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R/V Kaiyo Cruise Report

KY12-08

Tropical Ocean Climate Study and

Operation of TRTION buoys.

May.19.2012-Jul.9.2012

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

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Note

This cruise report is a preliminary documentation as of the end of the cruise. This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for latest information. Users of data or results on this cruise report are requested to submit their results to the Data Management Group of JAMSTEC.

1. Cruise information

1.1 Cruise ID

KY12-08

1.2 Ship

R/V Kaiyo (Captain: Masayoshi Ishiwata)

1.3 Title of cruise

Tropical Ocean Climate Study and Operation of TRITON buoys.

1.4 Title of Proposal

Tropical Ocean Climate Study and Operation of TRITON buoys.

1.5 Period

May 19, 2012 - July 9, 2012

1.6 Research area

Equatorial Eastern Indian Ocean

2. Introduction and observation summary

2.1 Introduction

The purpose of this cruise is to observe ocean and atmosphere in the equatorial eastern Indian Ocean for better understanding of climate variability involving the Indian Ocean Dipole mode (IOD) event. The IOD event is thought to largely affect climate in the East Asia involving Japan, however, its feature and mechanism have not been understood.

In order to observe the IOD event, we have been developing the TRITON (TRIangle Trans-Ocean buoy Network) buoys in the equatorial eastern Indian Ocean since 2001 at 5S90E (#17) and 1.5S90E (#18). A new station of the TRITON buoy, 8S95E (#19), was added to the observation network in the equatorial eastern Indian Ocean in 2009. Additionally, subsurface Acoustic Doppler Current Profiler (ADCP) buoys at the Eq90E are maintained to obtain time-series data of equatorial ocean currents in the Indian Ocean. The main missions of this cruise are maintenances and development of buoy network system in equatorial eastern Indian Ocean.

2.2 Observation summary

m - TRITON mooring deployment (include a new site #20; 5S97.25E):	4 moorings
m - TRITON mooring recovery (#18, 19; 1.5S 90E, 8S95E):	2 moorings
TRITON mooring recovery (#17 5S95E):	1 mooring
Subsurface ADCP mooring deployment (Eq90E):	1 mooring
Subsurface ADCP mooring recovery (Eq90E):	1 mooring
CTD (Conductivity, Temperature and Depth) and water sampling:	9 casts
XCTD (daikei track):	23 casts
XBT (to correction of sound velocity for MBES and SSBL):	5 casts
Shipboard ADCP	continuous

We successfully recovered and re-installed 3 TRITON/m-TRITON (#17, #18 and #19) buoys, and deployed the new site at 5S97.25E (m-TRITON #20) during this cruise. And we installed the new conductivity and temperature sensors, developed by Marine Technology Center of JAMSTEC, at 20m depth of m-TRITON buoy #20. This new type sensor deployed for endurance test about organism adhesion. Also, we successfully recovered the new sensors at 500m depth of m-TRITON buoy #19 (8S95E). We confirmed it had operated in the usual conditions. However, we found some serious damages which were probably due to vandalism in all recovered buoys. Also we successfully recovered and re-installed subsurface ADCP mooring at Eq90E.

During this cruise, we conducted CTD casts for checking TRTION sensor data quality. CTD casts were conducted down to 1000m depth near the deployed and recovered buoy for the purpose to compare with m-TRITON salinity sensors. And we conducted CTD casts for checking the sensors data quality near the ATLAS buoy (1.5N90E) and Bailong buoy (8S100E). At the same time, we checked the surface buoy condition about ATLAS (1.5N90E) and Bailong (8S100E) moorings, these looked normal. We had planned the CTD cast and checking the surface buoy, near the ATLAS buoy at 4N90E. But we gave up it because of rough weather.

We conducted 23 XCTD casts around the 4 site of RAMA (3 m-TRITONs 5S97.25E, 5S95E, 8S95E and 1 Bailong buoy 8S100E). The XCTD measurements were conducted to investigate ocean structure in the southeastern tropical Indian Ocean. The data is also used to estimate the divergence/convergence of ocean horizontal currents by calculations of geostrophic current.

3. Cruise period, ports of call, cruise log and cruise track

3.1 Cruise period

May 19, 2012 - July 9, 2012

3.2 Ports of call

Yokohama, Japan (Departure: May 19, 2012)

Sembawang, Singapore (Arrival: June 1, 2012 Departure June 3, 2012)

Bali, Indonesia (Arrival: June 24, 2012, Departure June26, 2012)

Yokosuka, Japan (Arrival: July 9, 2012)

3.3 Cruise log

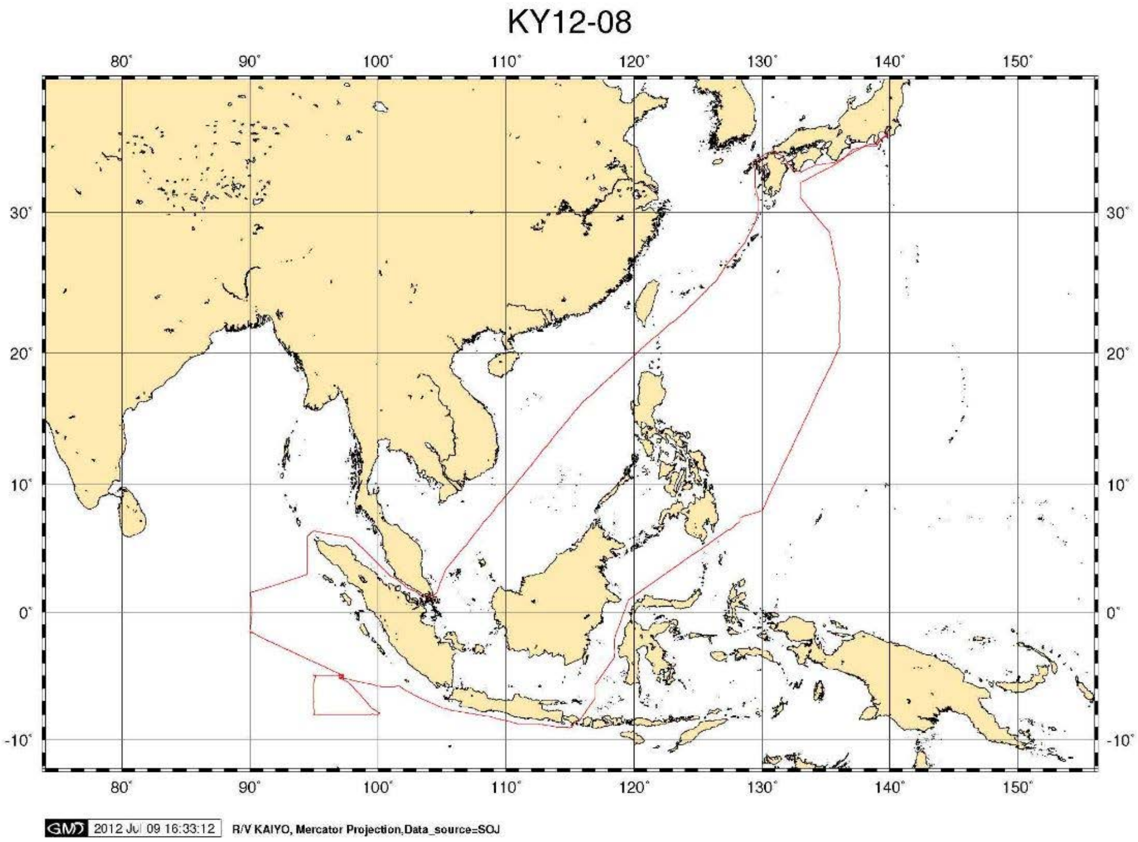
SMT	UTC	Event
May. 9, (Sat.) 2012		
09:00	02:00	Departure from Yokohama, Japan
		(SMT = UTC + 9h)
May. 24, (Thu.) 2012		
00:00	16:00	Time adjustment -1h (SMT = UTC + 8h)
Jun. 1, (Fri.) 2012		
09:00	01:00	Arrive at Sembawang, Singapore
Jun. 3, (Mon.) 2012		
09:00	01:00	Departure from Sembawang, Singapore
Jun. 5, (Tue.) 2012		
23:00	16:00	Time adjustment -1h (SMT = UTC + 7h)
Jun. 6, (Wed.) 2012		
10:00	03:00	Observational meeting
Jun. 7, (Thu.) 2012		
15:00	08:00	Arrive at CTD point (1.5N90E;Near the ATLAS buoy)
15:30-16:23	08:30-09:23	CTD/Water sampling (1,000m) around the ATLAS buoy
16:40-17:00	09:40-10:00	Visual checking of ATLAS buoy
Jun. 8, (Fri.) 2012		
05:00	22:00	Arrive at Subsurface ADCP mooring site (Eq90E)
05:47	22:47	XBT-1 (00-00.65N 90-08.77E)
06:45	23:45	Send release command to acoustic releaser
07:47-09:27	00:47-02:27	Recovery of subsurface ADCP mooring
11:05-13:15	04:05-06:15	Deploy (re-install) of subsurface ADCP mooring
		(Anchor position: 00-00.07N 90-08.68E Depth: 4084m)

