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CRUISE REPORT



राष्ट्रीय समुद्र विज्ञान
संस्थान

**NATIONAL INSTITUTE
OF
OCEANOGRAPHY**

ORV SAGAR KANYA

CRUISE 227

(1 - 29 August 2006)

NATIONAL INSTITUTE OF OCEANOGRAPHY
(Council of Scientific and Industrial Research)

Dona Paula, Goa 403004

REPORT ON CRUISE 227 OF ORV SAGAR KANYA

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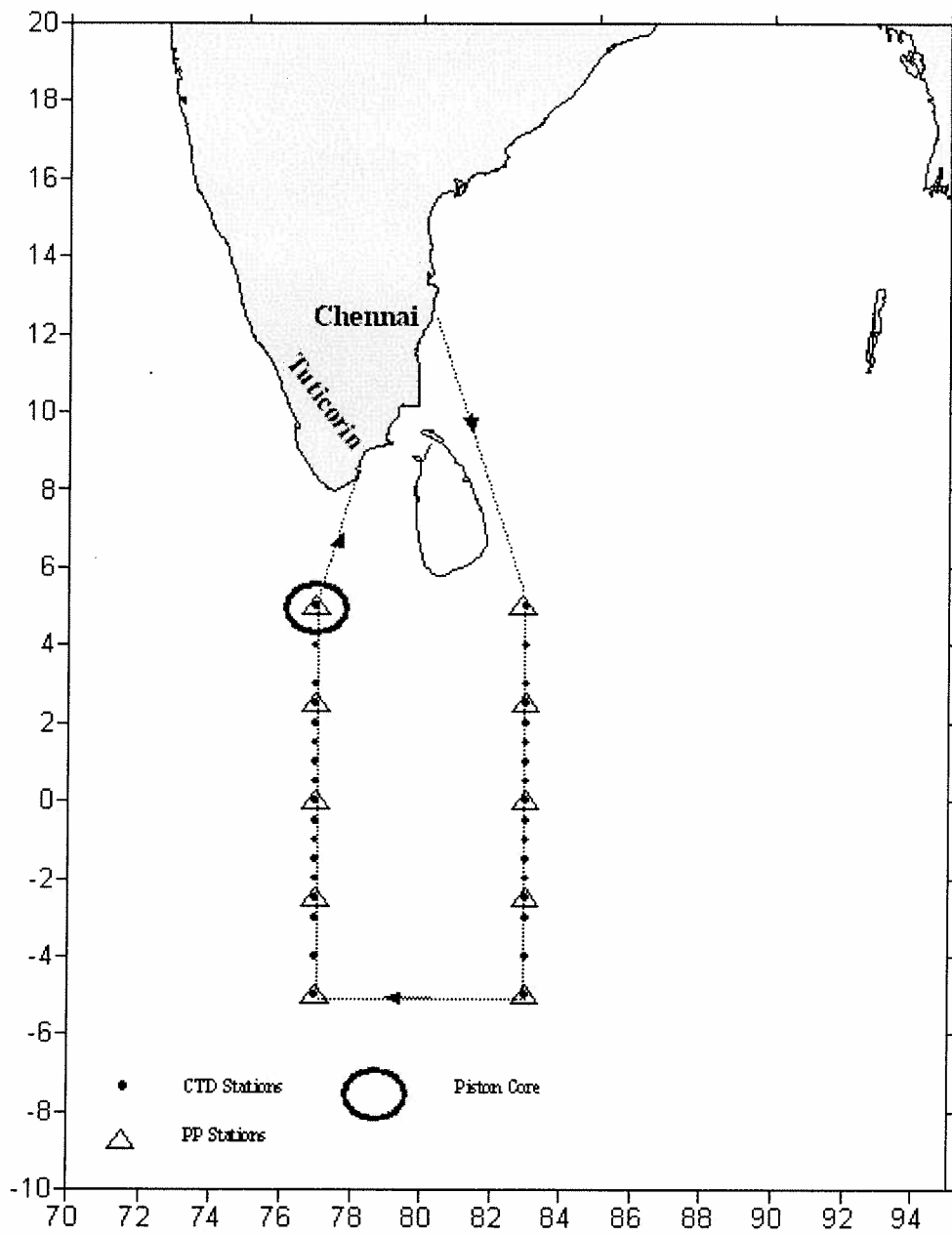
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1. SUMMARY

