



R/V Kaimei “Cruise Report”
KM18-04C

Confirmation of the protocol for survey technique on the
hydrothermal deposit

Okinawa Trough, South-West Japan

April.16,2018-May.21,2018

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

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Notice on Using

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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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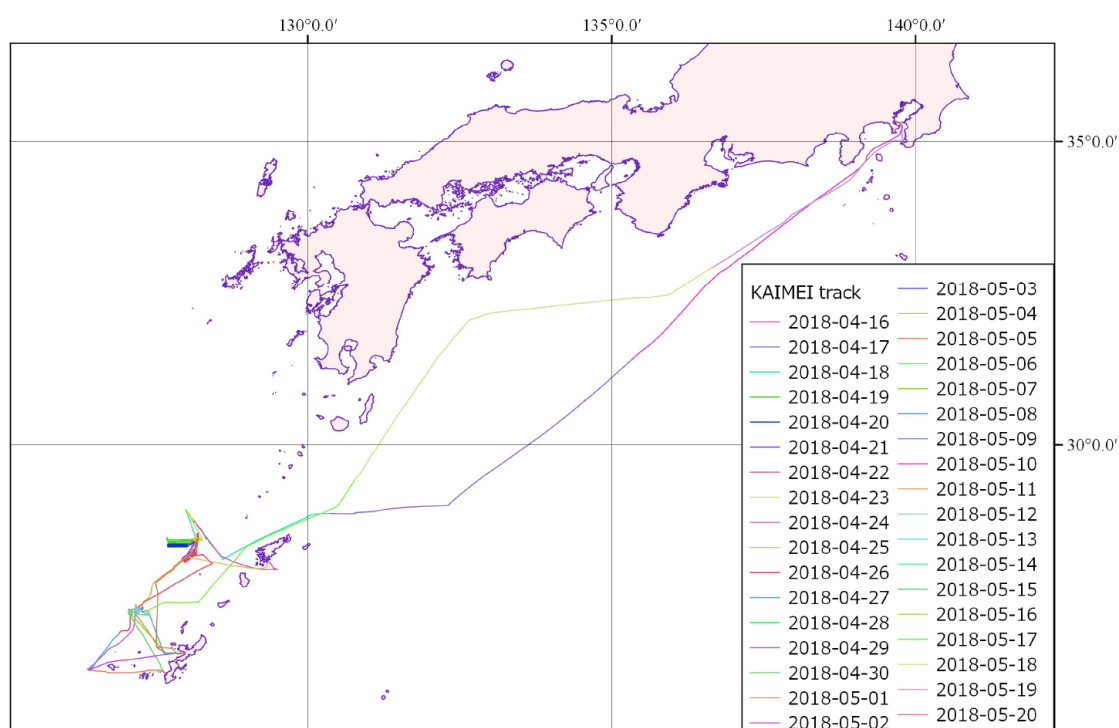
<http://www.godac.jamstec.go.jp/darwin/explain/1/e#report>
E-mail: submit-rv-cruise@jamstec.go.jp

Acknowledgements

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1. Cruise Information

- Cruise ID KM18-04C
- 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 April.16,2018–May.21,2018
- 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 [Affiliation]

Eiichi Kikawa [JAMSTEC]

- Science Party (List) [Affiliation, assignment etc.]

Scientists

Takafumi Kasaya (Chief Scientist)	JAMSTEC
Hisanori Iwamoto	JAMSTEC
Jyunji Kaneko	JAMSTEC
Yutaka Ohta *1	JAMSTEC
Tsuyoshi Yoshiume *1	JAMSTEC
Yoshinobu Nambu *1	JAMSTEC
Hiroshi Ochi *1	JAMSTEC
Tadahiro Hyakudome *1	JAMSTEC
Hiroshi Matsumoto *1	JAMSTEC
Yoshiyuki Nakano *1	JAMSTEC
Tatsuya Fukuda *1	JAMSTEC
Yoshitaka Watanabe *1	JAMSTEC
Koji Meguro *1	JAMSTEC
Norihiko Katayama *1	National Institute of Information and Communications Technology

*1 : During 4/16~5/1. Getting off the “KAIMEI” at Naha.

Marine Technician

Morifumi Takaesu	Nippon Marine Enterprises, LTD.
Satomi Minamizawa	Nippon Marine Enterprises, LTD.
Eri Sakamoto	Nippon Marine Enterprises, LTD.
Yutarou Murakami *1	Nippon Marine Enterprises, LTD.
Michiyasu Katagiri *2	Nippon Marine Enterprises, LTD.

*1 : During 4/16~5/1. Getting off the “KAIMEI” at Naha.

*2 : During 5/1~5/21. Onboard the “KAIMEI” at Naha.

R/V KAIMEI Officers and Crew

Captain	Rikita Yoshida
Chief Officer	Tatsuo Adachi
2nd Officer	Akira Suzuki
Jr.2nd Officer	Kazuki Miyake
3rd Officer	Yuki Ito
Chief Engineer	Koji Funae
1st Engineer	Takahiro Mori
2nd Engineer	Akira Hanawa
3rd Engineer	Hayato Ryosyu
Chief Electronic Operator	Hiroki Ishiwata
2nd Electronic Operator	Takatomo Shirozume
3rd Electronic Operator	Kazumi Ugajin
Boat Swain	Yuki Yoshino
Quarter Master	Saikan Hirai
Quarter Master	Takuya Miyashita
Quarter Master	Hideo Ito
Quarter Master	Yasunobu Kawabe
Sailor	Yudai Yoshimi
Sailor	Eishin Sato
No.1 Oiler	Keita Funawatari
Oiler	Shinya Sugi
Oiler	Yuji Higashikawa
Assistant Oiler	Motohiro Kawano
Steward	Kazuma Sonoda
Steward	Tsuyoshi Nagatomo
Steward	Shinobu Ohyu
Steward	Seiya Matsumoto

ROV and AUV operation team

Operation Manager	Atsumori Miura
Operation Manager	Fumitaka Saito
1st ROV Operator	Keita Matsumoto
2nd ROV Operator	Katsushi Chiba

2nd ROV Operator	Atsushi Takenouchi
2nd ROV Operator	Yoshikazu Kuramoto
2nd ROV Operator	Mitsuru Torigoe
2nd ROV Operator	Shinnosuke Kumagai
3rd ROV Operator	Naoto Minamino
3rd ROV Operator	Shuya Sugiura
3rd ROV Operator	Atsushi 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.

