doi : 10.17596/0003035

KR12-10 Cruise Report

Intensive seismic study around the deformed zone in the eastern margin of the Japan Sea & the Japan Trench

Apr. 2, 2012 – May. 13, 2012

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

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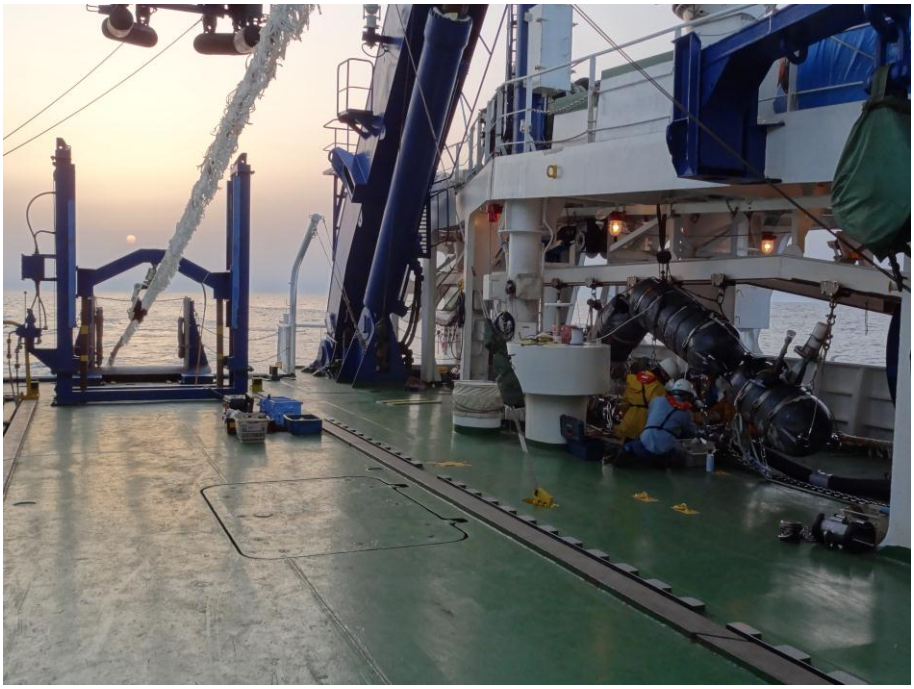

1. Cruise Information:

(1) **Cruise ID, Ship name:** KR12-10, R/V Kairei

(2) **Title of the cruise:** 2012FY "Intensive seismic study around the deformed zone in the eastern margin of the Japan Sea"

(3) **Title of proposal:** Intensive seismic study around the deformed zone in the eastern margin of the Japan Sea

(4) **Cruise period, Port call:** 2012/4/2-5/13, Yokosuka port (JAMSTEC) to Yokosuka port (JAMSTEC)

(5) **Research Area:** The eastern margin of the Japan Sea and the Japan Trench

(6) **Research Map:** Fig. 1

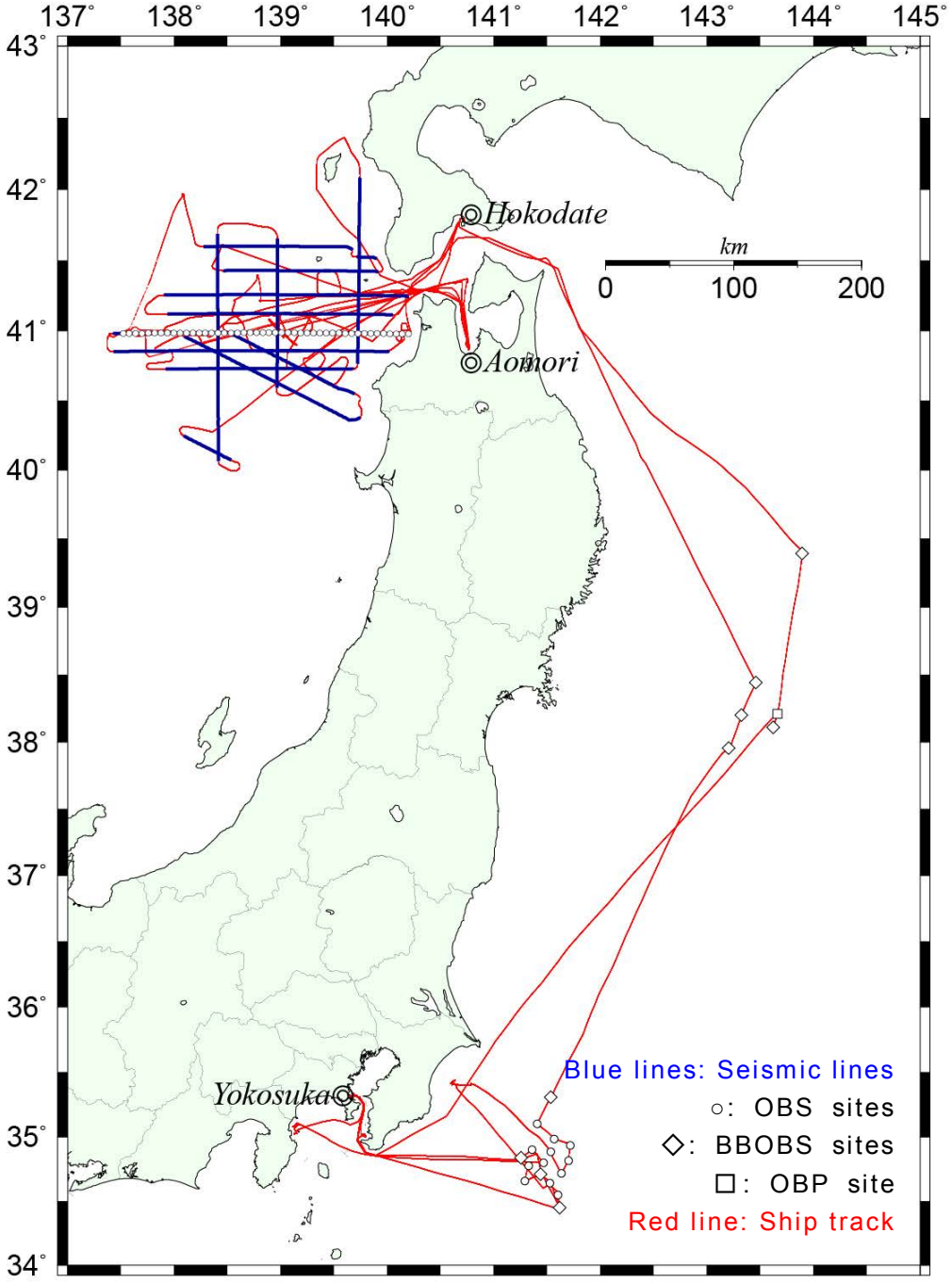

Fig. 1 Ship track during KR12-10 cruise.

2. Researchers:

(1) Chief Scientist [Affiliation]:

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(2) Representative of Science Party [Affiliation]:

Yoshiyuki KANEDA [JAMSTEC]

(3) Science party list:

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Takeshi SATO [JAMSTEC]
Tetsuo NO [JAMSTEC]
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Aki ITO [JAMSTEC]
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Hiroko SUGIOKA [JAMSTEC]: Scientist
Aki ITO [JAMSTEC]: Scientist
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Masayuki TOIZUMI [NME]: Technician (Seismic observer)
Masato SUGANO [NME]: Technician (Chief OBS technician)
Atsushi ISOGAI [NME]: Technician (Seismic source technician)
Yuta WATARAI [NME]: Technician (Seismic observer and navigator)
Ryo MIURA [NME]: Technician (Seismic data processor)
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Toshinori SAIJO [NME]: Technician (OBS technician)
Kimiko SERIZAWA [NME]: Technician (Seismic navigator)
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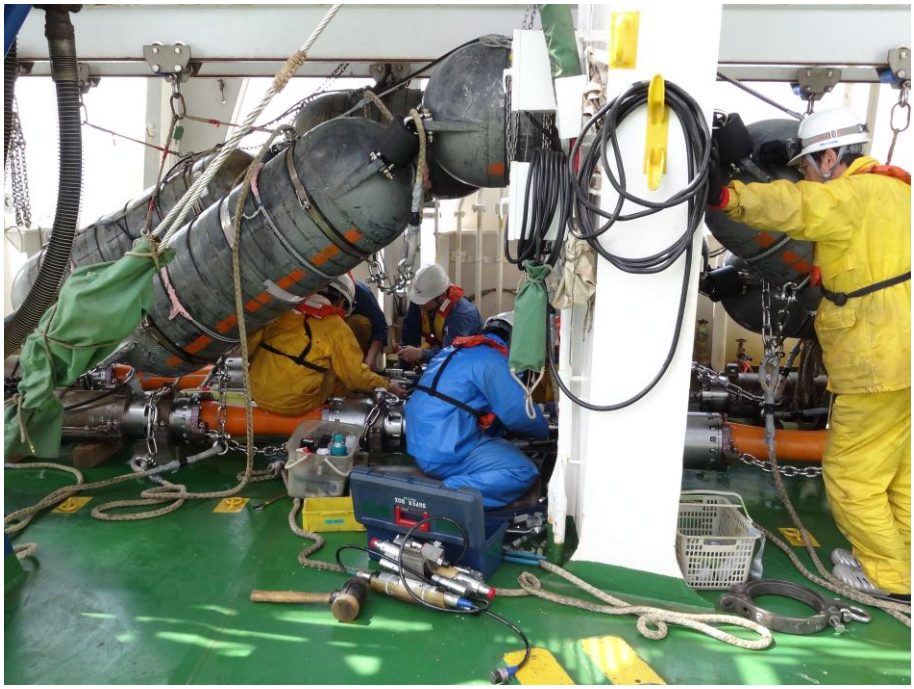
3. Overview of Observations:

(1) Objectives:

Large earthquakes have frequently occurred on the eastern margins of the Japan Sea (e.g., the 1964 Niigata earthquake (M_{JMA} 7.5), 1983 Nihonkai–Chubu earthquake (M_{JMA} 7.7), 1993 Hokkaido–Nansei–Oki earthquake (M_{JMA} 7.8)), and these earthquakes have caused very strong vibrations, large tsunamis, and serious damage across the coastline of the Japan Sea. However, this area has not been identified as a priority area for investigation. Therefore, we have collaborated with other Japanese research institutions in "Priority Investigations of Strain Concentration Areas" (using part of the Special Coordination Funds for Promoting Science and Technology), and have been performing seismic surveys from the R/V KAIREI at the eastern margins of the Japan Sea since 2008.

In April - May 2012, we conducted a marine seismic exploration survey around areas off Nishi-Tsugaru and Southwest Hokkaido which are two lines of strain concentration in the survey area (Okamura et al., 1995). Moreover, the survey area is located in the northern hypocentral region of the 1983 Nihonkai–Chubu earthquake. The northern part of survey area is the Matsumae plateau and the Okushiri basin which located in seismic gap (Ohtake, 2002). The western part is the Japan Basin and the eastern part is the Nishi-tsugaru basin and the continual shelf. We can understand these crustal structures from the seismic exploration data of this survey; besides, we carry out seismotectonic and growth structure studies off the shore of Aomori and Hokkaido.

