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R/V Kaimei Cruise Report

KM23-08,09C

Unravelling the abnormal gold enrichment mechanism at the Higashi Aogashima Knoll Caldera hydrothermal field: ROV dive survey part 3

26th June 2023 – 7th July 2023

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

Contents

1. Cruise Information

● Cruise ID: KM23-08,09C

● Name of vessel: R/V Kaimei

● Title of the cruise: Unravelling the abnormal gold enrichment mechanism at the Higashi Aogashima Knoll Caldera hydrothermal field: ROV dive survey part 3

● Title of proposal: (P23-01) Geophysical survey for the future BMS drilling at the Higashi-Aogashima Knoll Caldera hydrothermal field: Part 2

(JC23-01) Unravelling the abnormal gold enrichment mechanism at the Higashi Aogashima Knoll Caldera hydrothermal field: ROV dive survey part 3

● Cruise period: 26th June 2023 to 7th July 2023

● Ports of departure and arrival: JAMSTEC Yokosuka HQ to JAMSTEC Yokosuka HQ

● Research area: Higashi-Aogashima Knoll Caldera in the Izu-Ogasawara area

● Research map:

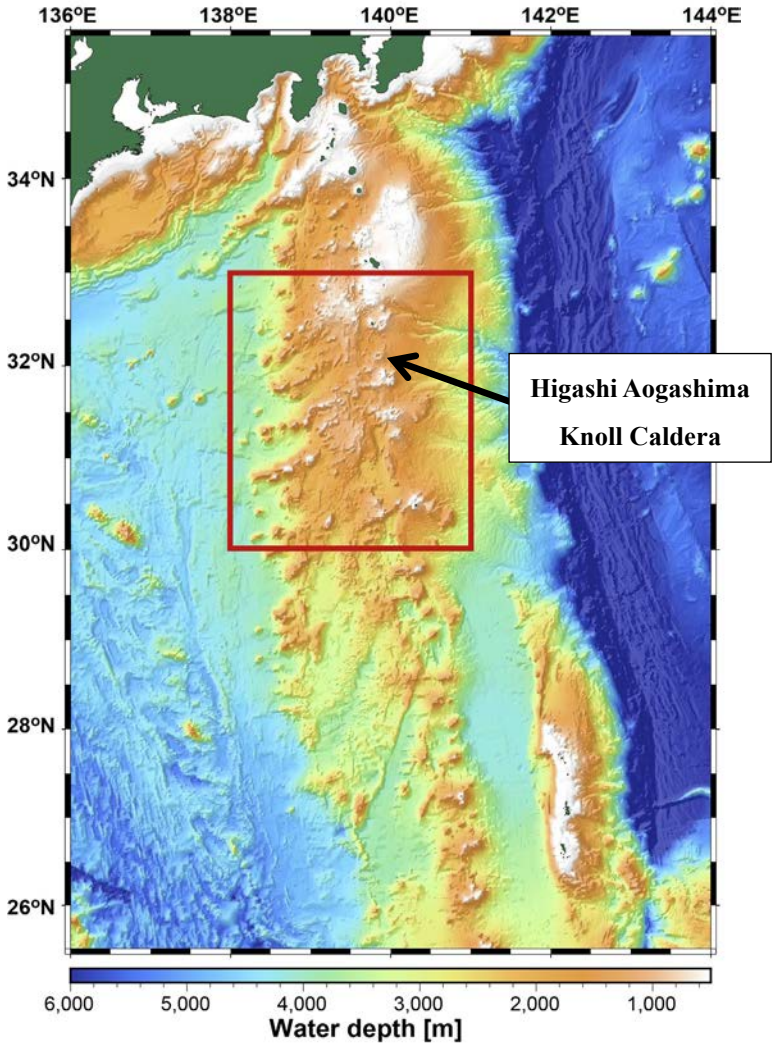

Fig. 1-1 Investigation area map of the cruise KM23-08,09C.

2. Researchers and Crews

● Chief scientist

NOZAKI Tatsuo (JAMSTEC)

● Representative of the scientific party

NOZAKI Tatsuo (JAMSTEC)

● Scientific party

TORIMOTO Junji	JAMSTEC
KIKUTA Hiroyuki	JAMSTEC
KAWAGUCCI Shinsuke	JAMSTEC
WATANABE Hiromi	JAMSTEC
CHEN Chong	JAMSTEC
WAKAI Satoshi	JAMSTEC
AIKAWA Shimpei	Japan International Research Center for Agricultural Sciences (JIRCAS)
KURIBAYASHI Takahiro	Tohoku University
ISHIBASHI Jun-ichiro	Kobe University
TOYODA Shin	Okayama University of Science
KAKUMOTO Miyu	Okayama University of Science
TONEDACHI Nanako	Tokyo University of Marine Science and Technology (TUMSAT)
FUKUSHIMA Yasuyuki	IHI Corporation
JAMIESON John	Memorial University of Newfoundland
MARTIN Andrew Jonathan	University of Nevada
HSU Fenghsin	National Taiwan University (NTU)
SUN Jin	Ocean University of China
HE Xing	Ocean University of China
JEON Yechan	Seoul National University (SNU)

● Technical supporting staffs:

IWAMOTO Hisanori	Nippon Marine Enterprises (NME)
SUGIMOTO Yohei	Nippon Marine Enterprises (NME)

● Kaimei crew members:

Captain	KIMURA Naoto
Chief Officer	SUZUKI Akira

2nd Officer	OZAWA Kanta
3rd Officer	TSURUMAKI Aoi
Jr.3rd Officer	SARASHINA Hiroki
Chief Engineer	FUNAE Koji
1st Engineer	GIBU Daisuke
2nd Engineer	SHIMADA Keito
3rd Engineer	IKEZAKI Kohshun
Chief Electronic Operator	NASU Tokinori
2nd Electronic Operator	OI Keisuke
3rd Electronic Operator	IKEDA Kohei
Boat Swain	KUWAHARA Yosuke
Able Seaman	FUJII Tatsuo
Able Seaman	HIRAI Saikan
Able Seaman	MIYASHITA Takuya
Able Seaman	HONJO Hotaka
Able Seaman	TOKUNAGA Daichi
Sailor	SUMOMOZAWA Kazuya
Sailor	NAKANO Mizuki
Sailor	NAKAYAMA Shotaro
No.1 Oiler	HIGASHIGAWA Yuji
Oiler	SATO ryo
Assistant Oiler	ONO Yutaro
Assistant Oiler	MIZUNO Riku
Assistant Oiler	SARAMOTO Koitaro
Assistant Oiler	AKIYOSHI Yuta
Assistant Oiler	KONDO Haru
Chief Steward	CHIKUBA Yukihide
Steward	KUNITA Masanao
Steward	NOJIRI Takehiro
Steward	ABE Kina

