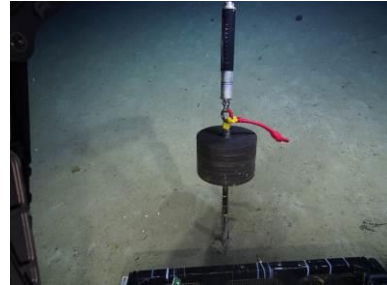




Kairei / Kaiko KR19-03 Cruise Report



Real time ocean bottom crustal movement observation

Off Kii Suido & Kumano-nada

Apr. 30th, 2019 - May. 10th, 2019

Research Institute for Marine Geodynamics
R&D Center for Earthquake and Tsunami Forecasting
Japan Agency for Marine-Earth Science and Technology

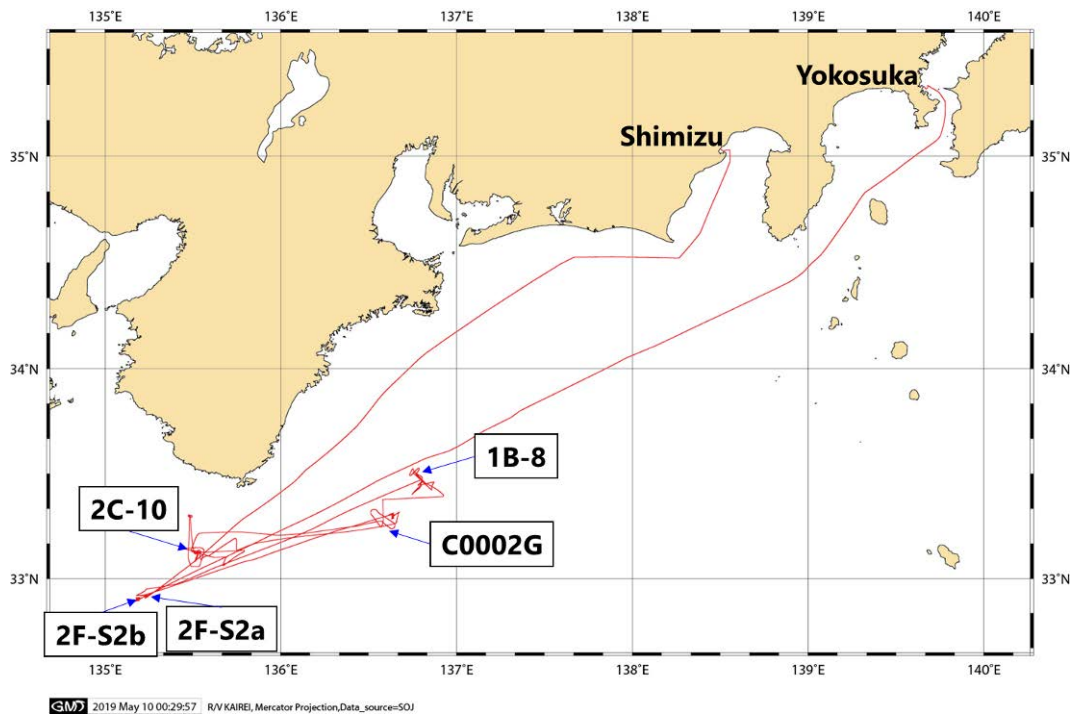
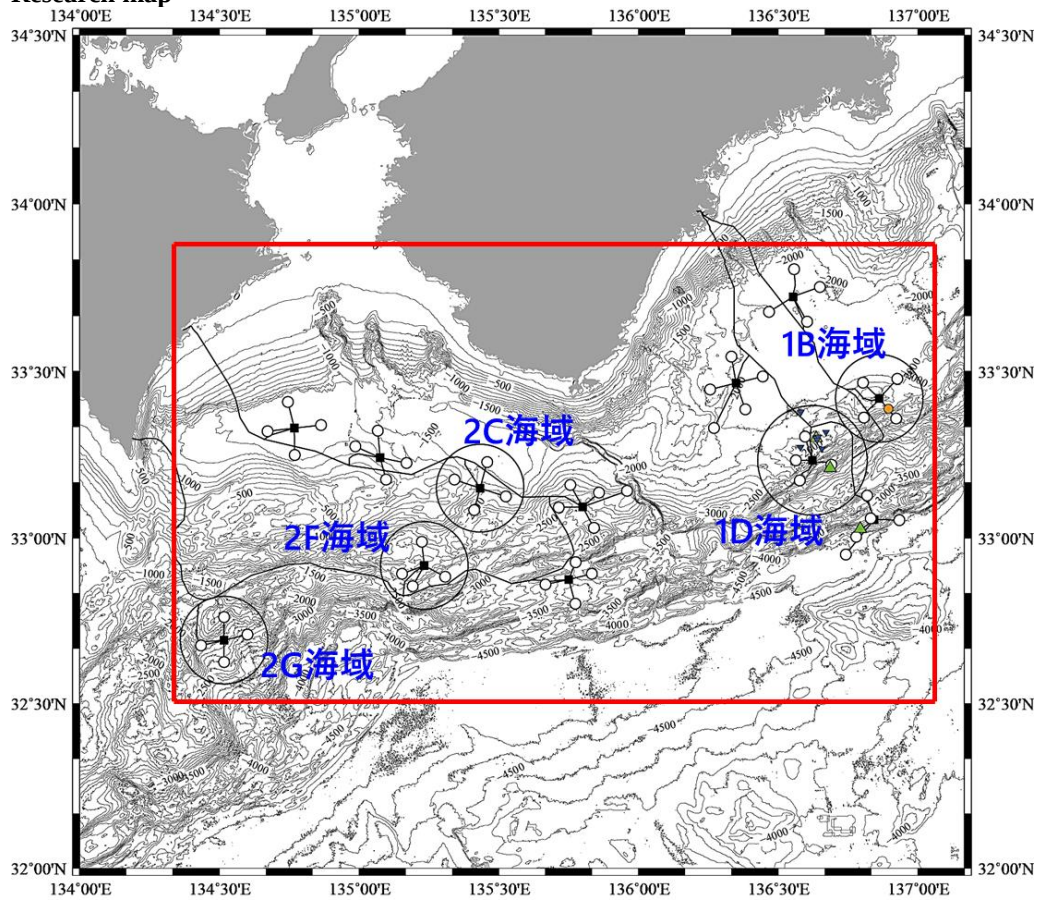
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1. Cruise Information

