



NT11-15 Cruise Report

North and middle Okinawa Trough

August 14, 2011 – August 24, 2011

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

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1. Cruise Information

1.1 Cruise summary

1) Cruise ID: NT11-15

2) Name of vessel: Natsushima with *Hyper Dolphin 3K*

3) Title of the cruise: Research of submarine silicic volcanism, hydrothermal activities and subseafloor chemical environment in the Okinawa Trough

4) Cruise period: from August 14th (Yokosuka) to August 24th, 2011 (Naha)

5) Research area: Okinawa Trough (ship tracks are shown in Fig. 1)

6) Proposals:

S11-08: Submarine silicic volcanism and hydrothermal activity on the Tokara Islands (proposed by H. Yokose and others)

S11-88: Diversity of subseafloor chemical environment related with lateral flow of hydrothermal fluids within a sediment-hosted hydrothermal system (proposed by J. Ishibashi and others)

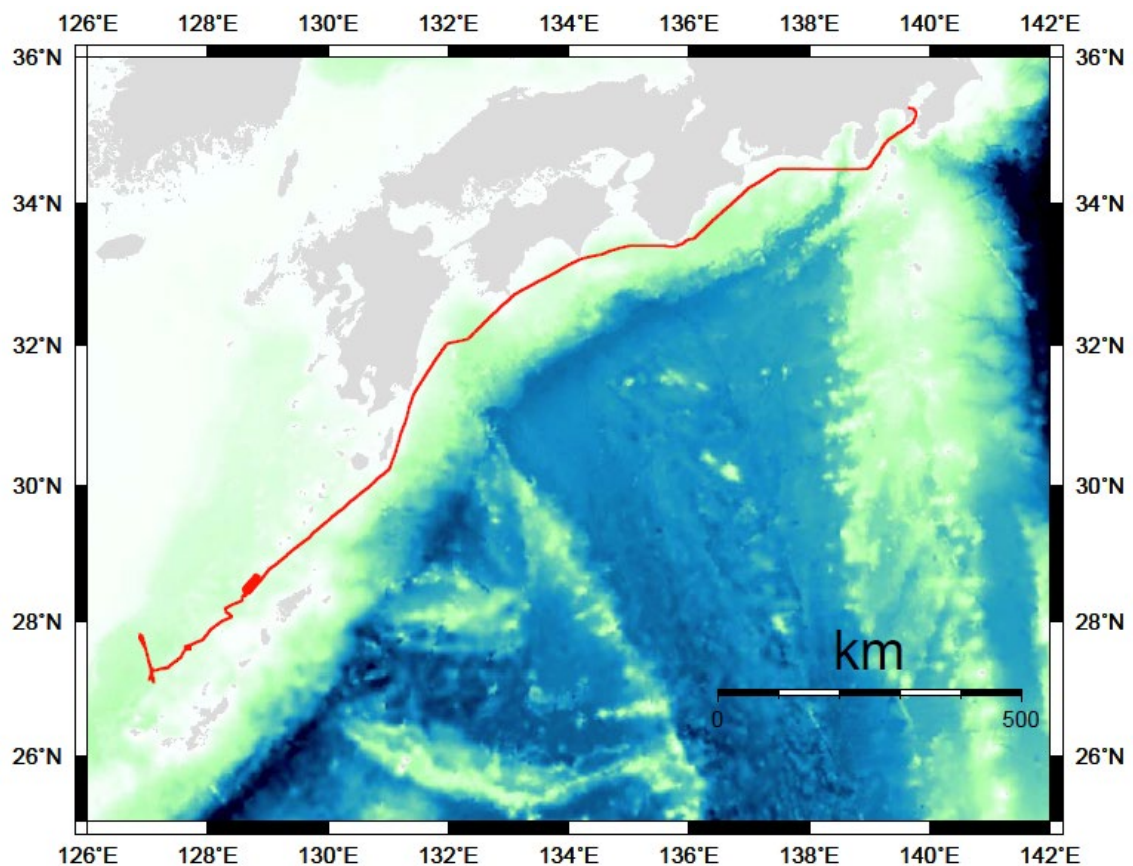


Fig. 1 Ship tracks during NT11-15 cruise conducted in the Okinawa Trough

1.2. List of members

<Science Party>

Chief scientist, Geochemist	Jun-ichiro ISHIBASHI (Kyushu Univ.)
Vice chief scientist, Geologist	Hisayoshi YOKOSE (Kumamoto Univ.)
Geochemist	Hiromi NAGASHIO (Okayama Univ.)
Geochemist	Yuji ONISHI (Okayama Univ.)
Geologist	Ryoto YOSHIZUMI (Univ. Tokyo)
Geologist	Shuntaro KANAMORI (Univ. Tokyo)
Geochemist	Shinsuke KAWAGUCCI (JAMSTEC)
Microbiologist	Mitsuhiro Yoshida (JAMSTEC)

