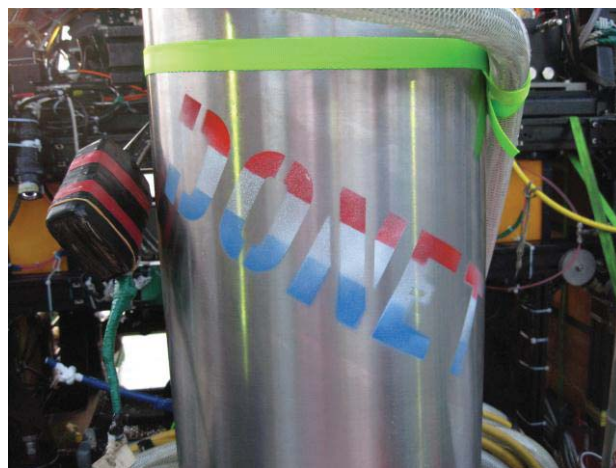


CRUISE REPORT

KY11-06Leg2

“Hyper-Dolphin” & “Kaiyo”



May 2011

Earthquake and Tsunami Research Project
for Disaster Prevention

JAMSTEC

1. INTRODUCTION

2. SCHEDULE

3. "HYPER-DOLPHIN" DIVE

4. CONCLUDING REMARKS

1. Introduction

DONET is a program to establish the technologies of large scale real-time seafloor research and surveillance infrastructure for earthquake, tsunami observation and analysis. This program has been carried out since 2006 to settle on To-Nankai region in Nankai trough as the target of observation. From January to March 2010, the DONET backbone cable system was laid on the seafloor through the cable laying ship. First DONET science node and observatory was constructed on seafloor by using ROV “Hyper Dolphin” in DONET expedition NT10-04 on March 2010. And the following surveys were carried out; NT10-09, NT10-18, KY10-15, and KY11-03, which installed all science nodes and developed eleven observatories on the seafloor. Expedition KY11-06Leg2 is scheduled to deploy the six observatories on seafloor to round out the original observatory network topology (Figure 1).

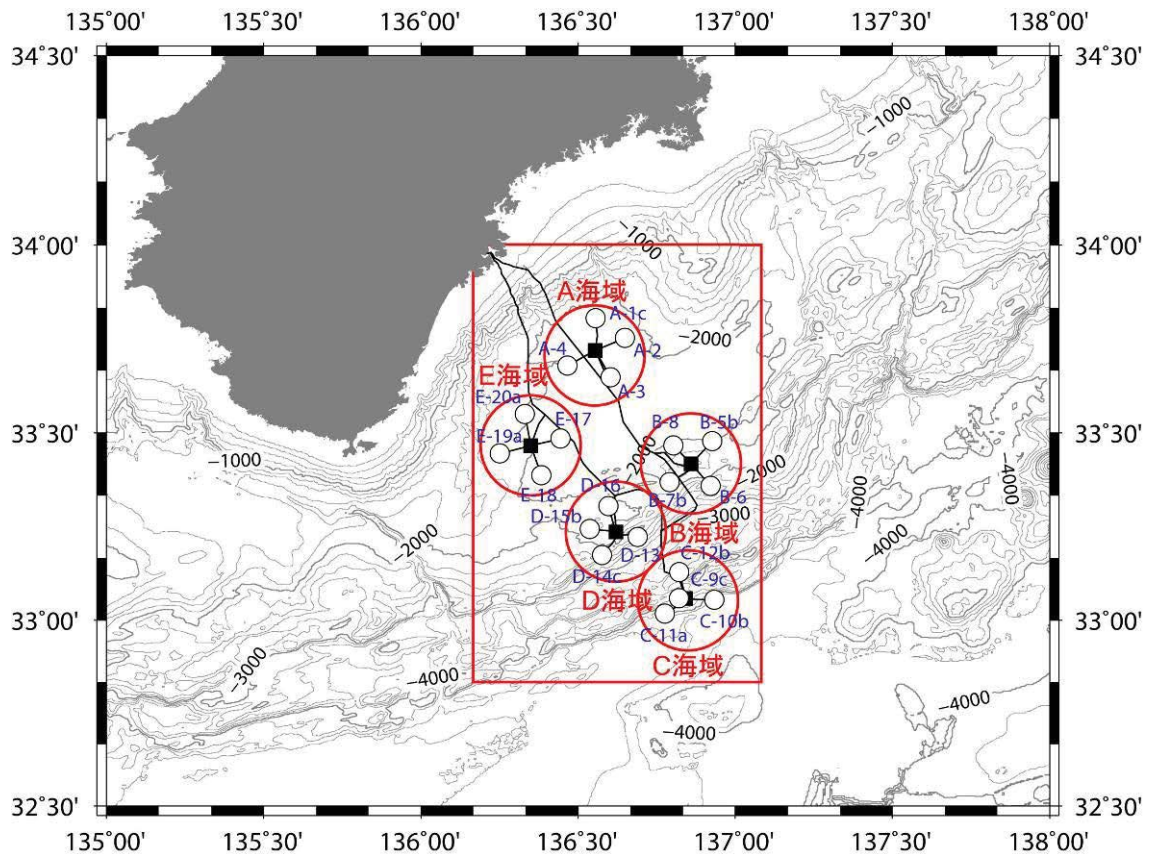


Figure 1 The original observatory network topology
White circles dots shows the observatories and black squares shows the science nodes,

2. Schedule/Summary

The present KY11-06Leg2 cruise is to conduct the following operations.

