DR M.T. JONES.
I.O.S (B)

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RRS CHALLENGER

CRUISE 12/79

18 AUGUST – 7 SEPTEMBER 1979

GEOLOGICAL INVESTIGATIONS IN THE NORTHERN NORTH SEA AND ON THE CONTINENTAL SHELF WEST AND NORTH OF SCOTLAND

RECOVERY AND RELAYING OF CURRENT METER MOORINGS SOUTH AND WEST OF THE WYVILLE-THOMSON RIDGE

CRUISE REPORT NO. 153

1983

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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INSTITUTE OF OCEANOGRAPHIC SCIENCES

WORMLEY

RRS CHALLENGER

Cruise 12/79

18 August - 7 September 1979

Geological investigations in the northern North Sea and on the continental shelf west and north of Scotland

Recovery and relaying of current meter moorings south and west of the Wyville-Thomson Ridge

Principal Scientist

J.B. Wilson

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ITINERARY

Departed Ardrossan	0900GMT	18/8/79
Arrived Kirkwall	1000GMT	25/8/79
Departed Kirkwall	1335GMT	27/8/79
Arrived Ardrossan	1606GMT	7/9/79

SCIENTIFIC PERSONNEL

Leg 1	A.J. Chitty		IOS	Wormley
	W.J. Gould	Principal Scientist	"	"
	G.R.J. Phillips		"	"
	I. Waddington		"	"
Leg 2	Mrs. G.F. Caston		"	"
	Miss J.M. Lewis		"	"
	C.D. Pelton		"	"
	A.R. Stubbs		"	"
	I. Waddington		"	"
	Mrs. J.M. Weller		"	"
	J.B. Wilson	Principal Scientist	"	"

SHIP'S OFFICERS

Master	G. Long
Chief Officer	P. Coombs
2nd Officer	S. Sykes
3rd Officer	A. Barton
Chief Engineer	D. Rowlands
2nd Engineer	I. McGill
3rd Engineer	C. Harman
4th Engineer	D. Hornsby

CRUISE PLAN

As originally planned, RRS Challenger Cruise 12/79 was to have been largely devoted to using the Mark II towed television and camera sledge developed jointly by MBA and IOS Wormley for sediment and faunal investigations in selected areas on the continental shelf to the west and north of Scotland.

Following the loss of the sledge during trials from MV Sarsia on 20 June 1979, the programme for the cruise was changed.

Leg 1 was therefore devoted to recovery and relaying current meter moorings and that part of the original programme which did not involve the use of the television and camera sledge was carried out during Leg 2.

J.B.W.

OBJECTIVES - LEG 2

(1) To investigate the occurrence of iceberg plough marks on the west side of the Norwegian Trough and in the northern North Sea east of 0°41.8'E (the eastern limit of data obtained from RRS John Murray in May 1972) using the MS47 transit sonar and EG & G 259 side-scan sonar systems.

(2) To investigate in more detail the faunas of sand sheets and sand patches and in particular to investigate the distribution of living and dead Ditrupa arietina on the sand sheets and sand patches on the continental shelf west of Scotland.

(3) To obtain further samples of the gravels between the sand patches.

(4) To obtain further dredge samples from the edge of the continental shelf at different depths to supplement existing collections.

(5) To take grab and dredge samples from new areas west of Orkney and Shetland not sampled on previous cruises.

(6) To obtain some samples for microfaunal study in the Geology Department, University of Exeter.

(7) To obtain further side-scan sonar coverage on the continental shelf west and north of Scotland to supplement existing IOS coverage in the area.

(8) To obtain further live specimens of Caryophyllia smithii and Ditrupa arietina for the continuation of experiments at M.B.A., Plymouth.

J.B.W.

NARRATIVE (all times are in GMT)

Leg 1.

RRS Challenger sailed from Androssan at 0900, 18th August 1979 and proceeded directly to the position of Mooring I4 (see mooring section for details of positions). Time was spent late on Sunday 19th to do wire tests on the acoustic release and command beacon units for the replacement moorings. Some problems were encountered due to the hydro wire being wound onto the drum in the wrong sense and hence tending to take back turns whenever the wire became slack. Four releases and four command beacons were successfully tested to 1800m and passage was resumed.

I4 was reached at 0400/20 and was recovered uneventfully by 0640. The relay of the mooring started at 0830 and was completed by 1000. Course was set towards I3, recovery commenced at 1800 and was completed by 1900/20. The ship then lay to overnight and the mooring was relaid by 0800/21.

I1 was recovered and relaid between 1700 and 2040 in winds of up to force 7 and course set towards I2. This was recovered the following morning (23rd) by 0915 and an acoustic search was started for moorings 260 (a full depth mooring set in September 1978) and 261 (a single near bottom current meter set in December 1978). Nothing was heard of either beacon by 1800 and it was decided to try to drag for Mooring 260 the acoustic release of which had been interrogated and fired in May.

