

Hakuho-maru “Cruise Report”

KH-19-5

Seafloor crustal movement and seismic history of
Sagami Trough great earthquakes/
Study on geosphere–hydrosphere–biosphere interaction via
submarine mud volcano – survey of mud volcano activity and
fluxes of life and materials released from mud volcano –

Sagami Bay, Kumano Trough, Off Tanegashima
August 9, 2019 to August 28, 2019

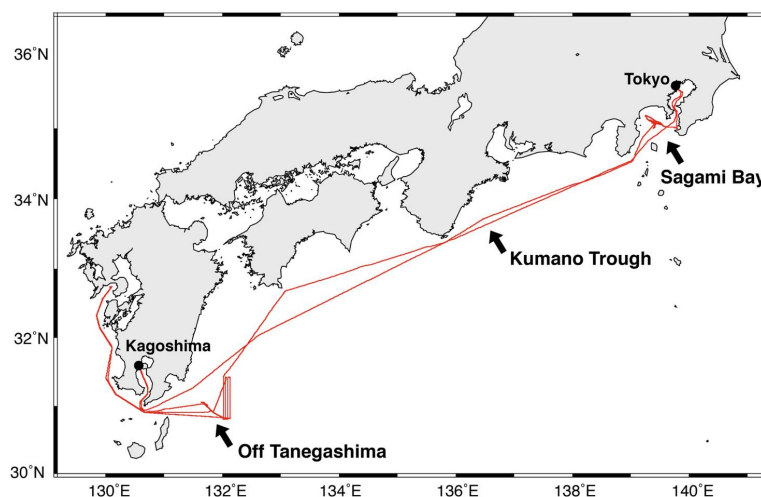
Joint Usage/Research Center for Atmosphere and Ocean Science (JURCAOS)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

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1. Cruise Information

- Cruise ID: KH-19-5
- Name of vessel: Hakuho-maru
- Title of cruise : Seafloor crustal movement and seismic history of Sagami Trough great earthquakes/
Study on geosphere-hydrosphere-biosphere interaction via submarine mud volcano
- survey of mud volcano activity and fluxes of life and materials released from mud volcano -
- Chief Scientist: Juichiro ASHI [University of Tokyo]
- Cruise period: August 9, 2019 to August 28, 2019
- Ports of departure/call/ arrival: Tokyo / Kagoshima / Tokyo
- Research area: Sagami Bay, Kumano Trough and Off Tanegashima Island
- Research map



2. Research Proposal and Science Party

- Title of proposal 1: Seafloor crustal movement and seismic history by Sagami Trough great earthquakes
- Representative of Science Party 1: Juichiro ASHI [University of Tokyo]
- Title of proposal 2: Study on geosphere-hydrosphere-biosphere interaction via submarine mud volcano
-survey of mud volcano activity and fluxes of life and materials released from mud volcano-
- Representative of Science Party 2: Akira IJIRI [JAMSTEC]
- Science Party
 - Juichiro Ashi (AORI, UTokyo) Leg 1, Leg 2
 - Asuka Yamaguchi (AORI, UTokyo) Leg 1
 - Ryo Nakanishi (AORI, UTokyo) Leg 1, Leg 2
 - Yuichi Okuma (AORI, UTokyo) Leg 1, Leg 2
 - Io Miura (AORI, UTokyo) Leg 1, Leg 2
 - Risa Kojima (AORI, UTokyo) Leg 1
 - Takiya Goto (AORI, UTokyo) Leg 1
 - Katsura Kameo (AORI, UTokyo) Leg 1, Leg 2
 - Makoto Takeuchi (AORI, UTokyo) Leg 1
 - Masanari Ashida (AORI, UTokyo) Leg 1, Leg 2
 - Miwa Nakagawa (AORI, UTokyo) Leg 2
 - Makoto Yamano (ERI, UTokyo) Leg 2
 - Kota Sasaki (ERI, UTokyo) Leg 2
 - Tomohiro Toki (Dept. Scineces, University of Ryukyu) Leg 1
 - Shugo Kurahashi (Dept. Scineces, University of Ryukyu) Leg 1
 - Yuki Mitsudome (Dept. Scineces, University of Ryukyu) Leg 1
 - Masafumi Murayama (FARMS, Kochi Univ.) Leg 1, Leg 2
 - Takuro Noguchi (FARMS, Kochi Univ.) Leg 1
 - Hiro Yoshi Miyamoto (FARMS, Kochi Univ.) Leg 1

Wataru Katanoda (FARMS, Kochi Univ.) Leg 1, Leg 2
 Ryoma Setoguchi (FARMS, Kochi Univ.) Leg 1, Leg 2
 Katsuya Nejigaki (Graduate School of Integrated Arts and Sciences, Kochi Univ.) Leg 1, Leg 2
 Moe Kato (College of Science and Engineering, Kanazawa Univ.) Leg 1
 Genki Kobayashi (Seto Marine Biological Lab., Kyoto University) Leg 2
 Kota Mukumoto (Faculty of Engineering, Kyushu University) Leg 2
 Ahmad Ahmad (Faculty of Engineering, Kyushu University) Leg 2
 Akira Ijiri (JAMSTEC) Leg 1
 Tatsuhiko Hoshino (JAMSTEC) Leg 1
 Kazuya Kitada (JAMSTEC) Leg 1
 Toshiya Kanamatsu (JAMSTEC) Leg 2
 Ken Ikehara (AIST) Leg 1, Leg 2
 Shiro Kato (Kaiyo Denshi) Leg 2
 Ei Hatakeyama (Marine Works Japan) Leg 1, Leg 2
 Masahiro Oorui (Marine Works Japan) Leg 1, Leg 2

3. Research Activities

3-1. Proposal 1 "Seafloor crustal movement and seismic history of Sagami Trough great earthquakes"

3-1-1. Background and objectives

Great earthquakes repeatedly occurred along the Sagami Trough where the Philippine Sea Plate subducts beneath the Okhotsk Plate, and devastated Tokyo and surrounding areas in 1923. A plate boundary fault was imaged by an onshore-offshore integrated seismic survey campaign (Sato et al., 2010, Geological Society of Japan Abstract). The splay fault was also recognized at the base of the eastern slope of the Sagami Bay. However, shallow sediment deformations by recent historical earthquakes has not been clarified. The purpose of our study is to reveal recent fault activity by subbottom profiling (SBP) survey, sediment sampling and long-term observation of heat flow.

