DISTRIBUTION RESTRICTED

CRUISE REPORT

ORV SAGAR KANYA

Cruise No. 124

(20 June to 15 July, 1997)

राष्ट्रीय समुद्र विज्ञान
संस्थान
NATIONAL INSTITUTE
OF
OCEANOGRAPHY

ORV SAGAR KANYA

Cruise No. 124

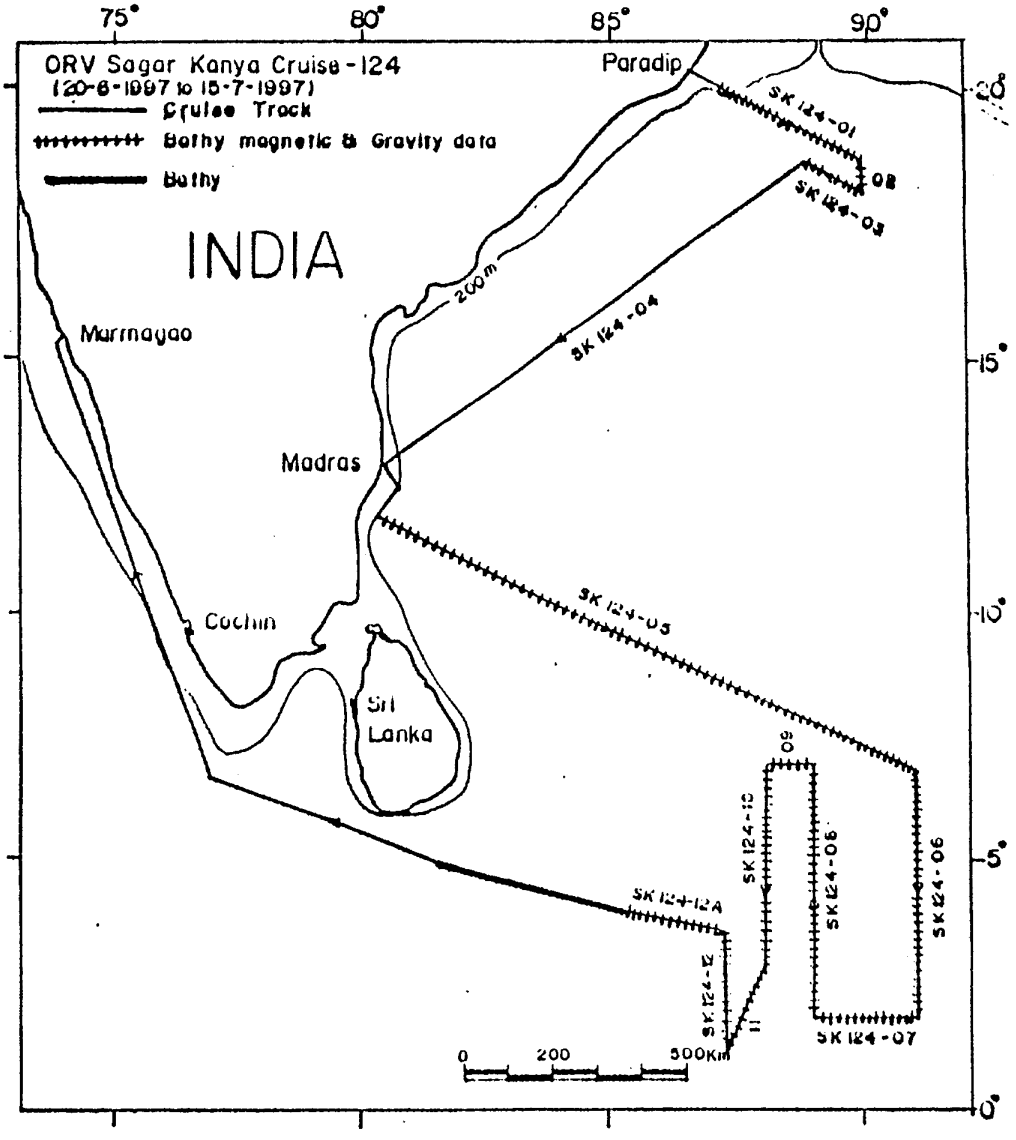
(20 June to 15 July, 1997)

NATIONAL INSTITUTE OF OCEANOGRAPHY
(Council of Scientific and Industrial Research)
Dona Paula - 403 004, GOA

Production : Scientist-in-Charge, Publication & Reprography Section
Editing : Rosy Thomas
Assistance : Cintia Lobo Po, Basinda Ribeiro & Vijaya Duggal

