



R/V Kaimei Cruise Report
KM21-12

Development of continuous real-time monitoring
technology for seafloor deformation

Kumano-nada and off Kii-suido

Dec. 10, 2021 – Dec. 28, 2021

Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

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1. Cruise Information

Cruise ID: KM21-12

Name of vessel: KAIMEI

Title of project: Development of continuous real-time monitoring technology for seafloor deformation

Title of cruise: Development of continuous real-time monitoring technology for seafloor deformation

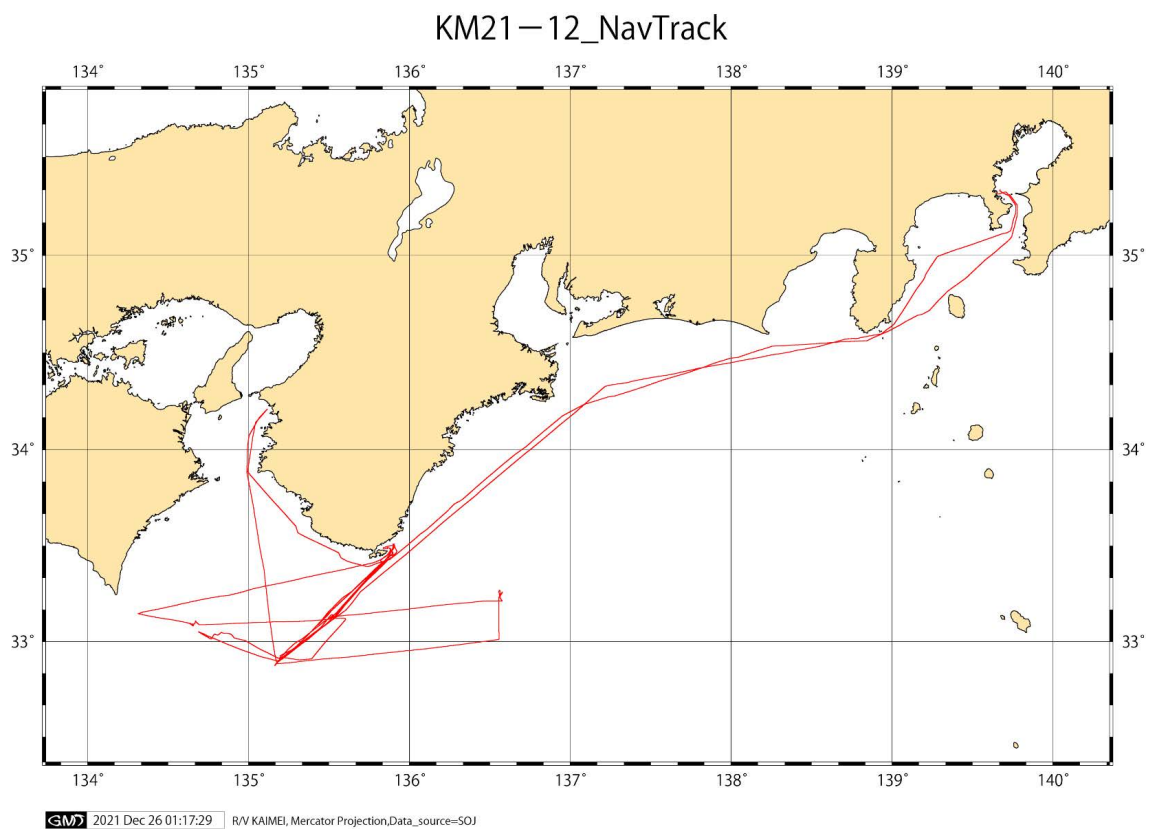
Chief Scientist [Affiliation] : Hiroyuki MATSUMOTO [JAMSTEC]

Cruise period: 2021/12/10– 2021/12/28

Ports of departure / call / arrival: Yokosuka Port/Yokosuka Port

Research area: Kumano-nada and off Kii-suido

Research map



2. Research Proposal and Science Party

- Title of proposal: Development of continuous real-time monitoring technology for seafloor deformation
- Representative of Science Party [Affiliation] : Eiichiro ARAKI [JAMSTEC]
- Science Party (List) [Affiliation, assignment etc.]
 - Hiroyuki Matsumoto [JAMSTEC]
 - Yuya Machida [JAMSTEC]
 - Koichiro Obana [JAMSTEC]
 - Takashi Saito [Mitsubishi Electric Tokki Systems Corporation]
 - Ken Adachi [Mitsubishi Electric Tokki Systems Corporation]
 - Daisuke Tetsuda [Mitsubishi Electric Tokki Systems Corporation]
 - Akari Saijo [Nippon Marine Enterprises]
 - Hisanori Iwamoto [Nippon Marine Enterprises]
 - Kenya Yamanaka [Nippon Marine Enterprises]

3. Research/Development Activities

3.1. Calibration of DONET pressure gauges

At a Hyper-Dolphin dive, i.e., HPD #2140, in-situ pressure calibration was conducted at the DONET station 2C-10. The pressure calibrator is used to compare the DONET pressure measurement with the pressure standard at the seafloor (Fig. 1). However, the power/communication cable between the pressure calibrator and the controller was in trouble during the dive (Fig. 2). Therefore, the in-situ pressure calibration was cancelled. Alternatively, we installed a step and four markers for the fly-by pressure calibration at 2C-10 (Figs. 3 and 4) at HPD #2141.

