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NATSUSHIMA Cruise Report
NT08-09 LEG1,2

Eastern margin of Japan Sea

April 29th, 2008 – May 21st, 2008

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Contents

1. Cruise Information

Cruise number: NT08-09 LEG1,2

Ship name: R/V *Natsushima*, ROV *Hyper-Dolphin*

Title of the cruise:

Integrated study on biogeoscience of methane hydrate and methane plume in the eastern margin of Japan Sea

Title of proposal:

Biological and geological researches on the methane hydrate and methane plume in the eastern margin of Japan Sea

Cruise period: April 29th, 2008 – May 21st, 2008

Port call:	April 29th	Departure	JAMSTEC, Yokosuka, Kanagawa
	May 10th – 12th	Port call	Naoetsu, Niigata
	May 21st	Arrival	JAMSTEC, Yokosuka, Kanagawa

Research area: Eastern margin of Japan Sea
Sado Ridge-Joetsu Knoll-offshore Okushiri Island-Shiribeshi Trough

Research map:

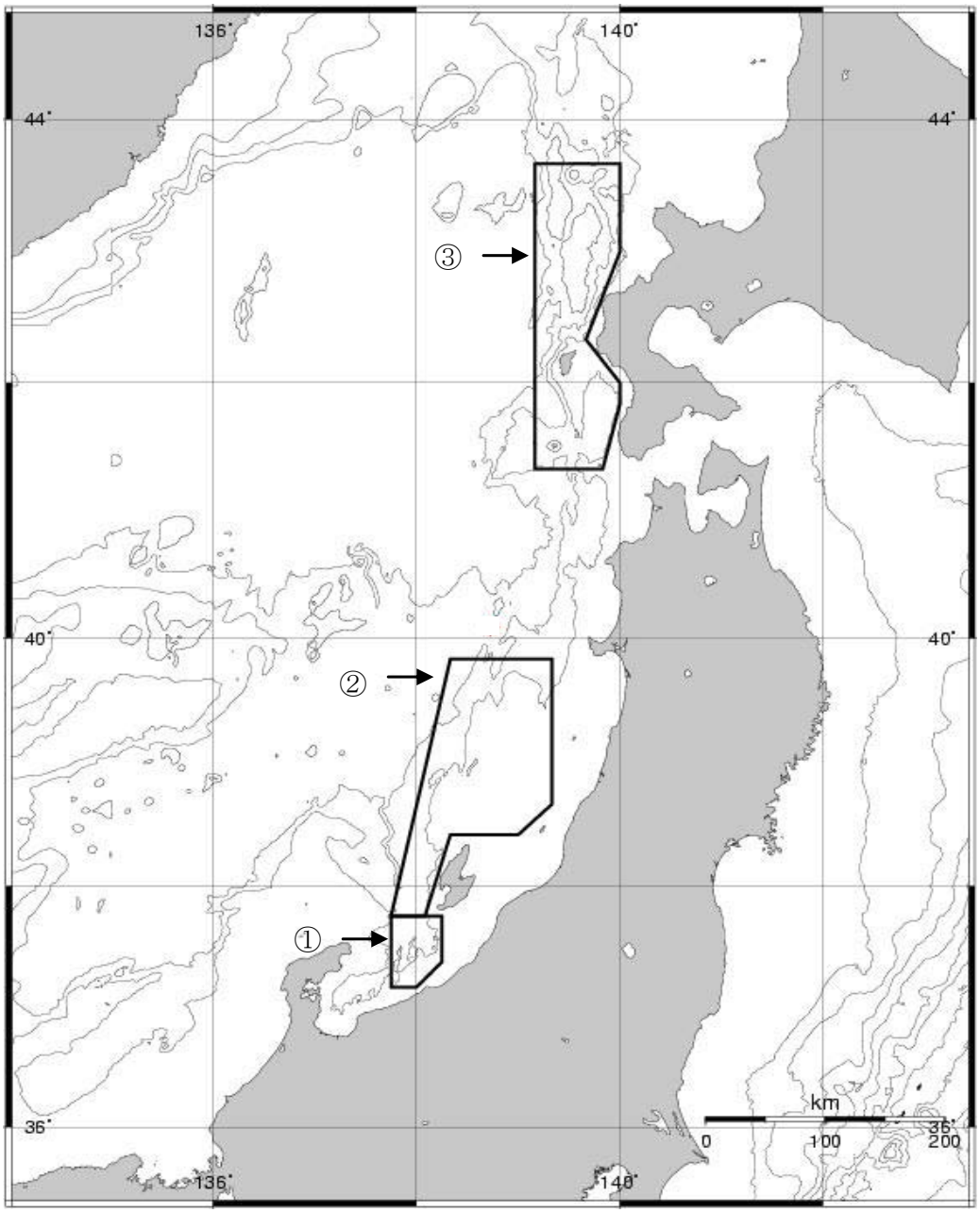

Fig. 1: Bathymetric map with proposed research areas; 1) Joetsu Knoll-Umitaka Spur area, 2) Sado Ridge, and 3) west off Hokkaido (Okushiri Island and Shiribeshi Trough).

2. Researchers

Chief Scientist: Ryo Matsumoto (Earth and Planetary Science, University of Tokyo)

Representative of Science Party:
Ryo Matsumoto (Earth and Planetary Science, University of Tokyo)

Science Party:

Table 1: List of science party of NT08-09.

Name	Affiliation	Assignment
Chief Scientist/ Representative of Science Party		
Ryo Matsumoto	Earth and Planetary Science, University of Tokyo	chief
Science Party		
Hideki Numanami	Tokyo Kasei Gakuin University	biology
Hideaki Machiyama	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	HF/SCS
Katsunori Fujikura	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	biology
Masato Joshima	National Institute of Advanced Industrial Science and Technology (AIST)	DAI PACK
Chiharu Aoyama	Japan's Independent Institute Co., Ltd.	echo sound
Akihiro Hiruta	Earth and Planetary Science, University of Tokyo	geochemistry
Fernando Freire	Earth and Planetary Science, University of Tokyo	sedimentlogy
Risa Sanno	Earth and Planetary Science, University of Tokyo	carbonate sed
Kazuhiro Tsuchinaga	Earth and Planetary Science, University of Tokyo	gas geochem
Maki Suzuki	Earth and Planetary Science, University of Tokyo	carbonate sed
Gin Kinoshita	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	biology
Eriko Seo	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	biology
Hitoshi Tomaru	New Energy Resources Research Center, Kitami institute of Technology	geochemistry
Satsuki Kataoka	System engineering course, Kitami Institute of Technology	geotechnical engineering
Yoshihiro Fujiwara*	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	biology
Mikio Satoh*	National Institute of Advanced Industrial Science and Technology (AIST)	geology
Mineo Hiromatsu*	Earth Sciences, Chiba University	geology

*: shore-based scientist

3. Research Summary

3.1. Objectives

Although marine gas hydrates have a close relation to our life in terms of gas resource, global environment, and potential disaster, their distribution and behavior are still a matter of debate. The goal of our research is to understand geological factors and processes controlling the distribution and behavior of marine gas hydrate system. The Japan Sea is a semi-isolated marginal basin which is surrounded by the Japanese Island Arc and the Asian main land, strong emission of methane from the seafloor into the overlying seawater may cause a large impact to marine environments. On the other hand, observations of active methane emissions point to higher gas resource potential along the eastern margin of the Japan Sea. This study focuses on geophysical and submersible researches in the Joetsu Knoll, Sado Ridge, and Okushiri Island-Shiribeshi Trough regions, and integration of geological, geochemical, and biological features among these sites to assess the total resource potential and methane activities in this region.

3.2. Observations & Activities

ROV *Hyper-Dolphin* dive surveys were conducted in the following regions;

(1) Joetsu Knoll region

(1)-1: Umitaka Spur area (water depth; 850-1000 m)

37°24.0’N – 137°59.5’E – 37°28.0’N – 138°02.0’E

(1)-2: Joetsu Knoll region (water depth: 900-1200 m)

37°31.0’N – 137°54.0’N – 37°38.0’N – 138°02.0’E

(2) Sado Ridge region

No dive researches

(3) Okushiri Ridge-Shiribeshi Trough region

(3)-1: South to Okushiri Island (water depth; 100-2800 m)

41°40.0’N – 139°10.0’E – 42°10.0’N – 139°10.0’E – 42°10.0’N – 139°23.0’E – 42°02.0’N – 139°23.0’E – 42°02.0’N – 139°33.0’E – 42°10.0’N – 139°33.0’E – 42°10.0’N – 139°45.0’E – 41°40.0’N – 139°45.0’E

(3)-2: South Shiribeshi Trough (water depth; 1000-3000 m)

42°30.0’N – 139°10.0’E – 43°00.0’N – 139°10.0’E – 43°00.0’N – 140°00.0’E – 42°30.0’N – 139°45.0’E

(3)-3: North-West Shiribeshi Trough (water depth; 500-3000 m)

43°00.0’N – 139°10.0’E – 43°30.0’N – 139°30.0’E – 43°30.0’N – 139°50.0’E – 43°00.0’N – 139°30.0’E

Single Channel Seismic (SCS) and SEABAT surveys were conducted by R/V

Natsushima in the following regions;

(3) Joetsu Knoll region

(1)-1: Umitaka Spur area (water depth; 260-2200 m)

37°10.0’N – 137°45.0’E – 37°45.0’N – 137°45.0’E – 37°45.0’N – 138°15.0’E – 37°22.5’N – 138°15.0’E – 37°10.0’N – 138°00.0’E

(1)-2: Joetsu Knoll region (water depth: 50-1100 m)

37°31.0’N – 137°54.0’N – 37°38.0’N – 138°02.0’E

(4) Sado Ridge region

37°45.0’N – 137°45.0’E – 39°50.0’N – 138°20.0’E – 39°50.0’N – 139°20.0’E – 38°40.0’N – 139°20.0’E – 38°25.0’N – 139°00.0’E – 38°25.0’N – 138°20.0’E – 37°45.0’N – 138°05.0’E

(3) Okushiri Island-Shiribeshi Trough region (water depth; 100-3300 m)

41°20.0’N – 139°10.0’E – 43°40.0’N – 139°10.0’E – 43°40.0’N – 140°00.0’E – 43°00.0’N – 140°00.0’E – 42°20.0’N – 139°40.0’E – 42°00.0’N – 140°00.0’E – 41°50.0’N – 140°00.0’E – 41°20.0’N – 139°50.0’E

3.3. Methods

ROV *Hyper-Dolphin*

1) Observation of seafloor morphology, methane plume, and benthic organisms with submarine video camera and monitor.
2) Experiments of gas hydrate dissociation/formation with double-evacuated syringe fluid sampler.
3) Sampling of methane hydrates and host sediments with rotary corer.
4) Long-term observation of methane plume with video monitor.
5) Fluid sampling with vacuum sampler and NISKIN sampler.
6) CTD measurements.
7) Experiment of methane plume quantification with quantitative echo sounder.
8) Sediment sampling with push corer (MBARI, MBARI-Long sampler).
9) Heat flow measurement with SAHF.
10) Seafloor survey with DAI-PACK.
11) γ-ray measurement.
12) Benthic organism sampling with slurp gun, rake, and basket (dredge).
13) Installation of H-SM type reaction chamber.

R/V *Natsushima*

1) Observation of seafloor morphology and methane plume distribution with SEABAT and quantitative echo sounder during transition or night time.
2) Determination of methane plume location with SEABAT during ROV

operation to conduct the ROV precisely.

3) Acquisition of sub-seafloor profile with SCS survey.

3.4. List of Observation Instruments

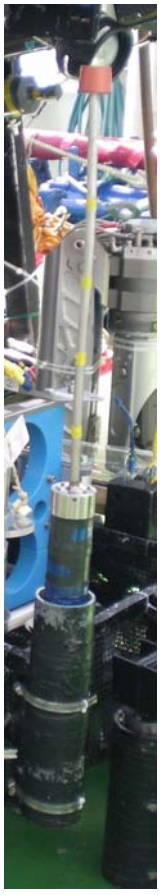

Fig. 2: Heat Flow Meter (SAHF)

Fig. 3: MBALI-type core (long)

