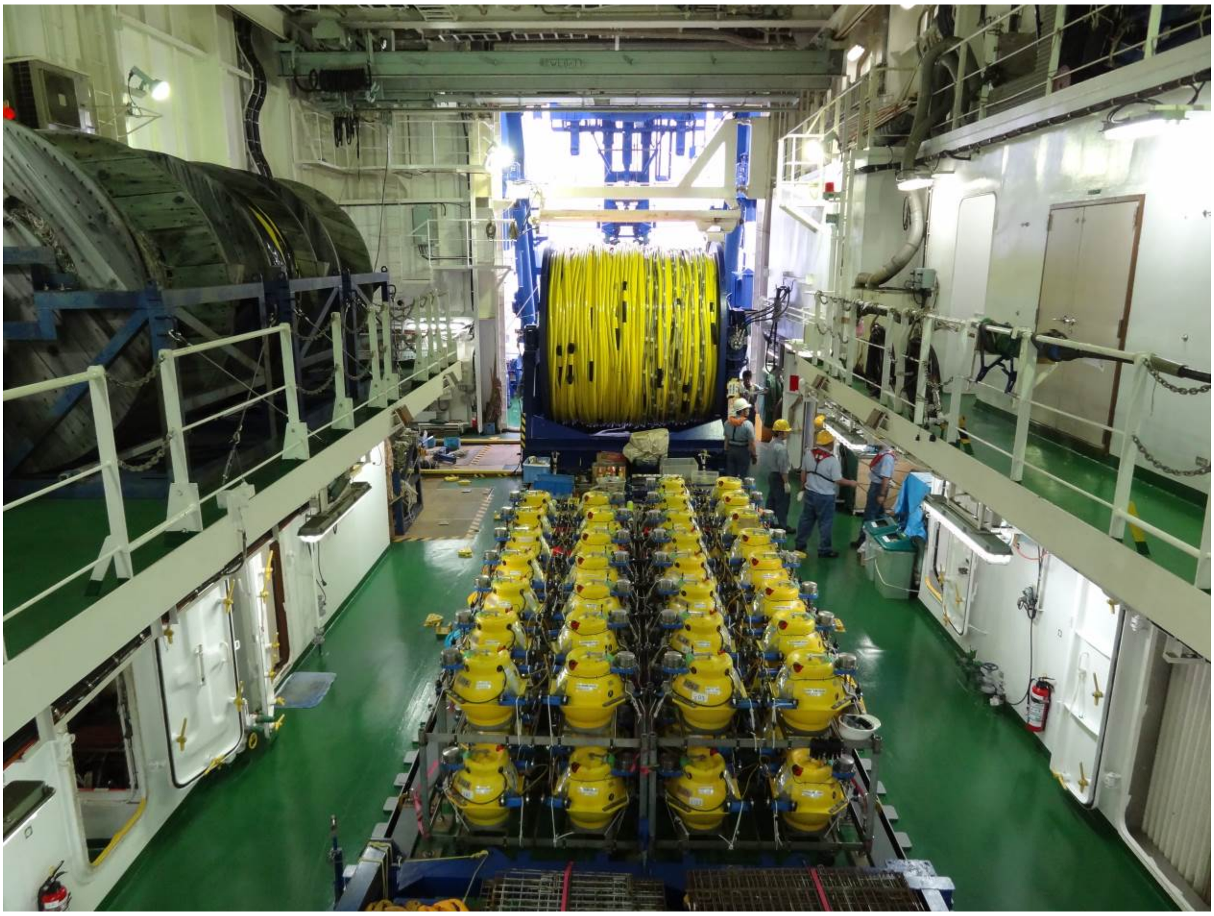
doi : 10.17596/0002882

KR14-08 Cruise Report

Integrated research project on seismic and tsunami hazards around the Sea of Japan



Jul. 22, 2014 – Aug. 30, 2014

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

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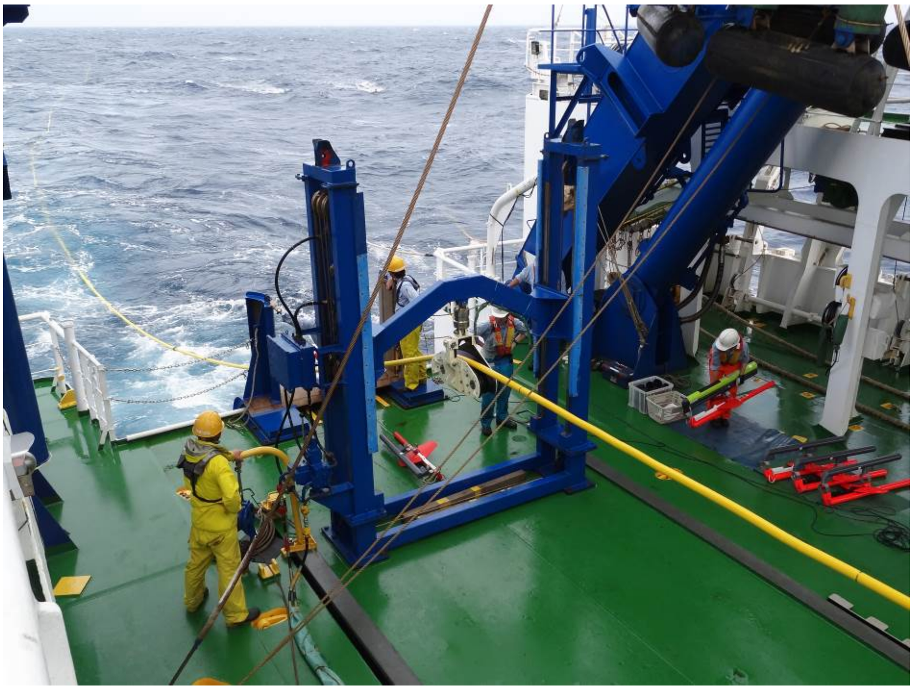

1. Cruise Information:

(1) **Cruise ID, Ship name:** KR14-08, R/V *Kairei*

(2) **Title of the cruise:** 2014FY "Integrated Research Project on Seismic and Tsunami Hazards Around the Sea of Japan"

(3) **Title of proposal:** Integrated Research Project on Seismic and Tsunami Hazards Around the Sea of Japan

(4) **Cruise period, Port call:** 2014/7/22 - 8/30, Maizuru port to Yokosuka port (JAMSTEC)

