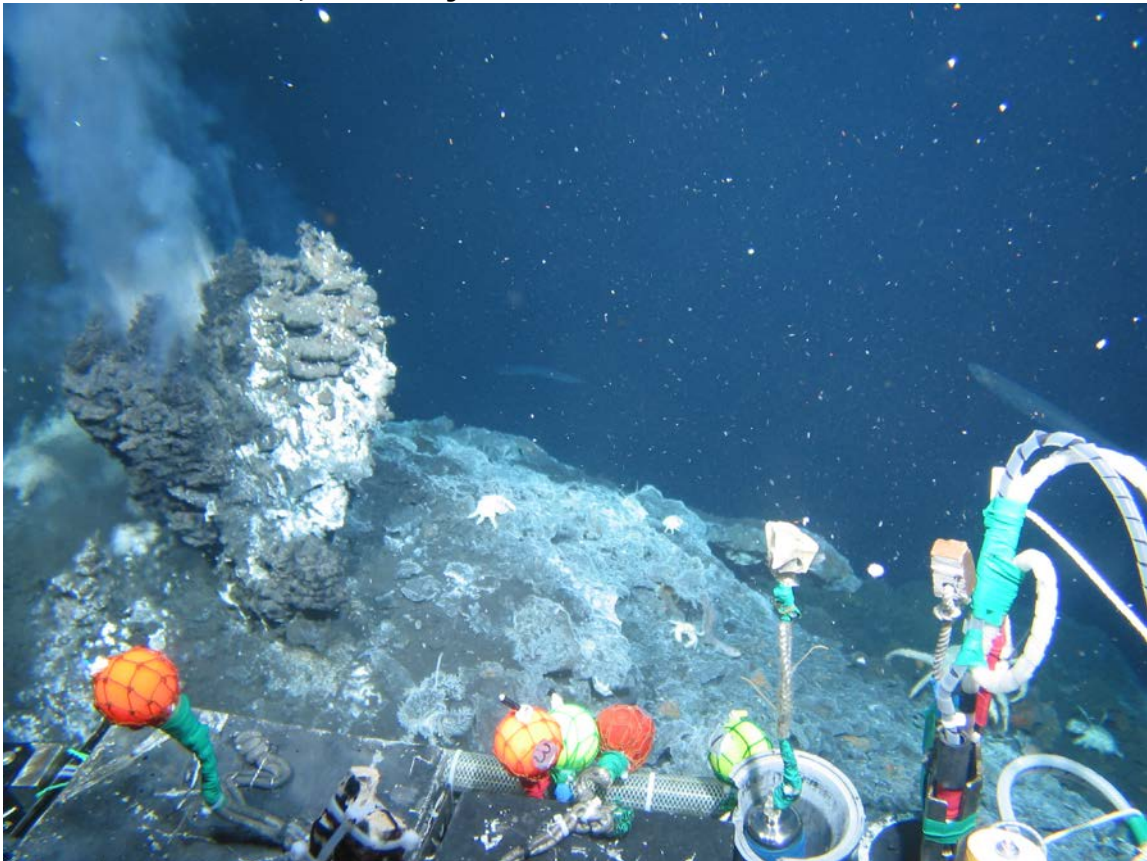




R/V Kaiyo & ROV Hyperdolphin Cruise Report KY14-01

**Post-drilling investigation of hydrothermal activities and
ecosystem in Iheya North field and exploration of
hydrothermal activities in the Iheya North Knoll**

**January 8, 2014 from Yokohama –
January 31, 2014 to Naha**



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

Acknowledgements

We are grateful to Captain Mr. T. Aoki, Chief Officer Mr. M. Chiba and Chief Engineer Mr. T. Abe for their safe navigation and their skillful handling of “R/V Kaiyo”. Great thanks are due to ROV Operation Manager Mr. T. Kondo and “HyperDolphin” operation team for their operations in sampling. We also thank Mr. S. Okada, Nippon Marine Enterprise, Ltd., for his attentive supports. We thank all the JAMSTEC personnels who have supported us and this cruise. Finally, we would like to appreciate all the persons who have encouraged directly or indirectly this cruise.

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Cruise information

Cruise ID: KY14-01

Vessel: Kaiyo

Title of the cruise: Post-drilling investigation of hydrothermal activities and ecosystem in Iheya North field and exploration of hydrothermal activities in the Iheya North Knoll

Chief scientist [Affiliation]: Dr. Ken Takai [JAMSTEC]

RePresentative of Science Party: Dr. Ken Takai

Title of proposal: Post-drilling investigation of hydrothermal activities and ecosystem in Iheya North field and exploration of hydrothermal activities in the Iheya North Knoll

Cruise period: January 8 – January 31, 2014

Ports of call: Yokohama – Naha, Japan

Research area:

1. Okinawa Trough

Research map:

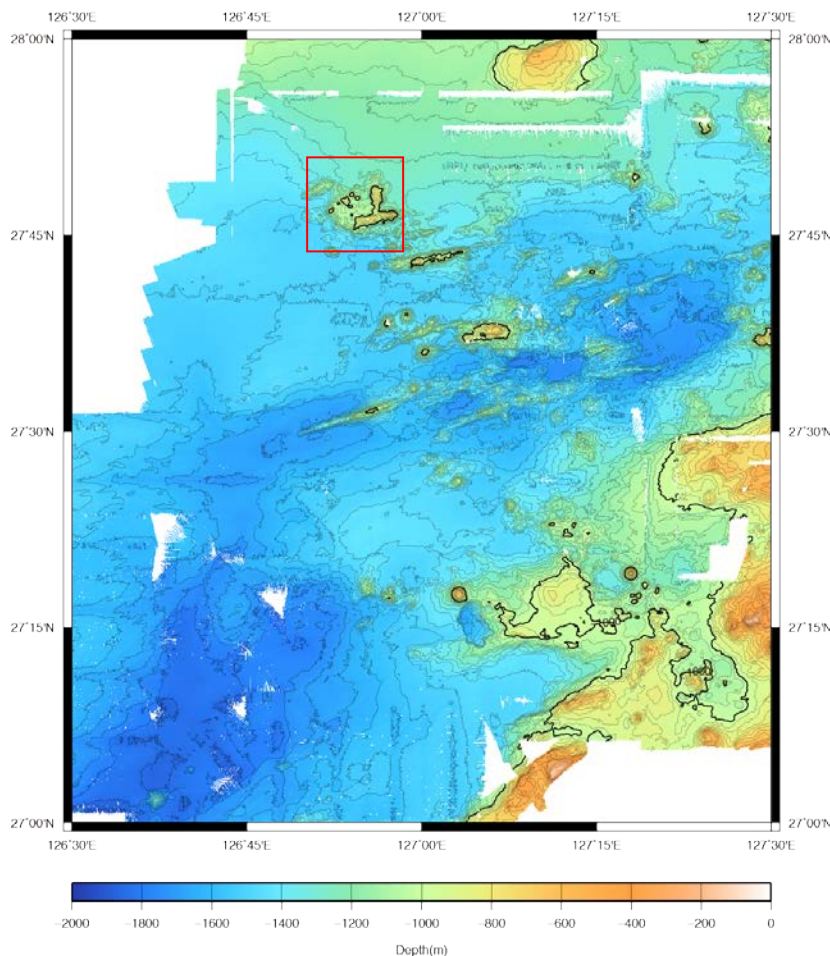


Fig. 1. Bathymetry map of mid-Okinawa Trough. Red square means the Iheya North Knoll that we focus on in this cruise.

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Chief Officer	Masato Chiba
2nd Officer	Tomoyuki Takahashi
3rd Officer	Tomohiro Yukawa
Chief Engineer	Tadashi Abe
1st Engineer	Kimio Matsukawa
2nd Engineer	Shiniki Ikuta
3rd Engineer	Shohei Miyazaki
Chief Radio Officer	Fukuo Suda
2nd Radio Officer	Sunsuke Fukagawa
3rd Radio Officer	Takayuki Mabara
Boat Swain	Kazuo Abe
Able Seaman	Shuji Takuno
Able Seaman	Nobuyuki Ichikawa
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Sailor	Yusaku Kanada
Sailor	Yosuke Horii
No.1 Oiler	Hiroyuki Oishi
Oiler	Yuji Higashigawa
Oiler	Keita Taniguchi
Assistant oiler	Tyo Sato
Assistant oiler	Aoi Takamiya
Chief steward	Tomihisa Morita
Steward	Koji Kirita
Steward	Yoshinobu Hasatani
Steward	Yukihide Chikuba
Steward	Kinoshita Haruka

“HyperDolphin” Operation Team

Operation Manager

2nd ROV operator

2nd ROV operator

2nd ROV operator

2nd ROV operator

2nd ROV operator

Tomoe Kondo

Katsushi Chiba

Yousuke Chida

Atsushi Takenouchi

Ryo Saigo

Ryu Asai

I. CRUISE SUMMARY

In KY14-01 cruise, we have totally conducted 11 dives of HyperDolphin in three different hydrothermal vent sites including newly discovered two sites in the Iheya North Knoll, Mid Okinawa Trough. In the first half of this cruise, we encountered quite bad sea conditions and thus, we conducted only two dives. In the first half, we planned to conduct the complete mapping of seafloor hydrothermal events in the Iheya North field, which had been highly affected by scientific drilling operations of Chikyu in September, 2010, using SeaXeroxs and Serpent Camera. Only one but exceptionally long dive of hyperDolphin, the SeaXeroxs and Serpent Camera surveys covered major hydrothermal event area, for example, huge hydrothermal mound area (NBC, SBC, ESBC, CBC, C0016B artificial hydrothermal vent and E18 vent), newly created hydrothermal vents and diffuse area (C0014G artificial hydrothermal vent) and diffusing flow area (C0013E artificial hydrothermal vent). These detail seafloor mapping will provide not only post-drilling impact on the whole landscape of the Iheya North field but also the world's first quantitative estimation of biomass and migration-colonization pattern shifts in the macrofaunal components in the vent-endemic chemosynthetic ecosystem that have responded to episodic environmental change events.

During the dive surveys in the Iheya North field in this cruise, I (Ken Takai) found that NBC mound structure and landscape had been considerably changed since the drilling operation. In two years after the drilling operation, high temperature hydrothermal fluid discharge was quite focused at the newly created vent (C0016A) and rapid growing big chimney was outstanding. However, during this cruise, more than three years later, the hydrothermal discharge from C0016A vent became weak. Instead, many diffusing flows and their total fluxes were highly increased from middle parts of NBC close to top of the mound. According to the increased side discharge flows, lots vent-endemic faunal communities increased their populations in the middle parts. This was an important observation of NBC mound structure and landscape that should be recorded at this stage.

In this cruise, we have established state-of-art in situ chemical measurements using Unisense multichemical sensors, particularly to characterize physical and chemical conditions of zonation of macrofaunal populations. We tested H₂, H₂S, DO and N₂O concentration sensors this time and will develop CH₄ concentration sensor next. Although operation and manipulation of sensors were still to be developed, the obtained data seemed to be excellent. We certainly detected tiny but clear difference of chemical environments of different representative fauna such as *Paralvinella*, *Shinkaia* and *Bathymodiolus*. The in situ chemical conditions were quite important to estimate their metabolic activities and rates of energy and carbon species derived from the hydrothermal fluid inputs. In addition, we conducted lots of onboard metabolic experiments of representative faunal species and chimney structures.

The most outstanding achievement during this cruise is discovery of two new hydrothermal vent fields in the Iheya North Knoll other than the Iheya North field (Iheya North Original field). Since November 2013, JAMSTEC Submarine Hydrothermal System Research Team had conducted the exploration of systematic submarine hydrothermal activities in the Mid Okinawa Trough by means of next generation surveys called as HOT EXPRESS (Hydrothermalisms in Okinawa Trough Exploration by Polyphasic Research Survey). R/V Natsushima, R/V Yokosuka and AUV Urashima had detected quite solid

visualized signals of hydrothermal activities several km south from the Iheya North Original field. The detail topographic mapping also identified possible hydrothermal mounds and chemical sensors indicated the hydrothermal plumes at around the signature positions. Based on these survey data, we conducted three dives of HyperDolphin at the most likely area in the southern parts of the Iheya North Knoll. Without any hesitation, we successfully found high-temperature hydrothermal fluid vents, hydrothermal mounds, widespread faunal communities, and seafloor hydrothermal deposits in the two candidate fields. The hydrothermal fluids of the two new fields (Iheya North Natsu field and Iheya North Aki field) seemed to be physically and chemically similar to those of the Iheya North Original field, and the faunal compositions quite resembled each other. These three hydrothermal fields likely had common sunseafloor hydrothermal fluid sources such as subseafloor hydrothermal fluid reservoir and whole hydrothermal fluid flow paths. This implied that Iheya North Original, Natsu and Aki fields comprised one gigantic hydrothermal system (>3 km horizontal extension at the seafloor events). The spatial magnitude was the largest among the hydrothermal systems ever found in the Okinawa Trough. More importantly, these two new hydrothermal fields were realistically surveyed, discovered and explored in 4.5 days totally. Our HOT EXPRESS scheme was a revolutionary method to uncover the previously unknown hydrothermal systems in the Okinawa Trough.

II. INTRODUCTION

1. General backgrounds

In September 2010, Integrated Ocean Drilling Program (IODP) Expedition 331 was conducted in the Iheya North field of the Okinawa Trough, Japan [Takai et al., 2011]. The goal of IODP Expedition 331, named as Deep Hot Biosphere, was to test for the presence of a functionally active, metabolically diverse subvent biosphere in its physical, geochemical, and hydrogeologic context within the Iheya North deep-sea hydrothermal system. The major scientific objectives of Expedition 331 drilling were: 1) to test for the existence of a functionally active, metabolically diverse subvent biosphere associated with seafloor hydrothermal activity; 2) to clarify the architecture, function, and impact of seafloor microbial ecosystems and their relationship to physical, geochemical, and hydrogeologic variations within the hydrothermal mixing zones around the discharge area; and 3) to establish artificial hydrothermal vents in cased holes from potential seafloor hydrothermal flows, and to prepare a research platform at each cased hole for later study of fluids tapped from various parts of the hydrothermal system and their associated microbial and macrofaunal communities.

Totally, five sites were drilled during Expedition 331: the active hydrothermal vent site and sulfide-sulfate mound at North Big Chimney (NBC) (Site C0016); three sites east of NBC at distances of ~100, 450, and 1550 m from the active vents (Sites C0013, C0014, and C0017, respectively); and one site on a hill ~600 m northwest of the active vents that represents a potential migration path for hydrothermal fluid (Site C0015) [Takai et al., 2011]. In addition, during the IODP Expedition 331, four new hydrothermal vents were created. These post-drilling artificial hydrothermal vents provide excellent opportunities to investigate the physical, chemical and microbiological characteristics of the previously unexplored seafloor hydrothermal fluid reservoirs, and to monitor and estimate how the anthropogenic drilling behaviors affect the deep-sea hydrothermal vent ecosystem. The IODP porewater chemistry of the cores pointed to the density-driven stratification of the phase-separated hydrothermal fluids and the natural vent fluids were likely derived only from the shallower vapor-enriched phases. However, the artificial hydrothermal vents had deeper fluid sources in the seafloor hydrothermal fluid reservoirs composed of brine phases [Kawagucci et al., 2013]. The fluids from the artificial hydrothermal vents were sampled by ROV at 5, 12, 18 and 25 months after the IODP expedition. The artificial hydrothermal vent fluids were slightly enriched with Cl as compared to the natural hydrothermal vent fluids [Kawagucci et al., 2013]. Thus, the artificial hydrothermal vents successfully entrained the previously unexplored seafloor hydrothermal fluids. The newly created hydrothermal vents also hosted the very quickly grown, enormous chimney structures, of which mineral compositions were highly variable among the vents. In addition, the IODP drilling operation not only created new hydrothermal vents but also induced the newly generated diffusing flows by many short drillings in the seafloor where no apparent hydrothermal fluid discharge was observed. The new widespread diffusing flows altered the habitat condition, and provided post-drilling propagation and colonization of indigenous hydrothermal chemosynthetic animals.

