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Preliminary Report
of
the *R/V KAIMEI* Cruise KM17-07

July 14 – August 12, 2017

Training cruise for 3 Dimensional Multi-Channel Seismic Survey

in the Japan Trench

Marine Technology and Engineering Center (MARITEC)
R&D Center for Earthquake and Tsunami (CEAT)

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

CONTENTS

PREFACE

In July to August, 2017, the KM17-07 cruise using *R/V KAIMEI* of JAMSTEC (Japan Agency for Marine-Earth Science and Technology) was successfully carried out in the Japan Trench, Off Tohoku, Japan. The cruise was divided into two Legs according to participants' schedule.

The purpose of this cruise is training for the new seismic reflection survey system onboard the *R/V KAIMEI*. To understand and practice the launch and recovery procedure for seismic streamer cable, paravane, air gun arrays was safely conducted during cruise. Towing layout was adjusted depends on the ship's speed and was finally confirmed.

The system was put into operation on several sea trials of the *R/V KAIMEI* in 2015, 2016, and 2017. After some modification of the system based on the experience on these trials, KM17-07 cruise marked its second scientific operation.

1. Participants aboard the *R/V KAIMEI* cruise

Leg1 (2017/07/14 ～ 07/26)

AMITANI Yasutaka *	JAMSTEC/MARITEC
NAKAMURA Yasuyuki	JAMSTEC/CEAT
KIKUCHI Hidekuni	JGI, Inc
KONNO Megumi	JGI, Inc

*Chief of the cruise

Leg2 (2017/07/27 ～ 08/12)

MAKI Tetsuji *	JAMSTEC/MARITEC
TANAKA Kyoko	JAMSTEC/MARITEC
NAKAMURA Yasuyuki	JAMSTEC/CEAT
KIKUCHI Hidekuni	JGI, Inc
KONNO Megumi	JGI, Inc

*Chief of the cruise

Marine technician

ITO Makoto [Nippon Marine Enterprises, Ltd. (NME)]: Chief marine technician

OHWATARI Yuki [NME]	SHIBATA Hidenori [NME]
NOGUCHI Naoto [NME]	SUZUKI Keita [NME]
IWAMARU Hikaru [NME]	MIURA Ryo [NME]
SERIZAWA Kimiko [NME]	KOMATSU Waka [NME]
KIMURA Ryo [NME]	AMIKURA Shintaro [NME]
JAMES Caywood [Sound Oceanics]	JACOB Green [Sound Oceanics]
HORIUCHI Yoshiki [NME] (Leg1)	TAWATA Miki [NME] (Leg2)

Crew

Captain	YOSHIDA RIKITA	
Chief Officer	SAMMORI YASUHIKO	
1st Officer	KIMURA NAOTO	
2nd Officer	FUJII SHOZO	
Jr.2nd Officer	MIYAKE KAZUKI	
3rd Officer	KOBAYASHI YUMIHIKO	
Chief Engineer	FUNAE KOJI	
1st Engineer	MORI TAKAHIRO	
2nd Engineer	HANAWA AKIRA	
3rd Engineer	FUJII KOTA	
Chief Electronic Operator	INOUE YOICHI	
2nd Electronic Operator	SAWAYANAGI EMI	
3rd Electronic Operator	ONIKUBO RYUJI	
Boat Swain	OHATA MASANORI	
Able Seaman	YOSHINO YUKI,	NAWA HAYATA
	ITO HIDEO,	NAKANISHI TORU
Sailor	SUZUKI SHO,	SATO EISHIN
No.1 Oiler	OISHI HIROYUKI	
Oiler	FUNAWATARI KEITA,	CHINO TATSUOMI
	KOZAKI MAKOTO	
Chief Steward	TAKEMURA RYUEI	
Steward	SONODA KAZUMA,	KUBOTA RYU
	KASHIWAGI KOICHIRO	

2. Observation

2-1. Background and objectives

In trench-outer rise regions, the normal faults develop due to the bending of the oceanic plate, and numerous normal-faulting earthquakes occur beneath the outer trench slope. To understand the structural variation and systematic changes of the oceanic plate (i.e., incoming sediments, horst-and-graben structure, the reflection character of the oceanic Moho, Vp and Vs structure), we conducted a seismic reflection survey along the survey lines approximately perpendicular to the trench axis. We used multi-channel seismic (MCS) system of *R/V KAIMEI*.

