



KAIYO Cruise Report

KY15-06

Construction of DONET2 system

Off Kii Channel

Kumano-nada

April.1 – April.20, 2015

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

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1. Cruise Information

- Cruise ID KY15-06
- Name of vessel R/V KAIYO
- Title of cruise Construction of DONET2 system
- Title of proposal Construction of DONET2 system
- Cruise period April.1 – April.20, 2015
- Ports of call Wakayama shimotsu – JAMSTEC Yokosuka
- Research area Off Kii-Channel, Kumano Nada
- Research Map

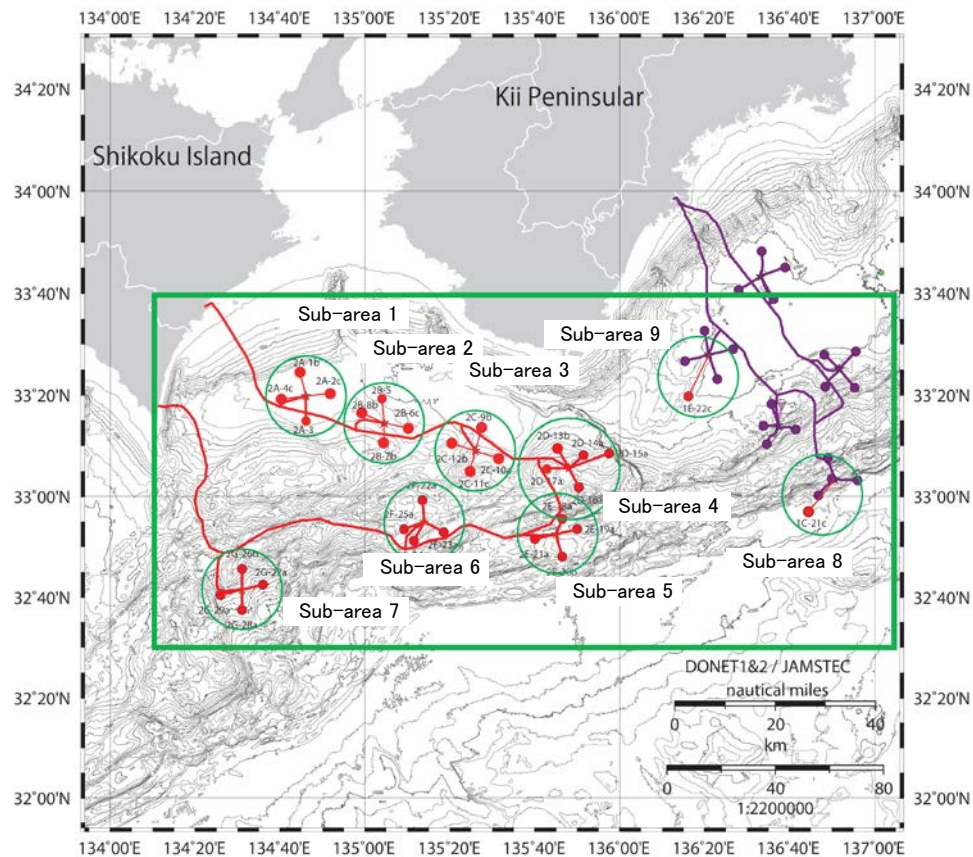


Figure 1.1 Research area and sub-area

2. Science Party

- Chief scientist: Takashi Yokobiki [JAMSTEC]
- Representative of the science party: Shuichi Kodaira [JAMSTEC]
- Science party: Jin-Kyu Choi [JAMSTEC]
Takeshi Ohki [JAMSTEC]
Isao Okabayashi [JAMSTEC]
- Marine Technician: Masayuki Toizumi [NME]
Yuji Fuwa [NME]
Kazuki Harumoto [NME]

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 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 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 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.

4. Operation list

Table 1 List of operation

Date	Area	Dive No.	Operation
1. April, 2015	Wakayama port		Departure
2. April, 2015	Off Kii Channel	Dive#1799	The sediment removal in the caisson; 2E-21
3. April, 2015			Canceled
4. April, 2015		Dive#1800	Installation of the measurement instruments; 2B-6
5. April, 2015			Harborage
6. April, 2015		Dive#1801	Laying operation of the extension cable; 2B-6
7. April, 2015		Dive#1802	Canceled
8. April, 2015			Harborage
9. April, 2015			Harborage
10. April, 2015			Harborage
11. April, 2015			Harborage
12. April, 2015		Dive#1803	Backfilling the seismometer; 2A-1
13. April, 2015			Harborage
14. April, 2015			Harborage
15. April, 2015			Harborage
16. April, 2015		Dive#1804	Installation of the measurement instruments; 2F-22
17. April, 2015		Dive#1805	The sediment removal in the caisson; 2B-7
18. April, 2015		Dive#1806	Laying operation of the extension cable; 2A-2
19. April, 2015			Shift to Yokosuka
20. April, 2015	Yokosuka		Arrival; End of KY15-06

5. Dive Summary

5.1. DIVE #1799 on April. 2, 2015: Sediment removal at 2E-21

In this dive, the preparations which install measurement instrument in a caisson were carried out. The tilting angle of the caisson at 2E-21 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 cover plate was placed on the caisson. The position of the caisson is (32-51.609N, 135-40.008E, Depth: 3535m).