On the way to the Japan Sea and Yokosuka, we were carried out BBOBS (Broadband Ocean Bottom Seismometer) recover, OBS (Ocean Bottom Seismometer) deployment, and OBP (Ocean Bottom Pressure gauge) deployment off Boso and off Miyagi. The aims of these observations are the studies of earthquakes and tsunami which are occurred in the offshore area from Sanriku to Boso.



(2) List of observation instruments:

1) Multichannel seismic reflection survey (MCS)

We conducted a MCS survey around the areas off Nishi-Tsugaru and Southwest Hokkaido in the eastern margins of the Japan Sea using the R/V KAIREI (Fig. 2). MCS data were acquired along 13 lines (EMJS1201, EMJS1202, EMJS1203, EMJS1204, EMJS1205, EMJS1206, EMJS1207, EMJS1208, EMJS1209, EMJS12A, EMJS12B, EMJS12C, and EMJS1105-2) with a total length of approximately 1,965 km. Survey lines were crooked to avoid the many fishing operations and equipment in the survey area.

Fig. 2 MCS system on R/V KAIREI.

a) Source:

To obtain good quality MCS data, we shot an airgun array at a spacing of 50 m. This corresponds to a spacing of 20–30 s, depending on the vessel speed (average 3.5–5 knots). The tuned airgun array has a maximum total capacity of 7,800 cubic inches (about 130 liters), and consists of 32 Bolt Annular Port airguns. The standard air pressure was 2,000 psi (about 14 MPa). The airgun array was maintained at a depth of 10 m below the sea surface throughout the experiment. Fig. 3 shows four strings of sub-arrays deployed at the port and starboard sides of the vessel. Their width was expanded to 30.0 m by a paravane system, and the central position of the array was set 170 m behind that of the ship's antenna.

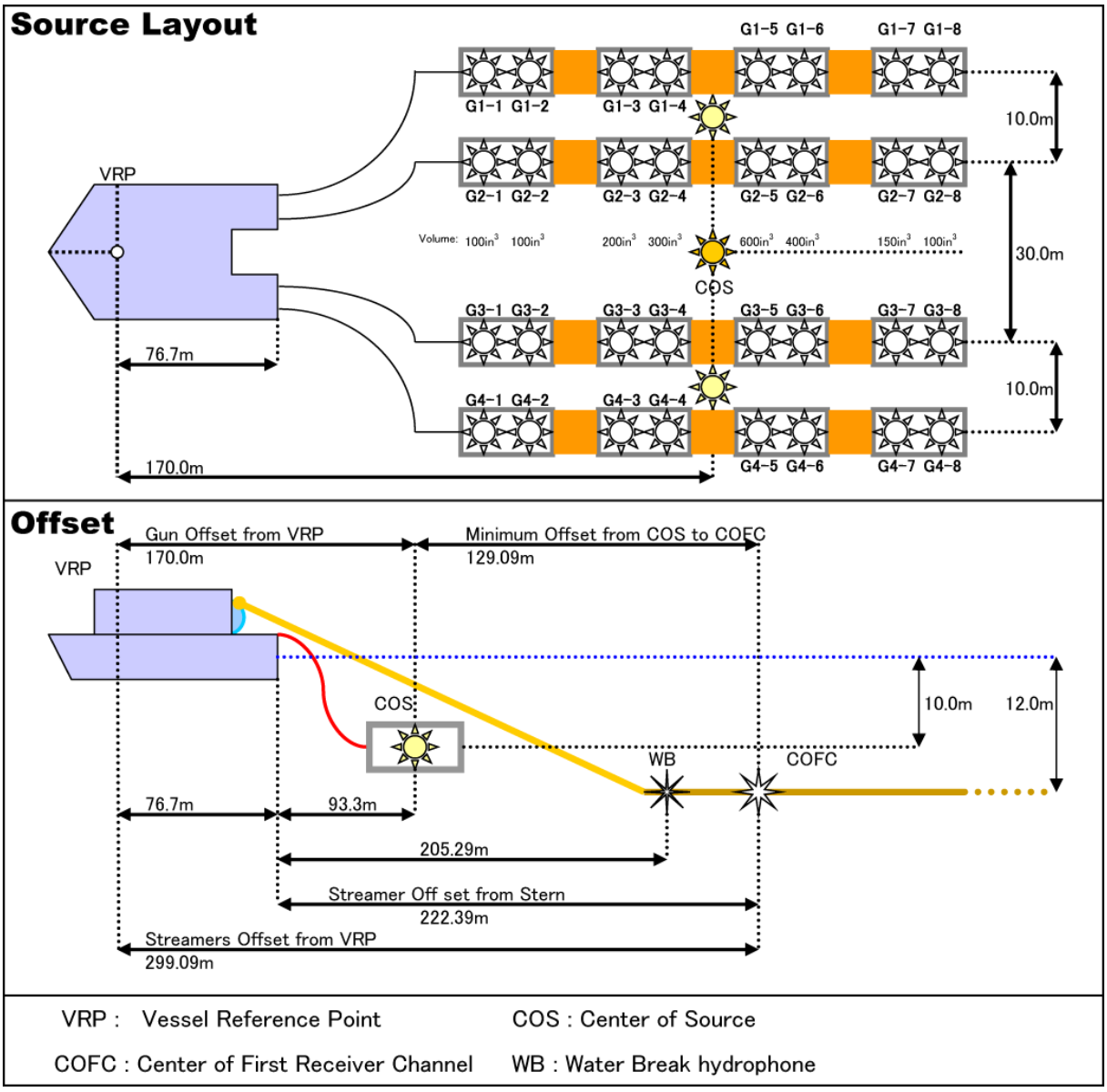


Fig. 3 Vessel towing geometry during the MCS survey. Top figure shows the source (airgun system) layout, bottom figure represents source–receiver depth and position, and navigation offsets.

b) Receiver:

During the airgun shooting, we towed a 444-channel hydrophone streamer cable (Sentinel Digital Streamer System, Sercel Inc.) (see Fig. 4). Hydrophone sensors (Benthos Reduced Diameter Array hydrophone) with a sensitivity of 19.7 V/Bar were used. The signals from eight sensors in the same group (channel) were stacked before A/D conversion. The interval of each group is 12.5 m. The length of the cable was about 6 km. The towing depth of the streamer cable was maintained at 12 m below the sea surface by the depth controller called Bird (I/O DigiCOURSE streamer depth controllers).

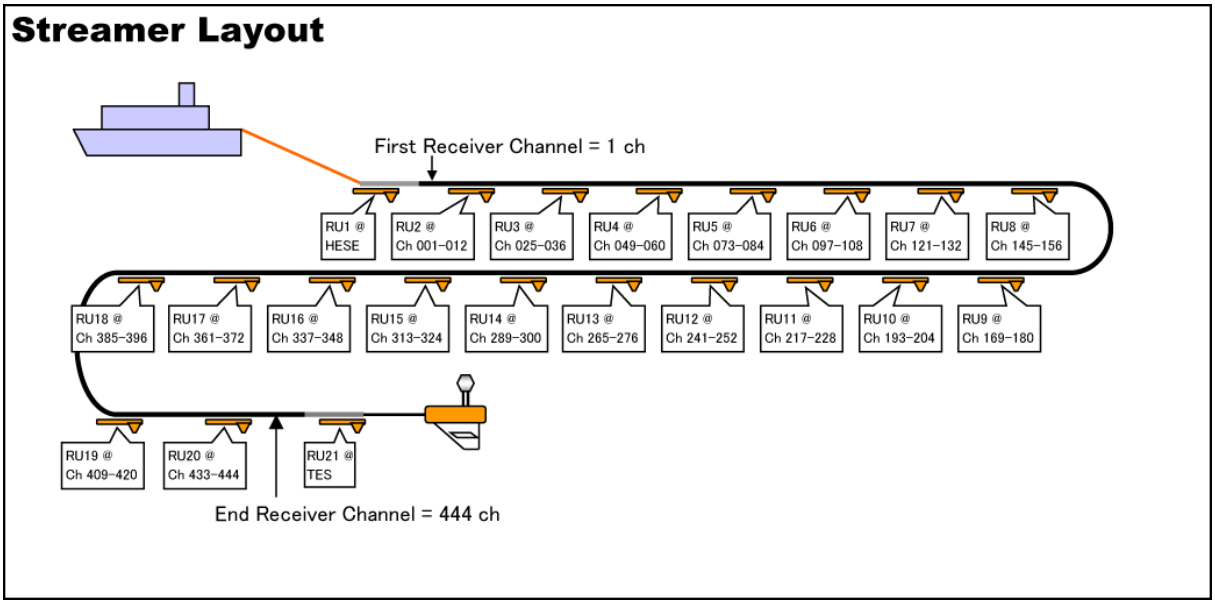


Fig. 4 Streamer cable configuration during the MCS survey.

c) Recording and navigation systems

A Sercel Seal System Ver.5.2 recording system, made by Sercel Inc., was used in the survey; this collected seismic data on 3590E tapes in the SEG-D 8058 Rev.1 format. The system delay was set to 200 ms, the sampling rate was 2 ms, and the recording length was 16 s.

The Differential Global Positioning System (DGPS) was used for positioning. We adopted NAVCOM's StarFire as the main positioning system, and used Fugro's SkyFix as the backup. The accuracy was reported to be about 0.4 m in StarFire and 5 m in SkyFix. We used SPECTRA 2D (Concept Systems Ltd.) as our navigation software for the seismic data acquisition. Positioning data collected from both StarFire and SkyFix were sent to the Power Real Time Navigation Unit (PowerRTNU) (Concept Systems Ltd.) via a terminal server connected to a LAN in the vessel. Shot times and shot points (SPs) were set on SPECTRA, and then a trigger signal was sent to the recording system and the gun controller (ION DigiSHOT Ver.3.1). The main navigation parameters were as follows: survey datum was WGS84; map projection was UTM; UTM zone parameter was 54N.

d) Onboard processing of MCS data:

Raw MCS reflection data were processed on board for the purpose of quality control in the study areas. Onboard data processing was conducted by preserving relative amplitudes under the conventional processing scheme, which includes trace header edit, trace edit, common midpoint (CMP) binning with an interval of 6.25 m, a bandpass filter (3–250 Hz), datum correction, amplitude compensation, predictive deconvolution, velocity analysis, normal moveout correction, a radon filter for multiple suppression, mute, CMP stack, F-K migration, and a bandpass filter (Figs. 5 and 6).