Cruise ID:	KR19-03
Name of vessel:	Kairei
Title of cruise:	Real time ocean bottom crustal movement observation
Representative of the Science Party [Affiliation]	
	Shuichi Kodaira [JAMSTEC]
Chief Scientist [Affiliation]:	Shuhei Nishida [JAMSTEC]
Boarding Scientist	Toshinori Kimura [JAMSTEC]
	Yuya Machida [JAMSTEC]
	Toshimasa Nasu [NME]
	Taro Shirai [NME]
Cruise period:	Apr. 30th, 2019 - May 10th, 2019
Ports of departure / arrival:	Shimizu / Sumitomo Heavy industries, Ltd. Yokosuka Works
Research area:	off Kii-suido, Kumano-nada

Research map



2. Research Proposal

JAMSTEC has been implementing the "Observation Project on wide area variation of ocean floor for building national resilience" since FY2017 in order to achieve the national mission of toughening the national land, securing people's safety and security. In this project, (1) development and deployment of ocean bottom crustal deformation observation technology based on the submarine cabled observation and monitoring system for earthquake and tsunami (DONET), using a pressure gauge, an inclinometer, a long-term borehole observation system installed in a borehole of "CHIKYU" deployed in the Nankai Trough. (2) High precision wide area survey of active submarine faults using three-dimensional seismic survey system of the ocean floor wide area research ship "KAIMEI" and etc., at Nankai Trough segment area, which is important for the evaluation of interactivity, and the Japan Trench outer rise area that may cause a tsunami earthquake. (3) Development and evaluation of more realistic simulation and transition prediction methods incorporating new survey and observation results obtained in (1) and (2) will be conducted. Through this, the prediction of the occurrence of huge earthquakes (Evaluation of urgency, scale and distribution) was imploded. In addition, the accuracy of tsunami inundation immediate prediction is improved by accurately estimating the epicenter area, its size, and the tsunami source immediately after the earthquake occurrence. The purpose is to realize disaster prevention and mitigation through these efforts.

3. Instruments

Figure 3-1 shows that the image of the in-situ calibration with the mobile pressure calibrator which is consist of a pressure measurement unit (PMU) and a level adjust unit. In order to realize the in-site calibration on ocean bottom, the PMU should reduce from environmental effect for the pressure sensor about pressure and temperature. And, the level adjust unit should measure the difference of level between the PMU to the pressure sensing system of DONET.

