

I.O.S.

MV FARNELLA

CRUISE 5

2 - 19 JANUARY 1982

**MORPHOLOGICAL STUDIES OF THE
AMAZON CONE AND BARBADOS OUTER RIDGE**

CRUISE REPORT NO. 151

1983

**NATURAL ENVIRONMENT
INSTITUTE OF OCEANOGRAPHIC SCIENCES
RESEARCH COUNCIL**

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INSTITUTE OF OCEANOGRAPHIC SCIENCES

WORMLEY

MV FARNELLA

Cruise 5

2 - 19 January 1982

Morphological studies of the
Amazon Cone and Barbados Outer Ridge

Principal Scientists

R.H. Belderson and J.E. Damuth

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ITINERARY

Departed Belem (Brazil) 1800 GMT, 2nd January 1982

Arrived Bridgetown (Barbados) 1300 GMT, 19th January 1982.

SCIENTIFIC PERSONNEL

R.H. Belderson	(Geology)	Co-Principal Scientist	IOS
J.M. Campbell	(GLORIA)		"
E.B. Cooper	(Computer)		RVS
J.E. Damuth	(Geology)	Co-Principal Scientist	LDGO
G. Dias	"		UFRJ
C.G. Flewellen	(Profiling)		IOS
R.D. Flood	(Geology)		LDGO
M.A. Gorini	"		UFRJ
G. Griep	"		"
V. Kolla	"		LDGO
R.O. Kowsmann	"		CENPES/PETROBRAS
M.C. Monteiro	"		"
J.J.C. Palma	"		DNPM
R.A. Phipps	(Profiling)		IOS
J. Revie	(GLORIA)		"
Ms S. Sichel	(Geology)		UFRJ
Mrs J.M. Weller	(GLORIA)		IOS

LDGO - Lamont-Doherty Geological Observatory of Columbia University

CENPES - Centro de Pesquisas e Desenvolvimento Leopoldo A. Miguez de Mello

UFRJ - Universidade Federal do Rio de Janeiro

DNPM - Departamento Nacional da Produção Mineral, Brazil

CRUISE OBJECTIVES

1. The main objective was to make a long-range side scan sonar study of the morphology of the Amazon Cone, and in particular the distributory channel patterns on the middle and upper fan.
2. A secondary objective was to investigate the southernmost part of the tectonically deformed Barbados Outer Ridge using long-range side scan sonar.

NARRATIVE (all times are GMT)

Following a delay of four days due to a compressor fault, FARNELLA sailed from Belem at 1800/2nd January. A course was set for the head of the Amazon Canyon and the PES fish launched and PES switched on at 1300/3rd January. The GLORIA vehicle was launched at 0245 and the air-gun (40 cu inch) and hydrophone streamed at 0315/4th January in the head of the Amazon Canyon at 03°15'N, 48°26'W, and the GLORIA and air-gun survey of the Amazon Cone commenced. Apart from breaks in the air-gun recording between 1000 and 1400/7th January and 1600 and 2000/13th January due to air-leaks, the survey proceeded uninterrupted until its completion. Due to restrictions imposed by the thermal structure of the water GLORIA was used to cover a 15km swathe of sea floor to each side, apart from a track to the lower fan and back which was run at the range of 30km each side. Total GLORIA coverage on the Amazon Cone is shown on Figure 1.

An event of note took place at 1000/15th January when we sighted and passed close by a French yacht on passage from Dakar to Cayenne towing a windsurfer. Conversation on the r.t. informed us that this was to be the first windsurfer crossing of the Atlantic.

At 1900/15th January (05°46'N, 49°15'W) GLORIA, PES fish, air-gun and hydrophone were recovered and course set for the start of the Barbados Outer Ridge survey. This passage was made at the maximum speed possible of about 12 knots - governed by the temperature of the sump oil in the ship's engines which is sea-water cooled.

At 1830/17th January (10°22'N, 57°51'W) the PES fish was launched, followed by the GLORIA vehicle, and transmitting and recording on the Barbados Outer

Ridge survey was underway by 1915.

After a zig-zag track of three legs using GLORIA at the 15km range each side, (Figure 2) the survey was concluded at 2000/18th January (11°16'N, 58°33'W) and the GLORIA vehicle and PES fish recovered. FARNELLA then headed for Bridgetown, Barbados, where she tied up alongside at 1300/19th January.

