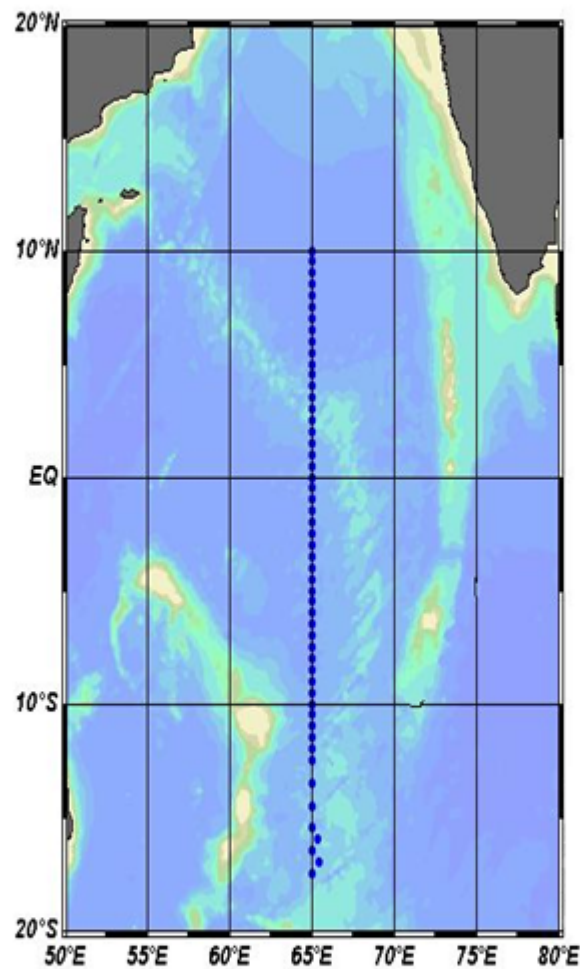


Biogeochemistry of Tropical Indian Ocean
during Southwest Monsoon



Cruise Report
SK-260
01st June - 03rd July 2009

Acknowledgement

We the scientific team of SK-260 onboard Sagar Kanya are grateful to the Secretary, Ministry of Earth Sciences for the immense help provided by him for the successful execution of this southwest monsoon cruise programme of the Tropical Indian Ocean Studies. We are thankful to the Director, NCAOR, Dr. Sudhakar [GD, OSSG] and Dr. Anil Kumar for their constant support in the successful implementation of this expedition. We thank the Master, Chief Engineer, Chief Officer and crew members of the vessel for their supreme co-operation throughout the cruise. We are also thankful to the Catering officer and all his staff for serving us tasty and homely food. We thank NORINCO engineers for the service provided by them in operating all the required scientific equipments onboard for the successful completion of this cruise.

*[RACHEAL CHACKO]
CHIEF SCIENTIST*

Objectives and Expected Results

1. A comprehensive understanding of the physical, chemical, and biological aspects of the tropical Indian Ocean. Studies related to the Equatorial Current system, Water masses and Zonal transport are the key importance of this investigation.
2. To understand the nutrient chemistry of the study region from the water samples collected from different depths.
3. The meteorological archive will be useful for a comprehensive understanding of the climatic variabilities.
4. To determine the total quantity of chlorophyll by spectrophotometric method.
5. To determine the total quantity of chlorophyll by spectrophotometric method.
6. To study the abundance, viability and culturability of bacteria.
7. To study the Manganese tolerant bacteria.
8. To prepare samples for ATP analysis.

For understanding the biogeochemistry of the tropical Indian Ocean a detailed data collection was planned at one degree latitude from 18°S including water sample collection from different depths.

The data archive will be useful for detailed approach to understand the climatic variabilities

Participating Organizations

- NATIONAL CENTRE FOR ANTARCTIC & OCEAN RESEARCH (NCAOR)
- NATIONAL INSTITUTE OF OCEANOGRAPHY, RC-KOCHI
- GOA UNIVERSITY
- YOGI VEMANNA UNIVERSITY
- NORINCO

Equipments Operated

- Single beam Echo sounder
- Conductivity Temperature Depth [CTD] with rosette samplers
- Portable CTD
- Expendable Bathythermograph (XBT)
- Automatic Weather Station
- Meteorological observations
- Sub-bottom Profiler
- Grab
- Spade Corer

Diary of Events

01-06-2009

Boarded the ship at 01:50 hrs. Vessel was alongside. Vessel moved to anchorage at 20:30 hrs

02-06-2009

The two American scientists' participants of the previous cruise (SK-259) who were detained on the ship due to visa formalities disembarked from the ship at 08:45 hrs. Vessel started sailing at 0930 hrs towards first station i.e. 10°N, 65°E. A pre-cruise meeting was held to discuss the operations involved and water sample requirements.

03-06-2009

The participants were divided into groups of two for the meteorological observations. Met observations would be taken at synoptic hours. All the equipments and computers was secured.

04-06-2009

Met observations were continued. The students were given an acclimatisation tour of the ship and all the labs and working of different instruments was explained to them.

05-06-2009

Met observations was being continued.

06-06-2009

Reached the first station i.e. 10°N 65°E at 1600 hrs. Deployed Idronaut and portable CTD. Water sampling was carried out for chemical and biological studies. The grab was also deployed but no sample could be collected. Winds were around 24 knots. Sea condition was rough. Since DP was used we did not drift. Met observations are being continued. XBT will be deployed at half degree interval from 10°N.

07-06-2009

Completed station 10N at 0230 hrs and vessel sailed to 09°S. Vessel reached 09°S at 0945 hrs. The Idronaut CTD was deployed to 2000m to test bottle firing at depths

deeper than 1000m. The bottles were fired at the following depths namely 2000m, 1750, 1500 and 1250m. At 2000m we got message confirming that the bottle had closed but at 1750, 1500 and 1250 it showed the command rosette error. When the CTD was brought to the surface it was seen that all the bottles had closed. When we started collecting water samples it was observed that water collected from 20m and 30m had the same temperature as the ones collected from 1000m. We had to redeploy the cast. Water samples were collected only for chemical analysis. Portable CTD was deployed to a depth of 3000m. Vessel sailed to 08°S after completion of 09°S at 1700 hrs.

