CRUISE REPORT

ORV SAGAR KANYA

Cruise No. 115

(2 - 22 August, 1996)

राष्ट्रीय समुद्र विज्ञान
संस्थान
NATIONAL INSTITUTE
OF
OCEANOGRAPHY

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Cruise No. 115

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NATIONAL INSTITUTE OF OCEANOGRAPHY

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REPORT ON THE 115TH OCEANOGRAPHIC CRUISE OF O.R.V. SAGAR KANYA

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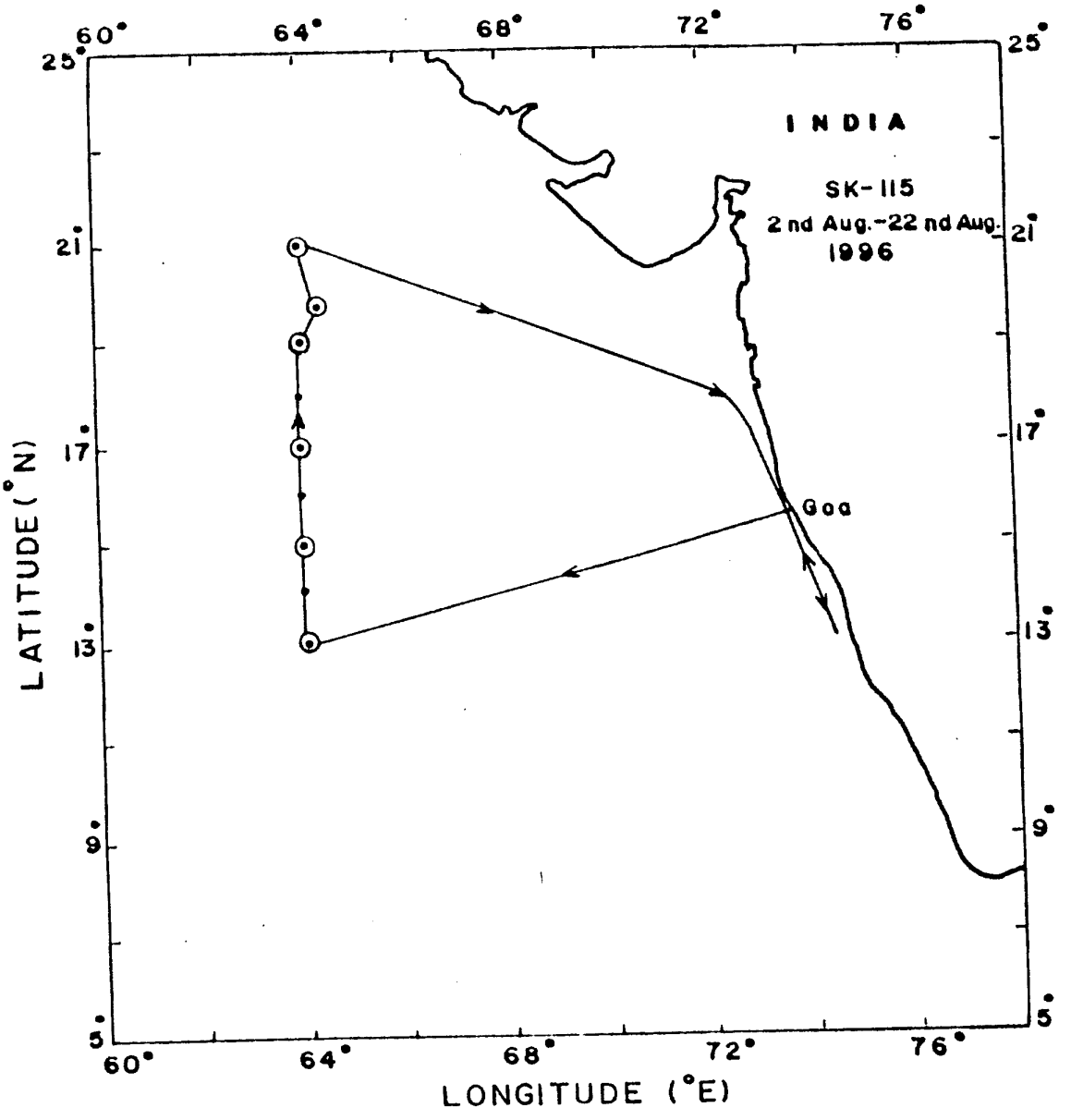
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INDIA
SK-115
2 nd Aug.-22 nd Aug.
1996
Goa
LATITUDE (°N)
LONGITUDE (°E)

