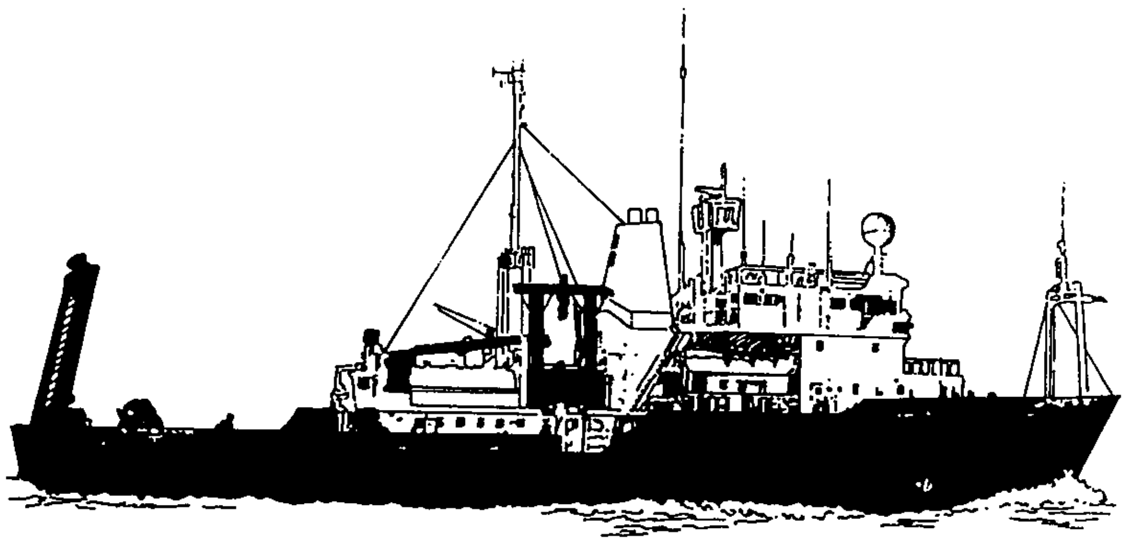
UNIVERSITY OF CAMBRIDGE

CRUISE REPORT

BULLARD LABORATORIES
DEPARTMENT OF EARTH SCIENCES



RESEARCH VESSEL
Charles Darwin

RRS CHARLES DARWIN 67
OCEAN III SEISMIC SURVEY

R.S.White

CHARLES DARWIN 67

OCEAN SURVEY AREA

16th April-4th May 1992

Barry, South Wales - Las Palmas, Gran Canaria

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SUMMARY

The objectives of this cruise were to make a seismic reflection and wide-angle seismic refraction survey using ocean bottom seismometers (OBS) and disposable sonobuoys of a 100 x 100 km study area of Mesozoic oceanic crust which had already been surveyed during earlier cruises: a magnetics, gravity and bathymetry survey from Charles Darwin 54 had defined the tectonic setting of the region, and the locations of ridge jumps and fracture zones; and a deep seismic reflection survey using a commercial ship (GECO Bin Hai 511) had recorded 580 km of profiles in September 1992. Our objectives were met in full, shooting two major wide-angle seismic profiles into two deployments of 5 OBS located across normal oceanic crust and fracture zone crust identified by the earlier surveys. The remainder of the time on station was used to fill in critical gaps in the earlier magnetics and gravity surveys.

Two IOSDL moorings which had been deployed more than 18 months previously were also successfully recovered: one a sediment trap and the other a bathysnap.

ACKNOWLEDGMENTS

This was an extremely successful cruise, and we are most grateful to the Master, the officers and and the crew of RRS Charles Darwin for their help and support. The RVS technicians worked long hours to make and keep the equipment operational and we thank them for providing us with the biggest airgun array NERC have thus far deployed. It is an excellent seismic source and we shall certainly use it again in the future. We also thank the two non-Cambridge members of the scientific team, Ben Boorman and Greg Jones, for all their work and assistance at sea. We would have missed them greatly had they not been there. Finally, the Cambridge team worked faithfully and willingly throughout the cruise and the work reported here would have been impossible without them.

NARRATIVE

Cambridge equipment was loaded on Wednesday, 15th April and the labs set up during the day. There was a lot of clutter on the benches for the subsequent cruise 68 which forced our equipment layout to be more fragmented than we would have preferred. A number of trigger leads required by RVS for the airguns had not arrived in time, so they were borrowed from BAS in Cambridge and driven to the ship in the afternoon by a member of the Cambridge Bullard Laboratories staff. Our equipment was set up in the Main Lab., the Controlled Temperature Lab. and the Wet Lab.

The ship sailed on schedule at 0740 BST on Maundy Thursday, 16th April and steamed at full speed to the IOSDL Bathysmap location, arriving there at 0920 on Tuesday, 21st April. We made good progress on passage, averaging above 12 knots. The clocks were set back to GMT for the duration of the scientific work. During the passage the Cambridge OBS were prepared and tested and the Oceano releases fitted in place of the IOS releases used hitherto. Immediately on sailing it became clear that the E/M log, which was damaged on the previous leg, was still not operational. Despite brave attempts to fix it or to re-calibrate it through the data logging computer, it remained unusable throughout the cruise. The sensor for the doppler log was lowered instead, but the doppler log proved unusable for 4-5 hours around dusk and dawn each day, presumably due to migration of the reflective plankton layer. Later in the cruise Tony Cummings manually locked it onto a deeper layer at around 150 m. depth, and this improved its stability. But it was never sufficiently reliable for real-time navigation.

Considerable effort was spent in attempting to optimise the Trimble 4000 GPS receiver. Continuous fixes were logged at a rate of approximately one per second, and a short-term average from the data logger Level C output was dis-played on the bridge to give the officer of the watch some idea of the ship's speed. The Oceano navigation system was also set up to display GPS navigation on the Bridge and in the Lab. and was used for navigating the seismic lines and OBS deployments and recoveries. It was acceptable in use, though clumsy because not designed primarily for this mode of operation.

Considerable effort was also expended during the transit in attempting to get the Reftek gun-firing monitor fully operational (never in fact achieved, although it was usable), and in preparing the airguns and the airgun beams for use. The hydraulics of the blue winch used for recovering the IOSDL moorings required a lot of work, and were never satisfactorily fixed.

On reaching the IOSDL Bathysmap mooring, the echo-sounder fish was deployed from the port mid-ships davit. The mooring released commendably rapidly, though recovery took several hours due to the small diameter of the blue winch and the leaking hydraulics. Although recovered successfully, the data-logger on the current meter had flooded and no data could be retrieved from it. Only one of the two pyros had detonated, the plug on the other one having flooded.

Following retrieval of the mooring, we made a wire-test of OBS 11 with the new release. Failure of the "RANGE" button to work and false indications on the ship-board command unit that the weight had been released caused considerable consternation, so a second wire test was made of OBS 13 with a different Oceano release unit. Similar problems were experienced with the command unit, though the weights were released when expected. It became clear subsequently that the "RANGE" option was inoperable in the configuration purchased by RVS and the false indications that the release had triggered were indeed only false. It was, however, with some trepidation that we sub-sequently proceeded to our full OBS deployment. These ambiguities would be removed if RVS were to purchase an appropriate cable for the Oceano fish.

Scientific watchstanding with 24 hour coverage was started at 1700 on Tuesday, 21st April, and the gravimeter remained on until the end of the cruise when we were inside the 200 nm limit of the Canary Islands. Peter Carter was taken ill on Monday, 20th and remained unable to work for the remainder of the week.

The IOSDL sediment trap was reached at 0800 on 22nd April 1992. Again the release responded immediately and the first buoy was on the surface about 200 m away by 0820. Throughout the cruise, the officers were able to position the ship just a few hundred metres away from the position at which moorings surfaced and this considerably speeded and simplified the recoveries. The mooring was onboard 5 hours later. As we left the mooring to steam to the OCEAN III survey area the magnetometer was deployed.