● KM-ROV Operation Team

ROV Operation Manager	ISHITSUKA Tetsuya
2nd ROV Operator	KUMAGAI Shinnosuke
2nd ROV Operator	GOTO Takuma
3rd ROV Operator	KOGUMA Atsushi

3rd ROV Operator	OKUHIRA Yuto
3rd ROV Operator	TAKEDA Kai

3. Observation

3.1 Objectives & Background

Higashi Aogashima Knoll Caldera (hereafter called HAKC) hydrothermal field is a relatively new one discovered in 2015 by the research group of The University of Tokyo (The University of Tokyo, 2015, 2016; Japan Oil, Gas and Metals National Corporation (JOGMEC), 2018). There have been known three hydrothermal sites within the HAKC hydrothermal field; (1) Central Cone Site, (2) Southeast Site and (3) East Site (Katase et al., 2016; Iizasa et al., 2019). Out of these three hydrothermal sites, an abnormal gold enrichment (average Au concentration = 102 ppm, n =15) was observed only at the Central Cone Site (Iizasa et al., 2019). In particular, the gold concentration of the mound samples at the Central Cone Site is abnormally high, up to 275 ppm (Iizasa et al., 2019). The abnormal gold enrichment at the Central Cone Site is considered to be closely associated with the boiling process of hydrothermal fluid and its concomitant transportation of nano Au particles from the subseafloor (Iizasa et al., 2019). However, researches on the HAKC hydrothermal field are at a beginning stage and only basic petrographic observations about chimney and mound rock samples, a bathymetric map by multibeam echosounder (MBES) (Katase et al., 2016) and preliminary water column (hydrothermal plume) survey by MBES (Kaneko and Kasaya, 2022) were reported so far.

Two years ago, the cruise KS-21-20 by R/V Shinsei Maru with remotely operated vehicle (ROV) Hyper Dolphin (HPD) was conducted as the first multi-disciplinary research cruise from the aspect of economic geology, (fluid) geochemistry, geochronology, macro-/micro-biology and geophysics. Purposes of the cruise KS-21-20 were to obtain the samples of rock, seawater, hydrothermal fluid, benthic animals and microorganisms as well as geophysical data such as bathymetry, gravity and magnetic intensity to unravel the reason/cause/phenomenon of abnormal gold enrichment in a multi-disciplinary manner at the HAKC hydrothermal field. In the last year's cruise KM22-11C, we tried to collect more rock, fluid, animal, microbiological samples as well as geophysical data to unraveling the abnormal gold enrichment mechanism at the HAKC field, but we could not conduct any dive surveys due to the impacts of typhoon and strong tidal currents. In the cruise KM23-08,09C, we tried to collect more samples and geophysical data, as well as the observation topographical unique points detected by AUV detailed bathymetric surveys conducted during previous cruises of YK21-10, KM23-01 and KM23-02.

References

Iizasa, K., Asada, A., Mizuno, K., Katase, F., Lee, S., Kojima, M. and Ogawa, N. (2019) Native gold and gold-rich sulfide deposits in a submarine basaltic caldera, Higashi-Aogashima hydrothermal field, Izu-Ogasawara frontal arc, Japan. *Mineralium Deposita*, **54**, 117–132.

Japan Oil, Gas and Metals National Corporation (JOGMEC) (2018) Verification of the occurrence of

new seafloor hydrothermal deposit at the Aogashima Island offshore, Izu-Ogasawara area. News Release on 27th December 2018. (In Japanese)

Iizasa, K., Mizuno, K., Asada, A., Matsuda, T. and Saito, Y. (2016) Seafloor hydrothermal deposits exploration by bathymetry and backscattering data using multibeam echo-sounder in the Higashi-Aogashima Caldera. *The Journal of the Marine Acoustics Society of Japan*, **43**, 208–218.

Kaneko, J. and Kasaya, T. (2022) Water column data analysis of the shipboard multibeam echo sounders using voxel model in Higashi-Aogashima Knoll Caldera submarine hydrothermal field. *Geoinformatics*, **33**, 87-94. (In Japanese with an English abstract)

The University of Tokyo (2015) Discovery of the seafloor hydrothermal deposit at the eastern offshore of Aogashima Island, Izu area; Development of a tool that can discover seafloor hydrothermal deposit in a short span of time. Press Release on 7th August 2015. (In Japanese)

The University of Tokyo (2016) Accomplishment of the practical and highest accurate exploration tool during the exploration at seafloor hydrothermal deposit in Higashi Aogashima Caldera, Izu Islands. Press Release on 2nd June 2016. (In Japanese)

3.2 Preliminary Results

During last year's cruise KM22-11C, we had planned to conduct remotely operated vehicle (ROV) dives at the Higashi-Aogashima Knoll Caldera hydrothermal field. Unfortunately, we could not conduct any dives due to the impact of typhoons and strong tidal currents. This year, during the cruise KM23-08, 09C, we sought to redeem ourselves. Despite frequently encountering strong currents that limited our dive durations and maneuverability, we successfully completed all seven planned dive days (Figs. 3-3 to 3-9).

As a result, we obtained a total of 42 rock, 12 seawater, 6 hydrothermal fluid, 1 push core and numerous biological and microbial samples from Central Cone, Southeast and East Sites of the Higashi-Aogashima Knoll Caldera hydrothermal field. Additionally, we discovered new sulfide mounds and hydrothermal vents to the south of Eastern Site, which we named the South of East (SOE) Site.

During the nights without dive surveys and the daytime periods when diving was not feasible, we conducted systematic mapping using a multibeam echosounder (MBES), investigated water column (hydrothermal plume), performed tricomponent magnetometer surveys and utilized a gravimeter for geophysical survey (Figs. 3-1 and 3-2). We adjusted various settings of the MBES and conducted thorough plume surveys, resulting in the collection of a substantial amount of data.

Moving forward, our plan is to analyze and interpret these samples and data in order to elucidate the mechanisms of gold enrichment at the Higashi-Aogashima Knoll Caldera hydrothermal field.