08-06-2009

Vessel reached 08°N at 0015 hrs. Idronaut and portable CTD were deployed and water samples were collected for chemical as well as biological analysis. Completed the station 08°N at 0800 hrs. Vessel proceeded to 07°N. At 1500 hrs vessel reached 07°N. Deployment of Idronaut and portable CTD took place and water sampling was carried out for chemical studies. Completed 07°N at 1900 hrs and vessel proceeded to the next station. XBT are being launched at half degree interval. Met observations were continued.

09-06-2009

At 0145 hrs ship reached 6°N. Water samples for chemical and biological analysis were collected by deploying Idronaut CTD. Portable CTD was deployed to a depth of 3000m. Station completed at 0640 hrs and vessel proceeded to next station. Vessel reached 05°N at 1300 hrs. While the Idronaut CTD was being lowered for the 1000m cast a problem surfaced. As soon as the CTD reached 1000m the first bottle was fired and the bottle came as closed but the probe tripped at that time. Attempts were made again to start the probe but there was no communication to the probe. The CTD was brought to the deck and soldering between the instrument and the sea cable was checked to rule out the possibility of water intrusion. In the meanwhile spade corer was deployed for collection of surface sediments. This time also no sediments could be collected. After the re-soldering was done the instrument was deployed again. This time the probe tripped as soon as the first bottle was fired i.e. a 1000m. The CTD was being brought back to the surface but at around 600m the CTD started working so it was

lowered again. But the same problem was seen. Portable CTD was lowered to 3000m. It was decided to cut about 1000m of cable to rule out any problems with CTD sea cable. Ship sailed to the next station at 2245 hrs. Met observations and firing of XBT's were continued.

10-06-2009

Vessel reached 04°N at 0600 hrs. The same problem persisted after cutting of sea cable. Vessel sailed from station 04°N at 1230hrs after completion of portable CTD operations and proceeded to 03°N. All the connectors were checked for water entry. All the joints between CTD and the slip disc was checked. Reached 03°N at 1930 hrs. When the CTD was lowered the same problem surfaced. The probe tripped around 600m, but as it was being retrieved the probe started functioning around 300m so samples were collected from only between 0-300m. Vessel sailed to the next station i.e. 02°N. Met observations and firing of XBT's were continued.

11-06-2009

Vessel reached 02°N at 0600 hrs. The problem still persisted. Water sampling restricted to 300m. Spoke to Mr. Subramaniam in the morning. Further cutting of the sea cable was ruled out as there seems to be no observed problem with the sea cable. Decided to replace the sea cable. Station completed at 1230 hrs and vessel proceeded to 01°N. Cable loading process was to began as soon as sailing started. The sea cable was removed from the forward winch. Reached Station 01°N at 1915hrs. Portable CTD was lowered at this location. Idronaut CTD could not be operated as the new wire couldn't be loaded. Since water sample was not collected at 01°N we did not proceed to the next station instead we drifted at 01°N. Operation completed at 22: 30 hrs. The loading of the new cable was being postponed to the next due to non availability of ship's staff since it was late at night.

12-06-2009

The cable was replaced and the CTD was deployed. But the same problem recurred. The probe tripped as soon as the CTD reached 660m. The CTD was brought back to the deck. So problem did not lie with the cable but the probe. Since the instrument was

under warranty further instructions from Idronaut was awaited. Till then it was decided that the water sampling will be done in the top 300m as there seemed to be no problem with the CTD in the top couple of meters. Station completed at 2000 hrs and vessel proceeding to next station i.e. 0°. Met observations and firing of XBT's are being continued.

13-06-2009

Reached 0° at 0430 hrs. Water sampling for chemical and biological analysis completed. Portable CTD deployed. Spade corer operation was also carried out and this time sediment samples could be collected. After completion of station ship proceeded to the next station 01°S and reached station at 1917 hours. Water sampling for chemical analysis and portable CTD operations were carried out. Station completed at 2330 hrs and vessel proceeding to next station. Met observations and firing of XBT's are taking place at regular intervals.

14-06-2009

Arrived station 02°S at 0600 hrs. During the water sample collection for biological studies the CTD tripped at 45m. After this the CTD was brought to the deck and all the accessory sensors were checked and it was found that there was a slight problem with the PAR sensor connector pins, one of the pins was seen to be broken. The sensor had to be removed. Since there were no sufficient dummy plugs, all the accessory sensors had to be removed. After this the CTD was deployed in water and it went to a depth of 1500 without tripping. Water samples were also collected from 1500 to surface without any problem. Ship proceeded to next station after completion of sampling and portable CTD operations. Reached 03°N at 1900 hrs. After completion of water sampling for chemical analysis and portable CTD operations the vessel proceeded to the next station at 2242 hrs. Met observations and firing of XBT's was taking place at regular intervals.

15-06-2009

Reached 04°S at 0600 hrs. Completed the station at 1100hrs and proceeding to the next station i.e. 05°S. The chlorophyll sensor was attached with the Idronaut CTD and it was deployed. There was no problem during the entire CTD operation. Synoptic

observations and firing of XBT's were taking place at regular intervals. Reached 05°S at 1720 hrs. The transmissometer was attached with the Idronaut CTD and deployed for water sample collection. The cast went on smoothly without any problems. Portable CTD was deployed after that. After completion of portable CTD operation there was spade corer operation. The spade corer was deployed but came up without any sediment because it did not close, so the spade corer was deployed again this time we got sediment samples. Met observations and firing of XBT's was taking place at regular intervals.

16-06-2009

Vessel sailed from 05°S at 0400 hrs and reached 06°S at 1140hrs. After completion of the entire operations vessel proceeded to the next station i.e. 07°S and reached station at 2320 hrs. Idronaut CTD was lowered for water sample collection. Portable CTD was deployed to a depth of 3000m. Synoptic observations and firing of XBT's are taking place at regular intervals.