SMT	UTC	Event
Jun. 9, (Sat.) 2012		
06:00	23:00	Arrive at m-TRITON mooring site (#18: 1.5S90E)
06:44	23:44	XBT-2 (01-38.51S 89-59.97E)
07:43-12:37	00:43-05:37	Deploy of m-TRITON mooring (#18)
		(Anchor position: 01-39.34S 89-59.74E Depth: 4700m)
13:45-14:30	06:45-07:30	CTD/Water sampling (1,000 m) around the deployed buoy
14:37-15:07	07:37-08:07	Data checking of deployed buoy sending
15:10	08:10	Visual checking of deployed buoy
15:54-16:40	08:54-09:40	CTD/Water sampling around the recovering buoy
17:00	10:00	Visual checking of recovering buoy
Jun. 10, (Sun.) 2012		
06:55	23:55	Send release command to acoustic releaser
07:55-11:41	00:55-04:41	Recovery of m-TRITON mooring (#18)
Jun. 11, (Mon.) 2012		
09:00	02:00	Observational meeting
Cruising to m-TRITON mooring site (#20: 5S97.25E)		
Jun.12, (Tue) 2012		
05:55	22:55	Arrive at new m-TRITON mooring site (#20:5S97.25E)
05:58	22:58	XBT-3 (04-56.90S 97-15.07E)
06:36-08:28	23:36-01:28	Bathymetry observation (MBES)
09:23-13:52	02:23-06:52	Deploy of m-TRITON mooring (#20)
		(Anchor position: 04-57.55S 97-17.13E Depth: 4988m)
14:51-15:34	07:51-08:34	CTD/Water sampling around the deployed buoy
15:45-15:55	08:45-08:55	Data checking of deployed buoy sending
16:00	09:00	Visual checking of deployed buoy
17:43	10:43	XCTD-1 (04-59.80S 97-01.77E)
20:22	13:22	XCTD-2 (04-59.99S 96-31.83E)
23:01	16:01	XCTD-3 (04-59.98S 96-01.82E)
Jun. 13, (Wed.) 2012		
01:35	18:35	XCTD-4 (04-59.99S 95-32.00E)
06:00	23:00	Arrive at m-TRITON mooring site (#17: 5S95E)
06:44	23:44	XBT-4 (04-57.16S 94-58.71E)
07:43-11:50	00:30-04:50	Deploy of m-TRITON mooring (#17)
		(Anchor position: 04-56.93S 94-58.51E Depth: 5023m)

SMT	UTC	Event
12:48-13:33	05:48-06:33	CTD/Water sampling around the deployed buoy
13:46-13:59	06:46-06:59	Data checking of deployed buoy sending
14:10	07:10	Visual checking of deployed buoy
15:07-15:50	08:07-08:50	CTD/Water sampling around the recovering buoy
16:00	09:00	Visual checking of recovering buoy
Jun. 14, (Thu.) 2012		
07:26	00:26	Launched working boat (remove fishing implement)
07:50	00:50	Send release command to acoustic releaser
08:18-13:02	01:18-06:02	Recovery of TRITON mooring (#17)
15:34	08:34	XCTD-5 (05-28.65S 95-00.26E)
18:02	11:02	XCTD-6 (05-58.03S 94-59.97E)
20:36	13:36	XCTD-7 (06-29.54S 94-59.99E)
23:25	16:25	XCTD-8 (06-59.74S 94-59.94E)
Jun. 15, (Fri.) 2012		
01:59	18:59	XCTD-9 (07-29.12S 95-00.01E)
06:30	23:30	Arrive at m-TRITON mooring site (#19: 8S95E)
06:43	23:43	XBT-5 (07-58.99S 95-02.51E)
07:33-11:37	00:33-04:37	Deploy of m-TRITON mooring (#19)
		(Anchor position: 07-59.97S 95-02.39E Depth: 5243m)
12:35-13:15	05:35-06:15	CTD/Water sampling around the deployed buoy
13:34-13:47	06:34-06:47	Data checking of deployed buoy sending
13:45	06:45	Visual checking of deployed buoy
14:29-15:11	07:29-08:11	CTD/Water sampling around the recovering buoy
15:20	08:20	Visual checking of recovering buoy
Jun. 16, (Sat.) 2012		
07:00	00:00	Send release command to acoustic releaser
07:51-12:16	00:51-05:16	Recovery of m-TRITON mooring (#19)
14:40	07:40	XCTD-10 (08-00.22S 95-28.08E)
17:29	10:29	XCTD-11 (08-00.00S 95-58.69E)
20:15	13:15	XCTD-12 (07-59.99S 96-29.74E)
22:57	15:57	XCTD-13 (08-00.02S 96-59.73E)
Jun. 17, (Sun.) 2012		
01:38	18:38	XCTD-14 (08-00.00S 97-29.76E)
04:24	21:24	XCTD-15 (08-00.01S 97-59.71E)
07:14	00:14	XCTD-16 (08-00.01S 98-29.75E)

SMT	UTC	Event
10:11	03:11	XCTD-17 (08-00.01S 98-59.45E)
13:09	06:09	XCTD-18 (08-00.37S 99-29.02E)
16:15-17:00	09:15-10:00	CTD/Water sampling at (8S100E)
18:00	11:00	Visual checking of Bailong buoy (7.9S 100.1E)
22:10	15:10	XCTD-19 (07-30.25S 99-28.08E)
Jun. 18, (Mon) 2012		
01:56	18:56	XCTD-20 (07-00.21S 99-05.16E)
06:01	23:01	XCTD-21 (06-30.20S 98-37.69E)
10:03	03:03	XCTD-22 (06-00.58S 98-10.51E)
14:05	07:05	XCTD-23 (05-30.57S 97-43.01E)
19:00	12:00	Re-Arrive at m-TRITON mooring (#20: 5S97.25E)
19:10-	12:10-	Start Bathymetry observation (MBES)
Jun. 19, (Tue.) 2012		
10:30	03:30	Intermission of Bathymetry observation
11:00	04:00	Visual checking of #20 buoy
11:30	04:30	Continuation of Bathymetry observation
12:50	05:50	Completion of Bathymetry observation
Jun.22, (Wed.) 2012		
01:00	17:00	Time adjustment +1h (SMT = UTC + 8h)
Jun. 24, (Sun.) 2012		
09:00	01:00	Arrive at Bali, Indonesia
Jun. 25, (Tue.) 2012		
19:00	11:00	Departure from Bali, Indonesia
Jun. 30, (Sat.) 2012		
01:00	16:00	Time adjustment +1h (SMT = UTC + 9h:JST)
Jul. 9, (Mon.) 2012		
09:00	00:00	Arrive at Yokosuka, Japan

3.4 Cruise track



4. Researchers

4.1 Chief scientist

Chief Scientist

Yutaka Ohta

Engineer

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4.2 Science Party

4.2.1 TRITON Buoy Network System Engineer

Yosaku Maeda

Yasuhisa Ishihara (not on board)

Shoichiro Baba (not on board)

Junichirou Tahara (not on board)

Tatsuya Fukuda (not on board)

Masayuki Yamaguchi (not on board)

Yukio Takahashi (not on board)

4.2.2 Tropical Ocean Climate Study

Kentaro Ando (not on board)

Yuji Kashino (not on board)

Iwao Ueki (not on board)

Takuya Hasegawa (not on board)

Takanori Horii (not on board)

4.3 R/V Kaiyo Scientist and technical stuff

Yutaka Ohta	JAMSTEC	Singapore – Bali
Yosaku Maeda	JAMSTEC	Singapore – Bali
Hiroshi Matsunaga	MWJ	Yokohama – Bali
Akira Watanabe	MWJ	Yokohama – Bali
Rei Ito	MWJ	Yokohama – Bali
Tomohide Noguchi	MWJ	Singapore – Bali
Hiroki Ushiromura	MWJ	Singapore – Bali
Kai Fukuda	MWJ	Singapore – Bali
Tamami Ueno	MWJ	Singapore – Bali
Kentaro Shiraishi	MWJ	Singapore – Bali
Shoko Tatamisashi	MWJ	Singapore – Bali
Keisuke Tsubata	MWJ	Singapore – Bali
Toru Koizumi	MWJ	Singapore – Bali
Takehiro Shibuya	MWJ	Singapore – Bali

JAMSTEC: Japan Agency for Marine Earth Science and Technology

MWJ: Marine Works Japan Ltd.

5. Observation
5.1 Operation of the TRITON/m-TRITON buoys
5.1.1 Personnel

Yutaka Ohta	(JAMSTEC): Principal Investigator
Yosaku Maeda	(JAMSTEC): Engineer
Akira Watanabe	(MWJ): Operation Leader
Hiroshi Matsunaga	(MWJ): Technical Staff
Tomohide Noguchi	(MWJ): Technical Staff
Hiroki Ushiromura	(MWJ): Technical Staff
Tamami Ueno	(MWJ): Technical Staff
Rei Ito	(MWJ): Technical Staff
Kai Fukuda	(MWJ): Technical Staff
Kentaro Shiraishi	(MWJ): Technical Staff
Shoko Tatamisashi	(MWJ): Technical Staff
Keisuke Tsubata	(MWJ): Technical Staff
Toru Koizumi	(MWJ): Technical Staff
Takehiro Shibuya	(MWJ): Technical Staff

5.1.2 Objectives

The large-scale air-sea interaction over the warmest sea surface temperature region in the western tropical Pacific Ocean and in the eastern Indian Ocean is though to be a key issue that affects the global atmosphere and causes El Nino phenomena in the Pacific Ocean and Indian Ocean Dipole (IOD) in the Indian Ocean. However, the formation mechanism of the warm pool and the air-sea interaction over the warm pool has not yet been well understood. Therefore long term data sets of temperature, salinity, currents and meteorological elements have been required at fixed locations in the area from western Pacific Ocean to the eastern Indian Ocean. The TRITON program aims to obtain the basic data to improve the predictions of El Nino, IOD and variations of Asia-Australian Monsoon system.

TRITON buoy (included m-TRITON buoy) array is integrated with the existing TAO (Tropical Atmosphere Ocean) array in the Pacific and with other RAMA array in the Indian Ocean, which is presently maintained by multinational efforts. This TRITON array is a component of international research program of CLIVAR (Climate Variability and Predictability), which is a major component of World Climate Research Program sponsored by the World Meteorological Organization, the International Council of Scientific Unions, and the Intergovernmental Oceanographic Commission of UNESCO. TRITON will also contribute to the development of GOOS (Global Ocean Observing System) and GCOS (Global Climate Observing System). Two m-TRITON buoys and one TRITON buoy have been successfully recovered and four m-TRITON buoys deployed during this cruise.

5.1.3 Measured parameters

The TRITON/m-TRITON buoy observes meteorological parameters and oceanic parameters as follows:

Meteorological parameters: wind speed/direction, air temperature, relative humidity, shortwave radiation, precipitation, Barometer (Only recovered buoys)

Oceanic parameters: water temperature and depth at 1m, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 140m, 200m, 300m, 500m, conductivity at 1m, 10m, 20m, 40m, 100m, currents at 10m

*TRITON and m-TRITON observes same oceanic parameters and meteorological parameters.