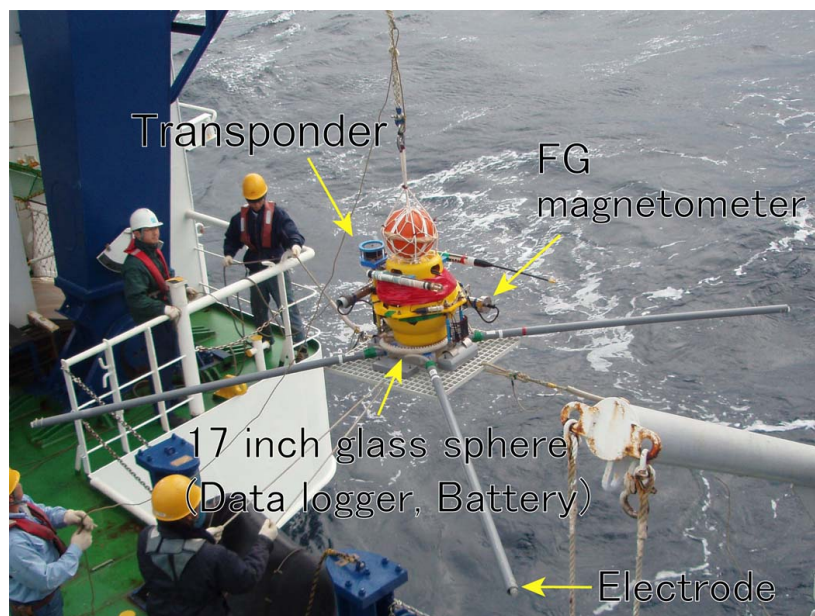


Fig. 3.1.1 OBEM system

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).

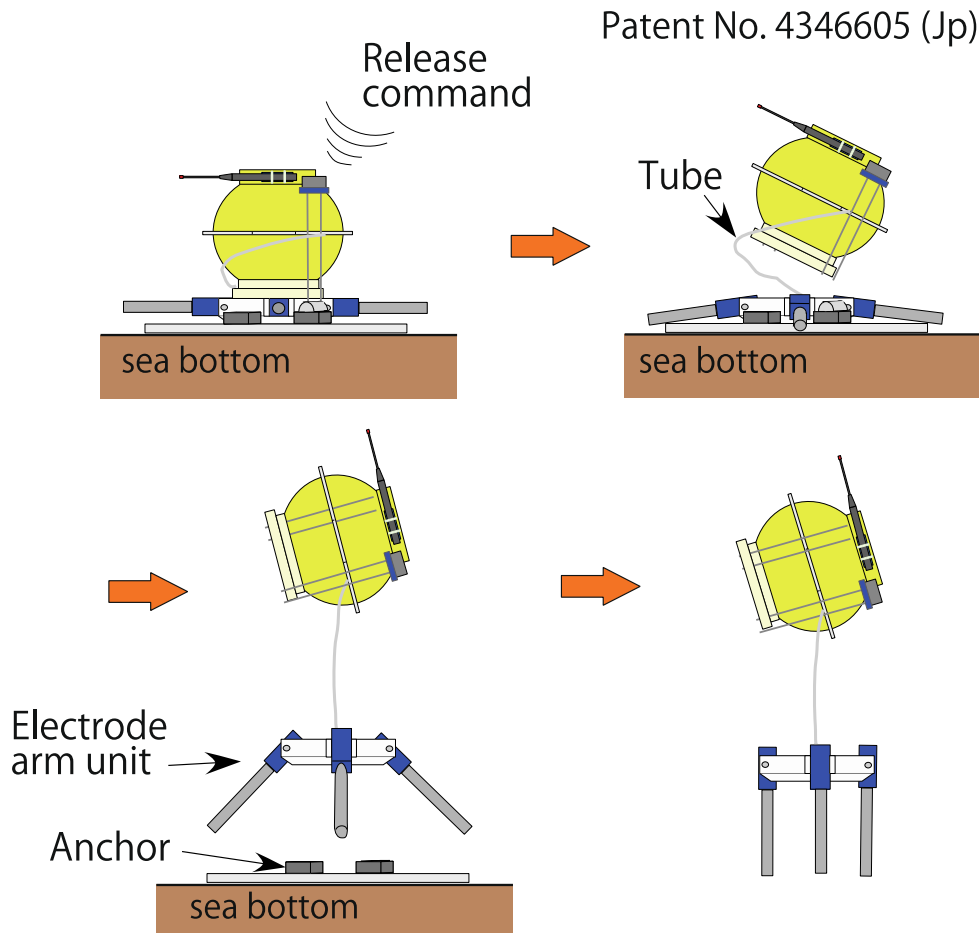


Fig. 3.1.2 Electrode arm-holding mechanism of type A OBEM

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 Electrometer

The electrometer system 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 three observation forms. One was installed by ROV as a mobile ocean bottom electrometer (OBE) (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). Lastly, the electrometer optimized for AUV was install on the fore head of AUV.



