doi : 10.17596/0003259

Cruise Report

NATSUSHIMA/Hyper-Dolphin NT08-15

Physiological adaptation of teleost fish to deep sea environments

and

Adaptation mechanisms for H_2S-rich environment in invertebrate animals colonized in deep sea hydrothermal vent

July 20 -25, 2008

Principal Investigator
Akihiro TAKEMURA

Tropical Biosphere Research Center, University of the Ryukyus

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

CONTENTS

1. OUTLINE OF THE CRUISE AND ACKNOWLEDGEMENTS

In this cruise (NT08-15), we visited Hatoma Knoll from 21-25 July, 2008. We had 4 dives of ROV/Hyper-Dolphin (Dive #875-878) on 22 and 23 July, 2008. This cruise included 2 research proposals (S08-23 and S08-51), which were proposed by Akihiro Takemura and Hideo Yamasaki, respectively. The researches were carried out based on the following purposes.

S08-23 by Akihiro Takemura

Organisms on the Earth adapt to changes in environments in habitat. For instance, the organisms in shallow waters utilize periodic changes in sunlight and entrain their activities to light-dark cycles at intervals of 24 hours. The organisms in deep sea, on the other hand, cannot utilize the benefit from the sun. To date, it is not unclear how the organisms adapted to deep sea adapt to such lightless environments and repeat their life cycles. The aim of the present study is to clarify the rhythmicity of fish in deep sea using physiological and molecular techniques.

S08-51 by Hideo Yamasaki

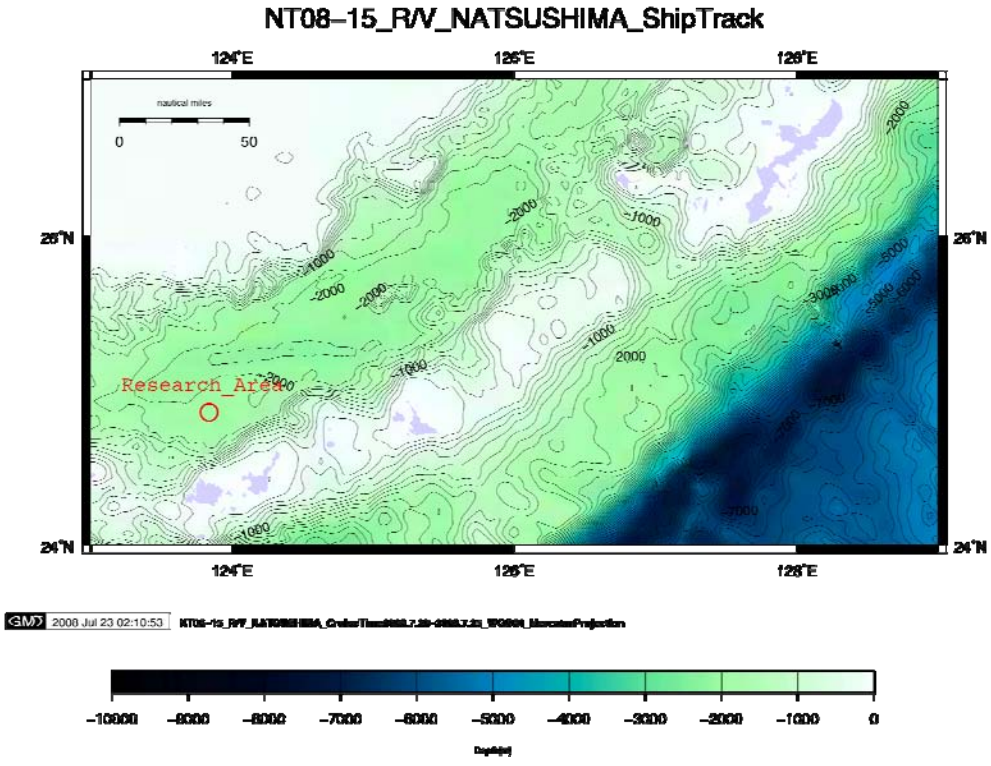
Deep-sea hydrothermal vents are one of the unique environments for living organisms. The ecosystems are not sustained by photosynthetic organisms that utilize solar light energy but by chemosynthetic bacteria that are capable of assimilating CO_2 in completely darkness. Hydrogen sulfide (H_2S) is a primary energy source for the chemosynthetic bacteria most of which have established symbiotic relationship with invertebrate animals. In general, H_2S is toxic for animals because the gas inhibits oxygenic respiration processes. It is therefore particular of interest how the invertebrate animals cope with such H_2S-rich environments. The aim of this project was to explore the adaptation mechanism for H_2S environments in the invertebrate animals inhabiting in deep-sea hydrothermal vents.

We would like to thank the clue of RV Natsushima and the operation team of ROV Hyper-Dolphin for their kind assistance with excellent techniques. We also appreciate JAMSTEC for providing us with this opportunity of deep-sea research and its stuff for helpful assistance. This research project was supported in part by the 21st Century Center of Excellence Program of the University of the Ryukyus from the Ministry of Education, Culture, Sports, Science and Technology, Japan.

2. Cruise Information

1) Cruise number/Ship name
   NT08-15/ RV Natsushima and ROV Hyper-Dolphin
2) Title of cruise
   “Hyper-Dolphin” Research Dive, Deep-sea Research, FY2008
3) Proposal number/ Title of proposal/ Representative of proposals
   S08-23/ Physiological adaptation of teleost fish to deep seaenvironments/ Akihiro TAKEMURA
   S08-51/ Adaptation mechanisms for H_2S-rich environment in invertebrate animals colonized in deep sea hydrothermal vent/ Hideo YAMASAKI
4) Cruise Period
   July 20, 2008 – July 25, 2008

5) Port Calls
   From Nahashinko Port (Okinawa, Japan) to Nago Port (Okinawa, Japan)
6) Investigation area

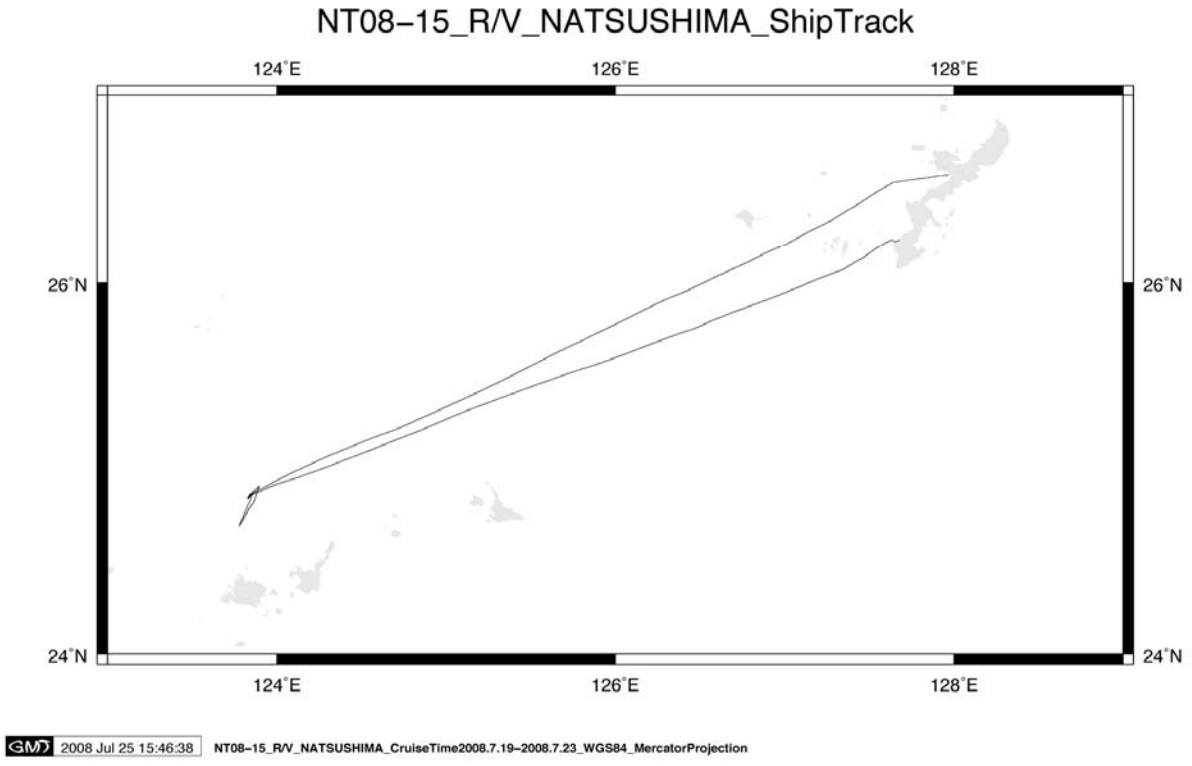


7) Dive list

Dive #	Observers*	Dive points	Keywords
875	A. Takemura	Hydrothermal vent field in caldera	Fish collection and observation of sea mount-specific organisms
876	H. Yamasaki	Hydrothermal vent field in caldera	Collection of invertebrates and observation of sea mount-specific organisms
877	A. Takemura	Hydrothermal vent field in caldera	Fish collection and observation of sea mount-specific organisms
878	H. Yamasaki	Hydrothermal vent field in caldera	Collection of invertebrates and observation of sea mount-specific organisms

*Author of dive report. Actually, observation was performed by multiple researchers in the control room on Natsushima through high-vision and CCD cameras equipped on ROV.

