doi : 10.17596/0003180

Yokosuka-Shinkai 6500 “Cruise Report”

YK11-06

Suiyo Seamount and western part of north Pacific Ocean

Aug.29,2011-Sept.12,2011

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

* There is no prescribed format. Images such as photographs may be included.

●**Contents**

1. Cruise Information

● Cruise ID: YK11-06

● Name of vessel: Yokosuka

● Title of the cruise: Suiyo Seamount and Western Part of North Pacific Ocean

● Title of proposal

(1) Unusual lipid biomarker and nitrogen isotope compositions at the submarine hydrothermal site of Suiyo Seamount

(2) *In situ* measurements of carbon consumption/fixation rates by benthic communities at the abyssal plain and their importance on global carbon cycle

● Cruise period: 8/29/2011-9/12/2011

● Ports of call: JAMSTEC～HARUMI

● Schedule

The schedule was largely modified by Typhoon 12, which born at Guam area on August 25th. 8 dives were scheduled originally starting from August 31st. But the actual dive started from September 6th, because of safety escaping at Tokyo Bay for the first one week. Total number of dives was only 5. This made it difficult to achieve planned scientific goals as described in the proposals.

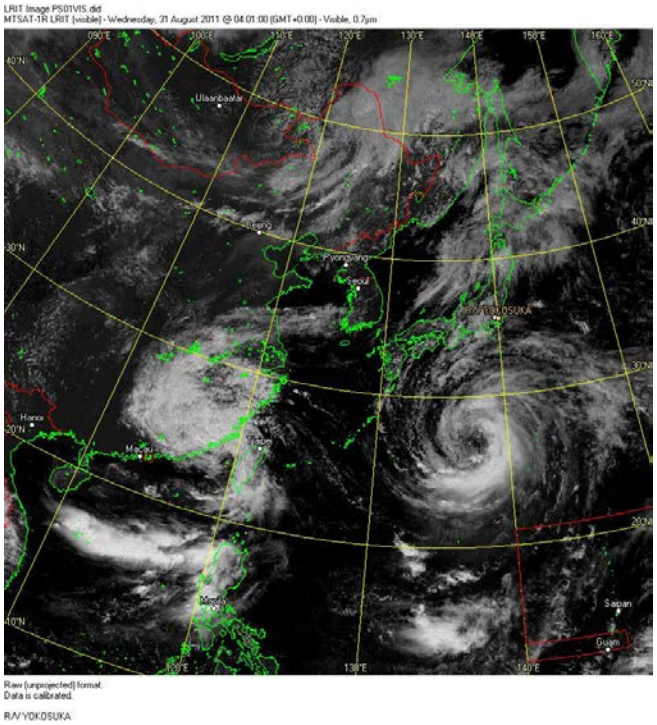


Fig.1: Weather map of August 31st.

August 29th	Fine weather, a port of call (Natsushima, JAMSTEC)
August 30th	Fine to cloudy, Safety escape from Typhoon 12 (stay at Tokyo Bay)
August 31st	Cloudy, partial rain, Safety escape from Typhoon 12 (stay at Tokyo Bay)
September 1st	Cloudy, partial rain, Safety escape from Typhoon 12 (stay at Tokyo Bay)
September 2nd	Cloudy, partial rain, Windy, Safety escape from Typhoon 12 (stay at Tokyo Bay)
September 3rd	Cloudy, partial rain, Windy, Safety escape from Typhoon 12 (stay at Tokyo Bay)
September 4th	Cloudy, fine, windy, leave for Suiyo Seamount at 9:00 a.m. Miyakejima at 18:00 p.m.
September 5th	Cloudy, Moving toward Suiyo Seamount (Torishima at 17:00 p.m.)
September 6th	Fine, slightly windy, dive at Suiyo Seamount (Dive1264)
September 7th	Fine, dive at western art of North Pacific Ocean (Dive 1265)
September 8th	Fine, dive at Suiyo Seamount (Dive1266)
September 9th	Fine, slightly windy, dive at western part of North Pacific Ocean (Dive1267)
September 10th	Fine, slightly windy. One crew became sick and today's dive was canceled. Helicopter rescue picked up a crew patient near Chichi jima at around 11 a.m. Then move toward Harumi.
September 11th	Fine, Moving toward Harumi. Arrived at Tateyama, Chiba at 17:00 p.m.
Spetember 12th	Fine, A port of call at Harumi, Tokyo

● Research are

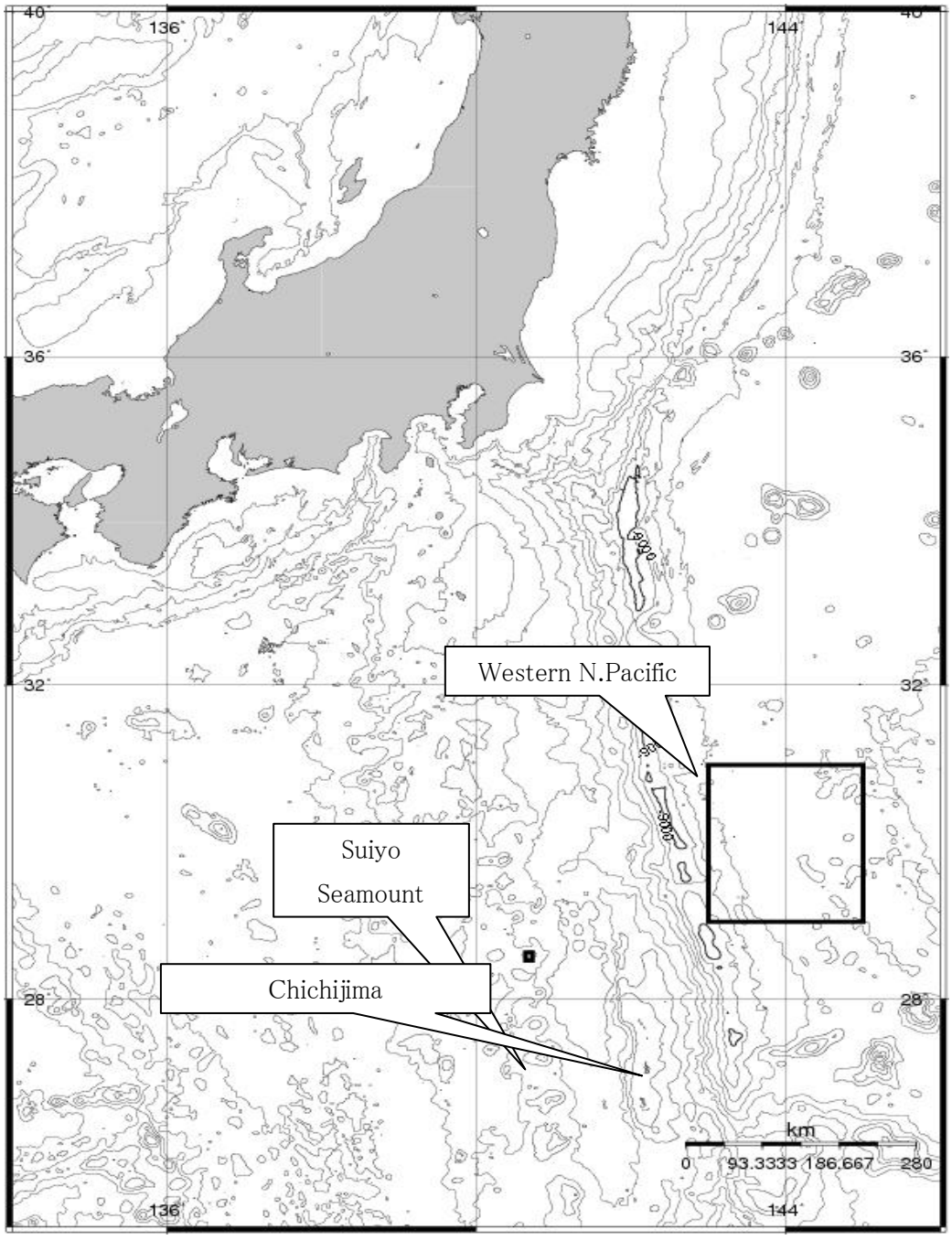


Figure 2: Locations of research areas.

● Research Map

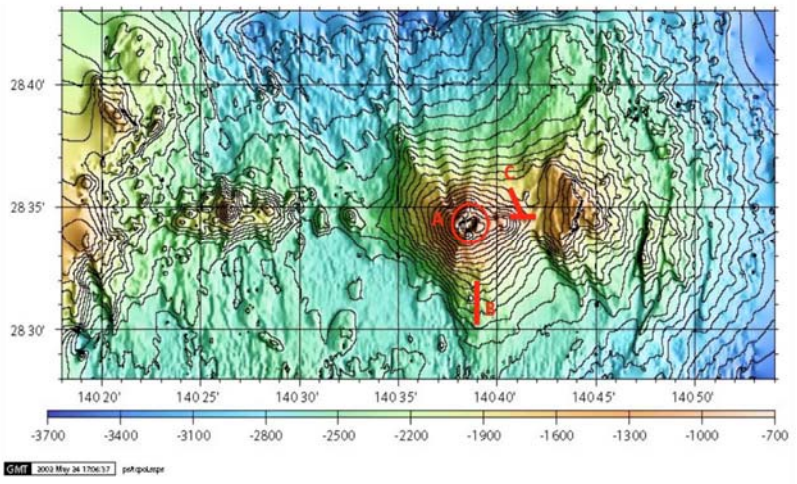


Figure 3: Bathymetrical map of the Suiyo Seamount

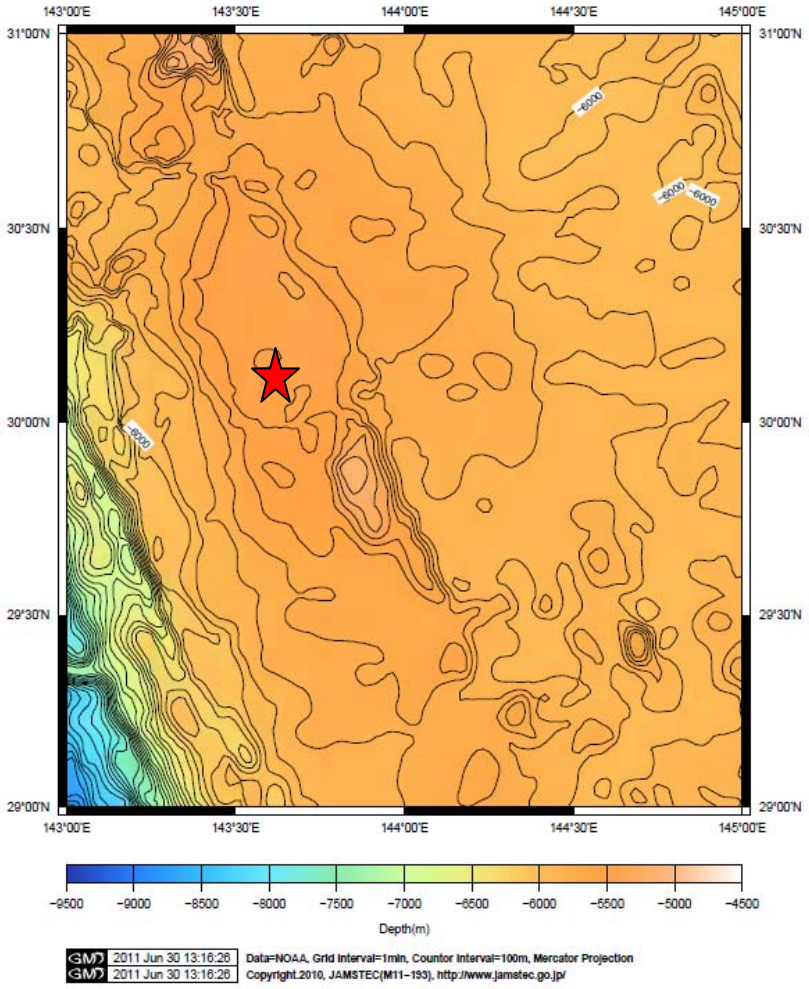


Figure 4: Bathymetrical map of the western part of North Pacific Ocean and the diving point (water depth = ~5370 m)

2. Researchers

● Chief scientist [Affiliation]:

Takeshi Kakegawa, Tohoku University

● Representative of the science party [Affiliation]

(1) Takeshi Kakegawa, Tohoku Univeristy for Suiyo Seamount

(2) Hidetaka Nomaki, JAMSTEC for Western part of North Pacific Ocean

● Science party (List)

<Scientists List>

Chief Scientist	TAKESHI KAKEGAWA [Univ. Tohoku]
	HIKARU HASHIZUME [Univ. Osaka]
	SATOSHI HANADA [IPOD, AIST]
	YOSHITSUGU NAKAHATA [Univ. Tohoku]
	MIKI HASEGAWA [Univ. Tohoku]
	KOJI MORI [NITE]
Co-chief scientist	HIDETAKA NOMAKI [Jamstec]
	KENTARO INOUE [Univ. Tokyo]
	MASASHI TSUCHIYA [Jamstec]
	Béatrice Lecroq [JSPS, Jamstec]
	Frederic Sinniger [Univ. Ryukyu]
	HARUKA SHIBATA [Univ. Kitazato]
	SEIJI MIYAWAKI [Univ. Kitazato]

<Crew List>

Captain	KOJI SAMESHIMA
Chief Officer	TAKAFUMI AOKI
Jr Chief Officer	TATSUO ADACHI
2nd Officer	SYOZO FUJII
3rd Officer	TSUBASA SHIOJIMA
Chief Engineer	HIROYOSHI KIKKAWA
1st Engineer	KIMIO MATSUKAWA
2nd Engineer	TADAHIRO MORI
3RD Engineer	KENTA IKEGUCHI
Jr 3RD Engineer	SYOGO YOSHIMURA
Chief Radio Officer	TOKINORI NASU
2nd Radio Officer	YOSHIKAZU KURAMOTO

3rd Radio Officer	RYOSUKE KOMATSU
Boat Swain	SYOICHI ABE
Able Seaman	NOBUYUKI ICHIKAWA
Able Seaman	MASANORI OHATA
Able Seaman	SAIKAN HIRAI
Able Seaman	SYUJI TAKUNO
Sailor	SHINSUKE UZUKI
Sailor	SYO SUZUKI
No1.Oiler	KAZUAKI NAKAI
Oiler	RYO SATO
Oiler	KAZUHO MURASE
Oiler	KEITA FUNAWATARI
Oiler	MASAYUKI FUJIWARA
Chief Steward	TERUYUKI YOSHIKAWA
Steward	TADAHIRO ABE
Steward	KATSUHIRO KAWASE
Steward	MIZUKI NAKANO
Steward	TORU WADA

<SHINKAI 6500 Team List>

Operation Manager	TOSHIAKI SAKURAI
Sub Operation Manager	SATOSHI OGURA
Submersible Staff	TSUYOSHI YOSHIUME
Submersible Staff	KEITA MATSUMOTO
Submersible Staff	HIROFUMI UEKI
Submersible Staff	MASANOBU YANAGITANI
Submersible Staff	KEIGO SUZUKI
Submersible Staff	HITOMI IKEDA
Submersible Staff	FUMITAKA SAITO
Submersible Staff	TAKUMA ONISHI
Submersible Staff	YUDAI TAYAMA
Submersible Staff	MASAYA KATAGIRI

<NME Marine Technician>

Marine Technician	SATOMI MINAMIZAWA
Marine Technician	TARO SHIRAI

3. Observation

3.1. Purpose and original plan

3.1.1. Suiyo Seamount

There exists three purposes for the Suiyo Seamount Project : (1) Lipid-biomarker and PCR examination for present and past microbial activities in cased pipes, which were drilled and settled at 2001 and 2002; (2) Detection of ^{14}N-enriched nitrogen isotope compositions in organic matter and clay-bound ammonia, to examine if "mantle" ammonia (or N_2) was already enriched in ^{14}N beneath the Suiyo Seamount; and (3) finding novel microbes, which may useful as resources.

