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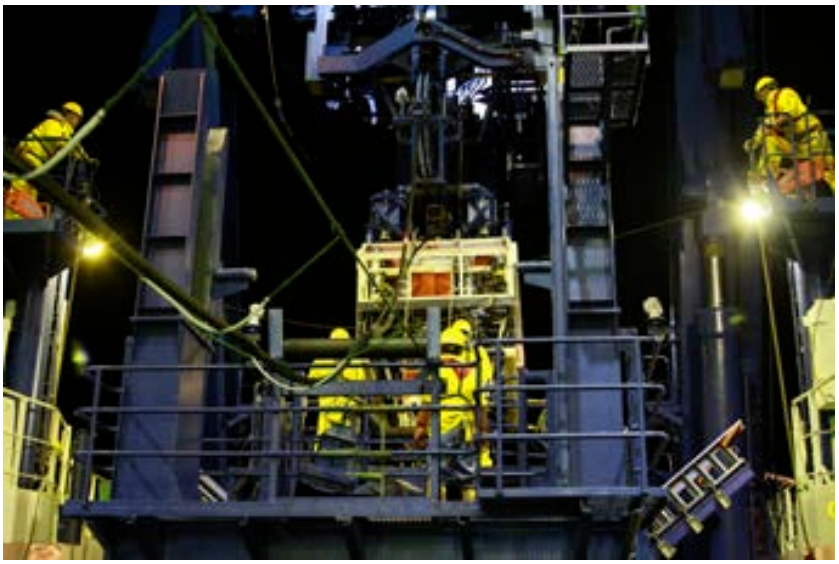
Kairei Cruise Report

KR11-11

Izu-Ogasawara Trench



Dec 8th – Dec 15th, 2011

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

1. Cruise Information

● Cruise ID KR11-11
● Name of vessel R/V Kairei
● Title of the cruise Expedition for Trench Biosphere – Microbiological and geochemical investigation for the Ogasawara Trench-
● Chief scientist [Affiliation] Takuro Nunoura [JAMSTEC]
● Representative of the Science Party Takuro Nunoura [JAMSTEC]
● Cruise period 8th Dec – 15th Dec, 2011
● Ports of call JAMSTEC (Yokosuka) - JAMSTEC (Yokosuka)
● Research area Ogasawara Trench, (Pacific Ocean)

The lander system deployed in the KR11-11 cruise was retrieved during the cruise described below due to a mechanical trouble in the R/V Kairei during the KR11-11 cruise.

● Cruise ID YK transit to dockyard
● Name of vessel R/V Yokosuka
● Chief scientist [Affiliation] Takuro Nunoura [JAMSTEC]
● Cruise period 22nd Dec – 26th Dec, 2011
● Ports of call JAMSTEC (Yokosuka) – Kawasaki Heavy Industries (Kobe)
● Research area Ogasawara Trench, (Pacific Ocean)

2. Acknowledgements

We are grateful to Captain Mr. M. Ishiwata, Chief Officer Mr. T. Aoki and Chief Engineer Mr. K. Kajinishi of "*R/V Kairei*", and Captain Mr. S. Ryono, Chief Officer Mr. T. Adachi and Chief Engineer Mr. K. Kaneda for their safe navigation and their skillful handling of "*R/V Yokosuka*", for their safe navigation and their skillful handling of the research vessels. Great thanks are due to Commander Mr. Y. Nanbu and "*ROV Kaiko*" operation team for their operations in sampling using the "*ROV ABISMO*". We also thank Ms. K. Tanaka, Nippon Marine Enterprise, Ltd. and Mr. Y. Hashimoto, Marine Works Japan for their attentive supports. We thank all the JAMSTEC personnel who have supported us. Finally, we would like to appreciate all the person who supported directly or indirectly this cruise.

3. Contents

4. List of participants

KR11-11

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Yasushi Hashimoto
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Chief Officer: TAKAFUMI AOKI
2nd Officer: TAKESHI EGASHIRA
3rd Officer: YUMIHIKO KOBAYASHI

Chief Engineer: KIYONORI KAJINISHI
1st Engineer: KOJI FUNAE
2nd Engineer: DAISUKE GIBU
Junior 2nd Engineer: KENICHI SHIRAKATA
3rd Engineer: YOSHIHIRO OTSUGA

Chief Electronics Operator: YOICHI INOUE
2nd Electronics Operator: MICHIYASU KATAGIRI

Boat Swain: YOSHIAKI KAWAMURA
Able Seaman: YASUO KONNO, YUKITO ISHII, YOSHIAKI MATSUO
Sailor: SHINSUKE UZUKI, TORU NAKANISHI, RYOMA TAMURA

No1. Oiler: MASARU KITANO
Oiler: KATSUYUKI MIYAZAKI, YOSHINORI KAWAI
Assistant Oiler: TAIJUN IWAO, TORU HIDAKA

Chief Steward: ISAO MATSUMOTO
Steward: SHINSUKE TANAKA, YOSHIO OKADA, AKIHIDE SAITO,
SHIHO SHIMIZU

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ROV Operator: ATSUMORI MIURA, TOMOE KONDO,
MASAYA KATAGIRI, RYU ASAI, SHOTA IHAR

YK transit to dockyard

Onboard Scientists

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Captain: SHINYA RYONO

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2nd Officer: TOMOYUKI TAKAHASHI

3rd Officer: TSUBASA SHIMOJIMA

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1st Engineer: KIMIO MATSUKAWA

