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Preliminary Report
of
the *R/V KAIMEI* Cruise KM16-09

October 17 – 25, 2016

Training cruise for Power Grab (PG)

in the Sagami-Bay and Bayonaise

Marine Technology and Engineering Center (MARITEC)
R&D Center for Submarine Resources (SRRP)

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

CONTENTS

PREFACE

In October, 2016, the KM16-09 cruise using *R/V KAIMEI* of JAMSTEC (Japan Agency for Marine-Earth Science and Technology) was successfully carried out in the Sagami-Bay and Bayonaise, Japan. The purpose of this cruise was training for the newly acquired Power Grab (PG) onboard the *R/V KAIMEI*. To understand and practice the launch and recovery procedure for two types of Power Grab was safely conducted during cruise. KM16-09 cruise marked its first scientific operation.

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

YAMAMOTO Fujio*	JAMSTEC
MAKI Tetsuji	JAMSTEC
TSUKIOKA Satoshi	JAMSTEC
SOH Akira	JAMSTEC
MIYAMOTO Goro	JAMSTEC
MACHIYAMA Hideaki	JAMSTEC
YAMAMOTO Hirofumi	JAMSTEC
TORIMOTO Atsushi	JAMSTEC
MITO Koichi	Nichiyu Giken Kogyo Ltd.
HAYASHI Tomoe	Mitsubishi Heavy Industries, Ltd.
KUSUE Shinji	Mitsubishi Heavy Industries, Ltd.
KAWAMURA Satoshi	Mitsubishi Heavy Industries, Ltd.
KOBAYASHI Akikazu	Nishiyama Ltd.
TORISAWA Yosuke	Nishiyama Ltd.
JOESPER Munk Larsen	MacArtney
CHRIS Christian Bojesen	MacAatney

*Chief of the cruise

KM-ROV/BMS Operation Team

MIURA Atsumori	Submersible Op. Manager
KONDO Tomoe	1st Submersible Tec. Officer
ONISHI Takuya	2nd Submersible Tec. Officer
KATAGIRI Masaya	2nd Submersible Tec. Officer
ASAI Ryu	2rd Submersible Tec. Officer
KUMAGAI Shinosuke	3rd Submersible Tec. Officer
SUGIURA Shuya	3rd Submersible Tec. Officer

Marine technician

KODERA Tohru	NME
HASHIMOTO Yasushi	NME
MURAKAMI Yutaro	NME
MURAKI Hiroaki	MWJ
FUWA Yuji	MWJ
YAMAGUCHI Mika	MWJ
KATAYAMA Yohei	MWJ

2. Power Grab (PG)

Finder mounted Power Grab (PG) is one of the tool that collects sea bottom sample in water depth down to 6,000 meters. Two types of PGs are equipped on the *R/V KAIMEI* and are used in the different type of seafloor. The difference between two types of the PGs is bucket's structure. Shell type PG(PGS) is used to collect sediment sample and Claw type PG (PGC) is to grab hard rock sample. Specifications of two PGs are shown in table 1, figure 1 and 2.

Specific features of the PGs compared with another type of sampler are its capacity and mobility. The capacity of each bucket is 1.0 m^3 and bucket is moved by hydraulic system. PG has five cameras and lights to watch the seafloor and 4 thrusters to move around and rotate the attitude controlled by operator from shipboard control van.

PG is connected via 7,000 meters BMS cable that is stored on the BMS winch in the winch room. At the control van, video signals of all cameras coming from PG through the BMS cable are displayed on the monitors and are recorded in the hard disk drive as an AVI format. So, we can monitor seafloor in real time and find the sampling location, at the control van. The control van is installed on the C deck of the *R/V KAIMEI*.

During launch and recovery, a docking head attached on the A-frame is used to latch the PG. Once PG leaves docking head and is deployed into the water, BMS cable is reeled out to water depth referring to depth sensor mounted on the PG.

Specifications of two types of Power Grabs are as follows;

	PGC	PGS
Length	：3.09m	3.48m
Width	：3.09m	2.40m
Height	：4.55m	4.36m
Weight in air (in water)	：6.0 t（4.5 t）	6.0 t（5.0 t）
Operating depth	：6,000m	6,000m
Capacity	：1m³	1m³
Bucket closing time	：20 seconds	
Cable	：BMS cable (35.6mmϕ×7,000m)	

PGC (claw type)

PGS (shell type)

Fig. 1 Power Grab

3. General observation

3-1. Meteorological measurement

3.1.1 Surface meteorological measurement

(1) Objective

Surface meteorological parameters are observed as a basic dataset of the meteorology. These parameters bring us the information about the temporal variation of the meteorological condition surrounding the ship.

(2) Instruments and Methods

(i) Surface meteorological observation system

Surface meteorological parameters were observed throughout this cruise. Meteorological Instruments are listed in Table 1.

