Scottish Marine Biological Association

Dunstaffnage Marine Research Laboratory

CRUISE REPORT

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DUNSTAFFNAGE MARINE LABORATORY

and the

SCOTTISH MARINE BIOLOGICAL ASSOCIATION

Oban, Argyll, Scotland

Cruise Report

RRS CHALLENGER

Cruise 71/1990

29 August - 17 September 1990

RRS CHALLENGER, Cruise 71/1990 : Leg 1

Duration: 1718 h 29 August - 0750 h 5 September 1990

All times GMT.

Locality: Rockall Channel and Scottish continental shelf.

Staff: D.J. Ellett
Dr. J.M. Graham
C.R. Griffiths
N. MacDougall
Miss S. Holt (ARE, Portland).

Aims: 1) To work the CTD stations of the Anton Dohrn Seamount section between Rockall and the shelf-edge.

2) To collect large-volume water samples between the shelf-edge and the Sound of Mull.

3) To redeploy the DML current meter in the Tiree Passage.

Narrative: CHALLENGER sailed from Victoria Dock, Aberdeen at 1718 h 29 August and after fuelling set course northward en route for Rockall. Good progress was made with winds of force 4-5 off the land, and the Butt of Lewis was passed at 1725 h 30 August. Fresher weather with southwest to west force 7 winds was encountered overnight, but conditions improved during 31 August and a short CTD section on to Rockall Bank from the east-northeast was begun at 1846 h. Four stations were worked from depths of 1250 m to 350 m and the ship steamed to station A near Rockall.

As CTD work begun here the cable parted with the loss of the Bissett-Berman 9041 CTD, water-bottle and pinger. The wire was sliced at an angle and hanging by two strands about a metre further inboard. A burnished kink between the cuts helped to suggest that a loose turn had been caught in the drum flanges or winding-on gear. The spare 9040 instrument was attached after cropping back some 10 metres of cable, and section work recommenced at 0248 h 1 September. The westerly force 4 winds increased to force 5-6 during the day and heavy squalls were frequent as the ship approached the Scottish shelf-edge on 2 September. The shelf section and large-volume water sampling began at 1835 h and continued eastwards with southwesterly winds occasionally reaching force 7 during 3 September. The Sound of Mull was reached in the forenoon and station 1G completed at 1016 h. In the interval before high slack water at the Tiree Passage meter mooring position, CHALLENGER rounded Ardnamurchan and worked four CTD stations of the Loch Moidart - Loch Boisdale section.

The current meter mooring was laid between 1715 and 1725 h 3 September and we returned to the section across the Sea of the Hebrides. The fresh force 5-6 southwesterly winds continued and the Loch Boisdale station was completed at 2342 h. The Loch Maddy - Loch Dunvegan section was worked between 0250 and 0552 h 4 September, and the section from Loch Bracadale towards Oigh Sgeir between 0813 and 1140 h. CHALLENGER then steamed via the Sound of Mull to the Lynn of Morven where we hove-to overnight, berthing at Railway Pier, Oban at 0850 h 5 September to exchange staff and gear.

Results

Aim 1) The CTD section from Rockall to the shelf-edge was worked on 1-2 September. Two additional stations were inserted over the edge of Rockall Bank to provide comparison with a short section of four lowerings worked about 12 km further north on the previous day. Water of salinity greater than 35.4 psu was found immediately beneath the surface thermocline over the centre of the Rockall Channel and over the Scottish shelf-edge. In the Labrador Sea water below 1500 m depth salinity was lower than in recent years.

Aim 2) Large volume water samples and CTD profiles were obtained at all the standard stations between the shelf-edge and the Sound of Mull.

Aim 3) The Tiree Passage current meter mooring was redeployed on 3 September. The previous mooring at the site was recovered on 28 June, but because of damage by fishing could not be replaced at that time.

Miscellaneous Standard CTD sections from Loch Moidart to Loch Boisdale, Loch Maddy - Loch Dunvegan and Loch Bracadale - Oigh Sgeir were worked on 3-4 September to provide comparison with earlier years.

