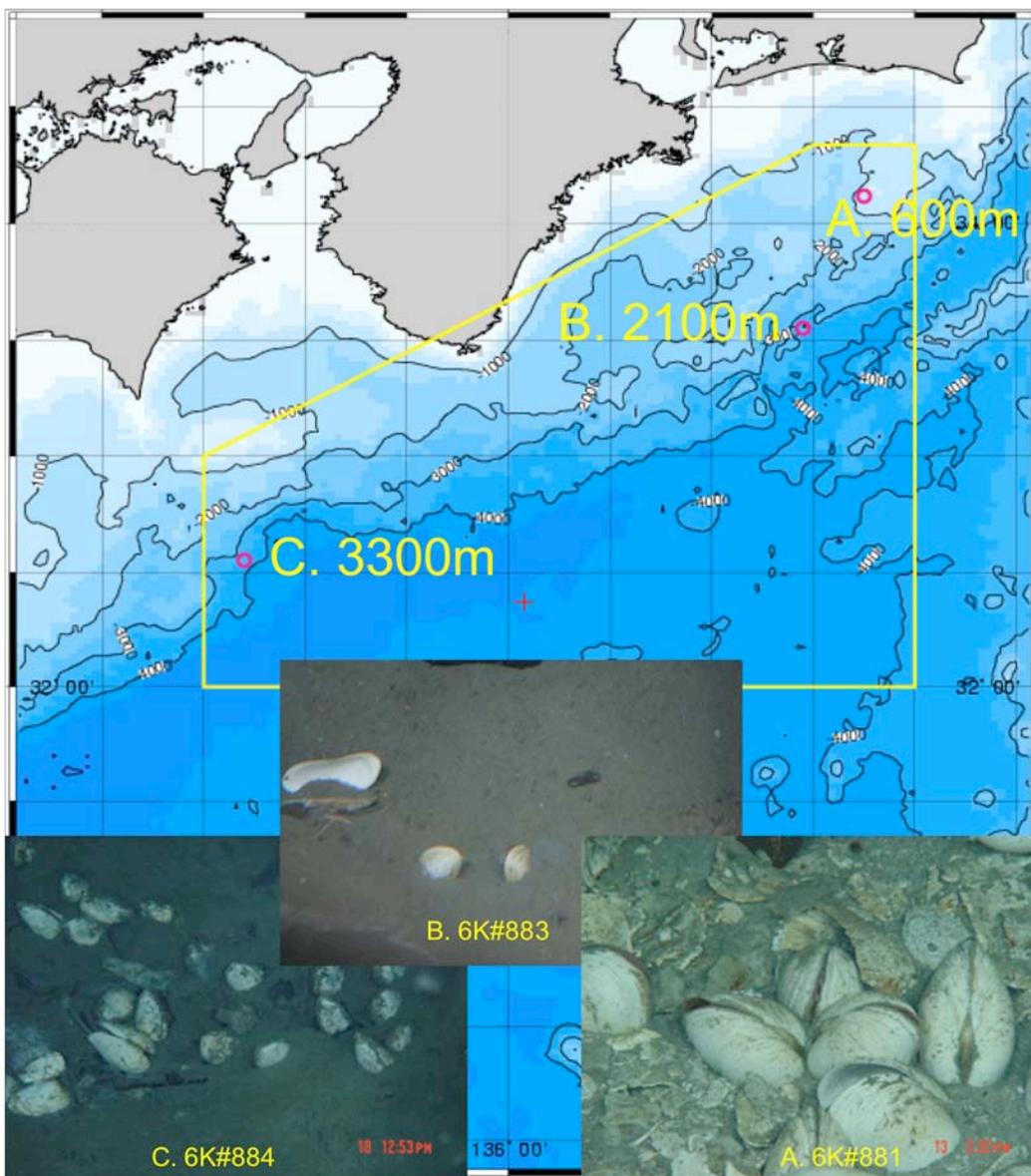


Comparative Genome Analysis of the *Calyptogena* Symbionts from Different Depths and Study for Biological Diversity in Their Environments in Nankai Trough

-Nankai Bio-Symbiont Cruise (NaBiSC)-

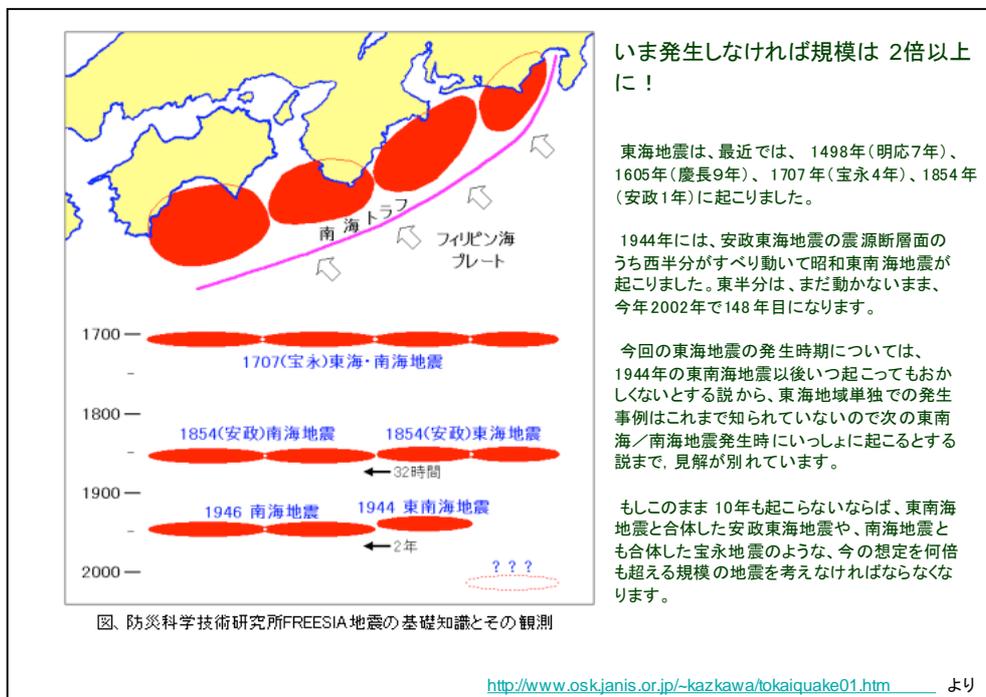


**On Board Report
June 10 (JAMSTEC) - 19 (Wakayama), 2005**

By YK0508 Cruise, Leg. 1, On Board Scientists

Preface

Nankai Trough is one of most active plate boundary regions, and there are expecting to get next huge earthquake caused by the plate tectonics as you can see the following URL.



There are cycling to get huge earthquake in 100~150 years at those areas, and Tokai-earthquake is still not happened for about 150 years as shown in above URL indicated as “???”. Thus, JAMSTEC is interested to survey those areas, and many of geological studies have been performing now. Actually, the first target area of the integrated ocean drilling program (IODP) has been decided in Nankai trough using the new drilling ship “CHIKYU”. The purpose of the drilling investigation could be not only for studying the plate movement prospect, but also for investigation of the methane hydrate, that is one of typical chemical compounds in the ocean subsurface, produced by the microbial communities in the cold seep environments, possibly. Methanogenic archaea would be the key microorganisms to produce amount of methane from carbon dioxide and hydrogen (Koga Y, 1988, Book “Archaeobacteria”, UP Biology Series 73, Tokyo Univ. Press) in the subsurface environment. Additionally, the chemoautotrophic animal communities have been also identified on the surface of those cold seep environments (Kulm LD, et al. 1986, Oregon subduction zone: Venting, fauna, and carbonates. Science, 231, 561-566), and methanotrophic and/or thiotrophic symbiosis systems must be very important to keep such communities. But it is so difficult to culture such microbes in the laboratory, because most of them could be on uncultivable stage. Thus, microbiological investigation in the plate boundary region is not enough studied until now.

We had proposed the investigation for biological diversity and functions in Nankai Trough area at different depths to discover more understanding the biological relations between chemoautotrophic animals and symbiotic bacteria. Fortunately we have succeeded to get a chance to take several samples, because of my colleagues' efforts. We also succeeded to organize the nice scientific party involving

Microbiologists, Marine Biologists, Chemists, and collaboration with Geologists, for the Nankai Trough Investigation Cruise. In this cruise report, I would like to involve the preliminary studies of each diving investigation, cruise conclusion, and the future plan. We hope to keep a good relation in the party, and get more publications and impact results.

Finally we would like to emphasize special thanks for the *Shinkai 6500* operation team, Mr. Y. Imai and coworkers, and the crew of the R/V *Yokosuka* for helping the deep-sea investigation in the NaBiSC cruise. We also thanks for my collaborators and colleagues of the Research Program of Marine Biology and Ecology, XBR, JAMSTEC. Except those cooperation, we cannot get any integrated science anymore, so we promise to give them our better scientific contributions in the future.

Thank you very much,

YK0508-NaBiSC Cruise Chair



Chiaki KATO



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1. SHINKAI6500 / YOKOSUKA YK0508-NaBiSC Cruise

Science Party

Chief Scientist

Dr. Chiaki KATO

Shinkai Operation Manager

Yokosuka Captain

Mr. Yoshiji IMAI

Mr. Sadao ISHIDA

Associate Chief Scientists

Dr. Takako SATO

Prof. Jing ZHANG

(Not on boarding)

Cruise Adviser

Prof. Takashi OKUTANI

On Board Scientists

Dr. Yoshihiro FUJIWARA

Dr. Yuichi NOGI

Dr. Satoshi KONISHI

Dr. Koji MORI

Ms. Shizuka ARAKAWA

Ms. Rumi SATO

Ms. Miki HANAZONO

Welcome Foreign Collaborators

Prof. Sang-Jin KIM

Prof. Jiasong FANG

Prof. Canganella FRANCESCO

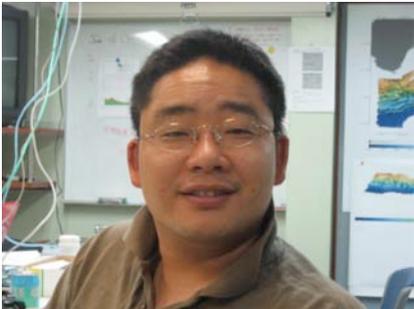
Ms. Giovanna BIANCONI

Thanks for Supporting

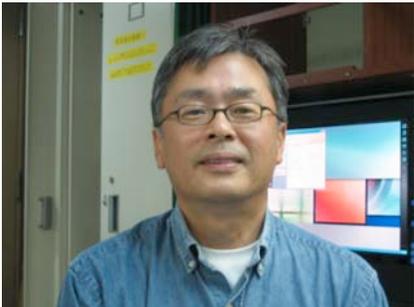
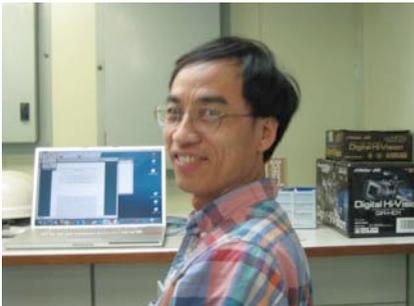
Mr. Mamoru SANO

Participants List (includes the collaborators who were not on board)

On Board Scientific Group

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	<p>Prof. Jiasong FANG, Geochemistry Iowa State University</p>
	<p>Prof. Francesco CANGANELLA, Microbiology, Thermophiles University of Tuscia, Department of Agrobiolgy and Agrochemistry</p>
	<p>Ms. Giovanna BIANCONI, Microbiology, Scientific diver University of Tuscia, Department of Agrobiolgy and Agrochemistry</p>



Mr. Mamoru SANO, Cruise assistant
Department of Marine Science
Nippon Marine Enterprises, Ltd.
c/o JAMSTEC

+++++

Collaborators (NOT ON BOARDING)

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Extremobiosphere Research Center
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Prof. Kaoru NAKASONE, Molecular Biology, Genome Biology
Department of Biotechnology and Chemistry
School of Engineering, Kinki University

Prof. Hideyuki TAMEGAI, Microbiology, Molecular Physiology
Department of Chemistry, College of Humanities and Sciences, Nihon University

Dr. Hiroshi MIYAKE, Marine Biology, Breeding Marine Invertebrate
Shin-Enoshima Aqua Museum

Dr. Kazuyo MATSUYAMA, Marine Algology, Genome Size Measurement
Visiting Researcher of JAMSTEC

Prof. Shigeru YAMANAKA, Microbiology
Shinshu University

Prof. Yujiro OGAWA, Geology, Leg. 2 chair
University of Tsukuba

Dr. Kiichiro KAWAMURA, Geology, Leg. 2 co-chair
Fukada Geo CTD

2. Cruise Objectives

The purpose of the NaBiSC investigation is as follows;

- Analysis of high-pressure adaptation strategy in deep-sea chemoautotrophic bivalves and their cell evolution mechanisms from symbiosis to organelle.
- Comparison of the microbial diversity in cold seep environments at different depths.
- Because Nankai trough is a special area where do exist the cold seep environments from 600 m to 5000 m depths at 6 to 50 MPa conditions.

Studies for comparative genome analysis of the symbiotic bacteria from different depths of *Calyptogena* would give us very important information about the adaptation to pressure environment and cell evolution in symbiosis systems. Nankai Trough is a very interesting area located on the accerationary prism structure at off Kumano and Muroto, and several *Calyptogena* communities at depths of 600~5000 m have been found by the past JAMSTEC investigation cruises at this area. Thus we proposed for diving studies at Nankai Trough to study the above purpose on last year, and fortunately our proposal got success in the FY2005 cruise plans. The particular objectives for the scientific party are as follows;

2.1. Microbiology

- 1) Comparison of the microbial diversity in the cold-seep sediments at different depths (S. Arakawa, T. Sato and C. Kato).
- 2) Cultivation studies under high-pressure conditions, for identification of novel piezophilic microorganisms (C. Kato, Y. Nogi, T. Sato and S. Arakawa).
- 3) Isolation of sulfur oxidized bacteria related with chemoautotrophic symbiotic bacteria (K. Mori and C. Kato).
- 4) Isolation of useful microorganisms from the cold-seep environments (S. J. Kim, Y. Nogi and C. Kato).

2.2. Biology

- 1) Taxonomy and biogeography of the chemosynthetic based animal community (T. Okutani and Y. Fujiwara).
- 2) Correlations between symbiotic bacteria and their host animals, and comparative genome analysis of symbiotic bacteria from different depths (T. Sato, Y. Fujiwara and C. Kato).
- 3) Cultivation and exhibition of the deep-sea animals at the aqua museum (H. Miyake, S. Konishi and T. Miwa).
- 4) Cellular biology study of deep-sea fishes using the DEEPAQUALIUM systems (S. Konishi and T. Miwa).

2.3. Chemistry

- 1) Chemical analysis (S, N, etc) of cold-seep sediments from different depths (R. Sato and J. Zhang).
- 2) Chemical analysis (S, N, etc) of different organs from *Calyptogena* clams (J. Zhang).

- 3) Chemical analysis of water samples from cold-seep environment (R. Sato and J. Zhang).
- 4) Fatty acids and biological marker analyses of the cold-seep sediments from different depths samples (J. Fang and C. Kato).

2.4. Others

- 1) Environmental metabolism analyses of the cold seep sediment samples (F. Canganella and G. Bianconi).
- 2) Metagenome analysis of the cold seep sediments (K. Nakasone, H. Tamegai, S. Arakawa and C. Kato).

3. Background

Microbial communities of the cold seep environments were not so well studied, because most of the typical microbes in the methane metabolisms and sulfur circulation were not be able to cultivate in the laboratory, called uncultivable microbes. Particularly symbiotic microbes in the chemoautotrophic invertebrates were very difficult to culture, however so many people have been trying in the world for last 20 years. Therefore it is so hard to develop to study metabolism and genome information in such environments.

Recently the new technology to analysis of the environmental microbial communities and structures has been discovered, called “environmental genome analysis” (ref?). In this technique, environmental DNA was recovered directly without cultivation process, and constructed several particular genome libraries, then the libraries were sequenced. Actually Dr. Craig Venter, called “(god)father of genome”, and his colleagues published an exiting article in Science issue on last year subjected “Sequencing of the Sargasso Sea” (Venter et al., 2004). He did mostly more than 1.6 Gbp DNA sequencing, and identified fuge groups of novel phylogenies in the Proteorhodopsin-like proteins, which could be functioned as main proteins of ancient photo biosynthesis pathway on the earth. He mentioned in this article, “We demonstrate here that shotgun sequencing provides a wealth of phylogenetic markers that can be used to assess the phylogenetic diversity of a sample with more power than conventional PCR-based rRNA studies allow.”, so we could agree his idea deeply. Thus we would like to sequence of the cold seep environments, too, and this idea should be considering for future plan. The back ground of the each field was explained as follows;

3.1. Geological setting of the Nankai Trough

Nankai Trough is focused on the study for earth quake activity, and is formed by the huge accretionary prism structure. Long standing geological survey had been found several cold seep environments, and large *Calymptogena* communities at different depths as you can see Fig. 3.1 (Kuramoto et al., 2001; Ashi et al., 2002). Still many of geological surveys could be on going, and the leg 2 of YK0508 cruise would be performed as geological investigations, too.

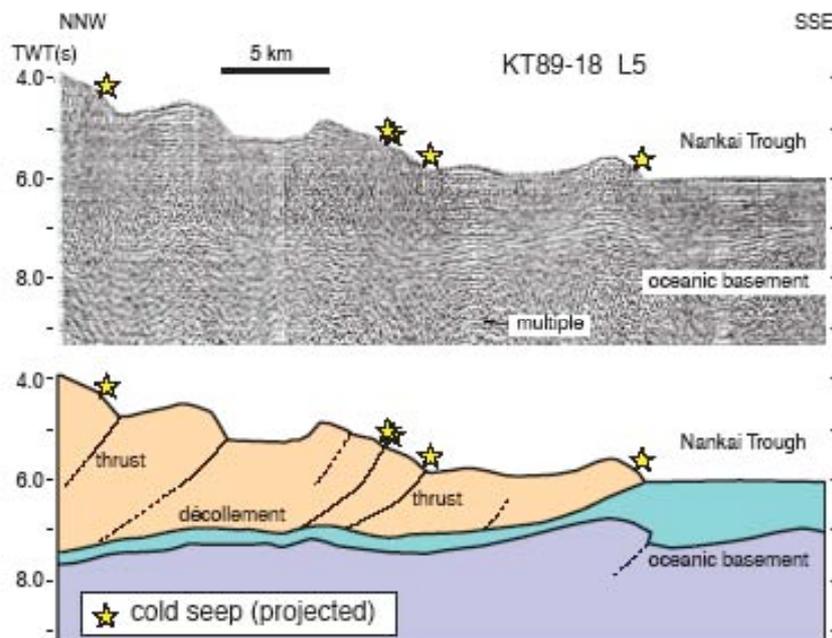


Fig. 3.1. Seismic reflection profiles at west of the diving survey transect (Yusuf, 1991). Distributions of the cold seeps are projected.

3.2 Distribution of the *Calyptogena* species at Nankai Trough

Kojima and his coworkers reported about geographic aspect of *Calyptogena* species in the world ocean (2004). Table 3.1 was indicated just *Calyptogena* species of Nankai Trough, picked up from the above paper, and you can see different species would be identified at different depths. The species distinction might be caused by pressure conditions at their environments, so these *Calyptogena* species could be good materials to study pressure adaptations. Otherwise, their symbiotic bacterial phylogeny indicated close relations between different host species as shown in Fig. 3.2 (Kojima et al., 2004; Fujiwara et al., 2003). This is also very exciting to consider the “cell evolution from symbiosis to organelle” by the comparative genome analysis of those symbiotic bacteria.

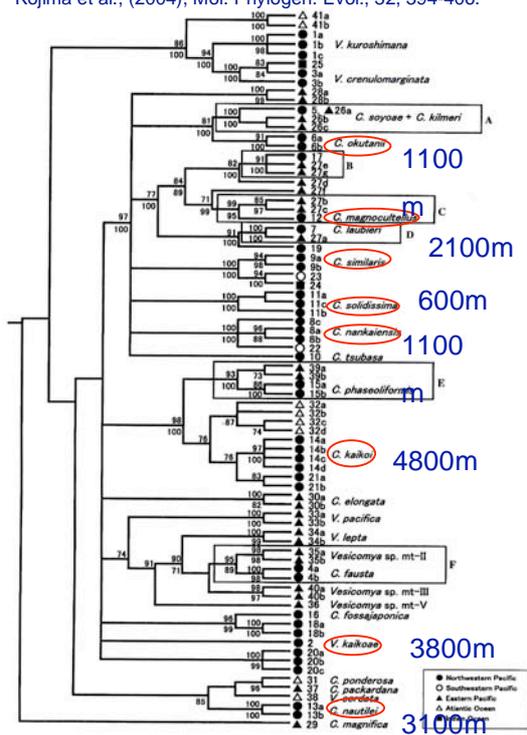
In this investigation, we would try to get sampling at different depths of *Calyptogena* species at Nankai Trough accretionary prism.

Table 3.1. *Calyptogena* species and their site information at Nankai Trough. Data from Kojima et al., 2004.

Sampling site	GPS position	Depth (m)	<i>Calyptogena</i> species
Tokai Thrust	34°06-07'N, 138°07-08'E	2100	<i>Calyptogena similis</i>
Yukie Ridge	33°50'N, 137°54-55'E	1900-2200	<i>C. fausta</i> , <i>C. similis</i> , <i>C. magnocultellus</i>
Third Tenryu Submarine Canyon	33°39'N, 137°55'E	3800	<i>C. laubieri</i> , <i>C. tsubasa</i> , <i>C. kaikoi</i>
Second Tenryu Knoll	34°04'N, 137°48'E	600*	<i>C. solidissima</i>
Ryuyo Submarine Canyon	34°12'N, 137°46'E	1100*	<i>C. okutanii</i> , <i>C. nankaiensis</i>
Tenryu Submarine Canyon	33°36-37'N, 137°32'E	3800	<i>C. laubieri</i> , <i>C. tsubasa</i>
First Kumano Knoll	33°43'N, 137°05'E	1900	<i>Calyptogena fausta</i>
Fourth Kumano Knoll	33°39'N, 136°38'E	2000	<i>Vesicomya crenulomarginata</i> , <i>C. similis</i>
Sixth Kumano Knoll	33°41'N, 136°34'E	2000	<i>V. crenulomarginata</i>
Off Kumano	33°16'N, 136°43'E	2100*	<i>C. similis</i> , <i>C. magnocultellus</i>
Off Kumano	33°08'N, 136°34'E	3100-3200*	<i>C. nautilei</i>
Off Kumano	33°07'N, 136°28'E	2500	<i>C. magnocultellus</i>
Off Muroto Point	32°21'N, 134°56'E	4600	<i>C. kaikoi</i>
Off Muroto Point	32°21'N, 134°51'E	4800*	<i>C. kaikoi</i>
Off Muroto Point	32°33'N, 134°42'E	3600-3800*	<i>V. kaikoe</i>
First Minami Muroto Knoll	32°21'N, 134°32'E	3600	<i>C. tsubasa</i> , <i>C. nautilei</i>

*Proposed diving sites.

