

R/V Shinsei Maru Cruise Report

KS-25-14

Clarification of Heat Transport Phenomena in Hydrothermal Systems and Investigation of Efficient Heat Collection Mechanisms



Oct. 16th – Oct. 23rd, 2025

Mid-Okinawa Trough

1. Cruise Information

Cruise ID: KS-25-14
Vessel: R/V Shinsei Maru
Cruise Title: Clarification of Heat Transport Phenomena in Hydrothermal Systems and Investigation of Efficient Heat Collection Mechanisms
Cruise Period: Oct. 16th, 2025 - Oct. 23rd, 2025
Ports: Kagoshima - Yokosuka
Research Area: Mid-Okinawa Trough
1. Iheya North Knoll (Original site, Aki site, Natsu site)
2. Iheya Minor Ridge (Noho site, Hitoshi site)
3. Izena Hole (Hakurei site, JADE site)

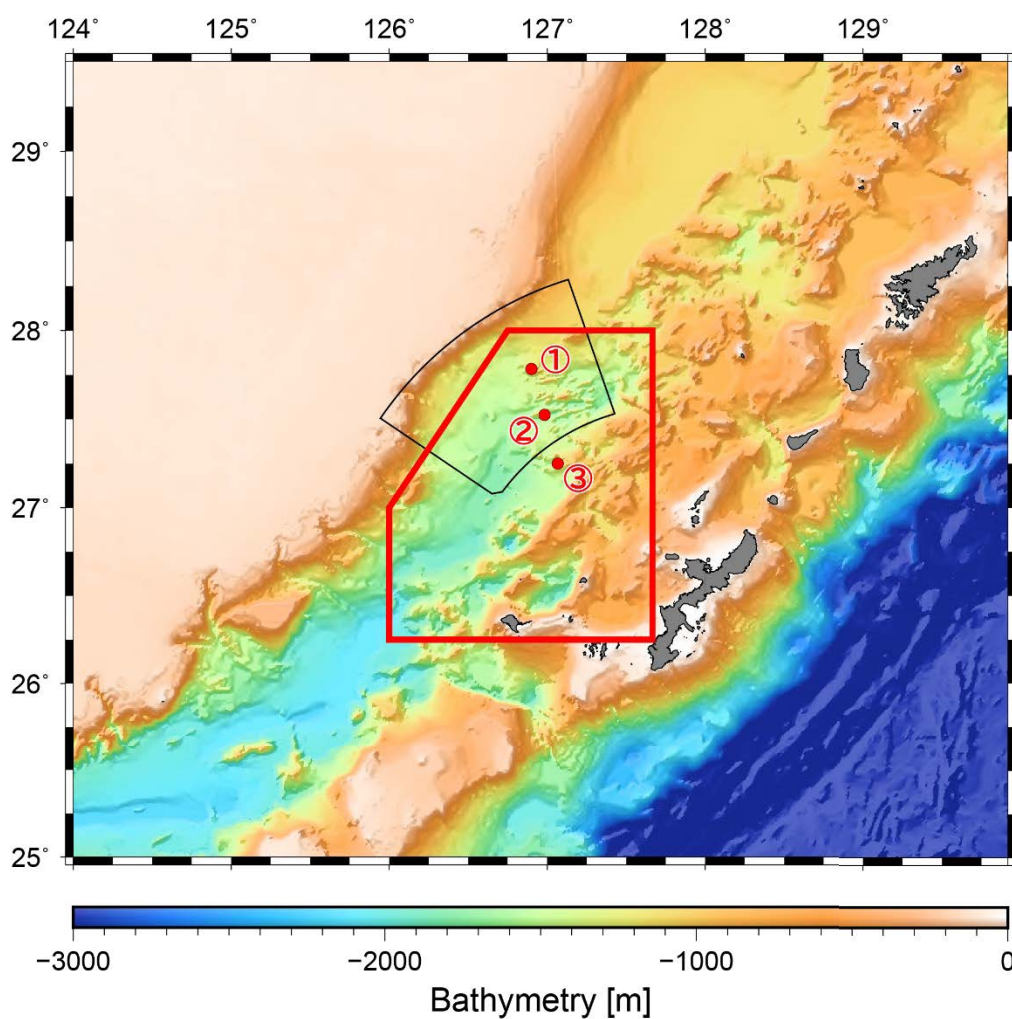


Fig. 1 Scheduled research points.