(a) Before operation



(b) Measuring the tilting angle



(c) After sediment removal



(d) Placing a cover plate on the caisson

Fig. 5.1. Measuring the tilting angle and sediment removal at 2E-21.

5.2. DIVE #1800 on April. 4, 2015: Installation of the measurement instrument at 2B-6

In this dive, we installed an observatory system at the caisson 2B-6. The observatory system consists of a seismometer, a pressure sensor package, and a battery package. First, the seismic sensor package was installed inside the caisson. Next, the pressure package was deployed next to the seismic package. These two sensors are initially connected. The battery package was then deployed next the pressure package and connected.

Observatory site 2B-6

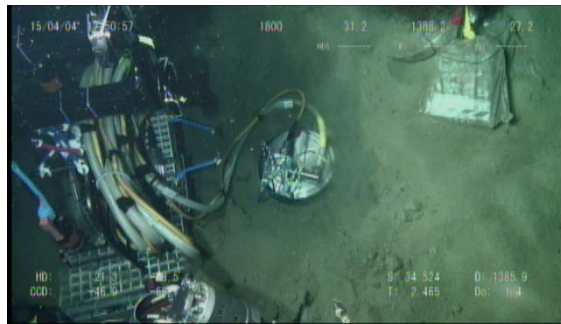
Depth 1388m

Position (33-13.512N 135-10.190E)

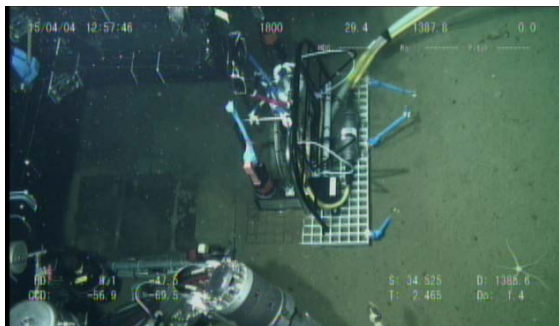
Homer ID: 50



(a) Caisson and a cover plate with seaweed before the installation



(b) Installation of the seismometer



(c) The pressure sensor package and battery were connected.

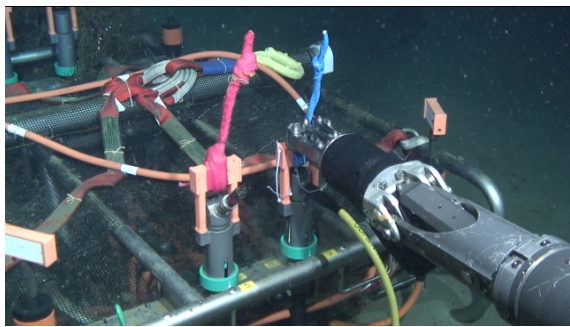


(d) Deployed the external battery

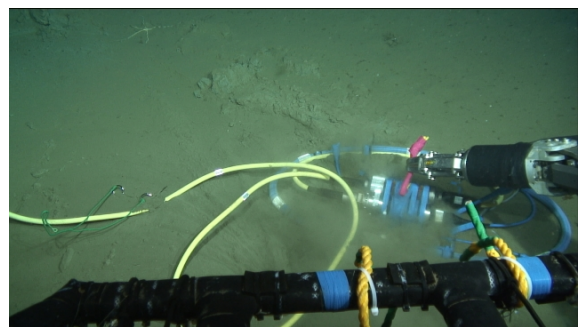
Fig 5.2. Installation of the measurement instruments at 2B-6

5.3. DIVE #1801 on April. 6, 2015: Laying operation of the extension cable at 2B-6

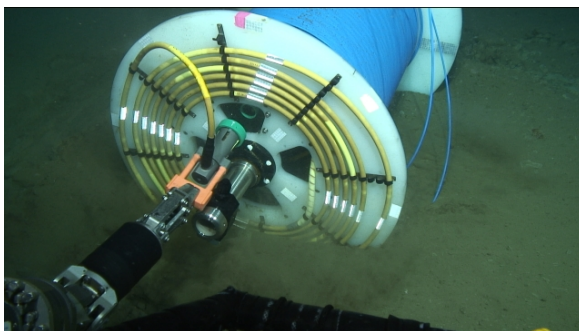
The cable laying operation from the Node 2B to the observatory 2B-6 was carried out using the automated cable laying system. After landing on near the node, the ROV first put the underwater mateable connector linking to the forefront of the extension cable into the port 3 of the Node 2B. After that, the junction box was put on the seafloor. Then, the cable laying operation was started. The ROV laid down the cable from the Node 2B to the observatory 2B-6, and then the cable bobbin was put on the seafloor near the observatory 2B-6. At last, the ROV connected the lower end of the extension cable to the observatory 2B-6. The length of the laid cable was 9,505 [m], the traveled distance was 9,038 [m].



