ORV- SAGAR KANYA

SK-313 Cruise Report

(June 3rd 2014 to June 21st 2014)

GEOSCIENTIFIC STUDIES OF THE EXCLUSIVE ECONOMIC ZONE

National Centre for Antarctic and Ocean Research

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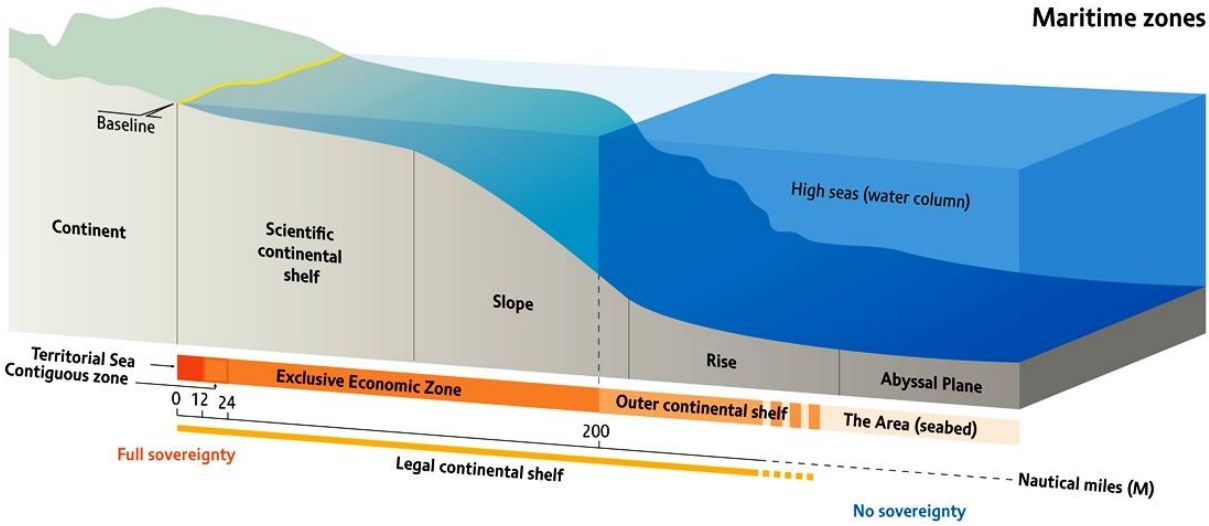
1. INTRODUCTION

Judicious utilization of offshore resources is very vital for the economic prosperity of any country in the world. The control over the oceans is regulated by the *Law of the Sea convention* of 1982, which came into force on November 16, 1994 and it defines oceanic jurisdiction for all countries. This Law extends the legal right to the coastal countries to exploit, develop, manage and conserve all resources to be found in the water and in the sub-soil of an area extending 200 nautical miles from its shore i.e. Exclusive Economic Zone (EEZ).

Utilities:

The Exclusive Economic Zone (EEZ), about 200 nautical miles from coast, the zone outside the territorial water of the country over which a country is permitted to do economic activities like fishing and is entitled to explore and exploit the natural resources of the area.



The detailed map of the EEZ shall be useful in the following purposes:

(i) Fishermen for fishing operations using deep trawl or bottom fishing gear,

(ii) Petroleum, natural gas and mineral exploration as well as exploitation,

(iii) Development and assessment of mineral resources,

(iv) Telecommunication industry for lying cables,

(v) Sub-sea pipe lines for geological hazard assessment,

(vi) Effective disposal of waste and reducing pollutants,

(vii) Ocean engineers for constructing and maintaining structures of port and harbor.

Indian EEZ:

India has an Exclusive Economic Zone (EEZ) with an area of about 23,05,143 km^2 along its 7516 km coastline (including the coastline of Andaman and Nicobar Islands and Lakshadweep Islands) as shown in figure-1. This constitutes about two-third of the land area of the country. Realizing the need to be cognizant about the enormous potentials of our country's EEZ, the *Government of India* has decided to prepare a comprehensive map of entire EEZ of India and *National Centre for Antarctic and Ocean Research (NCAOR), Goa* has been appointed as the nodal agency for the implementation of this programme.

