

## Cruise report of NT08-20 R/V Natsushima ROV HyperDolphin

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Research area: Kumano-nada Nankai Trough

Shipboard science party: Eiichiro Araki, Toru Kodera, Sho Kaneko

Cruise period : Sep. 15, 2008 (Owase-port) – Sep. 22, 2008 (Yokohama port)

### 1. Background and Overview

JAMSTEC started development of seafloor network for earthquake and tsunami observation (DONET) since 2006. The target area of the network deployment is Kumano basin and around, where Tonankai earthquakes recur every 100-150 years. As a part of system development for DONET, broadband seismometer installation was performed in a test field (A-3 in Fig. 1) during the NT08-20 cruise. The broadband seismometer deployment in this cruise is to simulate a case installation method considered for the DONET installation. A broadband seismometer package similar to that deployed in the future construction of DONET, was developed and the package was installed in a seafloor casing previously deployed in the test field this April. Our plan is to conduct test observation using the model seismometer package and installation method until this end of November to identify issues in the set of the seismometer package and installation method. Temperature monitoring was also conducted during the NT0820 cruise to assess effect of seafloor temperature fluctuation on the performance of the seismometer in the test field.

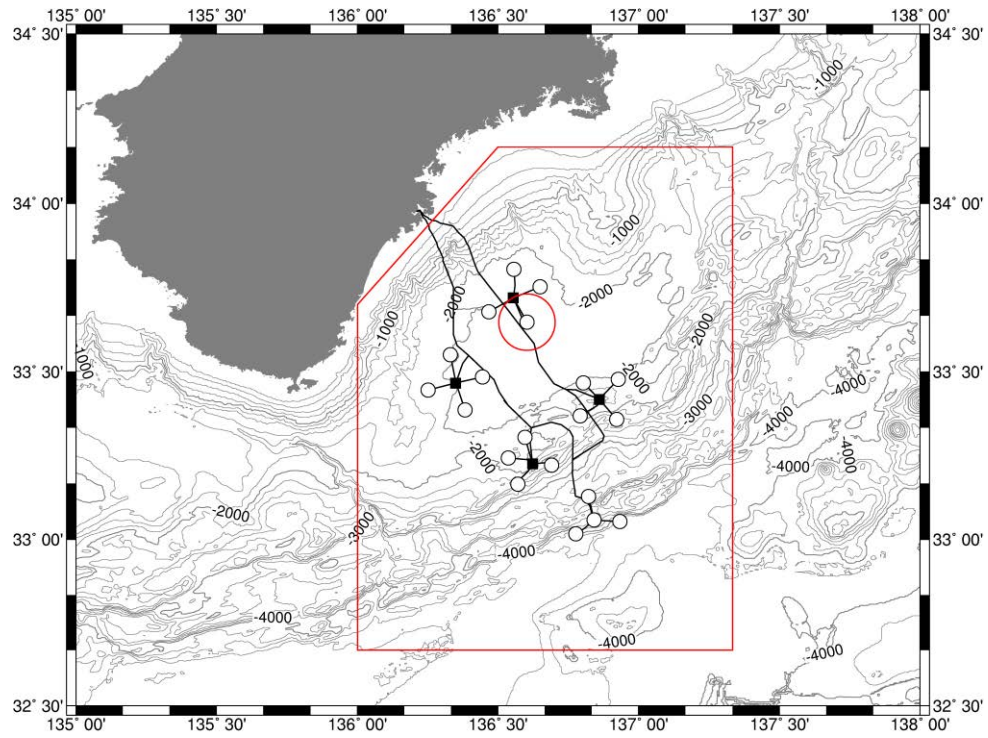


Figure 1 NT0820 test field map. The test field A-3 is in the center of the red circle (33-38.846°N 136-36.187°E 2065m).

## 2. Methods

### 2.1 Seismometer package

Fig. 2 illustrates the seismic package developed for the test during NT0820 cruise. A titanium cylinder houses a Guralp CMG-3T broadband seismometer, JAE JA5V-typeIII strong motion accelerometer on a motorized gimbals. The signal from these seismometers are digitized by the electronics in the cylinder and the data is sent to a seafloor data recorder called SAM. In addition to the seismometers, a differential pressure gauge was connected to the cylinder through 10m cable for measurement of small pressure fluctuation.