3-1-2. Methods and instruments

Subbottom profiling, sediment sampling and installation of heat flow instrument in this cruise were conducted by a remotely operated vehicle named "Navigable Sampling System (NSS)". NSS can take piston cores and install seafloor observation tool at pinpoint accuracy, and routinely acquire high resolution SBP image by pinging 1.1 to 1.6 kHz chirp frequency (Fig. 1). Heat flow monitoring was conducted by pop-up heat flow instruments developed by Earthquake Research Institute (see Section 3-1-5 for details). A multiple corer was also deployed to obtain surface sediments.

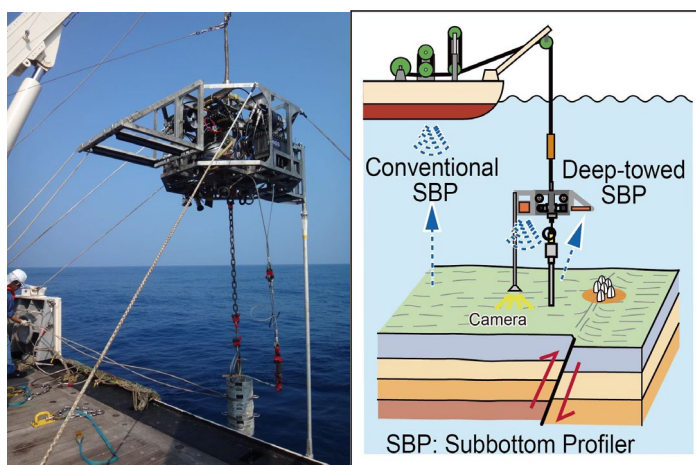


Fig. 1 Pilot vehicle photo (left) and schematic diagram of NSS operation (right).

3-1-3. Overview of Operations

Four NSS dives were done at the foot of the fault scarp west of the Miura Knoll (Fig. 2). One piston core was taken to penetrate the fault zone which was estimated from the SBP data recorded during the same dive mission (Dive 164)(Fig. 3). Three dives were dedicated to installation of heat flow instruments. Dive 165 was planned to deploy an instrument, but was not successful due to a trouble with the communication system of NSS. The heat flow probe of the instrument deployed during Dive 166 was not penetrated into the sediment. Therefore, we abandoned the monitoring and recovered the instrument after the dive. Dive 167 successfully installed a pop-up heat flow instruments at the base of the fault scarp (see Section 3-1-5 for details). About one year's observation is planned to monitor heat flow fluctuation near the active fault. Deep-towed SBP data around the fault scarp in the Miura Knoll were acquired during these dive operations (Fig. 3).

Dive 168 was conducted to investigate a NE-SW lineament in the Misaki Knoll by SBP (Fig. 2). This lineament cuts the knoll suggesting active fault deformation (see Section 3-1-6 for details). We plan to investigate surface sediment deformation on SBPs along this lineament. Dive 169 was conducted to know depositional process of Sakawa River fan delta slope (see Section 3-1-7 for details). SBP data were successfully acquired from the distal part to the middle part of the delta. In the northeastern part of the Sagami Bay, multiple sediment cores were obtained from nine sites for the studies of seismic event and related benthos activity.

Multiple cores were supplementarily taken from one site in the Kumano forearc basin off Kii Peninsula (see "Research map") for the purpose of seismic and flood event study.

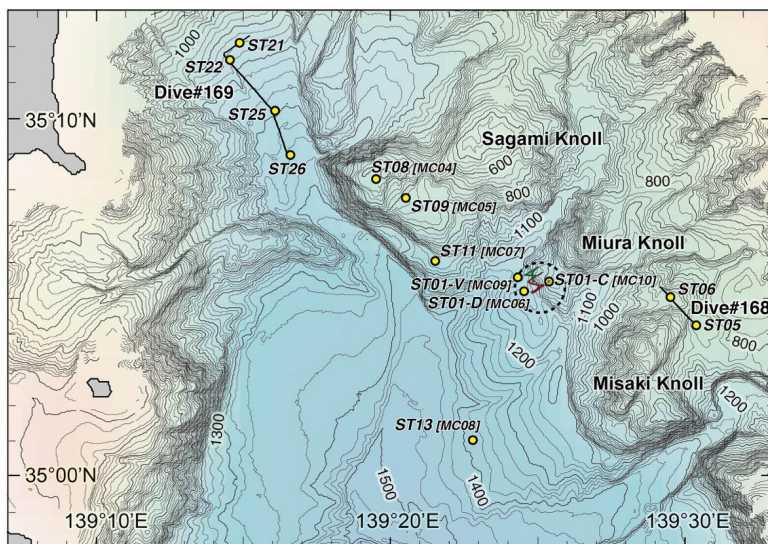


Fig. 2 Bathymetric map and survey sites in the Sagami Bay. See Fig. 3 for detail map of Site ST01.