Details of the instruments used on the TRITON/m-TRITON buoy are summarized as follows:

(1) Meteorological sensors

1) Precipitation (JAMSTEC)
   MODEL Y50203
   Sampling interval: 600sec

2) Relative humidity/air temperature (JAMSTEC)
   MODEL MP103A
   Sampling interval: 600sec

3) Shortwave radiation (JAMSTEC)
   MODEL EPSP
   Sampling interval: 600sec

4) Wind speed/direction (JAMSTEC)
   MODEL Y85000
   Sampling interval: 600sec

5) Barometer (JAMSTEC)
   MODEL DP4000
   Sampling interval: 600sec

*Meteorological sensors were assembled that used A/D (Analougue/Digital) conversion PCB (Print Cycle Board) made from MARITEC (Marine Technology Center)/JAMSTEC

(2) Oceanic sensors

1) CTD (Conductivity-Temperature-Depth meter, Sea Bird Electronics Inc.)
   SBE-37 IM Micro CAT
   A/D cycles to average: 4
   Sampling interval: 600sec
   Measurement range, Temperature : -5～+35 deg-C
   Measurement range, Conductivity : 0～+7 S/m
   Measurement range, Pressure : 0～full scale range

2) CTD (Conductivity-Temperature and Depth meter, JAMSTEC)
   JES10-CTIM
   Sampling interval: 600sec

Measurement range, Temperature: -5～+35 deg-C
Measurement range, Conductivity: 0～+7 S/m
Measurement range, Pressure: 0～full scale range

3) TD (Temperature and Depth meter, Sea Bird Electronics Inc.)

SBE-39 IM
Sampling interval: 600sec
Measurement range, Temperature : -5～+35 deg-C
Measurement range, Pressure : 0～full scale range

4) CRN (Current meter, Nortek AS)

Aquadopp IM400
Sampling interval: 1800sec
Sensor frequency: 2MHz
Velocity Range: ±5m/s

(3) Data logger and ARGOS transmitter

1) Data logger

Meteorological sensors are controlled by I/O RS485.
GPS and Inductive modem are controlled by RS232C.

2) ARGOS transmitter

The data in the interval of 10 minute are being transmitted through ARGOS transmitter.

5.1.4 Results

Locations of recovery and deployment are as follow:

(1) Locations of Recovery

Nominal location	5S95E (TRITON)
ID number at JAMSTEC	17504
ARGOS PTT number	27400
ARGOS backup PTT number	24246
Deployed date (UTC)	13 Jan. 2011
Recovered date (UTC)	14 Jun. 2012
Exact location	05 - 01.97S, 94 - 58.60E
Depth	5,014 m

Nominal location	1.5S90E (m-TRITON)
ID number at JAMSTEC	18505
ARGOS PTT number	9EB84D4
ARGOS backup PTT number	27411
Deployed date (UTC)	16 Jan. 2011
Recovered date (UTC)	10 Jun. 2012
Exact location	01 - 36.18S, 90 - 04.44 E
Depth	4,716 m

Nominal location	8S95E (m-TRITON)
ID number at JAMSTEC	19502
ARGOS PTT number	29EB779
ARGOS backup PTT number	24742
Deployed date (UTC)	11 Jan. 2011
Recovered date (UTC)	16 Jun. 2012
Exact location	08 - 04.05S, 95 - 07.40E
Depth	5,261 m

(2) Locations of Deployment

Nominal location	5S95E (m-TRITON)
ID number at JAMSTEC	17505
ARGOS PTT number	16C34BE
ARGOS backup PTT number	29791
Deployed date (UTC)	13 Jun. 2012
Exact location	04 - 56.93S, 94 - 58.51E
Depth	5,023 m

Nominal location	1.5S90E (m-TRITON)
ID number at JAMSTEC	18506
ARGOS PTT number	3E052AD
ARGOS backup PTT number	29792
Deployed date (UTC)	09 Jun. 2012
Exact location	01 - 39.34S, 89 - 59.74E
Depth	4,700 m

Nominal location	8S95E (m-TRITON)
ID number at JAMSTEC	19503
ARGOS PTT number	3E052BE
ARGOS backup PTT number	96773
Deployed date (UTC)	15 Jun. 2012
Exact location	07 - 59.97S, 95 - 02.39E
Depth	5,243 m

Nominal location	5S97.25E (m-TRITON)
ID number at JAMSTEC	20501
ARGOS PTT number	16C34C7
ARGOS backup PTT number	30830
Deployed date (UTC)	12 Jun. 2012
Exact location	04 - 57.55S, 97 - 17.13E
Depth	4,988 m

5.1.5 Data archive

The data in the interval of 10 minutes were transmitted via ARGOS satellite data-transmission system in real time. These data will be archived at the JAMSTEC Yokosuka Headquarters. And the data will be distributed worldwide through internet from the JAMSTEC web site (http://www.jamstec.go.jp/).

5.2 Subsurface ADCP moorings

5.2.1 Personnel

Yutaka Ohta	(JAMSTEC): Principal Investigator
Tomohide Noguchi	(MWJ): Operation leader
Hiroshi Matsunaga	(MWJ): Technical staff
Kentaro Shiraishi	(MWJ): Technical staff
Hiroki Ushiromura	(MWJ): Technical staff
Shoko Tatamisashi	(MWJ): Technical staff
Tamami Ueno	(MWJ): Technical staff
Rei Ito	(MWJ): Technical staff
Toru Koizumi	(MWJ): Technical staff
Keisuke Tsubata	(MWJ): Technical staff
Takehiro Shibuya	(MWJ): Technical staff

5.2.2 Objectives

The purpose of this ADCP observation is to get knowledge of physical process underlying the dynamics of oceanic circulation in the equatorial eastern Indian Ocean. Sub-surface currents are observed by using ADCP moorings at 90°E right on the equator. In this cruise (KY12-08), we deployed as well as recovered sub-surface ADCP moorings at 0°S, 90°E.

5.2.3 Method

Two instruments are mounted at the top float of the mooring. One is ADCP (Acoustic Doppler Current Profiler) to observe upper-ocean currents from subsurface down to around 400m depths. The second instrument mounted below the float is CTD, which observes pressure, temperature and salinity for correction of sound speed and depth variability.

Details of the instruments and their parameters are described as follows:

(1) Current meters

WorkHorse ADCP 75 kHz (Teledyne RD Instruments, Inc.)

Distance to first bin: 7.04 m

Pings per ensemble: 27

Time per ping: 6.66 seconds

Number of depth cells: 60

Bin length: 8.00 m

Sampling Interval: 3600 seconds

Recovered ADCP

Serial Number: 13123 (Mooring No.110118-0090E)

Deployed ADCP

Serial Number: 1248 (Mooring No.120608-0090E)

(2) CTD

SBE-37 (Sea Bird Electronics Inc.)

Sampling Interval: 1800 seconds

Recovered CTD

Serial Number: 1775 (Mooring No. 110118-0090E)

Deployed CTD

Serial Number: 1388 (Mooring No. 120608-0090E)

(3) Other instrument

1) Acoustic Releaser (BENTHOS,Inc.)

Recovered Acoustic Releaser

Serial Number: 677 (Mooring No. 110118-0090E)

Serial Number: 689 (Mooring No. 110118-0090E)

Deployed Acoustic Releaser

Serial Number: 600 (Mooring No. 120608-0090E)

Serial Number: 937 (Mooring No. 120608-0090E)

Transponder (BENTHOS,Inc.)

Recovered Transponder

- Serial Number : 57114 (Mooring No. 110118-0090E)

5.2.4 Deployment

Deployment of the ADCP mooring at 0°N, 90°E was planned to mount the ADCP at about 400m depths. During the deployment, we monitored the depth of the acoustic releaser after dropped the anchor.

The position of the mooring No. 120608-0090E

Date: 08 Jun. 2012 Lat: 00-00.0739N Long: 90-08.6829E Depth: 4,084m

5.2.5 Recovery

We recovered one ADCP mooring which was deployed on 18 Jan. 2011 (MR11-01 cruise). After the recovery, we uploaded ADCP and CTD data into a computer, then raw data were converted into ASCII code.

Results were shown in the figures in the following pages. Fig.5.2-1 shows the ADCP velocity data (zonal and meridional component / Eq-90E). Fig.5.2-2 shows CTD pressure, temperature and salinity data (Eq-90E).