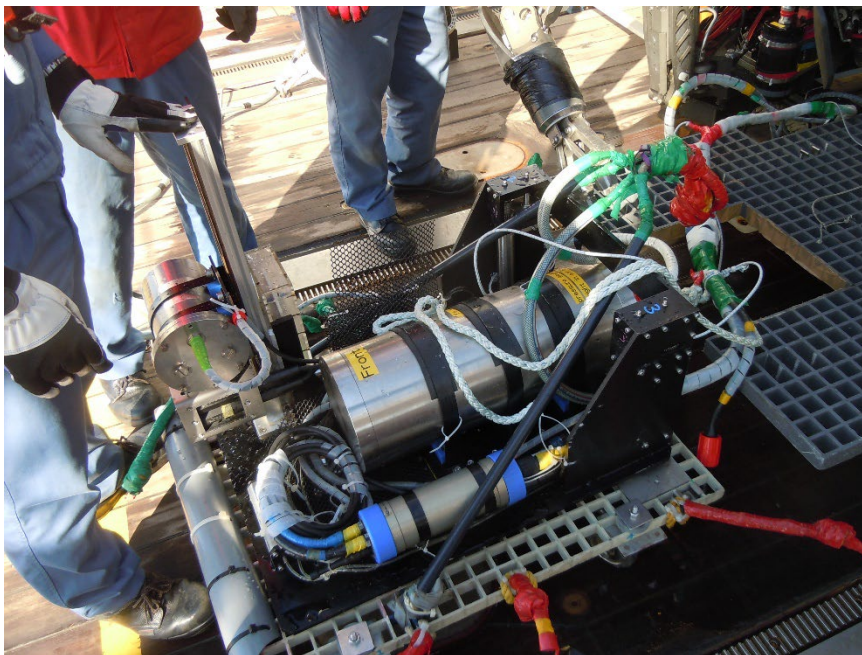


Fig. 1 Pressure calibrator

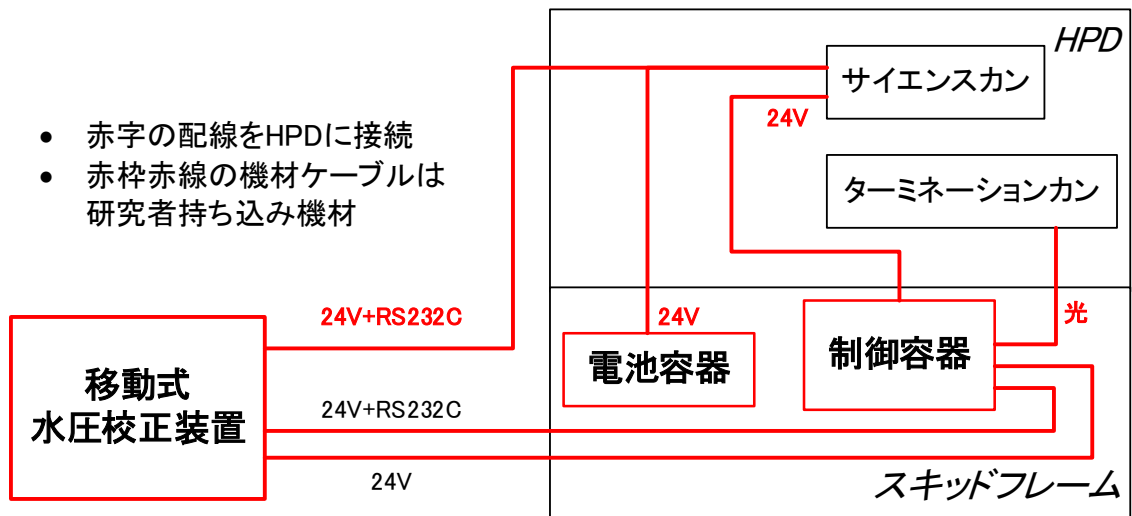


Fig. 2 Block-diagram of the pressure calibrator

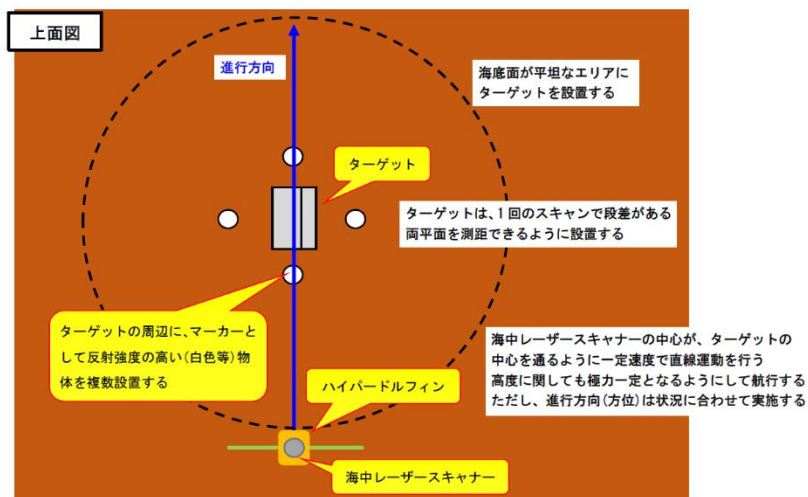


Fig. 3 Schematic figure of fly-by pressure calibration target

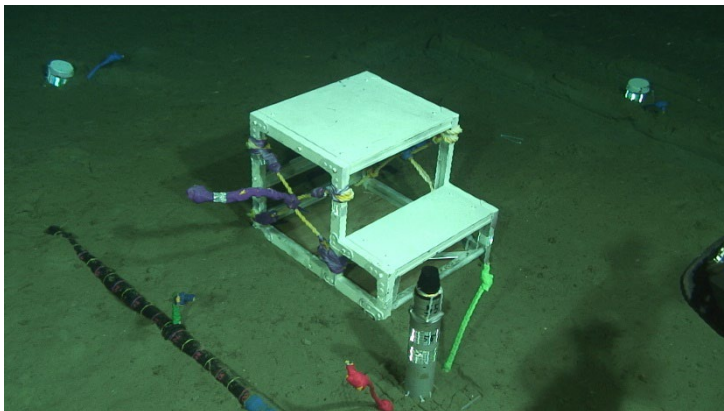


Fig. 4 Step and makers

3.2. Installation test of fiber optic strain-meter

Three dives, i.e., HPD #2142, #2143, and #2144 were conducted to perform the installation test for a fiber-optic strain-meter. Table 1 shows