REPORT ON THE 124th OCEANOGRAPHIC CRUISE OF ORV *SAGAR KANYA*

CONTENTS


75°
80°
85°
90°
20°
15°
10°
5°
0°
ORV Sagar Kanya Cruise - 124
(20-6-1997 to 15-7-1997)
Cruise Track
Bathy magnetic & Gravity data
Bathy
INDIA
Paradip
Marmagao
Madras
Cochin
Sri Lanka
200m
SK 124-01
SK 124-02
SK 124-03
SK 124-04
SK 124-05
SK 124-06
SK 124-07
SK 124-08
SK 124-09
SK 124-10
SK 124-11
SK 124-12
SK 124-12A
0 200 500Km

2. SUMMARY

The vessel ORV Sagar Kanya sailed off Paradeep Port on 20 June 1997 by 1700 hours towards the survey area in northern Bay of Bengal.

The main objectives were :

(i) Acquisition of multichannel seismic reflection data along the axis of 85°E Ridge and gravity, magnetic and bathymetric data along the predetermined cruise tracks in the Bay of Bengal to cover the existing data gaps

(ii) Mapping of seafloor spreading magnetic anomalies corresponding to the early cretaceous age (133.5-118 Ma) in the northern Bay of Bengal, and

(iii) Mapping/ identification of late cretaceous magnetic anomaly sequence A34 to A32 in the distal Bengal Fan.

Due to bad weather conditions and severe cyclonic depression off Paradeep in the northern Bay of Bengal, acquisition of multichannel seismic reflection data, as planned, could not be done. Further, acquisition of magnetic gravity and bathymetry data was also abandoned within three days due to persistent bad weather condition. The course of the vessel was altered from Madras to distal Bengal Fan (South of 7°N latitude) as this area was not under the influence of depression during the cruise period.

About 5000 lkm of bathymetry, 4000 lkm of total magnetic intensity and gravity data were collected along three NW-SE and four N-S trending tracks. The bathymetry in general depicts a smooth topography of the sea floor . Occasionally the seafloor is seen traversed with the channels. The depth varies from <700 m off Bengal to >4400 m in the distal Bay of Bengal.

The presence of Mesozoic magnetic anomaly sequence M11 to M0 (133.5 - 118 Ma) has been inferred along the profile SK124-05. However the anomalies M9 to M4 are seen affected by the sub-surface 85°E Ridge. The anomaly sequence A34 to A32 have been identified on all the north-south profiles. Thus the analysis of this magnetic data helped to decipher the boundary of the late cretaceous crust (~84 Ma) in the distal Bengal Fan without any ambiguity.

Free-air gravity data east of 86°E longitude shows no significant pattern of undulations that represents the impact of intraplate deformation between 7°N and 2°N latitudes. The bathymetry, magnetics and gravity data were collected for about 10 days between 7°N and 2°N east of 86°E longitude .As there was no considerable improvement in the weather condition but for few days, the surveys were abandoned and the vessel reached Mormugao port on 15 July, 1997. Inspite of the bad sea state and the weather conditions, fairly a good amount of underway geophysical data was collected.

3. PARTICIPANTS

3.1Scientific Component

M.V. Ramana	) —	Chief Scientist
V. Subrahmanyam	)	
K.V.L.N.S. Sarma	)	
N.P.C. Reddy	)	
S.K. Nanyasi	)	
P. Marathe	) —	NIO, Goa
V.D. Khedekar	)	
S.S. Pattansetti	)	
V. Fernando	)	
K.L.Naik	)	
M.M. Subrahmanyam	)	
Biju V Nair	)	
P. Bhoopathy	) —	M/s NORINCO Goa
J.P. Joseph	)	
Brian Telles	)	

3.2 Ship's Complement

Capt. W.T. Pereira	) —	Master
Sam Abraham	) —	Chief Officer
N.S. Bajwa	) —	3rd Officer
V. Gurnyyn	) —	AWKO
Ashwani Kumar	) —	AWKO
James Jose	) —	Med. Officer
G.S. Nagarcenkar	) —	Radio Officer
G. C. Jacques	) —	Purser
Vinay Kumar	) —	C/E/O
V. Singh	) —	2EO
Ravi R. Rao	) —	3EO
M. Mondal	) —	4EO
Y.K. Bhusan	) —	5EO.
Sreedharan P	) —	Elec. Officer
Vinay Kotnala	) —	Elec. Officer
I. R. Vaz	) —	Ctg. Officer
S. KarunakaranAsst.	) —	Ctg. Officer

