



KR21-16

Research cruise to observe and understand the Volcanic Activities of Izu- Ogasawara arc volcanoes

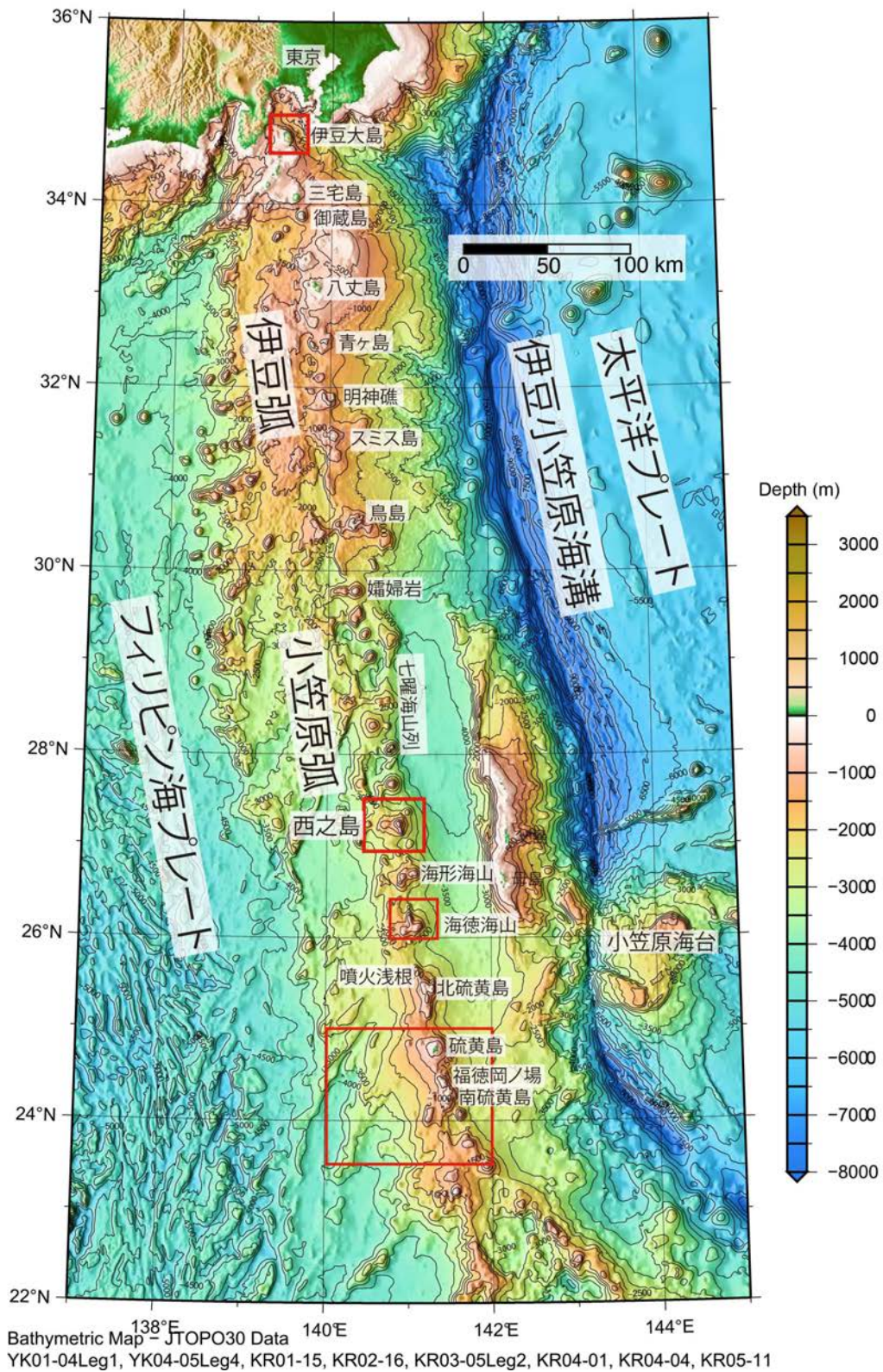
The areas around Izu-Oshima, Nishinoshima, and
Fukutoku-Oka-no-Ba
September 22, 2021 – October 11, 2021

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

1. Cruise Information

- Cruise ID: KR21-16
- Name of vessel: RV Kairei
- Title of cruise: **Research cruise to observe and understand the Volcanic Activities of Izu-Ogasawara arc volcanoes**
- Chief Scientist: Yoshihiko Tamura [IMG, JAMSTEC]
- Cruise period: From September 22 to October 11, 2021
- Ports of departure / call / arrival: JAMSTEC HQ/ JAMSTEC HQ
- Research area: The areas around Izu-Oshima, Nishinoshima, and Fukutoku-Oka-no-Ba. In practice, the research area is limited near Izu-Oshima by bad weather.

● Research map



2. Research Proposal and Science Party

- Title of proposals

Research cruise to observe and understand the Volcanic Activities of Izu-Ogasawara arc volcanoes (P21-09)

- Representative of Science Party [Affiliation]

Satoru Tanaka [IMG, JAMSTEC]

- Science Party (List) [Affiliation, assignment etc.]

	Name	Affiliation	Position	Assignment
1	Satoru Tanaka	IMG	GL	Director of the research cruise
2	Daisuke Suetsugu	IMG	Principal Researcher	OBS installation and observation
3	Takeshi Hanyu	IMG	GL	Sampling and analyses of geological samples
4	Morihisa Hamada	IMG	Researcher	Sampling and analyses of geological samples
5	Aki Ito	IMG	Researcher	OBS installation and observation
6	Tomoya Nakajima	IMG	Technical Staff	OBS installation and observation
7	Yuya Machida	IMG	Researcher	Hydraulic pressure corresponding to vertical seismic variation
8	Noriko Tada	IMG	Researcher	OBEM installation and observation
9	Kiyoshi Baba	ERI, Univ. of Tokyo	Associate Professor	OBEM installation and observation
10	Hiroshi Ichihara	Nagoya University	Assistant Professor	OBEM installation and observation
11	Hiroko Sugioka	JAMSTEC /Kobe University	Professor	OBS installation and observation and Wave Glider observation
12	Yozo Hamano	JAMSTEC /Kobe University	Visiting Professor	Wave Glider observation
13	Yoshihiko Tamura	IMG	Principal Researcher	Petrology of volcanic rocks
14	Yasuhiko Ohara	IMG	Invited Principal Researcher	Topographic survey
15	Shigeaki Ono	IMG	Director	Petrology of volcanic rocks
16	Osamu Ishizuka	IMG	Invited Senior Researcher	Isotope and Ar-Ar age analyses of volcanic rocks
17	Shinsuke Kawaguchi	X-Star	Researcher	Survey of hydrothermal vents and chemistry of ocean
18	Chong Chen	X-Star	Researcher	Description of

				chemosynthetic biological communities
19	Hiromi Watanabe	X-Star	Engineer	Description of chemosynthetic biological communities
20	Shuichi Kodaira	IMG	Director General	general management of the project
21	Makoto Ueshima	ERI, Univ. of Tokyo	Professor	OBEM installation and observation
22	Yoshiya Usui	ERI, Univ. of Tokyo	Assistant Professor	OBEM installation and observation
23	Takao Koyama	ERI, Univ. of Tokyo	Assistant Professor	OBEM installation and observation
24	Marceau Gresse	ERI, Univ. of Tokyo	PD	OBEM installation and observation
25	Roshan Kumar Singh	ERI, Univ. of Tokyo	Visiting Researcher	OBEM installation and observation
26	Dieno Diba	ERI, Univ. of Tokyo	Graduate student	OBEM installation and observation

LIST OF CRUISE PERSONNEL:

SCIENTIFIC PERSONNEL:

YOSHIHIKO TAMURA (IMG, JAMSTEC)
 SATORU TANAKA (IMG, JAMSTEC)
 TAKESHI HANYU (IMG, JAMSTEC)
 TOMOKI SATO (IMG, JAMSTEC)
 AKI ITO (IMG, JAMSTEC)
 NORIKO TADA (IMG, JAMSTEC)
 ERIKA TANAKA (IMG, JAMSTEC)
 TOMOYA NAKAJIMA (IMG, JAMSTEC)
 MORIHISA HAMADA (IMG, JAMSTEC)
 KENTA YOSHIDA (IMG, JAMSTEC)
 KIYOSHI BABA (ERI, UNIV. OF TOKYO)
 NOBUYOSHI FUKUHARA (NHK)
 TETSURO YASUDA (NHK)
 TAKASHI YOSHIDA (NHK)
 MASAMI FUJII (HEXAMEDIA)
 TAKUYA MAEKAWA (NME)

CAPTAIN AND CREW OF THE R/V KAIREI

TAKAFUMI AOKI (MASTER)
 HIROYUKI KATO (CHIEF OFFICER)
 MASAKI OKADA (SECOND OFFICER)
 TAIGA YAMAMOTO (THIRD OFFICER)
 EIJI SAKAGUCHI (CHIEF ENGINEER)

TAKAHIRO MORI (FIRST ENGINEER)
 YOSHINOBU HIRATSUKA (SECOND ENGINEER)
 YUDAI YOKOYAMA (THIRD ENGINEER)
 TOKINORI NASU (CHIEF ELECTRONICS OPERATOR)
 RYUJI ONIKUBO (SECOND ELECTRONICS OPERATOR)
 HIDEO ISOBE (BOAT SWAIN)
 TAKUYA MIYASHITA (QUARTER MASTER)
 AKIRA KURIHARA (QUARTER MASTER)
 KAZUMI OGASAWARA (QUARTER MASTER)
 KOSEI HIRAI (SAILOR)
 KODAI KAKUBARI (SAILOR)
 TAKUMA KONNO (SAILOR)
 YUKIHIRO YAMAGUCHI (NO. 1 OILER)
 SHINYA SUGI (OILER)
 SOTA MISAGO (OILER)
 KOTA MATSUMURA (ASSISTANT OILER)
 SOMA HAYASHIDA (ASSISTANT OILER)
 RUKI SAITO (ASSISTANT OILER)
 TATSUNARI ONOUE (CHIEF STEWARD)
 RYU KUBOTA (STEWARD)
 TSUGUMI TANAKA (STEWARD)
 TSUYOSHI NAGATOMO (STEWARD)
 MASARU SUGIYAMA (STEWARD)

KAIKO OPERATION TEAM

SEIJI SHIGETAKE (SUBMERSIBLE OPERATION MANAGER)
 TOMOE KONDO (1/SUBMERSIBLE TECHNICAL OFFICER)
 SHOTA IHARA (2/SUBMERSIBLE TECHNICAL OFFICER)
 NAOKI SATO (3/SUBMERSIBLE TECHNICAL OFFICER)
 ATSUSHI KOGUMA (3/SUBMERSIBLE TECHNICAL OFFICER)
 KUNIHIRO IWATA (3/SUBMERSIBLE TECHNICAL OFFICER)
 DAIKI ITINOSE (3/SUBMERSIBLE TECHNICAL OFFICER)

3. Research/Development Activities

RV KAIREI KR21-16 Cruise Log

Date & Time	Description	Weather / Wind / Sea Condition
2021/09/22 Wed.	Noon Position: 35-56.3N, 139-21.3E (Northward off Izu-Oshima)	c / SE-3 / 1
08:00	Science party came on board	
09:00	Let go all shorelines & left JAMSTEC for Izu-Oshima	
10:00	Carried out education & training for scientists	

