I.O.S.

R.R.S. SHACKLETON

CRUISE 3/76

LEG 1

BRIDGTOWN, BARBADOS TO PONTA DELGADA, AZORES

JUNE 4 TO JUNE 14, 1976

GREAT CIRCLE XBT SECTION

LEG 2

PONTA DELGADA, AZORES TO BARRY, U.K.

JUNE 18 TO JULY 11, 1976

GEOPHYSICAL STUDIES AT KURCHATOV

FRACTURE ZONE AND MID–ATLANTIC RIDGE

AND AT 45°24'N, 20°51'W

CRUISE REPORT NO 45

1976

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

INSTITUTE OF OCEANOGRAPHIC SCIENCES

Wormley, Godalming,
Surrey, GU8 5UB.
(0428-79-2122)

(Director: Professor H. Charnock)

Bidston Observatory,
Birkenhead,
Merseyside, L43 7RA.
(051-652-2396)
(Assistant Director: Dr. D. E. Cartwright)

Crossway,
Taunton,
Somerset, TA1 2DW.
(0823-86211)
(Assistant Director: M.J. Tucker)

Marine Scientific Equipment Serivce
Research Vessel Base,
No. 1 Dock,
Barry,
South Glamorgan, CF6 6UZ.
(04462-77451)
(Officer-in-Charge: Dr. L.M. Skinner)

R. R. S. SHACKLETON

CRUISE 3/76

LEG 1

BRIDGTOWN, BARBADOS to PONTA DELGADA, AZORES

June 4 to June 14, 1976

GREAT CIRCLE XBT SECTION

LEG 2

PONTA DELGADA, AZORES to BARRY, U. K.

June 18 to July 11, 1976

GEOPHYSICAL STUDIES AT KURCHATOV
FRACTURE ZONE AND MID-ATLANTIC RIDGE
AND AT 45°24'N, 20°51'W

CRUISE REPORT NO. 45

1976

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

CONTENTS

SUMMARY OF CRUISE

Leg 1	Departed Bridgtown, Barbados	June 4 Day 156
	Arrived Ponta Delgada, Azores	June 14 Day 166
Leg 2	Departed Ponta Delgada, Azores	June 18 Day 170
	Arrived Barry, U.K.	July 11 Day 193

Leg 1 consisted of a great circle expendable bathythermograph (XBT) section from Barbados to the Azores.

Leg 2 consisted of a gravity survey of the Kurchatov Fracture Zone, long seismic refraction lines over the axial part of the Mid-Atlantic Ridge and a detailed seismic study of Layer 2 around 45°24'N, 20°51'W.

LEG 1

PURPOSE OF CRUISE

The main purpose of the cruise was the occupation of an expendable bathythermograph (XBT) section on a great circle track from Barbados to the Azores (Fig. 1). These measurements were accompanied by surface temperature and salinity measurements from the towed temperature/salinity (T/S) fish and precision echo-sounder (PES) depth measurements.

NARRATIVE

Seismic explosives and other scientific equipment were loaded during Day 155 and the vessel sailed from Bridgtown in the afternoon of Day 156. On leaving harbour four log calibration runs were performed while within visual and radar range of the shore. These were completed by 1700 hrs local time and after streaming the PES fish the passage to the Azores was commenced. The first XBT probe was launched at 0000Z/157 (Stn 1609) and profiles were then made at nominally 40 km intervals thereafter (Table 1). The XBT were the T-7 model with a designed maximum depth of 750m.

The PES fish gave a poor performance throughout its use and was changed several times on passage. Finally the hull transducer was brought into service and provided a good clear trace.

In order to reduce the number of magnetic tapes used by the data logger the sampling interval was increased to 5 secs.

There were several problems associated with the data logger initially and also with the teletype printers on the satellite navigation receiver. These were overcome in the first two days of the cruise. There was a rather persistent fault with the automatic input of ship's heading and speed to the satellite navigation programme and this recurred intermittently throughout the cruise.

In general the quality of the satellite fixes was high.

The XBT data appeared to be of high quality with a low malfunction rate. The most serious problems were with a poor earth contact which developed after the ship's rail had been painted near the XBT launcher and with misalignment of the chart roll which caused slippage on some traces which then had to be re-run. The XBT spacing was reduced to half when interesting features were encountered.

