



R/V Kaimei “Cruise Report”
KM18-08C

Confirmation of the protocol for survey technique on the
hydrothermal deposit

R/V KAIMEI, BMS

Okinawa Trough, South-West Japan

Sep.3,2018-Oct.5,2018

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 cruise.
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Some maps don't include the detailed position because this cruise data relate with the natural resources.

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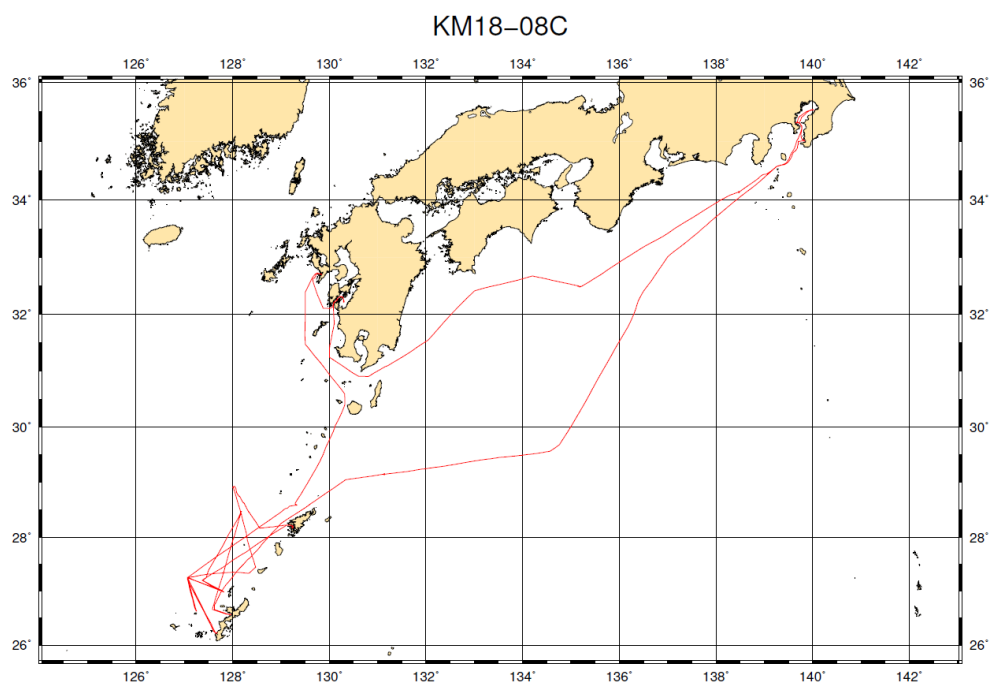
E-mail: submit-rv-cruise@jamstec.go.jp

Acknowledgements

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1. Cruise Information

- Cruise ID KM18-08C
- Name of vessel R/V KAIMEI
- Title of proposal Zipangu in the Ocean program
- Title of cruise Confirmation of the protocol for survey technique on the hydrothermal deposit
- Chief Scientist Takafumi Kasaya [JAMSTEC]
- Cruise period Sep.3,2018–Oct.5,2018
- Ports of call Yokosuka–Yokosuka
- Research area Okinawa Trough, South-West Japan
- Research map



2. Research Proposal and Science Party

- Title of proposal

Zipangu in the Ocean program

- Representative of Science Party

Eiichi Kikawa [JAMSTEC]

- Science Party (List)

Scientists

During 9/3~10/5. Onboard the “KAIMEI” at JAMSTEC, getting off at JAMSTEC.

Takafumi Kasaya (Chief Scientist)	JAMSTEC
Hideaki Machiyama	JAMSTEC
Hisanori Iwamoto	JAMSTEC
Yusuke Ohta	JAMSTEC
Harutaka Okayama	Japan Drilling Co., Ltd.
Takuya Nagaoka	Japan Drilling Co., Ltd.
Antony Kingan	Subsea Geo Services Inc.
Michael Avey	Subsea Geo Services Inc.
Masayuki Toizumi	Nippon Marine Enterprises, LTD.
Satomi Minamizawa	Nippon Marine Enterprises, LTD.
Eri Sakamoto	Nippon Marine Enterprises, LTD.
Yusuke Sato	Marine Works Japan Ltd.
Takehiro Kani	Marine Works Japan Ltd.

During 9/3~9/22. Onboard the “KAIMEI” at JAMSTEC, getting off at Naha.

Takao Sawa	JAMSTEC
Mana Yasui	JAMSTEC
Shohei Albert Tomita	JAMSTEC
Masanobu Yanagitani	JAMSTEC
Junichiro Ishibashi	Kyushu University
Hironobu Nosoko	International Communication Planning Co., Ltd.
Akihiko Fujihara	Marine Works Japan Ltd.

During 9/3~10/1. Onboard the “KAIMEI” at JAMSTEC, getting off at Kumamoto.

Shuhei Totsuka	JAMSTEC
Akihi Tsutsumi	Kyushu University

During 9/22~10/1. Onboard the “KAIMEI” at Naha, getting off at Kumamoto.

Junji Torimoto	JAMSTEC
Yusuke Kira	Kyushu University

During 9/22~10/5. Onboard the “KAIMEI” at Naha, getting off at JAMSTEC.

Tadanori Goto	JAMSTEC
Osamu Motohashi	Space Engineering Development Co., Ltd.

During 9/22~9/26. Onboard the “KAIMEI” at Naha, getting off at Nagasaki.

MacArtney technician 2 person

During 9/22~9/27. Onboard the “KAIMEI” at Naha, getting off at Nagasaki.

Satoshi Tsukioka

JAMSTEC

During 9/28~10/1. Onboard the “KAIMEI” at Nagasaki, getting off at Kumamoto.

