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Report on Oceanographic Cruise of O. R. V. Sagar Kanya

CRUISE No. 84

5th July to 1st August, 1993

National Institute of Oceanography
Dona Paula-403 004, Goa
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NATIONAL INSTITUTE OF OCEANOGRAPHY
(Council of Scientific & Industrial Research)
Dona Paula, Goa - 403 004

REPORT ON

84TH OCEANOGRAPHIC CRUISE OF

O.R.V. SAGAR KANYA

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C O N T E N T S

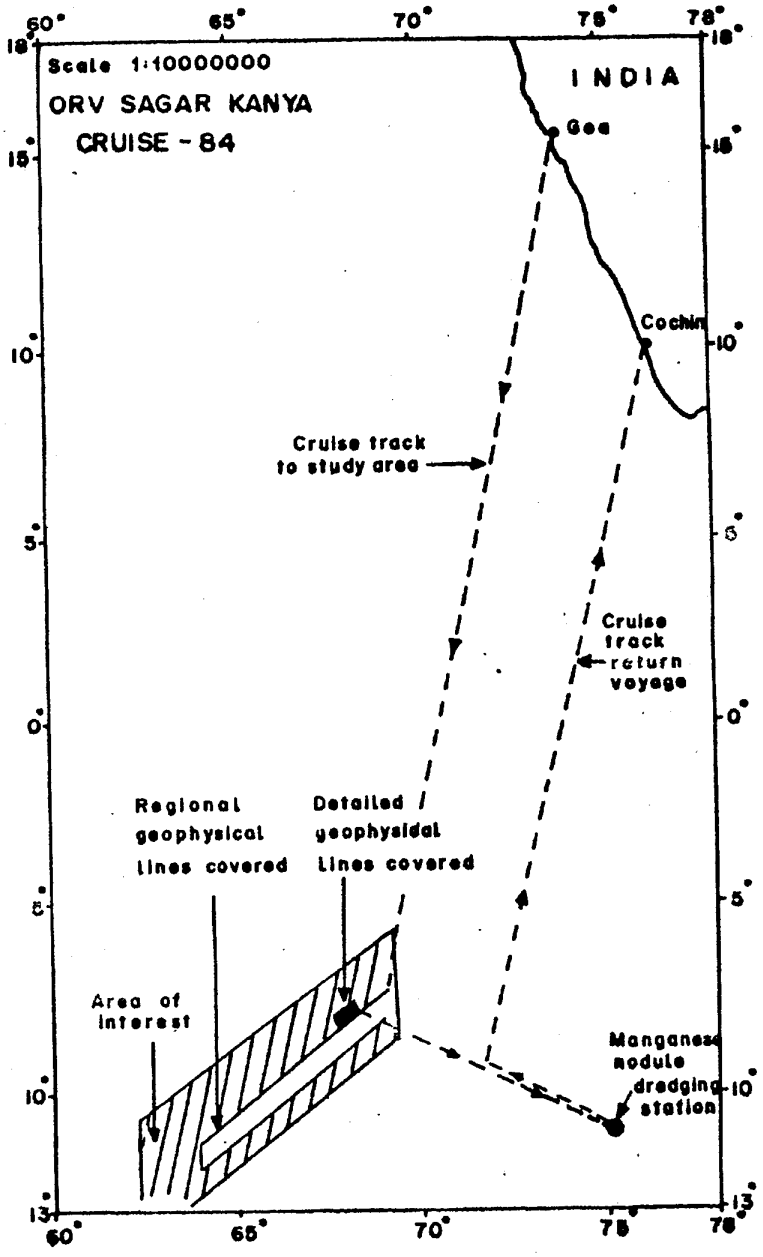

Fig. 1 The cruise tracks and the geophysical data collection.

2. CRUISE SUMMARY

The cruise 84 of ORV SAGAR KANYA was planned to study the Vema Fracture Zone in the Indian Ocean. The cruise started ffom Mormugao Harbour on 5 July, 1993 and ended at Cochin on 1 August, 1993. During the voyage, before reaching the study area, the hydromap was rectified and the two operation cameras were repaired. Geophysical studies comprising hydrosweep bathymetric mapping, magnetic and gravity intensity measurements were carried out to demarcate precisely the ridge axes, transform fault strike, ridge displacement and to define the age of the study area. A sediment core of 3.7 m long at 11°19.14'S and 63°54.06'E in a water depth of 3557 m was collected. This exhibits distinct sediment character zones at two places. A box dredge was operated at the sediment core station and seven pieces of fresh pumice ranging in diameter between 3 cm and 6 cm were collected.

