I.O.S.

R R S DISCOVERY
CRUISE 104

27 July – 19 August 1979

Geological studies in the Mediterranean

CRUISE REPORT NO 105
1980

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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SCIENTIFIC PERSONNEL

Mr. A. Andrews	IOS	(Ocean Engineering)
Mr. S. Bicknell	IOS	(Applied Physics)
Mr. R. Edge	IOS	(Ocean Engineering)
Mr. C. Flewellen	IOS	(Applied Physics)
Mr. N. Kenyon	IOS	(Geology) Principal Scientist
Mr. D. Lewis	RVS	(Computing)
Mr. M. McCartney	IOS	(Chemistry)
Dr. R. Morris	IOS	(Chemistry)
Mr. C. Pelton	IOS	(Geology)
Mr. R. Peters	IOS	(Ocean Engineering)
Mr. J. Revie	IOS	(Applied Physics)
Mr. P. Ridout	IOS	(Chemistry)
Dr. J. Thomson	IOS	(Chemistry)
Dr. R. Wilson	IOS	(Chemistry)

SHIP'S OFFICERS

M. Harding	Captain
T. Gray	Chief Officer
J. Seymour	2nd Officer
C. Dixon	3rd Officer
A. Coombes	Chief Engineer
T. Rees	2nd Engineer

OBJECTIVES

Following cruises in the Indian Ocean and the Red Sea, R.R.S. Discovery had reached Suez on a leg devoted mainly to work with GLORIA and seismic profilers. Thus cruise 104 was able to follow with only a small change around of personnel and equipment.

The Geology Programme

1. The main objective was to use GLORIA to improve our knowledge of tectonic trend and style on the Hellenic Outer Ridge. In addition it was intended to map the extent of features attributed to submarine salt solution, discovered by GLORIA in 1977 and looked at in detail by the Scripps Institution of Oceanography Deep Tow system in 1978.

2. If time allowed it was hoped to compare the Hellenic trench system west of Crete with that part of the system to the south of Crete surveyed by GLORIA in 1977. Parts of this area had been previously looked at by C.N.E.X.O. workers with their SEABEAM equipment, thus allowing comparative evaluation of the two techniques.

3. Opportunity would be taken to cross other geological features of interest during the passage to the U.K.

The Chemistry Programme

Sediment and pore water samples were to be obtained in order to examine the phenomena of sapropel formation and salt diffusion.

NARRATIVE

The ship sailed on time from Suez at 0600 on the 27th July. Attempts by the agents to delay sailing were effectively countered by the Master.

The auguries for the success of the cruise were not good. Permission for work had not been obtained for the territorial waters of Libya, Malta, Algeria, Spain and Portugal and we were expecting to spend some time in embarking and

disembarking a Greek observer. The scientific spares had not arrived in time. The ship's engines were giving trouble, with the insulation needing to be tested each day, which meant a half hours interruption to the GLORIA record.

Following the transit of the Suez Canal, and when clear of shipping, the equipment was launched at 2100 on the 27th. For the next 5 days we proceeded westwards covering new ground with GLORIA, 160 cu inch air gun, PES, hull mounted side-scan and, over the less disturbed ground on the Nile Cone, the 2KHz profiler. The proposed coring area, which had to be changed at the last minute at the request of the Italians in order to avoid submarine cables, was surveyed with GLORIA just before recovery.

Coring for the Chemistry Group was successfully accomplished in less time than expected, and so after 38 hours the geological programme was continued. GLORIA was launched at 1900 on 2nd August, after repair to a fault affecting the Port fixed gain record.

