CRUISE REPORT

ORV SAGAR KANYA

Cruise No. 104

(20 July to 12 August 1995)

राष्ट्रीय समुद्र विज्ञान
संस्थान

NATIONAL INSTITUTE
OF
OCEANOGRAPHY

ORV SAGAR KANYA

Cruise No. 104

(20 July to 12 August 1995)

NATIONAL INSTITUTE OF OCEANOGRAPHY

(Council of Scientific and Industrial Research)

Dona Paula - 403 004, GOA

REPORT ON THE 104TH OCEANOGRAPHIC CRUISE OF ORV SAGAR KANYA

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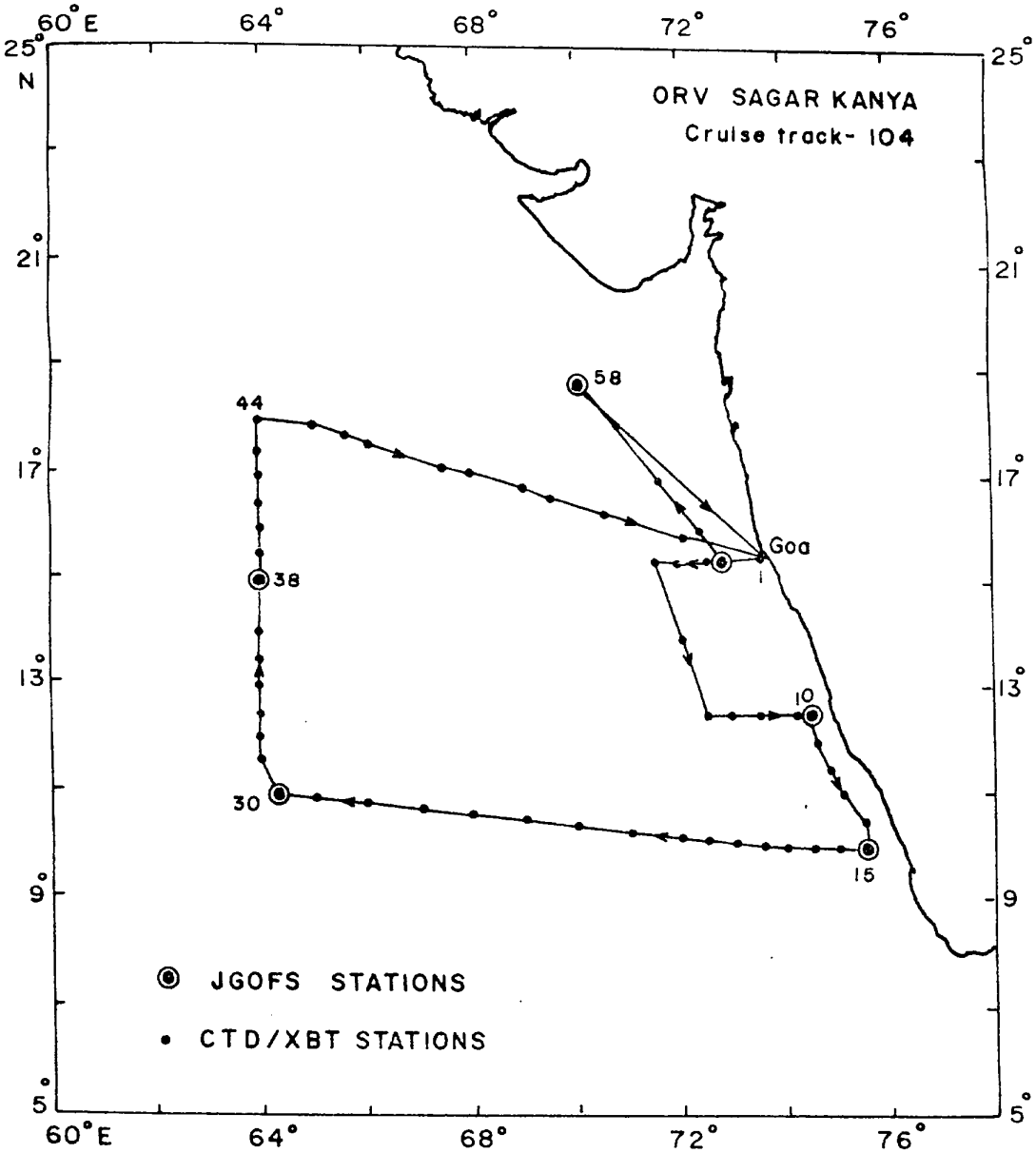
60°E
64°
68°
72°
76°
25° N
21°
17°
13°
9°
5°
ORV SAGAR KANYA
Cruise track- 104
58
44
Goa
1
38
10
30
15
JGOFS STATIONS
CTD/XBT STATIONS