Dragging operations continued over the LORAN C coordinates of the mooring throughout the night 22/23. A tow which terminated at 1730/23 gave higher loadings than had been encountered previously and on recovery there was evidence that a wire had been caught in one of the grapnel flukes. Some of the grapnels were also stained with rust. The drag was resumed and retrieved at 0545/24 with the acoustic release and deepest current meter attached.

Mooring I2 was then relaid by 0835 and course was set for Kirkwall. The ship docked at 1000/25.

W.J.G.

Leg 2

RRS Challenger sailed from Kirkwall at 1335 hrs on 27th August and proceeded eastwards towards the North Sea. The PES fish was deployed at 1730 hrs and watchkeeping commenced. The ship continued on an eastward course towards the west side

of the Norwegian Trough. The starting position for the work on the west side of the Norwegian Trough was reached at 1330 hrs on 28th August and the MS47 transit sonar was deployed and set working. The EG & G fish was also deployed but was found to be giving problems. A series of zig-zag courses were run, crossing and recrossing the western margin of the Norwegian Trough gradually working northwards. The EG & G fish was repaired and was redeployed at 1400 on 29th August. Weather conditions were not very good during this period with a heavy swell and Force 8 winds. Towards evening the weather improved and the sky cleared. The first iceberg plough marks were seen on the side-scan at 61°21'N 2°11'E at 1940 hrs on 29th. That evening displays of the aurora borealis were seen on three occasions between 2230 and 0100 hrs. The EG & G failed just after midnight and was brought inboard for further repair. The fault was traced to broken wires in the plug connector at the fish. This was replaced using the spare plug. An overnight side-scan run to the north-east to 61°46'N 1°55'E was made to see if iceberg plough marks were present on a bank marked on Admiralty Chart No. 295. The bank was found not to exist and details of the track and depths were taken to be forwarded to the Hydrographic Office.

The investigation into the eastward extent of the plough marks in the northern North Sea was completed by 1424 hrs on 30th August. We steamed to the edge of the continental shelf north-north-east of Unst to dredge. Quite unexpectedly several live Ditrupa arietina were obtained. Passage was then made to the shelf edge at 60°45.23'N, 2°51.01'W for further dredging at stations at water depths of 200m, 250m and 350m in an area where the deep water coral Lophelia pertusa had been reported.

We then steamed south-east to a location 43km north-west of Foula with the intention of searching for live Ditrupa using the grab. Weather conditions were such that this had to be abandoned. We then steamed back towards the Lophelia locality at the edge of the continental shelf to undertake side-scan runs using the EG & G system. In order to calibrate this in time, it was deployed during the passage to the shelf edge. At 2340 hrs on 1st September the cable was inspected and found to be in order. At 2342 hrs it was seen to be bird-caging. The fish was rapidly brought inboard and it was found that the fins were bent thus causing the fish to spin and the cable to rotate hence unwinding the armouring. As the paint on the starboard side of the fish was also scraped, it is thought that the damage was caused by a collision with a whale. Several pilot whales had been seen in the area earlier in the day. Plans to side-scan at the coral locality using the EG & G system were then abandoned and a course was set

for the Fair Isle Channel where two dredge stations were worked on the coarse shell gravel and a series of grab samples were taken across some large sand waves detected during RRS Challenger Cruise 14/74. On completion of this, a course was set to the location of Station JM72/120 to look for live Ditrupa and Caryophyllia. Several dredge hauls were made and grab samples collected on 2nd September but no live Ditrupa were obtained. Several live Caryophyllia were collected and these were put into tanks in the constnat temperature laboratory. Four grab stations were then worked to the north in an area not previously sampled before steaming overnight towards the Butt of Lewis. A series of grab samples were collected from sand patches and the adjacent gravel floor 31km west of the Butt of Lewis. Some difficulty was encountered with the hydrographic wire on the starboard midships davit as it tended to kink when the load was taken off and on several occasions lengths of wire had to be cut off. We then steamed west-south-west to dredge on a large sand sheet north-west of St. Kilda. We then steamed south overnight to a sand patch 59km west of Barra Head where a series of grab stations using both the Day and the Exeter grab were worked. Several live Ditrupa arietina were obtained. An anchor box dredge haul was then taken and several thousand live Ditrupa were obtained. We then steamed west towards Barra Head to dredge close to the location of Station S71/142. The prospect of south-westerly gales determined that we would then steam south to a sand sheet 78km west of Islay to obtain further live Caryophyllia. Four dredge hauls were completed and some 150 live Caryophyllia were obtained together with some live Ditrupa with young Caryophyllia growing on them. These were placed in the tanks in the constant temperature laboratory. The weather had deteriorated by 1400 hrs on 5th September and the sampling programme was therefore terminated. A series of side-scan lines were then run in the Malin Sea and North Channel to supplement existing IOS cover in the area and to obtain further data. The weather was poor while working off Inishowen Head but later improved and some good results were obtained. The side-scan runs in the North Channel were completed by 1040 hrs on 6th September and we steamed towards Ardrossan. The MS47 transducer and PES fish were brought inboard at 1500 hrs and Challenger docked at 1606 hrs. The equipment for both legs 1 and 2 was unloaded by 1030 hrs on the 7th September. The live Ditrupa and Caryophyllia were placed in large vacuum flasks and transported by road and then by air from the ship to IOS Wormley for the weekend where they were placed in the constant temperature chamber before going to MBA Plymouth the following week.

