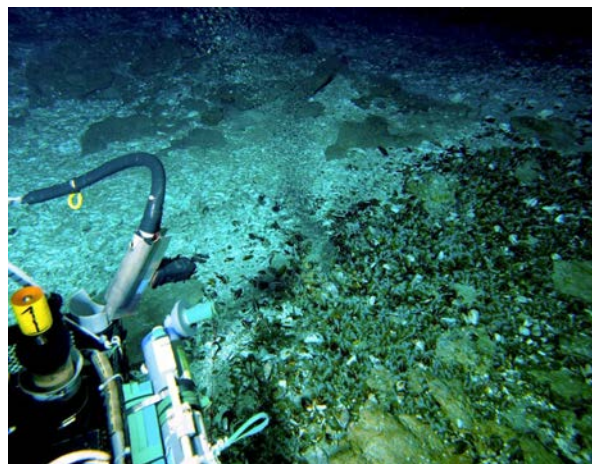
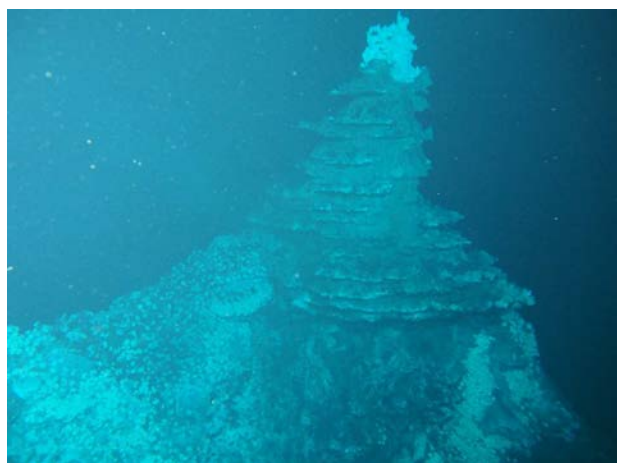




R/V Yokosuka & DSV Shinaki6500 Cruise Report

YK24-12

**Collection of genomic, microbial and faunal resources in deep-sea
hydrothermal fields of the Okinawa Trough (Leg#1) and
investigation of symbiotic relationship between benthic animals
and microorganisms in forearc of southern Ryukyu Trench
(Leg#2)**



**July 17, 2024 from JAMSTEC Yokosuka – July 23, 2024 to Amami,
and July 26 from Amami - August 1, 2024 to Sasebo**

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

Acknowledgements

We are grateful to Captain Mr. Y. Nakamura, Chief Officer Mr. Y. Furukawa, Chief Engineer Mr. K. Fujii and all the other crews for their safe navigation and their skillful handling of “R/V Yokosuka”. Great thanks are due to Shinkai6500 Operation Manager Mr. K. Chiba and Shinkai6500 operation team for their operations in sampling. 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.

CONTENTS

Acknowledgements	2
Contents	3
Cruise information	4
List of participants	5
Captain and crew of the R/V YOKOSUKA	9
“Shinkai 6500” Operation Team	10
I. Cruise summary	11
II. Introduction	12
III. Explanatory note	14
1. Manned Research Submersible “Shinkai 6500”	14
2. Research Vessel “Yokosuka”	15
IV. Dive report	16
Shinkai6500#1795 (J. Miyazaki)	17
Shinkai6500#1796 (K. Takai & T. Nunoura)	20
Shinkai6500#1797 (Y. Fukuyama)	23
Shinkai6500#1798 (K. Takai & C. Chen)	26
Shinkai6500#1799 (M. Hasegawa)	30

Cruise information

Cruise ID: YK24-12

Vessel: Yokosuka

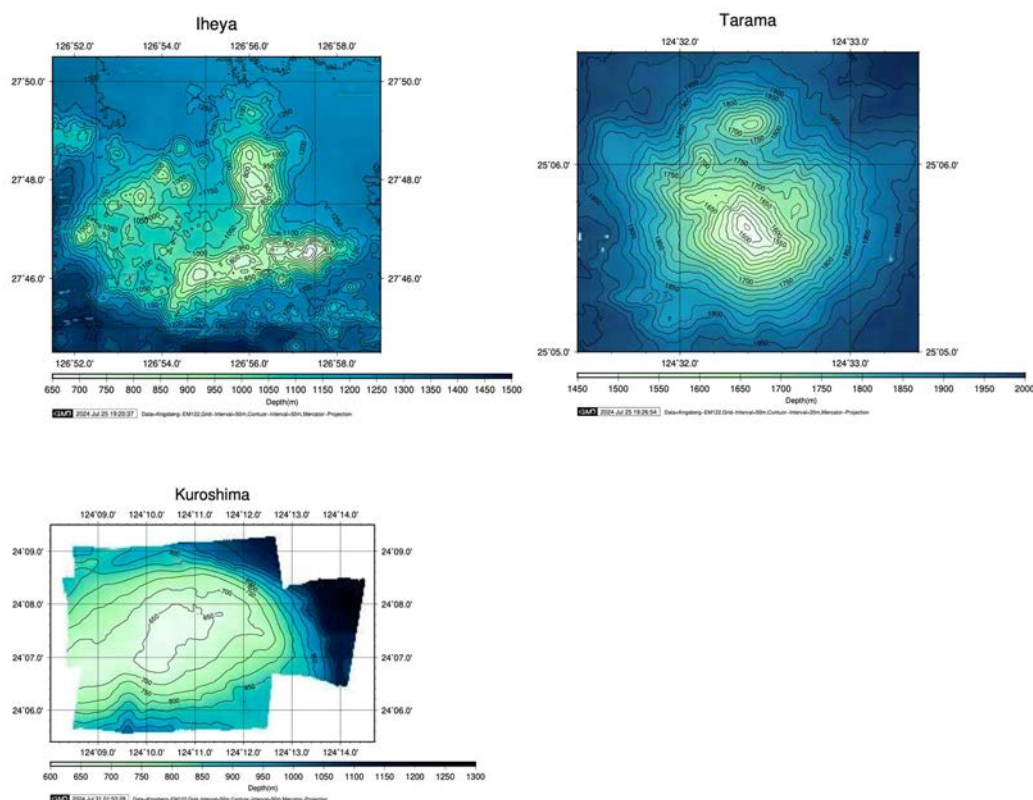
Title of the cruise: Collection of genomic, microbial and faunal resources in deep-sea hydrothermal fields of the Okinawa Trough (Leg#1) and investigation of symbiotic relationship between benthic animals and microorganisms in forearc of southern Ryukyu Trench (Leg#2)

Cruise period: July 27 – August 1, 2024

Ports of call: JAMSTEC Yokosuka – Amami - Sasebo, Japan

Research area: Okinawa Trough, and Ryukyu Trench

Research map:



General topographic map of Iheya North Knoll (upper left), Tarama Knoll (upper right) and Kuroshima Knoll (bottom)

List of Participants

Scientific party

Chief Scientist

Dr. Ken Takai (Leg#1 & Leg#2)

Director General (Geomicrobiology)

Staff Scientists

Dr. Junichi Miyazaki (Leg#1 & Leg#2)

Research Scientist Technology (Microbiology)

Dr. Takuro Nunoura (Leg#1)

