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# R/V Natsushima & ROV Hyperdolphin Cruise Report
# NT15-13

## 2015 Summer Tour of deep-sea hydrothermal vent fields in mid Okinawa Trough and investigation of their geochemical and (micro)biological diversity
## July 27, 2015 from Kumamoto – August 6, 2015 to Kagoshima

(photo by Dr. Chong Chen)

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

# Acknowledgements

We are grateful to Captain Mr. H. Masujima, Chief Officer Mr. M. Chiba, Chief Engineer Mr. K. Kajinishi and the crews for their safe navigation and their skillful handling of “R/V Natsushima”. Great thanks are due to ROV Operation Manager Mr. T. Kondo and “HyperDolphin” operation team for their operations in sampling. We also thank Mr. M. Kuno, Nippon Marine Enterprise, Ltd., for his attentive supports. We thank all the JAMSTEC persons 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: NT15-13**

**Vessel: Natsushima**

**Title of the cruise:** 2015 Summer Tour of deep-sea hydrothermal cent fields in mid Okinawa Trough and investigation of their geochemical and (micro)biological diversity

**Title of proposal:** Geochemical exploration of subseafloor hydrothermal fluid reservoirs for three closely located hydrothermal systems in the Iheya North Knoll through natural and artificial hydrothermal vents

**Title of proposal:** Taming of chemolithoautotrophic endosymbionts: micro-structural analysis staring at the “autophagy”

**Cruise period:** July 27 – August 6, 2015

**Ports of call:** Kumamoto – Kagoshima, Japan

**Research area:**
1. Okinawa Trough

**Research map:**

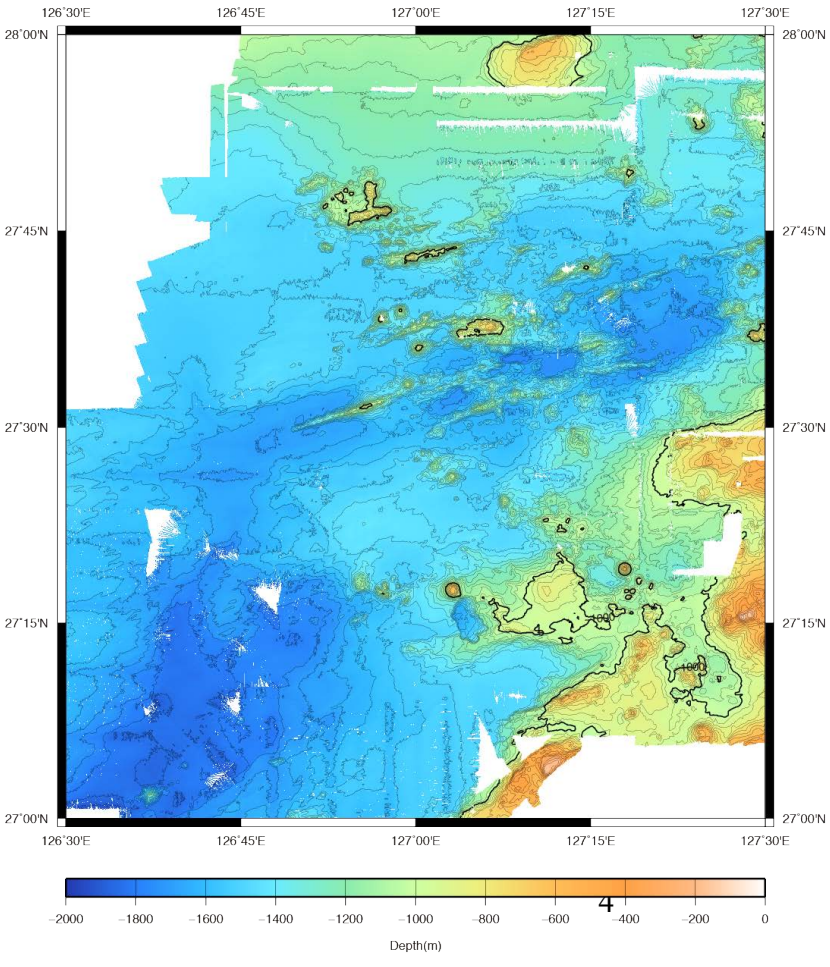


**Fig. 1. Bathymetry map of mid-Okinawa Trough. Red square areas mean the Iheya North Knoll and Iheya Small Ridge and their vicinities that we focus on in this cruise.**

# List of Participant
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| | |
|---|---|
| **Captain** | **MASUJIMA HIROAKI** |
| **Chief Officer** | **CHIBA MASATO** |
| **2nd Officer** | **KONNO HIDEHIKO** |
| **3rd Officer** | **YOSHIDA SATORU** |
| **Chief Engnieer** | **KAJINISHI KIYONORI** |
| **1st Engnieer** | **MATSUKAWA KIMIO** |
| **2nd Engnieer** | **SHIRAKATA KENICHI** |
| **3rd Engnieer** | **ONO KAZUKI** |
| **Chief Radio Officer** | **SAITAKE HIROYASU** |
| **2nd Radio Officer** | **TAKAKUWA TATSUHIRO** |
| **3rd Radio Officer** | **MABARA TAKAYUKI** |
| **Boat Swain** | **ODA HATSUO** |
| **Able Seaman** | **YAMAMOTO SHUICHI** |
| **Able Seaman** | **NAGAI HIROAKI** |
| **Able Seaman** | **ABE SHUN** |
| **Able Seaman** | **NAKANISHI TORU** |
| **Sailor** | **KOJIMA SHINYA** |
| **Sailor** | **SAGA TOSHIYA** |
| **Sailor** | **MURAI KYOHEI** |
| **No.1 Oiler** | **OISHI HIROYUKI** |
| **Oiler** | **FUJIWARA MASAYUKI** |
| **Oiler** | **TANAKA MASAKI** |
| **Oiler** | **WATANABE TAKUYA** |
| **Oiler** | **HIDAKA TORU** |
| **Oiler** | **NAKAJIMA KOSHI** |
| **Chief steward** | **SASAKI SUETO** |
| **Steward** | **TANAKA SHINSUKE** |
| **Steward** | **FUKUMURA HIDEO** |
| **Steward** | **SUZUKI AKIO** |
| **Stewerd** | **MIKAMI SOTA** |

## “HyperDolphin” Operation Team

| | |
|---|---|
| **Operation Manager** | **KONDO TOMOE** |
| **1st ROV operator** | **WAKAMATSU HOMAR** |
| **2nd ROV operator** | **CHIBA KATSUSHI** |
| **2nd ROV operator** | **KIKUYA SHIGERU** |
| **2nd ROV operator** | **IHARA SHOTA** |
| **2nd ROV operator** | **GOTO TAKUMA** |
| **2nd ROV operator** | **KUMAGAI SHINNOSUKE** |

# I. CRUISE SUMMARY

In NT15-13 cruise, we have totally conducted 6 dives of HyperDolphin in four different hydrothermal vent sites in the Iheya North Knoll and the Iheya Small Ridge of the Mid Okinawa Trough. We planed to conduct the wide range mapping of seafloor hydrothermal events in the Iheya North Original site and Sakai Noho site. With only one dive of hyperDolphin, the SeaXeroxs covered major hydrothermal event area, for example, huge hydrothermal mound area (NBC, SBC, ESBC, CBC, C0016B artificial hydrothermal vent and E18 vent). The detail seafloor mapping will provide not only post-drilling impact on the whole landscape of the Iheya North Original 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 original 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, almost five 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 disappeared in the top roof but 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 methane sensor, particularly to characterize physical and chemical conditions of zonation of macrofaunal populations. 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 (methane concentrations) of different representative fauna such as *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 successful sampling of lots of hydrothermal fluids, sulfide deposits, mixing waters and animal specimens from different hydrothermal vent sites. These samples will accelerate the future onboard multidisciplinary investigations.

# II. INTRODUCTION

## 1. General backgrounds

In the last dacade, water column observation using multibeam echo souder (MBES) system have been finding increasing use in exploation of seafloor hydrothermal vents. In 2013 and 2014, we conducted water column surveys using MBES systems by using R/Vs Natsushima and Yokosuka in the mid-Okinawa Trough for the purpose of clarifying the number and distribution of hydrothermal vent sites in this area. Finally, 10 hydrothermal vent sites, including previously known sites, belonging to four hydrotheraml vent fields that are located at the Izena Hole, Iheya North Knoll, Iheya Small Ridge, and a seamount 15 km northwest of the Izena Hole (Awashima Knoll) (Kasaya et al., 2015; Nakamura et al., 2015).

These new hydrothermal vent sites have potentials to host geochemical and biological diversity within the mid Okinawa Trough and even in the whole Okinawa Trough. However, detail investigations of these new hydrothermal vent sites have not yet conducted.

**References**

Kasaya, T., Machiyama, H., Kitada, K., and nakamura, K. (2015) A trial of exploration for a sign of hydrothermal activity using acoustic measurements. Geochemical Journal, in press.

Nakamura, K., Kawagucci, S., Kitada, K., Kumagai, H., Takai, K., and Okino, K. (2015) Mapping deep-sea hydrothermal vent sites with multibeam echo-sounding (MBES) in the mid-Okinawa Trough. Geochemical Journal, in press.

## 2. Objectives of the cruise

A primary scientific goal of this expedition is to understand the geochemical and biological diversity in the deep-sea hydrothermal vent sites (Iheya North Field Original site, Iheya North Field Aki site, Sakai Field Hitoshi site and Sakai Field Noho site) within the mid Okinawa Trough and even in the whole Okinawa Trough. Thus, lots of hydrothermal fluids, sulfide deposits, rocks, sediments, mixing zones of waters and a variety of chemosynthetic animals will be sampled and be investigated for various onboard research plans. In addition, compositional and functional diversity of symbioses in the chemosynthetic animals will be studied using different biological samples obtained from the various hydrothermal vent sites.