11:00	Carried out figure eight running for calibration	
12:31	Released XBT	
13:27	Released OBEM IO05	
15:14	Released OBEM IO01	
17:30	Research meeting	
17:19-20:45	Carried out MBES mapping survey	
2021/9/23 Thu.	Noon Position: 34-45.3N, 139-32.1E (Eastward off Izu-Oshima)	bc / SW-5 / 2
08:19	Released OBEM IO09	
09:29	Released OBEM IO03	
10:20	Released OBEM IO10	
13:13	Released OBEM IO08	
17:30	Research meeting	
18:00-19:31	Carried out MBES mapping survey	
2021/9/24 Fri.	Noon Position: 34-42.2N, 139-32.3E (Eastward off Izu-Oshima)	bc / NE-3 / 2
04:05	Released XBT	
08:34	Hoisted up "KAIKO Mk-IV"	
08:40	Launched "KAIKO Mk-IV", it dove and commenced her operation KK875	
10:03	Landed on the sea floor (D=1,202m)	
14:11	Left the sea bottom (D=955m)	
15:08	Refloated	
15:19	Recovered "KAIKO Mk-IV" and finished the operation	
18:30	Research meeting	
17:54 - 20:37	Carried out MBES mapping survey	
2021/9/25 Sat.	Noon Position: 34-36.7N, 139-18.9E (Southward off Izu-Oshima)	o / NNE-6 / 3
08:14	Released OBEM IO09	
09:11	Released OBEM IO03	
10:09	Released OBEM IO10	
11:04	Released OBEM IO08	
13:18 - 21:05	Carried out MBES mapping survey	
17:30	Research meeting	
2021/9/26 Sun.	Noon Position: 34-43.8N, 139-19.0E (Westward off Izu-Oshima)	r / NE-5 / 2

08:27 - 18:38	Carried out MBES mapping survey	
17:30	Research meeting	
18:40	Commenced proceeding to Tateyama for avoiding rough sea	
2021/9/27 Mon.	Noon Position: 35-00.7N, 139-46.4E (Tateyama Bay)	bc / N-6 / 3
13:00	Commenced proceeding to off Funabashi for avoiding rough sea	
16:15	Let go anchor, arrived at Off Funabashi	
17:30	Research meeting	
2021/9/28 Tue.	Noon Position: 35-35.7N, 140-00.0E (Off Funabashi)	bc / NNE-4 / 0
17:30	Research meeting	
2021/9/29 Wed.	Noon Position: 35-35.7N, 140-00.0E (Off Funabashi)	bc / N-1 / 0
17:30	Research meeting	
2021/9/30 Thu.	Noon Position: 35-35.7N, 140-00.0E (Off Funabashi)	c / NW-2 / 0
17:30	Research meeting	
2021/10/01 Fri.	Noon Position: 35-35.7N, 140-00.0E (Off Funabashi)	r / N-8 / 1
17:30	Research meeting	
2021/10/02 Sat.	Noon Position: 35-00.5N, 139-46.5E (Tateyama Bay)	bc / N-3 / 1
08:25	Heaving anchor, left Off Funabashi	
2021/10/03 Sun.	Noon Position: 33-38.6N, 139-43.6E (Southeastward off Mikurajima)	bc / ESE-4 / 4
09:00	Research meeting	
17:07 - 21:33	Carried out MBES mapping survey	
17:30	Research meeting	
2021/10/04 Mon.	Noon Position: 34-42.2N, 139-32.3E (Eastward off Izu-Oshima)	bc / SSW-3 / 2
08:54	Hoisted up "KAIKO Mk-IV"	
08:59	Launched "KAIKO Mk-IV", it dove and commenced her operation KK876	
10:00	Landed on the sea floor (D=796m)	
14:44	Left the sea bottom (D=566m)	
15:29	Refloated	
15:40	Recovered "KAIKO Mk-IV" and finished the operation	
19:00	Research meeting	
2021/10/05 Tue.	Noon Position: 34-50.2N, 139-29.3E (Northeastward off Izu-Oshima)	bc / SSW-4 / 2
	Suspended "KAIKO 7000II" diving operation due to mechanical trouble.	

13:55	Released BBOBS S5r	
16:30	Released BBOBS S1	
19:00	Research meeting	
20:16 - 21:54	Carried out MBES mapping survey	
2021/10/06 Wed.	Noon Position: 34-53.6N, 139-15.9E (Sagami Bay)	bc / NE-6 / 4
08:03	Released BBOBS S3r	
10:47	Released BBOBS S6r	
15:30 - 21:00	Carried out MBES mapping survey	
17:30	Research meeting	
2021/10/07 Thu.	Noon Position: 34-41.1N, 139-29.2E (Eastward off Izu-Oshima)	c / NNE-4 / 2
08:34	Hoisted up "KAIKO Mk-IV"	
10:02	Launched "KAIKO Mk-IV", it dove and commenced her operation KK877	
10:15	Landed on the sea floor (D=618m)	
13:26	Left the sea bottom (D=427m)	
14:24	Refloated	
14:59	Recovered "KAIKO Mk-IV" and finished the operation	
17:30	Research meeting	
18:10 - 20:55	Carried out MBES mapping survey	
2021/10/08 Fri.	Noon Position: 34-55.9N, 139-39.1E (Westward off Susaki)	bc / E-2 / 2
14:20	Let go anchor, arrived at YOKOSUKA port Section No.4	
2021/10/09 Sat.		
08:15	Heaving anchor, left YOKOSUKA port Section No.4	
09:00	Sent out 1st shore line, arrived at Nissan No.6, then completed voyage.	

OBEM: Marine magnetotelluric observation around Izu-Oshima volcano

Noriko Tada & Kiyoshi Baba

Marine magnetotelluric observation aims to elucidate the electrical conductivity structure of the crust and upper mantle beneath Izu-Oshima volcano. Since the electrical conductivity of rocks is enhanced significantly with temperature increase and if the rock is partially molten, it is expected that the conductivity structure can constrain magmatic bodies beneath the island at the present and help for discussion on possible eruptions in near future.

We deployed 10 ocean bottom electromagnetometers (OBEMs), which were supplied from JAMSTEC and ERI, University of Tokyo, in this cruise (Table 1). OBEMs measure time variations of natural electromagnetic field (three-component of magnetic field and horizontal two-component of electric field), together with the instrumental tilt and temperature at the magnetic sensor. Photo 1 shows three types of OBEM utilized in this project. Two of them, JAMSTEC type and ERI type I, look like each other, and they have 5.4-m-long electric dipoles and two 17-inch glass spheres covered in plastic sphere. One glass sphere equips a fluxgate magnetometer, two tiltmeters, a thermometer, and a recorder, and the other equips batteries and transducer circuit. JAMSTEC type consists of an aluminum frame and a sinker made of lead and aluminum, on the other hand, ERI type I consists of a titanium frame and a concrete sinker. ERI type II have 4.6-m-long electric dipoles, glass spheres as floats, and titanium pressure cases for housing the magnetometer, acoustic transducer, and batteries. Its sinker mainly consists of lead. All OBEMs are self-popup type instruments, which release their sinker by an acoustic command to ascend to the surface. A radio beacon and a flashlight are mounted on the OBEM frame

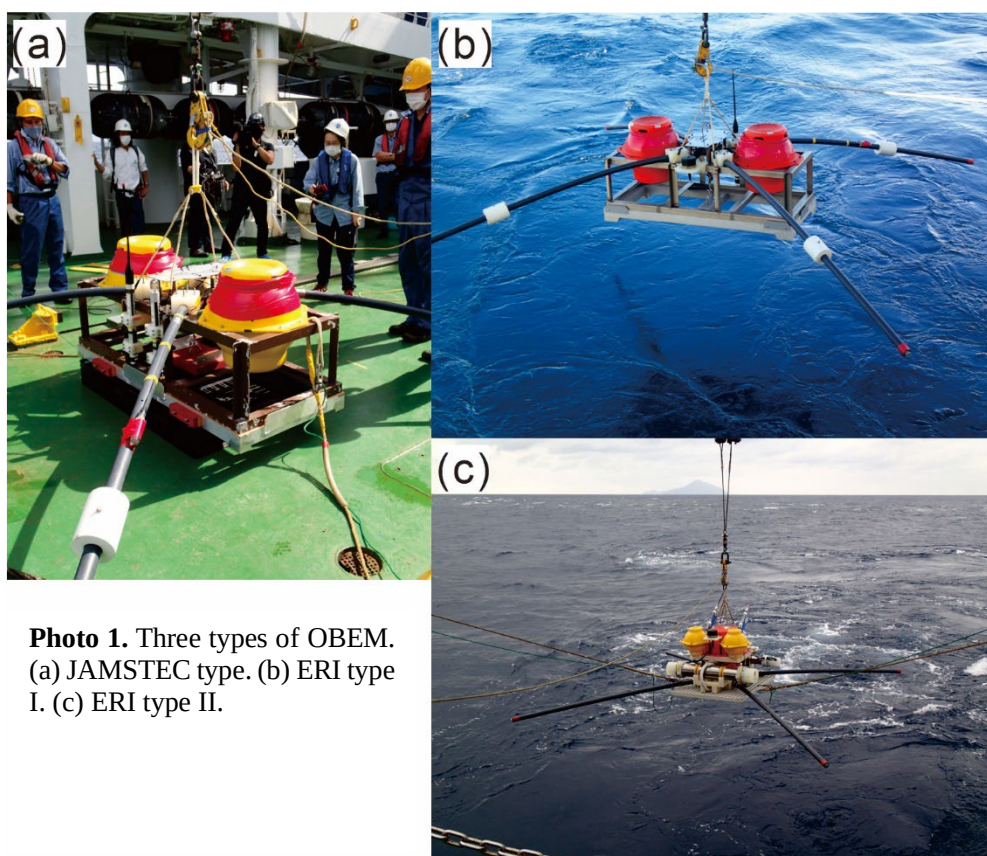


Photo 1. Three types of OBEM.
(a) JAMSTEC type. (b) ERI type I.
(c) ERI type II.

to help searching the instrument when it reaches to the sea surface in recovery time. The OBEMs were launched from the deck of R/V Kairei using an astern A-frame and a winch, and sunk by their own weights. Launched times and settled times or confirmed times when we checked the OBEM was on the seafloor were listed in Table 1. We confirmed that the OBEMs were successfully settled on the

seafloor by measuring acoustic signals. Then, the settled positions (Figure 2, Table 2) were determined by measurements of the slant ranges at three positions surrounding the launched point of each OBEM for IO08 and IO10 and by SSBL system equipped with R/V Kairei for the other eight sites.

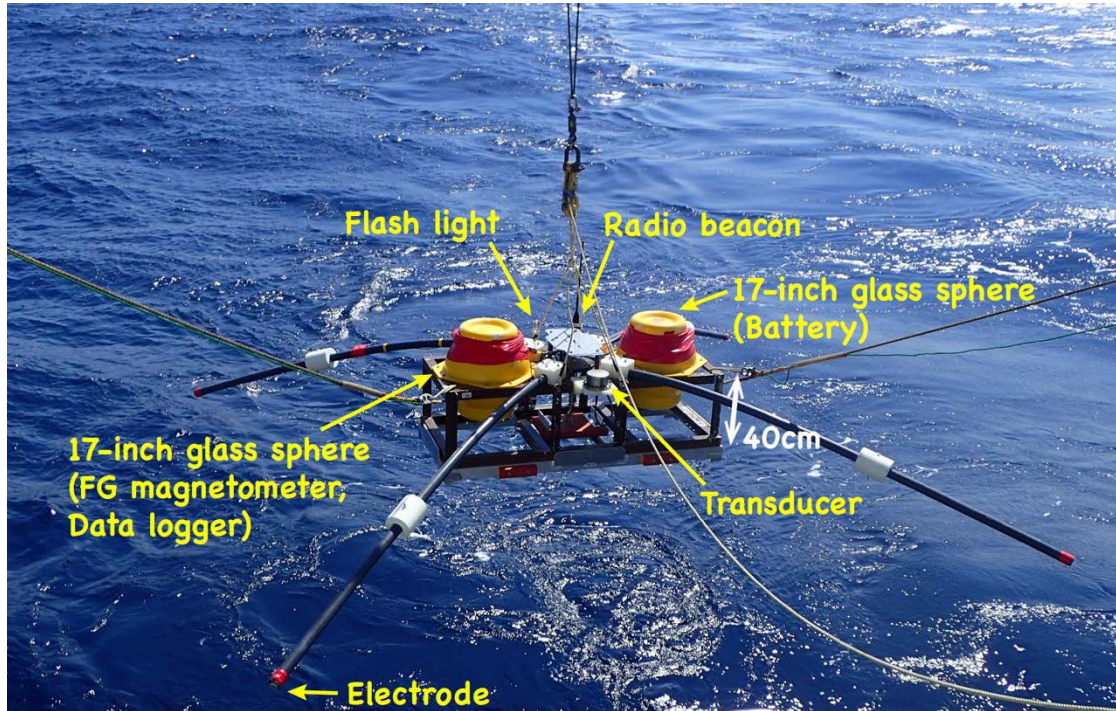


Photo 2. Specification of the OBEM (JAMSTEC type).