<Crew >

Captain	YOSHIYUKI NAKAMURA
Chief Officer	AKIHISA TSUJI
2nd Officer	ISAO MAEDA
3rd Officer	KAZUKI MIYAKE
Chief Engineer	EIJI SAKAGUCHI
1st Engineer	WATARU KUROSE
2nd Engineer	SABURO SAKAEMURA
3RD Engineer	SHOTA NAGANO
Chief Radio Officer	MASAMOTO TAKAHASHI
2nd Radio Officer	MICHIYASU KATAGIRI
3rd Radio Officer	SHINTA TAKAKUWA
Boat Swain	HATSUO ODA
Able Seaman	HIDEO ISOBE
Able Seaman	NAOKI IWASAKI
Able Seaman	TAKUYA MIYASHITA
Sailor	TORU NAKANISHI
Sailor	JUN SHINODA
Sailor	RYOMA TAMURA
No1.Oiler	SEIICHI MATSUDA
Oiler	KAZUO ABE
Oiler	SHINYA SUGI
Oiler	YUJI HIGASHIGAWA
Oiler	SHOTA SHIMOHATA
Chief Steward	ISAO MATSUMOTO
Steward	YOSHINOBU HASATANI

Steward	KIYOTAKA KOSUJI
Steward	MASARU TAKADA
Steward	TAKUMI YAMADA
<HPD Team>	
Chief ROV Operator	YOSHINARI ONO
ROV Operator	KAZUKI IJIMA
ROV Operator	KATSUSHI CHIBA
ROV Operator	HOMARE WAKAMATSU
ROV Operator	TEPPEI KIDO
ROV Operator	ATSUSHI TAKENOUCI
<NME Marine Technician>	
Chief Marine Technician	MASASHI ITO

1.3 Shipboard log

NT11-15 Shipboard Log
(14.August.2011-24.August.2011)

Date	Local Time	Note	Position/Weather/Wind/Sea condition
14.Aug.2011	9:00	Let go all shore line,left YOKOSUKA.	08/14 12:00(UTC+9h)
	10:00-1020	Meeting for HPD operation.	34-58.4N,139-29.6E
	10:30-11:15	Onboard education and safety training.	Fine but cloudy
	13:00-13:40	Meeting for MBES operation.	SW-4(moderate breeze)
	16:40	KONPIRA SANPAI	2(sea smooth)
			1(Low swell sea)
			Visibly:4
15.Aug.2011	08:00-09:45	Meeting for HPD operation.	08/15 12:00(UTC+9h)
	15:00-16:00	Scientists meeting.	33-24.4N,135-30.7E
			cloudy
			SW-4(moderate breeze)
			2(sea smooth)
			1(Low swell sea)
			Visibly:6
16.Aug.2011	9:00-10:15	Science seminar.	08/16 12:00(UTC+9h)
			31-47.0N,131-46.8E
			Fine but cloudy
			SW-3(gentle breeze)
			2(sea smooth)
			1(Low swell sea)
			Visibly:8
17.Aug.2011	09:00-10:00	Scientists meeting.	08/17 12:00(UTC+9h)
	12:57	Com'ced MBES mapping survey.	28-50.7N,129-08.2E
	22:05	Released XBT at 28-22.6768N 128-36.7157E	Fine but cloudy
			SSW-5(fresh breeze)
			4(sea moderate)
			2(Low swell long)
			Visibly:8
18.Aug.2011			08/18 12:00(UTC+9h)
			28-50.7N,129-08.2E
			Fine but cloudy
			SSW-5(fresh breeze)
			4(sea moderate)
			2(Low swell long)
			Visibly:8
19.Aug.2011		HPD#1310	08/19 12:00(UTC+9h)
	2:02	Finished MBES.	27-15.9N,127-04.5E
	3:15	Stop'd eng.com'ced drifting.	Fine but cloudy
	5:30	Finished drifting.com'ced proceeding to dive point.	South-2(light breeze)
	6:00	Arrived at dive point.	2(sea smooth)
	6:06	Released XBT at 27-16.2538N 127-03.9025E	1(Low swell sea)
	8:23	Hoisted up H.P.D.	Visibly:8
	8:28	Launched H.P.D. on the surface.	
	8:41	H.P.D. dove & started her operation #1310.	
	9:29	H.P.D. lauded on sea bottom.(D=1571m)	
	15:51	H.P.D. left the sea bottom(D=1338m)	
	16:28	H.P.D. floated	
	16:28	Hoisted up H.P.D.	
16:45	Recovered H.P.D & finished above operation		
18:39	Stoped end,commenced drifting		
20.Aug.2011		HPD#1311	08/20 12:00(UTC+9h)
	4:30	Finished drifting.	27-14.9N,127-04.0E
	8:18	Hoisted up H.P.D.	Fine but cloudy
	8:22	Launched H.P.D. on the surface.	SW-2(light breeze)
	8:34	H.P.D. dove & started her operation #1311.	2(sea smooth)
	9:27	H.P.D. lauded on sea bottom.(D=1635m)	1(Low swell sea)
	15:49	H.P.D. left the sea bottom(D=1632m)	Visibly:8
	16:36	H.P.D. floated	
	16:45	Hoisted up H.P.D.	
	16:51	Recovered H.P.D & finished above operation	
	17:00	Proceeded to IHEYA NORTH SEA KNOLL.	
19:45	Stopped end,commenced drifting		