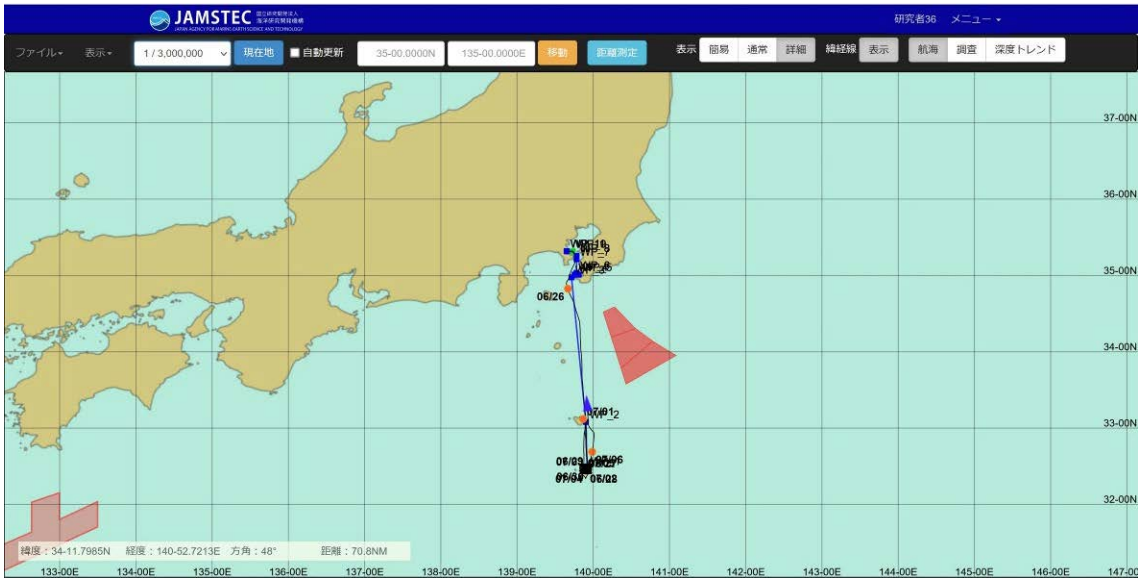

Fig. 3-1 Entire ship track during the cruise KM23-08,09C.

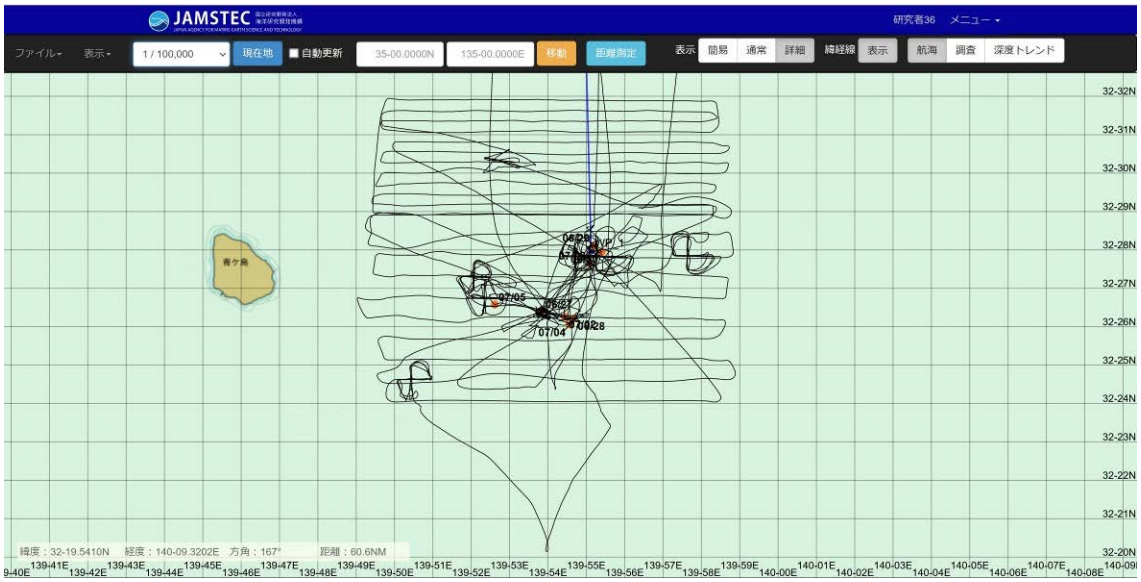

Fig. 3-2 Ship track around Higashi Aogashima Island during the cruise KM23-08,09C.

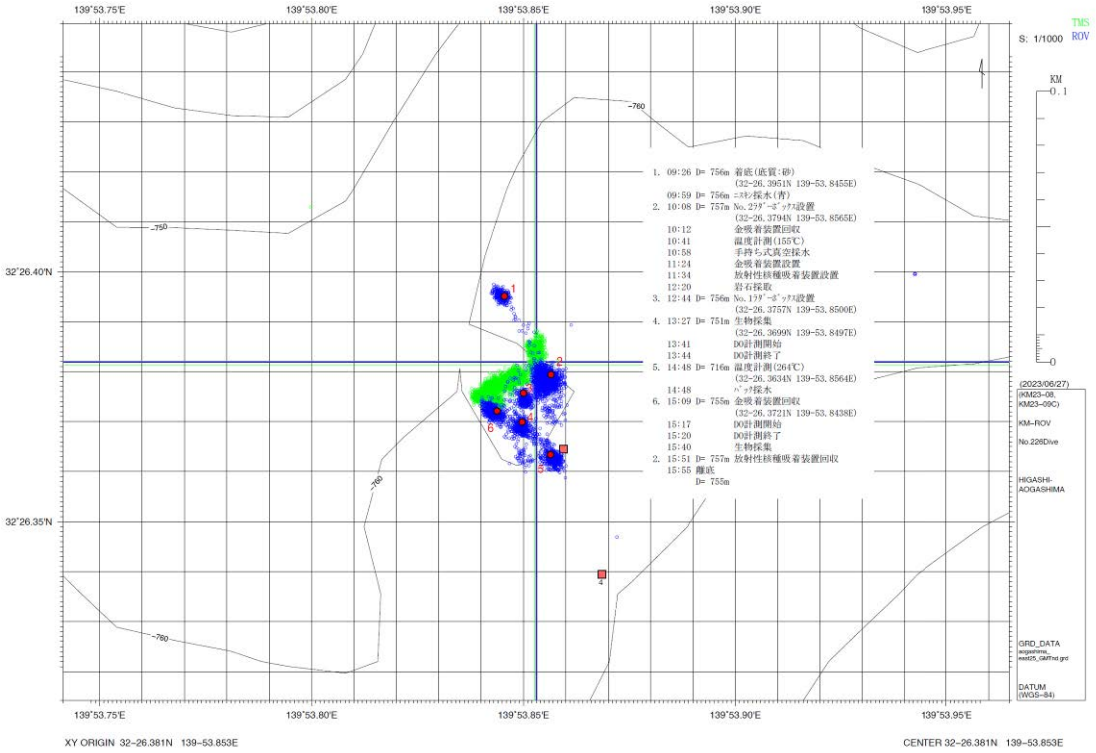

Fig. 3-3 ROV dive track during the dive KM-ROV#226 at Central Cone (CC) Site.