# 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.

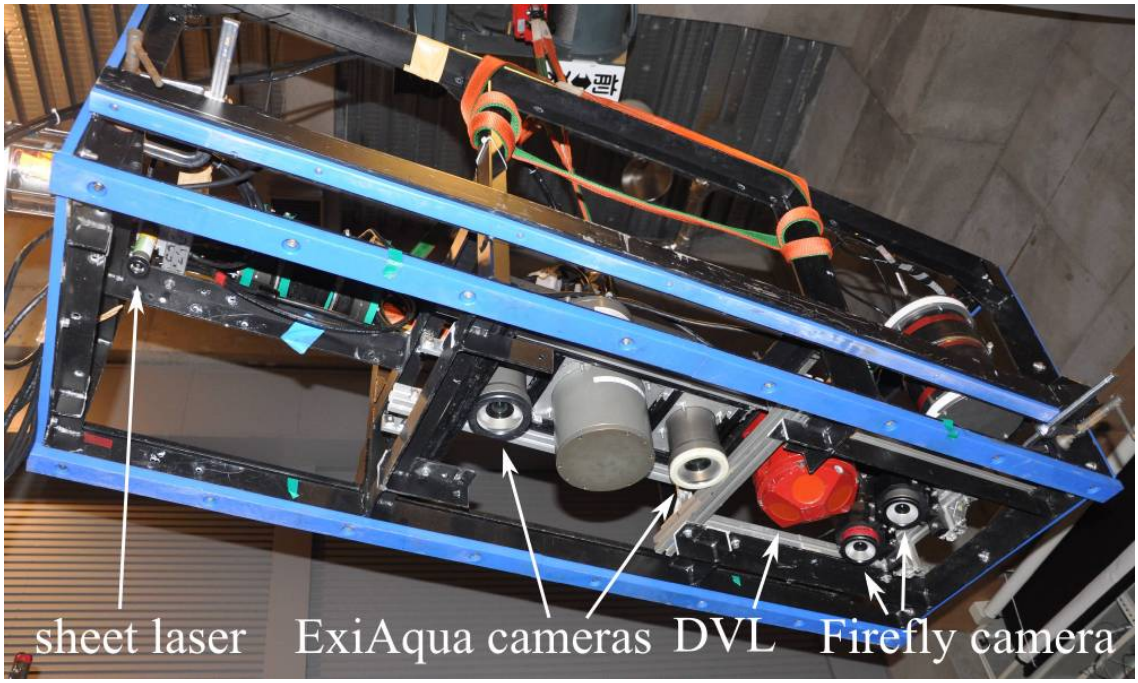


Fig. 1: SeaXerocks mapping system mounted on payload skid.

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 10 m, 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 $m^2$ 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-Dolpins'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 40,000$m^2$ of the seafloor was mapped. This data will be used to quantify the distribution of macro fauna habitats in the Iheya North Field.

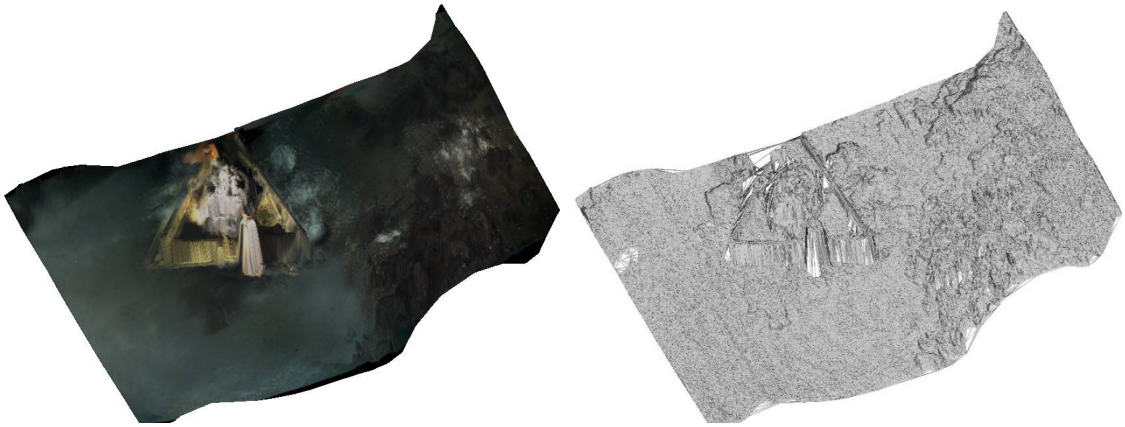


Fig. 2 Preliminary 3D colour reconstruction of guide base C0016B mapped in a single pass. The reconstruction shows significant deposition of sulphides surrounding the vent.

## 3. Geochemistry

### WHATS-III fluid sampler

WHATS-III (Water Hydrothermal Atsuryoku Tight Sampler III) has been 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 is composed of inlet tubing, 4 sample bottle sets consisting of serially concatenated 2 types of pressure-resistant bottles (bottle 1; 19.5 ml, bottle 2; 56.5 ml) with ball valves at the both end, rolling bars to open and shut the valve and a deep-sea compatible pump. We will extract gases from fluids in 19.5 ml bottle1 and will analyze liquid chemical properties (pH, H2S, NH3 and so on) from fluids in bottle2. Usually WHATS is installed just at the side shell of HyperDolphin and a sample inlet is handled with a manipulator. Operation is controlled from onboard control room. At the time of each sampling, fluid temperature can be monitored using a thermometer attached to the top of the inlet tube.

| Description | |
|---|---|
| Dimension of frame: | 375 mm × 325 mm x 700mm |
| Weight: | 32.95 kg in air |
| | 18.65 kg in seawater |
| Depth range: | 4000 m |
| Sample volume: | 76 ml x 4 (19.5 ml x 4 + 56.5ml x 4) |
| Sampling rate: | 97-390 ml / min |
| Electricity: | DC24 V / 1.0 A |

### Junshiki 4 tubes samplers

Junshiki 4 tubes sampler is a gas-tight fluid sampler by Junichi Miyazaki, which much less cost than WHATS-III. The whole sampling scheme is very similar with that of WHATS-III 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 4 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 4 tubes sampler is optimized to reduce valve operation and space occupation.

**Treatment and onboard analyses of fluid samples for gas chemistry**

In general, for vent fluid sampling, the WHATS-III sample bottles were used in pairs, one bottle for sample for soluble compoenents chemistry and the other for sample 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. Then, the valve on the bottle is opened and the fluid plus gas are allowed to drop into an evacuated flask. Sulfamic acid and mercury chloride have been put in the flask prior to the extraction, which acidify the fluid to extract dissolved $CO_2$ (carbon dioxide) and $H_2S$ (hydrogen sulfide). The water in the extraction flask is then agitated by stirring bar. The $H_2S$ gas and dissolved sulfide in the fluid are precipitated as HgS, which is provided for subsequent sulfur isotope analysis. The extracted gas phase was transferred to a total of 250 $cm^3$ 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 drawn into a 50 $cm^3$ 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 divided into a few bottles for each specific study. After samples for onboard analysis (pH, $NH_4$ and so on) and isotope determination were drawn, the rest of the fluid was filtered with a 0.45 μm disk filter. The filtrate was provided for chemical analysis of cations, anions and nutrients ($NH_4$). The rinse water was drawn into a bottle zinc acetate solution has been placed, to fix sulfide as zinc sulfide precipitation provided for sulfur isotope analysis. For a few samples, the fluid for isotope determination of specific organic matters was drawn in a small glass bottle and frozen immediately. The filtrate aliquot for cation (and trace metals) analysis was acidified with nitric acid to avoid hydroxide precipitation during storage. The filtrate aliquot for anion was storage in a refrigerator, and that for nutrients was frozen.

Because some chemical species (pH, alkalinity and some nutrients) are difficult to be conserved during storage, we therefore analyzed these species onboard, following Gieskes et al. (1991). Measurement of pH was conducted using an electrode (Radiometer, pHC2401-8) after calibration using JCSS standard solutions (pH = 6.86 and 4.01). Alkalinity was measured by 0.1N HCl titration, which end point was determined by gran's plot. Concentrations of ammonium ion ($NH_4$), and hydrogen sulfide ($H_2S$) were analyzed following classical methods; indo-phenol method (λ=640nm) for $NH_4$ and methylene blue method (λ=670nm) for $H_2S$, using a colorimeter (Shimazu, UV mini 1240). 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 (NH4).

**Treatment of sediment samples**

Sediment samples were collected using MBARI corers. After recovery, the sediment was divided into two parts; one half for microbiological study and the other half for geochemical study.

The geochemistry half was divided by 5-cm intervals. Each block was packed

into a plastic syringe of 50 mL volume and squeezed with a small vice to extract pore fluid. The pore fluid was collected into a small plastic syringe that connected with the sediment syringe, through a stainless mesh (500 mesh), filter paper, and 0.45 μm disk filter. The pore fluid samples were provided for chemical analysis, as well as the vent fluid samples. The remaining sediment samples were stored in a refregirator for further mineralogical and chemical analysis.

**4. 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 °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 °C. Some individuals of hydrothermal vent animals were frozen under -80 °C or fixed with ethanol or formalin.

# IV. DIVE REPORTS

**Dive Report: HPD Dive# 1857**
**Date:** July 29-July 30, 2015
**Site:** Noho site in Sakai Field
**Landing:** 21:48; 27˚31.310'N, 126˚59.106'E, D=1595 m
**Leaving:** 03:11; 27°31.219'N, 126°59.011'E, D=1579 m
**Observer:** Ken Takai (JAMSTEC)

**Objectives:**

The main objective of the dive #1857 is to explore the Noho in the Sakai field. We will take samples of fluids, chimneys, sediments, animals and others.

**Dive summary:**

HyperDolphin landed on the sediemnts at about 40 m west of Okumura Ika mat. Before landing on the bottom, a bottom water was sampled by Niskin sampler (green). Then we headed to Okumura Ika mat. We found the Okumura Ika Mat and then first measured methane concentration by methane sensor and sedimentary temperature by RMT thermometer. After these operation,s we take 2 MBARI (red & yellow) cores from this site. We set a marker#1857-1. At 75 m northwest from the Okumura Ika Mat, we found a new hydrothermal mound (Kasusu chimney). Only diffusing fluids were found. We headed to WOWOW chimney. Before arriving at WOWOW chimney, a calyptogena colony was found. Thus, we collected calyptogena individuals from this site. We could not find a WOWOW chimney. Thus, we headed to unexplored mounds in the eastern flank.

We found two softcream chimneys. One of them was successfully sampled. Hydrothermal fluid was sampled (Tmax = 81.7 ˚C). After that, we collected several shrimps. We also collected several pieces of crusts.

We surveyed unexplored mounds in the eastern flank, however most of them seemed to be lava mounds not sulfide mounds.

Finally we headed to Ese-JOGMEC mound and arrived there. However, there was not found many galatheids' colonies. So, we collected a dead sulfide.