The 227th cruise of ORV *Sagar Kanya* sailed from Chennai on 1st August 2006 and returned back to Tuticorin on 29th August 2006. This forms a part of the DOD funded programme of oceanic processes of the equatorial Indian Ocean (GAP-1402). The *in situ* measurements consisted of the CTD operation at half-a-degree interval along two transects along 77°E and 83°E from 3°N to 3°S and at one-degree-interval in the rest of the stations. Chemical parameters were analysed using the water samples collected by the CTD Rossette. *In situ* incubation was carried out by deploying Primary Productivity (PP) mooring at 5 locations at each of the 2 transects. In addition Multiple Plankton Net (MPN) was operated in the upper 1000 m for stratified sampling. A total of six Argo floats and fourteen drifting buoys were deployed at six pre-determined locations.

2. CRUISE TRACK



Equatorial Biogeochemistry Cruise SK-227 (August 2006)

3. INTRODUCTION

The 227th cruise of ORV *Sagar Kanya* is the second of the four cruises planned in the Equatorial Indian Ocean under the DOD funded programme of Oceanic processes of the equatorial Indian Ocean (GAP-1402) to address the seasonal variability of the upper ocean in response to atmospheric forcing and its implication to overall biogeochemistry. The *in situ* measurements in this cruise were designed to capture the southwest (Summer) monsoon signature. For *in situ* measurements, the CTD was operated at half-a-degree interval from 3°N to 3°S and at one-degree-interval in the rest of the stations (See Fig.1) along two transects along 77°E and 83°E from 5°N to 5°S with 30L/ 12L and/ 5L GoFLo/Niskin bottles. In all 34 CTD stations were occupied. Water samples for the analysis of chemical parameters were collected by operating the CTD twice (usually 1000 - 120 m and 100 - 1 m). Similarly there was separate cast for Primary Productivity (PP, up to 150 m). Multiple Plankton Net (MPN) was hauled up from 1000 m to surface with intermittent closing/opening of individual nets usually from 1000-500, 500-300, 300-60 thermocline), and from 60 to surface (mixed layer). To achieve *in situ* conditions for PP measurements, the PP mooring assembly with samples from 10 different depths after adding tracer substrates was deployed before day-break and recovered after sun set from 10 pre-decided stations.

4. ITINERARY

Departure: Chennai, 1 August 2006
Arrival: Tuticorin, 29 August 2006

5. CRUISE PARTICIPANTS

5.1 Scientific component

1. Dr. S. Prasanna Kumar, Chief Scientist	National Inst. of Oceanography
2. Dr. Sugandha Sardesai	-do-
3. Mr. G. Nampoothiri	-do-
4. Ms. Jayu Narvekar	-do-
5. Ms. Venecia Catul	-do-
6. Mr. Gaurish Salgaonkar	-do-
7. Ms. Vidya P.J	-do-
8. Mr. Vivek P.N	-do-
9. Mr. Sheldon Rebello	-do-
10. Ms. Madhumita Tripathy	-do-
11. Ms. A.S.N. Lakshmi	-do-
12. Mr. Suhas Shetye	-do-
13. Mr. N.V. Harikrishnachari	-do-
14. Mr. B. Srinivas	Andhra University
15. Mr. P. Sudarsana Rao	-do-
16. Mr. K. Madhusudan	NORINCO
17. Mr. A.J. Hemon Rohit	-do-
18. Mr. P. Boopathy	-do-
19. Mr. Hafizur Rahman	-do-