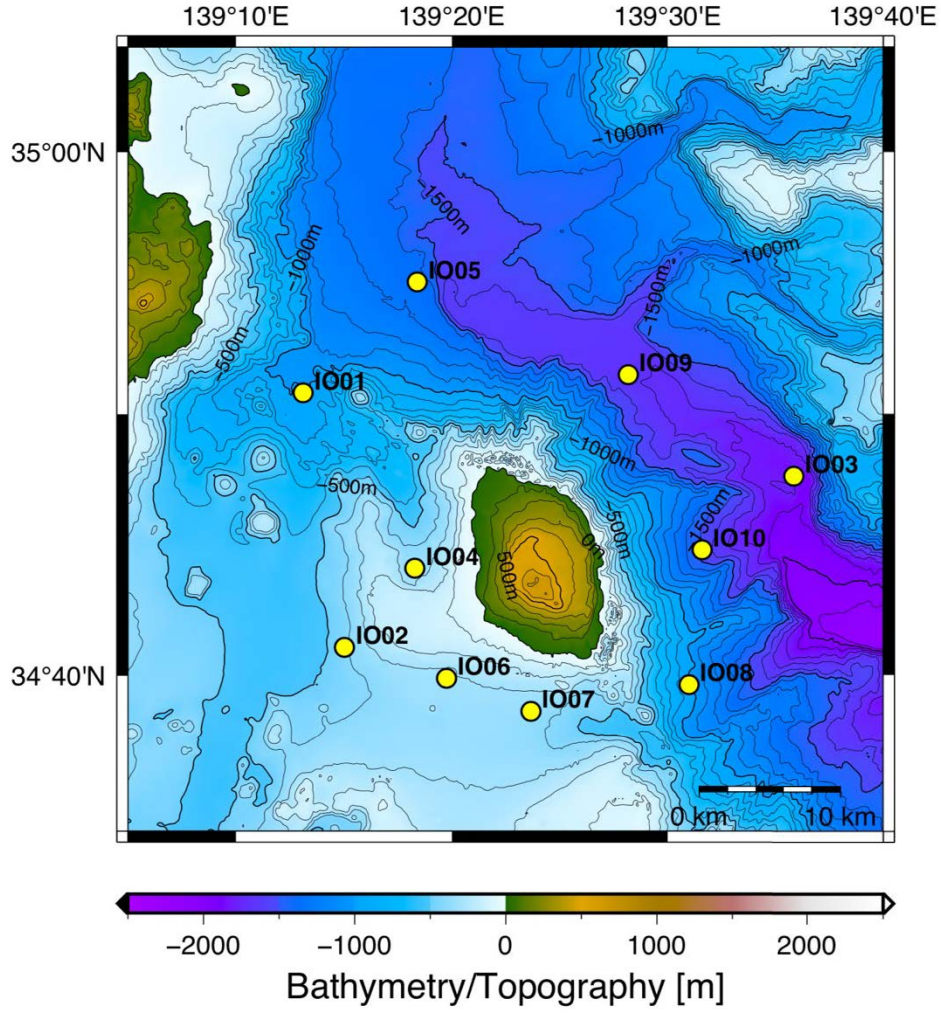


Figure 2. The location of the settled OBEMs with bathymetry of 150 m grid.

The clocks of the OBEMs were synchronized to UTC before deployment by a master clock unit directly or through a laptop PC using USB or RS232C communication. Sampling schedules were also set before the OBEMs were deployed (Table 2). The observation will start in the middle of November 2021, in parallel with magnetotelluric observations on Izu-Oshima island, for joint data analysis. The recovery of the OBEMs is planned in 2022.

Site ID	OBEM ID	OBEM type (Institute)	Deployment date	Launched time	Settled time (Confirmed time)	Descending speed [m/min]
IO01	TT4	ERI type I	2021/09/22	15:14:17	15:43:03	34.1
IO02	JM7	JAMSTEC	2021/09/25	10:09:07	10:19:33	40.6
IO03	ERI101	ERI type II	2021/09/23	09:29:55	(15:46:34)	-
IO04	ERI100	ERI type II	2021/09/25	11:04:42	11:12:52	41.8
IO05	JM2	JAMSTEC	2021/09/22	13:27:12	13:59:56	42.3
IO06	TT1	ERI type I	2021/09/25	09:11:53	09:21:18	33.7
IO07	ERI2	ERI type I	2021/09/25	08:14:05	08:24:51	32.8
IO08	JM8	JAMSTEC	2021/09/23	13:13:21	13:49:00	33.0
IO09	TT8	ERI type I	2021/09/23	08:19:26	(16:59:18)	-
IO10	JM1	JAMSTEC	2021/09/23	10:20:34	10:54:30	44.3

Table 1. The specifications, date and time of OBEM deployments, and descending speeds.

Site ID	Launched position		Settled position			Acoustic transponder code for anchor release	Radio beacon ID (43.528MHz)	Timer information [UTC] & Sampling intervals in ()
	Latitude	Longitude	Latitude	Longitude	Depth [m]			
IO01	34° 50.7613' N	139° 12.9596' E	34° 50.8137' N	139° 13.1175' E	998.7	4C-1	JS2166	2021/11/15 14:58 ~2021/12/20 14:58 (8Hz) 2021/12/20 14:59 ~ (10s)
IO02	34° 40.9879' N	139° 14.8111' E	34° 41.0855' N	139° 15.0339' E	423.6	3C-1	JS142	2021/11/15 14:58 ~ 2021/12/20 14:58 (8Hz) 2021/12/20 14:59 ~ (10s)
IO03	34° 47.6451' N	139° 35.7511' E	34° 47.6070' N	139° 35.8947' E	1851.2	1B-1	JS2167	2021/11/15 14:58 ~ 2021/12/20 14:58 (8Hz) 2021/12/20 14:59 ~ (10s)
IO04	34° 44.0548' N	139° 18.2369' E	34° 44.1151' N	139° 18.2886' E	342.3	1A-2	JS2168	2021/11/15 14:58 ~ 2021/12/20 14:58 (8Hz) 2021/12/20 14:59 ~ (10s)
IO05	34° 54.9528' N	139° 18.2681' E	34° 55.0477' N	139° 18.4048' E	1376.3	1C-1	JS2144	2021/11/15 14:58 ~ (10s)
IO06	34° 39.9173' N	139° 19.5403' E	34° 39.9030' N	139° 19.7637' E	325.5	2A-1	JS2163	2021/11/15 14:58 ~ 2021/12/20 14:58 (8Hz) 2021/12/20 14:59 ~ (10s)
IO07	34° 38.7138' N	139° 23.3943' E	34° 38.6410' N	139° 23.6750' E	367.8	1E-1	JS2161	2021/11/15 14:58 ~ 2021/12/20 14:58 (8Hz) 2021/12/20 14:59 ~ (10s)
IO08	34° 39.6761' N	139° 30.6432' E	34° 39.6617' N	139° 30.9906' E	990.8	3B	JS1363	2021/11/15 14:58 ~ 2021/12/20 14:58 (8Hz) 2021/12/20 14:59 ~ (10s)
IO09	34° 51.4929' N	139° 27.9519' E	34° 51.5080' N	139° 28.1777' E	1690.1	4D-1	JS2162	2021/11/15 14:58 ~ (10s)
IO10	34° 45.0152' N	139° 31.5451' E	34° 44.8213' N	139° 31.5942' E	1527.7	3H	JS1367	2021/11/15 14:58 ~ (10s)

Table 2. Positions and sampling schedules of OBEMs.



Ocean bottom observation using BBOBS

Aim and Observation

Our aim is to investigate the shallow earthquakes near Izu-Oshima Island. Swarm of shallow earthquakes has been observed off the northeastern region of Izu-Oshima Island from the land-based seismic observation (Figure 3). These earthquakes are possibly related to the volcanic activities such as magma intrusion below the seafloor. In this cruise, we conducted seafloor observation with BBOBS (Broadband Ocean Bottom Seismometer) near Izu-Oshima Island for one year to determine the precise hypocenter locations, and to detect small earthquakes which cannot be observed from land stations. Revealing seismic activities in detail will be helpful to assess the volcanic hazards of the future eruptions.

We deployed 4 BBOBSs in the northeastern region of Izu-Oshima Island. The DPG (Differential pressure gauge) was also equipped with BBOBSs. The deployment of BBOBSs was performed in 5th and 6th Oct. 2021 (JST), as shown in the location map (Figure 4). The deployment positions were pre-determined using the existing topography data based on Multi Narrow Beam. BBOBSs were launched by a small crane on R/V Kairei. After BBOBS has settled on the seafloor, we communicated with it using the acoustic transponder to check the status of leveling unit and calibrated its location by measuring the slant ranges between the ship and the BBOBS at three points around the launch position. Unfortunately, broadband sensor cannot be activated at one site (S3r) because the leveling unit cannot correct for the inclination of the seafloor where it has settled (approximately 30 degrees). Only DPG sensor is available at S3r. We set the recording period to be approximately 12 months and started recording manually at all sites. Deadline for recovering is Oct. 2023. The information of the BBOBS at each site is listed in Table 3.

Instruments

BBOBS has been developed at the Earthquake Research Institute (ERI) of the University of Tokyo (Figure 5). All of the instruments including broadband sensor (CMG-3T for OBS, Guralp Systems Ltd, UK), data logger (LS-9100, Hakusan Co.), transponder (SI-2, Kaiyo Denshi Co.) and batteries (Lithium cells) are packed into a 65-cm diameter titanium sphere housing, which allows for a maximum operating depth of 6000 m. A broadband sensor is stored in an active leveling unit that can self-correct for an inclination of up to 15 degrees. The data is digitized by a 24bit ADC with 100 Hz, and recorded on two SD cards with the total capacity of 64 GB in mirroring for all data loggers. DPG is often equipped with the BBOBS. Figure 6 shows the BBOBS before deployment in this cruise.

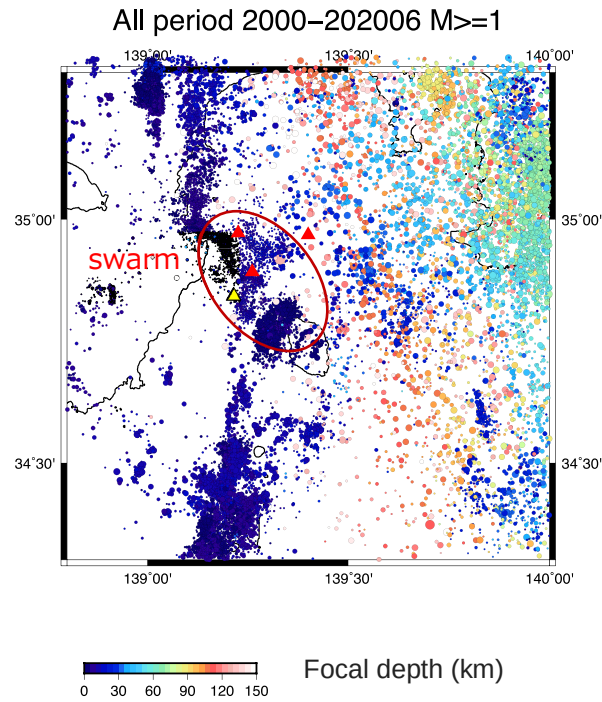


Figure 3. Regular earthquakes occurred from Jan. 2000–June 2020. The circles indicate the epicenters of $M > 1$ earthquakes from the Japan Meteorological Agency catalog. The colors correspond to the focal depth. Triangles indicate the location of BBOBSs deployed in this cruise.