2-2. List of observation

(1) MCS-3D survey

R/V KAIMEI 3D MCS system mainly consists of 4 streamer cables, 4 air gun arrays, and lab equipments.

Four seismic streamer cables are designed to have 960-channel with 3.125 m length per channel and receives the returned seismic signal. The streamer is equipped with depth controllers attached every 300 m which can be remotely monitored and controlled. The real time digital data are fed into the data acquisition system (NTRS) and the data are eventually stored onto hard disk drive as SEG-D format.

Total 4 air gun arrays are designed to have 10600 cu. in in total, 2650 cu. in each, which are tuned to generate spiky source signal with greater peak-to-bubble ratio. . The ship speed is kept ~3.5-4.5 knots during the shooting. Compressed air is supplied by three compressor systems permanently installed on the vessel.

In this Cruise KM 17-07 Leg 2, observation with three patterns was carried out. The depth in all observations was 10 m in air gun array and 12 m in streamer cable. The separation of Streamer cable was set to 100 m. The first observation line is 1312P1, 1320P1, the second observation is 1304P1, 1328P1, and the third observation is 1288P1, 1296P1, 1336P1, 1344P1, 1352P1. Streamer cable length in the first observation was No 1, 3, 4, 1901 m, No. 2 1939 m, and the number of channels was 600 channels each. All four Streamer cables were towed, but No. 4 was not used for observation due to electric leakage. Air gun array towed all of No. 1 to No. 4, but the actual shooting was carried out only with No. 1 and No. 4 array in the “flip-flop” mode, and the total Volume was 2650 cu.in in each array. The air gun array separation at the first observation was 61 m.

Streamer cable lengths in No. 2 and No. 3 observations were No. 1, 4, 1789 m, No. 2, 3, 1752 m, and the number of channels was all 552 channels. Only No. 1 and 4 Air gun arrays were towed, and the total capacity was 2650 cu.in each. At the second observation, the air

gun array separation was 70 m and the air gun array separation at the third observation was 52 m.

Though the system still requires further modifications for stable operations, it has proven to produce good quality, high resolution and deep penetration image of the crust beneath oceans.

Specifications for the streamer cable and air gun array system are as follows.

・Streamer cable

Manufacturer:	Hydroscience Technology, Inc
Number of channel:	4 × 960 channel streamer cable, maximum offset ~3 km
Group interval:	3.125 m
Cable depth:	12 m

・Air gun array system

Manufacturer:	Bolt Technology
Type of airgun:	1500LL and 1900LL Cluster
Total volume:	10,600 cu in
Air pressure:	2,000 psi
Source depth:	10 m

(3) XCTD and XBT measurements

We conducted XCTD and XBT casts at the north and south of the survey area to obtain the acoustic velocity profile in the water column.

(4) Bathymetry, gravity, magnetic surveys

Bathymetry data were collected by vessel mounted multi beam echo sounder (Kongsberg EM122) during the survey. Gravity and magnetic data were also collected.

2-3. Survey area

Fig. 1 shows planned MCS lines for this cruise.

