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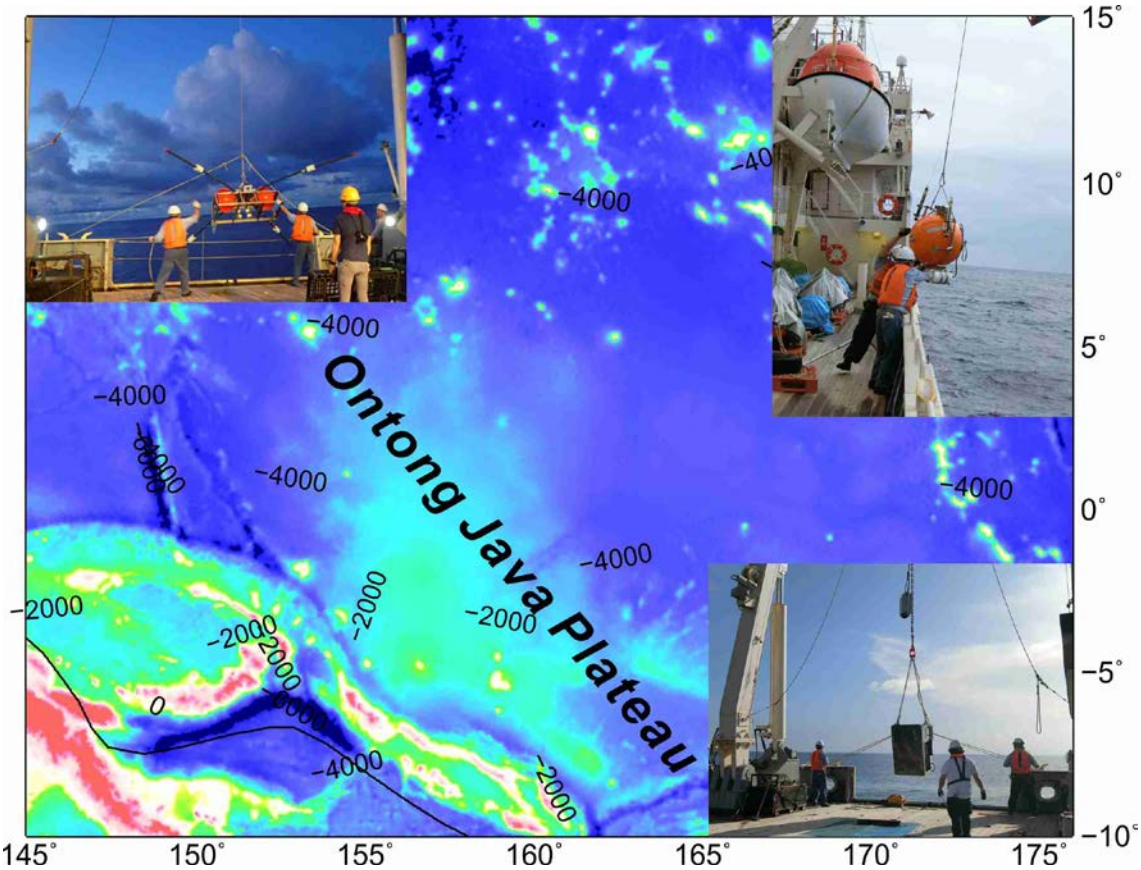
HAKUHO-MARU KH-17-J01
LEG1&LEG2 Cruise Report



Seafloor observation for crust and mantle structure beneath the Ontong Java Plateau

Jan. 9-Feb. 23, 2017

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

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1. Cruise Information

●Cruise code: KH-17-J01 LEG1 and LEG2

●Vessel: R/V HAKUHO MARU

●Cruise title: Seafloor observation for crust and mantle structure beneath the Ontong Java Plateau

●Chief Scientist:
Daisuke Suetsugu (LEG1), Director, Department of Deep Earth Structure and Dynamics Research
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Noriko Tada (LEG2), Research scientist, Department of Deep Earth Structure and Dynamics Research, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

●Representative of the Science Party
Daisuke Suetsugu (JAMSTEC)
Takashi Sano (National Museum of Nature and Science)

●Research titles

1. Seafloor observation for crust and mantle structure beneath the Ontong Java Plateau (D. Suetsugu)
2. Plume model has not explained genesis of Ontong Java Plateau, yet: importance for dredge of deeper igneous rocks (T. Sano)

● Cruise period: Jan. 9~Feb. 5, 2017

LEG1: Jan. 9~Feb. 5, 2017;   LEG2: Feb. 7~Feb. 23, 2017

● Ports of departure: Odaiba Liner, Tokyo, Japan

Port call: Pohnpei Island, Federated States of Micronesia

Port of arrival: Ariake MP, Tokyo, Japan

● Research area: 10°S-10°N, 150°E-175°E

● Research Map

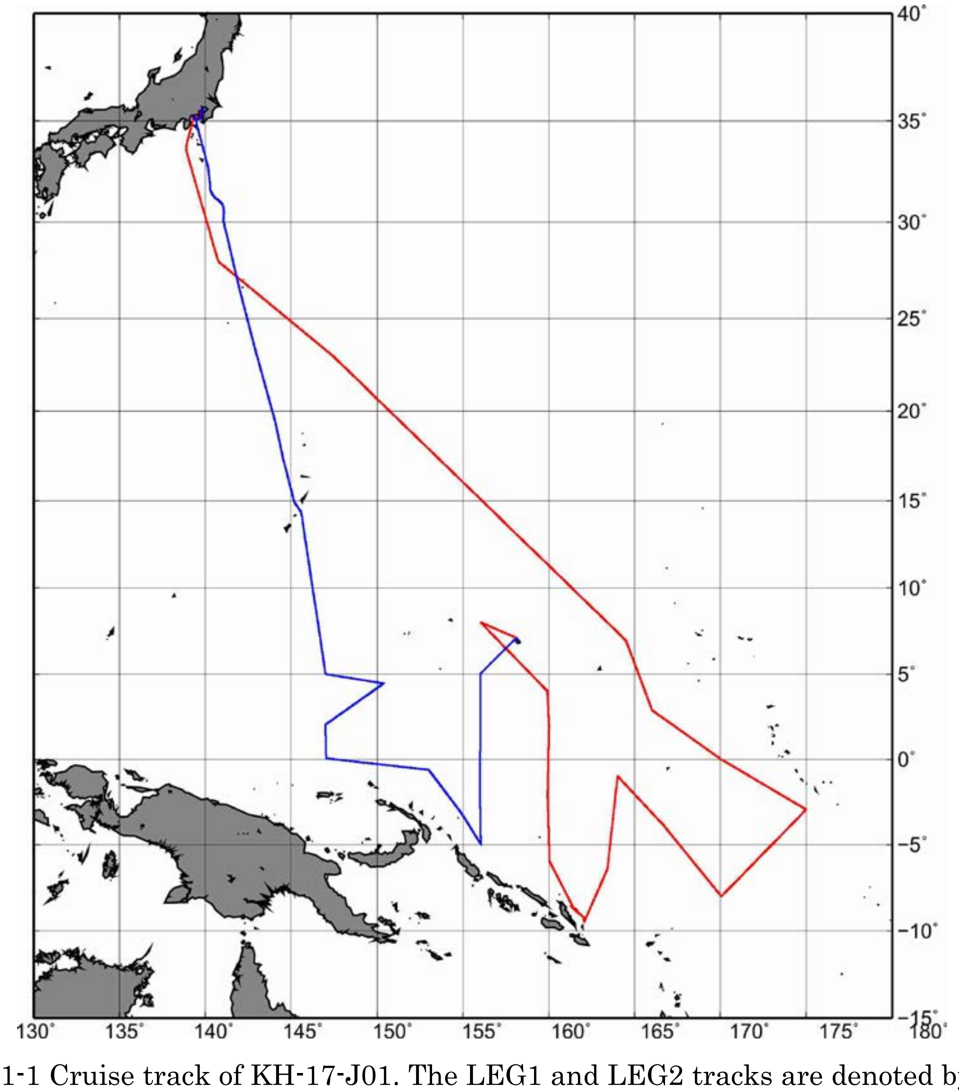

Fig. 1-1 Cruise track of KH-17-J01. The LEG1 and LEG2 tracks are denoted by red and blue lines, respectively.

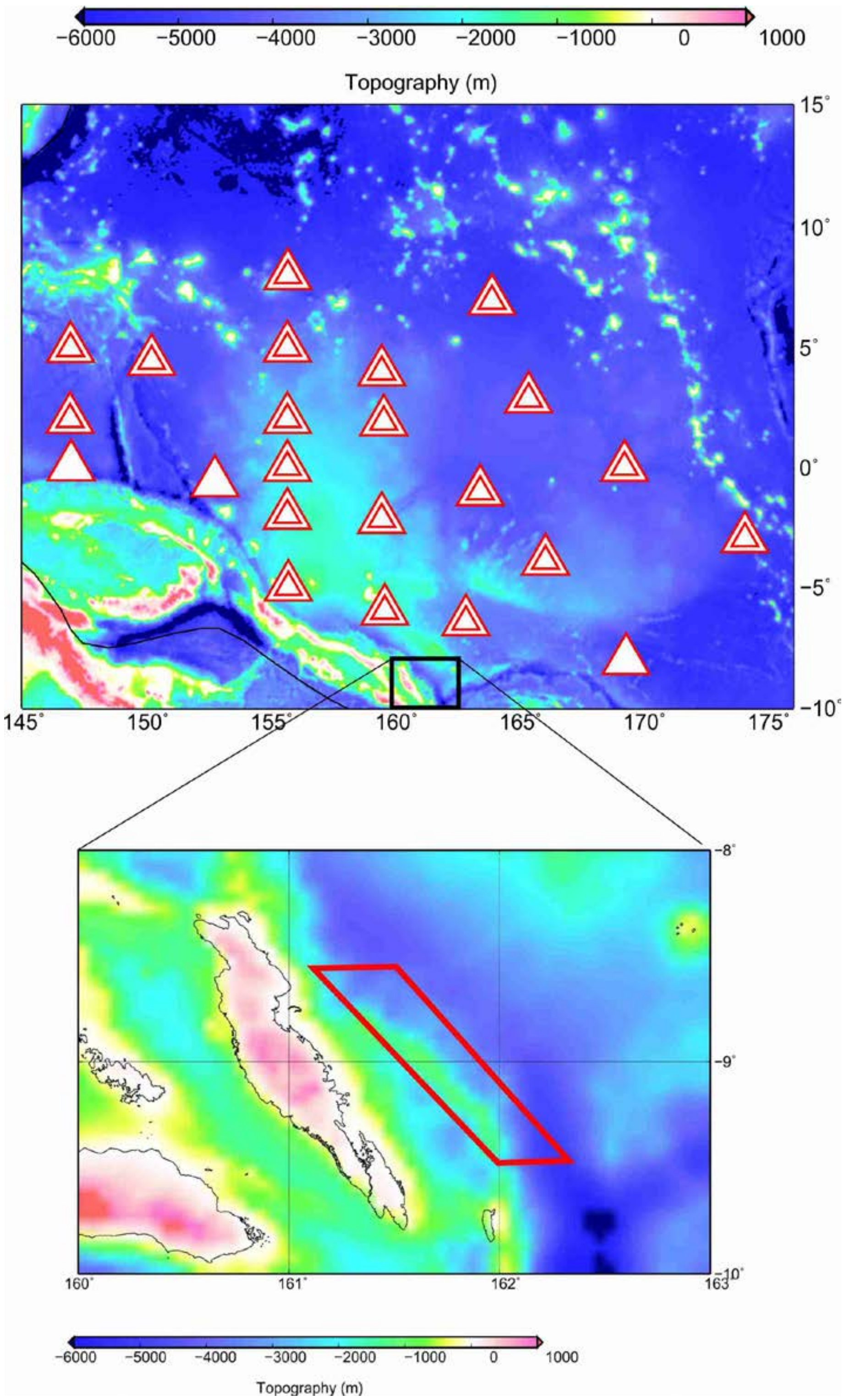

Fig. 1-2 Observation area. (top) Triangle: Location of Ocean Bottom Seismograph (OBS); Double triangle: Location of OBS and Ocean Bottom Electromagnetometer (OBEM); (bottom) Red quadrangle: Area of rock sampling with a dredge

2. Background, purpose, and summary of the research cruise

The Ontong Java Plateau (OJP) is the most voluminous Large Igneous Province on the oceanic region of the Earth, which was emplaced at 120 million years ago by massive eruptions. The volcanic eruption gave major environmental impacts, such as global climate change. However, the cause of the eruption remains to be controversial mainly due to a lack of information on the crust and mantle structure beneath the OJP and a lack of igneous rock samples from a deep part of the OJP crust. The missions of the project are (1) to determine the crust and mantle structure beneath the OJP with an unprecedented accuracy using ocean bottom observation; (2) Sampling of igneous rocks that represents the OJP crust. For the first mission, we deployed 23 ocean bottom seismographs (OBSs) and 20 ocean bottom electromagnetometers (OBEMs) on the seafloor in and around the OJP during the LEG1 and LEG2 of the MR14-06 cruise.

The major mission of the KH-17-J01 cruise (LEG1 and LEG2) is to recover all of the OBS and OBEM that were deployed by the MR14-06 cruise. The OBS and OBEM can continuously record an electromagnetic field and ground motions due to natural earthquakes that took place over the globe from 2014 to 2016. The data are stored in the ocean bottom instruments. We have successfully recovered all of the OBS and OBEM in the KH-17-J01 cruise. The data will be used to determine three-dimensional seismic and electrical conductivity structure, respectively. Surface wave tomography will be performed to obtain three-dimensional upper mantle structure; Body wave tomography will be conducted to obtain three-dimensional mantle structure deeper than that resolved by the surface wave tomography. Receiver function analyses will be employed to determine a thickness of the OJP crust, the lithospheric plate, and the mantle transition zone beneath the OJP.

Another mission of the KH-17-J01 cruise is to perform rock sampling on the seafloor by dredge. While mineralogical composition of the OJP is a key to elucidate the origin of the OJP, it has not been understood well, mainly because the igneous rocks have been taken only surficial part of the OJP crust by past drilling projects. We aim to collect rock samples off northeastern coast of Malaita Island, which is thought to be a deep part of the OJP crust. During the KH-17-J01 cruise, we could obtain various igneous rocks in the region for the first time. The samples will be used to obtain wide range of information on the OJP crust: petrological composition, age, source depth of the OJP crust. We also obtained bathymetry data with multi-beam echo sounding survey and gravity and magnetic data measured along the cruise track, which should be useful to understand general tectonics of the studied region. Combining the information from the seismological, electromagnetic studies with petrological and geochemical studies, we will be able to constrain the origin and formation process of the OJP.

3. List of participants

Principal Investigator: Dr. Daisuke Suetsugu

Director, Department of Deep Earth Structure and Dynamics Research

Japan Agency for Marine-Earth Science and Technology

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Table 3-1. Science party

Name	Affiliation	Appointment	Cruise Leg
Daisuke Suetsugu	Japan Agency for Marine-Earth Science and Technology	Chief scientist of LEG1 Director, scientist	LEG1
Takashi Sano	National Museum of Nature and Science	Co-Chief scientist of LEG1 Group leader	LEG1
Noriko Tada	Japan Agency for Marine-Earth Science and Technology	Chief Scientist of LEG2 Research scientist	LEG2
Hiroko Sugioka	Graduate School of Kobe University	Co-Chief Scientist of LEG2 Associate professor	LEG1, LEG2
Aki Ito	Japan Agency for Marine-Earth Science and Technology	Research scientist	LEG1
Hajime Shiobara	Earthquake Research Institute, the University of Tokyo	Professor	LEG2
Kenichiro Tani	National Museum of Nature and Science	Scientist	LEG1
Maria Luisa Tejada	Japan Agency for Marine-Earth Science and Technology	Scientist	LEG1
Akira Ishikawa	The University of Tokyo	Assistant professor	LEG1
Kiyoshi Baba	Earthquake Research Institute, the University of Tokyo	Assistant professor	LEG1
Hiroshi, Ichihara	Kobe University	Lecturer	LEG1
Takeshi Hanyu	Japan Agency for Marine-Earth Science and Technology	Senior scientist	LEG1
Takumi Kobayashi	Graduate School of Kobe	Graduate student	LEG1

	University		
Shoka Shimizu	Graduate School of Chiba University	Graduate student	LEG1
Yukihiko Nakano	Marine Work Japan Ltd.	Technical staff	LEG1
Yuji Fuwa	Marine Work Japan Ltd.	Technical staff	LEG1
Takehiro Kanii	Marine Work Japan Ltd.	Technical staff	LEG1
Toyonobu Ota	TIERRA TECNICA Ltd.	Technical staff	LEG2

Photo 3-1. Researchers and crew of the KH-17-J01 LEG1.

Photo 3-2. Researchers and crew of the KH-17-J01 LEG2.

4. Recovery of ocean bottom seismograph

4-1. Personnel

H. Sugioka (Graduate school of Kobe University) (LEG1, LEG2)

A. Ito (Japan Agency for Marine-Science and Technology) (LEG1)

H. Shiobara (Earthquake Research Institute, the University of Tokyo) (LEG2)

T. Kobayashi (Kobe University)

D. Suetsugu, PI (Japan Agency for Marine-Science and Technology) (LEG1)

4-2. Objectives

The seafloor observation with OBS had been performed to record seismograms from earthquakes over the globe for determination of the crust and mantle structure beneath the Ontong Java Plateau. The recovered data will be used in seismic tomography, receiver function method, and S-wave splitting analysis to elucidate three-dimensional seismic velocity structure, thickness of crust and depths of lithosphere-asthenosphere boundary, the 410-km discontinuity, and the 660-km discontinuity.

4-2. Specification and data of recovered OBS

The OBS system had been developed as an instrument with high mobility and sustainability at the seafloor under the Ocean Hemisphere network Project from 1996 to 2001 (Fukao et al., 2001). The OBS system is autonomous in deployment by free falling down to the bottom and recovery by popping up to the surface by itself. All of the seismic instrument components including sensor (CMG-3T, Guralp Systems Ltd), data logger (LS-9100, Hakusan Co), transponder (SI-2, Kaiyo Denshi Co.) and batteries (Lithium cells) are packed into a 65-cm diameter titanium alloy pressure housing, which allows for a maximum operating depth of 6000 m. We have conducted several large-scale and long-term seismic experiments in the Pacific since 1999, which more than 150 OBS systems are deployed arraying seismic seafloor network.

In this cruise, we recovered 23 OBSs spread above the Ontong Java Plateau, which had been deployed in 2014 to 2015 during the MR14-06 cruise in November of 2014 to January of 2015 and had been ended recording by a timer for 630 days continuous observation (Figure 4-1). The information of the OBS at each site is listed in Table 4-1.

There are two clock types set inside the recorder of LS-9100, which are different in precision. One has an atomic clock of CSAC whose accuracy is less than ±0.0003 ppm a month, which corrected at every 12 hours a quartz clock of TCXO, whose accuracy is ±1ppm a year. We arranged the OBS with the CSAC at almost regular interval in the network. Actually the drifting time corrected by the CSAC was just around 0.2 s in 800 days from the deployment to the recovery. The OBS at sites of O2, O6, O8, O11 and O14 and the OBEM at site of O16 has have a built-in differential pressure gauge (DPG) as a part of the instruments in order to improve quality of data (Araki and Sugioka, 2009). The DPG has a sensitivity of about 10000 counts/Pa in higher frequency shorter period than about 0.006 Hz. The OBSs at sites of O2, O6, O8, O11, O13 and O14 were equipped with longer anchor than normal one in order to improve their coupling with the ground, which is much effectively working in especially vertical component at frequencies of around 0.01 Hz in which infragravity waves are dominant as we have presented in our paper (Ito, Sugioka, and Araki, 2009). Figure 4-2 shows the power spectral densities as function of the time for the vertical and horizontal components at sites of O12 and O13 equipped without and with the longer anchor, respectively, which are chosen as closer sites each other for comparison, which tells that the longer anchor was effective to work on coupling with the ground in frequency of around 1 to 10 mHz. These frequency bands are dominant with the infragravity waves.

During this observation for 630 days, more than 800 earthquakes larger than magnitude (Mw and/or Ms) of 5.5 in the world as shown in Figure 4-1, some of whose were accompanied with large tsunami.

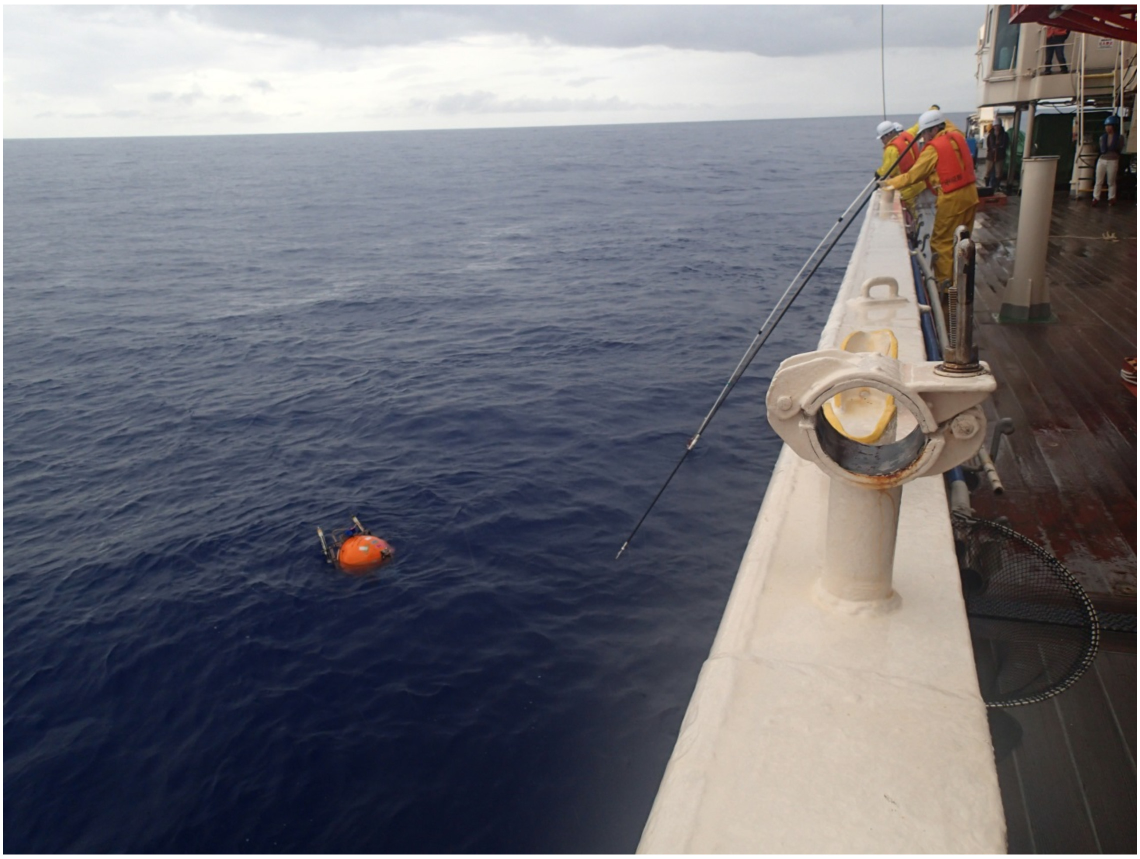

Photo 4-1. Recovery of OBS at the starboard.

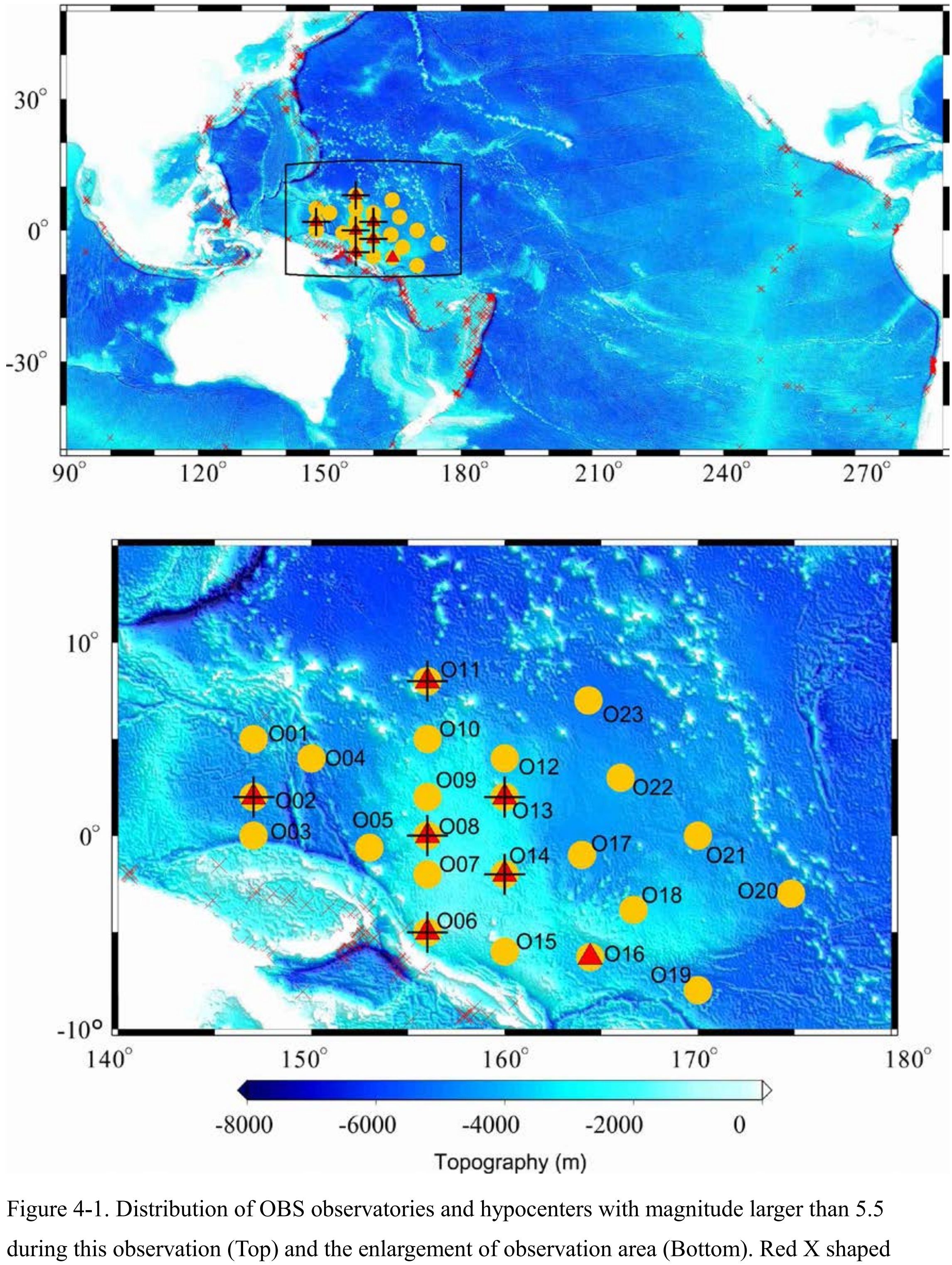

Figure 4-1. Distribution of OBS observatories and hypocenters with magnitude larger than 5.5 during this observation (Top) and the enlargement of observation area (Bottom). Red X shaped marks show hypocenters of earthquakes. Orange circles, black crosses and red triangles indicate the OBS and the differential pressure gauges, respectively. The OBS equipped with the long anchor were shown in black crosses. Background color shows topography in meter.

