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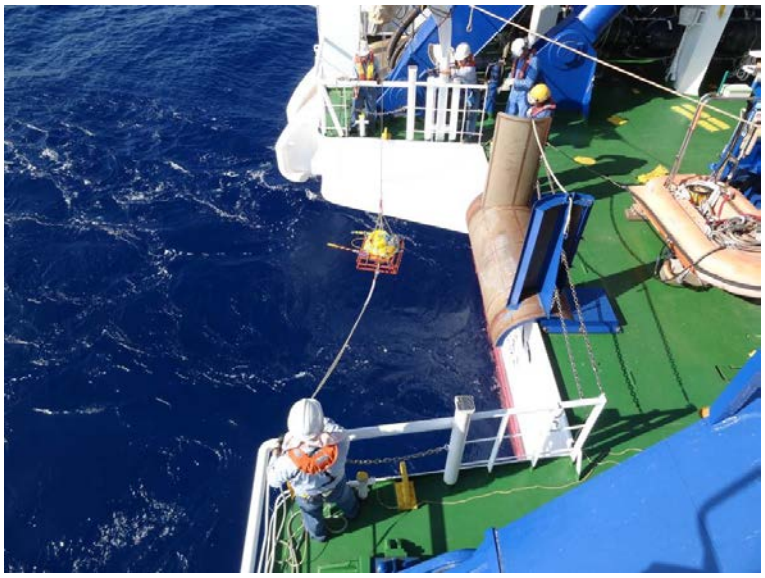
KR15-11 Cruise Report

Jul. 22, 2015 – Aug. 22, 2015

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Contents:



1. Cruise Information:

(1) **Cruise ID, Ship name:** KR15-11, R/V *KAIREI*

(2) **Title of the cruise:** 2015FY "Research project for compound disaster mitigation on the great earthquakes and tsunamis around the Nankai trough region" and "Integrated Research Project on Seismic and Tsunami Hazards Around the Sea of Japan"

(3) **Title of proposal:**

a) Research project for compound disaster mitigation on the great earthquakes and tsunamis around the Nankai trough region

b) Integrated Research Project on Seismic and Tsunami Hazards Around the Sea of Japan

(4) **Cruise period, Port call:** 2015/7/22 - 8/22, JAMSTEC port to JAMSTEC port (Yokosuka)

(5) **Research Area:** Off Nansei Islands, Japan Sea

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

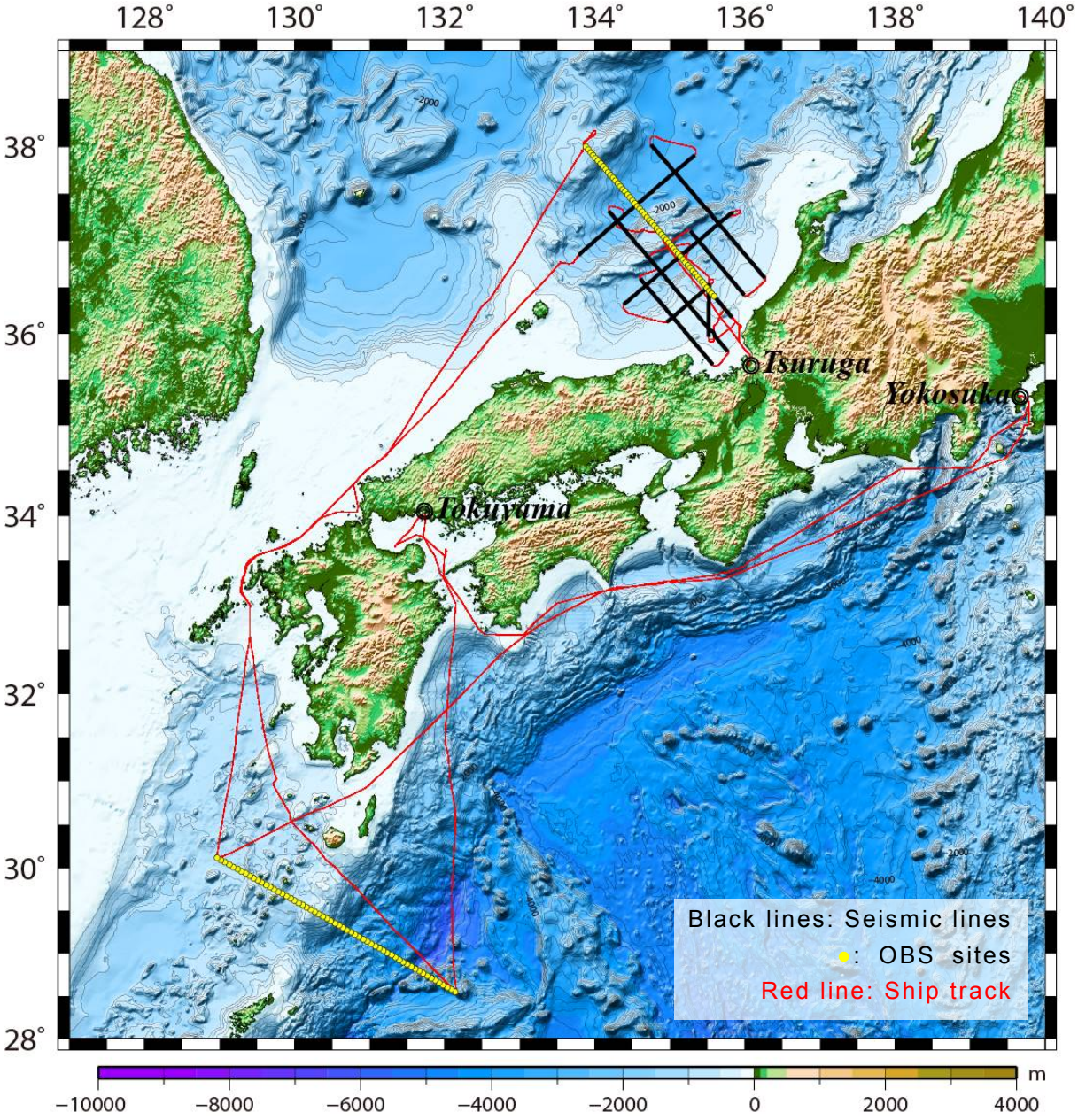


Fig. 1 Ship track during KR15-11 cruise.

