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Yokosuka Cruise Report

YK10-10

Shinkai6500 exploration and OBEM/OBS deployment Cruise in the southern Mariana Trough

Are there HyperSLiMEs in the subseafloor on basaltic hydrothermal field?

Direct verification of subseafloor microbial ecosystem utilizing high temperature torelance biosampler.

Southern Mariana Trough back-arc spreading system with three different hydrothermal activities

August 17, JAMSTEC – August 31, Guam, 2010

Japan Agency for Marine-Earth Science & Technology

(JAMSTEC)

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T. Sakurai	S. Susami

Acknowledgements

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Finally, we would like to appreciate all the people who supported directly or indirectly this cruise.

Contents

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2st Submarsible Staff	Fumitaka Saito
3rd Submarsible Staff	Yudai Tayama
3rd Submarsible Staff	Hitomi Ikeda
3rd Submarsible Staff	Masaya Katagiri

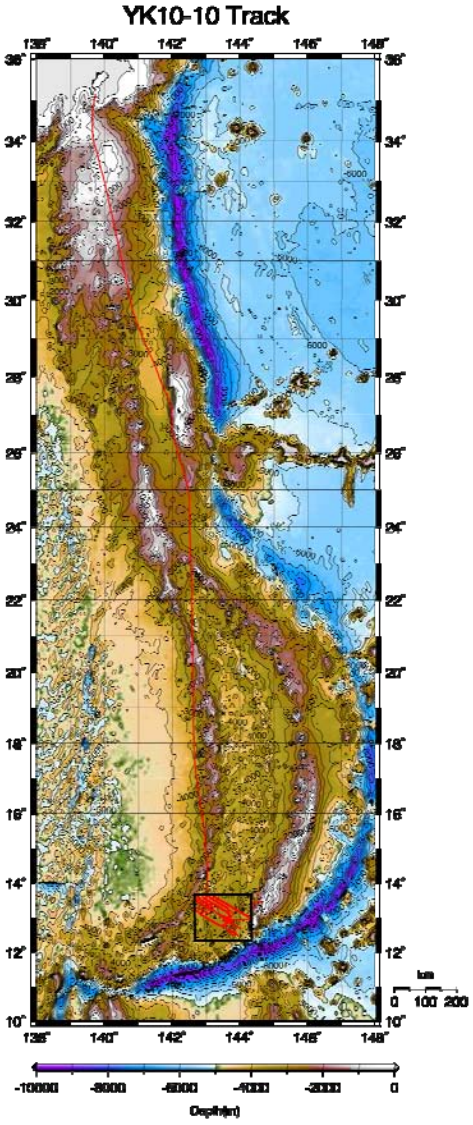
Shipboard Log of YK10-10

Actual schedule (YK10-10 10/08/17 - 10/08/30)				Position/Weather/Wind/Sea condition (Noon)
Date	Time	Description	Remark	
17, Aug, 2010	13:30	departure from JAMSTEC		8/17 12:00(JST)
	14:00 -15:30	scientific meeting, on board education	for safety YOKOSUKA life	JAMSTEC
	16:40	pray safety for KONPIRASAN		
18, Aug, 2010	9:00 -10:00	on board meeting	for research schedule	8/18 12:00(JST)
				29-34.0N, 140-52.3E
				fine but cloudy
				NNE-3(Gentle breeze)
19, Aug, 2010				8/19 12:00(JST)
				23-31.0N, 142-31.8E
				fine but cloudy
				SSE-4(Moderate breeze)
20, Aug, 2010	0:00	put ship's clocks ahead 1hour		8/20 12:00(JST+1h)
	9:00 -11:00	on board seminor		17-27.0N, 142-41.8E
				fine but cloudy
				E-4(Moderate breeze)
21, Aug, 2010	4:30	arrived at research area		8/21 12:00(JST+1h)
	6:13	deployed OBEM(site EM1)		12-53.5N, 143-41.3E
	7:42	deployed OBEM(site EM2S1)		rain
	7:48	deployed OBS(site EM2S1)		E-4(Moderate breeze)
	8:45	deployed OBEM(site EM3S2)		
	8:48	deployed OBS(site EM3S2)		
	9:40	deployed OBEM(site EM4S3)		
	9:46	deployed OBS(site EM4S3)		
	10:40	deployed OBEM(site EM5S4)		
	10:48	deployed OBS(site EM5S4)		
	11:41	deployed OBEM(site EM8S8)		
	11:44	deployed OBS(site EM8S8)		
	13:34	deployed OBEM(site EM9S9)		
	13:37	deployed OBS(site EM9S9)		
	14:29	deployed OBEM(site EM10S10)		
	14:32	deployed OBS(site EM10S10)		
	15:30	deployed OBEM(site EM11S11)		
	15:34	deployed OBS(site EM11S11)		
	15:40 -17:19	carried out calibration for OBEM & OBS		
	17:19	found OBS(S11)		
	17:42	recovered OBS(S11)		

	18:00 -20:30	carried out calibration for OBEM & OBS		
	20:40	received radio beacon of OBS(S4)		
	22:07	recovered OBS(S4)		
	23:55 -01:20	carried out calibration for OBEM & OBS		
22, Aug, 2010	7:30	arrived at research area		8/22 12:00(JST+1h)
	7:57	deployed OBS(site S17)		12-55.5N, 143-38.0E
	8:32	deployed OBS(site S16)		fine but cloudy
	9:09	deployed OBS(site S15)		ENE-4(Moderate breeze)
	9:43	deployed OBEM(site EM6S5)		
	9:46	deployed OBS(site EM6S5)		
	10:11	deployed OBS(site S6)		
	10:14	released XBT		
	11:04	deployed OBS(site S7)		
	11:45 -12:36	carried out MBES survey		
	13:16	deployed OBEM(site EM7)		
	13:52	deployed OBS(site S14)		
	14:29	deployed OBS(site S13)		
	15:05	deployed OBS(site S12)		
	16:10 -23:30	carried out calibration for OBEM & OBS		
23, Aug, 2010	6:15	arrived at Dive point		8/23 12:00(JST+1h)
	9:02	started 6K#1214 dive		12-55.3N, 143-38.9E
	10:20	arrived at bottom	D=2914m	over cast
	15:55	leave the bottom	D=2787m	W-2(Light breeze)
	17:03	surfaced 6K		
	17:30	recovered 6K		
	18:00	started calibration of OBEM & OBS		
24, Aug, 2010	5:16	finished calibration of OBEM & OBS		8/24 12:00(JST+1h)
	10:29	started 6K#1215 dive		12-57.2N, 143-37.2E
	11:43	arrived at bottom	D=2855m	cloudy
	16:08	leave the bottom	D=2841m	ESE-4(Moderate breeze)
	17:09	surfaced 6K		
	17:49	recovered 6K		
	18:30	started calibration of OBEM & OBS		
	19:00	scientific meeting		
25, Aug, 2010	5:20	finished calibration of OBEM & OBS		8/25 12:00(JST+1h)
	10:00	suspended operation of 6K		12-57.9N, 143-34.7E
	10:56 -11:45	carried out calibration for OBEM & OBS		cloudy
	11:50	set on Proton magnetmeter		ESE-3(Gentle breeze)
	13:34 -13:50	figure eight turn		
	12:14	commenced MBES mapping survey		

26, Aug, 2010	4:55	finished MBES mapping survey		8/26 12:00(JST+1h)
	6:37	recovered proton magnetmeter		12-56.2N, 143-37.8E
	9:56	started 6K#1216 dive		fine but cloudy
	11:23	arrived at bottom	D=3072m	N-3(Gentle breeze)
	15:56	leave the bottom	D=2981m	
	17:00	surfaced 6K		
	17:28	recovered 6K		
	17:57	set on Proton magnetmeter		
	18:04	commenced MBES mapping survey		
	19:00	scientific meeting		
27, Aug, 2010	5:40	finished MBES mapping survey		8/27 12:00(JST+1h)
	6:25	recovered proton magnetmeter		12-55.9N, 143-37.9E
	9:53	started 6K#1217 dive		fine but cloudy
	11:16	arrived at bottom	D=3077m	ESE-5(Fresh breeze)
	15:57	leave the bottom	D=2927m	
	17:06	surfaced 6K		
	17:31	recovered 6K		
	18:00	set on Proton magnetmeter		
	18:15	commenced MBES mapping survey		
	19:00	scientific meeting		
28, Aug, 2010	6:03	finished MBES mapping survey		8/28 12:00(JST+1h)
	6:36	recovered proton magnetmeter		12-57.0N, 143-37.2E
	9:46	started 6K#1218 dive		fine but cloudy
	11:16	arrived at bottom	D=2846m	S-5(Fresh breeze)
	16:05	leave the bottom	D=2896m	
	17:08	surfaced 6K		
	17:38	recovered 6K		
	18:06	set on Proton magnetmeter		
	18:23	commenced MBES mapping survey		
	19:00	scientific meeting		
29, Aug, 2010	5:20	finished MBES mapping survey		8/29 12:00(JST+1h)
	6:35	recovered proton magnetmeter		12-55.4N, 143-39.1E
	9:54	started 6K#1219 dive		fine but cloudy
	11:11	arrived at bottom	D=2909m	SSE-3(Gentle breeze)
	16:06	leave the bottom	D=2771m	
	17:08	surfaced 6K		
	17:34	recovered 6K		
	18:10	set on Proton magnetmeter		
	18:54	commenced MBES mapping survey		
	19:00	scientific meeting		
30, Aug, 2010	6:30 -6:46	figure eight turn		8/30 12:00(JST+1h)
	9:00 -11:00	on board seminor		13-26.5N, 142-56.0E
	16:15 -16:32	figure eight turn		fine but cloudy
				E-2(Light breeze)

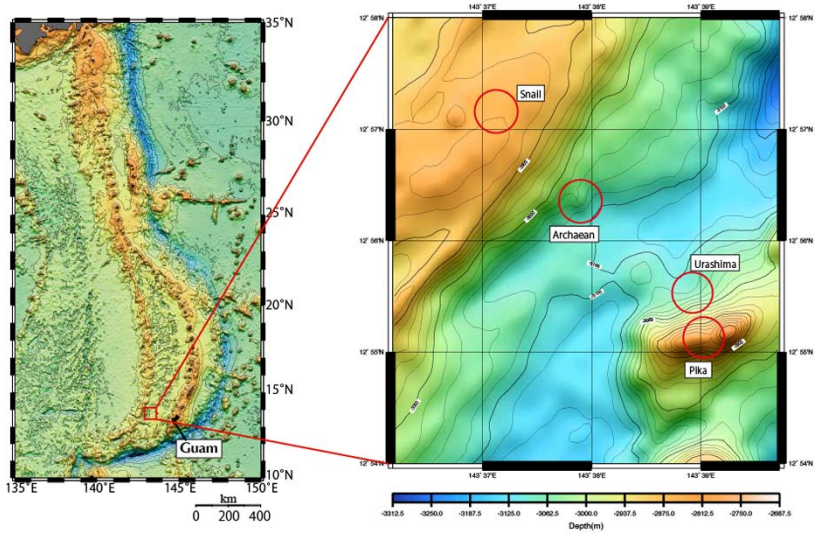
31, Aug, 2010	4:05	finished MBES mapping survey		8/31 12:00(JST+1h)
	6:05	recovered proton magnetmeter		Apra Port
	9:00	arrived at Apra Port		
	12:00	concluded YK10-10		



I. CRUISE SUMMARY

In the first half on this YK10-10 cruise, we successfully deployed 11 OBEMs and 15 OBS across the Southern Mariana Trough back-arc spreading system. We started our observation; the measurement of magnetic and electric field variations by OBEMs and seismic observation by OBSs at the ocean bottom. The observation continues up to the recovery of OBEM and OBS during another Yokosuka cruise in this November. Further, we conducted surface geophysical survey to collect multi-narrow beam bathymetry, magnetic field, and gravity field data mainly during night time, which cover total 1040 miles in the survey area. These observed data will be used to provide geophysical constraint on geodynamics of the Southern Mariana Trough back-arc spreading system with three different hydrothermal activities.

