INSTITUTE OF OCEANOGRAPHIC SCIENCES

R.R.S. DISCOVERY

CRUISE 75

22 October - 8 November 1975

Geochemical and Biological sampling off North West Africa

Cruise Report No. 43

1976

Institute of Oceanographic Sciences,
Wormley, Godalming,
Surrey, GU8 5UB

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ITINERARY

Departed Barry 22 October 1975
Arrived Vigo 25 October 1975
Arrived Las Palmas, Grand Canary 29 October 1975
Arrived Santa Cruz, Tenerife 8 November 1975.

SCIENTIFIC PERSONNEL

R.G. Aldred
C.H. Batchelor
J. Burnham
J.D. Burton (Southampton University)
S.E. Calvert (Principal Scientist)
Miss T. Colvin
M. Harris
A. Gooday
M.J. McCartney
C.I. Measures (Southampton University)
N. Merrett
R. Moore (Southampton University)
R.J. Morris
R. Peters
A.L. Rice
H. Spychala (Institut für Meereskunde, Kiel)
N. Timmins
M.H. Thurston
T.R.S. Wilson

SHIP'S OFFICERS

E.M. Bowen Master
J.J. Moran Chief Officer
J.S. Jones 2nd Officer
M.S. Putman 3rd Officer
P.A. Booker Extra 3rd Officer

SHIP'S OFFICERS contd.

C.S. Storrier	Chief Engineer
N.A. Wilson-Deroze	2nd Engineer
C.J. Phillips	3rd Engineer
R. Fletcher	4th Engineer
I.G. McGill	Extra 4th Engineer
C. Brown	5th Engineer
F.P. Sharpe	Snr. Elect. Engineer
P.G. Parker	Electrical Engineer
R.M. Cridland	Catering Officer

OBJECTIVES OF THE CRUISE

The principal objectives of the cruise were as follows:

1) To obtain a series of bottom sediment and pore water samples, using a new box corer and a new *in situ* pore water sampler, from a variety of environments off the north west African margin.

2) To obtain a series of large volume water samples, at all depths, for investigations of the organic and inorganic composition of suspended particles and for studies of the concentration patterns of selected dissolved trace metals.

3) To obtain samples of the sea-surface organic films.

4) To carry out an extensive benthic sampling programme, including near-bottom sampling using RMT equipment and a semi-balloon trawl.

The cruise was abruptly curtailed by an engine-room fire on 2-3 November; consequently, only a small part of the programmes was completed and samples requiring refrigerated storage were lost.

NARRATIVE

Discovery sailed from Barry at 1030 on 22 October 1975. After clearing the Bristol Channel, a course was set for a station at 41°25'N, 14°00'W. The echo sounder and salinity/temperature profiler fishes were streamed at 0900 on 24 October and normal scientific watches were started.

At 1630 on 24 October, we altered course for Vigo in northern Spain in order to land an engineering officer who required hospital treatment. We arrived at 1400 on 25 October and departed at 1500 on the same day. Course was then set for Las Palmas, Grand Canary, in order to pick up a replacement engineering officer, abandoning the station at 41°25'N, 14°00'W.

Three stations were occupied en route to Las Palmas where sea-surface film samples were collected in relatively calm conditions. A proton magnetometer, as well as the echo-sounder and salinity/temperature profiler fishes, were streamed between the first surface film station and the Canary Islands. We reached Las Palmas at 0900 on 29 October and departed at 1020 on the same day.

Our first station (8929) south of the Canary Islands was at 27°40.3'N, 15°05.6'W where a semi-balloon trawl was fished at about 500m depth and two RMT 8 nets were fished at 300-500m and 700-1000m depth. Wind speeds were 10 knots. After completing the station, course was set to a position at 25°02.7'N, 16°20.2'W at the top of the continental slope where a series of stations out to deeper water was started (see Fig. 1). On stations 8930 to 8933, between 1958/30 October and 1836/2 November, the semi-balloon trawl, a gravity corer and the pore-water sampler were used to obtain satisfactory samples. Wind speeds were 2 knots at the beginning of the profile and 26 knots on station 8933.

On completion of this station, we proceeded to a position at 24°00'N, 16°45.0'W to start a longer profile of stations from the continental slope to the abyssal plain area at 30°W. It was at 2350/2 November, while on this course, that the engine-room fire ended the scientific work of the cruise.