Fig. 4: H-SM type reaction chamber

Fig. 5: M-type double vacuum sampler

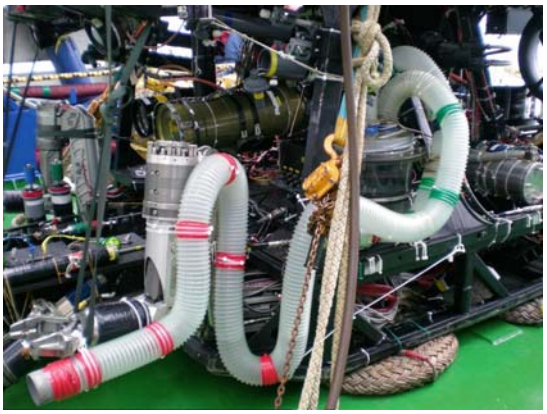

Fig. 6: Slurp gun

Fig. 7: NISKIN sampler

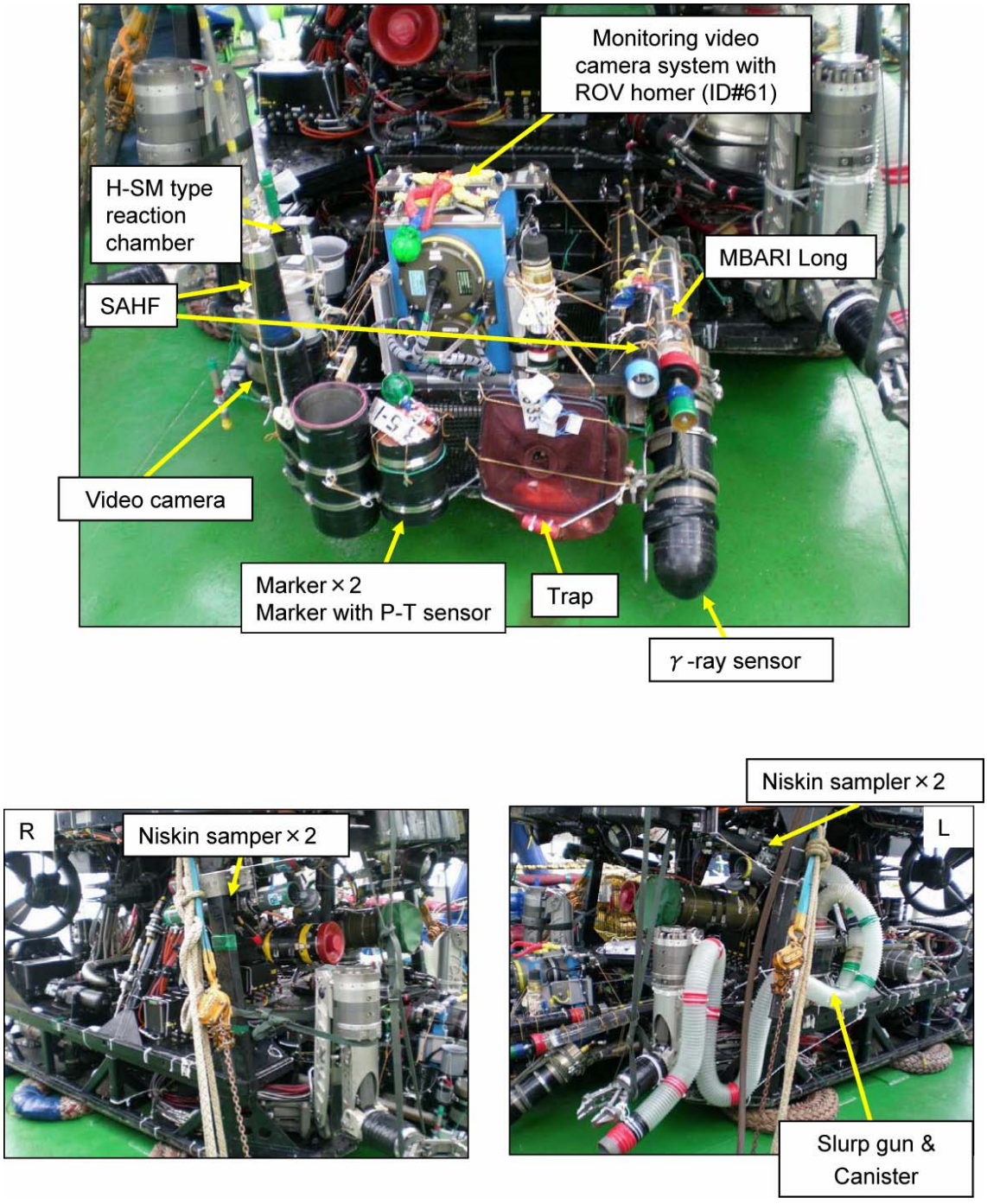

Fig. 8: Example of payloads (from Dive#835).

3.5. Cruise Log

Table 2: Cruise log of NT08-09.

Date	Operation	Area
April 29	Embarkation/Departure/Transit	JAMSTEC, Yokosuka
30	Transit	
May 1	Transit	Tsugaru Strait
2	SCS/SEABAT	Sado Ridge
3	SCS/SEABAT	Sado Ridge
4	SCS/SEABAT	Joetsu Basin – N Umitaka Spur
5	Dive#829 (DAI-PACK)	Southern Joetsu Knoll
	SCS/SEABAT	Northern Joetsu Knoll
6	Divbe#830 (Hydrate sampler)	Southern Joetsu Knoll
	SCS/SEABAT	Central Umitaka Spur
7	Dive#831 (DAI-PACK)	Northern Umitaka Spur
	Dive#832 (H-SM experiment)	Northern Umitaka Spur
	SCS/SEABAT	Southern Joetsu Knoll
8	Dive#833 (Gas hydrate obs.)	Northern Umitaka Spur
	Dive#834 (Gas hydrate obs.)	Central Umitaka Spur
	SCS/SEABAT	
9	Dive#835 (Monitor, H-SM exp.)	Central Umitaka Spur
	Dive#836 (GH dissociation exp.)	Southern Joetsu Knoll
	SCS/SEABAT	
10	Dive#837 (Monitor recovery)	Central Umitaka Spur
	Port call/Public lecture	Naoetsu
11	Public open	Naoetsu
	Embarkation (Leg 2)	Naoetsu
12	Departure	
	Dive#838 (GH dissociation exp.)	Central Umitaka Spur
	Transit	
13	Transit	
14	Dive#839	Northwestern Shiribeshi Trough
	SCS/SEABAT	South off Okushiri Island
15	Dive#840	South off Okushiri Island
	SCS/SEABAT	South off Okushiri Island
16	SCS/SEABAT	West off Okushiri Island
17	Dive#841	South off Okushiri Island
	Dive#842	South off Okushiri Island
	SCS/SEABAT	
18	Dive#843	South off Okushiri Island

19	Transit	
20	Disembarkation	Kamaishi

3.6. Dive Points

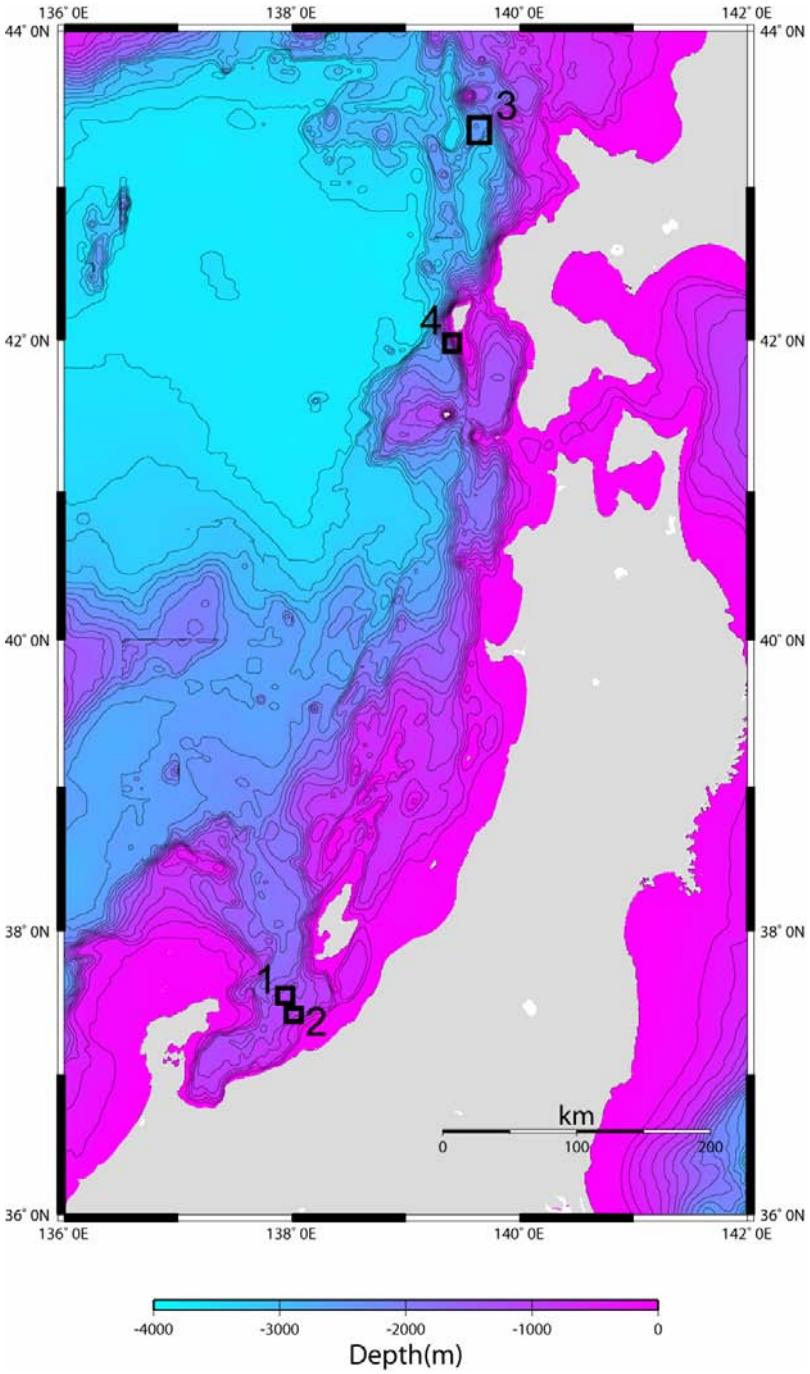

Fig. 9: Bathymetric map of the eastern margin of Japan Sea. Boxes denote detailed research areas shown in the following figures.

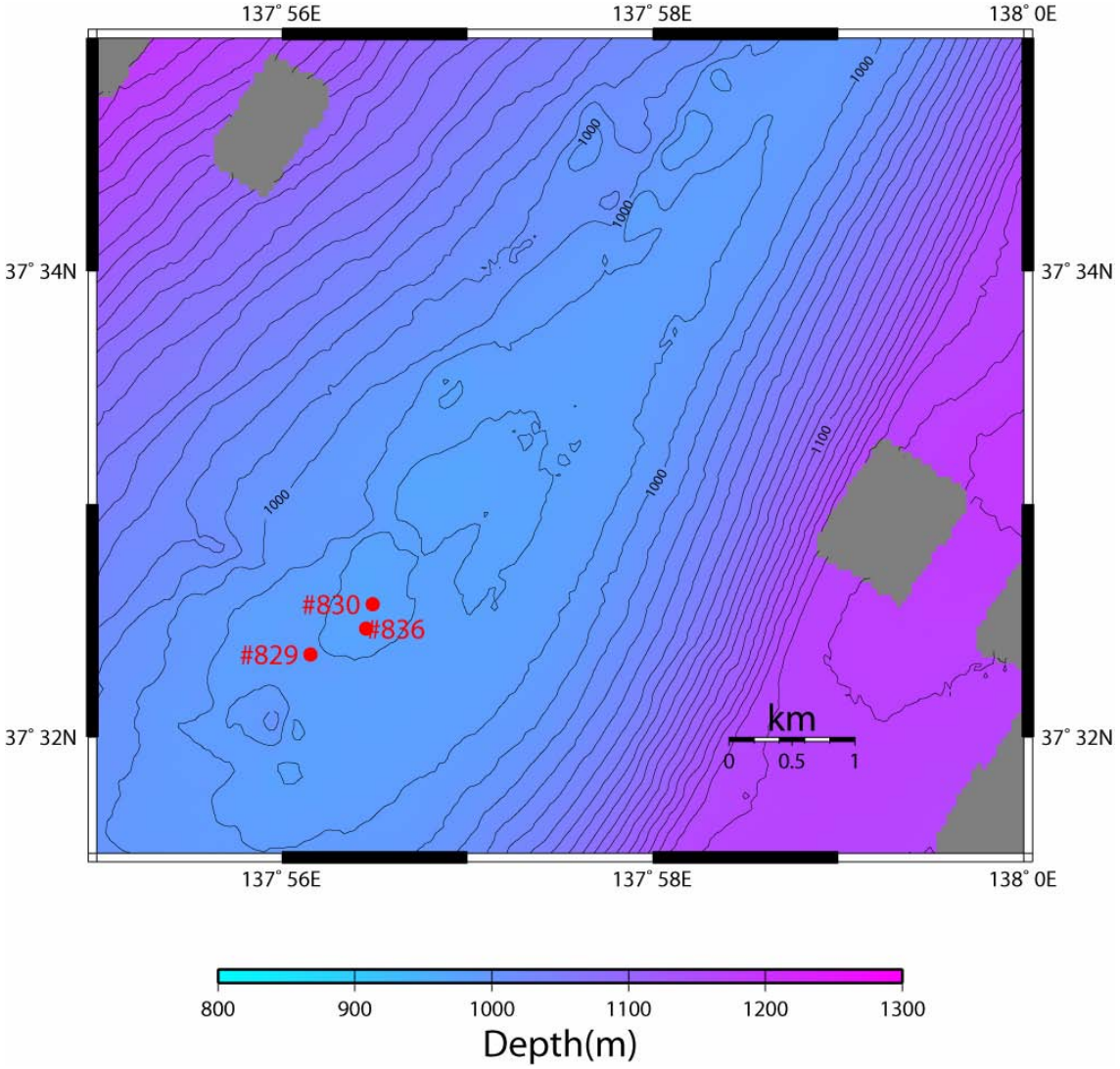

Fig. 10: Detailed map of the Joetsu Knoll (Box 1 in Fig. 9) with dive points of Dives #829, #830, and #836.