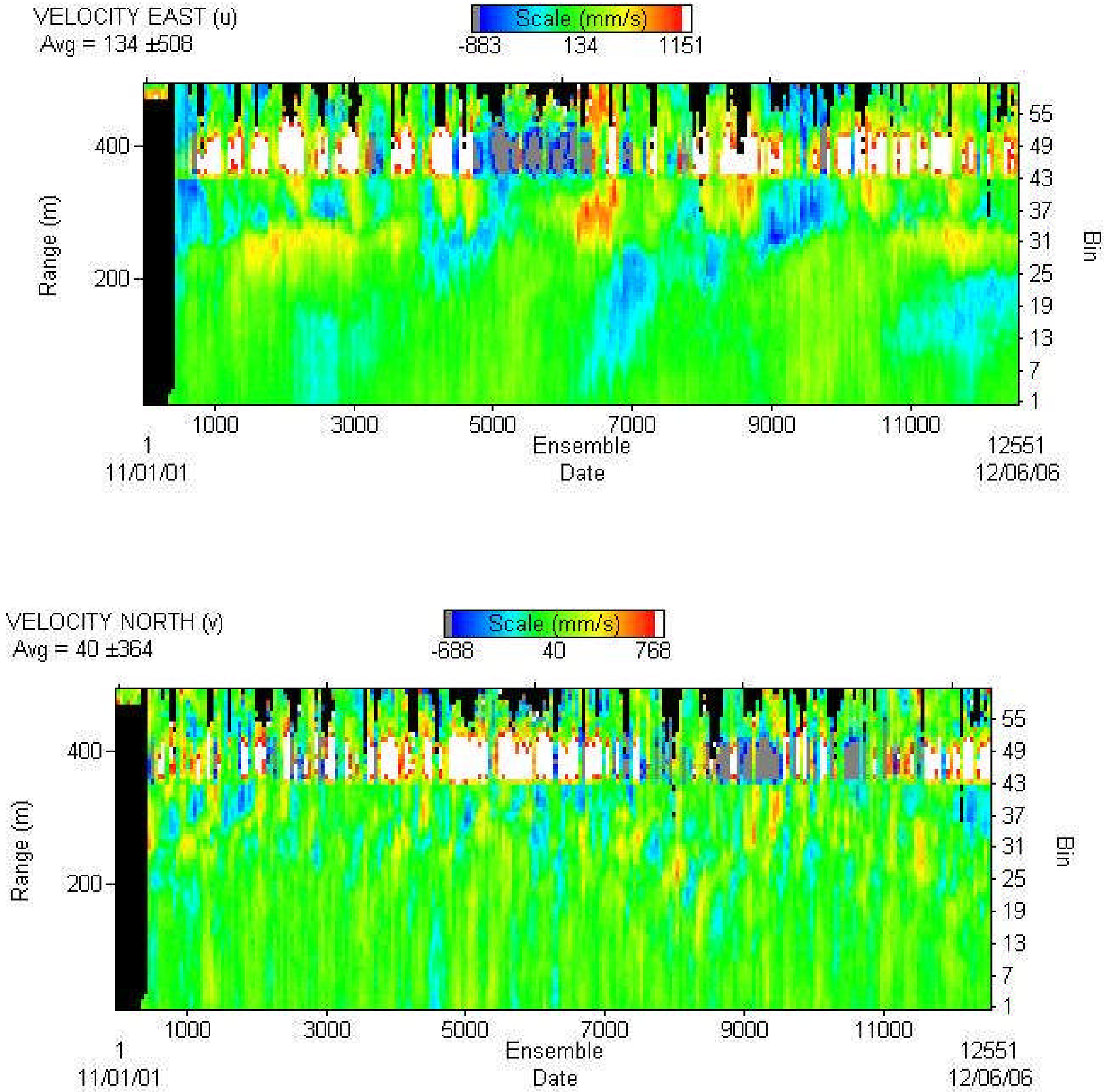


Fig.5.2-1 Time-depth sections of observed zonal (*top panel*) and meridional (*bottom panel*) currents obtained from ADCP mooring at Eq-90E.

(2011/01/18-2012/06/08)

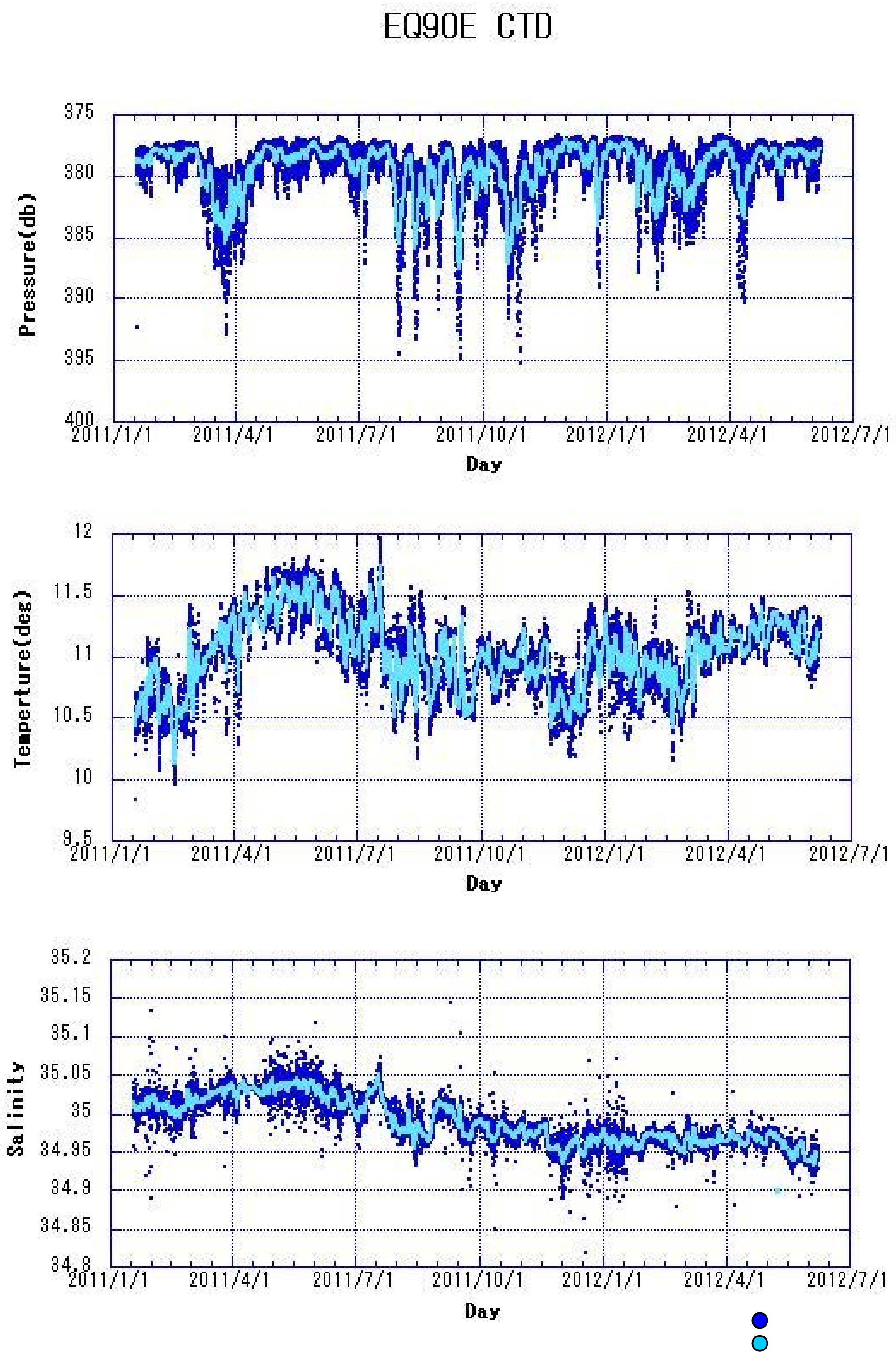


Fig.5.2-2 Time-series of the observed pressure (*top panel*), temperature (*middle panel*) and salinity (*bottom panel*) obtained from CTD at Eq-90E. The *dark-blue* curve indicates the raw data, while the *light-blue* curve shows the filtered data from 25 hours running-mean. (2011/01/18-2012/06/08)

5.3 CTD measurements

5.3.1 Personnel

Yutaka Ohta	(JAMSTEC): Principal investigator
Tomohide Noguchi	(MWJ): Operation leader
Hiroki Ushiromura	(MWJ): Technical staff
Syoko Tatamisashi	(MWJ): Technical staff
Tamami Ueno	(MWJ): Technical staff
Rei Ito	(MWJ): Technical staff

5.3.2 Objectives

The CTD measurements were conducted to investigation oceanic structure and water sampling and to compare the vertical structure of temperature and salinity with mooring buoy data.

5.3.3 Overview of the equipment and observation

CTD/Carousel water sampling system (CTD system), which is 12-position Carousel Water Sampler (SBE 32) with SBE 9plus (Sea-Bird Electronics Inc.), was used during this cruise. 5-litre Niskin bottles were used for sampling seawater. The sensors attached on the CTD were temperature (Primary and Secondary), conductivity (Primary and Secondary), and pressure. Salinity was calculated by measured values of pressure, conductivity and temperature. The CTD system was deployed from aft decks. During this cruise, 9 casts of CTD observation were carried out (see Table 5.3-1).

5.3.4 List of sensors and equipments

Under water unit:	SBE, Inc., SBE 9plus, S/N 09P9833-0357
Temperature sensor:	SBE, Inc., SBE 03-02/F, S/N 03P4421 (Primary)
Temperature sensor:	SBE, Inc., SBE 03-02/F, S/N 03P5329 (Secondary)
Conductivity sensor:	SBE, Inc., SBE 04-02/0, S/N 043064 (Primary)
Conductivity sensor:	SBE, Inc., SBE 04-02/0, S/N 043889 (Secondary)
Pump:	SBE, Inc., SBE 5T, S/N 054035 (Primary)
Pump:	SBE, Inc., SBE 5T, S/N 054032 (Secondary)
Deck unit:	SBE, Inc., SBE 11plus, S/N 11P39850-0705
Carousel Water Sampler:	SBE, Inc., SBE 32, S/N 3252859-0696
Water sample bottle:	General Oceanics, Inc., 5-litre Niskin

5.3.5 Data processing

The SEASOFT-Win32 (Ver. 7.21f) was used for processing the CTD data. Descriptions and settings of the parameters for the SEASOFT were written as follows.

DATCNV:

Converted the raw data to scan number, pressure, depth, primary temperature, primary conductivity, secondary temperature, secondary conductivity, descent rate, modulo error count and pump status. DATCNV also extracted bottle information where scans were marked with the bottle confirm bit during acquisition. The duration was set to 3.0 seconds, and the offset was set to 0.0 seconds.

BOTTLESUM:

Created a summary of the bottle data. The bottle position, date, time were output as the first two columns. Scan number, pressure, depth, primary temperature, primary conductivity, secondary temperature, secondary conductivity and descent rate were averaged over 3.0 seconds. And primary salinity, primary sigma-theta, primary potential temperature, secondary salinity, secondary sigma-theta and secondary potential temperature were computed.

WILDEDIT:

Marked extreme outliers in the data files. The first pass of WILDEDIT obtained an accurate estimate of the true standard deviation of the data. The data were read in blocks of 1000 scans. Data greater than 10 standard deviations were flagged. The second pass computed a standard deviation over the same 1000 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to pressure, depth, primary temperature, primary conductivity, secondary temperature, secondary conductivity, and decent rate.

CELLTM:

Used a recursive filter to remove conductivity cell thermal mass effects from the measured secondary conductivity. Typical values used were thermal anomaly amplitude alpha = 0.03 and the time constant 1/beta = 7.0.

FILTER:

Performed a low pass filter on pressure with a time constant of 0.15 seconds. In order to produce zero phase lag (no time shift) the filter runs forward first then backwards.

SECTION:

Selected a time span of data based on scan number in order to reduce a file size. The minimum number was set to be the starting time when the CTD package was beneath the sea-surface after activation of the pump. The maximum number was set to be the end time when the package came up from the surface.

