I.O.S.

RRS SHACKLETON CRUISE 8/79

31 AUGUST – 30 SEPTEMBER 1979

GEOLOGY AND GEOPHYSICS IN THE NORTHEAST ATLANTIC AND ON THE MID–ATLANTIC RIDGE

CRUISE REPORT NO 110

1981

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

INSTITUTE OF OCEANOGRAPHIC SCIENCES

Wormley, Godalming,
Surrey, GU8 5UB.
(0428 - 79 - 4141)

(Director: Dr. A.S. Laughton)

Bidston Observatory,
Birkenhead,
Merseyside, L43 7RA.
(051 - 653 - 8633)

(Assistant Director: Dr. D.E. Cartwright)

Crossway,
Taunton,
Somerset, TA1 2DW.
(0823 - 86211)

(Assistant Director: M.J. Tucker)

RRS SHACKLETON CRUISE 8/79

31 AUGUST-30 SEPTEMBER 1979

Geology and Geophysics in the Northeast Atlantic
and on the Mid-Atlantic Ridge

CRUISE REPORT NO. 110

1981

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

CONTENTS

DATES

Leg 1	Depart Barry	31st August, 1979	Day 243
	Arrive Ponta Delgada	13th September, 1979	Day 256
Leg 2	Depart Ponta Delgada	14th September, 1979	Day 257
	Arrive Gibraltar	30th September, 1979	Day 273

SCIENTIFIC PERSONNEL

			Leg 1	Leg 2
T.J.G. Francis	Principal Scientist	IOS Wormley	X	X
R.C. Lilwall		IOS Blacknest	X	X
I.T. Porter		IOS Blacknest	X	X
C.A. Tew		IOS Blacknest	X	X
R.E. Kirk		IOS Wormley	X	X
M.R. Saunders		IOS Wormley		X
A. Cumming		RVS Barry	X	X
J. Taylor		RVS Barry	X	
K. Smith		RVS Barry		X
J. Burnham		RVS Barry	X	X
G. Knight		RVS Barry	X	X
M. Sinha		Geodesy & Geophysics, Cambridge	X	
M. Rayner		Geodesy & Geophysics, Cambridge	X	
J. Duschenes		Geodesy & Geophysics, Cambridge	X	X

SHIP'S OFFICERS

G.H. Selby Smith	Master	
A. Moore	Chief Officer	Leg 1
E.M. Bowen	Chief Officer	Leg 2
P. Oldfield	2nd Officer	
A. Louch	3rd Officer	
C.S. Storrier	Chief Engineer	Leg 1
F. Hammond	Chief Engineer	Leg 2
G. Batten	2nd Engineer	
H. Peck	3rd Engineer	
B. Entwhistle	4th Engineer	
D. Scott	Radio Officer	
R. Overton	Purser/Catering Officer	

CRUISE OBJECTIVES

This cruise was originally conceived as a major ocean bottom seismograph exercise in which the five OBS from IOS Blacknest would be deployed together with a similar number of OBH from the Woods Hole Oceanographic Institution in a network designed to observe microearthquakes on the Mid-Atlantic Ridge. Unfortunately, we learned within three months of the cruise starting that the WHOI had failed to receive funding from the U.S. National Science Foundation. Thus the cruise objectives at the time of sailing were:

1. Deployment of a network of 5 OBS to record microearthquakes on the axis of the Mid-Atlantic Ridge. This would be the first full scale deployment of the Mk-II OBS designed to record continuously for up to 1 month. On this cruise deployments of 2-3 weeks were planned.

2. Observation of water temperature close to the sea-floor in the median valley with the IOS Temperature Telemetering Pinger (TTP), in a search for temperate anomalies associated with hydrothermal springs.

3. Coring sediments in an area south of King's Trough centred approximately at 42^{o}N, 22^{o}W.

4. Deployment of a prototype Buoyant Programmed Pinger on the Biscay Abyssal Plain just off the Western Approaches to the English Channel.