2. Researchers & Crews

- Chief Researcher	
IHARA Tomonori	Tokyo University of Marine Science and Technology (TUMSAT)
- On-Board Researchers	
KITADA Kazuya	JAMSTEC
NAKABAYASHI Takeya	Mitsui O.S.K. Lines, Ltd.
SASANO Masahiko	National Maritime Research Institute
TODA Kentaro	Tohoku University
AIZAWA Jun	TUMSAT
TAMAIZUMI Retsu	TUMSAT
HAYASHI Daiki	TUMSAT
IKEDA Kohei	Nippon Marine Enterprises
- ROV Kaiko Operating Team	
Submersible Op. Manager	KIDO Teppei
1st Submersible Tec. Officer	IHARA Shota
2nd Submersible Tec. Officer	YAMAGUCHI Taiken
2nd Submersible Tec. Officer	IWATA Kunihiro
2nd Submersible Tec. Officer	ASANO Wataru
3rd Submersible Tec. Officer	ENDO Taisei
- Shinsei Maru Crew Members	
Captain	SHISHIKURA Takaaki
Chief Officer	KAJISA Tomonari
2nd Officer	KUSUMI Keisuke
3rd Officer	KONDO Ryoma
Jr. 3rd Officer	NISHINAKAMA Daigo
Chief Engineer	ABE Tadashi
1st Engineer	MIKAMI Ryuzo
2nd Engineer	INOMOTO Takaatsu
Jr. 2nd Engineer	USUI Yuji
3rd Engineer	SATO Daito
Chief Electronics Op.	SAITAKE Hiroyasu
2nd Electronics Op.	ONIKUBO Ryuji
Jr. 2nd Electronics Op.	KOMAKI Yosuke
Boat Swain	YOSHINO Yuki
Able Seaman	NAKAE Kenji
Able Seaman	KAWAMURA Kosei
Able Seaman	UENO Shinya
Able Seaman	NAKANISHI Toru
Sailor	SEGUCHI Keito
Sailor	YAMADA Ryoya
No.1 Oiler	FUJIWARA Masayuki
Oiler	MIYAZAKI Katsuyuki
Oiler	SATO Daiki
Oiler	WATANABE Seiya
Assistant Oiler	MIZUNO Riku
Chief Steward	NOJIRI Takehiro
Steward	KAWASE Takeshi
Steward	TAKAMA Toshiyuki

3. Cruise Log

Date	Local Time	Note	Position/Weather/Wind/ Sea condition at noon (JST)
Oct. 16th	08:00	Researchers onboarded.	31-05.5N, 130-36.7E
	09:00	Let go all share line and left Kagoshima-honko port for research area.	Off South of Satamisaki
	09:30-10:05	Carried out education and training for researchers.	Weather: bc, Wind: SSE-2
	13:15-13:30	Practiced fire,water proof and lifeboat station drill.	Wave scale: 1, Swell scale: 1
	18:00-18:15	Researchers meeting.	Visibly: 8
Oct. 17th	15:00	Released XBT.	27-43.1N, 127-30.3E
	15:30	Deployed proton magnetometer.	Northwest of Okinawa
	16:19-16:38	Figure-eight for mag. calibration.	Northwest of Okinawa
	16:55	Survey line— IN.	Weather: bc, Wind: ENE-4
	19:58	Survey line — OUT	Wave scale: 3, Swell scale: 2
	20:00-20:20	Figure-eight for mag. calibration.	Visibly: 8
	20:39	Survey line — IN.	
Oct. 18th	06:07	Survey line — OUT.	27-31.0N, 126-58.8E
	07:04	Recovered proton magnetometer.	Iheya Minor Ridge, Noho site
	08:18	Hoisted up HPD.	Weather: bc, Wind: ENE-2
	08:32	Launched HPD #2274.	Wave scale: 2, Visibly: 8
	10:05	HPD landed on the sea bottom. (D=1577 m)	
	15:36	HPD left the sea bottom. (D=1580 m)	
	16:28	HPD refloated.	
	16:44	Recovered HPD& finished the operation.	
	16:57	Deployed proton magnetometer.	
	17:56	Survey line — IN.	
Oct. 19th	05:30	Survey line — OUT.	27-47.4N, 126-53.9E
	07:03	Recovered proton magnetometer.	Iheya North Knoll
	08:31	Hoisted up HPD.	Original site
	08:48	Launched HPD #2275.	Weather: bc, Wind: East-4
	09:40	HPD landed on the sea bottom. (D=1069 m)	Wave scale: 3, Swell scale: 3
	15:39	HPD left the sea bottom. (D=995 m)	Visibly: 8
	16:19	HPD refloated.	
	16:32	Recovered HPD& finished the operation.	
	16:50	Released XBT.	
	17:00	Deployed proton magnetometer.	
	17:40	Survey line — IN.	
	23:58	Survey line — OUT.	
Oct. 20th	00:32	Stopped logging of MBES, SBP, Proton.	29-31.0N, 128-58.2E
	00:40	Left research area and bound for JAMSTEC.	Off the Tokara Islands
	08:03	Recovered proton magnetometer.	Weather: r, Wind: East-3
	08:28-08:47	Figure-eight for mag. Calibration.	Wave scale: 3, Swell scale: 3
			Visibly: 7
Oct. 21st		Transit to JAMSTEC.	32-24.0N, 132-38.9E
	11:00	Engine room tour.	South of Cape Ashizuri
			Weather: o, Wind: East-5
			Wave scale: 5, Swell scale: 3
			Visibly: 8
Oct. 22nd		Transit to JAMSTEC.	34-12.9N, 136-58.1E
			Off the coast of Daiozaki
			Weather: r, Wind: North-5
			Wave scale: 4, Swell scale: 3
			Visibly: 7
	17:30	Researchers meeting	
Oct. 23rd	10:00	Arrived at JAMSTEC Yokosuka HQ.	
	12:00	Researchers disembarked.	