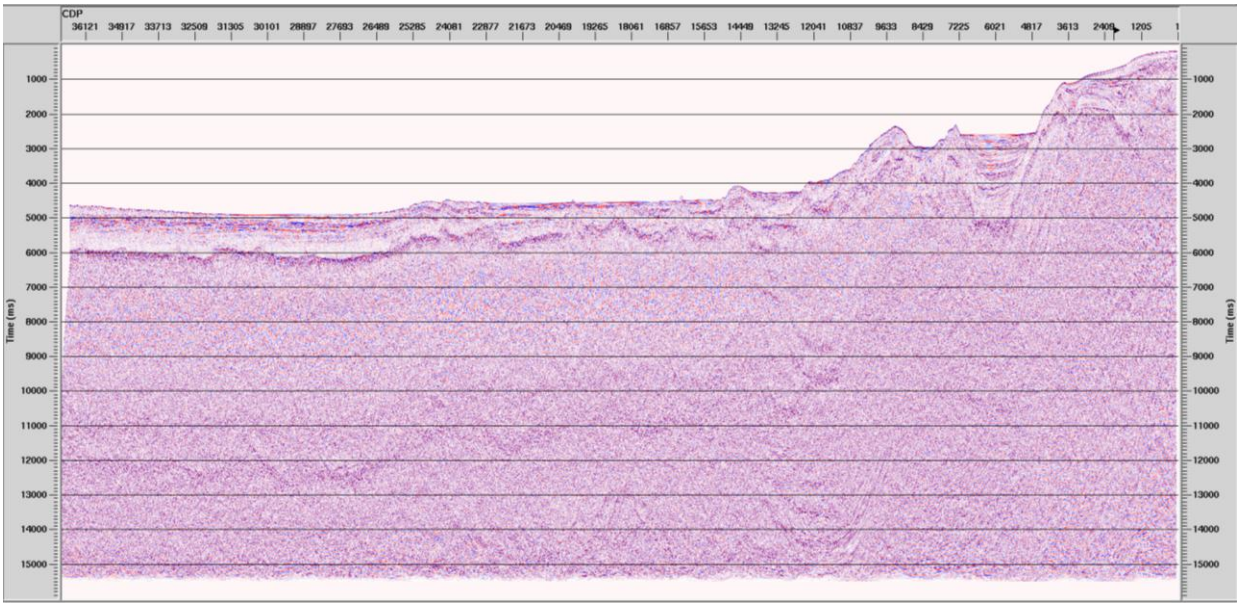


Fig. 5 Example of MCS profile with onboard processing (EMJS1205).

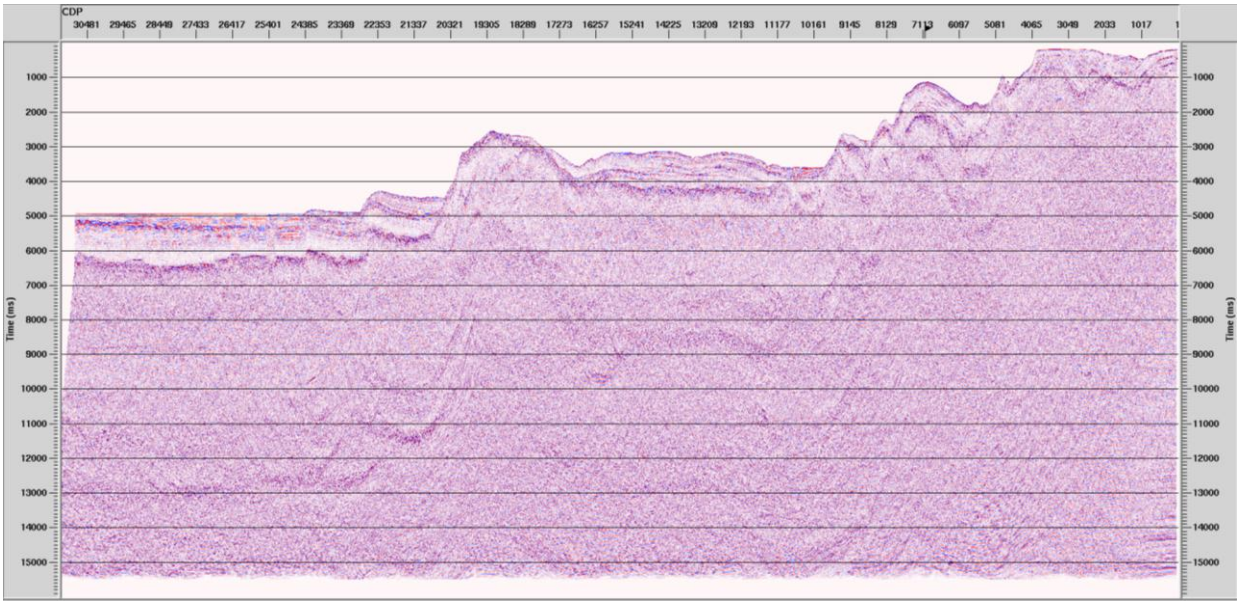


Fig. 6 Example of MCS profile with onboard processing (EMJS1207).

2) Refraction survey using OBSs

We deployed 46 OBSs at the EMJS1205, and performed a refraction survey using an airgun array with a spacing of 200 m. The airgun array in the OBS survey used the almost same configuration as in the MCS survey, though their width was expanded to 45.0 m by a paravane system, and the central position of the array was set 218.5 m behind that of the ship's antenna (Fig. 7). The interval of the OBS deployment was about 5 km. An OBS is deployed by freefall and retrieved by melting releaser composed of stainless steel plates connecting the OBS with a weight when a transponder system receives acoustic signal sent from a vessel. This acoustic communication between the OBS and the vessel was performed using transducers installed on the vessel. The position of OBSs on the seabed was estimated by a SSBL (Super short base line acoustic system) of the vessel's positioning system during the cruise. We edited the continuous OBS data to a length of 70 s and the SEG-Y format. At the same time, calibration of the OBS clock for GPS time was carried out using difference times between the OBS clock and GPS time, which were measured just before OBS deployment and just after OBS retrieval. Fig. 8 shows examples of two OBS record sections (OBS10 and 30).

Type	TOBS-24N, TOKYO SOKUSHIN CO., LTD.
Maximum Depth	6700 m
Sensor	Three-component Geophone & Hydrophone [One vertical and two horizontal components, Natural frequency: 4.5Hz, Sensitivity:0.41V/cm/s (OPEN)]
Recording System	Sampling continuously (Timer control is possible for start time) . Pre Amplifier Gain(40/40/40/20 dB)
Recording Media	Hard disk
Sampling Rate	24 bit, 200Hz
Power	Lithium battery
Acoustic Communication & Release System	Electric corrosion method
Attached Parts	Weight, Flush light, Radio beacon
Pressure Resistant Container	17 inch glass sphere

Table 1 OBS specifications of refraction survey.

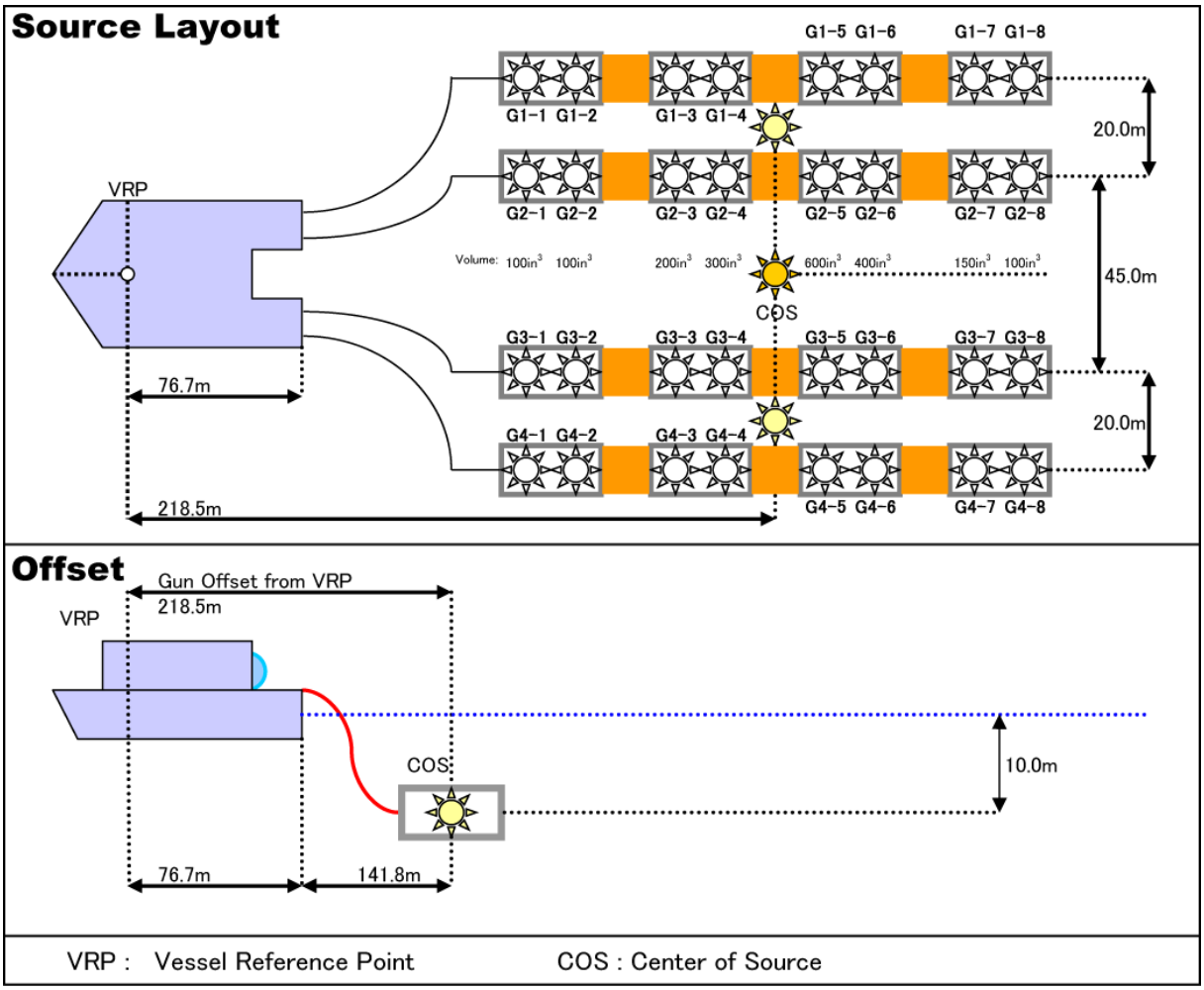
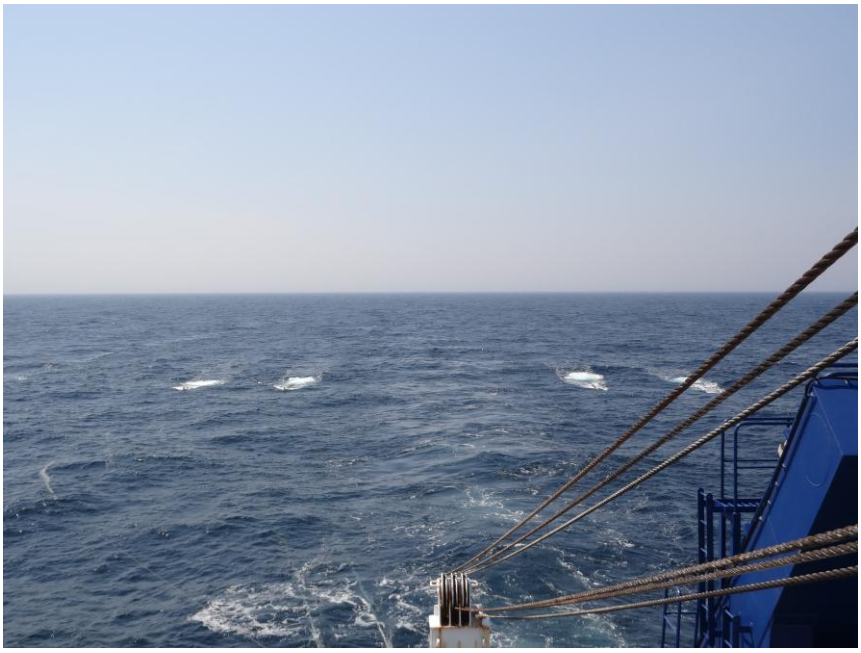
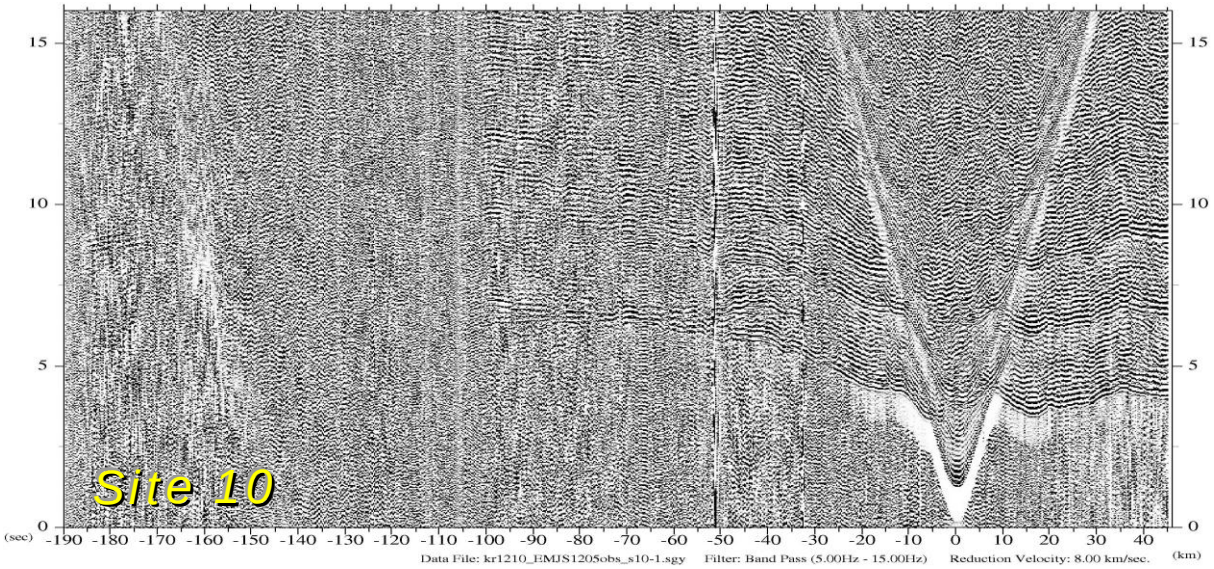
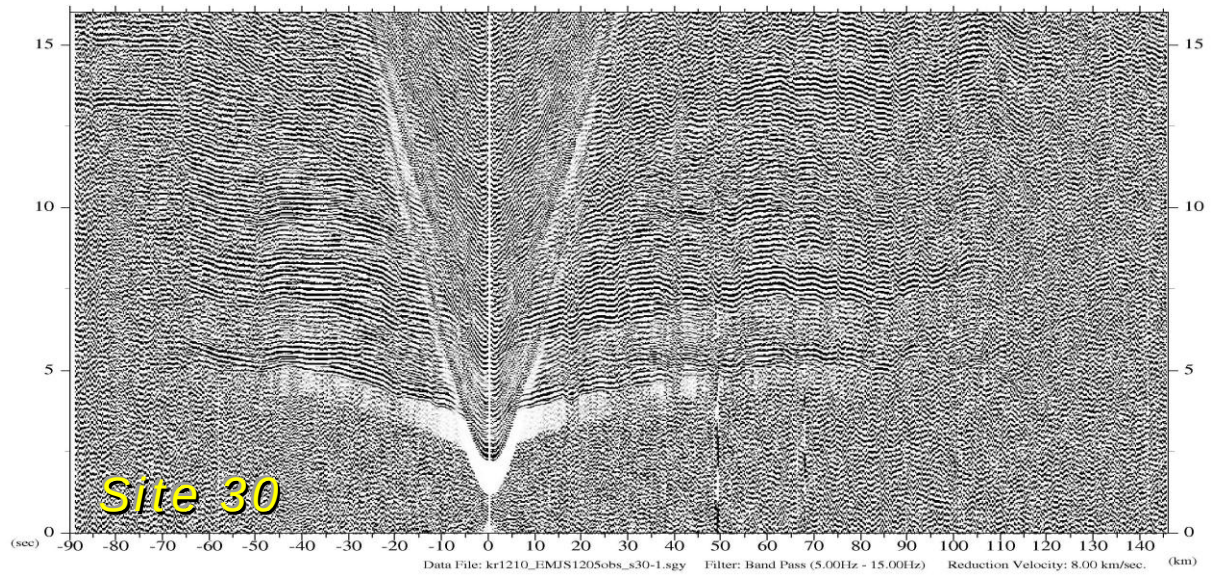