5. Testing a new Ocean Bottom Hydrophone developed at the Department of Geodesy and Geophysics, Cambridge University. Two Cambridge personnel participated in the cruise to carry out this work.

6. Pressure testing the Blacknest OBS in Peake Deep (3142 ucf, 5964 cm) in preparation for the deep deployments planned for the LADLE experiment in early 1980 on Discovery Cruise 107.

7. Should time permit, a bathymetric survey would be conducted in the vicinity of 49^{o}N, 34^{o}W, to provide data for the new GEBCO chart in an area of sparse coverage.

8. Bathymetric, magnetic and gravity data would be acquired continuously on passage. However, no shipboard computer or automatic data logging was available on this cruise.

All the above objectives were achieved with reasonable success with the exception of No. 7 for which insufficient time was available.

NARRATIVE (all times GMT)

After delays in the installation of a new stern "A" frame, Shackleton sailed from Barry at 1330/31 August (day 243). Scientific watchkeeping began at 0900/244 with the ship already seaward of the Scillies.

By 0900/245 we had reached the deep water of the Biscay abyssal plain and stopped to deploy the Buoyant Programmed Pinger (BPP). This was done on the main warp from the main "A" frame on the starboard side. The mooring itself, consisting of sinker, 50m of wire and the sphere housing the pinger, was attached to the main warp by a standard IOS acoustic release unit, 16m wire strop, and a swivel. Weights attached just below the swivel ensured that some load remained on the end of the main warp when the BPP was released. At 1031 the complete rig was in the water and being lowered. By 1232/245 a good bottom echo from the pinger had been observed on the PES and the BPP mooring was released from the main warp on acoustic command. Several satellite fixes received during the course of the deployment showed the ship drifting steadily eastwards at about 0.2kt. The position of the BPP mooring is 46°59'.95N, 10°58'.30W.

Following deployment of the BPP we remained on station to begin testing the OBS on the main warp. OBS 5A was in the water at 1458/245 and back inboard with both "puffers" (pyrolease dummies) successfully fired at 1855. During the night the ship proceeded westwards to the ridge.

At 0730/246 we stopped again in excellent weather to continue testing the OBS on the main warp. The tests on OBS 4A, 6A and 7A were all satisfactory, but an error made in the preparation of OBS 3A led to it being flooded. This testing station was completed by 1910/246 and we continued again towards the ridge.

At 1445/249 we reached the axis of the median valley, continued west to the crestal mountains on the western side to confirm our identification, then returned to commence laying a radar transponder buoy on the axis at 1915 in 3300m water. A survey was carried out south of the buoy during the night, OBS deployment commencing at first light the following morning. OBS 4A was launched some 5 miles WSW of the transponder buoy at 0836/250. At 1226/250 OBS 5A was launched 5 miles

ESE of the buoy. It was planned to launch OBS 6A next, but the instrument failed its pre-launch tests. Eventually OBS 7A was launched at 1902/250 about 2 miles N of the buoy. The ship then hove to to provide a steady platform while OBS 6A was stripped down in the laboratory. A cupful of water was found in the bottom, probably leaked through a faulty Marsh and Marine plug during the passage to the ridge.

At 0200/251 repairs of OBS 6A were complete. A bathymetric and magnetic survey was then conducted until 0810. During the forenoon OBS 6A was tested on the main warp to 2500m. Its acoustic functions operated perfectly and the instrument was inboard again at 1440. However, further tests indicated a power supply fault and it was decided to strip the instrument down again. The problem turned out to be a pinched wire shorting the power supply to earth. While repairs were being carried out, a velocimeter dip to 2000m was carried out from 2220 to 2350. The night was spent conducting a bathymetric and magnetic survey.