4. Research

4.1. Background and Objectives

Triggered by the Great East Japan Earthquake in 2011, Japan was forced to make a major shift in its energy policy. Currently, over 80% of Japanese primary energy supply now relies on fossil fuels. Recent trade balances show that we are wasting our great revenue by importing fossil fuels. Furthermore, geopolitical risks surrounding resource-producing countries—such as Russo-Ukrainian war and rising tensions in the Middle East—have reached a level that can no longer be ignored, making energy security an urgent issue. The economic losses caused by climate change are also enormous and achieving carbon neutrality has become a critical challenge for Japan. In response to these circumstances, the “Green Transformation (GX) Policy” was established in 2023, which has increased attention on the development and utilization of marine resources. Among these, deep-sea hydrothermal activity has been spotted for its potential in utilizing hydrothermal deposits formed by the discharge of hydrothermal fluids and the precipitation of metal components, which is also clearly stated in the revised “Plan for the Development of Marine Energy and Mineral Resources” of 2024. Recent studies have suggested that it is possible not only to use already existing resources but also to actively develop resources, such as the formation of artificial hydrothermal holes with self-venting hydrothermal discharge¹.

The key point of hydrothermal activity is the transport of thermal fluids accompanied by material transport. The behavior of seafloor hydrothermal fluids has been mainly studied from an oceanographic perspective² while little attention was paid to its potential for energy use. Recently, some studies have begun to treat deep-sea hydrothermal activity as a form of geothermal energy, applying land-based geothermal power generation technologies to the deep sea. Estimates suggest that a single hydrothermal vent could generate up to 20 MW of electricity³. If this “unused” deep-sea hydrothermal energy can be harnessed for power generation, it could serve as a carbon-neutral renewable energy source, enabling not only transmission to the power grid but also the production of synthetic fuels—thus opening up new possibilities for ocean resource utilization and providing a powerful tool for advancing the GX strategy.

However, there are several challenges in utilizing thermal energy from deep-sea hydrothermal activity. First, it is necessary to clarify how heat transport occurs at the seafloor. Investigations conducted under the SIP “Next-Generation Technology for Ocean Resources Exploration” program in the mid-Okinawa Trough have reported the locations of hydrothermal reservoirs in venting areas. While direct heat collection from these reservoirs via artificial hydrothermal vents created through drilling is the simplest method, the high costs of drilling combined with an immature market, make it difficult to foresee viable development. Therefore, collecting heat near the seafloor is currently the most realistic approach, and practical approach shall be developed.

Based on the above background, this study aims to clarify the heat transport phenomena in deep-sea hydrothermal activity and investigate efficient heat collection mechanisms for practical use. It involve measuring hydrothermal fluid flow and spatial temperature distribution, estimating activity duration from a mineralogical perspective, visualizing and describing heat transport from chimneys and high-temperature seafloor areas, and evaluating site potential. Prototype heat collection mechanisms are tested in the field to demonstrate the concept of deep-sea hydrothermal power generation with research dives. Geological/geophysical surveys were also performed to understand the area of investigation along with the dives.

¹ Nozaki, T., Nagase, T., Torimoto, J., Takaya, Y., Ishibashi, J.-i., Shimada, K., Watanabe, M., Masaki, Y., Iijima, K., Kitada, K., Saitoh, M., Yokoyama, T., Akiyama, K., Sakurai, N., Saruhashi, T., Kyo, M., Kumagai, H. and Maeda, L. (2021) *Mineralium Deposita*, 56, 975-990.

² e.g.: Bemis, KG., Silver, D., Xu, G., Light, R., Jackson, D., Jones, C., Ozer, S. and Liu, L. (2015) *Deep Sea Research Part II*, 121, 159-176.

³ e.g.: Matsuoka, T. and Osato, K. (2021) *Fukada Geological Institute*, 22, 67-81.

4.2. Dive Information

KS-25-14 had accomplished two dive opportunities at Iheya Minor Ridge, Noho site at HPD#2274, and Iheya North Knoll, Original site at HPD#2275.

4.2.1. HPD#2274

HPD#2274 operation was carried out at Iheya Minor Ridge, Noho site (27°31.01'N, 126°58.90'E, 1,550 m in depth). Fig. 2 shows the payload for this dive. Payloads are: Stereo camera (not in the figure), binary unit, thermometer, water sampler, STC, SAHF, thermoprofiler. Fig. 3 shows dive track and operation logs. Following description of this dive is noted with the marker indicated in this figure like “(n)” and pictures were numerated like Fig 4-*n* according to the marker. Some marker points have multiple pictures with sub-numbers like Fig.4-*n*-1.

