NATIONAL INSTITUTE OF OCEANOGRAPHY

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R.R.S. DISCOVERY

Cruise 37 Report

25th November - 10th. December 1970

EQUIPMENT AND METHODS IN BISCAY AREA

N.I.O. Cruise Report No. 37

(February 1971)

CONTENTS

	Page
Scientific Staff	1
Objects	2
Time-Table	2
Spar buoy	2
Current meter moorings	5
TSD and water sampling	5
Precision echo sounder	6
Radio-sonde	7
Pyro-releases	7
Radio beacon	7
Ship's dynamometer system	8
Station list	9

REPORT OF DISCOVERY CRUISE 37

Duration 25th November - 16th December 1970

Area Mostly near 47°35'N, 8°16'W in 2000m water depth in Biscay Area

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Both parts of cruise

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Objects

The principal objects of the cruise were three: (a) to test and operate a new spar-buoy for air-sea interaction measurements; (b) as part of the programme of developing deep-water current meter moorings, to locate and check a mooring laid in the previous June near 47°35'N, 8°16'W, to lay a short term mooring to make current measurements during the cruise and to make temperature and salinity measurements in the same area, finally recovering both these moorings and laying a new long-term mooring in the same area; and (c) to test and calibrate a new precision echo sounder system.

Other objects of the cruise were to develop further the LOCATE system of wind finding in the lower atmosphere, to test some pyro-release mechanisms for deep-water moorings, to test an improvement in the radio-beacon and to install and test new electronics and remote indicators for the ship's dynamometer system.

The area in which most of this work was carried out was determined by the location of the current-meter moorings and the opportunity was taken to make a detailed echo-sounding survey of this area of the continental slope.

Time-table

DISCOVERY sailed from Barry at 1700 (BST) on 25th November 1970 and arrived in the Biscay area at 0130 (GMT) on 27th. The search for the current meter mooring was begun and at 1920 the temporary mooring was laid; on the 28th a TSD and water bottle station was carried out from 0855 - 1022 and a first launch of the spar-buoy from 1025 - 1435. On the 29th a second station using TSD and multisampler was carried out from 0930 - 1040 followed by a balloon ascent for the LOCATE system at 1120. At 1400 course was set for Falmouth. The ship reached Falmouth at 0830 on 30th November, where scientific staff were exchanged, and arrived back in the Biscay area at 1125 on 1st December. During the remainder of the cruise the various items of work were interleaved in the same way as in the first period.

However, on 2nd December it was necessary to return to Falmouth for a second time, on account of the illness of an electrical officer. The ship left for Falmouth at 1430 on the 2nd, arrived at 0800 on the 3rd and had left again, with a replacement for the sick officer, before 1000. At 0840 on 4th the ship was back in the Biscay area.

At 1635 on 4th December, the ship set course south-westwards to find deeper water (approximately 4,500m) for a pyro-release test, returning to the main slope area at 0230 on 5th December, where she remained until 2030 on 14th December. She then returned to Barry, deviating from the shortest passage to investigate an area of sand waves near the edge of the shelf. She reached Barry at 0720 (BST) on 16th December.

Spar buoy

A second model spar-buoy (the first was tested on Cruise 22), intended as an instrument carrier for air-sea interaction measurements, was tested. This was 70 feet long, formed of high-duty aluminium alloy tubing, supported by a submerged buoyant can and counter-balanced by a flooded weighted can at the bottom. A gyro-unit with compass, two inclinometers and three accelerometers, was mounted axially below the buoyant can. A cup anemometer and thermistor were mounted on instrument arms near the top of the spar and a wind vane was mounted to keep these instruments upwind of the spar.

The spar was loaded on chocks at the after end of the Forecastle Deck on the port side, with the upper end pointing forward, so that the main weight was below the Schat davits (designed for use with GLORIA). It was launched and recovered in the horizontal position, using these davits, and was connected to the ship by a polyurethene rope and multi-core electric cable 300 yards long (in fact, of three lengths of 100 yards) through which power was fed to control the flooding and blowing of the lower can and to switch the gyro on and off and through which the instrument signals were returned to the ship.

