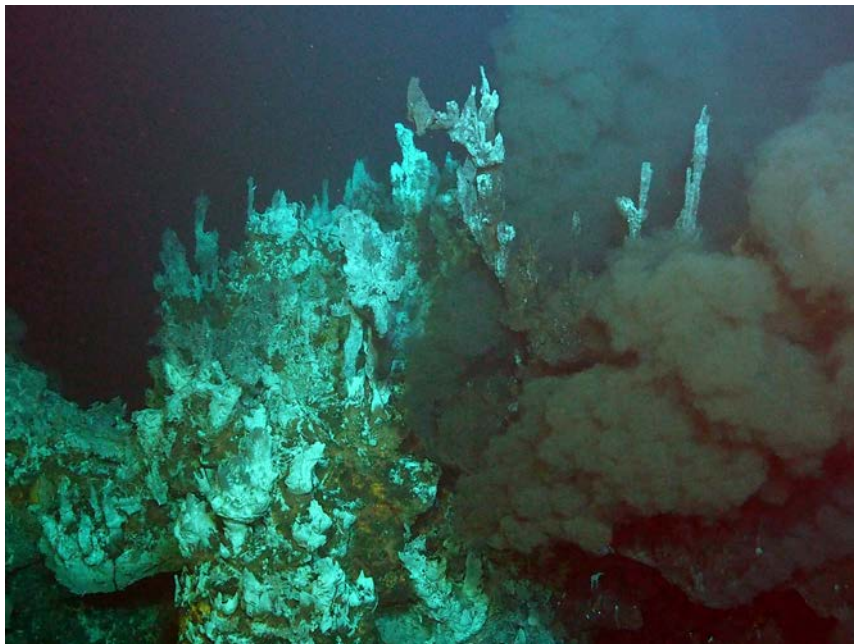


**Kairei Cruise Report**  
**KR16-16**  
**Cross-ministerial Strategic Innovation Promotion Program (SIP)**  
**Next-Generation Technology**  
**for Ocean Resources Exploration**

**Seeking and Hunting the Hydrothermal  
Activities in Southern Okinawa Trough**



**18th November 2016, Naha – 5th December 2016, Kagoshima**

**Japan Agency for Marine-Earth Science & Technology**  
**(JAMSTEC)**

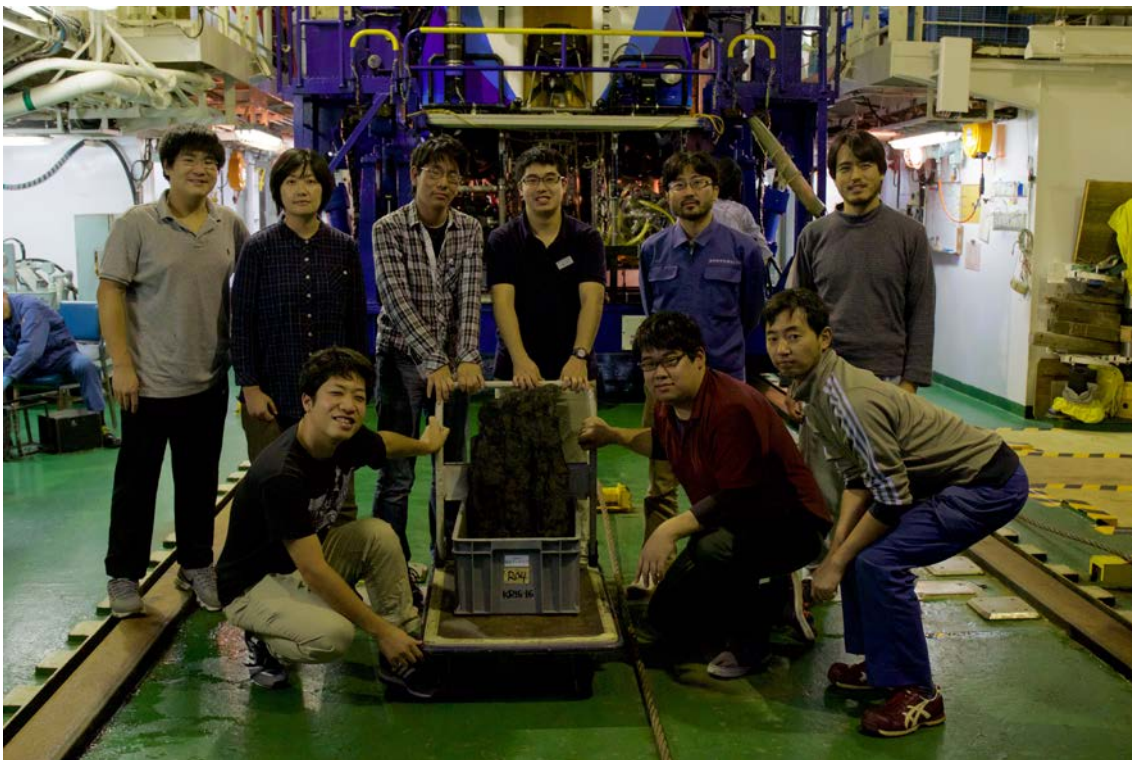
## Acknowledgements

We are grateful to Captain Mr. E. Ukekura, Chief Officer Mr. Y. Sammori and Chief Engineer Mr. E. Sakaguchi for their safe navigation and their skillful handling of “R/V Kairei”. Great thanks are due to Commander Mr. H. Wakamatsu and “Kaiko” operation team for their operations in sampling. We also thank Mr. Y. Hashimoto, Nippon Marine Enterprise, Ltd., for his attentive supports.

We thank all the JAMSTEC personnel who have supported us.

Finally, we would like to appreciate all the person who supported directly or indirectly this cruise.

This cruise was conducted under an umbrella of “Zipangu in the Ocean”, Next-Generation Technology for Ocean Resources Exploration, one of the Project as Cross-ministerial Strategic Innovation Promotion Program (SIP).



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## **Captain and crews of the R/V Kairei**

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Captain	EIKO UKEKURA
Chief Officer	YASUHIKO SAMMORI
2nd Officer	HIDEHIKO KONNO
3rd Officer	KEIJI ITAHASHI
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Quarter Master	NOBUYUKI ICHIKAWA
Quarter Master	YOSHIAKI MATSUO
Quarter Master	DAISUKE YANAGITANI
Sailor	TAKUMI MIURA
No.1 Oiler	YUKIHIRO YAMAGUCHI
Oiler	EIJI ARATAKE
Oiler	YUJI HIGASHIKAWA
Oiler	MASAKI TANAKA
Assistant Oiler	TORU HIDAKA
Chief Steward	TOYONORI SHIRAISHI
Steward	TORU MURAKAMI
Steward	KOICHIRO KASHIWAGI
Steward	MAO KIKUCHI

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Submersible Op. Manager	HOMARE WAKAMATSU
2/Submersible Tec. Officer	KEN YATSU
2/Submersible Tec. Officer	KIYOSHI TAKISHITA
2/Submersible Tec. Officer	TETSUYA ISHITSUKA
2/Submersible Tec. Officer	SEIJI SHIGETAKE
2/Submersible Tec. Officer	YUDAI SAKAKIBARA
2/Submersible Tec. Officer	SHOTA IHARA
2/Submersible Tec. Officer	TAKUMA GOTO

## Shipboard Log of KR16-16

Date	Local Time	Note	Description	Position/Weather/Wind /Sea condition
18 Nov 2016	08:00	Scientists onboard.		South of KUMEJIMA
	09:00	Let go all shore lines & left NAHA for research area		25-51.1N,127-01.8E
		(South OKINAWA Trough YOKOSUKA Site)		Fine but cloudy
	10:00-10:30	Carried out education & training for scientists.		SE-3 (Gentle breeze)
	10:40-11:00	Carried out education (KAIKO) for scientists.		2 (Smooth)
	16:40-17:00	Konpira ceremony		1 (Low swell)
	18:00-19:00	Scientist meeting.		Visibly : 8'
	~23h	Arrived at research area (Southern OKINAWA Trough YOKOSUKA Site)		
19 Nov 2016	00:04	Released XBT at 25-16.9584N, 124-27.6796E		Southern OKINAWA Trough
	01:37-04:50	Carried out MBES plume survey		YOKOSUKA Site
	05:45-05:58	Carried out MBES mapping survey (Pre-dive survey)		25-15.9N,124-22.3E
	08:31	Hoisted up 'KAIKO Mk-IV'		Fine but cloudy
	08:36	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #715(26)		SSE-3 (Gentle breeze)
	10:34	'KAIKO Mk-IV' landed on the sea bottom (D=2,178m)		2 (Smooth)
	15:00	'KAIKO Mk-IV' left the sea bottom (D=2,190m)		1 (Low swell)
	16:46	Hoisted up 'KAIKO Mk-IV'		
	16:55	Recovered 'KAIKO Mk-IV' & finished her operation		
	17:30	Proceeded to next research area (FUTAGOYAMA Site)		
	18:44	Com'ced MBES mapping survey		
	19:00-19:30	Scientist meeting.		
20 Nov 2016	01:34	Finished MBES mapping survey		Southern OKINAWA Trough
	04:35-04:56	Carried out eight figure turn		FUTAGOYAMA Site
	05:50	Arrived at research area (FUTAGOYAMA Site)		24-49.1N,123-16.8E
	05:56	Released XBT at 24-48.0182N, 123-16.3527E		Rain
	06:19-06:28	Carried out MBES mapping survey (Pre-dive survey)		NE-5 (Fresh breeze)
	08:31	Hoisted up 'KAIKO Mk-IV'		3 (Slight)