Table 1 Instruments and installations of *R/V KAIMEI* Surface Meteorological observation system

Sensors	Type	Manufacture	Location (altitude from surface)
Anemometer	WMT700	Vaisala, Finland	foremast (22.9m), compass deck(27.7 m)
Tair/RH	HMP155	Vaisala, Finland	foremast (21.9m), compass deck(18.3 m)
With radiation shied	DTR13	Vaisala, Finland	
Barometer	PTB330	Vaisala, Finland	navigation bridge deck(14.9 m) at No.1 Lab.
Rain gauge	50202	R. M. Young, USA	compass deck (18.2 m)
Radiometer (short wave)	CMP-22	Kipp & Zonen, The Netherlands	fore mast (21.8 m)
Radiometer (long wave)	CGR-4	Kipp & Zonen, The Netherlands	fore mast (21.8 m)

(ii) PAR

Photosynthetically Available Radiation (PAR) and Ultra violet radiation (UV) were observed throughout this cruise. Instrument specification is as below;

Manufacturer: Biospherical Instruments Inc.
Type: PUV-2510
Measured frequency: 305, 313, 320, 380, 395, 400 - 700 [nm]
Sample rate: 1 sec
Sensor Location (altitude): foremast (21.8 m)

(iii) ROSR

The Remote Ocean Surface Radiometer (ROSR) measured sea skin temperature. Instrument specification is as below;

Manufacturer:	RMR Co.
Sample rate:	10 min average skin temperature
Accuracy:	< 0.1 degree
Sensor Location (altitude):	foremast (21.3 m)

3.1.2 Ceilometer

(1) Objectives

Ceilometer is the system that measures cloud base height and backscatter profile. During this cruise, the ceilometer observation was carried out.

(2) Parameters

1. Cloud base height [m].
2. Backscatter profile, sensitivity and range normalized at 10 m resolution.
3. Estimated cloud amount [oktas] and height [m]; Sky Condition Algorithm.

(3) Instruments and Method

We measured cloud base height and backscatter profile using ceilometer (CL51, VAISALA, Finland) throughout this cruise. Major parameters for the measurement configuration are as below;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode Laser
Transmitting center wavelength:	910±10 nm at 25 degC
Transmitting average power:	19.5 mW
Repetition rate:	6.5 kHz
Detector:	Silicon avalanche photodiode (APD)
Measurement range:	Back scatter; 0 ~ 15 km
Cloud detection; 0 ~ 13 km	
Resolution: 10 meter in full range	
Sampling rate:	36 sec
Sky Condition:	0, 1, 3, 5, 7, 8 oktas (9: Vertical Visibility)
	(0: Sky Clear, 1:Few, 3:Scattered, 5-7: Broken, 8: Overcast)

On the archive dataset, cloud base height and backscatter profile are recorded with the resolution of 10 m (33ft).

(6) Data archives

The raw data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to public via web site of "Data Research for Whole Cruise Information in JAMSTEC".

3.1.3. GPS Meteorology

(1) Objective

Getting the GNSS satellite data to estimate the total column integrated water vapor content of the atmosphere.

(2) Instruments and Method

The GNSS satellite data was archived to the receiver with 1 sec interval. Analyzing the GNSS signal passing through the atmosphere, it estimates the radio wave propagation delay resulting from water vapor, to calculate the atmospheric delay.

Instrument specification is as below;

GNSS receiver:	NetR9 Ti-1 / Trimble
GNSS Antenna:	GNSS-Ti Choke Ring Antenna with radome / Trimble
Antenna location (altitude):	compass deck (18.2m)

(3) Data archive

The raw data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to public via web site of "Data Research for Whole Cruise Information in JAMSTEC".

3-2. Underway surface water monitoring

(1) Objective

To obtain continuous measurement of the sea surface temperature, salinity and dissolved oxygen along the ship's track.

(2) Instruments and Method

Sea surface measurements were made in this cruise by using TSG (Thermosalinograph) system. This system is connected to No.1 seawater pump at bow-thruster room, now therefore TSG usually measure fresh seawater pumped up.
Instrument specification is as below.

(i)Temperature and Conductivity sensor

Model:	SBE-45, SEA-BIRD ELECTRONICS, INC.
Measurement range:	Temperature -5 to +35 oC
	Conductivity 0 to 7 S m-1
Initial accuracy:	Temperature 0.002 oC
	Conductivity 0.0003 S m-1
Typical stability (per month):	Temperature 0.002 oC
	Conductivity 0.0003 S m-1
Resolution:	Temperatures 0.0001 oC
	Conductivity 0.00001 S m-1

(ii)Bottom of ship thermometer

Model:	SBE 38, SEA-BIRD ELECTRONICS, INC.
Measurement range:	-5 to +35 oC
Initial accuracy:	±0.001 oC
Typical stability (per 6 month):	0.001 oC
Resolution:	0.00025 oC

(iii) Dissolved oxygen sensor

Model:	ARO-CAR, JFE Advantech Co., Ltd.
Measuring range:	0 – 20mg/L
Resolution:	0.001 – 0.004 mg/L

(iv) Data archive

These data obtained in this cruise was submitted to the Data Management Group of JAMSTEC, and will be opened to the public via web site of "Data Research for Whole Cruise Information in JAMSTEC".

3-3. Shipboard ADCP

(1) Objective

To obtain continuous measurement of the current profile along the ship's track.

(2) Instruments and Method

Upper ocean current measurements were made in this cruise, using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system. For most of its operation the instrument was configured for water-tracking mode. Bottom-tracking mode, interleaved bottom-ping with water-ping, was made to get the calibration data for evaluating transducer misalignment angle in the shallow water.

Instrument specification is as below.

Manufacturer:	Teledyne RD Instruments
System:	OS38 / OS150
Frequency:	38.4 kHz / 153.6 kHz
Configuration:	4-beam phased array
Beam angle:	30deg
Transducer Depth:	5.5m beneath calm water line
ADCP data logger:	VmDas 1.46.5, Teledyne RD Instruments
Gyro & Motion:	PHINS, IXSEA BLUE
Navigation:	StarPack-D, Fugro

(3) Data archive

These data obtained in this cruise was submitted to the Data Management Group of JAMSTEC, and will be opened to the public via web site of "Data Research for Whole Cruise Information in JAMSTEC".