References

Takai, K., Mottl, M. J., Nielson, S. H. H., and the IODP Expedition 331 Scientists (2012) IODP Expedition 331 finds enormous hydrothermally altered lithostratigraphy comparable to typical Kuroko deposits and

chemically stratified hydrothermal fluid reservoir, and points to possible existence of functionally active microbial communities beneath the Iheya North hydrothermal system, the Okinawa Trough. *Scientific Drilling*, 13, 19-27.

Kawagucci, S., Miyazaki, J., Nakajima, R., Nozaki, T., Takaya, Y., Kato, Y., Shibuya, T., Konno, U., Nakaguchi, Y., Hatada, K., Hirayama, H., Fujikura, K., Furushima, Y., Yamamoto, H., Watsuji, T., Ishibashi, J., and Takai, K. (2013) Post - drilling changes in fluid discharge pattern, mineral deposition, and fluid chemistry in the Iheya North hydrothermal field, Okinawa Trough. *Geochem. Geophys. Geosyst.*, 14, 4774-4790.

2. Objectives of the cruise

A primary scientific goal of this expedition is to understand the post-drilling propagation, colonization and function of indigenous hydrothermal chemosynthetic faunal and microbial communities in the Iheya North field. We have already shown the post-drilling changes in the hydrothermal fluid discharging patterns and the hydrothermal fluid chemistry [Kawagucci et al., 2013]. However, the post-drilling propagation, colonization and function of indigenous hydrothermal chemosynthetic faunal and microbial communities have been not fully explored. In addition, it has been evident that the hydrothermal mineral deposition patterns in the new and artificial hydrothermal vents after the IODP expedition are different from the previous patterns found in the natural hydrothermal vents before. Thus, we try to deploy the cultivation cell of hydrothermal mineral deposits in the C0014 artificial hydrothermal vent in this cruise. This is another scientific objective of this cruise. Finally, recent R/V Natsushima cruise and R/V Yokosuka and AUV Urashima cruise have successfully found two potentially new hydrothermal fields several km south of the Iheya North field in the Iheya North Knoll. Thus, we are going to observe the realistic seafloor hydrothermal activities in the previously predicted candidates of hydrothermally active areas.

References:

Kawagucci, S., Miyazaki, J., Nakajima, R., Nozaki, T., Takaya, Y., Kato, Y., Shibuya, T., Konno, U., Nakaguchi, Y., Hatada, K., Hirayama, H., Fujikura, K., Furushima, Y., Yamamoto, H., Watsuji, T., Ishibashi, J., and Takai, K. (2013) Post - drilling changes in fluid discharge pattern, mineral deposition, and fluid chemistry in the Iheya North hydrothermal field, Okinawa Trough. *Geochem. Geophys. Geosyst.*, 14, 4774-4790.

III. EXPLANATORY NOTE

1. Remotely Operative Vehicle "HyperDolphin"

Hyper Dolphin is 3000m ROV which was built by SSI (Canada) in 2001. The vehicle has two manipulator, a Hi-definition super harp TV camera, and a color CCD TV camera. In addition, digital photo camera, black and white TV camera for back side monitoring, altitude sensor, depth sensor (with temperature sensor), sonar for obstacle avoidance sonar.

(1) Principal specification

Length: about 3.0m
Depth capability: Maximum 3000m
Breadth: about 2.0m
Payload weight: -100kg (in the air)
Height: about 2.3m
Speed in the water: 0~3kt
Weight in the air: about 3800kg
Manipulators: 2 sets

(2) Manipulator capability

Pivot: 7 pivoted
Working load: in the water 68kg (max outreach)
Length of arm: 1.53m
Grasping power: 450kg
Hoisting power: max 250kg (vertical)
Hand opening width: right 77mm, left 195mm

(3) TV camera

a) Super Harp High-definition TV camera: 1

TV camera tube: 2/3"HD Super Harp tube, RGB3 tube
Optics system: F1.8, M type total reflection prism
Lens : F1.8(5.5 ~ 27.5mm)
Field angle : 72°
Sensitivity: 2000Lux @ F5.6 (high-quality mode)
2Lux @ F1.8 (high-sensitive mode)
Pan : +170° ~ -170°
Tilt : +90° ~ -90°

b) Color CCD TV camera 1

Type: ARIES (made by Insite Tritech, Inc)
Image-taking device : 1/2" Interline Transfer, POWER HAD CCD (×3)
Horizontal resolution: 750TVL
Lowest-light intensity: 5Lux @ F1.4
Lens : 5.5mm~77mm, 12×, F1.9~F16
Pan : more than 90°
Tilt : more than 90°

c) Black-and-white TV camera: 1

Type: EX520 (made by ELIBEX, Inc)
Horizontal resolution: 570TVL
Lowest-light intensity: 0.12Lux
Pan : 180°

Tilt : 180°

d) Digital still camera

Type : Sea Max (DPC-7000, made by Deep Sea system, Inc)

Imaging sensor : 3.24 megapixel CCD

Lens : widest-angle~28mm~84mm (as 35mm film conversion)

Still image capacity : 2MB/1image

Laser scale : 4 point green laser(3mW), 10cm×10cm sq

e) High-definition TV camera capture

HD images can capture by mouse click.

Dpi: 2 megapixels

Left clic : 1image(single shoot)

Light clic : 8images(serial shoot)

(4) Obstacle avoidance sonars

Type : SIMRAD MS1000

Range : 10, 20, 25, 50, 100, 200m change

Detective distance: max 100m

Transmission frequency : 330kHz±1kHz

(5) Altitude sonar

Type: SIMRAD MS1007

Frequency: 200 kHz

Measure range: -200m

Accuracy: -2m

(6) Depth sensor (with temperature sensor)

Type: made by Paroscientific,Inc

Range of measuring depth: -4000m

Range of measuring temperature: -2-40deg.

(7) Light

Type: Sea Arc2 (made by Deep Sea P&L, Inc)

Output power : 400W×5

(8) CTD/DO

Type: CTD Sensor : SBE19, DO Sensor;SBE43 (made by Sea Bird,Inc)

2. SeaXerocks Seafloor Mapping System

SeaXerocks is a mapping system for collecting high quality image data of the seafloor from altitudes of up to 10m, which are then processed to generate a 3D reconstruction of the mapped area in its actual colours.

It consists of multiple cameras, four synchronised flashes, a sheet laser and navigation sensors. Fig. 1 shows the equipment mounted on a payload skid, which was fixed in Hyper-Dolphin's payload bay.

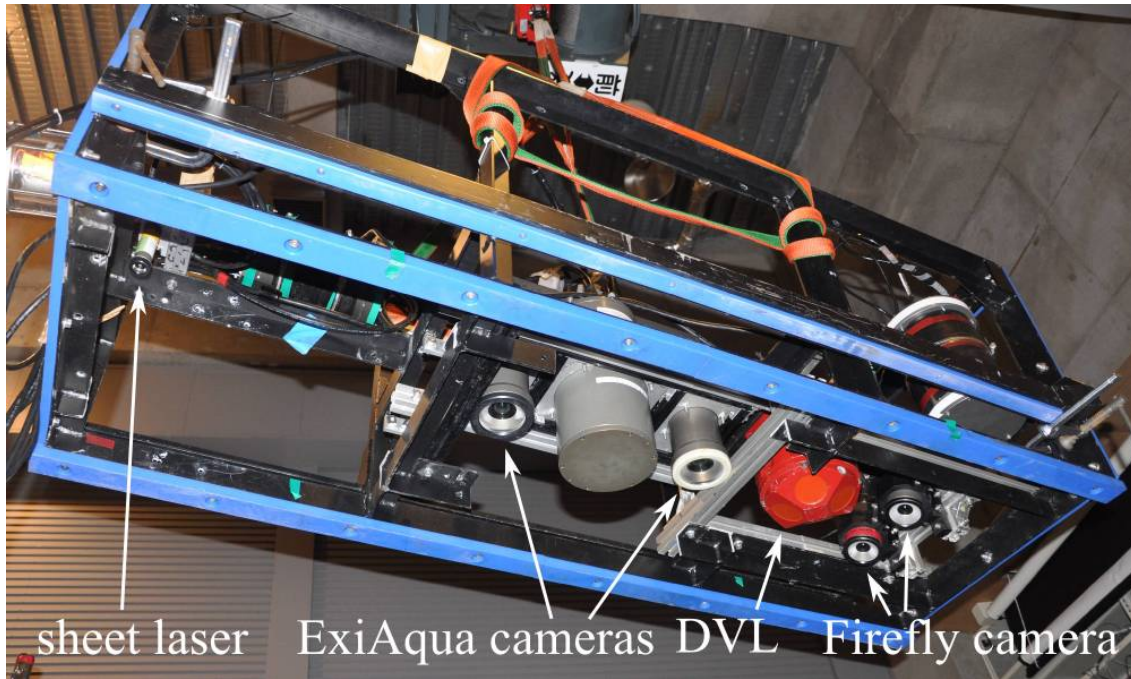


Fig. 1: SeaXerocks mapping system mounted on payload skid.

3D bathymetry information is measured using a laser scanning system, where a sheet laser projects a line onto the seafloor, and a camera (Fig. 1 Firefly) records images of it at a rate of 15 fps. Flashed images are taken with high-sensitivity cameras (Fig. 1 ExiAqua cameras) at an interval of 6s. The combination of high sensitivity cameras, strong illumination from the flashes (mounted at the front and the back of Hyper-Dolphin) and a long baseline between them make it possible to perform colour imaging of the seafloor from altitudes of up to 10m, which, to our knowledge, is the longest range achieved for colour imaging underwater. This leads to a large covered area per photo and allows for nearly 10 times the acquisition rate at over 8000 m² per hour (A. Bodenmann, B. Thornton et. al: "Wide area 3D seafloor reconstruction and its application to sea fauna density mapping." in Proc. *Oceans International Conference*, IEEE , San Diego, 2013.). Navigation data is recorded from a DVL and depth sensor, as well as Hyper-Dolphin's PHINS DVL and an SSBL.

The image and navigation data is transformed in post-processing into a coloured 3D reconstruction. The laser line projection is extracted in a set of images to calculate a bathymetry map with sub-centimetre resolution. The colour information is matched with an algorithm that is aware of the lighting system and models the beam pattern of all flashes to correct for differences in illumination. The colour-balance is corrected for attenuation in water separately for every mapped point on the seafloor as a function of the distance from that point to the camera.

The result is a highly resolved and dimensionally accurate 3D map in actual colours. A preliminary result from data collected on dive HPD1610 is shown in Fig. 2.

During the next dive, HPD1611, over 40,000m² of the seafloor was mapped. This data will be used to quantify the distribution of macro fauna habitats in the Iheya North Field.

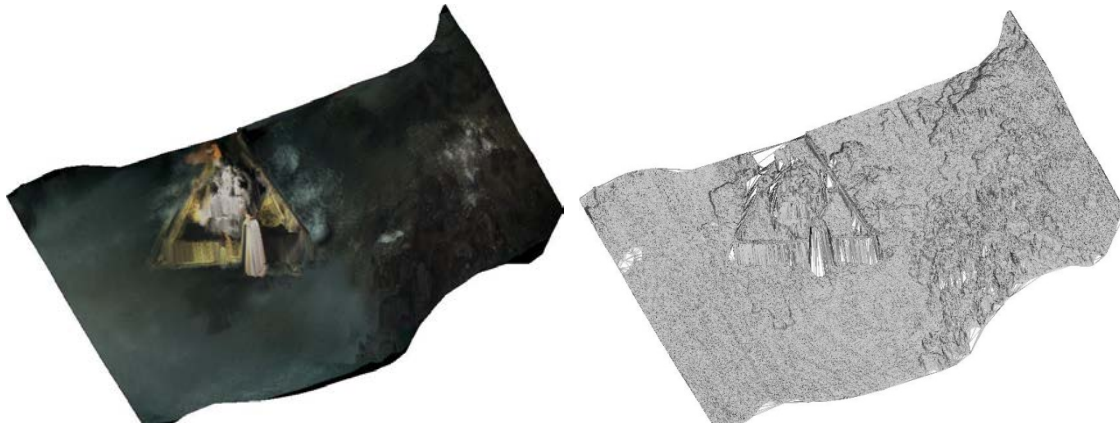


Fig. 2 Preliminary 3D colour reconstruction of guide base C0016B mapped in a single pass. The reconstruction shows significant deposition of sulphides surrounding the vent.

3. Serpent camera

The Autonomous Underwater Vehicle (AUV) group from the Australian Centre for Field Robotics (ACFR) have supplied the Serpent camera, a deep water stereo imaging camera for use on the Hyper Dolphin ROV.

The Serpent camera that has been attached to the sample basket on the Hyper Dolphin ROV contains two 1.3MP cameras, one colour and one monochrome configured as a stereo pair. The camera system has two LED strobes for illumination and internal storage for the images. The system is capable of taking images at up to 10 frames per second.

The camera is set up for operation at 2m altitude from the seafloor. Ideally the camera takes track lines with a 1m separation between lines. Using navigation data derived from the instruments on board the Hyper Dolphin and the ships SSBL along with the stereo images from the Serpent camera we are able to accurately determine the path that the ROV took. Once we know the path the ROV took we can create a 3D map of the sea floor using the data from the cameras and a stereo camera calibration which tells us the relative offsets of the cameras to each other.

Using tools developed at ACFR we are able to create a 3D mesh of the sea floor and drape the geo referenced images over the top giving a 3D image of the sea floor.

As part of the collaboration with the University of Tokyo we are able to also process the images from the SeaXerocks camera system to produce a 3D map via a different method to the one used in normal operation of this system.