	08:37	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #716(27)		1 (Low swell)
	10:35	KAIKO Mk-IV' landed on the sea bottom (D=1,735m)		Visibly : 8'
	14:26	KAIKO Mk-IV' left the sea bottom (D=1,567m)		
	15:43	Hoisted up 'KAIKO Mk-IV'		
	15:52	Recovered 'KAIKO Mk-IV' & finished her operation		
	16:37-16:46	Carried out MBES site survey		
	17:15	Com'ced MBES mapping survey		
21 Nov 2016	02:01	Finished MBES mapping survey		Southern OKINAWA Trough
	02:25-02:45	Carried out eight figure running		FUTAGOYAMA Site
	08:36	Hoisted up 'KAIKO Mk-IV'		24-52.1N,123-18.5E
	08:42	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #717(28)		Overcast
	10:10	KAIKO Mk-IV' landed on the sea bottom (D=1,381m)		NE-5 (Fresh breeze)
	14:50	KAIKO Mk-IV' left the sea bottom (D=1,286m)		4 (Moderate)
	15:57	Hoisted up 'KAIKO Mk-IV'		1 (Low swell)
	16:05	Recoverd 'KAIKO Mk-IV' & finished her operation		Visibly : 8'
	16:40	Proceeded to next rersarch area (YOKOSUKA Site)		
	17:15	Com'ced MBES mapping survey		
22 Nov 2016	01:36	Finished MBES mapping survey		South OKINAWA Trough
	05:00	Arrived at researvch area (YOKOSUKA Site)		YOKOSUKA Site
	07:31	Hoisted up 'KAIKO Mk-IV'		25-15.9N,124-22.4E
	07:40	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #718(29)		Cloudy
	09:33	KAIKO Mk-IV' landed on the sea bottom (D=2,199m)		NE-5 (Fresh breeze)
	13:14	KAIKO Mk-IV' left the sea bottom (D=2,156m)		3 (Slight)
	14:53	Hoisted up 'KAIKO Mk-IV'		1 (Low swell)
	15:01	Recoverd 'KAIKO Mk-IV' & finished her operation		Visibly : 8'
	15:45	Left resarch area for NAGURA WAN due to avoiding rough sea		
	19:30	Let go starboard anchor in 51m of water at Ishigaki jima Nagura Wan		
23 Nov 2016		Anchoring at NAGURA WAN, ISHIGAKI JIMA		NAGURA WAN
				24-24.2N,124-05.9E
				Rain

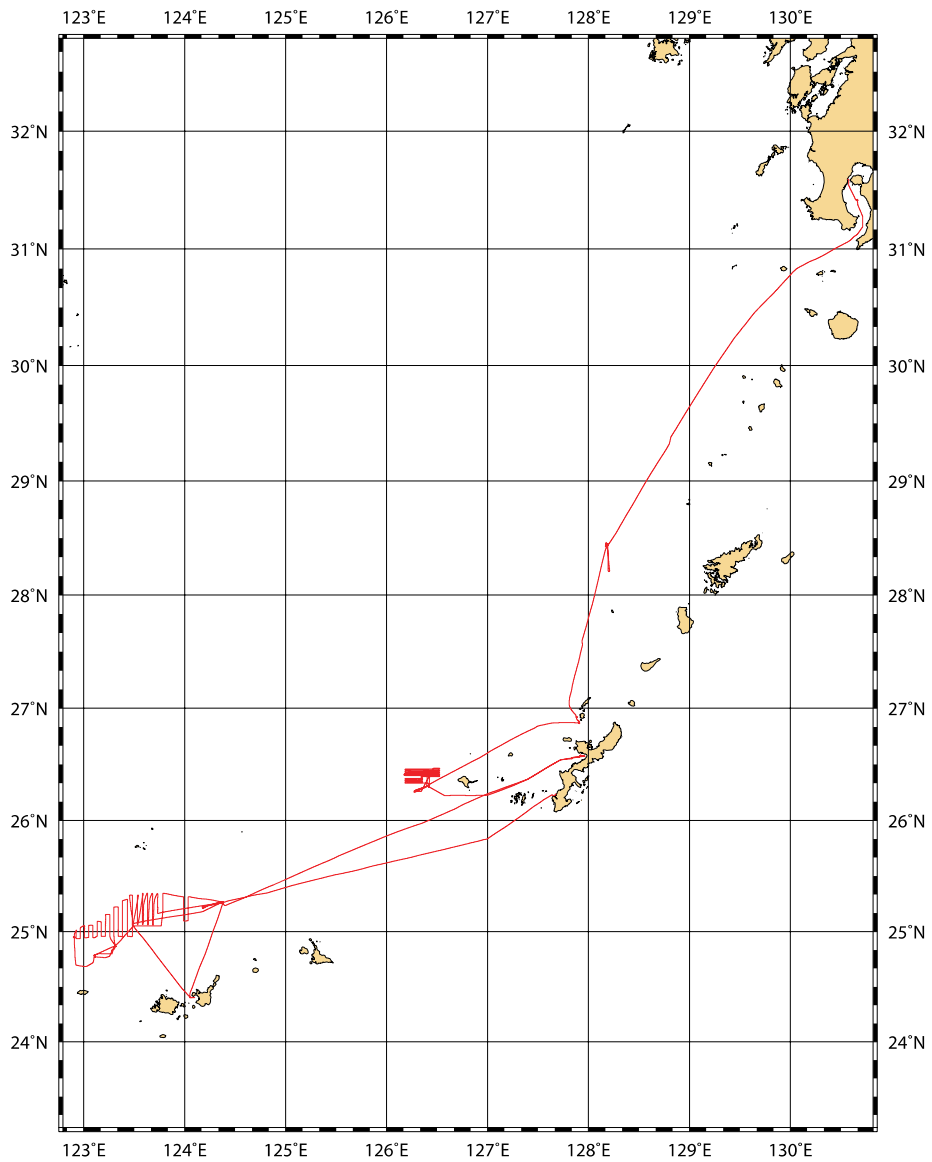
				NE-7 (Near breeze)
				3 (Slight)
				1 (Low swell)
				Visibly : 6'
24 Nov 2016		Anchoring at NAGURA WAN, ISHIGAKI JIMA		NAGURA WAN
	17:30- 18:00	Scientist meeting.		24-24.2N,124-05.9E
				Overcast
				NNE-6 (Strong breeze)
				3 (Slight)
				1 (Low swell)
				Visibly : 8'
25 Nov 2016	06:00	Up & down starboard anchor for research area (South Okinawa Trough)		South of SENKAKU Islands
	09:50	Arrived at research area (South Okinawa Trough)		25-17.7N,123-28.9E
	09:55	Released XBT at 25-02.0723N, 123- 30.2223E		Cloudy
	11:46	Com'ced MBES mapping survey		ENE-6 (Strong breeze)
				5 (Rough)
				3 (Moderate short)
				Visibly : 8'
26 Nov 2016	03:31	Finished MBES mapping survey		South OKINAWA Trough
	06:00	Arrived at research area (YOKOSUKA Site)		YOKOSUKA Site
	06:05	Released XBT at 25-16.0097N, 124- 21.8394E		25-15.8N,124-22.4E
	07:31	Hoisted up 'KAIKO Mk-IV'		Fine but Cloudy
	07:36	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #719(30)		SE-6 (Strong breeze)
	09:47	'KAIKO Mk-IV' landed on the sea bottom (D=2,184m)		4 (Moderate)
	13:22	'KAIKO Mk-IV' left the sea bottom (D=2,112m)		3 (Moderate short)
	15:02	Hoisted up 'KAIKO Mk-IV'		Visibly : 8'
	15:10	Recovered 'KAIKO Mk-IV' & finished her operation		
	16:00	Left research area for NAGO WAN due to avoiding rough sea		
27 Nov 2016	08:00	Arrived at NAGO WAN.		NAGO WAN
		Let go starboard anchor in 36m of water at NAGO WAN		26-34.6N,127-58.0E
				Rain
				N-3 (Gentle breeze)