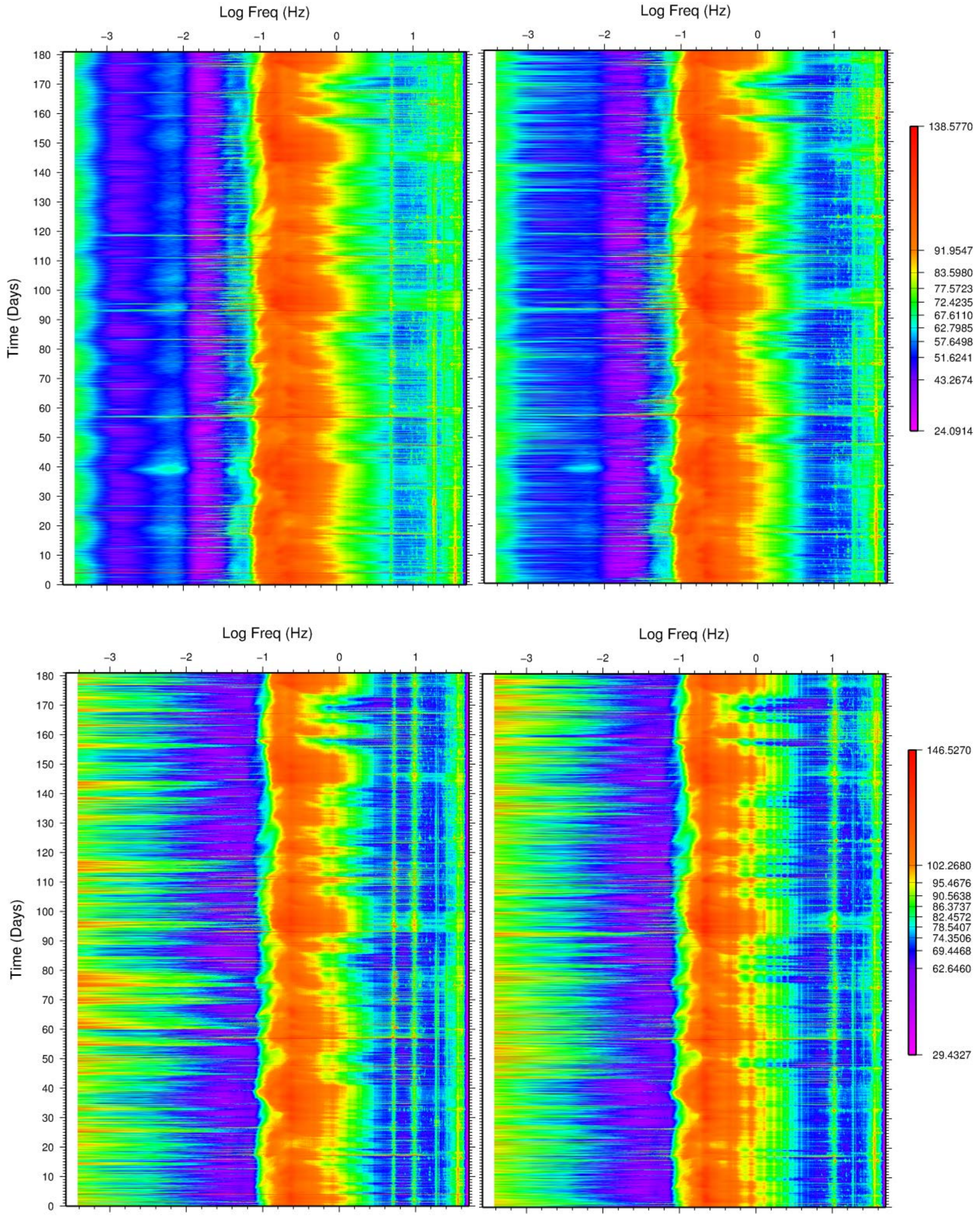

Figure 4-2. Power spectral densities with time for the vertical (Top) and the horizontal (Bottom) components of OBS at sites of O13 equipped with longer anchor (Left) and O12 (Right) for 6 months from February 1 to July 1 in 2015. Note that the longer anchor effectively worked on coupling with the ground at frequencies of 1-10 mHz especially in the vertical component, in which the infragravity waves is dominant.

Table 4-1. Descriptions of recovered OBS

Site Recovery Date	Location [deg.]	Depth [m]	Recording Period	Clock dt [s]*	S/N of CMG	Equipment
O1 2017/02/15	147.0005E 4.9957N	4275	2015/01/05 2016/09/27	TCXO −4.012	T3U46	-
O2 2017/02/13	146.9911E 2.0380N	4486	2015/01/06 2016/09/29	CSAC 1.500	T36768	L-Anchor DPG #11
O3 2017/02/13	147.0352E 0.0588N	4486	2015/1/8- 2016/10/1	TCXO 11.196	T3M57	-
O4 2017/02/14	150.3830E 4.4500N	3987	2014/12/16- - 2016/09/06	CSAC −7.573	T35594	-
O5 2017/02/11	153.0019E 0.6155S	4337	2014/12/9- 2016/8/31	TCXO 9.826	T3H79	-
O6 2017/02/10	156.0448E 4.9730S	1491	2014/12/25- 2016/9/15	CSAC −9.159	T3E28	L-Anchor DPG #7
O7 2017/02/09	155.9971N 1.9712S	1743	2014/12/26- 2016/9/17	TCXO 5.543	T3V33	-
O8 2017/02/09	156.0005E 0.0362S	1959	2014/12/28- 2016/9/20	CSAC −1.089	T3C11	L-Anchor DPG #8
O9 2017/02/08	156.0074E 2.0216N	2583	2014/12/30- 2016/9/22	CSAC −0.094	T35351	-
O10 2017/02/08	156.0128E 5.0093N	3608	2015/1/1- 2016/9/24	TCXO 1.964	T3F37	-
O11 2017/02/04	156.0245E 8.0129N	4875	2015/1/2- 2016/9/25	CSAC 0.947	T3C10	DPG #12
O12 2017/02/03	159.9176E 4.0016N	3756	2014/12/21- 2016/9/12	TCXO −8.056	T3V36	-
O13 2017/02/02	160.0164E 1.9263N	2948	2014/12/22- 2016/9/13	CSAC 0.281	T3X72	L-Anchor
O14 2017/02/01	159.9271E 2.1477S	2491	2014/12/23- 2016/9/14	CSAC 2.676	T3C12	L-Anchor DPG #4
O15 2017/01/31	160.0408E 5.9649S	1813	2014/12/6- 2016/8/27	TCXO −4.336	T3H55	-
O16	163.4168E	3558	2014/12/4-	CSAC	T36786	-

2017/01/27	6.4173S		2016/8/25	−0.706		
O17	164.0086E	4435	2014/11/28-	TCXO	T3D25	-
2017/01/25	0.9852S		2016/8/19	−1.407		
O18	166.7082E	3441	2014/11/27-	TCXO	T3C08	
2017/01/25	3.8879S		2016/8/18	0.213		
O19	170.0532E	4860	2014/11/23-	CSAC	T3D15	-
2017/01/23	8.0121S		2016/8/15	1.213		
O20	174.9907E	5077	2014/11/18-	CSAC	T3C05	-
2017/01/22	2.9458S		2016/8/10	−0.219		
O21	170.0046E	4458	2014/11/19-	TCXO	T33854	-
2017/01/20	0.0259N		2016/8/9	8.273		
O22	166.0263E	4309	2014/11/16-	CSAC	T3M66	-
2017/01/19	2.8711N		2016/8/7	0.277		
O23	164.4966E	5117	2014/11/15-	TCXO	T3D14	
2017/01/18	6.9544N		2016/8/6	13.131		

* 2 seconds of two leap seconds are subtracted from original measurement.

References

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5. Recovery of ocean bottom electromagnetometers

5-1. Personnel

Kiyoshi Baba (Earthquake Research Institute, The University of Tokyo) (LEG1)
Hiroshi Ichihara (Kobe University) (LEG1)
Takumi Kobayashi (Kobe University) (LEG1)
Daisuke Suetsugu (PI, Japan Agency for Marine-Earth Science and Technology) (LEG1)
Noriko Tada (Japan Agency for Marine-Earth Science and Technology) (LEG2)
Toyonobu Ota (Tierra Technica, Co., Ltd.) (LEG2)

5-2. Objectives

The mission of the marine electromagnetic (EM) observation team in this cruise is to recover 20 ocean bottom electromagnetometers (OBEMs). The OBEMs were deployed during the cruise, R/V MIRAI MR14-06 legs 1 and 2, in November 2015 to January 2016. The location of the sites is listed in Table 5-1 and shown on a map in Figure.1-2. The recovery work was done at the eastern 12 sites (O11–18, and O20–23) in LEG1 and at the western 8 sites (O1–2, O4, O6–10) in LEG2 (OBEM was not deployed at O3, O5, and O19).

5-3. Instrumentation

OBEM is an instrument to measure the time variation of the Earth's EM field. It also measures the instrumental tilt and temperature to correct the EM field data. We used different types of OBEM supplied by Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and Earthquake Research Institute (ERI), The University of Tokyo in this project. All OBEMs equip two-component electric dipoles with Ag-AgCl electrodes and a three-components flux-gate magnetic sensor for the EM field measurements. They also equip an acoustic transponder, an anchor release mechanics, a radio beacon and a flash light for the recovery work. The detailed specifications of each OBEM are listed in Tables 5-2 and 5-3. Photos 5-1a~e show the typical OBEMs.

5-4. Recovery work

Once we arrived at the observation site, we sent an acoustic signal from the ship to wake the OBEM up. Then, a command was sent to release its weight. It took ~3.5 to ~20 minutes to burn an Inconel wire (or a couple of stainless sheet) hanging the weight and start ascending. The slant range between the OBEM and the ship was measured during ascending. For these works, a hull acoustic transducer was available. However, at the sites where the water depth is around 5000 m, it was hard to detect the responses from the OBEMs probably because the matching between the acoustic deck unit and the hull transducer is insufficient. At the site O20, we used our own transducer hooked on the starboard side of the ship to send the weight-release command. The OBEMs, which mounts an acoustic transponder produced by Kaiyo Denshi Co., Ltd., utilized the built-in super short base line (SSBL) system on board the R/V HAKUHO MARU to provide real-time x, y, z position in the water column. By tracking the OBEMs, we could accurately predict their surface times and positions and quickly find them with the ship. The radio beacon and flash light mounted on the OBEM also helped for the search. The OBEMs release a small buoy with a 10-m long rope at the sea surface (Photo 5.1a). It makes easy to hook the OBEMs from the ship. However, the rope was not extended sufficiently rather twined around the frame in some cases. The OBEMs were hooked by crews on the starboard side of the ship and then they were passed around the stern and lifted on deck using the A-frame and a hoist (Photo 5.1b, c and d). The OBEM JM106 at O15 is smaller than the other OBEMs, and its pipes for the electric dipoles can be folded during the recovery. Therefore, it was lifted on the starboard side using the stretchable beam and a hoist (Photo 5.1e). The time process of the recovery work and the ascending rate of the OBEM for each site are listed in Table 5.4.

We compared the OBEM clock with a reference clock just after the recovery. The clock of a laptop PC was synchronized to UTC using GPS in advance, and then the OBEM time and PC time were compared five times (Table 5.5). The average time difference is used to correct the time stamp of the OBEM data in later analysis. The OBEM clock was alive powered by a back-up battery although the measurement had been stopped because of exhaustion of the main battery. We used an external power supply box to communicate with the OBEMs through the PC for this work.

The OBEM saves the data in a CF card in the data logger. The data were copied to the PC by fetching the CF card from the data logger in the pressure glass sphere or by communication via USB or RS-232C connection.

5-5. Data

All OBEMs recorded the data every 60 seconds but some of them started the recording with 10 seconds interval and switched to 60 seconds interval after two months, scheduled by multi-timer system. OBEM VTM1 deployed at O16 records electric field variation and differential pressure every one second. The recording times are listed in Table 5.6. Most of the data look good although there are noisy sections in some components. Figure 5.1–5.20 show the plots of the raw time-series data.

Table 5-1. The coordinates of the OBEM observation sites.

Site ID	Latitude			Longitude			Depth [m]
O01	04°	59.69'	N	147°	00.19'	E	4279
O02	02°	02.22'	N	146°	59.33'	E	4489
O04	04°	26.96'	N	150°	23.06'	E	3986
O06	04°	58.37'	S	156°	02.70'	E	1490
O07	01°	58.16'	S	155°	59.83'	E	1743
O08	00°	02.16'	N	156°	00.09'	E	1959
O09	02°	01.27'	N	156°	00.45'	E	2583
O10	05°	00.50'	N	156°	00.80'	E	3608
O11	08°	00.65'	N	156°	01.34'	E	4876
O12	03°	59.79'	N	159°	55.27'	E	3757
O13	01°	55.60'	N	160°	01.11'	E	2949
O14	02°	08.83'	S	159°	55.79'	E	2491
O15	05°	57.88'	S	160°	02.40'	E	1813
O16	06°	25.08'	S	163°	25.05'	E	3559
O17	00°	59.19'	S	164°	00.40'	E	4434
O18	03°	53.28'	S	166°	42.61'	E	3440
O20	02°	56.74'	S	174°	59.42'	E	5078
O21	00°	01.41'	N	170°	00.17'	E	4459
O22	02°	52.17'	N	166°	01.68'	E	4308
O23	06°	57.18'	N	164°	29.77'	E	5116

Table 5-2. Specification of the OBEM trims

OBEM ID	Institute	Data logger type	Dipole length (x, y) [m]	Pressure case	Frame	Acoustics transponder	Releaser
TT8	ERI	OBEM2001	5.400, 5.410	2 glass spheres	Titunium	Nichiyu Giken	Inconel wire
TT4	ERI	OBEM2005	5.405, 5.410	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI15	ERI	OBEM2005	5.400, 5.385	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI6	ERI	OBEM2005	5.395, 5.405	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI7	ERI	OBEM2005	5.415, 5.415	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI8	ERI	OBEM2005	5.415, 5.405	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI5	ERI	OBEM2005	5.405, 5.415	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI11	ERI	OBEM2005	5.400, 5.415	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
TT5	ERI	OBEM99	5.410, 5.405	2 glass spheres	Titunium	Nichiyu Giken	Inconel wire
ERI12	ERI	OBEM2005	5.395, 5.395	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI13	ERI	OBEM2005	5.410, 5.390	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
ERI14	ERI	OBEM2005	5.410, 5.420	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
JM106	JAMSTEC	OBEM2005	4.445, 4.445	1 glass sphere & 2 titunium tubes	N/A	Kaiyo Denshi	2 stainless sheets
VTM1	JAMSTEC	OBEM2005_VTM	5.395, 5.395	2 glass spheres	Titunium	Kaiyo Denshi	Inconel wire
JM7	JAMSTEC	OBEM2005	5.395, 5.385	2 glass spheres	Aluminum	Kaiyo Denshi	Inconel wire
JM4	JAMSTEC	OBEM2001	5.395, 5.400	2 glass spheres	Aluminum	Kaiyo Denshi	Inconel wire
JM2	JAMSTEC	OBEM2001	5.405, 5.405	2 glass spheres	Aluminum	Kaiyo Denshi	Inconel wire
JM8	JAMSTEC	OBEM2005	5.400, 5.400	2 glass spheres	Aluminum	Nichiyu Giken	Inconel wire
JM1	JAMSTEC	OBEM2001	5.420, 5.410	2 glass spheres	Aluminum	Nichiyu Giken	Inconel wire
JM6	JAMSTEC	OBEM2005	5.400, 5.410	2 glass spheres	Aluminum	Kaiyo Denshi	Inconel wire

Table 5-3. Specification the OBEM data logger

Data logger type	Magnetometer		Voltmeter		Tiltmeter		Thermometer		DPG		Multi-timer
	# ch	Resolution	# ch	Resolution	# ch	Resolution	# ch	Resolution	# ch	Resolution	
OBEM99	3	0.01 nT	2	0.305 μV	2	2.6×10^{-4} deg.	1	0.01 °C	N/A		N/A
OBEM2001	3	0.01 nT	2	0.305 μV	2	2.5×10^{-4} deg.	1	0.01 °C	N/A		N/A
OBEM2005	3	0.01 nT	4	1.192 nV	2	2.6×10^{-4} deg.	2	0.01 °C (Circuit) 1.49×10^{-4} °C (FG)	N/A		Available
OBEM2005_VTM	3	0.01 nT	2	1.192 nV	2	2.6×10^{-4} deg.	2	0.01 °C (Circuit) 1.49×10^{-4} °C (FG)	1	29.8 nV	N/A

Table 5-4. Time process of the OBEM recovery work.

Site ID	OBEM ID	Beacon freq. [MHz]	Release command	Time (Local time : UTC + 11 h)				Ascending rate [m/min.]	Remarks
				Send command	Release	On surface	On deck		
O01	TT8	159.250	3F	2017-02-15 11:48:00	11:58*	14:25	14:43	29.1	
O02	TT4	159.300	4C-1	2017-02-13 17:07:00	17:15	19:35	19:47	32.1	
O04	ERI15	159.250	4E-1	2017-02-14 16:03:30	16:11	18:17	18:28	31.8	Beacon didn't work.
O06	ERI6	159.200	2D-1	2017-02-10 14:38:00	14:47	15:34	15:46	31.8	
O07	ERI7	159.250	2E-1	2017-02-09 22:03:00	22:10:40	23:05	23:18	32.5	Beacon didn't work.
O08	ERI8	159.300	2F-2	2017-02-09 09:52:00	5:59:30	11:00	11:11	32.8	
O09	ERI5	159.150	2B-2	2017-02-08 21:06:00	21:14	22:38	22:51	31.0	Beacon didn't work.
O10	ERI11	159.250	3D-1	2017-02-08:03:19:00	3:27	5:29	5:44	29.6	Beacon and flash light didn't work
O11	TT5	159.300	3C	2017-02-04 04:35:00	4:42	7:29	7:54	29.2	Beacon didn't work.
O12	ERI12	159.300	3E-1	2017-02-02 20:51:00	20:57	23:02	23:22	30.1	
O13	ERI13	159.150	3F-1	2017-02-02 08:18:00	8:27	10:04	10:19	30.4	Flash light was broken.
O14	ERI14	159.300	4B-1	2017-02-01 09:55:00	10:03	11:23	11:38	31.1	
O15	JM106	159.150	4E-1	2017-01-31 12:17:00	12:37	13:22	13:37	41.2	Flash light didn't work.
O16	VTM1	159.200	5A-1	2017-01-27 03:02:00	3:09	4:57	5:35	33.0	Flash light didn't work.
O17	JM7	159.300	3C-1	2017-01-25 21:22:00	21:29	23:52	00:10 (+1d)	31.0	
O18	JM4	159.150	1A-1	2017-01-24 23:06:33	23:10	01:04 (+1d)	01:30 (+1d)	30.2	
O20	JM2	159.300	1C-1	2017-01-22 04:57:00	5:06	7:51	8:09	30.8	
O21	JM8	159.150	3B	2017-01-20 18:04:30	18:11*	20:41	21:00	29.8	
O22	JM1	159.200	3H	2017-01-19 13:50:00	13:57*	16:22	16:55	29.8	
O23	JM6	159.300	2C-1	2017-01-18 12:40:00	12:48	15:31	15:57	31.3	

* Release time was not detected but estimated from later slant range data.

Table 5-5. OBEM clock information.

Site ID	OBEM ID	Syncronized time before deployment (UTC)	Compared time after recovery (UTC)		Average time difference [s]
			OBEM clock	Reference clock	
O01	TT8	2015-01-03 04:39:00	2017-02-15 05:02:38	2017-02-15 05:01:57	41.000
			2017-02-15 05:02:39	2017-02-15 05:01:58	
			2017-02-15 05:02:40	2017-02-15 05:01:59	
			2017-02-15 05:02:41	2017-02-15 05:02:00	
			2017-02-15 05:02:42	2017-02-15 05:02:01	
O02	TT4	2015-01-05 00:20:00	2017-02-13 10:33:31.989	2017-02-13 10:31:53	98.987
			2017-02-13 10:33:33.986	2017-02-13 10:31:55	
			2017-02-13 10:33:35.984	2017-02-13 10:31:57	
			2017-02-13 10:33:37.982	2017-02-13 10:31:59	
			2017-02-13 10:33:39.994	2017-02-13 10:32:01	
O04	ERI15	2014-12-16 04:24:22	2017-02-14 08:52:04.734	2017-02-14 08:50:41	83.734
			2017-02-14 08:52:06.731	2017-02-14 08:50:43	
			2017-02-14 08:52:08.727	2017-02-14 08:50:45	
			2017-02-14 08:52:10.740	2017-02-14 08:50:47	
			2017-02-14 08:52:12.737	2017-02-14 08:50:49	
O06	ERI6	2014-12-23 11:34:00	2017-02-10 05:09:37.808	2017-02-10 05:07:32	125.814
			2017-02-10 05:09:39.820	2017-02-10 05:07:34	
			2017-02-10 05:09:41.817	2017-02-10 05:07:36	
			2017-02-10 05:09:43.814	2017-02-10 05:07:38	
			2017-02-10 05:09:45.810	2017-02-10 05:07:40	

Table 5-5. OBEM clock information (continued).

Site ID	OBEM ID	Syncronized time before deployment (UTC)	Compared time after recovery (UTC)		Average time difference [s]
			OBEM clock	Reference clock	
O07	ERI7	2014-12-24 23:48:00	2017-02-09 12:40:07.151	2017-02-09 12:39:21	46.150
			2017-02-09 12:40:09.147	2017-02-09 12:39:23	
			2017-02-09 12:40:11.144	2017-02-09 12:39:25	
			2017-02-09 12:40:13.156	2017-02-09 12:39:27	
			2017-02-09 12:40:15.153	2017-02-09 12:39:29	
O08	ERI8	2014-12-27 00:28:59	2017-02-09 01:11:00.219	2017-02-09 01:09:08	112.225
			2017-02-09 01:11:02.231	2017-02-09 01:09:10	
			2017-02-09 01:11:04.228	2017-02-09 01:09:12	
			2017-02-09 01:11:06.225	2017-02-09 01:09:14	
			2017-02-09 01:11:08.222	2017-02-09 01:09:16	
O09	ERI5	2014-12-29 00:10:00	2017-02-08 13:06:56.592	2017-02-08 13:06:01	55.595
			2017-02-08 13:06:58.589	2017-02-08 13:06:03	
			2017-02-08 13:07:00.602	2017-02-08 13:06:05	
			2017-02-08 13:07:03.597	2017-02-08 13:06:08	
			2017-02-08 13:07:05.593	2017-02-08 13:06:10	
O10	ERI11	2014-12-31 00:12:00	2017-02-07 19:20:59.827	2017-02-07 19:19:28	91.827
			2017-02-07 19:21:01.823	2017-02-07 19:19:30	
			2017-02-07 19:21:03.820	2017-02-07 19:19:32	
			2017-02-07 19:21:05.833	2017-02-07 19:19:34	
			2017-02-07 19:21:07.830	2017-02-07 19:19:36	

Table 5-5. OBEM clock information (continued).

Site ID	OBEM ID	Syncronized time before deployment (UTC)	Compared time after recovery (UTC)		Average time difference [s]
			OBEM clock	Reference clock	
O11	TT5	2015-01-02 04:51:29	2017-02-03 21:14:14	2017-02-03 21:12:29	105.000
			2017-02-03 21:14:15	2017-02-03 21:12:30	
			2017-02-03 21:14:16	2017-02-03 21:12:31	
			2017-02-03 21:14:17	2017-02-03 21:12:32	
			2017-02-03 21:14:18	2017-02-03 21:12:33	
O12	ERI12	2014-12-21 05:21:59	2017-02-02 12:44:10.476	2017-02-02 12:42:51	79.483
			2017-02-02 12:44:12.486	2017-02-02 12:42:53	
			2017-02-02 12:44:14.490	2017-02-02 12:42:55	
			2017-02-02 12:44:16.478	2017-02-02 12:42:57	
			2017-02-02 12:44:18.483	2017-02-02 12:42:59	
O13	ERI13	2014-12-22 04:57:00	2017-02-01 23:43:16.291	2017-02-01 23:42:03	73.289
			2017-02-01 23:43:18.296	2017-02-01 23:42:05	
			2017-02-01 23:43:20.285	2017-02-01 23:42:07	
			2017-02-01 23:43:22.286	2017-02-01 23:42:09	
			2017-02-01 23:43:24.286	2017-02-01 23:42:11	
O14	ERI14	2014-12-23 05:05:00	2017-02-01 00:58:44.944	2017-02-01 00:57:52	52.950
			2017-02-01 00:58:46.957	2017-02-01 00:57:54	
			2017-02-01 00:58:48.953	2017-02-01 00:57:56	
			2017-02-01 00:58:50.950	2017-02-01 00:57:58	
			2017-02-01 00:58:52.947	2017-02-01 00:58:00	

Table 5-5. OBEM clock information (continued).

