



Cruise Report
R/V YOKOSUKA
YK19-03

Field tests of underlying technologies using ROV and AUV to open up the
ocean frontier

Sagami-Bay, Suruga-Bay, Omuro-dashi

Mar. 17, 2019- Mar. 29, 2019

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

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1. Cruise Information

Cruise ID: YK19-03

Name of vessel: R/V YOKOSUKA

Title of the cruise: Field tests of underlying technologies using ROV and AUV to open up the ocean
frontier

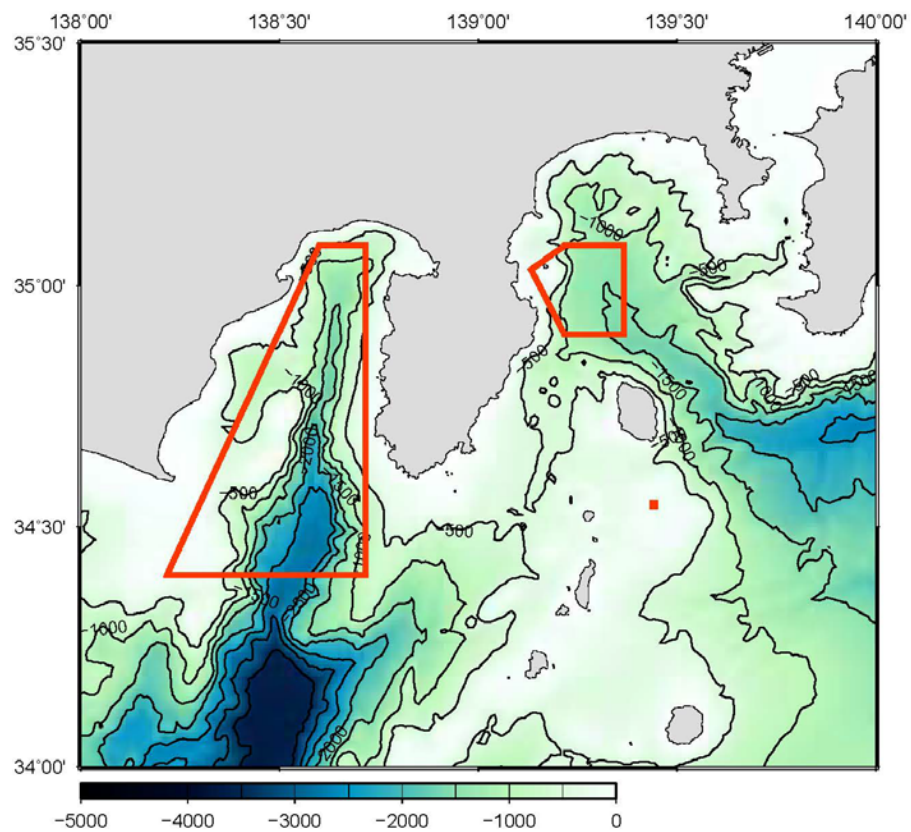
Cruise period: March 17- 29, 2019

Port of departure and arrival: JAMSTEC, Yokosuka

Port of call: JAMSTEC, Yokosuka (March 25, 2019)

Research area: Sagami-Bay, Suruga-Bay, Omuro-dashi

Research map:



2. Researchers

Chief scientist: Mr. Yosaku Maeda JAMSTEC Marin Technology Center (MARITEC)

Vice Chief Scientist: Mr. Tsuyoshi Yoshiume JAMSTEC MARITEC

Staff Scientists

1. Engineer and operator for YUMEIRUKA (On board period: March 17 – 25, 2019)

Mr. Yoshinobu Nanbu	JAMSTEC MARITEC
Dr. Hiroshi Ochi	JAMSTEC MARITEC
Mr. Tatsuya Aso	JAMSTEC MARITEC
Mr. Kazuhiro Kanayama	Mitsubishi Heavy Industries, Ltd.