the configuration of the robot for each dive. We changed the number of paddle and type of plough. Figure 5 shows the installation robot carried by Hyper-Dolphin.

Table 1 Configuration of the installation robot

HPD	Area	Number of paddle	Plough
#2142	2C-10	12	Weight 2 kg + Rudder
#2143	2F-S2	6	Rudder only
#2144	2F-S2	6 + net	Rudder only

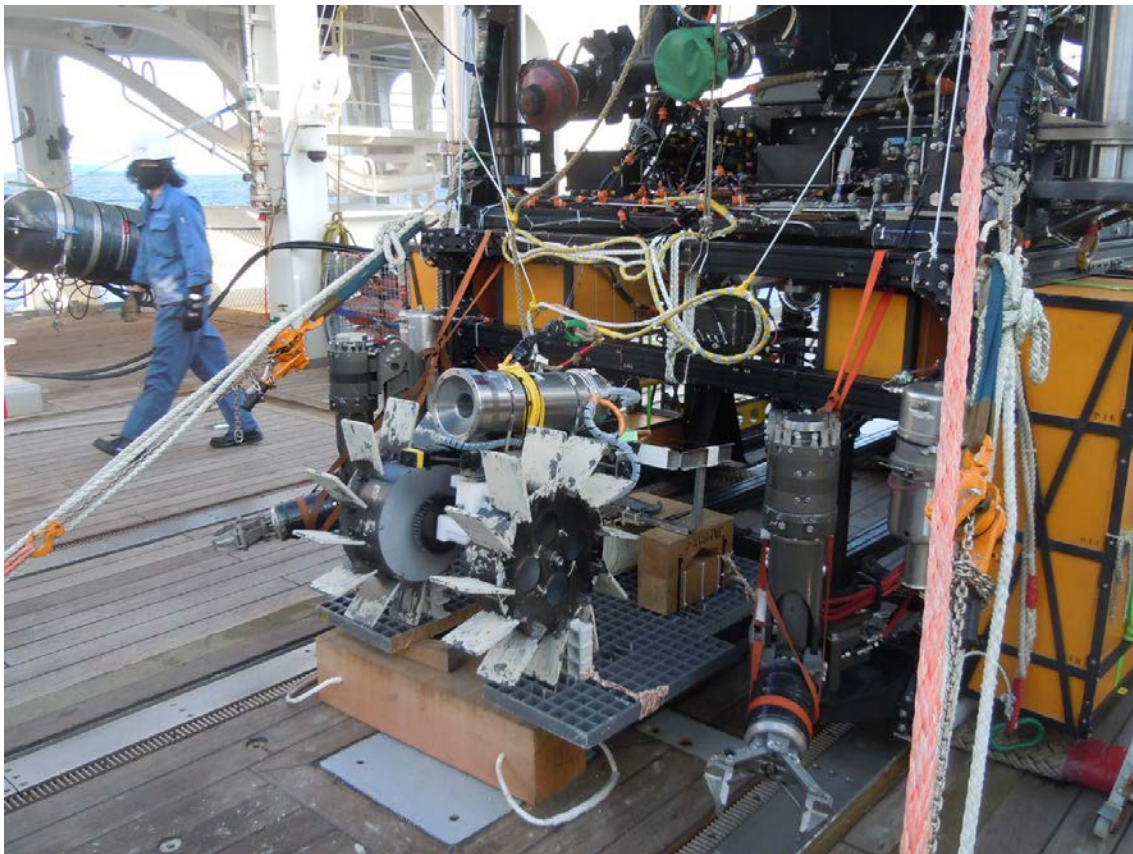


Fig. 5 Installation robot for a fiber-optic strain-meter on Hyper-Dolphin

(1) HPD #2142 dive

The summary of HPD #2142 dive is as follows.

