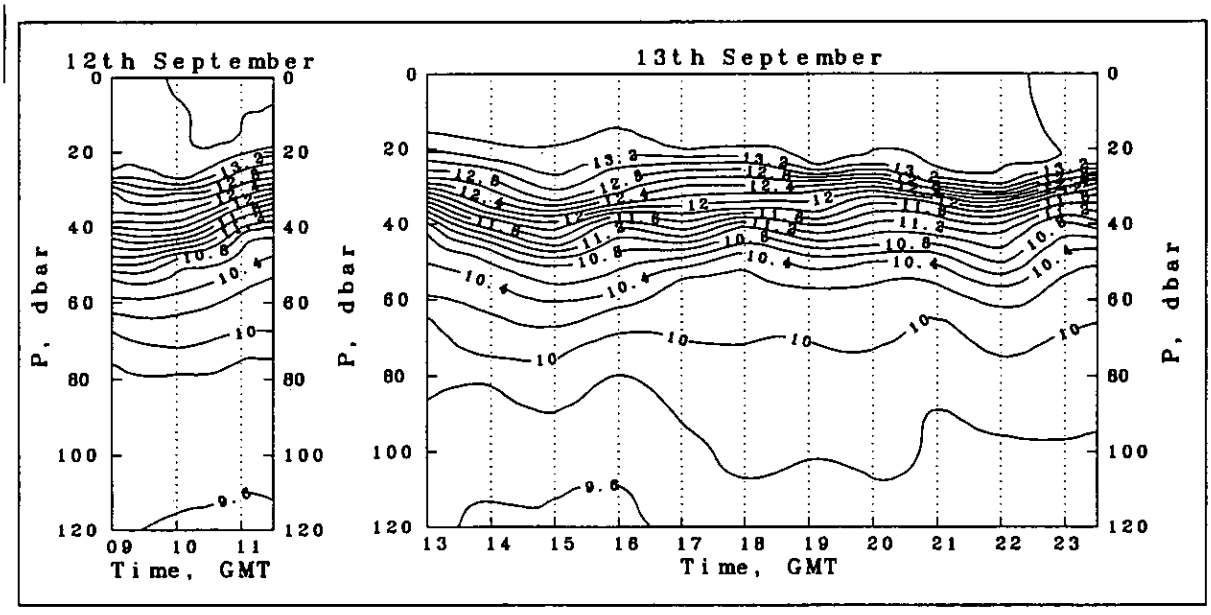


Figure 6b: A Time Series of Temperature at Station ERS 1 (56°50'N 8°40'N)

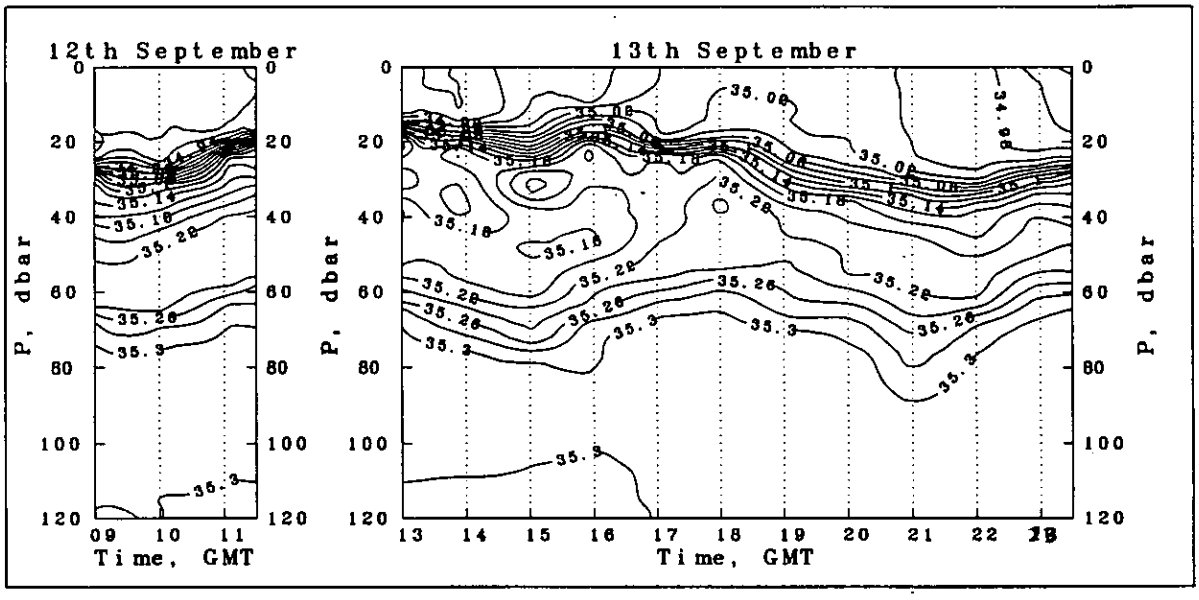
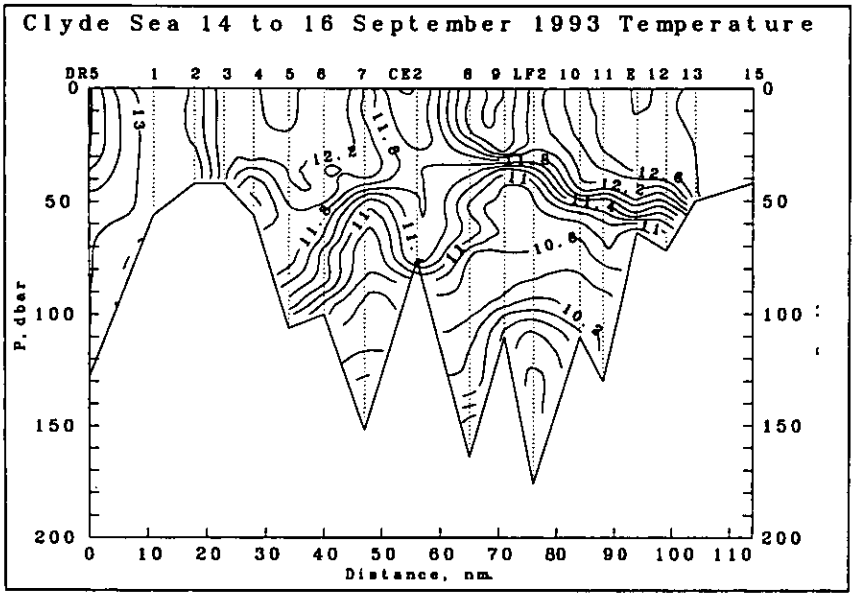
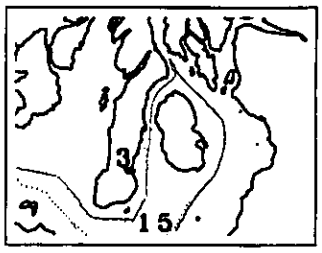