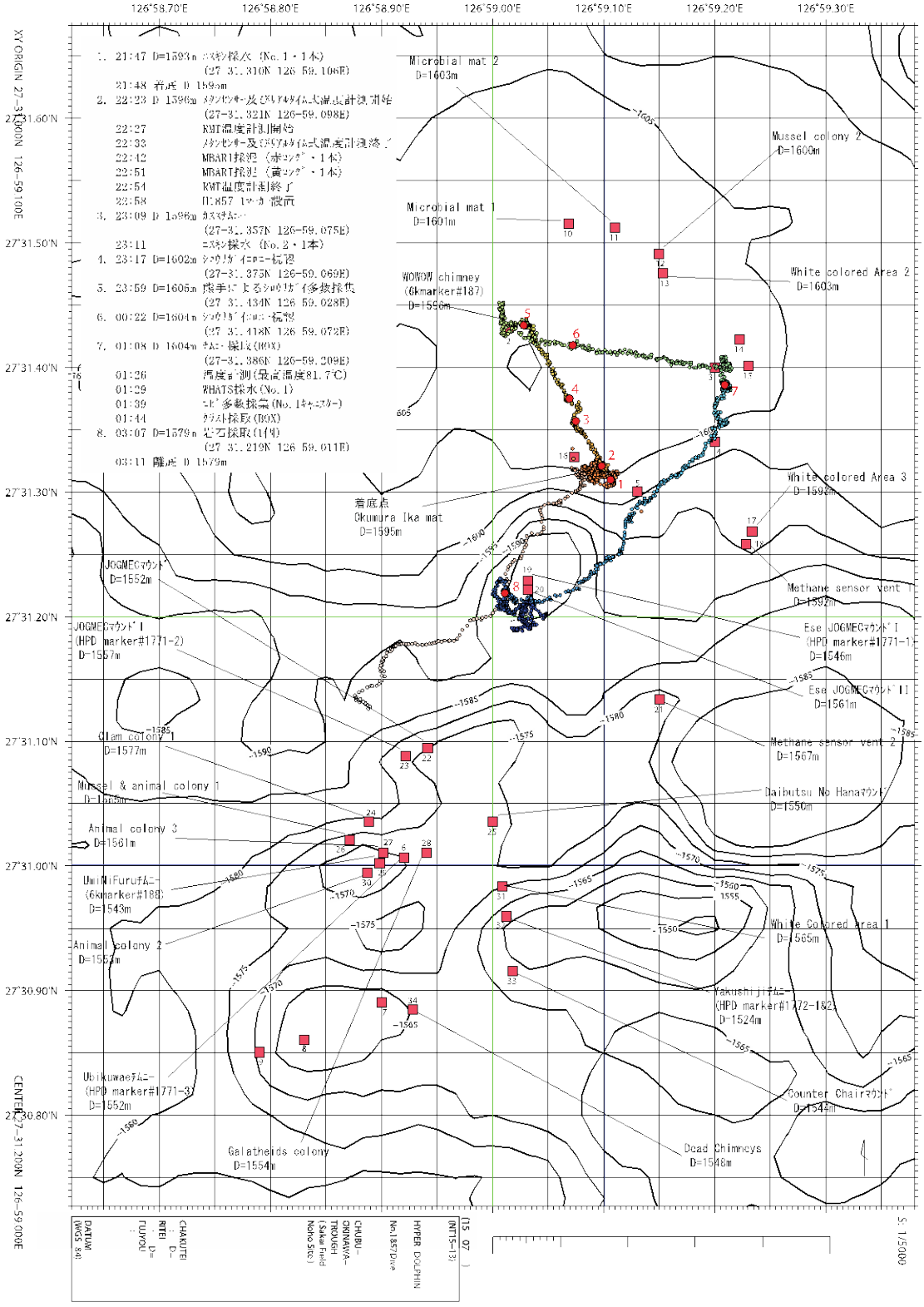
**Payloads:**

- 7 bottles canister x 1
- Slurp gun pomp x 1
- WHATS-III water sampler
- Methane sensor
- Turbidity sensor
- MBARI corer 35 cm x 2
- MBARI corer 50 cm x 2
- Sample box x 3
- Folk x 1
- Niskin water sampler x 2

**Event list:**

21:46 Sampling bottom water by Niskin sampler (green) (27˚31.310'N, 126˚59.106'E, D=1593 m)
21:47 Landing at sediment (27˚31.310'N, 126˚59.106'E, D=1595 m)
22:34 Finding Okumura Ika Mat (27˚31.321'N, 126˚59.098'E, D=1596 m)
22:34 Measurement methane concentration
22:34 Measurement sediment temperature (15 and 25 cm below seafloor)
22:36 MBARI (red) (25 cm?) taken
22:42 MBARI (yellow) (15 cm) taken
23:00 Set a marker #1857-1
23:11 Take a Niskin sampler (red) on the Kasusu chimney (27˚31.357'N, 126˚59.075'E, D=1596 m)
23:50 Sampling calyptogena individuals (27˚31.434'N, 126˚59.028'E, D=1596 m)
00:16 Heading to unexplored mounds
01:00 Found two softcream chimneys (27˚31.386'N, 126˚59.209'E, D=1604 m)
01:10 Collected a chimney structure (27˚31.386'N, 126˚59.209'E, D=1604 m)
01:31 Collected hydrothermal fluid (Tmax = 81.7 ˚C) (27˚31.386'N, 126˚59.209'E, D=1604 m)
01:38 Collected shrimps (27˚31.386'N, 126˚59.209'E, D=1604 m)
01:45 Collected several pieces of crusts (27˚31.386'N, 126˚59.209'E, D=1604 m)
03:00 Collect a sulfide rock ((27˚31.219'N, 126˚59.011'E, D=1604 m)

# Dive Track


126°58.70'E
126°58.80'E
126°58.90'E
126°59.00'E
126°59.10'E
126°59.20'E
126°59.30'E
27°31.60'N
27°31.50'N
27°31.40'N
27°31.30'N
27°31.20'N
27°31.10'N
27°31.00'N
27°30.90'N
27°30.80'N
Microbial mat 2
D=1603m
Mussel colony 2
D=1600m
Microbial mat 1
D=1601m
WOWOW chimney
(6kmarker#187)
D=1596m
White colored Area 2
D=1603m
着底点
Okumura Ika mat
D=1595m
White colored Area 3
D=1592m
JOGMECマウンド
D=1552m
Methane sensor vent 1
D=1592m
JOGMECマウンドI
(HPD marker#1771-2)
D=1557m
Ese JOGMECマウンドI
(HPD marker#1771-1)
D=1546m
Ese JOGMECマウンドII
D=1561m
Clam colony 1
D=1577m
Methane sensor vent 2
D=1587m
Mussel & animal colony 1
D=1565m
Daibutsu No Hanaマウンド
D=1550m
Animal colony 3
D=1561m
Umi NiFuruチムニー
(6kmarker#188)
D=1543m
White Colored Area 1
D=1565m
Animal colony 2
D=1554m
Yakushijiチムニー
(HPD marker#1772-1&2)
D=1524m
Ubikuwaeチムニー
(HPD marker#1771-3)
D=1552m
Counter Chairマウンド
D=1544m
Galatheids colony
D=1554m
Dead Chimneys
D=1548m
DATUM (WGS 84)
CHAKUTEI
CHUBU-OKINAWA-TROUGH (Sakai Field Note Stc)
HYPER DOLPHIN
S: 1/5000

**Dive Report: HPD Dive# 1858**
**Date:** July 30, 2015 to July 31, 2015
**Site:** Hitoshi hydrothermal site (Noho site) in the Sakai hydrothermal field
**Landing:** 21:56; 27°32.825'N, 126°59.414'E D=1341m
**Leaving:** 2:43; 27˚32.871'N, 126˚59.273'E, D=1334 m
**Observer:** Junichi Miyazaki (JAMSTEC)

**Objectives:**

The main objective of the Hyperdolphin dive #1858 is to explore unexplored area, particularly eastern area of Hitoshi site in the Sakai hydrothermal field. If there are hydrothermal events, we will take samples of fluids, chimneys, sediments, animals and others.

**Dive summary:**

During descent, we sampled water at 500 m water depth to the Niskin sampler (Green). And also just before landing, we sampled water at 500 m water depth to the Niskin sampler. We landed on hard slope covered with rock, headed to north and climbed the slope. And we ran via the targets 2, 3, 4 and 5. However we could not find hydrothermal activities. Therefore we headed to west. When we arrived at target 6, we found dead chimneys with flange and Kaiko 7000II marker around there. Next, we headed to southwest to go to target 8 and 7. In previous cruise, we found dead chimneys and set on marker #1770-1 at target 8, and we found animal colonies and hydrothermal shimmering at target 7. But we could not found any of these features. Therefore, we gave up find these objects and headed to north. We found tubeworm (*Alaysia* sp.) colony and then sampled. We continued to head to north and then we found hydrothermal vent. At this point, we sampled chimney structures and hydrothermal fluids into No.1 bottle set of WHATS-III. 141°C was recorded as a highest temperature. After these sampling, we moved to XX and we found mussels. We sampled mussels into No.1 bottle of canister and sulfide rocks into bascket. We headed to north to seek other hydrothermal activities and then we found active chimney which had mushroom-like shape. We tried to sample chimney structures but we failed because the chimney was very soft. We gave up sampling chimney structures. Next we sample hydrothermal fluids into No. 2 bottle set of WHATS-III. 280°C was recorded as a highest temperature. (After this HPD#1858 dive, this chimney was located near Miyamasa chimney which was found in previous HPD #1770 dive during the NT15-02 cruise.) After hydrothermal fluid sampling, we moved to north and landed in front of galatheids colony. First, we sampled fluid on colony into No. 3 bottle set of WHATS-III and Jun-shiki 4 tube sampler with measuring methane concentration by METS methane sensor. During the sampling, 4.2°C was recorded as a highest temperature. Next, we sampled galatheids into No. 2 and No. 3 bottle of canister by slurpgun. We moved slightly and landing in front of mussel colony. We sampled mussels into No. 4 bottle of canister by slurpgun and then rocks with mussels into sample basket. After these event, we went back to target 10 and found HPD marker #1770-2 which was set on Oono chimney in previous HPD dive #1770. We landed in front of the chimney and then sampled chimney into box. After chimney sampling, we sampled hydrothermal fluids. During the fluids sampling, 263.7°C was recorded as a highest temperature. We moved to adjoining dead chimney and sampled sponges into No. 5 bottle of canister. When the sampling sponges, we found marker and to confirm it, we moved to that position. We identified the marker as HPD marker #1770-1 which was set on dead chimneys in previous HPD dive #1770. We headed to west to go to the target 11, 12 and 13. When we arrived at target 11 in which we found shimmering and animal colonies in previous HPD #1770, but we did not any features of hydrothermal activities. Therefore we headed to north to go to target 12. We found animal colony at the north of

target 12. We sampled micro animals attached to tubeworms into No. 6 bottle of canister by slurpgun. After this event, we left the bottom at 2:43 A.M.