Vice director

Dr. Tomomi Sumida (Leg#1)

Research Scientist

Dr. Yuto Fukuyama (Leg#1)

Research Scientist

Dr. Kanae Kobayashi (Leg#1)

Research Scientist

Ms. Lyn Hobday (Leg#1)

Technical staff

Dr. Wakao Fukuda (Leg#1)

Research Scientist (Microbiology)

Mr. Kouhei Hidaka (Leg#1)

Research Scientist (Microbiology)

Mr. Kouhei Hidaka (Leg#1)

Research Scientist (Microbiology)

Mr. Yuma Miyazaki (Leg#1)

Research Scientist (Microbiology)

Mr. Koki Kasahara (Leg#1)

Technical Staff

Dr. Chong Chen (Leg#2)

Senior Research Scientist (Biology)

Dr. Masayuki Miyazaki (Leg#2)

Associate Research Scientist (Microbiology)

Dr. Yu Nakajima (Leg#2)

Research Scientist

Dr. Masumi Hasegawa (Leg#2)

Postdoctoral Scientist

Mr. Yu Yoshida

Graduate student

Dr. Akito Ogawa (Leg#2)

Research Scientist

Prof. Kiichiro Kawamura (Leg#2)

Professor

Ms. Momoko Tsutsumi (Leg#2)

Undergraduate student

Ms. Kimiko Serizawa

Marine Technician

Captain and crew of the R/V YOKOSUKA

Captain	NAKAMURA, Y.
Chief Officer	FURUKAWA, Y.
2nd Officer	KAJISA, T.
3rd Officer	SAKAMOTO, R.
Jr. 3rd Officer	KOYAISHI, Y.
Chief Engnieer	OTA, T.
1st Engnieer	FUJII, K.
2nd Engnieer	INOMOTO, T.
Jr. 2nd Engineer	YAMAGUCHI, K.
3rd Engnieer	FURUYAMA, Y.
Chief Electric Operator	ISHIWATA, H.
2nd Electric Operator	MABARA, T.
Jr. 2nd Electric Operator	MATSUI, R.
Boatswain	HIROSAKI, K.
Quarter Master	CHIMOTO, T.
Quarter Master	ISHIZUKA, N.
Quarter Master	KOJIMA, S.
Quarter Master	SAGA, T.
Sailor	MATSUDA, T.
Sailor	INOUE, S.
Sailor	NAGAMINE, Y.
No.1 Oiler	HIGASHIGAWA, Y.
Oiler	SATO, D.
Assistant Oiler	DANTSUKA, A.
Assistant Oiler	MATSUMURA, K.
Assistant Oiler	OCHIAI, K.
Assistant Oiler	FUJIURA, E.
Chief Steward	KOSUJI, K.
Steward	KUNITA, M.
Steward	SHIRAISHI, T.
Steward	TANAKA, T.
Steward	FUJIMOTO, Y.

“Shinkai6500” Operation Team

Operation Manager	CHIBA, K.
Deputy Op. Manager	MATSUMOTO, K.
1st Submersible Staff	KONDO, T.
1st Submersible Staff	ONISHI, T.
2nd Submersible Staff	SUZUKI, K.
2nd Submersible Staff	SAIGO, R.
2nd Submersible Staff	KURAMOTO, Y.
2nd Submersible Staff	IIJIMA, S.
2nd Submersible Staff	MINAMINO, N
2nd Submersible Staff	MATSUSAKA, M
3rd Submersible Staff	SATO, K.

I. CRUISE SUMMARY

In YK23-13 cruise, we totally conducted 5 dives of Shinkai6500 in the deep-sea hydrothermal fields of the Okinawa Trough (Iheya North original and aki fields and Tarama Knoll field) and in a forearc region of Ryukyu Trench (Kuroshima Knoll methane seep and foot submarine channel). One of the cruise foci was to collect genetic and microbial resources related with carbon fixation and transformation in the Okinawa Trough deep-sea hydrothermal systems. During 3 dives in Leg#1 of this cruise, a variety samples such as active and inactive hydrothermal vent chimneys and fluids, mixing zones of fluids, chemosynthetic animals, and hydrothermally affected sediments were successfully collected from the Iheya North original, aki and Tarama Knoll fields. These samples were properly processed onboard and will be applied to the subsequent and onshore researches related with NEDO GI project and JAMSTEC researches.

Due to the influence of Typhoon 3rd's approach to the Ishigaki Island, the dive survey for benthic animals in the Ryukyu Trench continental slope was significantly limited. Two dives were conducted at the Kuroshima Knoll methane seep site and a footage submarine channel. Once upon a time (til 2000s, the Kuroshima Knoll methane seep site is very famous to be "supreme mussels' paradise" in Japan. 6K Dive#1798 found that most of the mussels extincted probably due to the reduced methane efflux at the seafloor. However several focused methane bubbling sites were found and at around the bubbling sites, abundant chemosynthetic communities remained to be happy. Finally, at the 6K Dive#1799, lots of holothurian individuals were collected along the submarine channel. There seemed to be possible new species included. These holothurians will be applied to the subsequent and onshore researches related with symbiotic relationship between the deep-sea holothurians and microorganisms.

II. INTRODUCTION

General backgrounds & Scientific objectives

One of the scientific objectives of this cruise (Leg#1) is to collect genetic and microbial resources related with carbon fixation and transformation in the Okinawa Trough deep-sea hydrothermal systems. Microbial culture strains, genetic and genomic information, and potential samples including such resources are obtained as many as possible during the cruise, and will be utilized by a broad range of basic sciences, applied sciences and industrial developments in the future in Japan, which is financially supported by NEDO Green Innovation (GI) Perspective.

Since the first discovery of deep-sea hydrothermal system in the Okinawa Trough in 1980s, a number of microbial researches have been conducted elaborately by JAMSTEC researchers. Most of them were within basic sciences, and some applied sciences and industrial collaborations have been also conducted. Not all but many of the samples, though the volumes are limited now, are still preserved in JAMSTEC. However, the facts are not known at all widely to the domestic research communities in Japan, and are not open to the 3rd party researches. In the newly initiated NEDO GI program, a collaborated team among JAMSTEC, several national research institutions and a variety of universities is seeking to mine the genetic and microbial samples previously obtained and preserved, and of course, to collect fresh samples of many CO₂-fixing and -transforming microbial communities in natural chemosynthetic environments such as deep-sea hydrothermal systems and terrestrial hot springs. In this cruise, target environments are deep-sea hydrothermal systems in the Okinawa Trough, and potential surveys and samplings using Shinkai6500 will be planned in the Iheya North Knoll, Haoma Knoll and Tarama Knoll. Main target samples are active and inactive hydrothermal vent chimneys and fluids, mixing zones of fluids, chemosynthetic animals, and hydrothermally affected sediments. These samples are properly processed onboard and applied to the subsequent and onshore researches.

The other scientific objective of this cruise (Leg#2) is to investigate symbiotic relationship and association between deep-sea benthic animals and microorganisms at different physical and chemical environments of the Ryukyu Trench. One of the examples is a potential 'protective symbiosis' between deep-sea holothurians and intestine symbionts. In JAMSTEC, using many previously and newly obtained sea pig samples in the last several years, the occurrence, abundance and predominance of specific *Tenericutes* symbiotic bacteria in the gut tissues and the distribution of symbiosis have been investigated in different deep-sea environments. The results suggest that the symbiosis seems to occur specifically in deep-sea holothurians, but would not play an important physiological role in the host holothurians. However, these analyses were based on the samples sporadically collected from different geographic and geologic settings.

