



R/V Yokosuka Cruise Report

YK14-01



Development of buoy observation system
for tsunami and crustal movement.

Jan.11.2014 - Jan.15.2014

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

YK14-01

1.2. Ship

R/V Yokosuka (Captain: Shinya Ryono)

1.3. Title of cruise

Deployment of prototype buoy observation system for tsunami and crustal movement.

1.4. Title of Proposal

Development of buoy observation system for tsunami and crustal movement.

1.5. Period

Jan. 11, 2014 – Jan. 15, 2014

1.6. Research area

Kumano basin

2. Introduction and experiments summary

2.1. Introduction

Regarding of the urgent research for 2011 Off Tohoku Earthquake, It was approved based on the results of the director discussion which is held at 14th June 2012 to develop the Tsunami detection system around strong current area. The buoy observation system for tsunami and crustal movement consist of two subsystem which are an ocean bottom unit located at seafloor and a surface buoy mooring. The water pressure data from the ocean bottom unit are transmitted using acoustic pulse, and the pulse signal are received at wire-end station which are located at 1000m below water surface. The received data are transferred to the surface buoy using inductive modem or metal cable and the data are transmitted by satellite communication. And there are also another four systems on the surface buoy. They are GNSS antenna and receiver by JAXA, backup GPS receiver by Tohoku University, ETS-8 (KIKU No.8) transmitter by JAXA, GPS/Acoustic surface unit by Tohoku University. These purpose are tsunami monitoring and satellite communication and seafloor crustal deformation precise acoustic ranging.

The main mission of this cruise is to deploy the prototype buoy for tsunami and crustal movement. It is the second test in the sea.

2.2. Experiments summary

Surface buoy deployment:	1 mooring
Ocean Bottom Unit deployment:	1 mooring
XBT (to correction of sound velocity for MBES and SSBL):	1 casts
Acoustic signal monitor on YOKOSUKA	6 lines

We successfully deployed a prototype buoy mooring and an ocean bottom unit during this cruise.

We conducted acoustic signal monitor around the deployed site. These measurements were conducted to investigate acoustic data communication for the buoy.

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

3.1. Cruise period

Jan. 11, 2014 – Jan. 15, 2014

3.2. Ports of call

Yokosuka, Japan (Departure: Jan. 11, 2014)

Kobe, Japan (Arrival: Jan. 15, 2014)

3.3. Cruise log

SMT	UTC	Event
Jan. 11, (Sat.) 2014		
10:00	01:00	Departure from Yokosuka, Japan
11:00	02:00	Safety Lecture
13:00	04:00	Observational meeting
Jan. 12, (Sun.) 2014		
04:00	19:00	Arrive at Kumano basin, Japan
05:30	20:30	XBT-1 (33-30.49N 137-22.84E)
06:11-06:43	21:11-21:43	Bathymetry observation (MBES)
08:07-11:49	23:07-02:49	Deploy of Tsunami Monitoring prototype mooring (Anchor position: 33-32.33N 137-23.24E Depth: 2972m)
14:29-16:29	05:29-07:29	Deploy of Ocean Bottom Unit (position: 33-32.43N 137-23.41E Depth: 2973m)
18:07-20:33	09:07-11:33	Acoustic signal monitor #1 (line#1-1)
Jan. 13, (Mon.) 2014		
00:22-03:38	15:22-18:38	Acoustic signal monitor #2 (line#2-1)
04:00-11:14	19:00-02:14	Acoustic signal monitor #3 (line#3-1)
11:33-17:02	02:33-08:02	Acoustic signal monitor #4 (line#4-1)
18:27-19:40	09:27-11:40	Buoy command test via satellite #1
20:20-00:16	11:20-15:16	Acoustic signal monitor #5 (line#2-2)
23:25-23:50	14:25-14:50	Buoy command test via satellite #2
Jan. 14, (Tue.) 2014		
01:41-05:21	16:41-20:21	Acoustic signal monitor #6 (line#1-2)
02:28-02:46	17:28-17:46	Buoy command test via satellite #3
05:21-10:34	20:21-01:34	Acoustic signal monitor #7 (line#5-1)
10:34-14:37	01:34-05:37	Acoustic signal monitor #8 (line#6-1)
13:30-14:09	04:30-05:09	Visual checking of deployed buoy

SMT	UTC	Event
Jan. 14, (Tue.) 2014		
14:40	05:40	Departure from Kumano basin
Jan. 15, (Wed.) 2014		
09:00	00:00	Arrive at Kobe, Japan