- (i) The distance traveled is about 1m. (Fig. 6)
- (ii) The robot loses its speed due to the high resistance of the plough.
- (iii) The robot also gradually became subsidence due to the own weight. (Fig. 7)

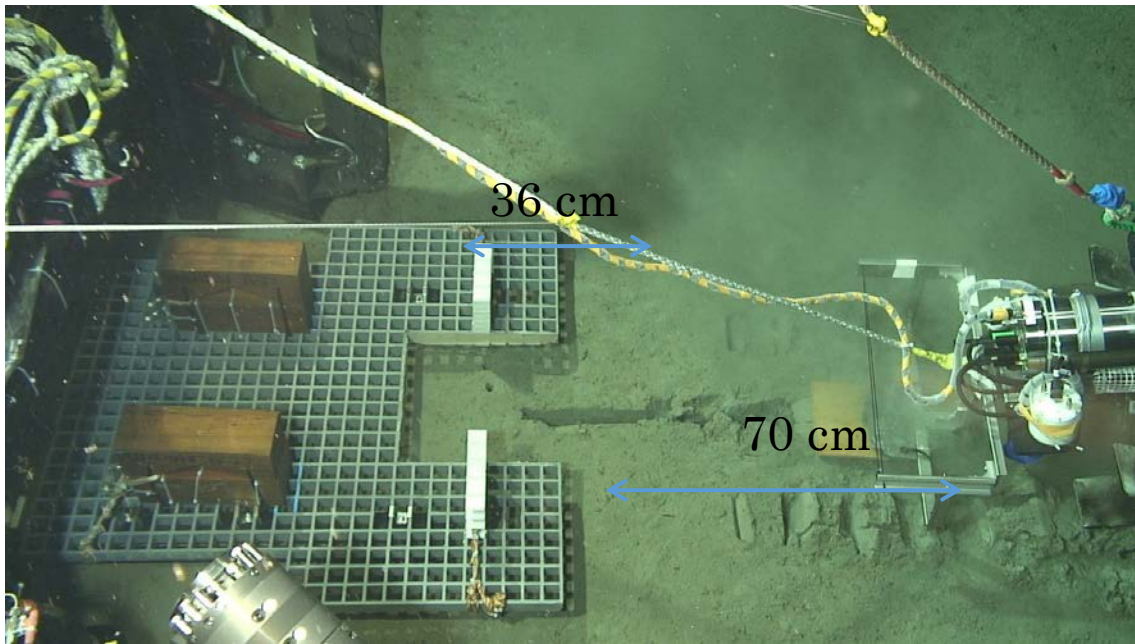


Fig. 6 Photo of the installation robot at HPD #2142

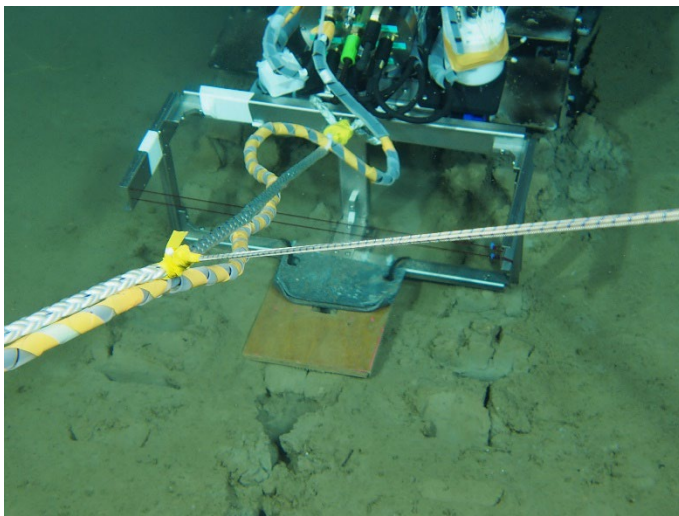


Fig. 7 Back-side view of the robot

(2) HPD #2143 dive

The HPD #2143 dive was conducted at DONET 2F-S2. Compared to the previous dive, we removed the counter weight equivalent to a bobbin weight and reduced the number of paddles. The summary of the present dive is as follows.

- (i) The bottom feature is softer than 2C-10, and the robot ran with a short distance as far as only 20 cm. (Fig. 8)
- (ii) The surface layer of 2F-S2 is very soft and sinks rather quickly, so the paddle cannot scratch the mud. Propulsive force is almost none.