3-1-4. Active structures of recurrent great Kanto earthquakes (Juichiro ASHI, UTokyo)

Subbottom profiles acquired during the previous cruises (KH-10-3, KH-15-2, KH-16-5) in the landward trench slope show reflectors reaching the seafloor surface. The reflector apparently dips northeast at 30 degrees along the NW-SE trending fault scarp. While the hanging-wall shows structureless, the foot-wall indicates horizontal layering or chaotic seismic character. The former and the later suggests underthrusting of the trough fill sequence and fault separation of talus deposits, respectively. We obtained a 6-meter-long core at the landward dipping reflector. The upper 1.2 meters of the core consists of alternation of dark green silty mud and pebbly mud with shell fragments of *Calyptogena* fossils. A 5 mm thick zone, which consists of silty mud with some granule size clasts and dips roughly northeast at 30 degrees, is recognized at 2.25 m from the core top. This zone is interpreted to correspond to the reflector of the fault plane identified on the subbottom profile. However, small age gaps on radiocarbon dating between the hanging-wall and the foot-wall suggests that the fault observed on the core sample corresponds to a subsidiary fault with small displacement. One of our objectives in this cruise was to obtain a core sample from the major fault zone. A piston coring during Dive 164 successfully

penetrated a fault reflector imaged by SBP of NSS. Dense SBP transects along the fault scarp was also conducted during Dive 164, 165 and 166 (Fig. 3). Our SBP survey and core sampling will reveal relations between recent deformations and historical earthquakes.

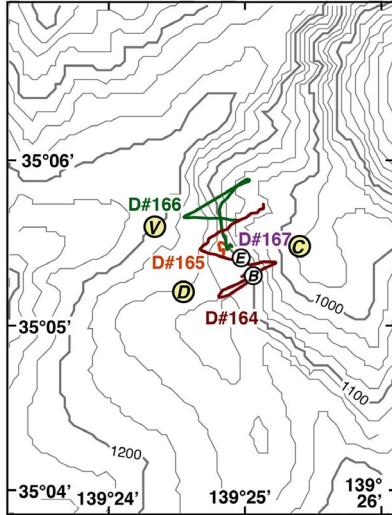


Fig. 3 Bathymetric map and survey localities at Site ST01.

3-1-5. Long-term temperature monitoring (Makoto YAMANO, ERI, UTokyo)

Pop-up heat flow instrument (PHF):

We used pop-up type heat flow probes for long-term monitoring of vertical temperature distribution in surface sediment. This type of instrument has been used for heat flow measurement in relatively shallow sea areas where temporal variation of the bottom water temperature significantly disturbs sediment temperature (e.g., Hamamoto et al., 2005). Analysis of long-term record of the temperature profile in surface sediment may also provide information on velocity or flux of vertical pore fluid flow (Goto et al., 2005).

On KH-19-5 cruise, we deployed two pop-up heat flow instruments (termed PHFs below) using the NSS. Main components of PHF are a recording unit, a temperature probe, an acoustic release unit and weight (Fig. 4). The temperature probe is 2 m long and has eight equally spaced temperature sensors. The recording unit records measurement time, temperatures, and two-axis instrument tilts. A small water temperature recorder is attached to the main frame for monitoring the bottom water temperature. The acoustic release unit receives acoustic commands from a surface ship and releases the weight and temperature probe, allowing the instrument pops up for recovery

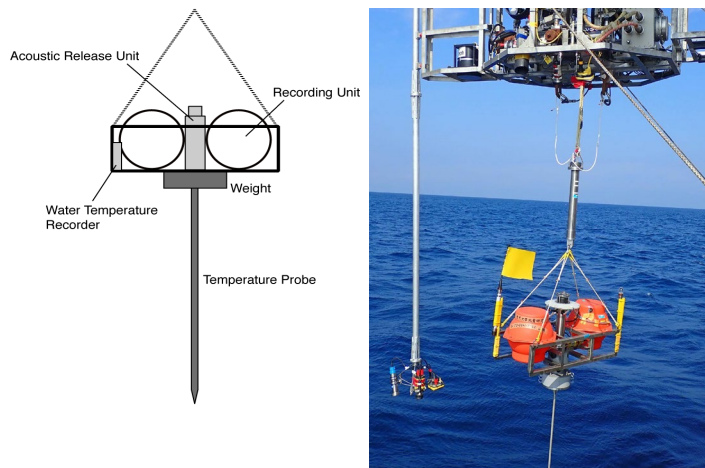


Fig. 4. Schematic configuration of pop-up heat flow instrument (PHF) PHF hung below the NSS via an acoustic releaser.

Deployment of PHF:

Deployment of the two PHFs was conducted using the NSS in an area where fluid seepage activity is indicated by biological communities (Table 1). Deployment points were determined based on visual observation of the sea floor through the NSS video cameras.

The first attempt of deployment was made on August 24, but was not successful due to a trouble with the communication system of the NSS. We then inserted another releaser between the NSS and the PHF for the second attempt on August 25 (cf. Fig. 4). The PHF was successfully deployed by activating the releaser with an acoustic command (PHF-1 in Table 1). However, it was found though the video camera picture that the temperature probe did not penetrate well into sediment and the instrument fell down on the sea floor. We thus decided to abandon temperature monitoring and recovered the instrument on the same day.

On August 26, we deployed the other PHF using the releaser of the NSS since the communication system had resumed working properly (PHF-2 in Table 1). The temperature probe appears to have almost fully penetrated judging from the video camera picture. We plan to recover the instrument in 2020.

Table 1. Deployment of pop-up heat flow instruments

Station	Deployment	Recovery	Coordinates	Water depth (m)
PHF-1	Aug. 25, 2019	Aug. 25, 2019	35°5.4546'N, 139°24.8728'E	1,086
PHF-2	Aug. 26, 2019	-----	35°5.4116'N, 139 24.9378'E	1,081

3-1-6. Uplifting of Misaki Knoll, Sagami Trough (Toshiya KANAMATSU, JAMSTEC)

Okinoyama Bank Chain aligns along the plate boundary of the Philippine Sea Plate in the northeast Sagami Trough. Misaki knoll is one of the members of Okinoyama Bank Chain. Geological formation of Misaki Knoll is correlated to Hayama and Miura Groups of Boso and Miura peninsulas (Kanie et al., 1991). The remarkable topographic feature of Misaki Knoll is a 100-m sharp step in NW-SE orientation (Fig. 5). NSS survey is proposed to understand the origin of this step, because the structure could be related to the past earthquake events in the Sagami Trough.