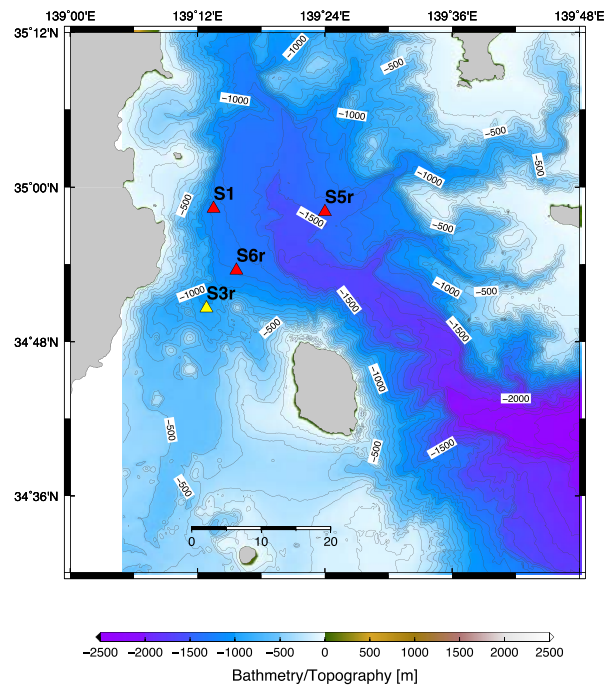


Figure 4. Location of BBOBSs.

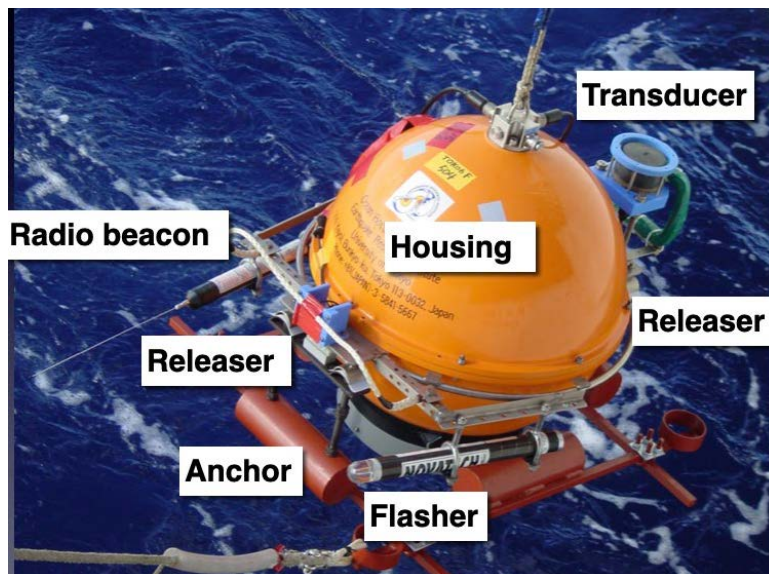


Figure 5. Specification of BBOBS.



Figure 6. BBOBS before deployment. DPG (white cylindrical instrument) are equipped with BBOBS.

Table 3. Summary of BBOBS stations.

Site	Deployment date and time (JST)	Settled Position			Recording period (UTC)	
		Lat., N	Lon., E	Depth, m	Start	End
S1	21/10/5 16:30	34-58.3466	139-13.5239	1286.4	21/10/05 08:13	22/10/31 00:00
*S3r	21/10/6 08:03	34-50.5907	139-12.8400	1047.0	21/10/06 00:36	22/10/31 00:00
S5r	21/10/5 13:55	34-58.0924	139-23.9862	1512.6	21/10/05 05:33	22/10/31 00:00
S6r	21/10/610:47	34-53.5444	139-15.6458	1247.7	21/10/06/02:24	22/10/31 00:00

*S3r: Only DPG is available.

Kaiko MkIV Dive# 875

Date: 24 September 2021

Site: East of Izu-Oshima

Landing: 34-42.3673N, 139-32.3991E, 1202 mbsl

Leaving: 34-41.9676N, 139-32.3510E, 955.00 mbsl

Chief observer: Takeshi Hanyu

Payload: Push corer (3), Sample box with a lid (2)

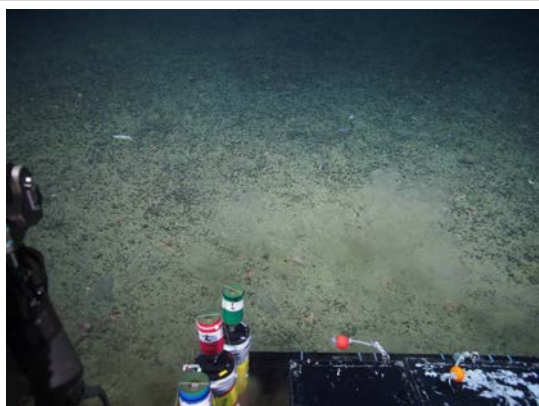
The objectives of this dive are to observe the seafloor and collect geological samples on the submarine ridge to the east of Izu-Oshima. Submarine ridges extending from the volcano likely form by horizontal magma intrusion from a magma chamber beneath the volcano. We will compare chemical compositions of the submarine and subaerial lavas to understand the evolution of magma systems of the volcano.

Kaiko landed on the seafloor at 1200 mbsl at the foot of the submarined ridge. The seafloor was covered by sands, and an outcrop with layered structure that is parallel to the slope was observed in front. We acquired a sediment core (Push core #1) and sampled a rock from the layered structure which was easily broken with Kaiko's fingers (R01). We headed south to climb up the ridge. On the way to the top of the ridge, the seafloor was mostly covered with sands, and layered structure appeared repeatedly. The second rock during this dive was sampled from the layered structure at 1174 mbsl (R02), which was again fragile. At 1136 mbsl, rounded rocks were observed above the layered structure, and we sampled two rounded rocks (R03, R04). At 1112 mbsl, flat shaped rock (again fragile) (R05) and a rounded hard rock (R06) were sampled. At this place, some black pieces of pebbles (turned out to be quenched glass after recovery) were scattered on the seafloor. Push coring at this place was failed, and we scooped black pieces of pebbles using a push corer and stored in a sample box with a lid (S01). At 1061 mbsl, a layered structure, consisting of white (R07) and yellowish (R08) bands, was observed, and we collected them. At 1039 mbsl, a large subrounded rock, which looks light-reddish volcanic rock, was observed, but we failed to sample it because it was too large. We collected a smaller subrounded light-yellowish rock (R09) adjacent to the large rock, instead. At 1027 mbsl, we sampled two rocks (R10, R11) from an outcrop of the layered structure. At 965 mbsl, we collected two black rocks (R12, R13) and obtained a sediment core (Push core #2). After sampling, we headed to the west along the ridge to reach the top of the ridge, and then turned to the south. We occasionally found rounded rocks around there. At 945 mbsl, we made final sampling of reddish-brown rounded rocks (R14, R15). Push coring at this place was failed, and then we left the bottom at 955 mbsl.

Rocks collected from layered structure are tuff and lapilli tuff. These rocks were generally flat in shape and fragile. Fe-Mn oxide coating is recognized on only R02 with the thickness of 3-4 mm. Lava blocks were boulder. Their shape is characteristically rounded to subrounded. They are relatively fresh and are never vesiculated. Mineral mode of the lava blocks varies from aphyric to moderately phyric (~10 vol%) with plagioclase, olivine, and clinopyroxene. The S01 sample scooped from the seafloor were black-colored vesiculated volcanic glass with the maximum size of 2cm.

The sediments of Push cores #1 and #2 are categorized into ash on the basis of Tamura et al. (2015; Proc. IODP Vol. 350). They are slightly to heavily bioturbated as characterized by dark patches (5Y2/2 to 2.5Y 2/1; Olive black to black) with white sand-sized microfossils. Both cores are mainly composed of silt- to sand-sized volcanic glass (sometimes forming oxides), plagioclase, olivine, and foraminifers with rare sponge spicules, and trace silicoflagellates. Push core #1 is normal graded from top to 17.5 cm but reverse graded from 17.5 cm to 25.3 cm (bottom), both of which are poorly sorted and contain rare granule-sized volcanic glass. Combined with the observation that foraminifers in Push core #1 are moderately preserved, Push core #1 could be

turbidite. In contrast, Push core #2 is well sorted and shows no grading from top to 22.4 cm (bottom). Foraminifers in Push core #2 are very well preserved, suggesting no disturbance during/after the deposition.



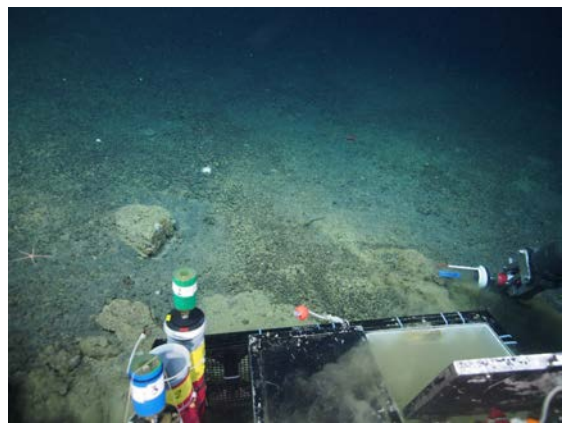
Glassy pebbles on the seafloor
(1202mbsl; 10:03am; Push core #1 at this site)



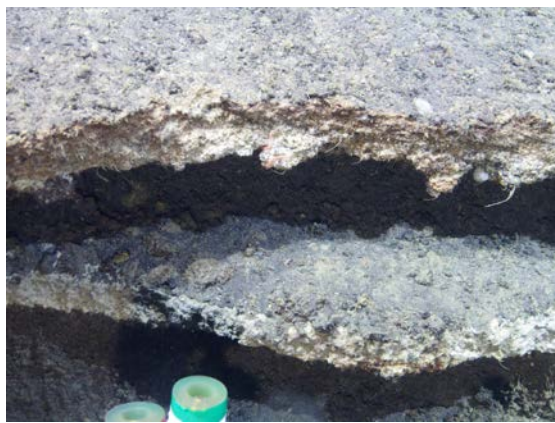
Layered structure
(1172 mbsl; 10:47am)



Tuff rock on the seafloor
(1109mbsl; 11:26am)



Glassy pebbles scooped by a push core
(1112 mbsl; 11:41am; S01)



White and yellow bands in the layered
structure (1060 mbsl; 12:08am)



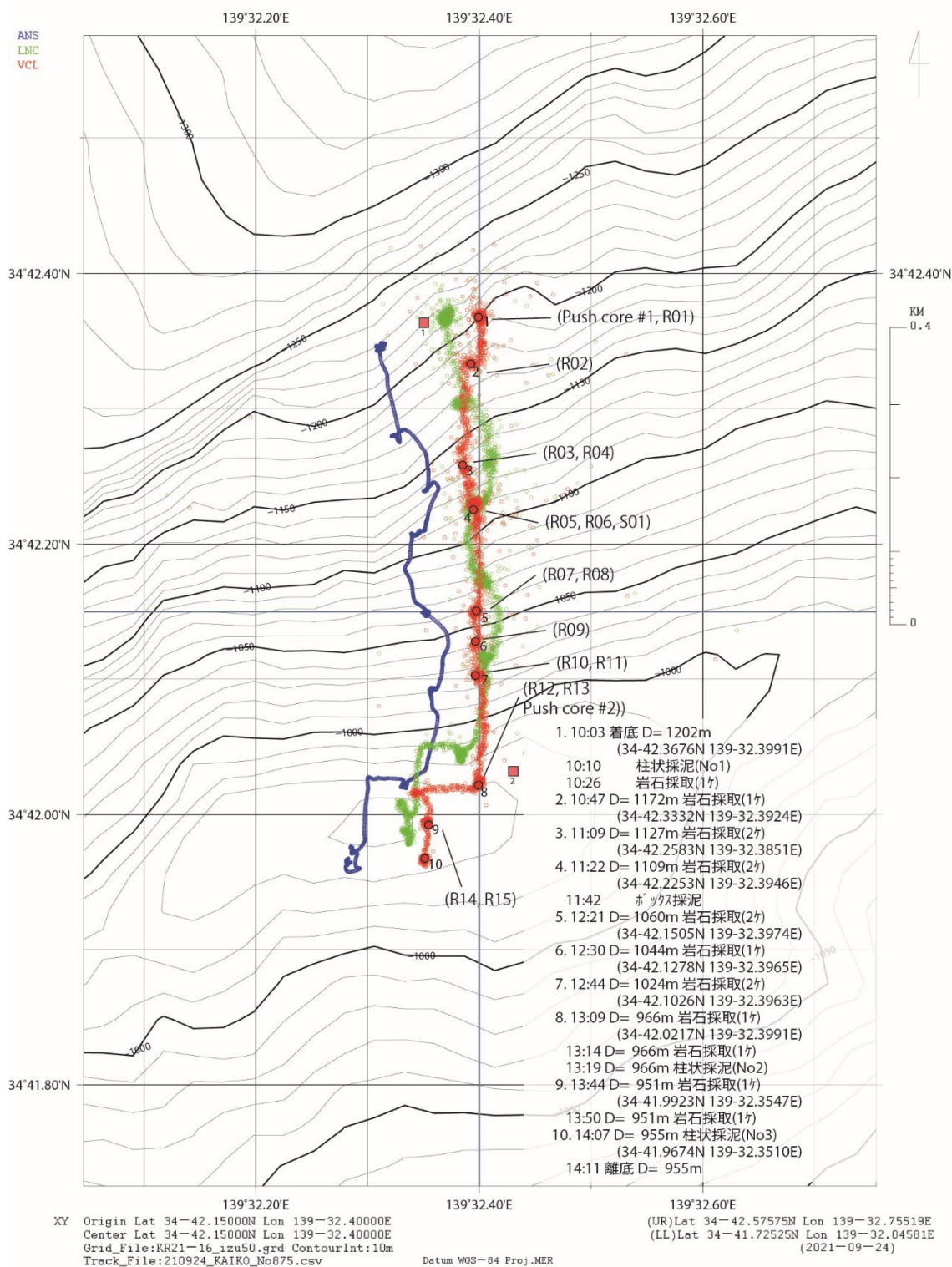
Subrounded boulder on the seafloor (1044
mbsl; 12:27am; sampled a small boulder
(R09) in front of the big boulder)