In proposal, we propose to survey three areas, named as areas A, B and C in the western peak of Suiyo Seamount (Fig. 2). The area A is the inside of crater and its water depth is about 1350 m. The area B, approximately 2000m in water depth, is located on the southern slope of the western peak. The area C is the flat area between western and eastern peaks. The water depth is corresponded to 1400 to 1800 m. Submarine hydrothermal activities are very high at the area A. Shallow subsurface areas of A was drilled by a past scientific project called Archean Park Project, and there exists several cased pipes in this region. Some drilled holes penetrated into subsurface hydrothermal aquifer and the drilled action created artificial discharging vents. Sulfide and silica mineral sinters developed inside of some cased pipes, and some pipes still discharging a part of hydrothermal fluids weekly. Previous studies found that some sinters were rich in organic matter, suggesting high microbial activities in cased pipes. Only lipid-biomarker studies were performed on the previously collected limited amounts of sinters. We plan to collect more sinters and then try to perform PCR analyses to constrain more about microbial activities. Mineralogical and stable isotope studies will be performed on the same samples. All information, in addition to the past data, are combined and developing history of microbial activities in the cased pipes will be constrained. For the purpose of PCR analyses, hydrothermal fluids which temperature ranges 30～150℃ and discharging natural vents, will be sampled by bag sampling method. Finding novel microbes is also purposed through the above research.

Previous researches indicated the presence of unusually ^{14}N -enriched ammonia in hydrothermal fluids at Suiyo Seamount. However, number of ^{14}N -enriched samples is limited and it was uncertain if ^{14}N -enriched features are very local or widespread in Suiyo Seamount. The presence of ^{14}N -enriched nitrogen species at Suiyo Seamount, rises another question as to if mantle nitrogen is already depleted in ^{15}N or submarine hydrothermal system has a unique isotope fractionation system. In order to approach this question, fresh igneous rocks will be collected. In particular, plagioclase-rich samples or volcanic glasses are desired materials to be collected.

3.1.2. Western part of North Pacific Ocean

Faunal compositions, metabolic activities, and biogeochemical cycles at the abyssal plain and their importance on global carbon cycle

Deep-sea is the largest single marine-ecosystem on earth. Abyssal plain dominates most of the deep-sea area while continental slope and trench dominate relatively smaller area. We have investigated on biogeochemical cycles and biological activities mainly on continental slope (Sagami Bay, Arabian Sea, etc) because major part of the C and N burial occurs at this area. However, little is known about biogeochemical cycles at the abyssal plain even though its potential importance.

Here, we investigated 1) mega- and macro-benthos community, meiofaunal community, protist community, and microbial community, 2) porewater chemistry, and 3) protists and microbial activity in situ. For the purpose 1), we observed mega- and macrobenthos by the camera of SHINKAI 6500 and collect some of them by using a suction sampler and push cores. Meiofauna, protist, and microbe communities were investigated with the push cores. Porewater samples were extracted from the sediments collected by a long push core (core tube length = 50 cm). *In situ* benthic activities were investigated by *in situ* incubation cores and chambers using different kinds of ^{13}C- or ^{15}N- labeled substrates.

3.2.Observation

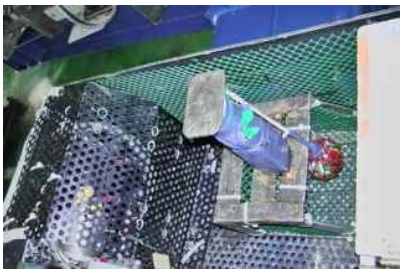
3.2.1.Methods and Instruments

3.2.1.1. Suiyo Seamount

Shinkai 6500 equipped with two baskets for sampling. Three sample boxes were set in one basket. A scoop is also stored in this basket. The other has three plastic bags for water sampling and two M-type mud samplers. A thermometer is equipped with an injection tube for water sampling. A switching valve is located between benthic a pump and each bag. This valve has four outlets and three are connected to bags and one is open to sea water.

Fig. 5. Entire view of payloads for Suiyo Cruise

M-type mud collector



Benthic Scoop

Water sampling bag

Pump and switcher

Figure 6 Representative payloads

3.2.1.2. Western part of North Pacific Ocean

We used several different types of sampling gears and incubation gears. For sediment samplings, we used two different diameter of push cores (inner diameter = 82 mm and 110 mm). For the sampling of megabenthos and macrobenthos, we used a suction sampler in addition to push cores. Water samples were also collected with Niskin bottles. In situ incubation cores and a chamber were used for in situ measurements of metabolic activities of the deep-sea benthic community. Payload pictures of dive # 1265 and 1267 represents above sampling gears on the *Shinkai 6500* baskets.

3.3. Research (Survey) Results

3.3.1. Cruise log (see appendix)

3.3.2. Dive information

Dive #1264

Diving Scientist: Koji Mori,

September 6th , Inside of crater of Suiyo Seamount.

We collected sulfide mounds, igneous rocks, volcanic sands (pumice), mussels and water samples. Most samples were directly collected by a manipulator, and then stored in separated sample box. Volcanic sands were collected by M-type mud collectors.

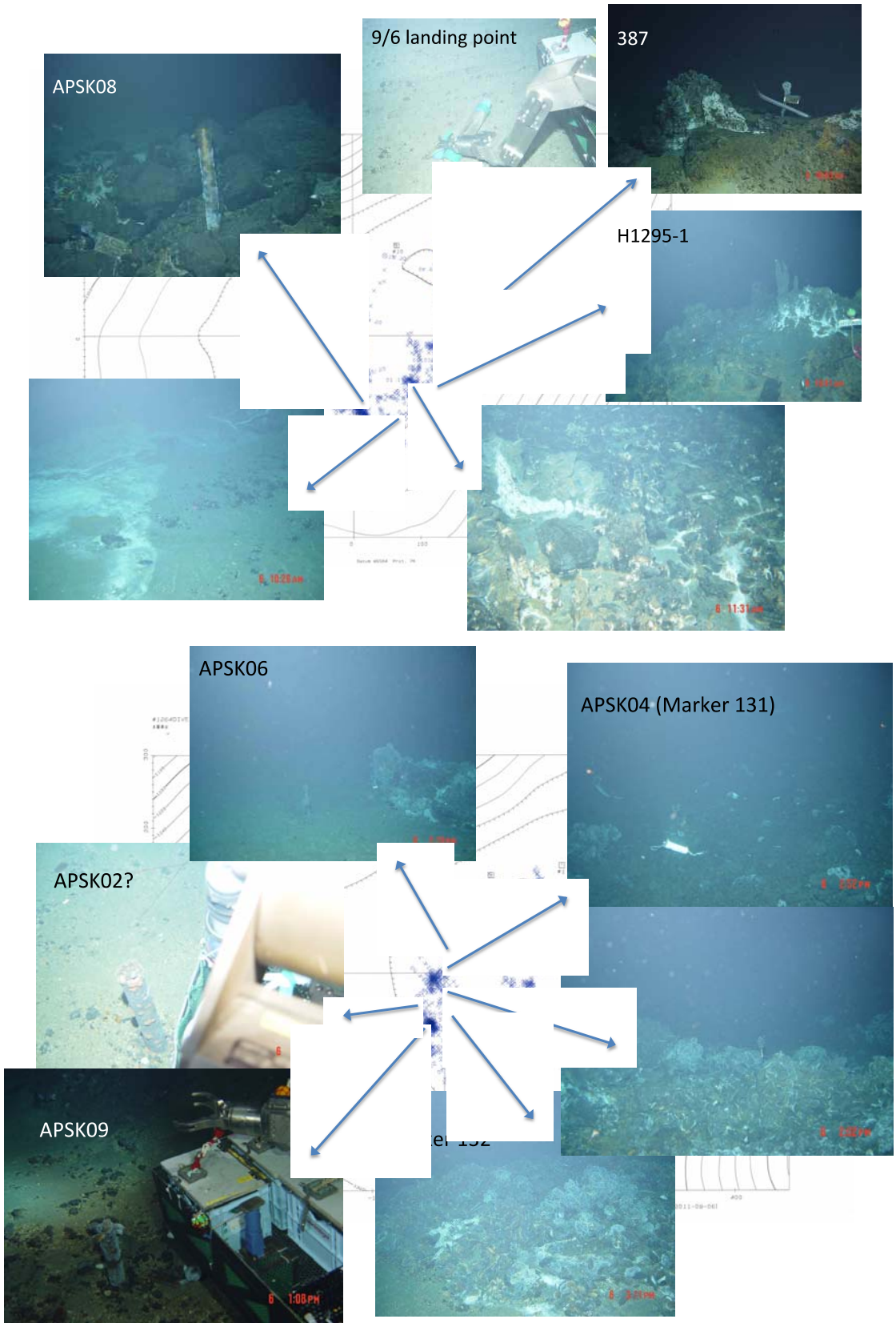
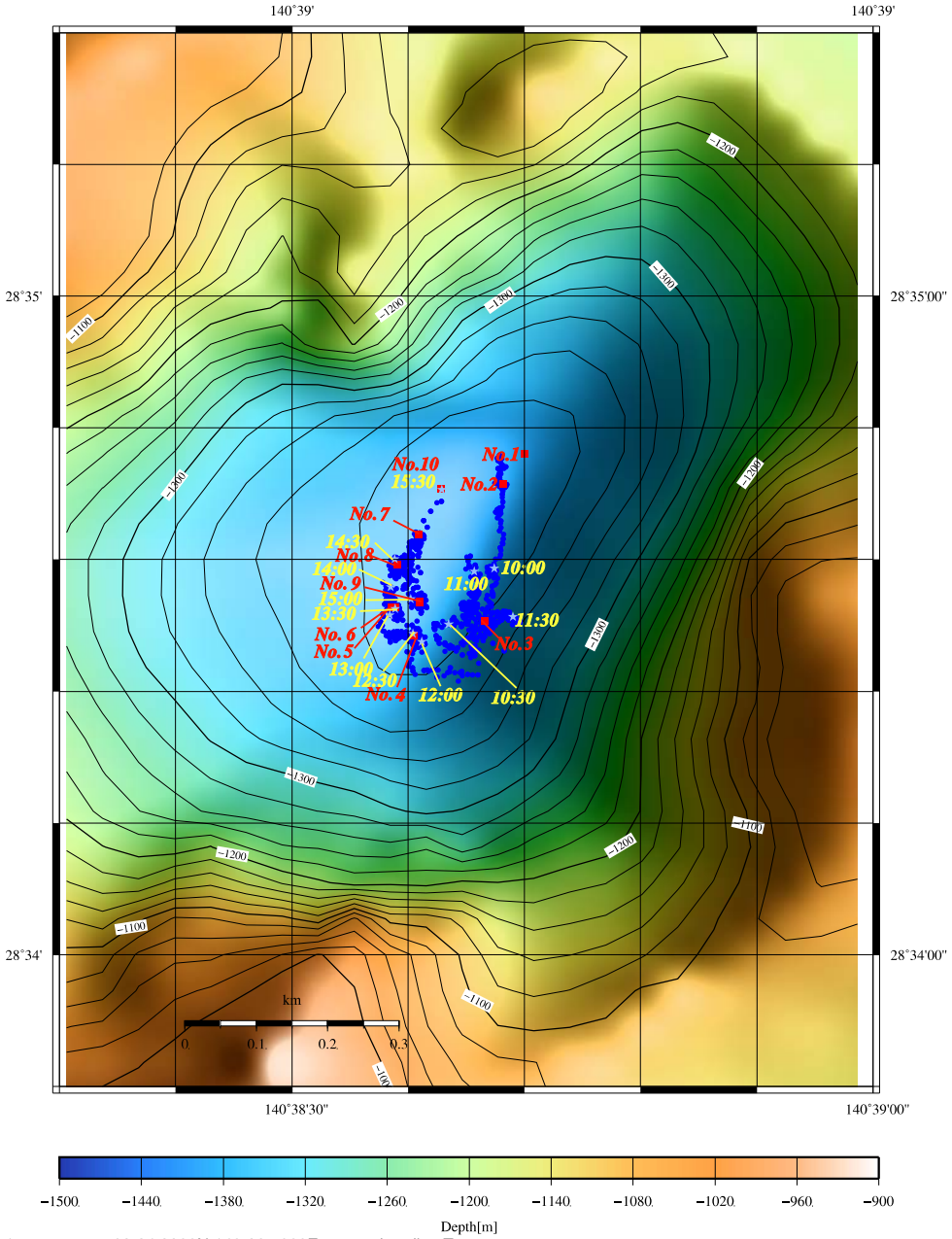


