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# R/V Kaimei Cruise Report
# KM18-07C_Leg2

SIP Project for Development of New-Generation Research Protocol for Submarine Resources: *joint survey for submarine hydrothermal deposits and for baseline condition of hydrothermal vent area*.

Okinawa Trough

August 10 to 26, 2018

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

**Contents**

**1. Cruise Information**

- Cruise ID
- Name of vessel
- Title of project
- Title of cruise
- Chief Scientist
- Cruise period
- Ports of departure / call / arrival
- Research area
- Research map

**2. Research Proposal and Science Party**

- Title of proposal
- Representative of Science Party
- Science Party (List)

**3. Research/Development Activities**

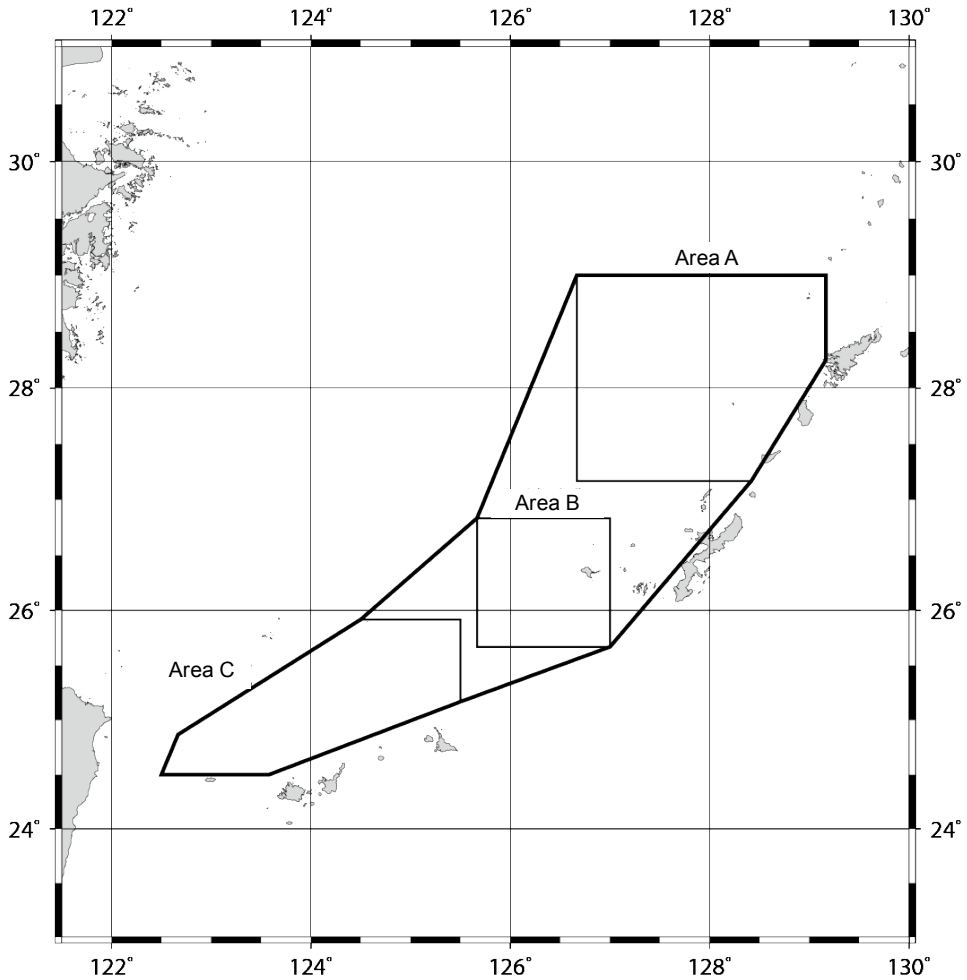
- Research activities
- Dive Information (dive number, location, payloads, dive log, dive track)

**4. Cruise Log**

**5. Notice on Using**

## 1. Cruise Information

● Cruise ID KM18-07C_Leg2
● Name of vessel R/V Kaimei
● Title of the cruise
SIP Project for Development of New-Generation Research Protocol for Submarine Resources: joint survey for submarine hydrothermal deposits and for baseline condition of hydrothermal vent area.
● Title of proposal Survey and monitoring the environments of hydrothermal vent area / A less-biased uniform area-exploration for hydrothermal activity in Southern-Okinawa Trough
● Cruise period August 10 to 26, 2018
● Ports of departure / call / arrival Naha / Naha / Yokosuka
● Research area Okinawa Trough
● Research Map