2. Researchers:

(1) Chief Scientists [Affiliation]:

Tsutomu TAKAHASHI [JAMSTEC] (Leg 1)
Tetsuo NO [JAMSTEC] (Leg 2–4)

(2) Representative of Science Party [Affiliation]:

Shuichi KODAIRA [JAMSTEC]

(3) KR15-11 Shipboard Science Party:

Tsutomu TAKAHASHI [JAMSTEC]: Chief Scientist (Leg 1)
Tetsuo NO [JAMSTEC]: Chief Scientist (Leg 2-4)
Takeshi SATO [JAMSTEC]: Vice-chief Scientist (Leg 1)
Ryuta ARAI [JAMSTEC]: Vice-chief Scientist (Leg 2-4)
Seiichi MORI [Nippon Marine Enterprises, Ltd. (NME)]: Chief marine technician (Leg 1-4)
Akie SUZUKI [NME]: Marine technician (Leg 1-4)
Hidenori SHIBATA [NME]: Marine technician (Leg1-4)
Hikaru IWAMARU [NME]: Marine technician (Leg1-4)
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Kaoru TSUKUDA [NME]: Marine technician (Leg2-4)
Keita SUZUKI [NME]: Marine technician (Leg 1-4)
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Naoto NOGUCHI [NME]: Marine technician (Leg 1-4)
Ryo MIURA [NME]: Marine technician (Leg 1-4)
Toshinori SAIJO [NME]: Marine technician (Leg 1)
Waka KOMATSU [NME]: Marine technician (Leg 2-4)
Yuki OHWATARI [NME]: Marine technician (Leg 2-4)

3. Overview of Observation:

(1) Objective:

a) Off Nansei Islands:

Seismic studies in Ryukyu subduction zone are usually based on the seismic data on islands, and therefore island distribution causes a significant restriction of estimations of seismicity and underground structures in this area. To elucidate details of seismicity, lithospheric structures and plate geometry of this arc, we launched a series of passive and active seismic surveys around Ryukyu arc, as a part of research project "Research project for compound disaster mitigation on the great earthquakes and tsunamis around the Nankai trough region" funded by Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. In 2013FY, we have conducted a seismic survey in southern part of Ryukyu arc. This observation successfully clarified high seismicity in the crust, the splay fault near the fault zone of the 1771 Yaeyama earthquake, and precise geometry of subducting Philippine Sea plate. In 2015FY and 2016FY, we will conduct seismic surveys in northern part of Ryukyu arc that is adjacent to the mega-thrust fault zone of Nankai trough. This study conducts a wide-angle refraction survey in northern Ryukyu arc to clarify the plate geometry and seismic velocity structure.

b) Japan Sea:

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). 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 MEXT of Japan; in particular, we have performed seismic surveys from the R/V *KAIREI* in the Japan Sea since 2014.

In August 2015, we conducted a marine seismic survey to study the crustal structure around the area off Fukui and Kyoto. The survey covered the areas from the continental shelf to the Yamato Basin and the Kita-Oki Bank. 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 (Ito et al., 2006; Nakanishi et al, 2008), we obtain the crustal structure imaging of the central Japan ranging from the Nankai Trough to the Japan Sea in the present study.

(2) List of observation instruments:

1) Multichannel seismic reflection (MCS) survey (Leg 3 [Japan Sea])

We used a multichannel seismic reflection (MCS) system of the R/V *KAIREI* (Miura, 2009) (Fig. 2). MCS data were acquired along 9 lines (SJ1502, SJ1503, SJ1506, SJ1507, SJ15A, SJ15B, SJ15C, SJ15MZ, and SJ15FK) with a total length of approximately 1358.9 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 45 m by a paravane system, and the central position of the array was set 203 m behind that of the ship's antenna.