Shore uplifting events in Boso and Miura Peninsulas relating to past earthquakes are well documented (Hatori et al., 1973; Shishikura, 2003). Yamashita et al.(2013) interpreted that the Okinoyama Bank Chain has formed its imbricating structures by horizontal compression induced from the reversal faulting at the Sunosaki Canyon. Furthermore, an aftershock of 1923 Kanto earthquake occurred around the Misaki Knoll. With those observations taken into consideration, the step of Misaki Knoll could be formed by earthquake upliftings. To understand the step structure of the Misaki Knoll, we planned to investigate sub-bottom structures of the step structure and sedimentary structures in adjacent small basins.

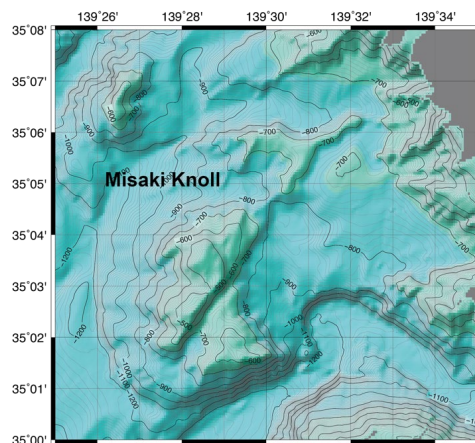


Fig. 5 Topography of Misaki Knoll.

3-1-7. Depositional process of Sakawa River fan delta slope, Sagami Bay (Ken IKEHARA, AIST)

For deep-sea paleoseismology, it is crucial to understand the depositional processes of event deposits. Although surface sediment remobilization by the earthquake ground shaking is a new idea to form fine-grained event deposits, outcrops and marine sediment samples indicate that the repeated occurrence of coarse-grained gravity flows on the coarse-grained fan delta slope. Sakawa River fan delta slope is a steep slope with its average gradient of 5–6° in the NW Sagami Bay. Severe coastal erosion along the coast near Sakawa River mouth have been occurred by strong typhoons. Epicenter of the 1923 Taisho Kanto earthquake located near the slope. Therefore, earthquake- and storm-induced coarse sediment transports are expected along the Sakawa River fan delta slope. Recent study (Ajioka et al., in press) indicated the occurrence of numerous shallow channels on the slope, and slope gradient controlled sediment distribution. However, no detailed survey on channels have been conducted. To clarify channel structures and surface features, we proposed surface sediment coring at 7 sites and NSS SBP profiling. Although surface sediment coring was not allowed due to the existence of submarine cables, we conducted a NSS SBP survey along a line shown in Fig. 6. We got a good profile along the line. A levee-like mound between the channels and spatial change of acoustic facies in a channel was recognized in the profile. Comparison of the SBP profile with the existing surface sediment data will be used in future study for understanding sedimentary processes of Sakawa River fan delta slope.

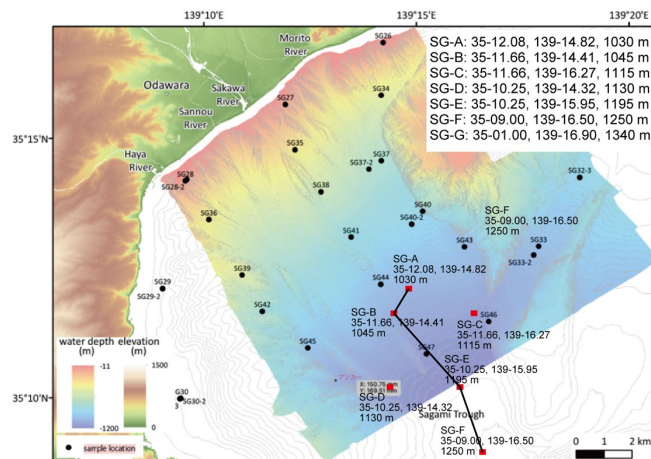


Fig. 6 Survey line on the Sakawa River fan delta slope

3-1-8. Future plans

There is no onboard results about sediment samples because all cores were stored in refrigerator of the ship and will be split after shorebased X-ray CT-scan. SBP data need to be processed using altitude and depth data recorded in the NSS pilot vehicle for shorebased study.

References

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3-2. Proposal 2 " Study on geosphere–hydrosphere–biosphere interaction via submarine mud volcano – survey of mud volcano activity and fluxes of life and materials released from mud volcano _"

3-2-1. Background and objectives

Submarine mud volcanoes occur along the margins of convergent plates and are formed by the vertical intrusion of low density, deformable sediments from the deep subsurface to the seafloor. Several tens of mud volcanoes have been found Island have been found off Tanegashima along the Ryukyu Trench. During the KH-15-2 cruise in 2015, we obtained two sediment cores from the summits of MV#1 (30°53'N, 131°46'E; water depth: 1540 m) (core length: 361 cm) and MV#14 (30°11'N, 131°23'E; water depth: 1700 m) (core length: 311 cm). The fluid advection rate estimated by the vertical profile of pore water chemistry, and nannofossils observation indicated that the activity of MV#14 is lower than the MV#1. During the cruise, we also obtained seawater samples from the water column above the central areas of MV#1 and MV#2. Then, we investigated the microbial communities in sediment and overlying seawater at the two mud volcanoes. The microbial communities in mud volcano sediments were generally distinct from those in the overlying seawaters. Nevertheless, we observed that *Atribacteria*, heterotrophic anaerobic bacteria that typically occur in organic-rich anoxic subseafloor sediments, are abundant in the methane plumes of the two SMVs (0.58 and 1.5×10^4 cells/mL, respectively) but not in surrounding waters, suggesting that microbial cells in subseafloor sediments are dispersed as “deep-biosphere seeds” into the ocean. These findings may have important implications for the microbial transmigration between the deep subseafloor biosphere and the hydrosphere.

In this context, our objectives for this proposal are 1) to investigate the activity of mud volcanoes off Tanegashima and clarify the relationship between mud volcano activity and the tectonic environment, and 2) to estimate the flux of methane and microorganisms released from the mud volcanoes, and to clarify the impact of mud volcanism on the biogeochemical cycle in the ocean.