In the 2nd half of this YK10-10 cruise, we conducted 6 Shinkai 6500 dives and we successfully deployed 4 *in situ* colonization systems (ISCS) into the vent or casing-inserted borehole to detect subsurface microbial ecosystem. These ISCSs will be recovered in YK10-13 Leg1 cruise at this October. And also we obtained very valuable samples to analyze microbial ecosystem, fluid chemistry, and rock composition. Finally, we discovered new hydrothermal field at north of Pika site. This discovery was predicted by AUV Urashima's data obtained from YK09-08 cruise. And also this discovery showed that survey by Urashima could become the efficient method for discovering hydrothermal fields. We propose the name of the newly discovered hydrothermal field as Urashima site.



Research Area of the YK10-10 cruise

II. INTRODUCTION

General background and objectives:

Research Title 1: Are there HyperSLiMEs in the subseafloor on basaltic hydrothermal field?

Direct verification of subseafloor microbial ecosystem utilizing high temperature torelance biosampler.

The primary scientific objective of this research project is to clarify whether there are HyperSLiME in subvent on basaltic hydrothermal field, Archaean site in Southern Mariana hydrothermal field. To clarify this question, we will use a short Bio Sampler (Miyazaki's Bio Sampler) which is pressure-tightly closed in deployed place to detect subvent microbial ecosystem without sea-water contamination.

In the DSV Shinkai 6500 dive #903 in YK05-09 Leg2, about 7-m height chimney structure was found around the 6k Marker #12. From the top of the chimney, black smoker (343°C) was erupted. On the other hand, from the foot of this chimney, clear smoker (117°C) was shimmered. Previous study shows that methane concentration of the clear smoker was 8 times higher than that of black smoker and the carbon isotopic ratio of methane of the clear smoker vent fluid in Archaean site was much lighter than that of the black smoker fluid. And also hydrogen concentration of clear smoker was slightly higher than that of Black smoker. Moreover carbon dioxide concentration of the clear smoker was slightly lower than that of black smoker. The vent distance between two smokers was almost 2 m. These results suggested that there is the subvent biosphere supported by methanogen (HyperSLiME) around the clear smoker stream. However, mother-rock of the Archaean hydrothermal fields is basalt. It is generally that these basaltic hydrothermal activities do not generate the enough amount of hydrogen to maintain methanogenic activity.

To investigate subvent biosphere in Archaean site, BMS (Boring machine system) cruise was conducted at in this June. We had a chance to directly investigate subvent biosphere, because in YK10-10 cruise, we deployed the pressure-tightly in situ colonization (Miyazaki's Bio Sampler) in the borehole. It is expected that binding core study and post-drilling study would have gratefully led us to understand subvent biosphere. However, boring at Archaean site was failed, so we cannot conduct this plan. To

accomplish the primary objective, we deployed the Miyazaki's Bio Sampler directly in the vents.

Miyazaki's short Bio Sampler is a product of Kandata project which is a post-drilling project and which has been supported by JAMSTEC AWARDS for "Observing system research and technological development". The goal of this project is an innovation of tools for post-drilling. The project has two rules. One is that this Kandata system must be conducted only by ROV, although many of post drilling research required a large drilling ship to access bore hole. Another feature is that this Kandata system required a tight system to prevent contaminations from seawater. Because these contaminations cause the error for detecting lower microbial population in subvent biosphere. Now in this project, we developed the tools with high-temperature tolerance. In this YK10-10 cruise, we will test the high-temperature tolerance of Bio sampler to capture microbes in the subvent biosphere under the clear smoker vents.

We have another research interests on this YK10-10. We will also investigate habitats of *Alviniconcha hessleri*, a chemosynthetic animal which have endosymbionts in their gill cells. *Alviniconcha hessleri* world-widely inhabits and these are almost the same species. However endosymbionts in the gill cells is different. For example, *Alviniconcha* in Indian Ocean possess ε-*Proteobacteria* in their gill cells. On the other hand, those in Lau Basin possess γ-*Proteobacteria* in their gill cells. Particularly, We will focus the expression of functional gene.

Research Title 2: Southern Mariana Trough back-arc spreading system with three different hydrothermal activities

We deploy ocean bottom electro-magnetometers (OBEMs) and ocean bottom seismometers (OBS) to observe magnetic and electric field variations and to conduct seismic observation at the ocean bottom across the Southern Mariana Trough back-arc spreading system. Observation continues up to the recovery of OBEMs and OBS during another Yokosuka cruise in this November. Some of OBSs will be used seismic survey to investigate seismic velocity structure during the recovery cruise. Further, we conduct surface geophysical survey mainly during night time. The Southern Mariana Trough back-arc spreading system shows asymmetry spreading, and has high relief at spreading axes, which infers abundant melt supply. Furthermore, three hydrothermal

vents that extrude different water contents, exits within 5 km near the spreading axis. The observed data will be analyzed to derive upper mantle structure, crustal structure, hypocenter distribution, and tectonic history, which will provide important constraint on following four main points to understand the back-arc spreading system; 1) imaging melt delivery to the spreading axis and off axis seamount including volcanic arc, 2) production and character of the crust, 3) relationship between melt supply and crustal formation, and 4) pathway and heat source for hydrothermal circulation with related to its formation.

Instruments

1. OBEM (ocean bottom electro-magnetometer)

The OBEMs (Photo 1) measure three components of magnetic field variation, three components of electric field variation, two components of instrument tilt, and temperature. Each OBEM has two pressure resistant cases (two pressure resistant glass spheres, or one pressure resistant glass sphere and one pressure resistant titanium cylinder case), which contains fluxgate type magnetometers, voltmeters, tilt meters, the transponder unit and battery packs (lithium batteries or alkaline batteries). They have pipes for attaching five Filloux-type silver-silver chloride electrodes (Filloux, 1987). The OBEM sensors are divided into two types. One type has a sensor made by Bartington Instruments Ltd. with using data logger made by Clover-tech Corp. (9 OBEMs). The other type is made by Tierra Tecnica Corp. (2 OBEMs). Data sampling will be carried out 16 times (3.2 seconds) per one minute with Bartington Instruments Ltd.'s sensors, and once per one minute with Tierra Tecnica Corp.'s sensor. The clock of the OBEM was set to the GPS clock before the deployment, and starting time of measurement was set to 9:00 (UTC) on 22th August All data are recorded internally on flash cards. The OBEM's also have radio beacon and flashing light for recovery.

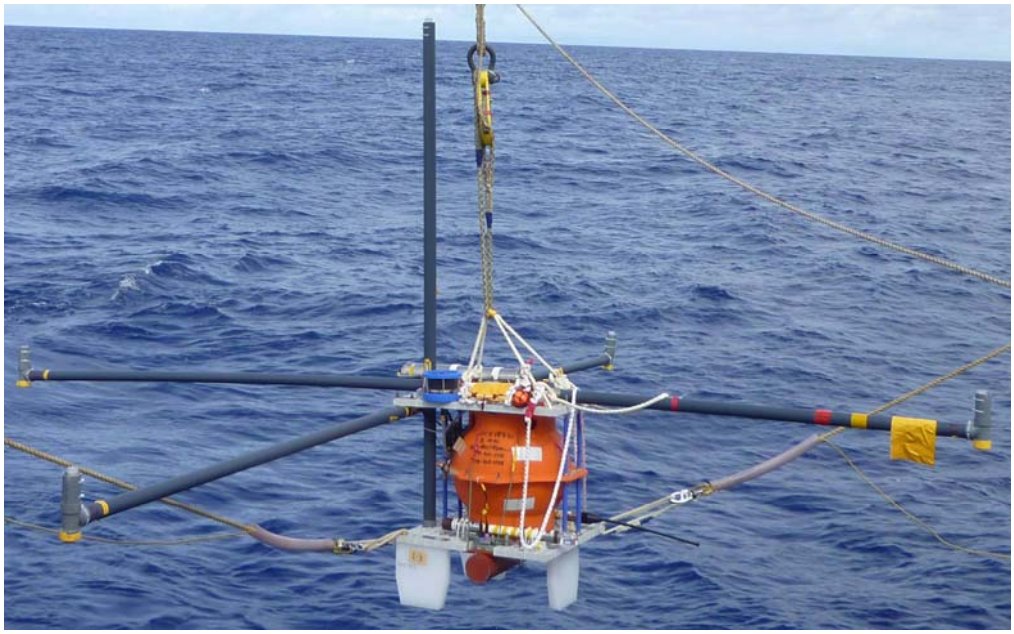


Photo 1a. BC1 type OBEM. BC2 type shows similar feature to BC1 type

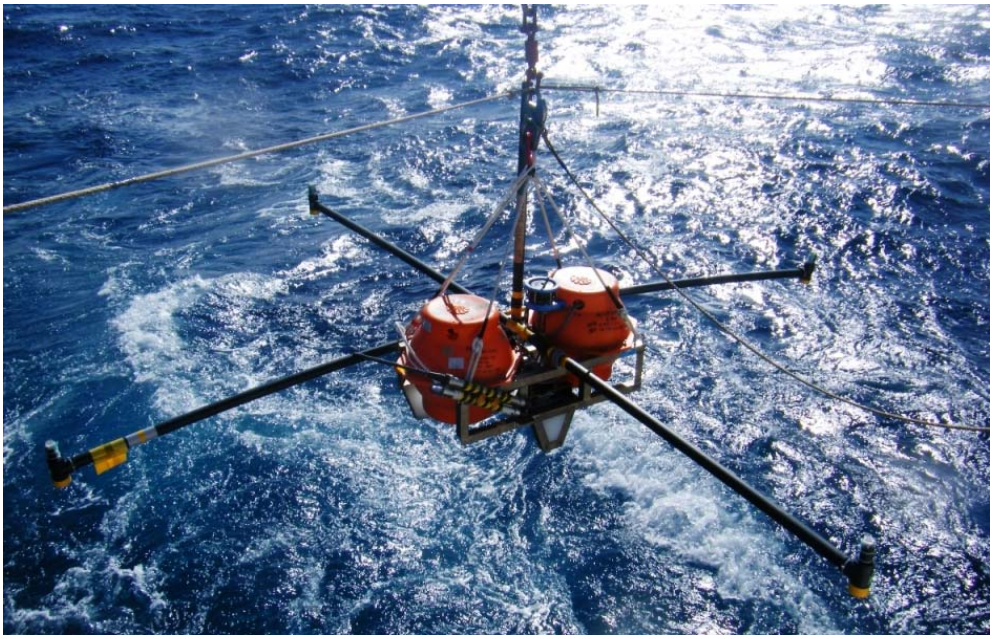


Photo 1b. T type OBEM

2. OBS (ocean bottom seismometers)

We used three types of digital OBSs, LTOBS_ERI, STOBS_ERI, and STOBS_Chiba (Photo 2). LTOBS_ERI was used 50cm titan sphere and equipped with three-component 1Hz natural frequency velocity seismometers, a 20-bit analogue-to-digital (A/D) converter, and a 40GB hard disks for storage of seismic waveform data. The

data-sampling rate was 200 Hz. STOBS_ERI was used 40cm glass sphere and equipped with three-component 4.5Hz velocity seismometers, a 20-bit A/D converter, and a 40GB hard disks. The data-sampling rate was 200 Hz. STOBS_Chiba was used 40cm glass sphere and equipped with three-component 4.5Hz velocity seismometers, a 24-bit A/D converter, and a 20GB hard disks. The data-sampling rate was 125 Hz. Two of STOBS_Chiba have a depth sensor (sampling rate is 30s), and one has a hydrophone (sampling rate is 125Hz).