(5) **Research Area:** Japan Sea

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

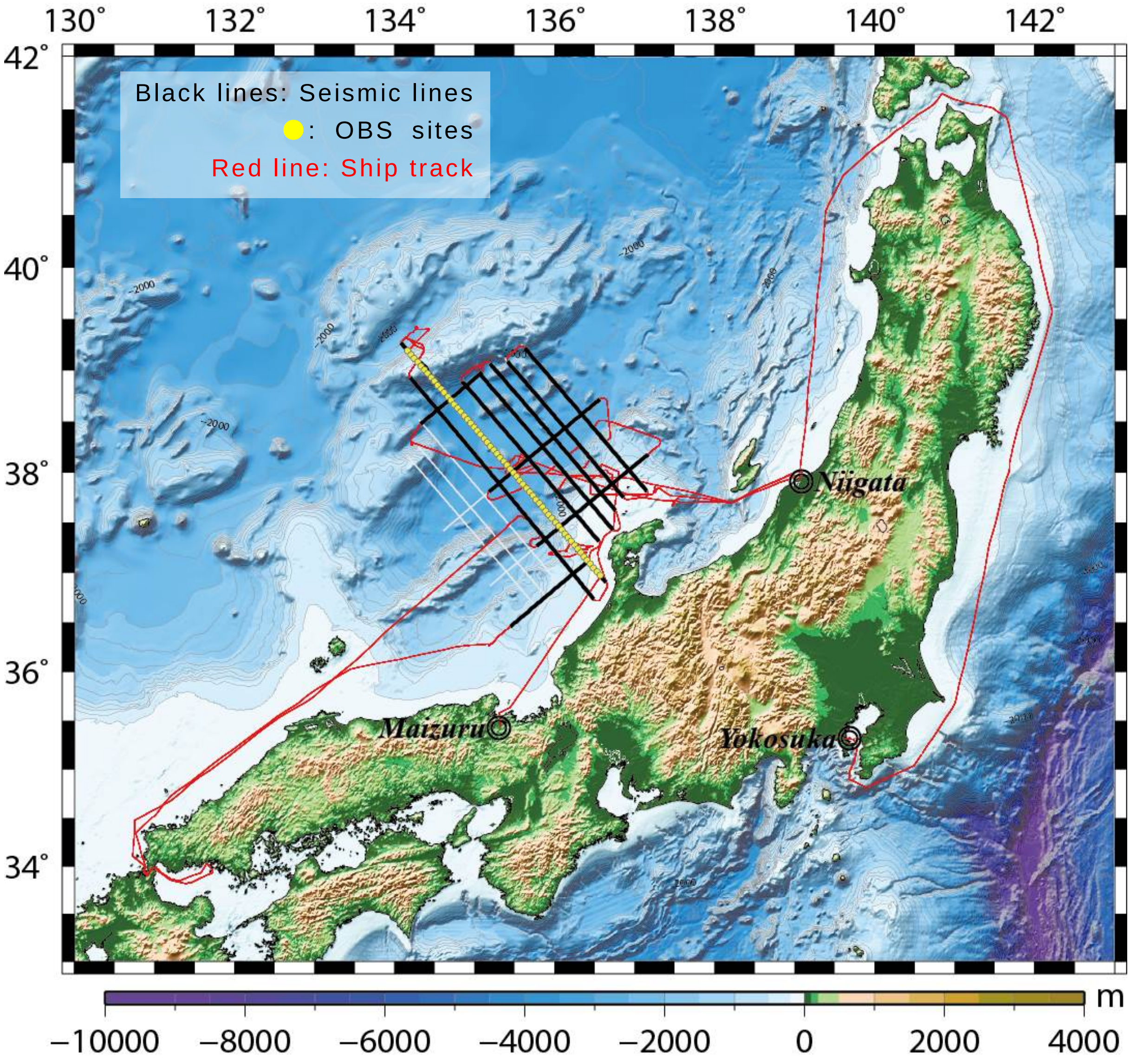

Fig. 1 Ship track during KR14-08 cruise.

2. Researchers:

(1) Chief Scientist [Affiliation]:

Tetsuo NO [JAMSTEC]

(2) Representative of Science Party [Affiliation]:

Shuichi KODAIRA [JAMSTEC]

(3) KR14-08 Shipboard Science Party:

Tetsuo NO [JAMSTEC]: Chief Scientist
Takeshi SATO [JAMSTEC]: Vice-chief Scientist
Makoto ITO [Nippon Marine Enterprises, Ltd. (NME)]: Chief marine technician (MCS)
Seiichi MORI [NME]: Chief marine technician (OBS)
Akie SUZUKI [NME]: Technician (Seismic source technician)
Hidenori SHIBATA [NME]: Technician (Seismic source technician)
Ikumasa TERADA [NME]: Technician (OBS technician)
Kaoru TSUKUDA [NME]: Technician (Seismic source technician)
Keita SUZUKI [NME]: Technician (Seismic navigator)
Kiyoshi SHIONO [NME]: Technician (Seismic observer)
Naoto NOGUCHI [NME]: Technician (Seismic data processor)
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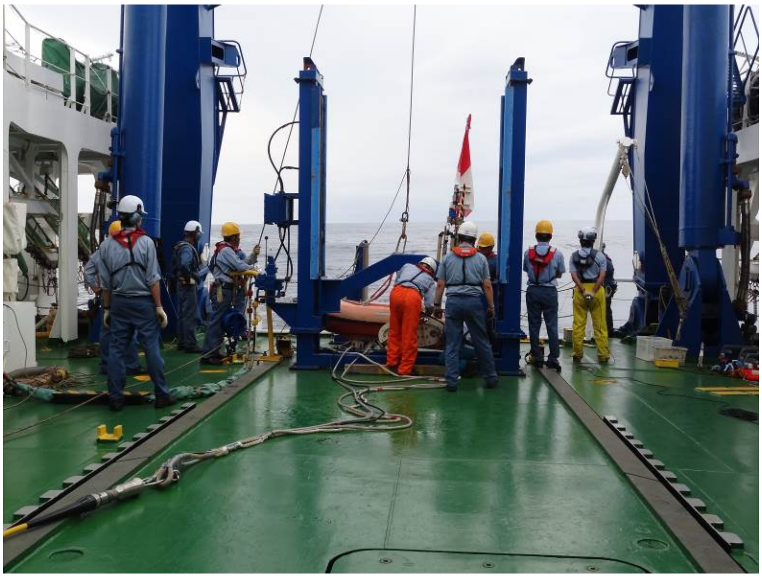
Waka AKIYAMA [NME]: Technician (Seismic observer)
Yuki OHWATARI [NME]: Technician (Seismic navigator)
Yuta WATARAI [NME]: Technician (Seismic navigator)

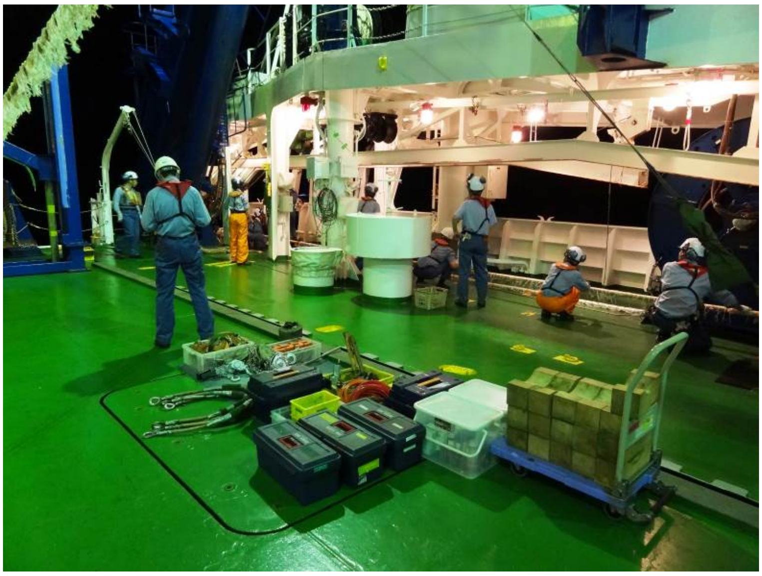


3. Overview of Observation:

(1) Objective:

The relationship between crustal structure and the earthquakes that have occurred along the eastern margin of the Japan Sea has been revealed recently by seismic survey as part of the research project "Multidisciplinary research project for construction of fault model in the high strain rate zone" (Sato et al., 2014; No et al., 2014). Elucidation of the crustal structure is essential in understanding the seismotectonics of the Japan Sea. However, many areas in the Japan Sea have not yet been conducted to seismic survey for study of the crustal structure. Therefore, we have participated in "Integrated Research Project on Seismic and Tsunami Hazards Around the Sea of Japan" conducted by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) of Japan; in particular, we have performed seismic surveys from the R/V *KAIREI* in the Japan Sea since 2014.

In July-August 2014, we conducted a marine seismic survey to study the crustal structure around area off Ishikawa. The survey covered the areas from the continental shelf to the Yamato Basin and the Yamato Rise. Using an improved seismic acquisition technology for deep seismic imaging, we are able to obtain data so as to clarify the detail crustal structure such as those presented by No et al. (2014) and Sato et al. (2014) for the eastern Japan Sea. Therefore, we will clarify more detail crustal structure than that reported previously by Ludwig et al. (1975), Katao (1988), and Hirata et al. (1989) in this area. Such data is important for studies of seismotectonics in the survey area and for understanding of the formation of the Japan Sea. Moreover, since an onshore-offshore seismic survey was conducted in the south extension of the survey area in previous study (Kodaira et al., 2004), we obtain the crustal structure imaging of the central Japan ranging from the Nankai Trough to the Japan Sea in the present study. In addition, the line SJ1405 was connected to the onshore-offshore seismic survey by the Earthquake Research Institute, University of Tokyo which was conducted in the same period.



(2) **List of observation instruments:**

1) Multichannel seismic reflection (MCS) survey

We used a multichannel seismic reflection (MCS) system of the R/V *KAIREI* (Miura, 2009) (Fig. 2). MCS data were acquired along 11 lines (SJ1404, SJ1405, SJ1406, SJ1407, SJ1408, SJ1409, SJ14A, SJ14B, SJ14C, and SJ14D) with a total length of approximately 2,278 km. Some seismic lines were crooked to avoid the fishing operations and equipment in the survey area.

