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13 MAR 1991

IOC/INF-846
Paris, 25 February 1991
English only

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

FIRST IOCEA CRUISE IN THE GULF OF GUINEA ON HYDRODYNAMICS AND SEDIMENTOLOGY OF THE SHALLOW CONTINENTAL SHELF
(10-25 October 1989)

DRAFT REPORT

This document was prepared by the IOC Secretariat based on the final cruise report produced by:

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as well as on other reports and documents transmitted to IOC by various participants in the cruise.

SC-91/CONF/212/COL/21

TABLE OF CONTENTS

Page

TABLES

FIGURES

CHARTS

ANNEXES

INTRODUCTION

Following the First Session of the IOC Regional Committee for the Central Eastern Atlantic (IOCEA) held in Praia, Cape Verde, 19-23 January 1987, and in accordance with the recommendation of the IOC Assembly at its Fourteenth Session (Paris, 17 March - 1st April 1987) regarding the Joint IOC-UN (OALOS) programme of Ocean Science in relation to Non-Living Resources (OSNLR), a Consultation Meeting of Experts on the development of OSNLR in the IOCEA region was held in Abidjan, Cote d'Ivoire (2-5 November 1988).

The main objective of the consultation meeting was to establish a mechanism to develop the research capabilities of participating countries, as recommended by the Regional Committee and endorsed by the IOC Assembly. The Consultation Meeting prepared a plan of Action for the implementation of the regional component of OSNLR. The project proposal "Sediment Budget along the West African Coast" was prepared during the meeting and endorsed by the IOC Assembly at its Fifteenth Session (Paris, 4-19 July 1989).

This proposal was made in order to focus research of the Regional Component on Coastal Erosion which is a major problem that most of the West African coastal states have to face. The proposed Plan of Action consists of the integrated study of sedimentary fluxes on the Continental Shelf from the Bight of Benin in Nigeria to Morocco. It includes two sub-projects:
(i) Sediment flux of rivers reaching the coast, and (ii) Hydrodynamics and sedimentology of the shallow continental shelf.

It was recommended to set up a Group of Experts from the region to organize the networks responsible for carrying out the above-mentioned projects. In pursuance of sub-project (ii) a cruise was planned in the Gulf of Guinea to study the hydrodynamic forces which play very important roles in coastal erosion. Research vessel SARKIM BAKA was offered by Nigeria and researchers from the various Member States of the IOCEA region participated in the cruise which took place on 10 - 25 October 1989.

1. BACKGROUND OF THE CRUISE: THE PLAN OF ACTION FOR THE DEVELOPMENT OF OSNLR IN THE IOCEA REGION

1.1 BACKGROUND

At the OSNLR Consultation Meeting in Abidjan (2-5 November 1988), discussions on coastal erosion concentrated on the need to provide a scientific basis for long-term and large scale coastal management and protection within the IOCEA region. Understanding of these phenomena implies that coastal evolution should be examined in terms of a continental shelf. A project entitled "Sediment Budget along the African Coast" was prepared in Abidjan meeting and then endorsed by the IOC Assembly at its Fifteenth Session (Paris, 4-19 July 1989). Expected outputs and inputs from the projected Action Plan were described as follows:

1.1.1 **Expected outputs**

The proposed project will have the following outputs:

(i) a denser network of research institutes and coastal observatories, who accepted to participate to obtain adequate information on:
- coastal erosion
- the geological nature of superficial deposit of the shelf
- river inputs into the ocean
- physical oceanography of the shelf: data on currents, waves, suspended material, and
- a regional sedimentary budget.

(ii) local experts trained to operate the sub-regional physical oceanography measurements required for the development of the project and associated methods.

1.2.1 **Expected inputs**

Based on a three-year project duration, the following inputs and facilities are required from participating countries:

(i) identification of sites representing key research areas for studying coastal sand erosion facilities such as suitable laboratories for analysis;

(ii) staff for measurement and/or sampling on the coastline (river discharge, coastal evolution, effects of waves on the shoreline) and on board (physical oceanography, sedimentology).

(iii)use of research or local fishing vessels, or those of the respective Port Authorities or Navy, for oceanographic measurements and sampling of the continental shelf.

1.2 THE PLAN OF ACTION FOR THE DEVELOPMENT OF OSNLR IN IOCEA

The project "Sediment budget along the west african coast" was presented in two forms:

1.2.1 **A study of the sedimentary fluxes from the continent to the coastal zone.**

This study will include the evolution of the coastline and beaches in relation to the fluviatile fluxes and evolution of these fluxes due to the damming of rivers. It was decided that the study will be developed on a national basis by researchers in each Member State of the region. Data to be collected are:

(i) Continental Fluxes to the Ocean. River discharges to the Ocean (of water and particulate matter) will be studied by measuring fluxes over different seasons. Available data concerning historical variations in water discharge and that of suspended materials (SM) will be collected and studied in comparison with data collected following damming of the rivers and/or recent climatic changes.

(ii) Satellite Imagery or Aerial Photography of the Shoreline and Continental

Shelf will provide essential information on the nature and location of river inputs to the ocean, the behavior of their related plumes over the continental shelf, the short-term evolution of coastline and areas of upwelling etc. These data and other observations could serve as a guide for other physical measurements on the shelf.

1.2.2 A study of sedimentary dynamics of the shelf of the bay of Benin

In relation to this objective, it was proposed at the Consultation Meeting in Abidjan that co-operative cruises on African ships would be organized with the participation of scientists of the various Member States of the Region. The first, covering the Gulf of Guinea sector, slated for the last quarter of 1989, was made possible by the offer from Nigeria to provide its Oceanographic Research Vessel, R.V. SARKIM BAKA. This offer welcomed in the Abidjan meeting, was then endorsed by the Guiding Group of Experts on OSNLR at its Third Session (Bordeaux, 21-25 February 1989). The Group strongly recommended IOC to seek ways and means to assist regional co-ordinator and a regional Group of Experts in the implementation of the planned cruise.

The ultimate objective should be to develop research capabilities of participating countries for the integrated and rational management of the coastal zone. The immediate targets should be: i) to provide training and experience in the observation and in situ measurements of hydrodynamics, ii) to obtain data on physical oceanographic processes, bathymetry and bottom topography, and geology of the continental shelf, iii) to produce a report integrating all data obtained from the cruise and relating them to the problem of coastal erosion in the region and sediment budget along the West African Coast.

At the Abidjan Meeting, it was decided that such objectives would be implemented through several IOCEA sea cruises undertaken in common. The first phase of this Plan took place from 10-25 October 1989, in the Gulf of Guinea on board Nigeria's research vessel SARKIM BAKA. The adopted specific theme for the cruise was "Hydrodynamics and sedimentology of the shallow continental shelf".

2. THE FIRST IOCEA COMMUNAL SEA CRUISE IN THE GULF OF GUINEA

2.1 GENERAL OVERVIEW ON THE CRUISE

The IOCEA Communal Sea cruise in the Gulf of Guinea on board the Research Vessel SARKIM BAKA of the Nigerian Institute for Oceanography and Marine Research officially took off on 10th October 1989.

The research vessel sailed out of the NIOMR's jetty at about 16.00 hrs local time after a flag off ceremony performed by the Director of the Institute Mr. J. G. Tobor and watched by a crowd that included journalists from the electronic and print media. Discussions had been held earlier on land about the scientific objectives of, and logistic for, the trip.

The following were on board:

1.	Mr. L. F. AWOSIKA -	Scientist and Cruise Leader	- Nigeria
2.	Mr. E. O. OYEWO -	Scientist	- Nigeria
3.	Mr. Chijoke IBE -	Scientist	- Nigeria
4.	Mr. S. AGBOGA -	Lab. Technologist	- Nigeria
5.	Mr. R. G. JOHNSON -	Scientist	- Sierra Leone
6.	Mr. Barry SADOU -	Scientist	- Guinea
7.	Mr. Abe JACQUES -	Scientist	- Côte d'Ivoire
8.	Mr. Aka KOUAME -	Scientist	- Côte d'Ivoire
9.	Mr. L. G. YOBA -	Scientist	- Congo Republic
10.	Mr. Malang BARROW -	Scientist	- Gambia
11.	Mr. A. B. BLIVI -	Scientist	- Togo

(Joined the Group on 12 October 1989)

12.	Lt. Moses JARUMAI	-	Nigerian Navy (Diving Supervisor)
13.	Mr. Julius GAMBA	-	Nigerian Navy (Diver)
14.	Mr. Dominic EZECHIMA	-	Nigerian Navy (Diver)

Also on board were twelve crew members who were part of the normal crew of "SARKIM BAKA".

A day-to-day account of activities undertaken on-board is given in Annex I. However a summary of their activities is given below:

During this 15-day sea cruise in the Gulf of Guinea between Long. 4°00.00"E (east of Lagos) and Long 8°00.00"W (the western boundary of Côte d'Ivoire) - the Scientists on board made the following measurement for data collection:

(i) A total of 68 stations were occupied for bottom sediment sampling while 31 stations were occupied for water sampling.

(ii) Two stations (One off the Avon Canyon east of Lagos long. 03° 51 81"E and Lat. 6°22 00"N) and the other of the Trou Sans Fond in Abidjan (Long 4° 01 29"W and Lat. 5°13 95"N) were occupied for current metering lasting 13 hours each.

(iii) Five stations were occupied for diving expeditions and XBT launches.

(iv) A total of 37 established lines of profiles (every degree longitude and cross-cutting lines) were sounded by bathymetry and bottom configuration.

(v) Oceanographic, meteorological and other hydrodynamic data were collected at every 20 minutes for a total of 15 days.

On the 25th October 1989, SARKIM BAKA and the scientists returned to Lagos, the dual objectives of the cruise -data gathering and on board training having been achieved.

2.2 OPERATIONAL PROCEDURES

2.2.1 Vessel

NIOMR's oceanographic research vessel R/V SARKIM BAKA is 42.00m long with a gross tonnage of 272 tons and a draft of 2.90m (fig.). The vessel has on board an echo sounder with a sounding range of 0-480m, colour echo sounder, gyro compass, satellite positioning system with course plotter, direction finder, expendable bathythermograph, hydrographic winch and weather facsimile.

2.2.2 Positioning

The satellite positioning system on board was used to position the vessel. Satellite fixes were used to update positions and make necessary corrections. Also conventional positioning system of compass bearing (Gyro and Conventional) was used to check vessel position in order to minimize error. A course plotter on board was used to plot tracks of the vessel.

2.2.3 Bathymetry

Nine longitudinal strike lines of profiles (lines 3-29) were established on a working map of scale 35 000 000 (Fig.2). Another 27 lines, some running parallel to the coast line and others running diagonal to the coastline were also established on the working map. Soundings were undertaken along these lines of profiles in minimum water depth of 20 meters and maximum of 500 meters of water. Along these sounding lines event marks were made at every 20 minutes. At the end of every profile a hard copy of the continuous profile was obtained from the echosounder.

2.2.4 Sediment and water sampling

Bottom sediment samples (table 1) were taken with a grab and phleger corer at water depths of 25m, 50m, 75m 100m and 125m. Water samples (table 2) using Nansen bottles were taken at the surface and depths of 10m, 20m, 30m, 50m, 100m and 125m.

2.2.5 Current metering (fig. 11 to 14)

At two stations, one off the Avon canyon (east of Lagos, longitude 03°.51'81"E and latitude 6°232.06"N in 20 meters of water) and the second off West of the Trou Sans Fond in Abidjan (Longitude 4°01'22"W and latitude 5°13'.95"N), current magnitude, direction, barometric pressure and wind data were collected for 13 hrs. at each station. For the current data, measurements were taken at near surface, mid depth and near bottom for 13 hours at each station.

2.2.6 Diving expeditions (Annex II)

Five stations were occupied for diving expeditions. At each diving station the vessel was anchored, and the skiff boat was used to take the divers out to the diving stations which were generally very near the mother vessel. Photographs of the bottom as well as bottom samples were taken at each station.

2.2.7 Expendable Bathythermograph (fig. 5 to 9)

For XBT launches the vessel steamed out to 500 meters of water where XBT probes were launched. Five stations were occupied for XBT.