Thanks are due to Captain Long and the officers and men of RRS Challenger for the smooth and efficient running of the ship during the cruise and for all their assistance in the completion of the scientific programme.

The willing help given by the members of the scientific party which contributed greatly to the success of the cruise is gratefully acknowledged.

J.B.W.

DETAILS OF MOORING OPERATIONS - LEG 1 (all times in GMT)

Mooring 271 (I4) Recovery

Release fired	0509	20-VIII-79		
Picked up at		LORAN C	50527.4	58° 51.7'N
			32850.6	11° 37.7'W
		Decca Green	J 35.42	

Discolouration on top 400m wire length (depth range 200-600m), otherwise all components in good condition. All current meters had full tapes.

Mooring 276 (I4) Deployment.

In position	1004	20-VIII-79		
At buoy release		LORAN C	50525.8	58° 51.95'N
			32852.1	11° 37.83'W
		Decca Green	J 35.47	

Mooring 268 (I3) Recovery.

Release fired	0716	20-VIII-79		
Picked up at		LORAN C	50143.4	58° 55.29'N
			32993.2	13° 16.34'W
		Decca Green	I 42.9	

All line and instruments in excellent condition. All current meters had full tapes. Transponder beacon at depth of 200m heard at 2km range.

Mooring 277 (I3) Deployment.

In position	0757	21-VIII-79		
At buoy release		LORAN C	50143.1	58° 55.65'N
			33003.0	13° 18.3'W
		Decca Green	I 42.90	

N.B. LORAN C reading actually 50153.1 but thought to be 10 digits high due to sky wave interference.

Mooring 269 (I1) Recovery.

Release fired	1708	21-VIII-79		
Picked up at		LORAN C	50403.0	59° 58.6'N
			33318.0	12° 12.3'W
		Decca Green	B 38.62	

All mooring components in excellent condition. Current meters all had full tapes.

Mooring 278 (I1) Deployment

In position	2043	21-VIII-79		
At buoy release		LORAN C	50407.8	59° 57.7'N
			33314.1	12° 11.2'W
		Decca Green	B 38.61	

Mooring 270 (I2)

Release fired	0805	22-VIII-79		
Picked up at		LORAN C	51116.7	60° 11.2'N
			33216.8	09° 18.1'W
		Decca Green	D 46.81	

Some corrosion on all wire lengths but no buildup of rust.
Corrosion less severe over the end 20m or so of each wire length.
(Perhaps this is indicative of the protection afforded by the galvanising on the shackles and D-rings).

All current meters had full tapes. Deepest meter had lost its rotor. Top meter had poor bottom bearing, perhaps rotor will underread.

Mooring 260 (I2) Recovery

Bottom current meter (Aa 3629) and CR 207 recovered by dragging. Alternate E-W, N-S drags across the LORAN C coordinates between 1830 22-VIII and 0545 24-VIII.

No significant corrosion on CR stainless steel components. Current meter extensively damaged by dragging but did not leak. Full data tape. Mooring had failed 0200 23-III-79. Acoustic contact had been made with CR in May and release put through firing position. Pinger was not reset and so batteries were dead when dragging operations were undertaken in August.

Broken end of wire found below 1000m current meter, it is not known if this occurred during dragging operations or was result of mooring failure. Wire in general was badly corroded, particularly near the terminations.

Buoy from this mooring found on Barra in Outer Hebrides and returned to IOS.

Mooring 279 (I2) Deployment

In position	0839	24-VIII-79		
At buoy release		LORAN C	51126.3	60° 12.7'N
			33221.0	09° 16.0'W
		Decca Green	D 47.44	

W.J.G.

SUMMARY OF RESULTS - LEG 2

(1) The eastward limit of iceberg plough marks in the northern North Sea was found to lie in the vicinity of 1°50'E.