2nd Engineer: KENTA IKEGUCHI

3rd Engineer: KOICHI HASHIMOTO

Chief Electronics Operator: HIROYASU SAITAKE

2nd Electronics Operator: YOHEI YAMAMOTO

3rd Electronics Operator: MAI MINAMOTO

Boat Swain: YOSHIKANE ODA

Able Seaman: SHUJI TAKUNO, TSUYOSHI CHIMOTO, NOBUYUKI ICHIKAWA, SAIKAN HIRAI

Sailor: JIRO HANAZAWA, YOSHIHIRO OGAWA, YUTA MOTOOKA

No1. Oiler: KAZUAKI NAKAI

Oiler: KEITA FUNAWATARI, SOTA MISAGO

Assistant Oiler: TOSHINORI MATSUI, EIJI ARATAKE, KAZUHO MURASE

Chief Steward: TOMIHISA MORITA

Steward: KAZUHIRO HIRATAMA, TORU WADA, MASANAO KUNITA, NAKAMICHI KANDA

Camera system Operation team

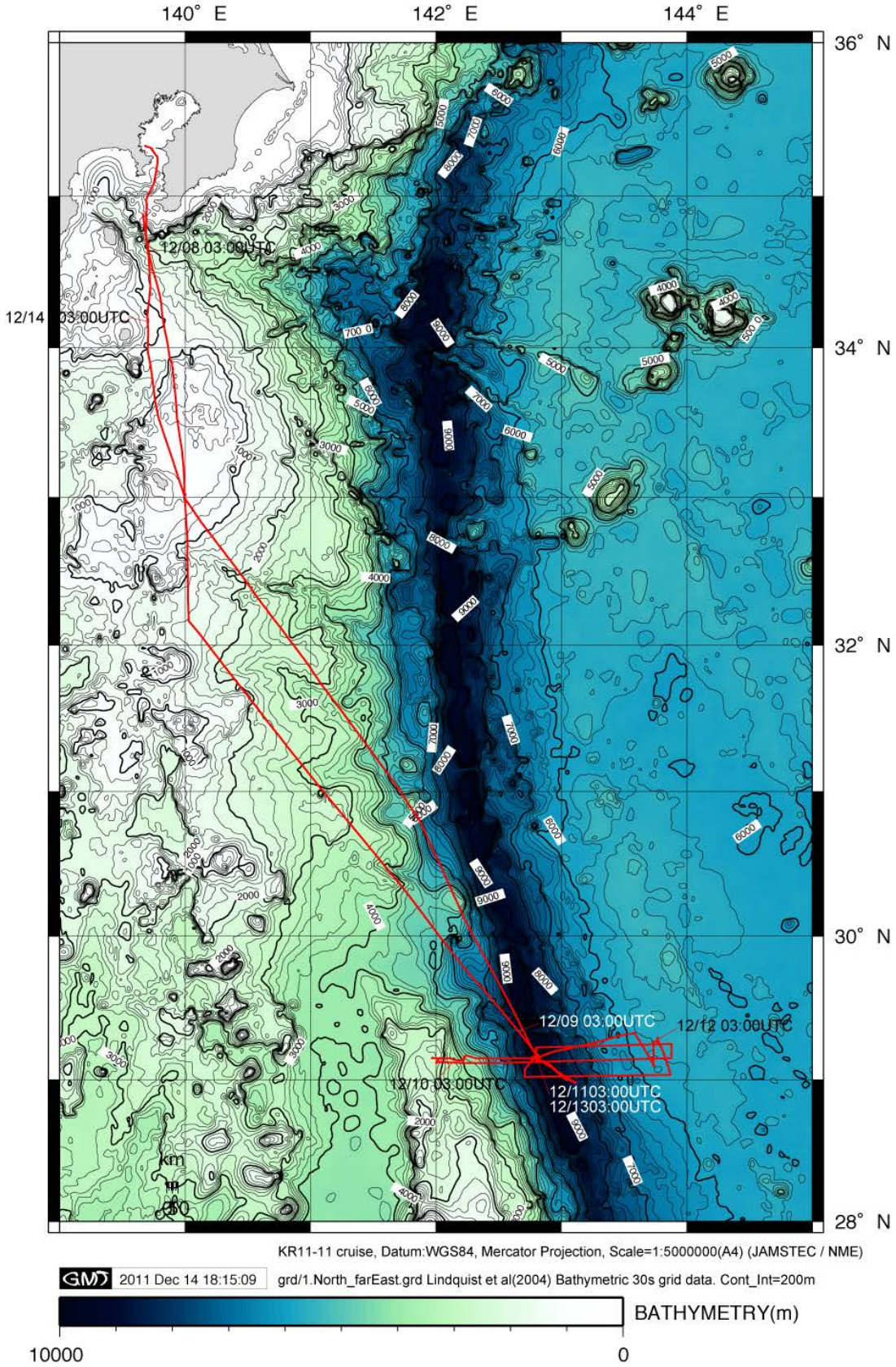
ROV Operator: AKIHISA ISHIKAWA, MASAYA KATAGIRI