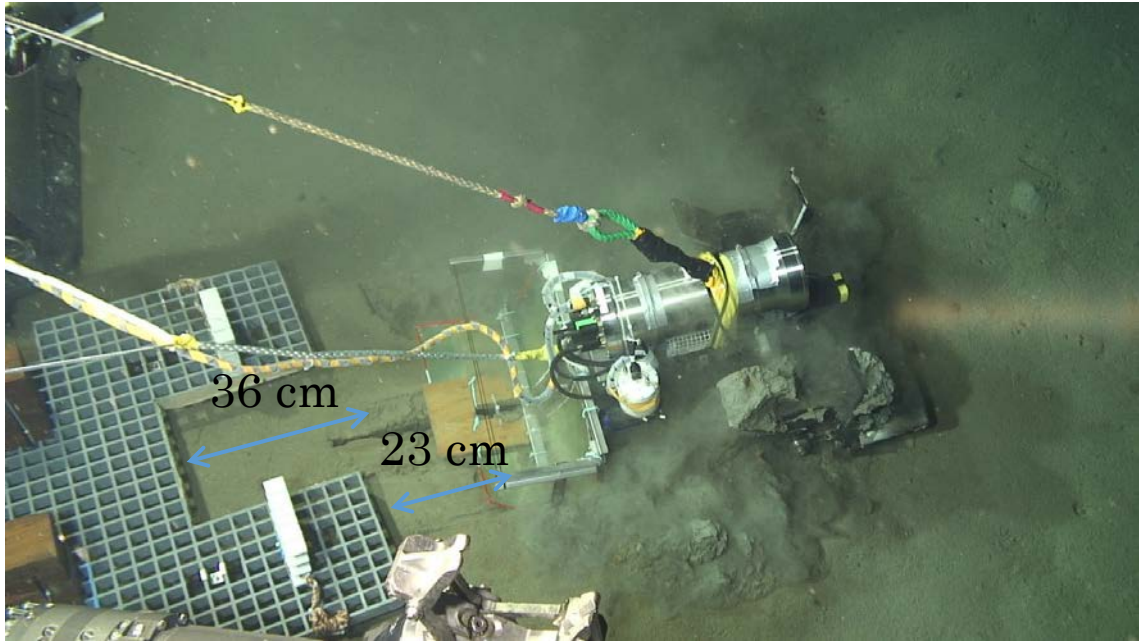


Fig. 8 Photo of the installation robot at HPD #2143

(3) HPD #2144 dive

The HPD #2144 dive was conducted at DONET 2F-S2, too. Net was additionally attached with the puddle. The summary of the present dive is as follows.

- (i) The moves forward about 20 cm. (Fig. 9)
- (ii) The attached net is not enough to hold its own weight.
- (iii) The resistance force increases as the suki advances and stops, so evaluation is necessary to isolate the force that causes loss of propulsive force.

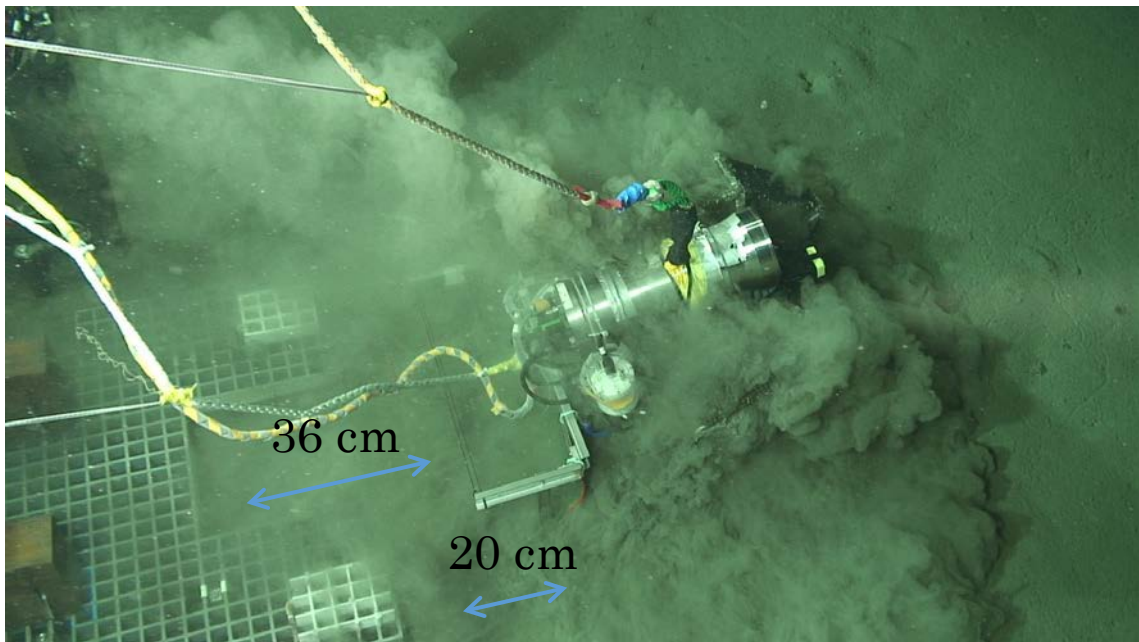


Fig. 9 Photo of the installation robot at HPD #2144

3.3. Recovery of temperature recording system

We had deployed the temperature recording system near the Muroto submarine cable during the KR21-13 cruise in August 2021. The location of the deployment is shown in Fig. 10. We sent acoustic commands to the self-recording temperature recorder system and detached the dead weights, and recovered it on board (Fig. 11). The system has two temperature sensors (Fig. 12), and it is confirmed that the two temperature sensors recorded ambient temperature completely (Fig. 13). The system has also the Doppler current meter (Fig. 14), and its data was obtained (Fig. 15).