The seismic package is deployed in the seafloor in a cased borehole. Fig. 3 illustrates the arrangement of the seismic package and the cased borehole. The casing was deployed in the seafloor prior to the cruise using a piston corer. ROV will recover remaining mud in the casing and lower the seismometer until the seismometer is in hold in the casing. To secure the seismometer in the casing, sand will be filled in the gap between the casing and the seismometer package.



Figure 2 seismometer package and data recorder

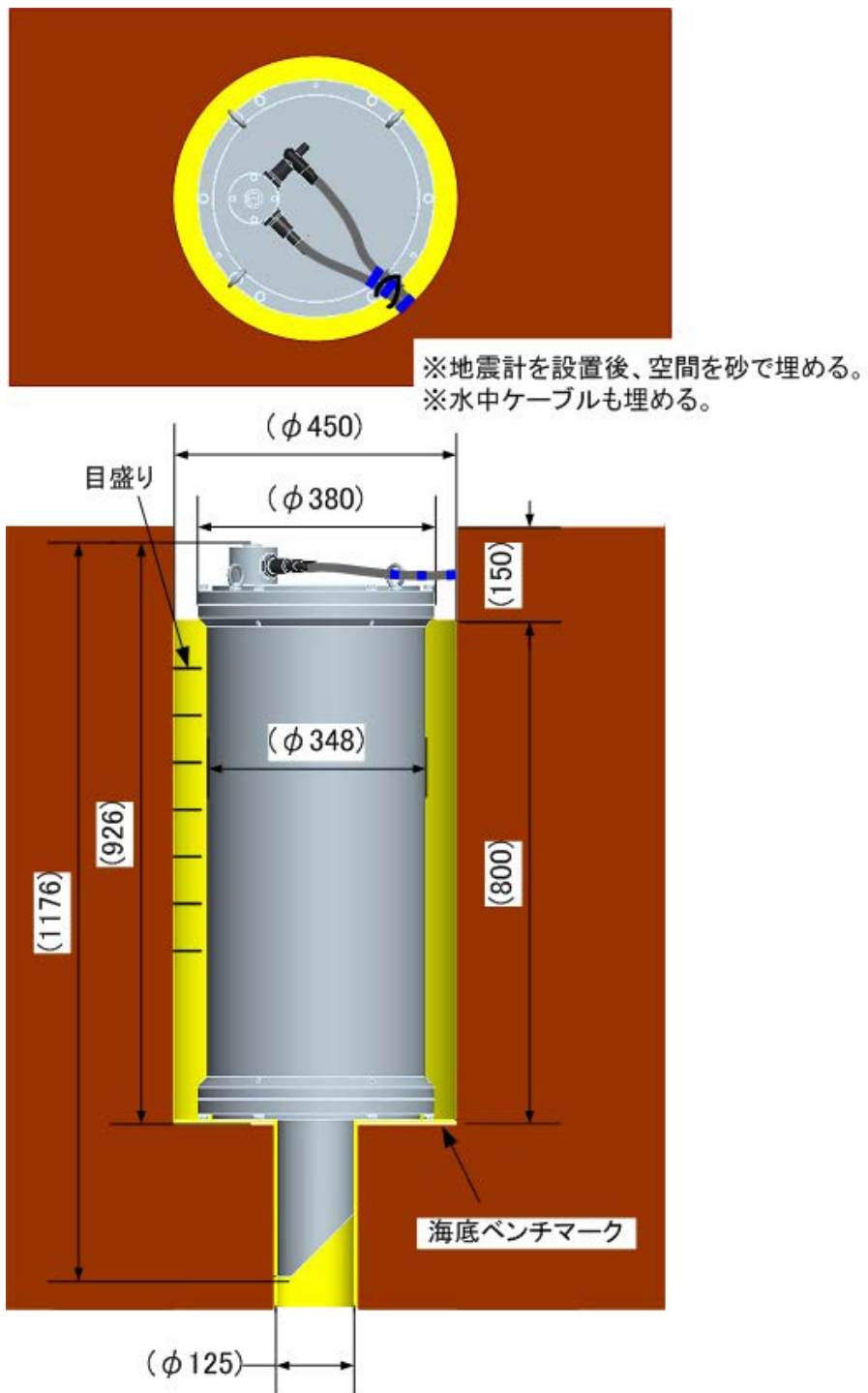


Figure 3. Seafloor cased borehole and the seismometer package

## 2.2 Thermometer spear

Thermometer spear (Fig 4) is a device to record temperature in seawater near the seafloor and ground temperature. Array of miniature thermometers is formed on a stainless steel pipe. Layout of instruments are 30cm below the seafloor, 0.5cm, 30.5 cm, 60 cm above the seafloor. Two of the thermometers records temperature every 5 sec while others record every 90 seconds.