OBS 6A was reassembled, passed at its pre-launch checks and was launched at 1114/252 some 8 miles north of the transponder buoy. The weather this day was exceptionally fine, with no more than light airs and the sea mirror-like. After completing the OBS 6A deployment we moved south 5 miles to lay the Cambridge OBH. It then transpired that its IOS type acoustic release used the same frequency as OBS 6A. So we moved further south before launching it at 1521/252. Firing the 1000 cu. in. airgun began at 1710, continuing at 2 minute intervals every odd minute from 1711. Courses were run over the OBS array and Cambridge OBH until 0615/253 at which time the airgun firing ceased.

The Cambridge OBH was acoustically released at 0720, surfacing at 0812/253. During the recovery we picked up a 167 Mhz signal on the VHF radio, close to the OBS 6A radio beacon frequency. Fearful that our acoustic commands to the OBH had also released OBS 6A, unlikely though this was at 18 miles range, we returned to make an acoustic check of the latter. Acoustic communication with OBS 6A on both its transpond and beacon frequencies failed to get any reply. Then at 1149/253, OBS 6A surfaced only 3 cables off. Inadvertently we had released it from the bottom. On surfacing, its radio beacon was detected at 169 Mhz. The 167 Mhz, it transpired, originated on the ship itself.

At 1202/253 OBS 6A was inboard yet again. While it was being serviced for redeployment, the first temperature telemetering pinger station was conducted from 1358 to 1948. At 2038, OBS 6A was relaunched. Once launched we recovered the Transponder Buoy, which had operated perfectly for four days at 2140, then set course for Ponta Delgada.

Such was our progress in the excellent weather that there was time to make another test drop of the Cambridge OBH. At 1324/254 the instrument was launched The 1000 cubic inch airgun was fired from 1359 on a 2 minute schedule. At 1545 the airgun was inboard. The OBH was released acoustically and by 1725 was inboard. We continued on passage to Ponta Delgada, concluding scientific watch-keeping at 2340/255. At 1012/256 Shackleton tied up along the mole in Ponta Delgada.

The ship sailed from Ponta Delgada at 1600/257. Scientific watchkeeping began again at 1100/258. With hurricane conditions reported in the vicinity of Flores the ship moved east before turning north to head for the first coring position. At 0852/259 we began our first core station. Coring continued for the next two days over the southern flank of the King's Trough region. By 0745/261 we had retrieved 8 cores. Details of the corer and of the core stations are given in the project report and the table.

At the conclusion of coring the ship headed west, reaching the ridge axis at approximately 43^{o}N at 1000/262. Before beginning a programme of Temperature Telemetering Pinger (TTP) stations we were diverted by the radar sighting of a buoy a few miles to the north of us. On investigation it proved to belong to the Bedford Institute of Canada. From the growth of barnacles and weed it must have been adrift for a couple of years. Being too big to recover we contented ourselves with signalling the owners of its whereabouts. We then began a series of TTP stations in the median valley, making our way between stations up the ridge axis towards the position of the OBS network.

At 1506/265 we concluded our twenty fifth TTP station and moved into position to moor the radar transponder buoy. This was slipped at 1820 with 3500m wire in 3200m waters. A survey was conducted overnight finishing over the OBS 4A position just before 0700/266. OBS 4A left the bottom at 0700 on its back-up clock, surfacing at 0751 within 2 cables of the ship and coming inboard at 0820. The remaining OBS were all brought up on acoustic command. OBS 5A was inboard at 1125, OBS 7A at 1348 and OBS 6A at 1640. The ascent rate of the Mk-II OBS (single sphere with syntactic foam buoyancy), determined from the three instruments with operating acoustic beacons (OBS 6A beacon did not work) averaged 0.79 m/sec.

Just after the last OBS was recovered, the transponder buoy disappeared from the radar. Returning to its position we found that the pole supporting the transponder and reflector had sheared off and disappeared. The remaining flotation part of the buoy was recovered by 1800/266. We then moved east of the crestal mountains to conduct more TTP stations. On station no. 27 the flexidrive for the metre wheel of the hydrographic winch broke. The station was completed relying entirely on the bottom reflection of the pinger. No quick repair was possible, so this concluded our TTP observations. Course was set for Antialtair Seamount.