5.2 Ship's complement

1. CAPT. K.S. Pandyan	Master
2. Mr. Sam Thomas	Chief Officer
3. Mr. Gopal Trivedi	2 nd Officer
4. Mr. D. Chakraborty	2 nd Officer
5. Dr. Justin Pereira	Medical Officer
6. Mr. Debabrota Mondal	RO
7. Mr. Lewis Henry Sooting	Purs. Officer
8. Mr. Syed Niaz Ahmed	CEO
9. Mr. S.K. Biswas	2 nd EO
10. Mr. Raktim Bora	3 rd EO
11. Mr. Naresh Chandra Das	4 th EO
12. Mr. Anil M. Kaple	EL/Eng
13. Mr. Julloberto Fernandes	Catg. Officer
14. Mr. Samiro T. Pereira	A/Catg. Officer

6. OBJECTIVES

1. To obtain a high-resolution biogeochemical measurements along two trans-equatorial sections along 77°E and 83°E from 5°N to 5°S to decipher spatial variations in physical, chemical and biological properties as a part of the seasonal cycle and the various forcing that are responsible for such variability in the equatorial Indian Ocean.
2. Collection of two sediment cores from 5°N and 83°E, and 5°N and 77°E.
3. Deploy Argo floats and drifting buoys at pre-determined locations.

7. WORK ACCOMPLISHED

7.1 Parameters measured

1. Temperature profile
2. Salinity profile
3. Sea surface temperature (SST)
4. Wind speed and direction
5. Air temperature and wet bulb temperature
6. Atmospheric pressure
7. Chlorophyll *a*
8. ¹⁴C based Primary production rate
9. Phytoplankton
10. Zooplankton
11. TCO₂
12. pH
13. Alkalinity
14. Nutrients (Nitrate, Phosphate)
15. TOC

7.2 Instrument and machinery used onboard

1. CTD with Rosette (Sea-Bird)
2. 30L GoFlo & 5L Niskin samplers
3. ADCP
4. AUTOSAL
5. Echo sounder
6. Multiple Plankton Net
7. Milli Q water purification system
8. Jib boom
9. Atlas crane
10. CTD winch
11. Deep sea winch
12. Piston corer

7.3 NIO equipment used onboard

1. Coulometer
2. pH meter
3. Spectrophotometer
4. Gas Chromatograph
5. Filtration units and pumps
6. 12 L GoFlo water samplers 12 numbers
7. PP Mooring system
8. Fluorometer
9. Dynalab met kit

7.4 ADCP operations

ADCP was not functional and hence could not collect underway-current measurements.

7.5 Surface met observations

Surface met observations were carried out at each station using hand-held met kit.

7.6 CTD operations

Sea-Bird CTD was operated at half-a-degree interval from 2°N to 2°S and at one-degree-interval at rest of the stations up to 1000 m depths to collect temperature and salinity profiles along 77°E and 83°E (see cruise track). Data was collected during down cast while water samples were collected during up cast. At each of the PP stations waters samples were collected using CTD Rosette for 2 casts for nutrient measurements, 1 cast for zooplankton, chlorophyll and PP. In all 34 CTD stations were occupied.

7.7 MPN operations

MPN was operated with flow meter sensor. Since the flow meter (out) was non-functional the flow was not known. Depth sensor was used to determine the closing depth of the net. In all 5 nets were operated to make stratified collection up to 1000 m. MPN was hauled up

from 1000 m to surface with intermittent closing/opening of individual nets usually from 1000-500, 500-300, 300-60 (thermocline) and from 60 to surface (mixed layer).

7.8 In situ primary production measurements

In situ primary production measurements were carried out by inoculating the samples drawn from CTD rosette from 10 depths (upper 150 m) by ^{14}C and deploying it in situ with the help of PP mooring. In all 10 PP stations were occupied, 5 along 77°E and 5 along 83°E.

7.9 Piston/ Gravity core operation

Piston core was operated at 4°N and 83°E to collect sediment core. But due to leakage in the hydraulic fluid and malfunctioning of gallows winch the operation was suspended. The Gallows winch was unable to take the load and instead of heaving the winch was paying out the wire.

Due to the problem with hydraulic system of gallow winch, instead of Piston core gravity corer was operated at 5°N and 77°E on 25th August at 1930 hrs. When the gravity corer was brought to deck it was found that no sample was collected.