2. Engineer and operator for Free fall and pop-up observation system “FFC11K” and ROV “RODD” (On board period: March 26 – 29, 2019)

Dr. Shoichiro Baba	JAMSTEC MARITEC
Dr. Yoshitaka Watanabe	JAMSTEC MARITEC
Dr. Kazumasa Oguri	JAMSTEC MARITEC
Mr. Koji Megro	JAMSTEC MARITEC
Mr. Hiroki Furuyama	JAMSTEC MARITEC
Mr. Keisuke Takeda	Marine Works Japan, Ltd.

3. Tests and Observations

In this cruise, we conducted technical tests of AUV “YUMEIRUKA” and a new Free fall and pop-up observation system “FFC11K” and an observation using ROV for the following three subjects: 1) Evaluation of stability of AUV YUMEIRUKA during altitude control, 2) Performance tests of FFC11K, 3) Measurement of temperature and current around hydrothermal vents at Omuro-dashi for developments of deep-sea generating system using hot water of hydrothermal vent.

(1) Evaluation of stability of AUV YUMEIRUKA during altitude control

In YUMEIRUKA, unstable pitch which often appears during altitude control has been confirmed through previous test dives. To find the cause of the unstable motion, the following tests were conducted.

A. Operation tests of YUMEIRUKA using NORTEK DVL 500 (Nortek) for DVL.

In order to compare the motion of YUMEIRUKA in altitude controlled by difference of DVL specification, NORTEK DVL 500 was used instead of WHN300 (Teledyne RDI) which was used conventionally for DVL of YUMEIRUKA. The test dive was conducted on a test survey line at Sagami Bay on March 23, 2019. Although YUMEIRUKA first dived using NORTEK DVL 500 for the DVL, the motion was stable with no problem. However, actual maximum bottom detected level was approximately 80m, which was almost half of the level of WHN300.

B. Operation tests of YUMEIRUKA using WHN300 for DVL.

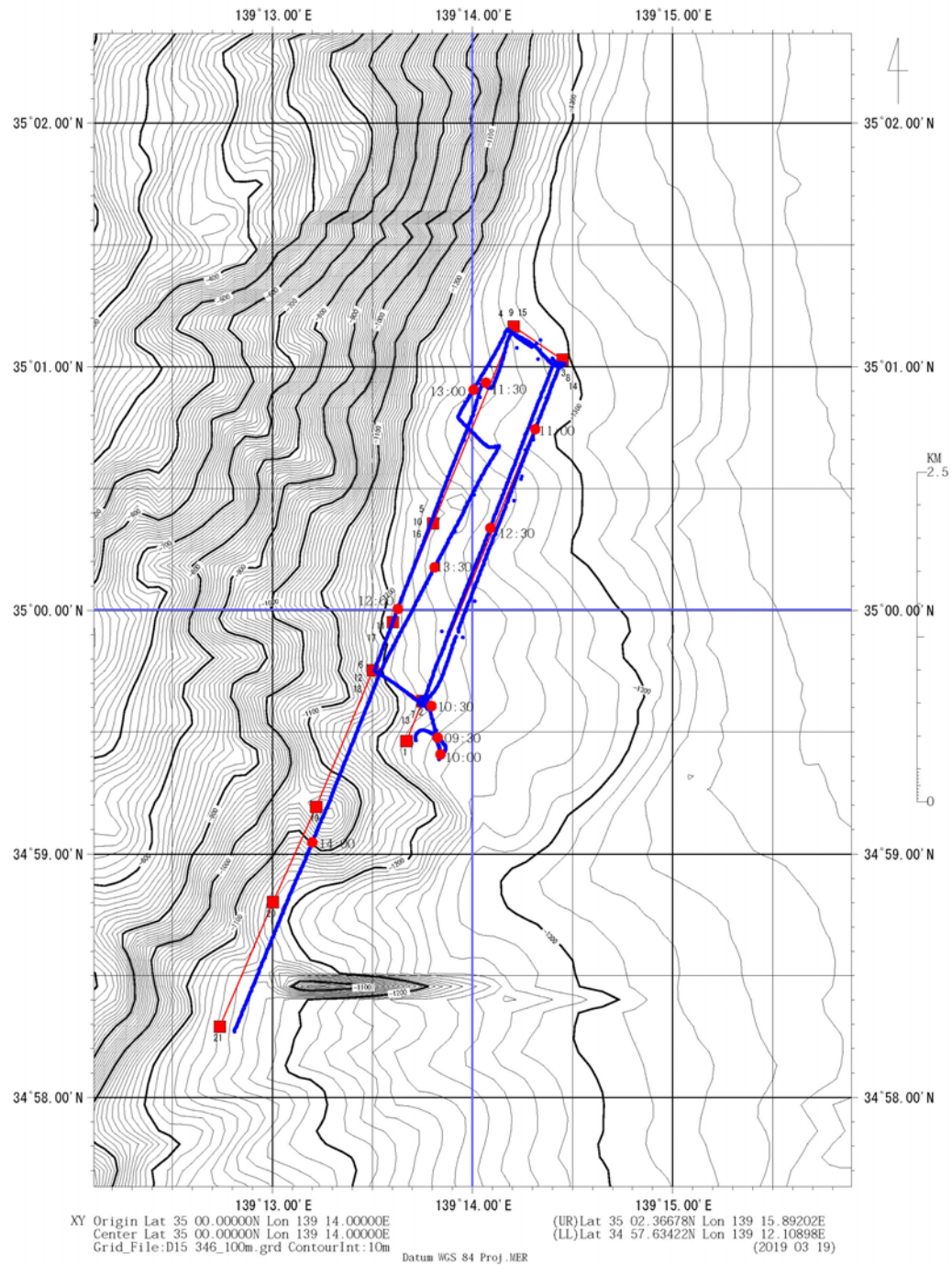
To obtain the motion data during altitude control using WHN300 in the same test line, NORTEK DVL 500 was replaced to WHN 300 on March 22, and YUMEIRUKA with WHN 300 dived on the same test survey line at Sagami Bay on March 23. The motion during altitude control was stable and we found that there was no clear difference compared to the using NORTEL DVL 500.