Site ID	OBEM ID	Syncronized time before deployment (UTC)	Compared time after recovery (UTC)		Average time difference [s]
			OBEM clock	Reference clock	
O15	JM106	2014-12-05 23:56:16	2017-01-31 04:04:59.250	2017-01-31 04:02:56	123.246
			2017-01-31 04:05:01.246	2017-01-31 04:02:58	
			2017-01-31 04:05:03.243	2017-01-31 04:03:00	
			2017-01-31 04:05:05.240	2017-01-31 04:03:02	
			2017-01-31 04:05:07.252	2017-01-31 04:03:04	
O16	VTM1	2014-12-04 02:48:56	2017-01-26 18:55:26.527	2017-01-26 18:54:14	72.530
			2017-01-26 18:55:28.524	2017-01-26 18:54:16	
			2017-01-26 18:55:30.537	2017-01-26 18:54:18	
			2017-01-26 18:55:32.534	2017-01-26 18:54:20	
			2017-01-26 18:55:34.530	2017-01-26 18:54:22	
O17	JM7	2014-11-28 00:06:51	2017-01-25 13:33:09.468	2017-01-25 13:32:55	14.460
			2017-01-25 13:33:11.453	2017-01-25 13:32:57	
			2017-01-25 13:33:13.456	2017-01-25 13:32:59	
			2017-01-25 13:33:15.460	2017-01-25 13:33:01	
			2017-01-25 13:33:17.463	2017-01-25 13:33:03	
O18	JM4	2014-11-26 21:59:50	2017-01-24 14:55:09	2017-01-24 14:51:45	204.000
			2017-01-24 14:55:10	2017-01-24 14:51:46	
			2017-01-24 14:55:11	2017-01-24 14:51:47	
			2017-01-24 14:55:12	2017-01-24 14:51:48	
			2017-01-24 14:55:13	2017-01-24 14:51:49	

Table 5-5. OBEM clock information (continued).

Site ID	OBEM ID	Syncronized time before deployment (UTC)	Compared time after recovery (UTC)		Average time difference [s]
			OBEM clock	Reference clock	
O20	JM2	2014-11-18 04:02:36	2017-01-21 21:37:24	2017-01-21 21:35:11	133.000
			2017-01-21 21:37:25	2017-01-21 21:35:12	
			2017-01-21 21:37:26	2017-01-21 21:35:13	
			2017-01-21 21:37:27	2017-01-21 21:35:14	
			2017-01-21 21:37:28	2017-01-21 21:35:15	
O21	JM8	2014-11-16 03:41:25	2017-01-20 10:27:37.479	2017-01-20 10:26:06	91.485
			2017-01-20 10:27:39.492	2017-01-20 10:26:08	
			2017-01-20 10:27:41.489	2017-01-20 10:26:10	
			2017-01-20 10:27:43.485	2017-01-20 10:26:12	
			2017-01-20 10:27:45.482	2017-01-20 10:26:14	
O22	JM1	2014-11-15 00:31:08	2017-01-19 06:35:06	2017-01-19 06:32:23	163.000
			2017-01-19 06:35:07	2017-01-19 06:32:24	
			2017-01-19 06:35:08	2017-01-19 06:32:25	
			2017-01-19 06:35:09	2017-01-19 06:32:26	
			2017-01-19 06:35:10	2017-01-19 06:32:27	
O23	JM6	2014-11-14 03:00:27	2017-01-18 05:50:27.333	2017-01-18 05:48:58	89.330
			2017-01-18 05:50:29.330	2017-01-18 05:49:00	
			2017-01-18 05:50:31.327	2017-01-18 05:49:02	
			2017-01-18 05:50:33.324	2017-01-18 05:49:04	
			2017-01-18 05:50:35.335	2017-01-18 05:49:06	

Table 5-6. OBEM record information.

Site ID	OBEM ID	Start time (UTC)	End time (UTC)	Sampling interval [s]
O01	TT8	2015-01-31 15:00:00	2016-05-20 23:59:00	60
O02	TT4	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-04-22 07:59:00	60
O04	ERI15	2015-01-31 14:59:40	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-05-30 03:59:00	60
O06	ERI6	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-07-30 07:59:00	60
O07	ERI7	2015-01-31 14:59:40	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-04-14 06:59:00	60
O08	ERI8	2015-01-31 14:59:40	2015-03-31 14:57:50	10
		2015-03-31 15:01:00	2016-06-26 23:59:00	60
O09	ERI5	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2015-06-16 06:59:00	60
O10	ERI11	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-06-12 23:59:00	60
O11	TT5	2015-01-31 15:00:00	2016-12-24 14:59:00	60
O12	ERI12	2015-01-31 14:59:40	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-05-07 11:59:00	60
O13	ERI13	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-04-28 09:59:00	60
O14	ERI14	2015-01-31 14:59:40	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-08-25 04:59:00	60
O15	JM106	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-04-04 16:59:00	60
O16	VTM1	2015-01-31 14:59:30	2015-03-31 14:57:40	10*
		2015-03-31:15:00:00	2016-02-08 01:19:00	60*
O17	JM7	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-08-01 09:59:00	60
O18	JM4	2015-02-02 00:00:00	2016-10-29 15:59:00	60
O20	JM2	2015-01-31 15:01:00	2017-01-11 11:59:00	60
O21	JM8	2015-01-31 14:59:40	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-07-22 01:59:00	60
O22	JM1	2015-01-31 15:00:00	2016-11-02 03:59:00	60
O23	JM6	2015-01-31 14:59:30	2015-03-31 14:57:50	10
		2015-03-31 15:00:00	2016-07-27 01:59:00	60

* Sampling interval of the voltmeter of OBEM2005_VTM is 1 second.

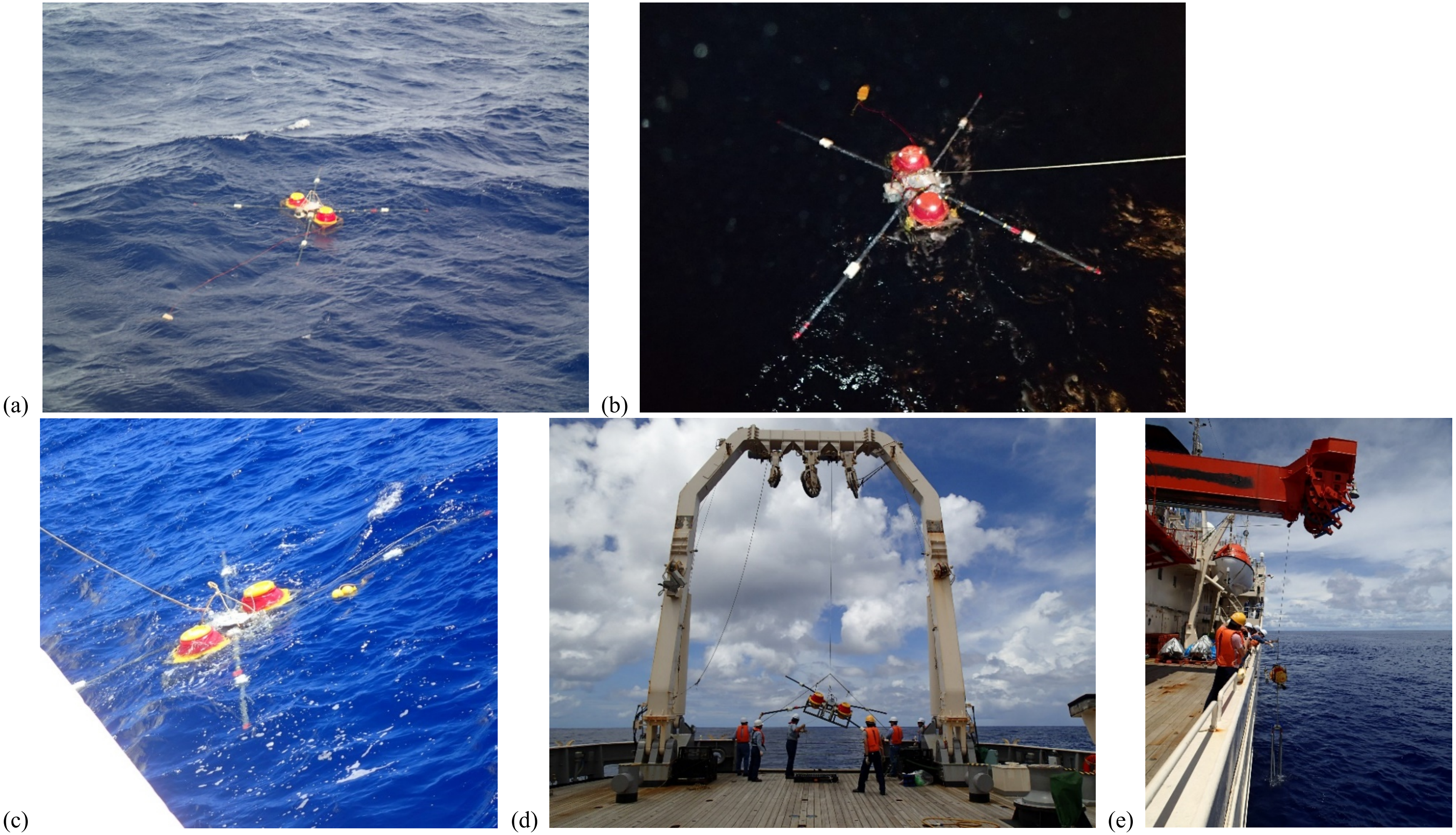

Photo 5-1. (a) OBEM JM6 on sea surface at O23. (b) OBEM VTM1 recovered in the night at O16. (c) OBEM ERI8 hooked by a crew at O08. (d) OBEM ERI14 lifted using the A-frame at O14. (e) OBEM JM106 lifted using the stretch beam at O15.

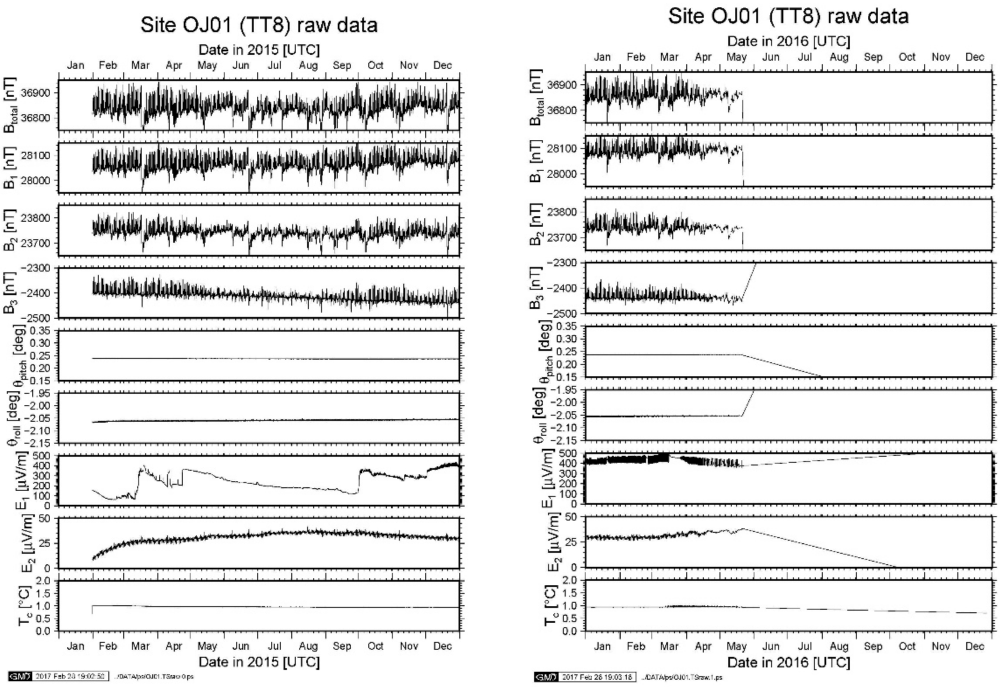

Figure 5-1. Raw time series data collected from O01. From the top to the bottom, the panel shows the total magnetic field intensity B_{total} calculated from the three-components of the magnetic field plotted below (upper two components B_1 and B_2 are nearly horizontal and third component B_3 is nearly vertical), the two-components of the instrumental tilt (θ_{pitch} is the angle of elevation in 1-3 axes plane and θ_{roll} is the angle of dip in 2-3 axes plane), 2 components of Electric field (E_1 and E_2), and temperature on the data logger circuit T_c.

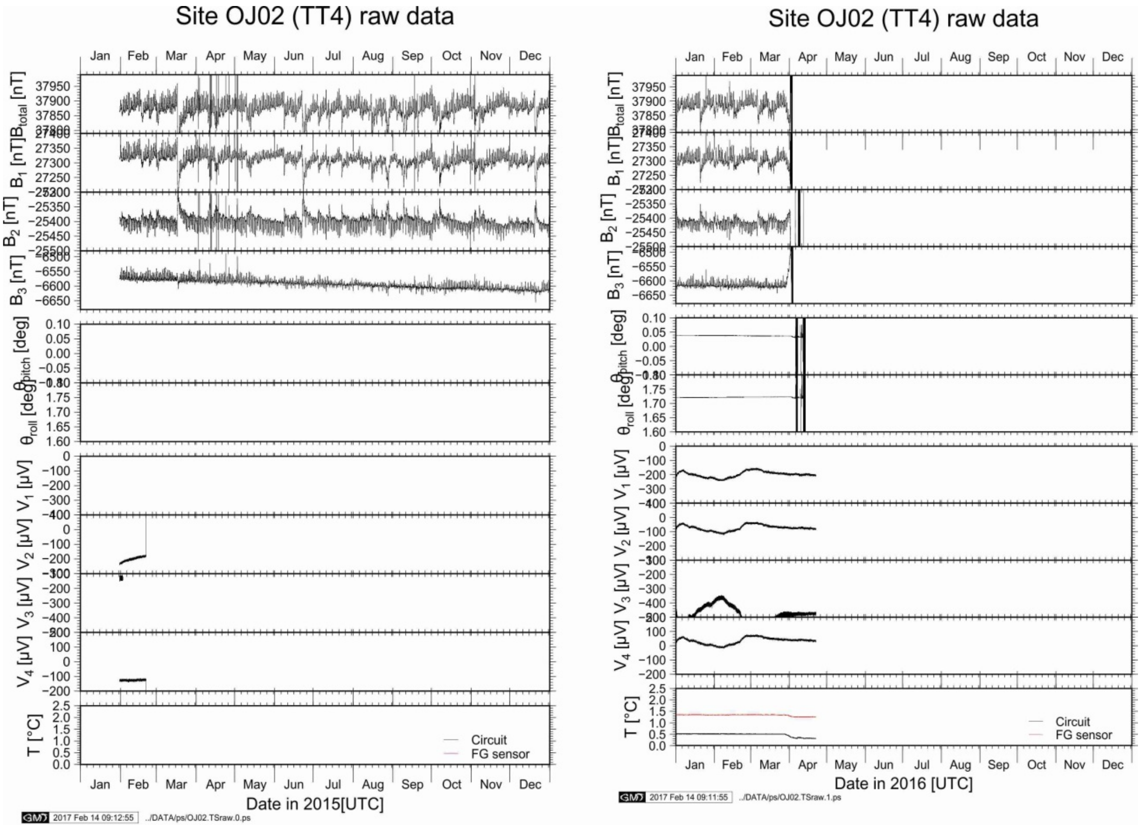

Figure 5-2. Raw time series data collected from O02. Each panel are the same as Fig. 5-1 except that 4 channels the voltage difference ($V_1 \sim V_4$) to the reference electrode are plotted instead of E_1 and E_2 and that the temperature on the flux-gate sensor T_{FG} is added at the bottom panel.

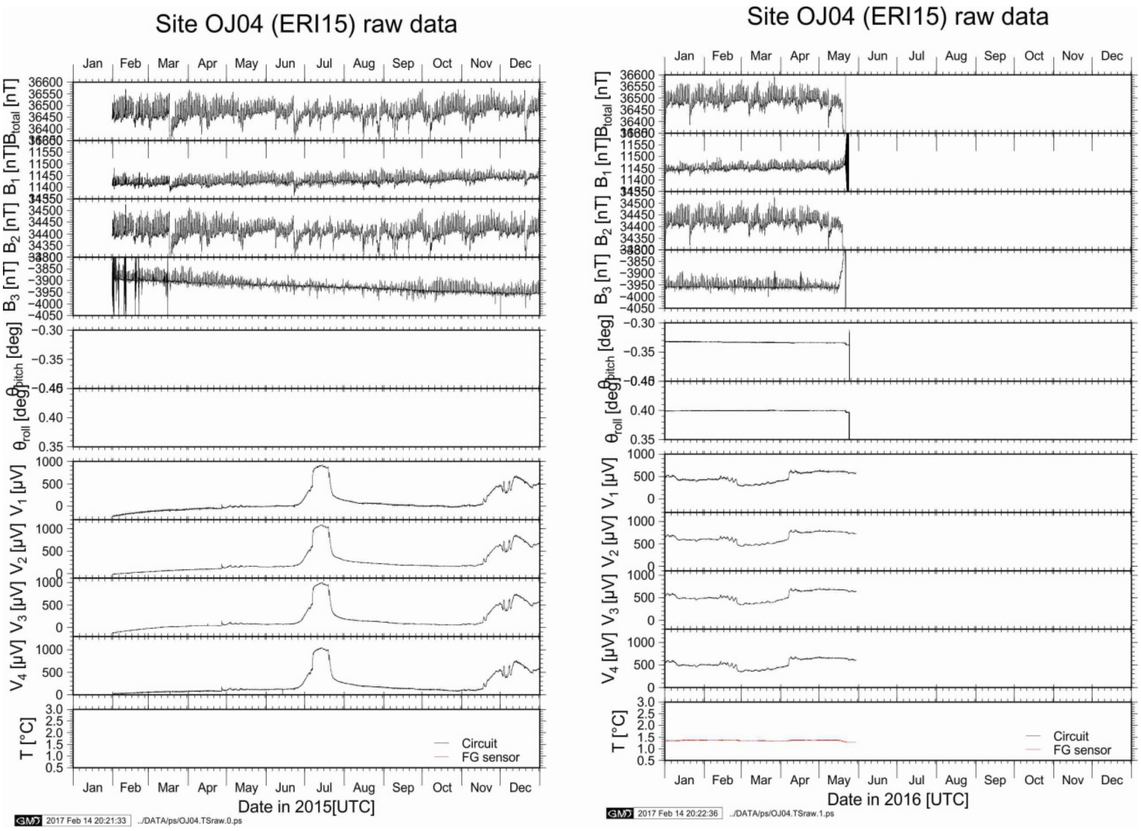

Figure 5-3. Raw time series data collected from O04. Each panel is the same as Fig. 5-2.

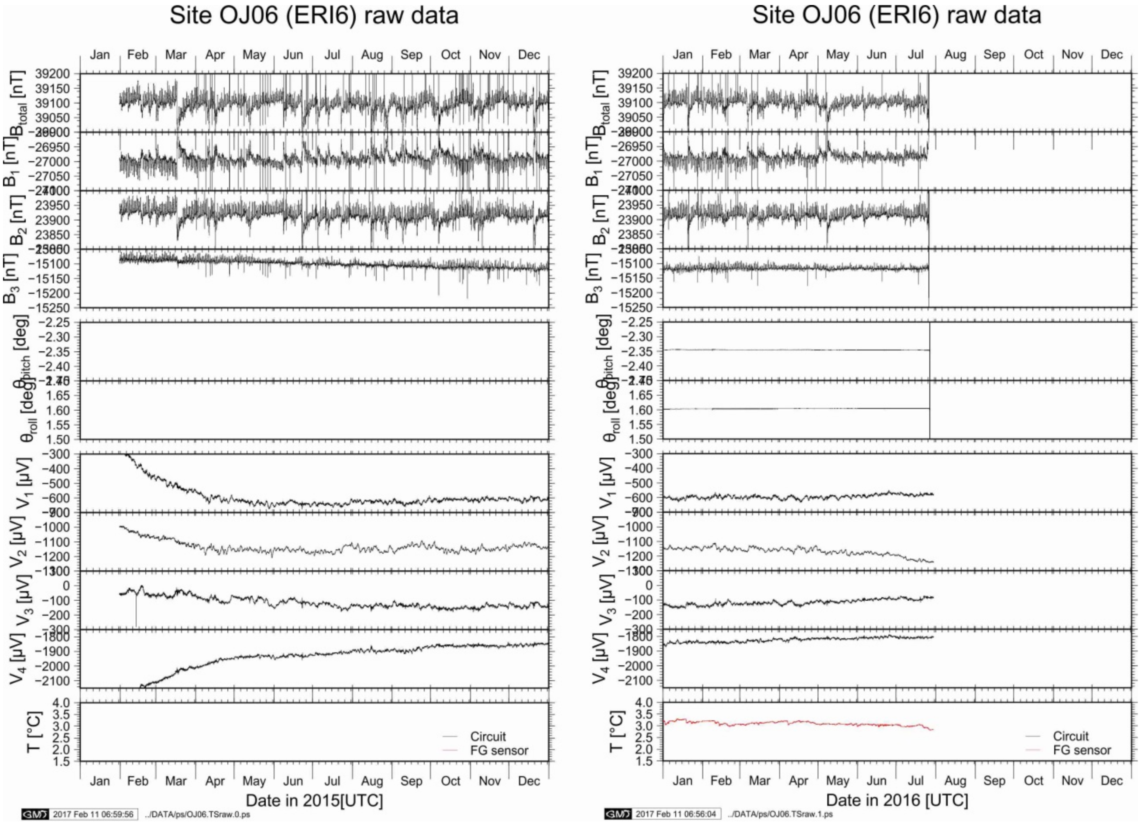

Figure 5-4. Raw time series data collected from O06. Each panel is the same as Fig. 5-2.

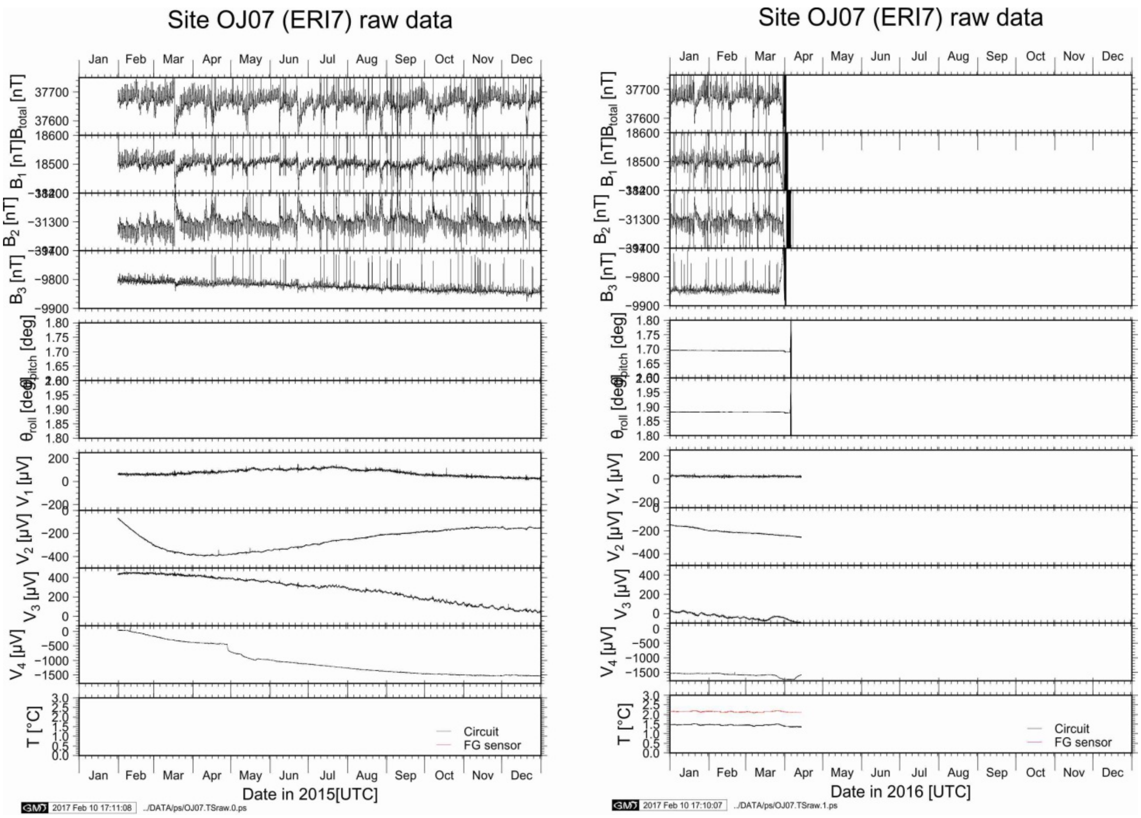

Figure 5-5. Raw time series data collected from O07. Each panel is the same as Fig. 5-2.