General Comments The loss of the CTD highlights the need for proper instruction in the use of the winch and A-frame for new winchmen. The interaction between A-frame components and winch cable is not easy to appreciate until experienced and some gear handling should be tried under supervision in daylight by those concerned. Improved lighting over the winch drums is necessary so that loose turns can be seen from the winch cab at night.

Captain Long, his officers and crew helped us to make good use of the time available and to complete all our aims.

D.J. Ellett
7 September 1990

RRS Challenger, Cruise 71/1990: Leg 2

Duration: 14.00 h 5 September - 21.00 h 16 September 1990

Locality: Rockall Trough

Staff: J.D.M. Gordon, Dunstaffnage Marine Laboratory, Principal Scientist
R. Harvey, Dunstaffnage Marine Laboratory
P. Lamont, Dunstaffnage Marine Laboratory
L. Vickers, Dunstaffnage Marine Laboratory
A. Blackstock, Dunstaffnage Marine Laboratory
G. Lawson, University of Southampton
H. Horsefall, University of Southampton
J. Hunt, British Geological Survey, Edinburgh
C. Stephanescu, Instituto de Ciencias del Mar, Barcelona, Spain

Aims: (1) To sample the benthos and benthopelagic fish of the Rockall Trough as part of a seasonal study of the biology of these deep-sea organisms.

(2) To collect gravity cores for BGS at a number of sites.

Narrative (all times GMT)

Challenger sailed on the second leg from Oban at 14.00 hrs (5/9/90) and headed up the Sound of Mull towards the Hebridean Terrace but with a north-westerly force 9 gale forecast Challenger sheltered off Tiree and Coll until 05.00 hrs (7/9/90). Challenger then proceeded to the first trawling station arriving at 15.25 hrs. The Marinovitch semi-balloon trawl (OTSB) was deployed on paired warps over a sounding of about 900 m. The trawl was recovered inboard at 18.42 hrs with a good catch despite the fact that the net was damaged and the bridles on the starboard wings had parted. A new trawl was rigged and the OTSB was again deployed on paired warps over a sounding of about 1200 m. The net was recovered at 01.04 hrs (8/9/90) with a good catch even although most was retained in the codend extension rather than the fine meshed codend. Challenger then proceeded to Station M and on arrival successfully deployed the BGS gravity corer between 07.42 and 08.37 hrs (Station 3). This was followed by a successful spade box core (Station 4) between 09.33 and 11.11 hrs. The epibenthic sledge was deployed (Station 5) at 12.40 hrs, towed successfully through Station M and recovered at 17.41 hrs. The work at Station M was completed with an Agassiz trawl fished between 18.38 and 22.56 hrs (Station 6).

Challenger then steamed to occupy a trawling station at about 1800 m to the south of the Hebridean Terrace and on passage the gravity corer was deployed between 01.30 and 02.10 hrs (9/9/90) (Station 7). The OTSB was then deployed between 04.06 and 08.48 but had never reached the bottom. The station was repeated between 11.10 and 16.02 hrs and on this occasion yielded a good catch of fish and invertebrates (Station 9). Challenger then began steaming towards the SMBA Permanent Station and on passage carried out three gravity cores at 1780, 1790 and 2370 m. The OTSB was also deployed on passage (Station 13) over a sounding of about 2400 m between 04.24 and 09.55 hrs (10/9/90) yielding an excellent catch of both fish and invertebrates.