- (1) Landed at the depth of 1,577 m.
- (2) SAHF measurement started.
- (3) Observed C9017A and C9017B.
- (4) Fluid temperature measured 54.4 °C. STC operation.
- (5) Tried to sample chimney.
- (6) Collected SAHF.
- (7) Left at the depth of 1,580 m.

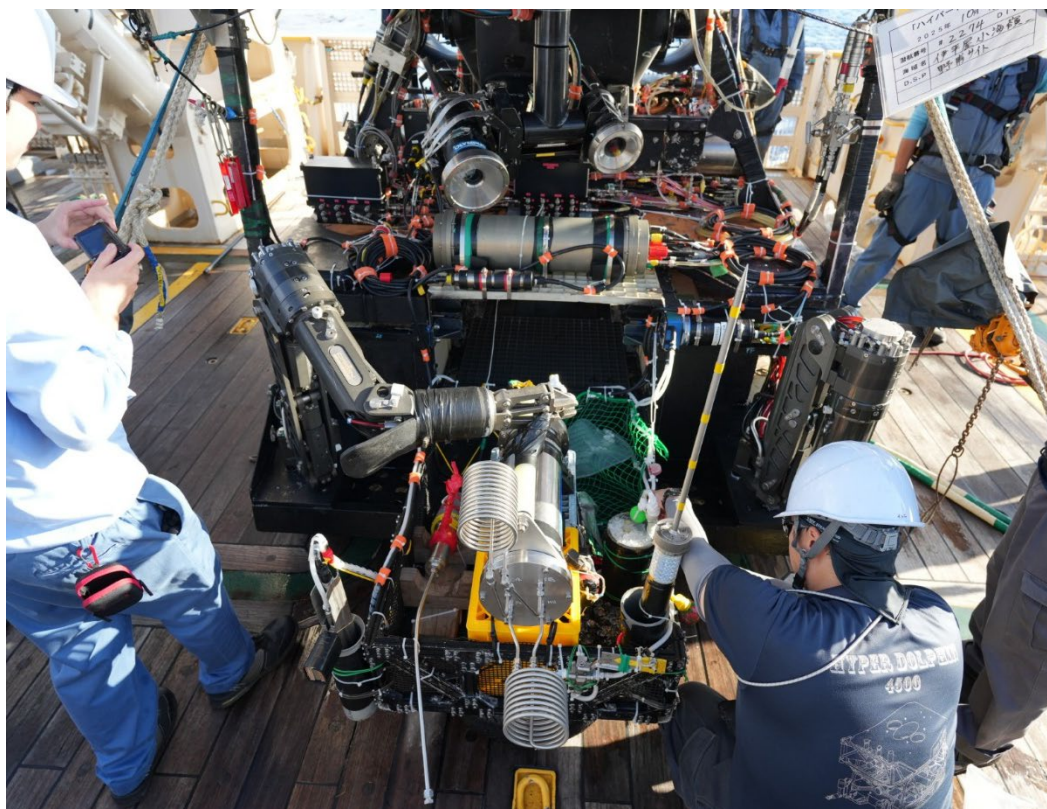


Fig. 2 Payloads on ROV Hyper-Dolphin at HPD#2274.

