doi : 10.17596/0002821

R/V Kaiyo Cruise Report

KY15-02

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

Jan.22.2015 - Jan.26.2015
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Table of contents

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

KY15-02

1.2. Ship

R/V Kaiyo (Captain: Takamichi Inoue)

1.3. Title of cruise

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

1.4. Representative of the Science Party [Affiliation]

Tatsuya Fukuda [JAMSTEC Marine Technology and Engineering Center]

1.5. Title of Proposal

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

1.6. Period

Jan. 22, 2015 – Jan. 26, 2015

1.7. Research area

Sagami Bay

2. Introduction and experiments summary

2.1. Introduction

Regarding 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 consists of two subsystem which are an ocean bottom unit (OBU) located at seafloor and a surface buoy mooring.

We carried out the mooring test twice in 2013 and 2014. We found some problems over all system. One of the most important is the acoustic communication portion. We revised frame of the OBU because we suspect the reason of this problem is reflection by the frame of OBU. The error rate of acoustic communication will decrease using new frame. We measure the acoustic signal level using vessel acoustic receiver to verify the characteristics of new frame. And also we observed the acoustic waveform using wire-end station (WES) to check the raw waveform at real receiver.

The main mission of this cruise is to measure the signal level characteristics of new OBU frame and to record the propagated acoustic signal for analyzing performance of signal detection at WES.

2.2. Experiments summary

Ocean Bottom Unit deployment:	1 mooring
Ocean Bottom Unit recovery:	1 mooring
XBT:	5 cast
Acoustic signal monitor with the Wire-end Station on KAIYO	4 times
Acoustic signal monitor on KAIYO	15 times

We successfully deployed and recovered an ocean bottom unit at Sagami Bay 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. 22, 2015 – Jan. 26, 2015

3.2. Ports of call

Yokosuka, Japan (Departure: Jan. 22, 2015)

Yokosuka, Japan (Arrival: Jan. 26, 2015)