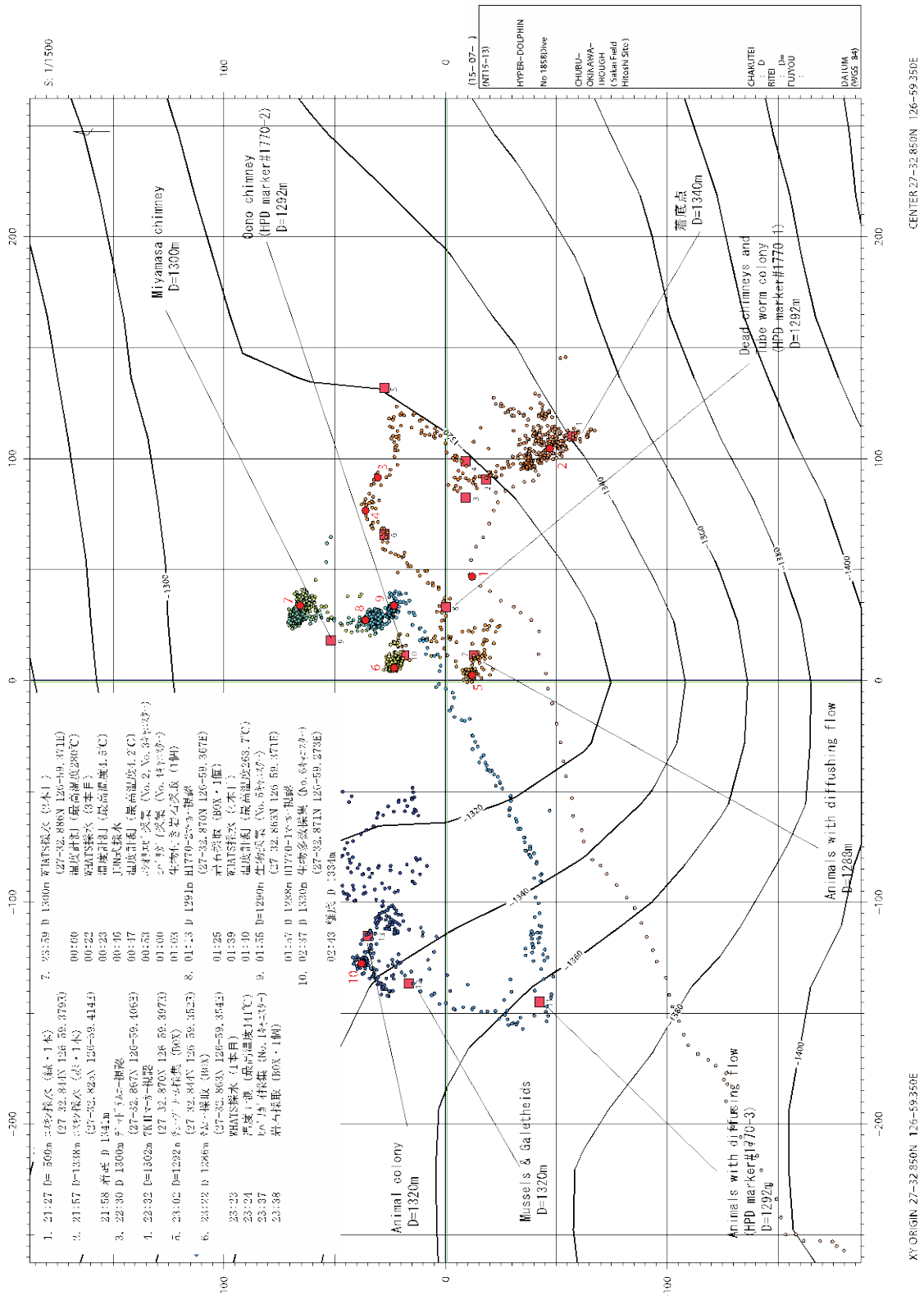
**Payloads:**

1. Suction sampler with multi-bottle (7-series) collectors
2. WHATS-III (Water and hydrothermal fluid Atsuryoku Tight Sampler)
3. Jun-shiki 4 tube sampler
4. METS methane sensor with standard
5. Sample box x 3
6. Kumade sampler
7. Niskin sampler x 2 (Red, Green)
8. Turbidity sensor
9. Marker (x 2 (HPD#1858-1 & -2)

**Event list:**

| | | | |
|---|---|---|---|
| 21:27 | 27°31.570'N, 126°59.023'E | D=510m | Water sampling to Niskin Green |
| 21:57 | 27°32.821'N, 126°59.414'E | D=1339m | Niskin Red Sampling. |
| 21:57 | 27°32.821'N, 126°59.414'E | D=1339m | Landing. |
| 22:30 | 27°32.867'N, 126°59.406'E | D=1300m | Finding dead chimneys with flange. |
| 22:32 | 27°31.474'N, 126°59.144'E | D=1302m | Finding Kaiko 7000-II marker. |
| 23:02 | 27°32.844'N, 126°59.352'E | D=1292m | Sampling tubeworms. (BOX) |
| 23:22 | 27°32.863'N, 126°59.354'E | D=1286m | Sampling chimney (BOX). |
| 23:23 | 27°32.863'N, 126°59.354'E | D=1286m | Sampling hydrothermal fluids (WHATS1)(Max temp.=141°C) |
| 23:37 | 27°32.863'N, 126°59.354'E | D=1286m | Sampling mussels (Canister 1) |
| 23:38 | 27°32.863'N, 126°59.354'E | D=1286m | Sampling rocks |
| 23:59 | 27°32.886'N, 126°59.371'E | D=1300m | Sampling hydrothermal fluid (WHATS2)(Max. temp.=280°C) |
| 00:22 | 27°32.886'N, 126°59.371'E | D=1300m | Sampling water on galatheids (WHATS3)(Max. temp.=4.5°C) |
| 00:46 | 27°32.886'N, 126°59.371'E | D=1300m | Sampling water on galatheids (Jun-shiki) (Max. temp.=4.2°C) |
| 00:53 | 27°32.886'N, 126°59.371'E | D=1300m | Sampling galatheids (Canister 2&3) |
| 00:53 | 27°32.886'N, 126°59.371'E | D=1300m | Sampling mussels (Canister 4) |
| 01:13 | 27°32.870'N, 126°59.367'E | D=1291m | Finding HPD marker #1770-2 |
| 01:25 | 27°32.870'N, 126°59.367'E | D=1291m | Sampling chimney (BOX) |
| 01:39 | 27°32.870'N, 126°59.367'E | D=1291m | Sampling hydrothermal fluid (WHATS2)(Max. temp.=264°C) |
| 01:55 | 27°32.863'N, 126°59.371'E | D=1290m | Sampling sponges (Canister 5) |
| 01:57 | 27°32.870'N, 126°59.367'E | D=1288m | Finding HPD marker #1770-1 |
| 02:37 | 27°32.871'N, 126°59.273'E | D=1330m | Sampling animals attached to tubeworm (Canister 5) |
| 02:43 | 27°32.871'N, 126°59.273'E | D=1334m | Left the bottm. |

# Dive Track


Miyamasa chimney
D=1300m
Ono chimney
(HPD marker#1770-2)
D=1292m
Dead chimneys and
Tube worm colony
(HPD marker#1770-1)
D=1292m
Animal colony
D=1320m
Mussels & Galatheids
D=1320m
Animals with diffushing flow
(HPD marker#1770-3)
D=1292m
Animals with diffushing flow
D=1288m
HYPER-DOLPHIN
No 1858Dive
CHUBU-OKINAWA-TROUGH
(Sakai Field Hitoshi Site)
CHAKUTEI
RITEI
FUJIYOU
DATUM
(WGS 84)
CENTER 27-32.850N 126-59.350E
XY ORIGIN 27-32.850N 126-59.350E

**Dive Report: HPD Dive# 1859**
**Date:** July 31- August 1, 2015
**Site:** Aki site in Iheya North Field
**Landing:** 20:43; 27˚46.203'N, 126˚54.037'E, D=1109 m
**Leaving:** 03:12; 27°45.928'N, 126°54.248'E, D=1067 m
**Observer:** Masayuki Miyazaki (JAMSTEC)

**Objectives:**

The main objective of the dive #1859 is to explore the Aki site in the Iheya north field. We will take samples of fluids, chimneys, sediments, animals and others.

**Dive summary:**

HyperDolphin landed on the gravels at about 100 m north of Ikinari chimney. After landing on the bottom, the bottom water was sampled by Niskin sampler (green). We found the Ikinari chimney and then first collected chimney in box. After Hydrothermal fluid was sampled (Tmax = 313.4 ˚C). We headed to Hidarite-Ha-Soerudake chimney. Before arriving at Hidarite-Ha-Soerudake chimney, Bimyou mount was found. Thus, we collected *Eosipho desbruyeresi nipponensis* and two rocks.

We found a new chimney (the name Hidarite-Ha-Yakerudake) and then first collected chimney in box. After Hydrothermal fluid was sampled (Tmax = 230.7 ˚C). We headed to Hidarite-Ha-Soerudake chimney.

We arrived at Hidarite-Ha-Soerudake chimney. We collected chimney in box. After Hydrothermal fluid was sampled (Tmax = 316.1 ˚C).

We headed to Grand Canyon mount. Before arriving at Grand Canyon mount, animal colony was found. We measured methane concentration by sedimentary temperature by RMT thermometer and take a MBARI (green) cores from this site. After we collected tubeworms and *Bathymodiolus*.

We found Grand Canyon mount. At first, the bottom water was sampled by Niskin sampler (red). We measured methane concentration by methane sensor and sampled water by JUN type. After we collected *Shinkaia crosnieri* and other animals.

We headed to *Clyptogena* colony neighbor Grand Canyon mount. We found *Clyptogena* and collected that in sample box. We measured methane concentration by sedimentary temperature by RMT thermometer and take a MBARI (black) cores from this site. Finally, we collected Asteroidea by Slurp gun.

