R.R.S. DISCOVERY
CRUISE 78 (3 LEGS)

8 SEPTEMBER - 18 OCTOBER 1976

Oceanic tidal recording SE and SW of Iceland and tests and use of side-scan sonar west of Hebrides

CRUISE REPORT NO 52

1977

Institute of Oceanographic Sciences
Bidston Observatory
Birkenhead

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ITINERARY

Leg 1 :	Leave Barry	8 Sep	1976
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SCIENTIFIC PERSONNEL

		Legs	
J B Rae	IOS-B	1	(Principal Scientist,
R Spencer	"	1 3	Leg 1)
B A Hughes	"	1 3	
A G Kerr	"	1 3	
G Ballard	"	1	
S Brown (Miss)	"	1	
D E Cartwright	"	3	(Principal Scientist,
J M Vassie	"	3	Leg 3)
K Taylor	"	3	
C MacDonald (Miss)	"	3	
T J P Gwilliam	IOS-W	1	
W E Elford		2	(Principal Scientist,
A R Stubbs	"	2	Leg 2)
J Legg (Mrs)	"	2	
D Morley	"	2	
N H Kenyon	"	2	
J Tidy (Miss)	"	2	
B Knowles	"	2	
W Mayer	Oxford U.	2	
D Flatt	IOS-B	2	
D L Leighton	"	2 3	
P R Hartland	MSES-Barry	1 2 3	
J Colvin (Miss)		1 2 3	

SHIP'S OFFICERS

M A Harding	Captain
A L Moore	Chief Officer
D Pilgrim	2nd Officer
W R Austin	3rd Officer
A Coombes	Chief Engineer

MAIN OBJECTIVES OF CRUISE

The primary object was to complete the northern portion of a circuit of tidal pressure recordings which has been determined piecemeal on a number of cruises since about 1970. The whole circuit encloses the part of the northeast Atlantic bounded in latitude by southern Iceland and Cape St. Vincent and in longitude by the mid-Atlantic ridge and the west European shelf edge. The present cruise covered three deep stations (D7,D8,D9) near the 30° Meridian from 53½° northward and two stations (R1,R2) of moderate depth on the Reykjanes Ridge and the Iceland-Fareoe Rise respectively. Deployment of sea-bed capsules at these sites entailed some 5,000 miles of steaming altogether, so a fair margin had to be allowed on the first and last legs for possible delays due to weather. This left a rather short period between mooring and recovery of some capsules, but it was arranged that each site should have more than 15 days' recording, which is about the minimum necessary for good tidal analysis.

The middle period (Leg 2), effectively 7 days of cruise time, was used mainly by the IOS Engineering Group from Wormley to test various pieces of equipment, principally the side-scan sonar systems which were used for some geological surveying in the seas near the Hebrides. Three current-meter rigs were also deployed for 24 hours in the Minch by Bidston's Research Technology Group.

During Leg 1 the opportunity of passing close to the position 63½°N 23⅓°W where Standard Sea Water is collected was taken to fill some containers with 500 gallons of sea water for the International Service based at Wormley.

NARRATIVE - LEG 1

After some delay in Barry due to engine control problems Discovery left Barry Dock at 1930 on 8 September (day 252). The port electromagnetic log was deployed, the starboard log having been removed in Barry for repair. Engine trials were successfully completed, but off Milford Haven the wind freshened to 35 knots and the sea was too rough to deploy the echo sounder fish. Weather conditions remained poor across the Celtic Sea to

the south and south west of Ireland. By 0930 on 10 September it became possible to deploy the echo sounder fish and to start scientific watches, but worsening conditions made it inadvisable to deploy the magnetometer. Little progress was made until conditions improved and a change of course to the south west was attempted at 1313 on 11 September.

At 1012 on 12 September the first tide gauge test station was reached at position 51°21'N 18°45'W. Wire tests on three deep tide gauges and acoustic systems were completed by 1717. The magnetometer was streamed and three engines were used to make up for lost time in heading for the first tide gauge station at D7. At 1818 on 13 September the echo sounder fish was exchanged for the spare fish because of excessive vibration at about 12 knots.

The vicinity of D7 was reached by 0625 on 14 September and an acoustic search was carried out for the deep tide gauge which was not recovered on Discovery Cruise No. 74. No trace of the gauge was found and wire tests were carried out on a shallow tide gauge. At 1254 an acoustic survey was started and a suitable tide gauge site was found in a depth of 3196 metres. A deep tide gauge was released at 1558 to reach the bottom at 1650. After confirming the position from a further satellite fix, full speed was made on a northerly course towards the second tide gauge station at D8.

By 1006 on 15 September an acoustic survey had been completed and a suitable tide gauge site found at D8 in a depth of 2448 metres. A deep tide gauge was released at 1105 reaching the bottom by 1204. Large apparent drifts in the dead reckoning positions during manoeuvring at this station were subsequently found to be caused by cross wiring of the athwartships component of the port electromagnetic log to the computer. The northerly course was continued at full speed towards tide gauge station D9.