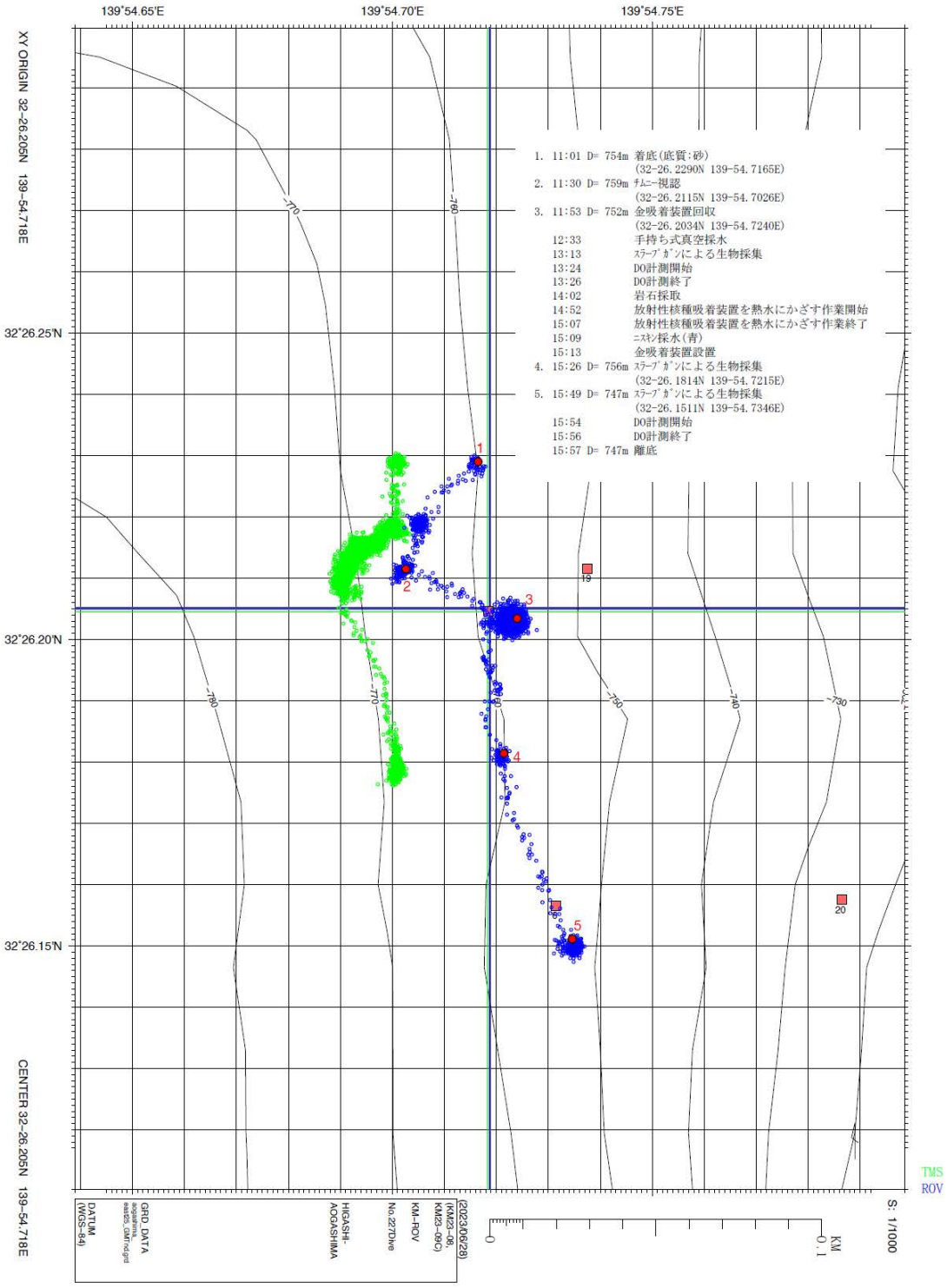

Fig. 3-4 ROV dive track of the dive KM-ROV#227 at Southeast (SE) Site.