Arrived in the survey area at about 0400 on Thursday, 23rd April and proceeded to do a 16 hour magnetics survey to define the seafloor magnetic anomalies to the north of the northernmost (un-named) fracture zone in the survey area. Completed the magnetics survey at 1830 at the position for the launch of the first OBS. Attempted to make a velocimeter dip on the CTD wire. But failure of the 'wire out' counter meant that we had to abandon it and instead proceeded to launch the first two OBS (OBS 11 and OBS 12) while the counter readout was fixed. These and all subsequent OBS were deployed within one cable of the planned locations, a tribute to the officers and to the GPS coverage.

The velocimeter dip to 3000 m and a coincident XBT to 750 m were made after the first two OBS deployments. Velocimeter readings appeared unusually low, so should be checked. After completion of the velocimeter dip at 0100 on Friday, 24th April, the remaining 3 OBS were deployed along the planned line, finishing at 0600 on 24th April.

Airgun deployments commenced after breakfast at 0800 on 24th April. The guns on the first beam did not initially seal, so they were brought back inboard and the orifice on one of them changed. After redeployment they worked perfectly. By lunchtime the first two beams were overboard and working correctly. The second two beams (3 and 4) proved more awkward. On beam 3 guns number 7 and 8 would work only at low pressure (<1500 psi) or high repetition rate (faster than 10 sec). Eventually gun 8 was coaxed into working properly but gun 7 was not operational for the duration of the first seismic experiment. On beam 4 a hose burst in the umbilical shortly after deployment. The beam was brought back inboard and a new hose plumbed in. During the first shooting line this hose burst, too. Ultimately we had one 700 cu. inch gun working correctly on this beam but the other 700 inch and 1000 inch gun did not work properly and were switched out at 0530 on Saturday, 25th. Eventually shot the first east-west line through OBS 15, starting a few hours late. Everyone was too tired to deploy the Geomechanique streamers, but since we were shooting along a previous GECO OCEAN II profile, this was not serious. Four disposable sonobuoys were deployed.

We finished the first shooting line at 0700 on Saturday, 25th April, and then retrieved Beam 4. The middle 700 cu. inch gun (a spare) was removed and the remaining 700 and 1000 inch guns made operational. The strain member in the umbilical was shortened to try to release strain on the hoses. No further trouble was experienced with this umbilical. Beam 4 was re-deployed late in the afternoon, and the main south-north line commenced with 10 guns (lacking just the 300 inch on beam 3, which in any case was a duplicate 300 inch).

The gun array continued working perfectly throughout the main shooting run, with the main difficulty being the absence of a working E/M log. This means that the speed sometimes dropped to as low as 4 knots, allowing the guns to sink and therefore changing the sourc signature. Failure of the Dowty low gain 906A buoys meant that we deployed instead some old SSQ41B sonobuoys which gave excellent results.

As we crossed the northern fracture zone during the morning of 26th April a good dipping mantle reflector was imaged on the single-channel monitor. So the profile was continued well north of the fracture zone to ensure a good profile was obtained. A second crossing of the same fracture zone further to the east recorded a similar image, so this line, too, was continued to give a long profile across it. Finally, in the evening a line was run from east to west along the fracture zone.

The airgunning was stopped at 0430 on Monday, 27th April, and after turning head to wind the airgun booms were recovered. Total recovery time of the booms and streamer was about 4.5 hours, finishing by 1030. The starboard airgun support buoys were still tangled when they were recovered, and the shot hydrophones on the bigger guns were all damaged or knocked off their mountings.

Through the rest of 27th April the five OBS were recovered, completing the last by just after midnight. Recovery was very smooth, using GPS to position the ship two or three cables downstream from the position the buoys surfaced. The first OBS recovered (OBS 11) ascended very slowly due, we discovered, to an imploded stray line buoy. None of the other buoys wasdamaged. During the day the weather deteriorated, gusting 30 knots (Force 7) by the time the last OBS was recovered.

Throughout Tuesday, 28th April we ran a 23 hour magnetics and gravity survey to fill in some critical gaps from the earlier CD54 survey. Uncomfortable motion in Force 7 seas. The OBS were replenished and the stray line buoys and mooring rope guard modified in an attempt to reduce the magnitude of approximately 1 Hz noise rcorded on the OBS as a result, most probably, of ocean currents near the bottom. A 5 Hz low cut filter (up from 1Hz) was also added to the OBS electronics.

Deployment of the OBS on the second shooting line started at 2300 on 28th April. The procedure for deployment is now very efficient, taking only about 10 mins. All OBS were dropped very close to their designated locations with the aid of GPS. Wind still 23-25 knots. OBS deployments completed by 0700 on 29th April.

Started deploying the hydrophone streamer at 0700 on 29th April, followed by the four renovated airgun booms. All 11 guns of our array were firing by 1400 on 29th April, followed by the four renovated airgun booms. All 11 guns of our array were firing by 1400 on 29th April. We then turned onto the shooting tracks through the OBS, and continued uneventfully until

0900 on 1st May. No problems with guns or compressors, although several shot hydrophones again showed damage and the Reftek gun firing was switched to 'Static' mode. Good deep mantle reflectors were again recorded from the fracture zone.

At 0900 on 1st May we spent an hour firing the guns at different rates to test the effect of different gun arrays and repetition rates. As we finished the Reftek failed completely.

Airgun recovery started at 1000 on 1st May and all the guns and the streamer were inboard by 1400. We then recovered the OBS in Force 6 seas. Again all were recovered safely, although failure of the flashing light on OBS 12 when it reached the surface at 2300 meant that we had to locate it using the Aldis lamp. The reflective numbers showed up well, and it was still possible to range on the OBS when it was on the surface using the Oceano system with the echo-sounder fish. The last OBS was recovered by 0200 on 2nd May, after which the magnetometer was deployed for a final magnetic survey across the region during the transit out towards Gran Canaria.

Seas still Force 6-7 during the final stage of the survey. With the wind directly ahead, it was heavy going towards Las Palmas. Clocks advanced to BST (GMT + 1) during the night of Saturday, 2nd May. The magnetometer and echo-sounder fish were recovered at 1630 on 3rd May.

Arrived outside Las Palmas at 0800 GMT and berthed two hours later. The berth was alongside a quay with several previous gravity base stations having the same values. The apparent drift rate was +0.126 mgal/day, over the period of the cruise. We stripped most of our equipment out of the main lab. and packed it in the hold. The OBS and flotation buoys were put in the container after unpacking equipment it contained for the following cruise. We left the ship in the afternoon.

CRUISE REPORT OF PROCEEDINGS

SHIP..RRS CHARLES DARWIN........ CRUISE No:..67............

CRUISE DATES (Port to Port Incl).16th April - 4th May 1992..........

It is requested that the following aspects of the Cruise may be covered in this report of proceedings for delivery to the Superintendent Research Vessel Services, immediately upon the ship's return to port.

a) Main objectives of the cruise.
b) Geographical area with Lat/long .
c) Sea and weather conditions encountered.
d) Conduct of cruise, degree of success and problems encountered.
e) Equipment performance.
f) Ship performance.
g) Any recommendations.
h) Signature and date.

Brief comments are preferred but, if necessary, continue on a separate sheet.

(a) **Objectives**: a detailed seismic reflection and refraction survey using ocean bottom seismometers (OBSs) of a previously studied area of Mesozoic ocean floor (OCEAN III). Recovery of two IOSDL moorings.

(b) **Geographical Area**: Within 23°30'N-25°00'N, 22°20'W-23°30'W

(c) **Sea and Weather**: Force 5-7 seas, winds up to 30 knots, warm and dry.

