

R/V *KAIYO* Cruise Report

KY09-05

Northern Japan Sea

– around the Okushiri Island –



July 31 – August 5, 2009

JAMSTEC – Naoetsu

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

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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.

1. Cruise Information

Ship Name:

R/V *Kaiyo*

Title of the cruise:

Northern Japan Sea – around the Okushiri Island

Title of the Proposal:

Integrated survey of bio-geochemical processes of the evolution of methane hydrate and methane plumes in the eastern margin of Japan Sea

Cruise Period:

July 31 – August 5, 2009

Ports of Call:

July 31	Departure	JAMSTEC Pier, Yokosuka, Kanagawa
August 5	Arrival	Naoetsu Port, Niigata

Research Area:

West of the Okushiri Island (east of the Japan Basin), eastern margin of Japan Sea (Figs. 1 and 2)

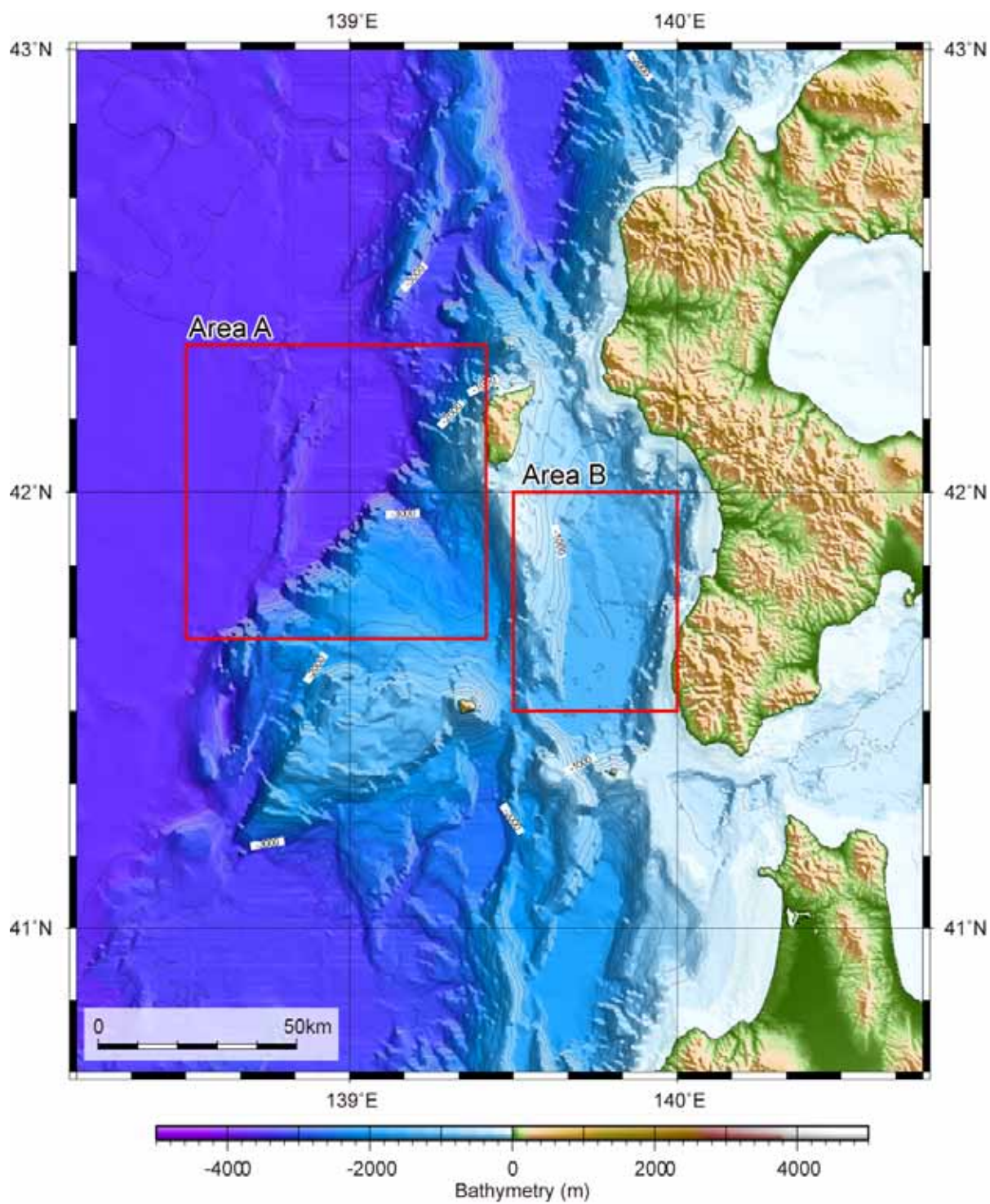


Fig. 1. Index map of the research area in the KY09-05 Cruise.

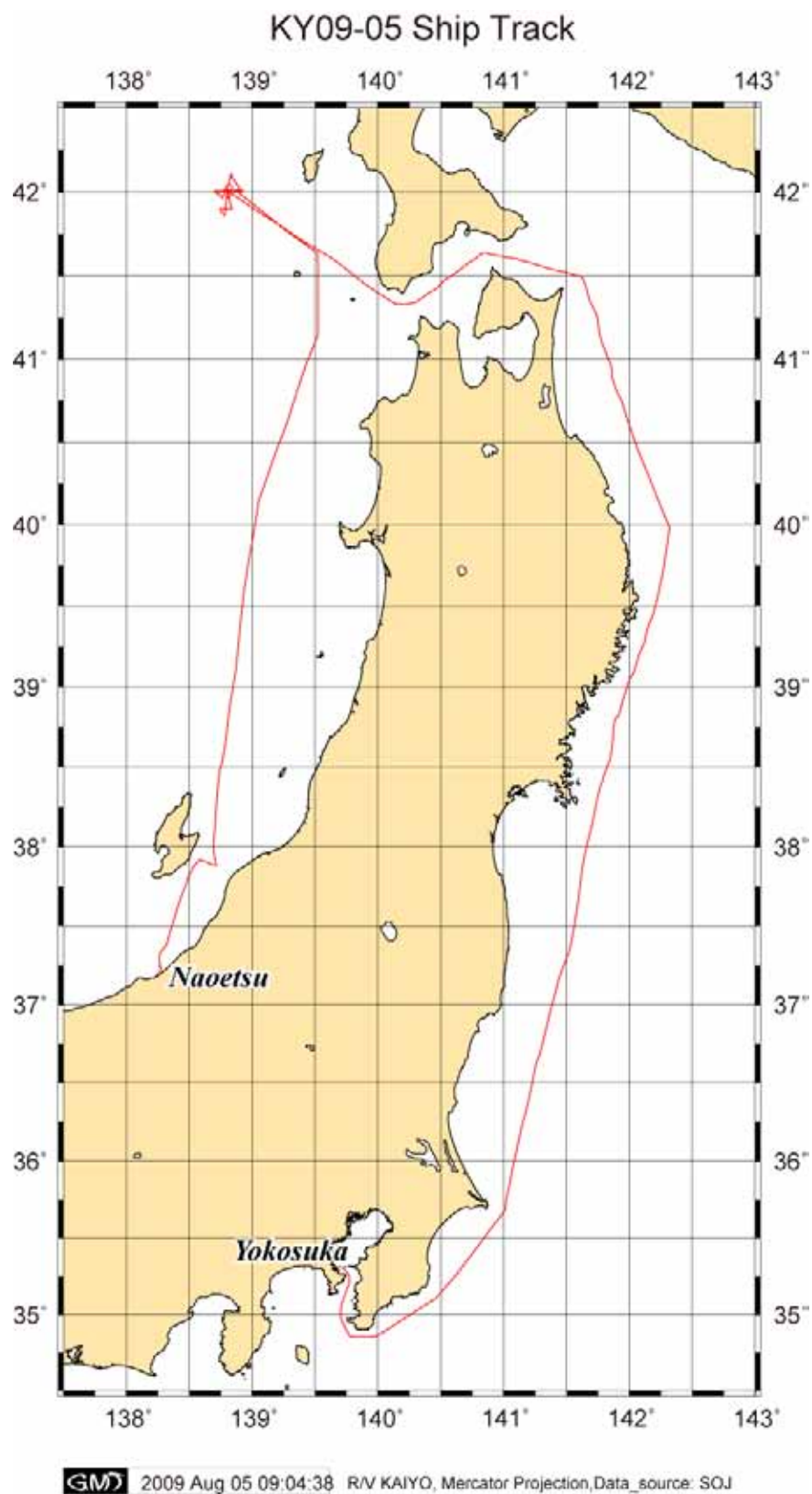


Fig. 2. Ship track of the KY09-05 Cruise.