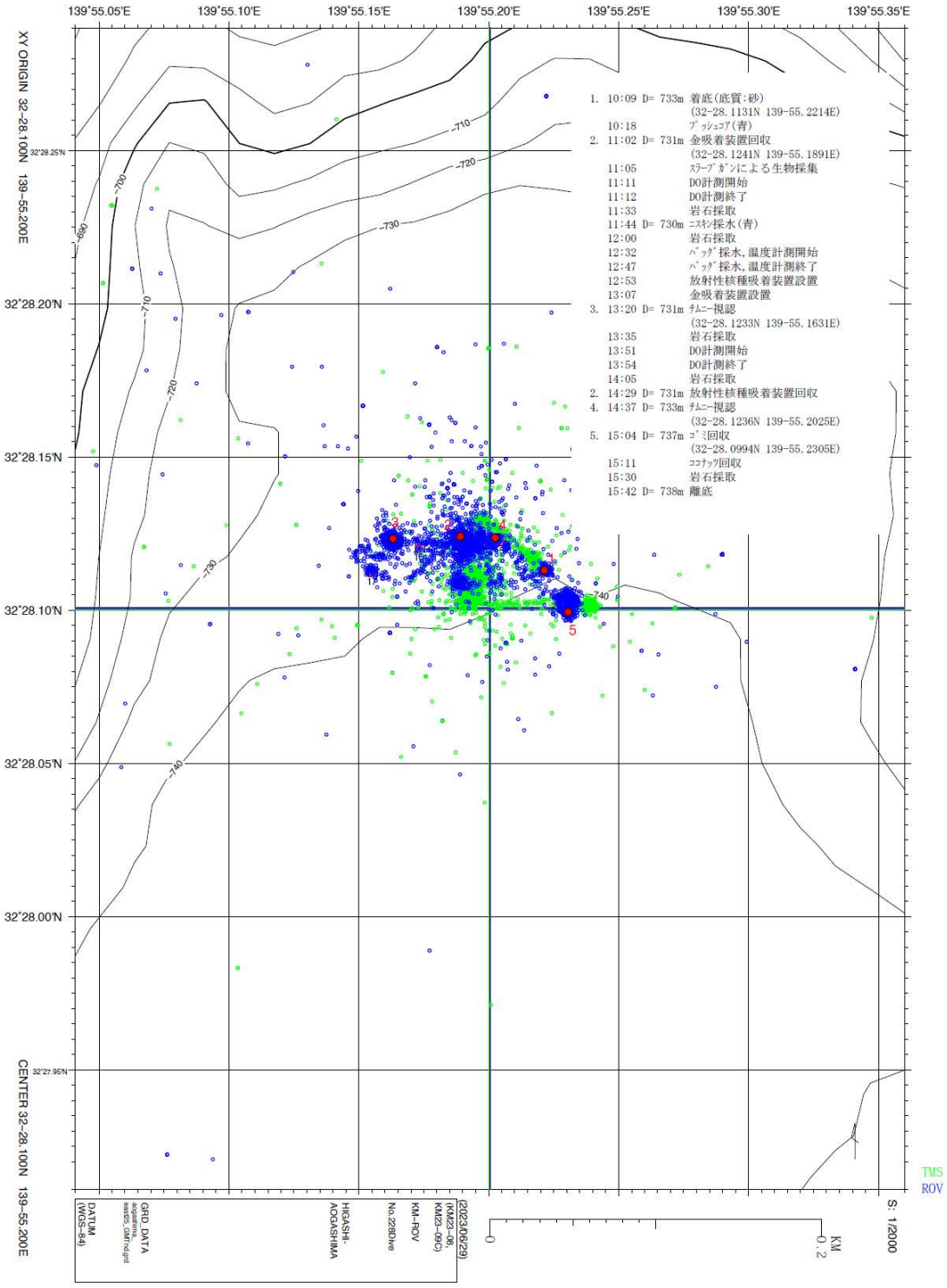

Fig. 3-5 ROV dive track of the dive KM-ROV#228 at East (E) Site.

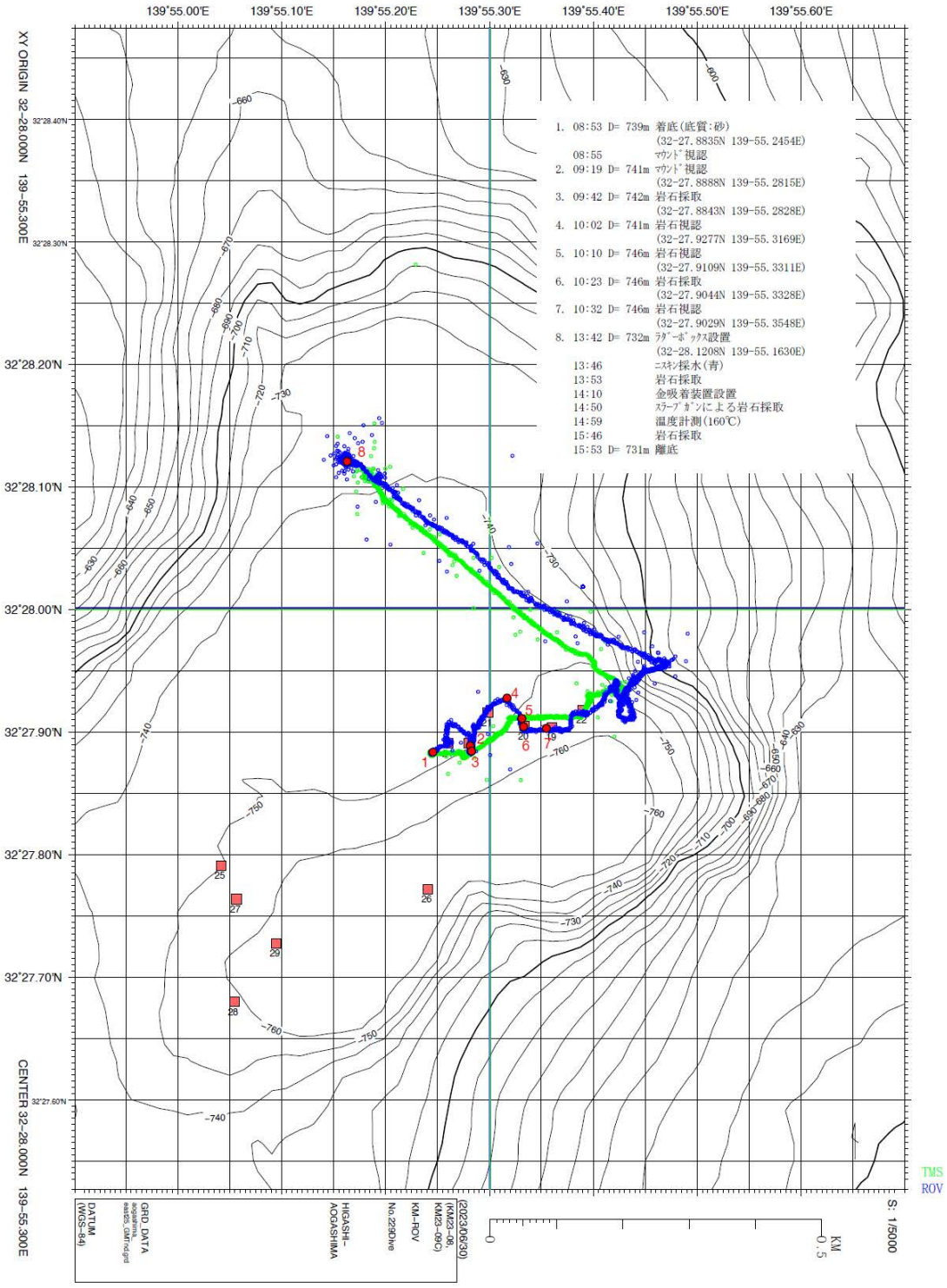

Fig. 3-6 ROV dive track of the dive KM-ROV#229 at East (E) Site (South of East (SOE) Site).