Fig. 7　Vessel towing geometry during the refraction survey. Top figure shows the source (airgun system) layout, bottom figure represents source depth and position, and navigation offsets.







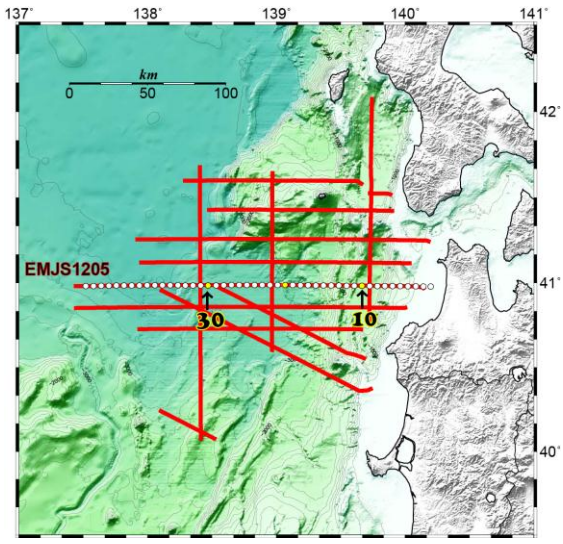


Fig. 8　Examples of OBS record sections (OBS10 and 30).

3) BBOBS recover and OBS deployment off Boso and off Miyagi

We deployed 12 OBSs and calibrated the location of BBOBSs deployed in MR12-E01 off Boso area. 12 OBSs were launched by rear small crane. We communicated with sinking OBS using the acoustic transponder down to about 300-500 m below the sea surface. Each OBS can record seismic signal for about one year. We calibrated the location of BBOBS stations at site BB1, BB3, BB5 and BB6 by measuring slant range between R/V Kairei and the settled BBOBS at three points around the launching position. About off Miyagi area, we successfully recovered five BBOBSs deployed in NT11-E02 and deployed one OBP. In recovery operation, we communicated with BBOBSs using the acoustic transponder to shut down running recording equipment and sent out command to release. After BBOBSs were floating on the sea surface, they were taken from the sea over starboard side. OBP was launched by rear small crane.

a) BBOBS

The Broadband Ocean Bottom Seismometer (BBOBS) has been developed at the Earthquake Research Institute (ERI) of the University of Tokyo since 1999 based on the Ocean Bottom Seismometer (OBS) with a geophone. A broadband sensor (CMG-3T for OBS, Guralp, UK) is installed on an active leveling unit developed at the ERI. The data is digitized by a 24 bit ADC with 200 Hz, and recorded on 2.5 inch HDDs with the total capacity of 80 GB. These and about 70 Li cells (DD size) are fixed inside of a titanium sphere housing (D = 65 cm). The BBOBS is deployed by a free fall from the sea surface and pop up by its buoyancy in the recovery. The anchor is released by a forced electrolytic corrosion of two thin titanium plates after receiving a command of an acoustic transponder from the ship. The differential pressure gauge (DPG) is often equipped with the BBOBS.

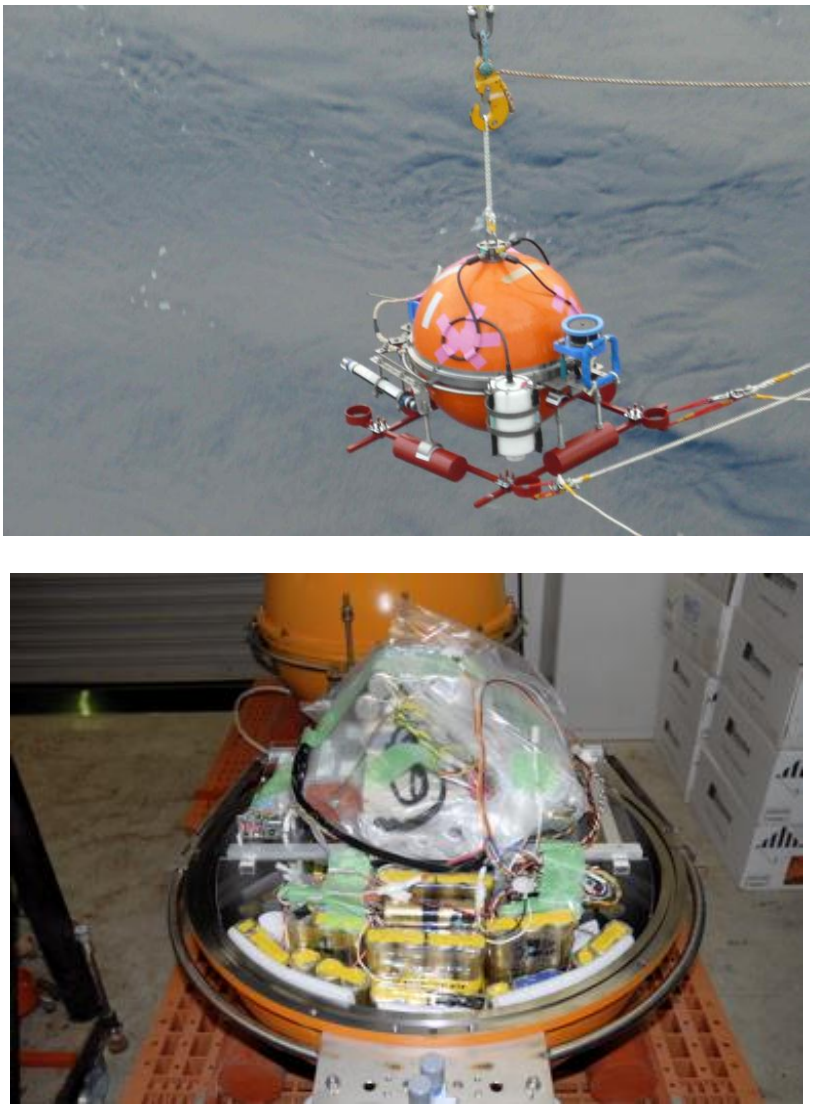


Fig. 9 The appearance (upper) and the inside (lower) of the BBOBS. The differential pressure gauge (DPG) was equipped with the BBOBS in the upper figure.