A: Tokara Islands area, depth 500m ~1,550m
B: Middle Okinawa Trough, depth 500m ~1,550m
C: Southern Okinawa Trough, depth 500m ~2,300m

**2. Research party**

● Chief Scientist:

| | |
|---|---|
| Hidenori KUMAGAI | JAMSTEC |

● Representative of the science party:

| | |
|---|---|
| Eiichi KIKAWA | JAMSTEC |

● Science party

| | |
|---|---|
| Kazuya KITADA | JAMSTEC |
| Jun'ichi MIYAZAKI | JAMSTEC |
| Tomo KITAHASHI | JAMSTEC |
| Kentaro INOMATA | JAMSTEC |
| Hiroshi KOSHIKAWA | National Institute of Environmental Studies |
| Shuhei OTA | National Institute of Environmental Studies |
| Hazuki SAKAMOTO | JAMSA |
| Narumi UEMICHI | JAMSA |
| Keita UCHIDA | JAMSA |
| Shimon KOIKE | JAMSA |
| Osamu MOTOHASHI | Space Engineering Development Co Ltd. |

(Marine Technician)

| | |
|---|---|
| Michiyasu KATAGIRI | NME |
| Eri SAKAMOTO | NME |

R/V KAIMEI CREW

| | |
|---|---|
| Captain | YOSHIDA Rikita |
| Chief Officer | KIMURA Naoto |
| 2nd Officer | SUZUKI Akira |
| 3rd Officer | YUKAWA Tomohiro |
| Chief Engineer | FUNAE Koji |
| 1st Engineer | IKUTA Shinichi |
| 2nd Engineer | YAMAGUCHI Katsuto |
| 3rd Engineer | RYOSYU Hayato |
| Chief Electronic Operator | NASU Tokinori |
| 2nd Electronic Operator | NISHIO Emi |
| 3rd Electronic Operator | UGAJIN Kazumi |
| Boat Swain | OHATA Masanori |
| Able Seaman | IWASAKI Naoki |
| Able Seaman | HIRAI Saikan |
| Able Seaman | KAWABE Yasunobu |
| Sailor | OHJIRI Yuta |
| Sailor | YOSHIMI Yudai |
| Sailor | SAITO Akira |
| No.1 Oiler | FUNAWATARI Keita |
| Oiler | HIGASHIGAWA Yuji |
| Oiler | MISAGO Sota |
| Assistant Oiler | YAMAZAKI Keita |
| Chief Steward | CHIKUBA Yukihide |
| Steward | YAMAMOTO Yoshitaka |
| Steward | ABE Takahiro |
| Steward | KUBOTA Ryu |

KM-ROV operator

| | |
|---|---|
| Operation Manager | MIURA Atsumori |
| 1st ROV Operator | SAITO Fumitaka |

| | |
|---|---|
| 2nd ROV Operator | ISHITSUKA Tetsuya |
| 2nd ROV Operator | TAKENOUCHI Atsushi |
| 2nd ROV Operator | KUMAGAI Shinnosuke |
| 3rd ROV Operator | SUGIURA Shuya |

## 3. Research/Development Activities

**Research overview**

This cruise has been planned in a series of joint research on environmental impact assessment and on ore-genesis study: to collect the baseline data of environments and biodiversity on Okinawa Through and adjacent sea area, to confirm the technical protocols of observation tools and operation processes, and to obtain less biased distribution of hydorthermalism in Okinawa Trough. Here, the baseline data, e.g. oceanographic structure, seafloor condition, biodiversity and distribution pattern, were gathered from hydrothermal vent fields where are anticipated the resource potentials of polymetallic sulfides.

**Onboard bioassay and monitoring of photoplanktons in surface seawater**

*Shuhei Ota*

We monitored impact of heavy metals on microbial communities especially targeting pico-nano size phytoplanktons in surface seawater. The samples used in this onboard experiments were collected from tap seawater (research-quality) or with a bucket from ship deck. At the same time, temperature and salinity of the surface seawater were measured with a handy CTD sensor (RINKO profiler). Four different metal solutions (Zn, Pb, Cu and As) were used for the evaluation of the impact of the metals on the natural microbial communities. The damaged phytoplanktons were detected using a portable flow cytometer (FCM) (On-chip Sort) and a high sensitivity luminometer (DF) (Hamamatsu Photonics). We could verify our procedures for onboard experiments and bioassay using natural seawater with FCM and DF tools.