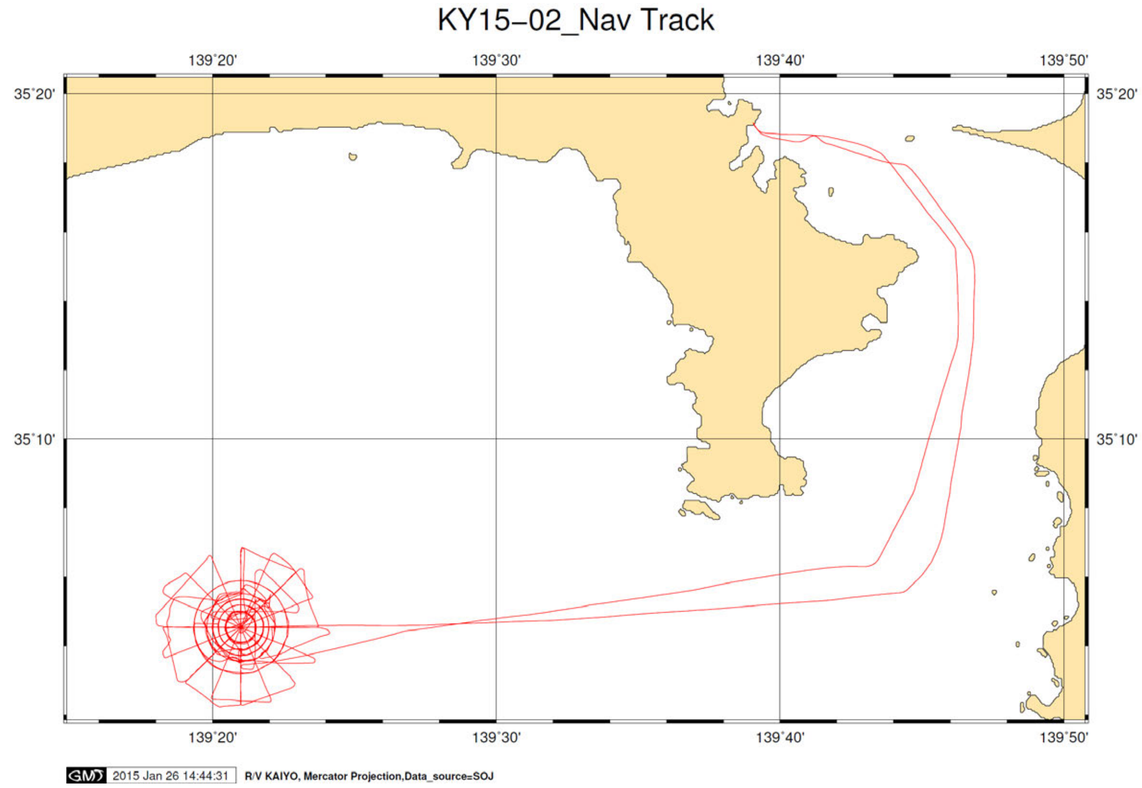
3.3. Cruise log

SMT	UTC	Event
Jan. 22, (Thu.) 2015		
09:00	00:00	Departure from Yokosuka, Japan
10:30	01:30	Safety Lecture
11:00	02:00	Meeting for this cruise
12:10	03:10	Arrive at Sagami Bay
12:10	03:10	XBT-1 (35-03.4838N 139-21.4013E)
12:30-13:20	03:30-04:20	MBES
14:30-14:50	05:30-05:50	Deployment of Ocean Bottom Unit
		(Target position: 35-04.30N 139-21.00E Depth: 1,443m)
15:47-16:58	06:47-07:58	Acoustic signal monitor with Wire-end Station
17:29-18:25	08:29-09:25	Position calibration of Ocean Bottom Unit
		(position: 35-04.5480N 139-20.9959E Depth: 1,443m)
18:25-20:47	09:25-11:47	Acoustic signal monitor #1 (line #1:r=800m)
20:54-06:23	11:54-21:23	Acoustic signal monitor #2 (line #2:r=1500m)
Jan. 23, (Fri.) 2015		
06:30	21:30	XBT-2 (35-04.3274N 139-20.0628E)
07:00	22:00	Deploy Wire-end Station (downward)
07:40	22:40	acoustic signal monitor with Wire-end Station (point #1-1)
08:47	23:47	acoustic signal monitor with Wire-end Station (point #2)
09:41	00:41	acoustic signal monitor with Wire-end Station (point #3)
10:35	01:35	acoustic signal monitor with Wire-end Station (point #4)
11:32	02:32	acoustic signal monitor with Wire-end Station (point #5)
12:33	03:33	acoustic signal monitor with Wire-end Station (point #6)
13:37	04:37	acoustic signal monitor with Wire-end Station (point #7)
14:30	05:30	acoustic signal monitor with Wire-end Station (point #8)
15:38	06:38	acoustic signal monitor with Wire-end Station (point #1-2)

16:04	07:04	Recover Wire-end Station
16:25	07:25	On-deck a transponder of Wire-end Station
18:03-22:16	09:03-13:16	Acoustic signal monitor #3 (line #3:r=2500m)
22:32-06:15	13:32-21:15	Acoustic signal monitor #4 (line #4:r=1200m)
Jan. 24, (Sat.) 2015		
06:30	21:30	XBT-3 (35-03.5829N 139-21.0279E)
07:00	22:00	Deploy Wire-end Station (upward)
07:39	22:39	acoustic signal monitor with Wire-end Station (point #1)
08:47	23:47	acoustic signal monitor with Wire-end Station (point #2)
09:41	00:41	acoustic signal monitor with Wire-end Station (point #3)
10:24	01:24	acoustic signal monitor with Wire-end Station (point #4)
11:33	02:33	acoustic signal monitor with Wire-end Station (point #5)
12:38	03:38	acoustic signal monitor with Wire-end Station (point #6)
13:43	04:43	acoustic signal monitor with Wire-end Station (point #7)
14:35	05:35	acoustic signal monitor with Wire-end Station (point #8)
15:18	06:18	Recover Wire-end Station
15:37	06:37	On-deck a transponder of Wire-end Station
17:01-19:05	08:01-10:05	Acoustic signal monitor #5 (line #5:E->W)
19:43-21:43	10:43-12:43	Acoustic signal monitor #6 (line #6:SW->NE)
22:20-00:24	13:20-15:24	Acoustic signal monitor #7 (line #7:N->S)
Jan. 25, (Sun.) 2015		
00:52-03:00	15:52-18:00	Acoustic signal monitor #8 (line #8:SE->NW)
03:22-05:29	18:22-20:29	Acoustic signal monitor #9 (line #9:WNW->ESE)
05:57-06:30	20:57-21:30	ADCP measurement
06:30	21:30	XBT-4 (35-04.6341N 139-19.7082E)
07:09	22:09	Deploy Wire-end Station (tilted)
08:10-16:00	23:10-07:00	acoustic signal monitor with Wire-end Station (circle #1)
16:04	07:04	Recover Wire-end Station
16:35	07:35	On-deck a transponder of Wire-end Station
16:48-18:54	07:48-09:54	Acoustic signal monitor #10 (line #10:WSW->ENE)
19:31-21:37	10:31-12:37	Acoustic signal monitor #11 (line #11:NNE->SSW)
22:09-00:14	13:09-15:14	Acoustic signal monitor #12 (line #12:SSE->NNW)
Jan. 26, (Mon.) 2015		
01:02-03:09	16:02-18:09	Acoustic signal monitor #13 (line #13:W->E)
03:41-05:45	18:41-20:45	Acoustic signal monitor #14 (line #14:NE->SW)
06:23-08:23	21:23-23:23	Acoustic signal monitor #15 (line #15:S->N)

07:23	22:23	XBT-5 (35-04.5600N 139-20.9952E)
09:06-10:09	00:06-01:09	Recovery of prototype Ocean Bottom Unit
		(position: 35-04.55N 139-21.00E Depth: 1443m)
10:30	01:30	Departure from Sagami Bay
14:30	05:30	Arrive at Yokosuka, Japan