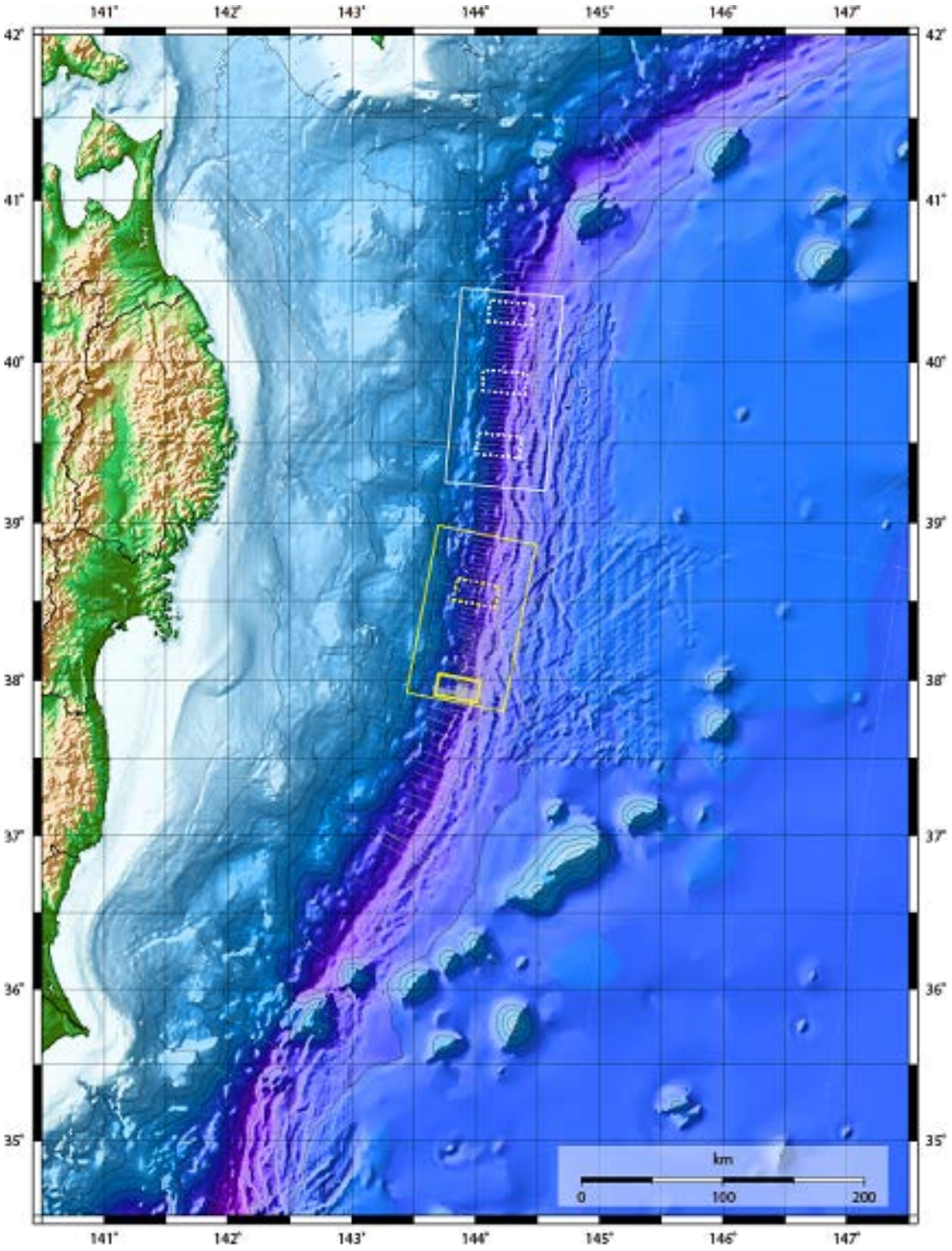

Fig. 2-1 Planned MCS lines

3. Cruise track

KM17-07 cruise was started from Hakodate port on July 14 and then, the vessel went to the survey area. MCS survey and bathymetric survey were conducted in the Japan Trench. Finally, the vessel arrived at Ariake Port on August 12 and we ended KM17-07 cruise.

Fig. 3-1 shows ship's tracks for the entire cruise and table 3-1 shows activity log during the cruise.