(d) **Conduct of Cruise**: Very successful, with all objectives met in full. 4,500 cu. in. array of 11 airguns gave a hefty and well-tuned seismic source received at ranges greater than 100 km by our OBS. Good reflection profiles recorded with deep upper mantle reflectors visible even on a single channel monitor, despite the archaic vintage of the Geomechanique streamer. This survey area, together with our earlier magnetic and gravity survey (Charles Darwin 54) and commercial (7000 cu. inch. 4.5 km streamer) seismic reflection profiles is destined to become a "type survey" of oceanic crust against which other results will be compared. It is now the best such survey in the world.

The main problem was the failure to supply an operational E-M log, after the damage it sustained on the previous cruise. Since a prime requirement of our work was precise navigation along pre-existing lines, this was rendered difficult by the lack of a working log. The airgun array required an enormous amount of work by the RVS staff to build it and get it going satisfactorily, but to their enormous credit it worked flawlessly throughout our second deployment. I am grateful to RVS for helping to arrange the loan of a fourth airgun umbilical from BAS.

contd.

(e) **Equipment Performance**: All five Cambridge digital OBS were recovered safely, with seismic data, after each of the two deployments, despite implosion of the stray line buoy on one, and the failure of the flashing light during a night recovery of another. The E-M log was never operational and the doppler log proved to be inadequate as a substitute. After a great deal of work building the airgun arrays, they worked perfectly throughout our second deployment. Apart from the E-M log, I was pleased with the performance of the RVS equipment and have nothing but praise for all the RVS technicians. Nevertheless the RVS equipment at the beginning of the cruise was in poorer shape than I have ever seen it before, and much of the geophysical equipment is now extremely long in the tooth and is operating well below current standards.

(f) **Ship Performance**: The ship performance was excellent in all quarters, engineering, hotel and deck. The deck officers displayed considerable skill in recovering moorings and overside equipment, often in difficult conditions. It was a pleasure to sail again on Charles Darwin.

(g) **Recommendations**:

(1) Airguns. At present the airguns are sucked inwards in the flow around the stern of the ship. On the first deployment the starboard towing buoys tangled, and it would have been impossible to deploy a full mcs hydrophone streamer. As it was, we had to omit the depth control birds from the Geomechanique streamer. I suggest

- addition of paravanes to the airgun beams to hold them out;
- lengthening of the hinged booms on the starboard and port quarters to increase the separation between airgun beams;
- use of torpedo-shaped buoys on the rear of the airgun beams rather than one or two mooring buoys as at present;
- a spare umbilical should be carried, or failing that, sufficient hoses and cabling to deploy one or two separate single guns if one of the umbilicals fails;
- different methods of mounting the shot hydrophones are required for the bigger (300 cu. inch. and up) guns, as they repeatedly failed using the present system;
- if the ships are to sail before the airgun beams are built up, and if RVS overtime is to be limited, then on future seismic cruises I shall need a minimum of four technicians to deal with the airguns, and would require the airguns to be in a far greater state of readiness for use before we sail.

contd.

(2) **Trimble GPS Navigator**: Now that the Bridge have an independent Racal GPS navigation unit, the Trimble should be moved down to the Lab or the Computer Room. For maximum effectiveness, it needs to be monitored and adjusted continually and the Deck Officers are in general not capable of this, or have other duties to attend to. Fixes were corrupted when the satellite phone was in use, and the reasons for this should be investigated.

(3) **Data Logging**: The navigation programs are not designed to handle continuous GPS fixes and need to be revised to use this information properly. Since good navigation is crucial to almost all marine scientific work, this should be a high priority.

(4) **OCEANO Releases**: The Oceano fish should be upgraded to make it capable of use for releasing bottom units. On this cruise we could only receive signals from the Oceano releases on the OBS by heaving to, stopping the main engines and the bow thruster, and deploying the overside transducer. That is an unsatisfactory and clumsy procedure and in some weather would be impossible. It is also extremely insecure to have major ocean bed equipment reliant on a single release command unit. As a matter of urgency RVS should supply a backup release command unit or, at the least, a full set of replacement boards and circuit diagrams for it.

(5) **Electronic Mail**: This worked well. There is sufficient traffic to institute a regular, daily schedule during weekdays. This would probably save money too, because on several occasions I know people made phone or telex calls where they would have used e-mail if the schedule had been reliably daily. Concerning privacy, I see no problem with the Master seeing all the messages relating to RVS matters, but it seems unnecessary and indeed undesirable that he should see all other e-mail messages too. The only other places I know of such intrusion is for servicemen on active duty and for people detained during Her Majesty's Pleasure, though I understand that the latter are challenging the right to privacy of their mail in the European Courts.

(6) Things that need fixing include:

- E/M log
- Reftek monitor display
- Hydraulics of the starboard airgun deployment crane
- Cables for Oceano fish

TIMING AND CLOCKS

1. All times are in GMT.

2. The master clock for all the seismic experiments was the Cambridge cream clock. This was calibrated approximately every 2 hours throughout the cruise against the DOBS master clock, the DOBS, the ship's clock IRIG B output and the Cambridge silver clock.

3. The Reftek was triggered off the Cambridge cream clock at 59.90 secs, and the Reftex used to align the gun pulses at 100 msecs after the trigger. Thus the airgun shot was at 00.00 sec on the Cambridge clock.

4. The trigger pulse used to trigger the SAQ sonobuoy records and the STORE 4DS tape recorder was at 59.90 secs.

AIRGUN ARRAYS

1. Four beams were deployed each with 3 guns as on the diagram. Depth of guns was 1 metre below depth of gun sensors and averaged 14-15 metres. Tow rope to buoys was 46 feet (14 metres) long. Firing pressure was approx 1900-1950 psi.

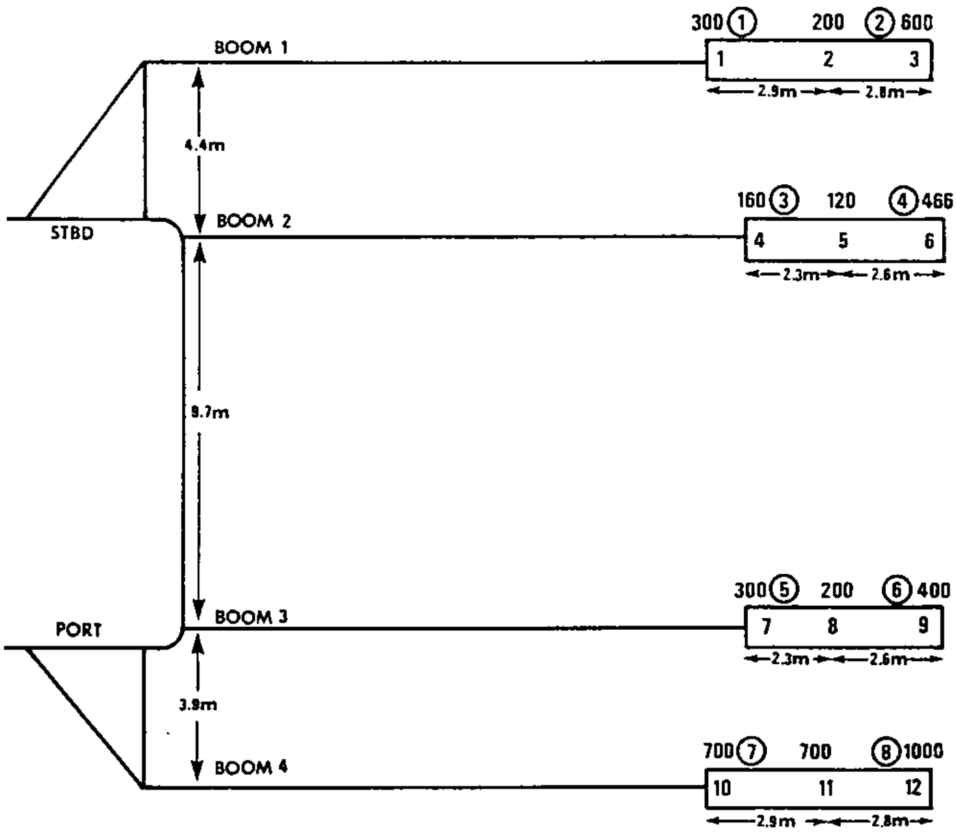
FIRST DEPLOYMENT

2028/115- 2047/115	Test firing guns off Reftek internal clock
2047/115- 0506/116	Firing off Cambridge clock at 60 sec. intervals 300 + 200 + 600 + 160 + 120 + 466 + 200 + 400 + 700 (+ possible 700, + 1000 at low amplitude)
0507/116- 0734/116	60 sec, 300 + 200 + 600 + 160 + 120 + 466 + 200 + 400 + 700
0746/116- 1513/116	60 sec, 300 + 200 + 600 + 160 + 120 + 466 + 200 + 400
1514/116- 1833.00/116	60 sec, 300 + 200 + 600 + 160 + 120 + 466 + 200 + 400 + 700 + 1000
1833:50/116- 1848:00/116	50 sec, as above
1848:55- 2023/117	55 sec, as above
2024/117- 0433/118	55 sec, 300 + 200 + 600 + 160 + 120 + 466 + 400 + 700 + 1000