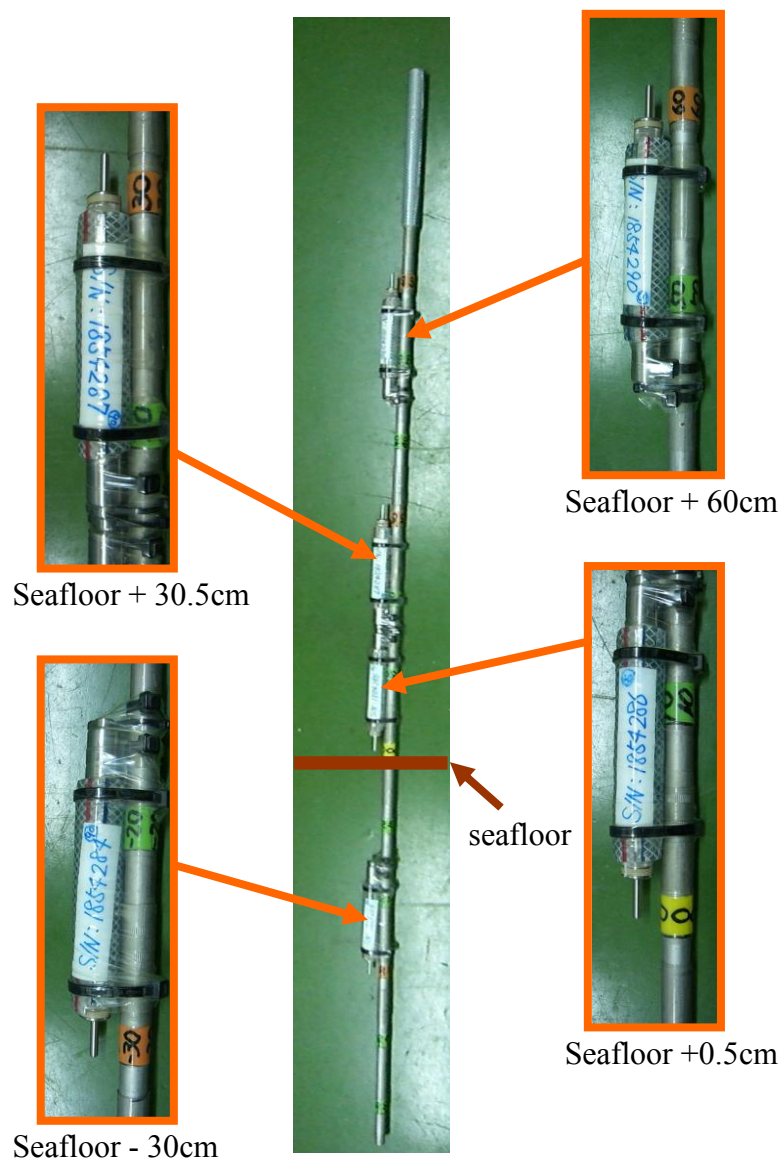


Figure 4 Thermometer spear.

### 2.3 Mooring for deployment of seismic instruments

In this test, the seismometer package and SAM data recorder was deployed in the seafloor, for both weight in air were too heavy as a payload for the ROV Hyper Dolphin. Figure 5 illustrate the mooring system used for deployment of the seismometer package and SAM data recorder.

