doi : 10.17596/0002834

KAIYO CRUISE REPORT

KY15-16 Leg1

Construction of DONET2

Off Kii Channel

Oct.16,2015-Nov.6,2015

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Contents

1. Cruise Information

- Cruise ID — KY15-16 Leg1
- Name of vessel — Kaiyo
- Title of the cruise — Construction of DONET2
- Title of proposal — Construction of DONET2
- Cruise period — October 16, 2015 – November 6, 2015
- Ports of call — JAMSTEC, Yokosuka – Wakayama
- Research area — Off Kii Channel, Kumanonada

- Research map

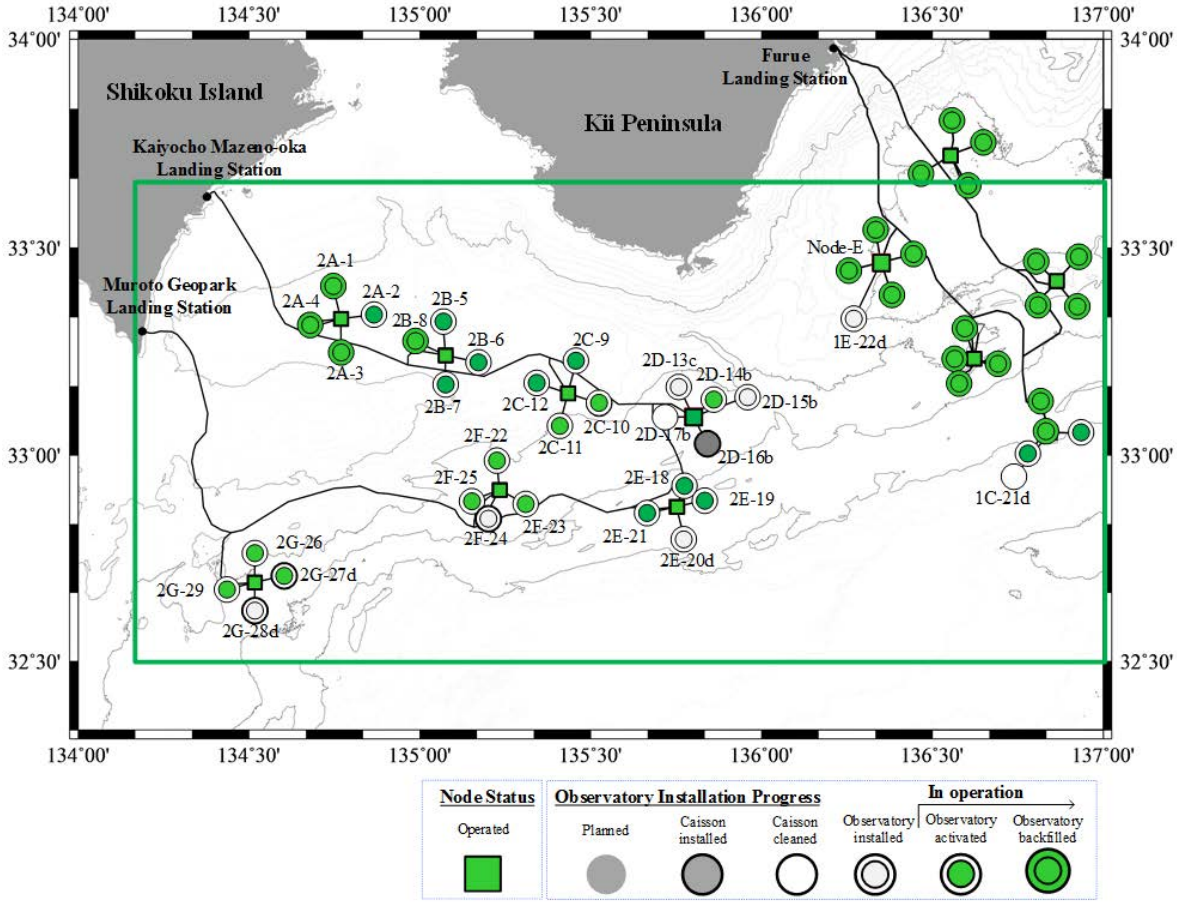

Fig. 1.1. Research area (construction situation of DONET2 on Nov. 6, 2015).