Kojima et al., (2004), Mol. Phylogen. Evol., 32, 394-406.



Fujiwara, Y. (2003) Jap. J. Ventholgy, 58.

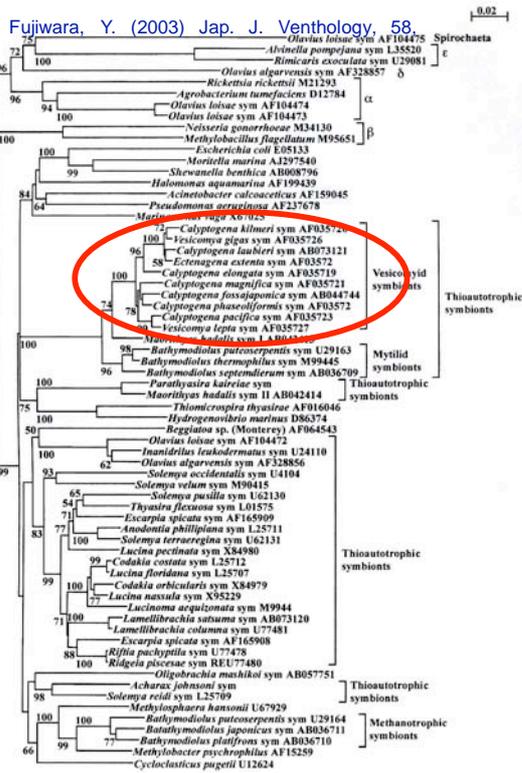


Fig. 3.2. Phylogenetic relations of host *Calyptogena* species (left, based on COI sequences) and their symbiotic bacteria (right, indicated by red circle, based on 16 rRNA gene sequences). *Calyptogena* species at our proposed depths are indicated as small red circle and water depths (m) on the left tree.

3.3. Microbial diversity in the cold seep environments

In the initial stage of the cold seep studies in our project, we have done the microbial diversity analyses of the seep sediments obtained from Nankai Trough (Li et al., 1999a), Japan trench (Li et al., 1999b; Inagaki et al., 2002), and north-east Japan Sea (Arakawa et al., 2004). The results suggested that there could be common microbial structures as shown in Fig. 3.3 (A), and ANME-2 / SRB (anoxic methane oxidizing archaea group2 / sulfate reducing bacteria) consortium and sulfide oxidation bacteria (symbiotic bacteria and/or bacterial mat) were key microbial communities to identify the cold seep environment (Kato and Arakawa, 2004). Additionally, we also identified a particular delta-proteobacterial phylogenetic group in the cold seep environments, called delta-proteobacterial group1, as indicated in Fig. 3.3 (B). This particular group of microbes can be as a marker to indicate the cold seep sediments.

In this investigation, we would like to compare the depth difference in microbial diversity at Nankai Trough cold seep environment, and look for depth differences.

4. Cruise Log

4.1. Survey Area and Map

Our study area were shown in Fig. 4.1, where located at 2nd Tenryu Knoll at 615 m (34°04.30'N, 137°47.34'E, NT06 site, dive No. 881, and 882), off Shiono Cape at 2,048 m (33°15.78'N, 136°42.99'E, NT20 site, dive No. 883), and off Muroto Cape at 3,310 m (32°34.97'N, 134°41.72'E, NT33 site, dive No. 884), in the Nankai Trough.

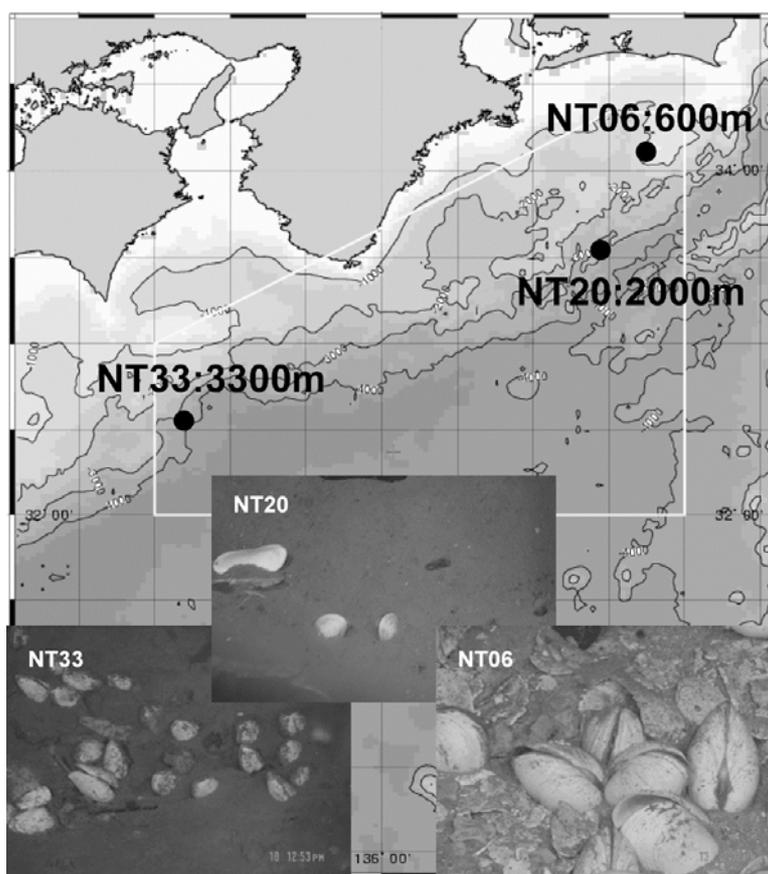


Fig. 4.1. Map of the sampling sites and their photographs in the cold-seep area at *Calyptogena* communities at different depths in the Nankai Trough. NT06: *Calyptogena* colony at a depth of 615 m, NT20: *Calyptogena* colony at a depth of 2,048 m, NT33: *Calyptogena* colony at a depth of 3,310 m, these sites are corresponding to the sampling sites shown in the photographs. The area in the white pentagon indicated the investigation area of the NaBiSC cruise.

4.2. Ship Log

Ship Log table of the NaBiSC were shown below.

Date / Time	Note	Weather/ Sea State/ Winds Dir. & Force
10.Jun.05	Noon Position; 35-34'N, 140-02'E Time Zone; UTC+9h	r / 2 / NE-4
09:00	Depart JAMSTEC for the research area Transit to off CHIBA	
10:00-10:30	Science Meeting in No.1 Laboratory	
11:00	Arrived at off CHIBA	
14:00-14:30	Guidance of ship's life for new participants in meeting room by chief officer and chief radio officer	
19:00-21:00	Science Meeting in No.1 Laboratory	
11.Jun.05	Noon Position; 35-07'N, 139-42'E Time Zone; UTC+9h	o / 7 / SSE-2
07:45	Transit to YKOSUKA Section 4	
09:40	Arrived at YKOSUKA Section 4	
10:00-10:30	Meeting with Shinkai6500 operation team in meeting room	
10:45	Transit to Nankai trough research area	
19:30-20:30	Science Meeting in No.1 Laboratory	
19:30	Arrived at research area Released XBT	
20:00-21:11	MNBES swath mapping survey	
22:17	MNBES swath mapping survey started	
12.Jun.05	Noon Position; 34-04'N, 137-47'E Time Zone; UTC+9h	c / 3 / WNW-4
07:10	MNBES swath mapping survey finished	
11:40	Suspended Shinkai6500 research dive due to rough sea	
17:30-18:00	Science Meeting in No.1 Laboratory	
13:40	MNBES swath mapping survey started	
13.Jun.05	Noon Position; 34-04'N, 137-47'E Time Zone; UTC+9h	bc / 2 / NNW-2
7:06	MNBES swath mapping survey finished (Dive#881)	
09:10	Swimmers standing by (Able seaman, Oiler, intern)	
09:59	Shinkai6500 opened vent, start test Dive#881	
10:32	Shinkai6500 on bottom (34-4.0032'N, 137-47.2171'E, D=652m)	
15:55	Shinkai6500 leave bottom (34-4.5962'N, 137-47.3491'E, D=606m)	
15:30	Swimmers standing by (Able seaman, 3E)	
16:11	Shinkai6500 on surface	
17:28-18:00	MNBES swath mapping survey	
1730:-20:30	Science Meeting in No.1 Laboratory	

14.Jun.05	Noon Position; 34-04'N, 137-47'E Time Zone; UTC+9h	bc / 4 / E-6
09:10	Swimmers standing by (Able seaman, Oiler, intern)	
09:59	Shinkai6500 opened vent, start test Dive#882	
10:32	Shinkai6500 on bottom (34-4.0032'N, 137-47.2171'E, D=652m)	
15:55	Shinkai6500 leave bottom (34-4.5692'N, 137-47.3491'E, D=606m)	
15:36	Swimmers standing by (Able seaman, 3E)	
16:20	Shinkai6499 on surface	
17:00	Transit to Dive#883 Released XBT MNBES swath mapping survey	
17:28-18:00	MNBES swath mapping survey	
19:30-18:00	Science Meeting in No.1 Laboratory	
15.Jun.05	Noon Position; 33-21'N, 137-00'E Time Zone; UTC+9h	r / 6 / NE-8
06:01	MNBES swath mapping survey finished	
06:01-06:39	MNBES swath mapping survey	
09:30	Suspended Shinkai6500 research dive due to rough sea	
10:00-10:30	Science Meeting in No.1 Laboratory	
19:00-19:30	Science Meeting in No.1 Laboratory	
16.Jun.05	Noon Position; 33-05'N, 131-12'E Time Zone; UTC+9h	r / 5 / SSW-7
10:00	Suspended Shinkai6500 research dive due to rough sea Transit to Dive#883 point	
10:30-11:00	Science Meeting in No.1 Laboratory	
19:30-20:00	Science Meeting in No.1 Laboratory	
17.Jun.05	Noon Position; 33-16'N, 136-43'E Time Zone; UTC+9h	o / 5 / E-2
07:30	Arrived at Dive#883 point	
09:13	Swimmers standing by (Able seaman, Oiler, intern)	
10:02	Shinkai6500 opened vent, start test Dive#883	
11:08	Shinkai6500 on bottom (33-15.8092'N, 136-42.9931'E, D=2,071m)	
15:45	Shinkai6500 leave bottom (33-15.7816'N, 136-43.0266'E, D=2,053m)	
16:07	Swimmers standing by (Able seaman, Assistant Oiler)	
16:32	Shinkai6500 on surface	
17:10	Transit to Dive#884 point	
19:30-20:30	Science Meeting in No.1 Laboratory	
18.Jun.05	Noon Position; 32-35'N, 134-42'E Time Zone; UTC+9h	o / 2 / ESE-2
07:30	Arrived at Dive#884 point	
09:13	Swimmers standing by (Able seaman, Oiler, intern)	
09:55	Shinkai6500 opened vent, start test Dive#883	
11:27	Shinkai6500 on bottom (32-35.0440'N, 134-41.7731'E, D=3,301m)	
15:58	Shinkai6500 leave bottom (32-35.1605'N, 134-41.5481'E, D=3,243m)	
16:45	Swimmers standing by (Able seaman, Assistant Oiler)	

17:07	Shinkai6500 on surface	
17:45	Transit to WAKAYAMA SHIMOTSU BAY	
19:30-20:30	Science Meeting in No.1 Laboratory	
21:00	Party for crew and scientist in officer's mess room	

Weather ; b (Blue sky), bc (Fine but Cloudy), c (Cloudy), o (Overcast), r (Rain)
Sea State ; 1 (Rippled Calm), 2 (Smooth), 3 (Slight), 4 (Moderate), 5 (Rough)
Wind Force; 0 (Calm), 1 (Light air), 2 (Light breeze), 3 (Gentle breeze; 3.4-5.4m/sec), 4 (Moderate breeze; 5.5-7.9m/sec), 5 (Fresh breeze; 8.0-10.7m/sec), 6 (Strong breeze; 10.8-13.8 m/sec), 7 (Near gale; 13.9-17.1 m/sec)



5. List of Dives and Payloads

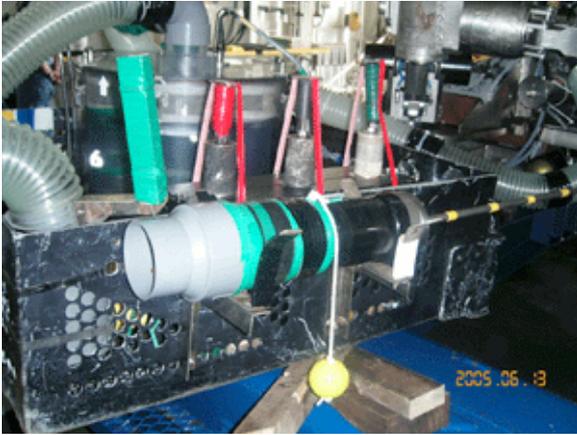
5. 1. List of the Dives on the NaBiSC

Dive #	Observer	Dive Purpose	Diving Point	Depth (m)	Payloads	Date
881	Yoishihiro Fujiwara (JAMSTEC)	Observation and collection of members of cold-seep community on the Daini Tenryu Knoll.	34°04.00'N 137°47.22'E	652	Suction sampler, Multi-camister, MBARI-type core samplers (3), Sterilized core samplers (3), Kumade sampler (s), Baited trap, Fish traps (2), SAHF	June 13, 05
882	Satoshi Konishi (JAMSTEC)	The capture of deep-sea fishes using the DEEP AQUARIUM system.	34°04.21'N 137°47.30'E	618	DEEP AQUARIUM system, Fish traps, MBARI, MT, Sterilized, Kumade, Baited trap, Sample box, NISKIN	June 14, 05
883	Takashi Okutani (JAMSTEC)	Biological sampling and observation of their life <i>in situ</i> . Collecting animals encountered en route.	33°15.81'N 136°42.99'E	2,071	Same as dive 881, + Big type sterilized core sampler, Bacterial mat bag sampler,	June 17, 05
884	Takako Sato (JAMSTEC)	Study of comparative genome analysis of the Calyptogena symbionts from different depth and biological diversity in their environments in Nankai Trough.	32°35.04'N 134°41.77'E	3,301	Same as above	June 18, 05

5.2. Payloads

Dive 881.

Right side



Left side



Dive 882.

Right side



Left side

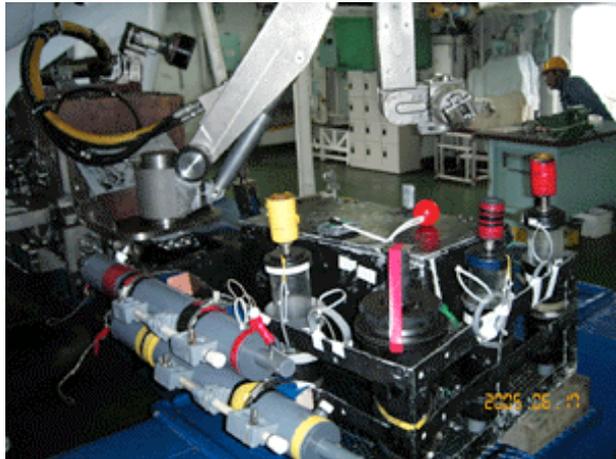


Dive 883.

Right side



Left side



Dive 884.

Right side



Left side



6. Dive Results and Descriptions

6.1. Dive 6K#881

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

DIVE NO.	881	DATE	05/06/13	
Main Purpose	Observation and collection of members of cold-seep community on the Daini Tenryu Knoll			
Dive Site	<i>Daini Tenryu Knoll</i>			
Landing	Latitude	Longitude	Time	Depth
	34°04.0032' N	137°47.2171' E	10:32	652 m
Lift-off	34°04.5692' N	137°47.3491' E	15:55	606 m
Payload	Suction sampler, Multi-canister, MBARI-type core samplers (3), Sterile core samplers (3), "Kumade" sampler (small), Baited trap, Fish trap (2), SAHF			
DIVE SUMMARY	<p>1) Sampling of benthos (<i>Calyptogena solidissima</i>, tubeworm and others) using "Kumade" sampler and suction sampler</p> <p>2) Sampling of cores (sterile and MBARI type)</p> <p>3) Heat flow measurement using SAHF</p> <p>4) Deployment of baited traps for fish and crustaceans</p>			
Key words	<i>Daini Tenryu Knoll</i> , <i>Calyptogena solidissima</i> , Vestimentiferan tubeworm, <i>Conchocele bisecta</i> , Thyasirid clam			
Sampling & marker points	<p>Site 1: Landing, sampling by MBARI corer (blue) and sterile corer (red), heat flow measurement, 34°04.0032'N, 137°47.2171'E, 652 m</p> <p>Site 2: Sampling of a tubeworm, deployment of fish & baited traps & #13 Marker, sampling of cores by MBARI corer (yellow) & sterile corer (black), heat flow measurement, sediment sampling by "Kumade" & suction sampler: 34°04.2980'N, 137°47.3420'E, 615 m</p> <p>Site 3: Sampling of tubeworms and sediment using "Kumade" sampler: 34°04.4834'N, 137°47.3405'E, 610 m</p> <p>Site 4: Sampling of cores by MBARI corer (red) & sterile corer (green), <i>Calyptogena solidissima</i>, sediment by "Kumade" sampler, deployment of a fish trap: 34°04.5074'N, 137°47.3140'E, 608 m</p>			

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 1

DIVE # 881

NAME: Yoshihiro FUJIWARA

1) Topography, Geology, Geophysics

Seafloor was covered by carbonate concretion at first landing point (Site 1). Small cracks and gaps were observed on bottom between Sites 1 and 2. A sedimentary stratum was relatively thin and there was hard layer (possibly concretion) underneath the sediment around clam bed. The sediment was primarily composed of fine silt and dead clamshells (from Sites 2 to 4).

2) Biology, Microbiology

A large number of small crinoids (~ 7 cm) were attached on the concretion at Site 1. Dense aggregations of dead clamshells (*Conchocelea bisecta* & *Calyptogena solidissima*) were observed between Sites 2 & 4. Several specimens of vestimentiferan tubeworms came out from siltstone outcrops between Sites 2 and 4 and one was collected at Site 2. Three specimens of limpet (~3 mm in diameter) were attached on the tube of the vestimentifera collected. Dense aggregations of the tubeworms were observed at Site 3. The worms fringed two gray-colored rocks (possibly carbonates). Most specimens were alive and were showing well-developed ctenidia. Several specimens were collected using manipulator. Six to ten specimens of live *C. solidissima* were discovered at Site 4. The clams were aggregated in a small patch (30 cm in diameter) and were surrounded by dead clamshells. Three specimens of *C. solidissima* were collected at this site. Single specimen of a small thyasirid clam (1 cm) and several pieces of gill and shell from *Conchocelea bisecta* were collected from Site 3 using suction sampler (bottle #2). Another type of thyasirid clam was collected with sediment by "Kumade" sampler but there was no information about the sites because of our repeated sampling of sediment.

Two baited traps (for fish and crustaceans) were deployed at Site 2 and one for fish at Site 4.

Three sets of cores (MBARI type & sterile) were collected at Site 1 (control) and Sites 2 & 4 (seep environment). Heat flow was measured using SAHF at the same sites.

3) Chemistry

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 2

DIVE # 881

NAME: Yoshihiro FUJIWARA

4) Ocean Physics

5) Engineering

A suction sampler and a multi-canister were installed on the *Shinkai 6500* and were operated successfully. Three bottles of multi-canister were used for biological sampling at Sites 2, 3 & 4. SAHF (Stand-Alone Heat Flow meter) was used at Sites 1, 2 & 4.