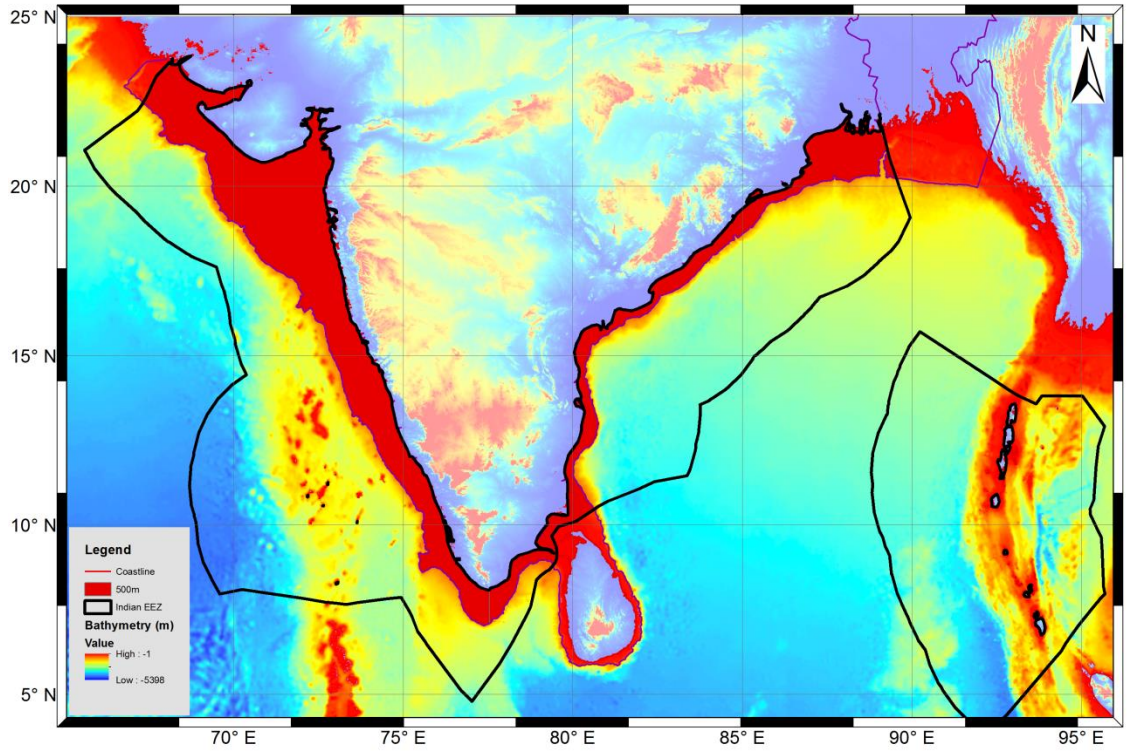


Figure 1: Indian EEZ map with the satellite bathymetry data

2. AREA OF OPERATION

The present cruise SK-313 survey was carried out in Bay of Bengal region. The total area covered is ~16800 km^2. Figure-2 shows shows the area location and track lines.

