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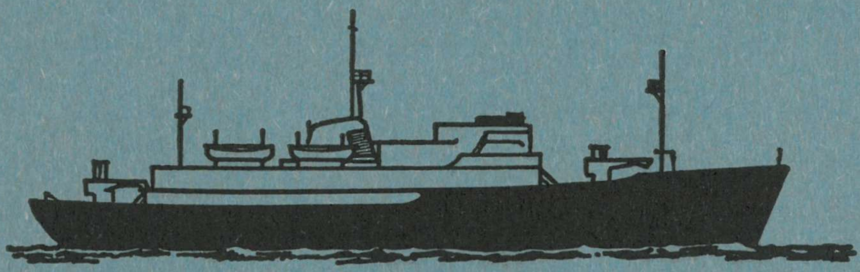

R.R.S. DISCOVERY

CRUISE 50

OCTOBER, 1972

EQUIPMENT TRIALS AND GEOLOGICAL OBSERVATIONS
IN THE ENGLISH CHANNEL AND NORTH SEA

N.I.O. CRUISE REPORT No. 56
(Issued March 1973)

N. I. O. CRUISE REPORTS

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SCIENTIFIC STAFF

Mr. R. H. Belderson	- joined 16 Oct. Felixstowe	
Mr. G. A. Bryan		
Mr. R. Dobson		
Mr. N. H. Kenyon	- left 16 Oct. Felixstowe	
Mrs. J. Legg		
Dr. B. S. McCartney		
Mr. J. McCune		
Mr. B. D. Page		
Mr. C. D. Pelton		
Mr. R. D. Peters		
Mrs. R. Sherwood		
Dr. A. H. Stride (Principal Scientist)		
Mr. A. R. Stubbs		
Dr. A. J. R. Voss		
Dr. J. B. Wilson	- joined 16 Oct. Felixstowe	
Captn. R. Phinn	- London Polytechnic Navigation School	14 to 16 Oct. Felixstowe
Mr. D. J. Hooper	Unit of Coastal Sedimentation	14 to 16 Oct. Felixstowe
Mr. R. Haine	Unit of Coastal Sedimentation	14 to 16 Oct. Felixstowe
Mr. D. N. Langhorne	Unit of Coastal Sedimentation	14 to 16 Oct. Felixstowe

EQUIPMENT USED

The scientific equipment included the Discovery side-scan sonar, E. G. & G. side-scan sonar (14 - 16 Oct. only), N. I. O. 250 kHz telesounder with heavemeter, Plessey velocimeter, Mark III P. D. R., Dynamco paper tape logger, U. C. S. magnetic tape logger, the compensating hydrographic winch and the ship's meteorological instruments. Navigational equipment included the ship's Main Chain Decca and Hifix with Track Plotter (14 - 16 Oct. only).

NARRATIVE

Discovery sailed from Barry during the morning of 11 October, 1972. On the run to Portland there were trials of the telesounder and use of this and

and the side-scan sonar. At Portland, reached on 13 October, an A. U. W. E. Boarding Officer directed the vessel over the sound range. In addition, a Decca Engineer joined the ship to clear a fault on the Hifix. Equipment trials and survey continued up to Felixstowe, which was reached on 14 October. Three U. C. S. staff joined ship there to participate in trials of the telesounder over a sand wave field, and Captain Phinn joined to conduct a survey of shipping movements off the Sunk Light Vessel. These four staff and the Decca Engineer were landed at Felixstowe on 16 October and there was an exchange of some N. I. O. staff. The subsequent equipment trials and geological studies took place in the central and northern North Sea. The ship reached Southampton on 26 October.