(2) Much new information on the faunas of sand sheets and sand patches was obtained including important data on the distribution of living and dead Ditrupa arietina.

(3) Several grab samples of the gravels adjacent to the sand patches west of the Butt of Lewis were collected.

(4) Several dredge hauls were made at the continental shelf edge and upper continental slope at three locations north and west of Shetland. Several live specimens of the coral Stenocyathus vermiformis were obtained.

(5) Grab samples were collected at four stations north of Sule Skerry.

(6) Six samples for microfaunal study were obtained.

(7) Several hundred additional miles of side-scan sonar records were obtained in the northern North Sea, on the continental shelf north and west of Scotland and in the North Channel using the MS47 transit sonar. Unfortunately only a few miles of record were obtained using the EG & G system.

(8) Approximately 40 live Caryophyllia and 150 live Ditrupa were successfully transported to MBA Plymouth.

J.B.W.

EQUIPMENT REPORT

Performance of Mooring Instrumentation

The command releases on all four moorings laid in May operated when first commanded at distances up to 4km. All releases released after normal transmission periods (maximum required was 2 minutes). Command beacons at 600m below the surface on two of the moorings were not switched at greater than 1km. Transponders on the other two moorings at 200m below the surface were detected at greater than 1km using the single element and Deck Control Unit system. All stainless steel seemed reasonable, no corrosion other than crevice type being obvious. Aluminium hardware appeared reasonable apart from heavy white spot deposits on one Mushroom Transducer. Particularly notable was the good condition of the soft anodised

aluminium of the ceramic ring transducers used on the two transponders. A good coating of grease still remained on most of the aluminium.

For the dragging for the remains of mooring I2 a standard pinger giving one pulse vertical and two pulses horizontal and beyond was used very successfully to monitor drag line behaviour. The release recovered during this drag was in good mechanical condition apart from heavy crevice type corrosion between rubbers and half clamps. One clamp had been totally penetrated.

Of the ten pyroreleases used on the five releases recovered, eight used Glenair type connectors. Of these six operated perfectly, one looked to have half fired and one failed to fire. Both the two unsatisfactory units had corroded pins on the Glenair connectors. The unit that failed to operate had both pins totally corroded through. Both male and female connectors on this unit were sawn through one quarter of an inch from the interface; at both points the pins were in good condition. This indicates faulty sealing of the shroud protecting the interface.

The locating ring of the Glenair type is of slightly different design to the standard Marsh and Marine design. Alternatively leakage may have been due to flashing left from the moulding process; this has occurred in the past.

The electronics associated with the ship's instruments all worked well apart from the five minute relay drive from the precision clock (a minor inconvenience). The PES fish again gave no trouble due in no small part, I am sure, to the excellent handling system.

G.R.J.P.

EXPLANATION OF TABLES AND FIGURES

Abbreviations used in Leg 2 Station List (Table 1)

RD - IOS Rock Dredge

DG - Day Grab

EG - Exeter Grab

BD - Anchor Box Dredge

* - denotes positions have not been computed (Station 1)

Track Chart for Leg 2 (Figures 2 & 3)

Full line denotes Precision Echo Sounder and side-scan sonar tracks (Kelvin Hughes MS47 transit sonar and occasionally EG & G dual channel towed side-scan sonar). Dotted line denotes Precision Echo Sounder track only.

