



Natsushima Cruise Report

NT15-11

Sea trial of Autonomous Underwater Vehicle

“Yumeiruka” around Omuro-dashi

Sagami Bay, Suruga Bay and Omuro-dashi

July 5, 2015 – July 10, 2015

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

●Contents

1. Cruise Information

2. Researchers

3. Technical Test

4. Notice on Using

1. Cruise Information

1.1 Cruise ID

NT15-11

1.2 Name of vessel

Natsushima

1.3 Title of the cruise

Sea trial of Autonomous Underwater Vehicle “Yumeiruka” at around Omuro-dashi

1.4 Title of proposal

Sea trial of Autonomous Underwater Vehicle “Yumeiruka” at around Omuro-dashi

1.5 Cruise period

Jul.5,2015-Jul.10,2015

1.6 Ports of departure / call / arrival

Departure from JAMSTES Yokosuka on July 5

Arrival at JAMSTEC Yokosuka on July 10

1.7 Research area

Sagami Bay, Suruga Bay and Omuro-dashi

1.7 Research Map

Area#1: Sagami-Bay

The area bounded by

[34° 55.0' N, 139° 13.5' E], [35° 00.0' N, 139° 06.5' E], [35° 11.0' N, 139° 18.0' E]
[35° 11.0' N, 139° 25.0' E], [34° 55.0' N, 139° 25.0' E]

Area#2: Suruga-Bay

The area bounded by

[35° 00.0' N, 138° 35.0' E], [35° 00.0' N, 138° 43.0' E]
[34° 05.0' N, 138° 40.0' E], [34° 05.0' N, 138° 05.0' E]

Area#3: Omuro-dashi

The area bounded by

[34° 12.0' N, 34° 45.0' N, 139° 11.0' E, 139° 42.0' E]