Yoshinobu NAMBU

JAMSTEC

OCC technician 6 person

R/V KAIMEI Officers and Crew

Captain	Rikita Yoshida
Chief Officer	Yasuhiko Sammori
2nd Officer	Akira Suzuki
3rd Officer	Tomohiro Yukawa
Chief Engineer	Koji Funae
1st Engineer	Takahiro Mori
2nd Engineer	Katsuto Yamaguchi
3rd Engineer	Hayato Ryosyu
Jr.3rd Engineer	Kota Fujii
Chief Electronic Operator	Yoichi Inoue
2nd Electronic Operator	Takatomo Shirozume
3rd Electronic Operator	Kazumi Ugajin
Boat Swain	Yuki Yoshino
Able Seaman	Naoki Iwasaki
Able Seaman	Saikan Hirai
Able Seaman	Yasunobu Kawabe
Sailor	Yuta Ohjiri
Sailor	Yudai Yoshimi
Sailor	Akira Saito
No.1 Oiler	Katsuyuki Yoshida
Oiler	Yuji Higashigawa
Oiler	Sota Misago
Assistant Oiler	Keita Yamazaki
Chief Steward	Katsuyuki Omiya
Steward	Yoshitaka Yamamoto
Steward	Shinobu Ohyu
Steward	Ryu Kubota

BMS and KM-ROV Operation team

Operation Manager	Atsumori Miura
1st ROV Operator	Mitsuhiro Ueki
1st ROV Operator	Yoshinari Ono
2nd ROV Operator	Tetsuya Ishitsuka
2nd ROV Operator	Katsushi Chiba
2nd ROV Operator	Atsushi Takenouchi
2nd ROV Operator	Yosuke Chida
2nd ROV Operator	Mitsuru Torigoe
2nd ROV Operator	Shigeru Kikuya
2nd ROV Operator	Shinosuke Kumagai
3rd ROV Operator	Shuya Sugiura
3rd ROV Operator	Atushi Koguma

3. Research/Development Activities

3.1 Instruments

3.1.1 Ocean bottom electro-magnetometer (OBEM)

The OBEM system can measure time variations of three components of magnetic field, two components of horizontal electric field, the instrumental tilts, and temperature. It mainly consists of one 17-inch glass sphere, sensor unit in aluminium/titanium pressure housing and electrode arm unit with arm holding mechanism (Fig. 3.1.1, Fig. 3.1.2). The glass sphere involves data logger and a lithium battery pack. The sensor unit has a high-accuracy fluxgate magnetometer, tiltmeter and thermometer. The electrodes are Ag-AgCl equilibrium type made by Clover Tech. For electric field, four voltage differences between the electrodes on the tip of the pipes and the ground electrode are measured. The electrodes were monitored their self-potentials in laboratory in advance of the seafloor observation and pairs that the coherence is high enough were selected, in order to reduce the noise due to the voltage drift of electrodes themselves. A transponder unit, radio beacon and a flashlight are also mounted on the OBEM. The acoustic system can communicate with the SSBL system and it is easy for us to detect its position in the sea or on the seafloor. There are a transponder unit mounted on the OBEM system. This transponder unit, of which the acoustic and the pressure case units are combined, has 2-year battery life.

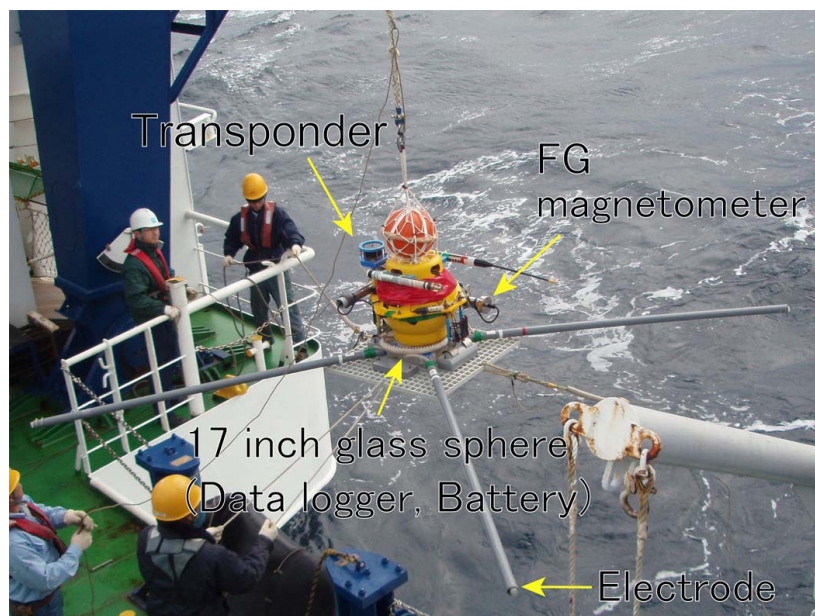


Fig. 3.1.1 OBEM system

Concepts of the type the OBEM system are miniaturization, a high sampling rate, easy assembly and recovery operations, and low costs of construction and operation. The arm holding mechanism, which electrode arm is folded when OBEM is in surfacing (Fig. 3.1.2), enable recovery

operation even by the small ship that do not equip A frame (Kasaya et al., 2006; Kasaya and Goto, 2009).