3.4. Cruise track

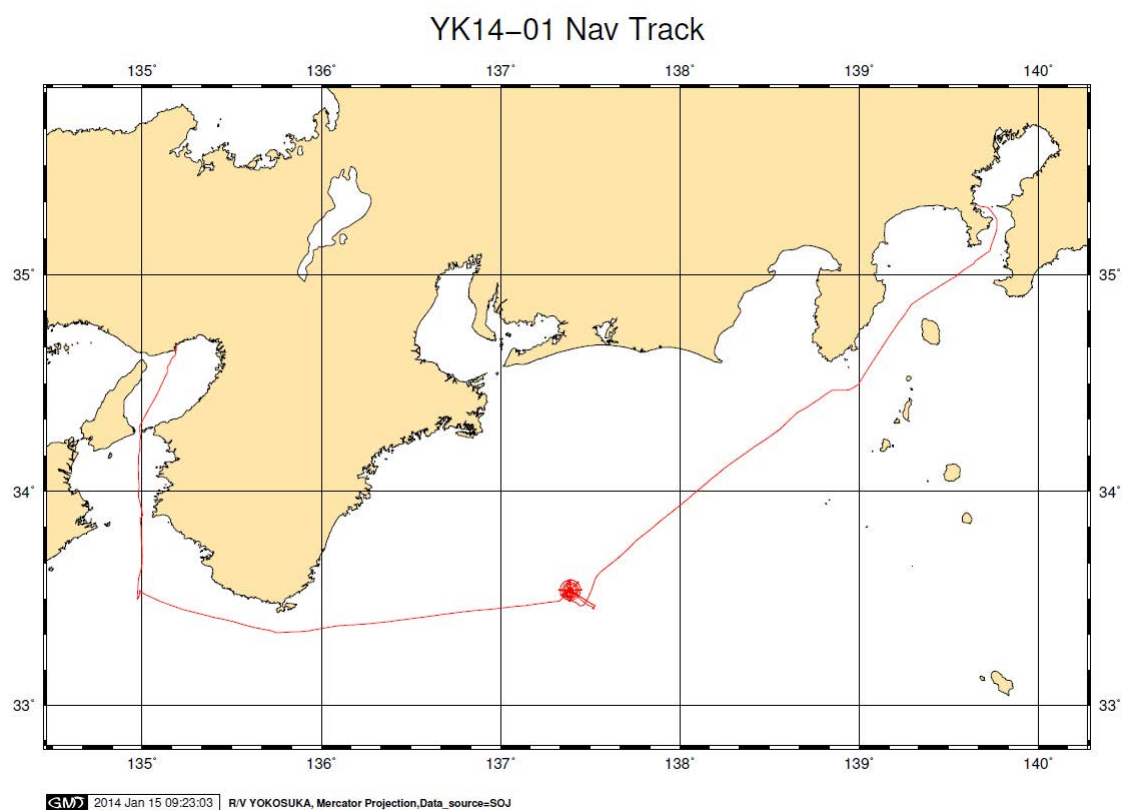


Fig. 3.4-1 YK14-01 Cruise Track

4. Researchers

4.1. Chief scientist

Chief Scientist

Tatsuya Fukuda

Engineer

Marine Technology and Engineering Center (MARITEC)

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Co - Chief Scientist

Hiroshi Ochi

Engineer

Marine Technology and Engineering Center (MARITEC)

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

4.2. Science Party

4.2.1. Buoy System Engineer

Yasuhisa Ishihara (not on board)

Junichirou Tahara

Tatsuya Fukuda

Yosaku Maeda (not on board)

Masayuki Yamaguchi (not on board)

4.2.2. Underwater Acoustic Engineer

Hiroshi Ochi

Takami Mori

Mitsuyasu Deguchi

4.2.3. Earthquake and tsunami Study

Narumi Takahashi

4.2.4. GPS/Acoustic Study

Motoyuki Kido(not on board)

Yusaku Ohta

Yukihito Osada

Fumiaki Tomita

4.2.5. GNSS System Study

Katsuhiko Mutoh(not on board)

Osamu Motohashi

4.2.6. ETS-8 Communication Engineer

Gousei Hashimoto

Osamu Motohashi

4.3. R/V Yokosuka Scientist and technical stuff

Tatsuya Fukuda	JAMSTEC	Yokosuka – Kobe
Narumi Takahashi	JAMSTEC	Yokosuka – Kobe
Hiroshi Ochi	JAMSTEC	Yokosuka – Kobe
Junichirou Tahara	JAMSTEC	Yokosuka – Kobe
Takami Mori	JAMSTEC	Yokosuka – Kobe
Mitsuyasu Deguchi	JAMSTEC	Yokosuka – Kobe
Gousei Hashimoto	JAXA	Yokosuka – Kobe
Osamu Motohashi	JAXA	Yokosuka – Kobe
Yusaku Ohta	Tohoku Univ.	Yokosuka – Kobe
Yukihito Osada	Tohoku Univ.	Yokosuka – Kobe
Fumiaki Tomita	Tohoku Univ.	Yokosuka – Kobe
Satoshi Tsubone	Interlink	Yokosuka – Kobe
Keisuke Matsumoto	MWJ	Yokosuka – Kobe
Satoshi Ozawa	MWJ	Yokosuka – Kobe
Hirokatsu Uno	MWJ	Yokosuka – Kobe
Hiroki Ushiromura	MWJ	Yokosuka – Kobe

JAMSTEC: Japan Agency for Marine-Earth Science and Technology

JAXA: Japan Aerospace Exploration Agency

Tohoku Univ.: Tohoku University

MWJ: Marine Works Japan, Ltd.

5. Experiments

5.1. Development of buoy observation system for tsunami and crustal movement

5.1.1. Personnel

Tatsuya Fukuda	(JAMSTEC): Principal Investigator
Hiroshi Ochi	(JAMSTEC): Engineer
Narumi Takahashi	(JAMSTEC): Researcher
Junichirou Tahara	(JAMSTEC): Engineer
Tomohiko Sugiyama	(JAMSTEC): Engineer
Gousei Hashimoto	(JAXA): Engineer
Osamu Motohashi	(JAXA): Engineer
Yusaku Ohta	(Tohoku Univ.): Researcher
Yukihito Osada	(Tohoku Univ.): Researcher
Fumiaki Tomita	(Tohoku Univ.): Master course student
Satoshi Tsubone	(Interlink): Engineer
Keisuke Matsumoto	(MWJ): Operation Leader
Satoshi Ozawa	(MWJ): Technical Staff
Hirokatsu Uno	(MWJ): Technical Staff
Hiroki Ushiromura	(MWJ): Technical Staff