**Development and test operation of onboard toxicant contamination alert system for surface environment**

*Hiroshi Koshikawa*

NIES and JAMSTEC are collaborating to develop an onboard toxicant contamination alert system for the surface environment around seafloor mining fields. The photosynthetic fluorescence yield (Fv/Fm and/or Fv'/Fm') of natural phytoplankton assemblages is one the candidates for a sensing parameter of toxic substances such as heavy metals. In this cruise, we installed a continuous Fv/Fm monitoring system onboard. It is mainly composed of a hand-made dark – light adaptation controller with a set of three 5 L tanks and two Fv/Fm measuring instruments equipped flow-through modules (FRRF (Kimoto Electronics, Japan) and Water-PAM (Walz, Germany)). It received the surface seawater taken continuously by a seawater pump of the R/V and determined the natural variation of the Fv/Fm on the trail.

**Surface geophysical survey: magnetic and gravity field**

*Kazuya Kitada*

We conducted the detailed magnetic and gravity surveys aboard the R/V Kaimei to characterize the sub-seafloor structures and the spatial distribution of the magmatic activity around the hydrothermal site. Magnetic field data were collected by two equipments; a shipboard three-component magnetometer (STCM, Tierra Tecnica SFG-2015) and a ship-towed cesium magnetometer (Geometrics Inc., G-882). The STCM data contain the effects of ship's magnetic field, which is required to be corrected in order to derive the real geomagnetic field. The 360° rotation data of both clockwise and counter-clockwise, called figure-eight turns, were conducted for the calibration and the twelve constants (B(1,1)-B(3,4)) related to the ship's permanent and induced magnetic field were estimated using the calibration data. During this cruise, figure-eight turns were conducted twice. Total geomagnetic field were measured by using a cesium marine magnetometer only in the area off Kumejima Island. The length of the towed cable was ~400 m to reduce the ship's magnetic effect. Magnetic anomaly was obtained by subtracting the International Geomagnetic Reference Field (IGRF) from the collected data. In addition, gravity field data were obtained by a shipboard gravimeter (MGS-6, Micro-g LaCoste) during this cruise. Free-air gravity anomaly was calculated with subtracting the normal gravity field and the correction of the Eötvös effect using the GNSS data. The gravity data measured by the portable gravimeter (CG-5 AUTOGRAV gravity meter, Scintrex) at Naha port and the pier of JAMSTEC Yokosuka HQ, before and after the cruise respectively, were used for the correction of instrumental drift.

**Survey by KM-ROV**

*Hidenori Kumagai, Jun'ichi Miyazaki, Osamu Motohashi, Norihiko Katayama (NICT shore-based)*

In this cruise, we performed three dives in the studied area: KM-ROV #76-78. Here the first and third ones were done in Northern Okinawa Trough, the second one was at the Nansei-Shoto Ridge (Kerama Gap). These dives were planned to achieve the following three objectives.

The first is to collect environmental base-line data to access any impact when exploitation of submarine resources once commenced: biodiversity and geochemical background in the targeted area. Such an commercial project has not been formulated yet, a couple of BMS drilling expedition is scheduled this September as in the SIP project, thus minimum observation and sampling are necessary. For this purpose, we carried out KM-ROV dives to observe seafloor environment and to sample sediments at northern part of Minami-Ensei Knoll and Jibli site of Higashi-Ensei hydrothermal field. And hydrothermal fluid was sampled by pressure-tight water sampler (WHATS-3) at Jibli site of Higashi-Ensei field. Moreover, several rock samples were picked up.

The second is a sea-trial of a compact data-logger for METS methane sensor we have developed. The apparatus is small enough to equip to mini AUV including Jinbei. We equipped them to KM-ROV in this cruise since AUV dives were canceled. The data from METS sensor were well recorded in the developed logger.

The third is geological observation at the wall of Kerama Gap to understand general geological environment of the arc-backarc system composed of Nansei-Shoto Ridge and Okinawa Trough. In this frame, rifting history of Okinawa Trough is to be important constraints; however, the detailed study at Kerama Gap is rather limited to date (e.g. Kimura et al., 1994).