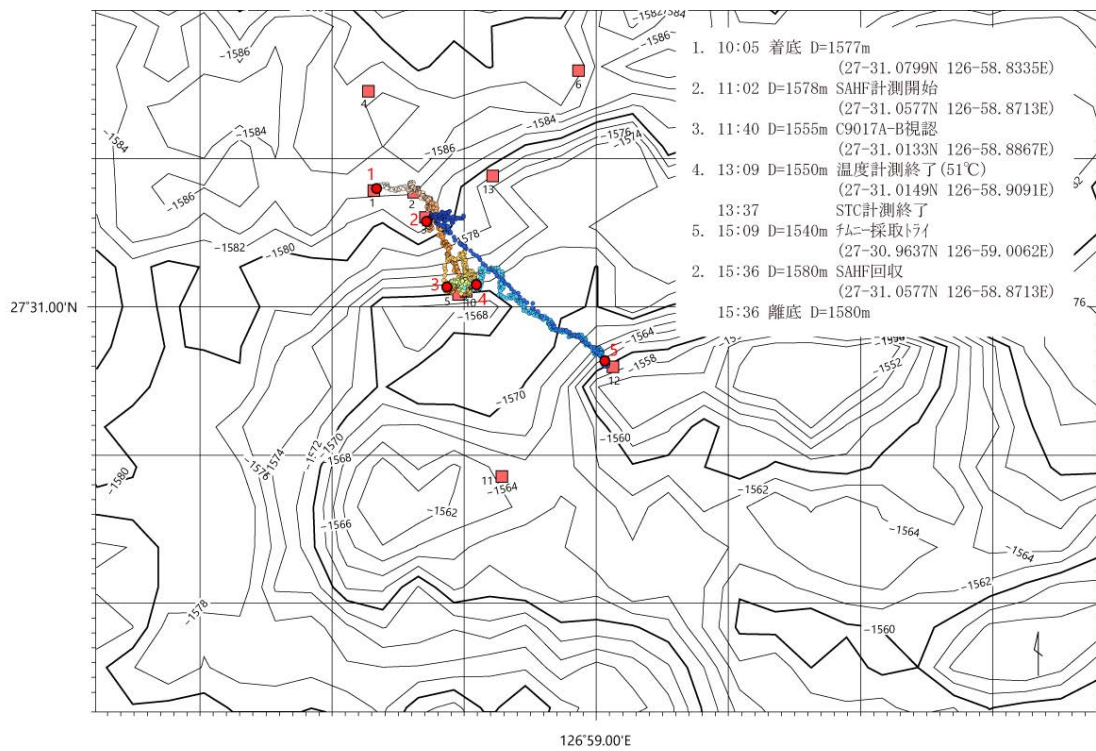


Fig. 3 Dive track of HPD#2274.

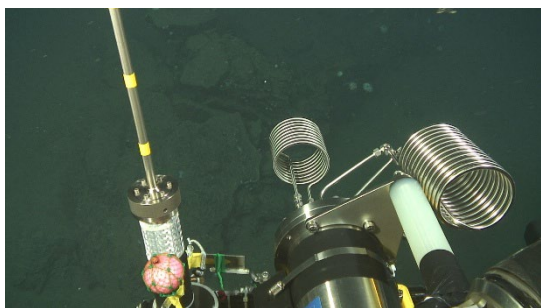


Fig. 4-1 Landed.



Fig. 4-2 SAHF deployed.



Fig. 4-3-1 C9017A covered with chimneys.



Fig. 4-3-2 C9017B.



Fig. 4-4-1 Temperature measurement at the foot of Yubikuwae Chimney.



Fig. 4-4-2 STC operation.

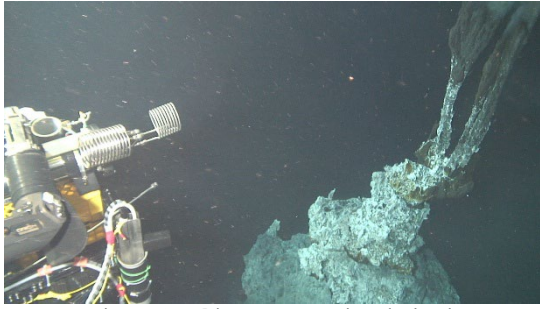


Fig. 4-5-1 Binary operation halted.



Fig. 4-5-2 Sample tried.

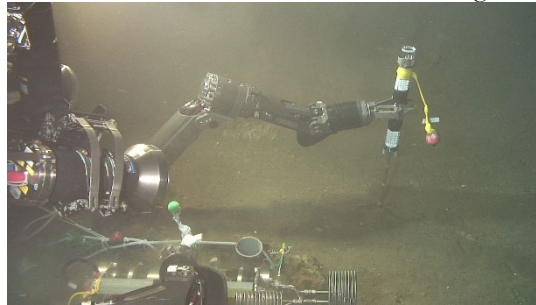


Fig. 4-6 SAHF collected.

4.2.2. HPD#2275

HPD#2275 operation was carried out at Iheya North Knoll, Original site (27°47.45'N, 126°53.80'E, 1,040 m in depth). Fig. 5 shows the payloads: thermometer, water sampler, STC, new gen UVP based flow profiler, thermo-distribution profiler as well as test pieces (not in the figure). Fig. 6 shows dive track and operation logs.

- (1) Landed at the depth of 1,069 m.
- (2) C0014G was observed (Height of 7 m).
- (3) Moved to C9024A. STC operation. R01 sampled. Temperature of the fluid was max. 142.3 °C.
- (4) Landed at the platform of C9024A. Temperature of the fluid was max. 310.9 °C. Flow measurement conducted.
- (5) Thermo-distribution profiling. Temperature of the fluid was max. 94.3 °C.
- (6) North Big Chimney was observed (Height of 20 m).
- (7) C0016B was observed. Temperature of the fluid was max. 292.8 °C. Thermo-distribution profiling. Sampled R02 and R03. Then left the seafloor at the depth of 995 m.

