

**NATIONAL INSTITUTE OF OCEANOGRAPHY**  
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**SIXTH AND SIXTH A CRUISE REPORT**

**OF**

**ORV SAGAR KANYA**

**(7 January to 2 February, 1984)**

## Report on Cruise No. VI A and No. VI of ORV SAGAR KANYA

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Fig. 1. Map showing the cruise tracks

## 1. PARTICIPANTS

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Shri V. P. Prnachandra Rao	)
Shri V. Ramaswamy	)
Shri J. N. Pattan	)
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Shri A. V. Mudholkar	) Geological
Shri G. Ranade	) Oceanography
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## 2. SHIP'S COMPLEMENT

Capt. B. K. Oberoi	....	Master
Shri R. Yadav	....	Adl. C/O
Shri C. U. Lincoln	....	Second Officer
Shri C. R. Tavares	....	Third Officer
Shri A. K. Goel	....	Chief Engineer
Shri K. N. Rao	....	Second Engineer
Shri I. Ahmed	....	Third Engineer
Shri J. B. Pereira	....	Radio Officer
Shri N. M. Belliappa	....	Electronic Officer
Shri V. K. Katyal	....	Electrical Officer
Shri S. Chinnaswamy	....	Medical Officer

### 3. INTRODUCTION

The trial cruise VI A was planned to try out the deep sea winch i.e. the traction winch and the storage winch, that had just been repaired. The objectives of the subsequent cruise VI was to carry out underway deep sea photography along pre-determined tracks using a photo-sledge and routine sampling of polymetallic nodules with boomerang grabs to fill up the gaps in the 25 km grid sampling carried out earlier.

### 4. EQUIPMENT USED AND RESULTS OF SURVEY

#### 4.1 Position fixing

The positions during the cruise were primarily obtained by a Satellite Navigator MX 1107 and also by MX 1105 as the Integrated Navigation System was non-operational due to computer malfunctioning. Positions were noted down at every half an hour interval.

#### 4.2 Marine geology and geophysics

##### 4.2.1 Bathymetry

A Honeywell-Elac Shallow Water Echosounder (150 KHz) with a depth range of 0-1500 m was used in shallow waters and a Honeywell-Elac Narrow Beam Sounder (12 KHz, 20 KHz & 30 KHz) with a range of 0-10000 m was used in deep waters.

Echosounding was started off Karwar at a depth of 48 m. The depth increased gradually over an even seabed till the shelf break at 114 m (fix 25). The upper slope is more or less smooth whereas the lower slope is uneven especially the foot of the slope where 25 to 30 m peaks and scarps are

observed. The slope shows a sediment cover of 20 m and

sediment slumping, especially between fixes 41 and 42. Beyond the slope a 60 m high ridge is observed with 50 to 60 m of sediment piled up on either side. The depth increases to 2741 m (fix 102) over even seabed, decreasing thereafter to 2602 m (fix 122) increasing again gradually over a very uneven seabed with 50 to 80 m relief to 4370 m. This is followed by uneven (20 to 30 m) to very uneven (50 to 70 m) seabed till fix 179 (4840 m).

From fix 179 onwards there is a zone of very rugged seabed (100 to 450 m relief) followed by a zone of even seabed (fix 215 to fix 227) with minor peaks (30 m) followed again by a zone of rugged topography with peaks of 100 to 350 m till stn. 001A (fix 294). The seabed is uneven to rugged the depth being around 5300 m. In general the sampling area from stn. 001 to stn. 014 is uneven to rugged with 50 to 100 m and at places 200 m elevations, with a 150 m peak at fix 315. Between fixes 347 (5148 m) and 352 (5191 m) two seamounts, one 500 m high and the other adjacent to it 600 m high, are present. This is followed by rugged seabed with a deep (300 m) valley like feature, between fixes 359 and 360.

From stn. 014 to stn. 015 the seabed is rugged between stn. 015 and stn. 017, followed by even topography (fix 408 to 410) and from fix 410 onward rugged seabed is observed as the depth decreases from 4684 m (fix 428) to 2612 m (fix 436), increasing again to 3151 m and then to 3579 m (fix 439). Between fix 440 (3578 m) and fix 444 (3047 m) a seamount 800 m high has been observed and the depth thereafter increases to 3715 m (fix 446) decreasing to 2644 m (fix 454)

over rugged seabed. It increases again to 4327 m (fix 467) over uneven topography and then decreases to 3083 m (fix 463). Rugged topography with sharp peaks (300, 700 m) and scarps (300 m) are observed between fixes 463 and 474.