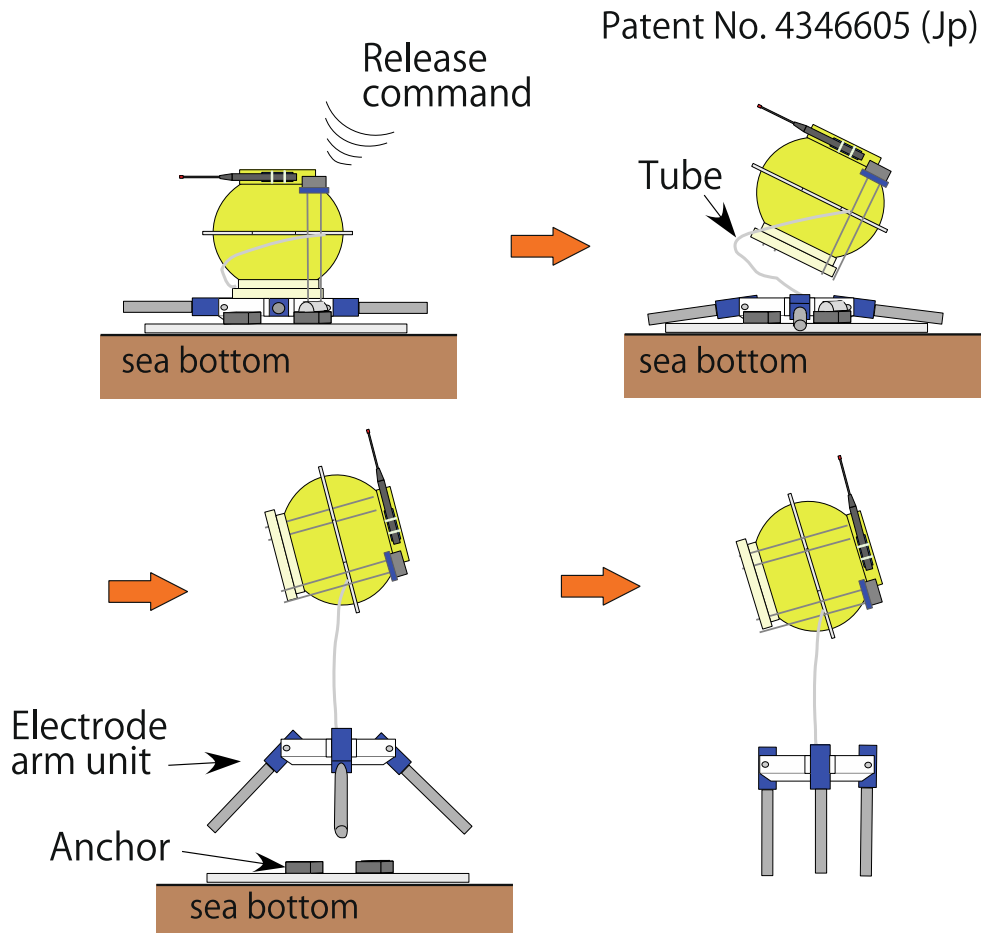


Fig. 3.1.2 Electrode arm-holding mechanism of type A OBEM

References

- Kasaya, T., T. Goto, and R. Takagi, Marine electromagnetic observation technique and its development –For crustal structure survey–, *BUTSURI-TANSA*, **59**, 585-594 (in Japanese with English abstract), 2006.
- Kasaya, T., and T. Goto, A small OBEM and OBE system with an arm folding mechanism, *Exploration Geophysics*, **40**, 41-48, 2009.

3.1.2 OBE

The OBE is designed for the controlled source survey with 1 kHz sampling rate (Table 3.1.1). All electric circuits and batteries are installed in a cylinder type aluminum or titanium pressure case. In this cruise, we used them with two observation forms. One was installed by ROV (see left panel of Fig. 3.1.3). Next is a pop-up OBE with the acoustic releaser and arm holding mechanism as mentioned in previous section (right panel of Fig. 3.1.3).



Fig. 3.1.3 Photos of an OBE system (Left panel: mobile style, Right panel: self -popup style).

Table 3.1.1 Specification of an electrometer

Logger unit

Measurement channels: 5 CH

Measurement Voltage Range: ± 100 mV

A/D converter: 24 bit

Recording Media: SDHC

Sampling rate: 1 kHz

3.1.3 Transmitter system on ROV

Controlled-source unit was loaded on the KM-ROV for MDCR survey (Fig. 3.1.4). A transmitter unit including the IGBT device and an AC/DC unit is installed in each cylinder type aluminum pressure cases. Its specifications are shown in Table 3.1.1.

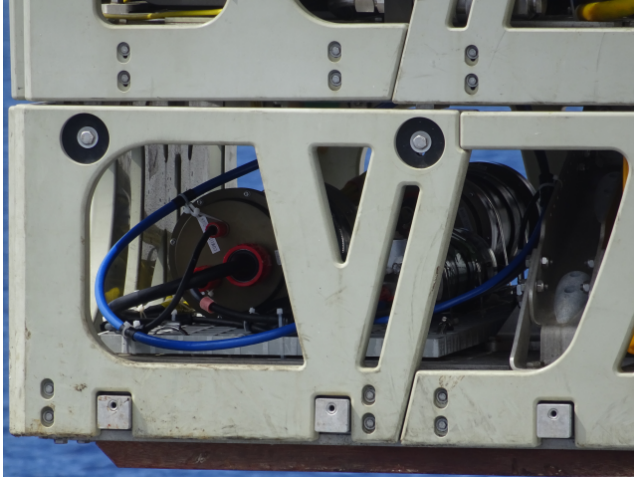


Fig. 3.1.4 Photo of a controlled source unit on the ROV.

Table 3.1.1 Specification of a control source survey system

Power unit

Max Input Voltage: 120 V

Max Output Current: 50 A

Circuit type: IGBT

Transmit channel: 2 ch

Main unit

Control unit

Max Measurement Current Range: 50 A

Max Measurement Voltage Range: 200V

A/D converter: 24 bit

Recording Media: SDHC

Sampling rate: 1 kHz

3.1.4 Long-term monitoring system

We have developed two types of long-term monitoring systems for the monitor subsurface structure changes after the mining. First system is that a current transmit unit and a multi-channel receiver unit is separated. Figure 3.1.5 shows the developed transmitter system based on the MDCR system and it is able to transmit the electric signal and obtain CTD data. A multi-channel receiver unit with 10 ch heat-flow meter can record 10 ch electric field data with 20 Hz sampling rate (Fig. 3.1.6). The other is the transmitter and receiver are integrated and two units are used in a pair for resistivity monitoring. Figure 3.1.7 shows its integrated system. All electrical data are recorded with 1 kHz sampling rate when current transmitting, and the potential data is recorded with 20 Hz sampling rate in other period. Each clock among instruments can do accurate synchronization.