2. Researchers

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3. Introduction

DONET (Dense Oceanfloor Network System for Earthquakes and Tsunamis) is a submarine cabled real-time seafloor observatory network and has been developing for the purpose of monitoring the seismogenic zone around the Nankai Trough. The development of DONET has been carried out since 2006 and the installation of twenty observatories at Kumanonada (called DONET1) has been completed in July 2011. In August 2011, the data of DONET1 have started to be provided to the Japan Meteorological Agency and the National Research Institute for Earth Science and Disaster Prevention for the earthquake and tsunami early warning. Currently, we have installing DONET2 that includes twenty-nine observatories at off Kii Channel to monitor a wider region; the monitoring area will be expanded to the western side of DONET1. In addition, two observatories are planned to be added to DONET1 (see Fig. 1.1).

DONET consists of landing stations, repeaters, branching units, terminal units, science nodes, and observational equipment. These are connected by submarine cables for real-time observation. Here, the repeater, branching unit and terminal unit are deployed with the backbone cable by a cable ship, and the science node, observational equipment and the cable connecting these two equipment are deployed by a remotely operated vehicle (ROV). Each observational equipment consists of a seismometer package, a pressure sensor package, and a battery equipment. The backbone cable of DONET2 was installed in October 2014. Before this expedition KY15-16 Leg1, twenty observatories of DONET2 have been deployed using the ROV Hyper Dolphin (HPD) and the data are currently transmitted to associated institutions.

In this expedition, KY15-16 Leg1, we continued the installation of DONET2 using the HPD and two observatories have been activated. The detailed operations carried out in this expedition are as follows.

1) Reinstallation of Node 2D

   The terminal unit 2D had a trouble during the system test carried out in 2014 and Node 2D was recovered to recover the troubled terminal unit and install a new one. In this expedition, Node 2D has been reinstalled because the original terminal unit 2D was recovered and a new one was installed before this expedition.

2) Cleaning the inside of four caissons for housing the seismometer packages

   We have cleaned the inside of the caissons at 2D-13, 2D-14, 2D-15 and 2D-17 (see Fig. 1.1 for the notation of the position).

3) Installation of three observational equipment

   We have installed observational equipment at 2D-13, 2D-14 and 2D-15.

4) Cable-laying operations for two observatories

   Cable-laying operations for activating two observatories at 2D-14 and 2G-27 have been

carried out successfully. These two observatories are now in evaluation.

Table 1 shows the schedule of the expedition KY15-16 Leg1 and the detailed contents of each HPD dive are described in the next section, Section 4.

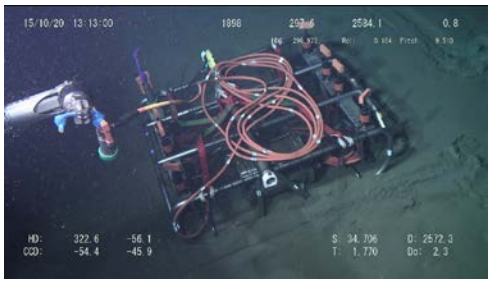
Table 1. Schedule of KY15-16 Leg1.

