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KR03-08 Cruise Report

Derived by Research Vessel KAIREI

(Northwestern Pacific Region)

From Warf FUJIWARA in Port MIYAKO to JAMSTEC Pier

11th July, 2003 — 18th July, 2003

Acknowledgement

We would like to express our gratitude to Captain Hitoshi Tanaka, the officers and crews of R/V Kairei for their safe and skillful operations. Following people are also appreciated for their sincere cooperations. Naoto Kimura, JAMSTEC carried on office procedures to complete of the cruise. Toshihiko Kanazawa, Hisashi Utada and Masanao Shinohara, Earthquake Research Institute, and Yoshio Fukao, IFREE, JAMSTEC supported this cruise from the point of scientific view. Tada-nori Goto and Takafumi Kasaya, JAMSTEC took their own research time off to help us for the maintenance and assembling of the instruments. Nobuhito Onishi, Takeo Ichikita, and Naoya Takamura, Tierra Technica Co.Ltd. gave us useful information to operate the instruments.

Contents

Introduction

1.1 Objectives of KR03-08 Cruise

(I) Proposition of KR03-08 Cruise

"An imaging of the Earth's deep interior by the long-term observation of broad-band ocean bottom seismographs (BBOBS) and of seafloor electromagnetic station (SFEMS)"

(II) Background and Objectives of KR03-08 Cruise

Nowadays, it comes to be recognized that the solid earth's dynamics have relation to the activities of the ocean, atmosphere and other planets. Ocean bottom observations are the most powerful tools to reveal these mutual activities. Ocean bottom observations are adequate to investigate the earth's deep interior due to make it possible to acquire the geophysical data that is not influenced by continental crust. In particular, those in the Pacific region are the most necessary so as to overcome the wide observation gap (Fig.1.1.1).

"Ocean Hemisphere Network Project (OHP)" is a plan to investigate the dynamics of the mantle downwelling in the western Pacific region, which is the most enormous one, by constructing a geophysical observation network. The resolution of the geophysical analyzing techniques such as seismic tomography and others depends entirely on spatial distance among observation sites. The spatial distances were generally 2,000 km or more in the former observation network. It is necessary that the observation network makes denser than at least twice in order to investigate the zoomed-up structure around subducting slab. On the oceanic islands in the western Pacific region, broad-band seismographs and geomagnetic sensors have been already established (Fig.1.1.2). However, since there is oceanic region where no island distributes, ocean bottom observation is indispensable so as to make the spatial distance of observation sites being below 1000 km. Furthermore, the acquired data is expected to keep high quality. The borehole observations on ocean bottom are suitable for these purposes. We, therefore, started the borehole observations in the northwestern Pacific region (WP-1 in Fig.1.1.3) and in the west Philippine basin (WP-2 in Fig.1.1.3). The linkage among these borehole, oceanic island, and seafloor data will provides the high resolved mantle imaging in the regional western Pacific region (Figs.1.1.4 and 1.1.5).

The oceanic lithosphere is renewed in 100 My derived by the mantle-core coupling and the signals from the mantle-core coupling are clearer in the oceanic region. Moreover, the northwestern Pacific region and the west Philippine basin are the most interested regions to elucidate the core-mantle couplings. For example, the WP-2 site enables us to observe the surface seismic waves on the oceanic plate, which occurred beneath the west coast of North and South America. A SFEMS equipped with absolute geomagnetic sensor at WP-2 can provide geomagnetic data by which “pacific dipole window problem” – geomagnetic dipole component is dominant in the Pacific region – is fixed. On the other hands, it is well known that a seismic low velocity region is inferred from 350 to 500 km in depth oceanward of subducting slab (Fig.1.1.6), which indicates an imaging of mantle upwelling. Seismic velocity structure and electrical conductivity structure are different geophysical parameters. Both independent information gives us deeper understandings of mantle dynamics.

The aim of this research cruise, KR03-08, is broad-band seismic and electromagnetic observation by using BBOBS, borehole seismographs and SFEMS in the western Pacific region in order to obtain a high resolved imaging of the earth’s deep interior.

1.2 Outline of KR03-08 Cruise

This research cruise KR03-08 was carried out from 11th July (Fri) to 18th July (Fri), 2003. The cruise schedule is described in chapter 4 in detail. The Research Vessel (R/V) 'Kairei' (JAMSTEC; 4,628 G/T) was used for this cruise. The research area is shown in Figs.1.2.1. Figure 1.2.2 represents the truck path of KR03-08. Here, we only enumerate the geophysical surveys derived in KR03-08 and the details are described in chapter 3.

