Scottish Marine Biological Association

Dunstaffnage Marine Research Laboratory

Cruise Report

R.R.S. Challenger

Cruise 11/1977

12 - 26 July 1977

RRS CHALLENGER, Cruise 11/1977

Duration of cruise: 1509 h 12 July to 1144 h 26 July 1977

All times BST.

Locality: Rockall Channel, 57° to 60°N.

Staff: D.J. Ellett

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Aims: Cruise 11 was the first of two CHALLENGER cruises devoted to JASIN 1977 work, in preparation for the major Joint Air-Sea Interaction experiment of JASIN 1978, and had the following aims:

1) To service the SMBA shelf current meter mooring in 57°N 9°W (mooring R) and lay another to the north-west of St. Kilda (S).

2) To lay four Wormley and one Bidston single-strand deep moorings in the northern Rockall Channel (W1 to W4 and B2) and one shallower Bidston single-strand mooring at the northern edge of Rockall Bank (B1).

3) To repeat STD profiles at 1200 m depth at a $6\frac{1}{4}$ hour interval at each apex of 15 km triangles contered upon moorings W1, W2, W3 and F.

4) To test and make measurements with the Heidelberg apparatus for determining the air-sea interface exchange rate by 222 Radon deficit.

5) To work the Anton Dohrn Seamount STD section.

6) To make hourly STD lowerings to 1200 m over a period of 25 hours at a number of locations as time permitted.

7) To record surface temperature and salinity along the ship's track using the STD in a pumped flow on deck, and to record soundings at 10-minute intervals.

8) To take 50 litre surface samples between the shelf-edge and the Sound of Mull for radiocaesium determination by the Fisheries Radiobiological Laboratory, Lowestoft.

Narrative: CHALLENGER sailed from Dunstaffnage at 1509 h 12 July in fine, calm weather and proceeded to soundings in excess of 200 m to the west of Lismore in order to test STD data logging programmes. This was carried out between 1700 h and 1913 h, when Mr A. Edwards disembarked for return to Dunstaffnage by laboratory dory. The ship then made passage via the Sound of Mull for the current meter mooring site in 57°N, 9°W (R) and hove to on station at 0820 h 13 July. The mooring was laid in force 4 northerly winds without incident by 1155 h and the ship set course for a second shelf mooring position (S) to the north-west of St. Kilda, where a rig was laid between 1832 and 1905 h. An STD lowering was made and further tests of logging programmes conducted, and upon completion of these at 2020 h the ship steamed westward, surface sampling by pump and STD en route to deep water so that acoustic releases for the deep moorings could be checked to depths of 2000 m. This was done from 0021 h 14 July and was followed by an STD lowering and a test run of the Heidelberg equipment, the ship steaming for Wormley mooring W3 at 0525 h. Upon arrival at this position at 0730 h two acoustic releases which had required adjustment were re-tested, the Heidelberg sampling gear lowered, and mooring deployment begun. Depths shoaled during the course of the anchor-first lay, and before attachment of the sub-surface float the ship steamed at minimal speed to deeper water, finally releasing the mooring at 1801 h. Due to stretch in the mooring wire, the two pellets on the recovery line from the sub-surface buoy remained on the surface,

but after some minutes as the ship stood by they submerged slowly and were lost to sight. An STD lowering was made, a Heidelberg station was worked, and at 2257 h course was set to the position for mooring W1, surface sampling overnight.

Upon arrival in the vicinity of W1 at 0813 h 15 July a short bathymetric survey was made and releases were tested. Laying commenced at 1255 h in south-easterly force 4-5 winds, and was completed by 1514 h. The ship then moved to the adjacent position for mooring W4, and whilst wires were being wound upon the winch Radon sampling was carried out with the Heidelberg pump. Upon completion of this at 1928 h, mooring W4 was laid, the sub-surface buoy being launched at 2245 h. Subsequently the ship steamed to the position for moorings W2 and B2, surface conditions being monitored with the STD along the ship's track. Between 0237 h and 1328 h 16 July six STD lowerings to 1200 m were made at the apices of a triangle of approximately 15 km side centered on W2 and B2 in order to obtain two profiles at a time difference of $6\frac{1}{4}$ hrs at each of three points.

