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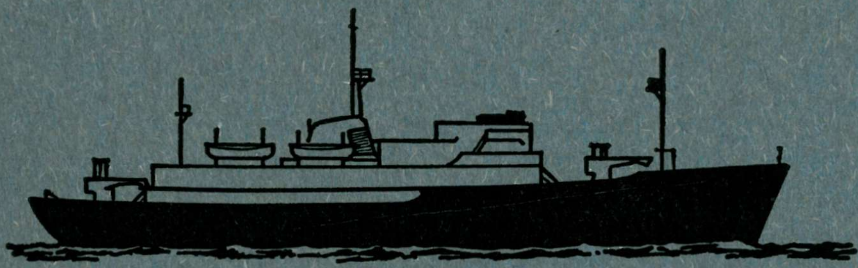

R. R. S. DISCOVERY

CRUISE 35 REPORT

JULY — AUGUST 1970

Geological Investigations
with GLORIA, side-scan and air guns

N. I. O. CRUISE REPORT No. 35

(Issued September 1970)

National Institute of Oceanography

Wormley, Godalming, Surrey.

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Contents

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R. R. S. "Discovery" - Cruise 35

11th July - 19th August

Scientific Staff	Before 1st August	After 1st August
Mr. B. J. Barrow	x	-
Mr. R. H. Belderson	x	x
Mr. S. V. Bicknell	x	-
Mr. D. G. Bishop	x	x
Mr. R. N. Bonner	x	x
Mr. A. C. Braithwaite	x	x
Mr. R. M. Carson	x	-
Mr. R. Dobson	x	x
Mr. R H. Edge	x	-
Mr. H. M. C. Fielding	x	x
Mr. N. H. Kenyon	x	x
Mr. V. A. Lawford	x	x
Mr. R. J. Morris	x	-
Dr. B. S. McCartney (Leader of Air Gun Team)	-	x
Mr. C. D. Pelton	-	x
Mr. R. Peters	x	x
Dr. J. S. M. Rusby (Leader of GLORIA Team)	x	x
Mr. J. Sherwood	x	x
Mr. P. J. Smith	x	x
Mr. M. L. Somers	x	x
Dr. A. H. B. Stride (Principal Scientist)	x	x
Mr. A. R. Stubbs	x	-
Mr. S. K. Willis	x	x
Mr. P. G. Woods	-	x

Dates

Saturday 11th July	-	Depart Southampton
Thursday 30th July	-	Arrive Palermo
Saturday 1st August	-	Depart Palermo
Wednesday 19th August	-	Arrive Southampton

Equipment used

GLORIA, side-scan asdic, air guns and hydrophones, echo-sounder, fast and slow Oxfam nets, Neuston net, "Oyster" and deep-sea camera.

Projects

a) Second sea trials of G. L. O. R. I. A., the long range side-scan asdic

(1) The Equipment (Dr. J. S. M. Rusby)

During the first sea trials of this equipment carried out last year in the Mediterranean and Atlantic it was found that the nylon rope accumulator system was inadequate for two main reasons. First, considerable live loading was experienced in only moderate sea states. Secondly, it was found that excessive snatching occurred in the main cable when the load was being transferred from the winch to the nylon accumulators. Two changes had been made for 1970, in an endeavour to overcome both these manifestations of live loading.

The nylon rope accumulators were replaced by a quite different towing system. A large, streamlined, fibre glass float was used, which was designed to carry most of the weight of the vehicle and its faired cable. The additional small amount of buoyancy required was provided by a streamlined trail float system attached to the main float. The idea was to tow the main float about 300 feet aft of the ship at a running depth of about 50 feet, where the particle velocity of the water due to surface waves was sufficiently low. The trail floats would act as a balloon rope in reverse, so that a depth would be reached where the vehicle weight in water was balanced by the net buoyancy of the main float plus the number of trail floats that were submerged. This system was based on $\frac{1}{5}$ scale towing trials carried out in January 1970. To overcome the second problem, that of transferring the load of the vehicle, with its entrained mass of water, to the towing system, a new scheme was adopted. This was simply to attach the cable to the towing system, in this case the main float, while the vehicle was still on the surface. Last year this had not been possible since it involved diving the vehicle on its full scope of towing cable, with the chance that the 25 foot long fairing lengths would be twisted during the dive. This risk could not be taken, for if a length of fairing was twisted there was a real chance that unbeknown to the ship it would be dragged off the cable at speed, later on. Accordingly, to make such a dive possible the fairings were reduced to 6 foot lengths for 1970. Tank tests had shown that a 360° twist was virtually impossible to retain at 6 knots for such short lengths.