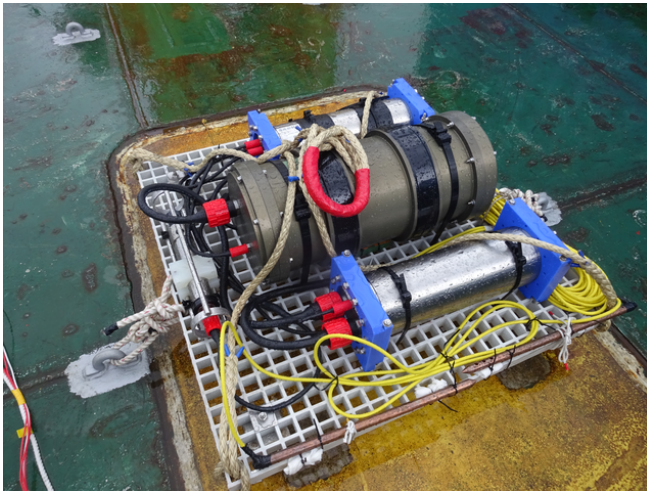


Fig. 3.1.5 Photo of a transmitter system for the long-term monitoring.



Fig. 3.1.6 Photo of an electrometer system with heat-flow meter for the long-term monitoring.

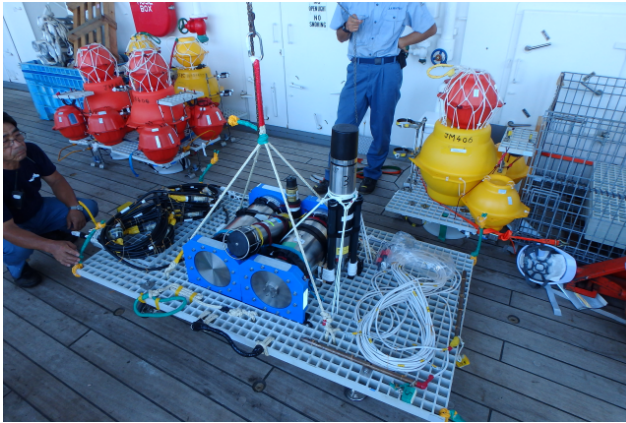


Fig. 3.1.6 Photo of an integrated transmitter and receiver system for the long-term monitoring

3.1.5 Around View Monitor (AVM) system

The underwater around view monitor was used for preliminary survey before ocean bottom coring.

The monitor consists of 5 fish eye HD cameras including the bottom view camera, an acoustic altimeter and 9-axis gyro. The altimeter is for changing shape of the virtual screen where around view are projected. When the altitude is detected by the sonar, the shape of seafloor. The view is projected on spherical screen at high altitude and bottom view camera looks downward. In other words, the view of the monitor covers lower hemisphere when a ROV is ‘flying’. Once the sea floor is detected by the altimeter, the shape of the screen is changed into a cylinder seamlessly in proportion to the altitude. The view is stabilized by calculating the attitude of the ROV with the motion information from 9-axis gyro. We can see the stable bird view, even if the ROV is rolled and tilted.



Fig. 3.1.6 Photo of AVM system

Table 3.1.2 specifications of AVM system

Max. operation depth	3000 [m]
Power consumption	200 [w] (100 [VAC])
Weight	40 [kg] in air
Dimension of bottle	198 [mm] dia., 650 [mm] len.
Interface	DBH13F for Ethernet 75CXBHFSS for HD-SDI
camera	HD multi SeaCam x 5 FOV: 145H x 85V x 165D [degree] Resolution: 1920x1080(1080p/30)
Sonar	Micron Sonar x 1 Center frequency: 700 [kHz] Max. range: 75 [m] Resolution: 0.3 [m]
Gyro	Mpu-9150 x 1 gyroscope: 3-axis accelerometer: 3-axis compass: 3-axis

3.2 Operation reports

3.2.1 OBEM and OBE operations

For characterization a back-arc basin development, we have obtained Magneto-telluric data using OBEMs. In this cruise, we carried out recovery operations of OBEMs which were deployed in KM18-04C cruise. (Fig. 3.2.1). The operations were quick and smooth. We could track the position and depth of each OBEM by acoustic navigation system after their pou-up.

The pop-up type OBEs and mobile OBEs were also installed in three areas for the survey using the controlled source.

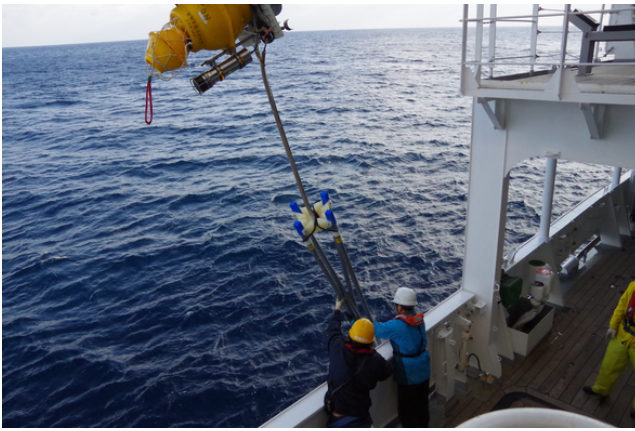


Figure 3.2.1 Photo of the OBEM recovery operation.

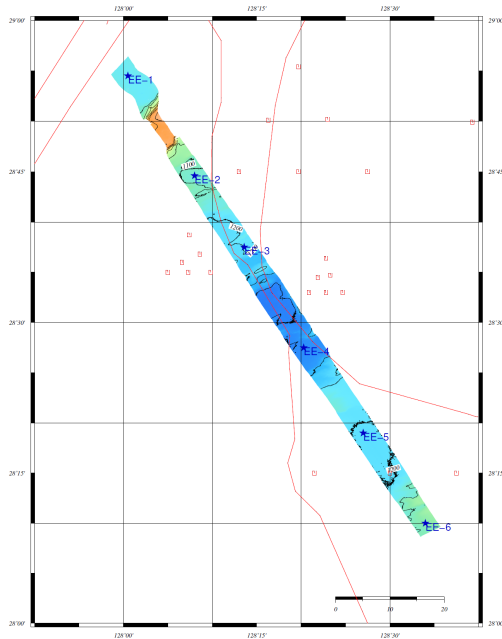


Figure 3.2.2 Positions of all deployed OBEMs.