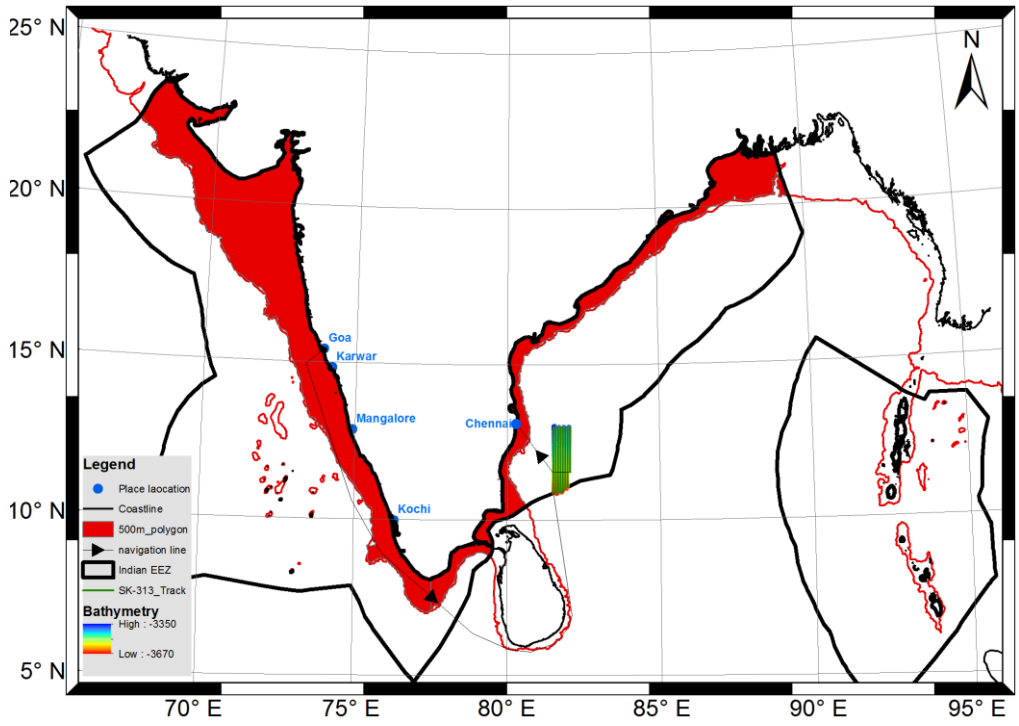


Figure 2: Figure shows the SK-313 survey area.

3. PLANNING OF SURVEY LINES

The survey lines are planned north to south and vice versa. The spacing between the adjacent lines was maintained at ~ 8 km to achieve complete coverage.

4. OBJECTIVE

The primary objective of the SK-313 cruise was to undertake multibeam bathymetric survey in Off-Chennai region in the Bay of Bengal within the EEZ of India as shown in figure-3. Other objectives including collection of:

i) CTD cast,

ii) Gravity core collection, and

iii) Shipboard training and acclimatization of university students.