- (1) Sensor installation operation
- (2) Extension cable laying operation between the science node and the observatory
- (3) Burial hole conditioning operation
- (4) Backfilling burial hole operation

Summary of the KY11-06Leg2 cruise was listed in Table 1. Our cruise started from Yokosuka shin-Kou to JAMSTEC via Kumano-nada. Twenty-two dives have been carried out.

Table 1 Summary of KY11-06Leg2 cruise

Date	Dive No	Site	Operation	Remarks
20 April			Departure	departure at 9:00 from Yokosuka Shin-Kou
21 April	1262	B-7d	Burial-Hole conditioning	6 sand bags deployed
22 April	1263	E-19d	Burial-Hole conditioning	6 sand bags deployed
	1264	E-20c	Burial-Hole conditioning	6 sand bags deployed
23 April	1265	E-20c	Sensor installation	
24 April	1266	B-7d	Sensor installation	
25 April	1267	E-7d	Extension-cable laying	Startup E-7 sensors
26 April	1268	E-20c	Extension cable laying	Interrupted due to ROV shutdown
27 April	1269	D-15d	Burial-Hole conditioning	
28 April	1270	D-15d	Sensor installation	Interrupted due to ROV shutdown
29 April	1271	C-12d	Cancelled due to ROV shutdown	
30 April	1272	C-12d	Cancelled due to ROV shutdown	
1 May	1273	D-13b	Burial-Hole conditioning	
2 May	1274	E-20c	Continuation of extension cable laying	Startup E-20 sensors

3 May	1275	D-15d	Extension cable laying	Startup D-15 sensors
4 May	1276 1277	Node A A-1c	Recovery of joint box Sensor installation	
5 May	1278	A-1c	Extension cable laying	Startup A-1 sensors
6 May	1279	D-13b	Burial-Hole conditioning	
7 May	1280	E-19d	Sensor installation	
8 May	1281	E-19d	Extension cable laying	Startup E-19 sensors
9 May	1282	D-13b	Extension cable laying	
10 May	1283	D-13b	Sensor installation	Startup D-13 sensors
11 May			Arrive at JAMSTEC	Arrived at 8:45

3. “Hyper-Dolphin” Dive

(1) Dive 1262 on 21 April

This dive was carried out to clear the inside of the Burial-Hole at B-7d observatory. The new mixture instrument was used to crush the mud layer (Fig. 3.1). It took one and half hours to clear the Burial-Hole. Angle of the casing was checked by the level-meter (fig3.2), and confirmed to be horizon within 10 degrees error. A lid was put on the casing, and six sand bags were deployed nearby the Burial-Hole.

Dive Point B-7d Lat:33°21.680'N, Long:136°48.445E, Depth:1975m

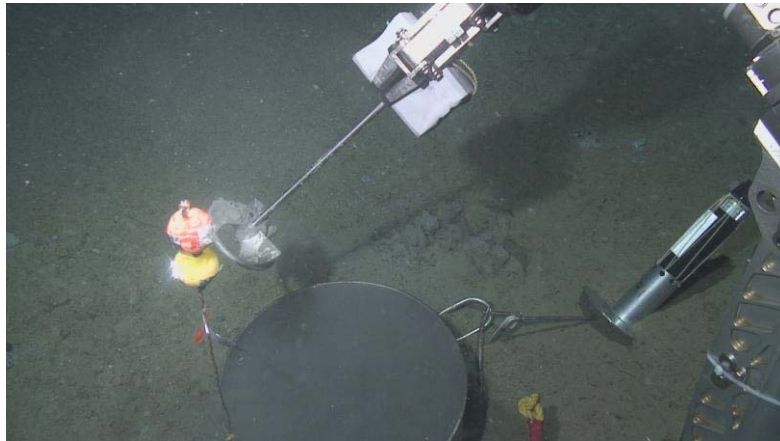


Fig 3.1 the new mixture instrument



Fig3.2 Check the angle by the level meter

(2) Dive 1263 and 1264 on 22 April

On 22 April, Hyper-Dolphin executed two dives to clear two Burial-Holes. HPD #1263 dive was carried out to clear the Burial-Hole of E-19d observatory. It took 25 minutes without the mixture instrument. The inside of the casing was checked by an auxiliary camera handled by the manipulator (Fig3.3), and it was confirmed that all mud that was inside the casing was removed. Angle of the casing was checked by the level-meter, and confirmed to be horizon within 10 degrees error. A lid was put on the casing, and six sand bags were deployed nearby the Burial-Hole. Hyper-Dolphin moved to E-19c, and recovered the miniature transponder; ID23.

Dive Point E-19d Lat:33-26.740'N, Long:136-15.390'E, Depth:1910m



Fig. 3.3 Check the inside of casing by the auxiliary camera

In Dive#1264, Hyper-Dolphin dived to clear the Burial-Hole of E-20c observatory. The clearing of the Burial-Hole started at 15:28, and finished at 15:48. Angle of the casing was checked by the level-meter, and confirmed to be horizon within 10 degrees error. A lid was put on the casing, and six sand bags were deployed nearby the Burial-Hole. Hyper-Dolphin moved to E-20b, and recovered the miniature transponder; ID69.

Dive Point E-20c Lat:33-32.669N, Long:136-19.944'E Depth:1977m



Fig. 3.4 The bottom of the casing E-20c

(3) Dive 1265 on 23 April

A seismometer package and a sensor package were deployed in this dive at E-20c. After the seismometer package was inserted into the Burial-Hole, Sensor package was put on the sea floor. The miniature transponder was relocated to the sensor package. After the lid was retrieved, Hyper-Dolphin had surfaced.