2. Researchers (Science Party)

Chief Scientist (Representative of the Science Party):

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Onboard Scientists:

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Aoyama, Chiharu (Japan's Independent Institute Co., Ltd.)
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Hiruta, Akihiro (University of Bremen)
Ito, Kaori (University of Tokyo)
Kakuwa, Yoshitaka (University of Tokyo)
Ketzer, Joao Marcelo (University of Tokyo)
Lu, Hailong (University of Tokyo)
Machiyama, Hideaki (JAMSTEC)
Matsuda, Nilo (University of Tokyo)
Suzuki, Maki (University of Tokyo)
Tomaru, Hitoshi (University of Tokyo)

Shore-based Scientists:

Aizawa, Shoichi (Gunma University)
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Fujikura, Katsunori (JAMSTEC)
Fujiwara, Yoshihiro (JAMSTEC)
Inagaki, Fumio (JAMSTEC)
Joshima, Masato (AIST)
Kinoshita, Masataka (JAMSTEC)
Matsukura, Seiya (University of Tokyo)
Muramatsu, Yasuyuki (Gakushuin University)
Numanami, Hideki (Tokyo Kasei Gakuin University)
Ogihara, Shigenori (University of Tokyo)
Sannou, Risa (University of Tokyo)
Sunamura, Michinari (University of Tokyo)
Tsuchinaga, Kazuhiro (University of Tokyo)
Uchida, Takashi (Akita University)

Yamano, Makoto (Earthquake Research Institute, University of Tokyo)

Yamashita, Satoshi (Kitami Institute of Technology)

Yanagawa, Katsunori (University of Tokyo)

3. Research Summary

3.1. Background and Objectives

Methane hydrate is a solid material composed of methane and water molecules, and is expected to become new energy resource. Methane hydrate is also important as an environmental mediator which drastically modifies carbon cycle on the earth's surface. We recognized methane plumes and recovered massive methane hydrate near surface sediments off Naoetsu, Joetsu Basin in 2004. Since then, we conducted a series of surveys including an ocean floor survey by ROV *Hyper-Dolphin*, piston coring, and single-channel seismic survey (SCS survey), and reached a hypothesis that massive accumulation of methane hydrate in Joetsu Basin is closely related with the origin and evolution of Japan Sea. In 2007, we expanded survey area to the entire eastern margin of Japan Sea from off Joetsu to the west of Hokkaido, and conducted SCS survey, ROV dives, and piston coring in the Shiribeshi Trough and west of Okushiri Island, Hokkaido, in 2008. 2008 surveys have revealed that the depth of SMI (sulfate-methane interface) on a small ridge ("West Okushiri Ridge") in the west of Okushiri Island is only 1 m, which suggests extremely high flux of methane. On the other hand, there are a number of large-scale pockmark-like structures in the Okushiri Basin, which are quite similar to pockmarks on the Umitaka Spur of the Joetsu Basin and are likely to suggest large scale methane seeps.

The objectives of this cruise are:

- (1) To determine the methane flux by taking a number of piston cores from the BSR (bottom simulating reflector) area,
- (2) To identify methane induced carbonate crust and nodules, and
- (3) To recover methane hydrate in the Area A, and
- (4) To know if large scale depressions are methane induced pockmarks or not in the Area B.

Unfortunately, bathymetric survey in the Okushiri Basin (Area B) was cancelled, because many squid boats were operating around the survey line.

3.2 Cruise Log

Date		Activity & Operation	Area
July	30	Embarkation	JAMSTEC Pier, Yokosuka
	31	Departure/ Transit <i>Briefing/ Science Meeting</i>	
August	1	Transit <i>Science Meeting</i>	Area A (West of Okushiri Island)
	2	Transit/ Survey <i>XBT/ Bathymetry (MBES)</i> <i>Piston Coring (PC01)</i> <i>Science Meeting</i> <i>Bathymetry (MBES)/ SCS Survey (in the night)</i>	
	3	Survey <i>Piston Coring (PC02, 03, 04)</i> <i>Science Meeting</i>	
	4	Transit <i>Science Meeting</i>	
	5	Disembarkation	Naoetsu Port, Niigata

3.3 Methods and Instruments

3.3.1 Bathymetry

Bathymetric survey was carried out by MBES (multi-beam echo sounder) using SEABEAM 2100 system (Frequency: 12 kHz). Water temperature profile obtained by XBT is shown in Fig. 3.