Challenger arrived at the Permanent Station at 18.00 hrs (10/9/90) and two epibenthic sledges were carried out between then and 06.45 hrs (11/9/90) (Stations 14 and 15). This was followed by a successful BGS gravity corer (Station 16) but an attempt to use the box corer failed when the one of the gimbals came loose. While the box corer was being repaired it was decided to deploy the RMT (Station 18). This was successfully accomplished between 12.34 and 16.45 hrs. Challenger then steamed back to the permanent station and deployed the box corer but no sample was obtained when the main warp caught on a projection from the body of the corer. The corer was redeployed at 20.52 hrs (Station 20) and a fairly good sample was obtained. The final epibenthic sledge haul at the Permanent Station (Station 21) was completed between 00.35 and 05.58 hrs (12/9/90). It had been intended to carry out the deep OTSB trawl on passage to the southern Feni Ridge but because of loss of time at the beginning of the cruise most of the available time would have been wasted on steaming for only a few hours of work. Furthermore the unreliability of the box core meant that a long steam could not be justified. It was therefore decided to deploy the trawl just to the north of the Permanent Station. This was accomplished between 07.00 and 14.39 hrs and a good catch of fish and invetebrates was obtained. Challenger then headed back towards the Hebridean Terrace to carry out a supplementary trawl at 700 to 800 m. On passage a gravity core was obtained from a depth of 2630 m (Station 23). The OTSB trawl on the Hebridean Terrace (Station 24) was fished on a single warp between 04.25 and 07.20 hrs (13/9/90) and yielded an excellent catch of invertebrates as well as fish. In an attempt to obtain specimens of corals for radiometric ageing studies, the Agassiz trawl was deployed at a depth of 1020 m (Station 25) but was recovered at 15.36 hrs with a badly torn net. It was then decided to utilise the remaining few hours in obtaining gravity cores. A core was obtained from 1095 m in marginal weather conditions. A further core was obtained from the adjacent shelf (145 m) but with an ever increasing swell all further coring had to be abandoned at 19.20 hrs. Challenger then headed west for deeper water to deploy a final Agassiz trawl but at 02.30 hrs (14/9/90) the swell was such that all scientific work had to be abandoned. Challenger steamed for Great Yarmouth and tied up alongside at 21.00 hrs on 16/9/90. The scientific gear was offloaded during the morning of 17/9/90 and all the scientists had left by midday.

RESULTS

AIM 1

Benthic Invertebrate sampling for SMBA ARP2 (Gage)

The primary aim of the sampling was to continue the time series of epibenthic sled and Agassiz trawl samples from two repeat stations begun in 1975. This seeks to assess inter-annual variation, but the series of 5 cruises in 1990/91 will also give improved resolution of life histories, particularly early post larvae of bivalves. The new epibenthic sleds provided by RVS are the main tool to achieve this. Secondary aims were the collection of box core samples at the repeat stations to supplement the sparse data obtained so far on spatial variability and community structure. We also hoped to core on the South Feni Ridge to provide a comparison with results from the Scottish side of the Rockall Trough. A number of other studies on population dynamics and zoogeography benefit from the large catches of megabenthic invertebrates often obtained with the fish trawl.

Good catches of invertebrates were obtained with the semi-balloon trawl at all except the first station. As noted on previous cruises, best results were obtained when fishing on a single warp. Excellent specimens of two rarely caught starfish were obtained, and at the last trawl station (24) an enormous specimen of the crab *Geryon* was taken. This station also produced a good haul of rarely encountered juvenile sea urchins, mainly *Echinus ? elegans* and some small *Spatangus raschi*.

Station 'M' was sampled as planned, with good catches with the RVS Agassiz trawl and SMBA Epibenthic Sled with 1 mm mesh net. A spade box core sample was obtained despite somewhat marginal conditions, but the surface of the core was disturbed, and the overlying water cloudy due to a poorly fitting drain spout. The surface of the core retained burrows and other signs of life, and a large echiurian worm was found at the bottom of the core.

