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I.O.S.

RRS DISCOVERY CRUISE 111
LEG 1

21 JUNE - 3 JULY 1980

GLORIA SURVEY OF THE BLAKE-BAHAMA
OUTER RIDGES

CRUISE REPORT NO. 103

NATURAL ENVIRONMENT
INSTITUTE OF OCEANOGRAPHIC SCIENCES
RESEARCH COUNCIL

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Institute of Oceanographic Sciences
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ITINERARY

Leg 1 departed Balboa, Panama 21 June, 1980 Day 173
 arrived Halifax, Nova Scotia 3 July, 1980 Day 185

SCIENTIFIC PERSONNEL

R.B. Kidd	Principal Scientist	IOS Wormley
P.M. Hunter	Geophysics	IOS Wormley
J. Revie	GLORIA	IOS Wormley
R. Walker	GLORIA	IOS Wormley
C. Flewellen	SRP	IOS Wormley
A.W. Gray	Workshop	IOS Wormley
S. Jones	Gravimeter	RVS Barry
D. Jones	Computer	RVS Barry
J. Gardner	U.S. Visitor	USGS Marine Geology Menlo Park, California
A. Shor	U.S. Visitor	Lamont-Doherty Geological Observatory, New York

SHIP'S OFFICERS

P. Maw	Master
M. Bowen	Chief Officer
M. Putman	Second Officer
G. Harries	Third Officer
R. Bell	Radio Officer
R. Overton	Purser Catering Officer
C. Latter	Chief Engineer
G. Batten	Second Engineer
J. Landry	Third Engineer
B. Entwistle	Fourth Engineer
R. Cotter	Fifth Engineer
P. Sharpe	Chief Electrical Engineer
G. Gimber	Fifth Engineer/Electrical Engineer

CRUISE OBJECTIVES

The first leg of Discovery Cruise 111 was to have been primarily a transit leg from Balboa Panama to Halifax, Nova Scotia with little time allowed for underway geophysical profiling. However, the previous December (1979) the charter ship R.V. Starella, on passage from Jacksonville, Florida to San Juan, Puerto Rico had obtained a GLORIA survey track over the Bahama Outer Ridge. The large scale sedimentary bedforms observed on the resulting sonographs were impressive. Thus a second passage track with GLORIA and 2 kHz high resolution seismic profiling was planned for this Cruise 111 transit leg. Allowance was made for Discovery to arrive in Halifax one day later than originally planned and it was hoped that an early transit of the Panama Canal and fair weather on transit would provide time for a deviation to the Blake-Bahama Outer Ridge area.

On the survey area our objectives mainly involved mapping of sea bed morphology using GLORIA and interpretation of large scale sedimentary features through 2 kHz high-resolution and precision echosounder profiling, and later linking these to 3.5 kHz profiles of Lamont-Doherty Geological Observatory. The resulting zonation of bottom morphology would then be related to current flow in the Western Boundary Undercurrent which is believed to have constructed the Outer Ridges themselves.

NARRATIVE

R.R.S. Discovery left the dockside in Balboa, Panama at 1700/173 (21st June) to an offshore anchorage in order to join a shipping queue for transit of the Panama Canal. We began transit of the Canal at 2230 that day and eventually departed Colon the next morning (0900/174) with no underway gear deployed. Three days were taken up making as fast as possible a transit of the Caribbean Sea and Windward Passage on two engines power, still streaming no underway gear. An average speed of around 10 knots was maintained despite strong headwinds over the early part of the transit (Figure 1).

We arrived to the south of the Blake-Bahama survey area on 26th June (Day 178). The PES fish, GLORIA, the magnetometer and 2 kHz array were streamed between 1200 and 1300. Only an intermittent signal was obtainable from the 2 kHz array so it was recovered and replaced with a spare array between 1400 and 1500/178.

The first part of the survey traversed the southeast flank of the Bahama Outer Ridge. At 1628/179 a course change took us on a northwesterly course paralleling the existing GLORIA track obtained from R.V. Starella. Following another course change at 2218/179, we crossed to the southwest flank of the Blake Outer Ridge and then followed this around its southern tip and up the entire northwest flank to our end of survey point.

GLORIA was recovered between 1300/181 and course was set for a 3-engine transit to a point 120 nm SSE of Halifax. Thick fogs were reported and forecast for Nova Scotian waters and time in hand would be required when the ship reached this area. High resolution (2 kHz) seismic profiling continued at around 12 knots until a following sea and beam swell began to cause snatching of the cable along with a very noisy record. Thus the 2 kHz array was recovered at 1400/182.

The first thick fog was encountered at around 40°N and the ship returned to two engine power (day 183).