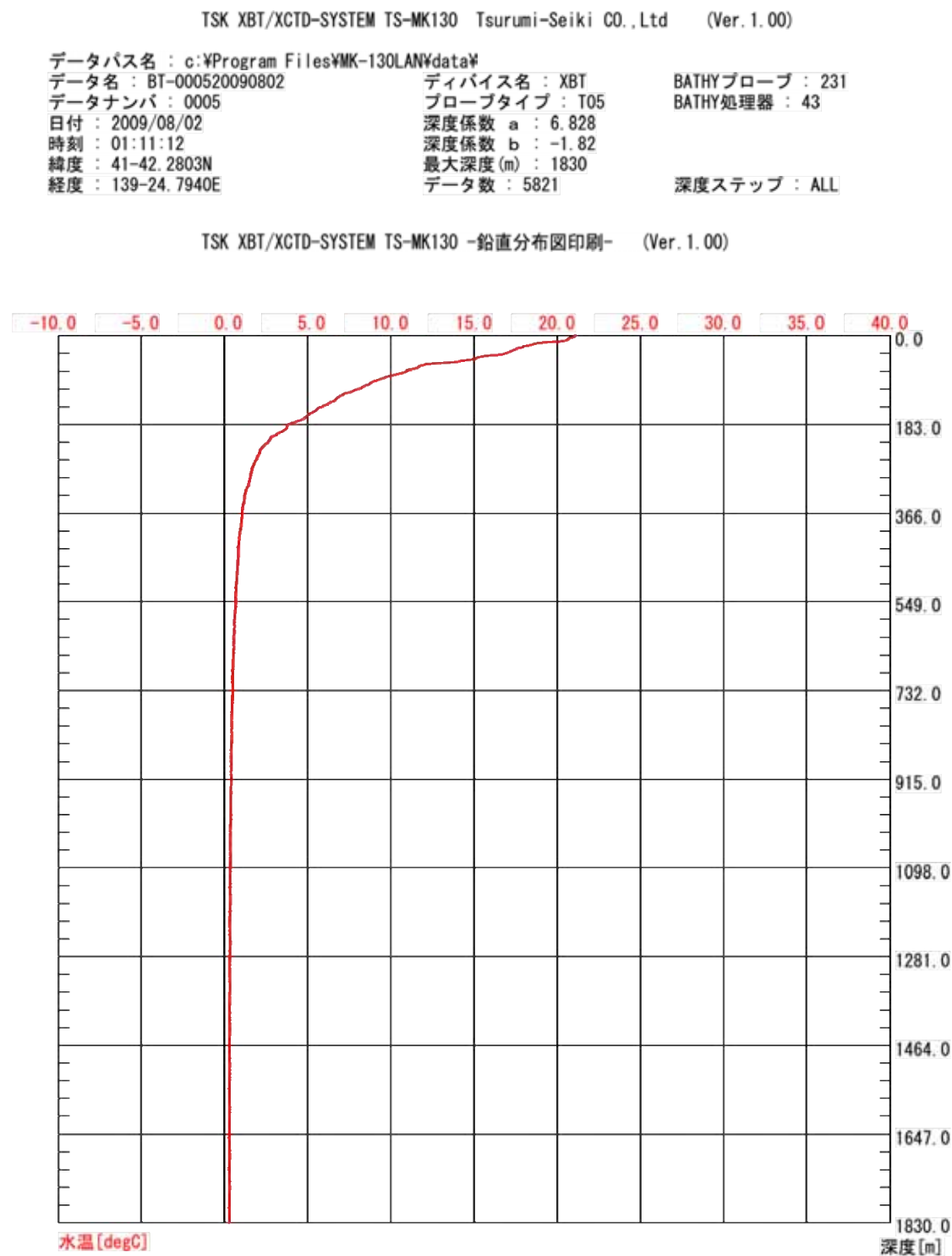


Fig. 3 Water temperature profile obtained by XBT for bathymetric survey.

3.3.2 Single-channel Seismic Survey (SCS survey)

Single-channel seismic survey was conducted around the Area A. We used Bolt 2800LLX Cluster Gun and S.I.G. 16 Streamer Cable systems for the SCS survey. This cluster gun system is good for imaging shallow part, especially BSR. Equipments and main specifications of SCS system is as follows (see details in Appendix I).

Cluster gun system

Type of airgun	Bolt 2800LLX Cluster Gun
Volume	80cu.in (40cu.in × 2)
Air pressure	13.5 MPa
Source depth	1.5 m

S.I.G. 16 Streamer cable

Active section length	47m
No. of hydrophones	48
Hydrophone interval	1m
Frequency	flat from 10Hz to 1000Hz
Receiver depth	2 m

3.3.3 Piston Coring

Piston core sampler consists of an 800 kg-weight, 6 m-long or 8 m-long stainless steel core barrel with a PVC (polyvinyl chloride) inner tube, and a pilot core sampler (Fig. 4). We used a Ewing-type corer and a small multiple corer, called “Ashura”, as a pilot core sampler. Detailed operations in each piston coring are summarized in Appendix II.

3.3.4 Heat Flow Measurement

Heat flow measurement was conducted by a HFPC (Heat Flow Piston Corer), which is a piston corer equipped with several small temperature data loggers (ANTARES Temperature Datalogger) along a core barrel, under the coring operation (Fig. 4).

Specifications of the heat flow probe are as follows.

Sensor	thermistor (ϕ 4 mm)
Resolution	about 1 mK
Recording interval	10 sec.
No. of sensors	5 — 7
Sensor vertical interval	50 — 70 cm
Measurement time	about 20 min.

In order to obtain reference temperature data, the HFPC was left still for 10 minutes about 50 m above the seafloor before penetration. After penetration into the

sediments, HFPC was left in the sediments for 20 minutes to avoid the frictional heat generated by the core barrel.

Thermal conductivities were measured on core samples, using the QTM (Quick Thermal Conductivity Meter). Each archive half section was used for QTM. Quartz glass, silicone rubber, and polystyrene foam are used as standard samples for calibration.

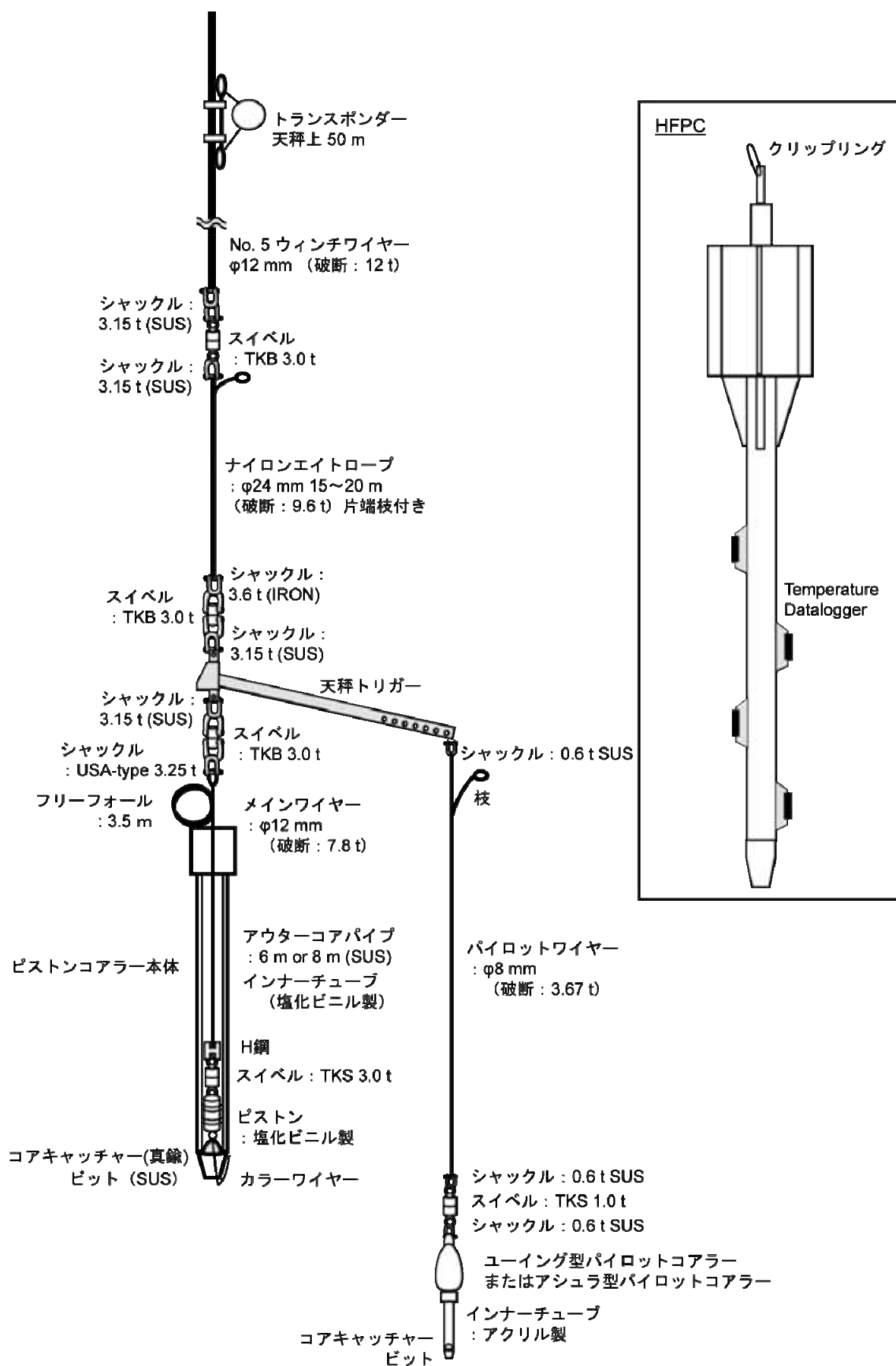


Fig. 4 Configuration of piston coring system in the KY09-05 Cruise.

3.4 Onboard Results

3.4.1 Bathymetry

Bathymetric survey was conducted around a small ridge (“West Okushiri Ridge”) in the west of Okushiri Island. This survey reveals in detail a NNE-SSW trending narrow ridge, which presents several peaks (Fig. 5).

