



R/V Kairei Cruise Report

KR18-14 Leg 1



Furtherance of pioneering scientific research on seafloor mineral resources using an artificial hydrothermal vent: Kuroko-ore cultivation, monitoring of hydrothermal fluid, deep-sea electric generation, ORP and resistivity measurements, and elucidation of electric ecological system

18th Oct. 2018 – 31st Oct. 2018

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

Contents

1. Cruise Information
2. Researchers and Crews
3. Observations
 - 3.1 Objectives & Background
 - 3.2 Methods & Instruments
 - 3.3 Dive Information & Preliminary Results
4. Notice of Using

1. Cruise Information

- Cruise ID: KR18-14 Leg 1
- Name of vessel: R/V Kairei
- Title of the cruise: Furtherance of pioneering scientific research on seafloor mineral resources using an artificial hydrothermal vent: Kuroko-ore cultivation, monitoring of hydrothermal fluid, deep-sea electric generation, ORP and resistivity measurements, and elucidation of electric ecological system
- Title of proposal: Kuroko-ore cultivation, monitoring of hydrothermal fluid, deep-sea electric generation, ORP and resistivity measurements, and elucidation of electric ecological system
- Cruise period: 18th, October 2018 to 31st, October 2018
- Ports of departure and arrival: Yokosuka HQ to Kagoshima
- Research area: Iheya-North Knoll, southern flank of Iheya Minor Ridge and Izena Hole at Middle Okinawa Trough
- Research Map:

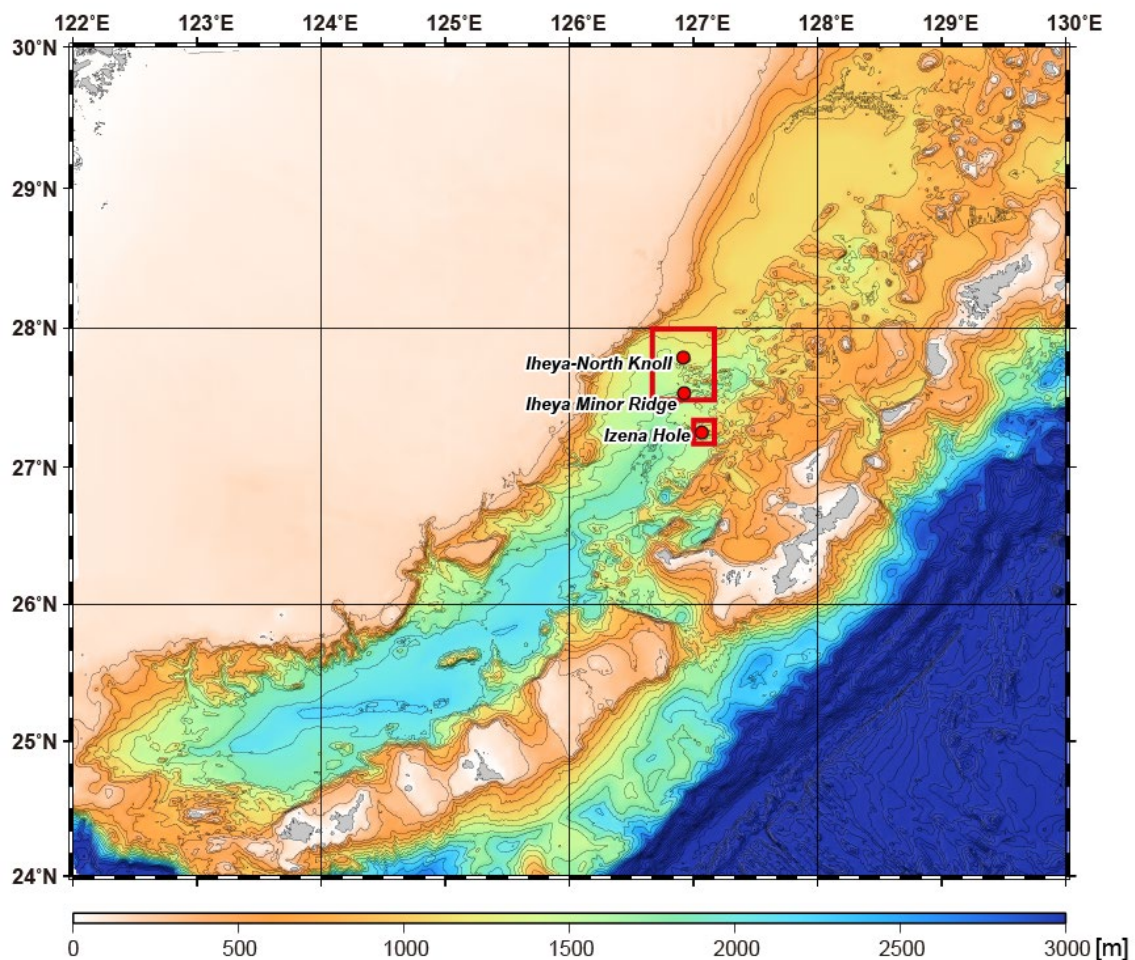


Fig. 1-1 Investigation area map of the KR18-14 Leg 1 Cruise.

2. Researchers and Crews

● Chief scientist

Tatsuo Nozaki [JAMSTEC]

● Representative of the science party

Tatsuo Nozaki [JAMSTEC]

● Science party

Masayuki Watanabe (JAMSTEC)

Koichi Iijima (JAMSTEC)

Kazuya Kitada (JAMSTEC)

Junji Torimoto (JAMSTEC)

Tomonori Ihara (JAMSTEC / Tokyo Univ. of Marine Science and Technology)

Koki Tajima (JAMSTEC / Tokyo Univ. of Marine Science and Technology)

Toshiro Nagase (JAMSTEC / Tohoku Univ.)

Keita Omori (JAMSTEC / Tohoku Univ.)

Yutaro Takaya (JAMSTEC / Waseda Univ.)

Makoto Nagasawa (JAMSTEC / Waseda Univ.)

Takuro Ikeshima (JAMSTEC / Hokkaido Univ.)

Shunsuke Horai (JAMSTEC / Kyushu Univ.)

Yasuyuki Fukushima (IHI)

Morifumi Takaesu (NME)

● Kairei Crew Members:

Master	Yoshiyuki Nakamura
Chief Officer	Tetsuo Shirayama
2nd Officer	Syunsuke Fujii
3rd Officer	Tatsumi Deguchi
Chief Engineer	Kazuhiko Kaneda
1st Engineer	Shinichi Ikuta
2st Engineer	Akira Hanawa
3rd Engineer	Shohei Miyazaki
Chief Electronics Operator	Tokinori Nasu
2nd Electronics Operator	Ryosuke Matsui
3rd Electronics Operator	Misato Taki

Boat Swain	Kaname Hirosaki
Quarter Master	Yasuo Konno
Quarter Master	Shuichi Yamamoto
Quarter Master	Nao Ishizuka
Sailor	Kenta Nasu
Sailor	Toshiya Saga
Sailor	Taisei Tanaka
Sailor	Ryo Nakanishi
No.1 Oiler	Junji Mori
Oiler	Toshinori Matsui
Oiler	Ryo Sato
Oiler	Makoto Kozaki
Assistant Oiler	Fubuki Homma
Chief Steward	Kazuhiro Hirayama
Steward	Tatsuya Hirai
Steward	Masaru Sugiyama
Steward	Koki Shinohara
Steward	Yuki Shirasaki

● Kaiko Operation Team

Submersible Op. Manager	Tomoe Kondo
1st Submersible Tec. Officer	Homare Wakamatsu
2nd Submersible Tec. Officer	Ryu Asai
2nd Submersible Tec. Officer	Seiji Shigetake
2nd Submersible Tec. Officer	Shota Ihara
2nd Submersible Tec. Officer	Takuma Goto
2nd Submersible Tec. Officer	Yuta Yamamuro
2nd Submersible Tec. Officer	Ryo Saigo
3rd Submersible Tec. Officer	Naoki Sato

3. Observation

3.1 Objectives & Background

There are several active hydrothermal sites in the Okinawa Trough within the Japanese Exclusive Economic Zone. Cu-Pb-Zn-rich sulfide deposits occurring at these hydrothermal sites are considered to be a modern analogue of the Kuroko-type volcanogenic massive sulfide (VMS) deposits on land (e.g., Halbach et al., 1989, 1993, 1997). In 2010, the drilling research cruise of the IODP Exp. 331 was conducted at the Iheya-North Knoll, middle Okinawa Trough (Takai et al., 2011, 2012; Yanagawa et al., 2016), whose main purpose of this expedition was unravelling “Deep-Hot Biosphere”. The massive sulfide core sample was successfully obtained (Yeats et al., 2017) and four artificial hydrothermal vents were formed during this expedition (Takai et al., 2012). Semi-annual ROV dive expeditions were performed to observe and collect fluid/rock samples from these artificial hydrothermal vents (Kawagucci et al., 2013). On the bare hole artificial hydrothermal vent formed at the NBC (North Big Chimney) mound, Iheya-North Knoll (Hole C0016A), rapid growth of chimney which became a 15 m height in 25 months was observed (Kawagucci et al., 2013; Nozaki et al., 2016). The sulfide-rich part of this rapidly grown chimney on the artificial hydrothermal vent has a similar chemical composition to that of high-grade Kuroko VMS ore on land (Nozaki et al., 2016). These observations inspired us “cultivation of seafloor mineral deposits” by controlling mixture and quench processes between hydrothermal fluid and ambient cold seawater through the Kuroko-ore cultivation apparatus which was collaboratively developing by the Research and Development (R&D) Center for Submarine Resources and the Center for Deep Earth Exploration (CDEX) at JAMSTEC. Totally three unique apparatuses have been installed at two hydrothermal sites, Original Site at the Iheya-North Knoll (Hole C9024A) and Noho Site at the southern flank of the Iheya Minor Ridge (Hole C9017B) in the Okinawa Trough during the CK16-01 Cruise as well as at the Noho Site (Hole C9017A) during the CK16-05 Cruise.

During the NT16-02 Cruise, we have done an *in-situ* function test of various hydraulic power tools for the future recovery operation of the Kuroko-ore cultivation apparatus using a ROV. The isolated hydraulic power unit (IHPU), hydraulic short drill and chisel were used at Hole C0014G of the Iheya-North Knoll, so as to remove a sulfide scale within the steel pipe on the corrosion cap, and then to install a temporal flowmeter after rejuvenation of hydrothermal fluid effluent. In this dive expedition, seawater invaded within the IHPU even into its controlling electric circuit. Thus, the IHPU became out of order and we have failed to install the temporal flowmeter at Hole C0014G. Based on the many important and precious experiences during the NT16-02 Cruise, the IHPU was repaired/improved, and ROV hydraulic tools including the IHPU functioned well during the CK16-01, CK16-05, KR16-17 and KR18-02C Cruises, which means that our ROV hydraulic tools became technically robust. Moreover, in the KR16-17 and KR18-02C Cruises, we have successfully recovered the three Kuroko cultivation apparatuses installed at Holes C9017A, C9017B and C9024A

during the CK16-01 and CK16-05 Cruises by using the IHPU with other ROV hydraulic tools.

In the KR18-14 Leg 1 Cruise, our main purposes were (1) installation of Kuroko-ore cultivation apparatus directly on a natural hydrothermal vent having gold adsorption apparatus and some seed crystals, (2) removal of scale within the steel pipe of the corrosion cap at Hole C0014G using a remodeled hydraulic power drill, (3) installation of the temporal flowmeter if hydrothermal fluid will discharge from Hole C0014G again, (4) flow rate measurement of hydrothermal fluid using ultrasonic waves, (5) installation and recovery of the gold adsorption apparatus, (6) sampling of rock and hydrothermal fluid and (7) observing drill holes formed during the CK16-01 and CK16-05 Cruises.

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- Yeats, C. J., Hollis, S. P., Halfpenny, A., Corona, J.-C., LaFlamme, C., Southam, G., Fiorentini, M., Herrington, R. J. and Spratt, J. (2017) Actively forming Kuroko-type volcanic-hosted massive sulfide (VHMS) mineralization at Iheya North, Okinawa Trough, Japan. *Ore Geology Reviews*, **84**, 20-41.

3.2 Methods & Instruments

3.2.1 Isolated hydraulic power unit (IHPU)

IHPU is a supply unit of hydraulic pressure to various tools equipped with a ROV (Fig. 3-1). The IHPU is isolated with the hydraulic power system of the ROV. So, if the IHPU was damaged and seawater invaded into this tool, the hydraulic power system of the ROV will be protected.

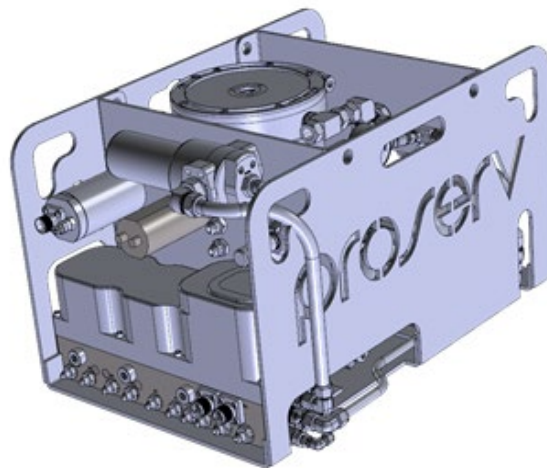


Fig. 3-1 Isolated hydraulic power unit (IHPU).

3.2.2 Hydraulic power drill

Hydraulic power drill was developed to remove scale within the steel pipe of the corrosion cap at Hole C0014G (Fig. 3-2). The hydraulic power of this drill is supplied from the IHPU and its stroke lengths are 32 and 64 inch, respectively, by using two different drill rods whose lengths are 32 and 64 inch although the maximum extension length of cylinder is 32 inch. This drill is a remodeled version from the old shot and long hydraulic power drills whose drilling strokes are 5 and 16 inch, respectively. This remodeled hydraulic power drill is fixed on the steel pipe by anchor clasp during the operation.

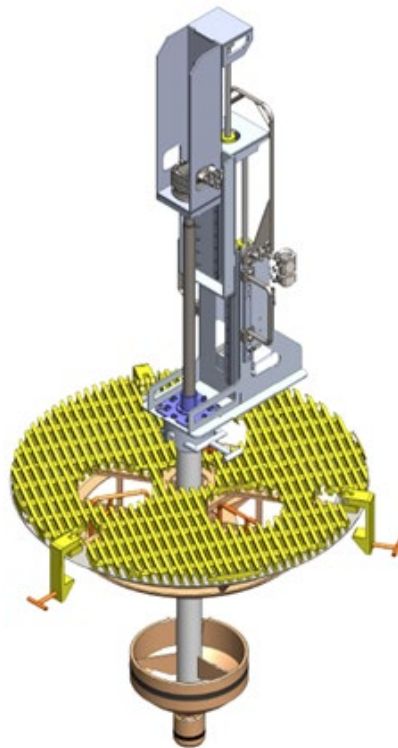


Fig. 3-2 Remodeled hydraulic power drill.

3.2.3 Kuroko-ore cultivation apparatus installed directly on a seafloor

Kuroko-ore cultivation apparatus has a circle mount to be installed directly on a natural hydrothermal vent and four vents for hydrothermal fluid with CFRP body to reduce the total weight in water (Fig. 3-3).

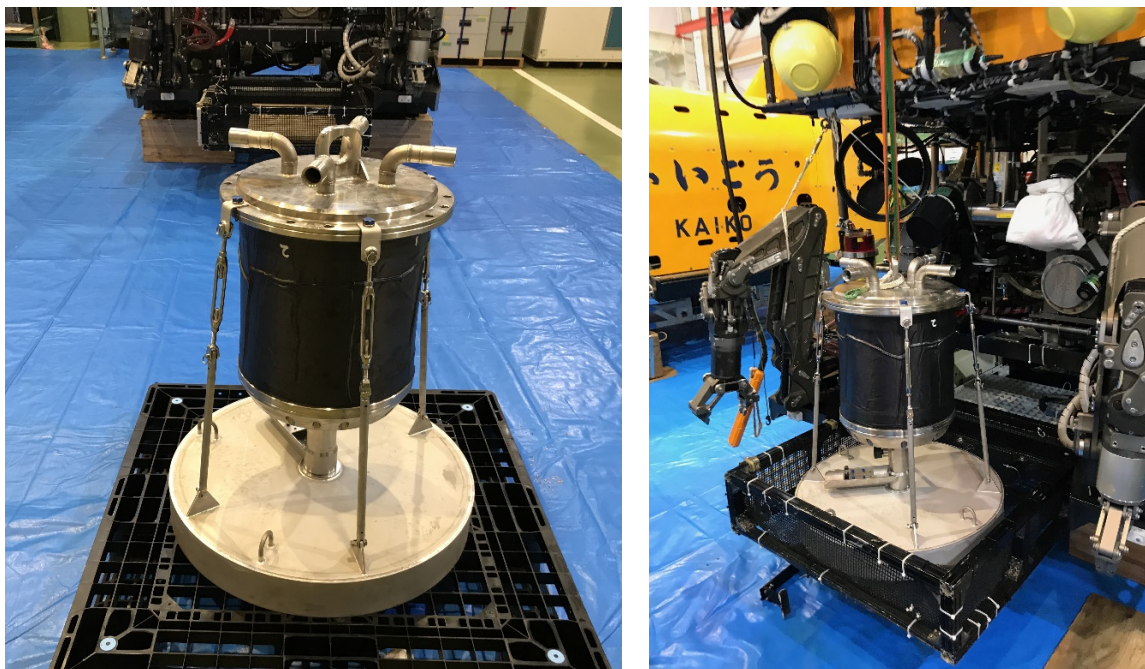


Fig. 3-3 Kuroko-ore cultivation apparatus installed directly on a seafloor.

One P/T sensor can be equipped with the basal part of this apparatus to monitor the pressure and temperature of hydrothermal fluid. In this cruise, gold adsorption material and seed crystals of pumice and pyrite are set into the inside of the Kuroko-ore cultivation apparatus.

3.2.4 Temporal flowmeter

Temporal flowmeter has both analogue and digital flowmeters together with pressure and temperature gauges and their sensor loggers (Fig. 3-4). We tried to install this temporal flowmeter after removing a sulfide scale within the steel pipe of the corrosion cap and rejuvenation of hydrothermal effluence at Hole C0014G to measure temperature, pressure and flow rate of hydrothermal fluid.

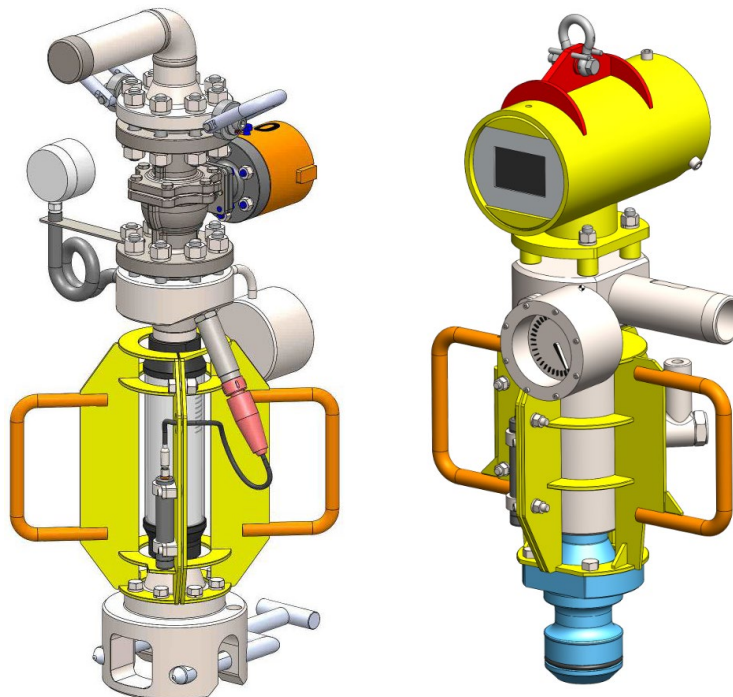


Fig. 3-4 Temporal flowmeter with pressure, temperature gauges and their sensor loggers. Right one is a revised type whose indicator of flow rate has a digital panel.