Date	Area	Contents	Remarks
Oct. 16, 2015	JAMSTEC	Departure	Embarkation
Oct. 17, 2015	Off Kii Channel		Waiting on weather
Oct. 18, 2015			Waiting on weather
Oct. 19, 2015			Waiting on weather
Oct. 20, 2015		Dive #1898	Reinstallation of Node 2D
Oct. 21, 2015			Taking refuge due to bad weather
Oct. 22, 2015			Taking refuge due to bad weather
Oct. 23, 2015			Waiting on weather
Oct. 24, 2015		Dive #1899 Dive #1900	Cleaning the inside of the caisson at 2D-14 Cleaning the inside of the caisson at 2D-15
Oct. 25, 2015			Taking refuge due to bad weather
Oct. 26, 2015		Dive #1901	Cleaning the inside of the caisson at 2D-13
Oct. 27, 2015		Dive #1902 Dive #1903	Installation of observational equipment at 2D-13 Installation of observational equipment at 2D-14
Oct. 28, 2015			Taking refuge due to bad weather
Oct. 29, 2015		Dive #1904	Cable-laying operation to 2G-27
Oct. 30, 2015		Dive #1905	Cable-laying operation to 2G-28 (stopped)
Oct. 31, 2015		Dive #1906	Installation of observational equipment at 2D-15
Nov. 1, 2015		Dive #1907	Cleaning the inside of the caisson at 2D-17
Nov. 2, 2015			Waiting on weather
Nov. 3, 2015		Dive #1908	Cable-laying operation to 2D-14
Nov. 4, 2015			Waiting on weather
Nov. 5, 2015			Taking refuge due to bad weather
Nov. 6, 2015	Yakayama	Arrival	Disembarkation

4. Dive Summary

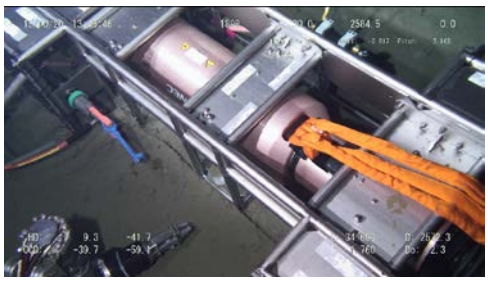
4.1. DIVE #1898 on Oct. 20, 2015: Reinstallation of Node 2D

In this dive, the Node 2D was reinstalled. After landing on the seafloor, the HPD moved toward the terminal unit 2D using an ROV-Homer (ID: 93) attached at the terminal unit and placed the node on the seafloor near the terminal unit. Then, the HPD pulled the underwater mateable connector from the node and took it to the terminal unit for connection. It was confirmed that the node is operated correctly after the connection. The figures below show the procedures of the installation operation. The position of the terminal unit is (33-05.767N, 135-47.805E, 2584m) and the node is (33-05.751N, 135-47.795E, 2584m).

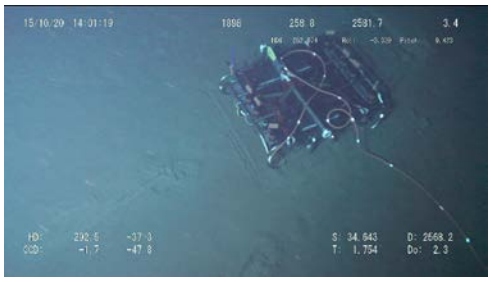


(a) Node 2D reinstalled on the seafloor

(b) Connection with the terminal unit 2D



(c) The terminal unit 2D after the connection



(d) Node 2D after the connection

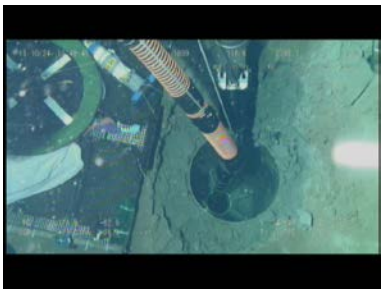
Fig. 4.1.1. Reinstallation of Node 2D.

4.2. DIVE #1899 on Oct. 24, 2015: Measuring the tilting angle and cleaning the inside of the caisson at 2D-14

In this dive, the tilting angle of the caisson at 2D-14 was measured to make sure whether it is suitable for housing the seismometer package. It was confirmed that the tilting angle is less than 10 degrees and this indicates that the caisson can be used for housing the seismometer package. After the measurement, the sediments inside the caisson were removed using the vacuum system mounted on the HPD and then a covering plate was placed on the caisson. The position of the caisson is (33-08.154N, 135-51.500E, Depth: 2,397m).

(a) Before cleaning

(b) Measuring the tilting angle



(c) After cleaning

(d) Placing a covering plate on the caisson

Fig. 4.2.1. Measuring the tilting angle and cleaning the inside of the caisson at 2D-14.