Figure 7: Representative photos and locations at Dive 1264

1264DIVE



No.1		28-34.3800N,140-38.7000E	Landing Target
No.2	9:40	28-34.3574N,140-38.6814E	Landing, Sampling Core-M(green) D=1382m
No.3	10:40	28-34.2534N,140-38.6658E	Finding #1285-1 Marker D=1378m
No.4	12:42	28-34.2419N,140-38.6051E	Sampling Rock(2),Water(#1Bag),Mussels D=1380m
No.5	13:50	28-34.2639N,140-38.5892E	F.#570-1 Marker S.Water(#3Bag),Mussels,Rocks Core-M D=1380m
No.6	13:54	28-34.2641N,140-38.5853E	Finding Pipe D=1379m
No.7	14:19	28-34.3195N,140-38.6094E	Finding APSK06 D=1384m
No.8	14:52	28-34.2964N,140-38.5910E	Finding APSK04,Set #131 Marker D=1382m
No.9	15:20	28-34.2681N,140-38.6098E	Sampling Rocks(2), Set #132 Marker,Retrieve Marker D=1380m
No.10	15:30	28-34.3727N,140-38.6401E	Left Bottom D=1375m(A=11m)

Figure 8: Event map of dive 1264

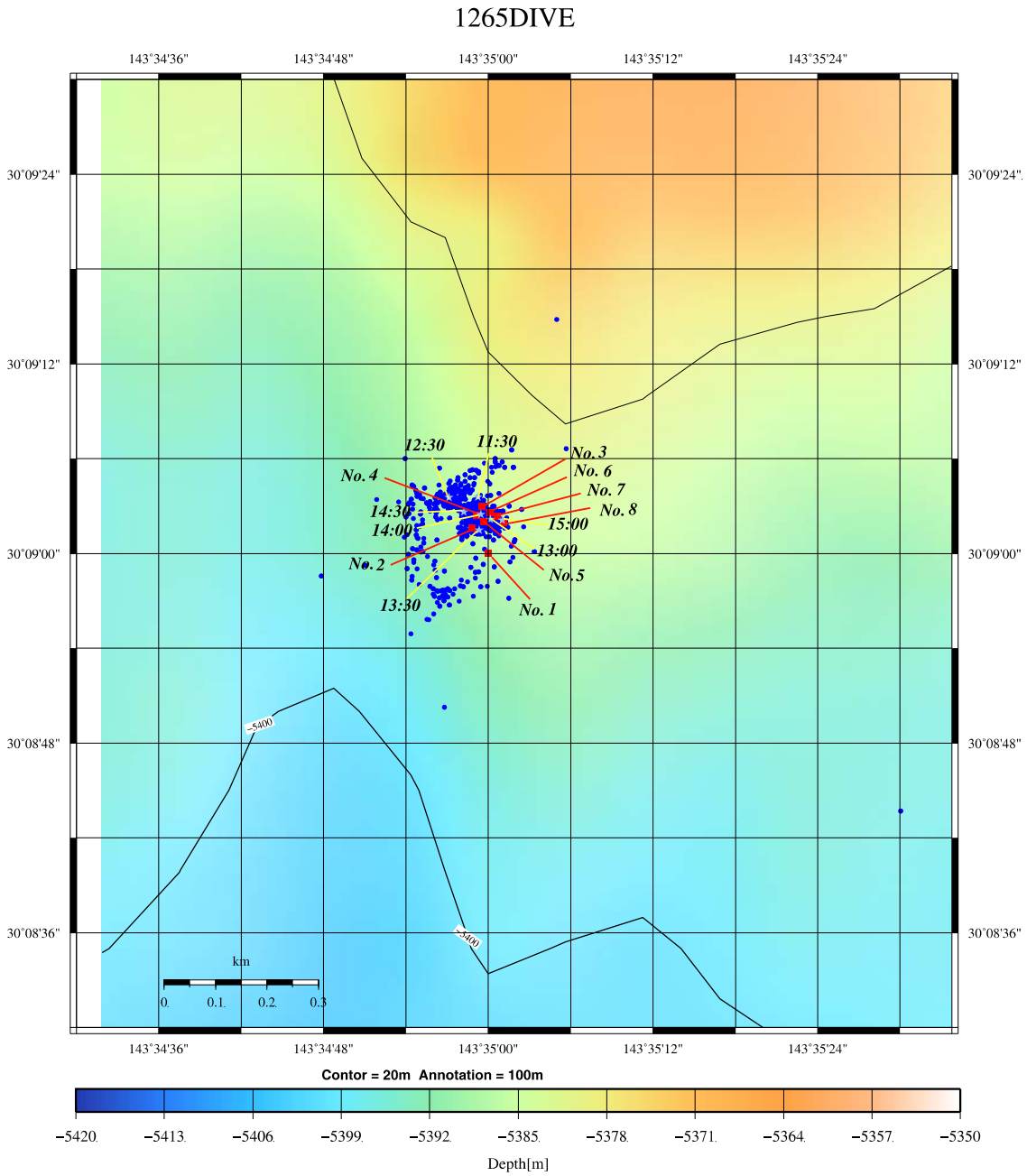
Dive 1265

Dive scientist: Hidetaka Nomaki

7th September, east off Torishima

We deployed 12 in situ incubation cores on the seafloor at the water depth of 5370 m (No 3 in the Map below). Four of them were recovered immediately after the deployments. In situ incubation chambers were also deployed at the same point. 9 cores were collected from the surrounding area including some Xenophyophore. Mega- and Macrobenthos were also collected with a suction sampler.

Figure 9: Payload for dive 1265



No.1		30-9.0000N,143-35.0000E Landing Target
No.2	11:20	30-9.0274N,143-34.9801E Landing D=5370m
N0.3	13:14	30-9.0336N,143-34.9950E Set In-situ Core(8), Incubation chamber, #134 Marker D=5370m
N0.4	13:53	30-9.0397N,143-34.9859E Sampling Core(No.8),Set In-situ Core(2) D=5370m
N0.5	14:40	30-9.0494N,143-34.9917E Sampling Core(6), Core-long, In-situ Core(2),Animals D=5370m
N0.6	14:46	30-9.0433N,143-35.0025E Sampling Animals D=5370m
N0.7	14:51	30-9.0393N,143-35.0104E Sampling Animals(2) D=5370m
N0.8	15:00	30-9.0328N,143-35.0183E Sampling Core, Set #133 Marker, Left Bottom D=5369m

Figure 10: Event map for dive 1265

Dive 1266

Diving Scientist: Satoshi Hanada

September 8th , Inside of crater of Suiyo Seamount.

We collected sulfide mounds, igneous rocks, volcanic sands (pumice), mussels and water samples. Most samples were directly collected by a manipulator, and then stored in separated sample box. Volcanic sands were collected by M-type mud collectors. We could revisit APSK01, 04 and 07 sites which were drilled year of 2001.

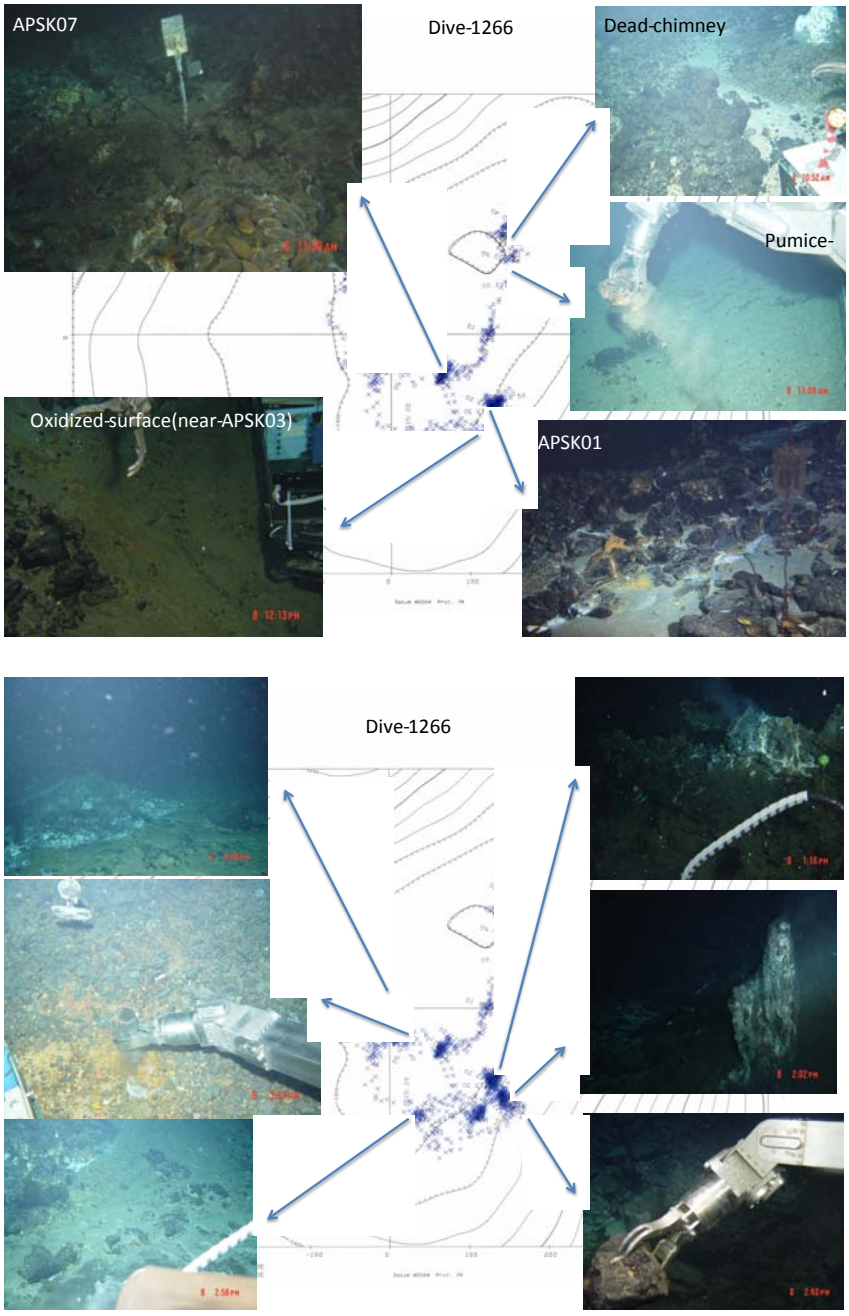
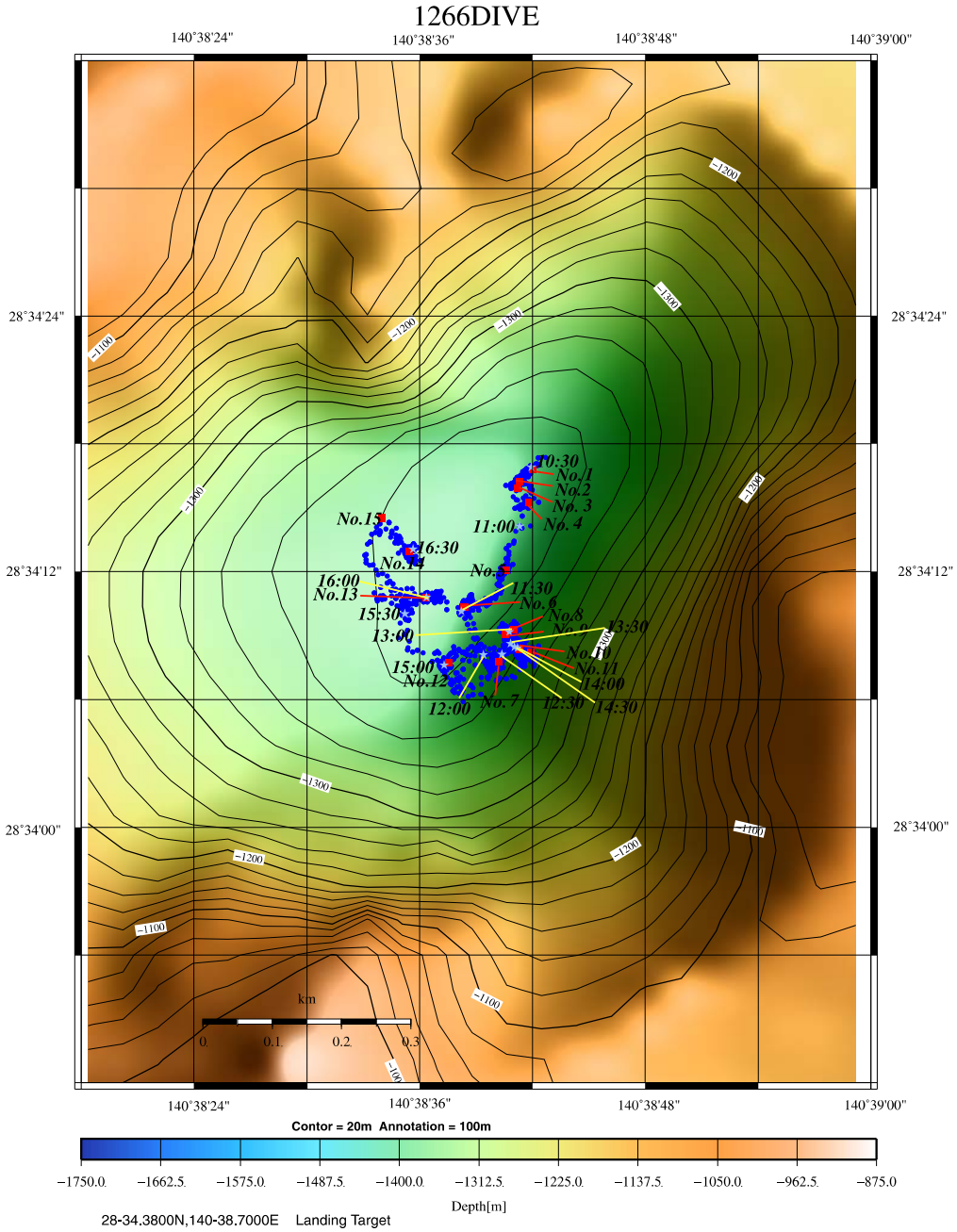


