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RV Kairei Cruise Report

KR14-01

Trench biosphere expedition for the Challenger Deep,

Mariana Trench

Jan.06-Jan.20, 2014

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

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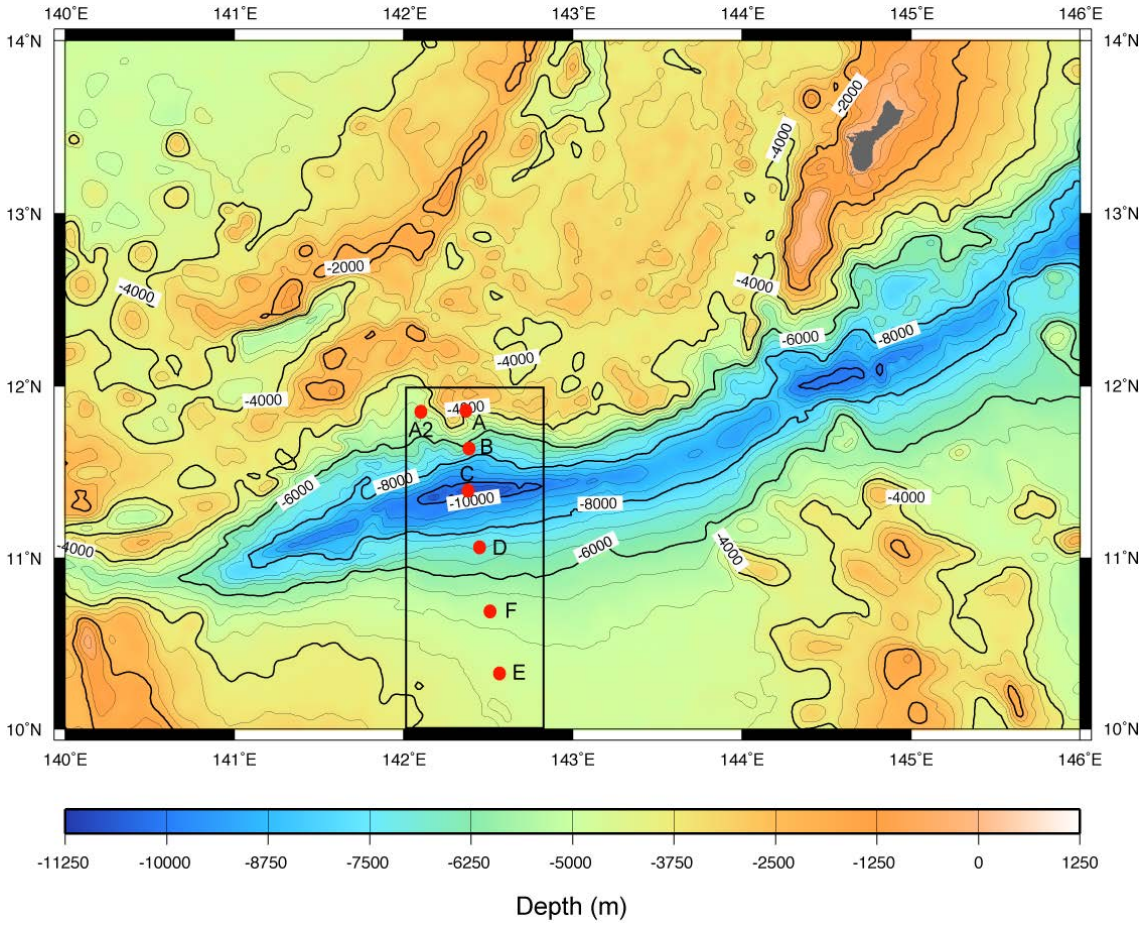
1. Cruise Information

- Cruise ID: KR14-01
- Name of vessel: RV Kairei
- Title of the cruise: Trench biosphere expedition for the Challenger Deep, Mariana Trench
- Title of proposal: Trench biosphere expedition for the Challenger Deep, Mariana Trench
- Cruise period: Jan.06-Jan.20, 2014
- Ports of call: Yokosuka-Saipan
- Research area: the Challenger Deep, Mariana Trench
- Research Maps



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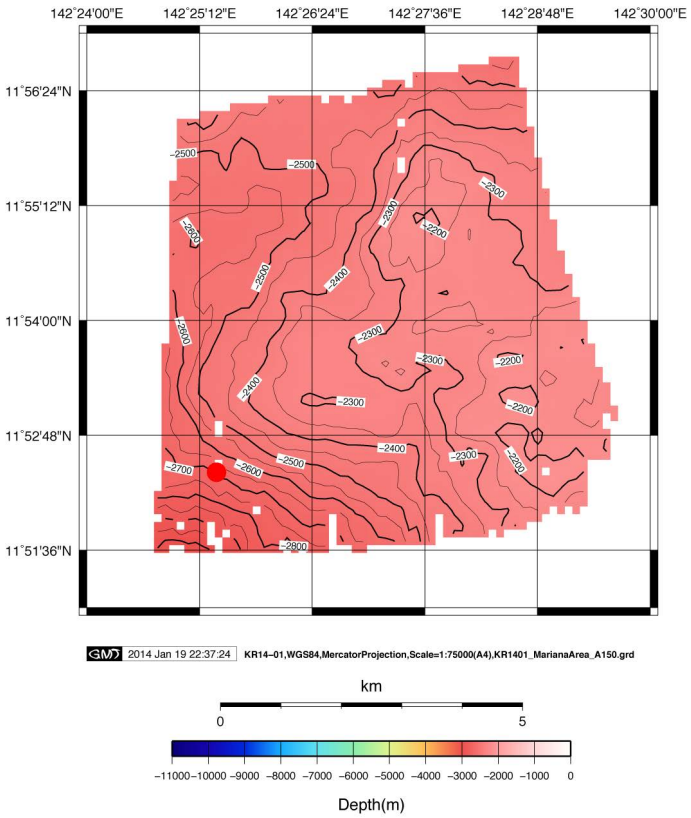

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Depth(m)

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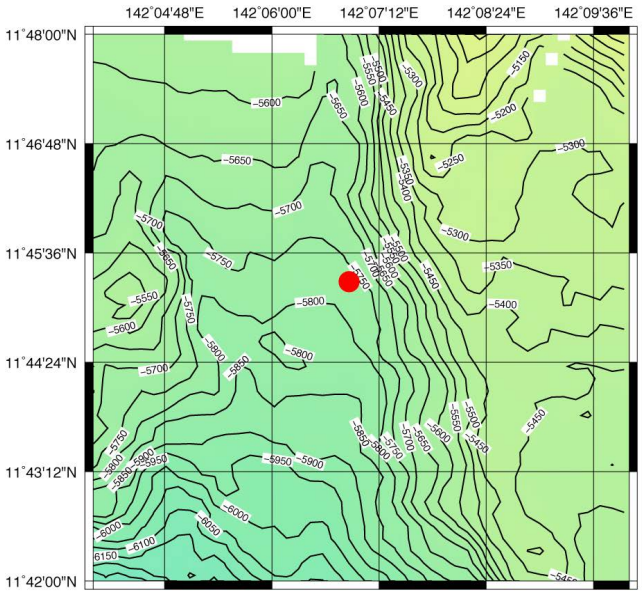