Dive Point E-20c Lat:33-32.669'N, Long:136-19.944'E Depth:1975m

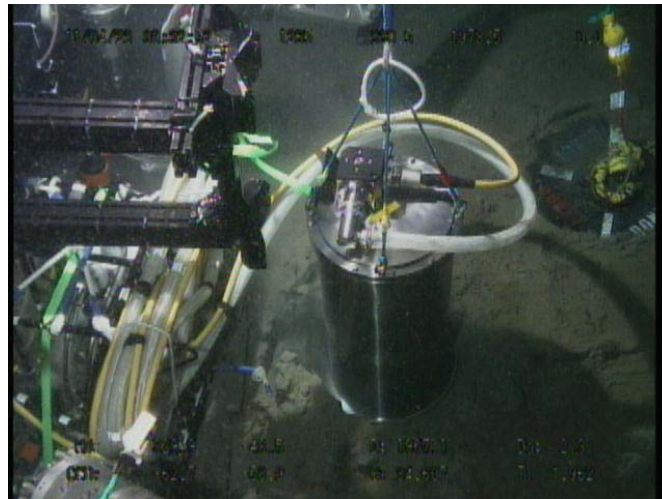


Fig. 3.5 Seismometer package

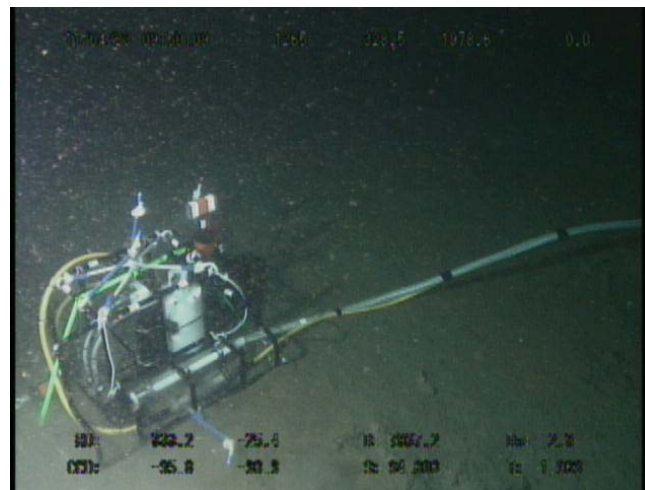


Fig 3.6 Sensor package

(4) Dive 1266 on 24 April

A seismometer package and a sensor package were deployed in this dive at B-7d. After the seismometer package was inserted into the Burial-Hole, Sensor package was put on the sea floor. The miniature transponder was relocated to the sensor package. Three sand bags were used to fill a gap between the seismometer package and the casing. And the other three sand bags were put on the cable to press down the cable. After the lid was retrieved, Hyper-Dolphin had surfaced.

Dive Point B-7d Lat:33-21.680'N, Long:136-48.433'E Depth:1980m

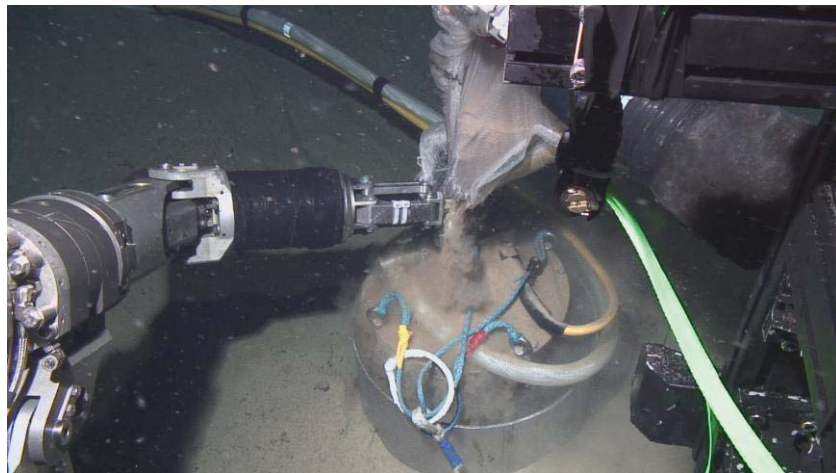


Fig. 3.7 The sand bag was tearing by manipulators.



Fig. 3.8 the seismometer package and sand bag

(5) Dive 1267 on 25 April

This dive was carried out to lay an extension cable from the science node B to Observatory B-7d. At first, Hyper-Dolphin approached to the science node B, and the flying connector of extension cable was connected to the Port No.3 of the science node B. After the joint box was put on the seabed, Hyper-Dolphin started the cable laying operation. 9 hours later, Hyper-Dolphin approached B-7d observatory, and the end of the extension cable was connected to the sensor package. The connection between the node B and B-7d observatory was checked from the landing station, and Hyper-Dolphin left the B-7d observatory.