On day 267 the weather deteriorated for the first time on the cruise. But it did not blow much over force 6. From 1050-1240/268 we spent an abortive two hours over Antialtair Seamount attempting to get sub-bottom penetration with an O.R.E. 3.5 kHz towed fish echo-sounder. It failed to achieve any penetration of what appeared to be a sedimentary feature at 1000 u.c.f. depth. We concluded that the system is unsuitable for oceanic depths.

At 1240/268 we continued on passage to Peake Deep, reaching the abyssal plain at 3142 u.c.f. (5964 corrected metres) depth which floors it at midnight on that day. The next twenty hours were spent pressure testing four OBS. Each instrument was lowered to depth and allowed to remain there for 1 hour before heaving in. OBS 3A and 6A were tested at 5900m wire out. The last 100m of wire had then to be cut off because of its poor condition. The remaining wire was sufficient for OBS 5A and 4A to be lowered to only 5800m wire out. The pressure testing was successfully completed at 2000/269 and course was set for Gibraltar.

Scientific watchkeeping was concluded at 0830/272 and the ship berthed in Gibraltar at 1100/273.

PROJECT REPORTS

Ocean Bottom Seismographs

Since four of the OBS Mk-II instruments had not been used at sea before, it was decided to test all instruments on the main warp before proceeding with the free fall deployments. These tests would allow the water tightness and acoustic command systems to be tested. Four of the instruments passed these checks satisfactorily, but unfortunately OBS 3A flooded due to a water tight bung not being in place. Because of this only four OBS were available for deployment on the ridge axis.

The Mk-II OBS differs from the original OBS in having a single sphere with additional buoyancy fitted to it in moulded "cheeses" of syntactic foam. We were particularly interested in the descent and ascent rates of this new configuration. These turned out to be 1.5 m/s and 0.8 m/s respectively.

Parameters of the OBS deployments are given in Table 1.

Buoyant Programmed Pinger

This instrument is designed to test the bearing strength of deep ocean sediment over a period of years. It consists of a 10 kHz pinger housed in a buoyant sphere attached by 50m of wire to a heavy sinker (weighing 850 lb in air). To conserve power and hence provide a long life, the pinger is programmed to operate for only three one-hour periods per week. If the sediment is not strong enough to support the weight of the sinker, then observation will show that the direct sound from the pinger gradually approaches that reflected from the sea bed.

The BPP deployed on 2nd September, 1979 is programmed to operate from 1000-1100 GMT on Sundays, Tuesdays and Thursdays. It was moored at $46^{o}59'.95N$, $10^{o}58'.30W$ in water depth 2510 uncorrected fathoms (4733 corrected metres). Immediately after deployment the height of the pinger above bottom was observed to be 27.2 uncorrected fathoms.

Coring

At all coring stations a 1000 lb MSES Gravity Corer fitted with a 12ft barrel was used, triggered by a 176 lb trigger weight. A pinger was attached only on the first station, but proved to be ineffectual so was not used on subsequent stations. However, the wire tension at the ship was monitored on a chart recorder and this allowed the triggering and pull out to be monitored at all stations. The maximum tension observed on pull out was 6200 lb at core station no. 2. At most stations the corer penetrated up to the bomb, as indicated by mud on the outside of the barrel and bomb, but the length of core within the barrel was always less - by a metre or so. Details of the core stations are given in Table 2.

Temperature Telemetering Pinger

This was the standard 10 kHz IOS instrument which telemeters the temperature of its surroundings by pulse delay modulation. The reference pulse is transmitted every 2 secs; following this at an interval of a few hundred millisec, according to temperature, is the temperature-indicating pulse. Temperature is determined by measuring the spacing of the pulses on the PES record. The calibration of the instrument used was such that temperature could be determined to $\pm$ 0.01°C. The instrument was lowered on the 6mm hydrographic wire, its mushroom transducer pointing upwards and located some 2m above the 150 lb bottom weight. Bottom echoes from the pinger were not always obvious in the rugged terrain of the median valley, but the instrument was rugged enough to stand dragging on the bottom. Mud on the instrument after some of the lowerings indicated that it had touched bottom on a few occasions. Details of the TTP stations are given in Table 3.