There were some problems with the towed T/S fish due primarily to an electrical fault in the towing cable and to the cable and fish becoming fouled with sargassum weed. These necessitated slowing the ship on several occasions to recover the fish and rectify the faults. Calibration values were obtained twice per day from bucket samples, the temperature and salinity of which were measured.

The weather was good throughout the passage with the only delays being caused by the necessity to recover PES and T/S fishes, and on Day 161 to render assistance to the topsail schooner 'Artemis', a competitor in the Tall Ships Race.

The vessel berthed at Ponta Delgada (Azores) on Day 166.

SCIENTIFIC PERSONNEL

W. J. Gould (Senior Scientist)	Institute of	Oceanographic		Sciences,	Wormley
J. Moorey	"	"	"	"	"
K. Robertson	"	"	"	"	Barry
P. Hillary	"	"	"	"	"

W. J. G.

LEG 2

DIVISION OF SHIPTIME

Shiptime on this cruise was shared between the Department of Geodesy and Geophysics, University of Cambridge, and the Institute of Oceanographic Sciences, Wormley (I. O. S. (W)). This report covers the work of I. O. S. (W); a separate report will cover the work of the Cambridge Group.

OBJECTIVES OF THE CRUISE

The objectives of I. O. S. (W) were two-fold. Firstly, to shoot three long refraction profiles west of the Mid-Atlantic Ridge north of the Azores, and secondly to carry out a gravity survey of the Kurchatov Fracture Zone (Fig. 2). The refraction lines were intended to complement earlier work carried out in 1974 and 1975, which had as its aim the detection of structures within the upper mantle and the lateral variation of such structures normal to the ridge axis. The gravity survey was aimed at detecting the contrast of lithospheric thickness across a fracture zone and the degree of isostatic compensation adjacent to a fracture zone.

NARRATIVE

R. R. S. Shackleton departed Ponta Delgada, São Miguel, Azores, at 1025/170 and headed for the Kurchatov Fracture Zone. Normal scientific watchkeeping was begun as soon as the ship cleared territorial limits. The precision echo-sounder (PES) fish was launched twice and failed to work both times probably due to a flooded towing cable. Clocks were advanced 1 hour during the night; the ship worked on G. M. T. for the remainder of the scientific work.

Seismic profiling was begun at 0700/171 and we turned onto the first (easternmost) of six 100 km long NS lines in the Kurchatov F.Z. gravity survey at 0910/171. The profiling gear was recovered at the end of that line (1610/171) and two further gravity lines were surveyed before the gravity survey was broken off at 1430/172. Then a survey was begun just north of the Kurchatov Fracture Zone for a site on which to lay two Pop-up Bottom Seismic Recorders (PUBS) for the first refraction line (Stn. 1742, Table 2). The second PUBS was launched at 2022/172. Then the array and a 160 ins^3 airgun were streamed and

shortly afterwards disposable sonobuoys 1 and 2 (the first failed) were launched. Shooting began on a half hourly schedule at 0214/172 and continued to 1200/173, while we steamed along an 005° course. 22 shots of 50 and 300 lbs were fired out to a range of 200 km.

The ship arrived back at the PUBS positions at 0300/174. Both instruments had been recovered by 0740/174 whereupon the gravity survey was resumed. A repaired PES fish was launched at 0930/175 and operated successfully from then until the end of the cruise. The gravity survey continued until early in the morning of Day 176. The profiling gear was deployed for the final westernmost gravity track and this profile was extended northwards to reoccupy a refraction line shot in 1974. This profile ended at 1140/176 whereupon a velocimeter station was occupied (Stn. 1743).

A survey for suitable PUBS sites was begun at 1600/176 as a preliminary for the second and third refraction lines (Stn. 1744). A site was readily identified 40 km west of the median valley but several hours were needed to find and survey a sediment pond within 25 km of the valley. Eventually a PUBS was laid in a small 2 x $\frac{1}{2}$ mile north-south pond. The second PUBS was laid at 2348/176. After deploying the array and 160 ins^3 airgun the ship passed over the first PUBS on a southerly course and disposable sonobuoy 3 was launched. Shooting on a half-hour schedule began at 0430/177 and continued until 1000/177 out to a range of 146 km. The ship returned to the north and 6 further shots were fired between 1400 and 1635 to increase the shot density along the north-south profile. At 1930 shooting began on the east to west profile, again on a half-hour schedule, and continued until 0330/178 out to a range of 129 km. In all 36 shots of 50 and 300 lbs were fired during this station. Both PUBS had been recovered by 1225/178.