8) Track line chart of the vessel



3. Researchers

1) Chief Scientist

Akihiro TAKEMURA, Tropical Biosphere Research Center, University of the Ryukyus

2) Representative of Science Party

Akihiro TAKEMIRA (shown above)

Hideo YAMASAKI, Faculty of Science, University of the Ryukyus

3) Researchers participated in the cruise (except for the principal investigator and representatives of proposals

Hiroyuki YAMAMOTO
Extremobiosphere Research Center, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Tetsuya MIWA
Marine basic technology R&D Group, Advanced Marine Technology Research Program Marine Technology Center, JAMSTEC

Hiromi WATANABE
Extremobiosphere Research Center, JAMSTEC

James Davis REIMER
Faculty of Science, University of the Ryukyus

Yong-Ju PARK
Graduate School of Engineering and Science, University of the Ryukyus

Sayoko SHIMOYAMA
Graduate School of Engineering and Science, University of the Ryukyus

Jose BOUCHARD
Graduate School of Engineering and Science, University of the Ryukyus

Takayuki KAMIKI
Graduate School of Engineering and Science, University of the Ryukyus

Kaori YAMADA
Faculty of Science, University of the Ryukyus

Toshiyuki OKANO
Graduate School of Advanced Science and Engineering, Waseda University

Satoshi TAMOTSU
Graduate School of Humanities and Sciences, Nara Women’s University

Momoe MIZOBUCHI
Graduate School of Humanities and Sciences, Nara Women’s University

Keichi Sato

Churaumi Aquarium

4) Co-researchers who are members of the proposals

Hitomi ITHO
Graduate School of Engineering and Science, University of the Ryukyus
Yuki TAKEUCHI
Graduate School of Engineering and Science, University of the Ryukyus
Gaku TOKUDA
Center of Molecular Biosciences, University of the Ryukyus
Seitaro YAMAZAKI
Graduate School of Engineering and Science, University of the Ryukyus
Hideyuki IMAI
Faculty of Science, University of the Ryukyus
Kensuke IWAMOTO
Faculty of Science, University of the Ryukyus

4. Observation

This cruise included the following research projects. Our major purpose was to carry out physiological researches on RV using live animals from deep-sea

Physiological adaptation of teleost fish to deep-sea environments (HPD #875 and #877)

Organisms on the Earth adapt to changes in environments in habitat. For instance, the organisms in shallow waters utilize periodic changes in sunlight and entrain their activities to light-dark cycles at intervals of 24 hours. The organisms in deep sea, on the other hand, cannot utilize the benefit from the sun. To date, it is not unclear how the organisms adapted to deep sea adapt to such lightless environments and repeat their life cycles. The aim of the present study is to clarify the rhythmicity of fish in deep sea using physiological and molecular techniques. The fish were collected in deep aquarium and subjected to the following experiments on RV.

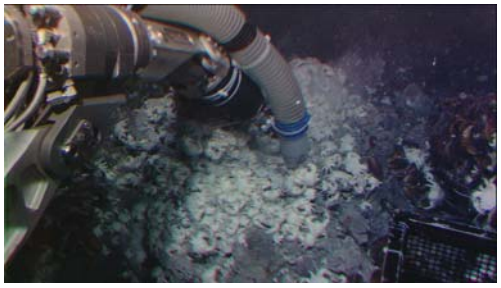
- The following experiments were carried out to demonstrate the histological and physiological characteristics of the retina in deep sea snail fish (Fig. 3). The retinal photoresponse was electrophysiologically studied. In order to investigate the histological features of the retinal ganglion cells, three eyes removed were incubated at about 4 ^{o}C in overnight after applying the neural tracer at the cut-end of the optic nerve and were fixed in 4% paraformaldehyde fixative. Two heads were fixed with 4% paraformaldehyde solution to study the projection site of the optic nerve in the brain.
- To assess the reproductive activities of the fish, their ovaries were cultured with precursor steroid hormones (testosterone and 17α-hydroxyprogesterone) for 24 hours at 4^{o}C. Productions of estradiol-17β and 17α,20β-dihydroxy-4-pregnen-3-one in the medium are measured with enzyme-linked immunorobent assay. The levels of these steroid hormones are compared with histological characteristics of ovarian conditions.
- Since sunlight does not reach to the deep sea, marine organisms living in the deep sea often lack the mechanisms for physiological responses in comparison with those living near the surface of the sea. In order to verify molecular mechanisms underlying this hypothesis, we obtained some organisms to try to explore their light responding systems. Now we are analyzing the obtained tissues by RT-PCR and cDNA cloning to identify genes encoding cryptochromes, photolyases, opsins and their related sequences. After identifying a gene for a photoreceptive molecule, we would like to examine its expression by in situ hybridization and/or immunoblot analysis.


Fish collection at Hatoma Knoll.

Adaptation mechanisms for H_2S-rich environment in invertebrate animals colonized in deep sea hydrothermal vent (HPD #876 and #878)

Deep-sea hydrothermal vents are one of the unique environments for living organisms. The ecosystems are not sustained by photosynthetic organisms that utilize solar light energy

but by chemosynthetic bacteria that are capable of assimilating CO_2 in completely darkness. Hydrogen sulfide (H_2S) is a primary energy source for the chemosynthetic bacteria most of which have established symbiotic relationship with invertebrate animals. In general, H_2S is toxic for animals because the gas inhibits oxygenic respiration processes. It is therefore particular of interest how the invertebrate animals cope with such H_2S-rich environments. The aim of this project was to explore the adaptation mechanism for H_2S environments in the invertebrate animals inhabiting in deep sea hydrothermal vents. We investigated physiological H_2S consumption activity of *Shinkaia crosnieri* that had been freshly collected from a deep sea hydrothermal vent at Hatoma Knoll.



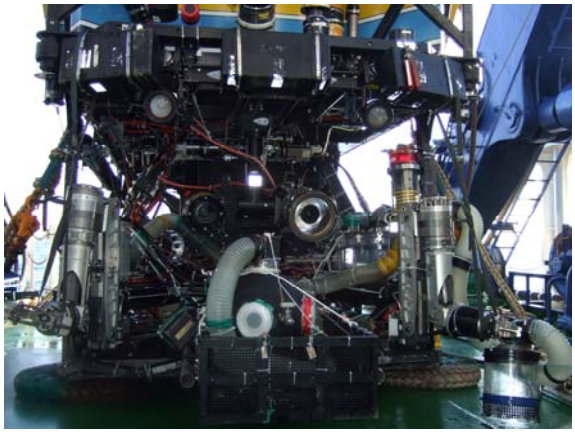
Collection of invertebrates at Hatoma Knoll.

- To assess H_2S consumption activity of *S. crosnieri*, we performed gas chromatography set on the RV Natushima with a sensitivity of ppb level. Producing H_2S artificially with the supplementation of Na_2S into seawater, we measured H_2S consumption kinetics of air space with or without the samples. The association of symbiotic bacteria in the activity was also tested.

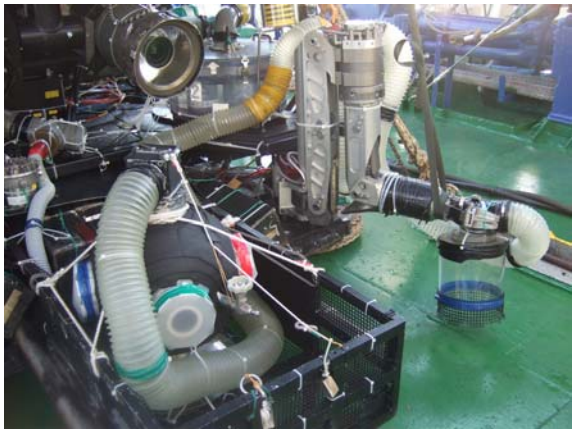
Hiroyuki Yamamoto and Hiromi Watanabe (JAMSTEC)

The following operations have been done in the dives of HPD #876 and #878 of NT08-15 Hatoma Knoll cruise: 1) collection of deep-sea larval plankton drifting on *Bathymodiolus platifrons* aggregations using the suction sampler with multiple canister system, 2) observation of the fauna in the white sediment area and the hydrothermal vent of #184-1M marker, and 3) recovery of in situ breeding cage settled in NT08-13 cruise by Yorisue of ORI, University of Tokyo.

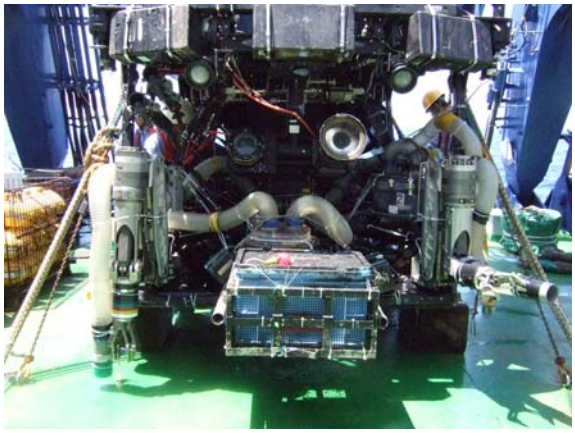
5. List of observation instruments



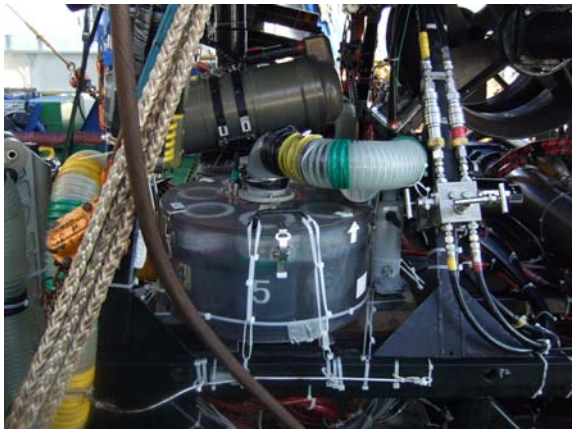
Deep-Aquarium loaded to Hyper-Dolphin.



Suction sampler and Deep-Aquarium loaded to Hyper-Dolphin.



Sample boxes



Suction sampler loaded to Hyper-Dolphin.