As per the instructions from the headquarters, the Vema work was abandoned and proceeded to CIOB for manganese nodule dredging. At the first dredging station, while hauling up of the dredge, power supply to the deep-sea winch was cut off and it took several hours to take the dredge on board. This power failure caused damage to the storage winch also. Hence the operations were abandoned and the ship sailed back to Cochin.

3. PARTICIPANTS

a) Scientific Component

V.K. Banakar	- Chief Scientist
K.A. Kamesh Raju	Geological Oceanography Division, N.I.O.
T. Ramprasad	
A.V. Mudholkar	
G. Ranade	
K.L. Kotnala	
S.K. Nanyasi	
V.S. Rajaraman	
V. Khedekar	
Senthilkumar	
Pramodkumar	Shipboard Trainees
S. Ravi	
G. Chandwale	
C. Subrahmanyam	- NGRI, Hyderabad
L. Elango	Anna Univ., Madras
S. Sanjeevi	
H. Wagle	- CMC

b) Ship's complement

R.S. Soni	-	Master
A.K.B. Nair	-	Chief Engineer
J.B. Singh	-	Chief Officer
A. Rocha	-	Radio Officer
M. Fernandes	-	Catering Officer

4. INTRODUCTION

The Vema fracture zone is the deepest part of the Indian Ocean and displaces the Mid-Indian Ridge along a transform fault (along 10°S,69°E and 8°S,69°E plane). This fracture zone though has been studied earlier during seventies, the studies were of preliminary nature. In view of this as well as the complexity of the fracture zone-ridge relationship, it was proposed to study this area during the workshop on research vessels, held at NIO in 1992. This was the first Indian expedition to study exclusively the Vema fracture zone.

5. OBJECTIVES

1) The main objective was to study the ridge segmentation processes and to delineate the morphotectonic features associated with an active transform fault (VEMA).

2) To understand the various mineralisation processes related to hydrothermal activity in the vicinity of active transform fault and the open ocean chemical precipitates.

The above studies are believed to provide information with respect to volcanic and magmatic accretion processes along the Central Indian Ridge and various mineralisation processes that might have occurred contemporaneous to ridge

crest formation in space and time.

6. ORIGINAL CRUISE PLAN

The following data acquisition and sample collection were proposed:

a) Geophysical studies comprising hydrosweep bathymetric mapping, magnetics and gravity intensity measurements along five regional lines of 180 mile each spaced at 60 mile interval in the study area to demarcate precisely the ridge axes, transform fault strike and ridge displacement. These studies would also help to identify the magnetic and gravity anomalies to define the age of the study area. The regional lines are followed by detailed geophysical lines of 60 mile each spaced at 3 mile interval on either side of the FZ covering the entire seafloor to construct the displaced ridge segments and rift valley systems.

b) Geological sampling on either side of the FZ as well as the ridge to understand the mineralisation processes. The proposed samples are to be collected using dredges and corers. The sediment cores are for understanding the CCD fluctuations in the basin and metal fluxes to the sediments in the study area.

7. ACTUAL WORK CARRIED OUT

The total package of this plan was requiring a cruise of at least 45 days duration. But due to the time constraint and limitations then existing on the vessel, it was possible to undertake a cruise of only 30 days. Before leaving Mormugao on 5th July, 1993 the problems associated with storage winch functioning were temporarily rectified.

However, the problem associated with hydromap was still existing and was rectified during the voyage before reaching the study area. Two onboard operation cameras were repaired during the voyage and fixed on the sampling equipments for continuous monitoring. The deep-sea winch gear was rusted due to non-maintenance which was cleaned and the almost empty gear chamber was filled with fresh luboil. The rusted drive line plate of the Jib-boom was greased.

Due to the time constraint, the regional geophysical lines were reduced to only two instead of five and detailed lines were reduced only to the northern adjacent portion of the FZ. The sampling locations were reduced to six instead of ten and decided to have only the operation at each station.