3-4. Underway geophysics

(1) Objective

Measurement of magnetic force on the ocean is required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. Thus, we measured geomagnetic field using a three-component magnetometer in this cruise.

(2) Instruments and method

A shipboard three-component magnetometer system is equipped on-board R/V KAIMEI. Three-axies flux-gate sensors with ring-cored coils are fixed on the compass deck. Instrument specification is as below.

Manufacturer:	Terra Technica
System:	SFG1216
Sampling rate:	8 Hz
Sensor location (altitude):	compass deck (19.2 m from sea surface)
Gyro & Motion:	PHINS, IXSEA BLUE
Navigation:	StarPack-D, Fugro

Principle of shipboard geomagnetic vector measurement. The relation between a magnetic-field vector observed on-board, Hob, (in the ship's fixed coordinate system) and the geomagnetic field vector, F, (in the Earth's fixed coordinate system) is expressed as:

Hob = F + Hp (a)

Where, and are the matrices of rotation due to roll, pitch and heading of a ship, respectively. is a 3 x 3 matrix that represents magnetic susceptibility of the ship, and Hp is a magnetic field vector produced by a permanent magnetic moment of the ship's body. Rearrangement of Eq. (a) makes

Hob + Hbp = F (b)

Where = -1, and Hbp = - Hp. The magnetic field, F, can be obtained by measuring, and Hob, if and Hbp are known. Twelve constants in and Hbp can be determined by measuring variation of Hob with, and at a place where the geomagnetic field, F, is known.

(3) Data Archives

These data obtained in this cruise was submitted to the Data Management Group of JAMSTEC, and will be opened to the public via web site of “Data Research for Whole Cruise Information in JAMSTEC”.

3-5. Swath Bathymetry

(1) Introduction

MultiBeam Echo Sounding system (MBES) is collecting continuous bathymetric data along ship's track to make a contribution to geological and geophysical investigations and global datasets.

(2) Specification and method

The "EM122" & "EM711" on R/V KAIMEI are multibeam echo sounder for bathymetry mapping. The system configuration and performance for EM122 (12 kHz system) and EM712 (40 ~ 100 kHz system) is listed below.

Deep multibeam echo sounder (Kongsberg / EM122)

Frequency:	12 kHz (10.5 ~ 13 kHz)
Beam width:	1 degree × 1 degree
Transmit pulse length:	CW; 3 to 15 msec. / FM chirp; 25 to 100msec (auto)
Depth range:	20 to 11,000 m
Number of beams:	288
Number of footprints:	432 (864; Dual swath mode)
Swath width:	150 degree (max)
Depth accuracy:	0.2 % of depth (swath width ± 45degree)
Gyro & Motion:	PHINS, IXSEA BLUE
Navigation:	StarPack-D (G2, XP2 and L1), Fugro

Shallow multibeam echo sounder (Kongsberg / EM712)

Frequency:	40 ~ 100 kHz
Beam width:	50 kHz; 1degree × 1 degree
	100kHz; 0.5 degree × 0.5 degree
Transmit pulse length:	CW; 0.2 to 2 msec, / FM chirp; 25 to 120 msec. (auto)
Depth range:	3 to 3,600 m
Number of beams:	256
Number of footprints:	400 (800; Dual swath mode)
Swath width:	140 degree (max)
Depth accuracy:	0.2 % of depth (swath width ± 45degree)
Gyro & Motion:	PHINS, IXSEA BLUE
Navigation:	StarPack-D, Fugro

To get accurate sound velocity of water column for ray-path correction of acoustic

multibeam, we used Surface Sound Velocimeter (Smart SV/AML) data to get the sea surface (5.5 m) sound velocity, and the deeper depth sound velocity profiles were calculated by temperature and salinity profiles from CTD and XBT data during the cruise.

(3) Data Archive

These data obtained in this cruise was submitted to the Data Management Group of JAMSTEC, and will be opened to the public via web site of "Data Research for Whole Cruise Information in JAMSTEC".

4. Survey area

Fig. 2 shows planned PG sampling points in Sagami-Bay.