Discovery drifted without main power from approximately 0000/3 November until 0730/6 November when the tug Friesland took us under tow to Santa Cruz, Tenerife. We were finally tied up at 0030/8 November.

The scientific party stood by on the aft area of the main deck during the fire, providing minor assistance when called upon by the Master, and were confined to the plotting office for the night of 2/3 November. The emergency was handled speedily and most effectively by the Master, the officers and crew and everything was done to make the period spent at sea without main power as comfortable as possible for all on board.

REPORTS OF PROJECTS

1). Hydrographic Work

Three hydrographic stations were occupied and a total of 8 casts were made

(Table 1). Combinations of 1, 8 and 30 litre sampling bottles were used, with a 1-litre bottle positioned 10m above a large-volume bottle.

The entire contents of the 8 and 30 litre bottles were pressure-filtered through 0.4μm pore size 47mm diameter Nuclepore membrane filters, using compressed ntirogen at 15 psi. The membranes were washed 5 times with aliquots of 0.5M ammonium formate to remove residual sea salt and finally stored in lucite petri dishes.

The filtrates from the large-volume bottles were split into a number of sub-samples for trace metal analysis (see 2.)

The samples from 1-litre bottles were used to determine salinity (at Wormley), dissolved oxygen and reactive silicate using standard procedures.

C.H. Batchelor, J.D. Burton, S.E. Calvert,
M.J. McCartney, C.I. Measures, R. Moore,
R.J. Morris.

2). Trace Metal Analyses

The objectives of the programme were : (1) To obtain information on the extent of association of dissolved copper with organic matter to form analytically distinguishable fractions and to examine the variations of these fractions with location and water depth. (2) To investigate base-line oceanic concentrations of selenium and their variation including the evaluation of a new analytical procedure.

For the investigation of copper, samples of surface water were collected commencing at 46°31'N, 09°35'W and further samples were taken from the water column at Stations 8930 and 8933. Each sample was membrane filtered and the available copper was removed from one aliquot by chelating ion-exchange and subsequently eluted with nitric acid. For the determination of total copper another aliquot was photo-oxidized, using ultra-violet irradiation, and then treated by the same concentration procedure. A further aliquot was solvent extracted with chloroform. After further treatment, the concentrates from these procedures were returned to Southampton for completion of the analysis.

Additional aliquots of the sample were stored frozen for subsequent shore analysis of the fraction associated with the bulk of the organic matter and determination of the dissolved organic carbon. When work was terminated the samples from Station 8933 were being handled and most of these had to be left at intermediate stages of the analysis. This material and the frozen samples were treated to avoid compositional changes as far as possible, so that some analysis could be completed ashore, but this introduces some uncertainties in interpretation of the results.

Preliminary concentration of selenium from aliquots of filtered water from Stations 8930, 8932 and 8933 was carried out by using two procedures. First, by the conventional method of coprecipitation with ferric hydroxide. Secondly, by solvent extraction of the 4-nitro-o-phenylene-diamine complex, this procedure being linked to subsequent shore analysis using a novel gas-liquid chromatographic method. Concentrates from both procedures were returned to Southampton for completion of the analysis, but the loss of deep-freeze facilities introduces uncertainty as to the validity of the second procedure.

J.D. Burton, C.I. Measures, R. Moore

3). Sediment sampling

A stainless steel gravity corer, with 10cm-diameter barrels 1m and 2m in length, was used to collect the sediment samples. A pinger was used 100m above the corer to determine likely bottom contact. Details of samples recovered are given in Table 1.

C.H. Batchelor, S.E. Calvert, R.J. Morris

4). Pore Water Sampling

The cruise plans called for an <u>in situ</u> pore water sampler to be used to obtain samples of sediment interstitial water unaltered by thermal and pressure effects. It was intended to analyse on board for the labile constituents alkalinity, sulphide, ammonia, dissolved gases and light hydrocarbons, and to compare these results with squeezed box core samples.

The first station was occupied at position 25°5'N and 16°57'W in 2551m depth (Table 1), although conditions were not ideal, with moderate swell, no problems were experienced in deployment, and the drogue modification to the tripping mechanism was found to have cured the tendency to pretrip which had previously existed under these conditions. The sampling process and recovery procedure operated correctly and without problems. However, during the collection of the samples from the unit after recovery, four of the eight sample port check valves leaked; total sample recovery was 54% of the maximum volume possible.