3.2.5 Hydrothermal flow rate measurement apparatus using ultrasonic waves

This apparatus was developed to measure the distribution of flow velocity of the hydrothermal fluid (Fig. 3-5) and flow rate can be estimated to be integrated the flow velocity distribution. This apparatus is equipped with transmitter and receiver of ultrasonic waves and sensor part, and flow velocity is calculated by the Doppler effect. Electric power of AC100V and 5A is supplied by ROV with data connection via the Ethernet cable.



Fig. 3-5 Hydrothermal flow rate measurement apparatus using ultrasonic waves.

3.2.6 Gold adsorption apparatus

This apparatus contains a special gold adsorption material enclosed by a glass wool. This apparatus was installed at a natural hydrothermal vent to adsorb gold selectively from hydrothermal fluid.



Fig. 3-6 Gold adsorption apparatus.

3.2.7 Concrete test block

Concrete test blocks including different microorganisms are installed on a deep-seafloor to monitor the degradation of the concrete block.

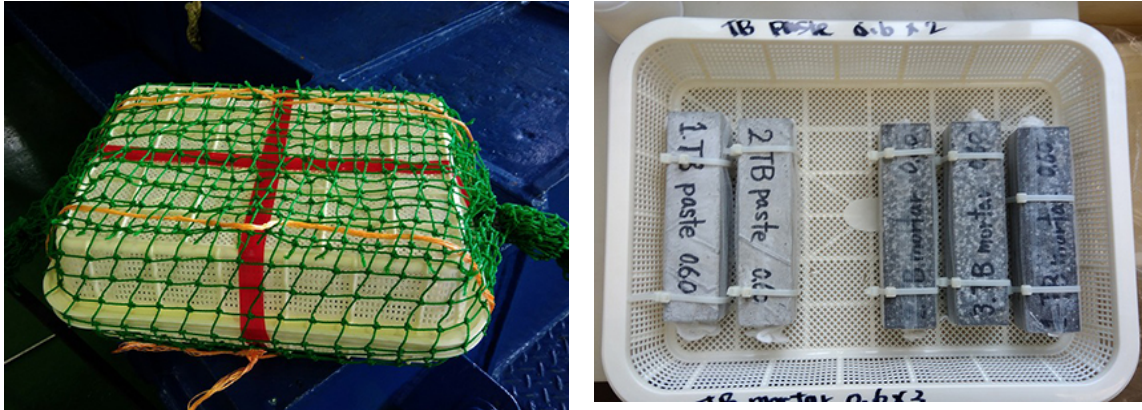


Fig. 3-7 Concrete test block.

3.3 Dive Information & Preliminary Results

3.3.1 KK#795 dive (21st October 2018) at the Original Site, Iheya-North Knoll

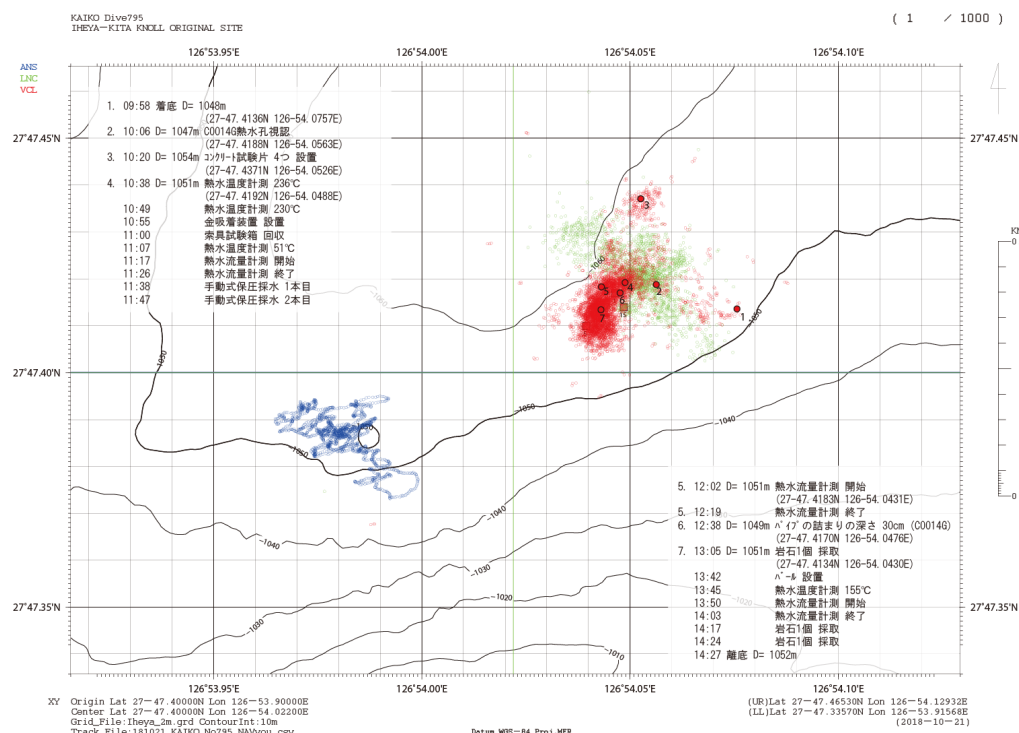


Fig. 3-8 Dive track and operation list of the KK#795 dive on a bathymetric map.

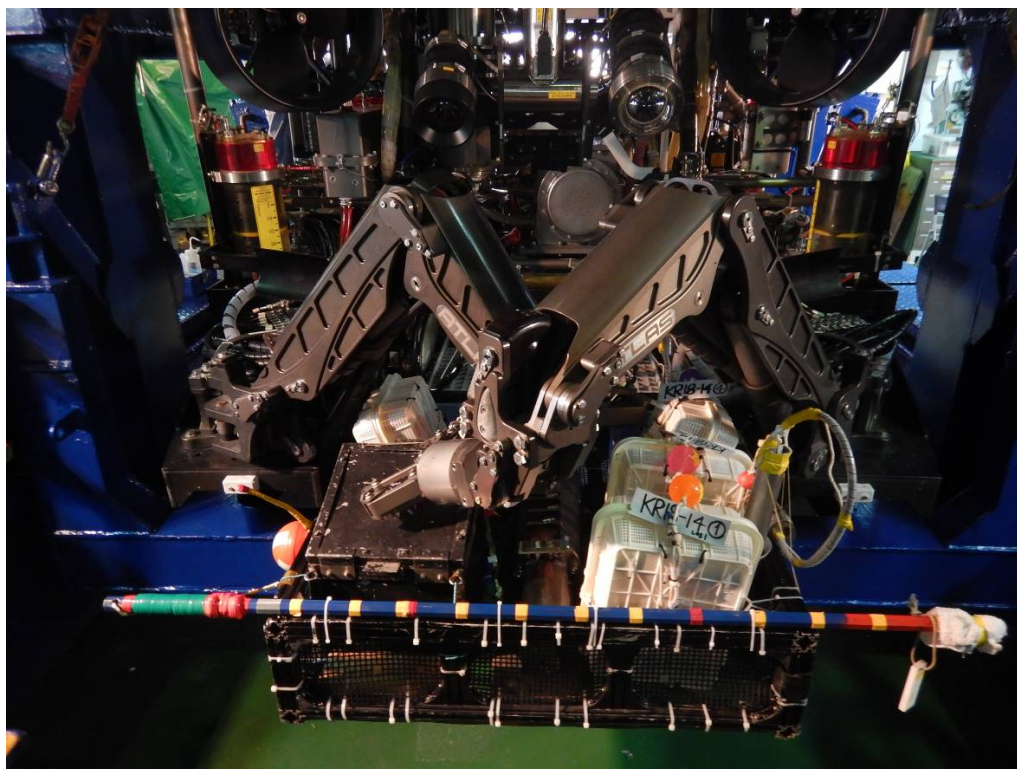


Fig. 3-9 Payload of the KK#795 dive.

Payload:

Long pinch bar x 1, gold adsorption apparatus x 1, hydrothermal flow rate measurement apparatus x 1, concrete test block x 4, handy-type vacuum water sampler x 2, thermometer for hydrothermal fluid x 1, isolated hydraulic power unit (IHPU) x 1, Morinaga x 2, covered box x 1.

Operation:

ROV KAIKO MK-IV moved to Hole C0014G to check the actual position, and then moved to 30 m northward to install four concrete test blocks on a seafloor without hydrothermal discharge (Fig. 3-10). Then, the ROV moved to near Hole C9024A to seek the suitable natural hydrothermal vent to install the gold adsorption apparatus. The gold adsorption apparatus was decided to be installed at the almost same position of the test box with different kinds of rope installed during the KR18-02C Cruise (Figs. 3-11 and 3-12). Before installing the gold adsorption apparatus, small chimney was destroyed by the thermometer for hydrothermal fluid and the temperature of hydrothermal fluid was measured by thermometer ($T_{\max} = 230^{\circ}\text{C}$). Then, the gold adsorption apparatus was installed on a natural hydrothermal vent, followed by recovery of the test box with different kinds of rope, temperature measurement of hydrothermal fluid ($T_{\max} = 51^{\circ}\text{C}$), hydrothermal flow rate measurement using ultrasonic waves and hydrothermal fluid sampling by handy-type vacuum water sampler (Figs. 3-11 to 3-14). After hydrothermal fluid sampling, the ROV moved to Hole C0014G again to measure the hole depth in the steel vent pipe on the corrosion cap by using a long pinch bar (Fig. 3-15). The hole depth in the steel vent pipe was ca. 30 cm due to the drilling operation using an old long hydraulic power drill whose maximum stroke is 16 inch in the KR18-02C Cruise. After the observation of seafloor and hydrothermal discharge in the periphery of Holes C0014G and 9024A, the installing point of the Kuroko-ore cultivation apparatus was decided, where was flattened by long pinch bar, followed by hydrothermal flow rate measurement by ultrasonic waves. Totally, three rock samples (KK#795R01 to R03) were obtained during this dive survey.

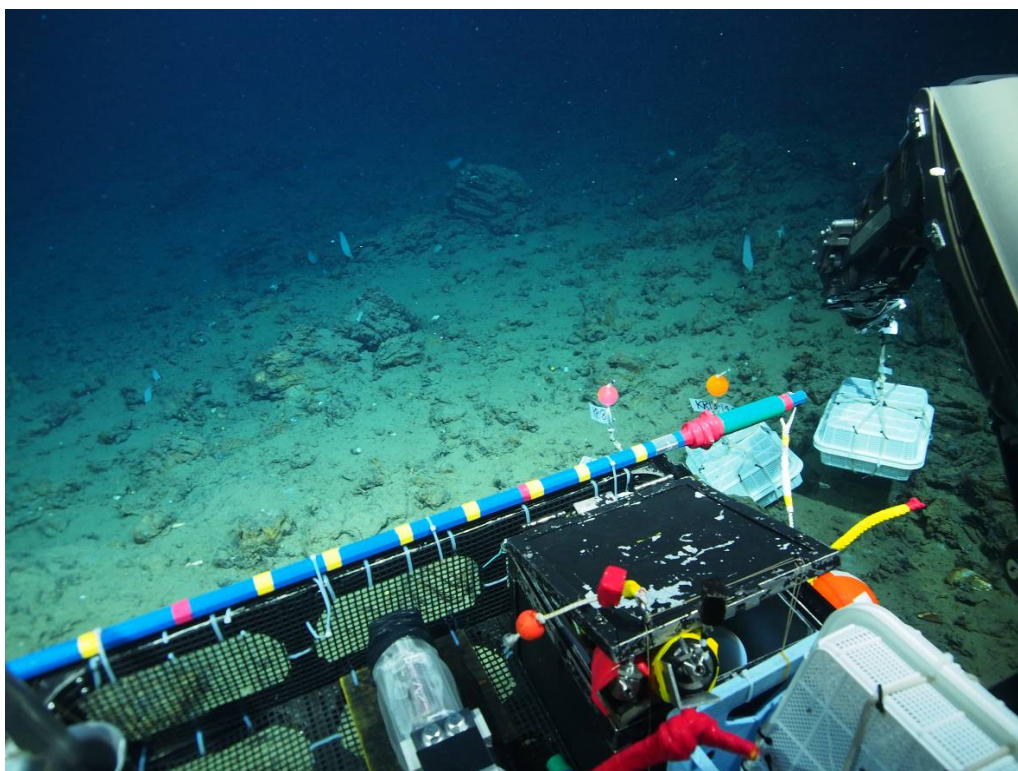


Fig. 3-10 Installation of the concrete test blocks at 30 m northward from Hole C0014G.

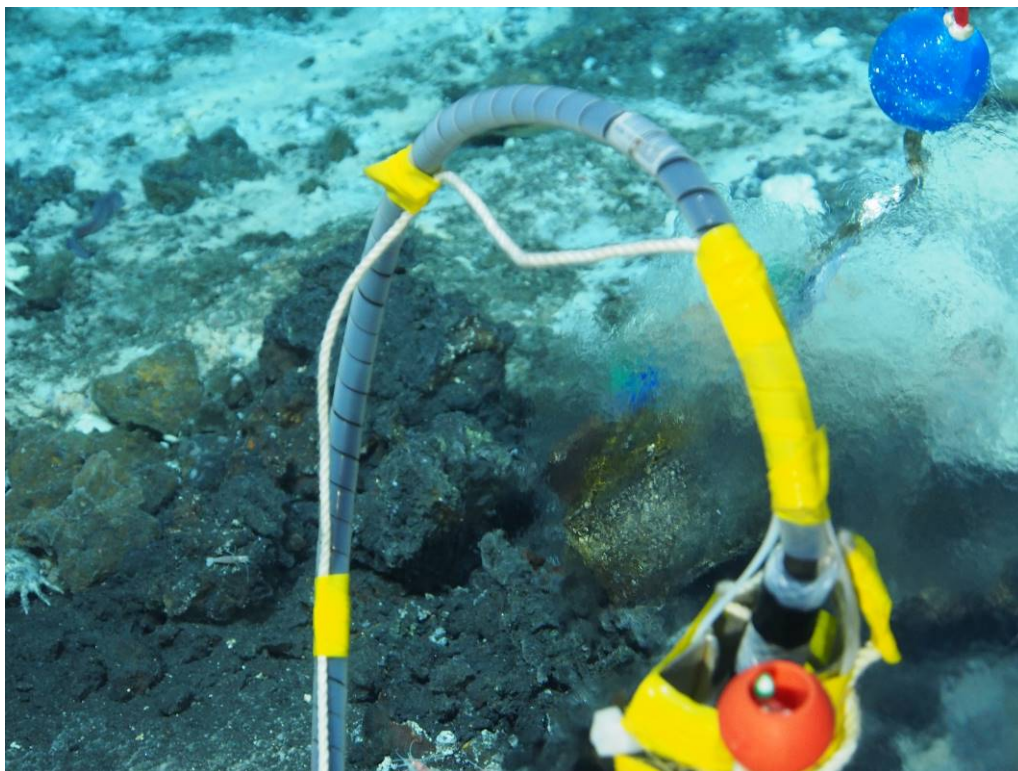


Fig. 3-11 Installation of the gold adsorption apparatus near Hole C0014G.

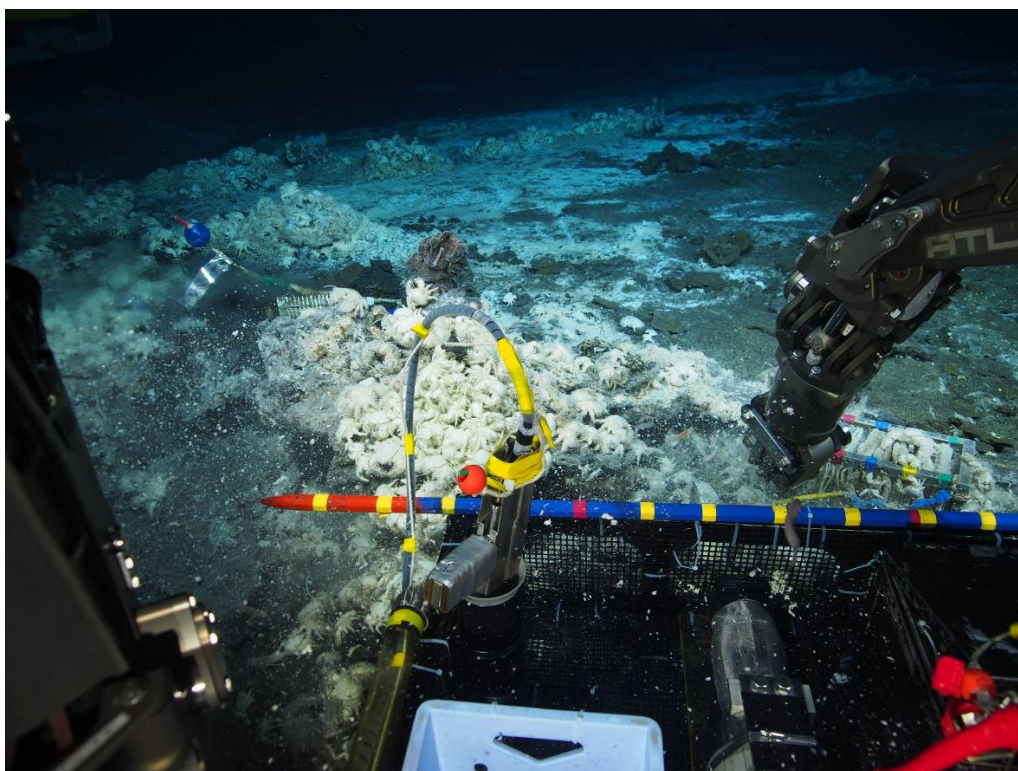


Fig. 3-12 Recovery of the test box with different kinds of rope installed during the KR18-02C Cruise.