Fig. 2 MCS system on R/V *KAIREI*.

a) Source:

To obtain high-quality MCS data, we shot an air gun array at a spacing of 50 m, which corresponds to a spacing of 20 to 30 s depending on the vessel speed (average of 4.5 kn). 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). During the experiment, the air gun array depth was kept at 10 m below the sea surface. 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.

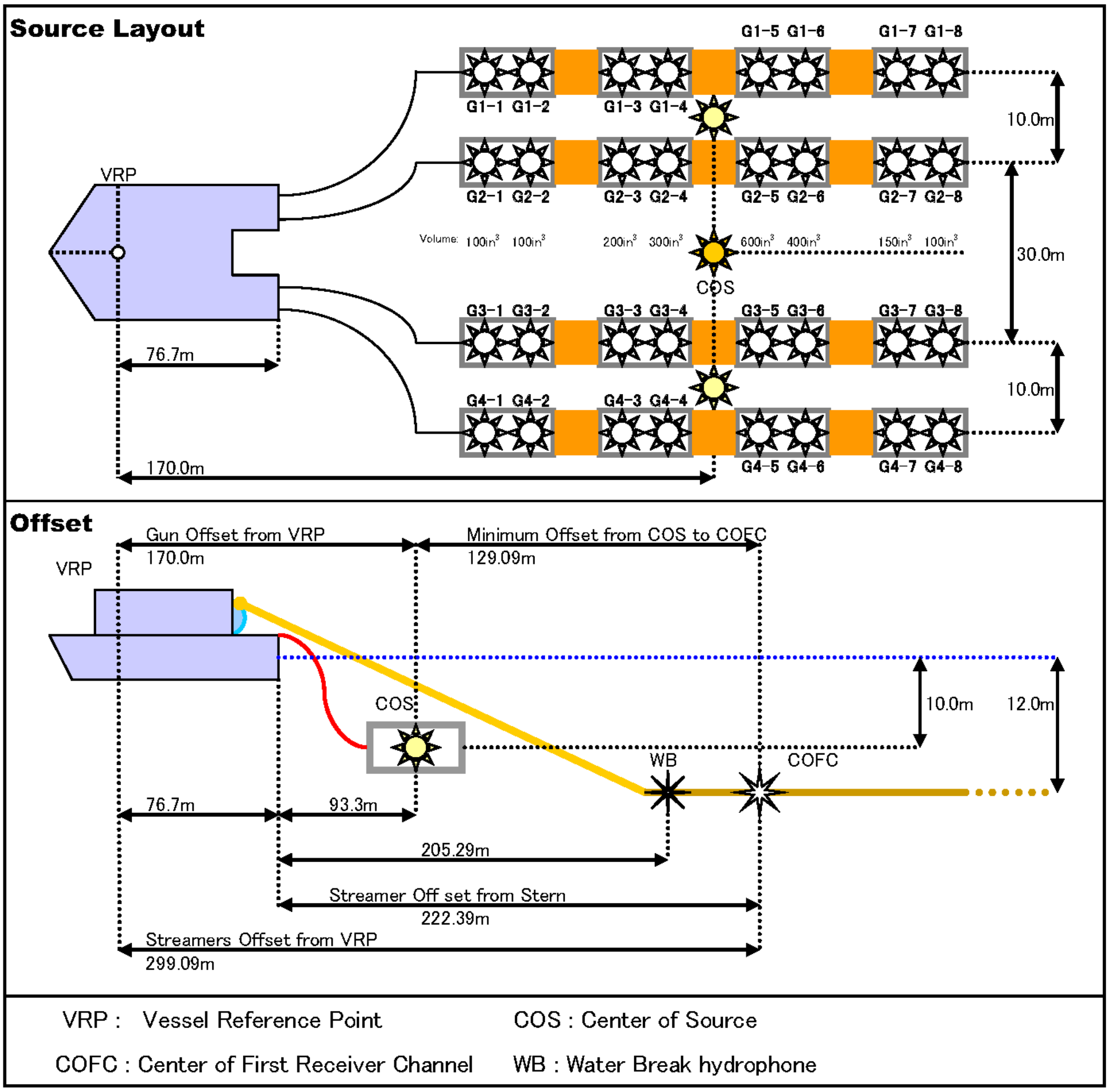


Fig. 3 Vessel towing geometry during the MCS survey. Top figure shows the source (airgun system) layout, bottom figure represents source–receiver depth and position, and navigation offsets.

b) Receiver:

During airgun shooting, we towed a 444-channel hydrophone streamer cable with a group interval of 12.5 m. (Sentinel Digital Streamer System, Sercel Inc.) (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 kept at 12 m below the sea surface by the depth controller called Bird (I/O DigiCOURSE streamer depth controllers).

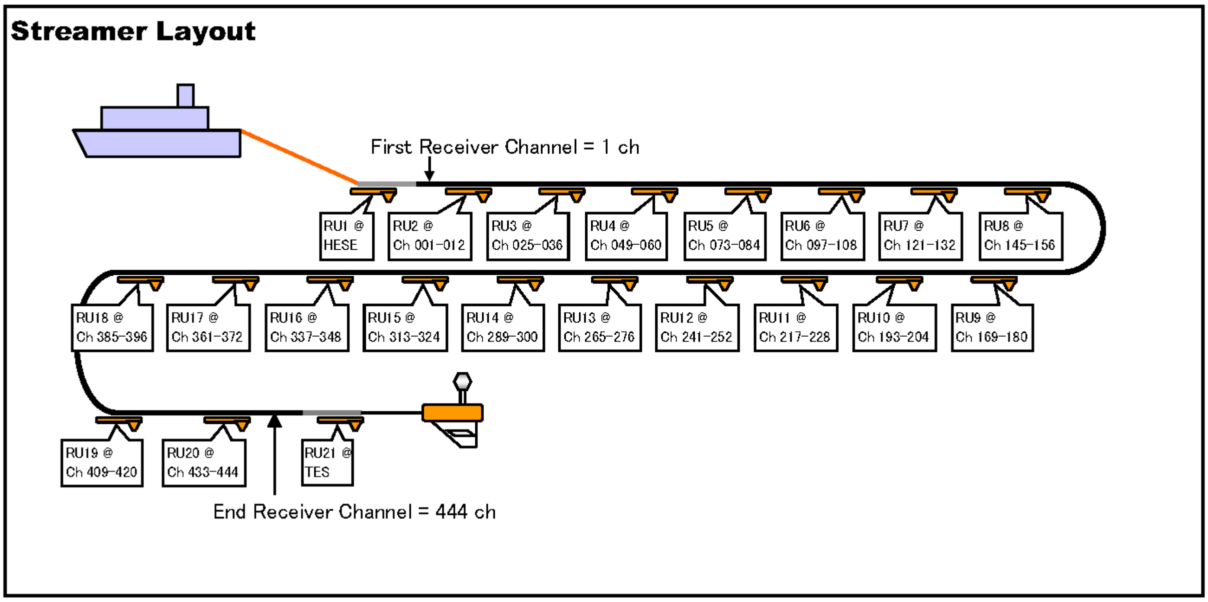


Fig. 4 Streamer cable configuration during the MCS survey.

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 LTO tape 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 53N.

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 in the conventional processing sequence, which includes trace header edit, trace edit, common midpoint (CMP) binning with an interval of 6.25 m, a bandpass filter, datum correction, amplitude compensation, predictive deconvolution, velocity analysis, normal moveout correction, multiple suppression, mute, CMP stack, F-K migration, and a bandpass filter (Figs. 5 and 6).