The spar was launched on five occasions; detailed in the accompanying table. The first launch was in the nature of a practice run and allowed the drill to be worked out. It was found necessary to modify the drive of the Schat davits to eliminate over-running and give direct electric drive. It was not found practicable to launch the spar with a tilt, so as to help keep the instruments from being wetted, but the same object was achieved, from the third launch, by putting a small lead weight in each of the rubber fenders of the two cans, opposite the instrument arms, and lowering the spar to the water in the horizontal position. However, this meant that the wind vane must hit the water first and the model first fitted was found to be too flimsy to stand up to this treatment. It was also found that the size of the wind vane, found more than adequate in previous reservoir tests, was not enough to orientate the spar in light winds with the considerable ocean swells.

After the first launch it was found fairly easy to keep the ship hove to riding to the spar drifting on the port beam, with about 200 yards of cable out, and to keep the cable reasonably slack. However some of the signal channels were affected by leaking at the junctions of the cable lengths and this trouble was not completely eliminated until the fourth launch.

On every launch the greatest difficulty was found in recovery. The first trouble was that, on every occasion, the spar fell away from the wind when the lower tank was blown, so that it was lying the wrong way for recovery on the davits. It was found possible to turn it simply by going ahead and towing it, but this was a rather lengthy and uncertain process. Secondly, during this process and the subsequent period of securing the recovery lines to the davits, which was also rather lengthy, water was able to work back into the can, under the pumping action of the waves and it was found that there was not enough spare air carried to be certain of blowing it again. During the recovery after the fourth launch, the anemometer cups(of light plastic) were damaged, though this may have been due to fouling by one of the recovery lines. The cups were, in any case, regarded as expendable, but it was also found that there was slight leakage into the rest of the assembly, which could not be cured in time for the fifth launch. The thermistor and its flimsy radiation shield survived without damage.

On the fifth launch, while the spar was being towed to reverse it for recovery, the towing line was let out too far and the spar fouled the stern and propeller of the ship. It was found impossible to free it without cutting the cable and allowing the spar to pass under the hull. In this process the spar was broken. When freed, it still floated, though with only about 3 feet proud of the water. Several attempts were made to recover it before the light failed. From 1730 on the 8th to 0820 on the 9th, the ship was heading slowly into a force 6 wind. It was then estimated

Table of Spar Buoy Launches

No.	Date	Time	Wind speed & dir.	Swell	Instruments	Remarks
1	28.11	1025-1435	4-8kt, W-SW	Heavy	Internal only	Wind vane damaged in launching.
2	1.12	1325-1545	10-15kt, NW	Moderate	Thermometer, unshielded	Squall at 1500 with gusts to 25kts.
3	4.12	1450-1620	11-20kt, W	Moderate	Thermometer shielded	Wind vane detached on launch.
4	5.12	1125-1300	4-8kt, W	Heavy	Thermometer & anemometer	Good records, improved wind vane ineffective in light winds.
5	8.12	1105-1510	20-25kt, ENE	Moderate, increasing	Thermometer	Good records wind vane effective. Spar fouled stern, partly recovered noon 9.12.

from the log that she had made 13-14 miles through the water. On running back about 12 miles, the spar was sighted at 0940, at a distance of almost 50 yards ! However, it was only at noon that the upper section of the spar was recovered and the cables holding the lower, negatively buoyant, section to it proved too weak to hold in the heavy swell. The upper can, which then floated away, was recovered an hour and a half later.

Current meter moorings

No signs were found of mooring 061, laid on 26th June 1970, on Cruise 34. Four attempts were made at dragging over its position, without success. It seems most likely that the release had fired prematurely, probably on ship noise, and the mooring had gone adrift. If the deep buoyancy material included in the mooring had still been there, it should have held up enough cable clear of the bottom to ensure that one of the dragging attempts would have caught it.

Two moorings were laid during the cruise. The first (No. 069), on 27th November, carried four current meters closely spaced in the steep temperature gradient near 1200-1300m in depth. The purpose of this was to provide information about coherence of horizontal and vertical motions (the latter inferred from the temperature structure) in the "internal wave" part of the spectrum. It was recovered on 11th December and all four current meters appear to have produced records. Another long-term mooring (No. 070) was laid in 2040m depth, with one current meter at 469m, on 13th December and was left for recovery in late January or early February 1971.