2. CRUISE SUMMARY

The cruise 104 of ORV *Sagar Kanya* was conducted in the Arabian Sea with the following objectives:

(i) To study the oceanographic processes that govern the flux of carbon and other biogenic elements during the monsoon, (ii) to understand the physical processes that trigger and transport the carbon in the monsoon regime of the Arabian Sea and (iii) to study the distribution of aerosol particles in the monsoon influenced Arabian Sea.

The cruise started from Mormugao harbour on 20.7.95 towards the southwest coast. The ship occupied 39 CTD stations and 19 XBT stations for observations. The first 20 and last five CTD observations were made on the shelf for studying upwelling. Though all sections have signatures of upwelling, it was more prominent at the section off Mangalore. Strong southward drift all along the cruise with intense westerlies was felt. Sea truth parameters were collected at every six hourly interval. Less wind was observed along the south and it ranged to the maximum towards the farthest northwest. Water samples were collected for analyses of oxygen, nutrients, pH, alkalinity and total carbon dioxide at 31 stations. The results suggest deepening of thermocline south of about 14°N and shallowed towards the north. Turbulence dominated the biological production at the surface causing changes in total carbon dioxide. Water samples were collected for chlorophyll concentration and productivity studies. Shallow stations registered higher biomass values compared to the deep stations. Zooplankton prodution was low in Goa region compared to Bombay, Mangalore and Cochin. Nitrous oxide and methane were measured from samples collected at JGOF stations and CTD stations. Surface sea air was also monitored on daily basis.

After completing the observations, the ship sailed back and arrived at Mormugao harbour on 12 August 1995.

3. PARTICIPANTS

3.1 Scientific Component

P.M.A. Bhattathiri	—	*Chief Scientist*
S.Raghukumar		
R.Mohanraju		
V. Subramaniam		
Mangesh U. Gauns		
Surekha Sawant		N.I.O., Goa
A.S. Muralinath		
P.M. Muraleedharan		
A. Almeida		
M. Dileepkumar		
A. Rajendran		
P.V. Shirodkar		
M.D. George		
S.N. De Souza		
V.V.S.S. Sharma		
Sunoj P. Raikar		
Ganesh Chandavale		Shipboard Trainee
T.C. Gopalakrishnan		N.I.O. Regional Centre, Cochin
P.N. Aravindakshan		
R. Rengarajan		
M. Dixit		PRL, Ahmedabad
T.K. Sunil Kumar		
Aditi Pant		NCL, Pune

3.2 Ship's Complement

Capt. Chidananda Pal	Master
M.S. Pangtey	Ch.Off.
H.C. Medha	Addl. Ch.Off.
M.Thangamani	W.N.O.
A.K. Tewari	A.W.K.O.
V.C. Chandran	Rad.Off.
Dr.S.Murthy	Med.Off.
R.Saldanha	Purser
S.Gangopadhyay	C/Engr.Off.
P.K.Mitra	2/Engr.Off.
R.P.Ghosh	3/Engr.Off.
M.N.Muraleedharan	3/Engr.Off.
D.Singh	4/Engr.Off.
K.Prasad Mishra	5/Engr.Off.
K.Pandey	Elect.Off.
P.J.Valson	Elect.Off.

4. OBJECTIVES

1. To study the oceanographic processes that govern the flux of carbon and other biogenic elements in the Arabian sea during the monsoon.
2. To understand the physical processes that trigger and transport the Carbon in the monsoon regime of the Arabian sea
3. To study the distribution of aerosol particles in the monsoon influenced Arabian sea

5. CRUISE DETAILS

5.1 Physical Processes

The cruise was conducted in the Arabian Sea and it covers 39 CTD stations and 19 XBT stations. The first 20 and last five CTD observations were made on the shelf for studying upwelling along the southwest coast of India. These stations were distributed in five legs, three across and two along the coast. Though all sections have signatures of upwelling, it was more prominent at the section off Mangalore. Strong southward drift all along the cruise with intense westerlies was felt.