Start point (Node B) Lat:33-25.134'N, Long:136-51.683'E, Depth:1859m

End point (B-7d) Lat:33-21.684'N, Long:136-48.443'E, Depth:1972m

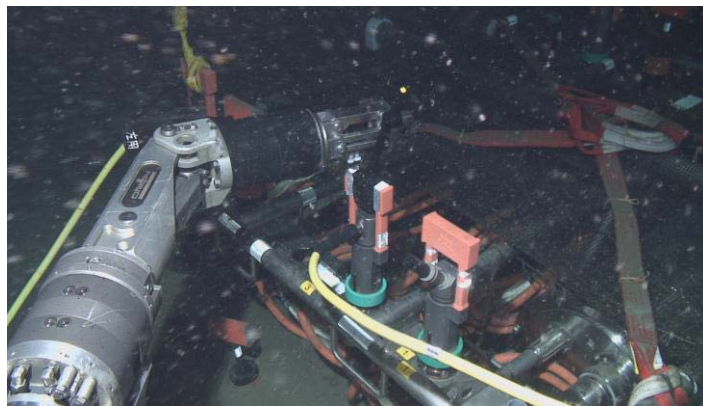


Fig. 3.9 Connected to the Port No.3 of the science node B

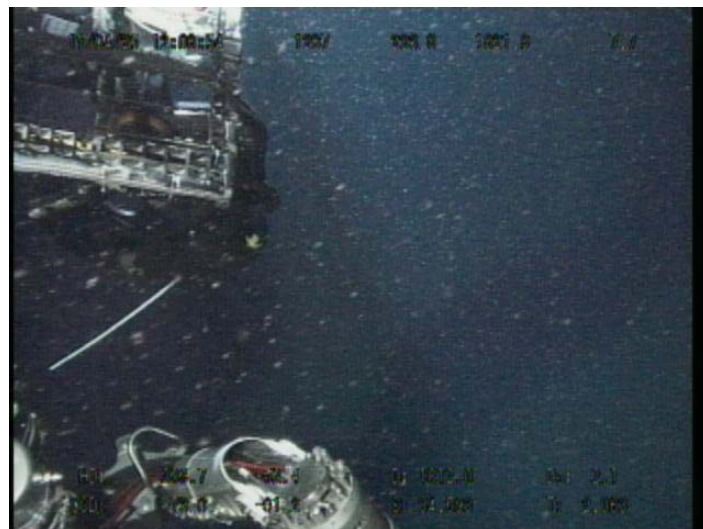


Fig. 3.10 Extension cable laying operation

(6) Dive 1268 on 26 April

This dive was carried out to lay an extension cable from the science node E to E-20c. Hyper-Dolphin approached to the science node E, and the loopback connector was taken off from the port No.1. The connector of extension cable was connected to the Port No.1 of the science node E. After the joint box was put on the seabed, Hyper-Dolphin started the cable laying operation.

Due to some troubles, the electric power of Hyper-Dolphin was shut off at the point of 5337m from the node E. During the trouble, the position of Hyper-Dolphin was monitored by the stand-alone type transponder.

The operators of Hyper-Dolphin were checked the electric power line and they confirmed that the electric power line was good. So, they started up Hyper –Dolphin.

After Hyper-Dolphin was started up, the cable bobbin was released on the position 33-30.903'N, 136-20.373'E, Depth: 2001m. The loopback connector was recovered, and ascent to surface at 18:02.

Start point (Node E) Lat:33-27.916'N, Long:136-20.945'E, Depth:1987m

Halt the laying and the bobbin released at 33-30.903'N, 136-20.373'E. Depth:2001m

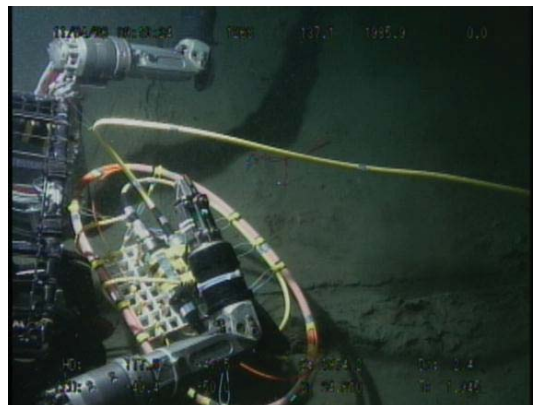


Fig. 3.11 Joint box



Fig. 3.12 Released the cable bobbin

(7) Dive 1269 on 27 April

This dive was carried out to clear the inside of the Burial-Hole at D-15d observatory. The casing was sticking out 40cm height (Fig3.13). It took 80 minutes to clear the Burial-Hole. Angle of the casing was checked by the level-meter, and confirmed to be horizon within 10 degrees error. Six sand bags were deployed nearby the Burial-Hole (Fig3.14). Hyper-Dolphin moved to D-15c, and recovered the miniature transponder; ID65.

Dive point D-15d Lat:33-13.988'N, Long:136-33.780'E, Depth:1909m



Fig. 3.13 Casing of D-15d observatory



Fig. 3.14 Casing and sand bags

(8) Dive 1270 on 28 April

A seismometer package and a sensor package were deployed in this dive at D-15d. After the seismometer package was inserted into the Burial-Hole, Hyper-Dolphin was going backwards to lay cables for sensor package. When the Hyper-Dolphin was preparing to put the sensor package, the electric power of Hyper-Dolphin was shut off. The operators of Hyper-Dolphin were checked the electric power line and they confirmed that the electric power line was good. Hyper-Dolphin was started up, and sensor package was put on the sea floor (Fig3.16). The miniature transponder was relocated near the sensor package.

The operators checked the electric power line of Hyper-Dolphin, and Hyper-Dolphin left the seabed at 17:44.