3.4. 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

4.2.2. Underwater Acoustic Engineer

Hiroshi Ochi

Takami Mori

Mitsuyasu Deguchi

4.2.3. Earthquake and tsunami Study

Narumi Takahashi (not on board)

4.2.4. GPS/Acoustic Study

Motoyuki Kido (not on board)

Yusaku Ohta (not on board)

Misae Imano (not on board)

Yuichiro Hirata (not on board)

4.2.5. GNSS System Study

Katsuhiko Mutoh (not on board)

Osamu Motohashi (not on board)

4.2.6. ETS-8 Communication Engineer

Gousei Hashimoto

Yasuyoshi Hisamoto

Masahiro Aota

4.3. R/V Kaiyo Scientist and technical stuff

Tatsuya Fukuda	JAMSTEC	Yokosuka - Yokosuka
Hiroshi Ochi	JAMSTEC	Yokosuka - Yokosuka
Junichirou Tahara	JAMSTEC	Yokosuka - Yokosuka
Takami Mori	JAMSTEC	Yokosuka - Yokosuka
Mitsuyasu Deguchi	JAMSTEC	Yokosuka - Yokosuka
Gousei Hashimoto	JAXA	Yokosuka - Yokosuka
Yasuyoshi Hisamoto	JAXA	Yokosuka - Yokosuka
Masahiro Aota	FWL.	Yokosuka - Yokosuka
Keisuke Matsumoto	MWJ	Yokosuka - Yokosuka
Hirokatsu Uno	MWJ	Yokosuka - Yokosuka
Hiroki Ushiromura	MWJ	Yokosuka - Yokosuka

JAMSTEC: Japan Agency for Marine-Earth Science and Technology

JAXA: Japan Aerospace Exploration Agency

FWL: Fujitsu Wireless Systems, Ltd.

MWJ: Marine Works Japan, Ltd.

5. Experiments

5.1. Acoustic Signal Monitor for buoy observation system for tsunami and crustal movement

5.1.1. Personnel

Tatsuya Fukuda	(JAMSTEC): Principal Investigator
Hiroshi Ochi	(JAMSTEC): Engineer
Junichirou Tahara	(JAMSTEC): Engineer
Takami Mori	(JAMSTEC): Engineer
Mitsuyasu Deguchi	(JAMSTEC): Engineer
Gousei Hashimoto	(JAXA): Engineer
Yasuyoshi Hisamoto	(JAXA): Engineer
Masahiro Aota	(FWL): Engineer
Keisuke Matsumoto	(MWJ): Operation Leader
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 are transmitted using acoustic pulse, and the pulse signal are received at wire-end station which are located at 1000m below from the water surface. The received acoustic pulse data are transferred to the surface buoy through the inductive modem or conducting wire and the data are transmitted by Iridium satellite communication system. And there are also another three systems on the surface buoy. First one is a GNSS system which is supplied by JAXA, ETS-8 (KIKU No.8) satellite communication system which is also supplied by JAXA, GPS/Acoustic surface unit which is supplied by Tohoku University. These purposes are tsunami monitoring and satellite communication and seafloor crustal deformation precise acoustic ranging.

During previous mooring test, we have some problems about acoustic pulse communication between WES and OBU. We revised the OBU frame to improve directional specification. In this cruise, we verify the improvement of OBU acoustic specification and the previous problems occur again or not. And we tests specification for the ETS-8 transmitter.

The purpose of this cruise is to deploy and recover the ocean bottom unit and monitor the acoustic signal from OBU. We have tested acoustic signal monitor at Sagami-Bay. We changed the plan because weather was bad. And an ocean bottom unit have been successfully deployed and recovered during this cruise.

5.1.3. Measured parameters

The ocean bottom unit observes engineering parameters as follows:

Engineering parameters: water depth
accelerometer

The wire-end station observes engineering parameters as follows:

Engineering parameters: water depth, temperature
accelerometer

5.1.4. Methods

For observing the acoustic signal from ocean bottom unit (OBU), we used hydrophone array of acoustic navigation system which is installed on the bottom of the ship. By moving ship position, various data were recorded on the ship.

Acoustic signal monitor was also carried out using the wire rope and the wire-end station. To investigate received signal at the WES, the acoustic communication equipment at the WES can record received raw signal. We carried out three kind of test. There were the acoustic communication equipment was located downward, upward and tilted. The tilted angle was similar to mooring test at 2013. We measured at 8 point around OBU.

5.1.5. Mooring Configuration

(1) The Wire-end Station

Mooring configuration of the wire-end station is shown in Fig. 5.1-1 and Fig. 5.1-2.