PROJECTS

1. Equipment Trials

(a) The Accuracy of the 250 kHz Telesounder Depth Measurements (Dr. B. S. McCartney and Mr. A. R. Stubbs)

Telesounder is the name given to a new type of side-scan sonar which has many narrow beams at known angles of depression so enabling the relief of the sea floor to one side of the ship to be displayed and subsequently measured. Errors in the measurements of depth are due to the finite width of the beams, to angular instability from uncompensated roll, to vertical movements of the transducer from ship's heave and pitch, and to refraction of sound from non-constant sound speed profiles. In order to measure the errors of the short-range 250 kHz telesounder, a survey was made some 3 n. miles N. E. of Sunk Head Tower, off Harwich, in the seaward approaches to the Thames Estuary. This area was chosen because of the known relief of gravel and sand waves (indicated by U. C. S. surveys), because the water is well mixed and hence iso-speed, and because it is well covered by the P. L. A. Hifix Chain. Several intersecting passes were made over an area approximately 400 m by 400 m, navigating by Hifix with the aid of a track plotter. Hifix data and ship's head were logged on paper tape using the Dynamco Logger and Hifix data were also recorded on the U. C. S. magnetic tape logger. The computed track plots from the paper tape suggest that the navigational control was good and should allow soundings to be overlapped to within a few metres. After allowing for tidal height changes, monitored by the P. L. A. at Walton, the differences in depth from several passes will be examined. Ship's roll was largely compensated by the gyro-controlled transducer servo-system. Corrections for vertical displacement can also be made, because a heavemeter was installed on top of the sonar plate and its output displayed on the telesounder record. The heavemeter consists of a gimballed accelerometer, as used in the N. I. O. wave recorder, connected to a transistorised double integrator, whose voltage output controlled a circuit generating a proportional pulse delay, made visible on the Mufax record.

In addition to this main survey, of an area of large relief, another smaller survey was made in a nearby area of gently undulating relief. These new results, together with the survey of Cruise 46 leg 4 on a flat sea floor, seem to provide enough data to assess the abilities of telesounders for wide swathe depth coverage.

(b) Reconnaissance with the Telesounders (Dr. B. S. McCartney and Dr. A. H. B. Stride)

The 250 and 36 kHz equipments have now been used over a wide variety of bottom types, including logitudinal furrows, sand ribbons, sand waves, sand patches, rocky floor, glacial relief, gently rolling ground and wrecks. A preliminary assessment of the results suggests that, in addition to the quantitative aspect of depth measurement discussed above, the method also has an immediate qualitative value. For example, it shows up the trends of gently rolling ground particularly well. It can show up the relief of sand waves when these are viewed along the length of the crests and the same applies to relatively simple rock outcrops. Thus, it has clear advantages over conventional side-scan sonar for showing relief. However, the two methods must be considered as complimentary to one another and it would be advantageous to display them side by side, as discussed below.

The main snag with the telesounder method is that the interference fringes can be so displaced by ship's heave as to make it difficult to identify features trending parallel with the sound beam, although the heave can be monitored and due allowance made for it.

Many examples of noise generated at the crests of sand or gravel waves have been observed at 250 kHz, supporting previous observations at similar frequencies using sector-scan sonar. In one case the noise bands were not present over sand waves during slack water, but were observed strongly before and after it, as would be expected.

Some short period records were taken using a twin helix recorder, displaying an 'in-phase' telesounder record on one half and an 'out-of-phase' record on the other. These phase switches enabled one record to present fringes where the other record had nulls so that no "conventional" side-scan data was missed.

The 250 kHz equipment can also be operated as a conventional side-scan sonar by using one instead of two transducers. It was used a little in this mode to demonstrate its higher resolution than that of the 36 kHz side-scan sonar (although with the reduced range of 250 m).

A particularly extreme case of distortion due to sound refraction was observed during side-scan operations in the Skagerrak. An associated sound velocity profile showed a most unusually severe sound velocity peak at a depth of about 35 m, with changes of about 5 m/s within a 2 m depth interval.

(c) The 36 kHz Side-scan Converted to a Telesounder (Dr. B. S. McCartney and Mr. A. R. Stubbs)

Telesounder operation of the 36 kHz sonar can be achieved in two ways. In the first method the uppermost and lowest horizontal rows of transducer elements were connected for transmission and reception and a range of about 800 m was achieved, the telesounder showing up relief of suitable size. The second method utilises the normal side-scan transducers for transmission and the outer two for reception only. This form of operation may be quite useful both because more power can be transmitted, but mainly because the normal transducers are available for simultaneous reception in the side-scan mode; thus by the use of a twin helix recorder both telesounder and conventional side-scan records can be achieved together. Unfortunately one of the two receivers required for this trial failed after a short time.