2.2.8 Oceanographic and Meteorological data

Oceanographic and Meteorological data e.g. Air and Sea temperature (fig. 4) wind velocity and direction, barometric pressure, etc. were measured routinely at every 20 minutes interval during the survey. The sea state was visually observed regularly.

2.2.9 Data analysis

During the survey, some water samples were analyzed on board, the results of which were cross-checked in the laboratory. Water samples were analyzed for salinity, density, dissolved oxygen and suspended sediment. The echograms obtained were also interpreted and depth data obtained were used to produce a bathymetric chart of the survey area. (Charts 1 and 2). Granulometric analysis of bottom sediments was also carried out. All analysis done so far were done at the laboratory of the Nigerian Institute for Oceanography and Marine Research, Lagos.

3. DATA PRESENTATION

3.1 BATHYMETRY AND BOTTOM MORPHOLOGY

Analysis of echograms from the study area has resulted in the categorization of the continental shelf into the following zones:

(i)	Inner Continental shelf	0-45 m
(ii)	Middle Continental shelf	45-85 m
(iii)	Outer continental shelf	85-110 m

(i) The bathymetry of the inner continental shelf runs generally parallel to the coastline all along the survey area. Pockets of sand bars running mostly parallel to the coastline were found within the inner continental shelf. Prominent areas of their occurrence are off the east coast of Lagos, Benin, Togo and the Côte d'Ivoire. Bottom topography here is mainly undulating with sand ridges. These sand ridges consist of mostly coarse to medium sand. However rocky bottom was encountered off Cape Three Points and Tema in Ghana.

The inner continental shelf is narrowest off Cape Three Points and east of Abidjan with a width of about 6km. The widest part of the inner continental shelf exists between east of Cape Three Points and Sekondi around long. 1 00'.00"W averaging about 50km.

(ii) The middle continental shelf is mainly undulating and narrower than the inner continental shelf being widest off Sassandra and east of Takoradi averaging about 45 km around longitude 2°.30'.00"W.

Pockets of dead Holocene coral banks occur around depths of 55m and 80-95 meters especially off Nigeria and Benin. These coral reefs are sometimes as high as seven meters (Fig. 3).

The middle continental shelf is incised by two major canyons, Avon Canyon off Lekki east of Lagos in Nigeria and Trou Sans Fond off Abidjan, Côte d'Ivoire.

Avon Canyon is approximately between longitude 3° 43'00"E and longitude 3°.51'00"E and around latitude 6°.11'00"N. It is a V-shaped canyon with the head only a few kilometers from the coastline. The western side of the canyon has a more gradual slope than the east. At depths of about 80m the walls drop abruptly to below 500m.

The Trou Sans Fond Canyon is located around longitude 4°5'.00"W. It is also a V-shaped canyon with its head in water depths of 25- 30 m and the 100 m contour running almost perpendicular to the coastline.

(iii) The outer continental shelf is the narrowest with a very steep slope. It is mostly undulating and spiky in some areas especially off Badagry in Nigeria, Benin, Togo and Ghana. The outer shelf appears as steps with gullies especially off Badagry in Nigeria, Benin and Côte d'Ivoire. At a general depth of 100-120 meters the outer shelf drops rather abruptly to the slope. The gullies which incise the outer shelf continue down the slope.

3.2 BOTTOM SEDIMENTS (Table 1)

Bottom sediments collected from the survey range from coarse sand size in the inner shelf and grade into fine sand to dark grey mud in the outer continental shelf.

The sediments from the shelf off Ghana are mostly dark grey, calcareous, with aggregates of coarse to medium sized sand. Analysis of the sand size fraction of the bottom sediments collected reveal the gradation of coarse to medium sand from the inner continental shelf to the outer shelf off Benin Republic. However a greater part of the sediment from the middle to outer shelf are calcareous.

3.3 WATER TEMPERATURE (Table 2)

Details of the distribution of sea water temperature in the area are contained in the Table 2 and the XBT recordings (Figs 5 to 9). The pattern off the coasts of Togo, Benin and Ghana is characterized by a wind mixed surface (0-20m) where conditions are almost isothermal. The thermocline occurs between the 20m and 90m isobaths. In sub-thermocline waters, there is a gradual decrease in temperature with depth up to about 500m which was the deepest limit in this survey.

Off of the coast of Côte d'Ivoire especially in the western extremity, the thermocline has virtually shoaled to the surface (as clearly shown in the XBT recordings) and around the Trou Sans Fond Canyon includes a broader range of temperature.

In addition, the XBT recordings off Côte d'Ivoire reveal the existence of a secondary thermocline, between the 240m and 300m isobaths. This picture is however not necessarily permanent and should be interpreted against the established dominance of an annual cycle in the region. For example, in earlier surveys carried out by the Nigerian Institute for Oceanography and

Marine Research in Nigerian coastal waters, the secondary thermocline that was observed at some stations in July 1987 had broken down in September 1988 even though the primary thermocline was still intact. The observations during this cruise are therefore probably only true for the time of the year when they were made.

3.4 SALINITY (Table 2)

Salinity in the study area was generally uniform with most of the surface and sub-surface values in the range 34-35.5 ppt.

This conforms with a priori expectations. Furthermore, the Guinean Trawling survey had earlier established that surface waters in the Gulf of Guinea are warm and of low salinity (T > 24° C, S< 35ppt). The only low attributable to the influx of fresh water.

3.5 DENSITY

The computed t values obtained from temperature and salinity data only are shown in table 2. As a general rule density increased with depths. The few apparent density anomalies are due probably to instrument error.

3.6 DISSOLVED OXYGEN (table 2 and fig. 10)

Most of the measurements were geared towards the practical training of participants. The values obtained at three stations however are shown in table 2. The surface waters are expectedly well oxygenated (Fig. 10).

3.7 CURRENT VELOCITY AND DIRECTION

Two stations Cm1 and Cm2 (one off the Avon Canyon east of Lagos and the other off the Trou Sans Fond off Abidjan) were occupied for current metering lasting 13 hours each.

3.7.1 Station 1 (Figs. 11 and 12)

This station is located around long.03°51'81"E and lat. 06 22'00"N in about 20 meters of water. Current metering was done at three different depths (near surface-1m, mid depths-9.5 meters and near bottom 19-19.5m) for 13 hrs.

Near surface current velocities (12.00 hrs. of 11-10-89 to 01.00 hrs. of 12-10-89 at every 30 minutes interval) ranged between 0.3m/s to 0.55m/s. The current direction was dominantly north-easterly. The near surface current is predominantly influenced by wind force as can be seen in figs. 9 and 10.

Mid-depth current velocities ranged between 0.05 m/s to 0.15m/s at low tide with a northeasterly direction. During the high tide current velocity is in an easterly direction. Near bottom current velocity again ranged between 0.05 m/s to 0.15 m/s with the maximum 0.15 m/s current velocity persisting for only 3 hours 30 minutes within the 13 hours period.

The dominant current direction for station 1 was generally north-easterly almost parallel to the strike of Avon canyon. The significance of this is that sediments are carried by the currents along the strike of the Canyon. The presence of the Avon Canyon east of Lagos acts as a chute down

which all the sediment from shore carried both by wave and tide generated currents are lost.

3.7.2 Station 2 (Figs. 13 and 14)

This station located just off the Trou Sans Fond off Abidjan at Long. 04°01'29"V and Lat. 05°13'95"N was occupied at about 25 meters of water. Current metering was at three different depths (near surface -1m, Mid depth - 12.5m, and near bottom - 24.5 m for maximum of 13 hours i.e; (22.00hrs of 21.10.89 t 11.00 hrs of 22.10.89). Near surface current velocities ranged between 0.10m/s to 0.4m/s with current direction predominantly in a northeasterly direction.

Mid-depth current velocities ranged between 0.5m/s to 0.25m/s with a general northeast to easterly direction. However, near bottom current velocities ranges between o.05m/s to 0.10m/s with the maximum 0.10m/s current velocity lasting for 3 hours within the 13 hours period. The current velocity direction was predominantly northeast-easterly direction.

In summary, measurements of current velocity and direction at three different depth - near surface, mid depth and near bottom at the two different locations have revealed that generally near surface current velocity is more under the influence of wind with a preferred northeasterly direction i.e. Near surface current velocity increases with increasing wind speed.

The mid-depths and near bottom currents generally run parallel to the strike of the canyons (NE approximately 230° for Avon Canyon and 220° for Trou Sans Fond off Abidjan).

3.8 SUSPENDED SEDIMENT

Table 2 gives the concentration of suspended material from 1 litre of sea water. The 1 litre of sea water was filtered under pressure using an 18.5 cm medium crystalline filter paper of 0.7 m.

Weights of suspended material recovered range from 0.03g to a maximum of 0.29g. Off Ghana along profiles 6 and 9 suspended material range as high as 0.26g in 1 litre of water and are mainly composed of biological materials.

The materials from the shelf off Benin and Togo are mainly fine silt at near surface and grade into silt concentration of suspended material especially of Côte d'Ivoire, Togo and Benin could be as a result of the availability of fine silt size sediments eroded from the adjacent coastline.

3.9 METEOROLOGIC PARAMETERS

The meteorological data collected during the duration of the cruise include wind speed and direction temperature and barometric pressure. Wind force during the survey range between 5m to 10m/hr with a dominant south westerly direction. Two days of high wind ranging between 10-15m/hrs were encountered. (14-15 October 1989).

During this period of rough sea the barometric pressure dropped to 1008mm as against the usual 1010mm to 1011mm recorded on most days during the cruise.

Very rough sea was encountered with sea heaps and high waves averaging 4.0m high. Vessel drifting was very intense and affected sampling and diving expedition off Ghana (Long. 0°57'8"00W and Let. 5°08'07"N).

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 DISCUSSION

Analysis of the data collected during this cruise has revealed the nature of the bottom of the continental shelf and hydrodynamics of the survey area in the Gulf of Guinea.

The nearshore area 0 - 45m generally consisted of sand ridges. These sand ridges are being shaped parallel to the coastline by waves and currents. However areas of rocky bottom off Cape Three Points are devoid of sand. The source of the sediments in the nearshore zone are inferred to have come from the sediments eroded along the beached. Off the Bar beach in Lagos for example where erosion rates range between 25-30 meters per year lenses of sand ridges were encountered in the nearshore.

The general profiles of the continental shelf off the survey area are also exposed. The varying gradient of the profiles are highly important in the interpretation of littoral process and must form a major part of most engineering measures to combat coastal erosion within this zone.

The data on the physico-chemical parameters of the continental shelf will serve the very useful purpose in the understanding of the relationship between the living resources and their environment. The abundance of calcareous suites off Ghana is explained by the upwelling occurring there.

The observed current velocities and direction in the heads of Avon Canyon and Trou Sans Fonds tend to support previous hypothesis by previous workers that currents move up and down the strike or bottom of canyons. These currents are responsible for transporting sediments from the nearshore and to the outer shelf and into deeper waters.

4.2 CONCLUSION

The first cruise in the Gulf of Guinea has been successful. However more light is expected to be shed on the result of the cruise as analysis of the data collected continues. It is hoped that the results of such analysis will help elucidate the hydrodynamic and oceanographic forces responsible for the aggravation of coastal erosion within the region.

Decision makers responsible for designing coastal erosion defence measures along the coastline of the Gulf of Guinea should find some of the results of this 1st cruise and further cruises very useful.

4.3 RECOMMENDATIONS FROM CRUISE CO-ORDINATOR AND CRUISE LEADER

(i) The non-availability of some geophysical equipment like side scan sonar, and shallow seismic uniboomer due to lack of funds has resulted in certain gaps in information. Efforts should be made to provide these equipment for future cruises.

(ii) Analysis of the mud size sediments could not be done because the laboratories in this region lacked functional equipment to analyze these sediments. Efforts should be made to either provide some laboratories in this region with the following equipment: X-ray diffractometer, Atomic Absorption spectrophotometer and sedigraph.

In the interim IOC should provide funds for some scientists within the region to go to some laboratories overseas where these analysis can be done.