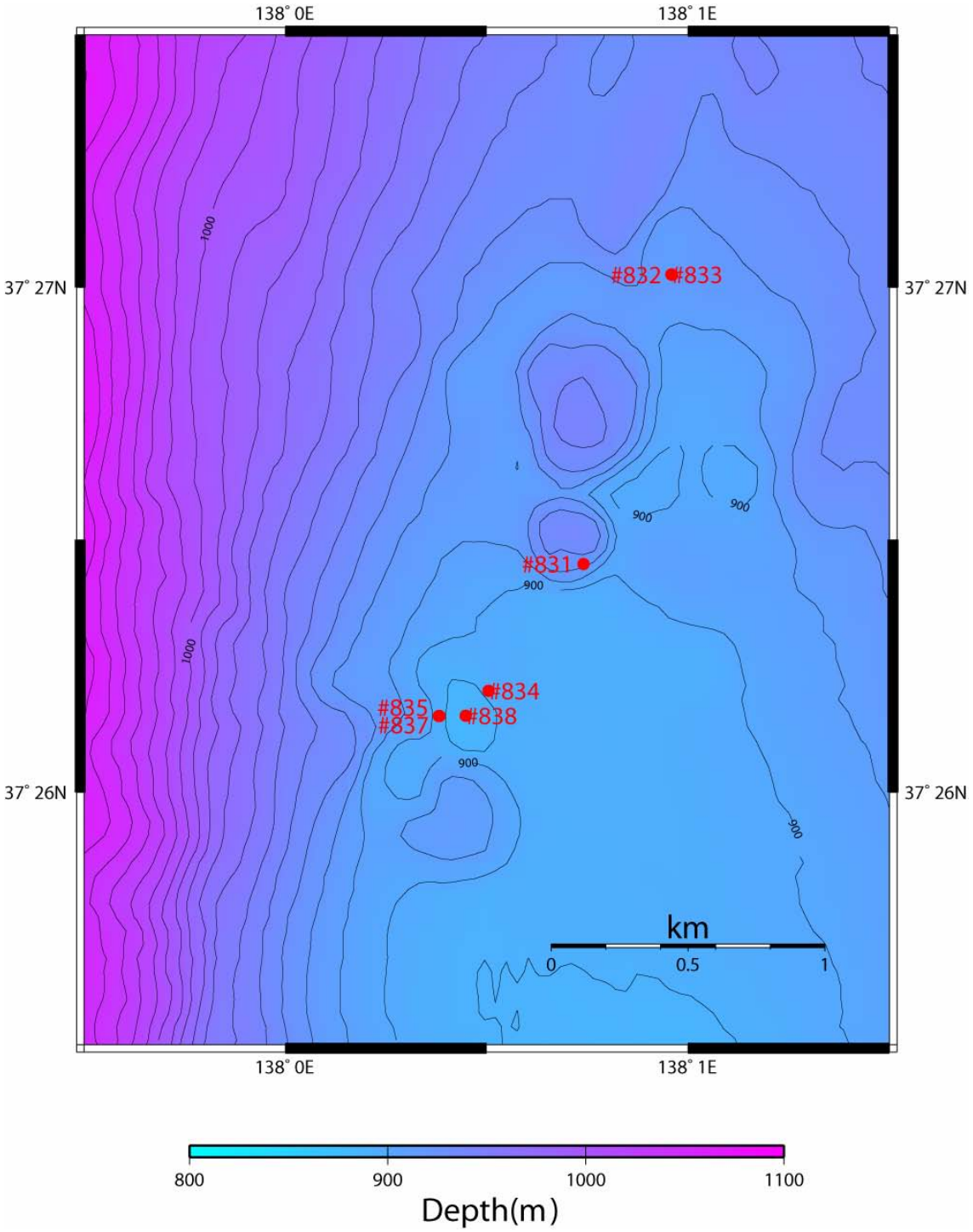

Fig. 11: Detailed map of the Umitaka Spur (Box 2 in Fig. 9) with dive points of Dives #831, #834, #835, #837, and #838.

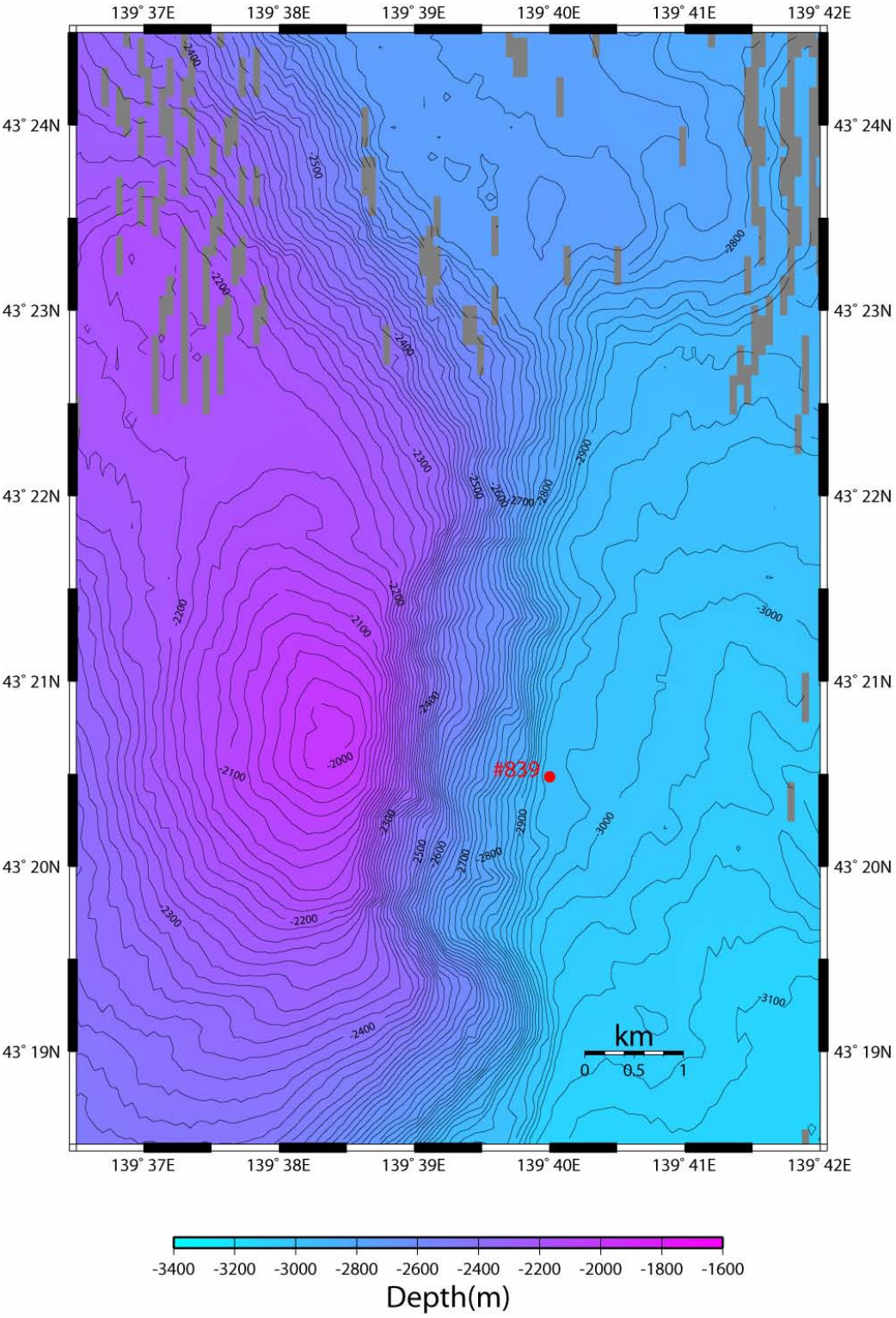

Fig. 12: Detailed map of southern Shiribeshi Trough (Box 3 in Fig. 9) with dive points of Dive #839.

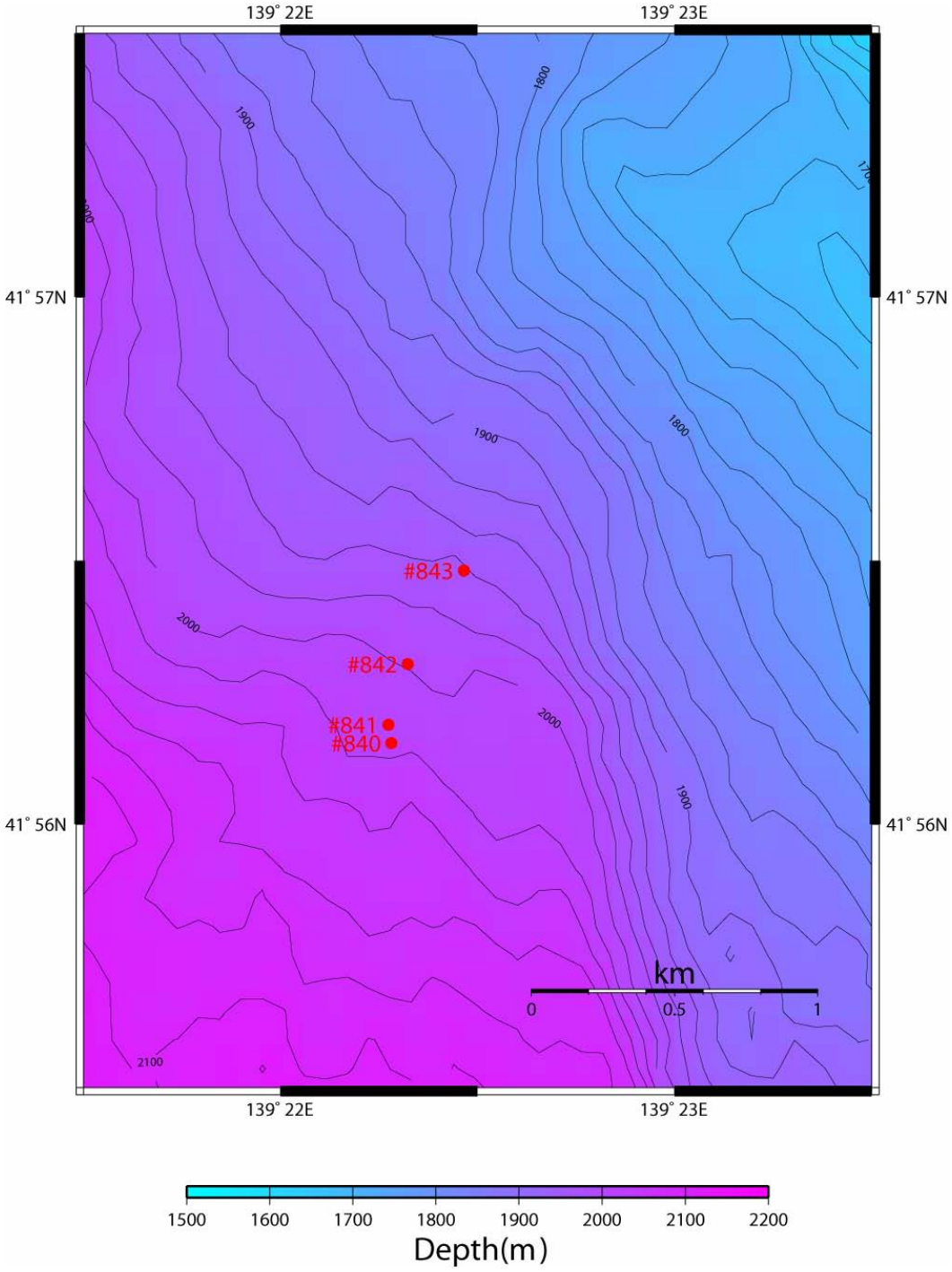

Fig. 13: Detailed map of south off Okushiri Island (Box 4 in Fig. 9) with dive points of Dives #840, #841, #842, and #843.

3.7. Dive Summary

1. Dive #829
2. Date 2008.05.05
3. Area Southern Joetsu Knoll
4. Reporter Masato Joshima (AIST)
5. Purpose of the dive DAI-PACK survey and methane plume survey
6. Landing time and point 09:02 37-32.355’N, 137-56.154’E; 987 m
7. Floating time and point 12:57 37-32.723’N, 137-56.263’E; 975 m
8. Payload
   - Box
   - DAI-PACK system with Joshima Camera
   - Escape cutter
   - H-SM type reaction chamber
   - M-type double vacuum sampler
   - MBARI
   - MBARI-L
   - MT-corer
   - NISKIN sampler
   - P-marker
   - Rake sampler
   - SAHF
   - Slurp gun
   - Vacuum fluid sampler
   - γ-ray sensor
9. Samples collected

Box	2
M-type double vacuum sampler	2
MBARI	4
MBARI-L	1
MT-corer	1
NISKIN sampler	4
Slurp gun	1
Vacuum fluid sampler	1

10. Outline of the dive

Finally 16 survey lines were carried out of 23 originally planned lines. South to central part of planned survey for mounds was studied, while northernmost mound was not studied. These planned survey lines were cut by the 800 m cut-off line from fishery tools. We found 8 colored area or bacterial mats along these survey lines. We found fishery rope near the end of Line 16 at 12:56 unfortunately, Dive #829 was then given up abruptly. Three NISKIN samplers were carried out at near bottom, 300 m below sea

level (mbsl), and 200 mbsl during the ROV recovery.

11. Highlights

IMAGINEX side-scan-sonar records were processed with SSBL acoustic positions.