2. CRUISE SUMMARY

This cruise was a part of the Joint Global Ocean Flux Study (JGOFS) programme. The objective of this cruise was to study the physical and bio-geochemical processes in the Arabian Sea along 64°E between 13 and 21°N during southwest monsoon. The ship sailed from Mormugao harbour on 2 August 1996 on a trial for testing the CTD cable and returned on 3 August. The main cruise started on 3 August and at the end of the cruise returned to the same harbour on 22 August.

During the cruise 9 CTD stations including the 5 JGOFS stations were occupied along 64°E. Five CTD profiles at each JGOFS station and 19 XBT profiles were taken all along the cruise track. Surface meteorological parameters were measured at all the stations. Drifting METOCEAN data buoy was deployed on 14 August at 18°58'N and 64°E.

The underway measurements of carbon dioxide confirm the finding that this gas is ejected into the atmosphere from the Arabian Sea. Chlorophyll distribution showed an increasing trend from 13 to 17°N and further, the values decreased. Mesozooplankton biomass was high in the thermocline layer. The axis of the Findlater Jet was observed around 17°N along 64°E. The thermohaline structure on either side of the jet was characterised by signatures of upwelling to the north and sinking to the south. The oxygen and nutrient levels were relatively lower in the north.

3. PARTICIPANTS

3.1 Scientific Component

M. Dileep Kumar	) —	Chief Scientist
M. Madhupratap	)	
S.N. De Souza	)	
S. Prasanna Kumar	)	
V. Ramaswamy	)	
N. Ramaiah	) —	NIO, Goa
A.S. Murallnath	)	
A. Almeida	)	
V.V.S.S. Sarma	)	
Surekha Sawant	)	
Mangesh Gauns	)	
Balakrishna Nair	)	
Ganesh Chandavale	)	
P.N. Aravindakshan	) —	NIO Regional Centre, Kochi
T.C. Gopalakrishnan	)	
R. Rengarajan	)	
T.K. Sunil Kumar	) —	PRL, Ahmedabad
S. Venkataramani	)	
Iqbal Ahmed	)	
Mohan Das	)	
J.P. Joseph	) —	NORINCO, Goa
Brian Telles	)	

3.2 Ship's Complement

Capt. R.M. Verma	) —	Master
M.S. Pangtey	) —	Ch. Officer
V. Subramanian	) —	Acting Ch. Officer
S. Udayasurian	) —	Second Officer
U. Gurayya	) —	AWKO
S. Roy	) —	Medical Officer
V.C. Chandran	) —	Radio Officer
R.G.S. D'Silva	) —	Purser
S. Janaka	) —	C.E. Officer
B. Singha	) —	2 E. Officer
H.K. Jain	) —	3 E. Officer
P.K. Ekka	) —	3 E. Officer
S. Chakraborty	) —	4 E. Officer
N. Tomar	) —	5 E. Officer
A.S. Bhatia	) —	Elect. Officer
D.P. Sharma	) —	Elect. Officer
L.M.F. Rodrigues	) —	Catering Officer

4. OBJECTIVES

The aim of the JGOFS (Joint Global Ocean Flux Study) programme is to quantify the seasonal and temporal variability in carbon pools and fluxes in the Arabian Sea. The objective of the present cruise was to study the physical and biogeochemical processes along 64°E, between 13°N and 21°N during the southwest monsoon with the following observations:

(a) variability in the physical structure of the water column in relation to upwelling and its influence on chemical and biological systems

(b) microbial activity and picoplankton abundance in relation to changes in physico-chemical conditions and productivity

(c) contribution of micro and mesozooplankton to carbon standing crop and their taxonomical studies

(d) spatial variations in coccolithophores

(e) air-sea exchange of carbon dioxide (including underway measurements), nitrous oxide and methane

(f) carbon export by sinking particulate material

(g) carbon export fluxes through isotopic studies and material transport through aerosols in the Arabian Sea

5. CRUISE DETAILS

The ship sailed on 2 August for a trial cruise with members of the Technical Evaluation Committee (TEC) and some participants. The CTD cable was tested with dummy weights and found that the condition of the cable was bad. Hence, about 350 m wire was cut, with the further realization that it is necessary to examine the wire more carefully in view of the safety of the CTD unit, at a deeper station. The ship returned to Mormugao in the morning of 3 August. The TEC members disembarked and all cruise participants joined.

The main cruise started at 1600 hrs on 3 August and proceeded to the first station at 13°N and 64°E. Enroute the vessel was stopped at about 4000 m water depth for checking the CTD wire. A dummy weight of 600 kg was used for lowering the wire. Although the wire withstood the weight attached, close and careful examination of the wire showed that about 1000 m of the wire needed to be removed for the safe operation of the CTD. Accordingly, a message was sent to Ship Cell and based on the suggestion received on 5 August, a 1000 m length wire was cut on 6 August and the vessel proceeded to the first station. The wire remaining on the drum is about 3900 m.

During the cruise 9 CTD stations were occupied along 64°E including the 5 JGOFS stations. The details of several operations carried out, alongwith station positions are given in Table-1. At each of the JGOFS station at least 5 CTD profiles were taken. In addition, 19 XBT profiles were taken all along the cruise track. Surface meteorological parameters were measured at all the stations.

The water samples obtained from CTD operations were subjected to several biological and chemical analyses. These are detailed in Table-2. Nutrients studied were nitrite, nitrate, phosphate and silicate. Gas analyses were done for carbon dioxide, nitrous oxide and methane. The parameters studied to understand the

carbon dioxide system included high precision spectrophotometric measurements of pH, alkalinity and coulometric analysis of total carbon dioxide. Besides, the underway measurements of partial pressure of carbon dioxide, in collaboration with the Woods Hole Oceanographic Institution, USA and Transparent Exopolymer Particles (TEP) analysis at discrete depths were carried out. TEP studies include particle abundance, particle sizes and their total concentration in terms of algenic acid. All these analyses were completed on board while Dissolved Organic Carbon samples were taken to the shore laboratory for analysis.

Biological measurements consisted chlorophyll *a* and new production, primary production through in-situ and deck incubations, picoplankton abundance, microzooplankton and mesozooplankton. Incubations, in situ, were done from dawn to dusk as per the JGOFS Protocols. Samples, except chlorophyll, will be analysed in the laboratory. Microbiological sampling and initial processing were performed on board for ^{3}H-thymidine uptake, bacterial abundance and for isolation of thraustochytrids. Further processing and analysis will be done in the laboratory.

For the isotopic analysis of ^{234}Th, ^{210}Po and ^{210}Pb water samples were processed through ferric hydroxide precipitation. Filtered samples (0.45 µm) were also used at 21oN station. The preconcentration was done in presence of yield tracers. The processing was completed within 40 hrs of sampling thus minimizing the ingrowth of short lived ^{234}Th and ^{210}Po from their parent nuclides ^{238}U and ^{210}Pb, respectively. 10 aerosol samples were also collected to find the atmospheric inputs of nutrients using ^{210}Pb as a tracer.

