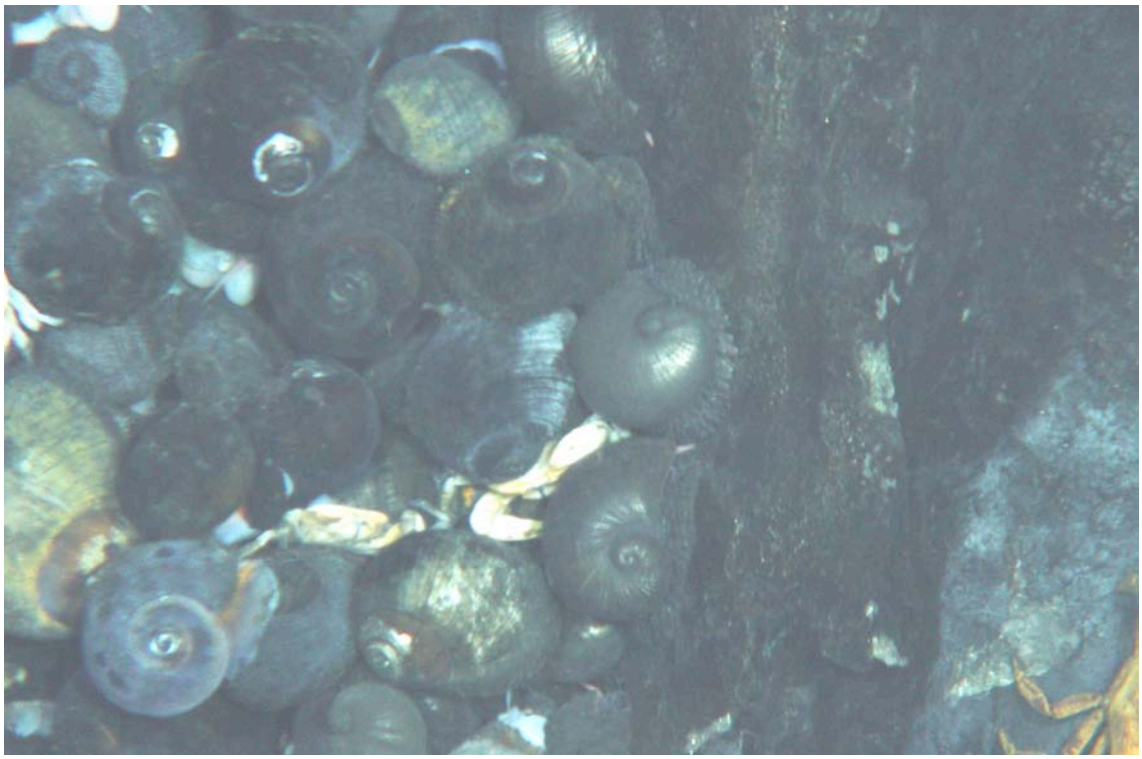
doi : 10.17596/0003634

YK05-16 UltraH^3

(Ultramafics-Hydrothermalism-Hydrogenesis-HyperSLiME)

Linkage Expedition Cruise Report (LEG#2)

February 4, Port Louis, Mauritius – February 24, Port Louis, Mauritius, 2006



Japan Agency for Marine-Earth Science & Technology

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Acknowledgements

We are grateful to Captain Mr. Masanori Ishiwatari, Chief Officer Hiroaki Masujima and Chief Engineer Mr. H. Shibata for their safe navigation and their skillful handling of “R/V Yokosuka”. Great thanks are due to Commander Mr. Y. Imai and “Shinkai 6500” operation team for taking us to deep sea floor and accurate operations in sampling. We also thank Miss. A. Mizota, Nippon Marine Enterprise, Ltd., for her attentive supports.

We thank all the JAMSTEC personnel who have supported us. Finally, we would like to appreciate all the person who supported directly or indirectly this cruise.

Contents

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Manned Research Submersible “Shinkai 6500”

Mission of “Shinkai 6500”

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

Specifications

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

Research Vessel “Yokosuka”

Mission of “Yokosuka”

1) Operate submersible “Shinkai 6500”
2) Operate underway-geophysical equipments;
   - Multi Narrow Beam Echo Sounder (Sea Beam 2112.04)
   - Gravity meter (Type S-63)
   - Ship-borne three-components magnetometer (Type SFG-1212)
   - Proton magnetometer (Typ STC10)

Research Facilities

In wet laboratory, a fumigation chamber, Mili-Q water purification system, -80˚C and -20˚C freezer, incubator and rock saw. In addition, “Yokosuka” has on-board video editing system for DVCAM, S-VHS and VHS.

Specifications

- Length: 105.22m
- Breadth: 16.0m
- Height: 7.3m
- Draft: 4.5m
- Gross tonnage: 4439t
- Cruising speed: about 16kts
- Cruising range: about 9000mile

Ship Log

Shipboard Log (YK05-16 Leg.2)				Position/Weather/Wind/Swell (Noon)
Date	Time	Comment.1	Comment.2	
03¥,Feb¥,06	10:30	scientists embark on NATSUSHIMA		(JST-5h)
	13:00	lecture about onboard life		
	16:00	immgration		
	21:30	scientific meeting		
04¥,Feb¥,06	10:00	leave Port Louis	head for survey area	(JST-5h) 20-26S,57-13E/fine/
	13:00	training for emergency		NNE:Moderate breeze/
	15:00	meeting (scientist and 6K team)		Low swell long
	16:40	Konpira ceremony		
	19:30	scientific meeting	seminar presentation:Takai,Nakamura	
05¥,Feb¥,06	19:00	scintific meeting & seminar	head for survey area	(JST-5h) 22-22S,62-03E/fine/
			seminar presentation:Toki, Suzuki	NE:Moderate breeze/
				Moderate short
06¥,Feb¥,06	19:00	scintific meeting	about Dive#928 plan	(JST-4h) 24-05S,66-34E/fine/
				E:fresh breeze/
				Moderate short
07¥,Feb¥,06	7:00	XBT measurement	Dive#928 CIR Kairei field (Takai)	(JST-4h) 25-19S,70-02E/fine/
	8:00	prepare for Dive#928	25-19.2154S, 70-02.3931E D=2495m	ENE:fresh breeze/
	11:21	6K lands on the seafloor		Moderate average
	17:16	6K float on the seasurface		
08¥,Feb¥,06	8:00	prepare for Dive#929		(JST-4h) 25-20S,69-51E/fine/
	10:00	suspend the Dive due to bad sea condition	dive suspension	E:strong breeze/
	19:00	scientific meeting and dive video sight		Moderate average
09¥,Feb¥,06	8:00	prepare for Dive#929		(JST-4h) 25-21S,69-37E/fine/
	10:00	suspend the Dive	dive suspension	E:strong breeze/

		due to bad sea condition		
	19:00	scientific meeting	viewing the dive#928 video	Moderate average
10¥,Feb¥,06	8:00	prepare for Dive#929		(JST-4h) 25-15S,69-39E/fine/
	9:00	suspend the Dive due to bad sea condition	dive suspension	E:strong breeze/
	19:00	scientific meeting and dive video sight		Moderate average
11¥,Feb¥,06	8:00	prepare for Dive#929		(JST-4h) 25-21S,69-37E/fine/
	9:10	suspend the Dive due to bad sea condition	dive suspension	E:Fresh breeze/
	19:00	scientific meeting		Moderate average
12¥,Feb¥,06	8:00	prepare for Dive#929	Dive#929 CIR Kairei field (Nakagawa)	(JST-4h) 25-19S,70-02E/fine/
	11:13	6K lands on the seabottom	25-19.203S, 70-02.416E D=2443m	ENE:fresh breeze/
	16:06	6K leaves the seabottom		Moderate average
	19:00	scientific meeting		
13¥,Feb¥,06	8:00	prepare for Dive#930	Dive#931 CIR Edmond field (Nunoura)	(JST-4h) 23-53S,69-36E/fine/
	11:35	6K lands on the seabottom	23-52.7303S, 69-35.7906E D=3316m	E:fresh breeze/
	16:00	6K leaves the seabottom		Moderate average
	19:00	scientific meeting		
14¥,Feb¥,06	8:00	prepare for Dive#931	Dive#931 CIR Edmond field (Hirayama)	(JST-4h) 23-53S,69-36E/fine/
	11:31	6K lands on the seabottom	23-52.6953S, 69-35.7030E D=3356m	E:fresh breeze/
	15:54	6K leaves the seabottom		Moderate average
	19:30	scientific meeting		
15¥,Feb¥,06	8:00	prepare for Dive#932	Dive#932 CIR Edmond field (Suzuki)	(JST-4h) 23-53S,69-36E/fine/
	11:31	6K lands on the seabottom	23-52.6953S, 69-35.7030E D=3356m	E:fresh breeze/
	16:03	6K leaves the seabottom		Moderate average
	19:30	scientific meeting		

16¥,Feb¥,06	8:00	prepare for Dive#933	Dive#933 CIR Kairei field (Kitada)	(JST-4h) 25-19S,70-02E/fine/
	11:15	6K lands on the seabottom	23-52.6953S, 69-35.7030E D=3356m	ENE:gentle breeze/
	16:06	6K leaves the seabottom		Moderate average
	19:30	scientific meeting		
17¥,Feb¥,06	8:00	prepare for Dive#934	Dive#934 CIR Kairei field (Suzuki)	(JST-4h) 25-19S,70-02E/fine/
	11:06	6K lands on the seabottom	25-19.2686S, 70-02.3650E D=2471m	ENE:gentle breeze/
	16:06	6K leaves the seabottom		Moderate average
	19:30	scientific meeting		
18¥,Feb¥,06	8:00	prepare for Dive#935		(JST-4h) 23-52S,69-26E/fine/
	9:00	suspend the Dive for 6K maintenance	dive suspension	E:fresh breeze/
	19:00	scientific meeting		Moderate average
19¥,Feb¥,06	8:00	prepare for Dive#935	Dive#935 CIR Edmond field (Takai)	(JST-4h) 23-53S,69-36E/cloudy/
	11:31	6K lands on the seabottom	23-52.7473S, 69-35.8613E D=3329m	ENE:gentle breeze/
	16:00	6K leaves the seabottom		Moderate average
	19:30	scientific meeting		
20¥,Feb¥,06	8:00	prepare for Dive#936	Dive#936 CIR Kairei field (Toki)	(JST-4h) 25-19S,70-02E/cloudy/
	11:09	6K lands on the seabottom	25-19.2888S, 70-02.3325E D=2523m	ENE:Moderate breeze/
	16:00	6K leaves the seabottom		Moderate average
	19:30	scientific meeting		
21¥,Feb¥,06	8:00	prepare for Dive#937	Dive#937 CIR Edmond field (Nakagawa)	(JST-4h) 23-153S,69-36E/rainy/
	11:09	6K lands on the seabottom	23-52.7426S, 69-35.7407E D=3349m	NE:Moderate breeze/
	16:00	6K leaves the seabottom		Moderate average
	19:30	scientific meeting		
22¥,Feb¥,06	16:00-18:00	BBQ@deck	head for Port Louis	(JST-4h) 22-38S,64-55E/rainy/
				NE:Moderate breeze/
				Moderate average
23¥,Feb¥,06	14:00-15:00	seminar for ship crew	by Takai and Suzuki	(JST-4h) 21-21S,60-11E/fine/

	15:00	clean Yokosuka Laboratory		ESE:Fresh breeze/
				Moderate average
24¥,Feb¥,06	9:00	arrive at Port Louis	No.1 port	
	15:00	Scientist leave R/V Yokosuka		

I. CRUISE SUMMARY

Geobiological expedition was conducted by means of RSV Shinkai6500 and its mother vessel R/V Yokosuka toward deep-sea hydrothermal systems in the Central Indian Ridge close to the Rodrigez .Triple Junction

Two active hydrothermal fields previously discovered, the Kairei Field and Edmond Field were exclusively surveyed. The most outstanding achievement of this cruise was the successful recovery and onboard fostering of novel gastropods *Crysomallon squamiferum* and *Alviniconcha heshleri* from the Kairei and Edmond fields. The scaly foot gastropod *Crysomallon squamiferum* was found only in the mixing zones of the lower parts of the Monju chimney (S25-19.22, E70-02.41, WD=2420 m) among all the vent sites of the Kairei and Edmond fields surveyed. They colonize the relatively lower temperatures (5-6 ˚C) of habitats attaching on the chimney walls without direct exposure to the clear diffusing flows. In contrast, *Alviniconcha heshleri* was found to be distributed widely in various vent sites such as Monju, Daikoku (S25˚ 19.21, E70˚ 2.39, WD=2442 m) and Gastropods crack (S23˚52.66, E69˚35.80, WD=3274 m) inn the Kairei and Edmond fields. Particularly in the Monju chimney, *Alviniconcha heshleri* shares similar habitats with *Crysomallon squamiferum* while *Alviniconcha heshleri* colonize evidently different niches. They cover *Crysomallon squamiferum* attaching chimney walls and reside over and over *Crysomallon squamiferum* and themselves. The average temperature of the layered *Alviniconcha heshleri* habitats were 10-20 ˚C, much higher than those in *Crysomallon squamiferum* habitats, strongly associated with clear diffusing flows. In addtion, it is interesting that *Bathymodiolus* sp. and barnacles colonize the lower places of the chimney structures than the habitats of gastropods and that Rimicaris spp. colonize the higher places of the chimney. These observations strongly suggested that these hydrothermal fluids-associated chemosynthetic macrofauna might be distributed in different niches controlled by steep physical and chemical variations formed in the Monju chimney.

Most of the animals retrieved from these habitats could survive in the aquarium equipped onboard. In addition, the gastropod specimens were applied to stable carbon isotope label experiments using $H^{13}CO_3^-$ under different conditions using H_2 or HS^- as a sole energy source. During the 3 days incubation, the gastropod individuals were still alive and properly processed and stored. The detail analyses would be performed immediately after returning to Japan. Most of animals would be tested for long-term

survival in onshore aquarium. The Shin-Enoshima Aquarium sought to keep these animals alive in their facility.

Many hydrothermal fluid and chimney samples were obtained and the STR-ISCS deployed at Kali (S25-19.22, E70-02.37, WD=2449 m), Monju and Nura Nura (S23˚52.66, E69˚35.81, WD=3277 m) vent sites for 10, 10 and 6 days, respectively, were successfully retrieved. These samples might be enough for the future geochemical, stable isotopic and geomicrobiological characterizations to prove the UltraH^3 Linkage hypothesis in the Central Indian Ridge deep-sea hydrothermal systems.

II. Introduction

General background

Deep-sea hydrothermal system has been for long time assumed as one of the most favorable places for origin of life in this planet since its discovery in the end of 1970s. Although recent investigations have revealed a greater diversity of deep-sea hydrothermal activities and microbial ecosystems therein than previously expected, this hypothesis still presents just a rough sketch and the key substantial questions to the place and process remains unanswered. Early evolution of energy metabolism of microorganisms could provide an important clue to reply the questions. Phylogenetic, biochemical and geochemical implications of early evolution of microbial energy metabolism strongly suggest that hydrogenotrophic methanogensis or hydrogenotrophic sulfur-reduction might be the primary energy metabolism of the last universal common ancestral (LUCA) community. In the modern Earth, however, such chemolithoautotrophic microbial ecosystem sustained by geologically supplied H_2 has been identified only in the subsurface environment of the extremely H_2-dominating hydrothermal system, which is originally proposed as hyperthermophilic subsurface lithoautotrophic microbial ecosystem (HyperSLiME). Extraordinary high amount of H_2 in hydrothermal fluid and occurrence of H_2-driven HyperSLiME might be strongly associated with the hydrothermal serpentinization of ultramafic rocks and the input of magmatic volatiles, both of which could situate on specific geological settings.

The “Ultramafics-Hydrothermalism-Hydrogensis” linkage is unequivocal and ubiquitously occurs in the modern Earth. This could provide an ideal habitat for a H_2-driven HyperSLiME or SLiME-like community. However, the habitats affected by the serpentinized fluids are in most cases very harsh environment for living organisms. It is due to a formation of extremely alkaline fluid (extremely high pH of fluid) concomitantly occurring during the hydrothermal serpentinization even though the detail mechanism for the chemistry is still unclear. The pore water samples from the serpentine mud volcanoes of the South Chamorro and the Conical Seamounts showed an average pH of 12.5, and the hydrothermal fluids in the Lost City represented pH 10-11 or even much higher pH of the end member fluids. These extremely high pH conditions are around the highest pH limit of growth for life known so far. At present, the highest pH limit of growth for life is pH 12.4 recorded in *Alkaliphilus transvaalensis* isolated from an ultradeep South African Au mine and very few microorganisms can grow under a pH condition of >11. In addition, under such high pH conditions, most of

the inorganic carbons are present as CO_3^{2-} and are hardly available for microbial energy and carbon metabolisms. Indeed, Kelley et al. (2005) suggested that TIC in the Lost City hydrothermal fluids was all CO_3^{2-} and the microbial communities might utilize CO_2 or HCO_3^- in the ambient seawater. Thus, the formation of extremely alkaline fluids associated with hydrothermal serpentinization potentially hinder the prosperous occurrence of the H_2-driven HyperSLiME or SLiME-like community. However, this seems to be the cases of the Lost City hydrothermal field and the Mariana Forearc serpentine Seamounts, since more H_2 abundant hydrothermal fluids of the Rainbow, the Logatchev and the Kairei hydrothermal fields circumvent the elevated pH of the fluids, representing pH of the fluids around 3. The acidic hydrothermal fluids are quite usual in most of the global deep-sea hydrothermal systems and are explained by input of magmatic volatiles whether they are provided directly from magma itself or subsequently from the inclusion magmatic volatiles of the heat source rocks. In these deep-sea hydrothermal systems, therefore, the magmatic input might play a significant role to prepare the moderate pH conditions and to add the inorganic carbons from the earth interior. With the magmatic input, the microbial ecosystems in the ultramafic rock-associated deep-sea hydrothermal systems such as the Rainbow, the Logatchev and the Kairei hydrothermal fields might be energized by H_2 from hydrothermal serpentinization of ultramafics. In such geological settings, "Ultramafics-Hydrothermalisms-Hydrogenesis-HyperSLiME" (UltraH^3) linkage could be operative.

Searching Ultramafics-Hydrothermalism-Hydrogenesis-HyperSLiME (UltraH^3) linkage in the Kairei Field, Central Indian Ridge.

The Kairei hydrothermal field is located in the first segment of the Central Indian Ridge (CIR-S1), which was the first deep-sea hydrothermal field discovered in the Indian Ocean. It is situated at the eastern axial valley wall very close to the inside corner of the ridge-transform intersection (RTI) between the first and second segments of the CIR. The local bathymetric topography and the dive surveys using *DSRV* Shinkai 6500 revealed that the hydrothermal activities of the Kairei field were distributed along the lava flow extending 100 m east to west and 40 m north to south. Based on the geochemical and stable isotopic characterizations of the hydrothermal fluids and the microbiological exploration of the subseafloor microbial communities, the extremely high concentration of H_2 and significantly ^{13}C depleted CH_4 in the fluids and the possible occurrence of HyperSLiME was demonstrated in the Kairei field. These are

solid evidences of Hydrothermalism-Hydrogenesis-HyperSLiME linkage in the Kairei hydrothermal field, and the extraordinary amount of H_2 in the fluids has strongly suggested the contribution of ultramafic rocks to the hydrothermal reactions. Nevertheless, the association of ultramafic rocks with the hydrothermal activities has been not directly identified from the petrological aspects.

The recent bathymetric and geophysical surveys of the southern CIR around the ridge-ridge-ridge type triple junction, the Rodrigez Triple Junction (RTJ), where the Kairei field is closely situated, suggest that the ultramafic rocks are relevant to the hydrothermal activity in the Kairei field. As a whole, the CIR has been characterized as the intermediate-rate spreading ridge, while the southern region of CIR is based on very variable morphological structures along the ridge axis. The heterogeneity was explained by the spatial and temporal variation of magma supply. For instances, the inflated axial high at the southern end of the third segment of CIR (CIR-S3) seems to be a morphological signature observed in a fast-spreading ridge, but the deep axial valley of the first segment (CIR-S1) is similar with the axial valleys in typical slow-spreading ridges like MAR. In such slow-spreading ridges with insufficient magma supplies, some significant portions of mantle peridotite reside within the shallow oceanic crust and very remarkable massifs characterized by corrugation perpendicular to the ridge axis, known as “megamullions,” are frequently found. This “megamullion”-like structure is found on the western flank of the CIR-S1, at an opposite position of the Kairei hydrothermal field. The relevant area shows not only the typical morphological signature of megamullion but also the strong positive anomaly of residual mantle Bouguer anomaly, indicating existence of dense materials beneath the massif. From a volcanological aspect, the very short length of the CIR-S1 (< 50km) might be consistent with a less amount of magma supply and a rapid cooling of magma by adjacent older lithosphere known as transform effect. In addition, the plate reconstruction approach of the RTJ and the southern CIR suggest the plasticity of the RTJ and the very short lifetime of the CIR-S1 associated with unstable setting of the RTJ. All these observations strongly suggest the geological settings of the CIR-S1 and the Kairei hydrothermal field hosted by abundant ultramafic rocks, mantle peridotites, as inferred from the extraordinary H_2 concentration in the hydrothermal fluids. To testify the hypothetical geological settings of the CIR-S1 and the Kairei hydrothermal field, a geological, geophysical and geochemical research expedition using R/V Yokosuka and DSV Shinkai6500 (YK05-16 Leg#1) was conducted in January, 2006 (chief scientist: Dr. Kumagai). One of the greatest results obtained from the YK05-16 Leg#1 was discovery of ultramafic rocks and olivine

gabbros in the “megamullion” located in the west of the CIR-S1 and even in the URANIWA mullion in the eastern flank of the Hakuho Knoll hosting the Kairei Field. This strongly suggests the input of ultramafic rocks into hydrothermal circulation of the Kairei field and the existence of “UltraH^3” Linkage in the Kairei field.

After the great proceedings of YK05-16 Leg#1, we are going to revisit the Kairei Field and to confirm the existence of HyperSLiME since the first discovery in 2002. In the 2002 cruise (YK01-15), only two hydrothermal vent sites (Kali & Fugen chimneys) were investigated. In this cruise (YK05-16 Leg#2), we extend our surveys to other hydrothermal vent sites. Furthermore, we will collect many specimens for mysterious gastropods *Alviniconcha* and Scaly foot. In this cruise (YK05-16 Leg#2), we also investigate the reference hydrothermal system in the CIR, the Edmond filed, located inn the CIR-S3. This is a hydrothermal system hosted by basaltic magma typical to intermediate to fast spreading MORs. The comparison of microbial ecosystem and macrofaunal community between two geologically different hydrothermal systems in the similar geographical region will provide a excellent insight into how geological and tectonic settings are associated with formation of microbial and macrofaunal ecosystems.

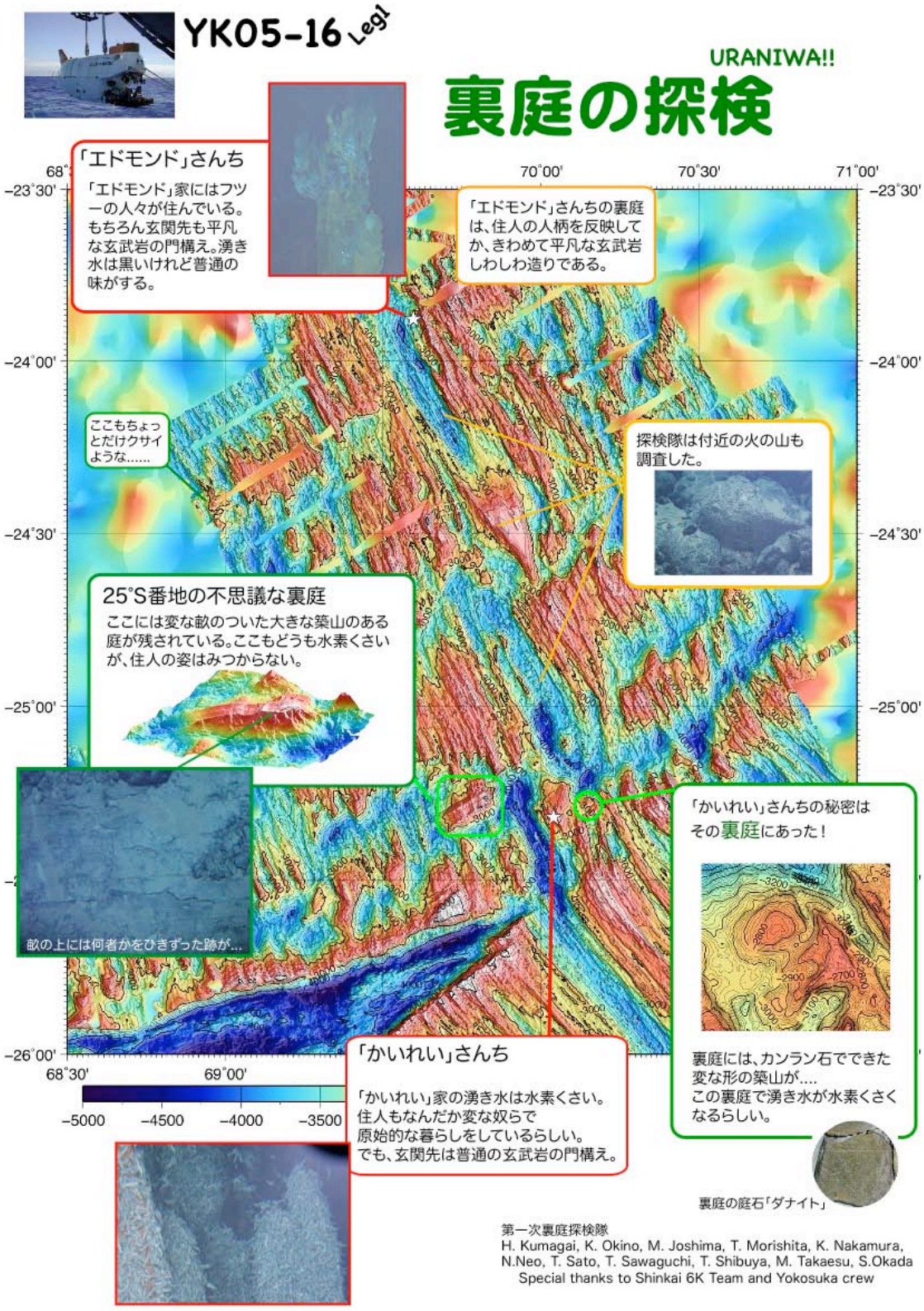


Fig. Results summary of the YK05-16 Leg#1

EXPLANATORY NOTE

GEOCHEMISTRY

1. WHATS fluid sampler

WHATS (Water Hydrothermal Atsuryoku Tight Sampler) was developed for collecting hydrothermal fluid samples without any loss and atmospheric contamination of gas species. Since it overflows its sample bottle with sampling fluids, it is rather easy to collect fluids close to the endmember.