3-2-2. Methods, instruments

In-situ physical-chemical sensors

In this cruise, we deployed the stand alone (off-lined) physical-chemical sensors (glass electrode pH sensor, Oxidation Reduction Potential; ORP sensor, and CTD-turbidity sensor) on the CTD carousel water sampling system (CTD-RMS)(Fig. 7). The sensor data was logged by every second.

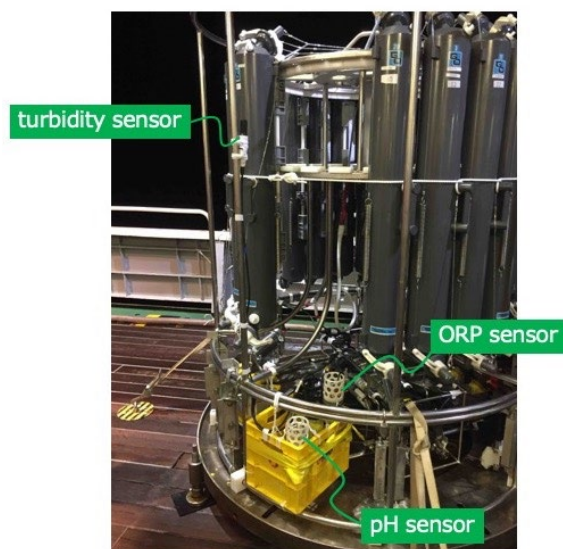


Fig.7 In-situ physical-chemical sensors METS sensor installed on the CTD system.

Dissolved methane sensor (METS sensor)

The METS sensor (Franatech GmbH, Germany) measures in-situ dissolved methane concentration using a gas-permeable membrane with tin-oxide (SnO_2) semiconductor detection (Fig. 8). It can detect concentrations of methane in the range of 1 to 500 nM at water depths down to 4000 m and temperatures of 0.5-20 °C and is used for the detection of methane-rich plume signals in the water column in cold seep areas.

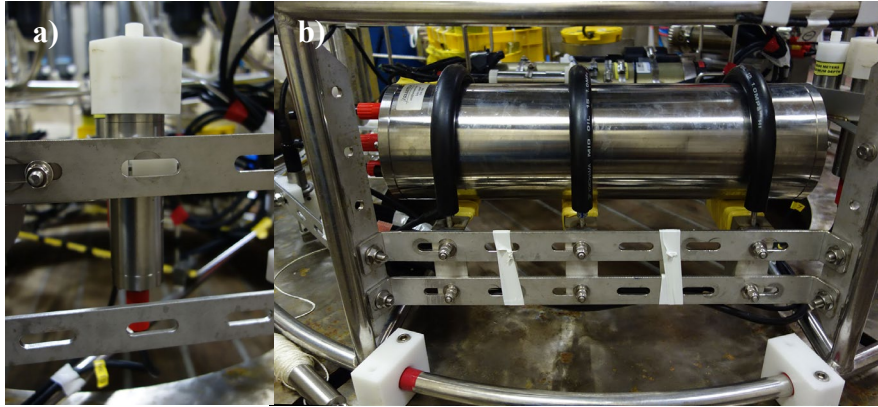


Fig. 8 a) METS sensor installed on the CTD system,
b) Data logger and power unit for the METS sensor.

3-2-3. Overview of Operations (Akira IJIRI, JAMSTEC)

During the cruise KH-19-5 Leg 1, we obtained sediment and seawater samples from MV#2 (30°55'N, 131°50.40'E; water depth: 140 m) and MV#3 (30°55'N, 131°50.40'E; water depth: 140 m) (Fig. 9). At MV#3, we conducted the survey by using a Navigable Sampling System (NSS).

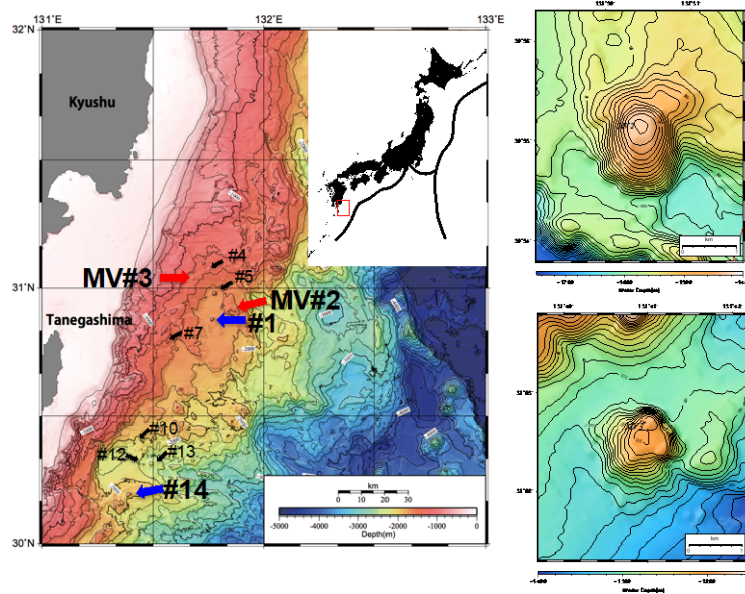


Fig. 9 Location map of MV#2 and MV#3.

3-2-4. Hydrocast survey (Akira IJIRI, JAMSTEC)

We conducted one and five hydrocast surveys on MV#2 (30°55'N, 131°50.40'E; water depth: 140 m) and MV#3 (30°55'N, 131°50.40'E; water depth: 140 m), respectively (Fig. 9). Water samples were collected by a Carousel Multi-Sampling system with twelve 12 L Niskin bottles. In each survey, the following in situ sensors were used: a conductivity-temperature-depth profiler with Carousel Multi-Sampling system, a backscatter turbidity meter, In-situ physical-chemical sensors, and dissolved methane sensor (see method). We observed the high turbidity just above MV#3 (Fig. 10), suggesting a release of suspended matters from the summit of MV#3. But such anomaly of the turbidity was not observed at MV#2.