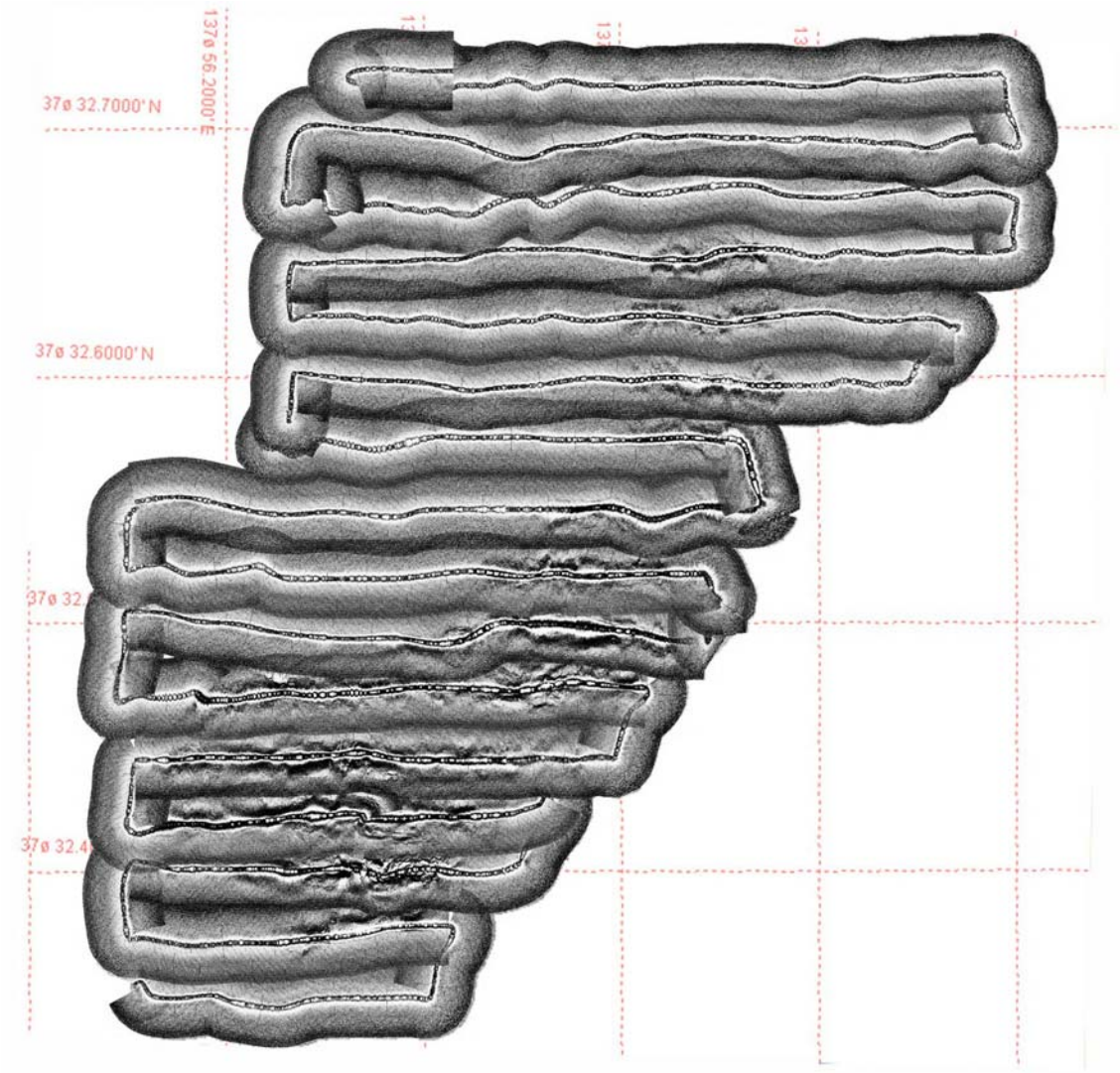

Fig. 14: Side-scan-sonar image at the southern Joetsu Knoll.

1. Dive #830
2. Date 2008.05.06
3. Area Jouetsu Knoll south
4. Reporter Hideki Numanami (Tokyo Kasei Gakuin Univ.)
5. Purpose of the dive Search for methane seep
6. Landing time and point 11:51 37-32.570'N, 137-56.489'E; 972 m
7. Floating time and point 17:13 37-32.411'N, 137-56.259'E; 973 m
8. Payload

Box
Escape cutter
MBARI
MBARI-Long
MH sampler
NISKIN sampler
P-marker
Rake Sampler
SAHF
Slurp gun
Vacuum fluid sampler
γ-ray sensor

9. Samples collected

Box	2
MBARI	2
MBARI-L	2
NISKIN sampler	4
Slurp gun	1
Vacuum fluid sampler	1

10. Outline of the dive

Because of the bad weather, dive was delayed. After ROV arrived on the seafloor covered with muddy surface sediments, it moved ~100 m to the south and then turned to the west. The ROV moved ~50 m to the west, patchy bacterial mats and carbonate crusts and nodules were found on the seafloor. Many red snow crabs, *Chionoecetes japonicas,* were also observed. A large number of crabs crowded under the sea anemone. Samplings of sediments, carbonates, and benthos and SAHF measurements were conducted around this point. Approximately100 m south to the landing point, gas bubbles were ejecting weakly from the seafloor. After fluid and sediment samplings, ROV arrived at the P-marker (H604-01) point, the seafloor in this area was covered with rough and hard mud and was characterized by cliff. The massive large blocks of gas hydrate were outcropping on the cliff wall. Samplings of sediments, carbonates, and benthos and SAHF measurement were conducted around this wall.

11. Highlights

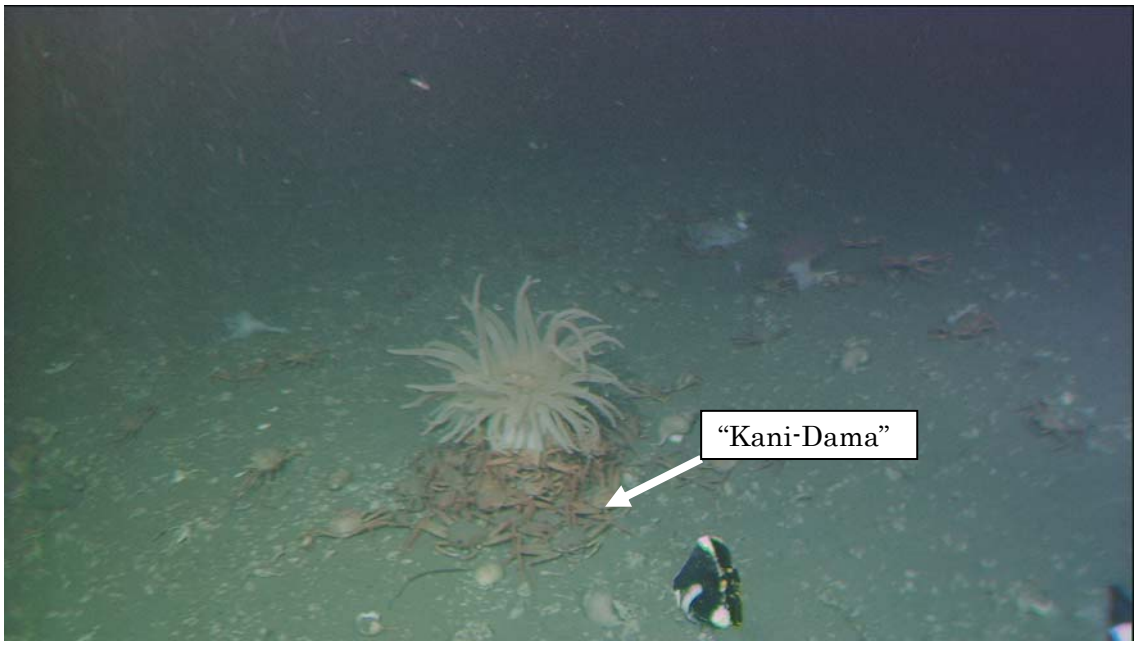

Fig. 15: Large number of red snow crabs, *Chionoecetes japonicus*, crowded under the sea anemone (“Kani-Dama”).

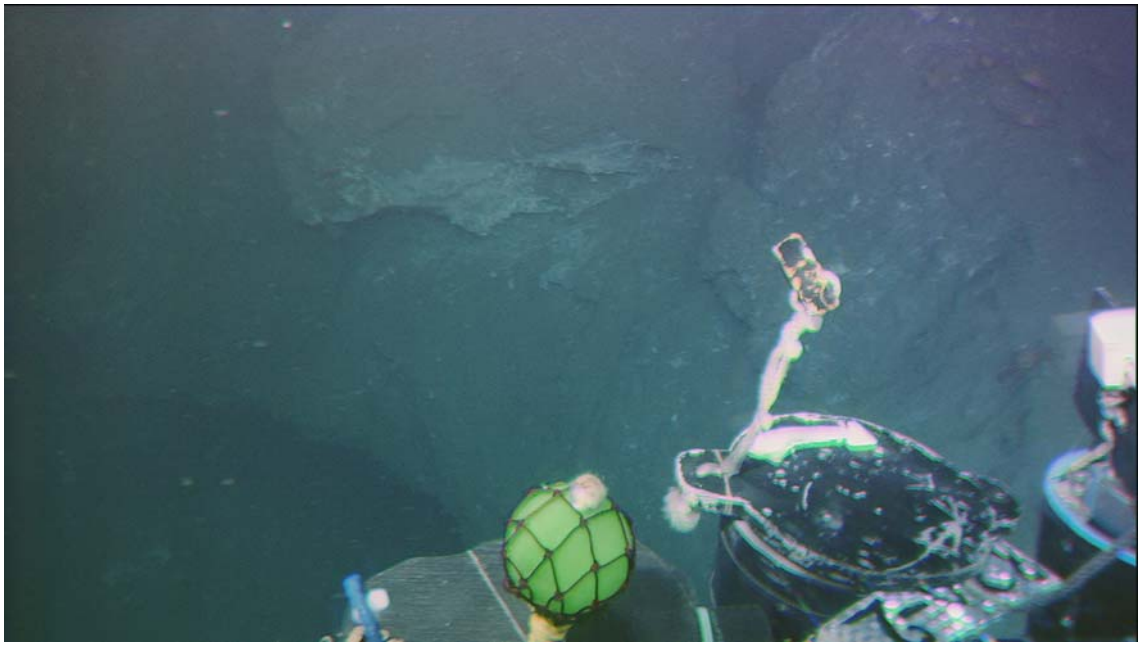

Fig. 16: Massive large blocks of gas hydrate outcropping on the hanging wall.

1. Dive #831
2. Date 2008.05.07
3. Area Northern Umitaka Spur
4. Reporter Masato Joshima (AIST)
5. Purpose of the dive DAI-PACK survey and methane plume survey
6. Landing time and point 08:51 37-26.452’N, 138-00.741’E; 895 m
7. Floating time and point 13:00 37-27.125’N, 138-00.970’E; 908 m
8. Payload

Box
DAI-PACK system with Joshima Camera
Escape cutter
H-SM type reaction chamber
M-type double vacuum sampler
MBARI
MBARI-L
MT-corer
NISKIN sampler
P-marker
Rake sampler
SAHF
Slarp gun
Vacuum fluid sampler
γ-ray sensor

9. Samples collected

Box	2
M-type double vacuum sampler	2
MBARI	4
MBARI-L	1
MT-corer	1
NISKIN sampler	4
Slarpgun	1
Vacuum fluid sampler	1

10. Outline of the dive

A total of 11 DAI-PACK survey lines were fully carried out, however this area is not so active compared with former Dive #829 and dives done in 2007. We found 5 colored areas at the southwestern edge and northeastern small mound. We moved to the active gas seep site found in 2007, Dive #755 area, and searched for gas bubble following the SEABAT information from R/V *Natsushima* but could not find and gave up the operation at 13:00. During the ROV recovery, 3 NISKIN samples were taken at 600, 250, and 100 mbsl.

11. Highlights

INAGINEX side-scan-sonar records were processed with the SSBL acoustic positions on board.

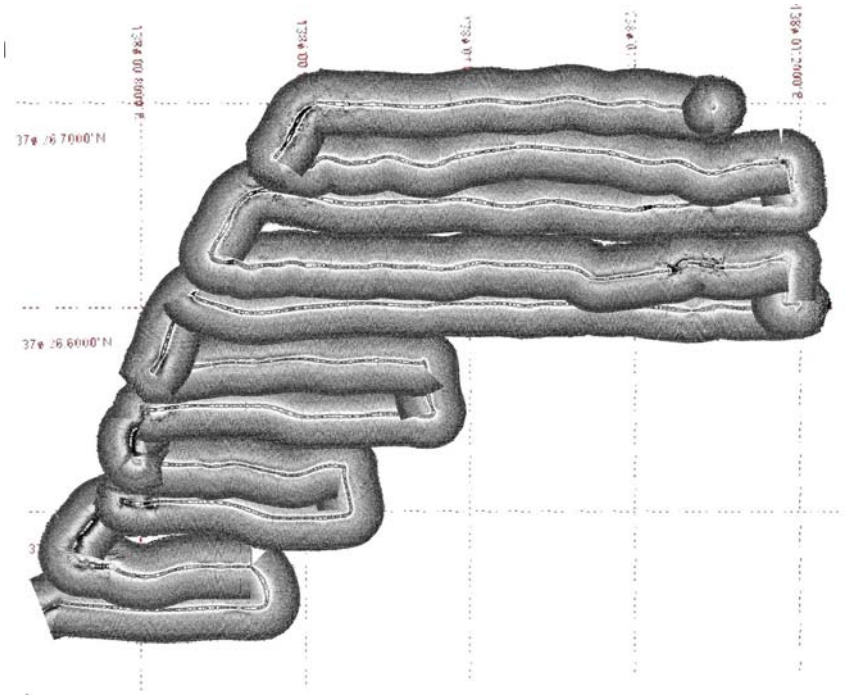

Fig. 17: Side-scan-sonar image at the northern Umitaka Spur.

1. Dive #832
2. Date 2008.05.07
3. Area Northern Umitaka Spur
4. Reporter Akihiro Hiruta (University of Tokyo)
5. Purpose of the dive Methane plume survey, Setting of H-SM reaction chamber
6. Landing time and point 15:38 37-27.025'N, 138-00.961'E; 914 m
7. Floating time and point 17:56 37-27.108'N, 138-00.964'E; 911 m
8. Payload

Box
Escape cutter
H-SM type reaction chamber
M-type double vacuum sampler
MBARI
MBARI-L
MT-corer
NISKIN sampler
P-marker
Rake sampler
SAHF
Slurp gun
Vacuum fluid sampler
γ-ray sensor

9. Samples collected

Box	2
MBARI-L	2
MT-corer	2
NISKIN sampler	4
Slurp gun	1

10. Outline of the dive

Dive #832 targeted the site at the northern Umitaka Spur, that has hilly topographic feature found during Dive #831 conducted this morning. After ROV arrived at the seafloor (15:38), it moved ~50 m to the west and then it headed to the northeast until the end of dive. Samplings of sediments and water by 2 MBARI, 2 NISKIN and 2 MT-corer, carbonates and benthos by manipulator and slurp gun and setting of two P-markers and one acryl tube filled with artificial sediment (H-SM type reaction chamber) were conducted ~200 m NNE to the landing point. Bore hole of MBARI sampling was used for setting of the chamber. Gas venting was found on the slope of the small mound. Because of rough seafloor, we gave up to settle the video monitoring system for bubbling observation. Two NISKIN bottle sampling (700 and 400 mbsl) were conducted during the ROV recovery.

