G/35/69

UNIVERSITY COLLEGE OF WALES

ABERYSTWYTH.

Celtic Sea (St George's Channel)

R. R. John Murray Cruise 10/69. 3rd December - 18th December.

Personnel

22/3/13

Dr. M. R. Dobson Senior Scientist

Professor A. Wood

Dr. J. Haynes

Mr. R. Whittington

Mr. K. James

Mr. K. O'Sullivan

Mr. B. Lewis

Mr. P. Sherrington

Mr. W. E. Evans

Mr. A. Hamam

Mr. R. Grounds

Equipment

R.V.U.	1000 J. E. G. & G. Sparker Seismic Profiling equipment, Boomer Varian Proton Magnetometer Muirhead P.D.R. La Coste Romberg Gravity Meter Umel Camera Hydro Products Camera Reineck Box Corer (Southampton University) Shipek Grab Rock Dredge Sargent Sediment corer.
Aberystwyth	Muirhead Seismic Recorder, external filter and amplifier Tanberg Tape recorder Kelvin Hughes Side-Scan Sonar Shear and compression test equipment Binocular Microscope.

Scientific Objectives.

The main object of the Cruise was to obtain a network of closely spaced Geophysical runs in St. George's Channel, supplemented by bottom samples. For the geophysical analysis the two principal instruments used were the low power (500-1000 J.) seismic profiler and the Kelvin Hughes Sonar.

In particular it was intended to:-

(1) Obtain from the Geophysical Survey a three dimensional picture of the superficial cover - its extent and thickness and the structural form of the rockhead material down to 600 ft. Simultaneously the patterns of sea bed sediment movement through the Channel were to be mapped using Asdic.

(2) Collect samples of the sea bed on a grid pattern using dredge and grab; principally to study sediment type to assist in local Asdic calibration and to obtain samples of macro- and micro-fauna.

(3) Obtain box cores as part of a programme to study the geotechnical properties of the boulder clay and recent sediments in the Channel area.
Gravity Corer in areas of Geophysically confirmed, thin superficials to collect samples of the rockhead.

The Gravity Meter and Magnetometer were run on all Geophysical lines, the Gravity Meter and Sonar and P.D.R. were also run during the daytime sampling programme. The results from these surveys are intended to supplement previous gravity data, and to extend the details of the aerial magnetic map westwards to the Irish Coast.

The Secondary objectives were as follows:-

To make a gravity survey of Tremadoc Bay, and to run Sparker and gravity lines in Cardigan Bay to better determine the form of the structurally controlled eastern margins of the Cardigan Bay trough, and the influence which the major faults of Mainland Wales have on the trough.

To make a Sparker traverse of the Devil's tail shoal and to rock dredge over known rock outcrops in North Cardigan Bay.

To make Geophysical runs in the Central and Western St. George's Channel especially around the latitude of Wicklow Head, so as to complete as far as possible a gravity map of the whole South Irish Sea.

To produce a Magnetic Map of Irish waters from Carnsore Point to Dublin Bay.

To collect bottom samples using dredge and grab up the axis of St. George's Channel, where it is impossible for the Department's Survey launch to collect.

It was thus intended to extend westwards to Ireland, the observations made on the 4/68 John Murray Cruise. Except for the wholly Geophysical Surveys in Tremadoc and Cardigan Bay the intention was to sample only during the 8 - 10 hours of daylight with geophysical runs of 14 - 16 hours through the night. This system was adopted and allowed a routine to be quickly established.

Track Chart at back of Report.

———— Geophysical runs - Gravity Sparker, Asdic Magnetometer and P.D.R.

– – – – – Gravity Asdic, and P.D.R. runs between sample stations.

Sample Stations.

Geophysical Equipment.

A total of 1300 miles of traverse, shown on the accompanying map, was obtained using gravimeter, magnetometer, side scan sonar and sparker equipment in conjunction with the precision Depth Recorder. In addition the gravimeter was used between sampling stations. Accuracy in reduction of the results generally and the gravity in particular, will be limited by the accuracy in ships positioning. Comparison of simultaneous connected Decca and radar fixes has revealed some discrepancies which remain to be resolved; this is particularly so in Irish Waters.

Gravimeter.

The La Coste and Romburg gravimeter gave excellent results in good weather but the results steadily deteriorated as the weather worsened until in Force 5 wind conditions with moderate seas the results were unusable. Although operated off the ships mains supply switching on or off of other equipment produced no noticeable transients on the gravimeter. However, a short period oscillation on the corrected gravityoutput of the analogue recorder appeared to be related to frequency fluctuation of the mains. An irregular spurious spiking effect also on the corrected gravity output could not be explained other than an instrument fault. Blockage of the ink supply to the pens of the analogue recorder occurred from time to time but was easily dealt with. Drift of the meter relative to the base station at Barry was less than ½ milligal for the two week period of use.