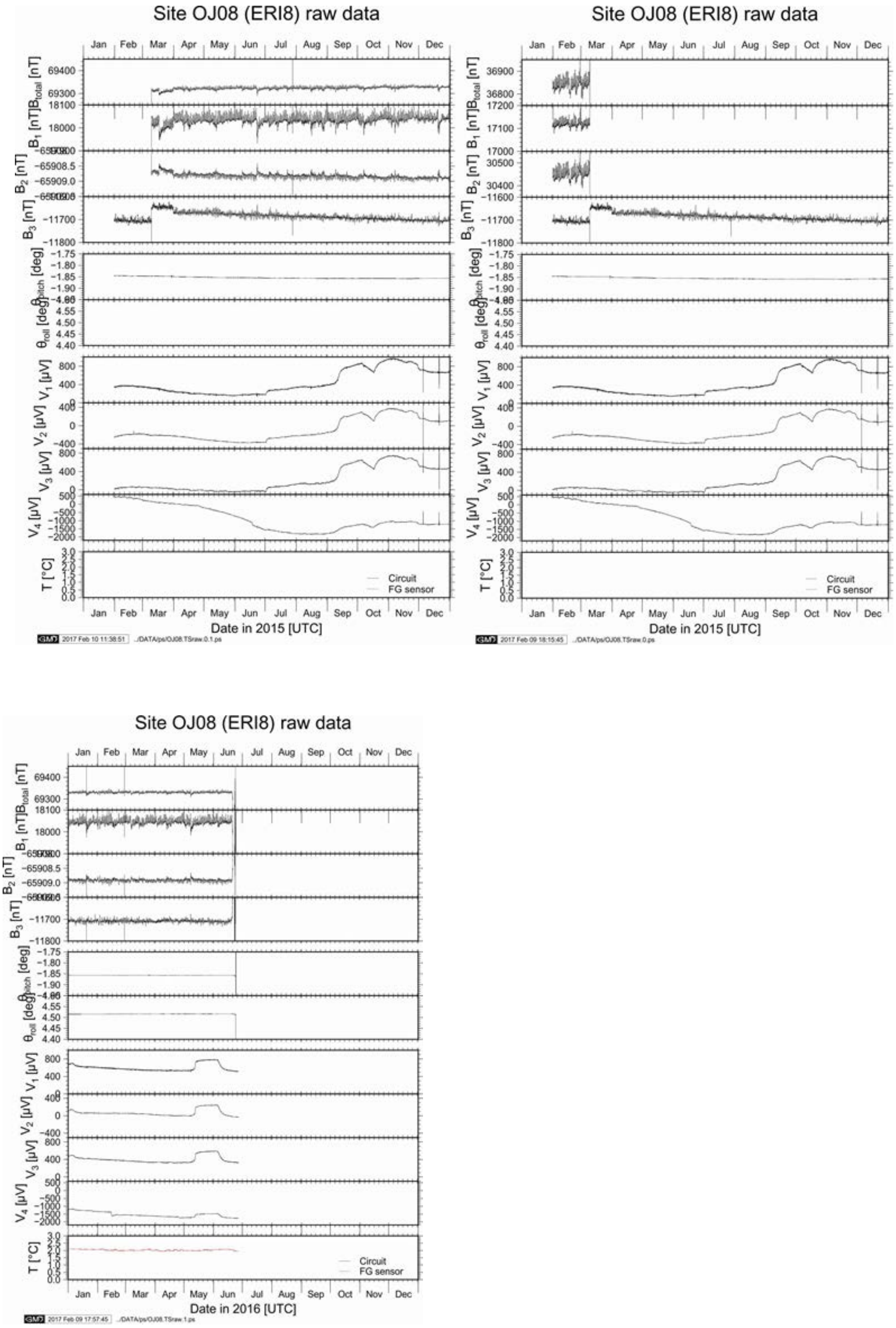

Figure 5-6. Raw time series data collected from O08. Each panel is the same as Fig. 5-2.

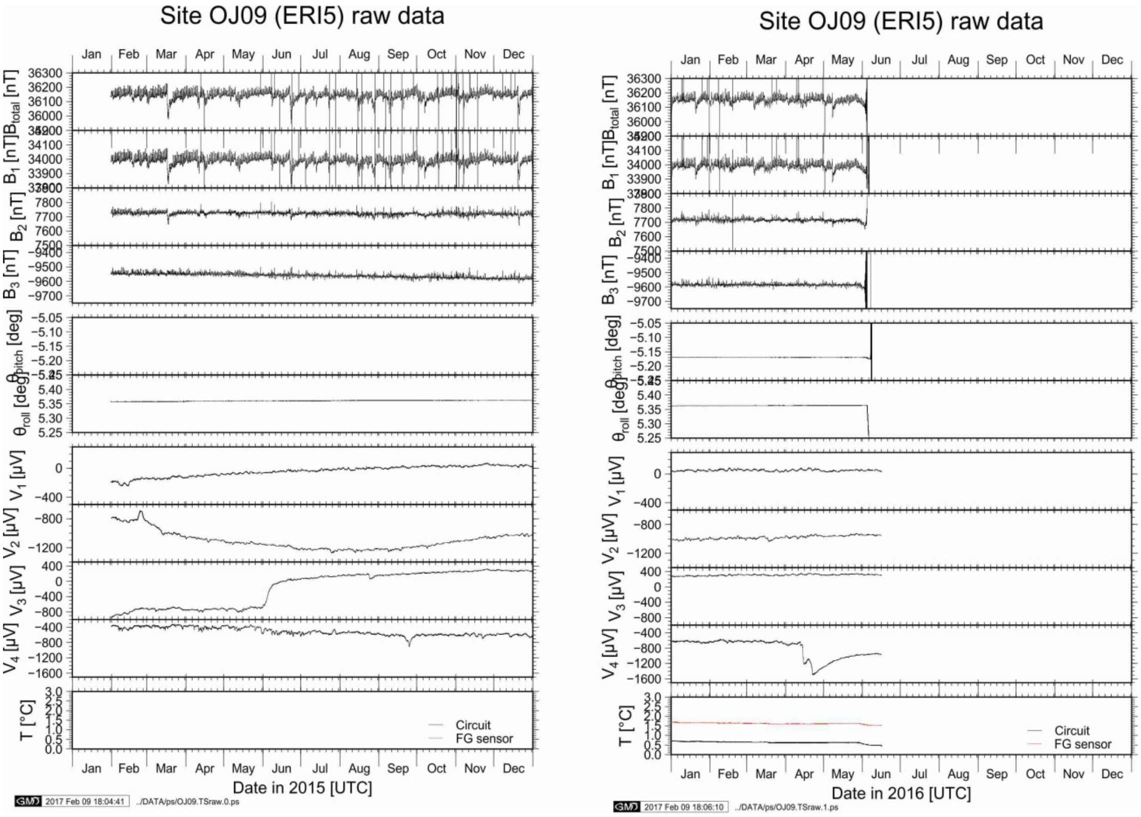

Figure 5-7. Raw time series data collected from O09. Each panel is the same as Fig. 5-2.

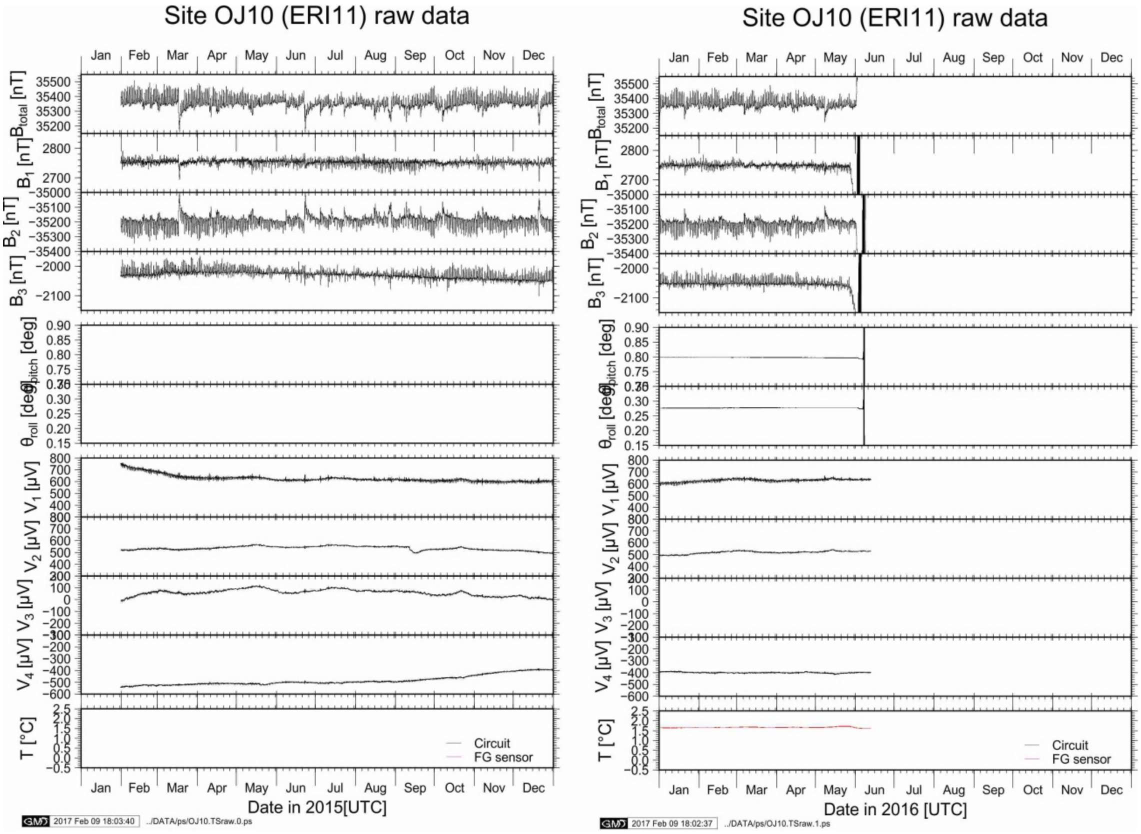

Figure 5-8. Raw time series data collected from O10. Each panel is the same as Fig. 5-2.

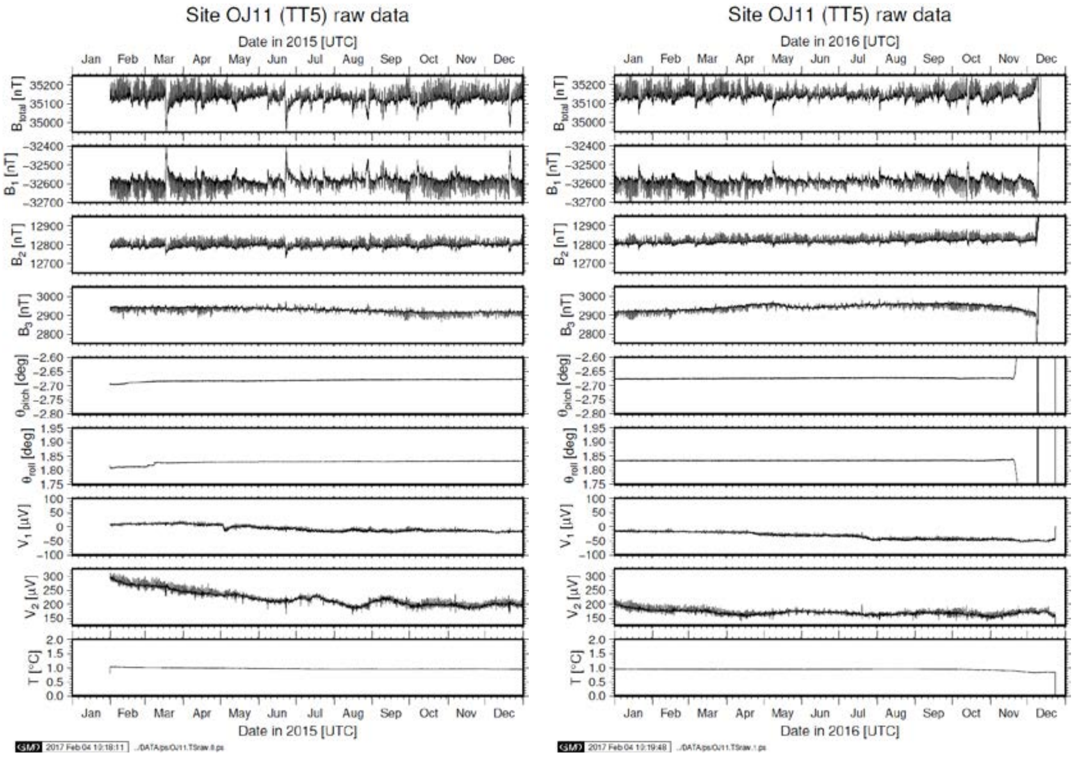

Figure 5-9. Raw time series data collected from O11. Each panel is the same as Fig. 5.-1 except for the second and third panels from the bottom which are not the electric field components but the voltage differences.

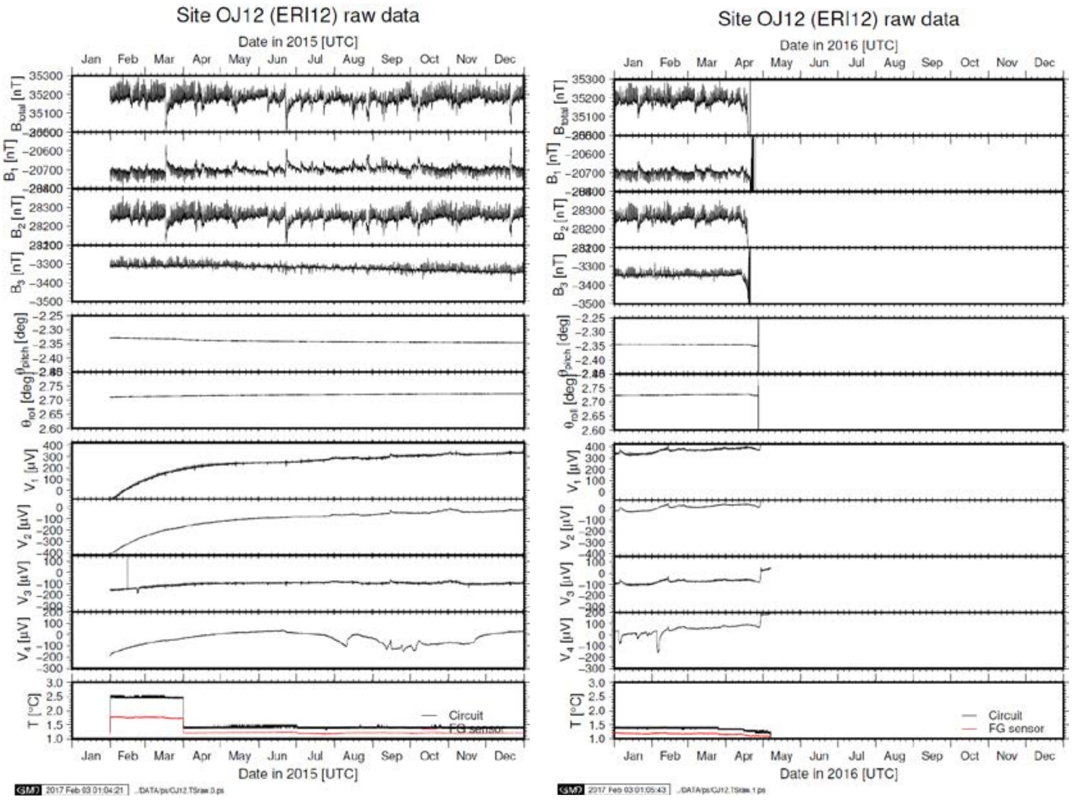

Figure 5-10. Raw time series data collected from O12. Each panel is the same as Fig. 5-2.

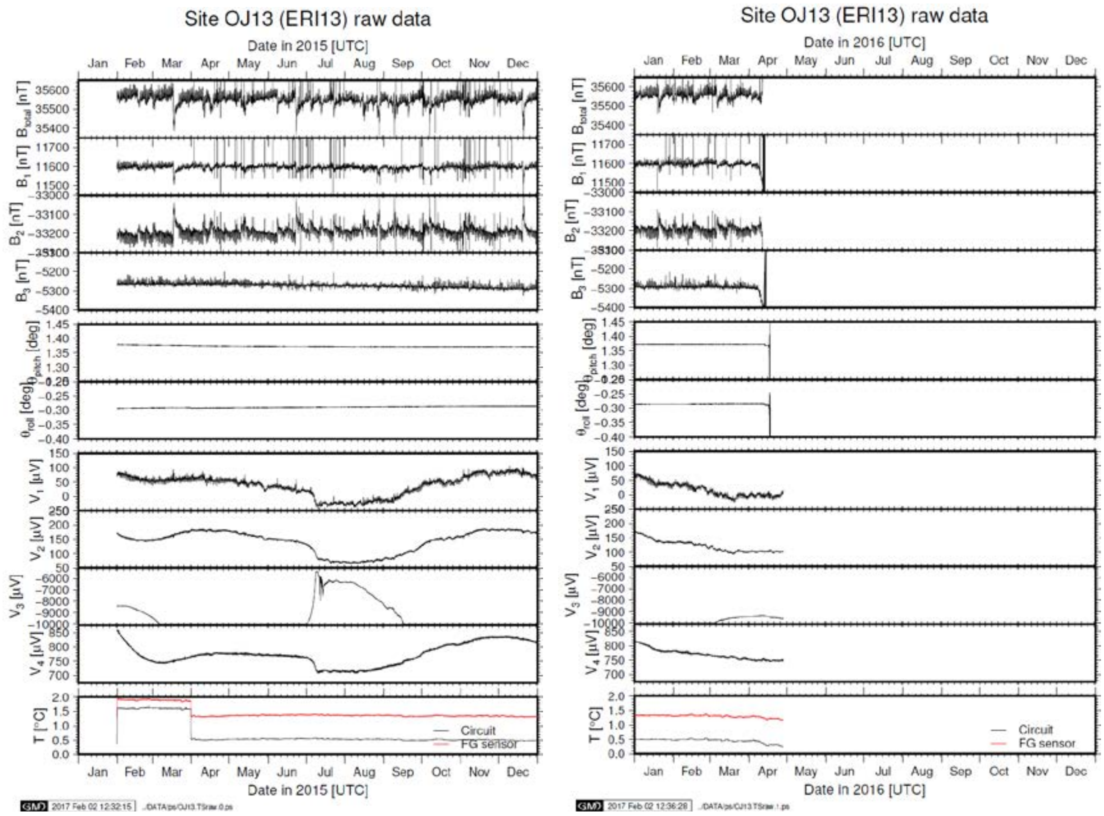

Figure 5-11. Raw time series data collected from O13. Each panel is the same as Fig. 5-2.

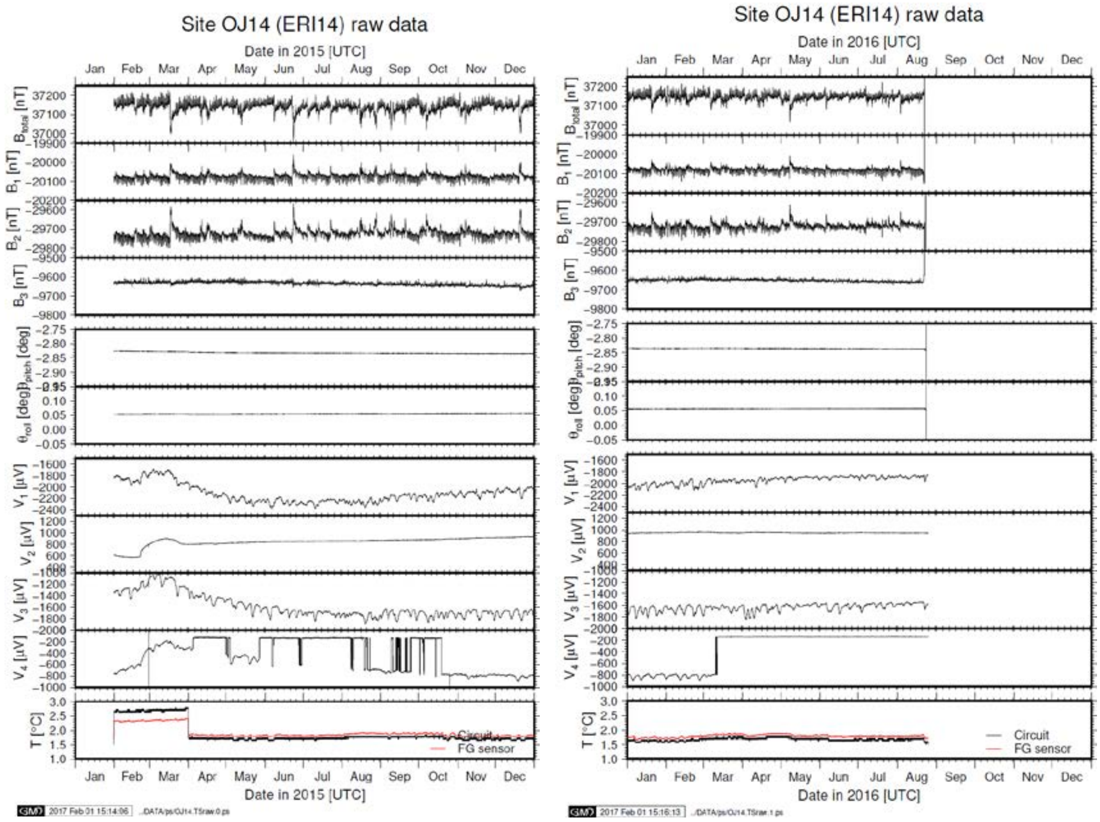

Figure 5-12. Raw time series data collected from O14. Each panel is the same as Fig. 5-2.

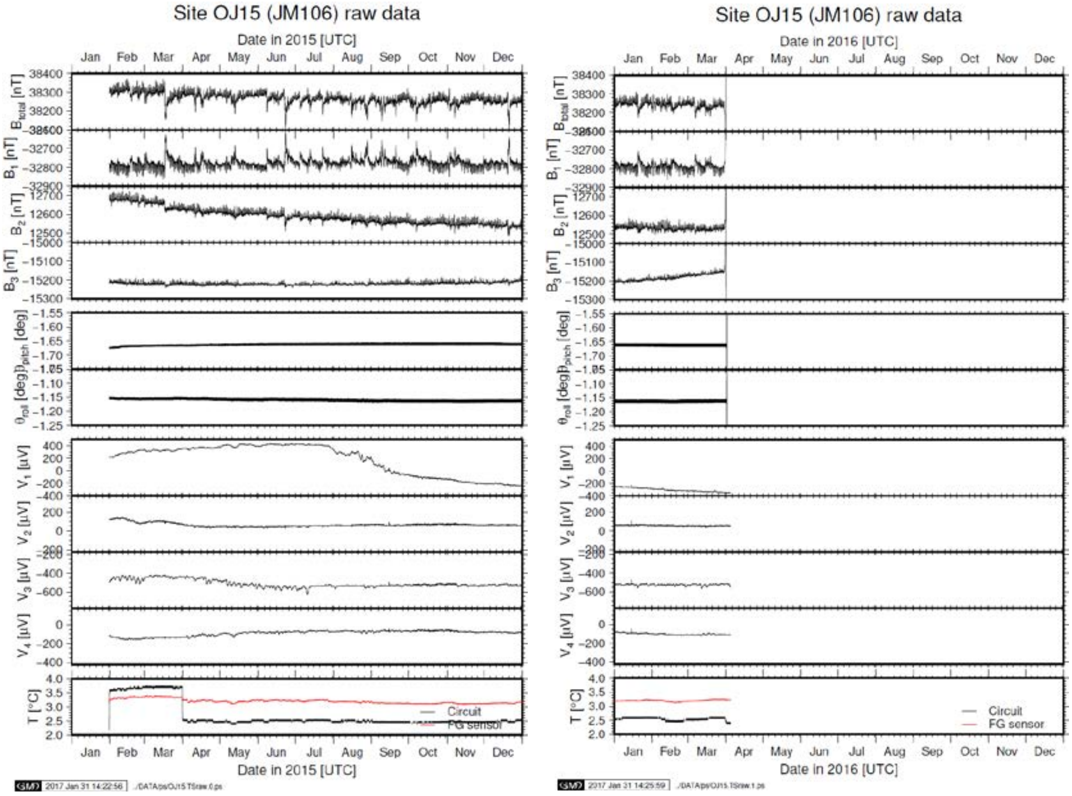

Figure 5-13. Raw time series data collected from O15. Each panel is the same as Fig. 5-2.

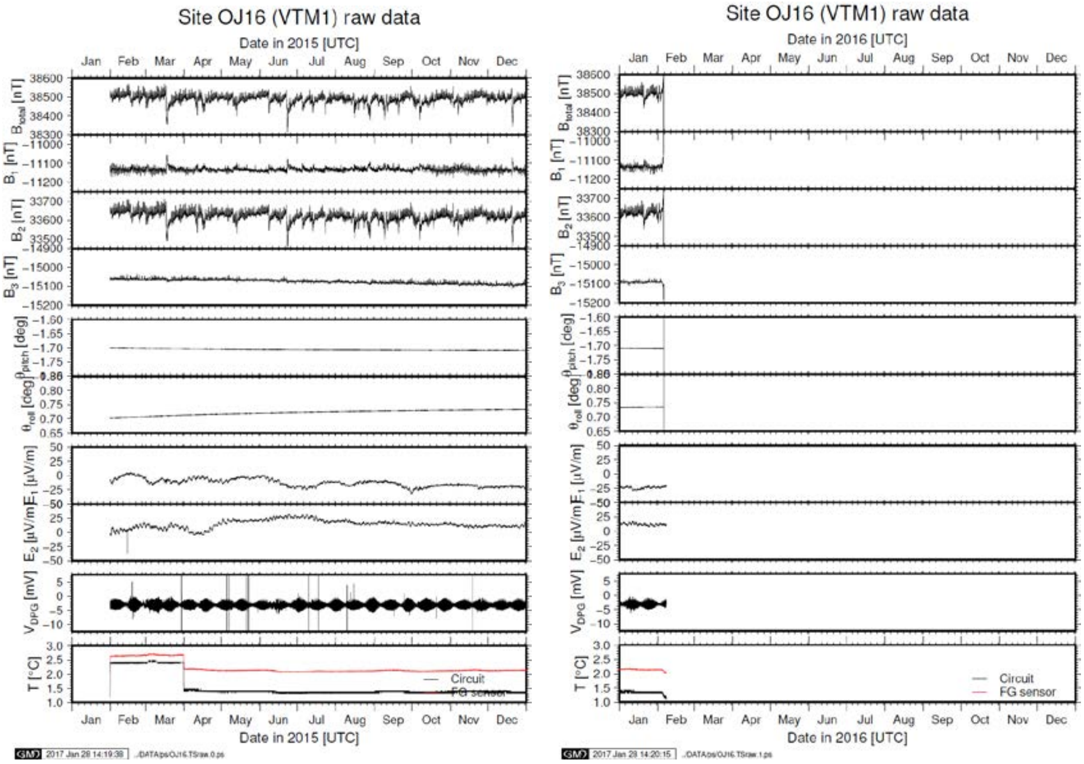

Figure 5-14. Raw time series data collected from O16. Each panel is the same as Fig. 5-1 but the voltage output from the DPG sensor is added in the second panel from the bottom.

