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R/V Kairei Cruise Report

KR13-16

Sea trial of new work class ROV
applied for submarine resource exploration

Sagami Bay, Izu-Ogasawara Trench

October. 29,2013 – November.03,2013

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

Contents

1. Cruise Information

1) Cruise ID : KR13-16

2) Name of vessel : R/V Kairei

3) Cruise Title : Sea trial of new work class ROV applied for submarine resource exploration

4) Chief scientist : Hiroyuki Osawa, MARITEC, JAMSTEC

5) Title of proposal : Sea trial of new work class ROV applied for submarine resource exploration

6) Representative of the Science Party : Hiroyuki Osawa, MARITEC, JAMSTEC

7) Cruise period : 2013/10/29 ～ 2013/11/3

8) Ports of call : Yokosuka(Sumitomo Heavy Industries, Ltd)
～ Yokosuka(Sumitomo Heavy Industries, Ltd)

9) Experiment Area :

Area A:

Sagami Bay (water depth of 80m ～ 1,500m)

(34°55.0'N,139°13.5'E)(35°00.0'N, 139°06.5'E)(35°14.0'N,139°13.0'E)

(35°14.0'N,139°30.0'E)(34°55.0'N,139°30.0'E)

Area B:

Izu-Ogasawara Trench (water depth of 2,000m ～ 6,000m)

(32°00.0'N, 140°30.0'E)(35°00.0'N, 140°30.0'E)

(35°00.0'N, 143°00.0'E)(32°00.0'N, 143°00.0'E)

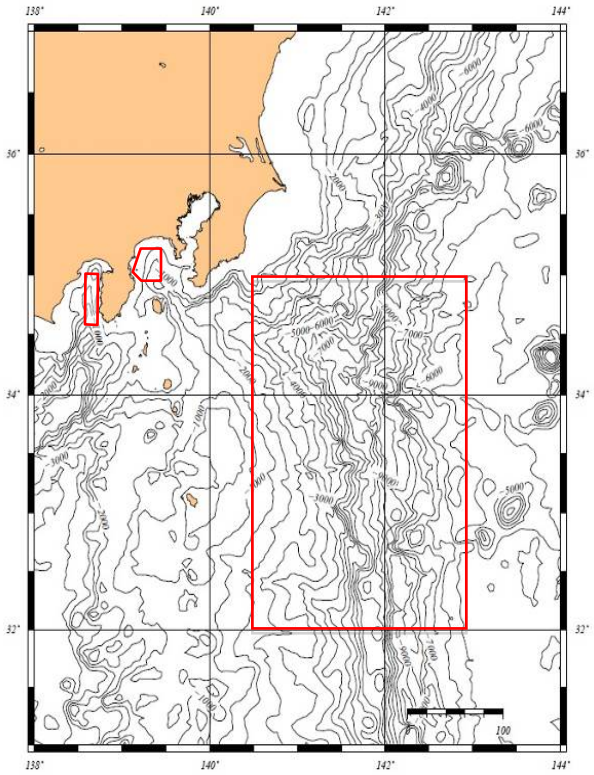

Figure 1: Test areas

2. Researchers

Chief scientist: Hiroyuki Osawa (JAMSTEC)

Science party (List)

Kazuyoshi Hirata (JAMSTEC)

Tsuyoshi Miyazaki (JAMSTEC)

Hidehiko Nakajoh (JAMSTEC)

Takao Sawa (JAMSTEC)

Hiromi Utsugi (JAMSTEC)

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Satoshi Tsukioka (JAMSTEC)

Yoshinobu Nanbu (JAMSTEC)

Noriyasu Yamauchi (Nippon Marine Enterprises Ltd.,)

Isao Yamanaka (Mitsui Engineering & Shipbuilding Co., Ltd.)

Mitsuru Takahata (Mitsui Engineering & Shipbuilding Co., Ltd.)

Shuji Koyama (Mitsui Engineering & Shipbuilding Co., Ltd.)

Shintaro Miyoshi (Akishima Laboratory Mitsui Zosen Inc.)

Kenta Watanabe (Mitsui Zosen Systems Research Inc.)

Yorimiti Ito (Technical Service Co., Ltd.)

Toshihiro Kobayashi, (Nissan Electric Mfg Co., Ltd.)

Yuhki Izumi (Nissan Electric Mfg Co., Ltd.)