Figure 11: Representative photos and locations for dive 1266



No.1		28-34.3800N,140-38.7000E	Landing Target
No.2	10:37	28-34.3707N,140-38.6883E	Landing D=1382m
No.3	10:44	28-34.3657N,140-38.6867E	Sampling Rock(1) D=1384m
No.4	10:55	28-34.3541N,140-38.6969E	Sampling Rock(1) D=1386m
No.5	11:09	28-34.3011N,140-38.6769E	Sampling Rock(1) D=1386m
No.6	11:51	28-34.2722N,140-38.6393E	Sampling Rocks(2), Mussels D=1382m
No.7	12:23	28-34.2300N,140-38.6703E	Sampling Core-typeM(green) D=1374m
No.8	12:38	28-34.2542N,140-38.6838E	Finding APSK01 D=1377m
No.9	13:31	28-34.2509N,140-38.6761E	Sampling Chimney, Bag D=1378m
No.10	14:32	28-34.2390N,140-38.6881E	Finding Chimney, Sampling Chimney D=1370m
No.11	14:42	28-34.2370N,140-38.6983E	Sampling Rocks(4) D=1356m
No.12	15:00	28-34.2289N,140-38.6256E	Finding Hidrothermal vent, Sampling Rock(1) D=1381m
No.13	16:04	28-34.2798N,140-38.6057E	Sampling Bag D=1382m
No.14	16:34	28-34.3155N,140-38.5910E	Sampling Rock(1) D=1378m
No.15	16:39	28-34.3417N,140-38.5667E	Left Bottom D=1373m

Figure 12: Event map for dive 1266

Dive 1267

Dive scientist: Masashi Tsuchiya

9th September, east off Torishima

We recovered 8 in situ incubation cores and three push cores from the incubation chamber. We also collected 13 push cores from neighboring areas. Mega- and Macrobenthos were also collected with a suction sampler. A rock and a beverage can were also collected, although the can has been lost while recovering on board.

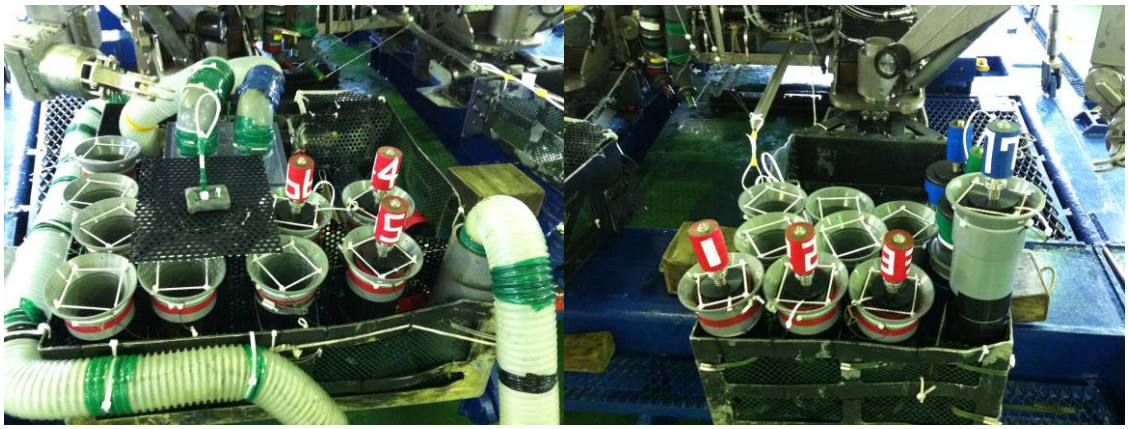
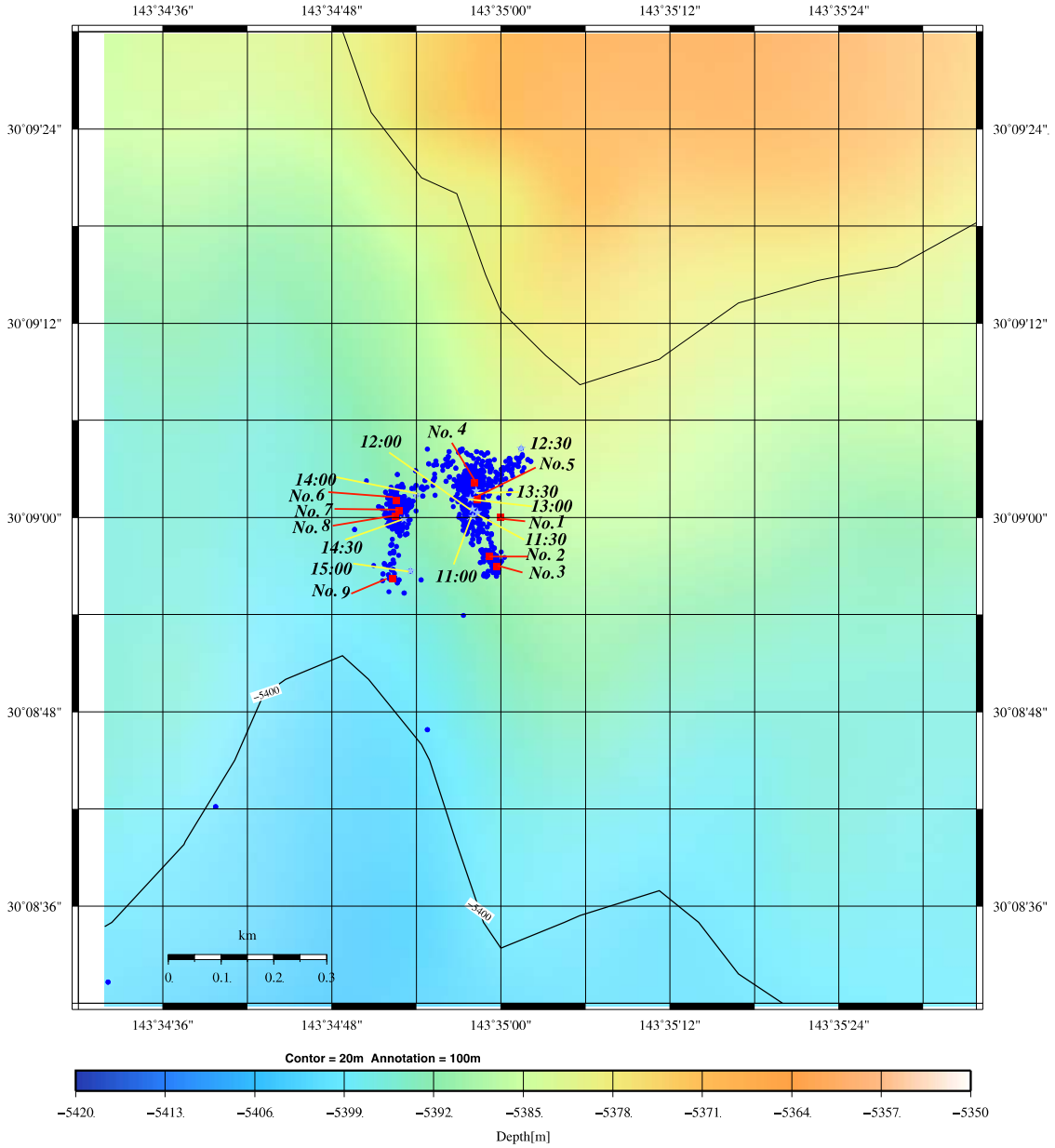


Figure 13 : Payload of dive 1267

1267DIVE



No.1 30-9.0000N,143-35.0000E Landing Target
No.2 11:10 30-8.9596N,143-34.9867E Landing, Sampling Niskin(2) D=5373m
No.3 11:22 30-8.9495N,143-34.9950E Sampling Animals(2) D=5373m
No.4 12:15 30-9.0184N,143-34.9718E Sampling MTcore(2),MBARI(#1,2,3,4,5,6),MBARIIong(1) D=5371m
No.5 13:38 30-9.0355N,143-34.9693E Retrieve InsituCore(8),Chamber Sampling Core(#7,8,9) D=5370m
No.6 14:13 30-9.0173N,143-34.8763E Sampling Animal, Rock D=5374m
No.7 14:30 30-9.0067N,143-34.8790E Sampling Animals(2), Sea cucumber D=5374m
No.8 14:45 30-9.0011N,143-34.8746E Sampling Can, Core(#0) D=5374m
No.9 15:03 30-8.9370N,143-34.8715E Left Bottom D=5377m

Figure 14: Event map of dive 1267

3.4. Research Information

3.4.1. Suiyo Seamount

(1) Stored rock samples at -80 degree C for the genomic DNA extraction (S. HANADA & K. MORI, AIST and NITE)

Collected samples (rocks and precipitates) were immediately stored in 2-mL tube at -80 degree C for the future microbial DNA research.

(2) Inoculation of water and rock samples to cultivate useful microorganisms (S. HANADA & K. MORI, AIST and NITE)

Various samples were inoculated into various media for enrichments of methanogens, sulfate reducers, fermenters, sulfur oxidizers, methane oxidizers, hydrogen oxidizers and other heterotrophs that inhabit a deep-sea hydrothermal field in Suiyo Seamount. All inoculated cultures were temporary kept at 4 degree C, and then will be incubated at the preferable temperatures after getting off the ship.

(3) Geological Surveyed Results

3-a: Change of hydrothermal activity since 2001

This research group has been studying the Suiyo submarine hydrothermal field since 2001. At 2001 and 2002, total of 10 sites were drilled and then cased by Fe or Fe-Ti pipes. Those sites are named as “APSK” sites. Distribution of black/grey smokers and sulfide mounds were illustrated in Fig.15, which was constructed using information from 2001 to 2003 cruises. At 2005, almost identical situation was observed by Natushima-Hiper-dorphine cruise. High temperature hydrothermal activities in 2001 to 2003 were concentrated in “central hydrothermal area” where high densities of mussel colonies are observed. Weak hydrothermal activities were observed in the eastern edge of crater (eastern hydrothermal area), where only clear smoker activities were observed except one locality near APSK01.

Points indicated by stars are sites where new hydrothermal activities were recognized. In particular, black smoker discharging was rare in the eastern hydrothermal area previously, but new activity (28°34.2289N, 140°38.6256E) was found during this cruise. At this site, black mounds are developing. Such black mounds are typical fine grains of sulfides, which are most likely still in amorphous phases before aging to transit crystalline FeS2, CuFeS2 and/or ZnS. In addition, Shinkai 6500 observed 1m high x 3m width of mound development in the eastern area of APSK03, where hydrothermal activities were considered to be low. Those findings suggest that hydrothermal activities in the eastern hydrothermal area are becoming higher than those at 2003 to 2005.

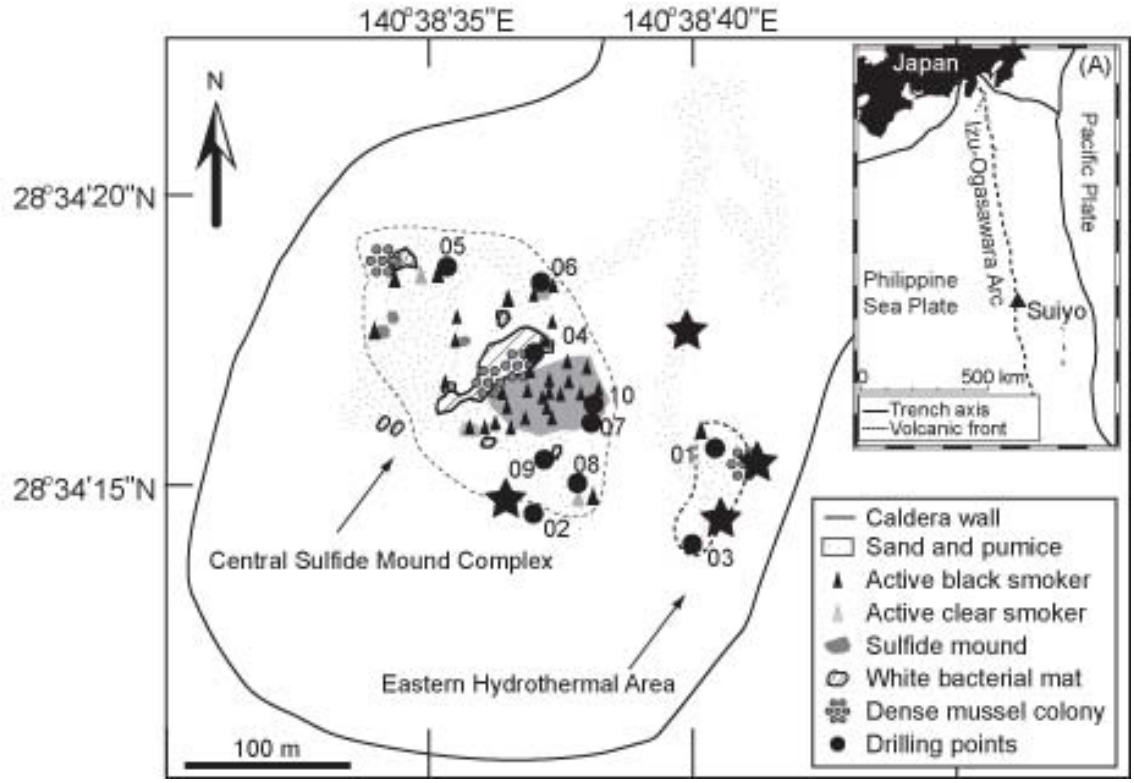


Figure 15: Distribution of black smokers, sulfide mounds, and mussels in Suiyo Seamount crater. Star symbols in this figure represent new hydrothermal sites, which were not discovered by previous cruise.