We would like to collect holothurians and other benthic animals in even more systematic locations and habitats such as trench slope environments at different depths. Thus, we picked up the southern Ryukyu Trench as one of the promised targets as it has been known that the southern Ryukyu Trench hosts abundant and diverse holothurians in the trench slopes due to the frequent occurrence of seismic and even non-seismic land slide events feeding benthic animal communities and accelerating the generation exchanges.

In addition, in YK24-12 Leg#2, we are seeking to obtain the chemosynthetic animals, microbial communities and gas samples from the Kuroshima Knoll, where unique methane gas seepages occur and enormous chemosynthetic animals are distributed. Until early 2000s, the Kuroshima Knoll was surveyed by HOV and ROV. But after the deployment of fishery buoys in mid-2000s, the survey was prohibited long time. In YK24-12, we try to survey thoroughly the surrounding environments and to re-start the explorations by HOV and ROV.

III. EXPLANATORY NOTE

1. Manned Research Submersible “Shinkai 6500”

Mission of “Shinkai 6500”

“Shinkai 6500” is able to operate surveys and observations down to the depth 6500 meters with one scientist and two pilots. During the operation, “Shinkai 6500” finds her position by two ways; Long Base Line system (LBL) and Super Short Base Line system (SSBL). The LBL system needs three bottom-mounted transponders to be deployed in the survey area. “Shinkai 6500” locates her own position by herself in real time and the mother ship determines the position of “Shinkai 6500” based on the position of transponders. The SSBL system does not require any transponder but the accuracy of the position is inferior to LBL system and “Shinkai 6500” cannot determine her own position.

Specifications

Length:	9.5m
Width:	2.7m
Height:	3.2m
Weight in air:	25.8t
Maximum operation depth:	6500m
Complement:	3 (2 pilots and 1 researcher)
Inner radius of pressure vessel:	2.0m
Normal dive time:	8 hours
Life support duration:	129 hours
Payload:	150kg (weight in air)
Under water speed:	0-2.0 knots (Emergency: 2.5 knots)
Observation instruments:	Pan-tilt-zoom color video camera Fixed-view color video camera 35mm still camera CTD sensors Gamma ray spectrometer CTFM sonar Video-image transmission system
Operating devices:	2 manipulators 2 retractable baskets

2. Research Vessel “Yokosuka”

Mission of “Yokosuka”

1) Operate submersible “Shinkai 6500”

2) Operate underway-geophysical equipments;

Multi Narrow Beam Echo Sounder (Sea Beam 2112.04)

Gravity meter (Type S-63)

Ship-borne three-components magnetometer (Type SFG-1212)

Proton magnetometer (Typ STC10)

Research Facilities

In wet laboratory, a fumigation chamber, Milli-Q water purification system, -80°C and -20°C freezer, incubator and rock saw are equipped. In addition, “Yokosuka” has on-board video editing system for digital video image.

Specifications

Length: 105.22m

Breadth: 16.0m

Height: 7.3m

Draft: 4.5m

Gross tonnage: 4439t

Cruising speed: about 16kts

Cruising range: about 9000mile

IV. DIVE REPORTS

6K#1795 DIVE (Tarama Knoll field)	Dr. MIYAZAKI, J.
6K#1796 DIVE (Iheya North original field)	Dr. TAKAI, K., and Dr. NUNOURA, T.
6K#1797 DIVE (Iheya North aki field)	Dr. FUKUYAMA, Y.
6K#1798 DIVE (Kuroshima Knoll)	Dr. CHEN, C., and Dr. NUNOURA, T.
6K#1712 DIVE (South Mariana Trench OR)	Dr. LI, J.
6K#1713 DIVE (South Mariana Trench OR)	Dr. WANG, F.
6K#1714 DIVE (South Mariana Trench OR)	Dr. DONG, L.
6K#1715 DIVE (South Mariana Trench OR)	Dr. MIYAZAKI, J., and Dr. TAKAI, K.

Dive Report: Shinaki6500#1795

Date: July 20, 2024

Site: Tarama knoll in the Southern Okinawa Trough

Landing: 11:10; 25°5.4450'N, 124°32.7608'E, D=1751m

Leaving: 15:28; 25°5.5391'N, 124°32.3118'E, D=1529 m

Observer: Junichi Miyazaki (JAMSTEC)

Objectives:

The objectives of this dive were sampling Chimney structure, hydrothermal fluids, animals, and iron mat.

Dive summary:

At 10m altitude before landing, we found plume caused by hydrothermal activities, we sampled water into Niskin bottle (Green).

At 11:10, we landed on the rocky seafloor. The temperature of ambient seawater at the bottom was 3.7 °C. We looked for positions where we could sample sediments by MBARI, but we could not find them. Therefore, we gave up sampling sediments by MBARI and then we headed to the Komainu chimney.

During the moving, we found the colony of sponges and then the colony of mussels. And in front of the chimneys, a lot of galatheas formed colony. After the galathea colony, we discovered two chimneys with about 8 - 10m height. In left chimney (west side), hydrothermal fluids were vented from some parts containing flange structures. On the surface, we found a lot of *Paralvinella* and the nests. On the other hand, in right chimney, hydrothermal fluid was vented only from top of th chimney. Many gastropods (?) were observed in the surface. We decided to sample these chimneys. First, we tried to sample the right chimney. We easily sampled the top of chimney structure. However, most part of the chimney was so hard that we obtain only the surface of the chimney. We gave up obtaining big pieces of that chimney and we next tried to approach to the right chimney. However, in order to strong current, it was difficult to approach the right chimney. During the attempts, we discovered a vent strongly venting hydrothermal fluids. Therefore, we tried to sample hydrothermal fluids, but we could not sample them because computer which was necessary for operating WHATS-III and thermometer was out of order because of very hot environment in cockpit. Therefore, we gave up sampling hydrothermal fluids in this dive. In stead of the WHATS sampling, we sampled water by Niskin (Red). Since galathea were existed near the vent, we sampled them and then we re-tried to approach to the right chimney. After several attempts, we access to the chimney and then sampled chimney structures. Since the time was 13:30, we headed to the tubeworm site (Swan site).

We arrived at the tubeworm site, we observed that most of them were covered with

sponges. Tubeworm existed under the sponges. We first sampled animals and microbes adhere to the sponges by suction sampler. Next, we sampled tubeworms. After sampling at this site, we headed to iron mat site.

About moving west for 30 minutes, we discovered area in which the surface color was red. However, comparing with previous dive in YK17-17, the surface was flat, and the color was slightly mixed to green. I felt that this iron mat was almost dead. Although I wanted to seek other active iron mat, it was reached to the limit of discharge. We gave up seeking the active iron mat and then we sampled iron mat at this site by M-type sampler and MBARI core sampler (about 5 cm we obtained). The time had come, we left the bottom.