17-06-2009

Completed station 07°S at 0330 hrs and vessel proceeded to the next station i.e. 08°S and reached station at 1000 hrs. Water sampling for chemical and biological analysis took place using the Idronaut CTD. Portable CTD was deployed to 3000m. Station completed at 1500hrs. Vessel proceeded to the next station 09°S. Arrived station at 2140 hrs. Idronaut CTD and portable CTD were deployed. Met observations and firing of XBT's are taking place at regular intervals.

18-06-2009

Completed operations at 09°S at 0120 hrs. Vessel proceeded to 10°S and arrived station at 0815hrs. The external salinity pump was connected to the Idronaut CTD and was deployed to a depth of 1200m. The cast went smoothly. Portable CTD operation also completed. Spade corer operation carried out for surface sediment sampling. After collection of sediment samples vessel moved from station and reached 11S at 2330. Met observations and firing of XBT's are taking place at regular intervals.

19-06-2009

Idronaut CTD and portable CTD were deployed. Station 11°S completed at 0345 hrs and vessel proceeded to next station 12°S and reached station at 1130hrs. Idronaut CTD was deployed to a depth of 1000 and water samples were collected. Portable CTD was deployed to 3000m. Vessel proceeded to 13°S after completion of station at 1600 hrs. Synoptic observations and firing of XBT's are taking place at regular intervals. Arrived at station 12°S at 2330 hrs. Met observations and firing of XBT's are taking place at regular intervals.

20-06-2009

Water sampling for biological and chemical analysis was carried out using Idronaut CTD and portable CTD was deployed to a depth of 3000m. Station completed at 0315 hrs. Vessel proceeded to next station 14°S and reached station at 1030hrs the same day. Idronaut CTD was deployed to a depth of 1000 and water samples were collected. Portable CTD operation completed and vessel proceeding to 15°S. Reached station 15°S at 2330 hrs. Synoptic observations and firing of XBT's are taking place at regular intervals.

21-06-2009

Idronaut CTD and portable CTD were deployed. Spade corer was also deployed and surface sediment samples were collected. Station completed at 0500 hrs. Vessel proceeded to next station 16°S and reached station at 1300 hrs. Idronaut CTD was deployed to a depth of 1000 and water samples were collected. Portable CTD deployed to a depth of 2800m. Station completed at 1730 hrs and vessel proceeded 17°S. Synoptic observations and firing of XBT's are taking place at regular intervals.

22-06-2009

Reached station 17°S at 0130 hrs. Idronaut CTD and portable CTD were deployed. Station completed at 0500 hrs the same day. Vessel proceeded to next station 18°S and reached station at 1330hrs the same day. At 18°S the Idronaut CTD was lowered to a depth of 1500 to test firing at deeper depths, but the same problem persists. When bottles are fired the message 'Rosette Error' is displayed but it is seen that the bottles

close. But we have confusion about the depth at which these bottles close as the sample collected from 50m is as cold as the sample collected at 1000m. The entire cast had to be repeated. After completion of the Idronaut cast portable CTD and Spade corer was operated. We did not any sediment samples but the spade corer returned with some rock samples. Completed the station at 2330 hrs. All the stations completed and vessel proceeding to Chennai. Synoptic observations and firing of XBT's are taking place at regular intervals.

23-06-2009

Synoptic observations and firing of XBT's was taking place at regular intervals.

24-06-2009

Met observations and firing of XBT's was taking place at regular intervals. Water rationing started from today.

25-06-2009

Met observations and firing of XBT's are taking place at regular intervals. Sea rough and winds around 30 knots average.

26-06-2009 to 02-07-2009

Met observations and firing of XBT's are taking place at regular intervals. On 30 the new Seabird CTD was tested satisfactorily by Norinco engineers.

03-07-2009

Vessel arrived and berthed at Chennai port at 0930 hrs. Scientific team disembarked from the vessel.

Physical Oceanography Studies

To have a better understanding of the thermohaline and current structure in the study area CTD and XBT observations were carried out. These observations were carried out at a 1 degree interval. The results obtained from the hydrographic data (XBT, CTD) collected in the tropical Indian Ocean during June - July , 2009 when compared to the previous studies will be attributed to the significant annual changes occurring in the upper ocean thermal structure and variation in the boundary of the equatorial current system and it's east west transport in the equatorial region.

Chemical Oceanography Studies

The data collected during this expedition will be used to understand the various chemical processes such as nutrient chemistry, dissolved oxygen, trace metal processes of the study region from the water sample collected from different depths.

Water samples were collected from 10° N, 9° N, 8° N, 7° N, 6° N, 5° N, 4° N, 3° N, 2° N, 1° N, 0 ,1° S, 2° S, 3° S, 4° S, 5° S, 6° S, 7° S, 8° S, 9° S, 10° S, 11° S, 12° S, 13° S, 14° S, 15° S, 16° S, 17° S and 18° S along 65° E longitude from surface, 10m, 20m, 30m, 50m, 75m, 100m, 120m, 150m, 180m, 200m, 300m, 500m, 750m and 1000 m depths and pH (pH meter), Dissolved Oxygen and nutrients such as nitrite, nitrate, silicate and phosphate were analyzed onboard using UV- Spectrophotometer (Shimadzu).

Collected water samples for trace metals analysis from 10° N, 5° N, 0° , 5° S and 10° S along 65° E longitude from surface, 20m, 50m, 75m, 100m, 150m, 200m, 300m, 500m, 750m and 1000m depths. The water samples have been preserved by lowering the pH to 2 on addition of supra pure nitric acid and hydrochloric acid. Further processing of these water samples will be carried out in the onshore laboratory and analyzed using ICP-MS.