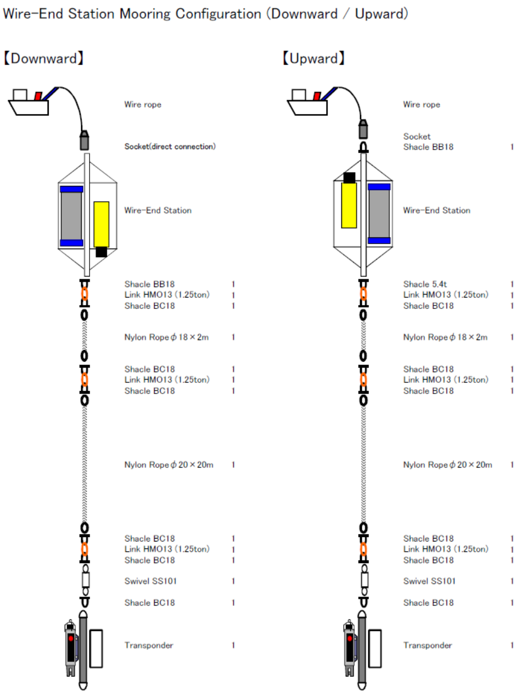


Fig. 5.1-1 Mooring Configuration of the Wire-End Station (Downward / Upward)

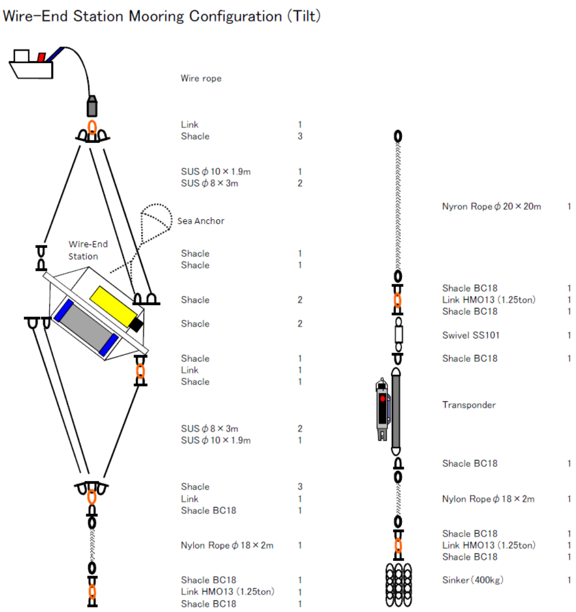


Fig. 5.1-2 Mooring Configuration of the Wire-End Station (Tilt)

(2) Ocean Bottom Unit

Mooring configuration of the ocean bottom unit is shown in Fig. 5.1-3.

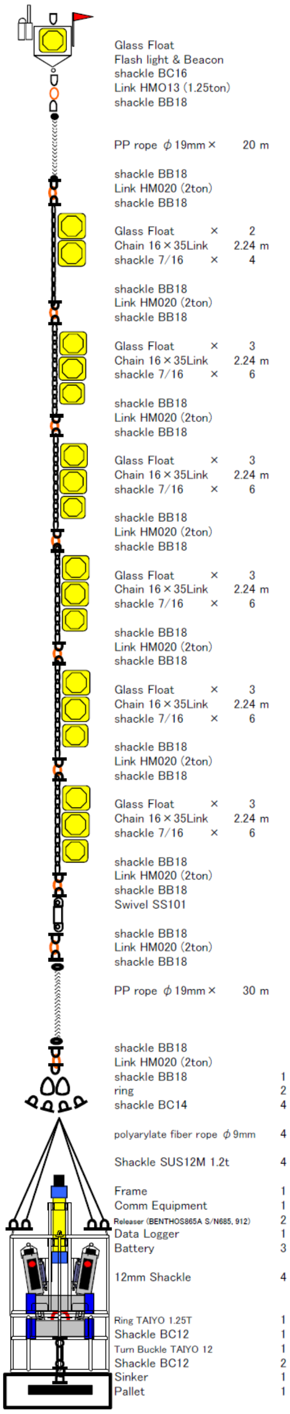


Fig. 5.1-3 Configuration of the ocean bottom unit

5.1.6. Preliminary Results

Locations of deployment and recovery are as follow:

(1) Locations of Deployment

1) The prototype Ocean Bottom Unit

Deployed date (UTC)	22 Jan. 2015 06:35
Recovered date (UTC)	26 Jan. 2015 01:09
Exact location	35 - 04.55N, 139 - 21.00E
Depth	1,443 m

(2) Research line

The acoustic signal from OBU were measured along with circle lines (Line #1 - #4) and straight lines (Line #5 - #15). The WES test were carried out at points (Point #1 - #8) and circle line (Line #16). Those are shown in Fig. 5.1-4 - Fig. 5.1-21.