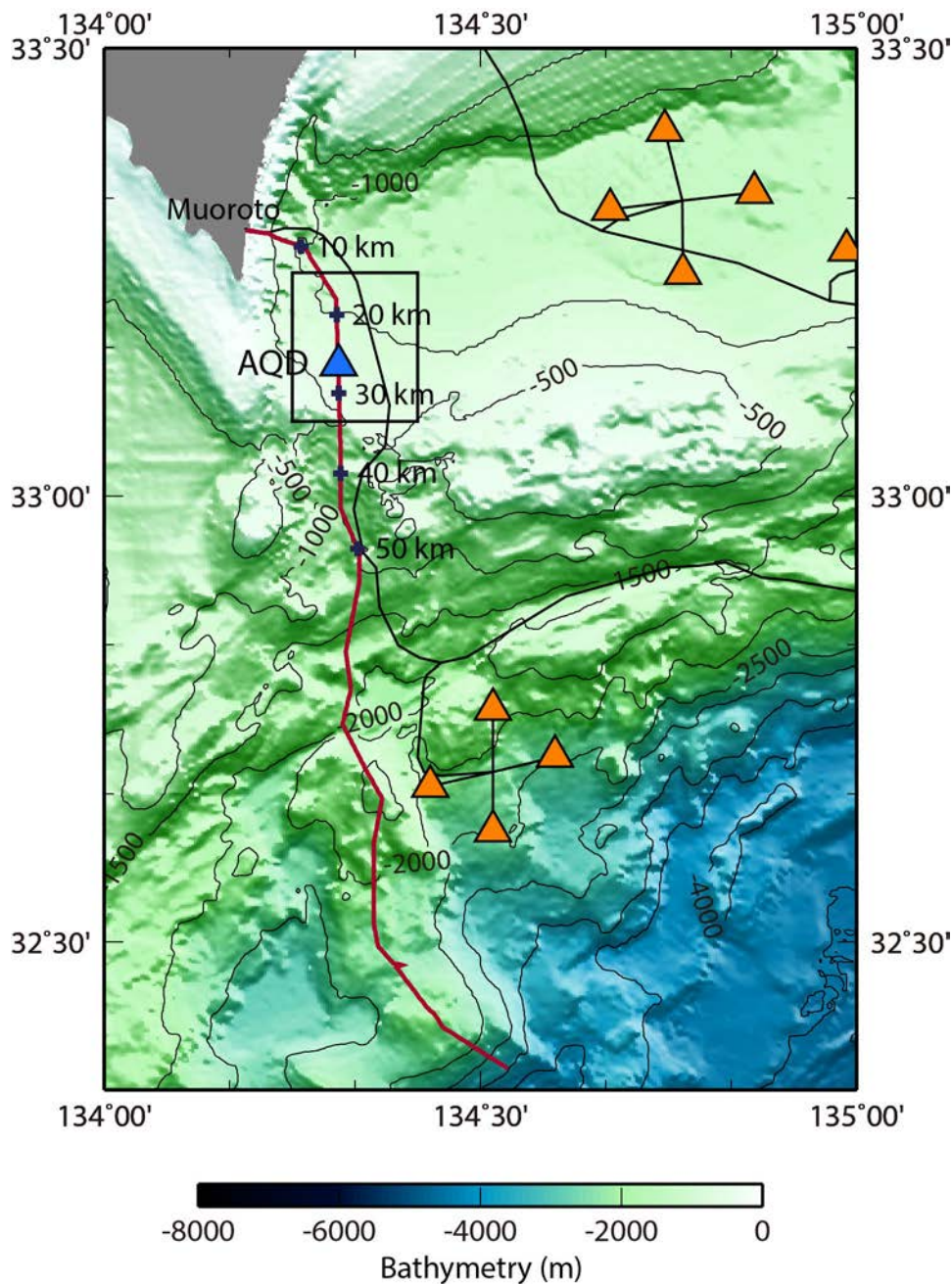


Fig. 10 Map showing the location of the temperature recording system indicated by AQD