In the central hydrothermal area, black smokers are actively discharging accompanied with mussel colonies. Hydrothermal activities in this area are not changed apparently since 2005. But there is an impression that activities of sulfur-oxidizing bacteria, which form dense filaments on the shell surface, are less compared to those at 2001. It is uncertain if this represents less discharging H_2S from hydrothermal fluids, corresponded to decreasing hydrothermal activities in the central hydrothermal area.

3-b: Change in the specific site

APSK01

This site was drilled and cased (Fe pipe) at 2001. Drilled rocks indicate that sulfide mounds are covering the surface by a few cm at this point. Clear smoker (ca.78C) was discharging through the pipe. Termination of discharging fluids was confirmed at 2002, and cased pipe was oxidized and broken by 2005. Weak hydrothermal activities from natural vents were recognized at around APSK01 in 2005 (Fig.16). Small colonies of mussels are distributed about the10m x10m area before. APSK01 marker (15cm x15cm plate) is still present, although bacteria cover on the marker-plate surface. However, it is found that most colonies disappeared. This is most likely because of migration of discharging points

toward east. Such migration is caused by clog of subsurface hydrothermal channels. This interpretation is consistent with finding new black smoker discharging at more eastern side. The cased pipe was completely oxidized and no longer exists.

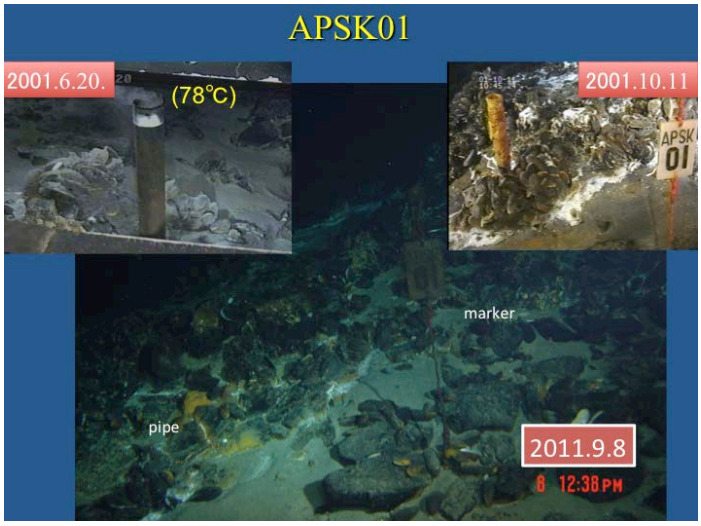


Figure 16: Development of APSK01 site from 2001 to 2011.

APSK04

This site was drilled and cased (Fe pipe) at 2001. Clear smoker (ca.40C) was discharging through the pipe right after the drilled action. Discharging fluids was not visible in 2002, and cased pipe was filled with precipitates. Mussel's habitat was observed at the top of the pipe in 2005. During this cruise, precipitated in the pipe removed and the temperature was measure at 14C. This suggests that a fluid is still discharging through the pipe. Black appearance of precipitates suggests the presence of sulfide. In order to avoid oxidation of sulfides, continuous supply of reduced fluids are necessary. Therefore, it is reasonable to consider that fluid supply is still on going through this pipe, although permeability is not good. We set new marker 132 here.

APSK07

APSK07 was drilled in 2001 and cased by Fe pipe. Platy marker is still present at this location. At that time, black smoker was discharging through the pipe, forming a small chimney. At 2002, black smoker discharge was not recognized but weak hydrothermal discharging was observed at APSK07 (Fig.17). During this cruise, it is found that hydrothermal discharge was completely terminated at APSK07, accompanied with more seafloor weathering (oxidation) of sulfide mounds. We set new marker 131 near this site.

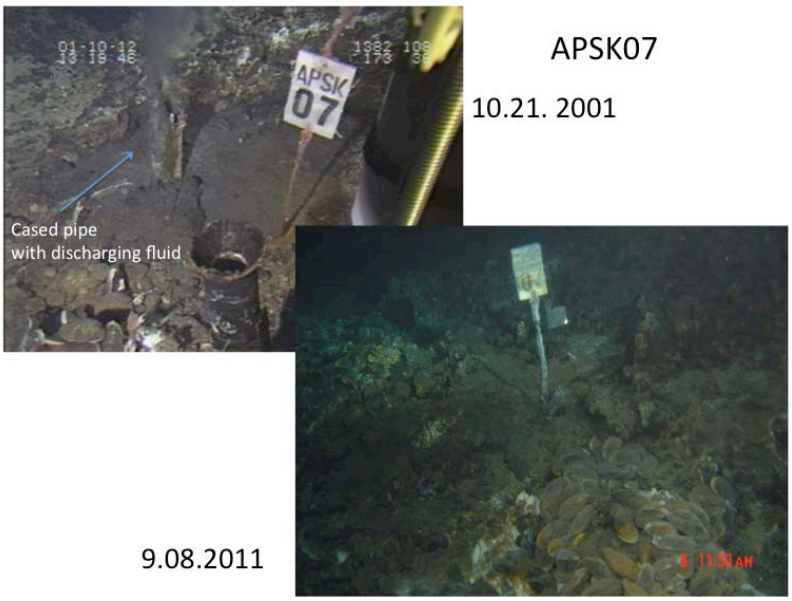


Figure 17: Development of APSK07 from 2001 to 2011.

APSK08

This site was drilled and cased (Ti-coated Fe pipe) at 2002. No fluids were discharged and no thermal activities were found when it was drilled. The same feature (no thermal activities and biological habitation, etc.) was found during this cruise.

APSK09

Surprisingly, the appearance of the cased pipe (Ti-coated Fe pipe) at APSK09 is not changed since 2002. When a thermometer is inserted inside cased pipe, temperature increased from 3.5 to 4.5 C. This maybe indicate that a fluid is still discharging through the same pipe, although it is uncertain if such fluid supplied from a diffusive flow or a part of the major discharging fluid.

3-c: Temperature of hydrothermal fluid

Temperatures of hydrothermal fluids were measured by thermocouples owned by Shinkai 6500 team. Fig.18 illustrates the measured temperature at each sites. Surprisingly, some artificial pipes, which were drilled and cased at years of 2001 or 2002, seem to discharging hydrothermal fluids. For example, a temperature of APSK09 fluid was 4.5C, although the ambient water temperature was about 3.5C. Such slight change of temperature may suggest that hydrothermal fluids are still "leaking" through the cased pipe. Indeed, mussels and S-oxidizing bacteria are active on the tope of the pipe. The temperature of inside APSK04was 14dC, though no visible hydrothermal discharge.

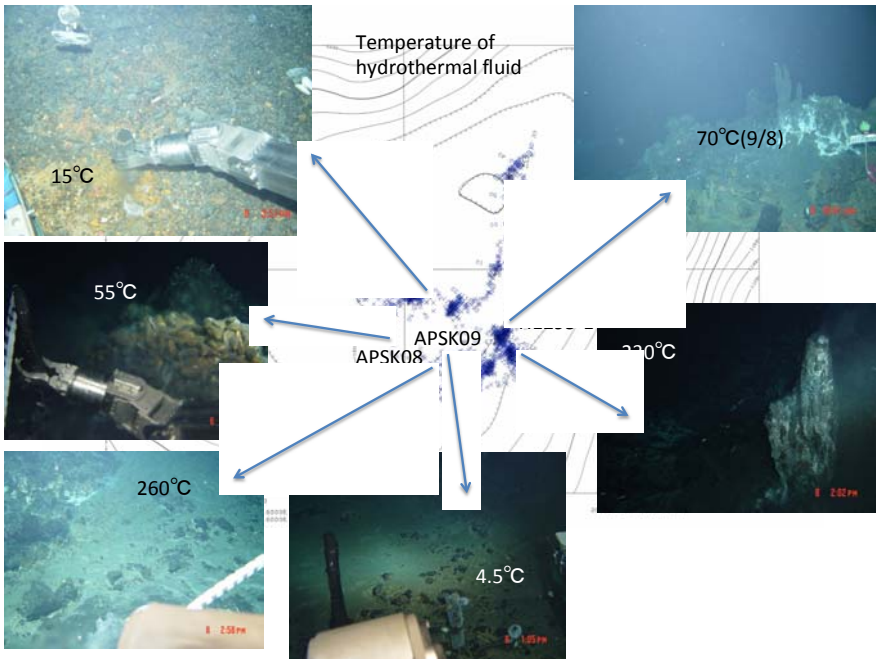


Fig.18 Temperature of hydrothermal fluids (measured either on 9/6 /2011or 9/8/2011)

3.5. Future Plans

3.5.1. Suiyo Seamount

(1) Nano scale mineralogy of sulfide and sulfate (Hasegawa, Kakegawa, Tohoku University)

Large numbers of publications exist for mineralogical and geochemical studies of submarine hydrothermal chimney and mounds. In most cases, microscopic euhedral shape of sulfides and sulfates are dominant crystal forms. On the other hand, unusual crystal forms, such as framboidal or colloform (finely laminated and fonded) pyrite, are often reported from the present and ancient hydrothermal chimneys. There is no report for such unusual morphology of sulfides at Suiyo Seamount because of the absence of detailed mineralogical studies. Here we perform detailed mineralogical studies based on X-ray diffraction, SEM observation and electron microprobe analyses at Tohoku University. In addition, sulfur isotope analyses will be performed on each sulfide at Tohoku University. When we find the unusual morpphology of sulfides, we extend to study to constrain the origin of texture and/or structure in nano scale. We hypothesize that the presence of organic molecules, such as protein, may have some roles (e.g., surface activating agents) to form framboidal and/or colloform pyrite. We further speculate that microbial activities on the surface of sulfides were responsible for such unusual morphology. Therefore, our study will be extended to organic geochemistry. Peptide/lipid analyses will be performed at Tohoku University on the unusual morphology, using GC and HPLC. Detailed TEM and laser Raman spectroscopy analyses will also be conducted to observe nano-structure of interface of crystal boundary.

(2) Nitrogen isotope analyses on biological samples, clays and volcanic rocks (Nakahata, Hashizume,

Kakegawa, Tohoku University and Osaka University)

Presence of very ^{14}N-enriched ammonia was suggested by previous preliminary analyses of nitrogen isotope compositions of clays and volcanic rocks at the Suiyo submarine hydrothermal field. However, number of analysis was limited in the previous study. Nitrogen isotope analyses of samples collected by this cruise may help to understand as to whether (1) ^{14}N-enriched features are widespread inside Suiyo, (2) mantle derived N_2 are already enriched in ^{14}N and (3) inorganic conversion of N_2 to ammonia are happening in the hydrothermal fluids. Nitrogen isotope analyses will be performed at Tohoku University and Osaka University. Tohoku University has a facility to perform conventional nitrogen isotope analyses. This method is suitable for bulk rock analyses or biological samples. Osaka University has a mass spectroscopy equipped with a step-heating gas extraction system. This is suitable for analyses of clay bound ammonia and rear nitrogen in volcanic rocks.

Nitrogen isotope compositions of biological samples, mostly mussels and S-oxidizing bacteria, were freeze-dried and then analyzed directly at Tohoku University. Clay minerals will be separated from rocks at Tohoku University. X-ray diffraction analyses identify the clay type, such as montmorillonite or chlorite. Those clay most likely bounds ammonia in their structure, behaving a "catcher" of hydrothermal ammonia. Nitrogen isotope compositions of those clays will be analyzed at Osaka Univeristy. The step-heating gas extraction method at Osaka University will be able to separate hydrothermal ammonia and ambient N_2 or NO_3^- adsorbed on clays.

Volcanic glasses and plagioclase will contain volcanic nitrogen coming directly from mantle. Therefore, nitrogen isotope analyses on those samples are useful to constrain the "mantle" value. Volcanic glasses and plagioclase will be separated at Tohoku University and characterized by standard X-ray and EPMA system. Then nitrogen isotope compositions will be analyzed at Osaka University. The method at Osaka University allows accurate and distinctive analyses of nitrogen isotope compositions of volcanic rocks, separating contamination from air and sea water.

(3) Microbial DNA researches (S. HANADA & K. MORI, AIST and NITE)

To evaluate the relationship between rock and microorganisms, we will perform the microbial molecular analyses such as quantitative PCR and clone library. The target genes are the 16S rRNA and metabolism-related genes.

(4) Enrichment and isolation of useful microorganisms (S. HANADA & K. MORI, AIST and NITE)

On board, collected samples were inoculated into various media. These cultures will be incubated in the laboratory at several different temperatures. Enrichments showing microbial activities will be analyzed by using the 16S rRNA gene comparison, and unknown organisms in the enrichments will be isolated.

3.5.2. Western part of North Pacific Ocean

3.5.2.1. *In situ* measurements of carbon consumption/fixation rates by benthic communities at the abyssal plain and their importance on global carbon cycle

Hidetaka Nomaki, Kentaro Inoue

Purpose

Phytodetritus is believed to be a sole food source for abyssal plain, where no chemosynthetic communities and slope-derived organic matters. However, recent microbial investigation revealed that chemoautotrophs may also be present at the deep-sea floor. Here, we carried out in situ ^{13}C- and ^{15}N-tracer experiments using manned submersible *SHINKAI 6500* at the well oxygenated abyssal plain at east off Torishima, western North Pacific to elucidate in situ activities of autotrophic microbes and its relative importance to phytodetritus derived from photic zone .

Materials and Methods

In situ incubation experiments were carried out at east of Torishima (water depth of 5370 m). We used two different types for *in situ* incubation; *in situ* incubation cores (inner diameter = 8.2cm) and an open box type incubation chamber (Nomaki 2011, KY11-01 cruise report). On 7th September, during Dive# 1265, we deployed 12 *in situ* incubation cores and one open box incubation chamber on the undisturbed seafloor. Incubation cores were settled 50 to 100 cm away from each other. Four out of 12 cores recovered immediately after deployments as time-0 controls. The other 8 cores were incubated for 2 days *in situ*. Three push cores were collected from the inner part of chambers. Two push cores were sampled at some tens meters away from the incubation station to investigate porewater compositions and natural background information. The inner diameter of the push cores were same to incubation cores (8.2cm).