The SMBA Permanent Station sampling was also completed as planned, although it was necessary to repeat one epibenthic sled haul as the 0.3 mm net had become kinked, preventing the bottom sediment from reaching the extension net properly. A good sample was obtained with the Rectangular Midwater Trawl using the 1 square metre net. The spade box corer caused considerable problems, but a fair sample was obtained at the third attempt. Since the box corer was not functioning well, a secondary objective of coring on the South Feni Ridge was abandoned, since a 13 hour steam to reach the first station would have been required, leaving only 10 hours of useable coring time; insufficient to complete the planned transect of 4-5 stations. This was particularly disappointing since the sea conditions were unusually conducive to coring. There was some compensation, however, in the excellent invertebrate catch from Station 24 which was fitted in with the remaining working time (see first paragraph).

R. Harvey, P. Lamont
and L. Vickers

Invertebrate sampling for University of Southampton

Cnidarians

Samples of commonly occurring sea pens and the gorgonian *Acanella arbuscula* were required for studies on the seasonality or otherwise of reproduction, and calorific content.

Only two sea pens were recovered, both from Station 2. Gonads were removed and fixed for electron microscopy (EM), the rest of the tissue being frozen. A good sample of *Acanella arbuscula* was obtained from SMBA Station 'M' (Station 6). Polyps were removed and fixed for EM, the remainder being frozen. A second species of gorgonian was obtained, possibly *Paramuricea biscaya*, with entwined brittle stars. This was frozen.

Echinoderms

Samples of seastars, brittle stars, sea urchins and sea cucumbers were required for the analysis of gut contents, both for their calorific content and also particle size and identify of the contents. Some gonad material was also required. Sediment samples from the spade box corer were to be frozen for analysis of ATP and organic content for comparison with that of gut contents.

Good samples of echinoderms were obtained in almost every haul, resulting in an excellent collection of material. A considerable amount of time was spent in dissecting out guts and gonads from a wide range of species, and fixing these for EM studies. As with the cnidarians, the remaining material was frozen; indeed there was so much material that some had to be frozen for dissection later at Southampton. A 21 cm long subcore was obtained from the spade box core at Station 'M' (Station 4). This was sectioned and frozen.

This was a successful cruise, with the majority of the aims accomplished. I would like to thank Ian Horsfall for his valuable assistance throughout the cruise.

G. Lawson

Fish Populations

The main aim is to carry out a seasonal study of the dominant species of the slope with particular emphasis on age, growth and reproduction. Most emphasis is being placed on the macrourid and morid fishes and good representative samples of otoliths were obtained from most species. Of special interest were large numbers of juvenile macrourids (especially *Coryphaenoides rupestris*) which will be especially useful for studies of age and growth. There was very little evidence of sexually mature gonads in any of the species examined. Detailed information was collected from all the other fish species and this will be of value for future work on the previous collections of Rockall fish.

J.D.M. Gordon

AIM 2

Report of geological sampling

Although the cruise was primarily of a marine biological nature, time was very generously made available by SMBA to enable a programme of gravity coring to be executed at selected sites in the area of the Rockall Trough. The sites were chosen to facilitate two research projects currently underway at British Geological Survey, Edinburgh.

(i) Late Quaternary and early Holocene Tephrochronology of the North East Atlantic Region

This project is attempting to quantify the areal extent and volume of volcanic ash (Tephra) erupted during the last phase of glacial activity and retreat in the North East Atlantic area. In particular volcanic ash from two volcanic centres is being sought, dated at 10,600 yrs BP and 9,000-9,100 yrs BP, though additional events have also been found, distinguishable on grounds of chemical analysis (electron microprobe). Because the deposition of volcanic ash is a geologically instantaneous event then its presence within a sedimentary sequence may be taken as a discrete age horizon. If ash is found in several such sequences then time planes or isochrons may be constructed over large geographical areas. This relative form of dating sediments is not prone to the uncertainties presented by many absolute radiometric dating methods relied on at present.

Ash layers from several eruptions have been found in terrestrial and marine sediments and it is this inter environmental occurrence that is so valuable. Examination of environmental indicators (terrestrial pollen and macrofossils, marine dinoflagellates and foraminifera e.g. *Globigerina* spp. change from dextro to laevo-coiling at critical water temperature) associated with the tephra enables synchronous palaeo-temperatures and climates to be compared over wide areas at an instant in time. If this can be done for several ages then the rate of change of environmental gradients can be assessed. This is of use at the close of the last Ice Age when poorly understood climatic conditions resulted in growth and decay of large ice sheets (e.g. Loch Lomond readvance) over a period of less than 1,000 years.