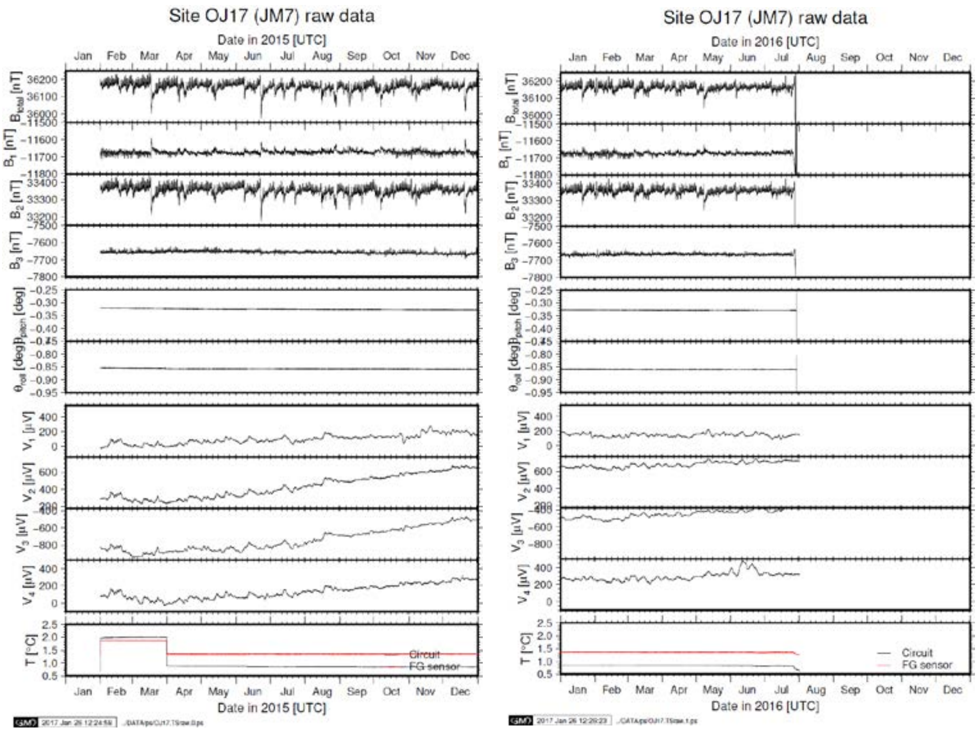

Figure 5-15. Raw time series data collected from O17. Each panel is the same as Fig. 5-2.

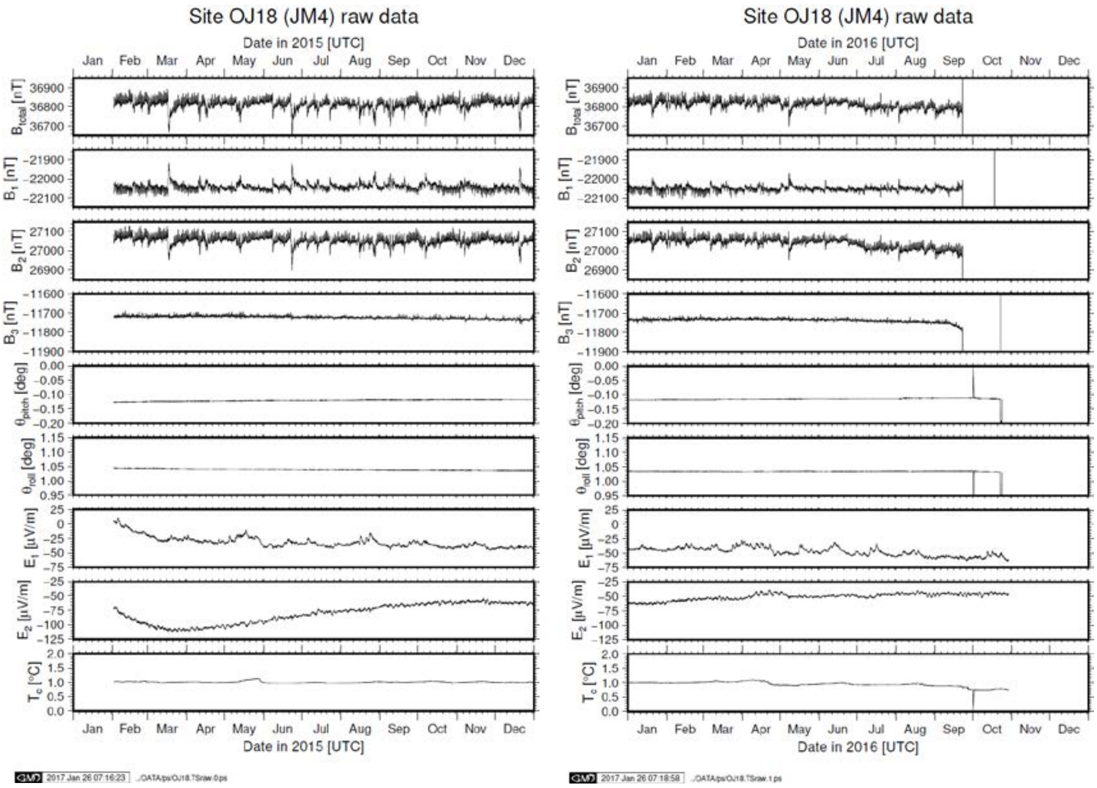

Figure 5-16. Raw time series data collected from O18. Each panel is the same as Fig. 5-1.

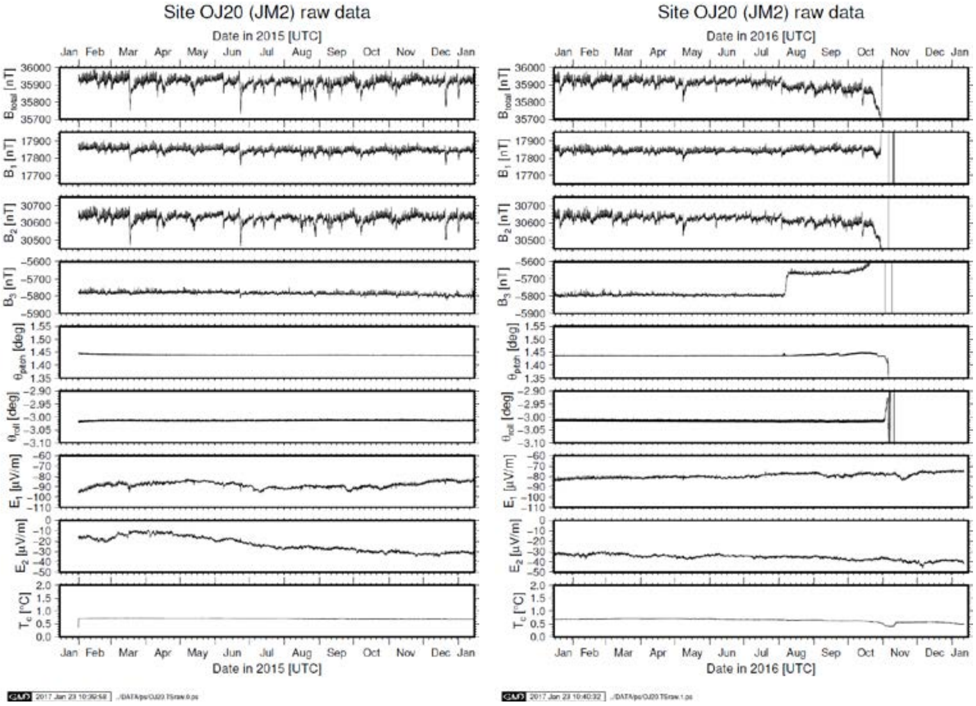

Figure 5-17. Raw time series data collected from O20. Each panel is the same as Fig. 5-1.

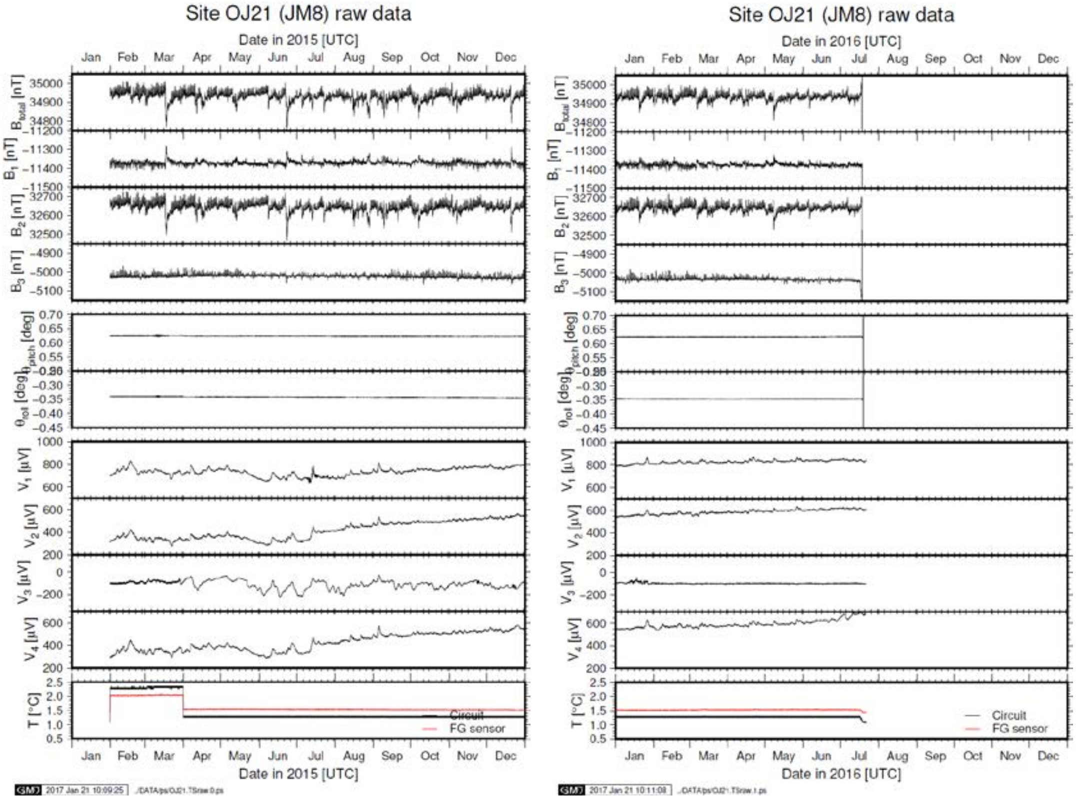

Figure 5-18. Raw time series data collected from O21. Each panel is the same as Fig. 5-2.

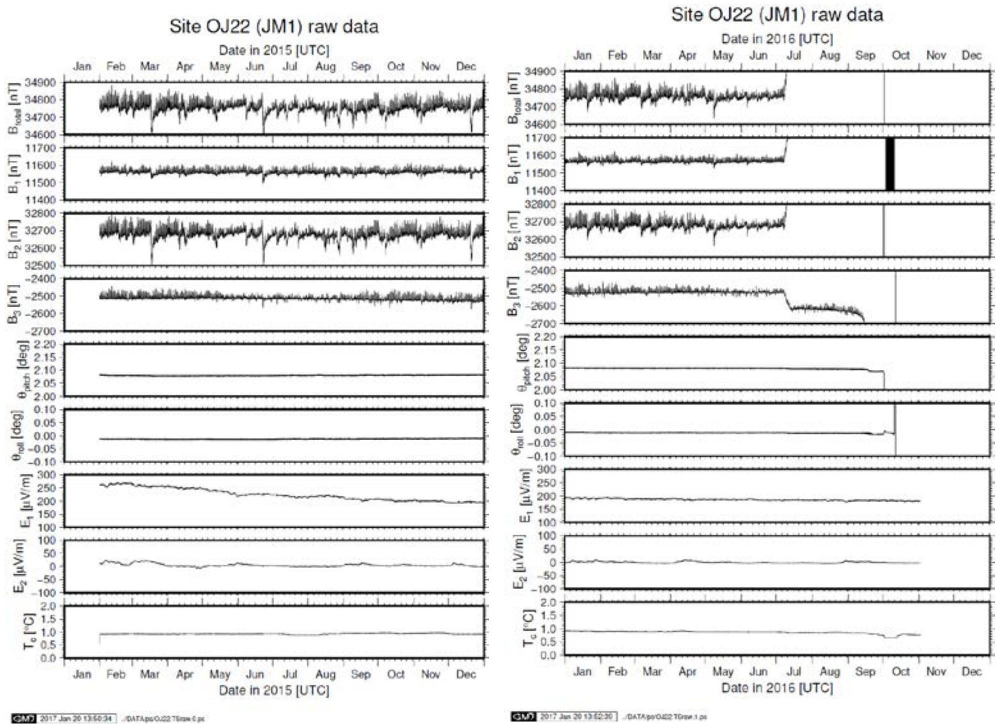

Figure 5-19. Raw time series data collected from O22. Each panel is the same as Fig. 5-1.

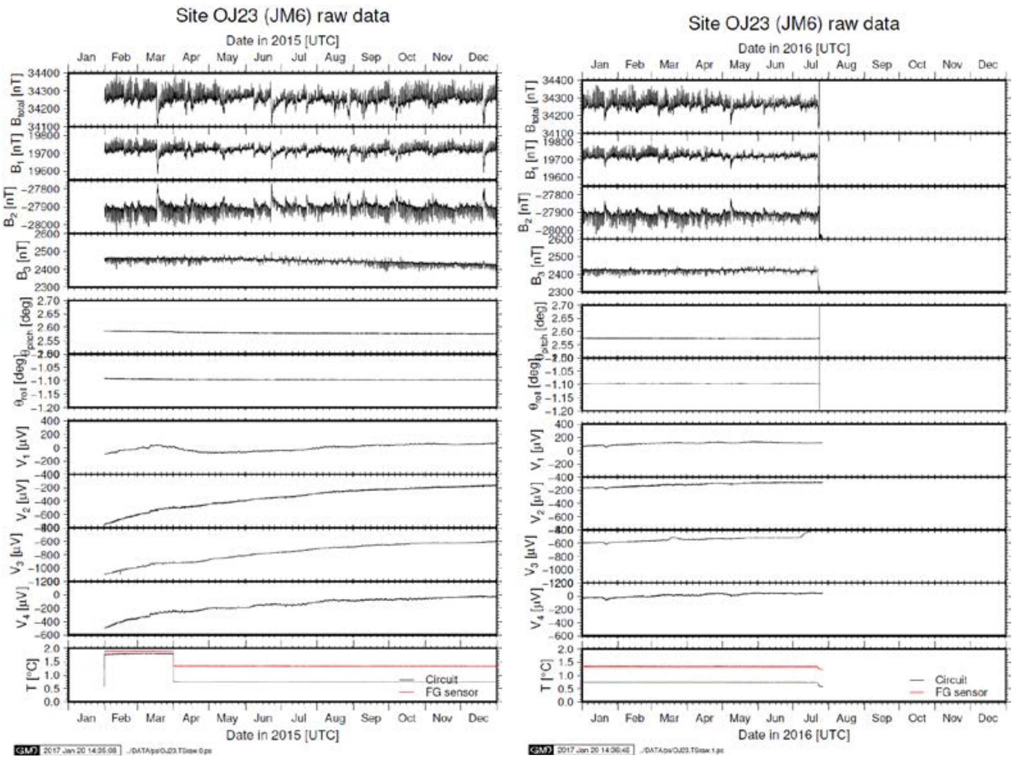

Figure 5-20. Raw time series data collected from O23. Each panel is the same as Fig. 5-2.

6. Sampling basement rock of the Ontong Java Plateau by dredge

6–1. Personnel

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6–2. Objective

The purpose of the project is to take rock samples by dredging off northeast coast of Malaita, Solomon Islands (Figure 6–1) in order to investigate the age and composition of the deeper parts of lava piles of the Ontong Java Plateau. As part of the dredging, we also attached a video camera to the dredge frame and/or a lead wire to test if it is possible to capture undersea outcrops on video.

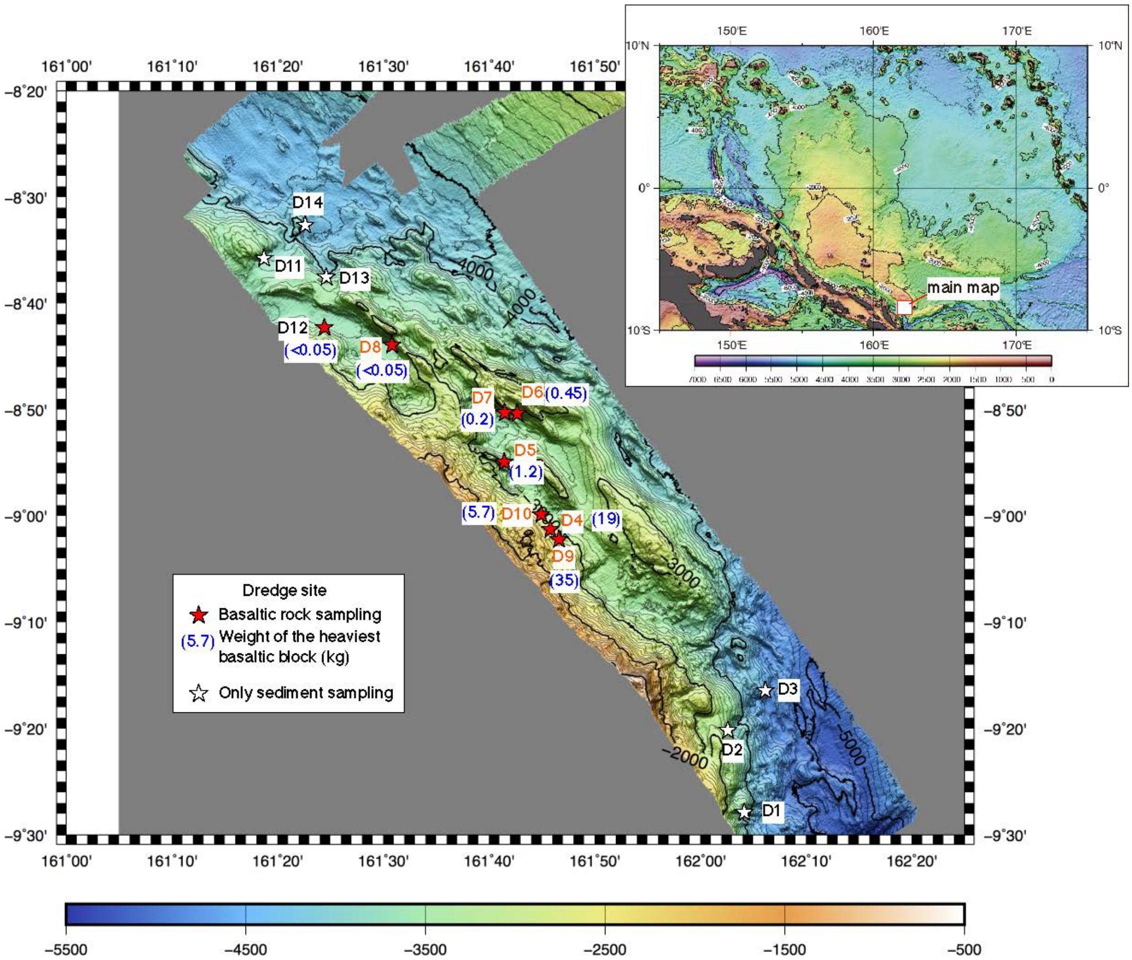

Figure 6-1. Bathymetry map of the research area. Red stars indicate the dredge stations where basement rocks were recovered, and white stars show dredge stations where only sediment samples were obtained. The inset in Fig. 6-1 shows the map of Ontong Java Plateau where the research area is indicated (red box). The edge of the plateau is defined by the –4000 m depth contour, except in the research area where part of the OJP has been uplifted through collision with the Solomon Arc.

6–3. Instrument and Methods

The dredge system used during the KH-17-J01 is as illustrated in Figure 6–2. The chief components of the system are a transponder, a pinger, a chain, a 200-kg weight, a pipe dredge or a camera sledge, fuse wires, life wires, and the Satsuki-type box-shaped dredge with a mounted camera system. The dredge assemblage was connected to the ship-board winch wire (14 mm in diameter).

1. The transponder is used to estimate the position of the dredge system. It is attached to the winch wire approximately 250 m above its end.

2. The pinger is used to estimate the altitude of the winch wire during dredging. It is attached to the winch wire approximately 200 m above its end.

3. The chain is used to stabilize the dredge on the sea floor during operation. It is 5 m long and 19

mm in diameter. It is connected to the winch wire by shackles (3.25 ton) and a swivel (5 ton).
4. The weight keeps the dredge on the sea floor during operation. A weight of 200 kg was used and connected to the chain by a fuse wire (0.25 m long), a life wire covered with a hose (2.3 m long), shackles (1.2 ton), and a swivel (1 ton).
5. The pipe dredge is connected to the chain by a fuse wire (0.25 m long), a life wire covered with a hose (1.5 m long), shackles (0.6 ton; 1.2 ton), and a swivel (1 ton). The camera sledge (Mago-camera, Figure 6–2) is connected to the chain by a fuse wire (0.25 m long), a life wire covered with a hose (1.5 m long), shackles (1.2 ton), and a swivel (1 ton). Either the pipe dredge or the camera sledge was used at each dredge site.
7. The dredge is connected to the chain by a fuse wire (0.25 m long), a life wire covered with a hose (4.6 m long), shackles (2 ton; 3.25 ton), a swivel (3 ton), and a master ring (5 ton). The box-shaped dredge, developed by Dr. Izumi Sakamoto of Tokai University, uses the technique of a mousetrap and has a camera on top (Satsuki-type, Figure 6–2).
8. Following the regulation of Hakuhomaru, all of the fused wires used in the dredge system were 8 mm in diameter (3.22 ton of breaking force). As for life wires, 8 mm wires (3.22 ton of breaking force) were used for dredge sites deeper than 3400 m, whereas 10 mm wires (5.03 ton of breaking force) were used for sites shallower than 3400 m.
9. The ship position was kept still above the starting point of the dredge during the lowering of the dredge assembly. The assembly was lowered at a full speed of 1 m/sec until the dredge was approximately 50 - 100 m above the seafloor, and then slowed down to a rate of 0.3 m/sec until the dredge touches the seafloor. As soon as the dredge landed on the seafloor, which was indicated by a decrease in wire tension, the winch was stopped. Then the dredge was pulled by the ship towards the end point at 0.5 knot (SOG). The position of the dredge and its movement was monitored by the transponder and pinger signals. If the ship reached the end point, or the distance between the ship and the transponder exceeded ~800 m, the wire was wound up at a rate of 0.3 m/sec until the dredge leaves the bottom.

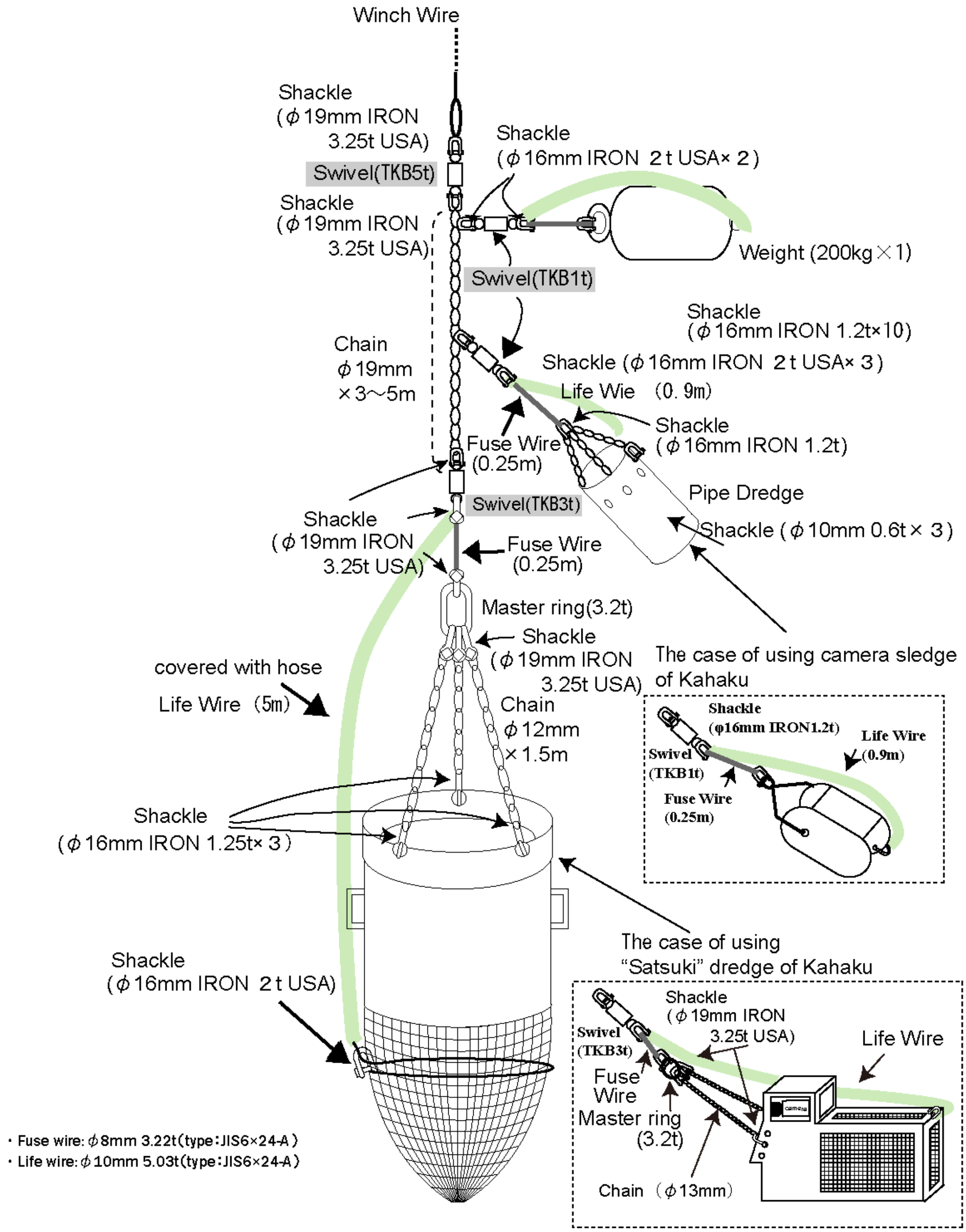

Figure 6–2. Detailed assembly of Satsuki-type dredge with camera and LED-light system.

