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KR20-E06

Research for the Volcanic Eruptions of Nishinoshima and the Ogasawara Trench Site Survey

The area around Nishinoshima and the Ogasawara Trench
December 15, 2020 – December 29, 2020

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

Figures 1 and 2. Violent Strombolian eruptions of Nishinoshima in July, 2020, after Yanagisawa et al. (Bull. Volcanol. Soc. Japan, 2020). Types of eruptions of Nishinoshima volcano changed from Strombolian to violent Strombolian during June-August, 2020. The maximum height of the volcanic plumes exceeded 8 km and a large amount of volcanic ash had been fallen both on the island and the surface of the sea more than 10 km from the island (Yanagisawa et al., 2020).

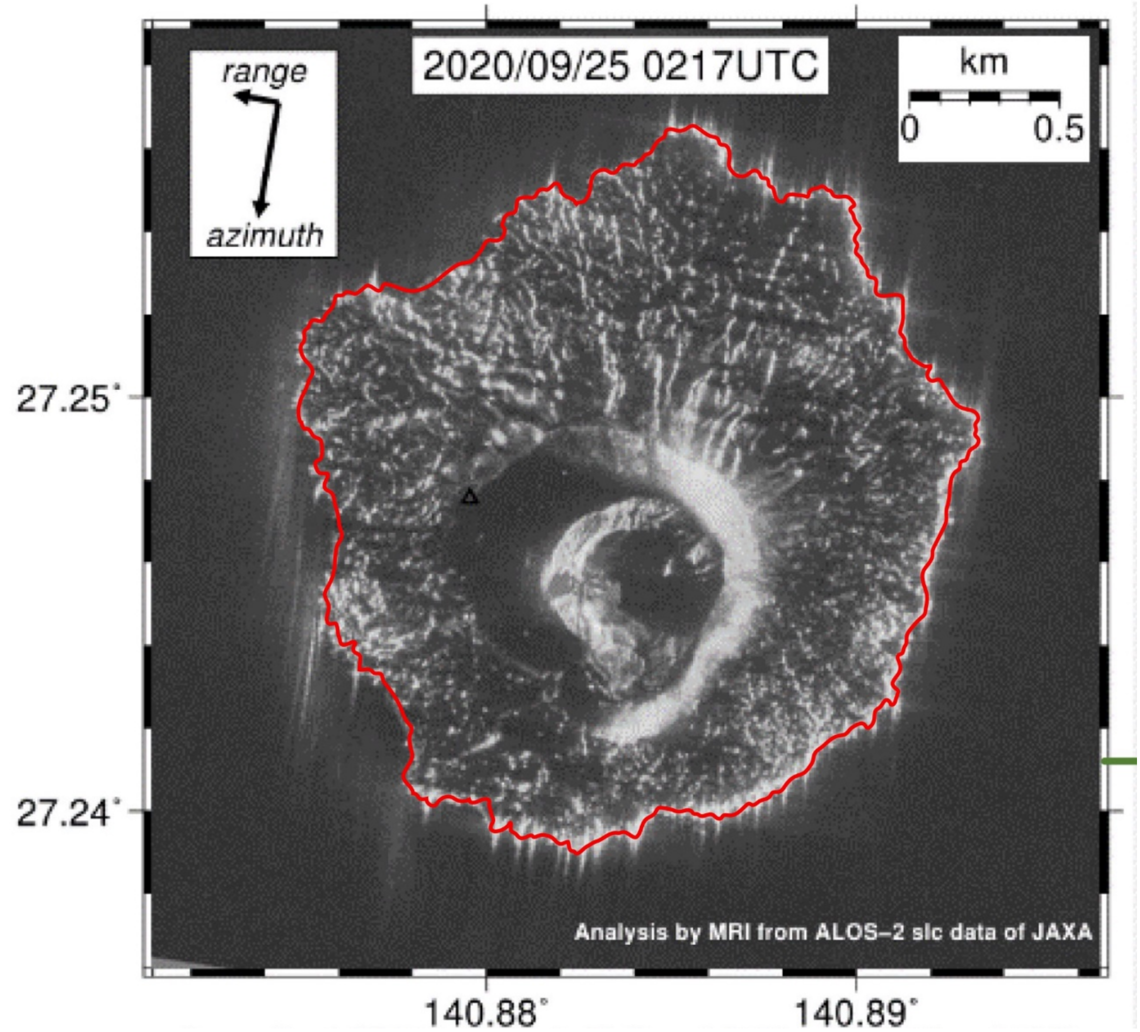

Figure 3. Satellite intensity image of Nishinoshima volcano of September 25, 2020, after the violent eruptions, generated from ALOS-2/PALSAR-2 data. The eruptions of Nishinoshima since 2013 continued intermittently, which have four eruption stages from the stage 1 (Nov. 2013-Nov. 2015), through stage 2 (April-August, 2017) and stage 3 (July 2018) to the most recent stage 4 (December 2019- August, 2020). The eruptions were characterized as Strombolian until the middle of June, 2020, but they have changed into the violent Strombolian eruptions from June to August, 2020, which produced a large amount of volcanic ash in addition to lava flows.

1. Cruise Information

● Cruise ID: KR20-E06
● Name of vessel: RV Kairei
● Title of cruise: Research for the Volcanic Eruptions of Nishinoshima and the Ogasawara Trench Site Survey
● Chief Scientist: Yoshihiko Tamura [IMG, JAMSTEC]
● Cruise period: From December 15 to December 29, 2020
● Ports of departure / call / arrival: JAMSTEC HQ/ JAMSTEC HQ
● Research area: Part of the Ogasawara trench and the area around Nishinoshima
● Research map

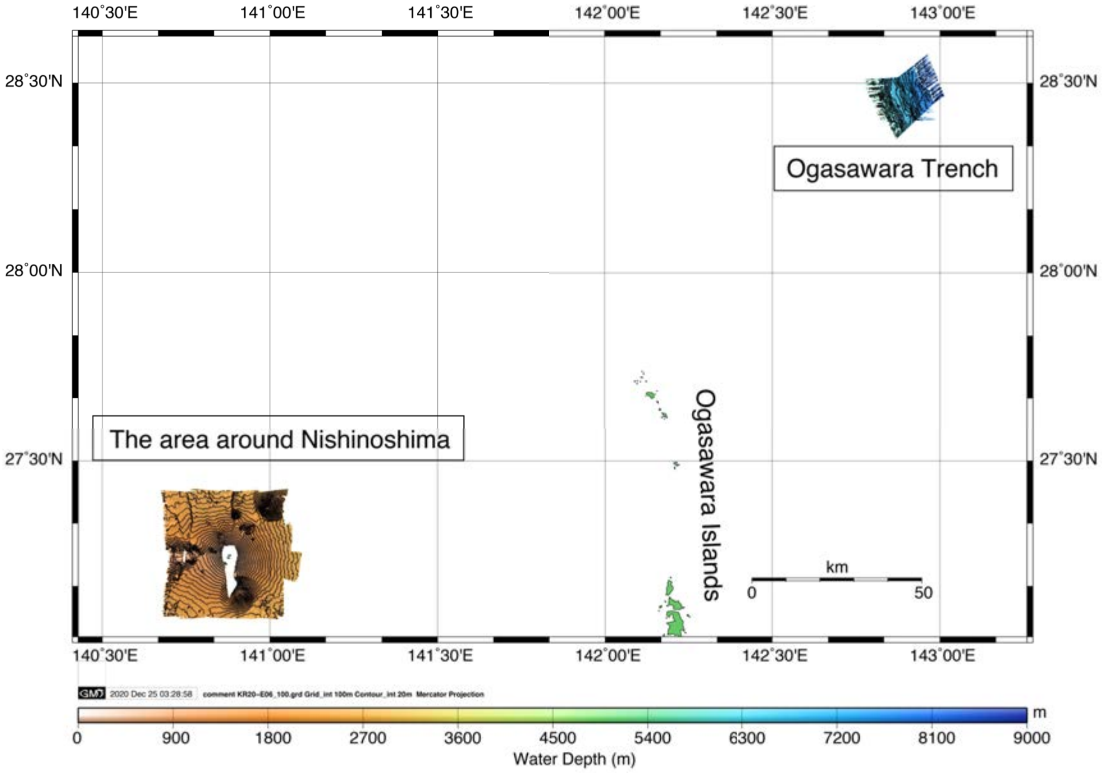

Figure 4. Research areas during the cruise KR20-E06. One area is for site survey of the Ogasawara Trench for the IODP drilling proposal and the other is the study of Nishinoshima volcano.