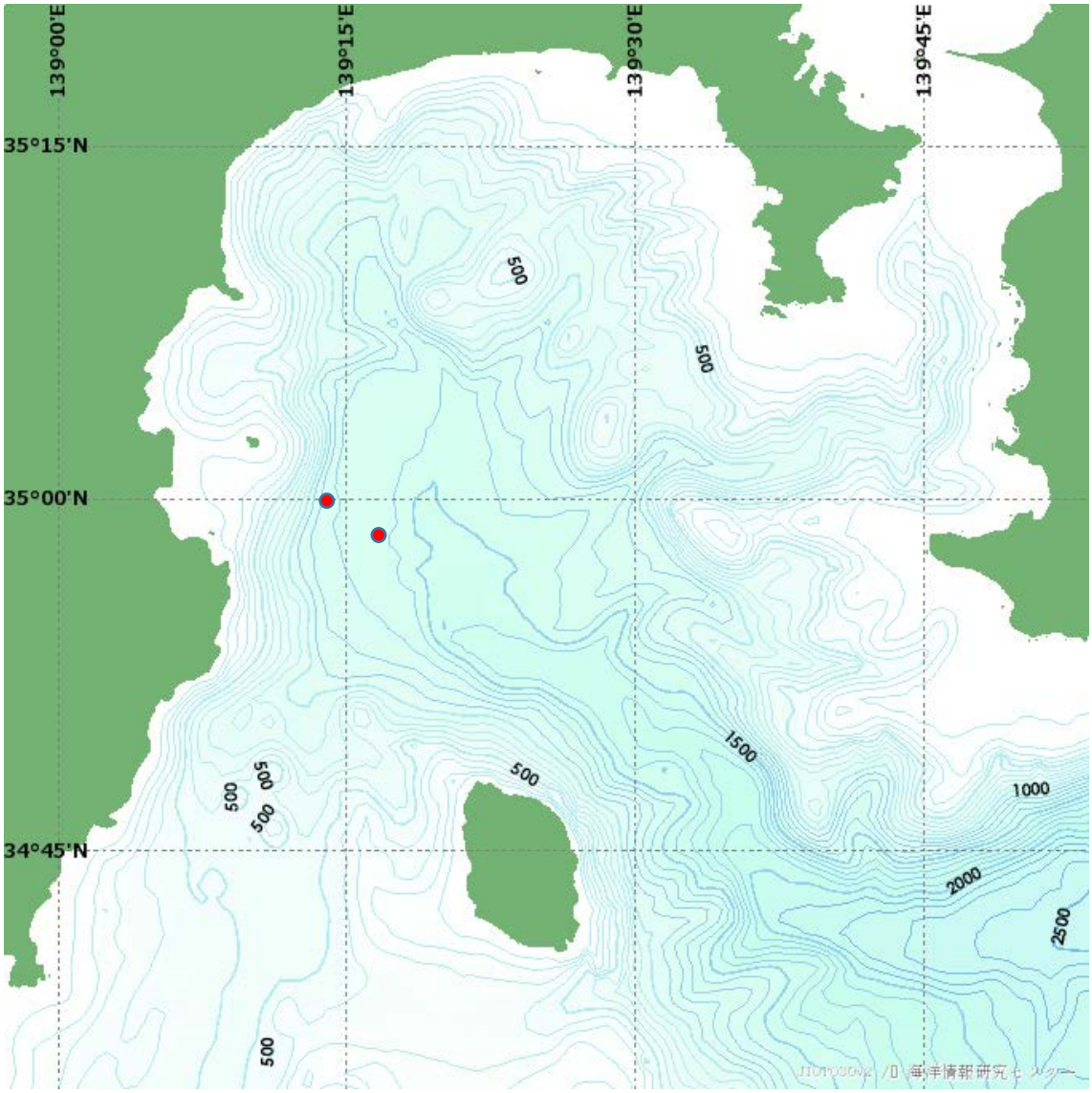

Fig. 2 Planned PG sampling points in the Sagami-Bay

Fig. 3 shows planned sampling area in the Bayonaise.

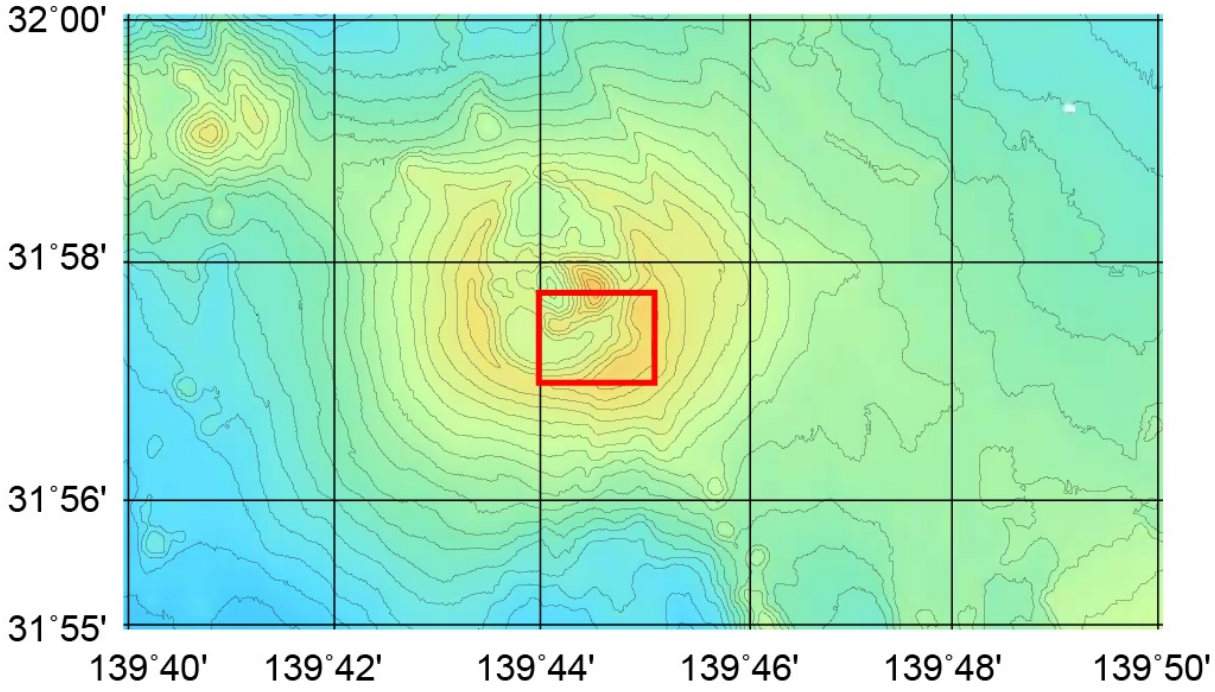

Fig. 3 Planned PGC sampling area in the Bayonaise

5. Cruise track

KM16-09 cruise was started from JAMSTEC pier on October 17 and then, the vessel went to the survey area in the Sagami-Bay. Three casts for PGC and two casts for PGS were finally conducted in the Sagami-Bay and Bayonaise. We ended KM16-09 cruise at JAMSTEC pier on October 25.