5. Cruise Log (JST)

KR11-11

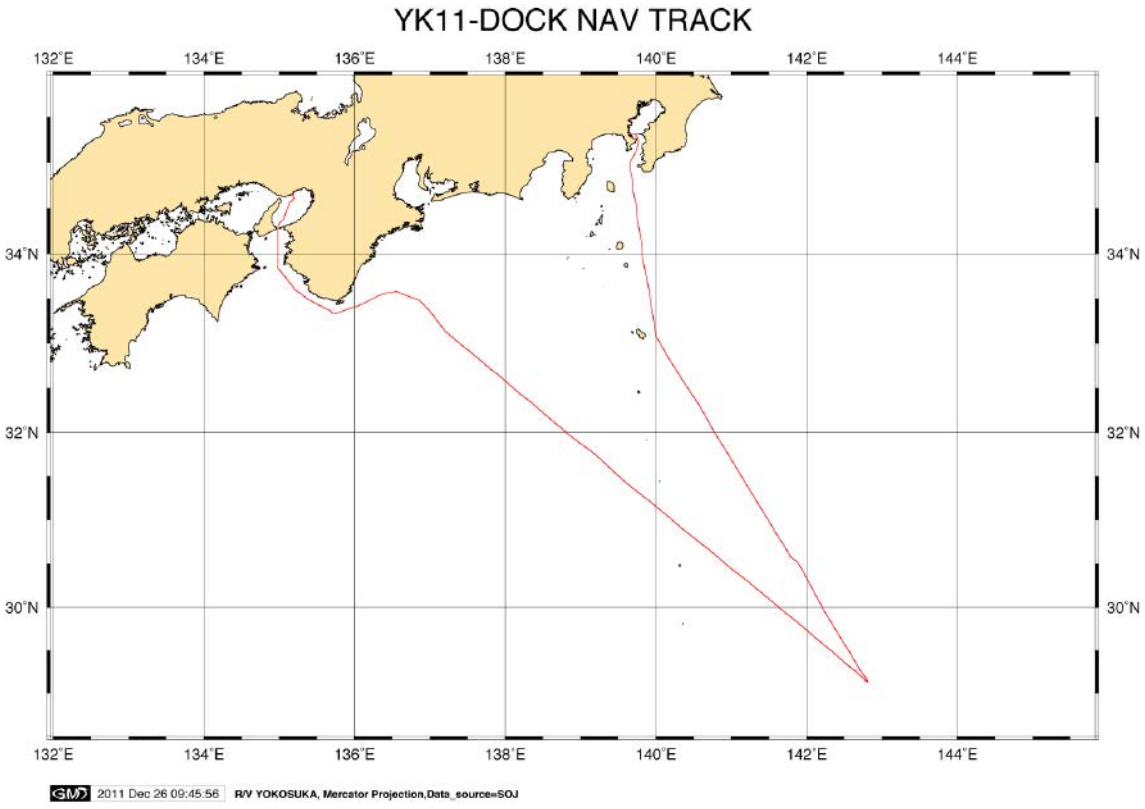
Date	Time	Description	Remark	Position/Weather/Wind/Sea condition (Noon)
08,Dec,11	8:00	Boarding KAIREI		12/08 12:00 (LCT)
	9:00	Sail out from JAMSTEC quay		34-41.1N, 139-42.0E
	10:30-11:00	Onboard seminar	for safety onboard life	Overcast
	16:40	Pray safety cruise to KONPIRASAN		North-4 (Moderate breeze)
				2 (Sea smooth)
				2 (Low swell long)
				Visibly: 5'
09,Dec,11	12:50	Arrived at research area		12/09 12:00 (LCT)
	12:55	Deployed XBT sensor	29-10.2N, 142-48.5E	29-20.8N, 142-37.6E
	14:06-14:27	Deployed camera system	29-09.0N, 142-48.0E	Fine but cloudy
	17:11	Camera system landed on sea bottom		WNW-6 (Strong breeze)
	17:11-18:38	Carried out calibration of camera system	29-08.8N, 142-47.9E	4 (Sea moderate)
			Depth: 9772m	3 (Moderate short)
	18:00-18:30	Scientists meeting		Visibly: 8'
	18:53-19:11	Carried out MBES site survey		
10,Dec,11	6:00	Arrived at research area		12/10 12:00(LCT)
	09:43-09:58	Carried out MBES site survey		29-20.8N, 142-37.6E
				Fine but cloudy
	13:00	Commenced MBES mapping survey		North-4 (Moderate breeze)
				3 (Sea slight)
				4 (Moderate average)
				Visibly: 8'
11,Dec,11	5:01	Finished MBES mapping survey.		12/11 12:00(LCT)
		Commnccd proccding to "ABISMO" divc point.		29-09.0N, 142-48.1E
	6:00	Arrived at "ABISMO" dive point.		Overcast
	7:31	Hoisted up "ABISMO"		WNW-5 (Fresh breeze)
	7:40	Launched "ABISMO"		4 (Sea moderate)
		Started ABISMO#15 dive		2 (Low swell long)
	17:08	Hoisted up "ABISMO"		Visibly: 8'
	17:59	Recovered "ABISMO" and finished operation		
12,Dec,11	7:00	Arrived at "ABISMO" dive point.		12/12 12:00(LCT)
	7:18	Deployed XBT sensor	29-16.8N, 143-46.0E	29-16.8N, 143-46.0E
	8:21	Hoisted up "ABISMO"		Overcast
	8:29	Launched "ABISMO"		North-3 (Gentle breeze)
		Started ABISMO#16 dive		2 (Sea smooth)
	13:12	Hoisted up "ABISMO"		2 (Low swell long)
	13:37	Recovered "ABISMO" and finished operation		Visibly: 8'
	14:15	Stopped engine and commenced drifting		
	19:30	Scientists meeting		
13,Dec,11	8:15	Hoisted up "ABISMO"		12/13 12:00(LCT)
	8:21	Launched "ABISMO"		29-09.0N, 142-48.1E
		Started ABISMO#16 dive		Overcast
	11:35	Hoisted up "ABISMO"		WNW-3 (Gentle breeze)
	11:47	Recovered "ABISMO" and finished operation		2 (Sea smooth)
	12:30	left research area		1 (Low swell short)
		commenced proceeding to YOKOSUKA		Visibly: 8'
14,Dec,11		proceeding to YOKOSUKA		12/14 12:00(LCT)
	17:10	arrived at YOKOSUKA section 4	35-19.7N, 139-40.8E	34-10.6N, 139-41.8E
	17:15	stationed for anchoring		Cloudy
				North-6 (Strong breeze)
				4 (Sea moderate)
				3 (Moderate short)
				Visibly: 8'
15,Dec,11	9:00	arrived at JAMSTEC quay		
		finised KR11-11 cruise		

KR11-11 Izu-Ogasawara Trench vessel track



YK11 Transit to dockyard

Date	Time	Description	Remark
22,Dec,11	7:00	Boarding YOKOSUKA	
	8:00	Sail out from JAMSTEC quay	
23,Dec,11	10:20	Arrived at research area	
	10:36	The camera system disengaged from the bottom	29-08.8N, 142-47.9E, depth 9772 m
	13:47	The camera system floated on oceanic surface	
	15:00	Start transit to Kobe	
24,Dec,11		proceeding to Kobe	
25,Dec,11		proceeding to Kobe	
	11:30	stationed for anchoring at Kobe	
26,Dec,11	9:30	Arrived at KAWASAKI Heavy Industries KOBE	



6. Instruments

1) AUTOMATIC BOTTOM INSPECTION AND SAMPLING MOBILE “ABISMO”

ABISMO has been developed to reach the deepest sea bottom, observe the area with a camera, and sample the bottom layer. Its maximum operating depth is 11,000 m. Figure 1 shows ABISMO just about to dive, and Fig. 2 gives an overview of the system used to operate ABISMO. Table 1 shows the dimensions of ABISMO. The underwater system of ABISMO consists of a launcher and vehicle. The vehicle is docked with the launcher at the first step of diving, and it remains docked until ABISMO arrives at the target depth, while the primary cable is being reeled out. After making observations with a camera and sampling the bottom layer, the vehicle approaches and touches down on the bottom as the secondary cable is reeled out, if this is required. The vehicle inspects the bottom surface with a camera by moving around with the crawler. In addition, we have thought about the operational flexibility of the ABISMO system. Therefore ABISMO is designed so that it is lightweight and has a small volume, and it will be possible to change its mother ship in future.

The launcher of ABISMO has a 160-m secondary cable drum system, a vehicle docking device, two kinds of mud samplers, a sampler winch, twelve water samplers, two 1,000-W thrusters, two NTSC surveillance video cameras, an HD observation camera, a 500-W halogen light, a gyro, an altimeter, a depth gauge, a responder, and an SSBL receiver array for vehicle tracking. Figure 3 shows an overview of the launcher and (docked) vehicle. The launcher reels the vehicle in and out with the cable drum systems. The vehicle is docked with the launcher by using a docking device, and released at the target depth. The cable drum system reels the released vehicle in and out, and the vehicle is fully reeled in and docked again after it has made its observations. The launcher can choose from a two- or three-meter-long gravity corer and a Smith-McIntyre mud sampler that is 220 mm in width and length. The gravity corer is dropped from the vehicle, free falls, and penetrates the seabed’s bottom layers. Some material from the bottom layer is captured and retrieved by reeling in the corer with the winch drum. The launcher has a responder at its tail so it can be tracked, and an SBL receiver array at the bottom to track the vehicle.