2. Research Proposal and Science Party

Research for the Volcanic Eruptions of Nishinoshima (P20-13)
The survey of crust-mantle boundaries at the Ogasawara trench (JC20-04)

● Representative of Science Party [Affiliation]
Shigeaki Ono [IMG, JAMSTEC]

● Science Party (List) [Affiliation, assignment etc.]
Satoru Tanaka [IMG, JAMSTEC, observation by using Wave Glider™]
Takeshi Hanyu [IMG, JAMSTEC, geochemical analyses of volcanic ash]
Yoshihiko Tamura [IMG, JAMSTEC, geochemical analyses of volcanic ash]
Tomoki Sato [IMG, JAMSTEC, geochemical analyses of volcanic ash]
Koichiro Obana [IMG, JAMSTEC, installation of Ocean Bottom Seismometer (OBS) and seismic observation by using them]

Hiroko Sugioka [JAMSTEC/Kobe University, OBS installation an observation and Wave Glider observation]
Yasushi Ishihara [IMG, JAMSTEC, seismic observations by using OBS]
Tsutomu Takahashi [IMG, JAMSTEC, seismic observations by using OBS]
Takayuki Kaneko [Earthquake Research Institute, University of Tokyo, observation and sampling by using drone]
Masanao Shinohara [Earthquake Research Institute, University of Tokyo, OBS installations and seismic observations]
Mie Ichihara [Earthquake Research Institute, University of Tokyo, observations of volcanic eruptions by using hydrophone, air vibration meter, and infrared camera]
Shuichi Kodaira [general management of the project]

LIST OF CRUISE PERSONNEL:

SCIENTIFIC PERSONNEL:

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TOMOKI SATO (IMG, JAMSTEC)
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YUICHI SEKI (NHK)
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HISASHI MAKABE (HEXAMEDIA)

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HARUKI DOI (NME)
MISAKI HORIUCHI (NME)
TAKUYA MAEKAWA (NME)
YUKI OHWATARI (NME)

AKIRA SO (MWJ)
KEISUKE TAKEDA (MWJ)

CAPTAIN AND CREW OF THE R/V KAIREI

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Toshiyo OHARA (CHIEF OFFICER)
Tatsuya NOZAWA (SECOND OFFICER)
Taiga YAMAMOTO (THIRD OFFICER)
Tadashi ABE (CHIEF ENGINEER)
Kazunori NOGUCHI (FIRST ENGINEER)
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Shinya KOJIMA (ABLE SEAMAN (C))
Satoshi SHIMPO (ABLE SEAMAN (D))
Saikan HIRAI (ABLE SEAMAN (E))
Tsubasa KUBOTA (ABLE SEAMAN (F))
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Fubuki HOMMA (OILER (A))
Aoi DANTSUKA (OILER (B))
Shion NARABE (OILER (C))
Toru HIDAKA (OILER (D))
Toru MURAKAMI (CHIEF STEWARD)
Tsuyoshi NAGATOMO (STEWARD (A))
Mizuki NAKANO (STEWARD (B))
Tsugumi TANAKA (STEWARD (C))
Masaru SUGIYAMA (STEWARD (D))

3. Research/Development Activities

●3-1 Ogasawara Trench Site Survey

1) Multichannel seismic reflection (MCS) survey (Figs. 5 and 6):
MCS surveys were conducted along 2 lines (NS5, NS4) with a total length of approximately 26 km.

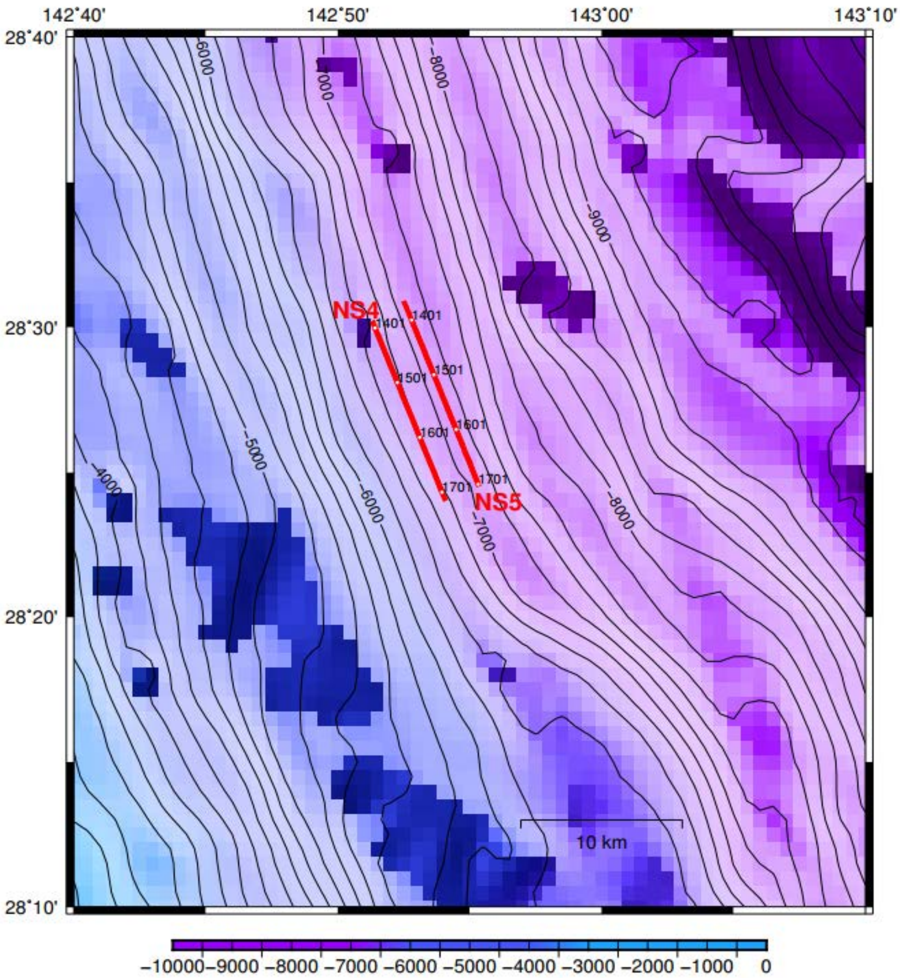

Figure 5. MCS survey line map

Figure 6. MCS system on R/V *KAIREI*.

a) Source:

To obtain superior quality MCS data, we shot an air gun array at a spacing of 37.5 m. The tuned air gun array has a maximum total volume of 380 cubic inches (approximately 3 L), and consists of 4 air guns (Bolt 2800LLX). The standard air pressure was 2,000 psi (approximately 14 MPa). During the experiment, the air gun depth was maintained at 5 m below the sea surface. The towing geometry of the MCS system has been provided in Fig. 7.

b) Receiver:

During air gun shooting, we towed a hydrophone streamer cable with a group interval of 6.25 m. (GEOEEL Digital Streamer, Geometrics). The signals from twelve sensors in the same group (channel) were stacked before A/D conversion. The towing depth of the streamer cable was kept at 6 m below the sea surface by the depth controller called Bird (ION DigiCOURSE streamer depth controllers).

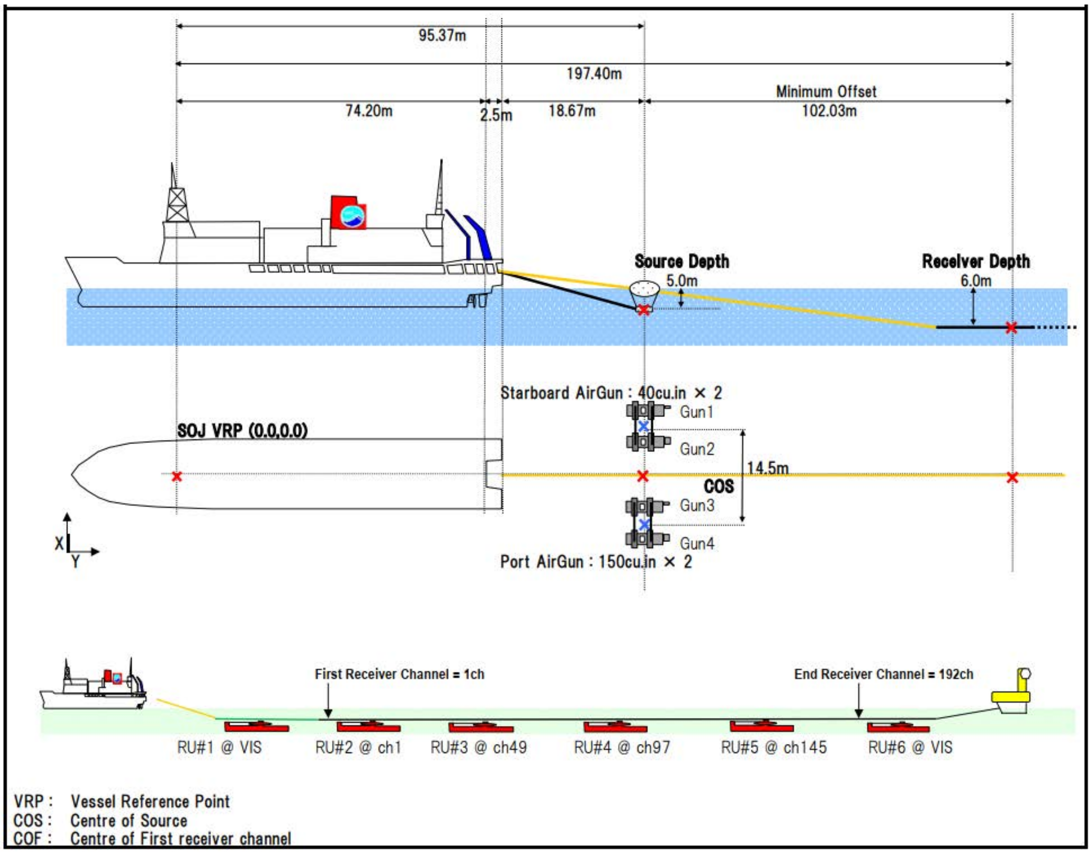

Figure 7. Towing geometry of the MCS system. Top figure shows source–receiver depth, positions, and navigation offsets, middle figure represents the source (air gun system) layout, bottom figure is streamer cable configuration during the MCS survey.

c) Recording and navigation systems

Geometrics CNT-2 recording system was used in the survey which collected seismic data in the SEG-D 8058 Rev.1 format. The system delay was set to 200 ms, the sampling rate at 1 ms, with the recording length of 14 sec. The differential global positioning system (DGPS) was used to determine accurate positions. We adopted NAVCOM's Star Fire as the main positioning system, and used NAVCOM's StarFix_XP as the backup. We used TriggerFish (InProspect Limited) as our navigation software for the seismic data acquisition. Shot times and shot points (SPs) were set on TriggerFish, and then a trigger signal was sent to the recording system and the gun controller (Realtime System HotShot). The main navigation parameters were as follows: survey datum was WGS84; map projection was UTM, and UTM zone parameter was 54N.

d) Onboard processing of MCS data:

Raw MCS reflection data from the study areas was processed onboard for quality control. Onboard data processing was conducted in the conventional processing sequence, which included trace header edit, common midpoint (CMP) binning with an interval of 3.125 m, a bandpass filter, noise attenuation, datum correction, amplitude compensation, velocity analysis, normal moveout correction, angle mute, CMP stack, time migration, and a bandpass filter (Fig. 8).