			1 (Calm)
			1 (Low swell)
			Visibly : 6'
28 Nov 2016		Anchoring at NAGURA WAN, ISHIGAKI JIMA	NAGO WAN
	16:00	Up & down starboard anchor then proceeded to drifting area	26-34.6N,127-58.0E
	17:09	Arrived at drifting area	Overcast
	17:30- 18:00	Scientist meeting.th	NNE-6 (Strong breeze)
	23:00	Proceeded to research area (Western off KUMEJIMA, the third Kume-Knoll)	3 (Slight)
			1 (Low swell)
			Visibly : 6'
29 Nov 2016	06:00	Arrived at research area (III Kume K.)	West of KUME JIMA
	06:23	Released XBT at 25-18.8517N, 126- 24.9087E	the third Kume-Knoll
	08:30	Hoisted up 'KAIKO Mk-IV'	26-18.4N,126-24.8E
	08:36	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #720(31)	Fine but Cloudy
	10:05	'KAIKO Mk-IV' landed on the sea bottom (D=1,441m)	NE-5 (Fresh breeze)
	14:46	'KAIKO Mk-IV' left the sea bottom (D=1,406m)	4 (Moderate)
	16:00	Hoisted up 'KAIKO Mk-IV'	3 (Moderate short)
	16:11	Recovered 'KAIKO Mk-IV' & finished her operation	Visibly : 8'
	17:02	Com'ced towing to proton magnetometer	
	17:22	Com'ced MBES mapping survey	
30 Nov 2016	02:00- 02:23	Carried out eight figure running	West of KUME JIMA
	05:01	Finished MBES mapping survey	the third Kume-Knoll
	06:49	Recovered proton magnetometer	26-18.1N,126-24.8E
	08:30	Hoisted up 'KAIKO Mk-IV'	Fine but Cloudy
	08:35	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #721(32)	ENE-4 (Moderate breeze)
	10:08	'KAIKO Mk-IV' landed on the sea bottom (D=1,439m)	3 (Slight)
	14:54	'KAIKO Mk-IV' left the sea bottom (D=1,351m)	1 (Low swell)
	16:05	Hoisted up 'KAIKO Mk-IV'	Visibly : 8'
	16:13	Recovered 'KAIKO Mk-IV' & finished her operation	
	17:02	Com'ced towing to proton magnetometer	
	17:27	Com'ced MBES mapping survey	
01 Dec 2016	04:30	Finished MBES mapping survey	West of KUME JIMA
	06:20	Recoverd proton magnetometer	the third Kume-Knoll

	07:27	Hoisted up 'KAIKO Mk-IV'	26-18.5N,126-24.9E
	07:34	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #722(33)	Rain
	09:05	KAIKO Mk-IV' landed on the sea bottom (D=1,455m)	NNE-5 (Fresh breeze)
	11:55	KAIKO Mk-IV' left the sea bottom (D=1,417m)	3 (Slight)
	13:08	Hoisted up 'KAIKO Mk-IV'	3 (Moderate short)
	13:17	Recovered 'KAIKO Mk-IV' & finished her operation	Visibly : 8'
	14:00	Proceeded to next research area (ENSEI East)	
	17:30-18:00	Scientist meeting.	
	18:45	Changed the destination to off OKINAWA Island, due to rough sea condition	
02 Dec 2016	17:30	Finished "heave-to".	West of IZENA JIMA
		Com'ced proceeding to survey area (Tokara Isl., Ensei West Site)	26-55.5N,127-52.9E
			Cloudy
			NE-6 (Strong breeze)
			3 (Slight)
			1 (Low swell)
			Visibly : 8'
03 Dec 2016	00:45	Arrived at research area (Tokara Isl., Ensei West Site)	TOKARA Isl.,
	0:50-1:09	Carried out eight figure running	Eastern Ensei Site
	05:30	Released XBT at 25-25.9740N, 128-11.1138E	28-26.4N,128-10.5E
	5:53-6:05	Carried out MBES mapping survey (Pre-dive survey)	Fine but Cloudy
	08:33	Hoisted up 'KAIKO Mk-IV'	NE-3 (Gentle breeze)
	08:39	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #723(34)	3 (Slight)
	10:10	KAIKO Mk-IV' landed on the sea bottom (D=1,267m)	1 (Low swell)
	14:43	KAIKO Mk-IV' left the sea bottom (D=1,218m)	Visibly : 8'
	15:48	Hoisted up 'KAIKO Mk-IV'	
	15:59	Recovered 'KAIKO Mk-IV' & finished her operation	
	16:33-16:47	Carried out MBES site survey	
04 Dec 2016	07:26	Hoisted up 'KAIKO Mk-IV'	TOKARA Isl.
	07:34	Launched 'KAIKO Mk-IV' then it dove & Com'ced her operation #724(35)	Eastern Ensei Site
	09:00	KAIKO Mk-IV' landed on the sea bottom (D=1,236m)	28-26.1N,128-11.5E
	12:03	KAIKO Mk-IV' left the sea bottom	Cloudy

		(D=1,218m)	
	13:10	Hoisted up 'KAIKO Mk-IV'	NE-2 (Light breeze)
	13:17	Recovered 'KAIKO Mk-IV' & finished her operation	1 (Calm)
	14:00	Left research area for KAGOSHIMA	1 (Low swell)
	18:00-18:30	Scientist meeting.	Visibly : 8'
05 Dec 2016	09:00	Arrived at KAGOSHIMA-ko, then completed voy. No.KR16-16.	

# KR16-16\_Nav\_Track



GM 2016 Dec 05 09:30:37 R/V KAIREI, Mercator Projection, Data\_source=SOJ

## I. CRUISE SUMMARY

In this KR16-16 cruise, we carried out 10 ROV Kaiko dives at hydrothermal sites in Southern Okinawa Trough, Western off Kume-shima, and Tokara islands based on data obtained in YK16-07 cruise.

In Southern Okinawa Trough, we conducted 5 Kaiko dives and we could find 3 novel hydrothermal sites. At Yokosuka field, we discovered hydrothermal vent chimneys. The fluid temperature was more than 360°C which was highest temperature of all hydrothermal vent fluids from hydrothermal sites in Okinawa trough. In Taka site of Futagoyama field (Southern hill of Futagoyama) we could find no hydrothermal vent, but CO<sub>2</sub> bubble emissions were observed. We concluded that this CO<sub>2</sub> bubbles were affected as the signatures obtained from MBES and side-scan sonar. In Waka site of Futagoyama field, we could discover hydrothermal field and rich animal colonies at the top of the knoll.

In Western off Kume-jima, we conducted 3 dives at the western flank of the third Kume-knoll. We had succeeded in sampling hydrothermal fluids and chimneys from several vents. And also we could survey the vigorous venting area from north end to south end.

In Tokara Islands, we conducted 2 Kaiko dives at Higashi-Ensei field. We discovered hydrothermal vent chimneys and sampled high temperature fluids which have never been sampled from Ensei area.

And through this KR16-16 cruise we obtained bathymetric data which were useful for future plume surveys.

Moreover, we obtained many samples from these newly discovered hydrothermal fields to characterize these fields.

Finally, We concluded that MBES surveys by research vessels and AUVs enable us to easily discover known and unknown hydrothermal activities.

## 1. General background and objectives

One of the goals of Next-Generation Technology for Ocean Resources **Exploration** funded by Cross-ministerial Strategic Innovation Promotion Program (SIP) was to construct efficient strategies for discovering unknown hydrothermal vent fields which became possible mineral deposits. Discovering hydrothermal vent fields had been difficult because we had to find the fields with only a few ten to hundred meters diameter from vastly wide ocean. Previously, the way of discovering hydrothermal field was to capture plumes derived from hydrothermal activities by chemical and turbidity sensors or CTD/water sampling system. This method was used much money, labor and time. And this method was rather inefficient because we could know only from a point whether there was plume or not.

Recently side-scan sonar and multi-beam echo sounder (MBES) equipped on AUV were useful for discovering hydrothermal activity (Nakamura et al., 2013). However, a survey by AUV could only conducted within a several square kilo meters.

It was reported that MBES equipped on vessels also capture plumes (Nakamura et al., 2015). Although the captured signature was thought to be CO<sub>2</sub> bubbles, we could survey seafloor larger than previous methods. To confirm efficiency of this MBES surveys, we must investigate the seafloor demonstrated by MBES on vessels or AUVs. So that ROV or HOV dives are required.

YK16-07 cruise was conducted this June. In this cruise, R/V Yokosuka and AUV Urashima surveys were carried out at Southern Okinawa Trough and Higasi-Ensei area. By MBES survey on R/V Yokosuka, plumes were detected at least 4 areas (OKN, OKN-nishi, Futagoyama, Higashi-Ensei) where hydrothermal activities have never been confirmed. And also in this cruise, detailed bathymetric maps were described in both Futagoyama and OKN sites by AUV Urashima.

The primary objective of KR16-16 cruise is to confirm whether there are hydrothermal activities at above detected sites. If we discover the novel hydrothermal activities, we will sample hydrothermal fluids, vent chimney structures and vent-endemic faunas to characterize the new sites. These samples are also used to compare known hydrothermal fields in Okinawa Trough.