SECOND DEPLOYMENT

1402/120- 0845/122	55 sec, 300 + 200 + 600 + 160 + 120 + 466 + 300 + 200 + 400 + 700 + 1000
0849-122- 0908/122	20 sec, normal, 200 + 160 + 120 + 466 + 300 + 400
0909/122- 0917/122	20 sec, randomised as above
0917/122- 0928/122	22 sec, normal as above
0928/122- 0841/122	22 sec, randomised as above

Air Gun Array on RRS Charles Darwin CD67



All gun sizes in cu.in.

① Mark depth sensors

Guns hung on chains 1m below depth sensors on booms.

14m ropes on buoys

FIRST OBS DEPLOYMENT

OBS	Deployment Time	Recovery Time	Deployment Lat.	Long.	Water Depth (uncorr. m)	Sink[1] Rate (m/min)	Rise Rate (m/min)
11	2052/114	1335/118	24°51.99'N	22°44.97'W	4839	68	57[3]
12	2016/114	1529/118	24°50.96'N	22°45.36'W	4840	77	66
13	0212/115	1838/118	24°36.23'N	22°49.24'W	4854	94[4]	67
14	0350/115	2135/118	24°24.95'N	22°52.32'W	4865	76	73
15	0545/115	0033/119	24°13.39'N	22°55.26'W	4866	78	67

Notes

1. Buoyancy used 4 off 17" Benthos spheres on the frame, plus one 13" sphere on the stray line. Oceano releases were used.

2. Anchor weights were approx. 75 kg (6 chain links) of anchor chain.

3. The 13" stray line sphere had imploded, reducing the buoyancy.

4. Ship was drifting fast during sink of OBS, so apparent sink rate is too high.

OBS SECOND DEPLOYMENT B

OBS	Deployment Time	Recovery Time	Deployment Lat.	Deployment Long.	Water Depth (uncorr. m)	Sink Rate (m/min)	Rise Rate (m/min)
11	0617/120	0155/123	23°52.65'N	22°54.94'W	4839	72	72
12	0500/120	2356/122	24°01.57'N	22°52.49'W	4840	79	65
13[2]	0305/120	2105/122	24°14.39'N	22°49.17'W	4850	76	68
14	0139/120	1830/122	24°23.07'N	22°58.90'W	4880	69	72
15[3]	2348/119	1524/122	24°19.17'N	22°41.72'W	4811	74	68

(1) Sink rate based on first 3 mins only
(2) Electronics inside were from OBS 15
(3) Electronics inside were from OBS 13 and had only 3 operational tape recorders.

IOSDL MOORINGS

The Benthic Biology Group (L.R.P.4) at I.O.S.D.L. has two stations in its current projection; one affected by the spring phytoplankton bloom and one not. To gain evidence that the southern station (31N 21W) is not affected by a bloom two moorings were laid.

The first, Bathysnap (a camera system for taking photographs of the sea bed over a long time period) was laid in September 1990 on Discovery 194. The second mooring consisted of three sediment traps and was laid in October 1990 on Charles Darwin 53, in conjunction with the Biogeochemical Ocean Flux Study (B.O.F.S., a community research project). Logistics problems prevented their planned recovery in early 1991, and although still within the nominal battery life of the CR200 releases some doubts were expressed as to the likelihood of recovery. However these fears turned out to be entirely groundless, with both releases responding and firing within thirteen signals being sent.

Bathysnap was recovered first without any hitches and all appeared well. Unfortunately the current meter had not sealed and was found to be full of water. The data storage unit was crushed and no data was recovered. Success or failure of the camera could not be determined prior to return to the laboratory. As an additional experiment two different pieces of wood were taped to the frame by Dr. Don Roberts of Queens University, Belfast. Both pieces of wood showed signs of vigorous animal attack and the remains of each piece have been preserved for later examination.

The sediment trap mooring proved to be difficult to recover. The mooring line had become tangled in two places and as a result two of the three traps came on board upside down. However both traps had taken samples, so it is presumed that the tangles occurred at the surface during recovery and not in deployment. The current meter and trap electronics have been interrogated and all have worked as planned. The samples have been preserved and refrigerated and will be examined by B.O.F.S. researchers and the data made available to L.R.P.4.

From an I.O.S.D.L. point of view this has been a very successful cruise, and thanks are due to the R.V.S. technical staff, and the officers and crew of RRS Charles Darwin for their assistance in the recovery of the moorings.

B. Boorman

GRAVITY MEASUREMENTS

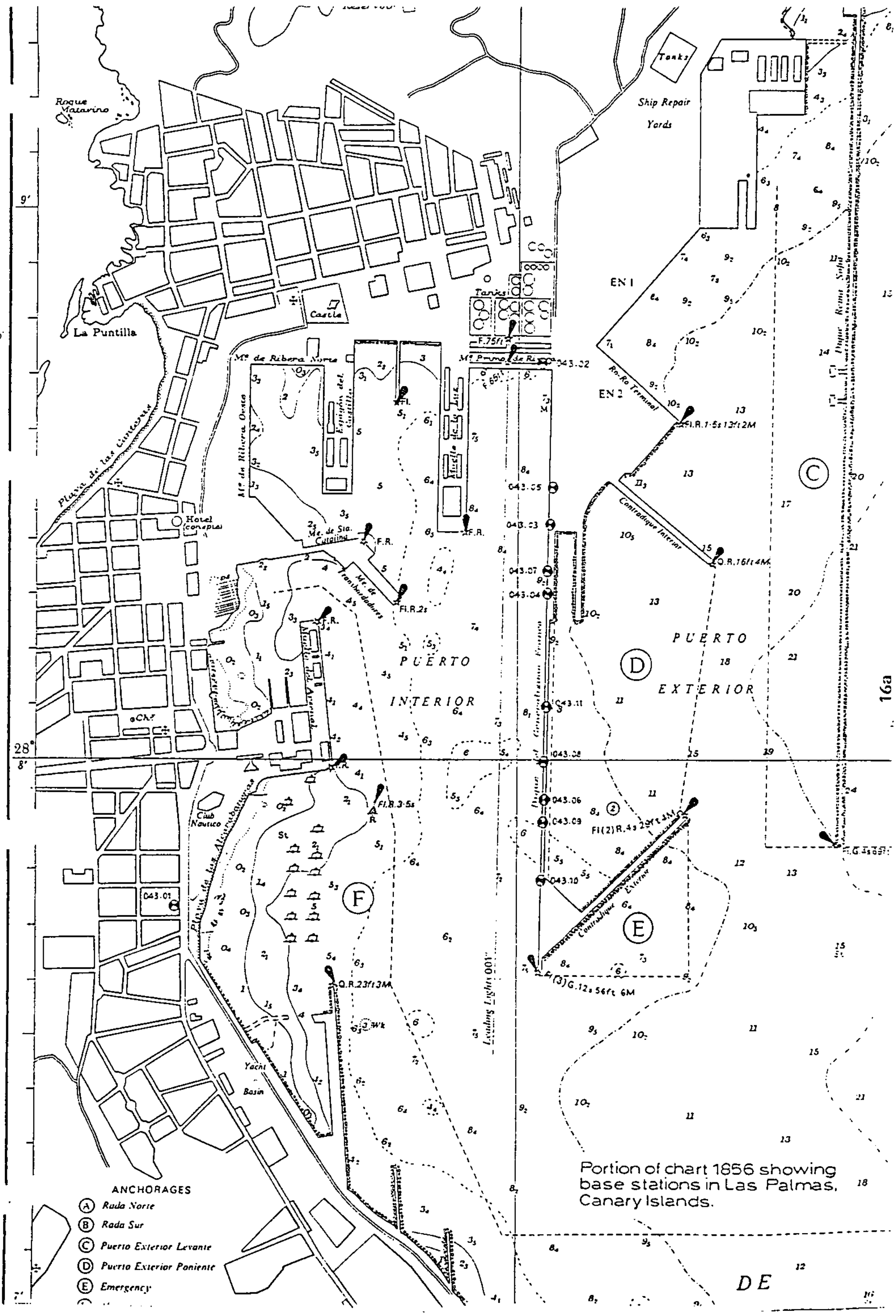
Shipboard gravimeter is a LaCoste-Romberg gravimeter S40. Calibration factor = 0.9917 mgals/div.