The first launch of the sonar during the present cruise was made in the Gulf of Cadiz on the 18th July. When towing was started it was found that the clamps attaching the main cable to the terylene warp towing the main float were not rugged enough. Next day the vehicle was surfaced so that modifications could be made to strengthen the clamps. When these had been completed two faults were found with the vehicle, the rudders had been forced round off their gear quadrant by the wave action when the vehicle was at the surface, and the centre vent valves had an electrical fault so that they could not be opened for sinking. These faults were overcome by fitting rudder clamps and a new vent valve harness while the vehicle was under tow.

On the 21st July the vehicle was submerged again and towing trials began. It was found that the new towing system worked well; in about Force 5-6 conditions with the float at 40 feet the measured tension in the main cable between the float and vehicle was 4.0 $\pm$ .25 tons, a satisfactory low level of live loading.

The measured yaw of the vehicle was about the same in amplitude as that experienced with the nylon accumulator system, but rather different in character.

It had little correlation with the long period ship yaw. The trail floats were rather unstable, this appeared to be a rather complex combination of two factors; tension in the interconnecting wire straps under load, and turbulence due to the wake of the ship. The trail floats also showed that it was quite practical to dive the vehicle to its position 300 feet below the main float with no problems due to fairing twist or loss of fairing.

Sonar runs were made from 1530 hours on the 21st July to 1230 hours on the 23rd July. The vehicle was then surfaced and recovered due to low internal air pressure and a bad weather forecast for the following day when it would otherwise have been too rough to recover it. During most of the first sonar runs a 12 millesecond pulse was used on the 7.3 nautical mile range. The resolution was rather degraded by the lack of rudder steering, although the receiver beam steering was in operation.

The system was next deployed on August 2nd in the southern part of the Tyrrhenian Sea, with the rudder in operation as well as the beam steering and then a course was laid towards the southern part of the Bay of Naples and thence towards Sardinia. During the major part of this work a 12 millesecond pulse was used on a 7.3 mile range. One seamount was observed twice on the same track, to test the effectiveness of the correlator against the CW system. The sonar was recovered on the 7th August. During recovery it was found that there was a leak in the after compartment of the vehicle, due to a missing shroud bolt. Divers attached a high pressure line to the vehicle at 30 feet and it was blown to the surface using an excess of air.

Once again a large measure of the operational performance achieved was due to the efforts of the overside team. A limited depth capability using aqualungs was a help on two occasions.

(2) <u>Geological results</u>

Extensive use was made of Gloria to examine a wide variety of sea floor types in the Gulf of Cadiz and Tyrrhenian Sea in plan view for the first time, with enough repetition of each type of feature to enable significant patterns to be recognised and also to make a further assessment of the equipment's limitations. The types of floor that were examined included the floors of submarine canyons, cliffs, smooth and rough rock ridges, abyssal plains and deep-sea channels, as well as a comparison of the active and recently active volcanic Aeolian Islands with sea-mounts in the Tyrrhenian Sea and views of the deeper-water sand-wave fields of the Gulf of Cadiz. The new "look" of some of these types of floor is far more complete than has been obtained previously by more conventional means and represents a most worthwhile addition to knowledge.

b) <u>Side-scan asdic survey</u>

Every opportunity was taken to use the side-scan asdic on the continental and island shelves, the deeper ground down to about 400 fms and beyond that as a narrow beam echo-sounder. Although the width of floor examined on the continental slopes was disappointingly narrow, due to water depth, the high yield of data fully justified its use.

c) <u>Sub-bottom profiling equipment</u> (Dr. B.S. McCartney)

The air gun reflection profiling equipment was operated for a total of 116 hours, mostly at a ship speed of 8 kts, although a few hours at 10.5 kts at the end of the cruise. The hydrophone depth and the filter bands were adjusted to optimise resolution, whilst retaining penetration of up to 1.5 secs (two-way travel time) below the sea floor in favourable conditions. Deeper-lying reflectors were probably undetected largely owing to the unsuitable structure of the sea floor.