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

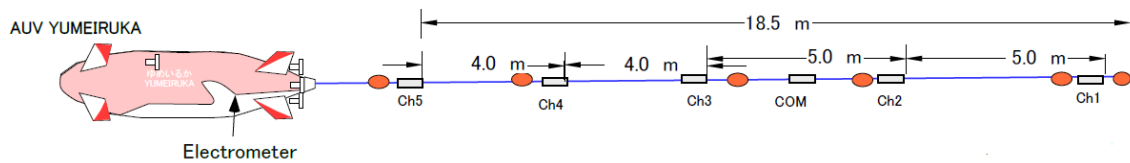


Fig. 3.1.4 Configuration of the electrode array on an AUV YUMEIRUKA.

Table3.1.1 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 AUV

On this cruise, we use new controlled-source system optimized for an AUV use which based on the deep-tow transmitter. This transmitter was loaded on the fore top of AUV JINBEI. Because of battery's capacity of AUV JINBEI, a battery for transmitter was also loaded (Fig. 3.1.5). A transmitter unit including the IGBT unit and all electrical circuits is installed in a cylinder type aluminum pressure case.

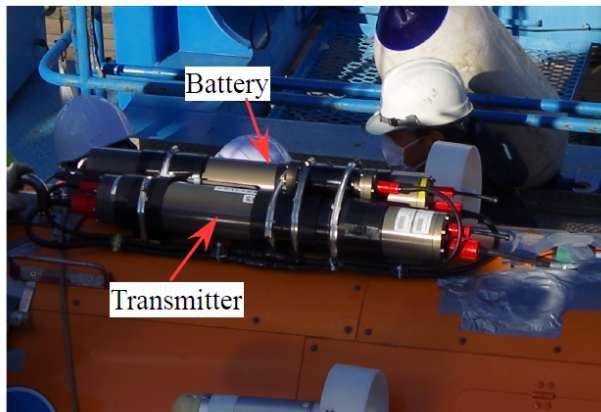


Fig.3.1.5 Photo of a controlled source survey system on the deep-tow system.

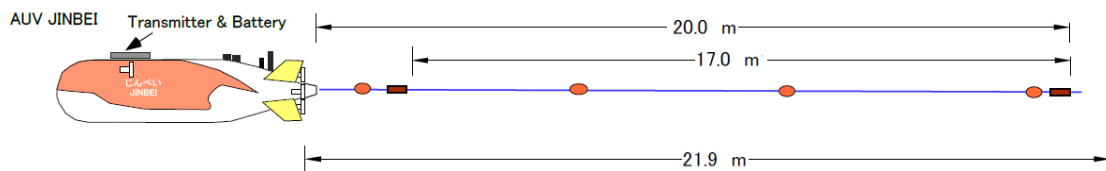


Fig. 3.1.6 Photo of a controlled source survey system on the deep-tow system.

Table3.1.1 Specification of a control source survey system

Max Output Current: 30 A

Circuit type: IGBT

Transmit channel: 1 ch

A/D converter: 24 bit

Recording Media: SDHC

Sampling rate: 500 Hz

3.1.4 Autonomous Surface Vehicle (ASV)

For the efficient observation of hydro-thermal deposit survey using multiple AUVs, JAMSTEC have developed and researched an autonomous Surface Vehicle (ASV). To monitor and control an AUV JINBEI, we used a demonstration ASV developed by JAMSTEC in this cruise. Because of the necessity to monitor and control AUVs with 2 knots, this vehicle can sail with a maximum speed of 5 knots taking the sea current into consideration. Typical operational cruising speed is about 3 knots. It is very important to communicate between a mother ship and an ASV. Therefore, two satellite communication systems, VHF communication system and wireless LAN are equipped on this ASV. DGPS, AIS and INU are also loaded for the nautical instruments. This ASV also can measure the position of an AUV using an acoustic navigation system.



Fig. 3.1.7 Photo of a demonstrational ASV.

Table 3.1.1 Specification of a ASV

The general specifications of a demonstration ASV

Length	4.45 m
Width	1.95 m
Height	1.81 m
Weight	2.0 t
Speed	typically 3 knots
Power source	Deisel engine
Actuator	Azimuth thruster
Communication equipment	Ka band satellite communication
	L band satellite communication
	VHF communication
	Wireless LAN

Nautical instrument	Acoustic communication
	DGPS
	AIS
	INU
	Acoustic positioning system

3.1.4 DCR long-term monitoring system

We developed the long-term monitoring system for the monitor subsurface structure changes after the mining. Figure 3.1.8 shows the developed transmitter system based on the MDCR system and it is able to transmit the electric signal and obtain CTD data. OBE system with 10 ch heat-flow meter can record 10 ch electric field data with 20 Hz sampling rate (Fig. 3.1.8).

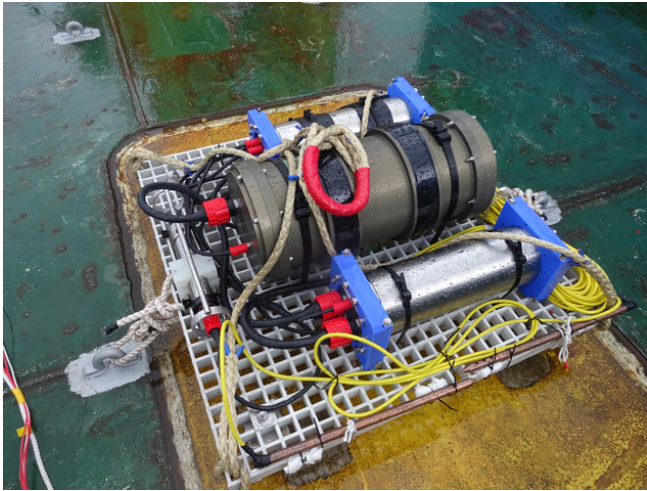


Fig.3.1.8 Photo of a transmitter system for the long-term monitoring.



Fig.3.1.9 Photo of a electrometer system with heat-flow meter for the long-term monitoring.