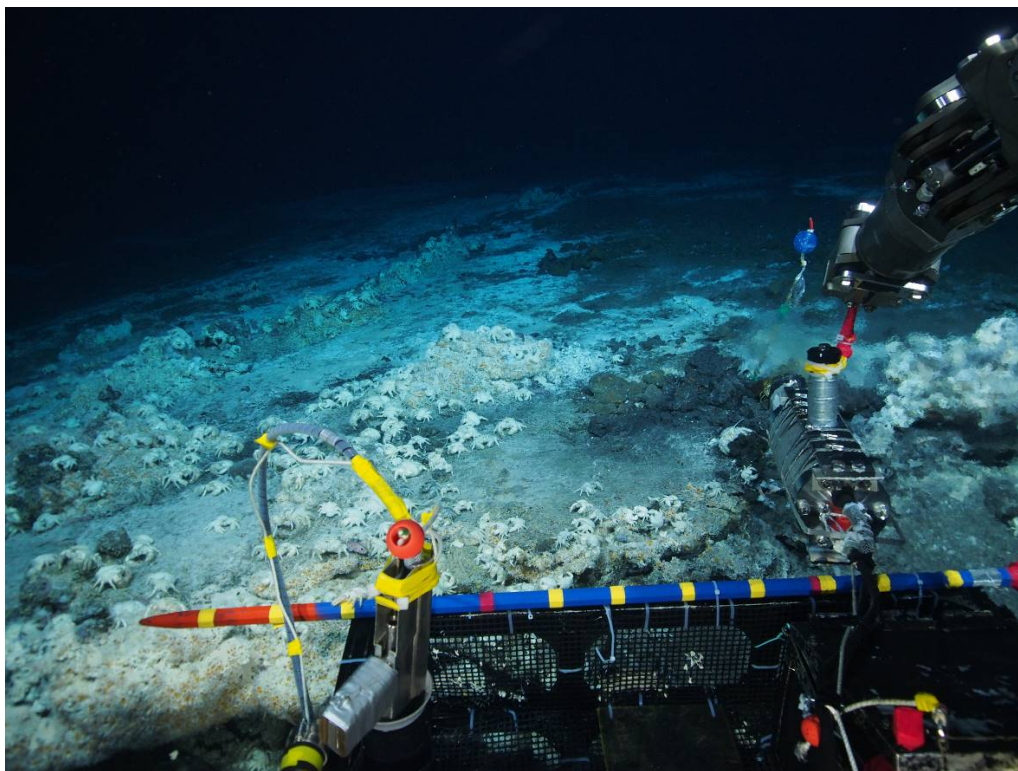


Fig. 3-13 First hydrothermal flow rate measurement in this cruise using ultrasonic waves.

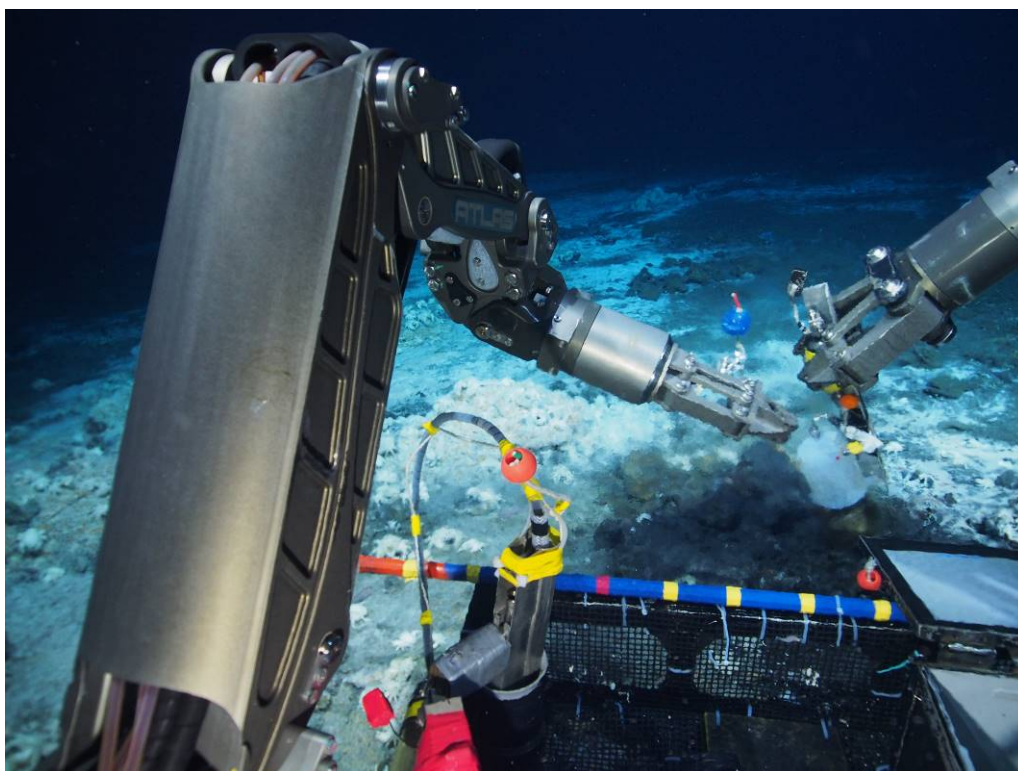


Fig. 3-14 Hydrothermal fluid sampling using a handy-type vacuum water sampler.

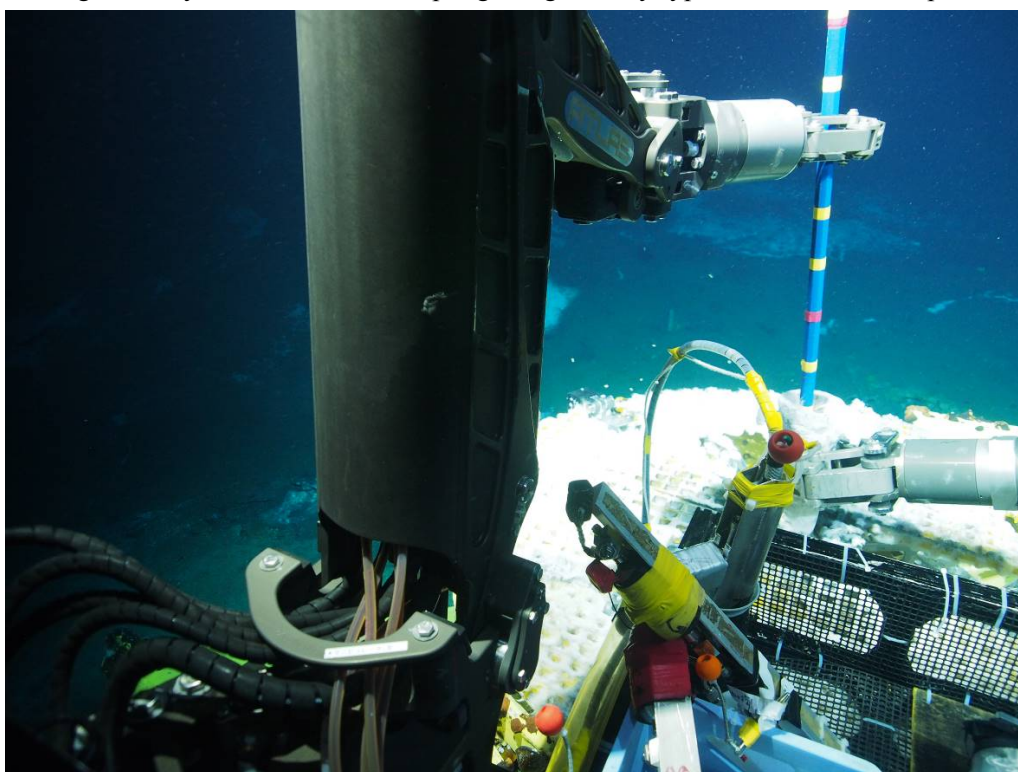


Fig. 3-15 Hole depth of the steel vent pipe on the corrosion cap at Hole C0014G was measured by long pinch bar. This hole depth was ca. 30 cm due to the drilling operation in the KR18-02C Cruise using an old long hydraulic power drill whose maximum stroke is 16 inch.

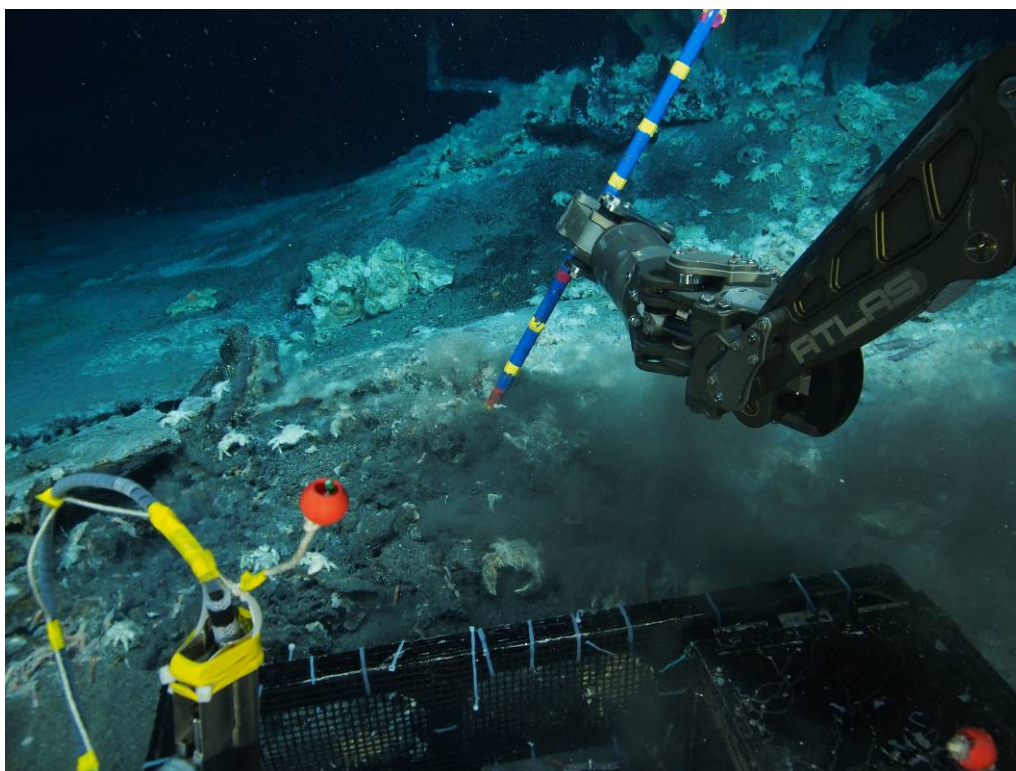


Fig. 3-16 Installation point for the Kuroko-ore cultivation apparatus directly on a natural hydrothermal vent was decided and was flattened by long pinch bar.

3.3.2 KK#796 dive (22nd October 2018) at the Original Site, Iheya-North Knoll

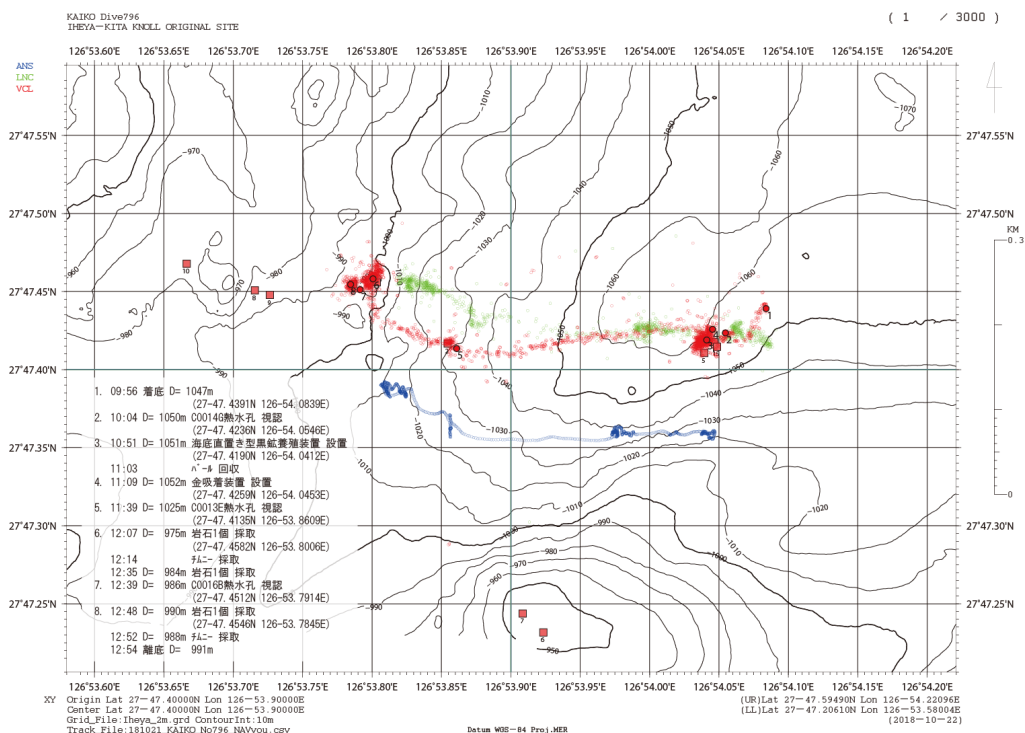


Fig. 3-17 Dive track and operation list of the KK#796 dive on a bathymetric map.

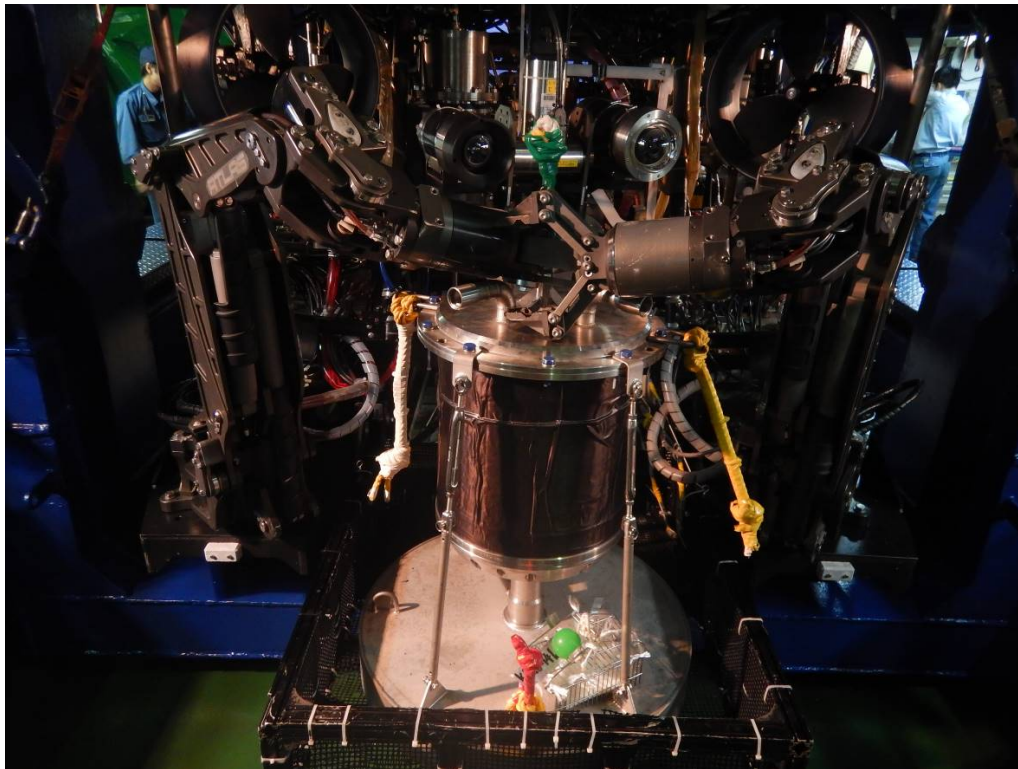


Fig. 3-18 Payload of the KK#796 dive.

Payload:

Gold adsorption apparatus x 1, thermometer for hydrothermal fluid x 1, isolated hydraulic power unit (IHPU) x 1, Kuroko-ore cultivation apparatus directly on a seafloor x 1.

Operation:

ROV KAIKO MK-IV moved to Hole C9024A to check the actual position, and then move to the installing point of the Kuroko-ore cultivation apparatus where was decided at the last dive (KK#795 dive). After the installation of the Kuroko-ore cultivation apparatus directly on a natural hydrothermal vent (Fig. 3-19), the long pinch bar which was put on a seafloor as a spot mark was recovered, followed by installation of the additional gold adsorption apparatus near Hole C0014G (Fig. 3-20). Then, the ROV moved to Holes C0013E, C0016A (NBC (North Big Chimney) mound) and C0016B in turn with sampling of five rock samples and observing seafloor and artificial hydrothermal vents (Figs. 3-21 to 3-23). The ROV launched a seafloor at two hours earlier than the normal schedule because the ROV payload had to be totally changed on deck for the hydraulic power drill operation in the next dive.

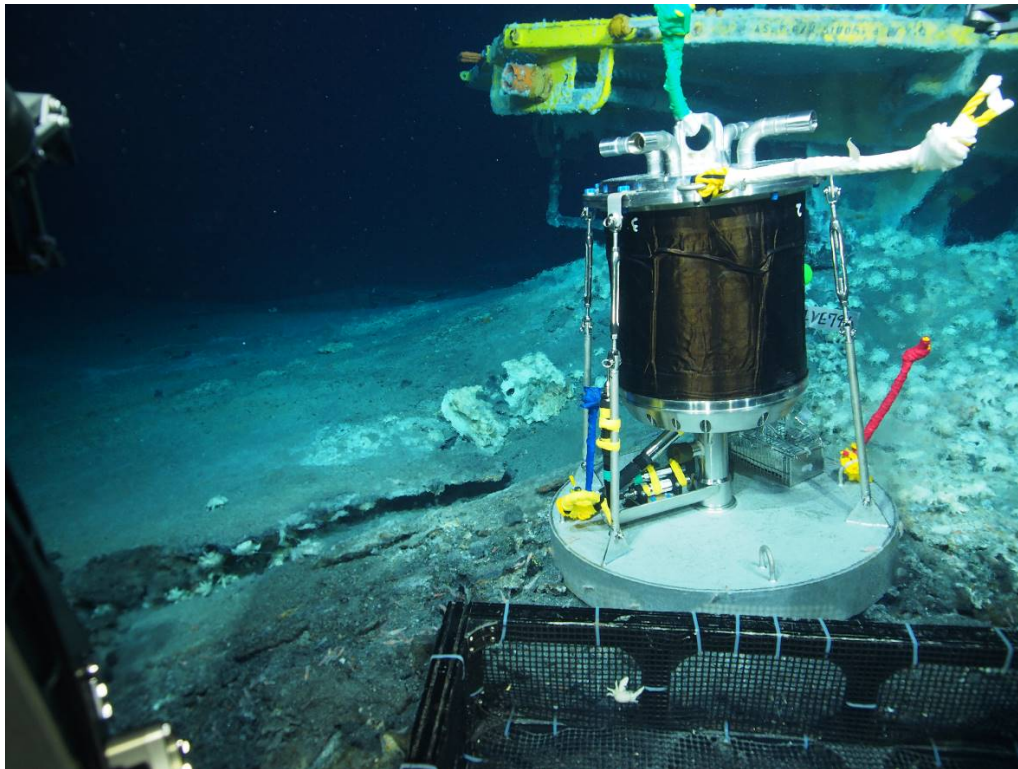


Fig. 3-19 Kuroko-ore cultivation apparatus equipped with two P/T sensors, gold adsorption apparatus and seed crystals of pumice and pyrite installed directly on a natural hydrothermal vent.