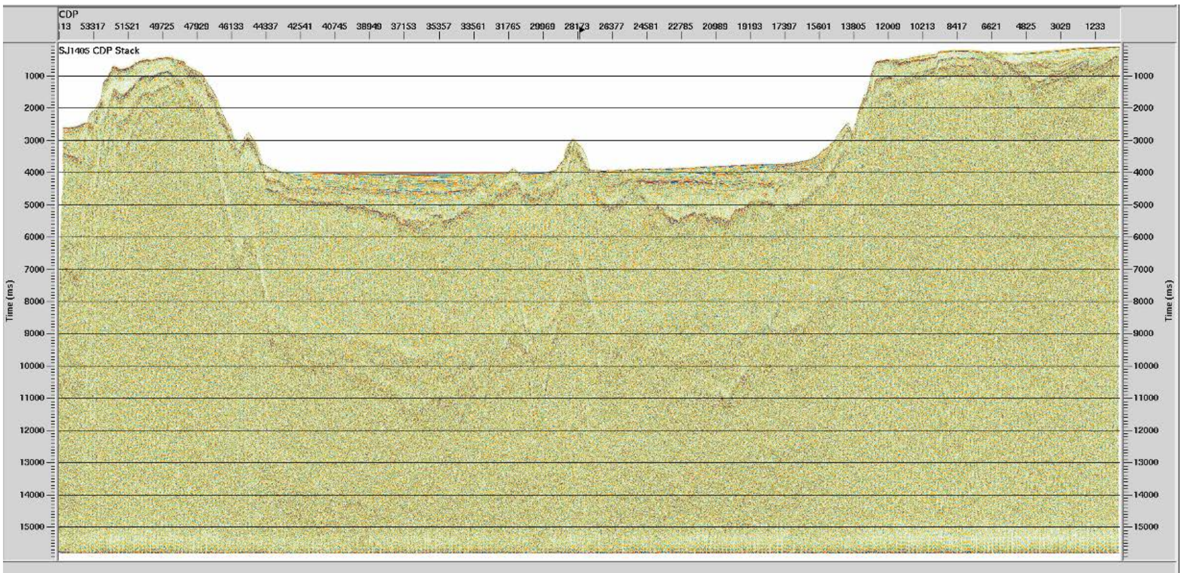


Fig. 5　Example of MCS profile with onboard processing (SJ1405).

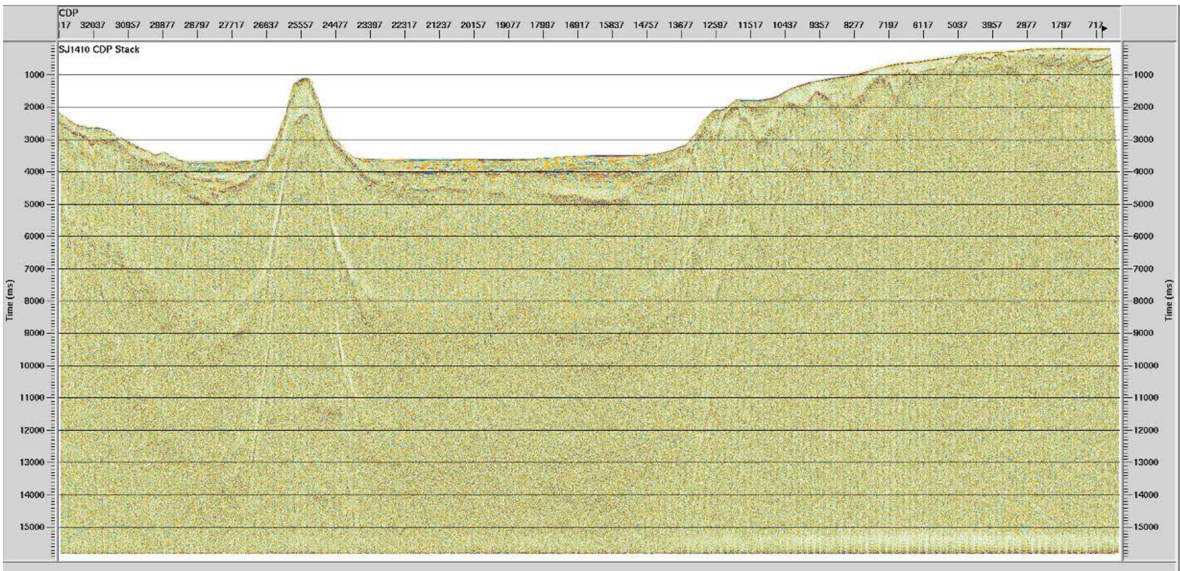


Fig. 6　Example of MCS profile with onboard processing (SJ1410).

2) Refraction survey using OBSs

We deployed 60 OBSs along the line SJ1405, and performed a refraction survey using an airgun array with a shot spacing of 100 or 200 m. The interval of the OBSs deployment was about 5.5 km. The airgun array in the seismic refraction/reflection survey by the OBSs was placed in almost the same configuration as that in the MCS survey, although the width was expanded to 45.0 m by a paravane system, and the central position of the array was set 203 m behind the ship's antenna (Fig. 7). Each OBS was equipped with three-component geophones with gimbal-leveling mechanisms, a natural frequency of 4.5 Hz, and a hydrophone sensor (Kaneda et al., 2005). The airgun signals were recorded by the OBSs with a sampling rate of 200 Hz. The position at the sea bottom of each OBS was determined using the super short baseline acoustic positioning system (SSBL) of the R/V *KAIREI*. Moreover, calibration of the OBS clock to GPS time was performed using the time difference between the OBS clock and GPS time, which was measured just before OBS deployment and just after OBS retrieval. Fig. 8 shows examples of two OBSs record sections, OBS10 and 40.

Type	TOBS-24N, TOKYO SOKUSHIN CO., LTD.
Maximum Depth	6,700 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.