Dive Information (HPD #875)

ハイパードルフィン　潜航記録

平成 20 年　NT08-15　行動　　記載者　石塚 哲也

潜航年月日　2008/07/21
潜航回数　1回
通算潜航回数　875回

位置　作図中心位置
緯度　24° 51.500 ' N
経度　123° 50.500 ' E
WGS-84

潜航海域　鳩間海丘

潜航目的　調査潜航　「硬骨魚類における暗黒深海環境への生理的適応」

調査主任　竹村 明洋
ビークル指揮　光藤 数也

Pilot　石塚 哲也
Co. Pilot　竹ノ内 純

作業経過時刻	
吊揚	08:03
着水	08:06
潜航開始	08:17
着底	09:08
離底	12:07
浮上	12:48
揚収完了	13:01

累計時間		
潜航時間		4:31
通算潜航		4118:22
ケーブル	ケーブルNo.	3
	使用時間	4:58
	通算時間	2895:18

気象・海象

天候	風向	風力	風浪	うねり	視程
bc	S	3	2	1	7

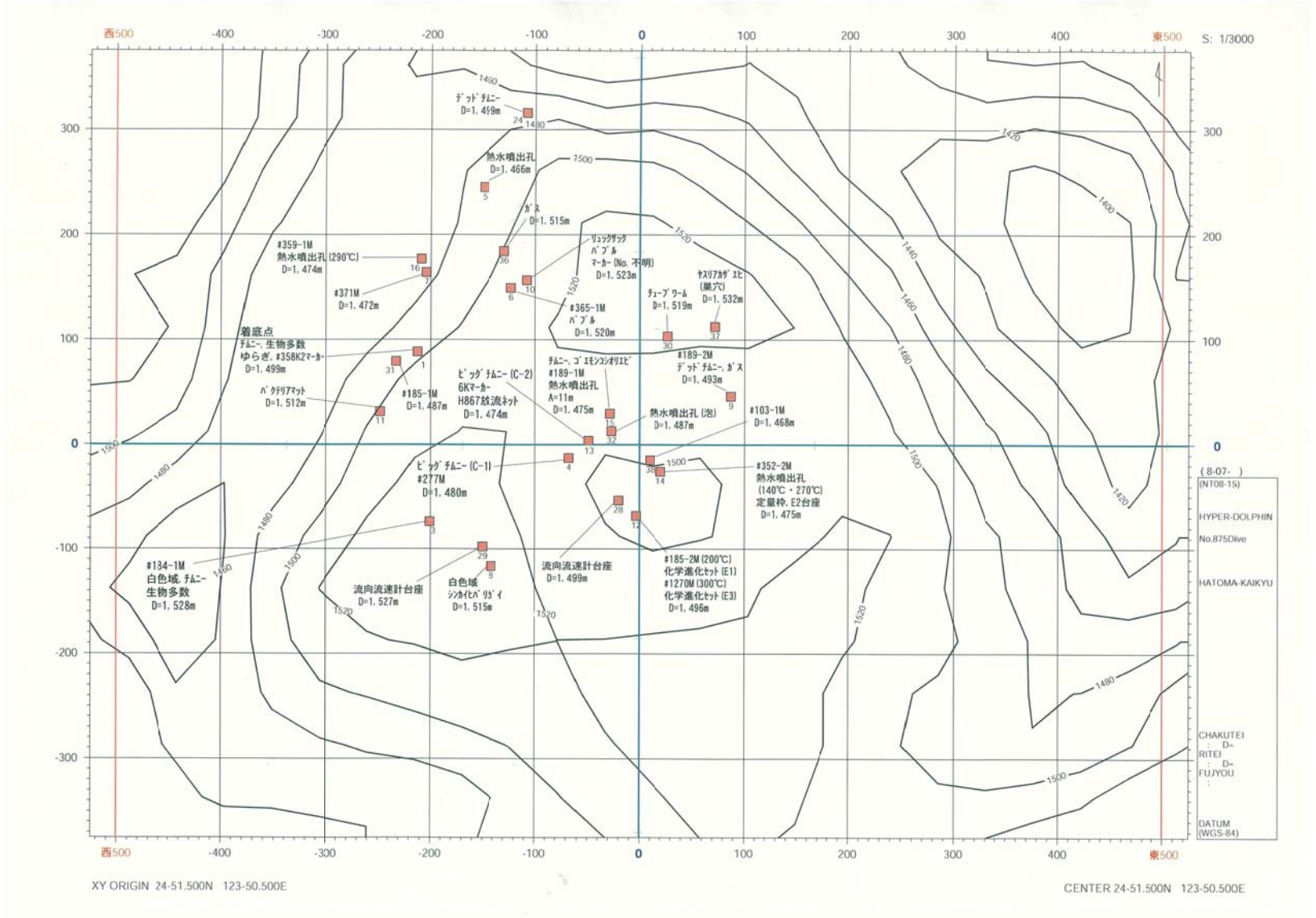
最大潜航深度　1513 m
着底深度　1513 m
着底底質　岩盤

離底深度　1455 m
離底底質　岩盤

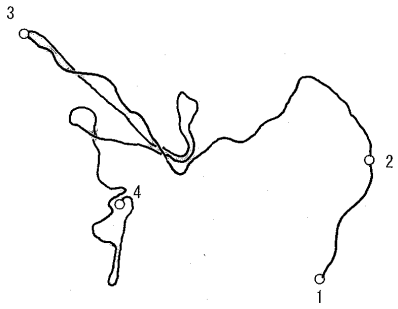
記事　海底を観察しながら航走し、生物採集を行った。

特　異　点				
	緯　度	経　度	深さ m	備　考
①	２４－５１．５４８Ｎ	１２３－５０．３７４Ｅ	1499 m	着底点 ﾁﾑﾆｰ、生物多数 ゆらぎ、#358K2ﾏｰｶｰ
③	２４－５１．４６０Ｎ	１２３－５０．３８１Ｅ	1528 m	#184-1M 白色域、ﾁﾑﾆｰ 生物多数
④	２４－５１．４９３Ｎ	１２３－５０．４６０Ｅ	1480 m	ﾋﾞｯｸﾞﾁﾑﾆｰ(C-1) #277M
⑤	２４－５１．６３３Ｎ	１２３－５０．４１２Ｅ	1466 m	熱水噴出孔
⑥	２４－５１．５８１Ｎ	１２３－５０．４２７Ｅ	1520 m	#365-1M、ﾊﾞﾌﾞﾙ
⑦	２４－５１．５８９Ｎ	１２３－５０．３７９Ｅ	1472 m	#371M
⑧	２４－５１．４３７Ｎ	１２３－５０．４１６Ｅ	1515 m	白色域 ｼﾝｶｲﾋﾊﾞﾘｶﾞｲ
⑨	２４－５１．５２５Ｎ	１２３－５０．５５２Ｅ	1493 m	#189-2M ﾃﾞｯﾄﾞﾁﾑﾆｰ、ｶﾞｽ
⑩	２４－５１．５８５Ｎ	１２３－５０．４３６Ｅ	1523 m	ﾘｭｯｸｻｯｸ、ﾊﾞﾌﾞﾙ ﾏｰｶｰ(No.不明)
⑪	２４－５１．５１７Ｎ	１２３－５０．３５３Ｅ	1512 m	ﾊﾞｸﾃﾘｱﾏｯﾄ
⑫	２４－５１．４６３Ｎ	１２３－５０．４９８Ｅ	1496 m	#185-2M(200℃) 化学進化ｾｯﾄ(E1) #1270M(300℃) 化学進化ｾｯﾄ(E3)
⑬	２４－５１．５０２Ｎ	１２３－５０．４７１Ｅ	1474 m	ﾋﾞｯｸﾞﾁﾑﾆｰ(C-2) 6Kﾏｰｶｰ H867放流ネット

特　異　点				
	緯　度	経　度	深さ m	備　考
⑭	２４－５１．４８６Ｎ	１２３－５０．５１２Ｅ	1475 m	#352-2M 熱水噴出孔 (140℃・270℃) 定量枠、E2台座
⑮	２４－５１．５１６Ｎ	１２３－５０．４８３Ｅ	1475 m	ﾁﾑﾆｰ、ｺﾞｴﾓﾝｺｼｵﾘｴﾋﾞ #189-1M, 熱水噴出孔 A=11m
⑯	２４－５１．５９６Ｎ	１２３－５０．３７６Ｅ	1474 m	#359-1M 熱水噴出孔(290℃)
24	２４－５１．６７１Ｎ	１２３－５０．４３６Ｅ	1499 m	ﾃﾞｯﾄﾞﾁﾑﾆｰ
28	２４－５１．４７１Ｎ	１２３－５０．４８８Ｅ	1499 m	流向流速計台座
29	２４－５１．４４７Ｎ	１２３－５０．４１１Ｅ	1527 m	流向流速計台座
30	２４－５１．５５６Ｎ	１２３－５０．５１６Ｅ	1519 m	ﾁｭｰﾌﾞﾜｰﾑ
31	２４－５１．５４３Ｎ	１２３－５０．３６２Ｅ	1487 m	#185-1M
32	２４－５１．５０７Ｎ	１２３－５０．４８４Ｅ	1487 m	熱水噴出孔(泡)
36	２４－５１．６００Ｎ	１２３－５０．４２３Ｅ	1515 m	ｶﾞｽ
37	２４－５１．５６１Ｎ	１２３－５０．５４３Ｅ	1532 m	ﾔｽﾘｱｶｻﾞｴﾋﾞ (巣穴)
38	２４－５１．４９２Ｎ	１２３－５０．５０６Ｅ	1468 m	#103-1M


西500
東500
S: 1/3000
デッドチムニー
D=1, 499m
熱水噴出孔
D=1, 466m
ガス
D=1, 515m
#359-1M
熱水噴出孔(290℃)
D=1, 474m
#371M
D=1, 472m
リュックサック
バブル
マーカー(No. 不明)
D=1, 523m
#365-1M
バブル
D=1, 520m
チューブワーム
D=1, 519m
ヤスリアカザエビ
(巣穴)
D=1, 532m
着底点
チムニー, 生物多数
ゆらぎ, #358K2マーカー
D=1, 499m
バクテリアマット
D=1, 512m
#185-1M
D=1, 487m
ビッグチムニー(C-2)
6Kマーカー
H867放流ネット
D=1, 474m
チムニー, ゴエモンコシオリエビ
#189-1M
熱水噴出孔
A=11m
D=1, 475m
#189-2M
デッドチムニー, ガス
D=1, 493m
熱水噴出孔(泡)
D=1, 487m
#103-1M
D=1, 468m
ビッグチムニー(C-1)
#277M
D=1, 480m
#352-2M
熱水噴出孔
(140℃・270℃)
定量枠, E2台座
D=1, 475m
#134-1M
白色域, チムニー
生物多数
D=1, 528m
流向流速計台座
D=1, 527m
白色域
シンカイヒバリガイ
D=1, 515m
流向流速計台座
D=1, 499m
#185-2M(200℃)
化学進化セット(E1)
#1270M(300℃)
化学進化セット(E3)
D=1, 496m
(8-07-)
(NT08-15)
HYPER-DOLPHIN
No.875Dive
HATOMA-KAIKYU
CHAKUTEI
: D=
RITEI
: D=
FUJYOU
:
DATUM
(WGS-84)
XY ORIGIN 24-51.500N 123-50.500E
CENTER 24-51.500N 123-50.500E