(iii) All the analysis of the data collected during this cruise were done solely in the laboratory and by staff of the Nigerian Institute for Oceanography and Marine Research. Samples sent to other laboratories within the region could not be analyzed due to lack of funds. IOC should provide funds to laboratories in the region for future analysis.

4.4 ACKNOWLEDGEMENTS

The cruise co-odinator, and the participants of the cruise would like to express their thanks to the Intergovernmental Oceanographic Commission (IOC) for sponsoring the Sea Cruise. Special thanks are due to the immediate past Secretary of IOC, Dr. Ruivo, the present Secretary, Dr. Gunnar Kullenberg, the IOC Technical Secretary, Dr. Gualter Soares, IOC Consultant, Dr. Claude Latouche and the Chairman of OSNLR, Prof. Michel Vigneaux for their contributions in making the cruise a reality.

The generosity of the government of the Federal Republic of Nigeria in donating the research vessel SARKIM BAKA and her crew is appreciated. the cooperation of the Director of the Nigerian Institute for Oceanography and Marine Research, Mr. J. G. Tobor is highly appreciated.

Finally, the Cruise Co-ordinator and cruise participants wish to thank all those who contributed in one way or the other to the successful implementation of this cruise in particular the crew of the R.V. SARKIM BAKA.

TABLE 1

GRAIN SIZE ANALYSIS

DATE	STATION NO	LOCATION LONG	LAT.	DEPTH(M)	MEAN	STD.DEV.	SKEWNESS	KURTOSIS	REMARKS
11/10/89	DIVE 1A	3.51'92E	06.22'10N	20	0.85	0.53	-0.42	0.53	CS, MVST, SCSK, VP
11/10/89	DIVE B	3.51'92E	06.22'10N	20	0.95	0.61	-0.56	0.59	CS, MVST, CSK, VP
11/10/89	IOCS3.1	1.58'99E	6.04'60N	125	-	-	-	-	CALCEROUS MUD
11/10/89	IOCS3.2	1.59'00E	6.05'47N	100	-	-	-	-	CALCAROUS MUD
11/10/89	IOCS3.3	1.59'01E	6.06'13N	75	-	-	-	-	SILTY MUD
11/10/89	IOCS3.4	1.59.06E	6.09'45N	50	-	-	-	-	SILTY MUD
11/10/89	IOCS3.5	1.59'00E	6.11'78N	30	2.26	0.00	-0.33	1.07	FS, MVST, CSK, N
11/10/89	IOCS3.6	1.59'00E	6.11'78N	14	-	-	-	-	SILTY MUD
13/10/89	DIVE 2	1.57'95E	6.14'14N	20	-	-	-	-	SILTY MUD
13/10/89	DIVE 2A	EAST SIDE(BENIN)	-	15	1.88	0.50	-0.11	1.14	MS, MVST, CSK, L.
13/10/89	2B	WEST SIDE(TOGO)	TOGO SIDE	15	1.91	0.50	-0.14	1.05	MS, MVST, MS, M.
13/10/89	DIVE 2C	1.57'95E (CENTRAL DIVE)	6.14'14N	20	1.51	0.53	-0.12	1.14	MS, MVST, MS, L.
13/10/89	IOCS6.1	0.59'24E	5.39'21N	100	-	-	-	-	SILTY MUD
"	IOCS6.2	1.00'00E	5.42'93N	35	-	-	-	-	SILTY MUD
13/10/89	IOCS6.3	1.00'42E	5.46'25N	22	-	-	-	-	SILTY MUD
14/10/89	IOCS9.1	0.00'49E	5.22'13N	174	-	-	-	-	SILTY MUD
14/10/89	IOCS9.2	0.00'51E	5.20'16N	98	-	-	-	-	CALCAROUS SILTY MUD
"	IOCS9.3	0.00'53E	5.20'10N	75	-	-	-	-	CALCAROUS SILTY MUD
"	IOCS9.4	0.00'42E	5.46'25N	50	-	-	-	-	
"	IOCS9.5	0.00'59E	5.23'48N	32	-	-	-	-	CALCAROUS SILTY MUD
"	IOCS9.6	0.00'64E	5.34'46N	20	0.80	-	-	-	CALCAROUS SILTY MUD
						0.80	[illegible]	0.62	MST, FSK, VP
15/10/89	IOCS12.1	0,59'34W	4.25'60N	118	-	-	-	-	CALCAROUS MUD
15/10/89	IOCS12.2	0.59'37W	4.26'50N	100	-	-	-	-	CALCAROUS MUD
15/10/89	IOCS12.3	0.59'29W	4.29'33N	75	2.35	-	-	-	FS,MST,MS, VP
15/10/89	IOCS12.4	0.55'05W	4.41'75N	50	-	0.7[illegible]	[illegible]	0.0	CALCAREOU SILTY MUD
15/10/89	IOCS12.5	0,55'50W	4.56'81N	30	1.25	[illegible]	[illegible]	-	MS, PST, FSK, VP
"	IOCS12.5	0.55'50W	4.56'81N	30	2.37	1.[illegible]	[illegible]	0.43	FS, MVST, CSK, L
"	IOCS12.6	0.57'81W	5.07'32N	20	1.15	0.6[illegible]	[illegible]	1.33	MS, MST, FSK, P.
"	IOCS12.6	0.57'81W	5.07'32N	20	1.26	0.[illegible]	[illegible]	0.80	MS, MST, FSK, P
						0.[illegible]	[illegible]	0.89	
16/10/89	IOCS15.1	2.00'09W	4.26'18N	125	1.30	-	-	-	MS, PST, FSK, VP
"	IOCS15.2	1.59'10W	4.25'14N	105	1.60	1.16	0.[illegible]	0.52	MS,PST,CSK, P.
"	IOCS15.3	1.59'98W	4.30'65N	76	-	1.18	0.[illegible]	0.80	SILTY MUD
						-	-	-	DARK GREY MUD
"	IOCS15.4	2.00'60W	4.38'55N	53	-	-	-	-	SILTY MUD
"	IOCS15.5	-	-	32	-	-	-	-	SILTY MUD
"	IOCS15.6	2.00'09W	4.43'27N	21	-	-	-	-	
17/10/89	IOCS18.1	3.00'04W	4.43'93N	125	-	-	-	-	DARK GREY MUD
"	IOCS18.2	3.00'02W	4.44'97N	100	2.05	0.59	0.[illegible]	0.30	FS, MVST, MS, VP
"	IOCS18.3	2.59'90W	4.49'56N	75	-	-	-	-	SILTY MUD
"	IOCS18.4	2.59'80W	4.56'23N	53	-	-	-	-	SILTY MUD
"	IOCS18.5	2.59'75W	5.00'20N	32	2.01	0.63	0.[illegible]	1.03	FS, MVST, MS, M
"	IOCS18.6	2.59'65W	5.01'99N	22	0.86	0.78	0.[illegible]	0.67	CS, MST, MS, VP
"	IOCS23.1	5.00'82W	4.56'64N	125	-	-	-	-	DARK GREY SILTY MUD
"	IOCS23.2	5.00'82W	4.58'39N	102	-	-	-	-	DG, SILTY MUD
17/10/89	IOCS23.3	5.03'62W	5.01'18N	75	-	-	-	-	DGSTN
"	IOCS23.4	5.02'50W	5.03'04N	53	-	-	-	-	DGSTN
"	IOCS23.5	4.59'85W	5.06'58N	33	-	-	-	-	DGSTN
"	IOCS23.6	4.59'23W	5.07'15N	24	-	-	-	-	SILTY MUD
18/10/89	IOCS26.1	6.00'21W	4.41'76N	125	-	-	-	-	DARK GREY MUD
"	IOCS26.1	6.00'21W	4.44'74N	114	-	-	-	-	DARK GREY
"	IOCS26.2	6.00'21W	4.41'88N	107	-	-	-	-	DARK GREY DARK GREY
"	IOCS26.3	6.00'21W	4.46'60N	75	-	-	-	-	DARK GREY
"	IOCS26.4	6.03'06W	4.48'20N	54	-	-	-	-	DARK GREY
"	IOCS26.5	6.01'68W	4.51'86N	32	-	-	-	-	DARK GREY
"	IOCS26.6	6.00'75W	4.53'89N	21	0.29	0.35	0.[illegible]	1.02	CS, VST, MS, M
18/10/89	IOCS29.1	6.59'92W	4.23'04N	125	-	-	-	-	DARK GREY MUD
"	IOCS29.2	6.59'94W	4.23'60N	100	-	-	-	-	DARK GREY
"	IOCS29.3	7.00'19W	4.27'26N	76	-	-	-	-	DARK GREY
"	IOCS29.4	7.00'19W	4.30'51N	54	-	-	-	-	SILTY MUD
"	IOCS29.5	7.00'26W	4.32'63N	40	-	-	-	-	SILTY
22/10/89	CM2 ABJ	4.01'29W	5.12'00N	25	1.50	0.56	0.[illegible]	1.12	MS, MVST, FSK, L.
"	IOCS32.1	3.58'14W	5.11'99N	103	-	-	-	-	DGSTN
"	IOCS31.1	-	-	53	-	-	-	-	DGSTN
24/10/89	IOCS34.1	1.30'18W	6.06'00N	33	2.57	0.[illegible]	0.[illegible]	1.63	FS, MST, SCSK, VL.

KEY TO REMARKS

CS, - COARSE SAND
MS, - MEDIUM SAND
FS, - FINE SAND
VST, - VELL SORTED
MST, - MODERATELY SORTED
MVST, - MODERATELY VELL STORTED
PST, - POORLY SORTED
CSK, - COARSE SKEVED
SCSK, STRONGLY COARSE SKEVED
FSK, - FINE SKEVED
NS, - NEAR SYMMETRICAL
P, - PLATYKURTIC
VP, - VERY PLATYKURTIC

TABLE 2

PHYSICO - CHEMICAL PARAMETERS OF WATER SAMPLES

STATION NO	LOCATION		WATER DEPTH (m)	SAMPLING DEPTH (m)	TEMPERATURE C	SALINITY o/oo	DENSITY OT	SUSPENDED SEDIMENT G/L	DISSOLVED OXYGEN
	LONGITUDE	LATITUDE							
IOCV 3.1	1.59'00W	6 05'47N	100	10	26.00	33.8245	21.926	0.12	
				20	26.00	34.5956	22.593	0.09	
				30	25.40	33.9432	22.271	0.11	
				50	24.60	35.3266	23.504	0.21	
				100	17.90	35.5463	25.766	0.71	
IOCV 3.2	1.59'06W	6 09'45N	50	0	26.60	33.3955	21.663	0.01	
				10	26.10	34.8675	22.945	0.15	
				20	26.00	35.1139	23.153	0.25	
				30	25.00	34.5701	23.050	0.65	
				50	20.50	35.4897	23.745	0.12	
IOCV 3.3	1.59'33W	6 11'78N	0	0	26.80				
			30	10	26.40	33.9593	22.032	0.66	
				20	25.60	34.7130	22.717	0.37	
				30	25.50	35.1455	23.038		
IOCV 3.4	1.59'00W	6 11'78N		0	26.70	32.3275	20.824	0.66	
			14	12	26.60	34.7037	22.629	0.13	
IOCV 6.1	0.59'24W	6 39'21N	115	0	26.70	34.2285	22.265	0.07	
				10	26.30	35.2505	23.153	0.07	
				20	25.22	35.1569	23.426	0.09	
				30	25.12	34.5277	23.489	0.05	
				50	23.42	35.5473	24.261	0.08	
				100	17.20	35.1623	25.613	0.10	
IOCV 6.2	0.59'25W	5 40'68N	35	0	26.75	34.3309	22.320	0.11	
				10	26.25	35.1227	23.075	0.17	
				20	27.30	35.4127	22.958	0.11	
				30	25.20	34.9942	23.307	0.10	
IOCV 6.3	0.00'42W	5 48'25N	22	0	26.58	34.8028	22.736	0.07	
				10	25.70	35.1451	23.273	0.08	
				20	25.52	35.2938	23.429	0.12	
IOCV 9.1	0.00'51E	5 21'16N	100	0		34.9763		0.07	
				10		34.8787		0.08	
				20		35.0248		0.17	
				30		35.0164		0.03	
				60		35.7005		0.14	
				100		35.2527		0.10	
IOCV 9.2	0.00'55W	5 23'49N	50	0	26.30	34.5782	22.645	0.05	
				10	26.30	35.0694	23.011	0.05	
				20	26.00	35.1348	23.161	0.09	
				30	25.85	35.3025	23.336	0.25	
				45	25.30	35.4314	23.605		
IOCV 9.3	0.00'59W	5.28'48N	30	0	26.20	35.1784	23.141	0.13	
				10	26.10	35.1741	23.163	0.12	
				20	26.10	35.2484	23.233	0.26	
				30	24.80			0.11	
IOCV 9.4	0.00'64W	5.34'46N	20	0	26.40	35.1323	23.033	0.04	
				10	26.20	35.2300	23.128	0.18	
				18	24.99	35.4040	23.287	0.22	