Use was made of free-running air-guns, adjusted to a firing period of approximately 8 seconds; a notable feature was the success of the new gun, made with slight modifications and to tighter tolerances than the older one. The latter had 3 failures in 17 hours compared with only 6 stoppages in 99 hours for the new gun, and threefold improvement in operating time between failures. At best, the new gun worked for over 27 hours on one occasion. The P.T.F.E. piston 'O' ring seal at the nose of the gun accounted for 6 of the 9 failures and was easily and quickly replaced, whilst two failures were due to loose pipes. It was a great advantage having two guns available for alternate use so that minimal profiling time was lost whilst major repairs were undertaken on one or other gun. Similarly, two towing frames were essential in view of the weld fractures which occurred. The compressor operated satisfactorily, but the external cooling sea water pump failed after 110 hours.

The hydrophones were towed 300 feet astern of the vessel. On the first leg the 200 foot hydrophone array was lost when a guide rope caught in one of the lead weights and broke the cable. For much of the second leg a new 100 foot array preceeded by a 100 foot long passive section was assembled. Later a 50 foot neutral section was added to its distal end, thereby reducing the number of transient noise spikes; which are believed to be due to hydrophone spheres knocking against the inside wall of the tube, especially at the end of the array where lateral vibrations are more severe.

The G.L.O.R.I.A. diving team made valuable observations of the attitude and dynamic stability while the hydrophone array and its cable were towed past them in a calm sea at 7 kts.

Level recordings of hydrophone noise spectra were taken when conditions such as the ship speed, weather conditions or array depth changed. Satisfactory profiles at 10.5 kts were again obtained when the sea state was about 4 to 5, although an increase in noise level is apparent on the records.

d) Transducer measurements (Dr. B. S. McCartney)

Admittance measurements using the new Dranety equipment were made on:-

(i) the P.E.S. transducer within a towed fish in air and water,

(ii) the hull transducer in water,

(iii) the asdic transducer in water.

The P.E.S. fish transducer is now satisfactory acoustically, but the fish itself is found to tow in towards the ship. Rotating the tail fin through 180° did not affect this, so that either the fairing or the basic balance of the fish are the cause.

e) Sound speed profiles (Dr. B. S. McCartney)

The sound speed profile was measured using the Plessey velocimeter in the Tyrrhenian Sea. A computer program was written to utilise the profile for calculating and plotting ray paths and wavefront positions. The ray paths enabled the optimum depression angle for the GLORIA transducer to be chosen. For the shorter range asdic this form of data is not essential as the Mufax record changes sufficiently rapidly that a 'trial and error' approach to the optimum angle is acceptable; for GLORIA this method is too slow. The wavefront plots however are valuable for both side-scan equipments, enabling corrections from slant (curved) ray path times to be converted to lateral distance from the ship, providing some assumption is made about the sea bed slope in that direction.

f) Gulf of Cadiz sedimentation

The ground that was investigated corresponded with that swept by the relatively dense water flowing out from the Mediterranean. The bed forms proven consist of sand ribbons and sand waves, occurring in zones of relatively strong and weak currents respectively, within and beyond which there is evidence of a considerable amount of deposition. This is the first time sand ribbons have been shown to exist on the continental slope under the influence of a unidirectional current, as compared with those known on the shelf formed by tidal streams

g) Balearic Island ridge geology

A new series of air gun reflection profiles were taken both among and around the Balearic Island ridge to supplement those obtained last year. In order to get conformity of approach the new ones were so placed as to have a small overlap with profiles of the deeper-lying floor obtained by other workers. The new profiles reveal the extensive occurrence of a series of reflectors which provide a good opportunity to discern aspects of the post-Alpine orogenic history of the region.

h) Sea-bed "Oysters"

A total of 39 sea-bed Oysters were spread in the western Mediterranean. These devices sink to the sea floor, record the near-bed current speed and direction and are then liberated to the sea surface where they drift around until they fetch up on a beach and are found. One series was put out in the deep northern part of the Tyrrhenian Sea, another series from the Bonafacio Strait (between Corsica and Sardinia) to the eastern end of the Balearic Island ridge, while a third series was spread out north west of Mallorca. Locations and depths are given in the station list.

