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Cruise Report
ORV SAGAR KANYA
EXCLUSIVE ECONOMIC ZONE OF INDIA

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Chief Scientist, Cruise No. SK-305
(23rd September to 18th October 2013)



National Centre for Antarctic & Ocean Research

Ministry of Earth Sciences, Government of India
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REPORT ON EXCLUSIVE ECONOMIC ZONE OF INDIA ORV SAGAR KANYA

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1. **Introduction:** 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 use the natural resources of the area. The detail map of the EEZ is useful in the following purposes:
 - (i) The Navy and Coast Guards for strategic purposes,
 - (ii) Fishermen for fishing operations using deep trawl or bottom fishing gear,
 - (iii) Petroleum, natural gas and mineral exploration as well as exploitation,
 - (iv) Development and assessment of mineral resources,
 - (v) Telecommunication industry for laying cables,
 - (vi) Sub-sea pipe lines for geological hazard assessment,
 - (vii) Effective disposal of waste and reducing pollutants,
 - (viii) Ocean engineers for constructing and maintaining structures of port and harbor.

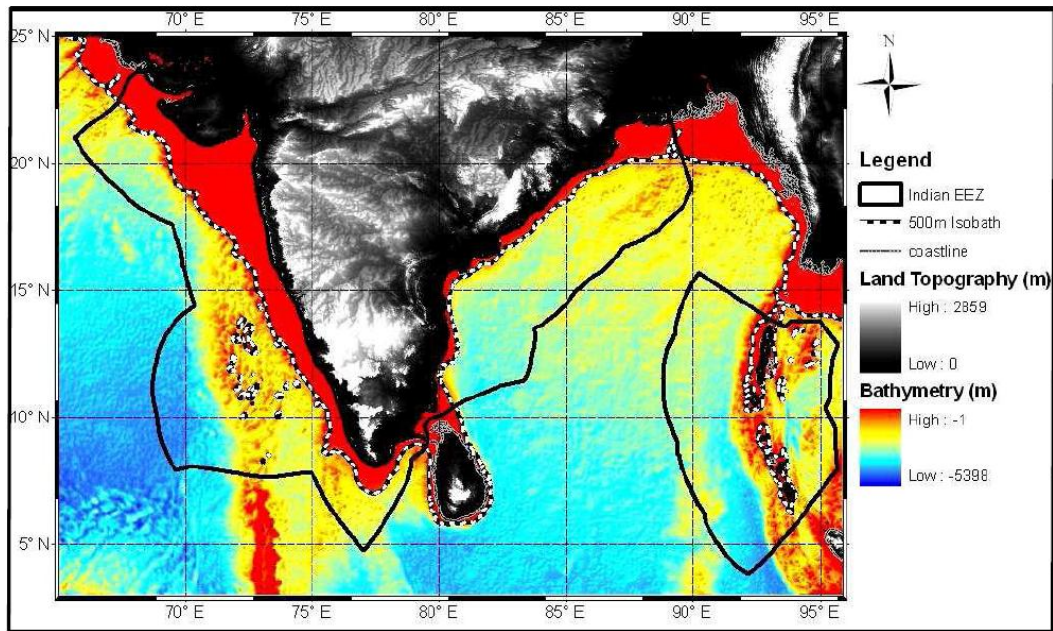


Figure 1: Map Shows Exclusive Economic Zone of India

2. **Objectives:** The objective of this cruise was to survey the Laccadive region using the SeaBat 7150 Multibeam Eco-Sounder (MBES) onboard ORV Sagar Kanya and prepare a comprehensive topographic map of western part of Laccadive regions. The scientific personnel boarded in the ship on 23rd September 2013 at Chennai Port, Tamil Nadu and started sailing on 26th September 2013 towards the designated survey area.
3. **Cruise Itinerary:**

Boarding	: Chennai Port, Tamil Nadu on 23 rd September 2013
Departure	: Chennai Port, Tamil Nadu on 26 th September 2013
Arrival	: Mormugao Port, Goa on 18 th October 2013
Total no of days	: 26 days

4. **List of Participants:** Participants in ORV Sagar Kanya Cruise SK-305 are as follows:

National Centre for Antarctic & Ocean Research, Goa

- | | | |
|----|---------------------------------|---|
| 1. | Dr. Dinesh Pandit | Chief Scientist (Project Scientist 'C') |
| 2. | Mr. Ratan Srivastava | Research Scientist 'B' |
| 3. | Mr. Suman Kilaru | Research Scientist 'B' |
| 4. | Mr. Mohammed Shafeeq Baheer Moh | Junior Research Fellow |
| 5. | Mr. Rupesh Ramdas Sawant | Shipboard Assistant |