(I) SFEMS Recovery and Deployment

A SFEMS were deployed at WP-2 (A-3 in Fig.1.2.1) in June, 2002 in the KR02-08 cruise and continues the observation. The outstanding feature of the SFEMS is being equipped with absolute Overhauser scaler proton precession sensor. SFEMS enables us not only to realize magnetotelluric (MT) survey but also to constrain geomagnetic potential. The SFEMS’ recording capacity is about 1 year. In the KR03-08 cruise, the old SFEMS was recovered and an alternative SFEMS was deployed and continues to observation in 1 year.

(II) Surface Geophysical Mapping (Bathymetry, magnetic anomaly and gravity anomaly)

Several onboard geophysical surveys were carried out in KR03-08 cruise. We used a multi-narrow beam system on R/V Kairei for mapping detailed bathymetry. A shipboard proton towed magnetometer for mapping geomagnetic anomalies on the sea surface. Simultaneously, a shipboard three components magnetometer with a precise gyroscope was also applied. A gravity meter on R/V Kairei was used for mapping gravity anomalies. These bathymetry, magnetic and gravity anomaly help us to interpret the mantle dynamics in the west pacific region. In addition total geomagnetic intensity anomaly mapping around SFEMS make it possible to simultaneous checking of the geomagnetic data acquired by the OHM and OBEM sensors.

(III) Deployment of Ocean Bottom Electro-Magnetometers (OBEM)

We deployed two OBEMs (owned by Earthquake Research Institute, Univ. of Tokyo) in the western Pacific region (A-1, A-2 in Fig.1.2.1). This deployment aims mainly to obtain electrical conductivity distribution in a seismic low velocity region from 350 to 500 km in depth oceanward of subducting slab. Moreover, a two-dimensional OBEM array across northwestern Japan's subduction zone will be complemented by this OBEM deployment and reveal the dynamics such as a chain of mantle upwelling and downwelling accompanied with the Pacific plate subduction conducted by an electrical conductivity structure.

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Figure Captions

Figure 1.1.1 Geophysical observation gap in the Pacific region.

Figure 1.1.2 Geomagnetic observation sites established by OHP. Solid circle represents that on an oceanic island.

Figure 1.1.3 Seismic observation sites established by OHP. Solid circle represents borehole observation site. WP-1 and -2 realize homogeneous distribution of observation sites. Gray and small circles show a site on ocean island of OHP and that of IRIS, respectively.

Figure 1.1.4 Resolution improvement demonstration of seismic structure by using ocean bottom observation sites. (a) Target region. A line shows the great circle that passes through WP-1 and -2. (b) A seismic mantle structure conducted by the present observation network. The Philippine sea plate subduction is not enough to be resolved. (c) A resolution test without observation sites in oceanic region. The checker board by black and white blocks is clearly shown where resolution is fine. (d) A resolution test with observation sites in oceanic region. It is clearly shown that ocean bottom observation improves resolution of the seismic analysis.

Figure 1.1.5 Resolution improvement demonstration of distribution of geomagnetic field. Contour line shows error level of geomagnetic field inferred by various combinations of observation sites. Observation site at the northwestern Pacific region improves the resolution of geomagnetic field distribution.

Figure 1.1.6 A seismic low velocity region from 350 to 500 km in depth oceanward of subducting slab. Color represents the seismic velocity disturbance. Squared and triangle marks are candidates of observation sites by OBEM in the future.

Figure 1.2.1 Research area of KR03-08 Cruise with bathymetry contour lines.

Figure 1.2.2 Truck path of KR03-08 (red line). Yellow marks are final points where the instruments were deployed.

