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Shinsei-maru Cruise Report

KS-16-J02

Construction of DONET2 system

Re-installation of DONET1 observatories

Off Kii Channel

Kumano-nada

January. 27, 2016 – March.1, 2016

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Contents

1. Cruise Information

- Cruise ID　KS-16-J02
- Name of vessel　R/V Shinsei-maru
- Title of the cruise

  Construction of DONET2 system, Re-installation of DONET1 observatories
- Title of proposal　Theme 1: Construction of DONET2 system

  Theme 2: Re-installation of DONET1 observatories
- Cruise period　January.27, 2016 - March.1, 2016
- Ports of call　Wakayama shimotsu - Wakayama shimotsu - JAMSTEC Yokosuka
- Research area　Off Kii-Channel, Kumano Nada
- Research Map

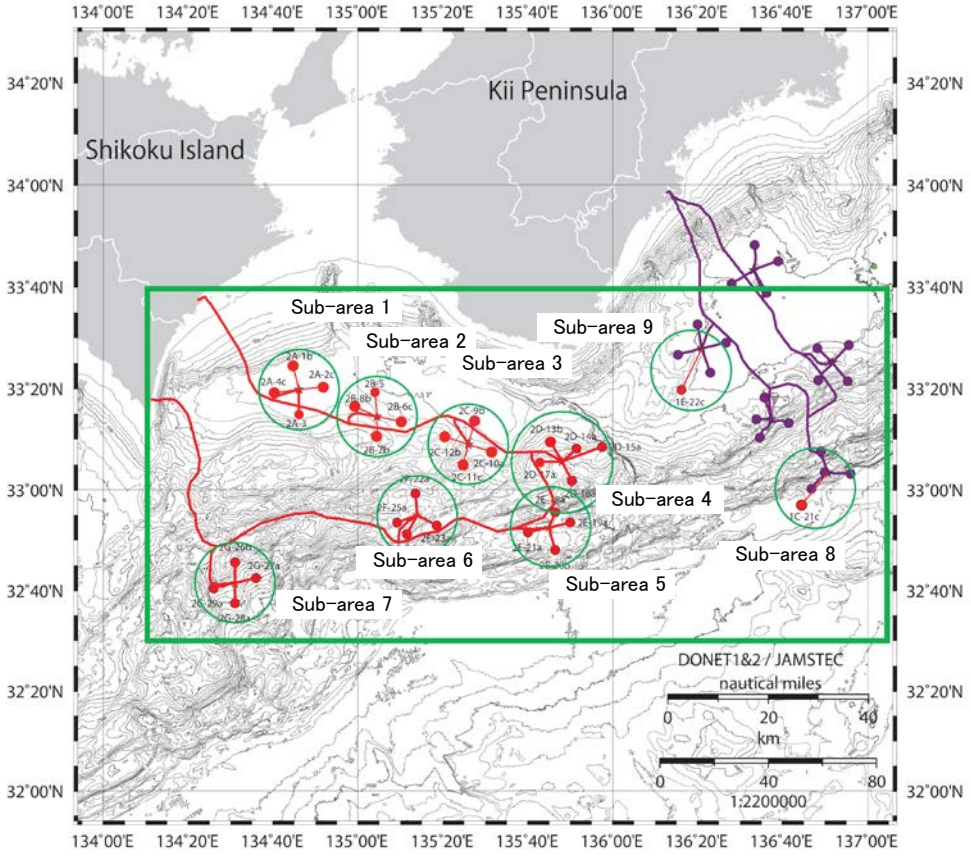

Figure 1.1 Research area and sub-area

2. Science Party

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● Representative of the science party:	Shuichi Kodaira	[JAMSTEC]
● Science party:	Jin-Kyu Choi	[JAMSTEC]
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	Shinichi Isono	[JAMSTEC]
	Tomoyasu Yamamoto	[JAMSTEC]
● Marine Technician:	Tooru Kodera	[NME]
	Takuya Onodera	[NME]
	Satsuki Iijima	[NME]
	Masayuki Toizumi	[NME]
	Morifumi Takaesu	[NME]
	Kiyoshi Shiono	[NME]

3. Background

3.1 Construction of DONET2 system

DONET (Dense Oceanfloor Network System for Earthquakes and Tsunamis) is a submarine cabled 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 system consists of three major components; the backbone cable system, the science node, and the measurement instrument. The electric power and the communication channels are provided to the underwater equipment through the high reliability backbone cable system that is developed based on submarine telecommunication cable systems. The science node is the device with the role of hub and electric power distributer. The measurement instruments are composed of precision seismometer and pressure gauge to observe small or large earthquakes, slow-slip events on the plate boundary, and tsunamis. The measurement instruments are connected to the science node with the extension cables that is laid on the sea bed using ROV. These components brings to DONET system three key features; Redundancy, Extendable, and Replaceable of the measurement instruments. The first DONET system named DONET1 has been operating with the 250km backbone cable, 5 science nodes and 20 observatories since August 2011. The second DONET project named DONET2 is composed of 320km backbone cable, 7 science nodes, 29 observatories and 2 additional observatories of DONET1. The first laying operation of the DONET2 backbone cable system was carried out from January to February in 2014. In the laying operation, three terminal units in the northern section were installed. The remaining section was installed in 2014 and two landing stations were connected through the backbone cable system. The purpose of this expedition is to connect the measurement instruments to the backbone cable system.