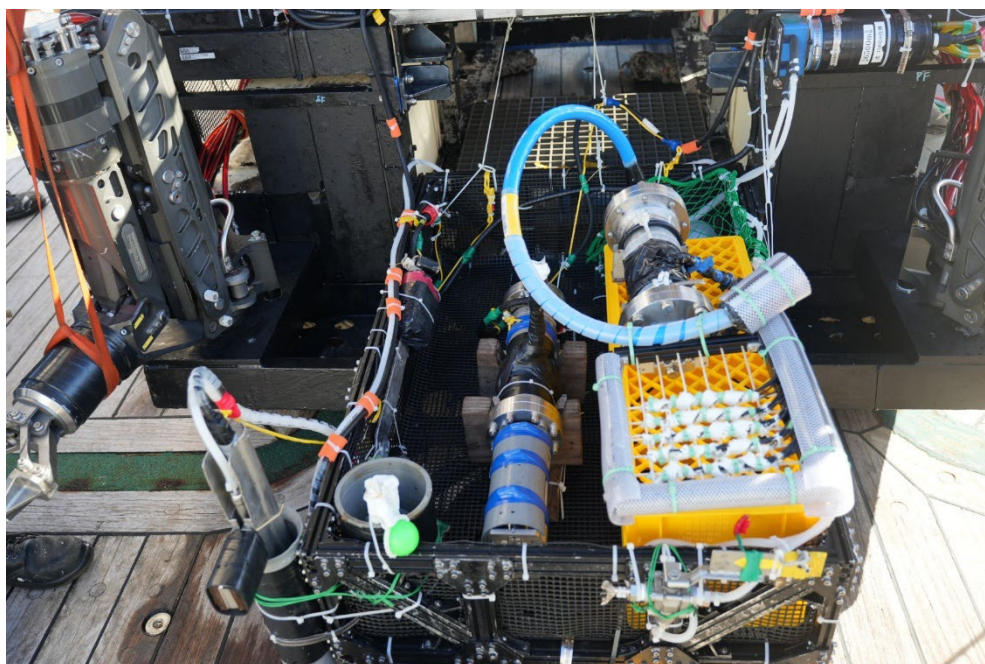


Fig. 5 Payloads on ROV Hyper-Dolphin at HPD#2275.

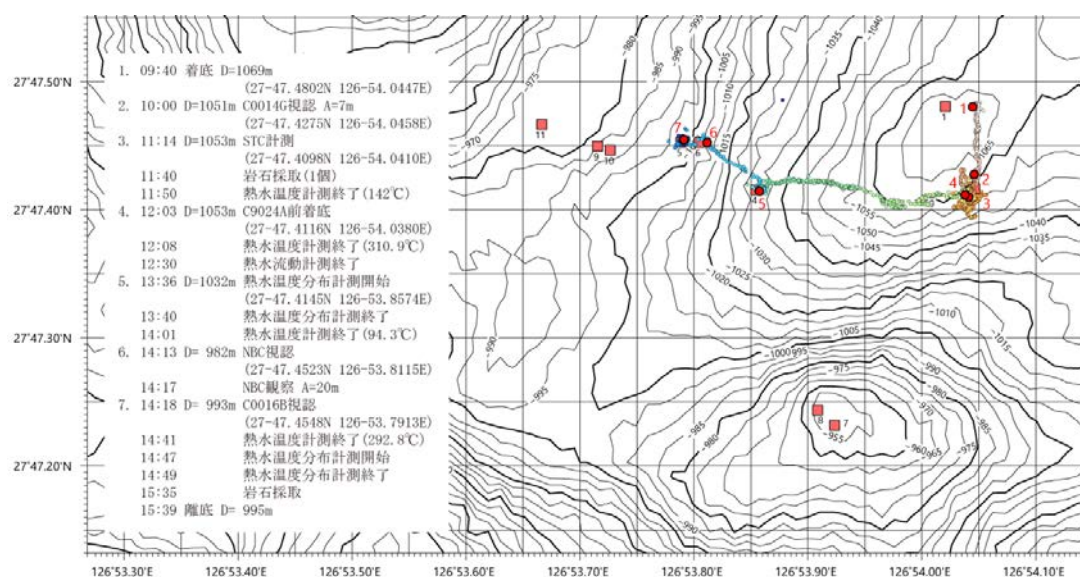


Fig. 6 Dive track of HPD#2275.



Fig. 7-2 C0014G, no active flow.

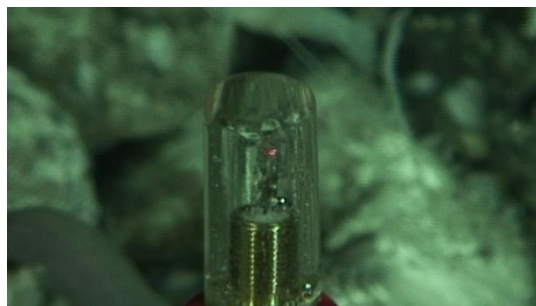


Fig. 7-3-1 STC operation.

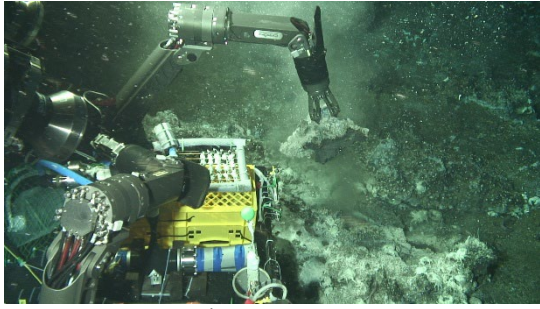


Fig. 7-3-2 R01.