3. Experiment

3-1. Background

JAMSTEC decided to advance the development of new work class Remotely Operated Vehicle (ROV) applied for various deep-sea explorations such as submarine resource explorations and so on, and it is able to operate at a maximum depth of 7,000m. Its construction started in April 2011 and completed in March 2013. This new ROV was built by Mitsui Engineering & Shipbuilding (MES). This new ROV is the vehicle part of KAIKO system. This new ROV named “KAIKO Mk-IV” in November 2013. The test dive of this new ROV started in October 2013.

3-2. ROV system: KAIKO Mk-IV

KAIKO Mk-IV is a new work class ROV applied for various deep-sea explorations such as submarine resource explorations and so on (Figure 2). Several advanced technologies developed in JAMSTEC, such as INS, buoyancy material, optical / power composite cable and so on, are adapted to this vehicle.

She has a hydraulic power unit (55kW) targeting improvement in its work capability. High performance thrusters and manipulators that are mounted on the vehicle are driven by supplied hydraulic pressure with the hydraulic power unit.

The vehicle's mission is to survey deep ocean areas that are impossible to survey with manned submersibles and deep ocean areas that are dangerous due to complicated topography.

The KAIKO Mk-IV vehicle is capable of diving to a maximum depth of 7,000 m and was deployed from its own launcher, which is also fitted with various operational sensors.

Table 1: Specifications

	Vehicle	Launcher
Length	3.0 m	5.2 m
Width	2.0 m	2.6 m
Height	2.6 m	3.2 m
Weight in air	5,500 kg	5,800 kg
Depth	7,000 m	11,000 m
Payload weight	200 kg (in water), 300 kg (in air)	
Power	3,200 V AC 3 phase from surface vessel via launcher	
Thrusters	forward/reverse: 4, vertical: 3 (total max. thrust force: 3.4kN)	
Payload	SBE-49 CTD (conductivity, temperature and depth) 2 × wide angle colour HDTV cameras, 1 × CCD colour TV camera, 1 × digital still camera (24 megapixels) 1 × wide angle underwater fisheye	CTD (conductivity, temperature and depth), side scan sonar, sub-bottom profiler, monochrome TV camera for monitoring coupling operations, secondary cable for monitoring,

	camera, 1 × 500 W and 2 × 250 W halogen lights, 2 × 400 W HMI lights, DO	monochrome TV camera
Manipulators	2 × manipulators (7-function master-slave)	
Navigation	Monochrome TV camera, altimeter, depth sensor, flasher, obstacle avoidance sonar, INS, DVL, ARGOS	Obstacle avoidance sonar, altimeter, depth sensor, compass
Cables	Optical/power composite cable: primary cable: 45 mm (diameter) × 12,000 m secondary cable: 29.5 mm (diameter) × 250 m	Optical/power composite cable: primary cable: 45 mm (diameter) × 12,000 m, secondary cable: 29.5 mm (diameter) × 250 m

Figure 2: KAIKO Mk-IV (JAMSTEC)

3-3. Cruise Log

KR13-16 Schedule

Date (2013)	Note	Test Area	contents
30, October (Wednesday)	Departure Dive #1	Sagami Bay	1) Fitting test with launcher and vehicle 2) Operational test at onboard 3) Pre dive check 4) Operational test at the sea
31, October (Thursday)		Sagami Bay	1) Vehicle maintenance
1, November (Friday)	Dive #2	Izu-Ogasawara Trench	1) Operational test at onboard 2) Pre dive check 3) Operational test at the sea
2, November (Saturday)	Dive#3	Sagami Bay	1) Operational test at onboard 2) Pre dive check 3) Operational test at the sea
3, November (Sunday)	Arrived at YOKOSUKA		1) Remove fittings

4. Experiment results

4-1. Dive #1

Contents of the dive:

1) Fitting test with launcher and vehicle
2) Operational test at onboard
3) Pre dive check
4) Operational test at the sea

Test Area: Off Hatsushima island in Sagami Bay

This first sea trial of new ROV (vehicle), which was connected launcher part of “KAIKO 7000II” system, was carried out after her construction.

First, we checked operational tests of all devices of new vehicle at the depth of 150m. After that, we were carried out new vehicle of cruising test by manual control at near the seafloor and sampling operation test for manipulators by using two MBALI-type core samplers.

Table 2: Dive log (Dive #1)

Data	Local Time	Note	Description
30, October	13：28	KAIKO dove and started her operation.	
	13：35	KAIKO began to dive into the sea.	
	15：24	The separation of the vehicle and launcher.	
	15：37	New vehicle landed on the sea bottom (D=1,003m).	
		Maximum dive depth in this operation was 1,003m.	
	16：22	New vehicle left the sea bottom (D=997m).	
	16：56	The vehicle was combined with a launcher again.	
	18：05	KAIKO surfaced.	
	18：21	Recovered KAIKO and finished the operation.	