In the vicinity of D9 on 16 September an acoustic survey revealed unsuitable topography. A much wider search was undertaken before an acceptable tide gauge site was found on the eastern side of Reykjanes Ridge in a depth of 1207 metres. A deep tide gauge was released at 1653 and was on the bottom at

1714. The course was set at 034° heading for the tide gauge site at R1.

Before commencing an acoustic survey at R1, surface pingers mounted on the shallow tide gauges were given an immersion test. The survey again revealed unsuitable topography and a wider search was required until a tide gauge site was found at 1306 on 17 September to the east of Reykjanes Ridge in a depth of 493 metres. A shallow tide gauge was released at 1543 and the pinger switched off after a confirmatory satellite fix was received at 1551. The course was set at 154° heading for a position suitable for the collection of water for the Standard Sea Water Service. During this passage the computer suffered a breakdown due to a disc drive failure. A temporary repair ensured correct operation until the defective part was replaced in Stornoway.

The sea water collection position at 63°30'N 22°20'W was reached by 1315 on 18 September and 500 gallons of water were pumped into containers while the ship was still underway. The collection was completed by 1402 and the course altered to 050°, towards the last tide gauge position at R2. This course was maintained throughout 19 September until R2 was reached at 0109 on 20 September. The Northern Lights were clearly visible during the night.

An acoustic survey at R2 was hindered by difficulties in accepting satellite fixes, but was completed by 0733, revealing a very flat bottom. A suitable tide gauge site was chosen in a depth of 444 metres and a shallow tide gauge was released at 0955. The gauge was on the bottom by 1003 and after obtaining a further satellite fix a course of 152° was set towards Stornoway. At 1730 on 21 September the magnetometer and echo sounder fish were recovered and the scientific watches completed. The port electromagnetic log was brought in at 0830 on 22 September and Discovery berthed in Stornoway at 0900, having completed 2360 nm.

In Stornoway the starboard electromagnetic log was fitted, the computer disc drive unit was replaced, and the Magnavox satellite navigation system was fitted in preparation for leg 2.

J.B. Rae,
Principal Scientist, Leg 1

NARRATIVE - LEG 2

The ship sailed from Stornoway approx. 0930 on 24.9.76, making a position off Pt. Fladdachuain to lay three experimental current meter moorings for IOS Bidston.

The lays were started at 1400 approx. and completed successfully at 1800 (except that the third lay Dhan-buoy sank). The positions of the moorings with respect to Pt. Fladdachuain were 090° - 1.74 mls, 096½° - 1.64 mls, and 060° - 0.84 mls (station 9056).

Since it was required to leave these moorings for approx. 24 hours, opportunity was taken to use the new side-scan experimentally in shallow water. These experiments carried on until the ship returned to the current meter positions at 1430 on 25/9. These moorings were retrieved in turn (except for the Dhan-buoy, which was jettisoned) by 2120.

Course was then set for Blackstones Bank and a survey carried out. The remaining period of the cruise was used mainly by the geologists, but interspersed with experimental recordings from the side-scan and telesounder equipment in various depths of water. It was necessary to go west of the Hebrides to find deep water on 25/9, the side scan being used as an echo sounder, and also to gain information on scattering layer migration.

Following this exercise, some runs were made on the shelf edge before proceeding north to Cape Wrath and into Loch Eriboll, for further experimental work on the side-scan. Whilst in the area, the opportunity was taken to go to the Pentland Firth area to look at sand wave patterns before returning to Stornoway on 1/10.

W.E. Elford,
Principal Scientist, Leg 2.

NARRATIVE - LEG 3

The main party of scientists from Bidston arrived at Stornoway by the Ullapool ferry at about noon, Monday 4 October, and we sailed an hour later. A quick decision had to be made whether to manoeuvre the circuit of stations in a clockwise direction, giving longer records at the northern stations but entailing an extra 500 miles steaming, or anticlockwise. The latter was chosen in the interests of steaming time and the most probable weather pattern. The PDR Fish was launched off Tiumpan Head at 1440, and the magnetometer at 1840 before crossing the shelf edge north of Lewis. Sounding and magnetometer watches were started at 2100 and continued for nearly all the deep-water passage work of the cruise except for short periods on 7 Oct. near Iceland, and on 9 Oct. when the speed had to be reduced to 2 knots. Exact repetition of the courses made on Leg 1 was satisfactorily avoided at every section.

The starboard e/m log had been repaired at Stornoway, so computer logging of the course was apparently improved. However, on detailed investigation of differences between computer logging and the ship's officers' D/R during the first few days of this Leg, it was found that the computer was reading the athwartships component in reverse sense. When the wiring polarity was altered on 6 Oct. much better agreement was achieved. P. Hartland corrected all the past logging of the cruise by a computer program.