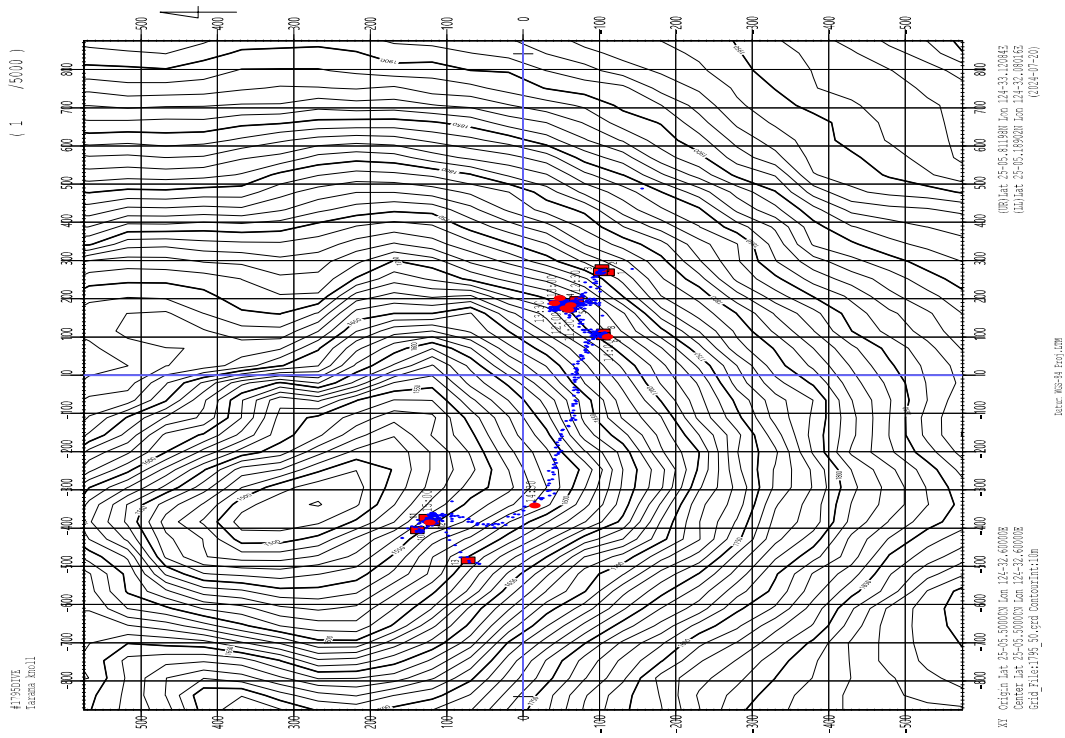
Payloads:

- WHATS-III
- Suction sampler with single canister
- Water inlet with temperature sensor
- Sample box (2, Black and Chibabox)
- Kumade sampler
- 6k markers (#277, #278)
- 4 x MBARI core sampler
- 2 x M-type sampler
- 2 x Niskin sampler
- RMT thermometer

Event list:

11:07	25°5.4442'N, 124°32.7666'E, D=1746m	Sampling Niskin (Green)
11:10	25°5.4450'N, 124°32.7608'E, D=1751m	Landing
11:20	25°5.4621'N, 124°32.7165'E, D=1701m	Finding mussel colony
11:24	25°5.4677'N, 124°32.7039'E, D=1686m	Finding and sampling Chimney
12:46	25°5.4749'N, 124°32.7105'E, D=1689m	Sampling galathea
13:21	25°5.4730'N, 124°32.7103'E, D=1685m	Sampling Chimney and Niskin(Red)
13:51	25°5.4433'N, 124°32.6661'E, D=1713m	Sampling around sponges
14:00	25°5.4437'N, 124°32.6606'E, D=1712m	Sampling tubeworm
14:55	25°5.5759'N, 124°32.3589'E, D=1541m	Finding Marker(GALI21)
15:06	25°5.5691'N, 124°32.3781'E, D=1537m	Measuremnt Temperature(RMT)
15:12	25°5.5646'N, 124°32.3718'E, D=1537m	Sampling iron mat and Set Marker#277"
15:28	25°5.5391'N, 124°32.3118'E, D=1529m	Left bottom

Dive track of 6K#1795



Dive Report: Shinaki6500#1796

Date: July 21, 2024

Site: Iheya North, original site

Landing: 27°47.3955N, 126-53.7587E, D=1003 m

Leaving: 27-47.5236N, 126-53.7964E, D=993

Observers: Ken Takai (JAMSTEC), Takuro Nunoura (JAMSTEC)

Pilots: Ohnishi, T

Objectives:

The objective of *Shinkai6500* Dive # 1796 was to collect the chimney, fluid, animal samples from the Iheya North original site.

Dive summary:

We landed on the southeast slope of the HRV (High Radioactive Vent) chimney mound at a depth of 1003 m. Before the landing, we collected the seawater by Niskin sampler (blue) 100 m above the landing site. At the landing site, we took the ambient sediment by a MBARI type corer. Soon after heading to HRV, clam shells and subsequently active *Calyptogen*a colonies were discovered. As we know no active *Calyptogen*a colonies were reported after 2002. After that, a big hole likely a pockmark or a drill hole was observed. Then, we arrived at the HRV that no biological and geochemistry samples were obtained after 1990s. The HRV was very active with numbers of flange structures, and we took active and inactive parts of the flanges, and sampled hydrothermal fluids. The detected max temperature was 301°C, but that during WHATS sampling was 292°C.

Then we headed to west to go the artificial vent on the guide base; IODP Hole 16B. Active venting with several flange structures were observed at the site, and two pieces of a flange structure were obtained. No fluid sampling was conducted due to a time limitation and technical difficulties. On the top of the east hill, CBC (Central Big Chimney) chimney was observed, and thus, we went north to go to the NBC (North Big Chimney). Finally, we arrived at the NBC. At NBC, we obtained a flange structure and *Shinkaia crosnieri*. Then, took fluids from the gassy venting fluids on the top of the NBC. The max temperature during the WHATS sampling was 308°C.

We then went north to find dead chimneys on the north end of the Original site. After leaving NBC, active venting of the NEC (North End Chimney) was observed. Then, small colonies of *Bathymodiolus* were observed without apparent venting on inactive chimney or volcanic rock-like structures. A dead chimney like structure was obtained in this area. Then, we further went north, and moreover discovered a previously unidentified big chimney, and left the bottom.