Dissolved Oxygen was found to vary from 5 ml/l in the surface to 2.09 ml/L at 1000m depth. The upper 50m was found to be almost saturated with oxygen (~ 4.5 ml/l). Observed pH range showed a variation from 8.9 in the surface to 7.61 at 1000m depth.

The nutrients (surface- 1000m depth) were observed in the following range:

Nitrite	0-0.2 μM
Nitrate	0-38 μM
Phosphate	0-3.4 μM
Silicate	1.1- 88 μM

The results obtained from the data could be helpful to understand the variation in nutrients, dissolved oxygen and the chemical characteristics of water masses in the Tropical Indian Ocean.

Surface Sediment samples were collected at 5° intervals and at all these stations water samples have been collected, acidified and deep freeze for TOC analysis. The depths selected for TOC analysis were 0, 30, 50, 75, 100, 150, 200, 300, 500, 750 and 1000 m. Surface sediment was collected using a spade corer. Small cores of 30 cm were obtained using an acrylic pipe. The sediment core was immediately sub-sampled at 2 cm interval and 15 sub-samples were obtained. An aliquot of the samples was oven dried at 60°C for organic carbon analysis. Remaining sample was stored in plastic bags for foraminifera and geochemical investigation.

Biological Oceanography Studies

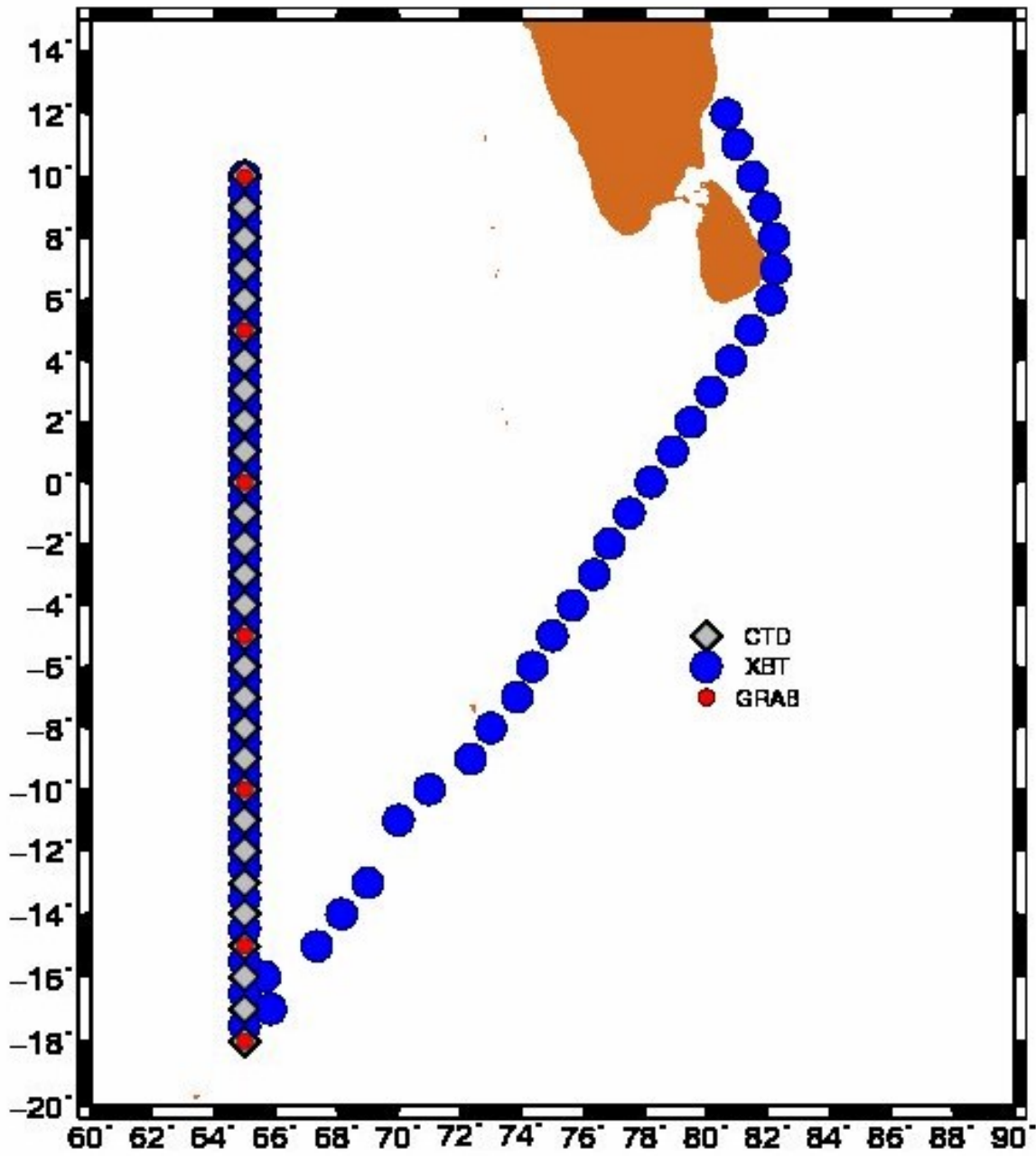
In order to study the biological aspects of tropical Indian Ocean during southwest monsoon the following observations were carried out.

For chlorophyll studies water samples were collected from 10°N to 18°S along 65°E longitude from surface, 10m, 20m, 30m, 50m, 60m, 75m, 100m, 120m, 150m, 180m, 200m depths. These samples will be analyzed by Strickland and Parsons standard procedure for chlorophyll estimation (Practical handbook of seawater analysis, 1968). For carrying out microbiological studies water samples were collected from 12 depths viz. surface, 10m, 20m, 30m, 50m, 60m, 75m, 100m, 120m, 150m, 180m, 200m. 5 ml samples were preserved with buffered formalin for direct count of bacteria and 100 μl samples were plated on 25% NB + 2% AA plate to see the culturability of bacteria. For studying manganese tolerance in bacteria samples were collected from 2 depths viz. 50m and 1000m. 50 ml sample was kept in refrigerator for further microbiological

analysis.