Attempts were made to improve these valves for the second drop, made at 24°59'N 17°57'W in a water depth of 2964m (Table 1). Again the system operated correctly except for check valve leakage, and a recovery of 65% was obtained. A different procedure was adopted for the third drop. Plugs were prepared for insertion in the check valve ports in order to prevent leakage when the samples were pressurised for sample recovery. This proved very effective, sample volume recovery at this station rising to 95% of the theoretical maximum, a very satisfactory value. This drop was made at 25°08'N, 17°52'W, in 2924m depth.

The fire and consequent power failure which occurred shortly after this station precluded analysis of most of the collected samples for the labile constituents mentioned above, although valuable experience of the operation of the analytical systems at sea was obtained from test runs while on passage to the sampling area. Since the quick-frozen samples were thawed after 24 hours, and could not be refrozen until arrival in the U.K. a week later analysis for these constituents was not possible. However the samples retain their usefulness for less labile constituents, such as the major cations, and for this reason were not discarded.

T.R.S. Wilson

5). Benthos

The programme had three main objectives; to test and develop a fishing technique for the recently acquired Marinovich semi-balloon trawl, to obtain a series of trawl samples at 500-1000m depth intervals down the continental slope, and to carry out a concentrated sampling programme with the semi-balloon trawl, the epibenthic sledge and the box corer within a small (c 100km^2) area at the

foot of the slope to examine relatively small-scale changes in the benthic community at such depths. In the event, only the first two objectives were achieved before the abrupt end of the cruise (Table 2).

A test fishing of the trawl in mid-water at station 8929#1 was fairly straightforward and produced a catch typical of the region and depth, with many of the organisms being obtained in remarkably good condition. Some of these were used in enzyme studies.

Subsequent bottom hauls were made at about 500m (8930#1), 1000m (8931), 2400m (8932#2) and 3000m (8933#3 and #4). Although some minor problems were encountered during these hauls, particularly in connecting and disconnecting the bridles and the single towing warp, the gear was generally very successful and reasonably easy to handle. The catches were naturally dominated by the larger benthic organisms, mainly fish, decapods and echinoderms, and good samples were obtained at the shallower stations.

The two hauls at 3000m were intended to provide the first of a series of samples from a restricted area at the foot of the slope, even though the echosounder survey failed to locate the clear slope change at the slope/rise junction which had been found some 300 miles further south during Cruise 63. The first of these hauls produced a rather small catch which was completely clear of sediment, whereas the second, begun from a point about 3km east of the start of the first and on a converging course, brough up well over half a ton of pink/cream calcareous mud. This presented a rather daunting sorting problem and only a very small proportion of the catch was able to be sieved, the remainder being hand sorted on deck. The result was again a rather small catch which, like the previous one, was dominated by decapods and holothurians.

Because of these small catches, and the difficult nature of the bottom, the original plan to concentrate the benthic sampling effort in this area was abandoned in favour of a survey somewhat further south, that is nearer to the area visited during Cruise 63. It was during the passage to this new position that the work was terminated.

R.G. Aldred, A. Gooday, N. Merrett, A.L. Rice,
H. Spychala, M.H. Thurston

6). Sea Surface Film Sampling

Samples of the sea-surface microlayer were obtained at the stations indicated in Table 1 in order to determine:

a) the typical natural product organic compounds present at the air-sea interface in areas of variable organic production.

b) compositional changes, if any, taking place at the interface under the influence of UV radiation, bacterial activity, polymerization, etc.

c) the extent of non-natural organic and inorganic pollution in the surface layers of the north Atlantic.

Samples were collected from a small rubber inflatable boat upwind from the ship by slowly draining the contents of a large polypropylene funnel, after it had been submerged and had broken the surface, thereby coating the inner surface of the funnel with the monomolecular organic film. This was then removed with $CHCl_3$/MeOH into glass containers. A subsurface water sample was also collected by hand at the same time.

R.J. Morris

7). Biochemical Studies

Specimens of an upper mid-water decapod Acanthephyra purpurea, a deep-water decapod A. pelagica and a deep-water mysid Gnathophausia sp. were collected using the RMT 8 net at station 8929. They were kept alive in fresh, filtered sea water at 5°C and under low light conditions.