21.Aug.2011		HPD#1312	08/21 12:00(UTC+9h)
	5:50	Arrived at IHEYA NORTH CAULDRON.	27-47.4N,126-53.8E
	5:51	Finished drifting.	Fine but cloudy
	5:56	Released XBT at 27-47.7610N,126-54.2662E.	WSW-3(gentle breeze)
	8:20	Hoisted up H.P.D.	2(sea smooth)
	8:24	Launched H.P.D. on the surface.	1(Low swell sea)
	8:37	H.P.D. dove & started her operation #1312.	Visibly:8
	9:16	H.P.D. lauded on sea bottom.(D=1054m)	
	16:02	H.P.D. left the sea bottom(D=1044m)	
	16:35	H.P.D. floated	
	16:45	Hoisted up H.P.D.	
	16:51	Recovered H.P.D & finished above operation	
	17:00	Proceeded to IZENA CAULDRON.	
	21:00	Stopped end,commenced drifting.	
22.Aug.2011		HPD#1313	08/22 12:00(UTC+9h)
	0:00	Finished drifting.	27-14.7N,127-04.0E
	9:06	Hoisted up H.P.D.	Fine but cloudy
	9:12	Launched H.P.D. on the surface.	South-4(moderate breeze)
	9:23	H.P.D. dove & started her operation #1313.	2(sea smooth)
	10:16	H.P.D. lauded on sea bottom.(D=1627m)	1(Low swell sea)
	16:21	H.P.D. left the sea bottom(D=1623m)	Visibly:8
	17:08	H.P.D. floated	
	17:17	Hoisted up H.P.D.	
	17:24	Recovered H.P.D & finished above operation	
	19:30	Stopped end,commenced drifting.	
23.Aug.2011		HPD#1314	08/23 12:00(UTC+9h)
	5:50	Finished drifting.	27-15.6N,127-04.1E
	13:18	Hoisted up H.P.D.	Fine but cloudy
	13:23	Launched H.P.D. on the surface.	South-4(moderate breeze)
	13:34	H.P.D. dove & started her operation #1314.	2(sea smooth)
	14:38	H.P.D. lauded on sea bottom.(D=1548m)	1(Low swell sea)
	18:00	H.P.D. left the sea bottom(D=1403m)	Visibly:8
	18:41	H.P.D. floated	
	18:50	Hoisted up H.P.D.	
	18:57	Recovered H.P.D & finished above operation	
	19:05	Com'ced proceeding to NAHA.	
24.Aug.2011	9:00	Sent out 1st shore line,then arrived NAHA.	