3.2 Operation reports

3.2.1 Shipboard data

For detailed bathymetric and geophysical data using shipboard instruments around the central Okinawa trough in the central part of Okinawa Trough, we obtained the bathymetric data, gravity data and magnetic data using shipboard equipment. However, a total magnetic observation was not carried out because many fish aggregating devices are existed in this area. Figure 3.2.1 shows the preliminary bathymetry map. In this cruise, these data were collected with about 5–8 knots ship speed. Acoustic intensity data in a water column of the MBES were also obtained through these observations for detecting distributions of the plume like structure in a water column.

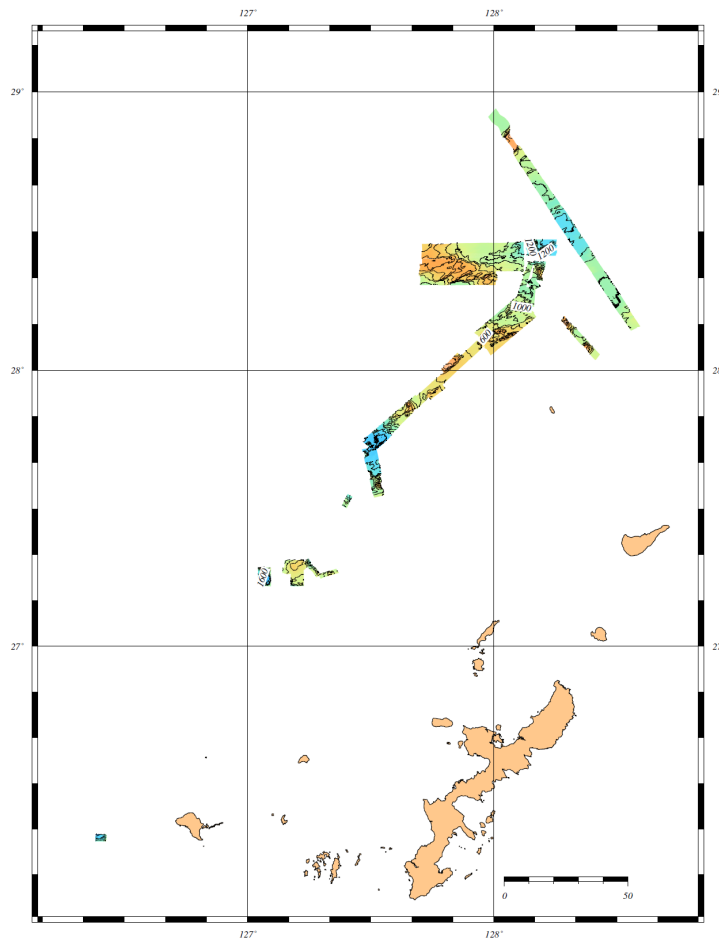


Fig. 3.2.1 Survey area of shipboard data in this cruise.

3.2.2 OBEM and OBE operations

For characterization a back-arc basin development, we have obtained Magneto-telluric data using OBEMs. In this cruise, OBEMs were launched using an articulated crane for all stations and sunk by their own weights (Fig. 3.2.2). The operations were quick and smooth. We tracked the OBEMs by acoustic signals and confirmed that all OBEMs were successfully settled on the seafloor. Then, each position was determined by the SSBL system equipped on the R/V KAIMEI (Fig. 3.2.3, Table 3.2.1). All OBEMs will be recovered in the KM18-08C cruise.

The pop-up type OBEs and mobile OBEs were also installed in three areas for the survey in Fig. 3.2.4 using the controlled source.

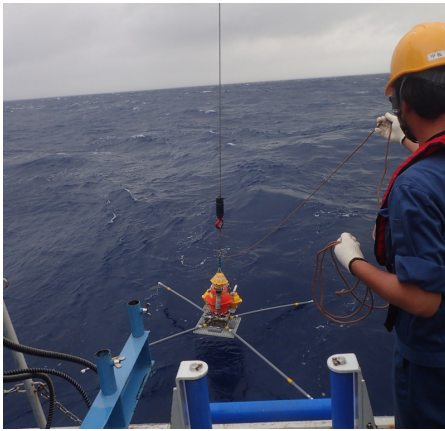


Figure 3.2.2 Photo of the OBEM deployment.

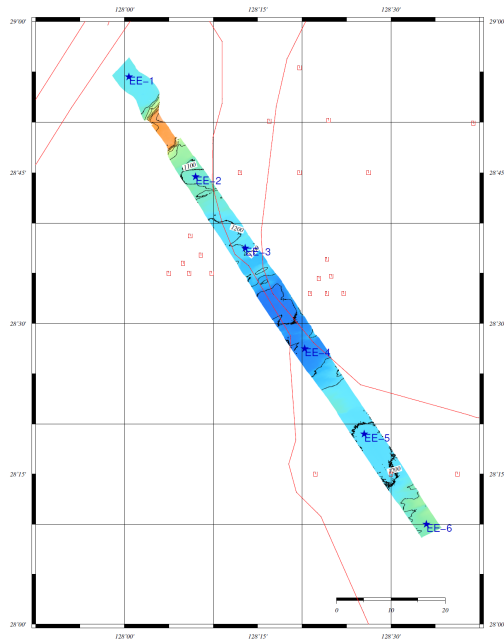


Figure 3.2.3 Positions of all deployed OBEMs.