All the 11 deep stations proposed at 64°E could not be completed because of strong wind and high sea state. Seven CTD stations of one degree intervals along with half degree XBT drops were successfully carried out at 64°E from 11°N to 18°N. All the data collected were analysed and plotted onboard. The preliminary analysis of the data indicate a steep decrease in the mixed layer depth (43 m) around 16°N coinciding with an all time low SST of 26.3°C and highest wind speed of 15.4 m/s. Higher mixed layer depth with high SST and relatively low wind speed prevailed on either side of this latitude. This peculiar feature may be associated with the appearance of Findlater jet at 16°N. The low SST and shallow mixed layer depth may be indicating the northern limit of the jet as it produced upwelling at its north and sinking at south. The deep mixed layer depth at south may be associated with sinking at the southern limit of the jet.

Various seatruth parameters such as wind speed, wind direction, air temperature, atmospheric pressure, sea surface temperature and other parameters like cloudiness, sea state, etc. were also collected. These data were collected at every six hours interval including all CTD stations.

Along the entire cruise track it was observed that the wind speed varied from no wind or very less winds along the southwestern horizontal western track to maximum winds towards the farthest northwest followed by least atmospheric pressure and highest sea state along the entire cruise track indicating low pressure area. It was also observed that the sea surface temperature roughly remained constant or was subject to very less variations.

5.2 Chemical Processes

Chemical analyses have been performed for oxygen, nutrients, pH, alkalinity and total carbon dioxide at 31 stations during the cruise. Samples were collected and stored for the shore analysis of dissolved organic carbon, dissolved boron and its isotopes. Surface samples were collected and stored for nitrous oxide analysis. In addition to the regular chemical analysis in the upper 1000m, surface samples at 5 stations were analysed for total carbon dioxide, pH and alkalinity. In order to understand the variabi·y in three hourly diurnal changes in surface pH, alkalinity

and total carbondioxide, analyses were performed at an offshore station (stn.38) and a coastal one (stn.54) around 15°N.

The salient features observed based on chemical analysis are: (a) Total carbon dioxide at surface is significantly lower at coastal stations off Goa and Mangalore, (b) Upwelling signatures are seen in nutrients (with about 8 µM of NO_3 at 10m) and total carbon dioxide (with about 300 µM gradient between 5 and 10m at stn.10), (c) Relatively higher concentrations of nutrients (NO_3 4 µM, NO_2 0.3 µM, PO_4 0.7 µM, SiO_4 0.5 µM) at stn.40 may be indicative of intense advection in the upper 70m, (d) results suggest deepening of thermocline south of about 14° N and shallowed towards the north of this latitude and (e) turbulence dominates the biological production at the surface, causing (diurnal) changes in total carbon dioxide.

5.3 Biological Investigations

Water samplings were made with Go-Flo Bottles upto a depth of 120 m. Eight discrete samples were collected from each station and 5 JGOFS stations were occupied. Productivity measurements were made by ^{14}C technique. samples were incubated *in situ* from sunrise to sunset. Light and dark bottles were used at each depth. One light bottle was used for zero time activity. After incubation samples were filtered onto GF/F filter and transferred to 90% acetone and kept in cold and dark condition for 24 hours. The fluorescence before and after acidification was measured in a Turner Design Fluorometer. Concentrations were calculated by using appropriate calibration factors. Samples from each depth were incubated onboard with addition of ^{15}N - Sodium nitrate to evaluate the new production. For analysis of Carbon and nitrogen concentration samples were filtered to a preheated GF/F filters.

At most of the coastal stations chlorophyll *a* concentration did not vary appreciably up to 50 m. However at open ocean the concentration did not vary up to 80 m. This is due to the fact that isothermal layer was around 45- 50 m in the coastal waters and above 75 m in the offshore waters. At 3 JGOFS stations productivity measurements were made by using O_2 technique. ETS activity of samples were made at the stations.