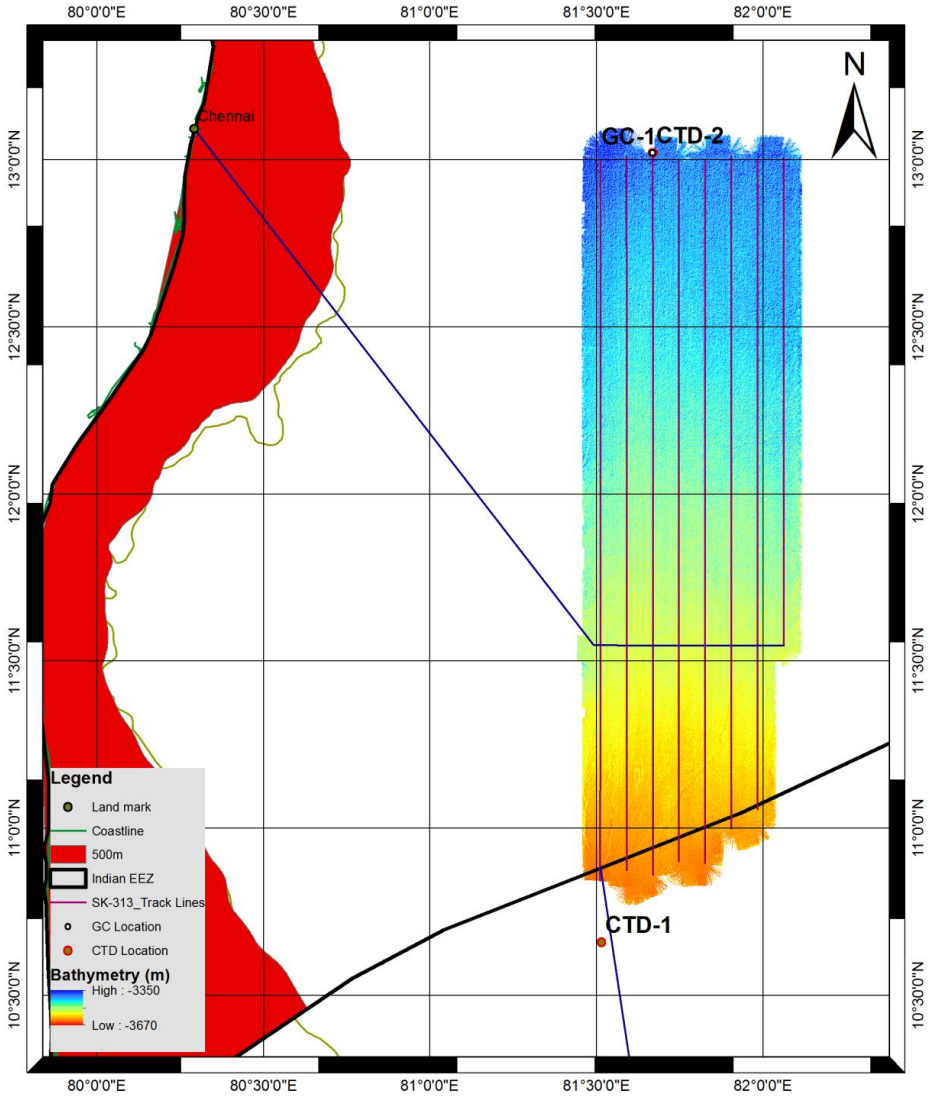


Figure 3: Survey area location with CTD and Gravity sampling location

5. CRUISE ITERNERY

The scientific team embarked onboard the vessel at Goa Port on 03rd June 2014. After the successful completion of the survey the vessel returned to Chennai port on 21st June 2014. An intermittent portcall was arranged on 09th Jun 2014 for disembarking OEM Engineers and embarking students from CUSAT, Kochi.

Departure : Goa, 06.06.2014

Arrival : Chennai, 21.06.2014

6. LIST OF PARTICIPENTS

A total of 34 scientific personnel participated in the cruise and are listed as under:

S. No	***Name***	***Organization***	***Designation***
1	**Abhishek Tyagi**	**NCAOR, Goa**	**Chief Scientist**
2	Ratan Srivastava	NCAOR, Goa	Dy. Ch. Scientist
3	Suman Kilaru	NCAOR, Goa	Scientist
4	Goverdhan K.	NCAOR, Goa	Scientific Asst.
5	Rupesh Sawant	NCAOR, Goa	Shipboard Asst
6	Viswanatha Vachaspati C	NPL, Delhi	Research Fellow
7	Silveria Karishma Marcilla	Goa University, Goa	M.Sc. Student
8	Bhogte Amey Shankar	Goa University, Goa	M.Sc. Student
9	Rodrigues Dolcy	Goa University, Goa	M.Sc. Student
10	Dias Crisha Vera Perpetua	Goa University, Goa	M.Sc. Student
11	Pullani Gayatri Jyotiprakesh	Goa University, Goa	M.Sc. Student
12	Nail Harshal Hari	Goa University, Goa	M.Sc. Student
13	Diniz Joel Elvio	Goa University, Goa	M.Sc. Student
14	Geacias Keziah Candace	Goa University, Goa	M.Sc. Student
15	Naik Saisree Ashok	Goa University, Goa	M.Sc. Student
16	Adel Sarvesh Shashikant	Goa University, Goa	M.Sc. Student
17	Rivankar Shantaram Laxmikant	Goa University, Goa	M.Sc. Student
18	Maurya Shilpa	Goa University, Goa	M.Sc. Student
19	Pawaskar Sonali Rajan	Goa University, Goa	M.Sc. Student
20	Sudhir Sweta Suresh	Goa University, Goa	M.Sc. Student
21	Toruskar Vijay Srikant	Goa University, Goa	M.Sc. Student
22	Saranya S. Kumar	CUSAT, Kochi	M.Sc. Student
23	Vishak J.	CUSAT, Kochi	M.Sc. Student
24	Naveen P.U.	CUSAT, Kochi	M.Sc. Student
25	Reshma K.S.	CUSAT, Kochi	M.Sc. Student
26	Slimmy Baby	CUSAT, Kochi	M.Sc. Student
27	Siva Chandiran A.	Bharathidasan Univ.	Research Scholar
28	Biju V. Nair	Norinco	Service Engg
29	V.C. Sarathchandran	Norinco	Service Engg
30	Elavarasan Vasantharaja	Norinco	Service Engg
31	Ganapathy Mahadevan	Norinco	Service Engg
32	Rajesh Srivastava	Kongsberg India Ltd	OEM Engg.
33	Nishant Bansal	Pan India Consultants Pvt. Ltd.	OEM Engg.
34	Vinay Dubey	Pan India Consultants Pvt. Ltd.	OEM Engg.