Fig. 4 shows ship's tracks for the entire cruise and table 2 shows activity log during the cruise.

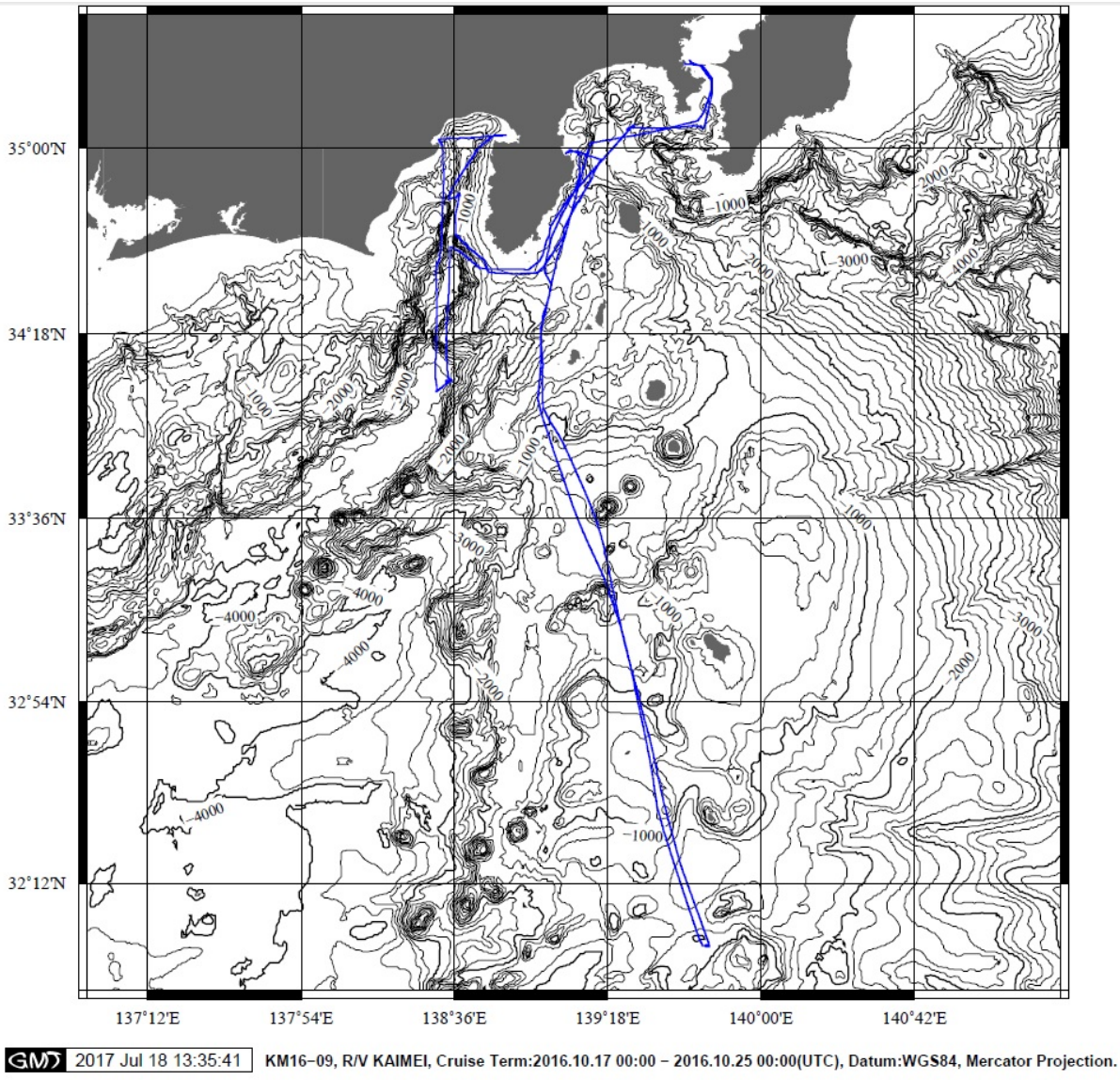

Fig. 4 Ship's tracks for the entire KM16-09 cruise

Table 2 Cruise log

Date	Local Time	Description	Position / Weather / Wind, Sea condition (Noon)
Mon. 17.Oct	08:00	Scientists party onboard R/V KAIMEI	SAGAMIWAN
	09:00	Let go all shore line & left JAMSTEC for test area (SAGAMIWAN)	35-01.5 N, 139-18.0 E
	10:00-10:35	Carried out education & training for scientists	Rain
	12:02	Started operation of TSG (Termosalinograph)	N-5 (Fresh breeze)
	12:15	Arrived at test area (SAGAMIWAN)	2 (Smooth)
	12:16	Released XBT at 35-01.3806N, 139-14.7184E	2 (Low Swell Long)
	13:35-15:02	Carried out FPG cast (PGC1/cast1)	Visibly: 4'
	16:45	Left test area (SAGAMIWAN) for next test area (Beyonesu)	
Tue. 18.Oct	08:00	Arrived at Test area (Beyonesu caldera)	The south of AOGASHIMA
	08:12	Released XBT at 31-59.4638N, 139-42.9256E	31-57.4 N, 139-44.7 E
	08:34-08:38	Carried out MBES mapping survey	Fine but Cloudy
	10:26-11:46	Carried out FPG cast (PGC2/cast2, D=777m)	NW-4(Moderate breeze)
	14:12-16:14	Carried out FPG cast (PGC3/cast3, D=830m)	3(Slight)
	17:00	Left test area (Beyonesu caldera) for next test area (SAGAMIWAN)	3(Moderate Short)
			Visibly: 8'
Wed. 19.Oct	08:15	Arrived at off ITOKO	Off ITOKO
	14:20	Let go starboard anchor in 48m of water at off ITOKO	34-59.7 N, 139-07.8 E
			Fine but Cloudy
			NE-3(gentle breeze)
			2(Smooth)
			2(Low Swell Long)
			Visibly: 8'
Thu. 20.Oct	07:30	Up & down starboard anchor	SAGAMIWAN
	07:45	Proceeded to test area (SAGAMIWAN)	34-57.4 N, 139-16.2 E
	08:30	Arrived at test area (SAGAMIWAN)	Fine but Cloudy
	9:20-10:37	Carried out FPG cast (PGS1/cast4, D=1339m)	N-2(light breeze)
	13:09-14:55	Carried out FPG cast (PGS2/cast5, D=1338m)	2(Smooth)
	18:00	Left test area (SAGAMIWAN) for SURUGAWAN	2(Low Swell Long)
			Visibly: 8'
Fri. 21.Oct	06:00	Proceeded to UCHIURAWAN	UCHIURAWAN
	08:20	Arrived at UCHIURAWAN	35-03.0 N, 138-50.3 E