Indian School of Mines, Dhanbad

- | | | |
|-----|-------------------------|---------------------|
| 6. | Mr. Mohit Singh | M. Sc. Tech Student |
| 7. | Mr. Ankit Singh | M. Sc. Tech Student |
| 8. | Mr. Ankit Kumar | M. Sc. Tech Student |
| 9. | Mr. Chandrakant Singh | M. Sc. Tech Student |
| 10. | Mr. Arka Das | M. Sc. Tech Student |
| 11. | Mr. Shankar Kumar Pawan | M. Sc. Tech Student |

Andhra University, Visakhapatnam

- | | | |
|-----|----------------------------|---------------------|
| 12. | Mr. Deepak Kumar | M. Sc. Student |
| 13. | Mr. Hemasunder Gottipalli | M. Sc. Tech Student |
| 14. | Mr. Luddinkumar Mallipeddi | M. Sc. Tech Student |
| 15. | Mr. Nagaraju Kukkala | M. Sc. Tech Student |
| 16. | Mr. Riteshkumar Muppana | M. Sc. Tech Student |
| 17. | Mr. Nanajee Undapalli | M. Sc. Tech Student |

M/s Norinco Pvt. Ltd.

- | | | |
|-----|------------------------------|----------------------|
| 18. | Mr. Kalasadan Madhusudan | AMC-Service Engineer |
| 19. | Mr. Madar Parshuram Durgappa | AMC-Service Engineer |
| 20. | Mr. Gurusamipalayam Kandavel | AMC-Service Engineer |
| 21. | Mr. Somasundaram Yogeswaran | AMC-Service Engineer |
| 22. | Mr. Natarajan Satish Kumar | AMC-Service Engineer |

5. **Area of Operation:** The survey was carried out to developed bathymetry map of seabed in Indian EEZ. The proposed area in Block 6 of EEZ located near Laksha Dweep in India. The present mapping comprises of 12 MBES survey lines (~5,070 line kms) with 5 km spacing between two consecutive lines, two intersecting lines and one patch line is covered.

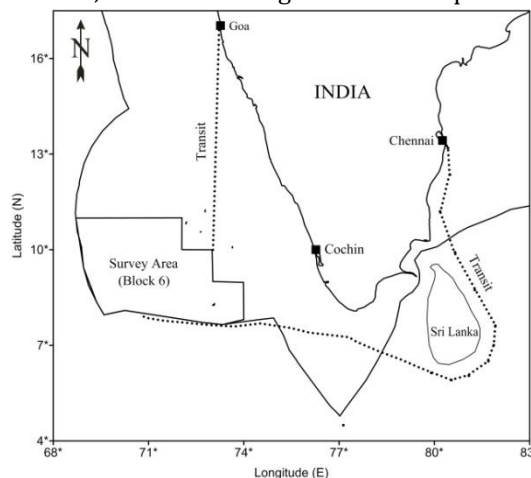


Figure 2: Survey Area (Block 6) near Laksha Dweep (India) in Arabian Sea and ORV Sagar Kanya Cruise SK-305 transit line.

Total length of cruise track during the survey is ~5,070 line kms. There are five sound velocity profile (SVP) stations and one gravity core station was attempted. Total area ~28,700 km² covered during the cruise SK-305. The designated area of MBES survey has given in Figure 2.

- Planning of Survey Lines:** The present ORV Sagar Kanya Cruise SK-305 is plan to carry MBES survey in Block-6 near Laksha Dweep, India. This cruise continues in connection with previous MBES survey Line 15 carried out by chartered Russian cruise RV Akademik Nikolaj Strakhov (ANS Cruise 29 Leg 9). The Russian cruise completed MBES Survey Line 15 and further planed Line 16 to Line 27 are parallel to the earlier Line 15. Two parallel intersections Line 01 & 02 planed across the survey Lines. One Patch Survey Line 01 parallel between surveys Line 15 & Line 16 is also planned in the latter part of the mapping to cover the data gaps. There are five Sound Velocity Profile (SVP) stations are planned for calibration of MBES data set. The detail planed cruise track lines and SVP stations are shown in Fig 3.