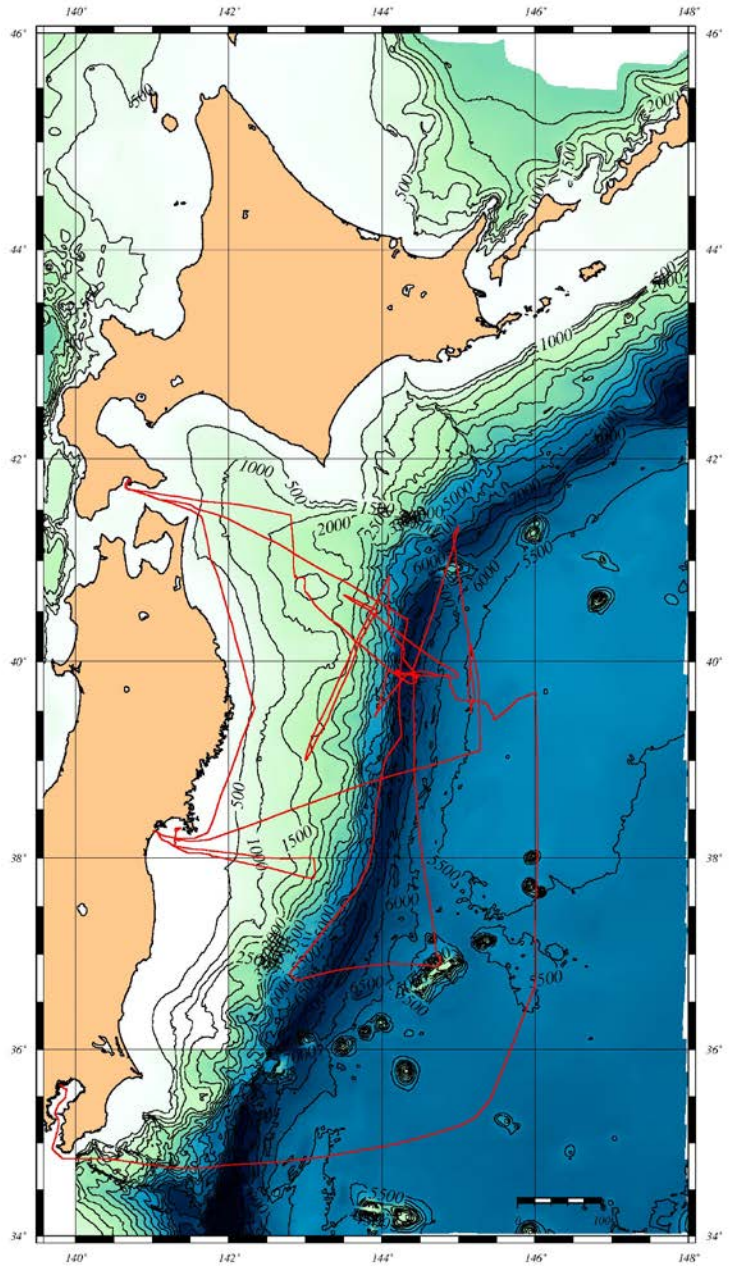

Fig. 3-1 Ship's tracks for the entire KM17-07 cruise

Table 3-1 Cruise log

Leg	Date	Remarks
1	2017/7/14	departure from Hakodate,transit to survey area
	2017/7/15	cable and air gun maintenance
	2017/7/16	cable and air gun maintenance
	2017/7/17	cable and air gun maintenance
	2017/7/18	cable and air gun maintenance
	2017/7/19	cable and air gun maintenance, transit to deployment area
	2017/7/20	transit to deployment area, XCTD cast, cable maintenance, 3D system deployment (200m cable separation, port side)
	2017/7/21	system recovery, cable maintenance
	2017/7/22	3D system deployment (100 m cable separation, port side), system recovery
	2017/7/23	transit to Ishinomaki bay to evacuate from rough sea, wait on weather
	2017/7/24	wait on weather at Ishinomaki bay, transit to survey area
	2017/7/25	gun signature observation, underwater video recording, transit to Sendai port
	2017/7/26	arrival at Sendai, change scientists
2	2017/7/27	departure from Sendai, transit to off Shimokita area to evacuate from rough sea
	2017/7/28	wait on weather off Hakodate port, system maintenance
	2017/7/29	wait on weather off Hakodate port, system maintenance
	2017/7/30	transit to survey area
	2017/7/31	3D system deployment (100 m cable separation)
	2017/8/1	3D system deployment (100 m cable separation), 3D MCS survey Line 1320, 1312, system recovery
	2017/8/2	system recovery, wait on weather off Sanriku
	2017/8/3	3D system deployment (100 m cable separation), system maintenance
	2017/8/4	system maintenance, 3D system deployment (100 m cable separation)
	2017/8/5	3D system deployment (100 m cable separation), 3D MCS survey Line 1328
	2017/8/6	3D MCS survey Line 1304, 1336, 1296, 1344, 1288, 1352, system recovery
	2017/8/7	system recovery, evacuate from typhoon
	2017/8/8	evacuate from typhoon
	2017/8/9	evacuate from typhoon, transit to Tokyo
	2017/8/10	transit to Tokyo
	2017/8/11	transit to Tokyo
	2017/8/12	arrival at Tokyo Ariake

4. Preliminary results

Fig. 4 shows the results of KM17-07 cruise.