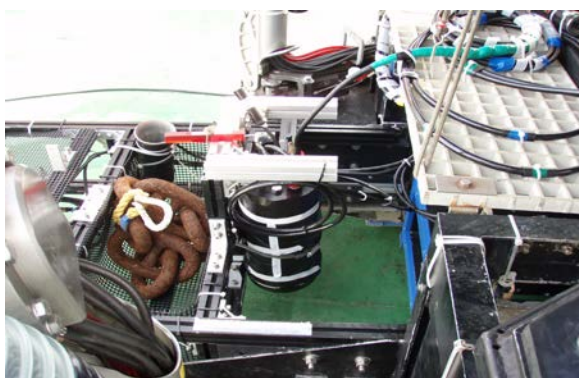
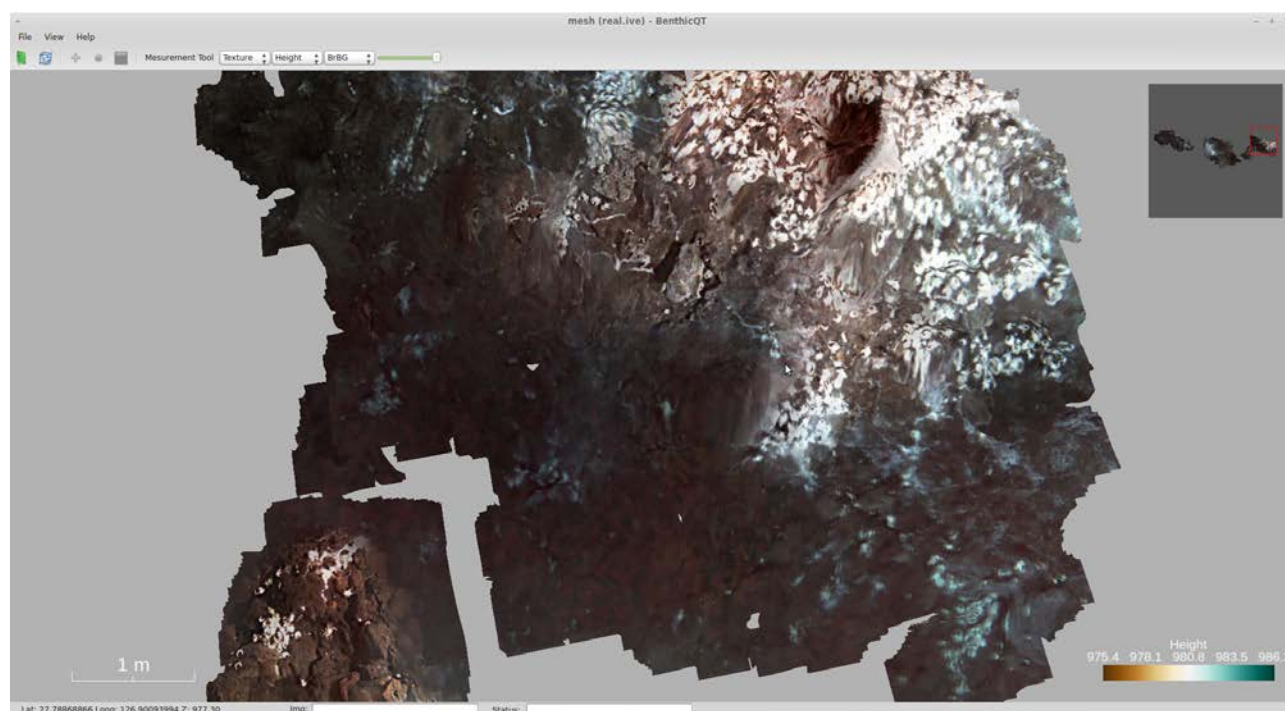


Photo showing the Serpent camera mounted in the sample basket of the Hyper Dolphin

ROV.



An example of a 3D reconstruction using the ACFR software. This was produced with data collected by the University of Tokyo's SeaXerocks camera. Due to a lack of time to collect data and an issue with the Serpent camera that involved opening the enclosure and thus requiring a recalibration no meshes could be generated. A calibration will be performed once the camera is back on Tokyo and the data will be processed in Sydney.

4. Geochemistry

WHATS fluid sampler

WHATS-II (Water Hydrothermal Atsuryoku Tight Sampler II) was developed for collecting hydrothermal fluid samples without any loss and atmospheric contamination of gas species. Since it overflows its sample bottle with sampling fluids, it is rather easy to collect fluids close to the endmember. This sampling system consists of inlet tubing, 4 pressure-resistant sample bottles with ball valves at both ends (volume of one bottle: 150 ml), an arm to open and shut the valve and a deep-sea compatible pump. Usually WHATS is installed just below the shell of Shinkai 6500 and a sample inlet is handled with a manipulator (Fig. 3-8). Operation is controlled from inside the shell. At the time of each sampling, fluid temperature can be monitored using a thermometer attached to the top of the inlet tube. It takes about 7 minutes to fill up one sample bottle of 150 ml capacity. Detailed description of the system is shown below.

Description

Dimension of frame:	600 mm × 660 mm
Weight:	35.2 kg in air 28.0 kg in seawater
Depth range:	4000 m
Sample volume:	150 ml × 4
Sampling rate:	75-300 ml / min

Electricity: DC24 V / 1.0 A

Ore-ryu 8 tubes & Junshiki 8 tubes samplers

Ore-ryu 8 tubes sampler is a newly developed gas-tight fluid sampler by Ken Takai, which much less cost than WHATS-II. The whole sampling scheme is very similar with that of WHATS-II but the manipulation of valve open/close is not operated by electric motor but by the submersible's or the ROV's manipulator. Gas-tight fluid is separately collected by 8 tubes and then are applied to the gas extraction and measurement. This improvement ensures the successful valve operation. However, in some cases, the successful valve operation is inhibited by messy payload and is affected by the unexpected physical misuse. Junshiki 8 tubes sampler further fakes Ore-ryu 8 tubes sampler and is more compact.

Description

Dimension of frame:	60 x 80 x 10 cm
Weight:	20 kg in air, 15 kg in water)
Depth range:	3500 m
Sample volume:	6 cc/tube
Sampling rate:	150 ml / min
Electricity:	DC24 V / 1.0 A

Treatment and onboard analyses of fluid samples for gas chemistry

In general, for vent fluid sampling, the WHATS-II sample bottles were in pairs, with one of the bottles used for the analysis of soluble components chemistry and the other for gas chemistry. The bottle devoted to gas chemistry was processed on board using a high vacuum line specifically designed for this purpose using the following procedure. After the WHATS bottle is connected to the vacuum line, all of the connecting lines are evacuated to high vacuum using an oil diffusion pump. When sufficient vacuum is achieved, the vacuum line is closed in a static condition, and the valve on the bottle is opened and the water plus gas is allowed to drop into an evacuated flask. Sulfamic acid or cadmium chloride is added to the flask prior to the extraction in order to acidify the sample and aid in the extraction of carbon dioxide or to precipitate H₂S gas and dissolved sulfide in the hydrothermal fluid as CdS for the subsequent sulfur isotope analysis. The water in the extraction flask is then agitated by stirring bar. The gas phase was transferred to a total of 150 cm³ evacuated stainless steel and glass container (for 34 compositional and isotope measurements of gas components). After the gas phase was obtained, the liquid phase was taken into a 50 cm³ polypropylene bottle (for major cation and anion measurements). The obtained gas sample in the glass container with a butyl rubber stopper was balanced with ultrapure He gas and the gas pressure was monitored by a manometer. Then, gas components were quantified by GC-PID system on board.

Onboard analyses for dissolved species

The bottle devoted to fluid chemistry was shared with microbiological study. After sample for pH, NH₄ and H₂S determination was drawn, the rest of the fluid was filtered with a 0.2μm disk filter. The filtrate was provided for chemical analysis of major elements, nutrients (NH₄), and trace metals. The filtrate aliquot for trace metals was acidified with nitric acid to avoid hydroxide precipitation during storage. Because some chemical species such as nutrients and pH are difficult to be conserved during storage, we therefore analyzed these species onboard. In this cruise, colorimetric methods and

titration were employed for onboard analyses as described below. Using the same apparatus, some conservative species were also analyzed. Most of these analytical methods are conventional ones and summarized in Gieskes et al. (1991).

Colorimetric method

Using a colorimeter (Shimazu, UV mini 1240), concentrations of ammonium ion (NH_4), and hydrogen sulfide (H_2S) were analyzed following classical methods; indo-phenol method ($\lambda=640\text{nm}$) for NH_4 and methylene blue method ($\lambda=670\text{nm}$) for H_2S . Analytical precision is usually better than 3% for seawater analysis, although sometimes the precision is somewhat worse for the case of hydrothermal fluids due to wide range of concentrations (H_2S) and interference by specific species (NH_4).

5. Microbiology and macrobiology

Sample preparation

For cultivation, water samples collected by the Niskin bottle and WHATS were immediately poured into sterilized glass vials under the atmosphere of nitrogen gas. Chimney samples were subsampled into several portions (e.g. vent orifice surface, inside structure, middle-inside structure). Each piece of chimney structure was slurried with filter-sterilized seawater under N_2 for cultivation. For molecular analysis, the rest of pieces was kept under $-80\text{ }^\circ\text{C}$. Hydrothermal vent animals were dissected, incubated, or fixed once onboard ship. Individuals or their tissues were applied to various onboard experiments (e.g. enzyme activity measurement and incubation under the H_2 -containing atmosphere), or kept under $-80\text{ }^\circ\text{C}$. Some individuals of hydrothermal vent animals were frozen under $-80\text{ }^\circ\text{C}$ or fixed with ethanol or formalin.

IV. DIVE REPORTS

#1610 DIVE (Iheya North Field Original site)	Dr. Hisako Hirayama
#1611 DIVE (Iheya North Field Original site)	Dr. Blair Thornton
#1612 DIVE (Iheya North Field Original site)	Dr. Hiromi Watanabe
#1613 DIVE (Iheya North Field Original site)	Dr. Yuka Masaki
#1614 DIVE (Iheya North Field Natsu site)	Dr. Ken Takai
#1615 DIVE (Iheya North Field Natsu site)	Dr. Ken Takai
#1616 DIVE (Iheya North Field Aki site)	Dr. Ken Takai
#1617 DIVE (Iheya North Field Aki site)	Dr. Ken Takai
#1618 DIVE (Iheya North Field Original site)	Dr. Hisako Hirayama
#1619 DIVE (Iheya North Field Original site)	Dr. Tomoo Watsuji
#1620 DIVE (Iheya North Field Original site)	Dr. Yuka Masaki

Dive Report: HPD Dive# 1610**Date:** January 12, 2014**Site:** NBC and C0016B sites in the Iheya North Hydrothermal Field**Landing:** 11:00; 27°47.5100N, 126°53.8531E, D= 1010m**Leaving:** 15:44; 27°47.4474N, 126°53.7852E, D=995 m**Observer:** Hisako Hirayama (JAMSTEC)**Objectives:**

The main objective of the dive #1610 is to collect vent-endemic animals in NBC mound for several purposes, such as activity measurements of microbial symbionts, an assessment of community changes induced by the IODP seafloor drilling, and various genetic analyses. In addition to the animal collection, there are several objectives in this dive. Other objectives are as follows: (1) recovery of two Hirayama's ISCS (in situ colonization system for microorganisms); (2) deployment of four Makita's ISCS; (3) collection of chimney fractions; and (4) deployment of calibration panels for a camera test at a landing point.

Dive summary:

HyperDolphin landed on the mud seafloor at about 130 m northeast of NBC, where there were white patches of microbial mats around there. We deployed two calibration panels for the camera test and Makita's ISCS (No.1) at the landing site. We headed to the northeast foot of NBC to retrieve Hirayama's ISCS (No. 1005-03) that was deployed in NT13-22 within a colony of *Bathymodiolus* mussels. After we found the ISCS (No. 1005-03), DO and temperature were measured next to the ISCS, and then the ISCS was retrieved in a sample box. Makita's ISCS (No.2) was deployed at the same site. *Bathymodiolus* mussels were sampled there in the No.1 & No.2 bottles of multi-bottle collector. The sampling sites for the No.1 & No.2 bottles were separated from each other for several meters.

We moved to galatheid colonies near the top of NBC. After DO and temperature measurement, galatheid individuals were collected in a single canister. We moved up to the top of NBC, and observed the hydrothermal venting for a while. A lot of *Shinkaicaris* shrimp were found to colonize on the surface of chimney close to the vent. After DO and temperature measurement, we collected *Shinkaicaris* shrimps in the No.3 bottle of multi-bottle collector. Chimney fractions were also collected in the No.4 bottle of multi-bottle collector and the Miyazaki's chimney box.

Next, we went down the NBC mound for several meters to find Hirayama's ISCS (No.1005-04) that was deployed in NT13-22 within a colony of galatheids and other various vent animals. After DO and temperature measurement next to the ISCS, it was retrieved in a sample box. Makita's ISCS (No.3) was deployed at the same place. The quantitative animal sampling was also conducted at the same place by using a mystery circle (the No.5 bottle of multi-bottle collector).

Next, we headed to the site C0016B where the seafloor was drilled by IODP

expedition in September 2010 and the guide-base was constructed around the borehole. First, we scanned the site C0016B using Blair's scan system to inspect any changes happened in the site. After the scan, the operation team of HyperDolphin found a cable issue. Recovery operations were carried out, and after one hour HyperDolphin was successfully recovered to good condition to do operations at the site C0016B. We measured DO and temperature at the chimney formed on the guide-base of C0016B. *Shinkaicaris* shrimps colonizing on the surface of chimney were collected in the No.7 bottle of multi-bottle collector. Makita's ISCS (No.4) was deployed on the guide-base. Chimney fractions were collected in both the sample box and the Miyazaki's chimney box. The RNA fixation reagent was injected into the Miyazaki's chimney box to protect microbial RNA in the chimney samples.

We successfully finished our operations and left the bottom. During ascending to the surface, the water in a single canister was exchanged with fresh seawater at depth of 800 m to keep galatheids in good condition.

Payloads:

- Suction sampler with multi-bottle (6-series) collectors and a single box collector
- DO sensor
- Recovery boxes (x3) for ISCS and chimney
- Miyazaki's chimney box for RNA fixation
- SeaXerox
- Stand-alone camera
- Makita's ISCS (x3)
- Calibration panels (x2)

Event list:

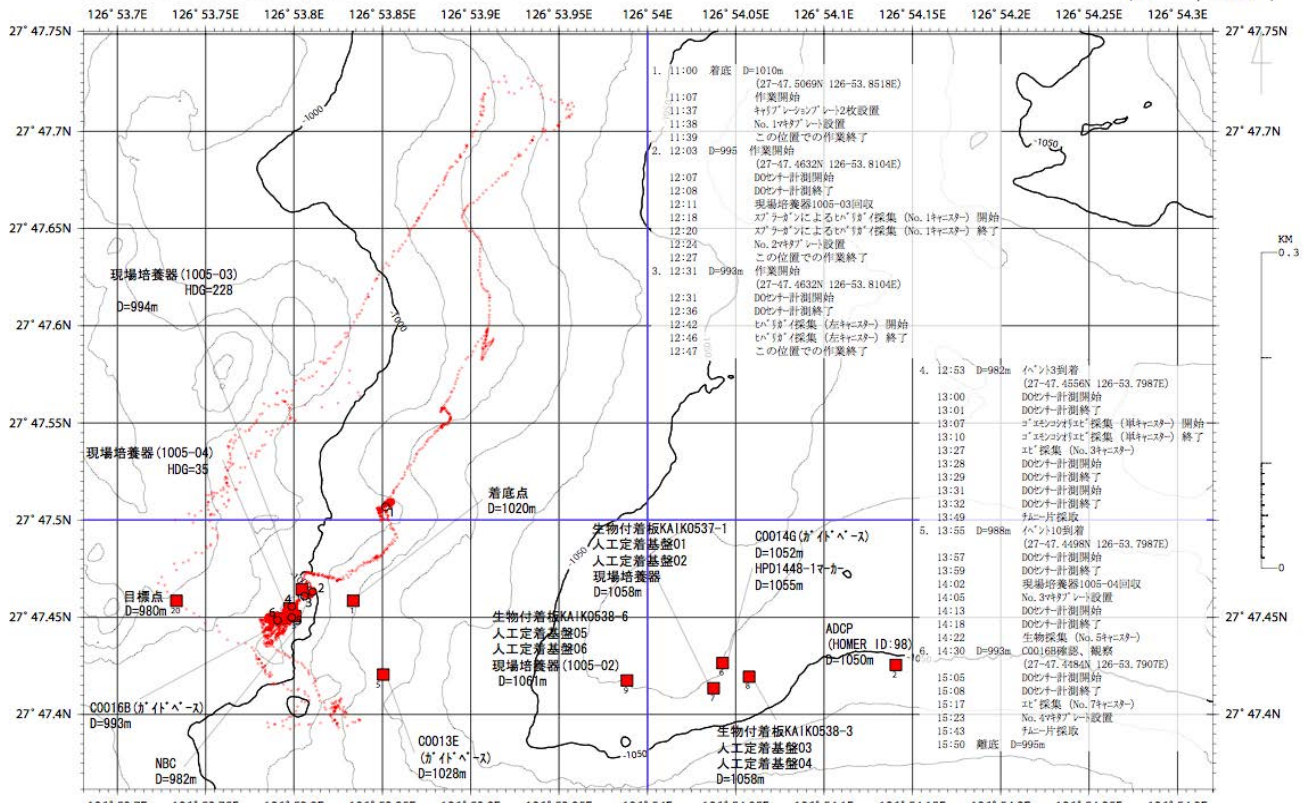
- 11:00 Landing at 120 m northeast of NBC, mud seafloor, white microbial mat patches there, a dead *Calyptogena* shell
27°47.5069N, 126°53.8518E, D=1010 m
- 11:10 Start deployment of calibration panels for the camera test
- 11:36 Finish the deployment of calibration panel at the landing site.
- 11:38 Deployment of Makita's plate at the landing site
- 11:42 Head to event mark #11 (*Bathymodiolus* colony at the foot of NBC mound)
- 12:03 Arrive at event mark #11
27°47.4632N, 126°53.8104E, D=995 m
- 12:07 DO measurement beside the ISCS (1005-03, light blue)
- 12:10 Recover ISCS in the box
- 12:16 *Bathymodiolus* mussel sampling (No.1 bottle)
- 12:23 Deployment of Makita's plate (No.2)