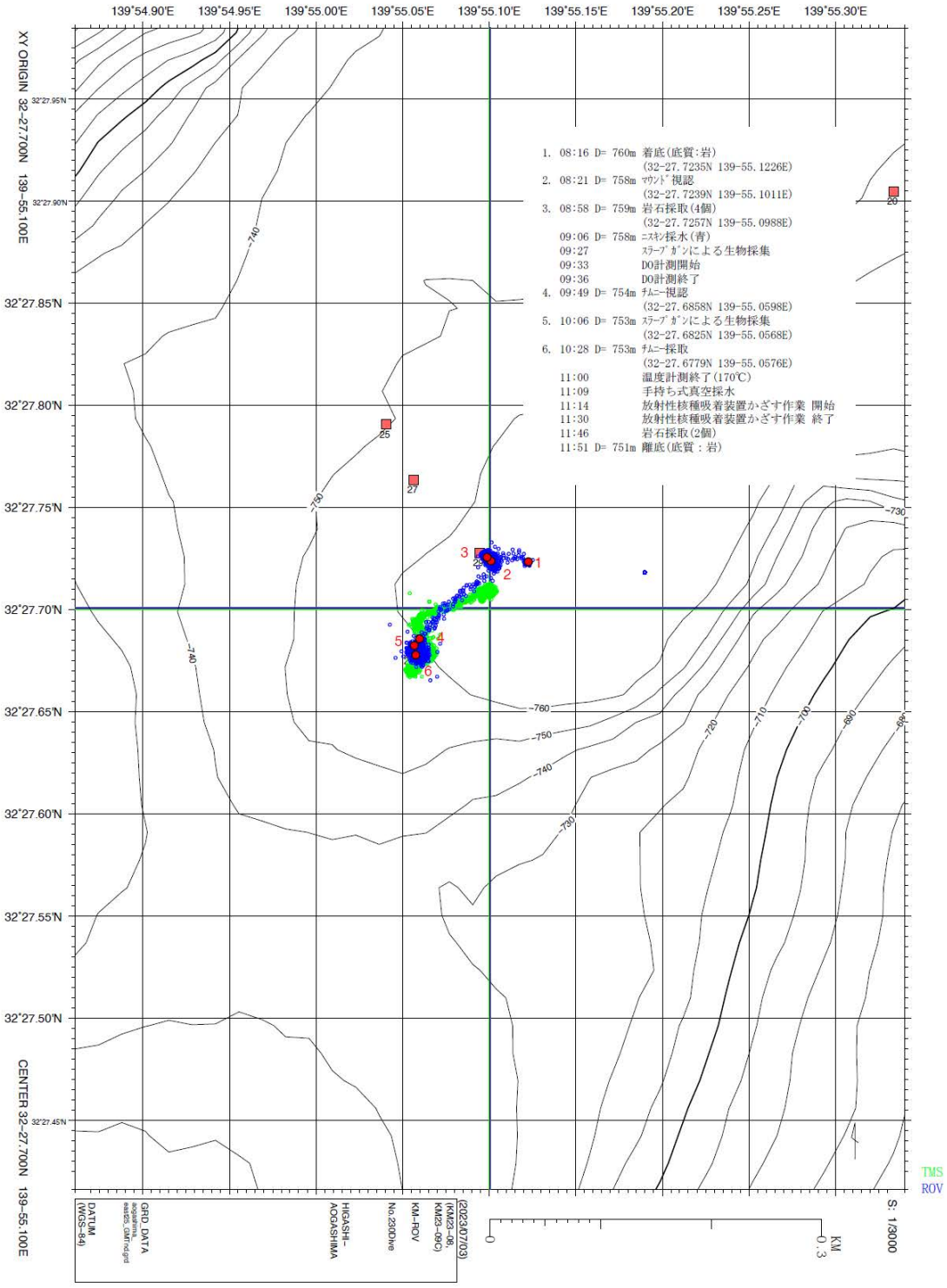

Fig. 3-7 ROV dive track of the dive KMROV#230 at East (E) Site (South of East (SOE) Site).

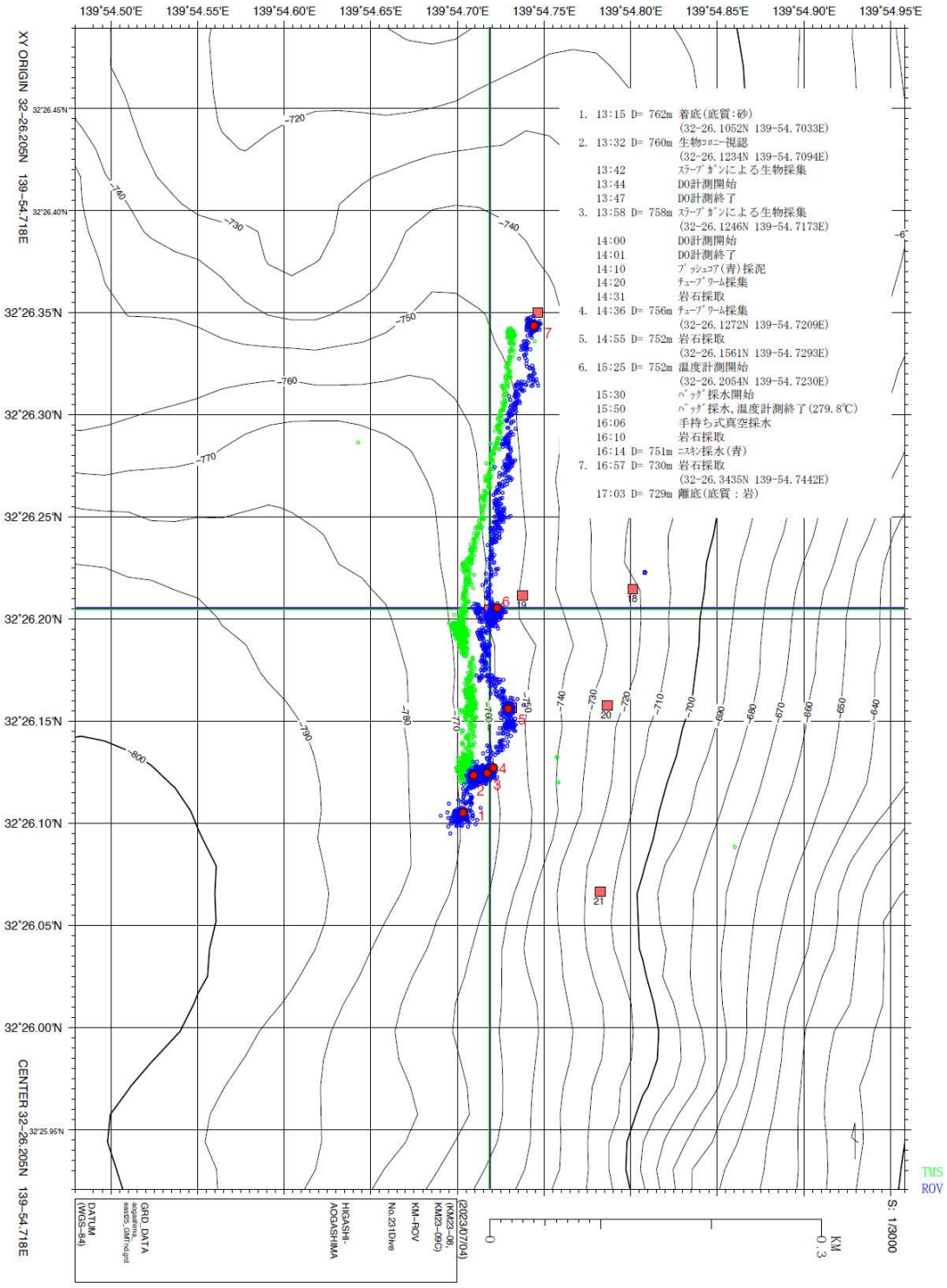

Fig. 3-8 ROV dive track of the dive KMROV#231 at Southeast (SE) Site.