The vehicle of ABISMO has buoyancies, four 400-W thrusters, crawlers for moving on

the sea bottom, an NTSC observation camera, a 500-W halogen light, an LED array, a gyro and a depth gauge. The vehicle can move on the sea bottom and then the crawlers can approach the targets closely and observe them with the NTSC camera in a stable environment. The thrusters help the vehicle to move along the soft sea bottom where the crawler is buried. The transponder, named an “ultra deepwater transponder”, can respond to acoustic pings from the mother ship, so we can directly navigate the vehicle at a depth of 11,000 m. In addition, the transponder can receive acoustic commands and active a release switch. If the secondary cable is cut accidentally and the crawler is not able to dock with the vehicle, the transponder can be given a command to drop a weight to enable the vehicle to surface. (But no drop weights are loaded on the vehicle at the moment.)

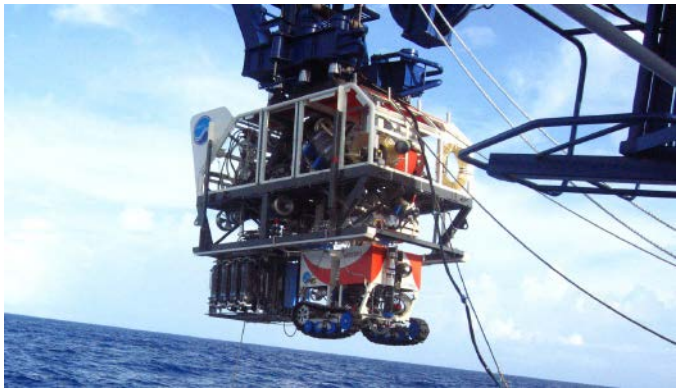


Fig. 1 The automatic bottom inspection and sampling mobile ABISMO.

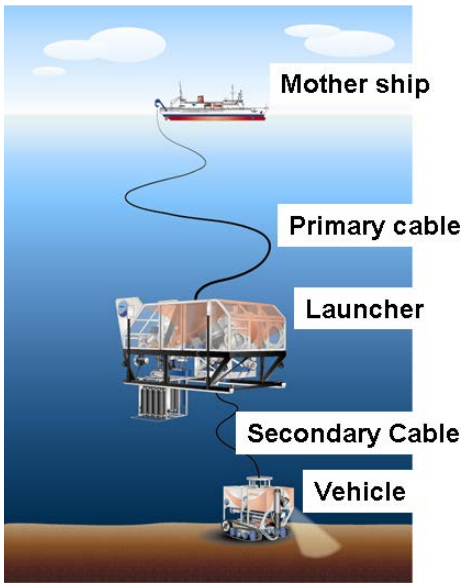


Fig. 2 Overview of ABISMO system.

Table 1 ABISMO's dimensions

Item	Launcher	Vehicle
Operating depth	11,000 m	11,000 m
Dimensions (L × B × D)	3.3 × 1.9 × 2.7 m	1.2 × 1.3 × 1.25 m (with crawler)
Weight in air	About 2,700 kgf	327 kgf
Weight in water	About 2,100 kgf	97 kgf

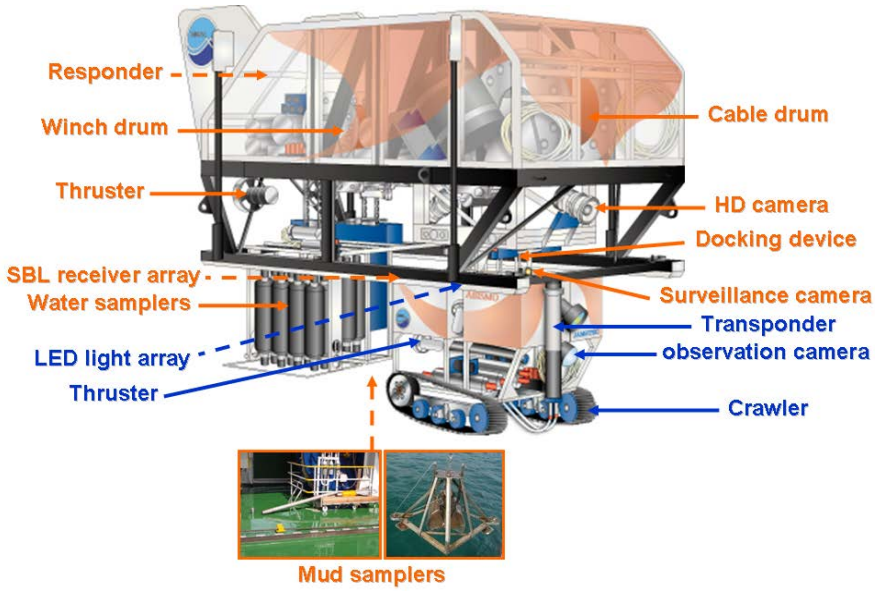


Fig. 3 Overview of the launcher and docked vehicle.

2) **Lander system**

A free fall camera system was used for the sampling of surface sediments and incubation experiments of sediments and water *in situ*. The free fall camera system was made by MARITEC, JAMSTEC, and consisted of CTD, a transponder, release weights, a battery, a deep-sea camera, two lights, and three sediment samplers attached to tripod aluminum frame.

For this cruise, we newly designed two *in situ* incubation systems. The first incubation system is set inside of sediment sampler tube which has 7.4 cm inner diameter. After landing on the seafloor, triggers are released and stable isotope tracer is injected onto sediment surface or into the sediments in the tubes. The second incubation system is a water sampler which includes chemicals and/or stable isotope labeled substrates. After

certain time, trigger is released and surrounding bottom water is introduced into the sampler.