3.2 Theme 2: Re-installation of DONET1 observatories

The seismometers currently used with DONET, is buried under the seabed to suppress the background noise. To make the hole for the purpose of burying the seismometer, the caisson is set under the seabed using a piston corer. Then, ROV dives to the position in order to confirm the conditions of the caisson, and the sediment in the caisson is removed using the suction pump equipped in a ROV if requirements of the caisson installation are met. Due to solid sediment, sometimes the caisson cannot penetrate completely with the caisson installation technique of the piston corer. In this case, installation of other caisson is indispensable. But this two operations; the caisson installation and ROV operation need cruise period respectively because of on-board equipment. Since the second caisson installation is carried out after the ROV operation, it becomes a cause of delay of the construction schedule. In addition, because of low accuracy of piston corer's position, the install operation cannot be carried out at the place in which observational equipment is already installed.

The new caisson installation technique using hydraulic vibration hammer is developed, as backup of the piston corer technique. The purpose of this expedition is to install new caissons using hydraulic vibration

hammer and re-install sensors at 1C-10 and 1C-11 of DONET1

4. Operation list

Table 1-1 List of KS-16-J02 operation

Date	Area	Dive No.	Operation
27. Jan, 2016	Wakayama port		Departure
28	Off Kii Channel	Dive#1936	Backfilling the seismometer; 2E-20
39			Harborage
30			Stand by
31		Dive#1937	Backfilling the seismometer; 2A-2
1. Feb, 2016		Dive#1938	Installation of the measurement instruments;1C-21(1)
2	Wakayama port		A call at Wakayama port
3			Departure
4		Dive#1939	Cancelled
5			A call at Wakayama port
6			Departure
7			Harborage
8		Dive#1940	Installation of the measurement instruments; 2D-17
9			Harborage
10		Dive#1941	Backfilling the seismometer; 2G-26
11		Dive#1942	Installation of the measurement instruments;1C-21(2)
12	Wakayama port		A call at Wakayama port

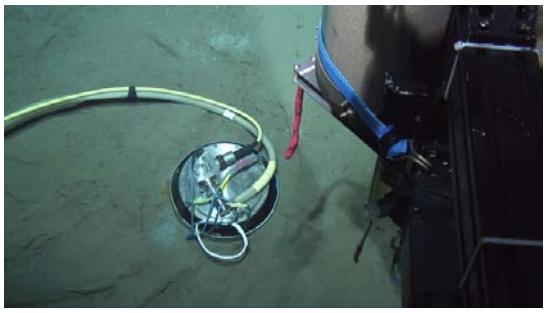
Table 1-2 List of KS-16-J02 operation

Date	Area	Dive No.	Operation
13.Feb, 2016	Wakayama port		Anchorage
14			Anchorage
15			Anchorage
16			Departure
17	Off kii Channel	Dive#1943	Backfilling the seismometer; 2B-5
18		Dive#1944	Laying operation of the extension cable; 2D-17
19		Dive#1945	Installation of the measurement instruments;2D-16
20			Harborage
21			Harborage
22		Dive#1946	Laying operation of the extension cable; 2D-16
23	Wakayama port		A Call at Wakayama port
24			Departure
25	Kumano nada		Harborage
26		Dive#1947 Dive#1948	Cancelled Cancelled
27			ROV maintenance
28		Dive#1949	Laying operation of the extension cable; 1C-21(1)
29			Move the ship to Off Yokosuka
1.Mar,2016			Arrival; End of KS-16-J02