The equipment was recovered at 0700 on 8th August before passing through shallow Maltese waters, and the opportunity was taken to sample thin films on the sea surface and to test the pore water sampler. Geological work resumed at 2200 on 8th August when we reached Italian waters and proceeded until 0100 on 12th August, when all gear was switched off, until 1730 on the same day, for the passage through forbidden Spanish and Algerian waters. After working in the Alboran Sea on the Moroccan side the equipment was recovered at 0900 on 13th August prior to going into Gibraltar. The Engineering Superintendent joined ship and medical advice was sought for Captain Harding. Discovery sailed at 2000 on 13th August and the geophysical equipment was launched west of the Straits of Gibraltar at 0230 on 14th August. After the fourth successful recovery of the GLORIA vehicle at 0900 on 15th August, just south of the Moroccan-Spanish median line, passage was made to Barry. The ship docked on the morning of 19th August.

NOTES ON EQUIPMENT

Gloria

The weather conditions for the four launches and recoveries were excellent with the exception of the last recovery which was accomplished in a wind speed of 20 knots and with a fairly big swell running. The cable used was the same one as on

the previous cruise and at the end was still in good condition with only some superficial damage to the outer cover. Insulation resistance tests gave "as new" figures.

The 2 sec, 50 KHz bandwidth pulse was transmitted at 20 sec pulse repetition period all the time, except for about 8 hours when the 4 sec, 100 KHz bandwidth was transmitted at 40 sec pulse repetition period. Three transducer sections on each side were used for transmission, and for reception all six sections were used each side, to form beams which were stabilised at right angles to the smoothed vehicle heading. Towing speed was mainly between 9.5 and 10 knots, and vehicle yaw was not a problem at any time. Forty six magnetic tapes were recorded during a working time of 348 hrs, while the ship steamed 3337 miles at an average speed of 9.6 knots. Less than one hour of recording time was lost for equipment maintenance. The four channels on all tapes were successfully replayed and the resulting points photographed on the anamorphic camera.

J. Revie

Air-gun profiler

The general condition of the 3 air-guns at the start of the previous cruise had been far from satisfactory. A lot of time and trouble was spent in order to keep them running. Effectively only one air-gun was available at the start of Cruise 104, as spare parts ordered by radio had not arrived.

The air-guns were kept operating but with some difficulties. The tail fittings on the top chambers, which were worn and loose, had to be shimmed. One one occasion the gun was recovered with the tail detached and hanging on the cables.

The hydrophone and air-gun capstan and nos. 1 and 2 A.C. compressors operated well throughout the cruise.

R. Peters

Sonar platform

The hydraulic power pack could not be used continuously because of the high leakage rate of oil at the hydraulic motor end. It was used only occasionally to re-align the plates. The plates could apparently be rotated through their

full range of vertical angles but the positions indicated did not correspond to those set on the control wheels.

R. Edge

CHEMISTRY PROGRAMME

1. Coring

Previous attempts to sample the Eastern Mediterranean sapropels with the standard 4 inch IOS gravity corer were unsuccessful. It was considered that there was now a better chance of coring this important facies with currently available corers, i.e. the 30cm square box corer developed at IOS, and the commercial 15cm square box gravity corer (Kastenlot). The opportunity was also seen as a good test of the comparative sampling capabilities and handling properties of the corers.

The specific cruise objectives were:
i) to obtain samples of the most recent sapropel by corers designed to retrieve with minimal disturbance of the sedimentary column,
ii) to sample earlier sapropels from similarly undisturbed cores, both with a view to subsequent investigation of a number of geochemical parameters which might elucidate the origin of the sapropels. A secondary geochemical objective was to obtain pore waters by squeezing of core subsamples for comparison with the Mk II IOS in situ pore water sampler.

Site selection

Areas receiving direct terrigenous input or liable to secondary sediment redistribution due to gravity slumping or current resuspension and deposition were avoided as these were considered likely to have rapid sediment accumulation with possibly disturbed strata and deeply buried sapropels. Areas of protected high ground were sought where, at the worst, part of the sediment could have been lost by the winnowing effects of current erosion. In such areas there is a better probability that the original sedimentary sequences have been retained, with the sapropels remaining close to the surface.