LOOPEDIT:

Marked scans where the CTD was moving less than the minimum velocity of 0.0 m/s (traveling backwards due to ship roll).

BINAVG:

Averaged the data into 1 decibar pressure bins. The center value of the first bin was set equal to the bin size. The bin minimum and maximum values are the center value plus and minus half the bin size. Scans with pressure greater than the minimum and less than or equal to the maximum were averaged. Scans were interpolated so that a data record exists in every decibar.

DERIVE:

It was used to compute primary salinity, primary sigma-theta, primary potential temperature, secondary salinity, secondary sigma-theta and secondary potential temperature.

SPLIT:

It was used to split data into the down cast and the up cast.

5.3.6 Preliminary Results

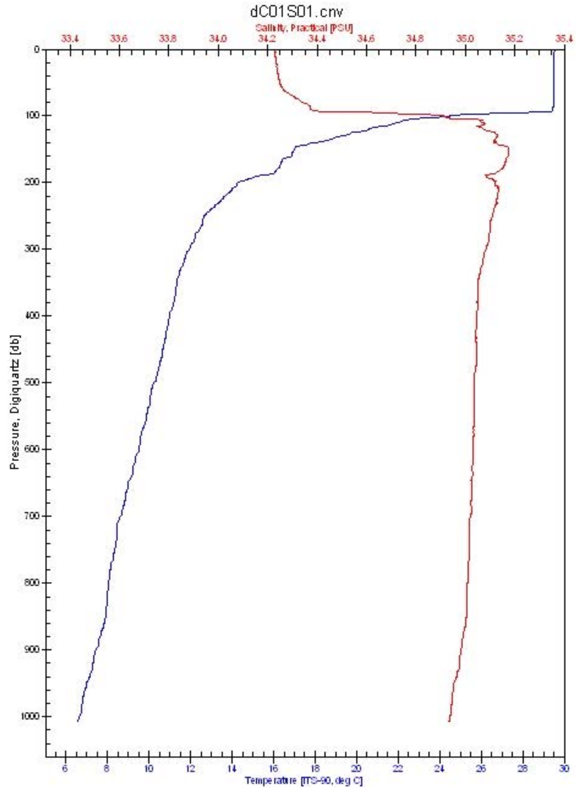
Date, time and locations of the CTD casts are listed in Table 5.3-1. Vertical profile (down cast) of primary temperature and primary salinity with pressure are shown in Figure 5.3-1.

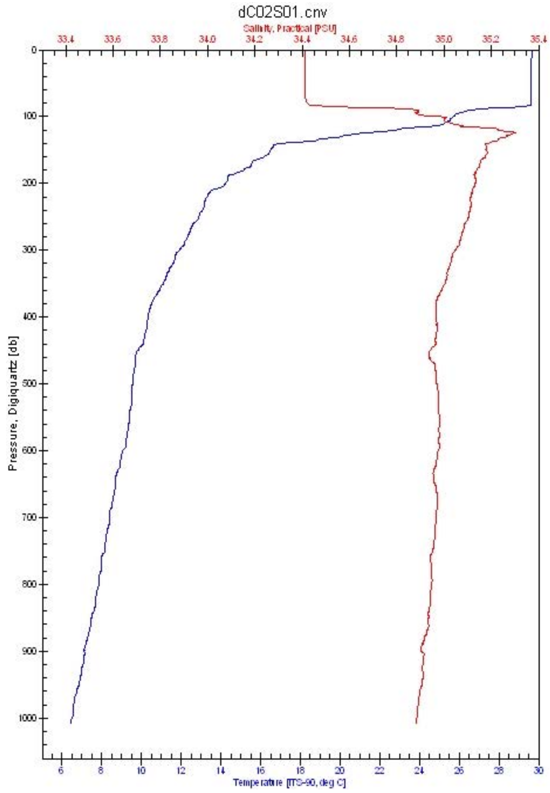
5.3.7 Data archive

All raw and processed data files will be submitted to JAMSTEC Data Integration and Analyses Group (DIAG) and corrected datasets will be available from Mirai Web site at http://www.jamstec.go.jp/mirai/.a

Table 5.3-1 CTD Cast Table

Stn.	Cast	Date(UTC)	Time(UTC)		Bottom Position		Depth	Wire	Max	Max	CTD	Remarks
		mmddyy	Start	End	Latitude	Longitude	(MNB)	Out	Depth	Pressure	File name	
C01	1	060712	08:41	09:22	01-33.28N	090-03.91E	2294.0	1008.7	1000.1	1007.1	C01S01	ATLAS buoy
C02	1	060912	06:49	07:30	01-38.59S	089-59.29E	4683.0	998.0	1000.9	1007.4	C02S01	m-TRITON deploy
C03	1	060912	08:59	09:39	01-36.56S	090-05.02E	4705.0	995.4	1001.1	1009.1	C03S01	m-TRITON recovery
C04	1	061212	07:54	08:34	04-57.43S	097-16.92E	4980.0	995.0	1000.4	1008.5	C04S01	m-TRITON deploy
C05	1	061312	05:52	06:33	04-56.95S	094-58.23E	5027.0	996.0	1000.8	1008.6	C05S01	m-TRITON deploy
C06	1	061312	08:10	08:49	05-01.43S	095-04.40E	5029.0	1000.0	1001.4	1009.8	C06S01	TRITON recovery
C07	1	061512	05:37	06:15	07-59.46S	095-02.26E	5246.0	995.0	1000.2	1008.4	C07S01	m-TRITON deploy
C08	1	061512	07:32	08:11	08-03.15S	095-03.42E	5234.0	995.0	1001.1	1009.1	C08S01	TRITON recovery
C09	1	061712	09:18	09:59	08-00.04S	100-00.06E	5696.0	994.0	1000.2	1008.1	C09S01	Chinese buoy


dC01S01.cnv
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]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Pressure, Digiquartz [db]
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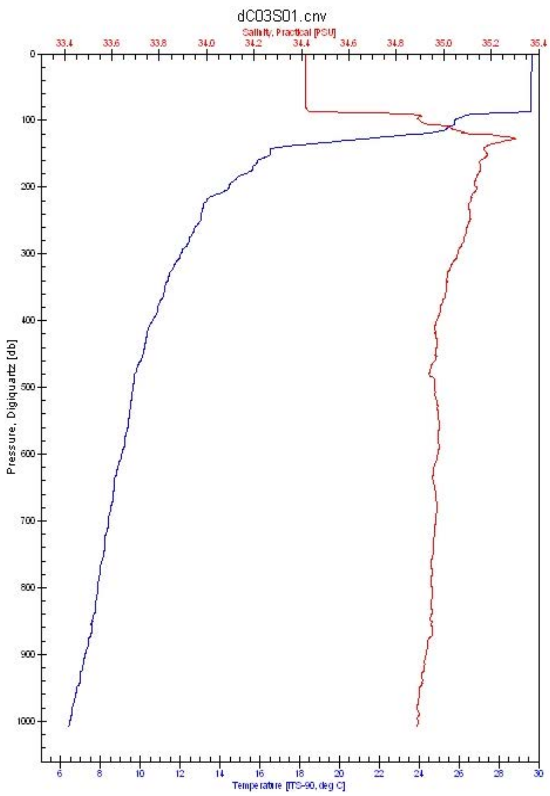
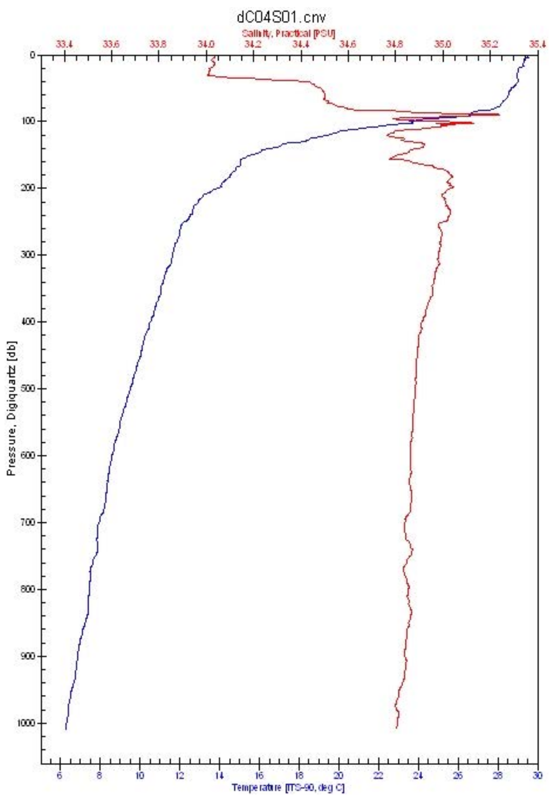
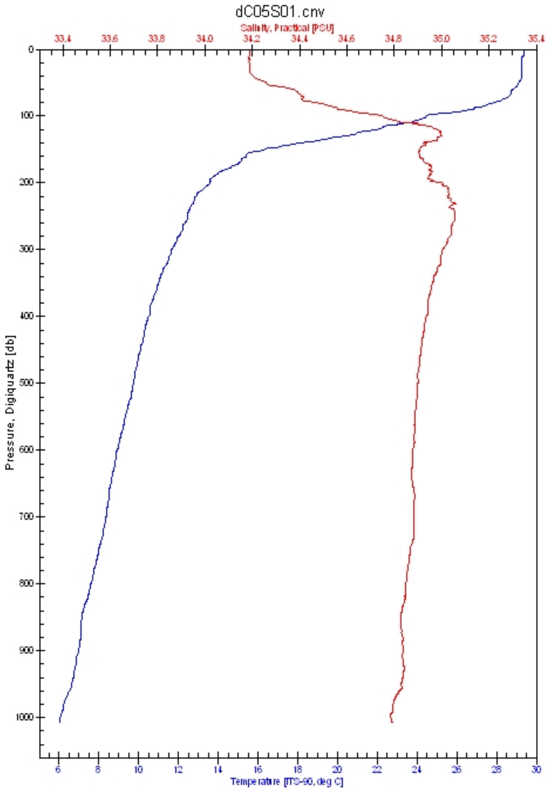
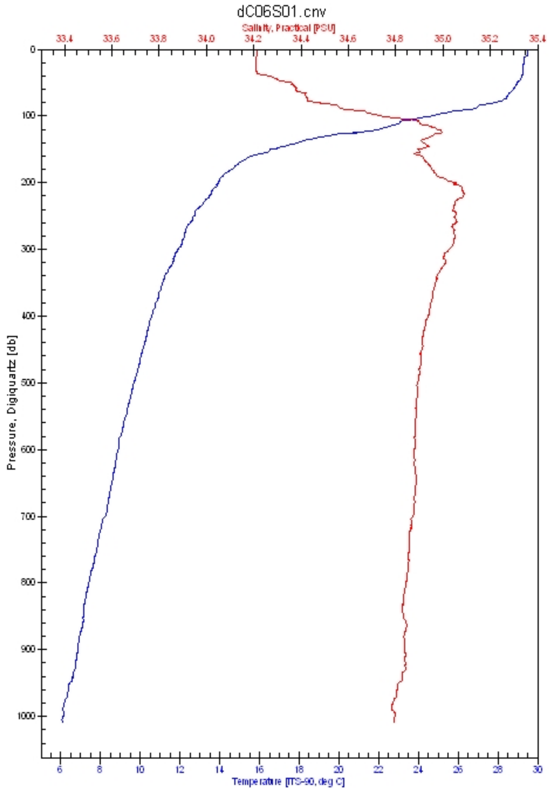
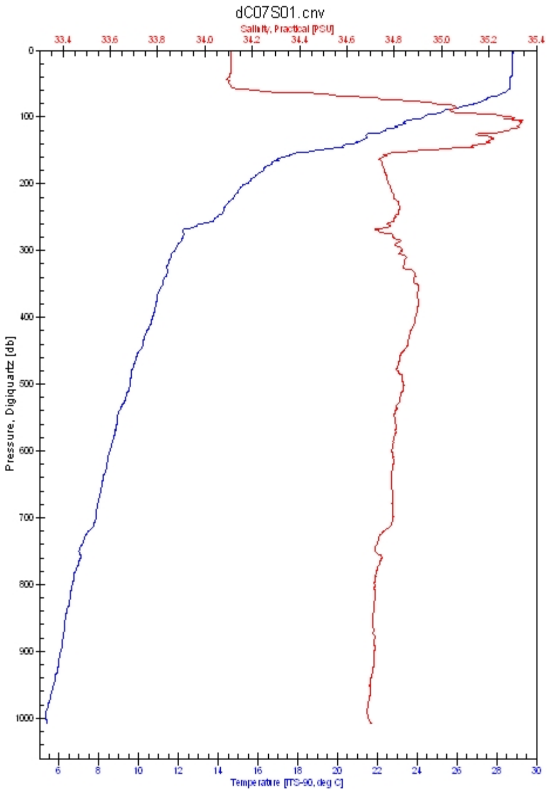
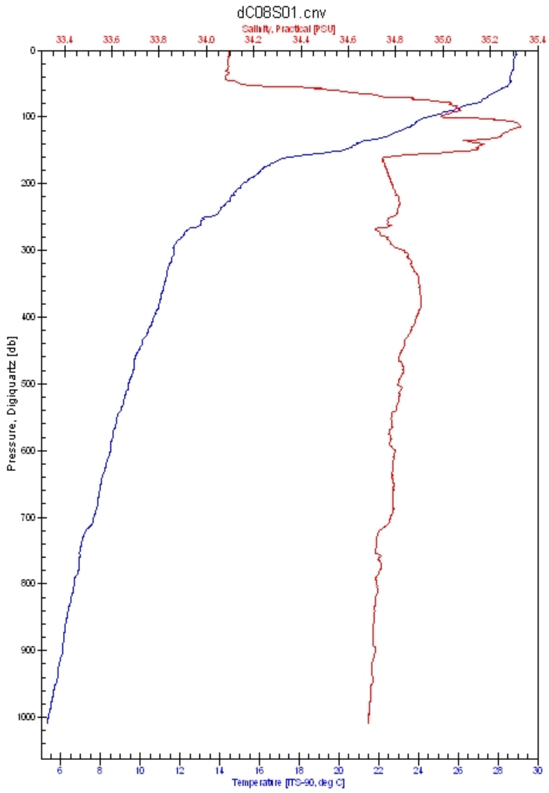