5.1.2. Objectives

The buoy observation system for tsunami and crustal movement consists of two subsystems which are an ocean bottom unit located at seafloor and a surface buoy mooring. The water pressure data from the ocean bottom unit (OBU) are transmitted using acoustic pulse, and the pulse signal are received at wire-end station which are located at 1000m below water surface. The received data are transferred to the surface buoy using inductive modem or metal cable and the data are transmitted by satellite communication. And there are also another four systems on the surface buoy. They are GNSS antenna and receiver by JAXA, backup GPS receiver by Tohoku University, ETS-8 (KIKU No.8) transmitter by JAXA, GPS/Acoustic surface unit by Tohoku University. These purposes are tsunami monitoring and satellite communication and seafloor crustal deformation precise acoustic ranging.

This is the second test in the sea. The purpose of this cruise is to verify the data communication of buoy observation system for tsunami and crustal movement in the sea and to verify the tsunami detection algorithm is working correctly at OBU. A prototype of tsunami monitoring buoy and an OBU have been successfully deployed during this cruise.

5.1.3. Measured parameters

The prototype buoy for tsunami and crustal movement observes engineering parameters as follows:

Engineering parameters:	water depth at 1.5m and 1000m
	currents at 1.5m
	accelerometer at surface and 1000m
	magnetic compass at 1000m

Details of the instruments used on the prototype buoy are summarized as follows:

(1) Data logger and Satellite transmitter

1) Data logger

Most of equipments are controlled by RS232C.

2) Iridium transmitter

The data in the interval of 60 minutes are being transmitted through Iridium transmitter.

3) ETS-8 transmitter (JAXA)

The data in the interval of 60 minutes are being transmitted through ETS-8 transmitter.

4) GNSS receiver and logger (JAXA)

Using 4 antennas, the attitude and NMEA data are stored itself.

5) Backup GPS receiver and logger (Tohoku Univ.)

Using an antenna, the NMEA data are stored itself.

6) GPS/Acoustic surface unit and transducer (Tohoku Univ.)

Using a transducer, the GPS/Acoustic seafloor geodetic observation data are stored itself.

(2) Engineering Sensor

1) CRN (at 1.5m, Current meter, Nortek AS)

Aquadopp IM400

Sampling interval: 600sec

Sensor frequency: 2MHz

Velocity Range: $\pm 5\text{m/s}$

2) D Sensor (at 1000m, Depth, Sea-bird electronics)

SBE37CTD-IM

Sampling interval: 600sec

Only using D sensor

Table 5.1-1 SBE37 specification

	Range	Accuracy	Resolution
Conductivity (S/m)	0-7	+/-0.0003	+/-0.00001
Temperature (degC)	-5-+35	+/-0.002	+/-0.0001
Pressure	0-7000meter	+/- 0.1%FS	+/- 0.002%FS

3) Accelerometer (MEMS Gyro)#1 (at Surface, xsens)

MTi-G GPS-aided AHRS

Sampling interval: 7days

4) Accelerometer #2 (at 1000m, Sumitomo Seimitsu Kogyo)

AMU-1802BR

Sampling interval: On Demand

Continuous record time 50min

Max number of recording 8times

5) Magnetic Compass (at 1000m, Honeywell)

HMR3400

Sampling interval: 600s

5.1.4. Results

Locations of recovery and deployment are as follow:

(1) Locations of Deployment

① The prototype buoy for tsunami and crustal movement

ARGOS backup PTT number 121999

Deployed date (UTC) 12 Jan. 2014 02:49

Exact location 33 - 32.33N, 137 - 23.24E

Depth 2,972 m

② Ocean Bottom Unit

Deployed date (UTC) 12 Jan. 2014 07:25

Exact location 33 - 32.43N, 137 - 23.41E

Depth 2,973 m

5.1.5. Data archive

The data in the interval of 60 minutes were transmitted via iridium satellite system in real time. These data will be archived at the JAMSTEC Yokosuka Headquarters.

5.1.6. Mooring Configuration

- (1) The prototype buoy for tsunami and crustal movement

Mooring configuration of the prototype buoy is shown in Fig. 5.1-1.