In the interests of time and of getting a more useful magnetometer record for the Geophysics Group, we made a small detour to pass between Bill Bailey's Bank and Faeroe Bank on the way to position R2. R2 was reached early on 6 Oct, but worsening weather forced us to delay recovery after switching the capsule's pinger on. By noon the wind was gusting to Force 10 and we were prepared for a long wait hove-to, but at 1330 the wind dropped with remarkable suddenness, owing to the eye of the depression passing over us. We quickly took advantage of this situation to return to the station (having drifted several miles off it in the storm) and to release the capsule, which was brought inboard by 1520/6.

During this Leg, special efforts were made by R. Spencer and J. Vassie to process the tapes from tide gauge capsules as soon as possible after recovery. Within 24 hours of each recovery a complete computer listing and plot of every record was produced on board and trivial errors removed by editing routines, thus saving a lot of time at the home laboratory and anxiety about sensor performance. A very good record was produced from the Digiquartz transducer from R2 on 7 Oct, but the strain gauge showed a higher temperature sensitivity than had been expected.

The sudden improvement in weather on 6 Oct proved to be of long duration, helped by our westerly steaming towards R1 and some shelter from Iceland. During the closest skirting of southern Iceland, around 18h - 20h/7 the Echo sounder and Magnetometer were switched off for reasons of political diplomacy.

Capsule R1 was recovered in the morning of the 8th in fairly calm weather but poor visibility. Translation showed all records good, with evidence of the capsule having dropped a few decimetres on one occasion during spring tides. This is not surprising in view of the extremely rugged bottom topography.

Very strong magnetic anomalies were observed when passing the top of Reykjanes Ridge, particularly at 2006/8 near 62^{o}N 26^{o}W.

The deep capsule at D9 was recovered between 08 and 24h/9, in quite rough conditions, Force 8-9 with 5-6 metres waves. However, sighting was difficult when it first surfaced, and the capsule was banged against the ship once on being brought inboard. The records when translated were again found to be good, despite quite large temperature variations, showing that P. Gwilliam's improvements in the thermal characteristics of the strain gauges were satisfactory.

Heavy rolling conditions on 9/10 Oct necessitated a slight change of course and reduction in speed, so that D8 was reached late in the evening of the 10th. We lay-to until first light because night-time pop-ups are risky, and started interrogating the acoustics at 07h/11. The capsule took a full hour to reach the surface from 2448m depth, and choppy seas and bright sunlight made it hard to locate on the surface. The capsule was

sighted after a half hour search and was inboard by 1145/11. Translation of the tape again showed a good record for the full period of 25 lunar days.

D7 was reached on the morning of 12 Oct. After initial acoustic contact we waited until 15h to complete a lunar cycle, the ship being well ahead of the planned schedule. However, the delay proved to be unnecessary, as the record later showed that it had stopped unaccountably $16\frac{1}{2}$ lunar days after laying. The capsule was brought inboard at 1658/12, thus completing a remarkably successful series of deployments and closing our first circuit of oceanic tidal recordings.

Having time in hand, we proceeded to make a final prolonged acoustic search for the capsule which had been lost in the area of D7 in October 1975. There had been some uncertainty about the satellite fixes in the earlier cruise and we wanted to make sure our previous searches had not merely been in the wrong position. After waiting for a fix at the most likely position, we started a rectangular spiral at about 6 knots, with continuous alternating series of acoustic transmissions and listening, 5 minutes on each, using the 'tadpole' at 40 watts and the PDR fish for listening. The course was managed by the ship's officers who are better equipped for such close work than scientists working with the vagaries of computed D/R with its readjustments after every satellite fix. We also switched the PDR fish to record depths at 30 minute intervals, so that the bathymetry could be mapped out. After some 15 hours it was clear that only a narrow zone across the area had the correct depth for the capsule. By 1850/13 the whole range of possible depths had been covered up to 6-7 miles from the first position without any pinger being detected, so the search was abandoned and the ship headed towards Fastnet and Barry.

During 12-13 Oct, the visual display unit used mainly for plotting the computed course had been producing fuzzy images. P. Hartland traced the cause to a faulty power supply, rigged up a substitute supply, and later repaired the old one on the 14th.

PDR/Magnetometer watches were maintained until 1300/16 on reaching the shelf edge. Both 'fish' were brought in shortly after that time. Barry dock was entered at 2230/17 October.

D.E. Cartwright
Principal Scientist - Leg 3.

REPORTS ON PROJECTS

Tidal Pressure Recorders

The sea bed tidal pressure recorders deployed during this cruise were Mark 3 deep sea tide gauges at positions D7,8 and 9, and Mark I tide gauges at the shallow positions R1 and R2. In all of these instruments two different pressure sensors and a temperature sensor provide frequency modulated inputs to the data logger, in which the inputs are integrated and recorded every 15 minutes. The gauges are allowed to free fall into the sea bed with a ballast frame and recovery is by release of this frame using modulated acoustic signals and double acting pyro-release units. Surface pingers and flashing lights are incorporated to assist recovery.