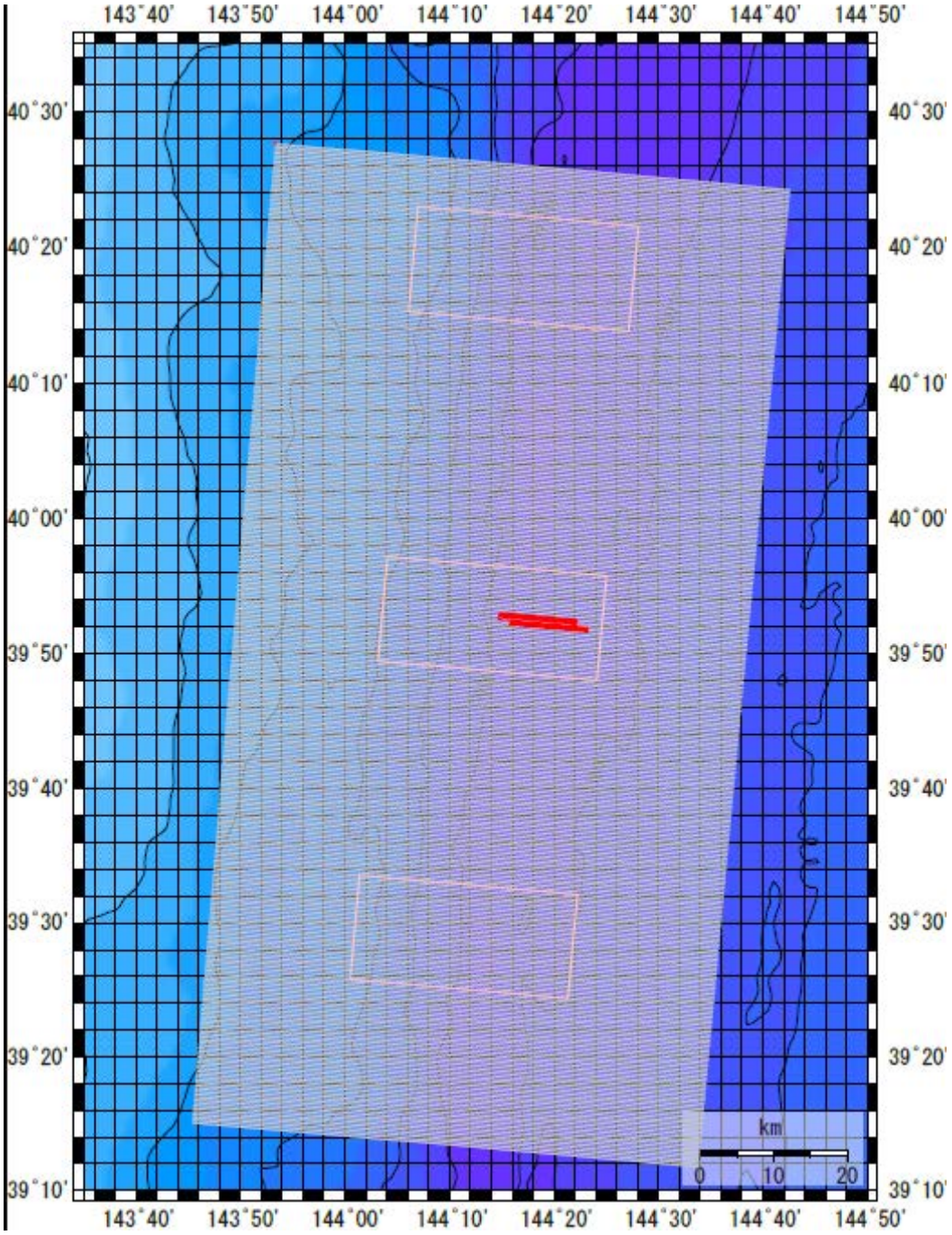

Fig. 4 Results of KM17-05 cruise

4-1. Bathymetric survey

A bathymetric survey by using Kongsberg EM122 (12kHz) was conducted in the survey area. The results of bathymetric survey is shown in Fig. 4-1.