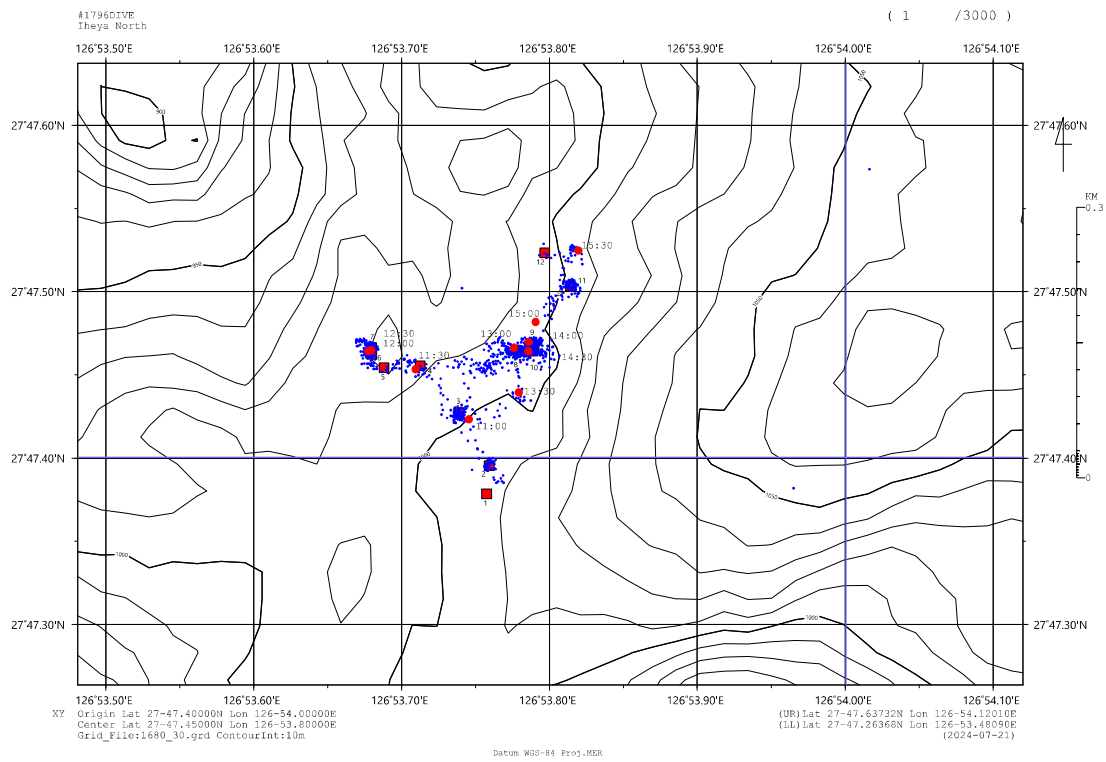
Payloads:

- MBARI corers (35 cm x 2)
- M-type sediment sampler x 2
- Suction sampler with a single canister
- WHATS water sampler
- Temperature sensor
- RMT temperature sensor
- Sample boxes (Black) x 2
- Sample box (ChibaChiba) x 1

Event list:

10:45	27°47.3955N,126-53.7587E	D=1003	Landing
10:52	27°47.3955N,126-53.7587E	D=1003	took sediment; MBARI(#3)
11:21	27-47.4271N,126-53.7382E	D=9941	found <i>Calypptogena</i> colonies and sampled the clams, took sediment on the colony; MBARI(#4), and measured the temperature on the sediment with RMT
11:29	27-47.4554N,126-53.7120E	D=985	found a big hole like a pockmark or drilling hole
11:37	27-47.4541N,126-53.6876E	D=953	found HRV chimney
11:43	27-47.4625N,126-53.6794E	D=948	sampled mixing water above the HRV; Niskin (Green)
12:22	27-47.4660N,126-53.6792E	D=954	took active and inactive flange structure of HRV and water; WHATS(1) (max 292°C)
13:11	27-47.4647N,126-53.7786E	D=995	took flange structure on a guide base at IODP Hole 16B
14:18	27-47.4678N,126-53.7891E	D=980	took flange structure and <i>Shinkaia crosnieri</i> on NBC
14:47	27-47.4644N,126-53.7884E	D=979	sampled water on the gassy fluid on NBC; WHATS(#2) (max 308°C)
15:20	27-47.5036N,126-53.8136E	D=1003	took a dead chimney
15:36	27-47.5236N,126-53.7964E	D=993	found an active chimney and leave the bottom

Dive track of 6K#1796



Dive Report: Shinaki6500#1797

Date: July 22, 2024

Site: Iheya North, Aki site

Landing: 27-46.0337N, 126-54.0900E, D=1106 m

Leaving: 27-45.9601N, 126-54.2098E, D=1066 m

Observers: Yuto Fukuyama (JAMSTEC)

Pilots: Satsuki Iijima, Naoto Minamino

Objectives:

The objective of *Shinkai6500* Dive # 1797 was to collect the chimney, fluid, sediment, and animal samples from the Iheya North Aki site.

Dive summary:

We landed on the west slope of the targeted chimney mound at a depth of 1106 m. Soon after heading to the chimney, we found a large white bacterial mat. After we arrived at the chimney, we took active parts of the flanges with nests of Ragworms and sampled hydrothermal fluids. The detected max temperature was 182°C during WHATS sampling. Then, we collected seawater containing plume by a Niskin sampler 3 m above the chimney. Then, we headed to the next chimney, located around the first chimney. On our way to the next chimney, we found a black mat in addition to several white mats. After we arrived at the chimney, we took active parts of the flanges and collected seawater containing plume using a Niskin sampler 30 cm above the chimney.

Next, we headed southwest to find the large chimney named “Hibarigaoka Hanayashiki” during the previous cruise. As heard from the observer at that time, the chimney was habitat of many mussels and galatheidæ. At the chimney, mussels were found in the inactive site, and galatheidæ were found in the active site at the crevice of the chimney. After we arrived at the chimney, we collected them using the Suction sampler with a single canister. Then, we tried to collect the active parts of the flanges with tubeworms. Because the chimney was too hard to collect, we took the chimney fragments and nests of Ragworms. We also sampled hydrothermal fluids. The detected max temperature was 172°C during WHATS sampling. Finally, we went south. After leaving the chimney, we observed white, pink, and yellow mats. We took two M-BARI core samples (#1 and 3) on a white mat and two M-BARI core samples (#2 and 4) on a yellow mat.

Payloads:

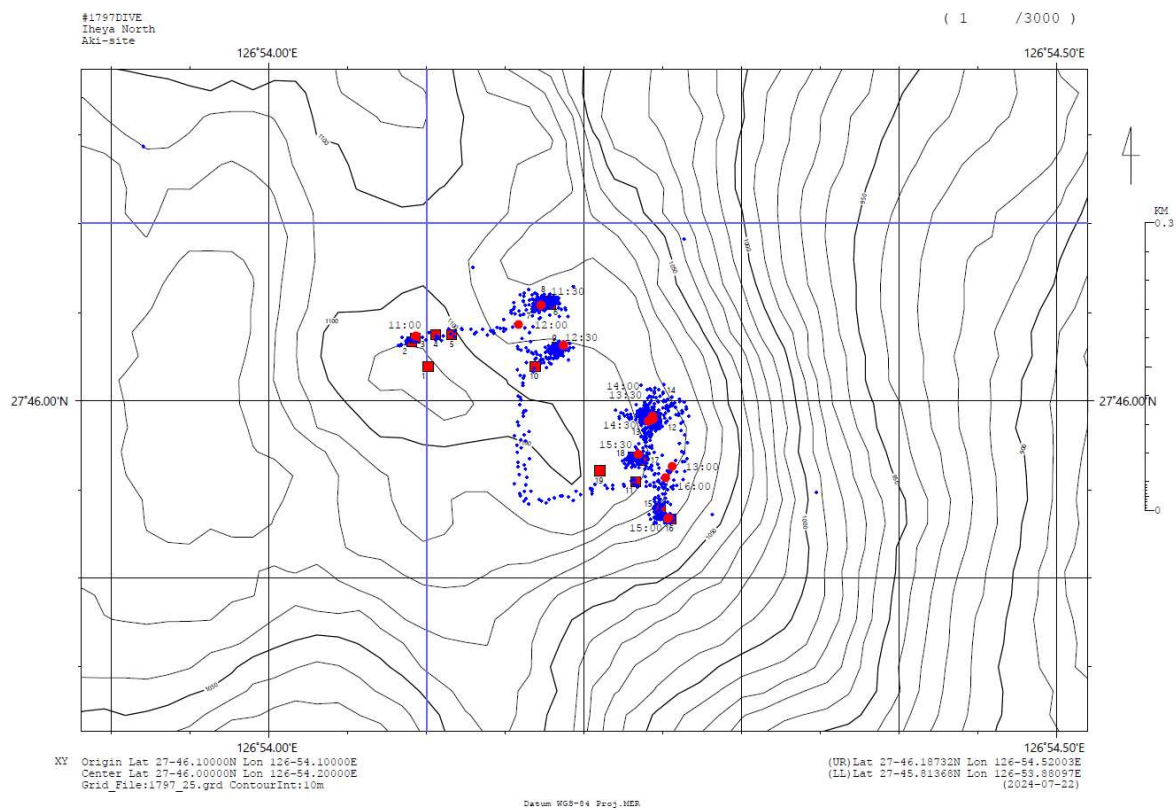
- MBARI corers (35 cm x 4)
- M-type sediment sampler x 1
- Suction sampler with a single canister
- WHATS water sampler

