NATSUSHIMA Cruise Report
NT09-10
Leg. 2

Tarama Seamount

July 19 (Naha) – July 25 (Naha), 2009

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

Contents

1. Cruise Information

1.1. Cruise number:

NT09-10 Leg. 2

1.2. Name of vessel:

R/V Natsushima

ROV Hyper-Dolphin

1.3. Title of the cruise:

'Hyper-Dolphin' deep-sea dive research

1.4. Titles of proposals:

- Geochemical and geocmirobiological investigation for unexplored hydrothermal fields in the Southern Okinawa Trough

1.5. Cruise period:

July 19 - July 25, 2009

1.6. Ports of call:

Naha (daparture) – Naha (arrival)

1.7. Research area:

Tarama Seamount, the Nansei Islands (Fig.1) The area surrounded with the following lines of longitudes and latitudes, 25˚03.0'N, 124˚29.0'E, 25˚16.0'N, 124˚55.0'E

1.8. Research map:

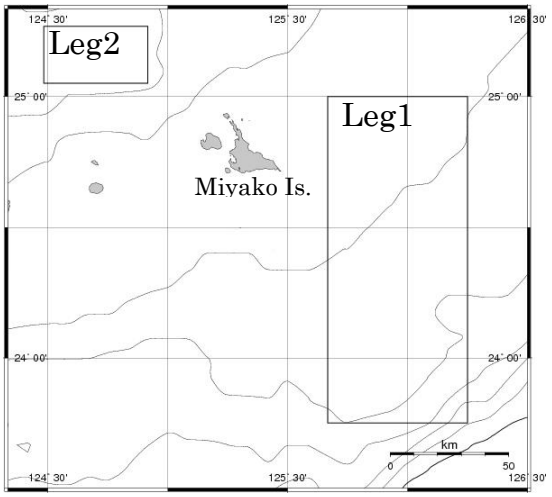


Fig.1　Research area

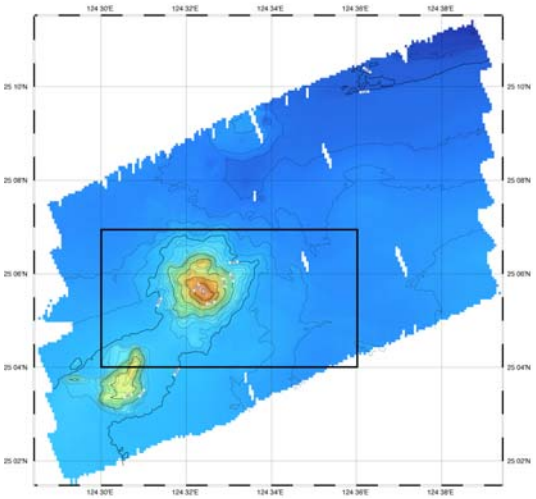


Fig.2　Bathymetory map of Tarama Semount

See ‘3.4. Dive information’ for the details.

2. Researchers

2.1. Chief scientist:

Toshiro Yamanaka [Okayama Universuty]

2.2. Representatives of the science party:

Toshiro Yamanaka [Okayama Universuty]

2.3. Science party:

Names	Affiliations
Toshiro Yamanaka	Okayama Universuty
Ayako Jinnai	Okayama Universuty
Kotaro Maeto	Okayama Universuty
Shingo Hirao	Kyushu Universuty
Shogo Oshima	Kyushu Universuty
Takuro Nunoura	JAMSTEC
Hiroko Makita	JAMSTEC
Mariko Abe	JAMSTEC
Hiromi Watanabe	JAMSTEC
Kentaro Nakamura	JAMSTEC
Kazuhiro Inoue	Tokyo Institute of Technology
Daigo Iwata	University of Ryukyus
Jun Kawai	Yokohama National University
Naoko Nomura	University of Tokyo
MiHye Seo	University of Tokyo
Shin Toyoda	Okayama University of Science
Fumihiro Sato	Okayama University of Sceince

3. Observation

3.1. Observation

3.1.1. Objective and Background

For understanding of whole Okinawa Trough as a single system, it is necessary to research of a blank area of possible hydrothermal activity. It is expected o strongly improve the knowledge how geology and tectonics control chemistry of the hydrothermal fluids and distribution of the related (micro-) organisms in the Okinawa Trough. To reach the goal our targets of this cruise are focused on the Irabu ensuidai and Karudera seamounts and the Tarama seamount, which are located southeastern part of western edge of the Okinawa Trough. In 2000 hydrothermal activity has been observed during Shinkai 6500 dive study on the Irabu ensuidai and Karudera seamounts, however, any geochemical and biological observation have not been done yet. On the other hand, significant turbidity and methane-concentration anomaly possibly originated in hydrothermal activity has been found on the summit of Tarama seamount during the KT05-26 cruise in 2005 by surface ship study. It is likely to easily identify the venting sites from those seamounts. After the identifying the venting sites we plant to conduct the geological, geochemical and (micro-) biological sampling and clarify the nature. Then we compare the nature with the known hydrothermal sites in the Okinawa Trough for further understanding of the linkage between the chemical and biological nature and the geological and tectonic background.

3.1.2. Methods and Instruments

For accomplish the objective, we sampled seawater (Niskin bottle, Bag pump sampler and WHATS with temperature probe), sediments (push corer), rocks and organisms (sponge, fish, etc. with suction sampler). In addition, during each dive the transmissivity of water had been measured.