The data collected will be useful to study the vertical distribution of chlorophyll during study period. The data of bacterial studies are useful to know the abundance, viability and culturability and their tolerance to different manganese concentrations.

Cruise Track



List of Participants

Ms. Racheal Chacko	Chief Scientist	NCAOR, Goa
Dr. (Mrs.) Zeena Jayan	Dy. Chief Scientist	NCAOR, Goa
Mr. Suhas Shetye	Research Fellow	NCAOR, Goa
Mr. Shramik Patil	Research Fellow	NCAOR, Goa
Ms. Sharon Noronha	Research Fellow	NCAOR, Goa
Mr. Jenson George	Research Fellow	NCAOR, Goa
Mr. Mohammedali Nelloyaputhenpedika	Research Fellow	NIO, RC-Kochi
Ms. Soniya Murgaonkar	Student	Goa University, Goa
Ms. Raisa Carvalho Mascarenhas	Student	Goa University, Goa
Ms. Seema Parab	Student	Goa University, Goa
Ms. Analiza D'Souza	Student	Goa University, Goa
Ms. Shruti Surlakar	Student	Goa University, Goa
Ms. Shusma Naik	Student	Goa University, Goa
Ms. Sangeeta Naik	Student	Goa University, Goa
Mr. Vineel Deshpande	Student	Goa University, Goa
Mr. Thummala Shiva Reddy	Student	Yogi Vemanna University, Kadappa
Mr. R. Kanaka Durgaiah	Student	Yogi Vemanna University, Kadappa
Mr. Vijay Parmar	S'board Assistant	NCAOR, Goa
Mr. Kalasadan Madhusudan	Service Engineer	NORINCO
Mr. V.C. Sarathchandran	Service Engineer	NORINCO
Mr. Y. K. Chaitanya	Service Engineer	NORINCO
Mr. Elavarasa Vasanthraja	Service Engineer	NORINCO

Observation details

Stn No.	Date	Start Time (IST)	End Time	Latitude	Longitude	Station Depth (m)	Instruments Operated
1	06-06-2009	15:56	02:30 (07-06-09)	10° N	65° E	4417	Idronaut CTD, Portable CTD, water sample collection, Grab
2	07-06-2009	09:44	17:00	09° N	65° E		Idronaut CTD, Portable CTD, water sample collection
3	08-06-2009	00:15	07:45	08° N	65° E	4611	Idronaut CTD, Portable CTD, water sample collection
4	08-06-2009	15:00	19:00	07° N	65° E	4714	Idronaut CTD, Portable CTD, water sample collection
5	09-06-2009	01:45	06:40	06° N	65° E	4716	Idronaut CTD, Portable CTD, water sample collection
6	09-06-2009	13:00	00:00 (10-06-09)	05° N	65° E	4047	Idronaut CTD, Portable CTD, Spade Corer water sample collection
7	10-06-2009	06:00	12:30	04° N	65° E	3880	Idronaut CTD, Portable CTD, water sample collection
8	10-06-2009	19:30	22:30	03° N	65° E	2876	Idronaut CTD, Portable CTD, water sample collection
9	11-06-2009	06:00	12:30	02° N	65° E	3282	Idronaut CTD, Portable CTD, water sample collection
10	11-06-2009	19:15	22:30	01° N	65° E	3671	Portable CTD
11	13-06-2009	04:30	12:20	00°	65° E	3700	Idronaut CTD, Portable CTD, Spade Corer water sample collection
12	13-06-2009	19:17	23:30	01° S	65° E	3480	Idronaut CTD, Portable CTD, water sample collection
13	14-06-2009	06:00	13:00	02° S	65° E	3400	Idronaut CTD, Portable CTD, water sample collection
14	14-06-2009	19:00	22:42	03° S	65° E	4163	Idronaut CTD, Portable CTD, water sample collection
15	15-06-2009	05:50	10:30	04° S	65° E	4091	Idronaut CTD, Portable CTD, water sample Collection

Stn No.	Date	Start Time (IST)	End Time	Latitude	Longitude	Station Depth (m)	Instruments Operated
16	15-06-2009	17:00 (16-06-09)	03:00	05° S	65° E	4123	Idronaut CTD, Portable CTD, Spade Corer water sample collection
17	16-06-2009	11:00	15:52	06° S	65° E	4224	Idronaut CTD, Portable CTD, water sample collection
18	16-06-2009	23:20 (17-06-09)	03:30	07° S	65° E	4186	Idronaut CTD, Portable CTD, water sample collection
19	17-06-2009	10:00	15:00	08° S	65° E	3939	Idronaut CTD, Portable CTD, water sample collection
20	17-06-2009	21:40	01:20 (18-06-09)	09° S	65° E	4155	Idronaut CTD, Portable CTD, water sample collection
21	18-06-2009	08:00	13:50	10° S	65° E	3147	Idronaut CTD, Portable CTD, Spade Corer water sample collection
22	18-06-2009	23:00	03:45 (19-06-09)	11° S	65° E	4141	Idronaut CTD, Portable CTD, water sample collection
23	19-06-2009	11:30	16:01	12° S	65° E	3367	Idronaut CTD, Portable CTD, water sample collection
24	19-06-2009	23:39	03:10 (20-06-09)	13° S	65° E	3515	Idronaut CTD, Portable CTD, water sample collection
25	20-06-2009	10:25	15:00	14° S	65° E	3352	Idronaut CTD, Portable CTD, water sample collection
26	20-06-2009	22:53	04:45 (21-06-09)	15° S	65° E	3463	Idronaut CTD, Portable CTD, Spade Corer water sample collection
27	21-06-2009	13:00	17:27	16° S	65° E	3131	Idronaut CTD, Portable CTD, Spade Corer water sample collection
28	22-06-2009	01:05	05:00	17° S	65° E	3676	Idronaut CTD, Portable CTD, Spade Corer water sample collection
29	22-06-2009	13:30	21:00	18° S	65° E	3712	Idronaut CTD, Portable CTD, Spade Corer water sample collection