11. Highlights

(1) Founding of gas bubble site. We could not approach gas plume sites that we found during the last NT07-20 cruise due to crab fishing tackles around the Umitaka Spur and Joetsu Knoll. Therefore, we must find gas bubble site in a limited area.
(2) We set acryl tube filled with synthetic sediment (quartz powder) for the first time. The objective of this experiment is to make SMI in artificial medium in which decomposition of organic matter does not occur.

Fig. 18: H-SM type reaction chamber. Pure quartz powder precombusted at 450 °C and crushed by ball mill was used for synthetic sediments.

1. Dive #833
2. Date 2008.05.08
3. Area Northern Umitaka Spur
4. Reporter Chiharu Aoyama (Japan's Independent Institute Co., Ltd.)
5. Purpose of the dive Methane plume survey
6. Landing time and point 08:49 37-27.026'N, 138-00.956'E; 913 m
7. Floating time and point 11:54 37-27.069'N, 138-00.951'E; 915 m
8. Payload

Box
Escape cutter
H-SM type reaction chamber
M-type double vacuum sampler
MBARI-L
MT-corer
NISKIN sampler
P-marker
Rake sampler
SAHF
Slarp gun
γ-ray sensor

9. Samples collected

MBARI-L	1
MT-corer	1
NISKIN sampler	4
Vacuum fluid sampler	1

10. Outline of the dive

At the gas seep site, gas bubbles were collected in the upside-downed funnel with volume of ~2000 mL attached on the ROV manipulator, resulting in the immediate formation of gas hydrate coating the bubbles. The hydrate-coated bubbles were then released into the water column, upwelling of these bubbles were observed with the quantitative echo sounder (transducer frequency at 38 and 120 kHz) onboard R/V *Natsuhisma* to obtain acoustic data.

We also took a chunk of gas hydrate from the hydrate crop on the seafloor near the seep site. The upwelling of the gas hydrate chunk was observed with the quantitative echo sounder (transducer frequency at 38 and 120 kHz) to obtain acoustic images.

11. Highlights

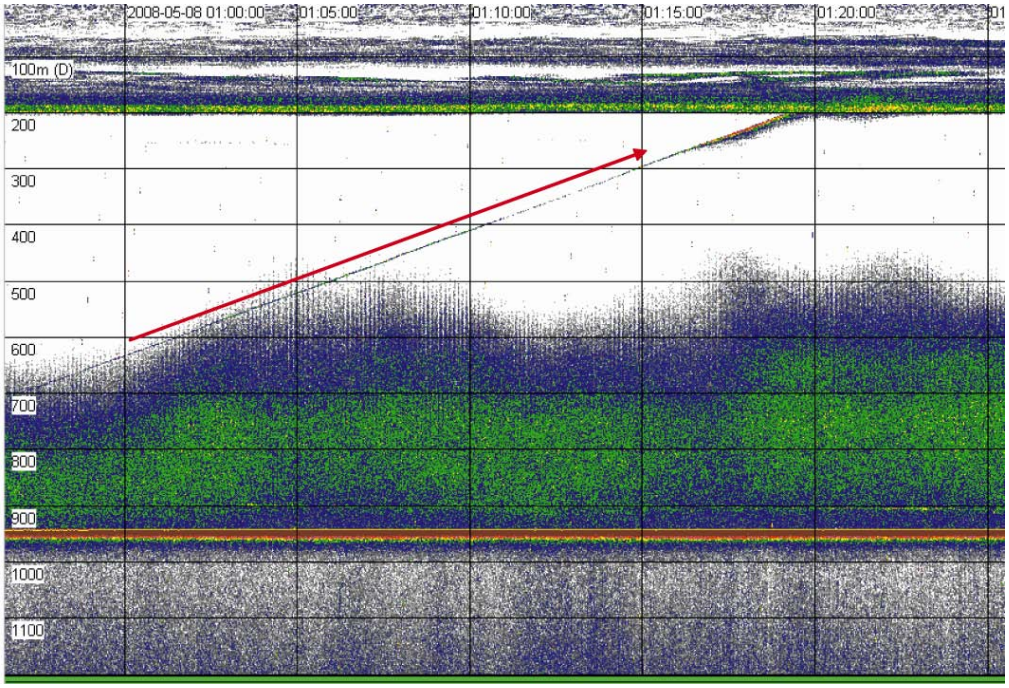

Fig. 19: Echogram during gas hydrate/gas bubble floating experiment. Red arrow indicates floating gas hydrate with time (X-axis, time from left to right; Y-axis, water depth). Scattered signals at ~250 mbsl represent gas hydrates dissociation into gas bubbles.

1. Dive #834
2. Date 2008.05.08
3. Area Central Umitaka Spur
4. Reporter Hitoshi Tomaru (Kitami Institute of Technology)
5. Purpose of the dive Methane plume survey
6. Landing time and point 14:49 37-26.201'N, 138-00.505'E; 893 m
7. Floating time and point 17:20 37-26.162'N, 138-00.383'E; 882 m
8. Payload

Box
Escape cutter
MBARI
MBARI-L
MT-corer
NISKIN sampler
P-marker
Rake sampler
SAHF
Slurp gun
Vacuum fluid sampler
γ-ray sensor

9. Samples collected

MBARI	3
NISKIN sampler	4
Slurp gun	1
Vacuum fluid sampler	1

10. Outline of the dive

Dive #834 was conducted to observe the seafloor, particularly gas plume distribution, for the future experimental monitoring of fluid flux with H-SM type reaction chamber on the central Umitaka Spur. We found an outcrop of gas hydrate on the cliff partially covered with rough surface sediments and white bacterial mats (film), and collected gas hydrate chunk with the MBARI sampler. We also found active gas plume, ~50 m west to the gas hydrate site, on the seafloor covered with carbonate crusts and white to gray bacterial mats, and performed SAHF measurement, water sampling, MBARI sampling, rake sampling there.

11. Highlights

We have observed several gas plume-related phenomena near the seafloor during Dive #834.

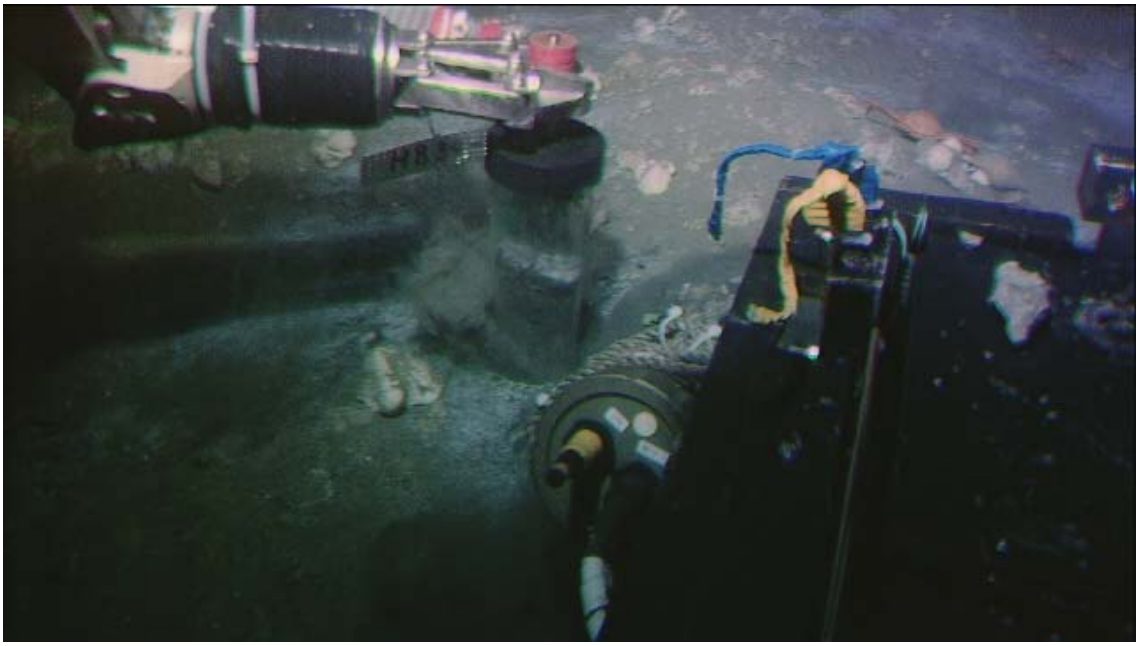

Fig. 20: MT core sampling on the white bacteria mat. Crab and sponge are often found near the bacteria mats.

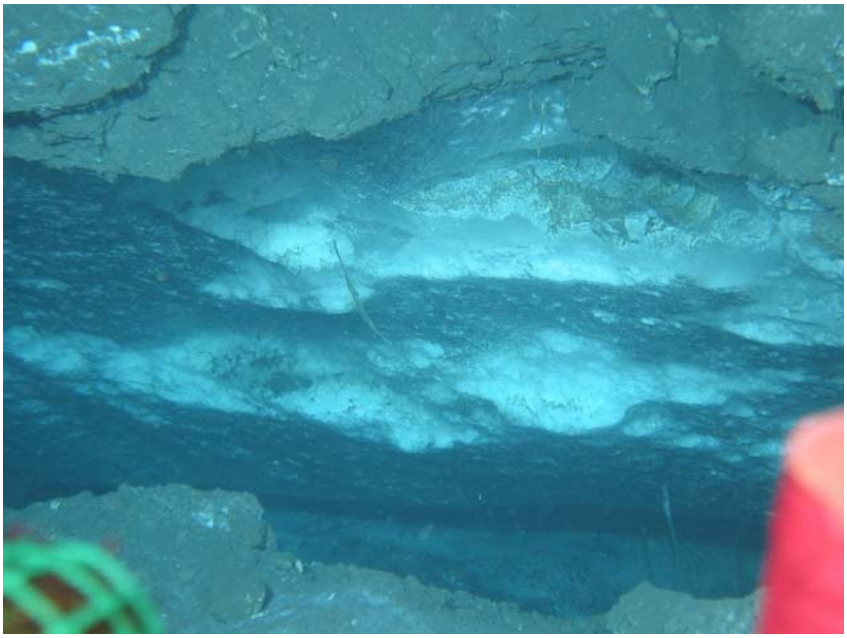

Fig. 21: Massive gas hydrate outcrop overhanging the cliff. Gas hydrates are covered with thin mud layer and sometimes associated with sheet-like bacteria mats.

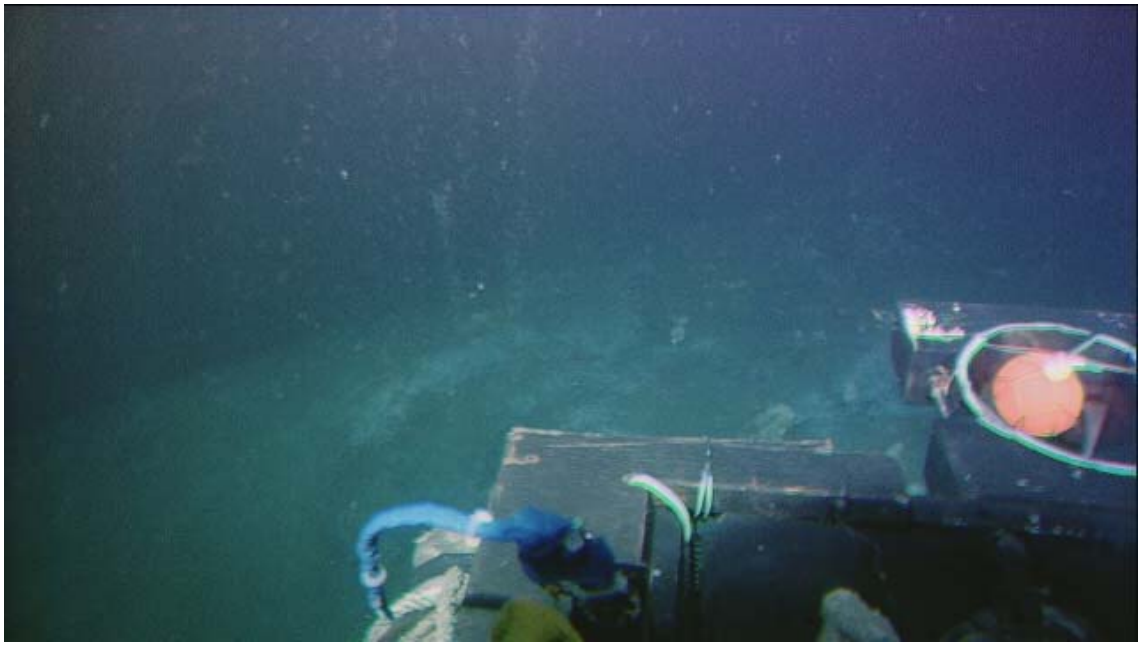

Fig. 22: Gas plume on the seafloor. Two gas chimneys are rising from the seafloor covered with bacterial mats.

1. Dive #835
2. Date 2008.05.09
3. Area Central Umitaka Spur
4. Reporter Hideaki Machiyama (JAMSTEC)
5. Purpose of the dive Installation of a video camera system
6. Landing time and point 08:53 37-26.161’N, 138-00.382’E; 885m
7. Floating time and point 11:06 37-26.159’N, 138-00.430’E; 882 m
8. Payload

Cage trap
Escape cutter
H-SM type reaction chamber
MBARI-type Long corer
Monitoring video camera system with ROV Homer (ID#61)
NISKIN water sampler x4
P-marker with temperature & pressure logger
Rake Sampler
SAHF
Slurp Gun

9. Samples collected

MBARI-type Long corer	1
NISKIN water sampler	4
Rock samples	2
Slurp Gun	crab x2, mud

10. Outline of the dive

We planned to install a monitoring video camera system and H-SM type reaction chamber in front of the methane bubbling site, discovered in Dive #834. Unfortunately, methane bubbling was stopped and no methane venting phenomena were observed around this station. We installed a monitoring video camera system, H-SM type reaction chamber, SAHF, and P-marker with pressure and temperature data logger in front of the venting site of Dive #834. We also installed a cage trap near the site.