4. Introduction

4.1 Back Ground

Under the programme on marine geophysical investigations of the Deep Sea Fans of Bay of Bengal, large amount of bathymetry, gravity, magnetic and multichannel seismic reflection data were collected onboard DSV Nanda Rachit and ORV Sagar Kanya during !989-'95. The analysis of the magnetic data thus collected revealed the presence of Mesozoic magnetic anomaly sequence M11-M0 of 133.5 to 118 Ma. Data gaps exist in the proximal and distal parts of the Bengal Fan which are critical areas to understand the evolutionary history of the Bay of Bengal. Hence to confirm the age and the nature of the crust in the above areas, acquisition of additional underway geophysical data was planned in this cruise. A detailed mapping of Mesozoic anomalies in the proximal parts of the Bengal Fan and the late cretaceous magnetic anomalies A34 to A32 east of 85°E longitudes would enhance the understanding of the tectonic framework of the area. Further, it was planned to study the effect of the intraplate deformation in the geographical area east of 86°E longitude and south of 7°N latitudes by taking gravity observations.

4.2 Quantum of Work

The following underway geophysical data were collected

a) Echosounding	~5000 lkm
b) Gravity	~4000 lkm
c) Magnetics	~4000 lkm

4.3 Itinerary

Dep	:	Paradeep	20. 6.1997
Arr	:	Mormugao	15. 7. 1997

5. ACQUISITION OF UNDERWAY GEOPHYSICAL DATA

5.1Navigation

The positions during the survey were obtained by using a Magnavox Series 5000 Integrated Navigation System (INS) and Global Positioning System receiver (GPS, Model MX 4400) as primary navigational aid. The survey lines were shot in a total distance mode with 300m as the shot point interval. Navigational information was logged in Integrated Navigational System (INS Series 5000). The WGS -84Satellite datum was used as system datum . Navigational Information for INS was derived mainly from Global Positioning System (GPS). GPS positioning system popularly known as Navstar (Navigation system with Time and Ranging) consists of satellite circling the earth nominally at 20,200 (10,900 nautical miles) orbits. Each satellite has an orbital period of 12 hours. They transmit signals to both the control segment and the user segment. The control segment monitors the satellite and transmits the corrected ephemerides, constellations almanac, and corrected time to the satellites. The user position is determined by taking time of arrival (TOA) measurements on the satellite signal and the satellite ephemerides for each satellite being tracked, at the precise time of transmission of its signal. The TOA at the receiver is determined within the clock bins of the signal , by synchronization of the receiver with the code generated by the satellite. The receiver can then calculate pseudo - range by scaling the sums of the signal propagation delays and clock bins by speed of light. This range is called pseudo - range because of clock errors of the receiver and satellite clocks. Information on the satellite

satellite clock bias contained in the signal from the satellite allows correction of pseudo - range by accounting for the effect of clock bias in the satellite clock.

By using three satellites and known height, or four satellites when height is unknown, for a position solution, the clock bias for the receiver clock can be determined. Velocity is calculated by making Doppler measurement on the carrier frequency of the broadcast signal. Each set of four Doppler measurements is processed to calculate three - dimensional velocity. Navigation is accomplished using the Kalman Filter, which is a software based navigation model stored in the receiver. It predicts and produces a continuous navigation solution based on the TOA and Doppler measurements.

In MAGNAVOX MX 4400 GPS receiver position can be obtained in the following three modes.

* Four satellites being tracked, Latitude, Longitude, Altitude (height) and time being obtained from the satellites.

* Three satellites being tracked , latitude , longitude and time being received from the satellites: Altitude is fixed or input of altitude supplied manually or by external devices.

* Two satellites being tracked , latitude, longitude only being received from satellites by Altitude and clock guiding (time).

During the cruise the GPS set was used in ALT - HOLD mode. In this mode three satellites are used in determination of the vessel position as altitude (i.e. antenna height) fixed from the sea level. The gravity data could not be logged on to the INS due to software problem.

Position Fixing: The satellite navigation system (Magnavox) was used for position fixing. Satellite transmits information as a function of time, about its position relative to the center of the earth. By measuring the change of the Doppler frequency of the received signals as the satellite approaches, passes and records, it is possible to fix the position of the ship relative to the satellite and hence precise position of the observation. Since there are small number of satellites between the satellite fixes, the positions were obtained under a dead reckoning mode.