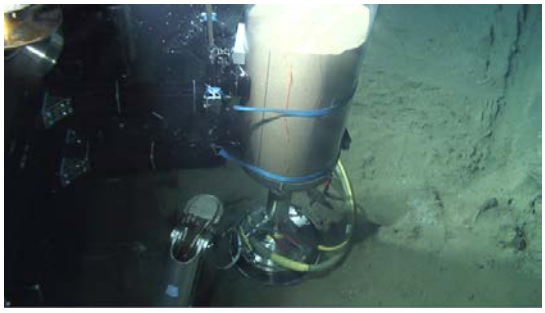
5. Dive Summary

5.1. DIVE #1936 on Jan. 28, 2016: Backfilling the seismometer at 2E-20

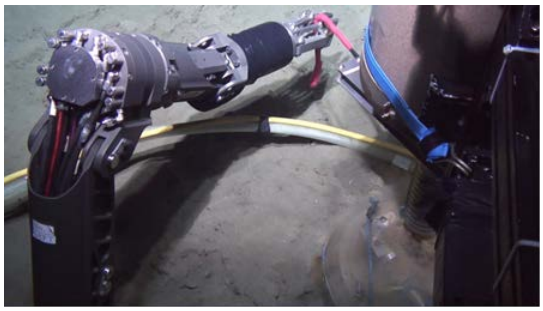
In this dive, ROV Hyper Dolphin (HPD) was operated around the observatory 2E-20. The objection of this dive was backfilling the seismometer of the observatory to reduce the measurement noise. Before this dive, the measurement of the broadband seismometer was suspended by remote control from YOKOHAMA Control Center, to protect the internal mechanism. HPD started to dive at 9:16, and landed near the seismometer at 11:19. The valve of the sand-feeder was opened at 11:41. HPD controlled her position and valve travel of the sand-feeder to fully cover the seismometer. The backfilling operation was finished at 11:50, and HPD leave the seabed at 12:05.



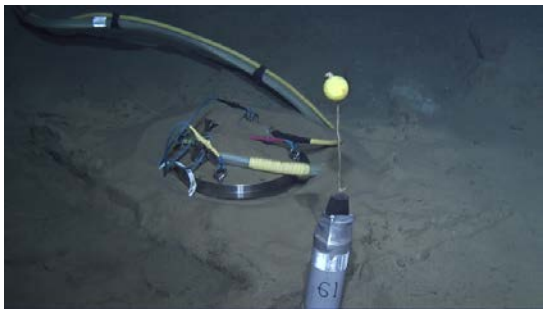
(a) Before backfilling



(b) The Sand-feeder was set



(c) Backfilling work

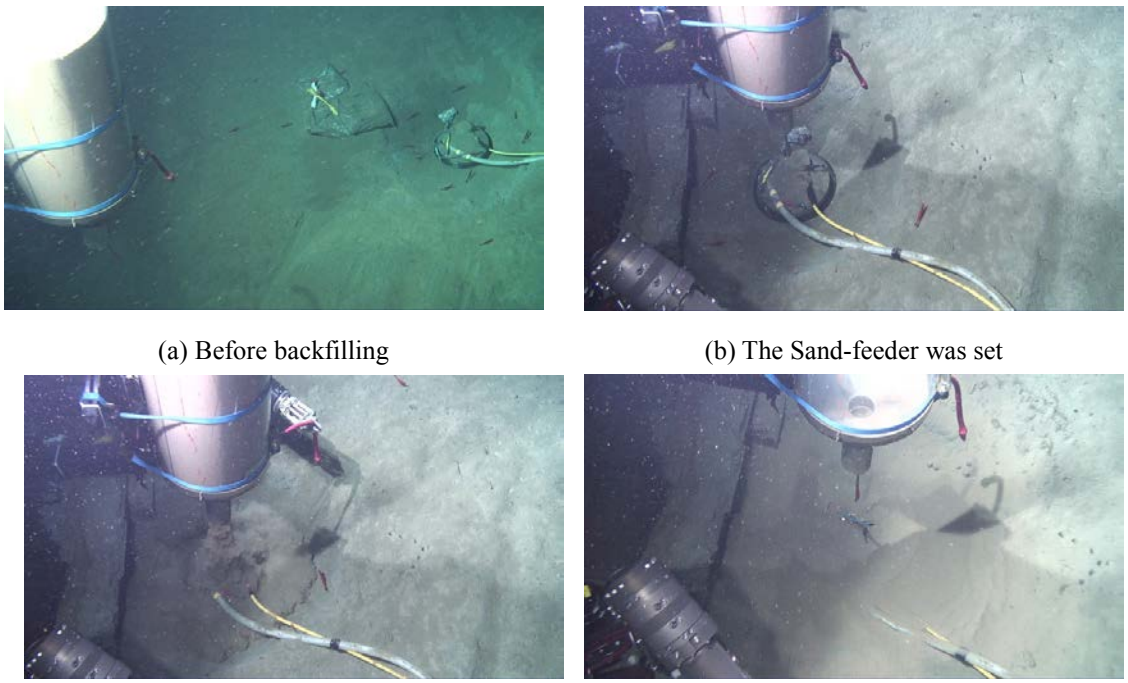


(d) The seismometer after the backfilling

Fig. 5.1. Backfilling operation at 2E-20

5.2. DIVE #1937 on Jan. 30, 2016: Backfilling the seismometer at 2A-2

In this dive, ROV/HPD was operated around the observatory 2A-2. The objection of this dive was backfilling the seismometer of the observatory to reduce the measurement noise. Before this dive, the measurement of the broadband seismometer was suspended by remote control from YOKOHAMA Control Center, to protect the internal mechanism. HPD started to dive at 9:10, and landed near the seismometer at 10:06. The valve of the sand-feeder was opened at 10:29. HPD controlled her position and valve travel of the sand-feeder to fully cover the seismometer. The backfilling operation was finished at 10:27, and HPD leave the seabed at 10:40.