Table 3.2.1 Information of the OBEMs.

site ID	OBE M ID	Deployed time (JST)	Deployed Latitude	Deployed Longitude	Calibrated time (JST)	Landed Latitude	Landed Longitude	OBEM Depth
EE-1	JM401	2018/4/25 7:05:32	28-54.328 2N	128-00.391 1E	2018/4/25 7:31:40	28-54.675 4N	128-00.657 1E	1169
EE-2	JM402	2018/4/25 9:12:50	28-44.356 1N	128-07.686 7E	2018/4/25 9:39:10	28-44.548 6N	128-07.907 6E	1120
EE-3	JM403	2018/4/25 10:54:58	28-37.282 4N	128-13.465 4E	2018/4/25 11:23:02	28-37.410 7N	128-13.605 8E	1197
EE-4	JM404	2018/4/25 13:00:40	28-27.229 3N	128-20.353 8E	2018/4/25 13:32:21	28-27.303 4N	128-20.320 5E	1388
EE-5	JM406	2018/4/25 14:57:15	28-18.925 7N	128-27.127 3E	2018/4/25 15:25:35	28-18.972 9N	128-27.107 9E	1206
EE-6	JM109	2018/4/25 16:52:00	28-10.018 5N	128-34.113 6E	2018/4/25 17:14:07	28-09.951 9N	128-34.091 6E	1058

3.2.3 ROV dives

We reluctantly carried out some MDCR operation and visual observation using the around view system (AVM). Recovery and install operation of long-term monitoring system were conducted in the hydrothermal area. Figure 3.2.3 shows the map of ROV dive areas. Around view monitor was used in the 5 dives and recorded the view near seafloor over 10 hours (Fig. 3.2.4). And some 3D image near seafloor was generated from the around view image experimentally (Fig. 3.2.5). It is very useful for ROV operators and observers to carry out the safety dive in the rough bathymetric area as a hydrothermal area because of all-round view as Fig.3.2.4

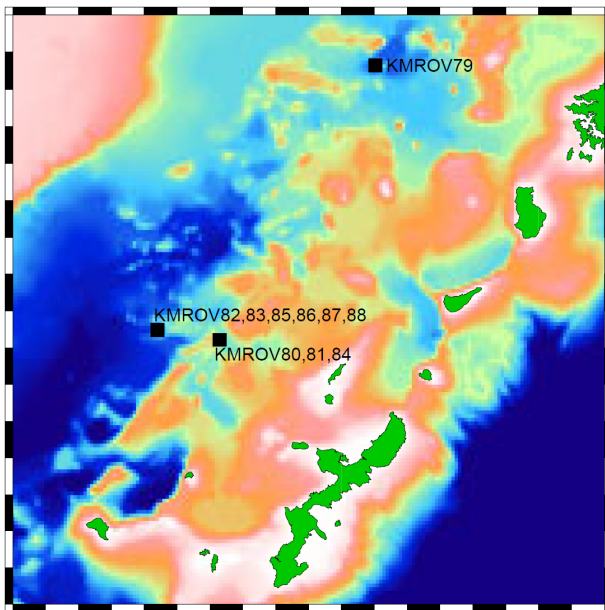


Fig. 3.2.3 ROV dive areas at the Okinawa trough.

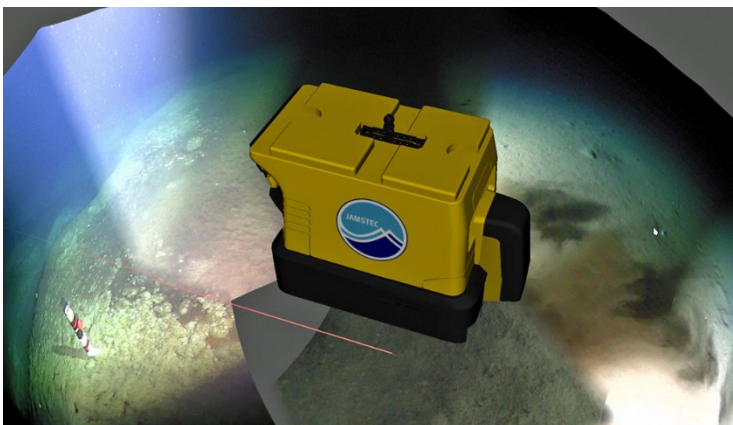


Fig. 3.2.4 Bird-view image by the around view monitor at seafloor. Bacterial mat is visible on the left side of the view. Underwater thermometer is on the left down and smokes is the right side. ROV operator can see and check the around of the ROV thorough this image immediately.

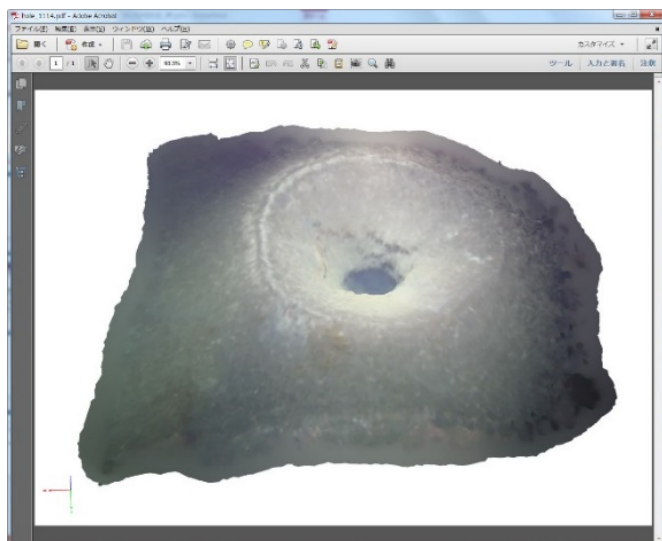


Fig. 3.2.5 3D image of the drilled hole. The image was generated from a fish-eye camera of the around view monitor using multi-view stereo technique.