Overlying water of the cores were sampled for the measurements of carbon isotopic compositions of dissolved inorganic carbon. Sediments were sectioned every half cm depth from the sediment surface to 3cm, every 1 cm from 3 to 5cm, and followed by 5-7, 7-10, and 10-15cm. They were separated into subsamples for 1) foraminifera, 2) bulk sediment analysis, and 3) microbial analysis (see Chapter by K

Inoue).

Future works

The sediment samples will be thawed and then sieved on the 32 μm screen using artificial seawater. Benthic foraminifera and metazoan meiofauna will be picked out from the sieved sediments. Both autotrophic activities and heterotrophic activities will be evaluated by both incorporation of label into those organisms and microbes and production/mineralization rates of carbon of the overlying water.

3.5.2.2. Bacterial community structure and function at a sediment-water interface at the Abyssal Plain

Kentaro Inoue,[1] Hidetaka Nomaki[2] and Kazuhiro Kogure[1]

[1] Atmosphere and Ocean Research Institute, the University of Tokyo

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

Introduction

Deep-sea is the largest single marine-ecosystem on earth. Abyssal plain dominates most of the deep-sea area while continental slope and trench dominate relatively smaller area. The purpose of this study was to clarify ecological characteristics of prokaryotic communities at the well oxygenated sediment-water interface (SWI) at the abyssal plain in the western part of North Pacific. In order to achieve the subject, we are investigating microbial community structure and function by molecular biological techniques and *in situ* incubation experiments as described below.

Sample treatment on board

The incubation experiments were carried out with using *in situ* incubation cores. ^{13}C and ^{15}N-labeled substrates, and ^{13}C-labeled bicarbonate were added for the cores, respectively. Incubation periods were two days. Core samples were carefully sliced into the following layers: 0-0.5, 0.5-1, 1-1.5, 1.5-2, 2-2.5, 2.5-3, 3-4, 4-5, 5-7, 7-10, and 10-15. Each layer was frozen at -80 degrees Celsius. Core samples for background data and initial time information were also carried out same methods.

Sample treatment in laboratory

DNA will be extracted from frozen sediment samples. DNA of microbial communities that incorporate stable isotope labeled substrate will be separated by density gradient equilibrium ultracentrifugation method. Clone libraries will be generated about the heavy nucleic acids, and background samples.

3.5.2.3. Distribution, genetic diversity and food preferences of Xenophyophorean foraminifers in the abyssal plain, east off Torishima Is., Northern Ogasawara Islands.

Masashi Tsuchiya, Seiji Miyawaki, Hidetaka Nomaki

Background

Although foraminifers form an ecologically important link between bacteria and macrobenthos in biological and physical cycles in nature, not enough studies have been conducted to clarify this. Studies on protists are indispensable to clarify the biological diversity of the deep-sea floor.

A large unicellular foraminifera, Xenophyophore, have large cell up to 10 ~ 15 cm in diameter, making their body with reticulate, bush or fan-like structures. Several studies have been conducted for classification and time-lapse observation (Gooday et al., 1993) so far. Recently, molecular phylogenetic studies and ultrastructural observation were carried out for Xenophyophore, *Shinkaiya lindsayi* (Lecroq et al., 2009). However, the ecology and the role of Xenophophore in the deep-sea are not clear.

Purpose

This study aims to clarify the ecological roles of Xenophyophore in the deep-sea population by using molecular techniques and stable isotope measurements. In this cruise, we conducted *in situ* experiment by adding ^{13}C and ^{15}N to illustrate their food preferences and mineralization process. We also carried out visual observation from the Shinkai 6500 to understand the distribution and density of Xenophyophores.

Research results

1) Dive #1265 and 1267 were conducted at east off Torishima Is., 30˚09.0'N, 143˚35.0'E, 5370 m.
2) Visual observation were done for landscape, sediment facies, distribution of organisms, and carried out sampling, and in situ experiment.
3) Sampling of sediment cores for SI analyses and DNA analyses.
4) Sampling of Xenophyophores

3.5.2.4. Eukaryotic richness assessment using second generation massive sequencing

Sinniger Frederic, Lecroq Beatrice

Background

Deep-sea sediments are home for a wide range of small-sized metazoan and protistan taxa. The diversity of this meiofaunal community is difficult to estimate, since its study suffers from undersampling, difficult access and impossibility to cultivate deep-sea organism. Moreover, most of the deep-sea species are tiny, fragile and difficult to identify. The environmental massive sequencing approach consistes in

getting numerous sequences from the global DNA and RNA extractions from environmental samples overcoming the time-consuming step of species isolation and identification under microscope and providing by far more sequence data than the traditional cloning method.
This study will focus on the environmental richness of 1) metazoan, 2) foraminifera and 3) eukaryotes in the vincity of xenophyophores (large size agglutinated foraminifera).

1) Metazoan meiobenthos is composed of a wide variety of organisms. Despite the wide diversity at high taxonomic level (phyla, order) most organisms share a very similar morphology adapted to the life in the sediments. Environmental metagenetics methods allow the comparison of whole biological communities using minimal sampling volumes and therefore are ideally suited for deep-sea sediments.

2) Benthic foraminifera form the most abundant and diverse group of deep-sea meiofauna, found even in the deepest ocean trenches. It has been shown that the large proportion of the deep-sea foraminifera belong to the early lineages characterized by simple, single-chamber (monothalamous), organic-walled or agglutinated tests, poorly preserved in the fossil record. Because of the poor preservation of their tests, their small size and the lack of distinctive morphological features, their diversity is especially difficult to assess and will highly benefit from environmental metagenetic approach.

3) Xenophyophores are one particularly enigmatic group of spectacularly large agglutinated foraminifera that could be extremely abundant in productive parts of the deep ocean. Epifaunal xenophyophores may constitute important habitat structures on the seafloor, providing refuges and possibly sustenance for numerous small metazoans and foraminifera. We propose to massively sequence environmental RNA and DNA from the vincity of xenophyophores specimen to investigate eukaryotic richness associated with them, living in the fold of their test or in the nearby sediment.

Main objectives:

- Collect sediments from Western North Pacific abyssal plain (East of Torishima)
- Collect xenophyophores and sediment from their vincity

Secondary objectives:

- Collect Abyssoanthus for comparison with Japan and Ryukyu trenches specimens

Methods and samples processing on board

The sediment samples metagenetic studies were collected using the Shinkai and push cores of 82 mm in diameter and 30 cm long. Samples have been collected during dive 1265 and 1267 (for further information on sampling sites please refer to the stations list). For each dive several cores have been collected in order to investigate the micro- and meso-scale variation in the richness composition. After deployment and recovering on deck, cores were immediately placed in cold place to prevent deterioration of DNA and/or RNA material. Subsampling for foraminiferal massive sequencing purpose has been conducted in sterile conditions and consisted in aliquoting 1 mL of raw sediment from each 0-1cm, 1-2 cm and 2-3 cm. For eukaryotic richness related to xenophyophores, raw sediment under the specimen has been subsampled in the same way (0-1cm, 1-2 cm and 2-3 cm) and, additionally, fragments of the specimen itself and in some case sediment in the fold of the specimen were also sampled. Each fragment and aliquot was immediately deep frozen into liquid nitrogen before getting stored in deep freezer at -80°C. For both foraminiferal and eukaryotic studies, samples have been collected during dive 1265 (red cores 1, 3 and 5) and dive 1267 (cores 0, 3 and 4).

For metazoan studies, two subsamples of the surface sediments of each core (0-3 cm) were collected. The first sample was immediately frozen at -80ºC while the other subsample was fixed in DESS and stored at room temperature. For metazoan metagenetics, additional sediments were obtained from dives 1264 and 1266 on Suiyo smt and processed as for the abyssal samples.

No Abyssoanthus could be observed during this cruise although 2 samples of anthozoan have been collected by F.S. for DNA barcoding analyses.

Post cruise sample processing:

Environmental DNA/RNA will be extracted from frozen sediments using MoBio kits. DNA/RNA extraction will be then amplified by PCR/RT-PCR using universal, eukaryotic or foraminiferal specific primers.

For metazoans, subsamples fixed in DESS will be sorted and individual organisms will be individually sequenced in order to create a control community to calibrate the environmental results.
Data obtained will be compared with those already obtained from the abyssal plain east of Japan Trench (YK09-12).

Note: During this cruise, F. Sinniger gave a seminar presenting the preliminary results of the metagenetic research performed on worldwide deep-sea sediments, including samples from the Japan Trench (YK09-12).

3.5.2.5. Deep-sea litter and floationg litter Off Western North Pacific

Haruka Shibata[1], Hiroshi Miyake[1], Yasuo Furushima[2]

[1] School of Marine Biosciences, Kitasato University

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

Objective and achievement in this cruise

Marine litter is found in the oceans of the world. Marine litter is classified into beach litter, floating litter and benthic litter. Floating litter drifts to the beach or sinks to the bottom. Marine litter causes environmental, human health and aesthetic problems. The aim of this cruise is to observe floating litter and deep-sea litter *in situ*.

Video recording was conducted for getting quantitative data of floating litter on day time. A video camera (Sony, HDR-SR7) was set during navigation on the bridge deck. At the same time, the kind of litter was checked by visual observation and photo images of floating litter were taken. During *Shinkai6500* dives, special attention was given to deep-sea litter. Deep-sea litter encountered was collected by the manipulator of *Shinkai6500*. Sediment nearby or under the litter was collected by the push core. We will make an analysis of the biological and physico-chemical environments and analysis of the video footages that recorded by *Shinkai6500* camera.

Appendix (in Japanese)

AP-1: Dive Log

Dive Log of
6K Dive #1264

Suiyo sea Mt.

Time (JST)	Dep. (m)	Alt. (m)	Head (Deg)	Pos. Xm	Pos. Ym	Description
08:58	0	-	-			潜航開始
						潜航中
09:40	1382	2	89	110	130	着底、底質:軽石質砂
09:43	1383	2	89			M 式採泥(緑色)
09:47	1384	2	89			着底点から移動
10:00	1386	2	112	-20	120	チムニー発見、マーカー＃387、活動停止中
10:05	1385	3	98			チムニー周辺に鉄酸化物(茶色)、頂部にシンカイヒバリガイ
10:12				-60	120	APSK01 周辺に到達
10:15	1367	2	197			ブラックスモーカー確認
10:16	1367	2	238	-90	120	
10:20	1377	2	236	-110	90	溶岩？らしき岩塊
10:25	1382	1	324	-110	40	海底面に白色帯
10:29	1382	1	53	-90	60	
10:33	1378	2	47			溶岩らしき岩塊
10:34	1377	4	73	-80	80	
10:39	1377	1	5	-90	100	
10:40	1378	2	13	-90	110	チムニーらしき岩塊、マーカーAPSK01?
10:45	1379	2	303	-70	90	マーカー#17
10:50	1381	2	29	-70	80	マウンドらしき岩塊
10:52	1381	1	356	-60	80	マーカー#H675
10:56	1384	2	355	-50	100	
11:00	1385	2	180	-20	90	
11:05	1382	1	207			低温熱水孔、シンカイヒバリガイ
11:06	1385	1	184	-60	90	マーカー＃229
11:14	1379	2	125	-80	90	
11:19	1371	2	87	-70	110	

11:22	1362	3	94	-70	140	
11:26	1360	3	349	-110	100	
11:31	1365	1	231			生物群集
11:34	1364	5	244	-100	100	
11:38	1366	2	221	-120	90	流れが速く水深下げ困難、APSK04 に向かう
11:45	1378	2	309	-150	50	海流強く、流されている
11:51	1380	1	359	-100	10	イベントマーク8番（APSK08）
11:55	1380	1	1			観察終了。このあと採水、岩石採取を行う。
12:01	1380	1	6			ヒバリガイが見える
12:03	1380	1	2			採水準備中。ケーシングパイプに採水口を入れる。
12:05	1380	1	3			採水中止。
12:07						ケーシングパイプからの湧水が確認できなかったため、近くの湧水から採水を行う。
12:09	1380	1	12			岩石採取。
12:25	1380	1	35			シンカイヒバリガイ採取
12:32	1380	1	21			湧水ポイントから採水①、55℃
12:37	1380	1	21			シンカイヒバリガイ採取ボックス①
12:41	1381	2	68			マウンド岩石1個採取カゴ①、作業終了後 APSK09(325°)に向かう
12:51	1379	2	325			APSK09 まであと 15m
12:57	1375	1	28			APSK09 まで、25°,30m
12:58	1377	2	28			APSK09 まで、90°,30m
12:59	1379	3	96			APSK09 まで、140°,20m
13:02	1380	2	57	-70	-20	APSK09 周辺に到達、ここでバック採水、先端にいるシンカイヒバリガイを採取する
13:08	1380	2	45			シンカイヒバリガイを採取、ボックス③
13:22	1380	2	63			シンカイヒバリガイ 1 個を採取、岩石2個をボックス③へ
13:27	1380	2	50			ケーシングパイプからバッグ採水③
13:37	1380	1	51			周辺の岩石、礫採取、ボックス③へ
13:43	1380	2	79			M 式採泥（青色）、作業終了後イベントマーク＃19へ向かう
13:48	1381	2	79	-70	-20	イベントマーク＃19 まで、北へ40m
13:53	1380	2	54			パイプ発見、マーカーなし（APSK02 かも？活動なし）

14:01	1380	2	272	-20	-30	このあたりにイベントマーク＃19があると思われる
14:07	1376	7	79	-10	-10	周辺を探索
14:16	1385	2	1	20	10	210° 60m にイベントマーク＃19、マーカー発見
14:19	1384	2	278			ケーシングパイプ 06 を確認
14:22	1379	3	218			220° 60m にイベントマーク＃19
14:29	1380	2	179			パイプ確認
14:39	1385	2	74	-10	-10	04 番と思われる地点、パイプ採取試みたが、固くて取れず。採水孔でパイプの入り口を軽くつついて水ごと採水 →詰まり有り、足場悪く、採水断念。マーカー#131 を設置
14:53	1385	2	74	-10	-10	作業終了後、イベントマーク＃18（-30,20）へ向かう
14:55	1383	2	103	-20	-10	
14:58	1379	2	56	-40	10	
15:02	1379	3	51			複数のマーカー発見（APSK 確認できず）、すぐそばにブラックスモーカーあり
15:05	1379	3	51	-60	20	マウンドの採取、見えているマーカーの回収、作業終了後マーカー設置
15:11	1380	2	31			岩石1個採取→ボックス②へ、マーカー＃132 設置完了
15:21	1380	2	35			マーカー回収→ボックス②へ、岩石1個採取→マーカー入っていたカゴに回収。作業終了後、海面に向かう
15:25	1382	2	27	-30	10	離底にむけて準備
15:28	1378	7	28	50	30	15:30まで航走後、離底
15:30	1375	11	24			離底
15:30	1368	18	19	130	70	
16:05						浮上

DIVE NUMBER：6K#1265　　YK11-06

DATE：2011/09/07　　DIVE SITE：　western north Pacific, east off Torishima Is.