C. YUMEIRUKA’s performance test in the almost maximum operation depth at Suruga-Bay.

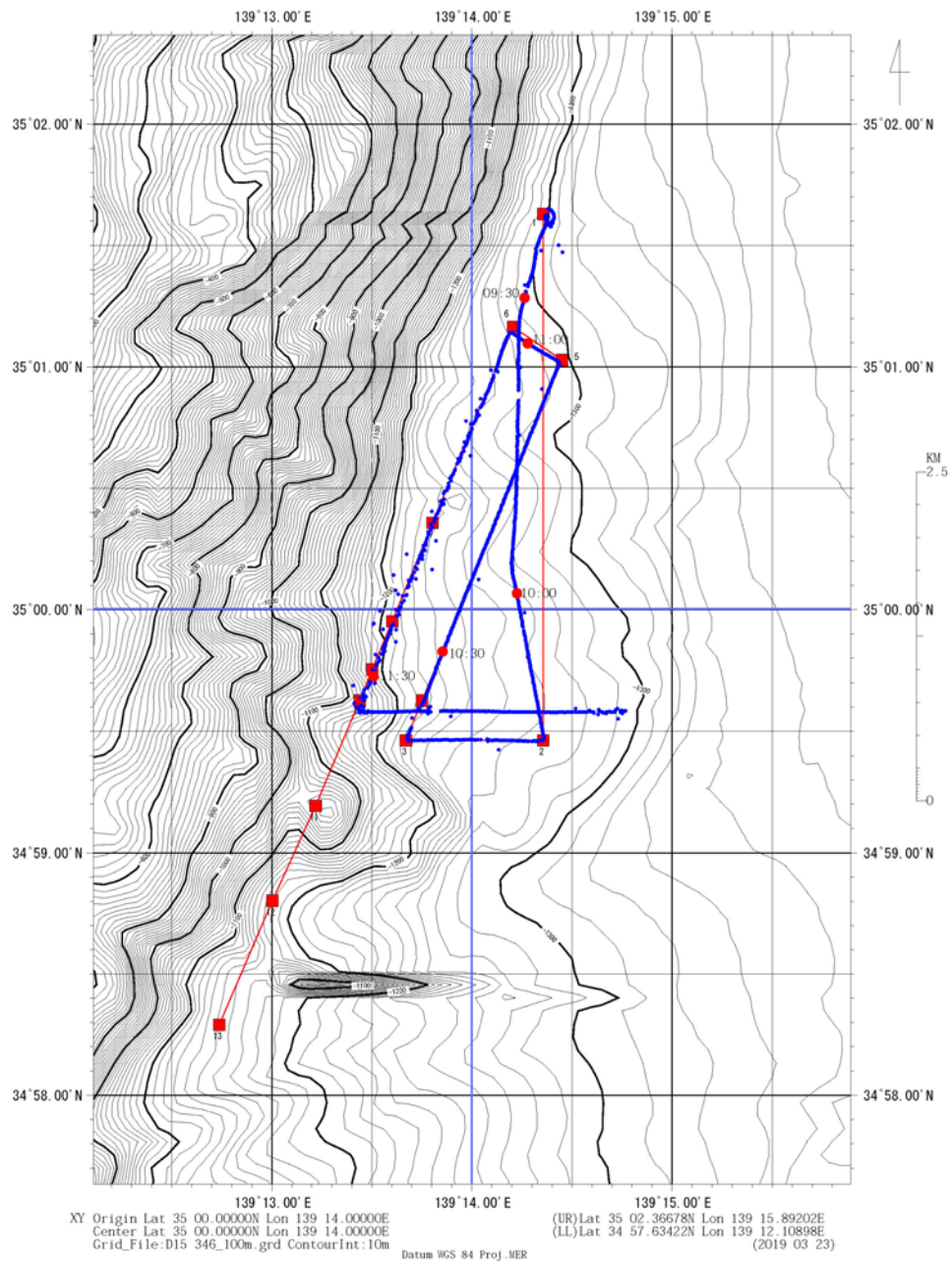
YUMEIRUKA dived to depth 2800meters at Suruga Bay and cruised in altitude control on test survey line to confirm the motion stability and performance in the almost maximum operation depth. We confirmed that UMEIRUKA have good performance in 2800m depth. But while diving along the rising seabed slope, YUMEIRUKA changed to emergency floating mode and started to ascent to surface because of alert unusually approaching to seabed. Detailed analysis of the log in YUMEIRUKA after recovery revealed that even though detected altitude by the DVL showed YUMEIRUKA kept sufficient distance to the seabed when the trouble, YUMEIRUKA judged the unusually approach the seabed. We found that altitude which YUMEIRUKA adopt tends to be

smaller than that by the DVL, and the difference increase as seabed slope is steep. As this might be related to the unstable motion during altitude control, we will continue to analyze the data.