Dive point (D-15d); Lat:33-13.986'N, Long:136-33.783'E, Depth:1909m

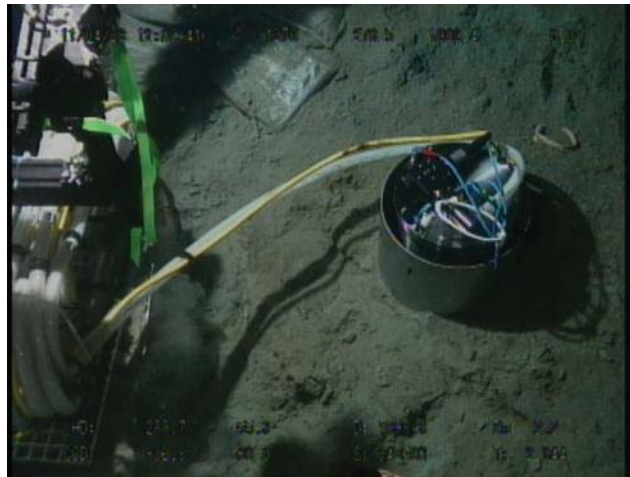


Fig.3.15 Seismometer package in the casing.



Fig.3.16 Sensor package and miniature transponder

(9) Dive 1271 on 29 April

In this dive, Hyper-Dolphin was planned to clear up the inside of the Burial-Hole at C-12d observatory. The Hyper-Dolphin started to descent at 9:58, but the electric power feeding for Hyper-Dolphin shut down at the depth of 1768m. The investigation of the trouble was executed, and this dive was cancelled. The electric power was supplied and ascent to surface at 13:19.

(10) Dive 1272 on 30 April

This dive was aimed to clear up the inside of the Burial-Hole at C-12d observatory again. The Hyper-Dolphin started to descent at 8:23. The electric power of Hyper-Dolphin shut down at the depth of 513m, and this dive was cancelled. The electric power was supplied and ascent to surface at 9:05.

(11) Dive 1273 on 1 May

This dive was carried out to clear the inside of the Burial-Hole at D-13b observatory. The casing was completely buried in seabed. When it dug down to 40cm in depth, the operation was quit due to bad weather condition (Fig3.17). Angle of the casing was checked by the level-meter, and confirmed to be horizon within 10 degrees error (Fig3.18). A lid was put on the casing, and Hyper-Dolphin left the seabed at 12:19.

Dive point (D-13b); Lat:33-13.207'N, Long:136-41.421'E, Depth:2440m



Fig.3.17 Dug down to 40cm in depth



Fig.3.18 Check the horizontal error of the casing

(12) Dive 1274 on 2nd May

The cable laying operation was quit due to the trouble of electric power line in dive 1268. In this dive, this cable laying operation was re-started from the position where the bobbin was released. The bobbin was equipped with the cable laying system, and started cable laying operation at 11:30. Hyper-Dolphin finished pay out the cable at 14:54, and the bobbin was put on the seabed at 15:23(Fig3.19). Hyper-Dolphin approached E-20c observatory, and the end of the extension cable was connected to the sensor package (Fig3.20). The connection between the node E and E-20c observatory was checked from the landing station, and Hyper-Dolphin left the E-20c observatory.

Re-start; Lat:33-30.894'N, Long:136-20.375'E, Depth:2000m

End point; Lat:33-32.644'N, Long:136-19.936'E, Depth:1978m

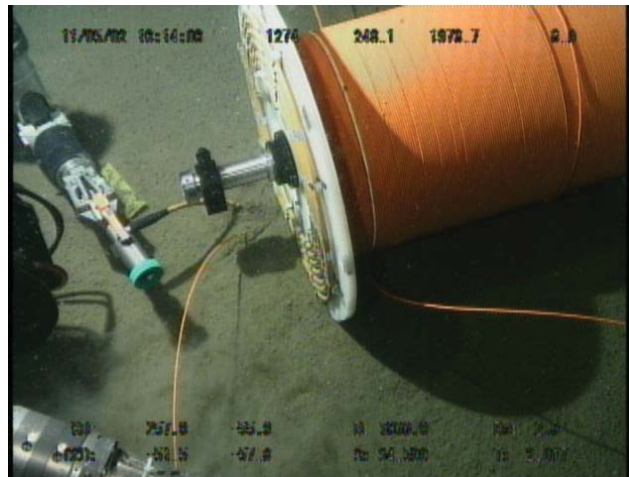


Fig3.19 the bobbin was released

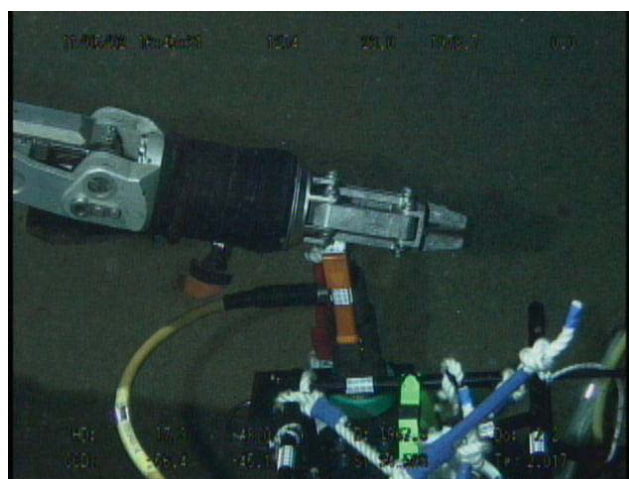


Fig3.20 Connected to the sensor package

This dive was carried out to lay an extension cable from the science node D to Observatory D-15d. At first, Hyper-Dolphin approached to the science node D, and the flying connector of extension cable was connected to the Port No.2 of the science node D. After the joint box was put on the seabed (Fig3.21), Hyper-Dolphin started the cable laying operation. 7 hours later, Hyper-Dolphin approached D-15d observatory, and the end of the extension cable was connected to the sensor package (Fig3.22). The connection between the node D and D-15d observatory was checked from the landing station, and Hyper-Dolphin left the D-15d observatory.