Aerosol sampling was carried out while the vessel was in motion through envirotech high volume sampler that was mounted on the boat deck. Its orientation was maintained from time to time to face the direction of the wind. The filters used were 8"x10" Whatman 41 or GF/F filters. Samples were collected during 5 runs which are as follows: (a) From Mormugao at 13°N and 64°E, (b) from 13°N to 15°N along 64°E, (c) from 15°N to 19°N along 64°E, (d) from 19°N and 64°E to 18°N and 70°E and (e) from 18°N and70°E to Mormugao. Further processing of these will be done in the laboratory.

Drifting sediment traps were planned to be deployed at 15°N and 64°E for a period of 3 days. The system was deployed on 9 August by 1000 hrs but was forced to be retrieved in the evening of the same day due to inclement weather conditions. The deployment could not be made at 21°N due to uncertain conditions with fast changing wind speeds.

Drifting METOCEAN data buoy was deployed on 14 August at 18° 55' and 64°E.

6. SALIENT FEATURES

The axis of the Findlater Jet was observed around 17°N along 64°E. The thermohaline structure on either side of the Jet was characterised by the signatures of upwelling to the north and sinking to the south. The mixed layer depth shoaled from 110 m in the south to about 50 m just north of the axis. SST also showed variation consistent with the upwelling and sinking which was about 26.9 just south of the Findlater axis and was 26.3 to the north, respectively. Thermohaline structure depicted the presence of Arabian Sea high salinity water mass, which shoals under the influence of the jet.

The distributions of oxygen and nutrients at the surface were consistent with the physical structure. In the subsurface layers, the oxygen levels decreased towards north and are lower compared to those observed during the southwest monsoon of 1995. The lowest concentration observed was 1 μM in the present study whereas it was about 10 μM in 1995. The trends in nutrients and total carbon dioxide remained the same but with relatively lower nitrate in the suboxic layers in the north. Despite the occurrence of highest nitrite at 14°N, the layer containing nitrite was thicker in the north.

The TEP concentrations ranged between 0 and 80 mg/l in terms of alginic acid. Interestingly, its concentration is relatively higher at the base of the surface mixed layer and generally exhibited minimum in the suboxic zone between the upper boundary of the thermocline and ~500m. In this zone, it amounted largely between 10 and 20 mg/l.

Continuous underway measurements of carbon dioxide confirm our finding that this gas is ejected into the atmosphere from the Arabian Sea. However, in places close to the coast where river water influence occurs the air equilibrated pCO_2 in water is about 210 μatm suggesting that this region would be a sink for atmospheric carbon dioxide during the southwest monsoon period. Further, high air equilibrated pCO_2 was noticed in water due to upwelling around 18-19°N at 64°E and also near the coast. However, the upwelled water with a pCO_2 of ~480 μatm does not seem to reach the surface at some places because of the occurrence of a lens of fresh water. XBT profiles in these places showed a near absence of mixed layer below ~3m.

The chlorophyll distribution was concomitant with the predicted Findlater jet axis. It showed an increasing trend from 13°N (surface chlorophyll a is 0.164 mg/m^3) to 17°N (0.57 mg/m^3). To the north of the latter, the values decreased to about 0.235 mg/m^3.

Mesozooplankton biomass was generally high in the thermocline layer. However, it was possibly high in the mixed layer as well and this could not be ascertained because the net was clogged by a phytoplankton bloom, especially between 15 and 19°N.

7. LOSSES

Four of the surface floats (with 25 kg buoyancy each) used in the drifting sediment trap mooring were lost because of very rough conditions at 15°N and 64°E.

8. RECOMMENDATIONS

(a) One PC still hangs from time to time and the other memory is not sufficient for running CTD software, hence both CTD Computers in Physics lab are to be upgraded to Pentium with PCI bus with at least 4 ISA slots, 1 GB EIDE harddisk and SVGA Colour Monitor 17" with 1248 x 1024 resolution both PCI based, minimum 3 serial ports, 2 parallel ports, 32 Mb RAM, 3.5" FDD CD drive, MS DOS Mouse with drivers, Windows.