7.10 Deployment of drifting buoys

In all 14 drifting buoys were deployed during the cruise at pre-determined locations and the details are given below:

Float ID	Date	Time (IST)	Latitude N/S	Longitude E
59356	3 rd August 2006	0231 hrs	8 00.00 N	82 30.8 E
63027	3 rd August 2006	0231 hrs	8 00.00 N	82 30.8 E
59357	4 th August 2006	0455 hrs	05 02.22 N	83 02.33 E
59358	4 th August 2006	0455 hrs	05 02.22 N	83 02.33 E
63028	4 th August 2006	0455 hrs	05 02.22 N	83 02.33 E
63029	7 th August 2006	1955 hrs	02 30.00 N	83 00.00 E
63030	9 th August 2006	2135 hrs	00 00.10 S	83 00.22 E
63031	11 th August 2006	2100 hrs	02 30.18 S	82 59.90 E
63032	16 th August 2006	2033 hrs	05 00.04 S	77 00.67 E
63033	17 th August 2006	1817 hrs	03 00.15 S	76 59.96 E
63034	20 th August 2006	2255 hrs	00 00.07 S	77 00.41 E
63035	22 nd August 2006	2115 hrs	02 30.06 N	77 00.03 E
63036	24 th August 2006	1930 hrs	05 00.11 N	77 00.71 E
59359	24 th August 2006	1930 hrs	05 00.11 N	77 00.71 E

7.11 Deployment of Argo floats

In all 6 Argo floats were deployed during the cruise at pre-determined locations and the details are given below:

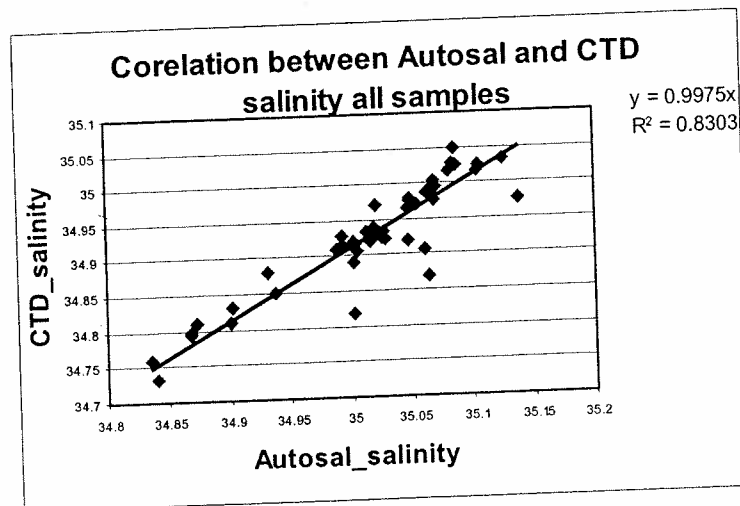
Float ID	Date	Time (IST)	Latitude N/S	Longitude E
2833	5 August 2006	0440 hrs	5 02.19 N	83 02.21 E
2834	7 August 2006	2000 hrs	2 30.00 N	83 00.00 E
2835	11 August 2006	1645 hrs	2 58.42 S	82 55.36 E
2745	13 August 2006	2145 hrs	5 00.75 S	83 00.34 E
2746	16 August 2006	2036 hrs	5 00.04 S	77 00.67 E
2767	18 August 2006	2207 hrs	02 30.35 S	77 00.04 E