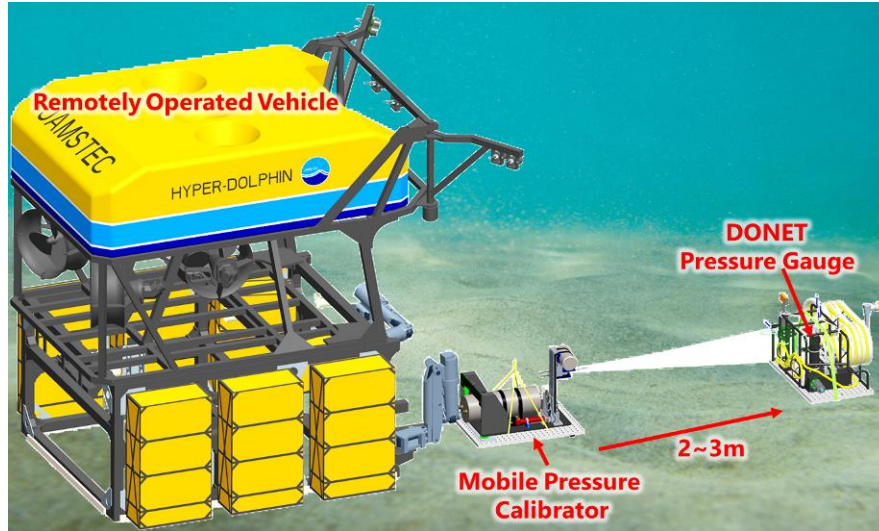


Fig.3-1 Concept image of in-situ calibration for bottom pressure gauge

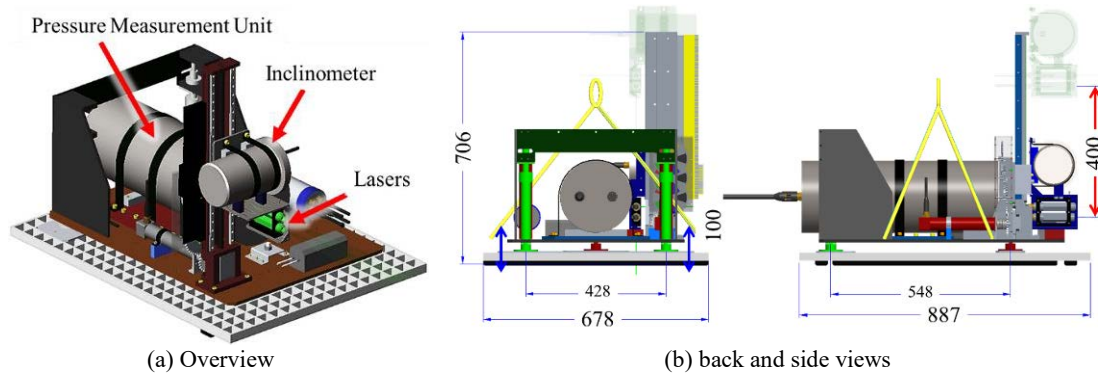


Fig.3-2 3D-CAD Images of level adjust unit

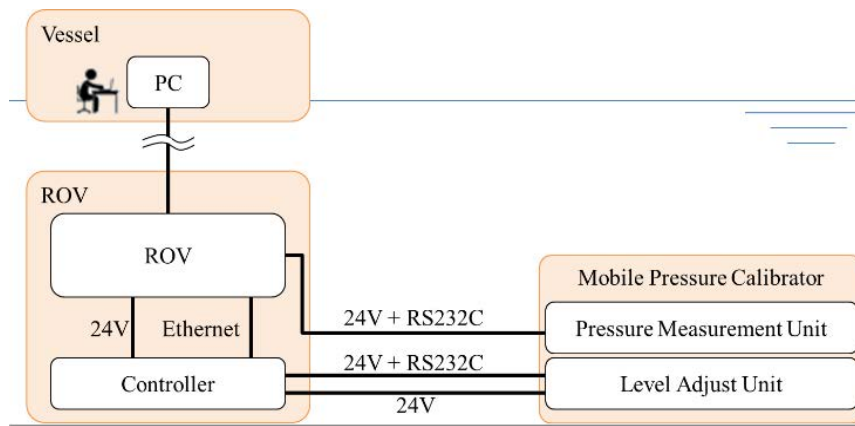


Fig.3-3 Interface connection diagram of mobile pressure calibrator

4. Activities and Results

The purpose of this research is the real time sea floor observation for crustal deformation based on submarine cabled monitoring system for the earthquake and tsunami (DONET) deployed in the Nankai Trough using various sensors, such as pressure gauges, inclinometers and borehole observation system.

In this expedition KR19-03, in-situ calibration, bottom sediment bearing strength investigation and OBSs recovery were carried out.

(1) In-Situ Calibration

The measurement was done at 2C-10 and 1B-8. Figure 4-1 shows the pictures taken before diving. The payloads were mounted in front of the ROV Kaiko shown in picture 4-1 (a) and (b).

Figure 4-2 shows pictures taken during the measurement. In Fig.4-2(a), the pressure gauge of DONET was shown on the upper left, and the mobile pressure calibrator was shown in the lower right. In this measurement, the calibrator was installed the position where the distance between them is about 2.5 m. As shown in Fig.4-2(b), the laser was irradiated to the black and white boundary of the cylinder in the pressure gauge, and the level was measured. At the same time, by subtracting the pressure corresponding to the difference of level from the pressure measured by the MPU, the desired value of DONET pressure gauge can be obtained.

(2) Bearing strength investigation about bottom sediment

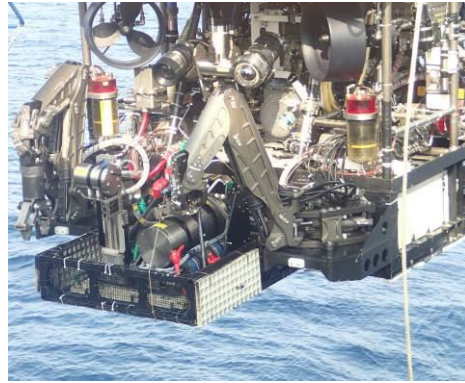
Two dive of Kaiko was carried out to investigate that the bottom sediment has enough strength for landing BMS (Boring Machine System). Figure 4-3 shows that a survey of bearing capacity. The rod under the weight was supported without penetrating into sediment.

(3) OBSs recovery

Ten OBSs (self-surfacing type ocean bottom seismometer) were recovered during this cruise. Six OBSs and Four OBSs were deployed during YK18-14 and CK18-04 cruise on November 2018, respectively. Also, Four OBSs deployed during CK18-04 were deployed by D/V Chikyu's ROV near the IODP C0002 riser drilling site. The OBSs (Katusjima-type) used 4.5 Hz type three component gimbal mounted geophones and 24 bit digital recording system with 100 Hz sampling rate. Long-term batter pack, for more than ten months continuous recording, was used for the OBSs. Fig.4-4 shows location map of the OBSs. Table 4-1 shows positions of the OBSs calibrated by acoustic transducer determined during each cruise.