Figure 6c: A Time Series of Salinity at Station ERS 1 (56°50'N 8°40'N)





Tracks in the Clyde

Figure 7a: Temperature Distribution (°C) (uncalibrated)

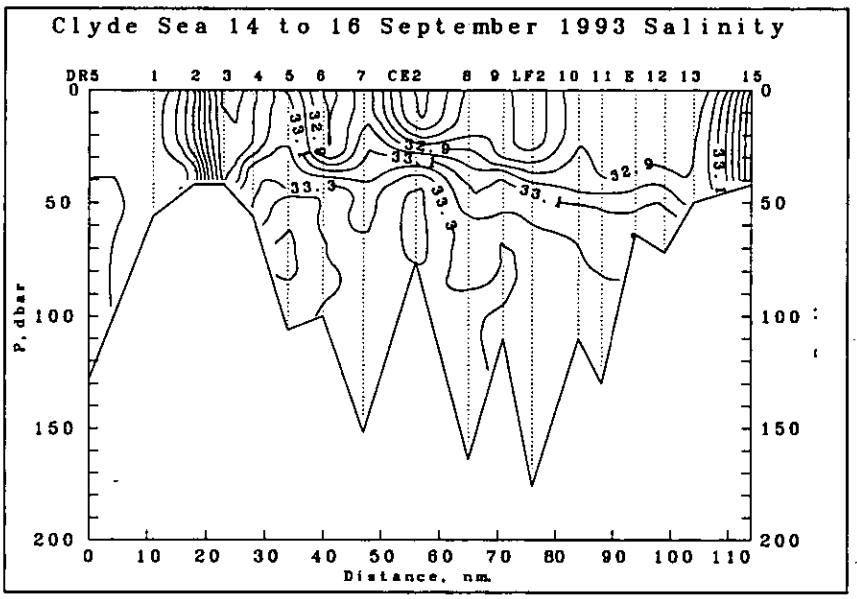


Figure 7b: Salinity Distribution (psu) (uncalibrated)

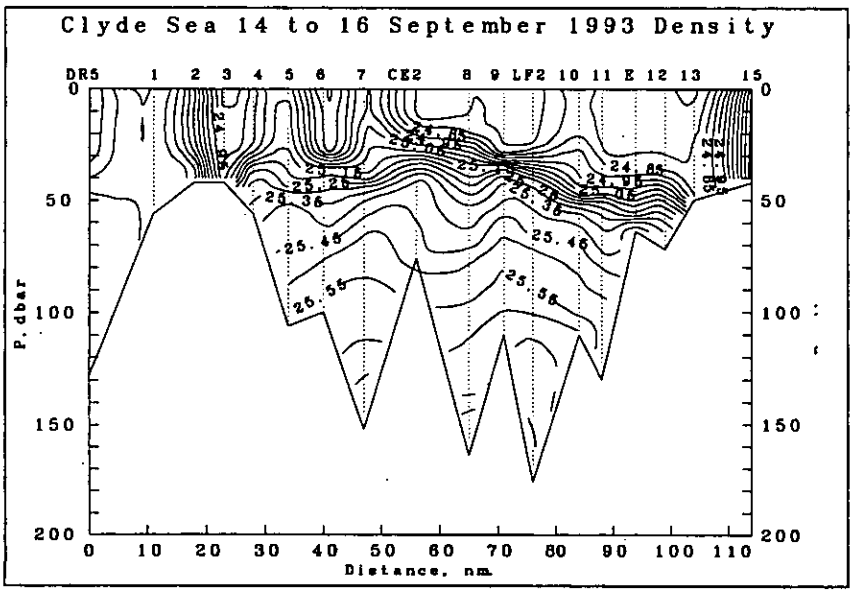


Figure 7c: Density Distribution (kg.m^{-3}) (uncalibrated)

Mooring at M

The DML/WOCE mooring at M comprised a 50m thermistor chain and SEACAT logger at a depth of about 1700m in a water depth of 2216m. The acoustic release was released at 1651Z on 4th September and all gear was inboard by 1800Z. Because of the failure of the acoustic release to respond to interrogation, it was however decided not to redeploy this instrument. The thermistor chain had recorded erratically soon after deployment in May but later recovered. The preliminary temperature, salinity and pressure record from the mooring is shown in figure 10. The Seacat logger was lowered with the CTD for comparison on the 5th September. There was good agreement in temperature throughout, and good agreement in salinity at the depths (500,1000,1500m and bottom) where the instruments were stationary and sufficient time had elapsed for the Seacat to reach equilibrium with the surrounding water.