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 AUVs and ROV dives

Main topic of this cruise is the collaboration dive using two AUVs and an ASV. We conducted these dives in three area (Fig. 3.2.4). First dive carried out in the northern area however some troubles of AUV JINBEI were occurred after starting the dive, we could not enough data. In second and third dives, we could complete all practical dive operations in the hydrothermal area during April 28 and 29. Marine direct current resistivity data could be obtained and three pop-up type OBEs recorded the electrical signals from the transmitter on an AUV JINBEI. In last collaborate dive (YM41 and JB64), we were able to cover an area of about 1 square kilometer with only 4 hr observation time near the seafloor. Figure 3.2.5 shows single AUV dive area for the signal transmission to OBEs and self-potential data acquisition. Fig 3.2.6 shows ROV dive area for rock sampling and visual observation during this cruise. In the Izena hole, we recovered and re-deployed the long-term monitoring system.

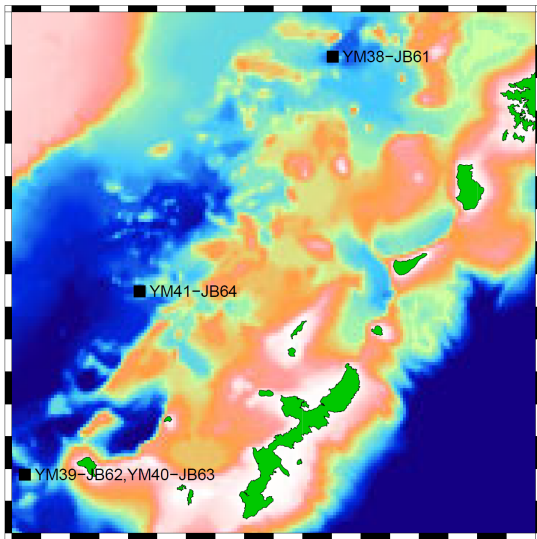


Fig. 3.2.4 Two AUVs and ASV collaboration dive areas at the Okinawa trough.

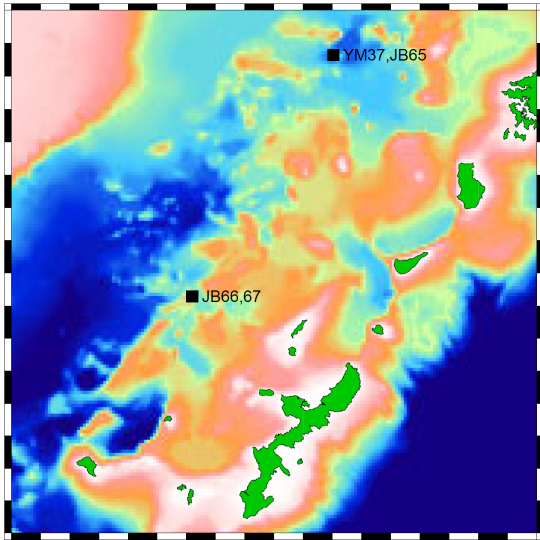


Fig. 3.2.5 Single AUV dive areas at the Okinawa trough.

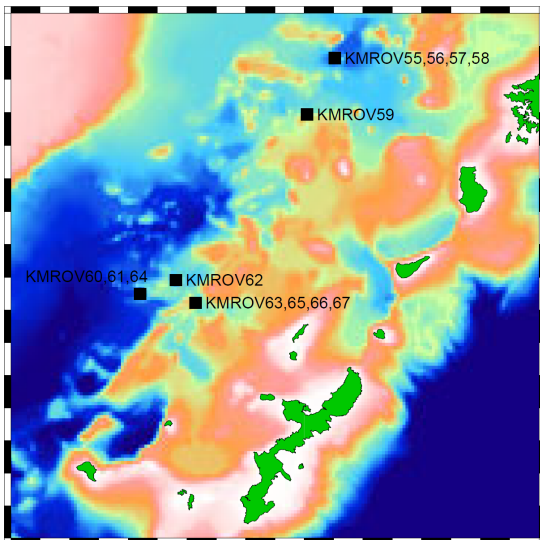


Fig. 3.2.4 ROV dive areas at the Okinawa trough.

4. Cruise Log

2018/04/16 North Ward of IZU-OSHIMA (34-55.6N, 139-23.9E)

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

08:00	Scientists onboard.
09:00	Let go all shore line, left YOKOSUKA, for research area (OKINAWA TROUGH).
10:00-10:40	Carried out education and training for scientists.
15:00-15:30	Scientists meeting.
16:40	Konpira ceremony.
18:00	Scientific meeting

2018/04/17 East ward TANEGASHIMA (30-53.5N, 134-45.1E)

Weather: Rain / Wind direction: E / Wind force: 5 / Wave scale: 3 / Swell scale: 1 / Visibility: 8 miles
(12:00 JST)

13:00-13:20	Carried out eight figure running
18:00	Scientific meeting

2018/04/18 North ward of AMAMI-OSHIMA

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

07:06-07:26	Carried out eight figure running
09:00-09:30	Scientist meeting for AUV route planning
16:16	Released XBT@28-07.0008N, 128-36.3709E
1639-23:26	Carried out MBES Mapping Survey
18:00	Scientific meeting

2018/04/19 West ward of AMAMI-OSHIMA

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

02:53	Released XBT@28-24.1017N, 128-10.2077E
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03:14-03:26	Com'ced of MBES pre dive survey
07:27-09:00	Com'ced out deploying 4 OBEs
09:15	Hoisted up " KM-ROV "
09:23	Launched " KM-ROV " and started her operation #55.
09:55	Started KM-ROV55 operation
09:59	" KM-ROV " landed on the sea bottom (Depth=1,240m)
16:06	" KM-ROV " left the sea bottom (Depth = 1,239)
16:47	Hoisted up " KM-ROV "
16:52	Recovered " KM-ROV " & finished above operation.
18:00	Scientific meeting
18:06	Com'ced MBES & SBP mapping survey
20:33	Launched XBT@28-27.5116N, 127-40.7633E