**Payloads:**

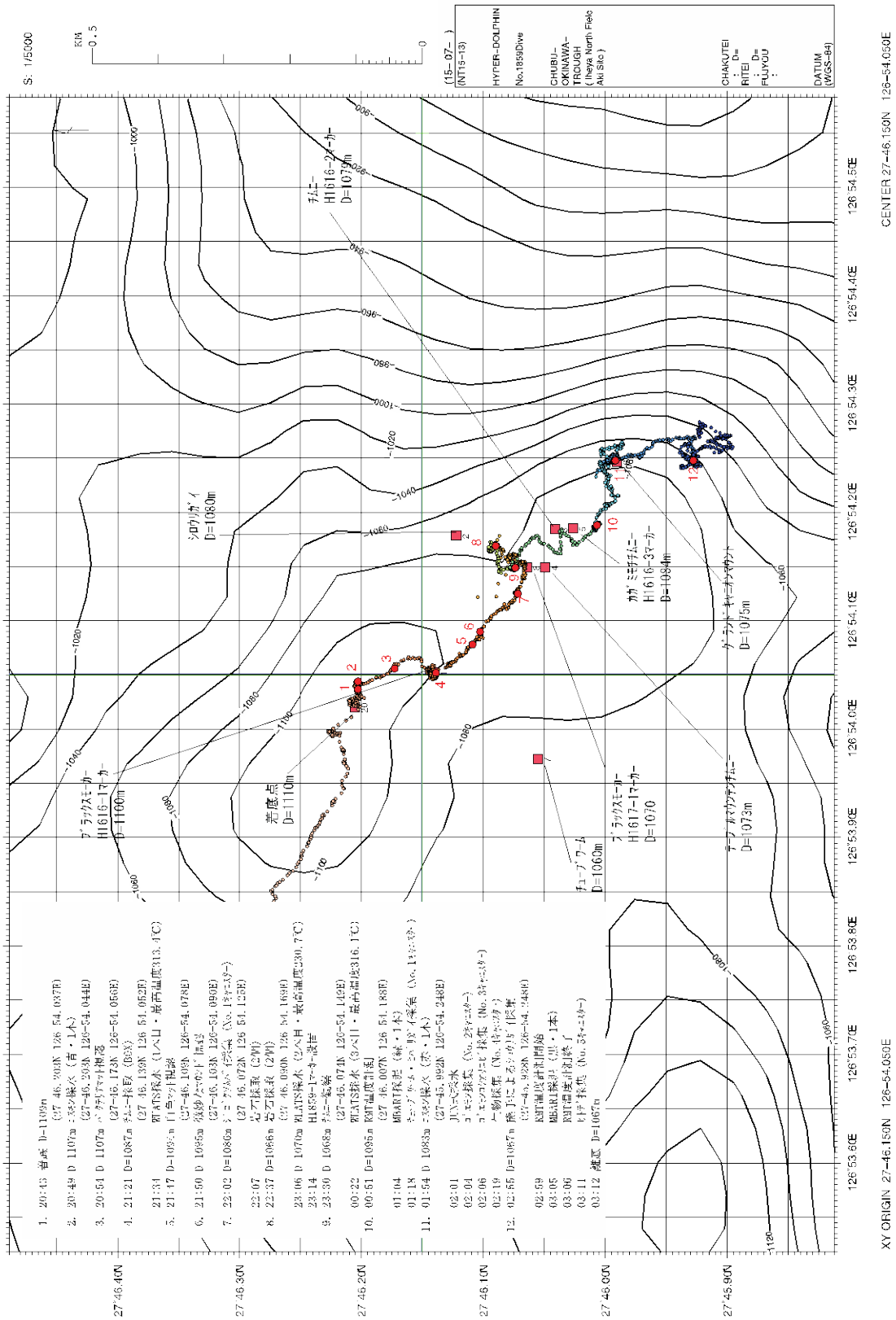
- 7 bottles canister x 1
- Slurp gun pomp x 1
- WHATS-III water sampler
- Thermometer with inlet

- Methane sensor
- Turbidity sensor
- MBARI corer 35 cm x 2
- Sample box x 3
- Niskin water sampler x 2
- RMT thermometer
- Marker x 2

**Event list:**

20:43 Landing at sediment (27˚46.203'N, 126˚54.037'E, D=1109 m)
20:49 Sampling bottom water by Niskin sampler (green) (27˚46.203'N, 126˚54.044'E, D=1107 m)
20:54 Found a bacteria mat (27˚46.173'N, 126˚54.056'E, D=1107 m)
20:58 Found Ikinari chimney (27˚46.144'N, 126˚54.056'E, D=1093 m)
21:21 Collected a chimney structure in sample box (27˚46.139'N, 126˚54.052'E, D=1087 m)
21:34 Collected hydrothermal fluid (Tmax = 313.4 ˚C) (27˚46.139'N, 126˚54.052'E, D=1087 m)
21:47 Found a white bacteria mat (27˚46.109'N, 126˚54.078'E, D=1094 m)
21:50 Found the delicate mount (27˚46.103'N, 126˚54.090'E, D=1095 m)
22:02 Collected a *Eosipho desbruyeresi nipponensis* (27˚46.072'N, 126˚54.125'E, D=1086 m)
22:07 Collected two rocks (27˚46.072'N, 126˚54.125'E, D=1086 m)
22:37 Collected dead chimneys (27˚46.090'N, 126˚54.169'E, D=1066 m)
22:47 Found Hidarite-Ha-Yakerudake chimney (27˚46.090'N, 126˚54.169'E, D=1070 m)
23:06 Collected hydrothermal fluid (Tmax = 230.7 ˚C) (27˚46.090'N, 126˚54.169'E, D=1070 m)
23:14 Set H1859-1 marker (27˚46.090'N, 126˚54.169'E, D=1070 m)
23:30 Found Hidarite-Ha-Soerudake chimney (27˚46.074'N, 126˚54.149'E, D=1068 m)
00:22 Collected hydrothermal fluid (Tmax = 316.1 ˚C) (27˚46.074'N, 126˚54.149'E, D=1068 m)
00:42 Found animals (27˚46.007'N, 126˚54.188'E, D=1095 m)
00:51 Measurement sediment temperature (Depth 15 cm) (Tmax = 212.4 ˚C) (27˚46.007'N, 126˚54.188'E, D=1095 m)
01:04 MBARI (green) (10 cm) taken (27˚46.007'N, 126˚54.188'E, D=1095 m)
01:18 Collected tubeworms and *Bathymodiolus* by Slurp gun (#1 canister) (27˚46.007'N, 126˚54.188'E, D=1095 m)
01:48 Found Grand Canyon mount (27˚45.992'N, 126˚54.248'E, D=1083 m)
01:54 Sampling bottom water by Niskin sampler (red) (27˚45.992'N, 126˚54.248'E, D=1083 m)
02:01 Sampling bottom water by JUN type (27˚45.992'N, 126˚54.248'E, D=1083 m)
02:06 Collected *Shinkaia crosnieri* by Slurp gun (#2 & #3 canister) (27˚45.992'N, 126˚54.248'E, D=1083 m)
02:19 Collected animals by Slurp gun (#4 canister) (27˚45.992'N, 126˚54.248'E, D=1083 m)
02:55 Collected *Clyptogena* sp. by Kumade sampler in sample box (27˚45.928.'N, 126˚54.248'E, D=1067 m)
02:59 Measurement sediment temperature (Depth 25 cm) (Tmax = 6.1 ˚C) (27˚45.928.'N, 126˚54.248'E, D=1067 m)
03:05 MBARI (black) (10 cm) taken (27˚45.928.'N, 126˚54.248'E, D=1067 m)
03:11 Collected a Asteroidea by Slurp gun (#5 canister) (27˚45.928.'N, 126˚54.248'E, D=1067 m)
03:12 Leaving at sand (27˚45.928'N, 126˚54.248'E, D=1067 m)

# Dive Track



**Dive Report: HPD Dive# 1860**
**Date:** July31-August 1, 2015
**Site:** Noho site in Sakai Field
**Landing:** 20:54; 27˚30.862'N, 126˚58.702'E, D=1559 m
**Leaving:** 03:12; 27°30.967'N, 126°59.002'E, D=1522 m
**Observer:** Ken Takai (JAMSTEC)

**Objectives:**

The main objective of the dive #1860 is to explore the Noho in the Sakai field. We will take samples of fluids, chimneys, sediments, animals and others.

**Dive summary:**

We collected Niskin sampler Green at a water depth of 500 m and Niskin sampler Red at a water depth of 1000 m first. HyperDolphin landed on the sediemnts at about 40 m west of unexplored mounds. After landing, methane sensor in situ calibration was conducted. Next we found a tube worm colony (Alaicia spp) and collected tube wroms. Just adjacent to the tube worm colony, a microbial mat with tube worm was found. In this site, RMT thermometer measurement was conducted. We found another microbial mat and then measured temperature. After this event, w found lots of dead chimney mounds (e.g., old twin towers chimney) but did not find active vents. Finally we encountered the Yubikuwae chimney and collected hydrothermal fluid (145 ˚C). In addition several pieces of flanges were sampled. At the western edge of the sulfide mound range, we found mussels and galatheids colonies and collected mussels and crusts here. Then 100 m east from the mussels' colony, we found the Umifuru chimney. Here, we collected chimney structures and black smoker hydrothermal fluids (334 ˚C). Galatehid colonies were relatively big in Umifuru chimney. So we collected the colony water (4.1 ˚C) and measured the methane concentrations. After the measurement, we collected galatheids and shrimps. Finally, we arrived at the Yakushiji chimney and left the bottom.