dC03S01.cnv
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]


dC04S01.cnv
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]


dC05S01.cnv
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]


dC06S01.cnv
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]


dC07S01.cnv
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]


dC08S01.cnv
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]

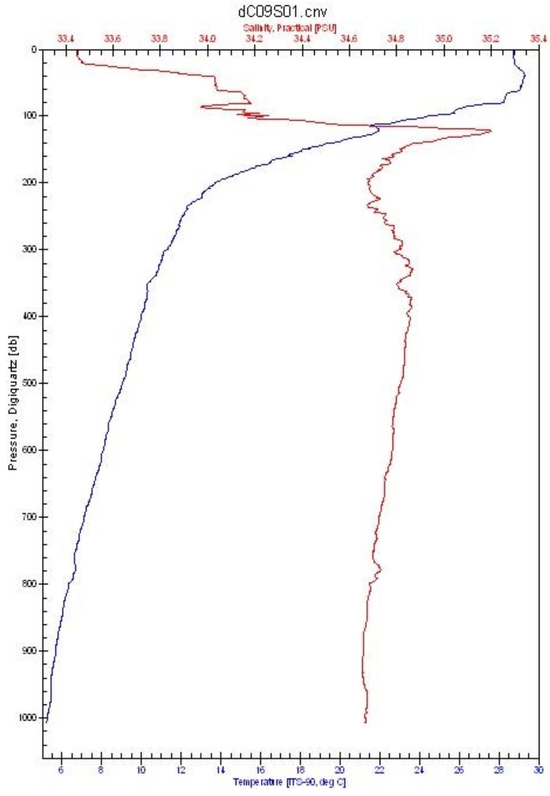


Figure 5.3-1 CTD profile
(C01S01, C02S01, C03S01, C04S01, C05S01, C06S01, C07S01, C08S01, and C09S01)

5.4 Water sampling (Salinity)

5.4.1 Personnel

Yutaka Ohta	(JAMSTEC): Principal Investigator
Hiroki Ushiromura	(MWJ): Operation Leader
Tamami Ueno	(MWJ): Technical staff

5.4.2 Objectives

To provide a calibration for the measurement of salinity of bottle water collected on the CTD casts.

5.4.3 Methods

(1) Salinity Sample Collection

Seawater samples were collected with 5 liter Niskin bottles. The salinity sample bottle of the 250ml brown glass bottle with screw cap was used for collecting the sample water. Each bottle was rinsed three times with the sample water, and was filled with sample water to the bottle shoulder. The sample bottle was sealed with a plastic insert thimble and a screw cap ; the thimble being thoroughly rinsed before use. The bottle was stored for more than 1 days in the laboratory before the salinity measurement.

The number of samples taken is 18.

(2) Instruments and Method

The salinity analysis was carried out on R/V KAIYO during the cruise of KY12-08 using the salinometer (Model 8400B “AUTOSAL” ; Guildline Instruments Ltd.: S/N 60132 with an additional peristaltic-type intake pump (Ocean Scientific International, Ltd.). A precision digital thermometer (Model 9540 ; Guildline Instruments Ltd.: S/N 68198 and 69443) were used. The thermometer monitored the ambient temperature and the bath temperature of the salinometer.

The specifications of the AUTOSAL salinometer and thermometers are shown as follows;

1) Salinometer (Model 8400B “AUTOSAL” ; Guildline Instruments Ltd.)

Measurement Range:	0.005 to 42 (PSU)
Accuracy:	Better than ±0.002 (PSU) over 24 hours without re-standardization
Maximum Resolution:	Better than ±0.0002 (PSU) at 35 (PSU)

2) Thermometer (Model 9540 ; Guildline Instruments Ltd.)

Measurement Range:	-40 to +180 deg C
Resolution:	0.001 deg C
Limits of error ±deg C:	0.01 deg C (24 hours @ 23 deg C ±1 deg C)
Repeatability:	±2 least significant digits

The measurement system was almost the same as Aoyama *et al.* (2002). The salinometer was operated in the air-conditioned ship's laboratory at a bath temperature of 24 deg C. The ambient temperature varied from approximately 20 deg C to 24 deg C, while the bath temperature was very stable and varied within +/- 0.001 deg C on rare occasion. The measurement for each sample was done with a double conductivity ratio and defined as the median of 31 readings of the salinometer. Data collection was started 10 seconds after filling the cell with the sample and it took about 10 seconds to collect 31 readings by a personal computer. Data were taken for the sixth and seventh filling of the cell. In the case of the difference between the double conductivity ratio of these two fillings being smaller than 0.00002, the average value of the double conductivity ratio was used to calculate the bottle salinity with the algorithm for the practical salinity scale, 1978 (UNESCO, 1981). If the difference was greater than or equal to 0.00003, an eighth filling of the cell was conducted. In the case of the difference between the double conductivity ratio of these two fillings being smaller than 0.00002, the average value of the double conductivity ratio was used to calculate the bottle salinity. In the case of the double conductivity ratio of eighth filling did not satisfy the criteria above, a ninth filling of the cell was measured to calculate the bottle salinity. The measurement was conducted in about 2 hours per day and the cell was cleaned with soap after the measurement of the day.

5.4.4 Preliminary results

(1) Standard Seawater

Standardization control of the salinometer was set to 408 and all measurements were done at this setting. The value of STANDBY was 24+5677 +/- 0001 and that of ZERO was 0.0+0002. The conductivity ratio of IAPSO Standard Seawater batch P153 was 0.99979 (double conductivity ratio was 1.99958) and was used as the standard for salinity. I measured 6 bottles of P153.

Fig.5.4-1 shows the history of the double conductivity ratio of the Standard Seawater batch P153. The average of the double conductivity ratio was 1.99957 and the standard deviation was 0.00002, which is equivalent to 0.0003 in salinity.

Fig.5.4-2 shows the history of the double conductivity ratio of the Standard Seawater batch P153 after correction. The average of the double conductivity ratio after correction was 1.99958 and the standard deviation was 0.00001, which is equivalent to 0.0003 in salinity.