6) Other

Video High Light of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

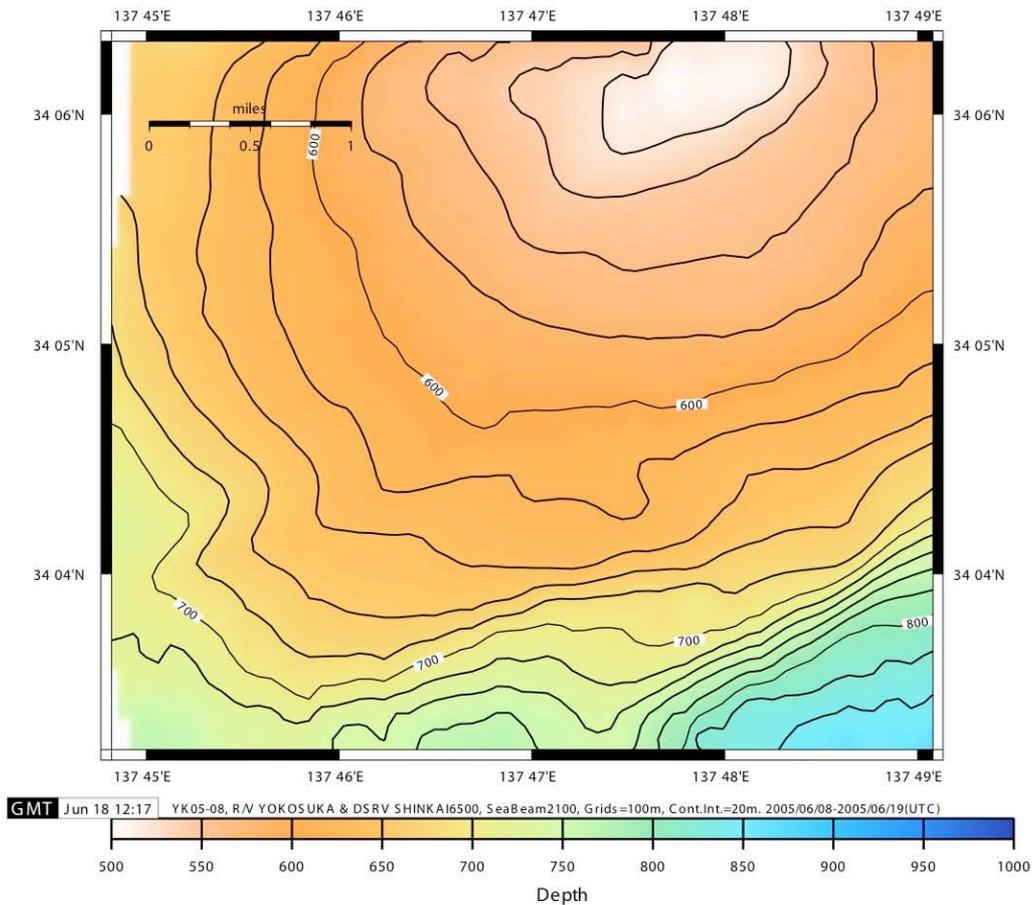
DIVE #881

NAME: Yoshihiro FUJIWARA

Video Time	Camera No.	Comments
1)	Site 1 (Landing point)	<p>10:30:20-10:30:35-Overview of landing point</p> <p>10:38:20-10:39:00-Core sampling using MBARI corer (blue)</p> <p>10:45:10-10:45:30-Heat flow measurement using SAHF</p> <p>11:00:10-11:00:30-Core sampling using sterile corer (red)</p> <p>11:02:22-11:02:42-Collecting sediment for "low contaminant" sample using manipulator</p> <p>11:03:20-11:03:30-Sediment collected in a receiver for sterile corer</p> <p>11:15:50-11:16:05-crack on bottom</p> <p>11:18:30-11:18:50-gap on bottom</p>
2)	Site 2 (several number of tubeworms and colored alteration)	<p>Over view</p> <p>11:36:50-11:37:00-Tubeworms</p> <p>12:18:46-12:19:10-Deployment of baited trap</p> <p>12:30:18-12:30:48-Core sampling using MBARI corer (yellow)</p> <p>12:31:14-12:31:29-Core sampling using MBARI corer (yellow)</p> <p>12:41:37-12:42:02-Heat flow measurement using SAHF</p> <p>12:44:40-12:44:50-Close-up view of SAHF</p> <p>12:56:58-12:57:15-Core sampling using sterile corer (black)</p> <p>13:10:50-13:11:10-"Kumade" sampling</p> <p>13:19:20-13:19:45-Suction sampling in bottle #1</p>
3)	Site 3 (dense aggregation of tubeworms)	<p>Over view</p> <p>13:47:50-13:48:25-Aggregation of tubeworms</p> <p>13:57:25-13:57:40-Close-up view of tubeworms</p> <p>13:58:37-13:59:22-Sampling of tubeworms</p> <p>14:06:50-14:07:15-"Kumade" sampling</p> <p>14:17:45-14:18:15-Suction sampling in bottle #2</p>
4)	Site 4 (live clam point)	<p>14:29:50-14:30:05-Over view of clam point</p> <p>14:28:55-14:29:15-Live clams (<i>Calypptogena solidissima</i>)</p> <p>14:36:30-14:36:45-Core sampling using MBARI core (red)</p> <p>14:37:08-14:37:18-Core sampling using MBARI core (red)</p> <p>14:55:25-14:55:45-Core sampling using sterile core (green)</p> <p>14:57:18-14:57:28-Core sampling using sterile core (green)</p> <p>15:04:22-15:04:44-"Kumade" sampling</p> <p>15:23:35-15:24:05-Deployment of fish trap</p>
5)	Dead clamshells	<p>15:46:25-15:46:45-extensive field of dead clamshells</p>

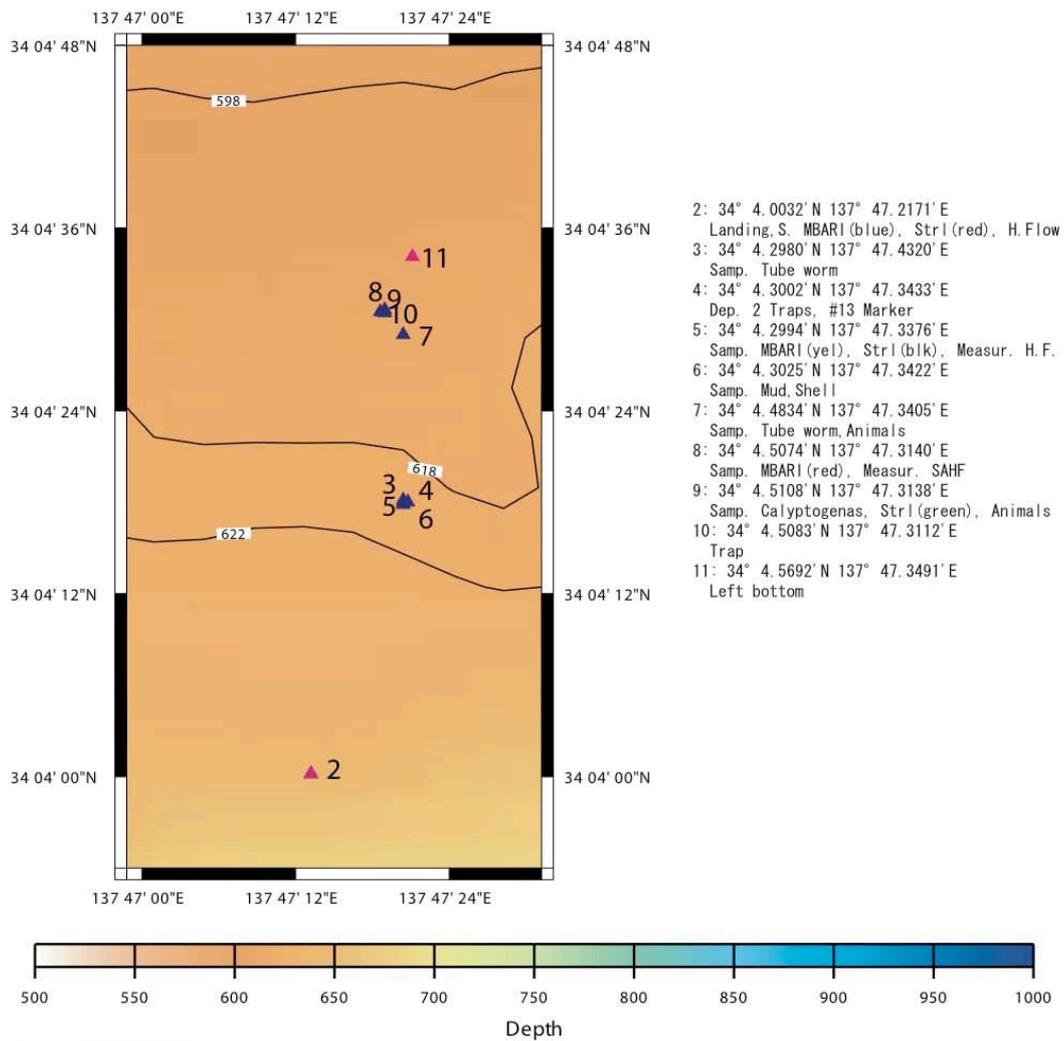
Site map of the diving points

YK05-08 Dive#881 and #882



Event markers of the diving survey

YK05-08 Dive#881



GMT Jun 16 12:54 YK05-08, R/V YOKOSUKA & DSRV SHINKAI6500, SeaBeam2100, Grids=100m, Cont.Int.=1m. 2005/06/08-2005/06/19(UTC)

Dive Log

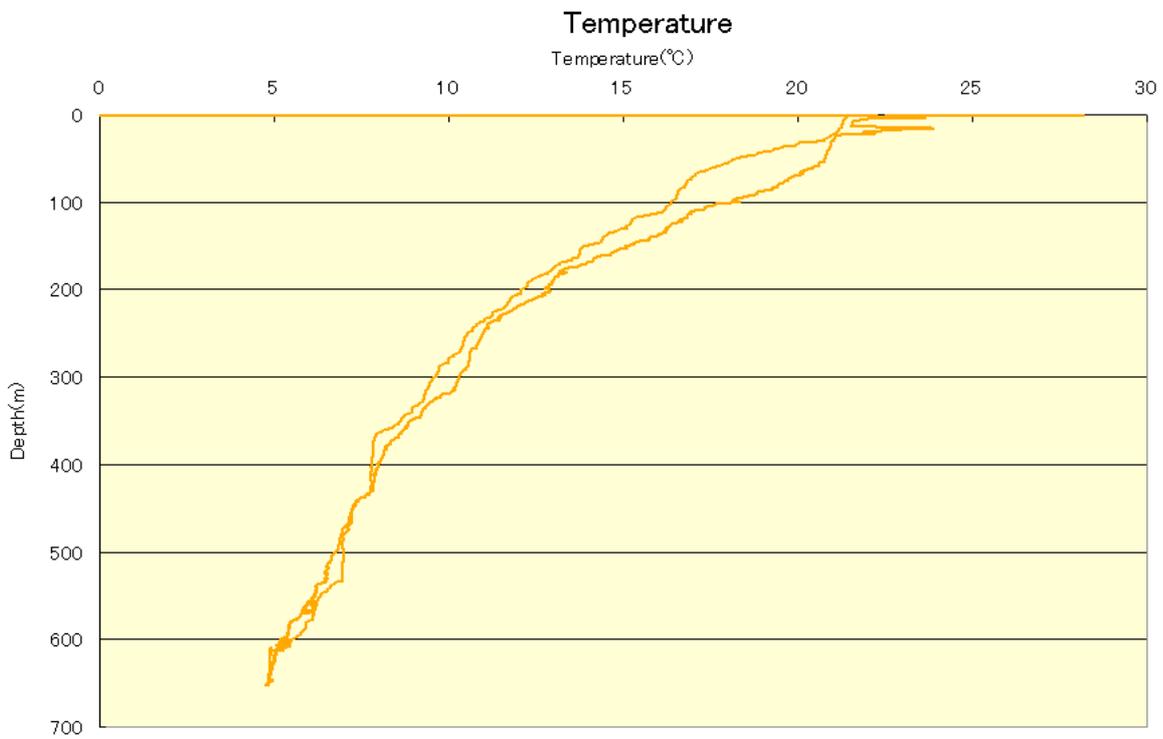
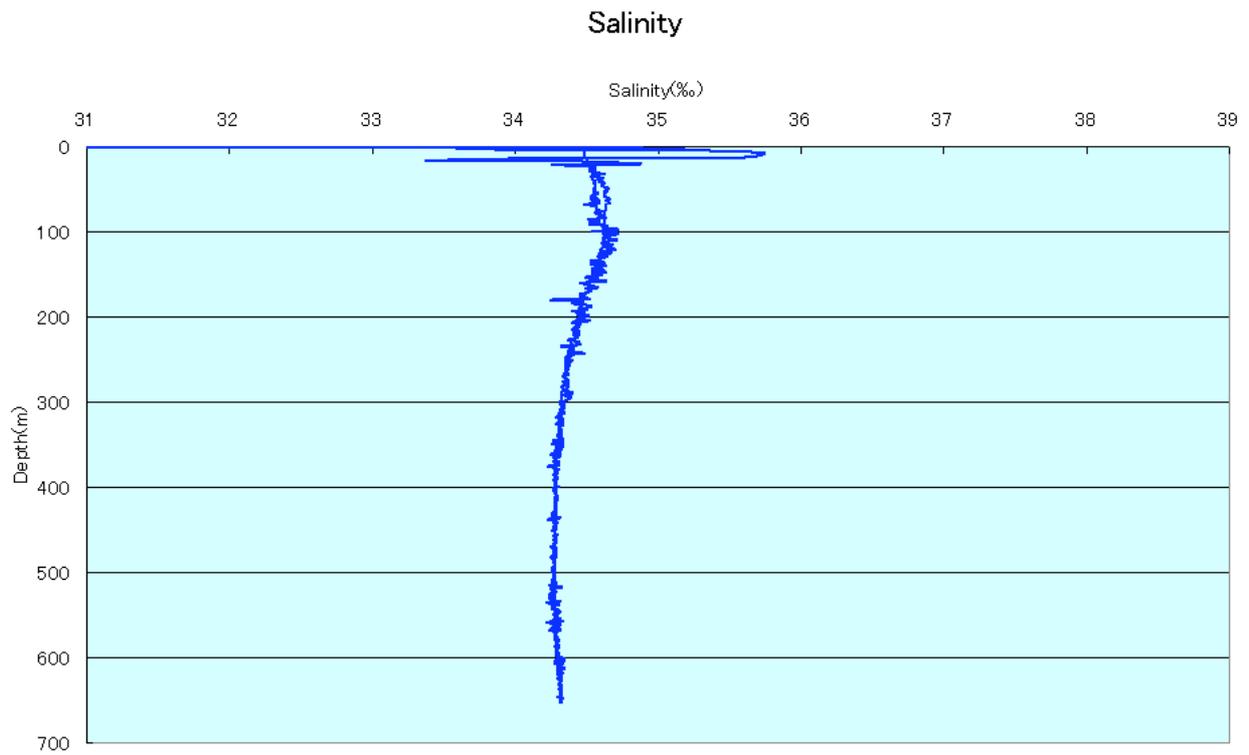
Dive#6K-881		Observer: Yoshihiro Fujiwara		Date: June,13 , 2005
Time	X, Y	Depth(m)	Event	Others
9:10			swimmer standby	
			shinkai at the surface	
9:56			vent open	
10:07	-1860,340			
		500	stop moving	
10:14	-1730,360	559	Co.=220	
10:18	-1730,366	554		
10:20	-1779,353	553	Trimming completed,海底へおりる	
10:26	-1779,353	630		
10:31	-1842,334	652	うみしだ	
10:34	-1841,340	653	Landing, mud, visibility=?, water temp.=4.8 degree C, current direction=140.	
10:36	-1842,335	653	urchin,star fish	
10:37	-1841,334	653	MBARI1 (blue) start--> control	
10:39	-1841,336	653	MBARI1(blue) finish--> 5 cm?	
10:41	-1841,336	653	sea cocumber?	
10:42	-1841,337	653	start SAHF1	
10:43	-1839,336	653	lobster?	
10:44-52	-1839,336	653	うみしだ	
10:45	-1838,334	653	re-start SAHF1	
10:55	-1949,336	653	snail?, fish?	
10:57		654	star fish or urchin?	
10:58			finish SAHF1	
10:59			watching sometiong	
11:00	-1841,336	654	start sterile core1(red) --> control	
11:03			rock?	
11:04	-1840,332	654	finish sterile core1 (red)	
11:07	-1840,330	654	Co.=11	
11:12	-1800,346	641	fish?	
11:16	-1744,331	636	fish?	
11:16	-1736,375	632	star fish	

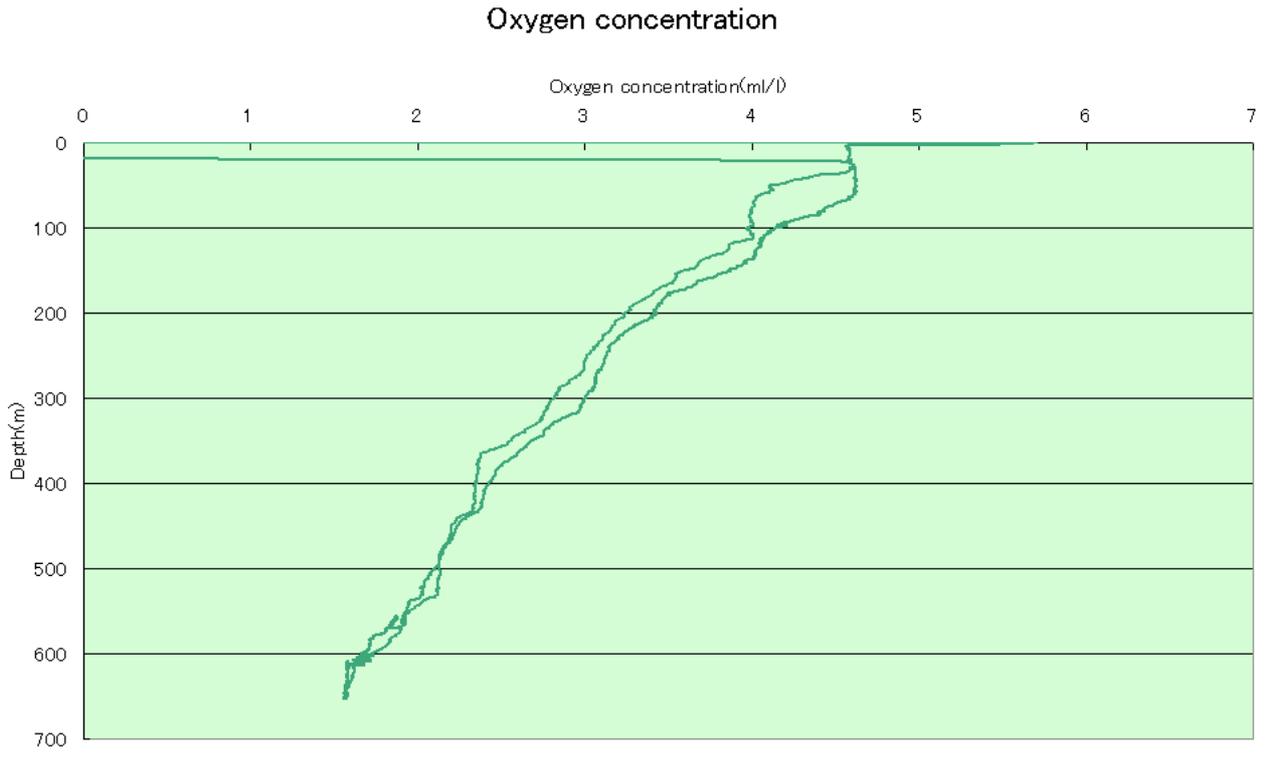
11:17	-1725,377	631	fish, star fish	
11:18	-1705,385	630	まつぼっくり?	
11:19	-1 6 6 6, 3 9 3	629	PET	
11:21	-1660,400	624	transit	
11:22	-1622,415	622	fish(shark?)	
11:27	-1460,477	618	stick?	
11:29	-1404,498	618	かさご	
11:30	-1390,500	616	transit	
11:31	-1360,515	616	snail, eel	
11:32	-1340,519	614	fish?	
11:32	-1342,522	614	eelpout	
11:36	-1303,529	614	ray、eel	
11:37	-1299,527	614	tube worm, calyptogena?	
11:41			fish(eel?)	
11:44			opened sample box	
11:53	-1253,520	614	tube worm sampling ,dropped this	
11:58	-1301,522	614	starfish	
12:02	-1301,524	614	this tube worm in sample box	
12:04	-1299,525	614	fish	
12:06	-1298,525	615	fish trap1 (with share) set	
12:11	-1294.519	616	fish comes to trap	
12:14	-1294,525	615	かさご	
12:15	-1 2 9 1, 5 2 7	615	finish setting trap	
12:17	-1291,527	615	setting marker (#13)	
12:18	-1294,528	615	setting baited trap	
12:21	-1300,521	616	star fish	
12:24	-1290,530	616	transit	
12:28	-1295,518	614	sampling something using KUMADE sampler	
12:30	-1294,518	615	start MBARI2(yellow)	
12:32?			finish MBARI2	
12:33	-1294,518	615	clams (calyptogena?)	
12:35	-1294,518	616	start SAHF2	
12:42			SAHF2 --> failed	
12:42			re-start SAHF2	
12:55			finish SAHF2	

12:56	-1290,520	616	start sterile core2 (black)	
13:00			finish sterile core2 (black)	
13:03?			sampling something using KUMADE sampler?	
13:08			getting something -->clams?	
13:18			finish sampling?	
13:19	-1291,526	615	sampling clam? --> multi canister (#1)	
13:24	-1289,527	615	finish sampling	Co.=302
13:28			moving	Co.=350
13:30	-1266,542	615		
13:35	-1196,534	614	crab,fish	
13:36	-1180,540	612		
13:37	-1129,551	611	fish	
13:41	-1060,570	612		
13:42	-1036,573	611	crab?	
13:45	-980,550	610		
13:46	-952,523	609	calyptogena colony,turbworm colony	
13:51	-955,526	610		
13:54	-955,525	610	starfish	
13:57	-958,524	610	getting many turbworms	
14:02	-954,522	610		
14:07	-954,522	610	sampling calyptogenas using KUMADE sampler	
14:11	-955,523	610	sampling calyptogenas using KUMADE sampler	
14:13	-957,523	610	sampling calyptogenas using KUMADE sampler	
14:18	-957.523	610	sampling calyptogenas --> multi canister (#2?)	
14:21	-960,520	610	moving	Co.=320
14:24	-948,511	610	eel	
			moving	Co.=310
14:27	-912,490	608	calyptogenas	
			find marker	
14:30	-910,482	608	aliving calyptogena colony	
14:35	-908,480	610	sampling MBRI core3 (red)	
14:40	-908,483	610		
14:41	-910,484	609	start SAHF3	
14:51	-909,484	609	crab	

14:53	-910,479	608	starfish	
14:53			finish SAHF3	
14:55	-911,478	609	sampling steile core3 (green)	
			eel	
15:04	-906,483	910	sampling aliving calyptogenas using KUMADE sampler	
15:05			sampling aliving calyptogenas using KUMADE sampler	
15:07			sampling aliving calyptogenas using KUMADE sampler	
15:10			sampling aliving calyptogenas using KUMADE sampler	
15:12			sampling aliving calyptogenas using KUMADE sampler	
15:16			sampling aliving calyptogenas using KUMADE sampler	
15:22	-907,479	608	sampling calyptogenas --> multi canister (#3?)	
15:24	-909,476	609	fish trap2 set	
15:25	-910,480	609	moving to north	
15:30	-893,492	607	eel	
			simmer standby	
15:31	-872,490	607	fish?	
15:33	-861,491	606	crabs	
15:39	-830,500	606	calyptogena colony	
15:42	-807,501	606	calyptogena colony	
			moving	Co.=65
			calyptogena colony	
15:46	-796,512	606	calyptogena large colony	
15:49	-785,539	606	octopus on calyptogena colony	
15:54	-796,354	606	left bottom	

CTDO profiles of the Dive 881





6.2. Dive 6K#882

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

DIVE NO.	882	DATE	05/06/14	
Main Purpose	The capture of deep-sea fishes using the DEEP AQUARIUM SYSTEM.			
Dive Site	Daini Tenryu Knoll			
Landing	Latitude	Longitude	Time	Depth
	34° 4.2096' N	137° 47.2999' E	10:28	618 m
Lift-off	34° 4.5131' N	137° 47.3025' E	16:03	607 m
Payload	DEEP AQUARIUM SYSTEM, Fish traps, MBARI-type core samplers, MT core sampler, Sterile core sampler, "Kumade" sampler, Baited trap, Sample Box, NISKIN			
DIVE SUMMARY	Capture of deep-sea fishes using DEEP AQUARIUM SYSTEM (which is piezo-stat capture system) was tried. <i>Conger sp.</i> was trapped in the fish trap which is settled yesterday (dive#881). <i>Eptatretus sp.</i> was trapped in the fish trap which is settled today. The direct vacuum method was not succeeded because of low vacuum power. Living tubeworms and <i>Calypptogenas</i> were sampled.			
Key words	DEEP AQUARIUM SYSTEM, deep-sea fish, piezo-stat			

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 1

DIVE # 882

NAME: Satoshi KONISHI

2) Topography, Geology, Geophysics

Landing point was 34° 4.2096' N 137° 47.2999' E 618 m depth.