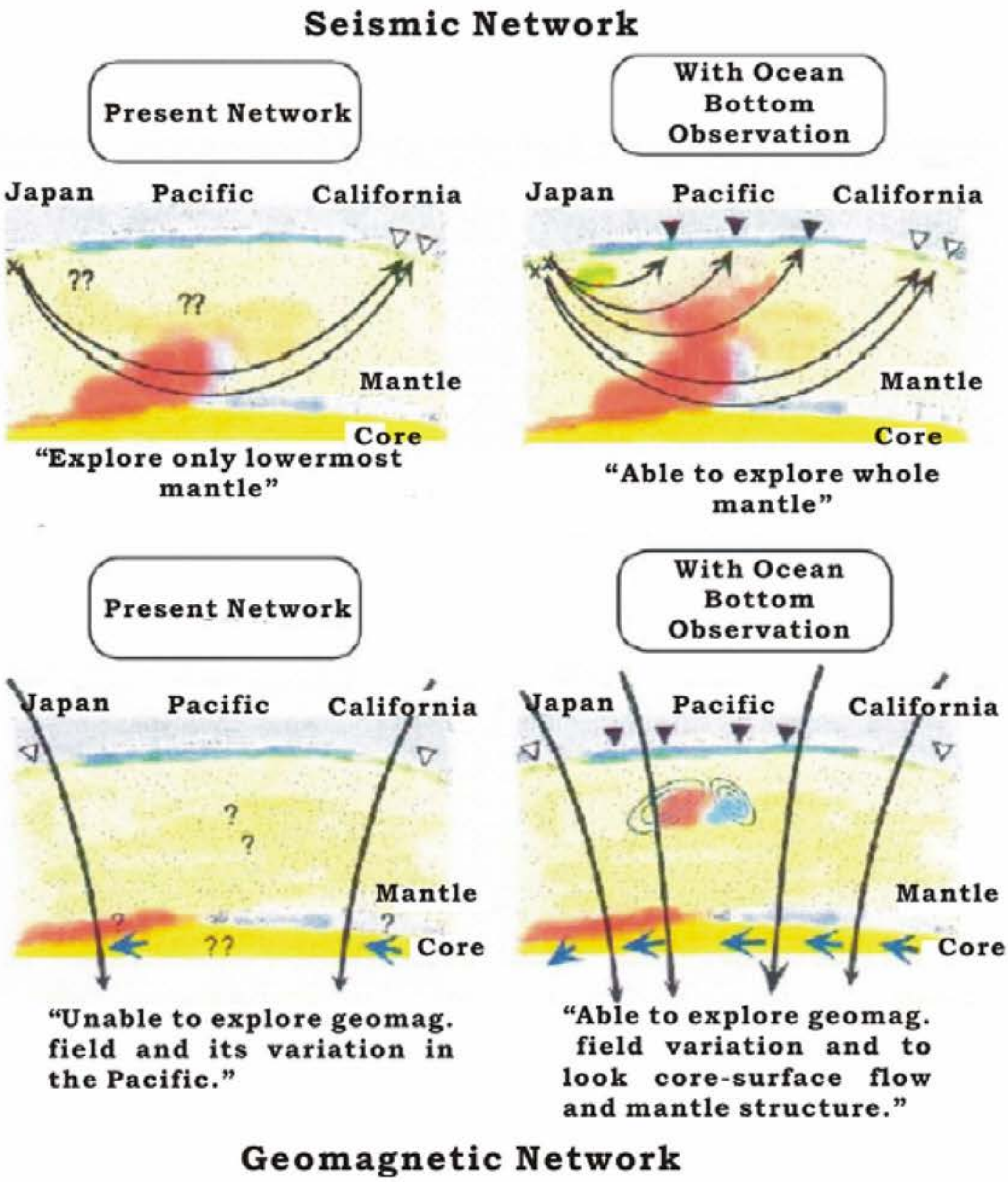
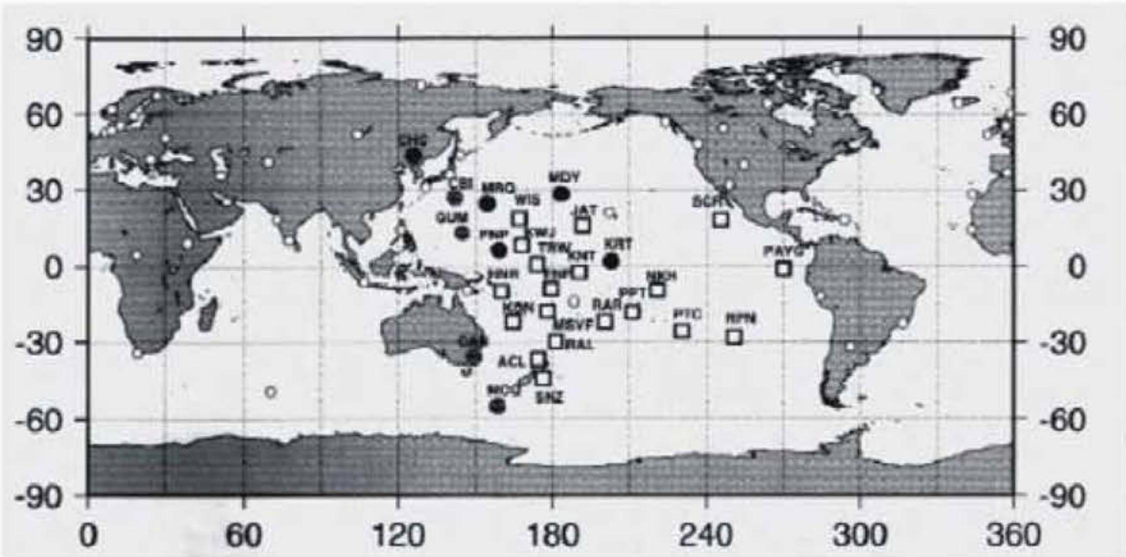