1. 09:08 着底 D=1513m
(24-51.526N 123-50.372E)
2. 09:20 D=1513m ﾋﾞｸﾆﾝ採集開始
(24-51.575N 123-50.394E)
3. 10:23 D=1507m
(24-51.626N 123-50.239E)
4. 12:07 D=1455m ﾋﾞｸﾆﾝ採集終了
(24-51.556N 123-50.282E)
12:07 離底 D=1455m



123° 50. 50E

24° 51. 50N

0 300m

※ 緯度、経度の１目盛りは、0.1分を示します。

ハイパードルフィン
＃８７５ ＤＩＶＥ
２００８年０７月２１日
鳩間海丘
縮尺 １／３０００

測 位 D-GPS(MX9400 LEICA)
測地系 WGS-84 DATUM（世界測地系）
音 速 １５００．３m／s（D＝１６００m）

Dive information (HPD #876)

ハイパードルフィン　潜航記録

平成 20 年　NT08-15　行動　　記載者　木戸 哲平

潜航年月日　2008/07/21
潜航回数　2回
通算潜航回数　876回

位置　作図中心位置
緯度　24° 51.500 ' N
経度　123° 50.500 ' E
WGS-84

潜航海域　鳩間海丘

潜航目的　調査潜航　「海底熱水噴出孔生物の硫化水素環境適応機構の解明」

調査主任　竹村 明洋
ビークル指揮　光藤 数也

Pilot　榊原 佑太
Co. Pilot　木戸 哲平

作業経過時刻	
吊揚	14:06
着水	14:10
潜航開始	14:22
着底	15:29
離底	16:25
浮上	17:05
揚収完了	17:18

累計時間		
潜航時間		2:43
通算潜航		4121:5
ケーブル	ケーブルNo.	3
	使用時間	3:12
	通算時間	2898:30

気象・海象

天候	風向	風力	風浪	うねり	視程
bc	SE	4	3	2	7

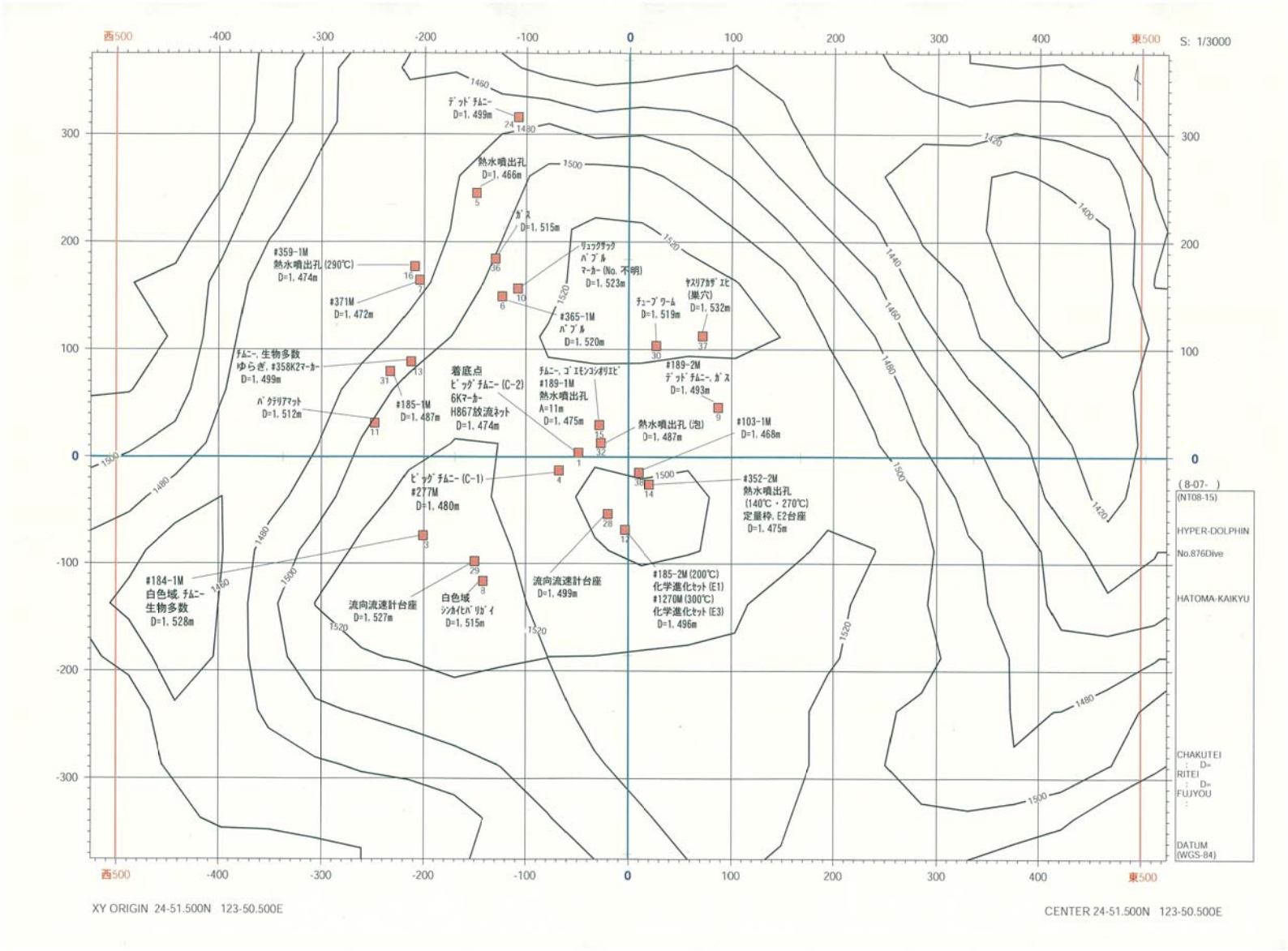
最大潜航深度　1476 m
着底深度　1476 m
着底底質　熱水鉱床

離底深度　1474 m
離底底質　熱水鉱床

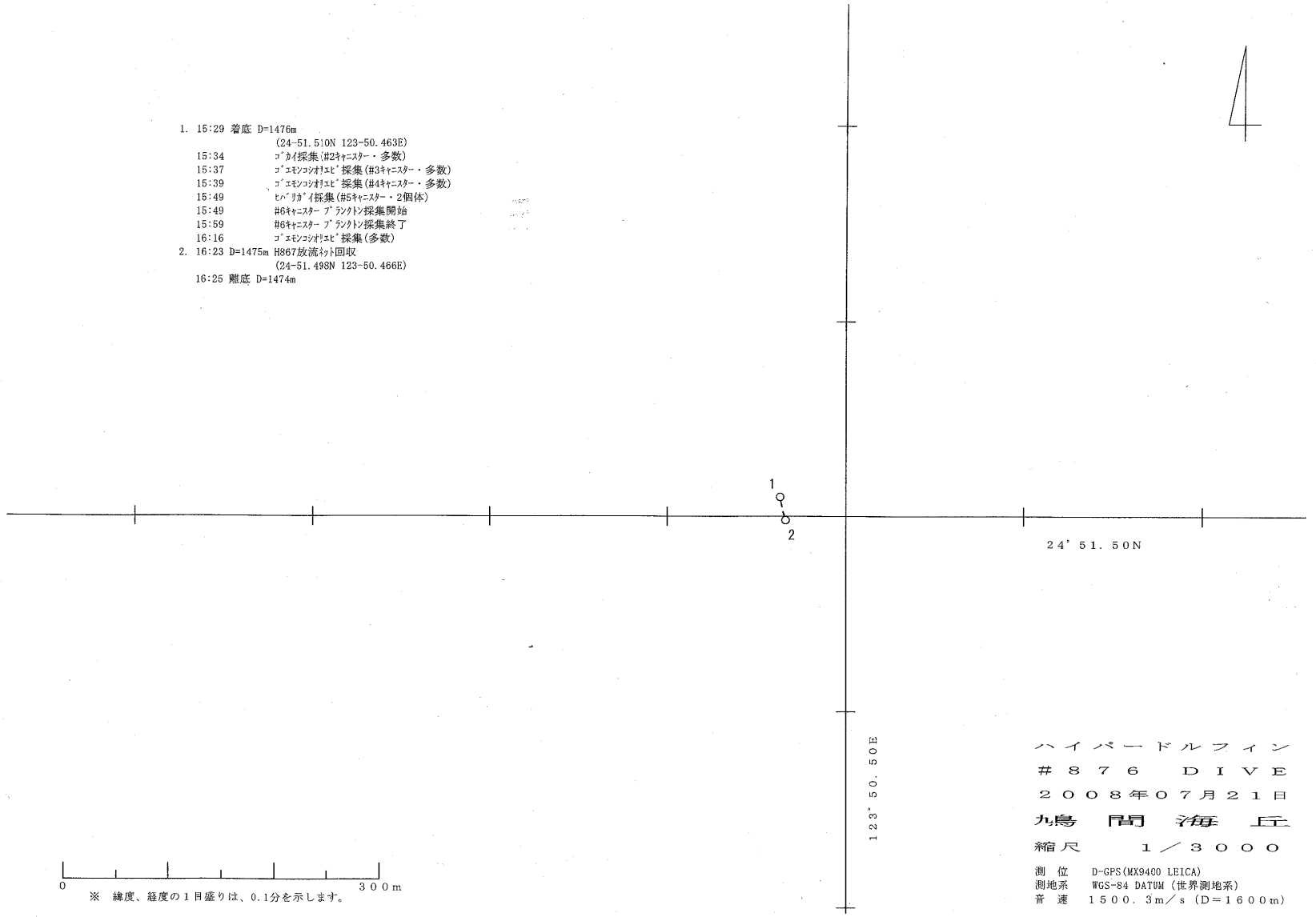
記事　海底を観察しながら航走し、生物採集を行った。

特　異　点				
	緯　度	経　度	深さ m	備　考
①	２４－５１．５０２Ｎ	１２３－５０．４７１Ｅ	1474 m	着底点 ﾋﾞｯｸﾞﾁﾑﾆｰ(C-2) 6Kﾏｰｶｰ H867放流ネット
③	２４－５１．４６０Ｎ	１２３－５０．３８１Ｅ	1528 m	#184-1M 白色域、ﾁﾑﾆｰ 生物多数
④	２４－５１．４９３Ｎ	１２３－５０．４６０Ｅ	1480 m	ﾋﾞｯｸﾞﾁﾑﾆｰ(C-1) #277M
⑤	２４－５１．６３３Ｎ	１２３－５０．４１２Ｅ	1466 m	熱水噴出孔
⑥	２４－５１．５８１Ｎ	１２３－５０．４２７Ｅ	1520 m	#365-1M、ﾊﾞﾌﾞﾙ
⑦	２４－５１．５８９Ｎ	１２３－５０．３７９Ｅ	1472 m	#371M
⑧	２４－５１．４３７Ｎ	１２３－５０．４１６Ｅ	1515 m	白色域 ｼﾝｶｲﾋﾊﾞﾘｶﾞｲ
⑨	２４－５１．５２５Ｎ	１２３－５０．５５２Ｅ	1493 m	#189-2M ﾃﾞｯﾄﾞﾁﾑﾆｰ、ｶﾞｽ
⑩	２４－５１．５８５Ｎ	１２３－５０．４３６Ｅ	1523 m	ﾘｭｯｸｻｯｸ、ﾊﾞﾌﾞﾙ ﾏｰｶｰ(No.不明)
⑪	２４－５１．５１７Ｎ	１２３－５０．３５３Ｅ	1512 m	ﾊﾞｸﾃﾘｱﾏｯﾄ
⑫	２４－５１．４６３Ｎ	１２３－５０．４９８Ｅ	1496 m	#185-2M(200℃) 化学進化ｾｯﾄ(E1) #1270M(300℃) 化学進化ｾｯﾄ(E3)
⑬	２４－５１．５４８Ｎ	１２３－５０．３７４Ｅ	1499 m	ﾁﾑﾆｰ、生物多数 ゆらぎ、#358K2ﾏｰｶｰ

特　異　点				
	緯　度	経　度	深さ m	備　考
⑭	２４－５１．４８６Ｎ	１２３－５０．５１２Ｅ	1475 m	#352-2M 熱水噴出孔 (140℃・270℃) 定量枠、E2台座