Bottom was flat and hard mud.

2) Biology, Microbiology

Conger sp. was trapped in the fish trap which is settled yesterday (dive#881). *Eptatretus sp.* was trapped in the fish trap which is settled today. Living tubeworms and *Calyptogenas* were sampled. Sterile cores were sampled.

Time , X, Y, Depth : Condition of *Calyptogenas*

10:28, -1460, 460, 619 ~ 11:51, -890, 490, 607 : There is a few shell.

11:51, -890, 490, 607 ~ 12:38, -905, 548, 609 : Bottom is filled with shells.

12:38, -905, 548, 609 ~ 13:47, -690, 530, 601 : Bottom is filled with shells and living *Calyptogenas* are scattered.

13:47, -690, 530, 601 ~ 14:07, -630, 461, 599 : There is no shell.

14:07, -630, 461, 599 ~ 14:50, -900, 510, 611 : Bottom is filled with shells and living *Calyptogenas* are scattered.

14:50, -900, 510, 611 ~ 16:03, -902, 457, 607 : There is a few shell.

3) Chemistry

MBARI core sampling was performed. But unfortunately, There were not any core in the sampler when submersible was on the surface of sea.

Two bottom waters were sampled by NISKIN.

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 2

DIVE # 882

NAME: Satoshi KONISHI

4) Ocean Physics

Temperature of bottom water was 4.6 °C. Current was very slow. Visibility was about 8m.

5) Engineering

Vacuum power of DEEP AQUARIUM SYSTEM was week. And at last vacuum tube was broken.

6) Other

Video High Light of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

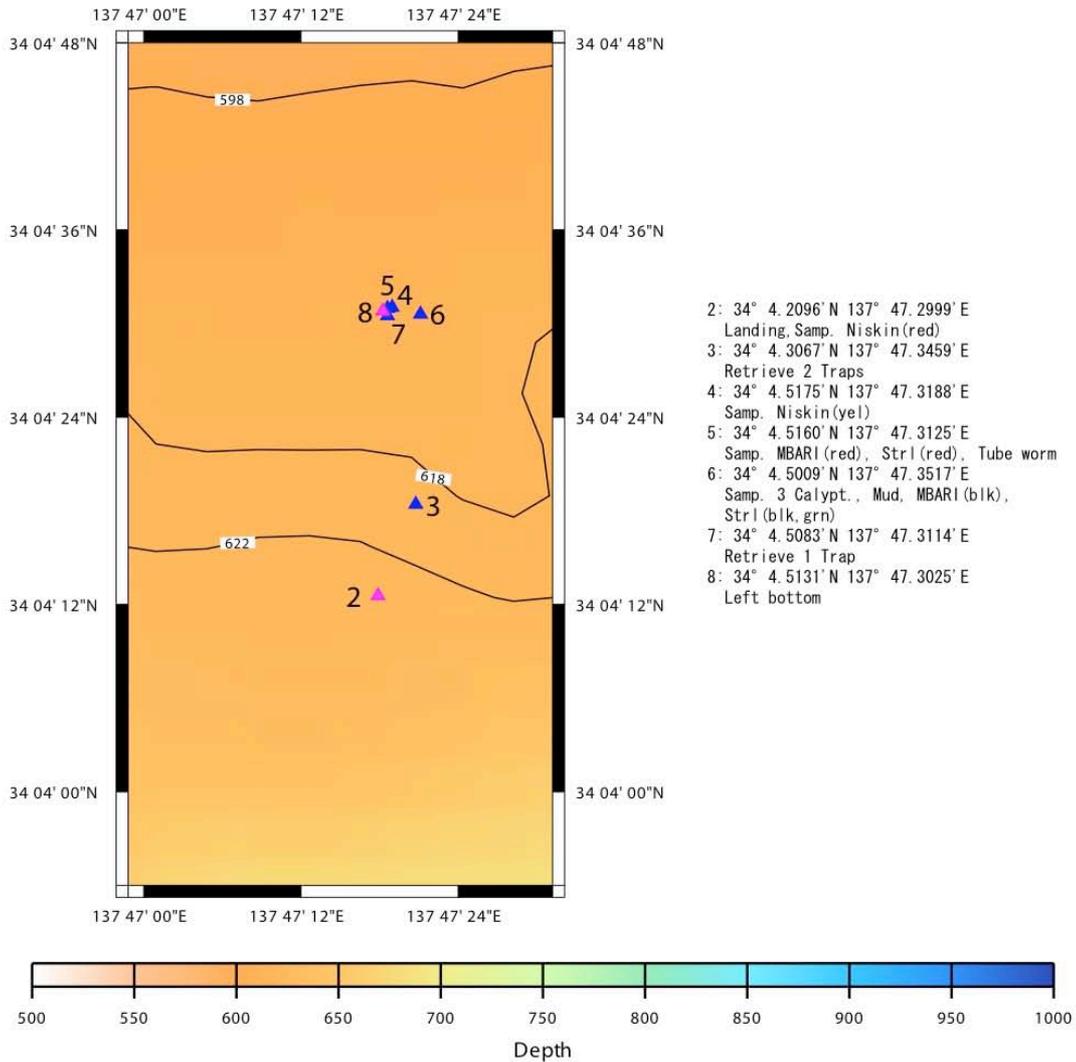
DIVE #882

NAME: Satoshi KONISHI

Video Time	Camera No.	Comments
6) 12:18:00-12:20:00	2	Sampling of alive tubeworms.
7) 12:34:33-12:35:20	2	Sampling of alive <i>Calyptogenas</i> .
8) 13:28:00-13:29:40	2	Sampling of fishes by DEEP AQUARIUM SYSTEM. There were many shells of <i>Calyptogena</i> .
9) 13:50:20-13:50:35	2	Bottom fish found. There was no shell of <i>Calyptogena</i> .
10) 15:42:40-15:43:50	2	Recovery of <i>Eptatretus sp.</i> in a fish trap.

Event markers of the diving survey

YK05-08 Dive#882



GMT Jun 16 17:15 YK05-08, R/V YOKOSUKA & DSRV SHINKAI6500, SeaBeam2100, Grids=100m, Cont.Int.=1m. 2005/06/08-2005/06/19(UTC)

Dive Log

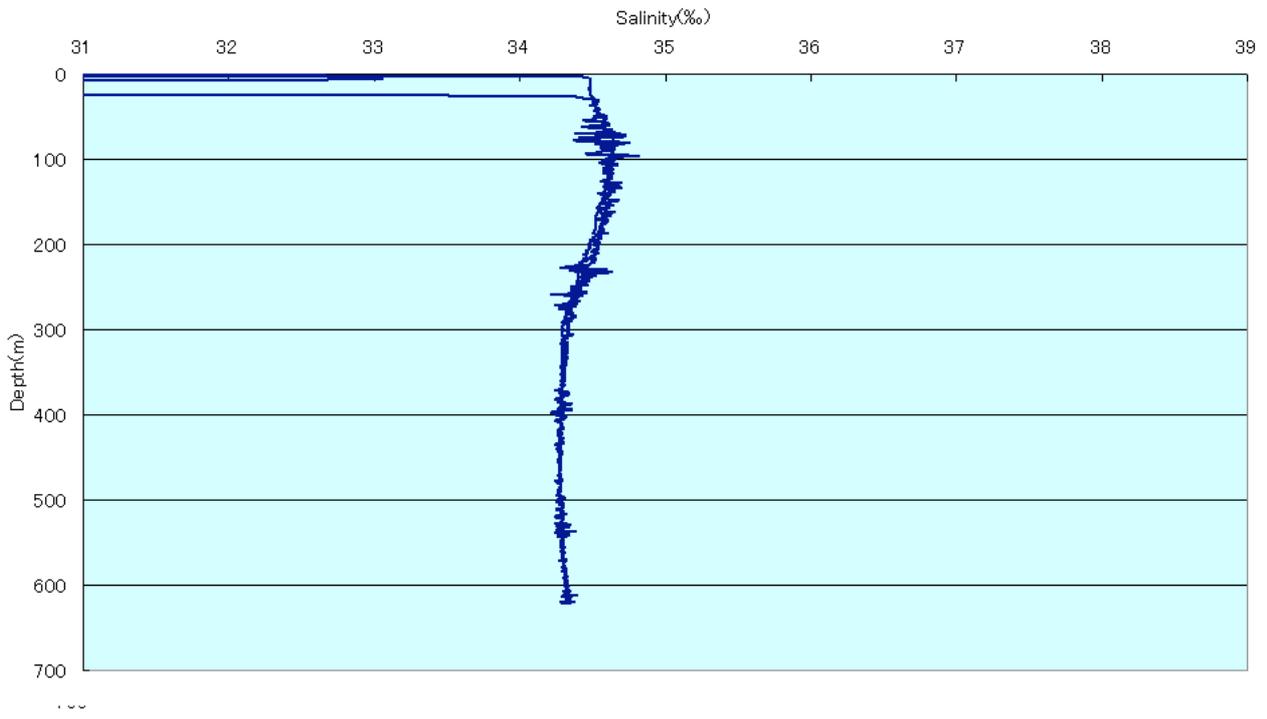
Dive#6K-882		Observer: Satoshi Konishi		Date: June,14 , 2005
Time	X, Y	Depth(m)	Event	Others
9:10			swimmer standby	
			shinkai at the surface	
10:00			vent open	
10:12	-1480,550		stop moving	
10:17	-1479,489		Trimming completed	
10:24	-1461,476	615	NISKIN1(red)	W-1
10:28	-1460,460	619	Landing, mud, visibility=8, water temp.=4.6 degree C, current direction=?.	
10:30	-1457,461	621	moving Co.=10	
10:34	-1370,480	619	transit,star fish	
10:36	-1332,486	619	Co.=30,tube worm	
10:37	-1300,500	616	transit	
10:39	-1270,510	617	feather star	
10:40	-1260,520	616	transit	
10:41	-1249,545	615	found trap	
10:44	-1282,536	614	bottle,wood thunk	
10:46	-1281,530	616	congereel in trap	
10:53	-1279,616	616	keep back fish trap	
			sampling something using KUMADE sampler	
10:56	-1281,530	617	baited trap	
10:59	-1293,594	615	congereel many	
11:05	-1286,538	615	moving Co.=350	
11:06	-1273,525	615	feather star	
11:08	-1233,509	615	fish	
11:14	-1220,490	616	transit,starfish	
11:16	-1179,488	613	Co.=0	
11:18	-1142,488	612	congereel	
11:20	-1100,490	654	transit, bottom fish	
11:24	-960,490	612	transit	
11:25	-925,501	611	found trap,calyptogena	
11:27	-910,497	610	vaccum fish, failed	
11:29	-908,497	608	tubeworm, bottom fish, congereel	
11:32	-905,487	608	feather star	

11:36	-923,471	609	fish,shark	
			no fish in trap	
11:41	-925,477	608	2 fishi traps set	
			eel	
11:46	-929,491	610	transit	
11:51	-890,490	607	NISKIN2(yellow)	W-2
			calyptogena colony	
11:54	-890,480	608		
11:59	-877,466	608		
12:04	-889,483	608	fish,vaccum calyptogena	
12:06	-891,475	607	fish	
12:08	-896,479	608	bottom fish	
12:10	-894,479	609	bottom fish	
			MBARI1(red) start	
12:14	-895,487	609	steril core 1(red)	S-1
12:17	-892,478	609	tube worm-->sampling	
12:22	-901,488	608	try to vaccum congereel	
12:33	-908,544	610	vaccum fish	
12:38	-905,548	609	MTcore, failed, vaccum fish, failed	
12:41	-901,543	610	vaccum fish,Mtcore-->failed	
12:42	-904,524	609	try to get calyptogena using Kumade samplar	
12:45			sampling three calyptogenas	aliving
12:52	-908,545	610	MBARI2(blue) start	
12:53			finish MBARI2	
12:55	-905,547	608	crab	
12:58	-908,544	609	steril core 2(black)	S-2
13:02	-903,545	610	start sterile core3 (green)	S-3
13:05			finish sterile core3(green)	
13:15	-874,514	608	moving Co.=0	
13:19	-857,518	607	vaccum fish	
13:21	-840,537	604	fish	
13:28	-805,533	607	stop moving,try to get fish	
			failed	
13:35	-796,510	605		
13:40	-756,516	605		
13:43	-724,523	602	89-5 and 89-2 marker found	
13:45	-713,524	604	fish	
13:46			カサゴ	

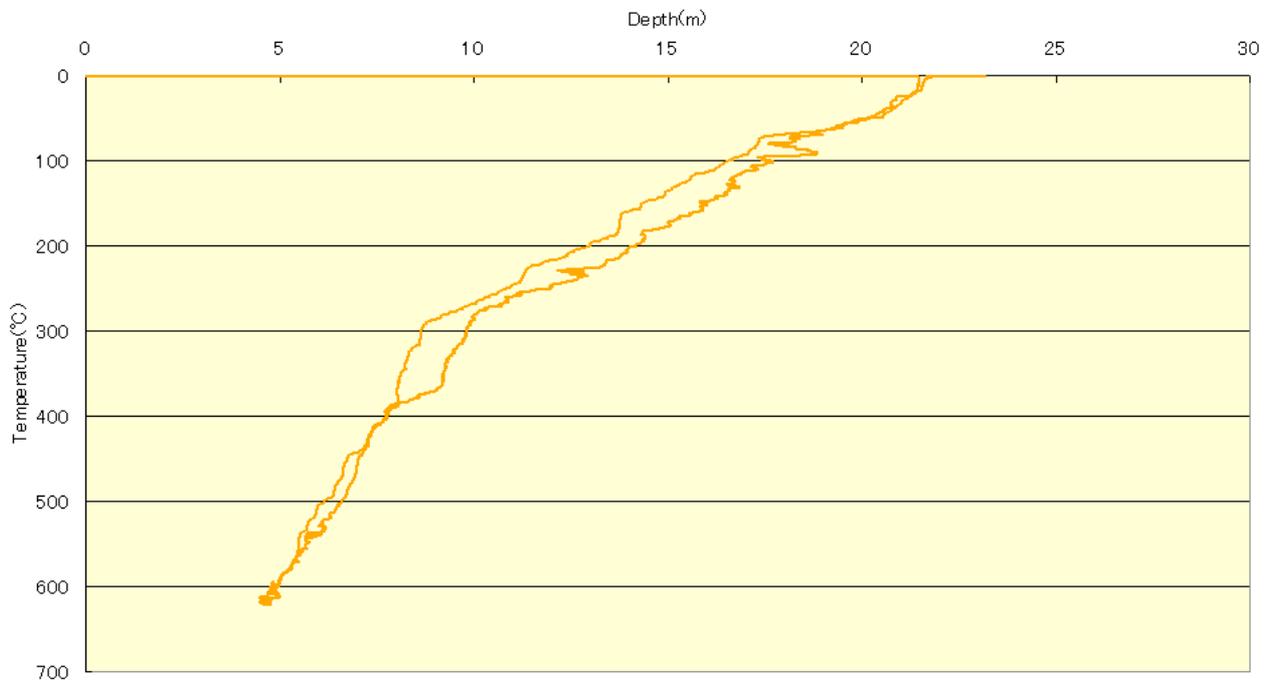
13:47	-690,530	601		
13:50	-652,537	600	カサゴ	
13:51	-632,542	599	eel	
13:53	-610,540	599	moving Co.=270	
14:00	-594,475	597		
14:02	-590,460	596	カサゴ	
			return trap point	
14:04	-587,443	596	moving Co.=170	
14:07	-630,461	599	calyptogena colony	
14:10	-639,472	600	カサゴ	
14:15	-665,469	601		
14:17	-673,471	602	fish	
14:18	-674,472	602	fish	
			crab	
14:19	-680,490	602		
14:21	-691,478	603	fish	
			try to vaccum fish,-->abandoned	
14:28	-713,487	602	fish	
			try to vaccum fish,-->abandoned	
14:37	-732,497	602	カサゴ	
14:42	-810,520	608		
14:44	-840,529	608	moving Co.=200	
14:49	-888,515	610		
14:52	-930,500	610	カサゴ	
14:54	-972,489	610	moving Co.=310	
14:56	-980,498	610	moving Co.=340	
14:58	-958,480	609	arrived at fish trap position	
15:06	-909,483	609		
15:07			recovered fish trap-->abandoned?	
15:13	-914,471	608		
15:19	-919,478	609	recovered fish trap and try to vaccum fish,-->abandoned	
			recovered fish trap and try to vaccum fish,-->success?	
15:26			vaccum two eels?	
15:37	-925,473	608	recovered fish trap	
15:58	-911,491	598	MT core sampling -->abandoned	
16:03	-902,457	607	left the bottom	

CTDO profiles of the Dive 882

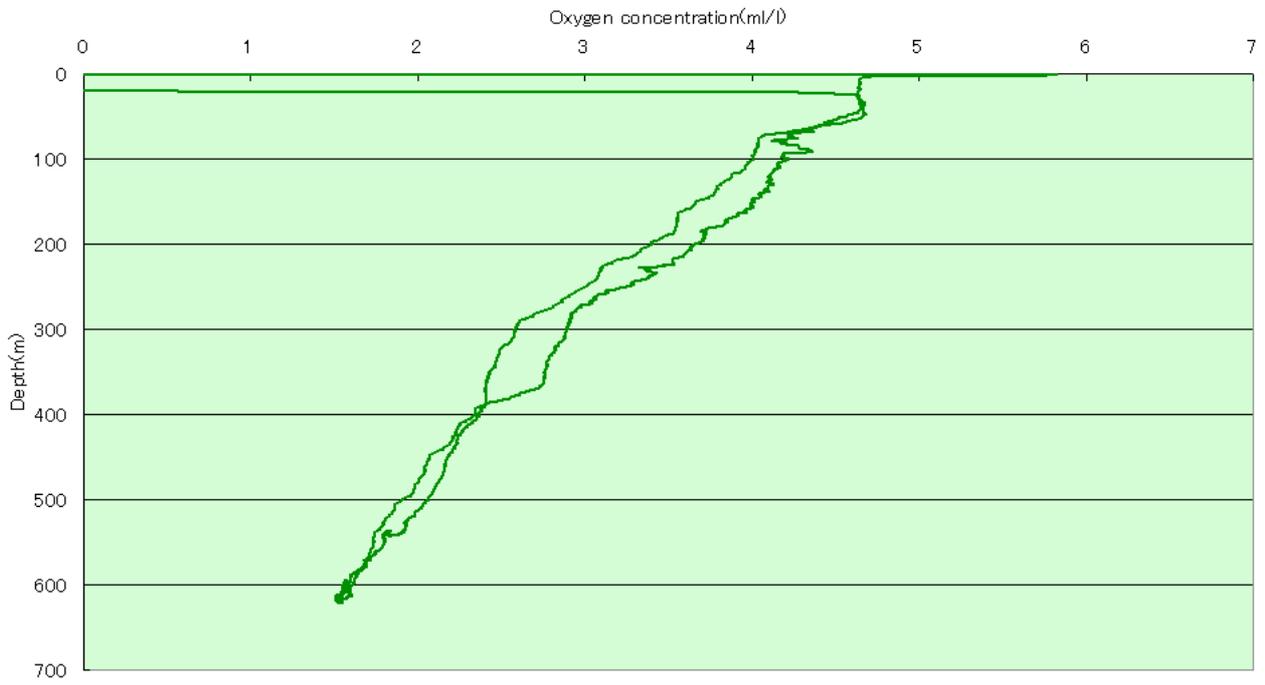
Salinity (Dive#882)



Temperature (Dive#882)



Oxygen concentration (Dive#882)



6.3. Dive 6K#883

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

DIVE NO.	883	DATE	05/06/17	
Main Purpose	Biological sampling (<i>Calyptogena</i> and other invertebrates associated with seep community) and observation of their life <i>in situ</i> . Collecting animals encountered en route.			
Dive Site	Off Kumano-Nada, 2047 m. Destination at the Marker 52 previously placed in 6K Dive 676.			
Landing	Latitude	Longitude	Time	Depth
	33° 15.8092' N	136° 42.9931' E	11:08	2071 m
Lift-off	33° 15.7816' N	136° 15.7816' E	15:45	2053 m
Payload	Suction sampler (1), Canister (1), MBARI-type core samplers (3), Sterilized core samplers (3), Big sediment sterilized sampler (1), Bacterial mat bag sampler (1), NISKIN water samplers (2), Kumade sampler (1), Sample box (1), and SAHF meter (1).			
DIVE SUMMARY	<p>1) Located a colony of <i>Calyptogena similis</i> in a short distance away from the landing point. It is an extension from the colony around the Marker 52.</p> <p>2) Live clams are sporadically distributed and usually isolated from each other. Ten specimens were collected.</p> <p>3) Water and core samples were all effectively collected by all samplers employed.</p> <p>4) No bacterial mat nor color-altered patch was detected.</p> <p>5) SAHF was lost immediately after launching.</p>			
Key words	<i>Shinkai 6500</i> . Dive 883, <i>Calyptogena similis</i> , Kumano-Nada			

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 1

DIVE # 883

NAME: Takashi Okutani

3) Topography, Geology, Geophysics

2) Biology, Microbiology

Live specimens of *Calyptogena similaris* were discovered in a limited area around the Marker 52 of 6KDive #676 (2047 m). They never form densely packed aggregation, but are sporadically distributed, and individuals were isolated from each other. They take a vertical posture exposing posterior half of shell above ocean floor. Small (young) specimens were seldom seen. In spite of the search along and around the same bathymetrical line (about 2045-2070m), discovery of another patch of *Calyptogena* was not successful. Large dead valves of *Conchocele bisecta* were very frequently witnessed along with those of *C. similaris*. Other occasionally observed megalobenthos were: Crinoida (stalked), Echinoida (*Hygrosoma hoplacantha* and three more species), Asterozoa, Ophiurozoa (*Ophiomusium* etc.), Holothurioida (*Peniagone*), and small crustaceans. Among the scooped sediment, some interesting mollusks were sorted out: *Acharax* (probably juvenile *A. johnsoni*), *Thyasira* sp., "Limpet" and an unidentified buccinid.

Immediately before lift-off, an unidentified octopus (*Bathypolypus* sp.) was captured by the slurp gun.

No bacterial mat was evident, even within or near the *Calyptogena* patch.

The sediment underneath the bottom surface exhibited white in "normal" (=control) sea floor, but grayish black within *Calyptogena* patch.