Seismic Network
Present Network
With Ocean Bottom Observation
Japan
Pacific
California
Mantle
Core
"Explore only lowermost mantle"
Japan
Pacific
California
Mantle
Core
"Able to explore whole mantle"
Present Network
With Ocean Bottom Observation
Japan
Pacific
California
Mantle
Core
"Unable to explore geomag. field and its variation in the Pacific."
Japan
Pacific
California
Mantle
Core
"Able to explore geomag. field variation and to look core-surface flow and mantle structure."
Geomagnetic Network

Figure 1.1.1



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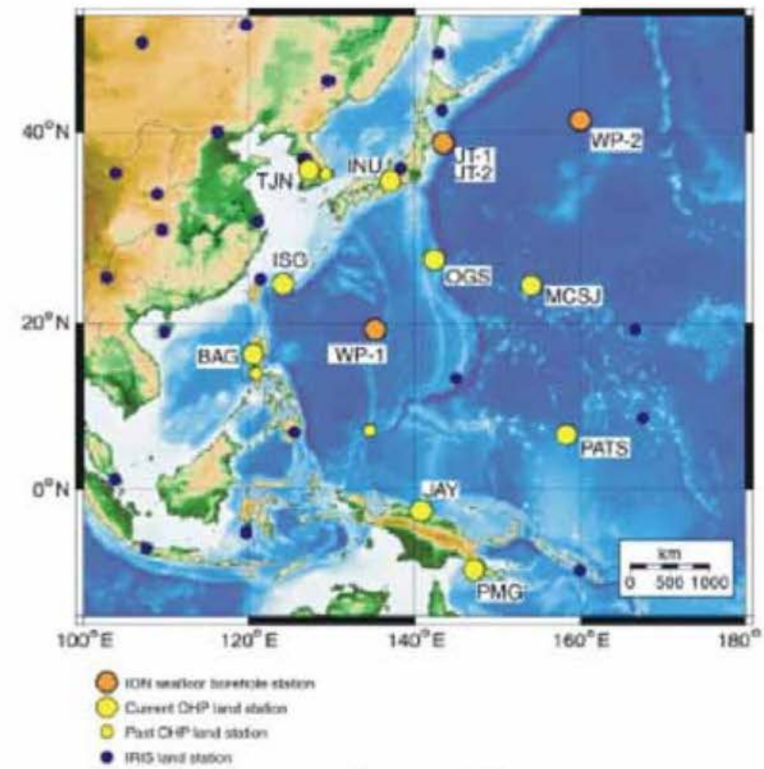