3.1.3. Research Results

We lost first two days due to Typhoon attack, therefore our survey was focused only on the Tarama seamount. During three dives, we could not identified any active venting site, but we found some red-brown areas on seafloor at around

1550 m in depth on the south slope, and we observed temperature anomaly at the red-brown area, where the surface sediment temperature was about 7˚C higher than that of the ambient bottom water. It may suggest that the gentle shimmering of hydrothermal fluids at the red-brown area. In addition, the bathymetry study prior to the dives of the ROV show that the actual Tarama seamount is much smaller than that of the bathymetry obtained from the previous data, and the true Tarama seamount has two peaks and is characterized by steep slopes. The rock samples obtained from the slopes were only pumice, implying that the seamount is a kind of pyroclastic cone and steep slope should be due to collapse of a part of the cone body.

Another each specific preliminary result is summarized as follows.

3.1.3.1. Preliminary results of petrological study on board

Kentaro Nakamura (JAMSTEC, Precam. Lab.)

During this cruise, 5 rock samples were recovered in 3 dives; 2 samples in Dive#1032, 1 sample in Dive#1033, 2 samples in Dive#1034. Among them, one sample was recovered in northern slope of the Tarama Seamount, whereas the other 4 samples were from the southeastern slope. Localities of the rock samples are shown in Fig.3.

All the samples are highly permeable pumiceous rocks, implying that the Tarama Seamout is mainly composed of pumiceous rocks. These samples are white to pale brown in color, and there are no visible phenocryst minerals in the samples. Although it is difficult to predict the chemical characteristics of the pumiceous rocks, these samples may be intermediate to acidic rocks with andesitic to dacitic composition. All the samples are not rounded and most of them are from outcrop. This suggests that the pumiceous rock samples are not volcaniclastic rocks (typical pumice), but volcanic rocks (pumiceous lavas).

These samples have very thin (typically <0.1 mm) Mn coating, indicative of their relatively young age. Only the sample HD#1032R02 has thin (<1 mm) Fe-oxyhydroxide coating, which is probably related to the hydrothermal activity “Iron TAIGA” discovered in this cruise.

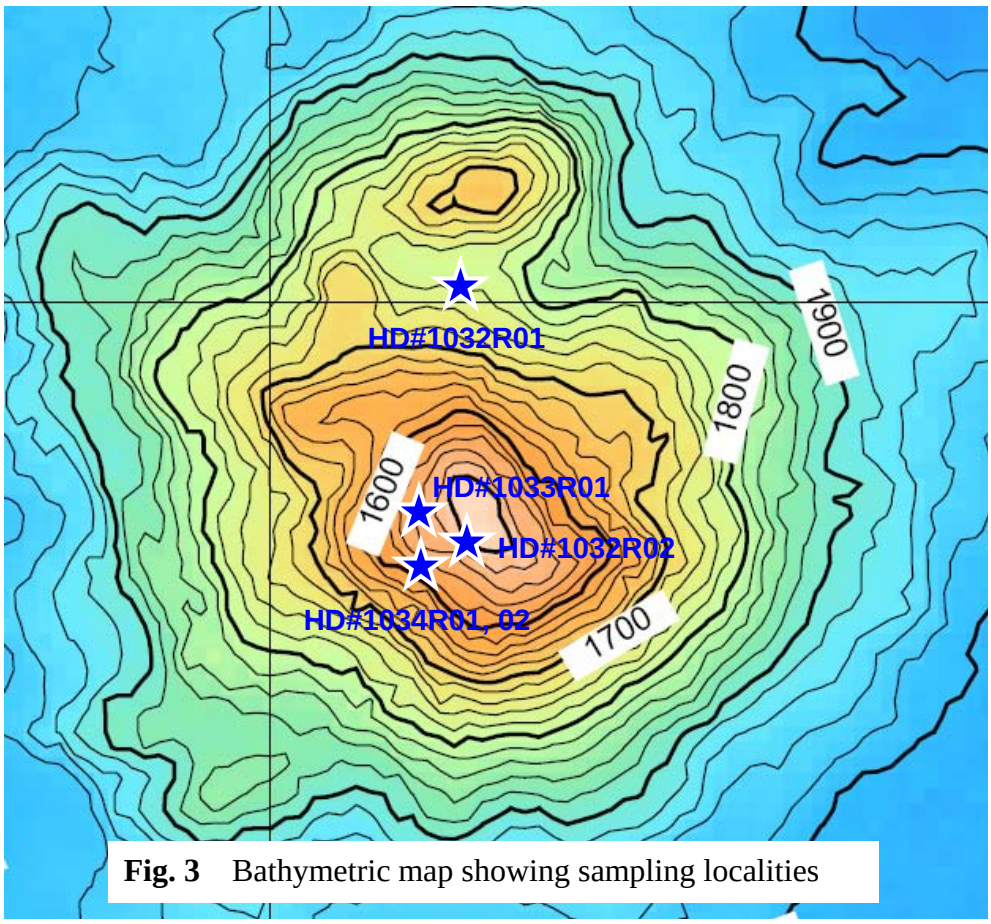


Fig. 3 Bathymetric map showing sampling localities

3.1.3.2. Preliminary results of biological study on board

Hiromi Watanabe (JAMSTEC)

MiHye Seo (ORI, University of Tokyo)

Faunal composition in the Tarama Knoll was observed during ROV Hyper-Dolphin dives in this cruise. At least two species of rossellid sponges (Fig. 4 & 5) were dominated, some synaphobranchid and liparid fishes and asteroids were also frequently observed. Typical hydrothermal vent-obligate animals have not been discovered in this cruise, but a rossellid species known around the Iheya Knoll hydrothermal vent field was similar to the most dominant rossellid of this cruise, and a liparid fish has been reported from hydrothermal vent fields in the Hatoma Knoll. This similarity in faunal composition may suggest existence of hydrothermal activity in Tarama Knoll.