- 12:31 Landing at several meter north from Makita's plate
27°47.4604N, 126°53.8061E, D=994 m
- 12:33 DO measurement First
- 12:34 DO measurement Second
- 12:36 DO measurement Third
- 12:39 Seamax photo
- 12:42 Sampling mussels (No.2 bottle)
- 12:59 DO measurement at the top of NBC
27°47.4556N, 126°53.7987E, D=982 m
- 13:08 Galatheid sampling in a single canister
- 13:20 Go around the top of NBC
- 13:25 Shinkaicaris (shrimp colonizing at the surface of top chimney) sampling (No.3 bottle)
- 13:28 DO measurement
- 13:31 DO measurement (a little bit upside)
- 13:39 Chimney sampling at the top of NBC in a chimney box and No.4 bottle in multiple-canister
- 13:49 After chimney sampling in the RNA fixation box, finish chimney sampling
- 13:53 ? Arrive at event #10
27°47.4498N, 126°53.7987E, D=986 m
- 13:57 DO measurement
- 14:02 Recovery of Hirayama's ISCS (No.1005-4, pink) at Gokai, Goemon site, in the middle of NBC mound.
- 14:05 Deployment of Makita's plate (No.3)
- 14:12 Set the mystery circle at the sample place
- 14:14 DO measurement
- 14:21 Mystery circle sampling (Galatheid) (No.5 bottle)
- 14:29 Arrive at C0016B
27°47.4484N, 126°53.7907E, D=995 m
- 13:35 Scan C0016B site by Blair's scan system
- 15:05 DO measurement at the chimney on the C0016B guide base
- 15:11 *Shinkaicalis* sampling on the C0016 guide base
- 15:23 Deployment of Makita's plate (No.4)
- 15:27 Chimney sampling in the box
- 15:43 Chimney sampling in the RNA fixation box
- 15:44 left bottom D=995 m
- *During ascending, the water inside the single canister was exchanged with fresh water at depth of 800 m.

Dive Track

KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1610

2014/01/12
(1 / 3000)



XY Origin Lat 27-47.50000N Lon 126-54.00000E
Center Lat 27-47.55600N Lon 126-54.00000E
Grid File: Iheya_2m.grd ContourInt:10m
Track File: 20140112_HPD3K_No1610.xyz
Datum WGS-84 Proj. MBR
(UR) Lat 27-47.75144N Lon 126-54.32010E
(LL) Lat 27-47.36156N Lon 126-53.68090E

Dive Report HPD Dive# 1611

Date: January 17, 2014

Site: NBC and C0014G sites in the Iheya North Hydrothermal Field

Landing: 8:23; 27°47.4393'N 126°53.8694'E, D= 1025m

Leaving: 22:04; 27°47.5100N, 126°53.8531E, D= 1010m

Observer: Blair Thornton (The University of Tokyo)

Objective

The objective of this dive was to collect data to generate wide area cm resolution, and detailed mm resolution 3D colour reconstructions of hydrothermally altered regions surrounding the C0014G guide base and the NBC mound. Mapping was performed at two altitudes to generate maps of different scales and resolutions. Wide area mapping was performed from 8m altitude using the seaXerocks mapping system of the University of Tokyo, and more detailed mapping was performed using the University of Sydney's Serpent mapping system. First, wide area single transect mapping of the route between the NBC mound, C0016B, C0013E, and C0014G. This will be used for comparison with data mapped in 2012 along the same transect to quantify changes in the distribution and density of macro fauna, and also quantify deposition of sulphides around the C0016B and C0014G guide base. Next, wide area and detailed mapping was performed of the region surrounding the C0014G guide base and the NBC mound. These maps will be used to estimate macro scale biological activity of the Iheya North Field.

Dive summary:

HyperDolphin reached the seafloor north of the NBC and mapped the route between C0016B, C0013E, and C0014G at 8m altitude. Next, wide area lawnmower pattern mapping of the area around C0014G was performed for about 2hours, followed by low altitude detailed mapping of the region west of the C0014G. Next wide area mapping lawnmower pattern mapping of the area around the NBC mound was performed for about 4hours. This was followed by detailed mapping north of the NBC mound at a region heavily populated by a large variety of vent animals. Finally, in situ calibration of the imaging systems used was performed before leaving the site.

Though the strong underwater currents near made navigation of the vehicle difficult, the objectives of the dive were successfully achieved and over 150GB of high resolution mapping data was collected together with navigation data from the PhinsDVL, SSBL and RDI-WHN1200. It was also the first time HyperDolphins PhinsDVL was integrated to a payload mapping system.

Payloads:

- SeaXerocks mapping system
- Serpent mapping system
- Stand-alone downward looking camera
- Suction sampler with multi-bottle (6-series) collectors and a single box collector
- Standalone CTD-Do-pH

Event list

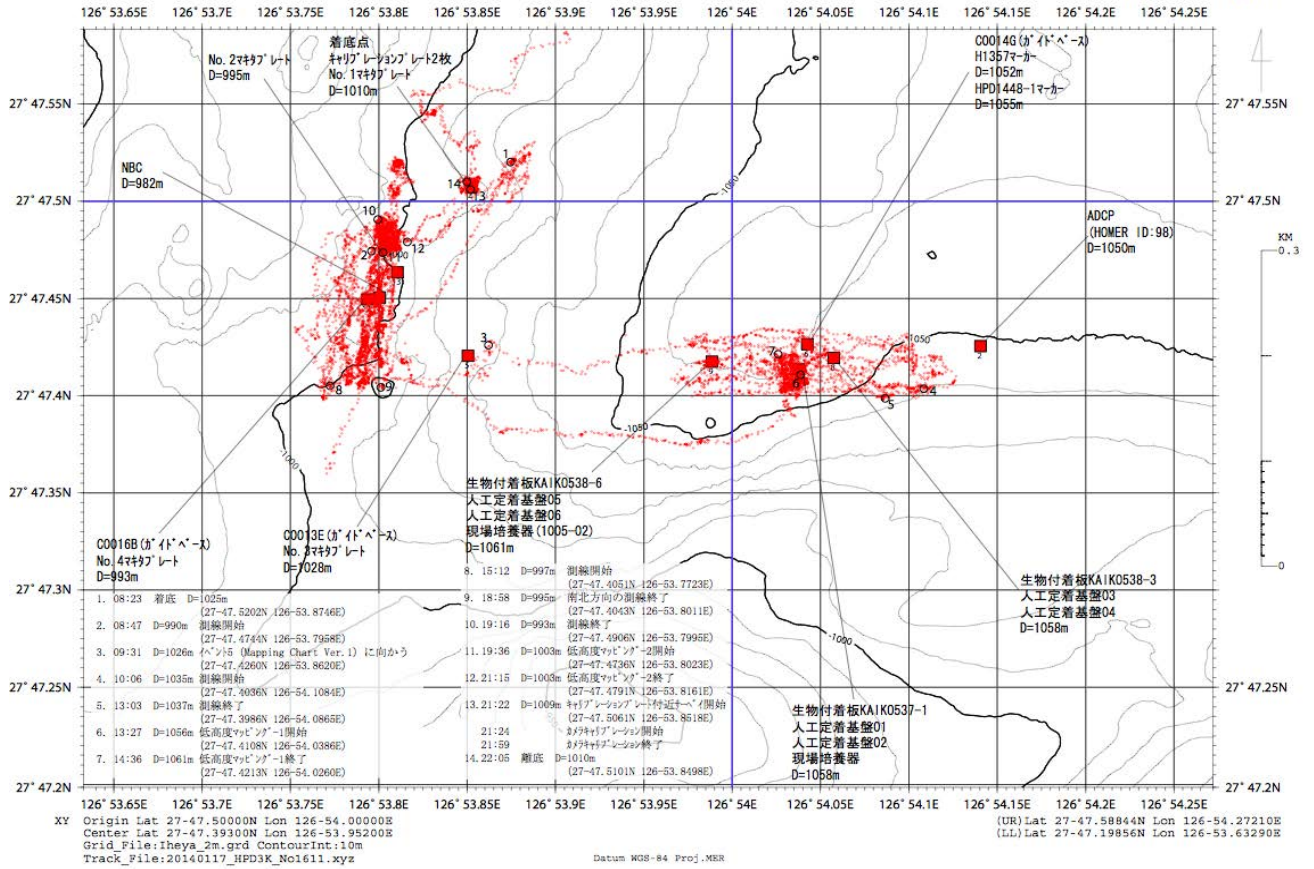
8 : 23 Reached seafloor
8 : 47 Start 8m altitude mapping of NBC-C016B-C0013E-C0014G route
 • 9 : 01 Pass over C0016B
 • 9 : 25 Pass over C0013E
 • 9 : 47 Pass over C0014G

9 : 50 Complete route
10 : 05 Start 8m altitude mapping around C0014G
13 : 03 End of mapping operations
13 : 29 Start 2m altitude detailed mapping SW of C0014G
14 : 36 End of mapping operations
15 : 12 Start 8m altitude mapping around NBC
18 : 10 Interruption of mapping operation due to SSBL error
18 : 29 Resume mapping
19 : 20 End of mapping operation
19 : 34 Start 2m altitude detailed mapping N of NBC
21 : 15 End of mapping operation
21 : 23 Start calibration of payload
22 : 04 End of dive

Dive Track

KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1611

2014/01/17
(1 / 3000)



Dive Report HPD Dive# 1612**Date:** January 20, 2014**Site:** NBC and C0016B sites in the Iheya North Hydrothermal Field**Landing:** 9:55; 27°47.4708'N, 126°53.8435'E, D=1024 m**Leaving:** 12:52; 27°47.4271'N, 126°54.1433'E, D = 1051m**Observer:** Hiromi Watanabe (JAMSTEC)**Objectives:**

The main objective of the dive #1612 is to collect vent-endemic animals with environmental measurement and water sampling in NBC mound and C0016B site for several purposes, such as activity measurements of microbial symbionts, an assessment of community changes induced by the IODP seafloor drilling, and various genetic analyses. In addition to the animal collection, there are several objectives in this dive. Other objectives are as follows: (1) recovery of ADCP (Acoustic Doppler Current Profiler); (2) deployment and recovery of inclinometer; and (3) collection of chimney fractions.

Dive summary:

ROV Hyper-Dolphin landed on the mud seafloor at about 20 m northeast of NBC, where white patches of microbial mats were distributed. The ROV headed to *Bathymodiolus* colony located near the base of NBC mound. Mystery circle procedure, which is to analyze environmental relationship between vent fauna and environments and consisted with deployment of a ring (Mystery circle; $\phi = 25\text{cm}$), measurements of environmental factors by DO and multi sensors in the ring, and quantitative faunal sampling inside of the ring, was carried out at both edges of *Bathymodiolus* colony that away from and toward the vent (the quantitative samples were collected into #1 (away from vent, number of *B. japonicas* was relatively high) and #2 (towards vent, no *B. japonicus* contained) bottles, respectively). The ROV continued to climb NBC and looked for *Shinkaia* assemblage for water and faunal samplings. The faunal sampling subsequent to sensors environmental acquisition and water sampling (Oreryu and Junshiki 8-bottle water sampler) was carried out near the top of NBC. The ROV headed to recover ADCP near C0014 site, which was deployed in Nov. 2013. The ADCP was successfully recovered using two hooks and the ROV left the bottom. At the depth 800m on the way to the surface, the water in a single chamber with *Shinkaia* assemblages was exchanged.