The regional geophysical lines reflected that the magnitude of the ridge displacement is quite larger than thought

before. The magnetic and gravity intensities in association with hydromap prepared onboard for the northern part of the Vema FZ revealed a precise location of ridge axis of one of the displaced ridge segment and the location of the rift valley.

A three-dimensional projection of hydrosweep data of the studied area indicating the displacement of the ridge along a transform fault is shown in Fig. 3. Though the acquired data was very limited to deduce a complete tectonic setting of the ridge-rift valley-transform fault system, it gives an idea of the ridge displacement processes which will be processed and interpreted in due course of time. The study area is quite interesting and a detailed work would yield very important information in understanding the active ridge-FZ relationships in space and time.

A sediment core of 3.7 m long at 11°19.14'S and 63°54.06'E in a water depth of 3557 m was collected. This location is a boundary area between Somali and Central Western Indian Ocean and is believed to be influenced by the deep water masses like AABW and NADW. The core location was quite off the Saya de Malha bank (Fig. 2). This sediment core which was collected using a cylindrical PVC pipe in a gravity core barrel of cylindrical shape, exhibits distinct sediment character zones

at two places as follows :

0.50 cm ..... milky white, fine grained, sticky nano-ooze. The preliminary microscopic studies indicated abundant discoster species while forams are absent or negligible.

50-160 cm .... light brown, loose, coarse carbonate ooze with abundant foraminifera.

160-250 cm .... as in 0-50 cm interval.

250-360 cm .... as in 50-160 cm interval.

360-370 cm .... core catcher, sediment continuation of above.

In general, the above variation in the sediment type indicates a sharp and frequent fluctuation of the carbonate compensation depth in this area. The proposed studies include detailed geochemical, mineralogical and biostratigraphy based on nanofossils to understand the CCD fluctuations and related variations in the depositional environments during the geological past. In one of the stations (Station 1) compact and hardened carbonate rocks often punctuated with several burrows and coated with 1-2 mm thick manganese oxide were recovered. The preliminary study based on the polished sections indicates a recrystallisation of carbonate ooze probably due to the

elevated temperatures in the vicinity of the active spreading centre (?). Several manganese oxide dendrites and particulate infillings have been noticed throughout the sections. The proposed studies include detailed geochemical and petrological investigations. These rock samples were dredged from a depth of 3200 m at 7°23.95'S and 68°59.56'E.

At the sediment core station (Station 1) a box dredge was operated and seven pieces of fresh pumice ranging in diameter between 3 cm and 6 cm were collected. Two dredge operations on the flanks of the ridge were unsuccessful while one dredge at the ridge crest was recovered upside down and the rock pieces fell into the water while taking the dredge onboard.

As per the instructions received from the HQ the Vema work was abandoned and proceeded to CIOB for manganese nodule dredging. At the first dredging station the operations were smooth till the hauling up of the dredge. While about 3000 m wire still in the water (out of 5200 m) the power supply to the deep-sea winch was cut off and created a lot of problem for the recovery of dredge and wire. It took nearly 9 hours to repair the electric problem and 6 hours to take the dredge on board. This power failure caused damage to the storage winch also which works in synchronisation with deep-sea winch

and forced us to abandon the operation and return back to Cochin on 1st August, 1993.

8. LOSSES AT SEA

A magnetometer sensor was lost while lowering after the completion of sampling stations. This sensor was about 10 yrs. old and had several patches on its body. Even the cable was very weak with several patches. Probably due to the entanglement with the propellor, the sensor might have been cut off from the cable.

9. PROBLEMS ONBOARD AND RECOMMENDATIONS

The overall maintenance of the vessel is extremely poor and the engineering side always tries to escape from the responsibility. Several power failures which are dangerous to the sensitive equipments were very common and frequent. The drinking water quality is extremely bad. The hatches leak and water from the deck gushes in the tightly closed hatches like a waterfall during rains. Several scientists cabins leak and toilets do not work. The railings and the plates on the deck are rusted and the rust is disguised under several paint layers. For every sampling equipment like cranes, winches, A-frame, Zib-boom, etc., the ship side was not taking any responsibility

and always were escaping from touching them. Due to this mentality and negligence of the concerned personnel, the condition of the sampling equipments and part of the deck (particularly the balloon deck) have been deteriorated. Therefore, it is suggested that the responsibilities of the SCI should be clearly defined and the necessary maintenance should be undertaken. Two fuel tanks are containing dead fuel for the last 2-3 years. If this fuel is removed and the tanks are made available for the bunkers then the vessel can take sufficient fuel for cruises more than 30 days. Air-condition unit from the storage winch room has disappeared and is very necessary for that room. The AC efficiency in the INS room is not adequate.