Locations at which XBT was deployed

Date	LATITUDE	LONGITUDE	SST (°C)
7/6/2009	9 30° N	65° E	29.5
7/6/2009	8 30° N	65° E	29.5
8/6/2009	7 30° N	65° E	29.5
8/6/2009	6 30° N	65° E	29.5
9/06/2009	5 30° N	65° E	29.5
10/06/2009	4 30° N	65° E	29.5
10/06/2009	3 30° N	65° E	30
11/06/2009	2 30° N	65° E	30
11/06/2009	1 30° N	65° E	30
12/06/2009	0 30° N	65° E	30
13/06/2009	0 30° S	65° E	29.5
14/06/2009	1 30° S	65° E	30
14/06/2009	2 30° S	65° E	29.5
15/06/2009	3 30° S	65° E	28
15/06/2009	4 30° S	65° E	28
16/06/2009	5 30° S	65° E	28
16/06/2009	6 30° S	65° E	28
17/06/2009	7 30° S	65° E	28
17/06/2009	8 30° S	65° E	28
18/06/2009	9 30° S	65° E	27.5
18/06/2009	10 30° S	65° E	27.5
19/06/2009	11 30° S	65° E	27
19/06/2009	12 30° S	65° E	26.5
20/06/2009	13 30° S	65° E	26.5
20/06/2009	14 30° S	65° E	27
21/06/2009	15 30° S	65° E	26.5
21/06/2009	16 30° S	65° E	26.5
22/06/2009	17 30° S	65° E	26.5
23/06/2009	17° S	65 30° E	27
23/06/2009	16° S	65 40° E	27
24/06/2009	15° S	67 20° E	26.5
24/06/2009	14° S	68 10° E	27
24/06/2009	13° S	69° E	26
25/06/2009	11° S	70° E	26
26/06/2009	10° S	71° E	26
26/06/2009	9° S	72 20° E	26

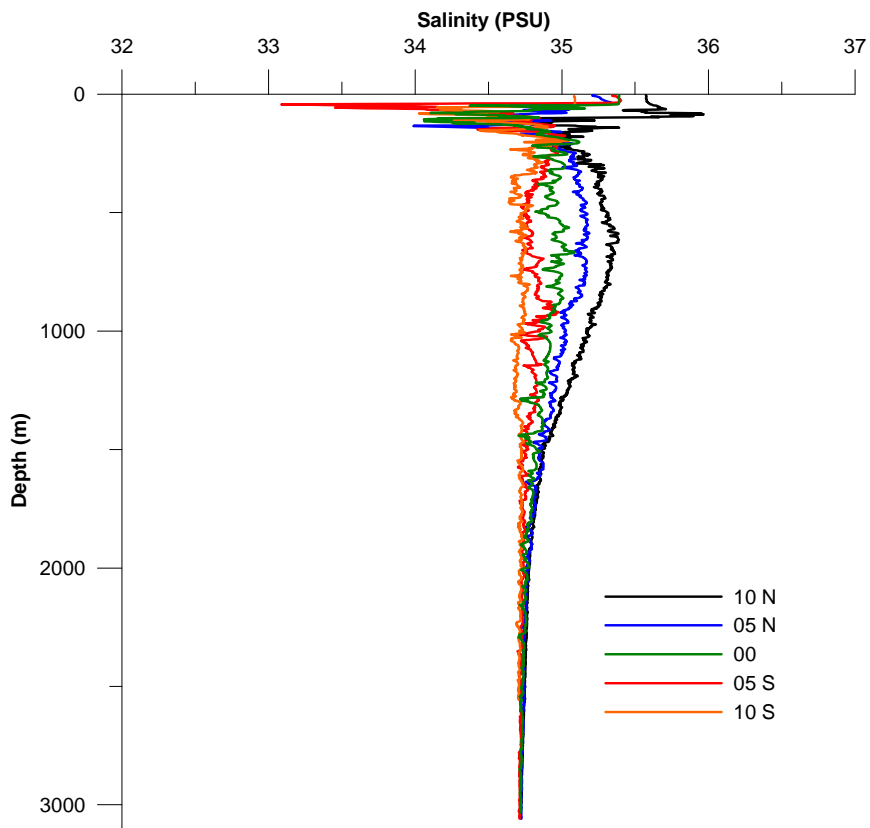
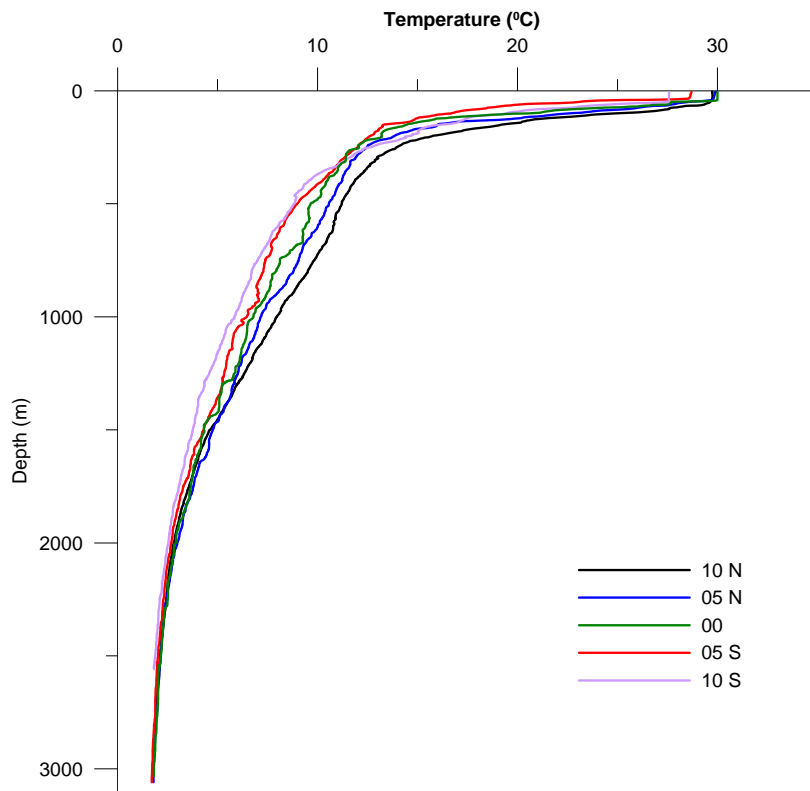
Date	LATITUDE	LONGITUDE	SST (°C)
26/06/2009	8° S	73° E	27
27/06/2009	7° S	73 30° E	27
27/06/2009	6° S	74 20° E	28
27/06/2009	5° S	75 00° E	28
28/06/2009	4° S	75 40° E	28
28/06/2009	3° S	76 20° E	29
28/06/2009	2° S	76 30° E	29
29/06/2009	1° S	77 03° E	29
29/06/2009	0° N	78 13° E	29
29/06/2009	1° N	78 53° E	29
30/06/2009	2° N	79 03° E	29
30/06/2009	3° N	80 10° E	29
30/06/2009	4° N	80 47° E	28.5
01/07/2009	5° N	81 26° E	28
01/07/2009	6° N	82 07° E	28
01/07/2009	7° N	82 16° E	29.5
01/07/2009	8° N	82 12° E	29
02/07/2009	9° N	81 55° E	29
02/07/2009	10° N	81 03° E	29
02/07/2009	11° N	81 00° E	28
03/07/2009	12° N	80 40° E	29