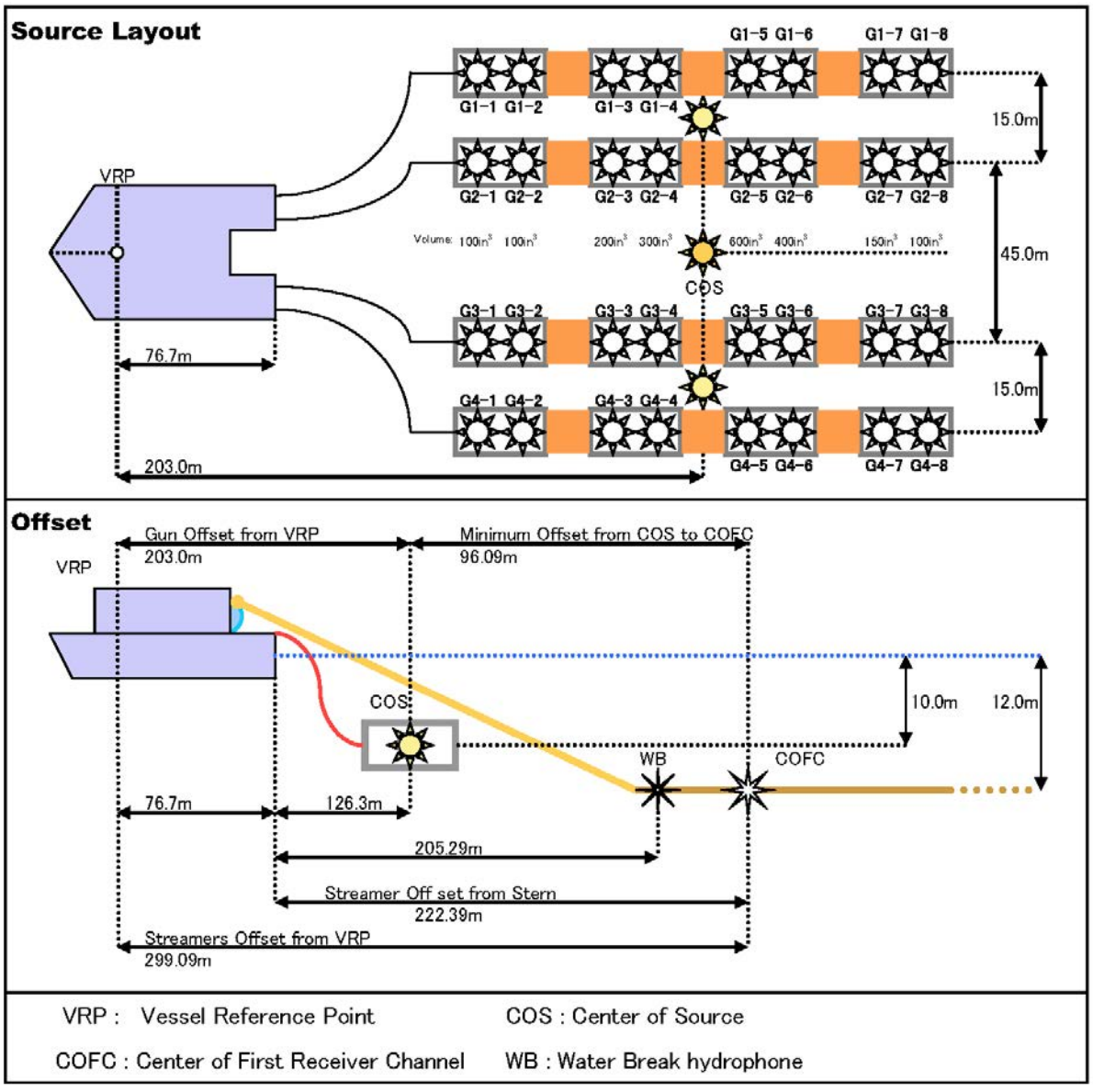


Fig. 3 Vessel towing geometry during the MCS survey. Top figure shows the source (airgun system) layout, bottom figure represents source–receiver depth and position, and navigation offsets.

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).

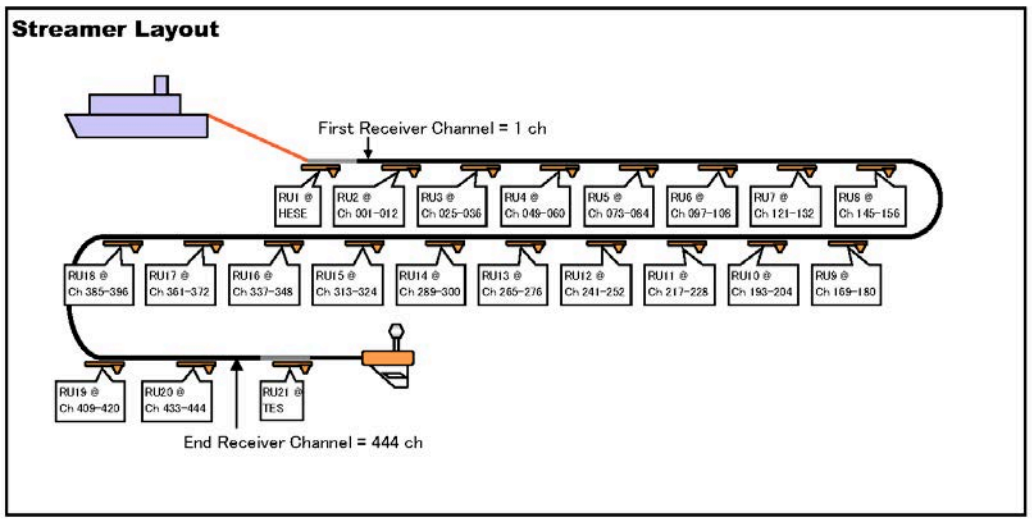


Fig. 4 Streamer cable configuration during the MCS survey.

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).

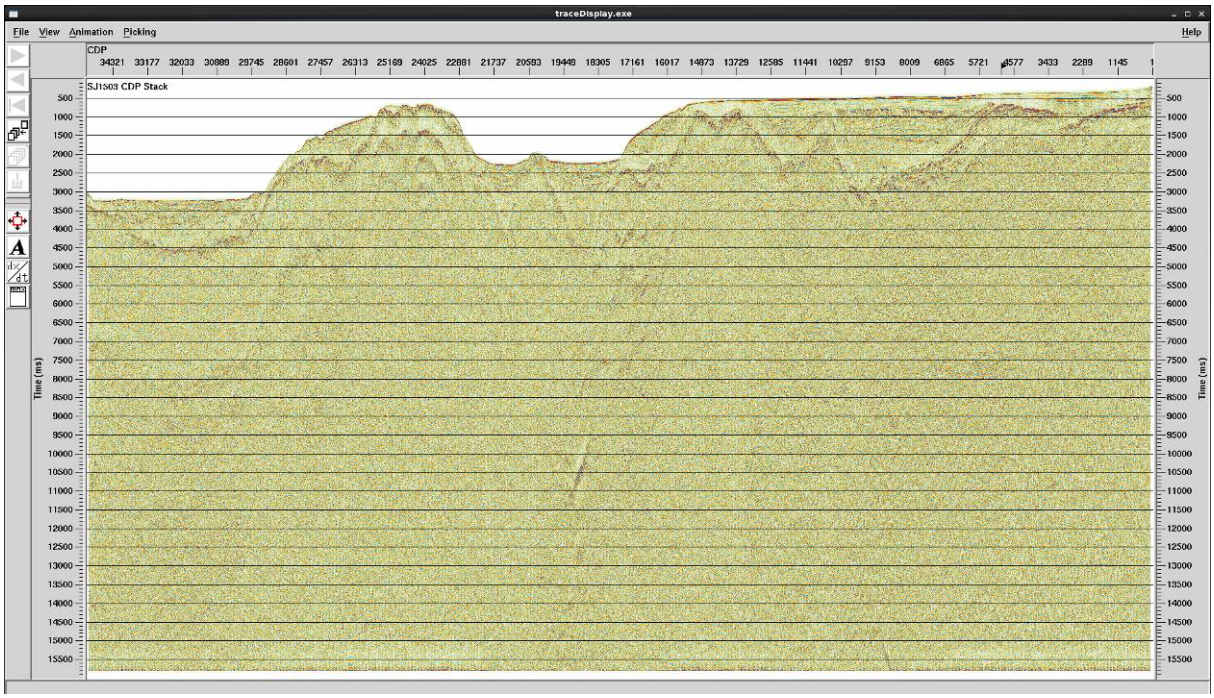


Fig. 5 Example of MCS profile with onboard processing (SJ1503).