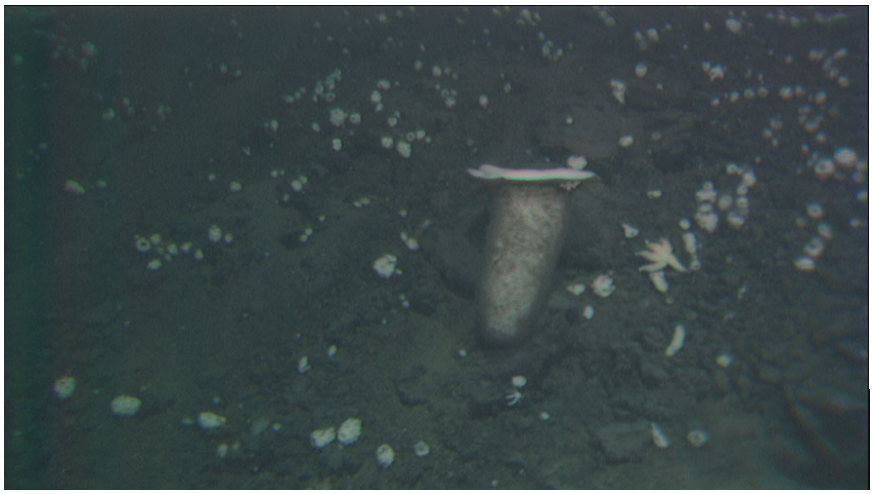


Fig. 4 *In situ* photo of animal community in the Tarama Knoll. Small rossellid sponge was dominant in this area.

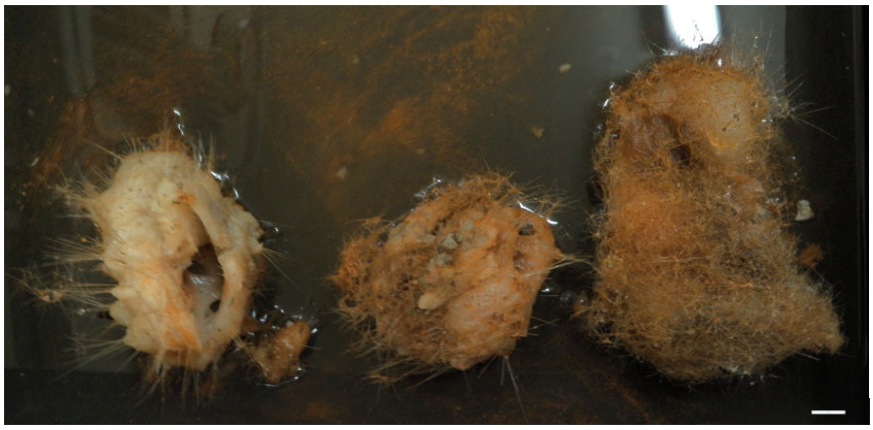


Fig. 5 Two species of rossellid sponges collected by #1034 dive of *ROV Hyper-Dolphin*. Scale bar = 1cm

3.1.3.2. Ecological study for primary producers which utilizing Iron and concerned rock alteration in the deep-sea hydrothermal fields

Hiroko Makita, Takuro Nunoura, Mariko Abe (JAMSTEC)

The purpose of this cruise is to obtain rocks, iron mat and fluid samples to examine the associations between endlithic microorganisms and rock alteration processes at plausible deep-sea hydrothermal field of the Tarama seamount.

Recent studies have demonstrated a diverse and abundant epi- and endo-lithic microbial community on seafloor basalts and in fluid emanating from ridge-flank crust. Rarefaction analyses show that the alteration basalt biome appears to harbour bacterial diversity and richness levels comparable to some of the most diverse identifies so far on Earth. In recent years, culture –depend and –independent microbiological characterization has demonstrated that the zeta-proteobacteria “Mariprofundus ferrooxidans”, which utilizing ferrous iron choemolithoautotrophic microorganism, commonly observed in some deep-sea

low-temperature hydrothermal fields; rocks alteration regions and iron mat site. This kind of iron utilizing chemolithoautotroph microorganisms has the most significant ecological roles, such as iron and carbon cycling, in microbial communities occurring in deep-sea low-temperature hydrothermal field. However, little is known about these iron-utilizing chomolithomicroorganisms, how many types existing, what is dominant species in each site, what exactly do they role in natural habitats, and how do they interact with other microorganisms and rocks. Objectives of our microbiological studies include, 1) the evaluation of microbial diversity and distribution, 2) the measurement of microbial activity by using cultivation-, enzymatic-, DNA and RNA approaches, and metabolic product analysis.

We have collected some iron mat samples during Leg NT09-10. And we have collected some fluid samples near the iron mat site by Niskin and bag water samplers. The iron mat samples were soft and fluffy texture, and were probably composed of amorphous silica and iron hydroxides. Samples were onboard prepared for future studies. Results of the analyses will provide insights into contribution of microorganisms to alteration of oceanic rocks, and iron utilizing microorganism's diversity.

3.1.4. Future Studies

We got seawater, sediment, rocks and biological samples during the dives. The water samples are provided to analyze some metal species for determining the hydrothermal contribution. From the interstitial water and its dissolved gas chemistries in the red-brown sediment sample we plan to decide whether the temperature anomaly is caused by a hydrothermal activity. Dissolved organic chemicals in the seawater samples are also important object for understanding the character of hydrothermal activity occurred in Okinawa Trough. DOC, volatile organic acids, amino acids, and some protein also plan to measure at the onshore-based laboratories. Such geochemical studies are conducted at the following institutions and colleagues: Okayama, Kyushu, and Yokohama National Universities, University of Ryukyus, and Tokyo Institute of Technology. In addition, from the isotopic signatures of the benthos samples we try to

estimate whether they rely on the chemosynthesis-based primary production. Such biogeochemical studies are conducted at the following institutions and colleagues: ORI, University of Tokyo, JAMSTEC, and Okayama University.

Another specific studies conducted by each colleague are proposed as follows.

3.1.4.1. Petrological study

Kentaro NAKAMURA (JAMSTEC, Precam. Lab.)