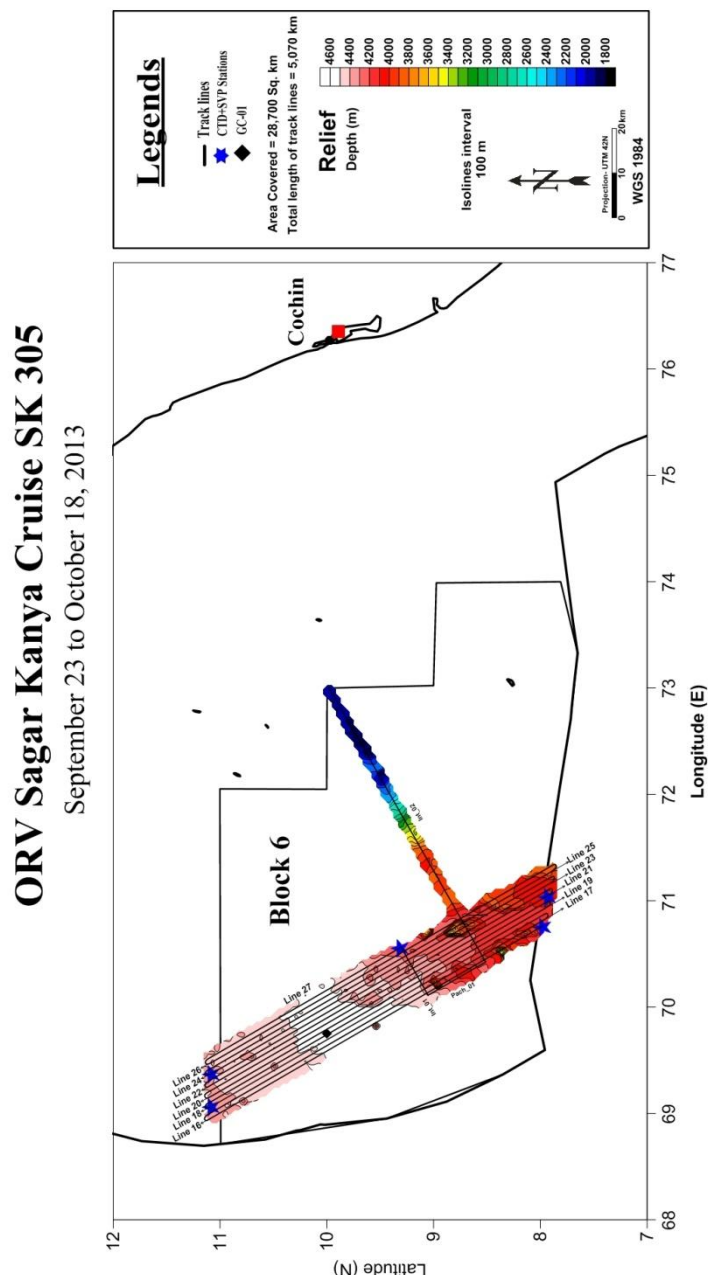


Figure 3: Detail MBES Survey area during Cruise SK-305 in Block 6

7. Technical Specifications of Equipments:

7.1. Multi-Beam Eco-Sounder System: The MBES survey was carried out using standard practice with reference to the methodology described in the special publication no 44 (S-44), International Hydrographic Organisation (IHO), Standards for Hydrographic Surveys, 5th Edition (2008). SeaBeam 3012 Multibeam Eco-Sounder onboard ORV Sagar Kanya was used to carry out the MBES survey near Laksha Dweep in Arabian Sea. The SB3012 is a 12 kHz, 201 beam sonar system, has a beam width of 1° at nadir and is capable of measuring depths ranging from 200 m to 11000 m. The technical specification of the SB-3012 MBES system is as follows:

Manufacturer	: L3-Communications ElAC-Nautik GmbH, Germany
Power Supply	: 115/230V AC (user selectable)
Number of Beams	: 201
Swath Coverage	: 140° SeaBeam 3012, 2° × 2° (5.5 × Depth), ~20 dB backscatter Depth = 4000 to 11, 000 m Coverage = 22,000 to 31,400 m
Frequency of Operation	: 12 kHz
Max. Source Level	: 1° = 247 dB/mPa 2° = 241 DB/mPa
Pulse Length	: 2, 3, 5, 7, 10, 14, 20 ms
Beam Width	: 1° or 2°
Side Lobe Suppression	: > -30 dB
Survey Speed/Swath Width	: 1° beam, 120° swath or 2°, 140° at 12 kn 2° beam, 120° swath at 24 kn
Technology	: Full motion compensation (Sweptbeam technology)
Acquisition Software	: Hydrostar
Data Processing Software	: EIVA NaviPac

The complete Multibeam system comprises of many sub systems:

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

Side Scan Imagery: Online printer provided with system and annotation interval was set at 30 minutes for acquiring side scan imagery.

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

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 user 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.

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 to configure and monitor the time server. After the network connection has been established, the timeserver can also be configured and monitored remotely from a work station via TEL/NET or FTP.

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-servers 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 enables 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. Sound Velocity Profile: The sound velocity profilers have a velocimeter that operates on the “sing-around” sound principle, and contain a transducer head and a reflective plate a known distance apart. The “sing-around” sound principle refers to the use of a transducer and reflective-plate pair that is known distance apart. The device calculates the speed of sound in water by effectively dividing this known distance by one-half the time required for a signal to be transmitted by the transducer, reflected by the reflective plate and received by the transducer. The sound velocity profiler used onboard ORV Sagar Kanya was Valeport MIDAS SVX2. The onboard processor calculates the sound velocity every second and stores it in the inbuilt memory of the SVP. The SVP data is uploaded after retrieval using the onboard data logging software. The MIDAS SVP is one of the most accurate sound velocity profilers in the world. It uses digital time of flight sound velocity sensor. It also comes with a pressure sensor with 0.01 % accuracy, a fast response PRT sensor and a high accuracy temperature compensated piezo-resistive pressure sensor. The SVP instrument was attached with CTD under-water unit to collect the sound velocity profiles at 4 stations near Laksha Dweep in Arabian Sea with depths ranging from 1500 m to 2500 m.