TABLE 1 OBS PARAMETERS

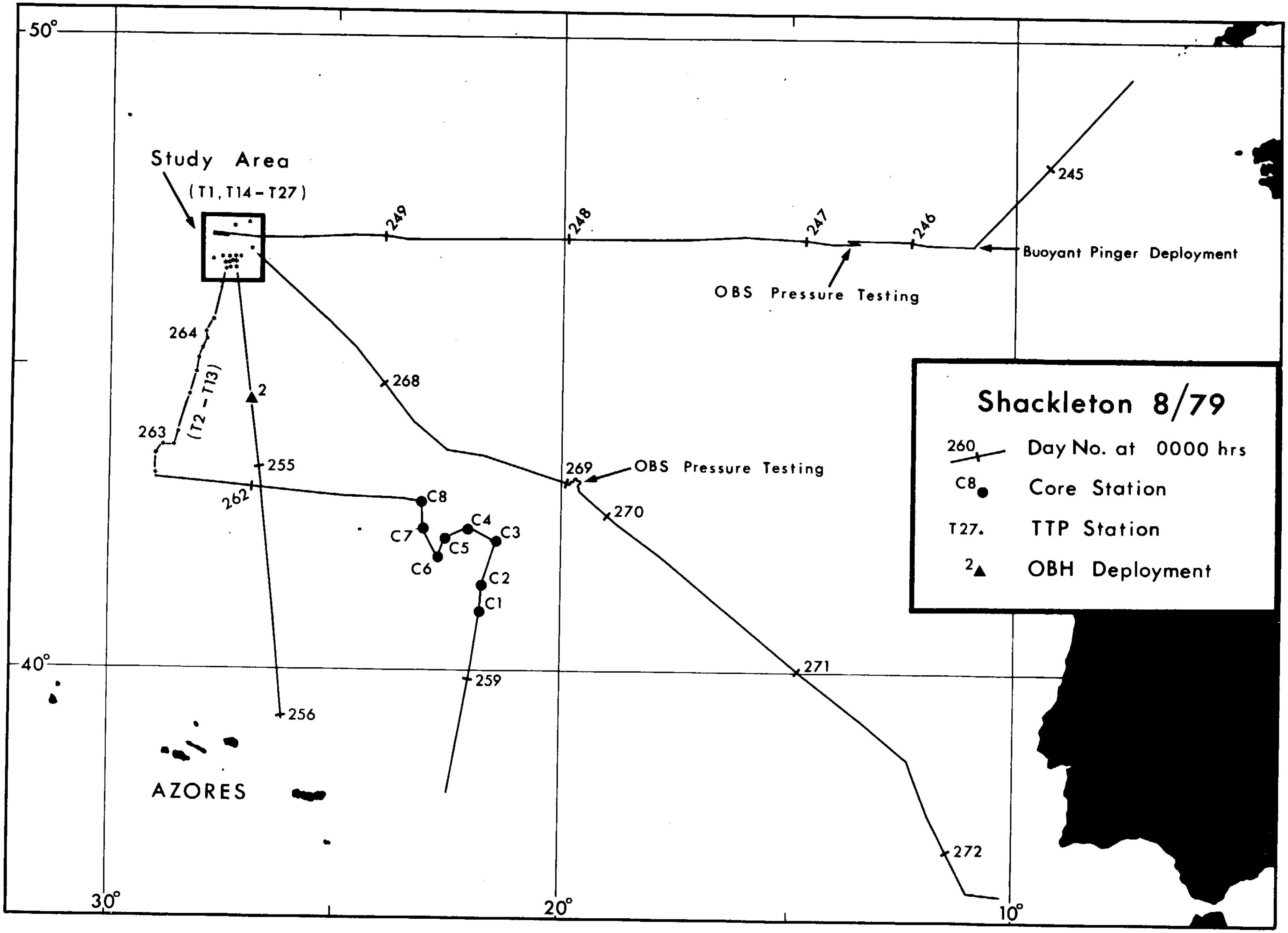
OBS	Launched	Recovered	Latitude N	Longitude W	Depth	Remarks
4A	0836/250	0820/266	46°58'.3	27°25'.6	2387m	Tape Recorder failed to run
5A	1226/250	1125/266	46°58'.5	27°11'.7	2816	Recorded
7A	1902/250	1348/266	47°01'.2	27°19'.3	3096	Tape Recorder stopped after few days
6A	1114/252	1202/253	47°07'.7	27°19'.4	3122	Prematurely brought to surface on acoustic command.
6A	2038/253	1640/266	47°07'.8	27°19'.9	2946	Recorded
COBH	1521/252	0830/253	40°49'.7	27°18'.0	2984	Cambridge OBH. Instrument test with Airgun
COBH	1324/254	1725/254	44°27'.7	26°50'.5	2665	Cambridge OBH. Instrument test with Airgun