2018/04/20 West ward of AMAMI-OSHIMA

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

01:55	Finished MBES & SBP Mapping survey
07:45	Launched "ASV " & com'ced her operation
08:10	Launched "YUMEIRUKA" & com'ced drove operation # 37
14:18	Hoisted up " YUMEIRUKA " & finished dive operation
15:30	Hoisted up " ASV " & finished above operation
18:00	Scientific meeting
19:14	Com'ced MBES & SBP mapping survey
20:19	Launched XBT@28-22.3003N, 127-54.7638E

2018/04/21 West ward of AMAMI-OSHIMA

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

02:55	Finished MBES & SBP Mapping survey
07:29	Launched "ASV " & com'ced her operation
07:52	Hoisted up " YUMEIRUKA "
07:54	Launched " YUMEIRUKA " then it dove
	Started her Operation #38
08:23	Hoisted up " JINBEI "

08:27	Launched “ JINBEI ” then it dove Started her operation #61
10:08-12:46	Used working boat
10:28	Refloated “ JINBEI ”
10:46	Hoisted up “ JINBEI ”
10:59	Recovered “ JINBEI ” then finished above operation
11:48	Hoisted up “ YUMEIRUKA ”
11:54	Recovered “ YUMEIRUKA ” then finished above operation
12:32	Hoisted up “ ASV ”
12:36	Recovered “ASV” then finished her operation
13:41	Hoisted up “ KM-ROV ”
13:48	Launched “ KM-ROV ”
14:23	Started KM-ROV56 operation
14:28	“ KM-ROV ” landed on the sea bottom(1,235m)
16:07	“ KM-ROV ” lefted the sea bottom(1186m)
16:49	Hoisted up “KM-ROV”
16:56	Recovered “ KM-ROV “
18:00	Scientific meeting
22:31	Carried out MBES mapping survey

2018/04/22 West ward of AMAMI-OSHIMA

Weather: Overcast / Wind direction: SE / Wind force: 5 / Wave scale: 3 / Swell scale: 2 / Visibility: 6 miles (12:00 JST)

02:35	Finished MBES mapping survey
08:06	Hoisted up “ KM-ROV ”
08:15	Launched “ KM-ROV ” then it dove,
08:49	Started KM-ROV57 operation
08:57	“ KM-ROV ” landed on the sea bottom(1,237m)
15:37	“ KM-ROV ” lefted the sea bottom(1,209m)
16:21	Hoisted up “KM-ROV”
16:28	Recovered “ KM-ROV “ finished her operation
18:00	Scientific meeting
21:50	Com'ced MBES & SBP mapping survey

2018/04/23 West ward of AMAMI-OSHIMA

Weather: Fine but cloudy / Wind direction: SSE / Wind force: 6 / Wave scale: 4 / Swell scale: 2 /
Visibility: 8 miles (12:00 JST)

03:05	Finished MBES & SBP mapping survey
08:21	Hoisted up “ KM-ROV ”
08:29	Launched “ KM-ROV ” then it dove, com’ced operation #58
09:07	“ KM-ROV ” landed on the sea bottom(1,223m)
14:45	“ KM-ROV ” left the sea bottom(1,209m)
15:27	Hoisted up “KM-ROV”
15:37	Recovered “ KM-ROV “ finished abobe operation
15:41	Recovered 4 OBEs
17:50	Com’ced MBES & SBP mapping survey
18:00	Scientific meeting

2018/04/24 West ward of AMAMI-OSHIMA (28-32.5N, 128-17.0E)

Weather: Rain / Wind direction: S / Wind force: 7 / Wave scale: 5 / Swell scale: 3 / Visibility: 5 miles
(12:00 JST)

03:30	Finished MBES & SBP mapping survey
05:30	Arrived at OBEM Deploying point
07:05	Deployed OBEM(E1)
09:12	Deployed OBEM(E2)
10:55	Deployed OBEM(E3)
13:00	Deployed OBEM(E4)
14:57	Deployed OBEM(E5)
16:52	Deployed OBEM(E6)
17:15	Com’ced proceeding to off AMAMI due to avoiding rough sea
18:00	Scientific meeting
21:20	Arrived at off AMAMI

2018/04/25 EAST Coast off AMAMI-OSHIMA (28-2.3N, 129-19.8E)

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

06:30-07:30	Shifted to new word
18:00	Scientific meeting

2018/04/26 West ward of AMAMI-OSHIMA

Weather: Overcast / Wind direction: NNW / Wind force: 3 / Wave scale: 2 / Swell scale: 2 /
 Visibility: 8 miles (12:00 JST)

00:00	Com'ced proceeding to research area (OOKINAWA TROUGH Central word)
08:04	Hoisted up " KM-ROV "
08:13	Launched " KM-ROV " then it dove,
08:40	Started KM-ROV59 operation
08:45	" KM-ROV " landed on the sea bottom(968m)
15:06	" KM-ROV " left the sea bottom(964m)
15:37	Hoisted up "KM-ROV"
15:44	Recovered " KM-ROV " finished above operation
17:25	Com'ced MBES & SBP mapping survey
18:00	Scientific meeting
19:49	Released XBT@28-11.4030N,128-15.4876E
22:26	Finished MBES & SBP Mapping survey

2018/04/27 Westward of KUME-SHIMA

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

05:15	Released XBT
07:00	Com'ced proceeding to Southward due to search for fishing boat
12:20	Arrived at Southward(KUME area)
12:30	Released XBT@27-18.2078N, 126-24.5893E
12:56-14:19	Carried out deploying OBE-C
14:38-15:52	Carried out deploying OBE-D
16:13-17:25	Carried out deploying OBE-E
17:58	Com'ced MBES & SBP mapping survey
18:00	Scientific meeting
21:44	Finished MBES & SBP Mapping survey

2018/04/28 Westward of KUME-SHIMA

Weather: Fine but Cloudy / Wind direction: ENE / Wind force: 5 / Wave scale: 3 / Swell scale: 2 /

Visibility: 8 miles (12:00 JST)