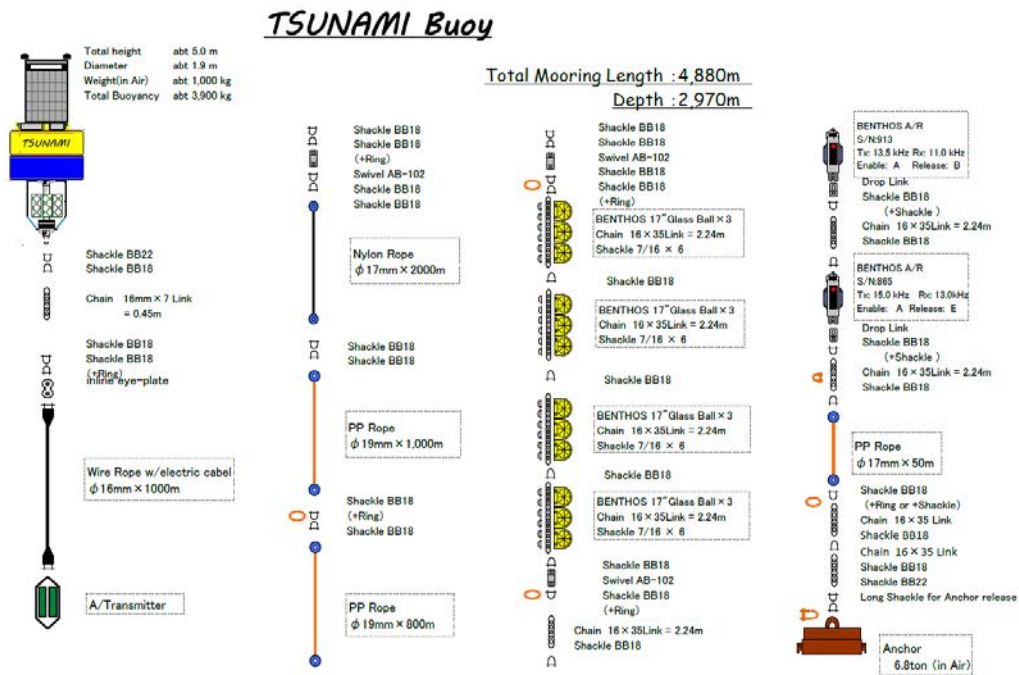


Fig. 5.1-1 Mooring Configuration of the prototype buoy

(2) Ocean Bottom Unit

Mooring configuration of the ocean bottom unit is shown in Fig. 5.1-2.

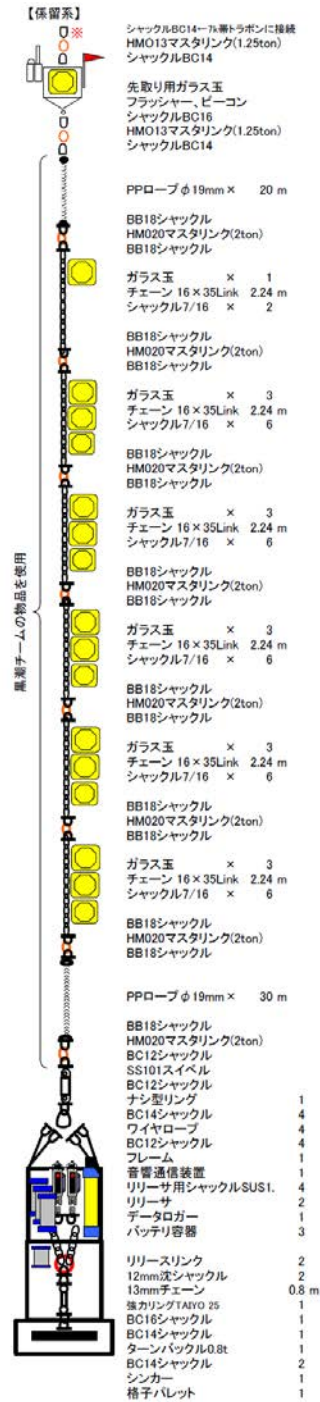


Fig. 5.1-2 Configuration of the ocean bottom unit

5.1.7. Bathymetry observation (MBES)

Bathymetry observation data and the positions of the prototype buoy and the ocean bottom unit and the seafloor transponders are shown in Fig. 5.1-3.