The region finally chosen for sampling was in the Ionian Sea on the northern arm of the Hellenic Outer Ridge. The area was protected from external perturbations by a deep basin to the east, an abyssal basin to the west and north and the ridge system itself to the south. The actual area where core samples could be taken was considerably reduced by the national permissions received and the presence of forbidden regions containing telephone cables. A more detailed inspection of the resultant site revealed a fairly complex local topography with an average water depth of 3900-2950m. Attempts were made to select the tops and flanks of specific local high spots for sampling, within limitations imposed by the ship's navigational system.

Cores obtained and shipboard sampling

Two box cores (62cm and 61cm long) and two Kasten cores (74cm and 130cm long) were taken within an area of approximately one square mile. With the aid of the ship's track, narrow and wide beam echo sounders and a GLORIA record, the individual sample sites were described relative to the local topography. All four cores contained a sapropel layer at varying depths (22-28cm) and of varying thickness (6.5 - 73cm), three cores representing apparently undisturbed sediment columns, the remaining core showing a very complex mixing/slumping structure. No second or subsequent sapropel layer was found, the Kasten corer failing to penetrate the stiff glacial clay which underlay the first sapropel layer.

Three cores were immediately sub-sampled either for deep-freezing and subsequent chemical analysis or for the shipboard extraction of pore waters under hydraulic pressure at low temperatures.

R. Morris

2. Pore water sampler

Mk II pore water sampler lowerings were planned primarily as an instrument test series, with studies on salt diffusion and dissolved gas distribution within and around sapropel layers as secondary objectives. Five lowerings were made at the Hellenic Outer Ridge site. Unfortunately, no samples were returned due to a persistent malfunction of the high pressure release valve. A series of replacements and modifications were made in an effort to clear this problem. These were not effective, and after leaving the sampling site the trouble was

finally traced to extensive sea water penetration into joints of the wiring harness. After this had been rectified two further tests were made on which all valves functioned correctly. Unfortunately the bottom detection system, which had worked well on the earlier drops, pretripped on both these test lowerings due to a faulty amplifier. Consequently it was not possible to fulfil the primary objective of a complete successful system test, although considerable useful operating experience was gained. It is hoped that design improvements stemming from this experience will facilitate the planned application of the Mk II design as a major component of the sampling programme on forthcoming cruises.

R. Wilson

3. Collection of water for Standard Sea Water Service

Six hundred gallons of surface water were collected from a site in the SW of the Bay of Biscay. The ship's fire hydrant system was used, having been flushed for 2 hours immediately prior to the filling. Collection took place in the late evening while the ship was underway at 11 knots. The 12 gallon bottles used for storage were thoroughly rinsed with sea water, then completely filled and stoppered.

SCIENTIFIC RESULTS OF THE GEOLOGY PROGRAMME

A large area of new ground was surveyed with GLORIA at a relatively fast speed. A slight reduction in the quality of the sonographs was apparent where sonographs obtained at about 10 knots could be compared with earlier records obtained at between 6 and 8 knots. It was considered worth sacrificing some quality in the air-gun records as the broken nature of much of the ground is unsuitable for profiling and there is much published coverage already available.

It was confirmed that the style and intensity of deformation on the Hellenic Outer Ridge and the Hellenic trench system is similar to both the south and to the west of Crete. There is a broadly ridge parallel trend with transverse, possibly conjugate, fault trends. The patches of presumed salt karst are confined to the inner part of the ridge. Many areas of such small scale roughness were found on the steep slopes in the Hellenic trench system, and could be outcrops of evaporites.

Further evidence of gravity controlled faulting was observed on the Nile Cone. Graben systems in the Straits of Sicily and diapirism in the Balearic Basin and the Gulf of Cadiz were also seen.

Comparisons of data from areas surveyed with GLORIA, the Scripps deep tow system and the C.N.E.X.O. seabeam system confirmed the complementary nature of the three techniques.

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