Payloads:

- Suction sampler with multi-bottle (7-series; #7 with cap) collectors and a single chamber with ice pack
- DO sensor
- Oreryu-8-bottle water sampler
- Junshiki-8-bottle water sampler
- Multisensor

- CTD-pH sensor
- inclinometer
- Still camera with HPD
- Mystery circle
- box

Event list

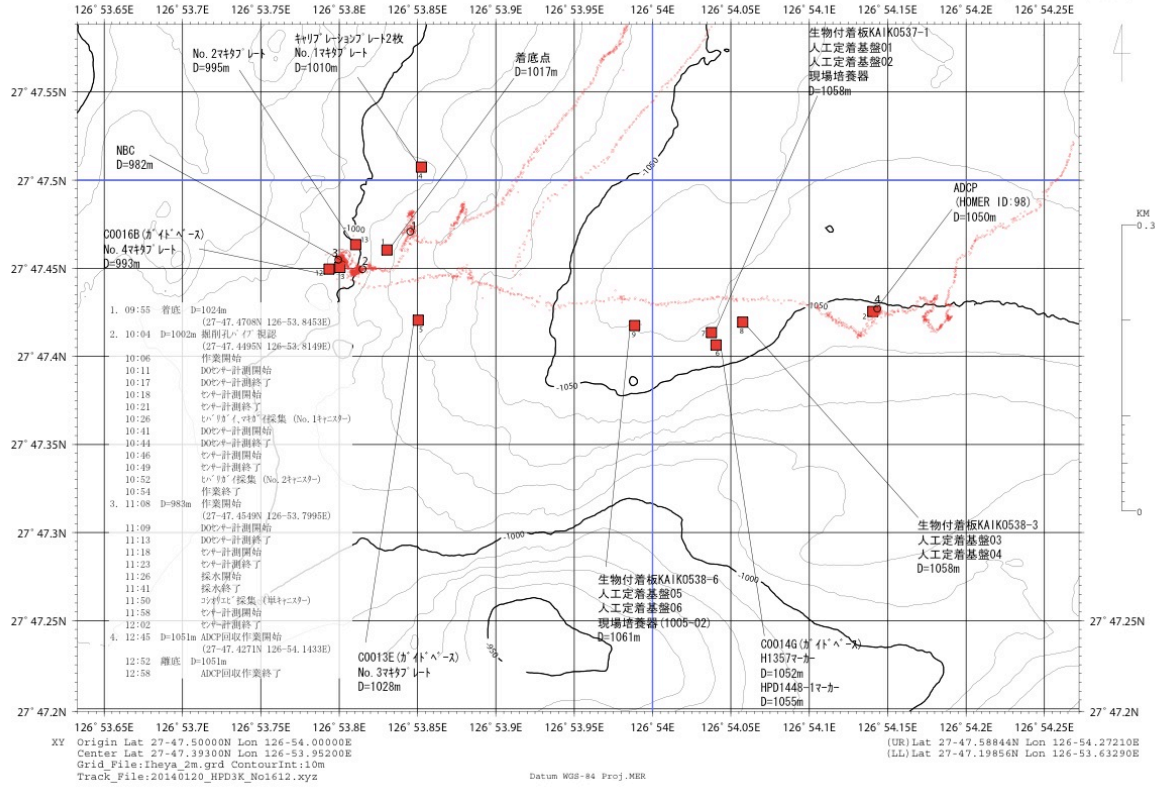
- 7:58 Start pumping (slow speed) for multisensor
- 9:55 Landing at 20 m northeast of NBC, mud on rocky seafloor, white microbial mat patches, dead *Calyptogena* shells were scattered
27°47.4708'N, 126°53.8435'E, D=1024 m
- 10:01 Observing H1247-3 colonization plate among rocky crevice. Left it.
- 10:03 Observing Chikyu's liner pipe near *Shinkaia* colonies, 27°47.4495'N, 126°53.8149'E, D = 1003m
- 10:08 Landing at *Bathymodiolus* colony (covered with bacteria), *Paralomis*, and a few *Shinkaia* crabs. Deployment of mystery circle.
- 10:10 Measurement of DO sensor: 10:10:52 – 10:12:19, 10:12:30 – 10:14:09, 10:14:43 – 10:15:50.
- 10:16 Measurement with multisensory in the mystery circle on the *Bathymodiolus* colony. 10:17:45 – 10:21:32, D = 1003 m, T_{max} = 4.4 °C.
- 10:22 Sampling *Bathymodiolus* colony (lower end of the distribution) into #1 bottle.
- 10:24 Recovery of mystery circle.
- 10:27 Move to collect *Eosipho* snail.
- 10:30 Sampling *Eosipho*. Move to find out dense aggregation of *Bathymodiolus*.
- 10:39 Landing at the front of a *Bathymodiolus* colony near *Shinkaia* colony. (D = 996m). Deploy mystery circle on the *Bathymodiolus* colony, and recover the circle.
- 10:41 Measurement by DO sensor; 10:41:18 – 10:42:32. (recovery to the case at 10:43:41) (D = 995m)
- 10:44 Measurement by multisensory; 10:46:04 – 10:49:06 (T_{max} = 4.5 °C).
- 10:49 Sampling *Bathymodiolus* colony (higher end of the distribution) to #2 bottle
- 10:53 Move to the top of NBC.
- 10:57 *Lamellibrachia* in top HD video camera
- 10:59 Observing Chikyu's drilling pipe (D = 985m)
- 11:02 Landing near hydrothermal vent (D = 982m), but no animals except for a few shrimp was observed. Move to another place.
- 11:07 Landing in front of *Shinkaia* colony near vigorous hydrothermal vent (A previously deployed unknown marker, and some black large *Shinkaia*). 27°47.4549'N, 126°53.7995'E, D = 983m.
- 11:09 Measurement by DO sensor on *Shinkaia* colony; 11:09:25 – 11:11:02, 11:11:22 – 11:12:35.
- 11:14 Measurement by multisensory on *Shinkaia* colony; 11:18:09 – 11:19:43, 11:19:49

- 11:21:59 (high speed; T = 8.6 °C) *Lepetodrilus* covered rocky surface under *Shinkaia*.
- 11:25 Water sampling in *Shinkaia* colony (slow speed to middle; T_{max} = 11 °C, T_{average} = 8°C, sampling to bag thru Oreryu-8-bottle and Junshiki-8-bottle water samplers).
- 11:40 Finishing water sampling.
- 11:42 Closing the valves of the water samplers. Exchanging slurp gun line from multi-bottle chamber to shingle chamber
- 11:49 Sampling *Shinkaia* colony (as many as possible) to the single chamber.
- 11:54 Closing the single chamber slurp line.
- 11:58 Measurement with multisensory on where the *Shinkaia* colony was distributed;
11:58:33 - 12:02:16 (high speed: T_{max} = 13 °C)
- 12:07 Leave NBC; transit to C0016
- 12:36 Near seabottom, with ROV homer to detect the place for ADCP, muddy bottom. D = 1044m
- 12:40 Try to find ADCP, change heading
- 12:42 Observing ADCP
- 12:44 Landing near ADCP, 27°47.4271'N, 126°54.1433'E, D = 1051m
- 12: 47 Hooking up ADCP
- 12:52 Left bottom , D = 1051m
- 13:03 Exchanging the water inside the single chamber (D = 800m)
- 13:06 Stopping exchanging water (D = 700m)

Dive Track

KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1612

2014/01/20
(1 / 3000)



Dive Report HPD Dive# 1613**Date:** January 23, 2014**Site:** From C0014 to NBC in the Iheya North Hydrothermal Field**Landing:** 10:22, 27°47.3939N, 126°54.0349E, D=1049 m**Leaving:** 16:14, 27°47.5051N, 126°53.8545E, D=1011 m**Observer:** Yuka Masaki (JAMSTEC)**Objectives:**

The main objective of the dive #1613 is an advanced operation around site C0014 for deployment of the artificial hydrothermal cultivate tools. In addition to the animal collection, there are several objectives in this dive. Other objectives are as follows: (1) recovery and deploy of colonization device; (2) recovery of Hirayama's ISCS (in situ colonization system for microorganisms); (2) measurement of DO meter; (3) collection of *Shinkaia* crab and *Shinkaicaris* shrimp; and (4) recovery of calibration panel.

Dive summary:

ROV "HyperDolphin" landed on the sandy seafloor at about few meters southeast of site C0014G, where there were white patches of microbial mats around there. We measured DO sensor and Multi sensor at the landing site. We move close the site C0014G. We measured Multi sensor and deployed "H1613" colonization device. We also recovered the colonization device with temperature measurement tool. Then, we moved to event marker 7 where Hirayama's ISCS deployed before to recovery of it, and measured DO sensor and Multi sensor measurement. We also sampled *Shinkaia* crab into #1 canister at the same place. We deployed the Mystery circle and measured DO sensor and sampled into the #2 canister in the circle, then measured the sensors in the shimmering place again. ROV moved to the guidebase of the site C0014G.

ROV landed on the guide base to remove the dummy cap and measured the angle of the guide base with inclinometer. There were many hydrothermal fragments, anhydrite minerals are sealed with dummy cap. We removed hydrothermal fragments with oil pressure chisel, then tried to remove the dummy cap, but it was failed. ROV moved to the seafloor under the guide base. We measured DO sensor twice and Multi sensor twice, and sampled *Shinkaia* crab into the #3 canister. ROV headed to event mark 3 where is located in NBC mound.

At NBC mound, there were many *Shinkaicaris* shrimp found, and we sampled them into the #4 canister. Then we move to more stable space to measure multi sensor. After the measurement, we moved to event mark 4 to recover the calibration panels which deployed at the previous dive. We had done all today's operations and left the seafloor.

Payloads:

➤ Inclinometer

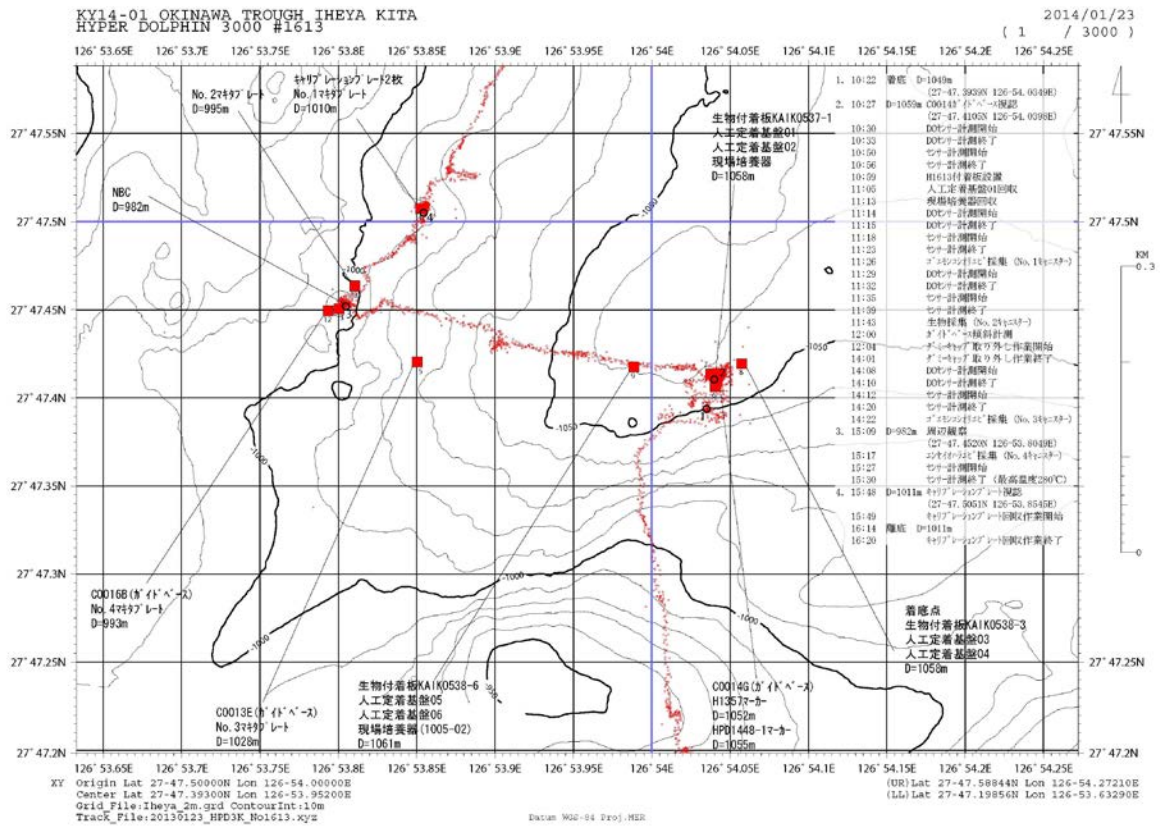
- Oil pressure chisel
- Moop to sweep the drilling hole
- Suction sampler with multi-bottle (7-series; #7 with cap) collectors
- Mystery circle
- DO sensor
- Colonization device (Deploy & Recovery)
- Hirayama's ISCS (Recovery)
- Calibration panels (x2) (Recovery)

Event list

- 10:20 Bottom in site, sandy bottom
- 10:22 Landing at site C0014G east
27°47.3939N, 126°54.0349E, D=1049 m
- 10:30 Start DO measurement
- 10:41 ROV raise up because of strong current
- 10:41 Landing again
- 10:50 Start Multi sensor measurement (Maximum temperature 5 degree)
- 10:58 "H1613" colonization device deployed
- 11:04 Recovery of colonization device with temperature measurement tool
- 11:08 Landing
- 11:11 Recovery of Hirayama's ISCS
- 11:14 Start DO measuremet
- 11:18 Start Multi sensor measurement (Maximum temperature 5.4 degree)
- 11:24 Sampling *Shinkaia* crab into #1
- 11:28 Start DO measurement in the Mystery circle (First)
- 11:30 Start DO measurement in the shimmering (Second)
- 11:35 Start Multi sensor measurement (Maximum temperature 7.7 degree)
- 11:40 Sampling in the Mystery circle
- 11:52 Head to site C0014G
- 11:55 Landing on the guide base of site C0014G
- 11:59 Strat inclinometer measurement (1 degree)
- 12:07 Try to remove dummy cap
- 12:11 Try to remove chimney fragments with oil pressure chisel
- 12:33 Move to opposite position and try to remove chimney fragments with oil pressure chisel
- 12:38 Landing
- 13:30 Sample chimney
- 13:31 Back to the previous position
- 13:36 Landing and try to turn around the dummy cap with handles
- 13:55 Strat inclinometer measurement again (2 degree)

14:01 Finish operation at the guide base
14:04 Shimmering
14:05 Landing again
14:07 Start DO measurement (First)
14:09 Start DO measurement (Second)
14:12 Start Multi sensor measurement (First, Maximum temperature 6.2 degree)
14:16 Start Multi sensor measurement (Second, Maximum temperature 4.9 degree)
14:20 Sampling *Shinkaia* crab into #3
14:23 Finish operation at this site, start to move to NBC, event mark 3
14:34 Pass event mark 9
15:01 Many dead shells
15:09 Arrived at the NBC, event mark 3
27°47.4520N, 126°53.8049E, D=982 m
15:12 Landing and sample *Shinkaicaris* shrimp into #4
15:26 Start Multi sensor measurement (Maximum temperature 280 degree)
15:30 Head to event mark 4
15:46 Stop pomp
15:48 Arrived at event mark 4
15:49 Start to recover of Calibration panels
16:10 Close the bulb (green)
16:14 Close the bulb (pink)
16:14 Leave the bottom
27°47.5051N, 126°53.8545E, D=1011 m
16:20 Recovery of Calibration panels

Dive Track



Dive Report HPD Dive# 1614 & 1615**Date:** January 24, 2014**Site:** A new hydrothermal site (Natsu site) in the Iheya North Knoll**Landing:** 9:32; 27°46.8215N, 126°54.0295E, D=1095 m**Leaving:** 11:17; 27°46.8488N, 126°54.0711E, D=1071 m**Observer:** Ken Takai (JAMSTEC)**Date:** January 24, 2014**Site:** A new hydrothermal site (Natsu site) in the Iheya North Knoll**Landing:** 14:38; 27°46.8514N, 126°53.9754E, D=1084 m**Leaving:** 16:54; 27°46.7858N, 126°54.1865E, D=1059 m**Observer:** Ken Takai (JAMSTEC)**Objectives:**

The main objective of the dive #1614 is to explore a potential new hydrothermal site in the Iheya North Knoll. If there are hydrothermal events on the seafloor, we will take samples of fluids, chimneys, sediments, animals and others.

Dive summary:

HyperDolphin landed on the breccia seafloor at about 50 m southwest of a hill (later it is named as “tube worm fields’ hill”). Along the slope, we headed to northeast and climbed the hill. Near the top of the hill, we found quite large tube worms’ colony. The colonies were scattered but spread all around the top of the hill. Two different types of tube worms and barnacles were predominant. We measured DO and applied multisensor measurement here.

After operations at the “tube worm fields’ hill”, we moved east to another hill. During the way, we found lots of dead chimneys and one of the chimney structures hosted mussels and galatheids. So, we stopped at the chimney and did DO and Multisensor measurements and obtained mussels and snails.