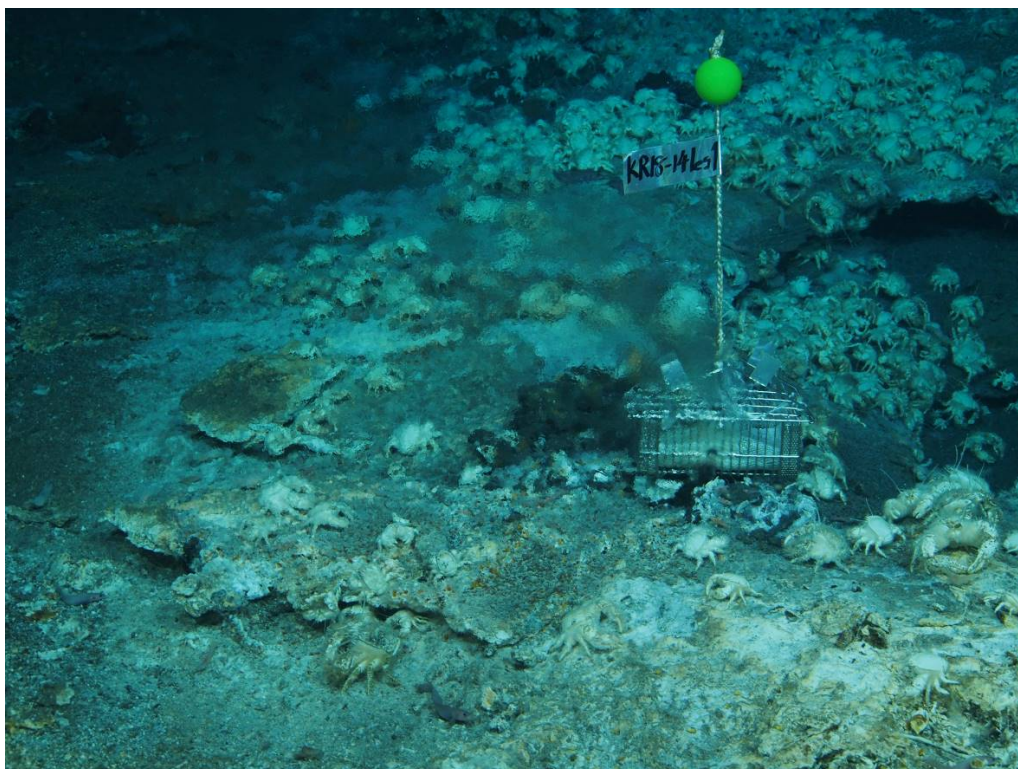


Fig. 3-20 Installation of the gold adsorption apparatus near Hole C0014G.

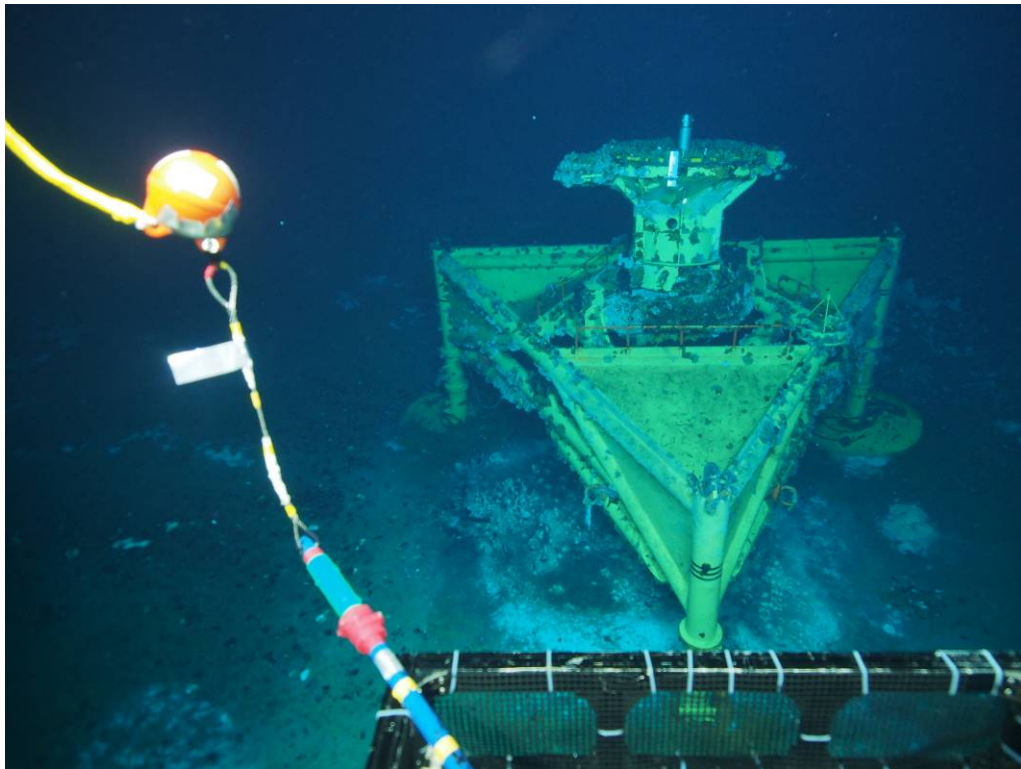


Fig. 3-21 Guide base and corrosion cap at Hole C0013E.

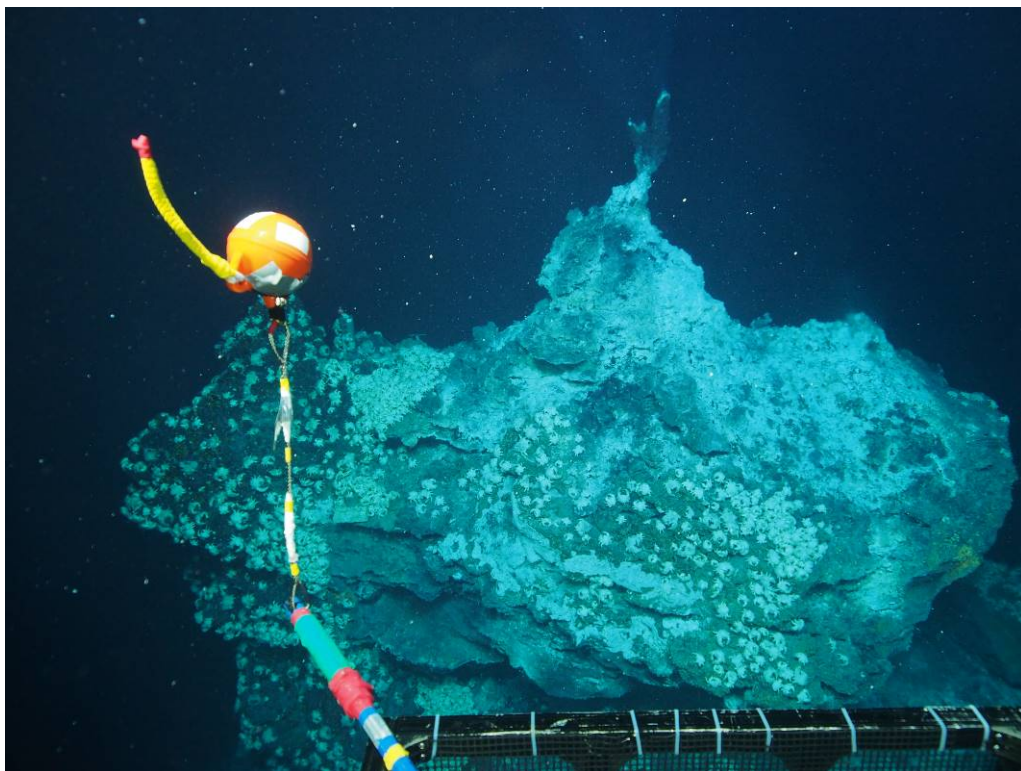


Fig. 3-22 Top of the chimney formed on Hole C0016A at the NBC mound.

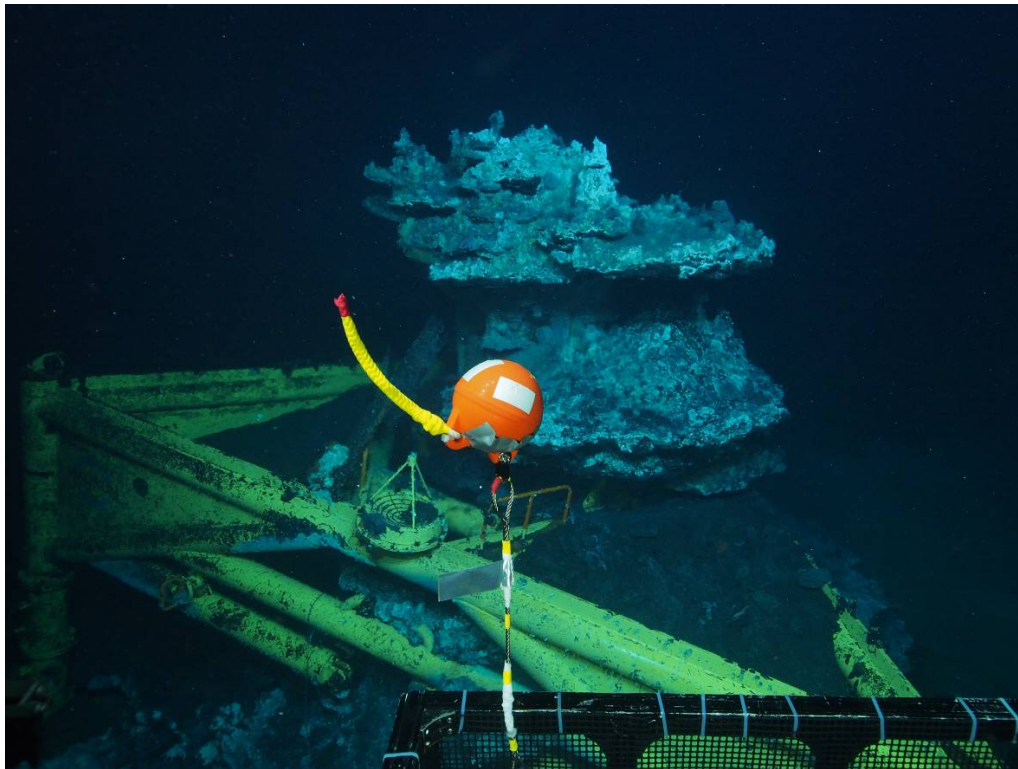


Fig. 3-23 Guide base and corrosion cap at Hole C0016B.

3.3.3 KK#797 dive (23rd October 2018) at the Original Site, Iheya-North Knoll

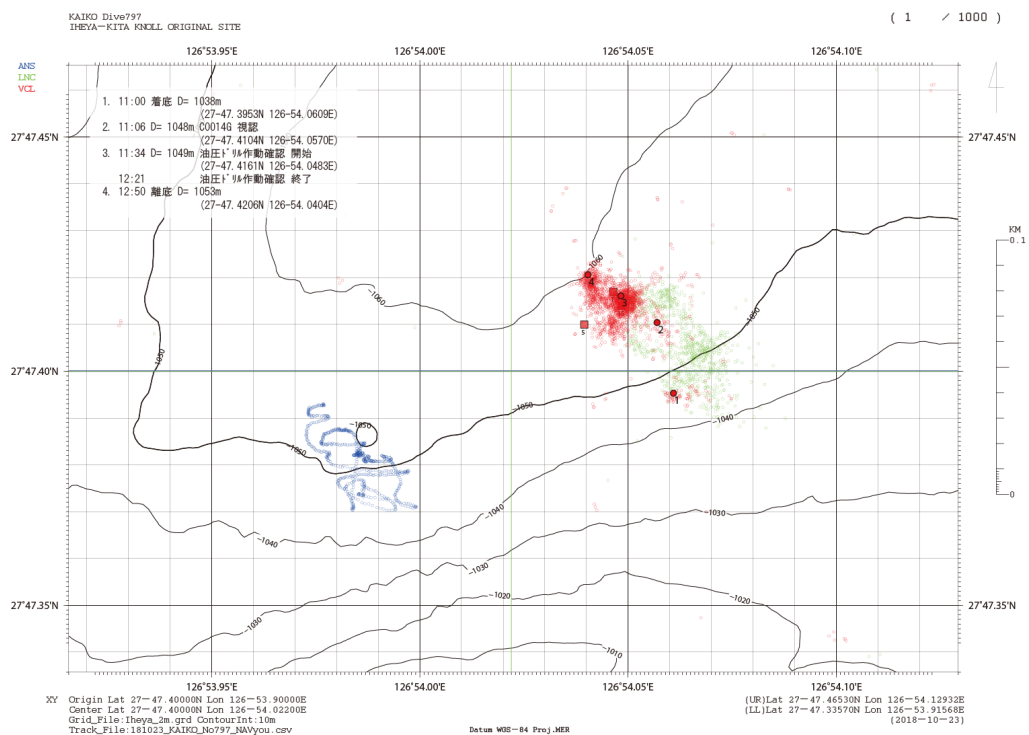


Fig. 3-24 Dive track and operation list of the KK#797 dive on a bathymetric map.



Fig. 3-25 Payload of the KK#797 dive.

Payload:

Thermometer for hydrothermal fluid x 1, isolated hydraulic power unit (IHPU) x 1, remodeled hydraulic power drill x 1, pintle mount for hydraulic power drill x 1.

Operation:

ROV KAIKO MK-IV moved to Hole C0014G for the scale removal operation of the steel vent pipe on the corrosion cap. Remodeled hydraulic power drill was successfully settled on the steel vent pipe (Fig. 3-26), but the fork which is an essential part to fix the hydraulic power drill with the corrosion cap was not able to be inserted to the fixing adaptor (Fig. 3-27). Moreover, as oil leakage occurred from the hotstab equipped with the hydraulic power drill during the descent to seafloor at the water depth of ca. 100 m (Fig. 3-28), we tried to pull out and re-insert the hotstab to prevent oil leakage. However, it was impossible to prevent the oil leakage from the hotstab and thus the scale removal operation in this dive was given up. After on deck of the hydraulic drill, fork and fixing adaptor were chamfered for smooth insertion.

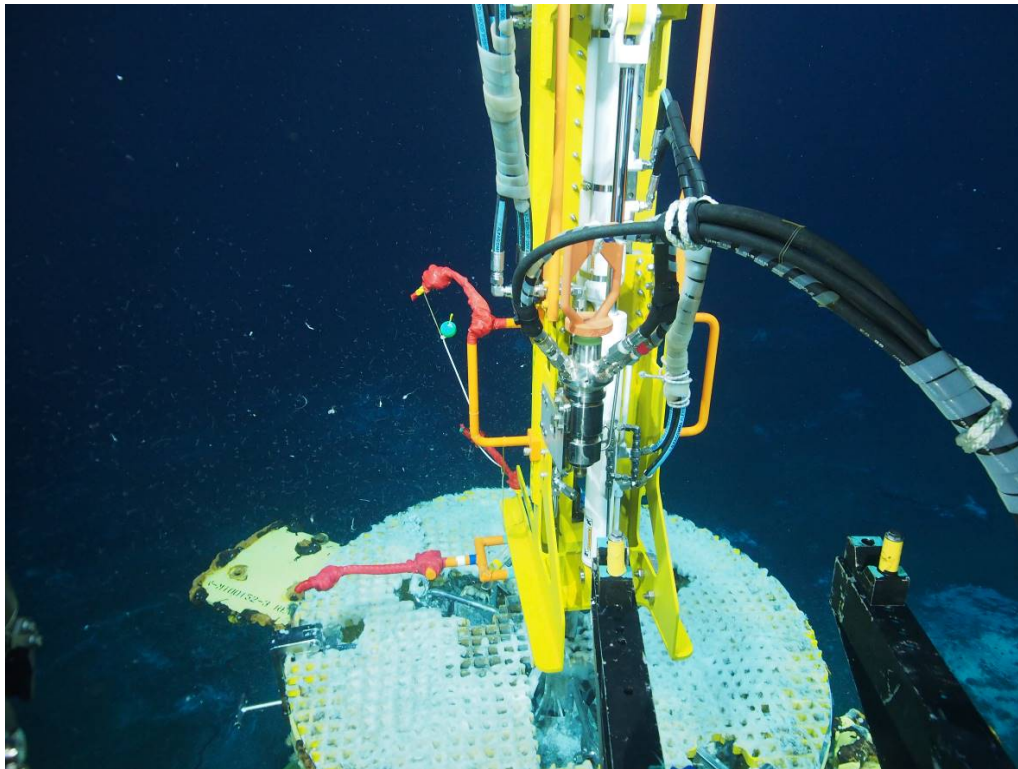


Fig. 3-26 Remodeled hydraulic power drill settled on the steel vent pipe of the corrosion at Hole C0014G.

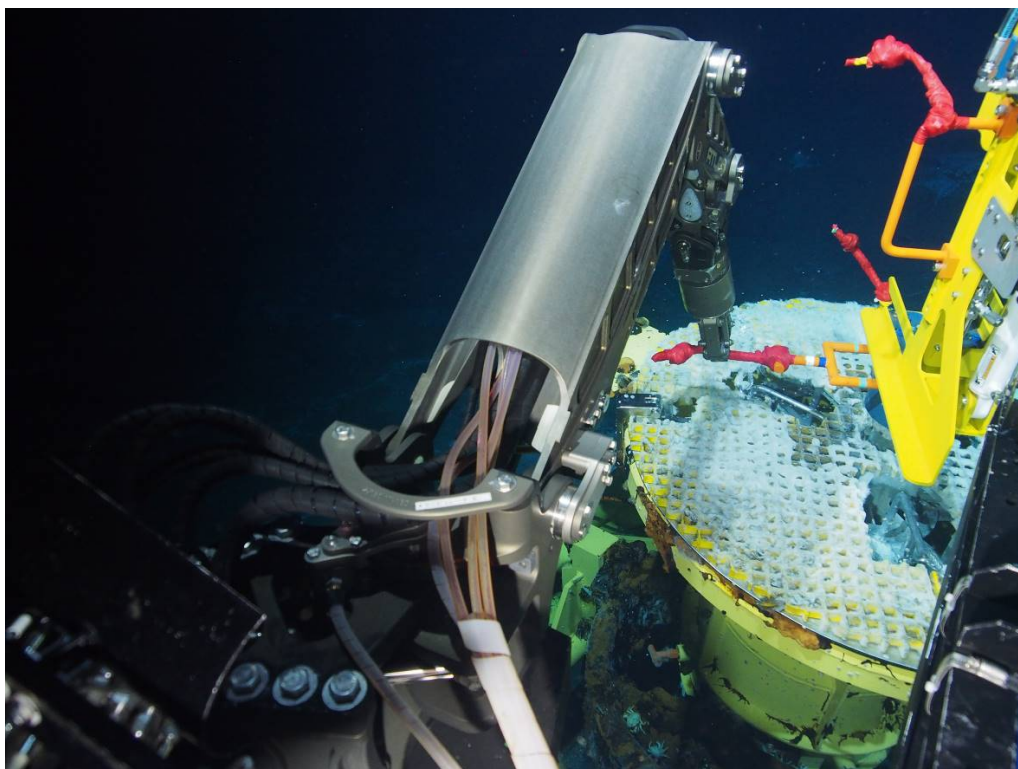


Fig. 3-27 Fork was not able to be inserted to the fixing adaptor of the hydraulic power drill.

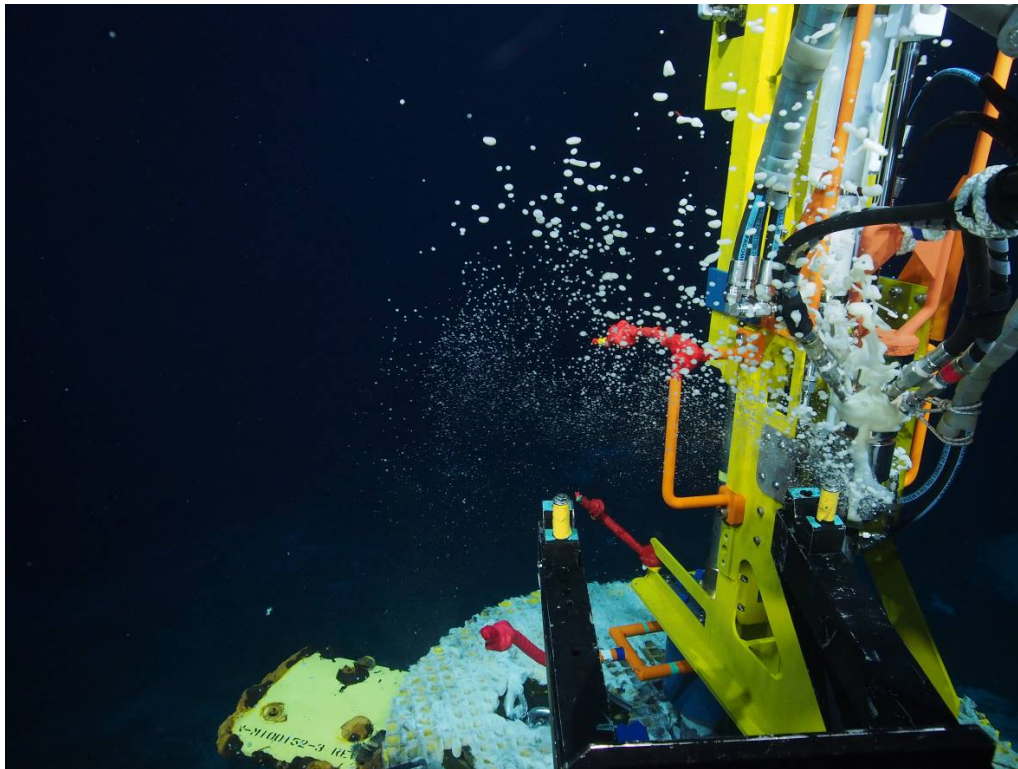


Fig. 3-28 Oil leakage occurred from the hotstab equipped with the remodeled hydraulic power drill.