A course change at 1052/184 brought the ship onto a final heading for Halifax. At 1515/184 a ship's engine power failure occurred and the magnetometer was recovered. By 1530/184 the power was restored but the magnetometer was not restreamed. At 1915/184 the PES fish was recovered and all watches were terminated.

BLAKE-BAHAMA OUTER RIDGE SURVEY

The GLORIA and 2 kHz HRP survey of the Blake-Bahama Outer Ridge was planned to supplement a single R.V. Starella passage track which crossed the northern flank of the Bahama Ridge and continued southeastwards towards Puerto Rico. Three days of survey were completed (1200/178 to 1300/181). The survey (Figure 2) investigated sea bed morphology over:

- 1) the area around $25^{\circ}\text{N}/70^{\circ}30'\text{W}$
- 2) the southeast flank of the Bahama Outer Ridge
- 3) a short track along the northeast flank of the Bahama Ridge paralleling the earlier "Starella" track
- 4) a crossing of the intervening trough to the Blake Outer Ridge
- 5) a transit following the southwest and northeast flank of the Blake Ridge

The first area studied was reputed from previous seismic reflection profiling studies to be an area of broad basement highs and outcrop of the widespread seismic

reflector Horizon B. Our HRP profiling shows wide areas of erosion with little soft sediment cover. The GLORIA sonographs to 2100/188 (point 13) show a block-faulted topography displaying two primary trends at 048° and 130° . Most of this relief ranges over 100 metres or less, however isolated hills rise to 200 metres, or even 650 metres, above the surrounding topography.

From Point B to 0000/179 a sediment wave field was encountered with a trend 070° and wave heights about 10 to 30 metres; wavelength about 3 km. No furrows were seen on GLORIA but strong hyperbolae were seen on the 2 kHz profiles.

Between 0000/179 and 0001/179 another small area of fault block topography was encountered. The 2 kHz records show a relief of 150m and a central graben within which is a sediment penetration of around 100 metres.

An abrupt change occurs at 0030/179 into sediment wave fields which continue onto the southeast flank of the Bahama Outer Ridge. Initially two sets are apparent at 80° and 150° up to Point C, and continue to 0600/179. Wave heights vary between 10 and 20 metres; wave migration is upslope and wave length about 3 km.

A strong 160° trend takes over between 0600 and 1100/179. Wave heights of 5 to 20 metres are prevalent here, wave lengths are 2 km and migration is still upslope. At 0800/179 we picked up the first indications of the crestal areas of Bahama Ridge, which change trend from 050° to 020° by 1400/179, on the port side of the ship's track.

At around $27^{\circ}45'N$ and $75^{\circ}45'W$, where the 'Starella' and 'Discovery' surveys cross, it is clear that the crestal GLORIA targets of the Bahama Ridge can be traced from one set of sonographs to the other.

Where our track turned to parallel the 'Starella' survey the major sediment wave trends swing round and parallel the changes in the Bahama Ridge crestal trends. At about 2100/179 to 0200/180 a secondary trend of 170° became evident which seems to correlate with some broad large scale topography on the profiles along track. These trends cross the intervening areas between the two Outer Ridges. Viewed from both sides the crestal areas here appear to curve around southwestwards as the slope of the ridge is approached. On the starboard side of our track from about 1630 to 2100/179 furrows are visible trending approximately 160° .

Along the southwest flank of Blake Outer Ridge only a minor random 000° trend is

evident and around the 'nose' of the ridge. Along the northeastern flank of the Blake Ridge appear the most striking sediment bedforms encountered in this survey.

Between Points J (1230/180) and K (0450/181) the dominant wave trend is 160° paralleling the ridge crest. Two conjugate sets are also present at 090° and 010° . Wave heights along track vary from 5 to 15 metres, wavelengths are 2-3 km but wave migration is unclear at this stage.

The last part of the survey was from Point K to Point L (1300/181). Near K the previous 160° trending sediment waves continue following the crestral trend and a second set of 070° becomes more important northwards. The profiles along track show a subdued topography, but isolated hills on the 070° trend rise 100 metres above the surrounding ridge area.

R.B.K.

EQUIPMENT REPORTS

GLORIA

The Gloria vehicle was launched at 1220 GMT on day 178 at a point 60 miles due east of San Salvador Island in the Bahamas. The Blake Bahama Outer Ridge survey was completed in a period of 72 hours and the vehicle was recovered at 1248 on day 181. The weather was good throughout the survey and a speed of 10 to 10.5 knots was maintained.