	Base Station Calibrations	Ship Gravimeter g(mgal)	G (meter units)
19.12.91	Lisbon (Doca do Alcantara)	980089.59	8433.74
24.1.92	Ponta Delgada	980116.50	8462.1
1.3.92	Ponta Delgada (Mohlo Salazar)	980115.14	8460.0
14.4.92	Barry Docks (Start of CD67)	981190.98	9547.9
4.5.92	Las Palmas (End of CD67)	979371.36	7715.6

Drift rate 14.4.92-4.5.92 is +0.126 mgal/day

Note

This gravity meter gave very poor cross-over errors, particularly during periods of rough weather. We suspect that the analogue correction circuits may be out of calibration.



Portion of chart 1656 showing base stations in Las Palmas, Canary Islands.

GRAVITY BASE STATION	043.11

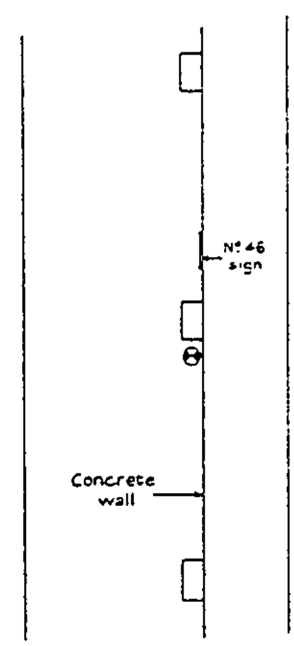
LAT. 28° 03'.1 N
LONG. 15° 24'.9 W
CHART REF. 1856
OTHER REF. NAVO 0056-82

COUNTRY/STATE CANARY ISLANDS
TOWN/CITY GRAN CANARIA - LAS PALMAS
STATION NAME DIQUE GEN FRANCO - BOLLARD 46
IGSN 71 g= 979 371.0 mgals

STATION DESCRIPTION

The station is located on Dique del Generalisimo Franco, at the base of the wall on the east side of the pier, 0.3 metres south of the pillar which lies just south at the sign for Bollard 46.

LOCATION DIAGRAM



OBSERVATIONS/CONNECTIONS

Date	Observed by	Instrument	Ref. Station	Value	Δg	
18 April 78	NAVOCEANO	LRG-72	043.06	979 371.0	0.0	AECBA

Prepared by Geophysics Section, MS 6. 2/1982 NP698

ECHO-SOUNDER

The echo-sounder used the SIMRAD inboard system, with an 8-element fish deployed on the port side. Depths on the Simrad readout assume a sound velocity in water of 1500 m/sec. All the depths in the data logger were tracked automatically by the Simrad. The seafloor is sufficiently flat over the OCEAN III Survey area that it was easy to track automatically.

MAGNETOMETER

Length of cable overboard approx. 600 feet.

DISPOSABLE SONOBUOYS

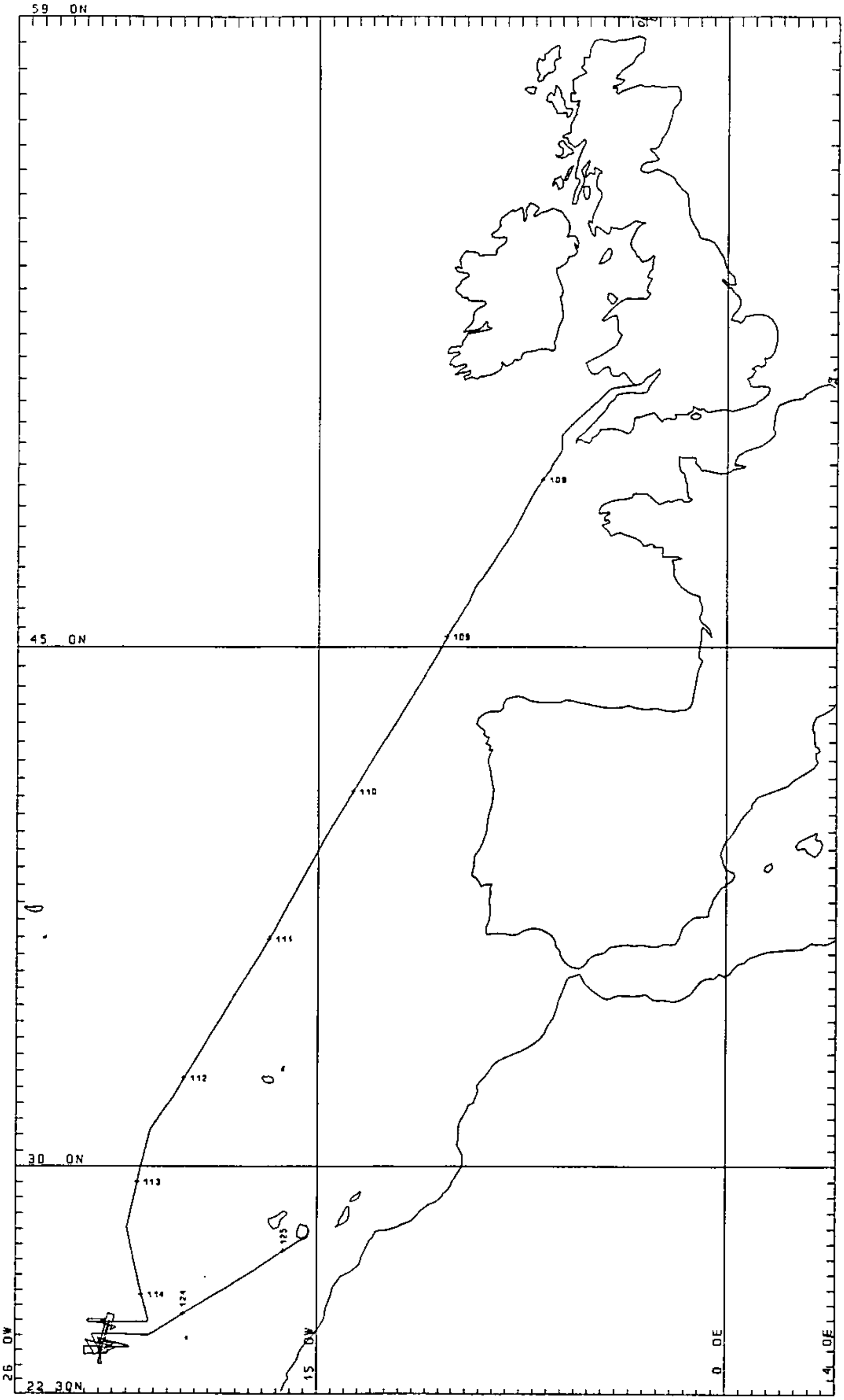
Sonobuoy No.	Deployment Lat.	Deployment Lon.	Time (GMT) Day	Time (GMT) H.M.	Water Depth	Hydrophone Depth	Sonobuoy Type	Sonobuoy No.	Comments
1	24°09.05'N	22°36.02'W	115	2234	4788	30	DOWTY LG SSQ906A(D)	1003	Strong carrier, but no hydrophone signal. Abandoned.
2	24°09.90'N	22°39.79'W	115	2311	4810	18.3	SSQ41B		Good record with refractions (changed gain on input signal near beginning of recording). SAQ recording at 8 msec is badly aliased; STORE 4DS OK.
3	24°14.10'N	22°58.28'W	116	0217	4875	30	DOWTY LG SSQ906A(D)	1012	Strong carrier heard. No signal. Abandoned.
4	24°14.60'N	23°00.73'W	116	0237	4880	18.3	SSQ41B		Excellent record, with P & S reflections; original SAQ recording at 8 msec is badly aliased (wrong filters); STORE 4DS record is OK. Redigitised.
5	23°56.82'N	22°59.61'W	116	1706	4860	122	SSQ41B		No record (?hydrophone lost?). Abandoned.
6	24°00.00'N	22°58.71'W	116	1742	4858	140	DOWTY LG SSQ906A(D)	56095-1001	Small amplitude noise only. No signal. Abandoned.
7	24°08.53'N	22°56.41'W	116	1917	4865	140	DOWTY		(Not low gain modified.) Very small high frequency signals only at very short range.
8	25°03.23'N	22°26.84'W	117	1343	4786	122	SSQ41B		Excellent record with refractions.
9	24°48.02'N	22°30.08'W	117	2314	4782	122	SSQ57A		Excellent record along fracture zone.
10	24°49.72'N	22°37.90'W	118	0035	4808	140	DOWTY LG SSQ906A(D)	56092-1010	Tiny signal only from direct range at very short range. Abandoned.