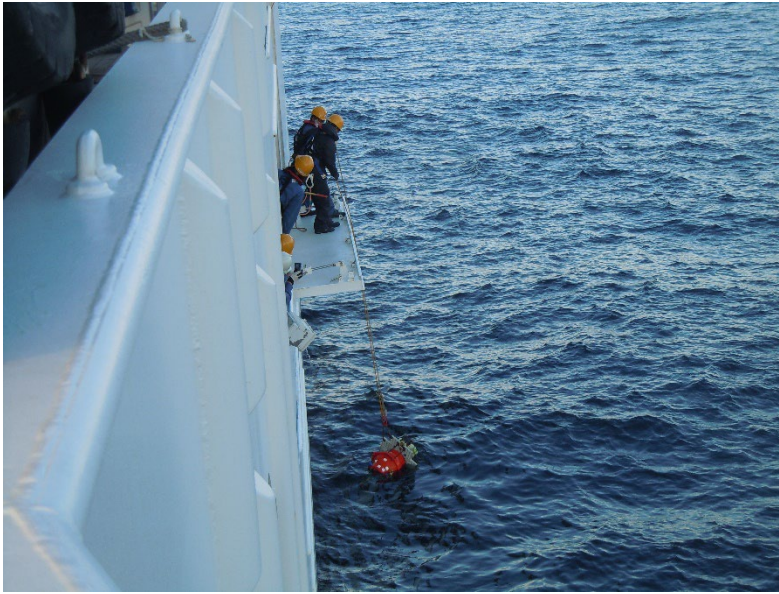


Fig. 11 Recovery of the temperature recording system

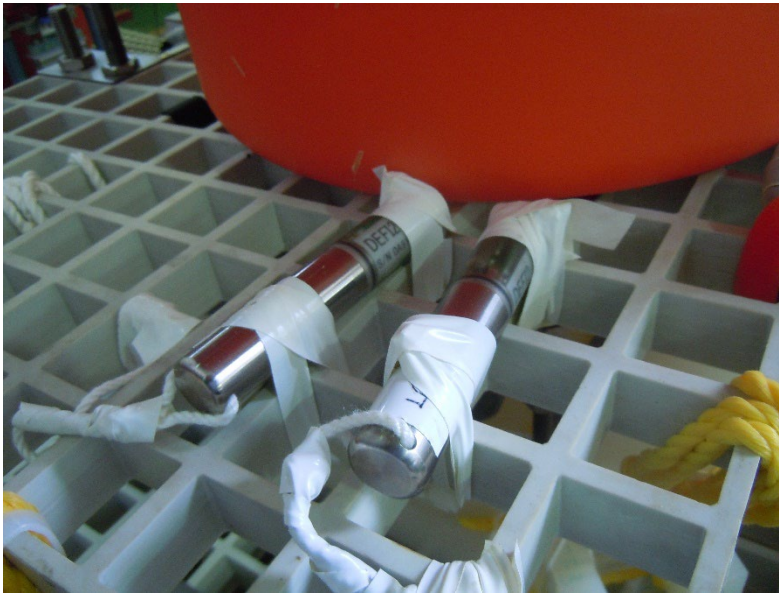


Fig. 12 Temperature sensors attached with the

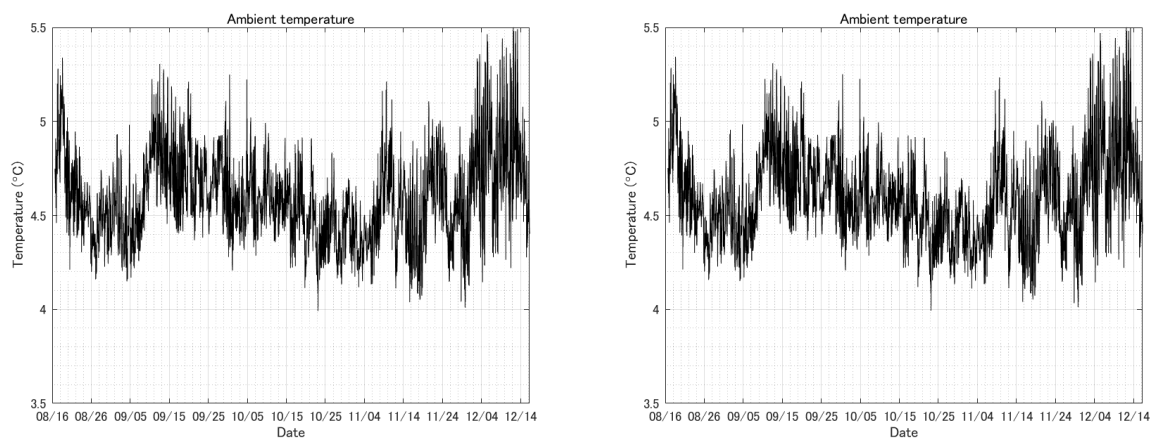


Fig. 13 Recording data of the two temperature sensors



Fig. 14 Doppler current meter

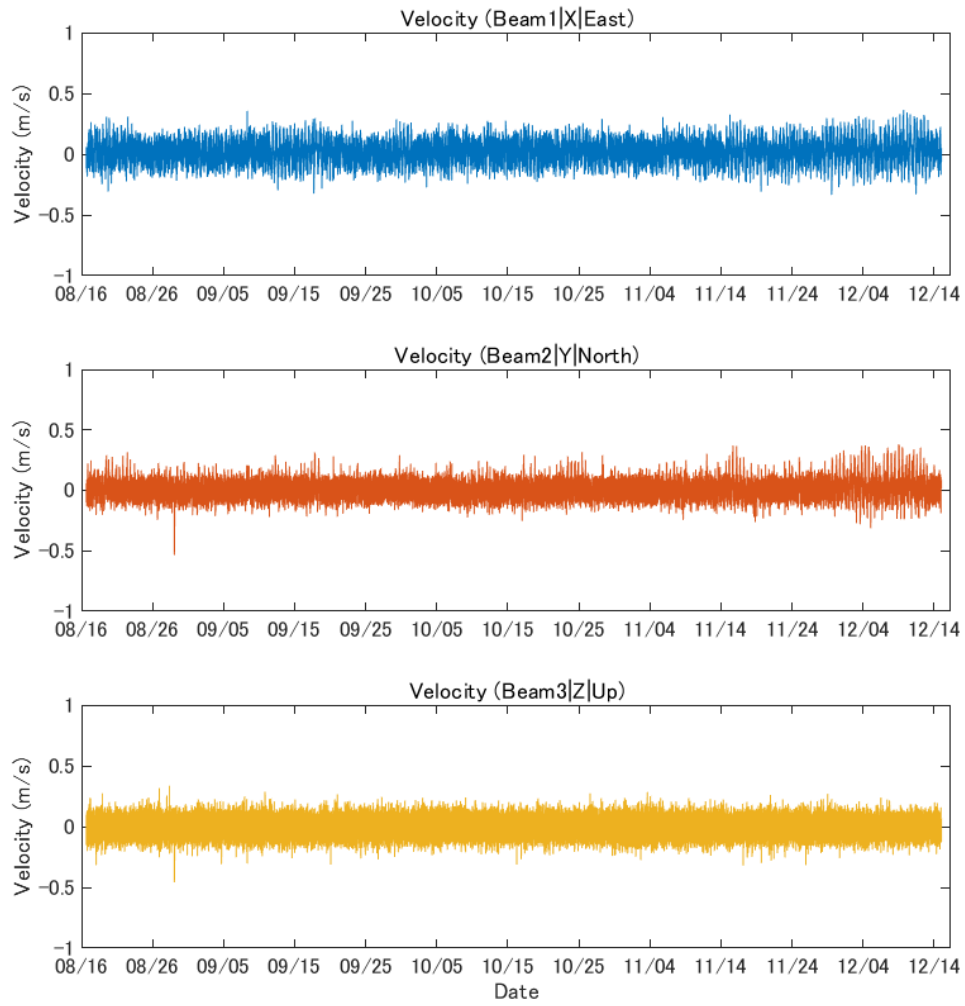


Fig. 15 Three-component velocity recording of the Doppler current meter

3.4. Installation and recovery of broadband OBSs

We have conducted a trial observation of broad-band ocean bottom seismograph (OBS). We used two ultra-deep OBSs (UDOBS) with the SPM recorder and replaced seismic sensors from a three-component 4.5 Hz short-period seismometer to a Nanometrics Trillium compact 20s. The tilt tolerance of the Trillium compact 20s is 10° although the Trillium compact 20s was installed in the pressure housing without leveling system. The OBSs were deployed at 2F-S2 site (2F-S2-1 and 2F-S2-2) on December 11, 2021 and recovered December 21, 2021.

Table 2 OBS locations (calibrated position on the seafloor)

Site	Latitude	Longitude	Water depth (m)
2F-S2-1	$32^\circ 52.8095' \text{ N}$	$135^\circ 09.9582' \text{ E}$	2283.07
2F-S2-2	$32^\circ 52.9551' \text{ N}$	$135^\circ 10.1398' \text{ E}$	2282.00

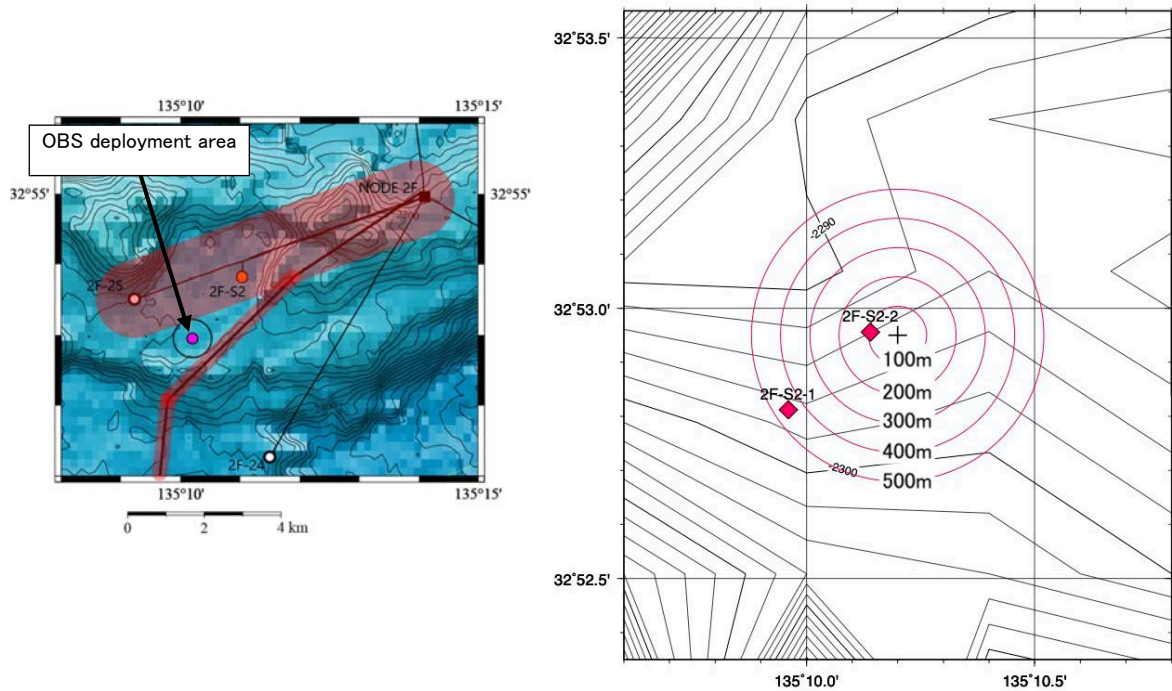