(d) Transistorised Version of the 36 kHz Side-scan Sonar (Dr. B. S. McCartney and Mr. J. McCune)

Progress on this equipment was a little show, though the receiver section was demonstrated to work despite being a little low in gain. The marking amplifier was found to be satisfactory. However, the power output stage needs some further development to allow more boards to be used simultaneously, so providing a higher output of power.

(e) Echo-sounder 'fish' Experiment (Dr. B. S. McCartney)

A comparison was made between the performance of the normal Mk III echo-sounder fish and one in which pressure release material had been inserted between the transducer and the fibre glass casing above it. The purpose of the pressure release baffle is to cut down back-radiation (i. e., up to the ship and the sea surface) so that surface scatter does not obscure bottom echoes in shallow water, or in deep water as the depth passes from one phase through to the next. The back-radiation was observed to be reduced by about 6 dB. This attenuation was enough to remove the 'ghost' bottom echo otherwise seen below the true bottom echo by an amount equal to the depth of the fish, and prevented confusion with genuine sub-bottom echoes, which showed up very well for suitable sediments.

(f) The Compensated Hydrographic Winch (Mr. R. Dobson)

Initial preparation of the compensated hydrographic winch included the fitting of a rear safety rail, levelling the drive to the Munro counters and general maintenance. For the first part of the sea trials its two winch drums were fitted with endless loops of wire rope running around the tachometer sheaves, so as to give a feedback which was similar to a rope running over the ship's side and yet enabled the winch to be run while the ship was underway. With this arrangement the winch was operated satisfactorily for 70 hours, using the controller in the ship's hold. The running conditions encountered, when on automatic control and heading into a sea, were more severe than they would be while on station, because of the more rapid frequency of encounter with waves which, at times, were steep. On this trial use was made of the ship's A. C. power, as the GLORIA generator was unserviceable. As a result, there was much less noise in the forward hold, so that a better assessment could be made of the gearbox noise level. It was found that with the controller on 'automatic' and the ship heading into a sea, there was excessive noise because the accelerations were higher than would be encountered under normal operation on station. Previous pitting of the helical spur gears, resulting from the presence of foreign bodies in the gearbox, were also partly responsible for part of this increase in noise level and increase in temperature, but these were within a tolerable level. The existing gears, manufactured from soft steel, should be replaced by hardened steel gears when their wear becomes excessive.

Trials of the winch, while on station, were carried out in shallow water off the Isle of Wight using 4 m/m wire, a 70 lb Lucas weight and the deck controller. The Lucas weight was raised and lowered many times, keeping it well below the water surface. During this period it was noticed that the winch tended to overspeed during hoisting; the tests were stopped when the winch failed to respond to the speed control, such that the weight hit the block, parted the wire and was lost. Later tests, carried out using the closed loop system on the 6 m/m wire drum and the controller in the ship's hold, gave rise to no trouble. Subsequent dockside examination of the deck controller revealed the presence of a faulty speed control potentiometer: either this fault or else some loose indicator wires could have caused the winch to overspeed when on station.

(g) Work of the Data Processing Group (Dr. A. J. R. Voss)

The aim of the D. P. G. during the cruise was to install as much as possible of the new MPX-SHIP system as possible. The main regions covered are outlined below.

Basic sampling: This worked satisfactorily but it was not checked with a mixture of solid state and relay analogue points.

Filtering: This is satisfactory.

Navigation sampling: The satellite system worked well throughout. If passes were very close, one was sometimes lost. The new sampling programs should ignore data until the last pass data has been cleared. Also, they should not start collecting until a 2 minute mark.

Loran-C works satisfactorily on-line.

There was a fault in the Decca sampling which gave 'rubbish' for one channel.

Course update programs: Testing of these programs was the largest part of our work for the cruise. They were basically functioned, but some cleaning up remained. Use with bad data or changes in Navaid can be expected to show up any troubles.