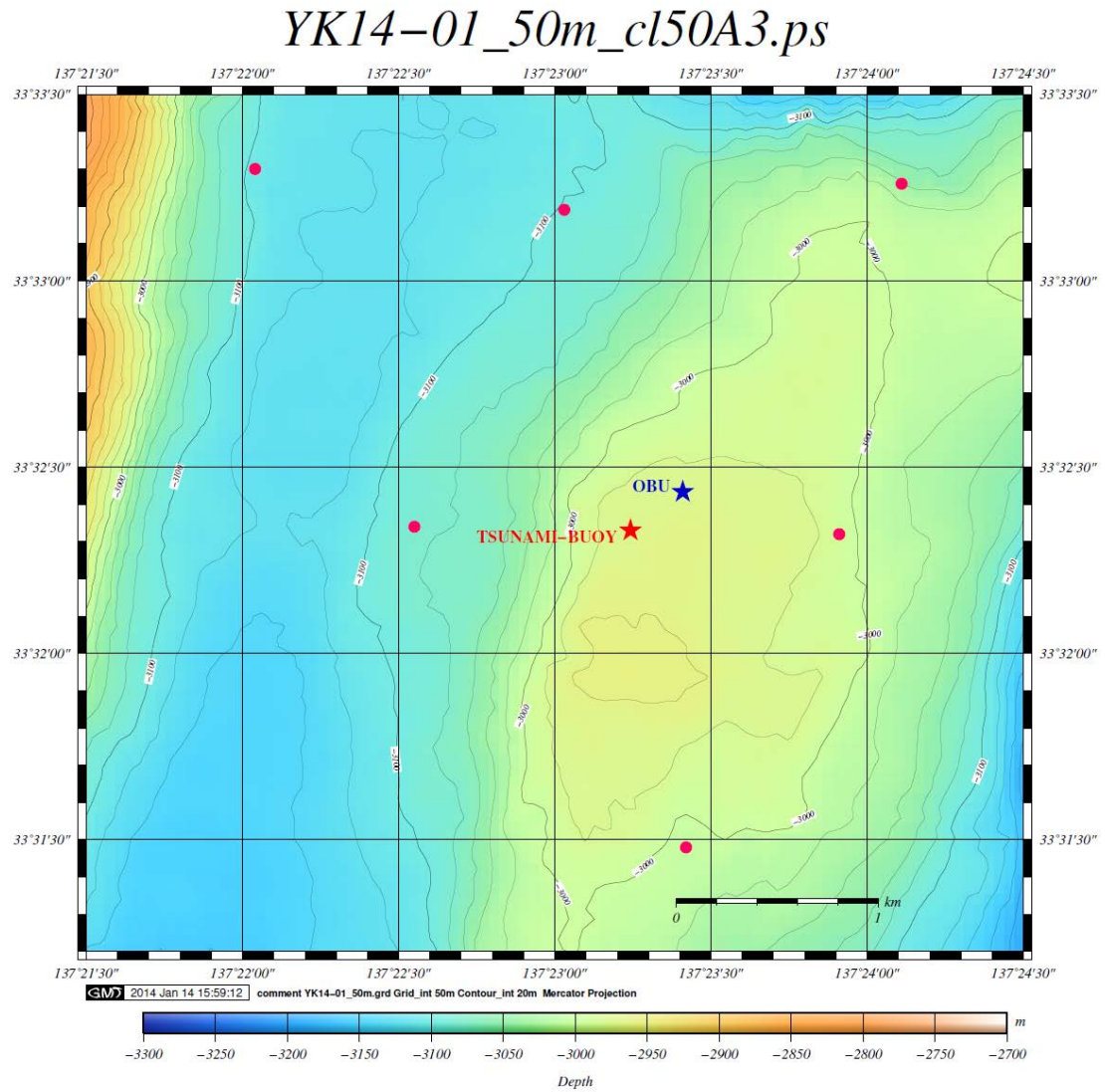


Fig. 5.1-3 Bathymetry data

5.2. Acoustic signal monitor at YOKOSUKA

5.2.1. Personnel

Tatsuya Fukuda	(JAMSTEC) Principal Investigator
Hiroshi Ochi	(JAMSTEC): Engineer
Takami Mori	(JAMSTEC): Engineer
Mitsuyasu Deguchi	(JAMSTEC): Engineer

5.2.2. Objectives

These measurements were conducted to investigate acoustic data communication for our buoy.

5.2.3. Methods

We observed the acoustic signal from OBU along 6 observation lines which the center of lines are OBU deployed position using hydrophone array which is installed on the bottom of vessel for acoustic navigation system.

5.2.4. Preliminary results

We observed the acoustic signal from OBU along 6 observation lines which the center of lines are OBU deployed position using vessel acoustic receiver which installed on the bottom of vessel.

The acoustic signal monitor lines are below and are shown in Fig. 5.2-1 - Fig. 5.2-8.

- Line #1-1,#1-2 Straight North-South 33-35.43N, 137-23.41E ~ 33-29.43N, 137-23.41E
- Line #2-1,#2-2 Straight East-West 33-32.43N, 137-26.41E ~ 33-32.43N, 137-20.41E
- Line #3-1 Circle Radius 3.9km Center: 33-32.43N, 137-23.41E
- Line #4-1 Circle Radius 3.0km Center: 33-32.43N, 137-23.41E
- Line #5-1 Circle Radius 5.2km Center: 33-32.43N, 137-23.41E
- Line #6-1 Straight NorthEast-SouthWest 33-30.45N, 137-21.09 E ~ 33-34.41 N,137-25.80E

5.2.5. Data archives

These data will be archived at the JAMSTEC Yokosuka Headquarters.

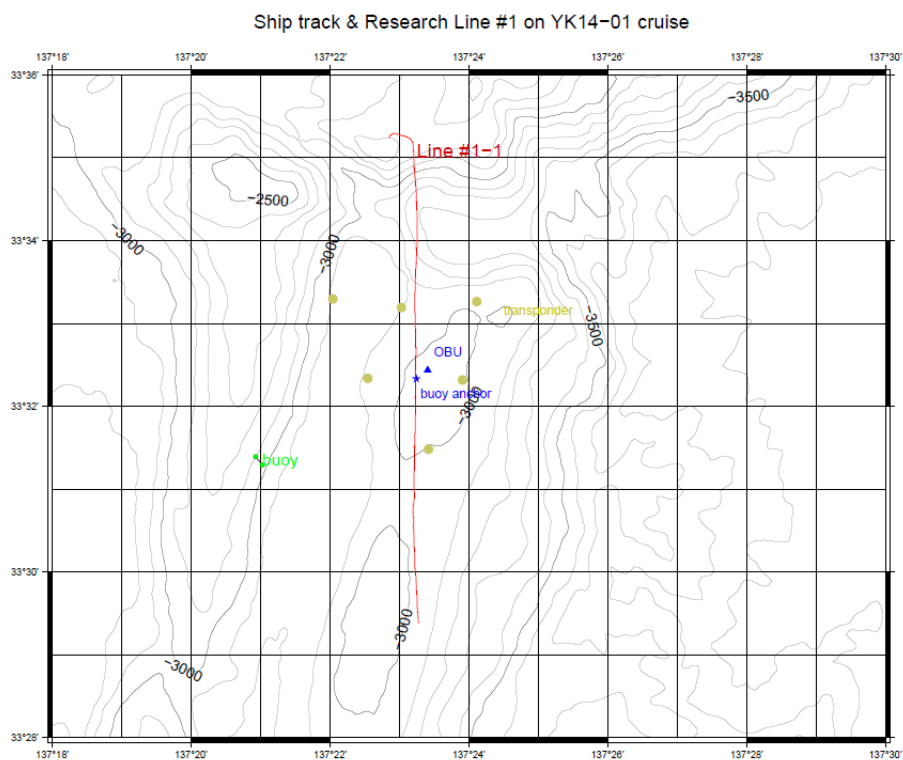


Fig. 5.2-1 Observation #1 (Line #1-1)