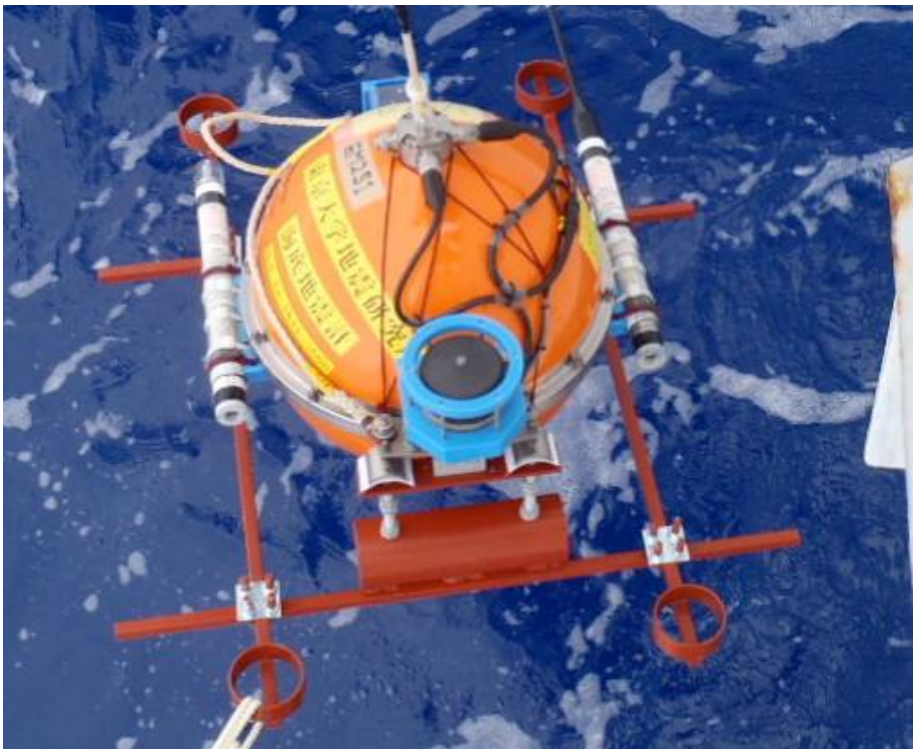


Photo 2a. LTOBS_ERI type OBS

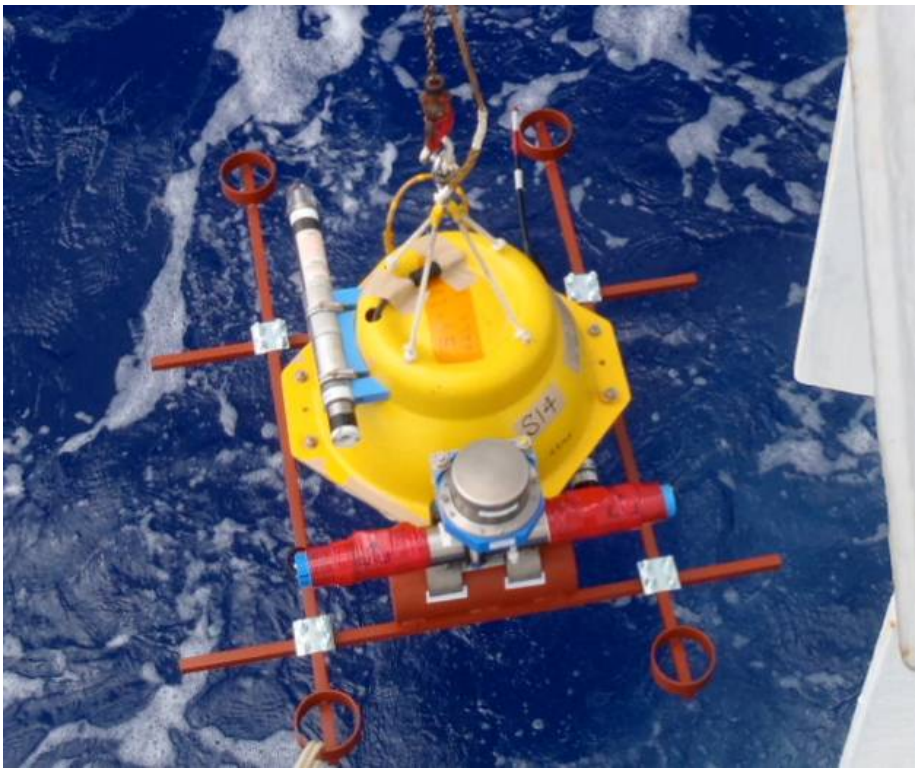


Photo 2b. STOBS_ERI type OBS

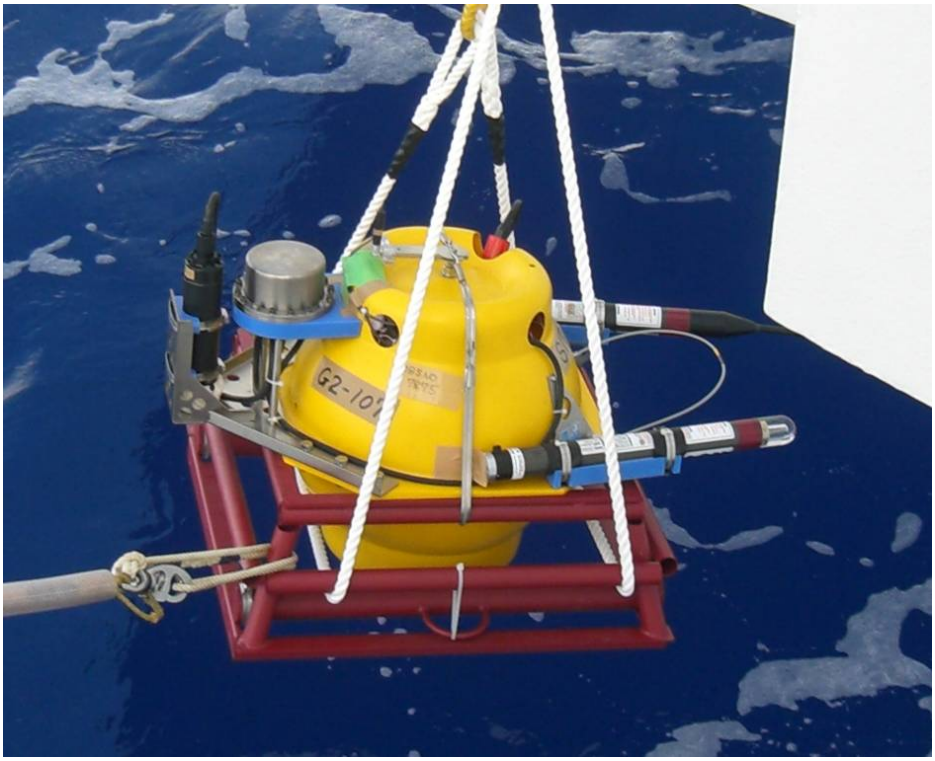


Photo 2c. STOBS_Chiba type OBS

III. DIVE REPORTS

Dive Report: Shinkai 6500 Dive#1214

Date: August 23, 2010
Site: Urashima and Pika sites
Landing: 10:20; 12°55.2584'N, 143°38.8470'E, 2914 m
Leaving: 15:55; 12°55.1013'N, 143°38.8916'E, 2787 m
Observer: Kentaro Nakamura (JAMSTEC)
Pilot: T. Yoshiume **Co-Pilot:** Y. Nanbu

Objectives:

Objectives of this dive are;

1) Searching new hydrothermal vent site at northern part of the Pika site, suggested by the AUV *Urashima* in the YK09-08 cruise.
2) Sampling hydrothermal/biological samples at the new hydrothermal site or #19 marker site in the Pika site.
3) Searching BMS-08 casing at the Pika site and then, sampling hydrothermal fluids from the casing and deploying the in-situ colonization system in the casing.

Dive Summary:

We landed at ~100m southwest of the possible area of the new hydrothermal vent site, ~200 m north of the Pika site. At 10:47, we headed to northeast to find out chimneys in the new site. Soon after, we found the first chimney (dead chimney) at the area of several tens of meters from the landing point. Around the first discovered chimney, there were many chimneys that lined with NW-SE direction. Although most of them are dead chimneys, spotted white mat and/or yellowish iron mat were recognizable on the surface of several chimneys indicative of shimmering fluids coming from the chimneys. This findings clearly proved that there is a previously unknown hydrothermal vent site at the area suggested by the AUV *Urashima* in the YK09-08 cruise. Then, after going over several arrays of dead chimneys, we successfully found an active gray smoker chimney at ~200m from the landing point. The gray smoker chimney accompanies several clear smoker chimneys and iron mat chimneys including one big (~10m height) iron mat chimney. We set #109 marker on the wall of the gray smoker chimney. Then, without sampling at the chimney, we continued to go to northeast. At ~50m northeast from the active gray smoker chimney, we found a big dead chimney (~10m height) with

only one big anemone on the wall. After that, we could found only very small dead chimneys (<~1m height) and recognized that surrounding seawater became clearer. We took these signatures as a sign of ending of hydrothermal vent area. We, thus, decided to turn and headed to west. Several minutes after, we found many chimneys with iron mat on the top. We recognized that small amounts of clear fluids were shimmering from the iron mat. We still continued to go to west and then found three big chimneys (several meters height), venting clear fluids from their side wall, at the point of ~30m from the iron mat-top chimneys. And then, we also found other clear smoker chimneys under the *Shinkai 6500* at ~30m from the triple chimneys. After that, we could not found any chimneys and again we recognized that the hydrothermal vent area is now ended. We, therefore, turn again and headed to southeast. Soon after we found again several dead chimneys on our left side. At 11:21, we found a big black smoker chimney whose height is ~10m or more. At the top of the chimney, we started to collect vent fluids with WHATS bottle 1 & 2, whose maximum temperatures are ~280 deg-C. After that, the top of the big chimney was broken by manupirator-chop (called 'Nanbu-chop'), and we corrected some chimney samples. In order to collect more chimney samples, we tried to hit the *Shinkai 6500* to the chimney, and finally the big chimney was completely falling down and we collected several broken chimney fragments. Then we collected animals (crabs and shrimps) by suction sampler. After the sampling at the black smoker chimney, we restarted to go to south. At the point ~100m south of the black smoker chimney, we found very slim and tall gray smoker chimney. Around the chimney, several clear smoker and iron mat chimneys, including one big (~10m height) iron mat chimney next to the slim chimney, were also found. After that, we could not find any chimneys until we reached to the Pika site, top of the seamount. On this slope, we found many whitish colored rock fragments (talus) which may be silicified and/or sericitized rocks, although we did not sample them. At a point near the #19 marker vent, we found a clear smoker site with many dead chimneys. However, we could not fine the marker and thus this site was considered not to be #19 marker site. At the 'pseud-#19' shimmering site, we found out a small Alviniconcha colony, although we did not sample it. We continued to go to south in order to find TAIGA BMS-08 casing. Around the area of ~100m south of the Alviniconcha site, we were looking for the casing for more 30 minutes, whereas we could not find out it. Finally, we left bottom at 15:54.

Payloads:

1) Suction sampler

2) WHATS
3) Sample box with lid
4) Niskin bottle
5) Marker

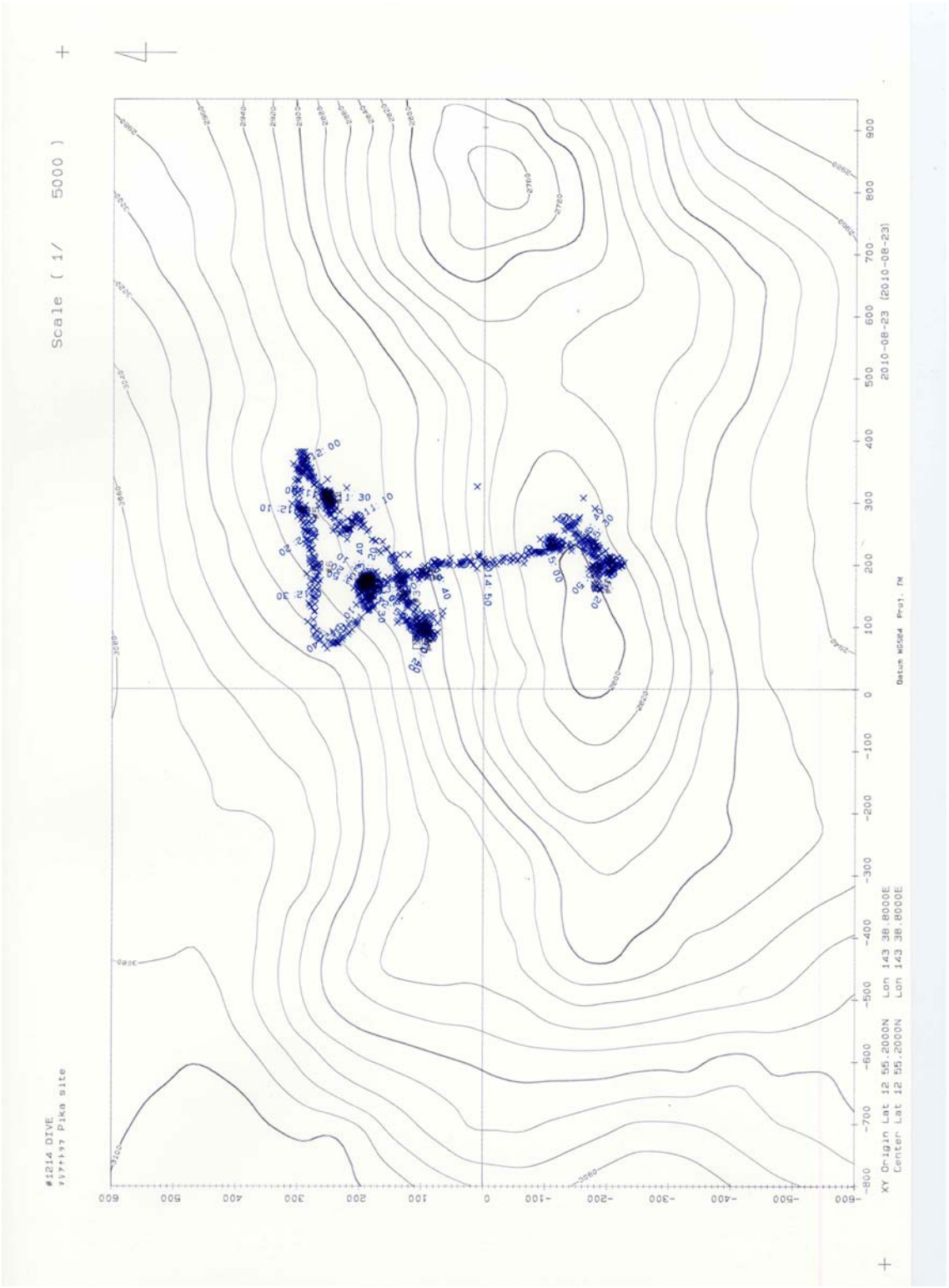
Location of Events:

As in the section, “Event List”.