4.3. DIVE #1900 on Oct. 24, 2015: Measuring the tilting angle and cleaning the inside of the caisson at 2D-15

In this dive, the tilting angle of the caisson at 2D-15 was measured, and it was confirmed that the caisson can be used for housing the seismometer package because the tilting angle is less than 10 degrees. After measuring the tilting angle, the sediments in the caisson were removed using the vacuum system mounted on the HPD and then a covering plate was placed on the caisson. The position of the caisson is (33-08.518N, 135-57.524E, Depth: 2,244m).

(a) Before cleaning

(b) Measuring the tilting angle

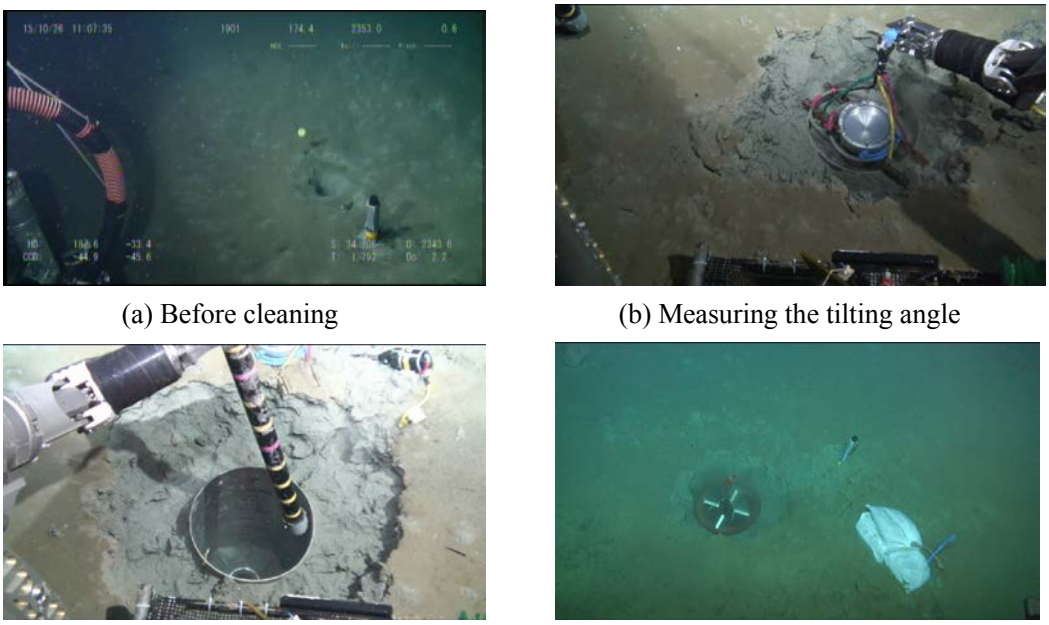
(c) After cleaning

(d) Placing a covering plate on the caisson

Fig. 4.3.1. Measuring the tilting angle and cleaning the inside of the caisson at 2D-15.

4.4. DIVE #1901 on Oct. 26, 2015: Measuring the tilting angle and cleaning the inside of the caisson at 2D-13

In this dive, the tilting angle of the caisson at 2D-13 was measured and it was confirmed that the caisson can be used for housing the seismometer package because the tilting angle is less than 10 degrees. After measuring the tilting angle, the sediments in the caisson were removed using the vacuum system mounted on the HPD and a covering plate was placed on the caisson. The position of the caisson is (33-09.567N, 135-45.339E, Depth: 2,353m).



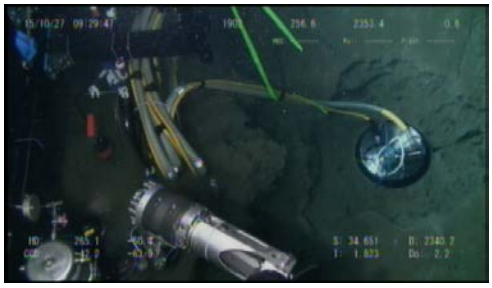
(a) Before cleaning (b) Measuring the tilting angle

(c) After cleaning (d) Placing a covering plate on the caisson

Fig. 4.4.1. Measuring the tilting angle and cleaning the inside of the caisson at 2D-13.