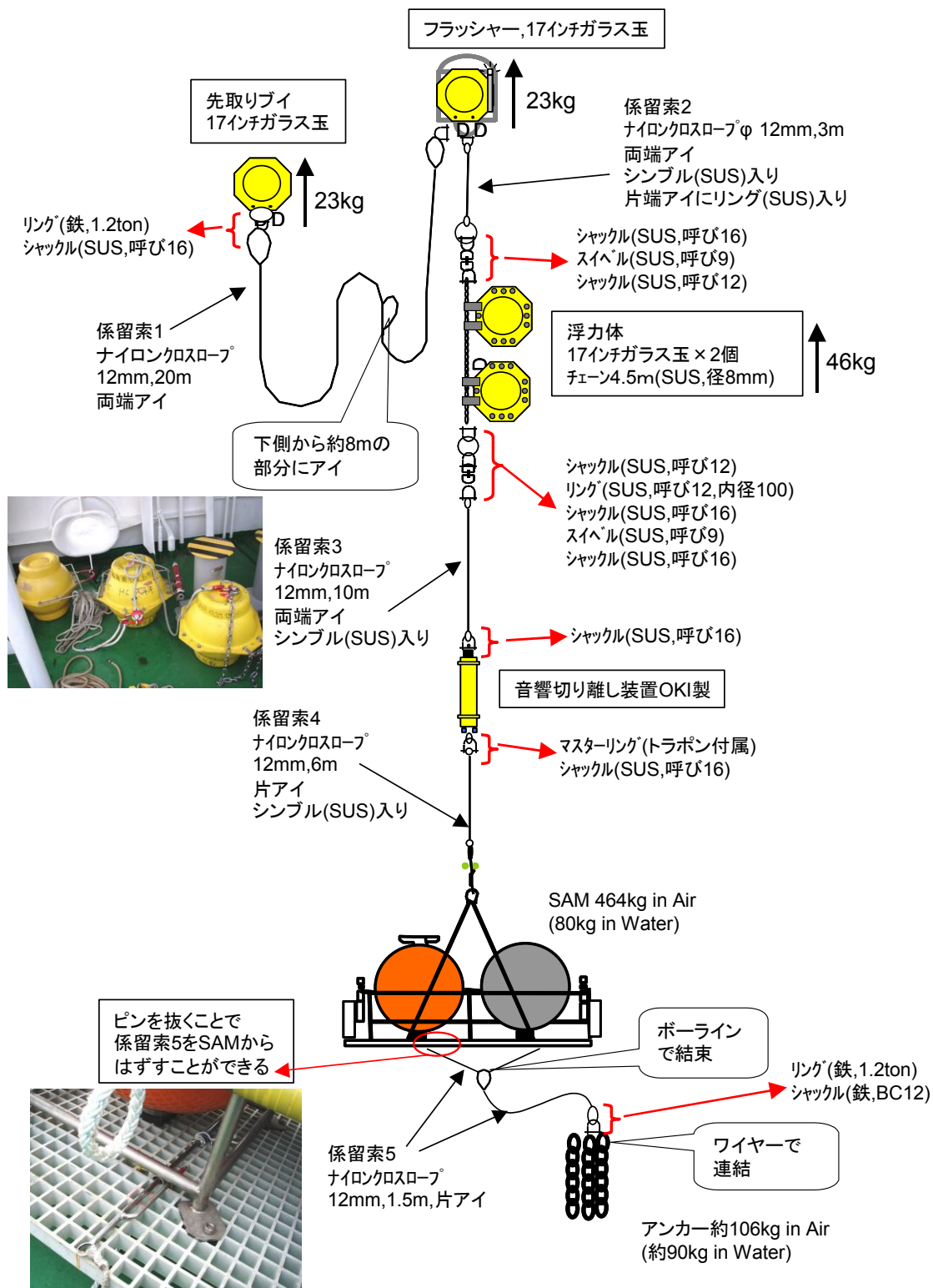


Figure 5 mooring used for deployment of the seismic package and SAM data recorder

### 3. Operations and Results

R/V Natsushima departed Owase port in the morning of September 15, and arrived at Yokohama port in September 22. During this cruise Two dives (Hyper dolphin dive #902, #903) were conducted in Kumano Basin of the Nankai Trough. During the period between Sep. 18 to Sep. 22, the Natsushima was in the Tokyo bay and Tateyama bay to avoid Typhoon No. 13.

Installation of a proto-type sensor for DONET (Dense Ocean Network for Earthquake and Tsunamis) was conducted in A-3 point of the Kumano Basin, the Nankai Trough. The sensor consisted of broadband seismometer, strongmotion accelerometer, and a differential pressure gauge. The sensor was buried in the sediment using a seafloor cased borehole (BM-04 at A-3 point). The Hyper Dolphin connected cable from the sensor to seismic recorder called SAM, and started long-term observation using the observation system. During the installation operation, data from the sensor was received to evaluate its quality. An array of thermometer was also installed to monitor seawater and ground temperature.