Event List:

1) 09:00, 12°55.2580'N, 143°38.8400'E, Landing Target
2) 10:20, 12°55.2584'N, 143°38.8470'E, Landing, Smpling Niskin (red), D=2914 m
3) 10:51, 12°55.2587'N, 143°38.8831'E, Find dead chimneys, D=2915 m
4) 11:44, 12°55.3376'N, 143°38.9712'E, Find active chimneys, Set #109 Marker, D=2929 m
5) 12:13, 12°55.3575'N, 143°38.9786'E, Find Ironmat chimneys, D=2934 m
6) 12:25, 12°55.3455'N, 143°38.9093'E, Find shimmering chimneys, D=2923 m
7) 14:23, 12°55.3014'N, 143°38.8946'E, Find black smoker chimney, Sampling WHATS(2), Animals, and Chimney, D=2922 m
8) 14:36, 12°55.2523'N, 143°38.9034'E, Find shimmering chimneys, D=2872 m
9) 15:55, 12°55.1013'N, 143°38.8916'E, Left bottom, D=2787 m

Dive Track:


Scale (1/ 5000)
#1214 DIVE
Pika site
XY Origin Lat 12 55.2000N Lon 143 38.8000E
Center Lat 12 55.2000N Lon 143 38.8000E
2010-08-23 (2010-08-23)
Datum WGS84 Proj. TM

Dive Report: Shinkai 6500 Dive#1215

Date: August 24, 2010
Site: Snail site
Landing: 11:43; 12°57.2434'N, 143°37.1505'E, 2855 m
Leaving: 16:08; 12°57.0957'N, 143°37.1656'E, 2841 m
Observer: Shingo Kato (Tokyo University of Pharmacy and Life Science)
Pilot: K. Chiba **Co-Pilot:** H. Saito

Objectives:

Objectives of this dive are to collect hydrothermal fluid from the casing pipe TAIGA10M-01, ambient seawater, animals and iron-rich mats, and to set an *in situ* incubation instrument to the casing pipe of the borehole TAIGA10M-01.

Dive Summary:

We landed at the north of the casing pipe of the Tagia01M-01. Seawater was collected with a Niskin bottle (red) at this point. Pillow lavas were observed on the seafloor.

Approximately 20 minutes later, we found the pipe of the Taiga01M-01 and confirmed fluid emission from the top of the pipe. The fluids were collected by the WHATS sampler (2 bottles), a bag sampler (but failed) and vacuum sampling instruments (2 bottles). The measured maximum temperature of the fluids was 6-7ºC. After the fluid sampling, an in situ cultivation system was deployed into the pipe. Particles (iron flocs?) flowed out from the pipe after insertion of the in situ cultivation system.

We went the Mrk#78 and ODP#18 to collect iron mats and hydrothermal fluids. Along the way, we found hydrothermal vents on some pillow lavas and sulfide mounds. ODP#21 (20?) with hydrothermal venting from the crack of the seafloor and ODP#22 with yellowish mats were also observed. We found ODP#18 and iron mats. However, the iron mats were relatively brownish, as compared with those observed in 2004 and 2005. It seemed that these mats were altered. Therefore, we returned to ODP#22 to collect hydrothermal fluids and fresh iron mats. Iron mats were found on a mound that was located next to the mound with ODP#22. We sampled shimmering fluids on the mats by WHATS sampler (2 bottles) and collected the mats by SUDO and M-type samplers. The measured maximum temperature of the fluids was over 60ºC.

Unfortunately, a small amount of mats was collected by SUDO sampler. Marker #108 was deployed on this point.

Next, we searched ODP#24, but it was not found. Alternatively, we found ODP marker A (a tube and disc) on a lava mound. Many snails, shrimps and crabs were observed around hydrothermal vents from a crack on the middle of the mound. We landed at this point and seawater was collected with a Niskin bottle (blue). Then, these animals were collected using a slurp gun. Over 100 individuals were collected.

Finally, we searched the casing pipe of the borehole APM01 that was drilled in 2004, however it was failed and then passed the time limit. We left the bottom.

Payloads:

1) WHATS sampler
2) In situ incubation instrument
3) Niskin bottles
4) SUDO sampler
5) M-type sampler with a thermometer
6) Slurp gun
7) Marker

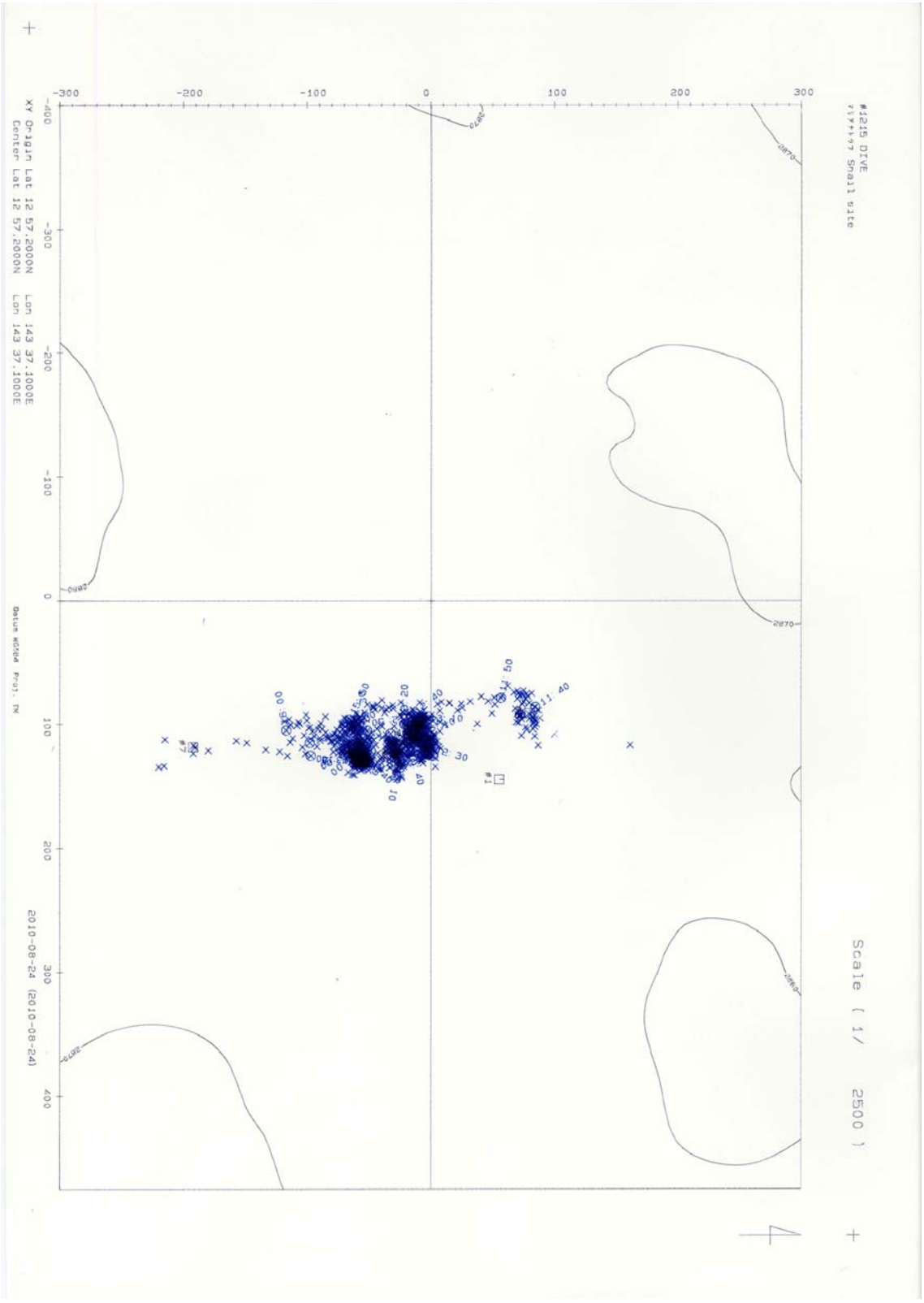
Location of Events:

As in the section, “Event List”.

Event List:

1) 10:00, 12°57.2300'N, 143°37.1800'E, Landing Target
2) 11:43, 12°57.2434'N, 143°37.1505'E, Landing, Sampling Niskin (red), D=2855 m
3) 13:14, 12°57.1937'N, 143°37.1579'E, Finding BMS01, Sampling WHATS (2), Water (2vavuum), Deploying ISCS, D=2849 m
4) 13:22, 12°57.1901'N 143°37.1616'E, Finding #21 ODP Marker, D=2844 m
5) 14:55, 12°57.1693'N 143°37.1701'E, Sampling WHATS (2), Core-SUDO, Core-typeM, Set #108 Marker, D=2853 m
6) 15:29, 12°57.1843'N, 143°37.1702'E, Sampling NISKIN (blue) and animals, D=2849 m
7) 16:08, 12°57.0957'N, 143°37.1656'E, Left bottom, D=2841 m

Dive Track:


#1215 DIVE
Shell site
XY Origin Lat 12 57.2000N Lon 143 37.1000E
Center Lat 12 57.2000N Lon 143 37.1000E
Datum WGS84 Proj. TM
2010-08-24 (2010-08-24)
Scale (1/ 2500)
-300
-200
-100
0
100
200
300
-400
-300
-200
-100
0
100
200
300
400
2870
#1
#7

Dive Report: Shinkai 6500 Dive#1216

Date: August 26, 2010
Site: Archaean site, South Mariana Hydrothermal Field
Landing: 11:23; 12°56.2262'N, 143°37.8270'E, 3072 m
Leaving: 15:56; 12°56.3510'N, 143°37.9559’E, 2981 m
Observer: Junichi Miyazaki (JAMSTEC)
Pilot: Y. Chida **Co-Pilot:** H. Ueki

Objectives:

Objectives of this dive are collecting hydrothermal vent chimneys, vent fluids and animals from 6k#12 chimney in Archaean site, and deploy in situ colonization systems in the vents.

Dive Summary:

We sampled reference seawater before landing (depth 3032 m). 10 minutes later, we landed on lava and headed to 30° to go to #12 site (depth 3072 m). When we reached at depth 3060 m, the slope became steep and we could not observed lava on seafloor. From this position to the top of mound, the seafloor was covered with sulfide rocks. At 11:56, we observed the huge dead chimney on the steep slope (depth 3023 m).