3.3.4 KK#798 dive (24th October 2018) at the Aki Site, Iheya-North Knoll

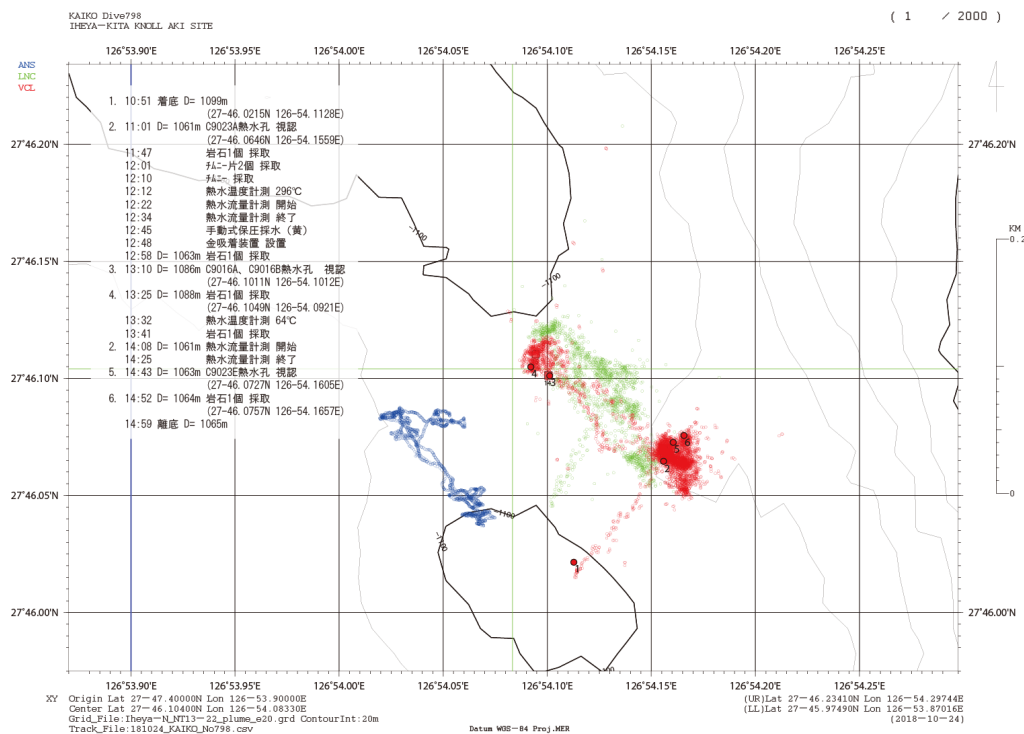


Fig. 3-29 Dive track and operation list of the KK#798 dive on a bathymetric map.

(Hole C9023A should be HSK mound and Hole 9023E should be Hole C9023A in this map!!)

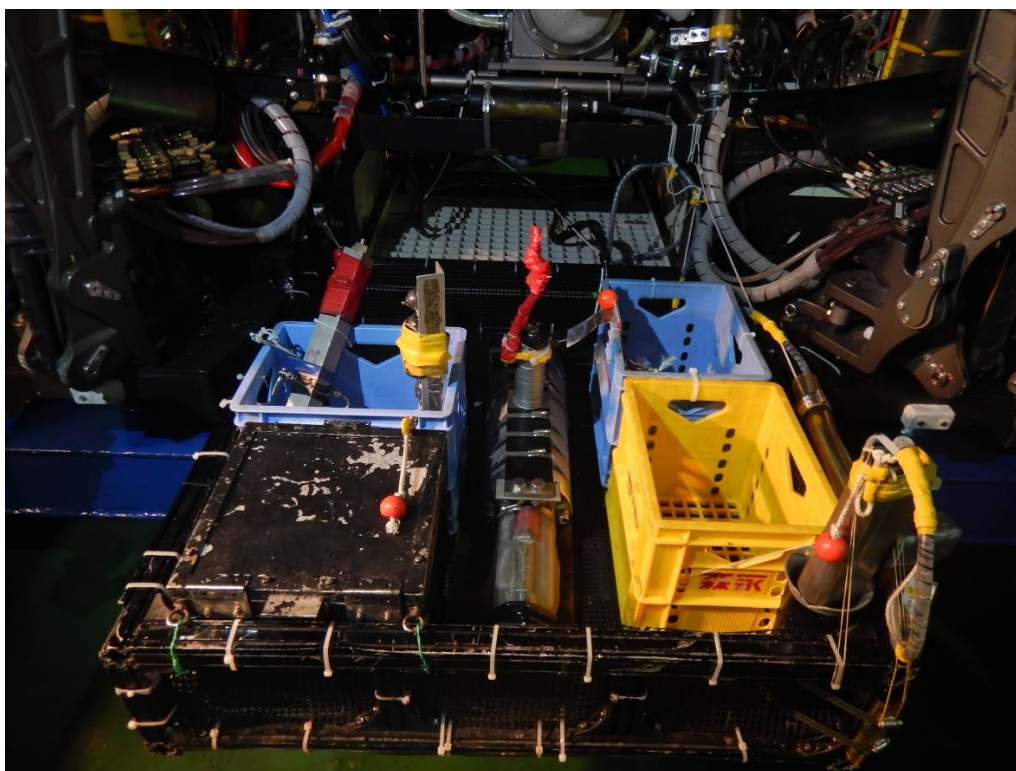


Fig. 3-30 Payload of the KK#798 dive.

Payload:

Gold adsorption apparatus x 1, hydrothermal flow rate measurement apparatus x 1, handy-type vacuum water sampler x 2, thermometer for hydrothermal fluid x 1, isolated hydraulic power unit (IHPU) x 1, Morinaga x 3, covered box x 1.

Operation:

ROV KAIKO MK-IV moved to the sulfide mound to seek the drill holes formed by the CK16-01 Cruise. After observing around the sulfide mound of the Aki Site, we misidentified the HSK (Hidaritehasoerudake) chimney mound as Hole C9023A (LWD hole) (Fig. 3-31). At the fake Hole C9023A (actually HSK mound), we conducted rock sampling, temperature measurement of hydrothermal fluid ($T_{\max} = 299^{\circ}\text{C}$), hydrothermal flow rate measurement by ultrasonic waves, hydrothermal fluid sampling by handy-type vacuum water sampler and installation of the gold adsorption apparatus (Figs. 3-32 to 3-34). Then, the ROV moved to Site C9016 to seek Holes C9016A (LWD hole) and C9016B (coring hole). At Hole C9016A, large drill hole was observed with some flange-shape chimneys and hydrothermal discharge (Fig. 3-35). After rock sampling and temperature measurement at Hole C9016A ($T_{\max} = 64^{\circ}\text{C}$), the ROV moved to Hole C9016B, but we were not able to observe any hydrothermal effluents from Hole C9016B (Fig. 3-36). Then, the ROV returned to the fake Hole C9023A (actually HSK mound), hydrothermal flow rate measurement was tried again at the same position of the first measurement at this dive. Since we were not convinced

that the fake Hole C9023A is truly Hole C9023A or not, the ROV moved around to check the actual position, followed by discovery of drill hole with vigorous hydrothermal discharge misidentified as Hole C9023E (actually Holes C9023A and C9023E). Totally, seven rock samples (KK#798R01 to R07) were obtained by manipulator during this dive survey with pumice in the ROV skid whose exact locality is unknown (KK#798R08).



Fig. 3-31 Sulfide mound at the Aki Site with HSK chimney (hereafter called HSK mound).

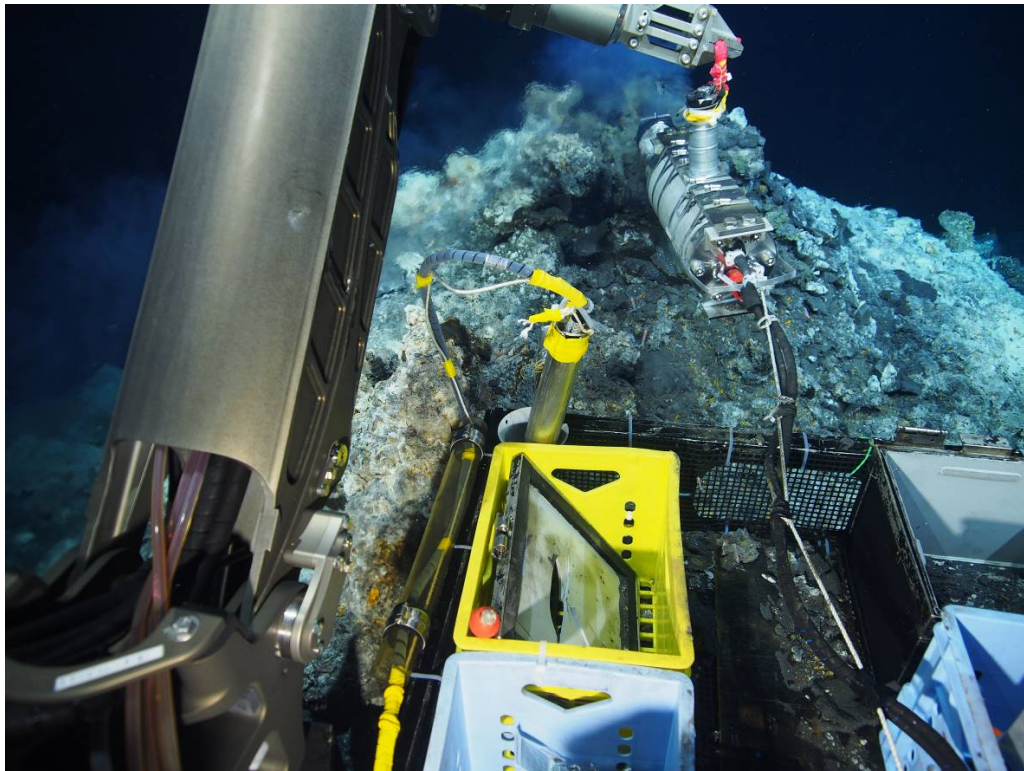


Fig. 3-32 Hydrothermal flow rate measurement by ultrasonic waves at the HSK mound.

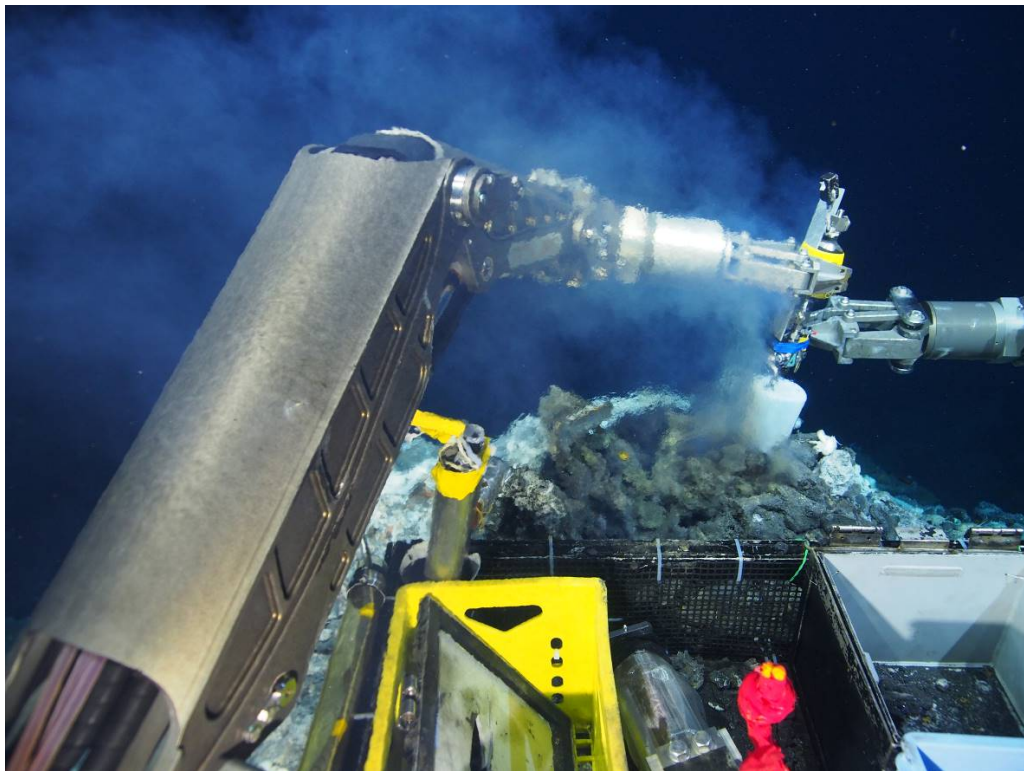


Fig. 3-33 Hydrothermal fluid sampling by handy-type water sampler at the HSK mound.

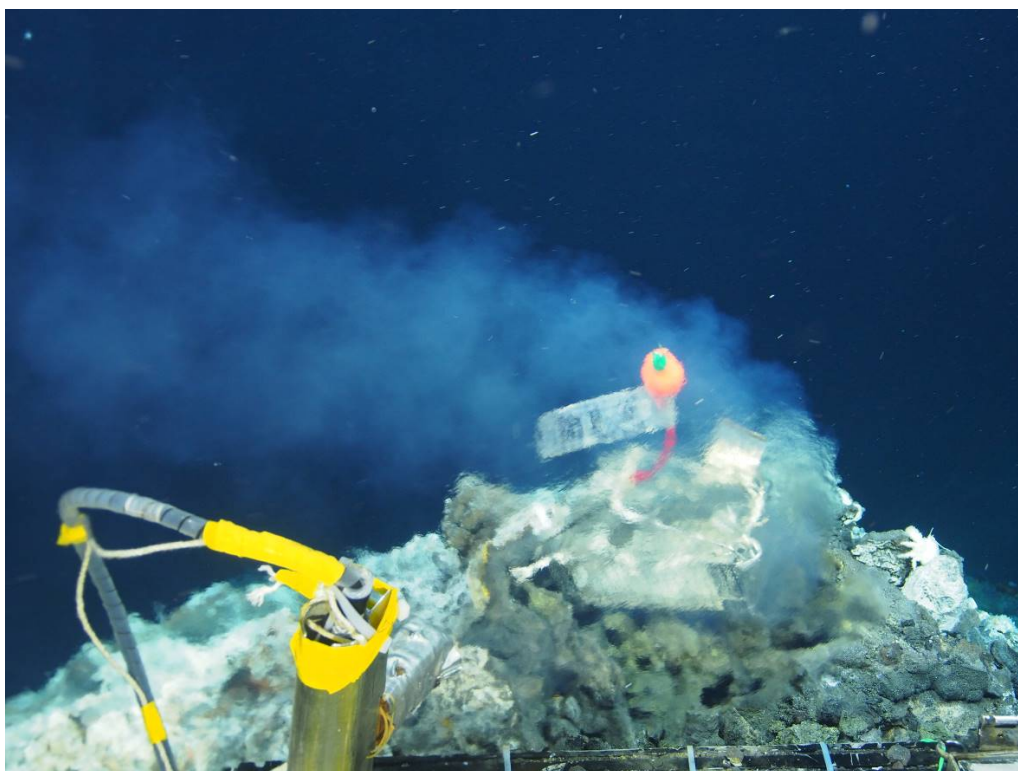


Fig. 3-34 Installation of the gold adsorption apparatus at the HSK mound.



Fig. 3-35 Hole C9016A with some chimney flanges and hydrothermal discharge.

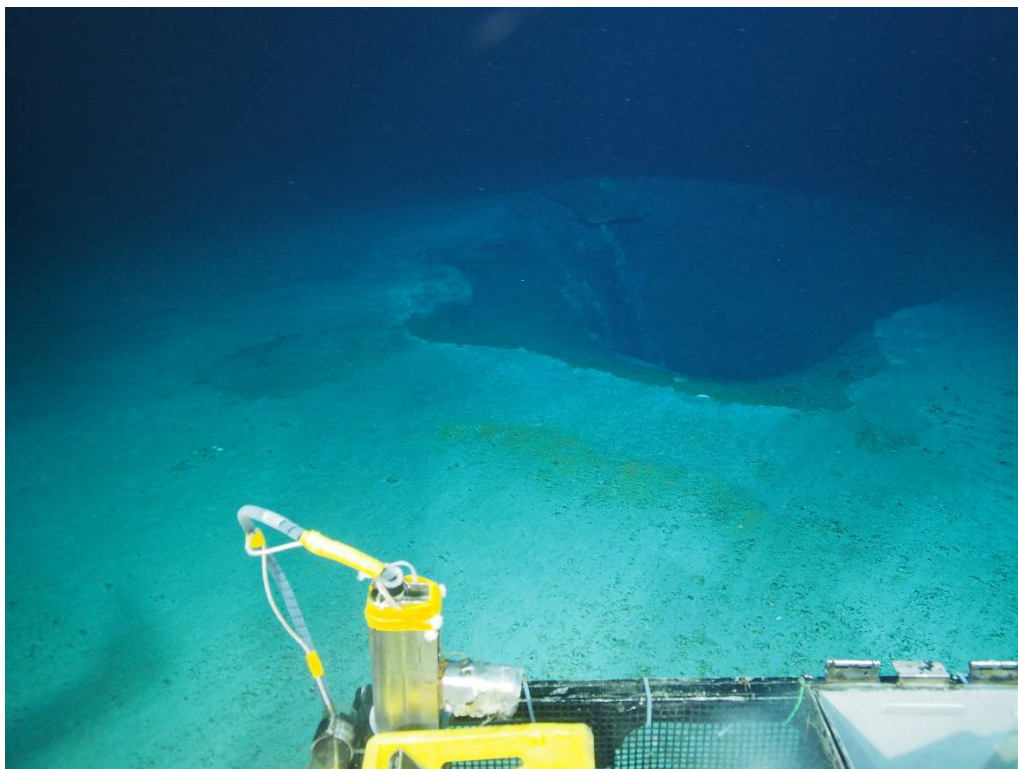


Fig. 3-36 Hole C9016B with no hydrothermal discharge.