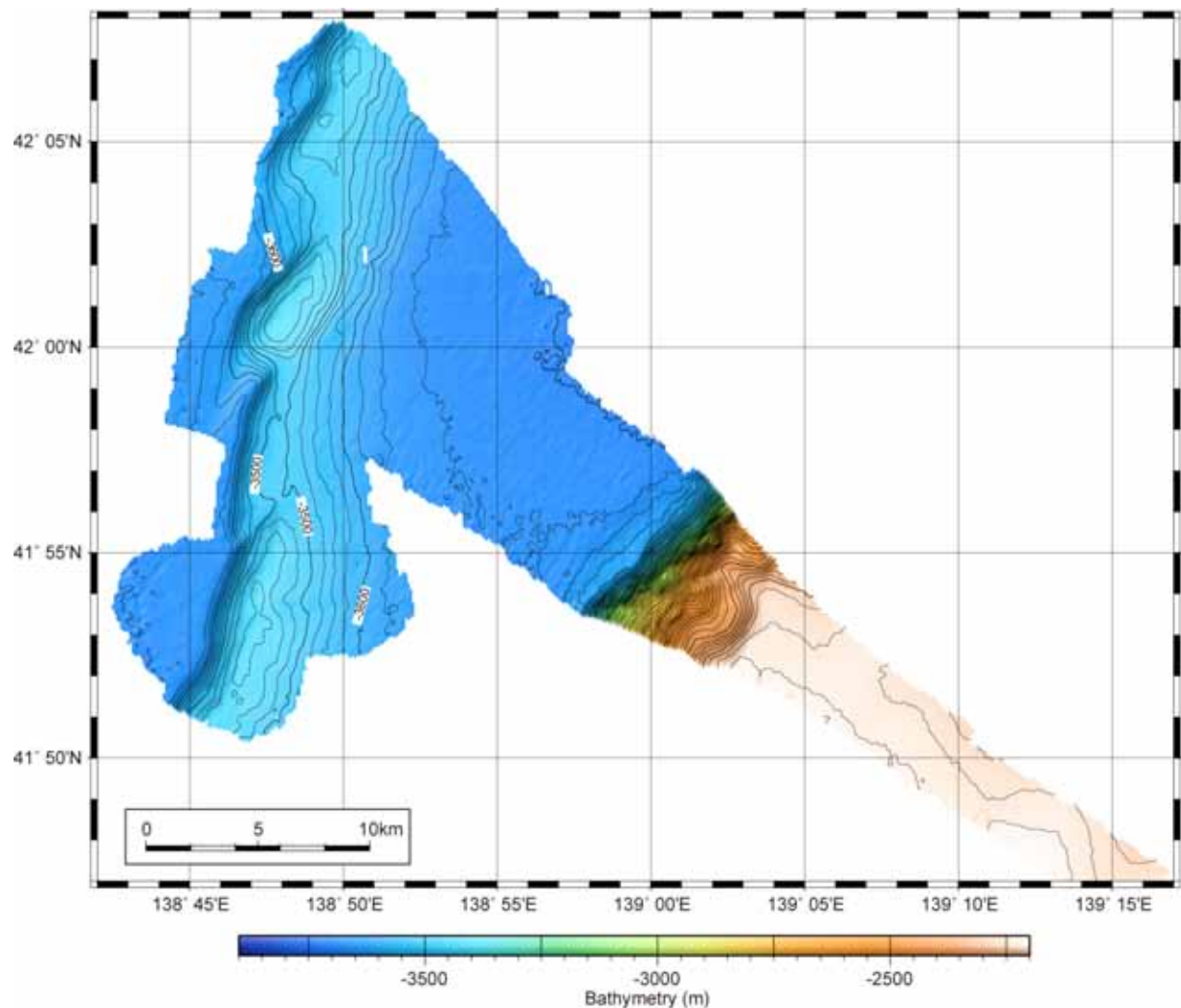


Fig. 5 Bathymetric chart in the west of Okushiri Island.

3.4.2 Single-channel Seismic Survey (SCS Survey)

Marvelous SCS data, totally 58.4 km of four survey lines (Line OK-8 — 11), was collected around a small ridge in the west of Okushiri Island (Figs. 6 & 7 and Table 1). Strong and continuous BSRs have been recognized over the ridge. Gas charged zone seems to occur in sediments above BSRs. Detailed interpretation will be performed in a post-cruise research.

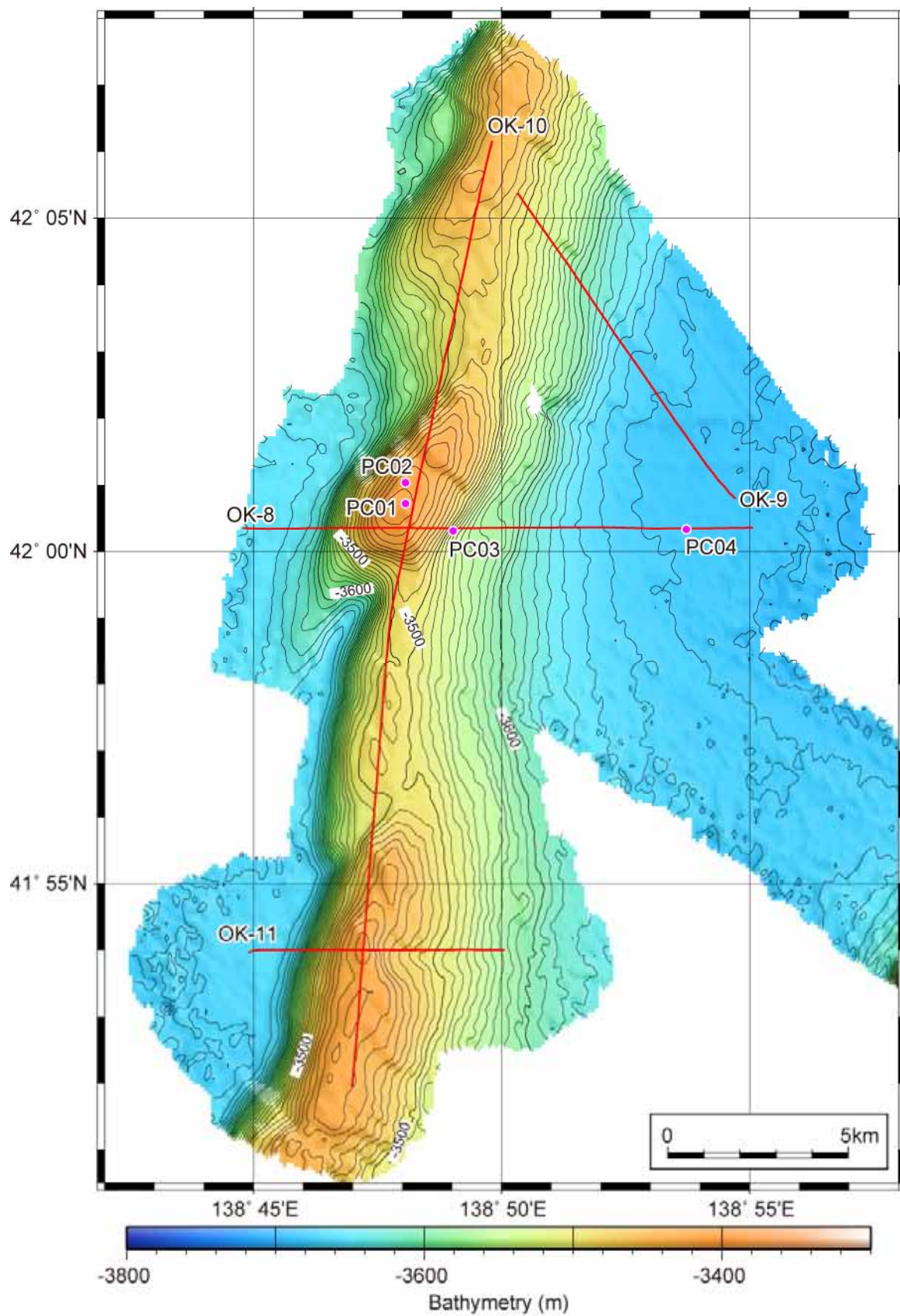


Fig. 6 SCS survey lines and the location of piston cores in the KY09-05 Cruise.