i) Zooplankton collection for lipid analysis

Surface net hauls were taken at night at various stations off the Atlantic coast of Spain and Morocco and then at intervals across the Mediterranean from Sueta to Palermo. Species of the smaller crustacea were specifically sought. The object of the collection of this material was to compare the chemical composition of the lipids of these animals with results already obtained from similar species taken from other stations in the north-eastern Atlantic and western Mediterranean. It is hoped that these and other results will enable a determination to be made, of the effects of geographical location and season on the lipid composition of marine fauna.

j) A chemical release

A pencil shaped piece of a magnesium nickel alloy was lowered to a depth of 3700m in the Bay of Biscay. The decomposition of the alloy was observed by means of a camera and flash unit, in order to determine whether the reaction took place at all depths.

Station List

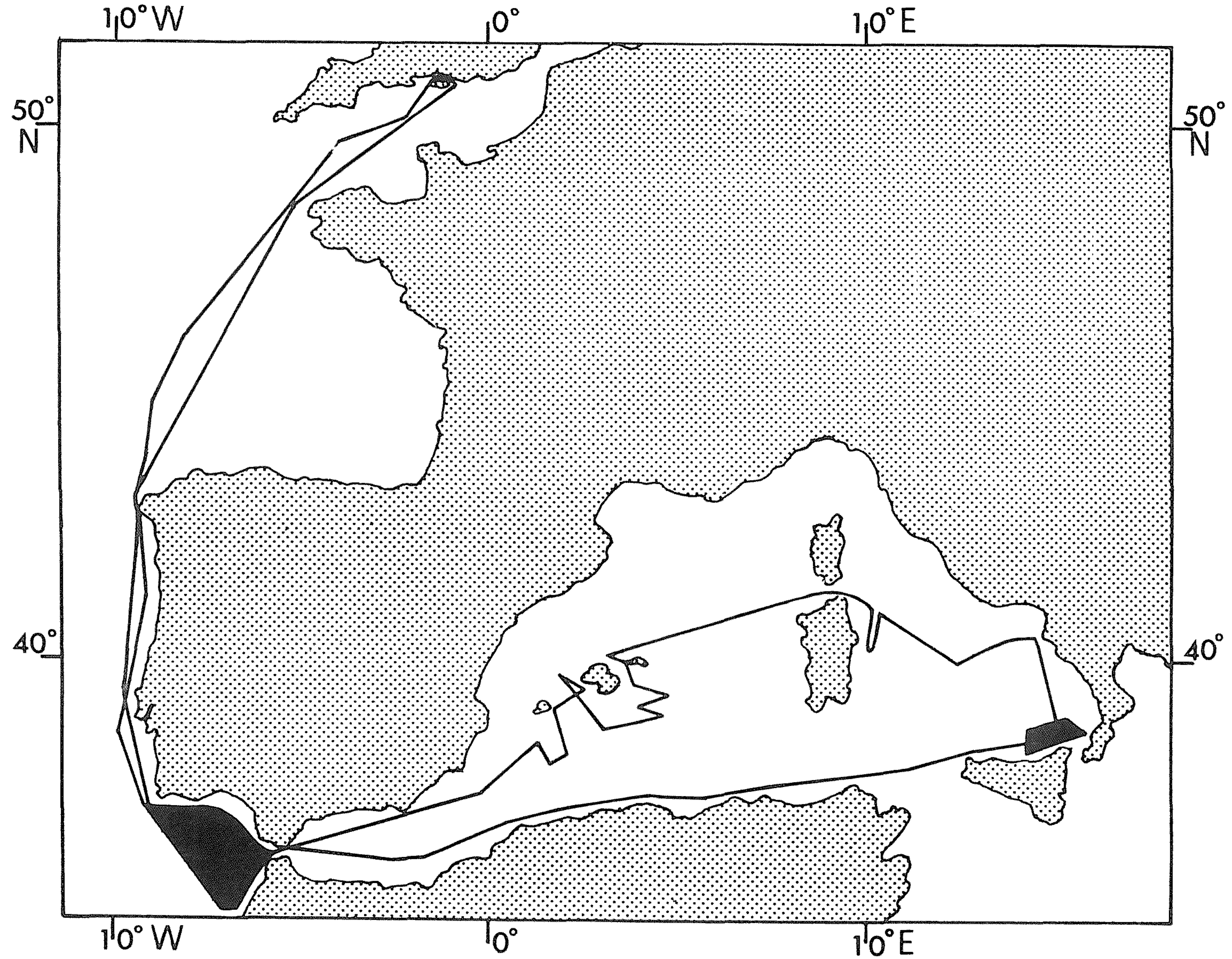
Discovery Station No.	Date	Latitude North	Longitude E/W	Equipment used
7358	17. 7. 70	36°14. 0'	06°55 4'W	N. N.
7359	23. 7. 70	36°09. 3'	06°45. 0'W	N. N.
7360	25. 7. 70	35°30. 0'	06°46. 0'W	O. N. N. N. F. O. N.
7361	26. 7. 70	35°50. 0'	03°52. 0'W	O. N. N. N. F. O. N.
7362	26. 7. 70	35°58. 8'	00°19. 2'W	O. N. N. N. F. O. N.
7363	27. 7. 70	36°11. 0'	00°11. 0'E	O. N. N. N. F. O. N.
7364	28. 7. 70	37°03. 0'	03°54. 0'E	O. N.
7365	29. 7. 70	38°11. 5'	12°26. 7'E	O. N.
7366	2. 8. 70	38°29. 2'	15°16. 0'E	V.
7367	5. 8. 70	39°59. 2'	13°00. 0'E	O
7368	5. 8. 70	39°59. 2'	12°21. 0'E	O
7369	5. 8. 70	40°03. 3'	12°15. 7'E	O
7370	5. 8 70	40°09. 5'	12°06. 4'E	O
7371	5. 8. 70	40°20. 9'	11°46. 9'E	O
7372	6. 8. 70	40°29. 2'	11°35. 0'E	O
7373	6. 8. 70	40°32. 2'	11°24. 3'E	O
7374	6. 8. 70	40°37. 0'	11°21. 0'E	O
7375	6. 8. 70	40°40. 0'	11°15. 0'E	O
7376	8. 8. 70	41°07. 5'	08°00. 2'E	O
7377	8. 8. 70	41°05. 4'	07°48. 1'E	O
7378	8 8. 70	41°03. 3'	07°34. 8'E	O
7379	8. 8 70	41°00. 0'	07°07. 6'E	O
7380	8. 8. 70	41°00. 0'	07° E	O
7381	8. 8. 70	40°58'	06°56'E	O
7382	8. 8 70	40°56'	06°41'E	O
7383	8. 8. 70	40°55'	06°26. 8'E	O
7384	8. 8. 70	40°53'	06°17. 8'E	O
7385	8. 8. 70	40°51'	06°13'E	O