07:25	Launched “ASV ” & com’ced her operation
07:48	Hoisted up “ YUMEIRUKA ”
07:49	Launched “ YUMEIRUKA ” then it dove
Started her Operation #39	
08:58	Hoisted up “ JIMBEI ”
09:02	Launched “ JINBEI ” then it dove
	Started her operation #62
13:59	Hoisted up “ JINBEI ”
14:07	Recovered “ JINBEI ” then finished above operation
14:44	Hoisted up “ YUMEIRUKA ”
14:50	Recovered “ YUMEIRUKA ” then finished above operation
15:24	Hoisted up “ ASV ”
15:28	Recovered “ ASV “ then finished her operation
18:00	Scientific meeting

2018/04/29 Westward of KUME-SHIMA

Weather: Fine but Cloudy / Wind direction: SE / Wind force: 3 / Wave scale: 2 / Swell scale: 1 /

Visibility: 8 miles (12:00 JST)

07:20	Launched “ASV ” & com’ced her operation
07:46	Hoisted up “ YUMEIRUKA ”
07:47	Launched “ YUMEIRUKA ” then it dove
Started her Operation #40	
08:12	Hoisted up “ JIMBEI ”
08:16	Launched “ JINBEI ” then it dove
	Started her operation #63
13:41	Hoisted up “ JINBEI ”
13:49	Recovered “ JINBEI ” then finished above operation
14:25	Hoisted up “ YUMEIRUKA ”

14:31	Recovered “ YUMEIRUKA ” then finished above operation
15:02	Hoisted up “ ASV ”
15:05	Recovered “ ASV “ then finished her operation
18:00	Scientific meeting
20:00	Com’ced proceeding to next dive point

2018/04/30 IZENA HOLE

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

07:16	Hoisted up “ASV ” & com’ced her operation
07:19	Launched “ASV ” & com’ced her operation
07:38	Hoisted up “ YUMEIRUKA ”
07:39	Launched “ YUMEIRUKA ” then it dove
Started her Operation #41	
07:59	Hoisted up “ JIMBEI ”
08:03	Launched “ JINBEI ” then it dove
	Started her operation #64
13:53	Hoisted up “ JINBEI ”
14:04	Recovered “ JINBEI ” then finished above operation
14:39	Hoisted up “ YUMEIRUKA ”
14:45	Recovered “ YUMEIRUKA ” then finished above operation
15:16	Hoisted up “ ASV ”
15:19	Recovered “ ASV “ then finished her operation
18:00	Scientific meeting
19:34-23:20	Carried out MBES mapping survey
23:20	Proceeding to NAHA OFF

2018/05/01 off NAHA-KO (26-14.9N, 127-38.9E)

Weather: Fine but Cloudy / Wind direction: SSE / Wind force: 4 / Wave scale: 2 / Swell scale: 1 / Visibility: 7 miles (12:00 JST)

09:16	12 scientists disembarked & 1 marine technician boarded
10:30-10:55	Carried out education & training for a marine technician
14:00	Proceeded to research area(KUME area)
18:00	Scientific meeting

2018/05/02 West ward KUMEJIMA

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

02:30	Arrived at research area (KUME area)
08:55	Recovered OBE-C
09:53	Recovered OBE-D
10:39	Recovered OBE-E

2018/05/03 NAGO bay (26-34.3N, 127-55.8E)

Weather: Rain / Wind direction: North / Wind force: 4 / Wave scale: 3 / Swell scale: 1 / Visibility: 6 miles (12:00 JST)

00:00	Drifting at Nago bay due to avoid rough sea.
18:00	Scientific meeting

2018/05/04 IZENA HOLE

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

00:00	Commenced proceeding to Dive Point
05:20	Arrived at Dive point
05:24	Released XBT
08:03	Hoisted up “KM-ROV”
08:12	Launched “KM-ROV” then it dives
08:54	Started KM-ROV60 operationcarried above operation #60(11)
08:59	“KM-ROV” landed on the sea bottom (D:1630m).
09:43	“KM-ROV” left the sea bottom (D:1632m)
10:36	Hoisted up “KM-ROV”
10:44	Recovered “KM-ROV” & finished the operation
10:45	Recovered Electromagnetism Monitoring System(transmitter)
13:01	Hoisted up “KM-ROV”
13:10	Launched “KM-ROV” then it dives
13:54	Started KM-ROV61 operation
13:59	“KM-ROV” landed on the sea bottom(D:1627m)
15:32	“KM-ROV” left the sea bottom(D:1632m)

16:32 Recovered KM-ROV

18:00 Scientific meeting

2018/05/05 West ward AMAMI-OSHIMA

Weather: Fine but Cloudy / Wind direction: SE / Wind force: 3 / Wave scale: 2 / Swell scale: 1 /

Visibility: 8 miles (12:00 JST)

03:13 Finished MBES mapping

03:26 Released XBT at 28-55.5259N,128-10.0275E

2018/05/06 NAGO bay (26-34.2N, 127-58.0E)

Weather: Fine but Cloudy / Wind direction: SE / Wind force: 4 / Wave scale: 2 / Swell scale: 1 /

Visibility: 8 miles (12:00 JST)

18:00 Scientific meeting

2018/05/07 NAGO bay (26-34.5N, 127-58.0E)

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

18:00 Scientific meeting

18:30 Commenced proceeding to IZENA dive point

2018/05/08 NW off IHEYAJIMA

Weather: Rain / Wind direction: WSW / Wind force: 5 / Wave scale: 4 / Swell scale: 3 / Visibility: 4 miles (12:00 JST)

08:13 Hoisted up “KM-ROV”

08:21 Launched “KM-ROV” then it dove

08:55 Started KM-ROV62 operation

09:00 “KM-ROV2 landed on the sea floor(D:1311m)

13:37 “KM-ROV” left the sea bottom(D:530m)