Cell-free and tissue slice cultures of the hepatopancreas and muscle tissue from the two decapods were prepared in order to compare the type and activity of the lipolytic enzymes present in these related species which are known to have different lipid compositions.

Specimens of A. purpurea and Gnathophausia sp. were kept on various diets (^{14}C-fatty acid, ^{14}C-amino acid and ^{14}C-glucose) for periods of up to 8 days in order to investigate pathways of lipid metabolism in such organisms.

R.J. Morris

8). Ornithology

Ornithological observations were made throughout the cruise as and when other duties permitted. Standard observations consisted of ten minute periods during which all birds in the vicinity of the ship were identified as far as possible and counted. About five such observations were made each day. Birds seen outside these periods were also noted.

Eleven species of seabirds and eleven species of landbirds were recognised during the cruise. North of lat. 42°N boreal species such as Gannet (Moris bassanus) Great skua (Catharacta skua), lesser black-backed gull (Larus fuscus) and Herring gull (L. argentatus) were frequently met with, although never in large numbers. South of lat. 40°N sea birds were present only in very small numbers. No seabirds were recorded during c. 75% of the standard observations made in warmer waters. Species most frequently seen during this period were Cory's shearwater (Calonectris diomedea) and Leach's storm petrel (Oceanodroma leucorhoa).

After leaving Vigo on 25 October light to moderate easterly winds were experienced with the result that migrating landbirds were more numerous than seabirds. Skylarks (Alaudra arvensis), White wagtails (Motacilla a. alba), Chiffchaffs (Phylloscopus cottybita) and Black redstarts (Phoenicurus ochruros) were the most frequently recorded species. South of the Canary Islands a number of Swallows (Hirudo rustica) were seen.

Seven Leach's storm petrels and one British storm petrel (Hydrobates pelagicus) found on the ship were measured and ringed before release.

M.H. Thurston

9). Computing

During the outward passage the computer was used for routine navigation and meteorological logging. This was interrupted from time to time by failures of the console printer. After several days the bridge printer was substituted

as a temporary measure requiring satellite fixes to be relayed to the bridge by the watchkeeper.

The XBT sampling system was provided but the instrument was not used.

Early on in the cruise it became apparent that the air-temperature readings bore no relationship to the actual physical values. Calibration constants had been provided but these were found to be incorrect and several days elapsed before they could be corrected. (ref. RRS DISCOVERY, Cruise 75, S.C.G. Report on Problems Concerning the Meteorological Instruments, T. Colvin, J. Burnham).

The visual display unit 'menu' options which provide navigational plotting aids and the biological data entry programs were successfully used throughout the cruise. The Live Track Plot facility was used for positioning the ship above required topographic features the program SMERC was used to provide permanent chart records of the ship's positions at any given time; and the suite of Biological Station Data Entry programs enabled details of station position, trawl net type, mean bottom sounding, distance travelled over the sea floor and other parameters to be recorded.

The normal end of cruise data processing could not be performed as usual but had to wait until the ship returned to Barry.

Theresa Colvin, John Burnham

TABLE 1. STATION LIST

Station No	Date	Day No	Position N. Lat.	Position W. Long	Depth (Corr. metres)	Equipment/ sampling	Results
8926	26.x	299	38°49.1'	10°37.5'	3224	SF	
8927	27.x	300	35°02.5'	12°22.9'	2736	SF	
8928	28.x	301	31°10.7'	14°04.1'	3076	SF	
8929	29.x	302	27°38.3'	15°07.6'	2525	OTSB RMT 8	
8930	30.x	303	25°05.7'	16°22.2'	575	OTSB GC HC	See Table 2 No Core 2 casts to 478m
8931	31.x	304	24°58.3'	16°31.0'	859	OTSB	
8932	31.x	304	24°53.6'	16°54.7'	2335-2560	OTSB GC HC PWH	See Table 2 88cm green clay 2 casts to 1973m 1 drop.
8033	01.xi- 02.xi	305	24°56.6' 25°11.2'	18°01.2' 17°54.0'	2914-2985	OSTB GC HC PWH	See Table 2 45cm calc. clay 4 casts to 2135m. 2 drops

Abbreviations:

SF Surface film sample

OTSB Otter trawl, semi-balloon

RMT 8 Rectangular mid-water trawl, 8 sq. m.