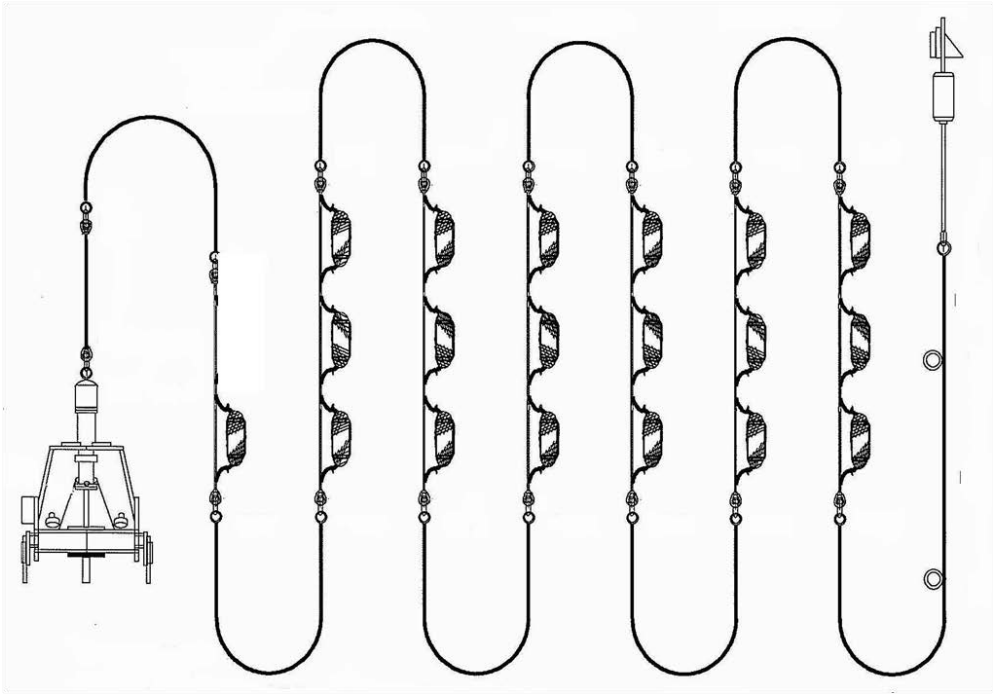


Figure. A schematic figure of the free fall camera system.

3) CTD of the ABISMO

SBE49, Sea-Bird Electronics

Conductivity:

Range: 0-9

Accuracy: 0.0003

Resolution: 0.00005 (oceanic waters; resolves 0.4 ppm in salinity)

Temperature:

Range: -5 – 35˚C

Accuracy: 0.002

Resolution: 0.0001

Pressure:

Range: 10000m

Accuracy: 0.1% of full scale range

Resolution: 0.002% of full scale range

4) DO sensor

Oxygen Optode 3830, Aanderaa Instruments

Range: 0-120 %

Accuracy: 5 %

Resolution: 0.4 %

5) Turbidity sensor

Compact_LTW, JFE Advantec, Inc.

Range: 0-10 FTU

Accuracy: 0.002 FTU

Resolution: ±0.002 FTU

7. Lander observatory

On 9th December, we released the free fall camera system to the seafloor of the Ogasawara Trench, water depth of 9772 m. The system sunk down at 58.5 m min^{-1} on average and reached to the seafloor at 17:11. After 14 days of incubation *in situ*, release command was sent to the camera system from the RV Yokosuka. The camera system floated at 51.5 m min^{-1} on average and reached to the oceanic surface at 13:47 on 23rd December. Three sediment cores, 7 incubation water samples, digital video images, and CTD data were successfully recovered.

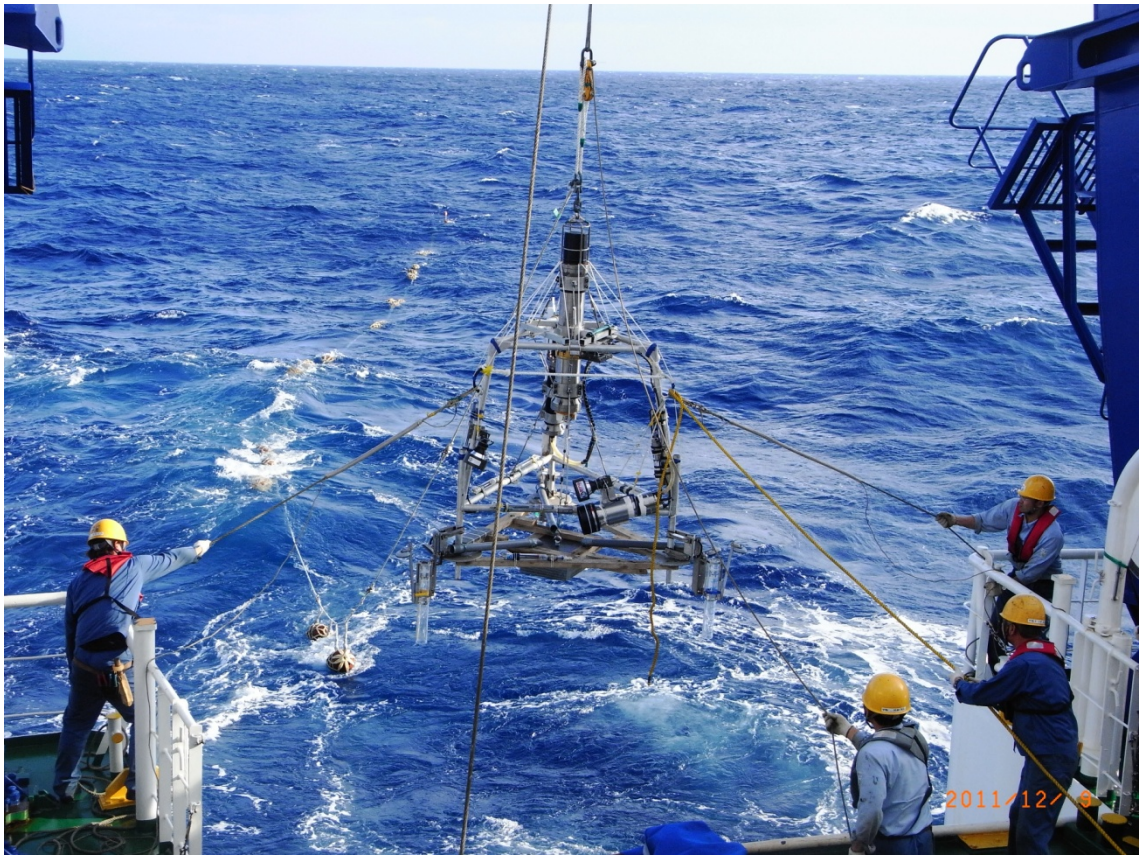


Figure. Deployment of the free fall camera system.