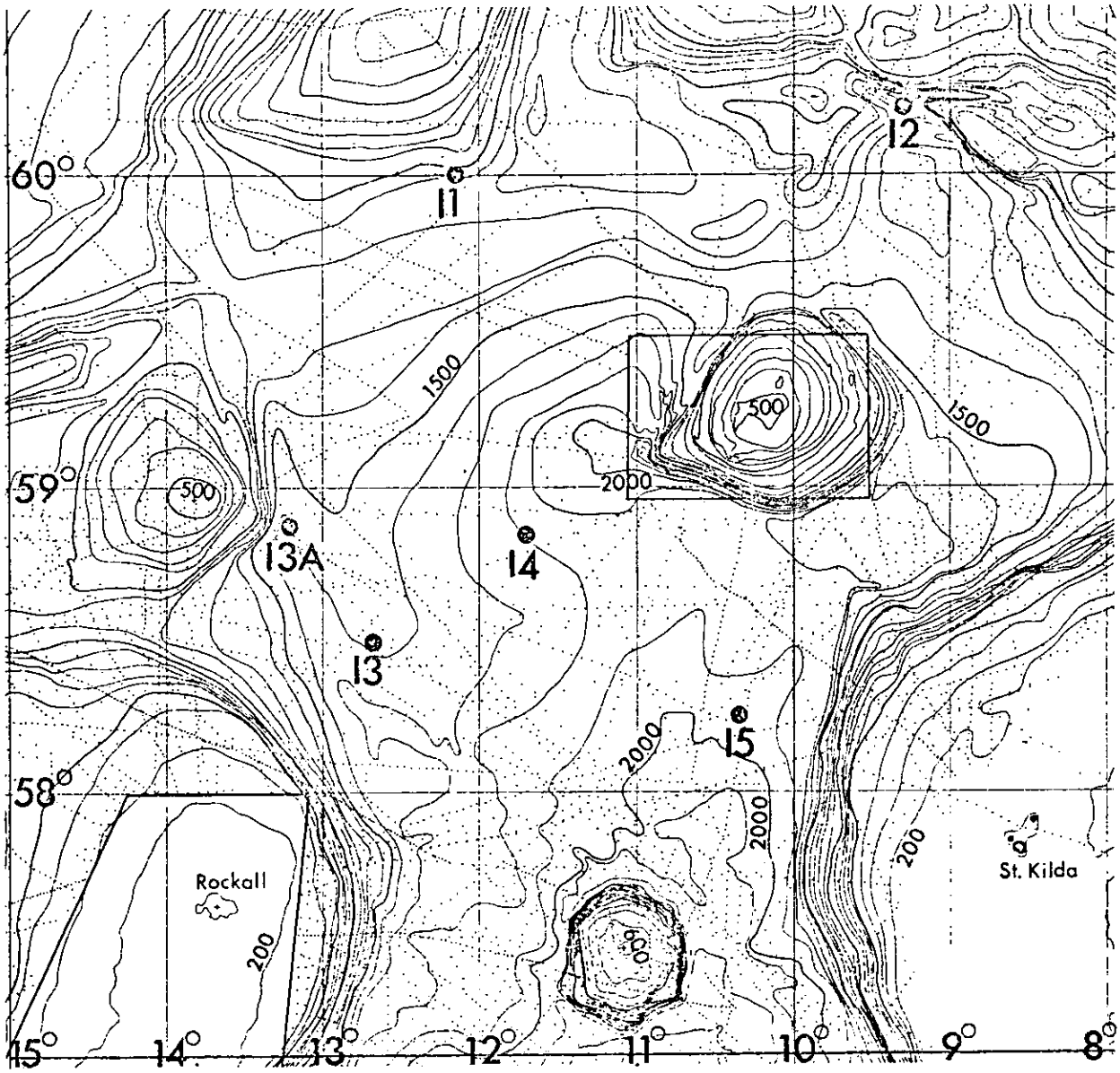
TABLE 1 LEG 2 STATION POSITIONS

Stn. No.	Haul No.	Gear Used	Date	Time From	Time To	Position From		Position To		Depth Range (m)
1*	1	R.D.	30/8/79	1750	1828	61°38.8'N	0°52.5'E	61°38.8'N	0°50.8'E	210-212
1*	2	R.D.	30/8/79	1934	1957	61°39.0'N	0°52.7'E	61°38.4'N	0°52.5'E	213-212
1*	3	B.D.	30/8/79	2112	2137	61°39.0'N	0°52.9'E	61°39.5'N	0°52.4'E	215-211
2	1	R.D.	31/8/79	1250	1320	60°46.02'N	2°40.33'W	60°44.63'N	2°40.56'W	195-235
3	1	R.D.	31/8/79	1444	1525	60°45.23'N	2°51.01'W	60°45.01'N	2°52.38'W	326-343
4	1	R.D.	31/8/79	1740	1816	60°38.22'N	2°55.77'W	60°38.89'N	2°58.16'W	240-258
5	1	D.G.	31/8/79	2057	2110	60°22.61'N	2°42.66'W	-		182
5	2	D.G.	31/8/79	2122	2133	60°22.59'N	2°42.65'W	-		185
6	1	D.G.	31/8/79	2157	2212	60°23.12'N	2°39.20'W	-		179
6	2	D.G.	31/8/79	2223	2245	60°23.08'N	2°39.16'W	-		177
7	1	R.D.	1/9/79	1024	1059	59°40.01'N	2°34.72'W	59°39.92'N	2°33.20'W	90-100
8	1	R.D.	1/9/79	1218	1252	59°39.66'N	2°29.30'W	59°39.63'N	2°27.41'W	92- 90
9	1	D.G.	1/9/79	1730	1738	59°23.19'N	1°59.64'W	-		110
9	2	D.G.	1/9/79	1739	1745	59°22.88'N	1°58.91'W	-		106
9	3	D.G.	1/9/79	1759	1805	59°22.56'N	1°58.05'W	-		115
9	4	D.G.	1/9/79	1811	1815	59°22.37'N	1°57.47'W	-		117
9	5	D.G.	1/9/79	1824	1830	59°22.13'N	1°56.99'W	-		117
9	6	D.G.	1/9/79	1841	1850	59°21.65'N	1°56.90'W	-		117
9	7	D.G.	1/9/79	1855	1900	59°21.49'N	1°57.07'W	-		117
9	8	D.G.	1/9/79	1927	1931	59°20.20'N	1°56.63'W	-		111
9	9	D.G.	1/9/79	1932	1937	59°19.81'N	1°56.61'W	-		115
9	10	D.G.	1/9/79	1943	1950	59°19.60'N	1°56.60'W	-		115
9	11	E.G.	1/9/79	2007	2014	59°18.91'N	1°56.72'W	-		110
9	12	E.G.	1/9/79	2110	2117	59°21.60'N	1°57.92'W	-		115
9	13	E.G.	1/9/79	2120	2123	59°21.29'N	1°58.02'W	-		115
9	14	E.G.	1/9/79	2227	2234	59°19.46'N	1°58.96'W	-		115