Table of moorings

No. 069: laid 1920/27. XI — $47^{\circ}35'$,6 N, $8^{\circ}26'$.8 W
released 1309/11. XII — 1798m depth

4 current meters at 1206, 1228, 1258, and 1268m

No. 070: laid 1542/13. XII — $47^{\circ}30'$.4 N, $8^{\circ}27'$.0 W
(for recovery February 1971) — 2040m depth

1 current meter at 469m

TSD and water sampling

On the outward passage from Barry the TSD sea unit was operated in a bath mounted on the asdic plate at the bottom of the asdic trunk, the bath being filled with fresh sea water, from a depth of about 4m, through a valve in the plate. The salinity and temperature channels of the TSD were recorded on Hewlett-Packard ship recorders in the electronics laboratory. The noise levels suggested that trouble from aeration occurred only when the ship was pitching badly, but the salinities were low on account of the limited depth of the bath. Surface temperatures and salinities were also recorded continuously on the Moorey salinity-temperature profiler at 10m and calibration samples were taken with an N.I.O. water bottle at 10m over the side. These observations will be used to estimate the small effect on the TSD salinity readings so as to allow surface salinities to be monitored regularly by a TSD salinity sensor mounted at the bottom of the asdic trunk, with water pumped through it.

Six TSD lowerings were carried out near the short-term current-meter mooring, to provide temperature profiles through the depth range occupied by the current meters. At the sixth lowering, the depth gauge developed a fault and further use was limited to shallow dips, recording temperature and salinity only, in conjunction with one of the spar-buoy trials.

On the first station (no. 7484) in the Biscay area, the 9006 TSD was lowered to 1500m and the data were fed directly, through a new interface, into the computer. The link was then broken and the computer was set to processing the data while the instrument was raised. Before it reached the surface, the corrected depth, temperature and salinity and the potential temperature and density had been printed out. The system seemed to be working satisfactorily, but, with only one disk available, it seemed better to keep this first record, rather than over-write later ones on it.

The rosette multi-sampler was tested four times, twice with the TSD and twice by itself, with water bottles for comparison. On its first lowering, a leaky Marsh and Marine plug caused failure at 600m depth: no further leaks occurred after that was repaired. On the three successful lowerings, all bottles of the multi-sampler were activated at the same depth and time as the water bottles immediately above were closed, so as to test whether the salinity samples collected by the multi-sampler are comparable with those obtained with N.I.O. water bottles. Samples were taken at 1000m depth, in the salinity maximum, so that any leakage during recovery should be detectable as a decrease of salinity. On each lowering, at least one of the bottles of the multi-sampler failed to close, but the reasons were apparent and these troubles can be avoided in future. The use of the multi-sampler disturbed the working of the 9006 TSD sea unit, which is liable to be upset by having its power switched off. It may be necessary to provide a standby battery supply for the TSD when the electric cable is in use for the multi-sampler.

After the TSD depth gauge became defective, four water-bottle casts were made near the short-term mooring, with bottles closely spaced in the depth range of the current meters. The opportunity was taken to test six new protected and six unprotected reversing thermometers.

Trials of Precision Echo Sounder Mark III

A new Precision Echo Sounder system was tested, which included a transistorised transmitter and receiver and a new transducer array.

The transmission and reception circuits were mounted in the usual type of Mufax 18-inch recorder chassis and gave no trouble. Nine higher power transducers replaced the twenty-five original elements and they also functioned satisfactorily. The instrument was used for a total running time of about 12 days and gave good clear records down to the maximum depth encountered of 4500 metres. Certain refinements are incorporated in the new instrument, including a variety of pulse lengths for different targets, a more sophisticated gating system and the ability to steer the beam electrically forward or aft to a maximum angle of 60° from the vertical.

A number of calibrations were carried out to determine the directivity of the array and of a single element, the power level in the water, the waveform of the transducer diaphragms and the effectiveness of the beam steering.

The opportunity was also taken to try out a new "clip-on" fairing, developed from the GLORIA system. It performed well, but care was needed to prevent it being unclipped by being twisted on the main sheave, because of overstretching when the fish was being put out. There was no tendency to detach at towing speeds up to 10 knots.