Next we move south because we found a quite large hydrothermal mound. The middle part of the mound (later it is named as “Yarigatake Chimney”) was covered with galatheids and mussels, and big flange fluid discharges were observed in the middle. Above the flange structure, lots of diffusing fluids were observed and polychaetes and tube worms colonized at the top part. In the very top, high temperature fluids flowed out. During the DO and multisensor measurements, the oil level of HyperDolphin suddenly decreased. Thus, HyperDolphin emergently left the bottom.

After the recovery of Hyper Dolphin onboard, the operation team repaired the oil leak very quickly. Then, we restarted HPD#1615 within 2 hours.

In HPD#1615, we landed 40 m SWW from the Yarigatake Chimney. During the navigation to the Yarigatake Chimney, we again found the tube worm fields in the “tube

worms' hill". After arriving at Yarigatake chimney, we again did the multisensor measurement & water sampling using Junshiki 8 bottles sampler on the polychaetes' colony at the middle of Yarigatake chimney (but water sampling was finally failed). Then, we collected the polychaetes and tube worms there. After the animal sampling, we arrived at the top of the chimney and tried to collect the chimney from the top vent site. It was also failed but we obtained the high temperature hydrothermal fluids from here using WHATS sampler (No. 1 & 2 bottles) (Tmax = 170 °C).

Next, we went down to the big flange of the Yarigatake chimney and successfully obtained the flange structures. From the broken flange structure, greyish focused hydrothermal fluid came out. From the focused fluid flow, we obtained the high-temperature hydrothermal fluid using WHATS sampler (No. 3 & No. 4 bottles) (Tmax = 305 °C). On the left of the flange, galatheids colonies were found. From these galatheid colonies, we did the DO measurement and collected the galatheid individuals.

After the operation at the Yarigatake chimney, we head to SEE to the eastern wall of the depression of Iheya North field Natsu site where other hydrothermal fluid discharge signals were observed by R/V Natsushima's Seabat MNBS and AUV Urashima side-scan sonar survey. Indeed, the area suggested by R/V Natsushima's Seabat MNBS and AUV Urashima side-scan sonar survey hosted lots of diffusing flows and microbial mats. The area looked like lava flow from the SE slope and the cracks of lava seemed to be diffusing fluid sites.

After the observation of the area, we surveyed the northern flank but no hydrothermal activity was observed. Then we left the bottom.

Payloads:

- Suction sampler with multi-bottle (7-series; #7 with cap) collectors
- DO sensor
- WHATS
- Junshiki-8-bottle water sampler
- Multisensor
- Sample box (x 3)
- Kumade sampler
- H-corer (x 2)
- Mystery circle

Event list:

HPD#1614

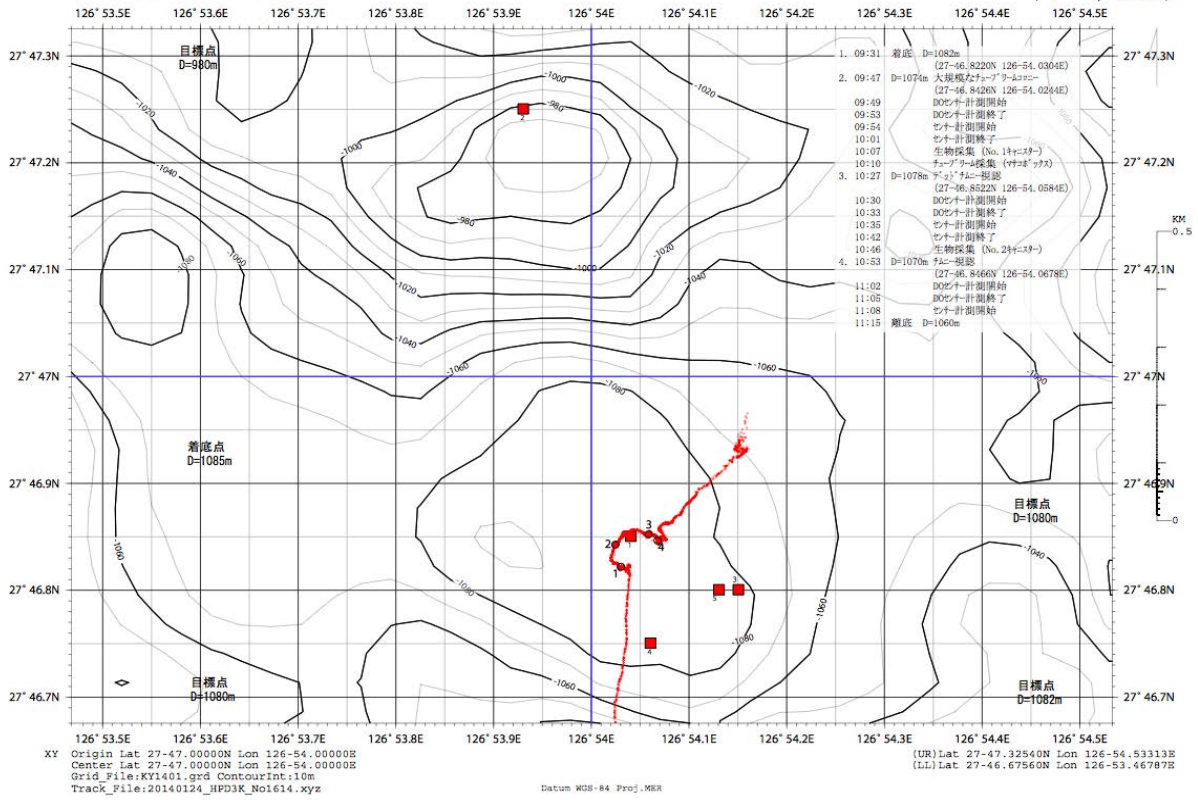
- 9:32 Landing on the seafloor of breccia south of a mound (27°46.8215N, 126°54.0295E, D=1095 m)
- 9:33 Climbing hill to north ("Tube Worms' Hill)
- 9:45 Fields of Tube worm dream (27°46.8417N, 126°54.0251E, D=1089 m)
- 9:49 DO measurement (2 points)
- 9:53 Multisensor measurements (Max Temp = 6.8 °C)
- 10:10 Sampling tube worms (No. 1 bottle)
- 10:26 Finding many dead chimneys and an active diffusing flow chimney (27°46.8521N,

126°54.0587E, D=1093 m)
10:28 DO measurement (2 points)
10:32 Multisensor measurements (Max Temp = 8.1 °C)
10:45 Sampling mussels and snails (No. 2 bottle)
10:52 Finding Yarigatake chimney
10:59 Landing near the top of Yarigatake chimney
11:01 DO measurements (polychaetes and tube worm colonies)
11:09 Multisensor measurement (Max Temp = 6.5 °C)
11:17 Emergent leaving bottom
Repaired on board
HPD#1615
14:38 Landing on the breccia seafloor (27°46.8514N, 126°53.9754E, D=1084 m)
14:41 Finding tube worm fields
14:49 Finding diffusing flows
14:56 Re-visited Yarigatake chimney (27°46.8488N, 126°54.0711E, D=1071 m)
15:02 Multisensor measurements (Max. Temp = 20.5 °C)
15:09 Sampling animals (polychaetes and tube worms)
15:27 Sampling chimney (failed)
15:29 WHATS sampling (No.1 bottle) (Max. Temp = 170 °C)
15:38 WHATS sampling (No. 2 bottle) (Max. Temp = 140 °C)
15:59 Sampling flange structures
16:03 WHATS sampling (No. 3 bottle) (Max. Temp = 280 °C)
16:08 WHATS sampling (No. 4 bottle) (Max. Temp = 305°C)
16:17 DO measurement (1 point)
16:26 Sampling Galatheid
16:30 Heading to 120 ° for 150 – 200 m
16:37 Finding hydrothermal crusts
16:54 Leaving bottom (27°46.7858N, 126°54.1865E, D=1059 m)

Dive Track (1614 & 1615)

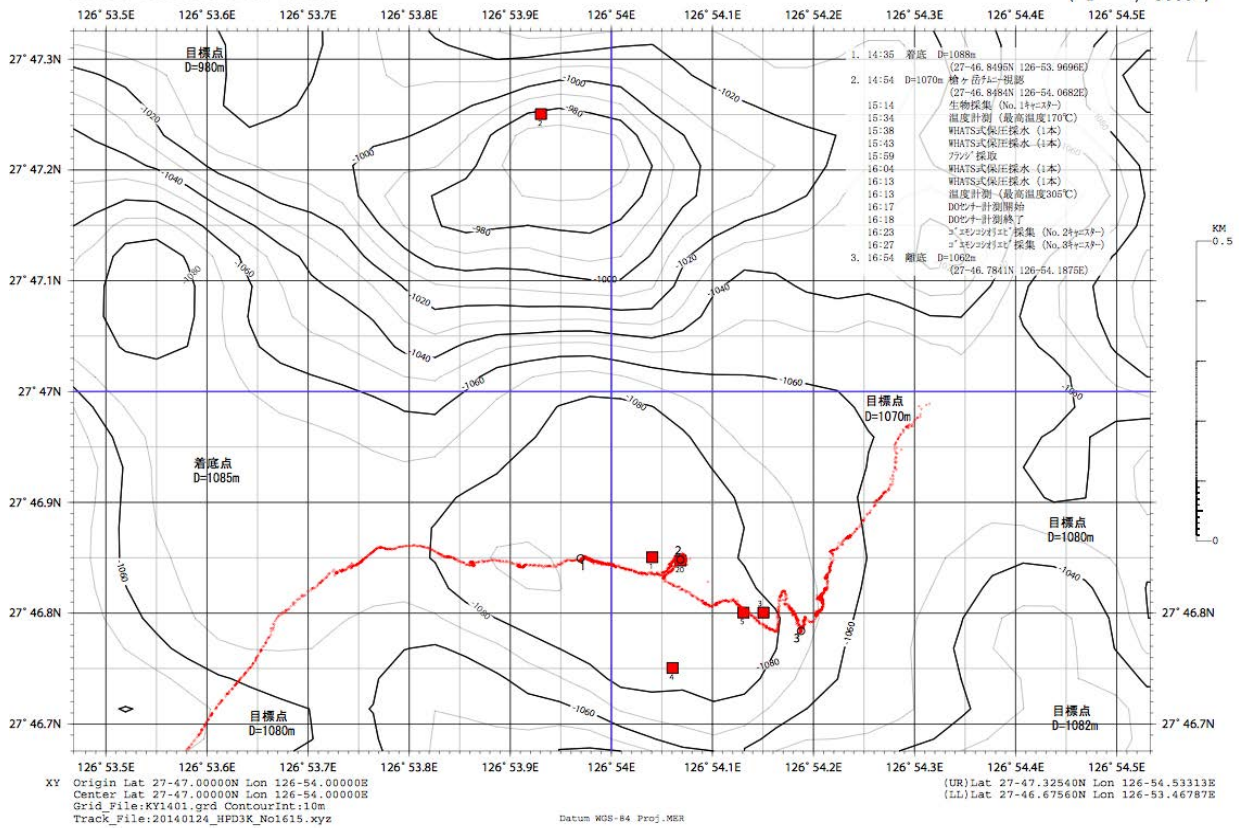
KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1614

2014/01/24
(1 / 5000)



KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1615

2014/01/24
(1 / 5000)



Dive Report HPD Dive# 1616**Date:** January 25, 2014**Site:** A new hydrothermal site (Aki site) in the Iheya North Knoll**Landing:** 9:25; 27°46.1387N, 126°54.0198E, D=1090 m**Leaving:** 15:48; 27°45.880'N, 126°54.2226'E, D=1043 m**Observer:** Ken Takai (JAMSTEC)**Objectives:**

The main objective of the dive #1616 is to explore a potential new hydrothermal site in the Iheya North Knoll. If there are hydrothermal events on the seafloor, we will take samples of fluids, chimneys, sediments, animals and others.

Dive summary:

HyperDolphin landed on the breccia seafloor at about 50 m west of a point where AUV Urashima had obtained a strong reflection signal by means of its side-scan sonar. At around the landing point, we found many dead chimney structures. Suddenly without any vent-endemic animal colonies and microbial mats, we found a black smoker discharge (exactly saying, it is grayish smoker). We collected the chimney samples and hydrothermal fluids (WHATS No. 1 and No. 2 bottles) at this "Ikinari Chimney" site. The maximal temperature was recorded to be 317 °C and it was boiling. 317 °C was the highest temperature of hydrothermal fluid ever recorded in the Iheya North Knoll. A marker#HPD1616-1 was deployed. We continued to go east and found lots of small galatheids' and mussels' colonies. At one of the colonies, we collected animals with a mystery circle, DO measurement and multisensory measurement. Through these animal colonies, the seafloor turned to be covered with sediments and be steep slope and lots of dead clams were observed. Finally, we found several colonies of living clams and obtained individuals by Kumade sampler. After the recovery of clams, H-type-cores were obtained from inside and outside of microbial mats adjacent to the clam colony.

We went to south 50-70 m for another point where AUV Urashima had obtained a strong reflection signal by means of its side-scan sonar. First we just observed several colored rocks and sediments around there but once HyperDolphin turned west, a hydrothermal mound was observed. From this "Furikaeri Chimney" site, we obtained high-temperature hydrothermal fluid (WHATS No. 3 & No. 4 bottles) from a flange structure together with sampling the host flange structure. The maximal temperature of hydrothermal fluid was 305 °C. During the fluid sampling, Mr. Chong Chen found several Bythograeid crabs. He is actually "Otaku" of deep-sea animal and shot one white Bythograeid crab among thousands white galatheids. It was unbelievable "Ota-gei". Then we collected galatheids and Bythograeid crabs, and polychaetes here with DO and multisensor measurements. A marker HPD#1616-2 was deployed in the foot of the mound.

We went on a little bit west and found another active hydrothermal mound. It was named as “Table Mountain” chimney. From “Table Mountain” chimney, we obtained the flange structures and high-temperature hydrothermal fluid by means of Junshiki 8 bottles sampler ($T_{max} = 306\text{ }^{\circ}\text{C}$).

After “Table Mountain” chimney, we headed to SE for another point where AUV Urashima had obtained a strong reflection signal by means of its side-scan sonar. In the way of the destination (huge mound), we also found a middle size of hydrothermal mound (“Kagamimochi” chimney) and observed it. A marker HPD#1616-3 was deployed in the foot of the mound.

At 20 m SE from Kagamimochi chimney, we finally encounter the enormous walls of hydrothermal deposits. All the hydrothermal mounds were largely covered with two types of mussels and their biomass was huge that had been never observed in the Iheya North Knoll. Lots diffusing vents were observed anywhere of The Walls. This assemblage of mounds was named as “Hibarigaoka Hanayashiki”. We could not sneak the skyscrapers due to the cable jam. It was magnificent view!

Through “Hibarigaoka Hanayashiki”, the seafloor was interlaced with crusts and sediments and the edges of crusts were covered with microbial mats. Lots of dead clams and some of living clams were found. Finally we left the bottom.