At 12:09, we found active chimneys on the left side, so that we headed to the west. The active chimneys existed on the ridge in Archaean mound. The chimney shape looks like Sagurada Family, so that we named this chimney “Sagrada Familia chimney”. There were 4 to 7 tall chimneys and the highest one is about 7 m. On the foot of the chimneys, there were many of small chimneys. The many black smokers were erupted from chimneys and clear smoker was shimmered on the chimneys. We moved to the south end of the chimney and then tried to sample black smoker. However, the chimney sampling was failed because of the softness. Next, we sampled hydrothermal fluid by WHATS sampler. The fluid temperature was 256 to 260°C. After sampling the fluid, we sampled chimney by Bamboo rake sampler. Next we tried to deploy ISCS (in situ colonization system) into the vent, but the vent was too small to deploy the ISCS into the vent. Therefore we put ISCS on this place.

We moved to the southwest and sampling clear smoker which was shimmered from the foot of the chimney. Sampling fluid at this place was performed and maximum temperature was 80°C. Next, we deployed Miyazaki11’s ISCS into the vent. After the

deployment of the Miyazaki's ISCS, we sampling rock covering clear smoker. Next we put on Watuji's hair ISCS near to the Miyazaki's ISCS.

To find *Alviniconcha*, we went to east side of the chimneys. However, we could not find *Alviniconcha* so that we gave up sampling *Alviniconcha*. When we set 6k marker #110 on the northwest side 2 m far from chimney, we finally found the strongest black smoker's vent which was north end of the chimney. Because there were no WHATS bottles to sample fluid from the vent, we only tried to sample chimney including the vent by a bamboo rake sampler. After sampling chimney, we headed to 90° and left the bottom.

Payloads:

1) Suction sampler
2) WHATS with 4 bottles
3) Sample box with lid (3 separated box (left basket) and 1 box (right basket))
4) 2 x Niskin bottles (Red and Blue)
5) 2 x in situ colonaization system (Old type)
6) Miyazaki11's short Bio sampler
7) Watsuji's ISCS
8) Bamboo rake sampler (in the right sample box)
9) 3 x Marker (#110, #111, #112)

Location of Events:

As in the section, "Event List".

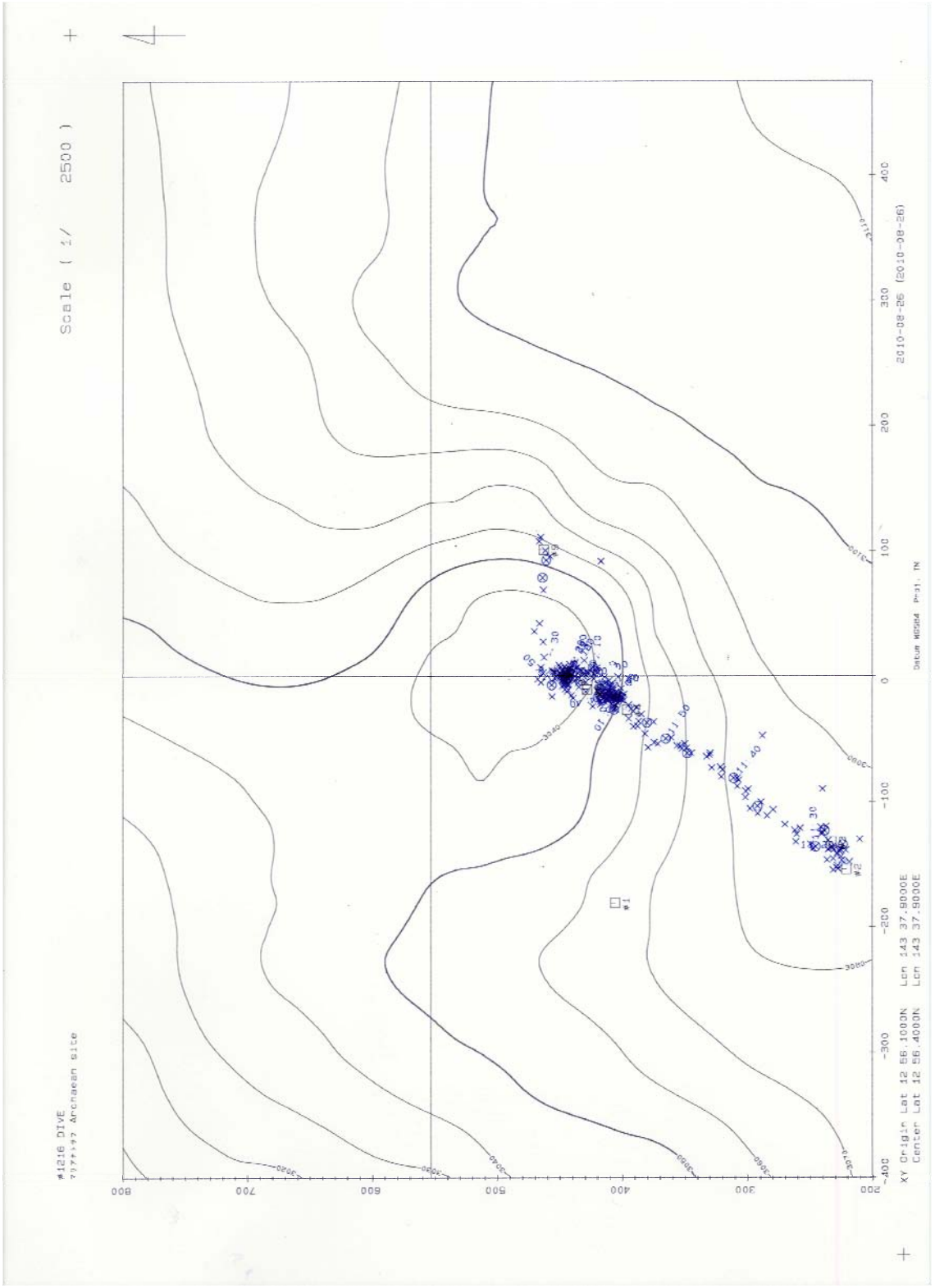
Event List:

1) 10:00, 12°56.3200'N, 143°37.800'E, Landing Target
2) 11:13, 12°56.2197'N, 143°37.8148'E, Sampling reference seewater (Red Niskin bottle), D=3035 m
3) 11:23, 12°56.2262'N, 143°37.8270'E, Landing, D=3072 m
4) 11:56, 12°56.3148'N, 143°37.8853'E, Finding Huge Dead Chimneys, D=3023 m
5) 12:30, 12°56.3148'N, 143°37.8943'E, Arriving at the active chimney (Sagrada Familia), D=3002 m
6) 13:28, 12°56.3148'N, 143°37.8943'E, Sampling WHATS (1, 2) (Pseudo Black Smoker, Temp=256°C, 260°C), D=3002 m
7) 14:14, 12°56.3148'N, 143°37.8943'E, Sampling Chimney (Pseudo Black Smoker),

D=3002 m

8) 14:26, 12°56.3148'N, 143°37.8943'E, Putting ISCS (Pseudo Black Smoker)
9) 14:55, 12°56.3148'N, 143°37.8943'E, Sampling WHATS (Clear Smoker, Temp=74°C, 80°C), D=3002 m
10) 15:00, 12°56.3148'N, 143°37.8943'E, Deployment Miyazaki11's ISCS (Clear Smoker), D=3002 m
11) 15:03, 12°56.3148'N, 143°37.8943'E, Sampling Rock (Clear Smoker), D=3002 m
12) 15:03, 12°56.3148'N, 143°37.8943'E, Deployment Watsuji's hair ISCS (Clear Smoker), D=3002 m
13) 15:22, 12°56.3387'N, 143°37.8994'E, Set #110Marker (Clear Smoker), D=3002 m
14) 15:35, 12°56.3444'N, 143°37.9024'E, Sampling animals (True Black Smoker), D=3000 m
15) 15:42, 12°56.3444'N, 143°37.9024'E, Sampling Chimney (True Black Smoker), D=3000 m
16) 15:56, 12°56.3510'N, 143°37.9559'E, Left Bottom, D=2981 m

Dive Track:


Scale (1/ 2500)
#1216 DIVE
Archaean site
XY Origin Lat 12 56.1000N Lon 143 37.9000E
Center Lat 12 56.4000N Lon 143 37.9000E
2010-08-26 (2010-08-26)
Datum WGS84 Proj. TM

Dive Report: Shinkai 6500 Dive#1217

Date: August 27, 2010
Site: Archaean site
Landing: 11:16; 12°55.9597´N, 143°37.9582´E, 3,077 m
Leaving: 15:57; 12°56.3652´N, 136°38.0054´E, 2,927 m
Observer: Tomohiro Toki (University of the Ryukyus)
Pilot: M. Yanagitani **Co-Pilot:** Y. Nanbu

Objectives:

During YK05-09 in 2005, hydrothermal fluid samples were collected and measured for these chemical and isotopic compositions. The results of chemical analysis showed enrichment of methane and carbon-12 in vent fluid of clear smoker at marker #12, but not enrichment in that of black smoker 1-2 m far from the clear smoker vent, indicating that enormous microbial productivity exists below the seafloor of clear smoker vent. In this dive, we collected hydrothermal fluid samples from the black and clear smoker vents at marker #12 in Archaean site to describe the processes below the seafloor.

Dive Summary:

Figure 1 shows *Shinkai* track of Dive 1217 on bathymetric map around Archaean site.

11: 16 Landing on the seafloor of lava. A piece of lava was sampled (R-1). Lava was covered by thin sediments, but the topography was significantly rough that many depressions were as high as about 10 m, which are filled with thick sediments. *Shinkai6500* transported heading north to observe the structure of the seafloor.
11: 39 Sediment became to look reddish brown, and its thickness increased. Visibility became poor.
11: 43 Pillow lava was observed on the sediment.
11: 46 Shinkai turned to the direction of 300° to go to Marker#110.
11: 48 Huge rocks was lying on the steep slope.
11: 55 Marker#110 and Oreshiki were found, and we landed beside the most active vent of black smoker located at the north of the chimneys.
12: 00 The black smoker was sampled (W-1), and its max temperature was 327°C. Continuously, the same smoker was sampled (W-2), and that was 312°C. ISCS

was deployed into the black smoker. Chimneys were sampled (R-2).

13: 29 One of the clear smokers was sampled by WHATS (W-3), of which max temperature was 105°C, and W-3 of 103°C.

13: 41 Prepared missions were completed. We transported to the other markers #17 and #18 that were deployed during YK05-09 to observe the transition of hydrothermal activities.

14: 05 Marker#17 was found on the top of the Archaean site, where low temperature fluid was shimmering, but Alvinconcha was not found.

14: 53 Large shimmering area was discovered on the western slope of the Archaean site, where active chimneys stood on the top of the slope, the slope was white-colored, and many shrimps and crabs were living. A dead chimney stood on the slope. Alvinconcha were found at the bottom of the dead chimney awash in shimmering fluid on the slope. Marker#111 was deployed around the shimmering field. We tried to observe the back of the active chimneys. We run into the other active chimneys in the westward of the large shimmering area.

15: 36 We transported to the westward more and more, and arrived at the other active chimneys in the above-mentioned active chimneys. We climbed up to the top of the extremely steep slope, and revisited the place at Marker#17.

15: 50 Transported to the eastward to leave the sea bottom.

15: 57 Leaving the seafloor.