3) Chemistry

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 2

DIVE # 883

NAME: Takashi Okutani

4) Ocean Physics

5) Engineering

6) Other

Video High Light of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

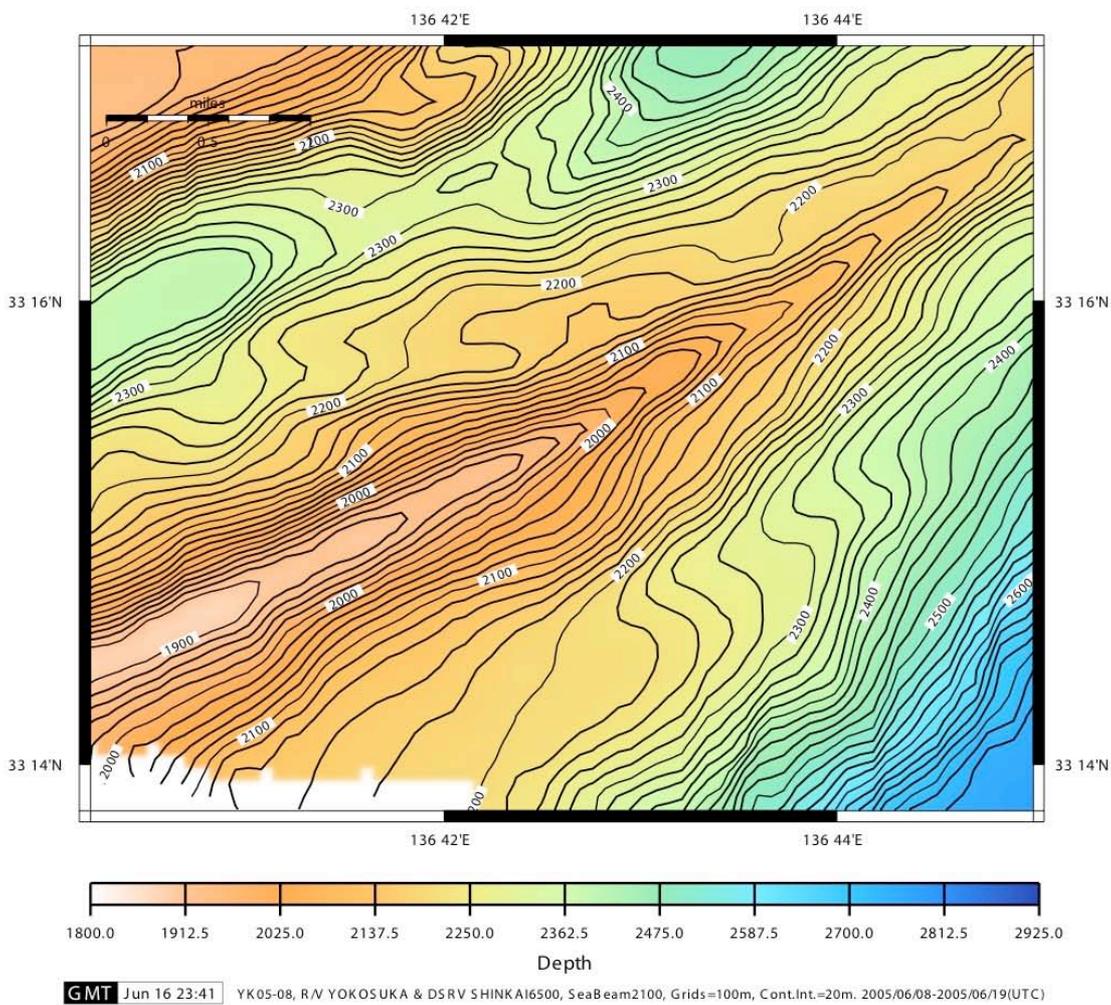
DIVE #883

NAME: Takashi Okutani

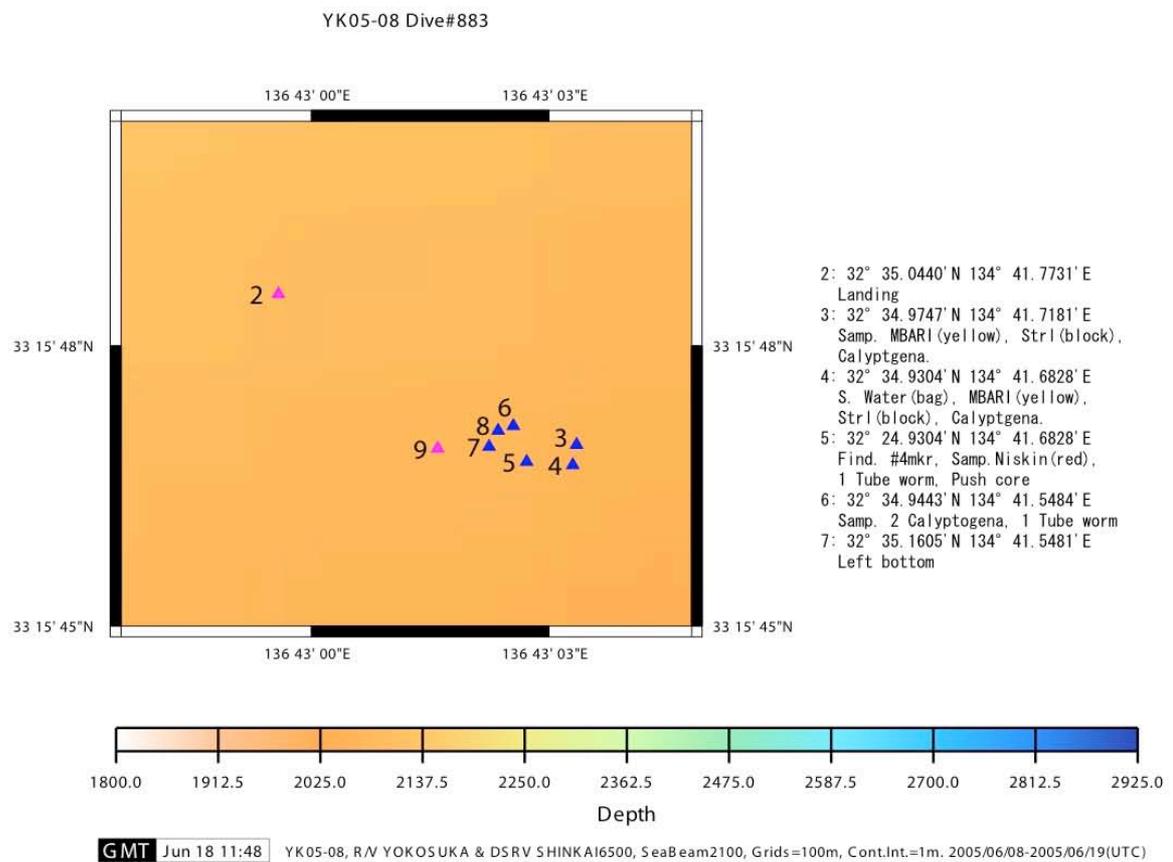
Video Time	Camera No.	Comments
11) 11:37 #2		Discovery of the first live <i>Calypptogena similaris</i> .
12) 13:00 #2		Scattering of empty valves of <i>C. similaris</i> .
13) 15:06 #2		Successful collection of a large specimen of <i>C. similaris</i> with the Kumade.
14) 15:25 #2		Collection of a long vestimentiferan tube with the manipulator.
15) 15:58 #2		Collection of an octopus, <i>Bathypolypus</i> sp., with the suction sampler.

Site map of the diving points

YK05-08 Dive#883



Event markers of the diving survey

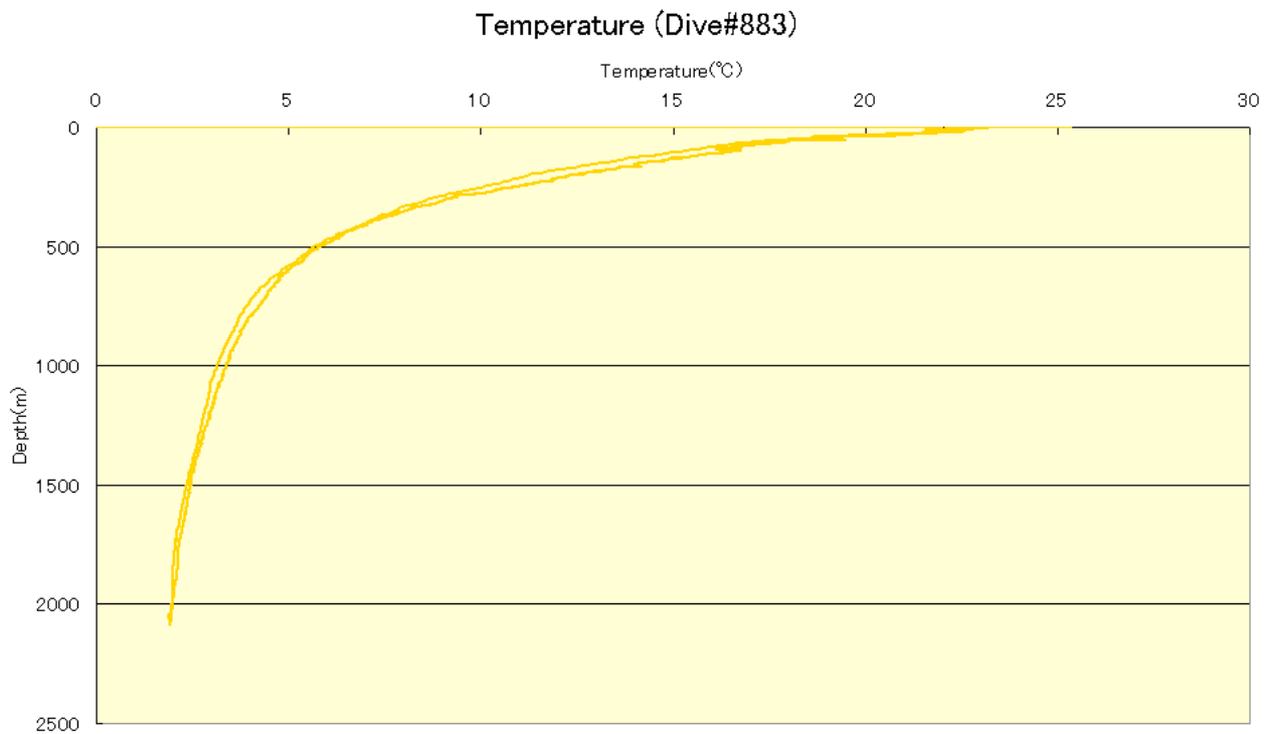
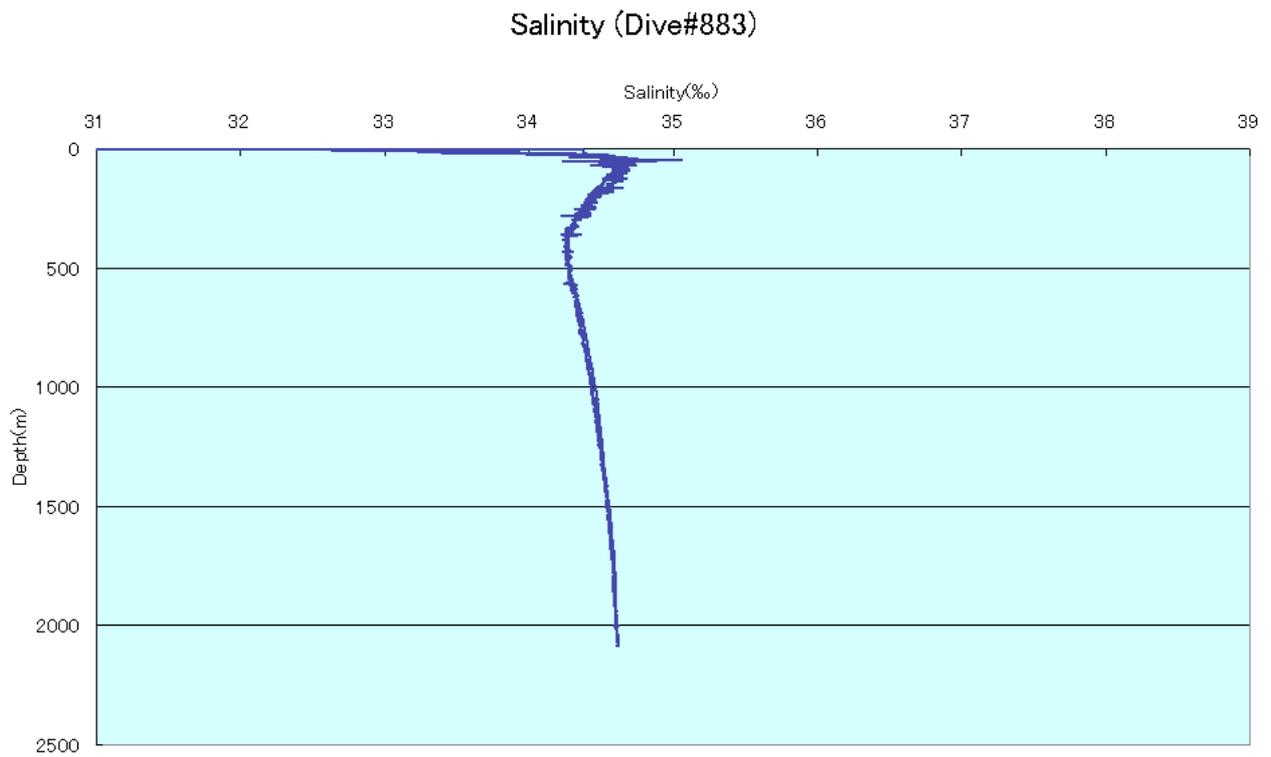


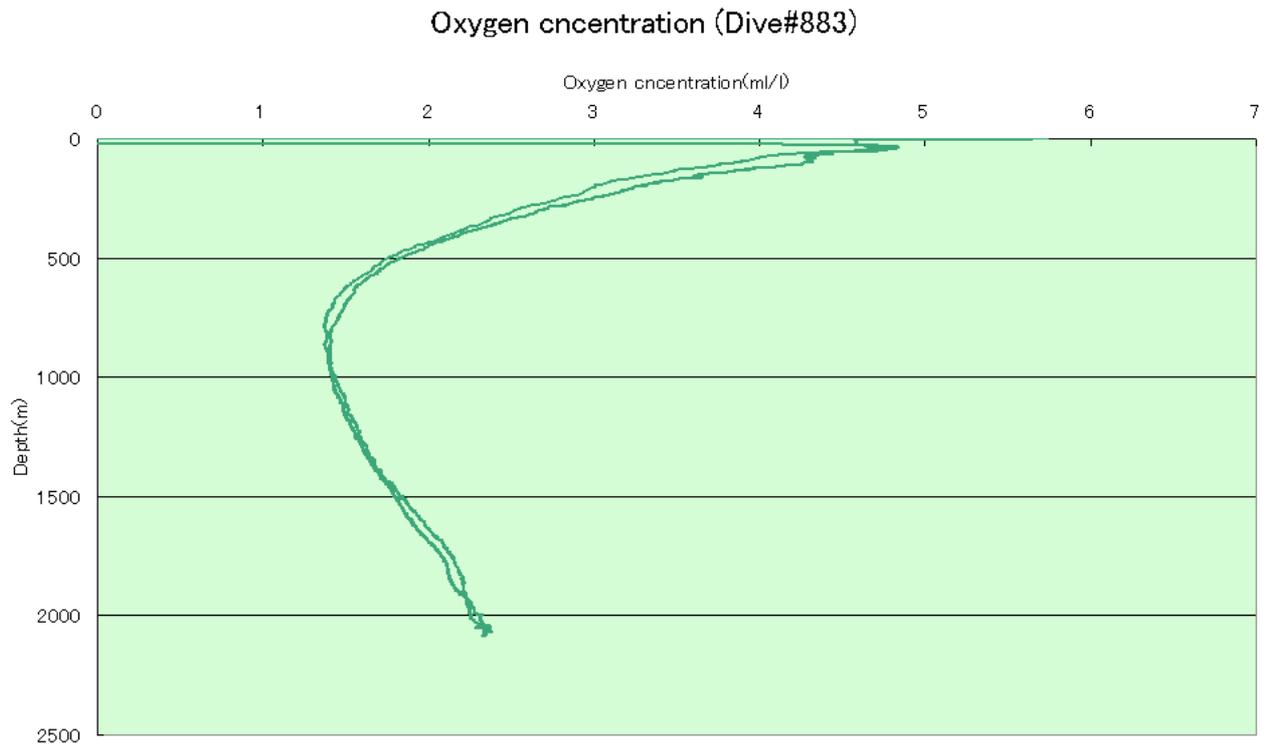
Dive Log

Dive#6K-883		Observer: Takashi OKUTANI		Date: June,17 , 2005
Time	X, Y	Depth(m)	Event	Others
9:10			swimmer standby	
9:58			shinkai at the surface	
10:05			vent open	
10:56	-381,-22		Trimming	
11:03	-361,-19	-4	NISKIN1(yellow) Control	W-1
11:10	-350,-10	2072	Landing, mud (礫まじりの泥) , visibility=8 m, water temp.=1.9 degree C, current direction=10 m/s.	
11:13	-350,-9	2073	sampling MBARI core1(yellow) -->1/2?	M-1
11:18			bacterial mat on the rock	
11:18			クモヒトデ?	
11:19			sampling sterile core1 (red)	S-1
11:22			finish sampling sterile core	
11:24	-362,-13	2071	moving Co.=120.	
11:29	-368,37	2066	fish (ヌタウナギ?)	
11:33	-380,80	2058	transit	
11:33			moving Co. = 180.	
11:37	-390,80	2051	transit, dead calyptogena	
11:37	-401,86	2048	found aliving calypogenas	
11:43	-398,85	2049	NISKIN2(Red)	W-2
11:50	-396,80	2048	MBARI2(Red)	M-2
11:50	-404,81	2048	found aliving calypogenas	
11:58	-416,92	2049	steril core 2(black)	S-2
12:01	-407,96	2048	clams, starfish	
12:03			sampling sterile core3 (big) --> start	S-4(BIG)
12:08			finish sampling sterile core	
12:11	-411,87	2048	starfish, calyptogenas	
12:12-22			sampling aliving calyptogenas using KUMADE sampler	
12:22	-404,82	2049	moving	Co.= 169.
12:25	-404,93	2047	starfish	
12:26-34:00	-402,86	2049	sampling aliving five calyptogenas using KUMADE sampler	
12:34	-410,80	2047	transit	

12:35			moving	Co. = 130.
12:38	-401,90	2048	observation	
12:43	-395、8 2	2051	等深線にそって航走開始	
12:51	-410,77	2047	found #52 marker	
12:55	-409,66	2051	landing near the marker	
12:55-13: 03			sampling aliving two calyptogenas using KUMADE sampler	
13:03-11	-406,69	2051	sampling dead calyptogena using KUMADE sampler	
13:11	-405,66	2050	等深線にそって航走開始	
13:13	-409,70	2048	shrimp	
13:16	-410,50	2047	transit	
13:20	-414,47	2048	礫が多くみられるようになったため、等深線に戻って航走開始	
13:31	-360,130	2055	transit	
13:36	-350,200	2051	transit	
13:39	-324,230	2056	found tube worm	
13:43	-290,200	2058	transit	
13:49	-270,390	2059	transit	
13:54	-307,427	2051		
13:55	-310,430	2048	transit	
14:05	-300,390	2050	transit	
14:13	-320,310	2050	transit	
14:21	-230,200	2070	transit	
14:26	-250,80	2085	transit	
14:27	-266,14	2092	moving	Co.=180
14:32	-320,-20	2081	transit	
14:37	-370,10	2065	transit	
14:50	-396,56	2052	sampling MBARI3(Tiger)	(M-3)
14:57	-398,61	2052	sampling sterile core4 (Green)	(S-3)
15:06	-394,64	2052	sampling big calyptogena using KUMADE sampler	
15:12	-401,59	2052	sampling calyptogena using KUMADE sampler	
15:25	-403,58	2050	sampling tube worm	
15:31	-400,60	2051	transit	
15:33	-396,69	2051	found starfish	
15:37	-397,65	2051	sampling octopus and calyptogena	
15:44	-405,35	2055	left bottom	

CTDO profiles of the Dive 883





6.4. Dive 6K#884

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

DIVE NO.	884	DATE	05/06/18	
Main Purpose	Study of Comparative Genome Analysis of the <i>Calyptogena</i> Symbionts from Different Depth and Biological Diversity in Their Environments in Nankai Trough			
Dive Site	Off Muroto, Nankai Trough			
	Latitude	Longitude	Time	Depth
Landing	32° 35.0440' N	134° 41.7731' E	11:27	3301 m
Lift-off	32° 35.1605' N	134° 41.5481' E	15:58	3243 m
Payload	Core Samplers (3 sets for Small, 3 for MBARI-Type, 3 for Small Sterilized, 1 for Big Sterilized), Suction Sampler with Regular Canister (1 set), Sample Box with "Kumade" Sampler (1 set), Bacterial Mat Bag-Type Sampler (1 set), Niskin Water Samplers (2 sets)			
DIVE SUMMARY	<p>1) We succeed to find a new chemosymthetic biological community consist of several species of <i>Calyptogena</i>, and to revisit to the former <i>Calyptogena</i> community site, identified by the dive #519.</p> <p>2) Two kinds of core samples by the MBARI-type sampler (one control, one <i>Calyptogena</i> site) were obtained and contributed to the chemical analysis.</p> <p>3) Two kinds of sediment samples by the small sterilized sampler (one control one <i>Calyptogena</i> site) were obtained.</p> <p>4) Bacterial mat samples by Bag-type sampler were obtained with water.</p> <p>5) Two kinds of water samples by NISKIN (one control and one <i>Calyptogena</i> site) were obtained.</p> <p>6) DNAs were isolated from those sediment and <i>Calyptogena</i> samples on board.</p>			
Key words	Nankai Trough, Off Muroto, <i>Calyptogena</i> clusters, Bacterial Mat, Comparative genome analysis			

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 1

DIVE # 884

NAME: Takako SATO

1) Topography, Geology, Geophysics

2) Biology, Microbiology

- A new *Calyptogen*a community was found in the area, and the size of the community was bigger than the one that was found in the dive #519 and revisited this time.
- Bacterial mat was found really few spots in the restricted area, and those were close to the *Calyptogen*a community.
- Three type of *Calyptogen*a was captured by manipulator and Kumade sampler.
- Bacterial mat was recovered by both Bag-type water sampler and the sterilized sediment sampler.
- The sediment samples were obtained by both small sterilized and MBARI-type core sampler.

3) Chemistry

- Microbial community analysis is going to perform using DNA and fatty acid from sediment samples obtained by the sterilized sampler. The water sample by NISKIN and sediment core samples by MBARI-type were obtained at same sites of microbial analysis samples and may be analyzed in geochemical technique. Those chemical and microbial data may be combined and discussed in future.