Further, a satellite connected high-speed off-shore internet service using WINDS† was available daytime (0830h-1700h) on weekdays. Through this connection, twice of trial to share the ROV camera images directly to shore-based members. Using a commercial encording instrument set on-board, the real time High-vision images were monitored in PC, then the desktop of the PC shared via skype(TM).

Note: †WINDS: Wideband InterNetworking Engineering Test and Demonstration Satellite (Journal of NICT vol. 54,issue 4).

**Making of practical EIA protocol**

*Tomo KITAHASHI, Kentaro INOMATA, Hazuki SAKAMOTO, Narumi UEMICHI, Keita UCHIDA, and Shimon KOIKE,*

We collected the sediment core sample using a H-type push corer, which was operated by the manipulator of the KM-ROV. The sediment cores were collected at three sites: Minami Ensei, Kerama Gap, and Higashi Ensei sites. At each site, three core samples were collected and were divided at onboard laboratory for meiofaunal composition, DNA analysis, and chemical properties.

The practical protocols related to environmental impact assessment for seabed mining are prepared for technology transfer to marine industries. During the research cruise of R/V *Kaimei* KM17-12C in November 2017, we made draft of the protocol for meiofauna analysis. In this cruse, confirmation of the protocol contents has been done to edit the final version.

●Dive information

KM-ROV Dive #76

Date: August 20, 2018

Location: Northern foot of Minami-Ensei Knoll

Area: 28°31.55 - 31.80'N, 127°43.50 - 43.90'E, 1028 - 1024 mWD

Payloads: WHATS-sampler (for hydrothermal fluid) w/ thermometer, METS sensor, turbidity meter, H-type push corer (6 sets), sample box

Description:

During the traverse, two vigorous bubbling were recognized where corresponds to the plumes in water column have been mapped. Numbers of platy consolidated sediments were scattered around the bubbling area.

KM-ROV Dive #77
Date: August 22, 2018
Location: Kerama Gap
Area: 25°51.95'-53.00'N, 127°43.50 – 43.90'E, 1213 - 410mWD
Payloads: WHATS-sampler (for hydrothermal fluid) w/ thermometer, METS sensor, H-type push corer (3 sets), sample box
Description:
Facing to the slope of Kerama Gap, up-climbing commenced. During the traverse, numbers of outcrops were recognized; most of the outcrops showed well layered, laminar structure, however, massive boulder dominated in the section above 800m WD consisting of limestone with thin ferromanganese coating. The upper and lower sections of traverse was consisted of the siltstones.

KM-ROV Dive #78
Date: August 23, 2018
Location: Higashi-Ensei Field, Southeastern deep near Ensei Knoll
Area: 28°26.34'-26.41'N, 128°10.34 – 10.55'E, 1242 – 1191 mWD
Payloads: WHATS-sampler (for hydrothermal fluid) w/ thermometer, METS sensor, turbidity meter, H-type push corer (6 sets), sample box
Description:
The vehicle touched down to the northern side of active chimney-mound complex where the seafloor was covered by brown color sediment and occasional rock fragment scattered. At the foot of the topographical high just north of the on-bottom point, numbers of platy block with white broken surface were scattered; one of such fragment was collected. Then the vehicle proceed to the depression almost center of the hydrothermal site to sampled the seafloor sediments by H-type push corer. Within 100m away from the rock-sampling point, the sediment cover on the seafloor seems to be thicken, Thus at two localities were selected almost center for the hydrothermal site in order to collect environmental base-line data in this hydrothermal field. Then, the vehicle proceed to the active chimney-mound complex that mapped in previous dive expeditions: KR16-16 and KM18-04. A huge chimney complex was appeared on the up-slope that has multiply stacked flange structure. The fluid temperature pooled beneath the flange showed 312.7°C at the pumping of the water sampler.