Time (LCT)	Dep. (m)	Alt. (m)	Head (Deg)	Description	Remarks (position)
9:03				潜航開始	
11:15	5370.0	1.0	85	着底	
11:17	5370.0	1.0	81	Xenophyophore?	

11:21	5370.0	1.0	81	Xenophyophore	100,-150
11:30	5370.0	1.0	64	core green A 設置開始	
11:34	5370.0	1.0	63	core green A 設置中	
11:41	5370.0	1.0	83	Fish(Sokodara?)	
11:44	5370.0	1.0	80	Set Core blue C	
11:47	5370.0	1.0	80	Core blue C トリガー	
11:49	5370.0	1.0	79	Set Core blue D	
11:50	5370.0	1.0	79	Core blue D トリガー	
11:53	5370.0	1.0	78	blue C,D 設置終了	
12:03	5370.0	1.0	98		50,30//90,-80
12:04	5370.0	1.0	99	core ？	
12:05	5370.0	1.0	99	core Yellow D	
12:11	5370.0	1.0	108	core yellow C	
12:34	5370.0	1.0	182	fish (rattail?)	
12:35	5370.0	1.0	183	back to incubation cores	
12:39	5370.0	1.0	203	Set core Green B	
12:42	5370.0	1.0	198	Core Green B	
12:44	5370.0	1.0	198	release Green B	
12:45	5370.0	1.0	198	Core Red A	
12:47	5370.0	1.0	197	release red A	
12:55	5370.0	1.0	193	Core red B	
12:57	5370.0	1.0	191	release red B	
12:57	5370.0	1.0	191	set incubation chamber	
13:12	5370.0	1.0	188	release incubation chamber	
13:14	5370.0	1.0	186	set yellow marker 134	
13:17	5370.0	1.0	186	end of sampling in the area	
13:23	5371.0	1.0	230	fish (rattail?)	
13:25	5371.0	2.0	141	small mount biological origin?	
13:25	5371.0	2.0	111	fish	
13:28	5371.0	1.0	051		40, -40
13:35	5370.0	1.0	31	begining of sampling in the area	
13:36	5370.0	1.0	31	plankton spiral	
13:38	5370.0	1.0	31	set core blue B	
13:40	5370.0	1.0	31	release core blue B and back in socket	
13:41	5370.0	1.0	31	set core blue A	

13:45	5370.0	1.0	31	gomi? xeno ? about 10 cm	
13:45	5370.0	1.0	30	release core Blue A and back in socket	
13:49	5370.0	1.0	30	set long core red 8 on the gomi/xeno	
13:52	5370.0	1.0	30	release long core red 8 and back in the socket	
13:54	5370.0	2.0	38		70, -20
13:57	5370.0	2.0	38	Yellow core A	
13:59	5370.0	2.0	38	release yellow core A and take back	
14:00	5370.0	2.0	38	yellow core B	
14:03	5370.0	2.0	38	release yellow core B and take back	
14:07	5370.0	2.0	36	xeno	
14:09	5370.0	2.0	36	drop core	
14:10	5370.0	2.0	36	core 3 just beside xeno	
14:13	5370.0	1.0	35	core 7 on xeno?	
14:17	5370.0	1.0	42	core 6 a few centimeters away from xeno	
14:19	5370.0	1.0	41	core 1 on xeno?	
14:29	5370.0	1.0	68	core 2	
14:33	5370.0	1.0	67	core 5 on little xeno	
14:36	5370.0	3.0	68	core 0	
14:37	5370.0	9.0	67	slurp gun on the long thing	
14:46	5370.0	72.0	1	slurp guned something?	
14:51	5369.0	88.0	1	2 individuals of something with slurp gun	
14:54	5370.0	86.0	1	core 4	
14:56	5369.0	82.0	1	marker 133	60, 30
14:59	5368.0	99.0	1	take off	

Dive Log of
6K Dive #1266

Suiyo sea Mt.

Time (JST)	Dep. (m)	Alt. (m)	Head (Deg)	Pos. Xm	Pos. Ym	Description
09:55	0	-	-			潜航開始
10:12	773	506	269	110	210	潜航中
10:37	1382	4	67	130	140	着底、底質:礫まじり砂、水温 3.5℃
10:43	1384	20	84			マニュピレータで岩石(約 10cm,溶岩)1個採取、バスケットへ

10:54	1386	5	173	100	160	マニュピレータで岩石 1 個(約 15cm、白色,微生物マットつき？)採取、バスケットへ
11:02	1386			20	120	マーカー#387へ移動
11:05						マニュピレータで岩石(約 20cm、茶色、鉄酸化物？)1個採取、バスケットへ
11:08						マニュピレータで岩石(約 25cm、黒色)1個採取、バスケットへ
11:10	1386			0	130	
11:13	1385	5	182	-10	120	
11:18	1384	1	237	-40	110	デッドチムニーらしきものを発見、確認後次のイベントマークへ向かう
11:23	1383	5	213	-50	70	板状マーカーAPSK07？(明確でない)と別のマーカーを発見、この地点でマウンドを採取する
11:34	1383	0	197	-50	70	デッドチムニーからヒバリガイ1個を採取、BOX①へ
11:48	1382	12	128	-50	70	マウンド1個(褐色,10cm)を BOX①、マウンド大(褐色,約 30cm)をバスケットへ
11:59	1377	2	160	-120	90	(訂正)#15 は APSK07 ではなく、#132 である
12:03	1372	1	119	-130	110	人工物あり
12:11	1374	1	131	-130	110	海底に赤茶けた沈殿物あり
12:23	1374	1	136	-130	110	M 式採泥器(緑)で沈殿物採取
12:35	1376	1	48	-90	130	イベントマーク#19 まで 20m
12:37	1377	5	62	-80	140	APSK01 に到達、周囲の探索
12:46	1377	6	99			クマデで金属パイプの残渣を回収→下の岩石が固く、断念
12:55	1377	6	97	-80	140	バッグ採水によるパイプ残渣の回収、バッグ①へ回収を試みたが口から漏れている様子。バッグ採水を断念。
13:06	1377	5	64			M 式採泥器(青)でパイプ残渣の回収を行う→すくえない、断念
13:14	1376	1	310			イベントマーク#18 まで、270°、20m
13:17	1378	5	6			イベントマーク#18 に到達、活動中のチムニーの採集を試みる
13:25	1378	6	0			活動中のチムニー片(約 10cm,約 20cm 程度,4つ,褐色)を採集、BOX②へ

13:28	1378	7	357			岩石の割れ目から噴く熱水(70℃)を採水バッグ④に採水
13:33	1377	1	353			作業終了。イベントマーク#17(APSK03)に向かう
13:38	1377	1	243	-100	130	イベントマーク#17 まで 250° ,40m
13:41	1376	2	309	-140	100	イベントマーク#17 まで 340° ,40m
13:42	1378	2	10			イベントマーク#17 まで N,70m
13:46	1382	1	41	-150	50	イベントマーク#17 まで 40° ,30m
13:51	1363	2	358	-110	120	付近でオールドチムニーを確認、サンプリング可能であれば採集する
14:02	1369	1	21	-110	140	活動中チムニー(高さ最大約60cm?,白色)を発見
14:16	1370	3	16			噴出孔の温度測定を行う、熱水(最高 260℃)を確認
14:19	1370	3	3			クマデでマウンドを採取。→BOX③へ
14:32	1370	2	19	-110	140	BOX③にチムニーを採集完了。作業終了後、周辺で熱水の影響を受けていない岩石の探索に移る
14:38	1356	1	41	-120	160	カルデラ側面の溶岩（窒素測定用）4つ回収、クマデ位置のバスケットへ
14:48	1373	3	312	-150	30	イベントマーク#16(APSK04)まで 310° ,50m
14:49	1375	1	352			イベントマーク#16(APSK04)まで 10° ,50m
14:52	1379	3	32	-160	50	イベントマーク#16(APSK04)まで 40° ,50m
14:56	1381	2	322	-130	40	ブラックスモーカーを発見、温度最高 230℃
15:04	1381	2	14			バクテリアマットつきの岩石(大)をクマデ位置上に積載
15:09	1376	3	96	-120	70	
15:11	1373	2	28	-130	100	人工物発見、＃2と書いてある。他にマーカー2つを確認。引き続きイベントマーク#16 へ向かう
15:13	1368	1	7	-130	120	
15:20	1377	3	310	-120	20	
15:26	1373	4	16	-50	-20	
15:31	1375	2	7	-40	-20	
15:34	1372	1	34	-40	-60	
15:37	1379	1	139	-20	-20	

15:40	1383	1	6			イベントマーク#16 まで、310°,40m
15:45	1383	1	355	-30	10	イベントマーク#16(APSK04)に到達、パイプを確認
15:53	1382	2	8			パイプ採取を試みたが、取れないので断念。
15:59	1382	1	8			パイプ内部を削りとり、バッグ採水をおこなう、バッグ③に採水、圧力 6.5 で安定→詰まっている可能性あり、採水終了。温度 14℃。
16:07	1382	2	8	-30	10	作業終了後、イベントマーク#14(APSK05)へ向かい、岩石サンプリング後離底せよ。
16:15	1375	2	356	-10	-40	イベントマーク#14 まで 20°,50m
16:18	1379	2	31	20	-80	イベントマーク#14 まで 80°,50m
16:21	1376	3	49	40	-30	イベントマーク#14(APSK05)周辺に到達、周辺を探索
16:26	1379	1	26	20	-10	
16:27	1379	2	10			マーカーを確認、岩石サンプリング後離底せよ
16:33	1379	2	353			岩石(マウンド)1個をサンプリングした、離底準備
16:36	1375	3	358			ブラックスモーカーを確認
16:38	1373	1	0	70	-40	離底

DIVE NUMBER：6K#1267 YK11-06

DATE：2011/09/09

DIVE SITE： western north Pacific, east off Torishima Is.

Time (LCT)	Dep. (m)	Alt. (m)	Head (Deg)	Description	Remarks (position)
8:54				潜航開始	
10:58	5317.0	52.0	159	trim ok	
11:06	5368.0	4.0	144	niskin	
11:09	5373.0	1.0	124	landing on the bottom Tem;1.5dc visibility 7 metre, no current	-70,-20
11;14	5373.0			Sampling animal	
11:16	5373.0	1.0	25	Sea anemone	
11:17	5373.0	1.0	25	Sampling Sea anemone	
11:20	5373.0	1.0	28	Sea pen	
11:22	5373.0	1.0	31	Sampling sea pen	

11:25	5373.0	2.0	349	Move to Head 350	
11:26	5373.0	1.0	350		-60,-20
11:30	5372.0	1.0	355		10,-40
11:33	5371.0	1.0	307	Xeno	
11:38	5371.0	1.0	270	Stop sampling Xeno	30,-50
11:42	5371.0	1.0	47	former tracks of Shinkai	
11:46	5371.0	1.0	41	start sampling in the area	
11:47	5371.0	1.0	39	collect Xeno with red core 4	
11:49	5371.0	1.0	39	red core 4 back to the socket	
11:52	5371.0	1.0	38	collect Xeno with blue MT core	
11:52	5371.0	1.0	37	blue MT core back to the socket	
11:54	5371.0	1.0	37	discard MT blue core	
11:58	5371.0	1.0	66	collect Xeno with blue MT core	
11:59	5371.0	2.0	72	blue MT core back to the socket	
12:04	5371.0	1.0	66	collect Xeno with green MT core	
12:05	5371.0	1.0	62	green MT core back to the socket	
12:07	5371.0	1.0	63	Blue core 7	
12:07	5371.0	1.0	63	Blue core 7 back to the socket	
12:08	5371.0	1.0	62	Red core 1	
12:09	5371.0	1.0	62	Red core 1 back to the socket	
12;09	5371.0	1.0	61	Red core 6	
12:10	5371.0	1.0	61	Red core 6 back to the socket	
12:10	5371.0	1.0	61	Red core 5	
12:11	5371.0	1.0	61	Red core 5 back to the socket	
12:12	5371.0	1.0	62	Red core 2	
12:13	5371.0	1.0	62	Red core 2 back to the socket	
12:14	5371.0	1.0	61	Red core 3	
12:14	5371.0	1.0	61	Red core 3 back to the socket	30,-50
12:18	5371.0	1.0	42	Move to #19, head 50	
12:20	5370.0	1.0	50	animal?	
12:24	5370.0	1.0	50		90.10
12:31	5369.0	1.0	254	Move to head 260	
12:33	5369.0	1.0	258	found the marker	
12:37	5369.0	1.0	188	found the incubation core and chamber	
12:49	5370.0	1.0	101	start sampling in the area	