Stn. No.	Haul No.	Gear Used	Date	Time From	Time To	Position From	Position To	Depth Range (m)
10	1	E.G.	2/9/79	1325	1330	59°12.72'N 4° 2.67'W	-	125
10	2	D.G.	2/9/79	1350	1356	59°12.34'N 4° 2.92'W	-	125
10	3	D.G.	2/9/79	1358	1405	59°12.20'N 4° 3.00'W	-	125
10	4	B.D.	2/9/79	1435	1455	59°11.75'N 4° 3.42'W	59°11.66'N 4° 3.42'W	125-120
11	1	R.D.	2/9/79	1551	1650	59°12.57'N 4° 6.19'W	59°11.59'N 4° 7.34'W	121-118
11	2	R.D.	2/9/79	1736	1816	59°11.39'N 4° 8.10'W	59°12.18'N 4° 7.13'W	116-121
11	3	R.D.	2/9/79	1903	1927	59°13.09'N 4° 4.62'W	59°13.46'N 4° 3.64'W	123-125
12	1	D.G.	2/9/79	2146	2152	59°24.64'N 4°23.43'W	-	98
12	2	D.G.	2/9/79	2154	2159	59°24.71'N 4°23.48'W	-	98
12	3	D.G.	2/9/79	2203	2210	59°24.79'N 4°23.56'W	-	97
13	1	D.G.	2/9/79	2250	2256	59°28.59'N 4°31.36'W	-	108
13	2	D.G.	2/9/79	2304	2310	59°28.64'N 4°31.48'W	-	108
14	1	D.G.	2/9/79	2350	2356	59°32.38'N 4°38.95'W	-	115
14	2	D.G.	2/9/79	2358	2404	59°32.41'N 4°38.98'W	-	116
15	1	D.G.	3/9/79	0050	0100	59°36.73'N 4°46.51'W	-	131
15	2	D.G.	3/9/79	0107	0120	59°36.75'N 4°46.45'W	-	131
16	1	D.G.	3/9/79	1051	1057	58°39.02'N 6°43.44'W	-	120
16	2	D.G.	3/9/79	1059	1110	58°39.00'N 6°43.40'W	-	120
17	1	D.G.	3/9/79	1121	1126	58°38.54'N 6°44.39'W	-	111
17	2	D.G.	3/9/79	1128	1133	58°38.53'N 6°44.33'W	-	111
17	3	D.G.	3/9/79	1143	1148	58°38.32'N 6°44.19'W	-	111
17	4	D.G.	3/9/79	1150	1154	58°38.25'N 6°44.16'W	-	110
17	5	D.G.	3/9/79	1156	1200	58°38.21'N 6°44.01'W	-	110
17	6	D.G.	3/9/79	1210	1215	58°38.21'N 6°43.94'W	-	110