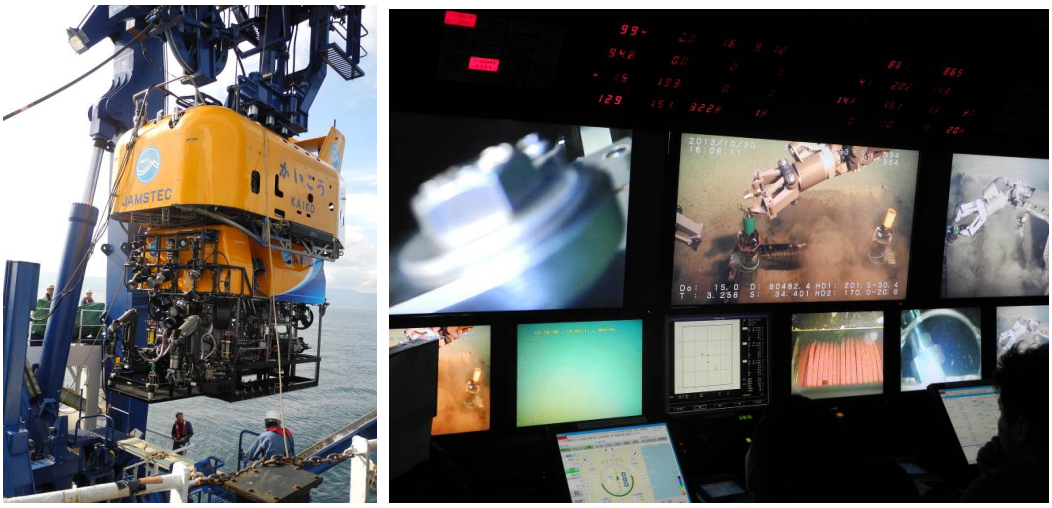

Figure 3: Sampling operation test using MBALI-type core sampler.

4-2. Dive #2

Contents of the dive:

1) Operational test at onboard
2) Pre dive check
3) Operational test at the sea

Test Area: Izu-Ogasawara Trench

In this dive, we were carried out new vehicle of cruising test by manual control and computer automatic control at near the seafloor and sampling operation test for manipulators by using two MBALI-type core samplers. In this time, we confirmed that the tests were successful at 5,450m depth of the water.

Table 3: Dive log (Dive #2)

Data	Local Time	Note	Description
1, December	07：32	KAIKO dove and started her operation.	
	07：35	KAIKO began to dive into the sea.	
	10：29	Separation of the vehicle and launcher.	
	10：59	New vehicle landed on the sea bottom (D=5,452m)	
		Maximum dive depth in this operation was 5,453m.	New record
	13：20	New ROV left the sea bottom (D=5,452m).	
	13：37	Vehicle was combined with launcher again.	
	16：07	KAIKO surfaced.	
	16：21	Recovered KAIKO and finished the operation.	

Figure 4: the operational test was successful at 5,450m depth of the water.

4-3. Dive #3

Contents of the dive:

1) Operational test at onboard

2) Pre dive check

3) Operational test at the sea

Test Area : Off Hatsushima island in Sagami Bay

In this dive, we were carried out new vehicle of cruising test by manual control and computer automatic control at near the seafloor and operational tests for manipulators by using MBALI-type core sampler and small transponder installation and recovery.

Table 4: Dive log (Dive #3)

Data	Local Time	Note	Description
2, December	08：32	KAIKO dove and started her operation.	
	08：37	KAIKO began to dive into the sea.	
	09：29	Separation of the vehicle and launcher.	
	11：29	New vehicle landed on the sea bottom (D=997m)	
		Maximum dive depth in this operation was 1,045m.	
	13：11	New ROV left the sea bottom (D=1,035m).	
	13：24	Vehicle was combined with launcher again.	
	14：14	KAIKO surfaced.	
	14：22	Recovered KAIKO and finished the operation.	

Figure 5: Installation and recovery of small transponder by using manipulator.

5. Summary

In this year, JAMSTEC has been planned three times as sea trials (November, December and February) of the new work class ROV applied for submarine resource exploration after construction.

This first sea trial of new ROV (vehicle), which was connected launcher part of “KAIKO 7000II” system, during KR13-16 cruise was carried out three times of dives. The purpose of this cruise was all devices of connections test, cruising test by manual control and computer automatic control, sampling test by manipulators and so on. Finally, we confirmed that the tests were successful at 5,450m depth of the water.

6. 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