BBOBS Outside	
Size	1m x 1m x 0.7m (Width x Depth x Height)
Weight in air	240kg (deployment), 150kg (recovery)
Pressure case	Titanium sphere (D=65cm, Buoyancy=70kg, Made in Russia)
Releasing mechanism	Forced electric corrosion of two thin Ti plates (t=0.4mm)
Recovery control	Acoustic transponder system with recorder communication
Recovery aids	Radio beacon (160 MHz band) and Xenon flasher with light switch
BBOBS Inside	
Sensor	CMG-3T for OBS (Guralp, UK) sensor on the active leveling unit
	Period: 360s ~ 50 or 100Hz
	Sensitivity: 1500V/m/s
Analog unit	leveling works up to 20 degree in tilting gain: 0 dB
	LPF: 32Hz (4th-order Butterworth)
A/D	24bit (0~5V)　100 or 200Hz sampling
	Win format like compression
Data media	Two 2.5inch 40GB SCSI HDDs
RTC	0.5ppm, backuped by two
Power supply	DD-size lithium cells (Electro Chem, 3.9V, 30Ah)
	Sensor: 8 parallels (15.6V, 240Ah)
	Recorder: 12 parallels (11.7V, 360Ah)
	DPG: 3 parallels (11.7V, 90Ah)

Table 2　BBOBS specifications in case of observation for one year.

b) OBS

The Ocean Bottom Seismometer (OBS) is equipped with a three-component 4.5-Hz short-period seismometer and a hydrophone. The data is digitized by a 24 bit ADC with 100 Hz. The OBS is deployed by a free fall from the sea surface and pop up by its buoyancy in the recovery. The anchor is released by a forced electrolytic corrosion of a thin stainless steel wire after receiving a command of an acoustic transponder from the ship.

OCEAN-BOTTOM SEISMOMETER	
Type	TOKYO SOKUSHIN TOBS-24N
Number of Channel	4
ch1	Vertical sensor
ch2 / ch3	Horizontal sensor (two directions)
ch4	Hydrophone
SENSOR	
Type	Geo Space Technologies HS-1LT
Sensitivity	- *1
Damping	80%
Natural Frequency	4.5 Hz
Frequency Tolerance	±0.75 Hz
Coil Resistance	1460 Ω
Coil Current Damping	1910 Ω
HYDROPHONE	
Type - A	HIGH TECH HTI-90-DY
Sensitivity	-170 dB re:1 V/uPa
Frequency Response	2 - 15 kHz
RECORDER	
Type	TOKYO SOKUSHIN DTC6730
Sample Rate	10.0 msec
A/D Converter	24 Bit
Frequency Response	-
Pre Amplifier Gain	
ch1/ch2/ch3/ch4	40 / 40 / 40 / 40 dB
Digital Filter	Linear Phase
Width of quantization step	0.336×10^{-3}
Recording Media	SSD 64GB
Clock Type	MCXO
Clock Frequency	32.768 kHz (3.2768 MHz)
Clock Accuracy	$\pm5*10^{-8}$ sec
Time Reference	GPS
*1	Damping 70%:0.78 V/inch/sec Open :1.22 V/inch/sec

Table 3 OBS specifications in case of observation for one year.

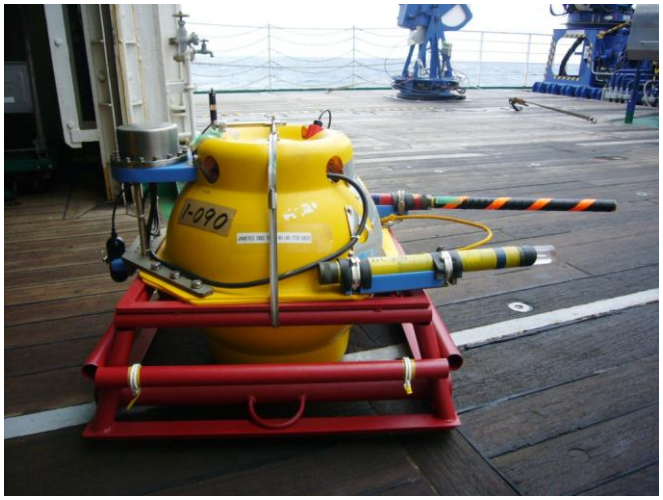


Fig. 10　The appearance of the OBS.

c)　OBP

The Ocean Bottom Pressure gauge (OBP) is equipped with a pressure gauge (Nano Resolution, Paroscientific, Inc., USA). The data is digitized with 20 Hz, and recorded on a SSD with the capacity of 32 GB. Recorder (CloverTech) and about 20 Li cells (DD size) are fixed inside of a grass sphere housing (D = 17 inch). The OBP is deployed by a free fall from the sea surface and pop up by its buoyancy in the recovery. The anchor is released by a forced electrolytic corrosion of a thin stainless steel wire after receiving a command of an acoustic transponder from the ship.

OCEAN-BOTTOM PRESSURE GAUGE	
Sensor Type	Nano Resolution, Paroscientific, Inc.
Recorder Type	CloverTech
Sample Rate	20Hz
Recording Media	SSD 32GB
Clock Type	MCXO
Power supply	DD-size lithium cells (Electro Chem, 3.9V, 30Ah) 11 parallels (7.6V, 330Ah)

Table 4　OBP specifications in case of observation for about 400 days.

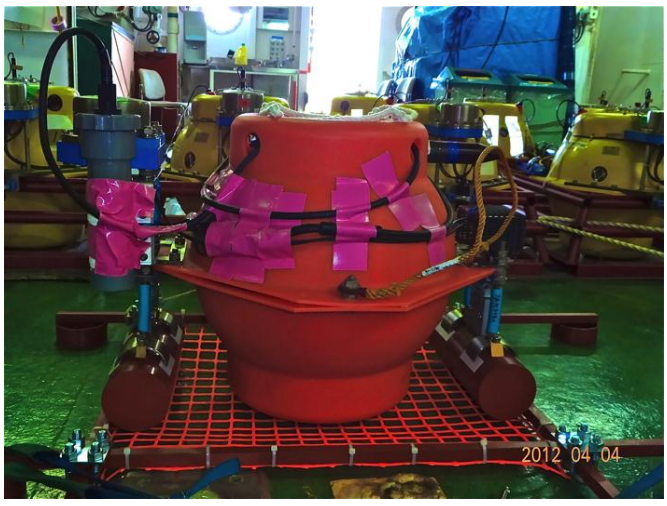


Fig. 11　The appearance of the OBP. The pressure gauge was inside a gray colored case on the left side in the picture.

4) Bathymetry, magnetic, and gravity observations:

Bathymetry, magnetic, and gravity data were recorded continuously during the survey. The bathymetry survey on R/V KAIREI used a multi-narrow beam echo sounder (Sea Beam 2112.004, SeaBeam Instruments) (Fig. 12). Gravity data was obtained by a shipboard gravimeter (BODESEEWERK KSS31, Fugro Co. Ltd.). The magnetic survey used a three-component magnetometer (SFG1214, Tiera Technica Corporation).

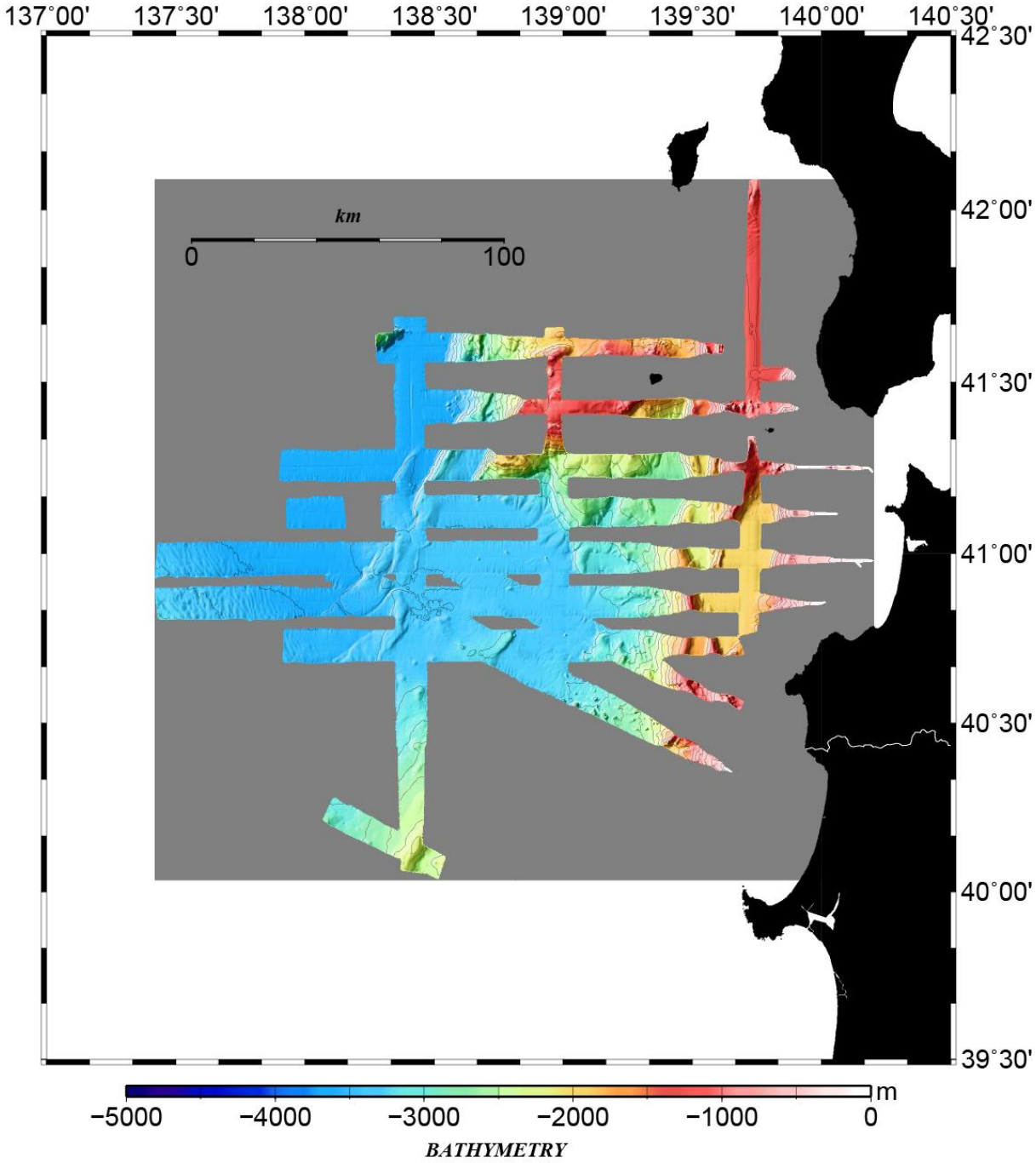


Fig. 12 Result of the bathymetric survey in the eastern margins of the Japan Sea.