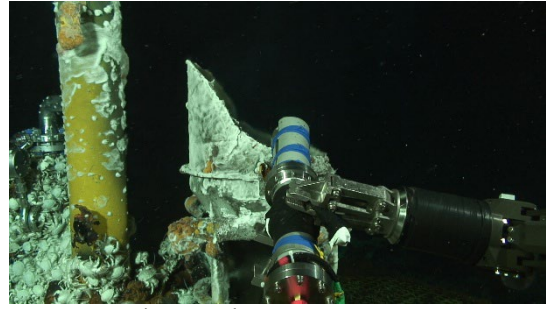


Fig. 7-4 Flow measurement.



Fig. 7-5-1 C0013E, no active flow.

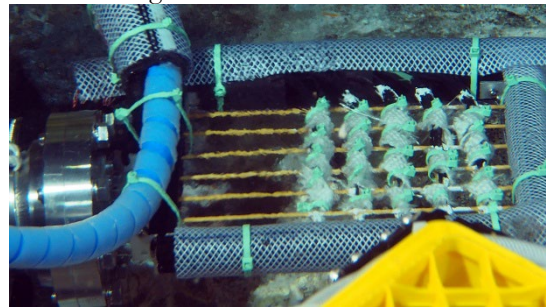


Fig. 7-5-2 Thermo-distribution measurement.

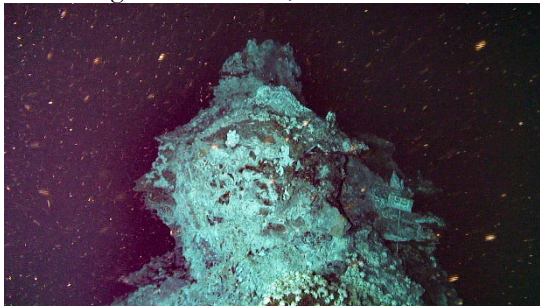


Fig. 7-6 North Big Chimney.



Fig. 7-7-1 C0016B.

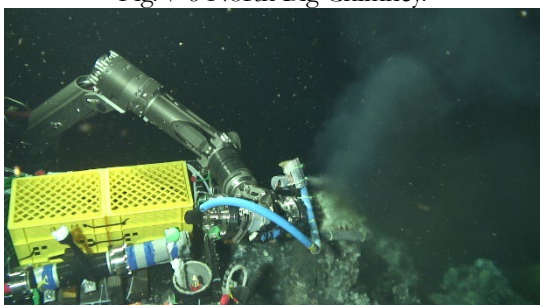


Fig. 7-7-2 Grilling the thermo-distribution device.

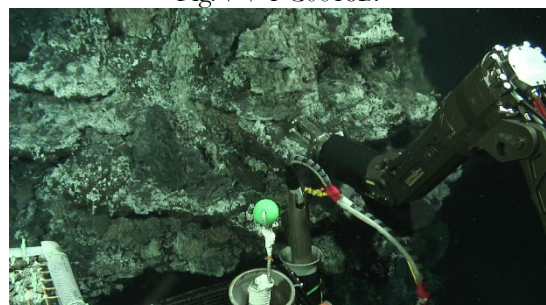


Fig. 7-7-3 Sampling R02.

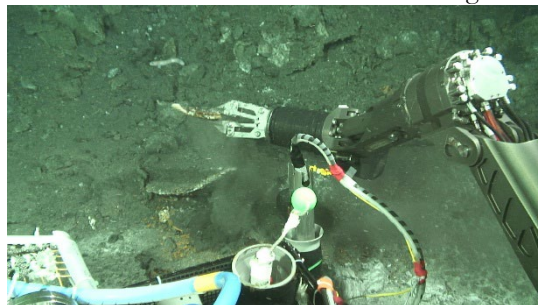


Fig. 7-7-4 Sampling R03.