This sampling system consists of inlet tubing, 4 pressure-resistant sample bottles with ball valves at both ends (volume of one bottle: 150 ml), an arm to open and shut the valve and a deep-sea compatible pump. Usually WHATS is installed just below the shell of SHINKAI2000 and a sample inlet is handled with a manipulator. Operation is controlled from inside the shell.

2. Treatment of WHATS Samples for Gas Chemistry

In general, for vent fluid sampling, the WHATS sample bottles were triggered in pairs, with one of the bottles used for the analysis of fluid chemistry and the other for gas chemistry. The bottle devoted to gas chemistry was processed on board using a high vacuum line specifically designed for this purpose using the following procedure.

After the WHATS bottle is connected to the vacuum line, all of the connecting lines are evacuated to high vacuum using an oil diffusion pump. When sufficient vacuum is achieved, the vacuum line is closed in a static condition, and the valve on the bottle is opened and the water plus gas is allowed to drop into an evacuated flask. Sulfamic acid is added to the flask previous to the extraction in order to acidify the sample and aid in the extraction of carbon dioxide and is mixed with $HgCl_2$ enough to thoroughly deposit H_2S as HgS. The water in the extraction flask is then agitated by immersing the flask in an ultrasonic bath. The gas phase was transferred to a 150 cm^3 evacuated stainless steel container (for content and isotope measurements of CH_4 and ΣCO_2). After the gas phase was obtained, the liquid phase was filtered (mesh size: 0.2 μm) and taken into a 50 cm^3 polypropylene bottle (for major cation and anion measurements).

3. Onboard Analyses

The bottle devoted to fluid chemistry was shared with microbiological study.

After sample for pH and H_2S determination was drawn, large part of the fluid was filtered with a 0.2μm disk filter, which filtrate was provided for chemical analysis. One of the filtrate aliquots was acidified with nitric acid to avoid hydroxide precipitation during storage.

Some chemical species such as nutrients are difficult to be conserved during storage, therefore should be analyzed onboard. In this cruise, potentiometric techniques, colorimetric methods, titration and ion chromatography were employed for onboard analyses as described below. Using the same apparatus, some conservative species were also analyzed. Most of these analytical methods are conventional ones and summarized in Gieskes et al. (1991).

3.1 pH and alkalinity

Determination of pH at room temperature was conducted with a pH meter with a combined glass electrode (Horiba, PHC2401-8). Measurements were done within an hour after sample distribution from the WHATS bottle. Calibration was conducted daily using JSCS buffer solutions (pH=6.865 and 4.010).

Alkalinity was determined by titration with hydrochloric acid. For calculation of the endpoint, Gran plot is employed using the pH/ion meter (PHM240). Calibration factor was checked by analysis of IAPSO standard seawater (which alkalinity must be 2.325mM). Analytical precision is estimated as within 5%.

3.2 Colorimetric method

Using a colorimeter (Hach, DR2010), concentrations of dissolved silica (SiO_2), ammonium ion (NH_4), and hydrogen sulfide (H_2S) were analyzed following classical methods; molybdenum blue method (λ=812nm) for SiO_2, indo-phenol method (λ=640nm) for NH_4, methylene blue method (λ=670nm) for H_2S. Analytical precision is usually estimated as within 3% for seawater analysis. However, sometimes the precision is somewhat worse for the case of hydrothermal fluids, because of wide range of concentrations (SiO_2 and H_2S), and of interference by specific species (NH_4).

3. Onshore based analyses

For gas species, while determination of methane concentration and isotopic measurements will be conducted in Hokkaido University, helium isotope will be measured by Dr. Yuji Sano in the University of Tokyo.

For dissolved elements, analyses will be conducted mainly in Kyushu Univ.

using ICP-AES, flame spectrophotometry, and ion chromatography. Determination of trace heavy metal elements concentrations will be conducted by collaboration with Mr. Takuro Noguchi in the University of Ryukyu.

MICROBIOLOGY

1. Subsampling procedures

For enrichment and MPN (Most Probable Number) cultivation analyses, water samples collected by Niskin and WHATS were immediately collected in sterilized glass vials on board, and then, if needed, added sodium sulfide (final conc. 0.05%) and filled headspace with nitrogen gas. For molecular ecological analyses, microbial components in water were concentrated using 0.22μm-pore size 25mm or 45mm cellulose acetate filters. Then, the filters were stored at –20˚C for molecular phylogenetic analysis and at 4˚C with 5% formaldehyde for FISH (Fluorescence In Situ Hybridization) analysis.

Chimney samples were subsampled into several sections (e.g. vent orifice surface, inside structure, middle-inside structure). Preparation of slurry and preservation for DNA based molecular analyses were performed as described for sediment samples.

2. STR-ISCS

In order to demonstrate the possible existence of hyperthermophilic microorganisms in >300˚C vent emission, which likely transported through as active microbial populations from subvent biosphere, the in situ colonization system (ISCS) was developed. This system consisted of stainless steel vessels and matrices, which might be newly given habitat for hyperthermophiles with vast surface area. The various candidates for matrices were tested in advance. Finally, we use pumice containing low proportion of aluminum. The vessels are created for fitting with vent orifice diameters. The vessels and matrices were sterilized by heating at 400˚C for 4 days. Any nucleic acids and microorganisms were removed. Then, bringing these ISCS with submersible dives, we place several ISCS in designed microhabitats such as vent emission and surrounding microhabitats. After several days or weeks, ISCS is retrieved by another dive and applied to shore based experiments.

However, it is not completely demonstrated whether ISCS was incubated at >300˚C during all the time of deployment. For conquering this query, we developed ISCS and named STR-ISCS (Self Temperature Recording – In Situ Colonization System) that consists of ISCS and temperature probe with automatically recording

system. The first system of STR-ISCS called Anomalocaris was developed and brought to deep-sea hydrothermal vents in 2002 but she had some troubles in operation. Thus, we further developed second type STR-ISCS and use it on this cruise. The data logger (4.1cm Ø x 25.5 cm) is hydrostatic pressure resistant up to 60 Mpa for 6000 m deep-sea hydrothermal vent fields. The temperature probe that is 38cm in length is able to resist up to 400˚C, and the code between data logger and temperature probe is exchangeable and the length are 20 – 100 cm. The data were transported into PC after retrieval onboard and memory limit are enough to measure the temperature in such a manner as 1 time per 1minute for 6 months.

IV. DIVE REPORTS

Dive Report: SHINKAI 6500 Dive #928

Date: 7 February, 2006
Site: Kairei Field at the CIR-S1
Landing: 11:21; 25°19.2971'S, 70°02.3686'E, 2495m
Leaving: 16:18; 25°19.2181'S, 70°02.4113'E, 2416m
Observer: Ken Takai (SUGAR Program, JAMSTEC)
Pilot: M. Yanagitani, **Co-Pilot:** Y. Chida

Objectives:
Two major objectives are underlying on this dive 928: 1) re-mapping the whole structure of the hydrothermal sites at the Kairei Field and (2) obtaining a variety of hydrothermal fluids, chimneys and animals and deploying STR-ISCSs in both of the Kaili & Fugen chimneys.

Dive Summary:
We landed on the basalt breccia with sands at approx. 140 m south of Kairei Field. During falling down before landing, we observed the buoying hydrothermal plume at a depth of about 2200 m and took a water sample by a Niskin water sampler at an altitude of 5 m. After landing, a surface-rested rock covered with sediments was sampled. Then, we headed north to the potential Kali chimney site. Approx. 140 m running, we saw the US marker#5, which was previously settled for remarking the Kali chimney. Surveying around US marker#5, we did not see the Kali chimney but at 7-10 m east, we identified the Kali chimney. The Kali chimney is located at the bottom of V-valley, which lies east-west direction. At the downstream of the V-valley, potential previous Kali vent sites, diagenesis of the host rock and dead chimney fractions were observed. The Kali vent site consisted of several sequential vent holes from the west (downstream) to the east (upperstream) and finally very steep cliff was present at the eastern end of the V-valley and Kali vent site. From the Kali site, the hydrothermal fluids were collected by WHATS (928WW1 & 928WW2, both are close to end member of fluids with 362 ˚C) and Bag pomp sampler (928Bag). Several pieces of chimneys were also sampled. Then, STR-ISCS was deployed in the Kali vent orifice and the 6K marker#22 was settled. At the north ridge of the Kali vent site, huge dead chimney structures with barnacles were identified. At the south ridge of the Kali vent site, active tall chimneys covered with Rimicaris shrimps were found.

We leaved the Kali vent site and headed east to the Fugen chimney. In the way to the Fugen chimney, at 10-20 m east from the Kaki site, many active chimneys covered with Rimicaris spp. were found. Then at 40-50 m east from the Kali site, we saw the 6K marker#20 and the chimney complex site, which was set by Dr. Kumagai several week ago. Since this site was considered to be the potential Fudo chimney, we passed through the site. After loitering east area for searching the Fugen chimney, we did not find any active chimney site around there, and decided to be back to the 6K marker#20. In the way back to the 6K marker#20, we encountered the active chimney site harboring lots of gastropods. Thus, we landed the site and sought to work there. The site was thin tall black smoker chimney complex covered with thousands shrimps and at the foot of the complex with diffusing flows, numerous Alviniconcha heshleri colonized. Below the Alviniconcha colonies, vent mussels Bathymodiolus spp. also resided. First, we collected the Alviniconcha and Bathymodiolus populations by sucsion sampler. Then, we obtained the chimney fractions. The hydrothermal fluids were collected by WHATS (928WW3 & 928WW4, of which temperatures were max. 280 ˚C and 299˚C, respectively). Finally, STR-ISCS was deployed in the potential Fudo chimney and the 6K marker#23 was settled. Finishing these manipulations, we left the bottom.

Payloads:

1) WHATS with a temperature probe for fluid sampling
2) Bag pomp sampler
3) Sample box x4
4) Suction sampler (single canister)
5) Marker x2 (#22 & #23)
6) STR-ISCSs x2

Location of Events:

Time	Position	Depth	Event
11:21	25°19.2971'S, 70°02.3686'E,	2495m	Niskin sampling
			Landed on basalt breccia with sands
			Sampling a rock
11:54	25°19.2224'S, 70°02.3668'E,	2455m	Found the US marker#5
12:00	25°19.2233'S, 70°02.3720'E,	2449m	Found the Kali vent site
13:33	25°19.2233'S, 70°02.3720'E,	2449m	Sampled chimneys

Collected hydrothermal fluids by WHATS (max. 362 ˚C)& Bag (7L)
Deployed a STR-ISCS
Put the 6K marker#22

13:57 25°19.2200'S, 70°02.4066'E, 2426m Found the 6K marker#20

14:37 25°19.2200'S, 70°02.4066'E, 2420m Found the active chimney site with lots of animals

16:14 25°19.2200'S, 70°02.4066'E, 2420m WHATS 3 (max. 280 ˚C) and 4 (max. 299 ˚C)
Recovered chimney samples
Sucked many animals
Deployed a STR-ISCS
Put the 6K marker#23

16:18 25°19.2181'S, 70°02.4113'E, 2416m Leaving the bottom

Video log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
10:02:00				vent open; Shinkai descends
				Observe plume
				See bottom
				See sea anemone
				Niskin sampling (Altitue = 5 m)
11:22:00	-180	-50	2495	Landed on bottom. Current = 130~135°; Distance = 7 m; Sandy; Temperature = 1.8°C
11:26:00				Rock sampling
11:28:00				Head off towards 360°
11:35:00	-80	-40	2456	
11:38:00	-60	-40	2457	Mkr#5 observed
11:45:00	-30	-70	2459	Chimney. Electrical image from Shinkai change from Camera1 to Camera2.
11:54:00	-30	-60	2466	Observe Mkr#5, again! We are lost guys. Don't worry, Kent! Mkr#5 have to be near the Kali
11:58:00	-40	-50	2453	Sea anemone everywhere around them.
12:00:00	-30	-60	2456	Black smoker!
12:04:02	-30	-40	2456	Nice view of active black smoker chimneys
12:05:00			2456	See many of shrimps on the chimneys
12:24:50	-40	-50	2458	Breaking off the chimney

12:28:50	-50	-50	2457	Sampling a piece of chimney
12:29:00	-50	-50	2457	Started high temperature water sampling (WHATS)
12:45:00	-40	-40	2457	It seems flow meter wheel turning, indicting flushing of samplers is occurring
12:48:00	-40	-40	2458	WHATS sampler No.1 finished (Tmax = 362°C)
12:57:06	-40	-40	2458	WHATS sampler No.2 finished (Tmax = 362°C)
13:08:00	-40	-40	2458	Bag sampler started.
13:13:30	-40	-40	2458	Bag sampler finished, and then trying to get chimney.
13:18:00				Only one chimney sampled, and begin to set the In-Situ Colonization System (ISCS).
13:23:00				Set the ISCS (large) on the top of a black smoker
13:33:00				Deployed Marker No.22 near the ISCS.
				Finished working at this site, then going to the Fugen.
				Close-up of barnacle on the chimney near the Kali site.
13:47:00	-50	-30	2450	Black smoker?!
13:50:00	-54	-42	2430	Huge chimney with lots of shrimps
13:55:00	-48	-12	2426	A marker? Huge chimney with lots of shrimps
13:57:00	-40	0	2426	The marker is recognized as "Marker No.20" that Dr. Kumagai set during Leg1.
				This site was considered as Fugen, but this may be Fudo based on the relative position to Kali Heading ~090°
14:05:00	-60	50	2425	
14:08:00	-30	70	2421	Running over the seafloor where we can't see anything at all.
14:11:00	-10	80	2419	
14:16:00	10	100	2423	Returning to the Mkr#20.
14:21:00	-30	50	2419	Observed barast for desending of a submersible.
14:25:00	-30	20	2417	Huge chimney with lots of shrimps, again!
14:26:00	-30	20	2419	
14:29:00	-20	0	2430	A number of anemone on the seafloor!!! I call Deep-Sea Botanical Garden (DSBG).
14:31:00	-20	-20	2433	
14:37:00	-30	-10	2421	Decide to sample samples near the Mkr#20.
				Huge chimney venting black smokers with a lot of shrimps and crabs like a aquarium.
				The faunas like a thermal water no more than Japanese do, including me.
14:46:00	-30	10	2426	Variable colored gostropods in colony of the fauna! And sampling them by the Slarp-gun
14:54:00				Sampling finished. Alviniconcha and Mussel are acquired.
15:04:00				Chimney sampled, and then getting water into WHATS No.3 bottle.
15:16:00				WHATS No.3 finished; Temperature: up to 280 deg.C.
15:24:00				WHATS No.4 finished; Temperature: up to 291 deg.C.
15:27:00				Measured temperature of water near the sampled Alviniconcha colony ranged 14~20 deg.C
15:36:00				Sampled a piece of chimney.
15:38:00				Starting the deployment of another ISCS (middle size).

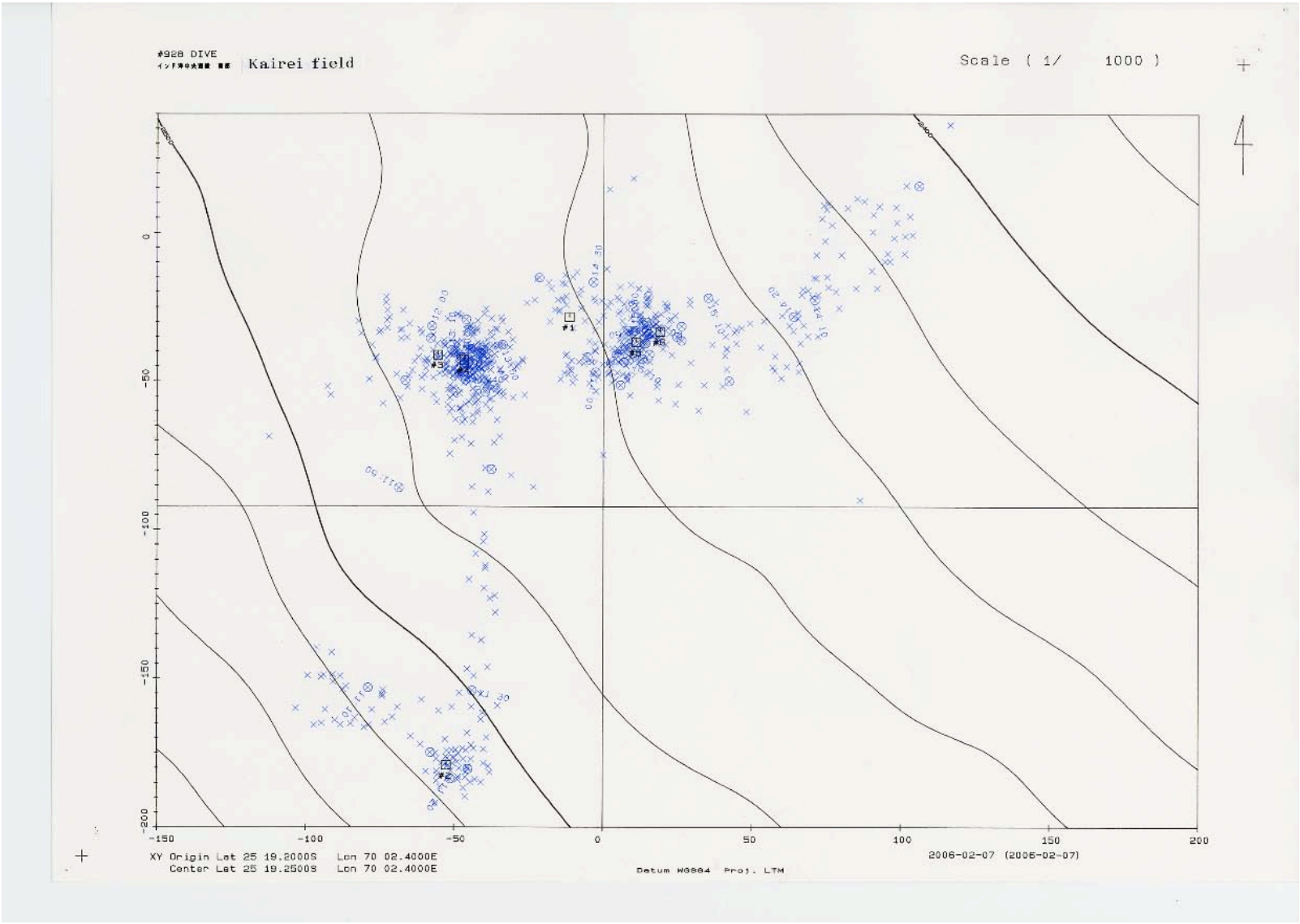
15:57:00				Say Okai to the question of a leaving time from the bottom at 16:00.
16:08:00				Finished the deployment, then set a marker at this site.
16:14:00				Set Marker No.23. They are leaving this site and the bottom at this time.
16:18:00				Left the bottom (Recovery time may be 17:15)

Finish the dive, and say "good jobs!" to Kent

Event List:

2006/02/07 9:00 -28.4, -11.5, 25-19.2154S, 70-2.3931E,
Landing Target
2006/02/07 11:21 -179.2, -52.6, 25-19.2971S, 70-2.3686E,
Landing D=2495m Samp. Niskin A=5m, Rock(1)
2006/02/07 11:54 -41.3, -55.7, 25-19.2224S, 70-02.3668E,
USA #5Marker D=2455m
2006/02/07 13:33 -43.0, -46.9, 25-19.2233S, 70-02.3720E,
S. Chimney(2), WHATS(2), Bag, D. ISCS, #22Mkr D=2449m
2006/02/07 16:14 -36.9, 11.0, 25-19.2200S, 70-02.4066E,
S. Animals, WHATS, Chimney D. ISCS, #23Mkr D=2420m
2006/02/07 16:18 -33.3, 19.0, 25-19.2181S, 70-02.4113E,
Leaving bottom

Dive Track:


#928 DIVE
Kairei field
Scale (1/ 1000)
0
-50
-100
-150
-200
-150
-100
-50
0
50
100
150
200
#1
#2
#3
#4
#5
XY Origin Lat 25 19.2000S Lon 70 02.4000E
Center Lat 25 19.2500S Lon 70 02.4000E
Datum WGS84 Proj. LTM
2006-02-07 (2006-02-07)

Dive Report: SHINKAI 6500 Dive #929

Date: February 12, 2006
Site: Kairei Field at the CIR-S1
Landing: 11:13; 25°19.0974'S, 70°02.3857'E, 2424 m
Leaving: 16:06; 25°19.2094'S, 70°02.3881'E, 2385 m
Observer: Satoshi Nakagawa (SUGAR Program, JAMSTEC)
Pilot: T. Sakurai, **Co-Pilot:** K. Matsumoto

Objectives:
Objectives were i) re-mapping hydrothermal activity at the Kairei field, and ii) collecting various hydrothermal samples such as chimney structures, vent fluids, rocks, and animals.

Dive Summary:

We landed at approximately 250 m NNE of Kali chimney. As in the case of dive #928, we found hydrothermal plume at the depth of about 2200 m. Sea bottom consisted of angular basaltic rocks covered by quite thin sediments. When we saw the sea bottom, we headed for south in order to find the Bishamon chimney. The more we went to south, the more abundant sea anemone and *Rimicaris* sp. were found. However, no hydrothermal activity was still apparent. When we run about 170 m (at event mark 3), we landed to collect rocks. Two rocks were collected (one was greenish, and another one was orange; both of the rocks were dead chimney?). Soon after we started running to south again, we found a huge chimney covered by lots of shrimps and #23 marker. This meant we passed over the area where we potentially could find the Bishamon chimney. The trouble with the main thruster made us to abandon going back to north to find the Bishamon chimney.

We decided to collect hydrothermal samples from the chimney in front of the submersible. The submersible hit the chimney, and hanged on it at an altitude of 2-3 m (at event mark 4). Considering the location and geological structure, this chimney must be the Fugen chimney. We successfully collected lots of chimney portions and vent fluids (with WHATS bottle 1 & 2, Bag sampler). Temperature of the vent fluids was really stable, which was between 304.6 and 304.8 deg. C. Then, we landed on the base of the chimney structure in order to look for the colonies of gastropods. Although we moved around there, we could not find any gastropods. All macro fauna we could find

there were sea anemones, shrimps and barnacles. We landed and collected a rock colonized by two sea anemones and several barnacles. Then, we decided to set to marker #23.

After several trials, we finally landed in front of marker #23 and found a number of gastropods. Although we zoomed the animal community up several times, we were unable to get any images of scaly foot. We sticked the inlet of sampler deep into the animal community and suctioned them which consisted of shrimps (mainly *Rimicaris*), gastropods (*Alviniconcha* and scaly foot [the ratio was 10:1]), crabs, and a clam (*Bathymodiolus*).

Then, we started surveying eastern part of the Kairei field. Although we run approx. 100 m, we could not find any hydrothermal activity there. In addition, quite few sea anemones were found in the eastern part of the Kairei field, suggesting there were no venting in the eastern part of the event mark 4. Thus, we decided to goback to the western area to find a vent from where we have not yet collect any fluids. Before we found it, the submersible arrived at the Kali chimney, and we were mostly running out of time. So we landed and collected several pieces of inactive chimney near Kali venting, and left bottom.

Payloads:

1) WHATS with a temperature probe for fluid sampling
2) Bag pomp sampler
3) Sample box x4
4) Suction sampler (single canister)
5) Marker x2 (#24 & #25)

Location of Events:

As in the section, “Event List”.