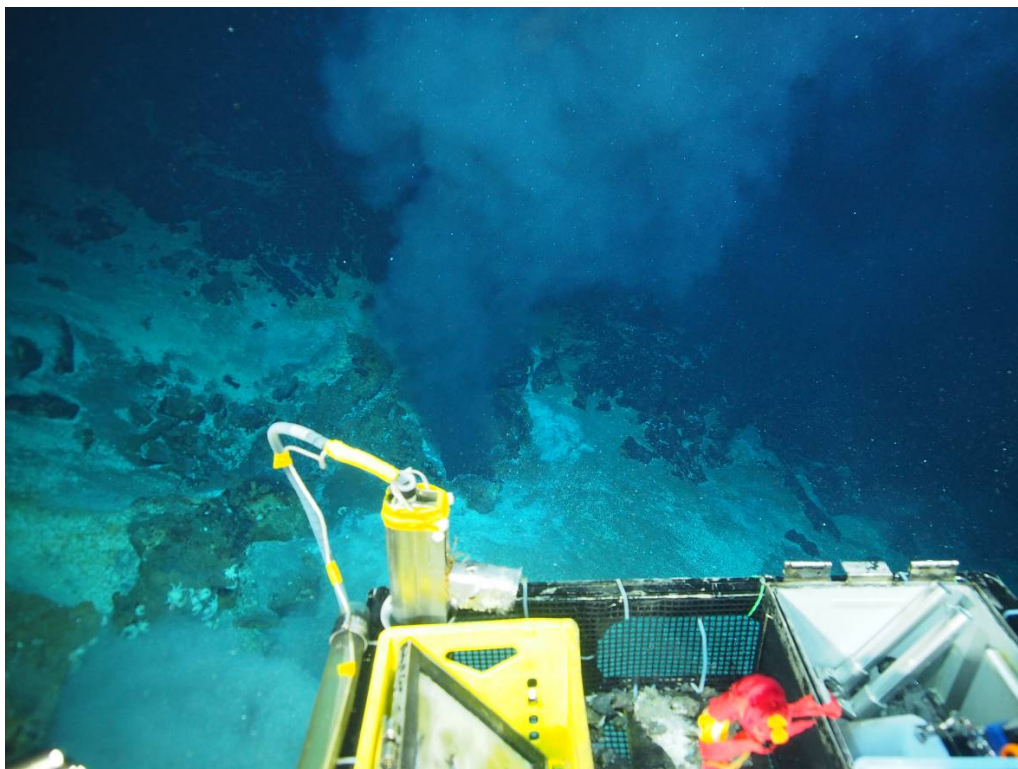


Fig. 3-37 Hole C9023E with vigorous hydrothermal discharge.

3.3.5 KK#799 dive (25th October 2018) at the Hakurei Site, Izena Hole

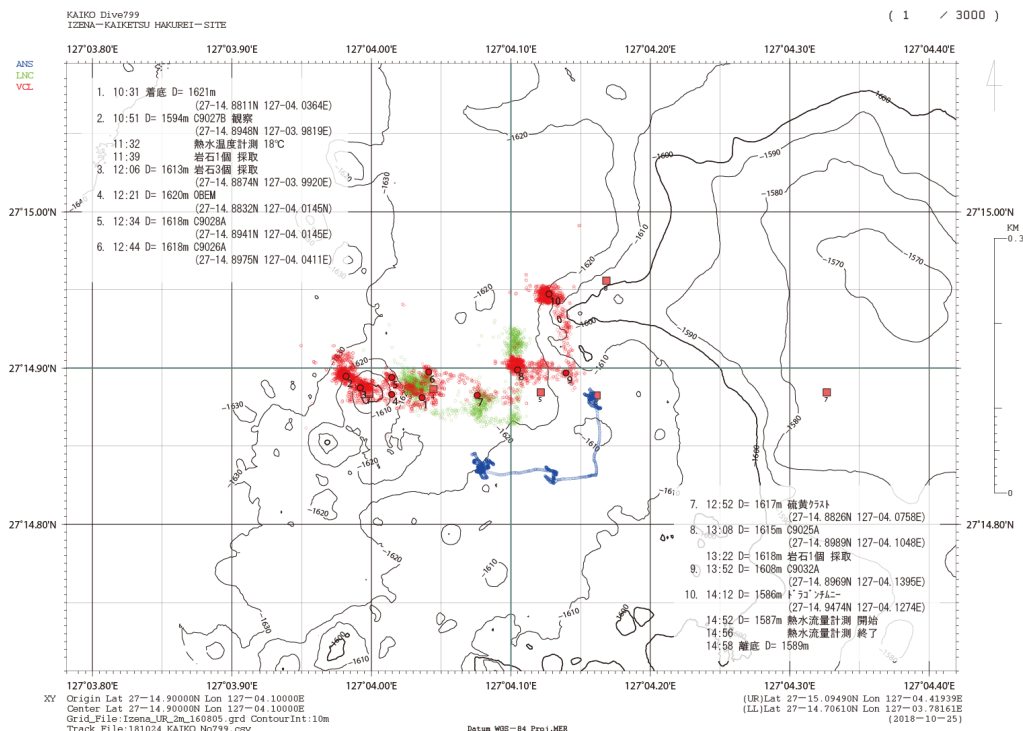


Fig. 3-38 Dive track and operation list of the KK#799 dive on a bathymetric map.

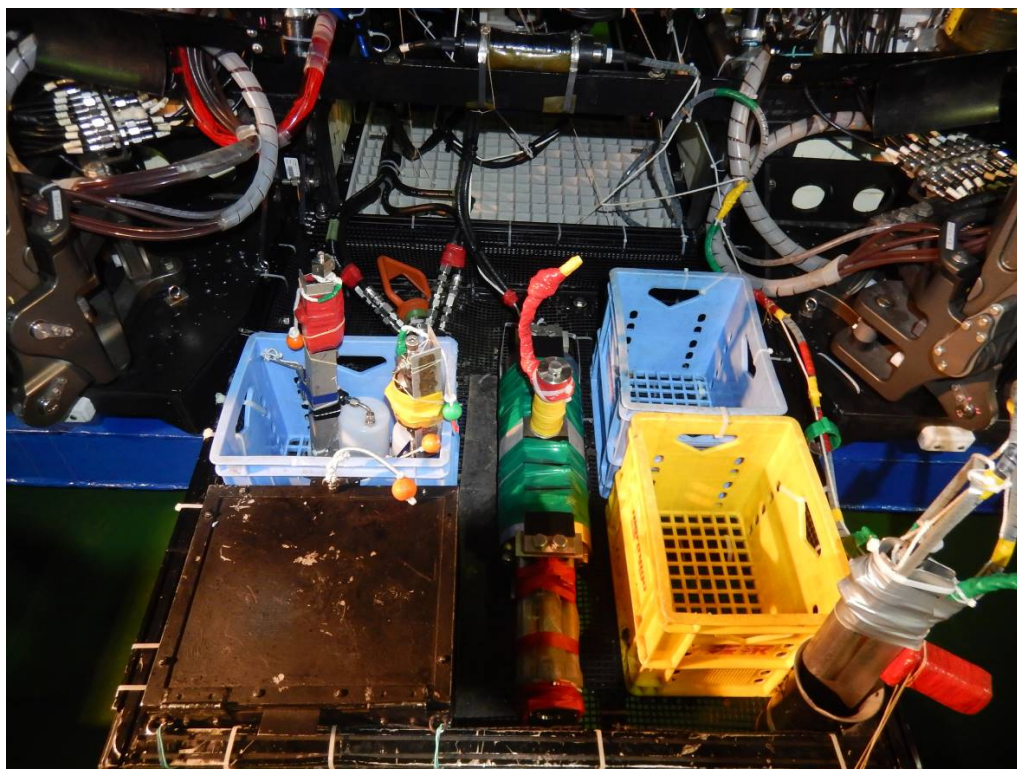


Fig. 3-39 Payload of the KK#799 dive.

Payload:

Hydrothermal flow rate measurement apparatus x 1, handy-type vacuum water sampler x 2, thermometer for hydrothermal fluid x 1, isolated hydraulic power unit (IHPU) x 1, hotstab x 1, Morinaga x 3, covered box x 1.

Operation:

During descent to seafloor, hotstab oil leakage test was conducted by hydraulic pressure supplied through the IHPU. In the water depth of 150 and 500 m, there were no oil leakages from the hotstab, but oil leakage was started to be observed at the water depth of ca. 650 m. This oil leakage from the hotstab did not stop during the KK#799 dive. ROV KAIKO MK-IV moved to the Northern Mound at the Hakurei Site and found Hole C9027B with hydrothermal shimmering formed by the CK16-05 Cruise (Fig. 3-40). At Hole C9027B, rock sampling and temperature measurement of hydrothermal fluid ($T_{\max} = 18^{\circ}\text{C}$) were conducted and then the ROV moved to Holes 9028A, 9026A, 9025A, C9032A and Dragon Chimney in turn (Figs. 3-41 to 3-45). No hydrothermal discharge was observed at Holes C9028A and C9026A, but hydrothermal shimmering with native sulfur-rich chimney formation were observed at Hole C9025A (Fig. 3-43) together with weak hydrothermal shimmering at Hole C9032A. Rock sampling at Hole C9025A and hydrothermal flow rate measurement at the Dragon Chimney were conducted. Totally, five rock samples (KK#799R01 to R05) were obtained during this dive survey.

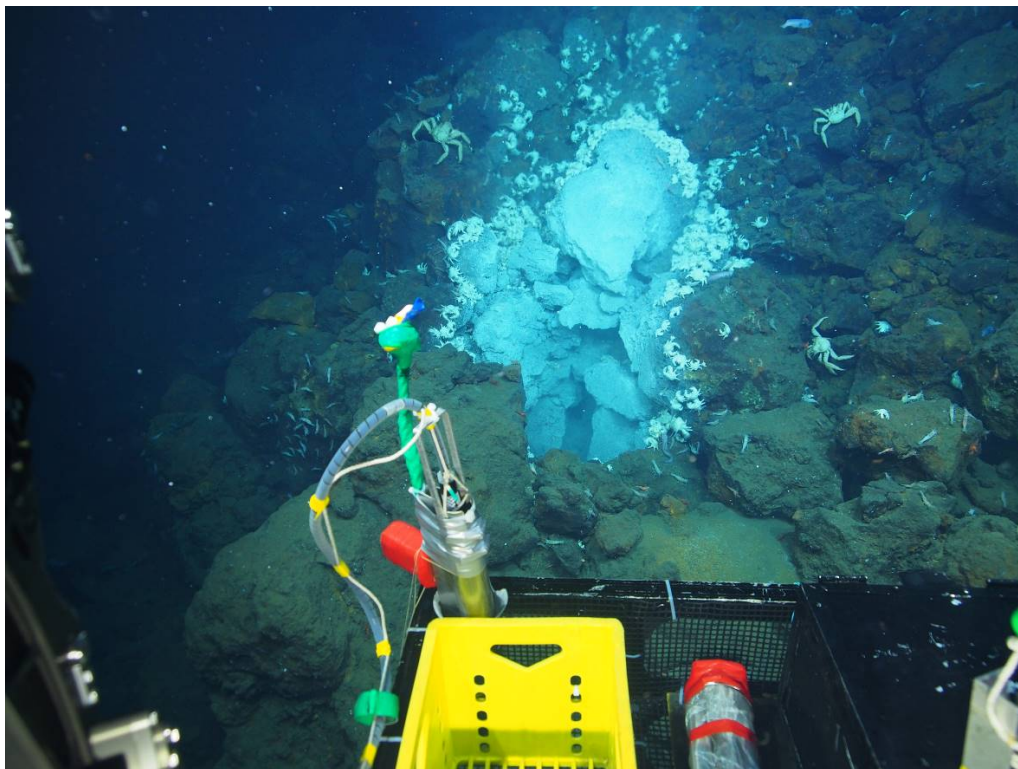


Fig. 3-40 Hole C9027B at the Northern Mound with hydrothermal shimmering

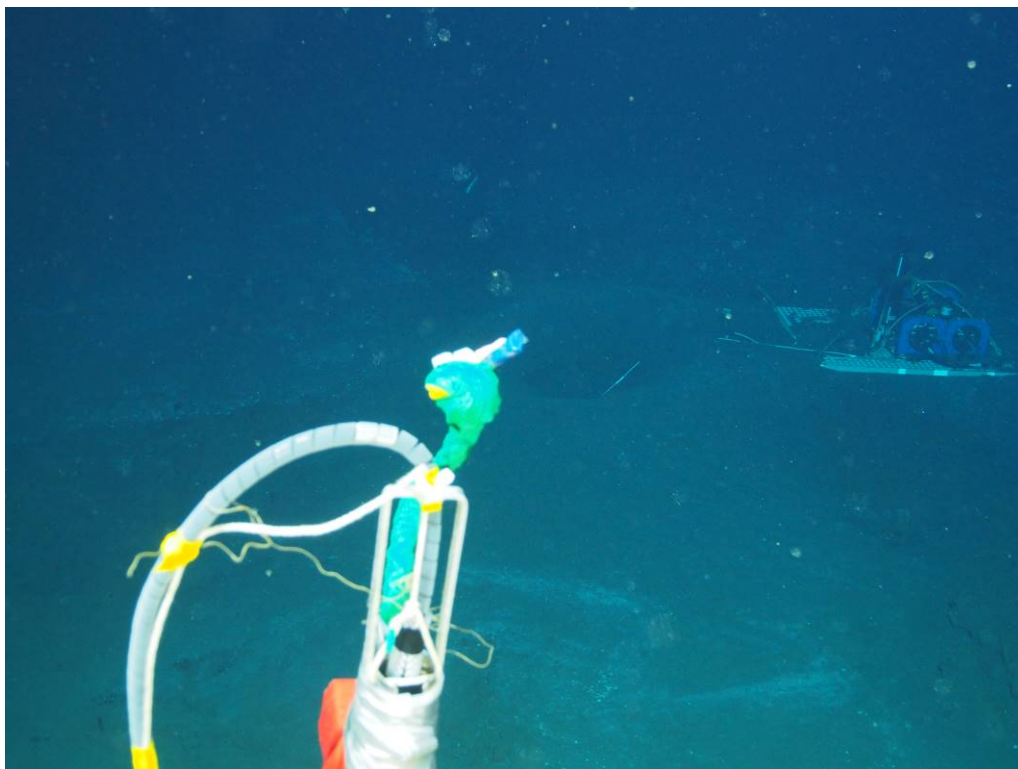


Fig. 3-41 Hole C9028A without any hydrothermal discharges.

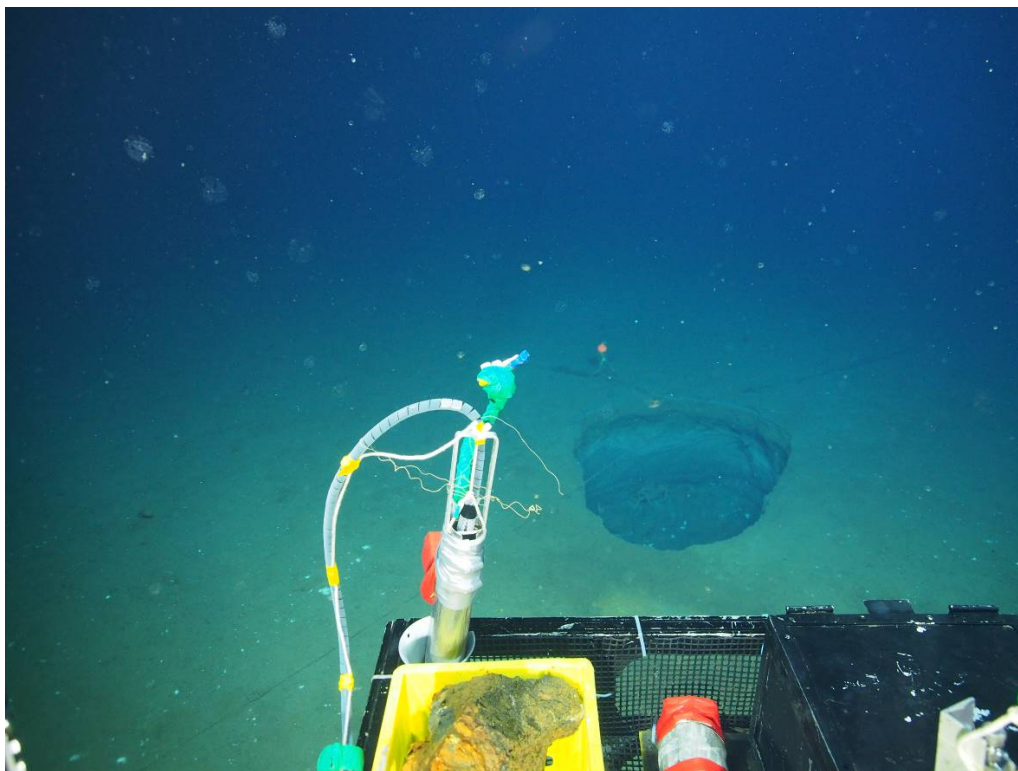


Fig. 3-42 Hole C9026A without any hydrothermal discharges.

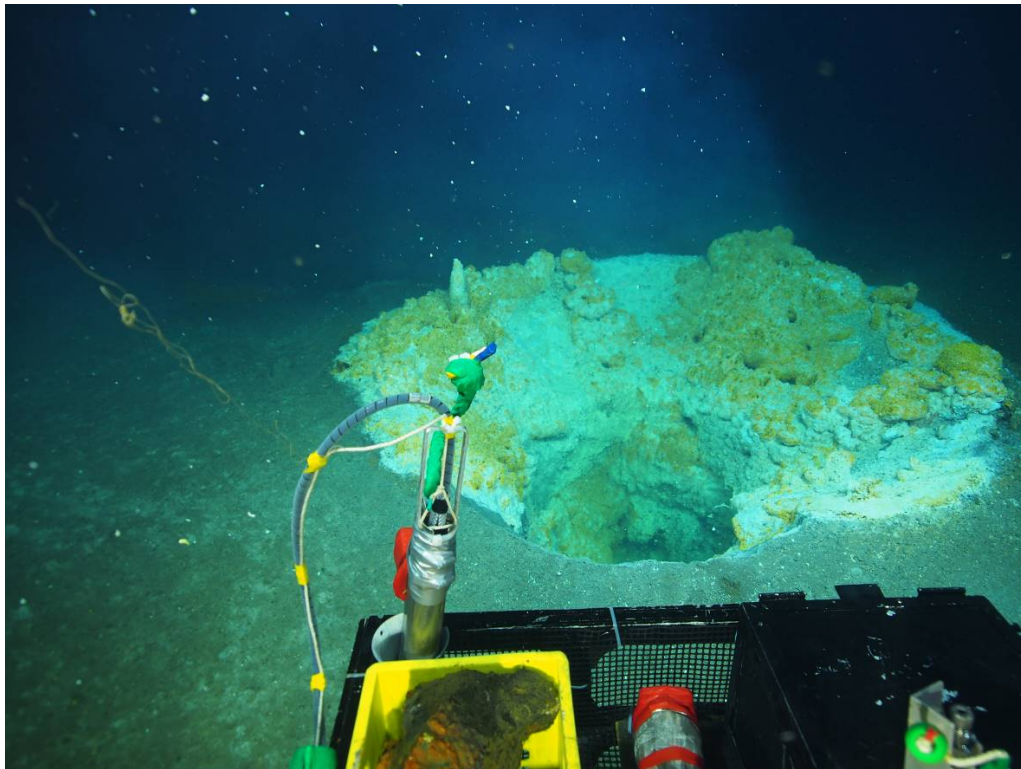


Fig. 3-43 Hole C9025A with native sulfur-rich chimney and hydrothermal discharge.