Payloads:

- Suction sampler with multi-bottle (7-series; #7 with cap) collectors
- DO sensor
- WHATS
- Junshiki-8-bottle water sampler
- Multisensor
- Sample box (x 3)
- Kumade sampler
- H-corer (x 2)
- Mystery circle
- Marker (x 3)

Event list:

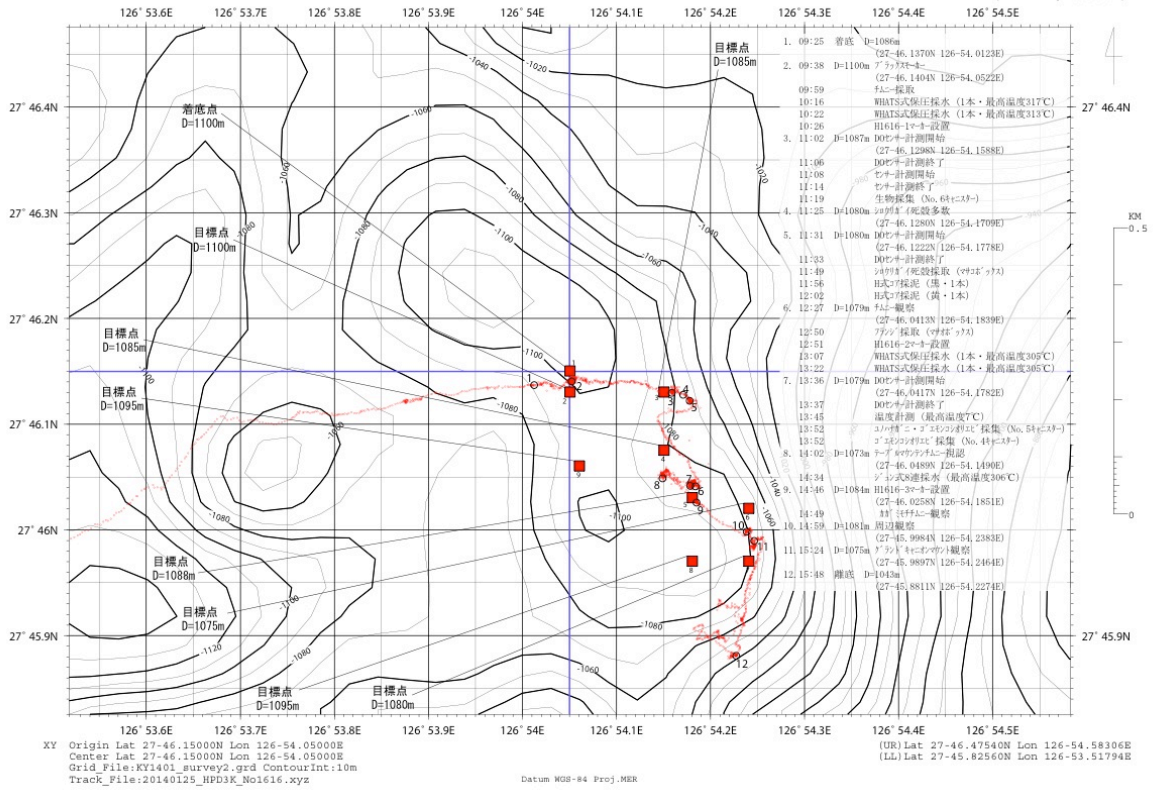
- 9:25 Landing on the seafloor of sediments ($27^{\circ}46.1387\text{N}$, $126^{\circ}54.0198\text{E}$, $D=1090\text{ m}$)
- 9:29 Heading to east
- 9:30 Finding dead chimneys with crabs
- 9:33 Heading to 45°
- 9:36 Finding a black smoker
- 9:38 Observation of “Ikinari vent”
- 9:49 Landing in front of beehive chimney ($27^{\circ}46.1433\text{N}$, $126^{\circ}54.0517\text{E}$, $D=1101\text{ m}$)
- 9:59 Sampling chimneys
- 10:08 Sampling hydrothermal fluid using WHATS (No.1 bottle) ($T_{max} = 317\text{ }^{\circ}\text{C}$)
- 10:16 Sampling hydrothermal fluid using WHATS (No.2 bottle) ($T_{max} = 313\text{ }^{\circ}\text{C}$)
- 10:25 Deployed a marker #H1616-1
- 10:37 Finding galatheids and mussels
- 10:56 ROV landed near mussel colony ($27^{\circ}46.1335\text{N}$, $126^{\circ}54.1585\text{E}$, $D=1088\text{ m}$)
- 10:58 Deployed “Mystery Circle” on mussel colony

11:00 Adjusted position of “Mystery Circle”
 11:02 DO sensor inside “Mystery Circle” (on large mussels) x 1 min
 11:04 DO sensor inside “Mystery Circle” (on small mussels) x 1 min
 11:07 Multi-sensor measurements (Tmax = 5.1 °C)
 11:15 Collecting mussels and animals (No. 6 bottle)
 11:30 Finding living Calyptogena colonies
 11:32 DO sensor on the Calyptogena colony x 1 min
 11:39 Collecting living Calyptogena clams in the box using KUMADE (10-12 individuals)
 (27°46.1218’N, 126°54.1781E, D=1080 m).
 11:54 Sampling a core (KURO) using a H-type corer next to the Calyptogena colony
 (colored).
 11:59 Sampling a core (yellow) using a H-type corer next to the Calyptogena colony
 (non-colored).
 12:08 Heading to southwest
 12:30 Finding “Furikaeri chimney”
 12:47 In the Furikaeri chimney, we found Bythograeid.
 12:49 Obtained flange structures (27°46.0458’N, 126°54.1789’E, D=1080 m)
 12:51 Deployed Marker#HPD1616-2
 13:00 Sampling hydrothermal fluid using WHATS (No. 3 bottle) (Tmax = 305 °C)
 13:04 Sampling hydrothermal fluid using WHATS (No. 4 bottle) (Tmax = 305 °C)
 13:37 Sampling Bythograeid (No.5 bottle)
 13:37 DO measurement
 13:40 Multisensor measurement (Tmax =7.6 °C)
 13:49 Sampling Galatheids (No. 5 bottle)
 13:50 Sampling Polychaetes (No. 4 bottle)
 13:51 Head to 280 °
 14:00 Finding the “Table mountain chimney” (27°46.0484’N, 126°54.1474’E, D=1072 m)
 14:28 Sampling flange fluid by using Jun-shilki 8 bottle sampler (Tmax = 306.1 °C)
 14:33 Heading to 130 °
 14:44 Finding “Kagamimochi chimney” (27°46.0270’N, 126°54.1868’E, D=1083 m)
 14:47 Deployed Marker#HPD1616-3 here
 14:59 Finding huge mussels’ colonies (with other species) (27°46.0006’N, 126°54.2737’E,
 D=1091 m)
 15:09 Finding an enormous dead chimney mound
 15:09 Finding a gigantic active hydrothermal mounds
 15:21 “Hibarigaoka Hanayashiki” (27°45.9893’N, 126°54.2460’E, D=1075 m)
 15:38 Finding very wide microbial mats
 15:48 Leaving bottom (27°45.880’N, 126°54.2226’E, D=1043 m)

Dive Track

KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1616

2014/01/25
(1 / 5000)



Dive Report HPD Dive# 1617**Date:** January 28, 2014**Site:** A new hydrothermal site (Aki site) in the Iheya North Knoll**Landing:** 9:38; 27°46.0439N, 126°53.9528E, D=1059 m**Leaving:** 15:45; 27°46.0655N, 126°54.1493E, D=1069 m**Observer:** Ken Takai (JAMSTEC)**Objectives:**

The main objective of the dive #1617 is to explore a potential new hydrothermal site in the Iheya North Knoll. If there are hydrothermal events on the seafloor, we will take samples of fluids, chimneys, sediments, animals and others.

Dive summary:

HyperDolphin landed on the breccia seafloor on the eastern slope of a hill at about 400 m west from "Hibarigaoka Hanayashiki". The seafloor consisted of sediments and breccia and was colonized by tube-worms and microbial mats. We surveyed the ridge of the hill but none of landscape changes was observed. We headed to east and in the eastern slope, tube-worms were sampled.

About 100 m east from top of hill, we observed many and patchy microbial mats. One microbial mat had lots of gastropods and a few chitons. We obtained the gastropods and chitons here.

We went on climbing the next hill. In the way, we found yellowish sulfur crusts covered with many small gastropods. We collected the sulfur crusts and gastropods here.

On top of the hill, several diffusing fluid flows and the associating galatheids and mussels were found. Passing through the hill, sandy and silty seafloor with patchy microbial mats were spread. When we turned to head north and went on, we encountered "Kagamimochi chimney" that we found the previous dive. So, from here, we went to southeast and approached to "Hibarigaoka Hanayashiki". In this dive, we carefully sneaked into "Hibarigaoka Hanayashiki", which was very complex and surrounded by tall hydrothermal structures. Successfully, we arrived at widespread galatheids' and mussels' colonies. In "Hibarigaoka Hanayashiki", myriads diffusing fluids discharged. We collected galatheids, blachish mussels and brown mussels, respectively.

After sampling at "Hibarigaoka Hanayashiki", we headed to northwest to find another black smokers. In the way, about 10 m north from "Kagamimochi chimney", we observed "Furikaeri chimney" and passed through it. About 100 m northwest from "Kagamimochi chimney" and "Furikaeri chimney", a vigorous black smoker was found. It was located on top of small hydrothermal mound. The hydrothermal vent orifice had an orifice about 10 cm of diameter. The hydrothermal fluid was boiling and the maximal temperature was 316 °C. We obtained chimney fractions and collected the hydrothermal fluid. A marker of HPD#1617-1 was deployed and we left the bottom from here.

Payloads:

- Suction sampler with multi-bottle (7-series; #7 with cap) collectors
- DO sensor
- WHATS
- Junshiki-8-bottle water sampler
- Multisensor
- Sample box (x 3)
- Kumade sampler
- H-corer (x 2)
- Mystery circle
- Marker (x 3)

Event list:

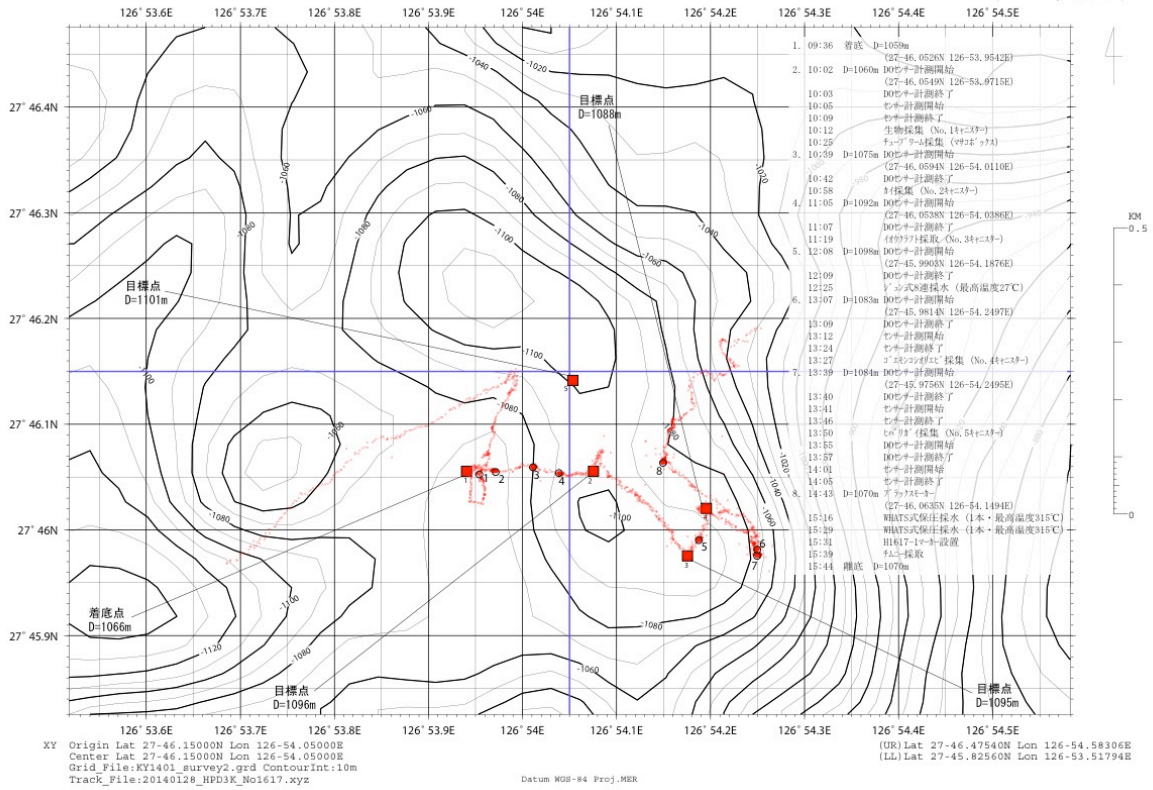
- 9:38 Landing on the seafloor of sediments and breccia and tube worm (27°46.0439N, 126°53.9528E, D=1059 m)
- 9:41 Heading to peak of the hill
- 9:45 Small and patchy microbial mats and tube worm colonies
- 10:00 Landing around tube worm colony (27°46.0564N, 126°53.9667E, D=1060 m)
- 10:02 DO measurement
- 10:05 Multisensor measurement
- 10:11 Suction sampling of the colony surface
- 10:25 Sampling of tube worm by handling
- 10:32 Many patchy microbial mats
- 10:37 DO measurement (on microbial mats)
- 10:40 DO measurement (on gastropods)
- 10:53 Sampling snails and chitons
- 11:05 Finding sulfur crust (27°46.0538N, 126°54.0412E, D=1092 m)
- 11:06 DO measurement
- 11:12 H-coring (yellow) failed
- 11:15 Sampling Sulfur crust fractions
- 11:18 Sampling snails (Bottle 3)
- 11:21 Calyptogena colony
- 11:24 Finding galatheids and mussels (27°46.0532N, 126°54.0610E, D=1092 m)
- 11:32 Climbing the hill
- 11:32 Heading southeast
- 11:38 Calyptogena colonies
- 11:43 Finding diffusing vents (27°46.0343N, 126°54.1209E, D=1092 m)
- 12:04 Finding diffusing fluid flows in the sediments (27°45.9921N, 126°54.1873E, D=1096 m)
- 12:09 DO measurement for 1 min
- 12:12 Sampling diffusion flow (T_{max} = 27 °C)
- 12:32 Heading NNE
- 12:45 Arriving at Kagamimochi chimney
- 12:45 Heading to Hibari Sky Towers
- 12:57 Landing in front of Hibari Sky Towers (27°45.9889N, 126°54.2465E, D=1084 m)
- 13:06 Landing at galatheid colonies
- 13:07 DO measurement (Galatheid)
- 13:09 DO measurement (Polychaetes)
- 13:12 Multisensor measurement (Galatheid) (T_{max} = 5.8 °C)
- 13:18 Multisensor measurement (Polychaetes) (T_{max} = 7.2 °C)
- 13:24 Sampling galatheids
- 13:36 Landing at black mussel colonies (27°45.9778N, 126°54.2472E, D=1083 m)
- 13:39 DO measurement
- 13:41 Multisensor measurement

13:45 Sampling black mussels
13:54 DO measurement (brown mussel)
14:00 Multi sensor (brown mussel) (Tmax = 3.7 °C)
14:06 Sampling brown mussels
14:43 Finding Hidaritehasoerudake chimney (27°46.0655N, 126°54.1493E, D=1069 m)
14:55 WHATS sampling (No. 1 bottle; Tmax = 316 °C)
15:12 WHATS sampling (No. 2 bottle; Tmax = 316 °C)
15:30 Deployed a marker of HPD#1617-1
15:40 Sampling a chimney fraction

Dive Track

KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1617

2014/01/28
(1 / 5000)



Dive Report: HPD Dive# 1618**Date:** January 29, 2014**Site:** NBC in the Iheya North Hydrothermal Field**Landing:** 09:21; 27°47.4574N, 126°53.8384E, D= 1023m**Leaving:** 10:43; 27°47.4545N, 126°53.8027E, D=971 m**Observer:** Hisako Hirayama (JAMSTEC)**Objectives:**

The main objective of the dive #1618 is *in situ* RNA fixation of *Bathymodiolus* mussels in NBC mound for a RNA analysis. Multi-sensor measurement and water sampling at the colony are also objectives of this dive to investigate chemical and physical conditions in the *Bathymodiolus* colony.