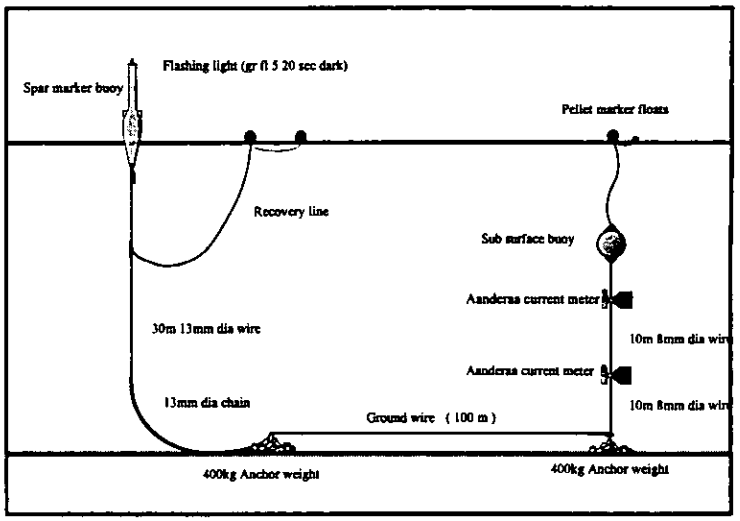


Figure 8: The Tiree Mooring

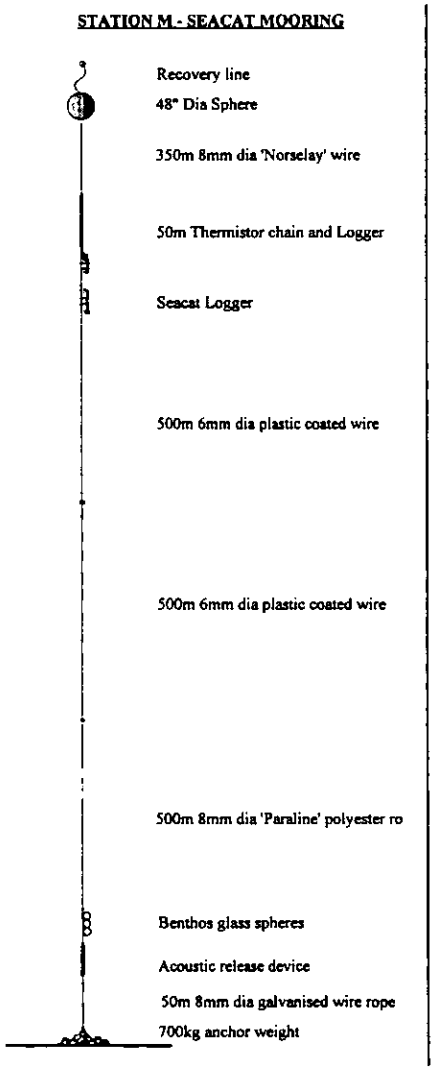


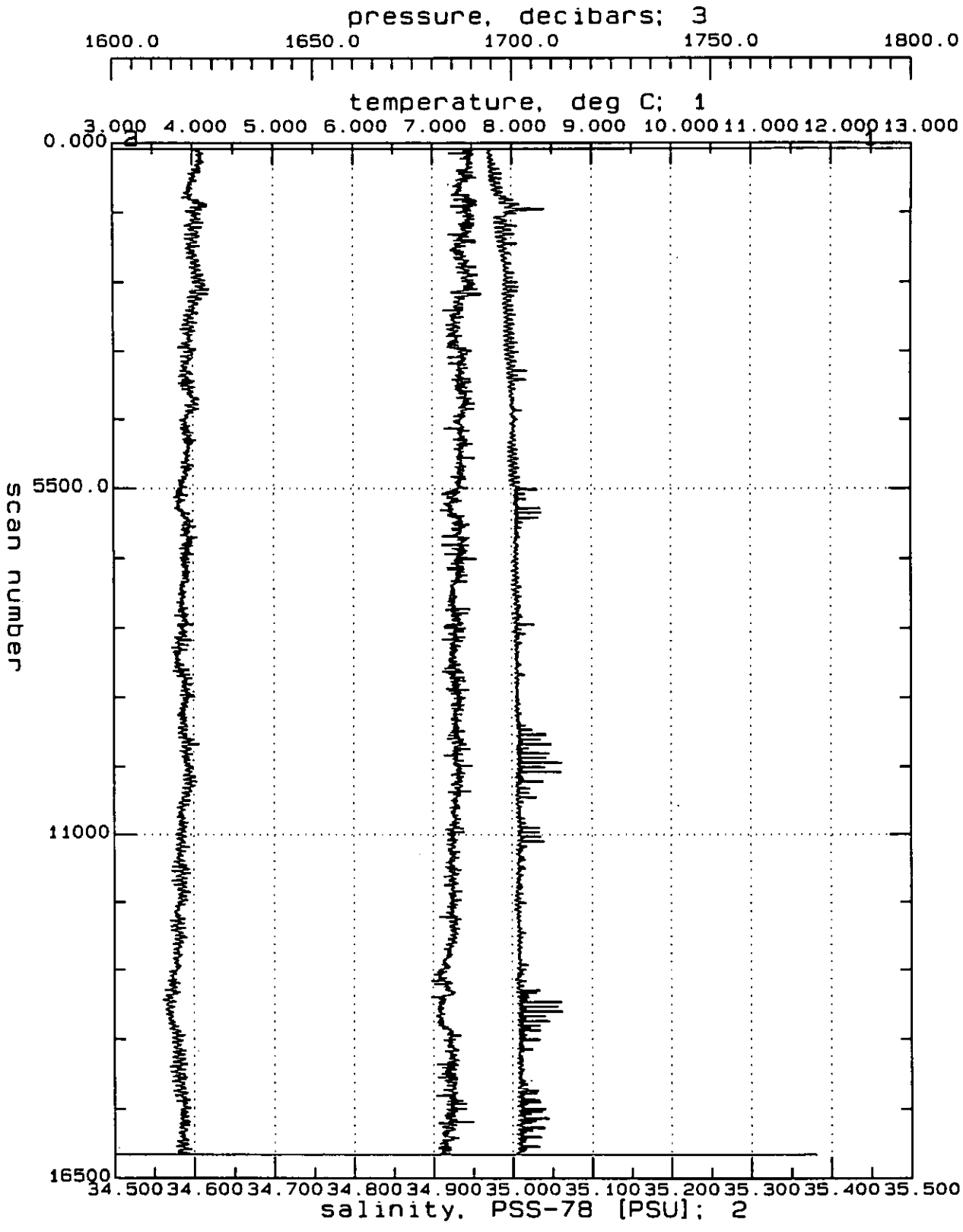
Figure 9: The Mooring at M

Figure 9 shows the replacement mooring at M that was installed on the 7th. It comprised a Seacat and thermistor logger with a 50m thermistor chain at about 650 metres depth in a depth of 2224 metres. The rig was in place at 57°17.7'N. 10°23.4'W by 0714Z .