In addition ash horizons, which in marine sediments are disseminated above and below the original layer of deposition, may be used to quantify degrees of bioturbation and sediment redistribution in the past. The depth at which they occur within cores from the Rockall area will give an estimate of postglacial sedimentation rates, of value to those involved with present day sea bed studies.

(ii) Gas Seeps

Recent work using "pinger" seismics has shown that dome-like reflectors rising from the sea bed may indicate gas escaping from deep reservoirs, rising through the Quaternary sediments and bubbling off at the sea bed. This is thought in some cases to lead to blow outs and subsequent formation of depressions (pockmarks) on the sea bed. Chemical analysis will reveal if any hydrocarbons are present within the sediments beneath these plumes.

(iii) Geology of coarse sea bed sediments

As various biological samples were recovered (trawls, epibenthic sleds, etc.) any rock fragments were collected for later examination. It may be possible on lithological grounds to pinpoint the origin of these sediments (4 mm - 400 mm) and gain an understanding of their transport paths. This may reveal whether ice rafting, slumping etc. play important parts in sedimentation during more recent times.

The coring work was successful in that more sites were investigated (8) than originally envisaged. Unfortunately the recovery of material was generally poor (0.98 m to 1.55 m) even though both long and short length barrels were used. It was clear from mud smearing on the exterior that the corer had penetrated to its maximum extent, and hence some factor was preventing the sediment from rising in the core liner. One possible factor could be frictional resistance within the liner. Clearly problems exist with the RVS gravity coring system.

From a technical point of view the gas seepage work could not be concluded satisfactorily owing to the lack of an echo sounder capable of recording sufficient depth with the appropriate frequency (the Simrad cannot function in depths greater than 1700 m, although in the suitable frequency range). The coring barrels were not in a usable state and some time was spent in repairing them.

J. Hunt

General Remarks

Apart from the loss of time at the beginning the weather was favourable and indeed unbelievably calm for the Rockall Trough for a while. With the exception of the problems with the box corer and some handling problems with the gravity corer the sampling was very satisfactory. Our scientific expertise was considerably diminished on this cruise and we are grateful to the 'first-timer' students who did much to make this cruise a success. We also thank Captain Long, his officers and crew for their support.