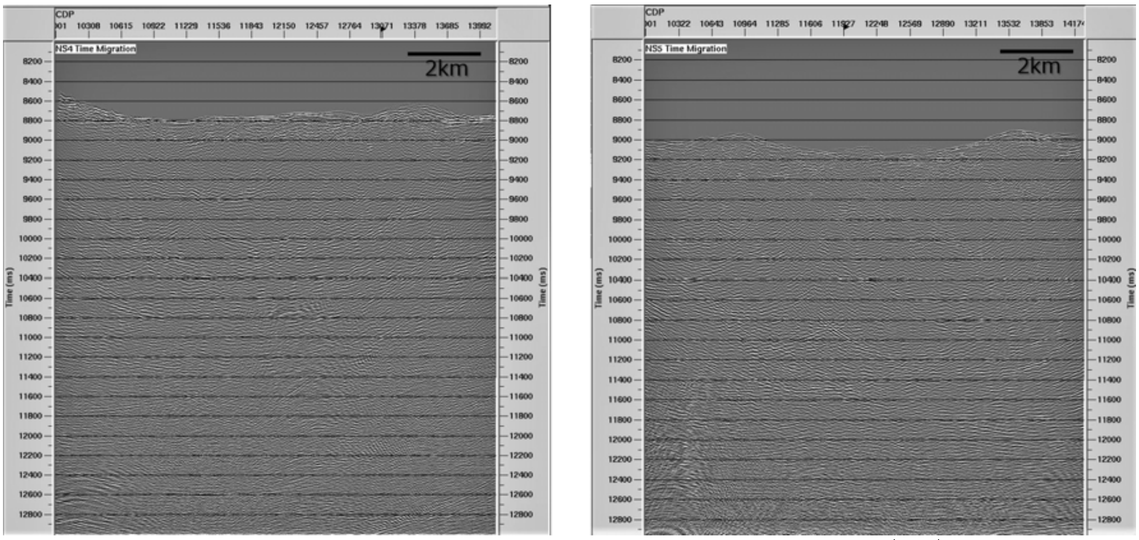

Figure 8. Examples of MCS survey with onboard processing on NS4 (left) and NS5 lines (right).

Seismic line list:

Table 1. List of MCS lines.

LINE NAME	DATE (UTC)	TIME (UTC)	F.S.P. / F.G.S.P. / L.G.S.P. / L.S.P.	VESSEL POSITION Lat.	VESSEL POSITION Lon.	Depth (m)	LENGTH FGSP - LGSP (km)
NS4_0	2020/12/19	04:45:39	1363	28_30.64617'N	142_51.10667'E	6575	12.3
	2020/12/19	04:54:11	1388	28_30.17517'N	142_51.32300'E	6657	
	2020/12/19	06:44:09	1717	28_23.96367'N	142_54.10333'E	6653	
	2020/12/19	06:44:09	1717	28_23.96367'N	142_54.10333'E	6653	
NS5_0	2020/12/19	02:02:15	1730	28_24.08033'N	142_55.55200'E	6923	12.7
	2020/12/19	02:10:52	1705	28_24.54367'N	142_55.32817'E	6917	
	2020/12/19	04:06:50	1366	28_30.95300'N	142_52.47667'E	6951	
	2020/12/19	04:07:10	1365	28_30.97200'N	142_52.46833'E	6964	
					Total		25.0

●3-2 Nishinoshima Survey

Instruments and Methods

(*) The Wave Glider™

The Wave Glider™ (WG) is developed by Liquid Robotics, Inc, which is an autonomous ocean-going platform for deploying custom sensors as shown in Figure 9 (the types of SV2 and SV3 that were used in this cruise). We equipped a monitoring system for an isolated volcanic island (MSIV) on the center of the float of WG-SV2 and SV3 (Fig. 10). The MSIV has been developed by JAMSTEC, Kobe University and the Earthquake Research Institute, University of Tokyo (assembled by Tierra Tecnica Corporation). The MSIV can measure the heave variation, take photos, and collect time-series data obtained by sensors at the ocean floor via acoustic transmission and sends the data to a server on land via Thuraya satellite communication. Furthermore, we equipped a hydrophone and microphone. Especially, the hydrophone on WG-SV3 is connected with the end of a 24 m long cable (Fig. 11). The hydrophone on WG-SV2 is set on the bottom of the glider (Fig. 12).

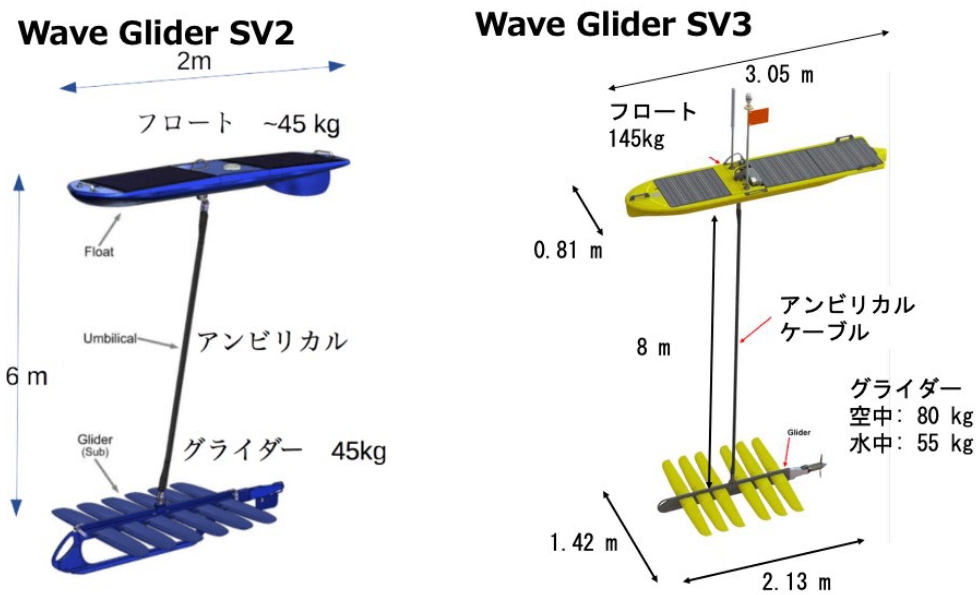

Figure 9. Schematic views of Wave Glider™ for the types of (left) SV2 and (right) SV3.

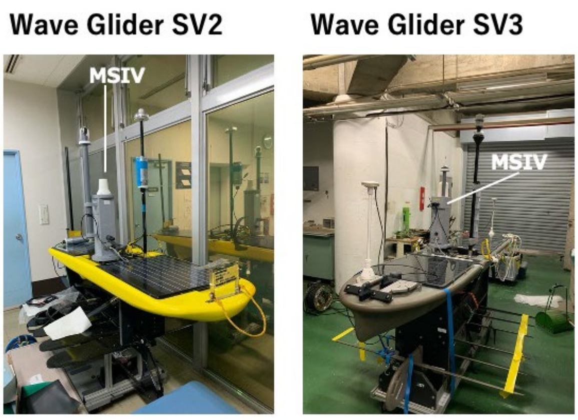

Figure 10. Photos of the equipment of monitoring system for an isolated volcanic island (MSIV) on (left) SV2 and (right) SV3,

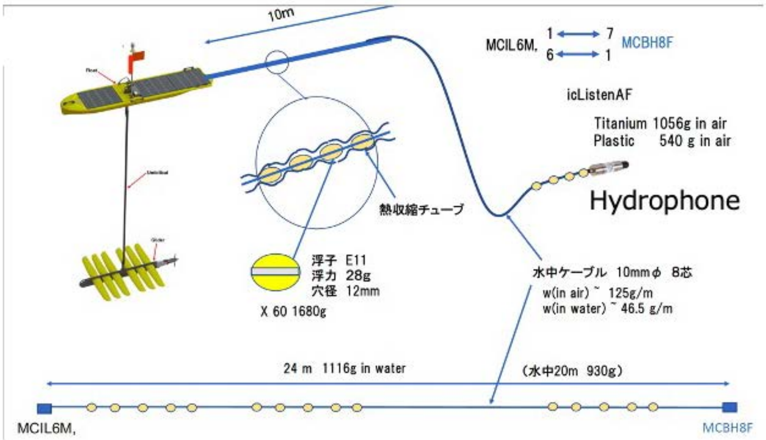

Figure 11. Schematic explanation for the setting of the hydrophone on WG-SV3.