IOSDL Mooring on the Barra Fan

This mooring comprised the ADCP, housed in a Flotation Technology 49 inch syntactic foam buoyancy sphere, 2 Aanderaa current meters to provide reference measurements and 2 CR200 acoustic releases. Back up buoyancy was 17 inch glass spheres at depths of 550 and 850 metres. An Argos SMM beacon and Benthos light were fitted to aid relocation and the mooring was to be monitored during its deployment period by the Argos Subsurface mooring monitoring service.

The deployment commenced at 0950Z 04-09-93. The ADCP was lifted on a cut away strop and allowed to drift astern. The mooring line was paid out from the ship's auxiliary winches and stopped off to allow insertion of the instruments and back-up buoyancy. The anchor was



MOORMMAY.CNV: MOORING M MAY 93 SEPT 93

Records from Mooring M in the Rockall Trough, May to September 1993

Challenger 105/93 Figure 10

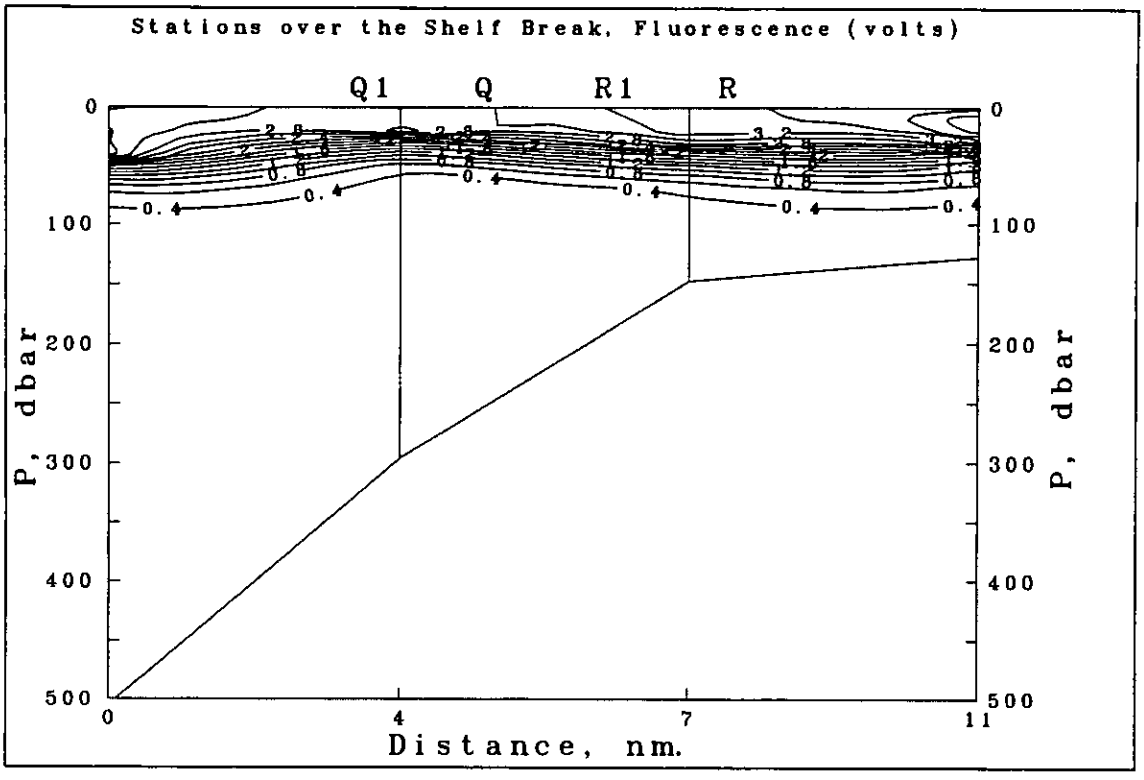


Figure 11a: Fluorescence voltage from the Seabird CTD over the shelf break, 9 September. 1993.