	14:00	Proceeded to off SHIMIZU	Cloudy
	15:30	Arrived at off SHIMIZU	SE-5 (Fresh breeze)
	16:05	9 persons emberked & 1 person disemberked by traffic boat KASHIWA MARU No.2	2 (Smooth) 1 (Low Swell short)
	16:10	Proceeded to off MIHO saki	Visibly: 8'
	16:30-16:50	Carried out education & training for scientists	
	17:00	Arrived at off MIHO saki, then keep this position by DPS	
	20:00-23:00	Meeting of BMS winch test (scientists & engineer)	
Sat. 22.Oct	00:00	Proceeding to Free fall point (NANKKAI TOROUGH)	The west of off KOZUSHIMA
	04:30	Arrived at Free fall point (NANKAI TROUGH)	34-07.4 N, 138-35.1 E
	8:00-9:00	Meeting of BMS winch test (KAIMEI Crew, scientists & engineer)	Overcast
	10:20	Com'ced Free fall of BMS winch	NE-6(Strong breeze)
	19:07	Finished Free fall of BMS winch	4(Moderate)
			3(Moderate Short)
			Visibly: 8'
Sun. 23.Oct	6:51-7:52	Carried out figure eight running	The west of off KOZUSHIMA
	8:00-9:30	Meeting of BMS winch test (KAIMEI Crew, scientists & engineer)	34-11.5 N, 138-34.1 E
	9:42-11:27	Carried out freefall of BMS winch (w.o.=2033m)	Cloudy
	11:45	Proceeded to next test area (SURUGAWAN)	NE-6(Strong breeze)
	14:20	Arrived at test area	4(Moderate)
	14:41	Com'ced Free fall of BMS winch (w.o.=1200m)	3(Moderate Short)
	16:38	Finished Free fall of BMS winch	Visibly: 8'
	16:50	Com'ced proceeding to SAGAMIWAN	
	18:00-2020	Meeting of BMS winch test (KAIMEI Crew, scientists & engineer)	
Mon. 24.Oct	6:46-7:39	Carried out figure eight running	YOKOSUKA Sec.4
	08:30	Finished test works then left test area SAGAMIWAN for YOKOSUKA Sec.4	35-19.7 N, 139-40.5 E Fine but Cloudy
	11:30	Let go portside anchor in 28m of water at YOKOSUKA No.4	NNE-2(Light breeze)
	13:00-14:00	Meeting of BMS winch test (KAIMEI Crew, scientists & engineer)	2 (Smooth)
			0 (No Swell)
			Visibly: 8'
Tue. 25.Oct	09:00	Completed voy. No. KM16-09	

6. Preliminary results

6-1. PGC sampling

Fig. 5 shows PGC cast 1 location. No sample was collected in this location.