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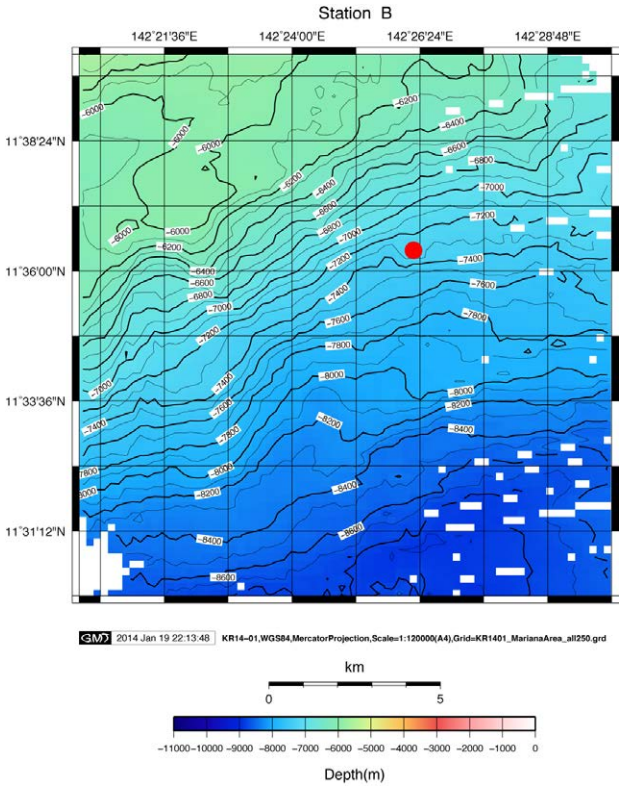
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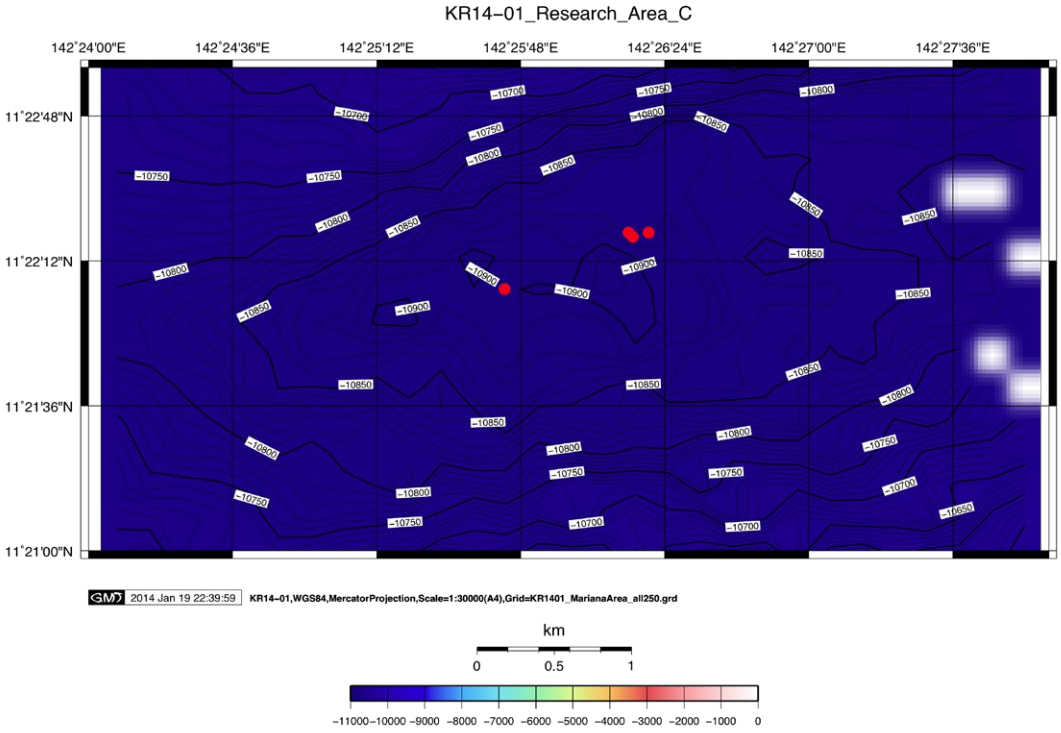
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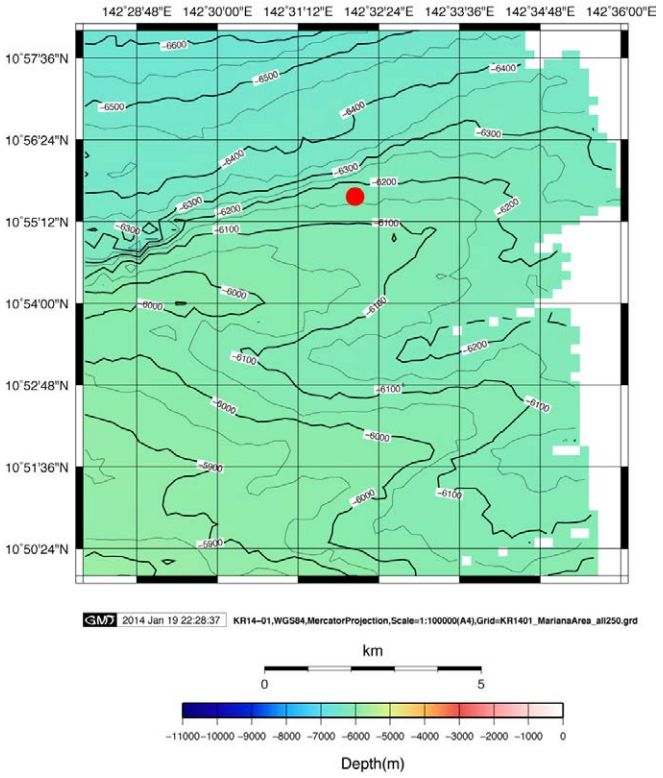

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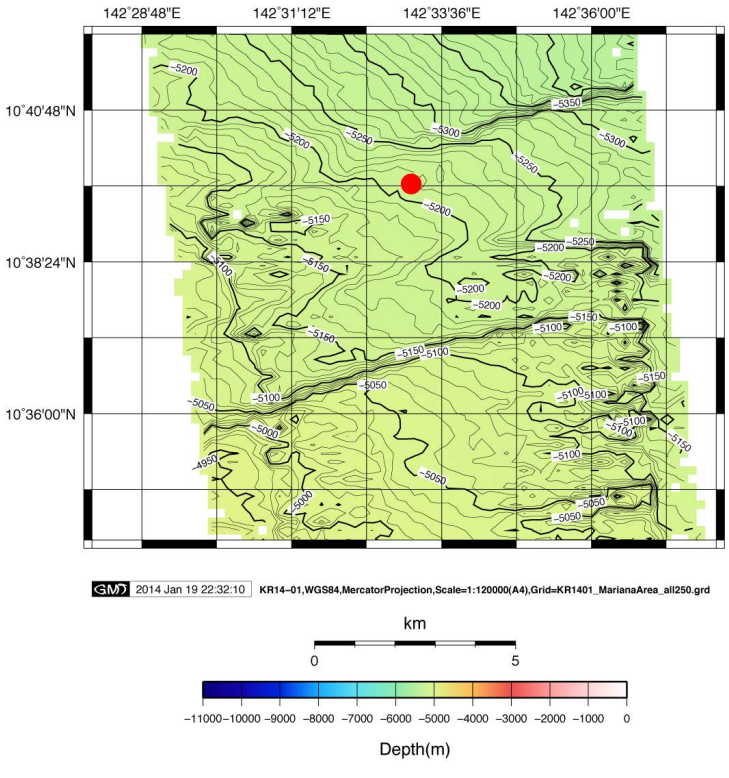