**Payloads:**

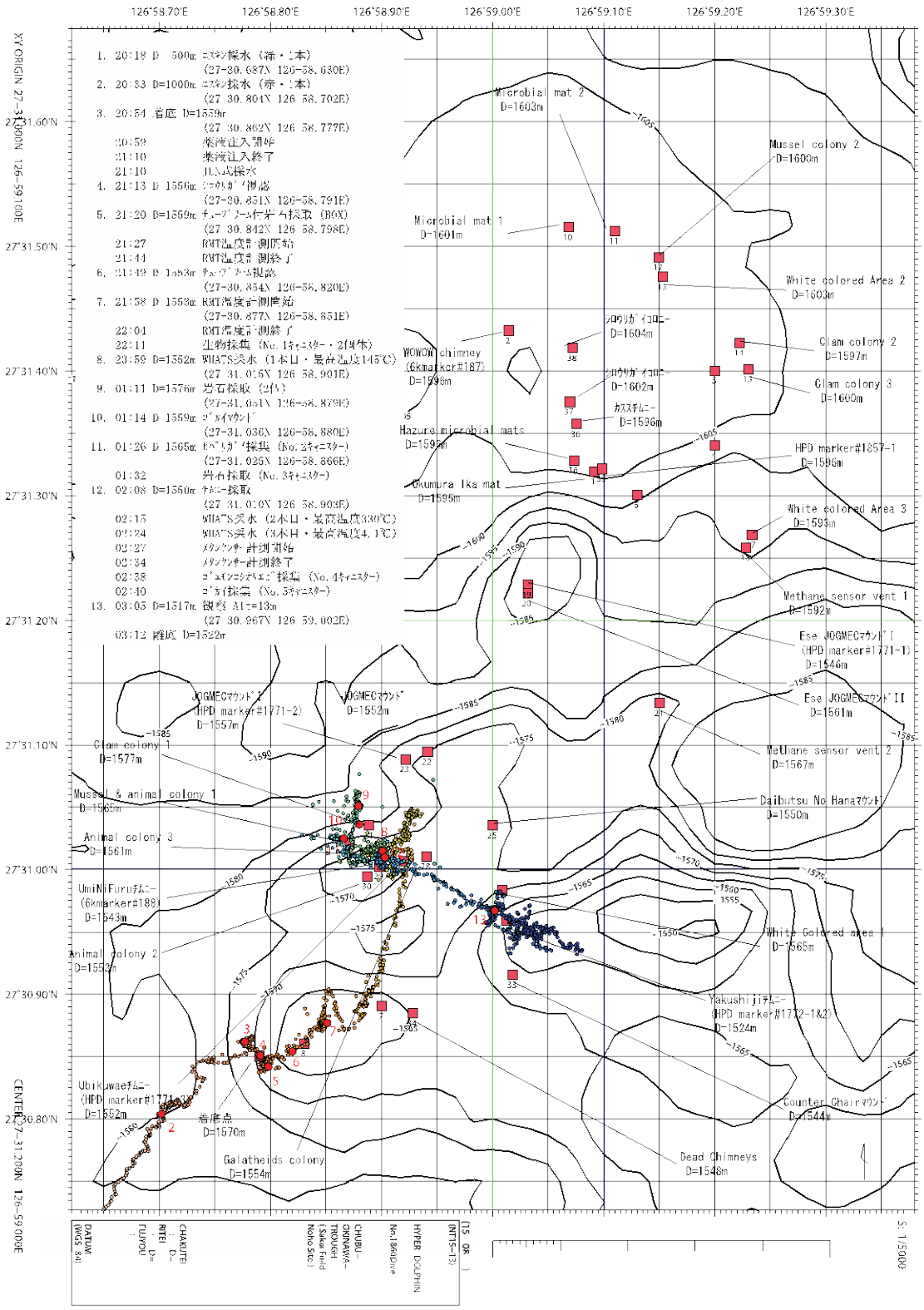
- 7 bottles canister x 1
- Slurp gun pomp x 1
- WHATS-III water sampler
- Methane sensor
- Turbidity sensor
- MBARI corer 35 cm x 2
- Methane sensor in situ standard
- Sample box x 3
- Folk x 1
- Niskin water sampler x 2

**Event list:**

21:00 Before landing, mid water at depths of 500 m and 1000 m were sampled by Niskin

sampler Green and Red, respectively
21:12 Landing and in situ calibration of methane sensor conducted (27˚30.862'N, 126˚58.702'E, D=1559 m)
21:13 Finding calyptogena's colony (27˚30.851'N, 126˚58.791'E, D=1556 m)
21:14 Finding tube-worm colony and sampling tube worms (27˚30.842'N, 126˚58.798'E, D=1559 m)
21:34 Finding a microbial mat and temperature measurement
21:58 Finding another microbial mat and temperature measurement (27˚30.877'N, 126˚58.851'E, D=1553 m)
23:46 Finding a Yubikuwae chimney and collecting hydrothermal fluid (27˚31.015'N, 126˚58.901'E, D=1552 m)
01:26 Collected mussels and crusts (27˚31.025'N, 126˚58.866'E, D=1565 m)
01:45 Found Umifuru chimney (27˚31.010'N, 126˚58.903'E, D=1550 m)
02:20 Collected chimneys and hydrothermal fluids (27˚31.010'N, 126˚58.903'E, D=1550 m)
02:30 Collected galatheids' colony water and measured the methane concentration (27˚31.010'N, 126˚58.903'E, D=1550 m)
02:40 Collected galatheids and shrimps (27˚31.010'N, 126˚58.903'E, D=1550 m)
03:05 Arriving at the Yakushiji chimney (27˚30.967'N, 126˚59.002'E, D=1517 m)
03:12 Leaving the bottom (27°30.967'N, 126°59.002'E, D=1522 m)

# Dive Track


126°58.70'E
126°58.80'E
126°58.90'E
126°59.00'E
126°59.10'E
126°59.20'E
126°59.30'E
27°31.60'N
27°31.50'N
27°31.40'N
27°31.30'N
27°31.20'N
27°31.10'N
27°31.00'N
27°30.90'N
27°30.80'N
XY ORIGIN 27-31.600N 126-59.100E
CENTER 27-31.200N 126-59.000E
1. 20:18 D 500m ﾆｽｷﾝ採水（薄・1本）
(27-30.687N 126-58.030E)
2. 20:33 D=1000m ﾆｽｷﾝ採水（赤・1本）
(27 30.801N 126 58.702E)
3. 20:54 着底 D=1559m
(27 30.862N 126 58.777E)
:59 薬液注入開始
21:10 薬液注入終了
21:10 JLA式採水
4. 21:13 D 1556m ﾋﾟｽｶﾞﾒ確認
(27-30.851N 126-58.791E)
5. 21:20 D=1559m ﾁｭｰﾌﾞﾜｰﾑ作業 ｶﾒ採取（BOX）
(27 30.842N 126 58.798E)
21:27 RMT温度計測開始
21:44 RMT温度計測終了
6. 21:49 D 1553m ﾁｭｰﾌﾞﾜｰﾑ視認
(27-30.854N 126-58.820E)
7. 21:58 D 1553m RMT温度計測開始
(27-30.877N 126-58.851E)
22:04 RMT温度計測終了
22:11 生物採集（No.1ｷｬﾆｽﾀｰ・2個体）
8. 23:59 D=1562m WHATS採水（1本目・最高温度145℃）
(27 31.015N 126 58.901E)
9. 01:11 D=1576m 岩石採取（2ヶ）
(27-31.041N 126-58.879E)
10. 01:14 D 1559m ｺﾞｶｲﾏｳﾝﾄﾞ
(27-31.036N 126-58.880E)
11. 01:26 D 1565m ﾋﾟｽｶﾞﾒ採集（No.2ｷｬﾆｽﾀｰ）
(27-31.025N 126-58.866E)
01:32 岩石採取（No.3ｷｬﾆｽﾀｰ）
12. 02:08 D=1550m ﾁﾑﾆｰ採取
(27 31.010N 126 58.903E)
02:15 WHATS採水（2本目・最高温度330℃）
02:24 WHATS採水（3本目・最高温度4.1℃）
02:27 ﾒﾀﾝｾﾝｻｰ計測開始
02:34 ﾒﾀﾝｾﾝｻｰ計測終了
02:38 ﾋﾞｰｴﾝｼﾞｪﾙﾈｴﾋﾞ採集（No.4ｷｬﾆｽﾀｰ）
02:40 ﾋﾞｰｽﾞ採集（No.5ｷｬﾆｽﾀｰ）
13. 03:03 D=1517m 観察 Alt=13m
(27 30.967N 126 59.002E)
03:12 離底 D=1522m
Microbial mat 2
D=1603m
Mussel colony 2
D=1600m
Microbial mat 1
D=1601m
White colored Area 2
D=1603m
WOWOW chimney
(6kmmarker#187)
D=1598m
Clam colony 2
D=1597m
Clam colony 3
D=1600m
Hazure microbial mats
D=1595m
HPD marker#1857-1
D=1596m
Okumura Ika mat
D=1595m
White colored Area 3
D=1593m
Methane sensor vent 1
D=1592m
Ese JOGMECﾏｳﾝﾄﾞI
(HPD marker#1771-1)
D=1546m
Ese JOGMECﾏｳﾝﾄﾞII
D=1561m
JOGMECﾏｳﾝﾄﾞ2
(HPD marker#1771-2)
D=1557m
JOGMECﾏｳﾝﾄﾞ
D=1552m
Clam colony 1
D=1577m
Methane sensor vent 2
D=1567m
Mussel & animal colony 1
D=1565m
Daibutsu No Hanaﾏｳﾝﾄ
D=1550m
Animal colony 3
D=1561m
UmiNiFuruﾁﾑﾆｰ
(6kmmarker#188)
D=1543m
White Colored area 1
D=1565m
Animal colony 2
D=1553m
Yakushiji ﾁﾑﾆｰ
(HPD marker#1772-1&2)
D=1524m
Ubikuwaeﾁﾑﾆｰ
(HPD marker#1771-3)
D=1562m
着底点
D=1570m
Counter Chairﾏｳﾝﾄﾞ
D=1544m
Galatheids colony
D=1554m
Dead Chimneys
D=1548m
DATUM (WGS 84)
TUYOU D=
RITEI D=
CHAKUTEI D=
CHUBU-OKINAWA-TROUGH (Sakai Field Noho Site)
No.1860Dive
HYPER DOLPHIN
(15 OR )
(INTI5-13)
S: 1/5000

**Dive Report: HPD Dive# 1861**
**Date:** August 2-August 3, 2015
**Site:** Iheya North Original Field
**Landing:** 20:52; 27˚47.448'N, 126˚53.863'E, D=1033 m
**Leaving:** 03:26; 27°47.242'N, 126°53.921'E, D=949 m
**Observer:** Satoshi Nakagawa (Kyoto University)

**Objectives:**

The main objective of the dive #1861 is to collect deep-sea hydrothermal vent-endemic animals. We will take animals, chimneys, fluids, and others.

**Dive summary:**

HyperDolphin landed on the rock (about 50m north of the bubbling site). After observing the landing point, we collected one individual of white snail. Then, the vehicle headed to the west (to the NBC mound (event #3)). Before arriving the NBC, we reached to the CBC mound, and collected shrimps and a chimney structure there.

When we moved about 10-20 m to the north, we found the NBC mound. We tried to collect the chimney structure, but the chimney was too fragile to be collected. We moved to the bottom of the NBC mound, and landed in front of the Bathymodiolus colony. We performed both DO measurement and methane conc measurement. Then, we collected the mussels using the slurp gun (2 bottles), and moved to the colony of squat crab.

We landed in front of the dense colony of Shinkaia, and performed DO and CH4 measurement. We could fluids sampling by using Jun-type sampler and a Niskin bottle (green). We then collected a lot of Shinkaia individuals. In addition, we sampled several pieces of chimney structure there. After sampling the chimney, we tried to collect the polychaete at the top of NBC mound, however, almost no polychaete was observed, and thus we headed to the HRV (event #19).

We collected several pieces of chimney structure (flange) at the HRV. Then we headed to the tubeworm colony (event #16).