11. Highlights

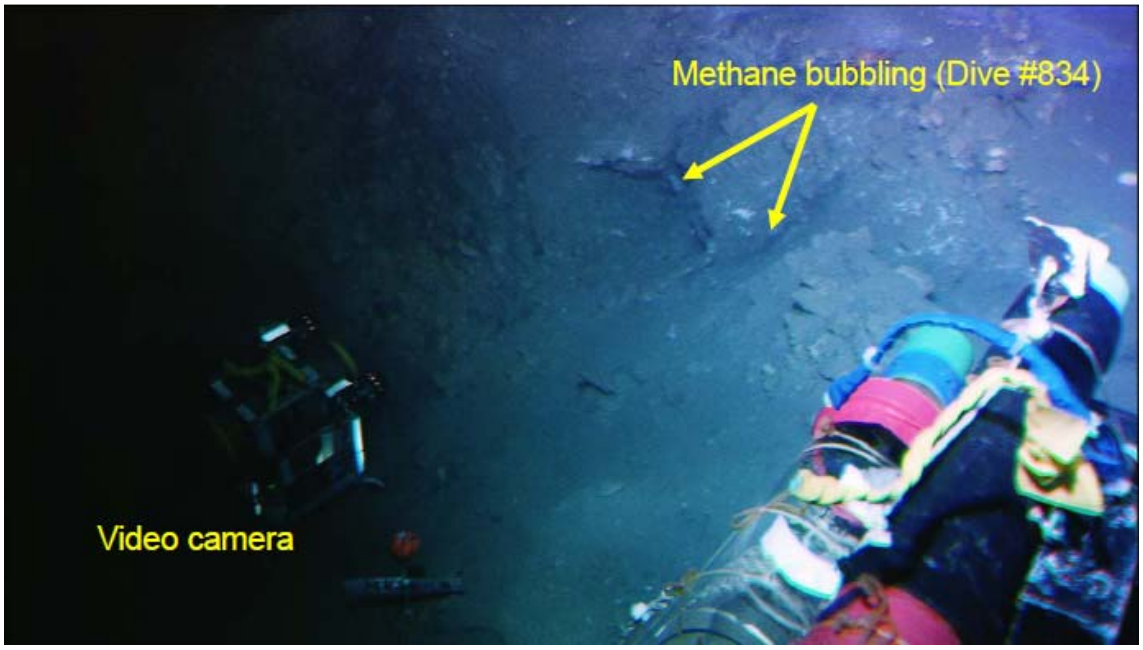

Fig. 23: A monitoring video camera system installed in front of the methane bubbling site discovered during Dive #834 (882 m).

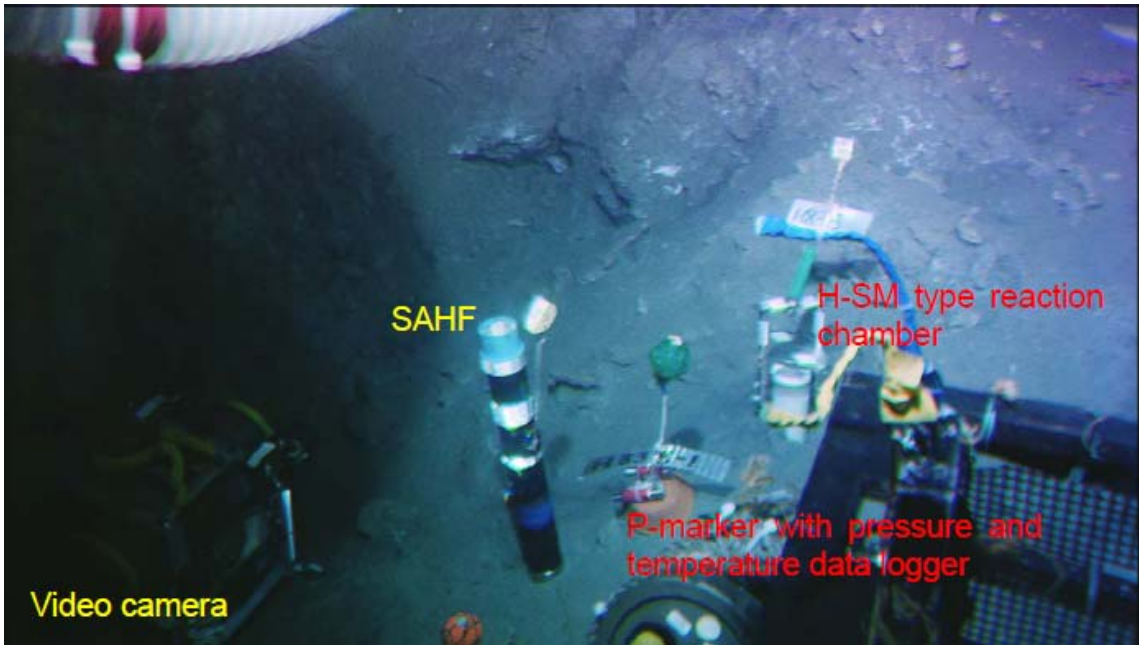

Fig. 24: Installed equipments adjacent to the methane bubbling site.

1. Dive #836
2. Date 2008.05.9
3. Area Southern Joetsu Knoll
4. Reporter Ryo Matsumoto (University of Tokyo)
5. Purpose of the dive Gas hydrate dissociation test
6. Landing time and point 14:06 37-32.465’N, 137-56.455’E; 973m
7. Floating time and point 17:24 37-32.406’N, 137-56.279’E; 976m
8. Payload

Escape cutter
MBARI-type corer
MT corer
Marker (H836-1)
NISKIN water sampler
Rake Sampler
Recovery rope
Slurp Gun
Vacuum fluid sampler

9. Samples collected

Carbonate

MBARI-type corer	1
MT corer	1
Rake sampler	mud
Slurp gun	crab, bivalve, shrimp
Vacuum fluid smapler	

10. Outline of the dive

Dive #836 visited the south of the Joetsu knoll, where the DAI-PACK survey revealed high topography and “hard ground” seafloor during the Dive #829. Two rock samples (carbonate nodules), three push core samples, and several bio-samples were collected on or near seep sites and bacterial mats. Vacuum fluid samples were also collected near hydrate exposures. The main objective of Dive #836 was to conduct an in situ experiment of methane hydrate dissolution and dissociation during the floating up to the sea surface. *Hyper dolphin* successfully re-visited the methane hydrate outcrop under the overhung wall along the collapsed crater structure. We took massive methane hydrate block, approximately 30cm × 15cm × 10cm from the wall and put the block into a wire net box (Joren in Japanese) then moved up to the sea surface. During the accent of *Hyper dolphin*, the massive block of methane hydrate became smaller and smaller in shallow levels due to dissolution from the surface, and finally completely dissolved and dissociated away at around 300 mbsl. The depth corresponds to the top boundary of methane hydrate stability in the Joetsu basin.

11. Highlights

Methane plumes had been observed to reach up to the shallow levels at around 250 mbsl.

This is explained to reflect that the plumes are not methane plumes but methane hydrate plumes. Bubbles are composed of solid methane hydrates, or at least, coated by thick hydrate rind. However, the methane concentration of the sea waters show high anomaly at around 400-600 mbsl as well as the depth of stability boundary of 250 mbsl. The question is the amount of dissolution of methane from methane hydrate bubbles. The experiment of Dive #836 has clearly demonstrated that significant amount of methane was dissolved from the surface of massive block of methane hydrate to decrease the size. We are now able to estimate the amount of dissolution from solid hydrate in cold deep waters.

Fig. 25: Gas hydrate block in a wire net box for dissociation/dissolution test.

Fig. 26: Trapped gas hydrate (during the accent at ~720 mbsf).

Fig. 27: Trapped gas hydrate (final dissolution at ~42 mbsl).

1. Dive #837
2. Date 2008.05.10
3. Area Central Umitaka Spur
4. Reporter Hideaki Machiyama (JAMSTEC)
5. Purpose of the dive Recovery of a video camera system
6. Landing time and point 08:52 37-26.151’N, 138-00.383’E; 884m
7. Floating time and point 09:56 37-26.160’N, 138-00.393’E; 882m
8. Payload

Escape cutter
MBARI-type corer
MT corer
NISKIN water sampler
Rake sampler
Recovery rope
Slurp gun

9. Samples collected

MBARI-type corer	1
NISKIN water sampler	4
Rake sampler	mud into the basket (ROV)
Slurp gun	mud

10. Outline of the dive

The purpose of this dive is to recover the equipments installed (a monitoring video camera system, SAHF, P-marker with pressure and temperature data logger, and a cage trap) during Dive #835. The recovery mission was successfully finished.

11. Highlights

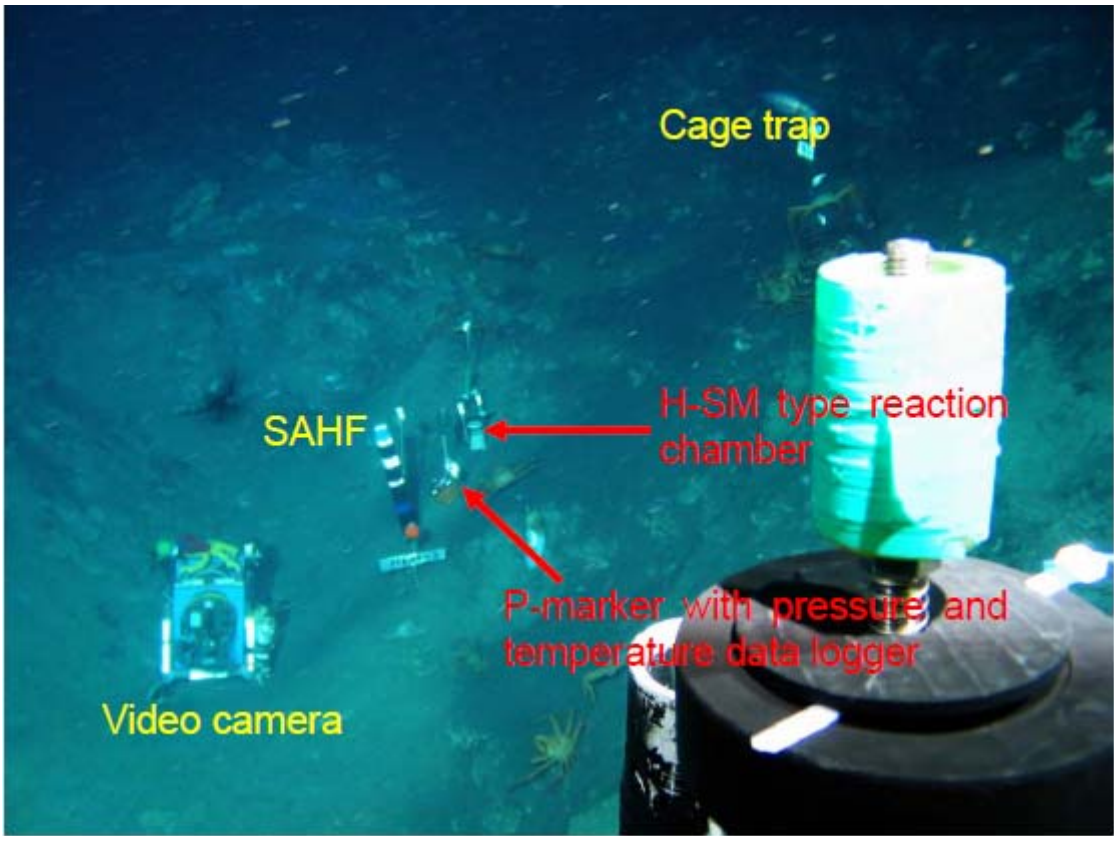

Fig. 28: Equipments installed during Dive #835.

1. Dive #838
2. Date 2008.05.12
3. Area Central Umitaka Spur
4. Reporter Ryo Matsumoto (University of Tokyo)
5. Purpose of the dive Sampling and seafloor observation
6. Landing time and point 11:08 37-26.152’N, 138-00.448’E; 884m
7. Floating time and point 16:05 37-26.163’N, 138-00.389’E; 882m
8. Payload

Escape cutter
MBARI-type corer
MBARI-type long corer
MT corer
Marker (H836-1)
NISKIN water sampler
Recovery rope
Rake sampler
Slurp gun
Vacuum fluid sampler

9. Samples collected

Carbonate	
MBARI	2
MBARI-Long	2
MT corer	
MT corer	
NISKIN water sampler	4
Rake sampler	mud
Slurp gun	crab
Vacuum fluid sampler	

10. Outline of the dive

On the way to Okushiri-Shiribeshi sites off Hokkaido, we decided to conduct additional dive to the central mound of the Umitaka Spur. We had identified strong plumes on echo grams on the area just two days ago. As we had only half day time for this dive, we headed to the Umitaka Spur center, and entered into the central mound from the eastern slope. The narrow gallery or elongated collapsed depression is surrounded by hydrate cemented “hard and frozen” sediment. The wall surface was strongly fractured and veined. At last, we found strong bubbling from such a hard wall. The gas venting was very strong. A 1000 mL funnel was full up in 5 minutes. We conducted release experiments of methane hydrate bubbles several times. The release was successful, but because of very strong natural venting, the echo gram could not discriminate the natural and experimental release.

11. Highlights

The gas venting at the central mound was the strongest one we have identified for the last five years. The bubbles were emitted from vertical fractures on the wall. This strongly indicates that the wall sediments of collapse structures are full of free gas.