Dive summary:

HyperDolphin landed on the seafloor at about 60 m east of NBC. We headed to NBC. *Bathymodiolus* colonies on the southeastern slope of NBC mound seemed to be small. Then, we moved to the northern slope of NBC mound, where the colonies were larger than those on the southeastern slope. DO and multi-sensor measurement was conducted in the *Bathymodiolus* colony. Colony water was collected using Ore-ryu & Miyajun water samplers. Next, we collected *Bathymodiolus* mussels. For a RNA analysis of endosymbionts of *Bathymodiolus* mussels, we prepared the Miyajun box for *in situ* RNA fixation. *Bathymodiolus* mussels were broken using manipulator of HyperDolphin and immediately put into the Miyajun box filled with the RNA fixation reagent in advance. After the lid of the Miyajun box was closed, the RNA fixation reagent in a plastic bag was further pumped into the box. We moved to *Shinkaia* colonies near the top of NBC, and the *Shinkaia* individuals were collected in a single canister. After these operations, we left the bottom.

Payloads:

- Suction sampler with multi-bottle (6-series) collectors and a single box collector
- Oreryu-type 8 x bottle water sampler
- Miyajun-type 8 x bottle water sampler
- Multi-sensor
- DO sensor
- Miyajun box and a bag of RNA fixation reagent for *in situ* RNA fixation of *Bathymodiolus* mussels

Event list:

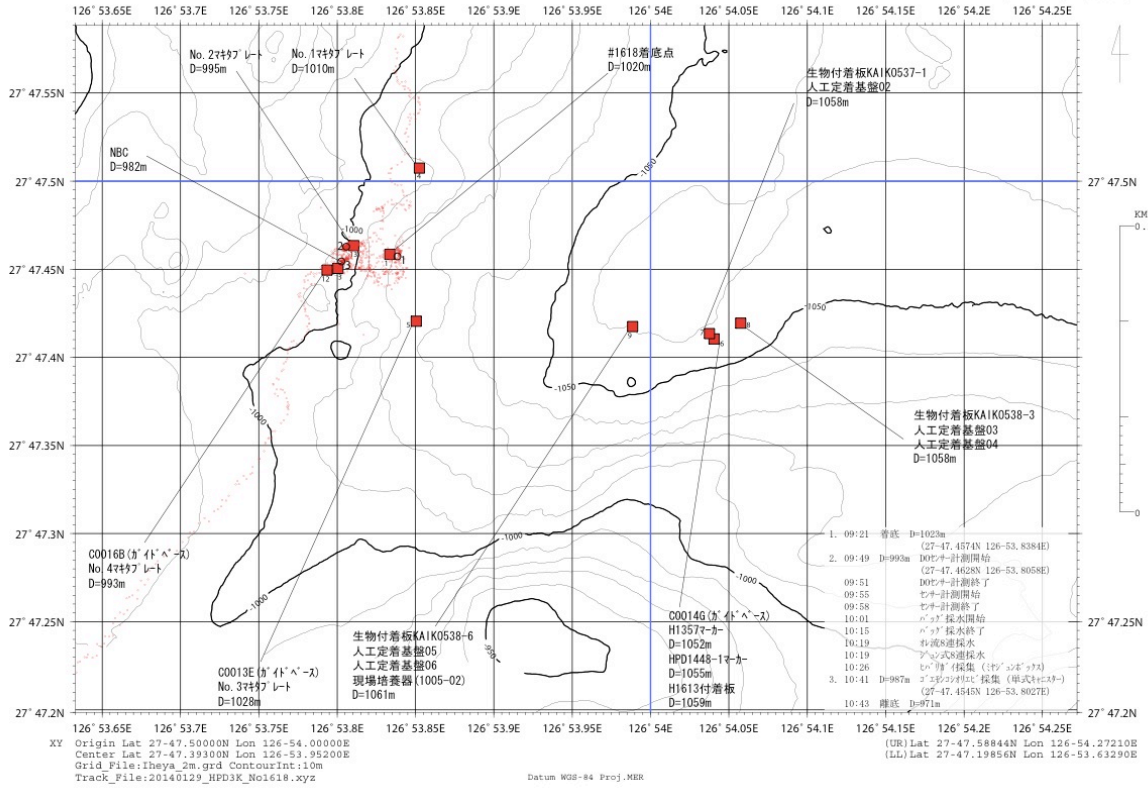
- 9:21 Landing (depth, 1023 m) (27°47. 4574N, 126°53. 8384E)
- 9:48 DO measurement, head 210° (993 m) (27°47. 4628N, 126°53. 8058E)
- 9:55 Multi sensor measurement
- 9:58 Finish multi sensor measurement
- 10:01 Start 8-series and bag water sampling

10:14 Finish water sampling
10:19 Start mussel sampling in Miyajun-box (broken mussels)
10:25 Finish mussel sampling
10:27 Finish injection of fixation reagent
10:37 Go up to *Shinkaia* colony (988 m) and sampling (27°47.4545N, 126°53.8027E)
10:43 Leaving the bottom (971 m)

Dive Track

KY14-01 OKINAWA TROUGH IHEYA KITA
HYPER DOLPHIN 3000 #1618

2014/01/29
(1 / 3000)



Dive Report: HPD Dive# 1619**Date:** January 29, 2014**Site:** NBC site in the Iheya North Hydrothermal Field**Landing:** 14:37; 27°47.4301'N, 126°53.9892'E, D=1066 m**Leaving:** 16:15; 27°47.4545'N, 126°53.8027'E, D = 990m**Observer:** Tomoo Watsuji (JAMSTEC)**Objectives:**

The main objective of the dive #1619 is collect vent-endemic animals with environmental measurement in and around NBC mound. Other objective is to recover colonization device and ISCS.

Dive summary:

A colonization device was put and previous colonization device and Hirayama's ISCS were recovered at event no. 9 (27° 47.4155N, 126° 53.99942E). Mystery circle procedure including DO and multi-sensor measurement was carried out at *Bathymodiolus* colony and *Cantreinia jamsteci* colony. At the top of NBC, *Shinkaia* was collected into single canister and the multi-sensor was calibrated with using standard solution. The water of single canister with collected *Shinkaia* individuals was not exchanged.

Payloads:

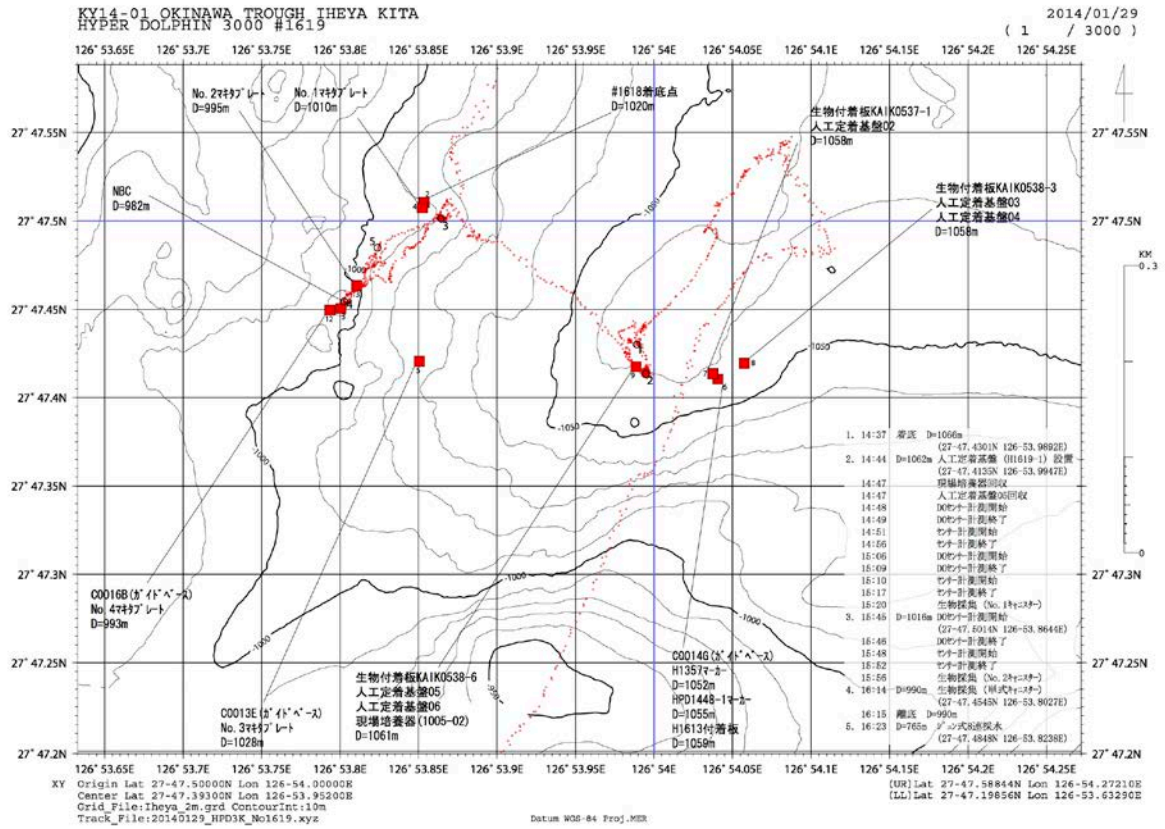
- Suction sampler with multi-bottle (7-series; #7 with cap) collectors and a single chamber with ice pack
- DO sensor
- Junshiki-8-bottle water sampler
- Multisensor
- CTD-pH sensor
- Mystery circle
- Sample box
- Box for in situ RNA fixation

Event list:

- 14:37 Landing at 20 m northeast of No.9, mud on rocky seafloor D=1066 Move to event no. 9
- 14:43 Put on new colonization device, 27° 47.4155N, 126° 53.99942E
- 14:47 Recovery of colonization 05 and Hirayama's ISCS
- 14:48 Measurement of DO sensor on *Bathymodiolus* and *Shinkaia* colony where the colonization 05 and Hirayama's ISCS had been put: 14:48:20 – 14:49:20
- 14:50 Measurement with multisensory on the *Bathymodiolus* and *Shinkaia* colony. 14:50:50

- 14:55:50, D = 1060 m, $T_{\max} = 4.2^{\circ}\text{C}$.
- 15:06 Measurement of DO sensor in the mystery circle on *Bathymodiolus* colony. 15:06:02
– 15:07:02, 15:07:32 – 15:08:32, D = 1064 m, $27^{\circ} 47.4160\text{N}$, $126^{\circ} 53.99937\text{E}$
- 15:10 Measurement with multisensory in the mystery circle on the *Bathymodiolus* colony.
15:10:07 – 15:14:28, D = 1064 m, $T_{\max} = 2.9^{\circ}\text{C}$,
- 15:19 Sampling *Bathymodiolus* colony in the mystery circle into #1 bottle.
- 15:20 Recover the circle
- 15:20 Move to the place where Makita's plate had been put (event no.4)
- 15:44 Measurement of DO sensor in the mystery circle on *Cantreinia jamsteci* colony,
15:44:50 – 15:46:17 D = 1015 m, $27^{\circ} 47.5028\text{N}$, $126^{\circ} 53.8621\text{E}$
- 15:48 Measurement with multisensory in the mystery circle on the *Cantreinia jamsteci*
colony. 15:48:07 – 15:52:30, D = 1015 m, $T_{\max} = 3.1^{\circ}\text{C}$
- 15:56 Sampling the *Cantreinia jamsteci* colony in the mystery circle into #2 bottle and
recover the circle
- 15:57 Move to NBC (event no.3)
- 16:13 Sampling *Shinkaia* colony in single canister at the top of NBC, 2747.4526N 126
 53.8027E
- 16:15 Multi-sensor calibration
- 16:15 Left bottom, D = 990 m

Dive Track



Dive Report: HPD Dive# 1620**Date:** January 30, 2014**Site:** Eastern basin and Hole C0014G in the Iheya North hydrothermal field**Landing:** 9:04, 27°47.454N, 126°54.426E, D=1073 m**Leaving:** 13:57, 27°41.401N, 126°54.188E, D=1041 m**Observer:** Yuka Masaki (JAMSTEC)**Objectives:**

The main objective of the dive #1620 is to remove a dummy cap on the guide base at site C0014 guide base. This operation is for advanced operation around site C0014 for deployment of the artificial hydrothermal cultivate tools. In addition during this dive, heat flow measurement were carried out to compare heat flow value before and after drilling.

Dive summary:

ROV “*HyperDolphin*” landed on the muddy seafloor at 600 meters east of Hole C0014G. We measured 3 heat flow before arriving at Hole C0014G. At Hole C0014G, we failed to remove a dummy cap covered on the top of drilling hole. We used Oil pressure chisel again to clean up around the cap to remove hydrothermal fragments. At last, we succeeded to remove a dummy cap. After the operation around Hole C0014G, then we moved to 200 m east from the Hole C0014G to measure heat flow. We had done all KY14-01 operations and left the seafloor.

Payloads:

- SAHF x1
- Oil pressure chisel
- Bar
- Safety fook
- H-type Core x2

Event list:

- 9:04 Bottom in site, sandy bottom
- 9:04 Landing
27°47.454N, 126°54.426E, D=1073 m
- 9:08 Heading to event mark #1
- 9:11 Arrived at event #1
- 9:14 SAHF calibration
27:47.452N, 126:54.399, D=1072 m
- 9:20 SAHF penetrated
- 9:26 H-type core sampled (black)
- 9:37 SAHF recovered, then move to 300 m west

10:00 Landing

10:02 SAHF calibration
27:47.453N, 126:54.218E, D=1057 m

10:08 SAHF penetrated

10:11 H-type core sampled (yellow)

10:24 SAHF pulled out, then move to event mark #10

10:49 Arrived at event #10

10:51 SAHF calibration
27:47.453N, 126:54.040E, D=1073 m

10:58 SAHF penetrated

11:13 SAHF pulled out, then move to event mark #6, site C0014G's guide base

11:21 C0014G guide base in site

11:26 Landing at the guide base, then remove hydrothermal fragments with oil pressure chisel
27:47.414N, 126:54.042E, D=1059

11:54 Turn around at the opposite side

12:11 Try to move the handle of the dummy cap

12:20 Push the pipe with manipulator

12:29 Pulled out!!

12:35 Cleaned up with oil pressure chisel

12:43 Move to opposite side, start to clean up with oil pressure chisel

12:49 Sample chimney

12:52 Pick up green rope on the guide base

12:55 Drop a pin on the guide base

12:59 Drop off a rock on the guide base

13:02 Drop off a pink rope on the guide base

13:03 Watch seafloor around the guide base, then move to event mark #2

13:28 Landing at event mark #2

13:33 SAHF calibration
27:47.401N, 126:54.19E, D=1041 m

13:39 SAHF penetrate

13:55 Finish SAHF measurement

16:14 Leave the bottom
27°41.401N, 126°54.188E, D=1041 m

Dive Track