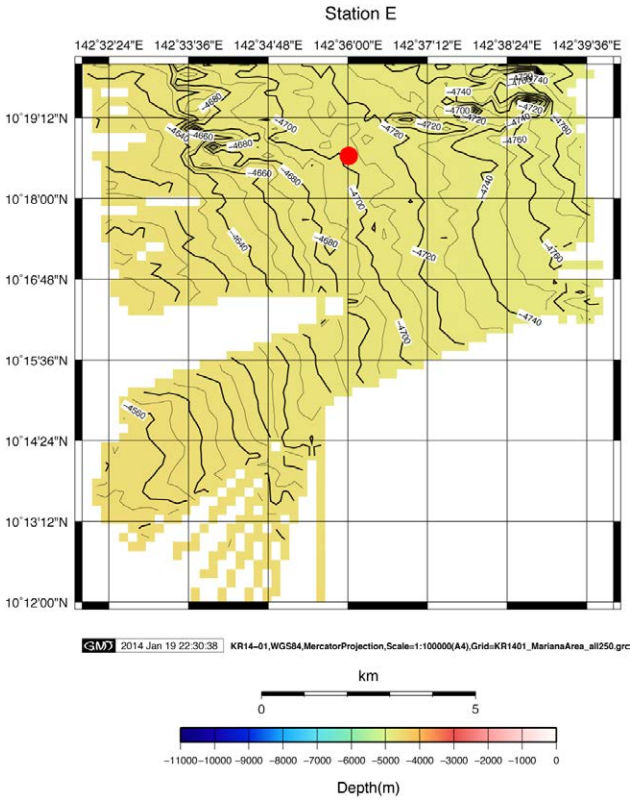
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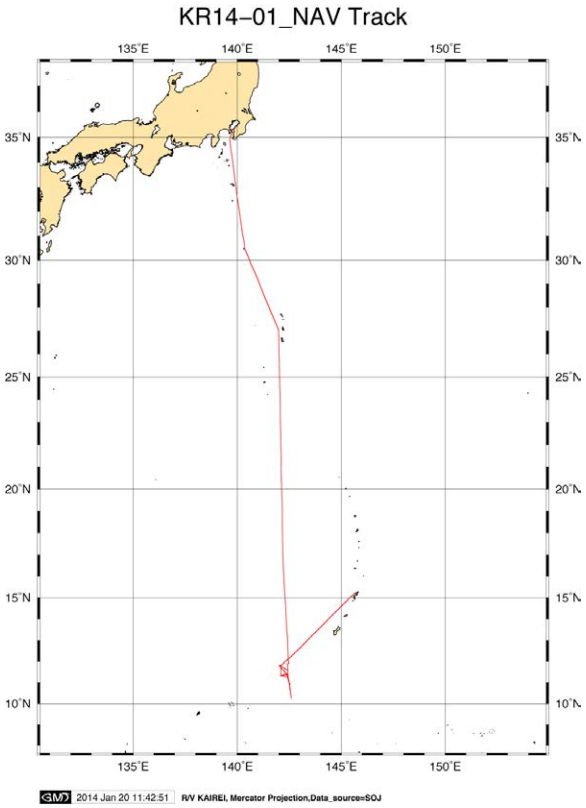
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2. Participants

I. Researchers

● Chief scientist: Takuro Nunoura [JAMSTEC]

● Representative of the science party: Takuro Nunoura [JAMSTEC]

● Science party

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Shinpei Goto
Marine Technology and Engineering Center
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Yuki Miyajima
Marine Works Japan, LTD.

Shungo Oshitani
Marine Works Japan, LTD.

III. Operation team of the KAIKO

1st Submersible Technical Officer	Atsumori Miura
2nd Submersible Technical Officer	Kiyoshi Takishita
2nd Submersible Technical Officer	Tetsuya Ishitsuka
2nd Submersible Technical Officer	Shota Ihara
3rd Submersible Technical Officer	Takuma Goto
3rd Submersible Technical Officer	Yoichi Yasue

IV. Captain and crew of the R/V KAIKO

Captain	Yoshiyuki Nakamura
Chief Officer	Akihisa Tsuji
2nd Officer	Toshiyo Ohara
3rd Officer	Kakeru Ijichi
Chief Engineer	Koji Hunae
1st Engineer	Takashi Ota
2nd Engineer	Ryuzo Mikami
3rd Engineer	Naoomi Uemura
Chief Radio officer	Yoichi Inoue
2nd Electronic Operator	Misato Hata
3rd Electronic Operator	Toshihiko Yuasa
Boat Swain	Masanori Ohata
Quarter Master	Shuichi Yamamoto
Quarter Master	Yukito Ishii
Quarter Master	Takumi Yoshida
Sailor	Kosei Kawamura
Sailor	Tomoaki Kubota
Sailor	Toshiya Saga
No.1 Oiler	Kozo Miura
Oiler	Katsuyuki Miyazaki
Assistant Oiler	Makoto Kozaki
Assistant Oiler	Toru Hidaka
Assistant Oiler	Atsumu Hara
Chief Steward	Yukio Tachiki
Steward	Yoshio Okada
Steward	Hiroyuki Ohba

Steward	Kana Yuasa
Steward	Yohei Ebiko

3. Objectives

I. Major Objectives

The objective of the project is to understand the geochemical and geophysical backgrounds of the uniqueness of the trench biosphere of the Challenger Deep that have been observed before shown below.

1. The trench water of the Challenger Deep harbors distinct microbial ecosystem comparing to that in the abyssal waters above the trench (Nunoura et al. in preparation).
2. Relatively high salinity water was observed below 9000 m in the Challenger Deep (Taira et al. 2005), and the water structure may influence the trench microbial ecosystem (Nunoura et al. in preparation).
3. The trench geography may influence the diversity and ecology of meiofauna represented by the primitive foraminifera discovered in 2005 (Todo et al. 2005).
4. The trench geography also impacts on the benthic microbial ecosystem (Glud et al. 2013).
5. Possible methane plume was observed at a depth of 7000m in the Challenger Deep during the JAMSTEC KR08-05 cruise (2008) (Ueno et al. unpublished). In addition, debris of ultramafic rock was also observed in the sediments (Michibayashi et al. unpublished). These could be signatures of unseen serpentine-hosted hydrothermal activity below 7000 m in the Challenger Deep while the Shinkai Sheep field was discovered around 5500 m in this deep (Ohara et al. 2012).

In this cruise, we took both water and sediment samples on the transect of the Challenger Deep by using ROV ABISMO, 11K camera system and multiple coring system in order to reveal geochemical and geophysical impacts of the Challenger Deep on microbial ecosystems associated with the trench environments as follows.