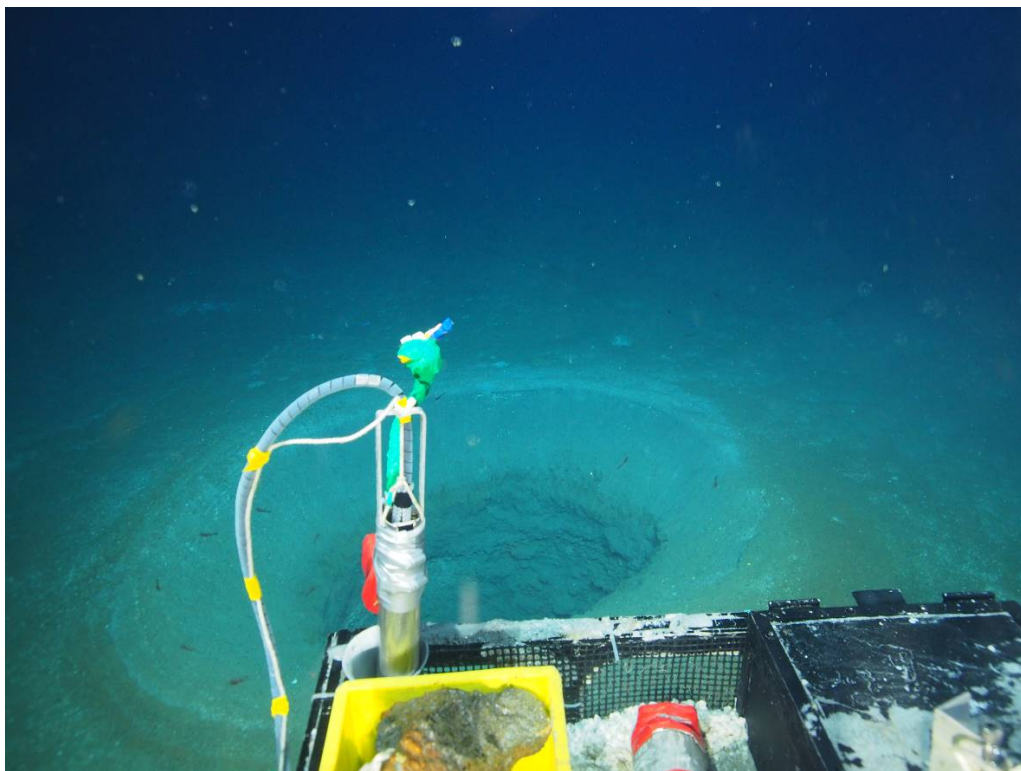


Fig. 3-44 Hole C9032A with weak hydrothermal shimmering.

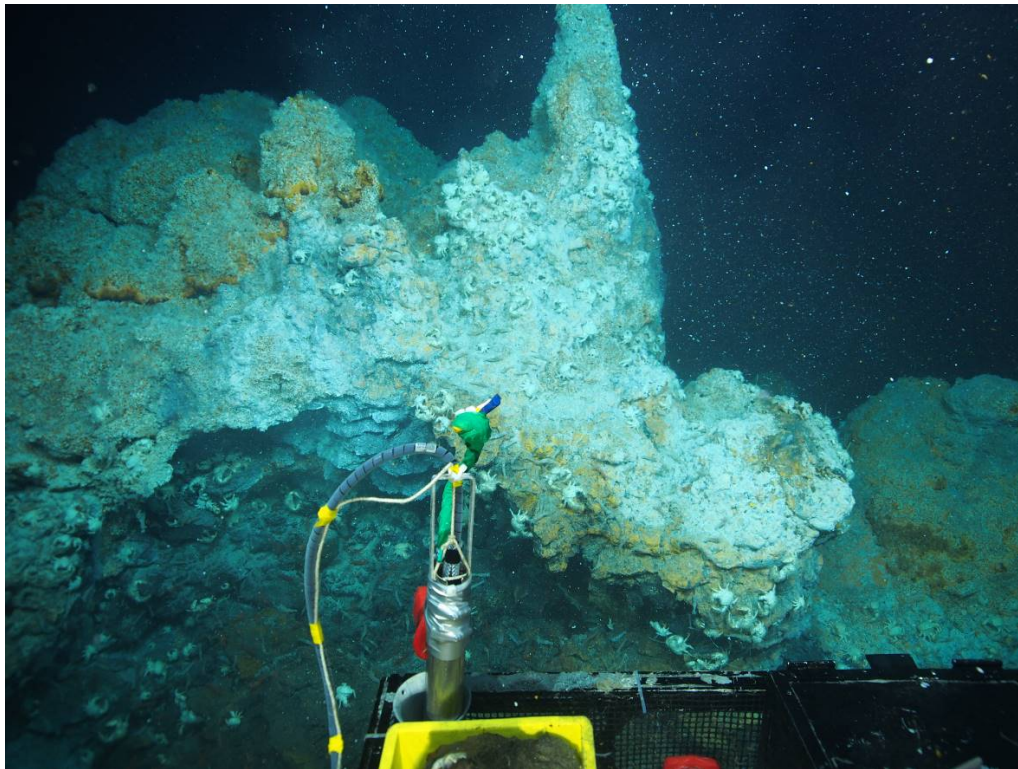


Fig. 3-45 Dragon chimney at the Hakurei Site.

3.3.6 KK#800 dive (26th October 2018) at the Original Site, Iheya-North Knoll

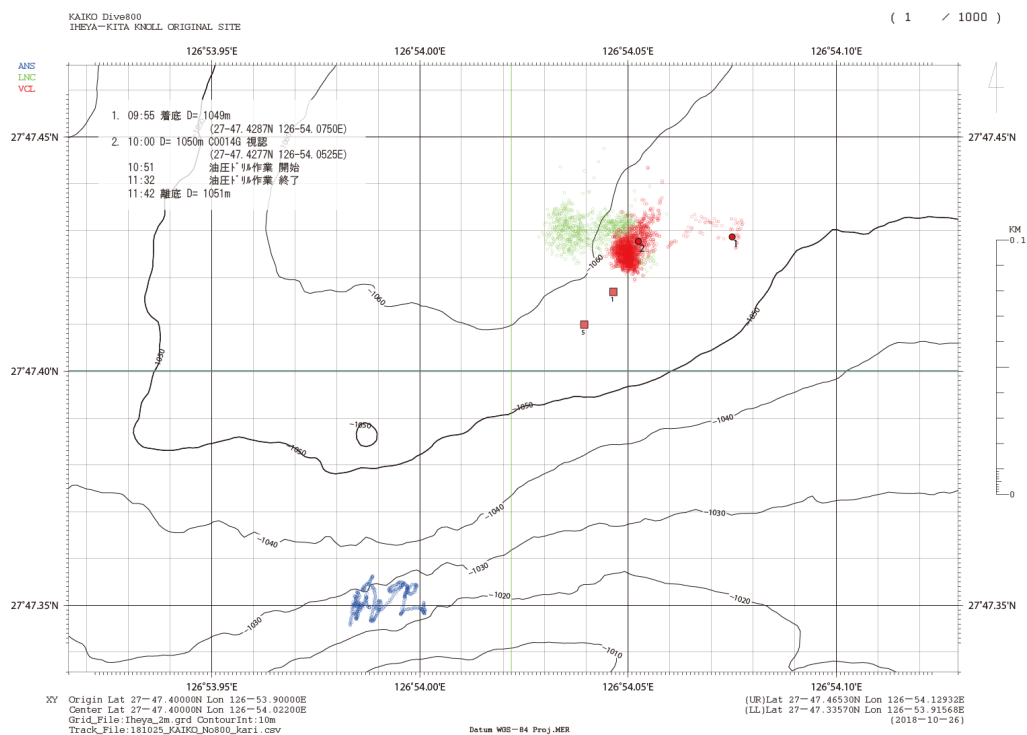


Fig. 3-46 Dive track and operation list of the KK#800 dive on a bathymetric map.



Fig. 3-47 Payload of the KK#800 dive.

Payload:

Thermometer for hydrothermal fluid x 1, isolated hydraulic power unit (IHPU) x 1, remodeled hydraulic power drill x 1, pintle mount for hydraulic power drill x 1.

Operation:

ROV KAIKO MK-IV moved to Hole C0014G to conduct the scale removal from the steel vent pipe of the corrosion cap and reactivate hydrothermal discharge from Hole C0014G. The remodeled hydraulic power drill was successfully settled on the steel vent pipe and fork was smoothly inserted to the fixing adopter due to chamfering after the KK#797 dive (Fig. 3-48). Before starting scale removal operation, hydraulic power was supplied to hotstab through the IHPU, then, oil leakage was observed from the hotstab (Fig. 3-49). We tried to pull out and re-insert the hotstab to prevent the oil leakage. However, it was impossible to prevent the oil leakage from the hotstab and thus the scale removal operation in this cruise was completely given up.

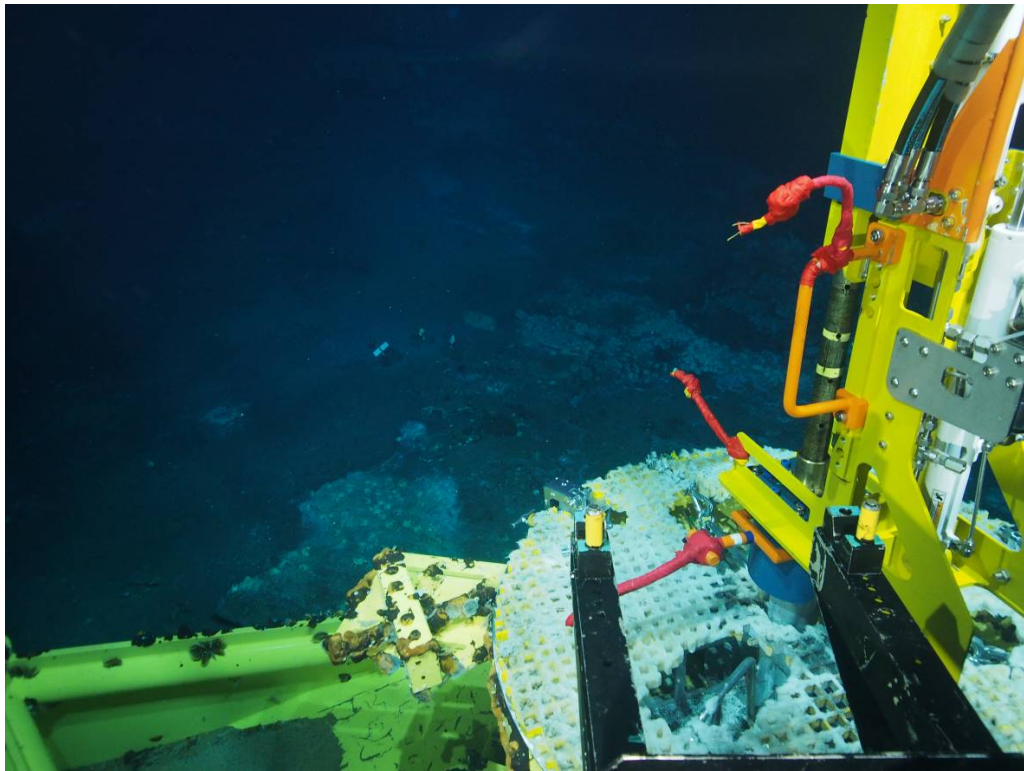


Fig. 3-48 Remodeled hydraulic power drill was set on the steel vent pipe of the corrosion cap at Hole C0014G and fork was inserted to the fixing adopter.

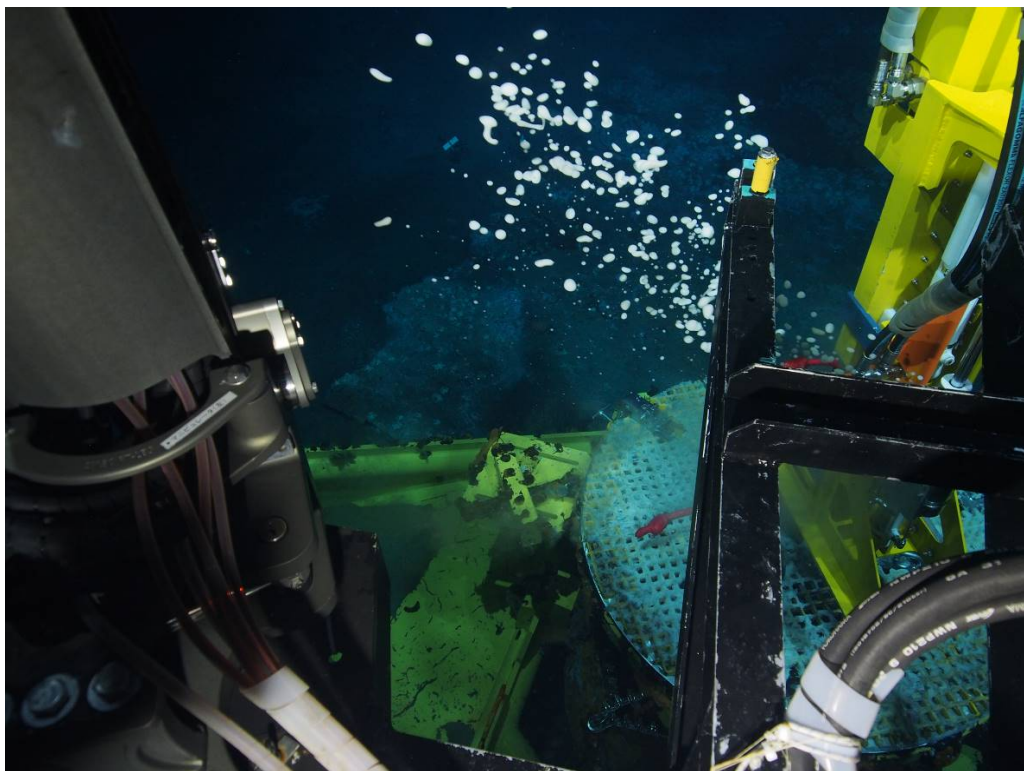


Fig. 3-49 Before starting scale removal operation by remodeled hydraulic power drill, hydraulic power was supplied to hotstab through the IHPU. Then, oil leakage was observed from the hotstab.

3.3.7 KK#801 dive (29th October 2018) at the Aki Site, Iheya-North Knoll

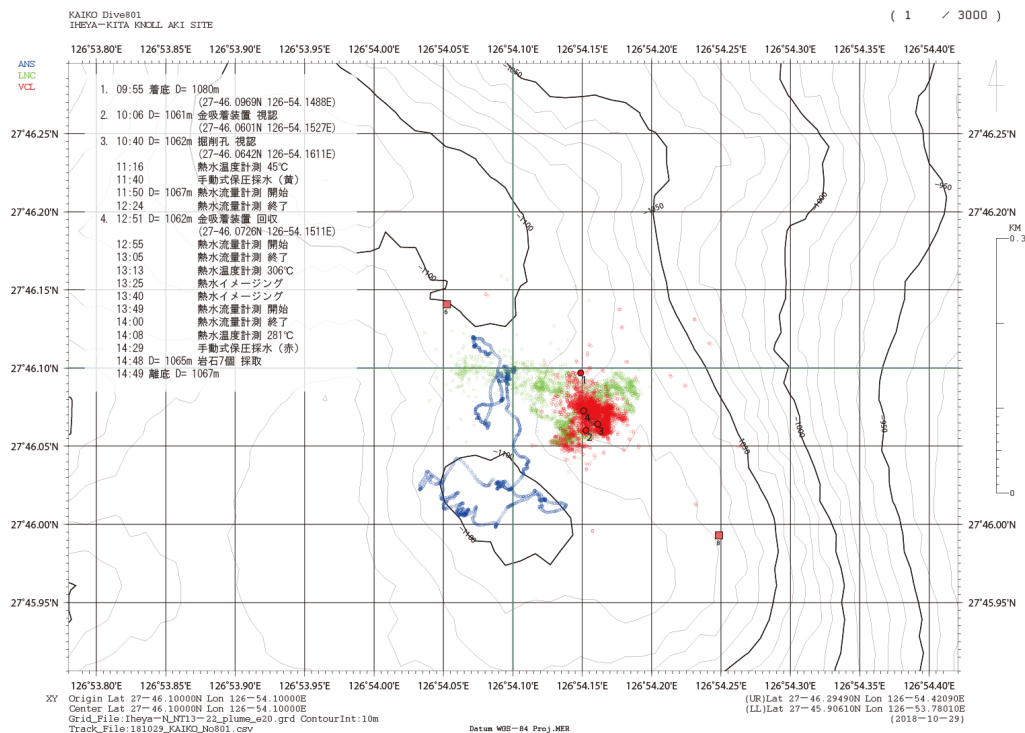


Fig. 3-50 Dive track and operation list of the KK#801 dive on a bathymetric map.

(掘削孔 = HSK mound, Holes C9023A and C9023E in this map!!)

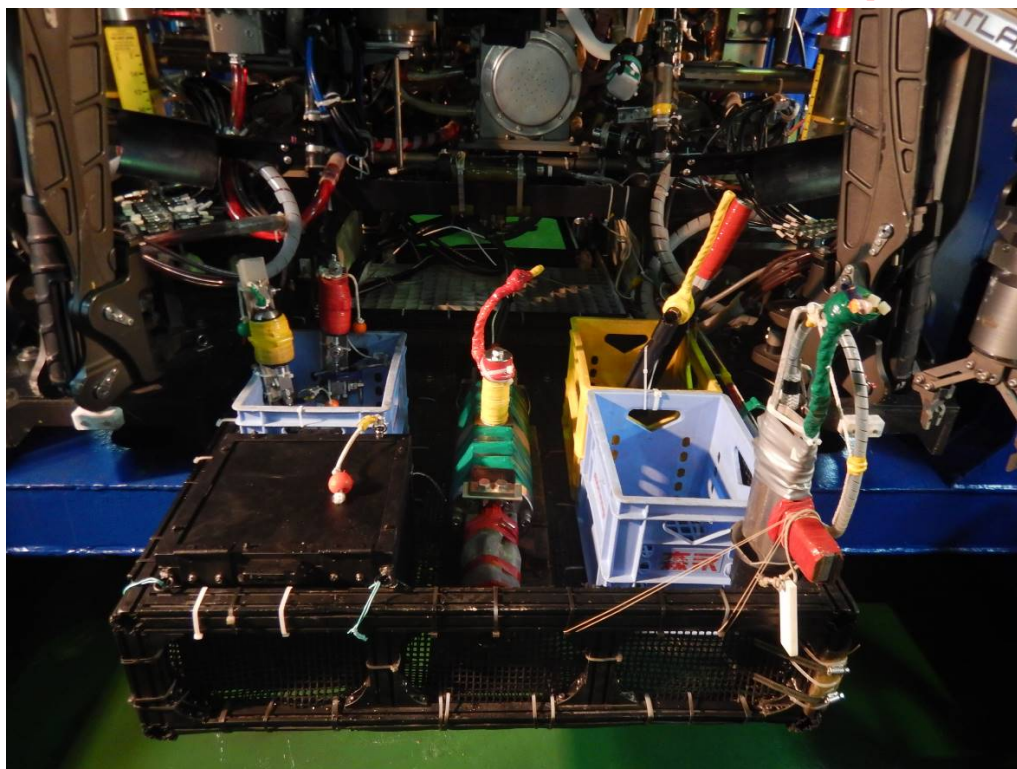


Fig. 3-51 Payload of the KK#801 dive.

Payload:

Hydrothermal flow rate measurement apparatus x 1, handy-type vacuum water sampler x 2, thermometer for hydrothermal fluid x 1, imaging plate for hydrothermal fluid x 1, Morinaga x 3, covered box x 1.