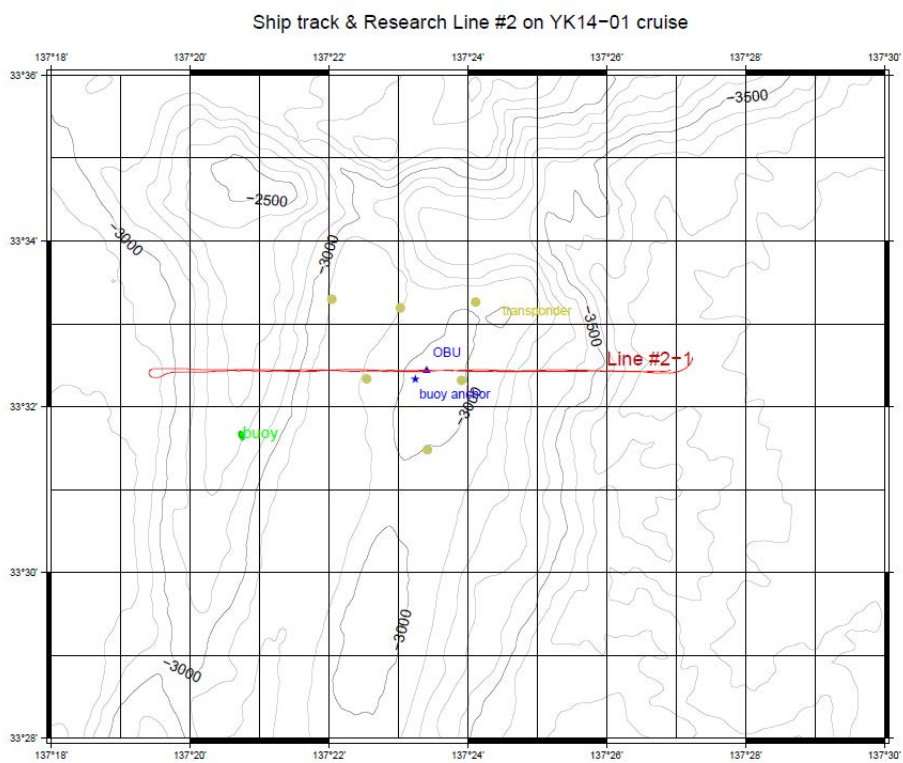


Fig. 5.2-2 Observation #2 (Line #2-1)

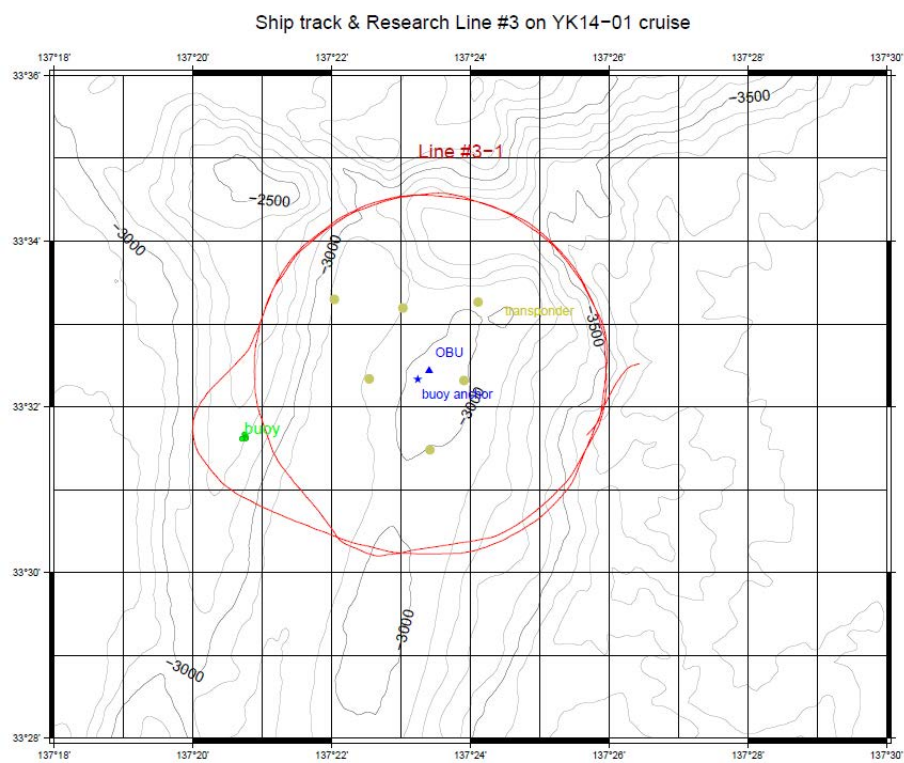


Fig. 5.2-3 Observation #3 (Line #3-1)