1. For the purpose of elucidating geological and petrological background of the "Iron TAIGA" hydrothermal activity, petrological and geochemical study of pumiceous rock samples from the Tarama Seamount will be performed. In order to determine major and minor elements, XRF and ICP-MS at JAMSTEC will be used.

2. Major, trace and rare-earth element analyses of iron mat and iron chimney samples will be conducted in order to clarify chemical characteristics of the iron deposits. For the proposed analyses, XRF and ICP-MS at JAMSTEC will be used.

3.1.4.2. Biological study

Hiromi Watanabe (JAMSTEC)

MiHye Seo (ORI, University of Tokyo)

To elucidate faunal composition in details, we will study the following things with our colleagues;

1. Morphological and phylogenetical analyses of rossellid sponges. Collaborative study with Dr. Yuji Ise in MMBS, University of Tokyo.

2. Molecular phylogenetic analyses of lirarid fish. Collaborative study with Dr. Shigeaki Kojima and his student Ms. Reina Maeda in ORI, University of Tokyo.

3. Morphological and molecular phylogenetic analyses of the octopus collected by #1033 dive of ROV Hyper-Dolphin. Collaborative study with Dr. Takashi Okutani in JAMSTEC.

4. Stable isotopic analyses by Dr. Toshiro Yamanaka in Okayama University.

3.1.4.3. Determination and imaging of growing chemolithotrophic microbial cells using syringe type *in situ* growth chamber

Naoko Nomura (University of Tokyo)

In this decade, dominant members of microbial community in hydrothermal area have been investigated and determined using cultivation technique, phylogenetic analysis, and cell analysis. Microbial isolates and phylogenetic genes of chemolithoautotrophs have been detected as the major population of microbial community in hydrothermal area. Functional genes of key enzymes related to the chemolithoautotroph have also recovered from the area. These results indicated that the chemolithotrophs play the important role in hydrothermal microbial ecosystems. In this research, we applied a FISH-BrdU approach to microbial cells incubated in a syringe type in situ growth chamber to determine the growth rate of microbial cells in hydrothermal area.

The syringe-type in situ growth chamber is combined six syringe-type water samplers (General Oceanics, co.) with trigger system (Fig. 6). Each syringe type water sampler collects a 60 ml of seawater sample by pushing a trigger. Tube and one-way valve was attached at the inlet of the syringe. In the tube, we added reagent chemicals to activate or to inhibit the metabolism of specific microbes. BrdU was also added in the tubing. We collected seawater at the depth of hydrothermal plume layer, which was determined by the turbidity meter attached to the ROV. The hydrothermal plume water was incubated around the seafloor during a dive. As soon as retrieval of the growth chamber, microbial cells in the incubated samples were killed and fixed by addition of 6ml of 38% formaldehyde solution.

BrdU is an analogue of thymidine, which has been used for the determination of microbial growth rate based on its incorporation rate into microbial DNA. After the reaction with antibody against BrdU, we can detect BrdU incorporated in microbial cells by fluorescent microscope. Radioisotopes are not necessary during the experiment, therefore BrdU detection are useful

for the in situ incubation experiment. In this cruise, we focused on the microorganisms, which oxidize methane, ammonium, and sulfur as an energy source. We designed 6 serious of incubation experiments to detect these chemolithotrophs through both in situ incubation and on board incubation. In the shore-based study, we plan to determine the phylogeny of cells and the growing cells by FISH and BrdU detection, respectively. Based on this approach, methane, ammonium, and sulfur oxidizing microbes are detected both substrate utilization and phylogenetic position at a single cell level. Unfortunately, we couldn't obtain 6 samples in one serious of in situ incubation. Although the syringe type in situ incubation chamber should be improved, we could successfully get the 3 syringe samples using this chamber.

Fig. 6 Photo image of syringe type *in situ* growth chamber

3.1.4.3. Chronological study of volcanic rocks

Shin Toyoda, Fumihiro Sato (Okayama University of Science)

For the purpose of elucidating history of volcanism and the following hydrothermal activity we will try to isolate suitable minerals for dating from the rock and sediment samples.

3. 2. Instruments

Place	Instruments
ROV payload	HWATS Bag pump sampler Niskin sampler Vacuum water sampler Syringe-type in situ growth chamber Sampling box Suction sampler Turbidity meter
Laboratory	HPLC pH meter Digital Titrator Gas extraction system UV-VIS Spectrophotometer Water tank with cooler and air pump

3.3. Cruise log:

Date (2009)	Vessel	Area	Work
Jul. 19 (Sun)	Departure	Naha	Embarkation
20 (Mon)	Dive #1032	Tarama Seamount	Seabat mapping and survey
21 (Tue)	Dive #1033		Research ・Data collection
22 (Wed)	Dives #1034 (Till noon) & Leave the site		・Sampling of water, rocks, and animals
23 (Thu)	Free fall		
24 (Fry)	Cruising		
25 (Sat)	Arrival	Naha	Disembark

3.4. Dive information:

3.4.1. #1032

Toshiro Yamanaka

Date: July 20, 2009
Site: Tarama Seamount
Landing: 14:39, Depth 1759 m, 25°06.038'N, 124°32.371'E
Leaving: 16:03, Depth 1483 m, 25°05.611'N, 124°32.422'E

Objective:

The major objective of this dive is finding hydrothermal venting site of the Tarama Seamount, then we plan to sample hot fluids, organisms, hydrothermal precipitations and rocks.