Preliminary Results of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

Dive Results - pg. 2

DIVE # 884

NAME: Takako Sato

4) Ocean Physics

5) Engineering

6) Other

Video High Light of SHINKAI 6500 Dive

YK0508 leg1 NaBiSC, JAMSTEC

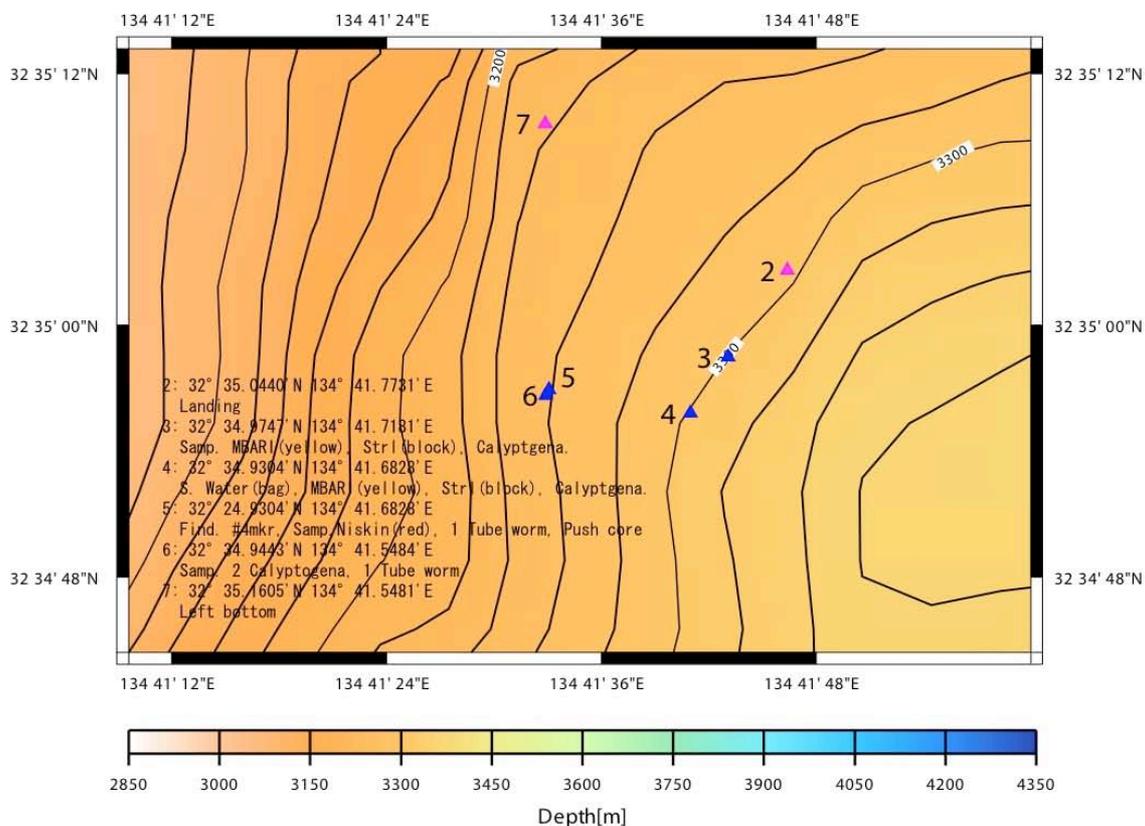
DIVE #884

NAME: Takako Sato

Video Time	Camera No.	Comments
1) 11:42:10 ~ 11:42:37, #2		The sediment sample was obtained by MBARI-type core sampler at normal sea floor as a control.
2) 11:42:10 ~ 11:42:37, #2 12:12:57 ~ 12:13:25, #2 12:26:00 ~ 12:26:20, #2		A new <i>Calyptogena</i> community was found. White bacterial mat was found in the <i>Calyptogena</i> community and sampled by Bag-type water sampler.
3) 12:36:30 ~ 12:36:55, #2 12:44:30 ~ 12:45:00, #2		The sediment sample was obtained by MBARI-type core sampler at the <i>Calyptogena</i> community site. The sediment sample was obtained by the sterilized sediment sampler at the <i>Calyptogena</i> community site.
4) 12:54:41 ~ 12:55:10, #2 13:04:55 ~ 13:05:35, #2		The <i>Calyptogena</i> shells were recovered by Kumade sampler and kept in the sample box. Number 14 marker was set at the new found <i>Calyptogena</i> community site.
5) 13:49:40 ~ 13:50:55, #2 14:00:27 ~ 14:00:42, #2 14:16:15 ~ 14:16:48, #2		The former <i>Calyptogena</i> community site (dive#519) was found again and tubeworm with sea anemone was observed. The tubeworm with sea anemone was collected. The big <i>Calyptogena</i> shells were recovered by Kumade sampler and kept in the sample box.

Site map of the diving points

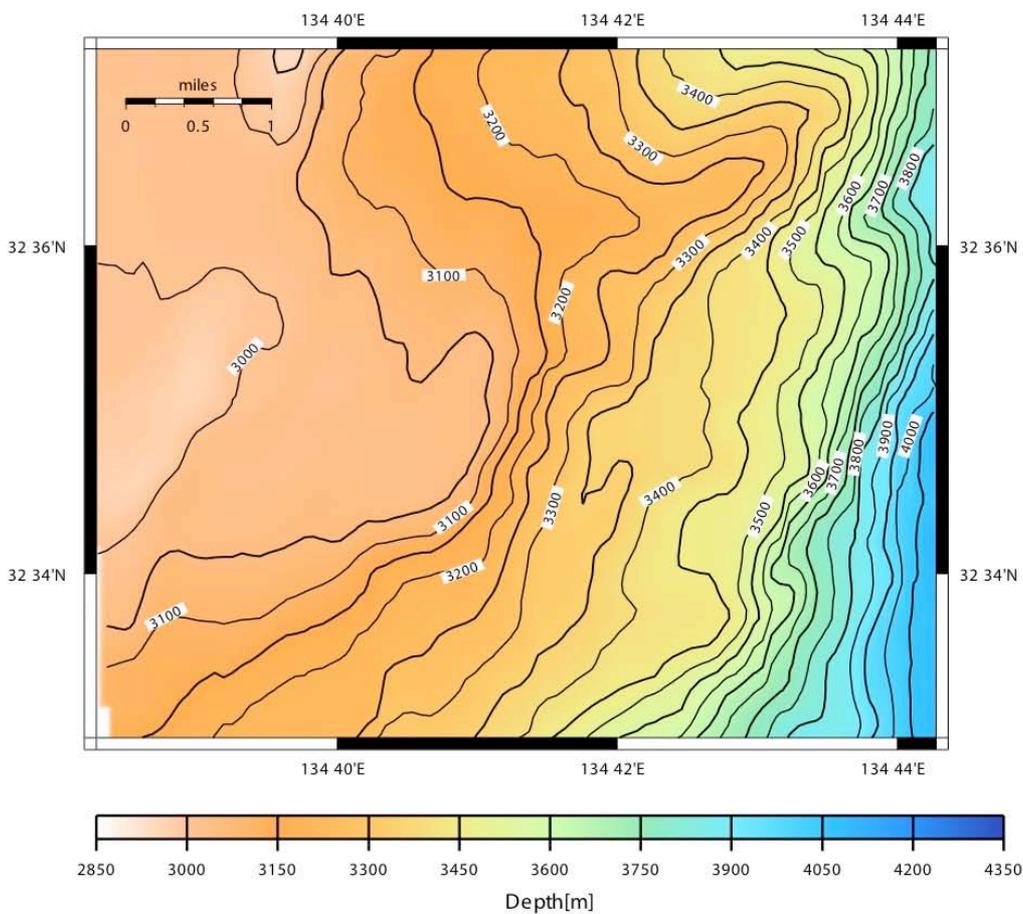
YK05-08 Dive#884



GMT Jun 19 05:00 YK05-08, R/V YOKOSUKA & DSRV SHINKAI6500, SeaBeam2100, Grids=100m, Cont.Int.=20m. 2005/06/08-2005/06/19(UTC)

Event markers of the diving survey

YK05-08 Dive#884



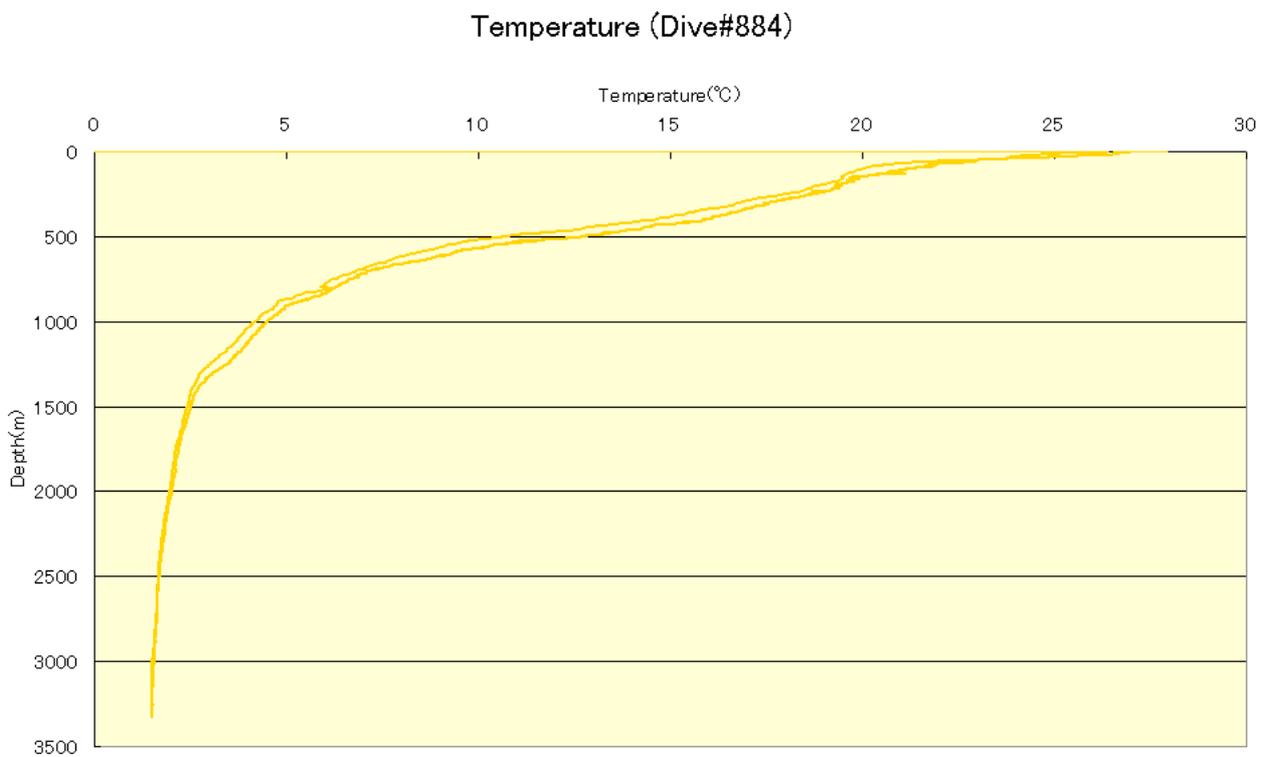
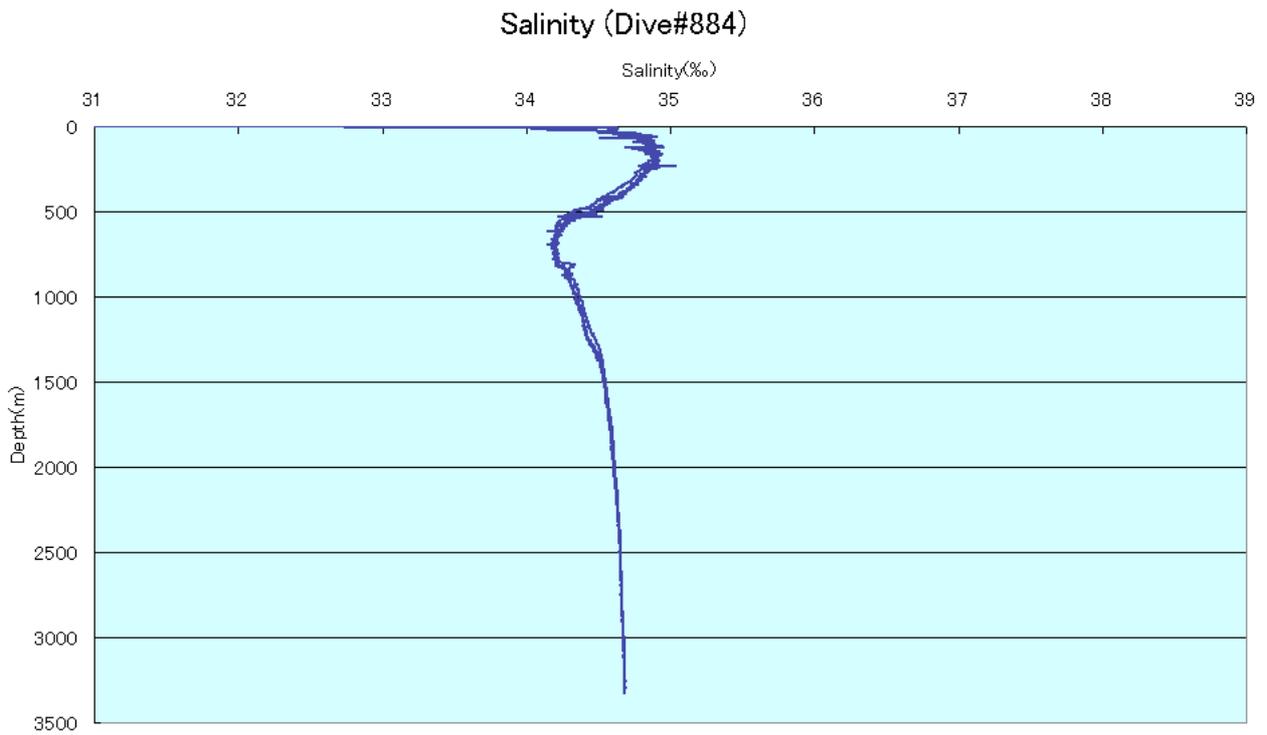
GMT Jun 19 03:04 YK05-08, R/V YOKOSUKA & DSRV SHINKAI6500, SeaBeam2100, Grids=100m, Cont.Int.=100m. 2005/06/08-2005/06/19(UTC)

Dive Log

Dive#6K-884		Observer: Takako SATO		Date: June,18 , 2005
Time	X, Y	Depth(m)	Event	Others
9:10			swimmer standby	
			shinkai at the surface	
10:00			vent open	
11:18	55,442	-90	Trimming completed,これより海底へおりる	
11:24	79,445	-3	NISKIN1(yellow) control	W-1
11:27	80,430	3301	Landing, mud, visibility=7 m, water temp.=1.5 degree C, current direction=8 m/s.	
11:37	9,361	3304	moving	Co.=186.
11:40	-46,344	3317	MBAR11(Red)--> full, spider star fish	M-1
11:45	-43,336	3317	Steril core 1(green)	S-1
11:52	-40,340	3316	transit	
11:54			moving to south	
11:59	-142,310	3317	found aliving calptogenas	
12:02	-140,310	3316	sampling aliving calyptogena using KUMADE sampler	
12:11	-135,285	3314	seacucumbur?	
12:12	-130,280	3314	calyptogena colonies	Small clams
12:16	-127,285	3314	bacterial mat	
12:16-30			vacumming bacterial mat	
12:34	-129,282	3312	MBAR12(Yelloow) --> 1/2	M-2
12:40	-132,285	3314	sterile core2 (black)	S-2
12:54	-117,285	3313	sampling aliving many calyptogenas using KUMADE sampler	
13:05	-123,288	3314	setting #14 marker	
13:11	-128,298	3312	vaccuming sediments --> main power something wrong	
13:19	-117,288	3311	fish	
13:22	-113,286	3309	shrimp,moving south	
11:29	-131,243	3297	moving	Co=270.
11:33	-30,200	3284	transit	
13:38	-100,110	3272	transit	
13:41	-113,85	3263	found #4 maker	

13:43	-96,78	3266	shrimp, calyptogena colony and star fish	
			NISKIN2(red) control	W-2
13:50	-96,78	3266	found tube worm shrimp	
13:51	-95,80	3267	gave up push core due to sea floor hard	C-1
14:00			sampling tube wome	
			sampling aliving many calyptogenas using KUMADE sampler	
14:11	-103,76	3265		
14:15	-103,72	3266	found tube worm	
14:19	-103,76	3266	sampling aliving calyptogena using KUMADE sampler	
14:21	-105,73	3265	sampling tube worm	
14:30	-130,70	3265	moving	Co.=280
14:31	-103,63	3263	found tube worm	
14:35	-100,40	3258	moving	Co.=290
14:40	-64,25	3242	transit	
14:45	-48,-89	3219	found calyptogena	
14:48	-41,-107	3214	moving	Co.=160
14:55	-160,-60	3202	transit	
14:57	-240,-30	3119	moving	Co.=90
15:01	-320,60	3202	transit	
15:06	-310,140	3256	moving	Co.=90
15:14	-290,370	3311	trnait	
15:20	-128,374	3326	eel	
15:22	-180,330	3316	transit	
15:28	-120,300	3315	transit	
15:30	-120,310	3307	transit	
15:46	-120,460	3310	transit	
			found calyptogena colony	
15:46	270,470	3289	transit	
15:52	334,235	3261		
15:57	308,75	3252	left bottom	

CTDO profiles of the Dive 884



Oxygen concentration (Dive#884)



7. Preliminary Results on Board

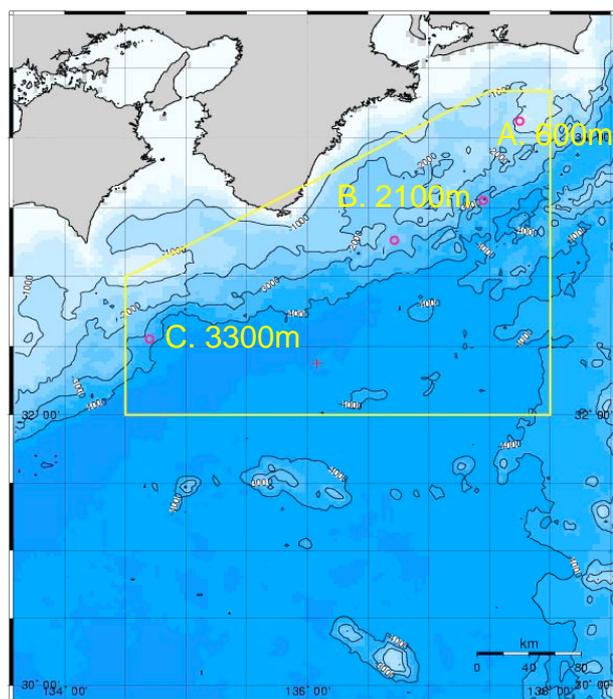
調査航海概要

(1) 目的：

本研究の目的は、異なった深度で生息するシロウリガイ類（オトヒメハマグリ科二枚貝）の共生細菌におけるゲノム構造の違いと、現場冷湧水環境中の微生物相との相関性について解析し、こうした化学合成共生系二枚貝における高圧環境適応戦略と細胞共進化の謎を解明する糸口を見いだす点にある。調査海域として特定した南海トラフは、これまでの調査の結果から深度600mから4800mに至るまでシロウリガイ類群集が見いだされている海域で、一つの海域として深度差4000mを超える範囲に同属の化学合成共生系生物が存在する世界でも希有の場所である。従って、前述の研究目的を達成するためには、この海域での調査の実施の必要性があった。

(2) 背景：

南海トラフは、東南海地震の震源域として着目されている海域で、フィリピン海プレートの沈み込みによる巨大な付加プリズム構造が存在する。こうした付加プリズム斜面には、海底活断層によると考えられている冷湧水（コールドシープ）域が連続的に存在し、こうした冷湧水ポイントからシロウリガイ類の群集が見いだされている。2000年度に実施されたYK00-10航海、ならびに2001年度に実施されたYK01-04航海において、本海域の地質構造と冷水湧出との相関について詳細な調査が行われた（Kuramoto et al., 2001, JAMSTEC J. Deep-sea Res., 19, 131-139; Ashi et al., 2002, JAMSTEC J. Deep-sea Res., 20, 1-8）。その際、異なる深度でのシロウリガイ類の生息環境についても詳細にマッピングされた。



一方、Kojimaらは、これまで報告された世界中のシロウリガイ類（オトヒメハマグリ科二枚貝）について、その生息環境と分類学的特徴についてまとめ、その生物地理学的な考察を報告している（Kojima et al., 2004, Mol. Phylogen. Evol., 32, 396-406）。この報告から、南海トラフから採取されたシロウリガイ類について抽出すると、連続した斜面であってもシロウリガイ類の種類は生育深度により異なっていることが示され、これらの化学合成共生系二枚貝は水深によりある程度の棲み分けをしていることが示されている。この結果は、深海高水圧下への環境適応を考えた場合、種組成の変化をもた

らすほどの遺伝子の変異が引き起こされている事が示唆され、加圧応答の遺伝子発現メカニズムの研究にとってもきわめて興味深い材料である事が推察される。本研究においては、限られた潜航回数でこうしたすべての深度をカバーすることはできないので、右図○印で示した特徴的な3海域（A~C海域）を選び、深度600mから深度3300m付近に生息するシロウリガイならびにコールドシープ底泥のサンプリングを行った。

（3）調査の概要：

・A海域（深度600m、第2天竜海丘）における調査—Dive 881, 882

本海域、第2天竜海丘は、「しんかい2000」により2002年に潜航された実績(2K#1377)のある地点で、すでに大きなシロウリガイ等の死殻コロニーが広がっていることが観察されている。Dive 881の潜航の目的は、本深度におけるシロウリガイを中心とした化学合成共生系2枚貝を採取し、その周辺の底泥を採取することであったが、潜航の成果として生きたシロウリガイ個体2個、チューブワーム数個体の採取に成功した。これらの生物サンプルは、低酸素水槽にて生きた状態で保持した。累々と広がる死殻コロニーの中で生きた貝は、ごくわずかしか見つからず、その採取には困難を極めた。底泥は予定通りコントロールとシープ堆積物の採取に成功した。本潜航で採取されたシロウリガイ（左写真）、並びにチューブワーム（右写真）の現場の様子を以下の写真に示す。



Dive 882の潜航地点はDive 881潜航とほぼ同じ地点で、前潜航により仕掛けられた魚トラップ等の回収ならびにDEEPAQUALIUMシステムによる深海魚の保圧採取を目的として潜航行動を行った。魚トラップに捕らえられていた深海魚は、ヌタウナギの類でサイズが大きすぎたため、小型の魚の捕獲を試みたが、最終的に吸い込み法での採集はうまくいかなかった。また、本潜航では各種採泥を行い、シロウリガイ個体、チューブワーム等の生物採取を行った。これらの生物は、低酸素水槽内にて生きている状態で保持されている。本航海アドバイザーの奥谷先生によると、これらのシロウリガイは、「エンセイシロウリガイ」であろうとのことであったが、詳しい分類学的な同定は、下船後に行う運びである。なお、本潜航にて採取されたヌタウナギの類は、元気な状態で加圧水槽内に保持され、現場の水圧・温度にて維持されている。今後徐々に減圧を行い、下船時には大気圧下にしてJAMSTEC横須賀の実験室まで持ち帰る予定である。本海域の底質は、砂まじりの泥で

MBARI 式のコア採泥には困難を極めたが、無菌採泥器による操作は良好であった。

・ B 海域（深度 2,000m、潮岬沖）における調査—Dive 883

Dive 883 の潜航目標点は、3年前の潜航 6K#676 で発見されたシロウリガイコロニーで、52 番マーカーが立てられている地点である。本潜航調査では、深度 2,048m にて同マーカーを確認し、小規模なシロウリガイコロニーを見いだした。本現場から、MBARI 式採泥、無菌採泥、採水等を行い、あわせ、シロウリガイのサンプリングを行った。本マーカーポイントを中心にシロウリガイコロニーをサーベイしたが、映像で確認した3年前の潜航と比較して、コロニーの規模が小さくなっていることが感じられた。あわせ各種生物のサンプリングを行った。本潜航では、下の写真に示されたような、かなり規模の小さなシロウリガイコロニーが見られ、これらの採取に成功した。



・ C 海域（深度 3,300m、室戸沖）における調査—Dive 884

本潜航ポイントは、黒潮の大蛇行点に重なり、その海流の問題から計画当初からその潜航の実施が危ぶまれていた。したがって、予備海域として第 4 潜航ポイントを設定し万全の体制で取り組んでいた。しかしながら、潜航当日は天候にも恵まれ、この室戸沖では梅雨前線が南に下がり、良好な状態で潜航行動を実施することができた。不思議なことに、本船の東西では前線が北上しており非常に幸運な状態に置かれていたことが、天気図から示された。Dive 884 の目的は、3000m 以深よりシロウリガイコロニーを見出し、カイとその周辺の堆積物を採取することであったが、これは達成された。次の写真で示されたように、小規模なシロウリガイコロニーを見だし、その周辺の底泥ともどもサンプリングにも成功した。本潜航の成功により、本行動における必要最低限の深度別サンプル（3 種類の深度、600m、2,000m、および 3,300m）を得ることができた。



当初の6回の潜航（各深度で2潜航ずつ）の計画に対して、最終的に4回の潜航で終わったのは梅雨前線による海況不良のためであったが、必要最低限のサンプルは確保できたので、これで仕事ができると希望を持つことができた。本行動を支えてくれた石田船長を始めとする「よこすか」乗組員の皆様、今井司令を始めとする「しんかい」チームの皆様に乗船研究者を代表して心より感謝申し上げます。この報恩として、必ずやいい成果を出すことを誓い、航海概要報告とさせていただきます。

なお、現在研究分担の取り決めに則り、各研究者が営々と実験作業を行っており、徐々に成果が出つつある。いずれの機会に発表させていただきます。



Appendix

A1. Sample list and distribution

-Sample Sharing Procedure-

- Sterilized sediment samples

1. Control sediments
2. Cold seep sediments (In side *Calyptogen* communities).
3. Different site of cold seep sediments.