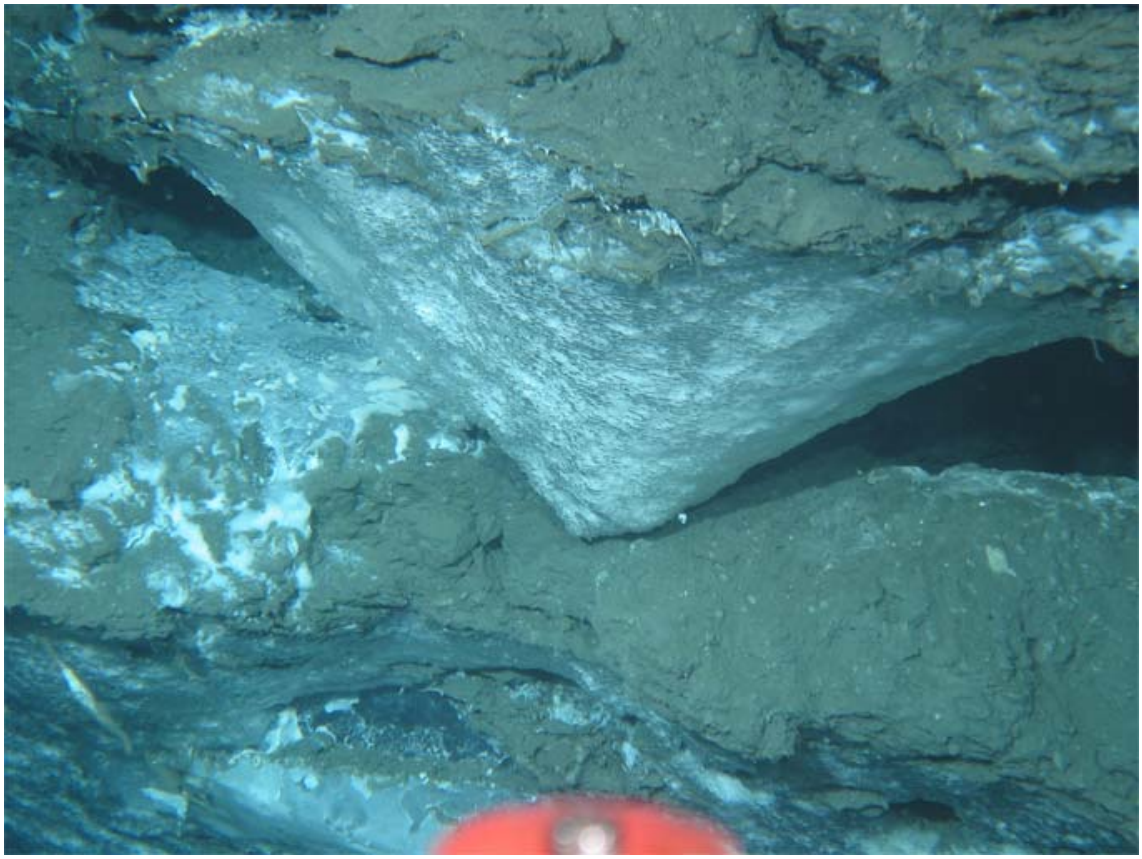

Fig. 29: Icicled gas hydrate.

1. Dive #839
2. Date 2008.05.14
3. Area Northwestern Shiribeshi Trough
4. Reporter Ryo Matsumoto (University of Tokyo)
5. Purpose of the dive Identification of methane-induced phenomena
6. Landing time and point 11:08 43-20.485’N, 139-40.002’E; 2988m
7. Floating time and point 16:01 43-20.168’N, 139-39.790’E; 2965m
8. Payload

Escape cutter
MBARI-type corer
MT corer
Marker (H836-1)
NISKIN water sampler
Recovery rope
Rake sampler
Slurp gun
Vacuum fluid sampler

9. Samples collected

Carbonate	
MBARI-type corer	2
NISKIN water sampler	4
Rake sampler	mud
Slurp gun	
Vacuum fluid sampler	

10. Outline of the dive

The target zone of the Dive 839 was the foot of the Shiribeshi Knoll. The Shiribeshi Knoll is uplifting due to active fault movement along the base of the knoll. We intended to identify methane-induced phenomena along the active fault by *Hyper Dolphin* dive to the foot of the knoll. The seafloor about 200 m away from the base of the knoll was dominated by monotonous mud and silt without any features of methane seeps, but narrow zone very close to the base was characterized by “leopard-skin” bacterial mat. However, carbonate nodules or chemosynthetic communities were not observed from these sites.

11. Highlights

“Leopard-skin” bacterial mat is well developed along a narrow valley at the foot of the knoll. The valley seems to be a feeder channel of debris flow from upper part of the knoll. “Leopard-skin” looks very fresh, suggesting that methane is actively venting.

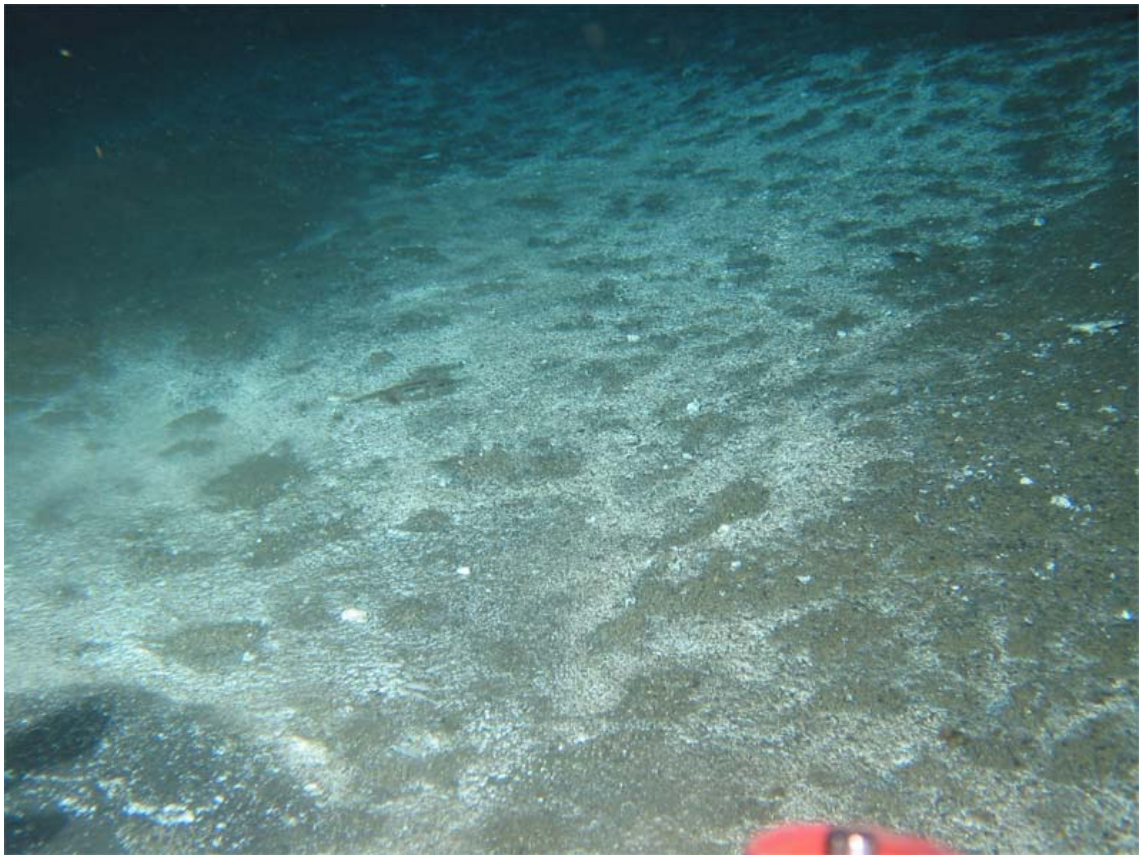

Fig. 30: “Leopard-skin” bacterial mat.

1. Dive #840
2. Date 2008.05.15
3. Area South off Okushiri Island
4. Reporter Hideki Numanami (Tokyo Kasei Gakuin University)
5. Purpose of the dive Search for methane seep
6. Landing time and point 9:15 41-56.154’N, 139-22.282’E; 2014 m
7. Floating time and point 9:21 41-56.159’N, 139-22.297’E; 2013 m
8. Payload

Box
Escape cutter
MBARI-type core
MT-corer
NISKIN sampler
P-marker
SAHF
Scoop sampler (Kumade)
Slurp gun
Vacuum fluid sampler

9. Samples collected

Slurp gun 1

10. Outline of the dive

The seafloor around the landing point was covered with muddy sediments. Several red snow crabs, *Chionoecetes japonicus*, were observed. Three individuals of *C. japonicus* were collected using a slurp gun. Only 6 minutes after the landing, ROV were recovered due to mechanical trouble.

11. Highlights

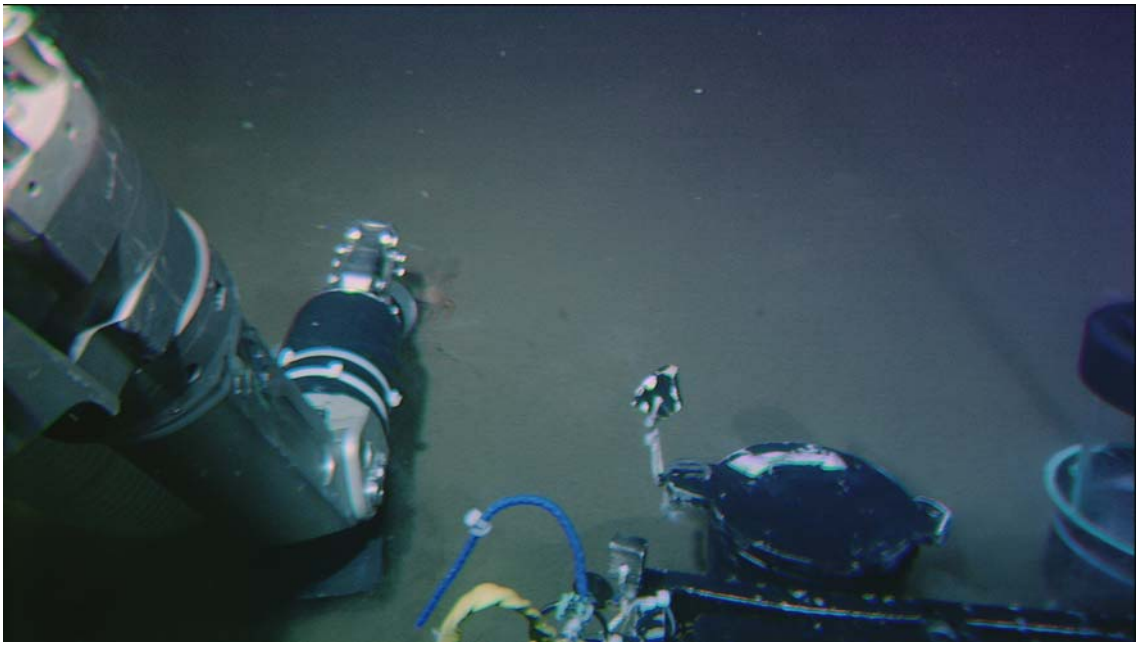

Fig. 31: Three individuals of *Chionoecetes japonicus* were collected from “the normal muddy bottom”.

1. Dive #841
2. Date 2008.05.17
3. Area South off Okushiri Island
4. Reporter Katsunori Fujikura (JAMSTEC)
5. Purpose of the dive Methane plume survey
6. Landing time and point 9:17 41-56.189’N, 139-22.247’E; 2010 m
7. Floating time and point 9:33 41-56.314’N, 139-22.336’E; 1998 m
8. Payload

Box
Escape cutter
MBARI-type core
MT-corer
NISKIN sampler
P-marker
Rake sampler
SAHF
Slurp gun
Vacuum fluid sampler

9. Samples collected

No sample

10. Outline of the dive

The seafloor was covered with muddy sediments. Several snow crabs, *Chionoecetes japonicus*, and a couple of sea anemone were observed. Only 16 min. after the landing, ROV was recovered due to mechanical trouble.

11. Highlights

No highlight for this dive survey.

1. Dive #842
2. Date 2008.05.17
3. Area South off Okushiri Island
4. Reporter Katsunori Fujikura (JAMSTEC)
5. Purpose of the dive Methane plume survey
6. Landing time and point 19:21 41-56.304’N, 139-22.323’E; 1997 m
7. Floating time and point 20:43 41-56.465’N, 139-22.469’E; 1996 m
8. Payload

Box
Escape cutter
MBARI-type core
MT-corer
NISKIN sampler
P-marker
Rake sampler
Slurp gun
Vacuum fluid sampler

9. Samples collected

Actinaria	1
Eggs	
Rock	1
Sediment core by MBARI-type	3
Several bivalves	
Several small rocks by slurp gun	
Sunken wood	1

10. Outline of the dive

During this diving survey, muddy sediments almost covered on the seafloor. Orange colored sediments sometime occurred on the seafloor. Bumps of active faults probably due to earthquake were observed. Height of bumps ranged from 10 cm to 1 m. Wall outcrops were of white-gray rock. Numerous beautiful red and white sea anemones were attached on a couple of outcrops. Dense colony of small sea anemones also was formed on an outcrop. At a glance, population density of snow crabs, *Chionoecetes japonicus*, were relatively high in spite of few foods. Only 16 min. after landing the seafloor, ROV was recovered due to mechanical trouble. Unfortunately, we could not find active methane seep area.