The Mark 3 gauge deployed at D7 in 3196 metres contained a Hewlett Packard quartz crystal pressure sensor and a strain gauge sensor. The strain gauge transducer was contained in a new pressure housing designed to minimise dynamic effects due to rapid temperature changes. Both pressure sensors and the temperature sensor provided good records, but unfortunately the tape stopped $17\frac{1}{2}$ days after deployment due to a mechanical fault. The precise nature of this fault is unknown since the tape restarted during recovery of the gauge.

A Mark 3 gauge was also deployed at D8 in 2448 metres. This gauge contained two conventional strain gauge pressure sensors and good records were obtained with no problems.

The Mark 3 gauge deployed at D9 in 1207 metres was the first deployment of a newly constructed gauge containing two strain gauge pressure sensors of the new design. Good records were obtained with no problems.

At R1 a Mark I tide gauge with a GRP sphere was deployed in 493 metres. Two strain gauge pressure sensors were used in the new type of housing, which appears to be effective in reducing the effects of rapid temperature changes. Some difficulty was experienced in finding a suitable deployment position at this site and 8 days after deployment the pressure sensors both show a sudden downward movement of about 0.5 metre. This gauge showed

evidence of a slight leak through the sphere insert for a Marsh and Marine connector. The small quantity of water was absorbed by the silica gel and no damage occurred.

The Mark I gauge deployed at R2 in 444 metres was also contained in a GRP sphere, and included a Digiquartz pressure sensor as well as a conventional strain gauge. Complete records were obtained from both sensors, but large temperature variations of between 0.1°C and 4.6°C were reflected in the strain gauge output due to its static temperature response.

Standard sea water sample

500 gallons were taken into 10-gallon containers via the ship's fire hydrant, which was turned on 2 hours before to flush the system. The filling operation (Station 9054) was started at 1315/18 Sep at 60°30'N 22°20'W and completed by 1402 at 60°35' 22°06'W.

Magnetometry and Bathymetry

These items were logged with the aid of continuous watch-keeping during each section of deep-water passage work during Legs 1 and 3, at the request of IOS Geophysics Department. The magnetometer, set up by P. Miles before leaving Barry, was maintained according to instructions and gave little trouble except for occasional malfunctioning of pens and ink flow. The PDR was logged at 6 minute intervals and the results written in the log book and keyed into the computer. Apart from the immediate vicinity of the mooring stations, duplication of courses from Leg 1 was avoided throughout Leg 3. All relevant chart rolls were passed to the Geophysics group at Wormley after the cruise.

Test moorings in the Minch (Leg 2)

Three U-shaped moorings were laid for 24 hours in shallow water in close proximity. Two of them had a pair of current meters (one a dummy) but different buoyancy sphere (40 inch and 32 inch), and the behaviour of the moorings was monitored by a tilt meter and a pressure recorder. The third tested a new bottom recording current/pressure recorder developed at Bidston. The moorings were successful in their objectives except for the loss of the dahn buoy in Rig 3.

Engineering Group Tests (Leg 2)

(a) Side-scan systems

The 30kHz side-scan transducer was used for the first time on this cruise. It was mounted flat on the starboard plate of the stabilised platform and worked successfully without causing 'ghosting' on the 36kHz records. The 36kHz transducer was mounted off the port plate closer to the fibreglass shell to try to reduce the refraction effects experienced on the previous cruise. With this arrangement the beam pattern was much less affected by the fibreglass, whereas the 30kHz system produced definite banding on the recorder at certain angles.

Various tests were carried out on both systems to measure their parameters, these included transducer insulation and impedance; pulse length, power, gain, bandwidths and noise of the electronic circuits. The second twin helix mufax recorder was used for the first time quite successfully and a number of mechanical improvements were made on both machines.

The scattering layers were observed over a 16 hour period in water about 2300m deep. One transducer was used in the echo-sounder mode, the other with a depression angle of 30^{o}. The object was an attempt to obtain the horizontal distribution of the layers using the vertical distribution as an aid to interpretation. The experiment was hampered by cavitation and other noise effects but correlations could be observed between the two records especially during the two migration periods.

Records on the shelf were mainly at 500m range with some at 1000m, the longer ranges also being used on the continental slope. Those using Automatic Gain Control proved useful on some occasions to clarify features not easily identified on the linear record.

(b) Telesounder

The pair of 250kHz transducers mounted off the port plate experienced differing refraction effects and hence did not produce a coherent fringe pattern on the record. The other pair of transducers mounted directly on the starboard plate were more similar in apparent beam shape and produced a much

better picture when combined.

Both records experienced intermittent bursts of interference which were traced to be transmitted from the ship's head gyro repeater in the Asdic compartment.

The parameters of the equipment were measured as for the side-scan systems and further several runs were made in shallow water using different tilt angles in the hope that information about the refraction caused by the pod might be discovered.

The telesounder was used continually on the shelf obtaining echoes at times out to 250m range.

(c) Cavitation

A speed trial was conducted to establish the onset of cavitation which it is thought is produced on the edge of the hole in the ship. Depending on the sea conditions this speed is between 7 and 8 knots.