Sparker.

An attempt was made to use the variable helix speed control of the 254 recorder to synchronise recording sweeps with that of a Mufax recorder (Aberystwyth equipment) so that two fascimile recordings and a tape recording might be obtained. This was abandoned as at best a long period sinusoidal drift occurred between the two instruments. Comparison of the fascimile recordings produced by the 254 and Mufax records revealed the greater sensitivity of the 254, however, as all Mufax paper supplied was older than the manufacturers last date of usage and showed signs of deterioration the comparison was not a fair one. The 254 recorder was therefore used for the main survey and the Mufax kept in reserve. Breakdowns on the 254 recorder was retricted to a bad contact onto the helix drum.

In less than 25 fathoms of water 500 Joules firing twice per second or 1000 Joules firing once per second with ½ or ¼ second recording sweep was used and gave limited penetration. In deeper water 1000 Joules of each of two arrays firing once per second with ½ second recording sweep gave penetration of up to ½ second two way travel time. An external variable frequency filter unit was used allowing greater flexibility of frequency settings than obtainable on the 254 recorder. A pass band of between 100 and 400 hertz. was found to give the best results. Throughout the sparker survey the short eight element hydrophone array was used. Some individual elements were found to be particularly noisy and were shorted out. The pre-amplifiers in the hydrophone itself were not used.

Record quality was of course dependent upon weather conditions but was generally satisfactory.

Boomer.

The E. G. and G. boomer was trailed successfully, however, due to the shortness of the cable it was found impossible to get the Boomer Fish to ride properly in the water, except in ideal sea conditions. An over-side boom will be needed to use the equipment rather than trailing it over the stern.

Magnetometer.

To prevent possible loss or damage to the magnetometer sensor whilst it was being used in shallow water, the sensor was buoyed to run about 15' - 20' below the sea surface. The sensor and cable were replaced after spurious readings were found to have been caused by a break in the cable. Magnetic relief over the area was generally smooth with a some localised dyke-like anomalies of a few hundred gammas.

Side Scan Sonar. (Aberystwyth Equipment).

After some initial difficulties in positioning the sonar transducer over the side of the John Murray the instrument was operated satisfactorily on a 800 yard range for the first week of the cruise. Thereafter a major breakdown in the return signal processor occurred and the instrument was not further used.

All fixes were marked on the instruments from one manually operated push button at 10 minute intervals. A digital output clock was used for time keeping.

Report on Sampling.

Three sampling methods were used, shipek grab, net dredge with bucket, and Reineck box corer. The performance of these devices is summarised in the table below.

Device	No. of Samples Obtained	No. of Partly Successful Runs	No. of Unsuccessful Runs
Dredge	29		2
Shipek Grab	46	2	1
Reineck Box Corer	1	2	4

Dredging was highly successful, the two failures out of 31 attempts being due to use of insufficient cable or steaming at too high a speed against a strong tidal current.

The shipek grab also proved to be highly satisfactory, there being only one station out of 49 where a sample could not be obtained after three attempts. This single negative result is believed to be due to the nature of the sea bed at that particular location where it is probable that the boulder clay is devoid of recent sediment cover. Only partial success at two stations occurred during rough weather conditions when the ship may have been drifting so fast that the grab hit bottom obliquely and so failed to get a good bite at the sediment.

Reineck Box Corer.

The only successful core was obtained in Milford Haven while at anchor. This core of dark grey plastic mud was obtained with an unmodified core box after an earlier failure using a N.E.R.C. - modified core box. This modification involved the welding of basal flanges on each side of the core box, so as to enable the bottom plate to be secured to the box after a core has been obtained. The failure of this modification is believed to be associated with the poor method used to lock the core box into the box holder. This method allows considerable lateral movement of the box after locking, and when extreme movement of the box to one side is combined with the increased box width caused by the addition of flanges, there is insufficient clearance for the spade of the closing mechanism to travel beneath the box. Consequently when pulled up the closing mechanism was found to have jammed against the box, badly deforming it. Subsequently only the unmodified boxes were used.