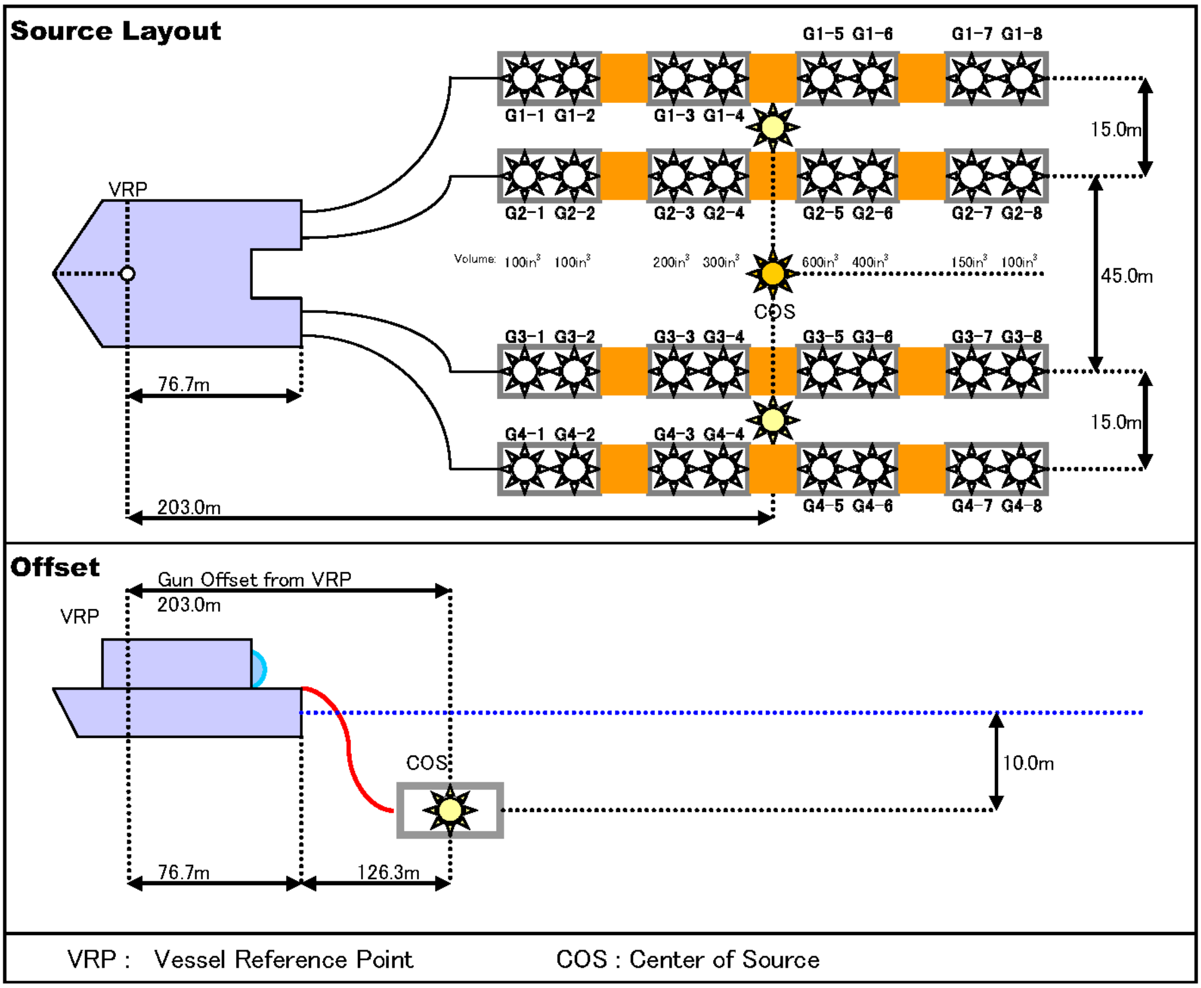
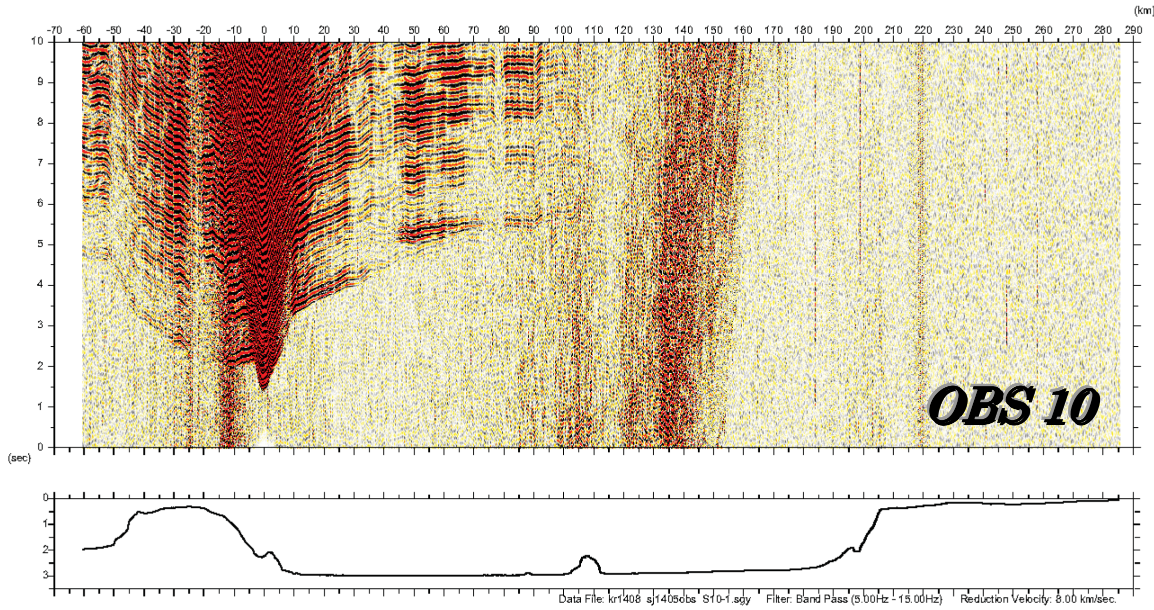
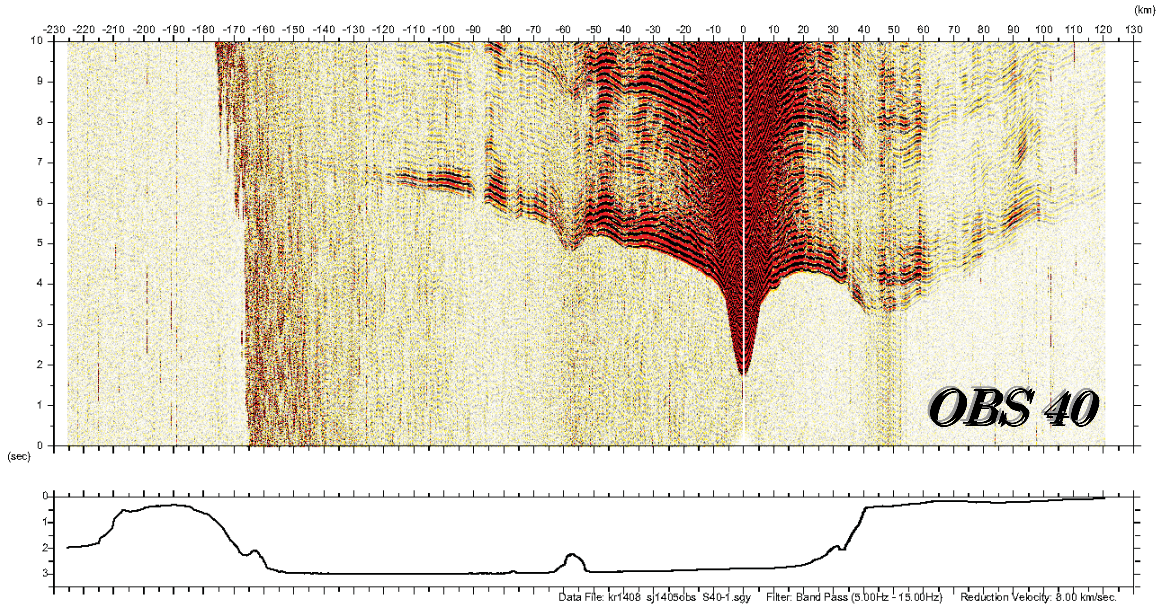


Fig. 7 Vessel towing geometry during the refraction survey. Top figure shows the source (airgun system) layout, bottom figure represents source depth and position, and navigation offsets.





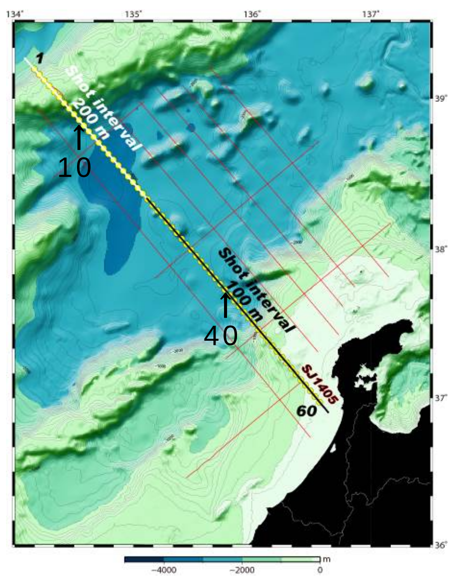


Fig. 8 Examples of OBS record sections (OBS 10 and 40).

3) Bathymetry, magnetic, and gravity observations:

Bathymetry, magnetic, and gravity data were recorded continuously during the survey. The bathymetry survey on the R/V *KAIREI* used a multi-narrow beam echo sounder (Sea Beam 3012, SeaBeam Instruments) (Fig. 9). Gravity data was obtained by a shipboard gravimeter (BODESEEWERK KSS31, Fugro Co. Ltd.). The magnetic survey used a three-component magnetometer (SFG-1214, Tiera Technica Corporation).