From fix 475 (3088 m) the depth decreases gradually first over even seabed to 3062 m (fix 480) and then over uneven seabed with peaks and mounds 200 m high and at fix 494 (2675 m) it decreases by 200 m over a scarp, being followed again by even topography till fix 500. Between fix 500 and fix 503 there is a mound about 800 m high. The seabed drops after the mound to 2580 m, the depth then decreasing to 2025 m (fix 508) and increasing again to 2500 m over uneven of a broad ridge. Thereafter the seabed is even till fix 559 with occasional peaks rising to a depth of about 2000 m, followed by high amplitude depth variations till fix 567. From this fix to fix 595 the seabed is smooth, the depth decreases gradually from 2732 m (fix 589) to 2654 m (fix 594) and then to 2030 m at fix 606 over the continental rise, and then abruptly to 136 m over the even continental slope which has about 10 to 20 m of sediment. The shelf break is gradual and occurs at a depth of 120 m after fix 613 (off Mangalore).

The remaining part of the track is off Marmagao and zigzags over the continental shelf. Beyond fix 680 the depth increases from 115 m at the shelf break to 808 m over even topography and then to 1238 m (fix 688) over very uneven seabed with 80 to 100 m topographic irregularities, thereafter first decreasing to 440 m (fix 690) over Angria

Bank and increasing again suddenly to 1240 m. This is followed by a gradual decrease in depth to 20 m (fix 694) over the Direction Bank. The depth increases again to 202 m and then 109 m and gradually to 46 to 55 m. The shelf break occurs at a depth of 100 m.

#### 4.2.2 Seabed sampling

Boomerang grabs (Preussag Model H) were used for seabed sampling. A total of 17 stations were occupied during the cruise. Seven boomerang grabs were deployed at each station in a hexagonal pattern, one being in the centre.

Boomerang grabs were dropped 118 times and successfully collected back 115 times. Three boomerang grabs failed to pop up. Manganese nodules were obtained from most of the stations occupied except for a few where only nodule traces were obtained. The nodule concentration varied from traces to 15.7 kg/m<sup>2</sup>.

During the trial cruise VI A a grab was taken at 2035 m. The box corer was operated successfully at 2040 m and a 6 m long core of clay/silty clay was obtained. Dredging was tried with the chain-bag dredge over a rocky patch but it was unsuccessful. After the dredging operation the box corer was lowered and a 6 m long core of stiff clay/silty clay was obtained.

#### 4.2.3 Deep Sea Photography

A Edgerton Deep Sea Camera Model 372 rated to a pressure equivalent to a depth of 12000 m with a model 380-34 data chamber, alongwith a Benthos Model 382 Edgerton Deep Sea Standard Flash (depth rating - 12000 m) and a Benthos Model



2216 Deep Sea Pinger mounted on a sledge, were used in a pre-programmed automatic mode.

The camera was set for a frame interval of about 15 seconds, the aperture was set between f 4 and f 5.6 and it was focussed at 5 m. A black and white NP55 (125 ASA) film was used. The system was pre-programmed to start after a delay of 200 minutes, to allow for the lowering time, and was lowered at 50 m/minute after having synchronized the Elac STE 73 Pinger Synchro Unit with the Pinger.

The system was operated four times. At stn. 001 A(4900 m) the sledge was operated with the above settings. It was first lowered to 30 m and the Pinger Synchro Unit was synchronized with the Pinger. Lowering was then resumed, at 50 m/minute observing the pinger trace. When the sledge was about 100 m above the bottom the system was lowered slowly to 5 m above the bottom and this separation was maintained, keeping a close watch on the pinger trace, as the system was towed at 1 kn., ship's speed. After about 4 hours of camera running time hauling up of the system was started. Once on board the battery was changed and a fresh film was loaded in the camera and the system was ready for the next operation. On the second operation the sledge was lowered to a depth of 5151 m. However, during the operation (1 kn tow speed) the reflected trace of the pinger was lost and there was not indication of the separation. Hauling was started but due to a mechanical problem with the winch the wire could not be heaved unless it was first paid out. Therefore, it was first

paid out and then heaved and when the system was taken in, it was noticed that the net was damaged and that the support arm of the port fin was broken and lost. Because of these problems the photography work was postponed. It was tried at stn. 002 A but abandoned due to rough weather. At stn. 015 A it was attempted again just to evaluate the performance of the winch.