4.5. DIVE #1902 on Oct. 27, 2015: Installation of observational equipment at 2D-13

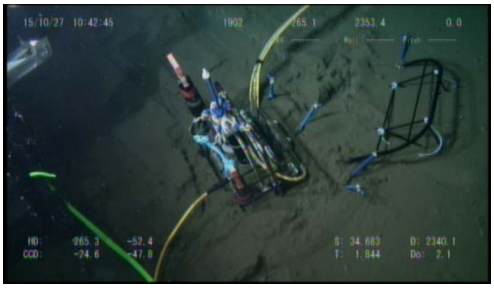
In this dive, we installed an observational equipment at 2D-13 using the ROV Hyper Dolphin (HPD). The observational equipment consists of the following three parts; a seismometer package, a pressure sensor package and a battery equipment. First, the seismometer package was installed inside the caisson and the pressure sensor package was placed on the seafloor next to the seismometer package. The battery equipment was then placed on the seafloor next to the pressure sensor package. These three equipment were connected by cables using the underwater mateable connector. Lastly, the covering plate placed on the caisson was recovered.



(a) Seismometer package

(b) Pressure sensor package

(c) Battery equipment



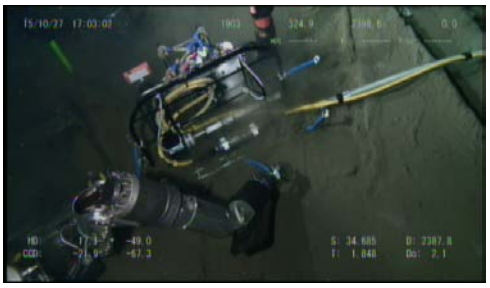
(d) Connection with the battery equipment

Fig. 4.5.1. Installation of observational equipment at 2D-13.

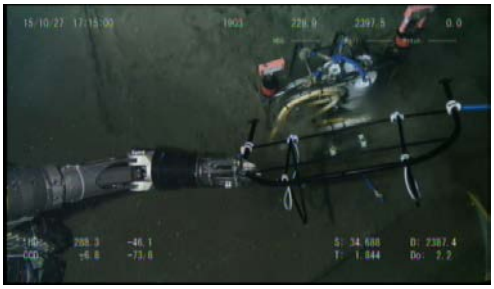
4.6. DIVE #1903 on Oct. 27, 2015: Installation of observational equipment at 2D-14

In this dive, we installed an observational equipment at 2D-14 using the HPD. The observational equipment consists of a seismometer package, a pressure sensor package, and a battery equipment. The seismometer package was first installed inside the caisson and the pressure sensor package was then placed on the seafloor next to the seismometer package. In addition, the battery equipment was deployed on the seafloor next to the pressure sensor package. Finally, the covering plate placed on the caisson was recovered.

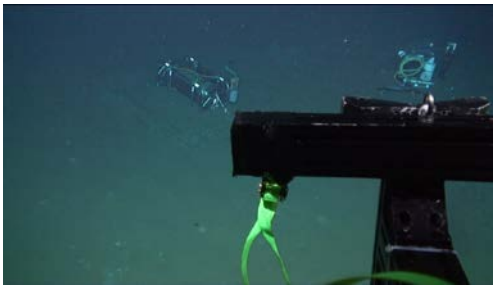
(a) Seismometer package



(b) Pressure sensor package



(c) Battery equipment

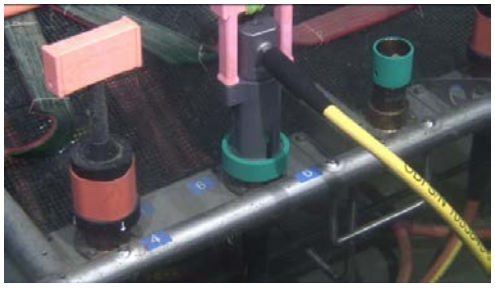


(d) Pressure sensor package and battery equipment

Fig. 4.6.1. Installation of observational equipment at 2D-14.