## **2. DIVE REPORTS**

1. Kaiko#715 DIVE (Yokosuka Field, west side)
2. Kaiko#716 DIVE (Futagiyama Field, Taka site)
3. Kaiko#717 DIVE (Futagiyama Field, Waka site)
4. Kaiko#718 DIVE (Yokosuka Field, west side)
5. Kaiko#719 DIVE (Yokosuka Field, west & east side)
6. Kaiko#720 DIVE (the third Kume-Knoll, northern part)
7. Kaiko#721 DIVE (the third Kume-Knoll, Southern part)
8. Kaiko#722 DIVE (the third Kume-Knoll, northern part)
9. Kaiko#723 DIVE (Higashi-Ensei Field, Ghibli site)
10. Kaiko#724 DIVE (Higashi-Ensei Field, Fukai site)

## **Dive Report: Kaiko Dive #715**

**Date:** November 19, 2016

**Site:** West side of Yokosuka field

### **Objectives:**

The objective of this dive is discovering hydrothermal vents in west side of Yokosuka field according to the plume survey data obtained by AUV Urashima in YK16-07 cruise. If we can find those, we will carry out sampling hydrothermal fluids, active chimney structures, vent-endemic animals to characterize Yokosuka field.

### **Dive Summary:**

In this dive, we met some troubles. Longitude and latitude shown by INS on vehicle (Kaiko Mk-IV) were not coincidence with those of SSBL on Kaiko Mk-IV and were not reliable. And bad visibility caused by hydrothermal activities prevented us to find any targets. Therefore it is difficult for us to identify the correct position of Kaiko Mk-IV. However, we first found tiny tubeworm colony. And the 50 m - east of this colony, we discovered large active hydrothermal vent chimney with big flanges (Named Neuschwanstein chimney). We tried to sample hydrothermal fluids but it was not so good because we could not land on the chimney to sample fluid stably. However, 350.6°C was recorded as the fluid temperature, indicating the highest temperature in all the fluids from hydrothermal vent sites in Okinawa trough.

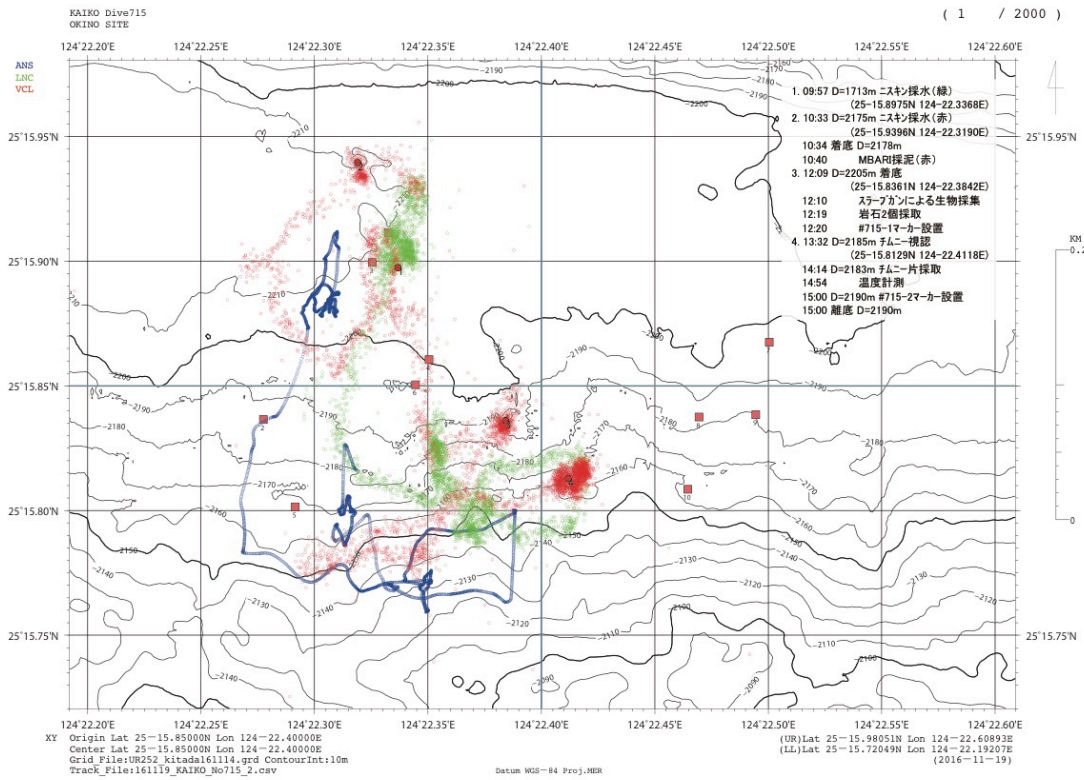
### **Payloads:**

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) MBARI push core sampler (Green and Red)
- 7) Kaiko Marker (#715-1, #715-2)
- 8) Gamma-ray detector

### **Dive Log:**

Time	Depth(m)	Latitude	Longitude	Event
09:57:00	1713m	25°15.8975'N	124°22.3368'E	Sampling Water into Niskin (Red)
10:33:00	2175m	25°15.9396'N	124°22.3190'E	Sampling water into Niskin (Green)
10:34:00	2178m	25°15.9396'N	124°22.3190'E	Landing
10:40:00	2178m	25°15.9396'N	124°22.3190'E	Sampling core (MBARI RED)
12:02:02	2205m	25°15.8458'N	124°22.3675'E	Finding Animal colony Tubeworm, musels, galetheides
12:11:02	2205m	25°15.8458'N	124°22.3675'E	Sampling animals in tubeworm colony
12:20:13	2205m	25°15.8458'N	124°22.3675'E	Sampling rocks (2 pieces){R1}
12:20:39	2205m	25°15.8458'N	124°22.3675'E	Set marker Kaiko#715-1
13:31:24	2185m	25°15.8354'N	124°22.4017'E	Finding Big Chimney (Neuschwanstein chimney)
14:18:43	2185m	25°15.8354'N	124°22.4017'E	Sampling chimeny structure{R2}
14:26:06	2185m	25°15.8354'N	124°22.4017'E	Sampling hydrothermal fluid (Temp(max)=350.6°C){W1}
15:00:51	2185m	25°15.8354'N	124°22.4017'E	Set marker Kaiko#715-2
15:02:16	2185m	25°15.8354'N	124°22.4017'E	Sampling rock into baschet{R3}
15:02:49	2185m	25°15.8354'N	124°22.4017'E	Left the bottom

# Dive Track:



## **Dive Report: Kaiko Dive #716**

**Date:** 20 November 2016

**Site:** Taka site in Futagoyama field

### **Objectives:**

The objective of this dive is discovering hydrothermal vents at Taka site in Futagoyama field according to the plume survey data obtained by AUV Urashima in YK16-07 cruise. If we can find those, we will carry out sampling hydrothermal fluids, active chimney structures, vent-endemic animals to characterize Futagoyama field.

### **Dive Summary:**

In this dive, longitude and latitude shown by INS on vehicle (Kaiko Mk-IV) were coincidence with those of SSBL on Kaiko Mk-IV and reliable. Therefore we could identify the correct position of Kaiko Mk-IV. We ran the Taka site from west to east but we could not catch the signature of hydrothermal activities. At the point 6, we found tiny vent-endemic animal colony. And the point 7, we found unique sediment structure. When we observed the structure, we could find bubbles spouted from sediment. We understood that the signatures detected by AUV Urashima and Vessels were resulted in these bubbles. We returned east side of Taka site but we could not find hydrothermal vent.

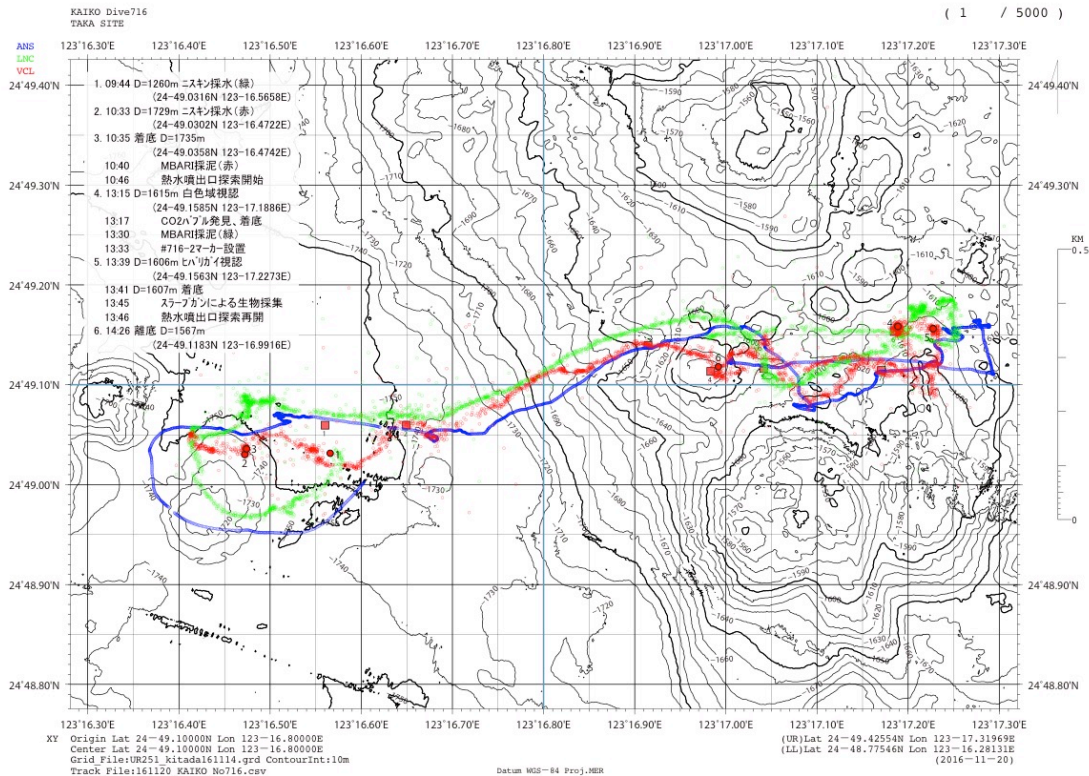
### **Payloads:**

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) MBARI push core sampler (Green and Red)
- 7) Kaiko Marker (#716-1, #716-2)
- 8) Gamma-ray detector

## Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
9:44:00	1233.1	24°49.0316'N	123°16.5658'E	Sampling water into Niskin (Green)
10:33:51	1730.5	24°49.0744'N	123°16.4377'E	Sampling water into Niskin (Red)
10:35:52	1733.1	24°49.0815'N	123°16.4280'E	Landing (Surface: Mud)
10:40:07	1735.3	24°49.0832'N	123°16.4222'E	Sampling Core (MBARI(Red))
11:30:26	1743.3	24°49.0510'N	123°16.6930'E	Pass through the point No.2
13:08:45	1594.5	24°49.1210'N	123°17.2334'E	Finding tiny vent-endemic animal colony
13:17:47	1617	24°49.1491'N	123°17.1661'E	Finding CO2 bubble
13:30:29	1616.5	24°49.1579'N	123°17.1898'E	Sampling Core (MBARI (Green))
13:33:06	1618.1	24°49.1575'N	123°17.1878'E	Set KaikoMarker#716-2
13:50:31	1592.3	24°49.1236'N	123°17.2299'E	Finding and Sampling animal colony.
14:26:41	1566.7	24°49.1197'N	123°16.9961'E	left the bottom

## Dive Track:



## **Dive Report: Kaiko Dive #717**

**Date:** 21 November 2016

**Site:** Waka site in Futagoyama field

### **Objectives:**

The objective of this dive is discovering hydrothermal vents at Waka site in Futagoyama field according to the plume survey data obtained by R/V Yokosuka in YK16-07 cruise. If we can find those, we will carry out sampling hydrothermal fluids, active chimney structures, vent-endemic animals to characterize Futagoyama field.

### **Dive Summary:**

We landed around the top of the knoll. We found sponges and recognize that we were close to hydrothermal activity. We moved to the top of the knoll and cloudiness caused by hydrothermal activities robbed our visibilities. But when we reached to the top, we found large vent endemic animal colonies and hydrothermal vents. We collected many samples at this point. During sampling hydrothermal fluids, 290.9°C was recorded. We moved to west to go to another top of the knoll but we could not find other vent-endemic animal colonies and hydrothermal vents.

### **Payloads:**

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) MBARI push core sampler (Green and Red)
- 7) Kaiko Marker (#717-1, #717-2)
- 8) Gamma-ray detector

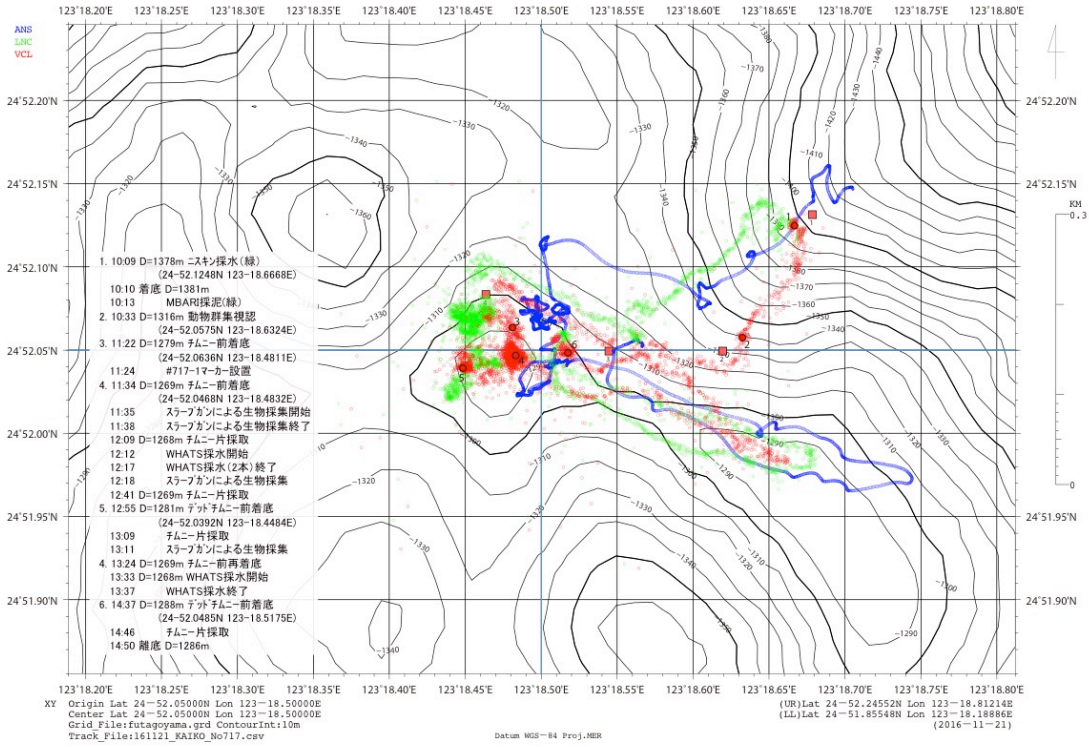
### **Dive Log:**

Time	Depth(m)	Latitude	Longitude	Event
10:08:54	1385.1	24°52.1197'N	123°18.6716'E	Sampling water (Niskin)
10:10:00	1385.1	24°52.1197'N	123°18.6716'E	Landing (Mud surface)

10:14:22	1387.2	24°52.1254'N	123°18.6651'E	Sampling core (MBARI (Green))
10:33:40	1316.4	24°52.0585'N	123°18.6322'E	Finding white colored area and animal colonies
11:25:10	1285.1	24°52.0646'N	123°18.4808'E	Finding chimney and set marker#717-1
11:37:18	1271.5	24°52.0509'N	123°18.4868'E	Sampling cancer and mussels
12:04:02	1267	24° 52.0450'N	123° 18.4840' E	Sampling chimney structures (Wakanohana Chimney){R1}
12:12:53	1269.7	24°52.0482'N	123°18.4837'E	Sampling hydrothermal fluid (Max. 290.9°C){W1}
12:15:02	1270	24°52.0449'N	123°18.4818'E	Sampling hydrothermal fluid (Max. 290.1°C){W2}
12:21:08	1270	24°52.0471'N	123°18.4848'E	Sampling Galetheids
13:09:00	1281	24°52.0392'N	123°18.4484'E	Sampling Dead chimney {R2}
13:11:00	1281	24°52.0392'N	123°18.4484'E	Sampling pararvinella
13:33:59	1274.3	24°52.0452'N	123°18.4828'E	Sampling hydrothermal fluid (Max. 286.9°C){W3}
14:47:07	1294.7	24°52.0490'N	123°18.5152'E	Sampling Dead chimney {R3}
14:50:09	1292.5	24°52.0506'N	123°18.5154'E	Left the bottom

**Dive Track:**





## **Dive Report: Kaiko Dive #718**

**Date:** November 22, 2016

**Site:** West side of Yokosuka field

### **Objectives:**

The primitive objective of this dive is sampling hydrothermal fluid, chimney structure, and vent-endemic animals. Moreover, we have an additional objective in this dive: discovering more hydrothermal vents in west side of Yokosuka field.

### **Dive Summary:**

In this dive, we met disharmony of longitude and latitude shown by between INS and SSBL on vehicle Kaiko Mk-IV. It might be a feature of this field. We looked for Neuschwanstein chimney which was discovered in previous #715 dive. But we could not find the chimney. After about an hour survey, we discovered a large active hydrothermal vent chimney, but it was not Neuschwanstein chimney. We named this chimney, Hohenschwangau chimney. Black smoker was vented from a big flange structure. We landed stably on flange structure and sampled hydrothermal fluid. 364.1°C was recorded, indicating a renewal of records of hydrothermal fluids in Okinawa Trough. We looked for Neuschwanstein chimney again but we found a large sponge colony. We ran along the sponge road, and then we arrived at a large active hydrothermal vent chimney. We observed the chimney and we identified that this chimney is not Neuschwanstein chimney (named Heidelberg chimney). 349.9°C was recorded during sampling hydrothermal fluids.