SUMMARY OF RESULTS

Most of the leveed channel system on the middle part of the Amazon deep-sea fan was mapped with GLORIA. The most striking channel characteristic is their high degree of sinuosity that results in extensive, intricate, often recurring meanders. Cutoffs and abandoned meander loops (oxbows) were observed in several places. Individual channels were continuously traced for distances of up to 150km. Channel bifurcation, although rarely observed, seems to result mainly from breaching of channel levees on the outside of meander loops. Whether both channels remain active for a while after branching or the original channel is abandoned by avulsion could not be determined on available data. These meandering channels are comparable in size and appearance to those of mature fluvial systems on land, such as the lower Mississippi River.

The seismic reflection (air-gun) profiles together with the GLORIA sonographs reveal the relative age-relationships between the major distributary channels of the upper and middle fan. These age relationships suggest that the fan grows through formation of a succession of broad levee complexes, each of which consists of several individual leveed distributary channels whose levee systems overlap or coalesce with one another. Only one channel is apparently active at any given time on an actively growing levee complex. Eventually this channel is abandoned, probably through avulsion, and a new channel and associated levee system form nearby, thereby enlarging the levee complex. Occasionally, the formation of a new channel will cause the present levee complex to be abandoned with the initiation of a new levee complex at a different location. In this manner a succession of overlapping levee complexes is formed through time, and the fan grows upward as well as radially outward downslope.

The Barbados Outer Ridge survey was designed to extend the survey undertaken during 1980 to cover the southernmost part of the Outer Ridge. The anticlines

and synclines of the deformed sediment pile were well observed by GLORIA, as were mud-volcanoes similar to those mapped further north during the earlier survey. Strong acoustic backscatter from many of the axes of the synclines suggests that terrigenous sediment originating from the Orinoco River finds its way down these axes to be deposited within the Barbados Outer Ridge (syn-orogenic deposition). In contrast, some Orinoco sediment passes along a deep-sea channel observed by GLORIA just east of the deformation front (pre-orogenic deposition).

EQUIPMENT REPORTS

GLORIA

The GLORIA vehicle was launched in quiet conditions at 0245/4th January and recovered at the end of the Amazon Cone survey at 1900/15th January. The 2 second pulse at 20 second pulse repetition period was used except for one period of 24 hours from 0800/5th January to 0800/6th January when the 4 second pulse was transmitted at 40 second intervals during a deeper-water leg of the survey (lower fan). 36 FM tapes and 7 digital tapes were recorded during the 280 hours of this part of the operation. No recording time was lost and the only problem with the equipment was in the vehicle heading display, where a defective servo amplifier was replaced on 14th January. However, this did not affect the sonar performance.

The Barbados Outer Ridge survey was completed between 1845/17th January and 2000/18th January still using the 2 second pulse and 20 second repetition period. A further 4 FM tapes and one digital tape were recorded.

J. Revie

SEISMIC REFLECTION PROFILING

Twelve days worth of two-channel SRP data were recorded on 44 digital tapes while being displayed on a Raytheon and two EPC line-scan recorders. During the remainder of the cruise tapes were replayed at both four and eight seconds as a service to various cruise participants. It became evident, as the replaying progressed, that the digitiser sampling-clock had been unstable when the data was

logged, and there was therefore a small amount of irremovable jitter marring otherwise good records.

Keeping EPC recorders free from mis-triggering and line-pairing was a major frustration. Later on, as time permitted, further copies were made of sections of record spoiled by recorder idiosyncracies.

C.G. Flewelling

SHIPBORNE COMPUTING

The logging system (PDP 11/04/CAMAC) was used to sample navigation parameters provided by the EM Log, Gyro and Satellite Navigator. The only other parameter required for processing was depth, and this was entered via the keyboard.

A problem was encountered at the start of the leg on the processing system (PDP 11/34). Once this initialization problem was overcome all the processing was accomplished with little difficulty.

Daily navigation back charts were produced for the duration of the cruise and plots of bathymetry at 1:1M at the end of the cruise.

E.B. Cooper

COMPRESSORS

There were no mechanical problems with the compressors, but the humid atmosphere caused the contacts to corrode which resulted in several small electrical problems. Because relatively small (40cu inch) air guns were in use, it was possible to rectify the faults before the reservoir bottle ran out of air. This meant that there was no resultant break in air-gun firing.

R.A. Phipps

FIGURE 1.

GLORIA coverage on the Amazon Cone.

FIGURE 2.

GLORIA coverage on the Barbados Outer Ridge, location of Fig. 1, and remaining ship's tracks.