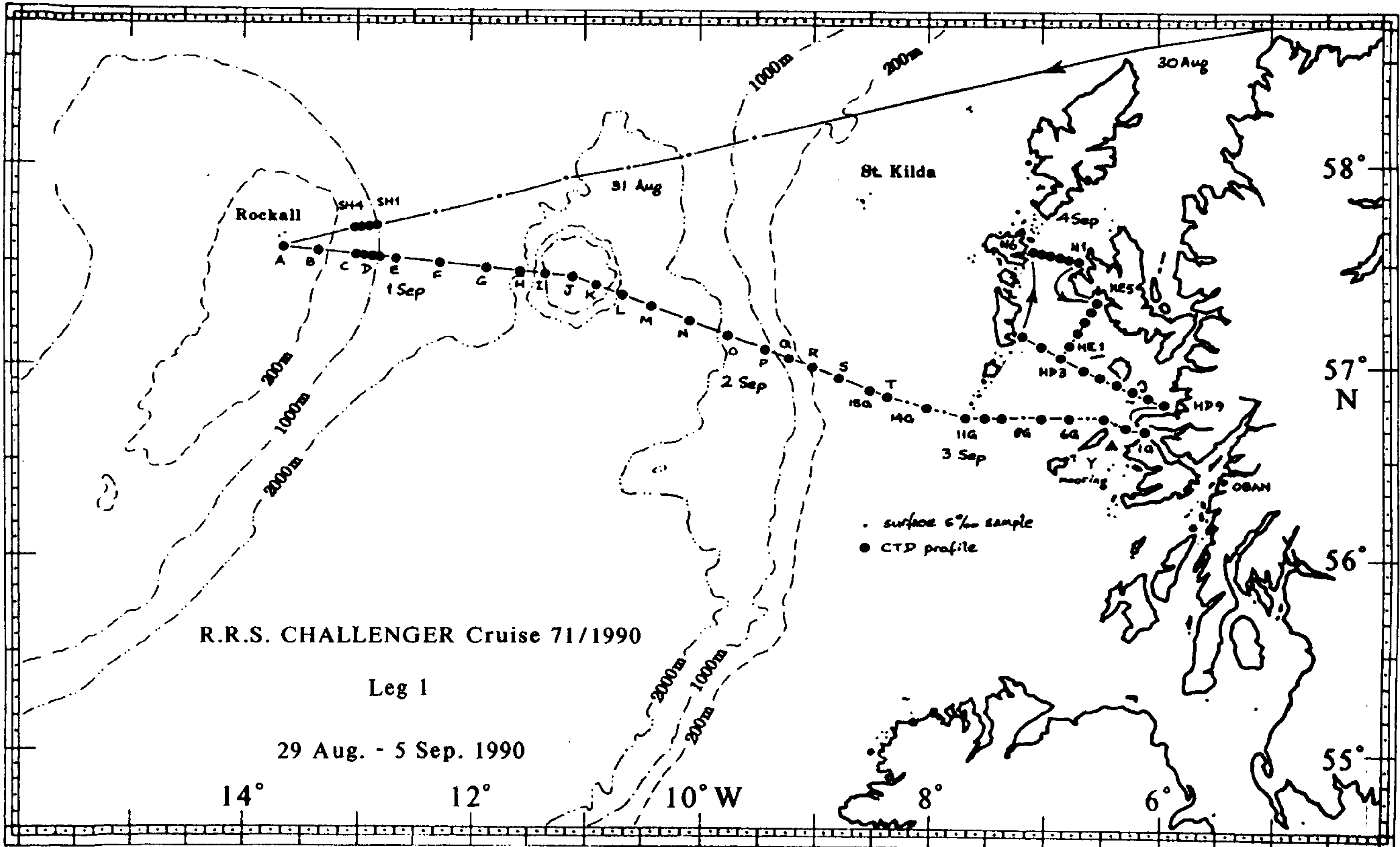
J.D.M. GORDON
November 1990.

Table 1. CTD Stations worked during Cruise 71/1990 (Leg 1)

Stations	CTD disc/ dip nos.	Location	Dates 1990	Observations
SH1 - SH4	156/001 - 004	Rockall Bank shelf-edge	31 Aug	CTD
A - BZ	156/005 - 008	Anton Dohrn Seamount section	1 Sep	CTD
C - E	157/009 - 014		1 Sep	CTD
F - G	158/015 - 016		1 Sep	CTD
H - K	159/017 - 020		1 Sep	CTD
L - M	160/021 - 022		2 Sep	CTD
N - O	161/023 - 024		2 Sep	CTD
P - Q	162/025 - 026		2 Sep	CTD
16G - 1G	162/027 - 039	Shelf-edge - Sd. of Mull	2-3 Sep	Surface S‰ ; CTD, Cs surface & sub-surface (16, 15, 13, 11, 9, 7, 6, 4, 2 & 1); (S, T & 10)
HD9 - HD4	162/040 - 045	Loch Moidart - Loch Boisdale	3 Sep	CTD
HD3 - HD1	158/046 - 048		3 Sep	CTD
N6 - N3	158/049 - 052	Loch Maddy - Loch Dunvegan	3 Sep	CTD
N2	159/053		3 Sep	CTD
N1	160/054		3 Sep	CTD
HE5 - HE3	160/055 - 057	Loch Bracadale - Oigh Sgeir	3 Sep	CTD
HE2 - HD3	161/058 - 060		3 Sep	CTD