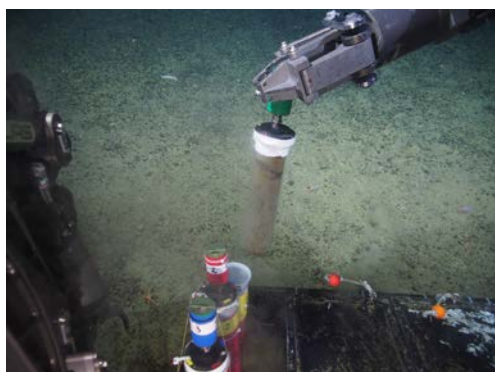
Subrounded boulder on the seafloor
(1044 mbsl; 12:31am)



Sandy seafloor where Push core #2 (and
R12 and R13) were collected (965 mbsl;
13:08am)



Sample photo



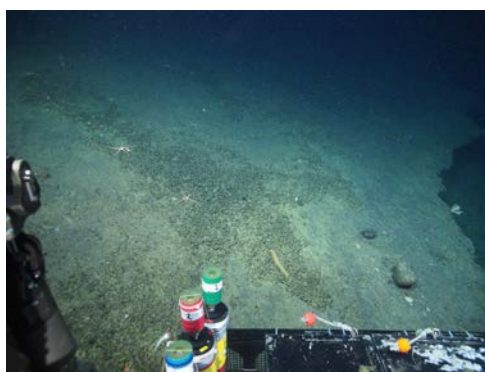
Push-core sample C01 (10:10, 1201 mbsl)



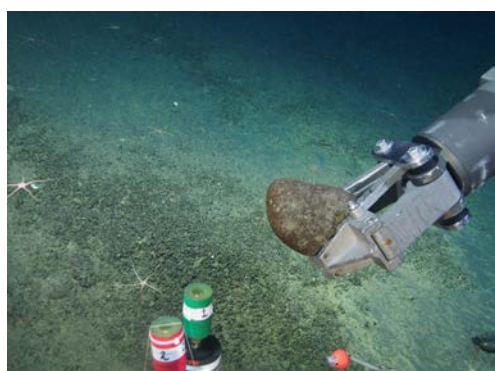
Outcrop of R01 (10:26, 1204 mbsl)



Outcrop of R02 (10:47, 1173 mbsl)



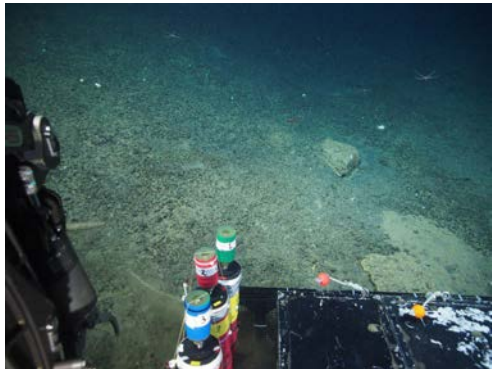
Occurrence of the boulder R03 & R04 (11:09, 1135 mbsl)



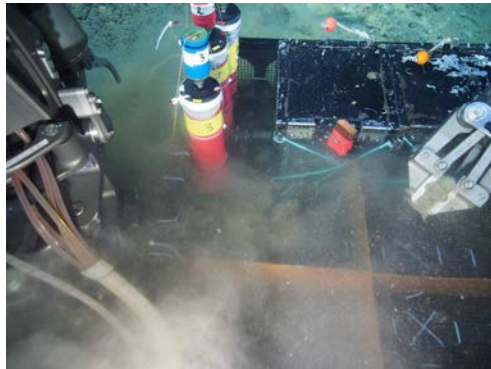
Closed view of R03 (11:09, 1135 mbsl)



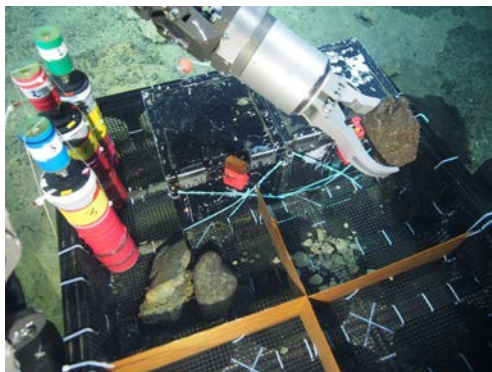
Closed view of R04 (11:10, 1135 mbsl)



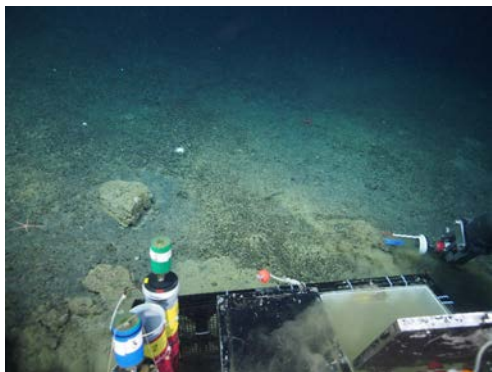
Closed view of R05 (11:22, 1109 mbsl)



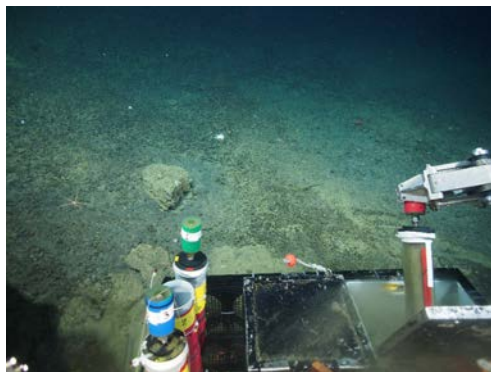
Closed view of R05 (11:22, 1109 mbsl)



Closed view of R06 (11:22, 1109 mbsl)



Sampling (11:41, 1109 mbsl)



Sampling (11:41, 1109 mbsl)



Outcrop view of R07 (lower, whitish layer) and R08 (upper, yellowish layer) (12:07, 1056 mbsl)



Closed view of R07 (12:12, 1056 mbsl)



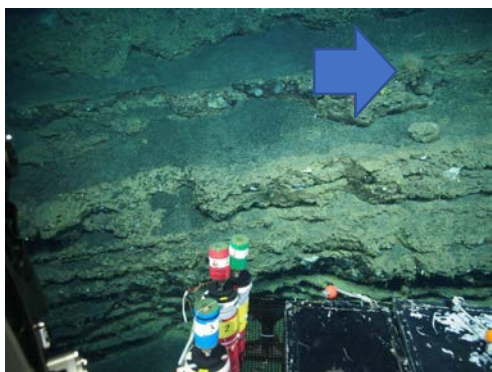
Closed view of R08 (12:19, 1056 mbsl)



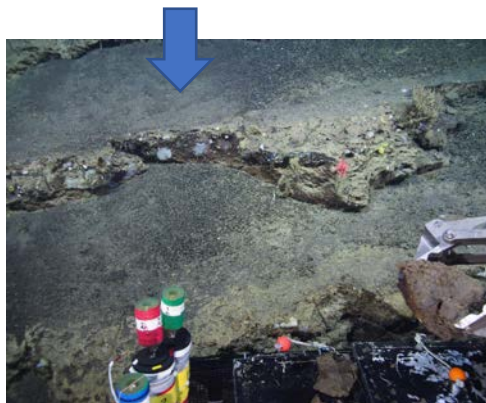
Occurrence of boulder R09 (12:27, 1039 mbsl)



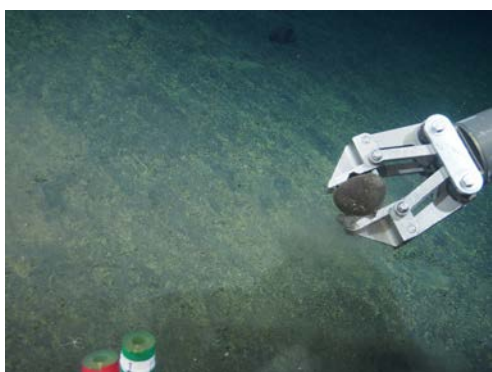
Closed view boulder R09 (12:27, 1039 mbsl)



Occurrence of boulder R10 (12:39, 1026 mbsl)



Closed view of R10 and outcrop view of R11 (arrowed) (12:39, 1026 mbsl)



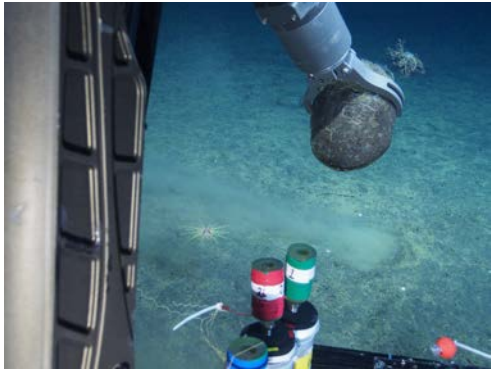
Boulder R12 (13:08, 965 mbsl)



Boulder R13 (13:13, 965 mbsl)



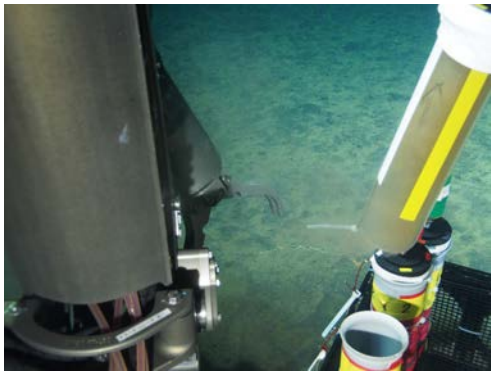
Push-core C02 (13:19, 965 mbsl)



Boulder R14 (13:43, 943 mbsl)



Boulder R15 (13:49, 943 mbsl)



Push-core C03 (failed) (14:07, 943 mbsl)

Kaiko MkIV Dive# 876

Date: 4 October 2021

Site: East of Izu-Oshima

Landing: 34-41.5249N, 139-29.9802E, 796 mbsl

Leaving: 34-41.2443N, 139-29.3203E, 565 mbsl

Chief observer: Yoshihiko Tamura

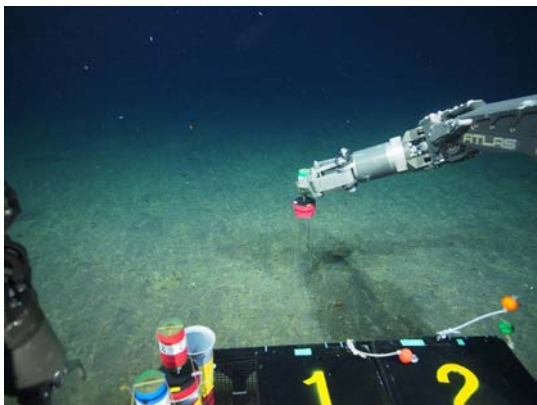
Payload: Push corer (3), Sample box with a lid (2), Scoop (Kumade; 1)

The objectives of this dive are to observe the seafloor and collect geological samples on the submarine ridge to the east of Izu-Oshima. The dive site is upper part of the submarine ridge surveyed by Kaiko#875.