End point (D-15d); Lat:33-13.980'N, Long:136-33.792'E, Depth:1910m

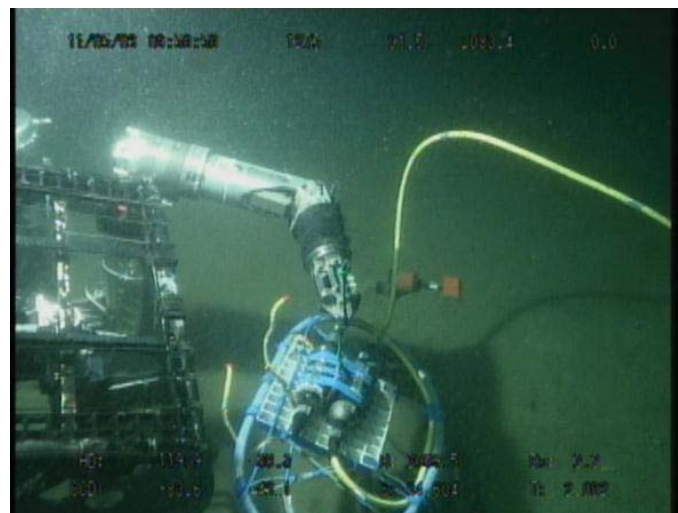


Fig3.22 connected to the sensor package

(14) Dive 1276 on 4th May

In KY10-05, the cable laying operation was interrupted on the way of A-1 observatory from node A. In KY11-03, the bobbin was recovered, and the underwater meetable connector (UMC), joint box, and 2km of extension cable were left on the seabed. In this dive, the joint box and the UMC were recovered from Node A.

Hyper-Dolphin approached joint box that was located near the node A, and cut the extension cable (Fig3.23). The junction box and the UMC were put in the sample basket, and ascent to surface at 9:48.

Dive point (Node A); Lat:33-43.347'N, Long:136-33.192'E, Depth:2011m

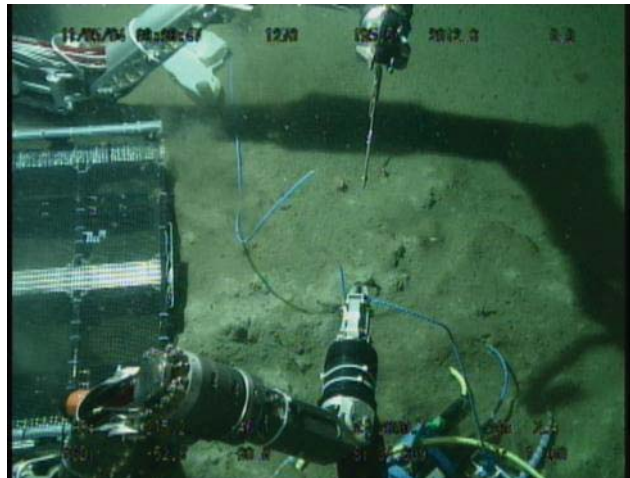


Fig. 3.23 Cut the extension cable

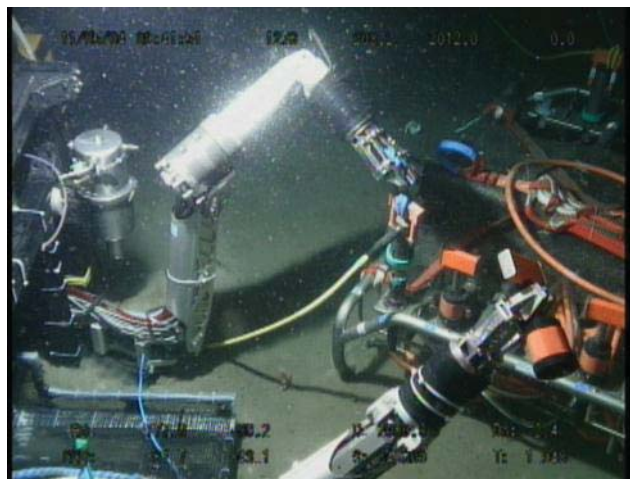


Fig. 3.24 The UMC was disconnected from Node A

(15) Dive 1277 on 4th May

On 4th May, 2 dives carried out. A seismometer package and a sensor package were deployed in this dive at A-1c observatory (Fig3.25, Fig3.26). After the seismometer package was inserted into the Burial-Hole, Sensor package was put on the sea floor. The miniature transponder was relocated to the sensor package. The lid was left near the seismometer package.

Dive point (A-1c); Lat:33-48.287'N, Long:136-33.421'E, Depth:2040m

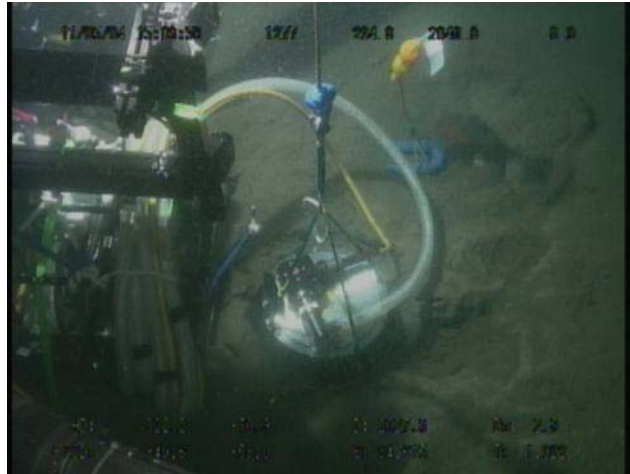


Fig3.25 The seismometer package and the lid



Fig3.26 Put the sensor package on the seabed

(16) Dive 1278 on 5th May

This dive was carried out to lay an extension cable from the science node A to Observatory A-1c. At first, Hyper-Dolphin approached to the science node A, and the flying connector of extension cable was connected to the Port No.2 of the science node A. After the joint box was put on the seabed, Hyper-Dolphin started the cable laying operation at 8:31. 8 hours later, Hyper-Dolphin approached A-1d observatory, and the end of the extension cable was connected to the sensor package. The connection between the node A and A-1d observatory was checked from the landing station, and Hyper-Dolphin left the A-1d observatory.