Dump procedures: Owing to an error these could not be tested satisfactorily.

External clock: The system was run on the external clock for about one week, and behaved well except during reloads. The reload procedures have been improved, but cannot be perfected until the external clock interrupt can be turned off by the computer. The computer appears to read the external clock one second behind the time on the display. The computer is, therefore, always one second slow.

MPXPT system: There were still a few difficulties with the operating system, but improvements were in hand. Multiprogramming showed a substantial reduction in CPU loading during sampling. In particular, Decca/Loran sampling caused only a minimal increase in load. The subsequent processing of the data collected was no faster, but the doubling of the cycle speed should help. There was room for optimisation of disk layout and possibly a look-up table for SINE/COSINE functions.

Cont rol of the system from a partition enables action to be taken quickly, even during times of high loading. Difficulties occurred when there were large quantities of output waiting for the 1816 printer, since this slowed down conversation via a partition. A second keyboard should help here.

Hardware: This generally functioned satisfactorily. The off-line punch/typewriter (CREED) functioned perfectly, although in heavy use throughout the cruise. The waiting time was sometimes substantial. A second machine is necessary.

2. Geological Observations (Dr. A. H. B. Stride)

(a) Sand Mobility

Opportunity was taken to search for morphological and textural evidence of erosion, transport and desposition of sand on the continental shelf and continental slope using side-scan sonar, telesounder and echo-sounder. Previously known ground was re-examined and a wide reconnaissance of new ground was made in the North Sea.

(b) Iceberg Plough Marks

These features were detected in the Norwegian Trench, in keeping with expectations based on recent N. I. O. studies around northern and western Scotland. In some localities the new features were masked by younger material.

3. Marine Traffic Flow Off the Sunk L. V., North Sea (Captn. Phinn)

The School of Navigation and the Department of Mathematics of the City of London Polytechnic are involved in a study of traffic patterns followed by shipping in congested waters such as Dover Strait. Preliminary observations have been made by analysing photographs of the screen of a radar simulator used for collision avoidance exercises for supposedly thick fog conditions in Gibraltar Strait, Dover Strait as well as the northern and southern approaches to the Thames Estuary. In addition, some 50 hours of observations have already been made of real situations in the vicinity of Sunk Light Vessel, off Felixstowe, for clear and restricted visibility conditions.

The observations aboard R. R. S. Discovery were made on 14, 15 and 16 October during periods of 2, 18 and 12 hours, respectively. They consist of a photograph of the radar screen every three minutes during these periods, amounting to about 600 photographs in all. This material significantly improves the sample for the Sunk L. V. region. It will be used in a statistical analysis to establish both the water surface being used by the ships and the passing distance between them, that is accepted in congested waters. It will be incorporated in a report "A Study of Ship Domain", by Mrs. E. M. Goodwin.

4. Meteorological Observations (Mrs. P. Edwards)

The regular logging of meteorological parameters by the shipboard computer was not expected to be available on the present cruise because of the need to develope and test the new TSX system. However, the meteorological sensors were serviced daily and visual readings were recorded by Colin Pelton, so as to provide a check of the logging system. The data logged were two-minute mean values of dry and wet bulb temperature, solarimeter (incoming radiation), and (usually) wind speed and direction. These observations are apparently, reliably logged, although due to changes in the program that correct for ship's position, the values of true wind speed and direction must be treated with care. The Leeds and Northrup recorder gave an analogue record of air temperatures and solarimeter values for use as a quick visual check that these instruments were in working order; it also indicated when radio interference was present.