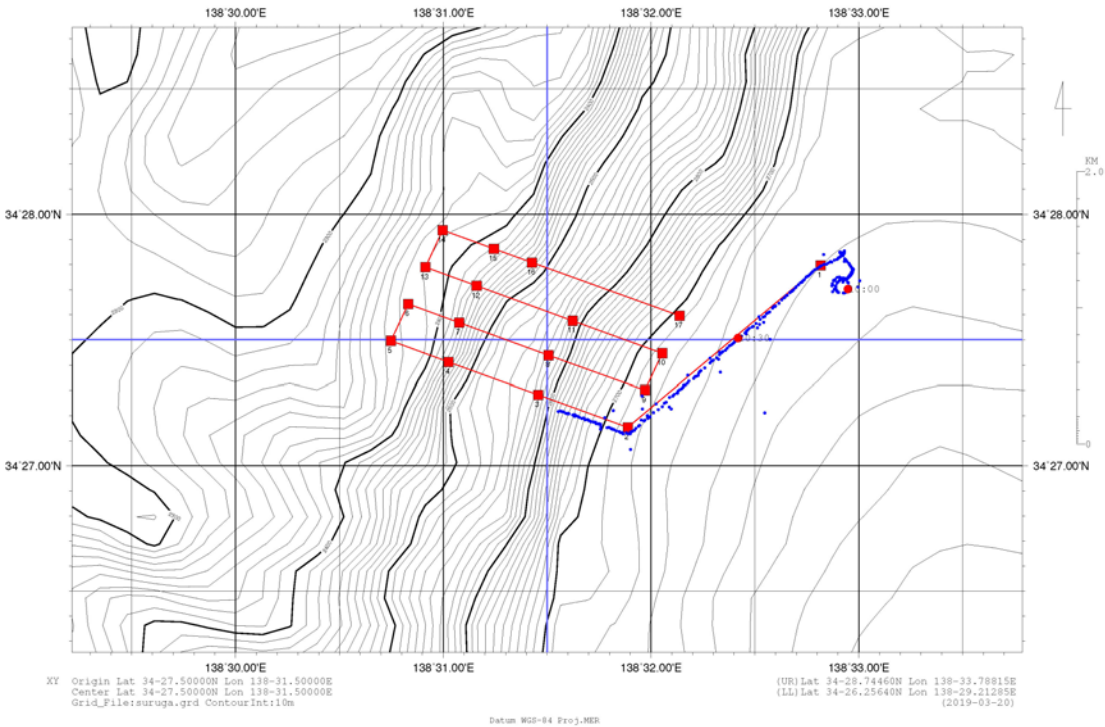
YUMEIRUKA dive track with NORTEK DVL 500 kHz on March 19, 2019



YUMEIRUKA dive track with WHN300 on March 23, 2019



YUMEIRUKA dive track on the depth of 2800m at Suruga-bay on March 20, 2019



(2) Performance tests of a new free-fall and popup observation system (FFC11K)

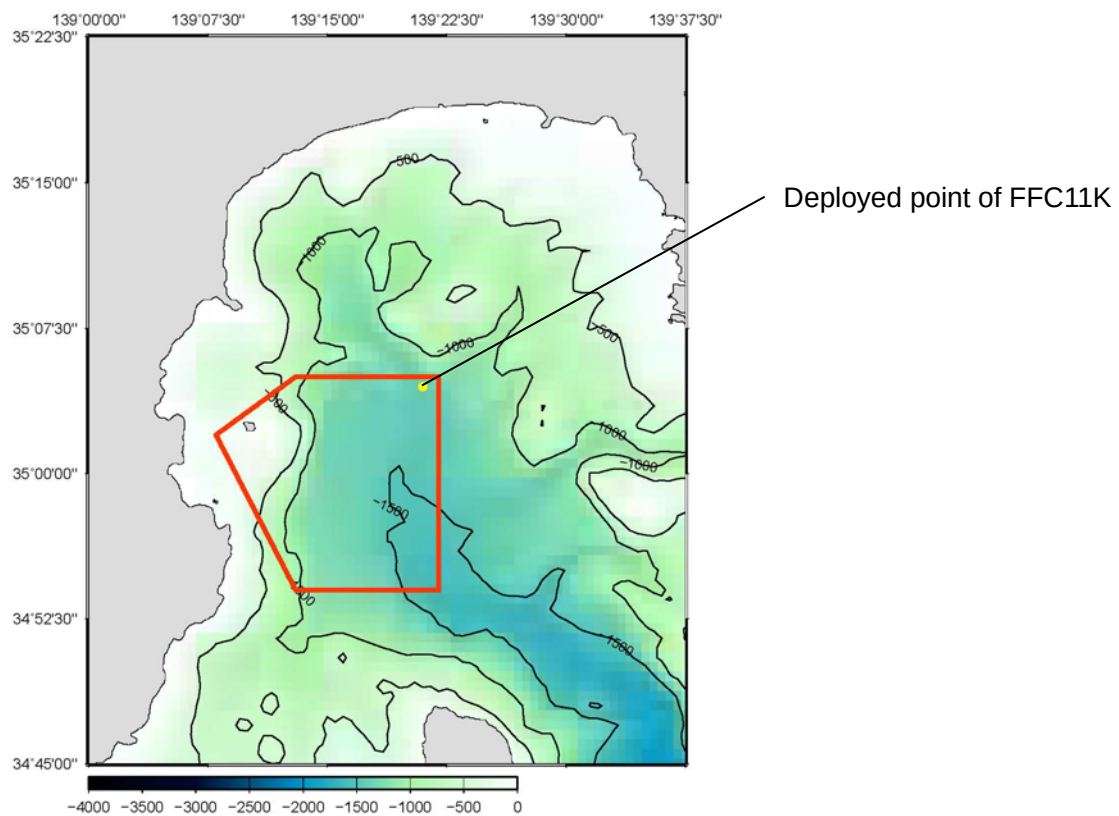
FFC11K has been developed by MARITEC since FY2018 and is designed to be able to conduct operation in full ocean depth such as environmental monitoring and sampling for marine research on seafloor. A releasable anchor weight system is adopted to deploy with Free-fall and recover with Self-floating, which greatly decreases the cost for the recovery equipment like ropes and their handling system. Technical specifications of FFC11K are shown by table 1. One of key feature is to be mounted Video transmission system with acoustic communication. The system decodes pictures that captured video files from main HD camera of FFC11K to analogue signals and then transmits as acoustic signals by applying the amplified signal voltage to transmitter. It is designed to can receive the analogue signals of the pictures on YOKOSUKA at 2.5 sec interval. The designed maximum operating depth is 11,000m.