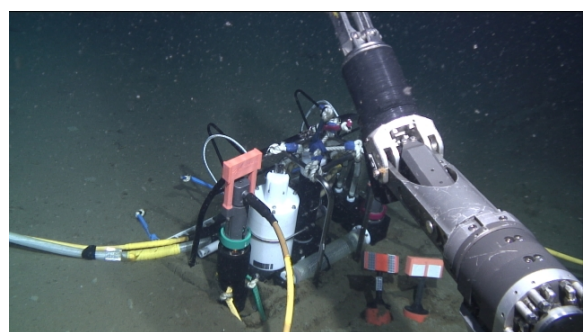
(a) Connection with the node (Port No.3)



(b) The junction box



(c) Cable bobbin on the seafloor



(d) The cable end was connected to observatory

Fig.5.3. Cable Laying operation of the extension cable at 2B-6

5.4. DIVE #1802 on April. 7, 2015: This dive was canceled due to oil leak.

The installation of the measurement instrument in site 1E-22 was planned in this dive. The ROV Hyper Dolphin began to dive at 8:27, and she arrived at 9:45 on the sea bed. When she started to move the miniature transponder near the caisson, the oil leak was found in the compensator of the right manipulator. The hydraulic system of the manipulator was cut off immediately and stopped the leaking. We decided to cancel the dive and she rise up with the measurement instrument.



(a) The lid on the caisson at the site 1E-22

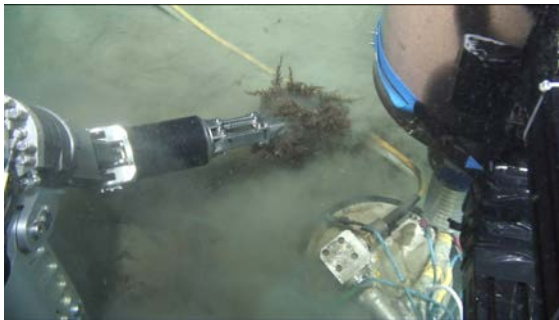


(b) Oil leak from the compensator

Fig. 5.4. The operation on the seabed at 1E-22

5.5. DIVE #1803 on April. 12, 2015: Backfilling the seismometer at 2A-1

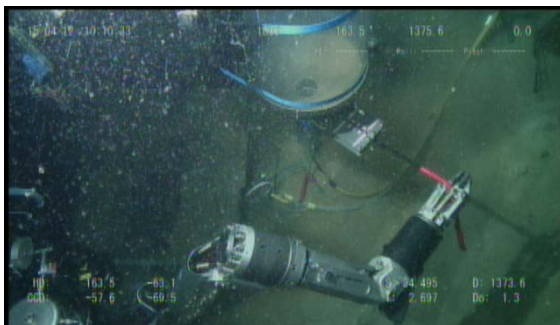
In this dive, ROV Hyper Dolphin (HPD) was operated around the observatory 2A-1. The objection of this dive was backfilling the seismometer of the observatory to reduce the measurement noise. Before this dive, the measurement of the broadband seismometer was stopped by remote control from YOKOHAMA control center, to protect the internal mechanism. HPD started to dive at 8:23, and landed near the seismometer at 9:31. After removing seaweed on the seismometer, the valve of the sand-feeder was opened at 9:46. HPD controlled her position and valve travel of the sand-feeder to fully cover the seismometer. The backfilling operation was finished at 10:10. The aluminum frame was removed from the pressure sensor package and HPD leave the seabed at 10:31.



(a) Removing seaweed



(b) Backfilling the seismometer



(c) The seismometer was covered



(c) The aluminum frame was removed

Fig. 5.5. Measuring the tilting angle and sediment removal at 2E-19

5.6. DIVE #1804 on April. 16, 2015: Installation of the measurement instrument at 2F-22

In this dive, we installed an observatory system into the caisson at the point 2F-22 using an ROV Hyper Dolphin (HPD). The observatory system consists of the three parts; 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. An ROV Homer (ID: 54) was placed near the pressure sensor package. Finally the cover plate was collected before leaving the point.