Dive Summary:

Before landing the seafloor we sampled seawater using the syringe-type and Niskin bottle sampler at 1475 m in depth, where hydrothermal plume was expected based on the previous study during KT05-25. The ROV first landed on the saddle between the two peaks of the seamount and start to survey south toward to the main peak of the seamount. During the survey we found many sponges and some fishes and crustaceans on the sea floor, but they were likely common marine animals, which do not rely preferentially on chemosynthetic primary production. When the ROV arrived at the peak we recognized dense turbid water. It was expected us that we closed to the hydrothermal vent, but that day's dive came to pass the time limit. Before leaving the seafloor, we sampled some rocks. After the leaving we sampled seawater using Niskin bottle at 1475 m in depth again.

Payloads:

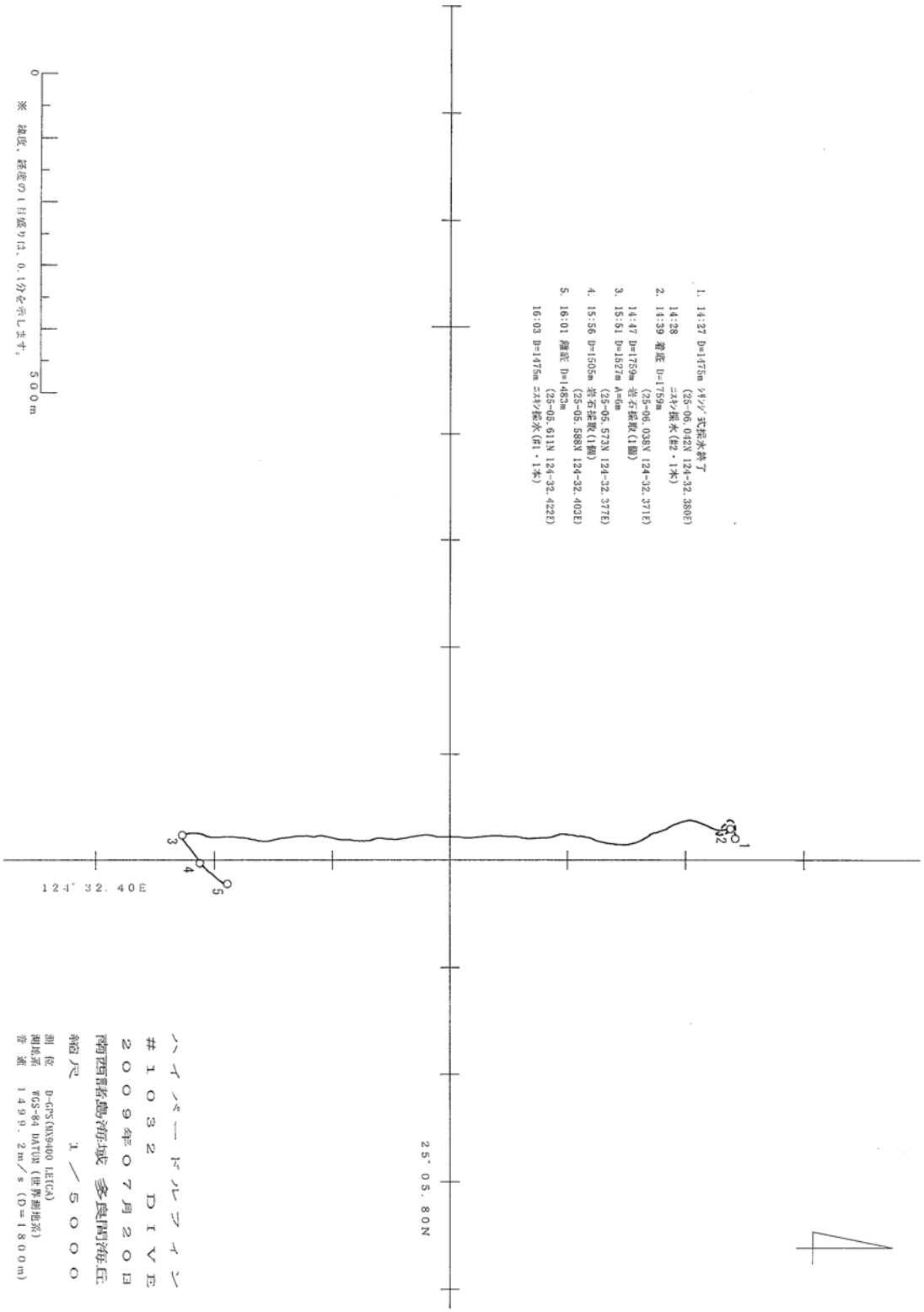
1) WHATS with a temperature probe
2) Vacuum bottle sampler

3) Bag pomp sampler (20L x 1)
4) Niskin bottles (2 bottles)
5) Suction sampler (multi canister)
6) Sample box x 2
7) Turbidity meter
8) M-type sediment sampler
9) MBARI core sampler
10) Syringe-type in situ growth chamber

Event List:

14:27 25°06.042'N, 124°32.380'E (D = 1475 m) Water sampling (Syringe-type, Niskin bottle #2)
14:39 25°06.038'N, 124°32.371'E (D = 1759 m) Landing on seafloor
15:56 25°05.588'N, 124°32.403'E (D = 1505 m) Rock sampling (sample box)
16:01 25°05.611'N, 124°32.422'E (D = 1483 m) Leaving bottom
16:03 25°05.611'N, 124°32.422'E (D = 1475 m) Water sampling (Niskin bottle #1)

Dive track:


1. 14:27 D=1475m ｼｬﾝﾊﾟｰﾄﾞﾚｰﾝ式採水終了
(25°06.042N 124°32.380E)
14:28 ニスキン採水(#2・1本)
2. 14:39 着底 D=1759m
(25°06.038N 124°32.371E)
14:47 D=1759m 岩石採取(1個)
3. 15:51 D=1927m A=6m
(25°05.573N 124°32.377E)
4. 15:56 D=1505m 岩石採取(1個)
(25°05.588N 124°32.403E)
5. 16:01 離底 D=1483m
(25°05.611N 124°32.422E)
16:03 D=1475m ニスキン採水(#1・1本)
0
500m
※ 緯度、経度の1目盛りは、0.1分を示します。
124° 32.40E
25° 05.80N
ハイパードルフィン
#1032 DIVE
2009年07月20日
南西諸島海域 多良間海丘
縮尺 1／5000
船位 D-GPS(MX9400 LEICA)
測地系 WGS-84 DATUM (世界測地系)
音速 1499.2m／s (D=1800m)