The 4 second, 100 Hz pulse was transmitted at 40 second pulse repetition period and echoes were received to near maximum range for most of the time. The vehicle ran at a depth of 100 to 105 feet and for a short time there was evidence of the enhanced signal return region immediately before the shadow zone, as had been noted previously on Cruise 110.

Ten magnetic tapes were recorded and the only loss of recording time was a break of half an hour caused by a fault in the power amplifier battery charger.

J.R.

2 kHz HIGH RESOLUTION PROFILER

The 2 kHz HRP system (with its hull mounted transducers and towed short hydrophone array) was used to considerable effect on the survey of the Blake-Bahama

Outer Ridges. When the first (older) array was paid out between 1200 and 1300/178 it was found to have an intermittent fault. The second array was deployed at 1400/178 but was then brought in about 100m to try to cut down 'pick-up' from GLORIA. However, this produced no improvement. The interference is thought to be caused by harmonics of the non-linear mixing of GLORIA's port and starboard transmissions, and this remained as a background signal on all the profiles recorded. Nevertheless, the records proved invaluable in determining sediment wave migration history on the survey area.

One power amplifier suffered an over-temperature fault and was replaced by a spare.

C.F. R.B.K.

36 kHz SIDESCAN SONAR

The medium range sidescan was used in its vertical mode over most of the Blake Bahama Outer Ridge survey as a narrow beam echo-sounder. This was with a view to possibly being able to resolve sea-floor morphology over areas that would cause hyperbolae on the 10 kHz PES. It did not prove useful, however, because the depths involved on the survey area (4000-5000m) were close to or beyond its working range and the soft sea-floor gave a generally faint echo.

At the end of the survey the MUFAX recorder failed. Components in the helix motor drive circuit and its power supply were replaced.

C.F. R.B.K.

MAGNETOMETER

The Varian V75 magnetometer was towed from 1200/178 to 1600/184 and performed reasonably well. However, the magnetometer recorder requires better ventilation. The present system of drawing the unit out of its case is considered rather unprofessional. Fans should be fitted to the rear of the unit circuit and dust filters fitted. Connectors gave a problem initially, and this type of connector needs replacing if the magnetometer is to be used intermittently during a cruise since connecting and disconnecting of the magnetometer many times, causes severe wear on the small pins and fine thread. The connector is also susceptible to corrosion.

Drying out of the servo-scribe pens was a recurring nuisance, perhaps 0.1 pens would prove to be better than the 0.03 pens presently used.

S.J.

GRAVIMETER

Because of problems on previous cruises, the S84 gravimeter was logged intermittently throughout the cruise. No land meter was available for a base tie-in at Panama but previous readings at a berth approximately half a mile away indicated low drift. The gravimeter performed satisfactorily during the cruise, the only trouble being in the IBM 1800 interface. The fault was rectified and gravity was logged throughout the Blake Bahama Outer Ridge survey. There is no air-conditioning in the gravity room at present. The existing 'Voyager' unit has to be isolated in order to provide sufficient circulation for units in other shipboard laboratories. If the ship returns to the tropics it will be necessary to install an efficient unit in the gravimeter room.

S.J.

SHIPBOARD COMPUTER AND NAVIGATION

IBM 1800 - No computer faults were experienced, except for an inexplicable event on DISC DRIVE (1). The disk drive indicated an off-line condition, requiring a system re-start. On testing the disk with DMP (Disc Management Programme) the disk was successfully written to and read from. The original disc on drive (1) was copied to a back-up and no further faults occurred.

Plotter 1627 - The plotter worked reasonably well throughout the cruise. It is however in need of a major overhaul since its bearings are loose on the carriage drive. Adjustment of the carriage scale factor was carried out. The drive cord was over-stretched and a new tension spring is required.

MX702/HP2100 Satellite Navigation System - The satellite navigator was reported by previous cruise participants as faulty. A major problem has been overheating. The Chief Engineer and Workshop Technician manufactured a priming plug to re-charge the Freon gas of the air-conditioner. The overheating, however, has caused a number of components on the receiver to become unreliable, particularly the automatic acquisition system. The satellite navigation system required almost constant attention during this cruise in order to maintain reliable track data.

TABLE 1 - Periods During Which Underway Equipment was Used

<u>EQUIPMENT</u>	<u>FROM</u>	<u>TO</u>	<u>DAYS</u>
Echo-sounding Fish	1258/178	1900/184	6 $\frac{1}{2}$
Gravimeter	0900/174	1900/184	10
Magnetometer	1542/178	1515/184	6
2 kHz Profiler	1700/178	1400/182	4
36 kHz Sidescan (vertical mode)	1140/178	0140/181	3
GLORIA	1200/178	1300/181	3