During preparations for mooring W2 one length of wire was found to lack a termination at one end due to a manufacturer's error, but by use of spare lengths and the re-arrangement of those assigned to mooring B2 it was found possible to make up two slightly shorter rigs for these two positions. In consequence it was agreed to lay the moorings in shallower soundings about 4 n. mls. west from the sites originally chosen, and W2 was set between 1436 and 1639 h 16 July. Radon was sampled nearby and

and an STD lowering was completed by 2105 h.

Overnight a surface sampling run was made westward and north-westward towards George Bligh Bank, returning towards the position of mooring B2 for the forenoon. Swell had increased during 16 July and the wind became south-east, force 7-8, leading to a reduction in speed at 0730 h 17 July. On return to the position of B2 at 1000 h the ship hove to, awaiting an improvement in the weather. Towards evening winds decreased to force 6-7 and Radon was sampled between 1758 and 2130 h. Acoustic releases were subsequently tested, and at 2327 h a $12\frac{1}{2}$ hour cycle of STD lowerings to 1200 m at a fixed position was begun. This was completed at 1230 h 18 July, and mooring B2 was laid from 1411 to 1557 h in a decreasing swell and north-easterly force 4-5 winds. Further Radon observations were taken between 1630 and 2015 h in the same vicinity and overnight course was set south-easterly and then westerly for surface STD logging.

At 0910 h 19 July the ship reached the position for mooring B1 on Rockall Bank, and the rig was laid by 0957 h. Further surface sampling was then carried out on a track to station F of the Anton Dohrn Seamount section, where a brief topographic survey was made for future mooring deployment, and thence to mooring W3. During the day the northerly winds rose to force 7, with accompanying moderate swell, and although a 12 hr triangle of STD observations was begun in the vicinity of W3 at 0204 h 20 July, work was suspended at 0400 h when conditions worsened. A check was made over the mooring position to confirm that the subsurface float pellet line had remained submerged, and by 0916 h

a gradual improvement in the weather permitted the Heidelberg pump to be used. After completion of pumping, STD observations were resumed at 1221 h and the triangle was completed at 2312 h.

During the night the ship steamed to northern moorings, W1 and W4, taking surface observations. A further 12 hr set of STD lowerings around a triangle was worked from 0845 h, 21 July, followed by a Radon sampling station which was completed by 2248 h. Subsequently surface conditions were surveyed in the area to the south of Bill Bailey's Bank and Lousy Bank, and thence southwards in 13°W latitude. Between 2048 and 2329 h 22 July a Radon station was worked, after which the surface survey was continued in force 6-8 winds and moderate swell to the first station of the Anton Dohrn Seamount STD section, on Rockall Bank. The section was begun at 0852 h 23 July and continued in marginal conditions to the Scottish continental shelf, the final station being completed at 0743 h 25 July. Two Heidelberg Radon sampling stations were worked in the course of the section, one on Rockall Bank at station B at 1059 h 23 July and the other on the continental shelf at 0224 to 0511 h 25 July. STD lowerings were made at standard radiocaesium sampling stations between the shelf-edge and the Sound of Mull with the exception of the final station off Ardmore Point, which was sampled at 1855 h. During the afternoon r.v. SARSIA was passed to the east of Barra Head, engaged in a survey of fronts and chlorophyll distribution around the British Isles, and notes were exchanged via VHF radio with the Naturalist in Charge, Dr Pingree.

CHALLENGER steamed via the Sound of Mull and Sound of Islay to the Clyde, securing alongside at Ardrossan at 1144 h 26 July.

Results Aim 1). The SMBA mooring in 57°N, 9°W was laid on the morning of 13 July. The two current meters were positioned at nominal depths of 36 m and 106 m in soundings of 135 m. The mooring in 58°N, approximately 12 n. ml. north-north-west of St. Kilda, was laid during the evening of the same day in depths of 143 m, with two current meters at nominal depths of 25 m and 114 m.

Aim 2). The six IOS Wormley and Bidston sub-surface moorings were successfully laid and details of the meters and thermistor chains carried by each are given in Table 1. These moorings will be raised in September during DISCOVERY cruise 85.

Aim 3). Three sets of STD lowerings were worked in triangles of approximately 15 km side around moorings W2, W3 and W1 on 16, 20 and 21 July respectively. Pairs of lowerings were obtained at an interval of $6\frac{1}{4}$ hours at each apex of the triangles and these will be examined for spacial and tidal-period variability in conditions around the moorings.