7. METHODOLOGY AND SURVEY EQUIPMENTS

a. Methodology :

The Multibeam survey was carried out using standard Survey practices. The tracklines were planned in order to obtain about 20% coverage at average speed of 8-9 knots. Navigational and attitude information is provided by C-NAV DGPS system. Ship track was maintained within ±20 m.

b. Equipment details:

7.2.1 SeaBeam-3012 Multibeam Echosounder System:

SeaBeam-3012 Multibeam Echosounder onboard ORV-Sagar Kanya was utilised to carry out the surveys in Off-Chennai region in Bay of Bengal. The SB-3012 is a 12 kHz, 201 beam sonar system, has a beam width of 2° at nadir and is capable of measuring depths ranging from 200 m to 11000 m. Brief technical specification of the SB-3012 MBES system are as follows:

Manufacturer : L3-Communications Elac-Nautik GmbH, Germany

Number of Beams : 201

Swath Coverage : 140°, 2° × 2° (5.5 × Depth), ~20 dB backscatter

Depth : 200 to 11, 000 m

Frequency of Operation : 12 kHz

Max. Source Level : 2° = 241 dB/mPa

Pulse Length : 2, 3, 5, 7, 10, 14, 20 ms

Side Lobe Suppression : > -30 dB

Technology : Full motion compensation (Sweptbeam technology)

Acquisition Software : Hydrostar

Data Processing Software : EIVA

The complete Multibeam system complex comprises of many sub systems:

a. Surface Sound velocity (SSV): The surface sound velocity profiler is an underway ocean surface profiling system that collects the water sound speed continuously.

b. Gyro & Motion Sensor: Multibeam system uses IXSEA-Octans sensor for Gyro and motion input. Octans is an IMO compliant survey grade gyrocompass with an integral motion sensor.

c. Positioning System: The C-NAV DGPS subsystem is used for positioning accuracy. C-Nav GcGPS corrections are similar to other wide area DGPS system such as the Federal Aviation Administration's (FDA) wide area augmentation system (WAAS). The C-Nav GPS receiver can accept two (2) different GcGPS correction service message formats. The C-Nav, dual frequency, GPS equipment receives either of these corrections broadcast from the communications satellite, applies them its own observed refraction corrected C/A code, dual frequency observations, and performs a navigation solution. The resulting corrected GPS position; velocity and time (PVT) are output from the C-Nav equipment to other subsystems on the platform/vehicle/vessel to support the navigation positioning control requirements.

d. Network Time Server with GPS Synchronized Time Base: LANTIME (local area network timeserver) provides a high precision time base to a TCP/IP network (stratum-1-server). The NTP (network time protocol) is used to synchronize all NTP clients with the reference. LANTIME/GPS is a set of equipment composed of a satellite controlled clock GPS167, a single board computer with integrated network board and a power supply, all installed in a metal 19" on the single-board computer flash disk. Four push buttons and a 2 x 40 character LC display can be used configure and monitor the time server. After the network connection has been bestialized, the timeserver can also be configured and monitored remotely from a work station via TEL/NET or FTP.

e. Network Time Protocol (NTP): NTP is a common method for synchronization of hardware clocks in local and global networks. Timeservers synchronize themselves by a reference time source, such as a radio controlled clock, GPS-receiver or modem time distribution. Stratum-1-server distribute

their time to several clients in the network which are called stratum-2. A high precision synchronization is feasible because of the several time references. Every computer synchronizes itself by up to three valued time sources. NTP enable the comparison of the hardware times and the adjustment of the own clock, a time precision of 128 ms, often better than 50 ms is possible.

7.2.2. Conductivity Temperature & Depth (CTD)

As the Sound Velocity Profiler (SVP) was under repair, the vertical structure of sound velocity was derived using CTD profiles. CTD is used to study various parameters like temperature, conductivity, pressure etc. at various depths. The *SBE-911plus* was utilized to measure conductivity, temperature, and pressure in depths up to 6,000 meters.