1. Comparing the microbial diversity and activities between the trench water and the abyssal water above the trench.
2. Comparing the sedimentary microbial and meiofaunal ecosystem among the trench bottom, trench slope and abyssal plain in the Mariana Trench area.
3. Sampling water and sediments on the northern slope of the Challenger Deep in order to assess the origin of methane plume at a depth of 7000m.

II. Scientific objectives of participants

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

Takuro Nunoura 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 and metaproteomic analyses 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.

Marine nitrogen dynamics in hadopelagic sediments

Manabu Nishizawa (JAMSTEC)

Our purpose is to understand nitrogen dynamics in hadopelagic sediments. In this cruise, we will investigate geochemistry of interstitial waters from the Mariana trench sediments. We will also determine potential rates of nitrification in the sediments by in-situ and shipboard incubations.

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 were investigated. Furthermore, we will perform viral metagenome analysis to reveal viral diversity in deep-sea.

Virus isolation and metagenomics

Mitsuhiro Yoshida (JAMSTEC)

Microorganisms are known to play an important role in deep-sea ecosystems, as well as other various environments. Microbial communities in the deep-ocean, such as the Mariana Trench, are still unexplored and hold great potential for both science and industry. In this cruise,

microbial communities, including heterotrophic bacteria and viruses, in the trench environment were investigated to know the microbial diversity and to explore the microorganisms capable of the industrial application use. Water samples were collected from different depths in the trench location. The 100 ml of each sample was directly added to the culture media for cultivating heterotrophic bacteria. Sediment samples were taken from different depths in the trench location, and we will try to isolate bacteria. In addition, we will try to isolate the viruses with the cultivated bacterial hosts. Furthermore, we will perform the singles-stranded viral metagenome analysis to reveal their viral diversity in deep-sea.

Prokaryotic activity in abyssopelagic zone of the Mariana Trench

Katsunori Yanagawa (JAMSTEC) and Michinari Sunamura (The University of Tokyo)

Marine prokaryotes play important roles on organic matter cycles in the oceans. Despite evolving understanding about the importance and the diversity of prokaryotes in marine ecosystems, the data are scarce regarding prokaryotic activity in the water columns of open oceans, particularly in deep water realm. In this cruise, we focused on the prokaryotic abilities to utilize carbon substrates in meso-, bathy- and abyssopelagic waters and the sediments, together with microbial cell abundances. Substrate uptake rates under 3-different incubation condition were evaluated using pressure tight water sampler with radiotracer experiments; in situ pressure condition, re-pressurized in situ pressure condition on board, and atmospheric pressure condition. To estimate the contribution of archaea to total prokaryotic substrate incorporations, we used an inhibitor approach. Seawater and sediment samples were mixed with radio-isotope-labeled substrates and incubated at in situ temperature under in situ or atmospheric pressure. Formaldehyde was used for killed controls. To estimate the contribution of archaea to total prokaryotic substrate incorporation, GC7 was used to inhibit archaeal activity. To stop the growth of ammonia oxidizers, inhibitors to ammonia oxidation (i.e., PTIO and acetylene) were added into a part of the samples. The incubation was stopped by the addition of formaldehyde, and samples were filtered through 0.2-μm-pore-size polycarbonate filters. The filters were then placed in scintillation vials and added with 10 ml of scintillation cocktail. The incorporated radioactivity was determined using a liquid scintillation counter.

Viral ecology in hadopelagic environments

Laura Carugati (*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 KR14-01 cruise organised by JAMSTEC (1-2014), the main aim of the italian research team (UNIVPM) was to investigate the dynamics in virus - prokaryotes interactions in the Mariana trench.

Materials and methods Seawater samples were collected in two stations from the sea surface to the bottom of the Mariana trench. The aim of the water sampling was to study viral production and extracellular enzymatic activities at different depths of the water column. Surface and sub-surface sediments were collected from the same stations. Other four stations were selected and sampled for sediment analysis. On these sediment samples, UNIVPM research team will conduct analyses for the determination of viral abundance and production, total prokaryotic abundance, abundance of Bacteria and Archaea, extracellular enzymatic activities, extracellular and intracellular DNA concentration. Additional experiments (*in situ* temperature incubations of replicated mesocosms) were conducted on board to study viral impact on Bacteria and on Archaea, both for seawater and sediment samples. Several antibiotics were used to inhibit Archaeal or Bacteral activity, in order to study the effects of this selective inhibition on viral production.

Future work The comparison of the new results with those reported in literature from the Mariana trench will allow to gain more information about the functioning of the trench ecosystem in relation to the surrounding environment. Discussion and collaboration with the other groups of scientists working on different aspects of deep-sea ecology will lead to a more complete knowledge of the trench ecology and functioning.

References

Danovaro, R. et al (2008). Nature 454: 1084-1087; Corinaldesi, C. et al (2011). Mol. Ecol. 20:

642-654. 5. Dell'Anno, A. & Danovaro, R. (2005). Science 309: 2179; Sogin, M. et al (2006). PNAS 32: 12115-12120; Suttle, C.A. (2007). Nature Rev. Microbiol. 5: 801–812.

Meiofaunal fauna at the Mariana Trench and adjacent deep-sea floor

Hidetaka Nomaki (JAMSTEC)

Introduction Trenches distribute along oceanic plate subduction zone and their water depths sometimes exceed 10,000 m depth. Due to its remoteness from the ocean surface, little is known about biological compositions and biogeochemical cycles at the Trench area. 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 investigate faunal compositions of meiofauna at the Challenger deep of the Mariana Trench, north landward slope, south seaward slope, and abyssal plain.

Materials and Methods Sediment samples were collected using a multiple corer and a free-fall camera system. Both sampling gear can equip 60 cm length core tube (inner diameter = 74 mm). Multiple core samplings were carried out at the Station A2 (5,840 m, North slope of Mariana Trench), Station D (water depth = 6,067 m, South slope of Mariana Trench) Station F (water depth = 5,183 m, abyssal plain), and Station E (water depth = 4,700 m, abyssal plain). Free-fall camera system samplings were carried out at the Station C, Challenger deep of the Mariana trench (water depth = ~10,900 m), on 12th and 17th January.

On board, oxygen profiles were measured with optical oxygen sensor through polycarbonate core tubes. Three cores from each multiple core deployment were sliced into 6 different depth layers down to 15 cm depth for meiofaunal analysis. Half volume of sediment in each layer were sampled for meiofauna and then fixed with rose-Bengal formalin. Another sediment core from each multiple corer deployment was sliced into every 2 cm depth down to 20cm depth followed by every 5 cm down to 30 cm depth if possible. Approximately 10 ml of each layer was sampled for sediment geochemistry analysis and rest was sampled for age determination. Both samples were kept frozen at -20 ˚C.

Protists in deep-ocean

Ryuji Kondo (Fukui Prefecture Univ)

The 'microbial loop' is known as a dynamic component of the food web in marine

systems. Heterotrophic nanoflagellates (HNF) are significant consumers of bacteria in aquatic environments. In this cruise, HNF abundance will be investigated in the water column and the bottom sediments of the Mariana Trench. We will also try to isolate and cultivate the eukaryotic microbes in order to know their physiology.