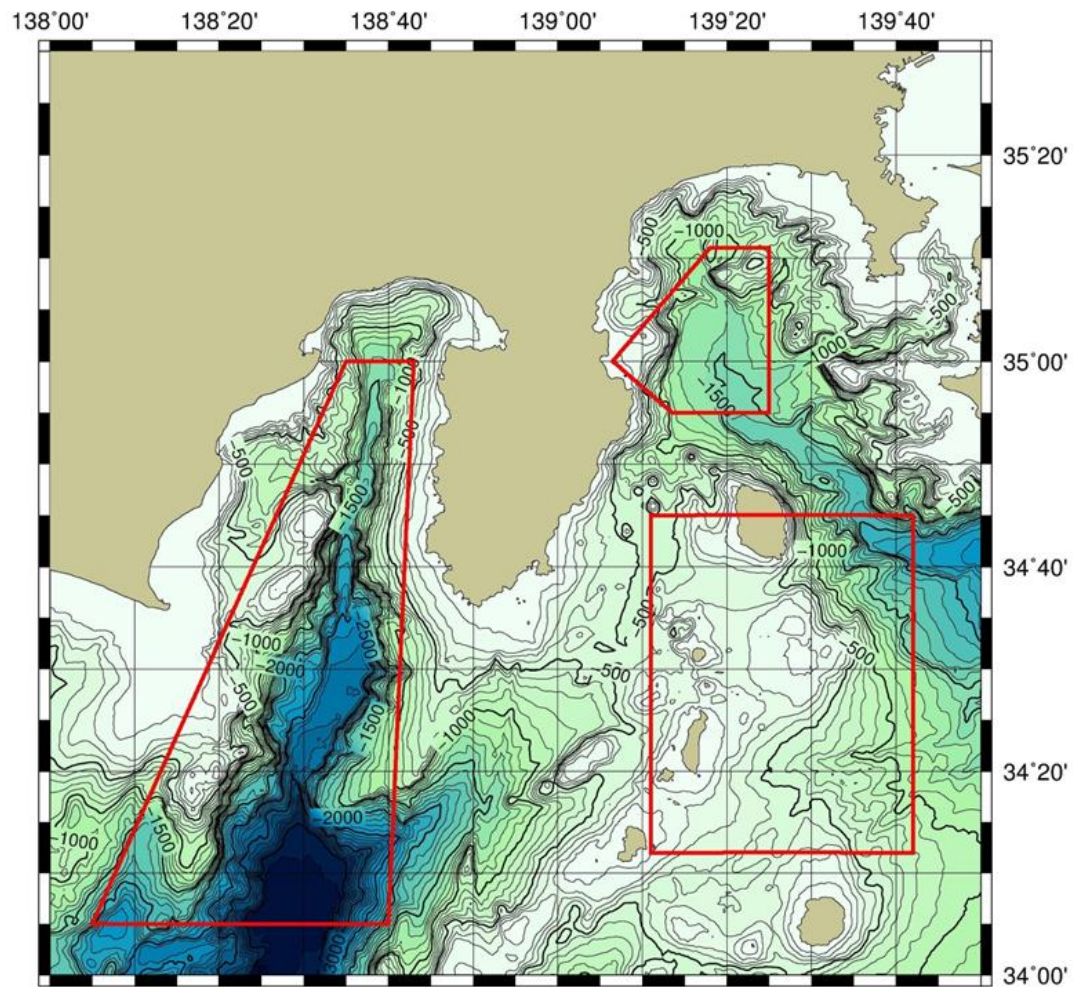


Fig. 1 Research map of NT15-11.

2. Researchers

2.1 Chief scientist [Affiliation]

Yutaka Ohta [JAMSTEC]

2.2 Representative of Science Party

Yutaka Ohta [JAMSTEC]

2.3 Science party (List) [Affiliation]

Shojiro Ishibashi	[JAMSTEC]
Hiroshi Yoshida	[JAMSTEC]
Makoto Sugawara	[JAMSTEC]
Kiyotaka Tanaka	[JAMSTEC]
Frank Hsiao Fan	[JAMSTEC]
Hiroshi Ochi	[JAMSTEC]
Takuya Shimura	[JAMSTEC]
Mituyasu Deguchi	[JAMSTEC]
Yoshiaki Yamauchi	[MHI]
Toshihiro Tani	[MHI]
Yoshimi Kaneko	[MHI]
Kazuhiro Kanayama	[MHI]
Masaki Takahashi	[MHI]
Yuji Nagata	[MHI]
Mutuo Takashima	[MHI]
Hirofumi Miyake	[RSG]
Kazunari Takahashi	[OST]

3. Technical Test

3.1 Purpose

This cruise was conducted to verify the capability of “Yumeiruka,”. After KY15-03 cruise, we improved the software systems (for about navigation performance and etc.) and electronic systems of “Yumeiruka”. In this sea trial, we intended to realize degree of the system completion and the stability of systems. And we checked acoustic communication range, autonomous cruising performance and observation performance of the AUV.

This is the first time cruise to operate the “Yumeiruka” by support ship “Natsushima”. So we also checked the fitting and operability of launch and recovery system for the “Yumeiruka”.

3.2 Activities

In this cruise, we planned five-days-test such as, 1 dive in Sagami-Bay, 2 dives in the Suruga-Bay, 2 dives in the Omuro-dashi. However, we had to change the plan by the bad weather. As a result, it was carried out for 5 dives (Dive#11 ~ Dive#15) such as, 2 dive in Sagami-Bay, 3 dives in Suruga-Bay in four days. Table 1 shows the schedule and activities of this cruise.

Table 1 Test Schedule.

Date	Action / Place	Plans	Actual
Jul. 5, Sun.	Depart / Yokosuka Sea Trial / Sagami-bay	Test Dive with Launch and Recovery Test	← 【Dive#11】
Jul. 6, Mon.	Sea Trial / Suruga-bay	For check the range of acoustic systems	Observation performance test at Sagami-bay 【Dive#12】
Jul. 7, Tue.	Sea Trial / Suruga-bay	For check the range of acoustic systems	Evacuation due to bad weather
Jul. 8, Wed.	Sea Trial / Omuro-dashi	For check the observation performance	Acoustic system check at Suruga-Bay 【Dive#13,14】
Jul. 9, Thu.	Sea Trial / Omuro-dashi	For check the observation performance	Observation performance test at Sagami-bay 【Dive#15】
Jul. 10, Fri.	Arrive / Yokosuka	Unloading shipping items	←

3.3 Dive information

In this cruise, it was confirmed the following items.

1) Operability of the “Yumeiruka” on board the “Natsushima”

At the first day, we conducted the dive #11 and checked a launch and recovery system. And during this cruise, we were able to operate the launch and recovery system of the “Yumeiruka”, without an accident.

2) Checked the range of acoustic systems up to 2,000 m depth.

We checked the range of acoustic systems in dive #13 and #14. As a result, “Yumeiruka” is able to communicate using acoustic system with “Natsushima” up to 2044 m depth. And also “Natsushima” can measure the position of “Yumeiruka” with SSBL positioning system.

3) Autonomous cruise with depth and altitude control

We conducted two dives of observation performance check (dive#12 and dive#15). During the dive #12, “Yumeiruka” was able to cruise using depth control with pitch control. And, “Yumeiruka” was able to cruise with altitude and pitch control in dive #15. We checked the navigation performance of “Yumeiruka”, which is it go up (or down) with pitch angle is 0 degree.