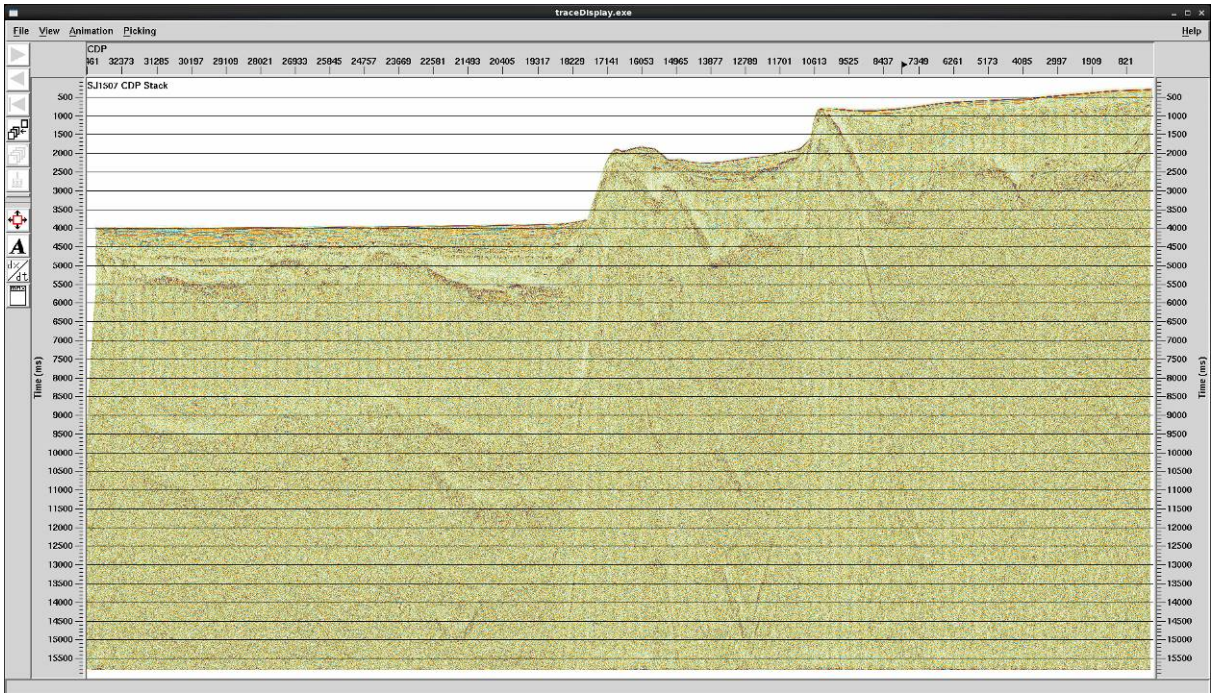


Fig. 6 Example of MCS profile with onboard processing (SJ1507).

2) Refraction survey using OBSs (Off Nansei Islands and Japan Sea)

We deployed 54 OBSs along the line SJ15FK (Japan Sea) and 60 OBSs along the line RK01 (Off Nansei Islands). Seismic survey of the line RK01 could not be conducted due to typhoons. The line SJ15FK performed a refraction survey using an airgun array with a shot spacing of 200 m. 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.

Though OBS retrieval of the line RK01 was carried out the R/V *KAIREI*, OBSs of the line SJ15FK were retrieved by other vessel (the *KAIYO MARU NO.5*). The position at the sea bottom of each OBS of the line RK01 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.

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.

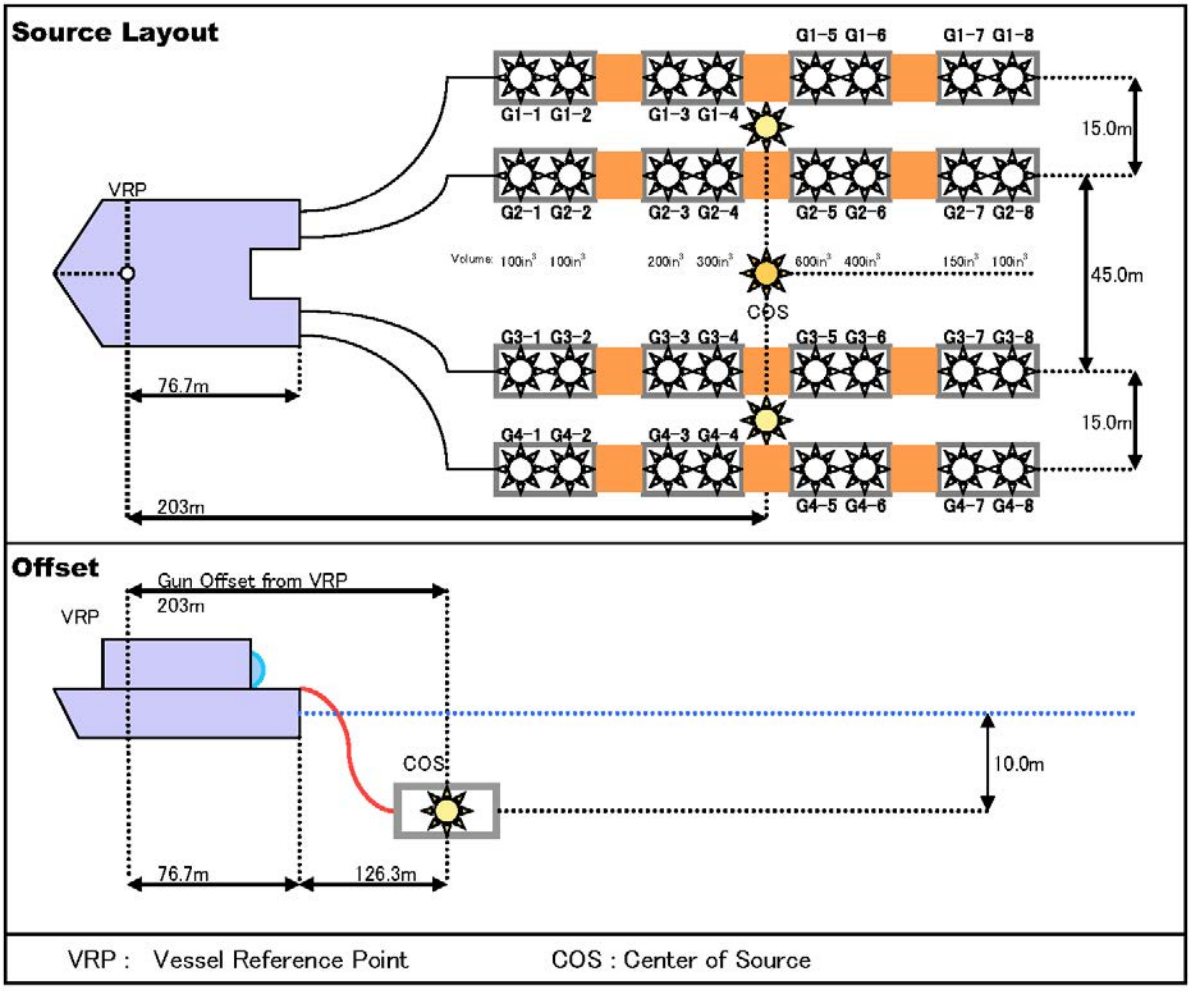
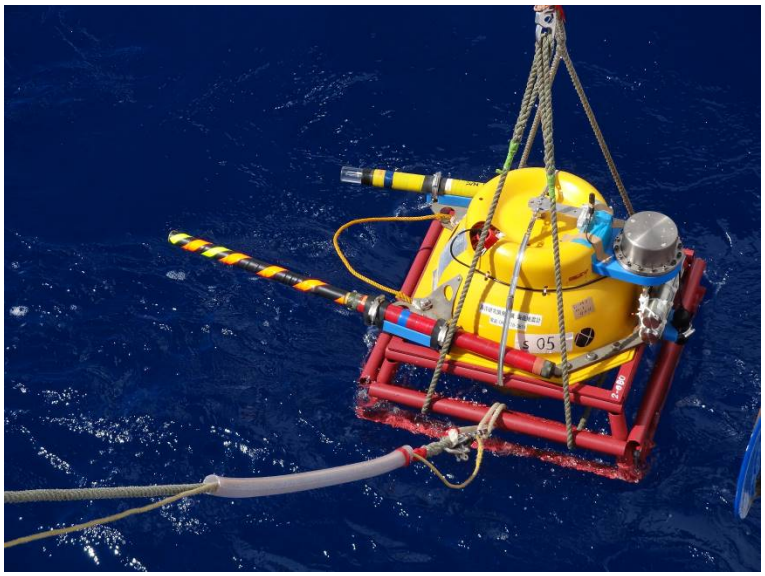