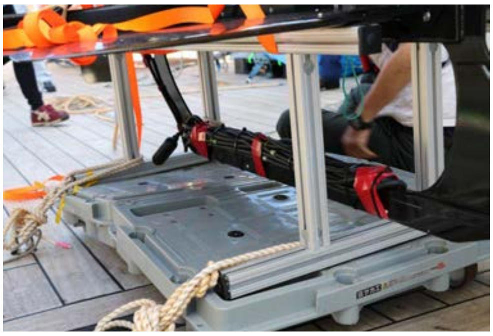
Figure 12. Photo indicating the setting style of the hydrophone on WG-SV2.

Research results

(*) The Wave Glider^{TM}

On December 21th, in the east of Nishinoshima, the Wave Glider^{TM} -SV3 (WG-SV3) was launched on the sea surface at the release point (27° 14.3706' N, 140° 55.6797' E) at 10:03 (JST) using the A-frame crane of R/V Kairei. Then it entered a polygon course following the waypoints located at a 3 km distance from the center of Nishinoshima. After 1 day traveling, the WG was let move to the waiting course (8-shaped) centered at (27° 20' N, 140° 52'E) in the north of Nishinoshima, and recovered at 15:00 (JST) on December 22nd. (Fig. 13)

Unfortunately, the monitoring system for an isolated volcanic island (MSIV) was fallen down at the launch of WG-SV3 and found to be lost during the traveling. However, we successfully obtained hydrophone and sound data. Figure 14 shows a dynamic spectrum of the hydrophone signal for 23 hours after the WG-SV3 launch, in which we did not have any signals from volcanic activities.

Next, we launched Wave Glider^{TM}-SV2 (WG-SV2) at 16:00 on December 24th. WG-SV2 entered a polygon course following the waypoints with a 3 km distance from the center of Nishinoshima. However, WG-SV2 tended to run along an arc and frequently entered the bounded area that is defined as a circle with a 2.5 km radius from the center of Nishinoshima. Thus we reset the polygon waypoints with a 5 km distance (Fig. 15). Unfortunately, the signal from the monitoring system for an isolated volcanic island (MSIV) stopped in the morning on December 25th probably due to the falling down of the MSIV. The observations with the hydrophone and microphone have been continued. WG-SV2 will be recovered in January, 2021 by a fisherman boat.

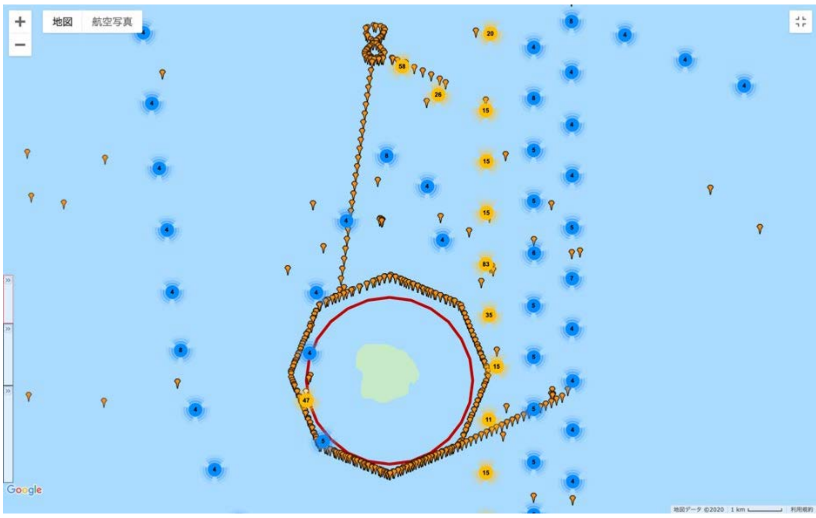

Figure 13. The traffic of WG-SV3 from the launch to recover.

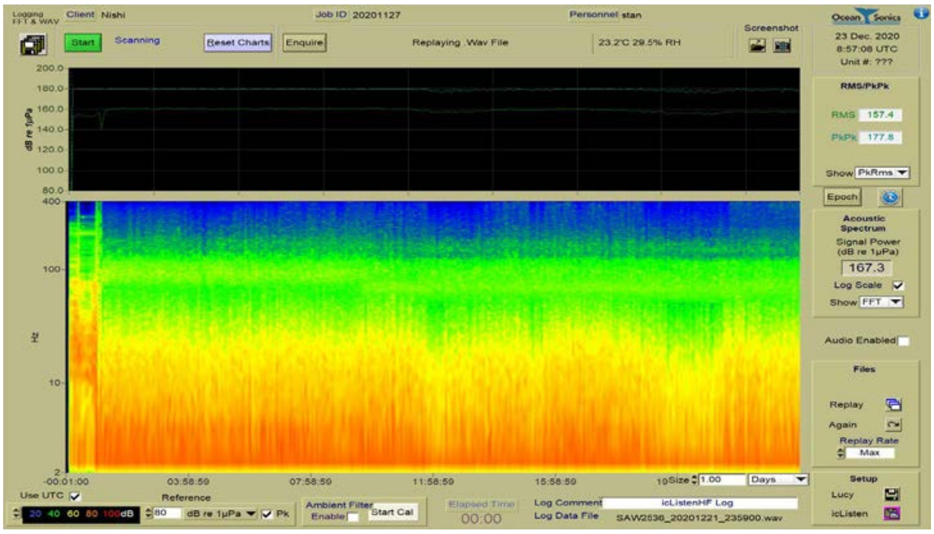

Figure 14. The dynamic spectrum of the hydrophone signal equipped on WG-SV3 for 23 hours after the launch.

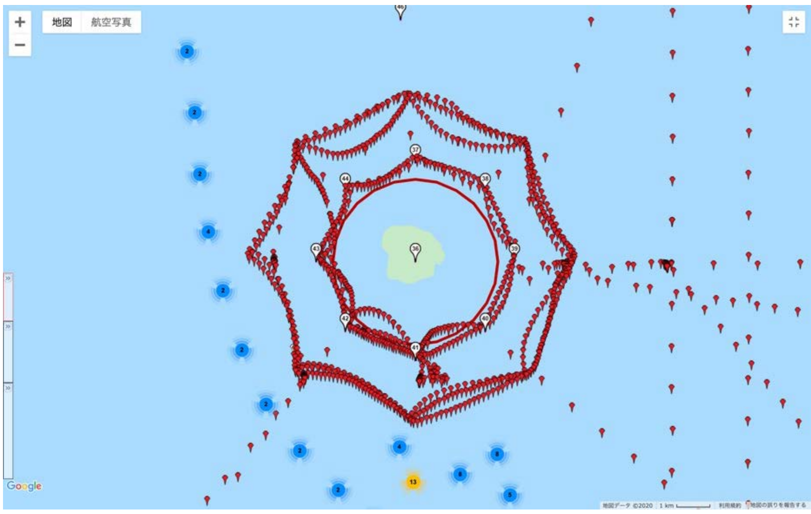

Figure 15. The traffic of WG-SV2 after December 24th to 27th.

● Sampling and observation of submarine tephra around Nishinoshima by using Box Corer and submarine camera

Yoshihiko Tamura (IMG, JAMSTEC), Tomoki Sato (IMG, JAMSTEC),

The whole nature of the violent Strombolian eruptions of Nishinoshima from June to August, 2020, have not been observed and understood clearly. The island of Nishinoshima have been covered by thick black ashes and thus it is impossible to follow the two-months eruptions chronologically. We have used Box Corer and deep-sea camera (Figs. 16-18) to sample the surface of the seafloor and the most recent eruptions from the volcano.

Methods, instruments

(a)

(b)

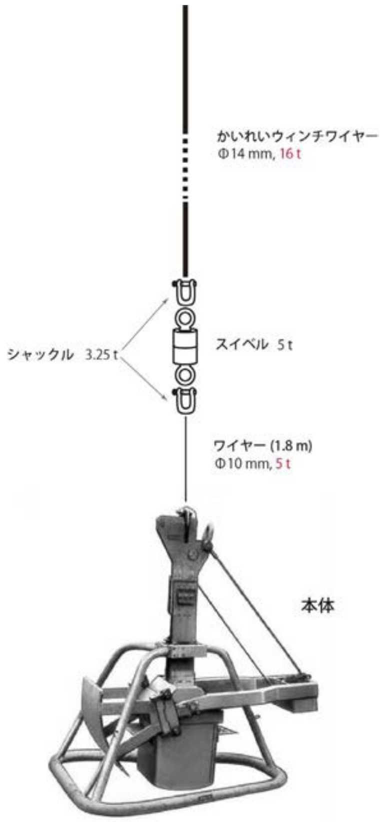

Figure 16. Box Corer. Size: 120cm (width) × 130cm (length) × 150cm (height). Weight: 260 kg
The bottom of the box covers and samples an area of 0.1 m^2 (33 cm×33 cm) of the sea floor.

Figure 17. Deep-sea camera and light, which are attached to the Box Corer. Sony HDR-AZ1 video camera is in the pressure container of the deep-sea camera that can stand up to the pressure of 7,000 m water depth.