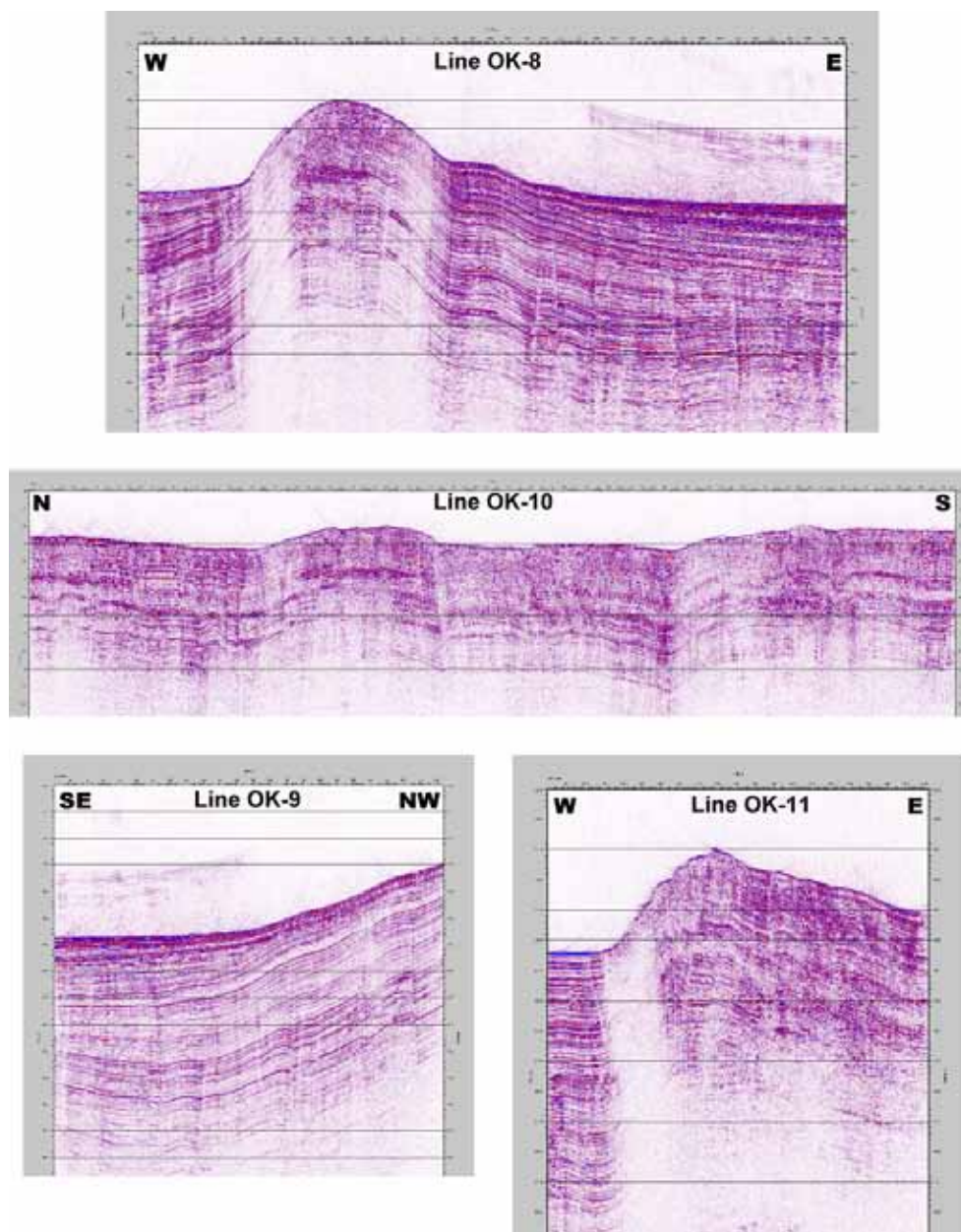


Fig. 7 SCS profiles.

Table 1 Line list of SCS survey.

Line No.	Shot No.	Vessel Position				Length (m)
		Latitude		Longitude		
OK-8	4	42-00.34698	N	138-44.86816	E	14197
	2007	42-00.35454	N	138-55.15045	E	
OK-9	3	42-00.84045	N	138-54.64325	E	10430
	1169	42-05.43663	N	138-50.26978	E	
OK-10	3	42-06.09993	N	138-49.79462	E	26589
	4150	41-51.88957	N	138-46.97754	E	
OK-11	3	41-53.98315	N	138-44.96979	E	7163
	1007	41-54.00192	N	138-50.14893	E	

3.4.3 Piston Coring

We obtained four piston cores in this cruise. Stations PC01 and PC02 are on a summit of the ridge (Fig. 6). Station PC03 is on the slope of the ridge, and Station PC04 is in the western part of the basin. These two stations are also on the Line OK-8 of SCS survey (Fig. 6). The results of piston core sampling are shown in Table 2 and Figures 8 and 9. All cores consist mainly of alternation of dark- and light-colored laminated layers and intercalated with thin ash layers. Inorganic and organic geochemical analysis, such as interstitial water chemistry, and micropaleontological analysis are scheduled in a post-cruise research.

Table 2 Summary of piston core sampling in the KY09-05 Cruise.

Core No.	Date	Latitude	Longitude	Depth (m)	Recovery (cm)
PC01	2009/8/2	42°00.7230'N	138°48.0656'E	3403	498
PC02	2009/8/3	42°01.0319'N	138°48.0656'E	3409	426
PC03	2009/8/3	42°00.3139'N	138°49.0251'E	3509	688
PC04	2009/8/3	42°00.3322'N	138°53.7239'E	3682	541