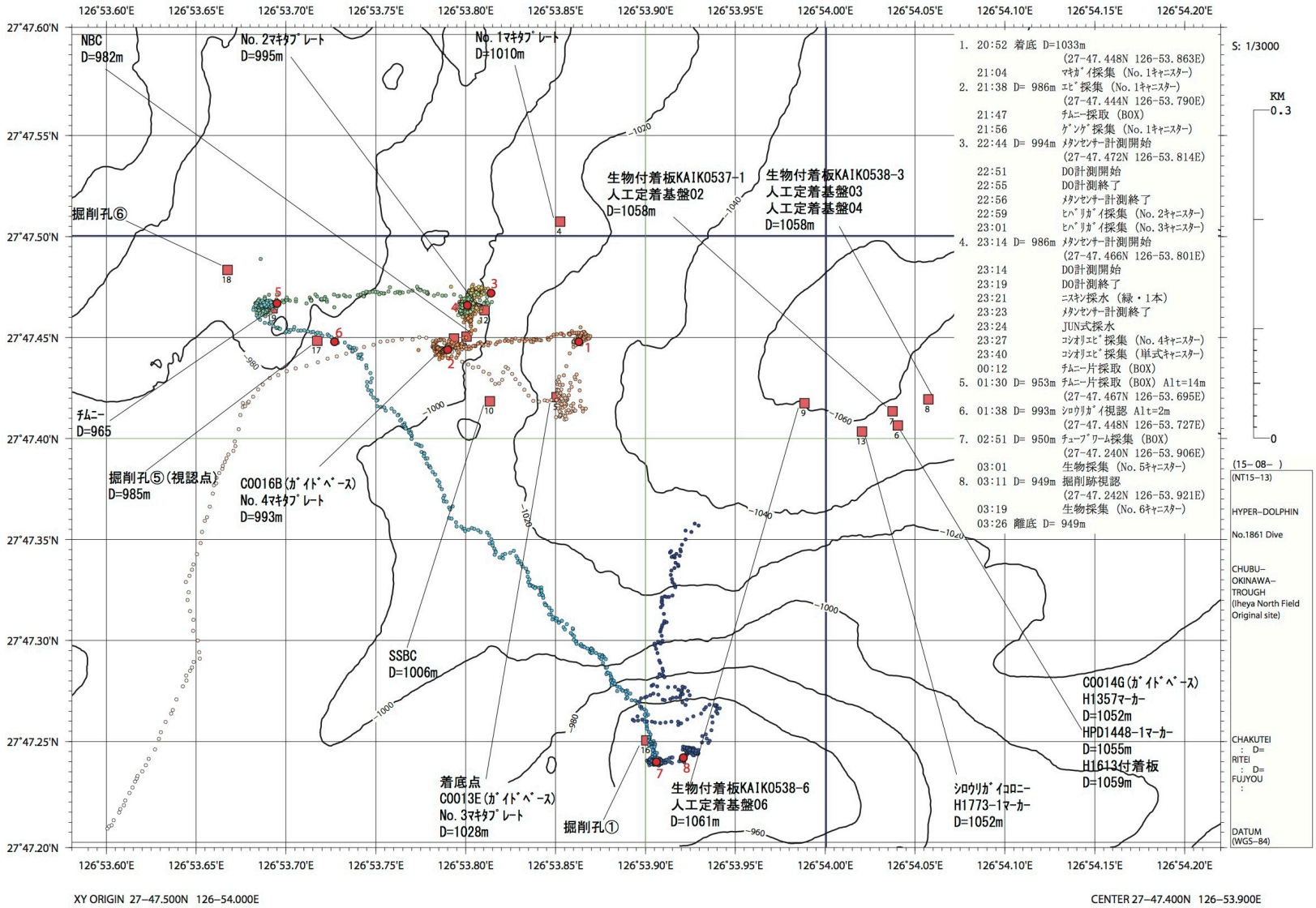
We collected tubeworms, snails, barnacles, and others. After fluid sampling with a Niskin bottle, we left the bottom.

**Payloads:**

- 7 bottles canister x 1
- Slurp gun pomp x 1
- Single canister x1
- Methane sensor

- Turbidity sensor
- DO sensor
- Sample box x 3
- Folk x 1
- Niskin water sampler x 2

**Event list:**
20:52 Landing (27˚47.448'N, 126˚53.863'E, D=1033m)
21:04 Sampling a snail
21:38 Sampling shrimps (27˚47.444'N, 126˚53.790'E, D=986m)
21:47 Sampling a chimney structure (CBC)
22:44 Measuring the methane concentration at the Bathymodiolus colony of NBC mound (27˚47.472'N, 126˚53.814'E, D=994 m)
22:51 DO measurement
22:59 Collecting Bathymodiolus mussels (two bottles)
23:14 Measuring the methane concentration at the Shinkaia colony of NBC mound (27˚47.466'N, 126˚53.801'E, D=986 m)
23:14 DO measurement
23:21 Sampling fluids with a Niskin bottle (green)
23:24 Sampling fluids with the Jun-type sampler
23:27 Sampling Shinkaia crabs
00:12 Sampling a chimney structure (NBC)
01:30 Sampling a chimney structure (HRV) (27˚47.467'N, 126˚53.727'E, D=993 m)
02:51 Sampling the tubeworm individuals (27˚47.240'N, 126˚53.906'E, D=950 m)
03:01 Sampling snails, barnacles, and others
03:19 Sampling snails, barnacles, and others
03:26 Left the bottle.


126°53.60'E
126°53.65'E
126°53.70'E
126°53.75'E
126°53.80'E
126°53.85'E
126°53.90'E
126°53.95'E
126°54.00'E
126°54.05'E
126°54.10'E
126°54.15'E
126°54.20'E
27°47.60'N
27°47.55'N
27°47.50'N
27°47.45'N
27°47.40'N
27°47.35'N
27°47.30'N
27°47.25'N
27°47.20'N
NBC
D=982m
No. 2ﾏｷﾀﾌﾞﾚｰﾄ
D=995m
No. 1ﾏｷﾀﾌﾞﾚｰﾄ
D=1010m
生物付着板KAIK0537-1
人工定着基盤02
D=1058m
生物付着板KAIK0538-3
人工定着基盤03
人工定着基盤04
D=1058m
掘削孔⑥
ﾁﾑﾆｰ
D=965
掘削孔⑤(視認点)
D=985m
C0016B(ｶﾞｲﾄﾞﾍﾞｰｽ)
No. 4ﾏｷﾀﾌﾞﾚｰﾄ
D=993m
SSBC
D=1006m
着底点
C0013E(ｶﾞｲﾄﾞﾍﾞｰｽ)
No. 3ﾏｷﾀﾌﾞﾚｰﾄ
D=1028m
掘削孔①
生物付着板KAIK0538-6
人工定着基盤06
D=1061m
ｼﾛｳﾘｶﾞｲｺﾛﾆｰ
H1773-1ﾏｰｶｰ
D=1052m
C0014G(ｶﾞｲﾄﾞﾍﾞｰｽ)
H1357ﾏｰｶｰ
D=1052m
HPD1448-1ﾏｰｶｰ
D=1055m
H1613付着板
D=1059m
1. 20:52 着底 D=1033m
(27-47.448N 126-53.863E)
21:04 ﾏｷｶﾞｲ採集 (No.1ｷｬﾆｽﾀｰ)
2. 21:38 D= 986m ｴﾋﾞ採集 (No.1ｷｬﾆｽﾀｰ)
(27-47.444N 126-53.790E)
21:47 ﾁﾑﾆｰ採取 (BOX)
21:56 ｹﾞﾝｹﾞ採集 (No.1ｷｬﾆｽﾀｰ)
3. 22:44 D= 994m ﾒﾀﾝｾﾝｻｰ計測開始
(27-47.472N 126-53.814E)
22:51 DO計測開始
22:55 DO計測終了
22:56 ﾒﾀﾝｾﾝｻｰ計測終了
22:59 ﾋﾊﾞﾘｶﾞｲ採集 (No.2ｷｬﾆｽﾀｰ)
23:01 ﾋﾊﾞﾘｶﾞｲ採集 (No.3ｷｬﾆｽﾀｰ)
4. 23:14 D= 986m ﾒﾀﾝｾﾝｻｰ計測開始
(27-47.466N 126-53.801E)
23:14 DO計測開始
23:19 DO計測終了
23:21 ﾆｽｷﾝ採水 (緑・1本)
23:23 ﾒﾀﾝｾﾝｻｰ計測終了
23:24 JUN式採水
23:27 ｺｼｵﾘｴﾋﾞ採集 (No.4ｷｬﾆｽﾀｰ)
23:40 ｺｼｵﾘｴﾋﾞ採集 (単式ｷｬﾆｽﾀｰ)
00:12 ﾁﾑﾆｰ片採取 (BOX)
5. 01:30 D= 953m ﾁﾑﾆｰ片採取 (BOX) Alt=14m
(27-47.467N 126-53.695E)
6. 01:38 D= 993m ｼﾛｳﾘｶﾞｲ視認 Alt=2m
(27-47.448N 126-53.727E)
7. 02:51 D= 950m ﾁｭｰﾌﾞﾜｰﾑ採集 (BOX)
(27-47.240N 126-53.906E)
03:01 生物採集 (No.5ｷｬﾆｽﾀｰ)
8. 03:11 D= 949m 掘削跡視認
(27-47.242N 126-53.921E)
03:19 生物採集 (No.6ｷｬﾆｽﾀｰ)
03:26 離底 D= 949m
S: 1/3000
KM
0.3
0
(15-08- )
(NT15-13)
HYPER-DOLPHIN
No.1861 Dive
CHUBU-OKINAWA-TROUGH
(Iheya North Field Original site)
CHAKUTEI : D=
RITEI : D=
FUJYOU :
DATUM (WGS-84)
XY ORIGIN 27-47.500N 126-54.000E
CENTER 27-47.400N 126-53.900E

**Dive Report: HPD Dive# 1862**
**Date:** August 4-August 4, 2015
**Site:** Iheya North Original Field
**Landing:** 20:29; 27˚47.455'N, 126˚53.802'E, D=992 m
**Leaving:** 03:24; 27°47.460'N, 126°53.798'E, D=978 m
**Observer:** Kazunori Nagano (Tokyo University IIS)

**Objectives:**

The main objective of the dive #1862 is to collect the data to make 3D map. We will get 200m x 100m grid map data.

**Dive summary:**

HyperDolphin landed on the rock (Near the NBC mound (event #3)). After aliment the phins, we make the route of 200m x 100m mesh (NS length 200m, interval 6m total NS line 16). Then, the vehicle went to the south west corner (to the Line 1 start point).