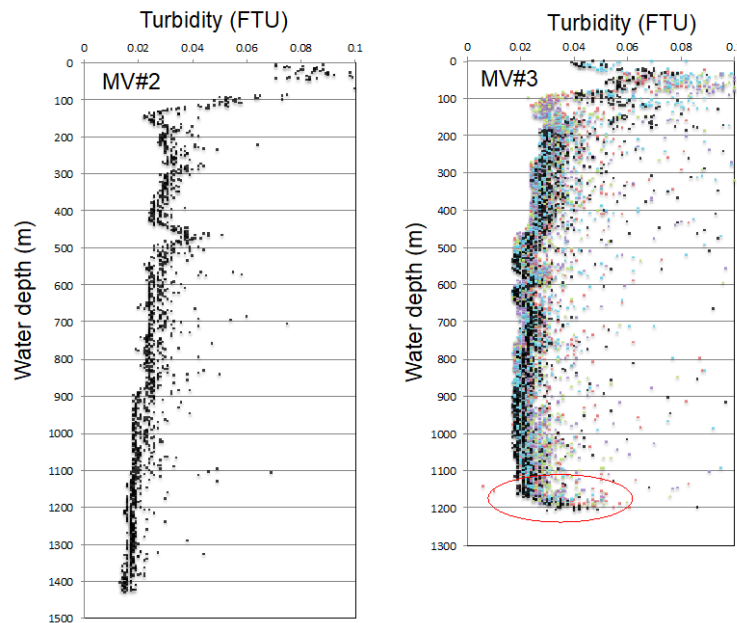


Fig. 10 Vertical profiles of turbidity observed at MV#2 and MV#3.

3-2-5. Sediment sampling and NSS survey (Akira IJIRI, JAMSTEC)

At MV#2, we took two sediment core samples (PC1, core length: 421 cm; PC2, core length: 350 cm) by a normal piston corer, one surface sediments by a multiple corer, and seawater samples by a Carousel Multi-Sampling system with twelve 12 L Niskin bottles. At MV#3, we conducted the survey by using a Navigable Sampling System (NSS). By camera observation, we found out that a lot of shells of *Calyplogena* distributed around the summit of MV#3 (Fig. 11), suggesting high activity of MV#3. Near the *Calyplogena* colony, we retrieved sediment sample by using piston corer equipped to NSS (PC3, core length 250 cm). On board laboratory of R/V *Haku-h-maru*, we took sub-samples from PC1 and PC3 for microbial analyses of sediments and chemical analyses of porewater. PC2 was brought to on-shore laboratory for the CT-Scan after the cruise.



Fig. 11 *Calymene* shells around the summit of MV#3.

3-2-6. Future plans

As a shore-based study, we plan to conduct 1) chemical analyses of porewater samples to investigate the origin of fluid and advection rate of the fluid, 2) dating of sediment to determine the age of mud-volcano sediment, and 3) investigation of microbial community by using sediment samples. For the seawater samples, we will analyze methane concentrations and microbial community in water column to investigate the distributions of methane plume and deep sourced microbes released from the mud volcanoes.

References

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4. Cruise Log

KH-19-5 Leg 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
9-Aug																							
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KH-19-5 Leg 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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KH-19-5 Leg 1

Date	Time	Latitude	Longitude	Depth (m)	Site	Remarks
190809	1603	35 39.169N	139 46.021E	0		LET GO ALL SHORE LINE
190811	102	31 25.033N	132 01.035E	1241		SEA BEAM SURVEY STARTED
190811	435	30 49.989N	132 00.971E	2225		PASSED NE7 south end
190811	440	30 49.171N	132 00.968E	2197		8 SHAPE ROTATION RIGHT TURNING STARTED
190811	450	30 49.321N	132 00.942E	2211		8 SHAPE ROTATION LEFT TURNING STARTED
190811	500	30 49.446N	132 00.990E	2212		8 SHAPE ROTATION TURNING FINISHED
190811	515	30 50.035N	132 03.220E	2143		PASSED NE6 South end
190811	851	31 25.012N	132 03.151E	1222		SEA BEAM SURVEY FINISHED
190811	853	31 25.268N	132 03.168E	1214		8 SHAPE ROTATION RIGHT TURNING STARTED
190811	903	31 25.288N	132 03.294E	1221		8 SHAPE ROTATION LEFT TURNING STARTED
190811	913	31 25.240N	132 03.460E	1233		8 SHAPE ROTATION TURNING FINISHED
190811	923	31 24.906N	132 03.358E	1228		LET GO XCTD
190811	1331	30 50.013N	132 05.354E	2172		SEA BEAM SURVEY STARTED
190811	1700	31 25.043N	132 05.320E	1235		PASSED NE5 North end
190811	1715	31 24.972N	132 07.496E	1529		PASSED NE4 North end
190811	2047	30 49.967N	132 07.489E	2123		SEA BEAM SURVEY FINISHED
190816	419	30 55.397N	131 50.175E	1495	MV#2	CTD-CMS STARTED
190816	509	30 55.079N	131 50.506E	1444	MV#2	CTD-CMS DEEPEST
190816	547	30 54.904N	131 50.581E	1464	MV#2	CTD-CMS FINISHED
190816	804	30 55.272N	131 50.129E	1475	MV#2	PISTON CORER STARTED
190816	854	30 55.102N	131 50.370E	1443	MV#2	PISTON CORER HIT BOTTOM
190816	856	30 55.101N	131 50.368E	1443	MV#2	PISTON CORER LEFT BOTTOM
190816	936	30 54.985N	131 50.576E	1454	MV#2	PISTON CORER FINISHED
190816	1047	30 55.265N	131 50.092E	1508	MV#2	PISTON CORER STARTED
190816	1131	30 55.104N	131 50.355E	1441	MV#2	PISTON CORER HIT BOTTOM
190816	1132	30 55.103N	131 50.358E	1442	MV#2	PISTON CORER LEFT BOTTOM
190816	1208	30 54.900N	131 50.472E	1455	MV#2	PISTON CORER FINISHED
190816	1312	30 55.166N	131 50.226E	1448	MV#2	MULTIPLE CORER STARTED
190816	1349	30 55.117N	131 50.361E	1441	MV#2	MULTIPLE CORER HIT BOTTOM
190816	1352	30 55.121N	131 50.365E	1441	MV#2	MULTIPLE CORER LEFT BOTTOM
190816	1423	30 55.015N	131 50.496E	1446	MV#2	MULTIPLE CORER FINISHED
190816	1810	31 03.091N	131 40.603E	1314	MV#3	CTD-CMS STARTED
190816	1924	31 02.531N	131 41.060E	1211	MV#3	CTD-CMS DEEPEST
190816	2002	31 02.276N	131 41.260E	1282	MV#3	CTD-CMS FINISHED
190816	2111	31 03.000N	131 40.551E	1316	MV#3	CTD-CMS STARTED
190816	2143	31 02.560N	131 40.932E	1208	MV#3	CTD-CMS DEEPEST
190816	2217	31 02.211N	131 41.211E	1282	MV#3	CTD-CMS FINISHED
190816	2313	31 02.771N	131 40.711E	1255	MV#3	CTD-CMS STARTED
190816	2342	31 02.411N	131 41.162E	1201	MV#3	CTD-CMS DEEPEST
190817	16	31 02.129N	131 41.549E	1310	MV#3	CTD-CMS FINISHED
190817	807	31 03.695N	131 38.105E	1120	MV#3	NSS+PISTON CORER STARTED