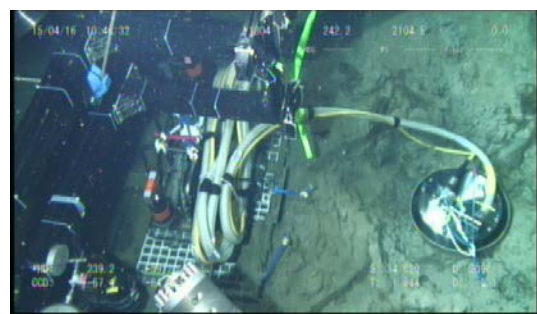
2F-22 Depth 2,104 m

Position (32-59.277N 135-13.500E)

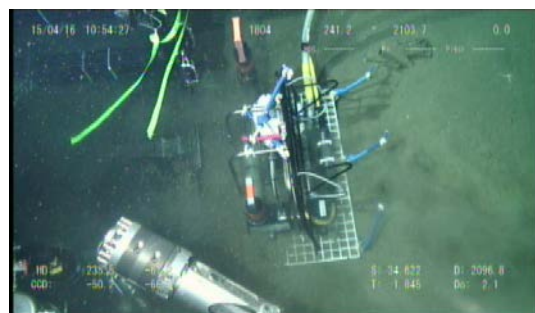
Homer ID: 54



(a) The lid on the caisson was covered with seaweed



(b) seismic sensor package



(c) Pressure sensor package



(d) External battery

Fig. 5.6. Installation of the measurement instrument at 2F-22

5.7. DIVE #1805 on April. 17, 2015: Sediment removal at 2B-7

In this dive, the preparations which install measurement instrument in a caisson were carried out. After landing, the ROV moved toward the caisson at 2B-7. The tilting angle of the caisson 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 ROV and then a cover plate was placed on the caisson.

The position of the caisson is (2B-7: 32-10.529N, 135-05.781E, Depth: 1,074m).



(a) Before sediment removal



(b) Measuring the tilting angle



(c) After sediment removal



(d) Placing a cover plate on the caisson

Fig. 5.7. Measuring the tilting angle and sediment removal at 2B-7

5.8. DIVE #1806 on April.18, 2015: Cable-laying operation at 2A-2

The cable-laying operation from Node 2A to the observatory 2A-2 was carried out using the automated cable-laying system. After landing near Node 2A, the ROV first put the underwater mateable connector linking to the upper-end of the cable into the port 6 of the node. After that, the junction box was put on the seafloor and the cable-laying operation was started. After arriving at near the observatory 2A-2, the ROV placed the cable bobbin on the seafloor and connected the cable from Node 2A with the observatory 2A-2 using the underwater mateable connector. It was confirmed that there is no problem in communication between the observatory 2A-2 and the landing station. The length of the dispensed cable was approximately 9309m and the traveled distance was approximately 9008m.

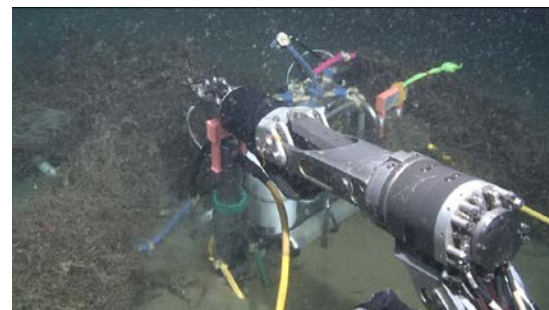
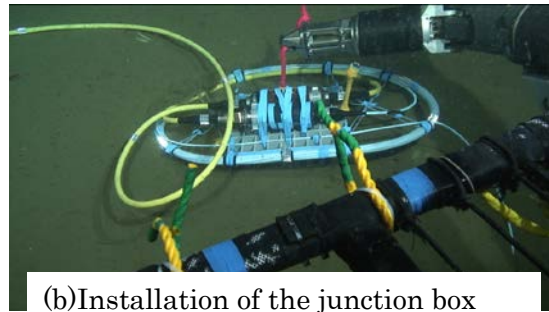
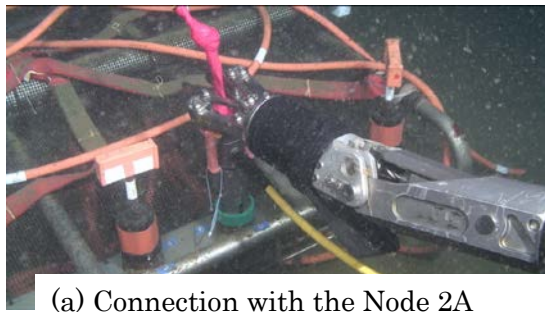


Fig 5.8. Cable-laying operation from Node 2A to the observatory 2A-2

6 . Notice on Using

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