4. Instruments

I. 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.)

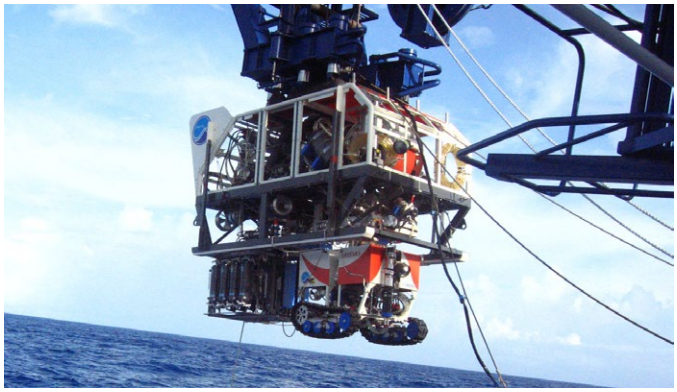


Fig. 1 The automatic bottom inspection and sampling mobile ABISMO.

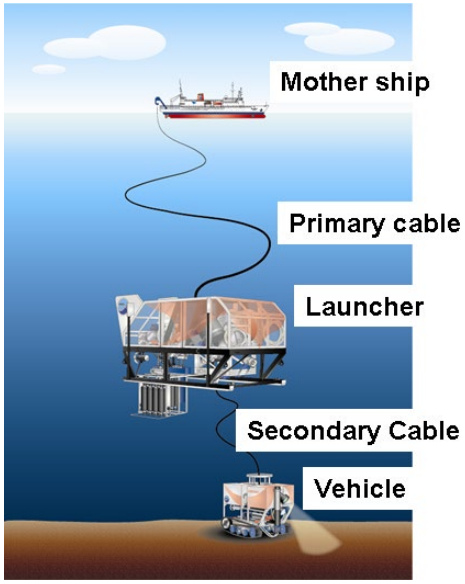


Fig. 2 Overview of ABISMO system.

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

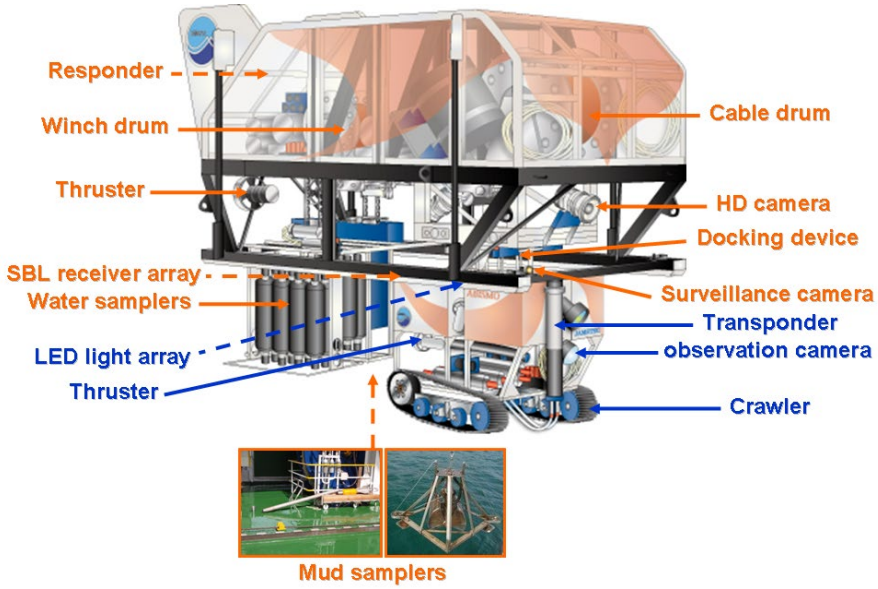
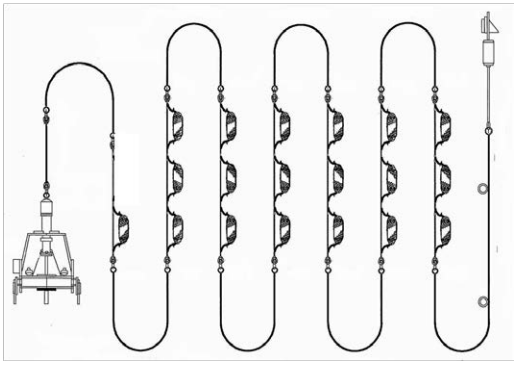


Fig. 3 Overview of the launcher and docked vehicle.

II. 11K Free Fall Camera 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.

III. CTD (Conductivity-Temperature-Depth profiler) in the ABISMO and the Lander system

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

IV. Natsushima 1 (4K camera) in ABISMO

Housing: 13 inch glass sphere (Okamoto Glass co.ltd.)

Depth rating: 9000m

4k camera: GoPro Hero 3+ black edition

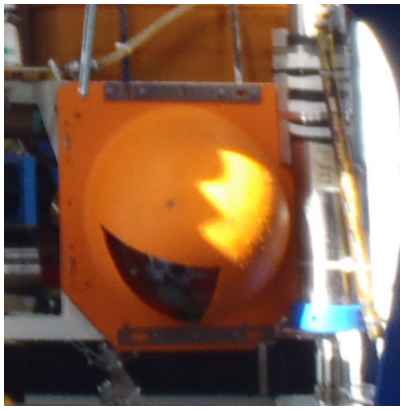


Figure. Natsushima 1 in an orange guard hat on the vehicle of ABISMO.

V. Multiple core samplings

a. Instruments and Method

Multiple corer (MC) used in this cruise consists of main body (620kg weight) and 8 sub-corer attachments. We used 8 polycarbonate pipes. Core barrel of polycarbonate is 60cm length and 74mm inner diameter.

b. Winch Operation

When we started lowering the MC, a speed of wire out was gradually increased to be 60m/min. The MC was stopped at a depth about 50m above the sea floor for 5minutes to stabilize of the sampler. After the sampler was stabilized, the wire was wound off at 20m/min,

and we watched carefully a tension meter. When the MC touches the bottom, wire tension leniently decreases by the loss of the sampler weight. After confirmation that is the MC touch seafloor, the wire out was stopped then another 5m rewinding. After waited 40 seconds, the wire was wound in at 20m/min until the tension gauge indicates that is the corer left the bottom. After left the bottom, which wire was wound in at the maximum speed (>60m/min). The MC came back the ship deck, sub-corer attachments was detached from main body.

VI. Turbidity sensor

Turbidity sensor is composed of Seapoint turbidity meter and XR420 as a data logger. XR420 contains a temperature and pressure sensors. In this cruise, we attached the sensor to Multiple Corer to measure the turbidity of water column in the Mariana Trench caused by landslip or methane seep. We also obtain the acculate depth and temperature of core samples with the sensor.

Detailed information
Sensor: Seapoint Turbidity Meter, SeaPoint
Logger with temperature and depth meter: XR420, Ruskin

• Power Requirements: 7-20 VDC, 3.5 mA avg., 6 mA pk.
• Output 0-5.0 VDC
• Output Time Constant 0.1 sec.