Apart from this the practice of collecting money from the scientists for movie cassettes by the club secretary on board should be stopped and the Victualling should be clearly defined by the SCI.

10. ACKNOWLEDGEMENTS

On behalf of the Project Co-ordinator and Project Leader, I wish to thank all the participants for maintaining a good scientific spirit throughout the cruise. I also thank those ship officers and crew members who helped us in carrying out our work.

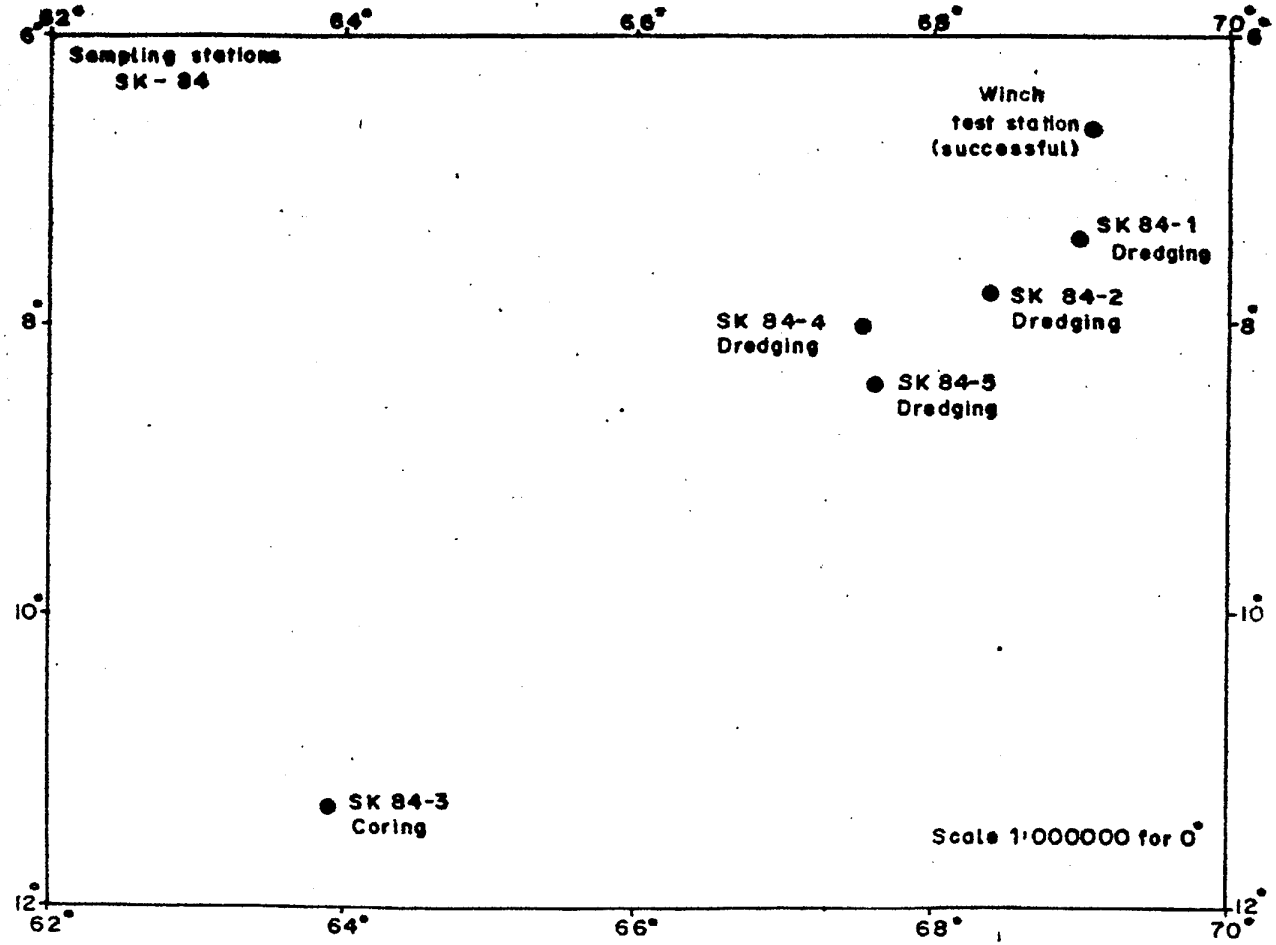

Fig. 2 Locations of the geological sampling stations and operations carriedout

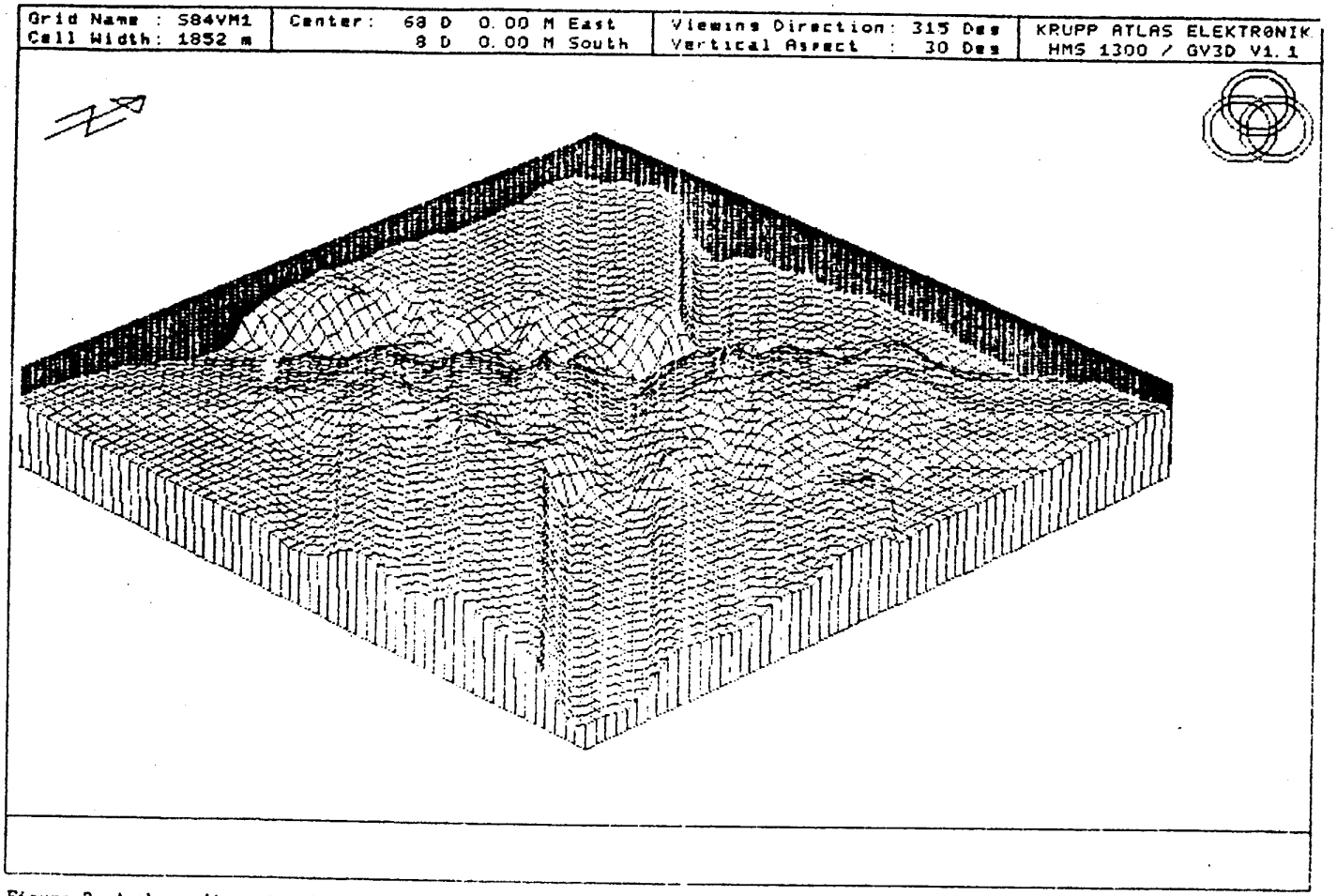

Figure 3. A three dimensional map of the ridge generated on hydromap indicatingthe ridge displacement around VEMA FZ.