PHYSICO - CHEMICAL PARAMETERS OF WATER SAMPLES (2)

STATION NO	LOCATION		WATER DEPTH (m)	SAMPLING DEPTH (m)	TEMPERATURE C	SALINITY o/oo	DENSITY σT	SUSPENDED SEDIMENT G/L	DISSOLVED GASES
	LONGITUDE	LATITUDE							
IOCV 12.4	0.55'05W	4.41'75N	52	0	26.30	34.7161	22.754	0.18	
				10	26.30	34.7233	22.752	0.04	
				20	26.10	34.7562	22.817	0.21	
				30	25.60	35.0270	23.313	0.15	
				50	24.30	35.1036	23.457	0.06	
IOCV 12.5	0.55'50W	4.50'83N	30	0	26.[illegible]	35.2332	23.258	0.15	
				10	25.[illegible]	35.1248	23.150	0.06	
				20	25.70	35.4362	23.469	0.12	
				30	24.60	35.5555	24.393	0.12	
IOCV 13.6	0.57'81W	5.07'32N	20	0		35.1531		0.16	
				10		35.4347		0.16	
				19		35.2743		0.12	
IOCV 15.1	1.59'10W	4.25'14N	105	0	26.43	34.1312	22.280	0.10	6.72
				10	26.43	34.1739	22.310	0.13	6.60
				20	26.20	34.7253	22.754	0.02	6.52
				30	24.53	35.1591	23.492	0.26	6.28
				50	20.60	35.7556	25.208	0.10	4.08
				100	16.10	35.3395	25.256	0.11	4.04
IOCV 15.2	2.00'60W	4.38'55N	53	0	26.40	34.8277	22.807	0.19	
				10	26.40	34.8798	22.845	0.25	
				20	25.70	35.0185	23.175	0.17	
				30	23.60	35.4545	24.130	0.14	
				40	23.00	35.5329	24.372	0.20	
				53	20.40	35.7375	25.142	-	
IOCV 15.3	2.00'09W	4.43'23N	20	0	26.30	34.6935	22.732	0.05	
				10	24.70	35.3646	23.727	0.04	
				18	24.40	35.4029	23.862	0.03	
IOCV 18.1	3.00'02W	4.44'57N	100	0	26.40	34.0020	22.182	0.11	6.04
				10	26.00	34.8795	22.820	0.09	6.00
				20	24.30	35.2311	23.754	0.02	5.36
				30	22.60	35.6362	24.833	0.06	5.20
				50	19.60	35.7465	25.434	0.05	3.40
				98	15.50	35.5734	26.010	0.01	2.40
IOCV 18.2	2.59'80W	4.54'23N	53	0	25.50	34.3071	22.697	0.07	
				10	23.30	35.4358	24.208	0.02	
				20	22.50	35.5174	24.394	0.07	
				30	22.50	35.5526	24.557	0.13	
				53	21.30	35.7477	25.256	0.01	
IOCV 18.3	2.59'75W	5.00'20N	32	5	25.30	34.0453	22.534	0.10	
				10	24.90	35.1418	23.316	0.26	
				20	...30	35.2235	24.174	0.01	
				30	22.20	35.5425	24.559	0.13	

PHYSICO - CHEMICAL PARAMETERS OF WATER SAMPLES (3)

IOCV 18.4	2.59'65S	5.01'99W	20	0	25.50	33.8187	22.334	0.07
				10	24.60	34.8954	23.420	0.17
				18	22.80	35.4567	24.369	0.31
IOCV 23.1	5.03'95W	4.59'66W	102	0	26.40	34.1739	22.310	0.09
				10	24.40	35.2149	22.310	0.15
				20	20.80	34.2717	24.025	0.07
				30	19.20	35.6925	25.501	0.11
				50	19.20	35.6925	25.531	0.04
				100	17.60	35.6801	25.915	0.39
IOCV 23.2	5.02'50W	5.03'04W	53	0	25.80	33.1360	21.728	0.07
				10	23.10	35.3799	24.223	0.06
				20	20.90	35.6676	25.089	0.05
				30	19.50	35.7217	25.369	0.09
				50	19.20	35.7262	25.562	0.16
IOCV 23.3	4.59'85W	5.06'56W	33	0	25.60	33.0869	21.750	0.24
				10	23.00	35.3431	24.235	0.20
				20	20.50	35.6095	25.006	0.15
				30	20.00	35.5115	25.173	0.13
IOCV 23.6	4.59'23W	5.10'23W	24	0	25.50	28.6150	18.425	0.15
				10	24.90	35.3395	23.813	0.17
				20	20.50	35.5651	25.098	0.23
IOCV 26.1	6.00'21W	4.41'88W	107	0	25.20	34.5185	23.245	0.22
				10	19.50	35.5706	25.274	0.15
				20	19.20	35.6902	25.531	0.11
				30	18.20	35.6226	25.571	0.11
				50	18.10	35.6655	25.782	0.20
				100	17.30	35.6353	25.960	0.18
IOCV 26.2	6.03'60W	4.48'20W	54	0	25.20	32.9193	21.745	0.17
				10	21.80	35.3275	24.555	0.23
				20	20.60	35.6465	25.124	0.23
				30	20.00	35.6138	25.269	0.12
				50	19.20	35.7206	25.554	0.13
IOCV 26.3	6.01.68W	4.53'89W	33	0	24.70	33.2134	22.114	0.07
				10	21.10	35.5684	24.933	0.18
				20	20.50	35.6063	25.114	0.16
				30	20.10	35.6152	25.237	0.16
IOCV 26.4	6.00'75W	4.53'89W	21	0	24.60	33.1175	22.076	0.19
				10	21.60	35.4783	24.719	0.21
				19	21.50	35.2145	24.550	0.17
IOCV 29.1	6.59'54W	4.23'60W	107	0	24.60	32.6993	21.759	0.13	7.86
				10	20.20	35.6700	25.245	0.18	3.28
				20	19.40	35.7213	25.504	0.18	3.84
				30	18.60	35.7135	25.687	0.24	3.48
				50	18.30	35.7022	25.765	0.07	3.63
				100	17.20	35.2725	25.697	0.19	3.40
IOCV 29.2	6.53'60W	4.59'96W	53	0	24.70	33.4635	22.302	0.16	
				10	21.10	35.4635	24.634	0.17	
				20	20.90	35.5352	25.044	0.08	
				30	19.50	35.6666	25.429	0.12	
				50	18.90	-	-	-	

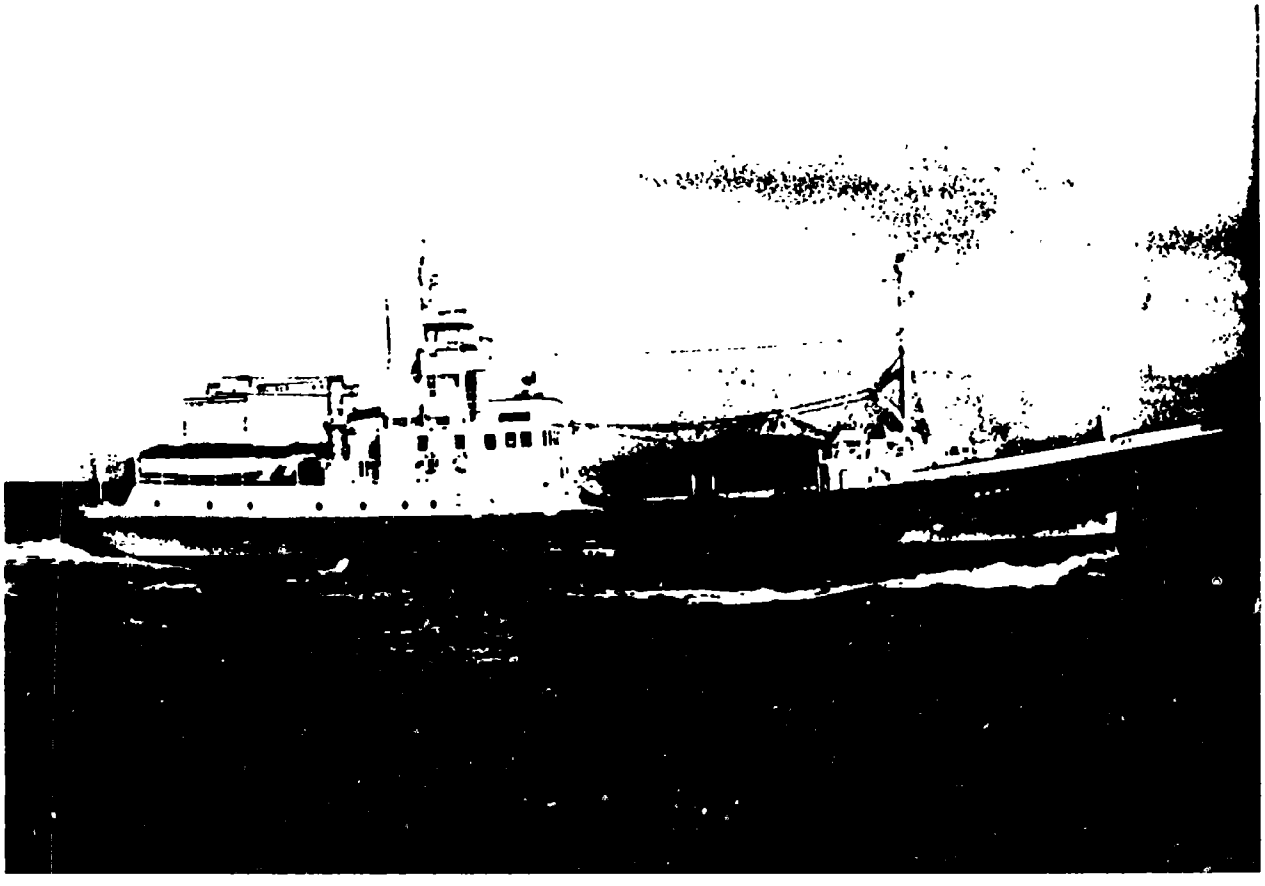


FIG. 1. R. V. "SARKIM BAKA"