It appears doubtful whether the addition of basal flanges would be acceptable from another standpoint, namely the recovery of an undisturbed core which is supposed to be one of the main features of a box corer. The core boxes being constructed of thin stainless steel are able to cut into the sediment without producing significant disturbance, whereas the increase in effective wall thickness produced by the addition of the basal flanges cause core disturbance in excess of the acceptable limits of Co less than 10 (- as defined by A. F. Richards and H. W. Parker in "Surface Coring for Shear Strength Measurement" - Proceedings of the Conference on Civil Engineering in the Oceans, A.S.C.E. Conference, San Francisco, California, September 6 - 8, 1967).

The other three unsuccessful runs together with one of the partly successful attempts, were probably caused by lag gravel and cobbles on the sea bed. This material appeared to have been jammed between the spade of the closing mechanism and the side of the core box, thus preventing closure and core recovery. During one such run the leverage of the cobble-jammed spade against the bottom of the core box produced a small break in the box holder.

The partly successful run referred to above, recovered two cobbles jammed between spade and core box, and a sliver of brown clay, probably boulder clay.

In the case of the remaining partly successful run, the closing mechanism did work, but a recovery of only 2 inches of very coarse shell hash and pebbles was obtained. Here failure is suspected to have been caused by loss of the finer material through the small clearance produced by small pebbles being jammed between the spade and the underneath of the core box. Even though the spade had completely closed the box, jamming of small pebbles could force the box and central stem to move upwards, the box holder lugs moving up along the oval hole in the lower lever portion of the closing mechanism.

It appears from this experience that the Reineck Box Corer is not suited to sediments coarser than sand grade, and even bimodal gravel-clay sediments with a relatively low proportion of gravel seem to be unsuitable. Thus much of the Southern Irish Sea, where very thin lag gravels overly boulder clay, is not suited to this sampling method. Rough sea and wave conditions produce another limitation on the use of the box corer. The device becomes unwieldy and possibly dangerous in wind conditions in excess of force 3. The main problem here is steadying the device so that it does not collide violently with the ship's stern or deck and so uncock. Attachment of ropes on each side of the frame provides some steadying during lowering into the water, but the development of special long boat-hook-like tools is suggested to aid both in lowering and raising of the device. Rigid boat hooks would have an obvious advantage over ropes in holding the device away from the ship.

Other mechanical modifications that appear to be required for better performance from the Reineck box corer are:-

1. A better method for attachment of the bottom plate, possibly employing four welded buttons on each box and each bottom plate. Secure attachment of the bottom plate to retain the core, could then be achieved with four jubilee-type clips.

2. Use of a strong pin in place of the cumbersome and laborious safety collar, used to prevent the central stem sliding through the gimbal.

3. Development of a stronger pin to prevent the tripping arm from falling while the device is on deck. The existing pin was bent under load during a previous cruise and rather unsatisfactory and dangerous makeshift substitutes were used during the cruise discussed here.

4. A better method for attachment of the core box to the box holder is needed to prevent the presently excessive lateral movement of the box. Suggested methods are, wider spacing of the spring - loaded pins in the box holder and of the holes in the top of the box, together with the use of shorter oval holes.

Shipboard Use of Shear-Strength Testing Methods.

Use of these methods was limited to the one successful box core obtained. Unfortunately this material was too weak to register reliable readings. However, the apparatus was given a trial under shipboard conditions, and confirmation of its suitability was obtained.

The hand vane tester can probably be used in all but the roughest sea conditions, whereas the unconfined compression test apparatus would probably be inaccurate in conditions over force 4.

Use of wax sealed sample tubes and onshore laboratory tests, together with shipboard hand vane tests would appear to be adequate and practical.

It now appears unlikely that Reineck box cores, even with the maximum possible 45 cm recoveries, can provide deep enough penetration for meaningful shear strength information to be obtained. The vibra core, Mackereth, or the N.G.I. torpedo fixed piston corer, should provide undisturbed cores of suitable length. The principle of incremental coring using the N.G.I. torpedo corer would probably be best suited to the deeper parts of St. George's Channel where the vibra corer is likely to be at its limit of efficiency.

Camera Work.

Only two partly successful camera runs were obtained out of the 6 attempted.

The first camera used failed on its first run, the flash reflector being lost, and the camera unit itself filling with water because of the absence of a gasket beneath the lens cover glass.

Subsequent runs with a second camera assembly failed for various reasons including failure of the microswitch controlling the film transport, failure of Marsh Marine connectors, and possibly incorrect film loading. Failure of the micro-switch may have been caused by bumping of the camera assembly against the ship's deck and stern during lowering and raising operations. Improvements in this micro-switch and use of long boat-hook type tools during lowering and raising of the camera assembly, are recommended.