6–4. Research results

Dredge hauls were conducted along steep seaward slopes northeast of Malaita, Solomon Island. The slopes are probably outcrops of thrust faulted sedimentary and upper crust section scraped off from the subducting Ontong Java Plateau and transferred to the Solomon Arc. Dredge locations were divided into three areas; southeast, central, and northwest (Figure 6–1). Hauls generally consisted of large amounts of sediments (i.e., mud) with variable amounts of sedimentary and basement rock (e.g., basalt) fragments, and pumice dropstones. Thin manganese crusts are sometimes present in the sedimentary rocks and basalts. For the purpose of description, basement rock types were grouped by similar characteristics and given sample numbers. However, sedimentary rocks were not described in detail (i.e., we did not describe cut surface) because they were not of primary interest and there was no experienced scientist on board to make such descriptions.

In all, dredges were taken from 14 stations during the 3-day survey period from January 27 to 30, 2017. Three stations (D1–D3) are in the southeast area, six stations (D4–7, D9–10) are in the central area, and five stations (D8, 11–14) are in the northwest area (Figure 6–1).

The main target for dredging was to recover samples from basement outcrops, because we hope to recover basement rocks amenable to radiometric dating and several kinds of geochemical analyses. Basement blocks were recovered in dredges D4, D9 and D10. Small, altered basalt fragments were also found within mud in dredges D5, D6, D7 and D8. These latter samples would be of no value for radiometric analysis and are of uncertain value for geochemical analysis. Sediments and sedimentary rocks were recovered in all dredge stations. Most of the sedimentary rocks are calcareous mudstone and limestone. Small amount of chert was also recovered. The position and depth of the dredge sites are summarized in Table 6–1. The total weight of the recovered rocks is 679 kg, out of which 245 kg is basement rocks.

Another target for dredging was mantle xenoliths and xenocrysts that may have been present in the northwest area, based on the location of alnoite occurrences in Malaita. Since several kinds of mantle xenoliths were collected from the northern part of Malaita Island, we expected to recover such samples seaward of this part of the island. However, we did not collect any xenolith from the northwest area.

We succeeded to take sediment and basement outcrops on video.

D1 (January 27, 2017)

This dredge was conducted on the eastern slope of the southeast area. The objective of the first dredge is to check the presence of basement outcrop in this area. Since the basement is covered by sedimentary layers, we selected relatively deep portion of the eastern slope. The dredge started at 4,129 m beneath sea level (mbsl) and ended at 3,631 mbsl.

Recovered samples were calcareous mudstones buried in a large amount of mud with high viscosity. Some mudstone fragments are covered by film of manganese crusts.

D2 (January 27, 2017)

The second station is also in the eastern slope of the southeast area. Depth of the D2 station (3,257–2,744 mbsl) is shallower than that of D1 because we expected to recover upper part of basement rocks. Since descriptions of D1 samples (no basement rock was sampled) were not finished before the beginning of the D2 dredge, we could not avoid failure to recover basement rocks.
Most recovered samples are mudstones coated by manganese crusts buried in mud with high viscosity. No basement rocks were sampled.

D3 (January, 27~28, 2017)
We selected the deepest part of the southeast area for the D3 station because only sedimentary rock samples were recovered from D1 station. The dredge started at 4,670 mbsl and ended at 4,374 mbsl. Unfortunately, still no basement rock was sampled from D3 station. Recovered samples were only calcareous mudstones buried in a large amount of mud with high viscosity.

D4 (January, 28, 2017)
Since no basement rocks were collected from D1 to D3 station, we gave up recovering basement rocks in the southeast area and moved to central area. The D4 dredge was conducted on the deepest part of the northern slope in the central area. The dredge started at 3,218 mbsl and ended at 2,817 mbsl.
The first successful recovery of basement rocks was at this station. The recovered basement rocks are a large (~10 cm) block and several volcanic rock fragments (size <5 cm) that consist of massive, vesicular, and amygdaloidal basaltic rocks. The basement rocks are aphyric to sparsely olivine-plagioclase phyric and olivine-plagioclase-augite phyric basalts. Limestones and other calcareous mudstones are also recovered. Another notable occurrence at this station is the discovery of a leaf fossil in mudstone.

D5 (January 28, 2017)
In the central and northwest areas, some NW-SE trending mounds are present (Figure 6–1), and they are likely composed of folded and thrust faulted sedimentary rocks and basement rocks. The D5 station is the north side of one small mound. The dredge started at 3,370 mbsl and ended at 2,916 mbsl.
Recovered samples are small basement clasts (< 5cm), blocks of volcanic pisolites, some pumice dropstones, and many calcareous mudstones buried in mud with high viscosity. Most basement clasts are aphyric to sparsely plagioclase phyric basalts, but a few of them are moderately to highly plagioclase phyric basalts.

D6 (January 28, 2017)

This dredge was conducted on the southern slope of one of the largest mounds in the central area (Figure 6–1). We first tried to collect basement rocks from southern slope of the mounds, and the dredge started at 3,397 mbsl and ended at 2,948 mbsl.
Recovered samples are small volcanic rock fragments (< 5cm), variable sizes of calcareous mudstone, and small fragments of chert (<2 cm) within mud. Most volcanic rock fragments are highly altered and aphyric, sparsely to moderately plagioclase phyric, plagioclase-augite phyric, and olivine-plagioclase- augite phyric basalts.

D7 (January 28, 2017)
In order to confirm the presence of basement rocks along the south side of the large mound, D7 dredge was conducted near the D6 station (Figure 6–1). The dredge started at 2,898 mbsl and ended at 2,886 mbsl.
Similar to D6 station, recovered samples are small volcanic rock fragments (< 6cm), variable sizes of calcareous mudstone buried in mud with high viscosity. The volcanic rock fragments are relatively fresh compared to those of D6 station, and they are sparsely to moderately plagioclase-augite phyric basalts.

D8 (January 28~29, 2017)
We moved to the northwest area and the D8 dredge was taken at the northern slope of a NW-SW trending mound. We expected to collect basement rocks because the D8 slope is the steepest among those mapped in the research area. The dredge started at 3,400 mbsl and ended at 3,003 mbsl.
We have sampled basement rocks, but they are only pebble (< 2cm in size) of basaltic fragments. Main recovered samples are calcareous mudstone, manganese crusts, and chert buried in viscous mud.

D9 (January 29, 2017)
Dredge results at D8 station tell us that basement outcrop may have not been present in the northwest area. We therefore decided to come back to the central area to collect a large amount of basement samples by dredging of basement outcrop. We have selected D9 station near D4 station for the best place to recover the basement samples. The dredge started at 2,831 mbsl and ended at 2,785 mbsl.
We have succeeded to recover a large amount of basement rocks. They are many basaltic blocks (up to 35 kg) and subordinate volcaniclastics. The basaltic blocks included a variety of rock types with aphyric, olivine-phyric, plagioclase-phyric, and plagioclase-augite phyric, as well as massive, coarser-grained rocks. They are weakly to strongly vesiculated and some are amygdaloidal. Vesicles are occasionally filled with calcite, zeolite, and other secondary minerals. Some basaltic blocks are

fresh, but all volcaniclastic rocks are highly altered.

D10 (January 29, 2017)

Similar to D9 dredge, D10 dredge was conducted near D4 station, in the northern slope of the central area, to get a lot of basement rocks. The dredge started at 3,139 mbsl and ended at 2,941 mbsl. Recovered samples are basement blocks, volcaniclastics, and calcareous mudstone. The basement blocks are generally aphyric, but olivine phyric, olivine-augite phyric and olivine-plagioclase phyric rocks are also present. Several crystal sizes, from aphanitic to coarse-grained, are found in the aphyric rocks. Most basement rocks have altered rinds and some of them are amygdaloidal basalts. The volcaniclastics are epiclastic rocks with rounded basaltic clasts and limestone cemented by volcanic sand.

D11 (January 29, 2017)

Since we have succeeded to collect plenty of basement rocks from D4, D9, and D10 stations, we changed our target to mantle xenoliths that we expected to be present in the northwest area. The D11 station is located in the southeastern slope of a mound in the northwest area (Figure 6–1). The dredge started at 3,789 mbsl and ended at 3,426 mbsl.

Recovered samples are only unsolidified mudstone in viscous mud.

D12 (January 29~30, 2017)

In order to grant the xenolith sampling that was requested by one of the shipboard scientists, we decided to dredge the northwest area until the end of the dredge operation. The D12 dredge was conducted on the northern slope of the northwest area (Figure 6–1). The dredge started at 3,470 mbsl and ended at 3,159 mbsl.

Recovered samples are mainly carbonates, mudstones, cherts, and manganese crusts in viscous mud. A highly altered basaltic fragment was also recovered.

D13 (January 30, 2017)

The dredge was conducted on the northern bay slope of a mound in the northwest area (Figure 6–1). The dredge started at 3,989 mbsl and ended at 3,490 mbsl.

Recovered samples are only mudstones in viscous mud.

D14 (January 30, 2017)

The final dredge was conducted on the eastern slope of a small mound in the northwest area (Figure 6–1). The dredge started at 3,980 mbsl and ended at 3,967 mbsl.

Recovered samples are carbonates, mudstones and manganese crusts in viscous mud.

Table 6–1. The position and depth of the dredge sites.

Dredge number	On the bottom						Tension max. (t)
	Date Time (UTC)	Lat. (Transponder)	Lon. (Transponder)	Lat. (Ship)	Lon. (Ship)	Depth (m)	
D1	2017/1/27 13:18	9-28.1702 S	162-04.3824 E	9-28.2082 S	162-04.4658 E	4,129	4.7
D2	2017/1/27 18:53	9-19.4301 S	161-59.7388 E	9-19.4065 S	161-59.6716 E	3,257	5.6
D3	2017/1/27 23:33	9-16.4071 S	162-06.5986 E	9-16.5746 S	162-06.5500 E	4,670	4.3
D4	2017/1/28 6:10	8-59.7017 S	161-45.2216 E	8-59.7450 S	161-45.1763 E	3,218	3.2
D5	2017/1/28 10:32	8-53.9927 S	161-40-7699 E	8-54.0517 S	161-40.8707 E	3,370	2.8
D6	2017/1/28 15:12	8-50.6693 S	161-42.1394 E	8-50.6210 S	161-42.1514 E	3,397	3.6
D7	2017/1/28 20:23	8-50.3007 S	161-41.6176 E	8-49.8646 S	161-41.7915 E	2,898	3.7
D8	2017/1/29 1:02	8-41.3905 S	161-27.7931 E	8-41.2938 S	161-27.9091 E	3,400	2.7
D9	2017/1/29 7:34	9-00.2976 S	161-45.7324 E	9-00.7649 S	161-45.9552 E	2,831	4.2
D10	2017/1/29 11:01	8-58.4185 S	161-43.3647 E	8-58.4209 S	161-43.4353 E	3,139	2.5
D11	2017/1/29 17:26	8-35.4953 S	161-19.1266 E	8-35.5448 S	161-19.0694 E	3,789	3.1
D12	2017/1/29 22:25	8-42.2918 S	161-24.5135 E	8-42.4709 S	161-24.5104 E	3,470	3.6
D13	2017/1/30 3:11	8-37.1017 S	161-24.6024 E	8-37.2009 S	161-24.5802 E	3,989	3.0
D14	2017/1/30 8:18	8-32.6985 S	161-22.7093 E	8-32.6312 S	161-22.3266 E	3,980	3.8

Dredge number	Off the bottom						Survey time
	Date Time (UTC)	Lat. (Transponder)	Lon. (Transponder)	Lat. (Ship)	Lon. (Ship)	Depth (m)	
D1	2017/1/27 15:07	9-27.7874 S	162-04.1995 E	9-27.6751 S	162-04.0809 E	3,631	1h49min
D2	2017/1/27 19:54	9-19.4104 S	161-59.3366 E	9-19.3736 S	161-59.2617 E	2,744	1h1min
D3	2017/1/28 0:44	9-16.3418 S	162-06.1895 E	9-16.4123 S	162-05.9897 E	4,374	1h11min
D4	2017/1/28 7:09	8-59.6880 S	161-44.8550 E	8-59.6910 S	161-44.7785 E	2,817	59min
D5	2017/1/28 11:45	8-54.4587 S	161-40.7630 E	8-54.6022 S	161-40.8144 E	2,916	1h13min
D6	2017/1/28 16:20	8-50.2520 S	161-42.2835 E	8-50.0658 S	161-42.3478 E	2,948	1h8min
D7	2017/1/28 20:51	8-50.0268 S	161-41.7071 E	8-49.8622 S	161-41.7598 E	2,886	28min
D8	2017/1/29 2:07	8-41.1151 S	161-28.3509 E	8-41.0291 S	161-28.5300 E	3,003	1h5min
D9	2017/1/29 8:09	9-00.7741 S	161-45.9217 E	9-00.9111 S	161-46.0198 E	2,785	35min
D10	2017/1/29 11:47	8-58.6670 S	161-43.5965 E	8-58.7496 S	161-43.6949 E	2,941	46min
D11	2017/1/29 18:22	8-35.2912 S	161-18.6242 E	8-35.2939 S	161-18.5085 E	3,426	56min
D12	2017/1/29 23:27	8-42.6482 S	161-24.3901 E	8-42.8036 S	161-24.3928 E	3,159	1h2min
D13	2017/1/30 4:09	8-37.5255 S	161-24.3840 E	8-37.8064 S	161-24.3776 E	3,490	58min
D14	2017/1/30 8:43	8-32.6429 S	161-22.4676 E	8-32.6280 S	161-22.3169 E	3,967	25min

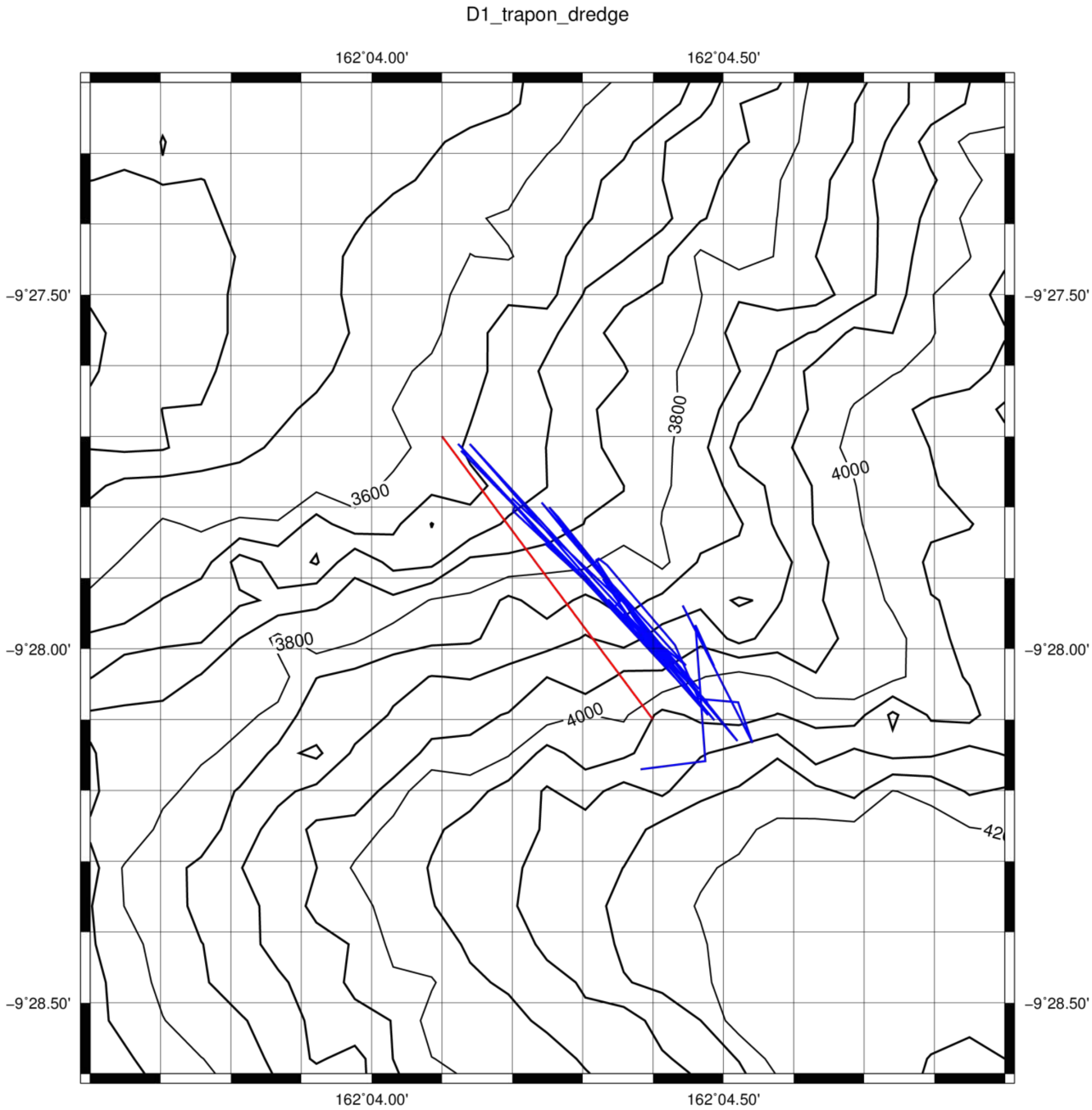

Figure 6–3 (A). Bathymetry of D1 dredge location. Red line is the scheduled track before the dredge and blue line shows dredge track traced by transponder.

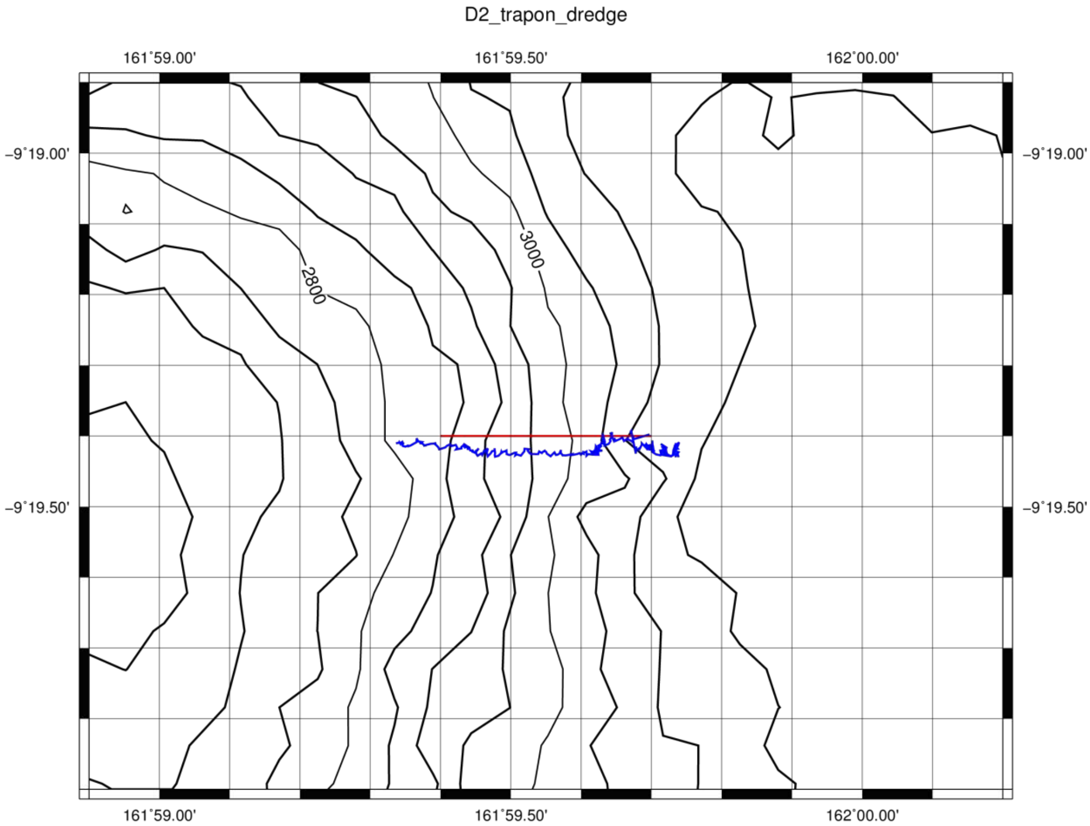

Figure 6–3 (B). Bathymetry of D2 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

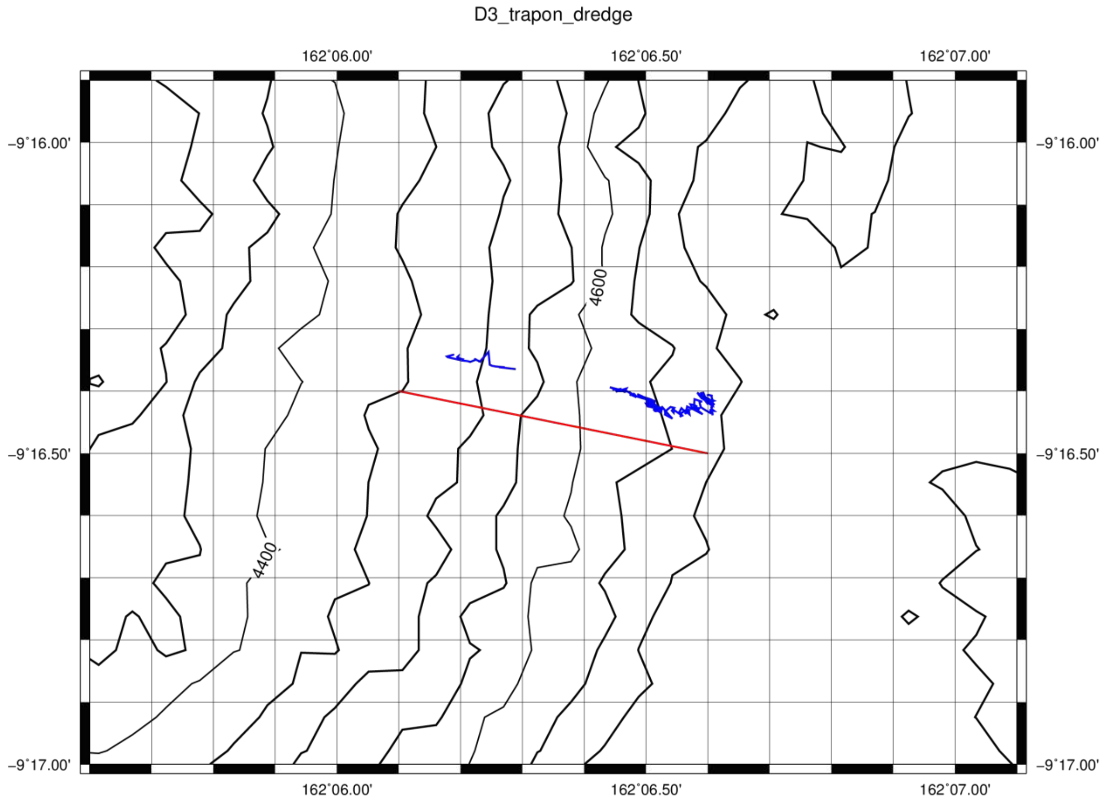

Figure 6–3 (C). Bathymetry of D3 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

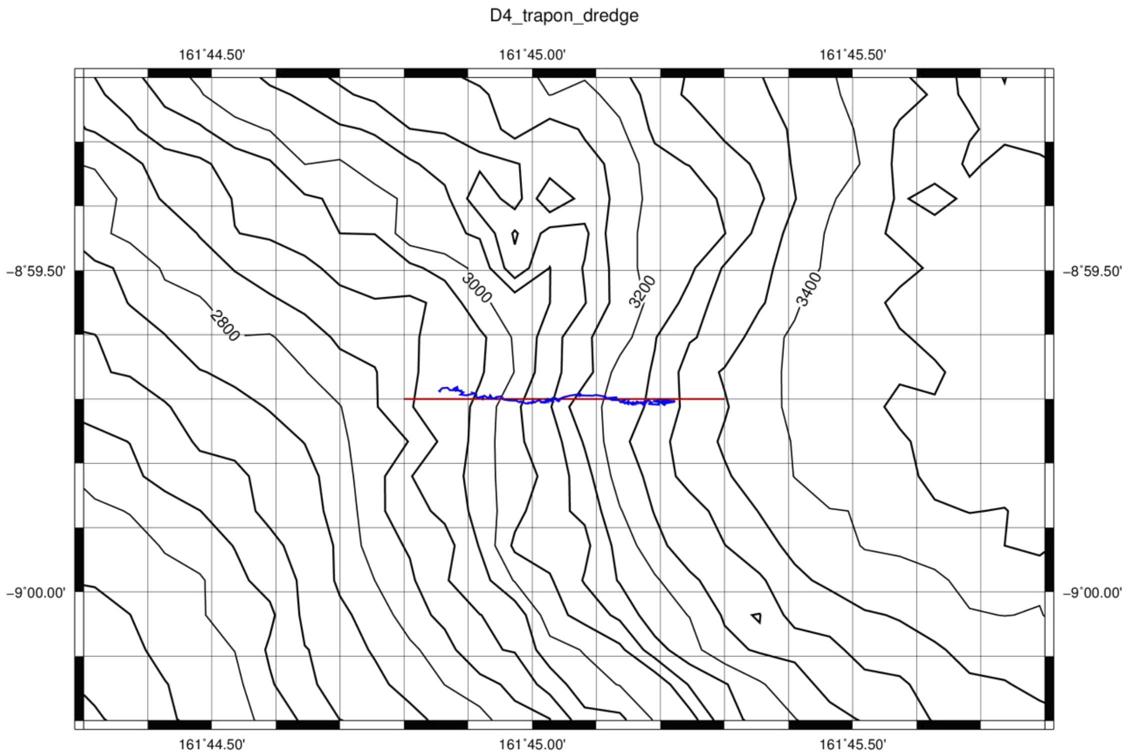

Figure 6–3 (D). Bathymetry of D4 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