Fig. 7　Vessel towing geometry during the refraction survey of the line SJ15FK. Top figure shows the source (airgun system) layout, bottom figure represents source depth and position, and navigation offsets.



3) Bathymetry, magnetic, and gravity observations (Off Nansei Islands and Japan Sea):

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. 8). 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).

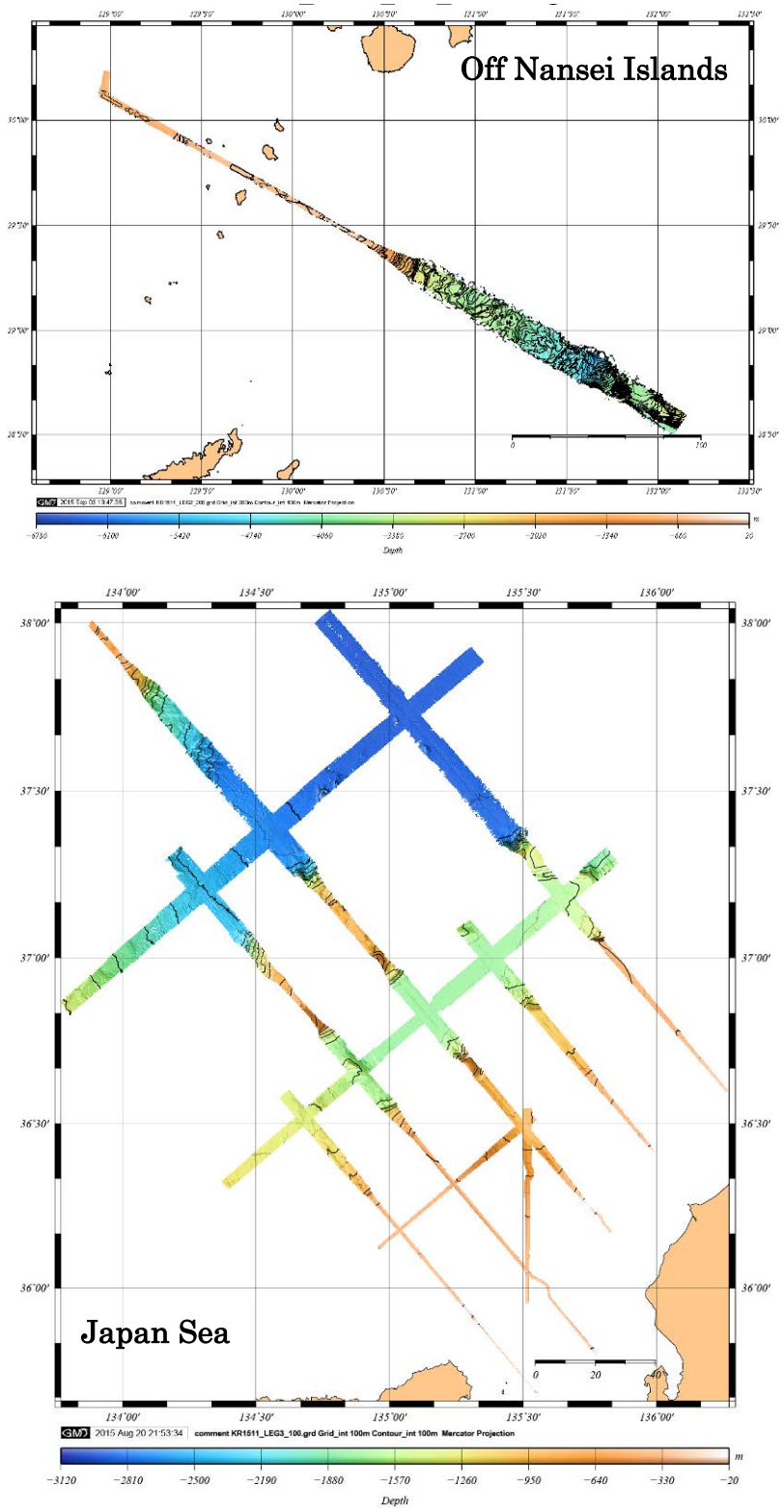


Fig. 8 Result of the bathymetric survey in this survey.