(d) EM Log Calibration

The refitted starboard log was calibrated against the port log as no measured mile was available in the area. During runs at speeds of 5 and 10 knots a series of readings of the fore and aft voltages were taken for the two logs and brought back to the Institute for analysis.

A.R. Stubbs

Geological results (Leg 2)

Every opportunity was taken to use the new side-scan sonar, supported by P.E.S. records, whenever it was not being used experimentally by Applied Physics and Engineering Group staffs.

Several gaps in the existing coverage were filled, particular attention being paid successively to the following areas.

(a) the Little Minch (between Skye and Harris)
(b) the supposed igneous centre at Blackstone Bank
(c) the sand wave zone in the Malin Sea
(d) the outer shelf south west of the Outer Hebrides, where long range sonographs had previously revealed a curvi-linear pattern.
(e) the top of the Continental Slope

(f) the supposed Lewisian rocks west of the Outer Hebrides
(g) Loch Eriboll
(h) the sand waves zone west of the Pentland Firth

Valuable data was obtained relating to bed-transport paths, the distribution of sediment bedforms, the outcrop of ancient rocks and the late glacial history of the continental shelf.

The sonargraphs showed an improvement in quality over those obtained with the previous single sided equipment.

N.H. Kenyon.

Computer Group (MSES) Reports

(a) Computer operations, Legs 1 and 3

Accurate navigation was important during all the three legs but particularly so during the first and the third. Course-corrected printout was provided every two minutes at stations and as a second navaid required by the scientists fixes were obtained using LORAN C in addition to satellites. Although the hyperbolic fixes were never stored they were very useful and often agreed closely with the satellite fixes. Difficulties were incurred in the setting up of the 'fixed errors'. (Part of the DEFINE HYPERBOLICS function of SAMON). This became a process of 'trial and error'. Satellite prediction tables were provided daily for the Bridge and the scientists.

At most stations the Live Track Plot facility was constantly used. Unfortunately at one station during Leg 3, a fault occurred on the scaling factor of the Y-axis of the V.D.U. Program PLOTS was written to draw a continuous diagonal line on the V.D.U. for testing purposes.

Track charts were produced on the I.B.M. 1627 plotter to aid in recovery of the tide gauge capsules during Leg 3.

Daily listings of all depths entered were printed on the TALLY line printer. These were used to check the manual log sheets.

The magnetometer was logged during the first and third leg, although there were initial hardware problems at the start of Leg 1. After analysing the relevant data paths and the digital inputs from volume II of the ship system documentation, the hardware inputs were changed from 68 and 73 to 71 and 73.

On two occasions the gyro was found to be faulty. Firstly, it was reading approximately 10^{o} out and had to be re-adjusted. Shortly afterwards it was discovered to be reading a steady 0^{o}. The latter was traced to a loose connection at the back of the interface.

Most of the 'hang-ups' were caused by the 1816 going off-line. This seemed to usually occur when changing from the lower to the upper case. It was serviced between stations but still sometimes gave 'no response' throughout the remainder of the cruise. However, this did not occur during a keyboard operation and therefore caused no further problems. It was always brought back on-line by pressing the RETURN key.

Throughout the cruise trouble was experienced when trying to cold-start the system. It frequently took several attempts and on some occasions it was necessary to power off and on before a cold start could be performed. Usually RELOADS could only be done by pressing START twice.

The routine sampling had to be stopped for a total of four hours during Leg 1 mainly because of hardware problems on drive 1. The system had to be shutdown for servicing but luckily the ship was steaming to the next station at the time.

The I.B.M. 1800 was greatly used during Leg 3 to edit data from the recovered tide gauges. The data was first translated from magnetic to papertape. Many plots were produced of the raw frequencies of temperature and pressure sensors. Help was given to Ian Vassie of IOS Bidston who later ran the programs.

While on station at the beginning of Leg 3 it was finally decided that the polarity on the athwartships component of the E.M. Log was reversed. This was corrected and program DATSC built to edit the relevant CDAT data.

The hyperbolic navigation often produced a HYSAM SYNC ERROR, and unfortunately this occurred once during the PACK option of MANDP. It was followed by I-level PARITY ERRORS and the PACK function aborted. The resultant CDAT file contained the present and previous days data in time order but not in day order, i.e. a block of data for day 283 was followed by data for data 282 and then data for 283 again, with some blocks repeated.

Analysis of the CDAT and FINDX files showed no data had been lost but meanwhile CDAT was rapidly filling up and the samplong had to be suppressed. The packing could not be performed again, as the message 'NO DUMPED DATA' appeared. It was decided to dump the data for the previous day and pack the file.

Repeated data was dumped to CDAT 5.

The XBT system was run once at the end of Leg 3. The software appeared to function correctly and the data plotted out using program SXBTP.

(b) Computer operations, Leg 2

As the ship remained within DECCA range for the majority of Leg 2 an attempt was made to use the HP2100A computer and satellite navigation system on the bridge in preparation for Leg 3. This was hampered by hardware problems and the attempt had to be abandoned just before the start of the third leg.