8. ABISMO Dive Reports

Dive Report ABISMO#15

Takuro Nunoura

Date: December 11, 2011
Site: Ogasawara Trench
Location: 29°09.00' N, 142°48.12 'E, 9776 m

Objectives:

1) Taking bottom sediments by a gravity corer in order to reveal nitrogen circulation by geochemical and microbiological analyses.
2) Sequential sampling of waters from the trench bottom to the shallow water mass in order to compare microbial community structure and geochemical parameters between trench waters and waters above the trench.

Payloads:

1) CTD
2) Water sampler (5L Niskin bottles)
3) Gravity corer

Event List:

12:20	D= 9696 m	Height 80m from the bottom Water sampling (W1) (29°08.9200' N, 142°48.2400 'E)
12:21	D= 9696 m	Water sampling (W2)
12:22	D= 9696 m	Taking a sediment core (D=9776 m)
13:29	D= 8515 m	Water sampling (W3)
14:10	D= 7512 m	Water sampling (W4) (1.8˚C)
14:44	D= 6212 m	Water sampling (W5) (1.7˚C)
15:02	D= 5010 m	Water sampling (W6) (1.5˚C) (29°08.9349' N, 142°48.1887 'E)
15:02	D= 4996 m	Water sampling (W7) (1.5˚C) (29°08.9349' N,

142°48.1887 'E)

15:21 D= 3507 m Water sampling (W8) (1.5˚C) (29°08.9956' N, 142°48.0474 'E)

15:42 D= 2015 m Water sampling (W9) (1.9˚C) (29°08.9664' N, 142°48.1490 'E)

16:15 D= 1005 m Water sampling (W10) (3.8˚C) (29°08.9608' N, 142°48.1156 'E)

Accurate sampling positions that are not mentioned above were not obtained due to a mechanical problem of sonar navigation system.

Results:

A sediment core was successfully retrieved from the trench bottom (length: 1.55m).

Dive Report ABISMO#16

Takuro Nunoura

Date: December 12, 2011
Site: Ogasawara Trench
Location: 29°16.79' N, 143°46.04 'E, 5747 m

Objectives:

1) Taking abyssal plain sediments by a gravity corer in order to reveal nitrogen circulation by geochemical and microbiological analyses.
2) Sequential sampling of waters from the bottom to the shallow water mass in order to compare microbial community structure and geochemical parameters between water columns on the Ogasawara trench and abyssal plain.

Payloads:

1) CTD
2) Water sampler (5L Niskin bottles)
3) Gravity corer
4) DO sensor
5) Tubidity sensor

Event List:

10:47	D= 5669 m	Height 79 m from the bottom
		Water sampling (W1) (1.57 ˚C)
10:49	D= 5669 m	Taking a sediment core (D=5747 m)
11:18	D= 4506 m	Water sampling (W2) (1.48˚C)
11:35	D= 3201 m	Water sampling (W3) (1.52˚C)
11:51	D= 2011 m	Water sampling (W4) (1.87˚C)
12:07	D= 1504 m	Water sampling (W5) (2.45˚C)
12:24	D= 1004 m	Water sampling (W6) (3.7˚C)
12:32	D= 753 m	Water sampling (W7) (4.9˚C)
12:32	D= 749 m	Water sampling (W8) (4.9˚C)

12:40	D= 503 m	Water sampling (W9) (10.8˚C)
12:52	D= 250 m	Water sampling (W10) (16.9˚C)

Accurate sampling positions were not obtained due to a mechanical problem of sonar navigation system.

Results:

A sediment core was successfully retrieved from the abyssal plain (length: 1.23m). The core was mostly consisted of reddish pelagic clay and was significantly different from the sediment structure observed in the sediment core from the trench bottom.

Dive Report ABISMO#17

Takuro Nunoura

Date: December 11, 2011
Site: Ogasawara Trench
Location: 29°09.00' N, 142°48.12 'E, 3091 m

Objectives:

1) Dense sequential sampling of waters from the upper water mass above the Ogasawara trench.

Payloads:

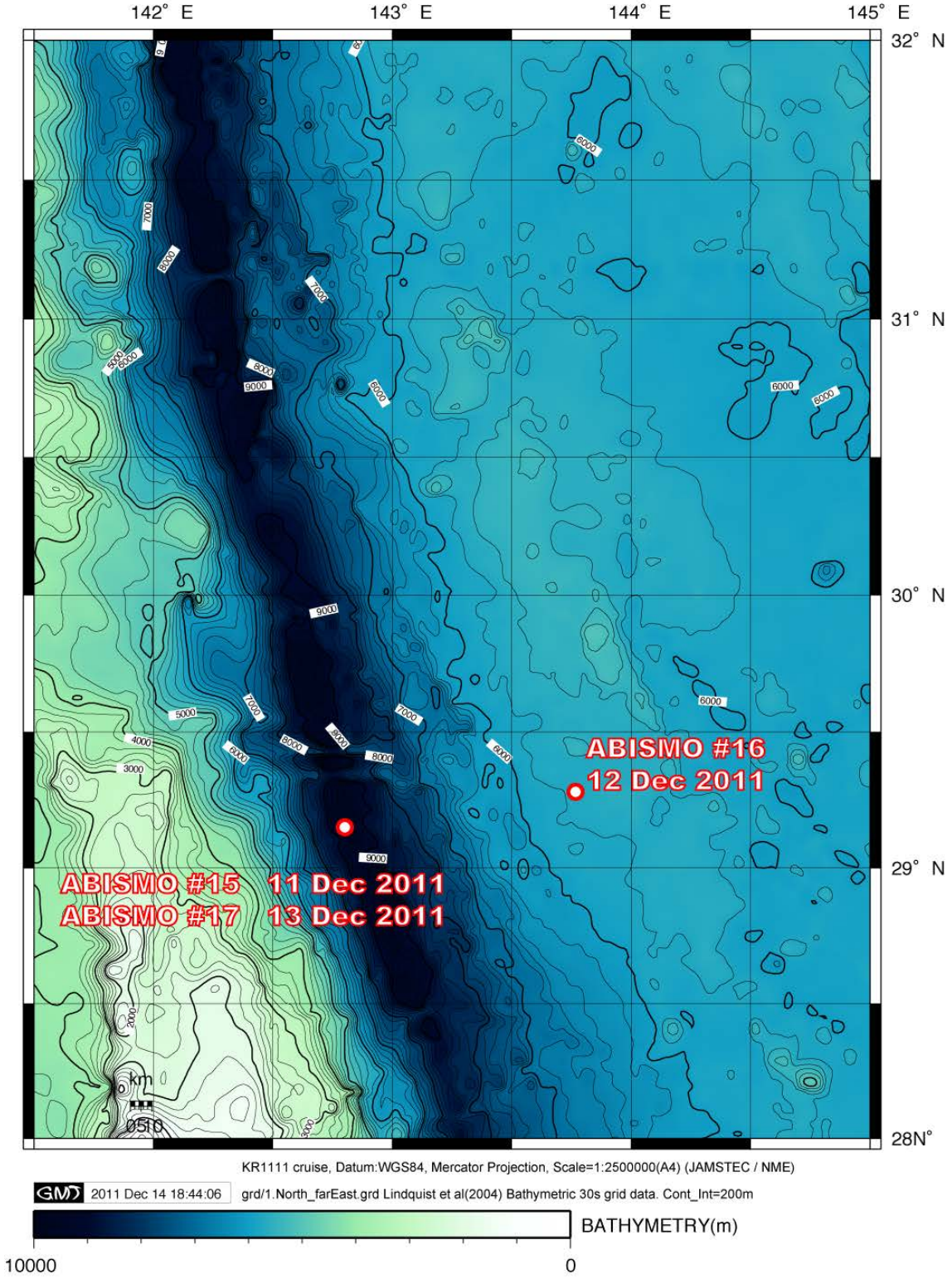
1) CTD
2) Water sampler (5L Niskin bottles)
3) DO sensor
4) Turbidity sensor