12:51	5370.0	1.0	98	Yellow core D back to the socket	
12;53	5370.0	1.0	98	Yellow core C back to the socket	
12:55	5370.0	1.0	97	Blue core D back to the socket	
12:57	5370.0	1.0	96	Red core A back to the socket	
12:59	5370.0	1.0	96	Blue core C back to the socket	
13:02	5370.0	1.0	96	Green core B back to the socket	
13:04	5370.0	1.0	97	Red core B back to the socket	
13:05	5371.0	1.0	96	Green core A back to the socket	
13:07	5370.0	2.0	96	start sampling in the chanber	
13:13	5370.0	1.0	95	Green core 9	
13:17	5370.0	1.0	95	Red core 7	
13:19	5370.0	1.0	97	Red core 8	
13:23	5370.0	1.0	98	Red core 8 back to the socket	
13:24	5370.0	1.0	98	Red core 7 back to the socket	
13:26	5370.0	1.0	98	Green core 9 back to the socket	
13:32	5370.0	1.0	96	incubation chamber	
13:38	5370.0	1.0	95	finished sampling at this location moving to #20	
13:41	5370.0	1.0	44	found the marker #133	
13:43	5370.0	2.0	44	arrived at marker (point #20)	
13:44	5369.0	1.0	38	ballasts (2)	
13:50	5370.0	2.0	270		120, -60
13:55	5372.0	1.0	242		100,-100
14:03	5374.0	1.0	189	sea cucumber	
14:07	5374.0	1.0	174	collect anthozoan (primnoid octocoral?)	
14:09	5374.0	1.0	179	collect organism on rock with slurp gun	
14:11	5374.0	1.0	174	collect rock with arm	
14:13	5374.0	1.0	189		30, -200
14:16	5374.0	1.0	150	white organism sea cucumber? or sea slug?	
14:18	5374.0	1.0	137	collect the white organism	
14:21	5374.0	1.0	151		10, -200
14:22	5374.0	1.0	126	found some organism 5 metres ahead	
14:24	5374.0	1.0	118	glass sponges	
14:25	5374.0	1.0	126	collect glass sponge with slurpgun	

14:26	5374.0	2.0	149	sea cucumber	
14:29	5375.0	1.0	130	collect sea cucumber with slurp gun	
14:41	5375.0	2.0	126	litter found	
14:34	5375.0	1.0	120	coca cola can collected	
14:45	5374.0	1.0	86	glass sponge collected with push core 0	
14:46	5374.0	1.0	80		0,-200
14:58	5377.0	1.0	180	fish with long "lower lip"	
15:02	5377.0	1.0	213	leave the bottom	

AP-2: Sample List

Suiyo Seamount

6K Dive #1264 110908

サイト名	JAMSTEC#	サンプルNo	名前	時間	大きさ	重さ	DNA用	詳細
着底地点		1190601	軽石質砂	9:40				着底点でM式で採集
APSK08		1190602	熱水	13:50				天然ベントから採集。55℃
APSK08	6K#1264-R01	1190603	硫化物マウンド	13:50	15x5x5	500g	○	天然ベントのマウンド
APSK08		1190604	ヒバリガイ	13:50				
APSK09		1190605	熱水	12:42				ケーシングパイプからの採水、3.5から4.5℃に
APSK09		1190606	ヒバリガイ	12:42				ケーシングパイプ内に付着したもの
APSK09	6K#1264-R02	1190607	硫化物マウンド	15:20	20x15x10	1000g	○	
APSK09	6K#1264-R03	1190612	軽石	15:50	5x5x5	300g		ヒバリガイ採集時に混入
APSK09		1190608	軽石質砂	15:50				周辺にあった砂をM式で採集
Marker132	6K#1264-R04	1190609	変質粘土岩	15:20	15x5x5	800g	○	粘土が海底面から採集されたのは始めて
Marker132	6K#1264-R05	1190610	変質した軽石	15:20	5x5x3	400g		表面がMn酸化物で覆われる

6K Dive #1266 110908

サイト名	JAMSTEC#	サンプルNo.	名前	時間	大きさ	重さ	DNA用	詳細
着底地点	6K#1266-R01	11908-01	軽石	10:43	20×20×10	500g		着底点で岩石を1つ、下だけ白色
#387	6K#1266-R02	11908-02	硫化物マウンド	10:54	10×10×5	500g		Chimney sampling、赤茶＋白色、Dead chimney
#387	6K#1266-R03	11908-03	軽石	11:05	30×30×20	800g	○	#20イベントマーク近くの変質岩、黒色、軽石
#387	6K#1266-R04	11908-04	軽石	11:08	20×20×10	500g		変質著しい、黒色、一部濃い赤色
APSK07	6K#1266-R05	11908-05	硫化物マウンド	11:34	15×15×5	600g		APSK07Chimney片、sulfate含む、マウンド
APSK07		11908-06	ヒバリガイ	11:34				APSK07、ヒバリガイ
APSK07	6K#1266-R06	11908-07	硫化物マウンド	11:34	40×40×30	15kg	○	硫化物マウンドから採取、大きなDead chimney、 下部硫酸塩、上部Cu,Zn-rich
APSK07付近		11908-08	赤色堆積物	12:23				熱水性鉄の酸化層を伴う。 深部は軽石質白色の砂岩（軽石のくだけた物）
#H1295-1	6K#1266-R13	11908-09	硫化物マウンド	13:21	5×5×5	200g		Chimney sampling、CuZn、サビがある、
#H1295-1	6K#1266-R07	11908-10	硫化物マウンド	13:21	20×10×10	2kg	○	Znリッチ、表面はさびている
#H1295-1	6K#1266-R14	11908-11	硫化物マウンド	13:21	5×5×5	200g		Chimney sampling、pyriteリッチ
#H1295-1	6K#1266-R15	11908-12	硫化物マウンド	13:21	15×15×10	800g		Chimney sampling、Cuリッチ、表面さびている
#H1295-1		11908-13	熱水	13:28				採水パック④、岩石の割れ目から噴く熱水、70℃
APSK01-northeast	6K#1266-R16	11908-14	チムニー	14:19	10x10x10	500g	○	生きている熱水chinmey，白色の硫酸塩を伴う。紙のようにもろい
APSK01東側壁より	6K#1266-R08	11908-15	デイサイト	14:38	15×15×5	1.5kg		火山岩、表面Mnコーティング
APSK01東側壁より	6K#1266-R09	11908-16	デイサイト	14:38	15×10×5	1.5kg		火山岩、表面Mnコーティング、花崗岩質部分？あり
APSK01東側壁より	6K#1266-R10	11908-17	安山岩	14:38	10×5×5	500g		火山岩、表面Mnコーティング、安山岩質
		11908-18						欠番
調査地域南端域	6K#1266-R11	11908-19	硫化物マウンド	15:04	50×40×30	30kg	○	巨大Chimney、CuとZnリッチ
APSK04		11908-20	パイプ内沈殿物	15:59				採水パック③、14℃。パイプ内部をこすり浮いた物を採水器で採集
APSK05付近	6K#1266-R12	11908-21	岩石	16:33	30×20×20	5kg	○	Cu, Znリッチ, カルコパイライト、デッドチムニー
								JAMSTECオレンジ番号：アーカイブ無し

Sample lists from the east off Torishima were not listed here. Please refer the metadata sheets.

YK11-06 Shipboard Log
(29.Aug, 2011 - 12.Sep, 2011)

Suiyo Sea Mt.
Western Northwest Pacific

Date	Local Time	Note	Description	Position/Weather/ Wind/Sea condition
29 Aug, 2011	13:00	Let go all shore line, left YOKOSUKA	for CHIBA	
	14:00-14:30	Onboard education & training for scientist	chief officer, chief ratio	
	15:35	Let go starboard anchor then arrfived at CHIBA Outer Harbor		
	18:00-18:30	Scientist meeting		
30 Aug, 2011	10:00	Meeting for SHINKAI 6500 operation		08/30 12:00 (UTC+9h)
	15:00-16:05	Scientist meeting about sample request	nomaki group	35-34.8N, 140-00.5E
	18:00-18:05	Scientist meeting		Fine but Cloudy
				NE-4 (Moderate breeze)
				2 (Sea smooth)
				1 (Low swell short or average)
				Visibly: 8'
31 Aug, 2011	10:00-11:00	Onboard tour	bridge and engine room	08/31 12:00(UTC+9h)
	13:00-14:00	Scientist meeting and seminar	presenter Mr. Kakegawa	35-34.8N, 140-00.5E
	18:00-18:05	Scientist meeting		Overcast
				North-3 (Gentle breeze)
				2 (Sea smooth)
				1 (Low swell short or average)
				Visibly: 6'
01 Sep, 2011	15:00-16:30	Science Seminar	presenter Mr. Hashizume	09/01 12:00(UTC+9h)
	18:00-18:05	Scientist meeting		35-34.8N, 140-00.5E
				Overcast
				ESE-5 (Fresh breeze)
				2 (Sea smooth)
				1 (Low swell short or average)
				Visibly: 6'
02 Sep, 2011	10:00-15:00	SHINKAI6500 tour		09/02 12:00(UTC+9h)
	15:00-16:00	Science Seminar	presenter Mr. Nomaki	35-34.8N, 140-00.5E
	18:00-18:05	Scientist meeting		Overcast
				ESE-5 (Fresh breeze)
				3 (Sea slight)
				1 (Low swell short or average)
				Visibly: 6'
03 Sep, 2011	15:00-16:00	Sience Seminar	presenter Mr.Sinniger	09/03 12:00(UTC+9h)
	18:00-18:05	Scientist meeting		35-34.8N, 140-00.5E
				Cloudy
				South-6 (Strong breeze)
				4 (Sea moderate)
				1 (Low swell short or average)
				Visibly: 6'
04 Sep, 2011	09:00	Hove up anchor and com'ced proceeding to research area.		09/04 12:00(UTC+9h)
	19:00	Stoped engin and comeceed drifting her.	Off MIYAKE	35-07.5N、139-44.2E
				Overcast
				SE-5 (Fresh breeze)
				3 (Sea slight)
				2(Low swell long)
				Visibly: 6'
05 Sep, 2011	01:30	Come'ced proceeding to research area	Suiyo SMt.	09/05 12:00(UTC+9h)
	13:00-13:15	Scientist meeting		31-50.6N、140-32.6E
				Cloudy
				SW-5 (Fresh breeze)
				3 (Sea slight)
				3(Moderate short)
				Visibly: 7'
06 Sep, 2011	05:30	Arrived at research area	Suiyo SMt.	09/06 12:00(UTC+9h)
	05:40	Released XBT		28-34.2N、140-38.6E
	06:11-06:26	Carried out MBES site survey		Fine but Cloudy
	08:42	Hoisted up SHINKAI 6500		SW-5 (Fresh breeze)

YK11-06 Shipboard Log
(29.Aug, 2011 - 12.Sep, 2011)

Suiyo Sea Mt.
Western Northwest Pacific

Date	Local Time	Note	Description	Position/Weather/ Wind/Sea condition
	08:50	Launched SHINKAI 6500		3 (Sea slight)
	08:57	Started 6K#1264 dive operation		2(Low swell long)
	09:40	Landed at sea bottom	Depth=1382	Visibly: 8'
	15:30	Left bottom	Depth=1375	
	16:04	Refloated SHINKAI 6500		
	16:23	Hoisted up SHINKAI 6500		
	16:30	Recovered		
	17:00	Commenced proceeding to next research area	western part of north pacific	
	18:00-18:10	Scientific meeting		
07 Sep, 2011	05:00	Arrived at research area	western part of north pacific	09/07 12:00(UTC+9h)
	05:13	Released XBT		30-09.0N、143-35.0E
	05:42-06:10	Carried out MBES site survey		Fine but Cloudy
	08:48	Hoisted up SHINKAI 6500		SW-4 (Moderate breeze)
	08:55	Launched SHINKAI 6500		3 (Sea slight)
	09:03	Started 6K#1265 dive operation		1 (Low swell short or average)
	11:20	Landed at sea bottom	Depth=5370	Visibly: 8'
	15:00	Left bottom	Depth=5369	
	16:53	Refloated SHINKAI 6500		
	17:12	Hoisted up SHINKAI 6500		
	17:20	Recovered		
	17:40	Commenced proceeding to next research area	Suiyo SMt.	
	18:30-18:40	Scientific meeting		
08 Sep, 2011	07:00	Arrived at research area	Suiyo SMt.	09/08 12:00(UTC+9h)
	09:39	Hoisted up SHINKAI 6500		28-34.4N、140-38.7E
	09:54	Started 6K#1265 dive operation		Fine but Cloudy
	10:37	Landed at sea bottom	Depth=1382m	SE-3 (Gentle breeze)
	16:39	Left bottom	Depth=1373m	2 (Sea smooth)
	17:13	Refloated SHINKAI 6500		1 (Low swell short or average)
	17:29	Hoisted up SHINKAI 6500		Visibly: 8'
	17:45	Recovered		
	18:00	Commenced proceeding to next research area		
	19:00-19:10	Scientific meeting		
09 Sep, 2011	08:40	Hoisted up SHINKAI 6500		09/09 12:00(UTC+9h)
	08:54	Started 6K#1265 dive operation		30-09.0N、143-35.0E
	11:10	Landed at sea bottom		Fine but Cloudy
	15:03	Left bottom		East-5 (Fresh breeze)
	17:04	Refloated SHINKAI 6500		3 (Sea slight)
	17:21	Hoisted up SHINKAI 6500		2(Low swell long)
	17:30	Recovered		Visibly: 9'
	18:00	Commenced proceeding to next research area		
10 Sep, 2011	05:30	Arrived at research area	Suiyo SMt.	09/10 12:00(UTC+9h)
	05:45	Com'ced proceeding to Chichijima		27-32.7N、141-09.4E
	11:35	Com'ced proceeding to KEIHIN		Fine but Cloudy
	18:00-18:20	Scientific meeting		ENE-6 (Strong breeze)
				4 (Sea Moderate)
				3 (Moderate Short)
				Visibly: 12'
11 Sep, 2011			Transit to HARUMI	09/11 12:00(UTC+9h)
				33-30.5N、139-48.0E
				Fine but Cloudy
				East-4 ((Moderate breeze)
				2 (Sea smooth)
				1 (Low swell short or average)
				Visibly: 12'

YK11-06 Shipboard Log
(29.Aug, 2011 - 12.Sep, 2011)

Suiyo Sea Mt.
Western Northwest Pacific

Date	Local Time	Note	Description	Position/Weather/ Wind/Sea condition
12 Sep, 2011	10:00	Arrived at HARUMI		

Acknowledgement

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4. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

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.
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