11. Highlights

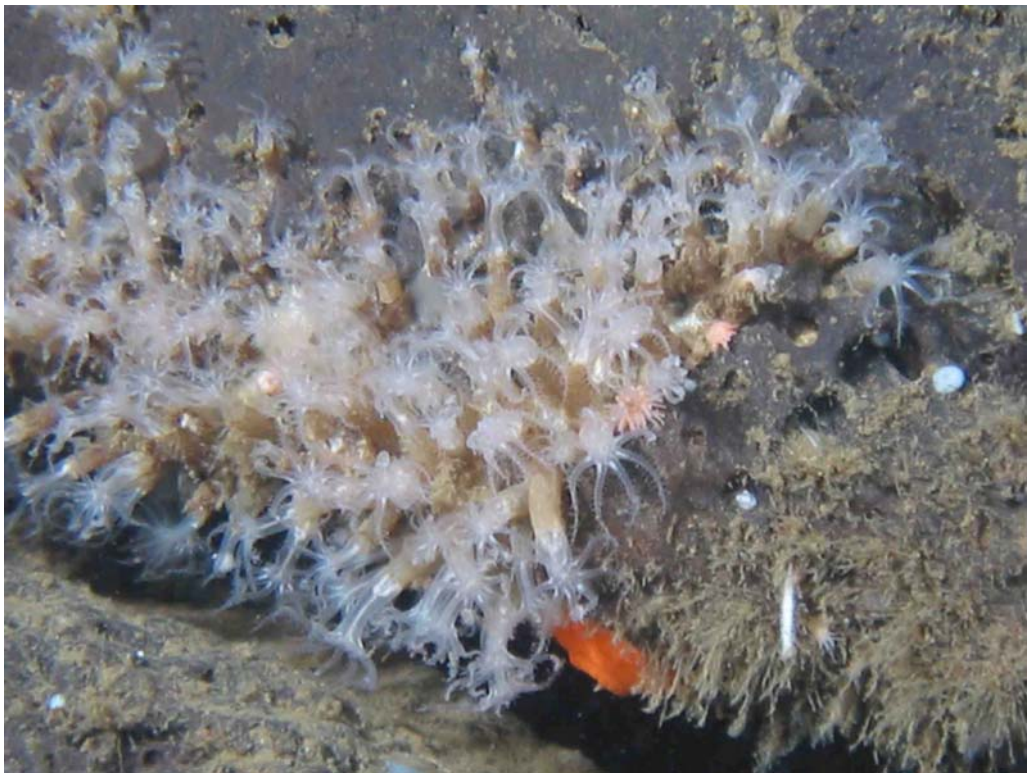

Fig. 32: Dense colony of small sea anemones (19:46).

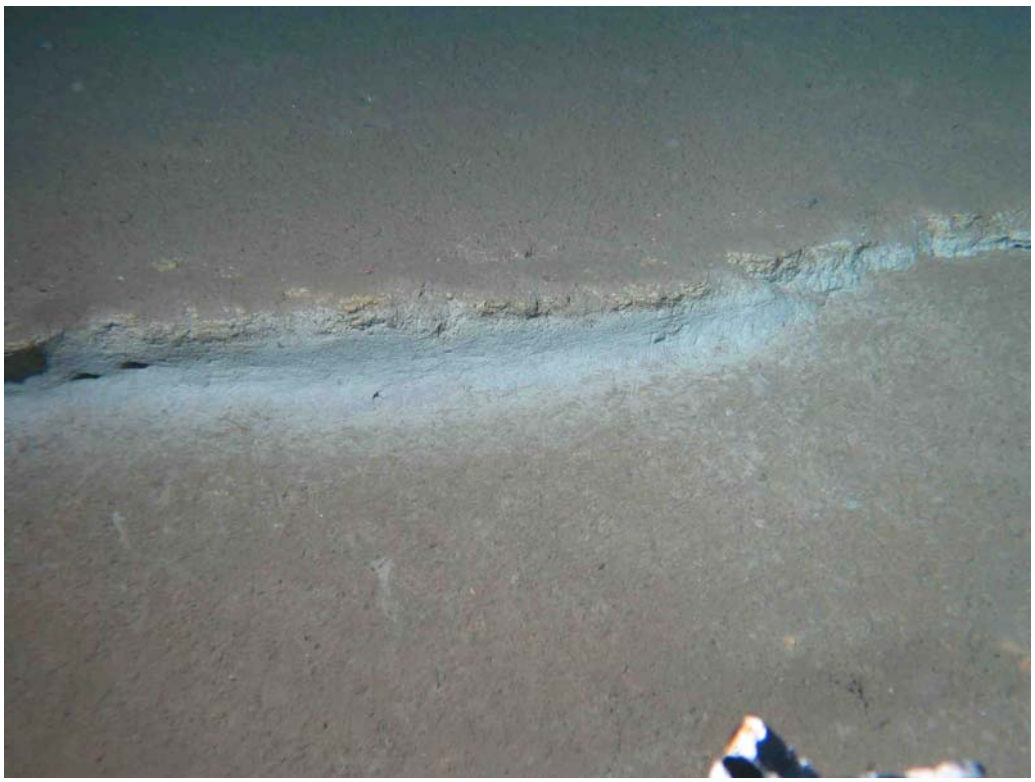

Fig. 33: Bumps of active faults (20:03).

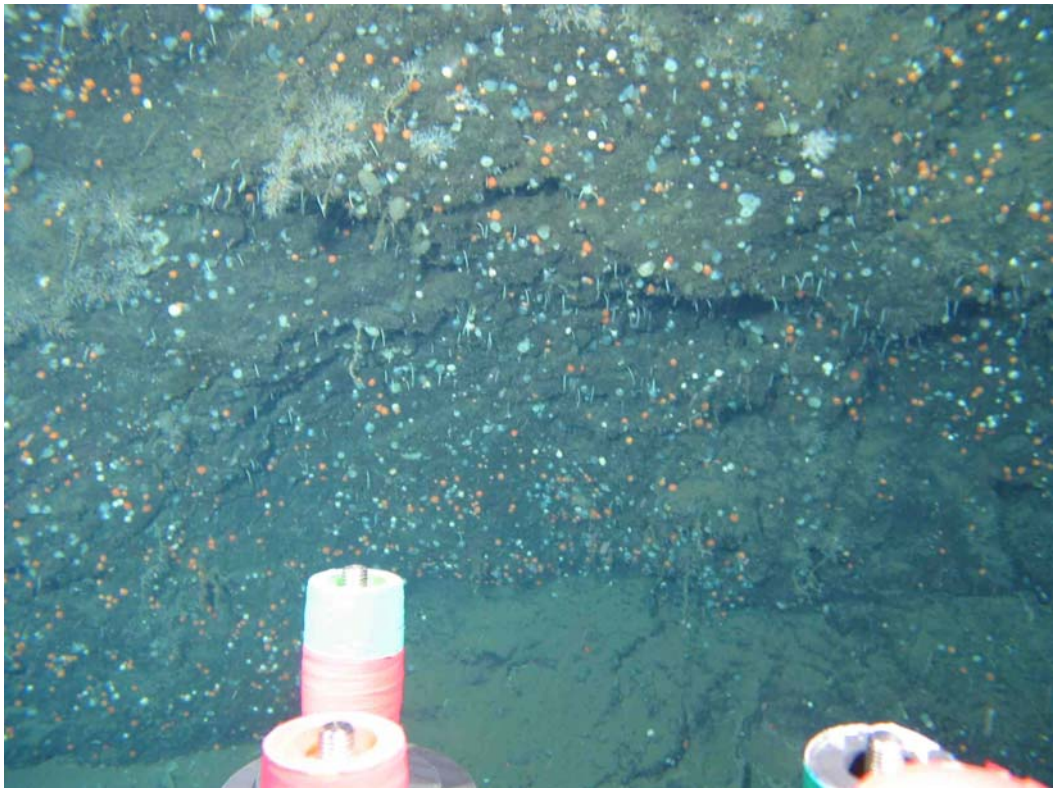

Fig. 34: Numerous beautiful red and white sea anemones (20:32).

1. Dive #843
2. Date 2008.05.18
3. Area South off Okushiri Island
4. Reporter Ryo Matsumoto (University of Tokyo)
5. Purpose of the dive Observation and sampling at bacterial mat
6. Landing time and point 09:08 41-56.481’N, 139-22.466’E; 1955 m
7. Floating time and point 15:40 41-57.319’N, 139-23.101’E; 1706 m
8. Payload

Box
Escape cutter
MBARI-type core
MT-corer
NISKIN sampler
P-marker
Rake sampler
Slurp gun
Vacuum fluid sampler

9. Samples collected

Carbonate	
MBARI-type core	2
MT-corer	1
NISKIN	4
Slurp gun	crab, fish
Sunken wood	1
Vacuum fluid sampler	

10. Outline of the dive

The main objective of the dive was to observe bacterial mat and to collect sediments and carbonate nodules from the bacterial mat area. However, bacterial mat was not identified on the slope except for one minor bacterial points related with drift-wood community. Debris flow deposits are common through the slope with common volcanic breccias. Only the seep related phenomena was old and small mud volcano, about 30 cm in diameter and 30 cm high. The volcano is not active at all, probably formed during and after the earthquake shock 10 years ago.

11. Highlights

Old, inactive mud volcano on the slope, which is probably the heritage of earthquake related seeps.

Fig. 35: Minor bacterial points related with drift-wood community.

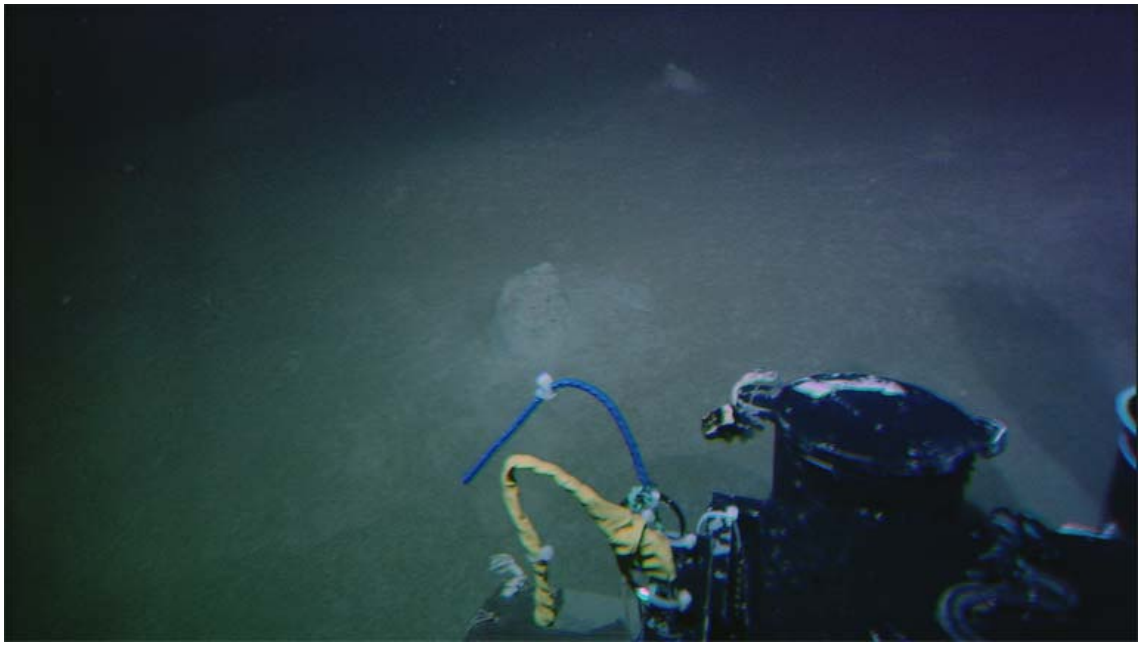

Fig. 36: Old and small mud volcano.

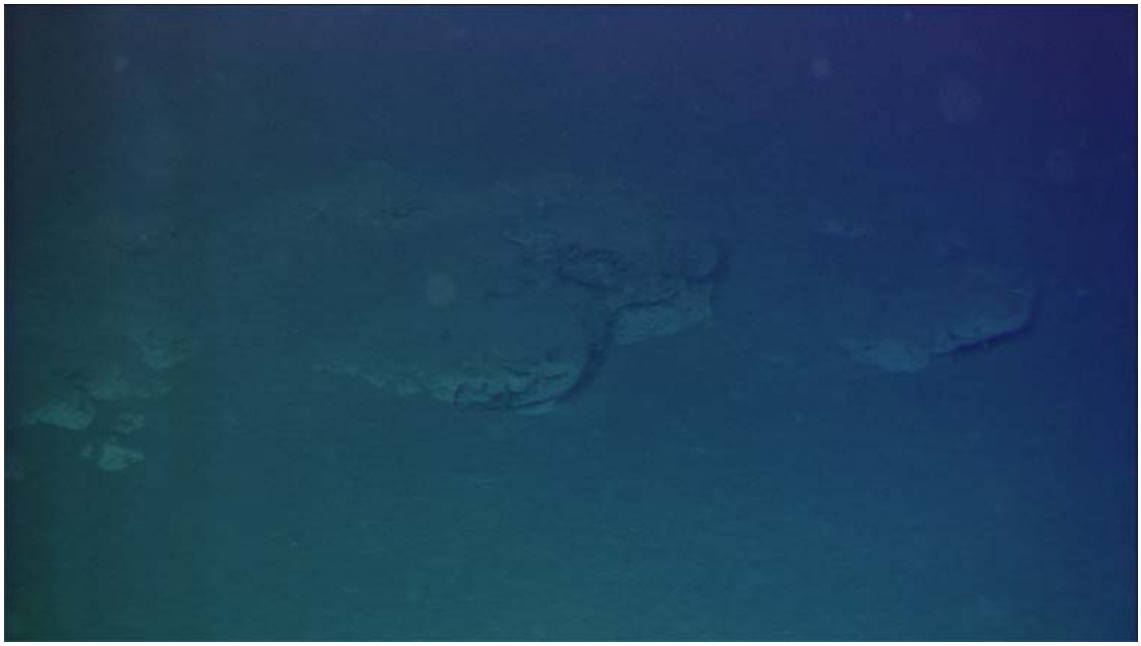

Fig. 37: Debris flow deposits with common volcanic breccias.

Notice on using

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

Acknowledgements

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