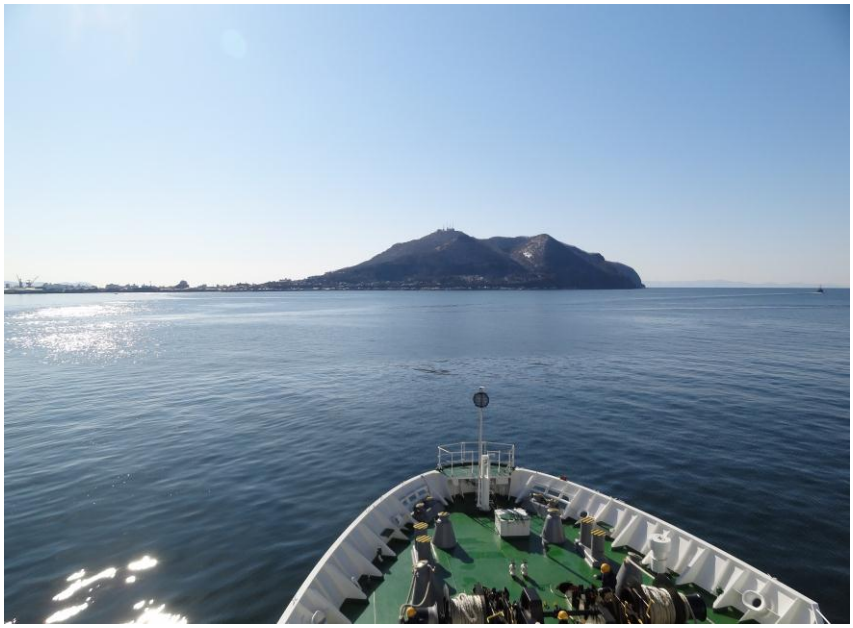
(3) **Cruise log:** Table 5

Date		Remarks
2012/4/2	Mon.	Departure from Yokosuka port (JAMSTEC), transit to the survey area off Boso. OBS deployment, BBOBS operation.
2012/4/3	Tue.	OBS deployment. Stop survey due to bad weather and sea condition, and transit to the Tokyo bay.
2012/4/4	Wed.	Stand by all day in the Tokyo Bay due to bad weather and sea condition.
2012/4/5	Thu.	Transit to the survey area off Miyagi.
2012/4/6	Fri.	OBP deployment, BBOBS retrieval, transit to the survey area of the Japan Sea.
2012/4/7	Sat.	OBS deployment (Site#46-#10)
2012/4/8	Sun.	OBS deployment (Site#9-#1), airgun shooting (EMJS1205, 200 m shot interval). Stop shooting due to bad weather and sea condition, and retrieve all equipments.
2012/4/9	Mon.	Stand by all day in the Mutsu Bay due to bad weather and sea condition.
2012/4/10	Tue.	Airgun shooting (EMJS1205, 200 m shot interval). Stop shooting due to bad weather and sea condition, and retrieve all equipments.
2012/4/11	Wed.	Stand by all day off Hakodate port due to bad weather and sea condition.
2012/4/12	Thu.	Call at the Hakodate port due to supplies and so on. Transit to the Line EMJS1205.
2012/4/13	Fri.	Airgun shooting (EMJS1205, 200 m shot interval).
2012/4/14	Sat.	OBS retrieval (OBS#1-#11).
2012/4/15	Sun.	OBS retrieval (OBS#12-#36).
2012/4/16	Mon.	OBS retrieval (OBS#37-#46), MCS survey (EMJS1209).
2012/4/17	Tue.	MCS survey (EMJS1209, 1208, 1207).
2012/4/18	Wed.	MCS survey (EMJS1207, 1206, 1205).
2012/4/19	Thu.	MCS survey (EMJS1205, 1204).
2012/4/20	Fri.	MCS survey (EMJS1204, 1201).
2012/4/21	Sat.	MCS survey (EMJS1201, 1202). Stop survey due to bad weather and sea condition, and retrieve all equipments.
2012/4/22	Sun.	Stand by all day in the Mutsu Bay due to bad weather and sea condition.
2012/4/23	Mon.	Stand by all day in the Mutsu Bay due to bad weather and sea condition.
2012/4/24	Tue.	MCS survey (EMJS1203, 12A).
2012/4/25	Wed.	MCS survey (EMJS12A). Stop survey due to bad weather and sea condition, and retrieve all equipments.
2012/4/26	Thu.	Stand by all day in the Mutsu Bay due to bad weather and sea condition.
2012/4/27	Fri.	Stand by all day in the Mutsu Bay due to bad weather and sea condition.
2012/4/28	Sat.	MCS survey (EMJS1204, 1203).
2012/4/29	Sun.	MCS survey (EMJS1203, 1204).
2012/4/30	Mon.	MCS survey (EMJS1205, 1206).
2012/5/1	Tue.	MCS survey (EMJS1207).
2012/5/2	Wed.	MCS survey (EMJS1207, 1208). Stop survey due to bad weather and sea condition, and retrieve all equipments.

Table 5　Cruise log during the survey.

2012/5/3	Thu.	Stand by all day in the Mutsu Bay due to bad weather and sea condition.
2012/5/4	Fri.	Stand by all day in the Mutsu Bay due to bad weather and sea condition.
2012/5/5	Sat.	MCS survey (EMJS1202).
2012/5/6	Sun.	MCS survey (EMJS1202, 12B).
2012/5/7	Mon.	MCS survey (EMJS12B, 12C).
2012/5/8	Tue.	MCS survey (EMJS12C, 1105-2), and retrieve all investment equipments. Transit to the survey area off Miyagi.
2012/5/9	Wed.	Transit to the survey area off Miyagi.
2012/5/10	Thu.	BBOBS retrieval, transit to the survey are off Boso.
2012/5/11	Fri.	BBOBS operation, OBS deployment.
2012/5/12	Sat.	BBOBS operation, transit to Yokosuka port (JAMSTEC).
2012/5/13	Sun.	Arrival at Yokosuka port (JAMSTEC).

Table 5 (Continued)　Cruise log during the survey.



(4) **Seismic lines** : Figs. 13-14

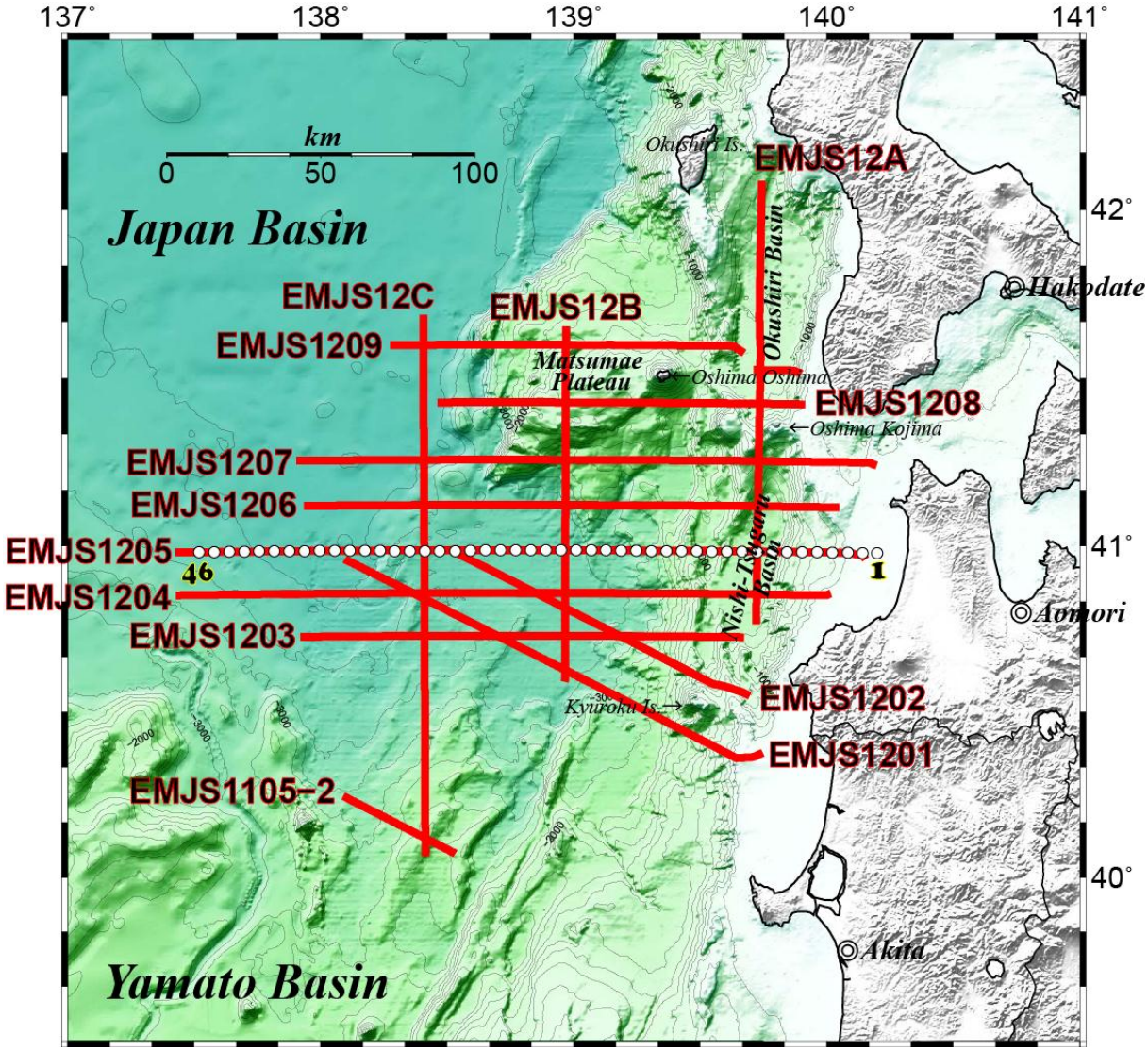


Fig. 13 Bathymetry and location maps of the survey area in the eastern margins of the Japan Sea. Red lines are the MCS lines of this survey, and white circles are the positions of the OBS sites.