[Using vessel acoustic receiver]

- Line #1 Circle Radius 0.80km Center: 35-04.55N, 139-21.00E
- Line #2 Circle Radius 1.50km Center: 35-04.55N, 139-21.00E
- Line #3 Circle Radius 2.50km Center: 35-04.55N, 139-21.00E
- Line #4 Circle Radius 1.20km Center: 35-04.55N, 139-21.00E
- Line #5 Straight E->W 8.0km Center: 35-04.55N, 139-21.00E
- Line #6 Straight SW->NE 8.0km Center: 35-04.55N, 139-21.00E
- Line #7 Straight N->S 8.0km Center: 35-04.55N, 139-21.00E
- Line #8 Straight SE->NW 8.0km Center: 35-04.55N, 139-21.00E
- Line #9 Straight WNW->ESE 8.0km Center: 35-04.55N, 139-21.00E
- Line #10 Straight WSW->ENE 8.0km Center: 35-04.55N, 139-21.00E
- Line #11 Straight NNE->SSW 8.0km Center: 35-04.55N, 139-21.00E
- Line #12 Straight SSE->NNW 8.0km Center: 35-04.55N, 139-21.00E
- Line #13 Straight W->E 8.0km Center: 35-04.55N, 139-21.00E
- Line #14 Straight NE->SW 8.0km Center: 35-04.55N, 139-21.00E
- Line #15 Straight S->N 8.0km Center: 35-04.55N, 139-21.00E

[Using WES: downward and upward]

- point #1 South from OBU distance:1.80km Center: 35-04.55N, 139-21.00E
- point #2 South-West from OBU distance:1.80km Center: 35-04.55N, 139-21.00E
- point #3 West from OBU distance:1.80km Center: 35-04.55N, 139-21.00E
- point #4 North-West from OBU distance:1.80km Center: 35-04.55N, 139-21.00E
- point #5 North from OBU distance:1.80km Center: 35-04.55N, 139-21.00E
- point #6 North-East from OBU distance:1.80km Center: 35-04.55N, 139-21.00E

・point #7 East from OBU distance:1.80km Center: 35-04.55N, 139-21.00E

・point #8 South-East from OBU distance:1.80km Center: 35-04.55N, 139-21.00E

[Using WES: tilted about 50 degrees by drag]

・Line #16 Circle Radius 1.80km Center: 35-04.55N, 139-21.00E

5.1.7. Data archive

These data will be archived at the JAMSTEC Yokosuka Headquarters.

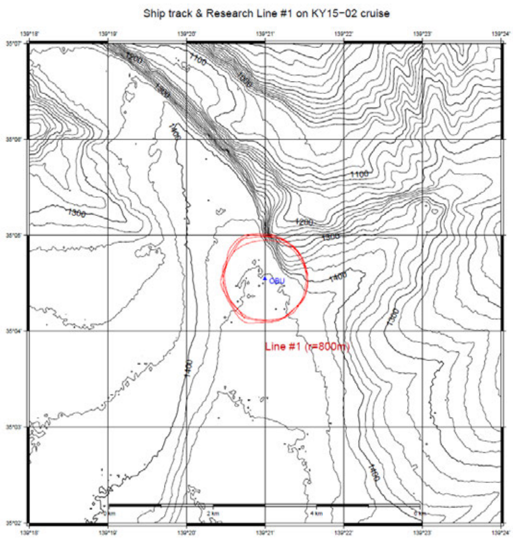


Fig. 5.1-4 Obervation #1 (Line #1)

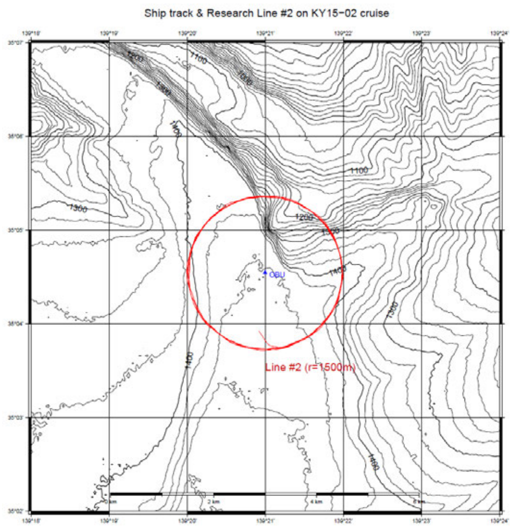


Fig. 5.1-5 Obervation #2 (Line #2)

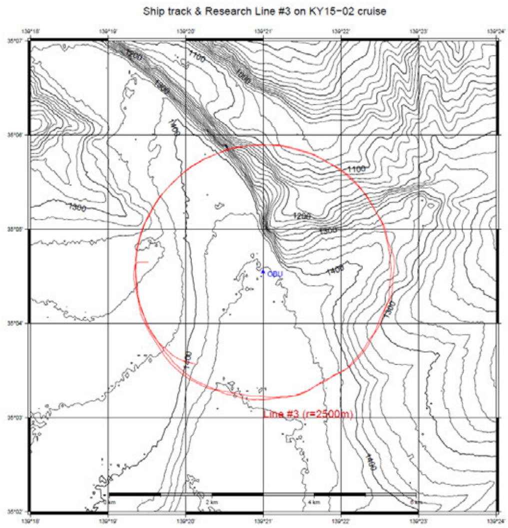


Fig. 5.1-6 Observation #3 (Line #3)