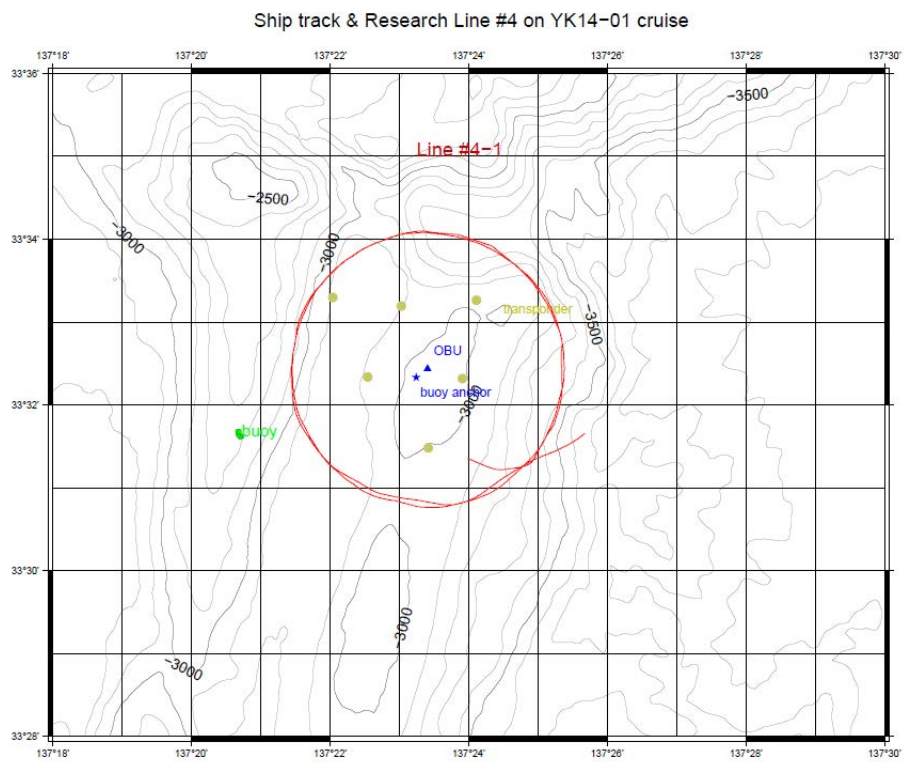


Fig. 5.2-4 Observation #4 (Line #4-1)

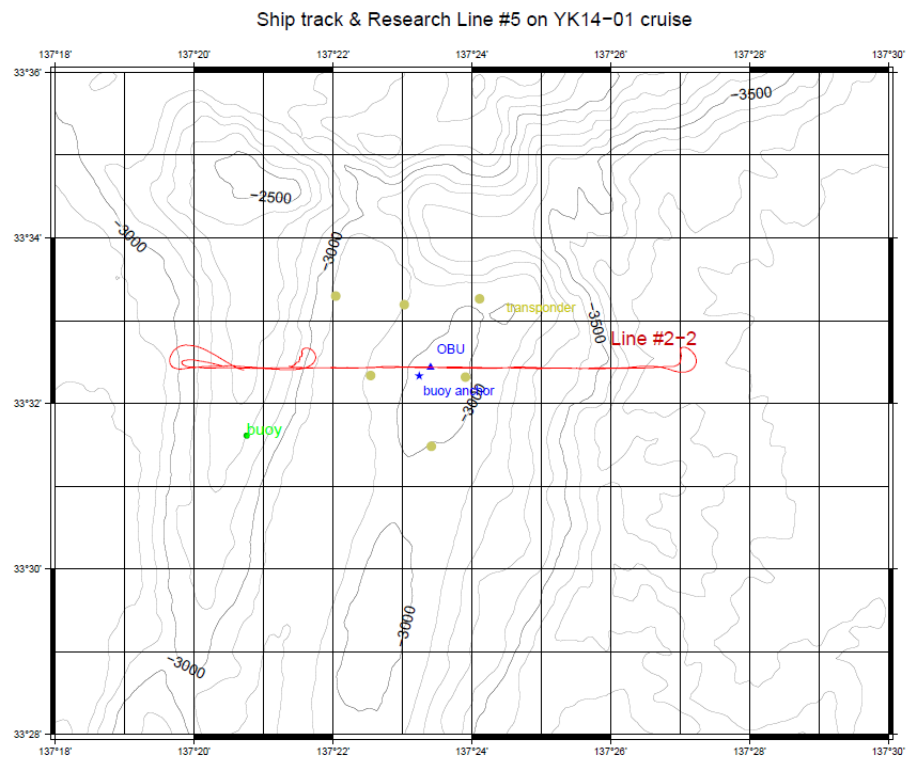


Fig. 5.2-5 Observation #5 (Line #2-2)

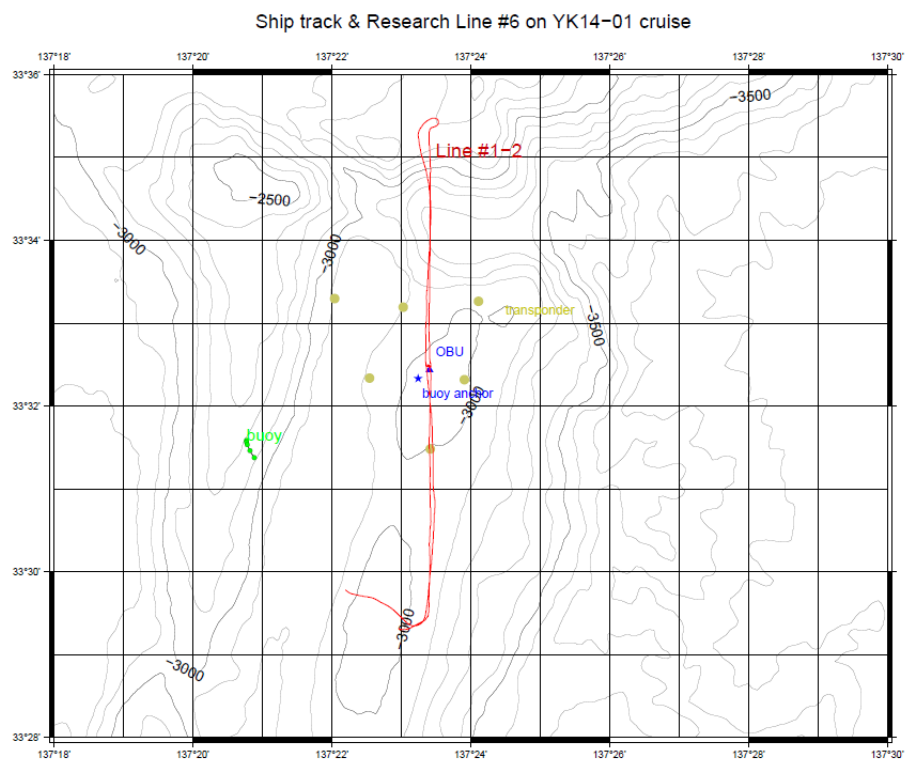


Fig. 5.2-6 Observation #6 (Line #1-2)