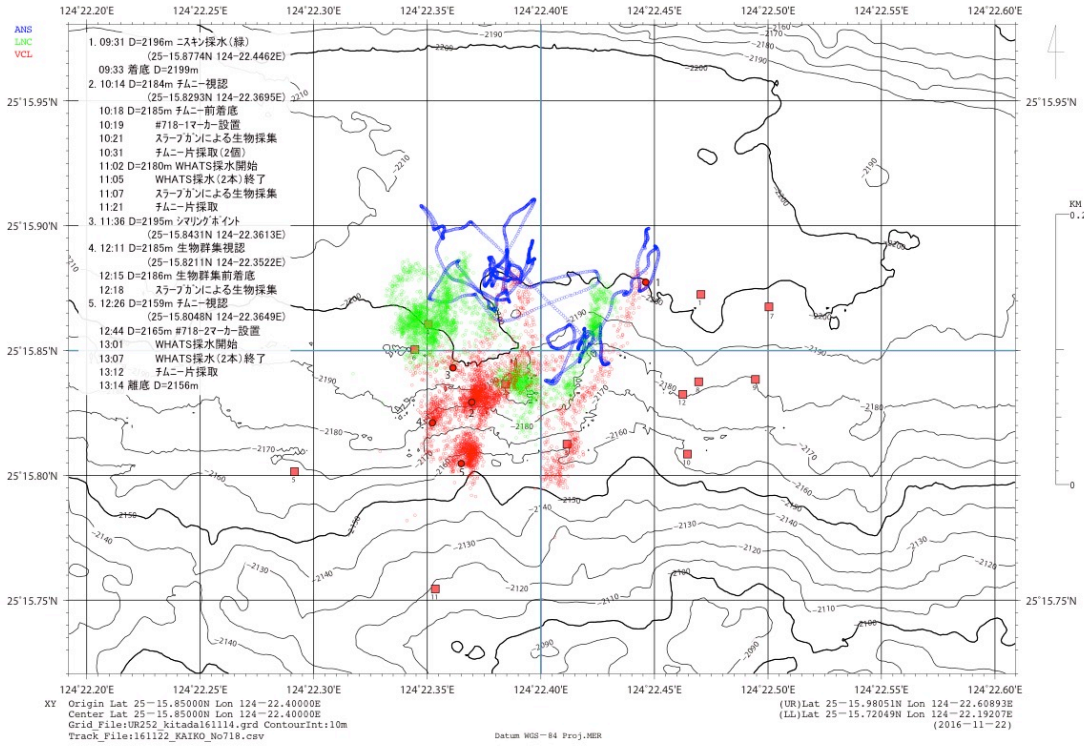
### **Payloads:**

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) Kaiko Marker (#718-1, #718-2)
- 7) Gamma-ray detector

## Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
09:31:49	2203.1	25°15.8775'N	124°22.4453'E	Sampling water (Niskin Green)
09:33:00	2201.8	25°15.8821'N	124°22.4422'E	Landing [Surface: rock]
10:15:46	2187.6	25°15.8315'N	124°22.3720'E	Finding chimney (Hohenschwangau chimney)
10:19:49	2188.7	25°15.8285'N	124°22.3705'E	Set Kaiko marker#718-1
10:20:44	2188	25°15.8299'N	124°22.3695'E	Sampling shrimps
10:31:06	2190.2	25°15.8351'N	124°22.3749'E	Sampling Dead chimney structures{R1}
10:31:22	2190	25°15.8340'N	124°22.3737'E	Sampling Dead chimney structures{R2}
11:02:35	2182.7	25°15.8227'N	124°22.3670'E	Sampling hydrothermal fluid (Temp (max)=364.1°C {W1}
11:04:12	2182	25°15.8258'N	124°22.3669'E	Sampling hydrothermal fluid (Temp (max)=364.1°C {W2}
11:08:07	2177.9	25°15.8299'N	124°22.3759'E	Sampling shrimps
11:15:35	2180.9	25°15.8246'N	124°22.3743'E	Sampling chimney {R3}
11:35:41	2204.9	25°15.8401'N	124°22.3628'E	Finding shimmering point
12:17:55	2187	25°15.8286'N	124°22.3546'E	Sampling animals
12:29:41	2160.4	25°15.7998'N	124°22.3690'E	Finding active vent chimney (Heidelberg chimney)
12:44:16	2165.5	25°15.8090'N	124°22.3647'E	Set Kaiko marker#718-2
12:44:16	2165.5	25°15.8090'N	124°22.3647'E	Sampling rock {R4}
13:02:48	2158.2	25°15.8122'N	124°22.3719'E	Sampling hydrothermal fluid (Temp (max)=348.0°C) {W3}
13:05:24	2160.2	25°15.8074'N	124°22.3703'E	Sampling hydrothermal fluid (Temp (max)=349.9°C) {W4}
13:09:15	2159.2	25°15.8059'N	124°22.3698'E	Sampling active chimney structure {R5}
13:15:09	2154.3	25°15.8143'N	124°22.3737'E	Left the bottom

## Dive Track:



## Dive Report: Kaiko Dive #719

**Date:** November 26, 2016

**Site:** West and east sides of Yokosuka field

### Objectives:

The primitive objective of this dive is sampling hydrothermal fluid from Neuschwanstein chimney. Moreover, we have an additional objective in this dive: discovering more hydrothermal vents at east side of Yokosuka field.

### Dive Summary:

In this dive, we also met disharmony of longitude and latitude shown by between INS and SSBL on vehicle Kaiko Mk-IV. We looked for Neuschwanstein chimney which was discovered in previous #715 dive. During searching, we discovered large active hydrothermal vent chimney, but it also was not Neuschwanstein chimney (named Shisa chimney). However across this chimney, we at long last found Neuschwanstein chimney. 356.9°C was recorded during sampling hydrothermal fluids. We next moved to east side of Yokosuka field. We conducted about 2 hour survey, but we could not find any hydrothermal vents in eastern area of Yokosuka field.

### Payloads:

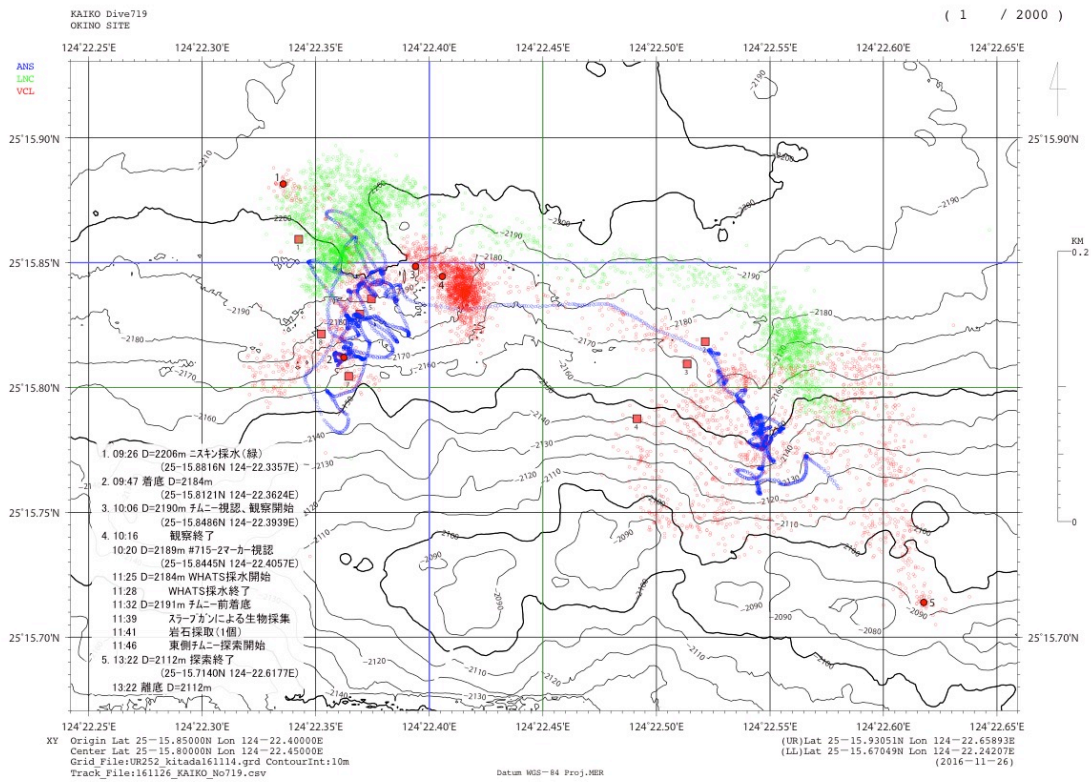
- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) Kaiko Marker (#719-1, #719-2)
- 7) Gamma-ray detector

### Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
09:26:23	2211.8	25°15.8827'N	124°22.3381'E	Sampling Seawater (Niskin Green)
09:48:09	2173.1	25°15.8183'N	124°22.3595'E	Landing
10:10:15	2187.2	25°15.8495'N	124°22.3948'E	Finding chimney (Shisa chimney)

10:20:43	2190	25°15.8520'N	124°22.4094'E	Finding Marker #715-2
11:28:26	2181.9	25°15.8401'N	124°22.4169'E	Sampling hydrothermal fluid (356.9°C){W1}
11:35:59	2189.9	25°15.8332'N	124°22.4113'E	Sampling animals
11:35:59	2189.9	25°15.8332'N	124°22.4113'E	Sampling rock{R1}
13:24:39	2119.8	25°15.7471'N	124°22.6081'E	Left the bottom

### Dive Track:



## Dive Report: Kaiko Dive #720

**Date:** November 29, 2016

**Site:** a known vigorous venting area, western flank of the third Kume-Knoll

### Objectives:

The primitive objective of this dive is sampling hydrothermal fluids, chimney structure, and vent-endemic animals in northern part of the site to characterize this site. Through this sampling, we carried out mapping in the site.