Video log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
9:57:00				vent open; *Shinkai* descends
11:15:00	180	-20	2424	Land on garavel (basalt?)
11:30:00	90	-20	2454	on basaltic lava?
11:33:00	34	-30	2464	sea anemone ?
11:39:00	20	-20	2461	Sampling two pieces of rock
11:46:00				head to 90˚ (to climb slope)
11:52:00	-2	16	2436	Dead chimneys with anemone
11:57:00	-30	16	2420	anemone garden
11:58:00	-30	20	2422	See marker #
12:03:00	-45	35	2418	See black smoker chimneys covered with numerous shrimps
12:05:00	-40	50	2418	Probably find the Fudo chimneys
12:05:00				Started chimney sampling
12:12:00				Nice close up view of shrimps on a chimney
12:38:00	-40	30	2418	Started high temperature water sampling (WHATS 1st) 305˚C
12:50:00				Started high temperature water sampling (WHATS 2nd) 305˚C
13:28:00				Sampling hydrothermal fluids by bag sampler
13:30:00				Sampling macrofauna
13:50:00	-30	13	2430	Sampling a rock (attached with "Kamenote" and sea anemone?)
13:58:00	-30	12	2421	See marker #
14:16:00	-30	-9	2430	See marker # on the foot of the chimney structures
14:28:00	-35	0	2429	See marker #20 (settled in a dive of Leg 1) amd looking around this
14:37:00	-20	0		
14:58:00	-38	8	2425	land near marker #23 and start sampling gastropods and crabs
15:05:00				Finish animal sampling. Head to the east.
15:14:00	-25	20	2423	
15:22:00	-25	90	2416	No signature of hydrothermal activity. Return to the west.
15:29:00	-35	30	2417	
15:35:00	-40	-20	2443	
15:38:00	-30	-50	2444	
15:42:00	-50	-80		
15:43:00				See marker #22
15:46:00			2444	See ISCS near marker #22
15:55:00	-45	-45	2451	Finish sampling of pieces of dead chimney
16:05:00	-40	-10	2405	
16:06:00				Leave the bottom

Event List:

8:00, 25° 19.2030’S, 70° 2.4160’E, Landing Target

11:13, 25° 19.0974’S, 70° 2.3857’E,Landing, D=2424 m

11:42, 25° 19.1917’S, 70° 2.3853’E, Sampling Rocks (2), D=2462 m

13:27, 25° 19.2271’S, 70° 2.4155’E, Sampling Chimney, WHATS (2; temp.=304.6-304.8 °C) and Bag, D=2419 m

13:53, 25° 19.2166’S, 70° 2.4103’E, Sampling Rock with Sea Anemones (1), D=2427 m

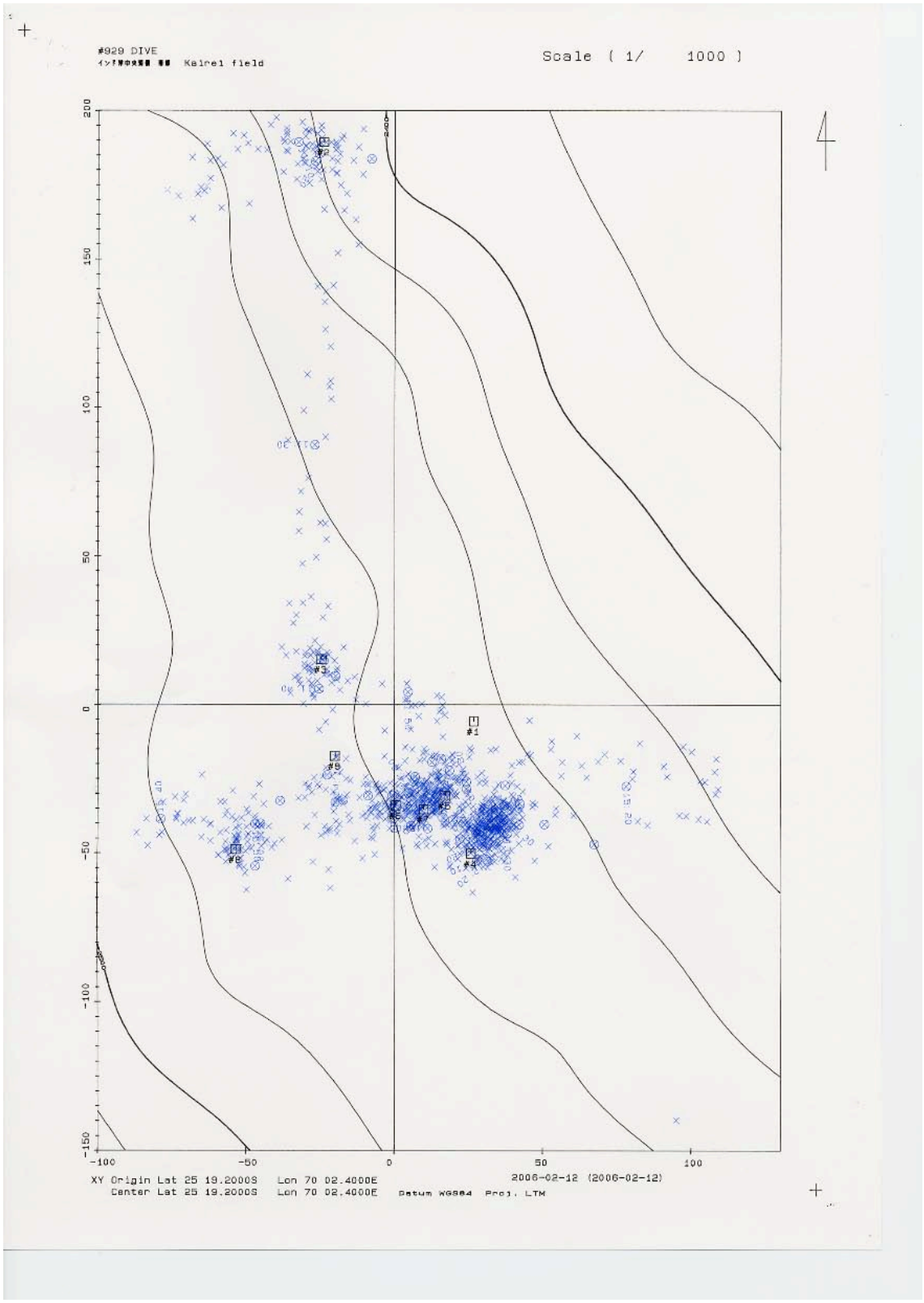
14:27, 25° 19.2184’S, 70° 2.4004’E, #20 Marker, D=2428 m

15:04, 25° 19.2191’S, 70° 2.4060’E, #23 Mkr, Sampling Animals, D=2420 m

15:58, 25° 19.2264’S, 70° 2.3682’E, Sampling Fragments of Inactive Chimney, D=2451 m

16:06, 25° 19.2094’S, 70° 2.3881’E, Left Bottom, D=2385 m, A=60 m

Dive Track:


#929 DIVE
Kairei field
Scale (1/ 1000)
200
150
100
50
0
-50
-100
-150
-100
-50
0
50
100
#1
#2
#3
#4
#5
#6
#7
#8
#9
XY Origin Lat 25 19.2000S Lon 70 02.4000E
Center Lat 25 19.2000S Lon 70 02.4000E
2006-02-12 (2006-02-12)

Dive Report: SHINKAI 6500 Dive #930

Date: 13 February, 2006
Site: Edmond Field at the CIR-S3
Landing: 11:35; 23°52.7303'S, 69°35.7906'E, 3316m
Leaving: 16:00; 23°52.6646'S, 69°35.7898'E, 3272m
Observer: Takuro Nunoura (SUGAR Program, JAMSTEC)
Pilot: I. Kawama, **Co-Pilot:** Y. Chida

Objectives: Two major objectives of this dive are 1) obtaining chimney structure and hydrothermal fluids and deploying STR-ISCS on black smoker chimney that was discovered at dive #923 and 2) mapping Edmond hydrothermal field.

Dive Summary:
We landed on basalt (?) gravel approximately 120 m south from homer #70 and #21 marker that had settled at dive #923. The direction of water current at landing point was 250˚. We head north and climbed slope. Soon after we ran to north, the seafloor turned to sulfide sand that might fall down from the slope and we found many sea-anemone, and several burnacle and sponges on sulfide rock that are the sign of the hydrothermal activity around there. We were encouraged by these animals and continued to go north along the slope seeing the enormous amount of sea-anemone. Just about twenty meters north from first animal colonies, we found dead chimneys. Passing through dead chimneys, we were surprised by shrimp pond under 'Shinkai 6500'. Vast amount of shrimps flock on seafloor and we sometimes found black smoke from shrimp pond. However, any chimney structure or distinct hydrothermal vents were not around here and we continued to climb the slope to exploring large chimney structure or distinct hydrothermal vent in order to sampling hydrothermal fluids and chimney structure. The slope was really covered by shrimps and several small chimney structures were observed near the top of the slope. Shinkai 6500' approached to several chimney structures, but it was very difficult to find appropriate space to settle herself. In an attempt to approaching the active chimney structure, we could not keep position for sampling chimney structure and hydrothermal fluids, but fortunately, we found 20 to 30 gastropods beside the small chimney. The sulfide structure that gastropods inhabited was not covered by shrimp and colored brown, and clear shimmering fluids was observed. Before, leaving this site, gastropods were obtained by suction sampler and

#24 marker was deployed. Then, we moved to the direction of homer (maker #21) that two black smoker chimney were there. The #21 marker site was located just 10 – 20 m north from #24 marker site but shrimp carpet was completely disappeared. At #21 marker site, there were two black smoker chimneys that height was approximately 3m in each and US ROV marker was observed. At first, we obtained chimney structure from the top of the chimney and tried to hydrothermal fluids but we could not keep good position to sample fluids. Thus, we tried to break top of the chimney by 'Shinkai 6500' herself to make it small. However, the chimney was completely destroyed and we were blown away by black smoke. When, we back to this site, we found a big black vent but not chimney. From this vent, we sampled hydrothermal fluids by WHATS and bag sampler and one block of chimney basement, and then deployed STR-ISCS. The maximum temperature of hydrothermal fluids was 374 ˚C that was the highest record of 'Shinkai 6500'. After these operations, we went to the shrimp slope and retried to obtain chimney structure and hydrothermal fluids. In spite of several trial to take chimney structure and hydrothermal fluids, but we could not. Therefore, we left this site and decided to survey another site. 'Shinkai 6500' landed on the opposite side of shrimp slope. At the landing point, sea-anemone colonies were observed and we climbed the slope. Near the top of the slope, many dead chimneys were observed and we went along dead chimneys to south. About 90 m southwest from marker #21, we found thin active chimneys that have black smoke and were surrounded by thin dead chimneys. At the end of this dive, we tried to obtain chimney structure and hydrothermal fluids, but in vein. We deployed #25 marker and left the bottom. After leaving the bottom, we found active chimney that may be 3-4 m in height and observed the buoying hydrothermal plume from 20 to 300 m from seafloor.

Payload

• WHATS water and gas samplers
• STR-ISCS (x2; M size)
• Bag water sampler
• Sample box with lid (x4)
• Single cylinder slurp gun (suction sampler)
• Marker (x2)

Dive plan

(1) Landing point:: 23˚52.6720 S, 69˚35.8099 E (#70 homer)3320 m

Target #1: 23˚52.6720 S, 69˚35.8099 E

(2) Sampling chimneys

(3) Sampling hydrothermal fluids by WHATS & Bag

(4) Deploy a STR-ISCS

(5) Survey another black or white smoker

(6) Sampling chimneys

(7) Sampling hydrothermal fluids by WHATS

(8) Deploy a STR-ISCS

(9) Survey hydrothermal vent sites

Location of Events:

Time Position Depth Event

11:55-12:50 (23˚52.6756'S, 69˚35.7906'E, 3283m) - (23˚52.6639'S, 69˚35.7973'E, 3274m) Many many schrimp coplnies

12:53 23˚52.6639'S, 69˚35.7973'E, 3274m Sampling gastropds and schrimps

Deployed marker #24

13:21 23˚52.6624'S, 69˚35.8079'E 3274m Sampling Chimney

13:29 23˚52.6624'S, 69˚35.8079'E 3274m Destroyed Chimney

14:42 23˚52.6624'S, 69˚35.8079'E 3274m Deploying STR-ISCS

14:48-15:20 Revisit schrimp slope

15:34-15:56 around (23˚52.6993'S, 69˚35.8075'E 3294m) Observed needle chimneys

15:56 23˚52.6993'S, 69˚35.8075'E 3294m Deployment markert #25

16:00 23˚52.6646'S, 69˚35.7898'E 3272m, Alt=10m Left bottom

Dive Log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
9:57:00				vent open; Shinkai descends
11:37:00	-50	-10	3316	Land on garavel
11:56:00	45	-15	3283	Rimicaris colony & chimneys
12:45:00	75	5	3274	Try to sample animals such as gastropods (Alviniconcha & Crysomallon?)
12:50:00	75	5	3274	Acquired several (?) gastropods
12:52:00	75	5	3274	Place 6K marker#24

13:04:00	69	4	3274	Two tall chimneys
13:20:00	69	13	3274	Collect the active chimney
13:35:00	69	13	3274	Break the chimeny and drift
13:50:00	77	6	3277	Started high temperature water sampling (WHATS 1st) 374˚C
14:00:00	77	6	3277	Started high temperature water sampling (WHATS 2nd) max 374˚C
14:10:00	77	6	3277	Sampling hydrothermal fluids by bag sampler
14:25:00	77	6	3277	Start to deploy the 1st ISCS
15:00:00	45	-15	3271	Come back to 1st Remicaris chimneys
15:10:00	45	-15	3271	Collected a chimney piece
15:15:00	45	-15	3271	Failure high temperature water sampling (WHATS 3rd)
15:55:00	7	-32	3294	Place 6K maker#25
16:00:00	7	-32	3294	Leave the bottom

Event List

2006/2/13 10:00 23˚52.6720’S 69˚35.8099’E 51.6 16.8 Landing Target

2006/2/13 11:35 23˚52.7303’S 69˚35.7906’E -55.9 -15.9 Landing D=3316m

2006/2/13 11:55 23˚52.6756’S 69˚35.7906’E 45.0 -15.9 Chimney, Schrimp colony D=3283m

2006/2/13 12:53 23˚52.6639’S 69˚35.7973’E 66.6 -4.5 Sampling Animals Deployment #24Mkr D=3274m

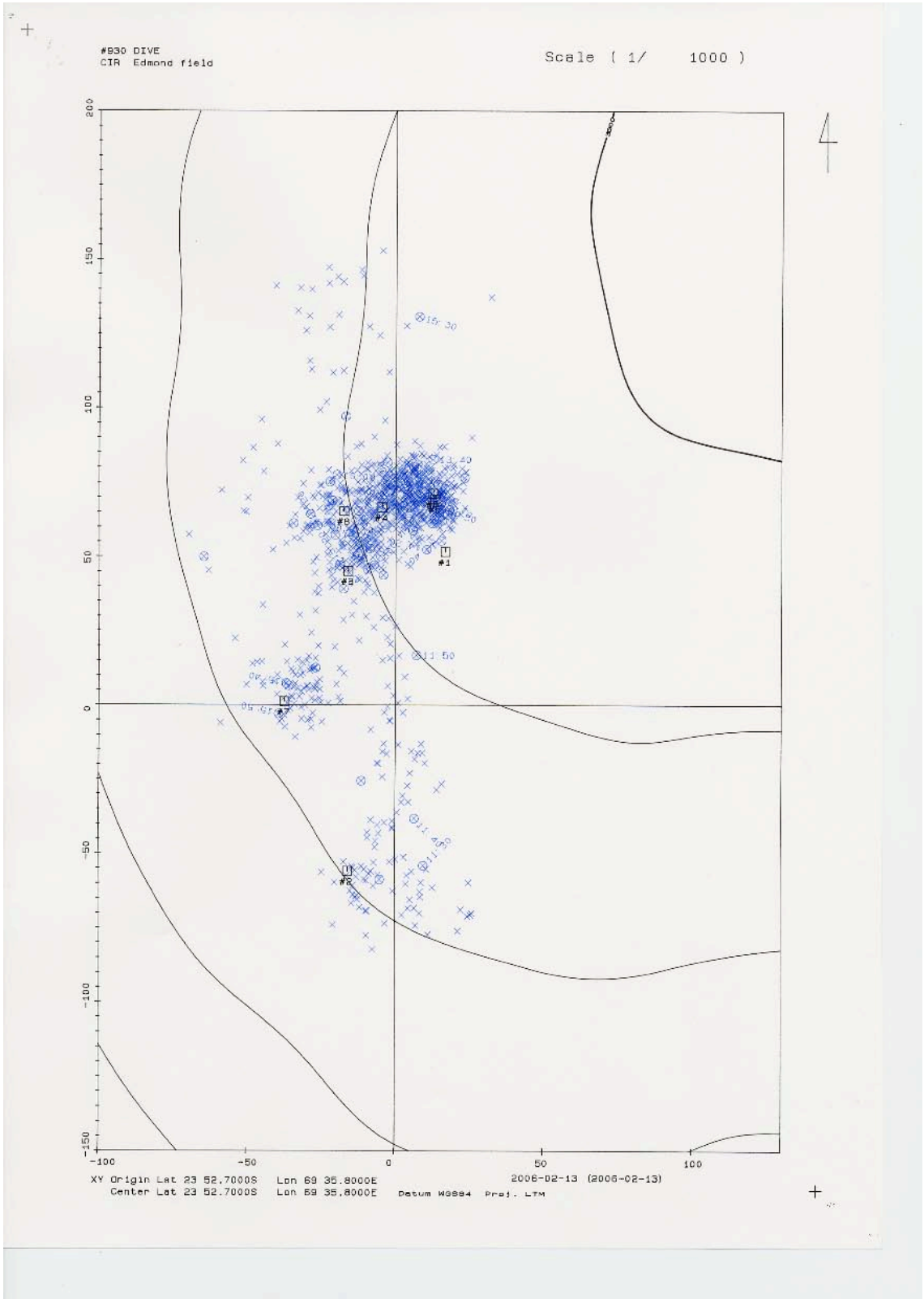
2006/2/13 13:21 23˚52.6624’S 69˚35.8079’E 69.4 13.4 Sampling Chimney D=3274m

2006/2/13 14:46 23˚52.6614’S 69˚35.8075’E 71.2 12.7 Sampling WHATS(2), Bag, Fragment Chimney Deployment ISCS D=3277m

2006/2/13 15:56 23˚52.6993’S 69˚35.8075’E 1.2 -37.2 Deployment #25Mkr D=3294m

2006/2/13 16:00 23˚52.6646’S 69˚35.7898’E 65.3 -17.3 Left Bottom D=3272m, Alt=10m

Dive Track:


#930 DIVE
CIR Edmond field
Scale (1/ 1000)
200
150
100
50
0
-50
-100
-150
-100
-50
0
50
100
#1
#2
#3
#4
#5
#6
#7
#8
XY Origin Lat 23 52.7000S Lon 69 35.8000E
Center Lat 23 52.7000S Lon 69 35.8000E
Datum WGS84 Proj. LTM
2006-02-13 (2006-02-13)

Dive Report: SHINKAI 6500 Dive #931

Date: 14 February, 2006
Site: Edmond Field at the CIR-S3
Landing: 11:31; 23°52.6953'S, 69°35.7030'E, 3356m
Leaving: 15:54; 23°52.6195'S, 69°35.7140'E, 3338m
Observer: Hisako Hirayama (SUGAR Program, JAMSTEC)
Pilot: Y. Ohno, **Co-Pilot:** K. Iijima

Objectives:
Two major objectives are underlying on this dive 931: 1) mapping the whole structure of the hydrothermal sites at the Edmond Field and (2) obtaining a variety of hydrothermal fluids, chimneys and animals.

Dive Summary:
We landed on gravel of sulfide with sands (23°52.6953'S, 69°35.7030'E) at approx. 200 m west-southwest of the #70 homer settled during Dr. Kumagai's Leg 1 cruise. On the way to the east, we saw a forest of dead chimneys attached with sea anemones at approx. 120~80 m west of the homer, and also observed some of them emitted weakly simmering fluids. Next we saw the marker #25 settled by the dive #930. Chimneys were observed around the marker #25, some were dead but the others were active with clear or gray simmering fluids. The active chimneys had strange structures consisting of sulfide base and white-colored top. One of such chimneys seemed to be more active, then, we took hydrothermal fluids by WHATS (1&2 bottles) and two pieces of the base sulfide (event mark #3; 23°52.6772'S, 69°35.7847'E). The temperature of WHATS waters were ave. 257°C, max. 264.3°C for the no.1 bottle, and ave. 256°C, max. 262.9°C for the no.2 bottle. After the sampling, we settled the marker #26 near the chimney. Immediately after a restart to the east, we unexpectedly sampled a big piece of dead chimney by a collision with the chimney. Next we saw the marker #24 at the foot of a chimney on which Alviniconcha heshleri colonized, and also saw the homer #70. Near the #70 homer, the tall and slender NuraNura-2 chimney (found in dive #930) that was emitting black smoker was seen. Furthermore we found another black smoker chimney at just 6~7 m south of the NuraNura-2 chimney. This chimney was a huge complex one. Most of the chimney surface was covered with so many shrimps but there was no shrimp around the black smoker vent that was located in the northeast part. We

took black smoker fluids at this chimney by WHATS and pump water sampler (event mark #4; 23°52.6660'S, 69°35.8075'E). The temperature probe was broken during WHATS sampling, so we couldn't know the exact temperature of the fluid, but max. 324.5˚C was recorded just before the pump started. After the black smoker fluid sampling, we took two pieces of the chimney and settled the marker #27 near the vent. Then, we took a course to the northwest. We observed several weak black smoker emissions directly from the bottom floor and a lot of shrimps colonizing around the smoker at about 30 m northwest from the #27 marker chimney. However, after we passed through those, there was nothing indicating hydrothermal activity on the way to the leaving point. The bottom of the leaving point (23°52.6195'S, 69°35.7140'E) was covered with fine reddish-brown sands. After we left the bottom, we observed a dense white plume at 3130~2900 m depth.

Payloads:

1) WHATS with a temperature probe for fluid sampling
2) Bag water sampler with pump
3) Sample box x4
4) Suction sampler (single canister)
5) Marker x2 (#26 & #27)
6) MBARI corer x2

Location of Events:

Time	Position	Depth	Event
11:31	23°52.6953'S, 69°35.7030'E,	3356m	Landed on gravel of sulfide with sands
11:50	23°52.6680'S, 69°35.7590'E,	3302m	Found dead chimneys
11:54	23°52.6680'S, 69°35.7650'E,	3293m	Found almost dead chimneys with weak simmering
11:56	23°52.6993'S, 69°35.7780'E,	3293m	Found 6K marker #25
12:01	23°52.6772'S, 69°35.7847'E,	3294m	Found active chimneys
			Sampled chimneys
			Collected hydrothermal fluids by WHATS 1(ave. 257˚C, max. 264.3˚C) & 2 (ave. 256˚C, max. 262.9˚C)
			Put the 6K marker #26

13:02 23°52.6730'S, 69°35.7940'E, 3285m Accidentally sampled dead chimney

13:10 23°52.6639'S, 69°35.7973'E, 3275m Found the 6K marker #24

13:22 23°52.6720'S, 69°35.8099'E, 3277m Found the 6K homer #70

13:25 23°52.6614'S, 69°35.8075'E, 3277m Found NuraNura-2 chimney

13:27 23°52.6660'S, 69°35.8075'E, 3273m Found active black smoker chimney

Sampled hydrothermal fluids by WHATS 3&4 (before suction, max. 324.5˚C) and bag water (10L)

Recovered chimney samples

Put the 6K marker#27

15:54 23°52.6195'S, 69°35.7140'E, 3338m Left the bottom

Video log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
10:02:00				vent open; *Shinkai* descends
11:32:30	10	-160	3360	Land on garavel (basalt)
11:44:00	37	-120	3323	anemone
11:50:00	60	-60	3300	See dead chimneys
11:57:00	20	-50	3300	See marker #25
12:08:00	63	-17	3299	Sampling a piece of chimney(Sample is in center box),and spout black smoker
12:25:00				Started high temperature water sampling (WHATS)
12:36:00				WHATS 1st finished, 264 ˚C
12:46:00				WHATS 2nd finished, 282 ˚C
12:58:00	36	-15	3297	Set Marker #26
13:03:00	57	1	3279	anemone
13:07:00	40	20	3284	
13:14:00	69	-3	3281	See marker #24, chimneys covered with numerous shrimps
13:30:00	55	12	3278	See black smoker
13:34:00	60	30	3278	Started high temperature water sampling (WHATS)
13:46:00	54	16	3276	WHATS 3rd finished, 317˚C
13:56:00	68	18	3277	「Thermometer stood at 453℃!」,and WHATS 4th started
14:05:00	56	21	3276	WHATS 4th finished, 317˚C,and Bag sampler started
14:30:00				See crabs

14:39:00	63	18	3277	Bag sampler finished ,and sampling chimney(in right box)
15:08:00	55	18	3275	Sampling a piece of chimney(in left box),and「saw dead chimney near the Marker #26」
15:15:00	66	9	3276	Set Marker #27
15:33:00	90	-10		
15:40:00	100	-30	3308	
15:47:00	170	-100	3334	
15:52:00	150	-160	3348	
15:54:00	149	-141	3338	Leave the bottom

Event List:

2006/02/014 10:00, 51.6, 16.8, 23°52.6720'S, 69°35.8099'E, Landing Target

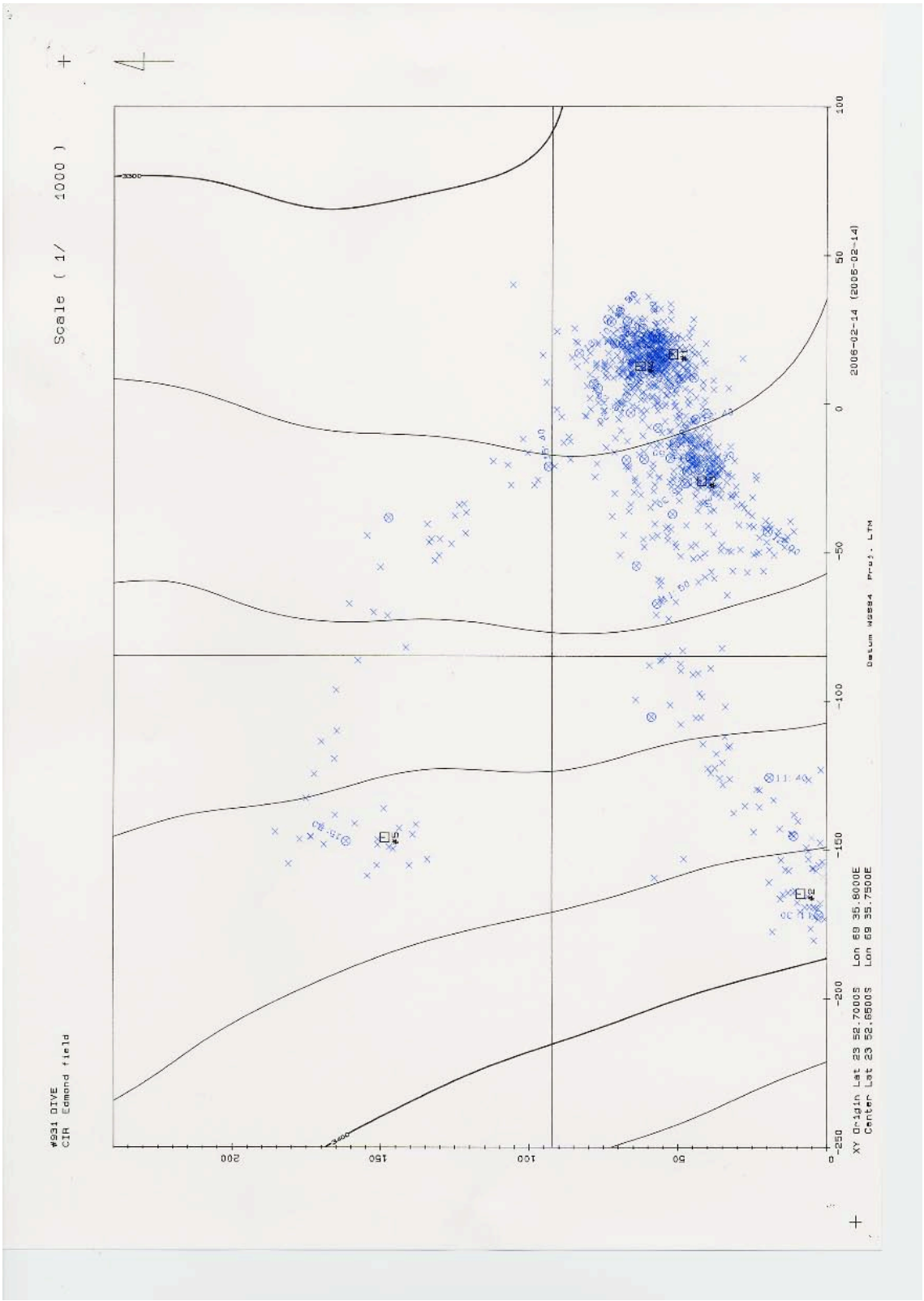
2006/02/014 11:31 8.6, -164.6, 23°52.6953'S, 69°35.7030'E, Landing, D=3356m

2006/02/14 12:58 42.0, -25.9, 23°52.6772'S, 69°35.7847'E, Sampling chimney, WHATS (2), Deployment #26Mkr, D=3293m

2006/02/014 15:12 62.7, 12.7, 23°52.6660'S, 69°35.8075E, Sampling WHATS(2), Bag, Fragment chimney (2), D. #27Mkr D=3273m

2006/02/14 15:54 148.5, -145.9, 23°52.6195'S, 69°35.7140E, Left bottom D=3338m

Dive Track:


#931 DIVE
CIR Edmond field
Scale (1/ 1000)
XY Origin Lat 23 52.7000S Lon 69 35.8000E
Center Lat 23 52.6500S Lon 69 35.7500E
Datum WGS84 Proj. LTM
2006-02-14 (2006-02-14)

Dive Report: SHINKAI 6500 Dive #932

Date: 15 February, 2006
Site: Edmond Field at the CIR-S3
Landing: 11:31; 23°52.7079S, 69°35.8236E, 3310m
Leaving: 16:03; 23°52.7571S,69°35.7764E, 3255m
Observer: Yohey Suzuki (GSJ, AIST)
Pilot: T. Sakurai, **Co-Pilot:** M. Yanagitani

Objectives: Two major objectives of this dive are 1) mapping of macrofauna and 2) sampling of macrofauna in the Edmond field.