• RMS Noise < 1 mV
• Output Impedance 1000 ohms
• Power-up Transient Period < 1 sec
• Light Source Wavelength 880 nm
• Sensing Distance < 5 cm (approx.)
(from windows)
• Linearity < 2% deviation 0-1250 FTU, <5% deviation 0-1600 FTU

• Sensitivity/Range
Gain: 100x, 20x, 5x, 1x
Sensitivity (mV/FTU): 200, 40, 10, 2
Range (FTU): 25, 125, 500, 4000**
** (output is non-linear above 750 FTU)

Figure The turbidity sensor attached to Multiple corer

- Temperature Coefficient < 0.05%/°C
- Depth Capability 6000 m (19,685 ft)
- Weight (dry) 86 g (3.0 oz)
- Operating Temperature 0°C to 65°C (32°F to 149°F)

5. Cruise log

日付 Date	時間 Local Time	内容 Note	特記事項 Description	本船位置／気象／海象 Position/Weather/Wind/Sea condition
6-Jan-14		**Let go all shore lines & left YOKOSUKA for Research area.**		1/6 12:00(UTC+9h)
	09:00	Scientists onboarded.		YOKOSUKA
	13:00-13:30	Scientists meeting.		26-06.0N, 127-45.7E
	14:00	Let go all shore lines ,		Blue sky
		& left YOKOSUKA for Research area(MARIANA Trench).		ESE-2(Light breeze)
	15:00-15:30	Carried out shipboard education & training for scientists.		1(Calm)
	18:00-18:40	Scientists meeting.		1(Low swell sea)
	16:40-17:00	Carried out KONPIRA pray.		Visibly-8
7-Jan-14		**Proceeded to research area.**		1/7 12:00(UTC+9h)
	10:00-10:30	Scientists meeting.		OFF North-East TORISHIMA
	15:00-16:00	Scientists meeting.		30-35.5N, 140-22.0E
				Fine but Cloudy
				NNW-3(Gentle breeze)
				2(Calm)
				3(Moderate short)
				Visibly-8
8-Jan-14		**Proceeded to research area.**		1/8 12:00(UTC+9h)
				OFF North-East KITA IOUTOU
				25-44.5N, 142-00.7E
				Fine but Cloudy
				ESE-5(Fresh breeze)
				3(Sea smooth)
				3(Moderate short)
				Visibly-8
9-Jan-14		**Proceeded to research area.**		1/9 12:00(UTC+9h)
	13:00	Scientists meeting.		OFF West MAUG ISLANDS
	24:00	Ship Local time + 1hour.		20-32.0N, 142-07.0E
				Fine but Cloudy
				ESE-4(Moderate breeze)
				3(Sea smooth)
				4(Moderate average)
				Visibly-8
10-Jan-00		**Proceeded to research area.**		1/10 12:00(UTC+10h)
	13:00-14:00	Scientists meeting.		OFF West SAIPAN ISLANDS
				15-34.0N,142-17.0E
				Fine but Cloudy
				NE-5(Fresh breeze)
				3(Sea smooth)
				4(Moderate average)
				Visibly-8
11-Jan-14		**1st MultipleCoreSampler operation,& Deployed FreeFallCameraSystem**		1/11 12:00(UTC+10h)
	06:00	Arrived at area A.		MARIANA trench
	06:03-06:36	Carried out MBES site survey.		11-44.0N,142-26.0E
	06:45	Releaseded XBT.	11-54.1436N,142-24.2097E	Fine but Cloudy
	08:00	Launched multiple cores.		ENE-6(Strong breeze)
	08:10-08:15	Sampling surface sea water.	11-52.8085N,142-25.1308E	4(Sea moderate)
	09:08	Multiple cores stuckm in the sea bottom(Depth=2,597m).	11-52.2518N,142-25.2305E	4(Moderate average)
	09:10	Multiple cores left the sea bottom.		Visibly-8
	10:07	Recovered Multiple cores.		
	10:50	Proceeded to area C.		
	14:00	Arrived at area C.		
	15:04-15:19	Launched Free Fall Camera System.	11-22.1687N,142-25.7960E	
	18:31-19:31	Carried out Calibration for abobe Free Fall Camera System(Depth=10,901m).	11-22.0533N,142-25.4486E	
12-Jan-14		**Recovered Free Fall Camera System & Deployed FreeFallCameraSystem.**		1/12 12:00(UTC+10h)
	06:02	Sent out release command Free Fall Camera System		MARIANA trench
	06:06	Free Fall Camera System left the sea bottom.		11-22.0N,142-25.0E
	08:20-08:30	Sampling surface sea water.	11-22.0391N,142-25.0908E	Fine but Cloudy
	09:40	Refloated Free Fall Camera System.		ENE-6(Strong breeze)
	10:17	Recovered FreeFallCameraSystem.		4(Sea moderate)
	16:12-16:25	Launched Free Fall Camera System.	11-22.2540N,142-26.0350E	4(Moderate average)
	19:46-20:44	Carried out Calibration for abobe Free Fall Camera System(Depth=10902.6m).	11-22.1942N,142-25.7594E	Visibly-8
	20:45	Proceeded to area E.		
	20:59	Com'ced MBES site survey.		
13-Jan-14		**2nd & 3rd Multiple CoreSampler operation**		1/13 12:00(UTC+10h)
	03:50	Finished MBES site survey,& Arrived at area E.		MARIANA trench
	05:47	Released at XBT.	10-15.8258N,142-35.7994E	10-27.8N,142-35.0E
	07:24	Launched multiple cores.		Fine but Cloudy
	08:25-08:30	Sampling surface sea water.	10-18.0056N,142-36.0331E	East-4(Moderate breeze)
	09:13	Multiple cores stuckm in the sea bottom(Depth=4,700m).	10-17.9803N,142-36.0157E	3(Sea slight)
	09:15	Multiple cores left the sea bottom.		4(Moderate average)
	10:50	Recovered Multiple cores.		Visibly-8
	11:00	Proceeded to area F.		
	13:00	Arrived at research areaF.		
	13:50	Lounched multiple cores.		
	15:40	Multiple cores stuckm in the sea bottom(Depth=5,183m).	10-38.9897N,142-33.0738E	
	15:42	Multiple cores left the sea bottom.		
	14:00	Sampling surface sea water.		
	17:26	Recovered Multiple cores.		
	18:10	Proceeded to area D.		
	19:40	Arrived at research areaD.		
	19:44-20:01	Carried out MBES site survey.		
	20:04	Released to XBT.		
14-Jan-14		**4th MultipleCoreSampler operation**		1/14 12:00(UTC+10h)
	08:19	Launched multiple cores.		MARIANA trench
	08:30-09:00	Scientists meeting.		10-55.0N,142-32.0E
	09:25	Sampling surface sea water.	10-54.9488N,142-32.0340E	Fine but Cloudy
	10:27	Multiple cores stuckm in the sea bottom(Depth=6,067m).	10-54.9966N,142-32.0730E	East-5(Fresh breeze)
	10:29	Multiple cores left the sea bottom.		4(Sea moderate)
	12:37	Recovered Multiple cores.		4(Moderate average)
	15:30	Proceeded to area C.		Visibly-8
	17:50	Arrived at area C.		
	17:53-18:33	Carried out MBES site survey.		