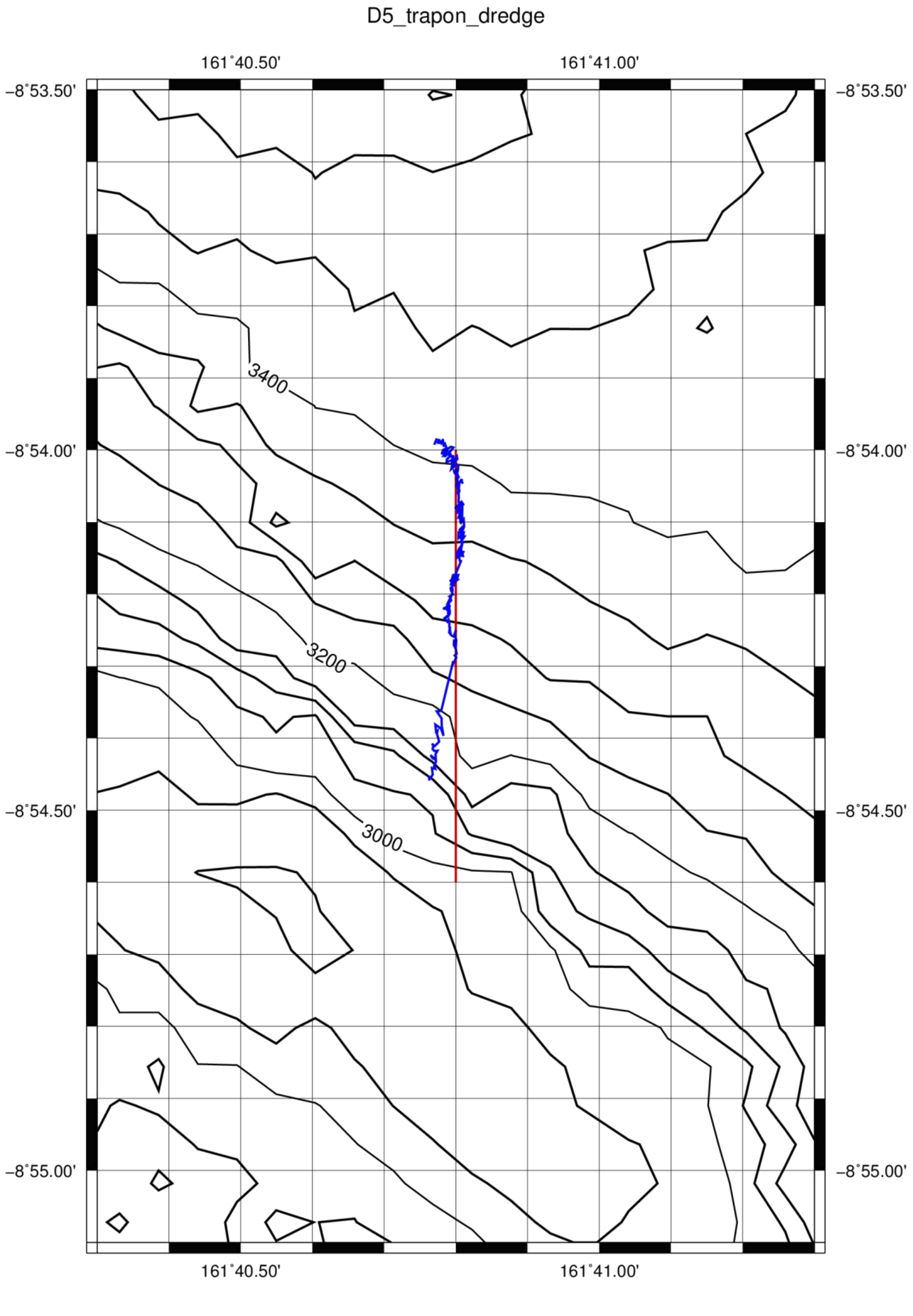

Figure 6–3 (E). Bathymetry of D5 dredge location. Bathymetry of D4 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

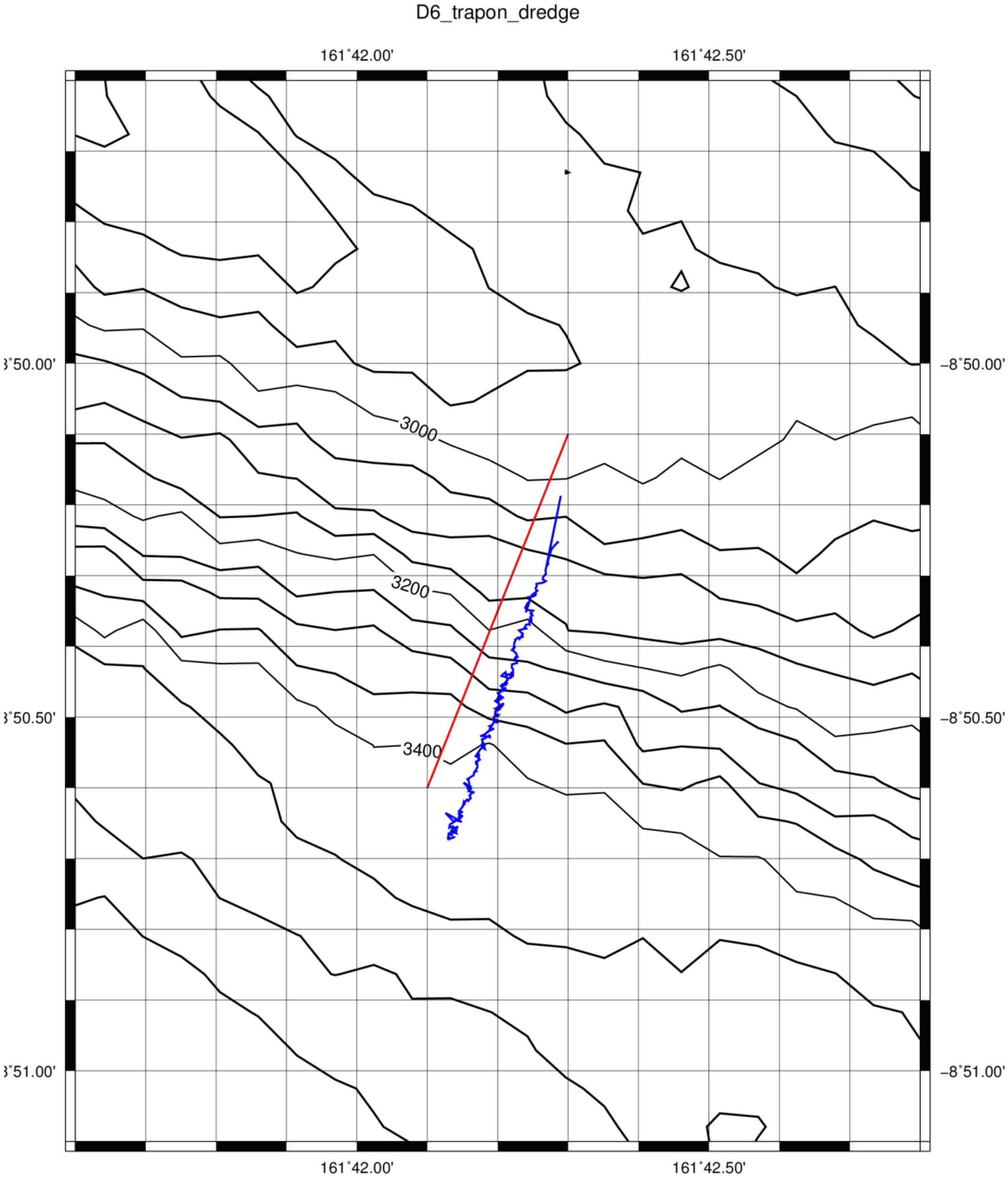

Figure 6–3 (F). Bathymetry of D6 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

D7_trapon_dredge

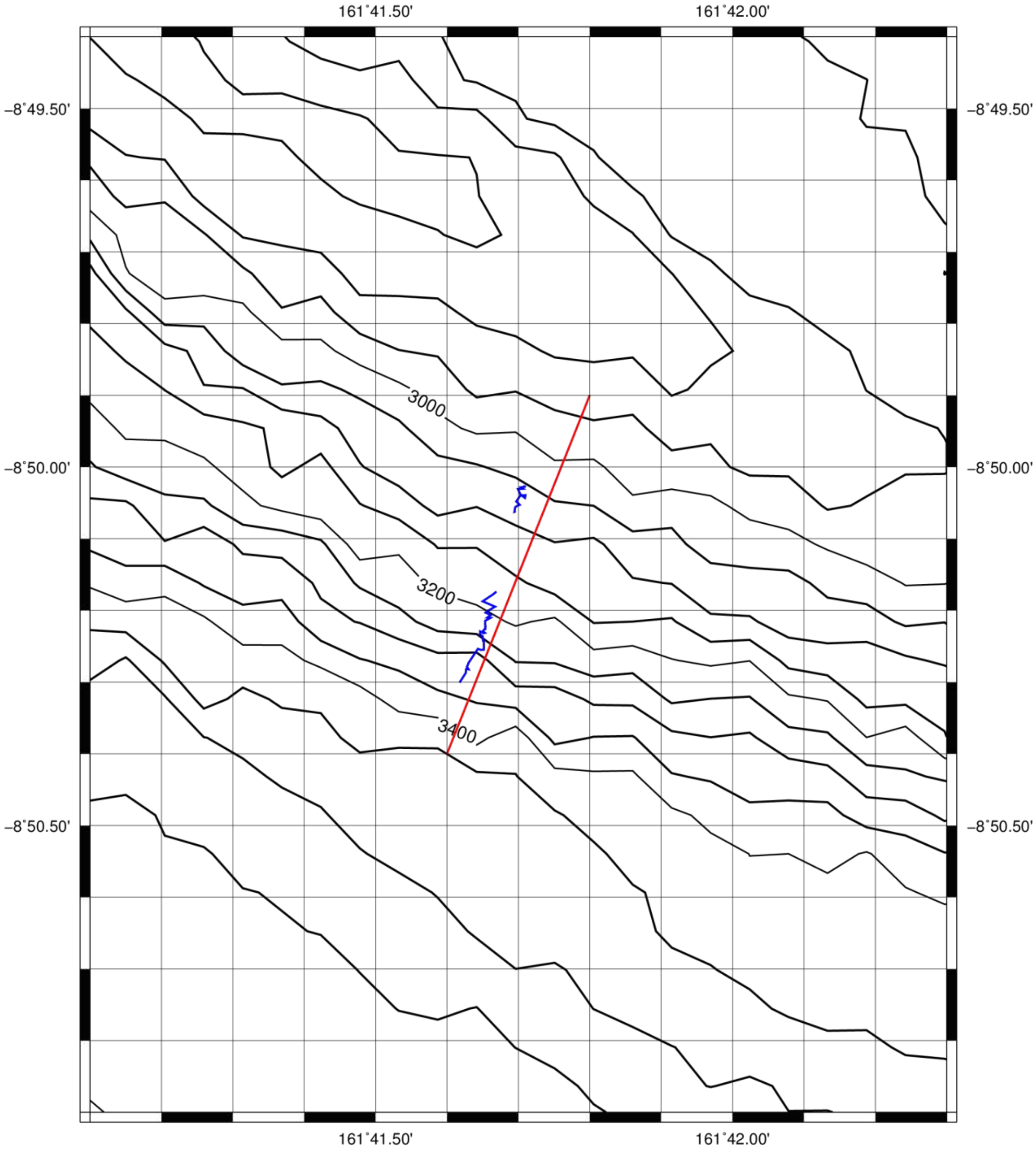

Figure 6–3 (G). Bathymetry of D7 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

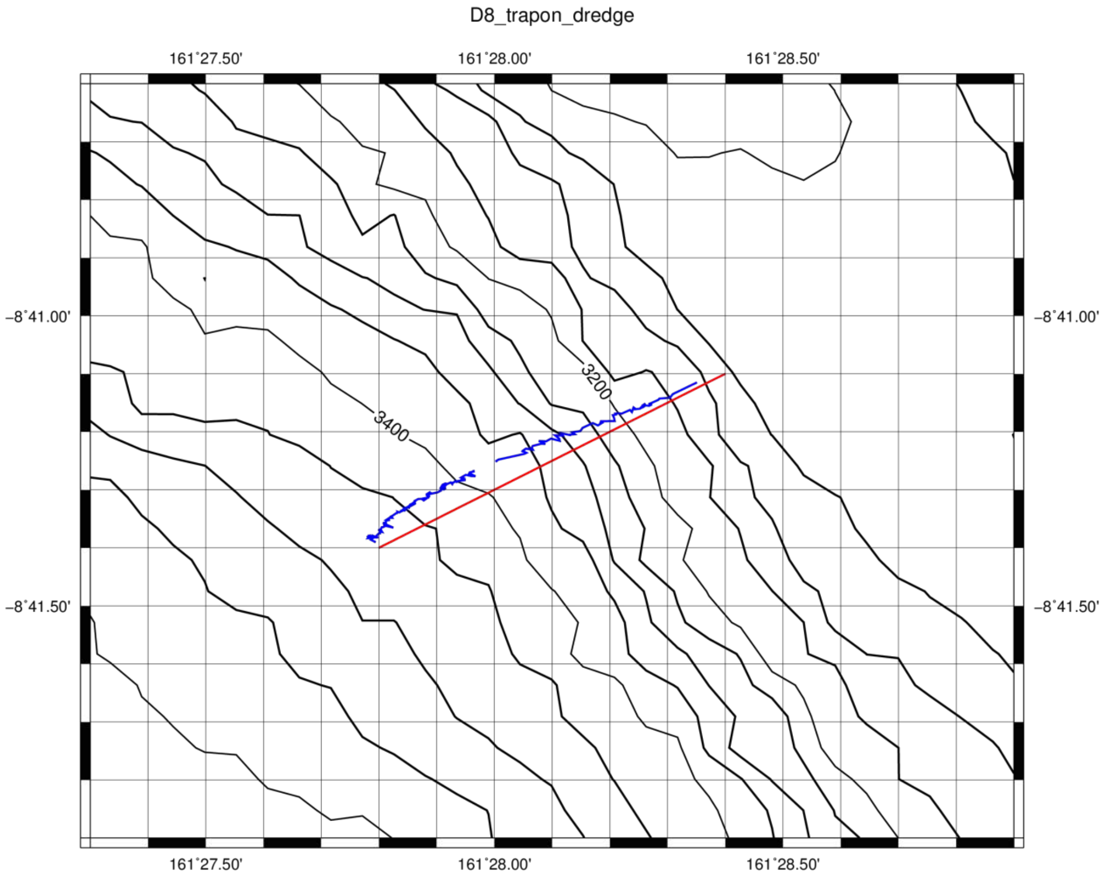

Figure 6–3 (H). Bathymetry of D8 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

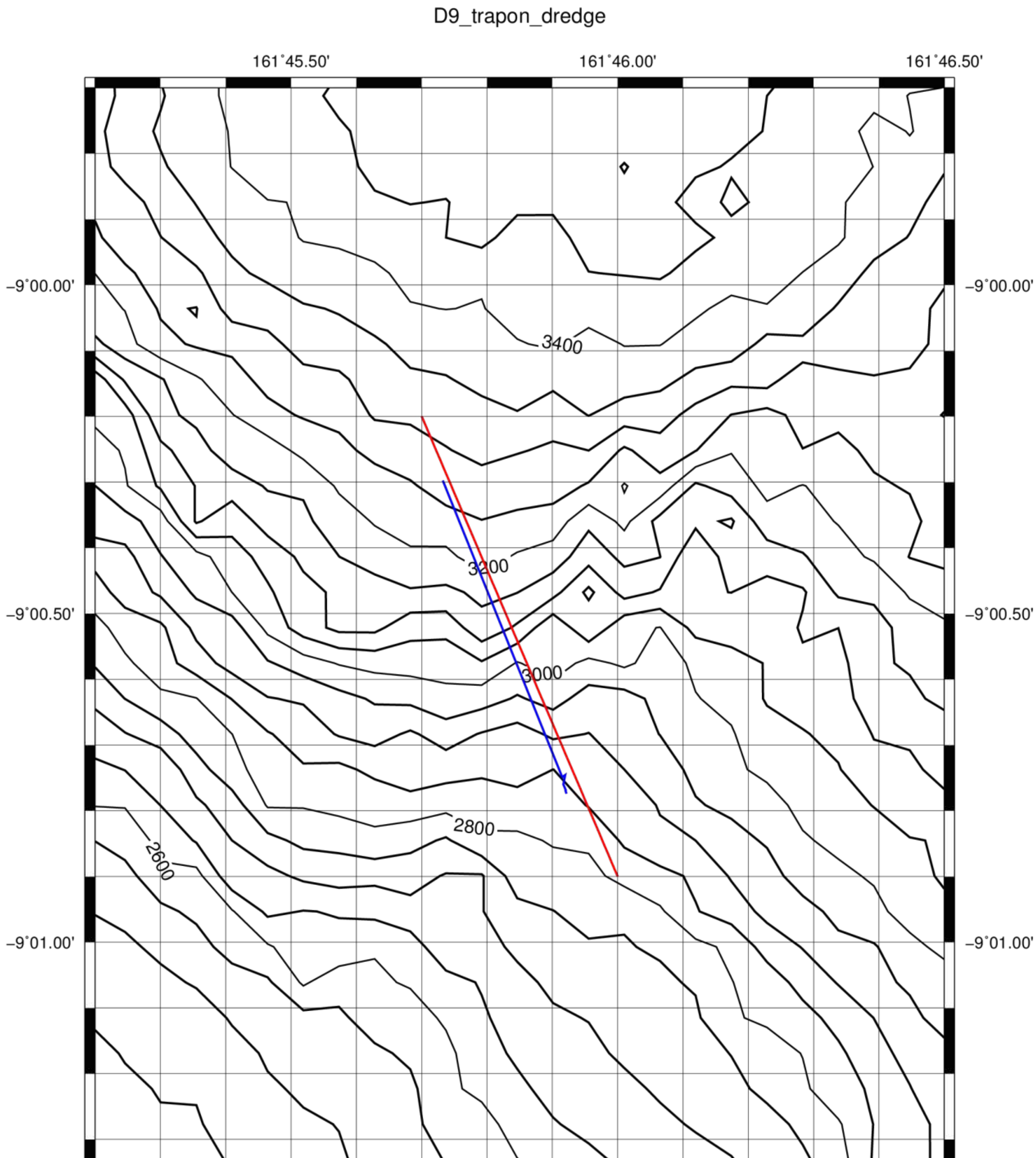

Figure 6–3 (I). Bathymetry of D9 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

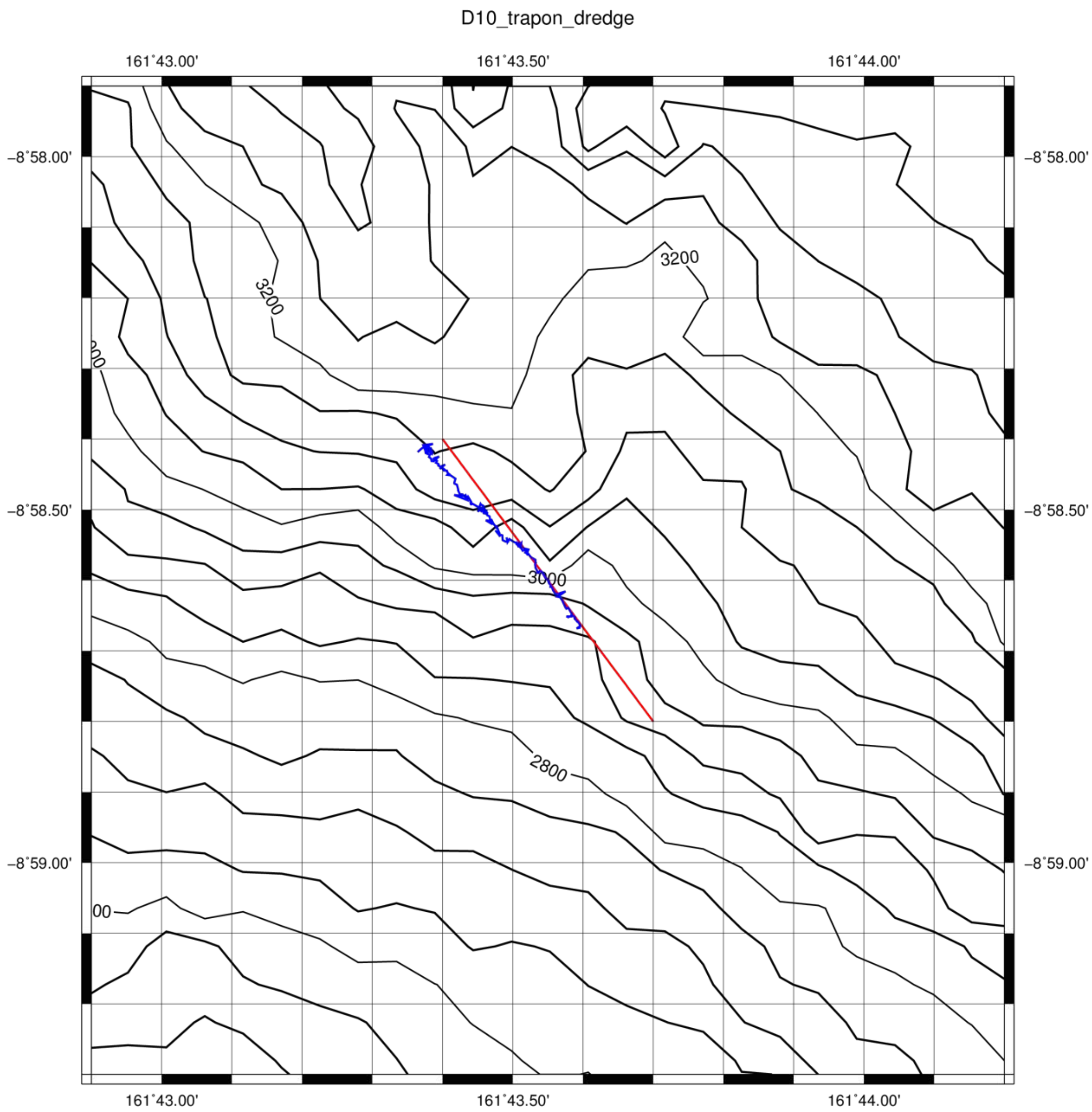

Figure 6–3 (J). Bathymetry of D10 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

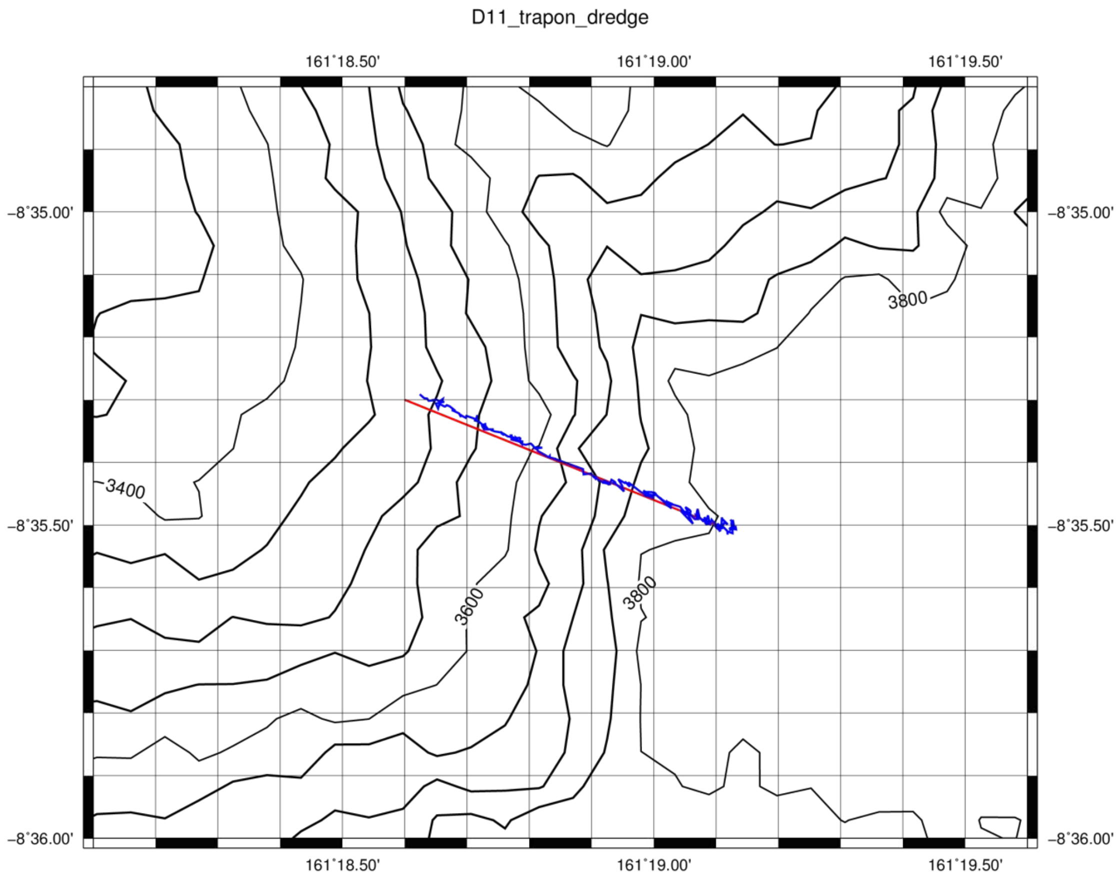

Figure 6–3 (K). Bathymetry of D11 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