The array and 160 ins^3 airgun were then deployed and a seismic profile obtained along the east-west refraction line just shot. Disposable sonobuoy 4 was launched at this time. The profile ended at 0140/179.

Lastly, Shackleton steamed NNE to re-occupy an east-west refraction line shot in 1975. A seismic profile was obtained along this line with a 300 ins^3 gun from 0845/179 until 2000 during which disposable sonobuoys 5 and 6 (5 failed) were launched. At the end of this profile the Cambridge team took charge of the scientific operations.

Briefly the Cambridge work was an experiment to measure the irregularities of the upper and lower surfaces of seismic Layer 2 in a small area about 15' x 15' centred on 45°24'N, 20°51'W. It consisted of closely spaced NS and EW reflection profiles, supplemented by disposable sonobouys, a velocimeter dip (Stn. 1745), a single reversed refraction line and an array of shots fired around a 23 km radius circle. Some 40 shots were fired during the latter experiment (Stn. 1746) and were all recorded by a single PUBS at the centre of the circle.

Shackleton left the Cambridge area at 1800/189 and set course for the westward extension of a continental margin seismic profile requested by D. G. Roberts of I. O. S. (W). The profile had been extended because some spare time remained in the program. However, on reaching 48°20'N, 17°30'W at 1740/190 large seas were running and attempts to obtain a profile were only partly successful because of noise attributable to the sea state. A reduction in speed to reduce this noise, although feasible, would have put the time allotted to the continental margin profile in jeopardy and therefore profiling was abandoned after $2\frac{1}{2}$ hours. The margin profile was started with a 300 ins^3 gun at 0400/191 by which time the weather had moderated slightly. However, at 2010 with 25 ft seas running and winds close to Force 8 the profile eventually had to be abandoned just before darkness fell.

The 100 fathom line was crossed early the following morning and scientific watchkeeping was ended at 0800/192. R. R. S. Shackleton docked at Barry at 1845/193.

ACKNOWLEDGEMENTS

We are grateful to the Master, Officers and Crew of R. R. S. Shackleton for their ready assistance in carrying out the scientific programme. We also thank our Cambridge colleagues without whose help the work could not have been completed.

SCIENTIFIC PERSONNEL

R. E. Kirk — Institute of Oceanographic Sciences, Wormley
J. J. Langford — " " " " "

P. R. Miles	Institute of Oceanographic Sciences, Wormley
R. C. Searle	" " " " "
R. B. Whitmarsh (Co-Senior Scientist)	" " " "
P. Hillary	Institute of Oceanographic Sciences, Barry
K. Robertson	" " " " "
A. Bunch	Department of Geodesy and Geophysics, Cambridge
A. Claydon	" " " " "
M. Mason	" " " " "
D. H. Matthews (Co-Senior Scientist)	" " " "
R. S. White	" " " "

R. B. W.

TABLE 1

LIST OF XBT STATIONS (LEG 1)