GC Gravity core

HC Hydrographic casts

PWH Pore Water Harpoon

STN.	DATE 1975	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	WATER DEPTH (M)
8929	29/10	27 38.4N	15 7.1W	OTSB14	0- 500	1742-2015	DEPTH ONLY APPROX.	
# 1		27 32.5N	15 7.7W			DUSK		
8929	29/10	27 32.8N	15 9.4W	RMT 1	310- 500	2130-2233		
# 2		27 33.3N	15 11.6W	RMT 8		NIGHT	FLOW DIST. 3.46 KM.	
8929	29/10	27 33.8N	15 14.7W	RMT 1	500- 900	2343-0059		
# 3		27 34.2N	15 18.2W	RMT 8		NIGHT	FLOW DIST. 5.55 KM.	
8930	30/10	25 0.5N	16 22.6W	OTSB14	501- 520	2020-2206		
# 1		25 4.1N	16 23.9W			NIGHT		
8931	31/10	24 58.8N	16 31.1W	OTSB14	955-1012	0248-0600		
# 1		25 5.4N	16 32.2W			NIGHT		
8932	31/10	24 53.6N	16 54.7W	OTSB14	2344-2406	1106-1500		
# 2		25 0.7N	16 56.8W			DAY		
8933	1/11	24 56.6N	18 1.2W	OTSB14	2980-2990	1224-1845		2985
# 3		25 9.9N	17 53.8W			DAY		
8933	1/11	24 57.5N	17 57.1W	OTSB14	2962-2977	2140-0430		2970
# 4		25 11.2N	17 54.0W			NIGHT		

TABLE 2.

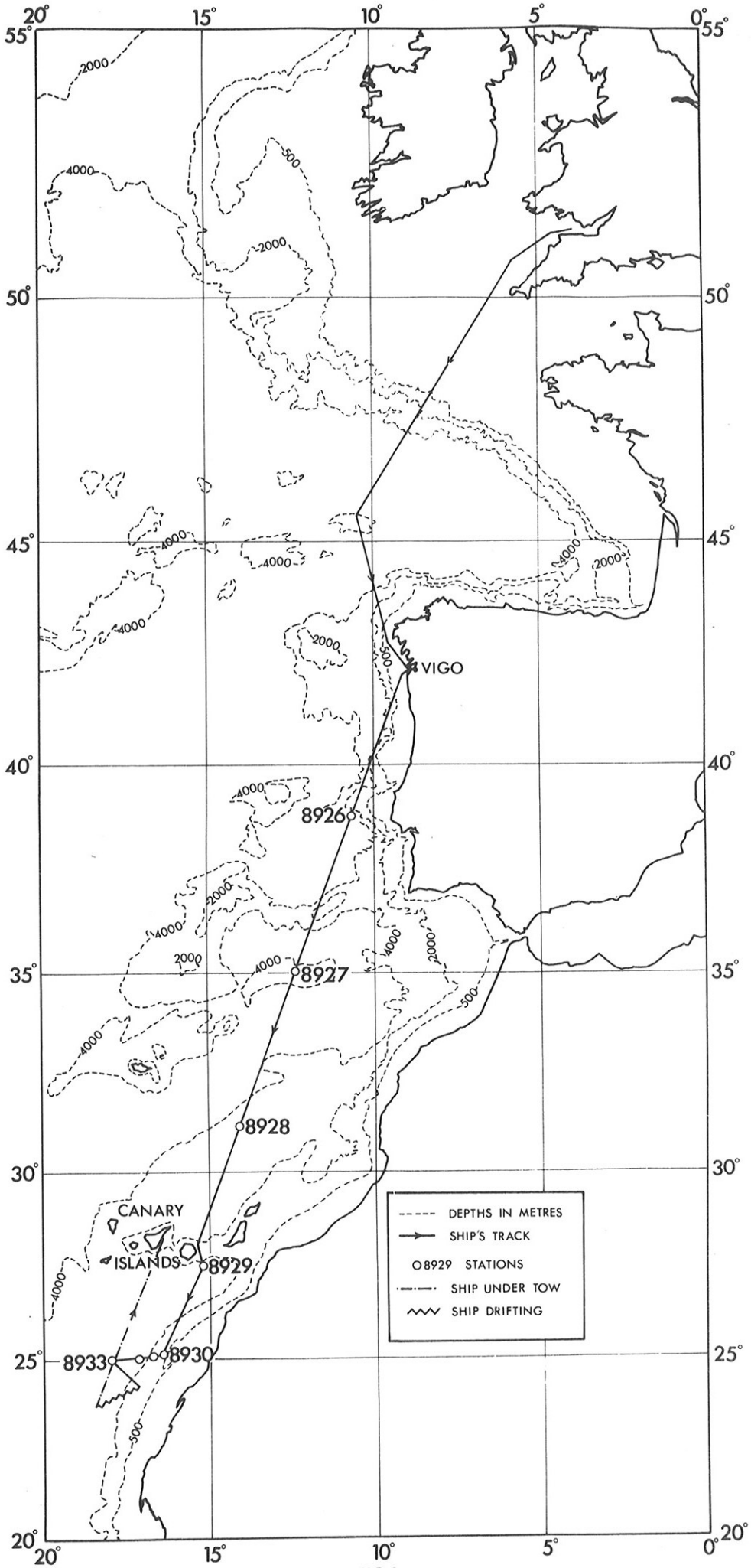
20°
15°
10°
5°
0°
55°
50°
45°
40°
35°
30°
25°
20°
2000
4000
500
VIGO
8926
8927
8928
8929
8930
8933
CANARY
ISLANDS
DEPTHS IN METRES
SHIP'S TRACK
O8929 STATIONS
SHIP UNDER TOW
SHIP DRIFTING