Table.1 Technical specification

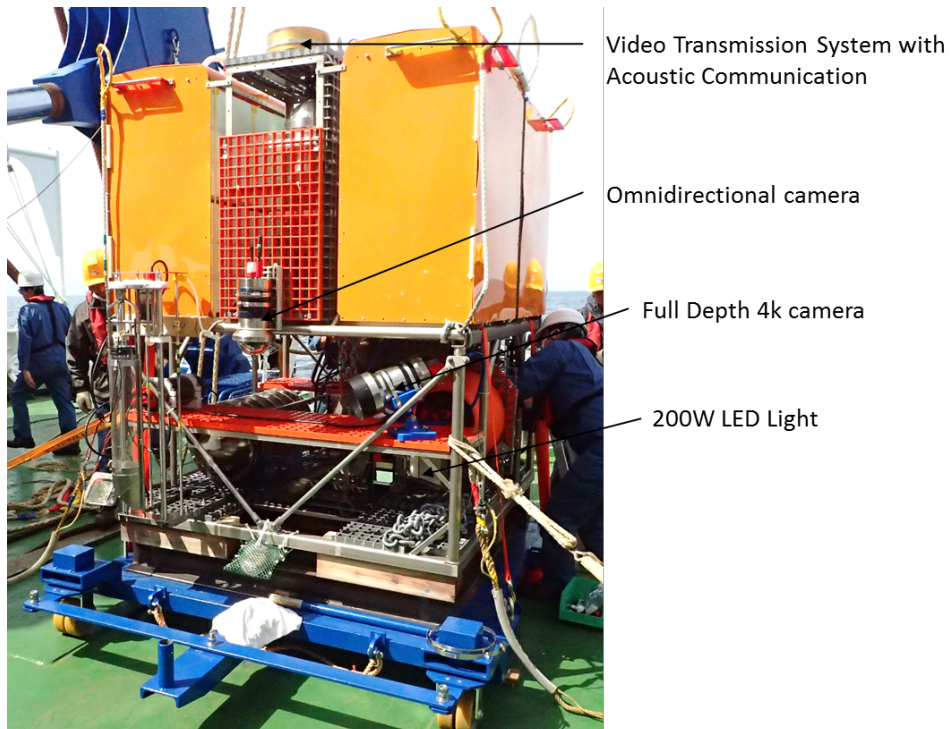
Size	1.6m×1.7m×2.2m(include Anchor weight)
Weight in air	2.0 ton (with Anchor wight), 1.7 ton (without Anchor wight)
Weight in surface seawater	110kg (with Anchor wight), -145kg (without Anchor wight)
Max. operating Depth	11000m
POWER SUPPLY	Litium ion battery pack 7kWh
Standard sensors and devices	Two stand alone Releser (Teledyne Benthos R12K and 865A)
	SBE49 CTD sensor
	HD camera (Sony EB6500)
	200W LED light ×2
	Iridium beacon
	Flasher
Buoyancy module	Torelleborg TG-11500
Communication	Video Transmission System with Acoustic Communication
	Acoustic modem (~3000m)