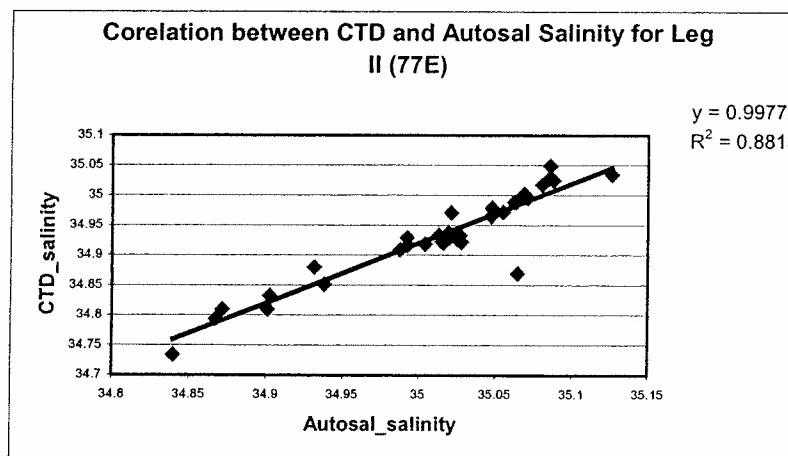
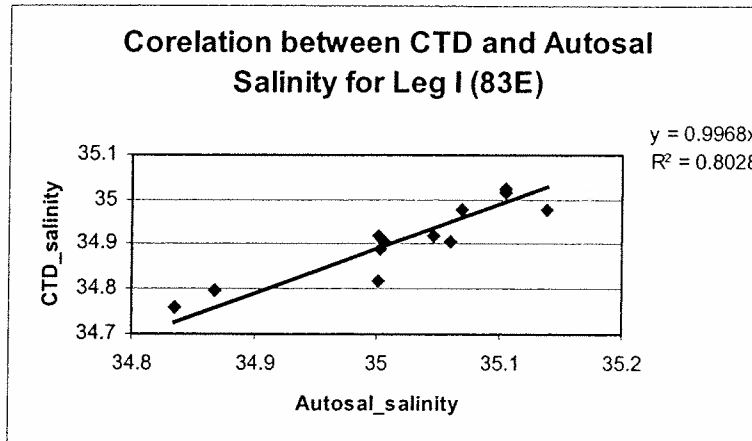
8. PERFORMANCE OF THE EQUIPMENTS USED

Sea-Bird CTD - calibration of CTD salinity with Autosol salinity

The salinity from the conductivity sensor of onboard Sea-Bird CTD was calibrated with water samples collected from 600 m, 800 m and 1000 m depth and salinity estimated with the help of onboard Autosol. In all 49 samples from 18 locations - 12 locations (34 samples) along 77°E and 6 locations (15 samples) along 88°E - were used to calibrate the CTD salinity with Autosol salinity. The regression for both transects (along 77°E and 83°E) is given in the below figures separately.

Calibration





CTD Rosette

The CTD Rosette was used with 12 bottles for sampling purposes. Of these 12 bottles, 4 each were of 30L, 10L and 5L capacity. Initially, the bottle positions 9 and 10 were not triggering and were subsequently repaired. The 30L GoFlo bottle at 12th position though worked well for the deep cast (deeper depths) did not function well for shallow depths. The 5L bottle at 8th position did not trigger well for 40m and hence were repositioned to shallower depth. The 30L bottle at position 5 was replaced with 10L bottle and 10L bottle at position 4 was replaced with 30L bottle. The 30L bottle at 5th position did not work well during most of the operation.

Hydrographic winch

Hydrographic winch developed winding problem during the operation at first CTD station on 3rd August 2006. The chain of the wire guide gave way. This was repaired and operation was resumed. The roller of the pulley of the hydrographic winch was replaced on 18th August at CTD station 21 due to wear and tear. At CTD 22 station on 19th August the level winder of hydrographic winch used for CTD operation developed problem which has been rectified subsequently. The water leakage in the slip ring on 23rd August night at CTD station 32 caused a spark. This has been serviced and operation was resumed.

Multiple Plankton Net

In the first operation of MPN at CTD station 1 on 5th August 2006, the motor was not rotating and hence operation was suspended and the instrument was attended and repaired. Subsequent operations did not have any problem. Though MPN had provision for 5 nets, only 4 nets were available for use in the present cruise.

Auto analyzer

The auto analyzer was not functional and hence was not available for the analysis of nutrients in the present cruise. Samples were, however, analysed manually using spectrophotometer.