13:58 Hoisted up “KM-ROV”

14:04 Recovered “KM-ROV” & finished the operation

2018/05/09 Out of NAGO-GYOKO (26-34.7N, 127-58.4E)

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

00:00	Arrived at IZENA dive point
08:13	Hoisted up “KM-ROV”
08:21	Launched “KM-ROV” then it dove & commenced above operation
08:55	“KM-ROV” landed on the sea bottom
13:37	“KM-ROV” left the sea bottom(D:530m)
13:58	Hoisted up “KM-ROV”
14:04	Recovered “KM-ROV” & finished the operation
17:35-1920	Carried out MBEs mapping Survey
19:30	Commenced proceeding to OFF NAGO WAN
23:50	Arrived at OFF NAGOWAN

2018/05/10 Out of NAGO-GYOKO (26-34.7N, 127-58.4E)

Weather: Cloudy / Wind direction: NNE / Wind force: 6 / Wave scale: 3 / Swell scale: 1 / Visibility:
8 miles (12:00 JST)

08:30	Stationed for anchoring
08:45	Let go started anchor in 33.2m of water at OFF NAGO GYOKO
18:00	Scientific meeting

2018/05/11 NAGO bay (26-34.0N, 127-54.4E)

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

09:00	1 engineer loaded by traffic boat
15:30	1 engineer disembarked by traffic boat

2018/05/12 NW off IHEYAJIMA

Weather: Overcast / Wind direction: ENE / Wind force: 5 / Wave scale: 3 / Swell scale: 1 / Visibility:
8 miles (12:00 JST)

07:05-0814	Carried out deploying 4OBE
08:28-0939	Carried out deploying OBE at Site-3
09:53-1055	Carried out deploying OBE at Site-4
11:11	Hoisted up “KM-ROV”

11:20	Launched "KM-ROV" then it dove
11:57	Started KM-ROV63 operation #63(14)
12:01	"KM-ROV" landed on the sea bottom(D:1096m)
14:47	"KM-ROV" left the sea bottom(D:1097m)
15:21	Hoisted up "KM-ROV" & finished the operation
19:00	Scientific meeting

2018/05/13 NW off IHEYAJIMA

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

03:20 Finished MBES mapping survey

0714-0844 Carried out deploying Electromagnetism Monitoring System (transmitter)

08:59	Hoisted up KM-ROV
09:07	Launched
09:48	Started KM-ROV64 operation
09:53	Landed on the sea floor (D=1,629m)
12:51	Left the sea bottom (D=1,631m)
13:39	Hoisted up "KM-ROV"
13:44	Recovered KM-ROV
14:00	Proceeded to OBE deployment point(Site1)
15:00	Arrived at the point
1534~1627	Carried out deploying OBE(Site1)
18:00	Scientific meeting

2018/05/14 NW off IHEYAJIMA

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

08:36	Hoisted up JINBEI
08:40	Launched
08:43	Started JB66 operation
09:14	Landed on the sea floor (D=1,007m)
14:33	Left the sea bottom (D=734m)
14:57	JINBEI floated
15:26	Recovered JINBEI

18:00 Scientific meeting

2018/05/15 NW off IHEYAJIMA

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

08:04 Hoisted up KM-ROV
08:11 Launched
08:39 Started KM-ROV65 operation
08:44 Landed on the sea floor (D=1,099m)
14:33 Left the sea bottom (D=1,095m)
14:39 KM-ROV floated
15:13 Recovered KM-ROV
18:00 Scientific meeting

2018/05/16 NW off IHEYAJIMA

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

08:33 Hoisted up JINBEI
08:37 Launched
08:37 Started JB67 operation
09:10 Landed on the sea floor (D=1,002m)
12:40 Left the sea bottom (D=962m)
13:04 JINBEI floated
13:37 Recovered JINBEI
14:43 Recovered OBE-D
15:23 Recovered OBE-C
16:06 Recovered OBE-B
16:48 Recovered OBE-A
17:06 Released XCTD
18:00 Scientific meeting

2018/05/17 NW off IHEYAJIMA

Weather: Fine but Cloudy / Wind direction: South / Wind force: 3 / Wave scale: 2 / Swell scale: 1 /

Visibility: 8 miles (12:00 JST)

09:31	Hoisted up KM-ROV
09:38	Launched
10:07	Started KM-ROV66 operation
10:11	Landed on the sea floor (D=1,071m)
12:44	Left the sea bottom (D=1,097m)
12:58	KM-ROV floated
13:30	Hoisted up KM-ROV
13:36	Recovered KM-ROV
13:38	Recovered mOBE
13:58	Hoisted up KM-ROV
14:04	Launched
14:34	Started KM-ROV67 operation
14:38	Landed on the sea floor (D=1,094m)
14:54	Left the sea bottom (D=1,097m)
15:27	Hoisted up "KM-ROV"
15:31	Recovered KM-ROV
16:39	Released XCTD
17:00	Left research area for YOKOSUKA
18:00	Scientific meeting

2018/05/18 SE off TANEGASHIMA

Weather: Fine but Cloudy / Wind direction: SSW / Wind force: 4 / Wave scale: 3 / Swell scale: 1 /

Visibility: 8 miles (12:00 JST)

18:00	Scientific meeting
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2018/05/19 East ward SHIONOMISAKI (33-19.5N, 137-16.7E)

Weather: Overcast / Wind direction: North / Wind force: 6 / Wave scale: 4 / Swell scale: 3 /

Visibility: 8 miles (12:00 JST)

18:00	Scientific meeting
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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

Wave scale

0	Calm (Glassy)	0.0m
1	Calm (Rippled)	0~1/10m
2	Smooth (Wavelet)	1/10~1/2m
3	Slight	1/2~1 1/4m
4	Moderate	1 1/4~2 1/2m

SWELL SCALE

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