Operation:

ROV KAIKO MK-IV moved to the HSK mound to check the gold adsorption apparatus installed at the KK#798 dive. Then, the ROV moved to Hole C9023E, followed by temperature measurement of hydrothermal fluid ($T_{\max} = 45^{\circ}\text{C}$), hydrothermal fluid sampling by handy-type vacuum water sampler and hydrothermal flow rate measurement using ultrasonic waves (Figs. 3-52 to 3-54). The ROV returned to the HSK mound and the gold adsorption apparatus was recovered, but we can not estimate how long this apparatus was soaked into hot hydrothermal fluid because new anhydrite-rich chimney was formed in five days at this point from the KK#798 dive (Fig. 3-55). After the recovery of the gold adsorption apparatus at the HSK mound, we conducted temperature measurement of hydrothermal fluid ($T_{\max} = 306^{\circ}\text{C}$), hydrothermal flow rate measurement by ultrasonic waves, imaging of the flow field by imaging plate, hydrothermal fluid sampling by handy-type vacuum water sampler and rock sampling (Figs. 3-56 to 3-58). Totally, eight rock samples (KK#801R01 to R08) were obtained during this dive survey.

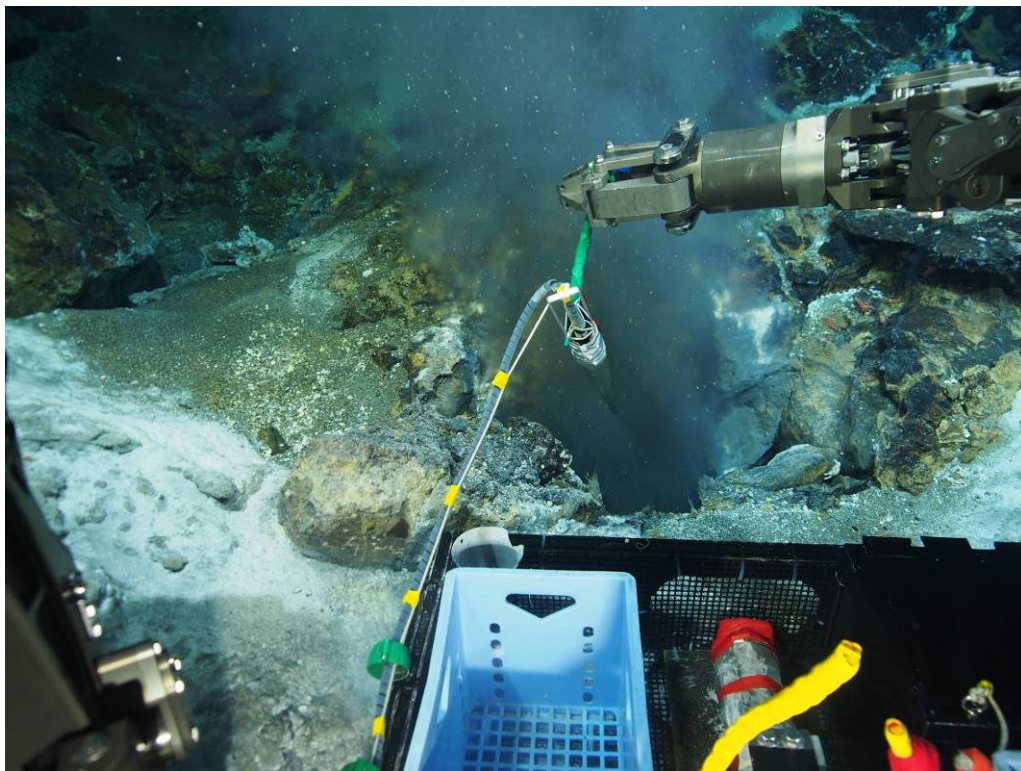


Fig. 3-52 Temperature measurement of hydrothermal fluid at Hole C9023E.

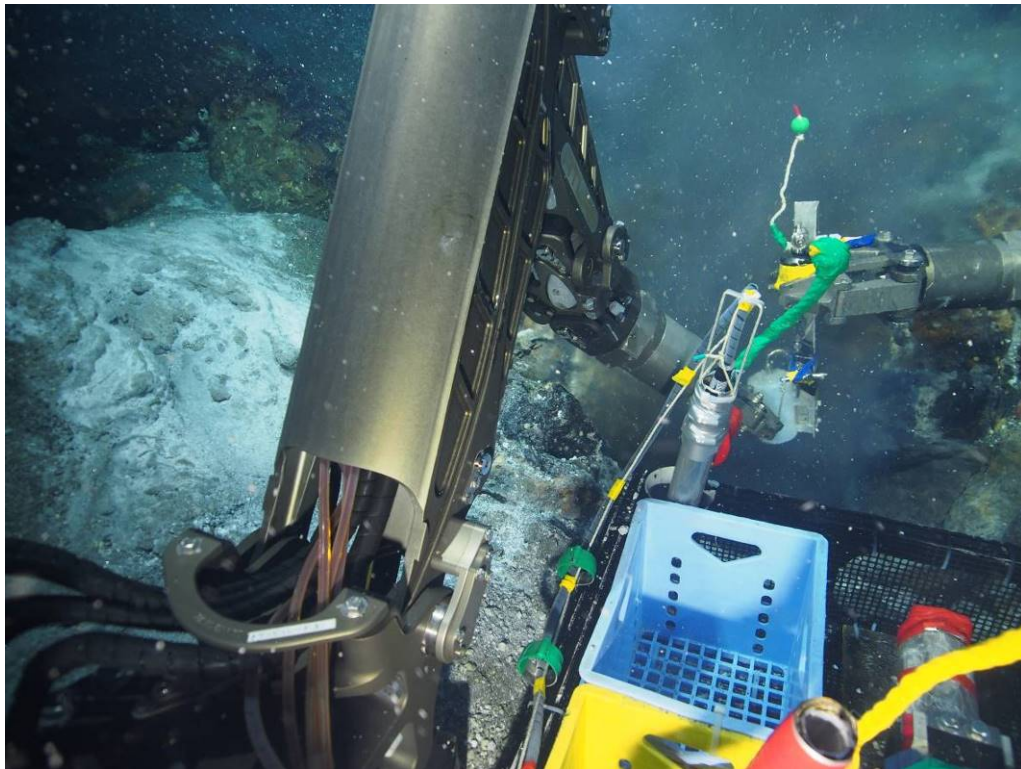


Fig. 3-53 Hydrothermal fluid sampling at Hole C9023E.

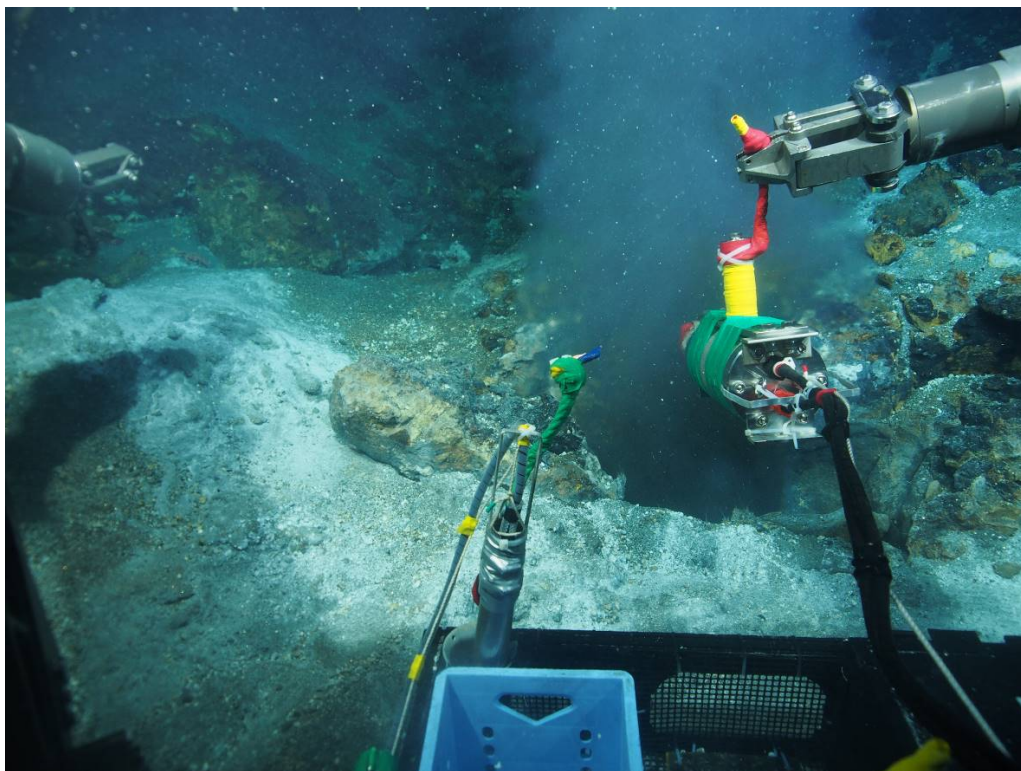


Fig. 3-54 Hydrothermal flow rate measurement using ultrasonic waves at Hole C9023E.

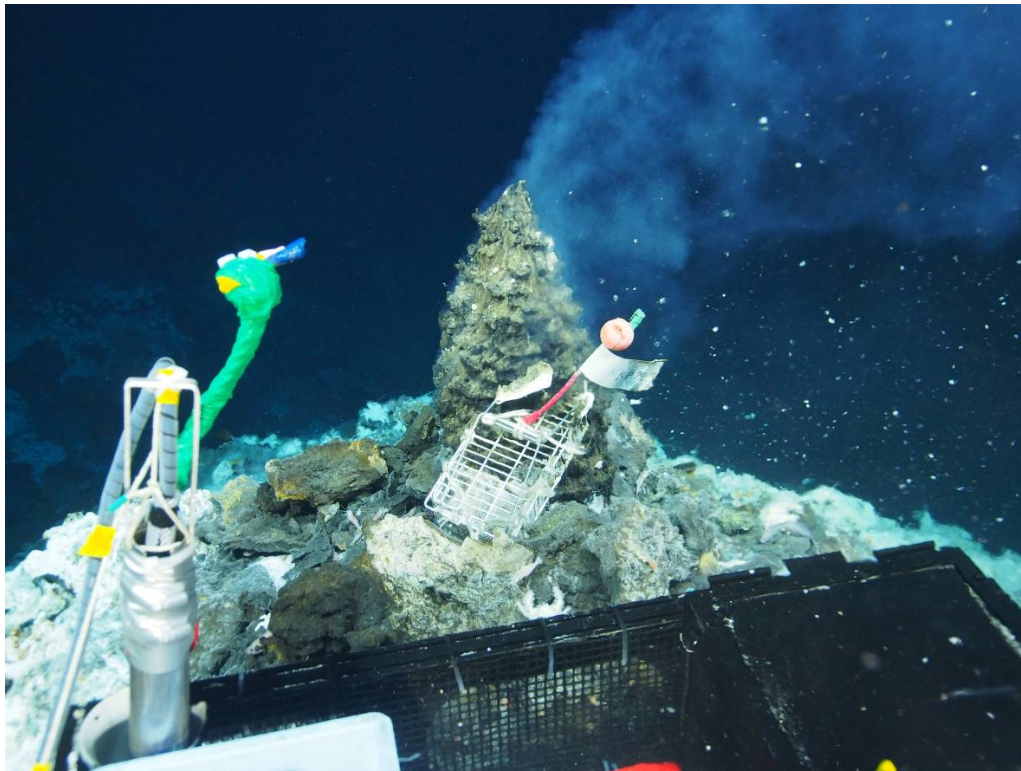


Fig. 3-55 New anhydrite-rich chimney was formed in five days from the KK#798 dive on the gold adsorption apparatus installed at the HSK mound.

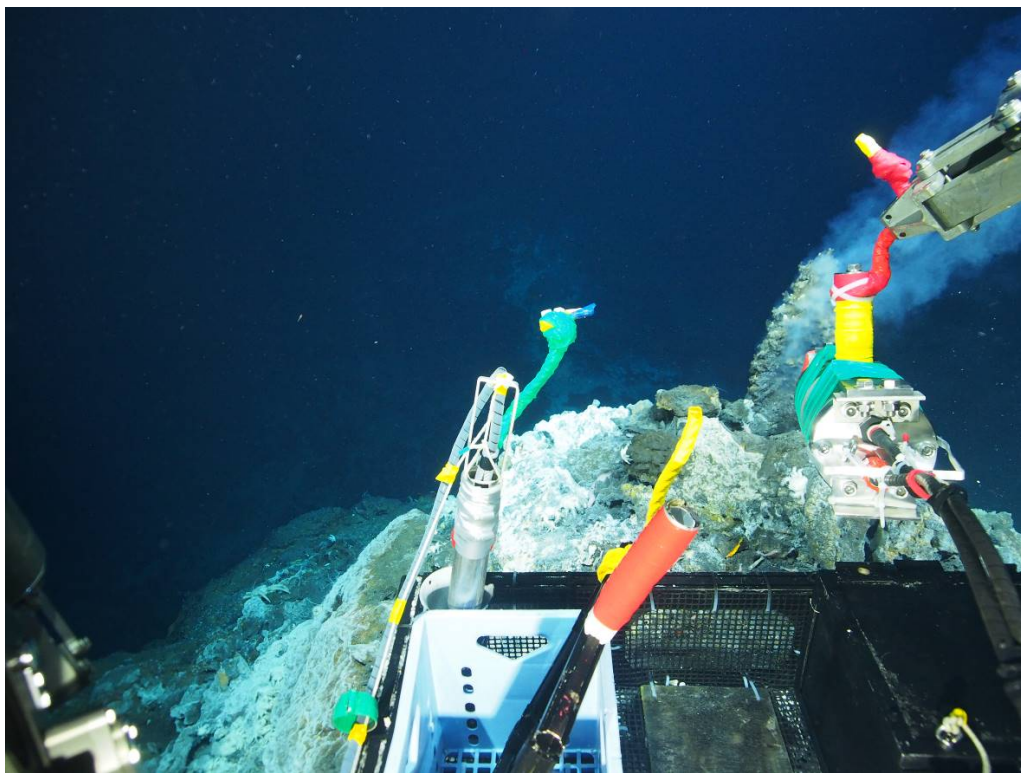


Fig. 3-56 Hydrothermal flow rate measurement using ultrasonic waves at the HSK mound.

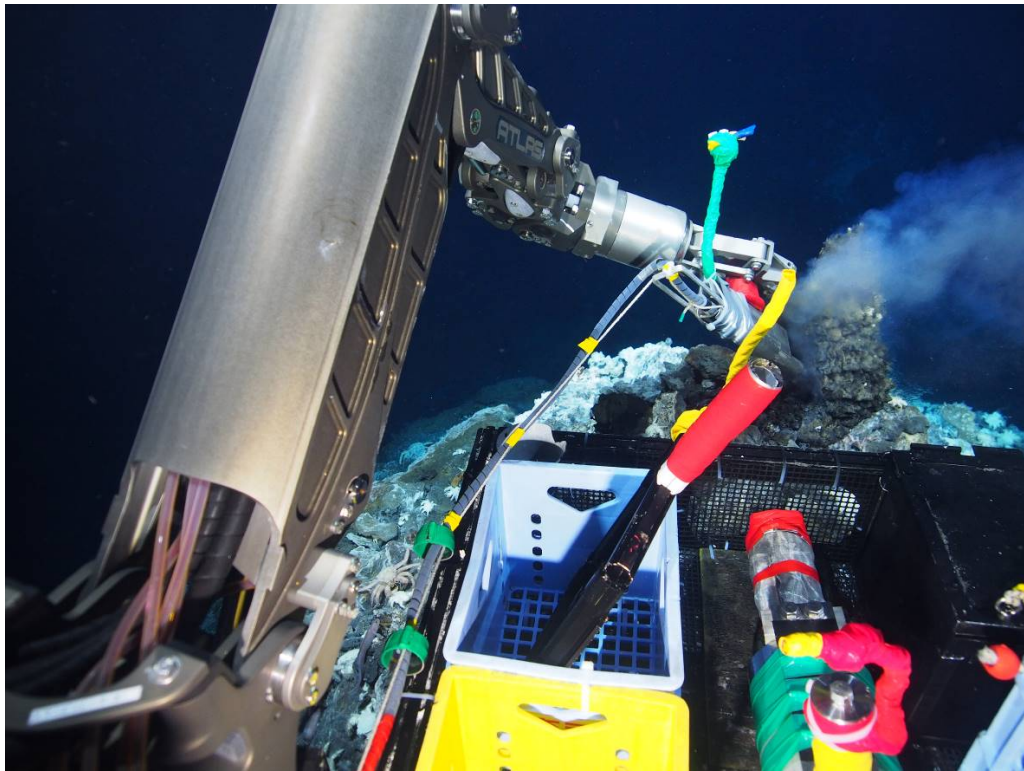


Fig. 3-57 Temperature measurement of hydrothermal fluid at the HSK mound.

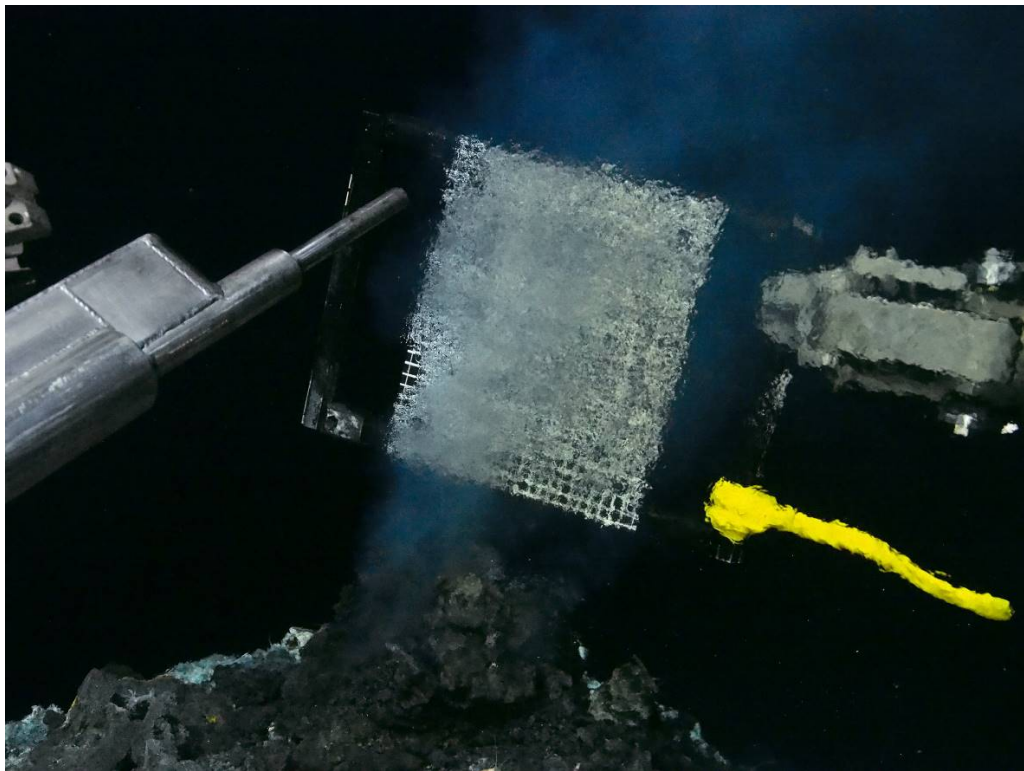


Fig. 3-58 Imaging of the flow field of hydrothermal fluid by imaging plate at the HSK mound.

4. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

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

This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for latest information.

Users of data or results on this cruise report are requested to submit their results to the Data Management Group of JAMSTEC.