4.7. DIVE #1904 on Oct. 29, 2015: Cable-laying operation from Node 2G to the observatory at 2G-27

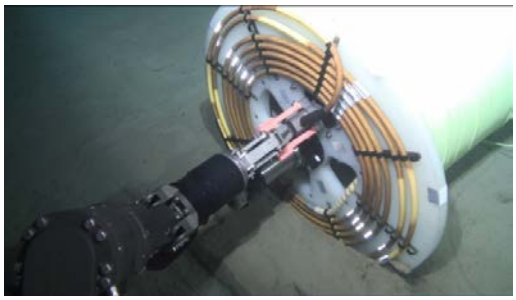
The cable-laying operation from Node 2G to the observatory at 2G-27 was carried out using the automated cable-laying system developed by us. After landing on near Node 2G, the HPD first put the underwater mateable connector linking to the forefront of the cable on the cable bobbin into the port 6 of Node 2G. After that, the junction box was put on the seafloor and then the cable-laying operation was started. After arriving at the observatory at 2G-27, the cable bobbin was placed on the seafloor. Lastly, the observatory was connected with the cable wound on the cable bobbin using the underwater mateable connector (UMC). The length of the dispensed cable is 8,448m and the distance traveled was 7,953m.



(a) Connection with Node 2G

(b) Placing the junction box on the seafloor

(c) Cable laying



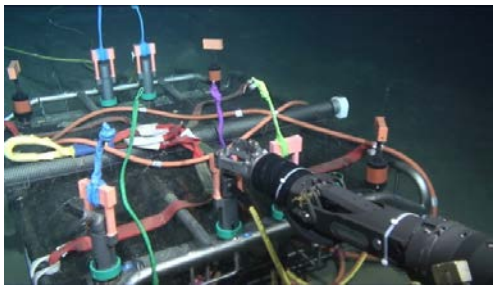
(d) Pulling out the UMC from the cable bobbin

(e) Connection with the observatory

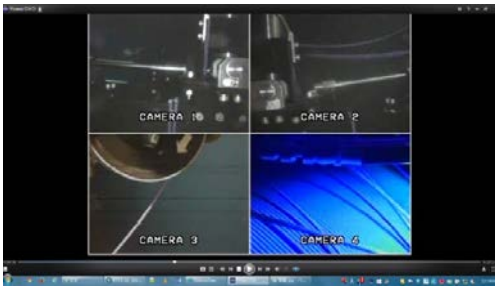
Fig. 4.7.1. Cable-laying operation from Node 2G to the observatory at 2G-27.

4.8. DIVE #1905 on Oct. 30, 2015: Cable-laying operation from Node 2G to the observatory at 2G-28 (stopped)

The cable-laying operation from Node 2G to the observatory at 2G-28 was carried out in this dive; however, it was stopped because the loosened cable on the cable bobbin was entangled with a part of the cable bobbin just after starting cable-laying operation. Thus, the underwater mateable connector (UMC) connected with Node 2G and the junction box placed on the seafloor before starting the cable-laying operation was recovered.

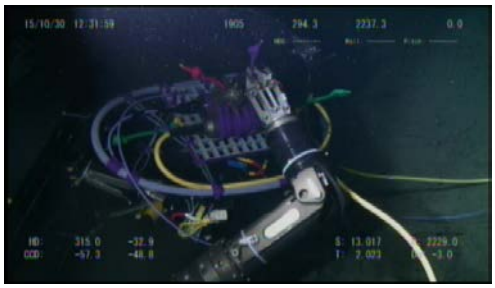


(a) Connection with Node 2G



(b) The cable on the cable bobbin got tangled

(c) Recovering the UMC connected with Node 2G

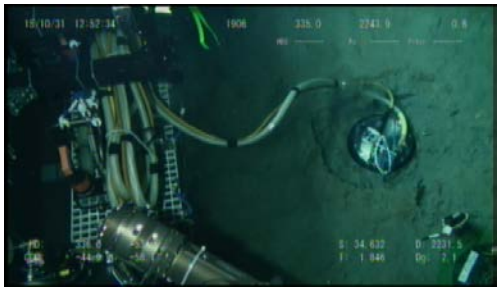


(d) Recovering the junction box

Fig. 4.8.1. Cable-laying operation from Node 2G to the observatory at 2G-28 (stopped).