TABLE 2 CORE STATIONS

No	Start	Finish	Latitude	Longitude	Depth (ucf)	Depth (cm)	Length of Core Recovered
1	0852/259	1205/259	41°04'.3N	21°44'.2W	1960	3687	2.54m
2	1505/259	1812/259	41°28'.5N	21°41'.4W	2126	4003	2.75m
3	2230/259	0130/260	42°08'.7N	21°23'.6W	2174	4095	3.65m
4	0510/260	0805/260	42°22'.6N	22°03'.1W	2060	3877	2.56m
5	1100/260	1400/260	42°13'.5N	22°33'.9W	2012	3785	2.46m
6	1710/260	2000/260	41°51'.9N	22°44'.2W	2030	3819	2.01m
7	2326/260	0150/261	42°19'.9N	23°03'.5W	2003	3768	3.03m
8	0454/261	0745/261	42°49'.6N	23°03'.8W	1872	3520	1.63m

TABLE 3 TEMPERATURE TELEMETERING PINGER STATIONS

No	Start	Finish	Latitude N	Longitude W	Depth
1	1358/253	1948/253	47°9'.0	27°18'.9	3118m
2	1141/262	1346/262	43°12'.9	28°59'.7	3155
3	1636/262	1830/262	43°32'.0	29°00'.2	2922
4	2010/262	2230/262	43°41'.0	28°48'.9	3394
5	2353/262	0145/263	43°41'.5	28°36'.4	3381
6	0332/263	0529/263	43°54'.0	28°27'.8	3162
7	0931/263	1115/263	44°30'.0	28°13'.4	3072
8	1346/263	1523/263	44°50'.7	28°06'.3	3244-3376
9	1712/263	1839/263	45°05'.7	28°03'.9	2584-2809
10	1957/263	2142/263	45°16'.1	27°57'.7	3204
11	2247/263	2400/263	45°24'.1	27°53'.0	3158
12	0100/264	0304/264	45°31'.3	27°53'.4	3258
13	0430/264	0645/264	45°41'.4	27°46'.2	3600
14	1308/264	1414/264	46°39'.5	27°47'.2	2738
15	1505/264	1600/264	46°39'.7	27°36'.5	2403
16	1722/264	1910/264	46°40'.1	27°23'.0	3386
17	1955/264	2121/264	46°39'.8	27°17'.0	3524
18	2200/264	2300/264	46°39'.9	27°11'.3	1981
19	0005/265	0120/265	46°35'.2	27°18'.8	3227
20	0202/265	0337/265	46°35'.5	27°20'.7	4114
21	0450/265	0655/265	46°35'.3	27°31'.0	2908
22	0804/265	0915/265	46°30'.0	27°29'.0	2522
23	0920/265	1109/265	46°30'.4	27°25'.5	3416
24	1155/265	1301/265	46°30'.0	27°17'.4	2905
25	1350/265	1506/265	46°34'.9	27°25'.1	3254
26	2030/266	2213/266	47°10'.6	26°57'.2	3107
27	0143/267	0330/267	46°48'.2	26°56'.3	2862