3.2.4 BMS operation

Main topic of this cruise is to obtain the drilling samples using the Boring machine system (BMS) by Cellula Robotics Ltd. for the confirmation of our geophysical exploration results. Unfortunately, many troubles of cable and winch system related to the BMS occurred. During this cruise, we tried to fix all troubles with many technician of manufacturing companies and MARITEC of JAMSTEC. However we were not able to obtain any samples due to two typhoon and insufficient repairing operation.

4. Cruise Log

2018/09/03 CHIBA-KO CHIBA-KU No.4 sec. (35-31.9N, 140-01.5E)

Weather: Rain / Wind direction: North / Wind force: 3 / Wave scale: 1 / Swell scale: 1 / Visibility: 5 miles (12:00 JST)

08:00 Scientists onboarded KAIMEI at YOKOSUKA
09:00 Let go all share lines & left YOKOSUKA for CHIBA off
10:00-10:40 Carried out education & training for scientists
11:15 Arrived CHIBA Chiba-ku Sec.4
13:15 Let go starboard anchor
14:00 Scientists meeting

2018/09/04 CHIBA Chiba-ku No.4 sec. (35-31.8N, 140-01.5E)

Weather: Cloudy / Wind direction: South / Wind force: 6 / Wave scale: 3 / Swell scale: 0 / Visibility: 8 miles (12:00 JST)

08:45 Heaved up starboard anchor
13:19-13:48 Carried out BMS launch test
18:00 Scientists meeting

2018/09/05 CHIBA Chiba-ku No.4 sec. (35-31.8N, 140-01.5E)

Weather: Fine but Cloudy / Wind direction: SSW / Wind force: 7 / Wave scale: 4 / Swell scale: 0 / Visibility: 7 miles (12:00 JST)

12:30 Commenced proceeding to off YOKOSUKA
14:45 Arrived at off YOKOSUKA
18:00 Scientists meeting

2018/09/06 West ward TOSHIMA (34-28.0N, 139-07.0E)

Weather: Cloudy / Wind direction: SW / Wind force: 6 / Wave scale: 4 / Swell scale: 2 / Visibility: 7 miles (12:00 JST)

06:15 Commenced proceeding to survey area (OKINAWA trough)
16:40 Pray for safety of cruise to KONPIRASAN

2018/09/07 South ward off SHIKOKU (30-31.0N, 135-21.0E)

Weather: Fine but Cloudy / Wind direction: South / Wind force: 5 / Wave scale: 3 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

Proceeded to survey area all day

2018/09/08 NE ward AMAMI-OSHIMA (28-47.0N, 129-54.0E)

Weather: Cloudy / Wind direction: SSW / Wind force: 6 / Wave scale: 4 / Swell scale: 2 / Visibility: 8 miles (12:00 JST)

06:12-06:42 Carried out eight figure running
18:00 Scientists meeting

2018/09/09 NAGO bay (26-34.0N, 127-58.0E)

Weather: Cloudy / Wind direction: SSE / Wind force: 2 / Wave scale: 1 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

14:22-14:52 Carried out BMS launched test
18:00 Scientists meeting

2018/09/10 A1 area of Okinawa Trough

Weather: Cloudy / Wind direction: NE / Wind force: 4 / Wave scale: 2 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

05:00 Arrived at survey area (East of ENSEI area; A1)

05:12	Released XBT
08:13	“KM-ROV” dove & started her operation (Dive79)
08:51	Launched on the sea bottom (D=1,241m)
16:14	Left the sea bottom (D=1,238m)
16:55	Refloated “KM-ROV”
17:01	Recovered “KM-ROV” and finished her operation
18:00	Scientists meeting
19:00	Commenced proceeding to survey area (Ieyama area; B)

2018/09/11 B area of Okinawa Trough

Weather: Fine but Cloudy / Wind direction: SSE / Wind force: 3 / Wave scale: 2 / Swell scale: 2 /
 Visibility: 8 miles (12:00 JST)

02:00	Arrived at survey area (B)
06:01	Released XBT
08:09	“KM-ROV” dove & started her operation (Dive80)
08:59	Launched on the sea bottom (D=1,100m)
09:59	Left the sea bottom (D=1,102m)
10:41	Refloated “KM-ROV”
10:50	Recovered “KM-ROV” and finished her operation
11:58	“KM-ROV” dove & started her operation (Dive81)
12:30	Launched on the sea bottom (D=1,086m)
15:53	Left the sea bottom (D=1,077m)
16:27	Refloated “KM-ROV”
16:33	Recovered “KM-ROV” and finished her operation
16:45	Commenced proceeding to off Iheyajima
18:00	Scientists meeting
19:00	Arrived at off Iheyajima

2018/09/12 C area of Okinawa Trough

Weather: Fine but Cloudy / Wind direction: SE / Wind force: 3 / Wave scale: 2 / Swell scale: 1 /
 Visibility: 8 miles (12:00 JST)

00:00	Commenced proceeding to “KM-ROV” dive point (Izena Hole; C)
03:30	Arrived at “KM-ROV” dive point (C)
08:13	“KM-ROV” dove & started her operation (Dive82)
09:01	Launched on the sea bottom (D=1,634m)
09:41	Left the sea bottom (D=1,634m)
10:35	Refloated “KM-ROV”
10:44	Recovered “KM-ROV” and finished her operation
11:47	“KM-ROV” dove & started her operation (Dive83)
12:34	Launched on the sea bottom (D=1,634m)
13:21	Left the sea bottom (D=1,633m)
14:12	Refloated “KM-ROV”
14:20	Recovered “KM-ROV” and finished her operation
14:45	Commenced proceeded to off Okinoerabujima
18:00	Scientists meeting
20:30	Arrived at off Okinoerabujima
22:45	Commenced proceeded to OBEM point

2018/09/13 West ward AMAMI-OSHIMA (28-34.0N, 128-16.0E)

Weather: Fine but Cloudy / Wind direction: SE / Wind force: 3 / Wave scale: 2 / Swell scale: 2 /
 Visibility: 8 miles (12:00 JST)