- Temperature sensor
- RMT temperature sensor
- Sample boxes (Black) x 2
- Sample box (ChibaChiba) x 1

Event list:

10:56	27-46.0337N,126-54.0900E	D=1106	Landing
10:59	27-46.0353N,126-54.0924E	D=1104	found Bacteria mat
11:02	27-46.0379N,126-54.1052E	D=1095	found Mussels colony
11:03	27-46.0376N,126-54.1155E	D=1092	found Bacteria mat(white)
11:20	27-46.0544N,126-54.1782E	D=1092	sampled water above a chimney; Niskin (red)
11:31	27-46.0545N,126-54.1706E	D=1077	sampled water on the gassy fluid on the chimney;
WHATS(1)(max 182°C)			
11:54	27-46.0565N,126-54.1760E	D=1077	took active flange structure of the chimney
12:29	27-46.0304N,126-54.1826E	D=1084	took active flange structure of a chimney
13:30	27-45.9900N,126-54.2453E	D=1080	sampled mussels and galatheidæ
14:05	27-45.9906N,126-54.2408E	D=1078	sampled water on the gassy fluid on the chimney;
WHATS(2)(max 172°C)			
14:17	27-45.9913N,126-54.2422E	D=1078	took active flange structure of the chimney
15:07	27-45.9330N,126-54.2544E	D=1059	sampled the sediment on the white bacterial mat;
MBARI(#1, 3), and measured the temperature on the sediment with RMT			
15:40	27-45.9665N,126-54.2364E	D=1078	sampled the sediment on the white bacterial mat;
MBARI(#2, 4)			

Dive track of 6K#1797



Dive Report: Shinkai6500 #1798

Date: July 28, 2024

Site: Kuroshima Knoll, Ryukyu Arc

On bottom: 10:50; 24°7.6991'N, 124°12.7627'E, D=817 m

Leave bottom: 16:30; 28°34.2144'N, 140°38.5232'E, D=1359 m

Observer: Chong Chen (JAMSTEC), Ken Takai (JAMSTEC)

Pilot: Takuma Onishi

Objectives:

The objective of *Shinkai 6500* Dive #1798 was to explore the chemosynthetic ecosystem on Kuroshima Knoll, in order to 1) observe the changes in the extent and distribution of seepage in the area since last visited by a submersible in 2005; 2) sample unique biological and geological specimens to improve our understanding of this site; 3) collect echinoderms to study their symbiosis with exceptional microbes.

Dive summary:

We first saw the seabed at 10:30, east of the *Pliocardia kuroshimana* colony site sighted on previous dives. Heading towards the *P. kuroshimana* site, we found a trail of several living *P. kuroshimana* sparsely distributed in sand, and collected a few as well as a cidaroid urchin that was nearby (10:50). We then took a reference pushcore for geology on the sandy bottom (11:00). Continuing on, we located the *P. kuroshimana* colony on hardened crust, and sampled *P. kuroshimana* clams, a pushcore on bluish bacterial mat, and two pieces of crust with one comatulid (feather star) attached (11:14). We set marker 6K#278 here (11:33). This concluded our activity at the eastern side of the site, and we started to travel to the western side by leaving the bottom and 'warping' in mid-water. During the warp, we pulled the red Niskin bottle (depth =785 m, 11:44).

We arrived at the eastern side of the seep site at 12:50, observing numerous faults and dead shells of *Akebiconcha kawamurai* clams and some small patches of *P. kuroshimana* clams. Moving northeast towards the points where plumes were seen in a previous 2016 cruise and where chimneys have been sampled in the past, we encountered numerous dead chimney structures covered by thick bacterial mat. We continued to search for fresh-looking chimney, and sampled one using scoop sampler (13:25). Next, we headed to the *Bathymodiolus* Garden location where a very dense expanse of seep community has been previously found. During the move, we found that the layer of *Akebiconcha* clam shells (mixed with some shells of *Pliocardia* and *Lucinoma* clams as well as *Enigmaticolus* whelks) became thicker and relatively fresh-looking as we approached *Bathymodiolus* Garden. This shelly layer has evidently formed a thick concretion layer of at least 50 cm thick on surface of the seamount, visible from occasional cracks.

Eventually, we arrived at the *Bathymodiolus* Garden site (13:50), confirmed by several markers of submersibles such as ROV *Dolphin-3K* and ROV *Hyper-Dolphin*. However, most of the colony were extinct, with a huge expanse of silvery dead *Bathymodiolus* still retaining the inner nacreous layer scattered around the area. We found a fresh-looking crack still with some living *Bathymodiolus* mussels and bacterial growth, and proceeded to sample the fluid seeping out from the crack using the WHATS-III sampler (14:17). We then collected the live *Bathymodiolus* mussels with *Enigmaticolus* snails on them, as well as an asteroidean that happened to be nearby, after dissolved oxygen (DO) measurements on the mussels.

After that, we continued to search around the area for living colonies of *Bathymodiolus*. Fortunately, we found a patch with densely aggregated live mussels and very strong gas bubbles continually emerging from the colony (14:50) – presumably methane. We collected the fluid with this methane bubble using the WHATS-III sampler and set the marker 6K#279 (14:53-15:00). Initially these bubbles appeared to come from small chimneys, but then we realized these were actually towers of live mussels connected by byssus threads. We also sampled two of these *Bathymodiolus* towers and took DO measurements (15:05-15:25). In addition, we took an empty shell of the clam *Akebiconcha kawamurai* (15:30). We then pulled the green Niskin bottle (15:42) after leaving the area affected by active seepage towards the south, and prepared to leave the bottom. During this course, we saw several piles of dead chimneys (15:45). We left the bottom at 15:46.