(3) **Cruise log:** Table 2

Leg	Date		Remarks
1	2015/7/22	Wed.	Departure from JAMSTEC port (Yokosuka), transit to the survey area (off Nansei Islands).
	2015/7/23	Thu.	Transit to the survey area (off Nansei Islands).
	2015/7/24	Fri	Stand by all day in the Seto Inland Sea due to a typhoon.
	2015/7/25	Sat	Stand by all day in the Seto Inland Sea due to a typhoon.
	2015/7/26	Sun	Stand by all day in the Seto Inland Sea due to a typhoon.
	2015/7/27	Mon	Stand by all day in the Seto Inland Sea due to a typhoon.
2	2015/7/28	Tue	Transit to the survey area (off Nansei Islands).
	2015/7/29	Wed	OBS deployment.
	2015/7/30	Thu	OBS deployment.
	2015/7/31	Fri	Transit to the survey area (Japan sea).
3	2015/8/1	Sat	OBS deployment.
	2015/8/2	Sun	OBS deployment.
	2015/8/3	Mon	Call at the Tsuruga port due to supplies in the morning. Airgun shooting from the afternoon (SJ15FK, 200 m shot interval).
	2015/8/4	Tue	Airgun shooting (SJ15FK, 200 m shot interval).
	2015/8/5	Wed	Airgun shooting (SJ15FK, 200 m shot interval), and MCS survey (SJ15FK).
	2015/8/6	Thu	MCS survey (SJ15FK, 15C).
	2015/8/7	Fri	MCS survey (SJ1507).
	2015/8/8	Sat	MCS survey (SJ1507, 1506).
	2015/8/9	Sun	MCS survey (SJ1506, 15FK, 15C).
	2015/8/10	Mon	MCS survey (SJ15C, 15FK, 15MZ).
	2015/8/11	Tue	MCS survey (SJ150MZ, 15A, 15B).
	2015/8/12	Wed	MCS survey (SJ15B, 1503).
	2015/8/13	Thu	MCS survey (SJ1503, 1502).
	2015/8/14	Fri	MCS survey (SJ1502, 1503, 15C).
	2015/8/15	Sat	MCS survey (SJ15C), and retrieve all equipments.
	2015/8/16	Sun	Transit to the survey area (off Nansei Islands).
4	2015/8/17	Mon	OBS retrieval.
	2015/8/18	Tue	OBS retrieval.
	2015/8/19	Wed	OBS retrieval.
	2015/8/20	Thu	OBS retrieval. Stop survey due to typhoons, and transit to JAMSTEC port.
	2015/8/21	Fri	Transit to JAMSTEC port (Yokosuka).
	2015/8/22	Sat	Arrival at JAMSTEC port (Yokosuka).

Table 2　Cruise log during the survey.

(4) **Seismic lines** : Fig. 9

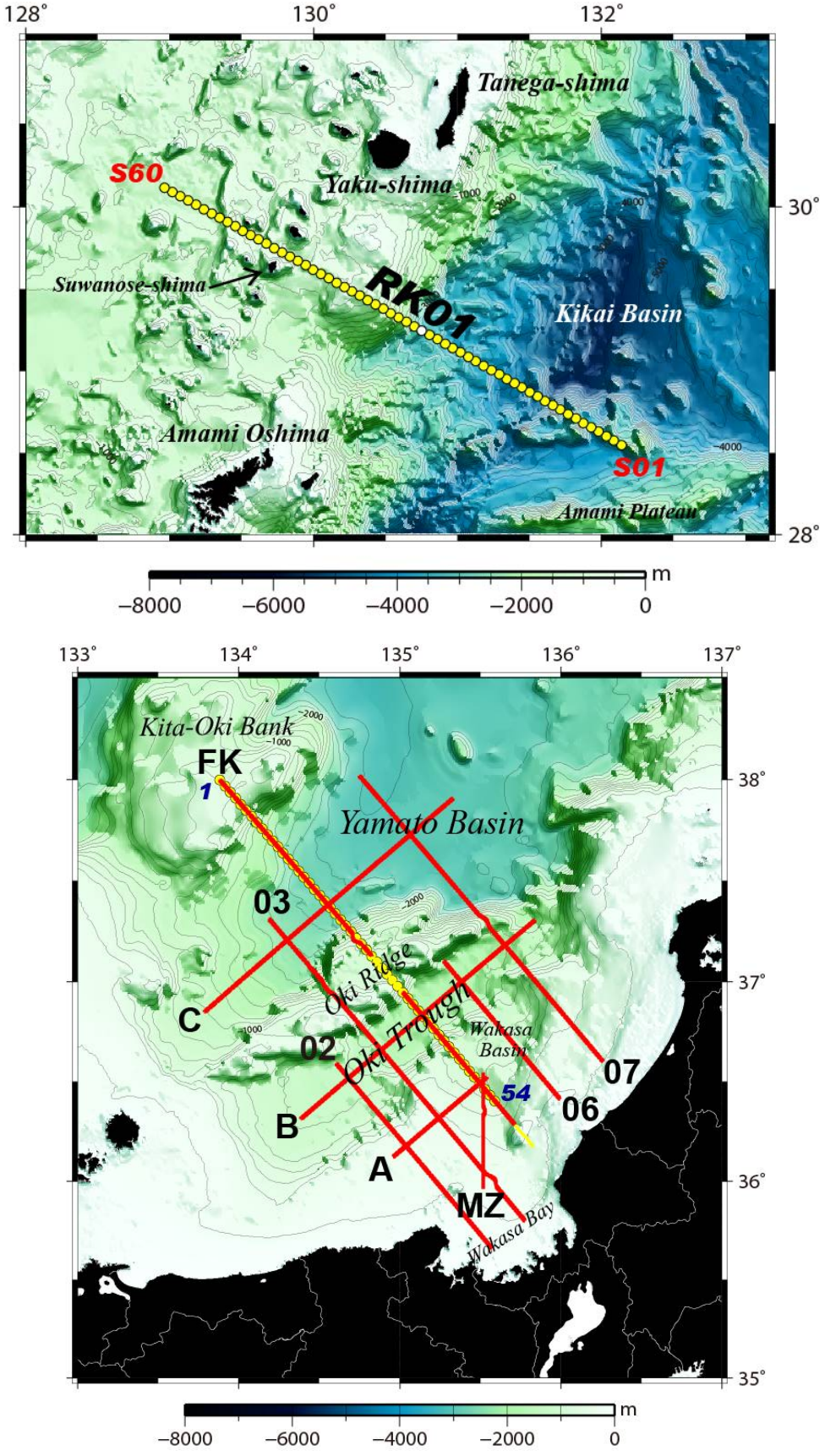


Fig. 9 Bathymetry and location maps of the survey area. Red lines are the MCS lines of this survey, and yellow circles are the positions of the OBS sites.