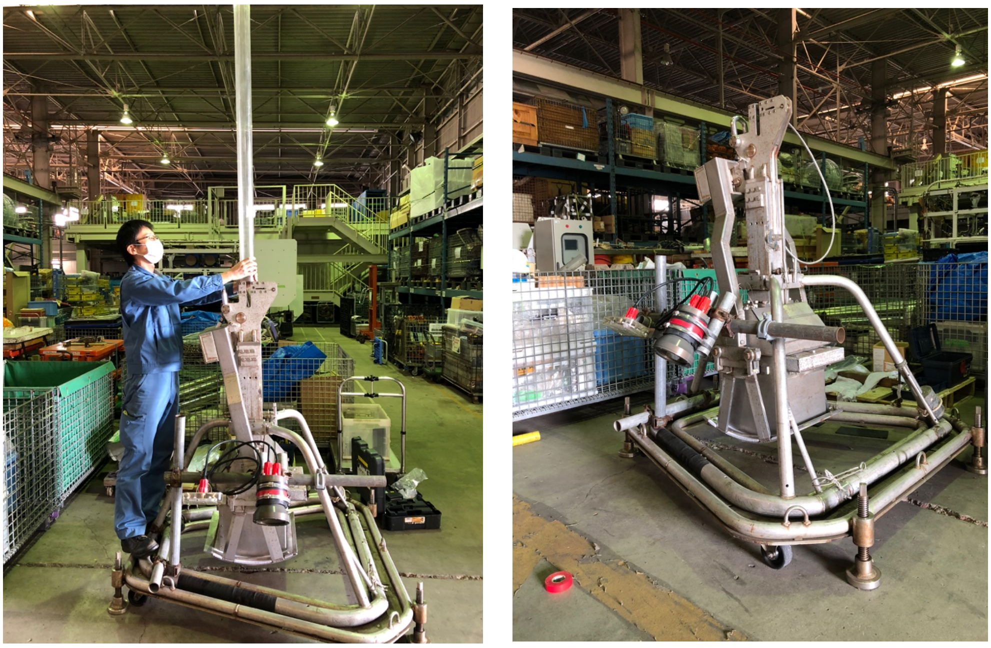

Figure 18. The deep-sea camera and light are attached to the box corer. The wire from the box corer is passed along plastic tube to prevent the wire from twinning around the camera and light.

Results

Samplings by using Box Corer were conducted at 6 places (BX#01~BX#06) around Nishinoshima at depths of water ranging from 800 m to 1500 m (Fig. 19, Table 1). Five sites were successfully sampled, but the lid at the bottom of the Box Corer had not been closes and nothing has been recovered at BX#04. The reason of the failure could be the imperfect landing of the Box Corer at the seafloor. The following attempts (BX#05 and BX#06) corrected the mistake and successfully recovered samples.

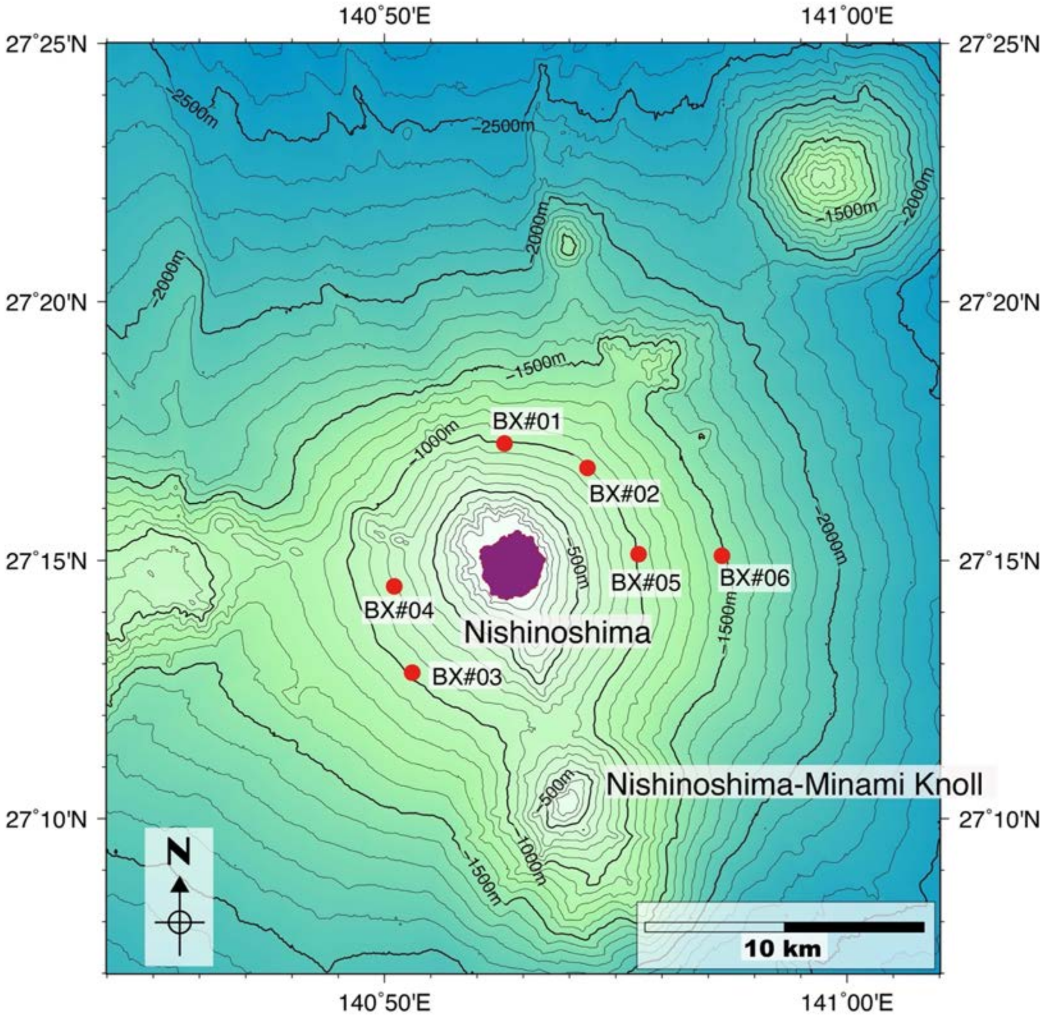

Figure 19. Sampling sites around Nishinoshima, using Box Corer during cruise KR20-E06.

Date	Time (JST)	Box Core No.	Depth (m)	Ship position Latitude (N)/ Longitude (E)		Transponder Latitude (N)/ Longitude (E)		Recovered sediment (㎝)
Dec. 20	15:43	BX#01	945	27°17.1844’	140°52.5994’	27°17.1507’	140°52.6202’	19
Dec. 22	16:15	BX#02	952	27°16.4107’	140°54.6166’	27°16.3395’	140°54.6209’	15
Dec. 23	13:55	BX#03	987	27°12.6867’	140°50.7292’	27°12.6648’	140°50.7095’	12
Dec. 23	15:43	BX#04	803	27°14.5837’	140°50.1738’	27°14.5646’	140°50.1750’	None
Dec. 24	9:04	BX#05	1,021	27°14.4697’	140°55.6014’	27°14.4998’	140°55.5606’	4
Dec. 24	11:06	BX#06	1,471	27°14.4604’	140°57.4123’	27°14.5107’	140°57.3887’	12

TABLE 2. Sampling sites of the Box Corer during cruise KR20-E06 of R/V Kairei.

BX#01

BX#01 landed the northern submarine flank of Nishinoshima at the depth of 945 m (Fig. 20). The seafloor shows weak ripple marks and light-colored fragments were observed in mostly black materials (Fig. 21). The recovered sediments consist of scorias, pumices, fragments of lavas, and altered rocks (Figs. 22 and 23). Right photo of Fig. 23 shows a pumice on the surface of the seafloor.

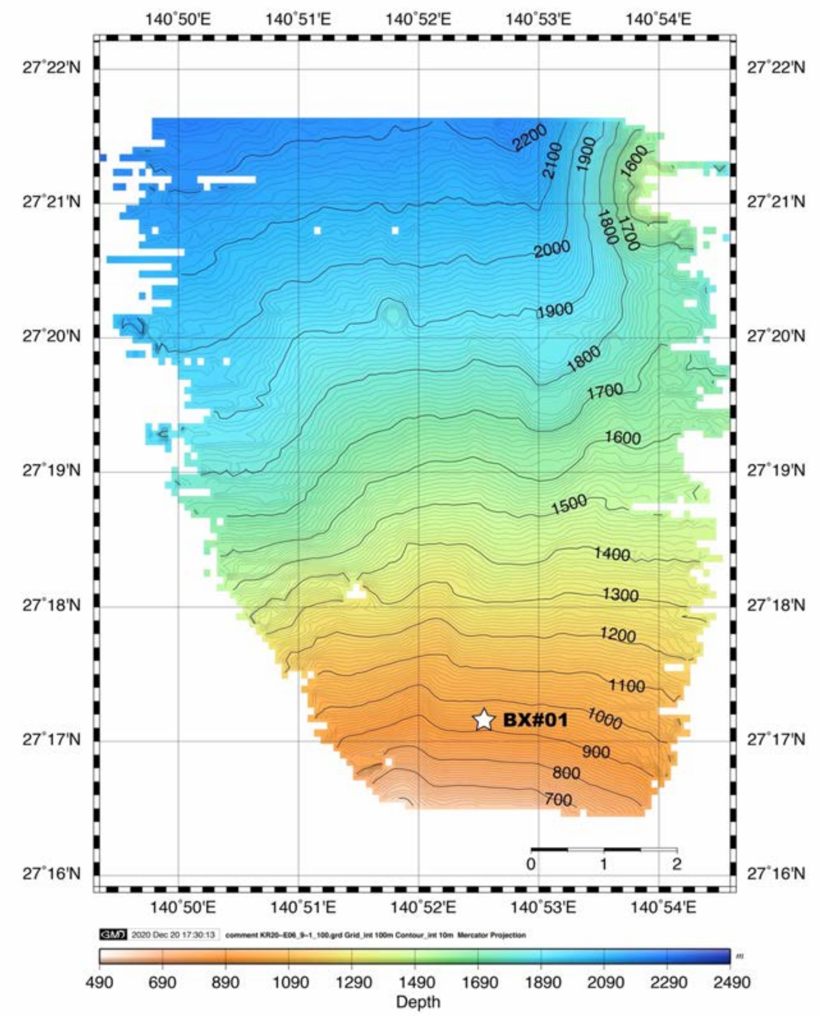

Figure 20. Location of Box Core (BX#01) on northern flank of volcano.