4.9. DIVE #1906 on Oct. 31, 2015: Installation of observational equipment at 2D-15

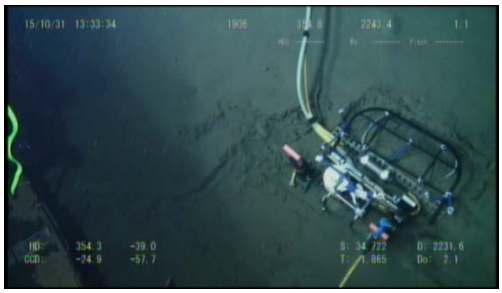
In this dive, we installed an observational equipment at 2D-15 using the ROV Hyper Dolphin (HPD). The observational equipment consists of a seismometer package, a pressure sensor package and a battery equipment. First, the seismometer package was installed inside the caisson and the pressure sensor package was then placed on the seafloor next to the seismometer package. In addition, the battery equipment was deployed next to the pressure sensor package. These three equipment were connected by cables using the underwater mateable connector. Finally, the covering plate placed on the caisson was recovered before leaving the point.



(a) Seismometer package

(b) Pressure sensor package

(c) Battery equipment



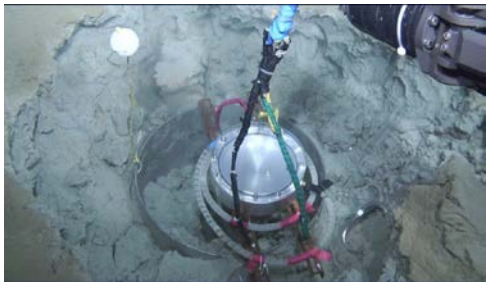
(d) Pressure sensor package connected with battery equipment

Fig. 4.9.1. Installation of observational equipment at 2D-15.

4.10. DIVE #1907 on Nov. 1, 2015: Measuring the tilting angle and cleaning the inside of the caisson at 2D-17

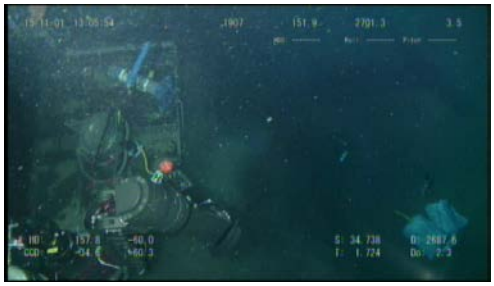
In this dive, the tilting angle of the caisson at 2D-17 was measured to make sure whether it is suitable for installation of the seismometer package. It was confirmed that the tilting angle is less than 10 degrees and this indicates that the caisson can be used for housing the seismometer package. After measuring the tilting angle, the sediments in the caisson were removed using the vacuum system mounted on the HPD and then a covering plate was placed on the caisson. The position of the caisson is (33-05.511N, 135-42.878E, Depth: 2,705m).

(a) Before cleaning



(b) Measuring the tilting angle

(c) After cleaning

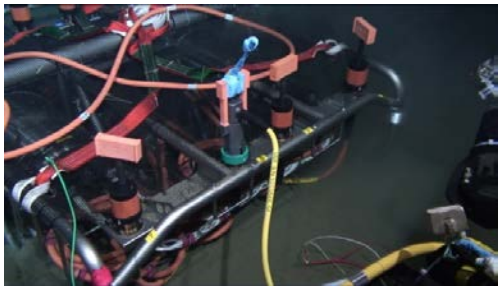


(d) Placing a covering plate on the caisson

Fig. 4.10.1. Measuring the tilting angle and cleaning the inside of the caisson at 2D-17.