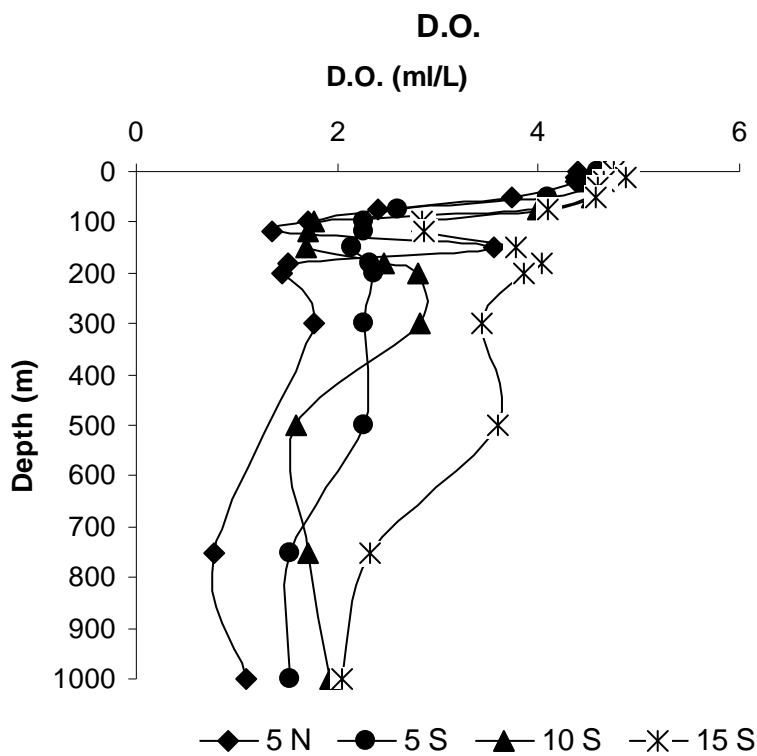
Details of sediment sampling

Position		Depth (m)	Instrument used	Remarks
Latitude	Longitude			
10°N	65° E	4417	Grab	No sediment retrieved
5°N	65° E	4047	Spade Corer	No sediment retrieved
0°N	65° E	3808	Spade Corer	Sediment sample sandy and calcareous in texture
5°S	65° E	4127	Spade Corer	Sediment sample clayey in texture
10°S	65° E	3142	Spade Corer	Sediment sample sandy and calcareous in texture
15°S	65° E	3946	Spade Corer	Sediment sample clayey in texture
18°S	65° E	3946	Spade Corer	Rock samples were retrieved

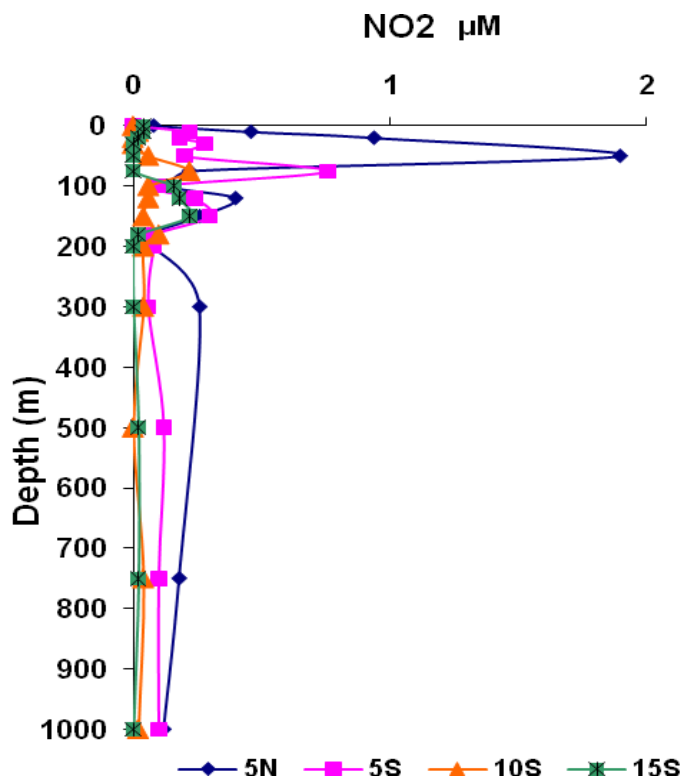
Details of Biological Sampling

Sl. No	Latitude	Longitude	Observations
1	10°N, 8°N, 6°N, 4°N, 2°N, 0, 2°S, 4°S, 6°S, 8°S, 10°S, 12°S, 14°S, 16°S, 18°S	65°E	<p>For chlorophyll estimation water samples collected from 12 depths viz 0m,10m 20m, 30m, 50m, 60m, 75m, 100m, 120m, 150m, 180m and 200m and filtered through GF/F filter paper.</p> <p>For ATP analysis water collected from 12 depths viz 0m,10m 20m, 30m, 50m, 60m, 75m, 100m, 120m, 150m, 180m and 200m and filtered through 0.22μ filter paper.</p> <p>5 ml sample collected from same depth and preserved with 250μl buffered formalin for direct count of bacteria and 200 ml sample collected and kept in fridge for further microbiological analysis.</p>