Figure 1.1.3

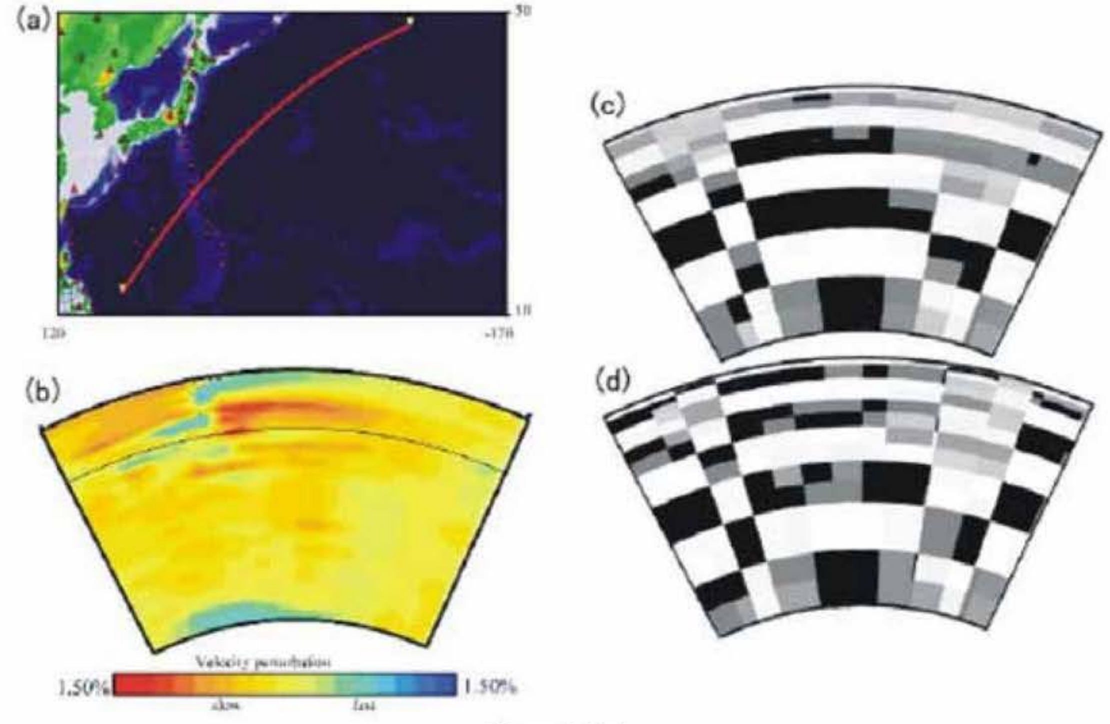


Figure 1.1.4

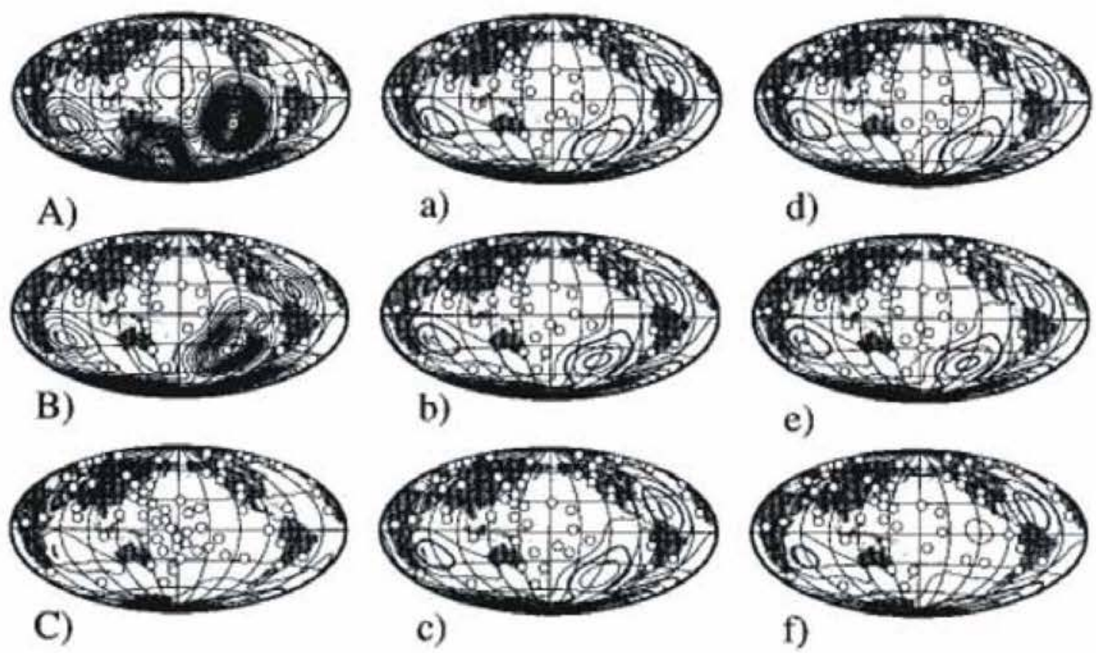


Figure 1.1.5

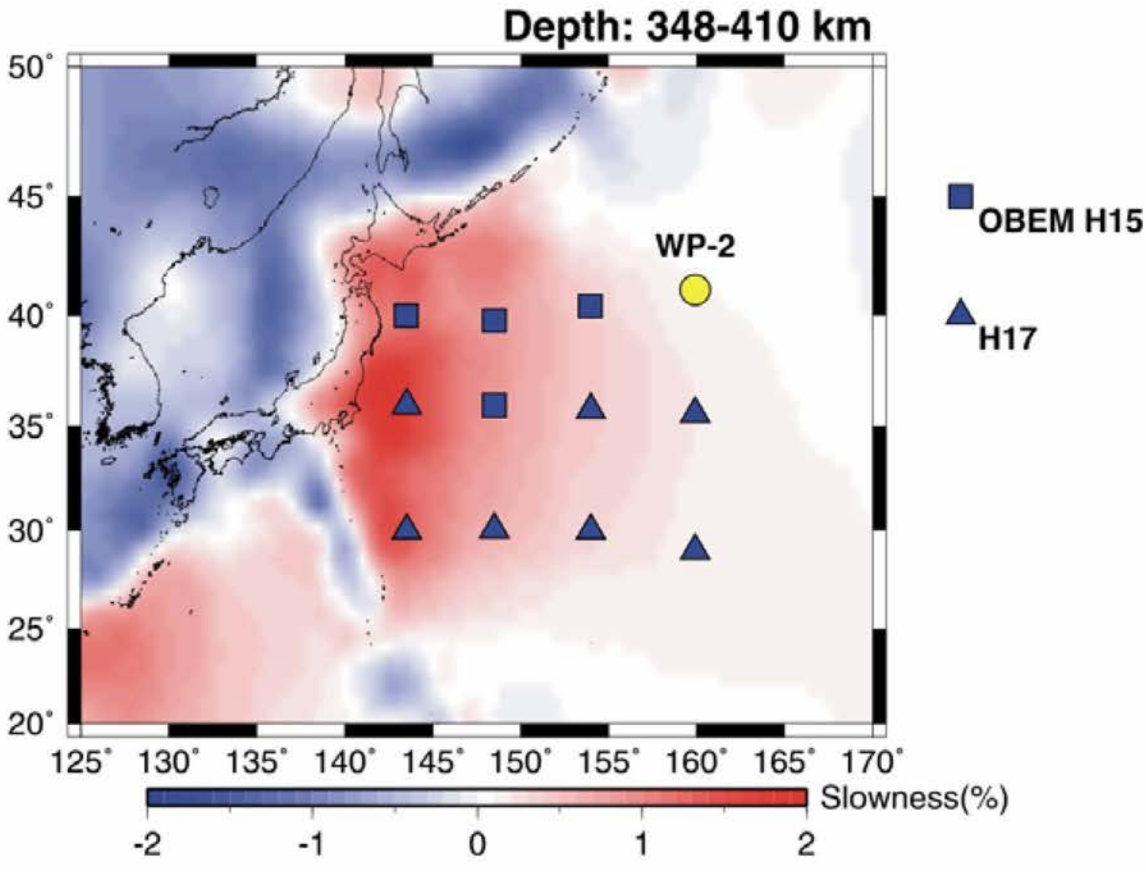

Depth: 348-410 km
50°
45°
40°
35°
30°
25°
20°
125° 130° 135° 140° 145° 150° 155° 160° 165° 170°
WP-2
OBEM H15
H17
Slowness(%)
-2
-1
0
1
2