Start point (Node A); Lat: 33-43.362'N, Long: 136-33.199'E, Depth: 2013m

End point (A-1d); Lat: 33-48.295'N, Long: 136-33.429'E, Depth: 2040m

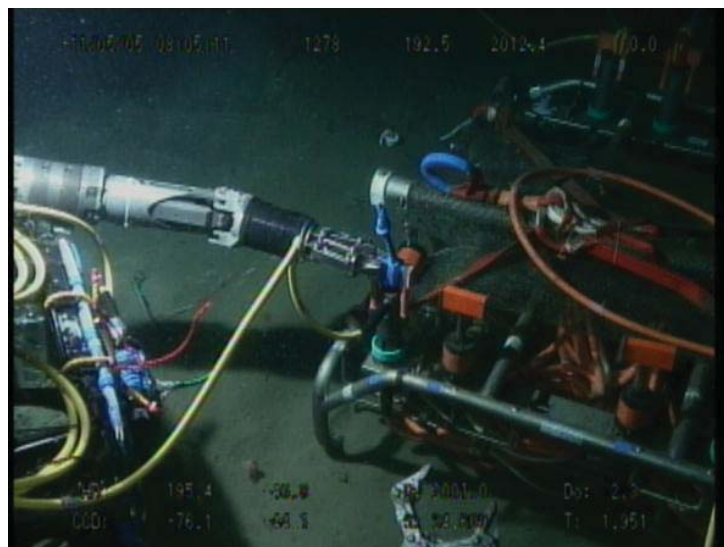


Fig3.27 The extension cable was connected to port No.2

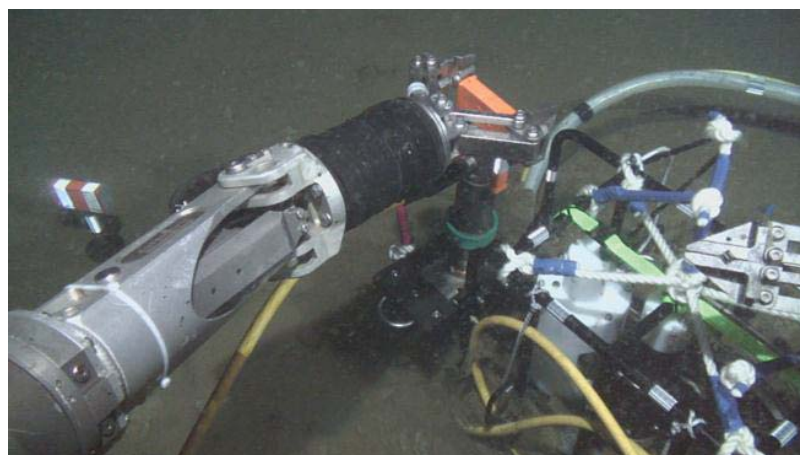


Fig3.28 The other end of extension cable was connected to the sensor package

(17) Dive 1279 on 6th May

This dive was carried out to completely remove the mud that was inside the casing of D-13b observatory. The new mixture instrument of second version was used to crush the mud layer (Fig. 3.29). It took 2 hours to clear the 20cm depth of remnant of the mud. Angle of the casing was checked by the level-meter, and confirmed to be horizon within 10 degrees error. A lid was put on the casing, and three sand bags were deployed nearby the Burial-Hole (Fig3.30). Hyper-Dolphin moved to D-13a, and recovered the miniature transponder; ID17.

Dive point (D-13b); Lat:33-13.201'N, Long:136-41.408'N, Depth:2441m



Fig3.29 The second version of the new mixture instrument



Fig3.30 The lid and three sand bags

A seismometer package and a sensor package were deployed in this dive at E-19d. The Hyper-Dolphin started to dive at 13:25. After the seismometer package was inserted into the Burial-Hole (Fig3.31), Sensor package was put on the sea floor (Fig3.32). The miniature transponder was relocated to the sensor package. After the lid was retrieved, Hyper-Dolphin began to ascent at 15:30.

Fig3.32 Put the sensor package on the seabed

(19) Dive 1281 on 8th May

This dive was carried out to lay an extension cable from the science node E to Observatory E-19d. At first, Hyper-Dolphin approached to the science node E, and the flying connector of extension cable was connected to the Port No.2 of the science node E. After the joint box was put on the seabed, Hyper-Dolphin started the cable laying operation at 8:10. 8 hours later, Hyper-Dolphin approached E-19d observatory, and the end of the extension cable was connected to the sensor package. The connection between the node E and E-19d observatory was checked from the landing station, and Hyper-Dolphin left the E-19d observatory.