We already confirmed basic performance of FFC11K in deep water (6180m) in YK19-E01C cruise. Therefore, in this cruise, we focused performance tests of wireless communication using Video Transmission System with Acoustic Communication (VTSAC) and the acoustic modem.

FFC11K has been deployed for the tests from March 26 to March 28, 2019 at Sagami-bay. Deployed position was 35-04.4832N, 139-21.054E.



Arrangement of FFC11K during the test is shown in below pictures.



Acoustic modem



Detail of the wires communication tests describes the followings.

- 1) On/ OFF control for each devices from YOKOSUKA
- 2) Receiving status from FFC11K on YOKOSUKA
- 3) Control setting and focus etc. of the camera on FFC11K from YOKOSUKA
- 4) Check the moving of a motor corer that put on FFC11K through VTSAC on YOKOSUKA

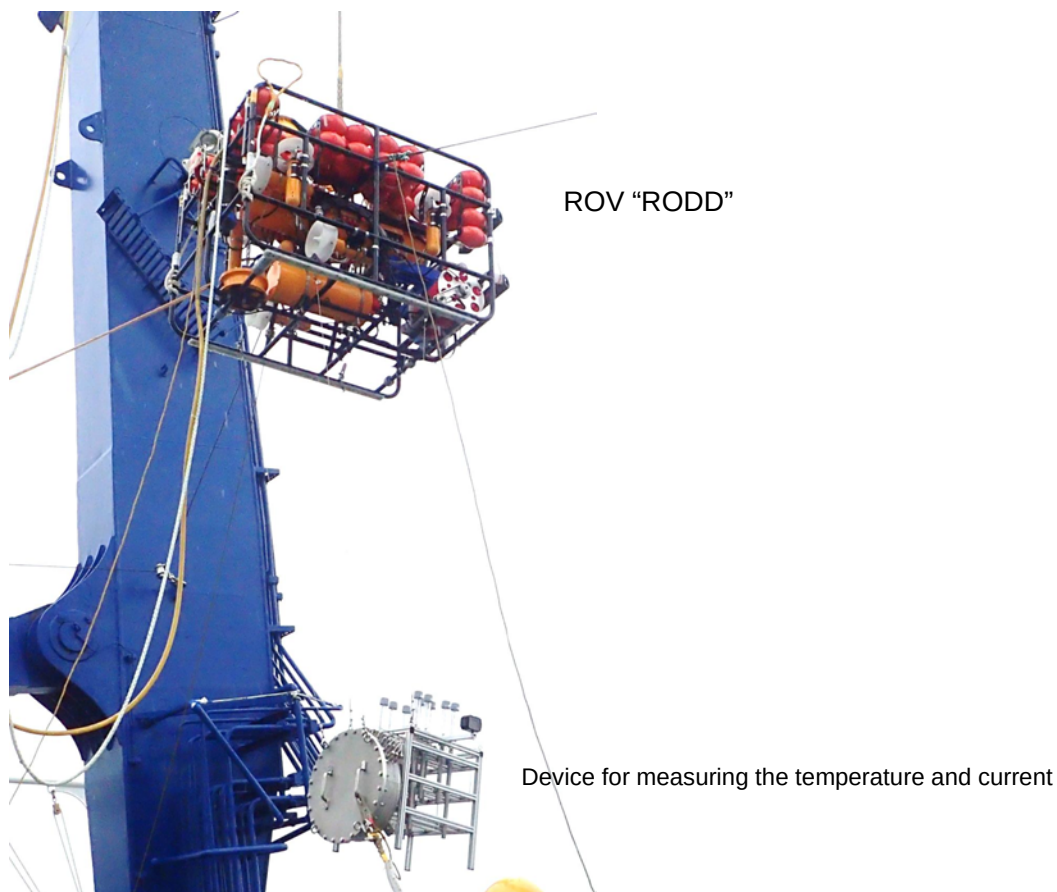
We also conducted continuous observation using FFC11K by timer sequence mode for 48 hours days.