#### 3.1 ROV operations

##### Sep 16 HPD Dive #902.

Firstly, we identified the BM-04 borehole (Fig 6) in the seafloor in A-3 site by ROV. The BM-04 borehole is filled with meat-ball like mud as well as garbage such vinyl bags and PET bottles. It took two hours to clean the hole by suction pump by ROV.

We also moved SAM data recorder and the seismometer package deployed by mooring (Fig 7).

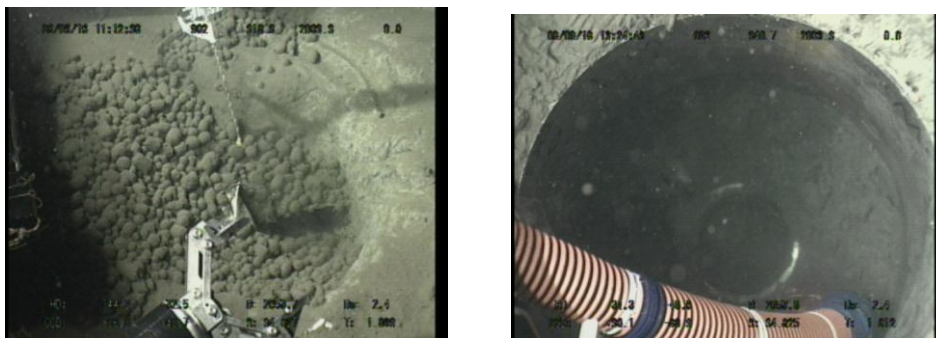


Figure 6. Seafloor cased borehole BM-04.

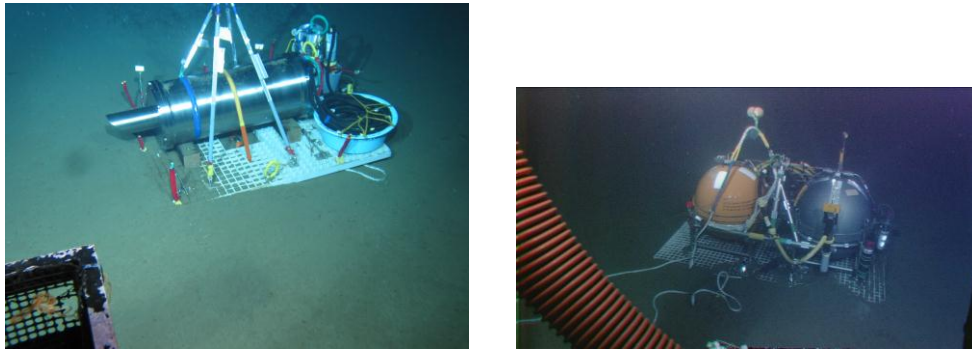


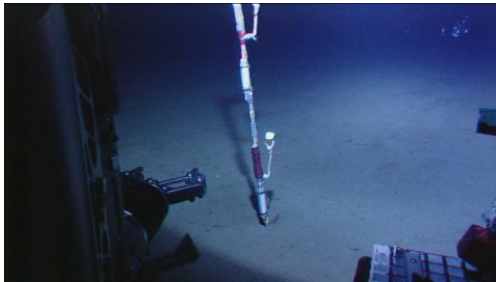
Figure 7. Mooring deployed seismometer package (left) and SAM data recorder (right).

#### Sep 17 HPD Dive 903.

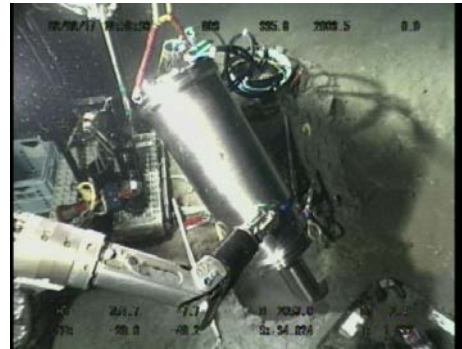
Recovery of seismometer mooring was conducted prior to the ROV dive. Payload of the Hyper Dolphin was a device to pull seismometer and a sand bag (20l) and a thermometer spear. During the ROV dive, the following operation was performed.