(a) Before backfilling (b) The Sand-feeder was set

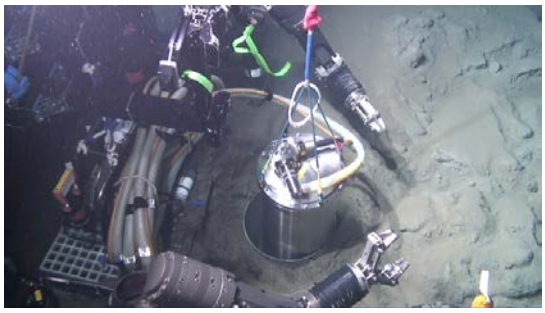
(c) Backfilling work (d) The seismometer after the backfilling

Fig. 5.2. Backfilling operation at 2A-2

5.3. DIVE #1938 on Feb. 1, 2016: Installation of the measurement instrument at 1C-21

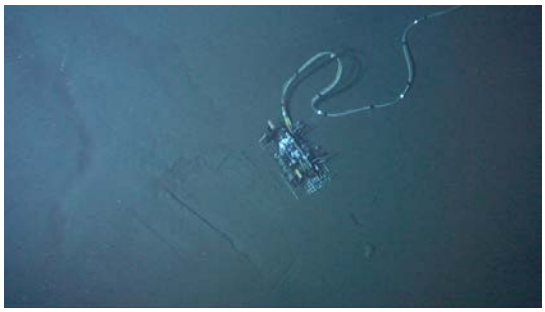
In this dive, we installed an observatory system into the caisson at the point 1C-21 using an ROV Hyper Dolphin. The observatory system consists of the three parts; a seismic sensor package, a pressure sensor package and a battery package. First the seismic sensor package was installed inside the caisson. The pressure sensor package was then deployed on the seafloor next to the seismic package. The battery package was connected to the pressure sensor package. These three packages are connected by cables. Finally the cover plate was recovered before leaving the point.

(a) The cover plate (Left)



(b) The seismometer installation

(c) The seismometer was put into the caisson

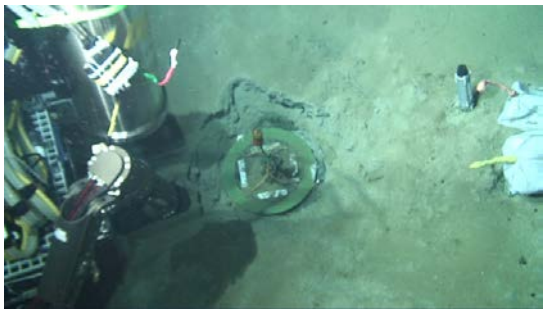


(d) The pressure sensor package

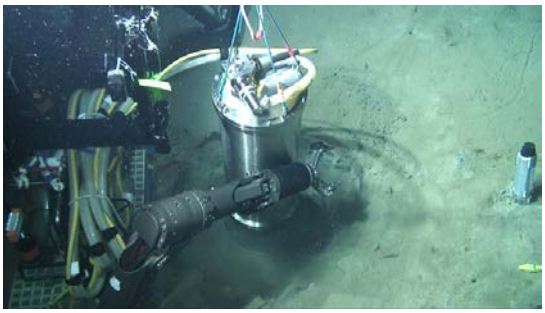
Fig. 5.3. Installation of the measurement instrument at 1C-21

5.4. DIVE #1940 on Feb. 8, 2016: Installation of the measurement instrument at 2D-17

In this dive, we installed an observatory system into the caisson at the point 2D-17 using an ROV Hyper Dolphin. The observatory system consists of the three parts; a seismic sensor package, a pressure sensor package and a battery package. First the seismic sensor package was installed inside the caisson. The pressure sensor package was then deployed on the seafloor next to the seismic package. The battery package was connected to the pressure sensor package. These three packages are connected by cables. Finally the cover plate was recovered before leaving the point.

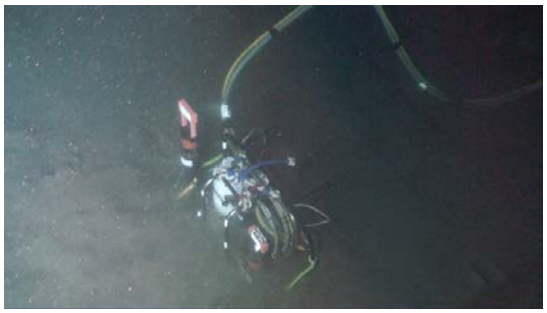


(a) The cover plate (Center)



(b) The seismometer installation

(c) The seismometer was put into the caisson

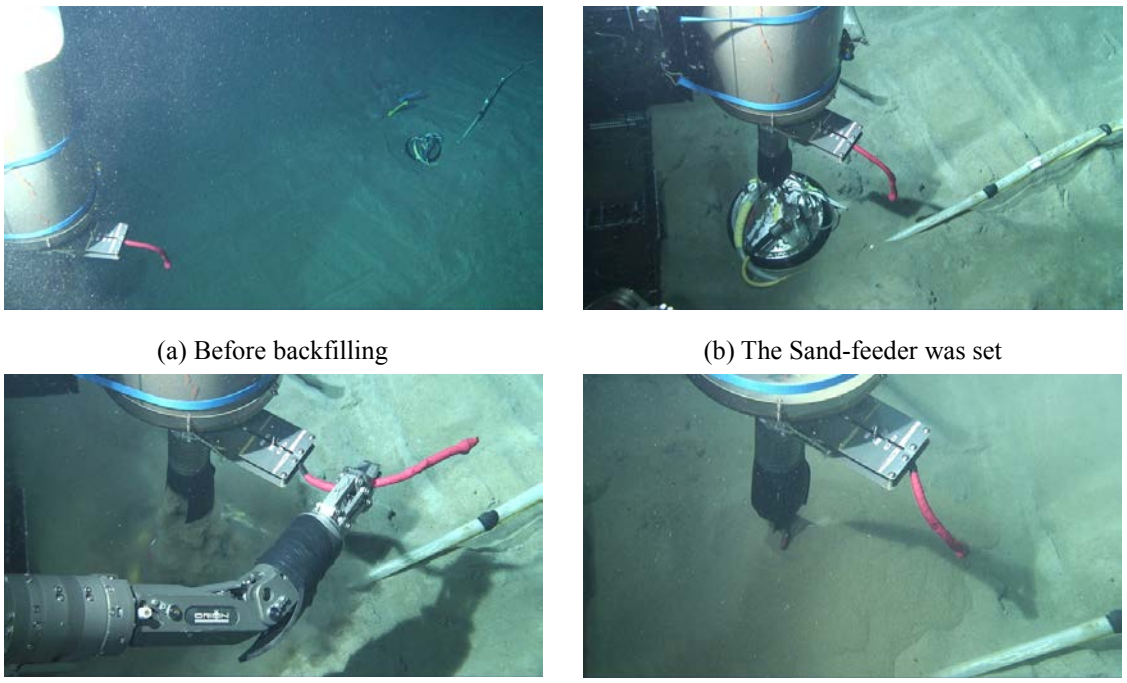


(d) The pressure sensor package

Fig. 5.4. Installation of the measurement instrument at 2D-17

5.5. DIVE #1941 on Feb. 10, 2016: Backfilling the seismometer at 2G-26

In this dive, ROV/HPD was operated around the observatory 2G-26. The objection of this dive was backfilling the seismometer of the observatory to reduce the measurement noise. Before this dive, the measurement of the broadband seismometer was suspended by remote control from YOKOHAMA Control Center, to protect the internal mechanism. HPD started to dive at 8:43, and landed near the seismometer at 9:48. The valve of the sand-feeder was opened at 10:48. HPD controlled her position and valve travel of the sand-feeder to fully cover the seismometer. The backfilling operation was finished at 10:29, and HPD leave the seabed at 11:40.



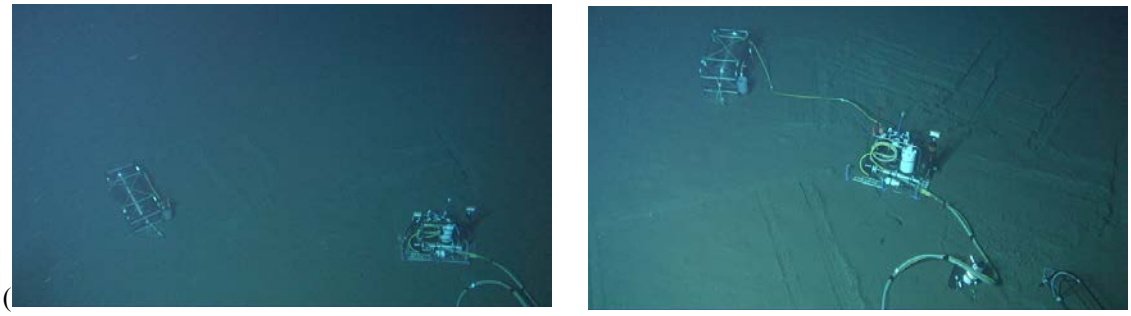
(a) Before backfilling (b) The Sand-feeder was set

(c) Backfilling work (d) The seismometer after the backfilling

Fig. 5.5. Backfilling operation at 2G-26

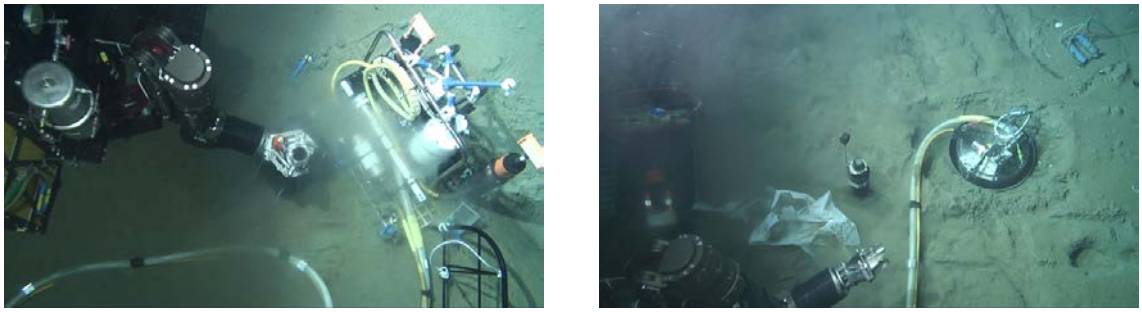
5.6. DIVE #1942 on Feb. 11, 2016: Observatory Construction at 1C-21

During Dive#1938, there was no response from the miniature transponder put in 1C-21. That cause serious problem in the cable laying operation. Therefore, the miniature transponder was replaced in this dive. ROV/HPD started to dive at 8:40, and landed near the pressure sensor package at 11:31. At first, HPD connected the pressure sensor package and the external battery; it was remaining work in Dive#1938. The new transponder (ID:22) was put near the pressure sensor package and conformed the response at 11:38. At last, the existing transponder was recovered and HPD leave the seabed at 12:24.



a) The pressure sensor package(right), and the external battery(Left)

(b) Connected the battery



(c) The new transponder

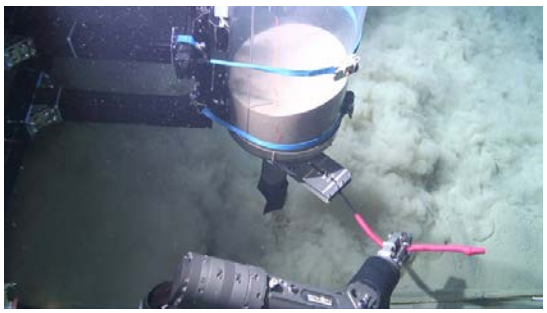
(d) Recovering the existing transponder

Fig. 5.6. Observatory Construction at 1C-21

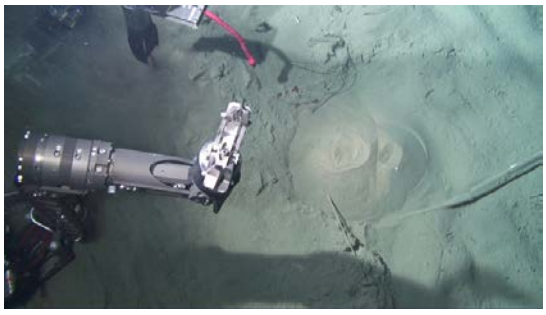
5.7. DIVE #1943 on Feb. 17, 2016: Backfilling the seismometer at 2B-5

In this dive, ROV/HPD was operated around the observatory 2B-5. The objection of this dive was backfilling the seismometer of the observatory to reduce the measurement noise. Before this dive, the measurement of the broadband seismometer was suspended by remote control from YOKOHAMA Control Center, to protect the internal mechanism. HPD started to dive at 8:38, and landed near the seismometer at 9:53. The valve of the sand-feeder was opened at 10:17. HPD controlled her position and valve travel of the sand-feeder to fully cover the seismometer. The backfilling operation was finished at 10:48. The miniature transponder ID: 49 was recovered and HPD leave the seabed at 10:58.

(a) Before backfilling



(b) Backfilling work



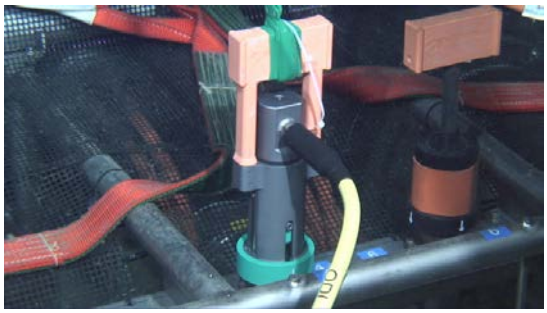
(c) After the Backfilling

(d) The transponder was recovered

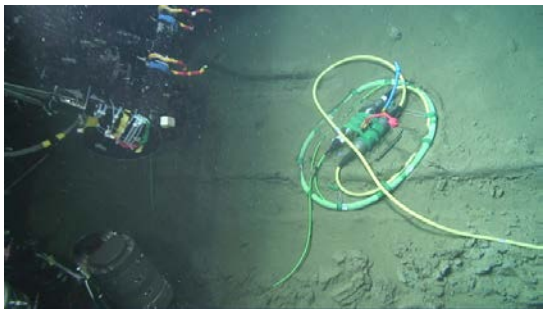
Fig. 5.7. Backfilling operation at 2B-5

5.8. DIVE #1944on Feb. 18, 2016: Laying operation of the extension cable at 2D-17

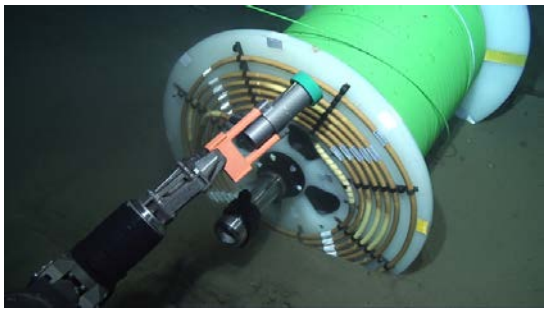
The cable-laying operation from Node 2D to the observatory 2D-17 was carried out using the automated cable-laying system. After landing near Node 2D, the ROV first put the underwater mateable connector linking to the forefront of the cable on the cable bobbin into the port 4 of the node. After that, the junction box was placed on the seafloor and the cable-laying operation was started. After arriving at near the observatory 2D-17, the ROV placed the cable bobbin on the seafloor and connected the cable from Node 2D with the observatory 2D-17 using the underwater mateable connector. It was confirmed that there is no problem in communication between the observatory 2D-17 and the landing station. The length of the laid cable was 7,943.7 [m], the traveled distance was 7,684 [m].



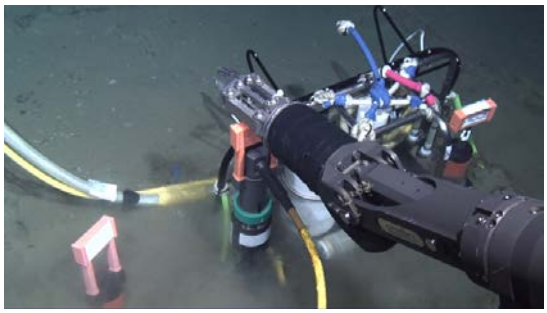
(a) Connection with Node 2D



(b) Placing the junction box



(c) The cable bobbin near the pressure sensor package

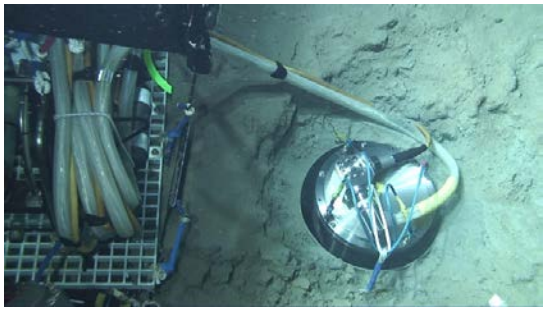


(d) Connection with the pressure sensor package

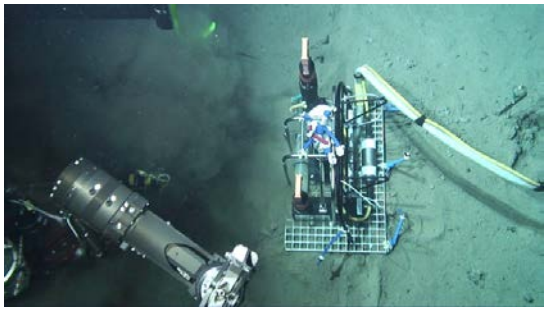
Fig.5.8. Cable Laying operation of the extension cable at 2D-17

5.9. DIVE #1949 on Feb. 19, 2016: Installation of the measurement instrument at 2D-16

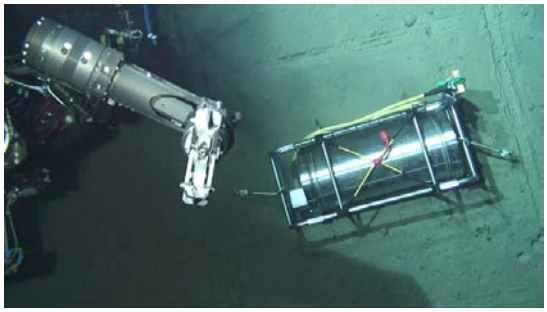
In this dive, we installed an observatory system into the caisson at the point 2D-16 using an ROV Hyper Dolphin. The observatory system consists of the three parts; a seismic sensor package, a pressure sensor package and a battery package. First the seismic sensor package was installed inside the caisson. The pressure sensor package was then deployed on the seafloor next to the seismic package. The battery package was connected to the pressure sensor package. These three packages are connected by cables. Finally the cover plate was recovered before leaving the point.



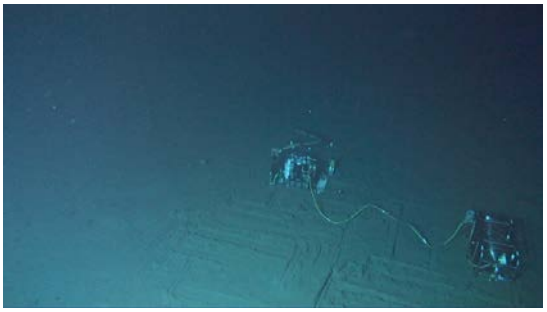
(a) The seismometer was put into the caisson



(b) The pressure sensor package



(c) The external battery



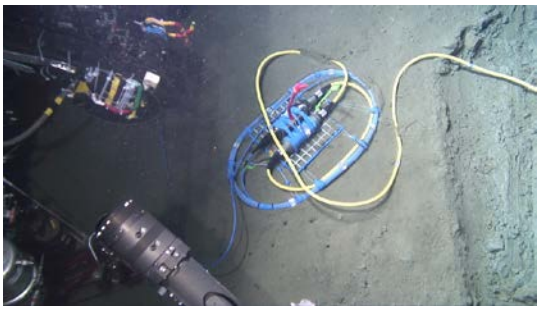
(d) The pressure sensor package(center) and the external battery(right)

Fig. 5.9. Installation of the measurement instrument at 2D-16

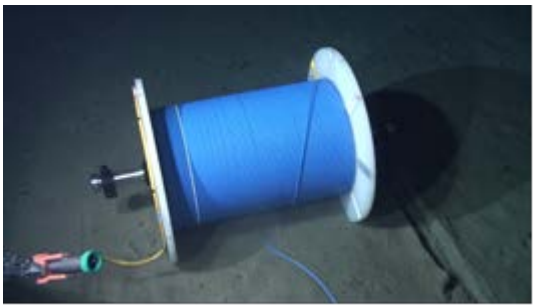
5.10. DIVE #1946 on Feb. 18, 2016: Laying operation of the extension cable at 2D-16

The cable-laying operation from Node 2D to the observatory 2D-16 was carried out using the automated cable-laying system. After landing near Node 2D, the ROV first put the underwater mateable connector linking to the forefront of the cable on the cable bobbin into the port 6 of the node. After that, the junction box was placed on the seafloor and the cable-laying operation was started. After arriving at near the observatory 2D-16, the ROV placed the cable bobbin on the seafloor and connected the cable from Node 2D with the observatory 2D-16 using the underwater mateable connector. It was confirmed that there is no problem in communication between the observatory 2D-16 and the landing station. The length of the laid cable was 9203 [m], the traveled distance was 8786 [m].

(a) Connection with Node 2D



(b) Placing the junction box



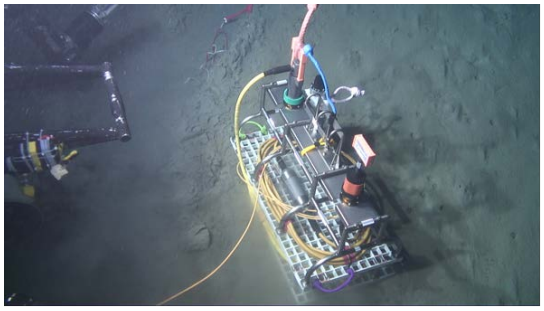
(c) The cable bobbin near the pressure sensor package

(d) Connection with the pressure sensor package

Fig.5.10. Cable Laying operation of the extension cable at 2D-16

5.11. DIVE #1948 on Feb. 28, 2018: Laying operation of the extension cable at 1C-21(1)

The cable-laying operation from the Connection Box 1C to the observatory 1C-21 was carried out using the automated cable-laying system. After landing on the halfway point between Node 1C and site 1C-21, the ROV put the Connection Box 1C that was connected to the upper end of the cable on the cable bobbin. After that, the junction box was put on the seafloor. Then, the cable laying operation was started. The ROV laid the cable from the Connection Box 1C to the observatory 1C-21, and then the cable bobbin was put on the seafloor near the observatory 1C-21. At last, the ROV connected the extension cable to the observatory 1C-21. The length of the laid cable was 9,058 [m], the traveled distance was 7,441 [m].



(a) The Connection Box 1C

(b) Cable laying operation

(c) Cable bobbin with cable

(d) The pressure sensor package(center) and the external battery(right)

Fig.5.11. Cable Laying operation at 1C-21(1)

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.