9. PERFORMANCE OF THE SHIP

In general, the shipboard machinery and equipment worked satisfactorily but the major problem encountered was with air-conditioning system. The air-conditioning in the labs, specially chemistry lab, dry port lab, dry starboard lab, photography lab (Fluorometer lab for chlorophyll analysis) was not functioning as lab temperature was 30°C most of the time. Due to this chemical analysis and several other analysis have to be shifted from their designated place to labs which were cooler such as Gravimeter room, multi-purpose lab etc. In some labs additional fans were fitted to give more ventilation thereby reducing the temperature marginally.

Several cabins were infested by bedbugs.

10. LOSS REPORT

- One 10 L GoFlo bottle belonging to NIO was damaged during the course of the operation.
- One strand of deep-sea winch wire came out during gravity core operation on 25 August 2006 at 2115 hrs at Lat. 05° 06.36' N and 77° 15.36'E. The wire rope was found damaged at a length of about 2033 m.

11. CONCLUSIONS

Data was collected at all the planned stations.

1. All 34 stations were covered for various observations and data collection..
2. CTD was operated at half-a-degree interval up to 1000 m depth along 77°E and 83°E.
3. Nutrients and chlorophyll a measurements were carried out at one-degree interval along 77°E and 88°E. However, near the equator the sampling was carried out at half-a-degree spatial interval.
4. ¹⁴C based primary production measurement were carried in-situ at 10 stations, 5 each along 77°E and 88°E.
5. 6 Argo floats and 14 drifting buoys were deployed at pre-determined positions.

12. RECOMMENDATIONS

1. Unable to make any underway-current measurements using ADCP, as it is not functional since the commencement of the cruise and hence need repair.
2. Since the auto analyzer was not working nutrients could not be analysed using this instrument. This needs replacement/repair.
3. We were also informed that the Milli-Q system onboard is using the last filter that is available with NORINCO, which will last till the end of the cruise. But for subsequent cruises the necessary arrangements needs to be made.
4. MPN nets need to be procured as presently only 4 nets are available instead of 5. Even out of this four one net is damaged.
5. As most of the sampling bottles are not functioning well, new ones may be procured (3oL, 10L and 5L) as this is a common usage item in all multi-disciplinary cruises.
6. Most of the PC's are old and needs replacements. No CD writer is available onboard and hence PC with CTD/DVD writer may be procured.
7. An LCD projector and a PC may be made available permanently at the conference room to facilitate talks, seminars and discussions.

13. ACKNOWLEDGEMENTS

Master, Chief Engineer, Chief Officer, all other Officers as well as the entire shipboard personnel from deck, engine and catering departments cooperated very well to make this cruise a great success. The Chief Scientist and the entire team record their appreciation for this co-operation.

Similarly, the NORINCO engineers extended their technical support whenever required.

The constant encouragement by the Director, NIO and the excellent logistical support extended by Dr. M. Sudhakar and NCAOR team is greatly acknowledged.

Equatorial project team acknowledges the funding support by the Department of Ocean Development, Government of India for carrying out this measurement programme.