4.11. DIVE #1908 on Nov. 3, 2015: Cable-laying operation from Node 2D to the observatory 2D-14

The cable-laying operation from Node 2D to the observatory at 2D-14 was carried out using the automated cable-laying system developed by us. After landing on beside Node 2D, the HPD first put the underwater mateable connector (UMC) linking to the forefront of the cable on the cable bobbin into the port 5 of Node 2D. After that, the junction box was placed on the seafloor and the cable-laying operation was started. After arriving at the observatory at 2D-14, the cable bobbin was placed on the seafloor near the observatory, and the cable wound on the cable bobbin was connected with the observatory using the UMC. The length of the laid cable was 8,157m and the distance traveled was 7,283m.

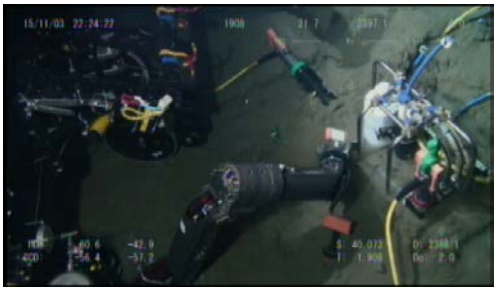


(a) Connection with Node 2D

(b) Placing the junction box on the seafloor

(c) Cable laying

(d) Pulling out the UMC from the cable bobbin



(e) Connection with the observatory

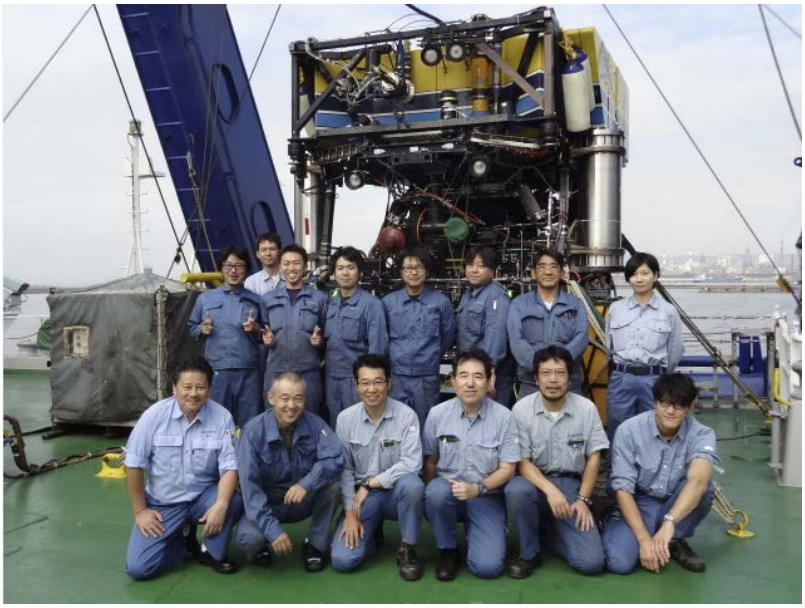
Fig. 4.11.1. Cable-laying operation from Node 2D to the observatory at 2D-14.

5. Conclusion

In this expedition, we have carried out the installation operations of DONET2 using the ROV Hyper Dolphin. The detailed operations are as follows: Node 2D was reinstalled; the inside of four caissons was cleaned for housing the seismometer packages; three observational equipment were installed; and cable-laying operations were carried out for two observatories. As a result, two observatories have been activated in this expedition. The installation of DONET2 will be continued during coming expedition and is planned to be completed in this fiscal year.

Acknowledgment

We would like to thank the captain and crew of the research vessel Kaiyo and the operation team of the ROV Hyper Dolphin for their assistance during the expedition. In addition, the research vessel Kaiyo will retire in January next year and this expedition was the last Kaiyo cruise of boarding scientists. We give our sincere thanks to Kaiyo for her contribution to the installation of DONET1 and DONET2.



6. Notice on Using

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.