DISPOSABLE SONOBUOYS contd.

Sono-buoy No.	Deployment Lat.	Lon.	Time (GMT) Day	H.M.	Water Depth	Hydro-phone Depth	Sonobuoy Type	Sonobuoy No.	Comments
11	24°15.9'N	22°27.2'W	120	1626	4730	122	SSQ41B		Good results.
12	24°18.8'N	22°39.7'W	120	1847	4799	137	SB6E4		Good results.
13	24°1.77N	22°56'.18W	121	0416	4814	122	SSQ41B		Good results.
14	23°42.47'N	22°57.66'W	121	1337	4818	122	SSQ41B		Did not work. Abandoned.
15	23°43.6'N	22°57.3'W	121	1350	4811	122	SSQ41B		Excellent sonobuoy with refractions - best recording is on SAQ ch. 2 and STORE 4 Ch. 1

TABLE OF JULIAN DAY NUMBERS

JULIAN DAY	DATE	
106	15th April 1992	
107	16th	Maundy Thursday
108	17th	Good Friday
109	18th	
110	19th	Easter Day
111	20th	
112	21st	
113	22nd	
114	23rd	
115	24th	
116	25th	
117	26th	
118	27th	
119	28th	
120	29th	
121	30th	
122	1st May	
123	2nd	
124	3rd	
125	4th	



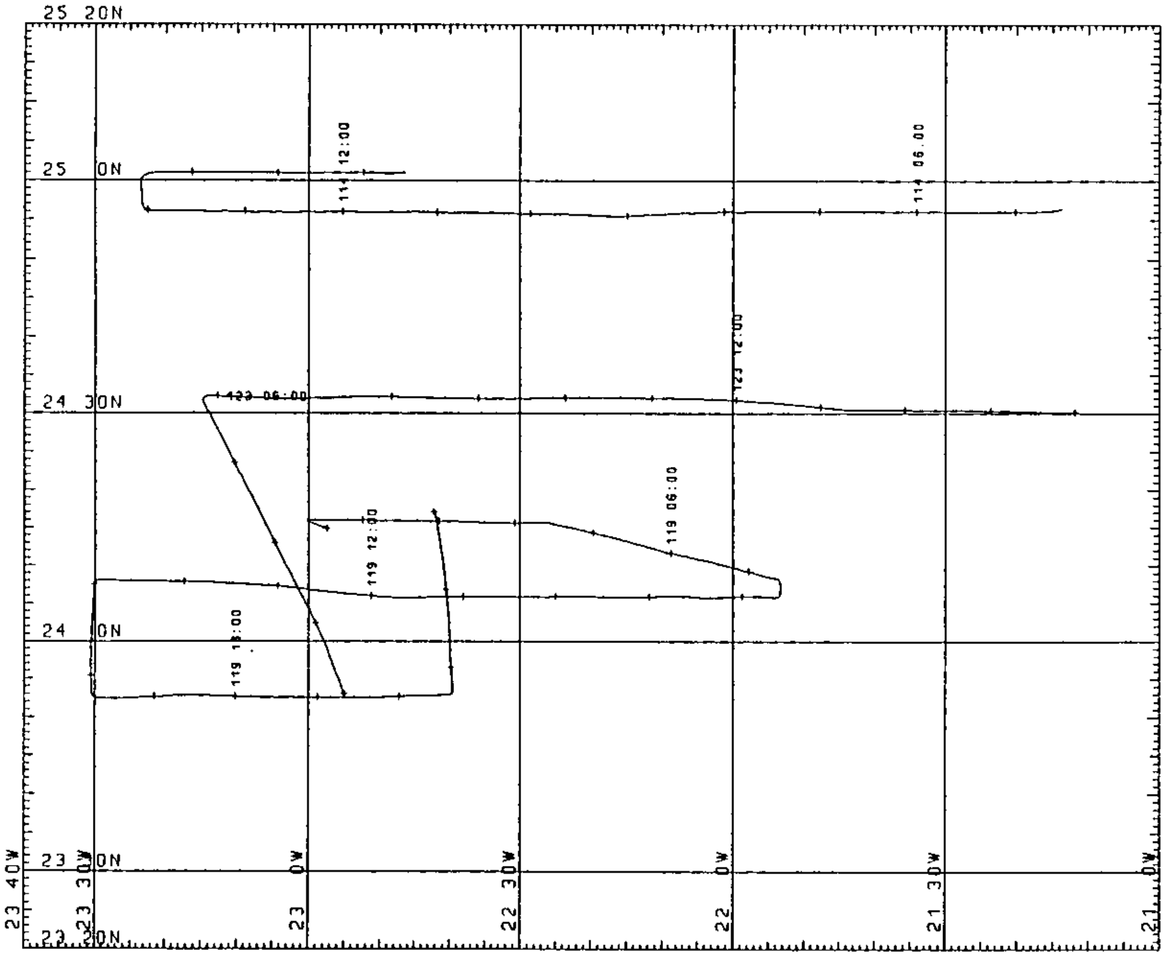
MERCATOR PROJECTION

GRID NO. 1

SCALE 1 TO 10000000 (NATURAL SCALE AT LAT. 38)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