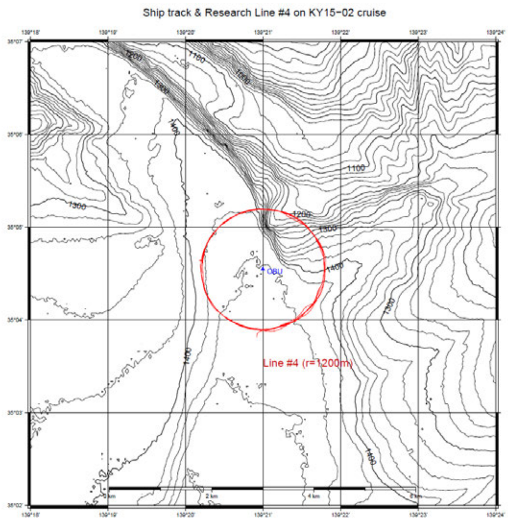


Fig. 5.1-7 Observation #4 (Line #4)

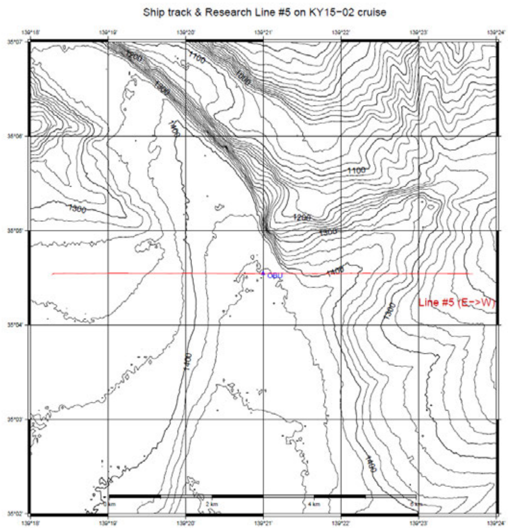


Fig. 5.1-8 Observation #5 (Line #5)

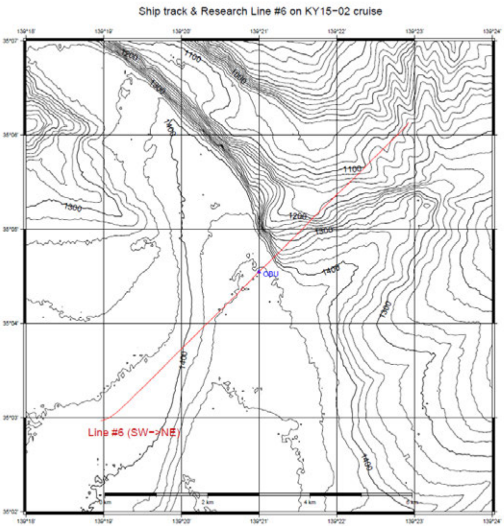


Fig. 5.1-9 Observation #6 (Line #6)

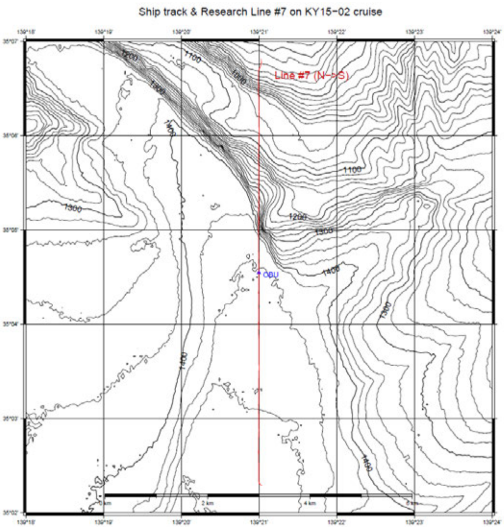


Fig. 5.1-10 Observation #7 (Line #7)

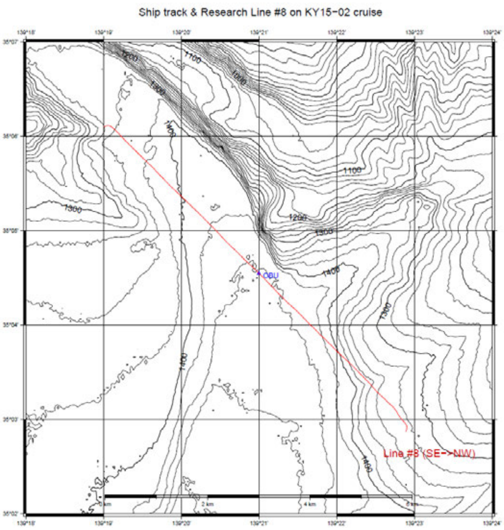


Fig. 5.1-11 Observation #8 (Line #8)

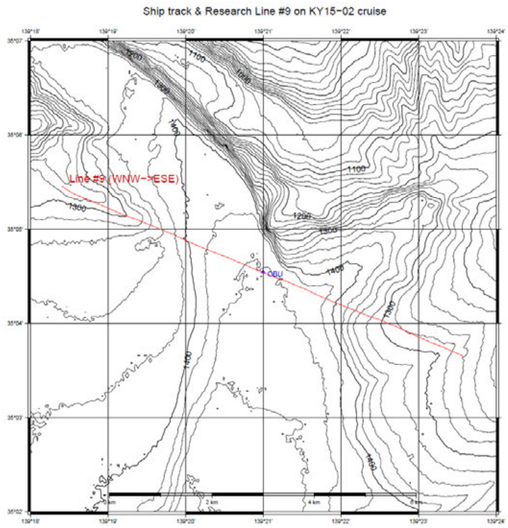


Fig. 5.1-12 Observation #9 (Line #9)