05:30	Arrived at OBEM point
07:16	Recovered OBEM (EE-1)
09:36	Recovered OBEM (EE-2)

11:28 Recovered OBEM (EE-3)
 13:38 Recovered OBEM (EE-4)
 15:31 Recovered OBEM (EE-5)
 17:21 Recovered OBEM (EE-6)
 17:30 Commenced proceeding to off Amami Oshima
 20:00 Arrived at off Amami Oshima

2018/09/14 Satsukawa-wan, AMAMI-OSHIMA (28-10.5N, 128-14.4E)

Weather: Fine but Cloudy / Wind direction: NE / Wind force: 3 / Wave scale: 1 / Swell scale: 0 /
 Visibility: 8 miles (12:00 JST)

06:30 Commenced proceeding to Satsukawa-wan
 07:20 Arrived at Satsukawa-wan
 10:45 Let go port anchor at Satsukawa-wan

2018/09/15 Satsukawa-wan, AMAMI-OSHIMA (28-10.5N, 128-14.4E)

Weather: Fine but Cloudy / Wind direction: SE / Wind force: 3 / Wave scale: 1 / Swell scale: 0 /
 Visibility: 8 miles (12:00 JST)

09:15-10:30 On board assembly station and fire drill at Satsukawa-wan

2018/09/16 Satsukawa-wan, AMAMI-OSHIMA (28-10.5N, 128-14.4E)

Weather: Fine but Cloudy / Wind direction: SE / Wind force: 2 / Wave scale: 1 / Swell scale: 0 /
 Visibility: 14 miles (12:00 JST)

15:45 Heaved up port anchor
 17:30 Commenced proceeding to off Amami Oshima
 18:00 Scientists meeting
 18:50 Arrived at off Amami Oshima
 21:00 Commenced proceeding to “KM-ROV” dive point (survey area B)

2018/09/17 B area of Okinawa Trough

Weather: Fine but Cloudy / Wind direction: ESE / Wind force: 3 / Wave scale: 2 / Swell scale: 2 /
 Visibility: 8 miles (12:00 JST)

05:00 Arrived at “KM-ROV” dive point (survey area B)
 06:07 Released XBT
 08:12 “KM-ROV” dove & started her operation (Dive84)
 08:55 Launched on the sea bottom (D=1,088m)
 16:06 Left the sea bottom (D=1,077m)
 16:39 Refloated “KM-ROV”
 16:45 Recovered “KM-ROV” and finished her operation
 18:00 Scientists meeting
 18:00 Commenced proceeding to off the Iheya islands
 20:15 Arrived at off the Iheya islands

2018/09/18 C area of Okinawa Trough

Weather: Fine but Cloudy / Wind direction: NE / Wind force: 2 / Wave scale: 2 / Swell scale: 1 /
 Visibility: 8 miles (12:00 JST)

01:00 Commenced proceeding to “KM-ROV” dive point (survey area C)
 04:15 Arrived at “KM-ROV” dive point (survey area C)
 08:13 “KM-ROV” dove & started her operation (Dive85)
 09:03 Launched on the sea bottom (D=1,613m)
 15:19 Left the sea bottom (D=1,645m)
 16:12 Refloated “KM-ROV”
 16:18 Recovered “KM-ROV” and finished her operation
 18:00 Scientists meeting

2018/09/19 C area of Okinawa Trough

Weather: Fine but Cloudy / Wind direction: NE / Wind force: 1 / Wave scale: 1 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

05:00 Arrived at OBE point (survey area C)
07:08 Hoisted up "OBE-C"
08:09 Launched on the sea bottom "OBE-C"
08:47 Hoisted up "OBE-D"
09:37 Launched on the sea bottom "OBE-D"
10:11 Hoisted up "Mobile OBE (mOBE)"
11:06 Launched on the sea bottom "mOBE"
11:55 "KM-ROV" dove & started her operation (Dive86)
12:40 Launched on the sea bottom (D=1,632m)
15:23 Left the sea bottom (D=1,640m)
16:10 Refloated "KM-ROV"
16:15 Recovered "KM-ROV" and finished her operation
16:25 Commenced proceeding to off Agunijima
18:00 Scientists meeting
19:30 Arrived at off Agunijima

2018/09/20 C area of Okinawa Trough

Weather: Fine but Cloudy / Wind direction: SSW / Wind force: 3 / Wave scale: 2 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

02:00 Commenced Proceeded to survey area (C)
05:00 Arrived at survey area (C)
07:04 Hoisted up "OBE-E"
07:53 Launched on the sea bottom "OBE-E"
08:31 Hoisted up "OBE-F"
09:27 Launched on the sea bottom "OBE-F"
10:26 "KM-ROV" dove & started her operation (Dive87)
11:14 Launched on the sea bottom (D=1,632m)
15:59 Left the sea bottom (D=1,618m)
16:50 Refloated "KM-ROV"
16:55 Recovered "KM-ROV" and finished her operation
18:00 Scientists meeting

2018/09/21 NE off AWAKUNIJIMA (26-48.0N, 127-18.0E)

Weather: Fine but Cloudy / Wind direction: WSW / Wind force: 3 / Wave scale: 2 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

07:02 Hoisted up electromagnetic monitoring system No.1
07:52 Launched on the sea bottom electromagnetic monitoring system No.1
08:23 Hoisted up electromagnetic monitoring system No.2
09:13 Launched on the sea bottom electromagnetic monitoring system No.2
09:45 Commenced proceeding to NAHA
15:30 Arrived at NAHA

2018/09/22 Port NAHA ko Shinko 5-2 (26-14.4N, 127-40.6E)

Weather: Fine but Cloudy / Wind direction: NW / Wind force: 2 / Wave scale: 1 / Swell scale: 0 / Visibility: 8 miles (12:00 JST)

15:30 7 scientists disembarked, and 7 scientists embarked KAIMEI at NAHA
16:00 Let go all shore lines & left NAHA to research area (OKINAWA trough)
18:00 Scientists meeting
18:30-19:00 Carried out education & training for Scientists