Stn. No.	Haul No.	Gear Used	Date	Time From	Time To	Position From	Position To	Depth Range (m)
17	7	D.G.	3/9/79	1220	1225	58°38.07'N 6°43.99'W	-	110
17	8	D.G.	3/9/79	1231	1237	58°38.10'N 6°43.85'W	-	110
17	9	D.G.	3/9/79	1240	1248	58°38.09'N 6°44.01'W	-	110
17	10	D.G.	3/9/79	1251	1254	58°38.10'N 6°44.07'W	-	110
18	1	D.G.	3/9/79	1314	1319	58°38.30'N 6°44.96'W	-	110
18	2	D.G.	3/9/79	1320	1323	58°38.28'N 6°45.05'W	-	110
19	1	R.D.	3/9/79	2203	2248	58° 3.88'N 8°23.80'W	58° 2.66'N 8°24.01'W	148-146
20	1	D.G.	4/9/79	0927	0933	57° 5.43'N 8°35.65'W	-	135
20	2	D.G.	4/9/79	0937	0943	57° 5.47'N 8°35.70'W	-	135
21	1	D.G.	4/9/79	1005	1010	57° 5.05'N 8°35.64'W	-	135
21	2	D.G.	4/9/79	1013	1018	57° 5.09'N 8°35.70'W	-	135
21	3	E.G.	4/9/79	1024	1031	57° 5.07'N 8°35.70'W	-	134
22	1	E.G.	4/9/79	1106	1111	57° 3.58'N 8°33.19'W	-	144
22	2	E.G.	4/9/79	1119	1125	57° 3.57'N 8°33.17'W	-	143
22	3	E.G.	4/9/79	1127	1133	57° 3.58'N 8°33.16'W	-	145
22	4	D.G.	4/9/79	1213	1220	57° 3.68'N 8°33.01'W	-	145
22	5	D.G.	4/9/79	1221	1232	57° 3.62'N 8°32.90'W	-	145
22	6	D.G.	4/9/79	1235	1242	57° 3.56'N 8°32.71'W	-	145
22	7	D.G.	4/9/79	1245	1253	57° 3.49'N 8°32.63'W	-	145
22	8	D.G.	4/9/79	1322	1329	57° 3.54'N 8°33.14'W	-	145
22	9	D.G.	4/9/79	1334	1340	57° 3.51'N 8°33.08'W	-	145
22	10	D.G.	4/9/79	1342	1348	57° 3.43'N 8°33.06'W	-	145
22	11	B.D.	4/9/79	1444	1514	57° 3.93'N 8°33.06'W	57° 3.36'N 8°33.36'W	145-144
23	1	R.D.	4/9/79	2037	2109	56°44.42'N 7°56.60'W	56°43.82'N 7°57.29'W	110-109
24	1	R.D.	5/9/79	0932	0956	55°55.80'N 8°39.28'W	55°55.34'N 8°39.74'W	135-129

Stn. No.	Haul No.	Gear Used	Date	Time From	Time To	Position From		Position To		Depth Range (m)
24	2	R.D.	5/9/79	1047	1114	55°56.10'N	8°38.14'W	55°55.65'N	8°38.04'W	135-135
24	3	R.D.	5/9/79	1208	1233	55°55.62'N	8°37.30'W	55°55.21'N	8°38.36'W	135-135
24	4	R.D.	5/9/79	1336	1405	55°54.89'N	8°36.53'W	55°54.33'N	8°36.94'W	136-133


60°
59°
58°
15°
14°
13°
12°
11°
10°
9°
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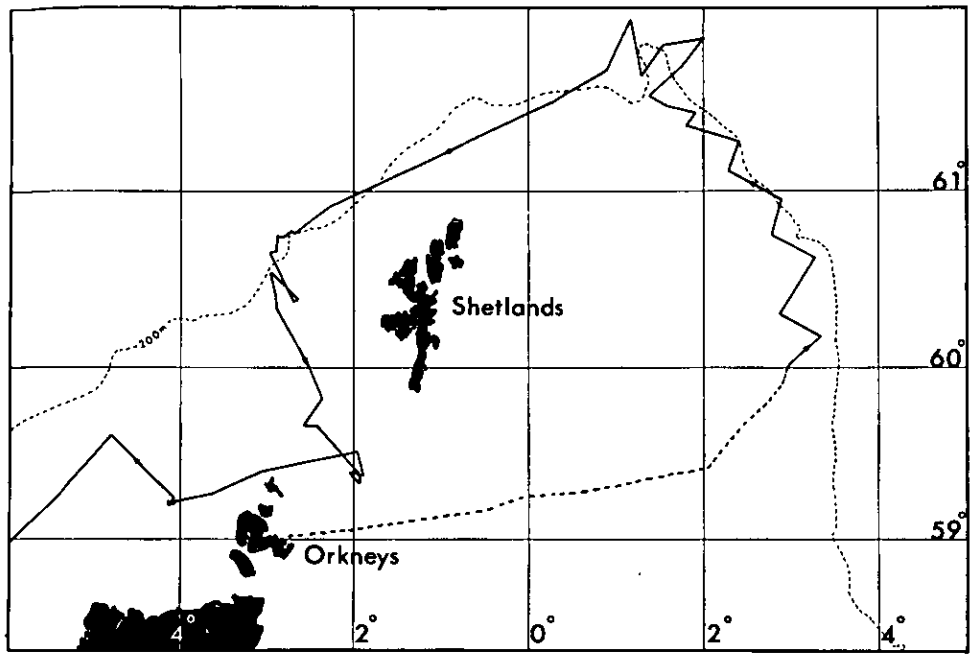
12
13A
13
14
15
500
1500
2000
200
Rockall
St. Kilda