Aim 4). Messrs. Kromer and Fischer have contributed the following report: "On cruise 11 of RRS CHALLENGER we tested successfully our apparatus for making continuous measurements of the gas exchange rate at the atmosphere-ocean interface by means of Radon 222.

The measured quantity is the deficit in the mixed layer of the Radon concentration with respect to its precursor Radium 226 due to loss of Radon into the Radon-free atmosphere.

The Radon concentration is measured by extracting the air dissolved in the seawater and counting the α - decays in a set of four ionisation chambers.

To get a true integral of the deficit in the mixed layer a hose was attached to the wire of the hydrographic winch and lowered through the mixed layer. The equilibrium concentration of Radon was obtained by measuring water from 80 m below the surface. The system worked without failure.

We measured profiles on eight stations and calibrated the ionisation chambers on two others. The deficit we found amounted to 25% at wind speeds of 7-9 m/sec and increased to 30% after two days of higher wind speeds (10-15 m/sec), showing lower values in the top 10 m of the mixed layer. The equilibrium concentrations are $\sim$ 5 dpm/100 l. The Radon concentration below the mixed layer increased considerably on the shelf (ca 12 dpm/100 l) and there was a more complex structure on Rockall Bank.

The final data processing will be done at the Institut für Umweltphysik, Heidelberg. Prolonged measurements needed for parametrisation of gas exchange rate with respect to the wind speed and sea state will be carried out during JASIN 1978.

We are grateful to the SMBA for giving us the opportunity of participation and we thank all participants and the crew of RRS CHALLENGER for much support and helpful discussions.

Bernd Kromer and K-H. Fischer."

Aim 5). The twenty STD stations of the Anton Dohrn Seamount section were worked on 23-25 July in mainly westerly winds. An unusual feature was observed at station H, immediately to the west of the seamount, where temperatures at approximately 1000m depth dropped by 1.7 deg C for 80 m descent, the sharpest gradient being a fall of 1 deg C in about 20 m. The water above this thermocline was anomalously warm by comparison with neighbouring stations.

Aim 6). Time did not permit sampling for 25 hours at one position, but STD lowerings were made at $1\frac{1}{2}$-hour intervals from 2327 h 17 July to 1230 h 18 July near mooring B2. Some progressive changes in the depths of the isotherms were observed, but it became apparent that a longer series of observations would be desirable to fully resolve their character.

Aim 7). Surface temperature and salinity were logged from the STD in a pumped flow on deck along most of the ship's track. The non-toxic supply delivered about 100 l per minute into the Bidston tank without aeration. Both temperature and salinity changes were small, and the evidence was of patchiness in surface temperature due presumably to varying wind speeds, rather than of frontal structures. Soundings from the precision echo-sounder were taken at 10-minute intervals.