Start point (Node E); Lat:33-27.908'N, Long:136-20.954'E, Depth:1987m

End point (E-19d); Lat:33-26.741'N, Long:136-15.406'E, Depth:1909m



Fig3.33 The extension cable was connected to port No.2



Fig3.34 The other end of extension cable was connected to the sensor package

(20) Dive 1282 on 9th May

This dive was carried out to lay an extension cable from the science node E to Observatory D-13b. At first, Hyper-Dolphin approached to D-13b observatory, and Hole-Pole was inserted into the casing (Fig3.35). After the joint box was put on the seabed, Hyper-Dolphin started the cable laying operation at 8:19. 7 hours later, Hyper-Dolphin approached to the science node D, and the end of the extension cable was connected to the Port No.4 of the science node D (Fig3.36). Hyper-Dolphin left the node D at 16:54.

Start point (D-13b); Lat:33-13.202'N, Long:136-41.416'E, Depth:2441m

End point (Node D); Lat:33-13.989'N, Long:136-37.341'E, Depth:2081m



Fig3.35 Insert the Hole-Pole



Fig3.36 Connected to the Port No.4 of the science node D

A seismometer package and a sensor package were deployed in this dive at D-13b observatory. After the Hole-Pole was removed, the seismometer package was inserted into the Burial-Hole (Fig3.37). Sensor package was put on the sea floor (Fig3.38). The UMC was detached from the Hole-Pole, and connected to the sensor package. The connection between the node D and D-13b observatory was checked from the landing station. The miniature transponder remained near to the sensor package. After the lid and Hole-Pole were retrieved, Hyper-Dolphin began to ascent at 8:47.

11/15/2007 17:01:20 1203 2/3.0 3408.7 0.0

233.5 40.7 01: 40.6.1 233.5 40.7

0000 00.0 00.0 01: 00.000 00.0 00.0

11/05/10 09:19:30 1283 312.6 2442.1 0.0

Fig3.38 Put the sensor package on the seabed

4. Concluding Remarks

In the KY11-06 Leg2 cruise, six new observatories began to start operation by twenty dives. It is the first time in DONET project to install all on board equipment.

Total 17 observatories has been operating today (Fig4.1).

At the end of the cruise, we would like to express our best thanks to all crew of “Kaiyo” and also to all member of “Hyper-Dolphin” operation team.

Update: 2011/05/10

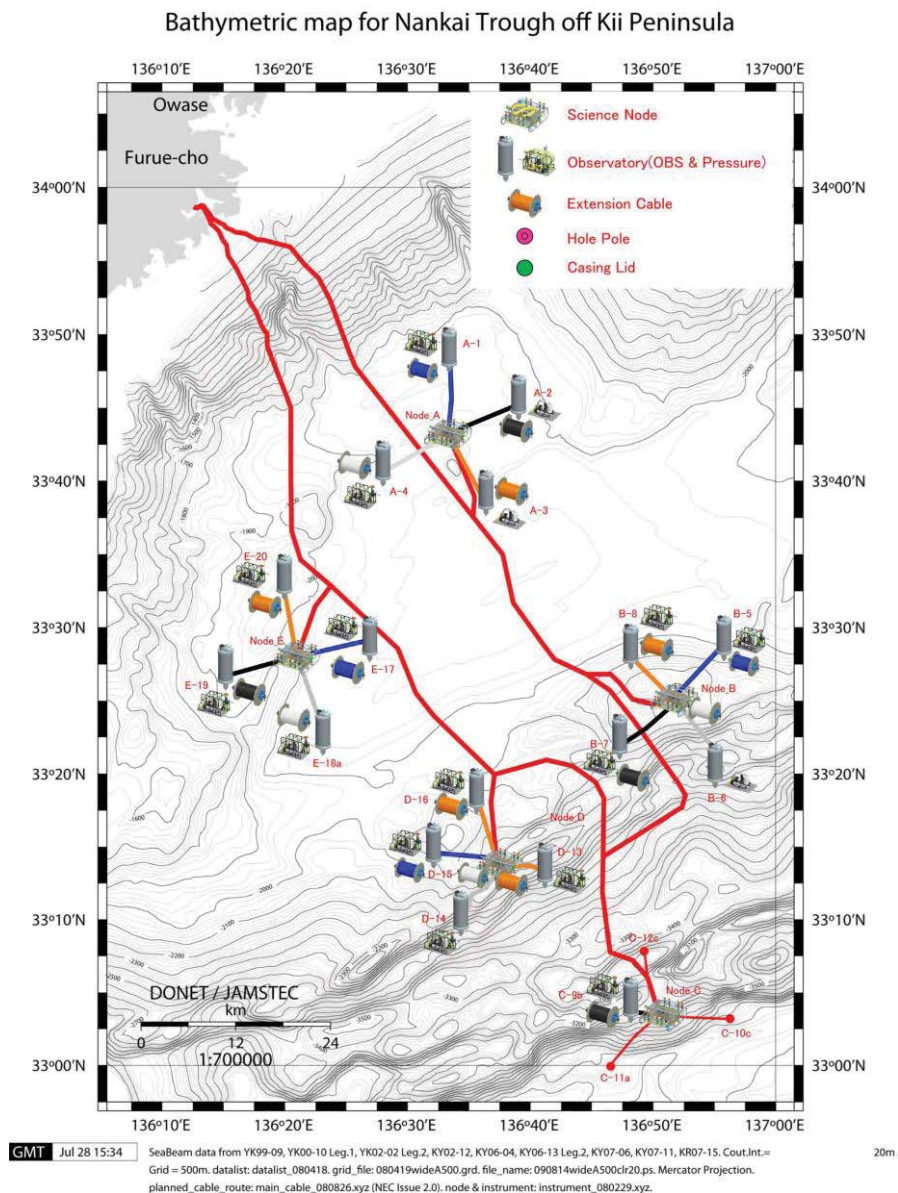


Fig. 4.1 Status of the DONET observatory after KY11-06 Leg2