Stratified zooplankton collections were made using Multiple Plankton Net. A total of five stations were worked out, of which four were shallow, along the 200m depth line and the fifth was a deep station. The shallow stations were off Bombay, Goa, Mangalore and Cochin and the deep station was at 10°58'N and 64°20'E. The strata sampled were one above the thermocline, one through the thermocline and 1 to 3 strata below the thermocline depending upon the depth of the station (1000 to 500, 500 to 300, 300 to below thermocline,through thermocline and above thermocline). In each station two observations were made around midday and mid night. Biomass was estimated by measuring the displacement volume and computing the values to ml/100 m^3. Shallow stations registered higher biomass values (2.9 to 200 ml/100 m^3) compared to the deep stations (negligible values to 40.0 ml/m^3). Surface layers had more zooplankton biomass and the values decreased with depth. Generally the night collections were richer. Among the shallow stations, zooplankton production was low in the Goa region, maximum being 40.0 ml/ 100 m^3 only, compared to the other three regions where it was 100 ml/100 m^3 or more. Samples from Mangalore and Cochin areas were having plenty of decapod larvae. Gelatinous tunicates were present in the Bombay region. Deep sea samples contained larvae of some myctophids and red prawns.

Microzooplankton were also collected using Go-Flo bottles from 5 depths and water was filterd through 40 micron bolting silk. The depth of sampling ranged within 0 to 200 m and the strata sampled varied depending on the thermal stratification and depth.To study the nannoflagellate biomass 60 ml of water samples were filtered from different depths using 0.2 and 0.8 micron nucleopore filters. These were stained using DAPI, and counter stained with Proflavine for further studies using epifluorescence microscope in the laboratory.

Water samples from 5 to 8 depths at 6 stations were collected to study the following parameters: a) Bacterial abundance, using the acridine orange direct detection method; b) Bacterial productivity based on the incorporation of tritiated thymidine; c) Total picoplankton counts using epifluorescence microscopy and d) Numbers of thraustochytrid protists, using the acriflavine direct detection technique. Water samples were fixed in 3 % formalin and stored at 10°C in the dark to estimate bacterial, picoplankton and thraustochytrid populations. In order to measure bacterial productivities, 27.8 ml samples were incubated for 1 hr in tritiated thymidine at a final concentration of 10 nM with an activity of 4.7 microcurie. Following incubation, bacteria were collected over 0.1 µm Millipore filters and placed in liquid scintillation cocktail for radioactivity measurements in the laboratory. Phytoplankton samples were collected from surface waters at 2 stations using a net.

5.4 Radionuclide Studies

Among the particle-reactive-daughter and passive-parent radioactive nuclide pairs, ^{234}Th- ^{238}U is widely used for studying particle associated scavenging processes. Shortlived ^{234}Th (halflife = 24 d) is produced by the radioactive decay of dissolved 238 . Once produced,Th atom is hydrolysed and readily attached to particle surfaces. The chemical scavenging processes are important within the euphotic zone - a region of maximum biological production. It is possible to use the production rates of radionuclides from dissolved parents and their export from the euphotic zone, both of which can be measured precisely to estimate "new production". Towards this objective, six seawater profiles upto 300 m depth from the JGOFS stations., each comprising of eight samples were collected to measure ^{234}Th.Also four surface air samples were collected along the cruise track using glass fibre filters to study the atmospheric input flux of ^{210}Pb and nutrients.Six surface seawater samples were also collected for the assay of ^{210}Pb. Preliminary processing of the samples were completed onboard.

5.5 Trace Gas Studies

Under the air-sea interaction programme, nitrous oxide and methane were measured by Electron Capture Detector (ECD) and Flame Ionisation Detector (FID) respectively using standard chromatographic techniques. Six seawater depth profiles from JGOFS Stations upto 1000 m each comprising of sixteen samples, on an average, were collected and measured for N_2O and CH_4. Apart from this, surface samples from the mixed layer were collected from 25 CTD stations and analysed for N_2O and CH_4.At regular intervals of 6 hours, surface sea air was also monitored on daily basis.

5.6 Biogenic fluxes studies: Coccolithophores

Water samples were collected from 10,20,40, 80, 100,150, and 200 m, both during day and nights, by Niskin bottles (about 4.0 l) for the studies on Coccolithophores. These samples were filtered through Millipore filters and the suspended samples

were stored for further studies in the laboratory.Simultaneously,samples were also collected for Zooplankton studies at the same stations to study their total abundance.