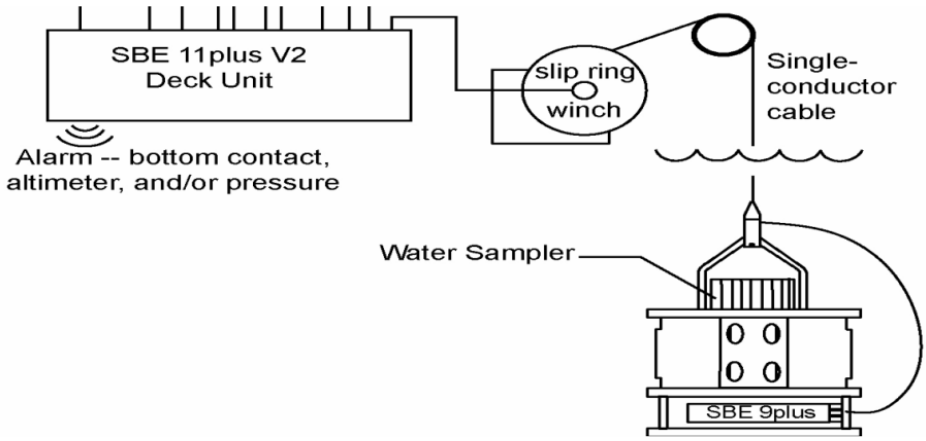


Figure 4: CTD deployment

7.2.3: Gravity Coring:

Gravity corer was used for sediment sample collection at one location. The corer consists of an open-ended tube with lead weight (~700kgs).The corer is lowered into the seabed and generally penetrates to a depth of up to 5-6 m.

Figure 5: Gravity corer

8. SCIENTIFIC OBSERVATION AND OTHER WORK DURING THE CRUISE

a. During the cruise, the MB data was processed with CARIS and plotted. A channel levee is identified with length of ~100 km in the NE-SW direction.

b. Gravity core was collected at one location and sample recovered of ~4.38 meters. The sediment core was sub-sampled at 1cm interval upto 1m, 2cm up to 2m and remaining core at 5cm interval.

c. SBP & SSS acquisition s/w was installed and trials carried out. Although the system is operational but not fully commissioned as the data quality is very poor. Further, OEM informed, trials shall be carried out in forthcoming cruises to rectify the problem.

9. DIARY OF EVENTS

DATE	ACTIVITIES
07-Jun-2014	POSN @ 0800hrs Lat: 14 49.119N Long: 73 49.965E Course: 160 Speed: 8.7kn Depth: 56m Sky Overcast • Pilot Onboard: 0206hrs; sailed out & RFA: 0300hrs • Vessel proceeding to Coring Stn. (BDN-02)
08-Jun-2014	POSN @ 0800hrs Lat: 11 50 48N Long: 74 43 23E Course: 155 Speed: 8.06kn Depth: 75m Sky Overcast • SBP & SSS s/w Installation and trials. Installation successful but system is not commissioned. • Gravity coring successful BDN-02 stn, rec.-~4.5m. 1549UTC, Locn.: 10 30 07N; 75 22 30E; D=517m

09-Jun-2014	POSN @ 0800hrs Lat: 09 58 8.67N Long: 76 15 18.9E Course: 126 Speed: 6kn Sky Overcast, intermittent rains • Kochi Port call activities: • Vsl alongside 1000hrs. • 3 OEM Engrs. & BDN Univ. participant disembarked. • 5 CUSAT students embarked. • pilot confirmed at 1400hrs but arrived late ~1630hrs • Vsl sailed out 1820hrs.
10-Jun-2014	POSN @ 0800hrs Lat: 08 20.87N Long: 76 45.63E Course: 137 Speed: 8.6kn Sky Overcast, intermittent rains • Proceeding to survey area.
11-Jun-2014	POSN @ 0800hrs Lat: 06 24 32N Long: 79 21 09E Course: 125 Speed: 7.5kn • Proceeding to survey area.
12-Jun-2014	POSN @ 0800hrs Lat: 06 38 26N Long: 82 01 02E Course: 011 Speed: 7.0kn Sky Overcast • Proceeding to survey area.
13-Jun-2014	POSN @ 0800hrs Lat: 09 11 09N Long: 81 53 55E Course: 344 Speed: 6.3kn Sky Overcast, sea rough • 2300hrs - CTD cast at 10 49 27N; 81 30 53E; d= 3645m. Operation delayed due to winch problem, total time for cast ~6hrs.
14-Jun-2014	POSN @ 0800hrs Lat: 11 91 13.4N Long: 81 30 42.76E Course: 356.9 Speed: 6.2kn