Technical Specification for Sound Velocity:

Range : 1400 to 1600 m/s (extended range on request)
 Resolution : 0.001 m/s
 Accuracy : ±0.03 m/s

Mechanical Specifications & Materials

Housing : Steel; Exceptions : Sound velocity sensor uses carbon composite rods

Cage: Stainless steel (316 grade) with polypropylene clamping brackets

Dimensions: Instrument 88 mm Ø, 540 mm long (including connector)

Weight (in cage): 7.5 kg (air), 4.5 kg (water)

Depth Rating: 500 m (unless smaller pressure sensor fitted)

Connectors:

Instrument: 10 pin female Subconn bulkhead type (MCBH10F) with lock ring.

Comms Cable: Valeport 3 m Y lead. 10 pin male subconn line type (MCIL10M) to instrument, 2 × 4 mm bunch pins to external power, 9 pin female D type to PC.

Switching Plug: 10 pin male Subconn line type (MCIL10M) with lock ring.

Performance:

Memory: 16 Mb solid state memories (upgradeable in 16 Mb steps to 64 Mb)

Internal Power: 8 × 1.5 volt alkaline C cells. The unit will accept 8 × 3.6 volt Li C cells with no alteration required. Do not mix battery types.

External Power: between 9 and 30 volt DC

Current Drain: ~50 mA at 12 volt when running, and 0.25 mA in sleep mode

Sampling Rate: 1, 2, 4 or 8 Hz (synchronized)

Data Output: RS232, RS485 or RS422 depending on pin selection. Baud rate is user selectable from 2400 to 460800

Sampling Mode:

Profile Mode: This mode sets the instrument to take readings at fixed depth intervals as it is lowered and raised through the water column

Electrical Specifications

Internal: 8 × C cells, 1.5 V alkaline or 3.6 V lithium battery; External: 9 to 30 V DC

Power: 0.7 W (sampling and <1 mW (sleeping)

Battery Life: <100 hours operation (alkaline) & <250 hours operation (Li)

Connector: Subconn titanium MCVH10F

Communications: The instrument will operate autonomously with setup and data extraction performed by direct communications with PC before and after deployment. It also operates in real time with a choice of communication protocols for a variety of cable lengths, all fitted as standard and selected by pin choice on the output connector.

Standard:

RS232: up to 200 m cable, direct to serial port via USB adaptor

RS485: up to 1000 m cable addressable half duplex communications

Memory: The MIDAS sVX2 fitted with 16 Mb solid-state non-volatile flash memories. Total capacity depends on sampling mode such as continues and burst modes have a single time stamp at the start of the file. Trip mode stores a time stamp with each reading. A single line of SVP data uses 10 bytes and a time stamp uses 7 bytes.

Continues: > 16,00,000 data points; Profile: > 9,80,000

Data Accusation: The MIDAS SVX2 uses the concept of distributed processing, where each sensor has its own microprocessor controlling sampling and calibration or readings. Each of these is then controlled by a central processor, which issues global commands and handles all the data. This means that all data is sampled at precisely the same instant giving superior quality profile data.

Software: System is supplied with DataLog Express Windows based PC software for instrument setup, data extraction and display. DataLog Express is license free.

7.3. Seafloor Sampling (Gravity Coring): Gravity corer is an instrument in which a weight is freely dropped down to the seabed. At the foot corer has steel chisel point with core flap so called spider. There are metal ballast weight rings and cap block with water valve on the top side of the corer. There is polyethylene pipe inside steel corer for reducing core friction and convenience of sampling. Gravity corer is lifting down using winch with the speed of about 1-1.5 m/s until the drop point (~70-100 meters above the seabed) and then it is dropping with the speed of about 3-4 m/s for providing a maximum speed of penetration inside the bottom. After penetration it is immediately winching up to avoid corer hogging while vessel drifting.