6. SUGGESTIONS

1. The CTD could be used with 1.7 and 5 litres bottles in seas with a wind force of 6 i.e. wind speeds of 20 knots. But operating the CTD with 30 litre bottles in seas with a wind force of 4 i.e. wind speeds of 15 knots or more posed the following problems :

   The wave action on the CTD as it entered the water used to heave up the entire CTD and produce snap loads on the CTD winch wire which could threaten to snap off the CTD from the wire. Further the ships heave motion produce jerks on the wire which over a time could result in a break in the wire rope.

   While lowering the CTD or taking out of the water, it swings aganist the ship's side causing serious electronic damage.

   Lifting the CTD with large samplers on to a wooden platform with the present movable pulley system is difficult and contaminates the samples with grease and rust.

   A suitable CTD winch with a tensioner designed to take in or spool out the wire-rope as it rides the waves at the surface will take care of a part of the problem. Only a modification of the winch deck will provide effective service for the future. The following are the modifications suggested:

   a) When the new CTD winch is installed it should be installed 2 meters inside of the present CTD winch.

   b) A telescopic crane with a reach of 15m and S.W.L. of 5 tons similar to the Atlas crane should be fitted to the roof of the winch deck.

   c) The present A-frame should be cut and fitted only for the hydrographic winch.

   d) 3 meters of the winch deck in front of the CTD winch should be cut so as to enable the entire CTD to be swung inside the main- deck and also to be lifted onto any platform.

2. The Wave recorder sensors near the engine room gets flooded from time to time destroying the sensors. It is suggested to build a water-proof well or shift the sensor 1 meter above its present level.

3. One of the present CTD PC's hard disk is damaged and the mother boards of both PCs behave erratically. Both the PCs need replacement urgently as the present memory requirement are not sufficent. It is suggested to replace these with 486 with 500 MB of hard-disk memory using extended IDE drive and 16 MB of High speed RAM with a SuperVGA color monitor and PCI local bus.

4. It is suggested that all the PCs and data collecting sensors like the Surface Met be interfaced to each other using a LAN.

5. E-mail facility be made available to assist in quick and economical communication with NIO and other scientists.

6. The Deep-sea Echosounder is not functioning and has to be repaired. The repeater Echosounder in the Wet port lab should be made operational so that continuous depth can be monitored especially at shelf edges.
7. CTD and Carousel spares should be purchased as no spares available.
8. A stand to store the 30 litre samplers should be made in the Scientific store or some other suitable place having a.c.

7. ACKNOWLEDGEMENTS

The Chief Scientist and others thank the Master, his officers and the crew of ORV *Sagar Kanya* for providing all necessary help onboard.

Station Positions

Station No	Latitude ^{O}N	Longitude ^{O}E
1	15.41	73.50
2	15.41	73.09
3	15.41	72.50
4	15.41	72.00
5	15.41	71.30
6	12.50	72.50
7	12.50	73.00
8	12.50	73.50
9	12.50	74.20
10	12.50	74.50
11	12.00	74.60
12	11.50	74.86
13	11.00	75.11
14	10.50	75.50
15	10.00	75.60
16	10.00	75.00
17	10.00	74.50
18	10.00	74.00
19	10.03	73.53
20	10.08	73.00
21	10.15	72.50
22	10.21	72.00
23	10.30	71.00
24	10.40	70.00
25	10.50	69.00
26	10.60	68.00
27	10.70	67.00
28	10.79	66.00
29	10.87	65.00
30	10.96	64.33
31	11.60	64.00
32	12.00	64.00
33	12.46	64.00
34	13.00	64.00
35	13.49	64.00
36	14.00	64.00
37	14.00	64.00
38	15.00	64.00
39	15.50	64.00
40	16.00	64.00

41	16.45	64.00
42	17.00	64.00
43	17.45	64.00
44	18.00	64.00
45	17.91	65.00
46	17.73	65.66
47	17.58	66.08
48	17.12	67.50
49	17.03	68.00
50	16.76	69.00
51	16.58	69.55
52	16.30	70.55
53	15.87	72.04
54	15.40	72.78
55	16.00	72.35
56	17.00	71.55
57	18.00	70.80
58	18.66	70.00