4) Observation performance of interferometry sonar

We checked the interferometry sonar (IFS) observation in dive #12 and #15. As a result, we could obtain the bathymetric data and side scanning mosaic image.

Dive information is listed in table 2.

Table 2 Dive information.

Dive#	Date, Time	Depth / Altitude	Remarks
#11	Jul. 5, 14:16(Launch) ~ 15:21(Surfacing)	227 m / -	Launch and Recovery Test
#12	Jul. 6, 12:10(Launch) ~ 14:52(Surfacing)	536 m / 110 m*	Observation test with depth control
#13	Jul. 8, 7:52(Launch) ~ 8:53(Surfacing)	1,026 m / -	3,000 m trial
#14	Jul. 8, 11:38(Launch) ~ 13:33(Surfacing)	2,044 m / -	3,000 m trial
#15	Jul. 9, 11:03(Launch) ~ 12:19(Surfacing)	380 m / 100 m*	Observation test with altitude control

*Altitude is an averaged value during observation.

3.4 Results of dives

In this cruise, it was obtained the following results.

1) Depth (or altitude) control with pitch control

We checked the navigation performance of “Yumeiruka”, which is an arrangement of two sets of X-rudders. As a result it enables the vehicle to trace the sea bottom with controlled attitude.

"Yumeiruka" can follow the terrain of an irregular seabed with its pitch angle fixed to 0 degree. The attitude control capability allows the vehicle to aim the onboard sensors vertically at the sea bottom, resulting in more efficient survey of the seafloor.

2) IFS observation

Figure 2 shows a bathymetric data at Suruga-bay by using IFS which is equipped with “Yumeiruka”. It was possible to obtain the terrain of the seabed.

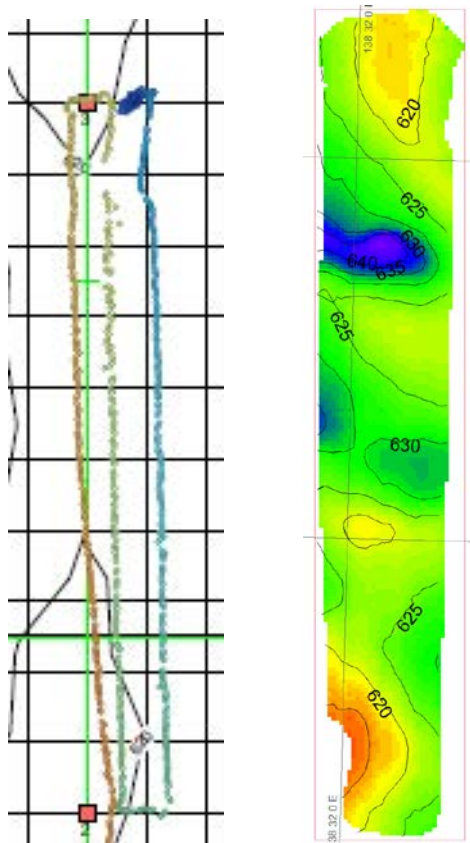


Fig. 2 Result of DIVE#12 (Left; cruise track, Right; Bathymetric data by IFS (at Suruga-bay)).

3.4 About “Yumeiruka”

AUV "Yumeiruka" was developed to perform seabed resource survey. "Yumeiruka" is equipped with two sets of X-rudders, one in the front, and one in the rear part of the vehicle. This arrangement of the rudders enables the vehicle to trace the sea bottom with controlled attitude. For example, "Yumeiruka" can follow the terrain of an irregular seabed with its pitch angle fixed to 0 degree. The attitude control capability allows the vehicle to aim the onboard sensors vertically at the sea bottom, resulting in more efficient survey of the seafloor.

Table. 3 Specifications of “Yumeiruka”

Item	Specification
Dimensions (L, B, H)	5.0 m, 1.4 m, 1.4 m
Weight (in air)	2,700 kg
Maximum Operation Depth	3,000 m
Cruising Speeds	2 knots (Max. 3 knots)
Minimum Operation Altitude	50 m
Propulsion system	4 × 400W thrusters, 2 × X-rudders (fore and aft)
Power Source	Rechargeable lithium ion Battery
Endurance	16 hrs
Navigation sensors	INS, DVL
Observation sensors	CTD, pH meter, fluoro-meter, IFS, SAS, SBP



Fig. 3 AUV “Yumeiruka”



Fig. 4 Launching scene of the “Yumeiruka”

4. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

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.