## 4. Cruise Log

| Date | Local Time | Note | Position/Weather/Wind/Sea condition |
|---|---|---|---|
| 10-Aug-18 | | **Started KM18-07C_Leg2 & Proceeding to research area Avoiding Typhoon** | NAHA-PORT |
| | 16:00 | Left Naha & Started KM18-07C_Leg2 | 26-14.4N, 127-40.6E |
| | 18:30 | Scientist meeting | Cloudy |
| | | | North-3 (Gentle breeze) |
| | | | 1 (Sea Calm Rippled) |
| | | | 0 (No Swell) |
| | | | Visibly: 8' |
| 11-Aug-18 | | **Arrived at SATSUKAWA-WAN to avoid typhoon** | SATSUKAWA-WAN |
| | 6:45 | Arrived at SATSUKAWA-WAN to avoid typhoon | 28-10.5N, 129-14.4E |
| | 18:30 | Scientist meeting | Fine but Cloudy |
| | | | East-6 (Strong breeze) |
| | | | 2 (Sea Smooth) |
| | | | 0 (No Swell) |
| | | | Visibly: 8' |

| | | | |
|---|---|---|---|
| 12-Aug-18 | | **Avoiding typhoon at SATSUKAWA-WAN** | SATSUKAWA-WAN |
| | 18:30 | Scientist meeting | 28-10.1N, 129-14.8E |
| | | | Fine but Cloudy |
| | | | ESE-5 (Fresh breeze) |
| | | | 2 (Sea Smooth) |
| | | | 0 (No Swell) |
| | | | Visibly: 8' |
| 13-Aug-18 | | **Avoiding typhoon at SATSUKAWA-WAN** | SATSUKAWA-WAN |
| | 18:30 | Scientist meeting | 28-10.1N, 129-14.8E |
| | | | Rain |
| | | | East-4 (Moderate breeze) |
| | | | 2 (Sea Smooth) |
| | | | 0 (No Swell) |
| | | | Visibly: 8' |
| 14-Aug-18 | | **MBES Survey & Towing Cesium Magnetmeter** | NE ward of AGUNI-JIMA |
| | 4:00 | Left SATSUKAWA-WAN for Research Area | 26-54.0N, 127-29.0E |
| | 15:53 | XBT Observation | Fine but Cloudy |
| | 16:00 | Surface Sea Water Sampling by Bucket | East-6 (Strong breeze) |
| | 16:16 | Started Towing the Cesium Magnetmeter | 4 (Sea Moderate) |
| | 17:18 | Started Bathymetry Mapping & Searching Plume with MBES | 2 (Low Swell Long) |
| | 18:30 | Scientist meeting | Visibly: 8' |
| | 20:04 | Started figure eight running | |
| | 20:19 | Finished figure eight running | |
| 15-Aug-18 | | **MBES Survey & Towing Cesium Magnetmeter** | W ward of KUME-JIMA |
| | 13:15 | Finished Towing the Cesium Magnetmeter | 26-31.5N, 126-07.0E |
| | 15:02 | Finished Bathymetry Mapping & Searching Plume Survey with MBES | Fine but Cloudy |
| | 15:15 | Surface Sea Water Sampling by Bucket | East-6 (Strong breeze) |
| | 15:30 | Proceeding to NAGO-WAN to Avoid Typhoon | WSW-4 (Moderate breeze) |
| | 18:30 | Scientist meeting | 2 (Sea Smooth) |
| | | | 3 (Moderate Short) |
| | | | Visibly: 8' |
| 16-Aug-18 | | **Avoiding typhoon** | NAGO-WAN |
| | 18:30 | Scientist meeting | 26-29.5N, 127-47.0E |
| | | | Rain |
| | | | South-6 (Strong breeze) |
| | | | 3 (Sea Slight) |
| | | | 3 (Moderate Short) |
| | | | Visibly: 8' |
| 17-Aug-18 | | **Arrived at NAHA & Fixing Acoustic Navigation System** | NAHA-PORT |
| | 8:30 | Arrived at NAHA & Fixing Acoustic Navigation System | 26-14.3N, 127-40.7E |