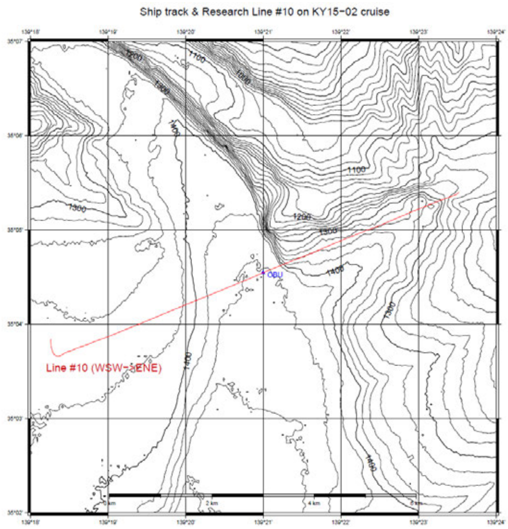


Fig. 5.1-13 Observation #10 (Line #10)

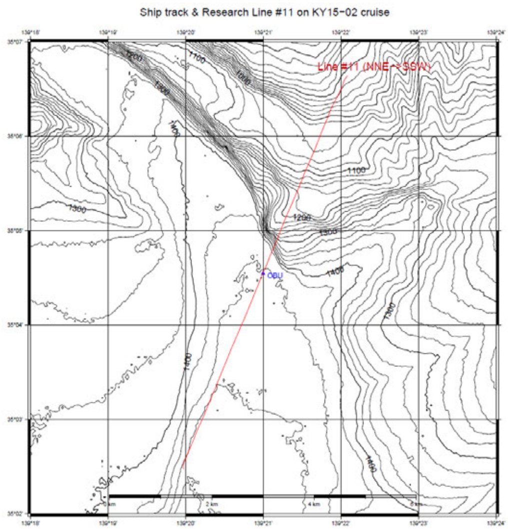


Fig. 5.1-14 Observation #11 (Line #11)

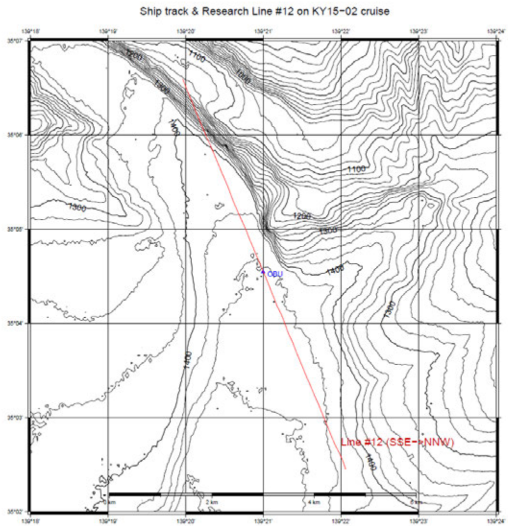


Fig. 5.1-15 Observation #12 (Line #12)

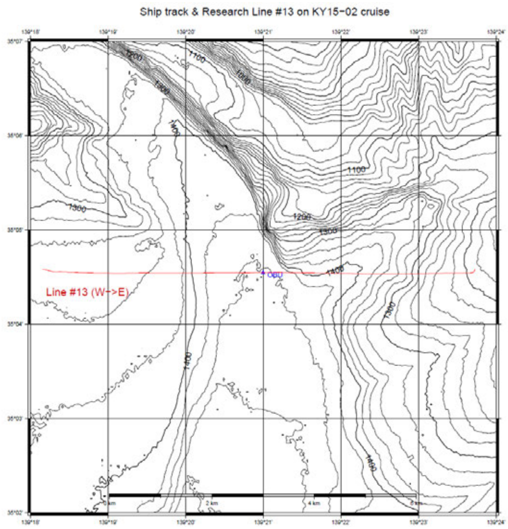


Fig. 5.1-16 Observation #13 (Line #13)

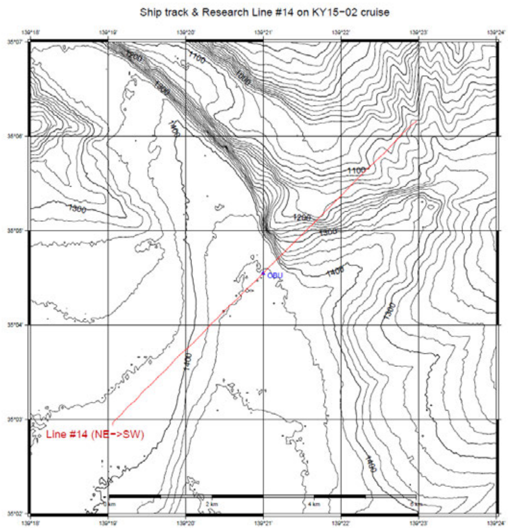


Fig. 5.1-17 Observation #14 (Line #14)