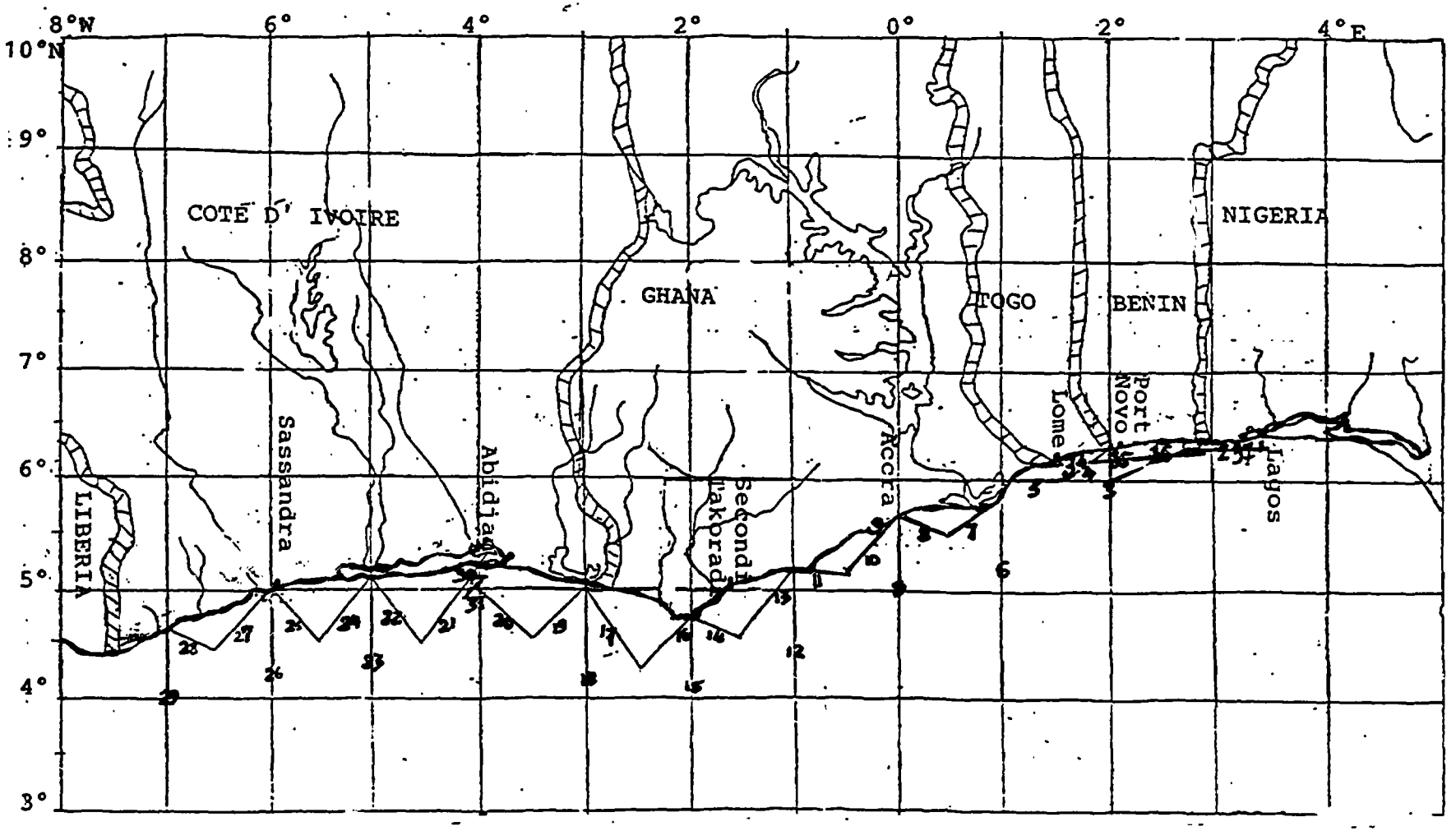


FIG.2 MAP OF SURVEY AREA SHOWING PROFILE LINES

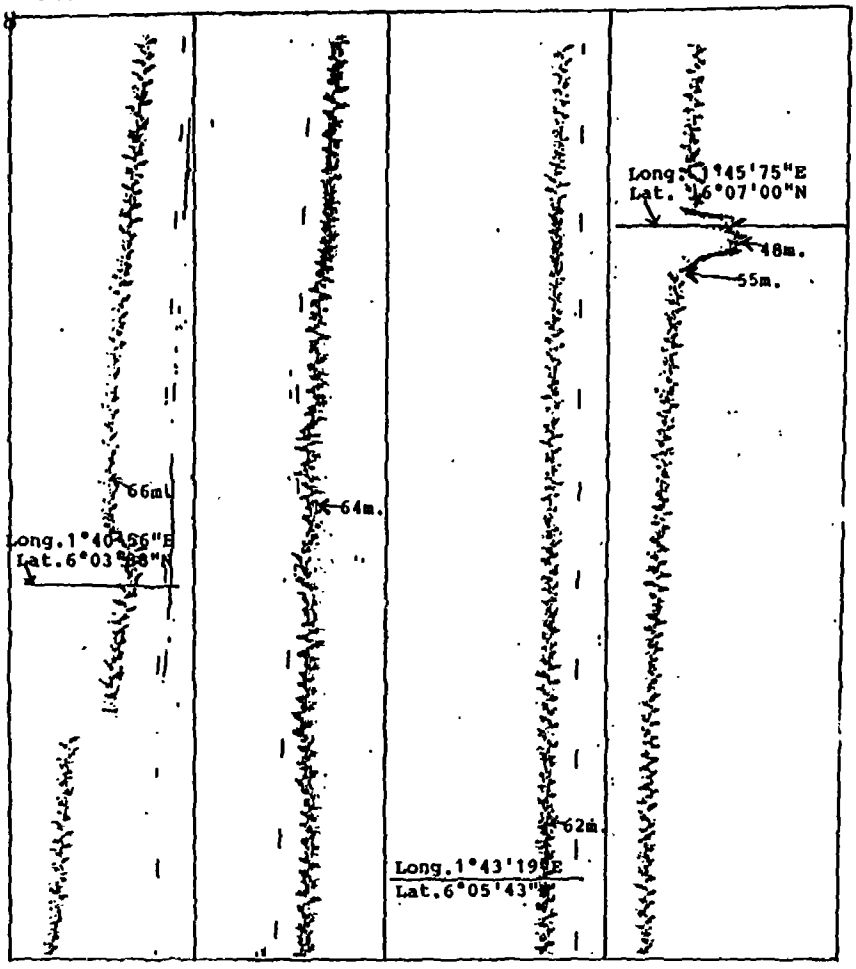


FIG.3 ECHOGRAM ALONG SOUNDING LINE 3 SHOWING CORAL BANKS

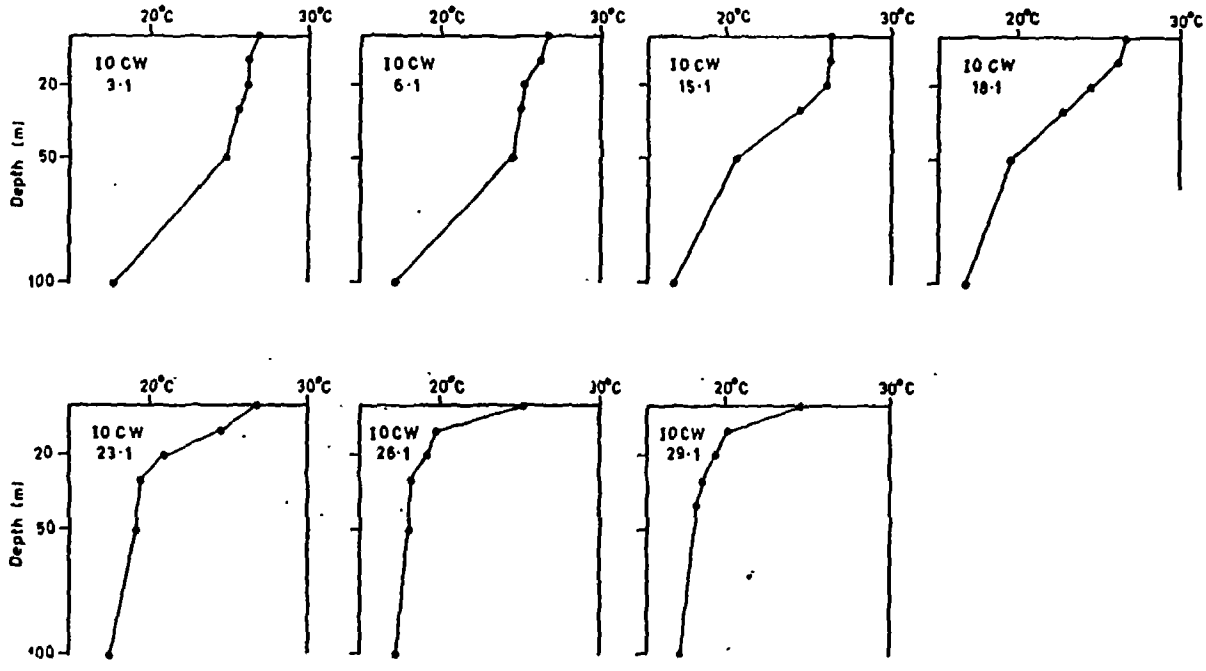


FIG.4 WATER TEMPERATURE PROFILES (See table 2 for locations)

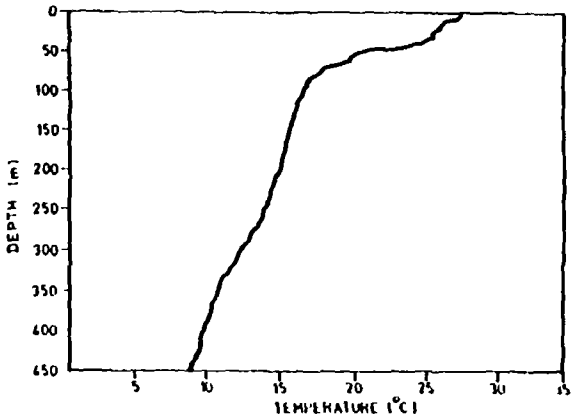


FIG. 5 XBT TEMPERATURE PROFILE ONE BININ/[illegible] BORDER.
LONG. 1° 58' 81"E, LAT. 6° 02' 13"N
OCT. 13, 1989. 1.30 GMT.

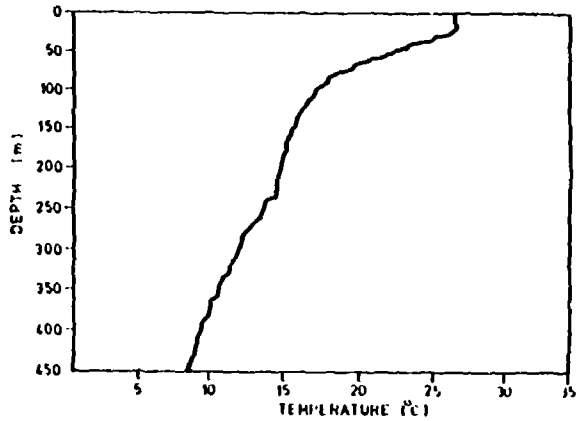


FIG. 6 XBT TEMPERATURE PROFILE ONE SENA (GHANA)
LONG. 0° 00' 04"W, LAT. 5° 18' 96"N
OCT. 14, 1989. 00.05 GMT.

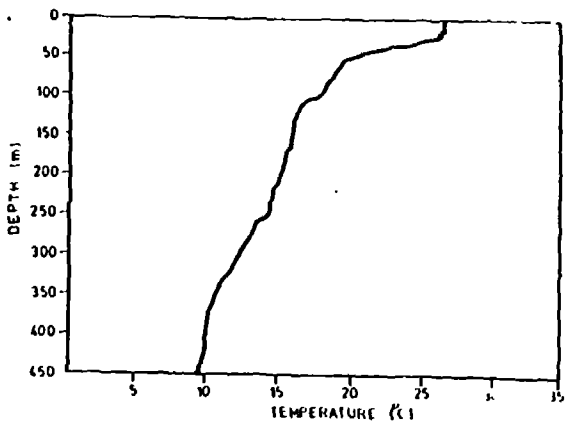


FIG. 7 XBT TEMPERATURE PROFILE ONE CAPE THREE POINTS (GHANA)
LONG. 2° 00' 09"W, LAT. 4° 40' 45"N
OCT. 16, 1989. 05.50 GMT.

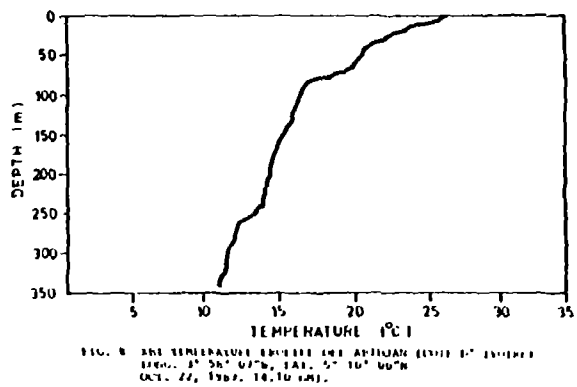


FIG. 8 XBT TEMPERATURE PROFILE ONE ABIDJAN (COTE D' IVOIRE)
LONG. 3° 56' 07"W, LAT. 5° 16' 00"N
OCT. 22, 1989. 18.10 GMT.