| | | | |
|---|---|---|---|
| | | | Fine but Cloudy |
| | | | SE-3 (Gentle breeze) |
| | | | 1 (Sea Calm Rippled) |
| | | | 0 (No Swell) |
| | | | Visibly: 8' |
| 18-Aug-18 | | **Left Naha & MBES Survey** | NAHA-PORT |
| | 15:00 | Left Naha | 26-14.3N, 127-40.7E |
| | 18:30 | Scientist meeting | Fine but Cloudy |
| | 20:20 | Arrived at Research Area | NE-3 (Gentle breeze) |
| | 20:28 | XBT Observation | 1 (Sea Calm Rippled) |
| | 21:07 | Started Bathymetry Mapping & Searching Plume with MBES | 0 (No Swell) |
| | | | Visibly: 8' |
| 19-Aug-18 | | **MBES Survey & Acoustic Navigation System Caribration** | NW ward of KUME-JIMA |
| | 2:20 | Finished Bathymetry Mapping & Searching Plume with MBES | 26-42.0N, 126-18.0E |
| | 6:22 | XBT Observation | Fine but Cloudy |
| | 8:23 | Released the Acoustic Transponder Mooring System | SE-5 (Fresh breeze) |
| | 8:45 | Surface Sea Water Sampling by Bucket | 3 (Sea Slight) |
| | 9:01 | Started Acoustic Transponder positioning | 2 (Low Swell Long) |
| | 10:13 | Finished Acoustic Transponder positioning | Visibly: 8' |
| | 10:38 | Started Caribration for Acoustic Navigation System | |
| | 14:13 | Finished Caribration for Acoustic Navigation System | |
| | 15:08 | Recovered the Acoustic Transponder Mooring System | |
| | 15:15 | Surface Sea Water Sampling by Bucket | |
| | 18:30 | Scientist meeting | |
| 20-Aug-18 | | **MBES Survey & KM-ROV DIVE 76** | W ward of AMAMI-OSHIMA |
| | 2:00 | Started figure eight running | 28-32.0N, 127-44.0E |
| | 2:31 | Finished figure eight running | Fine but Cloudy |
| | 4:04 | XBT Observation | East-3 (Gentle breeze) |
| | 4:37 | Started Bathymetry Mapping & Searching Plume with MBES | 3 (Sea Slight) |
| | 5:15 | Finished Bathymetry Mapping & Searching Plume with MBES | 2 (Low Swell Long) |
| | 7:03 | Hoisted up KM-ROV | Visibly: 8' |
| | 7:09 | Launched | |
| | 7:38 | Started KM-ROV76 operation | |
| | 7:43 | Landed on the sea floor (D=1,026m) | |
| | 11:12 | Left the sea bottom (D=1,027m) | |
| | 11:18 | KM-ROV floated | |
| | 11:50 | Recovered KM-ROV | |
| | 18:30 | Scientist meeting | |
| | | | |
| 21-Aug-18 | | **MBES Survey** | NW ward of |

| | | | |
|---|---|---|---|
| | | | KUME-JIMA |
| | 3:59 | XBT Observation | 26-12.0N, 126-10.0E |
| | 4:27 | Started Bathymetry Mapping & Searching Plume with MBES | Fine but Cloudy |
| | 13:16 | Finished Bathymetry Mapping & Searching Plume with MBES | NW-3 (Gentle breeze) |
| | 15:24 | XBT Observation | 2 (Sea Smooth) |
| | 15:42 | Started Bathymetry Mapping & Searching Plume with MBES | 1 (Low Swell Short or Average) |
| | 17:17 | Finished Bathymetry Mapping & Searching Plume with MBES | Visibly: 8' |
| | 18:30 | Scientist meeting | |
| 22-Aug-18 | | **KM-ROV 77 DIVE** | S ward of KUME-JIMA |
| | 8:03 | Hoisted up KM-ROV | 25-53.0N, 126-45.0E |
| | 8:11 | Launched | Fine but Cloudy |
| | 8:42 | Started KM-ROV77 operation | SW-4 (Moderate breeze) |
| | 8:49 | Landed on the sea floor (D=1,213m) | 3 (Sea Slight) |
| | 15:00 | Left the sea bottom (D=410m) | 2 (Low Swell Long) |
| | 15:11 | KM-ROV floated | Visibly: 8' |
| | 15:27 | Recovered KM-ROV | |
| | 15:40 | Surface Sea Water Sampling by Bucket | |
| | 18:30 | Scientist meeting | |
| 23-Aug-18 | | **KM-ROV 78 DIVE & Proceeding to JAMSTEC at YOKOSUKA** | W ward of AMAMI-OSHIMA |
| | 9:23 | Surface Sea Water Sampling by Bucket | 28-26.0N, 128-11.0E |
| | 11:13 | XBT Observation | Fine but Cloudy |
| | 13:04 | Hoisted up KM-ROV | SW-4 (Moderate breeze) |
| | 13:11 | Launched | 3 (Sea Slight) |
| | 13:44 | Started KM-ROV78 operation | 4 (Moderate Average) |
| | 13:49 | Landed on the sea floor (D=1,242m) | Visibly: 8' |
| | 15:42 | Left the sea bottom (D=1,192m) | |
| | 16:05 | KM-ROV floated | |
| | 16:43 | Recovered KM-ROV | |
| | 18:30 | Scientist meeting | |
| | 20:00 | Left Research Area for JAMSTEC at YOKOSUKA | |
| 24-Aug-18 | | **Bound for JAMSTEC at YOKOSUKA** | S ward of TOI-MISAKI |
| | 18:30 | Scientist meeting | 31-14.0N, 131-10.0E |
| | | | Cloudy |
| | | | South-5 (Fresh breeze) |
| | | | 3 (Sea Slight) |
| | | | 4 (Moderate Average) |
| | | | Visibly: 7' |
| | | | |
| 25-Aug-18 | | **Bound for JAMSTEC at YOKOSUKA** | |
| | 18:30 | Scientist meeting | |

