

Kaiyo Cruise Report

KY12-03

Sagami Bay

19.February.2012 – 23.February.2012

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

Contents

1. Cruise Information	3
2. Researchers.....	4
3. Experiment.....	5
Cruising AUV “UnRE#1”	5
Launch and Recovery System.....	7
Cruise Log.....	8
Experiment results.....	8

1. Cruise Information

Cruise Number : KY12-03

Ship Name : "Kaiyo"

Title of the Cruise : Sea Trial of Small & High Performance AUV

Title of Proposal : Sea Trial of Small & High Performance AUV

Cruise Period : 19 February 2012 - 23 February 2012

Port Call : JAMSTEC (Departure) – JAMSTEC (Back)

Experiment Area :

Sagami Bay (Depth: 80 -1,500m)

34.92Lat. 139.23Long., 35.00Lat. 139.11Long.

35.23Lat. 139.22Long., 35.23Lat. 139.42Long.

34.92Lat. 139.42Long.

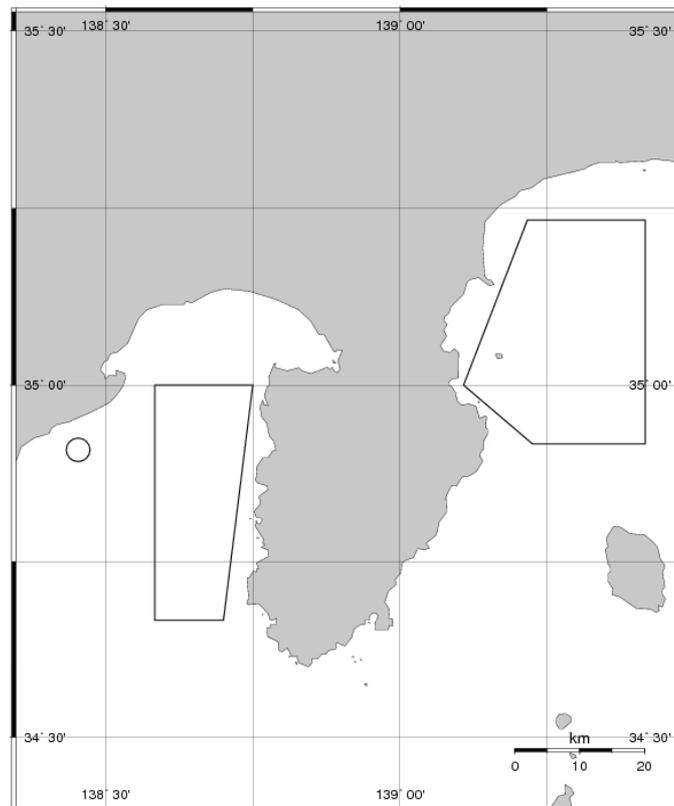


Fig.1 Experimental Diving Area in the Sagami Bay

2. Researchers

Chief Scientist : YOSHIDA Hiroshi
[JAMSTEC - Marine Technology Center]

Representative of Science Party : YOSHIDA Hiroshi
[JAMSTEC - Marine Technology Center]

Science party (List)

Name	Affiliation
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YOSHIIUME Tsuyoshi	Nippon Marine Enterprises, Ltd
SAITO Fuminori	Nippon Marine Enterprises, Ltd
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NAGAO Hajime	Mitsubishi Heavy Industries, Ltd
MATSUOKA	Mitsubishi Heavy Industries, Ltd
KUBO Toshiaki	Mitsubishi Heavy Industries, Ltd
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HADA Jyunji	Mitsubishi Heavy Industries, Ltd
EGUCHI Kazuki	Mitsubishi Heavy Industries, Ltd
TAKAHASHI Kazunari	OKI Seatec Co., Ltd
NAOI Toshimichi	Tokyo Denpa CO., Ltd
ABE Masayoshi	Ryoyu System Engineering Co., Ltd.
SUZUKI Masaya	Clover tech Inc.

3. Experiment

Background :

JAMSTEC has tried a feasibility study of carbon dioxide capture and storage (CCS) using geobiological processes in the deep subsurface. We expect a biological CO₂ turnover. Japan Society for the Promotion of Science (JSPS) funded this project. We found that a hydrocarbon system associated with lignite-coalbed is buried more than 2,000 meters below the seafloor off the Shimokita Peninsula in 2006. In this project, they need to perform pre-survey and post-survey of CO₂ distribution around the target seafloor. And they also carry out detail survey of the bathymetry in this area. To perform above things, two AUVs were required. One is cruising AUV, the other is working AUV to approach sea floor.