(continued)

KH-19-5 Leg 1

Date	Time	Latitude	Longitude	Depth (m)	Site	Remarks
190817	1338	31 02.554N	131 40.890E	1206	MV#3	NSS+PISTON CORER HIT BOTTOM
190817	1340	31 02.551N	131 40.889E	1206	MV#3	NSS+PISTON CORER LEFT BOTTOM
190817	1445	31 01.220N	131 43.658E	1474	MV#3	NSS+PISTON CORER FINISHED
190817	1605	31 02.771N	131 40.540E	1285	MV#3	MULTIPLE CORER STARTED
190817	1650	31 02.551N	131 40.900E	1206	MV#3	MULTIPLE CORER HIT BOTTOM
190817	1653	31 02.551N	131 40.898E	1206	MV#3	PISTON CORER LEFT BOTTOM
190817	1719	31 02.523N	131 41.106E	1211	MV#3	MULTIPLE CORER FINISHED
190817	1804	31 03.116N	131 40.594E	1313	MV#3	CTD-CMS STARTED
190817	1903	31 02.686N	131 41.062E	1207	MV#3	CTD-CMS DEEPEST
190817	1937	31 02.688N	131 41.412E	1307	MV#3	CTD-CMS FINISHED
190817	2027	31 02.460N	131 40.259E	1325	MV#3	CTD-CMS STARTED
190817	2057	31 02.410N	131 40.802E	1219	MV#3	CTD-CMS DEEPEST
190817	2131	31 02.449N	131 41.215E	1202	MV#3	CTD-CMS FINISHED
190818	1006	31 35.646N	130 33.915E	0		SENT FIRST SHORE LINE

KH-19-5 Leg 2

Date	Time	Latitude	Longitude	Depth (m)	Site	Remarks
190821	1358	31 35.651N	130 33.908E	0		LET GO ALL SHORE LINE
190822	1643	33 42.711N	136 28.582E	2059	KP04	MULTIPLE CORER STARTED
190822	1732	33 42.485N	136 28.488E	898	KP04	MULTIPLE CORER HIT BOTTOM
190822	1734	33 42.484N	136 28.489E	883	KP04	MULTIPLE CORER LEFT BOTTOM
190822	1813	33 42.443N	136 28.455E	2058	KP04	MULTIPLE CORER FINISHED
190823	805	35 05.448N	139 24.636E	1137	ST01	NSS+PISTON CORER STARTED
190823	1559	35 05.301N	139 24.992E	1751	ST01	NSS+PISTON CORER HIT BOTTOM
190823	1601	35 05.302N	139 24.995E	1743	ST01	NSS+PISTON CORER LEFT BOTTOM
190823	1657	35 05.658N	139 25.103E	1028	ST01	NSS+PISTON CORER FINISHED
190823	1957	35 08.279N	139 19.459E	527	ST08	MULTIPLE CORER STARTED
190823	2025	35 08.281N	139 19.481E	0	ST08	MULTIPLE CORER HIT BOTTOM
190823	2027	35 08.283N	139 19.479E	527	ST08	MULTIPLE CORER LEFT BOTTOM
190823	2045	35 08.343N	139 19.505E	523	ST08	MULTIPLE CORER FINISHED
190823	2121	35 07.723N	139 20.522E	728	ST09	MULTIPLE CORER STARTED
190823	2148	35 07.715N	139 20.573E	730	ST09	MULTIPLE CORER HIT BOTTOM
190823	2150	35 07.719N	139 20.571E	730	ST09	MULTIPLE CORER LEFT BOTTOM
190823	2207	35 07.742N	139 20.478E	724	ST09	MULTIPLE CORER FINISHED
190824	1021	35 05.472N	139 24.868E	1067	ST01	NSS+PHF STARTED

(continued)