2018/09/23 C area of Okinawa Trough (27-14.9N, 127-04.0E)

Weather: Fine but Cloudy / Wind direction: NE / Wind force: 3 / Wave scale: 2 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

00:00 Commenced proceeding to “KM-ROV” dive point (C)
05:40 Arrived at dive point
08:09 “KM-ROV” dove & started her operation (Dive88)
08:55 Launched on the sea bottom (D=1,639m)
18:17 Left the sea bottom (D=1,632m)
19:10 Refloated “KM-ROV”
18:30 Scientists meeting
19:28 Recovered “KM-ROV” and finished her operation
20:20 Left research area due to forecast rough sea, then proceeded to F.F. point

2018/09/24 North ward AMAMI-OSHIMA (28-47.0N, 129-24.0E)

Weather: Fine but Cloudy / Wind direction: NNE / Wind force: 5 / Wave scale: 4 / Swell scale: 2 / Visibility: 8 miles (12:00 JST)

07:20 Arrived at F.F. point
08:22-10:15 Carried out BMS winch F.F.
11:00 Commenced proceeding to West of KYUSHU
18:00 Scientists meeting

2018/09/25 Off NAGASAKI ko (32-43.4N, 129-44.5E)

Weather: Fine but Cloudy / Wind direction: North / Wind force: 4 / Wave scale: 3 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

14:00 Arrived at NAGASAKI

2018/09/26 Port NAGASAKI ko, Kogakura-Yanagi KITA1 (32-42.3N, 129-50.6E)

Weather: Overcast / Wind direction: NNE / Wind force: 3 / Wave scale: 1 / Swell scale: 0 / Visibility: 8 miles (12:00 JST)

08:00 2 scientists disembarked KAIMEI at NAGASAKI

2018/09/27 Port NAGASAKI ko, Kogakura-Yanagi KITA1 (32-42.3N, 129-50.6E)

Weather: Blue sky / Wind direction: North / Wind force: 4 / Wave scale: 1 / Swell scale: 0 / Visibility: 8 miles (12:00 JST)

08:00 1 scientist disembarked KAIMEI at NAGASAKI

2018/09/28 The sea of AMAKUSA (32-38.0N, 129-42.0E)

Weather: Fine but Cloudy / Wind direction: ENE / Wind force: 4 / Wave scale: 2 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)

08:00 4 scientists disembarked KAIMEI at NAGASAKI
08:30 7 scientists embarked KAIMEI at NAGASAKI
10:00 Let go all shore lines & left NAGASAKI for YATSUSHIRO
11:00-11:25 Carried out education & training for Scientists
16:30 Let go port anchor at YATSUSHIRO KAI

2018/09/29 The sea of AMAKUSA (32-13.5N, 130-17.6E)

Weather: Rain / Wind direction: NE / Wind force: 6 / Wave scale: 3 / Swell scale: 1 / Visibility: 6 miles (12:00 JST)

09:15 Heaved up port anchor

2018/09/30 The sea of AMAKUSA (32-13.5N, 130-17.7E)

Weather: Rain / Wind direction: North / Wind force: 10 / Wave scale: 5 / Swell scale: 2 / Visibility: 1 mile (12:00 JST)

18:00 Scientists meeting

2018/10/01 The sea of AMAKUSA (32-15.0N, 130-18.0E)

Weather: Fine but Cloudy / Wind direction: NNE / Wind force: 1 / Wave scale: 1 / Swell scale: 0 /
Visibility: 8 miles (12:00 JST)

10:00 11 scientists disembarked KAIMEI by traffic boat
11:40 Commenced proceeding to YOKOSUKA
18:00 Scientists meeting

2018/10/02 Off south ward MUROTO-MISAKI (32-38.0N, 134-28.0E)

Weather: Fine but Cloudy / Wind direction: NE / Wind force: 2 / Wave scale: 2 / Swell scale: 1 /
Visibility: 8 miles (12:00 JST)

14:15-14:47 Carried out eight figure turn

2018/10/03 Off Suzaki (35-00.0N, 139-45.0N)

Weather: Overcast / Wind direction: NNE / Wind force: 3 / Wave scale: 2 / Swell scale: 1 / Visibility:
7 miles (12:00 JST)

12:30 Arrived at Tateyama-wan
13:00 Let go starboard anchor

2018/10/04 YOKOSUKA-KO No.4 sec. (35-19.7N, 139-40.5E)

Weather: Rain / Wind direction: North / Wind force: 5 / Wave scale: 3 / Swell scale: 1 / Visibility: 5
miles (12:00 JST)

09:45 Heaved up starboard anchor
09:48 Commenced proceeding to YOKOSUKA-ko Sec.4
11:57 Arrived at YOKOSUKA-ko Sec.4
12:00 Let go starboard anchor

2018/10/05 Arrive at YOKOSUKA

08:30 Heaved up starboard anchor
09:30 Arrived at YOKOSUKA
11:00 Disembarked "KAIMEI" at JAMSTEC
Finished KM18-08C cruise

#Wind Scale

0	Calm	0~0.2m/s
1	Light air	0.3~1.5m/s
2	Light breeze	1.6~3.3m/s
3	gentle breeze	3.4~5.4m/s
4	Moderate breeze	5.5~7.9m/s
5	Fresh breeze	8.0~10.7m/s
6	Strong breeze	10.8~13.8m/s
7	Near gale	13.9~17.1m/s
8	Gale	17.2~20.7m/s
9	Strong gale	20.8~24.4m/s
10	Storm	24.5~28.4m/s

#Wave scale

0	Calm (Glassy)
1	Calm (Rippled)
2	Smooth (Wavelet)
3	Slight
4	Moderate
5	Rough

#SWELL SCALE

0	No Swell
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- | | | |
|---|----------------------------|---------|
| 1 | Low Swell Short or Average | < 2m |
| 2 | Low Swell Long | < 2m |
| 3 | Moderate Short | 2m ~ 4m |