FIG. 1

CRUISE REPORTS

CRUISE No. and/or DATE REPORT No.

R.R.S. "DISCOVERY"

1 (International)
2 (Indian Ocean)
3 (Expedition)

Published and distributed by the Royal Society

		NIO CR[1]
4	February – March 1965	4
37	November – December 1970	37
38	January – April 1971	41
39	April – June 1971	40
40	June – July 1971	48
41	August – September 1971	45
42	September 1971	49
43	October – November 1971	47
44	December 1971	46
45	February – April 1972	50
46	April – May 1972	55
47	June – July 1972	52
48	July – August 1972	53
49	August – October 1972	57
50	October 1972	56
51	November – December 1972	54
52	February – March 1973	59
53	April – June 1973	58

		IOS CR[2]
54	June – August 1973	2
55	September – October 1973	5
56	October – November 1973	4
57	November – December 1973	6
58	December 1973	4
59	February 1974	14
60	February – March 1974	8
61	March – May 1974	10
62	May – June 1974	11
63	June – July 1974	12
64	July – August 1974	13
65	August 1974	17
66	August – September 1974	20
68	November – December 1974	16
73	July – August 1975	34
74	Leg 2 } Sept. Oct. 1975	33
74	Leg 1 & 3 } Sept. Oct. 1975	35

[1] NIO CR — National Institute of Oceanography, Cruise Report.

[2] IOS CR — Institute of Oceanographic Sciences, Cruise Report.

CRUISE REPORTS

CRUISE No. and/or DATE	REPORT No.
R.R.S. "CHALLENGER"	
August – September 1974	IOS CR 22
R.V. "EDWARD FORBES"	
October 1974	IOS CR 15*
January – February 1975	IOS CR 19
April 1975	IOS CR 23
May 1975	IOS CR 32
May – June 1975	IOS CR 28
July 1975	IOS CR 31
July – August 1975	IOS CR 36
R.R.S. "JOHN MURRAY"	
April – May 1972	NIO CR 51
September 1973	IOS CR 7
March – April 1974	IOS CR 9
October – November & December 1974	IOS CR 21
April – May 1975	IOS CR 25
N.C. "MARCEL BAYARD"	
February – April 1971	NIO CR 44
M.V. "RESEARCHER"	
August – September 1972	NIO CR 60
R.V. "SARSIA"	
May – June 1975	IOS CR 30
R.R.S. "SHACKLETON"	
August – September 1973	IOS CR 3
January – February 1975	IOS CR 18
March – May 1975	IOS CR 24
February – March 1975	IOS CR 29
July – August 1975	IOS CR 37
M.V. "SURVEYOR"	
February – April 1971	NIO CR 38
June 1971	NIO CR 39*
August 1971	NIO CR 42*
D.E. "VICKERS VOYAGER" and "PISCES III"	
June – July 1973	IOS CR 1

*Not distributed