Dive Summary:
We landed on gravel slightly covered with orange mud at the southeastern end of the hydrothermally active area in the Edmond field. Instead of directing to the center of the hydrothermallsm where active black smoker chimneys were previously found, we headed north around the hydrothermal area. We found huge dead chimney complexes about 120 m north from the center. It was speculated that a similar hydrothermal activity as that found at the current center used to occur in this area. We turned around and headed south to the center. Alongside, we found a mound with clear simmering. We reached the north side of the center and found a relatively small chimney covered with shrimps. Then, we searched unknown hydrothermal activity by heading to the West up to 200 m. No hydrothermalism was evident and headed back to the center. The western side of the center, we first found white chimneys with clear to gray simmering and then bumped into a huge active chimney densely covered with shrimps as well as the shrimp carpet. We ascended to see the top of the chimney and found several vigorous venting of black smoker. We conducted two WHATS sampling of black smoker, and the temperature ranged from ~20 to 250˚C. We descended to search macrofaunas at the basement of the active chimney. Although we avoided shrimps to see the chimney surface, no bivalves of the genus *Bathymodiolous* were found. In a shrimp-free patch with clear simmering, we found about 10 *Alviniconcha* gastropods and collected them. Next we headed to the north side where the colony of *Alviniconcha* was previously found. We found the *Alviniconcha* colonies and collected two WHATS samples and a bag sample from a hydrothermal fluid associated with the *Alviniconcha* habitat (Temp. 80 ˚C). As we ran out time, we left the bottom. In summary, there appears to be a clear

distribution pattern of macrofaunal species in the Edmond field. Far from center, anemones and barnacles inhabit. Near the center, Rimicaris shrimps dominate over Chorocaris shrimps, crabs, red tubellarian flat worms and *Alviniconcha* gastropods. It is surprising that no bathymodiolid mussels were found considering their superior dispersal ability. *Crysomallon* gastropods were never found in the Edmond field, neither.

Payload

• WHATS water and gas samplers
• Bag water sampler
• Sample box with lid (x4)
• Single cylinder slurp gun (suction sampler)
• Marker (x2)
• MBARI (x1)
• RMT

Dive plan

(1)Landing point: 23˚5 2.7303 S, 69˚35.7906 E 3316 m (Landing point of Dvie 320)
(2) Mapping macrofaunal communities
(3) Sampling water from macrofaunal colonies by WHATS & Bag
(4) Sampling macrofaunal species
(5) Collect chimneys and rocks
(6) Survey hydrothermal activity and macrofaunal communities

Location of Events:

Time	Position	Depth	Event	
12:5	23-52.5696S,69-35.7925E	3301	Found deadchimney	
12: 8	23-52.5981S,69-35.7925E	3292	Found simmering mound	
13:0	23-52.6523S,69-35.6704E	3393	Collect MBARI sample	
13:40	23-52.6671S,69-35.8008E	3272	Found black smoker chimneys covered with shrimps	
14:27	23-52.6632S,69-35.8122E	3265	SamplingWHATS(2)D=3265m	14:55
	23-52.6671S,69-35.8008E	3272	Sampling Alviniconcha	
15:53	23-52.6574S,69-35.8079E	3275	SamplingWHATS(2) and Bag	

Dive Log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
10:02:00				vent open; *Shinkai* descends
11:31:00	-10	40	3320	Land on garavel (dark brownish dead chimney & white sediment?)
12:01:00	230	-20	3301	See dead chimneys (whitish?)
12:09:00	170	-20	3292	*See big clear venting?*
12:20:00				See many sea anemone on dead chimneys
12:24:00	80	10	3274	Find Mkr#
12:25:00	70	20	3273	See big chimneys covered with numerous shrimps
				Stop and observe the "Rimicaris colony & chimneys"
12:30:00	70	20	3273	Try to displace the shrimps to find out gastropods (e.g., Alviniconcha & Crysomallon)
12:36:00	70	30	3273	Can't find out gastropods under the "shrimp carpet"
12:38:00	60	20	3254	See black smoker just under *Shinkai*
13:00:00	90	-220	3393	Sampling brownish sediment by MBARI
13:19:00	20	-60	3298	See many sea anemone on dead chimneys
13:23:00	10	-50	3299	See many dead chimneys
13:25:00	0	-50	3299	Try to sample top white part of chimney and failed
13:29:00	0	-40	3292	Find Mkr#25
13:30:00	20	-30	3290	Find Mkr#26
13:34:00	50	-20	3287	See dead chimneys and a active chimney covered with shrimps
13:35:00	50	-20	3287	Stop and observe the "Rimicaris colony & chimney"
13:39:00	50	-20	3287	ry to displace the shrimps to find out gastropods (e.g., Alviniconcha & Crysomallon)
13:41:00	50	-20	3287	Can't find out gastropods under the "shrimp carpet"
13:44:00	60	-10	3272	Find Mkr#24
13:50:00	60	0	3267	See big chimneys covered with numerous shrimps
14:02:00	70	20	3265	Started high temperature water sampling (WHATS)
14:19:00	70	20	3265	WHATS 1st finished, 20-240 ˚C (unstable: sampling high temperature fluid)
14:26:00	70	20	3265	WHATS 2nd finished, 275 ˚C
14:32:00	80	20	3271	Measure seawater temperature, 6 ˚C (RMT 3 ˚C)
14:37:00	70	10	3271	Stop and observe "Rimicaris colony & chimney"
14:55:00	60	0	3275	Find out gastropods under the "shrimp carpet" and sampling them
15:21:00	80	10	3274	Find Mkr#24
15:21:00	80	10	3274	Started high temperature water sampling (WHATS)
15:30:00	80	10	3274	WHATS 3rd finished, ~60 ˚C (max 120 ˚C)
15:47:00	80	10	3274	WHATS 4th finished, 112 ˚C
15:47:00	80	10	3274	Bag sampler started
15:54:00	80	10	3274	Bag sampler finished

16:02:00	-100	-30	3255	Leave the bottom

Event List

2006/ 2/15 10: 0: 0, -55.9, -15.9,23-52.7303S, 69-35.7906E,Landing Target

2006/ 2/15 11:31: 0, -14.5, 40.0,23-52.7079S, 69-35.8236E,Landing D=3310m

2006/ 2/15 12: 5: 0, 240.6, -12.7,23-52.5696S, 69-35.7925E,Dead chimney D=3301m

2006/ 2/15 12: 8: 0, 188.0, -12.7,23-52.5981S, 69-35.7925E,Simmering D=3292m Alt=18m

2006/ 2/15 13: 0: 0, 88.0, -219.9,23-52.6523S, 69-35.6704E,Sampling MBARI D=3393m

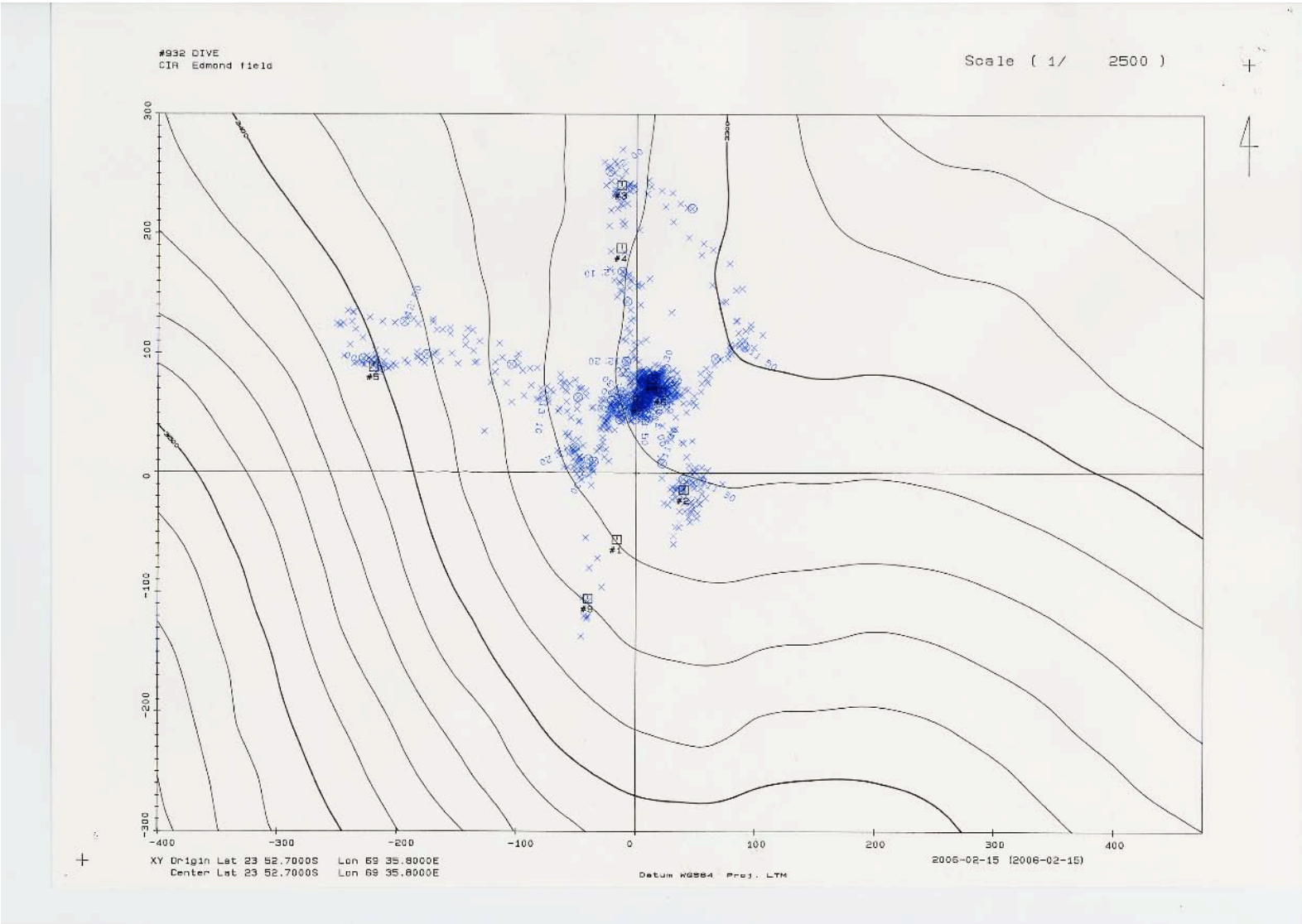
2006/ 2/15 14:27: 0, 67.9, 20.7,23-52.6632S, 69-35.8122E,Sampling WHATS(2) D=3265m

2006/ 2/15 14:55: 0, 60.7, 1.3,23-52.6671S, 69-35.8008E,Sampling Alviniconcha D=3272m

2006/ 2/15 15:53: 0, 78.6, 13.4,23-52.6574S, 69-35.8079E,Sampling WHATS(2), Bag D=3275m

2006/ 2/15 16: 3: 0, -105.3, -40.0,23-52.7571S, 69-35.7764E,Left Bottom D=3255m Alt=80m

Dive Track:


#932 DIVE
CIA Edmond field
Scale (1/ 2500)
XY Origin Lat 23 52.7000S Lon 69 35.8000E
Center Lat 23 52.7000S Lon 69 35.8000E
Datum WGS84 Proj. LTM
2006-02-15 (2006-02-15)

Dive Report: SHINKAI 6500 Dive #933

Date: February 16, 2006
Site: Kairei Field at the CIR-S1
Landing: 11:15; 25°19.1119'S, 70°02.4215'E, 2379 m
Leaving: 16:06; 25°19.2435'S, 70°02.4300’E, 2363 m
Observer: Mitsugu Kitada (Enoshima aquarium)
Pilot: K. Matsumoto, **Co-Pilot:** K. Iijima

Objectives:
Objectives were i) re-mapping hydrothermal activity at the Kairei field, and ii) observing ecology of gastropods (Scaly foot, *Alviniconcha)*and collecting hydrothermal samples such as chimney structures, fluids and animals.

Dive Summary:

We aimed the same landing points of dive #928, but had landed a little east. As for depth, 2379m and a low quality were covered with brown rocks. We headed for south in order to find the Bishamon chimney just like the dive #929. In this place, the living thing was few, lonely places. However, we could see a swimming sea cucumber (*Enypniastes eximia*: YUMENAMAKO: Japanese Name*)* when the submarine began to head for the south. On the sea bottom, the more we went to the south, the more increased, sediment was. In addition, it began to see some dead chimneys, when going to the south. It landed to one of the dead chimneys attached polyps, sea anemones and barnacles. We sampled two dead chimneys attached small anemones after observation. We looked for hydrothermal fluids. And then, we could find hydrothermal fluids in the vicinity soon. After sampling the chimneys with the sea anemone in this place, we noticed hydrothermal fluids being all over the place. And, the marker #28 was deployed on the place where black smoker were going out best. Seeming the place where it is called "Bishamon chimney" around here apparently. We could discover the "Bishamon chimney".

After deploying the marker #28, we headed to west. Then, we saw an old marker at once. The surface of marker was dirty. We approached because we were not able to confirm the number of marker from a long distance. When we approaching, and having landed, the marker#47 was able to be confirmed. This point seems to be "Daikoku chimney". This chimney was huge, and spouted a lot of black smoker. We sampled

some chimneys in this point. There were no gastropods at this chimney, but were many mussels, I found.

After sampling chimneys at "Daikoku chimney", we finally headed to #23marker point to sample gastropods and hydrothermal fluids that gastropods inhabit. At this place, we sampled hydrothermal fluids of inhabiting gastropods. (by WHATS1) The fluids temperature was between 34 and 37 deg. While we sampled fluids, we could see a swimming sea cucumber (*Enypniastes eximia*) again (Video log time: 14:20). And, we looked for Scaly foot at this surface of *Alvinichonca* colony. However Scaly foot couldn't be confirmed. We gauged the temperature of *Alvinichonca* colony. The temperature was between 12 and 39 deg, I thought that I was higher than it thought. We destroyed the surface of *Alvinichonca* colony by broom. And we sampled hydrothermal fluids that lived gastropods (*Alvinichonca*) by WHATS2 and Bag sampler. WHATS2's temperature was about 30 deg. (Maximum is 86 deg.) We tried to observe the surface destroyed, and we could observe a lot of scaly foots. I made sure that scaly foots were under a lot of *Alvinichonca* or *Rymicaris*. I thought that the scaly foot and *Alvinichonca* had a few differences of inhabiting in the hydrothermal habitat. The water temperature of scaly foot inhabiting was 5 deg, was lower than *Alvinichonca* inhabiting. We sampled them while observing ecology. When we finished sampling, we were mostly running out of time. And, we were toward the south and left bottom.

Payloads:

1) WHATS with a temperature probe for fluid sampling
2) Bag pomp sampler
3) Sample box with lid(x4)
4) Single cylinder slurp gun (suction sampler)
5) Marker x2 (#28 & #30)
6) Shovel
7) RMT temperature probe

Location of Events:

As in the section, "Event List"

Video log:

Time	X	Y	Depth	Event

				No. 2 camera (pan and tilt)
10:15:00				vent open; *Shinkai* descends
11:15:53	167	36	2385	Landed on bottom. Current = 300°; Distance = 7 m; Breccia; Temperature = 1.8°C
				Head off towards 180°
11:27:53	66	68	2421	bottom of the valley
11:30:00	37	68	2429	Head to 210˚
11:33:00	2	58	2427	
11:38:00	-14	15	2435	Found dead chimneys
11:50:00	-21	20	2435	Obtain a sea anemone with dead chimney
12:00:00	-20	20	2433	Observe many sea anemones and shrimps on chimneys (dead chimney?)
12:24:00	-20	20	2435	Obtain two sea anemones with a piece of dead chimney
12:28:00	-10	10	2433	Found a black smoker
12:35:00	-20	12	2434	Place 6K marker#28 (Bisyamon)
12:58:00	-16	13	2440	Found 6K marker#47 (Daikoku)
13:17:00	-23	-14	2440	Sampling chimneys
13:26:00	-14	-8	2443	Head to 160 ˚
13:34:00	-66	15	2425	See 6K marker#20
13:40:00	-42	26	2422	Found 6K marker#23 and landed there
14:10:00	-40	5	2423	Start water sampling by WHATS
14:26:00				Finish no.1 bottle of WHATS
14:57:00				Start no.2 bottle of WHATS (max. temp. 43˚C before water sampling) around gastropod (see 5 scaly foot)
15:03:00				Finish no.2 bottle of WHATS (max. temp. 86˚C during water sampling)
15:10:00	-40	10	2324	Start pump water sampling
15:24:00				Start scaly foot sampling
15:30:00				Finish scaly foot sampling
15:54:00	-50	0	2423	Finish animal sampling
16:06:00	-80	60	2363	Left the bottom

Event List:

10:00, 25˚ 19.0974’S, 70˚ 2.3857’E, Landing Target

11:15, 25˚ 19.1119’S, 70˚ 2.4215’E,Landing, D=2379m

11:53, 25˚ 19.2072’S, 70˚ 2.4159’E, Sampling Chimney (2), D=2435m

12:24, 25˚ 19.2108’S, 70˚ 2.4127’E, Sampling Rocks with sea anemone(2), D=2434m

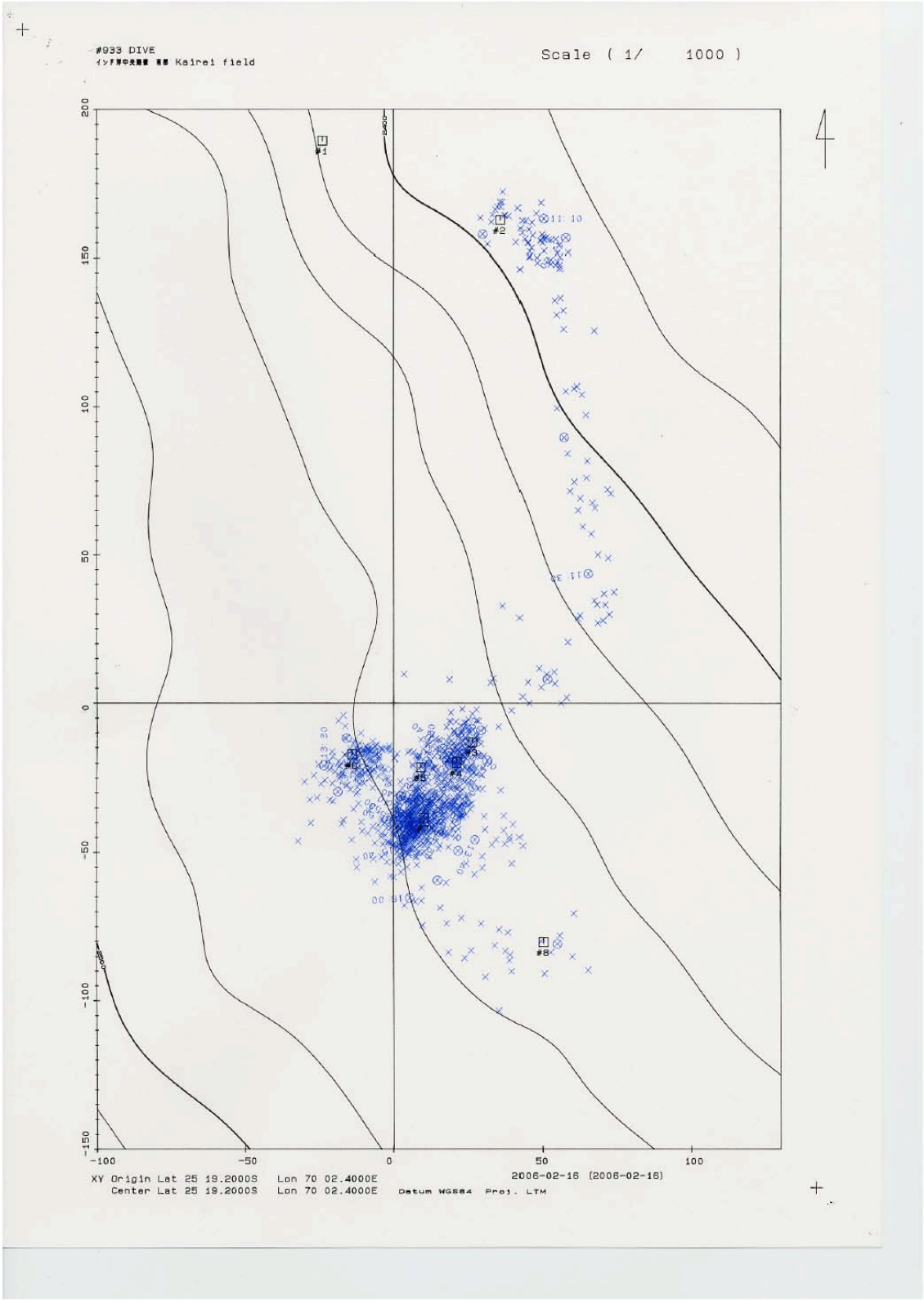
12:35, 25˚ 19.2116’S, 70˚ 2.4056’E, Deployment #28Marker, D=2434m

13:00, 25° 19.2094’S, 70° 2.3917’E, Finding #47Marker Sampling Chimney, D=2442m

15:53,25° 19.2209’S,70° 2.4062’E,Sampling WHATS(2) , Bag, Scaly foot ,D=2422 m

16:06, 25° 19.2435’S, 70° 2.4300’E, Left Bottom, D=2363m

Dive Track


#933 DIVE
Kairei field
Scale (1/ 1000)
#1
#2
#3
#4
#5
#6
#7
#8
200
150
100
50
0
-50
-100
-150
-100
-50
0
50
100
XY Origin Lat 25 19.2000S Lon 70 02.4000E
Center Lat 25 19.2000S Lon 70 02.4000E
Datum WGS84 Proj. LTM
2006-02-16 (2006-02-16)

Dive Report: SHINKAI 6500 Dive #934

Date: 17 February, 2006
Site: Kairei Field at the CIR-S1
Landing: 11:06; 25°19.2686'S, 70°2.3650'E, 2471m
Leaving: 16:06; 25°19.2816'S, 70°2.3589'E, 2392m
Observer: Yohey Suzuki (GSJ, AIST)
Pilot: I. Kawama, **Co-Pilot:** Y. Ohno

Objectives: Two major objectives of this dive are 1) to collect two ISCSs from Kali and monju chimneys and 2) to sample water inside the colonies of macrofaunas such as *Alviniconcha* gastropods and *Rimicaris* shrimps..

Dive Summary:
We landed on gravel slightly covered with mud in the South of Kali chimney. We intended to reach Kali chimney, but we ended up with seeing the Marker 23, which was placed nearby the ISCS at Monju chimney. We collected two WHATS samples from the second surface layer of *Alviniconcha* aggregates. The temperature fluctuated between10 to 20 ˚C. Then we tried to locate the ISCS and found it buried underneath gastropod colonies. We successfully collected the ISCS, the handle of which was attached many *Alviniconcha* and *Crysomallon* gastropods. Before leaving Monju chimney, we collected *Neolepas* barnacles attached on the chimney surface. We headed to Kali chimney, but we lost our way several times. We barely arrived at Kali chimney and collected the ISCS. Then we collected the remaining WHATS samples from black smoker (temp >300 ˚C). Bag sampling was unsuccessful due to the leakage of the bag. After collecting non-aged chimney pieces from where the ISCS was deployed, we left the seafloor.

Payload
• WHATS water and gas samplers
• Bag water sampler
• Single sample box with lid (x4)
• Single cylinder slurp gun (suction sampler)
• Marker (x2)
• ISCS holder (x2)

• Kumade sampler (x1)
• RMT

Dive plan

(1) Landing point: 25˚19.2233 S, 70˚2.3720 E 2449 m (ISCS at Kali chimney)
(2) Recovery of ISCS and sampling of hydrothermal fluid from Kali chimney.
(3) Recovery of ISCS and sampling water especially from shrimp colonies at Monju chimney.
(4) Survey hydrothermal activity and macrofaunal communities

Location of Events:

Time	Position	Depth	Event
12:29	25-19.2246S, 70- 2.4079E,	2421m	WHATS (1)
12:38	25-19.2246S, 70- 2.4079E,	2421m	WHATS (2)
12:47	25-19.2246S, 70- 2.4079E,	2421m	Retrieval of ISCS12:29
12:19	25-19.2246S, 70- 2.4079E,	2421m	Sampling Rock with Barnacle
14:54	25-19.2274S, 70- 2.3672E,	2451m	Ret. ISCS
15:04	25-19.2274S, 70- 2.3672E,	2451m	RMT measurement
15:16	25-19.2274S, 70- 2.3672E,	2451m	WHATS (3)(4)
15:50	25-19.2274S, 70- 2.3672E,	2451m	Bag sampling

Dive Log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
9:58				vent open; *Shinkai* descends
10:56	-144	-58	2415	got trim
11:02	-136	-62	2464	found seafloor
11:05	-130	-60	2471	landed; clay and rocks; 1.8 deg. C
11:09	-128	-59	2472	zoomed sea eel-like fish
11:32	-30	-10	2435	shrimps and sea anemones on seafloor
11:36	-37	2	2422	#23 marker (Monju chimney)
12:29	-40	10	2421	started to sample fluids surrounding Alviniconcha (WHATS1), 14 ˚C
12:37	-40	10	2421	finished sampling fluids (WHATS1), started WHATS2
12:51	-40	10	2421	recovered only the data logger of ISCS
13:11	-40	10	2421	recovered the ISCS (perforated pipe) colonized by Alviniconcha
13:22	-40	10	2421	observed barnacles

13:30	-40	10	2421	collected a rock colonized by barnacles, made toward the Kali chimney
13:56	-30	-20	2439	set to south
14:12	-67	-15	2436	found a marker (#X6)
14:28	-50	-70	2455	#5 marker
14:30	-50	-62	2457	#22 marker
14:58	-47	-50	2451	recovered the ISCS
15:24	-42	-54	2451	collected vent fluids with WHATS #3, maximum 315 ˚C
15:34	-42	-54	2451	collected vent fluids with WHATS #4, maximum 339 ˚C
15:54	-42	-54	2451	collected vent fluids with bag sampler, vent fluids holed the bag…
16:01	-42	-54	2451	collected two pieces of the chimney
16:06	-159	-74	2388	left bottom