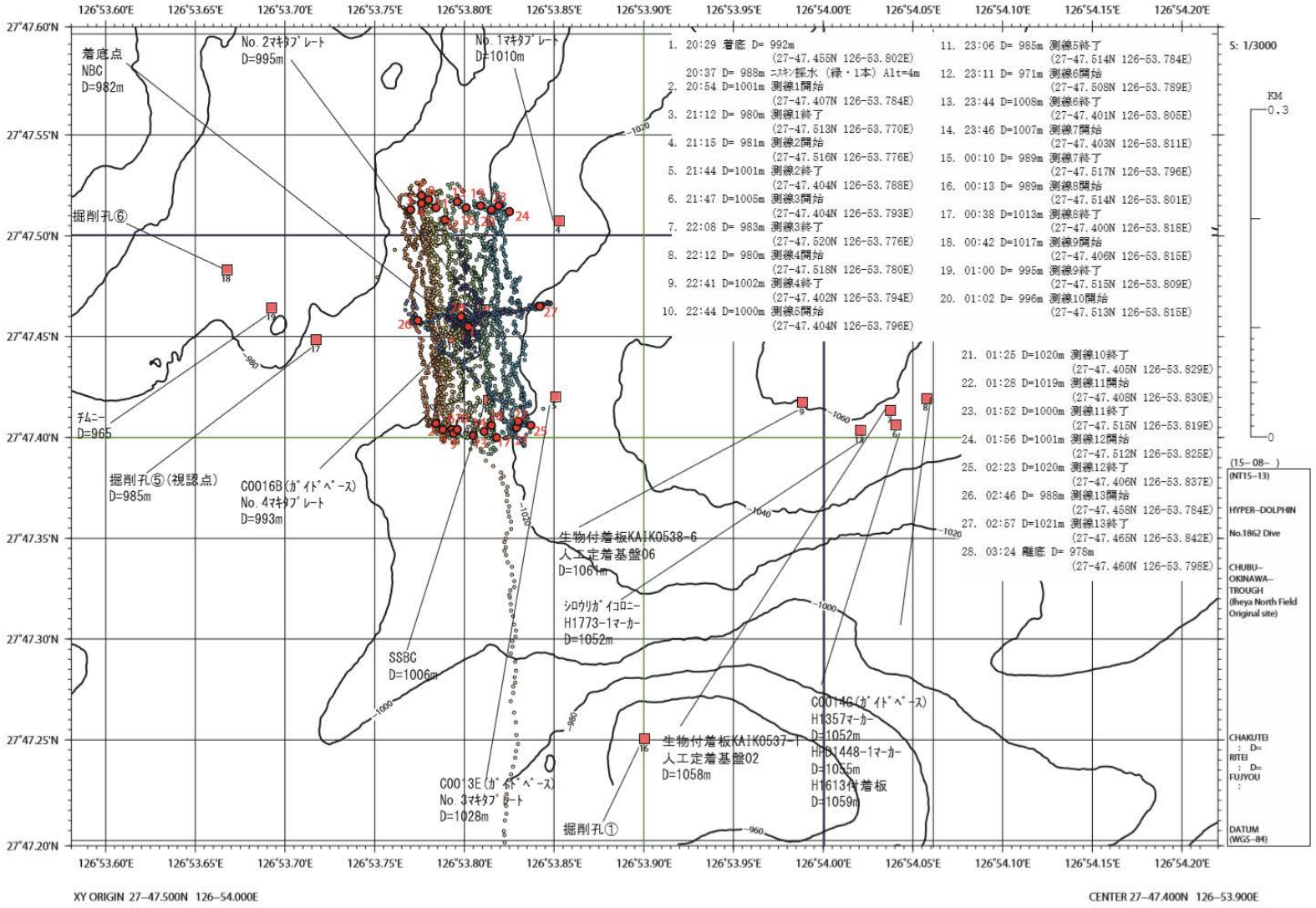
When we arrived Line 1 start point, decide vehicle altitude and speed (altitude about 7m, speed 20cm/second). Until 2:30AM we finished 12 NS line and 1 EW line. Finely, we got the 200m x 72m area map data.

**Payloads:**

- Sea Xerocks 3 x 1
- Multi beam sonar : Delta-T x 1
- Niskin water sampler x 2

**Event list:**
20:29 Landing (27˚47.455'N, 126˚53.802'E, D=992m)
20:37 Sampling fluids with a Niskin bottle (green)
20:54 Line 1 start (27˚47.407'N, 126˚53.784'E, D=1001 m)
21:12 Line 1 end (27˚47.513'N, 126˚53.770'E, D=980 m)
21:15 Line 2 start (27˚47.516'N, 126˚53.776'E, D=981 m)
21:44 Line 2 end (27˚47.404'N, 126˚53.788'E, D=1001 m)
21:47 Line 3 start (27˚47.404'N, 126˚53.793'E, D=1005 m)
22:08 Line 3 end (27˚47.520'N, 126˚53.776'E, D=983 m)
22:12 Line 4 start (27˚47.518'N, 126˚53.780'E, D=980 m)
22:41 Line 4 end (27˚47.402'N, 126˚53.794'E, D=1002 m)
22:44 Line 5 start (27˚47.404'N, 126˚53.796'E, D=1000 m)
23:06 Line 5 end (27˚47.514'N, 126˚53.784'E, D=985 m)
23:11 Line 6 start (27˚47.508'N, 126˚53.789'E, D=971 m)
23:44 Line 6 end (27˚47.401'N, 126˚53.805'E, D=1008 m)
23:46 Line 7 start (27˚47.403'N, 126˚53.811'E, D=1007 m)
00:10 Line 7 end (27˚47.517'N, 126˚53.796'E, D=989 m)
00:13 Line 8 start (27˚47.514'N, 126˚53.801'E, D=989 m)
00:38 Line 8 end (27˚47.400'N, 126˚53.818'E, D=1013 m)
00:42 Line 9 start (27˚47.406'N, 126˚53.815'E, D=1017 m)
01:00 Line 9 end (27˚47.515'N, 126˚53.809'E, D=995 m)
01:02 Line 10 start (27˚47.513'N, 126˚53.815'E, D=996 m)

01:25 Line 10 end (27˚47.405’N, 126˚53.829’E, D=1020 m)
01:28 Line 11 start (27˚47.408’N, 126˚53.830’E, D=1019 m)
01:52 Line 11 end (27˚47.515’N, 126˚53.819’E, D=1000 m)
01:56 Line 12 start (27˚47.512’N, 126˚53.825’E, D=1001 m)
02:23 Line 12 end (27˚47.406’N, 126˚53.837’E, D=1020 m)
02:46 Line 13 start (27˚47.458’N, 126˚53.784’E, D=988 m)
02:46 Line 13 end (27˚47.465’N, 126˚53.842’E, D=1021 m)
03:24 Left the bottom.


着底点
NBC
D=982m
No.2ﾏｷﾀﾌﾞﾚｰﾄ
D=995m
No.1ﾏｷﾀﾌﾞﾚｰﾄ
D=1010m
掘削孔⑥
ﾁﾑﾆｰ
D=965
掘削孔⑤(視認点)
D=985m
C0016B(ｶﾞｲﾄﾞﾍﾞｰｽ)
No.4ﾏｷﾀﾌﾞﾚｰﾄ
D=993m
生物付着板KAIK0538-6
人工定着基盤06
D=1061m
ｼﾛｳﾘｶﾞｲｺﾛﾆｰ
H1773-1ﾏｰｶｰ
D=1052m
SSBC
D=1006m
C0014G(ｶﾞｲﾄﾞﾍﾞｰｽ)
H1357ﾏｰｶｰ
D=1052m
H1448-1ﾏｰｶｰ
D=1055m
H1613付着板
D=1059m
生物付着板KAIK0537-1
人工定着基盤02
D=1058m
C0013E(ｶﾞｲﾄﾞﾍﾞｰｽ)
No.3ﾏｷﾀﾌﾞﾚｰﾄ
D=1028m
掘削孔①
1. 20:29 着底 D= 992m (27-47.455N 126-53.802E)
20:37 D= 988m ﾆｽｷﾝ採水 (緑・1本) Alt=4m
2. 20:54 D=1001m 測線1開始 (27-47.407N 126-53.784E)
3. 21:12 D= 980m 測線1終了 (27-47.513N 126-53.770E)
4. 21:15 D= 981m 測線2開始 (27-47.516N 126-53.776E)
5. 21:44 D=1001m 測線2終了 (27-47.404N 126-53.788E)
6. 21:47 D=1005m 測線3開始 (27-47.404N 126-53.793E)
7. 22:08 D= 983m 測線3終了 (27-47.520N 126-53.776E)
8. 22:12 D= 980m 測線4開始 (27-47.518N 126-53.780E)
9. 22:41 D=1002m 測線4終了 (27-47.402N 126-53.794E)
10. 22:44 D=1000m 測線5開始 (27-47.404N 126-53.796E)
11. 23:06 D= 985m 測線5終了 (27-47.514N 126-53.784E)
12. 23:11 D= 971m 測線6開始 (27-47.508N 126-53.789E)
13. 23:44 D=1008m 測線6終了 (27-47.401N 126-53.805E)
14. 23:46 D=1007m 測線7開始 (27-47.403N 126-53.811E)
15. 00:10 D= 989m 測線7終了 (27-47.517N 126-53.796E)
16. 00:13 D= 989m 測線8開始 (27-47.514N 126-53.801E)
17. 00:38 D=1013m 測線8終了 (27-47.400N 126-53.818E)
18. 00:42 D=1017m 測線9開始 (27-47.406N 126-53.815E)
19. 01:00 D= 995m 測線9終了 (27-47.515N 126-53.809E)
20. 01:02 D= 996m 測線10開始 (27-47.513N 126-53.815E)
21. 01:25 D=1020m 測線10終了 (27-47.408N 126-53.829E)
22. 01:28 D=1019m 測線11開始 (27-47.408N 126-53.830E)
23. 01:52 D=1000m 測線11終了 (27-47.515N 126-53.819E)
24. 01:56 D=1001m 測線12開始 (27-47.512N 126-53.825E)
25. 02:23 D=1020m 測線12終了 (27-47.406N 126-53.837E)
26. 02:46 D= 988m 測線13開始 (27-47.458N 126-53.784E)
27. 02:57 D=1021m 測線13終了 (27-47.465N 126-53.842E)
28. 03:24 離底 D= 978m (27-47.460N 126-53.798E)
S: 1/3000
KM
0.3
0
(15--08--)
(NT15-13)
HYPER-DOLPHIN
No.1862 Dive
CHUBU--OKINAWA--TROUGH
(Iheya North Field Original site)
CHAKUTEI : D=
RITEI : D=
FUJYOU :
DATUM (WGS-84)
126°53.60'E
126°53.65'E
126°53.70'E
126°53.75'E
126°53.80'E
126°53.85'E
126°53.90'E
126°53.95'E
126°54.00'E
126°54.05'E
126°54.10'E
126°54.15'E
126°54.20'E
27°47.60'N
27°47.55'N
27°47.50'N
27°47.45'N
27°47.40'N
27°47.35'N
27°47.30'N
27°47.25'N
27°47.20'N
XY ORIGIN 27-47.500N 126-54.000E
CENTER 27-47.400N 126-53.900E