Figure 1.1.6

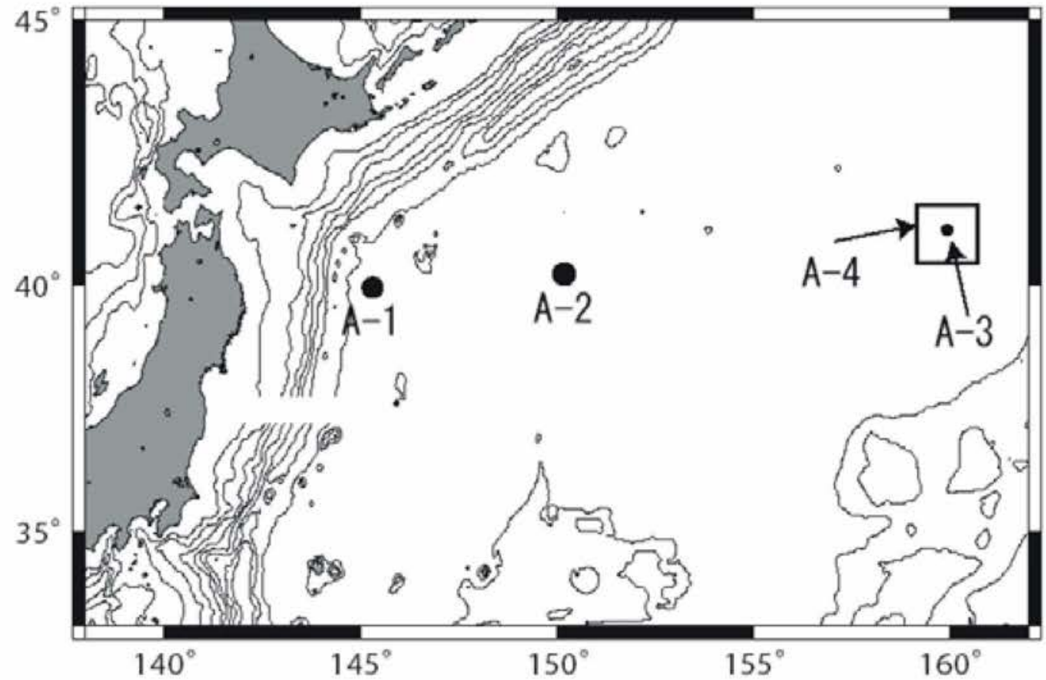


Figure 1.2.1

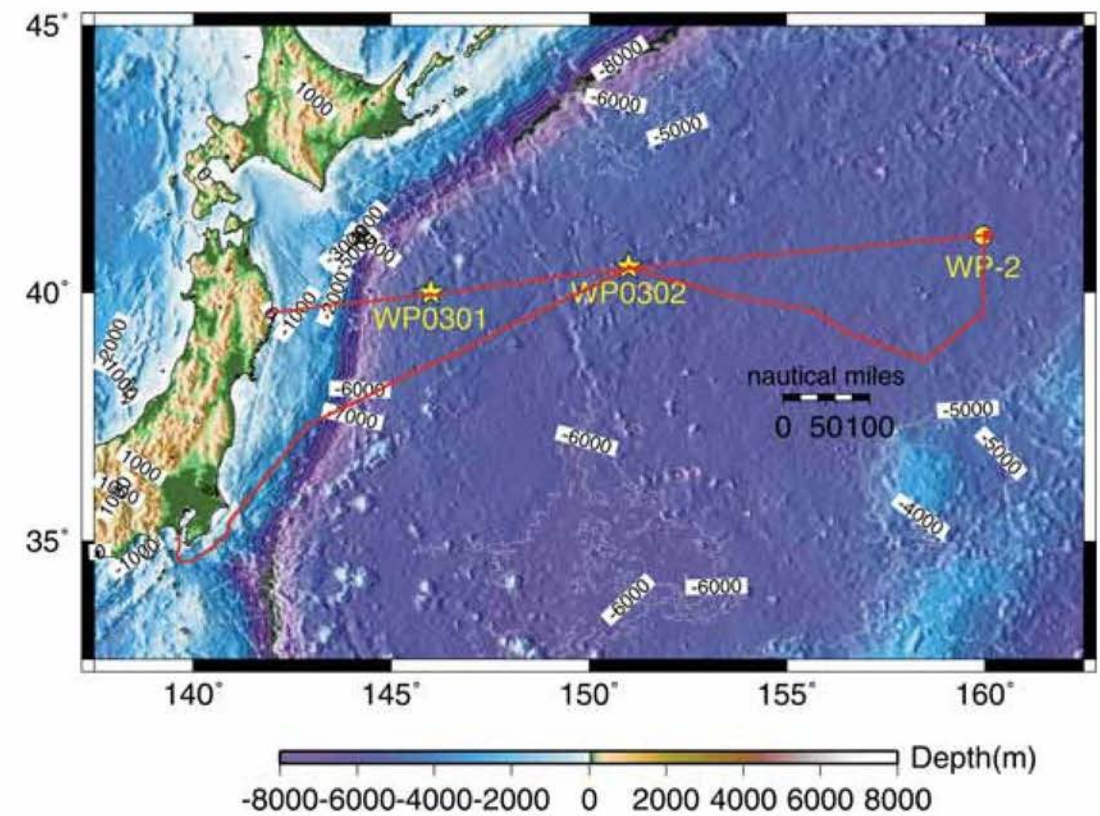


Figure 1.2.2

List of Embarkation People

2.1 Researchers

Name	Organization	Position	
Hiroaki Toh	Toyama University	Associate Professor	(Chief scientist)
Kiyoshi Baba	IFREE, JAMSTEC	Technical Researcher	
Masahiro Ichiki	IFREE, JAMSTEC	Researcher	
Tetsuo No	NME	Marine Technician	