Figure 21.   Seafloor at the site of BX#01 captured by an attached camera.


Figure 22. Recovered sediment (0.1 m^2 in area).

Figure 23. (Left) recovered sediment (~19 cm). (Right) a few mm of pumice are contained in addition to scorias and lava fragments.

BX#02

BX#02 landed the northeastern submarine flank of Nishinoshima at the depth of 952m (Fig. 24). The seafloor shows weak ripple marks and monotonously black with little light-colored fragments (Fig. 25). The recovered sediments consist of scorias, fragments of lavas (lithic fragments), and altered lithic fragments (Figs. 26). Figure 27 shows recovered scorias, which have irregular elongated shapes. These shapes suggest that these are primary eruption products and not are secondary reworked materials.

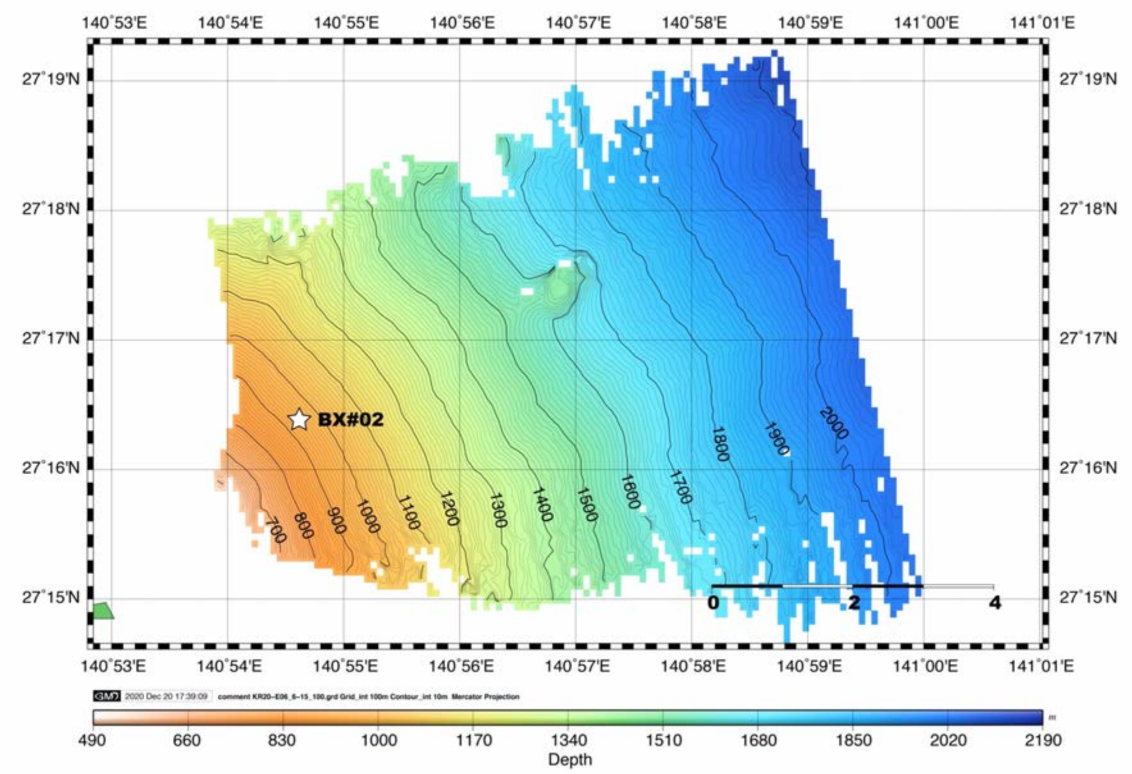

Figure 24. Location of Box Core (BX#02) on northeastern flank of volcano.

Figure 25. Seafloor at the site of BX#02 captured by an attached camera.

Figure 26. Recovered sediment (0.1 m^2 in area).

Figure 27. Recovered scorias, which have irregular elongated shapes. These shapes suggest that these are primary eruption products and not are secondary reworked materials.

BX#03

BX#03 landed the southwestern submarine flank of Nishinoshima at the depth of 987m (Fig. 28). The seafloor shows weak ripple marks and monotonously black with little light-colored fragments (Fig. 29). The recovered sediments consist of scorias, fragments of lavas (lithic fragments), and altered lithic fragments (Figs. 30). Figure 30 shows recovered scorias, some of which have irregular elongated shapes. Light-colored pumices are absent.

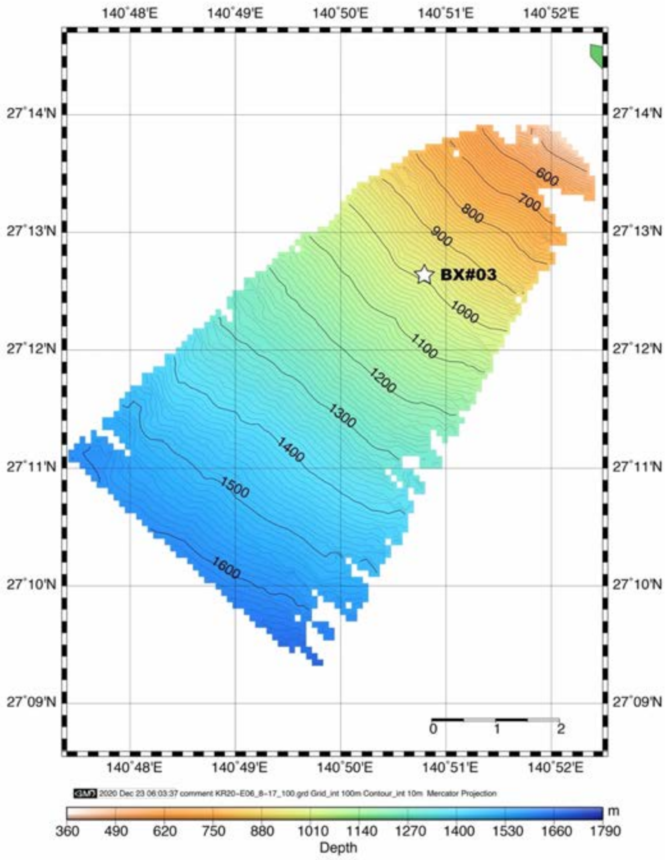

Figure 28. Location of Box Core (BX#03) on southwestern flank of volcano.

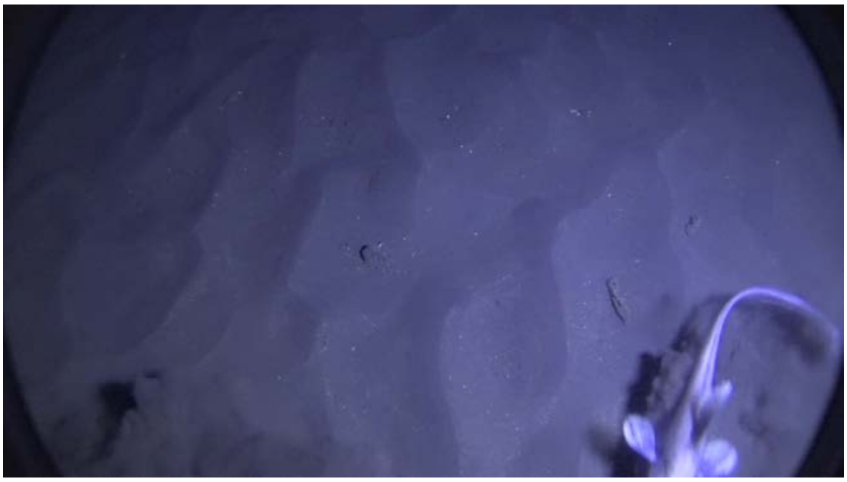

Figure 29. Seafloor at the site of BX#03 captured by an attached camera

Figure 30. Recovered scorias, some of which have irregular elongated shapes. Most scorias are dark-colored without light-colored pumices.

BX#4

BX#04 landed the western submarine flank of Nishinoshima at the depth of 803m (Fig. 31). The seafloor shows weak ripple marks and monotonously black with little light-colored fragments (Fig. 32). Unfortunately, the landing at the site was imperfect and the lid at the bottom of the box did not close, which resulted in failure of sampling.