5. Sound Range Trials Off Portland

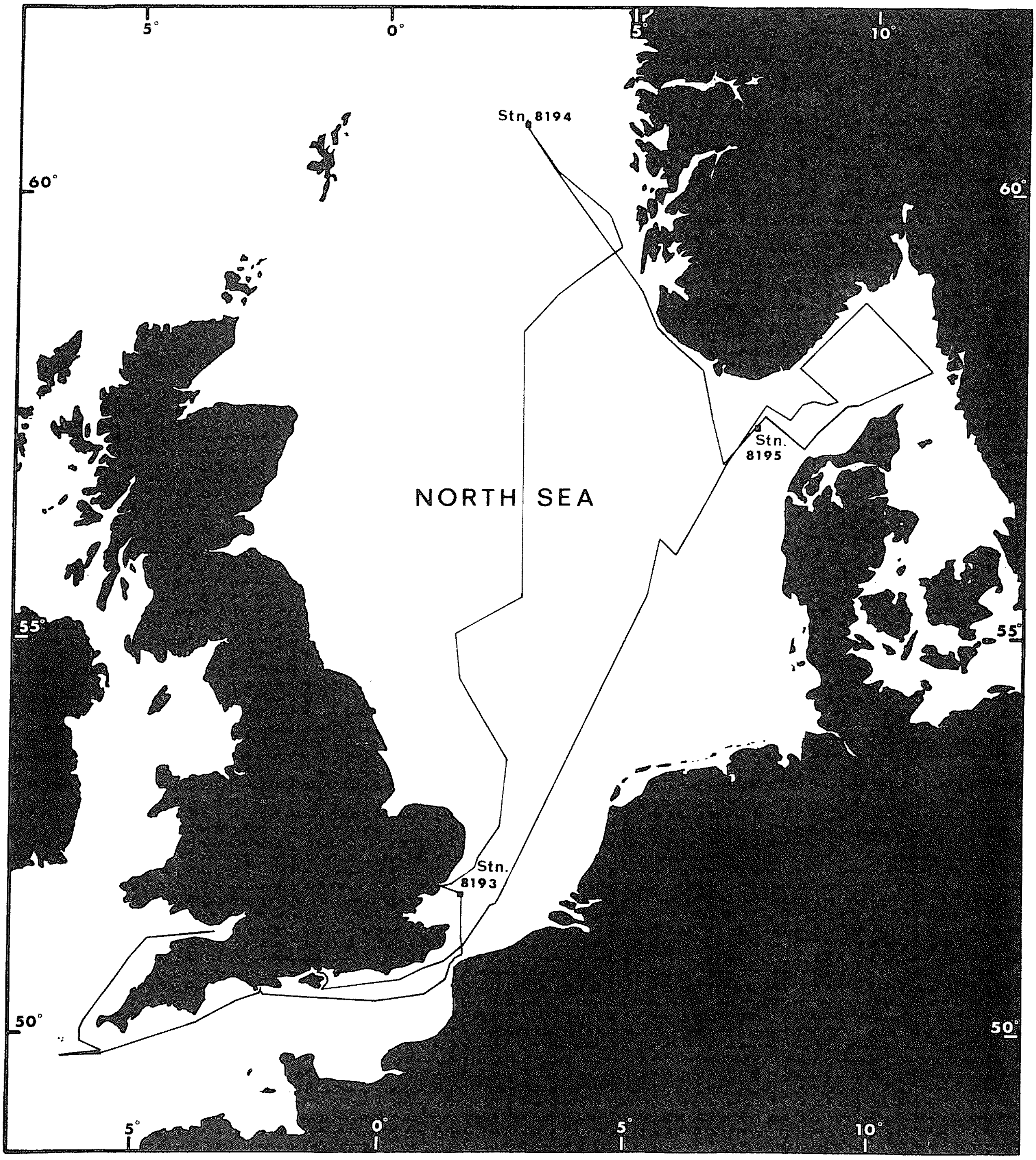
These were completed satisfactorily and are the subject of a separate report.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the help of the Master and Officers of R. R. S. Discovery throughout the cruise and of the three members of the U. C. S. for their help during the work off Felixstowe.

STATION LIST

Station No.	Date	Latitude	Longitude	Gear Used
8193	15. 10. 72	51°49. 05'N	01°37. 40'E	Velocimeter
8194	20. 10. 72	60°38. 0'N	02°48. 0'E	Wave Recorder
8195	21. 10. 72	57°27. 2'N	07°28. 5'E	Velocimeter



5°
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10°
60°
60°
55°
55°
50°
50°
Stn. 8194
NORTH SEA
Stn. 8195
Stn. 8193
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