Technical Specifications

Material: Steel;	Length : 6 meters;	Inner Diameter : 150 mm;
Outer Diameter : 168 mm;		Weight : 1000 kg;
Lifting Speed : 1 to 1.5 m/s;		Drop Speed : 3 to 4 m/s

- 8. Method of Data Collection & Analysis:** Hydrotar is the data acquisition and control system for Multibeam echosounder onboard ORV Sagar Kanya. It also acts as an interface for various external sensors (position, motion, heading and sound velocity sensors). NaviPac software was used for navigation and data acquisition from various feeds such as GPS, Gyro, Motion sensor, etc. The NaviPac also allows the navigator to perform all phases of surface, sub-sea and remote navigation, to view all sensor data, to perform changes in navigation principles and components. The programme reads all basic information from the setup DB, present all available stations and let the navigator specify the stations wanted. All the information's is stored in the online DB file, which can be maintained by one or more online

programs. NaviPac is installed in Window NT workstation. NaviEDIT, NaviModel and NaviPlot are the software to edit the data and create the bathymetric grid model. The processed multibeam datasets of Block-6 were imported, mapped, and analyzed in the same platform. During the Cruise SK-305 following data were acquired

Multi Beam Eco-Sounder Bathymetry	: 5,070 line km
SVP Stations	: 5 no

- 9. Diary of Events:** The ORV Sagar Kanya Cruise SK-305 sailed from Chennai Port on 24th September 2013 by 19:00 hrs (IST) towards designated survey area near Laksha Dweep in Indian territorial region of the Arabian Sea. On 1st October 2013, the vessel arrived in the planned survey area and started bathymetry survey. The bathymetry survey is continued until 15th October 2013. There are five SPV operation was conducted during this period. On 16th October 2013 at 04:00 hrs (IST), vessel transited from survey area towards Goa and anchored on 17th October 2013 at 20:00 hrs (IST) near Mormugao Port, Goa.

Abbreviations:	IST	= India Standard Time
	UTC	= Coordinated Universal Time i.e., GMT
	Lat	= Latitude
	Long	= Longitude

The detail sequences of events discuss as follows date wise:

- 9.1. Date 23/09/2013:
 15:00 (IST): Sign-On in ORV Sagar Kanya for 22 participants.
 16:00 (IST): All participants were boarded & materials loaded in vessel
 17:00 (IST): Engine repairing work is in progress & delayed in Estimated Time of Departure (ETD)
- 9.2. Date 24/09/2013:
 Engine repairing work is in progress & there is further delayed in ETD
- 9.3. Date 25/09/2013:
 19:00 (IST): Maintenance and repairing work is completed.
 19:30(IST): ORV Sagar Kanya Cruise SK-305 is start sailing from Chennai Port to designated survey area near Laksha Dweep in the Arabian Sea.
- 9.4. Date 26/09/2013: ORV Sagar Kanya Cruise SK-305 transit from Chennai Port towards designated survey area near Laksha Dweep in the Arabian Sea.
- 9.5. Date 27/09/2013: ORV Sagar Kanya Cruise SK-305 transit from Chennai Port towards designated survey area near Laksha Dweep in the Arabian Sea.
- 9.6. Date 28/09/2013: ORV Sagar Kanya Cruise SK-305 transit from Chennai Port towards designated survey area near Laksha Dweep in the Arabian Sea. Multi-Beam Eco-Sounder (MBES) instrument is tested for survey and standard quality bathymetry data acquired. GeoPro Sub-Bottom Profiler computer's CPU was crashed during the test trials.
- 9.7. Date 29/09/2013: ORV Sagar Kanya Cruise SK-305 transit from Chennai Port towards designated survey area near Laksha Dweep in the Arabian Sea.
- 9.8. Date 30/09/2013: ORV Sagar Kanya Cruise SK-305 transit from Chennai Port towards designated survey area near Laksha Dweep in the Arabian Sea.
- 9.9. Date 01/10/2013:
 10:00 (UTC): ORV Sagar Kanya Cruise SK-305 arrived at the designated survey area near Laksha Dweep in the Arabian Sea.
 10:55 (UTC): SVP station #1 (Lat: 07°58'37.34"N, Long: 70°45'11.63"E) is successful data logging up to depth ~1800 meters.
 12:50 (UTC): MBES survey Line 16 is started
 (Lat: 07°58'57.3126"N, Long: 70°44'45.1452"E, Depth: 4135 meters).