2. Outline of the proposals

2.1 Submarine silicic volcanism and hydrothermal activity on the Tokara Islands (Proposal S11-08 by Hisayoshi Yokose, Graduate School Science and Technology, Kumamoto University)

Amami caldera is a one of four silicic huge submarine calderas along the volcanic front of the northern Ryukyu arc (Yokose, 2007; Yokose et al., 2010). The caldera is consists of two depressions with central domes. Total volume of the depressions is about 80km³, which is compare to that of Kikai caldera. Geological information on Amami caldera has been obtained by dredge surveys. Lava domes occurred around the calderas are made up of vesiculated rhyolite. The Rhyolitic rocks recovered from the submarine domes are considered to be younger than Pleistocene. One of the submarine lava domes occurs Fe-Mn oxide crusts rich in As, suggesting volcanogenic hydrothermal activities in the caldera. These observations appear to be important not only to mitigate the hazard of submarine volcanic eruption, but also to explore hydrothermal ore deposits at the northern Ryukyu arc and Okinawa trough.

Although bathymetric maps of the north to middle Ryukyu arc is published by the Japan coast guard, the resolution is insufficient to geomorphological investigation of eruption styles based on the topographic characteristics such as shape of lava flows and volcanic cone, much less to recognize the spatial relationships between volcanic activities and hydrothermal vent positions. In order to solve the problems, a high resolution bathymetric maps and, if possible, sidescan images are inevitable. It will possible to delineate the small scale topographic characteristics and indicate the distribution area of volcanic edifices and some valuable sites for hydrothermal active region.

To understand the small scale topographic characteristics, bathymetric survey with narrow multibeam sonar system, SEABAT8160 hull-mounted on R/V Natsushima, was proposed as proposal S11-08. Bathymetric survey on the volcanic cones aligned at the volcanic front is not only efficient management of the ship time of NT11-15, but also important to explore a volcanogenic hydrothermal ore deposit. For instance, a large crater ~2km in diameter on the summit, which was expressed as a simple conical mound without crater even in a public bathymetric map have discovered from one of the volcanic cones, named NE-Izena. ROV-HPD investigations during NT10-16 cruise confirmed that NE-Izena has active hydrothermal vents on the northern crater wall. The other example is recovery of volcanogenic hydrothermal Fe-Mn oxide crusts from the summit of Daiichi Tokuno-shima cone. Perhaps the other cones at the volcanic front

are indicated as a simple conical shape without a crater due to the lower resolution of a bathymetric map. Therefore they are expected to find a crater by obtaining a precise bathymetric map.

2.2 Diversity of subseafloor chemical environment related with lateral flow of hydrothermal fluids within a sediment-hosted hydrothermal system (Proposal S11-88 by Jun-ichiro Ishibashi, Faculty of Science, Kyushu University)

In June 2011, TAIGA11 Expedition was conducted to investigate subseafloor environment below active hydrothermal fields by direct access using a shallow drilling system (called as BMS). The expedition focused on a subseafloor hydrothermal fluid circulation system that develops in sediment consists of volcanoclastic and hemipelagic materials and three active hydrothermal fields at Iheya North Knoll ($27^{\circ}47'N$, $126^{\circ}54'E$), at Izena Cauldron Jade site ($27^{\circ}16'N$, $127^{\circ}05'E$) and at Izena Cauldron Hakurei site ($27^{\circ}15'N$, $127^{\circ}04'E$) were selected as exploration targets.

To access a fluid circulation system from the seafloor side complementing the previous drilling study, ROV dive survey was proposed as S11-88. Subseafloor chemical environment within sediment layer would be affected by subseafloor lateral hydrothermal fluid flow, and in turn should control metabolic responses and biological processes of microbial communities and formation of hydrothermal precipitates. Observation of the cased holes and extensive samplings of hydrothermal fluids, ore deposits, and sediment was proposed to conduct geochemical, mineralogical and microbiological studies.

3. Record of surveys

3.1 Bathymetric survey

During the NT11-15 cruise, Aug. 17 to Aug. 18, bathymetric surveys were carried out using the SEABAT8160 hull-mounted narrow multibeam system on the R/V Natsushima. The first target was Amami caldera area. Total length of the survey lines was 184 miles as shown in Fig. 2. The second target was summit region of volcanic cones at the volcanic front of the middle Ryukyu arc shown. Total length of the survey lines was 124 miles as shown in Fig. 3.