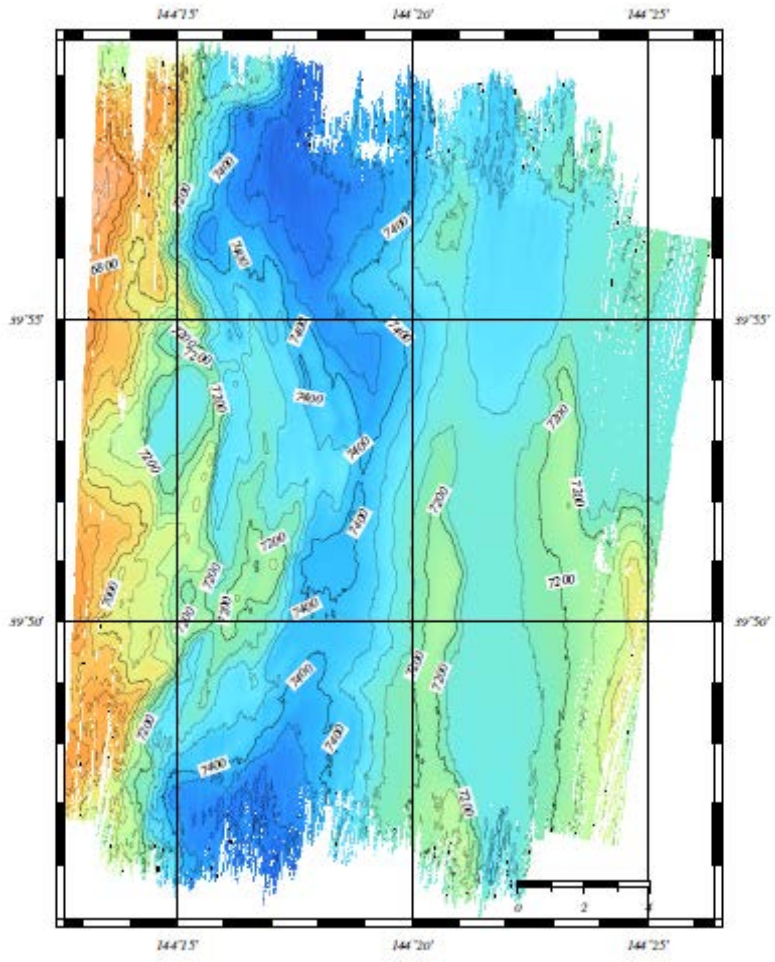

Fig. 4-1 Bathymetric chart

4-2. Seismic survey

A total of 98.9 km of MCS3D data was collected in the survey area. Table 4-2 shows results of the MCS3D survey. Differential Global Positioning System (DGPS) of WGS84 was used for the positioning. Raw MCS3D reflection data was processed for the purpose of quality control during the cruise.