Kaiko landed on the seafloor at 796 mbsl at the foot of the submarined ridge. The seafloor was covered by sands, where we acquired a sediment core (Push core #1). We headed south to climb up the ridge. Soon after the start of the drift, some boulders were placed on the sandy seafloor, and collected two rocks (R01, R02) at 790 mbsl. At 778 mbsl, sampling of a large boulder was failed, and we collected a smaller boulder, instead (R03), and then we changed the direction to the west to climb along the ridge. At 756mbsl, another boulder was sampled (R04). Layered structure, as often seen during Kaiko#875, first appeared at 748 mbsl. Rocks could not be obtained from the layered structure, as they were easily broken by Kaiko's fingers. We sampled a flat-shaped rock on the layered structure (R05; this sample is turned to be a lava block, although we supposed that it was a sedimentary rock during dive operation). At 730 mbsl, several boulders were placed on the sandy seafloor and one of those was collected (R06). At 725 mbsl, black and white pebbles scattered on the seafloor, and they were collected by a scoop (kumade) (S01). Soon after this place, we traversed a steep slope, where ripple mark was observed on the sandy surface, suggesting strong water current. At 699 mbsl, we tried to take a large flat-shaped rock, but broken pieces were only sampled (R07). At 697 mbsl, a wrecked boat was discovered. At 645 mbsl, we changed the direction to SW to reach to a cone on the ridge. At 641 mbsl, white layered structure was observed, but we failed to sample the material from the layered structure with a push corer. The slope became steeper, as we were close to the cone at around 600 mbsl. However, an outcrop did not appear. The slope was covered by sands with some boulders scattered around. We made a final sampling of a rock (R08) and sediments (Push core #2) at 565 mbsl before leaving the bottom.

Most rocks collected during this dive were lava blocks. The samples R02, R03, R05, and R06 are less-vesiculated lavas including plagioclase +/- clinopyroxene +/- olivine. In particular, the sample R06 is a highly plagioclase-phyric rock (the mode of which is nearly 50%). The sample R01 is a piece of vesiculated aphyric lava. The sample R08 is an irregular-shaped aphyric volcanic rock with glassy rinds (~8 mm thickness), which was moderately fractured. This sample includes elongated bubbles with a diameter of ~1 cm. The sample R07 is a volcanic sand stone. The sample R04 may be an artificial material. The sample S01, scooped by a kumade, is volcanic sands including ~1 cm-size scoria.

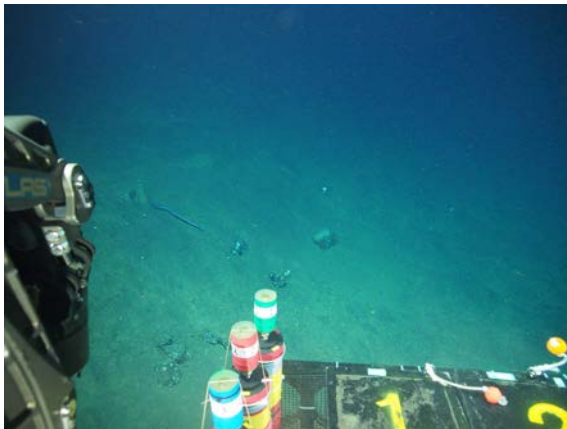
The sediments of Push cores #1 and #2 are categorized into ash and lapilli-ash, respectively, on the basis of Tamura et al. (2015; Proc. IODP Vol. 350). Both cores do not preserve any lithology and structure due to core disturbance, which was probably caused by coarse grain size and high permeability to water of the sediments. The sediment color is 5Y 4/2 to 5Y 2/2 (grayish olive to olive black) in Push core #1, and 7.5Y 3/2 to 5Y 2/1 (olive black to black) in Push core #2. Push core #1 is mainly composed of silt- to sand-sized volcanic glass (sometimes forming oxides) and plagioclase with rare foraminifers (very well sorted). Push core #2 is composed of sand- to gravel-sized angular scoria and volcanic glass with trace foraminifers, sponge spicules, shells, and plagioclase (less sorted). The scoria in Push core #2 shows the similar shape/texture to those of R08.



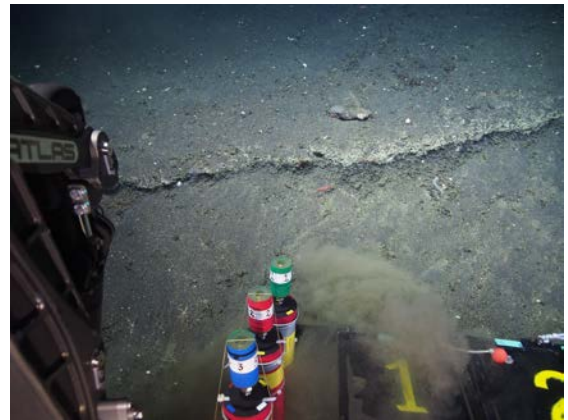
Sandy seafloor at the bottom of the ridge
(796 mbsl; 10:02am; Push core #1 at this
site)



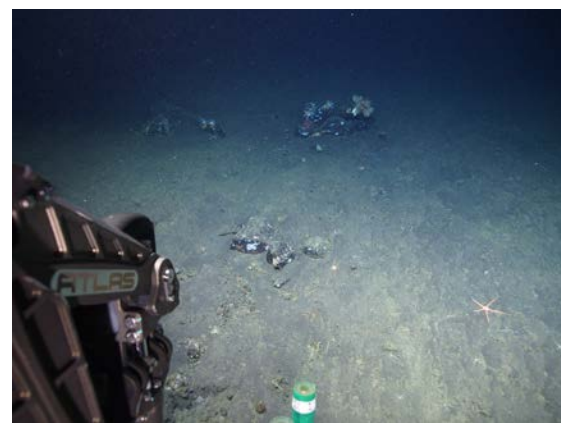
A boulder on the sandy seafloor (R02)
(790 mbsl; 10:17am)



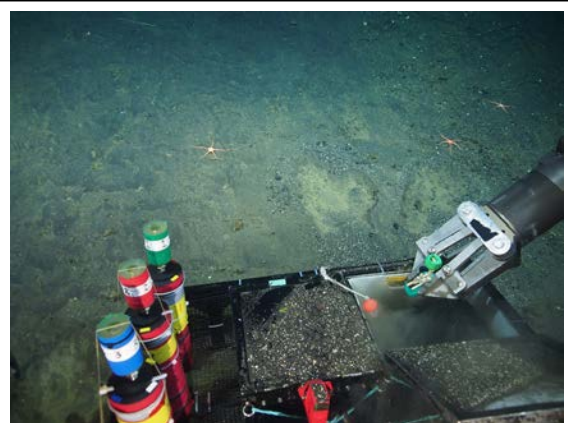
Boulders on the sandy seafloor (R03)
(778 mbsl; 10:51am)



Layered structure and a flat-shaped boulder (R05) (748 mbsl; 11:33am)



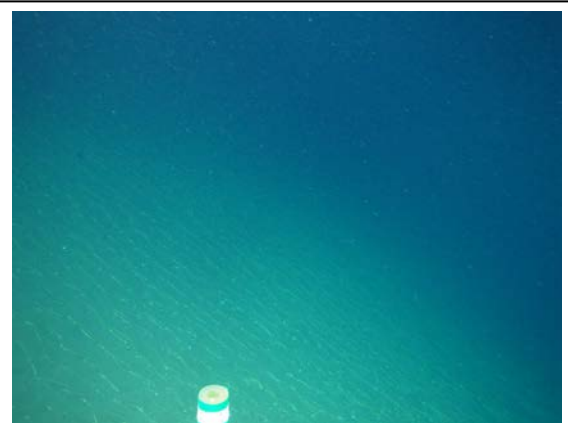
Boulders on the sandy seafloor (R06)
(730 mbsl; 11:57am)



Black and white pebbles sampled by a kumade (S01) (725 mbsl; 12:14am)



Fish rock?
(around 720 mbsl; 12:20am)



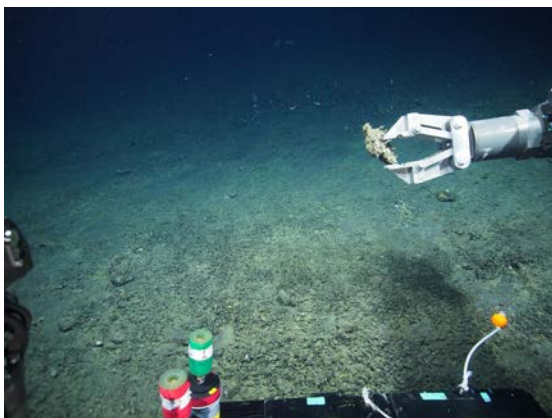
Ripple mark on the slope
(around 710 mbsl; 12:28am)



A wrecked boat
(around 697 mbsl; 12:47am)

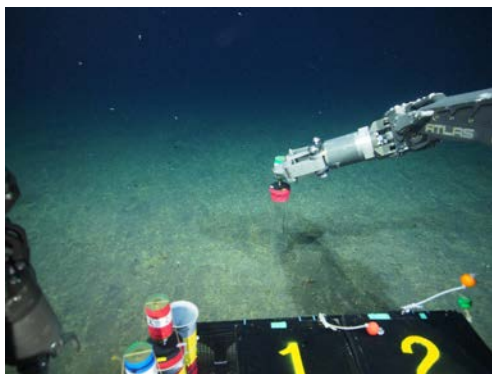


Layered structure (push coring failed)
(around 641 mbsl; 13:26am)

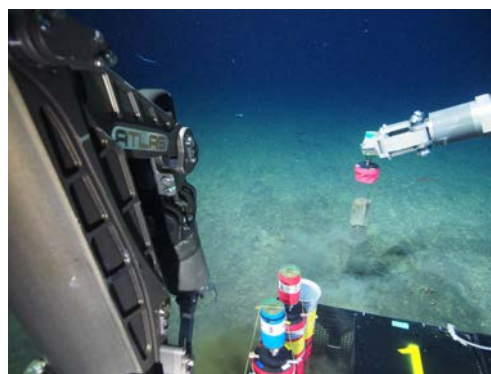


Scoria scattered on the seafloor (R08)
(around 565 mbsl; 14:36am)

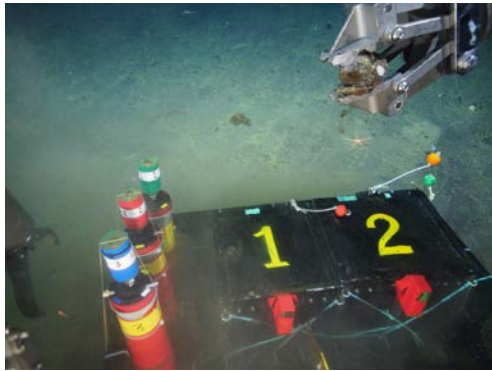
Sample photo



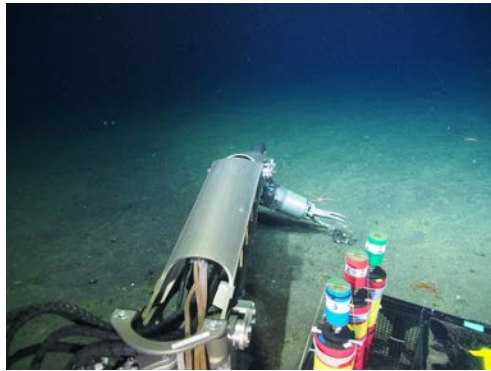
Push-core sample C01 (10:00, 797 mbsl)