The results of the photography work have not been very encouraging. This is attributed to the difficulty in keeping the system within 5 m of the bottom, due to rough sea, and to the use of a slow film (125 ASA). A 400 ASA or higher speed film would give better results in view of the fact that a single 100 W flash light is used in this system.

#### 4.2.4 Magnetics

The absolute total magnetic intensity data was collected with Geometrics EG&G magnetometer by towing the sensing head at a distance of 180 m behind the vessel. The data was recorded at a sampling rate of 12 sec. The analyses of the magnetic data gives the following information.

While proceeding to the survey area high amplitude and short wavelength anomaly of the order of 1000 nT was observed between fixes 3 and 4 which may be due to the presence of an intrusion at a shallow depth. From fix 18 to 47 the magnetic picture has a smooth character and at some places broad wavelength anomalies were noticed and may be due to the deeper basement.

Between fixes 55 and 58 wavelength (10 km) medium amplitude (300 to 400 nT) anomaly was observed. Further the

field is smooth with a variation of 100-200 nT upto fix 104. At fix 125 broad wavelength (8 km) medium amplitudes 400-500 nT anomaly was observed. Between fixes 134 and 138 a broad wavelength (6-7 km) with an amplitude of 600-700 nT anomaly was observed. Between 140 and 145 fixes the anomalies are of broad wavelength and less amplitude. At fix 162 a broad wavelength (8 km) medium amplitude (500 nT) anomaly was observed. Between the fixes 167-188 a series of broad wavelength (7-8 km) <sup>high</sup> amplitude (700-800 nT) anomalies were observed. ~~low amplitude (200-300 nT) anomalies were observed.~~ Further upto fix 223, the field was almost smooth. From 224 to 235 broad wavelength (8-12 km) anomalies with an amplitude of 400 to 600 nT were noticed. Between fixes 248 and 253 very high amplitude (2000 nT) anomaly with a wavelength of 5 to 6 km was observed. Thereafter a set of highs and lows were noticed between fixes 274 and 280. Till fix 293 the magnetic picture is comparatively smooth.

In the actual survey area no magnetic data has been collected because the sampling stations are in a very close grid. In the return track a broad wavelength anomaly with an amplitude of 400 nT was noticed at fix 411, the field being smooth upto fix 416. Further between fixes 417 and 418 an increase of 700 nT was observed. Between 426 and 429 broad magnetic highs and lows were noticed with an amplitude of 200 nT. Upto fix 455, the field is smooth. Magnetic low of 400 nT was noticed between 456 and 459. At fixes 466 and 470 magnetic highs of 800 nT were observed.

Further upto fix 484 the field varies between 100 to 200

nT. The field being smooth upto fix 499. Broad wavelength lows and highs were noticed between fixes 500 and 520 with an amplitude of 300 nT. A magnetic high of 300 nT was observed between 525 and 526. Further the field is smooth. Between the fixes 550 and 610 the variation in the magnetic field is 100 to 300 nT. At fix 618 a broad wavelength (10 km) anomaly was observed, with an amplitude of 300 nT. Further upto fix 647 there is an increase of 800 nT in the magnetic field. Upto fix 655 high frequency anomalies were noticed. Further upto fix 666 the field is smooth. Again upto fix 670 the high frequency field was observed. Magnetic low of 300-400 nT was noticed at fix 673. Further the field is smooth upto fix 689. Broad low was noticed, between the fixes 690 and 691. Not much variation in the field upto the end of the survey (fix 714).

#### 4.2.5 Gravimetry

The gravimeter could not be used due to malfunctioning of the Integrated Navigation System to which it is coupled.