The starboard log was fitted while the ship was in port at the end of Leg 1. Raw data was collected for the instrument group from both logs for comparison.

While the ENDIG function of SAMON was being done at the end of Leg 1, DATLY was dumped to each data disk as file DATK. It was found that the leader had been corrupted, the sequence number of the next dumped file being zero.

Many track charts were produced for the scientists, however the demands on the 1800 during Leg 2 were far less than Legs 1 and 3.

(c) Engineering Report, Leg 1

Satellite navigation and to a lesser extent Loran C and Decca have all been used to obtain fixes at the various stations. The successful completion of the cruise was dependent on the recovery of the tide gauge capsules on Leg 3.

Due to the limited recovery detection range, accurate fixes to within half a mile were essential. This placed dependence on Satellite fixes and considerable time was spent waiting for good fixes, and on numerous occasions two satellites arrived together or very infrequently.

Further problems were concerned with re-loads whilst on station, (caused by a parity error), producing on two occasions a jump in Latitude and Longitude. It was a great pity that the new satellite navigation system was not available, as on this type of cruise a stand-alone system would have proved its worth.

After indexing problems with Loran C, the set was adjusted and gave reasonable fixes for a number of stations, however, slight adjustments to the fixed errors were necessary to agree with the satellite fixes.

1816-Typewriter

Numerous system 'hang-ups' after I.B.M. service call. Changed C5 contact and re-adjusted upper case/lower case interlock. Platen and red shift mechanism changed and many adjustments carried out during the process in CE diagnostic mode.

Tally-lineprinter

Occasionally caused I-Level Storage Protect during power on, otherwise a great asset.

1053-Bridge Printer

Overheating motor causing field winding thermal trip, when printer was used for two minute Loran C and D.R.

2310-Disk Drive 1

Cable clamps to voice coil leads shorted to ground due to insulation breakdown. This caused wire to burn out, and subsequent system seek error. Luckily no damage was done to M2 Driver Card. Exchanged drive and SLT cable to drive 2 whilst a temporary rapair was made.

Loran C

Index pre-set adjusted for third cycle on strong signal.

Magnetometer Interface

Initial problem with low amplitude ECO transfer to instrument, causing magnetometer to 'stick' at one value. Problem found to be faulty 7404 integrated circuit which was replaced.

1801-Central Processor Unit

Parity error occured during Hyperbolic sampling. This error only appeared twice, but on both occasions caused serious soft-

ware problems. Core tests are being carried out to isolate the fault.

T. Colvin

(d) Engineering Report, Legs 2-3

During the 8 day period between Leg 1 and 3 the Magnavox Satellite Navigation System was installed on DISCOVERY in preparation for use on Leg 3. Initial installation problems were caused by the base of the computer fouling the underside pins of the I-O slots, and further problems were then encountered with the wiring of the Reader Interface. These were fully checked, but many attempts to load the program failed, due to sumcheck errors.

An attempt was made to use the Creed as the input device using the teletype interface, but again this was unsuccessful due to sumcheck errors.

After many attempts at copying tapes, trying different speeds and tensions the Nato program was successfully loaded.

It was then found that initialisation of day and time was not being correctly done. It appeared that initialisation to a certain day was divided by 2, and erroneous times were set from those entered.

The second fault appeared to be in the floating point arithmetic unit (division) and as this was a plug in option, an attempt was made to pass this circuit using instead the standard feature. This again proved unsuccessful and it was finally decided to return the computer to Magnavox.

During the time that the system was running the computer appeared to occasionally go to a halt mode and the Satellite Receiver power supplied tripped, this could be attributed to mains spikes. Provision of an RF Filter appeared to cause no further problems, but as this was operational for a very limited time the results of this solution seemed inconclusive.

We would like to thank Steve Audley and Derek Lewis for all their hard effort and the hours of lost sleep whilst the ship was in Stornoway.

Most of Leg 2 was devoted to side scan sonar trials off NW Scotland and consequently there was very little demand on the 1800.

Leg 3 Recovery of Tide Gauge Capsules layed on Leg 1

After an obvious anomaly in a live track plot it was concluded that the polarity of the EM Log athwart ships components was reversed. This was corrected.

2310 Disk Drives 1 and 2 would not read due to pitting of the motor start. Relay contacts - these were removed and cleaned. Drive 1 voice coil leads were repaired after the problem on Leg 1 and a full RM done.

1801 CPU Hysam Sync error followed by internal level parity error caused software problems. Possible primary cause unknown, but suspect Loran Receiver or Multiplexor.

VDU 611 Wrap Round fault caused by defective 7401 gate in display driver module; also dry jointed IC re-soldered. Noisy X-Y deflections caused by power supply fault, (see below).

Camac PU The +6 volt supply found to oscillate at 100kHtz. Dry joint found on regulator card, also -6 volt regulator had unsoldered component.

Tel term Every second and then fourth line misprinting caused by defective line Buffer Card.