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| 26-Aug-18 | | **Arrived at JAMSTEC at YOKOSUKA & Finished KM18-07C_Leg2** | |
| | 9:00 | Arrived at JAMSTEC at YOKOSUKA & Finished KM18-07C_Leg2 | |
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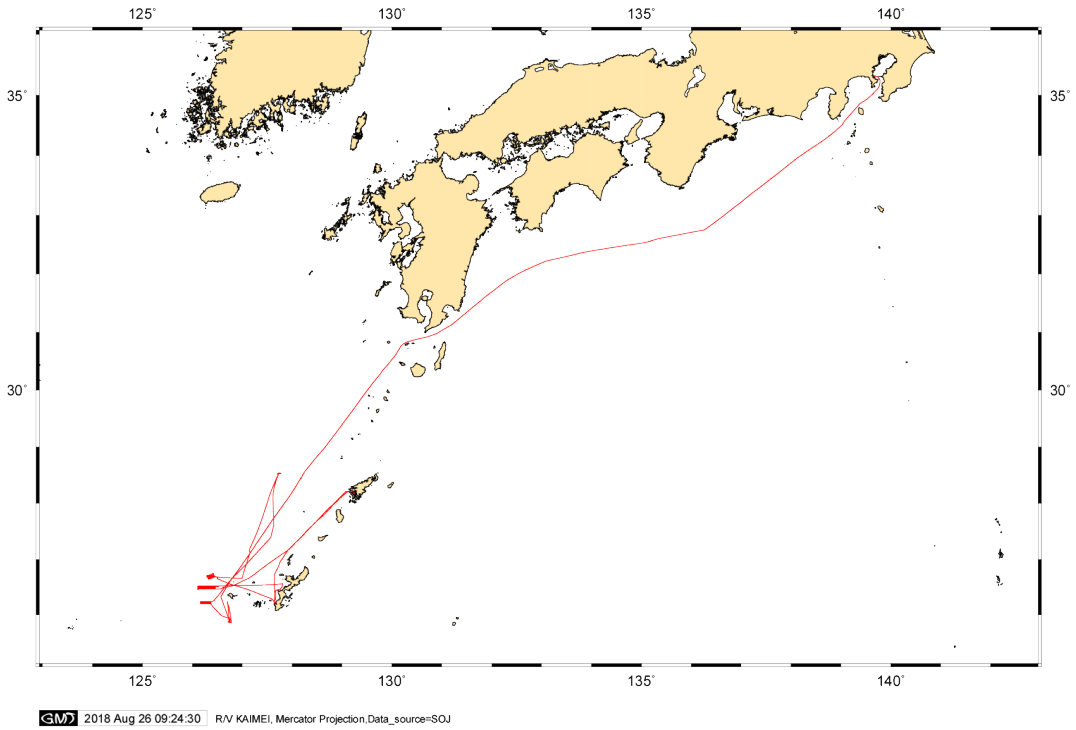
| | | | |




## 5. Notice on Using

This cruise report is a preliminary documentation as of the end of cruise.
This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.
Users of information on this report are requested to submit Publication Report to JAMSTEC.

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