



## **R/V NATSUSHIMA Cruise Report**

**NT13-14**

**Kumano-Nada, Off Kii Peninsula**

**July.09, 2013 - July.18, 2013**

**Japan Agency for Marine-Earth Science and Technology**

**(JAMSTEC)**

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## 1. Cruise Information

- Cruise ID NT13-14
- Name of vessel R/V NATSUSHIMA
- Title of the cruise Constructing and cable root survey for DONET2 system
- Title of proposal  
Constructing and cable root survey for DONET2 system  
Development of automated cable laying system  
Development of installation of sub-seabed casing using the Vicky Hummer
- Cruise period July 9 – July 18, 2013
- Ports of call Yokohama Shin-Kou - Shimonoseki
- Research area Kumano-Nada, Off Kii Peninsula
- Research Map

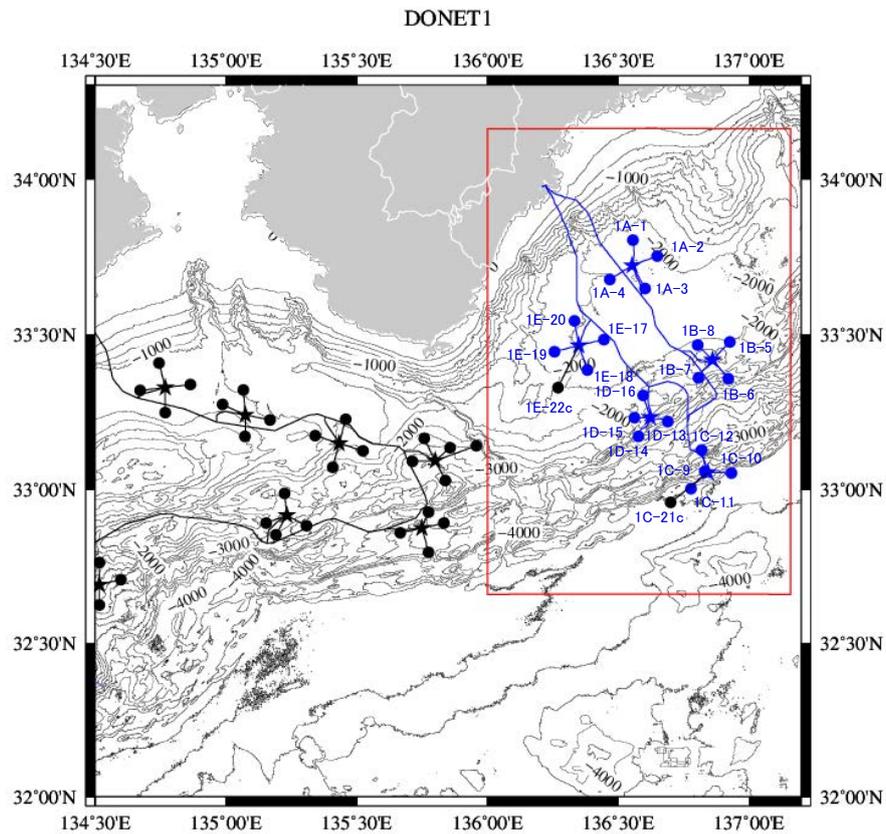


Figure 1.1 Research area and observatory site of DONET1 in Kumano Nada

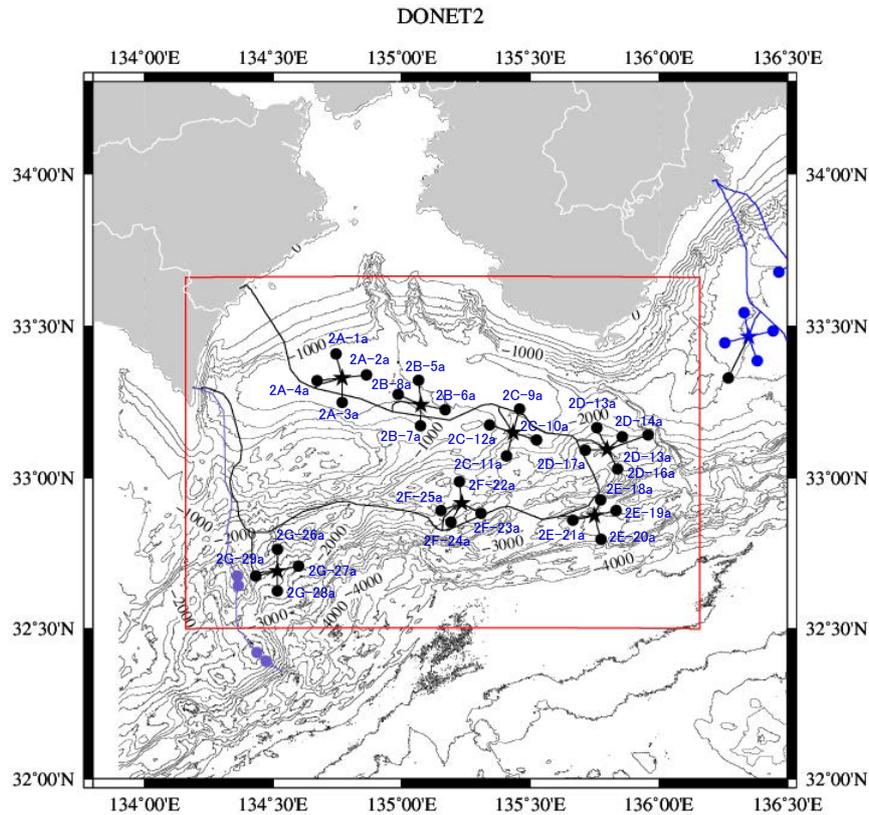


Figure 1.2 Research area and the observatory site of DONET2 off Kii-Channel

## 2. Science party

- |                                       |                    |           |
|---------------------------------------|--------------------|-----------|
| ● Chief scientist                     | Takashi Yokobiki   | [JAMSTEC] |
| ● Representative of the science party | Yoshiyuki Kaneda   | [JAMSTEC] |
| ● On-board Scientists                 | Hiroyuki Matsumoto | [JAMSTEC] |
|                                       | Shuhei Nishida     | [JAMSTEC] |
|                                       | Choi Jin-Kyu       | [JAMSTEC] |

## 3. Background

Development of the first DONET system started in 2006, in order to research the large scale real-time observation in Nankai Trough using dense ocean-floor sensor network. This system consists of three major components; the backbone cable system, the science node, and the measurement instruments. 