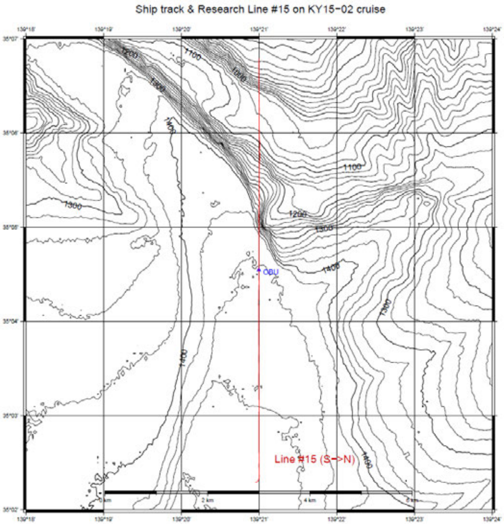


Fig. 5.1-18 Observation #15 (Line #15)

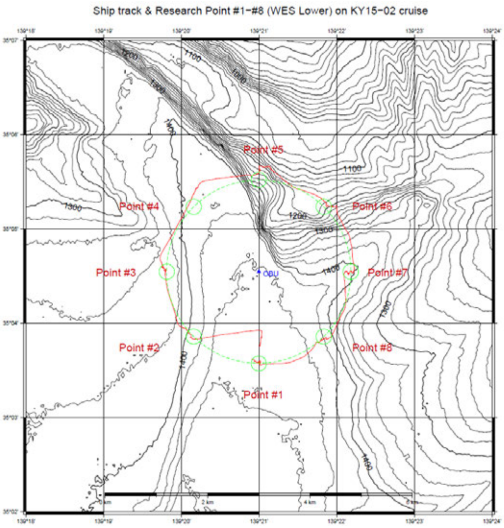


Fig. 5.1-19 Observation #16 (Point #1-#8: WES Downward)

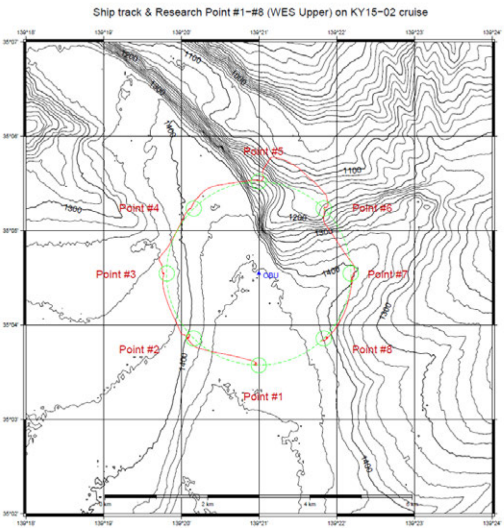


Fig. 5.1-20 Observation #17 (Point #1-#8: WES Upward)

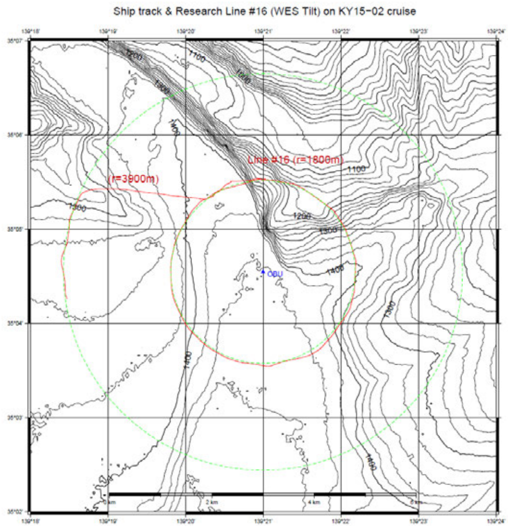


Fig. 5.1-21 Observation #18 (Line #16: WES Tilt)

5.2. ETS-8 satellite communication test

5.2.1. Personnel

Gousei Hashimoto	(JAXA): Engineer
Yasuyoshi Hisamoto	(JAXA): Engineer
Masahiro Aota	(FWL): Engineer

5.2.2. Objectives

There are a few failures on the ETS-8 transmitter during a mooring period. To improve satellite communication by ETS-8 transmitter, we need to measure signal level characteristics on the mooring location.

5.2.3. Measured parameters

The ETS-8 transmitter unit observes engineering parameters as follows:

Engineering parameters: frequency characteristics for received signal

5.2.4. Methods

Using a spectrum analyzer, the signal level was measured. And the ETS-8 transmitter send data to land station at Tsukuba.

5.2.5. Preliminary Results

The data were sent from ETS-8 transmitter on compass deck during cruise.

5.2.6. Data archive

These data will be archived at the JAXA.