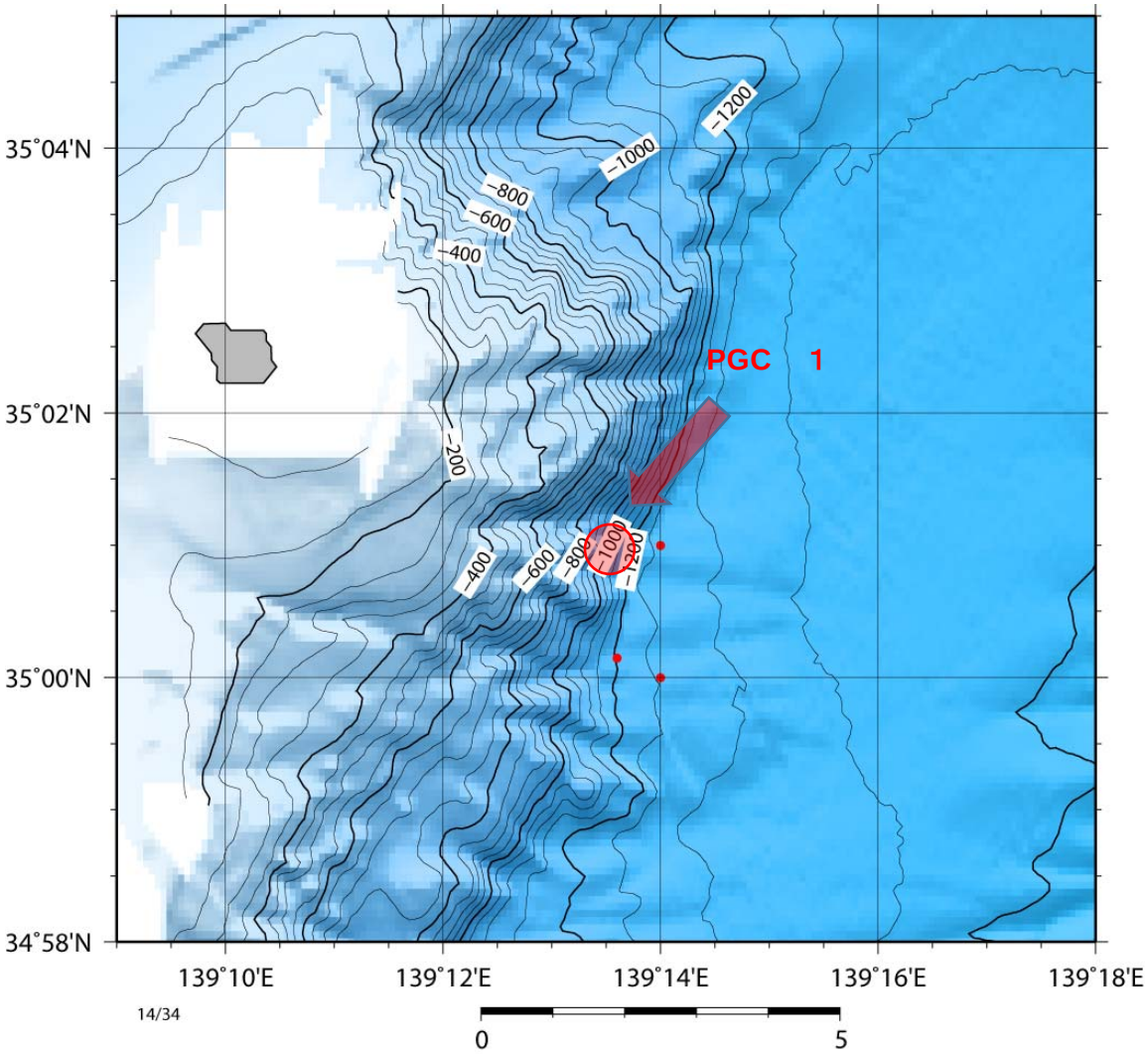

Fig. 5 PGC sampling location (PGC cast 1)

PGC 1 Location : 35° 01.000′N 139° 13.500′E Depth : 960 m

Fig. 6 shows PGC cast locations. Hard rock samples were collected in those locations shown in Fig. 7.

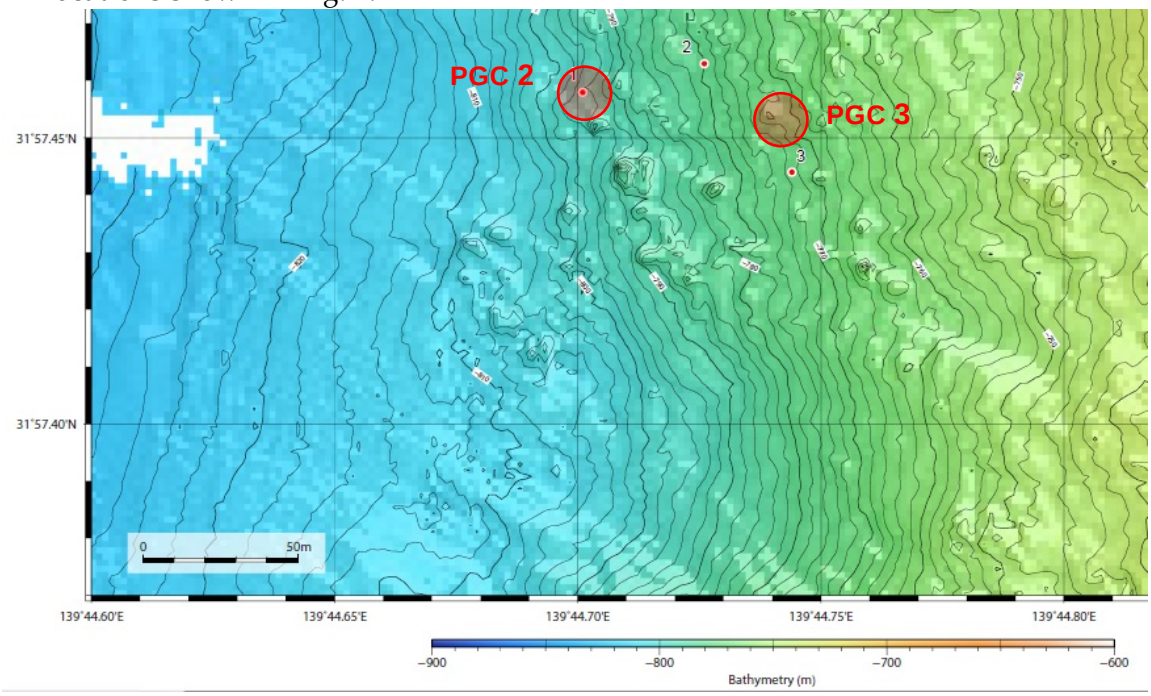

Fig. 6 PGC sampling locations (PGC cast 2 and 3)