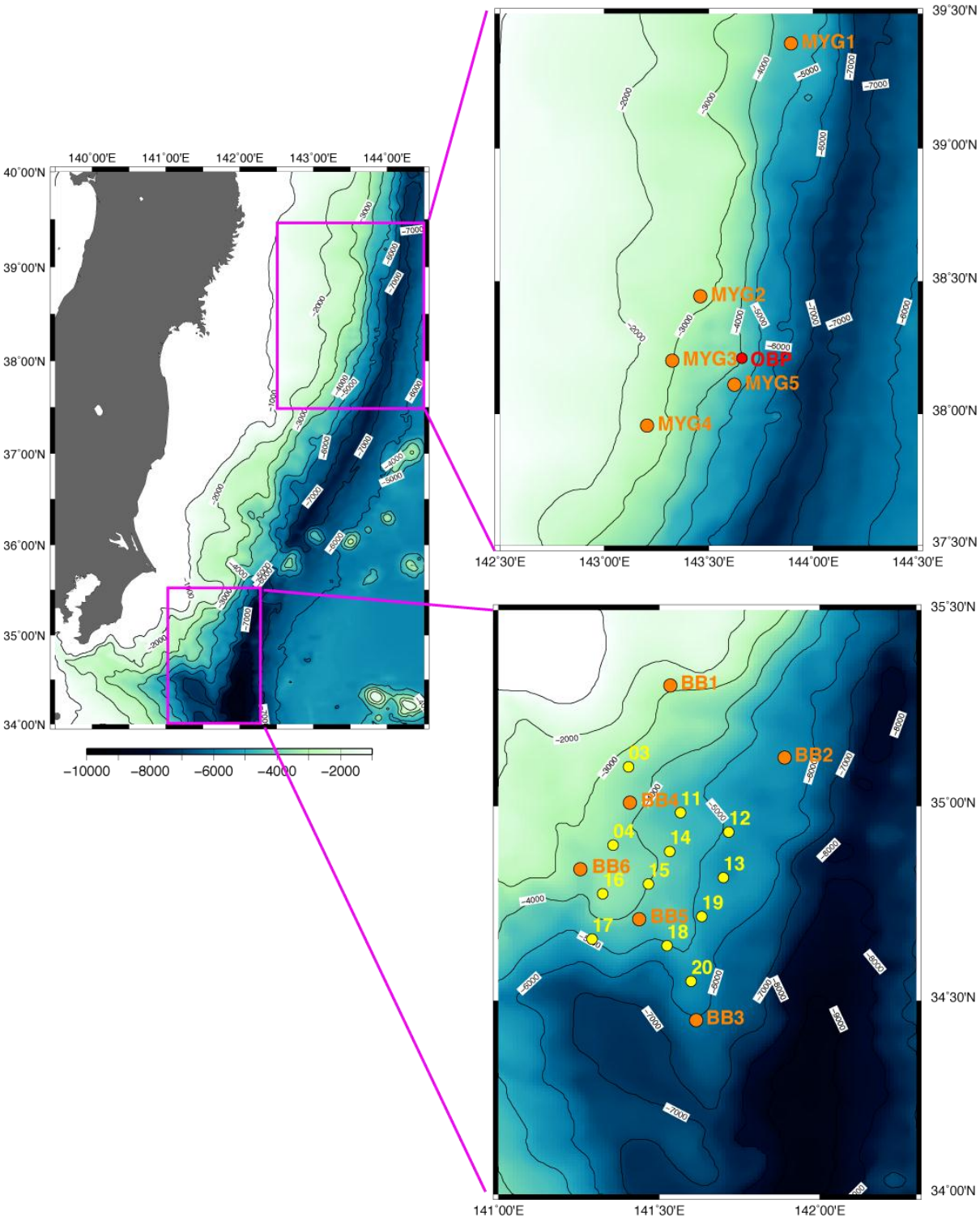


Fig. 14　Locations of BBOBS (orange circle), OBS (yellow circle) and OBP (red circle) stations off Boso and Miyagi area.

(5) **Seismic line list:** Tables 6-10

LINE NAME	DATE (UTC)	TIME (UTC)	F.S.P. / F.G.S.P. / L.G.S.P. / L.S.P.	VESSEL POSITION Lat.	VESSEL POSITION Lon.	Depth (m)	LENGTH FGSP - LGSP (km)	DIRECTION (°)	Mode (m)
EMJS12A_0	24/04/2012	10:40:57	3930	40_45.96443'N	139_43.23067'E	1845	146.4	1.8	Distance (50.0m)
	24/04/2012	10:41:53	3928	40_46.01846'N	139_43.23190'E	1845			
	25/04/2012	04:22:47	1001	42_05.09708'N	139_44.58516'E	880			
	25/04/2012	04:22:47	1001	42_05.09708'N	139_44.58516'E	880			
EMJS12B_0	06/05/2012	05:56:10	4375	40_35.59210'N	138_57.92034'E	3229	117.2	1.5	Distance (50.0m)
	06/05/2012	06:01:21	4360	40_35.99715'N	138_57.93566'E	3232			
	06/05/2012	19:20:28	2017	41_39.29183'N	138_58.15054'E	1865			
	06/05/2012	19:20:28	2017	41_39.29183'N	138_58.15054'E	1865			
EMJS12C_0	07/05/2012	01:53:52	1080	41_41.22048'N	138_24.35128'E	3665	180.3	181.5	Distance (50.0m)
	07/05/2012	01:54:49	1083	41_41.13947'N	138_24.35306'E	3669			
	07/05/2012	22:28:59	4688	40_03.77101'N	138_24.81046'E	2394			
	07/05/2012	22:28:59	4688	40_03.77101'N	138_24.81046'E	2394			
EMJS1105-2_0	08/05/2012	02:01:07	3710	40_04.32284'N	138_31.81403'E	2250	42.2	298.9	Distance (50.0m)
	08/05/2012	02:02:12	3713	40_04.35998'N	138_31.72023'E	2261			
	08/05/2012	07:00:24	4556	40_14.75783'N	138_05.31755'E	2966			
	08/05/2012	07:00:24	4556	40_14.75783'N	138_05.31755'E	2966			
EMJS1201_0	20/04/2012	01:37:24	4435	40_57.54559'N	138_05.86978'E	3623	150.8	118.3	Distance (50.0m)
	20/04/2012	01:49:41	4405	40_57.18319'N	138_06.82553'E	3620			
	20/04/2012	22:46:20	1390	40_21.87686'N	139_43.24492'E	102			
	20/04/2012	23:05:58	1365	40_22.71911'N	139_44.81494'E	116			
EMJS1202_0	21/04/2012	02:05:27	1141	40_33.00037'N	139_41.58205'E	992	32.4	298.3	Distance (50.0m)
	21/04/2012	02:06:11	1143	40_33.02321'N	139_41.51777'E	997			
	21/04/2012	06:00:48	1791	40_40.04637'N	139_20.41683'E	2436			
	21/04/2012	06:00:48	1791	40_40.04637'N	139_20.41683'E	2436			
EMJS1202_1	05/05/2012	07:14:21	3365	40_59.25694'N	138_30.74681'E	3385	89.5	118.3	Distance (50.0m)
	05/05/2012	07:22:54	3340	40_58.95526'N	138_31.54420'E	3383			
	05/05/2012	17:24:17	1551	40_36.98123'N	139_28.19172'E	1122			
	05/05/2012	17:24:17	1551	40_36.98123'N	139_28.19172'E	1122			
EMJS1203_0	24/04/2012	03:56:01	2225	40_43.73890'N	139_07.58532'E	3214	45.7	91.5	Distance (50.0m)
	24/04/2012	04:00:50	2210	40_43.73571'N	139_08.11805'E	3173			
	24/04/2012	09:44:30	1297	40_43.54125'N	139_40.54425'E	1750			
	24/04/2012	09:44:30	1297	40_43.54125'N	139_40.54425'E	1750			
EMJS1203_1	28/04/2012	13:00:12	1965	40_43.70023'N	139_16.57778'E	2997	114.6	271.5	Distance (50.0m)
	28/04/2012	13:00:54	1967	40_43.70135'N	139_16.50675'E	2996			
	29/04/2012	02:08:24	4259	40_43.61695'N	137_55.12431'E	3479			
	29/04/2012	02:08:24	4259	40_43.61695'N	137_55.12431'E	3479			

Table 6 List of seismic survey lines.

EMJS1204_0	19/04/2012	01:29:18	1175	40_51.39465'N	140_00.91643'E	143	81.7	271.5	Distance (50.0m)
	19/04/2012	01:29:18	1175	40_51.39465'N	140_00.91643'E	143			
	19/04/2012	10:30:45	2809	40_51.48262'N	139_02.76465'E	3279			
	19/04/2012	11:17:58	2953	40_51.49432'N	138_57.64081'E	3299			
EMJS1204_1	19/04/2012	11:39:18	3004	40_51.50124'N	138_55.82614'E	3316	91.8	271.5	Distance (50.0m)
	19/04/2012	11:40:12	3006	40_51.49936'N	138_55.75502'E	3313			
	19/04/2012	22:06:17	4841	40_51.30759'N	137_50.47921'E	3560			
	19/04/2012	22:06:17	4841	40_51.30759'N	137_50.47921'E	3560			
EMJS1204_2	28/04/2012	04:27:08	3265	40_51.51058'N	138_46.78150'E	3345	34.7	91.5	Distance (50.0m)
	28/04/2012	04:28:13	3262	40_51.51122'N	138_46.88826'E	3344			
	28/04/2012	08:03:06	2569	40_51.45246'N	139_11.54653'E	3192			
	28/04/2012	08:03:06	2569	40_51.45246'N	139_11.54653'E	3192			
EMJS1204_3	29/04/2012	08:22:58	4711	40_51.34856'N	137_55.10220'E	3587	41.4	271.5	Distance (50.0m)
	29/04/2012	08:23:41	4713	40_51.34586'N	137_55.03108'E	3587			
	29/04/2012	12:59:48	5541	40_51.06722'N	137_25.59138'E	3231			
	29/04/2012	12:59:48	5541	40_51.06722'N	137_25.59138'E	3231			
EMJS1205_0	18/04/2012	12:47:52	2912	40_59.20344'N	139_04.00694'E	3014	91.2	91.5	Distance (50.0m)
	18/04/2012	12:50:32	2904	40_59.19871'N	139_04.29212'E	3007			
	18/04/2012	23:26:59	1080	40_57.50735'N	140_09.29907'E	119			
	18/04/2012	23:26:59	1080	40_57.50735'N	140_09.29907'E	119			
EMJS1205_1	29/04/2012	15:09:43	5669	40_58.79202'N	137_25.75320'E	3420	143.1	91.5	Distance (50.0m)
	29/04/2012	15:17:48	5645	40_58.79846'N	137_26.60803'E	3444			
	30/04/2012	07:23:00	2784	40_59.19119'N	139_08.57052'E	3149			
	30/04/2012	07:23:00	2784	40_59.19119'N	139_08.57052'E	3149			
EMJS1205obs_0	08/04/2012	03:15:30	2175	40_58.78575'N	137_24.78429'E	3397	25.0	91.5	Distance (200.0m)
	08/04/2012	03:16:49	2174	40_58.78659'N	137_24.92679'E	3398			
	08/04/2012	06:00:48	2049	40_58.96443'N	137_42.73752'E	3552			
	08/04/2012	06:00:48	2049	40_58.96443'N	137_42.73752'E	3552			
EMJS1205obs_1	10/04/2012	01:25:03	2070	40_58.92418'N	137_39.74522'E	3546	39.8	91.5	Distance (200.0m)
	10/04/2012	01:27:49	2068	40_58.93998'N	137_40.02979'E	3555			
	10/04/2012	06:00:40	1869	40_59.14321'N	138_08.39237'E	3618			
	10/04/2012	06:00:40	1869	40_59.14321'N	138_08.39237'E	3618			
EMJS1205obs_2	13/04/2012	00:46:49	1881	40_59.12714'N	138_06.68168'E	3626	175.4	91.5	Distance (200.0m)
	13/04/2012	00:50:53	1878	40_59.13006'N	138_07.10948'E	3625			
	13/04/2012	21:20:08	1001	40_58.67351'N	140_12.17004'E	85			
	13/04/2012	21:20:08	1001	40_58.67351'N	140_12.17004'E	85			
EMJS1206_0	17/04/2012	23:38:03	1145	41_06.88902'N	140_02.93336'E	78	86.1	271.5	Distance (50.0m)
	17/04/2012	23:38:48	1147	41_06.88994'N	140_02.86191'E	77			
	18/04/2012	10:19:47	2869	41_07.31440'N	139_01.34004'E	2815			
	18/04/2012	10:19:47	2869	41_07.31440'N	139_01.34004'E	2815			

Table 6 (Continued) List of seismic survey lines.