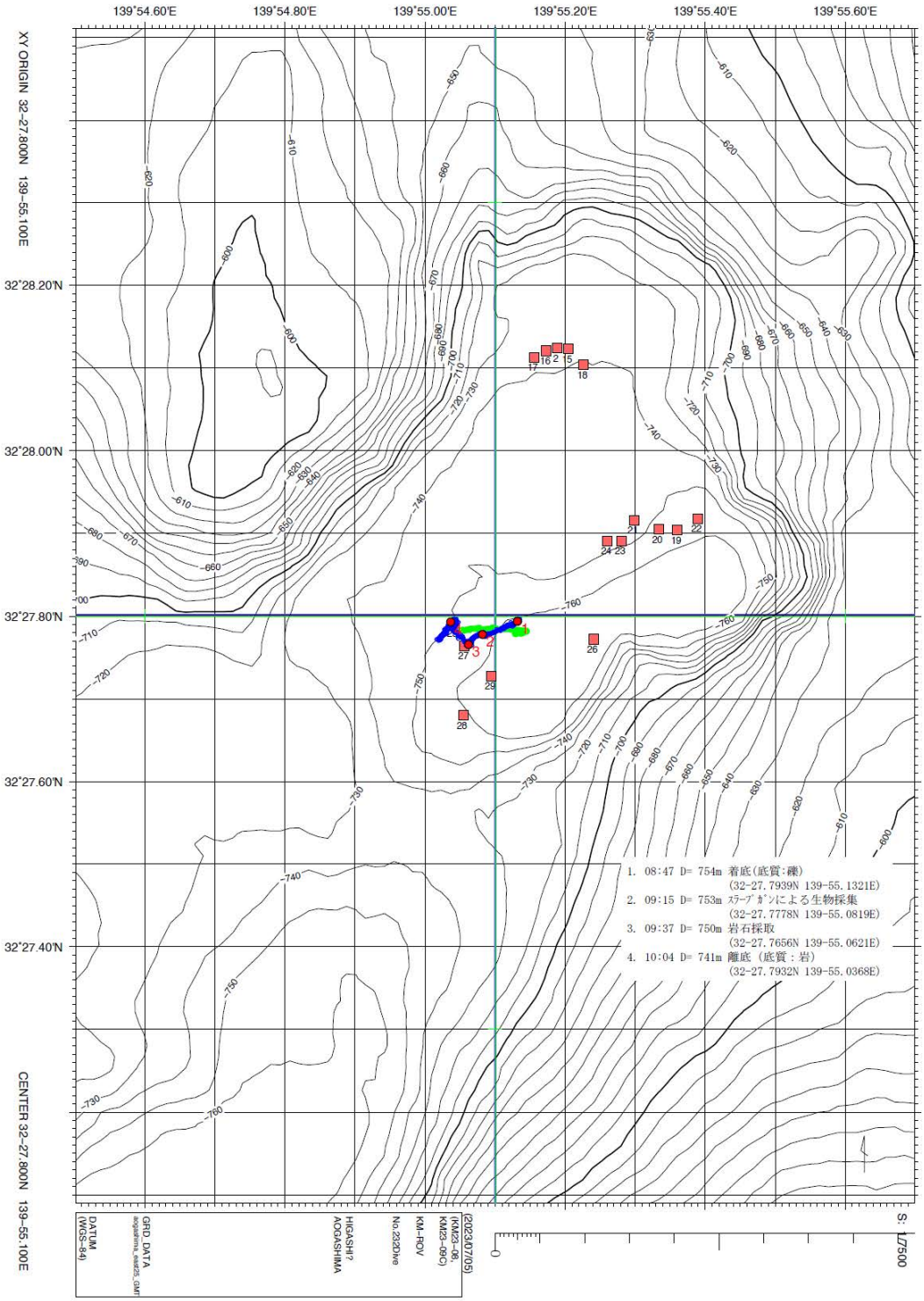

Fig. 3-9 ROV dive track of the dive KMROV#232 at East (E) Site (South of East (SOE) Site).