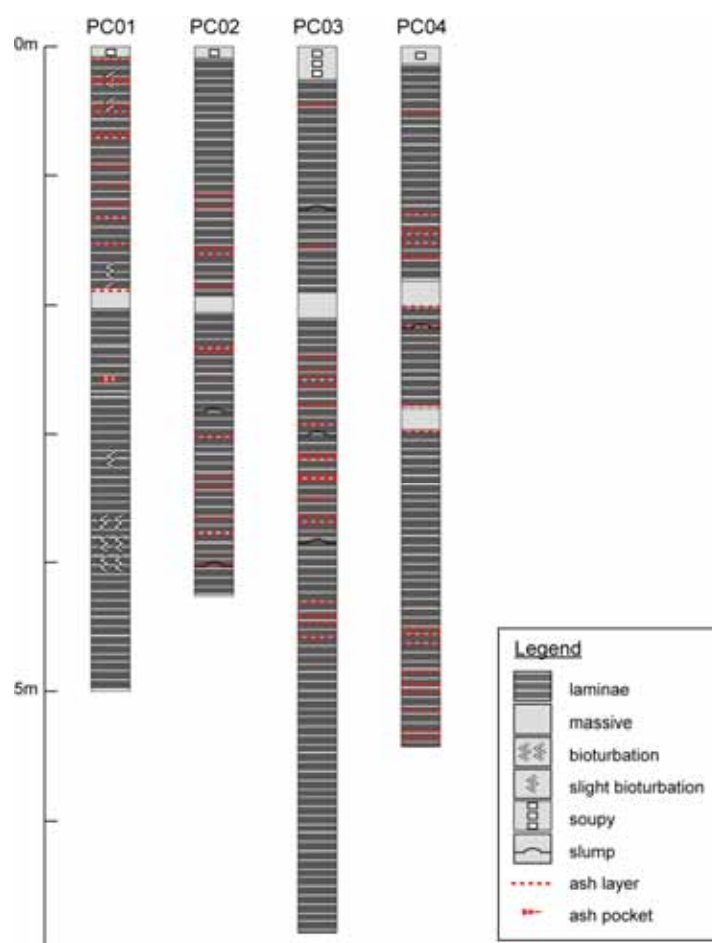


Fig. 8 Core summary

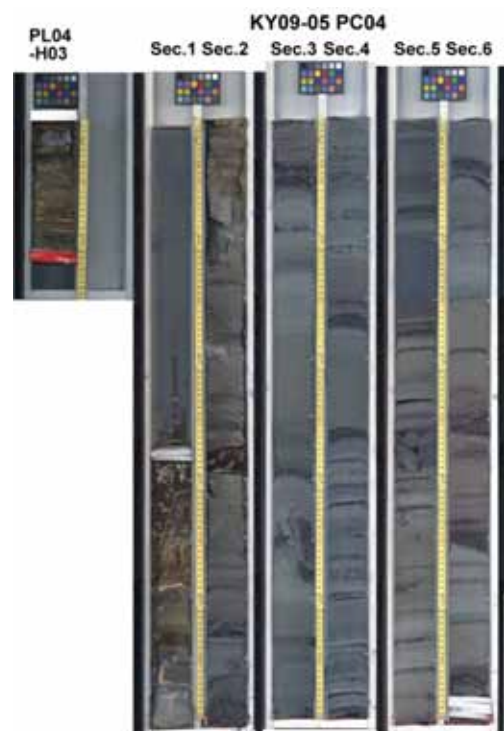
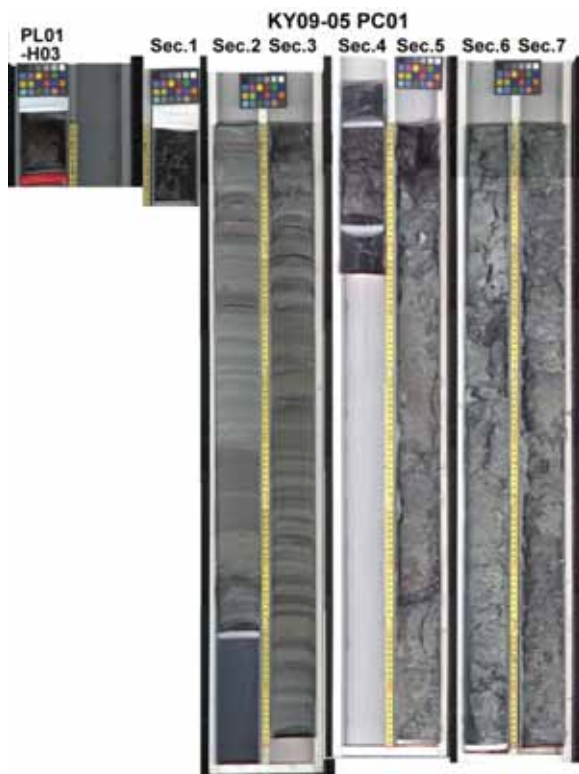


Fig. 9 Scanned photographs of each core section.

3.4.4. Heat Flow Measurement

Heat flow measurement was conducted using a Ewing-type heat flow probe in the Station PC02 (summit of the ridge) and PC04 (basin floor) (Fig. 6). Both results are good, and show a linear temperature profile (Fig. 10). Geothermal gradient value (onboard tentative value) of Station PC02 and PC04 is 115 mK/m and 128 mK/m, respectively. The value of the basin floor is slightly higher than that of the summit of the ridge. Onboard measurement of thermal conductivity was finished by the end of cruise. Heat flow calculation will be performed in a post-cruise research.

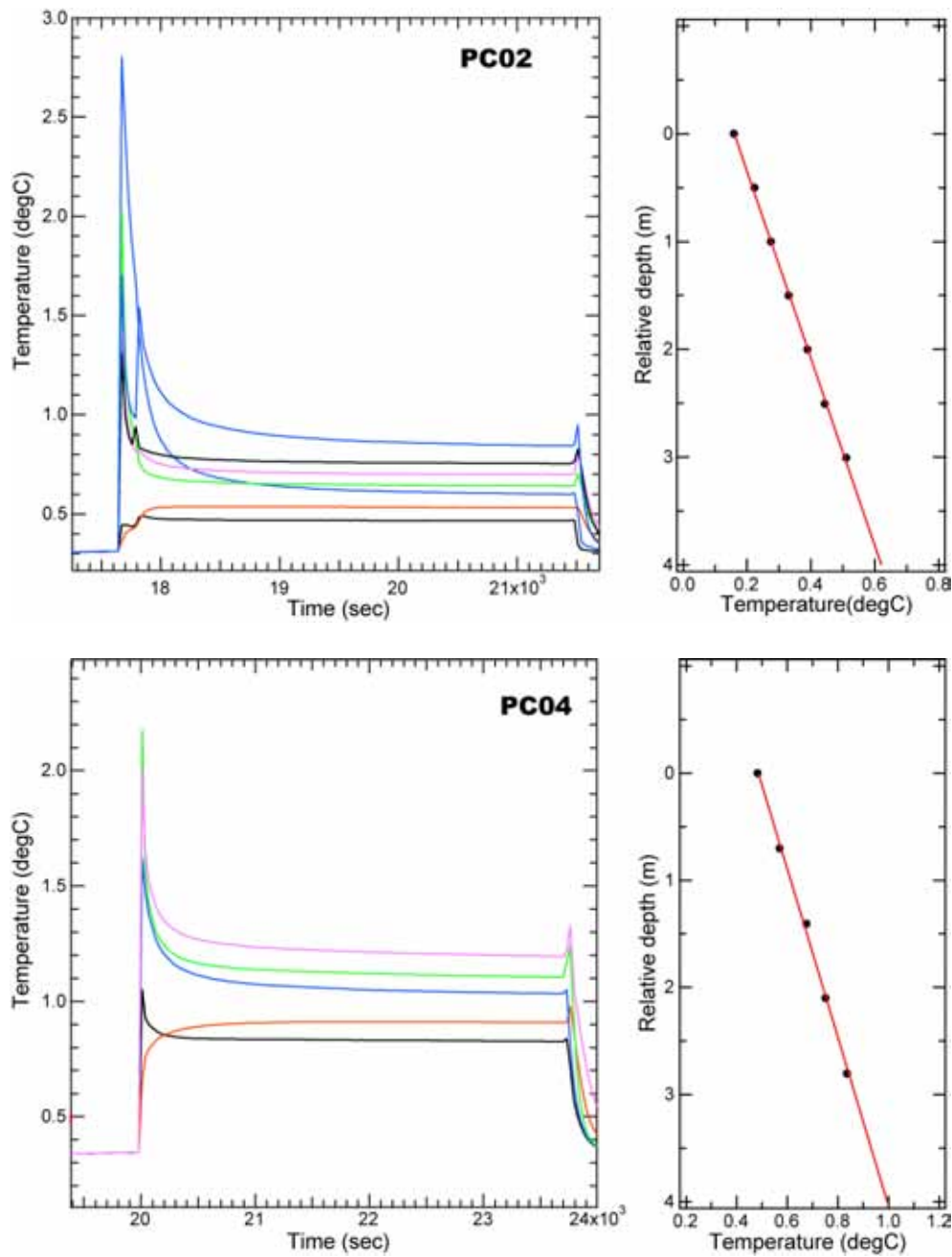


Fig. 10 Time-temperature and temperature-depth profiles in each station.

Acknowledgements

We are grateful to Captain Kouji Sameshima, the crew of R/V *Kaiyo*, and marine technicians for their professional support during this cruise. We also thank Research Vessel Management and Operations Department of JAMSTEC for their kind and helpful supports.