Echo-sounding surveys

An echo-sounding survey was made on the slope covering the area within 15 miles of the point 47°35'N, 8°20'W, at a spacing of about 1 mile. In addition the area between the parallels 47°20'N and 47°30'N and the meridians 8°15'W and 9°0'W was covered at about 2 miles spacing.

A local survey was also made of some sand waves on the edge of the shelf in the area of Banc de la Chapelle.

Radio-sonde launches using the LOCATE system

The purpose of this work was to make an operational test of a new method in which digital samples of the positional information from the LOCATE system were obtained by the computer. Eight radio-sondes were launched, four of these being conventional ascents using a single balloon and four double transits of the lower 2000m of the atmosphere using a tandem balloon system. The sampled values were output on paper tape after each ascent and verified by comparison with the traces of the LOCATE chart recorder, using a plotting programme developed during the cruise. The true velocity of the ship was also measured on various occasions to calibrate the LOCATE system.

Table of launches

No.	Date	Time (GMT)	Comments
70	29.11.70	1120	Single balloon ascent
71	1.12.70	1640	Single balloon ascent
72	4.12.70	1040	Tandem ascent
73	6.12.70	1120	Tandem ascent
74	8.12.70	1045	Single balloon ascent
75	8.12.70	1335	Tandem ascent
76	10.12.70	1105	Single balloon ascent
77	11.12.70	1420	Tandem ascent
-	12.12.70	1500	Calibration by steering the ship in a triangle

Tests of Pyro-releases

Two types of pyro-release (to take the place of explosive releases in deep-water moorings) were tested at depth. Three tests of the Mark II's were carried out on 4th December at a depth of 4300m; two of van Doom type were tested, one at 1800m depth on 1st December and one at 2200m on 6th. All the tests were successful.

Radio Beacon

The 4.15MHz radio beacon, used with pop-up buoy systems has given very disappointing ranges, not greater than 1½ miles. To improve the range a new aerial and loading coil were designed and these were tested on 12th December, with the beacon mounted on a dhan buoy. A range of about 6½ miles was achieved, with very little loss of signal strength. From this result it is estimated that ranges of at least 20 miles may be expected.

Ship's Dynamometer System

New electronics and remote indicators for the ship's dynamometers were installed and it was intended to test these under operating conditions. In the event the installation was not quite completed; however, the port and starboard sheaves were calibrated, using a digital voltmeter and a hydraulic ram. The port sheave was satisfactory, but the starboard sheave was found to have a large offset output and to be non-linear. Investigation showed the internal parts of the sheave to be fouled up with rust and it was decided to remove both sheaves to N.I.O. for overhaul. Trouble was also experienced with the reed switches on the starboard sheave, preventing good indications of cable length. Load readings obtained during the cruise from the port sheave were satisfactory and rate-meter indications were good.

Station List

Stn. No.	Date	Time (GMT) Start	Finish	Lat. N	Long. W	Gear Used
7484	28.XI	0855	1022	47°35'.0	8°26'.8	TSD, WB (1500m)
7485	"	1025	1434	47°35'.9	8°28'.2	Spar Buoy
7486	29.XI	0933	1040	47°35'.0	8°24'.9	TSD, Multisampler (700m)
7487	1.XII	2118	2320	47°34'.8	8°28'.4	TSD, WB (1800m)
7488	4.XII	1026	1210	47°36'.4	8°24'.6	TSD, WB (1650m)
7489	5.XII	0906	1302	47°35'.3	8°25'.0	TSD, WB, Multisampler (1500m) Spar Buoy
7490	6.XII	1311	1454	47°35'.4	8°25'.2	TSD, WB (1700m)
7491	8.XII	1106	1735	47°33'.4	8°26'.2	Spar Buoy TSD, WB (90-110m, 3 dips)
7492	10.XII	1340	1510	47°36'.3	8°25'.1	TSD, WB (8 bottles) (1320m) (TSD defective)
7493	"	1644	1750	47°36'.7	8°26'.0	WB (1320m)
7494	"	1822	1940	47°37'.2	8°26'.0	WB (1320m)
7495	11.XII	1543	1653	47°36'.4	8°26'.9	WB (1320m)