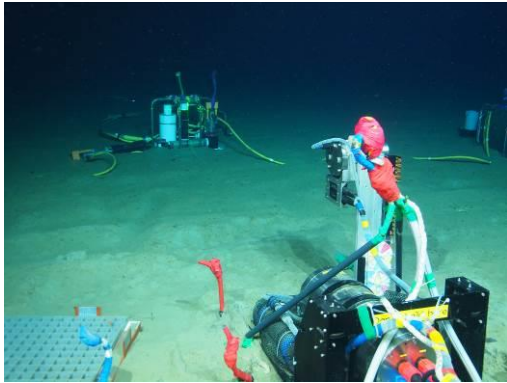


(a) mobile pressure calibrator with ROV Kaiko



(b) mobile pressure calibrator on basket for payload

Fig.4-1 Payload with the ROV



(a) Mobile Pressure Calibrator and DONET Pressure Sensor



(b) Laser projected on DONET water pressure gauge

Fig.4-2 Overview of in-situ pressure calibration operation

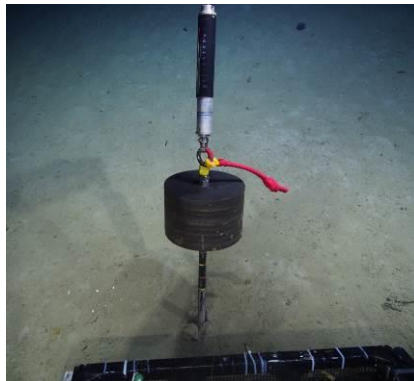


Fig.4-3 measurement equipment for bearing force of bottom sediment

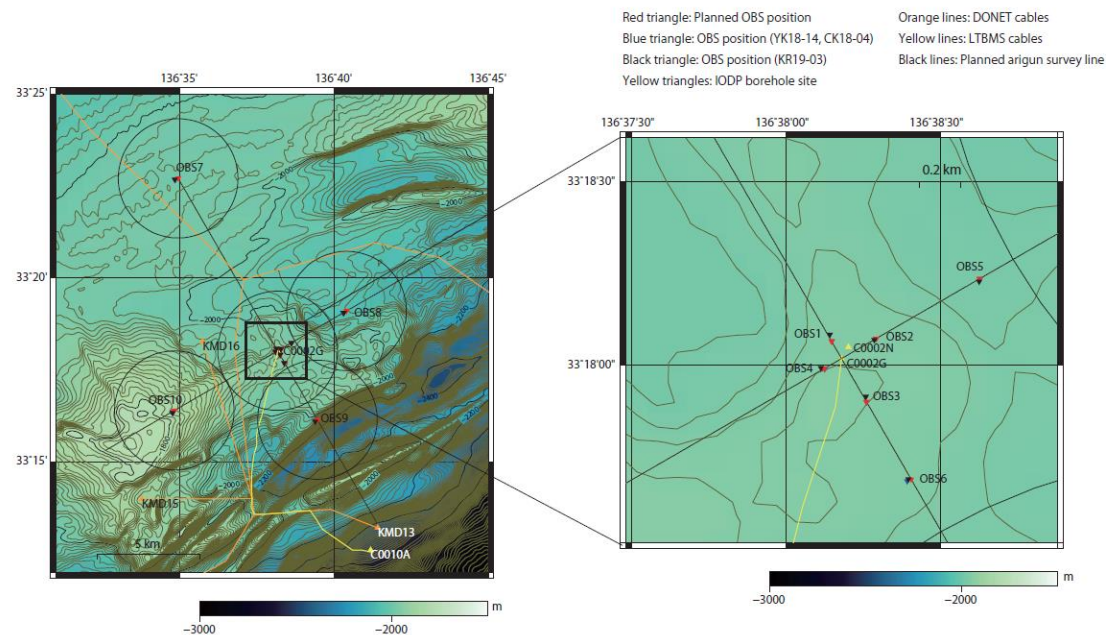
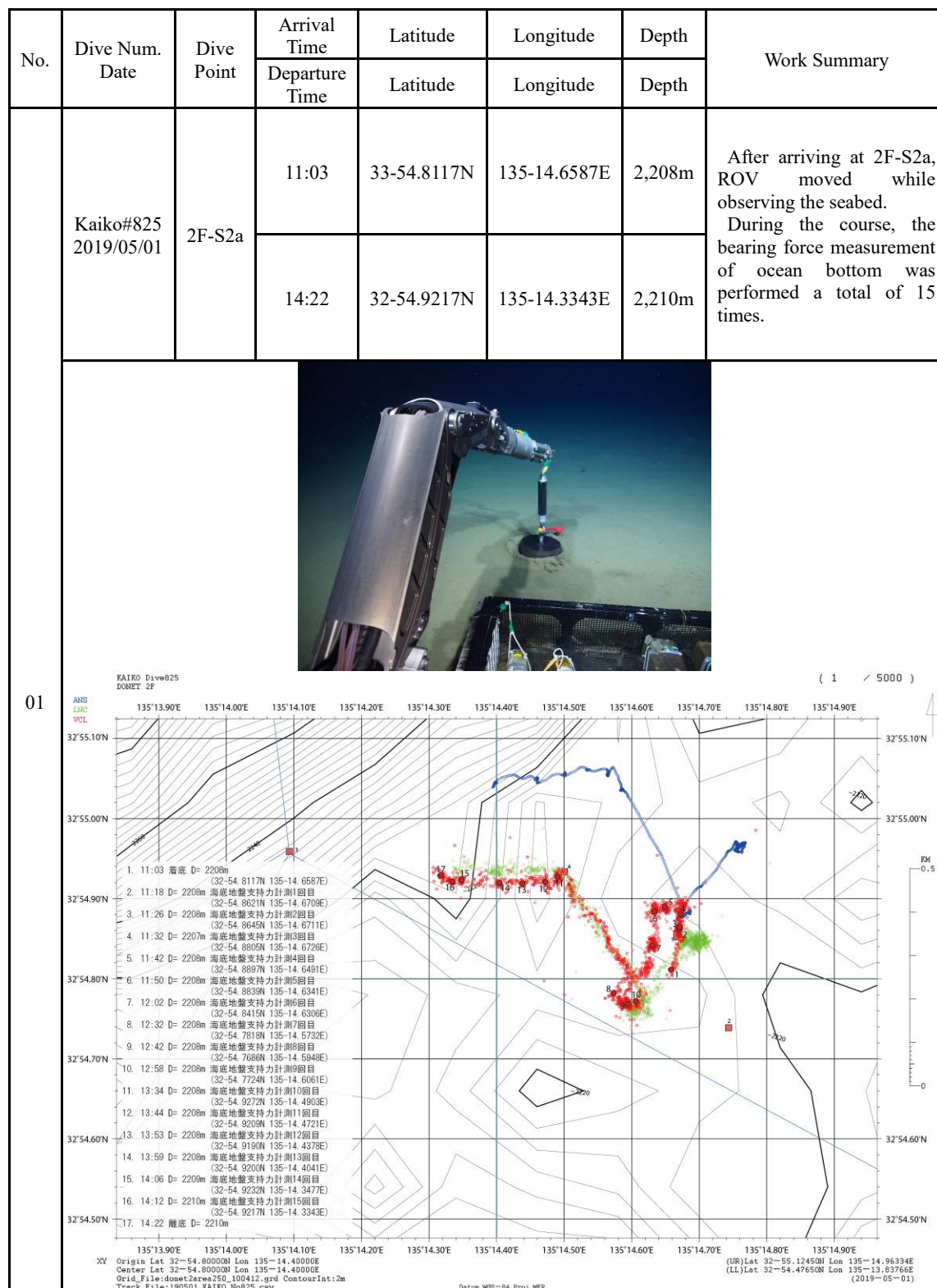