EMJS1206_1	30/04/2012	12:08:16	2745	41_07.30419'N	139_05.76998'E	2630	97.7	271.5	Distance(50.0m)
	30/04/2012	12:08:57	2747	41_07.30417'N	139_05.69854'E	2623			
	30/04/2012	23:00:14	4700	41_07.17301'N	137_55.94310'E	3645			
	30/04/2012	23:00:14	4700	41_07.17301'N	137_55.94310'E	3645			
EMJS1207_0	17/04/2012	14:18:16	2325	41_15.31793'N	139_26.03408'E	2656	63.8	91.5	Distance (50.0m)
	17/04/2012	14:19:56	2320	41_15.31715'N	139_26.21309'E	2657			
	17/04/2012	21:12:34	1044	41_14.31632'N	140_11.88204'E	135			
	17/04/2012	21:12:34	1044	41_14.31632'N	140_11.88204'E	135			
EMJS1207_1	01/05/2012	03:52:08	4885	41_15.25470'N	137_54.40535'E	3657	134.1	91.5	Distance (50.0m)
	01/05/2012	03:53:07	4882	41_15.25612'N	137_54.51268'E	3655			
	01/05/2012	18:19:31	2200	41_15.28877'N	139_30.50914'E	1938			
	01/05/2012	18:19:31	2200	41_15.28877'N	139_30.50914'E	1938			
EMJS1208_0	17/04/2012	06:15:42	1001	41_25.33754'N	139_54.75758'E	153	41.5	271.5	Distance (50.0m)
	17/04/2012	06:28:14	1036	41_25.36874'N	139_53.50156'E	547			
	17/04/2012	11:01:10	1866	41_25.59761'N	139_23.70869'E	1953			
	17/04/2012	11:01:10	1866	41_25.59761'N	139_23.70869'E	1953			
EMJS1208_1	01/05/2012	21:01:40	1746	41_25.56455'N	139_28.01599'E	2098	81.4	271.5	Distance (50.0m)
	01/05/2012	21:18:49	1802	41_25.58201'N	139_26.00592'E	2062			
	02/05/2012	07:04:38	3430	41_25.68456'N	138_27.57564'E	3663			
	02/05/2012	07:04:38	3430	41_25.68456'N	138_27.57564'E	3663			
EMJS1209_0	16/04/2012	12:57:06	3661	41_35.90947'N	138_16.58486'E	3164	114.9	91.5	Distance (50.0m)
	16/04/2012	13:03:41	3641	41_35.91438'N	138_17.30439'E	3388			
	17/04/2012	01:47:10	1344	41_35.16450'N	139_39.95421'E	1396			
	17/04/2012	01:59:09	1329	41_34.34556'N	139_40.48257'E	1397			
EMJS1209_1	17/04/2012	03:01:21	1261	41_31.45861'N	139_42.88641'E	1397	15.5	91.5	Distance (50.0m)
	17/04/2012	03:02:00	1259	41_31.45821'N	139_42.95828'E	1397			
	17/04/2012	04:42:48	950	41_30.76615'N	139_54.05637'E	447			
	17/04/2012	04:42:48	950	41_30.76615'N	139_54.05637'E	447			

Table 6 (Continued) List of seismic survey lines.

(6) **OBS, BBOBS, and OBP position list:** Table 7 to 10

Site	Lat. (N)	Lon. (E)	Depth (m)
1	40_58.6698	140_11.9764	89
2	40_58.7022	140_08.4625	131
3	40_58.7588	140_04.9721	186
4	40_58.7864	140_01.3399	440
5	40_58.8015	139_57.7828	586
6	40_58.8278	139_54.1883	810
7	40_58.8254	139_50.5763	1215
8	40_58.8583	139_47.0651	1909
9	40_58.8798	139_43.5034	1925
10	40_58.9462	139_39.9041	1928
11	40_58.9679	139_36.3107	1751
12	40_58.9739	139_32.7554	2197
13	40_59.0100	139_29.1719	1890
14	40_59.0412	139_25.5904	1945
15	40_59.0571	139_22.0187	2527
16	40_59.0592	139_18.4263	2850
17	40_59.1219	139_14.8653	2963
18	40_59.1367	139_11.2715	3173
19	40_59.1795	139_07.7097	3168
20	40_59.1860	139_04.1442	3035
21	40_59.1992	139_00.5555	3342
22	40_59.2160	138_56.9909	3354
23	40_59.2102	138_53.4124	3370

Site	Lat. (N)	Lon. (E)	Depth (m)
24	40_59.1878	138_49.8536	3386
25	40_59.1773	138_46.2876	3388
26	40_59.1879	138_42.7156	3391
27	40_59.1704	138_39.1190	3404
28	40_59.1146	138_35.5560	3407
29	40_59.0655	138_31.9657	3408
30	40_59.0251	138_28.2093	3408
31	40_59.0434	138_24.6866	3385
32	40_59.0583	138_21.1321	3356
33	40_59.0558	138_17.5626	3411
34	40_59.1140	138_14.0939	3564
35	40_59.1387	138_10.5411	3631
36	40_59.1305	138_06.9566	3653
37	40_59.1015	138_03.4086	3653
38	40_59.0852	137_59.8036	3661
39	40_59.0595	137_56.2121	3666
40	40_59.0339	137_52.6247	3670
41	40_59.0113	137_49.0584	3654
42	40_58.9842	137_45.4787	3633
43	40_58.9566	137_41.9097	3600
44	40_58.9197	137_38.3294	3566
45	40_58.8885	137_34.7536	3531
46	40_58.8502	137_31.2009	3508

Table 7　List of OBS deployment position for refraction survey of the Line EMJS1205.

Site	Calibrated position			Remarks
	Lat (N)	Lon (E)	Depth (m)	
BB1	35_18.6169	141_32.1821	2864.4	Calibrated in this cruise using SOJ data
BB2	35_07.5812	141_53.4393	5579.1	Calibrated in MR12-E01
BB3	34_27.1246	141_36.9869	5922.4	Calibrated in this cruise
BB4	35_00.6185	141_24.7328	3826.7	Calibrated in MR12-E01
BB5	34_42.7463	141_26.5023	4518.8	Calibrated in this cruise
BB6	34_50.4510	141_15.5823	3855.1	Calibrated in this cruise
Site	**Deployed position**			**Remarks**
	Lat (N)	**Lon (E)**	**Depth (m)**	
03	35_05.9652	141_24.3002	3372.0	
04	34_53.9788	141_21.3263	3935.0	
11	34_58.9750	141_34.0249	4657.0	
12	34_55.9500	141_42.9868	5327.0	
13	34_48.9760	141_41.9945	5605.0	
14	34_53.0020	141_31.9488	4342.0	
15	34_48.0190	141_27.9011	4085.0	
16	34_46.2798	141_19.3372	3385.0	
17	34_39.4466	141_17.5668	4897.0	
18	34_38.4759	141_31.2573	5005.0	
19	34_42.9993	141_38.0013	5386.0	
20	34_33.0025	141_35.8857	5557.0	

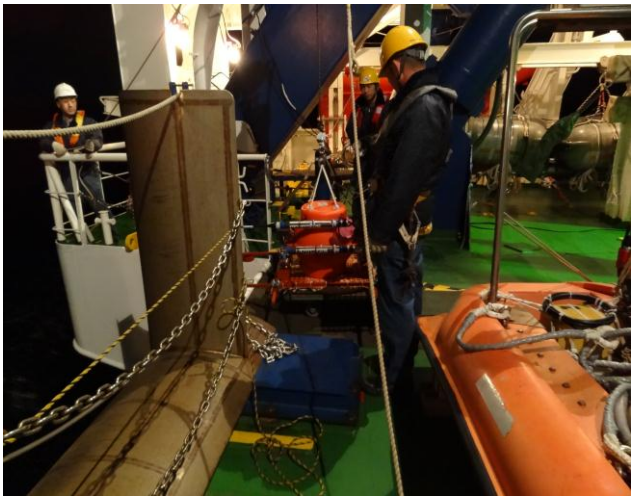
Table 8　Calibrated position of BBOBSs and deployed position of OBSs off Boso area.

Site	Start time of the recording	End time	Deadline for recovering	Remarks
03	2012/05/10 23:00	2013/03/26 00:00	2013/6/23 0:00:00	
04	2012/04/02 23:58	2013/02/16 00:00	2013/6/23 0:00:00	
11	2012/05/10 23:01	2013/03/26 00:00	2013/6/23 0:00:00	
12	2012/05/10 23:02	2013/03/26 00:00	2013/6/23 0:00:00	
13	2012/05/10 23:03	2013/03/26 00:00	2013/6/23 0:00:00	
14	2012/05/10 23:05	2013/03/26 00:00	2013/6/23 0:00:00	
15	2012/04/02 23:57	2013/02/16 00:00	2013/6/23 0:00:00	
16	2012/04/02 23:59	2013/02/16 00:00	2013/6/23 0:00:00	
17	2012/04/02 23:50	2013/02/16 00:00	2013/6/23 0:00:00	
18	2012/04/02 23:49	2013/02/16 00:00	2013/6/23 0:00:00	
19	2012/05/10 23:04	2013/03/26 00:00	2013/6/23 0:00:00	
20	2012/04/02 23:48	2013/02/16 00:00	2013/6/23 0:00:00	

Table 9　Time schedule for OBSs deployed off Boso area.

Site	Position			Remarks
	Lat (N)	Lon (E)	Depth (m)	
MYG1	35_18.4943	141_32.1168	2877	Deployed and Calibrated in NT11-E02
MYG2	35_07.4536	141_53.4536	5628	Deployed and Calibrated in NT11-E02
MYG3	34_26.9935	141_36.9687	5993	Deployed and Calibrated in NT11-E02
MYG4	35_00.5059	141_24.5438	3794	Deployed and Calibrated in NT11-E02
MYG5	34_42.6028	141_26.2698	4421	Deployed and Calibrated in NT11-E02
Site	Deployed position			Remarks
	Lat (N)	Lon (E)	Depth (m)	
OBP	38_12.6447	143_39.5390	4128	

Table 10　Position of BBOBSs and deployed position of OBP off Miyagi area.



4. Notice on use:

This cruise report is a preliminary document as of the end of the cruise. It may not be corrected even if changes in content (i.e., taxonomic classifications) are found after publication. It may also be changed without notice. Data in the cruise report may be raw or unprocessed. Please ask the PI for the latest information before using. Users of data or results of this cruise are requested to submit their results to the Data Integration and Analysis Group (DIAG), JAMSTEC.

Acknowledgement:

We would like to thank the captain, Koji Samejima, and crew of the R/V KAIREI, and Kaoru Tsukuda and the marine technician team (Nippon Marine Enterprises, Ltd.), for their efforts in obtaining MCS data, OBS data, and other geophysical data. We are grateful to participants of Leading Project (Earthquake and Tsunami research project for Disaster Prevention), IFREE (Institute for Research on Earth Evolution), and MARITEC (Marine Technology Center) in JAMSTEC for their great support in this cruise. This project is funded by a program called "Priority Investigations of Strain Concentration Areas," which is part of the Special Coordination Funds for Promoting Science and Technology of the Ministry of Education, Culture, Sports, Science, and Technology. We used "The Generic Mapping Tools" (Wessel and Smith, 1991) to make figures.