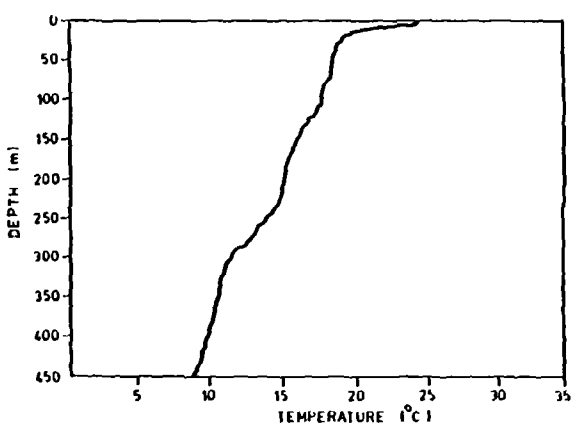


FIG. 9 XBT TEMPERATURE PROFILE ONE COTE D' IVOIRE/LIBERIA BORDER.
LONG. 6° 59' 82"W, LAT. 4° 30' 34"N
OCT. 18, 1989. 17.05 GMT.

FIG. 5 - 9

XBT TEMPERATURE PROFILE

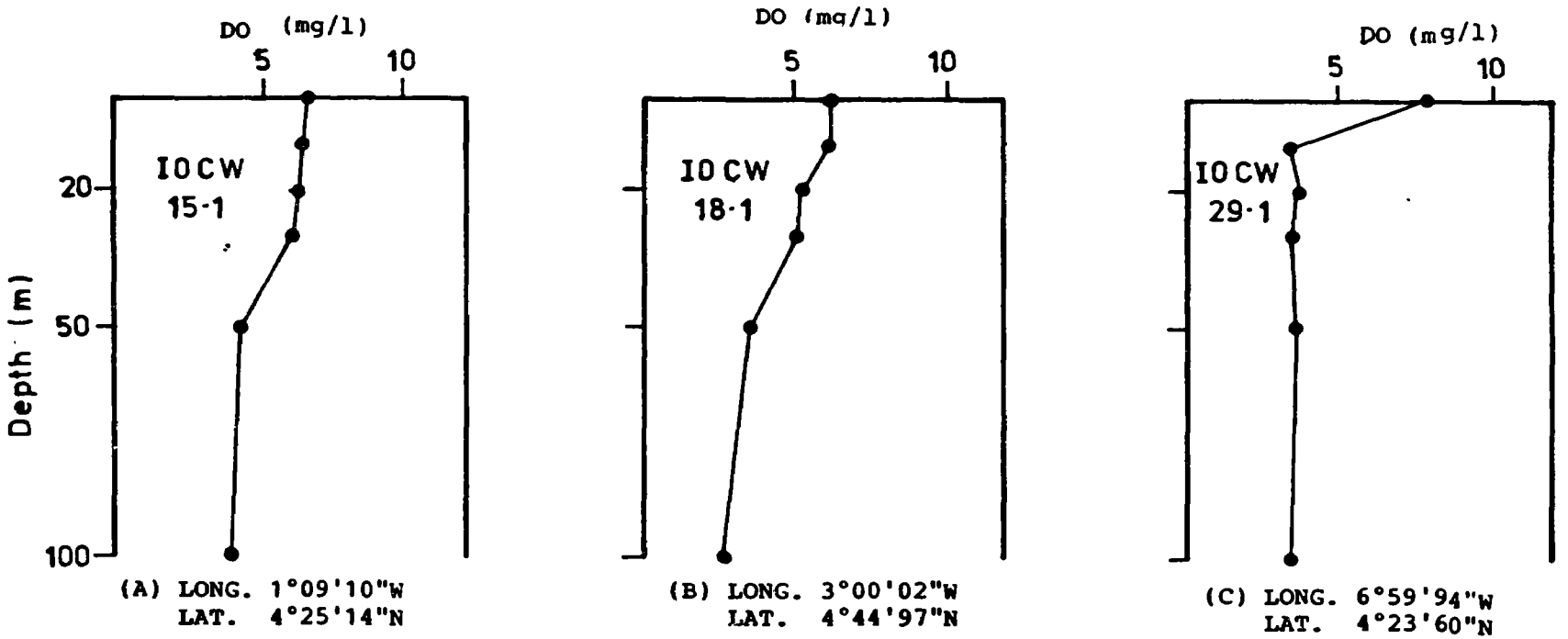


FIG. 10 DISSOLVED OXYGEN PROFILES AT 3 STATIONS.

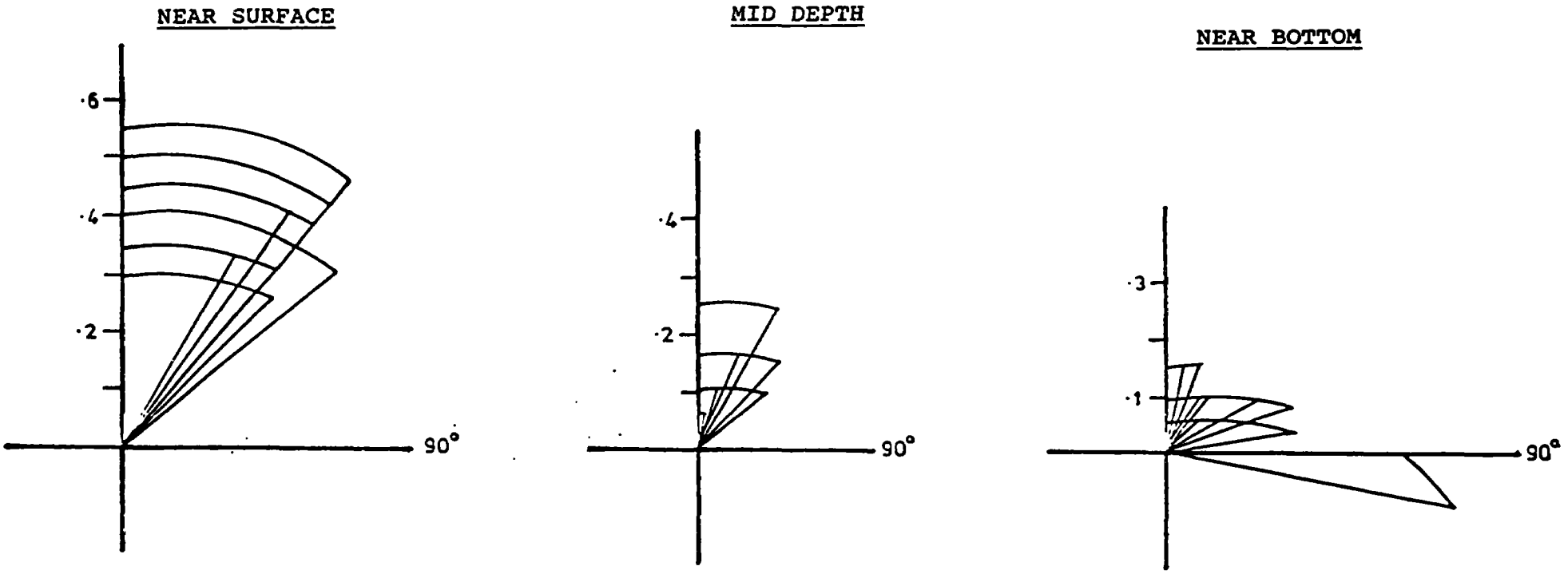


FIG.11. CURRENT ROSES AT LONGITUDE 3°51'81"E AND LATITUDE 6°22'00"N OFF AVON CANYON.

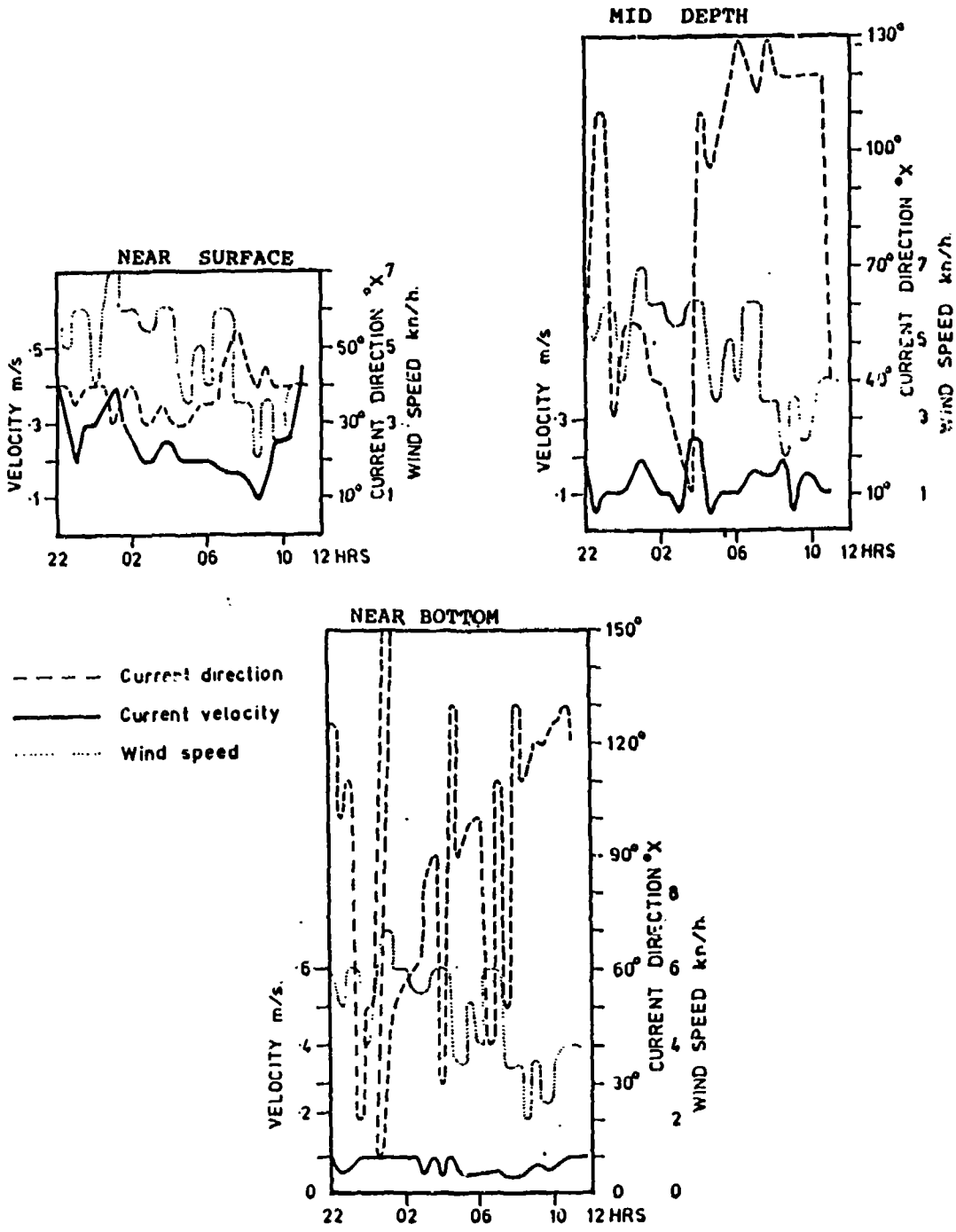


FIG.12. SHOWING PLOTS OF CURRENT VELOCITY ,DIRECTION AND WIND SPEED (LONG.3°51'81"E, LAT.6°22'00"N)