Fig.4-4 Location map of OBSs. (Left) all OBSs. (Right) 6 OBSs deployed around the C0002 site.

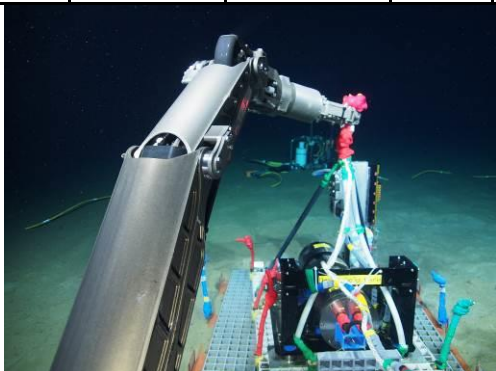
Table 4-1. OBS deployment and recovery information.

Site	Deployment				Release command		Recovery			Calibrated position			Calibrated position			Calibrated position			Remarks
	Time UTC	Vessel position			Time UTC	Time UTC	Vessel position			S/V YOKOSUKA			D/V CHIKYU			R/V KAIREI			
		Lat(N)	Lon(E)	Depth(m)			Lat(N)	Lon(E)	Depth(m)	Lat(N)	Lon(E)	Depth(m)	Lat(N)	Lon(E)	Depth(m)	Lat(N)	Lon(E)	Depth(m)	
OBS1	2018/11/15 12:37:00	-	-	-	2019/05/02 00:33:15	2019/05/02 01:28:25	33_17.8742	136_38.1587	1943.0	-	-	-	33_18.0670	136_38.1497	1944.0	33_18.0844	136_38.1433	1936.4	(*)2
OBS2	2018/11/16 05:55:00	-	-	-	2019/05/02 01:34:37	2019/05/02 02:29:28	33_17.8876	136_38.3119	1944.0	-	-	-	33_18.0735	136_38.2932	1944.0	33_18.0701	136_38.2872	1949.6	(*)2
OBS3	2018/11/16 04:44:00	-	-	-	2019/05/01 22:28:10	2019/05/01 23:25:04	33_17.7117	136_38.2506	1947.0	-	-	-	33_17.9010	136_38.2621	1942.0	33_17.9160	136_38.2601	1937.8	(*)2
OBS4	2018/11/15 13:01:00	-	-	-	2019/05/01 23:29:38	2019/05/02 00:26:50	33_17.7796	136_38.1225	1949.0	-	-	-	33_17.9913	136_38.1266	1941.0	33_17.9942	136_38.1136	1942.7	(*)2
OBS5	2018/11/01 21:47:49	33_18.3073	136_38.6933	1973.3	2019/05/02 03:45:51	2019/05/02 04:38:25	33_18.0535	136_38.6131	1956.0	33_18.2368	136_38.6296	1973.7	-	-	-	33_18.2289	136_38.6270	1983.6	(*)1
OBS6	2018/11/01 21:15:01	33_17.7641	136_38.4809	1954.9	2019/05/01 21:28:50	2019/05/01 22:20:52	33_17.4594	136_38.3276	1964.0	33_17.6864	136_38.3940	1957.5	-	-	-	33_17.6920	136_38.3974	1961.8	(*)1
OBS7	2018/11/01 16:26:32	33_22.7423	136_34.9518	1998.0	2019/05/06 00:51:00	2019/05/06 01:46:00	33_22.6615	136_34.9683	1993.0	33_22.6698	136_34.8666	1992.7	-	-	-	33_22.6709	136_34.8508	2000.8	(*)1
OBS8	2018/11/01 17:47:01	33_19.1477	136_40.4183	2059.7	2019/05/02 04:56:33	2019/05/02 05:51:53	33_18.8669	136_40.3027	2044.0	33_19.0532	136_40.3004	2049.9	-	-	-	33_19.0538	136_40.3245	2104.7	(*)1
OBS9	2018/11/01 18:56:27	33_16.1867	136_39.4713	2041.3	2019/05/02 06:15:47	2019/05/02 07:15:21	33_15.8657	136_39.2452	2081.0	33_16.0986	136_39.4047	2040.7	-	-	-	33_16.0968	136_39.3989	2061.6	(*)1
OBS10	2018/11/01 20:03:27	33_16.4346	136_34.8464	1823.3	2019/05/05 23:07:45	2019/05/06 00:01:52	33_16.2755	136_34.8553	1824.0	33_16.3492	136_34.7848	1823.6	-	-	-	33_16.3326	136_34.7789	1827.3	(*)1
		... SEG-Y Header Position																	
Remarks																			
	(*)1 Deployed by S/V Yokosuka																		
	(*)2 Deployed by D/V Chikyu's ROV. Positions were calibrated by the ROV during deployment.																		

5. Dive Information of ROV Kaiko



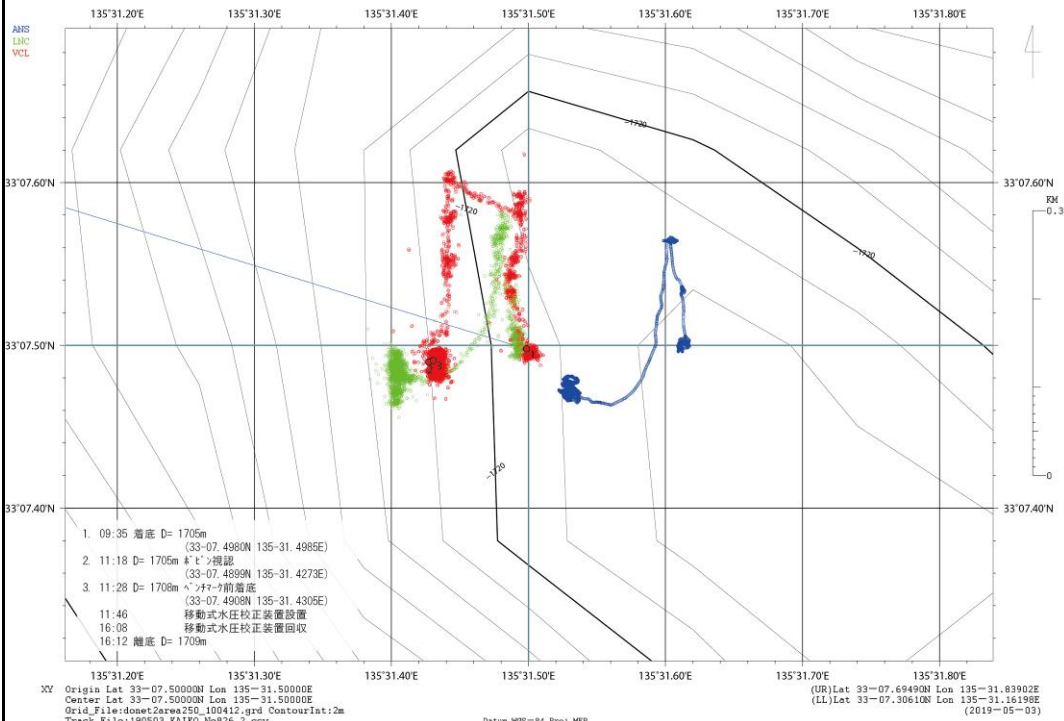
No.	Dive Num. Date	Dive Point	Arrival Time	Latitude	Longitude	Depth	Work Summary
			Departure Time	Latitude	Longitude	Depth	
	Kaiko#826 2019/05/03	2C-10	09:35	33-07.4980N	135-31.4985E	1,705m	After reaching in front of the DONET 2C-10 pressure sensing system, a mobile pressure calibrator was deployed on benchmark. And then the level difference with the DONET pressure sensor system and the pressure was measured using the mobile pressure calibrator.
			16:12	33-07.4908N	135-31.4305E	1,705m	