Event List:

9:57	D= 3092 m	Depth at 3091m (1.55˚C)
10:00	D= 2995 m	Water sampling (W1) (1.55˚C)
10:30	D= 1505 m	Water sampling (W2) (2.53˚C)
10:40	D= 1206 m	Water sampling (W3) (3.25˚C)
10:40	D= 1202 m	Water sampling (W4) (3.26˚C)
10:55	D= 754 m	Water sampling (W5) (5.6˚C)
11:03	D= 505 m	Water sampling (W6) (11.6˚C)
11:13	D= 306 m	Water sampling (W7) (16.9˚C)
11:13	D= 303 m	Water sampling (W8) (16.9˚C)
11:18	D= 205 m	Water sampling (W9) (17.7˚C)
11:23	D= 105 m	Water sampling (W10) (20.8˚C)

Accurate sampling positions were not obtained due to a mechanical problem of sonar navigation system.

KR11-11 Izu-Ogasawara Trench ABISMO dive point



9. Scientific objectives

A. Major objectives

Geochemical cycles and microbial ecosystems in hadopelagic environments have not been investigated. The *ROV ABISMO* that harbors water samplers and a gravity corer can take both water and sediment samples from 10000 m below the sea surface. In the previous cruises for the *ROV ABISMO* conducted in 2007 and 2008 (KR07-17 and KR08-5), we obtained a sediment core from the Izu-Ogasawara Trench, and waters and sediments from the Challenger Deep in the Mariana Trench. These sediments and waters provided unprecedented views of nitrogen cycle and microbial ecosystems in hadopelagic environments described below.

1. Unique nitrogen cycle in the Izu-Ogasawara Trench

   We found unusual molecular microbial and stable isotopic signatures that suggested co-occurrence of nitrification and denitrification in the hadopelagic sediments.

2. The trench biosphere in the Challenger Deep

   Molecular microbiological analyses (clone analyses and quantitative analyses for SSU rRNA gene and functional genes) revealed that microbial communities in trench waters were distinct from abyssal waters above the trench.

One of the major objectives of this cruise is to obtain clear evidence of unique nitrogen cycle in trench sediments that was suggested by previous results. The other is to verify the generality of the trench biosphere that was discovered in the Challenger Deep, and clarify the role of developing trench biosphere.

B. Scientific objectives of participants

Molecular analyses for hado- and abysso-pelagic waters and sediments

Takuro Nunoura, Yuriko Nagano and Miho Hirai (JAMSTEC)

In order to know the nitrogen cycles in abysso-pelagic waters and sediments, we will examine clone analysis and quantitative PCR targeting functional genes and SSU

rRNA genes related to aerobic and anaerobic nitrification for both sediment and water samples. In addition, metagenomic analysis and single cell genomic analysis targeting water samples will be conducted to know the adaptation mechanisms for had-pelagic environments and the role of trench microbial ecosystems in water.

Viral abundance and diversity in hado- and abysso-pelagic waters

Yukari Yoshida (JAMSTEC)

Viruses are now recognized as significant components of marine surface ecosystems. It has been suggested that they regulate microbial cellular and functional abundances and, consequently, affect global nutrient and energy cycles. Viruses can also mediate lateral gene transfers and drive the co-evolution between viruses and hosts. However, in contrast to the extensively studied marine surface environments, viral functions and ecology in deep-sea environments remain poorly characterized. In this cruise, viral and prokaryotic abundances in deep-sea environments (especially the Ogasawara Trench) were investigated. Furthermore, we will perform viral metagenome analysis to reveal viral diversity in deep-sea.

Cultivation of heterotrophic microbes

Osamu Koide, Takaaki Kubota, Yuriko Nagano (JAMSTEC)

As with other environments, microorganisms are known to play an important role in deep-sea ecosystems. Microorganism communities in deep-ocean, such as Ogasawara Trench, are still unexplored and hold great potential for both science and industry.

In this cruise, heterotrophic microbial communities, including prokaryotes and eukaryotes (mainly focused on fungi) in Ogasawara Trench were investigated for diversity analysis, and microorganisms capable of industrial application use.

Water samples were collected from different depths in three different sites. 100ml of each water sample was filterized by 0.2 μ m, 1.0 μ m pore size membrane. Post-filterization membranes were directly added to the culture media for the isolation of

microorganisms. Sediment samples were taken from different depths and cultivated for the isolation of heterotrophic bacteria and fungi. Both water and sediment samples were also screened for useful agents.

Microbial uptake of carbon substrate in the abysso-pelagic zone

Katsunori Yanagawa and Michinari Sunamura (The University of Tokyo)

Purpose

Marine crenarchaeota show the numerical dominance in the meso- and bathy-pelagic zone. They have been regarded as chemolithoautotorophic organisms that assimilate carbon dioxide as a sole carbon source through nitrification activity. Thus, marine crenarchaeota have been thought to be significant contributors to nitrogen and carbon cycling. However, we can't disregard the potential that bathy- and abysso-pelagic crenarcaeota utilize organic matter heterotrophically. In this cruise, we focused on the microbial abilities to utilize the carbon substrate in the hadal environment. Microbial carbon substrate uptake was evaluated through ^{14}C-label tracer experiments. Furthermore, we will determine microbial community structure by using fluorescence in situ hybridization (CARD-FISH) and elucidate the vertical distribution of crenarchaeota in the water column sample taken during this cruise. The comparison of these results will provide important insight into marine crenacrchaeotic carbon substrate utilization.