### Dive Summary:

In this dive, we landed the west of the northern main mound of the site and then climbed the mound. During the course toward the main mound, we found many tall chimneys. At the top of the mound (named Daimajin mound), we found three large chimneys. At the east end of the chimneys, we tried to sample hydrothermal fluid. However the hose connected with nozzle and WHATS-III was melted during the sampling. Therefore we failed to sample hydrothermal fluids. Next, we went to northern part of the site. In this area, we found brown chimneys which were quite different from chimneys erupting high temperature fluid.

### Payloads:

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) Kaiko Marker (#720-1, #720-2)
- 7) Gamma-ray detector

### Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
10:04:47	1439.9	26°18.3548'N	126°24.6433'E	Sampling Seawater (NiskinGreen){NG}
10:05:30	1440	26°18.3546'N	126°24.6392'E	Landing [Surface: mud]
10:30:17	1340.8	26°18.3163'N	126°24.8004'E	Finding Galetheids

11:00:51	1312.3	26°18.3451'N	126°24.8228'E	Sampling Pararvinella
11:09:32	1311.5	26°18.3449'N	126°24.8286'E	Sampling chimney structure {R1}
11:17:28	1314.6	26°18.344'N	126°24.825'E	Sampling hydrothermal fluids (250.1°C){W1}
11:30:05	1336.4	26°18.3401'N	126°24.8235'E	Sampling animals
12:16:42	1331.5	26°18.338'N	126°24.829'E	Sampling hydrothermal fluids but failed (Stack nozzle) [314.4°C]{W2, W3}
12:29:07	1336.7	26°18.3422'N	126°24.8276'E	Set Kaiko Marker#720-1
12:31:11	1337.5	26°18.3384'N	126°24.8228'E	Sampling a rock R2}
12:36:12	1338.6	26°18.3292'N	126°24.8284'E	Sampling animals (Galetheids)
12:47:48	1341.1	26°18.3324'N	126°24.8347'E	Sampling animals
13:15:57	1447.7	26°18.5455'N	126°24.8431'E	Sampling Dead chimney {R3}
13:41:46	1463.4	26°18.5822'N	126°24.9318'E	Sampling Dead chimney {R4}
14:18:36	1419.6	26°18.5264'N	126°24.8988'E	Sampling animals
14:33:55	1403	26°18.5017'N	126°24.9283'E	Sampling chimney structure {R5}
14:38:42	1408.4	26°18.5038'N	126°24.9257'E	Set Kaiko Marker#720-2
14:46:43	1406.2	26°18.4971'N	126°24.9185'E	Left the bottom



## Dive Report: Kaiko Dive #721

**Date:** November 30, 2016

**Site:** a known vigorous venting area, western flank of the third Kume-Knoll

### Objectives:

The primitive objective of this dive is sampling hydrothermal fluids from northern main mound (named Daimajin mound), chimney structure, and vent-endemic animals in southern part of the site to characterize this site. Through this sampling, we carried out mapping in the site.

### Dive Summary:

In this dive, we re-tried to sample hydrothermal fluid which we could not sample in previous dive (Kaiko #720). We have succeeded in sampling hydrothermal fluid. During sampling the fluids, 313.9°C was recorded. Next we went to center of the site. In the center, we found very tall chimney and at the top, we found eruption of hydrothermal fluids. During sampling hydrothermal fluids, 314.7°C was recorded. Next we headed to south. The southern end of the site, we also found very tall chimney. At the top of the chimney, we tried to sample hydrothermal fluids. During sampling, 264.7°C was recorded.

### Payloads:

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) Kaiko Marker (#721-1, #721-2)
- 7) Gamma-ray detector

### Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
10:08:51	1440.4	26°18.3584'N	126°24.6598'E	Sampling Seawater [Niskin Green]
10:09:00	1440	26°18.3596'N	126°24.6593'E	Landing [Surface: mud]

10:22:27	1429.9	26°18.3439'N	126°24.6852'E	Sampling Dead chimney{R1}
11:12:31	1330.3	26°18.338'N	126°24.841'E	Sampling hydrothermal fluid [Temp max=313.9°C]{W1}
11:15:37	1332.8	26°18.3401'N	126°24.8418'E	Sampling hydrothermal fluid [Temp max=313.9°C]{W2}
11:19:31	1331.4	26°18.3481'N	126°24.8415'E	Sampling shrimps
12:04:42	1377	26°18.1608'N	126°24.7348'E	Found the Marker#GD16-16
13:00:00	1370	26°18.1197'N	126°24.7471'E	Sampling chimney structure{R2}
13:05:08	1370	26°18.1197'N	126°24.7471'E	Sampling hydrothermal fluids [Temp max=314.7°C]{W3}
13:11:10	1373.2	26°18.1225'N	126°24.7434'E	Setting Kaiko Marker#721-1
13:23:03	1382.3	26°18.0538'N	126°24.7208'E	Finding borehole, the marker#GD15-06 and microbial mat
13:48:37	1374.7	26°17.9516'N	126°24.7216'E	Sampling Dead chimney{R3}
14:47:42	1345.4	26°17.8712'N	126°24.739'E	Sampling chimney{R4}
14:48:01	1341.3	26°17.878'N	126°24.7371'E	Sampling hydrothermal fluids [Temp max=264.7°C]{W4}
14:54:57	1352.8	26°17.8752'N	126°24.7536'E	Setting kaiko marker#721-2
14:55:08	1348.2	26°17.8668'N	126°24.7514'E	Left the bottom

## Dive Report: Kaiko Dive #722

**Date:** December 1, 2016

**Site:** a known vigorous venting area, western flank of the third Kume-Knoll

### Objectives:

The primitive objective of this dive is sampling hydrothermal fluids, chimney structure from brown-colored chimneys and vent-endemic animals in northern part of the site again to characterize this site. Through this sampling, we carried out mapping in the site.

### Dive Summary:

As soon as landing, we headed to Kaiko marker #720-2 where we found brown chimneys in previous dive. We found the marker and carried out sampling. During sampling hydrothermal fluid, 277°C was recorded. We moved to the eastern end of the site. We found hydrothermal vent chimney and set marker #722-1.

### Payloads:

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) Kaiko Marker (#722-1, #722-2)
- 7) Gamma-ray detector

### Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
09:04:14	1458.8	26°18.585'N	126°24.8885'E	Sampling Seawater (Niskin Green)
09:05:40	1460.2	26°18.5847'N	126°24.892'E	Landing [Surface: Mud]
09:22:40	1404	26°18.4941'N	126°24.9255'E	Confirming Kaiko marker#720-2
09:40:26	1414.1	26°18.4871'N	126°24.9294'E	Sampling Chimney{R1}
09:55:43	1413.3	26°18.4883'N	126°24.9314'E	Sampling hydrothermal fluid [Temp Max=125.8°C]{W1}
10:47:05	1408.5	26°18.4907'N	126°24.9326'E	Sampling chimney{R2}

11:04:38	1409.5	26°18.4875'N	126°24.9274'E	Sampling	hydrothermal	fluids	[Temp Max=270°C]{W2}
11:14:39	1400.6	26°18.4968'N	126°24.9131'E	Sampling	hydrothermal	fluids	[Temp Max=271°C]{W3}
11:17:16	1403.2	26°18.4981'N	126°24.915'E	Sampling	hydrothermal	fluids	[Temp Max=277°C]{W4}
11:27:37	1417.4	26°18.4646'N	126°24.9138'E	Discovering rusty-colored area			
11:35:44	1378.4	26°18.4214'N	126°24.9351'E	Discovering active chimney			
11:44:18	1403.5	26°18.419'N	126°24.9416'E	Set Kaiko marker#722-1			
11:54:55	1417.6	26°18.4063'N	126°24.9539'E	Sampling Dead chimney{R3}			
11:55:40	1418.7	26°18.4074'N	126°24.9545'E	Left the bottom			

## **Dive Report: Kaiko Dive #723**

**Date:** December 3, 2016

**Site:** Ghibli site in Higashi-Ensei field

### **Objectives:**

The objective of this dive is discovering hydrothermal vents at Ghibli site in Higashi-Ensei field according to the plume survey data obtained by MBES on R/V Yokosuka in YK16-07 cruise. If we can find those, we will carry out sampling hydrothermal fluids, active chimney structures, vent-endemic animals to characterize Higashi-Ensei field.