Fig. 16 OBS positions at 2F-S2 site. Red diamonds on the right panel are the OBS locations on the seafloor. The cross indicates the center of the planned OBS trial area and red circles are the area with a radius from 100 m to 500 m. The black lines are the iso-depth contour of the seafloor based on a bathymetry data.

4. Cruise Log

Cruise log is provided as follows.

Date	Ship log	Area	Activities
12/10	Departure from Yokosuka		
12/11	Operation	2F-S2	Recovery of OBSs
12/12	Dive HPD #2140	2C-10	Pressure calibration
12/13	Diverted	East Shiono-misaki	
12/14	Dive cancelled	2C-10	Trouble in the pressure calibrator
12/15	Dive HPD #2141	2C-10	Step and markers installation
12/16	Operation	Off Muroto	Recovery of temperature
12/17	HPD maintenance	East Shiono-misaki	
12/18	HPD maintenance	East Shiono-misaki	
12/19	Diverted	2F-S2	
12/20	Dive HPD #2142	2C-10	Test of installation robot
12/21	Dive HPD #2143	2F-S2	Test of installation robot
12/22	Dive HPD #2144	2F-S2	Test of installation robot
12/23	Preparation	Off Wakayama	
12/24	Preparation	Off Wakayama	Researchers onboard
12/25	Move to Yokosuka		
12/26	Standby for arrival	Off Yokosuka	
12/27	Standby for arrival	Off Yokosuka	
12/28	Arrived at Yokosuka		

5. Notice on Using

This cruise report is a preliminary documentation as of the end of cruise.

This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

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