CHARLES DARWIN 67 APRIL-MAY 1992



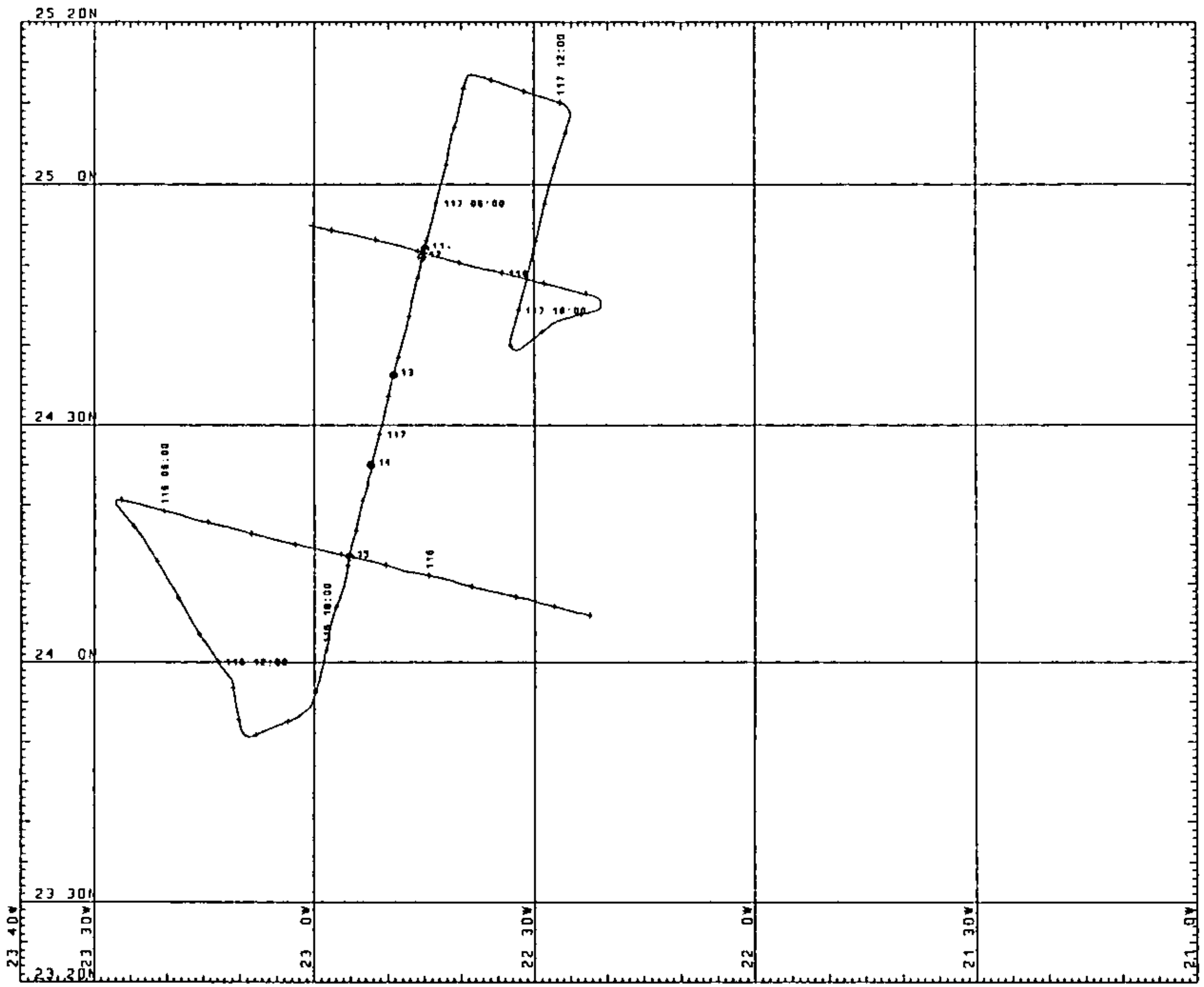
MERCATOR PROJECTION

SCALE 1 TO 1000000 (NATURAL SCALE AT LAT. 33)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

GRID NO. 1

CHARLES DARWIN 67 Magnetic Survey Lines

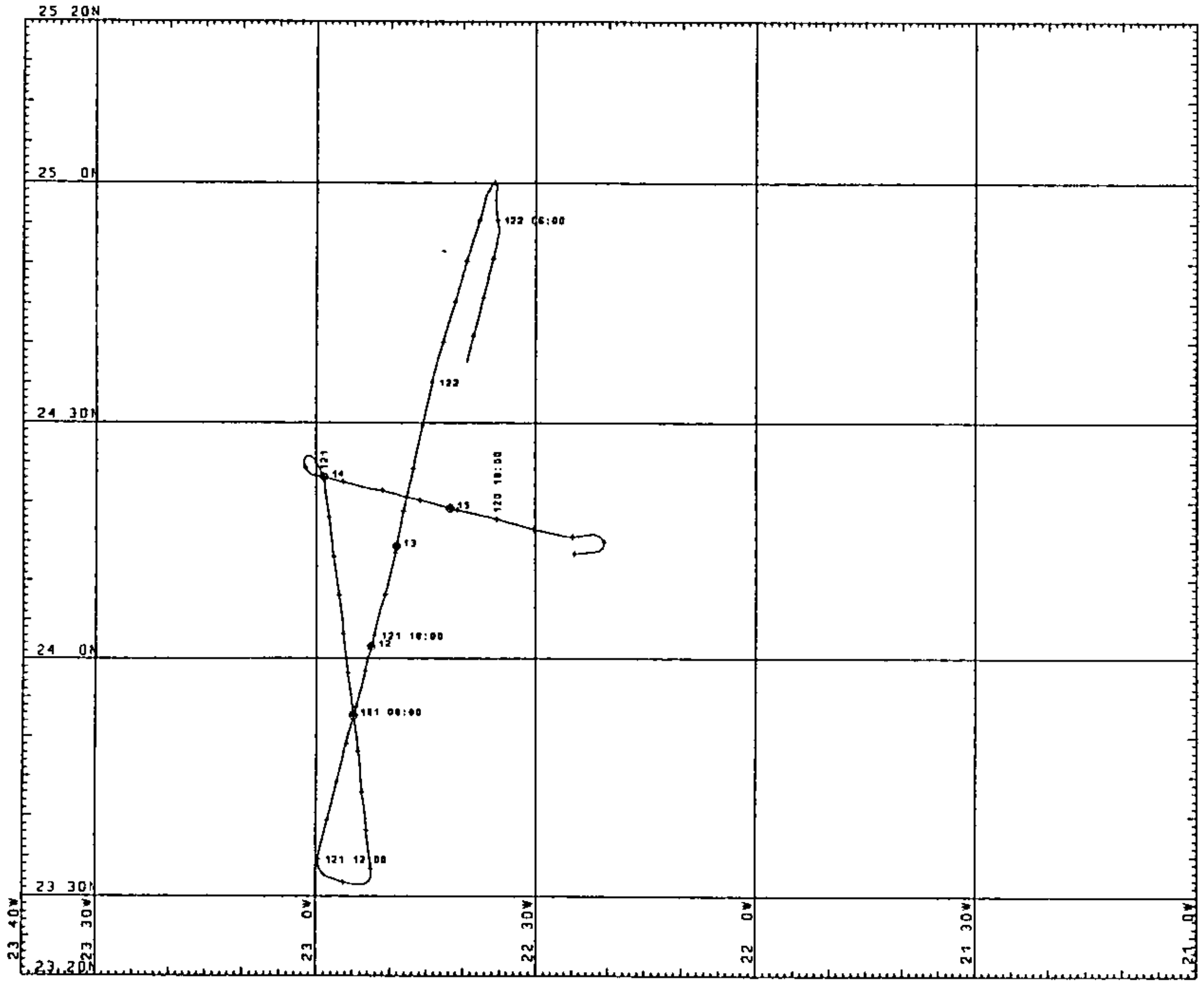


MERCATOR PROJECTION GRID NO. 1

SCALE 1 TO 750000 (NATURAL SCALE AT LAT. 33)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