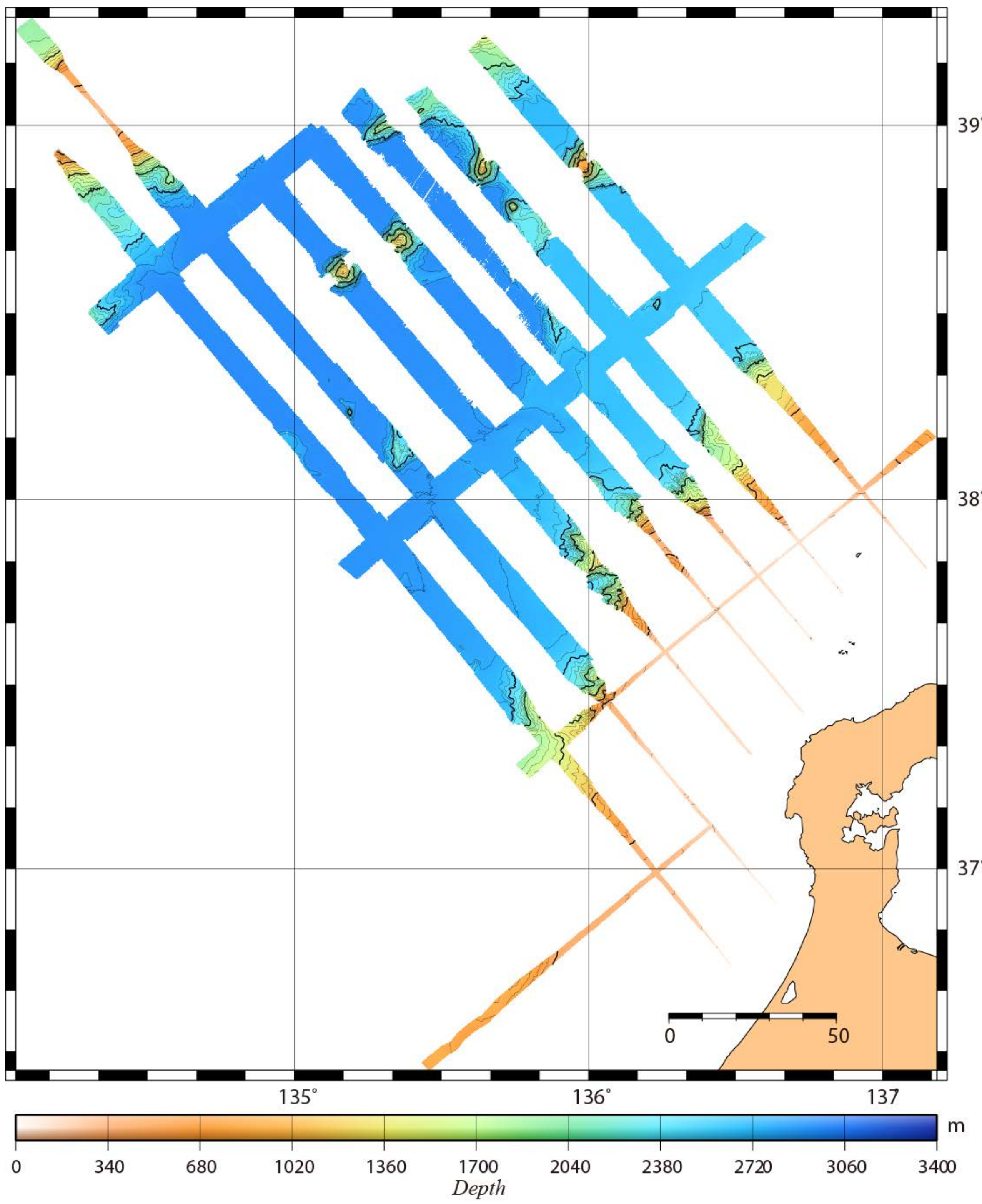


Fig. 9 Result of the bathymetric survey in this survey.

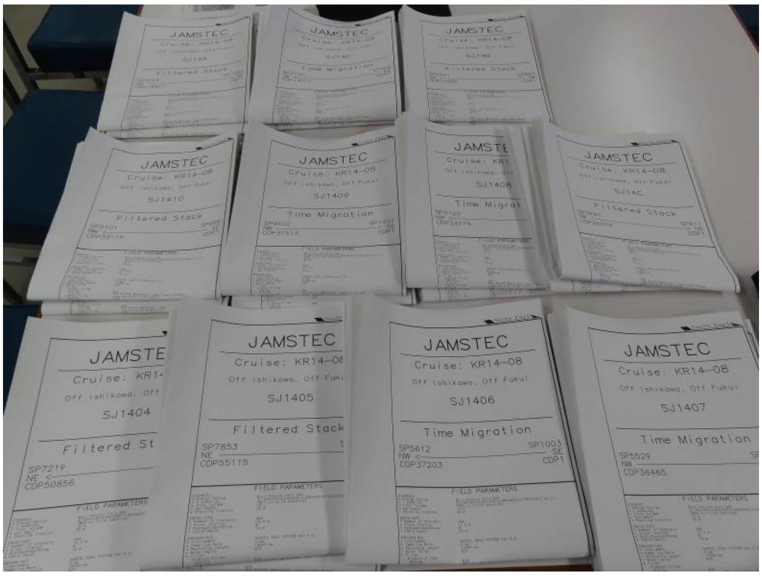
(3) Cruise log: Table 2

Date		Remarks
2014/7/22	Tue.	Departure from Maizuru port, transit to the survey area. OBS deployment (Site#60-49).
2014/7/23	Wed.	OBS deployment (Site#48-12).
2014/7/24	Thu.	OBS deployment (Site#11-1), airgun shooting (SJ1405 [NW to SE], 200 m shot interval).
2014/7/25	Fri	Airgun shooting (SJ1405 [NW to SE], 200 m shot interval).
2014/7/26	Sat	Airgun shooting (SJ1405 [NW to SE, SE to NW], 200 m shot interval). Stop shooting due to bad weather and sea condition, and retrieve all equipments.
2014/7/27	Sun	Airgun shooting (SJ1405 [SE to NW], 200 m shot interval).
2014/7/28	Mon	Airgun shooting (SJ1405 [SE to NW], 200 m shot interval), OBS retrieval (Site#1-9).
2014/7/29	Tue	OBS retrieval (Site#10-27).
2014/7/30	Wed	OBS retrieval (Site#28-38).
2014/7/31	Thu	OBS retrieval (Site#39-#54).
2014/8/1	Fri	OBS retrieval (Site#55-#60).
2014/8/2	Sat	Call at the Niigata port due to supplies and so on.
2014/8/3	Sun	Call at the Niigata port due to supplies and so on.
2014/8/4	Mon	Departure from Niigata port, transit to the survey area.
2014/8/5	Tue	MCS survey (SJ1405).
2014/8/6	Wed	MCS survey (SJ1405, 1404).
2014/8/7	Thu	MCS survey (SJ1404). Stop survey due to a tropical cyclone, and retrieve all equipments.
2014/8/8	Fri	Stand by all day in the Seto Inland Sea due to a tropical cyclone.
2014/8/9	Sat	Stand by all day in the Seto Inland Sea due to a tropical cyclone.
2014/8/10	Sun	Stand by all day in the Seto Inland Sea due to a tropical cyclone.
2014/8/11	Mon	Stand by all day in the Seto Inland Sea due to a tropical cyclone.
2014/8/12	Tue	MCS survey (SJ14A).
2014/8/13	Wed	MCS survey (SJ14A, 1406).
2014/8/14	Thu	MCS survey (SJ1406, 1407, 1408).
2014/8/15	Fri	MCS survey (SJ1408, 1409, 1410).
2014/8/16	Sat	MCS survey (SJ14B).
2014/8/17	Sun	MCS survey (SJ14B, 1404).
2014/8/18	Mon	MCS survey (SJ1404, 1405).
2014/8/19	Tue	MCS survey (SJ1405).
2014/8/20	Wed	MCS survey (SJ14C).
2014/8/21	Thu	MCS survey (SJ1410).
2014/8/22	Fri	MCS survey (SJ1409, 1408).
2014/8/23	Sat	MCS survey (SJ1408, 1407).
2014/8/24	Sun	MCS survey (SJ1407, 1406).
2014/8/25	Mon	MCS survey (SJ14D). Retrieve streamer cable system.
2014/8/26	Tue	Retrieve airgun array system.

Table 2 Cruise log during the survey.

Date		Remarks
2014/8/27	Wed	Transit to JAMSTEC port (Yokosuka).
2014/8/28	Thu	Transit to JAMSTEC port (Yokosuka).
2014/8/29	Fri	Transit to JAMSTEC port (Yokosuka).
2014/8/30	Sat	Arrival at JAMSTEC port (Yokosuka).

Table 2 (Continued)　Cruise log during the survey.