The specifications of SSW used in this cruise are shown as follows;

1) Batch:	P153
2) Conductivity ratio:	0.99979
3) Salinity:	34.992
4) Preparation date:	8th-March-2014

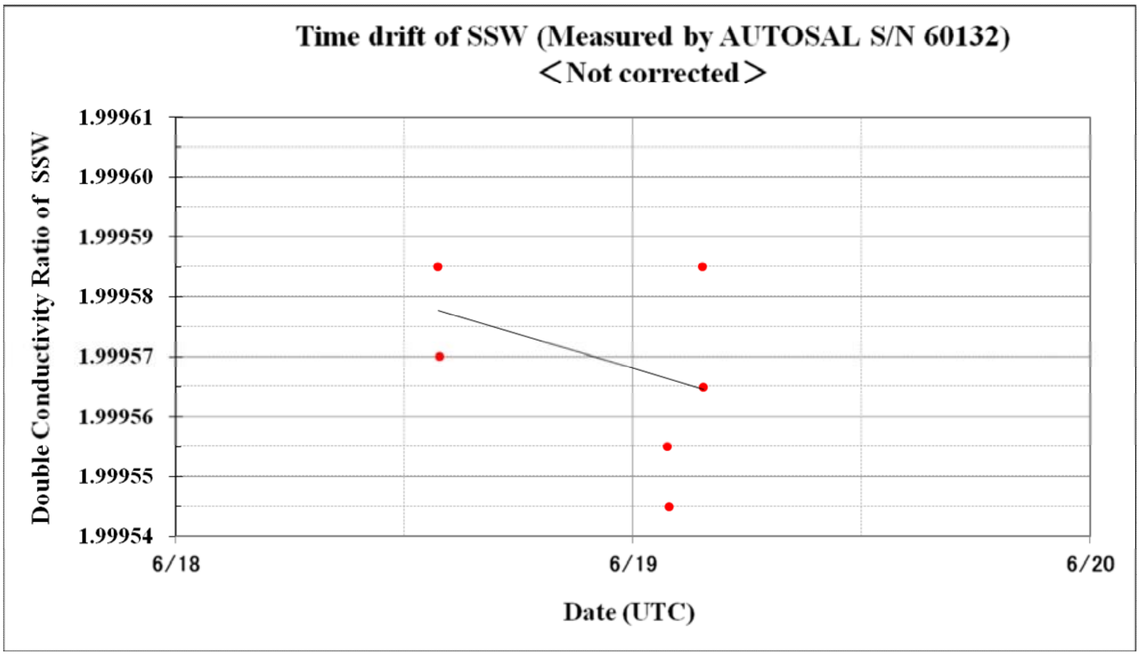


Fig. 5.4-1 History of double conductivity ratio for the Standard Seawater batch P153 (before correction)

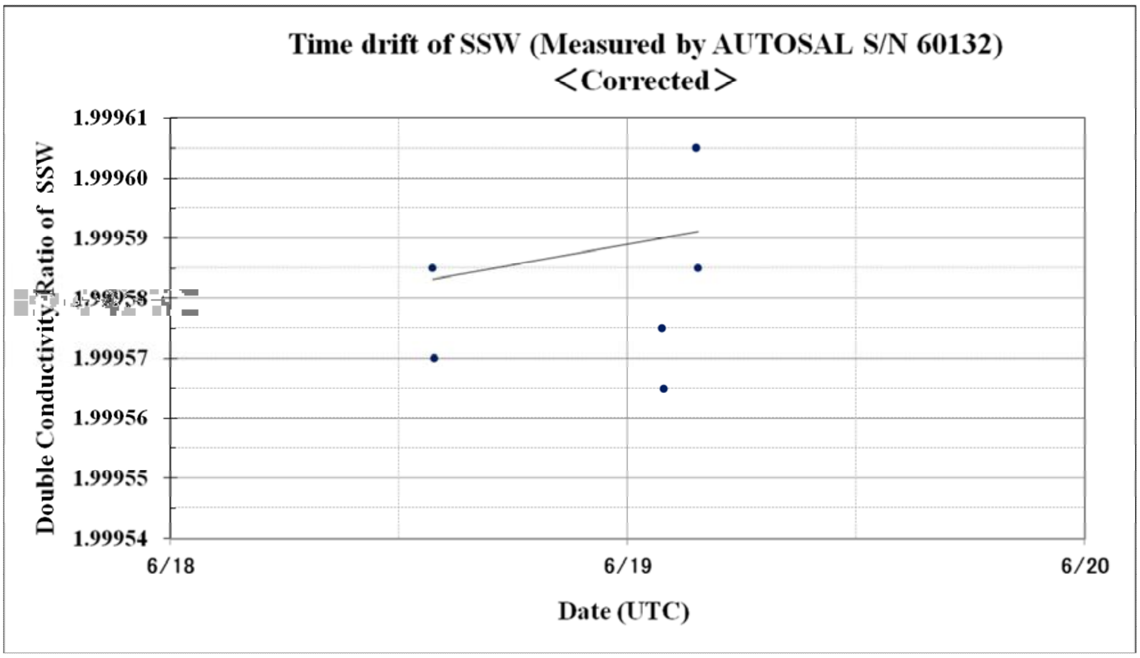


Fig. 5.4-2 History of double conductivity ratio for the Standard Seawater batch P153 (after correction)

(2) Sub-Standard Seawater

Sub-standard seawater was made from deep-sea water filtered by a pore size of 0.45 micrometer and stored in a 20 liter container made of polyethylene and stirred for at least 24 hours before measuring. It was measured about every 6 samples in order to check for the possible sudden drifts of the salinometer.

(3) Replicate Samples

I estimated the precision of this method using 9 pairs of replicate samples taken from the same Niskin bottle. The average and the standard deviation of absolute difference among 9 pairs of replicate samples were 0.0003 and 0.0003 in salinity, respectively.

5.4.5 Data archives

These raw datasets will be submitted to JAMSTEC Data Management Office (DMO).

5.4.6 Remarks

Reference

・Aoyama, M., T. Joyce, T. Kawano and Y. Takatsuki : Standard seawater comparison up to P129. Deep-Sea Research, I, Vol. 49, 1103～1114, 2002

・UNESCO: Tenth report of the Joint Panel on Oceanographic Tables and Standards. UNESCO Tech. Papers in Mar. Sci., 36, 25 pp., 1981

5.5 XCTD

5.5.1 Personnel

Yutaka Ohta	(JAMSTEC) Principal Investigator
Hiroki Ushiromura	(MWJ): Operation leader
Kentaro Shiraishi	(MWJ): Technical staff
Shoko Tatamisashi	(MWJ): Technical staff
Tamami Ueno	(MWJ): Technical staff
Keisuke Tsubata	(MWJ): Technical staff
Takehiro Shibuya	(MWJ): Technical staff

5.5.2 Objectives

The XCTD measurements were conducted to investigate ocean structure in the southeastern tropical Indian Ocean. The data is also used to estimate the divergence/convergence of ocean horizontal currents by calculations of geostrophic current.

5.5.3 Methods

We observed oceanic structure for sea water temperature and salinity by using XCTD profiling system TS-MK-130 (The Tsurumi Seiki Co, Ltd: TSK) which is made up of a digital converter (TS-MK-130), a personal computer for data acquisition, a hand-held launcher (LM3A), and probes (XCTD-1) on R/V KAIYO during KY12-08 cruise.

The specifications of the XCTD system and probes are shown as follows;

XCTD (Model XCTD-1)

Maximum Depth:	1000m
Ship Speed:	12 knots
Range:	Temperature: -2 to +35 deg C
	Conductivity: 0 to 60 mS/ cm
Resolution:	Temperature: 0.01 deg C
	Conductivity: 0.015 mS/ cm
Accuracy	Temperature: ±0.02 deg C
	Conductivity: ±0.03 mS/ cm

* XCTD (eXpendable Conductivity, Temperature, and Depth probe)

5.5.4 Preliminary results

Date, time, locations, and other information for the XCTD observations are listed in Table 5.5-1 and XCTD data are shown in Fig.5.5-1~5.

5.5.5 Data archives

These raw datasets will be submitted to JAMSTEC Data Management Office (DMO).

Table 5.5-1 KY12-08 XCTD Observation Log

No.	Probe S/N	Date (UTC)	Time (UTC)	Latitude	Longitude	Current Direction(deg)	Current Speed(kt)	Depth (m)	File Name
XCTD-01	12026176	2012/06/12	10:14:14	04-59.8021S	097-01.7672E	35.7	0.3	5199	CTD-017220120611
XCTD-02	12026177	2012/06/12	13:22:08	04-59.9918S	096-31.8347E	20.1	0.4	5139	CTD-017320120612
XCTD-03	12026178	2012/06/12	16:01:21	04-59.9825S	096-01.8247E	357.8	0.6	4992	CTD-017420120612
XCTD-04	12026179	2012/06/12	18:35:25	04-59.9902S	095-32.0044E	358.8	0.4	4998	CTD-017520120612
XCTD-05	12026180	2012/06/14	08:34:42	05-28.6482S	095-00.2574E	217.9	0.9	5077	CTD-017620120614
XCTD-06	12026181	2012/06/14	11:02:56	05-58.0280S	094-59.9730E	177.8	0.6	5141	CTD-017720120614
XCTD-07	12026182	2012/06/14	13:36:42	06-29.5389S	094-59.9963E	235.9	0.3	5155	CTD-017820120614
XCTD-08	12026183	2012/06/14	16:25:09	06-59.7409S	094-59.9395E	246.6	0.8	5197	CTD-017920120614
XCTD-09	12026184	2012/06/14	18:59:26	07-29.1230S	095-00.0105E	245.3	0.8	5229	CTD-018020120614
XCTD-10	12026185	2012/06/16	07:40:02	08-00.2187S	095-28.0845E	221.4	0.7	5246	CTD-018120120616
XCTD-11	12026186	2012/06/16	10:29:36	08-00.0003S	095-58.6935E	225.6	0.5	5423	CTD-018220120616
XCTD-12	12026187	2012/06/16	13:15:40	07-59.9975S	096-29.7394E	274.1	0.4	5411	CTD-018320120616
XCTD-13	12026188	2012/06/16	15:57:24	08-00.0158S	096-59.7326E	202.6	0.6	4951	CTD-018420120616
XCTD-14	12026189	2012/06/16	18:38:35	08-00.0028S	097-29.7631E	256.9	0.2	5336	CTD-018520120616
XCTD-15	12026190	2012/06/16	21:24:38	08-00.0064S	097-59.7141E	242.7	0.8	4909	CTD-018620120616
XCTD-16	12026212	2012/06/17	00:14:58	08-00.0118S	098-29.7517E	232.0	0.8	5195	CTD-018720120617
XCTD-17	12026213	2012/06/17	03:11:13	08-00.0075S	098-59.4455E	223.5	1.1	5334	CTD-018820120617
XCTD-18	12026214	2012/06/17	06:09:41	08-00.3731S	099-29.0209E	226.1	0.7	5491	CTD-018920120617
XCTD-19	12026215	2012/06/17	15:10:25	07-30.2501S	099-28.0825E	106.1	0.4	5138	CTD-019020120617
XCTD-20	12026216	2012/06/17	18:56:32	07-00.2095S	099-05.1561E	158.4	0.5	5172	CTD-019120120617