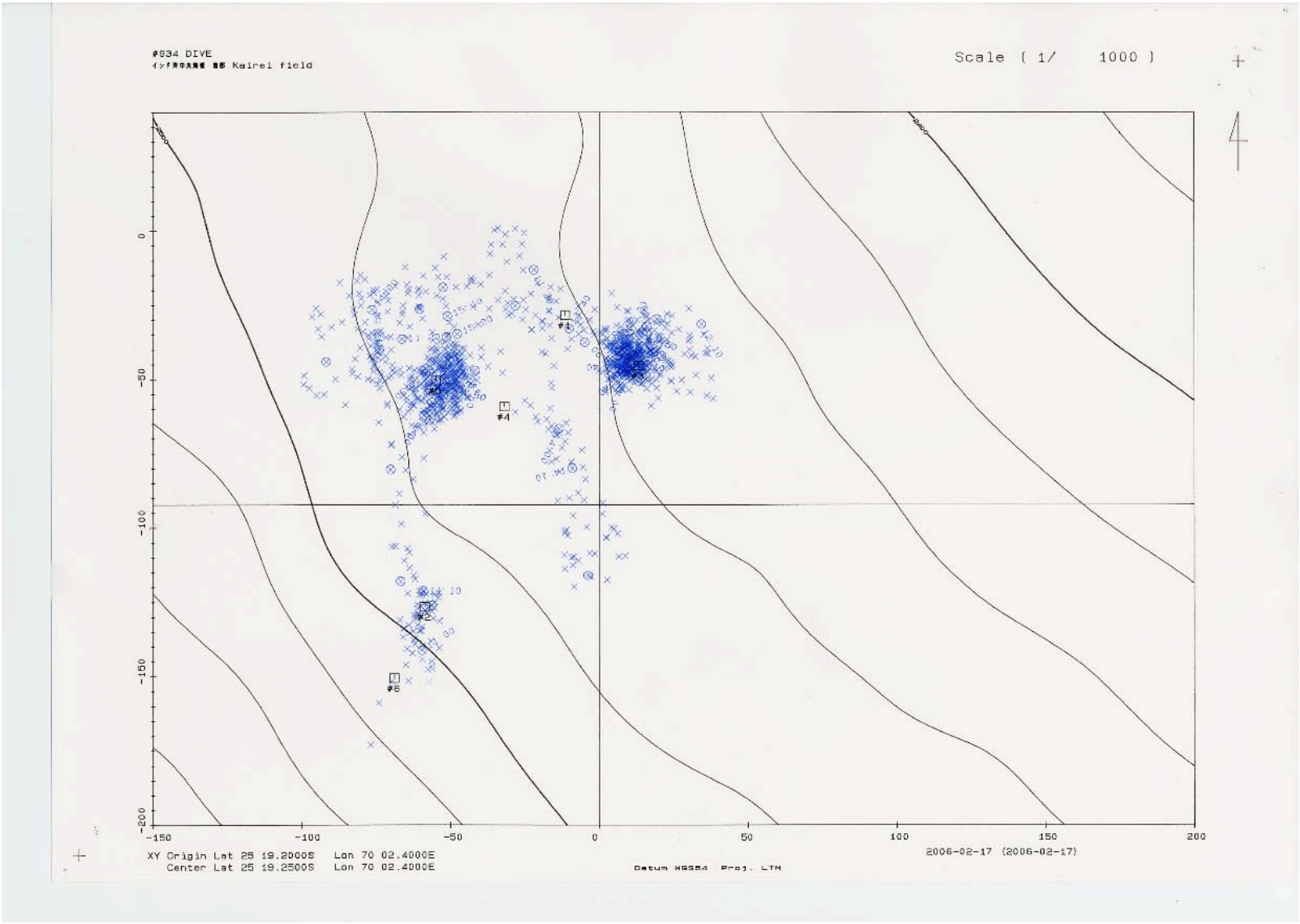
Event List

2006/ 2/17 11: 6: 0, -126.6, -58.7, 25-19.2686S, 70- 2.3650E, Landing D=2471m 2006/ 2/17 13:13: 0, -45.4, 13.2, 25-19.2246S, 70- 2.4079E, Retrieve ISCS Sampling Rock with Barnacle D=2421m

2006/ 2/17 14:12: 0, -59.2, -32.0, 25-19.2321S, 70- 2.3809E, #46 Marker? 2006/ 2/17 16: 1: 0, -50.5, -55.0, 25-19.2274S, 70- 2.3672E, Ret. ISCS Samp. WHATS(2), Bag, Fragment Chimney(2) D=2451m

2006/ 2/17 16: 6: 0, -150.6, -68.9, 25-19.2816S, 70- 2.3589E, Left Bottom D=2392m Alt=89m

Dive Track:


#934 DIVE
Kairei field
Scale (1/ 1000)
#1
#2
#3
#4
#5
#6
0
-50
-100
-150
-200
-150
-100
-50
0
50
100
150
200
XY Origin Lat 25 19.2000S Lon 70 02.4000E
Center Lat 25 19.2500S Lon 70 02.4000E
2006-02-17 (2006-02-17)

Dive Report: SHINKAI 6500 Dive #935

Date: 19 February, 2006
Site: Edmond Field at the CIR-S3
Landing: 11:31; 23°52.7437'S, 69°35.8613'E, 3329m
Leaving: 16:08; 23°52.6296'S, 69°35.8086'E, 3239m
Observer: Ken Takai (SUGAR Program, JAMSTEC)
Pilot: K. Iijima, **Co-Pilot:** Y. Chida

Objectives:
Three major objectives are underlying on this dive 935: 1) mapping the whole structure of the hydrothermal sites at the Edmond Field and (2) obtaining a variety of hydrothermal fluids, chimneys and animals and (3) recovering a STR-ISCSs deployed in the Nura Nura chimney.

Dive Summary:
We landed on the sediments with small basalt breccia at approx. 170 m SSE of Edmond Field. During falling down before landing, we took a water sample by a Niskin water sampler at an altitude of 5 m. After landing, we looked for the colored sediments that had been previously observed at the Dive#932. At a 50 m west of the landing point, pathy, white-brown coloered sediments were observed. We first measured the temperature of the sediments by RMT probe and detected ~0.6-1 ˚C higher temerature of the sediments than that of the ambient seawater. Then, the colored sediments were obtained by 30 cm MBARI corer.

After obtaining sediments, we headed to the Nura Nura chimney. Unfortunately, it was very difficult to reach the proper direction by means of strong tide current. During the naviation to the Nura Nura chimney, northern, northwestern and western area of the main hydrothermal mound could be survey, which provided a good image for the whole structure of the hydrothermal activities in the Edmonnd Field. Finally, by way of the south wall of the Grand Shrimp Valley, we arrived at the Nura Nura chimney. From the Nura 1 chimney, the STR-ISCS was successfully retrieved with a piece of 0 age chimney. It was found to be exposed to 372 ˚C during the deployment. Then, 3L of pure-endmember fluid was sampled by the Bag sampler. We tried to take chimney and fluid from the Nura 2 chimney. However, to approach the Nura 2 chimney, 3 m of

chimney structure fell down and explosive black smoker carried Shinkai6500 to the somewhere around western area.

In the way back to the Nura Nura chimney, we encountered a huge Monk-Head chimney at approx. 50 m west of the Nura Nurra chimney. It looked like gas-rich fluid-emitting chimney. We decided to take chimneys and fluids here. The hydrothermal fluid was weak black smoke and had a max. temperature of 220 ˚C. From here, we run over the Grand Shrimp Valley and reached to the Nura Nura chimney.

Near the Nura 2 chimney, the intact chimney structure was lay down. First, we obtained the top part of the Nura 2 chimney. Then, we re-accessed to the vent orifice of the Nura 2 chimney. Finally, we obtained two bottles of the endmember fluids (371 ˚C) from the Nura 2 chimney. After finishing the fluid sampling, we run to the north and left the bottom.

Payloads:

1) WHATS with a temperature probe for fluid sampling
2) Bag pomp sampler
3) Sample box x3
4) Suction sampler (single canister)
5) Marker x2 (#29 & #30)
6) Recovery box for STR-ISCS
7) RMT probe
8) Niskin water sampler

Location of Events:

Same to the Event list

Video log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
10:00				vent open; Shinkai descends
11:29	-97	130	3329	collected seawater with a Niskin bottle
11:31	-80	100	3329	landed

11:40	-83	30	3321	found ballast on light brownish sediments
11:44	-79	26	3320	measured temp. with RMT probe (1_C higher than seawater)
11:47	-99	29	3320	successfully collected whitish (?) sediments with a MBARI-type corer
11:50	-58	31	3320	set to 30_
12:03	90	50	3283	set to 320_
12:07	120	10	3300	try to find event mark 13 (Nura2 ?chimney)
12:22	40	0	3274	see sea anemones and shrimps on brown colored chimneys
12:34	58	3	3276	recovered the #70 homer
12:45	48	8	3275	recovered the ISCS
12:49	48	8	3275	measured temp. of vent fluids with RMT probe; ?_C (no report)
13:08	48	8	3275	collected the vent fluids with a bag sampler
14:00	50	-40	3281	white cone
14:23	60	-40	3281	collected portions of the dark brownish beehive chimney
14:28	51	-42	3289	put #29 marker
14:36	60	-40	3281	started sampling vent fluids with WHATS (bottle1)
14:45	60	-40	3281	finished sampling vent fluids with WHATS (bottle1); max 216_C
14:45	60	-40	3281	started sampling vent fluids with WHATS (bottle2)
14:52	60	-40	3281	finished sampling vent fluids with WHATS (bottle2); max 218_C
14:58	60	-40	3281	collected a portion of the chimney structure
15:35	59	31	3279	collected top parts of the chimney taken down previously
15:47	45	28	3278	started sampling vent fluids with WHATS (bottle3)
15:54	45	28	3278	finished sampling vent fluids with WHATS (bottle3); max _?_C (no report)
15:54	45	28	3278	started sampling vent fluids with WHATS (bottle4)
15:59	45	28	3278	finished sampling vent fluids with WHATS (bottle4); max 371_C
16:08	129	15	3239	left bottom

Event List:

2006/02/19 11:31 -80.6 104.0 23-52.7437S, 69-35.8613E, Sampling Niskin, Landing D=3329m

2006/02/19 11:49 -73.2 37.3 23-52.7397S, 69-35.8220E, Sampling MBARI D=3321m

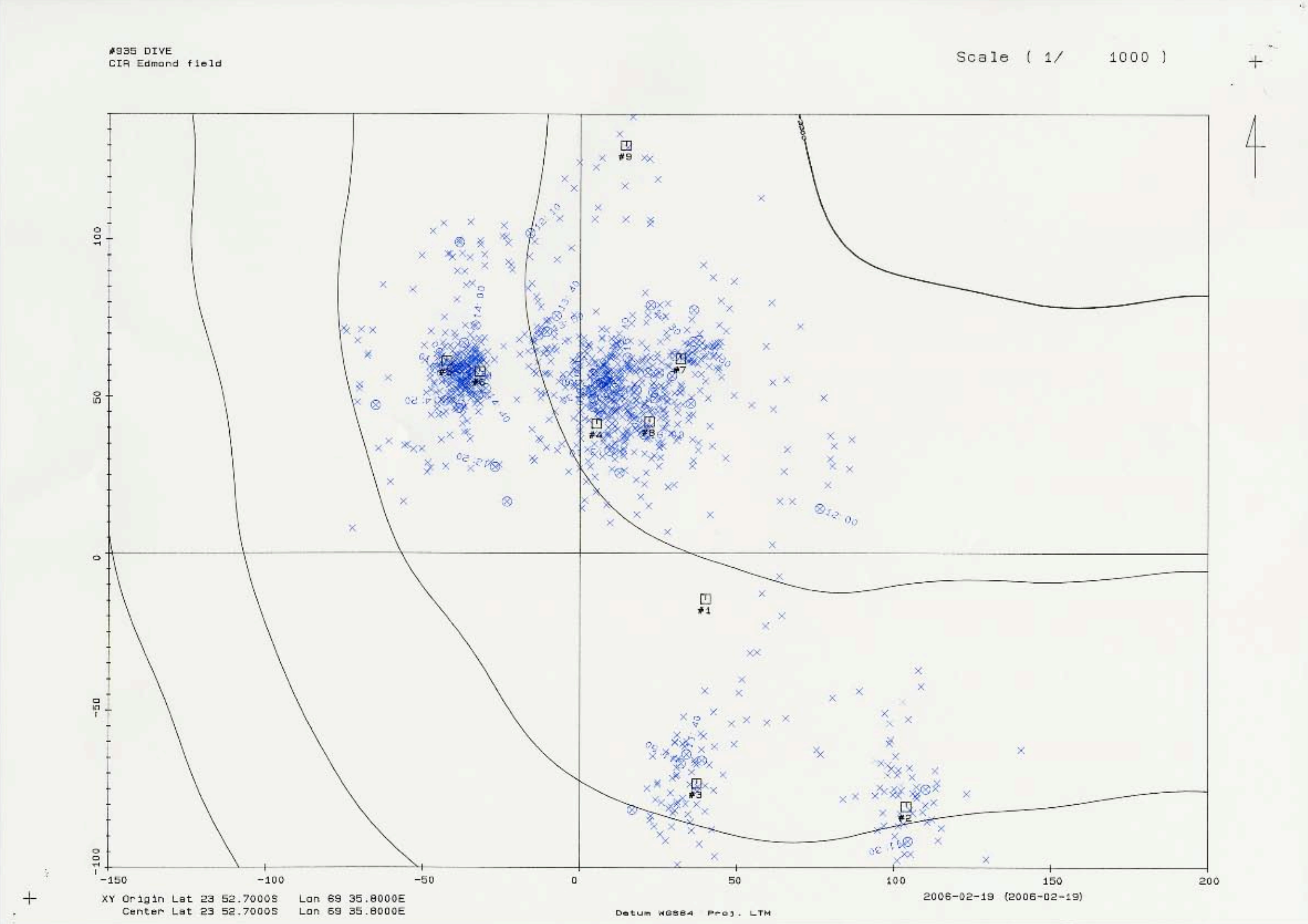
2006/02/19 13:08 41.3 5.2 23-52.6776S, 69-35.8031E, Retrive #70Homer & ISCS, Sampling Bag D=3275m

2006/02/19 14:23 61.2 -42.6 23-52.6668S, 69-35.7749E, Sampling Chimney, Deployment #29Mkr D=3289m

2006/02/19 14:57 57.9 -32.0 23-52.6686S, 69-35.7811E,

Sampling WHATS(2), Chimney(2)				D=3281m
2006/02/19	15:34	62.0	32.0	23-52.6664S, 69-35.8189E,
Sampling Chimney(2)				D=3279m
2006/02/19	15:59	42.0	22.0	23-52.6772S, 69-35.8130E,
Sampling WHATS(2)				D=3278m
2006/02/19	16:08	129.9	14.5	23-52.6296S, 69-35.8086E,
Left Bottom				D=3239m

Dive Track:


#935 DIVE
CIR Edmond field
Scale (1/ 1000)
4
#9
#5
#6
#7
#4
#8
#1
#3
#2
XY Origin Lat 23 52.7000S Lon 69 35.8000E
Center Lat 23 52.7000S Lon 69 35.8000E
Datum WGS84 Proj. LTM
2006-02-19 (2006-02-19)

Dive Report: SHINKAI 6500 Dive #936

Date: 20 February, 2006
Site: Kairei Field at the CIR-S1
Landing: 11:09; 25°19.2888'S, 70°02.3325'E, 2523m
Leaving: 16:01; 25°19.2251'S, 70°02.3501’E, 2476m
Observer: Tomohiro Toki (ORI, the University of Tokyo)
Pilot: M. Yanagitani, **Co-Pilot:** T. Sakurai

Objectives:

(1) Obtaining hydrothermal fluids and chimneys from the Daikoku and Bishamon sites
(2) Collecting fresh gastropods from the Monju site
(3) Sampling fluid where gastropods live at the Monju site
(4) Sampling white-colored rocks

Dive Summary:

We landed on the basalt breccias and climbed up along the slope heading north to the Mrk#22. We arrived at the Mrk#22 that was previously deployed close to the Kali site, but the marker fell down on the white coarse sand of broken chimneys along the galley from the Kali site. We landed near the Mrk#22 and sampled the white rolling rock from the seafloor, the D936 R-1. We tried to transport to the next galley southward of the Kali site, but we observed the KAIKO marker on the next ridge to south of the Kali site and went to the marker, passing through the targeted galley. We flied southward and surveyed a desired white rock again. At the re-landing point, white rocks were observed anywhere, one of which was put in the sample box, the D936 R-2. The SHINKAI 6500 began to run heading eastward over the north ridge of the Kali site in order to look for the Mrk#47 at the Daikoku site. During the transition, we could see the dead and inactive chimneys along the north ridge of the Kali site. Then, we observed the Mrk#20 and changed the head to the north, and arrived at the Daikoku site with the Mrk#47 at 12:43.

The Daikoku site had an actively venting chimney of ca. 10 meters with too many shrimps on the surface, and several active chimneys stood in the line of 130 degree. At 12:58, hydrothermal fluid was sampled from one of black smokers at the Daikoku site by WHATS (D936 W-1) recording 315 degree C of the maximum temperature during the fluid sampling. At 13:12, the followed sampling of hydrothermal

fluid was carried out from the same smoker by WHATS (D936 W-2; average temperature: 290 degree C). At 13:23, the Mrk#47 with barnacles was retrieved and the Mrk#30 was deployed at the same place, and then left the Daikoku site for transporting to the Mrk#28 at the Bishamon site. The Daikoku site had variable biological spices, though the number of each species was not so many, Alviniconcha, Rimicaris, Bathymodiolus, buccinidae, planaria, Umi-kemushi, barnacle.

At 13:52, we arrived at the Bishamon site and fluid sampling started using WHATS from 14:04 (D936 W-3; temperature range: 160~170 degree C), followed by sampling using WHATS from 14:16 (D936 W-4, average temperature: 260 degree C). Dead chimneys, D936 R-3 and -4, were taken into the basket in order to position near the vent for the water sampling. We could observe many sea anemones on dead chimneys everywhere at this site, and shrimps were gathering near the venting black smoker from the seafloor between the dead chimneys. A few mussels were colonized on some dead chimneys around active vent. After the water sampling, we left the Bishamon site, going to the Monju site marked by the Mrk#23 and trying to acquire fresh Alvinconcha and Scaly-foot.

At 14:45, we were starting shimmering fluid overlying Alvinconcha colony at the Monju site close to the Mrk#23. Next, we removed too many shrimps gathering around the Alvinconcha colony by shovel and looked for Scaly-foot in the Alvinconcha colony. We found area where Scaly-foot densely lived and vacuumed the Scaly-foot by the slurp-gun. But some Scaly-foot attached to the rock in so sticky that couldn’t be vacuumed by the slurp-gun. We got rid of the Scaly-foot from the rock by the shovel, and then the fallen ones were sampled by the gun. Additionally, we looked for nests of Scaly-foot, removing shrimps gathering chimney behind the venting crack that the ISCS had been placed in. We could find the colonized Scaly-foot on the chimney, but its sampling required the right basket of the submersible placed on the venting crack so that couldn’t be operated.

After these missions, we completely made the pre-programmed plan before the dive realized, so sightseeing was carried out around the hydrothermal area in the Kairei Field, mapping the position of each site, Monju, Fudo, Bishamon, Daikoku, and Kali. Finally, we flied off the hydrothermal area, and we left the seafloor at 16:01.

Payloads:

1) WHATS with a temperature probe for fluid sampling

2) Bag pump sampler

3) Sample box x2
4) Movable sample box “Morinaga”
5) Suction sampler (single canister)
6) Shovel
5) Marker x2 (#30 & #31)

Location of Events:

Time	Position	Depth	Event
11:09	25°19.2888'S, 70°02.3325'E,	2523m	Landed on basalt breccias
11:34	25°19.2274'S, 70°02.3714'E,	2454m	Sampling rock
11:44	25°19.2433'S, 70°02.3750'E,	? m	Finding KAIKO marker (#?-1)
12:10	25°19.2350'S, 70°02.3543'E,	2466m	Sampling rockSampled chimneys
13:28	25°19.2159'S, 70°02.3942'E,	2443m	Collected hydrothermal fluids by WHATS (max. 315 ˚C)
			Retrieved the 6K marker#47
			Deployed the 6K marker#30
14:27	25°19.2181'S, 70°02.4024'E,	2432m	WHATS 3 (160 ~ 170 ˚C) and 4 (ave. 260 ˚C)
			Recovered chimney samples
15:27	25°19.2285'S, 70°02.4036'E,	2422m	Collected shimmering fluids by Bag
			Sucked many animals
16:01	25°19.2251'S, 70°02.3501'E,	2476m	Leaving the bottom

Video log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
10:02:00				vent open; Shinkai descends
11:08:00	-170	-110	2522	Landed on bottom. Current = none; Distance = 8 m; Breccia; Temperature = 1.8°C
				Head to the north
11:36:53	-42	-50	2457	Obtained two white rock
11:44:00	-85	-45	2450	Found Kaiko marker
11:49:00	-80	-40	2442	Headed to the south & look for the colored rock again
11:57:00	-120	-50	2458	Climb the cliff
12:10:00	-60	-70	2466	Obtained a whitish rock (altered basalt?)

12:22:00	-40	-30	2428	See many sea anemones on the seafloor
12:26:00	-50	-10	2430	Found marker #20
12:43	-20	-10	2442	Found Daikoku chimney
12:58	-30	-10	2443	WHATS#1, 290 ˚C stable, 315˚C max
13:12	-30	-10	2443	WHATS#2, 300˚C stable,
13:23	-30	-10	2443	Replace maker#47 to marker#30
13:52	-28	4	2431	Found maker#28
14:04				Start WHATS#3, 160~170 ˚C
14:16				Start WHATS#4, ave. 260 ˚C
14:29	-30	0	2434	Sampled 2 pieces of chimney. Head to marker#23
14:45	-50	2	2423	Start bag water sampling around Alviniconcha at marker#23
15:01				Start animal sampling.
15:45				Observing around there to make sure the location of the markers
15:55	-50	-10	2449	Head 270˚
16:01				Left the bottom.

Event List:

2006/02/20 10:00, -28.4, -11.5, 25-19.2154S, 70-2.3931E, Landing Target

2006/02/20 11:09-163.9, -113.2, 25-19.2888S, 70-2.3325E, Landing D=2523m

2006/02/20 11:34-50.5, -47.9, 25-19.2274S, 70-02.3714E, Sampling Rock(1) D=2454m

2006/02/20 11:44-79.9, -41.9, 25-19.2433S, 70-02.3750E, Finding KAIKO Marker (#?-1) D=?

2006/02/20 12:10-64.6, -76.6, 25-19.2350S, 70-02.3543E, Sampling Rock(1) D=2466m

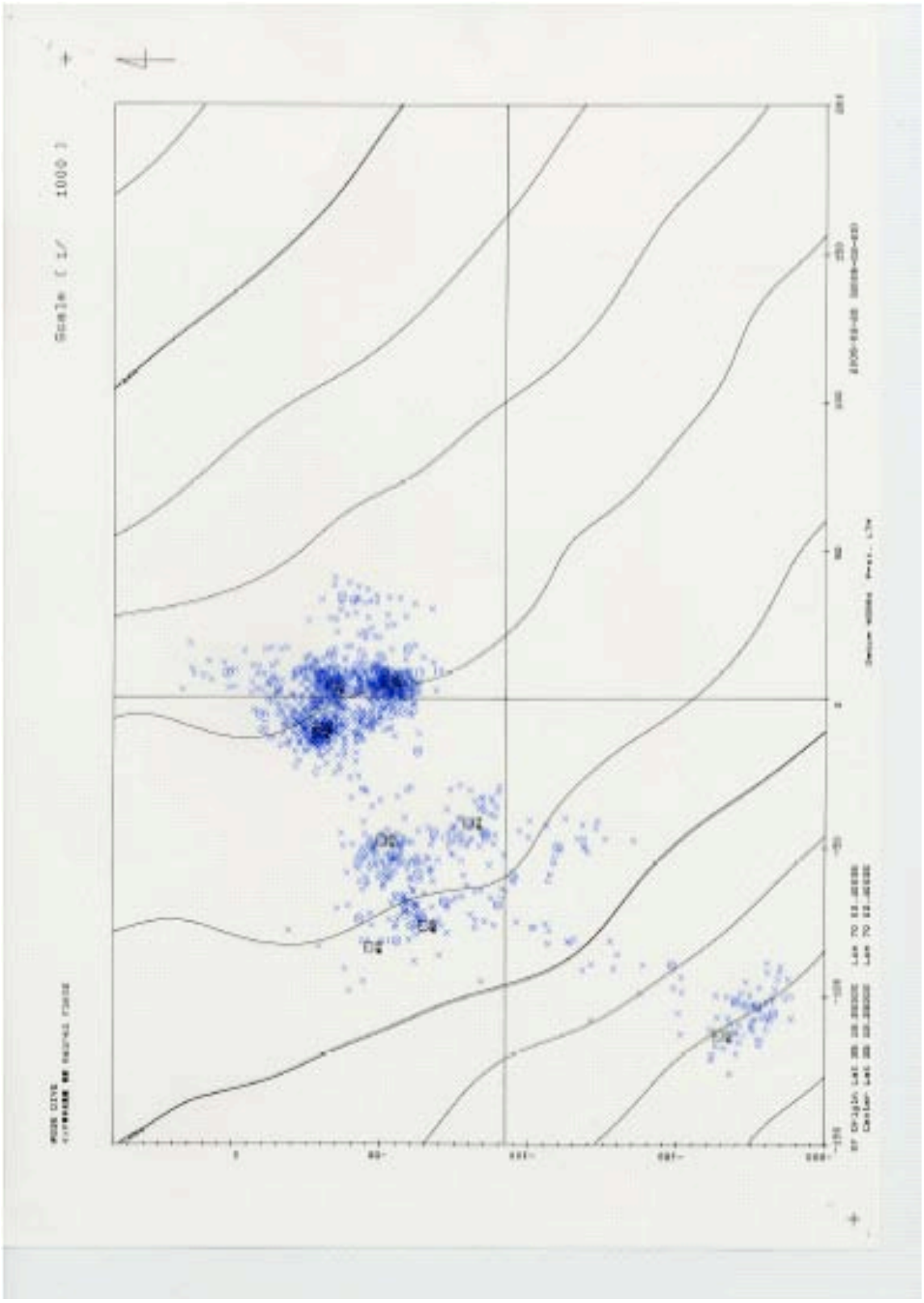
2006/02/20 13:28-29.3, -9.7, 25-19.2159S, 70-02.3942E, Samp. WHATS(2), Ret. #47Mrk, Dep. #30Mrk D=2443m

2006/02/20 14:27-33.4, 4.0, 25-19.2181S, 70-02.4024E, Sampling WHATS(2), Chimney(2) D=2432m

2006/02/20 15:27-52.6, 6.0, 25-19.2285S, 70-02.4036E, Sampling Bag, Animals D=2443m

2006/02/20 16:01-46.3, -83.7, 25-19.2251S, 70-02.3501E, Left Bottom D=2476m

Dive Track:



Dive Report: SHINKAI 6500 Dive #937

Date: February 21, 2006
Site: Edmond Field at the CIR-S3rd
Landing: 11:29, 23˚52.7426'S, 69˚35.7407'E, Landing, D=3349m
Leaving: 15:54, 23˚52.6772'S, 69˚35.7317'E, Left Bottom, D=3264m Alt=70m
Observer: Satoshi Nakagawa (SUGAR Program, JAMSTEC)
Pilot: Y. Ohno, **Co-Pilot:** I. Kawama

Objectives:
• Mapping Edmond Field
• Sampling & measuring temp. of fluids surrounding the *Alviniconcha* colony (#24)
• Sampling chimneys and hydrothermal fluids

Dive Summary:

We landed at approximately 150 m SW of #24 marker. Seafloor mainly consisted of blackish or greenish angular rocks. During going underwater, we accidentally lost a sample box. Soon after landing, we headed to NE. On the way to the #24 marker (near the location of marker #26), we found complexes of small chimney structures (mostly inactive).