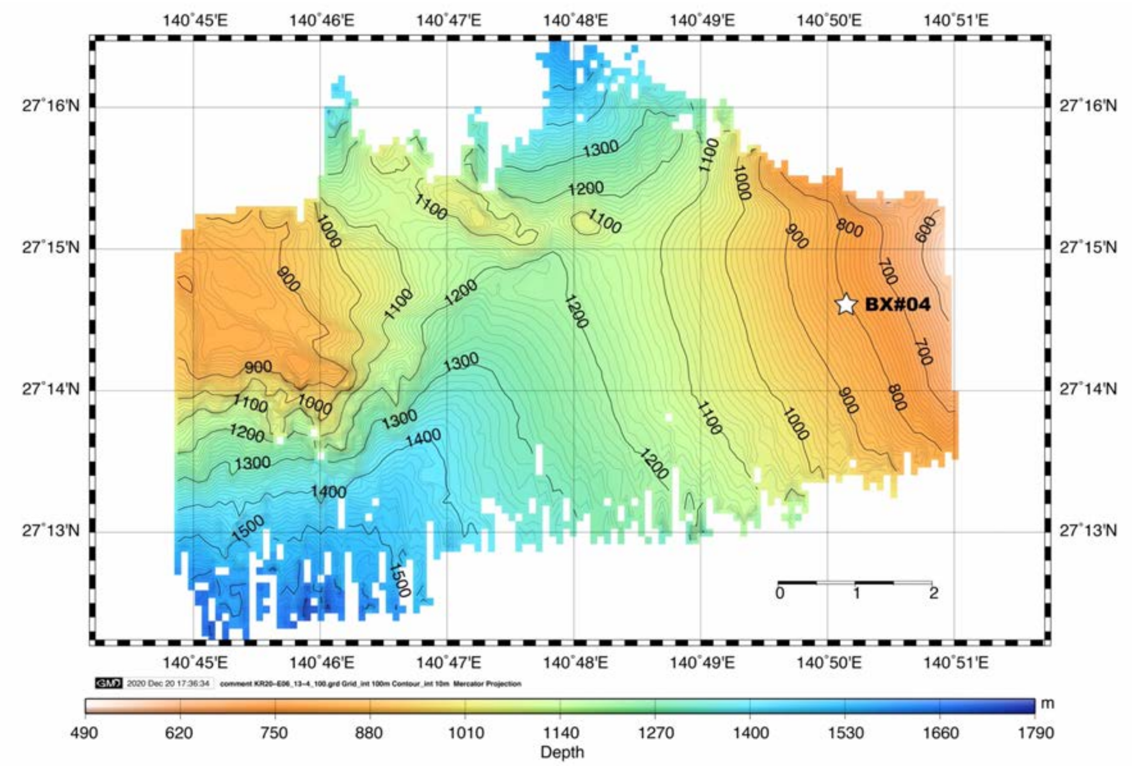

Figure 31. Location of Box Core (BX#04) on western flank of volcano.

Figure 32. Seafloor at the site of BX#04 captured by an attached camera

BX#05

BX#05 landed the eastern submarine flank of Nishinoshima at the depth of 1021 m (Fig. 33). The seafloor shows weak ripple marks and light-colored fragments were observed in mostly black materials (Fig. 34). The recovered sediments mostly consist of scorias and lithic fragments.

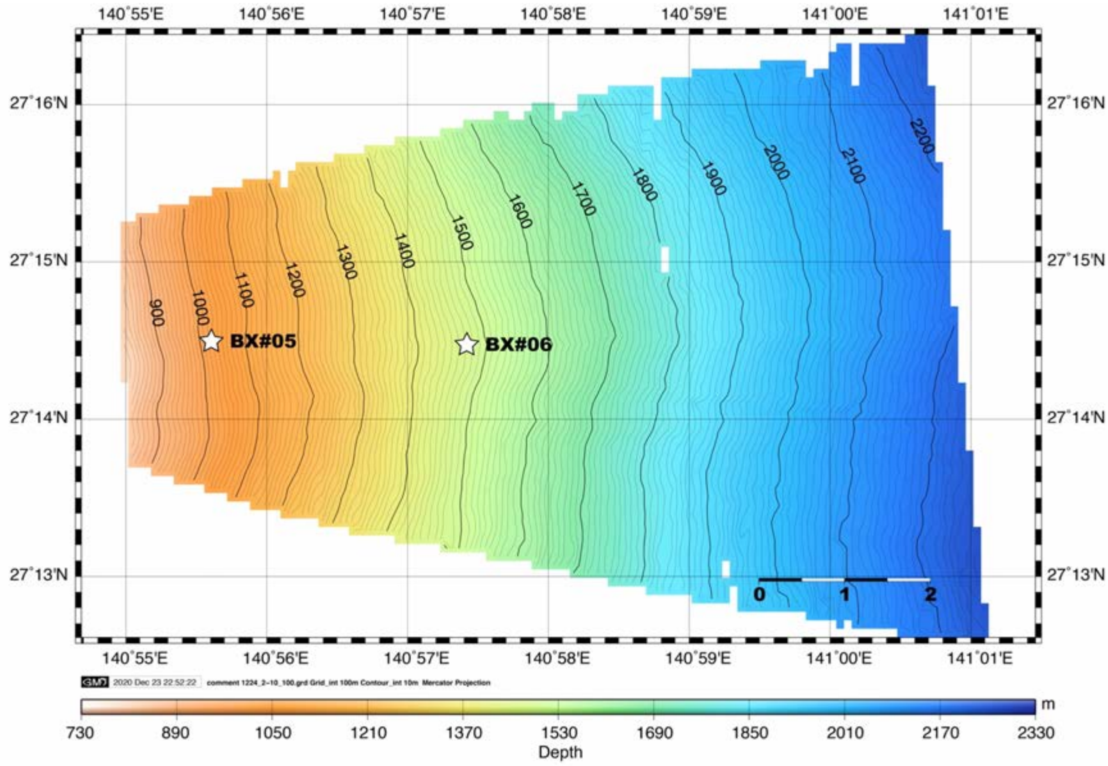

Figure 33. Location of Box Core (BX#05) on eastern flank of volcano.

Figure 34. Seafloor at the site of BX#05 captured by an attached camera

BX#06

BX#06 landed the eastern submarine flank of Nishinoshima at the depth of 1471 m (Fig. 35). The seafloor shows strong ripple marks with little light-colored fragments (Fig. 36). The recovered sediments consist of mostly scorias and lithic fragments (Fig. 37).

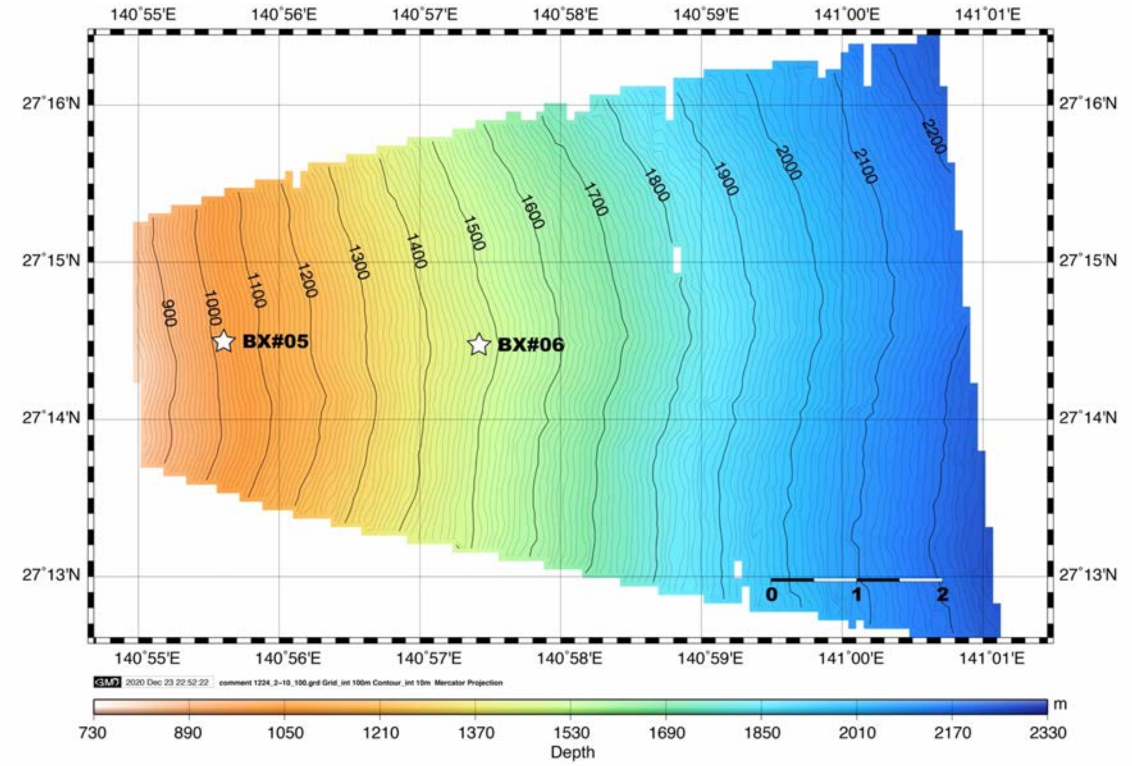

Figure 35 Location of Box Core (BX#06) on eastern flank of volcano.