1. Installation of thermometer spear near BM-04 hole (Fig 8-a)
2. Installation of seismometer in BM-04 borehole using pulling device by ROV. (Fig 8-b,c)
3. Installation of Differential pressure gauge (Fig 8-e)
4. Connection of the seismometer to SAM data recorder. The connector was located near the DPG.
5. Seismometer burial with sand. 80l sand pack was necessary to bury the seismometer (Fig 8-d)
6. Seismometer control to start observation by connecting cable to SAM data recorder.

Figure 9 shows orientation of seismic package checked by ROV camera. Figure 10 illustrates distribution of seafloor instruments in A-3 site.



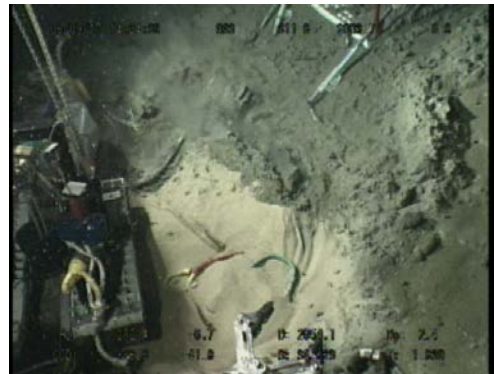
a)



b)



c)



d)



e)

Figure 8 ROV operation during dive 903.

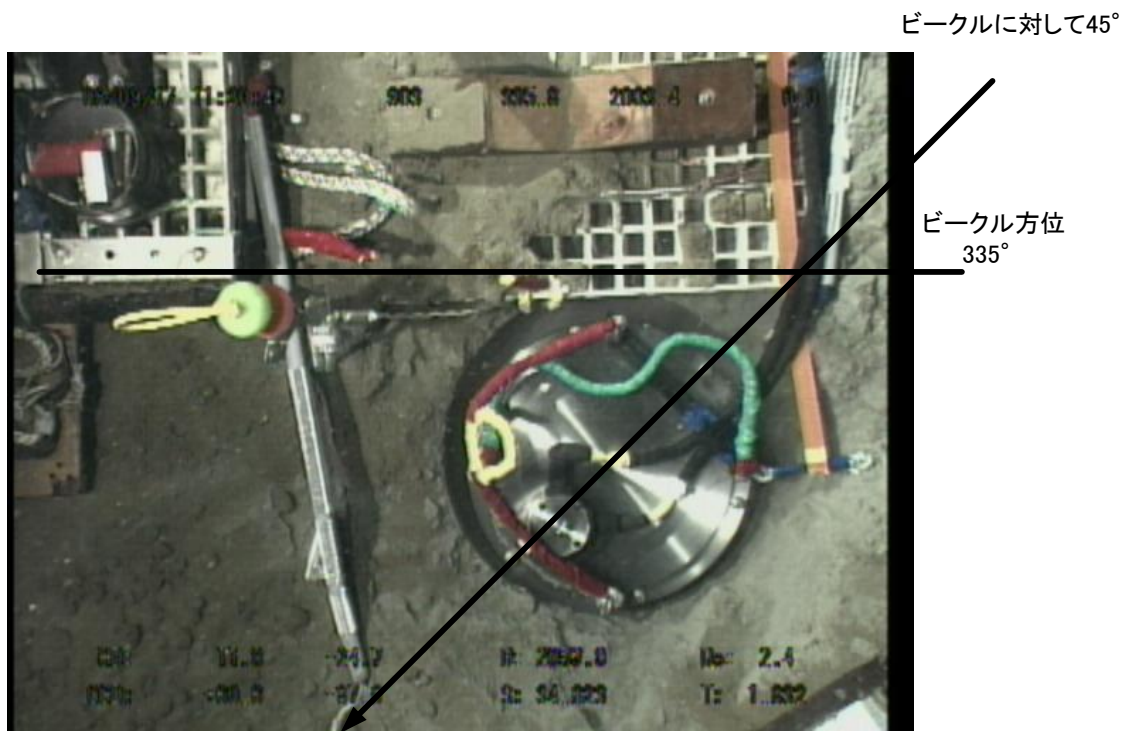


Figure 9 Seismometer layout confirmed by ROV.