P.R. Hartland

STATION LISTS

Details of tidal pressure stations are given in a table on a separate page.

Station 9054 was allotted to the sea water collection on Leg 1.

Station 9056 consisted of the following test moorings :

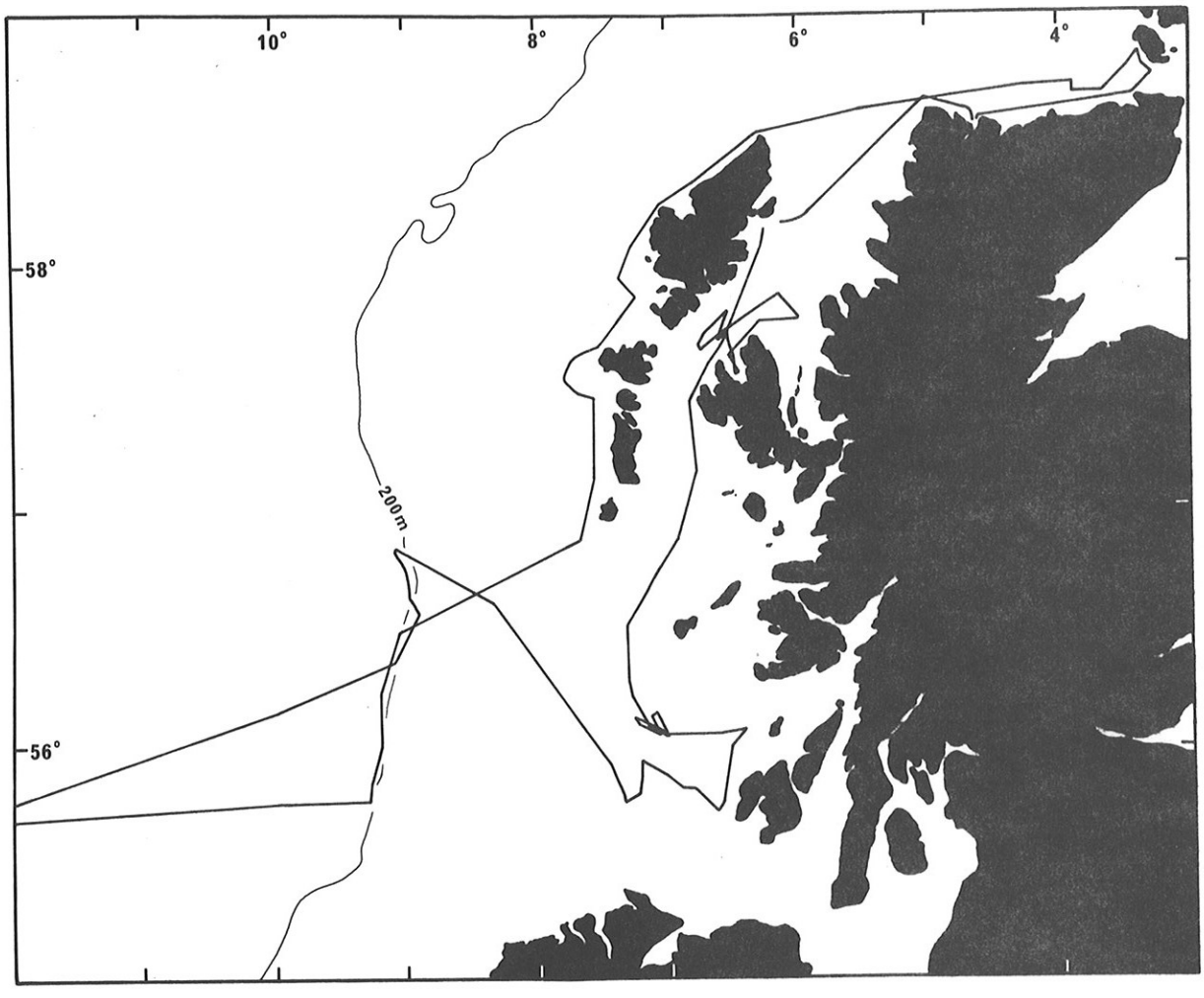
	Type	Time/Date	Depth	Position
Rig 1	2 c/m + 40" sphere	1523/24 - 1639/25	91m	57°44'9N 6°31'0W
Rig 2	2 c/m + 32" sphere	1616/24 - 1800/25	106m	57°45'2N 6°29'5W
Rig 3	Bottom mounting	1803/24 - 2120/25	128m	57°45'8N 6°26'9W

TRACK CHARTS

Two charts are shown separately, one showing track, noon positions and moorings on Legs 1 and 3, the other showing the track covered during Leg 2.