3.4.2. #1033

Takuro Nunoura

Date: July 21, 2009
Site: Tarama Seamount
Landing: 9:13, Depth 1536 m, 25°05.656'N, 124°32.283'E
Leaving: 16:00, Depth 1591 m, 25°05.503'N, 124°32.380'E

Objectives:

The major objective of this dive is finding hydrothermal venting site of the Tarama Seamount, then we plan to sample hot fluids, organisms, hydrothermal precipitations and rocks.

Dive Summary:

During this dive we mainly survey the southern slope of main peak of Tarama Seamount. The dive was done between 1575 and 1536 m (top of the peak) in depth. Only the last survey line we started observation form 1689 m depth. The detailed survey lines during the dive were shown in the dive track (solid lines).

Unfortunately, we could not found any evidence of hydrothermal discharge, such as macroscopic fluid emission and characteristic animal during the dive. However we found stained bottom sediments on the southwest slope of seamount, it seemed to distribute beltlike at between 1520 and 1540 m in depth widely. The stains were red-brown and sampled by manipulator. The stained sediment was likely consisted of iron oxide and it covered the seafloor about 10 cm thick. Such wide and thick distribution suggests that hydrothermal activity should be contributed to form such deposits. It means that there used to be hydrothermal discharge there.

Existences of the iron oxide deposits and dense turbid water were strongly expected us current vigorous activity of hydrothermal discharge around the seamount.

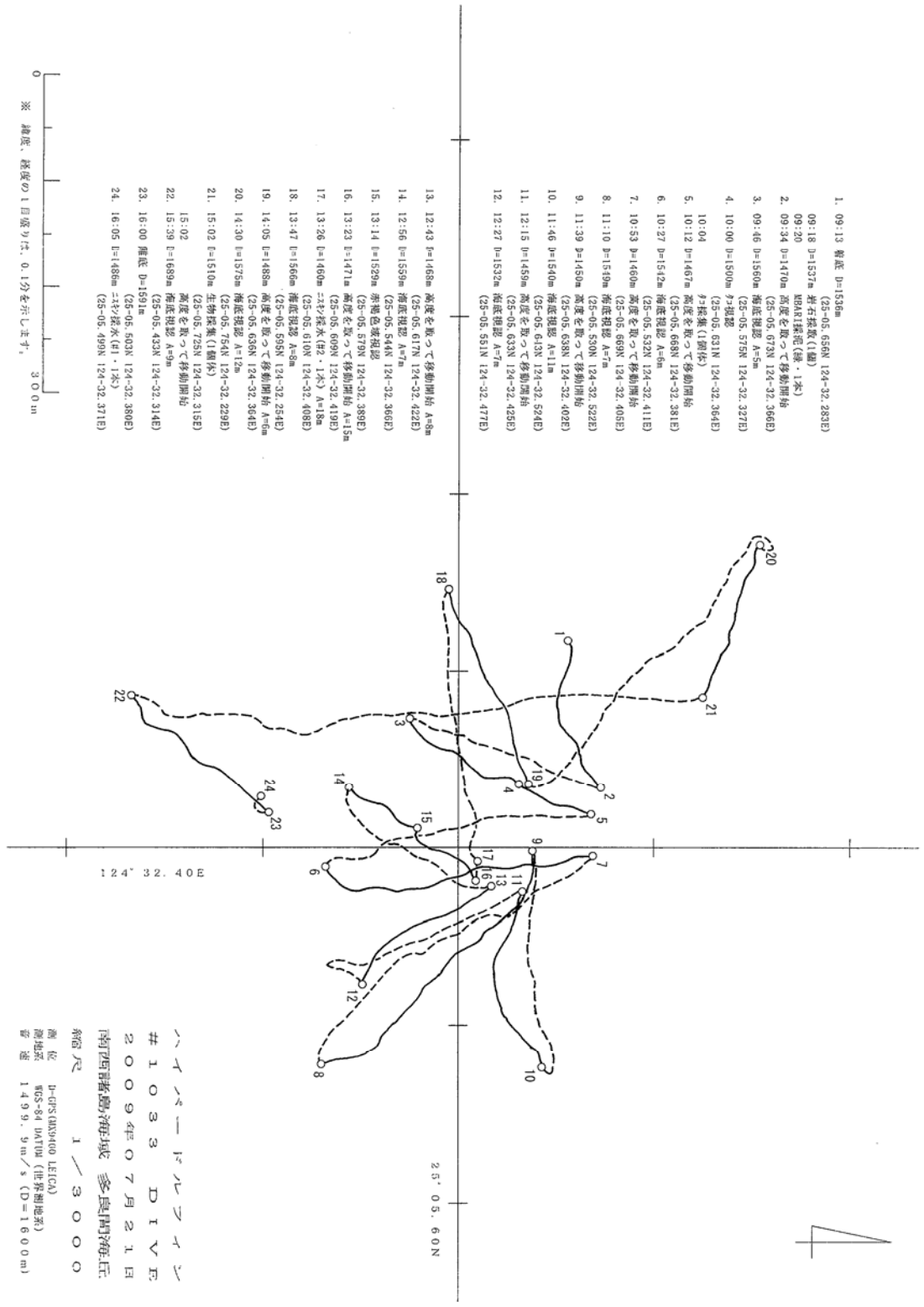
Payloads:

1) WHATS with a temperature probe
2) Vacuum bottle sampler
3) Bag pomp sampler (20L x 1)
4) Niskin bottles (2 bottles)
5) Suction sampler (multi canister)
6) Sample box x 2
7) Turbidity meter
8) MBARI core sampler

Event List:

9:13 25°05.656'N, 124°32.283'E (D = 1536 m) Landing
9:18 *ditto* Rock sampling
9:20 *ditto* MBARI core sampling (Green x 1)
9:57 Red-brown sediment was found
10:04 25°05.631'N, 124°32.364'E (D = 1500 m) Sampling of animal (octopus)
10:35 Observation of the red-brown sediment
10:54 (D = 1430 m) Turbid water was found
12:35 (D = 1479 m) Red-brown sediment was found
13:03 Red-brown sediment was found
13:14 25°05.579'N, 124°32.389'E (D = 1529 m) Red-brown sediment was sampled
13:26 25°05.610'N, 124°32.408'E (D = 1492 m) Turbid water sampling (Niskin bottle #2)
15:02 25°05.725'N, 124°32.315'E (D = 1510 m) Animal sample was obtained (white worm)
16:00 25°05.503'N, 124°32.380'E (D = 1591 m) Leaving bottom
16:05 25°05.499'N, 124°32.371'E (D = 1486 m) Water sampling (Niskin bottle #1)

Dive track:


1. 09:13 着底 D=1536m
(25-05. 656N 124-32. 283E)
09:18 D=1537m 岩石採取(1個)
09:20 MBARI採泥(鉄・1本)
2. 09:34 D=1470m 高度を取って移動開始
(25-05. 673N 124-32. 366E)
3. 09:46 D=1560m 着底視認 A=5m
(25-05. 575N 124-32. 327E)
4. 10:00 D=1500m ﾀﾗﾊﾞ採取
(25-05. 631N 124-32. 364E)
10:04 ﾀﾗﾊﾞ採集(1個体)
5. 10:12 D=1467m 高度を取って移動開始
(25-05. 668N 124-32. 381E)
6. 10:27 D=1542m 着底視認 A=6m
(25-05. 532N 124-32. 411E)
7. 10:53 D=1460m 高度を取って移動開始
(25-05. 669N 124-32. 405E)
8. 11:10 D=1549m 着底視認 A=7m
(25-05. 530N 124-32. 522E)
9. 11:39 D=1450m 高度を取って移動開始
(25-05. 638N 124-32. 402E)
10. 11:46 D=1540m 着底視認 A=11m
(25-05. 643N 124-32. 524E)
11. 12:15 D=1459m 高度を取って移動開始
(25-05. 633N 124-32. 425E)
12. 12:27 D=1532m 着底視認 A=7m
(25-05. 551N 124-32. 477E)
13. 12:43 D=1468m 高度を取って移動開始 A=8m
(25-05. 617N 124-32. 422E)
14. 12:56 D=1559m 着底視認 A=7m
(25-05. 544N 124-32. 366E)
15. 13:14 D=1529m 赤褐色壁視認
(25-05. 579N 124-32. 389E)
16. 13:23 D=1471m 高度を取って移動開始 A=15m
(25-05. 609N 124-32. 419E)
17. 13:26 D=1460m ニスキン採水(#2・1本) A=18m
(25-05. 610N 124-32. 408E)
18. 13:47 D=1566m 着底視認 A=8m
(25-05. 595N 124-32. 254E)
19. 14:05 D=1488m 高度を取って移動開始 A=6m
(25-05. 636N 124-32. 364E)
20. 14:30 D=1575m 着底視認 A=12m
(25-05. 754N 124-32. 229E)
21. 15:02 D=1510m 生物採集(1個体)
(25-05. 725N 124-32. 315E)
15:02 高度を取って移動開始
22. 15:39 D=1689m 着底視認 A=9m
(25-05. 433N 124-32. 314E)
23. 16:00 離底 D=1591m
(25-05. 503N 124-32. 386E)
24. 16:05 D=1486m ニスキン採水(#1・1本)
(25-05. 499N 124-32. 371E)
0
※ 緯度、経度の1目盛りは、0.1分を示します。
300m
124° 32. 40E
25° 05. 60N
ハイパードルフィン
#1033 DIVE
2009年07月21日
南西諸島海域 多良間海丘
縮尺 1／3000
測位 D-GPS(MX9400 LEICA)
測地系 WGS-84 DATUM (世界測地系)
音速 1499.9m／s (D=1600m)

3.4.3. #1034

Hiroko Makita

Date: July 22, 2009
Site: Hatoma knoll
Landing: 9:12, Depth 1595 m, 25°05.535'N, 124°32.329'E
Leaving: 10:55, Depth 1524 m, 25°05.601'N, 124°32.374'E

Objectives:

The major objective of this dive is finding hydrothermal venting site of the Tarama Seamount, then we plan to sample hot fluids, organisms, hydrothermal precipitations and rocks.

Dive Summary:

During this dive we focused unexplored area of the last dive on the southwest slope of the seamount. We confirmed turbid water at around 1540 m depth again, but we could not identify any hydrothermal vent during the dive.

We sampled rock, red-brown sediment and animals during the dive, and we measured the temperature of the just beneath the seafloor at the red-brown sediment area. The temperature of the surface sediments was approximately 11.7˚C, this value was about 7˚C higher than that of the ambient seawater. It strongly suggest that gentle hydrothermal discharge was occurred at the stained area.