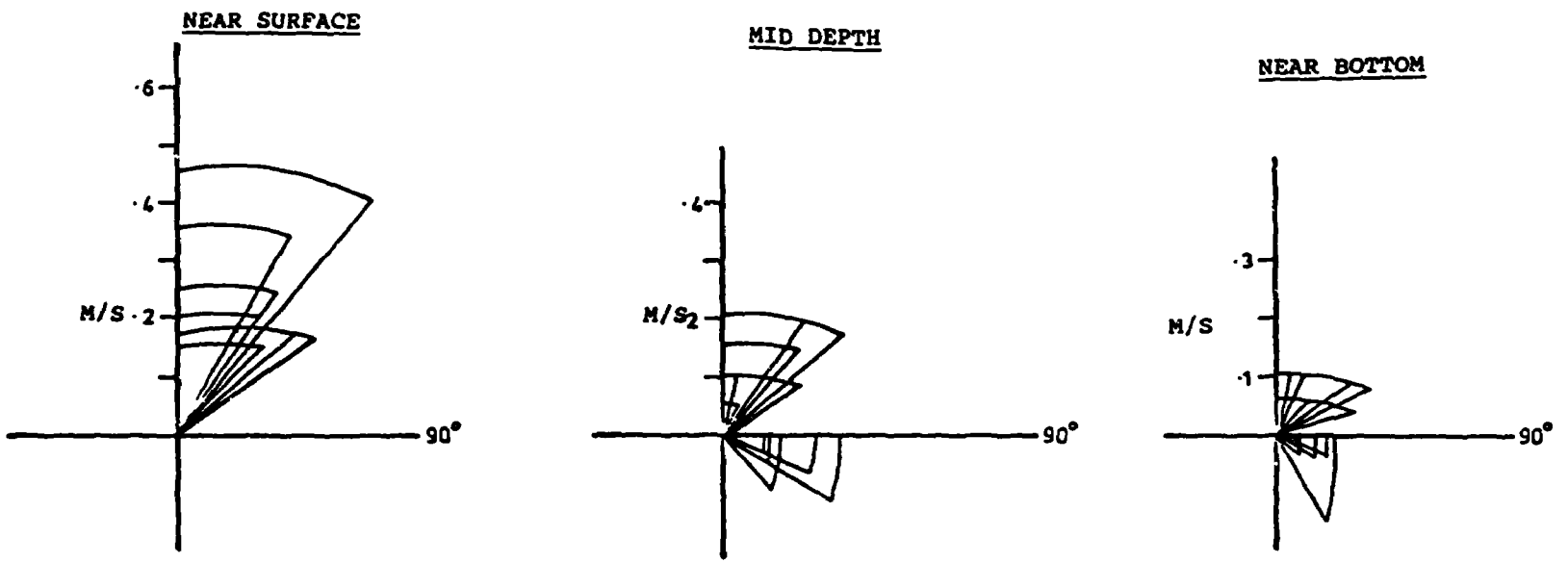


FIG.13. CURRENT ROSES AT LONGITUDE 4°01'29"W AND LATITUDE 5°13'95"N OFF TROU SANS FOND, ABIDJAN.

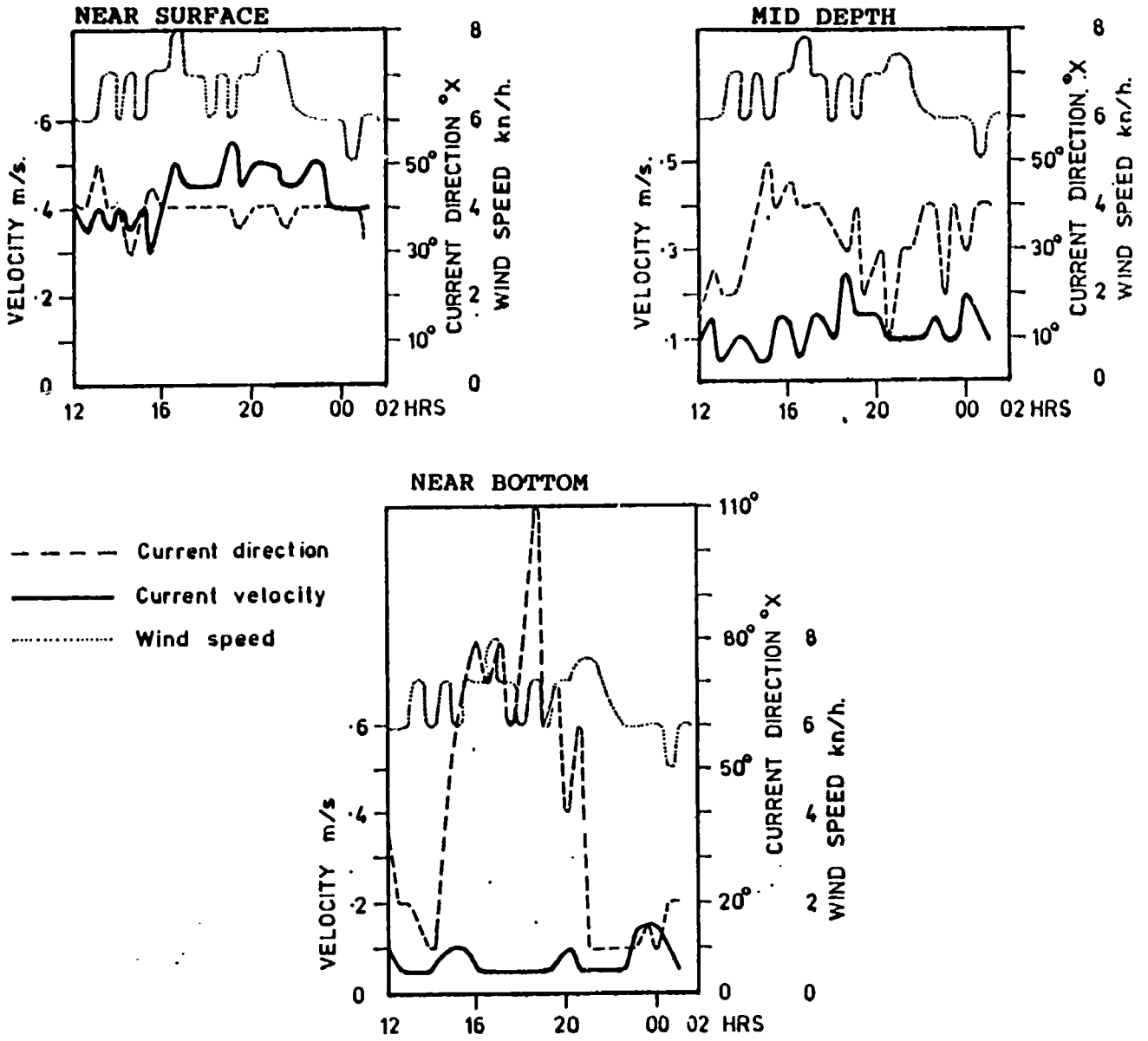
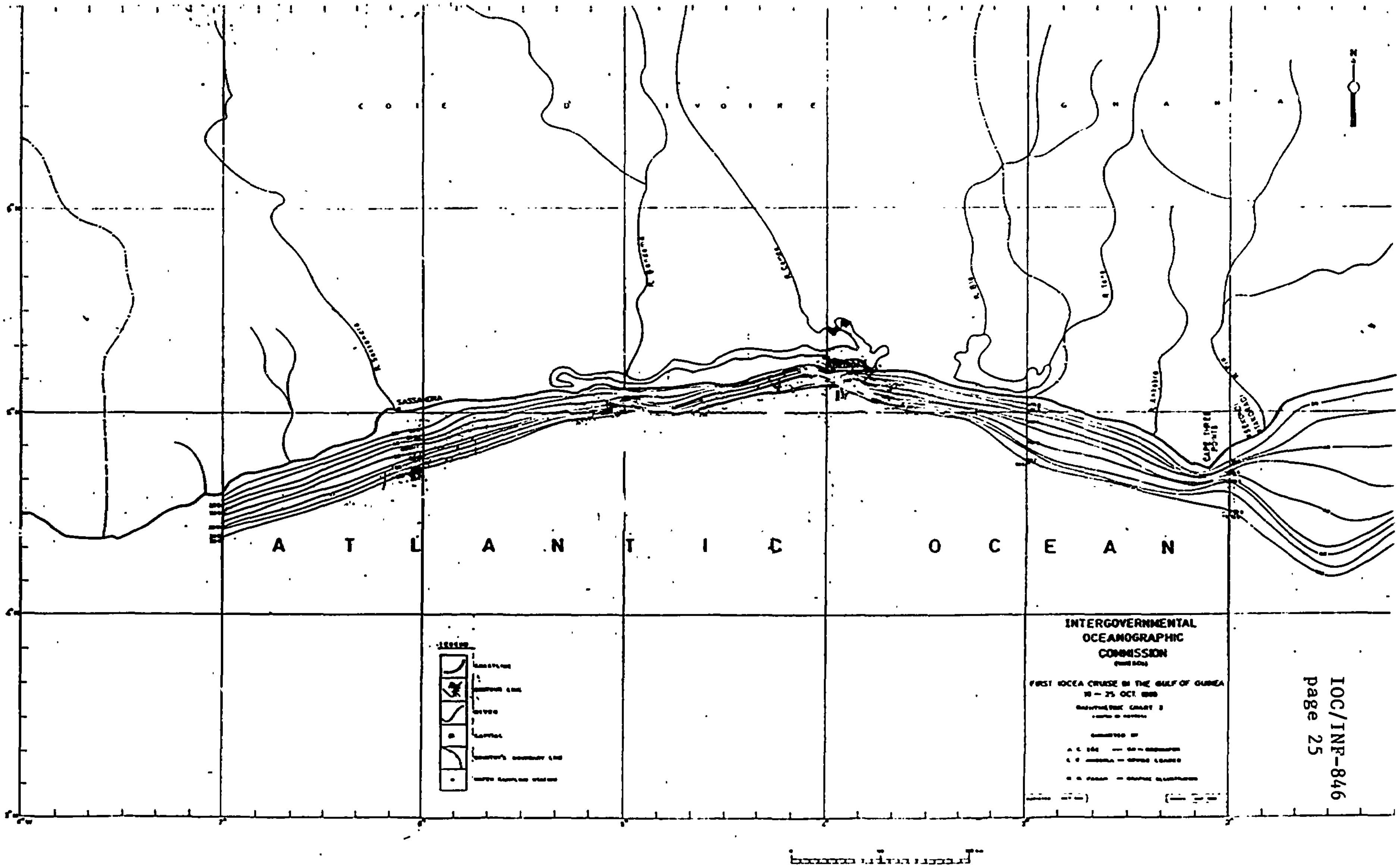
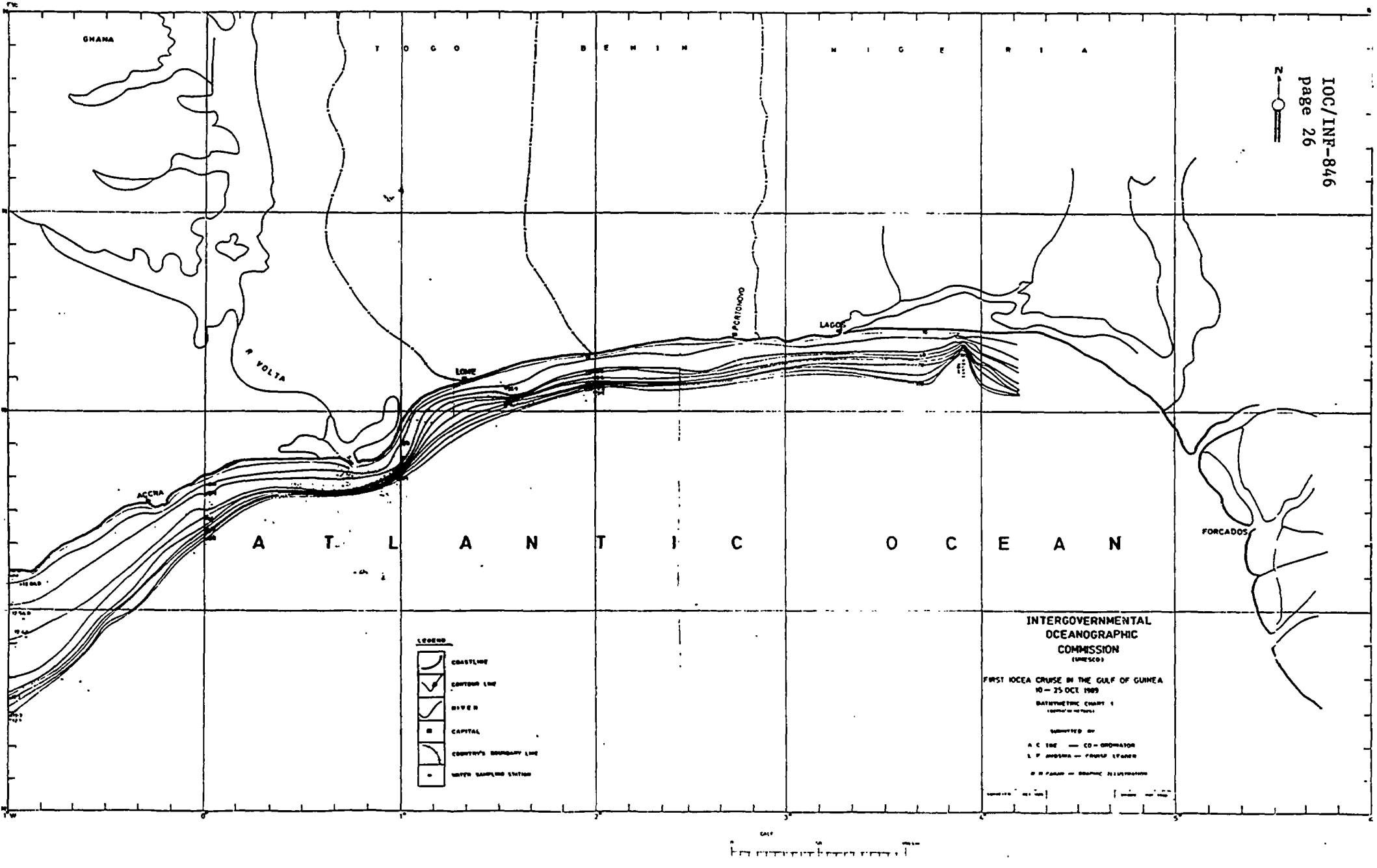