Table 2. Stations worked during Cruises 71/1990 (Leg 2)

Station No.	Date	Gear	Position	Depth (m) Min	Max	Mean		Remarks
71/90/1	7/9/90	OTSB (P)	56° 35.9'N 09° 14.7'W	875	1035	968		Net torn but good sample
71/90/2	8/9/90	OTSB (P)	56° 36.4'N 09° 27.2'W	1267	1315	1282		
71/90/3	8/9/90	Gravity Corer	57° 18.0'N 10° 22.9'W			2225		
71/90/4 SBC 398	8/9/90	Box Corer	57° 18.0'N 10° 22.0'W			2215		
71/90/5 ES 399	8/9/90	Epibenthic Sledge	57° 18.0'N 10° 18.0'W			2200	Mid Point	
71/90/6 AT 400	8/9/90	Agassiz trawl	57° 19.0'N 10° 20.0'W			2205	Mid Point	
71/90/7	9/9/90	Gravity Corer	57° 00.4'N 09° 55.3'W			2025		
71/90/8	9/9/90	OTSB (S)	56° 50.0'N 09° 34.0'W					No sample, not on bottom
71/90/9	9/9/90	OTSB (S)	56° 52.2'N 09° 34.8'W	1730	1790	1754		
71/90/10	9/9/90	Gravity Corer	56° 35.1'N 09° 54.1'W			1780		
71/90/11	9/9/90	Gravity Corer	56° 23.1'N 09° 57.9'W			1790		
71/90/12	10/9/90	Gravity Corer	55° 49.7'N 10° 30.0'W			2370		
71/90/13	10/9/90	OTSB (S)	55° 36.8'N 10° 24.7'W	2385	- 2415	2401		
71/90/14 ES 401	10/9/90	Epibenthic Sledge	54° 40.2'N 12° 16.1'W			2900	Mid Point	
71/90/15 ES 402	11/9/90	Epibenthic Sledge	54° 40.6'N 12° 15.9'W			2900	Mid Point	
71/90/16	11/9/90	Gravity Corer	54° 39.9'N 12° 16.6'W			2910		
71/90/17	11/9/90	Box Corer	54° 39.8'N 12° 18.0'W					No sample, Gimbals broken
71/90/18 RMT 403	11/9/90	RMT	54° 41.0'N 12° 23.0'W			2900		3900 m wire out
71/90/19	11/9/90	Box Corer	54° 40.0'N 12° 15.8'W			2910		No sample
71/90/20 SBC 404	11/9/90	Box Corer	54° 38.0'N 12° 18.1'W			2910	Mid Point	
71/90/21 ES 405	12/9/90	Epibenthic Sledge	54° 40.0'N 12° 20.0'W			2910	Mid Point	
71/90/22	12/9/90	OTSB (S)	54° 57.9'N 12° 20.5'W	2885	2885	2885		
71/90/23	12/9/90	Gravity Corer	55° 33.6'N 11° 15.6'W			2630		
71/90/24	13/9/90	OTSB (S)	56° 23.6'N 09° 13.9'W	705	860	742		
71/90/25 AT 406	13/9/90	Agassiz trawl	57° 10.6'N 09° 26.2'W			1020	Mid Point	Not torn
71/90/26	13/9/90	Gravity Corer	57° 12.3'N 09° 22.4'W			1095		
71/90/27	13/9/90	Gravity Corer	57° 19.1'N 08° 30.1'W			145		