KAIKO Dive#826
KIISUIDO DONET 2C-10

(1 / 3000)

02



ANS
LMC
VCL

135°31.20'E 135°31.30'E 135°31.40'E 135°31.50'E 135°31.60'E 135°31.70'E 135°31.80'E

33°07.60'N
33°07.50'N
33°07.40'N

1. 09:35 離底 D= 1705m
(33-07.4980N 135-31.4985E)
2. 11:18 D= 1705m # t>確認
(33-07.4899N 135-31.4273E)
3. 11:28 D= 1708m # フレ-9前着底
(33-07.4908N 135-31.4305E)
11:46 移動式水圧校正装置設置
16:08 移動式水圧校正装置回収
16:12 離底 D= 1709m

XY Origin Lat 33-07.50000N Lon 135-31.50000E
Center Lat 33-07.50000N Lon 135-31.50000E
Grid_File:donet2area250_100412.grd ContourInt:2m
Track_File:190503_KAIKO_No826_2.csv

(UR)Lat 33-07.69490N Lon 135-31.83902E
(LL)Lat 33-07.30610N Lon 135-31.16198E
(2019-05-03)

Datum WGS-84 Proj. MER

No.	Dive Num. Date	Dive Point	Arrival Time	Latitude	Longitude	Depth	Work Summary
			Departure Time	Latitude	Longitude	Depth	
03	Kaiko#827 2019/05/04	2C-10	09:26	33-07.4767N	135-31.4330E	1,708m	After reaching in front of the DONET 2C-10 pressure sensing system, a mobile pressure calibrator was deployed. And then the level difference with the DONET pressure sensor system and the pressure was measured using the mobile pressure calibrator
			15:24	33-07.4767N	135-31.4330E	1,709m	

KAIKO Dive#827
KIISUIDO DONET 2C-10

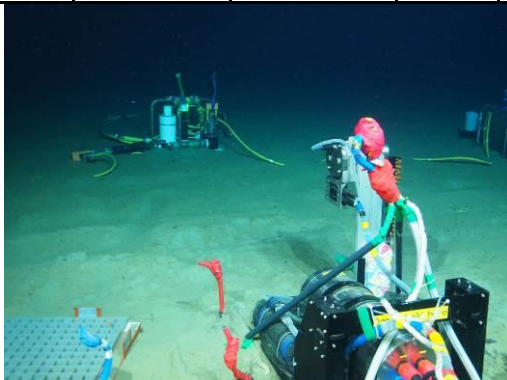
(1 / 3000)

ANS
LBC
VCL

1. 09:26 着底 D= 1708m
(33-07.4767N 135-31.4330E)
移動式水圧校正装置設置
09:34
14:23 1点目計測開始
14:35 1点目計測終了
14:37 2点目計測開始
14:47 2点目計測終了
14:51 3点目計測開始
15:02 3点目計測終了
15:04 4点目計測開始
15:15 4点目計測終了
15:23 移動式水圧校正装置回収
15:24 離底 D= 1709m

XY Origin Lat 33-07.50000N Lon 135-31.50000E
Center Lat 33-07.50000N Lon 135-31.50000E
Grid File: donet2cwa250_100412.grd ContourInt: 2m
Track File: 190504_KAIKO_80827.csv
Datum WGS-84 Proj: MER
(UR) Lat 33-07.69490N Lon 135-31.83902E
(LL) Lat 33-07.30610N Lon 135-31.16198E
(2019-05-04)

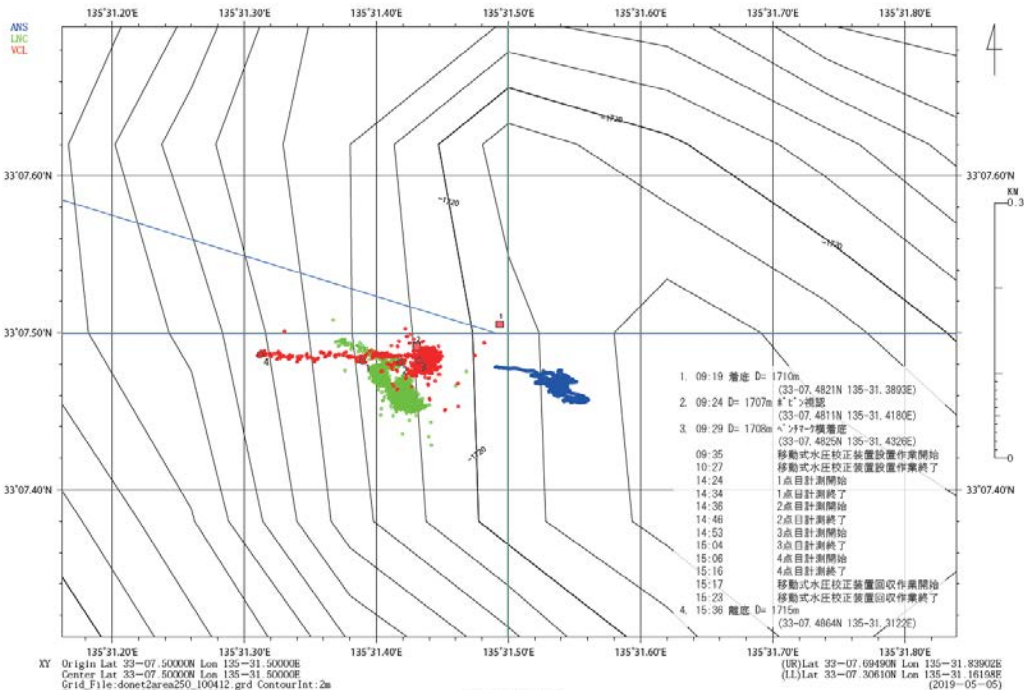
No.	Dive Num. Date	Dive Point	Arrival Time	Latitude	Longitude	Depth	Work Summary
			Departure Time	Latitude	Longitude	Depth	
	Kaiko#828 2019/05/05	2C-10	09:19	33-07.4821N	135-31.3893E	1,710m	After reaching in front of the DONET 2C-10 pressure sensing system, a mobile pressure calibrator was deployed. And then the level difference with the DONET pressure sensor system and the pressure was measured using the mobile pressure calibrator
			15:36	33-07.4864N	135-31.3122E	1,715m	