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 brings 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 system named DONET2 has 320km backbone cable, 7 science nodes, 29 observatories and 2 additional observatories of DONET1. The laying operation of backbone cable system is scheduled in this fiscal year. The construction of observatories using ROV is also scheduled in March 2014.

The purposes of this expedition are construction of DONET2 observatory site, and check the new equipment used in DONET2 construction.

#### 4. Dive Summary

##### (1) Dive #1545 on July 10, 2013

In this area “1E-22”, we have installed six bottom casings. Three casings were installed using piston corer system. They named “KY12-11 BM02”, “KY13-08 BM01” and “KY13-08 BM03”. And the other casings named “KY13-08 BM01”, “KY13-08 BM02” and “KY13-08 BM03” were installed using deep-tow. At first in this dive, checking the installation condition of six bottom casing is carried out. Figure 4.1.1–4.1.6 shows that the installation condition of the bottom casings. In six bottom casings, the casing “KY12-11 BM02” had the least outcrop length and tilt. We select the casing “KY12-11 BM02” for an installation of a seismometer. And then, the cleaning in the BM02 was carried out. The overview of the BM02 after cleaning is shown in fig.4.1.7. Next, the experiment of burying the bottom casing using hydraulic hammer named Vicky hammer was carried out. After the Vicky hammer was put on the bottom casing which put on the sea bottom by the ROV, the Vicky hammer was worked. In the result, the bottom casing was buried under the bottom completely.

The ROV carried out all tasks in this dive and then she left from the bottom at 20:02 (33-19.804N, 136-16.186E, 1836m).



Fig.4.1.1 Installation Condition of “KY12-11 BM02”



Fig.4.1.2 Installation Condition of “KY13-08 BM01”



Fig.4.1.3 Installation Condition of "KY13-08 BM03"

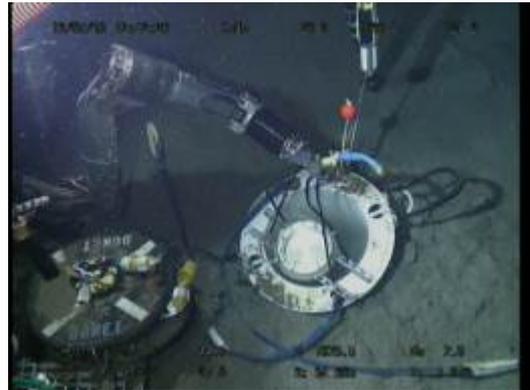


Fig.4.1.4 Installation Condition of "KY13-08 DM01"