Payloads:

1) WHATS with a temperature probe for fluid sampling
2) In situ incubation instrument Sample boxes (large & small)
3) Suction sampler (single canister)
4) Shovel
5) Markers (#111& #112)

Location of Events:

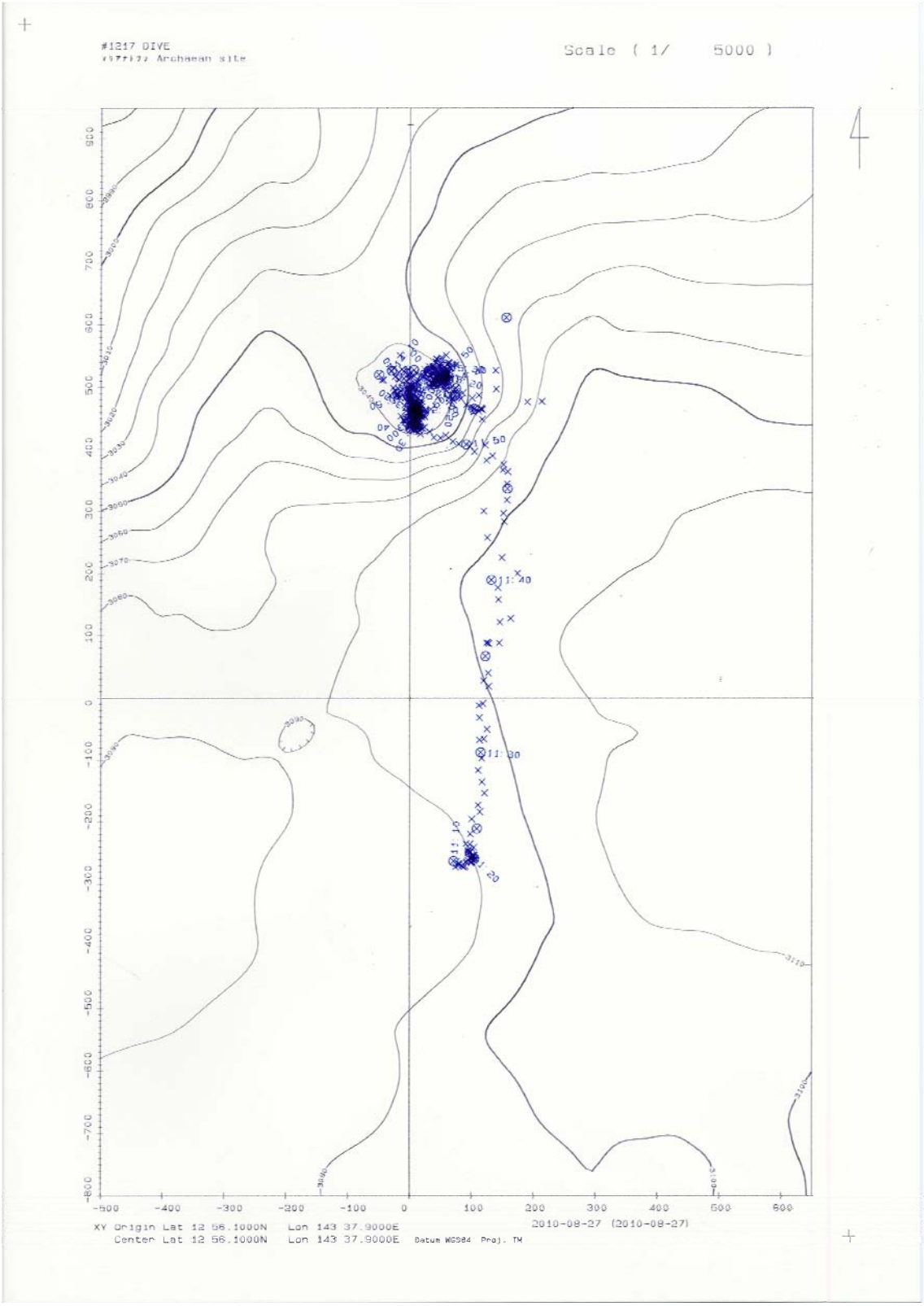
As in the section, “Event List”.

Event List:

Table 1 Location of events

Point	Time	LAT	LON	Depth	Event
1	10:00	12-56.0000N	143-37.9000E		Landing Target
2	11:16	12-55.9597N	143-37.9582E	3,077	Landing Point, Sampling Rock
3	13:42	12-56.3490N	143-37.9044E	3,000	Sampling WHATS(4), Chimney(2), Deployment ISCS
4	14:02	12-56.3764N	143-37.9000E	2,980	Find Dead Chimney
5	15:15	12-56.3873N	143-37.9262E	3,000	Find Chimney, Samping Animals, Set #111 Marker
6	15:36	12-56.3757N	143-37.9066E	2,972	Find Clear smoker
7	15:57	12-56.3652N	143-38.0054E	2,927	Left Bottom

Dive Track:


#1217 DIVE
Archaean site
Scale (1/ 5000)
XY Origin Lat 12 56.1000N Lon 143 37.9000E
Center Lat 12 56.1000N Lon 143 37.9000E Datum WGS84 Proj. TM
2010-08-27 (2010-08-27)

Dive Report: Shinkai 6500 Dive#1218

Date: August 28, 2010
Site: Snail site
Landing: 11:16; 12°57.0463'N, 143°37.1723'E, 2846 m
Leaving: 16:08; 12°57.0789'N, 143°37.1939'E, 2836 m
Observer: Tomoo Watsuji (JAMSTEC)
Pilot: H. Ueki **Co-Pilot:** A. Ishikawa

Objectives:

The major objectives are to 1) collect *Alviniconcha* sp. individuals and the surrounding fluid, and 2) to collect Iron rich mat, the hydrothermal fluid under the mat, ambient seawater and ambient rock and to set *in situ* incubation instruments (Gali) on the mat.

Dive Summary:

We landed on the south near the event no. 1. Then, 6K headed to the event no. 17 (*Alviniconcha* site).

We found ODP#A marker indicating event no. 17 and landed near the *Alviniconcha* colony. First, we collected ambient seawater as reference water by a Niskin bottle (red) and *Alviniconcha* individuals by using slurp gun. Then, we collected fluid surrounding *Alviniconcha* individuals by using WHATS sampler (no. 1). The temperature of fluid was approximately 15 °C. After the fluid collection, we headed to event no. 18 (fresh iron mats site).

We found #108 marker indicating event no. 18 and landed near the fresh iron mat found in Dive#1215. First, we collected seawater by vacuum samplers (two bottles). Then, we collected the iron mat by M-type sampler (green) to emit fluid under the mat. Because fluid under the mat strongly erupted, we collected the fluid by pump sampling using bag (no. 3). At the same point, we performed WHATS sampling (no. 2 and 3). The temperature of fluids was approximately 50 °C. In addition, we put Gali (no. 9) on the hydrothermal vent and collected ambient rocks. We headed to event no. 17 again and collected fluid surrounding *Alviniconcha* individuals by using WHATS sampler (no. 4) at the same point. After the fluid sampling, we headed to event no. 19 (dead iron mats site).

We found ODP-18 marker indicating event no. 19 and landed near the dead iron mat. First, we collected the iron mat by M-type sampler (blue) to emit fluid under the mat,

but fluid did not erupt. However surrounding seawater on the iron mat was collected by bag sampler (no.1). In addition, we put Gali (no. 8) on the mat and collected ambient rocks. We set #112 marker on the dead iron mat and headed to event no. 20 (casing pipe of APM01).

We found the pipe of APM01 indicating event no. 20. We confirmed fluid mildly erupted from the top of the pipe and set #113 marker there. In this point, we found that ballast of 6K was covered with iron mat. Then, we headed to the east and newly found the existences of fresh iron mats and fluid emissions in the wide area. Therefore, we set #114 marker. Mission was accomplished and we left the bottom.

Payloads:

1) WHATS sampler
2) In situ incubation instrument (Gali)
3) Niskin bottle
4) M-type sampler with a thermometer
5) Bag sampler
6) Slurp gun
7) Vacuum sampler
8) Marker

Location of Events:

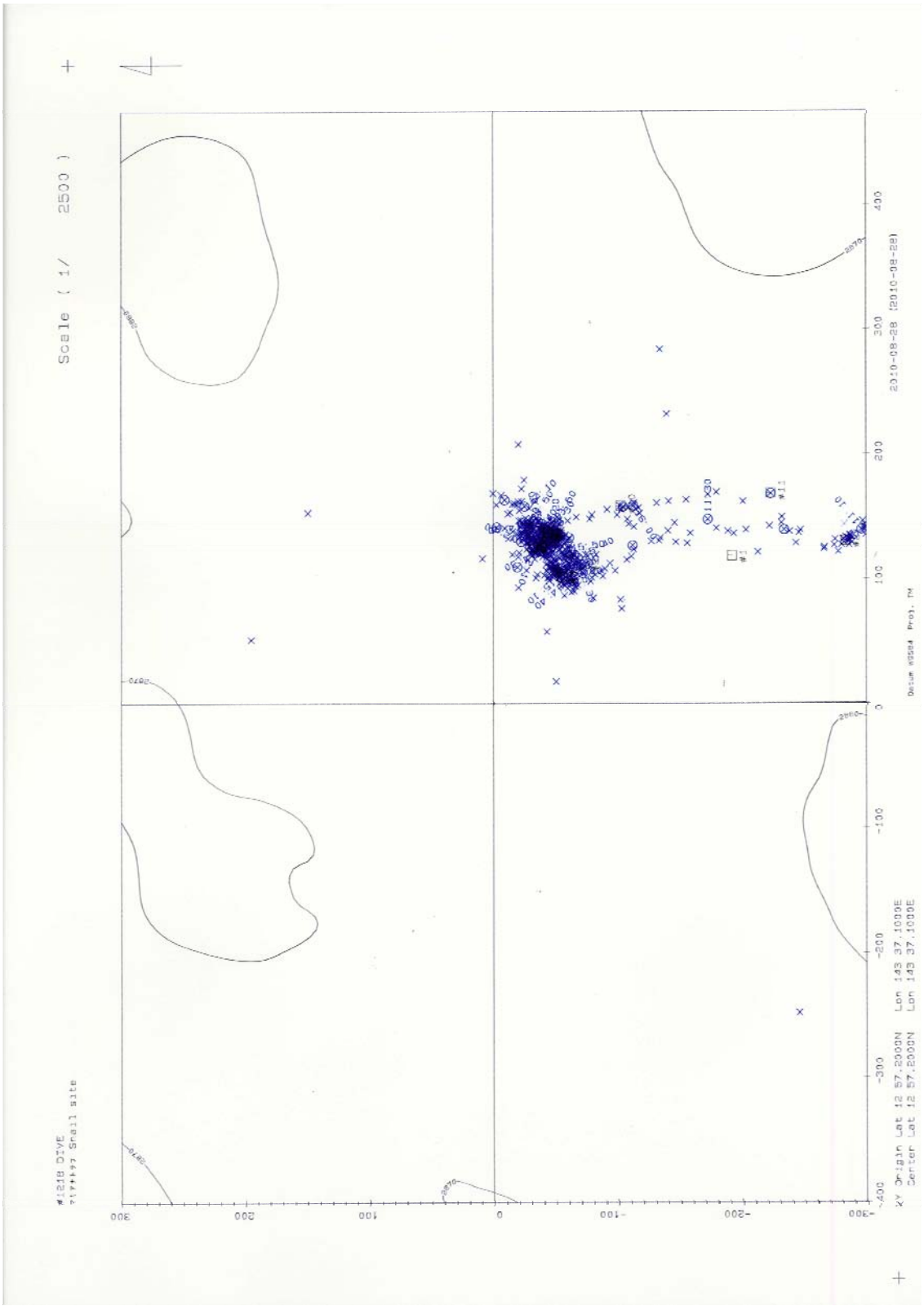
As in the section, “Event List”.

Event List:

1) 10:00, 12°57.0958'N, 143°37.11656'E, Landing Target
2) 11:16, 12°57.0463'N, 143°37.1723'E, Landing, D=2846 m
3) 12:47, 12°57.1828'N, 143°37.1693'E, Sampling Niskin (red), Alviniconcha, WHATS (1) D=2849
4) 14:05, 12°57.1761'N, 143°37.1760'E, Sampling Niskin (blue), Water (2 vacuum), Core-typM (Green) D=2854
5) 14:05, 12°57.1761'N 143°37.1760E, Sampling WHATS (2), Bag, Rock Setting Gali (no.9) D=2854 m
6) 14:31, 12°57.1828'N 143°37.1693'E, Sampling WHATS (1) D=2854 m
7) 15:16, 12°57.1698'N, 143°37.1562'E, Sampling Core-typeM (blue), water (Bag), Rock D=2849 m

8) 15:16, 12°57.1698'N, 143°37.1562'E, Setting Gali (no.8), #112 marker
9) 15:32, 12°57.1602'N, 143°37.1618'E, Finding APM01 Setting #113 marker D=2853
10) 16:00, 12°57.1443'N, 143°37.1877'E, Finding shimmering, iron mat Setting #114 marker D=2850
11) 16:08, 12°57.0789'N, 143°37.1939'E, Left bottom, D=2836 m

Dive Track:


Scale (1/ 2500)
#4218 DIVE
Shell site
2010-08-28 (2010-08-28)
Datum WGS84 Proj. TM
XY Origin Lat 12 57.2000N Lon 143 37.1000E
Center Lat 12 57.2000N Lon 143 37.1000E

Dive Report: Shinkai 6500 Dive#1219

Date: August 29, 2010
Site: Urashima and Pika sites
Landing: 10:00; 12°55.3347'N, 143°39.1333'E, 2909 m
Leaving: 15:55; 12°55.1246'N, 143°38.9134’E, 2771 m
Observer: Hiroko Makita (JAMSTEC)
Pilot: T. Yoshiume **Co-Pilot:** H. Saito

Objectives:

Objectives of this dive are;

1) Searching #19 hydrothermal vent at the Pika site and then, sampling hydrothermal fluid from the #19 natural vent.
2) Sampling hydrothermal/biological samples at the Urashima site and Alvinococcus vent in the Pika site.