Outline :

The cruise KY12-03 was the first sea trial for cruising AUV code name “UnRE#1”.

Experiment items :

- 1) Test and Training for launch and recovery system
- 2) Body balance check at the surface of the sea
- 3) Ballast release Test
- 4) Working of the Equipments Test
- 5) Software Debug

Cruising AUV “UnRE#1”

“UnRE#1” is shown in figure 2. The vehicle is one of small cruising type Autonomous Underwater Vehicle. The vehicle was developed to measure quantity of carbon dioxide in underwater and survey underwater resources. The vehicle equipped with hybrid pH-CO₂ sensor, multi beam echo sounder, side scan sonar and so on. The vehicle controls its body with four rear thrusters and X rudders at cruising. The vehicle has high maneuver with two azimuth thrusters mounted on midship of the body using at low cruising speed. The vehicle has buoyancy control system. The system consists of an oil tank contained in a pressure vessel (VBT: Variable Ballast Tank) and an oil bladder. The system is able to change buoyancy from 0kg to 20kg according to water density. “UnRE#1” can cruise close to seafloor for CO₂ measurement because it has range of cruising speed from 0.7 to 3.0 knots.



Fig.2 Overview of Cruising AUV "UnRE#1"

Specifications of the vehicle

Weight in the air	:	2,000kg
Size	:	4 (L) x 1.1 (W) x 1.0 (H)
Maximum Depth	:	3,000m
Speed	:	0.7 - 3 knots (2knots@cruising speed)
Minimum Altitude	:	30 m (can down to 10 at flat seafloor)
Turning Radius	:	20m @cruising speed
Max. Climbing Ability	:	30°
Endurance	:	10 hours @ cruising speed
Actuators	:	400 W Thruster x 4 400 W Azimuth Thruster x 2 Rear X Rudders Buoyancy Control System
Communication Devices	:	Acoustic Telemetry, Optical Communications, Satellite Communications, Wireless LAN
Navigation Devices	:	Inertial Navigation System, Doppler Velocity Log, Depth sensor, Altimeter, SSBL, LBL, VLBL
Observation Devices	:	Multi Beam Echo Sounder, Side Scan Sonar, CTD meter, DO sensor, Fluor-Turbidimeter, Hybrid pH-CO ₂ sensor

Launch and Recovery System

The launch and recovery system for “UnRE#1” is shown in figure 3. The system consists of elector launcher, sheave, air winches and ropes for not swaying and rolling. The vehicle is lifted perpendicular position both launching and recovering. While the launcher erects by oil pressure to perpendicular position, the vehicle is fixed to the launcher. Then lift up the vehicle by A-frame crane. When the vehicle is moved from deck to the surface of the sea, rolling and swaying of the vehicle is suppressed by ropes. Finally the vehicle is released after soaked 3/4 part of the body in the sea.