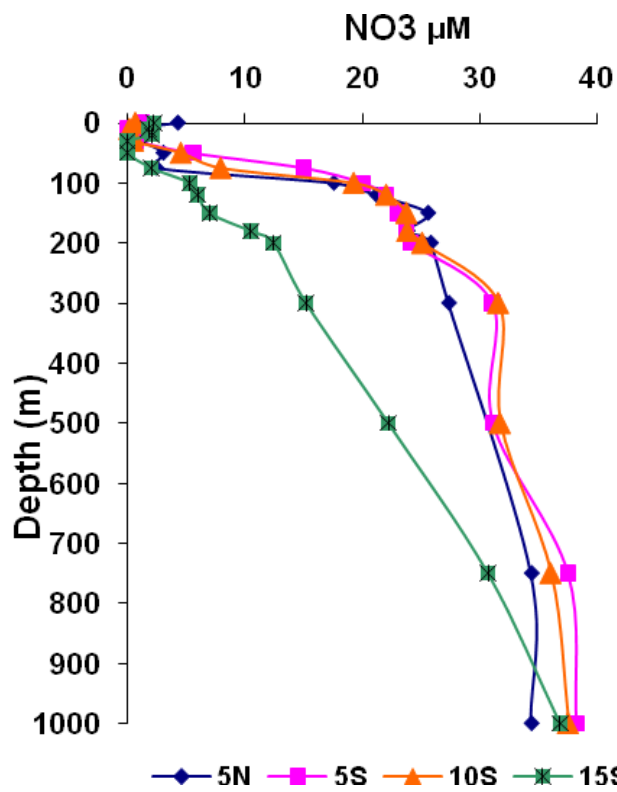




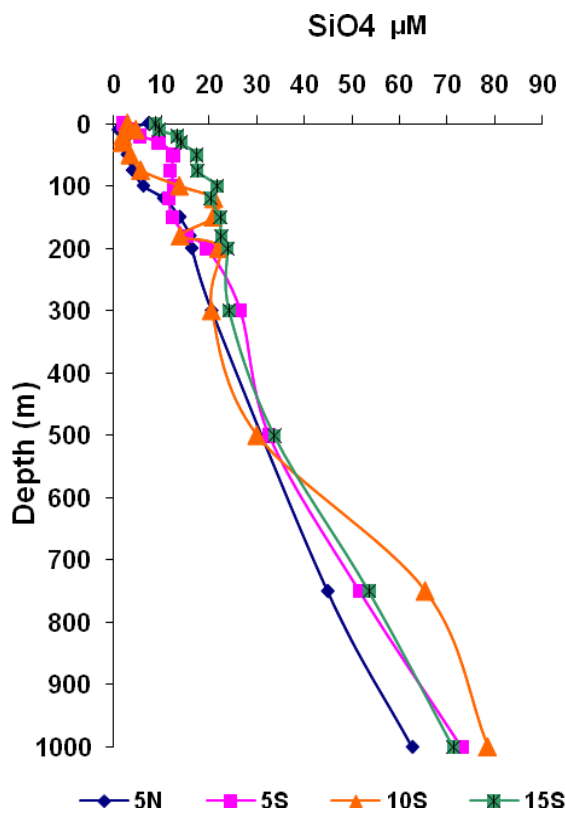
Vertical variation of DO (ml/l) at 5°N, 5°S, 10°S and 15°S



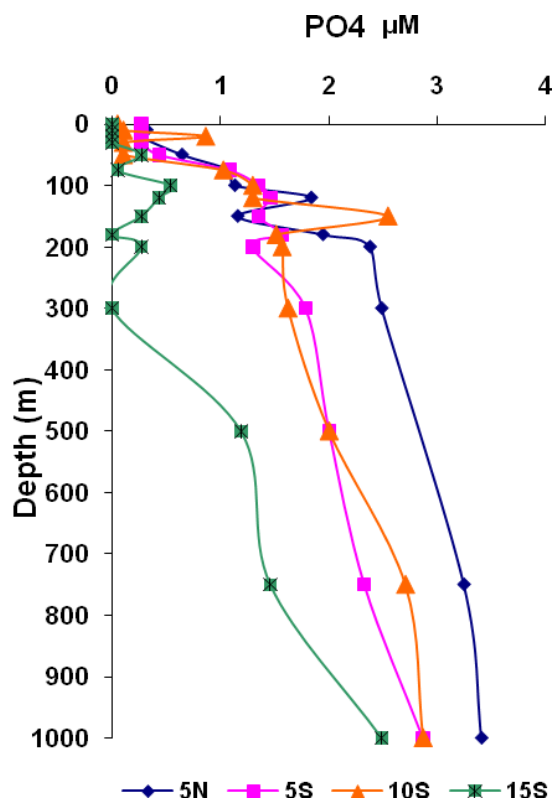
Vertical variation of NO₂ (μM) at 5°N, 5°S, 10°S and 10°S



Vertical variation of NO₃ (µM) at 5°N, 5°S, 10°S and 15°S



Vertical variation of SiO₄ (µM) at 5°N, 5°S, 10°S and 15°S



Vertical variation of PO₄ (µM) at 5°N, 5°S, 10°S and 15°S