FIG.14 SHOWING CURRENT VELOCITY, DIRECTION AND WIND SPEED.
(LONG.4°13'95"W LAT.5°13'95"N)


COTE D'IVOIRE
GHANA
SASSANDRA
ATLANTIC OCEAN
INTERGOVERNMENTAL
OCEANOGRAPHIC
COMMISSION
FIRST IOCEA CRUISE IN THE GULF OF GUINEA


GHANA
T O G O
B E N I N
N I G E R I A
N
R. VOLTA
LOME
R. PORTONOVO
LAGOS
ACCRA
A T L A N T I C O C E A N
FORCADOS
LEGEND
COASTLINE
CONTOUR LINE
RIVER
CAPITAL
COUNTRY'S BOUNDARY LINE
WATER SAMPLING STATION
INTERGOVERNMENTAL
OCEANOGRAPHIC
COMMISSION
(UNESCO)
FIRST IOCEA CRUISE IN THE GULF OF GUINEA
10 – 25 OCT. 1989

ANNEX I

DAY TO DAY ACCOUNT OF ACTIVITIES

by L. F. Awosika, Cruise Leader

10 October 1989

The vessel steamed eastward to occupy the first current metering position off the head of avon Canyon (Lat. 6°22'.00"N and Long. 0 3°51'.81"E). The vessel arrived on location in 20 metres of water at 21.00 hrs and anchored. Mobilization of equipment continued till 23.50 hrs.

11 October 1989

Current metering started on location at 12.00hrs. Measurements - (for direction and velocity) were taken at 3 different depths - near surface, mid depth and near bottom. Readings were taken every 30 minutes for a total of 13 hours. (12.00hrs of 11 October to 1.00hrs of 12 October 1989).

A diving expedition was undertake at this station.

12 October 1989

After the 13hrs of current metering the boat lifted up and cruised back westward to start sounding and sampling by the Nigerian/Benin boarder. Participants also seized this opportunity to familiarize themselves with the scope of work and the operation of the equipment and satellite positioning onboard.

Along this westward cruise the boat stopped at the NIOMR Jetty to pick up Mr. A. Blivi participant from Togo who arrive on 10 November 1989 after the vessel had been flagged off. Continuous sounding of line IOCB I started at 16.40 hrs and ended at 23.04hrs. Along this line of profile, event marks and other data like wind speed and direction, pressure, water temperature, position and distance to land were recorded at every twenty minute interval.

13 October 1989

1. Continuous sounding of lines 2,3,4,5,6 and collection of Oceanographic data along sounding lines at 20 minute interval.

2. Collection of bottom sediment samples at water depths of 125m, 100m, 75m, 50m, 30m and 14m along lines 3 and 6.

3. Collection of water samples at depths of 100m, 50m 30m and 14m, along lines 3 and 6.

4. Launching of XBT at water depth of 500m, on line 3 (long. 1°58'87"E and Lat. 6°02'13"N).

5. Diving expedition on line 3 (Long. 1°57'95"E and Lat. 6°14'14"N).

14 October 1989

1. Continuous sounding of lines 8,9,10 and collection of Oceanographic data along sounding lines at 20 minute interval.

2. Collection of bottom sediment samples at water depths of 174m, 98m, 75m, 50m, 32m, and 20m along line 9.

3. Collection of water samples at water depths of 100m, 50m, 30m, and 20m along line 9.

4. Launching of XBT at water depth of 500m on line 9 (long. 0°°°.64"W Lat. 5°18'96"N).

5. Slack time for Saturday cruise party 13hrs - 18.00hrs (On board).

15 October 1989

1. Continuous sounding lines 11, 12, 13 and collection of Oceanographic data along sounding lines at 20 minute interval.

2. Collection of bottom sediment samples at water depths of 118m, 100m, 75m, 50m, 30m, and 20m along line 12.

3. Collection of water samples at depths of 100m, 75m 59m 30m and 20m along line 12. The diving expedition was canceled due to very bad weather.

16 October 1989

1. Continuous sounding of line 14, 15, 16, 17 and 18 and collection of oceanographic data along sounding lines at 20 minute interval.

2. Collection of bottom sediment samples at water depths of 125m, 105m, 76m, 53m and 32m along lines 15 and 18.

3. Collection of water samples at depths of 105m, 53m and 20m along lines 15 and 18.

4. Diving expedition at long. 2°1'00"KW and lat. 4°32'.2"N in 23m of water off Cape Three Points (Ghana).

5. Launching of XBT in 500m of water (long.2°00.09"W, lat. 4°20'.45"N).

17 October 1989

1. Continuous sounding of lines 19, 20, 21, 22, 23 and 24 and collection of oceanographic data along sounding lines at 20 minute interval.

2. Collection of bottom sediment samples at depths of 125m, 102m, 75m, 53m, 33m and 24m along line 23.

3. Collection of water samples at depths of 102m, 53m, 33m and 24m along line 23.

18 October 1989

1. Continuous sounding of lines 25, 26, 27, 28 and 29 and the collection of oceanographic data along sounding lines at 20 minute interval.

2. Collection of bottom sediment samples at water depths of 125m, 107m, 75m, 54m, 32m and 21m along line 26 and water depths of 125m, 100m, 75m, 54m and 25m along line 29

3. Collection of water samples at water depths of 107m, 54m, and 21m on line 26 and water depths of 107m, 53m, and 33m along line 29.

4. Launching of XBT at 500m of water on line 29 (long. 6°59' 82"W, Lat. 4°30'.34"N).

19 October 1989

Steamed westward towards Abidjan.

1. Arrived at Abidjan Port entrance at 16.40hrs and started sounding criss-cross lines 30, and 31 on the Abidjan entrance and Canyon head.

2. Piloted into Abidjan Port at 19.00hrs. Boat berthed at Abidjan Port at 20.00hrs.

Togo participant left the boat to return to his country.

20 October 1989

1. Courtesy call on the Centre de Recherche Oceanographiques in Côte d'Ivoire and tour of centre.

2. Courtesy call on the Nigerian Ambassador to Côte d'Ivoire at Nigerian House in Abidjan.

21 October 1989

Restful day in the Abidjan Port. Piloted out of Abidjan Port at 17.00hrs. Anchored at 25m, of water west of Abidjan Port (Long. 4°.01' 29"W and Lat. 5°13'.95"N) for 13 hrs of current metering which started at 22hrs.

22 October 1989

1. Continued current metering on location until 11.00hrs.

2. Diving expedition on location and north of location.

3. After the above exercises, line 32 and 33 (Canyon head) off the Abidjan entrance were sounded.

4. Collection of bottom sediment samples at water depths of 103m, and 53m, on line 32 and 33 meters of water on line 33. (Canyon head samples).

5. XBT launched inside the Canyon at a depth of 350m (Long 3°58'07"W Lat. 5°10'.00"N).

6. Collection of water samples at depths of 25 and 103 along line 32.

7. Commenced homeward cruise at 14.30hrs.

8. Analysis of water samples on board commenced.

23 October 1989

1. Homeward cruise - with hourly event marks and recording of oceanographic data

2. Analysis of water samples on board.

24 October 1989

1. Sounding of lines 34, 35 and 36 and collection of oceanographic data along lines of profiles at every 20 minute interval.

2. Diving expedition near Togo/Benin border at long. 1°44'.70"E and Lat. 6°10'.79"W along line 34.

3. Collection of bottom sediment samples at 33m depth (long. 1°30'.18"E and lat. 6°06'.00n).

4. Anchored off Badagry at 19.30hrs.

5. Analysis of water on board continued.

25 October 1989

1. Continuous sounding along profile line 37. Finished sounding at 12.27 hrs and steamed towards Lagos harbour entrance.

2. Arrived at NIOMR jetty at 14hrs to a fanfare and welcome reception.

ANNEX II

DIVING REPORT

A total of three hundred and twelve minutes of diving was put in during this cruise.

During each dive the following activities were undertaken: sampling of seabed, pictures of seabed, description of seabed topography and bottom lithology typing and currentology.

All the dives were successfully carried out except the one in Ghana at position lat. 5° 07'08"N long. 0° 57'03"W which had to be aborted due to bad weather.

COUNTRY	-	Nigeria
POSITION	-	Lat 6° 22'.10"N, Long. 3° 51'.92"E
DATE	-	11 - 10 - .89
DEPTH	-	22 meters
CURRENT	-	Very strong
TIME	-	11.00hrs. - 12.45hrs.
VISIBILITY	-	Good
SEABED	-	(A) Sandy and rippled with heaps of sand as high as 1 1/2 meters
COUNTRY	-	Benin Rep. and Togo Border
POSITION	-	Lat. 6° 14'.14N, Long. 1° 57'.95"E Diving was carried out three different areas (1) West of Benin/Togo Border (2) East of Benin/Togo Border dive sample-sandy mixed with stones (3) Central dive: on border line
DATE	-	10 - 10 - 89
TIME	-	07 30 hrs - 08 55 hrs
DEPTH	-	20 meters
CURRENT	-	Nil
VISIBILITY	-	Good (Sunny)
SEABED	-	Sandy, packed in rippled heaps lenses
COUNTRY	-	Ghana
POSITION	-	Lat. 4° 43'.02"N, Long. 2° 00'.00"W
DATE	-	16 - 10 - 89
TIME	-	1245 hrs - 1330 hrs
DEPTH	-	23 meters
CURRENT	-	Very strong

VISIBILITY	-	Good (Sunny)
SEABED	-	Rocky with corals
COUNTRY	-	Cote d'Ivoire
POSITION	-	Lat. 5° 18'.02"N, Long. 4° 1'.33"W
DATE	-	22 - 10 - 89
TIME	-	1100 hrs - 1210 hrs
DEPTH	-	22.8 meters
CURRENT	-	Strong
VISIBILITY	-	Good
SEABED	-	Diving was carried out at three spots:- (a) West of Position-Sandy (White) in heaps 1/2 m. high. (b) Central dive - sands mixed with black sand in small heaps (c) East of Position and closer to the Port entrance: Sandy, with Grayish colour
COUNTRY	-	Togo
POSITION	-	Lat. 6° 10'.00"N, Long. 1° 50'.00"W
DATE	-	24 - 10 - 89
TIME	-	0900 - 1020 hrs
DEPTH	-	21 Meters
CURRENT	-	Minimal
SEABED	-	Sandy, also packed in heaps.