Figure 36 Seafloor at the site of BX#06 captured by an attached camera

Figure 37. Recovered scorias, some of which have irregular elongated shapes. Most scorias are dark-colored without light-colored pumices.

BX#01 Dec. 20 2020

sample No.	rock type	shape	X (cm)	Y (cm)	Z (cm)	weight(kg	colour	alteration	phenocrysts	vesiculation	Memo
S01a	ラピリ(2cm以下)	subrounded				0.06	light gray	fresh	aphyric	moderately	少し円磨されている。ボックスコアの表層(最上部)
S01b	ラピリ(2cm以下)	subrounded				0.015	light gray	fresh	aphyric	moderately	S01aと同じ(分取)
S02	火山性sand-ラピリ	subangular /subrounded				23	black	fresh			S01の下
C01	S01+S02		Φ8		20	0.97					ボックスコアからコア抜き
C02	S01+S02		Φ8		20	0.97					ボックスコアからコア抜き
R01	andesite	subangular	9.5	8.5	5.5	0.46	dark gray	fresh	pl(20)	weakly	S2中のレキ
R02a	スコリア	rounded	5.5	3.5	2.0	0.03	black	fresh	aphyric	strongly	S2中のレキ、光沢あり
R02b	スコリア	rounded	3.0	2.5	2.0	0.01	black	fresh	aphyric	strongly	S2中のレキ、光沢あり
R02c	スコリア	rounded	3.0	2.0	1.5	0.007	black	fresh	aphyric	strongly	S2中のレキ、光沢あり
R02d	スコリア	rounded	3.0	1.5	1.0	0.002	black	fresh	aphyric	strongly	S2中のレキ、光沢あり
R03	basaltic andesite		5.0	4.0	2.0	0.045	dark gray	fresh	ol(~1)/px(~1)/pl(~3)	moderately	S2中のレキ、cumulate（集斑晶）あり
R04	andesite	subrounded	5.0	3.5	2.0	0.04	茶色がかった dark gray	fresh	pl(20)	weakly	S2中のレキ
R05	andesite	subangular	5.0	3.5	2.5	0.05	gray	fresh	pl(30)/px(+)	weakly	S2中のレキ
R06	andesite（R05と同じ）	angular	4.0	3.5	3.0	0.035	gray	fresh	pl(30)/px(+)	weakly	S2中のレキ
R07	andesite（R05と同じ）	angular	4.0	3.0	2.5	0.04	gray	fresh	pl(30)/px(+)	weakly	S2中のレキ
R08	andesite	subangular	4.0	3.5	2.0	0.045	gray	fresh	px(5)/pl(10)	weakly	S2中のレキ、斑晶が細粒
R09	andesite（R08とほぼ同じ）		3.5	3.5	2.0	0.035	gray、表面が赤褐色	fresh			S2中のレキ
R10	hyaloclastite?	subangular	4.5	2.5	2.5	0.03	gray	weakly altered	aphyric	weakly	S2中のレキ、空隙はあるが発泡ではない
R others						0.4					S2中のレキ、4cm以下、約30個
M01											表層5cm

BX#02 Dec. 22 2020

sample No.	rock type	shape	X (cm)	Y (cm)	Z (cm)	weight(kg)	colour	alteration	phenocrysts	vesiculation	Memo
S01	volcanic sand						black	fresh			ごく表層。物はS02Eと同じ。
S02E	volcanic sand		sand ~ gravel				black	fresh			粗粒（レキ）を除いた残り
S others	volcanic sand						black	fresh			ボックスの外に甲板デッキ上で流れたもの
C01	volcanic sand		Φ8		18	2	black	fresh			ボックスコアからコア抜き
C02	volcanic sand		Φ8		18	2	black	fresh			ボックスコアからコア抜き
R01	basaltic andesite	subangular	6.5	4.5	2.5	0.065	black	fresh	pl(15)	moderately	S中のレキ
スコリアー type1	basalt	フレーク状	3>	2>	1>		black	fresh	pl(+)	strongly	全部で65g。S中のレキ
スコリアー type2	basaltic scoria	subangular /subrounded	2>	2>	1>		black	fresh	pl(+)	moderately	全部で50g。S中のレキ。
スコリアー type3	andesitic	subangular /subrounded	1.5>	1>	0.5>		dark gray 茶色っぽい	fresh		moderately	17個で5g。S中のレキ。
異質岩片 lithic fragments	andesite	subangular	最大3	2	1	数g	gray/pale gray/brown	fresh/weakly altered	px(0)/pl(0)	weakly	約20個で60g。S中のレキ。
M01											表層5cm

BX#03 Dec. 23 2020

sample No.	rock type	shape	X (cm)	Y (cm)	Z (cm)	weight(kg)	colour	alteration	phenocrysts	vesiculation	Memo
S01	細かい火山砂 (fine sand size)					0.08	black				ボックスコアの表層
S02	volcanic sand					2.4	black				
S02E	volcanic sand					7	black				粗粒を除いたS02
C01	volcanic sand		Φ8		19	2.2					ボックスコアからコア抜き
C02	volcanic sand		Φ8		18	2.2					ボックスコアからコア抜き

R01	andesite スコリア	angular	6	3.5	2.5	0.035	black	fresh	pl(+)	weakly	S中のR
R02	andesite pumice	subangular	4	3	2.5	0.017	gray（表面 light gray）	fresh	pl(+)	moderately	S中のR
R03	andesite scoria	subangular	4	2.5	2	0.01	black	fresh	pl(+), aphyric	moderately	R01より少し発泡度高い。S中のR。
R04	andesite scoria（R03と同じ）	subangular	4	1.5	1.5	0.01	black	fresh	pl(+), aphyric	moderately	S中のR
R05	R02に類似	subangular	3	2	1.5	0.005	black（表面は light）	fresh		moderately	S中のR
スコリア others	R01, R03のスコリアと同じ		最大 3.5	1.5	1.5	0.32	black			moderately/weakly	S中のスコリア
パミス others	R02に類似	subangular	最大1	1.5	1.5	0.145	light gray	fresh	pl(+)	moderately	S中のパミス
パミス others2	パミスothersと同じ（後に同梱した）		最大1	1	0.5	0.02	dark gray	fresh		moderately	S中の洗浄時、最後に浮いてきたやつ回収。パミス以外も入ってるかも。
異質岩片	安山岩か？	subangular /subrounded	最大2	2	1.5	0.035	dark gray/light gray/赤褐色	weakly altered	pl(＋)	weakly	S中の異質岩片

BX#05 Dec. 24 2020

rock type	weight(kg)	colour	Memo
volcanic san	7	black	量が少ないため、船上で分別していない。

BX#06 Dec. 24 2020

sample No.	rock type	shape	X (cm)	Y (cm)	Z (cm)	weight(kg	colour	alteration	phenocrysts	vesiculation	Memo
S01	細粒 volcanic sand					0.5	black	fresh			表層5cm
S02	volcanic sand					4	black				S01の下。実体鏡でスコリア、溶岩片、軽石、変質レキ（白色、パイライト含）
S02E	volcanic sand					2.5	black				粗粒を除いたS02
C01			Φ8		15	1					ボックスコアからコア抜き
C02			Φ8		17	1.2					ボックスコアからコア抜き

スコリア-A	basaltic andesite	angular	最大1.5	1	0.5	0.005	black	fresh	pl(+)	strongly	S02中の洗い出したレキ。高発泡度、不規則形。BX#02に同様のfresh scoria.
スコリア-B	andesite	subangular /subrounded	最大3	2	1	0.13	black	fresh	pl(+)	moderately	S02中の洗い出したレキ（スコリア）
pumice	andesite	subrounded	最大1.5	1	0.5	0.04	dark gray ~ dark brown	fresh	pl(+)	moderately	S02中の洗い出したレキ（pumice）
異質レキ	andesite	subangular /subrounded	最大1.5	1	0.5	0.005	dark gray/赤褐色	weakly/moderately altered	pl(+)	weakly	S02中の洗い出したレキ
M01											表層5cm

Drone operations

Drones operated by Katsuya Noguchi and Hisashi Makabe (HEXaMedia) have been used to sample volcanic materials directly from the Nishinoshima island and to study the topographic changes of the island.

Figure 38. R/V Kairei and Nishinoshima on December 20, 2020.

Figure 39. Nishinoshima taken from the north. Thick volcanic ashes cover the surface of rugged lava flows. The underlying lavas were still hot and emit vapor through narrow cracks of the ashes .

Drone samples

sample No.	Date	hh:mm (JST	latitude(N)		longitude(E)		depth (m)	rock type	size X (cm)	size Y (cm)	size Z (cm)	weight(kg)	Memo
HX01-01	21/12/2020	13:30	27	14.7194	140	52.2122	陸上 10m	Basaltic andesite	3>	2>	2>	0.16	Black scoria sand and lapilli. 西側
HX01-02	21/12/2020	14:40	27	14.6844	140	52.2792	陸上 15m	andesite	0.5>	0.5>	0.5>	0.02	Light gray ash
HX-02	22/12/2020	9:20	27	14.7515	140	52.2272	陸上 10m	andesite	0.5>	0.5>	0.5>	0.02	Light gray ash
HX-03	23/12/2020	10:20	27	14.3507	140	52.52	陸上 25m	andesite	5>	3>	3>	0.22	Red oxidized socoria lapilli. 南側

● 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.
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