STN. NO.	IOS(B) DESIG-NATION	MOORING TYPE	DEPTH (m)	DATE LAY	DATE RECVY.	TIME/DAY NO. LAY	TIME/DAY NO. RECOVERY	POSITION LAT.(N)	POSITION LONG.(W)	LENGTH OF RECORD
9050	D7	T/G. MKIII	3196	14 Sept.	12 Oct.	1558/258	1521/286	53°39.95 53°40.80	30°09.95 30°10.50	Tape stopped after 17 days
9051	D8	T/G. MKIII	2448	15 Sept.	11 Oct.	1105/259	1009/285	57°03.04 57°03.00	30°02.20 30°03.50	25d. 22h.
9052	D9	T/G. MKIII	1207	16 Sept.	9 Oct.	1653/260	1303/283	60°12.55 60°12.60	28°46.35 28°46.20	22d. 20h.
9053	R1	T/G. MK I	493	17 Sept.	8 Oct.	1543/261	0756/282	62°50.21 62°50.50	24°43.16 24°43.20	20d. 16h.
9055	R2	T/G. MK I	444	20 Sept.	6 Oct.	0955/263	1454/280	62°58.55 62°58.40	10°58.01 10°58.60	16d. 5h.

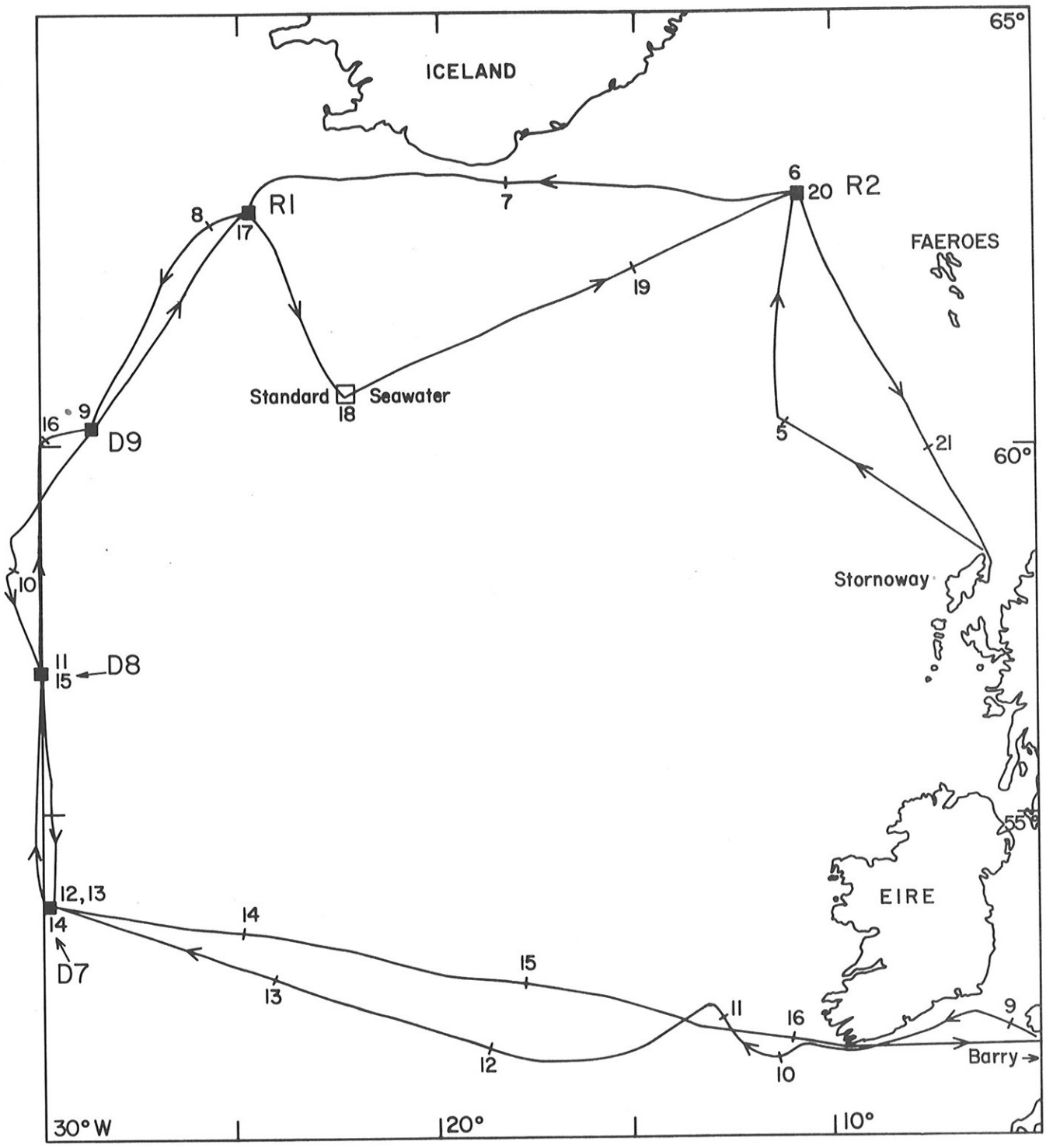
TABLE OF TIDAL PRESSURE STATIONS



Discovery Cruise 78

Track Chart

Leg 2



DISCOVERY CRUISE 78 TRACK CHART - LEGS 1 AND 3