#### 5. LOSSES AT SEA

Two boomerang grabs with radio markers were lost at station 001 and 005. A photoboomerang with radio marker and lamp beacon was lost at stn. 004.

On the second operation of the photo-sledge at the first station 001 A the net of the sledge was damaged and a support of the port fin was broken and lost.

#### 6. SUMMARY

Trial cruise VI A was planned to try out the deep sea winch and the objectives of the subsequent cruise VI was to

carry out underway photography and routine sampling with boomerang grabs of Polymetallic Nodules.

The vessel cruised for 7800 lkm and over 7788 lkm of echosounding and 7178 lkm of magnetics data were collected. Navigation during the cruise were carried out by a satellite Navigator MX1107 system.

The echograms show the shelf to be even till the shelf break at 114m (fix 25). The upper slope is smooth whereas the lower slope is uneven, with 25 to 30 m peaks and scarps at the foot. This is followed by a 60 m high ridge with 50 to 60 m of sediment accumulation on either side. The depth increases to 4370 m over very uneven seabed with 50 to 80 m relief and then to 4840 m over uneven seabed. This is followed by a zone of very rugged topography (100 to 450 m relief) till stn. 001 A. From this region to the first relief till stn. 001 A. From this region to the first sampling station the seabed is uneven to rugged.

In general the sampling area from stn. 001 to stn. 014 is uneven to rugged. Between fixes 347 and 352 two seamounts one 500 m high and the other 800 m high are present.

From stn. 014 to stn. 015 the seabed is rugged and between fixes 374 and 378 a 600 m deep valley has been recorded.

On the return track the seabed exhibits rugged topography as the depth decreases from 4684 to 2612 m and increasing again to 3579 m. Between fix 440 and fix 444 a 800 m high seamount has been observed. From fix 475 the depth decreases gradually first over even and then over

uneven seabed with 200 m high peaks. The depth continues to decrease over uneven seabed of a broad ridge with a seamount between fix 500 and fix 503. The seabed is even and then smooth over the continental rise decreasing rapidly to 136 m over the continental slope. The shelf break is gradual and occurs at a depth of 120 m. A grab sample was taken at 2035 m and two 6 m long box cores, clay/silt and stiff clayey clay respectively, were collected during the trial cruise VI A. Dredging was also tried but it was unsuccessful.

The remaining part of the track is off Marmagao zigzagging over the continental shelf. The depth increases and decreases as the tracks cross the shelf break (104 m, 115 m). The depth over Angria Bank was 440 m and as the Direction Bank was crossed the depth decreased to 20 m increasing to 202 m and then decreasing to 46 m at the end of the track.

During the cruise (VI) to the Central Indian Ocean sampling was carried out at 17 stations. A total of 118 boomerang grab launchings and 115 recovery operations were carried out. Manganese nodules were obtained from most of the stations. Their concentration varied from tracers to *as much as* 15.7 kg/m<sup>2</sup>.

Deep sea photography was tried four times at three stations at depths of around 5100 m. Due to problems with the winch and rough weather it could not be carried out continuously along the pre-determined tracks. The results of the photography work have not been very encouraging due to (1) the difficulty in keeping the system within 5 m above the

bottom due to rough sea and (2) the use of a slow film (125 ASA).

Magnetic data collected shows a high amplitude and short wavelength anomaly of the order of 1000 nT between fix 3 and fix 4, on the shelf, which may be due to a shallow depth intrusion. Off Mangalore and on the slope the field is smooth and at places broad wavelength anomalies were noticed. Broad wavelength medium amplitude anomalies 400-500 nT at fix 125 and 600-700 nT between fix 134 and fix 138 were observed. This is followed by low amplitude broad wavelength anomalies till fix 162 where a medium amplitude (500 nT) anomaly is observed. Between fix 248 and fix 253 a very high amplitude (2000 nT) anomaly was observed followed by highs and lows between fixes 274 and 280, the field being smooth thereafter till the sampling area.

In the return track a broad wavelength 400 nT anomaly was noticed at fix 411. In general broad magnetic highs and lows with amplitudes in the range of 100-300 nT were recorded. A magnetic low of 400 nT was observed between fix 456 and fix 459 and a 800 nT high was recorded between fixes 466 and 470.