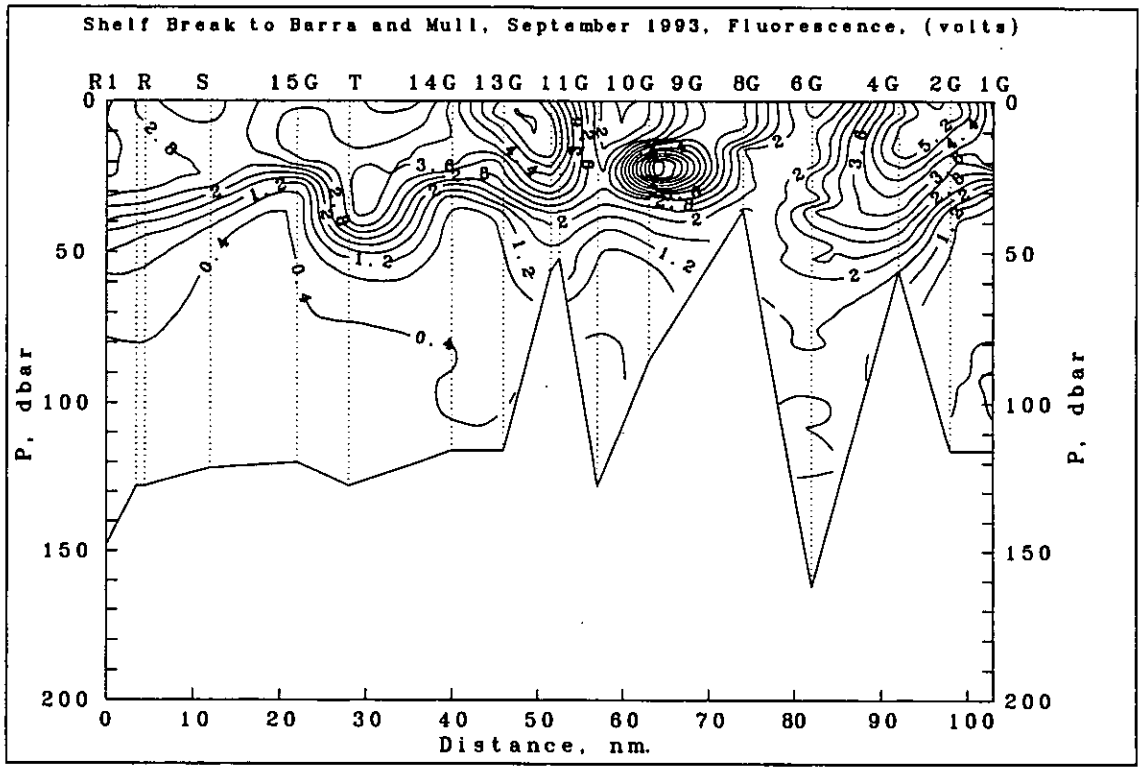
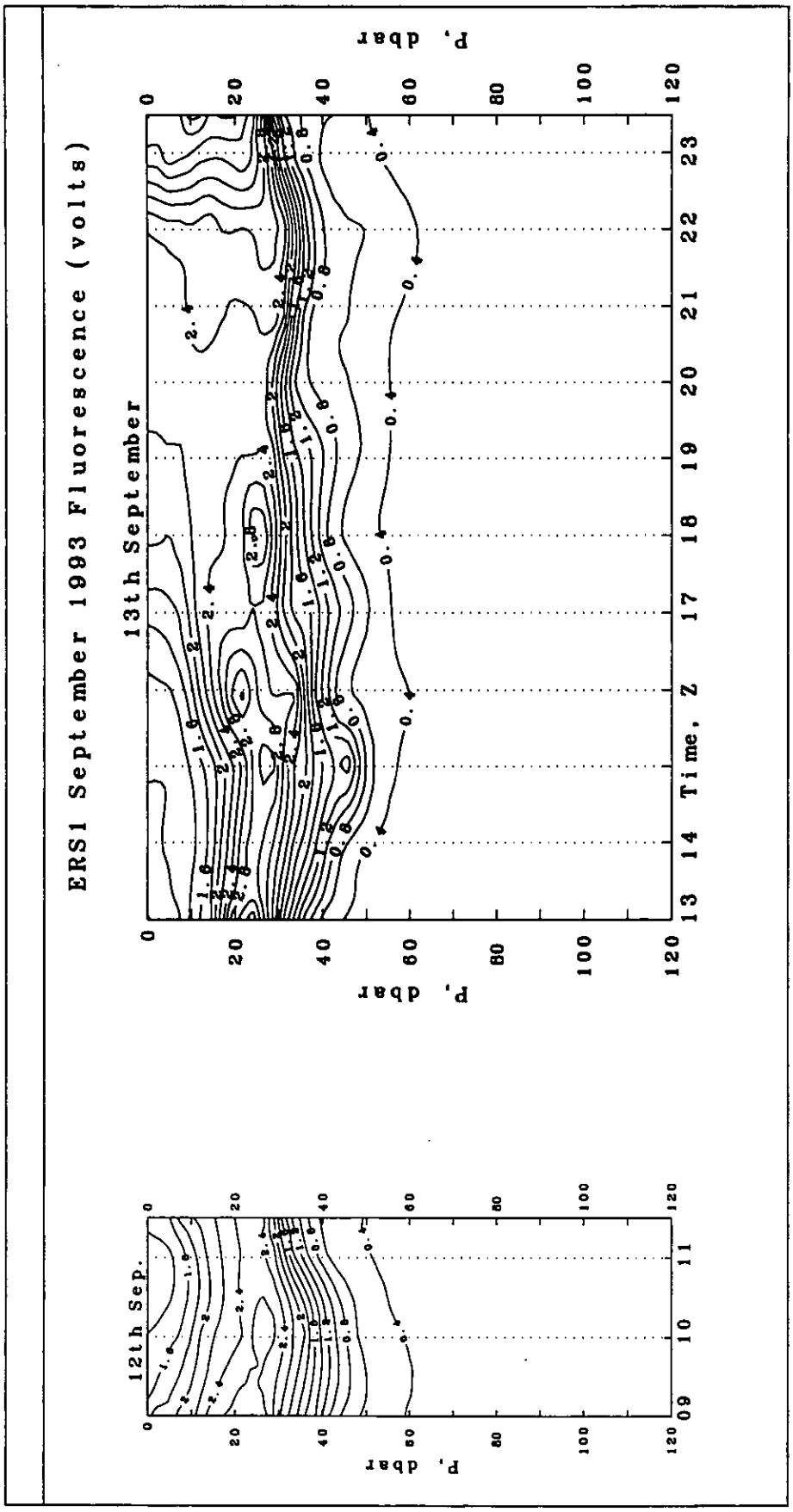


Figure 11b: Fluorescence voltage from the Seabird CTD on the shelf, 9-10 September. 1993.



Fluorescence voltage from the Seabird CTD at ERS1, 12 & 13 September 1993.