Station List (Contd.)

Discovery Station No.	Date	Latitude North	Longitude E/W	Equipment used
7386	8. 8. 70	40°52'	06°05'E	O
7387	8. 8. 70	40°50'	05°54'E	O
7388	8. 8. 70	40°47'	05°45'E	O
7389	8. 8. 70	40°46'	05°34'E	O
7390	8. 8. 70	40°44'	05°27'E	O
7391	8. 8. 70	40°39'	05°13'E	O
7392	8. 8. 70	40°	05°00'E	O
7393	8. 8. 70	40°35. 2'	04°48'E	O
7394	11. 8. 70	39°29'	01°59'E	O
7395	11. 8. 70	39°35'	01°50'E	O
7396	11. 8. 70	39°37. 2'	01°46'E	O
7397	11. 8. 70	39°39. 9'	01°41. 8'E	O
7398	11. 8. 70	39°38. 7'	01°41. 7'E	O
7399	11. 8. 70	39°37'	01°46. 8'E	O
7400	11. 8. 70	39°34. 6'	01°51. 9'E	O
7401	11. 8. 70	39°34'	01°57'E	O
7402	11. 8. 70	39°32. 2'	02°01. 7'E	O
7403	17. 8. 70	46°28'	06°59'W	A. G. W. C.

Abbreviations:-

O = Sea-bed Oyster
O. N. = Slow Oxfam Net
F. O. N. = Fast Oxfam Net
N. N. = Neuston Net
A. G. W. = Air Gun Waveform
C. = Chemical Release
V. = Velocimeter



10°W
0°
10°E
50° N
50° N
40°
40°
10°W
0°
10°E