Table 4-2 MCS log

KM17-07 LINE LIST

NO.	LINE NAME	UKOOA P1/90 P2/94	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)	NUMBER OF SHOT FGSP - LGSP (SP# Increment)	LENGTH FGSP - LGSP (km)	DIRECTION (°)	Mode (m)
1	1288P1	1288P1.WGS-84.p190 1288P1.000.p294	06/08/2017	05:43:51	1987	39_52.13508'N	144_15.61794'E	7198	294 (+1)	11.0	93.0	Distance (37.5m) Flip-Flop
			06/08/2017	05:43:51	1987	39_52.13508'N	144_15.61794'E	7198				
			06/08/2017	06:57:22	2280	39_51.60132'N	144_23.28654'E	7165				
			06/08/2017	06:57:22	2280	39_51.60132'N	144_23.28654'E	7165				
2	1296P1	1296P1.WGS-84.p190 1296P1.000.p294	05/08/2017	23:12:31	1987	39_52.24230'N	144_15.63036'E	7231	294 (+1)	11.0	93.0	Distance (37.5m) Flip-Flop
			05/08/2017	23:12:31	1987	39_52.24230'N	144_15.63036'E	7231				
			06/08/2017	00:26:33	2280	39_51.71280'N	144_23.29980'E	7150				
			06/08/2017	00:26:33	2280	39_51.71280'N	144_23.29980'E	7150				
3	1304P1	1304P1.WGS-84.p190 1304P1.000.p294	05/08/2017	15:30:53	1987	39_52.34826'N	144_15.64830'E	7172	294 (+1)	11.0	93.0	Distance (37.5m) Flip-Flop
			05/08/2017	15:30:53	1987	39_52.34826'N	144_15.64830'E	7172				
			05/08/2017	16:43:01	2280	39_51.80976'N	144_23.31720'E	7148				
			05/08/2017	16:43:01	2280	39_51.80976'N	144_23.31720'E	7148				
4	1312P1	1312P1.WGS-84.p190 1312P1.000.p294	01/08/2017	02:33:09	1987	39_52.47828'N	144_15.65466'E	7337	294 (+1)	11.0	93.0	Distance (37.5m) Flip-Flop
			01/08/2017	02:33:09	1987	39_52.47828'N	144_15.65466'E	7337				
			01/08/2017	03:49:50	2280	39_51.91386'N	144_23.32182'E	7163				
			01/08/2017	03:49:50	2280	39_51.91386'N	144_23.32182'E	7163				
5	1320P1	1320P1.WGS-84.p190 1320P1.000.p294	31/07/2017	22:58:22	2253	39_52.04292'N	144_22.28550'E	7256	294 (-1)	11.0	273.0	Distance (37.5m) Flip-Flop
			31/07/2017	22:58:22	2253	39_52.04292'N	144_22.28550'E	7256				
			01/08/2017	00:29:59	1960	39_52.57284'N	144_14.61444'E	7202				
			01/08/2017	00:29:59	1960	39_52.57284'N	144_14.61444'E	7202				
6	1328P1	1328P1.WGS-84.p190 1328P1.000.p294	05/08/2017	11:41:19	2253	39_52.20186'N	144_22.30488'E	7205	294 (-1)	11.0	273.0	Distance (37.5m) Flip-Flop
			05/08/2017	11:41:19	2253	39_52.20186'N	144_22.30488'E	7205				
			05/08/2017	13:25:37	1960	39_52.73622'N	144_14.63442'E	7272				
			05/08/2017	13:25:37	1960	39_52.73622'N	144_14.63442'E	7272				
7	1336P1	1336P1.WGS-84.p190 1336P1.000.p294	05/08/2017	19:24:25	2253	39_52.30680'N	144_22.32318'E	7253	294 (-1)	11.0	273.0	Distance (37.5m) Flip-Flop
			05/08/2017	19:24:25	2253	39_52.30680'N	144_22.32318'E	7253				
			05/08/2017	21:15:33	1960	39_52.84002'N	144_14.65278'E	7281				
			05/08/2017	21:15:33	1960	39_52.84002'N	144_14.65278'E	7281				
8	1344P1	1344P1.WGS-84.p190 1344P1.000.p294	06/08/2017	02:17:54	2253	39_52.40712'N	144_22.33476'E	7248	294 (-1)	11.0	273.0	Distance (37.5m) Flip-Flop
			06/08/2017	02:17:54	2253	39_52.40712'N	144_22.33476'E	7248				
			06/08/2017	04:00:16	1960	39_52.94370'N	144_14.66484'E	7286				
			06/08/2017	04:00:16	1960	39_52.94370'N	144_14.66484'E	7286				
9	1352P1	1352P1.WGS-84.p190 1352P1.000.p294	06/08/2017	08:49:11	2253	39_52.52172'N	144_22.34844'E	7252	294 (-1)	11.0	273.0	Distance (37.5m) Flip-Flop
			06/08/2017	08:49:11	2253	39_52.52172'N	144_22.34844'E	7252				
			06/08/2017	10:34:33	1960	39_53.02698'N	144_14.67426'E	7284				
			06/08/2017	10:34:33	1960	39_53.02698'N	144_14.67426'E	7284				
							Total		2646	98.9		