Challenger 105/93 Figure 11

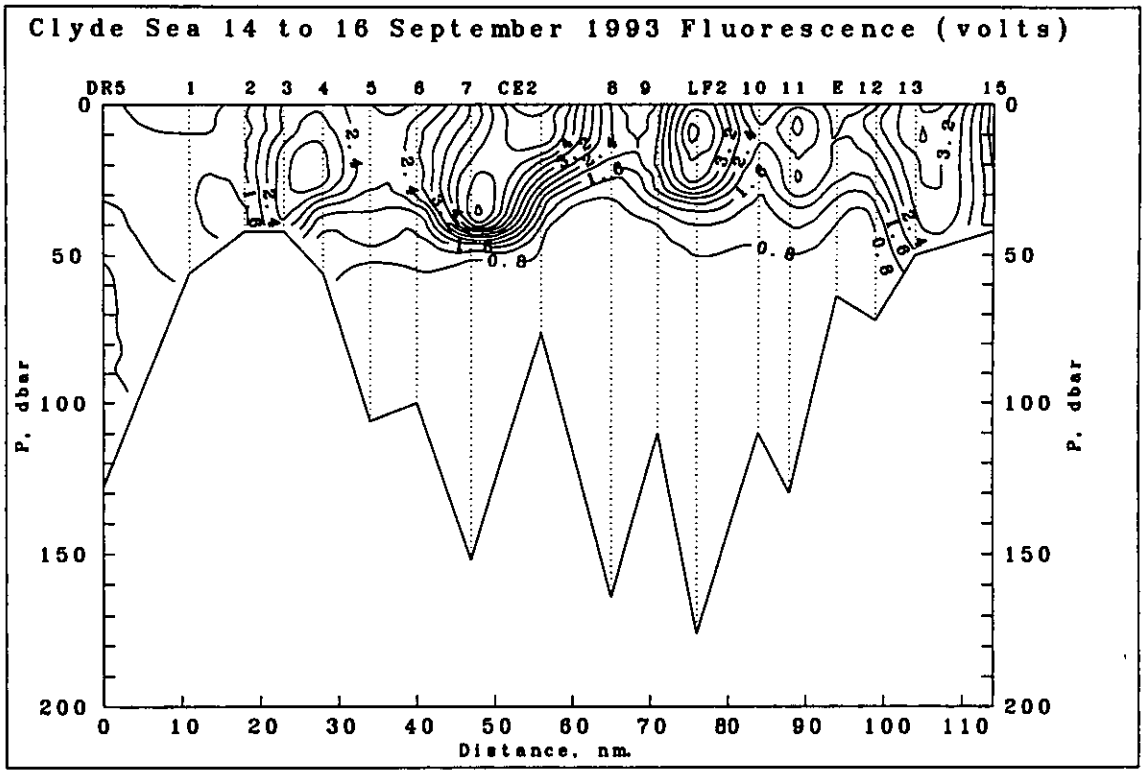


Figure 11d: ***Fluorescence voltage from the Seabird CTD in the Clyde Sea, 14th to 16th September. 1993***

cut away at 1036Z at 56° 39.54' N 09° 35.66' W in a depth of 1507m and was seen on the bottom at 1048Z, with a strong bottom echo below it.

We started to recover the mooring at 1508Z on the 12th September. The acoustic releases were interrogated and turned on. The ship was positioned downwind of the site. The releases fired but the mooring failed to rise. No bottom echo could be seen this time. Further attempts were made until 1830Z without success. The cause of the failure is unknown and we hope that a further attempt at recovery may be made at a later date.

Rectangular Mid-water Trawls (RMT)

In total, we made seven RMT 1&7 tows, 6 of which were successful (Table 1). The initial tow made at Rockall on the 5th to a depth of 1000m was unsuccessful. This owed mainly to paying the wire out too quickly. Two other tows in oceanic water netted good samples with large numbers of deep sea taxa including copepods such as *Euchaeta* and *Megacalanus*, shrimp such as *Sergestes*, chaetognaths and several species of fishes including representatives of the genus *Cyclothone*. We towed thrice on the continental slope and once on the adjacent shelf. The zooplankton samples were preserved in 5% formaldehyde and a small portion was frozen for later CN analysis. Deep sea fish were preserved in 70% alcohol for subsequent DNA analysis at the Natural History Museum & Institute, Chiba, Japan.

Table 1. Station details for RMT1&7 trawls made during the cruise.

Date /9/93	*Station*	*Wire Out m.*	*Start Position °N.°W.*		*Location*	*Tow Type*
05	D.5	2000	57°32'32	12°44'19	Rockall	Oblique
07	M.5	500	57°14'96	10°07'58	Anton Dohrn	Oblique
08	O	2000	57°09'70	9°42'16	Oceanic	Oblique
09	P1-2	1400	57°06'85	9°33'10	Slope	Stepped
11	R2	1000	56°54'90	9°06'66	Slope	Stepped
12	Q1-2	600	57°04'80	9°19'55	Slope	Stepped
13	Q1-3	275	57°08'74	9°12'82	Shelf	Oblique

Specimens of *Pleuromamma robusta* were obtained at midnight at 400 m depth during the cruise by using the tow net (a mesh size of 400 μm). 30 live specimens of *Pleuromamma robusta* were sorted immediately under the dissecting microscope. They were examined using the epifluorescent microscope to determine accurately the number and localization of the luminescent organs. Some live specimens were kept at 5°C in the refrigerator, destined for examination of feeding behaviour and swimming speed using the high speed video at DML. Some specimens were preserved in Hexamine buffered 5% formalin to study their stomach contents and to use the scanning electron microscope. In addition, a phytoplankton tow net was used to collect phytoplankton to compare with the stomach contents of *Pleuromamma robusta* at midnight at 300 m depth.

Multicorer and Craib Cores

Subsets of cores were variously destined for: incubation to determine their Dissolved Oxygen Utilisation (DOU) and that of the overlying water; measurement of their C/N profile;

preservation with Mercuric Chloride, Glutaraldehyde for Scanning Electron Microscopical examination, Rose Bengal for meiofaunal and Protozoan analysis; freezing for later chemical sulphur (AVS,PVS,ES) analysis; particle size analysis and dinoflagellate resting stages.

Table 2: Multicorer and Craib Cores

Station	*Long °N.*	*Lat .°W.*	*Drops/Cores*	*Comments*	*Depth, m.*
M	57° 18.0'	10° 23'	3/18		~2200
O	57° 09.0'	09° 42'	3/18		~1920
P	57° 06.0'	09° 25.0'	3/18		~1360
Q1	57° 04.5'	09° 19.0'	3/18		~720
ERS1	57° 50'	08° 40'	Craib	Sandy stony, unsuitable	~130
CS4	55° 21.8'	05° 04.7'	Craib	C/N	~66
CL15	55° 17.0'	05° 27.5'	Craib	C/N	~50
CS6	55° 32.2'	04° 59.0'	Craib	C/N	~110
CS7	55° 38.4'	05° 01.8'	Craib	C/N	~164

CTD and water bottles

The WOCE Seabird CTD worked successfully, with no failures. The connector to the tail was remade once. We collected water samples with NIO bottles on the hydrographic wire. Table 3 summarises the stations.