⑮	２４－５１．５１６Ｎ	１２３－５０．４８３Ｅ	1475 m	ﾁﾑﾆｰ、ｺﾞｴﾓﾝｺｼｵﾘｴﾋﾞ #189-1M, 熱水噴出孔 A=11m
⑯	２４－５１．５９６Ｎ	１２３－５０．３７６Ｅ	1474 m	#359-1M 熱水噴出孔(290℃)
24	２４－５１．６７１Ｎ	１２３－５０．４３６Ｅ	1499 m	ﾃﾞｯﾄﾞﾁﾑﾆｰ
28	２４－５１．４７１Ｎ	１２３－５０．４８８Ｅ	1499 m	流向流速計台座
29	２４－５１．４４７Ｎ	１２３－５０．４１１Ｅ	1527 m	流向流速計台座
30	２４－５１．５５６Ｎ	１２３－５０．５１６Ｅ	1519 m	ﾁｭｰﾌﾞﾜｰﾑ
31	２４－５１．５４３Ｎ	１２３－５０．３６２Ｅ	1487 m	#185-1M
32	２４－５１．５０７Ｎ	１２３－５０．４８４Ｅ	1487 m	熱水噴出孔(泡)
36	２４－５１．６００Ｎ	１２３－５０．４２３Ｅ	1515 m	ｶﾞｽ
37	２４－５１．５６１Ｎ	１２３－５０．５４３Ｅ	1532 m	ﾔｽﾘｱｶｻﾞｴﾋﾞ (巣穴)
38	２４－５１．４９２Ｎ	１２３－５０．５０６Ｅ	1468 m	#103-1M


西500
東500
S: 1/3000
デッドチムニー
D=1, 499m
熱水噴出孔
D=1, 466m
ガス
D=1, 515m
#359-1M
熱水噴出孔(290℃)
D=1, 474m
#371M
D=1, 472m
リュックサック
バブル
マーカー(No. 不明)
D=1, 523m
#365-1M
バブル
D=1, 520m
ヤスリアカザエビ
(巣穴)
D=1, 532m
チューブワーム
D=1, 519m
チムニー, 生物多数
ゆらぎ, #358K2マーカー
D=1, 499m
バクテリアマット
D=1, 512m
#185-1M
D=1, 487m
着底点
ビッグチムニー(C-2)
6Kマーカー
H867放流ネット
D=1, 474m
チムニー, ゴエモンコシオリエビ
#189-1M
熱水噴出孔
A=11m
D=1, 475m
#189-2M
デッドチムニー, ガス
D=1, 493m
熱水噴出孔(泡)
D=1, 487m
#103-1M
D=1, 468m
ビッグチムニー(C-1)
#277M
D=1, 480m
#352-2M
熱水噴出孔
(140℃・270℃)
定量枠, E2台座
D=1, 475m
#184-1M
白色域, チムニー
生物多数
D=1, 528m
流向流速計台座
D=1, 527m
白色域
シンカイヒバリガイ
D=1, 515m
流向流速計台座
D=1, 499m
#185-2M(200℃)
化学進化セット(E1)
#1270M(300℃)
化学進化セット(E3)
D=1, 496m
(8-07-)
(NT08-15)
HYPER-DOLPHIN
No.876Dive
HATOMA-KAIKYU
CHAKUTEI
: D=
RITEI
: D=
FUJYOU
:
DATUM
(WGS-84)
XY ORIGIN 24-51.500N 123-50.500E
CENTER 24-51.500N 123-50.500E

1. 15:29 着底 D=1476m
(24-51.510N 123-50.463E)
15:34 ｺﾞｶｲ採集(#2ｷｬﾆｽﾀｰ・多数)
15:37 ｺﾞｴﾓﾝｺｼｵﾘｴﾋﾞ採集(#3ｷｬﾆｽﾀｰ・多数)
15:39 ｺﾞｴﾓﾝｺｼｵﾘｴﾋﾞ採集(#4ｷｬﾆｽﾀｰ・多数)
15:49 ﾋﾊﾞﾘｶﾞｲ採集(#5ｷｬﾆｽﾀｰ・2個体)
15:49 #6ｷｬﾆｽﾀｰ ﾌﾟﾗﾝｸﾄﾝ採集開始
15:59 #6ｷｬﾆｽﾀｰ ﾌﾟﾗﾝｸﾄﾝ採集終了
16:16 ｺﾞｴﾓﾝｺｼｵﾘｴﾋﾞ採集(多数)
2. 16:23 D=1475m H867放流ﾈｯﾄ回収
(24-51.498N 123-50.466E)
16:25 離底 D=1474m



0 300m

※ 緯度、経度の１目盛りは、0.1分を示します。

ハイパードルフィン
＃８７６ ＤＩＶＥ
２００８年０７月２１日
九鳥間海丘
縮尺 １／３０００

測 位 D-GPS(MX9400 LEICA)
測地系 WGS-84 DATUM（世界測地系）
音 速 １５００．３m／s（D＝１６００m）

Dive information (HPD #877)