KAIKO Dive#828
K11SU1D0 DONET 2C-10

(1 / 3000)

04



ANS
LWC
WCL

1. 09:19 着底 D= 1710m
(33-07.4821N 135-31.3893E)

2. 09:24 D= 1707m # "t">確認
(33-07.4811N 135-31.4180E)

3. 09:29 D= 1708m ^ ">FF-9観測器
(33-07.4825N 135-31.4326E)

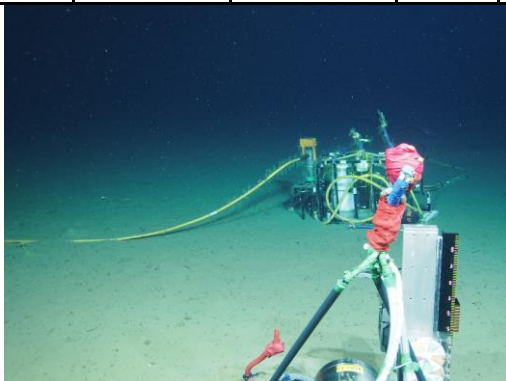
移動式水圧校正装置設置作業開始
移動式水圧校正装置設置作業終了
1点目計測開始
14:34 1点目計測終了
14:36 2点目計測開始
14:46 2点目計測終了
14:53 3点目計測開始
15:04 3点目計測終了
15:06 4点目計測開始
15:16 4点目計測終了
移動式水圧校正装置回収作業開始
移動式水圧校正装置回収作業終了
4. 15:36 離底 D= 1715m
(33-07.4864N 135-31.3122E)

XY Origin Lat: 33-07.50000N Lon: 135-31.50000E
Center Lat: 33-07.50000N Lon: 135-31.50000E
Grid File: donet2area250_100412.grd ContourInt: 2m
Track File: 190505_KAIKO_No828.csv

Date: WGS-84 Proj: NED

(U) Lat: 33-07.69459N Lon: 135-31.83902E
(L) Lat: 33-07.30610N Lon: 135-31.16198E
(2019-05-05)

No.	Dive Num. Date	Dive Point	Arrival Time	Latitude	Longitude	Depth	Work Summary
			Departure Time	Latitude	Longitude	Depth	
	Kaiko#829 2019/05/07	1B-8	09:53	33-28.0279N	136-48.1754E	1,912m	After reaching in front of the DONET 1B-8 pressure sensing system, a mobile pressure calibrator was deployed. And then the level difference with the DONET pressure sensor system and the pressure was measured using the mobile pressure calibrator
			15:39	33-27.9643N	136-48.1574E	1,911m	



KAIKO Dive#829
ROMANONADA DONET 1B-8

(1 / 3000)

05

4

ANS
LPG
WCL

1. 09:53 着底 D= 1912m
(33-28.0279N 136-48.1754E)

2. 10:07 D= 1909m 4' 1" 観測
(33-27.9621N 136-48.1677E)

3. 10:13 D= 1911m 圧力計A-C 計測 前着底
(33-27.9643N 136-48.1574E)

10:22 移動式水圧校正装置設置作業開始

11:41 移動式水圧校正装置設置作業終了

12:16 移動式水圧校正装置再設置作業開始

14:32 1点目計測開始

14:42 1点目計測終了

14:46 2点目計測開始

14:55 2点目計測終了

15:08 3点目計測開始

15:18 3点目計測終了

15:21 4点目計測開始

15:31 4点目計測終了

15:34 移動式水圧校正装置回収作業開始

15:39 移動式水圧校正装置回収作業終了

15:59 離底 D= 1911m

XY Origin Lat: 33-28.00000N Lon: 136-48.20000E
Center Lat: 33-28.00000N Lon: 136-48.20000E
Grid File: donet2area250_100412.grd ContourInt: 2m
Track File: 190507_KAIKO_8029.csv

Date: WGS-84 Proj: MGRS

(00) Lat: 33-28.19490N Lon: 136-48.54034E
(11) Lat: 33-27.90610N Lon: 136-47.86066E
(2019-05-07)

05

6. 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.

Users of information on this report are requested to submit Publication Report to JAMSTEC.

<http://www.godac.jamstec.go.jp/darwin/explain/1/e#report>

E-mail: submit-rv-cruise@jamstec.go.jp