- 9.10. Date 02/10/2013:
14:18 (UTC): MBES survey Line 16 is completed
(Lat: 11°04'57.9816"N, Long: 68°57'12.3642"E, Depth: 4391 meters).
14:54(UTC): MBES survey Line 17 is started
(Lat: 11°05'30.4100"N, Long: 69°00'44.4900"E, Depth: 4388 meters).
- 9.11. Date 03/10/2013:
16:06 (UTC): MBES survey Line 17 is completed
(Lat: 07°57'56.1822"N, Long: 70° 48'19.7940"E, Depth: 4145 meters)
16:32 (UTC): MBES survey Line 18 is started
(Lat: 07°57'12.7584"N, Long: 70° 51'27.6492"E, Depth: 4158 meters).
- 9.12. Date 04/10/2013:
19:32(UTC): MBES survey Line 18 is completed
(Lat: 11°04'21.1416"N, Long: 69° 03'48.9336"E, Depth: 4391 meters).
20:20 (UTC): SVP Station #2
(Lat: 11°04'30.7596"N, Long: 69°03'42.2268"E, Depth: 3065 meters) is successful data logging up to depth 3065 meters. SVP is assembled with SBE CTD and tested at Station #2. Test results are successful and up to reasonable standard level.
22:23 (UTC): MBES survey Line 19 is started
(Lat: 11°04'49.7134"N, Long: 69°06'33.9288"E, Depth: 4388 meters).
- 9.13. Date 05/10/2013:
02:51(UTC): MBES survey Line 19 is completed
(Lat: 07°56'09.2956"N, Long: 70° 55'40.6914"E, Depth: 4145 meters).
03:13 (UTC): MBES survey Line 20 is started
(Lat: 07°56'50.5908"N, Long: 70°57'40.1124"E, Depth: 4108 meters).
06:55 (UTC): Gravity Core Station #1
(Lat: 09°59'57.9440"N, Long: 69°45'05.3136"E, Depth: 4533 meters).
Gravity core fails to collect samples due to technical failure in deep-sea winch. Full-length steel cable connected to deep-sea winch with the gravity core is also lost during the operation. There is major fault in the hydraulic pump that supports the deep-sea winch and needs major maintenance for further operations.
Details of the event leading to the above accident are as follows:
(i) After lowering each 100 meters length of deep sea winch wire, winch was stopped & heaving tried out satisfactorily,
(ii) After lowering 1780 meters cable length, winch speed reduced,
(iii) Afterwards, winch was stopped, break was applied manually & observed brake was holding in winch-stopped condition. In winch-stopped condition, power pack p/p was stopped for renewing #2 pump suction filters. After 10 minutes observed brake not holding and friction winch suddenly picked up lowering speed,
(iv) Manually started storage winch pump for back pressure for reducing lowering speed, but due to cable high speed, one hydraulic pipe on storage winch p/p gave away from union, so storage winch also could not reduce the speed,
(v) Winch drum picked up high speed & remaining cable of storage winch went down in water at high speed breaking cable bitter end locking on the storage winch, thus leading to loss of full length deep sea winch cable along with gravity coring pipe and deadweight,
(vi) It is to be noted that this incident was purely accidental due to machinery failure & no human negligence/error on part of any person involved. The incident was beyond the control of personnel involved.
12:00 (UTC): MBES survey Line 20 is continued.

- 9.14. Date 06/10/2013: MBES survey Line 20 is continued.
- 9.15. Date 07/10/2013:
 05:23 (UTC): MBES survey Line 20 is completed
 (Lat: 11° 04'56.0222"N, Long: 69°09'43.9072"E, Depth: 4383 meters).
 05:48 (UTC): MBES survey Line 21 is started
 (Lat: 11° 03'46.0406"N, Long: 69°12'47.7867"E, Depth: 4395 meters).
- 9.16. Date 08/10/2013:
 07:29 (UTC): MBES survey Line 21 is completed
 (Lat: 07°5'57.60"N, Long: 71°01'54.12"E, Depth: 4108 meters).
 07:29 (UTC): SVP Station #3
 (Lat: 07°55'56.0142"N, Long: 71°01'55.0794"E, Depth: 4107 meters) is successful
 data logging up to depth 3450 meters. SBE CTD data logging failed at SVP Station #3
 10:50 (UTC): MBES survey Line 22 is started
 (Lat: 07°55'42.3204"N, Long: 71°04'49.7766"E, Depth: 4107 meters).
- 9.17. Date 09/10/2013:
 11:57 (UTC): MBES survey Line 22 is completed
 (Lat: 11° 04'56.4458"N, Long: 69° 15'48.6048"E, Depth: 4396 meters)
 12:31 (UTC): MBES survey Line 23 is started
 (Lat: 11° 04'56.0274"N, Long: 69° 19'02.5454"E, Depth: 4401 meters)
 Yesterday (date 08/10/2013), SBE CTD along with SVP is deployed at SVP station #3.
 SBE CTD data was recorded up to 1089 meters depth but after that suddenly
 connectivity fails between CTD Sensors and Deck Board Unit. Therefore, data logging
 is not possible. Mr. Madhusudan and his NORINCO team, today (date 09/10/2013)
 carefully checked the CTD instrument sensors and conducting cable. There is some
 fault in the conducting cable nearly around 985 meters lengths from the initial point.
 The necessary rectification and repairing work is in progress for the next test at SVP
 station #4.
- 9.18. Date 10/10/2013:
 14:17 (UTC): MBES survey Line 23 is completed
 (Lat: 07° 54'46.0044"N, Long: 71° 08'54.8106"E, Depth: 4069 meters)
 14:47 (UTC): MBES survey Line 24 is started
 (Lat: 07° 53'48.3084"N, Long: 71° 11'41.8830"E, Depth: 4009 meters)
- 9.19. Date 11/10/2013:
 16:00 (UTC): MBES survey Line 24 is completed
 (Lat: 11° 03'59.9534"N, Long: 69° 22'29.3994"E, Depth: 4395 meters)
 16:19 (UTC): SVP Station #4
 (Lat: 11° 04'49.0948"N, Long: 69° 22'02.7072"E, Depth: 4396 meters)
 Earlier reported that there was a fault recognized in the communication cable at
 length ~1000 m from the initial point. The same amount of cable is removed from the
 main bundle. Now the SBE CTD is functioning properly. SBE CTD is successfully tested
 up to depth 3055 meters at SVP Station #4.
 19:15 (UTC): MBES survey Line 25 is started
 (Lat: 11° 04'51.9156"N, Long: 69° 25'11.8890"E, Depth: 4401 meters)
 20:50 (UTC): There was some problem recorded in the MBES System during 20:50
 hrs to 21:12 hrs (UTC, date 11/10/2013) because of the poor response of transmitter
 and receiver (pining connectivity lost). The MBES System and the HydroStar data
 acquisition software was properly shutdown and immediately restarted. Now the
 MBES systems and HydroStar software is functioning properly and data acquisition is
 continuing.
- 9.20. Date 12/10/2013: 21:15 (UTC): MBES survey Line 25 is completed
 (Lat: 07° 53'44.8072"N, Long: 71° 15'45.4476"E, Depth: 3836 meters)
 21:47 (UTC): MBES survey Line 26 is started
 (Lat: 07° 53'33.4038"N, Long: 71° 19'06.1350"E, Depth: 3875 meters)