Appendix I

***Equipment, Survey Specification,
and General Information of SCS Survey***

Single Channel Seismic Equipment and Survey Specification for KY09-05

Streamer

Manufacturer	S.I.G
Active section length	47m
Hydrophone Interval	1m
Type of Hydrophone	S.I.G.16
Hydrophone output	-90 dB, re 1V/ μ bar, ± 1 dB
Frequency	flat from 10Hz to 1000Hz
Depth sensor	Yes
Preamplifier	gain 39
Lead in cable	120m
Receiver depth	See General Information

Source

Manufacturer	Bolt
Type of airgun	Bolt 2800LLX Cluster Gun
Volume	80cu.in [40cu.in \times 2] See General Information
Air pressure	13.5 Mpa
Source depth	See General Information
Depth sensor	No
Gun Controller	GCS90

Air Compressor

Manufacturer	Hamworthy KSE
Type of machine	Type4 TH565W100-425E \times 2
Air supply Capacity	8 m ³ /min.

Recording System

Manufacturer	GEOMETRICS
Type of system	Geode
Recording format	SEG-D Rev.1
Recording length	2,400 msec
Water Delay	0.6 sec
Sample rate	1.0 msec
High cut filter	None
Low cut filter	None
Recording media	HD

GPS System

Manufacturer	Fugro
Type of system	SkyFix XP
DGPS Reference Station	ALL

GPS System

Manufacturer	MARIMEX JAPAN
Type of system	NAVLOG

Shot Point Geometry

Time mode shooting	See General Information
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Geodetic Parameter

Spheroid	WGS84
Semi-major Axis	6,378,137m
Inverse Flattening	298.26
Projection	U.T.M
	Zone54



GENERAL			RECEIVER		REMARKS
CLIENT	JAMSTEC		RECEIVER TYPE	SIG Streamer	SHIP SPEED AGAINST GROUND : 3.68 knot SHIP SPEED AGAINST WATER : 4.07 knot
CRUISE	KY09-05		HYDROPHONE	S.I.G.16	
AREA	Okushiri		NUMBER OF CHANNEL	1	Direction : 193.4 (SP No.1-2047)、186.0 (SP No.2048-4150)
LINE	OK-10		NO. OF HYD./GROUP	48	
DIRECTION (°)	193.4, 186.0		SENSITIVITY	90.0 +/- 1 dB ref 1V/ubar	The time in the Navigation data was recorded on LCT
DATE	2009/08/02 (UTC)		CABLE DEPTH	2.0m	
WEATHER	Overcast		ACTIVE SECTION	47m	
WIND	NNE Gentle breeze → NNE Moderate breeze		LEAD-IN SECTION	120m	
SEA CONDITION	Sea Smooth				
FIRST SHOT POINT	SP No.	1	RECORDING		
FIRST USABLE SHOT POINT	SP No.	3			
	N	42-06.09993N	RECORDING SYSTEM	Geode	
	E	138-49.79462E	SAMPLE FREQUENCY	1,000 Hz	
	Time (UTC)	15:11:06	RECORDING LENGTH	2,400 msec	
	Water Depth (m)	3448.0	WATER DELAY	0.6 sec	
LAST SHOT POINT	SP No.	4150	RECORDING FORMAT	SEG-D Rev.1	
LAST USABLE SHOT POINT	SP No.	4150	ANALOG PREAMP	39.0dB	
	N	41-51.88957N	HICUT FILTER	None	
	E	138-46.97754E	LOWCUT FILTER	None	
	Time (UTC)	19:06:07	SYSTEM DELAY	120msec (from start recording to gun firing)	
	Water Depth (m)	3433.0	GPS SYSTEM	SkyFix DGPS (No.1 Antenna)	
			NAVIGATION SYSTEM	Navlog	
SOURCE			DATA		PROCESSING
GUN TYPE	Bolt 2800LLX Cluster Gun				
SHOT TYPE	Simultaneous				BAND PASS FILTER15-25-400-500
SHOT MODE	Time				STATIC CORRECTION3952 msec
SHOT INTERVAL	3.4 sec				SPHERICAL DIVERGENCE CORR. T^5
NUMBER OF STRINGS	1				Kill TracesNone
TOTAL VOLUME	80cu.in				
CONFIGURATION	40cu.in × 2				
GUN DEPTH	1.5m		OBSERVER		
AIR PRESSURE	13.5 Mpa				
GUN CONTROLLER	GCS90				
GUN TOWING WIRE LENGTH	30m				



GENERAL			RECEIVER		REMARKS	
CLIENT	JAMSTEC		RECEIVER TYPE	SIG Streamer	SHIP SPEED AGAINST GROUND : 4.08 knot SHIP SPEED AGAINST WATER : 3.97 knot	
CRUISE	KY09-05		HYDROPHONE	S.I.G.16		
AREA	Okushiri		NUMBER OF CHANNEL	1		
LINE	OK-11		NO. OF HYD./GROUP	48	The time in the Navigation data was recorded on LCT	
DIRECTION (°)	91.4		SENSITIVITY	90.0 +/- 1 dB ref 1V/ubar		
DATE	2009/08/02 (UTC)		CABLE DEPTH	2.0m		
WEATHER	Overcast		ACTIVE SECTION	47m		
WIND	NNE Gentle breeze → NNE Moderate breeze		LEAD-IN SECTION	120m		
SEA CONDITION	Sea Smooth					
FIRST SHOT POINT	SP No.	1	RECORDING			
FIRST USABLE SHOT POINT	SP No.	3				
	N	41-53.98315N	RECORDING SYSTEM	Geode		
	E	138-44.96979E	SAMPLE FREQUENCY	1,000 Hz		
	Time (UTC)	19:45:20	RECORDING LENGTH	2,400 msec		
	Water Depth (m)	3667.0	WATER DELAY	0.6 sec		
LAST SHOT POINT	SP No.	1007	RECORDING FORMAT	SEG-D Rev.1		
LAST USABLE SHOT POINT	SP No.	1007	ANALOG PREAMP	39.0dB		
	N	41-54.00192N	HICUT FILTER	None		
	E	138-50.14893E	LOWCUT FILTER	None		
	Time (UTC)	20:42:14	SYSTEM DELAY	120msec (from start recording to gun fireing)		
	Water Depth (m)	3581.0	GPS SYSTEM	SkyFix DGPS (No.1 Antenna)		
SOURCE			NAVIGATION SYSTEM	Navlog	PROCESSING	
GUN TYPE	Bolt 2800LLX Cluster Gun		DATA		BAND PASS FILTER	15-25-400-500
SHOT TYPE	Simultaneous				STATIC CORRECTION	3952 msec
SHOT MODE	Time		SEISMIC DATA	1.sgd - 1007.sgd	SPHERICAL DIVERGENCE CORR. T^5	
SHOT INTERVAL	3.4 sec			(Folder name : ok-11)	Kill Traces	None
NUMBER OF STRINGS	1		NAVIGATION DATA	ok-11_Shot.csv		
TOTAL VOLUME	80cu.in					
CONFIGURATION	40cu.in × 2					
GUN DEPTH	1.5m		OBSERVER			
AIR PRESSURE	13.5 Mpa					
GUN CONTROLLER	GCS90					
GUN TOWING WIRE LENGTH	30m					

Appendix II

Summary of Piston Coring Operation

Cruise ID	KY09-05		
Date	09/8/2	Operator: Hatakeyama	
Core ID	PC01		
Pilot ID	PL01		
Survey area	West of the Okushiri Island		
Station ID	PC919		
Corer type	Inner tube		
Barrel length	8 m		
Pilot type	"Ashura"		
Pilot weight	100 kg		
Pilot wire length	14.0 m		
Main waire length	14.0 m		
Free fall	3.6 m		
Weather	Fine		
Wind direction	55 deg	Speed	5.5 m/s
Current direction	36.0 deg	Speed	0.6 knt