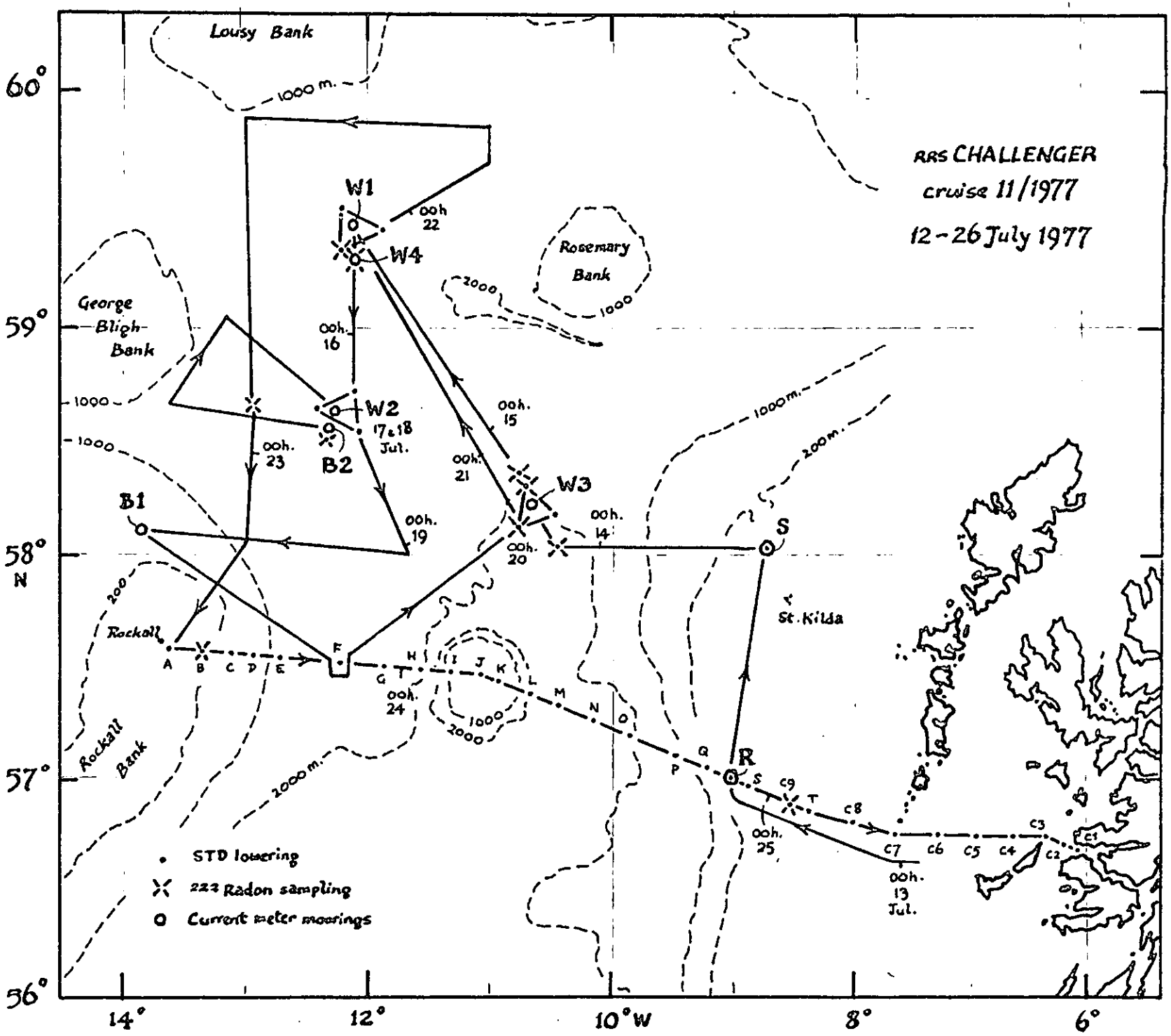
Aim 8). 25 litre surface samples were taken at ten standard positions between the shelf-edge and the Sound of Mull for ^{137} Caesium determination by the Fisheries Radiobiological Laboratory. STD lowerings were made at all except the easternmost station.

D.J. Ellett

16 August 1977.

Table 1. Single-strand moorings set during CHALLENGER cruise 11/1977.

	W1	W2	W3	W4	B1	B2
Position	59° 29.1N 12° 11.5W	58° 38.3N 12° 21.4W	58° 15.7N 10° 42.8W	59° 18.1N 12° 15.3W	58° 06.0N 13° 49.2W	58° 34.6N 12° 22.8W
IOS Number	230	232	229	231	234	233
Sounding (m)	1426	1647	1970	1519	237	1639
Depth of float (m)	19	31	11	28	69	245
Nominal meter depths (m) and type	27V 75A	39V 87A	19V 66A	36V 83A	97A 203A	297A 501A
(A: Aanderaa)	197A	208A	185A	205A		754A
(V: VACM)	504A	311A	490A	510A		959A
	1017A		1000A	1019A		1217A
						1475A
Thermistor chain depths (m)	30-75	42-87	21-66	38-83	-	-
Laid at (GMT)	1415h 15 Jul.'77	1540h 16 Jul.'77	1702h 14 Jul.'77	2145h 15 Jul.'77	0857h 19 Jul.'77	1457h 18 Jul.'77


RRS CHALLENGER
cruise 11/1977
12 - 26 July 1977
Lousy Bank
1000 m.
Rosemary Bank
2000
1000
George Bligh Bank
1000
1000
1000m.
200m.
200
Rockall
Rockall Bank
2000m.
W1
W2
W3
W4
B1
B2
S
R
St. Kilda
00h 22
00h. 16
00h. 15
00h. 23
17 & 18 Jul.
00h. 21
00h. 19
00h. 14
00h. 20
00h. 24
00h. 25
00h. 13 Jul.
A B C D E F G H I J K L M N O P Q S T C9 C8 C7 C6 C5 C4 C3 C2 C1
60°
59°
58° N
57°
56°
14°
12°
10° W
8°
6°
STD lowering
222 Radon sampling
Current meter moorings

HIAS 2124