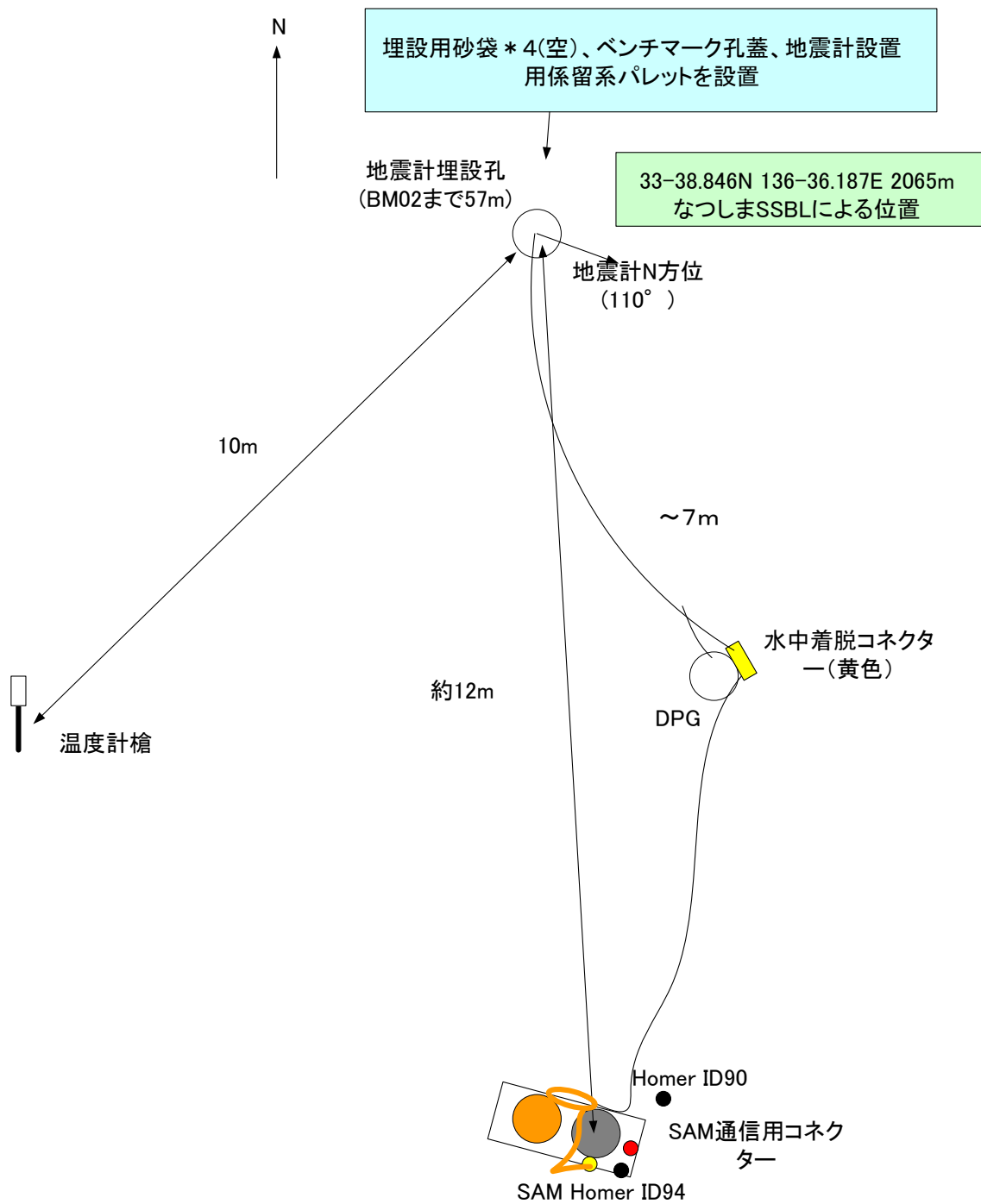


Figure 10. Layout of seafloor instruments in A-3 site.

#### 4. Conclusions

Test seismometer package installation in a cased borehole in A-3 test site for DONET development was successfully conducted during the NT0820 cruise. The seismometer package was buried in the seafloor with sand and the seafloor data recorder continues the seismic observation until the recovery of data recorder planned in November in JAMSTEC Natsushima NT08-23 cruise. The data from the test seismometer package will be evaluated for performance. The installation operation will also be evaluated to improve the future DONET installation operations.

#### Acknowledgement.

The installation of seismic package in the seafloor was impossible without skilled operations performed by the captain and the crew of R/V Natsushima and ROV Hyper Dolphin operation team. We thank for their professional work to support our test during the NT08-20 cruise.