	Sky Overcast • MB surveys started, • BOL-01 @ 0500hrs. UTC • EOL-01 @ 1735hrs. UTC • BOL-02 @ 1837hrs. UTC
15-Jun-2014	POSN @ 0800hrs Lat: 12 06 43.6632N Long: 81 35 25.5990E Course: 173.7 Speed: 6.7kn Scattered Clouds • EOL-02 @ 1216hrs. UTC • BOL-03 @ 1325hrs. UTC
16-Jun-2014	POSN @ 0800hrs Lat: 12 35 41.0048N Long: 81 40 08.9472E Course: 0.4 Speed: 7.6kn • EOL-03 @ 1216hrs. UTC • BOL-04 @ 1325hrs. UTC
17-Jun-2014	POSN @ 0800hrs Lat: 11 28 52.3548N Long: 81 44 52.5416E Course: 181.5 Speed: 6.4kn sea rough • EOL-04 @ 0800hrs. UTC • BOL-05 @ 0901hrs. UTC • Gravity Coring Stn and CTD cast - successful.
18-Jun-2014	POSN @ 0800hrs Lat: 12 59 32.8650N Long: 81 54 18.7914E Course: 185.0 Speed: 6.2kn • EOL-05 @ 0126hrs. UTC • BOL-06 @ 0218hrs. UTC • EOL-06 @ 2019hrs. UTC • BOL-07 @ 2113hrs. UTC
19-Jun-2014	POSN @ 0800hrs Lat: 11 40 20.4276N Long: 81 59 02.8272E Course: 2.0 Speed: 7.7kn

	• EOL-07 @ 1237hrs. UTC • BOL-08 @ 1330hrs. UTC
20-Jun-2014	POSN @ 0800hrs Lat: 11 46 29.1562N Long: 82 03 45.8202E Course: 180.2 Speed: 6.9kn • EOL-08 @ 1237hrs. UTC • Crossline BOL @ 0441hrs. UTC • Crossline BOL @ 1047hrs. UTC
21-Jun-2014	• Vsl arrived Chennai port. • Scientific team Disembarked.

10. ACKNOWLEDGEMENT

The Chief Scientist and participants of SK-313 place on record their deep sense of gratitude to *Director, National Centre for Antarctic and Ocean Research,* for assigning responsibilities for EEZ survey cruise. Team is also thankful to *Dr. John Kurian P.* and *Mr. M. M. Subramaniam* for their support for the success of SK-313 cruise. The Scientific team also wishes to thank the Master and crew of the vessel for their co-operation during the cruise. The support and co-operation rendered by NORINCO personnel is appreciated.

Annexure-I

Details of survey lines:

S. No.	STARTING		ENDING		PROFILE
	LONG	LAT	LONG	LAT	
1	81.51137	10.8427	81.51222	13.00034483	LINE 01
2	81.58945	13.00998	81.59047	10.87399833	LINE 02
3	81.66926	10.8603	81.66892	13.021085	LINE 03
4	81.74743	13.00091	81.74786	10.89967733	LINE 04
5	81.82658	10.89402	81.82656	13.00118717	LINE 05
6	81.90544	13.01274	81.9053	10.99851144	LINE 06
7	81.98401	11.05662	81.98396	13.0013025	LINE 07
8	82.06239	13.00817	82.06271	11.5462045	LINE 08
9	82.06271	11.5462	81.44668	11.53869022	Transit1

Details of CTD operations:

S. No.	Longitude (Deg)	Latitude (Deg)	Depth (m)	Location
1	81.51497	10.65755	3645	BOL-01
2	81.66892	13.02109	3442	BOL-04

Details of Sediment Sampling:

S. No.	Longitude (Deg)	Latitude (Deg)	Depth (m)	Recovery
1	81.66892	13.02109	3442	4.38 m