KH-19-5 Leg 2

Date	Time	Latitude	Longitude	Depth (m)	Site	Remarks
190824	1644	35 05.645N	139 25.002E	1034	ST01	NSS+PHF FINISHED
190824	1953	35 05.197N	139 24.548E	1150	ST01	MULTIPLE CORER STARTED
190824	2027	35 05.190N	139 24.526E	1149	ST01	MULTIPLE CORER HIT BOTTOM
190824	2029	35 05.192N	139 24.524E	1150	ST01	MULTIPLE CORER LEFT BOTTOM
190824	2054	35 05.104N	139 24.523E	1138	ST01	MULTIPLE CORER FINISHED
190824	2135	35 06.001N	139 21.515E	1051	ST11	MULTIPLE CORER STARTED
190824	2207	35 05.990N	139 21.473E	1052	ST11	MULTIPLE CORER HIT BOTTOM
190824	2208	35 05.990N	139 21.474E	1052	ST11	MULTIPLE CORER LEFT BOTTOM
190824	2233	35 05.964N	139 21.445E	1053	ST11	MULTIPLE CORER FINISHED
190825	838	35 05.483N	139 24.864E	1056	ST01	NSS+PHF STARTED
190825	1221	35 05.483N	139 24.896E	0	ST01	PHF SET BY NSS
190825	1315	35 05.700N	139 24.816E	1068	ST01	SBP SURVEY BY NSS STARTED
190825	1602	35 05.634N	139 25.035E	1029	ST01	SBP SURVEY BY NSS FINISHED
190825	1638	35 05.760N	139 25.236E	1018	ST01	NSS FINISHED
190825	1730	35 05.355N	139 24.861E	1117		RELEASED PHF
190825	1754	35 05.547N	139 25.234E	1003		POPPED UP PHF
190825	1814	35 05.486N	139 25.033E	1033		PHF RETRIEVED
190825	1952	35 00.976N	139 22.752E	1409	ST13	MULTIPLE CORER STARTED
190825	2028	35 00.972N	139 22.740E	1214	ST13	MULTIPLE CORER HIT BOTTOM
190825	2030	35 00.969N	139 22.740E	1262	ST13	MULTIPLE CORER LEFT BOTTOM
190825	2058	35 00.900N	139 22.812E	1407	ST13	MULTIPLE CORER FINISHED
190826	833	35 05.434N	139 24.947E	1052	ST01	NSS+PHF STARTED
190826	1012	35 05.439N	139 24.964E	0	ST01	PHF SET BY NSS
190826	1048	35 05.488N	139 24.879E	1053	ST01	NSS FINISHED
190826	1230	35 04.000N	139 30.506E	876	ST01	NSS STARTED
190826	1320	35 04.191N	139 30.435E	879	ST01	SBP SURVEY BY NSS STARTED
190826	1534	35 05.340N	139 29.187E	771	ST01	SBP SURVEY BY NSS FINISHED
190826	1609	35 05.585N	139 28.678E	851	ST01	NSS FINISHED
190826	1954	35 05.599N	139 24.379E	1199	ST01	MULTIPLE CORER STARTED
190826	2026	35 05.614N	139 24.374E	1197	ST01	MULTIPLE CORER HIT BOTTOM
190826	2028	35 05.614N	139 24.371E	1199	ST01	MULTIPLE CORER LEFT BOTTOM
190826	2052	35 05.595N	139 24.469E	1182	ST01	MULTIPLE CORER FINISHED
190826	2112	35 05.514N	139 25.384E	984	ST01	MULTIPLE CORER STARTED
190826	2140	35 05.503N	139 25.411E	983	ST01	MULTIPLE CORER HIT BOTTOM
190826	2142	35 05.504N	139 25.412E	982	ST01	MULTIPLE CORER LEFT BOTTOM
190826	2202	35 05.503N	139 25.482E	981	ST01	MULTIPLE CORER FINISHED
190827	825	35 08.987N	139 16.499E	1260	26-21	NSS STARTED
190827	912	35 08.955N	139 16.476E	1257	26-21	NSS DEEPEST
190827	914	35 08.952N	139 16.480E	1258	26-21	SBP SURVEY BY NSS STARTED
190827	1520	35 12.291N	139 15.189E	1044	26-21	SBP SURVEY BY NSS FINISHED
190827	1602	35 11.983N	139 15.399E	1083	26-21	NSS FINISHED
190828	857	35 37.075N	139 47.180E	0		SENT OUT 1ST SHORE LINE

5. Sample List

Sample ID	Length (cm)	Area	Site	Day	Time	Latitude	Longitude	Positioning	Depth (m)	Number
PC01	4.21	Tanegashima	MV2	8/15	14:52	30° 55.104'N	131° 50.4085'E	Transponder	1443	5+CC
PC02	3.50	Tanegashima	MV2	8/15	17:31	30° 55.1032'N	131° 50.3954'E	Transponder	1442	3
PC03	2.50	Tanegashima	MV3	8/16	13:29	31° 02.5552'N	131° 40.9319'E	Transponder	1168	3
PC04	3.75	Sagami Bay	ST01B	8/23	16:00	35° 05.3246'N	139° 25.0278'E	Transponder	1081	5+CC
MC01	0.27	Tanegashima	MV2	8/16	13:49	30° 55.1158'N	131° 50.3944'E	Transponder	1366	8
MC02	0.20	Tanegashima	MV3	8/17	16:51	31° 02.5373'N	131° 40.9536'E	Transponder	1136	8
MC03	0.30	Kumano Basin	KP04	8/22	17:32	33° 42.4850'N	136° 28.4880'E	Ship	2058	8
MC04	0.22	Sagami Bay	ST08	8/23	20:25	35° 08.2948'N	139° 19.4376'E	Transponder	527	8
MC05	0.24	Sagami Bay	ST09	8/23	21:48	35° 07.7150'N	139° 20.5730'E	Transponder	725	8
MC06	0.25	Sagami Bay	ST01D	8/24	20:27	35° 05.1898'N	139° 24.5256'E	Transponder	1149	8
MC07	0.32	Sagami Bay	ST11	8/24	22:07	35° 05.9903'N	139° 21.4728'E	Transponder	1051	8
MC08	0.38	Sagami Bay	ST13	8/25	20:28	35° 00.9720'N	139° 22.7420'E	Ship	1408	8
MC09	0.40	Sagami Bay	ST01V	8/26	20:27	35° 05.6140'N	139° 24.3720'E	Ship	1197	8
MC10	0.24	Sagami Bay	ST01C	8/26	21:40	35° 05.5030'N	139° 25.4110'E	Ship	984	8

This cruise report is a preliminary documentation as of the end of cruise.

This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

Users of information on this report are requested to submit Publication Report to Cooperative Research System Office.

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