(4) Seismic lines：Fig. 10

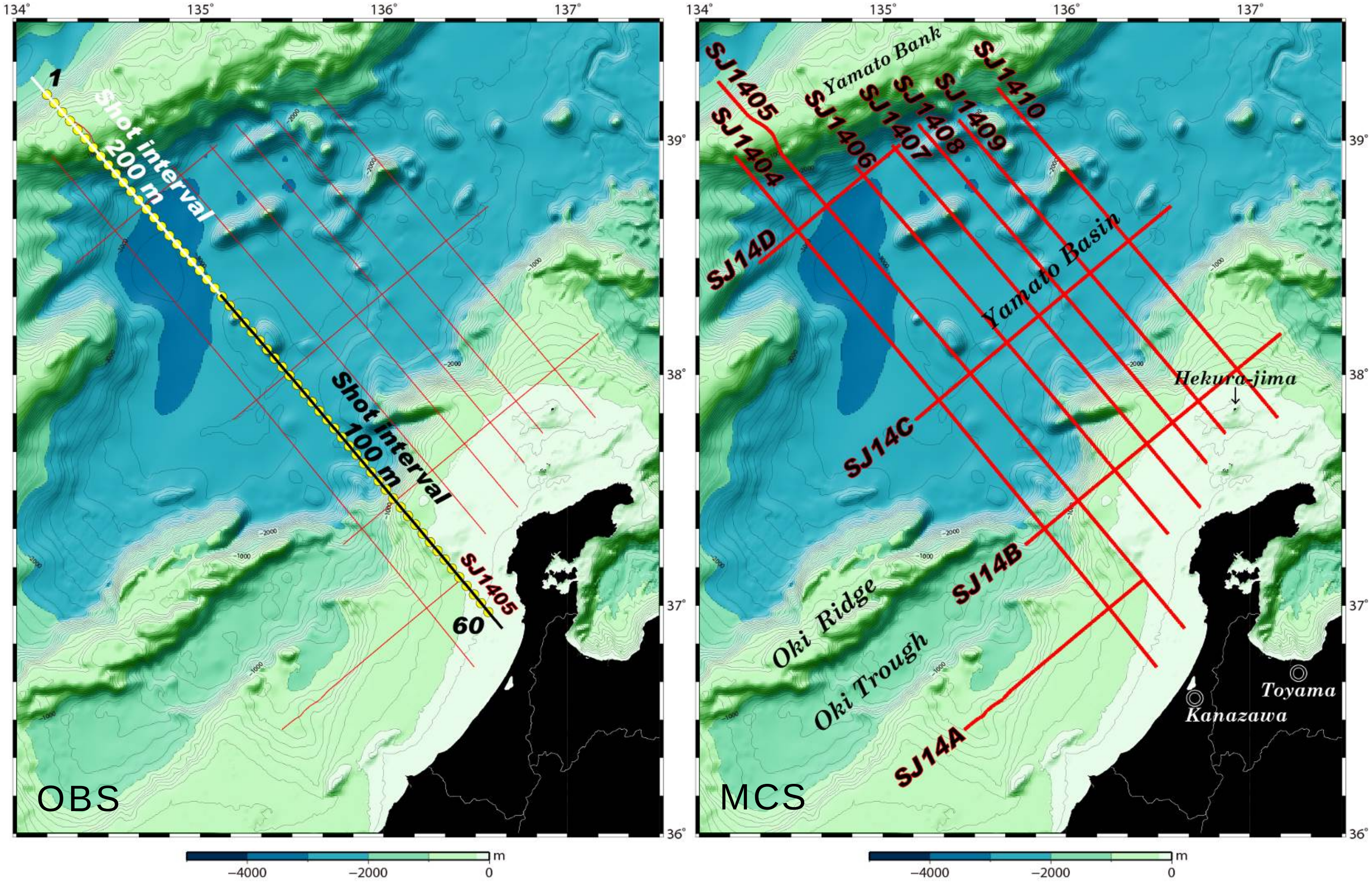


Fig. 10 Bathymetry and location maps of the survey area in the eastern margins of the Japan Sea. Red lines are the MCS lines of this survey, and yellow circles are the positions of the OBS sites.

(5) Seismic line list: Table 3

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
SJ14A_0	12/08/2014	06:28:54	3522	36_27.50587'N	135_26.81553'E	820	112.8	49.5	Distance (50.0m)
	12/08/2014	06:28:54	3522	36_27.50587'N	135_26.81553'E	820			
	12/08/2014	20:10:33	1266	37_06.66262'N	136_24.97695'E	212			
	12/08/2014	20:10:33	1266	37_06.66262'N	136_24.97695'E	212			
SJ14B_0	15/08/2014	23:46:46	861	38_10.53213'N	137_10.05950'E	834	158.9	229.6	Distance (50.0m)
	15/08/2014	23:47:24	863	38_10.49830'N	137_10.00609'E	830			
	16/08/2014	17:17:41	4041	37_15.82559'N	135_46.57247'E	1768			
	16/08/2014	17:17:41	4041	37_15.82559'N	135_46.57247'E	1768			
SJ14C_0	19/08/2014	18:45:35	4050	37_48.36183'N	135_10.78774'E	2936	154.0	49.6	Distance (50.0m)
	19/08/2014	19:12:14	3961	37_49.92332'N	135_13.09612'E	2942			
	20/08/2014	11:32:32	881	38_43.30489'N	136_34.16834'E	2608			
	20/08/2014	11:32:32	881	38_43.30489'N	136_34.16834'E	2608			
SJ14D_0	24/08/2014	18:13:44	990	38_58.83479'N	135_05.51033'E	2972	84.0	230.2	Distance (50.0m)
	24/08/2014	18:34:59	1050	38_57.78392'N	135_03.92732'E	2979			
	25/08/2014	04:00:04	2730	38_28.57823'N	134_19.52695'E	2284			
	25/08/2014	04:00:04	2730	38_28.57823'N	134_19.52695'E	2284			
SJ1404_0	06/08/2014	07:54:49	881	36_44.00112'N	136_29.36667'E	77	108.7	320.2	Distance (50.0m)
	06/08/2014	08:07:10	915	36_44.71886'N	136_28.65291'E	83			
	06/08/2014	19:00:29	3088	37_30.27847'N	135_42.31520'E	2702			
	06/08/2014	19:00:29	3088	37_30.27847'N	135_42.31520'E	2702			
SJ1404_1	16/08/2014	20:58:07	2848	37_25.26132'N	135_47.47888'E	2003	216.9	320.2	Distance (50.0m)
	16/08/2014	21:07:35	2881	37_25.95124'N	135_46.76935'E	2097			
	17/08/2014	20:20:27	7219	38_56.02050'N	134_11.58083'E	448			
	17/08/2014	20:20:27	7219	38_56.02050'N	134_11.58083'E	448			
SJ1405_0	05/08/2014	08:36:41	4056	37_57.25823'N	135_31.97027'E	2871	150.6	139.2	Distance (50.0m)
	05/08/2014	08:54:54	4012	37_56.30604'N	135_32.87558'E	2881			
	06/08/2014	04:15:37	1001	36_54.02489'N	136_38.61374'E	57			
	06/08/2014	04:15:37	1001	36_54.02489'N	136_38.61374'E	57			
SJ1405_1	18/08/2014	04:34:22	7855	39_14.85829'N	134_06.22299'E	1928	3.2	139.2	Distance (50.0m)
	18/08/2014	04:57:13	7787	39_13.47524'N	134_07.77994'E	1908			
	18/08/2014	05:17:57	7723	39_12.17614'N	134_09.24850'E	1821			
	18/08/2014	05:33:40	7678	39_11.26336'N	134_10.28189'E	1551			
SJ1405_2	18/08/2014	12:59:03	7840	39_14.55712'N	134_06.57230'E	1937	193.6	139.2	Distance (50.0m)
	18/08/2014	13:28:40	7764	39_13.01217'N	134_08.31331'E	1889			
	19/08/2014	11:44:49	3892	37_53.82987'N	135_35.52245'E	2874			
	19/08/2014	11:44:49	3892	37_53.82987'N	135_35.52245'E	2874			

Table 3 List of seismic survey lines.