3.3 Cruise Log

日付 Date	時間 Local Time	内容 Note	本船位置／気象／海象 Noon Position Weather/Wind/Sea Condition
26-Jun-23	8:00	Scientists party onboard R/V KAIMEI	Off the west coast of BOSO penir
	9:00	Let go all shore line & left YOKOSUKA port	34-49.6N,139-39.9E
	10:00-11:10	Onboard lecture for evacuation and onboard life	Weather: o
	18:00-18:35	Researcher's meeting	Wind direction/force: South/2
	23:00	Arrived at research area(AOGASHIMA)	Wave scale: 1
	23:09	Let go XBT	Swell scale: 1
	23:28	Com'ced MBES Low speed ploom survey	Visibility(miles): 7
27-Jun-23	6:12	Finished MBES Low speed ploom survey	East AOGASHIMA knoll caldera
	8:37	Hoisted up "KM-ROV" #226	32-26.4N,139-53.8E
	8:42	Lounched "KM-ROV",then it dove & com'ced her operation #2	Weather: o
	9:18	"KM-ROV"breakaway	Wind direction/force: SSW/3
	9:26	"KM-ROV"landed on the sea bottom	Wave scale: 3
	15:55	"KM-ROV"left the sea bottom	Swell scale: 1
	16:03	"KM-ROV"combined	Visibility(miles): 8
	16:23	Hoisted up "KM-ROV"	
	16:29	Recovered "KM-ROV"& finished the operation	
	17:44	Com'ced MBES Low speed ploom survey	
	18:00-18:10	Researcher's meeting	
28-Jun-23	2:52	Finished MBES Low speed ploom survey	East AOGASHIMA knoll caldera
	10:21	Hoisted up "KM-ROV" #227	32-26.2N,139-54.6E
	10:27	Lounched "KM-ROV",then it dove & com'ced her operation #2	Weather: bc
	10:52	"KM-ROV"breakaway	Wind direction/force: West/4
	11:01	"KM-ROV"landed on the sea bottom	Wave scale: 4
	15:57	"KM-ROV"left the sea bottom	Swell scale: 1
	16:07	"KM-ROV"combined	Visibility(miles): 8
	16:30	Hoisted up "KM-ROV"	
	16:35	Recovered "KM-ROV"& finished the operation	
	18:00-18:10	Researcher's meeting	
	18:09	Com'ced MBES Low speed ploom survey	
29-Jun-23	4:36	Finished MBES Low speed ploom survey	East AOGASHIMA knoll caldera
	9:04	Hoisted up "KM-ROV" #228	32-28.1N,139-55.2E
	9:09	Lounched "KM-ROV",then it dove & com'ced her operation #2	Weather: bc
	9:59	"KM-ROV"breakaway	Wind direction/force: WSW/5
	10:09	"KM-ROV"landed on the sea bottom	Wave scale: 4
	15:42	"KM-ROV"left the sea bottom	Swell scale: 3
	15:48	"KM-ROV"combined	Visibility(miles): 8
	16:09	Hoisted up "KM-ROV"	
	16:14	Recovered "KM-ROV"& finished the operation	
	18:00-18:10	Researcher's meeting	
	22:27	Com'ced MBES Low speed ploom survey	
30-Jun-23	2:55	Finished MBES Low speed ploom survey	East AOGASHIMA knoll caldera
	3:08	Com'ced MBES mapping survey	32-27.9N,139-55.4E
	4:21	Finished MBES mapping survey	Weather: bc
	8:19	Hoisted up "KM-ROV" #229	Wind direction/force: SW/6
	8:25	Lounched "KM-ROV",then it dove & com'ced her operation #2	Wave scale: 4
	8:46	"KM-ROV"breakaway	Swell scale: 1
	8:53	"KM-ROV"landed on the sea bottom	Visibility(miles): 8
	15:53	"KM-ROV"left the sea bottom	
	16:01	"KM-ROV"combined	
	16:21	Hoisted up "KM-ROV"	
	16:27	Recovered "KM-ROV"& finished the operation	
	18:00-18:10	Researcher's meeting	
	17:15	Proceeded to off HACHIJOJIMA due to avoiding rough sea area	
	20:40	Arrived at HACHIJOJIMA & com'ced avoiding rough sea	
1-Jul-23	00:00-24:00	Avoiding rough sea at Off the coast of HACHIJOJIMA	Off the coast of HACHIJOJIMA
			33-07.1N,139-51.9E
			Weather: bc
			Wind direction/force: South/6
			Wave scale: 4
			Swell scale: 1
			Visibility(miles): 8

日付 Date	時間 Local Time	内容 Note	本船位置／気象／海象 Noon Position Weather/Wind/Sea Condition
2-Jul-23	4:00	Proceeding to research area(AOGASHIMA)	East AOGASHIMA knoll caldera
	7:20	Arrived at research area(AOGASHIMA)	32-26.2N,139-54.6E
	13:00	Poor sea conditions , canceled today's "KM-ROV" dive	Weather: bc
	14:07	Com'ced MBES ploom survey	Wind direction/force: WNW/5
	18:00-18:10	Researcher's meeting	Wave scale: 4
			Swell scale: 1
			Visibility(miles): 8
3-Jul-23	5:45	Finished MBES ploom survey	East AOGASHIMA knoll caldera
	7:16	Hoisted up "KM-ROV" #230	32-27.7N,139-55.0E
	7:21	Lounched "KM-ROV",then it dove & com'ced her operation #2	Weather: c
	7:56	"KM-ROV"breakaway	Wind direction/force: SSW/3
	8:16	"KM-ROV"landed on the sea bottom	Wave scale: 2
	11:51	"KM-ROV"left the sea bottom	Swell scale: 1
	11:55	"KM-ROV"combined	Visibility(miles): 6
	12:17	Hoisted up "KM-ROV"	
	12:22	Recovered "KM-ROV"& finished the operation	
	13:45	Com'ced MBES Low speed ploom survey	
	17:25	Finished MBES Low speed ploom survey	
	18:00-18:10	Researcher's meeting	
	18:20	Com'ced MBES mapping survey	
4-Jul-23	6:00	Finished MBES mapping survey	East AOGASHIMA knoll caldera
	12:33	Hoisted up "KM-ROV" #231	32-26.2N,139-54.7E
	12:39	Lounched "KM-ROV",then it dove & com'ced her operation #2	Weather: bc
	13:07	"KM-ROV"breakaway	Wind direction/force: NNE/5
	13:15	"KM-ROV"landed on the sea bottom	Wave scale: 3
	17:03	"KM-ROV"left the sea bottom	Swell scale: 1
	17:08	"KM-ROV"combined	Visibility(miles): 8
	17:27	Hoisted up "KM-ROV"	
	17:33	Recovered "KM-ROV"& finished the operation	
	18:00-18:05	Researcher's meeting	
	18:49	Com'ced MBES mapping survey	
5-Jul-23	5:56	Finished MBES mapping survey	East AOGASHIMA knoll caldera
	8:04	Hoisted up "KM-ROV" #232	32-26.6N,139-52.6E
	8:10	Lounched "KM-ROV",then it dove & com'ced her operation #2	Weather: c
	8:40	"KM-ROV"breakaway	Wind direction/force: SE/4
	8:47	"KM-ROV"landed on the sea bottom	Wave scale: 2
	10:04	"KM-ROV"left the sea bottom	Swell scale: 1
	10:08	"KM-ROV"combined	Visibility(miles): 8
	10:32	Hoisted up "KM-ROV"	
	10:38	Recovered "KM-ROV"& finished the operation	
	13:30-13:45	Researcher's meeting	
	15:50-15:54	MBES mapping survey	
	20:56	Com'ced MBES mapping survey	
6-Jul-23	4:00	Finished MBES mapping survey	East AOGASHIMA knoll caldera
	10:00	Poor sea conditions , canceled today's "KM-ROV" dive	32-41.5N,139-58.5E
	10:45	Left research area(AOGASHIMA) & Proceeded to YOKOSUKA	Weather: o
			Wind direction/force: SW/6
			Wave scale: 4
			Swell scale: 4
			Visibility(miles): 6
7-Jul-23		Arrived at YOKOSUKA, then completed voyage KM23-08,09C	

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