The SEABAT8160 system is a 50 kHz echo sounder with 126 beams per ping in the cross-track direction and has swath width of 150 degree. The swath width and spatial resolution are a function of water depth. The quality of the obtained bathymetry depends mostly on the sea state, which had been very good during this cruise. Raw data were processed by software package of CARIS on board. To maintain the quality of bathymetric data, ship speed was changed depending on wave direction. Heading to the NE, the ship speed was at 10 kt and to the SW it was at 6kt.

Noise correction of the bathymetric data has finished just before disembarkation. Therefore detailed geomorphological study could not proceed. In spite of that, obtained precise bathymetric image indicates two important findings: (1) Amami caldera has complicated volcanic history related to the regional tectonic movements, and (2) two other cones with a large crater similar to the NE-Izena cone are identifiable. Further geomorphological investigations probably allow us to comprehensive understanding of the submarine volcanism at the volcanic front of the middle to north Ryukyu arc. Hence they will lead us to submarine locations of valuable hydrothermal ore deposits.

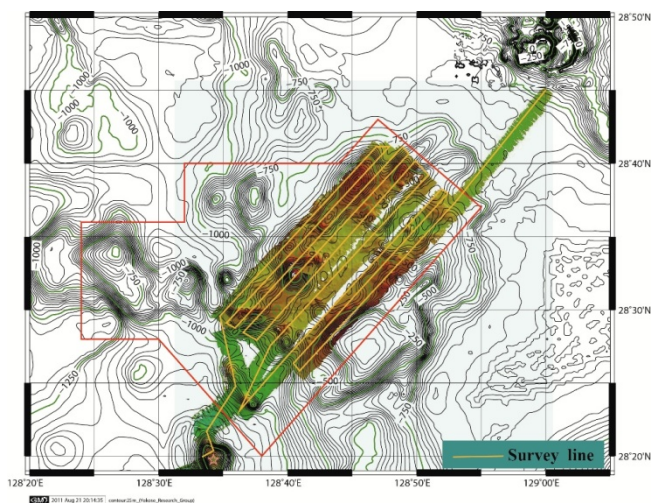


Fig. 2 Bathymetric survey of Amami caldera area

NT11-15 CRUISE

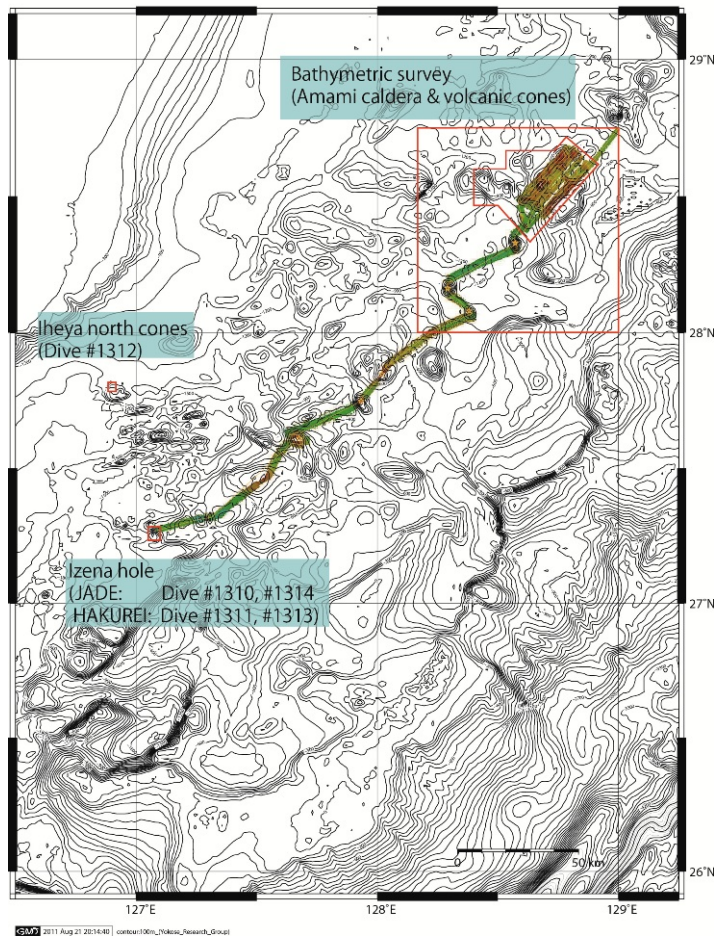


Fig. 3 Topographic map showing target areas of bathymetric surveys and of ROV dive surveys

3.2 ROV dive survey

During NT11-15 cruise, five dives of ROV *Hyper Dolphin* were conducted as summarized in Table 1 and Fig. 4. During the first dive (HD1310), the cased hole BMS-J-1 which was drilled during the previous TAIGA 11 cruise was witnessed. However, this was the only one accomplishment of the mission to relocation of the drilled holes.