It was highly difficult to land at marker #24 because of the strong water current. After several trials, we could land in front of the gastropod colony. First, we started fluids sampling surrounding the gastropods with the WHATS sampler. Temperatures of their habitat were found to vary between 15 and 23 ˚C (av. 16-18 ˚C). After taking fluids with two bottles of the sampler, we sampled approx. 10 litters of the fluids with bag sampler. Then, we checked the distribution of the *Alviniconcha* sp, and found their habitat was quite restricted. Although we planned to suction the gastropods, we could not do this because of the broken canister. At this point, we concluded there was most probably no scaly foot, not so many *Alvinoconcha* in the crack having shimmering.

Then, we headed to the big chimney (SE of #24; 30 m in hight) colonized by lots of *Rimicaris.* We filmed the whole structure of the big chimney, and landed on its basal part, called "shrimp valley" (Actually, seafloor was covered by thick-layered shrimps). All that we could find except for the shrimps were a few crabs and sea anemones. We performed WHTAS sampling there. Temperature of the fluids surrounding the shrimps varied in the range of 11-18 ˚C (av. 16-17 ˚C). 300 ml of the fluids was successfully

taken in the two gas-tight bottles. Then, we tried to collect chimney structures emitting hot fluids. However, the chimney structure itself was pretty fragile, and its basal part was too hard to grab off. We kept doing this operation for over 30 minutes, and finally got several pieces of the chimney structure. After putting the marker #31, we left bottom.

Payloads:

• WHATS water and gas samplers
• Bag water sampler
• MBARI-type corer (x1)
• Sample box with lid (x3)
• Single cylinder slurp gun (suction sampler)
• Marker (x2)

Location of Events:

As in the section, “Event List”.

Video log:

Time	X	Y	Depth	Event
				No. 2 camera (pan and tilt)
10:02				vent open; *Shinkai* descends
11:30	-70	-100	3349	Land on garavel partly covered with dark brownish sediment
11:42	-20	-75	3296	Dead chimneys with sea-anaemon
11:48	20	-40	3285	Find Mkr#
11:55	50	0	3271	Found Mkr#24
12:00	60	0	3277	Many sea amemones, gatropods and shrimps on brownish chimneys
12:41	40	20	3271	WHATS 1st started
13:26	55	5	3274	Come back to Mkr#24
13:34	65	5	3272	Resume WHATS 1st
13:42	50	-5	3273	Finish WHATS 1st and start WHATS 2nd
13:46	50	-5	3273	Finish WHATS 2nd
13:48	50	-5	3273	Start bag sampling
14:05	50	-5	3273	Can't find out Crysomallon gastropods under the shrimp mat
14:19	50	-5	3273	Sampling two Alviniconcha gastropods, heading to shrimp garden
14:37	40	0	3273	Arrival at schrimp garden and start shooting
14:51	50	0	3273	Start to avoid shrimps to see gastropods.
15:05	40	-10	3275	Start WHATS 3rd
15:15	50	10	3275	Start WHATS 4th
15:23	50	10	3275	Finish WHATS 4th
15:47	65	15	3272	Place Mkr#31
15:54	35	-115	3270	Leave the bottom

Event List:

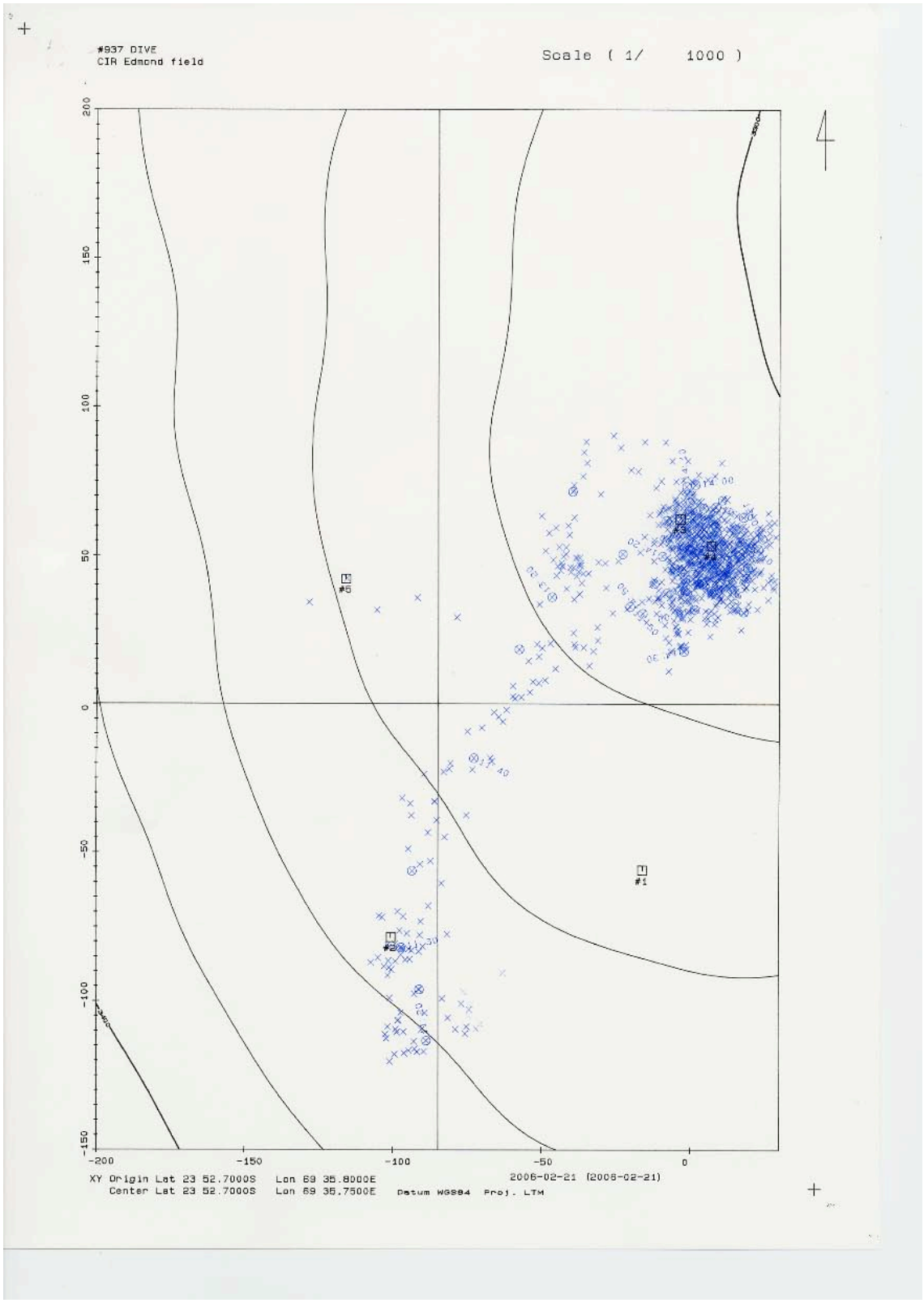
11:29, 23˚52.7426’S, 69˚35.7407’E, Landing, D=3349m

14:19, 23˚52.6662’S, 69˚35.7980’E, WHATS(2), Bag, Alvinconcha(2), D=3273m

15:22, 23˚52.6711’S, 69˚35.8041’E, WHATS(2), Chimney, Deployment #31Mkr, D=3273m

15:54, 23˚52.6772’S, 69˚35.7317’E, Left Bottom, D=3264m Alt=70m

Dive Track:


#937 DIVE
CIR Edmond field
Scale (1/ 1000)
200
150
100
50
0
-50
-100
-150
-200
-150
-100
-50
0
#1
#2
#3
#4
#5
XY Origin Lat 23 52.7000S Lon 69 35.8000E
Center Lat 23 52.7000S Lon 69 35.7500E
Datum WGS84 Proj. LTM
2006-02-21 (2006-02-21)

V. PRELIMINARY RESULTS

General results

Geobiological expedition was conducted by means of RSV Shinkai6500 and its mother vessel R/V Yokosuka toward deep-sea hydrothermal systems in the Central Indian Ridge close to the Rodrigez Triple Junction. Totally, 10 dives were successfully performed. 5 dives were conducted for the Kairei Field and 5 dives for the Edmond Field. The location and bathymetry of each hydrothermal field are demonstrated in the figures coupled with general structure of the Central Indian Ridge (Figs. 1, 2 & 3).

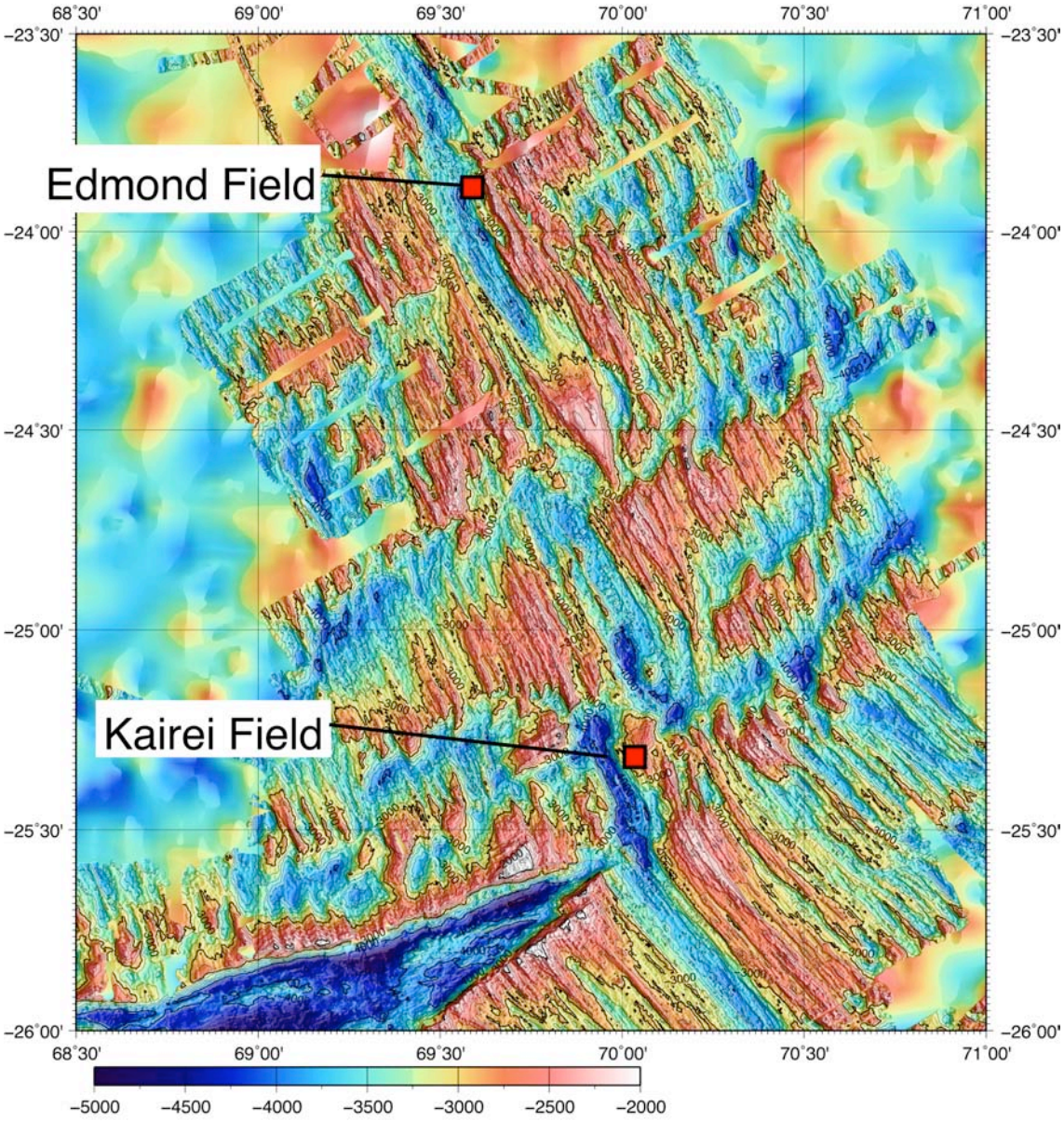


Fig. 1. Bathymetry map of the Central Indian Ridge around the RTJ

Kairei Field:

The Kairei Field is located at the western slope of the Hakuho Knoll in the CIR-S1. The detail map and description of hydrothermal events in the Kairei Field are summarized in Fig. 2. In the Kairei Field, two major trend lines of distribution of the hydrothermal vent sites are evident: one is the Kali-Kissho-Fudo-Monju-Fugen line and the other is Kali-Daikoku-Bisyamon line. These trends might represent the potential hydrothermal fluid paths in the subseafloor. The most active and the highest temperature of hydrothermal vent site is the Kali vent site and it is the hydrothermal activity center of the Kairei Field. Based on the seafloor observation by Shinkai 6500, large scale of weathered sulfide structures are found at around presently active hydrothermal vent sites. The location of each hydrothermal vent site and the temperature of hydrothermal fluid from each vent site are quite similar with those observed in YK01-15 performed in 2002. Thus, the hydrothermal activity of the Kairei Field has been stable at least for past 4 years and has been probably continued for relative long term, a certain geologic time scale.

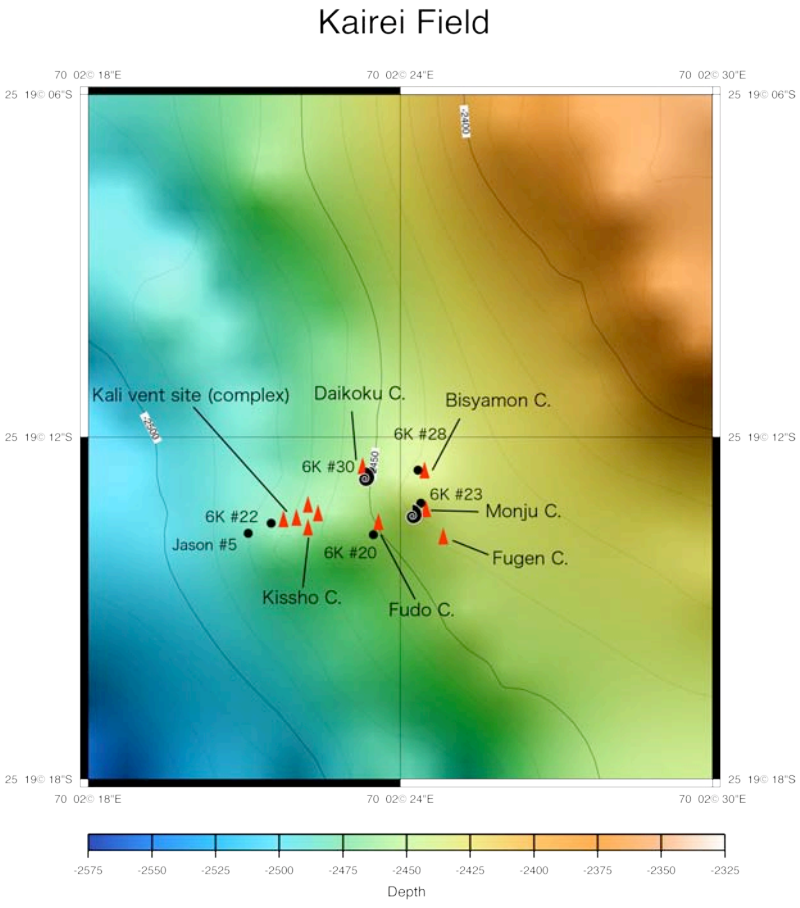


Fig. 2. Local map of hydrothermal events in the Kairei Field.

Edmond Field:

The Edmond Field is located in the western slope of the eastern ridge crest of the CIR-S3. The Edmond Field was originally discovered by Jason-Knorr expedition in 2001. However, the detail hydrothermal vent distribution, hydrothermal fluid chemistry and microbiological characteristics have been poorly described. In this expedition, the detail distribution of the hydrothermal vent sites are characterized (Fig. 3). The Grand Shrimp Valley is located at south to southwest slope of the enormous hydrothermal mound, which had been the hydrothermal activity center in the Edmond Field for the long time. However, the most active and the highest temperature of hydrothermal ventings are now found at the east slope of the mound. The highest temperature (375 ˚C) of the fluid is obtained from the Nura Nura chimney, where the fluid is boiling. In addition to Rimicarid shrimp and anemones, *Alviniconcha heshleri* is another major animal in the Edmond Field. In the western and southern area of the Grand Shrimp Valley, lots of slowly effluent black smokers and diffusing vents are distributed. Probably, the Edmond Field has been also continued for relative long term, a certain geologic time scale, as described in the Kairei Field.

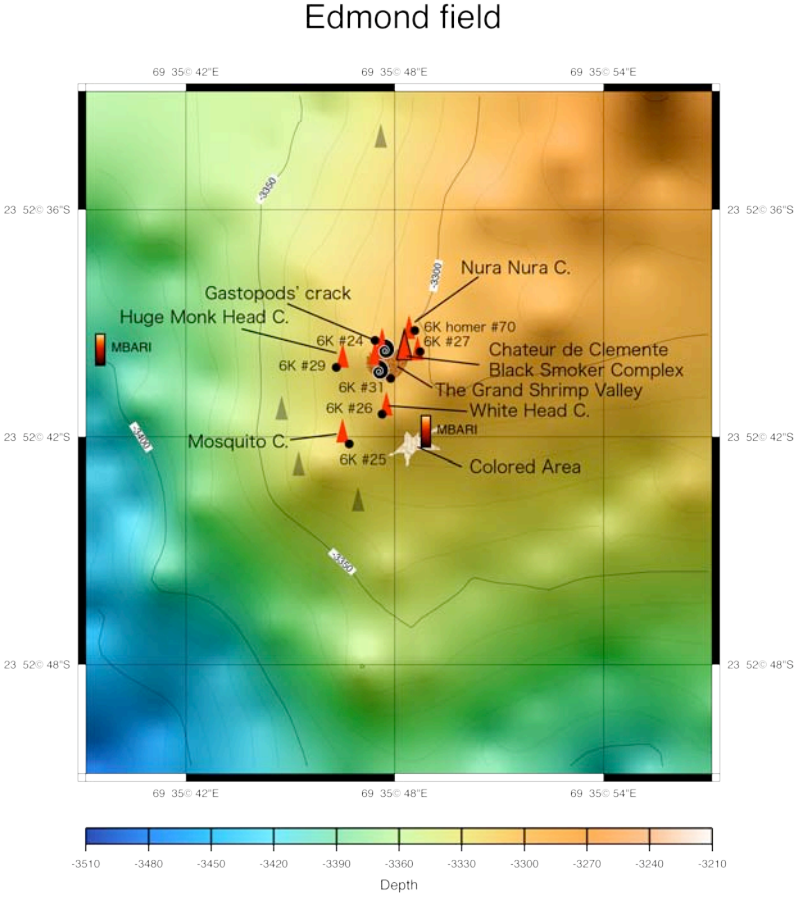


Fig. 3. Local map of hydrothermal events in the Edmond Field.

MICROBIOLOGY

SUGAR Project, JAMSTEC

During this cruise, we had a variety of hydrothermal activity-related samples such as chimneys, fluids, ambient seawaters, mixing fluids and animals from the Kairei and Edmond Fields (see Sample List Section). These samples will be investigated onshore as described in the Section of Shorebase Study. Here, we can just indicate the preliminary results of the temperature shift profiles of the STR-ISCS deployed in the black smoker vent orifice of the Kali and Monju vent sites in the Kairei Field and in the the black smoker vent orifice of the Nura Nurra chimney in the Edmond Field (Fig. 4). Both of the STR-ISCS from the Kairei Field were deployed for 10 days and the Edmond STR-ISCS was for 6 days. The STR-ISCS deployed in the Kali vent site was placed in the range of pure endmember fluid to seawater and the temperature probe was positioned just at the mixing point (49.3 ± 8.2 ˚C). Thus the temperature represents relatively low but the substratum in the bottom of the ISCS might be exposed to 362 ˚C during the deployment. The STR-ISCS deployed in the Monju chimney is also placed in the mixing zone. The temperature probe is positioned in relatively high temperature region (50.9 ± 4.6 ˚C). The substratum in the bottom of the ISCS might be exposed to 10-20 ˚C, which is the habitats for *Alviniconcha heshleri*. The STR-ISCS from the Nura Nura chimney is completely exposed to 375 ˚C during the deployment. These ISCS samples are very good samples for the future microbiological characterization of the communities entrapped in the ISCS.


06/02/07 16:14:02 08°
27° -28° 2000 F036
105° 2421M 2M

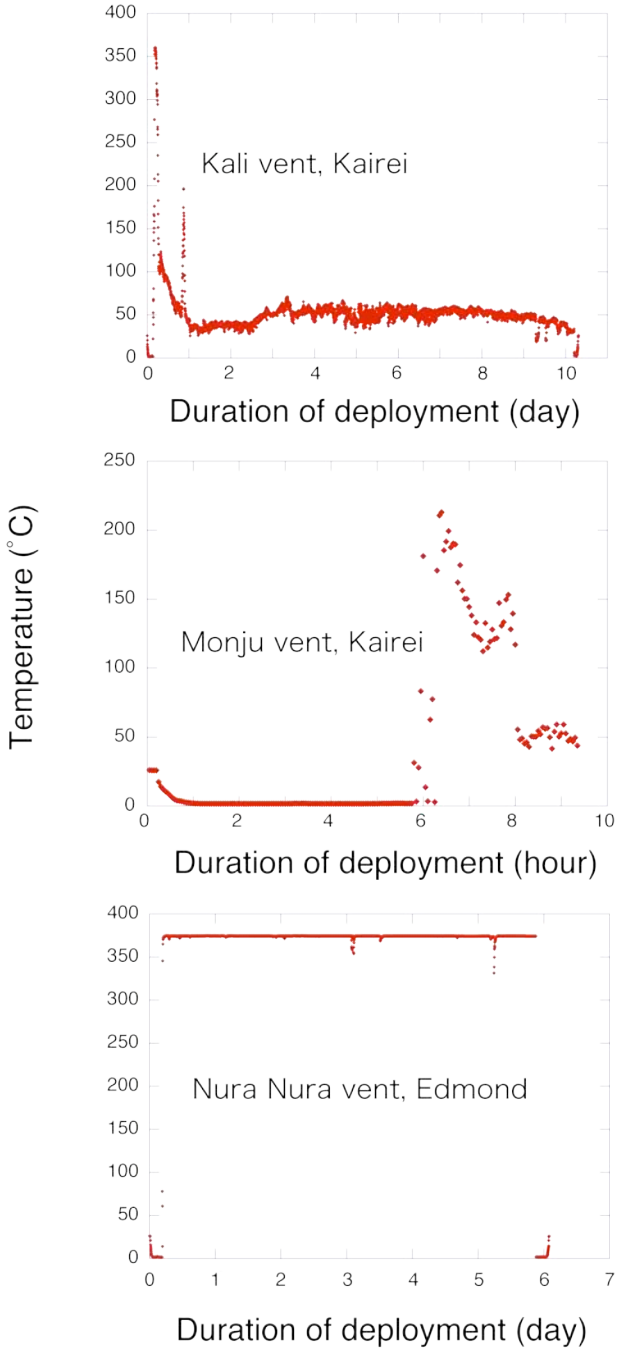


Fig. 4. STR-ISCS deployed and the temperature shift profile of the ISCS

Dive	Bottle	Max.	Av.*	STD*	Vent
928	1	362.0	344.3	11.1	Kali vent fluid, Kairei Field
	2	361.8	352.3	8.7	
	3	278.0	270.9	3.3	Monju vent fluid, Kairei Field
	4	298.7	236.9	31.4	
929	1	305.1	304.6	0.1	Fugen vent fluid, Kairei Field
	2	305.2	304.7	0.2	
930	1	375.4	361.7	9.3	Nura1 vent fluid, Edmond
	2	375.4	355.5	19.1	
931	1	264.3	262.3	1.4	Pseudo-monk vent fluid, Edmond
	2	262.9	251.3	4.2	
	3	ND	ND	ND	#27 vent fluid, ed
	4	ND	ND	ND	
932	1	247.6	140.6	36.6	Shrimp chimney/vent fluid, Edmond
	2	280.9	197.2	49.0	
	3	25.1	2.8	4.5	Alviniconcha colony_source, Edmond
	4	115.6	112.4	2.2	
933	1	41.6	37.4	0.7	Alviniconcha colony_source
	2	87.3	42.6	20.5	Monju, Kairei/fluids surrounding Alviniconcha
934	1	29.7	15.3	2.1	Monju, Kairei/fluids surrounding Alviniconcha
	2	21.7	15.6	1.2	Monju, Kairei/fluids surrounding Alviniconcha
	3	315.7	302.3	7.0	Kali vent fluid, Kairei Field
	4	318.3	149.8	88.5	Kali vent fluid, Kairei Field
935	1	217.1	139.7	19.6	Baldie chimney
	2	222.6	210.7	5.3	
	3	371.3	371.0	0.1	Nura
	4	371.3	371.0	0.1	
936	1	314.9	303.9	5.5	Daikoku
	2	306.1	303.7	1.2	
	3	183.1	149.9	13.2	Bishamon
	4	262.8	245.0	9.6	
937	1	22.9	19.5	1.7	Alviniconcha colony
	2	25.9	23.5	1.0	
	3	18.7	15.7	1.2	Rimicaris colony
	4	19.1	16.4	3.2	

*Average and standard deviation were calculated based on temperatures recorded for 2 minutes before closing the valve.

GEOCHEMISTRY

Results of onboard analysis

Tomohiro "Aniki" Toki (ORI)

During the YK05-16 Leg2, 34 WHATS samples, 10 Bag samples, and 2 Niskin were collected from the Kairei Field and the Edmond Field. The samples of hydrothermal fluids are measured for Si, pH, alkalinity, NH_4, salinity, H_2S, and total gas content (T.G.C.) on board the tender ship within a day from the sample recovery. The analytical results are shown in Table 1, and the data only for WHATS and Niskin samples are illustrated in Fig. 1 (Bag samples are contaminated by distilled water initially filled in the dead space of the sampler).

In Fig. 1, the Si concentration is plotted on the x-axis (instead of magnesium) as an index of the hydrothermal component. The highest silica concentration was 15.2 mM in the Kairei samples and 16.7 mM in the Edmond samples. These values approximate quartz saturation at the pressure of depth at each site and the venting temperature, suggesting the highest Si concentration is the end-member composition of each field.

Salinity of the high temperature fluids (maxT = 362ºC) from the Kairei Field have a constant value as 35 permil comparable to usual seawater, on the other hand that from the Edmond Field (maxT = 374ºC) show variable salinity ranging between 55 permil and 31 permil (Fig. 1a). The highest salinity in the Edmond samples is ca. 57 % enrichment compared to usual seawater. These facts can be explained by phase separation occurring only at the Edmond Field, not at the Kairei Field. We, however, cannot clearly classify the Edmond samples between a salinity-depleted, vapor-rich fluid and a salinity-enriched, brine-rich fluid as generally shown in such a phase separated hydrothermal system (Figs. 1a, 1c, and 1d). It suggests that phase separation would occur in not so deep zone beneath the sea bottom at the Edmond Field, resulting in the mixture of brine-fluids with vapor-fluids in the subsurface prior to discharging from vents, not pass through the individual pathway from the boiler at the great depths. This interpretation is harmonious with observation of the vent, boiling in the orifice of the chimney structure.