Dive Summary:

At 11:11, we landed at ~100m northeast of the new hydrothermal vent site ”Urashima site”. Lavas were observed on the seafloor. At 11:14, seawater was collected with a Niskin bottle (red) at this point. Approximately 30 minutes later, we found the #109 maker that was set at #1214 dive. At 12:12, we collected iron mat with M-type sampler (Green) from Golden horn chimney near the #109 maker. We recognized that the clear fluids were shimmering from every part of the iron chimney, which was called Golden horn chimney. And, we collected only surface structure of iron mat with bag sampler (Bag No.1). Furthermore, we collected inside structure of iron mat with M-type sampler (Green). And then, we started to collect vent fluids with Bag sampler (Bag No.2) and WHATS bottle 1 & 2, whose maximum temperatures are ~70 deg-C, the temperature average was about 40 deg-C. And then, we collected iron mat chimney with manipulator and Ushi-Tora scoop sampler. Finally, the Golden horn chimney was failing down and we successfully collected iron chimney fragment. After the sampling, we restarted to go to south.

At 14:27, we successfully found the ODP-P maker and #19 maker. We recognized that the iron mat with shimmering of clear fluids near the makers. Soon after, black smoker was observed. And then, we collected hydrothermal vent fluid with WHATS bottle 3 & 4, whose temperature are ~321 deg-C, and average temperature average was

about 318 deg-C. And, we set on two set of the radiation counter. Furthermore, we set the new maker (#115), and we collected #19 maker. Finally, we collected chimney fragment. After the sampling at the #19 black smoker chimney, we restarted to go to Alvinococcus vent.

At 15:46, while we searched Alvinococcus vent site, we found a new chimney with black smoker, which called was Byakko chimney. However, we could not find Alvinococc us vent site. Finally, we left bottom at 16:06.

Payloads:

1) Suction sampler
2) WHATS
3) Sample box with lid
4) Niskin bottle
5) Bag sampler
6) M-type sediment sampler
7) Ushi-Tora scoop sampler
8) Marker

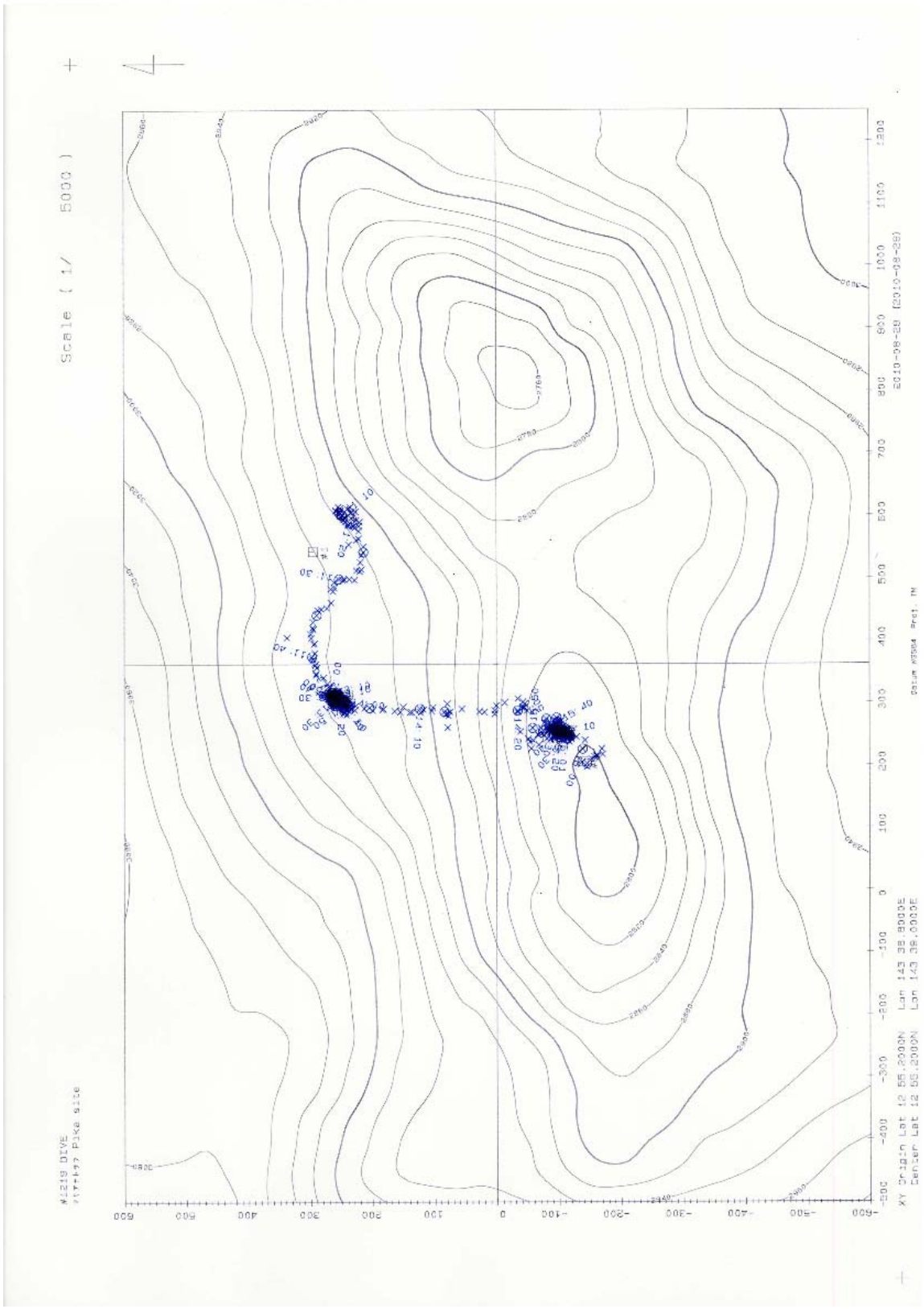
Location of Events:

As in the section, “Event List”.

Event List:

1) 10:00, 12°55.3600'N, 143°39.1000'E, Landing Target
2) 11:11, 12°55.3347'N, 143°39.1333'E, Landing, Smpling Niskin (red), D=2909 m
3) 11:44, 12°55.3376'N, 143°38.9712'E, Find #109 Marker, D=2931 m
4) 13:56, 12°55.3407'N, 143°38.9674'E, Sampling Core-type M (Green, Black), Chimney, Water (2 bags), D=2931 m
5) 13:56, 12°55.3407'N, 143°38.9674'E, Sampling fluid with WHATS (2 bottles), D=2931 m
6) 15:35, 12°55.1433'N, 143°38.9405'E, Sampling hydrothermal vent fluids with WHATS (2 bottles), Chimney and then, two sets of Radiation Counter, D=2760 m
7) 15:35, 12°55.1433'N, 143°38.9405'E, Sampling Niskin (Blue), D=2922 m
8) 15:46, 12°55.1556'N, 143°38.9349'E, Find Black smoker, D=2765 m
9) 16:06, 12°55.1246'N, 143°38.9134'E, Left bottom, D=2771 m

Dive Track:



IV. OBEM and OBS deployment

Deployments of 11 OBEMs and 17 OBSs were made at 21 sites across the Southern Mariana Trough back arc spreading center. Site locations are given in Figure 1 and Table 1 and, and the instrument information at each site is given in Tables 2. The OBEMs deployments were made using the A-frame, and the OBSs were small enough to be released from a small davit. All deployments were successful except for two OBSs where the anchor ballast weight was forced to be released from the OBSs (sites S4 and S11) probably due to an impact of the touchdown at sea bottom. These instruments had to be recovered from the sea surface, which resulted in 15 OBS observation sites. We did not make tracking after the deployment because of limitation of the time. Sites spacing was approximately 4 km in the vicinity of the spreading center, but the spacing was coarser at the both ends (15-30km). The recovery will be done during another S/V Yokosuka cruise in November, 2010. Positioning of the each instrument on the ocean floor was performed during night time. The final location of instruments will be determined by using slant ranges between the transponder of the instrument and that of the ship at different three locations around the site.

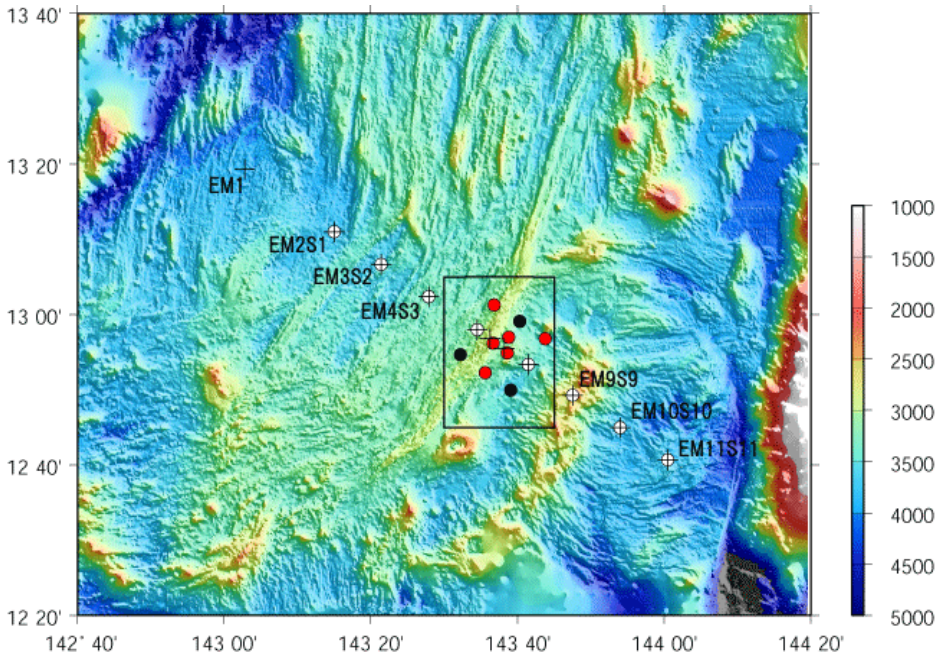


Figure 1a. Location map of OBEM (crosses) and OBS (circles). Colors of circles show different types of OBSs (white, black, and red correspond to LTOBS_ERI, STOBS_ERI, and STOBS_Chiba types of OBSs, respectively). Location of Figure 1b is shown by square.

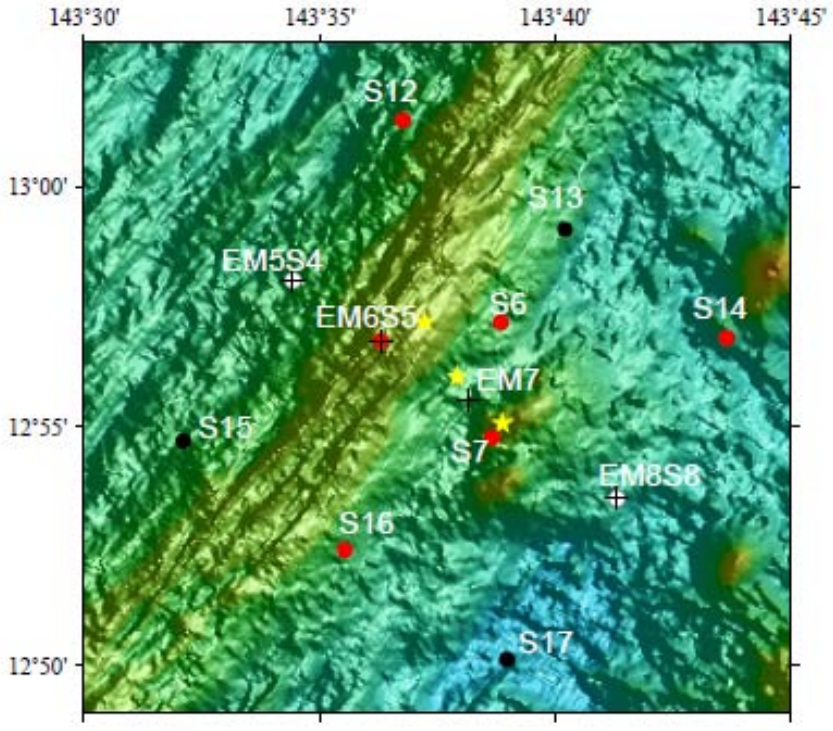


Figure 1b. Location map of OBEM and OBS near the spreading center. Symbols are the same as Figure 1a. Three hydrothermal fields that extrude different water contents are also shown by yellow stars.