Station No.	Sequence No.	Date	Time (Z)	Latitude N	Longitude W
1609	1	5. 6. 76	0002	13° 27. 5'	59° 35'
1610	2	"	0233	13° 44. 9'	59° 20'
1611	3	"	0505	14° 03. 8'	59° 05. 9'
1612	4	"	0733	14° 22. 2'	58° 52. 6'
1613	5	"	1001	14° 39'	58° 40'
1614	6	"	1225	14° 56. 2'	58° 28'
1615	7	"	1451	15° 14. 8'	58° 07. 1'
1616	8	"	1615	15° 24. 8'	58° 01. 9'
1617	9	"	1725	15° 32'	57° 52. 7'
1618	10	"	1952	15° 49. 8'	57° 38. 8'
1619	11	"	2210	16° 10'	57° 23. 5'
1620	12	6. 6. 76	0036	16° 24'	57° 11'
1621	13	"	0253	16° 39'	56° 55. 3'
1622	14	"	0514	16° 55. 6'	56° 39. 4'
1623	15	"	0731	17° 12. 1'	56° 26. 1'
1624	16	"	0945	17° 27. 9'	56° 10. 9'
1625	17	"	1204	17° 46'	55° 55. 1'
1626	18	"	1419	18° 02. 4'	55° 38. 2'
1627	19	"	1638	18° 17. 8'	55° 22. 7'
1628	20	"	1905	18° 33. 6'	55° 05'
1629	21	"	2126	18° 46'	54° 46'
1630	22	"	2349	19° 01. 5'	54° 28. 3'
1631	23	7. 6. 76	0219	19° 18. 3'	54° 09. 7'
1632	24	"	0224	19° 18. 8'	54° 09'
1633	25	"	0449	19° 34. 9'	53° 51. 2'
1634	26	"	0704	19° 48. 5'	53° 33. 9'
1635	27	"	0925	20° 02. 2'	53° 16'
1636	28	"	1143	20° 17. 1'	53° 00. 4'
1637	29	"	1401	20° 30. 4'	52° 43'
1638	30	"	1618	20° 46. 9'	52° 25. 7'
1639	31	"	1835	21° 01. 7'	52° 08. 3'
1640	32	"	2047	21° 15. 7'	51° 50. 8'
1641	33	"	2333	21° 31. 7'	51° 32. 1'
1642	34	8. 6. 76	0151	21° 46. 8'	51° 17. 1'
1643	35	"	0412	22° 01. 4'	51° 00. 1'
1644	36	"	0617	22° 15. 5'	50° 43. 7'
1645	37	"	0828	22° 31. 2'	50° 26. 8'
1646	38	"	1037	22° 46. 5'	50° 10'
1647	39	"	1245	23° 00. 1'	49° 53. 8'
1648	40	"	1452	23° 14. 4'	49° 36. 5'
1649	41	"	1702	23° 29'	49° 18. 5'
1650	42	"	1916	23° 43. 6'	48° 59. 6'
1651	43	"	2116	23° 57. 3'	48° 42. 8'
1652	44	"	2319	24° 11. 9'	48° 23. 9'
1653	45	9. 6. 76	0124	24° 26. 2'	48° 05. 4'
1654	46	"	0326	24° 40. 4'	47° 47'

Station No.	Sequence No.	Date	Time (Z)	Latitude N	Longitude W
1655	47	9. 6. 76	0533	24° 54.1'	47° 28. 2'
1656	48	"	0731	25° 07. 3'	47° 10. 7'
1657	49	"	0934	25° 21. 4'	46° 52. 5'
1658	50	"	1136	25° 36'	46° 34. 8'
1659	51	"	1140	25° 36.4'	46° 34. 3'
1660	52	"	1424	25° 52. 7'	46° 12. 9'
1661	53	"	1428	25° 53'	46° 12. 5'
1662	54	"	1436	25° 53. 8'	46° 11. 4'
1663	55	"	1445	25° 54. 7'	46° 10. 3'
1664	56	"	1545	25° 59. 4'	46° 06'
1665	57	"	1609	26° 02. 3'	46° 01'
1666	58	"	1815	26° 15. 8'	45° 42'
1667	59	"	2017	26° 28. 8'	45° 23. 5'
1668	60	"	2219	26° 40. 5'	45° 05'
1669	61	10. 6. 76	0018	26° 52. 9'	44° 47. 2'
1670	62	"	0220	27° 07. 2'	44° 25. 8'
1671	63	"	0421	27° 20. 1'	44° 07. 5'
1672	64	"	0429	27° 20. 9'	44° 06. 4'
1673	65	"	0617	27° 32. 5'	43° 48. 3'
1674	66	"	0822	27° 46. 2'	43° 29'
1675	67	"	0828	27° 46. 8'	43° 28. 1'
1676	68	"	1023	27° 58. 9'	43° 11. 4'
1677	69	"	1241	28° 13. 6'	42° 48. 6'
1678	70	"	1426	28° 25. 4'	42° 30. 5'
1679	71	"	1629	28° 37.5'	42° 13. 8'
1680	72	"	1830	28° 48. 8'	41° 53. 2'
1681	73	"	2053	29° 01'	41° 33. 1'
1682	74	"	2252	29° 13. 5'	41° 16. 9'
1683	75	11. 6. 76	0056	29° 26. 9'	40° 56. 8'
1684	76	"	0257	29° 40'	40° 38. 5'
1685	77	"	0458	29° 52. 7'	40° 19. 8'
1686	78	"	0658	30° 05. 9'	40° 00. 2'
1687	79	"	0858	30° 18. 8'	39° 41. 1'
1688	80	"	1058	30° 34. 7'	39° 21. 4'
1689	81	"	1102	30° 35'	39° 20. 8'
1690	82	"	1311	30° 49. 5'	38° 59. 4'
1691	83	"	1500	30° 57. 9'	38° 46. 3'
1692	84	"	1700	31° 08. 9'	38° 31. 2'
1693	85	"	1900	31° 24'	38° 00'
1694 failed	86				
1695	87	"	2104	31° 36. 6'	37° 41. 5'
1696	88	"	2301	31° 47. 9'	37° 19. 6'
1697	89	12. 6. 76	0103	31° 59. 2'	37° 00. 1'
1698	90	"	0304	32° 12. 6'	36° 38. 4'
1699	91	"	0505	32° 24. 2'	36° 16. 5'
1700	92	"	0517	32° 25. 3'	36° 13. 8'
1701	93	"	0614	32° 30. 9'	36° 03. 1'
1702	94	"	0705	32° 36. 1'	35° 52. 3'
1703	95	"	0800	32° 41. 4'	35° 40. 8'
1704	96	"	0905	32° 47. 7'	35° 27. 9'
1705	97	"	1005	32° 53. 7'	35° 17. 9'