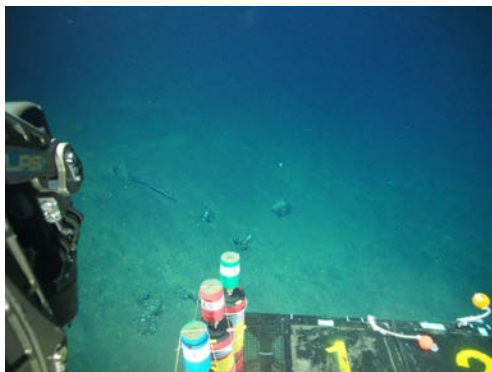
Push-core sample C01 (10:00, 797 mbsl)



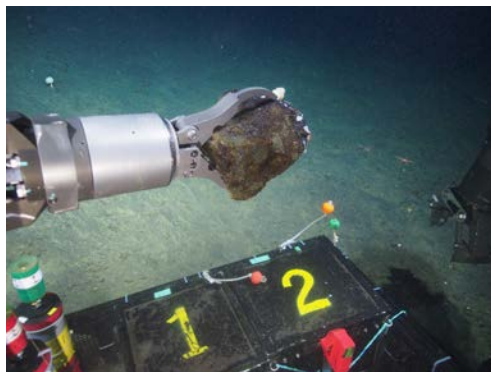
Occurrence of boulder R01 (10:14, 785 mbsl)



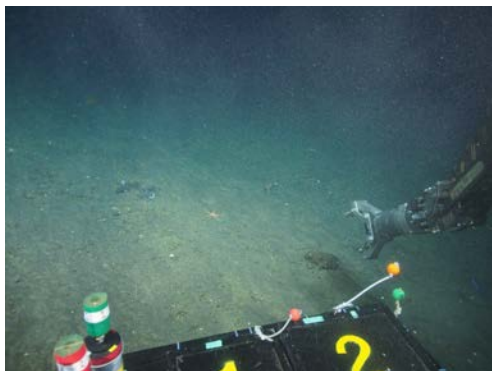
Occurrence of boulder R02 (10:19, 787mbsl)



Occurrence of R03 (10:57, 778 mbsl)



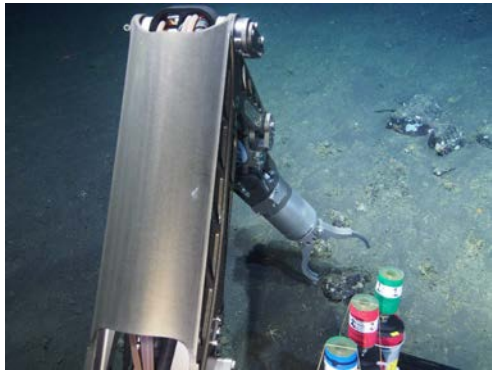
Closed view of R03 (10:57, 778 mbsl)



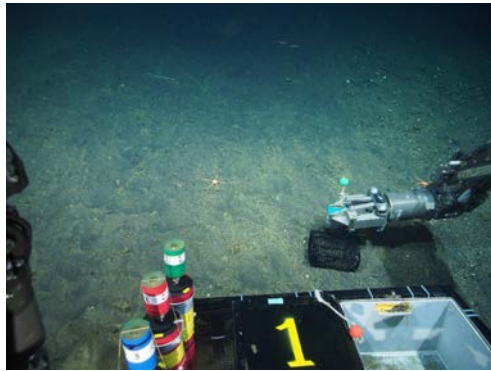
Occurrence of R04 (11:23, 752 mbsl)



Occurrence of R05 (11:38, 746 mbsl)



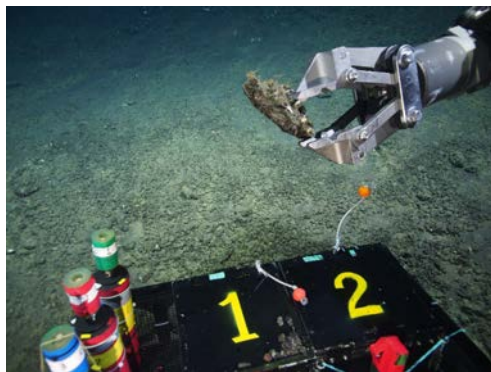
Occurrence of R06 (11:57, 726 mbsl)



Sampling view of S01 (12:04, 718 mbsl)



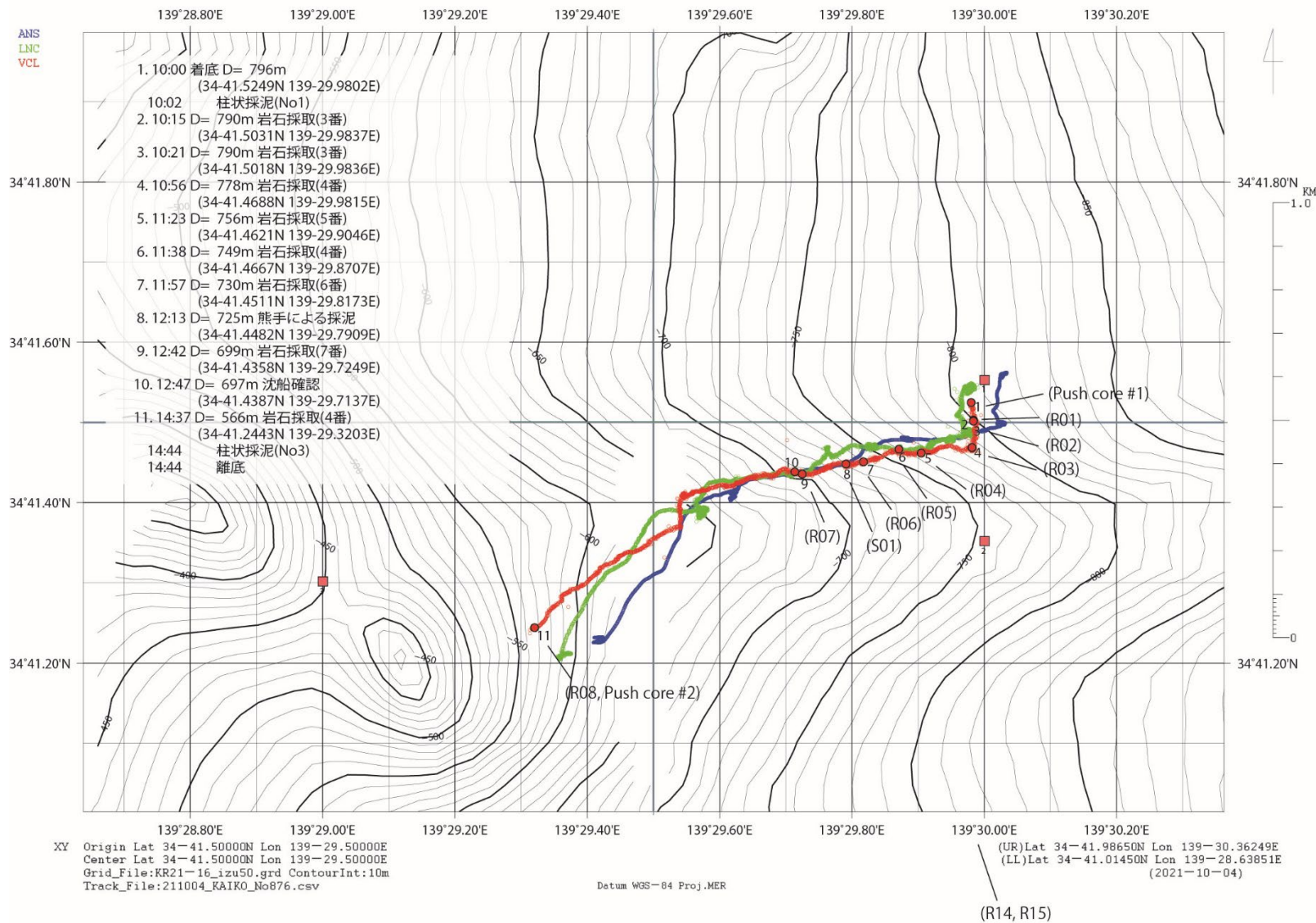
Occurrence of R07 (12:33, 693 mbsl)



Closed view of R08 (14:32, 558 mbsl)

KAIKO Dive876
IZU-OHSHIMA

(1 / 7500)



Kaiko MkIV Dive# 877

Date: 7 October 2021

Site: East of Izu-Oshima

Landing: 34-41.1047N, 139-29.3941E, 618 mbsl

Leaving: 34-41.1712N, 139-29.1231E, 427 mbsl

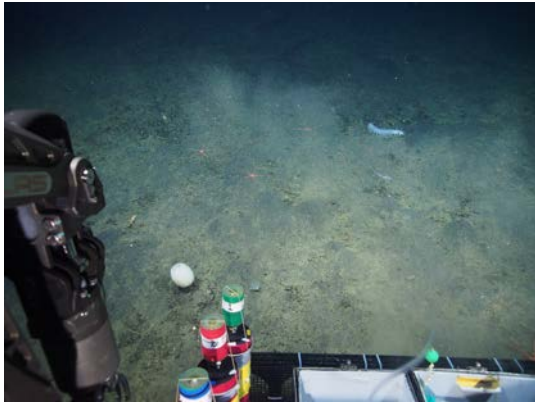
Chief observer: Takeshi Hanyu

Payload: Push corer (3), Sample box with a lid (2), Scoop (Kumade; 1)

The objectives of this dive are to observe the seafloor and collect geological samples on the submarine ridge to the east of Izu-Oshima. The dive trajectory is designed to climb up a cone-like structure on the submarine ridge surveyed by Kaiko#875 and #876.

Kaiko landed on the seafloor at 618 mbsl at the foot of a cone-like structure on the submarine ridge. The seafloor was covered by sands with some black pebbles scattered around. We tried sediment sampling with a push core there, but it was a failure. We headed NW to climb up the cone. We sampled a boulder on the sandy seafloor soon after the drift at 606 mbsl (R01). At 555m, some boulders were placed on the seafloor, and collected one of them (R02). At 519 mbsl, black pebbles scattered on the seafloor were scooped with a kumade (S01). At 501 mbsl, ripple mark was identified on the sandy surface, suggesting strong water current. As we climbed up the cone, volcanic rocks (scoria) appeared more densely on the seafloor, and then we sampled rocks (R03, R04) and scooped black pebbles (S02) at 496 mbsl. At 448 mbsl, we sampled a rock that looks like a scoria spatter (R05). Near the top of the cone, the surface was almost covered by sands with less rocks appeared than on the mid-slope. At 419 mbsl, we sampled a small rock (R06) and scooped a few pieces of pebbles on the surface (S03). Although we wanted to drift to another cone, strong water current forced us to abandon further survey at this site.

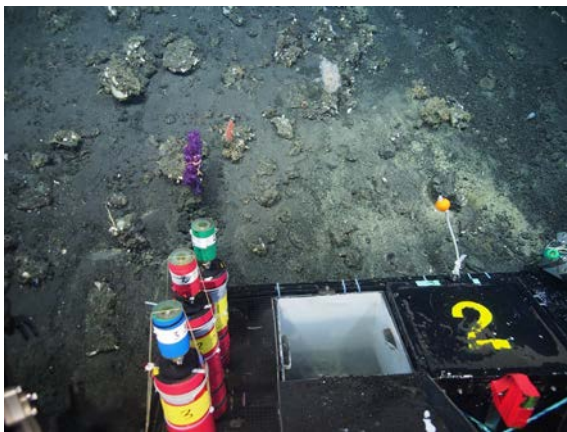
All rocks collected during this dive are scoria. Some of them have irregular shape and glassy rinds with the thickness up to 4 mm. Some rocks are moderately fractured as seen on the sample collected during the previous dive (Kaiko#876-R08). The rocks are nearly aphyric but some of them included plagioclase. In some rocks, vesicles were elongated and matrix is stretched. The black pebbles scooped by a kumade are fragments of glassy scoria. From these observations, we assume that the mound structure is a scoria cone formed by submarine eruption of basalts on the submarine ridge.