(b) Printer sharer (parallel port), plotter sharer (serial port), and printer ribbons & plotter pens are to be procured.

(c) New winch when purchased should strictly come with the new CTD cable tension wound with a load of 1 ton by the manufacturers, as this is the main cause of the CTD wire kinking and winding problems.

(d) New 8 mm meter wheel for CTD

(e) Electrical motorised CTD carrying arrangement.

(f) Spectrophotometer in Chemistry laboratory and a 586 Pentium computer, with specifications as at (a) above to enable immediate data processing.

(g) Fluorimeter, a Liquid Scintillation Counter, a vacuum pump and a 350 litre no frost fridge in Biology laboratory.

(h) LAN should be established

(i) Appropriate meteorological sensors (wind wane, anemometer, hygrometer, barometer, pyerheliometer for incoming solar radiation measurements) should be installed alongwith automatic data logging facility for continuous measurement and to make the data available on LAN.

(j) Thermosalinograph probes need to be calibrated immediately. This instrument needs to be interfaced to a computer for direct data recording.

(k) On board E-mail facility should be established at the earliest to enable scientists to contact NIO and other institutions as and when required which is quick and cost effective.

(l) It is strongly recommended that M/s NORINCO should update the requirements of spares/accessories of all the instruments after each cruise and procure the necessary items immediately.

(m) The washing machine on the forecastle deck meant for scientists should be replaced by an automatic one.

(n) A Laser Jet printer should be procured for the printing and plotting of the processed data.

9. ACKNOWLEDGEMENTS

We acknowledge and appreciate the Master, officers and crew for their excellent cooperation that made the cruise successful. We also thank the Department of Ocean Development, Government of India for their financial support for carrying out this work.

Table 1 : Operational Details

Station/Date	Lat.	Long.	Time Arr. (hrs)	Sounding Depth (m)	CTD	Operations			
						Multi. net	Plank. net	pp incu. insitu	Sed. Tr. drifting
CTD 1 (JGOFS 1) 7-8/8/96	13 00	64 00	0430	4000	Y	Y	Y	Y	—
CTD 2 8/8/96	14 00	64 00	1235	4000	Y	—	—	—	—
CTD 3 (JGOFS 2) 9-11/8/96	15 00	64 00	0045	4000	Y	Y	Y	Y	Y
CTD 4 12/8/96	16 00	64 00	0425	4000	Y	—	—	—	—
CTD 5 (JGOFS 3) 12-13/8/96	17 00	64 00	1655	3438	Y	Y	Y	Y	—
CTD 6 14/8/96	18 00	64 00	0405	3500	Y	—	—	—	—
CTD 7 (JGOFS 4) 14-15/8/96	19 03	64 05	1700	3400	Y	Y	Y	Y	—
CTD 8 15-16/8/96	19 45	64 37	2330	3200	Y	—	—	—	—
CTD 9 (JGOFS 5) 16-17/8/96	21 00	64 00	1100	3350	Y	Y	Y	Y	—

Y = Collected

Table 2 : Analyses of Samples

Station	Oxygen/ Nutrients	Gases	TEP	Isotopic studies	Primary Prod.	Micro Zoopla.	Coccolithores	Microbial
CTD 1	Y	Y		Y	Y	Y	Y	Y
CTD 2	Y	Y	—	—	—	—	—	—
CTD 3	Y	Y	Y	Y	Y	Y	Y	Y
CTD 4	Y	Y	Y	—	—	—	—	—
CTD 5	Y	Y	Y	Y	Y	Y	Y	Y
CTD 6	Y	Y	Y	Y	—	—	—	—
CTD 7	Y	Y	Y	Y	Y	Y	Y	Y
CTD 8	Y	Y	Y	—	—	—	—	—
CTD 9	Y	Y	Y	Y	Y	Y	Y	Y

Y = Analysed