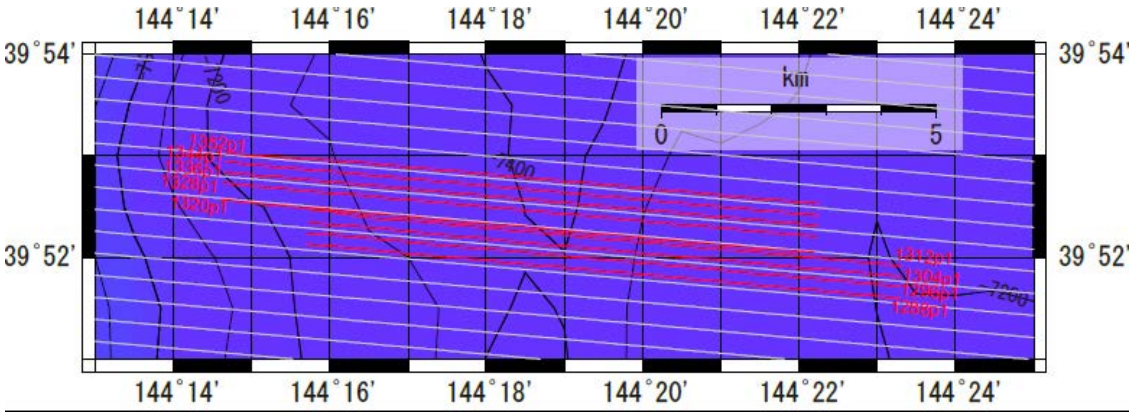

Fig. 4-2. Survey Line Chart

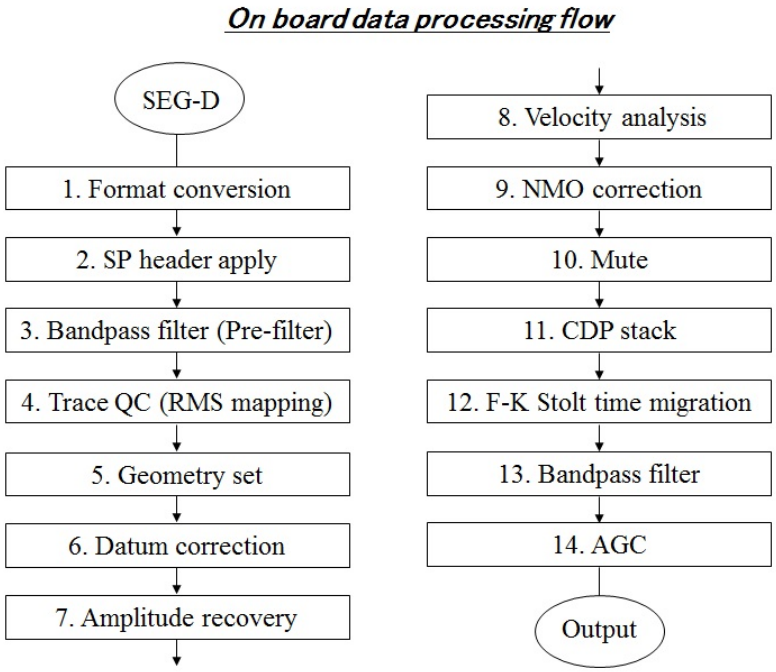

Fig. 4-2 Bathymetric chart

We imported the raw data (SEG-D) and navigation data (UKOOA) to SeisSpace, then applied a conventional data processing flow to the seismic reflection data. We checked the data quality using RMS mapping of traces, and applied datum correction, amplitude recovery, velocity analysis, normal moveout correction, muting, common depth point stacking, time migration, band-pass filter, and automatic gain control.

(2)Seismic profile

Fig. 4-3 shows one of the results of the onboard data processing. Interpretation will be performed afterwards.

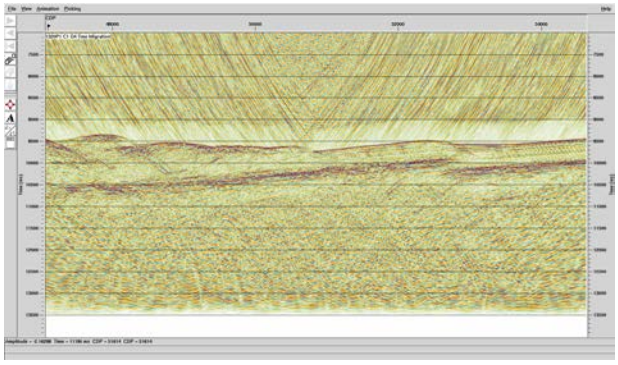

Fig. 4-3 Line 1320P1 MCS3D

5. Acknowledgement

We thank Captain YOSHIDA Rikita, crew and technical staffs of our experiments conducted during the KM17-07 cruise, for their kind and thoughtful supports during the cruise.

※ 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 Integration and Analysis Group (DIAG) of JAMSTEC.