SJ1405OBS_0	24/07/2014	04:36:22	7913	39_16.02312'N	134_04.90787'E	1990	345.6	139.2	Distance (200.0m)
	24/07/2014	04:36:22	7913	39_16.02312'N	134_04.90787'E	1990			
	25/07/2014	22:51:26	1001	36_54.01121'N	136_38.62820'E	56			
	25/07/2014	22:51:26	1001	36_54.01121'N	136_38.62820'E	56			
SJ1405OBSR_0	25/07/2014	23:23:58	995	36_54.06312'N	136_38.59435'E	56	59.4	319.2	Distance (200.0m)
	25/07/2014	23:23:58	995	36_54.06312'N	136_38.59435'E	56			
	26/07/2014	05:54:06	2183	37_18.69668'N	136_12.85767'E	218			
	26/07/2014	05:54:06	2183	37_18.69668'N	136_12.85767'E	218			
SJ1405OBSR_1	27/07/2014	04:32:05	2127	37_17.53794'N	136_14.07248'E	167	153.0	319.2	Distance (200.0m)
	27/07/2014	04:32:05	2127	37_17.53794'N	136_14.07248'E	167			
	27/07/2014	22:00:38	5187	38_20.58652'N	135_06.53463'E	2972			
	27/07/2014	22:00:38	5187	38_20.58652'N	135_06.53463'E	2972			
SJ1406_0	12/08/2014	23:51:12	1003	37_18.79639'N	136_33.15015'E	146	87.6	319.1	Distance (50.0m)
	13/08/2014	00:08:45	1049	37_19.74730'N	136_32.14661'E	155			
	13/08/2014	10:54:05	2801	37_55.95434'N	135_53.74426'E	2600			
	13/08/2014	10:54:05	2801	37_55.95434'N	135_53.74426'E	2600			
SJ1406_1	23/08/2014	22:08:54	2561	37_51.00673'N	135_59.04193'E	2000	148.5	319.1	Distance (50.0m)
	23/08/2014	22:32:48	2643	37_52.69917'N	135_57.23553'E	1967			
	24/08/2014	13:45:28	5612	38_53.60507'N	134_50.80030'E	2808			
	24/08/2014	13:45:28	5612	38_53.60507'N	134_50.80030'E	2808			
SJ1407_0	13/08/2014	13:58:14	2806	38_02.80924'N	136_04.22461'E	2554	87.3	139.0	Distance (50.0m)
	13/08/2014	14:17:24	2747	38_01.59837'N	136_05.53748'E	2488			
	13/08/2014	23:14:05	1001	37_25.51331'N	136_43.84849'E	106			
	13/08/2014	23:14:05	1001	37_25.51331'N	136_43.84849'E	106			
SJ1407_1	23/08/2014	00:21:19	5530	38_58.68154'N	135_03.16030'E	2980	141.9	139.0	Distance (50.0m)
	23/08/2014	00:43:22	5464	38_57.33819'N	135_04.66448'E	2979			
	23/08/2014	19:05:31	2627	37_59.12452'N	136_08.19015'E	2078			
	23/08/2014	19:05:31	2627	37_59.12452'N	136_08.19015'E	2078			
SJ1408_0	14/08/2014	02:23:23	891	37_37.16393'N	136_45.79264'E	106	75.0	318.9	Distance (50.0m)
	14/08/2014	02:26:59	902	37_37.39133'N	136_45.55173'E	109			
	14/08/2014	10:58:09	2401	38_08.35745'N	136_12.57283'E	2628			
	14/08/2014	10:58:09	2401	38_08.35745'N	136_12.57283'E	2628			
SJ1408_1	22/08/2014	05:21:55	2150	38_03.18429'N	136_18.12963'E	2228	146.7	318.9	Distance (50.0m)
	22/08/2014	05:36:47	2186	38_03.92594'N	136_17.33248'E	2392			
	22/08/2014	21:57:11	5120	39_04.12159'N	135_11.53864'E	2837			
	22/08/2014	21:57:11	5120	39_04.12159'N	135_11.53864'E	2837			
SJ1409_0	14/08/2014	13:41:40	2406	38_13.79318'N	136_21.03185'E	2525	68.0	138.8	Distance (50.0m)
	14/08/2014	13:59:41	2360	38_12.84866'N	136_22.05737'E	2480			
	14/08/2014	22:01:33	1001	37_44.78276'N	136_52.00434'E	109			
	14/08/2014	22:01:33	1001	37_44.78276'N	136_52.00434'E	109			

Table 3 (Continued) List of seismic survey lines.

SJ1409_1	21/08/2014	11:44:15	4905	39_05.06910'N	135_24.93421'E	2382	130.2	138.8	Distance (50.0m)
	21/08/2014	12:05:28	4843	39_03.79848'N	135_26.33703'E	2114			
	22/08/2014	02:43:23	2240	38_10.37517'N	136_24.71659'E	1827			
	22/08/2014	02:43:23	2240	38_10.37517'N	136_24.71659'E	1827			
SJ1410_0	15/08/2014	01:49:57	996	37_48.90865'N	137_09.04499'E	146	83.8	318.7	Distance (50.0m)
	15/08/2014	02:09:38	1057	37_50.16795'N	137_07.70338'E	145			
	15/08/2014	11:00:23	2732	38_24.75610'N	136_30.72156'E	2512			
	15/08/2014	11:00:23	2732	38_24.75610'N	136_30.72156'E	2512			
SJ1410_1	20/08/2014	18:09:34	2510	38_20.18637'N	136_35.66228'E	1550	127.1	318.7	Distance (50.0m)
	20/08/2014	18:23:52	2559	38_21.19410'N	136_34.57080'E	1697			
	21/08/2014	08:30:14	5101	39_13.34206'N	135_37.39593'E	1581			
	21/08/2014	08:30:14	5101	39_13.34206'N	135_37.39593'E	1581			

Table 3 (Continued) List of seismic survey lines.

(6) **OBS position list**: Table 4

Site	Lat. [N]	Lon. [E]	Depth (m)	Site	Lat. [N]	Lon. [E]	Depth (m)
1	39_11.4949	134_09.7797	1659	**31**	38_04.1872	135_24.4244	2923
2	39_09.2702	134_12.4457	763	**32**	38_01.9437	135_26.9055	2932
3	39_07.1402	134_14.9478	551	**33**	37_59.6912	135_29.3161	2913
4	39_04.8495	134_17.5635	401	**34**	37_57.4244	135_31.7780	2916
5	39_02.6111	134_19.9585	312	**35**	37_55.0907	135_34.2242	2902
6	39_00.4289	134_22.5055	343	**36**	37_52.8401	135_36.6412	2888
7	38_58.1090	134_25.0955	520	**37**	37_50.5980	135_39.1992	2877
8	38_55.8586	134_27.5565	890	**38**	37_48.4694	135_41.6739	2850
9	38_53.5904	134_30.0906	1761	**39**	37_46.2147	135_44.0479	2834
10	38_51.4243	134_32.5644	2247	**40**	37_43.9087	135_46.4447	2806
11	38_49.1473	134_35.1306	2590	**41**	37_41.6245	135_48.7491	2806
12	38_46.6605	134_37.4185	2916	**42**	37_39.3354	135_51.1743	2807
13	38_44.5278	134_40.0497	2968	**43**	37_36.9869	135_53.5767	2729
14	38_42.3935	134_42.5436	2979	**44**	37_34.7063	135_55.9909	2607
15	38_40.0896	134_45.1895	2976	**45**	37_32.4976	135_58.2578	2288
16	38_37.8390	134_47.8390	2983	**46**	37_30.1371	136_00.8020	2063
17	38_35.5966	134_49.9878	2978	**47**	37_27.8611	136_03.2135	1011
18	38_33.2920	134_52.2986	2978	**48**	37_25.5949	136_05.5920	356
19	38_31.1316	134_54.9756	2975	**49**	37_23.3281	136_07.9706	380
20	38_28.9094	134_57.3917	2973	**50**	37_21.0308	136_10.3720	267
21	38_26.5910	134_59.8160	2975	**51**	37_18.7729	136_12.7423	236
22	38_24.3796	135_02.2430	2979	**52**	37_16.5262	136_15.1456	151
23	38_22.2439	135_04.9173	2950	**53**	37_14.2335	136_17.3529	164
24	38_19.8908	135_07.3444	2969	**54**	37_11.9822	136_19.9567	201
25	38_17.6012	135_09.8511	2948	**55**	37_09.7002	136_22.3242	216
26	38_15.4591	135_12.1381	2868	**56**	37_07.5105	136_24.6204	209
27	38_13.2745	135_14.6622	2996	**57**	37_05.1682	136_27.0731	229
28	38_10.9930	135_17.0554	2990	**58**	37_02.8908	136_29.4370	161
29	38_08.7600	135_19.5355	2708	**59**	37_00.5637	136_31.8521	147
30	38_06.4428	135_21.9141	2395	**60**	36_58.2866	136_34.1803	86

Table 4 List of OBS position of the line SJ1405.

4. Notice on using:

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.

Acknowledgement:

We thank the captain, Mr. Shinya Ryono, and the crew of the R/V *KAIREI*, and the marine technician team (Nippon Marine Enterprises, Ltd.) for their efforts in obtaining the MCS data, OBS data, and other geophysical data. We are grateful to participants of CEAT (Research and Development center for Earthquake and Tsunami) and MARITEC (Marine Technology Center) in JAMSTEC for their great support in this cruise. This project is funded by a program called "Integrated Research Project on Seismic and Tsunami Hazards Around the Sea of Japan," 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" by Wessel and Smith (1991) to construct the figures.

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