H_2S concentrations of the samples in this cruise are compared with the values previously reported in Gamo et al. (2001) and YK01-15 Cruise Report (Fig. 1d). Based on the plot, the end-member of H_2S in the Kairei and Edmond hydrothermal systems in 2005 is 6~7 mM as high as that of the mid-oceanic ridge fluids. The 2005 end-member of the Kairei Field higher than that of both Gamo et al. (2001) and YK01-15 samples

may due to stimulating the hydrothermal activity between 2001 and 2005.

One of the main objectives in this cruise is clarification of the chemical factor in the environment where macrofauna lives. We collected the shimmering fluids above Alvinconcha and Rimicalis colony, of which chemical components are Si concentration is as low as several mM correspond to several 10ºC of fluid temperature, and H_2S concentration is the order of μM. As for the other components, hydrogen, methane, TCO_2, cation, anion, and heavy metal, the extracted gas and distributed fluid samples will be analyzed in the onshore laboratory as quickly as possible.

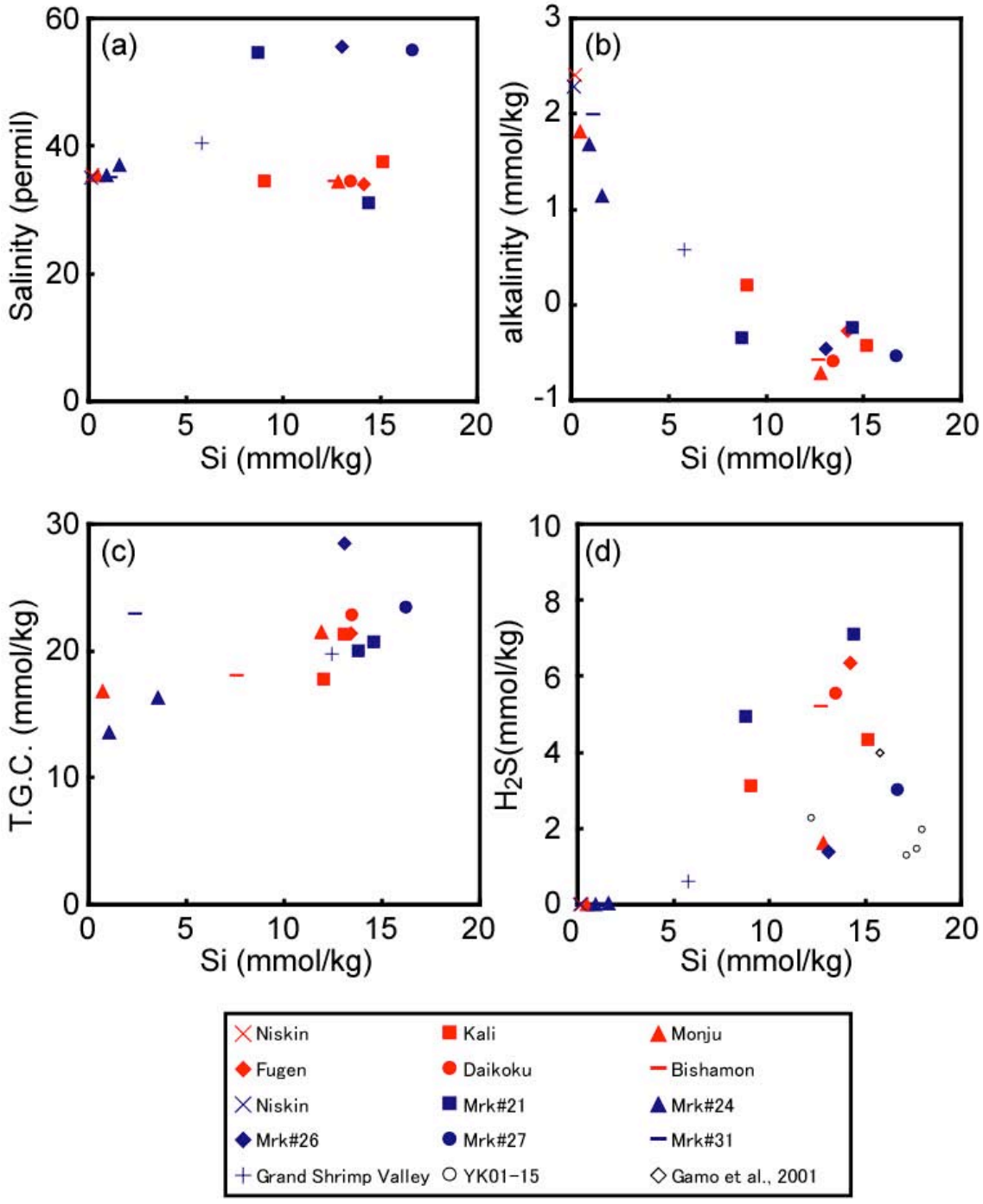


Fig. 1 Analytical results of the samples collected from the Kairei Field and Edmond Field

Table 1 Onboard analytical results of the hydrothermal fluids collected in this cruise

Date	dive	observer	area	site	type	Sample	pH	Alk.	Sal.	Si	NH4	H2S	TGC
								meq	‰	mM	uM	mM	mM
2006.2.7	928	K. Takai	Kairei field	Before landing (A=5m)	Niskin	N	7.6	2.4	35.5	0.2	2.3	0.000014	---
				Kali (Mrk#22)	WHATS	W1	3.4	-0.4	37.5	15.2	27.2	4.3	---
				Kali (Mrk#22)	WHATS	W2	---	---	---	13.1	---	---	21.3
				Kali (Mrk#22)	Bag	B	3.1	-0.8	36.5	11.5	14.6	4.0	---
				Monju (Mrk#23)	WHATS	W3	3.6	-0.7	34.5	12.8	24.0	1.6	---
				Monju (Mrk#23)	WHATS	W4	---	---	---	11.9	---	---	21.5
2006.2.12	929	S. Nakagawa	Kairei field	Fugen	WHATS	W1	3.4	-0.3	34.0	14.2	10.0	6.4	---
				Fugen	WHATS	W2	---	---	---	13.4	---	---	21.4
				Fugen	Bag	B	6.9	2.1	34.0	19.0	16.7	1.4	---
2006.2.13	930	T. Nunoura	Edmond	Nura1 (Mkr#21)	WHATS	W1	3.3	-0.4	54.5	8.8	6.3	4.9	---
				Nura1 (Mkr#21)	WHATS	W2	---	---	---	14.6	---	---	20.7
				Nura1 (Mkr#21)	Bag	B	5.1	0.3	44.5	8.5	3.3	0.16	---
2006.2.14	931	H. Hirayama	Edmond	White Head (Mkr#26)	WHATS	W1	3.1	-0.5	55.5	13.1	13.4	1.4	---
				White Head (Mkr#26)	WHATS	W2	---	---	---	13.1	---	---	28.5
				Mkr#27	WHATS	W3	3.2	-0.5	55.0	16.7	7.7	3.0	---
				Mkr#27	WHATS	W4	---	---	---	16.3	---	---	23.4
				Mkr#27	Bag	B	4.0	0.3	45.0	9.7	10.0	1.0	---
2006.2.15	932	Y. Suzuki	Edmond	Grand schrimp valley	WHATS	W1	5.1	0.6	40.5	5.8	10.3	0.59	---
				Grand schrimp valley	WHATS	W2	---	---	---	12.4	---	---	19.8
				Alvinconcha live in (Mrk#24)	WHATS	W3	6.1	1.1	37.0	1.6	21.6	0.030	---
				Alvinconcha live in (Mrk#24)	WHATS	W4	---	---	---	3.5	---	---	16.3
				Alvinconcha live in (Mrk#24)	Bag	B	6.7	0.8	23.5	3.4	9.8	0.0044	---
2006.2.16	933	M. Kitada	Kairei	Alvinconcha source (Mrk#23)	WHATS	W1	---	---	---	0.7	---	---	14.8
				Alvinconcha live in (Mrk#23)	WHATS	W2	---	---	---	2.3	---	---	22.9
				Alvinconcha live in (Mrk#23)	Bag	B	6.8	1.5	35.0	1.0	1.1	0.039	---
2006.2.17	934	Y. Suzuki	Kairei	Alvinconcha live in (Mrk#23)	WHATS	W1	7.0	1.8	35.5	0.5	1.1	0.0021	---
				Alvinconcha live in (Mrk#23)	WHATS	W2	---	---	---	0.7	---	---	16.8
				Kali (Mrk#22)	WHATS	W3	---	---	---	12.0	---	---	17.7
				Kali (Mrk#22)	WHATS	W4	4.1	0.2	34.5	9.1	5.7	3.1	---
				Kali (Mrk#22)	Bag	B	6.4	1.1	36.5	2.6	0.7	0.0037	---
2006.2.19	935	K. Takai	Edmond	Before landing (A=5m)	Niskin	N	7.7	2.3	35.0	0.1	0.6	0.000034	---
				Nura1 (Mkr#21)	Bag	B	3.5	-0.3	47.5	8.3	3.1	1.7	---
				Bouzu (Mrk#29)	WHATS	W1	3.2	-0.4	54.0	11.1	2.2	0.82	---
				Bouzu (Mrk#29)	WHATS	W2	---	---	---	11.3	---	---	25.8
				Nura2 (Mkr#21)	WHATS	W3	3.2	-0.2	31.0	14.5	11.7	7.1	---
				Nura2 (Mkr#21)	WHATS	W4	---	---	---	13.8	---	---	20.0
2006.2.20	936	T. Toki	Kairei	Daikoku (Mkr#47=30)	WHATS	W1	3.4	-0.6	34.5	13.5	6.8	5.6	---
				Daikoku (Mkr#47=30)	WHATS	W2	---	---	---	13.5	---	---	22.8
				Bishamon (Mrk#28)	WHATS	W3	---	---	---	7.6	---	---	18.0
				Bishamon (Mrk#28)	WHATS	W4	3.4	-0.6	34.5	12.7	6.8	5.2	---
				Alvinconcha live in (Mrk#23)	Bag	B	7.2	2.0	35.0	0.4	0.6	0.00043	---
2006.2.21	937	S. Nakagawa	Edmond	Alvinconcha live in (Mrk#24)	WHATS	W1	6.5	1.7	35.5	0.9	3.8	0.00050	---
				Alvinconcha live in (Mrk#24)	WHATS	W2	---	---	---	1.1	---	---	13.6
				Alvinconcha live in (Mrk#24)	Bag	B	6.5	1.5	35.5	1.3	3.7	0.0023	---
				Rimicaris live in (Mrk#31)	WHATS	W3	6.6	2.0	35.0	1.1	8.1	0.00060	---
				Rimicaris live in (Mrk#31)	WHATS	W4	---	---	---	1.0	---	---	13.7

BIOLOGY

Chemoautotrohic symbiosis

Yohey Suzuki (AIST)

We succeeded in sampling and rearing *Rimicaris* aff. *exoculta* and *Alviniconcha* aff. *hessleri* from the Kairei and Edmond fields, as well as *Bathimolous* sp., *Neplepas* sp. and *Crysomallon squamiferun* from the Kairei fields.

Remarkably, *Crysomallon* and *Alviniconcha* gastropods thrive well in a water tank set up on ship. We conducted a set of experiments for *Crysomallon* and *Alviniconcha* gastropods to test whether ^{13}C-lablled bicarbonate is incorporated into the host as well as the endosymbiont by using hydrogen as an electron donor.

We also dissected numerous individuals of *Crysomallon* and *Alviniconcha* gastropods and preserved the dissected tissues for later RNA-based analyses. We also found the eggs of *Crysomallon* and *Alviniconcha* gastropods, which were also preserved for TEM observations and FISH analysis.

On board summary of keeping samples

Mitsugu Kitada (Enoshima aquarium)

We tried to keep alive several of the deep sea animals that collected by submarine. Upon rearing, we prepared three water tanks in the vessel. The water temperature was set to five degrees first respectively. In the case of dive #928, the sampling animals that sampled in Kairei Field almost were alive when submarine came to the surface. However, when we began to put them in water tank, the shrimps began to die one after another. The result, shrimps survived only the entire half the number. About gastropods and crabs were no problem of keeping. However, the water temperature of rearing animals didn’t fit, I thought. They inhabited in hydrothermal vents, and I raised the water temperature slowly with observing them. And we decided to rear them by ten degrees because shrimp’s movement became well. In the case of samples collected in Edomond Field, we reared only shrimps, the survival rate and how to rear was same.

A lot of animals were collected in the latter half. The species with good conditions were rearing and observed them. I could observe that gastropod’s (Scaly foot) scales began to become white. Gastropods and vent crabs hardly died, however, keeping alive shrimps was difficult for me, so they hardly survived still to the last minute. We try to take them to Enoshima aquarium, because we research in the future.

Species and rough survival rate sampled for culture

Location	Organism	Number of total collections	Survival rate
Kairei	*Alviniconcha*	165	69%
	Austinogaea	82	88%
	Bathymodiolus	24	20%
	anemone	5	0%
	Rimicaris	1383	2%
	Crysomallon	85	98%
Edomod	*Rimicaris*	1301	Less than 1%

MINERALOGY and PETROLOGY

Syunsaku Awaji (Tokyo University) and Kentaro Nakamura (JAMSTEC)

During YK05-16 Leg 2, 27 rock samples were recovered. The rock samples can be classified into three types of basalt, active chimney and dead chimney. From the Kairei hydrothermal field, one basalt (Dive#928-R1), five active chimneys (Dive#928-R2, R4, Dive#929- R3, Dive#933-R3, Dive#934-R2), and 13 dead chimneys (Dive#928-R3, R4-2, Dive#929-R1, R2, R4, R5, Dive#933-R1, R2, Dive#934-R1, Dive#936R1, R2, R3, R4) were sampled. On the other hand, seven active chimneys (Dive#930-R1, Dive#931-R1, R3, Dive#935-R1, R2, R3, Dive#937-R1) and two dead chimneys (Dive#930-R2, Dive#931-R2) were sampled from the Edmond hydrothermal field.

The young active chimneys from both sites consist mainly of anhydrite with very fine grained sulfide particles. Coarse grained sulfide crystals are restricted along hydrothermal fluid paths. Compared to the active chimneys, modal abundance of anhydrite is noticeably low in dead chimneys probably due to its retrograde solubility (it is saturated in seawater at temperatures >150°C, whereas undersaturated <150°C). Thus the dead chimneys are composed mainly of sulfide minerals such as pyrite and chalcopyrite. Only two whitish dead chimneys recovered from the Kairei hydrothermal field (Dive#936R1, R2) contain significant amounts of anhydrite. These may be a constituent of deeper part of hydrothermal mound reported from TAG hydrothermal mound (Humphris et al., 1995).

The comparisons of mineralogy and geochemistry between the young active chimneys and the old dead chimneys will elucidate the forming process of seafloor hydrothermal metal ore deposits such as Besshi-type sulfide ore deposits.

References

Humphris, S. E., Herzig, P. M., Miller, D. J., Alt, J. C., Becker, K., Brown, D., et al., 1995, The internal structure of an active sea-floor massive sulphide deposit: Nature, v. 377, p. 713-616.

VI. SHORE BASE STUDY

Microbiology

Geomicrobiology in deep-sea hydrothermal systems, Kairei & Edmond Fields, CIR

Ken TAKAI, Satoshi Nakaggawa Hisako HIRAYAMA, and Takuro NUNOURA (SUGAR, JAMSTEC)
Collaborated with Yohey Suzuki, Tomohiro Toki, Syunsaku Awaji and UltraH^3 group

We intend to investigate the structures, distribution and variation of microbial ecosystem by the combination of culture-dependent and culture-independent molecular ecological studies. Furthermore, microbiological data will be coupled to geochemical and geophysical data and construct a grand sketch of the UltraH^3 Linkage in the modern Earth.

Culture-dependent ecological surveys

Microbiologists often say that culturable microbes are only 0.1 to 1% in natural environment, and culture–independent molecular ecological surveys have been very popular and indispensable tools for microbial ecologist. However, it is very difficult to show the direct evidence of metabolism and physiology of microorganisms. Thus, culture-dependent analyses are still important and effective tools in microbial ecology. Furthermore, coupling the information of culture-independent molecular ecological, geochemical and geophysical analyses provide the effective data for cultivation of previously uncultured organisms. In fact, our group has been tried to cultivate previously uncultured organisms with the information of geochemical investigation in hydrothermal vents in Iheya North, Yonaguni Knoll IV, TOTO caldera, Lau Basin, Kermadec Arc, Suiyo Seamount and MAR hydrothermal systems and has succeeded in cultivation of more than 10% of the members that were detected in culture-independent analyses in each habitat.

Using samples obtained in this cruise, we will try to cultivate these Archaea and Bacteria; Methanogens, autotrophic sulfur reducers such as *Desulfococcales*, *Aquificales, Deferribacteriales* and *Epsilonproteobacteria*, autotrophic sulfur oxidizers such as *Aquificales, Alphaproteobacteria, Gammaproteobacteria* and

Epsilonproteobacteria, nitrate or nitrite reducers such as *Aquificales, Deferribacteriales,* and *Epsilonproteobacteria*, sulfate reducers such as *Archaeoglobales* and *Thermodusulfobacteriales* and *Deltaproteobacteria*, iron oxidizers and fermenters such as *Thermococcales* and *Thermotogales* for each samples; chimneys, hydrothermal fluids and ISCS. In addition, we will evaluate the cultured members of microorganisms by MPN method.

MPN analysis: Serial-dilution [Most Probable Number (MPN) cultivation experiments were performed to enumerate organisms whose metabolism are correspond to the condition of medium. Homogenized sediment slurries were diluted in 10-fold steps into liquid media, which should support the growth and putative population of specific physiological types of microorganisms. The microorganisms in the highest dilutions with positive growth are possibly dominant species in the cultured condition. This approach is applied to the predictable members in each environment.

Culture –independent molecular ecological surveys

Culture–independent molecular ecological surveys produce high resolution mapping of diversity and distribution of microorganisms. In this study, we will analyze the microbial diversity in chimney structures, hydrothermal fluids and ISCS by biomass evaluation, 16S rRNA gene clone analysis and quantitative PCR.

Evaluation of biomass: In order to evaluate the population and distribution of microbial components, we will evaluate total microbial density by direct counting of DAPI or AO stained cells.

Quantitative PCR, a modification of two-step PCR, is essentially a fluorescens assay used to quantify the number of target genes in an environmental sample (Takai and Horikoshi 2000). In the analysis based on 16S rDNA, we will study the population ratio between the domain Bacteria and Archaea using the specific probe for each domain. In addition, we also quantify the amount of functional genes as DNA as template by gene specific primers.

Gene sequencing is necessary process to obtain the primary information of the gene sequence itself that is essential for all phylogenetic analysis and identification of microorganisms. We will construct clone libraries for target genes (e.g. 16S rDNA, Methyl CoM reductase, dissimilatory sulfite reductase etc.) with each subsamples and compare each library associated with geochemical and geological data.

FISH (Fluorescence In Situ Hybridization) analysis is the microscopic observation of the cells that rRNA was hybridized with the specific fluorescence probes

designed based on the variability of 16S rRNA sequence. Thus, this technique visualizes the results of clone analysis based on 16S rDNA.

Metagenome analysis

If we fortunately found a sample that has unique microbial components such as Korarchaeota and Nanoarchaeota, and their population ratio, that is determined by quantitative PCR or FISH analysis, is more than 5%, we will try metagenome analysis. We will have two strategies. The one is constructing Bac or Fosmid library and the other is constructing shotgun library.

Bac or Fosmid library : Bac and Fosmid vector can clone large size of insert; - 150kb and – 45kb, respectively. These library are used for screening clones that contain 16S rRNA gene or conservative functional gene by PCR and sequencing of both ends of all clones. The positive clones that contain the genome from target microorganisms are sequenced by whole genome shotgun methods.

Shotgun library: DNA from the sample is shared in 1-2kb and cloned into plasmid vector. The shotgun library is used for the sequence of whole genomic structure of target microorganisms or all microbes in the sample

Microbiological characterization of endosymbiotic Epsilonproteobacteria in *Alviniconcha heshleri*

Satoshi Nakagawa, Hisako HIRAYAMA, Takuro NUNOURA and Ken Takai (SUGAR, JAMSTEC)
Collaborated with Yohey Suzuki, Tomohiro Toki and Mitsugu Kitada

Suzuki et al. (2005) demonstrated that *Alviniconcha heshleri* from the Kairei Field had an endosymbiont of the Group F *Epsilonproteobacteria*. During the enzymatic analysis of the gill lysates, evident activities of soluble MV-hydrogenase and sulfite: ferredoxin oxidoreductase of *Epsilonproteobacteria* were detected. According to the general rule postulated by Takai et al. (2005), these enzyme activities represented the energy metabolism utilizing both hydrogen- and sulfur-oxidation of the epsilonproteobacterial endosymbiont. This is a quite important subject to be proved. Using stable isotope labeled and non-labeled specimens, expression of mRNAs and enzymes for key enzymes of epsilonproteobacterial hydrogenase and Sox systems should be examined. In addition, to understand the genetic basis of the endosymbiosis

between *Epsilonproteobacteria* and *Alviniconcha heshleri*, the genome sequence and structure of the endosymbiont have to be determined and to be thoroughly compared with the phylogenetically related, free-living *Epsilonproteobacteria*, *Sulfurovam* sp. NBC37-1, of which the genome sequence has been just determined by SUGAR Project.

Chemoautotrophic Symbiosis

Yohey Suzuki (AIST))
In collaboration with Sugar Group at JAMSTEC, the 13C-labelled gastropods will be analyzed for their carbon isotopic compositions.

Changes in the activity of endosymbionts and the contents of iron and sulfur in various body parts during rearing on board and shore will be quantified.

The endosymbiotic system of *Crysomallon squamiferun* will be re-examined by using molecular phylogenetic and isotopic analyses.

cDNA libraries will be constructed for *Crysomallon* and *Alviniconcha* gastropod hosts.
Gastropods belonging to the family Provannnidae are endemic to sulfide-rich environments including hyrdrothermal vents, cold seep, sunken wood, and so on. Nutrition of the Provannid gastropods depend either on chemoautotrophic bacteria inside the epithelium cells of their gill called bacteriocytes or on grazing bacteria mats on the solids. The main purpose of this study is to elucidate what kind of free-living or endosymbiotic bacteria the Provannid gastropods nutritionally depend on.

GEOCHEMISTRY (Study plan)

Toki (ORI)
Gas
(1) Concentration of CH_4, C_2H_6, CO_2, CO, N_2O, H_2, N_2, Ar, and O_2
(2) $\delta^{13}C(CH_4)$, $\delta^{13}C(C_2H_6)$, $\delta^{13}C(CO_2)$, $\delta^{13}C(CO)$, $\delta D(H_2)$, $\delta^{15}N(N_2)$, $\delta^{18}O(O_2)$, and $^3He/^4He$

Fluid
(1) Mg, Ca, Sr, Na, K, Li, B, Cl, Br, I, SO_4, NO_3, Mn, Fe, Ba, Heavy metal, REE

(2) $\delta^{18}O(H_2O)$, $\delta D(H_2O)$, and $\delta^{37}Cl$

MINERALOGY and PETROLOGY

Shunsaku AWAJI (Univ. of Tokyo)

Mineralogical and geochemical studies of hydrothermal chimneys from Kairei and Edmond hydrothermal fields will be performed in order to understand the forming process of seafloor hydrothermal sulfide deposits. We will also compare mineralogical and geochemical features between Kairei-type and Edmond-type hydrothermal chimneys to clarify how the difference of chemical composition of hydrothermal fluid affects that of mineralogy and geochemistry of hydrothermal deposits.

Mineral assemblages will be determined by microscopic observation and XRD at the University of Tokyo, mineral compositions will be analyzed by EPMA at Ocean Research Institute, the University of Tokyo, and whole rock compositions will be analyzed by ICP-MS at the University of Tokyo. In this work Dr. K. Tamaki, Dr. Y. Kato (Univ. of Tokyo) and Dr. K. Nakamura (JAMSTEC) will be involved.

BIOLOGY

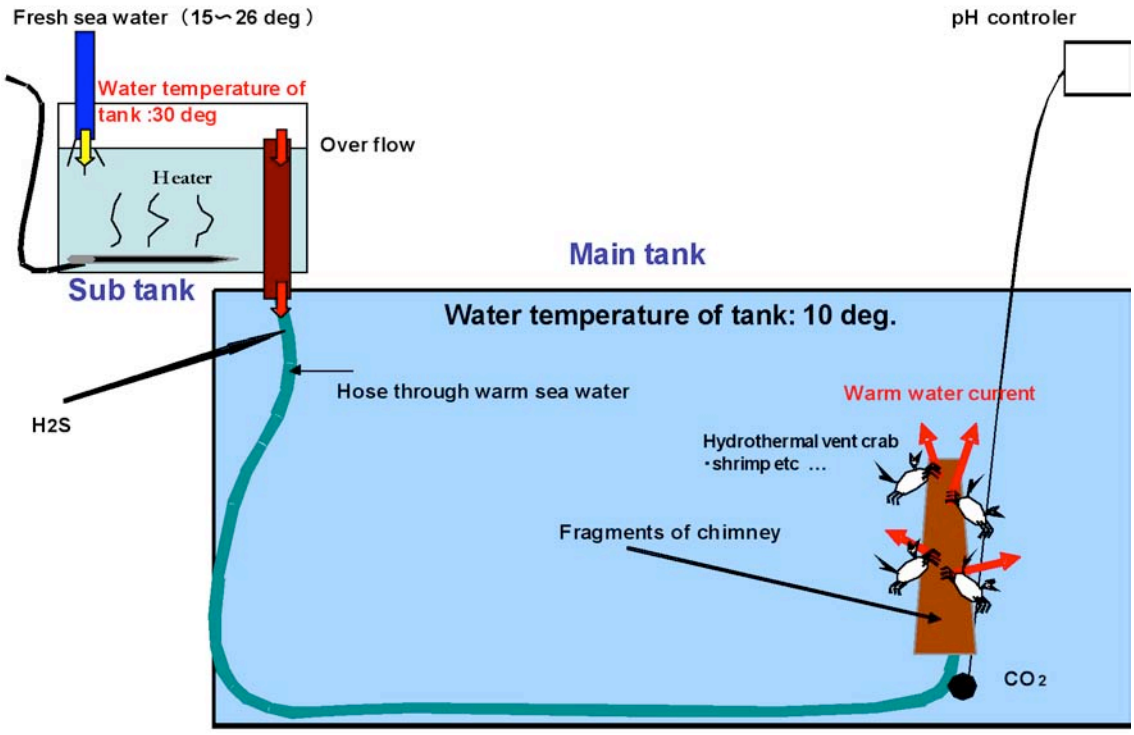
1. Rearing the hydrothermal vent animals of Indian Ocean.

Mitsugu Kitada (Enoshima aquarium)

In this cruise, we observed the living thing in various hydrothermal vent animals, and were able to sampling them. The main samples were gastropods (*Alvinichonca*, *Crysomallon*), shrimps (*Rymicaris*), mussels (*Bathmodiolus*), crabs (*Austinograea*), and barnacle (*Neolepas*). We try to rear them after taking them to Japan. How to take them to Japan were 1) taking them with luggage to Japan, (It took 24 hours until arriving from the research ship to Japan.), 2) keeping them in the tanks of the research ship (It took a month until arriving from the research ship to Japan.).