Table 5.5-1 KY12-08 XCTD Observation Log (continued)

No.	Probe S/N	Date (UTC)	Time (UTC)	Latitude	Longitude	Current Direction(deg)	Current Speed(kt)	Depth (m)	File Name
XCTD-21	12026217	2012/06/17	23:01:06	06-30.2045S	098-37.6925E	108.3	0.7	5335	CTD-019220120617
XCTD-22	12026218	2012/06/18	03:03:11	06-00.5783S	098-10.5144E	136.2	0.6	4670	CTD-019320120618
XCTD-23	12026219	2012/06/18	07:05:18	05-30.5703S	097-43.0142E	114.9	0.3	5025	CTD-019420120618

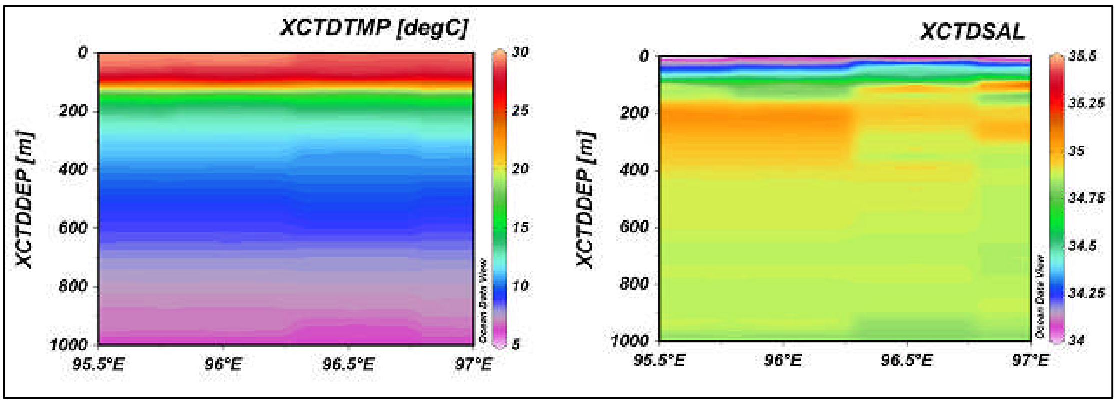


Fig.5.5-1 Line1 XCTD temperature and Salinity

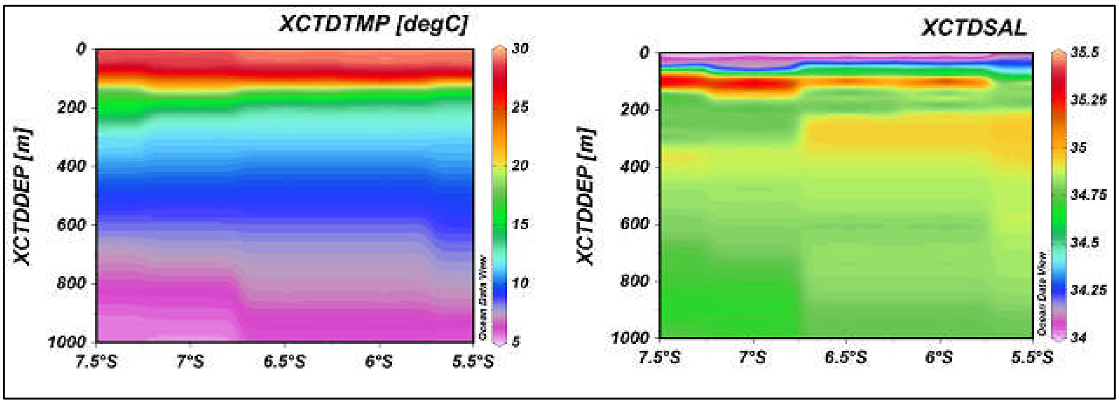


Fig.5.5-2 Line2 XCTD temperature and Salinity

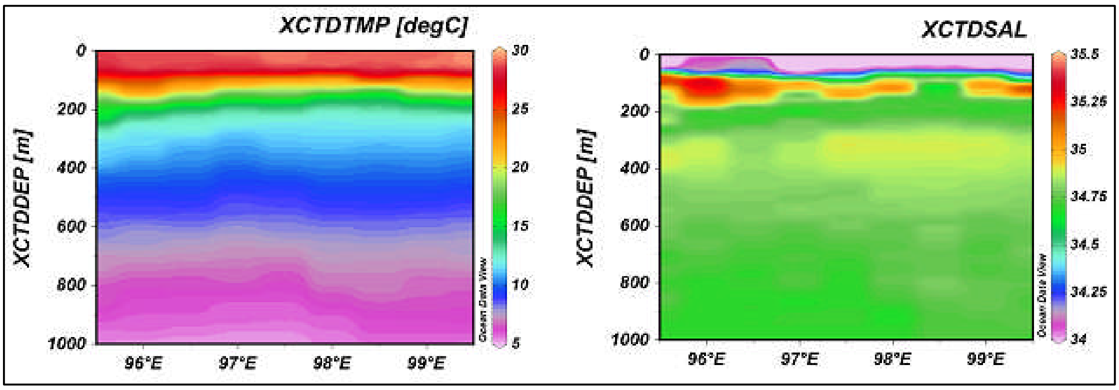


Fig.5.5-3 Line3 XCTD temperature and Salinity

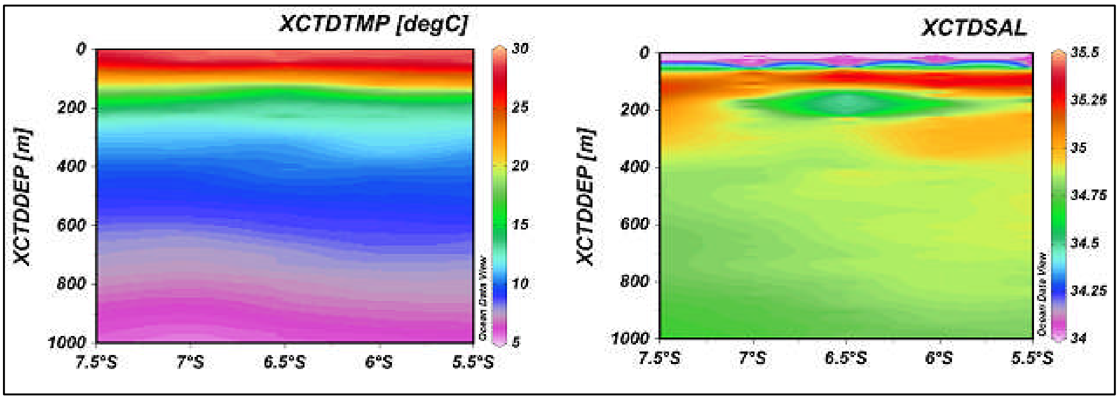


Fig.5.5-4 Line4 XCTD temperature and Salinity

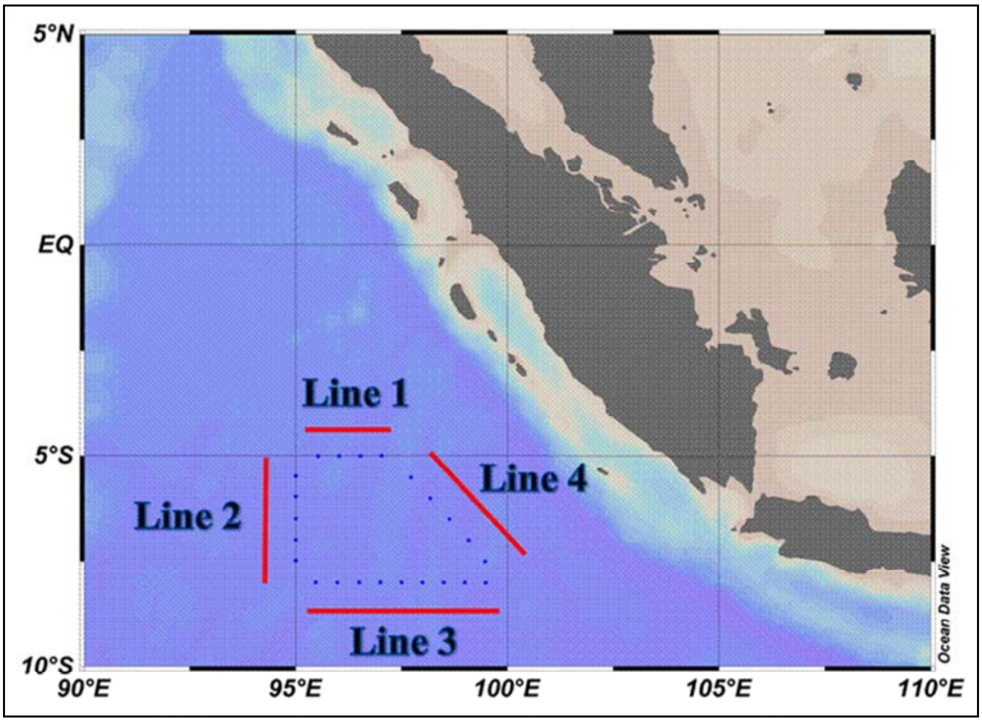


Fig.5.5-5 Observation map