ハイパードルフィン　潜航記録

平成 20 年　NT08-15　行動　　記載者　榊原 佑太

潜航年月日　2008/07/22
潜航回数　3回
通算潜航回数　877回

位置　作図中心位置
緯度　24° 51.500 ' N
経度　123° 50.500 ' E
WGS-84

潜航海域　鳩間海丘

潜航目的　調査潜航　「硬骨魚類における暗黒深海環境への生理的適応」

調査主任　竹村 明洋
ビークル指揮　光藤 数也

Pilot　木戸 哲平
Co. Pilot　榊原 佑太

作業経過時刻	
吊　揚	08:00
着　水	08:03
潜航開始	08:13
着　底	09:04
離　底	10:12
浮　上	10:53
揚収完了	11:04

累計時間		
潜航時間		2:40
通算潜航		4123:45
ケーブル	ケーブルNo.	3
	使用時間	3:04
	通算時間	2901:34

気象・海象

天候	風向	風力	風浪	うねり	視程
b	SSW	3	2	1	7

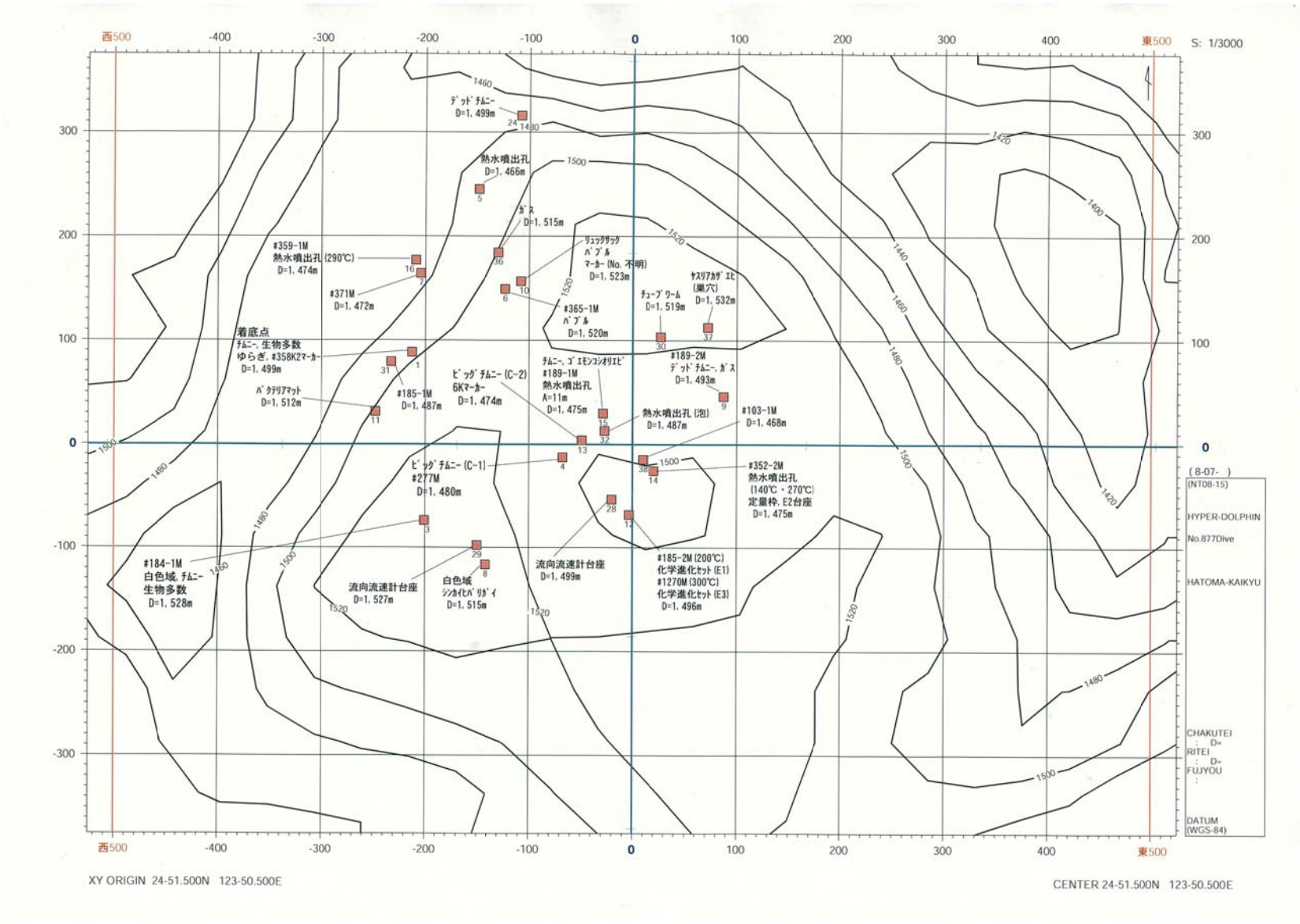
最大潜航深度　1527 m
着底深度　1527 m
着底底質　泥

離底深度　1458 m
離底底質　岩盤

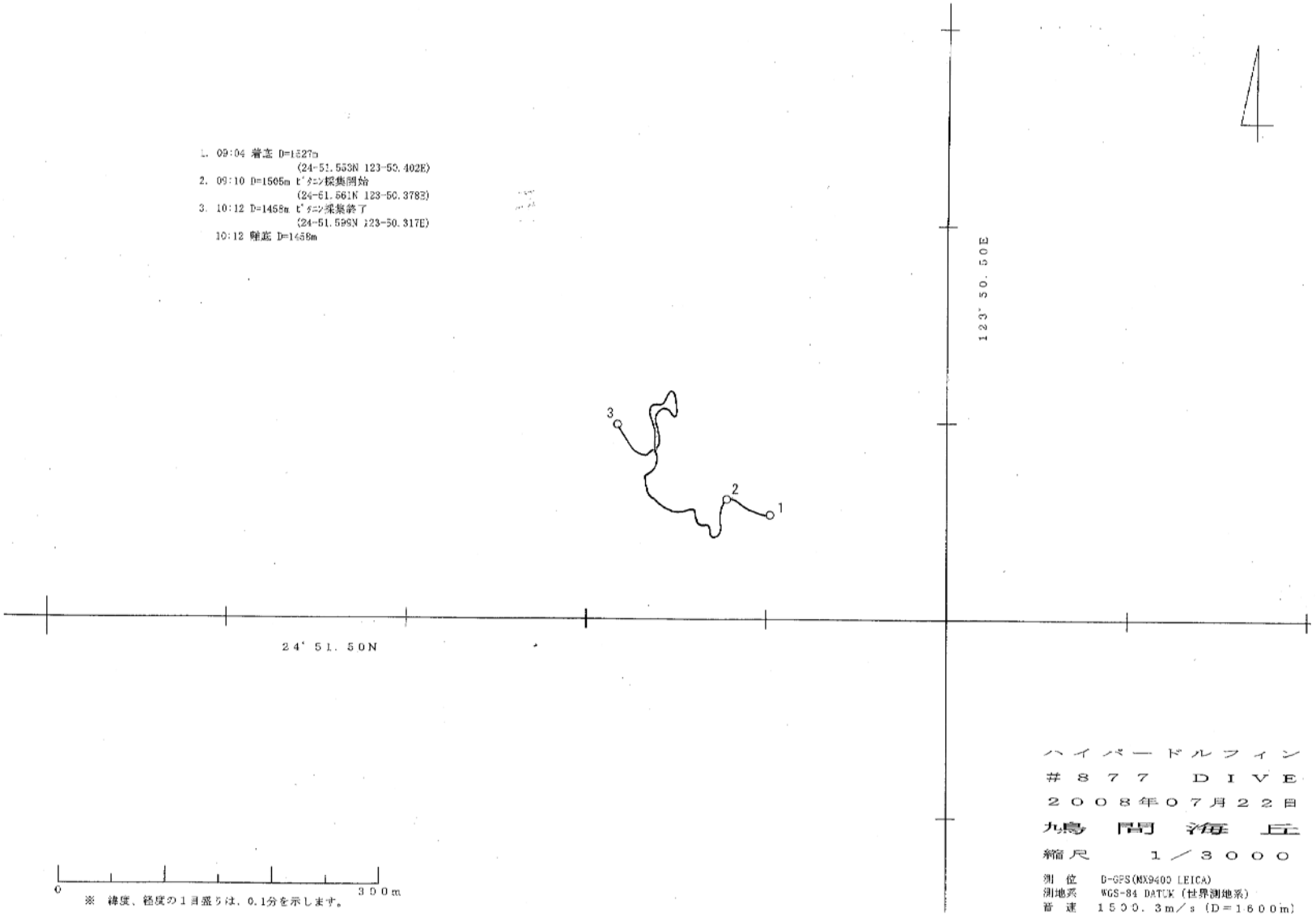
記事　海底を観察しながら航走し、生物採集を行った。

特　異　点				
	緯　度	経　度	深さ m	備　考
①	２４－５１．５４８Ｎ	１２３－５０．３７４Ｅ	1499 m	着底点 ﾁﾑﾆｰ、生物多数 ゆらぎ、#358K2ﾏｰｶｰ
③	２４－５１．４６０Ｎ	１２３－５０．３８１Ｅ	1528 m	#184-1M 白色域、ﾁﾑﾆｰ 生物多数
④	２４－５１．４９３Ｎ	１２３－５０．４６０Ｅ	1480 m	ﾋﾞｯｸﾞﾁﾑﾆｰ(C-1) #277M
⑤	２４－５１．６３３Ｎ	１２３－５０．４１２Ｅ	1466 m	熱水噴出孔
⑥	２４－５１．５８１Ｎ	１２３－５０．４２７Ｅ	1520 m	#365-1M、ﾊﾞﾌﾞﾙ
⑦	２４－５１．５８９Ｎ	１２３－５０．３７９Ｅ	1472 m	#371M
⑧	２４－５１．４３７Ｎ	１２３－５０．４１６Ｅ	1515 m	白色域 ｼﾝｶｲﾋﾊﾞﾘｶﾞｲ
⑨	２４－５１．５２５Ｎ	１２３－５０．５５２Ｅ	1493 m	#189-2M ﾃﾞｯﾄﾞﾁﾑﾆｰ、ｶﾞｽ
⑩	２４－５１．５８５Ｎ	１２３－５０．４３６Ｅ	1523 m	ﾘｭｯｸｻｯｸ、ﾊﾞﾌﾞﾙ ﾏｰｶｰ(No.不明)
⑪	２４－５１．５１７Ｎ	１２３－５０．３５３Ｅ	1512 m	ﾊﾞｸﾃﾘｱﾏｯﾄ
⑫	２４－５１．４６３Ｎ	１２３－５０．４９８Ｅ	1496 m	#185-2M(200℃) 化学進化ｾｯﾄ(E1) #1270M(300℃) 化学進化ｾｯﾄ(E3)
⑬	２４－５１．５０２Ｎ	１２３－５０．４７１Ｅ	1474 m	ﾋﾞｯｸﾞﾁﾑﾆｰ(C-2) 6Kﾏｰｶｰ

特　異　点				
	緯　度	経　度	深さ m	備　考
⑭	２４－５１．４８６Ｎ	１２３－５０．５１２Ｅ	1475 m	#352-2M 熱水噴出孔 (140℃・270℃) 定量枠、E2台座
⑮	２４－５１．５１６Ｎ	１２３－５０．４８３Ｅ	1475 m	ﾁﾑﾆｰ、ｺﾞｴﾓﾝｺｼｵﾘｴﾋﾞ #189-1M, 熱水噴出孔 A=11m
⑯	２４－５１．５９６Ｎ	１２３－５０．３７６Ｅ	1474 m	#359-1M 熱水噴出孔(290℃)
24	２４－５１．６７１Ｎ	１２３－５０．４３６Ｅ	1499 m	ﾃﾞｯﾄﾞﾁﾑﾆｰ
28	２４－５１．４７１Ｎ	１２３－５０．４８８Ｅ	1499 m	流向流速計台座
29	２４－５１．４４７Ｎ	１２３－５０．４１１Ｅ	1527 m	流向流速計台座
30	２４－５１．５５６Ｎ	１２３－５０．５１６Ｅ	1519 m	ﾁｭｰﾌﾞﾜｰﾑ
31	２４－５１．５４３Ｎ	１２３－５０．３６２Ｅ	1487 m	#185-1M
32	２４－５１．５０７Ｎ	１２３－５０．４８４Ｅ	1487 m	熱水噴出孔(泡)
36	２４－５１．６００Ｎ	１２３－５０．４２３Ｅ	1515 m	ｶﾞｽ
37	２４－５１．５６１Ｎ	１２３－５０．５４３Ｅ	1532 m	ﾔｽﾘｱｶｻﾞｴﾋﾞ (巣穴)
38	２４－５１．４９２Ｎ	１２３－５０．５０６Ｅ	1468 m	#103-1M