On samples arrival, we try to rear them in various methods. The rearing systems of Enoshima aquarium are DO controller of adding N_2, pH controller of adding CO_2, system of adding H_2S. More, we made system of hydrothermal vent that add warm sea water. Up to now, good result in the hydrothermal vent crabs inhabiting in Ogasawara

has been put out. The crab gathers in the warm sea water and various ecologies can be observed. This time we rearing suitable for each environment, and reveal their behavior and ecology. Moreover, not only the field of rearing, these will study at other fields as laboratory animals too.



System of rearing hydrothermal vent animals.

VII. APENDIX

Sample list for Microbiology, Geochemistry and Mineralogy

Sample list for Biology

Rock sample description

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
7.Feb.06	#928	Water (WHAT)	25°19.2224'S, 70°2.3668'E	2455m	<362	928WW-1	150ml	Chem	Toki (U.Tokyo)	Kali chimney
								CLT,DNA	Takai(JAMSTEC)	
			25°19.2224'S, 70°2.3668'E	2455m	<362	928WW-2	150ml	Chem	Toki (U.Tokyo)	Kali chimney
			25°19.2200'S, 70°2.4066'E	2420m	260-270	928WW-3	150ml	Chem	Toki (U.Tokyo)	#23 Monju chimney
								CLT,DNA	Toki (U.Tokyo)	
			25°19.2200'S, 70°2.4066'E	2420m	290-300	928WW-4	150ml	Chem	Takai(JAMSTEC)	#23 Monju chimney
		Water (Niskin)	25°19.2971'S, 70°2.3686'E	2495m		928NW-1	2.5L	Chem	Toki (U.Tokyo)	ambient deep-sea water (5m above sea-floor)
								CLT,DNA	Takai(JAMSTEC)	
		Water (Bag)	25°19.2224'S, 70°2.3668'E	2455m		928 BW	10L	Chem	Toki (U.Tokyo)	Kali chimney
								CLT,DNA	Takai(JAMSTEC)	
		Rock	25°19.2971'S, 70°2.3686'E	2495m		928R1			Kumagai(JAMSTEC)	basalt
			25°19.2224'S, 70°2.3668'E	2455m		928R2		CLT, DNA	Takai(JAMSTEC)	Kali chimney
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			25°19.2224'S, 70°2.3668'E	2455m		928R3		CLT, DNA	Takai(JAMSTEC)	#23 Monju chimney: sampled accidentally
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			25°19.2200'S, 70°2.4066'E	2420m		928R4		CLT, DNA	Takai(JAMSTEC)	#23 Monju chimney
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			25°19.2200'S, 70°2.4066'E	2420m		928R4-2			Awaji (U. Tokyo)	inactive part of #23 Monju chimney
									Chiba(Okayama U.)	
		Animals	refer to on board reports							

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution
7.Feb.06	#928	Alviniconcha	25°19.2200'S, 70°2.4066'E	2420m	3-30°C		138		
						alvie	7		Enoshima
						frozen total	105		
						frozen (Feb 7)	10		Nakagawa(JAMSTEC)
						frozen(Feb10)	50		
						frozen(Feb12)	30		Suzuki(AIST)
						frozen(Feb19)	6		Suzuki(AIST)
						frozen(Feb22)	7		
						13C uptake	8		
						dissected	5		
		Austinogaea	25°19.2200'S, 70°2.4066'E	2420m	3-30°C		19		Enoshima
						alive	17		
						frozen(Feb19)	2		
		Bathymodiolus	25°19.2200'S, 70°2.4066'E	2420m			7		
						alive	0		
						frozen	7		
		Rimicaris	25°19.2200'S, 70°2.4066'E	2420m			34		
						alive	3		Enoshima
						frozen total	31		
						frozen (Feb 8)	15		
						frozen(Feb10)	14		
						frozen (Feb13)	2		
		Crysomallon	25°19.2246'S, 70°2.4079'E	2441m			3		
						alive	0		
						frozen total	0		
						frozen (Feb ?)	3		

Remarks

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
12.Feb.06	#929	Water	25°19.2271'S, 70°2.4155'E	2419m	305	929WW-1	150ml	Chem	Toki (U.Tokyo)	Fugen chimney
								CLT,DNA	Takai(JAMSTEC)	
			25°19.2271'S, 70°2.4155'E	2419m	305	929WW-2	150ml	Chem	Toki (U.Tokyo)	Fugen chimney
		Water (Bag)	25°19.2271'S, 70°2.4155'E	2419m		929 BW	10L	Chem	Toki (U.Tokyo)	Fugen chimney
								CLT,DNA	Takai(JAMSTEC)	highly contaminated by seawater (broken of inlet line)
		Rock	25°19.1917'S, 70°2.3853'E	2462m		929R1			Awaji (U. Tokyo)	dead chimney (brownish)
			25°19.1917'S, 70°2.3853'E	2462m		929R2			Awaji (U. Tokyo)	dead chimney (greenish)
			25°19.2224'S, 70°2.3668'E	2455m		929R3		CLT, DNA	Takai(JAMSTEC)	Fugen chimney
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			25°19.2166'S, 70°2.4004'E	2428m		929R4			Kitada (Enoshima)	foot of Fugen chimney: Processed with animals

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution	Remarks
11.Feb.06	#929	Alviniconcha	25°19.2271'S, 70°2.4155'E	2419m			56			
						alvie	10		Enoshima	
						frozen total	46			
						frozen(Feb11)	6		Suzuki(AIST)	
						frozen(Feb19)	20			
						frozen(Feb22)	7			
						frozen(Feb ?)	13			
						13C uptake	24			
						dissected	3			
		Austinogaea	25°19.2200'S, 70°2.4066'E	2420m	3-30°C		140			
						alive	18		Enoshima	
						frozen	132			
		Neolepas	25°19.2200'S, 70°2.4066'E	2420m			13			
						frozen	5			
						dissected	3			
						fixed	5			
		Rimicaris	25°19.2200'S, 70°2.4066'E	2420m			34			
						alive	8		Enoshima	
						frozen total	158			
						frozen(Feb12)	135			
						frozen(Feb13)	23			
		Crysomallon	25°19.2246'S, 70°2.4079'E	2441m			23			
						alive	23		Enoshima	
						frozen total	0			
						frozen (Feb ?)	0			

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
13.Feb.06	#930	Water	23°52.6614'S, 69°35.8075'E	3277m	370	930WW-1	150ml	Chem	Toki (U.Tokyo)	Nura 1 chimney #21
								CLT,DNA	Takai(JAMSTEC)	
			23°52.6614'S, 69°35.8075'E	3277m	370	930WW-2	150ml	Chem	Toki (U.Tokyo)	Nura 1 chimney #21
		Water (Bag)	23°52.6614'S, 69°35.8075'E	3277m		930 BW		Chem	Toki (U.Tokyo)	Nura 1 chimney #21
								CLT,DNA	Takai(JAMSTEC)	
		Rock	23°52.6614'S, 69°35.8075'E	3277m		930R1		CLT, DNA	Takai(JAMSTEC)	top of Nura 1 chimney #21
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			23°52.6614'S, 69°35.8075'E	3277m		930R2			Awaji (U. Tokyo)	basement of Nura 1 chimney #21
		animals	refer to on board report							

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution	Remarks
13.Feb.06	#930	Alviniconcha	23˚52.6639'S, 69˚35.7973'E	3274m			18			
						frozen total	?			
						dissected	3			
						fixed	15			
		Austinogaea	23˚52.6639'S, 69˚35.7973'E	3274m			1			
						fixed	1			
		Rimicaris	25˚19.2200'S, 70˚2.4066'E	2420m			758			
						alive	3		Enoshima	
						frozen total	755			
						frozen(Feb13)	685			
						frozen(Feb?)	20			
						Ethanol	50			

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
14.Feb.06	#931	Water	23˚52.6772'S, 69˚35.7847'E	3293m	250(254	931WW-1	150ml	Chem	Toki (U.Tokyo)	#26 White Head chimney
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.6772'S, 69˚35.7847'E	3293m	250(254	931WW-2	150ml	Chem	Toki (U.Tokyo)	#26 White Head chimney
			23˚52.6660'S, 69˚35.8075'E	3273m	<314	931WW-3	150ml	Chem	Toki (U.Tokyo)	#27 chimney: temperature probe was broken
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.6660'S, 69˚35.8075'E	3273m	<314	931WW-4	150ml	Chem	Toki (U.Tokyo)	#27 chimney: temperature probe was broken
		Water (Bag)	23˚52.6660'S, 69˚35.8075'E	3273m		931 BW		Chem	Toki (U.Tokyo)	#27 chimney
								CLT,DNA	Takai(JAMSTEC)	
		Rock	23˚52.6772'S, 69˚35.7847'E	3293m		931R1		CLT, DNA	Takai(JAMSTEC)	#26 White Head chimney
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			10 to 20 m east from 23˚52.6772'S, 69˚35.7847'E			931R2			Awaji (U. Tokyo)	Sampled accidentally from dead chimney
			23˚52.6660'S, 69˚35.8075'E	3273m		931R3		CLT, DNA	Takai(JAMSTEC)	#27 chimney
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
15.Feb.06	#932	Water	23˚52.6632'S, 69˚35.8122'E	3265m	20-200˚C	932WW-1	150ml	Chem	Toki (U.Tokyo)	big chimney in the Grand schrimp valley
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.6632'S, 69˚35.8122'E	3265m	av. 200˚C	932WW-2	150ml	Chem	Toki (U.Tokyo)	big chimney in Grand schrimp valley
			23˚52.6574'S, 69˚35.8079'E	3275m	<80˚C	932WW-3	150ml	Chem	Toki (U.Tokyo)	#24 shimmering above Alvinconcha
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.6574'S, 69˚35.8079'E	3273m	80 - 120˚C	932WW-4	150ml	Chem	Toki (U.Tokyo)	#24 shimmering above Alvinconcha
		Water (Bag)	23˚52.6574'S, 69˚35.8079'E	3273m		932 BW		Chem	Toki (U.Tokyo)	#24 shimmering above Alvinconcha
								CLT,DNA	Takai(JAMSTEC)	
		Sediments	23˚52.6523'S, 69˚35.6704'E	3393m		932MS	2, 12cm	CLT, DNA	Takai(JAMSTEC)	
							2,7,12		Awaji (U. Tokyo)	
		animals	refer to on board results							

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution	Remarks
15.Feb.06	#932	Alviniconcha	23°52.6671'S, 69°35.8008'E	3272m			4			
						alive	0			
						frozen total	4			
						frozen(Feb15)	4		AIST(Suzuki)	
						fixed	0			
		Rimicaris	various sources				593			
						alive	7		Enoshima	
						frozen total	586			
						frozen(Feb15)	550			
						frozen (Feb ?)	36			

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
16.Feb.06	#933	Water (WHAT)	25˚19.2209'S, 70˚2.3917'E	2442m	30-37˚C	933WW-1	150ml	Chem	Toki (U.Tokyo)	#23 Monju chimney: hydrothermal fluid under gastropods community
			25˚19.2209'S, 70˚2.3917'E	2442m	30-80 ˚C	933WW-2	150ml	Chem	Toki (U.Tokyo)	#23 Monju chimney: mixing water in gastropods community
		Water (Bag)	25˚19.2209'S, 70˚2.3917'E	2442m		933 BW		Chem CLT,DNA	Toki (U.Tokyo) Takai(JAMSTEC)	#23 Monju chimney: mixing water in gastropods community
		Rock	25˚19.2072'S, 70˚2.4159'E	2435m		933R1			Kitada(Enoshima)	dead chimney with animal community
			25˚19.2108'S, 70˚2.4127'E	2434m		933R2			Kitada(Enoshima)	dead chimney with animal community
			25˚19.2094'S, 70˚2.3917'E	2442m		933R3		CLT, DNA	Takai(JAMSTEC) Awaji (U. Tokyo) Chiba(Okayama U.)	#47 chimney
		animals	see onboard results							

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution	Remarks
16.Feb.06	#933	Alviniconcha	25°19.2209'S, 70°2.4062'E	2422m			185			
						alvie	30		Enoshima	
						frozen total	150			
						frozen (Feb16)	150		100 Nakagawa(JAMSTEC), 50 Suzuki(AIST)	
						6K team	5			
		Austinogaea	25°19.2209'S, 70°2.4062'E	2422m			60			
						frozen total	60			
						frozen (Feb16)	60			
		Bathymodiolu					2			
						alvie	2		Enoshima	
						frozen total	0			
						frozen (Feb16)	0			
		Rimicaris	25°19.2209'S, 70°2.4062'E	2422m			72			
						alive	16		Enoshima	
						frozen total	46			
						frozen (Feb16)	46			
						frozen (Feb?)	10			
		Crysomallon	25°19.2209'S, 70°2.4062'E	2422m			120			
						alive	35		Enoshima	
						frozen total	80			
						frozen (Feb 16)	55		30 Suzuki(AIST), 25 Nakagawa (JAMSTEC)	
						13C uptake	25			
						6K team	5			

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
		Water		2421m	30-37˚C	934WW-1	150ml	Chem	Toki (U.Tokyo)	#23 Monju chimney mixing water in gastropods
17.Feb.06	#934	(WHAT)	25˚19.2246'S, 70˚2.4079'E							community
								DNA, CLT	Takai (JAMSTEC)	
				2442m	30-80 ˚C	934WW-2	150ml	Chem	Toki (U.Tokyo)	#23 Monju chimney mixing water in gastropods
			25˚19.2246'S, 70˚2.4079'E							community
			25˚19.2274'S, 70˚2.3672'E	2451m	<300˚C	934WW-3	150ml	Chem	Toki (U.Tokyo)	Kali chimney
			25˚19.2274'S, 70˚2.3672'E	2451m	<300˚C	934WW-4	150ml	Chem	Toki (U.Tokyo)	Kali chimney: under bulb was opened accidentally
								DNA, CLT	Takai (JAMSTEC)	
		Water (Bag)	25˚19.2274'S, 70˚2.3672'E	2451m		934 BW		Chem	Toki (U.Tokyo)	Kali chimney: Bag was melted
		Rock	25˚19.2246'S, 70˚2.4079'E	2442m		934R1			Kitada(Enoshima)	#23 Monju chimney: Dead chimney with barnacle
			25˚19.2274'S, 70˚2.3672'E	2451m		934R2		DNA, CLT	Takai (JAMSTEC)	Kali chmimney: grown after #928
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
		ISCS	25˚19.2246'S, 70˚2.4079'E	2442m		934 ISCS1		DNA, CLT	Takai (JAMSTEC)	#23 Monju chimney: deployed at #928
			25˚19.2274'S, 70˚2.3672'E	2451m		934 ISCS2		DNA, CLT	Takai (JAMSTEC)	Kali cnimney : deployed at #928

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution	Remarks
17.Feb.06	#934	Alviniconcha	25˚19.2246'S, 70˚2.4079'E	2421m			1			
						alvie	0			
						frozen total	1			
						frozen (Feb)				
		Austinogaea	25˚19.2246'S, 70˚2.4079'E	2421m			1			
						alvie	1		Enoshima	
						frozen total	0			
		Neolepas	25˚19.2246'S, 70˚2.4079'E	2421m			20			
						alvie	12		Enoshima	
						frozen total	5			
						frozen (Feb				
						dissected	3			
		Rimicaris	25˚19.2200'S, 70˚2.4066'E	2420m			4			
						alive	4		Enoshima	
						frozen total	0			
						frozen (Feb)				
		Crysomallon	25˚19.2246'S, 70˚2.4079'E	2441m			1			
						alive?	1		Enoshima	
						frozen total	0			
						frozen (Feb)				

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
19.Feb.06	#935	Water	23˚52.667'S, 69˚35.778'E	3289m	<210˚C	935WW-1	150ml	Chem	Toki (U.Tokyo)	#29 Bouzu chimney
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.667'S, 69˚35.778'E	3289m	<210˚C	935WW-2	150ml	Chem	Toki (U.Tokyo)	#29 Bouzu chimney
			23˚52.67'S, 69˚35.816'E	3278m	<372˚C	935WW-3	150ml	Chem	Toki (U.Tokyo)	#21 Nura2 chimney
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.67'S, 69˚35.816'E	3278m	<372˚C	935WW-4	150ml	Chem	Toki (U.Tokyo)	#21 Nura2 chimney
		Water (Bag)	23˚52.6776'S, 69˚35.8031'E	3275m		935 BW		Chem	Toki (U.Tokyo)	#21 Nura1 chimney
								CLT,DNA	Takai(JAMSTEC)	
		Niskin	23˚52.7437'S, 69˚35.8613'E	3329m		935NW		Chem	Toki (U.Tokyo)	ambient deep-sea seawater
		Rock	23˚52.67'S, 69˚35.816'E	3278m		935R1		CLT, DNA	Takai(JAMSTEC)	#21 Nura1 chimney: 0 age
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			23˚52.667'S, 69˚35.778'E	3289m		935R2			Takai(JAMSTEC)	#29 Bouzu chimney
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
			23˚52.67'S, 69˚35.816'E	3278m		935R3		CLT, DNA	Takai(JAMSTEC)	#21 Nura2 chimney
									Awaji (U. Tokyo)	
									Chiba(Okayama U.)	
		ISCS	23˚52.667'S, 69˚35.778'E	3289m		935ISCS		CLT, DNA	Takai(JAMSTEC)	#21 Nura1 chimney: deployed at #930
		Sediments	23˚52.7397'S, 69˚35.8220'E	3321m		935MS	30cm	CLT, DNA	Takai(JAMSTEC)	
							30cm		Awaji (U. Tokyo)	
		animals	refer to on board results							

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
20.Feb.06	#936	Water	25˚19.2159'S, 70˚2.3942'E	2443m	av. 200˚C	936WW-1	150ml	Chem	Toki (U.Tokyo)	#30 (#47) Daikoku chimeny
								DNA, CLT	Takai (JAMSTEC)	
			25˚19.2159'S, 70˚2.3942'E	2443m	av. 200˚C	936WW-2	150ml	Chem	Toki (U.Tokyo)	#30 (#47) Daikoku chimeny
			25˚19.2181'S, 70˚2.4024'E	2432m	160-170˚C	936WW-3	150ml	Chem	Toki (U.Tokyo)	#28 Bishamon chimney
			25˚19.2181'S, 70˚2.4024'E	2432m	av.160˚C	936WW-4	150ml	Chem	Toki (U.Tokyo)	#28 Bishamon chimney
								DNA, CLT	Takai (JAMSTEC)	
		Water (Bag)	25˚19.2285'S, 70˚2.4036'E	2422m		936BW		Chem	Toki (U.Tokyo)	#23 Monju chimney: mixing water above gastropods
								DNA, CLT	Takai (JAMSTEC)	
		Rock	25˚19.2274'S, 70˚2.3714'E	2454m		936R1			Awaji (U. Tokyo)	Dead chimney (whitish)
			25˚19.2350'S, 70˚2.3543'E	2466m		936R2			Awaji (U. Tokyo)	Dead chimney (whitish)
			25˚19.2181'S, 70˚2.4024'E	2432m		936R3			Awaji (U. Tokyo)	#28 Bishamon dead chimney (small piece)
			25˚19.2181'S, 70˚2.4024'E	2432m		936R4			Takai (JAMSTEC)	#28 Bishamon dead chimney (large piece)

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution	Remarks
20.Feb.06	#936	Alviniconcha	25°19.2285'S, 70°2.4036'E	2422m			185			
						alvie	30		Enoshima	
						frozen total	150			
						frozen (Feb16)	150			
						6K team	5			
		Austinogaea	25°19.2285'S, 70°2.4036'E	2422m			60			
						frozen total	60			
						frozen (Feb16)	60			
		Bathymodiolu	25°19.2285'S, 70°2.4036'E				2			
						alvie	2		Enoshima	
						frozen total	0			
						frozen (Feb16)	0			
		Rimicaris	25°19.2285'S, 70°2.4036'E	2422m			72			
						alive	16		Enoshima	
						frozen total	46			
						frozen (Feb16)	46			
						frozen (Feb?)	10			
		Crysomallon	25°19.2285'S, 70°2.4036'E	2422m			120			
						alive	35		Enoshima	
						frozen total	80			
						frozen (Feb 16)	55		30 Suzuki(AIST), 25 Nakagawa (JAMSTEC)	
						13C uptake	25			
						6K team	5			

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Sample Category	Position	Depth	Temp.	Sample description	Volume	Investigation	Distribution	Remarks
21.Feb.06	#937	Water	23˚52.6662'S, 69˚35.7980'E	3273m	15-23 (av.17-18)˚C	937WW-1	150ml	Chem	Toki (U.Tokyo)	#24 above gastropods
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.6662'S, 69˚35.7980'E	3273m	15-23 (av.17-18)˚C	937WW-2	150ml	Chem	Toki (U.Tokyo)	#24 above gastropods
			23˚52.6711'S, 69˚35.8041'E	3273m	11-18 (av.17-18)˚C	937WW-3	150ml	Chem	Toki (U.Tokyo)	#31 above shrimps
								CLT,DNA	Takai(JAMSTEC)	
			23˚52.6711'S, 69˚35.8041'E	3273m	11-18 (av.17-18)˚C	937WW-4	150ml	Chem	Toki (U.Tokyo)	#31 above shrimps
		Water (Bag)	23˚52.6662'S, 69˚35.7980'E	3273m		937 BW		Chem	Toki (U.Tokyo)	#24 above gastropods
								CLT,DNA	Takai(JAMSTEC)	
		Rock	23˚52.6711'S, 69˚35.8041'E	3273m		937R1		CLT, DNA	Takai(JAMSTEC)	#31 chimney
									Awaji (U. Tokyo)	

YK05-16 Leg-2 sample list & distribution

Date	Dive NO.	Organism	Position	Depth	Temp.	Sample description	n	Investigation	Distribution	Remarks
21.Feb.06	#937	Alviniconcha	23°52.6662'S, 69°35.7980'E	3273m			6		6K team	
		Austinogaea	23°52.6662'S, 69°35.7980'E	3273m						
						fixed	1		Enoshima	
		Rimicaris	23°52.6662'S, 69°35.7980'E	3273m						
						alive	2		Enoshima	
						frozen total	6			
						frozen(Feb21)	6			

Rock Sample Sheet

Cruise: YK05-16 Leg2
Area: CIR_Kairei Hydrothermal Field

Sample No.	6K#928-R01	Date	07 Feb, 2006
Sampling information		Time	11:21:00
Position(X:NS,Y:EW)	X:_ Y:_	Depth	2495 m
Position(Lat, Lon)	25°19.2971'S 70° 2.3686'E		
mode of occurrence	float		
Rock name	Pl-basalt		
Phenocrysts/Primary min	Pl		
Mn coating (max)	5 mm		
Size (l x m x s)	16 x 13 x 10 cm		
Weathering	(C, VH, H, M, S, F)		
Alteration	(C, VH, H, M, S, F) /		
Weight	3.1 kg		

Note
- highly Pl phyric

Described by Kentaron
Date of drawing 07 Feb 2006
Date of revision

Rock Sample Sheet

Cruise: YK05-16 Leg2
Area: CIR_Kairei Hydrothermal Field

Sample No.	6K#929-R1	Date	12 Feb, 2006
Sampling information		Time	11:13:00
Position(X:NS,Y:EW)	X: Y:	Depth	2462 m
Position(Lat, Lon)	25°19.1917'S 70°2.3857'E		
mode of occurrence	float		
Rock name	dead chimney		
Phenocrysts/Primary minera	—		
Mn coating (max)	— mm		
Size (l x m x s)	26 x 20 x 10 cm		
Weathering	(C, VH, H, M, S, F)/		
Alteration	(C, VH, H, M, S, F)/		
Weight	8.0 kg		

Note

Described by Kentaron
Date of drawing 12 Feb 2006
Date of revision

Rock Sample Sheet

Cruise: YK05-16 Leg2
Area: CIR_Kairei Hydrothermal Field

Sample No.	6K#929- R2	Date	12 Feb, 2006
Sampling information		Time	11:13:00
Position(X:NS,Y:EW)	X:_ Y:_	Depth	2462 m
Position(Lat, Lon)	25°19.1917'S 70°2.3857'E		
mode of occurrence	float		
Rock name	dead chimney		
Phenocrysts/Primary minera	—		
Mn coating (max)	— mm		
Size (l x m x s)	12 x 9 x 7 cm		
Weathering	(C, VH, H, M, S, F) /		
Alteration	(C, VH, H, M, S, F) /		
Weight	1.0 kg		

Note

Described by Kentaron
Date of drawing 12 Feb 2006
Date of revision

Rock Sample Sheet

Cruise: YK05-16 Leg2
Area: CIR_Edmond Hydrothermal Field

Sample No.	6K#931- R2	Date	14 Feb, 2006
Sampling information		Time	
Position(X:NS,Y:EW)	X:_ Y:_	Depth	3293 m
Position(Lat, Lon)	23°52.6772'S 69°31.1847'E		
mode of occurrence			
Rock name	dead chimney		
Phenocrysts/Primary min			
Mn coating (max)	mm		
Size (l x m x s)	30 x 28 x 20 cm		
Weathering	(C, VH, H, M, S, F) H		
Alteration	(C, VH, H, M, S, F) H		
Weight	~~20~~ 15 kg		
Note			

Described by Kentaron
Date of drawing 14 Feb 2006
Date of revision

Rock Sample Sheet

Cruise: YK05-16 Leg2
Area: CIR_Kairei Hydrothermal Field

Sample No.	6K#936- R 1	Date	20 Feb, 2006
Sampling information		Time	
Position(X:NS,Y:EW)	X:_ Y:_	Depth	2454 m
Position(Lat, Lon)	25° 19.2274′ S 70° 2.3750′ E		
mode of occurrence	on outcrop ?		
Rock name	dead chimney		
Phenocrysts/Primary minera			
Mn coating (max)	mm		
Size (l x m x s)	8 x 3 x 4 cm		
Weathering	(C, VH, H, M, S, F)___		
Alteration	(C, VH, H, M, S, F)___		
Weight	0.~~4~~2 kg		

Note

Described by Kentaron
Date of drawing 20 Feb 2006
Date of revision_____

Rock Sample Sheet

Cruise: YK05-16 Leg2
Area: CIR_Kairei Hydrothermal Field

Sample No.	6K#936- R2	Date	20 Feb, 2006
Sampling information		Time	
Position(X:NS,Y:EW)	X:_ Y:_	Depth	2466 m
Position(Lat, Lon)	25° 19.2350′ S 70° 2.3543′ E		
mode of occurrence	on outcrop ?		
Rock name	dead Chimney		
Phenocrysts/Primary minera			
Mn coating (max)	mm		
Size (l x m x s)	30 x 18 x 16 cm		
Weathering	(C, VH, H, M, S, F)___		
Alteration	(C, VH, H, M, S, F)___		
Weight	8.5 kg		

Note

Described by Kentaron
Date of drawing 20 Feb 2006
Date of revision_____