R.R.S. CHALLENGER Cruise 71/1990
Leg 1
29 Aug. - 5 Sep. 1990
Rockall
St. Kilda
OBAN
30 Aug
31 Aug
1 Sep
2 Sep
3 Sep
4 Sep
SH4
SH1
A
B
C
D
E
F
G
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56°
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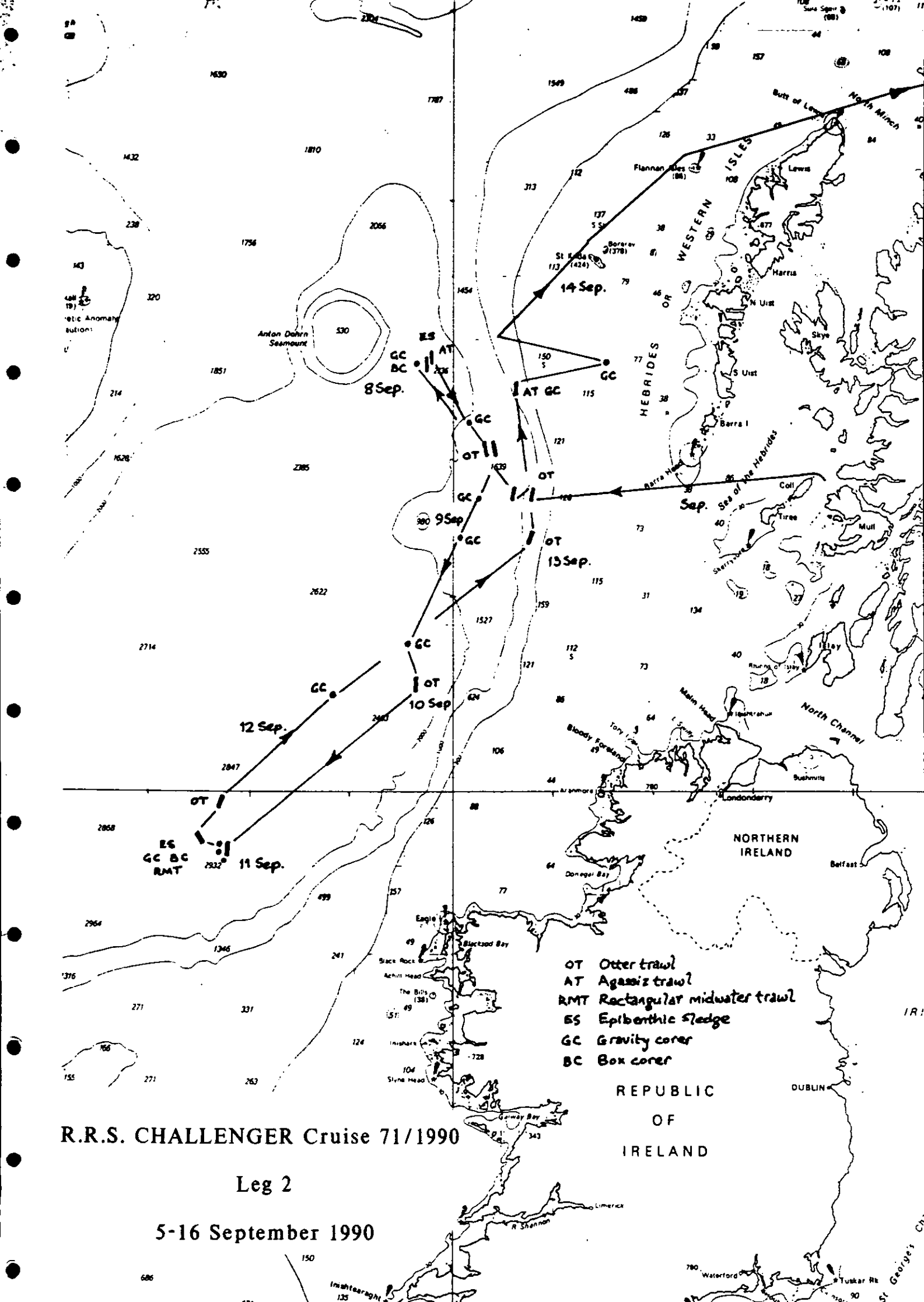

R.R.S. CHALLENGER Cruise 71/1990

Leg 2

5-16 September 1990