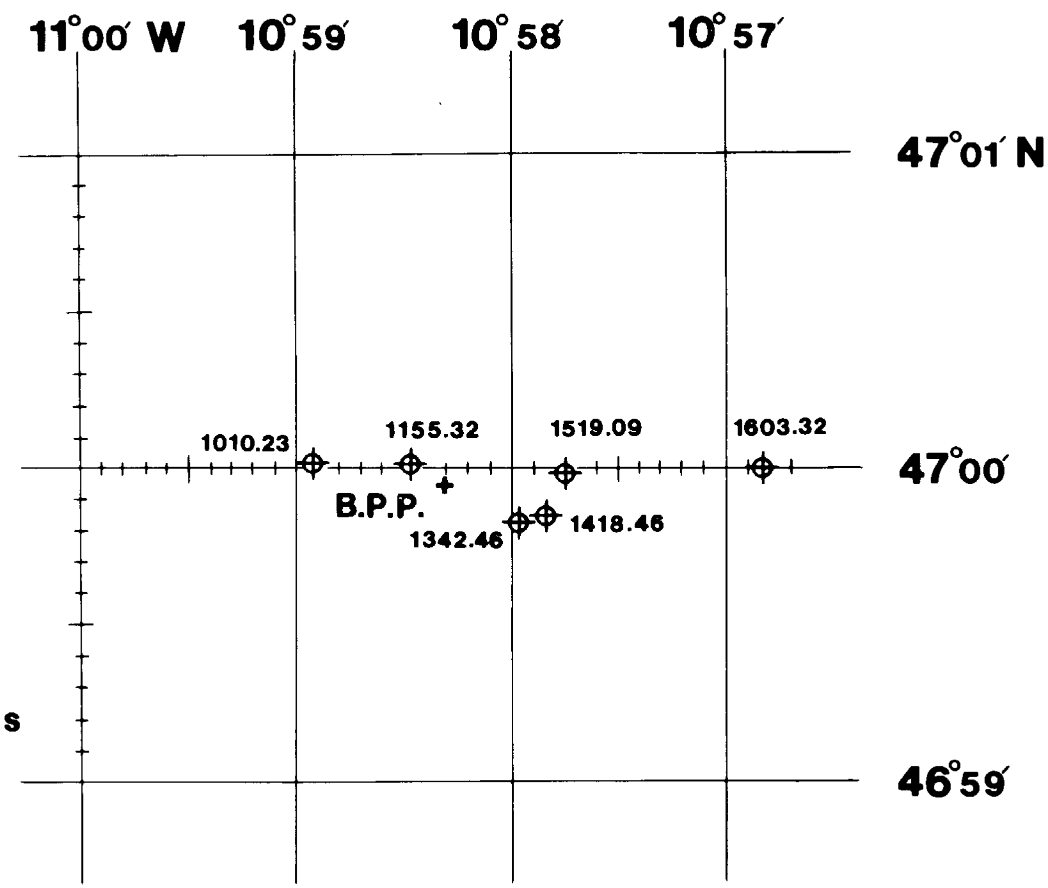
Shackleton 8/79
260 Day No. at 0000 hrs
C8 Core Station
T27. TTP Station
2 OBH Deployment
Study Area
(T1, T14-T27)
(T2 - T13)
Buoyant Pinger Deployment
OBS Pressure Testing
OBS Pressure Testing
245
246
247
248
249
255
256
259
262
263
264
268
269
270
271
272
2
C1
C2
C3
C4
C5
C6
C7
C8
AZORES
50°
40°
30°
20°
10°

SHACKLETON 8/79

BOUYANT PINGER POSITION

46° 59·95′ N   10° 58·30′ W

WATER DEPTH   2510 ucf.
4733 corr. metres



Drift of ship during Buoyant Programmed Pinger deployment, day 245.