Site		Location					Time (UTC)	
		Latitude (N)		Longitude (E)		Depth (m)	Date	Time
		Deg.	Min.	Deg.	Min.			
EM1	EM1	13	19.25	143	02.81	3924	2010/8/20	20:13:15
EM2S1	S1	13	10.99	143	15.03	3746	2010/8/20	21:42:57
	EM2	13	10.92	143	15.02	3746	2010/8/20	21:48:32
EM3S2	S2	13	06.72	143	21.45	3550	2010/8/20	22:45:41
	EM3	13	06.69	143	21.49	3550	2010/8/20	22:48:40
EM4S3	S3	13	02.39	143	27.92	3268	2010/8/20	23:40:43
	EM4	13	02.37	143	27.99	3255	2010/8/20	23:46:51
EM5S4	S4*	12	58.01	143	34.48	3097	2010/8/21	0:40:59
	EM5	12	58.04	143	34.50	3091	2010/8/21	0:48:04
EM6S5	S5	12	56.81	143	36.34	2865	2010/8/21	23:43:05
	EM6	12	56.82	143	36.37	2867	2010/8/21	23:46:07
S6	S6	12	57.20	143	38.87	3074	2010/8/22	0:11:49
S7	S7	12	54.59	143	38.87	2984	2010/8/22	1:04:42
EM7	EM7	12	55.52	143	38.23	3113	2010/8/22	3:16:22
EM8S8	S8	12	53.52	143	41.31	3315	2010/8/21	1:41:19
	EM8	12	53.57	143	41.29	3291	2010/8/21	1:44:40
EM9S9	S9	12	49.10	143	47.54	2585	2010/8/21	3:34:33
	EM9	12	49.13	143	47.57	2581	2010/8/21	3:37:19
EM10S10	S10	12	45.00	143	54.02	3684	2010/8/21	4:29:47
	EM10	12	44.99	143	53.98	3676	2010/8/21	4:32:34
EM11S11	S11*	12	40.68	144	00.53	3761	2010/8/21	5:30:41
	EM11	12	40.71	144	00.51	3766	2010/8/21	5:34:49
S12	S12	13	01.39	143	36.81	3073	2010/8/22	5:05:33
S13	S13	12	59.12	143	40.23	3135	2010/8/22	4:29:06
S14	S14	12	56.85	143	43.66	3161	2010/8/22	3:52:40
S15	S15	12	54.75	143	32.11	3104	2010/8/21	23:09:38
S16	S16	12	52.47	143	35.55	3084	2010/8/21	22:32:58
S17	S17	12	50.18	143	39.01	3542	2010/8/22	21:57:50

Notes:
* Two OBSs at sites S4 and S11 were forced to be recovered after the deployment and no observation is conducted at these two sites.

Table 1. Location and Time of OBEM and OBS deployment.

Site	Type	No.(frame / pressure case)	S/N (data logger / sensor)	Transponder Code	Radio Beacon ID
EM1	BC1	K2010-001 / 107 - K2010-001	18 / -	7C-1	JS334
EM2	BC1	K2010-002 / 104 - K2010-003	17 / 1598	1C-1	JS333
EM3	BC1	K2010-003 / 101 - K2010-004	16 / 1729	6C-3	JS337
EM4	BC2	K2010-008 / 108 – KN2010-001	22 / -	5C-2	JS323
EM5	T	KN2007-002 / 5	KB1-OBEM	5A-2	JS329
EM6	BC1	K2010-005 / 106 – K2010-005	20 / 1725	7B-1	JS338
EM7	BC1	K2010-007 / 105 - K2010-006	19 / 1728	1D-1	JS335
EM8	T	KN2007-001 / 11	NIPR2-OBEM	2B-2	JS326
EM9	BC1	K2010-004 / 102 - K2010-002	15 / 1726	5D-2	JS332
EM10	BC2	K2010-009 / 109 - KN2010-002	23 / -	6B-3	JS324
EM11	BC1	K2010-006 / 103 - K2010-007	21 / 1727	2C-2	JS336

Notes:
BC1: Sensor made by Bartington Instruments Ltd. with using data logger made by Clover-tech Corp. and all of these are packed in on a pressure case (Photo 1a).
BC2: Sensor made by Bartington Instruments Ltd. with using data logger made by Clover-tech Corp. and the sensor are packed in an independent pressure case.
T: Sensor and data logger made by Tierra Tecnica Corp. (Photo 1b).
The radio beacon frequency is 43.528MHz.
All OBEMs have a flashing light, but that of OBEM at site EM7 may not work properly, because it showed different behavior onboard from the others.

Table 2a. Instrument information on OBEM at each site

Site	Type	OBS No.	Transponder Code	Radio Beacon ID
S1	LTOBS_ERI	724	724	JS1191
S2	LTOBS_ERI	722	722	JS1080
S3	LTOBS_ERI	729	729	JS197
S4	LTOBS_ERI	786	786	JS193
S5	STOBS_ERI	ERI-5B	4A-1	JS1271
S6	STOBS_ERI	ERI-5F	2B-1	JS1310
S7	STOBS_ERI	ERI-5C	1C-3	JS1195
S8	LTOBS_ERI	662	662	JS1188
S9	LTOBS_ERI	744	744	JS1241
S10	LTOBS_ERI	752	752	JS1190
S11	LTOBS_ERI	787	787	JS1277
S12	STOBS_ERI	ERI-5D	2D-1	JS1314
S13	STOBS_Chiba	7876	G2-109	JS1772
S14	STOBS_ERI	ERI-5E	4B-1	JS1086
S15	STOBS_Chiba	7882	G2-108	JS1771
S16	STOBS_ERI	ERI-5A	1D-1	JS1289
S17	STOBS_Chiba	7875	G2-107	JS1770

Notes:
The radio beacon frequency is 43.528MHz.
All OBSs have a flashing light.

Table 2b. Instrument information on OBS at each site

V. Surface Geophysical Survey

We conducted a surface geophysical survey to collect multi-narrow beam bathymetry, magnetic field, and gravity field data. The ship tracks of the survey area are shown in Figure 2. Multi-narrow beam bathymetric data were obtained using a SeaBeam 2112 (Swath width 150°; 150 beams with its width and interval of 2°and 1°, respectively), which also provides a backscatter image that will be processed after the cruise. We could cover total 1040 miles in the survey area. An XBT was done at 0:14 on August 22 (UTC). The DGPS (differential global positioning system) was used to derive the ship's location. Magnetic field data were collected with two instruments: a shipboard three component magnetometer (STCM: Isezaki, 1986) that can measure the vector geomagnetic field using deck-mounted fluxgate magnetometers and gyros, and a ship-towed proton precession magnetometer that can measure the intensity of the geomagnetic field. The STCM data contain the effects of the ship's magnetic field that must be corrected in order to derive the real geomagnetic field. Twelve constants related to the ship's permanent and induced magnetic field are estimated using data from "Figure 8 turns". "Figure 8 turns" is made by steering the ship in a tight circle, both clockwise and counter clockwise. During the cruise, "Figure 8 turns" were conducted three times and these are listed in Table 3. The ship-towed proton precession magnetometer has anomalous noise and was forced to stop sampling for the maintenance for a few times. Gravity field data were obtained from a shipboard gravimeter (Model S-63, Lacoste & Romberg). The gravity field data at Yokosuka and Guam ports measured with a portable gravimeter will be used to correct the instrument drift.

No.	Date	Time(UT)	Latitude	Longitude
1	25/Aug.	03:34-03:50	12°42.4'N	143°29.9'E
2	29/Aug.	20:30-20:46	13°37.0'N	142°41.1'E
3	30/Aug.	06:15-06:32	13°12.8'N	143°13.3'E

Table 3. List of "Figure 8 turns"

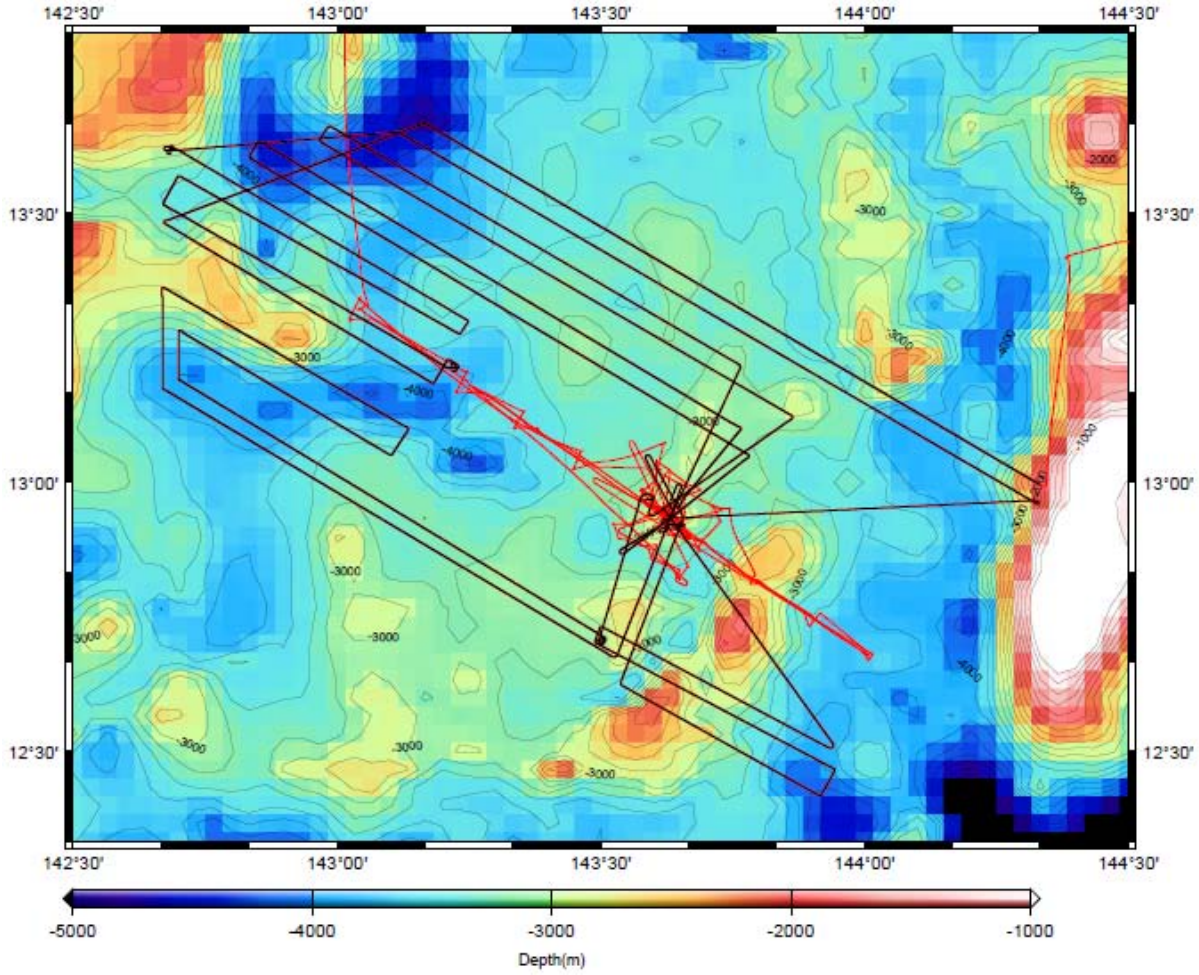


Fig. 2 Ship tracks (red and black lines) of the cruise in the survey area and black lines shows ship tracks for the surface geophysical survey