Station No.	Sequence No.	Date	Time (Z)	Latitude N	Longitude W
1706	98	12. 6. 76	1106	32° 59. 6'	35° 06. 5'
1707	99	"	1206	33° 03. 1'	35° 00. 4'
1708	100	"	1318	33° 08. 2'	34° 50. 2'
1709	101	"	1418	33° 20. 3'	34° 32. 9'
1710	102	"	1518	33° 24. 5'	34° 27. 7'
1711	103	"	1618	33° 30. 3'	34° 13. 7'
1712	104	"	1817	33° 44. 4'	33° 49. 6'
1713	105	"	2017	33° 55. 6'	33° 28. 3'
1714	106	"	2216	34° 06. 5'	33° 06. 1'
1715	107	13. 6. 76	0017	34° 17. 7'	32° 43. 3'
1716	108	"	0021	34° 18. 1'	32° 42. 6'
1717	109	"	0216	34° 30. 8'	32° 19. 6'
1718	110	"	0315	34° 35. 4'	32° 07. 1'
1719	111	"	0415	34° 40. 5'	31° 55. 6'
1720	112	"	0515	34° 46. 1'	31° 44. 3'
1721	113	"	0615	34° 51. 2'	31° 33. 1'
1722	114	"	0715	34° 56. 7'	31° 22. 2'
1723	115	"	0817	35° 02. 6'	31° 10. 4'
1724	116	"	0918	35° 06. 7'	30° 59. 9'
1725	117	"	1012	35° 11. 8'	30° 49. 8'
1726	118	"	1112	35° 17'	30° 39. 3'
1727	119	"	1203	35° 22. 2'	30° 28. 8'
1728	120	"	1258	35° 25. 6'	30° 20. 7'
1729	121	"	1353	35° 30. 8'	30° 10. 1'
1730	122	"	1358	35° 31'	30° 11. 4'
1731	123	"	1544	35° 40. 7'	29° 51'
1732	124	"	1735	35° 51. 4'	29° 30. 1'
1733	125	"	1925	36° 00. 6'	29° 11. 5'
1734	126	"	2119	36° 12'	28° 49. 3'
1735	127	"	2310	36° 23. 9'	28° 26. 3'
1736	128	14. 6. 76	0101	36° 35. 6'	28° 04. 5'
1737	129	"	0253	36° 46. 8'	27° 43. 3'
1738	130	"	0443	36° 58'	27° 20. 6'
1739	131	"	0634½	37° 07. 9'	26° 57. 7'
1740	132	"	0826	37° 18. 3'	26° 36'
1741	133	"	1023	37° 29. 2'	26° 12. 9'

TABLE 2

LIST OF I. O. S. (W) STATIONS (LEG 2)

Station No.	Station Type	Latitude	Longitude	Depth (m)	Comments
1742	R	41° 0.37'N 41° 3.50'N 42° 51'N	30° 26.9'W 30° 26.59'W 30° 11'W	2622 2603	PUBS D position PUBS E position northernmost shot
1743	V	41° 53.7'N	29° 51.4'W	2130	Velocimeter dip to 2000 m
1744	R	42° 7.84'N 42° 12.23'N 40° 53'N 42° 13'N	29° 33.02'W 29° 46.16'W 29° 37'W 31° 20'W	2331 2554	PUBS D position PUBS E position southernmost shot westernmost shot