日付 Date	時間 Local Time	内容 Note	特記事項 Description	本船位置／気象／海象 Position/Weather/Wind/Sea condition
15-Jan-14		**ABISMO #20 Dive**		1/15 12:00(UTC+10h)
	08:22	Hoisted up ABISMO		MARIANA trench
	08:29	Launched ABISMO,then it dove & com'ced her operation #20.		11-22.2N,142-25.8E
	08:30-09:00	Scientist meeting.		Fine but Cloudy
	15:15	Hoisted up ABISMO.		East-5(Fresh breeze)
	15:25	Recovered ABISMO & Finished her operation.		4(Sea moderate)
	16:00	Proceeded to area B.		4(Moderate average)
	18:13-21:06	Carried out MBES site survey.		Visibly-8
16-Jan-14		**ABISMO #21 Dive**		1/16 12:00(UTC+10h)
	07:00	Arrived at area B.		MARIANA trench
	08:29	Hoisted up ABISMO		11-35.8N,142-25.7E
	08:35	Launched ABISMO,then it dove & com'ced her operation #21.		Fine but Cloudy
	12:00	ABISMO on the sea bottom(Depth=7,477m).		East-4(Moderate breeze)
	12:24	ABISMO left sea bottom(Depth=7,477m).		3(Sea slight)
	15:54	Hoisted up ABISMO.		4(Moderate average)
	16:14	Recovered ABISMO & Finished her operation.		Visibly-8
	17:25	Proceeded to area C.		
	19:30	Arrived at area C.		
17-Jan-14		**Recovered Free Fall Camera System & ABISMO #22 Dive**		1/17 12:00(UTC+10h)
	05:05	Sent out release command Free Fall Camera System.		MARIANA trench
	08:00-08:20	Scientists meeting.		11-22.2N,142-25.7E
	08:29	Refloated to Free Fall Camera System.		Fine but Cloudy
	08:35-09:00	Recovered Free Fall Camera System.		East-4(Moderate breeze)
	11:20	Hoisted up ABISMO		3(Sea slight)
	11:26	Launched ABISMO,then it dove & com'ced her operation #22.		4(Moderate average)
	11:45	Sampling surface sea water.	10-54.9488N,142-32.0340E	Visibly-8
	14:20	Hoisted up ABISMO.		
	14:30	Recovered ABISMO & Finished her operation.		
	15:30	Proceeded to area A2.		
	17:22	Arrived at area A2.		
	17:22-18:41	Carried out MBES site survey.		
18-Jan-14		**5th MultipleCoreSampler operation**		1/18 12:00(UTC+10h)
	08:17	Launched multiple cores.		MARIANA trench
	08:30-09:00	Scientists meeting.		11-22.2N,142-25.7E
	10:19	Multiple cores stuck in the sea bottom(Depth=5,838m).	11-44.7785N,142-06.5215E	Fine but Cloudy
	10:29	Multiple cores left the sea bottom.		East-4(Moderate breeze)
	12:22	Recovered Multiple cores.		3(Sea slight)
	12:14	Proceeded to SAIPAN.		4(Moderate average)
				Visibly-8
19-Jan-14		**Proceeding to SAIPAN**		1/18 12:00(UTC+10h)
				West Rota Islands
				14-06.4N,144-30.0E
				Fine but Cloudy
				ENE-3(Gentle breeze)
				2(Sea sooth)
				3(Moderate short)
				Visibly-8
20-Jan-14		**Arrived at SAIPAN**		11/24 12:00 (UTC+9h)
	11:00	Sent out 1st shore line, arrived at SAIPAN,completed KR14-01.		SAIPAN

6. Observations

I. Camera system observatory

a. 1st deployment

Date: Jan 11, 2014 (15:04) – Jan 12, 2014 (10:17) (LTC)
Site: C (Challenger Deep)
Deploy (in): 15:04-15:19
On the bottom: 11-22.0533 N, 142-25.4486, 10901 m (19:13)
Release from the bottom: 06:06
Refloated: 9:40

Objective:
1) Taking trench bottom surface sediments and waters.

Payload:
1) CTD
2) 3 Sediment samplers
3) 3 5L Niskin bottles

Results
Each three cores and Niskin bottles of bottom waters were successfully retrieved. Niskin bottles were closed about 23:00 11th by using electric erosion triggers.

b. 2nd deployment

Date: Jan 12, 2014 (16:12) – Jan 17, 2014 (9:00) (LTC)
Site: C (Challenger Deep)
Deploy (in): 16:12-16:25
On the bottom: 11-22.1942 N, 142-25.7594, 10903 m (19:39)
Release from the bottom: 5:05 17th
Refloated: 8:29

Objectives:
1) In situ incubation for benthic nitrification.
2) Taking trench bottom waters

Payload:
1) CTD

2) 3 Sediment samplers with in situ incubation system

3) 1 5L Niskin bottle

4) 1 syringe water sampler

Results

Three cores (two incubation cores and one control cores) and one Niskin bottle were successfully recovered. The bottle was closed at 15th evening using an electronic erosion trigger. However, syringe water sampler did not functioned.

II. Multiple corer operations

Station A

Date: Jan 11, 2014

Location: 142-25.2305 E, 11-52.2518 N

Depth: 2,597m

Landing time: 9:07 (LTC)

Result: No core recovery. Only a small rock was obtained.

Station E

Date: Jan 13, 2014

Location: 142-36.0157 E, 10-17.9803 N

Depth: 4,700m

Landing time: Time: 9:12 (LTC)

Result:

E-1：35.5 (cm)

E-2：36.0

E-3：32.0

E-4：37.0

E-5：3.0

E-6：37.5

E-7：39.0

E-8：38.0

Station F

Date: Jan 13, 2014

Location: 142-33.0738 E, 10-38.9897 N

Depth: 5,183 m

Landing time: 15:40 (LTC)
Payload: turbidity sensor

Result:

F-1 : 18.0 (cm)
F-2 : 7.5
F-3 : 0
F-4 : 4.5
F-5 : 0
F-6 : 20.0
F-7 : 22.5
F-8 : 0

Station D
Date: Jan 14, 2014
Location: 142-32.0340 E, 10-54.9488 N
Depth: 6,067m
Landing time: 9:10 (LTC)
Payload: turbidity sensor

Result:

D-1 : 17.0 (cm)
D-2 : 26.0
D-3 : 21.5
D-4 : 12.0
D-5 : 7.5
D-6 : 25.5
D-7 : 25.5
D-8 : 26.0

Station A2
Date: Jan 18, 2014
Location: 142-06.5215 E, 11-44.7785 N
Depth: 5,838 m
Time: 10:18 (LTC)
Payload: turbidity sensor

Result:

A2-1 : 39.5 (cm)
A2-2 : 35.0
A2-3 : 37.0
A2-4 : 26.5
A2-5 : 25.5
A2-6 : 14.0
A2-7 : 36.0
A2-8 : 3.0

ABISMO Dives

#AB20

Date: Jan 15, 2014
Location: 142-25.75'E, 11-22.19 N
Station C
Depth: 7900 m
Dive: 8:29 -15:15 (LTC)
Payloads:
1) CTD
2) 7 5L Niskin bottles
3) 5 pressure tight water samplers
4) 4D camera system (Natsushima 1)

Objectives and dive summary

Taking trench waters and bathypelagic waters by Niskin bottles in order to estimate activities and genetic diversity of both microbes and viruses. Pressure tight water samplers were also deployed in this dive, but they did not function well. On the other hand, we tested newly arranged 4D camera system was applied in the ABISMO dive, and it functioned well.