Time (JST)	Water depth (m)	Wire out (m)	Latitude*	Longitude*	Tension (kN)	Wire out speed (m/min)	Remarks
13:56	3404	-			-	-	start operation
14:07	3403	0	42°00.7478 N	138°48.0518 E	9	~20	wire 0 m resetm start lowering
14:25	3404	500			11	50	↓
14:35	3403	1000			14	50	↓
14:56	3403	2000			19	50	↓
15:18	3403	3000			24	50	↓
15:26	3403	3300			27	-	stop lowering, 3 min. keep
15:30	3403	3300			26	~20	↓ restart lowering
15:36:33	3403	3440	42°00.7230 N	138°48.0656 E	14	20	↓ hit bottom (Lat./Lon. Transponder)
			42°00.6898 N	138°48.0494 E			hit bottom (Lat./Lon. Ship)
15:37:33	3403	3427	42°00.7410 N	138°48.1163 E	36**	20	↑ leave bottom (Lat./Lon. Transponder)
			42°00.6891 N	138°48.0494 E			leave bottom (Lat./Lon. Ship)
15:46	3401	3000			26	50	↑
16:06	3405	2000			21	50	↑
16:26	3406	1000			15	50	↑
16:35	3406	500			12	50	↑
16:51	3405	0	42°00.5704 N	138°48.0941 E	10	20	↑ wire length 0 m
17:06	-	-			-	-	complete recovery

*GPS: WGS84

**Max. tension in pull-up

Cruise ID KY09-05
 Date 09/8/3 Operator: Hatakeyama
 Core ID PC02
 Pilot ID PL02
 Survey area West of the Okushiri Island
 Station ID PC920
 Corer type Inner tube
 Barrel length 6 m
 Pilot type Ewing
 Pilot weight 60 kg
 Pilot wire length 12.0 m
 Main waire length 12.0 m
 Free fall 3.6 m
 Weather Cloudy
 Wind direction 357 deg Speed 7.8 m/s
 Current direction 35.0 deg Speed 0.3 knt

Time (JST)	Water depth (m)	Wire out (m)	Latitude*	Longitude*	Tension (kN)	Wire out speed (m/min)	Remarks
7:03	3413	-			-	-	- start operation
7:18	3409	0	42°00.9389 N	138°48.0400 E	8	~20	- wire 0 m resetm start lowering
7:36	3410	500			11	50	↓
7:47	3411	1000			13	50	↓
8:08	3408	2000			18	50	↓
8:29	3410	3000			23	50	↓
8:38	3409	3360			26	-	- stop lowering, 10 min. keep for reference temp.
8:48	3412	3360			26	~20	↓ restart lowering
8:53:30	3409	3441	42°01.0319 N	138°48.0656 E	14	20	↓ hit bottom (Lat./Lon. Transponder)
			42°00.9943 N	138°48.0827 E			hit bottom (Lat./Lon. Ship)
							20 min. keep for heat flow measurement
9:13	3412	3443			18	~20	↑ start pull up
9:14:30	3409	3424	42°01.0148 N	138°48.0830 E	35**	20	↑ leave bottom (Lat./Lon. Transponder)
			42°00.9906 N	138°48.0000 E			leave bottom (Lat./Lon. Ship)
9:23	3410	3000			26	50	↑
9:42	3411	2000			20	50	↑
10:02	3411	1000			15	50	↑
10:12	3416	500			12	50	↑
10:28	3413	0	42°00.8321 N	138°48.3259 E	9	20	↑ wire length 0 m
10:52		-			-	-	- complete recovery

*GPS: WGS84

**Max. tension in pull-up

Cruise ID	KY09-05			
Date	09/8/3			Operator: Hayashi
Core ID	PC03			
Pilot ID	PL03			
Survey area	West of the Okushiri Island			
Station ID	PC921			
Corer type	Inner tube			
Barrel length	8 m			
Pilot type	"Ashura"			
Pilot weight	100 kg			
Pilot wire length	14.0 m			
Main waire length	14.0 m			
Free fall	3.6 m			
Weather	Cloudy			
Wind direction	337 deg	Speed	5.9 m/s	
Current direction	23.8 deg	Speed	0.4 knt	

Time (JST)	Water depth (m)	Wire out (m)	Latitude*	Longitude*	Tension (kN)	Wire out speed (m/min)	Remarks
11:42	3470	-			-	-	start operation
11:55	3477	0	42°00.5290 N	138°49.0066 E	10	~20	wire 0 m resetm start lowering
12:15	3483	500			11	50	↓
12:25	3476	1000			14	50	↓
12:45	3485	2000			18	50	↓
13:05	3495	3000			22	50	↓
13:15	3510	3400			27	-	stop lowering, 3 min. keep
13:18	3505	3400			27	~20	↓ restart lowering
13:27:44	3509	3558	42°00.3139 N	138°49.0251 E	15	20	↓ hit bottom (Lat./Lon. Transponder)
			42°00.3256 N	138°48.9703 E			hit bottom (Lat./Lon. Ship)
13:28:47	3508	3539	42°00.3395 N	138°49.0202 E	36**	~20	↑ leave bottom (Lat./Lon. Transponder)
			42°00.3266 N	138°48.9709 E			leave bottom (Lat./Lon. Ship)
13:39	3527	3000			26	50	↑
13:57	3545	2000			20	50	↑
14:15	3552	1000			16	50	↑
14:24	3552	500			12	50	↑
14:37	3552	0	42°00.2563 N	138°49.3923 E	10	10	↑ wire length 0 m
14:49		-			-	-	complete recovery

*GPS: WGS84

**Max. tension in pull-up

Cruise ID	KY09-05			
Date	09/8/3		Operator: Hayashi	
Core ID	PC04			
Pilot ID	PL04			
Survey area	West of the Okushiri Island			
Station ID	PC922			
Corer type	Inner tube			
Barrel length	8 m			
Pilot type	"Ashura"			
Pilot weight	100 kg			
Pilot wire length	14.0 m			
Main wire length	14.0 m			
Free fall	3.6 m			
Weather	Cloudy			
Wind direction	4 deg	Speed	8.0 m/s	
Current direction	359.0 deg	Speed	0.2 knt	

Time (JST)	Water depth (m)	Wire out (m)	Latitude*	Longitude*	Tension (kN)	Wire out speed (m/min)	Remarks
15:31	3684	-			-	-	start operation
15:46	3681	0	42°00.6286N	138°53.6746 E	-	~20	wire 0 m resetm start lowering
16:05	3682	500			10	50	↓
16:14	3684	1000			14	50	↓
16:32	3684	2000			19	50	↓
16:52	3682	3000			24	50	↓
17:02	3684	3500			26	50	↓
17:06	3682	3630			28	-	stop lowering, 10 min. keep for reference temp.
17:16	3682	3630			27	~20	restart lowering
17:21:01	3682	3714	42°00.3322 N	138°53.7239 E	16	20	↓ hit bottom (Lat./Lon. Transponder)
			42°00.3166 N	138°53.6652 E			hit bottom (Lat./Lon. Ship)
							20 min. keep for heat flow measurement
17:41	3684	3717			21	~20	↑ start pull up
17:42:02	3684	3698	42°00.3271 N	138°53.7673 E	37**	~20	↑ leave bottom (Lat./Lon. Transponder)
			42°00.3162 N	138°53.6707 E			leave bottom (Lat./Lon. Ship)
17:46	3683	3500			29	50	↑
17:55	3683	3000			27	50	↑
18:11	3682	2000			21	50	↑
18:28	3679	1000			16	50	↑
18:36	3684	500			13	50	↑
18:50	3683	0	42°00.0003 N	138°53.5858 E	10	10	↑ wire length 0 m
19:10		-			-	-	complete recovery

*GPS: WGS84

**Max. tension in pull-up