Appendix I

Table 1 - Station locations and operations

Sl. No.	Station number	Latitude N/S	Longitude E	Date	Time IST	Operations
1	Drifting Buoy (DB)	8° 00'N	82° 32'E	3-8-06	0231	Deployment of drifting buoy ID 59356 & 63027
2	CTD_01	5° 00'N 5° 02'N 5° 02'N	82° 59'E 83° 02'E 83° 02'E	3-8-06 4-8-06 5-8-06	2240 0445 0630 1820 0330 0440 0455	Transect along 83°E CTD deep cast up to 1000 m PP & Shallow cast up to 150 m PP mooring deployment PP mooring recovery MPN up to 1000 m. Did not work Deployment of Argo float ID 2833 Deployment of drifting buoy ID 63028, 59357 & 59358
3	CTD_02	4° 00'N	83° 00'E	5-8-06	1200 1415 1555	CTD deep cast up to 1000 m CTD shallow cast 100 m Piston core operation. Operation suspended due to failure of Gallow winch.
4	CTD_03	3° 00'N	82° 59' E	6-8-06	0110 0245	CTD Deep cast up to 1000 m CTD shallow cast 150 m
5	CTD_05	1° 58'N	82° 59' E	6-8-06	0925 1135 1235	CTD deep cast up to 1000 m CTD shallow cast up to 150 m MPN up to 1000m
6	CTD_04	2° 30'N 2° 30'N	83° 00' E 83° 00' E	6-8-06 7-8-06	1730 1940 2330 0325 0630 1815 1955 2000	CTD deep cast up to 1000 m CTD shallow cast up to 150 m MPN up to 1000 m PP cast up to 150 m PP deployment PP recovery Deployment of Drifting buoy ID 63029 Deployment of Argo float ID 2834
7	CTD_06	1° 29' N	82° 59' E	8-8-06	0315 0515	CTD deep cast up to 1000 m CTD shallow cast up to 200 m
8	CTD_07	0° 59'N	82° 58' E	8-8-06	0915 1130	CTD deep cast up to 1000 m CTD shallow cast up to 200 m
9	CTD_08	0° 29'N	82° 59' E	8-8-06	1640 1835	CTD deep cast up to 1000 m CTD shallow cast up to 150 m
10	CTD_09	0° 00'S 0° 00'S 0° 00'S	82° 59' E 83° 00'E 82° 59' E	8-8-06 9-8-06 9-8-06 10-8-06	2330 0335 0430 0530 1810 2135 2150 0015	MPN up to 1000 m PP cast up to 150 m PP repeat cast up to 100 m PP deployment PP recovery Deployment of Drifting buoy ID 63030 CTD Deep cast up to 1000 m CTD shallow cast up to 150 m
11	CTD_10	0° 30'S	82° 59' E	10-8-06	0505 0710	CTD deep cast up to 1000 m CTD shallow cast up to 150 m
12	CTD_11	1° 00'S	82° 59' E	10-8-06	1220 1435	CTD deep cast up to 1000 m CTD shallow cast up to 150 m

Sl. No.	Station number	Latitude N/S	Longitude E	Date	Time IST	Operations
13	CTD_12	1° 30'S	82° 59' E	10-8-06	2005	CTD deep cast up to 1000 m
14	CTD_13	2° 00'S	83° 00' E	11-8-06	0205 0400	CTD deep cast up to 1000 m CTD shallow cast up to 150 m
15	CTD_15	3° 01'S 3° 00'S 2° 58'S	83° 00'E 82° 58'E 82° 55'E	11-8-06	1215 1335 1610 1645	MPN up to 1000 m CTD deep cast up to 1000 m CTD shallow cast up to 150 m Deployment of Argo float ID 2835
16	CTD_14	2° 30'S 2° 30'S	82° 59'E 83° 00'E	11-8-06 12-8-06 12-8-06	2100 2115 2330 0000 0320 0510 1810	Deployment of Drifting buoy ID 63031 CTD deep cast up to 1000 m CTD shallow cast up to 150 m MPN up to 1000 m PP cast up to 150 m PP deployment PP recovery
17	CTD_16	4° 00'S	82° 59' E	13-8-06	1025 1225 1250	CTD deep cast up to 1000 m CTD shallow cast up to 150m MPN up to 1000m
18	CTD_17	5° 00'S 5° 00'S 5° 00' S	83° 00' E 82° 58' E 83° 00' E	13-8-06 14-8-06	2145 2150 2345 0020 0345 0510 1810	Deployment of Argo float ID 2745 CTD deep cast up to 1000 m CTD shallow cast up to 150 m MPN up to 1000 m PP cast up to 150 m PP deployment PP recovery
19	CTD_18	5° 00'S 5° 00'S 5° 00'S	77° 03'E 77° 00'E 77° 00'E	16-8-06 16-8-06 17-8-06	0215 0515 1825 2033 2036 2045 2200 0005	Transect along 77°E PP cast up to 150 m PP deployment PP recovery PP recovery Deployment of Drifting buoy ID 63032 Deployment of Argo float ID 2746 CTD Shallow cast up to 150 m CTD deep cast up to 2000 m MPN up to 1000 m
20	CTD_19	4° 00'S 3° 51'S	77° 00'E 76° 59'E	17-8-06	0730 1030 1205	CTD deep cast up to 2000 m CTD shallow cast up to 150 m MPN up to 1000 m
21	CTD_20	3° 00'S 2° 59'S	76° 59'E 76° 57'E	17-8-06	1817 1825 2115	Deployment of Drifting buoy ID 63033 CTD deep cast up to 2000 m CTD shallow cast up to 600 m
22	CTD_21	2° 29'S 2° 30'E 2° 30'E	76° 59'E 77° 00'E 76° 59'E	18-8-06 18-8-06 19-8-06	0355 0518 1830 2207 2215 0125	PP cast up to 150 m PP deployment PP recovery Deployment of Argo float ID 2747 CTD deep cast up to 2000 m CTD shallow cast up to 150 m
23	CTD_22	1° 59'S	77° 00' E	19-8-06	0630 0915	CTD deep cast up to 1000 m CTD shallow cast up to 150 m
24	CTD_23	1° 29' S	77° 00' E	19-8-06	1315 1555	CTD deep cast up to 1000 m CTD shallow cast up to 150 m