Payloads:

- Suction sampler with multiple (6) canisters
- Sample box x 2
- Scoop
- Full depth temperature probe
- WHATS-III fluid sampler
- Peristaltic pump
- MBARI push core (30 cm) x 4
- DO sensor
- RMT temperature probe
- Niskin sampler x 2

Event list:

10:50 24°7.6991N 124°12.7627E 817 m deep

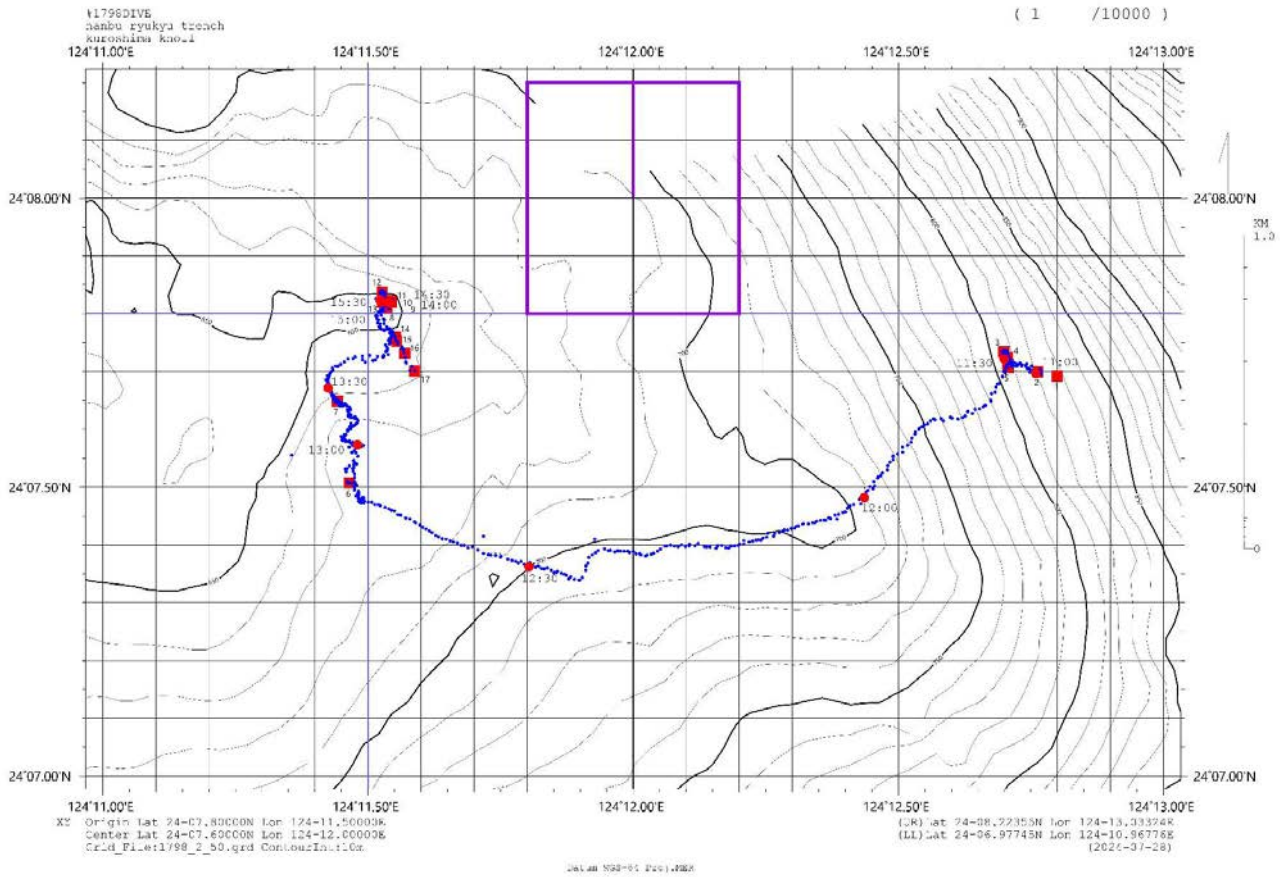
Landing, sampling *Pliocardia*, Cidaroid urchin, Core (Yellow 1)

11:14 24°7.7344N 124°12.6982E 806 m deep

Finding Bacteria mat, Sampling Core(Yellow #2),Sampling Clams(2),Sampling Crust

11:33 24°7.7241N 124°12.7048E 805 m deep
 Sampling Clams(2),Chimney?, Comatulida, Set Marker (#278)
 11:44 24°7.7077N 124°12.7062E 785 m deep
 Sampling Niskin(Red)
 12:50 24°7.5074N 124°11.4649E 666 m deep
 Finding Fault
 13:25 24°7.6489N 124°11.4416E 657 m deep
 Sampling Dead Chimney
 13:50 24°7.8111N 124°11.5354E 640 m deep
 Finding Marker(H163)
 14:05 24°7.8200N 124°11.5427E 641 m deep
 Sampling asteroidean (sea star)
 14:17 24°7.8221N 124°11.5406E 641 m deep
 Sampling WHATS(1&2)
 14:27 24°7.8226N 124°11.5379E 641 m deep
 Sampling Mussels, Measurement DO
 14:39 24°7.8377N 124°11.5263E 643 m deep
 Sampling Mussels
 14:53 24°7.8206N 124°11.5263E 641 m deep
 Sampling WHATS(3&4),Sampling Mussels, Measurement DO, Set Marker#279
 15:42 24°7.7596N 124°11.5513E 648 m deep
 Sampling Niskin (Green)
 15:43 24°7.7524N 124°11.5531E 650 m deep
 Finding Chimney
 15:44 24°7.7318N 124°11.5690E 654 m deep
 Finding Chimney
 15:46 24°7.7015N 124°11.5873E 647 m deep
 Left Bottom(A=8m)

Dive Track of Shinkai6500 #1798



Dive Report: Shinkai6500 #1799

Date: July 29, 2024

Site: Kuroshima Knoll, Ryukyu Arc

On bottom: 10:25; 23°59.9201'N, 124°13.7855'E, D=2528 m

Leave bottom: 15:01; 24°0.8166'N, 124°13.7972'E, D=2347 m

Observer: Masumi Hasegawa (JAMSTEC)

Pilot: Ryo Saigo

Co-Pilot: Tomoe Kondo

Objectives:

The objectives of *Shinkai 6500* Dive #1799 were to collect echinoderms to study their symbiosis with exceptional microbes and to collect sediment samples for biology and geology.

Dive summary:

We landed on the seabed at 10:25, and collected water sample into Niskin bottle (Green) and sandy sediment core samples by MBARI type corer (red #A and B) (depth = 2528 m, 10:39). Near the landing site, we found and sampled a sea cucumber (*Deima validum validum*) with a suction sampler and into canister (yellow #1) (10:51).

While moving headed to north, we found two Ophiuroidea (*Ophiura irorrata* and *Ophiuroidea* sp.). We collected them by suction sampler and into canister (#2) (depth = 2528 m, 11:03). Then we found a sea urchin (*Palaeopneustidae* sp.), and collected it by manipulator and into Masaco BOX (depth = 2404 m, 11:12). We also found some dead sea urchins (*Palaeopneustidae* sp.) around the surrounding sampling site of a sea urchin.