Each 10g for Environmental DNA → Shizuka (Kato, Nakasone, Tamegai), Kim

Each 10-20g for storage in Liquid nitrogen conditions → Nogi

Each 10g for lipid analysis → Jiasong (-80 C)

Others for BioLog analysis → Francesco & Giovanna

Others for microbial isolation → Nogi, Kim, Francesco, Kato (Pressure experiments, Prof. Yamanaka's collab.)

- MBARI core samplers

1. Control sediments
2. Cold seep sediments (In side *Calyptogen* communities).
3. Different site of cold seep sediments.

Each 1-2 cm cuttings, for Rumi+Shizuka, Mori, Fujiwara (Yamanaka).

- Biological samples

1. *Calyptogenas* → Takako for isolation symbiotic bacteria, Prof. Okutani
2. Others → Fujiwara & Prof. Okutani
3. Part of organs → Rumi (Chie), Jiasong, for chemical analysis.

Sediment Samples, and Sharing

Date : June 13, 2005

Dive # : 881

Observer : Yoshi FUJIWARA

No.	Sample No.*	Time	Depth	Type of Sample	Sampling site (Lat., Lon.)	Remarks
1	6K#881-S1	11:00	654	sediment by sterilized sampler	34 4.0032'N, 137 47.2171'E	Red, control, 100ml, Nogi-60ml, Shizuka-10ml, Jiasong-10ml, Others for Francesco, Kim, CK
2	6K#881-S2	12:56	616	sediment by sterilized sampler	34 4.2994'N, 137 47.3376'E	Black, CS, 15 ml, Nogi-10ml, Others for Francesco, Kim, CK
3	6K#881-S3	14:55	609	sediment by sterilized sampler	34 4.5074'N, 137 47.3140'E	Green, CS, Nogi-20 ml, Others for Francesco, Kim, CK
4	6K#881-M1	10:37	653	Core	34 4.0032'N, 137 47.2171'E	Blue, control, Rumi & Shizuka, Yamanaka(Yoshi)
5	6K#881-M2	12:30	615	Core	34 4.2994'N, 137 47.3376'E	Yellow, CS, Rumi, Yamanaka(Yoshi)
6	6K#881-M3	14:35	610	Core	34 4.5074'N, 137 47.3140'E	Red, CS, Yamanaka(Yoshi), Mori

Sediment; S(sterilized sediment sampler), M(MBARI style core sampler), or C(core sampler).

Rock; R-**, Biological sample; B-**, Water Sample; W-**, etc.

CS: Cold seep sediments.

Date : June 14, 2005

Dive # : 882

Observer : Satoshi KONISHI

No.	Sample No.*	Time	Depth	Type of Sample	Sampling site (Lat., Lon.)	Remarks
1	6K#882-S1	12:14	609	sediment by sterilized sampler	34 4.5160'N, 137 47.3125'E	Red, 20ml, Nogi, Others for Francesco, Kim
2	6K#882-S2	12:58	609	sediment by sterilized sampler	34 4.5099'N, 137 47.3517'E	Black, CS, 45 ml, Nogi, Shizuka-10ml, Jiasong-10ml, Others for Francesco, Kim
3	6K#882-S3	13:02	610	sediment by sterilized sampler	34 4.5099'N, 137 47.3517'E	Green, CS, 40ml, Nogi, Others for Francesco, Kim
4	6K#882-M1	12:10	609	Core	34 4.5160'N, 137 47.3125'E	nothing
5	6K#882-M2	12:52	610	Core	34 4.5099'N, 137 47.3517'E	nothing
6	6K#882-M3			Core		missing
7	6K#882-W1	10:24	615	Control water	34 4.2096'N, 137 47.2999'E	Red, control, 500ml-Rumi, 2-3ml-Kim, others Jiasong?
8	6K#882-W2	11:51	607	water on the Calyptogena	34 4.5175'N, 137 47.3188'E	Yellow, CS water, 500ml-Rumi, 2-3ml-Kim, others Jiasong?

Date : June 15, 2005

Dive # : 883

Observer : Takashi OKUTANI

No.	Sample No.*	Time	Depth	Type of Sample	Sampling site (Lat., Lon.)	Remarks
1	6K#883-S1	11:19	2073	sediment by sterilized sampler	33 15.8092'N, 136 42.9931'E	Red, control, 60ml, Nogi-20ml, Shizuka-10ml, Jiasong-10ml, Others for Francesco, Kim, CK
2	6K#883-S2	11:58	2049	sediment by sterilized sampler	33 15.7823'N, 136 42.9931'E	Black, CS, 25 ml, Nogi-20ml, Others for Francesco, Kim, CK
3	6K#883-S3	14:57	2052	sediment by sterilized sampler	33 15.7857'N, 136 43.0425'E	Green, CS, 30 ml, Nogi-20 ml, Others for Francesco, Kim, CK
4	6K#883-S4(Big)	12:03	2048	sediment by sterilized sampler	33 15.7823'N, 136 42.9931'E	Big sterilized sediment sampler, 70 ml, Nogi-20 ml, Shizuka-10ml, Jhiasong-10ml, others, Francesco, Kim, CK
5	6K#883-M1	11:13	2073	Core	33 15.8092'N, 136 42.9931'E	Yellow, control, Rumi & Shizuka, Yamanaka(Yoshi)
6	6K#883-M2	11:50	2048	Core	33 15.7823'N, 136 42.9931'E	Red, CS, Rumi & Shizuka, Mori, Yamanaka(Yoshi)
7	6K#883-M3	14:50	2052	Core	33 15.7857'N, 136 43.0425'E	Red/black, CS, Rumi & Shizuka, Mori, Yamanaka(Yoshi)
8	6K#883-W1	11:03	2068	Niskin water sample	33 15.8092'N, 136 42.9931'E	Yellow, Control, Rumi, Kim
9	6K#883-W2	11:43	2049	Niskin water sample	33 15.7823'N, 136 42.9931'E	Red, CS top water, Rumi, Kim

Date : June 16, 2005

Dive # : 884

Observer : Takako SATO

No.	Sample No.*	Time	Depth	Type of Sample	Sampling site (Lat., Lon.)	Remarks
1	6K#884-S1			sediment by sterilized sampler	34 4.0032'N, 137 47.2171'E	Red, control, 100ml, Nogi-60ml, Shizuka-10ml, Jiasong-10ml, Others for Francesco, Kim, CK
2	6K#884-S2			sediment by sterilized sampler	34 4.2994'N, 137 47.3376'E	Black, CS, 15 ml, Nogi-10ml, Others for Francesco, Kim, CK
3	6K#884-S3	x				Green, CS, Nogi-20 ml, Others for Francesco, Kim, CK
4	6K#884-S4(Big)	x				
5	6K#884-M1			Core	34 4.0032'N, 137 47.2171'E	Blue, control, Rumi & Shizuka, Yamanaka(Yoshi)
6	6K#884-M2			Core	34 4.2994'N, 137 47.3376'E	Yellow, CS, Rumi, Yamanaka(Yoshi)
7	6K#884-M3	x				Red, CS, Yamanaka(Yoshi), Mori
8	6K#884-C1					
9	6K#884-C2	x				
10	6K#884-W1					

Sediment samples (NOGI format)

6K#881 Dive (2005.6.13)

Sample No.	Latitude	Longitude	Water Depth (m)	Description	Sample Type	Amount (ml)	Treatment	Distribution
6K881-S1	34°4.003N	137°47.217E	652	control (normal bottom)	Light gray clay	100	liquid nitrogen, cultuer, DNA analyze, Chemical analyze	JAMSTEC (Nogi, Arakawa, Kato, Sato) , KORDI (Kim), Iowa Univ. (Fang), Tucia Univ. (Canganella, Bianconi)
6K881-S2	34°4.299N	137°47.337E	615	Chemosynthetic communitites (<i>Calyptogena</i> etc.)	Gray sludge & dark gray sand	15	liquid nitrogen, cultuer	JAMSTEC (Nogi, Kato, Sato) , KORDI (Kim), Tucia Univ. (Canganella, Bianconi)
6K881-S3	34°4.510N	137°47.313E	608	Chemosynthetic communitites (<i>Calyptogena</i> etc.)	Gray sludge & dark gray sand	25	liquid nitrogen, cultuer	JAMSTEC (Nogi, Kato, Sato) , KORDI (Kim), Tucia Univ. (Canganella, Bianconi)



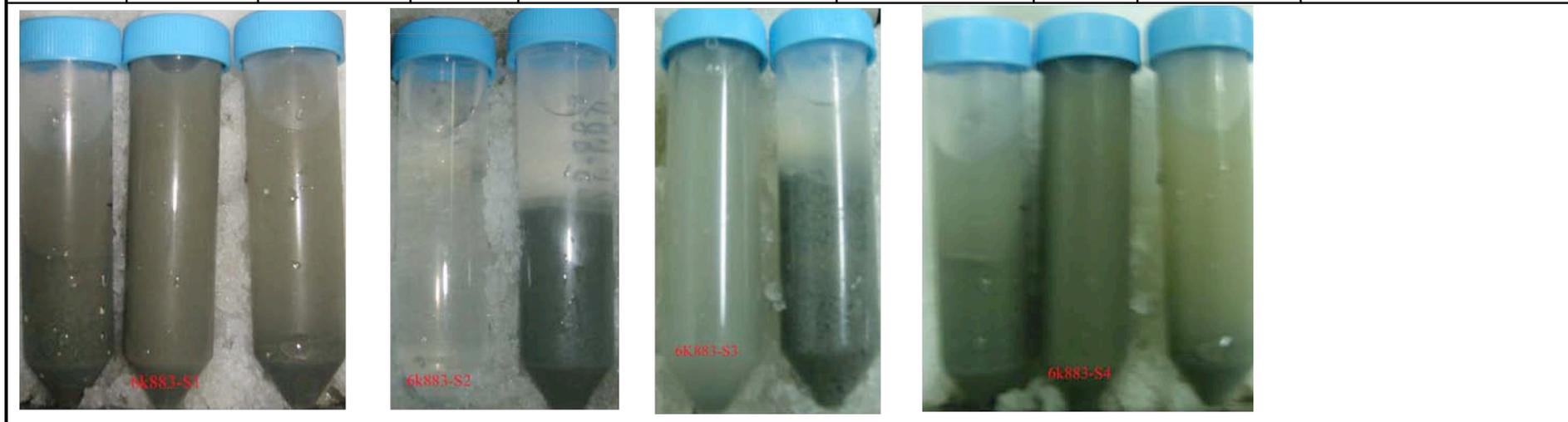
6K#882 Dive (2005.6.14)

Sample No.	Latitude	Longitude	Water Depth (m)	Description	Sample Type	Amount (ml)	Treatment	Distribution
6K882-S1	34°4.516N	137°47.312E	609	Chemosynthetic communities (Calyptogena etc.)	Gray sludge & dark gray sand	20	liquid nitrogen, cultuer	JAMSTEC (Nogi, Kato, Sato), KORDI (Kim), Tucia Univ. (Canganella, Bianconi)
6K882-S2	34°4.509N	137°47.351E	609	Chemosynthetic communities (Calyptogena etc.)	Gray sludge & dark gray sand	45	liquid nitrogen, cultuer, DNA analyze, Chemical analyze	JAMSTEC (Nogi, Arakawa, Kato, Sato), KORDI (Kim), Iowa Univ. (Fang), Tucia Univ. (Canganella, Bianconi)
6K882-S3	34°4.509N	137°47.351E	609	Chemosynthetic communities (Calyptogena etc.)	Gray sludge & dark gray sand	40	liquid nitrogen, cultuer	JAMSTEC (Nogi, Kato, Sato), KORDI (Kim), Tucia Univ. (Canganella, Bianconi)



6K#883 Dive (2005.6.17)

Sample No.	Latitude	Longitude	Water Depth (m)	Description	Sample Type	Amount (ml)	Treatment	Distribution
6K883-S1	33°15.809N	136°42.993E	2,071	Control (normal bottom)	Light gray clay	60	liquid nitrogen, cultuer, DNA analyze, Chemical analyze	JAMSTEC (Nogi, Arakawa, Kato, Sato) , KORDI (Kim), Iowa Univ. (Fang), Tucia Univ. (Canganella, Bianconi)
6K883-S2	33°15.782N	136°43.055E	2,046	Chemosynthetic communitis (Calyptogena etc.)	Gray sludge & dark gray sand	25	liquid nitrogen, cultuer	JAMSTEC (Nogi, Kato, Sato) , KORDI (Kim), Tucia Univ. (Canganella, Bianconi)
6K883-S3	33°15.785N	136°43.042E	2,050	Chemosynthetic communitis (Calyptogena etc.)	Gray sludge & dark gray sand	30	liquid nitrogen, cultuer	JAMSTEC (Nogi, Kato, Sato) , KORDI (Kim), Tucia Univ. (Canganella, Bianconi)
6k883-S4	33°15.782N	136°43.055E	2,046	Chemosynthetic communitis (Calyptogena etc.), (Big sterilize core)	Gray sludge & dark gray sand	70	liquid nitrogen, cultuer, DNA analyze, Chemical analyze	JAMSTEC (Nogi, Arakawa, Kato, Sato) , KORDI (Kim), Iowa Univ. (Fang), Tucia Univ. (Canganella, Bianconi)



6K#884 Dive (2005.6.18)

Sample No.	Latitude	Longitude	Water Depth (m)	Description	Sample Type	Amount (ml)	Treatment	Distribution
6K884-S1	32°34.974N	134°41.718E	3,310	Control (normal bottom)	Light gray clay	80	liquid nitrogen, cultuer, DNA analyze, Chemical analyze	JAMSTEC (Nogi, Arakawa, Kato, Sato) , KORDI (Kim), Iowa Univ. (Fang), Tucia Univ. (Canganella, Bianconi)
6K884-S2	32°34.930N	134°41.682E	3,306	Chemosynthetic communitis (Calyptogena etc.)	Gray sludge & dark gray sand	25	liquid nitrogen, cultuer, DNA analyze, Chemical analyze	JAMSTEC (Nogi, Arakawa, Kato, Sato) , KORDI (Kim), Iowa Univ. (Fang), Tucia Univ. (Canganella, Bianconi)
6K884-C3	32°34.948N	134°41.558E	3,259	Chemosynthetic communitis (Calyptogena etc.)	Gray sludge & dark gray sand	40	liquid nitrogen, cultuer	JAMSTEC (Nogi, Kato, Sato) , KORDI (Kim)





Sample List for Toyama University

Sample List of YK05-08 Leg.1 (Toyama University)

Dive No.	Date	Position	Depth (m)	Sample description	Length	Investigation	Remarks	Share		
#881 (Y. Fujiwara)	13. Jun. 05	34° 4.0032'N, 137° 47.2171'E	652	6K #881-M1 (MBARI Blue)	2cm					
				1	0-2 cm	PW(Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl)	brown mud	R.Sato, Yamanaka		
		34° 4.2994'N, 137° 47.3376'E	615	6K #881-M2 (MBARI Yellow)	7cm					
					1	0-1 cm	PW(Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl)	gravel, a little H ₂ S smell	R.Sato, Yamanaka	
					2	1-2 cm	"	gravel, muddy rocks, shell , a little H ₂ S smell	"	
					3	2-3 cm	"	gravel, olive gray silty clay, shell , a little H ₂ S smell	"	
					4	3-4 cm	"	"	"	
					5	4-5 cm	"	olive gray silty clay , a little H ₂ S smell	"	
					6	5-6 cm	"	olive gray silty clay, shell , a little H ₂ S smell	"	
		7	6-7 cm	"	olive gray silty clay, gravel, shell , a little H ₂ S smell	"				
		34°4.5074'N, 137°47.3140'E	608	6K #881-M3 (MBARI Red)	5? cm		failed in treatment (unable vertical profile)	Yamanaka, Mori		

#883 (T. Okutani)	17. Jun. 05	33°15.8092'N, 136°42.9931'E	2071	6K #883-M1 (MBARI Yellow)	24cm				
				1	0-2 cm	PW(Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl)	brown mud	R.Sato, Yamanaka	
				2	2-3 cm	"	"	"	
				3	3-5 cm	"	brown mud , olive grey silty clay	"	
				4	5-7 cm	"	"	"	
				5	7-9 cm	"	"	"	
				6	9-11 cm	"	olive gray silty clay	"	
				7	11-13 cm	"	"	"	
				8	13-15 cm	"	"	"	
				9	15-17 cm	"	"	"	
				10	17-19 cm	"	"	"	
				11	19-21 cm	"	"	"	
				12	21-24 cm	"	"	"	
	33°15.7823'N, 136°43.0558'E	2046	6K #883-M2 (MBARI Red)	23 cm					
					1	0-1 cm	PW(Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl, ¹³ C	brown mud, gravel , a little H ₂ S smell	R.Sato, Toki
					2	1-2 cm	"	"	"
					3	2-3 cm	"	"	"
					4	3-4 cm	"	gray mud, gravel, olive grey silty clay , a little H ₂ S smell	"
					5	4-5 cm	"	"	"
					6	5-7 cm	"	"	R.Sato, Toki, Yamanaka
7	7-9 cm	"	gray mud, gravel , a little harder H ₂ S smell	"					

				8	9-11 cm	PW(Nutrient, Major Ion, ^{18}O , ^{34}S , ^{37}Cl)	gray mud, gravel, olive grey silty clay , a little harder H ₂ S smell	R.Sato, Yamanaka
				9	11-13 cm	"	gravel, olive grey silty clay , a little harder H ₂ S smell	"
				10	13-15 cm	"	"	"
				11	15-17 cm	"	olive grey silty clay , a little harder H ₂ S smell	"
				12	17-19 cm	"	olive grey silty clay , harder H ₂ S smell	"
				13	19-21 cm	"	"	"
				14	21-23 cm	"	"	"
		33°15.7857'N, 136°43.0425'E	2050	6K #883-M3 (MBARI Red/Blk)	5.5 cm			
				1	just above water	Nutrient, Major Ion, ^{18}O , ^{34}S , ^{37}Cl		
				2	0-1 cm	PW(Nutrient, Major Ion, ^{18}O , ^{34}S , ^{37}Cl , ^{13}C)	black gravel, black mud , strong H ₂ S smell	R.Sato, Toki
				3	1-2 cm	"	black gravel , strong H ₂ S smell	R.Sato, Toki, Yamanaka
				4	2-3 cm	"	black gravel, black mud , strong H ₂ S smell	R.Sato, Toki
				5	3-4 cm	"	black gravel , strong H ₂ S smell	"
				6	4-5.5 cm	"	black gravel, black mud , strong H ₂ S smell	"