Table 3: "Challenger" Cruise 105/93: CTD and Water Bottles

Notes:

1. SS : *surface salinity sample for the Atlantic Salinity Anomaly Programme (ASAP).*
2. N : *a neuston tow of about ten minutes. 39 tows were made in total.*
3. U : *denotes a 10 litre sample for SURRC U^{234} analysis.*
4. V : *a vertical plankton net haul of depth shown. e.g. V3 is at 300 metres.*
5. % : *Carbon/Nitrogen determination.*
6. : *Chlorophyll and Nutrient samples were taken at subsets of a set of standard depths of 0, 5, 10, 20, 40, 80, 150, 300, 600, 900, 1200, 1500, 1800, 2100. In the table, for example, 5~40 denotes 5,10,20,40 metres. Any other depths are listed. Some chlorophyll samples were analysed with a DCMU technique.*
7. : *The CTD depth shown is derived from the sounding and pinger height over the bottom or wire out indicator.*

Station	**Disc** /Dip	Lat ° ' N	Long ° ' W	**Date/** Time GMT	Water Depth metres	CTD Depth metres	Sample Depth (m) for *Nutrient;* Chlorophyll/**DCMU**	Other Work
Goy1	-	56°39.6'	9°35.7'	**4/9** 1027	-	-	-	-
M	-	57°18.0'	10°23.2'	1530	-	-	-	-

Station	**Disc** /Dip	Lat ° ' N	Long ° ' W	**Date/** Time GMT	Water Depth metres	CTD Depth metres	Sample Depth (m) for *Nutrient;* Chlorophyll/**DCMU**	Other Work
WOCE: Anton Dohrn Section								
A	**01**/001	57°35.0'	13°38'	**5/9** 0444	118	110	*5-80,100,110;* **5~80**,100	N
B	002	57°34.0'	13°20'	0854	184	178	*0~184;* 0,**5~80**	U(150) U(0);N
C	003	57°33.0'	13°00'	1028	300	285	*0~250,285;* 0,**5~150**	N
D	004	57°32.5'	12°52'	1304	1108	1100	*0~1045;* 0,**5~150**	N
E	005	57°32.0'	12°38'	1717	1658	1636	*0~1655;* 0,**5~150**	N
F	**02**/006	57°30.5'	12°15'	2130	1809	1730	*5~1809;* 0,**5~150**	V3,V4
G	007	57°29.5'	11°51'	**6/9** 0453	1803	1788	*0~1800;* 0,**5~150**	N
H	**03**/008	57°29.0'	11°32'	748	2023	2013	*5~2020;* 0,**5~150**	N
I	009	57°28.0'	11°19'	1240	746	734	*5~600,730;* 0,**5~150**	N
J	010	57°27.0'	11°05'	1439	586	573	*5~300;* 0,**5~150**	N
K	**02**/011	57°24.0'	10°52'	1756	768	760	*5~600;* 0,**5~150**	N
L	**04**/012	57°22.0'	10°40'	1947	2125	2120	*5~1500;* 0,**5~150**	V4,V3
M	013	57°18.0'	10°23'	**7/9** 0410	2221	2195	*5-2000;* 0,**5~150**	V3
N	**05**/014	57°14.0'	10°03'	1457	2108	2094	*5~2100;* 0,**5~150**	N; U(0)
O	**06**/015	57°09.0'	9°42'	2144	1917	1901	*5~1900;* 0,**5~150 %**	NV4V3
P1	/016	57°07.5'	9°33.5'	**8/9** 0457	1775	1751	*0~1200,1755;* 0,**5~150 %**	N;
P	017	57°06.0'	9°25.0'	0700	1360	1455	*5~1400;* 0,**5~150 %**	N;
Q1	**07**/018	57°04.5'	9°19.0'	1927	712	694	*0~714;* 0,**5~150 %**	N;
	Fluorimeter attached to CTD for work at 0 to 500 metres							
Q1	019	"	"	2055	648	500	-	-
Q	020	57°03'	9°13.0'	2217	316	298	*0~500;* 0,**5~150 %**	NU0V3
R1	021	57°01.5'	9°06.5'	**9/9** 0056	155	147	*5~120;* 0,**5~120 %**	N;
R	022	57°00'	9°00.0'	0155	135	125	*0~120;* 0,**5~120 %**	N;
S	023	56°57'	8°47.0'	0348	129	122	*5~120;* 0,**5~120 %**	N;
Section across the Southern end of the Minch								
11G	**09**/024	56°44'	7°40'	2043	58	51	*5~40;* 0,**5~40**	N;U(0);
10G	025	56°44'	7°30'	2214	211	191	*5~200;* **5~150**	N;
9G	026	56°44'	7°20'	2331	161	140	*5~120;* 0,**5~120**	N;U(0);

Station	**Disc** /Dip	Lat ° ' N	Long ° ' W	**Date/** Time GMT	Water Depth metres	CTD Depth metres	Sample Depth (m) for *Nutrient;* Chlorophyll/**DCMU**	Other Work
8G	SS	56°44'	7°10'	**10/9**/0040		-	-	-
7G	027	56°44'	7°00'	0147	140	124	*0~130;* 0,**5~130**	N;
6G	028	56°44'	6°45'	0315	50	40	*0~20;* 0~**20**	N;
5G	SS	56°44'	6°36'	0418	-	-	-	-
4G	029	56°44'	6°27'	0508	93	83	*0~80;* 0,**5~80**	N;
3G	SS	56°42.5'	6°22'	0550	-	-	-	-
2G	030	56°41'	6°17'	0618	42	35	*0~20;* 0,**0~20**;	N;Cs 0,25
1G	031	56°40'	6°08'	0831	165	155	0~150,**5~150**;	N;Cs 0,53,120
Barra to the Hebridean Shelf Edge at R								
11G	032	56°44'	7°40'	1657	65	55	-	N;
12G	SS	56°45.5'	7°50'	1739	-	-	-	-
13G	033	56°47'	8°00'	1818	123	115	*0~120;* 0,**5~120 %**	N;
14G	034	56°48.5'	8°10'	1958	125	107	*0~120;* **5~120**	N;
T	035	56°50'	8°20'	2102	135	121	*0~120;* **5~120**	N;
15G	036	56°53'	8°30'	2240	128	117	*0~120;* **5~120**	N;
S	037	56°57.0'	8°47.0'	**11/9** 0017	30	123	*0~120;* **5~120**	N;
RN;	**09**/038	57°00.0'	9°00.0'	0212	136	125	*0~120;* **5~120**	-
Line M across the continental slope on the southern edge of the LOIS box.								
M10	39	56°40'	8°45'	1308	130	120	*5~120;* **5~120**	-
M9	040	56°40'	8°50'	1430	132	120	*5~120;* **5~120**	N;
M8	041	56°40'	8°55'	1528	131	120	*0~120;* 0,**5~120**	-
M7	042	56°40'	9°00'	1654	366	344	*0~150;* **5~150**	N;
M6	**07**/043	56°40'	9°05'	1800	651	500	*0~150;* **5~150**	-
M5	044	56°40'	9°10	2015	945	500	*0~150;* **5~150**	N;
M4	045	56°40'	9°15'	2133	1120	500	*0~150;* **5~150**	-
M3	046	56°40'	9°20'	**12/9** 0005	1245	500	*0~150;* **5~150**	N;
M2	**10**/047	56°40'	9°25'	0120	1312	500	*0~150;* **5~150**	-
M1	048	56°40'	9°30'	0347	1425	500	*0~150;* **5~150**	N;
Time Series at ERS1								
ERS1	049	56°50.00	8°39.66	0900	130	120	-	-
ERS1	050	56°50.08	8°39.91	0956	131	"	-	-
ERS1	051	56°49.99	8°39.99	1055	131	"	-	-