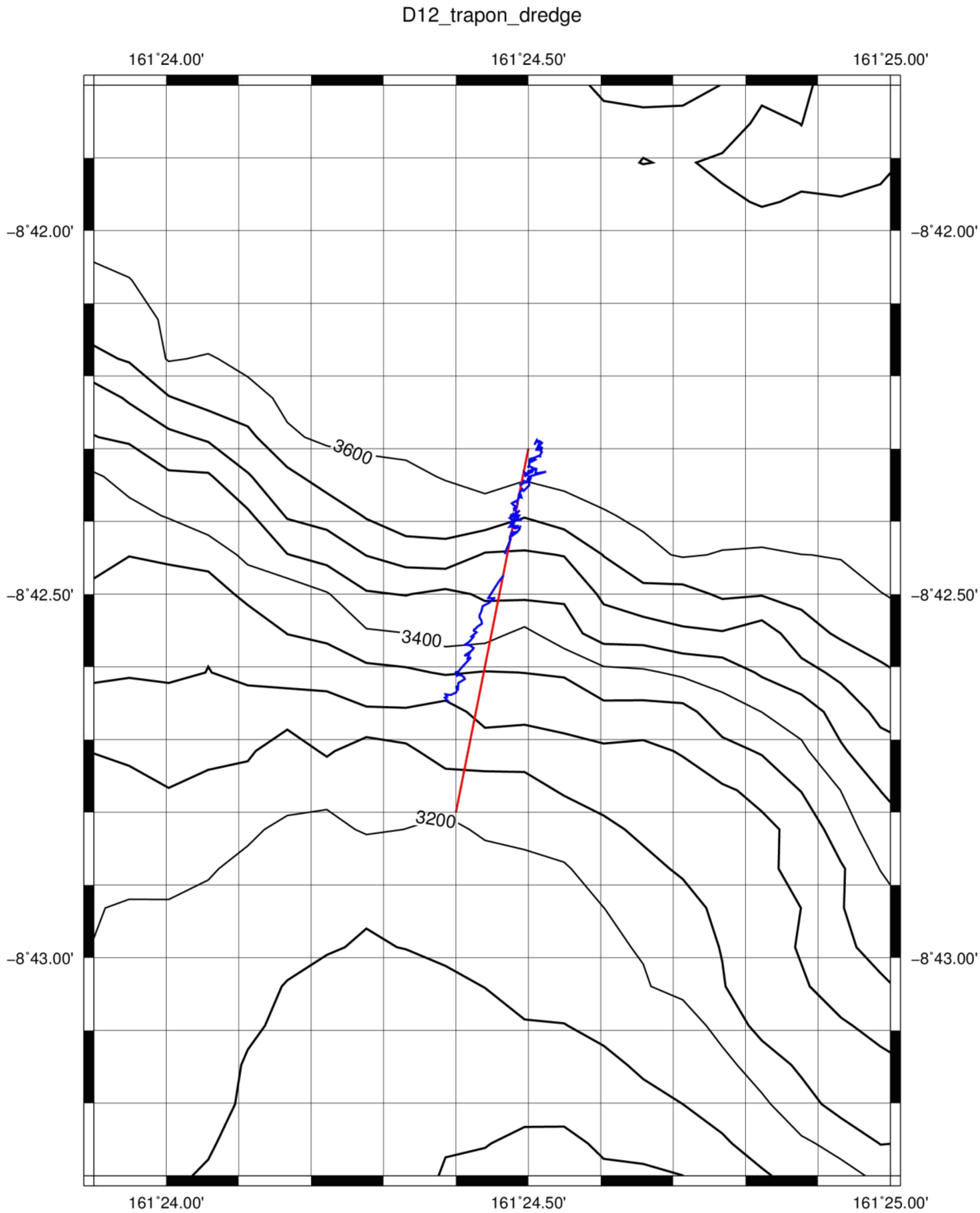

Figure 6–3 (L). Bathymetry of D12 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

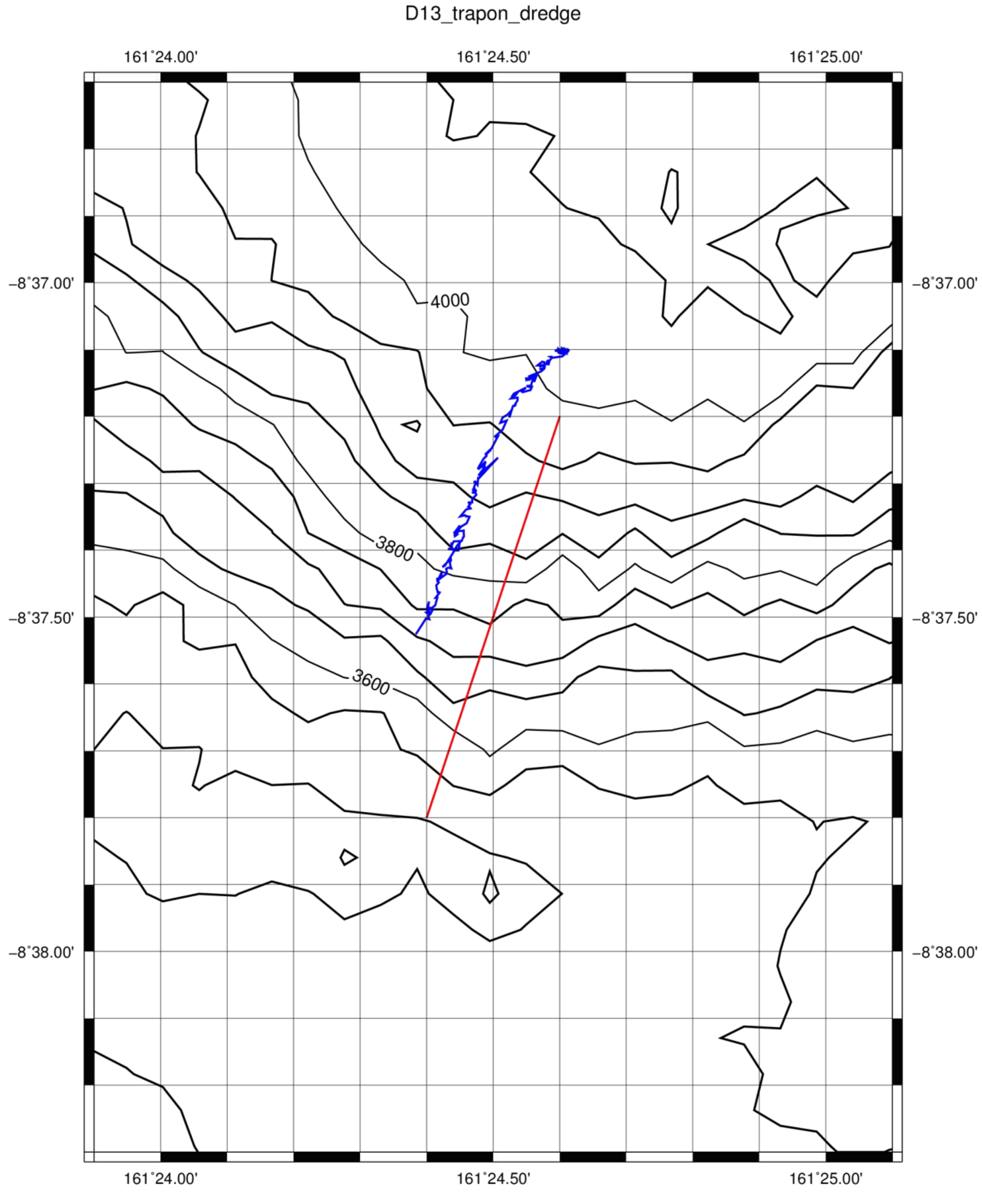

Figure 6–3 (M). Bathymetry of D13 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

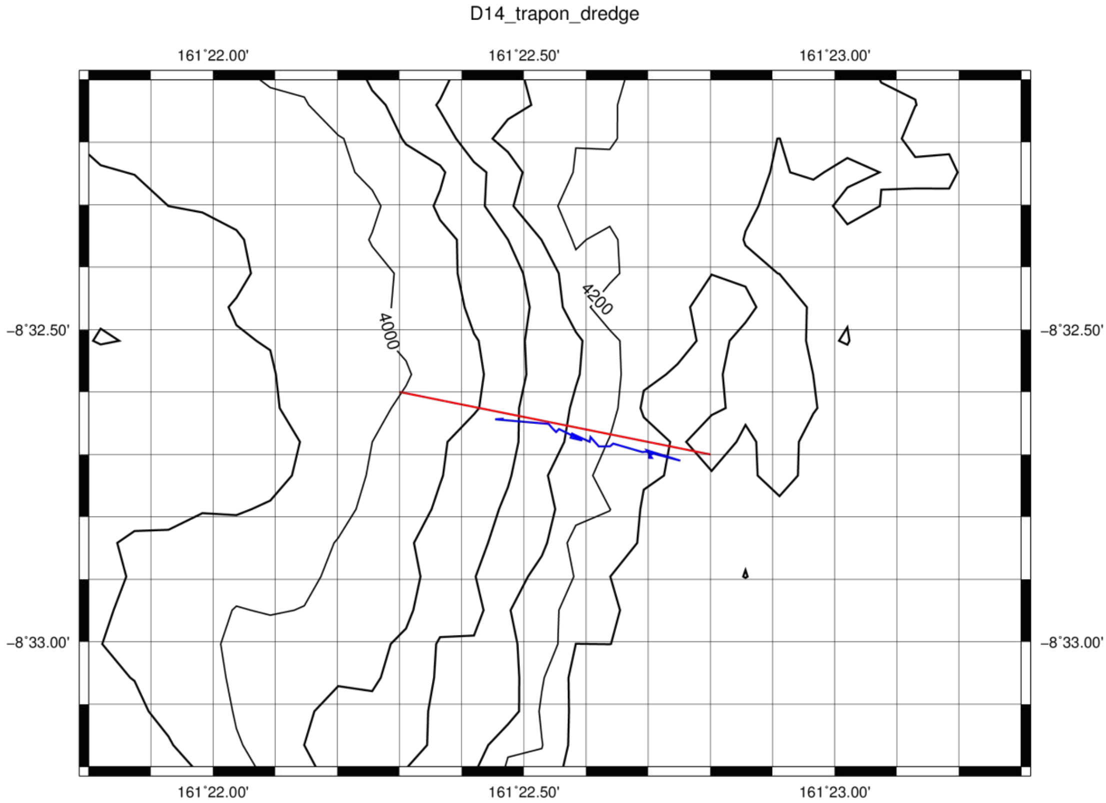

Figure 6–3 (N). Bathymetry of D14 dredge location. Red line is scheduled track before the dredge and blue line shows dredge track traced by transponder.

7. Underway geophysical observation

7-1. Personnel

Shoka Shimizu (Chiba University) (LEG1)

Masao Nakanishi (Chiba University, not on-board)

Daisuke Suetsugu (PI, Japan Agency for Marine-Earth Science and Technology) (LEG1)

Takashi Sano (National Museum of Nature and Science)

7.1. Proton magnetometer

7.1-1. Objectives

Measurement of total magnetic force on the sea is required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure.

7.1-2. Instruments and Methods

Total magnetic force was recorded during the cruise of LEG1. We measured total geomagnetic field using a proton magnetometer

The sensor fish towed 300 m behind the vessel to reduce the effects of the ship's magnetic field. Table 7.1. 1 shows system configuration of proton magnetometer system of this cruise.

Table 7.1.1 Setting of proton magnetometer

Cycle rate	6.0 sec
Isolation	3.0 sec
Sampling rate	20.0 sec

7.1-3. Data Period(UTC)

05:33 15 Jan. 2017 – 00:19 18 Jan. 2017

05:18 15 Jan. 2017 – 01:33 19 Jan. 2017

06:14 19 Jan. 2017 – 06:21 20 Jan. 2017

10:20 20 Jan. 2017 – 16:57 21 Jan. 2017

16:27 21 Jan. 2017 – 05:04 22 Jan. 2017

13:20 22 Jan. 2017 – 08:03 23 Jan. 2017

10:28 23 Jan. 2017 – 11:30 24 Jan. 2017

10:28 23 Jan. 2017 – 11:30 24 Jan. 2017

14:52 24 Jan. 2017 – 09:45 25 Jan. 2017

13:32 25 Jan. 2017 – 15:40 26 Jan. 2017

18:55 26 Jan. 2017 – 11:06 27 Jan. 2017

18:55 01 Feb.2017 – 09:25 02 Feb. 2017

12:40 02 Feb. 2017– 17:11 03 Feb. 2017

7.2. Shipboard three-component magnetometer

7.2-1. Objectives

Measurement of magnetic force on the sea is required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure.

7.2-2. Instruments and Methods

Magnetic force was recorded during the cruise of LEG1. We measured magnetic force using a shipboard three-component magnetometer. Three-component magnetometer consists of three-axes flux-gate sensors.

For calibration of the ship’s magnetic effect, we made a “figure-eight” turn (a pair of clockwise and anti-clockwise rotation). This calibration was carried out as below.

04:30 – 04:50 15 Jan. 2017 (UTC)
10:54 – 11:14 25 Jan. 2017 (UTC)
22:08 – 22:29 01 Feb.2017 (UTC)

7.3. Swath bathymetry

7.3-1. Objectives

Swath bathymetry is basic information for geology and geophysics.

7.3-2. Instruments and Methods

Bathymetry was recorded during the cruise. We used a multi-narrow beam echo sounder (SeaBeam 2100).

7.4. Shipboard gravimeter

7.4-1. Objectives

The local gravity is an important parameter in geophysics and geodesy.

7.4-2. Instruments and Methods

Relative gravity was recorded during the cruise. We used a shipboard gravimeter for the gravity measurement.

To convert the relative gravity to absolute gravity, we measured absolute gravity, using portable gravimeter, at Harumi as the reference point and Daiba and Pohnpei.

8. Cruise log

Date, time (SMT)	Location	Activity/Event
Jan. 9 14:00 15:00 15:45		 Departure from Odaiba liner, Tokyo The KH-17-J01 LEG1 is started. Continuous observations (Gravity meter, MBES, 3C-Magnetometer) are started. Meeting (onboard scientists, crew) Evacuation drill
Jan. 10		Transit
Jan. 11 13:00-14:00		Transit Seminar on the research of the Ontong Java Plateau
Jan. 12 14:00-15:00 21:00		Transit Seminar on the research of the Ojin Rise Time adjustment of SMT by +1 hour (SMT=UTC+10 hour)
Jan. 13 14:00-15:30		Transit Seminar on the research of the pMCS study of OJP and tomographic study of off the Boso Pen.
Jan. 14 14:00-15:00		Transit Seminar on the MT study in Hokkaido
Jan. 15 10:00-11:00 14:30-14:50 15:01	 16-26.699N, 154-34.251E 16-25.689N, 154-35.155E	Transit Seminar on the Ojin Rise Calibration of shipboard magnetometer Proton magnetometer launched
Jan. 16 01:00		 Time adjustment of SMT by +1 hour (SMT=UTC+11 hour)

14:00-16:00		Seminar on the research of *South Pacific mantle plumes *Estimation of T, H2O, CO2, melt, etc from EM data
Jan.17 14:00-16:00		 Seminar on the research of the OJP petrology and seismology
Jan. 18 12:01 15:05 15:58 16:15	 06-57.265N, 164-29.796E	 Proton magnetometer is recovered. Arrival at O23 site Recovered OBS on deck Recovered OBEM on deck Departure from O23 Proton magnetometer is launched
Jan. 19 13:31 13:44 15:47 16:56 17:00 17:10	 02-52.814N, 166-01.357E 02-52.264N, 166-01.581E 2-51.823N,166-02.212E	 Proton magnetometer is recovered. Arrival at O22 site Recovered OBS on deck Recovered OBEM on deck Departure from O22 Proton magnetometer is launched
Jan. 20 17:36 17:45 20:10 21:05 21:17	 00-01.450N, 170-00.245E 00-01.552N, 170-00.278E	 Proton magnetometer is recovered. Arrival at O21 site Recovered OBS on deck Recovered OBEM on deck Departure from O21 site Proton magnetometer is launched
Jan. 21		 Transit
Jan. 22 04:16 04:17 07:07 08:09	 02-56.823S, 174-00.051E 02-56.745S, 174-59.442E	 Proton magnetometer is recovered. Arrival at O20 site Recovered OBS on deck Recovered OBEM on deck

08:15		Departure from O20 site
08:26	02-57.486S, 174-58.473E	Proton magnetometer is launched
16:15	04-05.702S, 173-52.935E	Proton magnetometer is recovered.
Jan. 23		
19:19	08-00.593S, 170-03.325E	Proton magnetometer is recovered.
19:25	08-00.729S, 170-03.190E	Arrival at O19 site
21:10		Recovered OBS on deck
21:15		Departure from O19 site
21:27	07-59.826S, 170-02.492E	Proton magnetometer is launched.
Jan. 24		
22:48	03-53.272S, 166-42.490E	Proton magnetometer is recovered.
22:57	03-53.272S, 166-42.490E	Arrival at O18 site
00:07		Recovered OBS on deck
01:29		Recovered OBEM on deck
01:40		Departure from O18 site
01:50	03-57.486S, 166-58.473E	Proton magnetometer is launched
Jan. 25		
21:04	00-59.408S, 164-00.834E	Proton magnetometer is recovered.
21:18	00-59.112S, 164-00.514E	Arrival at O17 site
21:54-22:14		Calibration of shipboard magnetometer
23:15		Recovered OBS on deck
00:10		Recovered OBEM on deck
00:27	01-00.237S,164-00.548E	Departure from O17 site
		Proton magnetometer is launched
Jan. 26		
		Transit
Jan. 27		
02:54	03-53.272S, 166-42.490E	Proton magnetometer is recovered.
02:58	03-53.272S, 166-42.490E	Arrival at O16 site
04:44		Recovered OBS on deck
05:35		Recovered OBEM on deck
05:50		Departure from O16 site
	03-57.486S, 166-58.473E	Proton magnetometer is launched.
22:14		Proton magnetometer is recovered.
22:34		Arrival at D1 site (survey line 11)

		Dredge started
Jan. 28		
00:18	09-28.2082S, 162-04.4658E, 4129m	Dredger on seafloor
02.07		Dredger detached from seafloor
03:08		Dredger recovered on deck
04:38		Dredge started at D2 (survey line 3).
05:53	09-19.4065S, 161-59.6716E, 3257m	Dredger on seafloor
06:54	09-19.3736S, 161-59.2617E, 2744m	Dredger detached from seafloor
07:54		Dredger recovered on deck
08:57		Dredge started at D3 (survey line 32).
10:33	09-16.5746S, 162-06.5500E, 4670m	Dredger on seafloor
11:44	09-16.4123S, 162-05.9897E, 4374m	Dredger detached from seafloor
13:12		Dredger recovered on deck
15:52		Dredge started at D4 (survey line 29).
17:10	08-59.745S, 161-45.176E, 3218m	Dredger on seafloor
18:09	08-59.691S, 161-44.779E, 2817m	Dredger detached from seafloor
19.12		Dredger recovered on deck
20:14		Dredge started at D5 (survey line 26).
21:32	08-54.0517S, 161-40.8707E, 3370m	Dredger on seafloor
22:45	08-54.6022S, 161-40.8144E, 2916m	Dredger detached from seafloor
23:56		Dredger recovered on deck
Jan. 29		
00:57		Dredge started at D6 (survey line 20).
02:12	08-50.6210S, 161-42.1514E, 3397m	Dredger on seafloor
03:20	08-50.0658S, 161-42.3478E, 2948m	Dredger detached from seafloor
04:51		Dredger recovered on deck
05:35		Dredge started at D7 (survey line 18).
07:23	08-49.8646S, 161-41.7915E, 2898m	Dredger on seafloor
07:51	08-49.8622S, 161-41.7598E, 2886m	Dredger detached from seafloor
09:07		Dredger recovered on deck

10:44		Dredge started at D8 (survey line 34).
12:02	08-41.2938S, 161-27.9091E, 3400m	Dredger on seafloor
13:07	08-41.0290S, 161-28.5308E, 3003m	Dredger detached from seafloor
14:09		Dredger recovered on deck
16:46		Dredge started at D9 (survey line 30B).
18:34	09-00.7649S, 161-45.9552E, 2831m	Dredger on seafloor
19:09	09-00.9111S, 161-46.0198E, 2785m	Dredger detached from seafloor
20:10		Dredger recovered on deck
20:52		Dredge started at D10 (survey line 28B).
22:01	08-58.4209S, 161-43.4353E, 3139m	Dredge on seafloor
22:47	08-58.7496S, 161-43.6949E, 2941m	Dredge detached from seafloor
23:50		Dredge recovered on deck
Jan. 30		
03:04		Dredge started at D11 (survey line 41).
04:26	08-35.5448S, 161-19.0694E, 3789m	Dredger on seafloor
05:22	08-35.2939S, 161-18.5085E, 3426m	Dredger detached from seafloor
06:32		Dredger recovered on deck
08:06		Dredge started at D12 (survey line 36).
09:25	08-42.4709S, 161-24.5104E, 3470m	Dredger on seafloor
10:27	08-42.8036S, 161-24.3928E, 3159m	Dredger detached from seafloor
11:46		Dredger recovered on deck
12:46		Dredge started at D13 (survey line 35).
14:11	08-37.2009S, 161-24.5802E, 3989m	Dredger on seafloor
15:09	08-37.8064S, 161-24.3776E, 3490m	Dredger detached from seafloor
16:24		Dredger recovered on deck
17:22		Dredge started at D14 (survey line 40).
19:18	08-32.6312S, 161-22.3266E, 3266m	Dredger on seafloor
19:43	08-32.6280S, 161-22.3169E, 3967m	Dredger detached from seafloor
21:07		Dredger recovered on deck
Jan. 31		

12:14 13:39 14:21 14:25	05-57.891S, 160-02.448E	Arrival at O15 site Recovered OBEM on deck Recovered OBS on deck Departure from O15 site
Feb. 1 09:30 10:45 11:38 11:39	 02-08.865S, 159-55.628E	 Arrival at O14 site Recovered OBS on deck Recovered OBEM on deck Departure from O14 site
Feb. 2 07:57 09:02 10:19 10:25 20:40 20:48 22:30 23:22 23:37	 01-55.580S, 160-00.984E 04-00.098S, 159-55.057E 04-00.098S, 159-55.057E	 Arrival at O13 site Recovered OBS on deck Recovered OBEM on deck Proton magnetometer launched Departure from O13 site Proton magnetometer recovered Arrival at O12 site Recovered OBS on deck Recovered OBEM on deck Proton magnetometer launched Departure from O12 site
Feb. 3		 Transit
Feb. 4 04:28 04:32 07:09 07:48 07:50 19:20	 08-00.774S, 156-01.468E	 Proton magnetometer recovered Arrival at O11 site Recovered OBS on deck Recovered OBEM on deck Departure from O11 site Gravity meter/MBES are terminated.
Feb. 5 10:30		 Arrival at the Pohnpei port KH-17-J01 LEG1 is completed.
Feb. 6		Stay at the Pohnpei port

Feb. 7 15:01 13:00 13:30 15:01		 Departure from the Pohnpei port KH-17-J01 LEG2 is started Evacuation drill Meeting (onboard scientists, crew)The Continuous observations (Gravity meter and MBES) are started
Feb. 8 03:14 05:05 05:44 05:45 21:02 22:17 22:51 22:52	 05-00.560N, 156-00.770E 02-01.296N, 156-00.443E	 Arrival at O10 site Recovered OBS on deck Recovered OBEM on deck Departure from O10 site Arrival at O09 site Recovered OBS on deck Recovered OBEM on deck Departure from O09 site
Feb. 9 08:57 09:58 11:11 11:12 21:18 22:15 23:18 23:19	 00-02.173N, 156-00.027E 01-58.269S, 155-59.828E	 Arrival at O08 site Recovered OBS on deck Recovered OBEM on deck Departure from O08 site Arrival at O07 site Recovered OBS on deck Recovered OBEM on deck Departure from O07 site
Feb. 10 13:52 14:45 15:46 15:47	 04-58.377S, 156-02.688E	 Arrival at O06 site Recovered OBS on deck Recovered OBEM on deck Departure from O06 site
Feb. 11		

19:23 21:02 21:03	00-36.928S, 153-00.113E	Arrival at O05 site Recovered OBS on deck Departure from O05 site
Feb. 12 01:00		Transit Time adjustment of SMT by -1 hour (SMT=UTC+10 hour)
Feb. 13 05:13 06:51 06:52 17:03 19:18 19:47 19:48	 00-03.531N, 147-02.114E 02-02.281N, 146-59.466E	 Arrival at O03 site Recovered OBS on deck Departure from O03 site Arrival at O02 site Recovered OBS on deck Recovered OBEM on deck Departure from O02 site
Feb. 14 15:48 17:38 18:28 18:29	 04-27.000N, 150-22.978E	 Arrival at O04 site Recovered OBS on deck Recovered OBEM on deck Departure from O04 site
Feb. 15 11:29 13:07 14:43 14:44	 04-59.745N, 147-00.301E	 Arrival at O01 site Recovered OBS on deck Recovered OBEM on deck Departure from O01 site
Feb. 16 21:08		Transit Gravity meter/MBES are stopped
Feb. 17		Transit
Feb. 18		Transit Time adjustment of SMT by -1 hour (SMT=UTC+9 hour)
Feb. 19 12:27		Transit Gravity meter/MBES are restarted
Feb. 20		Transit

Feb. 21		Transit
Feb. 22 15:01		Transit MBES is terminated
Feb. 23 09:50 10:04		 Arrival at Ariake MP, Tokyo Gravity meter is terminated KH-17-J01 LEG2 is completed