Sl. No.	Station number	Latitude N/S	Longitude E	Date	Time IST	Operations
25	CTD_26	0° 00'S	76° 59' E	20-8-06	0120 0315 0510 1830	MPN up to 1000 m PP cast up to 150 m PP deployment PP recovery Deployment of Drifting buoy ID 63034 CTD deep cast up to 2000 m CTD shallow cast up to 150 m
		0° 00'S	77° 00'E	20-8-06	2255 2310 0226	
				21-8-06	0855 1125	
26	CTD_24	1° 00' S	76° 59' E	21-8-06		CTD deep cast up to 1000 m CTD shallow cast up to 150 m
27	CTD_25	0° 29' S	76° 59' E	21-8-06	1510 1705	CTD deep cast up to 1000 m CTD shallow cast up to 150 m
28	CTD_27	0° 30' N	76° 59' E	21-8-06	2335	CTD deep cast up to 1000 m CTD shallow cast up to 150 m
				22-8-06	0130	
29	CTD_28	0° 59' N	76° 59' E	22-8-06	0535 0730	CTD deep cast up to 1000 m CTD shallow cast up to 150 m
30	CTD_29	1° 30' N	76° 59' E	22-8-06	1110 1245	CTD deep cast up to 1000 m CTD Shallow cast up to 150 m
31	CTD_30	2° 00' N	77° 00' E	22-8-06	1610 1745	CTD deep cast up to 1000 m CTD Shallow cast up to 150 m
32	CTD_31	2° 30' N	77° 00' E	22-8-06	2115	Deployment of Drifting buoy ID 63035 CTD deep cast up to 1000 m CTD Shallow cast up to 150 m MPN up to 1000 m PP cast up to 150 m. PP deployment PP recovery
		2° 30' N	76° 59' E	22-8-06	2125 2247 2315	
		2° 30' N	77° 00' E	23-8-06	0410 0525 1830	
33	CTD_32	3° 00' N	77° 00' E	23-8-06	2250	CTD deep cast up to 1000 m CTD shallow cast up to 200 m
				24-8-06	0125	
34	CTD_33	3° 59' N	76° 59' E	24-8-06	0910 1100	CTD deep cast up to 1000m CTD shallow cast up to 150 m
35	CTD_34	5° 00' N	77° 00' E	24-8-06	1930	Deployment of Drifting Buoy ID 59359, ID 63036 CTD deep cast up to 1000 m CTD Shallow cast up to 150 m MPN up to 1000 m PP cast up to 150 m PP Deployment PP recovery Gravity Core operation Core came without sample
		5° 00' N	76° 59' E	25-8-06	1940 2125 2230 0315 0505 1830	
		5° 05' N	77° 14' E	25-8-06	1940	