Materials and Methods

Immediately after sampling of 5L-Niskin water, we transfer them into plastic bag, added RI-labelled carbon substrate (bicarbonate, glucose, pyruvate, and amino acid), and incubated at in situ temperature for 2-3 days on board. In order to stop the growth of ammonia oxidizing archaea, inhibitors to ammonia oxidation was added into a part of the samples. Pressure vial was used for the incubation at in situ pressure in a specific water depth. The microbial activity was stopped by addition formalin. Then the microbial cells were filtered onto 0.2-μm-pore sized polycarbonate membrane. The filtrated water, which passed through a filter with a nominal pore size of 0.2 μm, was used for carbon isotope analysis of dissolved organic carbon (DOC) to clarify the carbon flow from microbial cells into extracellular materials. These samples were stored at -80°C until future onshore

analysis.

Future works

CARD-FISH and radioactivity measurements of microbial cells and DOC materials by liquid scintillation are planned in the near future. Combination of microautoradiography and FISH (MAR-FISH), which is an important tool for microbial ecology and able to detect the utilization and uptake of RI-labelled substrate at a single cell level, will be the next step to clarify the phylogenetic affiliation of the autotrophic/heterotrophic microbial cells in the abyssopelagic seawater.

Viral ecology in hadopelagic environments

Eugenio Rastelli and Marco Lo Martire (*Department of Life and Environmental Sciences, Polytechnic University of Marche, Italy)*

Introduction:

Viruses are by far the most abundant biological entities in the world's oceans (approximately 4×10^{30}, Suttle 2007). Recent estimates suggest that every kg of deep-sea sediment contains 10^{12} viruses and 10^{11} prokaryotes (Sogin et al 2006). Recent studies revealed that viral infection in aquatic sediments can be the major cause of mortality for benthic prokaryotes (Danovaro et al 2008). Viral lysis transforms infected microbes into organic detritus, which can then be used again by non-infected prokaryotes and/or contribute to biogeochemical cycles. Extracellular DNA is likely to play a key role in both processes (Dell'Anno & Danovaro 2005) and can be a reservoir of genes (1 kg of deep-sea sediment can contain 10^{13} copies of 16S rRNA genes; Corinaldesi et al 2011).

Purpose:

During the Ogasawara trench cruise organised by JAMSTEC, the goal of the italian research team (UNIVPM) was to know the dynamics and functioning of the trench ecosystem and of the ecosystem surrounding the trench, concerning marine viruses and

their relationship with prokaryotes.

Materials and methods:

Seawater samples were collected during the Ogasawara trench cruise in two stations, one inside the trench (depth 9669 m) and one on the east of the trench (depth 5669 m). The aim of the sampling was to study viral abundance and production and prokaryotic abundance at different quotes of the water column.
Surface and sub-surface sediments were collected from the same stations. On these samples, UNIVPM research team will conduct analyses for the determination of viral abundance and production, total prokaryotic abundance, extracellular and intracellular DNA concentration, the structure of the prokaryotic assemblages by fish on Bacteria and Archaea, bacterial diversity by ARISA and archaeal diversity by TRFLP.
Additional experiments (*in situ* temperature incubations of replicated mesocosms) were conducted onboard to study extracellular and intracellular gene composition (assumed to change during the incubation as a result of the cell burst by viral infection) and to study the effect of GC_7 (antibiotic selectively inhibiting archaea) on prokaryotes and viruses.

Future work:

The comparison and correlation of the results of these analyses with the evidences obtained by other groups of scientists working on different aspects of deep-sea ecology will allow to gain more information about the functioning of the trench ecosystem in relation to the surrounding environment.

References

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Marine nitrogen dynamics in hadopelagic environments

Manabu Nishizawa (JAMSTEC) and Megumi Kuroiwa (TUAT)

Our purpose is to understand nitrogen dynamics in hadopelagic environment, including water column and sediments. First, we plan to collect sediment samples at the Ogasawara trench and abyssal hills around the trench, and then conduct geochemical and microbial analyses with high spatial resolution. Second, we plan to collect water samples at depth from surface to 10000 mbss, and then conduct microbial and geochemical analyses.

Summary of sampling

First, we successfully collected sediments and interstitial water samples from the Ogasawara trench (10000 mbss) and abyssal plain around the trench (5700 mbss) for geochemical and microbial analyses onshore. Second, we collected water samples at depth from sea surface to 10000 mbss for geochemical and microbial analyses onshore.

In situ incubation of sedimentary organisms in the Ogasawara Trench, 9772m

Hidetaka Nomaki, Manabu Nishizawa, Takuro Nunoura (JAMSTEC), Tomo Kitahashi (Univ. Tokyo)

1. Introduction

Trenches are seafloor features that are isolated from each other (Angel, 1982), the upper boundary of which typically begins at a water depth of 6,000 m. Due to its remoteness from the ocean surface, little is known about biological compositions and biogeochemical cycles at the Trench. In the deep-sea, meiofauna exceed megafauna and macrofauna in density and biomass (e.g., Rex et al., 2006) and play an important role in the deep-sea ecosystems in addition to microbes. Here, we investigated the faunal compositions of foraminifera and metazoan meiofauna at the bottom of the Ogasawara Trench. Their ingestion rates of algal organic matter will be investigated by carrying out an *in situ* incubation experiment using a deep-sea free fall camera system. Microbial activities *in situ* will also be analyzed by using a different substrate in the incubation experiment.

2. Materials and Methods

The *in situ* incubation experiment was carried out at the deepest area of Ogasawara Trench (water depth of 9772 m). We used the free fall camera system for the sampling and *in situ* incubations. The camera system was deployed on 9th December. After 14 days of *in situ* incubation, the camera system was recovered by RV Yokosuka on 23rd December. Three cores and 7 water samples were retrieved by the camera system.

On board, overlying water samples of the cores were sampled for inorganic geochemistry and microbial studies. Oxygen concentrations through the seawater to sediments were measured by microelectrode down to the bottom layer of the cores. Sediments were sampled for eukaryotic works, microbiological works, and organic geochemistry works. The sediment samples for eukaryotic works were stained with rose-Bengal and fixed with buffered seawater/formalin solution.

3. Future works

The sediment samples for eukaryotic works will be sieved with 32 um mesh. All the stained specimens of benthic foraminifera and metazoan meiofauna will be picked out from the sediments. Both taxonomical and geochemical analyses will be performed with those samples and bulk sediment samples.

10. Appendix

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.

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