### **Dive Summary:**

When landing, we found bacterial mats on sediments. We tried to sample sediments by MBARI push core sampler, but failed because clay layer was not included in the corer. We gave up sample core and headed to the west. For a moment, we found shimmering from sulfur crust. We sampled crust and hydrothermal fluids. During sampling fluids, 70°C was recorded. We headed to north, and we found very tall chimney (named Howl chimney). We observed the chimney from the bottom to the top, but we could not find hydrothermal vent with high temperature fluid venting. Therefore we moved to west and we found tall chimney with huge flange structures. Although we could not find active vent at the top of the chimney, black smoker ventings were found from huge flange structure. We sampled the structure and fluids. During fluid sampling, 318.6°C was recorded. We head to east and went point No.2. Many microbial mats were found in this area.

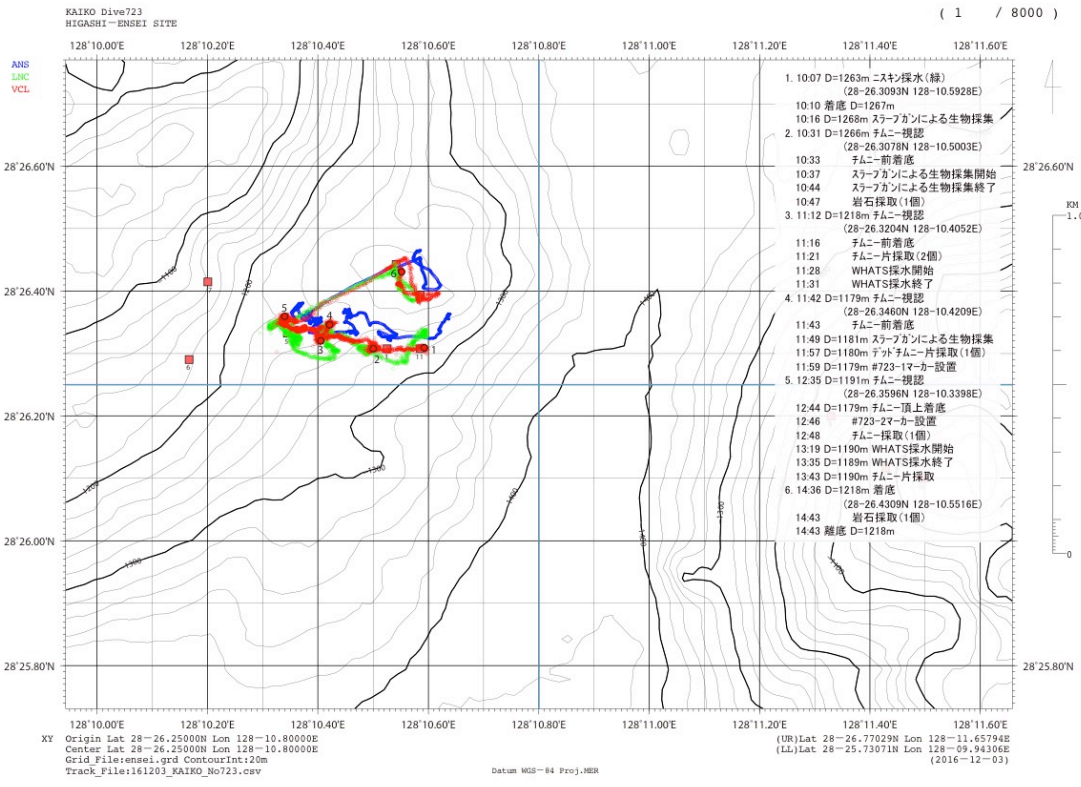
### **Payloads:**

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) Kaiko Marker (#723-1, #723-2)
- 7) MBARI push core sampler x 2 (Green and Red)
- 8) Gamma-ray detector

## Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
10:07:39	1266.1	28°26.3094'N	128°10.5883'E	Sampling Seawater [Niskin Green]
10:10:22	1270.8	28°26.3087'N	128°10.5929'E	Landing
10:16:39	1271.2	28°26.3041'N	128°10.5894'E	Finding microbial mat, trying to sampling core but failed
10:16:47	1271.1	28°26.306'N	128°10.5827'E	Sampling animals
10:34:15	1261.4	28°26.3054'N	128°10.4866'E	Finding animal colony and microbial mat
10:42:36	1266.3	28°26.3082'N	128°10.5096'E	Sampling animals
10:47:12	1269.2	28°26.3092'N	128°10.4981'E	Sampling Rock{R1}
11:15:26	1223.3	28°26.3201'N	128°10.4025'E	Finding Active chimney
11:24:38	1220	28°26.3208'N	128°10.4000'E	Sampling chimney structure (Nigiri chimney){R2}
11:28:41	1221.1	28°26.3228'N	128°10.4000'E	Sampling hydrothermal fluid [Temp max=70.0°C]{W1}
11:47:11	1184.2	28°26.3469'N	128°10.4233'E	Find hydrothermal mound (Height 40m)
11:47:47	1184.6	28°26.3495'N	128°10.4243'E	Sampling animals
11:56:39	1182	28°26.3487'N	128°10.4206'E	Sampling Dead chimney{R3}
11:59:12	1177.5	28°26.3487'N	128°10.4166'E	Setting Kaiko marker#723-1
12:38:36	1186.6	28°26.3586'N	128°10.3366'E	Finding chimney (Rapyuta chimney)[Height 40m]
12:46:11	1184.1	28°26.3616'N	128°10.3344'E	Setting Kaiko marker#723-2
12:50:27	1183.4	28°26.3593'N	128°10.3432'E	Sampling dead chimney{R4}
13:20:00	1190.4	28°26.3576'N	128°10.3428'E	Sampling hydrothermal fluid [Temp max=317°C]{W2}
13:21:14	1191.9	28°26.3582'N	128°10.3433'E	Sampling hydrothermal fluid [Temp max=318.6°C]{W3}
13:43:15	1194.1	28°26.3546'N	128°10.3425'E	Sampling chimney structure{R5}
14:08:09	1223.1	28°26.4531'N	128°10.5586'E	Arriving at Point 2, finding microbial mat
14:43:51	1220.9	28°26.4312'N	128°10.5502'E	Sampling rock{R6}
14:44:15	1221.2	28°26.4324'N	128°10.5492'E	Left the bottom

## Dive Track:



## Dive Report: Kaiko Dive #724

**Date:** December 4, 2016

**Site:** Fukai site in Higashi-Ensei field

### Objectives:

The objective of this dive is discovering hydrothermal vents at Fukai site in Higashi-Ensei field according to the plume survey data obtained by R/V Yokosuka in YK16-07 cruise. If we can find those, we will carry out sampling hydrothermal fluids, active chimney structures, vent-endemic animals to characterize Higashi-Ensei field.

### Dive Summary:

As soon as landing, we climbed up knoll. We found microbial mats. We further climbed up. But when we arrived at the top, we only observed tubeworm colony. We continued to look for hydrothermal vent around the top, but we could not find.

### Payloads:

- 1) WHATS-III (Pressure tight fluid sampler)
- 2) Temperature sensor for hydrothermal fluid
- 3) Sample Box x 2
- 4) Suction Sampler
- 5) Niskin Sampler x 2 (Green and Red)
- 6) Kaiko Marker (#724-1, #724-2)
- 7) Gamma-ray detector

### Dive Log:

Time	Depth(m)	Latitude	Longitude	Event
09:00:47	1243.5	28°26.2637'N	128°11.2531'E	Sampling seawater [Niskin Green]
09:01:00	1240.7	28°26.2627'N	128°11.2507'E	Landing [Surface:mud]
09:17:01	1178.6	28°26.2192'N	128°11.3205'E	Finding tubeworm colony
09:19:21	1186.1	28°26.2206'N	128°11.3187'E	Sampling animals
09:38:44	1168.2	28°26.2068'N	128°11.3156'E	Sampling animals
09:40:21	1166.7	28°26.2058'N	128°11.3172'E	Setting Kaiko Marker#724-1
09:56:59	1118.5	28°26.1828'N	128°11.3538'E	Finding sulfur crust



10:54:54	962	28°26.1132'N	128°11.4893'E	Sampling animals
11:42:07	962.2	28°26.1123'N	128°11.4898'E	Sampling animals
11:52:43	960.5	28°26.1249'N	128°11.4900'E	Sampling animals
12:02:29	957.2	28°26.1207'N	128°11.5158'E	Sampling Rock
12:03:01	955.6	28°26.122'N	128°11.5163'E	Left the bottom

## Dive Track:

