



KAIYO Cruise Report

KY14-14

Construction of DONET2 system

Off Kii Channel

Kumano-nada

Leg1: October.31 - November.11, 2014

Leg2: November.21 – December.7, 2014

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Contents

1. Cruise Information	3
2. Science Party	3
3. Background	4
4. Operation list	4
5. Dive Summary	6
5.1. DIVE #1743 on Nov. 2, 2014: Installation of the node at 2G	6
5.2. DIVE #1744 on Nov. 4, 2014: Installation of the Node at 2F	6
5.3. DIVE #1745 on Nov. 7, 2014: Installation of the node at 2D	7
5.4. DIVE #1746 on Nov. 8, 2014: Installation of the Node at 2E	8
5.5. DIVE #1747 on Nov. 22, 2014: Recovery of Node 2D	9
5.6. DIVE #1748 on Nov. 22, 2014: Installation of the Verification Node for TU 2D	10
5.7. DIVE #1749 on Nov. 23, 2014: Recovery of the Verification Node at 2D	10
5.8. DIVE #1750 on Nov. 24, 2014: Remove the sediment in the caisson; 2F-25	12
5.9. DIVE #1751 on Nov. 24, 2014: Remove the sediment in the caisson; 2F-22	13
5.10. DIVE #1752 on Nov. 26, 2014: Remove the sediment in the caisson; 2G-26	13
5.11. DIVE #1753 on Nov. 27, 2014: Observatory installation at 2G-26	14
5.12. DIVE #1753 on Nov. 27, 2014: Observatory installation at 2F-25c	16
5.13. DIVE #1755 on Dec.3, 2014: Backfilling at 2A-4	16
5.14. DIVE #1756 on Dec.4, 2014: Backfilling at casing 2B-8	17
5 . Notice on Using	19

3. Background

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 seismic 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 distributor. 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 instrument is connected to the science node with the extension cable that is laid on the sea bed using ROV. These components bring to DONET system three key features; Redundancy, Extendable, and Replaceable of the measurement instruments. The first DONET system deployed off Kii Peninsula 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 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 purposes of this expedition are to connect the measurement instruments to the backbone cable system.

4. Operation list

Table 1 schedule of KY14-14

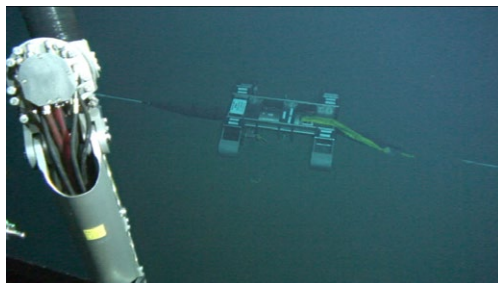
Date	Area	Dive No.	Operation	
Oct. 31, 2014	Yokohama		Departure	
Nov. 1, 2014			Cruise	
Nov. 2, 2014	Off Kii Channel	Dive#1743	Installation of Node 2G	
Nov. 3, 2014			Harborage	
Nov. 4, 2014		Dive#1744	Installation of Node 2F	
Nov. 5, 2014			Harborage	
Nov. 6, 2014			Harborage	
Nov. 7, 2014		Dive#1745	Installation of Node 2D	
Nov. 8, 2014		Dive#1746	Installation of Node 2E	
Nov. 9, 2014		Off Yura		Cruise to Off Yura
Nov. 10, 2014		MES Yura		
Nov. 11, 2014			End of Leg1 (Scientists leave KAIYO)	

Nov. 12, 2014	MES Yura		
Nov. 13, 2014			
Nov. 14, 2014			
Nov. 15, 2014			
Nov. 16, 2014			
Nov. 17, 2014			
Nov. 18, 2014			
Nov. 19, 2014			
Nov. 20, 2014			
Nov. 21, 2014			
Nov. 22, 2014	Off Kii Channel	Dive#1747	Recovering Node 2D
		Dive#1748	Installation of a Verification node for TU 2D
Nov. 23, 2014		Dive#1749	Recovering the Verification node
Nov. 24, 2014		Dive#1750	Remove the sediment in the caisson; 2F-25
		Dive#1751	Remove the sediment in the caisson; 2F-22
Nov. 25, 2014			Harborage
Nov. 26, 2014		Dive#1753	Remove the sediment in the caisson; 2G-26
Nov. 27, 2014		Dive#1754	Installation of the measurement instrument; 2G-26
Nov. 28, 2014		Dive#1755	Installation of the measurement instrument; 2F-25
Nov. 29, 2014			Harborage
Nov. 30, 2014			Harborage
Dec. 1, 2014			Harborage
Dec. 2, 2014			Harborage
Dec. 3, 2014		Dive#1756	Burying of seismometer; 2A-4
Dec. 4, 2014	Dive#1757	Burying of seismometer; 2B-8	
Dec. 5, 2014			Cruise
Dec. 6, 2014	Suruga Bay		Harborage
Dec. 7, 2014	SHI Yokosuka		End of Leg2

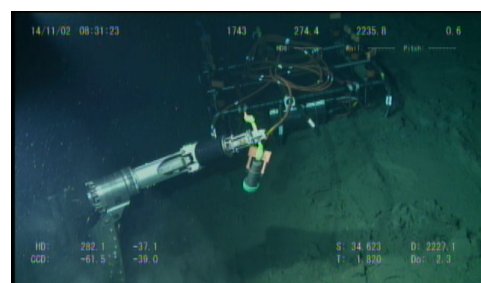
5. Dive Summary

5.1. DIVE #1743 on Nov. 2, 2014: Installation of the node at 2G

This dive is the first dive of the ROV “Hyper Dolphin” (HPD) for DONET2 construction in this expedition. In this dive, a node has been deployed at 2G. After landing on the seafloor, the HPD moved toward the terminal unit installed by a cable ship 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. After the connection, it was confirmed in the landing station that the node is operated correctly. The figure shows the procedures of the installation operation. The position of the terminal unit is (32-41.507N, 134-31.027E, 2236m, ROV-Homer ID: 27) and the node is (32-41.500N, 134-31.031E, 2237m)



(a) Terminal unit



(b) The node installed on the seafloor



(c) Connection with the terminal



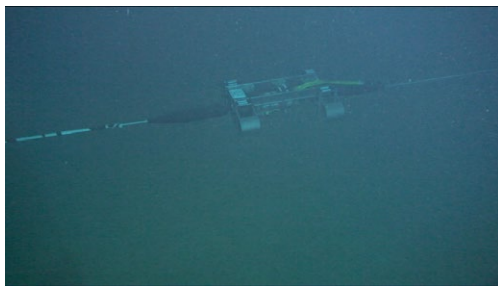
(d) After the connection

Fig. 5.1. Installation of the node at Area 2G.

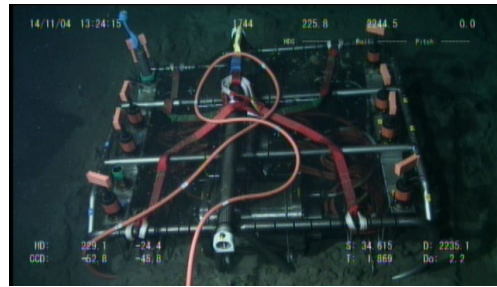
5.2. DIVE #1744 on Nov. 4, 2014: Installation of the Node at 2F

In this dive, we installed a Node system at 2F. Before landing on the seafloor, we confirmed a condition of a Terminal Unit (TU) deployed by the cable laying vessel “Segero”. Then the HPD landed about 15 meters away from the TU. The Node system was deployed there. The HPD pulled the Underwater Mateable Connector (UMC) from the Node system using a manipulator equipped on the HPD and moved toward the TU with the UMC. The UMC was connected with the TU. After the connection, an establishment of communication with the land station was confirmed. The figures show the procedures of the installation operation. The position of the terminal unit is (32-54.964N, 135-14.088E, 2245 m,

ROV-Homer ID: 26) and the Node is (32-54.955N, 135-14.093E, 2244 m).



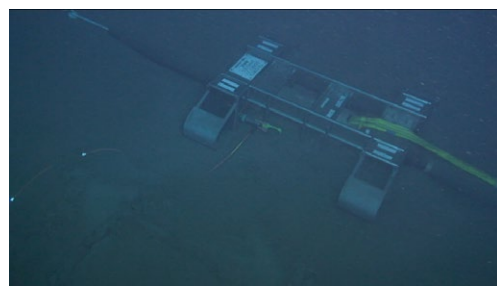
(a) Terminal unit



(b) The node installed on the seafloor



(c) Connection with the terminal

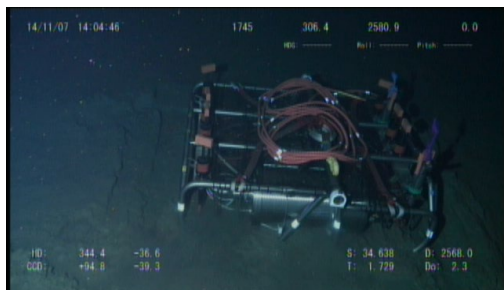


(d) The Terminal unit after the connection

Fig. 5.2. Installation of the node at Area 2F.

5.3. DIVE #1745 on Nov. 7, 2014: Installation of the node at 2D

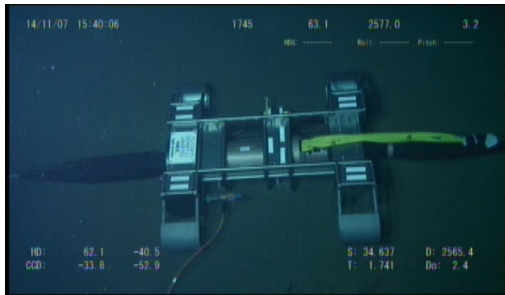
In this dive, a node has been deployed at 2D. After landing on the seafloor, the HPD moved toward the terminal unit using an ROV-Homer (ID: 24) and placed the node on the seafloor near the terminal unit. Then, the HPD pulled the underwater mateable connector from the node and took it to the terminal unit for connection. It was confirmed that the node is operated correctly after the connection. The figure below shows the procedures of the installation operation. The position of the terminal unit is (33-05.746N, 135-47.869E, 2580m) and the node is (33-05.740N, 135-47.8614E, 258m)



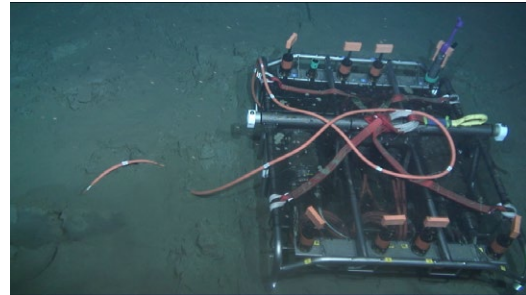
(a) The node deployed on the seafloor



(b) Connection with the terminal unit



(c) The terminal unit after the connection

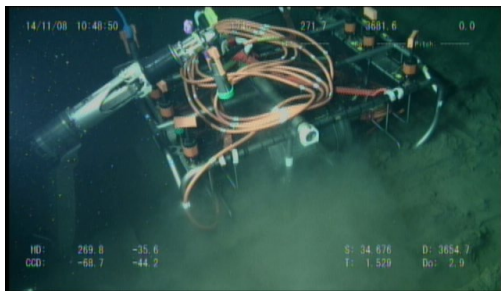


(d) The node after the connection

Fig. 5.3. Installation of the node at Area 2D.

5.4. DIVE #1746 on Nov. 8, 2014: Installation of the Node at 2E

In this dive, we installed a Node system at 2E. Before landing on the seafloor, we confirmed a condition of a Terminal Unit (TU) deployed by the cable laying vessel “Segero”. Then the HPD landed about 17 meters away from the TU. The Node system was deployed there. The HPD pulled the Underwater Matable Connector (UMC) from the Node system using a manipulator equipped on the HPD and moved toward the TU with the UMC. The UMC was connected with the TU. After the connection, an establishment of communication with the land station was confirmed. The figures show the procedures of the installation operation. The position of the terminal unit is (32-54.543N, 135-45.067E, 3681 m, ROV-Homer ID: 25) and the Node is (32-52.536N, 135-45.064E, 3682 m)



(a) The node deployed on the seafloor



(b) Connection with the Terminal Unit

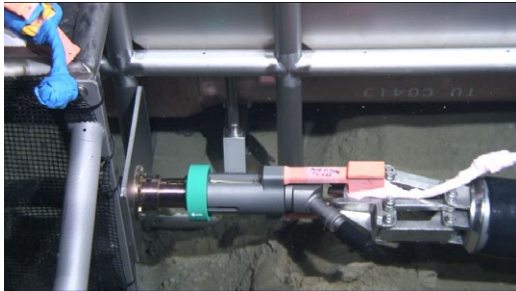


(c) The node after the connection

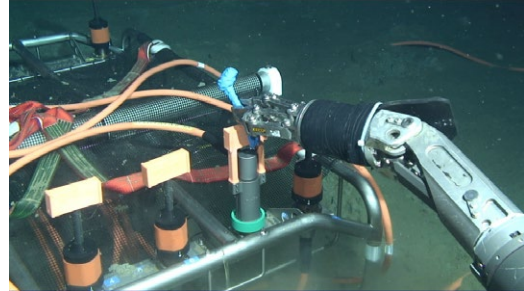
Fig. 5.4. Installation of the node at 2E

5.5. DIVE #1747 on Nov. 22, 2014: Recovery of Node 2D

A failure has been occurred on Node 2D during system test that was carried out on Nov. 10, 2014 after deploying all nodes of DONET2. A part of Node 2D or TU 2D is estimated to be the cause of the failure; however, it is difficult to identify the faulty place unless an evaluation node is connected to TU-2D; the faulty place will be a part of Node 2D if the evaluation node is operated correctly. In this dive, we have recovered Node 2D to install the evaluation node. The recovering process is as follows. After landing on the seafloor, the HPD first placed the weight of 150kg on the seafloor at a distance of 300m from Node 2D and moved toward Node 2D using an ROV-Homer (ID: 24). The HPD then landed on the seafloor close to TU 2D and pulled the connector of Node 2D from TU 2D. After that, a loopback connector was connected to TU 2D and the connector of Node 2D was collected to Node 2D with its cable. Lastly, the HPD connected the hook for recovery to Node 2D and ascended for recovery.



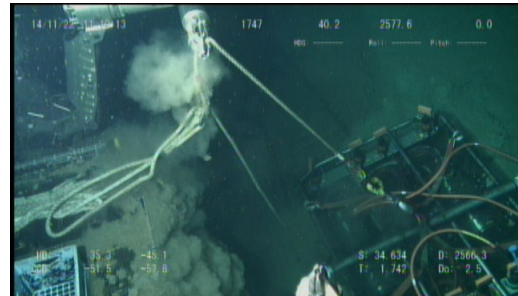
(a) Connecting a loopback connector to TU 2D



(b) Collecting the connector of Node 2D



(c) Connecting the hook for recovery to Node 2D

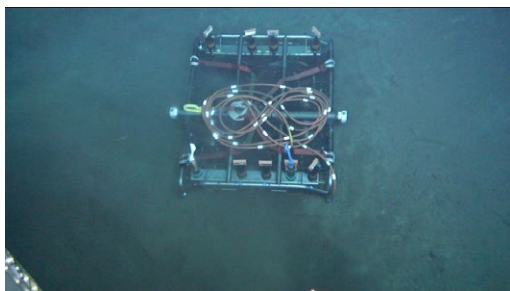


(d) Recovering

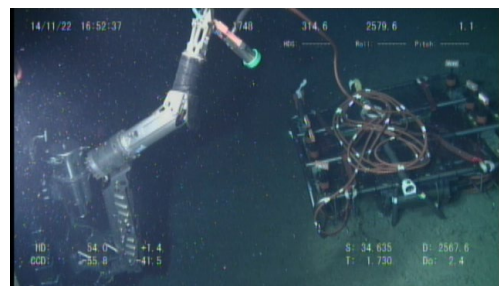
Fig. 5.5. Recovering process of Node 2D

5.6. DIVE #1748 on Nov. 22, 2014: Installation of the Verification Node for TU 2D

In this dive, the Verification Node has been connected to TU 2D instead of the recovered Node 2D for fault diagnosis. After landing on the seafloor, the HPD moved toward TU 2D using an ROV-Homer (ID: 24) and placed the Verification Node on the seafloor near TU 2D. The HPD then pulled the connector from the Verification Node and took it to TU 2D for connection. It was confirmed through tests in the landing station that the faulty place is a part of TU 2D. As a result, the installed Verification Node will be recovered by the HPD on the next dive and TU 2D will also be recovered by a cable ship.



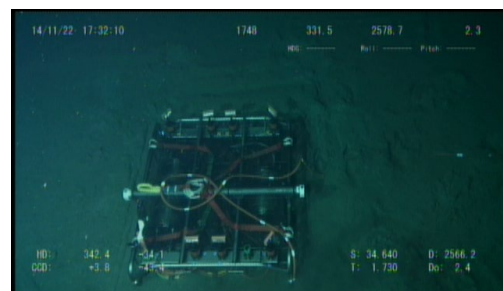
(a) The Verification Node on the seafloor



(b) Taking the connector to TU 2D for connection



(c) Connection with TU-2D



(d) The Verification Node after the connection

Fig. 5.6. Installation process of the Verification Node

5.7. DIVE #1749 on Nov. 23, 2014: Recovery of the Verification Node at 2D

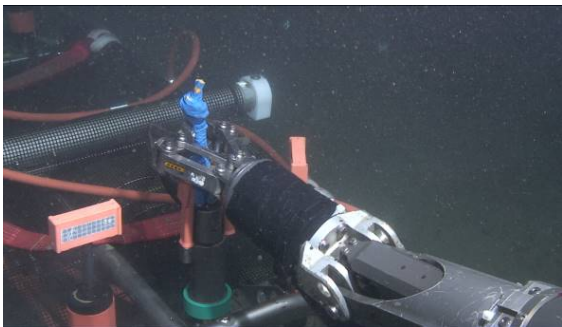
In this dive, the Verification Node was recovered. After landing on the seafloor, the HPD deployed the sinker of 150kg on the seafloor at a distance of 300m from the Verification Node and moved toward TU 2D using an ROV-Homer (ID: 24). The HPD landed close to TU 2D and pulled the Underwater Matable Connector (UMC) of the Verification Node from TU 2D. After that, a loopback connector was connected with TU 2D and the connector of the Verification Node was collected with its cable. Lastly, the HPD connected the hook for recovery to the Verification Node and ascended for recovery.



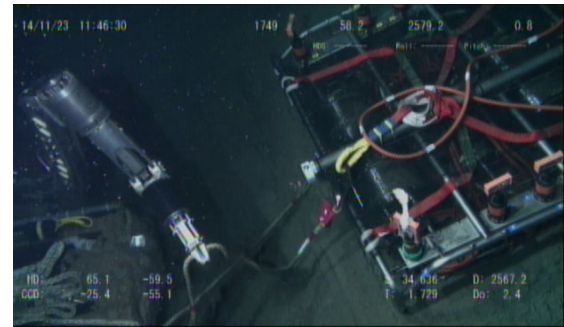
(a) Pulling out the UMC from TU-2D.



(b) Connecting a loopback connector to TU 2D



(c) Connected the UMC to the Verification Node.



(d) Connecting the hook for recovery

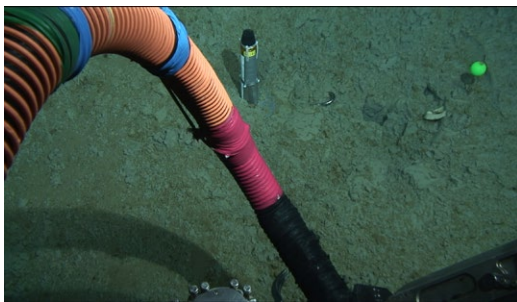
Fig. 5.7. Recovering process of the Verification Node

5.8. DIVE #1750 on Nov. 24, 2014: Remove the sediment in the caisson; 2F-25

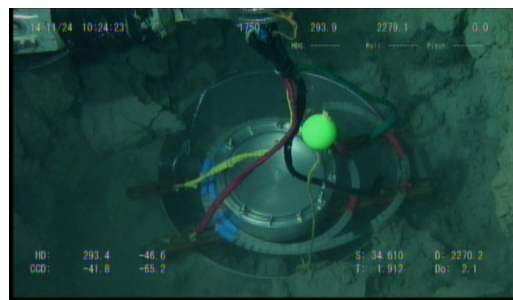
In this dive, ROV Hyper Dolphin (HPD) was operated around the observatory site 2F-25. Measuring the casing tilt angle and cleaning inside of the casing was objectives of this dive. For the first objective, the measured casing tilt angle was less than 10 degrees. Therefore it was confirmed that the casing was installed properly. Sediments in the casing was then removed using a suction pump equipped with the ROV. Finally, the casing cover plate was deployed on the casing.

The position of the casing 2F-25: 32-53.511N 135-09.225E

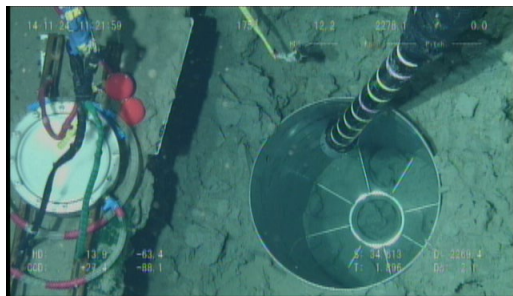
ROV-Homer ID: 42.



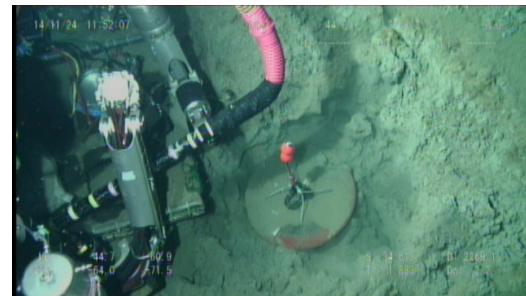
(a) Initial state



(b) Casing tilt angle measurement



(c) Cleaned casing



(d) Casing cover

Fig. 5.8. Remove the sediment in the caisson

5.9. DIVE #1751 on Nov. 24, 2014: Remove the sediment in the caisson; 2F-22

In this dive, ROV Hyper Dolphin (HPD) was operated around the observatory site 2F-22. The mission objective is measuring the casing tilt angle and cleaning inside of the casing. First, the casing tilt angle was measured and confirmed that it is less than 10 degrees. Sediments in the casing was then removed using a suction pump equipped with the ROV. Finally, the casing cover plate was deployed on the casing.

The position of the casing 2F-22: 32-59.280N 135-13.489E.

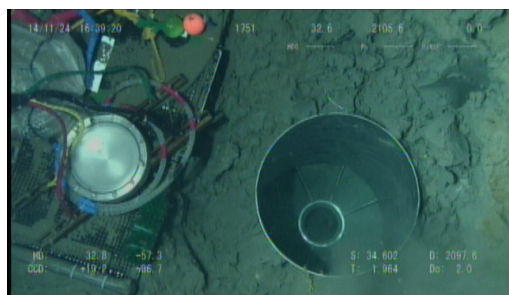
ROV-Homer ID: 54.



(a) Before cleaning



(b) Measuring the tilting angle.



(c) After cleaning.



(d) The lid was put on the casing

Fig. 5.9. Measuring the tilting angle and cleaning of the casing 2F-22.

5.10. DIVE #1752 on Nov. 26, 2014: Remove the sediment in the caisson; 2G-26

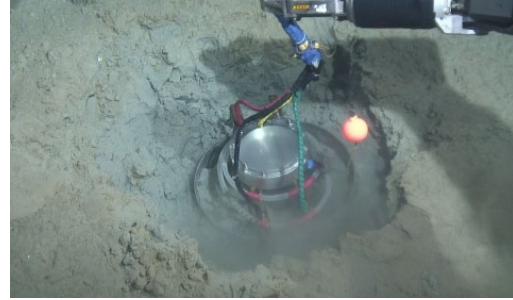
In this dive, ROV Hyper Dolphin (HPD) was operated around the observatory site 2G-26. The mission objective is measuring the casing tilt angle and cleaning inside of the casing. First, the casing tilt angle was measured and confirmed that it is less than 10 degrees. Sediments in the casing was then removed using a suction pump equipped with the ROV. Finally, the casing cover plate was deployed on the casing. This installation taken time than usually for cleaning inside of the casing.

The position of the casing 2G-26: 32-45.691N, 134-31.003E

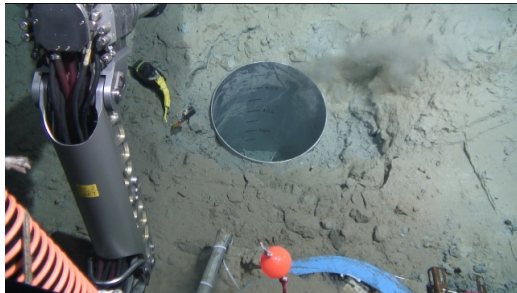
Used ROV-Homer ID: 45



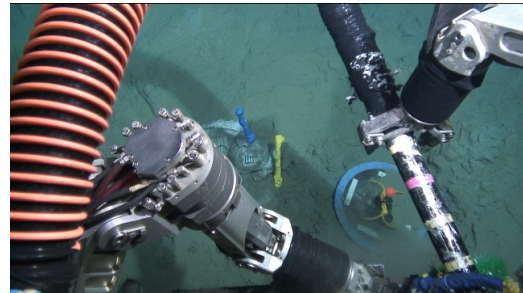
(a) Before cleaning



(b) Measuring the tilting angle



(c) After cleaning.



(d) The lid was put on the casing

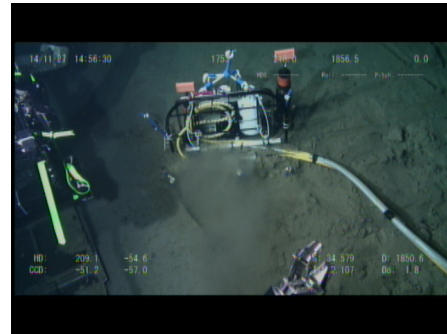
Fig. 5.10. Measuring the tilting angle and cleaning of the casing 2G-26.

5.11. DIVE #1753 on Nov. 27, 2014: Observatory installation at 2G-26

In this dive, we installed an observatory at 2G-26 using the HPD. The observatory system consists of a seismometer package, a pressure sensor package, and a battery equipment. After landing on the seafloor, the seismometer package was first installed inside the caisson and the pressure sensor package was then placed on the seafloor at a distance of approximately 9m from the seismometer package. After that, the battery equipment was put on the seafloor next to the pressure sensor package. Finally, the HPD connected the battery equipment to the pressure package linking with the seismometer package using the underwater mateable connector. Before taking off, the HPD moved the ROV Homer (ID: 45) from near the seismometer package to near the pressure sensor package and the covering plate placed on the caisson was recovered.



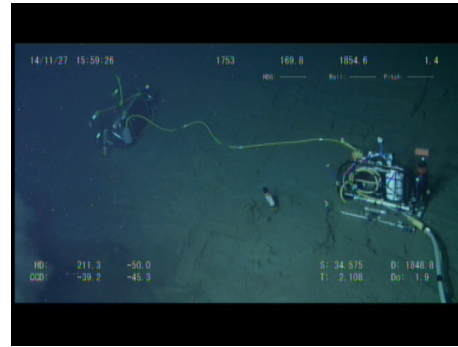
(a) Seismometer package



(b) Pressure sensor package



(c) Battery equipment



(d) After connection with the battery equipment

Fig. 5.11. Observatory installation at 2G-26.

5.12. DIVE #1753 on Nov. 27, 2014: Observatory installation at 2F-25c

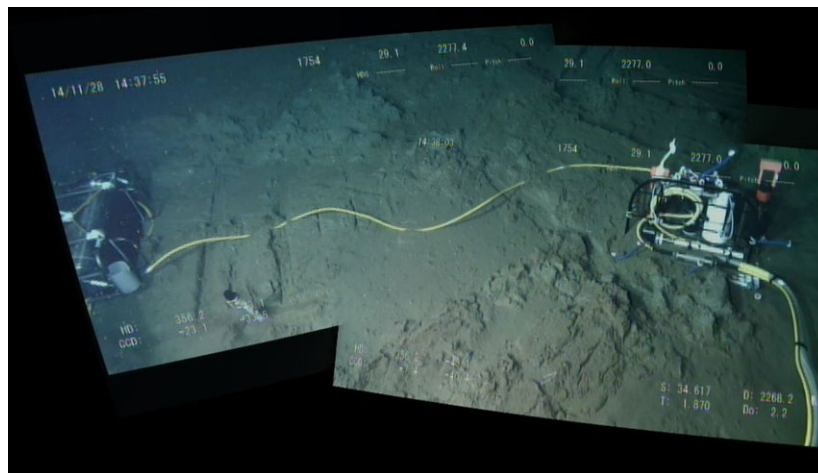
In this dive, we installed an observatory at 2F-25 using the HPD. The observatory system consists of a seismometer package, a pressure sensor package, and a battery equipment. After landing on the seafloor, the seismometer package was first installed inside the caisson and the pressure sensor package was placed on the seafloor at a distance of approximately 9m from the seismometer package. After that, the battery equipment was put on the seafloor next to the pressure sensor package. Finally, the HPD connected the battery equipment to the pressure package linking with the seismometer package using the underwater mateable connector. Before taking off, the HPD moved the ROV Homer (ID: 42) from near the seismometer package to near the pressure sensor package and the covering plate placed on the caisson was recovered.



(a) Installation of the seismometer package



(b) Pressure sensor package



(c) After connection with the battery equipment

Fig. 5.12. Observatory installation at 2F-25c

5.13. DIVE #1755 on Dec.3, 2014: Backfilling at 2A-4

In this dive, ROV Hyper Dolphin (HPD) was operated around the observatory 2A-4. This dive objective is backfilling the seismometer casing of observatory 2A-4 by sand. Backfilling is conducted in order to

reduce the measurement noise. In addition, the deployed homer is collected because this dive completes the 2A-4 observatory development.

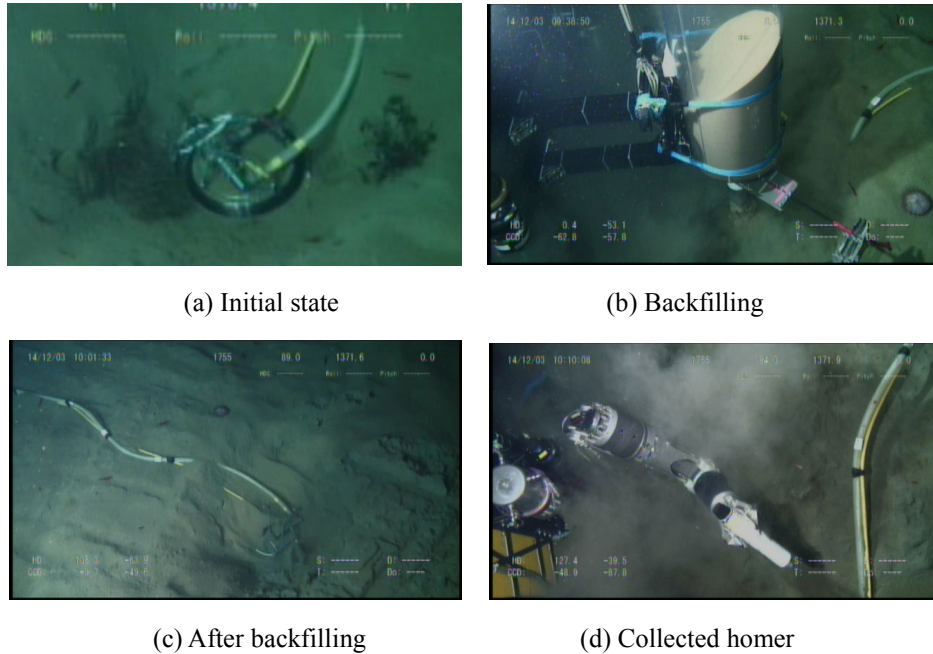
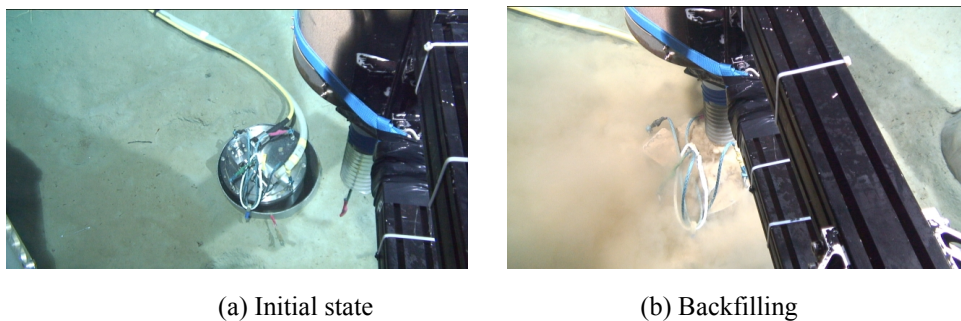
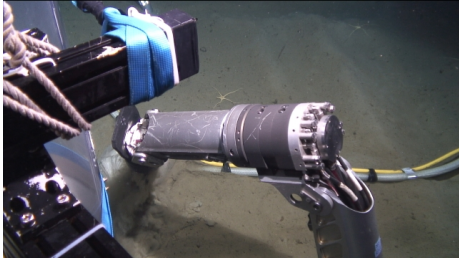


Fig. 5.13. Backfilling of the seismometer at the observatory 2A-4

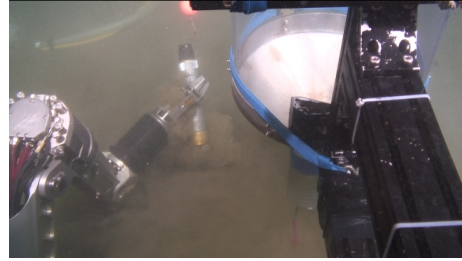
5.14. DIVE #1756 on Dec.4, 2014: Backfilling at casing 2B-8

In this dive, ROV Hyper Dolphin (HPD) was operated around the planned observatory 2B-8. This dive objective is backfilling the seismometer casing of observatory 2B-8 by sand. Backfilling is conducted in order to reduce the measurement noise. In addition, the deployed homer is collected because this dive completes the 2B-8 observatory development.





(c) After backfilling



(d) Collected homer

Fig. 5.14. Backfilling of the seismometer at the observatory 2B-8

5 . 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.

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