During the five dives, samples of hydrothermal fluids, hydrothermal sediment, and hydrothermal precipitates were extensively collected as summarized in Table 1. They will be provided for chemical analysis as well as microbial and mineralogical analysis.

Table 1 Summary of ROV dives during NT11-15

dive	date	landing	takeoff	area	latitude	longitude	depth	samples
1310	8/19	8:41	16:28	Izena Hole (Jade Field)	27°16.0'N	127°05.0'E	1571 m	W1-W3, B1-B3, G01-G08, MB, MR
1311	8/20	8:34	16:36	Izena Hole (Hakurei Field)	27°15.0'N	127°04.0'E	1635 m	W1-W2, B1, G01-G08
1312	8/21	8:37	16:35	Iheya North Knoll	27°47.4'N	126°53.9'E	1058 m	W1-W4, B1-B3, S, G01-G05, MR
1313	8/22	9:23	16:11	Izena Hole (Hakurei Field)	27°15.0'N	127°04.0'E	1634 m	W1-W4, B1-B2, S1, G01-G05, MR, MB
1314	8/23	13:34	18:41	Izena Hole (Jade Field)	27°16.0'N	127°05.0'E	1548 m	W1, G01-G05, MB

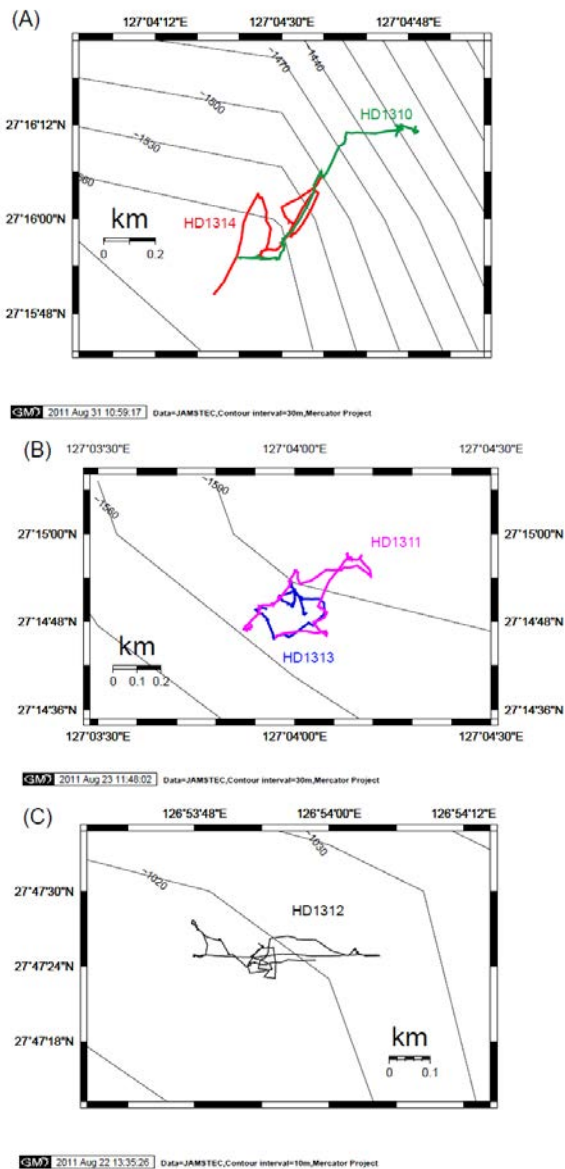


Fig. 4 Dive tracks of ROV *Hyper Dolphin* imposed on topographic maps. (A) Hakurei field in the Izena hole (B) Jade field in the Izena hole (C) Iheya North knoll

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

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