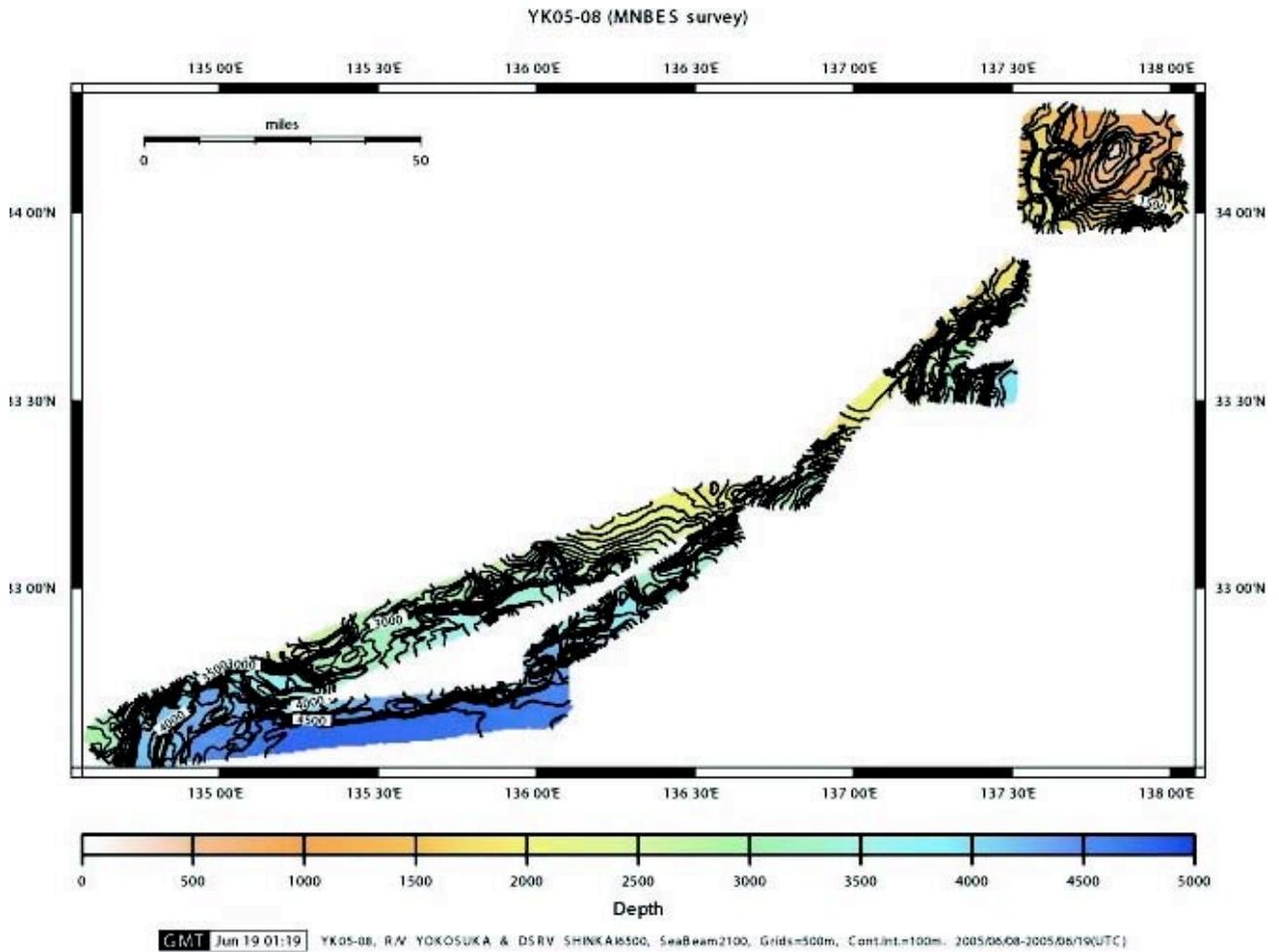
#884 (T. Sato)	18. Jun. 05	32°34.9747'N, 134°41.7181'E	3310	6K #884-M1 (MBARI Red)	25cm				
				1	0-2 cm	PW(Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl)	brown mud	R.Sato, Yamanaka	
				2	2-4 cm	"	"	"	
				3	4-6 cm	"	brown mud , olive grey silty clay	"	
				4	6-8 cm	"	"	"	
				5	8-10 cm	"	"	"	
				6	10-12 cm	"	"	"	
				7	12-14 cm	"	olive grey silty clay	"	
				8	14-16 cm	"	"	"	
				9	16-18 cm	"	"	"	
				10	18-20 cm	"	"	"	
				11	20-22 cm	"	"	"	
				12	22-24 cm	"	"	"	
	13	24-25 cm	"	"	"				
			32°34.9304'N, 134°41.6828'E	3306	6K #884-M2 (MBARI Yellow)	12cm			
					1	just above water	Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl		
					2	0-1 cm	PW(Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl, ¹³ C	black mud , strong H ₂ S smell	R.Sato, Toki
					3	1-2 cm	"	"	"
					4	2-3 cm	"	black mud, a little muddy rocks , strong H ₂ S smell	"
					5	3-4 cm	"	"	"

				6	4-5 cm	"	"	"
				7	5-6 cm	"	black mud, muddy rocks , strong H ₂ S smell	"
				8	6-7 cm	"	black mud, muddy rocks, clay , strong H ₂ S smell	"
				9	7-8 cm	"	"	"
				10	8-9 cm	"	black mud, muddy rocks, gravel , strong H ₂ S smell	"
				11	9-10 cm	"	"	"
				12	10-11 cm	"	olive grey silty clay , strong H ₂ S smell	"
				13	11-12 cm	"	olive grey silty clay, muddy rocks , strong H ₂ S smell	"

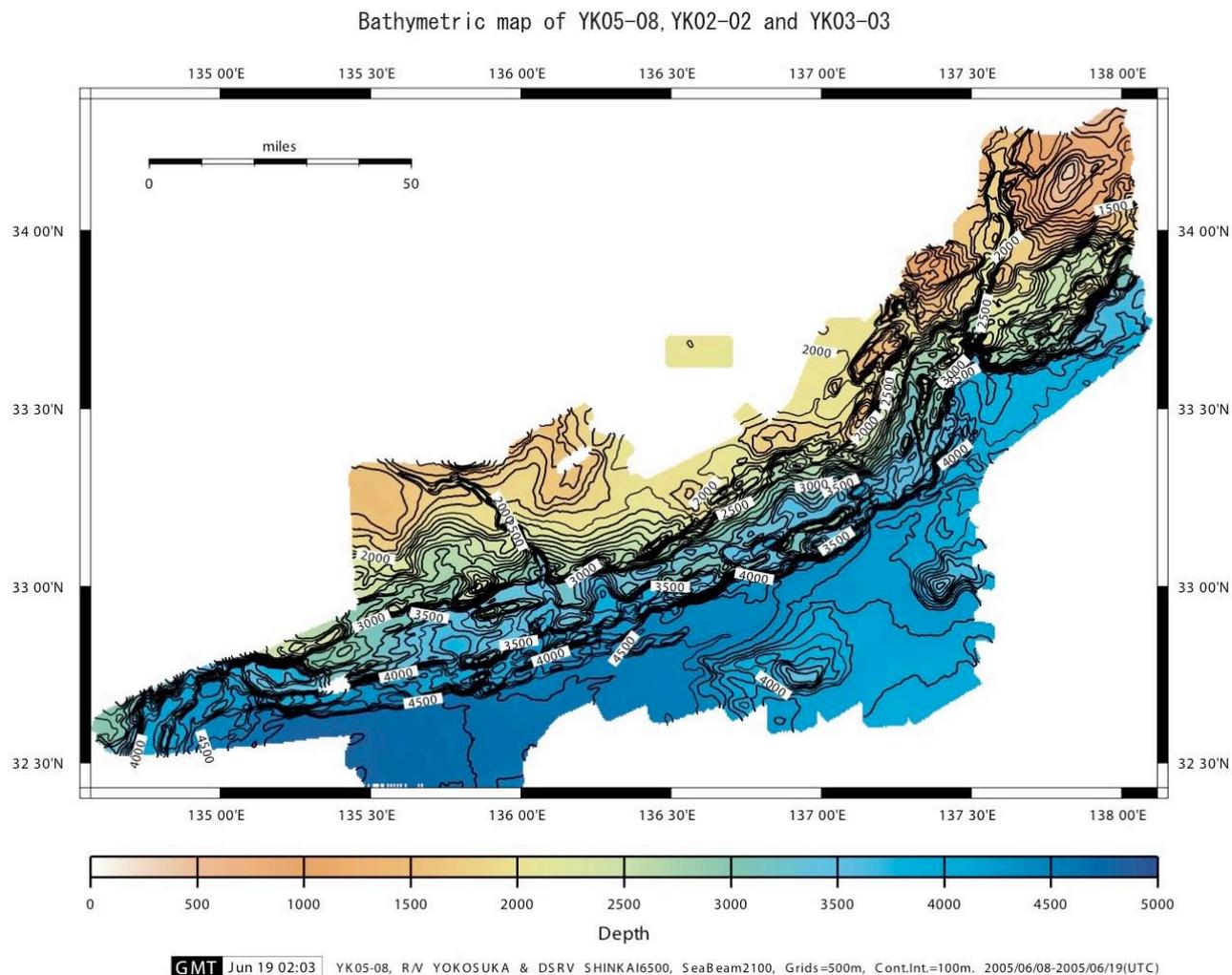
Dive No.	Date	Position	Depth (m)	Sample description	Volume	Investigation	Remarks	Share
#882 (S. Konishi)	14. Jun. 05	34°4.2096'N, 137°47.2999'E	618	6K #882-W1 (NISKIN Red)	bottom water	Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl		R.Sato, Kim.
		34°4.5160'N, 137°47.3125'E	608	6K #882-W2 (NISKIN Yellow)	120mL	"		"
#883 (T. Okutani)	17. Jun. 05	33°15.8092'N, 136°42.9931'E	2071	6K #883-W1 (NISKIN Yellow)	bottom water	Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl		R.Sato, Kim.
		33°15.7823'N, 136°43.0558'E	2046	6K #883-W2 (NISKIN Red)	120mL	"		"
#884 (T. Sato)	18. Jun. 05	32°35.0440'N, 134°41.7731'E	3301	6K #884-W2 (NISKIN Yellow)	bottom water	Nutrient, Major Ion, ¹⁸ O, ³⁴ S, ³⁷ Cl		R.Sato, Kim.
		32°34.9488'N, 134°41.5513'E	3259	6K #884-W3 (NISKIN Red)	120mL	"		"

A2. Data list (Map survey)

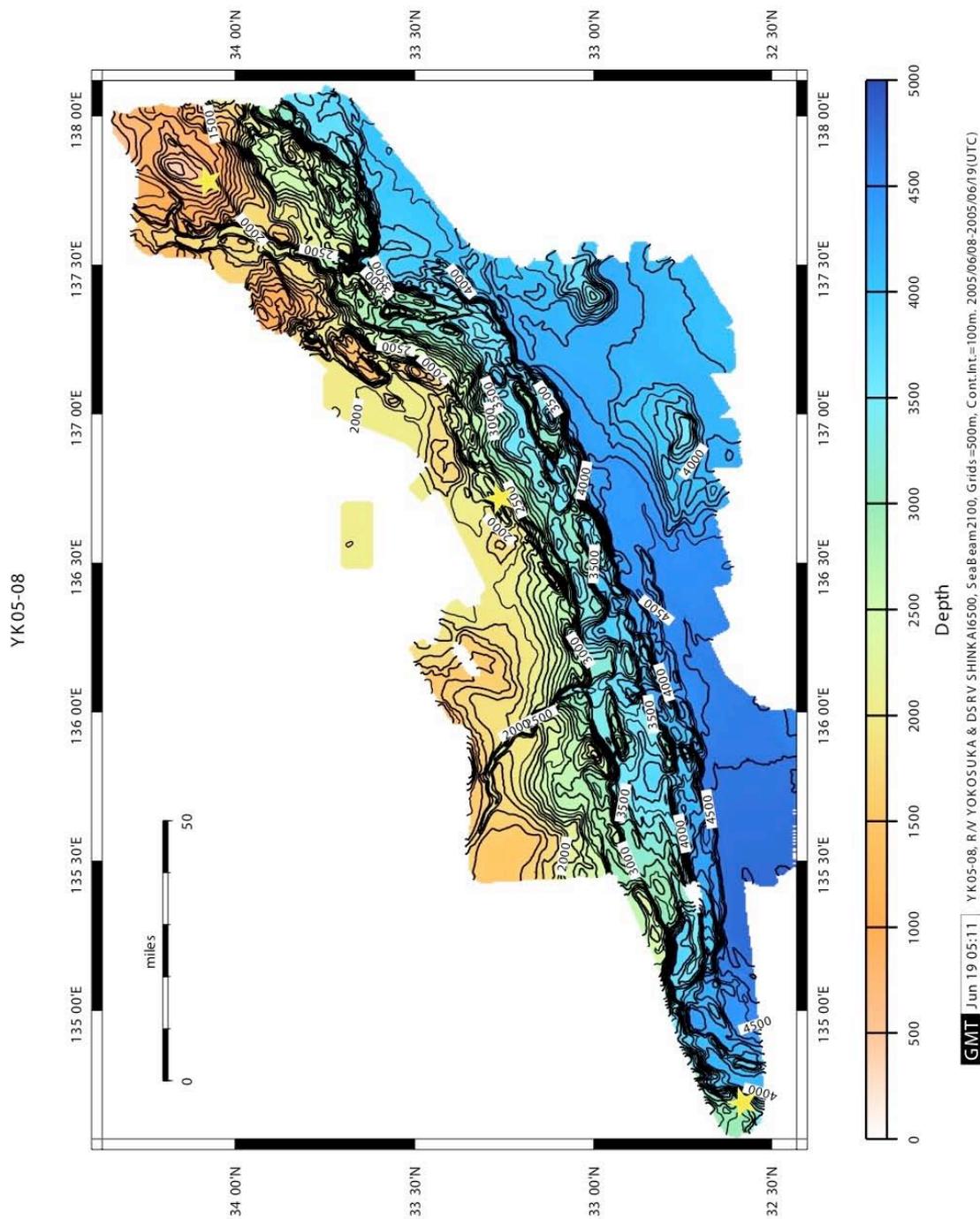
Sea beam survey by NaBiSC cruise (YK05-08)



Combined the datas with NaBiSC (YK05-08), YK02-02, and YK03-03



Yellow stars pointed the diving points in the NaBiSC (YK05-08) Cruise on the combined survey map.



A3. Cruise diary by Chair, CK.

航海日誌

YK0508, leg1 航海 (NaBiSC, Nankai Bio-Symbiont Cruise)

6月10日 (金曜日)

9時 出港、その後、台風4号の影響を避けるため千葉沖の東京湾にてアンカーを降ろし停泊。

10時 Science Meeting、本航海の目的と各自の役割分担を確認。船上での研究上の注意点を確認。

14時 Meeting with YOKOSUKA operation、船上生活での注意事項についてレクチャーを受け、受講の証明として全員がサインをする。

15時30分～16時30分 潜航予定者の潜水船ブリーフィング。

17時 Science Meeting、現状の状況を確認し、明日の行動予定を伝達。Dive#6K-881について潜航研究者の藤原研究員より説明があり、ペイロード、サンプル分配について意見交換。その後、2002年にしんかい2000により潜航した、今回のターゲットポイントの映像を確認し、皆で意見交換した。

6月11日 (土曜日)

8時 横須賀機構岸壁構外に向け航走開始。

9時30分過ぎ 機構岸壁構外にてアンカー、通船を出す。理由は、DEEPAQUALIUM システムの圧力維持ポンプに不具合が発生し、業者とのやり取りを行った結果、船上での修復が不可能であることが判明したため、機構研究室においてある予備ポンプを取りに行くことである。本実験担当者の小西研究員、花園実習生が通船により取りに行くこととする。本行動は、同ポンプの作動不具合が、本調査の成果に重大な支障をもたらすとの首席の判断の下、司令とも相談の上船長の判断によって、実施された。今後、こうした重要な機器類に関しては、必ず予備品を持ち込み、バックアップ体制をきちっとすることでやっていくこととしたい。研究者グループとして深く反省しなければならない。その後現場海域に向け航走開始。

10時 6Kチームとの最終打ち合わせ。各潜航時におけるペイロードを確認し、潜航行動について意見交換した。その後、6Kチームの方でペイロードの搭載作業を始める。

17時 Science Meeting 船内ラボにおける冷蔵庫等の利用に関する場所の分担に着いて確認し、各自のサンプルシェア、研究目的について確認した。その後、6K#881 に関しての計画を確認。夜間に潜航海域に到着し、シームサーベィを行う。

6月12日 (日曜日)

10時に潜航 6K#881 開始の予定であったが、海峡不良のため11時30分まで待機した。11時30分、本日中の海峡の回復が見込めないため、「潜航中止」の決定があった。サイエンスグループとしては、潜航の順番をこのままスライドして、明日も藤原潜航でいくことを確認した。本日は、これより、潜航調査点の周りのシービームサーベィを行う。

17時30分よりサイエンスミーティングを行い、短時間で伝達事項の確認をした。

6月13日（月曜日）

9時過ぎより潜航の最終点検を行い、10時過ぎに第881潜航（潜航研究者、藤原義宏研究員、JAMSTEC）を開始した。10時30分着底、深度652m。本海域、第2天竜海丘は、「しんかい2000」により2002年に潜航された実績（2K#1377）のある地点で、すでに大きなシロウリガイ等の死殻コロニーが広がっていることが観察されている。今回の潜航の目的は、本深度におけるシロウリガイを中心とした化学合成共生系2枚貝を採取し、その周辺の底泥を採取することであったが、潜航の成果として生きたシロウリガイ個体2個、チューブワーム数個体の採取に成功した。これらの生物サンプルは、低酸素水槽にて生きた状態で保持した。累々と広がる死殻コロニーの中で生きた貝は、ごくわずかしは見つからず、その採取には困難を極めた。底泥は予定通りコントロールとシープ堆積物の採取に成功した。現在、船内ラボにて、生物ソーティング、DNA抽出、微生物分離等の作業を行っている。

19時30分よりサイエンスミーティングを行い、潜航報告、サンプル分配、明日の潜航計画等について議論した。

6月14日（火曜日）

潜航海域にうねりがあって、潜航実施までの決断を要したが、予定通り、第882潜航（潜航研究者、小西聡史研究員、JAMSTEC）を行った。潜航地点は昨日の第881潜航とほぼ同じ地点で、前潜航により仕掛けられた魚トラップ等の回収ならびに DEEPAQUALIUM システムによる深海魚の保圧採取を目的として潜航行動を行った。魚トラップに捕らえられていた深海魚は、ヌタウナギの類でサイズが大きすぎたため、小型の魚の捕獲を試みたが、最終的に吸い込み法での採集はうまくいかなかった。また、本潜航では各種採泥を行い、シロウリガイ個体、チューブワーム等の生物採取を行った。これらの生物は、低酸素水槽内にて生きている状態で保持されている。本航海アドバイザーの奥谷先生によると、これらのシロウリガイは、「エンセイシロウリガイ」であろうとのことであったが、詳しい分類学的な同定は、下船後に行う運びである。なお、本潜航にて採取されたヌタウナギの類は、元気な状態で加圧水槽内に保持され、現場の水圧・温度にて維持されている。今後徐々に減圧を行い、下船時には大気圧下にして JAMSTEC 横須賀の実験室まで持ち帰る予定である。本海域の底質は、砂まじりの泥で MBARI 式のコア採泥には困難を極めたが、無菌採泥器による操作は良好であった。

19時30分よりサイエンスミーティングを行い、潜航報告、サンプル分配、明日の潜航計画等について議論した。

6月15日（水曜日）

本日は海況不良のため、予定されていた潜航#883（潜航予定研究者、奥谷喬司、JAMSTEC）は中止された。本第2潜航地点は、深度約2000mの潮岬南東方であったが、10時からサイエンスミーティングを行い、潜航はスライドして行う旨首席の決断を確認した。ただしこの地点で予定されていた2潜航分を1回の潜航でやるので、ペイロードに大型無菌採泥器等の機器を搭載する旨、6Kチームと相談の上了承された。19時の定例ミーティングにて本日の概況を説明し、明日の行動予定を確認した。

6月16日（木曜日）

本日も海況不良のため、潜航#883は中止となった。そのため、第3潜航ポイントである室戸沖深度

3800m のシーブームサーベイを行うため、現地に向かいサーベイを行った。10時のミーティングで現状について説明し、今後の方針として潜航者ならびに潜航地点のプライオリティについて首席の意思を伝えた。その後、司令・船長とも意見交換し、天候概況などの資料を勘案して可能性のある今後の2行動について以下のようにまとめた。

1) 第2潜航ポイント（潮岬南東方 2000m）を明日の潜航でねらう。

2) 第3潜航ポイント（室戸沖 3800m）を明後日の潜航でねらう。

19時の定例ミーティングにてこの方針を伝え、サンプリングの優先順位等について意見交換した。

6月17日（金曜日）

10時より潜航#883が、第2潜航ポイント（潮岬南東方 2,000m）で実施された（潜航者、奥谷喬司、JAMSTEC）。潜航目標点は、3年前の潜航 6K#676 で発見されたシロウリガイコロニーで、52番マーカーが立てられている地点である。本潜航調査では、深度 2,048m にて同マーカーを確認し、小規模なシロウリガイコロニーを見いだした。本現場から、MBARI 式採泥、無菌採泥、採水等を行い、あわせ、シロウリガイのサンプリングを行った。本マーカーポイントを中心にシロウリガイコロニーをサーベイしたが、映像で確認した3年前の潜航と比較して、コロニーの規模が小さくなっていることが感じられた。あわせ各種生物のサンプリングを行い、予定通り 16時30分には浮上した。19時30分より定例ミーティングを行いサンプルの分配、整理について確認した。

6月18日（土曜日）

10時より、室戸岬南東方海域（第3潜航ポイント、深度 3,300m）にて第884潜航が実施された（潜航者、佐藤孝子、JAMSTEC）。本潜航ポイントは、黒潮の大蛇行点に重なり、その海流の問題から計画当初からその潜航の実施が危ぶまれていた。したがって、予備海域として第4潜航ポイントを設定し万全の体制で取り組んでいた。しかしながら、本日は天候にも恵まれ、この室戸沖では梅雨前線が南に下がり、良好な状態で潜航行動を実施することができた。不思議なことに、本船の東西では前線が北上しており非常に幸運な状態に置かれていたことが、天気図から示された。

本潜航の目的は、3000m 以深よりシロウリガイコロニーを見出し、カイとその周辺の堆積物を採取することであったが、これは達成された。これまでの3回のどの潜航でもみられたより大きなシロウリガイコロニーを見だし、その周辺の底泥ともどもサンプリングにも成功した。本潜航の成功により、本行動における必要最低限の深度別サンプルを得ることができた。19時30分より定例ミーティングを行いサンプル分配、整理について確認した。明日（19日）午前8時に和歌山の下津港中埠頭3号に着岸して本行動は終了する。

6回の潜航の計画に対して、4回の潜航で終わったのは梅雨前線による海況不良のためであったが、これで仕事ができると希望を持つことができた。本行動を支えてくれた石田船長を始めとする「よこすか」乗組員の皆様、今井司令を始めとする「しんかい」チームの皆様に乗船研究者を代表して心より感謝申し上げます。この報恩として、必ずやいい成果を出すことを誓い、本航海日誌を終了させていただく。

Thanks for collaboration! See you again!!