Payloads:

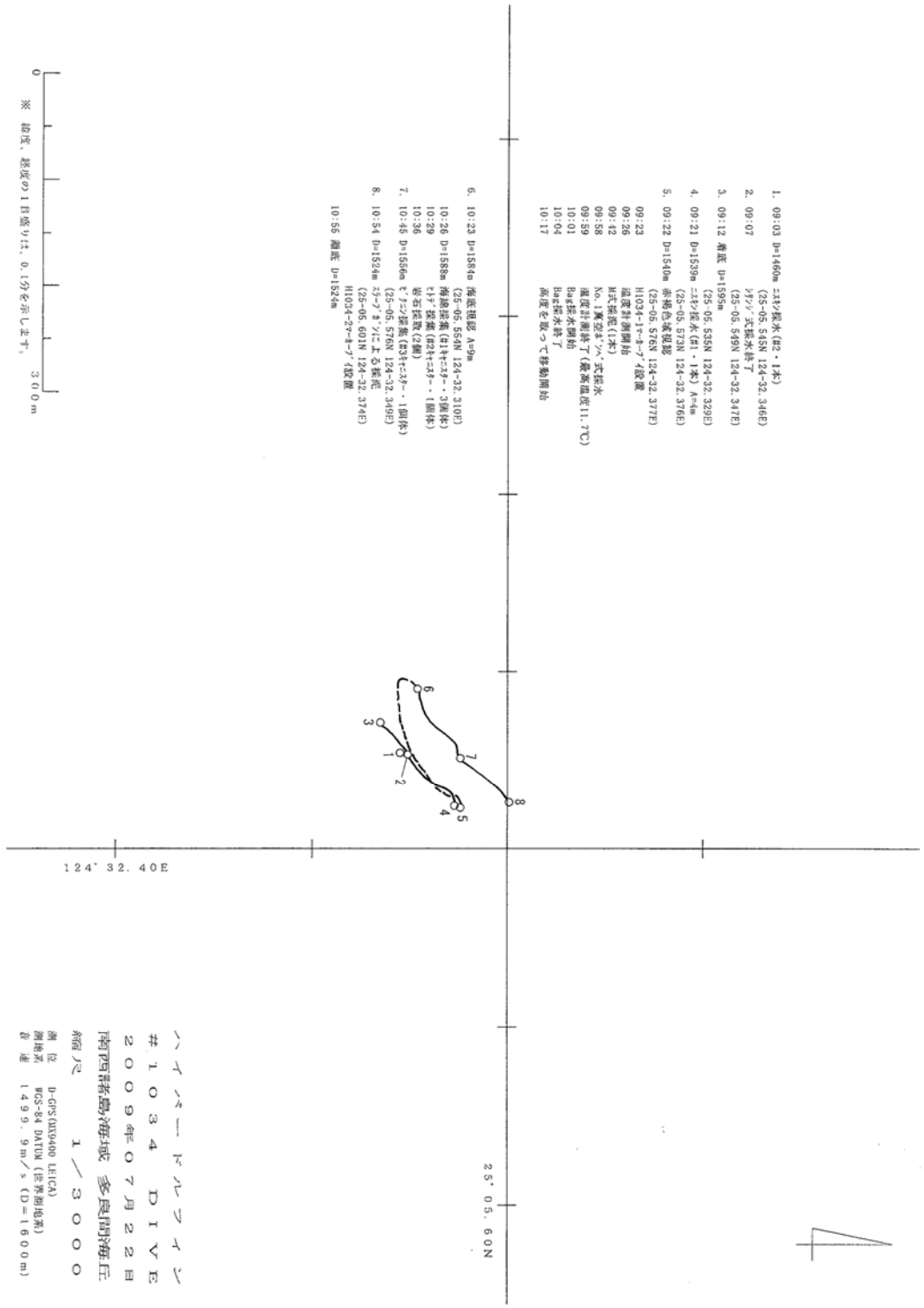
1) WHATS with a temperature probe
2) Vacuum bottle sampler
3) Bag pomp sampler (20L x 1)
4) Niskin bottles (2 bottles)
5) Suction sampler (multi canister)
6) Sample box x 2

7) Turbidity meter
8) M-type sediment sampler

Event List:

9:03 25°05.545'N, 124°32.346'E (D = 1460 m) Water sampling (Niskin bottle #2, Syringe-type)
9:12 25°05.535'N, 124°32.329'E (D = 1595 m) Landing on seafloor
9:21 25°05.535'N, 124°32.329'E (D = 1539 m) Water sampling (Niskin bottle #1)
9:22 25°05.576'N, 124°32.377'E (D = 1540 m) Red-brown sediment was found
9:23 *ditto* H1034-1 Marker buoy deployed
9:26 *ditto* Temperature measurement started
9:54 *ditto* Sediment sampling with M-type sampler
9:58 *ditto* Water sampling (WHATS #1)
9:59 *ditto* Temperature measurement finished
10:01 *ditto* Bag pump water sampling
10:26 25°05.554'N, 124°32.310'E (D = 1584 m) Sea sponge sampling (Suction sampler #1 canister)
10:29 *ditto* Animal sampling (Suction sampler #2 canister)
10:36 *ditto* Rock sampling (x 2)
10:45 25°05.576'N, 124°32.349'E (D = 1556 m) Animal sampling (Suction sampler #3 canister)
10:50 25°05.601'N, 124°32.374'E (D = 1522 m) Red-brown sediment was found
10:53 *ditto* (D = 1524 m) Sediment sampling (Suction sampler #4 canister)
10:55 *ditto* H1034-2 Marker buoy deployed
10:55 *ditto* Leaving bottom

Dive track:



ハイパードルフィン

＃１００３４　ＤＩＶＥ

２００９年０７月２２日

南西諸島海域 多良間海丘

縮尺　１／３０００

測位　D-GPS(DX3400 LEICA)
測地系　WGS-84 DATUM (世界測地系)
音速　1499.9m/s(D=1600m)

4. Notice on Using

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

This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for latest information.

Users of data or results on this cruise report are requested to submit their results to the Data Integration and Analysis Group (DIAG) of JAMSTEC.