5.2 Bathymetry

The bathymetric data was collected with 12 KHz frequency Honeywell Elac deep sea echosounder. The data was recorded on a 25.5cm wide electrostatic paper. The master was kept in 5000 m range, whereas the record on a repeater/slave was obtained at enhanced scales for resolution purpose.

5.3 Magnetics

During thecruise earth's total magnetic field intensity was measured along the tracks using G886 proton precession magnetometer. The sensor was towed approximately 300m astern of the ship to avoid the ship's noise. The data were recorded continuously in analog form with sampling interval 6 sec.

5.4 Gravity

The gravity data was collected using Bodensewerk KSS 30 model Sea Gravimeter which consists of GSS 30 gravity sensor subsystem,KT 30 stabilization sub system and data handling system. The gravity data was collected along three/four NW - SE and four N-S trending tracks. Parabola and hall calibration tests were carried out prior to commencement of cruise. The Phillips dual channel chart recorder was used for quality control and ship's acceleration. The digital gravity printout was taken on teletype printer and simultaneously stored in diskettes.

6. SALIENT OBSERVATIONS

Bathymetry: The depth in the area surveyed range from about 700 m to 4400 m. Turbidity channels exist between 85° E longitude and west of Ninetyeast Ridge. Most of the study area is characterized by smooth topography except in the near shore regions off Madras.

Magnetics: The earth's total intensity magnetic field in the study area varies between 40,440 and 43824 nT from south to north. The data collected along NW-SE trending SK 125-05 profile show the magnetic anomalies resemble that of the seafloor spreading type magnetic anomalies. A close study of the distribution of the anomalies along the profile SK 124-05 and their comparison with Mesozoic anomaly sequence M11 to M0 suggests that the anomalies M4 - M0 and M11 - M9 are more conspicuous on the eastern and the western sides of the sub-surface 85° E Ridge respectively. Further, the identified magnetic anomaly M11 appears to be the oldest anomaly close to the east coast of India. The N-S profiles collected in the distal Bengal Fan east of 86°E longitude and between 7°N and 2°N latitudes depict variation of the magnetic field from 40741 to 41493. The preliminary analysis of the magnetic data revealed the presence of late cretaceous anomalies represented by anomaly isochrons A34 to A32.

Gravity: Around -60 m Gal free air gravity anomaly was observed over the shelf break region. Beyond the shelf break, the gravity field gradually rises to a maximum of about -15 m Gal, probably indicating crustal thinning further offshore. Along the NW-SE trending gravity profile (SK 124-05), a gravity low of the order of -70 m Gal is observed across the 85° E Ridge. Between 85°E Ridge and the Ninetyeast Ridge low amplitude gravity highs and lows are observed. Some of these highs and lows appear to be partly due to the undulations of the underneath crust and that of the sediments. Along the north-south gravity profiles the gravity field varies 26 m Gal to +98 m Gal. The gravity data depict least influence of intraplate deformation in the form of undulations within the gravity field east of 85°E longitude between 7°N - 1°N latitudes.

Mapping of the late cretaceous crust characterized by the magnetic anomaly isochrons A34 to A32 in the distal Bengal Fan and confirmation of the presence of Mesozoic anomaly sequence M11to M0 in the proximal and central Bay of Bengal further enhanced the understanding of the evolutionary history of the Bay of Bengal .

7. PROBLEMS/RECOMMENDATIONS

(i) Gravity data is not going to INS due to hardware problem.

(ii) Magnetic data is to be logged along with navigational data on INS

(iii) Digital display unit of Elac Narrow beam echosounder should be repaired and interfaced with INS so that all gravity anomalies (Bouguer, Eotvos) can be computed onboard during the cruise.

(iv) A standby deep sea winch motor unit is to be kept available on board.

(v) As the existing INS System became obsolete, it is suggested to replace with a new state -of-the art system that can be used as a data logger too.

(vi) The IIP 1000 Computer situated in chart and drawing room has also become obsolete and requires frequent service and maintenance. Hence this system should also be replaced immediately with a suitable computer for scientific data processing.

(vii) Personal Computers (Pentium 100) minimum two numbers may be immediately installed on board the ship.

(viii) The shipshould be facilitated with the E mail/internet systems for fast communication purpose.

(ix) The R-T system available at NIO should be either upgraded or ensured its function regularly with out any technical hindrance.

8. ACKNOWLEDGEMENTS

The Chief Scientist and all the members of the scientific team express their sincere thanks to Captain and crew members of *ORV Sagar Kanya* for their excellent cooperation during the cruise. They also express their sincere thanks to Department of Ocean Development, Government of India for providing the valuable ship time.