While moving headed to north again, we found a sea cucumber (*Paelopatides* sp.). We then collected a sediment sample with MBARI type corer (yellow #1) and this sea cucumber with suction sampler and into canister (#3) (depth = 2504 m, 12:01).

We then continued to search around the area and moved to north for 30 minutes. We found one sea cucumber (other *Paelopatides* sp.). Although we try to collect this sea cucumber after collecting a sediment core sample, the sea cucumber started to flee from here. We then collect this sea cucumber at first by manipulator, and into the right BOX, and collect a sediment sample by MBARI type corer (yellow #2) (depth = 2495 m, 12:31).

From here we can find garbage like such as plastic and cans. We discovered sea cucumbers (*Synallactidae* sp., n = 10?). We collect two of them by suction sampler and into Masaco BOX, and collect a sediment sample by MBARI type corer (yellow #3) (depth = 2488 m, 13:20).

After continuing northward and climbing the slope, we attempted to collect a sediment

core sample with the MBARI corer (red #C) (depth = 2445 m), but were unable to retrieve it. Therefore, we gave up on collecting a sediment core and left this MBARI type corer (24°0.6260'N, 124°13.7476'E, 14:25).

We continued to climb the slope and move to northeast. We collected water sample into Niskin bottle (Red) (depth = 2431, 14:37). After climbing further up the slope, we collected a sediment sample with MBARI type corer (red #E) (depth = 2431, 14:37). After moving to northeast again, we left the bottom at 15:01.

Payloads:

- Suction sampler with multiple (6) canisters
- Sample box x 1
- Masaco box x 1
- Scoop
- MBARI push core (red, 50 cm) x 10
- MBARI push core (yellow, 35 cm) x 5
- Niskin sampler x 2

Event list:

10:25 23°59.9201'N 124°13.7855'E 2528 m deep

Landing

10:39 23°59.9201'N 124°13.7855'E 2528 m deep

Sampling Niskin (green), Core (red #A and #B)

10:51 23°59.9377'N 124°13.7887'E 2528 m deep

Sampling sea cucumber (*Deima validum validum*)

11:03 23°59.9135'N 124°13.7859'E 2528 m deep

Sampling ophiuroidea (*Ophiura irorrata* and *Ophiuroidea* sp.)

11:12 23°59.9304'N 124°13.7825'E 2525 m deep

Sampling sea urchin (*Palaeopneustidae* sp.)

12:01 24°0.1480'N 124°13.7575'E 2504 m deep

Sampling core (yellow #1), sea cucumber (*Paelopatides* sp.)

12:31 24°0.2252'N 124°13.7162'E 2495 m deep

Sampling sea cucumber (*Paelopatides* sp.), core (yellow #2)

13:20 24°0.3577'N 124°13.6982'E 2488 m deep

Sampling sea cucumbers (*Synallactidae* sp. x 2), core (yellow #3)

13:25 24°0.3636'N 124°13.7036'E 2488 m deep

Finding a lot of sea cucumber (*Synallactidae* sp.)

14:25 24°0.6260'N 124°13.7476'E 2445 m deep

Lost core (red #C)

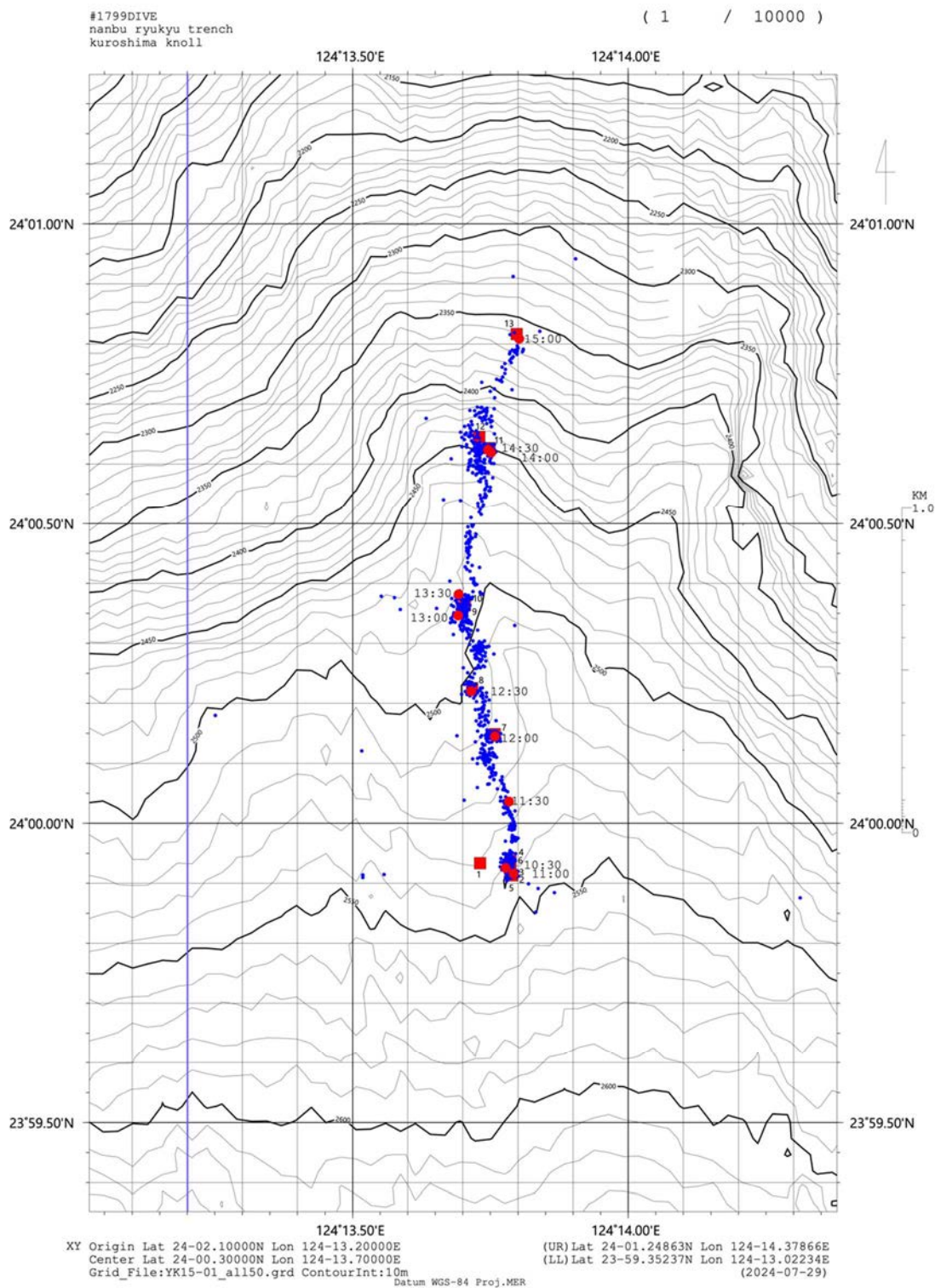
14:37 24°0.6450'N 124°13.7291'E 2445 m deep

Sampling Niskin (red)

15:01 24°0.8166'N 124°13.7972'E 2347 m deep

Left bottom

Dive Track of Shinkai6500 #1799



Notice on Using

This cruise report is a preliminary documentation as of the end of cruise.

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