西500
-400
-300
-200
-100
0
100
200
300
400
東500
S: 1/3000
デッドチムニー
D=1, 499m
熱水噴出孔
D=1, 466m
ガス
D=1, 515m
#359-1M
熱水噴出孔 (290℃)
D=1, 474m
#371M
D=1, 472m
着底点
チムニー, 生物多数
ゆらぎ, #358K2マーカー
D=1, 499m
バクテリアマット
D=1, 512m
#185-1M
D=1, 487m
ビッグチムニー (C-2)
6Kマーカー
D=1, 474m
リュックサック
バブル
マーカー (No. 不明)
D=1, 523m
#365-1M
バブル
D=1, 520m
チムニー, ゴエモンコシオリエビ
#189-1M
熱水噴出孔
A=11m
D=1, 475m
チューブワーム
D=1, 519m
ヤスリアカザエビ
(巣穴)
D=1, 532m
#189-2M
デッドチムニー, ガス
D=1, 493m
熱水噴出孔 (泡)
D=1, 487m
#103-1M
D=1, 468m
ビッグチムニー (C-1)
#277M
D=1, 480m
#352-2M
熱水噴出孔
(140℃・270℃)
定量枠, E2台座
D=1, 475m
#184-1M
白色域, チムニー
生物多数
D=1, 528m
流向流速計台座
D=1, 527m
白色域
シンカイヒバリガイ
D=1, 515m
流向流速計台座
D=1, 499m
#185-2M (200℃)
化学遮化セット (E1)
#1270M (300℃)
化学遮化セット (E3)
D=1, 496m
(8-07-)
(NT08-15)
HYPER-DOLPHIN
No.877Dive
HATOMA-KAIKYU
CHAKUTEI : D=
RITEI : D=
FUJYOU :
DATUM
(WGS-84)
XY ORIGIN 24-51.500N 123-50.500E
CENTER 24-51.500N 123-50.500E

1. 09:04 着底 D=1527m
(24-51.553N 123-50.402E)
2. 09:10 D=1505m ﾋﾞﾀﾞﾝ採集開始
(24-51.561N 123-50.378E)
3. 10:12 D=1458m ﾋﾞﾀﾞﾝ採集終了
(24-51.599N 123-50.317E)
10:12 離底 D=1458m



0 300m
※ 緯度、経度の１目盛りは、0.1分を示します。

ハイパードルフィン
＃８７７ ＤＩＶＥ
２００８年０７月２２日
鳩間海丘
縮尺 １／３０００
測位 D-GPS(MX9400 LEICA)
測地系 WGS-84 DATUM (世界測地系)
音速 1500.3m／s (D＝1600m)

Dive information (HPD #878)