CHARLES DARWIN 67 First Seismic Deployment



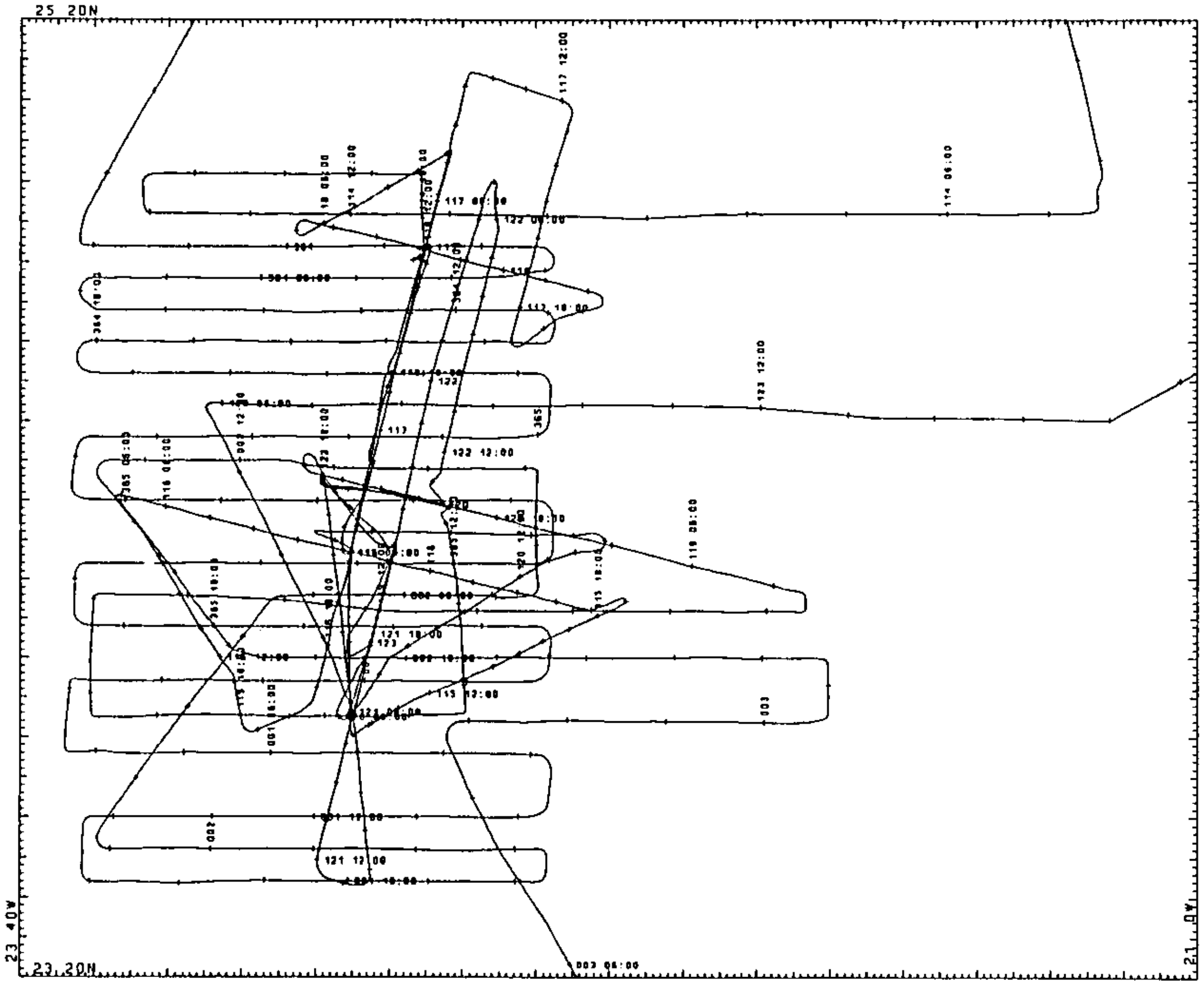
MERCATOR PROJECTION

SCALE 1 TO 759000 (NATURAL SCALE AT LAT. 33)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

GRID NO. 1

CHARLES DARWIN 67 Second Seismic Deployment



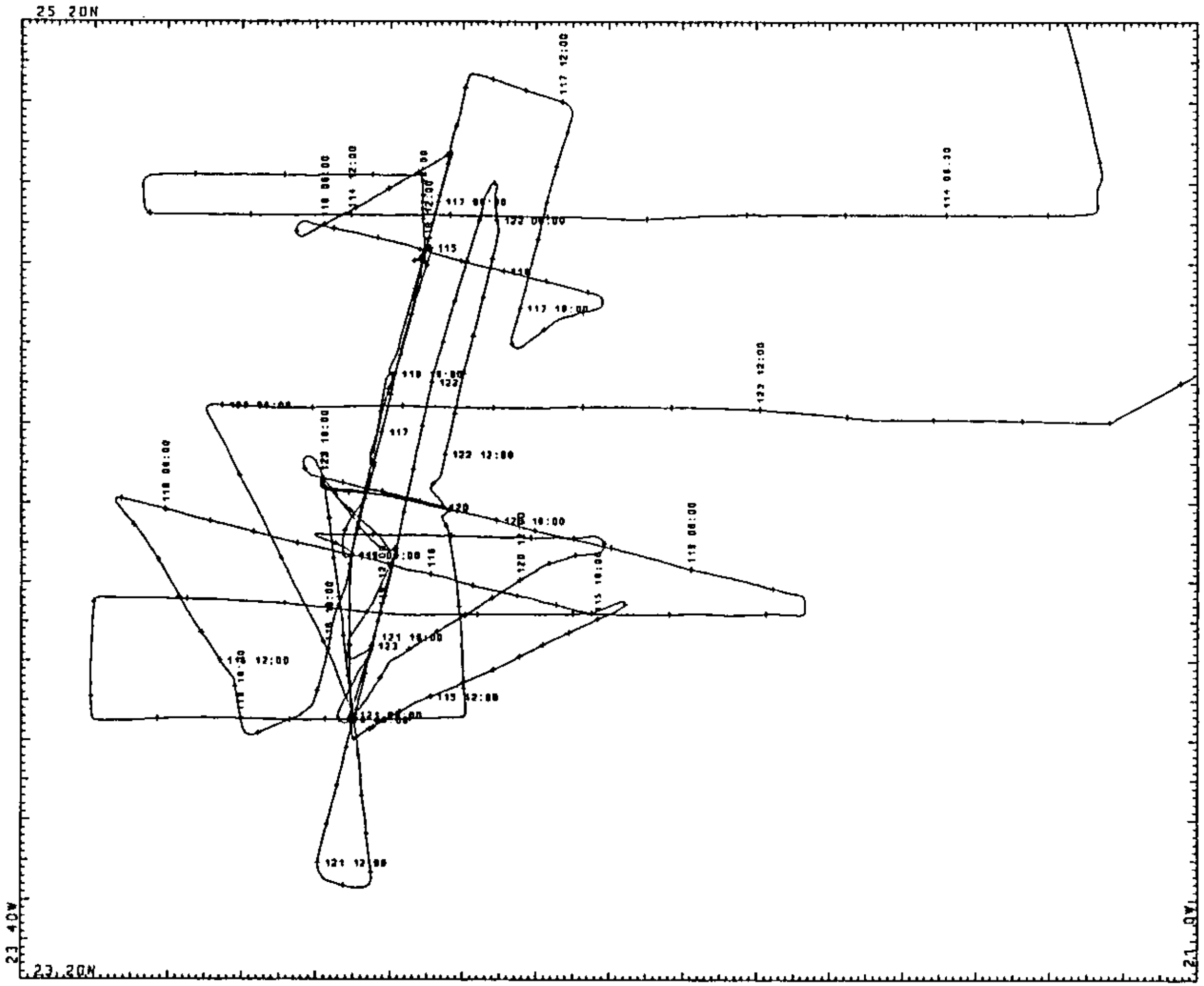
MERCATOR PROJECTION

GRID NO. 1

SCALE 1 TO 758000 (NATURAL SCALE AT LAT. 33)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

CHARLES DARWIN 54 & 67 Combined Survey Track Plots



MERCATOR PROJECTION

GRID NO. 1

SCALE 1 TO 739000 (NATURAL SCALE AT LAT. 33)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

CHARLES DARWIN 67 Survey Track Plot