R = seismic refraction line

V = velocimeter dip

R.R.S. SHACKLETON CRUISE 3 LEG 1 4-14 JUNE 1976

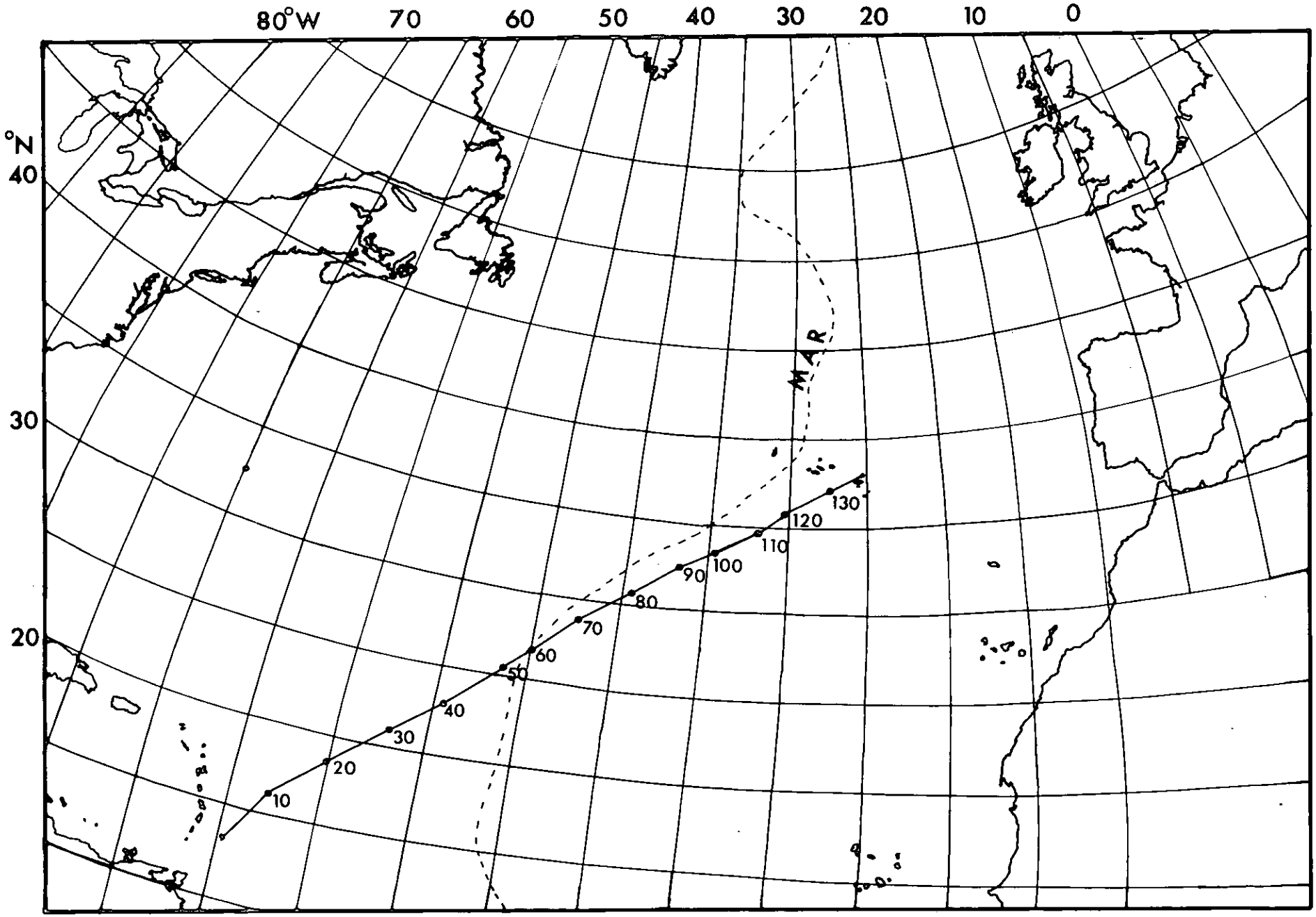

Figure 1 Positions of XBT Stations

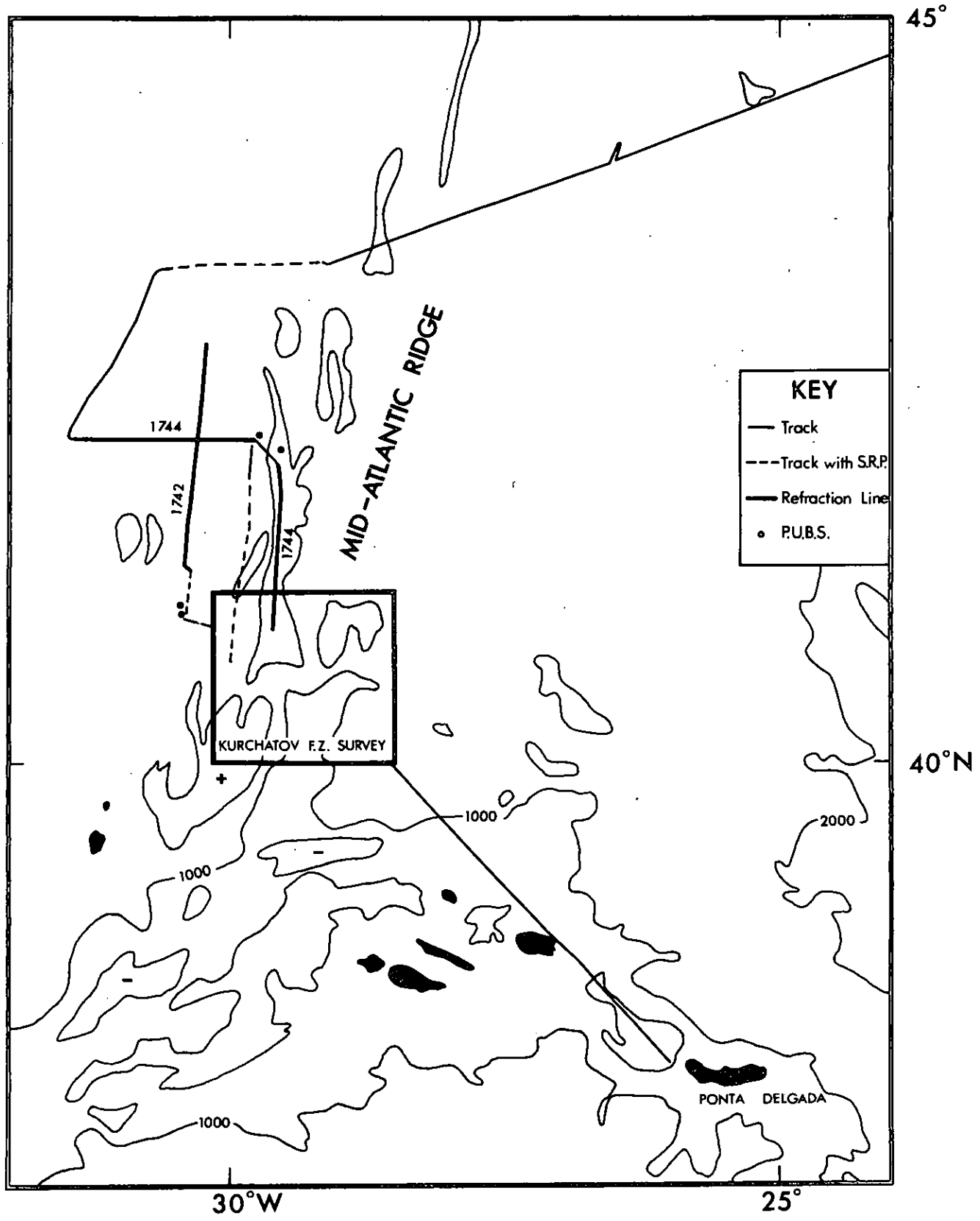

Figure 2 I. O. S. (W) track, Leg 2

R.R.S. SHACKLETON CRUISE 3 LEG 2 18 JUN – 11 JUL 1976.

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
75	October - November 1975	43

[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
August – September 1975	IOS CR 41
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
April 1975	IOS CR 39
October – November 1975	IOS CR 40
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
August – September 1975	IOS CR 38
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