These tests all resulted in successful operation.

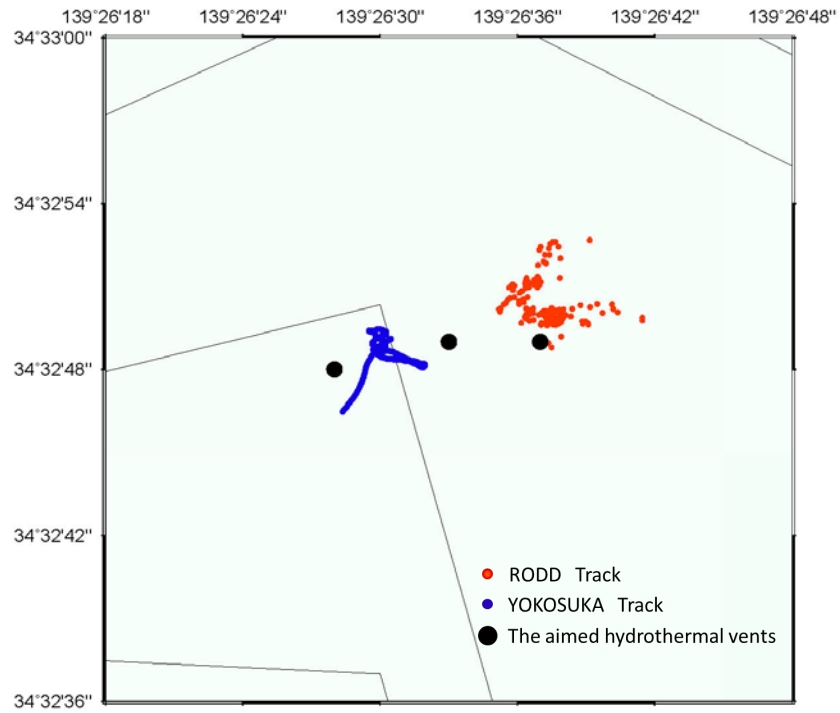
(3) Measurement of temperature and current distribution around hydrothermal vents at Omuro-dashi for development of a deep-sea generation system using temperature difference by hot water from a hydrothermal vent.

We have been developed a deep-sea generation system using temperature difference by hot water from a hydrothermal vent. To obtain fundamental environment data around hydrothermal vents for the generation system, we tried to measure temperature and current distribution around hydrothermal vents at Omuro-dashi using ROV “RODD” in this cruise. RODD has a HDTV camera and four forward-backward thrusters and vertical thrusters. The operating depth is depth of 300 meters. We had plan to look for hydrothermal vents at Omuro-dashi by the HDTV camera of RODD referring the positioning data by previous dive other ROV, then put a device for measuring the temperature and current on the seabed. The device was suspended from bottom frame of RODD.

A picture of RODD and measuring device for the temperature and current distribution



RODD with the device launched to the aimed hydrothermal vents at Omuro-dahi (see below map) on March 27, 2019. Unfortunately we could not reach the hydrothermal vents due to strong current from KUROSHIO and rough sea condition during this cruise.



4. 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 Management Group of JAMSTEC.

Acknowledgement

We are grateful to captain Masahisa Tsuji and all crew of “R/V Yokosuka” for their safe navigation and their skillful handling of “R/V Yokosuka” and we thank all the JAMSTEC persons who have supported us and this cruise.