ハイパードルフィン　潜航記録

平成 20 年　NT08-15　行動　　記載者　石塚 哲也

潜航年月日　2008/07/22
潜航回数　4回
通算潜航回数　878回

位置　作図中心位置
緯度　24° 51.500 ' N
経度　123° 50.500 ' E
WGS-84

潜航海域　鳩間海丘

潜航目的　調査潜航　「海底熱水噴出孔生物の硫化水素環境適応機構の解明」

調査主任　竹村 明洋
ビークル指揮　光藤 数也

Pilot　竹ノ内 純
Co. Pilot　石塚 哲也

作業経過時刻	
吊揚	12:32
着水	12:36
潜航開始	12:46
着底	13:53
離底	15:48
浮上	16:29
揚収完了	16:40

累計時間		
潜航時間		3:43
通算潜航		4127:28
ケーブル	ケーブルNo.	3
	使用時間	4:08
	通算時間	2905:42

気象・海象

天候	風向	風力	風浪	うねり	視程
bc	WSW	2	1	1	7

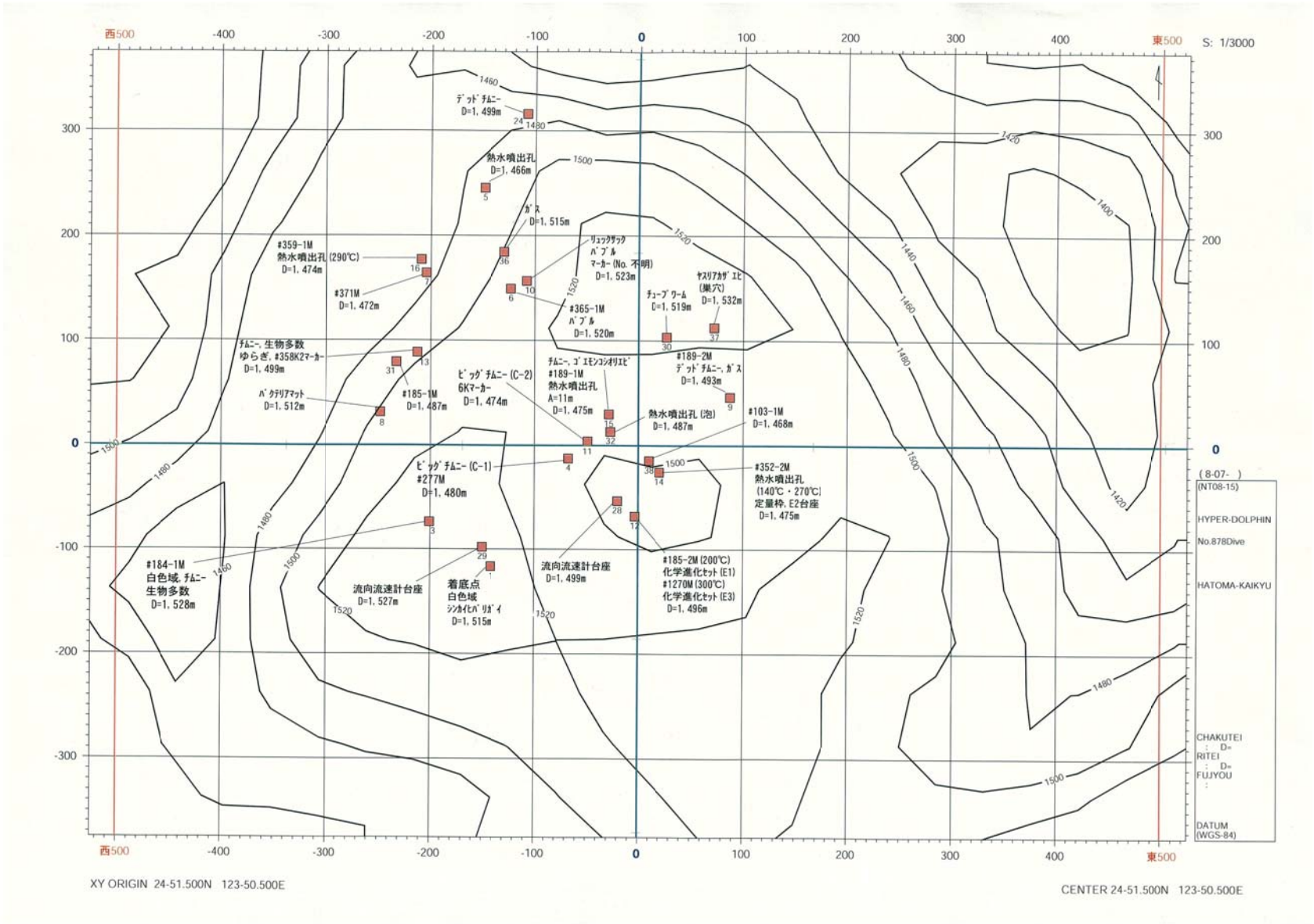
最大潜航深度　1528 m
着底深度　1518 m
着底底質　岩盤

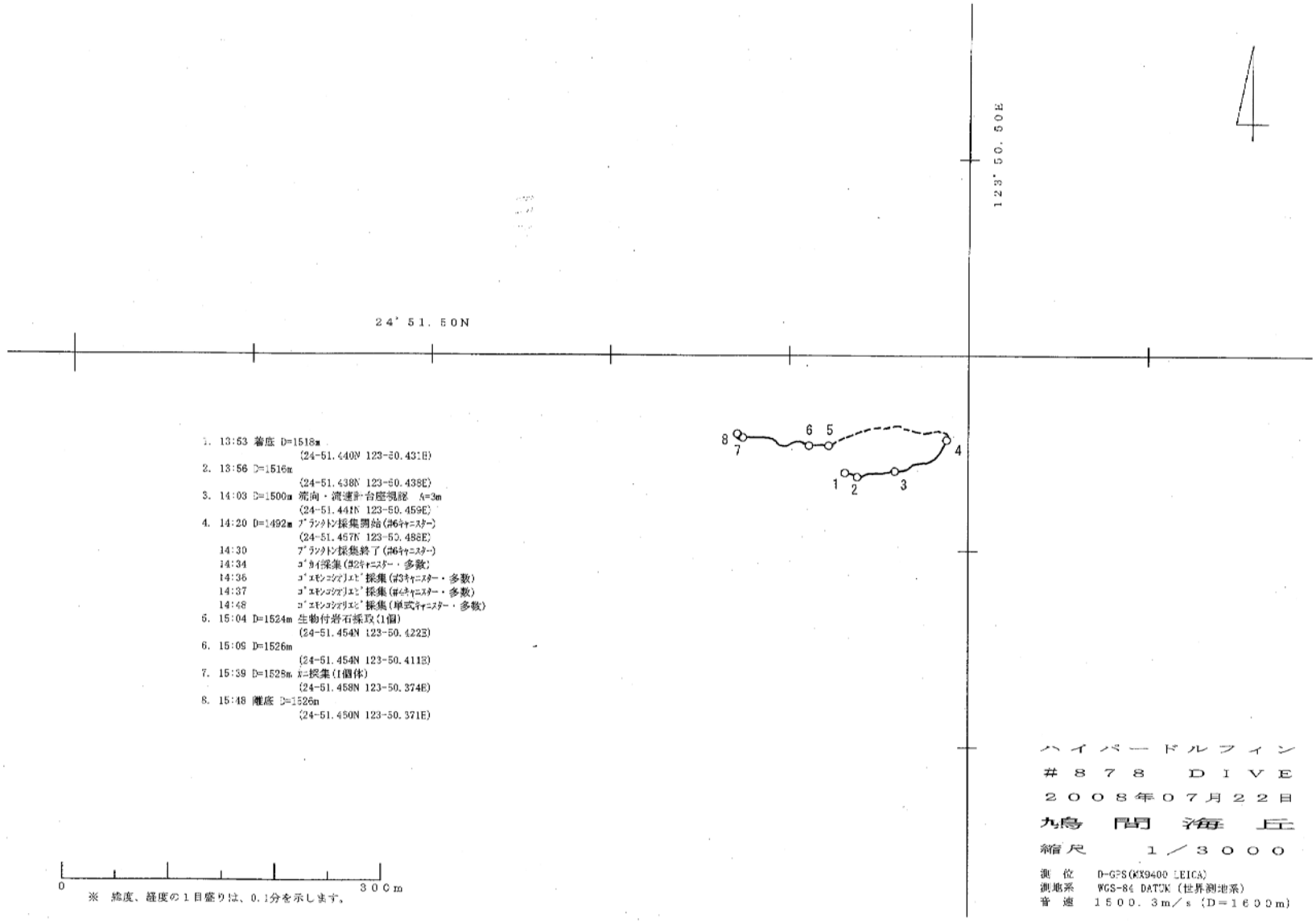
離底深度　1526 m
離底底質　岩盤

記事　海底を観察しながら航走し、生物採集を行った。

特　異　点				
	緯　度	経　度	深さ m	備　考
①	２４－５１．４３７Ｎ	１２３－５０．４１６Ｅ	1515 m	着底点 白色域 ｼﾝｶｲﾋﾊﾞﾘｶﾞｲ
③	２４－５１．４６０Ｎ	１２３－５０．３８１Ｅ	1528 m	#184-1M 白色域、ﾁﾑﾆｰ 生物多数
④	２４－５１．４９３Ｎ	１２３－５０．４６０Ｅ	1480 m	ﾋﾞｯｸﾞﾁﾑﾆｰ(C-1) #277M
⑤	２４－５１．６３３Ｎ	１２３－５０．４１２Ｅ	1466 m	熱水噴出孔
⑥	２４－５１．５８１Ｎ	１２３－５０．４２７Ｅ	1520 m	#365-1M、ﾊﾞﾌﾞﾙ
⑦	２４－５１．５８９Ｎ	１２３－５０．３７９Ｅ	1472 m	#371M
⑧	２４－５１．５１７Ｎ	１２３－５０．３５３Ｅ	1512 m	ﾊﾞｸﾃﾘｱﾏｯﾄ
⑨	２４－５１．５２５Ｎ	１２３－５０．５５２Ｅ	1493 m	#189-2M ﾃﾞｯﾄﾞﾁﾑﾆｰ、ｶﾞｽ
⑩	２４－５１．５８５Ｎ	１２３－５０．４３６Ｅ	1523 m	ﾘｭｯｸｻｯｸ、ﾊﾞﾌﾞﾙ ﾏｰｶｰ(No.不明)
⑪	２４－５１．５０２Ｎ	１２３－５０．４７１Ｅ	1474 m	ﾋﾞｯｸﾞﾁﾑﾆｰ(C-2) 6Kﾏｰｶｰ
⑫	２４－５１．４６３Ｎ	１２３－５０．４９８Ｅ	1496 m	#185-2M(200℃) 化学進化ｾｯﾄ(E1) #1270M(300℃) 化学進化ｾｯﾄ(E3)
⑬	２４－５１．５４８Ｎ	１２３－５０．３７４Ｅ	1499 m	ﾁﾑﾆｰ、生物多数 ゆらぎ、#358K2ﾏｰｶｰ

特　異　点				
	緯　度	経　度	深さ m	備　考
⑭	２４－５１．４８６Ｎ	１２３－５０．５１２Ｅ	1475 m	#352-2M 熱水噴出孔 (140℃・270℃) 定量枠、E2台座
⑮	２４－５１．５１６Ｎ	１２３－５０．４８３Ｅ	1475 m	ﾁﾑﾆｰ、ｺﾞｴﾓﾝｺｼｵﾘｴﾋﾞ #189-1M, 熱水噴出孔 A=11m
⑯	２４－５１．５９６Ｎ	１２３－５０．３７６Ｅ	1474 m	#359-1M 熱水噴出孔(290℃)
24	２４－５１．６７１Ｎ	１２３－５０．４３６Ｅ	1499 m	ﾃﾞｯﾄﾞﾁﾑﾆｰ
28	２４－５１．４７１Ｎ	１２３－５０．４８８Ｅ	1499 m	流向流速計台座
29	２４－５１．４４７Ｎ	１２３－５０．４１１Ｅ	1527 m	流向流速計台座
30	２４－５１．５５６Ｎ	１２３－５０．５１６Ｅ	1519 m	ﾁｭｰﾌﾞﾜｰﾑ
31	２４－５１．５４３Ｎ	１２３－５０．３６２Ｅ	1487 m	#185-1M
32	２４－５１．５０７Ｎ	１２３－５０．４８４Ｅ	1487 m	熱水噴出孔(泡)
36	２４－５１．６００Ｎ	１２３－５０．４２３Ｅ	1515 m	ｶﾞｽ
37	２４－５１．５６１Ｎ	１２３－５０．５４３Ｅ	1532 m	ﾔｽﾘｱｶｻﾞｴﾋﾞ (巣穴)
38	２４－５１．４９２Ｎ	１２３－５０．５０６Ｅ	1468 m	#103-1M


西500
-400
-300
-200
-100
0
100
200
300
400
東500
S: 1/3000
デッドチムニー
D=1, 499m
熱水噴出孔
D=1, 466m
ガス
D=1, 515m
#359-1M
熱水噴出孔 (290℃)
D=1, 474m
#371M
D=1, 472m
リュックサック
バブル
マーカー (No. 不明)
D=1, 523m
#365-1M
バブル
D=1, 520m
チューブワーム
D=1, 519m
ヤスリアカザエビ
(巣穴)
D=1, 532m
チムニー, 生物多数
ゆらぎ, #358Kマーカー
D=1, 499m
バクテリアマット
D=1, 512m
#185-1M
D=1, 487m
ビックチムニー (C-2)
6Kマーカー
D=1, 474m
チムニー, ゴエモンコシオリエビ
#189-1M
熱水噴出孔
A=11m
D=1, 475m
#189-2M
デッドチムニー, ガス
D=1, 493m
熱水噴出孔 (泡)
D=1, 487m
#103-1M
D=1, 468m
ビックチムニー (C-1)
#277M
D=1, 480m
#352-2M
熱水噴出孔
(140℃・270℃)
定量枠, E2台座
D=1, 475m
#184-1M
白色域, チムニー
生物多数
D=1, 528m
流向流速計台座
D=1, 527m
着底点
白色域
シンカイヒバリガイ
D=1, 515m
流向流速計台座
D=1, 499m
#185-2M (200℃)
化学進化セット (E1)
#1270M (300℃)
化学進化セット (E3)
D=1, 496m
(8-07-)
(NT08-15)
HYPER-DOLPHIN
No.878Dive
HATOMA-KAIKYU
CHAKUTEI
: D=
RITEI
: D=
FUJYOU
:
DATUM
(WGS-84)
XY ORIGIN 24-51.500N 123-50.500E
CENTER 24-51.500N 123-50.500E



1. 13:53 着底 D=1518m
   (24-51.440N 123-50.431E)
2. 13:56 D=1516m
   (24-51.438N 123-50.438E)
3. 14:03 D=1500m 流向・流速計・台座視認 h=3m
   (24-51.441N 123-50.459E)
4. 14:20 D=1492m ﾌﾟﾗﾝｸﾄﾝ採集開始(#6ｷｬﾆｽﾀｰ)
   (24-51.457N 123-50.488E)
   14:30 ﾌﾟﾗﾝｸﾄﾝ採集終了(#6ｷｬﾆｽﾀｰ)
   14:34 ｺﾞｶｲ採集(#2ｷｬﾆｽﾀｰ・多数)
   14:36 ｺﾞｴﾓﾝｺｼｱﾘｴﾋﾞ採集(#3ｷｬﾆｽﾀｰ・多数)
   14:37 ｺﾞｴﾓﾝｺｼｱﾘｴﾋﾞ採集(#4ｷｬﾆｽﾀｰ・多数)
   14:48 ｺﾞｴﾓﾝｺｼｱﾘｴﾋﾞ採集(単式ｷｬﾆｽﾀｰ・多数)
5. 15:04 D=1524m 生物付岩石採取(1個)
   (24-51.454N 123-50.422E)
6. 15:09 D=1526m
   (24-51.454N 123-50.411E)
7. 15:39 D=1528m ｴﾋﾞ採集(1個体)
   (24-51.458N 123-50.374E)
8. 15:48 離底 D=1526m
   (24-51.450N 123-50.371E)

0 300m

※ 緯度、経度の１目盛りは、0.1分を示します。

ハイパードルフィン
＃８７８　ＤＩＶＥ
２００８年０７月２２日
鳩間海丘
縮尺　１／３０００

測位　D-GPS(MX9400 LEICA)
測地系　WGS-84 DATUM (世界測地系)
音速　１５００．３m／s (D＝１６００m)

7. Notice on Using

"This cruise report is a preliminary documentation as of the end of the cruise. It may not be corrected even if changes on content (i.e. taxonomic classifications) are found after publication. It may also be changed without notice. Data on the cruise report may be raw or not processed. Please ask the Chief Scientist for the latest information before using.

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