PGC 2 Location : 31° 57.4548′N 139° 44.7065′E Depth : 777 m

PGC 3 Location : 31° 57.4584′N 139° 44.7430′E Depth : 763 m

Fig. 7 Example of sample collected in the PGC cast 3 location

6-2. PGS sampling

Fig. 8 shows PGS casts locations. No sample was collected during PGS cast 1, but soft sediment sample was collected during PGS cast 2. Push core samples were taken from the soft sediment shown in Fig.9.

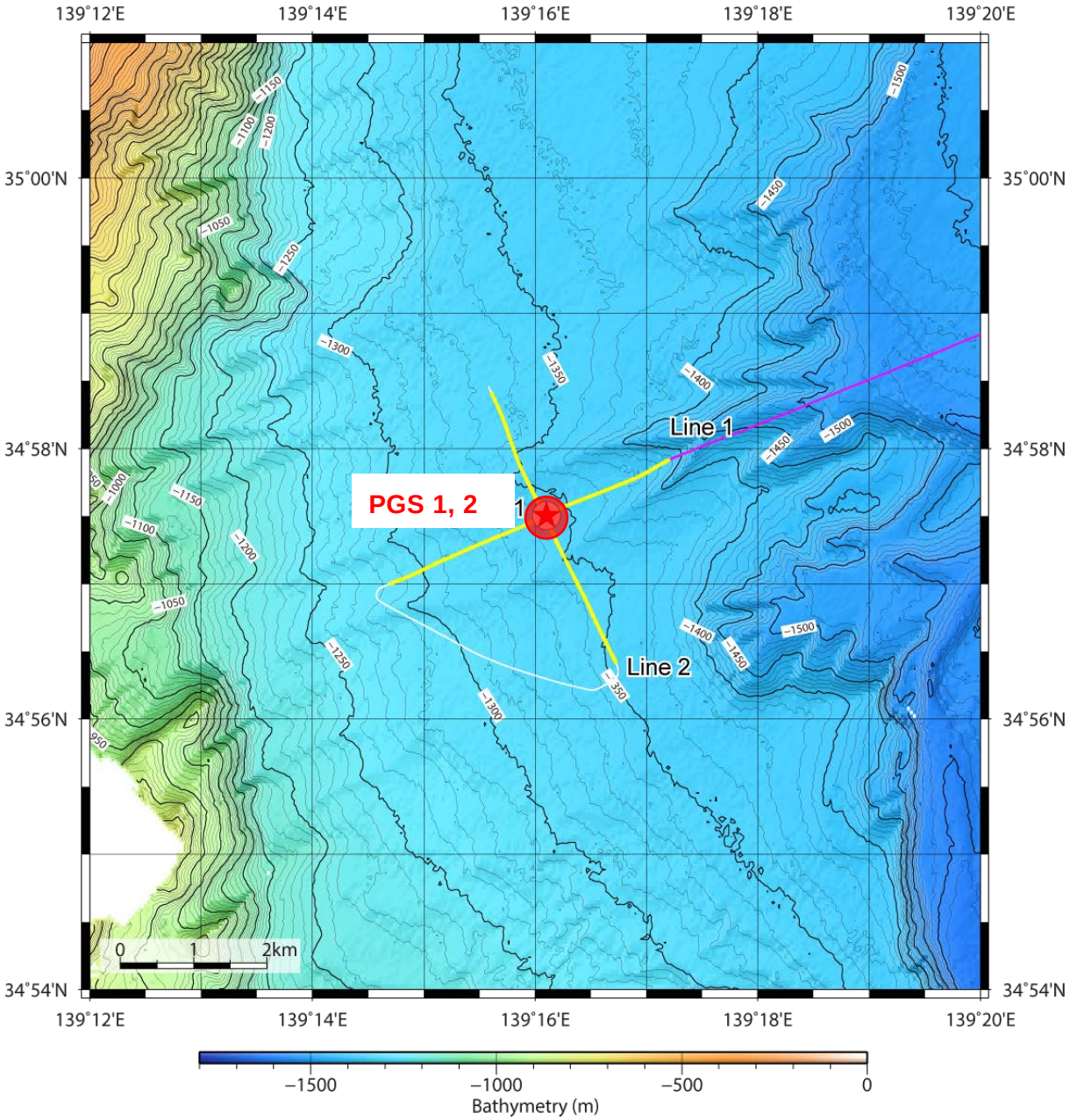

Fig. 8 PGS sampling locations (PGS cast 1 and 2)

PGS 1	Location : 34°	57.4935′N	139°	16.1084′E	Depth : 1,336 m
PGS 2	Location : 34°	57.4893′N	139°	16.1143′E	Depth : 1,337 m

Fig. 9 Example of sediment sample collected during PGS cast 2

7. Acknowledgement

We thank Captain YOSHIDA Rikita, crew and technical staffs of our experiments conducted during the KM16-09 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.