- 9.21. Date 13/10/2013: MBES survey Line 26 is continue.
- 9.22. Date 14/10/2013:
 01:04 (UTC): MBES survey Line 26 is completed
 (Lat: 11° 04'56.0036"N, Long: 69° 28'15.6580"E, Depth: 4408 meters)
 01:32 (UTC): MBES survey Line 27 is started
 (Lat: 11° 05'51.5900"N, Long: 69° 30'56.5000"E, Depth: 4401 meters)
 15:58 (UTC): MBES survey Line 27 is completed
 (Lat: 09° 18'43.5648"N, Long: 70° 38'55.7022"E, Depth: 3875 meters)
 15:58 (UTC): SVP Station #5
 (Lat: 09° 18'43.5648"N, Long: 70° 38'55.7022"E, Depth: 4239 meters)
 Attempt #1 SVP + SBE CTD successfully tested up to depth 268 m.
 Attempt #2 SVP + SBE CTD lowered up to depth 3037 m and data recorded successfully. However during up-casting connectivity fails and only CTD data is not recorded from depth 1158 m.
 19:30 (UTC): MBES survey Intersecting Line 01 is started
 (Lat: 09° 18'41.5410"N, Long: 70° 32'57.9400"E, Depth: 4231 meters)
 23:26 (UTC): MBES survey Intersecting Line 01 is completed
 (Lat: 09° 03'30.9552"N, Long: 70° 06'08.5272"E, Depth: 4432 meters)
 23:30 (UTC): MBES survey Patch Line 01 is started
 (Lat: 09° 03'11.6400"N, Long: 70° 06'04.3500"E, Depth: 4420 meters)
- 9.23. Date 15/10/2013:
 03:22 (UTC): MBES survey Patch Line 01 is completed
 (Lat: 08° 31'06.6800"N, Long: 70° 24'38.5241"E, Depth: 4219 meters)
 03:24 (UTC): MBES survey Intersecting Line 02 is started
 (Lat: 08° 31'10.3734"N, Long: 70° 24'55.0491"E, Depth: 4215 meters)
 22:30 (UTC): MBES survey Intersecting Line 02 is completed
 (Lat: 09° 59'48.8450"N, Long: 72° 59'54.7158"E, Depth: 1987 meters)
 22:30 (UTC): ORV Sagar Kanya is transiting from designated survey area near Laksha Dweep towards Goa, India.
- 9.24. Date 16/10/2013: ORV Sagar Kanya is transiting.
- 9.25. Date 17/10/2013: ORV Sagar Kanya is transiting. The ORV Sagar Kanya arrived at Mormugao Port, Goa at 20:00 hrs (IST).
- 9.26. Date 18/10/2013: The geoscientific expedition cruise SK-305 is completed.