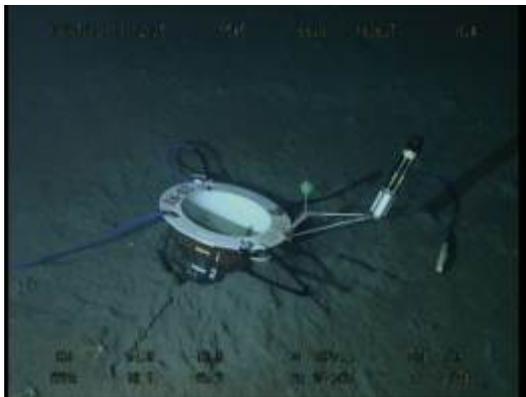


Fig.4.1.5 Installation Condition of "KY13-08 DM02"

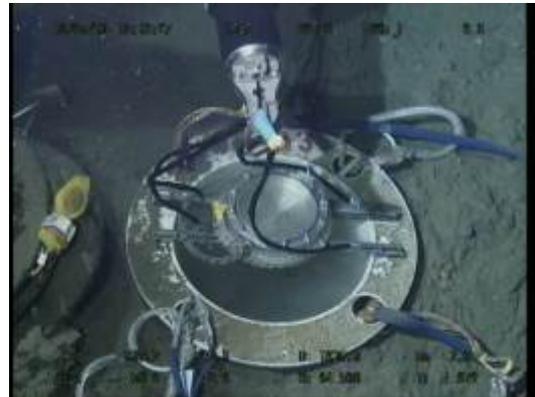


Fig.4.1.6 Installation Condition of "KY13-08 DM03"



Fig.4.1.7 The condition of after cleaning in the casing "KY12-11 BM02"

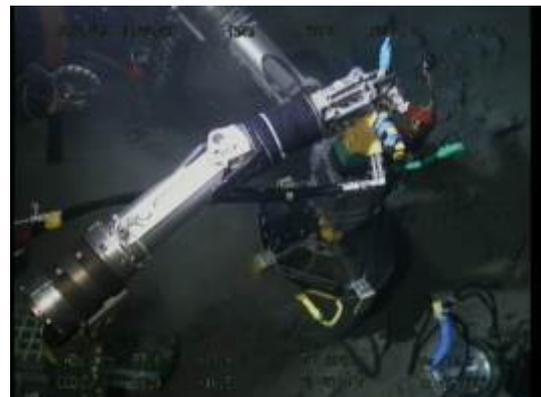


Fig.4.1.8 The Hydraulic Hammer on the bottom casing



Fig.4.1.9 The overview after hammer in the bottom casing The Hydraulic Hammer

(2) DIVE #1546 on July 13, 2013

Impact of the Vicky hammer was checked in this dive. In order to set up the test condition of Dive #1545 similarly, this test was carried out in 1E-22. The casing used in this dive had twice size of cross section area than the usual casing installed by the Vicky hammer. Therefore much power for installation was required. This special casing and the Vicky hammer were simply tied down on the sample-basket of Hyper-dolphin (figure 4.2.1).

After Hyper-dolphin was on the sea-floor, the casing was put on and inserted into sea-bed using both manipulators (figure 4.2.2). And the Vicky hammer was put on the top of the casing to check the casing's incline using the level (figure 4.2.3). Since the inclination was less than 10 degree, the Vicky hammer started the vibration. 4 minute later, the casing was completely inserted into the sea-bed (figure 4.2.4). The miniature transponder (ID:92) was recovered and the Hyper-dolphin was leave the sea-floor.



Fig.4.2.1 The hammer and the casing on the sample-basket



Fig.4.2.2 The situation of casing that was put into by manipulators.



Fig.4.2.3 The level and the hammer



Fig.4.2.4 The casing after the operation

(3) DIVE #1547 on July 14, 2013

In this dive, we tested the automated cable-laying system and the mechanism that can release the cable on the sheave so as to put it on the seafloor. The lower limit of the cable payout speed was examined. The automated cable-laying system consists of two electric motors for driving the cable bobbin and the sheave, a DVL (Doppler Velocity Log) for measuring the ground speed, a pressure vessel for keeping related electric circuits, a GUI (Graphical User Interface) for system monitoring and control and a MMI (Man-Machine Interface) for human intervention. The two motors, DVL, and the pressure vessel are installed on the frame that is fixed at the bottom of the ROV “Hyper Dolphin” of JAMSTEC.

The landing position is (33° 20.439’N, 136° 16.558’E, 1870m depth) and we first tested the cable release mechanism and confirmed that it can work well. Figs. 4.3.1 and 4.3.2 show the cable on the cable and the cable put on the seafloor by the mechanism. After that, we tested the automated cable-laying system. The anchor for fixing the end-point of the cable (the weight in air is approximately 15kg) was put on the seafloor and then the cable-laying test was started. The start point is the same as the landing position and the goal position is (33° 19.811’N, 136° 16.205’E, 1836m depth). The cable-laying test was completed without any problem, and the traveled distance is approximately 1.3km and the length of paid out cable is 1.25km; this means that the anchor was dragged by about 50m during the cable laying. Through this test, we found the lower limit of the payout speed and this provides information to adjust the control gain in order that the payout speed should be controlled not to be lower than the limit. The laid cable during the test was all recovered by the automated cable-laying system.