Station	**Disc** /Dip	Lat ° ' N	Long ° ' W	**Date/** Time GMT	Water Depth metres	CTD Depth metres	Sample Depth (m) for *Nutrient;* Chlorophyll/**DCMU**	Other Work
ERS1	052	56°49.99	8°40.02	1129	131	"	-	-
ERS1	053	56°50.04	8°39.87	**13/9** 1218	130	"	-	-
ERS1	054	56°50.21	8°39.56	1257	131	"	-	-
ERS1	055	56°50.01	8°40.80	1355	132	"	-	-
ERS1	056	56°50.13	8°39.15	1555	132	"	-	-
ERS1	057	56°49.90	8°39.90	1555	134	"	-	-
ERS1	058	56°50.10	8°40.00	1654	133	"	-	-
ERS1	059	56°50.00	8°39.80	1755	133	"	-	-
ERS1	60	56°50.05	8°39.99	1854	132	"	-	-
ERS1	**08**/061	56°50.00	8°40.03	1954	130	"	-	-
ERS1	062	56°49.96	8°39.96	2054	130	"	-	-
ERS1	063	56°50.02	8°40.03	2155	130	"	-	-
ERS1	064	56°50.02	8°40.00	2226	130	"	-	-
Stations in the Clyde Sea and North Channel								
MK4	065	55° 13.0'	05° 55.0'	**14/9** 1650	133	120	-	-
DR5	066	55° 00.0'	05° 30.0'	1710	136	125	*5~120;* **5~120**	-
CS1	067	55° 09.5'	05° 22.3'	2314	55	47	*5~60;* **5~60**	-
CS2	068	55° 13.9'	05° 15.0'	**15/9** 0044	51	40	*5~40;* **5~40**	-
CS3	069	55° 18.0'	05° 11.3'	133	51	40	*5~40;* **5~40**	-
CS4	070	55° 21.8'	05° 04.7'	308	66	55	*5~55;* **5~55**	-
CS5	071	55° 26.7'	05° 01.3'	400	114	105	*5~80;* **5~80**	-
CS6	072	55° 32.2'	04° 59.0'	639	110	100	*5~80;* **5~80**	-
CS7	073	55° 38.4'	05° 01.8'	735	164	150	*5~150;* **5~150**	-
CE2	074	55° 46.7'	04° 58.8'	0955	83	75	*5~80;* **5~80**	U(0)
CS8	075	55° 41.9'	05° 08.9'	1118	171	165	*5~30,55,90,120,155;* **5~30,90,120,155**	-
CS9	076	55° 46.1'	05° 15.5'	1259	120	110	*5~100;* **5~100**	-
LF2	077	55° 50.6'	05° 19.8'	1352	187	175	-	U(0)
CS10	078	55° 42.6'	05° 20.1'	1512	118	110	*5~100,110;* **5~100,110**	-
CS11	079	55° 40.3'	05° 25.4'	1627	138	130	*5~130,100;* **5~130,100**	-
CSE	080	55° 34.4'	05° 25.4'	1722	74	65	*5~50,60,70;* **5~50,60**	-
CS12	081	55° 30.1'	05° 26.5'	1825	81	72	*5~40;* **5~40**	-

Station	**Disc** /Dip	Lat ° ' N	Long ° ' W	**Date/** Time GMT	Water Depth metres	CTD Depth metres	Sample Depth (m) for *Nutrient;* Chlorophyll/**DCMU**	Other Work
CS13	082	55° 26.0'	05° 28.9'	1910	58	50	-	-
CS15	**10**/083	55° 17.0'	05° 27.5'	2040	49	42	*5~40;* **5~40**	-
CS5	084	55°27.0'	05°02.0'	2244	123	116	-	-
AD4	**11**/085	55°25.0'	04°56.8'	2332	66	55	-	-
AD5	086	55°24.1'	4°52.14'	0007	61	50	-	U(0)

POL Drifting Argos Buoys Deployment

Seven buoys were launched with vertical cylindrical drogues at 30m depth. The transmissions from all buoys were checked before launch. The navigation lights were all checked overnight and fitted with replacement batteries where necessary. Table 4 summarises the deployments.

Table 4: Argos Buoys Deployments

Buoy Number	Switched on	Deployed	Lat. °N.	Long °W.
1	12/9/93/1615Z	14/9/93/1730Z	54° 59.70'	5° 29.40'
3	12/9/93/1552Z	14/9/93/1906Z	54° 44.25'	5° 27.86'
4	12/9/93/1510Z	14/9/93/1941Z	54° 46.19'	5° 22.87'
5	12/9/93/1851Z	14/9/93/1943Z	54° 46.18'	5° 22.83'
7	12/9/93/1811Z	14/9/93/2018Z	54° 48.36'	5° 17.96'
8	12/9/93/1834Z	14/9/93/2021Z	54° 48.37'	5° 17.97'
10	12/9/93/1753Z	14/9/93/2057Z	54° 51.47'	5° 13.04'

Equipment

Ship's Gear

- This comment was made at the end of cruises 86/91, 87/92 and 101/93. Despite the passage of time, it is still relevant: it is inconvenient that the Simrad Echo sounder cannot be triggered with a selectable delay relative to a standard clock. Could this be done, it would be easier to find the trace of pingers used to monitor the approach of equipment to the sea-bed.
- It was a matter of concern that the freezer used for scientific samples was not working properly in the last days of the cruise.

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