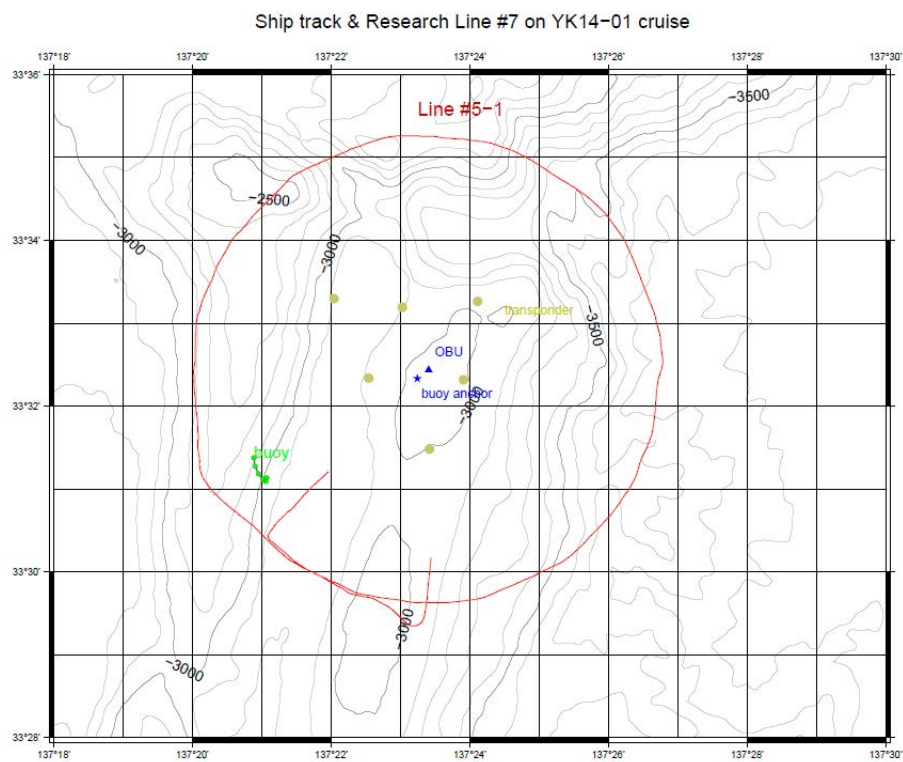


Fig. 5.2-7 Observation #7 (Line #5-1)

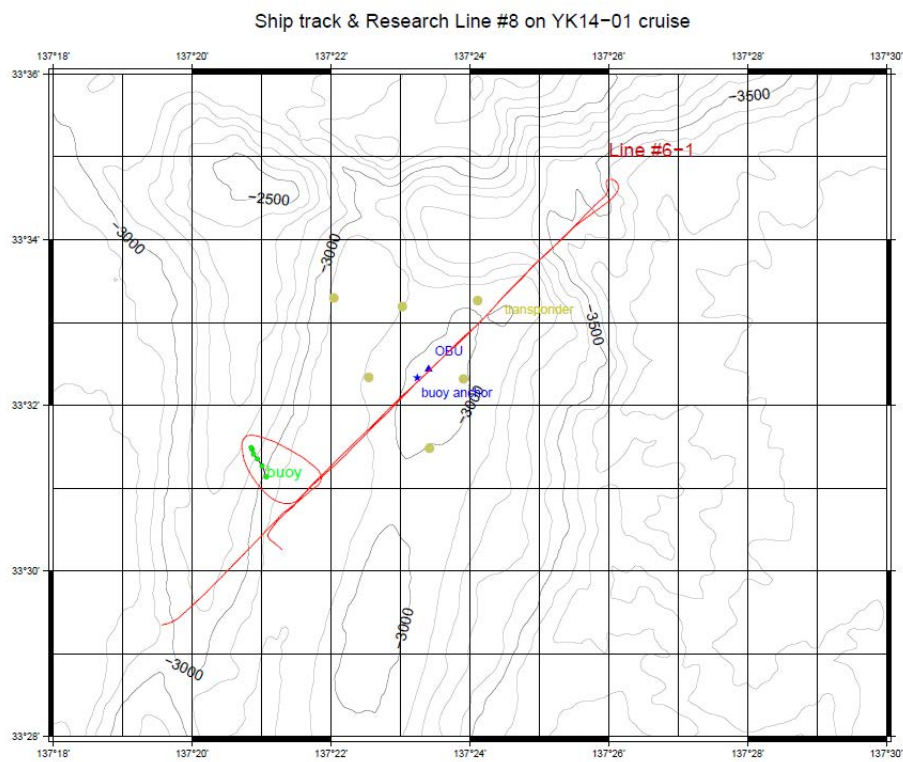


Fig. 5.2-8 Observation #8 (Line #6-1)