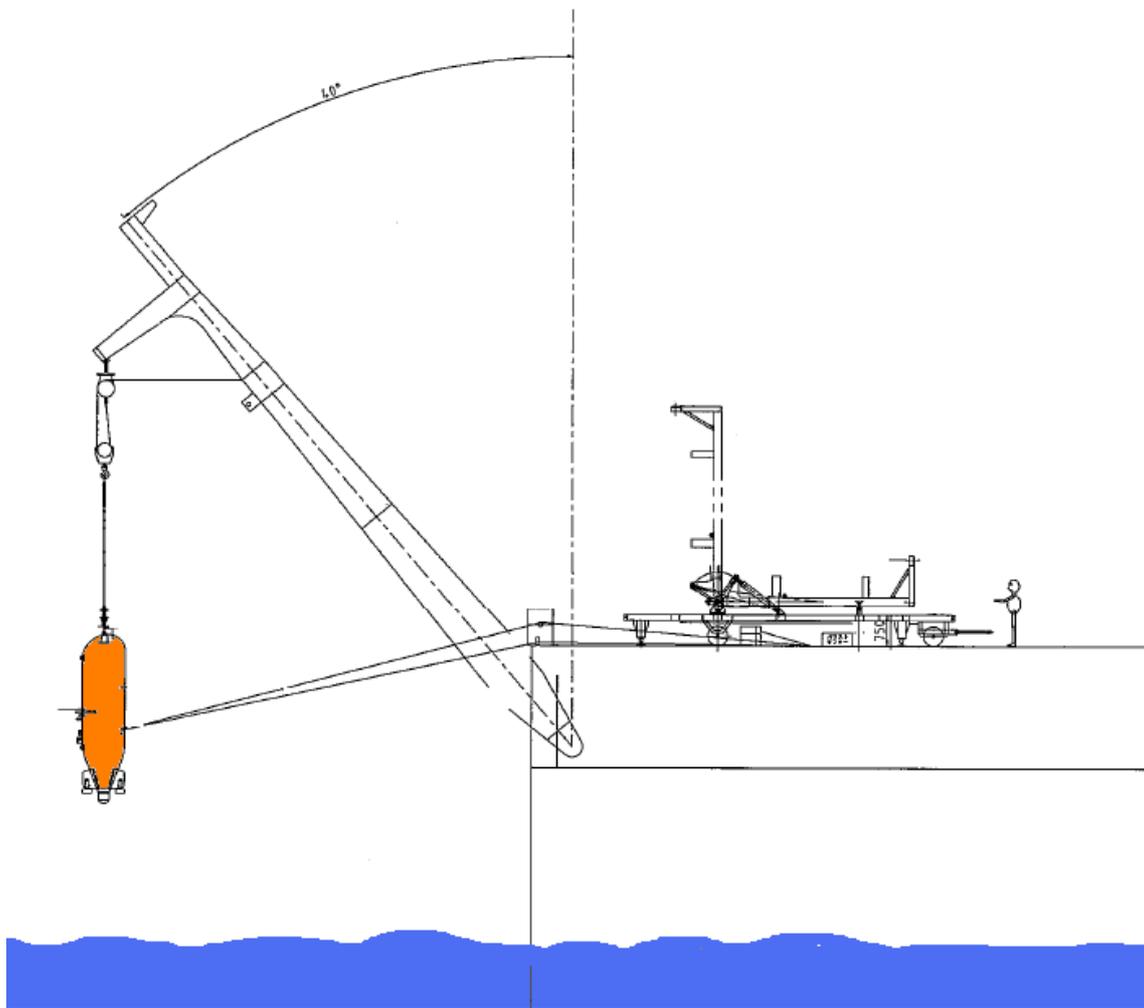


Figure 3 Image of Launch and Recovery scene

Cruise Log

KY12-03 Schedule

Date	“YOKOSUKA”	Test Area	Contents
2012			
20, February (Monday)	Departure Experiment1	Tokyo Bay	1) Launch System Test 2) Ballast Release Test 3) Software Debug
21, February (Tuesday)	Experiment 2	Tokyo Bay	1) Launch System Test 2) Body Balance Check 3) Working of the Equipments Test
22, February (Wednesday)	Experiment 3	Sagami Bay	1) Launch System Test 2) Body Balance Check 3) Software Debug
23, February (Thursday)	Return to Port	JAMSTEC	
24, February (Friday)	Port	JAMSTEC	Remove fittings

Experiment results

2012 February 20

Test area: Tokyo Bay

At first, we tested the launch and recovery system. We checked behavior of the launch system and the vehicle, while the launcher erected and the vehicle was lifted perpendicular position. Figure 4 shows at that scene.

Second, we tested ballast release system of the vehicle on board of the vessel. This is the very important system for the vehicle to surfacing in the sea. So, we needed to check how it worked well before diving.

Third, we carried out software debugging.



Figure 4 Testing launch system

2012 February 21

Test area: Tokyo Bay

We checked body balance of the vehicle at the surface of the sea. The vehicle needs positive buoyancy because it can surface. After body balance check, the equipments of the vehicle running test were carried out. At that time, the vehicle was lifted by A-frame crane and surfaced of the sea. Figure 5 shows at that scene.



Figure 5 Scene at body balance check and running test of equipments

2012 February 22

Test area: Sagami Bay

We checked again body balance of the vehicle at the surface of the sea and confirmed the vehicle had positive. After that, we carried out launch and recovery test of the vehicle. Figure 6 shows recovery scene.



Figure 6 Recovery scene