FIG 1


Shetlands
Orkneys
200m
61°
60°
59°
4°
2°
0°
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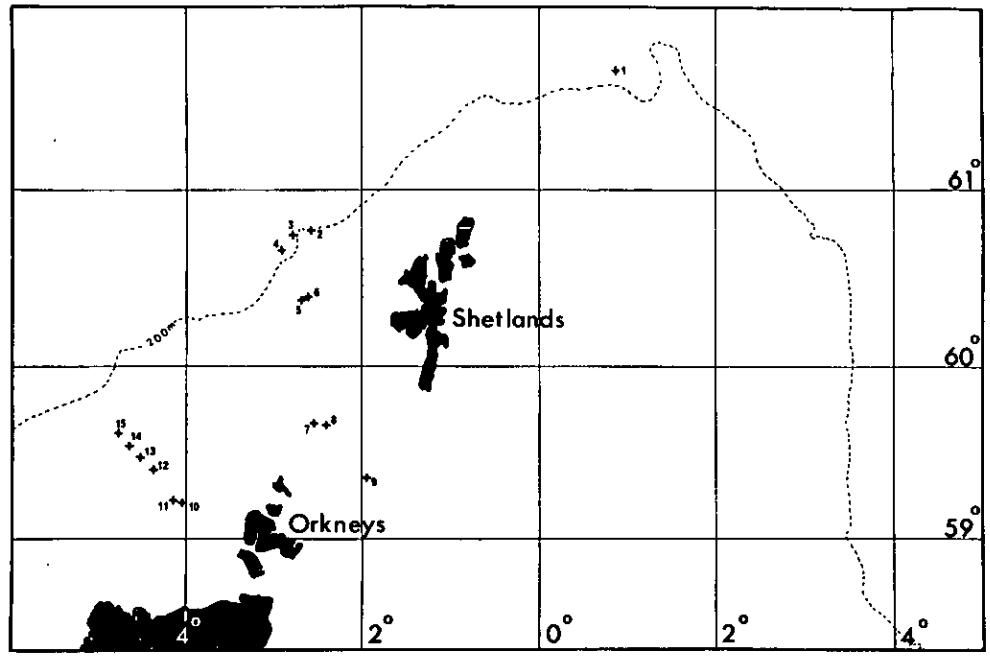
Shetlands
Orkneys
200m
61°
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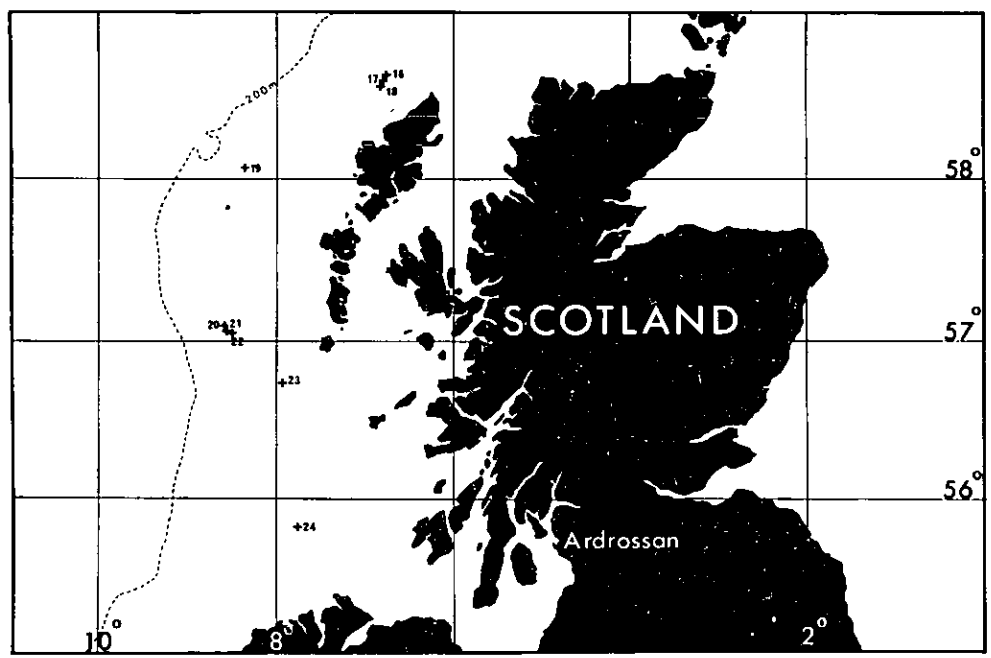
SCOTLAND
Ardrossan
200m
58°
57°
56°
10°
8°
2°


SCOTLAND
Ardrossan
200m
58°
57°
56°
10°
8°
2°

Figures 2 - 5