10. Issues and Suggestions:

- (i) In the transit period from Chennai Port to designated survey area on date 28/09/2013, the GeoPro Sub-Bottom Profiler computer was booted for the first time in this expedition for test trials. However, it is found that the CPU controlling sub-bottom profiler was not booting properly. Later Mr. Madhusudan K and his NORINCO team examined the sub-bottom profiler and controlling CPU in detail. They reported that the CPU was crashed at the time of test trials. The computer system & CPU controls the Sub-Bottom Profiler (GeoPro) is required urgent rectifications for further operations in forth-coming cruises.
- (ii) ORV Sagar Kanya was engaged in gravity coring operation on date 05/10/2013 at proposed GC Station #1 (Lat 10°00'N & Long 69°45'E) during SK-305 cruise in the Arabian Sea. Entire length of deep-sea winch cable along with gravity coring pipe and deadweight was lost in the ocean due to failure of hydraulic brake system of deep-sea winch. At the time of above operation vessel was in DP mode, wind direction northwest & wind speed 22 knots, swell direction northwest & swell height 1.0 m, sea height 1.5 m & charted depth 4570 m. Gravity corer fails to collect samples due to technical failure in deep-sea winch. Full-length steel cable connected to deep-sea winch with the gravity corer is also lost during the operation. There is major fault in the hydraulic pump that supports the deep-sea winch and needs major maintenance for further operations.

11. Appendix:

Annexure I: Tables Shows Coordinates of MBES Survey Lines in SK-305

Line #	Starting Point			Ending Point		
	Latitude (N)	Longitude (E)	Depth (m)	Latitude (N)	Longitude (E)	Depth (m)
SVP #1	07°58'37.3400"	70°45'11.6300"	1800			
Line 16	07°58'57.3126"	70°44'45.1452"		11°04'57.9816"	68°57'12.3642"	4391
Line 17	11°05'30.4100"	69°00'44.4900"	4388	07°57'56.1822"	70°48'19.7940"	4145
Line 18	07°57'12.7584"	70°51'27.6492"	4158	11°04'21.1416"	69°03'48.9336"	4391
SVP #2	11°04'30.7596"	69°03'42.2268"	3065			
Line 19	11°04'49.7134"	69°06'33.9288"	4388	07°56'09.2956"	70°55'40.6914"	4145
Line 20	07°56'50.5908"	70°57'40.1124"	4108	11°04'56.0222"	69°09'43.9072"	4383
GC #1	09°59'57.9440"	69°45'05.3136"	4533			
Line 21	11°03'46.0406"	69°12'47.7867"	4395	07°5'57.6000"	71°01'54.1200"	4108
SVP #3	07°55'56.0142"	71°01'55.0794"	4107			
Line 22	07°55'42.3204"	71°04'49.7766"	4107	11°04'56.4458"	69°15'48.6048"	4396
Line 23	11°04'56.0274"	69°19'02.5454"	4401	07°54'46.0044"	71°08'54.8106"	4069
Line 24	07°53'48.3084"	71°11'41.8830"	4009	11°03'59.9534"	69°22'29.3994"	4395
SVP #4	11°04'49.0948"	69°22'02.7072"	4396			
Line 25	11°04'51.9156"	69°25'11.8890"	4401	07°53'44.8072"	71°15'45.4476"	3836
Line 26	07°53'33.4038"	71°19'06.1350"	3875	11°04'56.0036"	69°28'15.6580"	4408
Line 27	11°05'51.5900"	69°30'56.5000"	4401	09°18'43.5648"	70°38'55.7022"	3875
SVP #5	09°18'43.5648"	70°38'55.7022"	4239			
Int-01	09°18'41.5410"	70°32'57.9400"	4231	09°03'30.9552"	70°06'08.5272"	4432
Patch-01	09°03'11.6400"	70°06'04.3500"	4420	08°31'06.6800"	70°24'38.5241"	4219
Int- 02	09°59'48.8450"	70°24'55.0491"	4215	09°59'48.8450"	72°59'54.7158"	1987

Annexure II: Summary of MBES Survey Data Log Book in SK-305

The ORV Sagar Kanya Cruise SK-305 expedition results are located in the Hard Disk folder (SK305 Data) with the following structure:

SK305 Data	.../MBES Log File	.../SK305MBES Log.doc .../Cruise Report SK305.pdf
	.../Other Files	...SK305.hydrostar
	.../Output Files	.../SK305_Lines 16-27_ASCII Files_50 m grid_DD Format.txt .../SK305_Lines 16-27_ASCII Files_50 m grid_DDM Format.txt .../SK305_Lines 16-27_ASCII Files_100 m grid_DD Format.txt .../SK305_Lines 16-27_ASCII Files_100 m grid_DD Format.txt
	.../Processed Data	In organized format according to NaviPac
	.../Raw Data	In organized format according to NaviPac
	.../SVP Files	.../SVP-01-SK305_01 Oct 2013_.svp .../SVP-02-SK305_05 Oct 2013_.svp .../SVP-03-SK305_08 Oct 2013_.svp .../SVP-04-SK305_11 Oct 2013_.svp .../SVP-05-SK305_15 Oct 2013_.svp

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Date: 18 October 2013

Place: Mormugao Port, Goa, India

Dinesh Pandit

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