Brief Summary of Events:-

Aberystwyth advanced party arrived at Barry on the 1st to install equipment and become familiarised with the new La Coste Romberg Gravity Meter as R.V.U. personnel were not available for the cruise. Earlier in November the Asdic frame cleats had been welded to the port side of John Murray and the Box Corer collected from Southampton. Equipment faults were corrected in time for sailing at 2. p.m. on 3.12.69.

3-12. Departed Barry fresh to strong winds - gravity run into Carmarthen Bay (from Swansea) not attempted. Geophysical equipment started at St. Gowan's Head. Sparker developed Hydrophone amplifier fault, in worsening weather decided to make for Milford Haven.

4-12. N.E.R.C. staff arrived to assist - no obvious fault traced - equipment working again. Tested box corer - adjusted asdic frame - Departed Milford Haven 22.30 and started first geophysical run across St. George's Channel.

5-12. E. - W. run completed. Sparker brush contacts repaired - Decca erratic - sampling continued throughout day - although restricted to radar range because of Decca failure. Box Corer tried unsuccessfully. Camera also failed (filled with water). Proceeded Rosslare for Decca repairs. Weather deteriorating. Departed Rosslare 20.45. Because of sea state, continued survey close to Irish Coast.

6-12 Continued Geophysical run throughout day. All 5 instruments working - Decca again faulty - restricted to radar range of Irish Coast.

7-12 Decided to cross to Tremadoc Bay and have Decca repaired at end of first leg. Completed Tremadoc Bay Survey. Attempted rock dredging over known rock outcrops. Geophysical runs in N. Cardigan Bay. Calm weather.

8-12 Radar fixes only. Geophysical Survey continued close inshore, continuing in a general southerly direction to Fishguard. Calm weather.

9-12. Arrived Fishguard 8.00 a.m. Personnel changed. Decca repaired and auxiliary set placed in plotting room. Camera replaced. N.E.R.C. personnel checked and repaired Gravimeter and Sparker.

9-12. Departed Fishguard 19.12. Boomer worked, but Sparker record preferred - latter therefore used. Geophysical run continued throughout night, weather calm.

10-12. Geophysical run ended 09.30. Sampling continued throughout day. Weather moderate. Bridge Decca unreliable - auxiliary, O.K. Automatic steering became unreliable. Asdic repaired. Geophysical run started 19.27. Continued throughout night.

11-12. Geophysical run ended at 09.00. Weather flat calm. Sampling throughout the day. Box corer again tried - ground unsuitable - camera successful. 8 sample stations occupied - all dredges and grabs successful. Geophysical run started at 17.50. Steering gear failed twice in the night.

12-12. All equipment off at 9.00 a.m. Successful throughout night. Weather again flat calm. Sampling successful, although strong spring tides caused long delays between stations. 10 stations occupied. Auxiliary Decca only reliable. Geophysical run commenced 19.30.

13.12. Geophysical run completed at 09.35. Sampling continued throughout day. Weather freshened during the day 8 stations occupied. Sampling finished early because of poor weather. Geophysical run commenced - results poor weather worsened, made for shelter of Wicklow Head.

14-12. Anchored Wicklow Head 04.00. Later departed for Dublin, arrived 17.36.

15-12. Departed Dublin 13.30. Weather still bad, but intended to keep inside Irish Coast Banks. Asdic not working. 6 sample stations occupied. Geophysical run started at 20.00. Agreed to attempt run outside banks as weather moderating (Eye of depression passed across Irish Sea).

16.12. Weather remained moderate. A good geophysical run completed in Central part of southern Irish Sea. Sampling started at 08.30 and seven stations were occupied. The Geophysical equipment was started at 16.30 - but weather deteriorated rapidly - preventing course towards Tuskar Rock. A run due south was commenced.

17.12. During the early part of morning records started to lose quality owing to bad weather. Finally at 11.30 all gear was inboarded. Ship headed for Barry.

18.12. Arrived Barry Docks. 04.00.

We would very much like to thank the Officers and men of the John Murray for making the cruise a successful and happy one. Special thanks go to Captain Perry particularly for his help and advice with weather matters which ensured the vessel was always in the right area to take maximum working advantage of the weather.

We thank the Bos'un and his crew for their efficient handling of their difficult and dangerous (Box corer) equipment, and the technical staff of R.V.U. for their assistance before the Cruise and their willingness to come to Milford and Fishguard to check the equipment.

We were especially impressed by the variety of food and entertainment provided during this Christmas Cruise - the Christmas dinner was magnificent.

Dr. Max Dobson.
Senior Scientist.


ARKLOW
WEXFORD
BARMOUTH
ABERDOVEY
ABERYSTWYTH
ABERAYRON
NEW QUAY
CARDIGAN
FISHGUARD
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