Fig. 4.3.1 Cable on the sheave.



Fig. 4.3.2 Cable put on the seafloor.

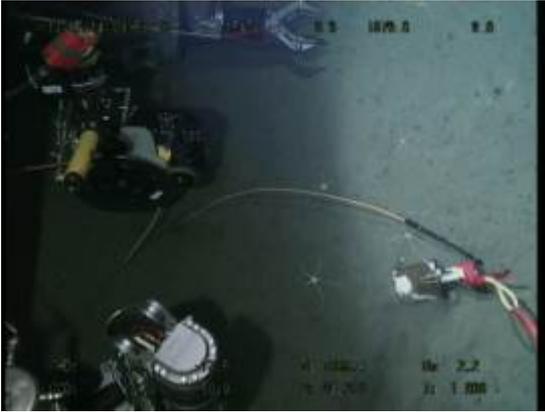


Fig. 4.3.3 Anchor put on the seafloor.

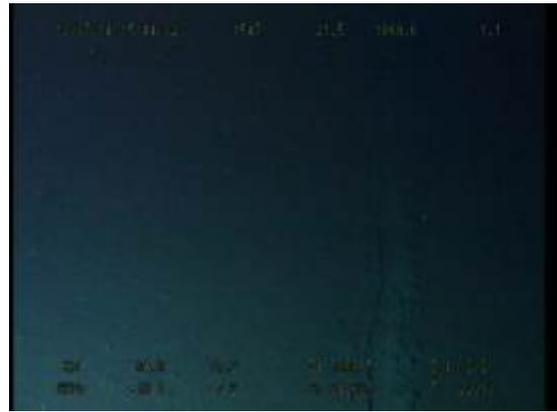


Fig. 4.3.4 Dragged trace of the anchor.

#### (4) DIVE #1548 on July 15, 2013

The purpose of this dive is to test the automated cable-laying system and the cable release mechanism. It was investigated through this test whether the cable tautness can be controlled automatically. The cable tautness represents the ratio of the traveled distance and the length of paid out cable; for example, a cable tautness of 100% means that the traveled distance is the same as the length of paid out cable.

After landing, the cable release mechanism was tested and we confirmed its work. Figs. 4.4.1 and 4.4.2 show the cable on the cable and the cable put on the seafloor. The landing position is ( $33^{\circ} 19.826'N$ ,  $136^{\circ} 16.142'E$ , 1834m depth). Then, the cable-laying test was carried out. The 15kg anchor was used to fix the end of the cable (Fig. 4.4.3). The cable laying was stopped at the position ( $33^{\circ} 20.321'N$ ,  $136^{\circ} 16.413'E$ , 1857m depth). During the test, the automated cable-laying system was worked without any problem. The traveled distance is approximately 987m and the length of paid out cable is 1059m; the cable tautness is 93.2% with respect to the desired value of 97%. The lower limit of the payout speed obtained when DIVE #1547 was used. The anchor and the laid cable during the test were recovered (Fig. 4.4.4).



Fig. 4.4.1 Cable on the sheave.



Fig. 4.4.2 Cable put on the seafloor.



Fig. 4.4.3 Anchor put on the seafloor.



Fig. 4.4.4 Recovering of the anchor.

(5) DIVE #1549 on July 16, 2013

The purpose of this dive is to test the automated cable-laying system and the cable release mechanism. It was investigated whether the cable tautness can be controlled automatically.

The landing position is (33° 05.316'N, 135° 24.833'E, 1962m depth) and the cable-laying test was first carried out. The 15kg anchor was used to fix the end of the cable (Fig. 4.5.1) and the cable laying was finished at the position (33° 05.854'N, 135° 24.968'E, 1846m depth). The traveled distance is approximately 1030m and the length of paid out cable is 1068m; the cable tautness is 96.4% with respect to the desired value of 98%. Before landing off, the cable release mechanism was tested and we confirmed that it can work well (Figs. 4.5.2 and 4.5.3). The anchor and the laid cable during the test were recovered (Fig. 4.5.4).



Fig. 4.5.1 Anchor put on the seafloor.



Fig. 4.5.2 Cable on the sheave.



Fig. 4.5.3 Cable put on the seafloor.



Fig. 4.5.4 Recovering of the anchor.

## 5. Conclusions

In this expedition, the construction of DONET2 was carried out at 1E-22. The equipment that will be used in DONET2 construction, were checked in field test. All planned tests were successfully completed.

## 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.