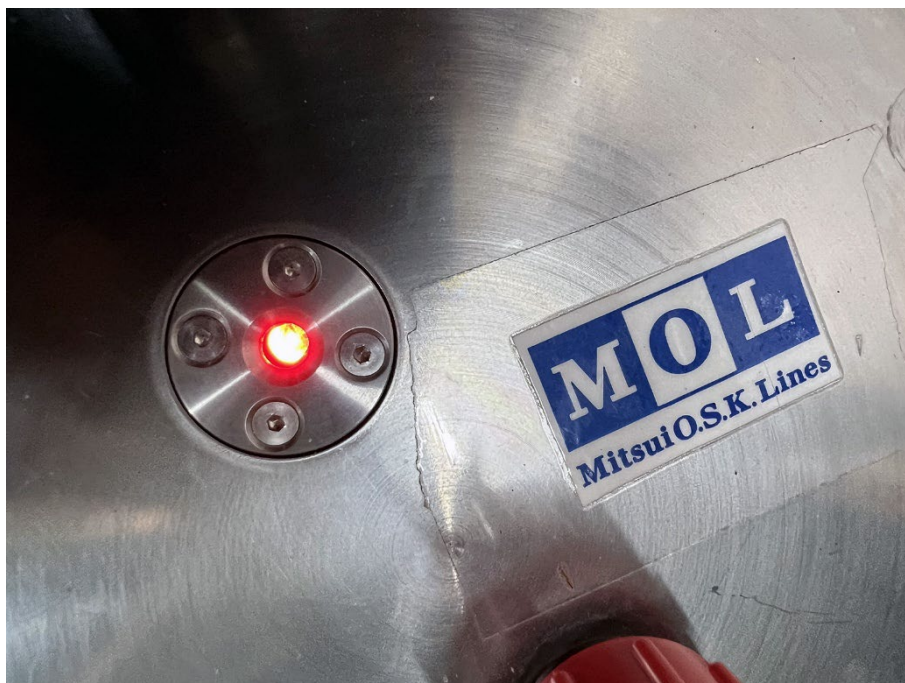
5. Summary

We have tried to live stream the video footage of HPD during the research dives to researchers on land. The streaming was done via Webex meeting system with a standard PC equipped with HDMI capture device and microphone to deliver the discussion from the lab, which was quite easy and said revolutionary experience owing to the broadband satellite Internet system. Data usage was approx. 1 GB/hour, which means the streaming would consume up to 10 GB/day. Considering the scientific values, simultaneous collaboration with researchers on land would be a standard soon.

We only had two dives but gained valuable samples/data as well as knowledges. It was astonishing that many corrosion caps deployed one decade ago were completely covered by deposits. Hydrothermal activity in mid-Okinawa trough is quite aggressive and this fact gives us some insights when it comes to the engineering usage. Some payloads experienced water tight failure and we were trying to recover and retry at the third dive, which became reluctantly cancelled due to the sea condition not at the dive point but on the way back to Yokosuka. Further research work and discussions shall follow.

Our great appreciation goes to HPD op. team crews, Mr. Kido, Mr. Ihara, Mr. Yamaguchi, Mr. Iwata, Mr. Asano and Mr. Endo as well as R/V Shinsei Maru crews (Capt. Shishikura). Many support and work by Dr. Yamamoto and Dr. Kashima also enabled this research cruise.

Last but not least, this cruise was enabled by many works of Atmosphere and Ocean Research Institute (AORI) at the university of Tokyo, and The Institute for Marine-Earth Exploration and Engineering (MarE3) at JAMSTEC. We express our sincere gratitude to them too.



Notice on Using

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

This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

Users of information on this report are requested to submit Publication Report to Cooperative Research Cruise office.

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KS-25-14（新青丸）共同利用研究航海報告書

- * 航海番号 KS-25-14次研究航海
- * 航海名称 深海熱水活動における熱輸送現象の解明とその活用に向けた効率的な集熱機構の探索
Clarification of Heat Transport Phenomena in Hydrothermal Systems and Investigation of Efficient Heat Collection Mechanisms
- * 観測海域 中部沖縄トラフ海域
Mid-Okinawa Trough area
- * 航海期間 令和7年10月16日（木）～令和7年10月23日（木）
- * 出港日時・場所 10月16日09時 鹿児島港
- * 入港日時・場所 10月23日10時 横須賀港
- * 寄港期間・場所 無し
- * 研究課題 深海熱水活動における熱輸送現象の解明とその活用に向けた効率的な集熱機構の探索
- * 主席研究員（氏名・所属・職名）
井原 智則・東京海洋大学・准教授
- * 研究内容、主調査者、観測項目
1. 熱水流動計測および熱水温度計測，井原智則，熱水の流動および温度・温度分布
 2. 熱水エネルギーを利用した発電検証，井原智則，小型バイナリー発電実証および半導体増感型熱利用発電実証
 3. 地中温度計による計測，北田数也，SAHF 計測
 4. 岩石試料の採取，戸田賢太郎，岩石の組成
 5. 海底地形調査および熱水プルーム探査，北田数也，MBES 測線調査
 6. 地球物理観測，北田数也，三成分磁力計・プロトン磁力計計測
- * 乗船研究者氏名・所属・職名
- | | | |
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| 中林 岳也 | 商船三井 | 主任研究員 |
| 篠野 雅彦 | 海上技術安全研究所 | グループ長 |
| 戸田 賢太郎 | 東北大学 | 大学院生 |
| 相澤 惇 | 東京海洋大学 | 大学院生 |
| 玉泉 烈 | 東京海洋大学 | 学部生 |
| 林 大輝 | 東京海洋大学 | 学部生 |

* 航跡・測点図