(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
SJ1502_0	13/08/2015	02:47:52	1001	35_39.66210'N	135_34.21226'E	90	132.9	319.9	Distance (50.0m)
	13/08/2015	03:01:40	1043	35_40.53416'N	135_33.32005'E	94			
	13/08/2015	20:02:48	3701	36_35.52812'N	134_36.23794'E	1355			
	13/08/2015	20:02:48	3701	36_35.52812'N	134_36.23794'E	1355			
SJ1503_0	12/08/2015	07:31:03	3901	36_45.82730'N	134_46.39305'E	1500	140.0	139.7	Distance (50.0m)
	12/08/2015	07:31:44	3899	36_45.78627'N	134_46.43694'E	1505			
	12/08/2015	23:54:55	1100	35_47.83593'N	135_46.59876'E	131			
	12/08/2015	23:54:55	1100	35_47.83593'N	135_46.59876'E	131			
SJ1503_1	13/08/2015	23:17:25	3779	36_43.48015'N	134_48.87028'E	1688	82.3	319.7	Distance (50.0m)
	13/08/2015	23:43:08	3852	36_44.98647'N	134_47.28514'E	1611			
	14/08/2015	08:42:07	5498	37_18.79640'N	134_11.17369'E	2241			
	14/08/2015	08:42:07	5498	37_18.79640'N	134_11.17369'E	2241			
SJ1506_0	08/08/2015	04:40:49	1201	36_24.81667'N	135_59.56100'E	110	94.1	319.5	Distance (50.0m)
	08/08/2015	05:18:16	1320	36_27.28602'N	135_57.00415'E	287			
	08/08/2015	15:15:26	3201	37_06.20031'N	135_16.27735'E	1581			
	08/08/2015	15:15:26	3201	37_06.20031'N	135_16.27735'E	1581			
SJ1507_0	07/08/2015	01:11:41	5340	38_01.05724'N	134_45.00081'E	2953	205.2	139.3	Distance (50.0m)
	07/08/2015	01:24:09	5304	38_00.32479'N	134_45.81114'E	2948			
	08/08/2015	00:21:19	1201	36_35.85443'N	136_15.86278'E	203			
	08/08/2015	00:21:19	1201	36_35.85443'N	136_15.86278'E	203			
SJ15A_0	10/08/2015	20:14:58	3301	36_31.23528'N	135_32.27653'E	796	67.9	229.5	Distance (50.0m)
	10/08/2015	20:19:09	3313	36_31.02689'N	135_31.96829'E	804			
	11/08/2015	04:30:17	4670	36_07.27026'N	134_57.39854'E	299			
	11/08/2015	04:30:17	4670	36_07.27026'N	134_57.39854'E	299			
SJ15B_0	09/08/2015	10:27:39	3902	37_18.22589'N	135_50.16320'E	1737	72.3	229.6	Distance (50.0m)
	09/08/2015	10:38:21	3934	37_17.67216'N	135_49.33091'E	1755			
	09/08/2015	18:16:29	5379	36_52.49932'N	135_12.02577'E	1746			
	09/08/2015	18:16:29	5379	36_52.49932'N	135_12.02577'E	1746			
SJ15B_1	11/08/2015	11:53:28	7303	36_18.82623'N	134_23.18695'E	1229	99.0	49.6	Distance (50.0m)
	11/08/2015	12:15:22	7239	36_19.95759'N	134_24.80578'E	1262			
	11/08/2015	23:50:10	5259	36_54.74179'N	135_15.31427'E	1762			
	11/08/2015	23:50:10	5259	36_54.74179'N	135_15.31427'E	1762			
SJ15C_0	05/08/2015	23:48:27	6102	37_12.28165'N	134_17.90141'E	2383	117.9	49.6	Distance (50.0m)
	06/08/2015	00:04:00	6057	37_13.07877'N	134_19.05092'E	2412			
	06/08/2015	14:54:12	3700	37_54.49206'N	135_19.91078'E	2935			
	06/08/2015	14:54:12	3700	37_54.49206'N	135_19.91078'E	2935			

Table 3 List of seismic survey lines in the Japan Sea.

SJ15C_1	14/08/2015	12:24:38	5937	37_15.05342'N	134_21.91758'E	2513	64.3	229.6	Distance (50.0m)
	14/08/2015	12:56:04	6017	37_13.64300'N	134_19.86598'E	2456			
	14/08/2015	21:25:00	7303	36_50.82796'N	133_47.12944'E	1408			
	14/08/2015	21:25:00	7303	36_50.82796'N	133_47.12944'E	1408			
SJ15FKmcs_0	05/08/2015	00:41:29	6401	37_59.75944'N	133_53.07328'E	575	125.0	139.6	Distance (50.0m)
	05/08/2015	01:00:09	6350	37_58.72126'N	133_54.21968'E	600			
	05/08/2015	17:21:53	3850	37_07.54889'N	134_49.70045'E	971			
	05/08/2015	17:21:53	3850	37_07.54889'N	134_49.70045'E	971			
SJ15FKmcs_1	08/08/2015	18:44:28	3323	36_56.70388'N	135_01.23415'E	1355	19.2	139.6	Distance (50.0m)
	08/08/2015	19:09:14	3272	36_55.65706'N	135_02.35284'E	1692			
	08/08/2015	22:00:14	2888	36_47.74408'N	135_10.72249'E	1749			
	08/08/2015	22:00:14	2888	36_47.74408'N	135_10.72249'E	1749			
SJ15FKmcs_2	09/08/2015	19:24:09	3008	36_50.21660'N	135_08.10808'E	1750	77.3	139.6	Distance (50.0m)
	09/08/2015	19:44:47	2946	36_48.93816'N	135_09.45763'E	1753			
	10/08/2015	04:33:11	1401	36_17.00310'N	135_42.85462'E	288			
	10/08/2015	04:33:11	1401	36_17.00310'N	135_42.85462'E	288			
SJ15FKobs_0	03/08/2015	10:18:08	1069	36_10.28974'N	135_49.79918'E	230	266.6	319.6	Distance (200.0m)
	03/08/2015	10:18:08	1069	36_10.28974'N	135_49.79918'E	230			
	04/08/2015	17:43:53	6401	37_59.92319'N	133_52.88854'E	571			
	04/08/2015	17:43:53	6401	37_59.92319'N	133_52.88854'E	571			
SJ15MZ_0	10/08/2015	11:41:16	1001	35_57.74393'N	135_30.97267'E	242	61.9	359.7	Distance (50.0m)
	10/08/2015	11:58:50	1061	35_59.36676'N	135_30.96971'E	258			
	10/08/2015	18:21:05	2298	36_32.82255'N	135_30.97029'E	840			
	10/08/2015	18:21:05	2298	36_32.82255'N	135_30.97029'E	840			

Table 3 (Continued) List of seismic survey lines in the Japan Sea.