Samples:

Water samples (Niskin bottles)

KR14-01 CANW1 (7900 m)
KR14-01 CANW2 (7900 m)
KR14-01 CANW3 (7900 m)

KR14-01 CANW9 (7900 m)
KR14-01 CANW10 (3977 m)
KR14-01 CANW11 (3971 m)
KR14-01 CANW12 (3965 m)

#AB21

Date: Jan 16, 2014
Location: 142-25.70 'E, 11-35.82 N
Station B
Depth: 7477 m
Dive: 8:35-15:54 (LTC)
Payloads:
1) CTD
2) 11 5L Niskin bottles
3) 1 pressure tight water sampler
4) 1 gravity corer (2m)
5) 4D camera system (Natsushima 1)

Major objectives of this dive were i) to identify the hydrothermal activity on the north slope of the Challenger Deep below 5500m by taking trench waters and sediments, and ii) to estimate activities and genetic diversity of both microbes and viruses in trench waters and mesopelagic waters. On the aspect of technical development of the ROV operation, we tested landing of a beagle of the ROV system that had not been completed before.

We successfully obtained 11 Niskin bottles of waters and a gravity cores, but a pressure tight water samplers did not function well. Landing of the beagle was successfully achieved and the 4D camera system on it took good movies of the north slope of the Challenger Deep.

Samples:

Waters
KR14-01 BANW1 (7395 m)
KR14-01 BANW3 (6933 m)
KR14-01 BANW4 (6967 m)
KR14-01 BANW5 (6495 m)

KR14-01 BANW6 (5994 m)
KR14-01 BANW7 (5494 m)
KR14-01 BANW8 (2994 m)
KR14-01 BANW9 (1249 m)
KR14-01 BANW10 (1241 m)
KR14-01 BANW11 (1233 m)
KR14-01 BANW12 (99 m)

Sediment
KR14-01 BAGC (1.88m) (7496m)

#AB22
Date: Jan 17, 2014
Location: 142-25.75'E, 11-22.19 N
Station C
Depth: 7900 m
Dive: 8:29 -15:15 (LTC)
Payloads:
1) CTD
2) 12 5L Niskin bottles
3) 4D camera system (Natsushima 1)
4) turbidity sensor

Objectives and dive summary

Taking (meso)pelagic waters by Niskin bottles in order to estimate activities and genetic diversity of both microbes and viruses. 11 of the Niskin bottles successfully functioned.

Samples:
Water samples (Niskin bottles)
KR14-01 C2ANW1 (2000 m)
KR14-01 C2ANW2 (2000 m)
KR14-01 C2ANW3 (2000 m)
KR14-01 C2ANW4 (2000 m)
KR14-01 C2ANW5 (503 m)
KR14-01 C2ANW6 (502 m)

KR14-01 C2ANW7 (501 m)

KR14-01 C2ANW8 (500 m)

KR14-01 C2ANW10 (204 m)

KR14-01 C2ANW11 (203 m)

KR14-01 C2ANW12 (201 m)

7. List of sampling stations

Date	Sample	Detail	Sea Area		LCT (UTC+10hour)	Depth(m)	LON		LAT	
2014.1.11	water	ocean depth water	Multiple cores	A	9:07	2,597.0	142-25.2305	E	11-52.2518	N
		ocean surface water	bucket		8:10	0.0	142-25.1308	E	11-52.8085	N
	other	benthos?	Multiple cores		9:07	2,597.0	142-25.2305	E	11-52.2518	N
2014.1.12	water	ocean depth water	Free Fall Camera System	C	6:06	10,899.0	142-25.4486	E	11-22.0533	N
		ocean surface water	bucket		8:20	0.0	142-25.0908	E	11-22.0391	N
	sediment	-	Free Fall Camera System		6:06	10,901.0	142-25.4486	E	11-22.0533	N
2014.1.13	water	ocean depth water	Multiple cores	E	9:12	4,700.0	142-36.0157	E	10-17.9803	N
				F	15:40	5,183.0	142-33.0738	E	10-38.9897	N
		ocean surface water	bucket	E	8:21	0.0	142-36.0331	E	10-18.0056	N
				F	14:00	0.0	142-33.0189	E	10-39.0173	N
	sediment	-	Multiple cores	E	9:12	4,700.0	142-36.0157	E	10-17.9803	N
				F	15:40	5,183.0	142-33.0738	E	10-38.9897	N
2014.1.14	water	ocean depth water	Multiple cores	D	10:27	6,067.0	142-32.0340	E	10-54.9488	N
		ocean surface water	bucket		9:26	0.0	142-32.0730	E	10-54.9966	N
	sediment	-	Multiple cores		10:27	6,067.0	142-32.0340	E	10-54.9488	N
2014.1.15	water	ocean depth water	Niskin water sampler (ABISMO)	C	11:43	7,900.0	142-25.8041	E	11-22.1922	N
					13:14	4,000.0	142-25.7641	E	11-22.1980	N
2014.1.16	water	ocean depth water	Niskin water sampler (ABISMO)	B	11:34	7,395.0	142-25.7723	E	11-35.8323	N
					13:05	6,967.0	142-25.7616	E	11-35.8348	N
					13:06	6,933.0		E		N
					13:14	6,495.0	142-25.7675	E	11-35.8269	N
					13:22	5,994.0	142-25.7686	E	11-35.8370	N
					13:30	5,494.0	142-25.7693	E	11-35.8316	N
					14:09	2,994.0	142-25.7429	E	11-35.8518	N
					14:59	1,249.0	142-25.7407	E	11-35.8605	N
						1,241.0		E		N
					15:00	1,233.0		E		N
	sediment	?	Gravity core(ABISMO)		12:42	7,476.0	142-25.7734	E	11-35.8337	N
2014.1.17	water	ocean depth water	Niskin water sampler (ABISMO)	C	12:53	2,000.0	142-25.7660	E	11-22.1899	N
					12:54			E		N
					13:47	503.0	142-25.7227	E	11-22.1841	N
						502.0				N
						501.0				N
						500.0				N
					14:03	204.0	142-25.6857	E	11-22.1668	N
					14:04	203.0				
						201.0				
			Free Fall Camera System		5:05	10,902.6	142-25.7594	E	11-22.1942	N
		ocean surface water	bucket		11:45	0.0	142-25.8032	E	11-22.1886	N
	sediment	-	Free Fall Camera System		5:05	10,903.2	142-25.7594	E	11-22.1942	N
2014.1.18	water	ocean depth water	Multiple cores	A2	10:18	5,838.0	142-06.5215	E	11-44.7785	N
	sediment	-	Multiple cores							

8. Acknowledgements

We are grateful to Captain Mr. Nakamura, Chief Officer Mr. Tsuji and Chief Engineer Mr. Funae for their safe navigation and their skillful handling of “R/V Kairei”. Great thanks are due to Commander Mr. Miura and “Kaiko” operation team and a multiple core operation team (Mr. Miyajima and Mr. Oshitani) for their operations in sampling. We also appreciate Mr. Nasu for his any assistance in any aspects of the expedition.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.

9. 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.