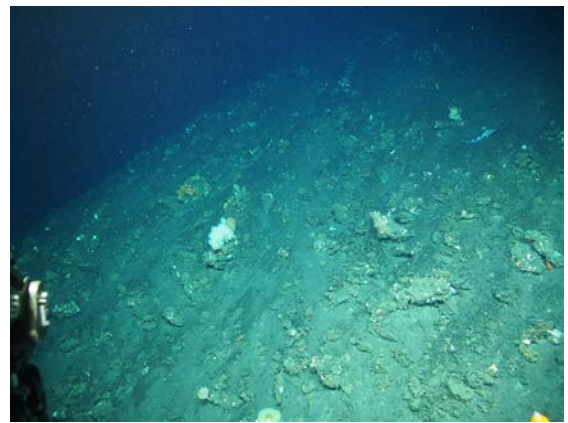
Sandy seafloor at the bottom of the volcanic cone (618 mbsl; 10:15am; Push core #1 at this site)



Boulders on the sandy seafloor (R02) (555 mbsl; 11:06am)



Rocks and sediments collected (R03, R04, S02) (496 mbsl; 12:04am)



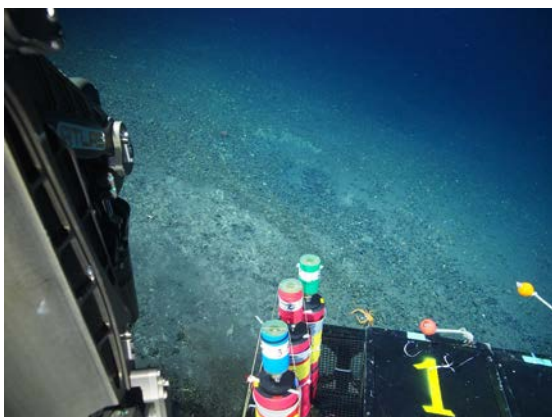
More spatters on the upper part of the cone (around 460 mbsl; 12:16am)



Ray
(around 460 mbsl; 12:16am)

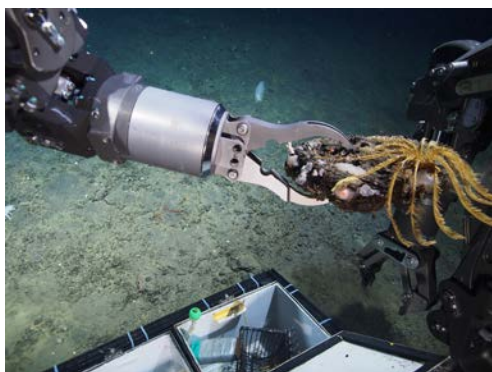


Spatters on the steep slope (R05)
(448 mbsl; 12:31am)



Less rocks on the top of the cone. Black
pebbles sampled by a kumade (S03)
(419 mbsl; 13:06am)

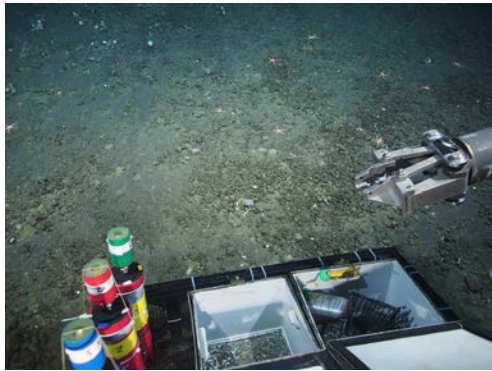
Sample photo



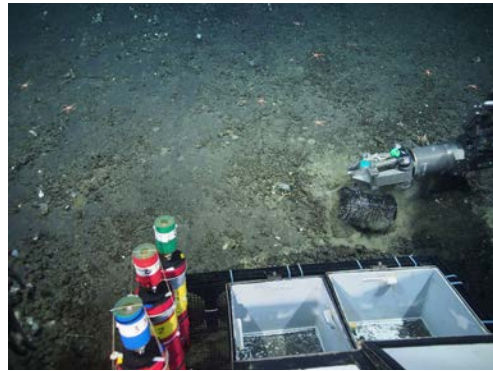
Occurrence of boulder R01 (10:40, 607mbsl)



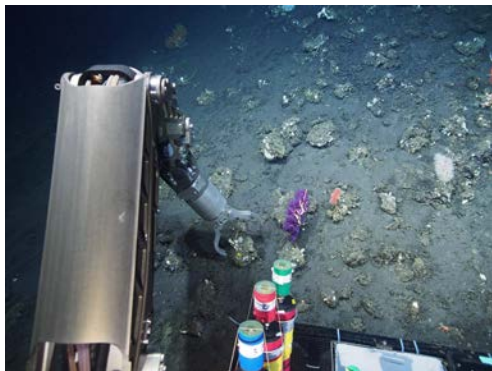
Occurrence of boulder R02 (11:10, 550 mbsl)



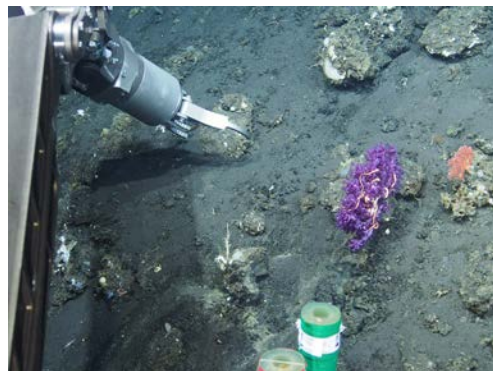
Sampling place of S01 (11:35, 515 mbsl)



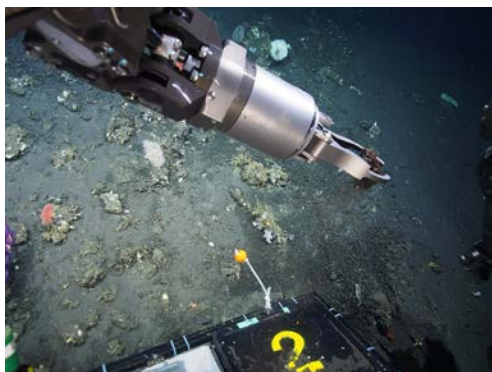
Sampling of S01 (11:35, 515mbsl)



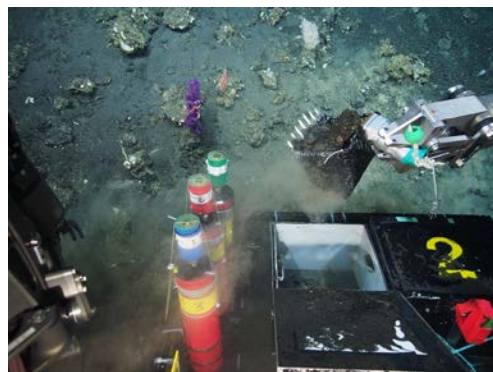
Occurrence of R03. Mixed with S02 as collected from the same place (11:48, 491 mbsl)



Occurrence of R04 (11:56, 492 mbsl)



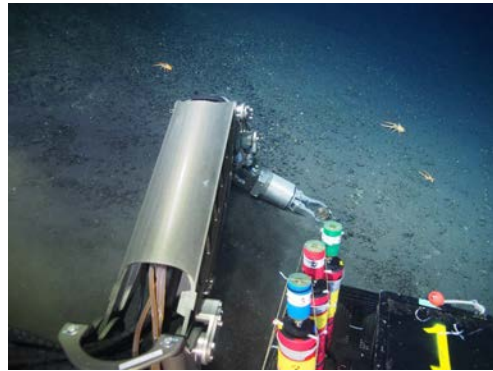
Sampling place of S02 (12:06, 494 mbsl)



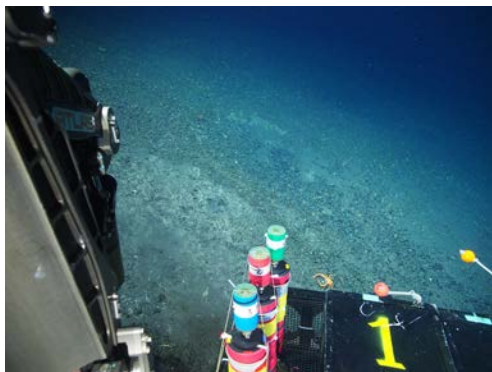
Sampling of S02 (12:06, 494 mbsl)



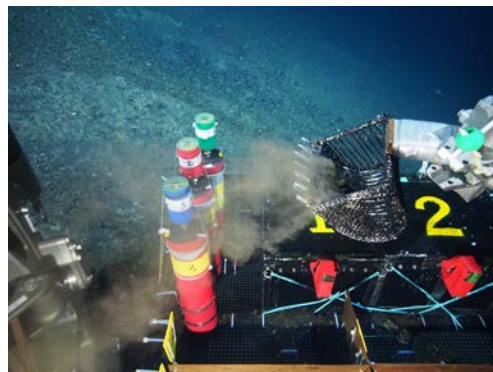
Occurrence of R05 (12:33, 445 mbsl)



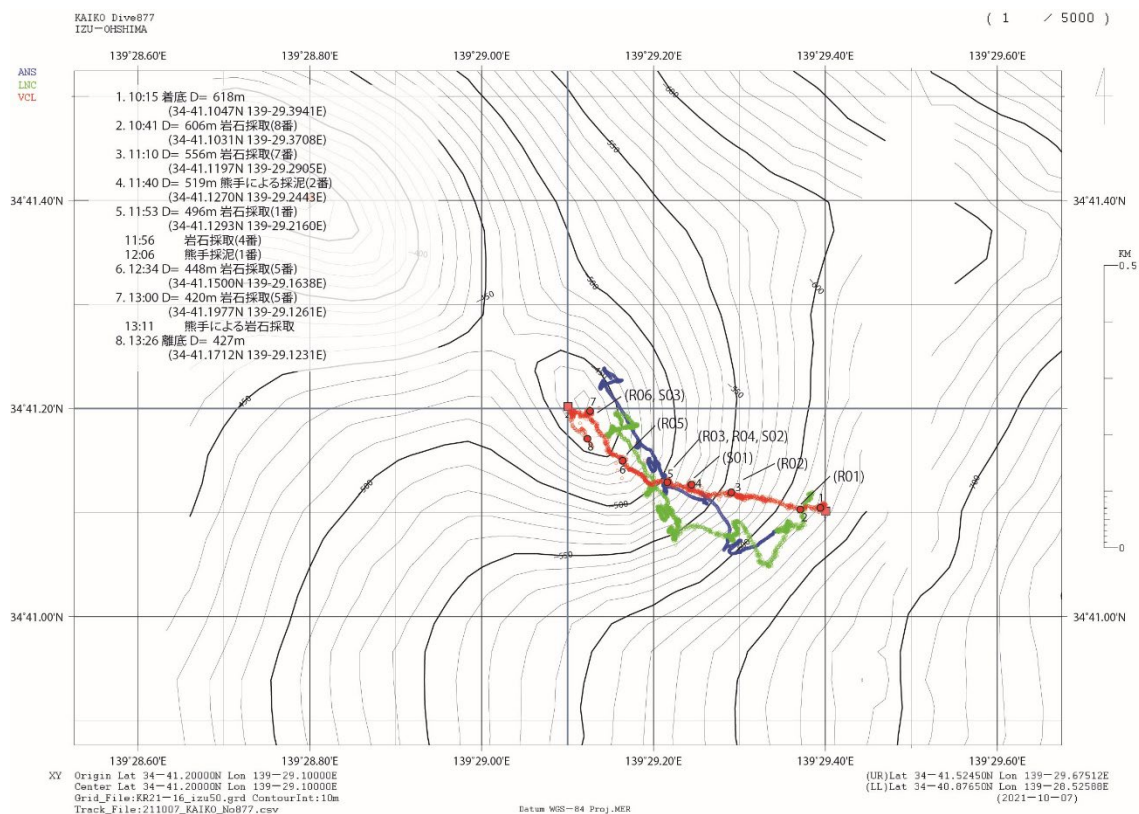
Occurrence of R06 (12:54, 419 mbsl)



Sampling place of S03 (13:09, 416 mbsl)



Sampling of S03 (13:09, 416 mbsl)



4. Notice on Using

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 JAMSTEC.

<http://www.godac.jamstec.go.jp/darwin/explain/1/e#report>

E-mail: submit-rv-cruise@jamstec.go.jp