(6) **OBS position list:** Tables 4 and 5.

Site	Lat. [N]	Lon.[E]	Depth [m]	Site	Lat. [N]	Lon.[E]	Depth [m]
1	37_59.8709	133_53.0330	574	**28**	37_11.2177	134_45.7724	1104
2	37_58.0250	133_54.9965	573	**29**	37_09.4230	134_47.7024	949
3	37_56.2377	133_56.9398	608	**30**	37_07.6290	134_49.6126	972
4	37_54.4334	133_58.9196	638	**31**	37_05.7973	134_51.5634	869
5	37_52.6340	134_00.9221	652	**32**	37_05.8399	134_51.5277	891
6	37_50.8302	134_02.9004	1022	**33**	37_03.8809	134_53.3981	931
7	37_49.0364	134_04.8598	1151	**34**	37_02.2446	134_55.3738	731
8	37_47.2460	134_06.8182	1747	**35**	37_00.3694	134_57.3651	970
9	37_45.4546	134_08.7729	1979	**36**	36_58.5256	134_59.3013	1347
10	37_43.6583	134_10.7347	2044	**37**	36_54.9234	135_03.1209	1732
11	37_41.8598	134_12.7037	2053	**38**	36_53.1196	135_05.0309	1745
12	37_40.0633	134_14.6484	2214	**39**	36_51.3040	135_06.9524	1751
13	37_38.2633	134_16.6053	2252	**40**	36_49.4866	135_08.8736	1749
14	37_36.4632	134_18.5721	2493	**41**	36_47.6793	135_10.7794	1747
15	37_34.6704	134_20.5162	2595	**42**	36_45.8543	135_12.6968	1672
16	37_32.8649	134_22.4699	2735	**43**	36_44.0486	135_14.6064	1551
17	37_31.0552	134_24.4385	2742	**44**	36_42.2288	135_16.5146	1134
18	37_29.2430	134_26.3557	2722	**45**	36_40.4382	135_18.3490	649
19	37_27.4579	134_28.3130	2713	**46**	36_38.4972	135_20.4804	992
20	37_25.6605	134_30.2633	2702	**47**	36_36.8333	135_22.2235	926
21	37_23.8667	134_32.1925	2709	**48**	36_35.0203	135_24.1251	939
22	37_22.0672	134_34.1392	2724	**49**	36_33.1654	135_26.0376	942
23	37_20.2579	134_36.0792	2721	**50**	36_31.3905	135_27.9501	899
24	37_18.4541	134_38.0192	2690	**51**	36_29.5038	135_30.0533	882
25	37_16.6449	134_39.9629	2530	**52**	36_27.7393	135_31.7706	855
26	37_14.8892	134_41.8846	2105	**53**	36_25.9300	135_33.5889	817
27	37_13.0335	134_43.8289	1211	**54**	36_24.1821	135_35.5884	723

Table 4　List of OBS position of the line SJ15FK.

Site	Lat. [N]	Lon.[E]	Depth [m]	Site	Lat. [N]	Lon.[E]	Depth [m]
S01	28_32.8947	132_08.3963	2958	**S31**	29_21.3347	130_32.6303	1266
S02	28_34.7302	132_05.4016	2606	**S32**	29_22.9266	130_29.2603	1047
S03	28_36.3068	132_02.0746	3233	**S33**	29_24.3826	130_26.0944	688
S04	28_37.9322	131_58.9325	3631	**S34**	29_26.1348	130_22.7573	565
S05	28_39.4668	131_55.7684	3911	**S35**	29_27.4495	130_19.5337	664
S06	28_41.0057	131_52.6630	4020	**S36**	29_29.0802	130_16.3174	608
S07	28_42.6542	131_49.5584	3453	**S37**	29_30.7712	130_12.9410	591
S08	28_44.3000	131_46.1591	3598	**S38**	29_32.4073	130_09.7559	417
S09	28_45.9692	131_43.0463	4181	**S39**	29_34.0636	130_06.4178	538
S10	28_47.5349	131_39.9316	5156	**S40**	29_35.4751	130_03.2162	587
S11	28_49.0636	131_36.6898	5079	**S41**	29_37.0284	129_59.9799	517
S12	28_50.7344	131_33.5403	4832	**S42**	29_38.6408	129_56.8250	565
S13	28_52.4315	131_30.3397	4950	**S43**	29_40.2611	129_53.5822	678
S14	28_53.9936	131_27.2022	4942	**S44**	29_41.8166	129_50.3275	709
S15	28_55.6353	131_23.9511	4473	**S45**	29_43.4453	129_47.0783	605
S16	28_57.3566	131_20.6461	4438	**S46**	29_45.0185	129_43.8474	547
S17	28_58.9775	131_17.5397	4452	**S47**	29_46.5282	129_40.6082	544
S18	29_00.6359	131_14.5377	4044	**S48**	29_48.1284	129_37.2318	592
S19	29_02.3323	131_11.2207	3585	**S49**	29_49.6983	129_34.1116	617
S20	29_03.8164	131_08.0017	4095	**S50**	29_51.2645	129_30.9155	636
S21	29_05.5463	131_04.7974	3479	**S51**	29_52.9373	129_27.6096	645
S22	29_07.2140	131_01.6434	3703	**S52**	29_54.5431	129_24.3393	600
S23	29_08.6108	130_58.5443	4701	**S53**	29_56.0921	129_21.0809	843
S24	29_10.2125	130_55.1047	3925	**S54**	29_57.7199	129_17.9544	875
S25	29_11.8672	130_51.9141	3719	**S55**	29_59.2290	129_14.5450	881
S26	29_13.4425	130_48.7134	3335	**S56**	30_00.7769	129_11.2198	898
S27	29_14.9177	130_45.2408	3110	**S57**	30_02.2901	129_07.9422	875
S28	29_16.6159	130_42.2333	3088	**S58**	30_03.7422	129_04.5905	890
S29	29_18.5767	130_39.1470	2088	**S59**	30_05.2778	129_01.0840	912
S30	29_19.9690	130_36.0507	1849	**S60**	30_06.8936	128_57.9813	912

Table 5　List of OBS position of the line RK01. OBS S27 was not recovered due to no response to acoustic call from onboard.

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 Scientists 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.

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