2.2 Officers and Crew

Name	Position
Hitoshi Tanaka	Captain
Yoshiyuki Nakamura	Chief Officer
Shinichi Kusaka	Second Officer
Tetsuya Yokota	Third Officer
Eiji Sakaguchi	Chief Engineer
Akimitsu Fukuda	First Engineer
Kazunori Noguchi	Second Engineer
Masahiko Sato	Third Engineer
Tokinori Nasu	Chief Operator
Jun Suenaga	Second Operator
Yusuke Takeuchi	Third Operator
Makio Nakamura	Boatswain
Kazuo Abe	Able Seaman
Kiyoshi Kaneda	Able Seaman
Hatsuo Oda	Able Seaman
Katsuhiko Sato	Able Seaman
Kaname Hirosaki	Able Seaman
Kaito Murata	Old Seaman
Masayuki Masunaga	No.1 Oiler
Kazuaki Nakai	Oiler
Jyunji Mouri	Oiler
Keita Funawatari	Oiler
Sukeyuki Tanaka	Oiler
Kiyotoshi Teranishi	Chief Steward
Teruyuki Yoshikawa	Cook
Shinsuke Tanaka	Cook
Isao Matsumoto	Cook
Hideki Kubota	Cook

Brief Report of Geophysical Survey in KR03-08

3.1 SFEMS Recovery and Acquired Data

Prior to deployment of SFEMS, recovery of the previously installed SFEMS was conducted on 14th/JUL/'03. This means that overlapped seafloor data were unable to be obtained by this expedition. It was unfortunate that the rough sea condition prevented the research vehicle from staying around the A-4 area for more than 12 hrs. The acoustic release command was sent to SFEMS at the seafloor at 03:08 UTC. It took about 2 hrs and 40 min for SFEMS to reach the sea surface, during which time its ascent was monitored by acoustic ranging. In spite of the bad weather, SFEMS was successfully retrieved on deck without any serious damage to the instrument.

SFEMS was found to be still alive even after the recovery. The system clock gained only 32 sec for over 380 days. Voltages of remaining power supply of SFEMS's interface were 2.21 V and 7.743 V for the Overhauser magnetometer and the interface itself, respectively. Those of OBEM were 7.77 V, -19.35 V and 14.65 V for system power and two fluxgate excitation, respectively. It turned out that not only the power for the Overhauser magnetometer had been totally dead but also that of the positive fluxgate excitation was insufficient. The former is critical since the Overhauser magnetometer worked for only half as long as OBEM. FOG Voltage was also measured to be 15.55 V. Two glass spheres were opened to retrieve recorded data in the interface flash memory, the Overhauser magnetometer and OBEM, respectively. The former two had been installed in the same sphere. Since the Overhauser and OBEM data were originally recorded in ASCII, the binary data in the interface memory alone was pertinently expanded in ASCII format to be saved onto hard disks of different PC's together with the Overhauser and OBEM data. Preliminary report on the acquired data will be described in rest of this section except for 2-component geoelectric data. This is because the geoelectric data contains periodic spike noises due to instrumental malfunction of OBEM. They will be easily corrected using factory data. However, we can not proceed to any further data processing without it.

Figure 3.1.1 shows the absolute geomagnetic total force measured by the Overhauser magnetometer for over 180 days. Synthetic total force using 3-component geomagnetic data measured by OBEM is also plotted at the top for reference. Synthetic minus absolute total force is shown at the bottom. The large noises seen on 1st/SEP/'02 and 1st/DEC/'02 are caused by the FOG operations. It is curious that the FOG noises do not appear in the synthetic total force. It is likely that the FOG noises were selectively leaked into the Overhauser magnetometer since FOG and the

Overhauser magnetometer had a common circuit ground for a practical reason. They should be isolated in future experiments. Except for the FOG noises, it is evident that the baseline of OBEM's fluxgate magnetometer is quite stable within a few nonoteslas. Other minor spike noises occasionally seen in the difference may be due to the absolute total force miscounted by the Overhauser magnetometer. The baseline value of the absolute total force was also compared with the predicted baseline by IGRF2000. It was found that they differ as large as 900 nT. This difference can be explained by local magnetic anomalies of crustal origin, as will be further discussed in section 3.3.

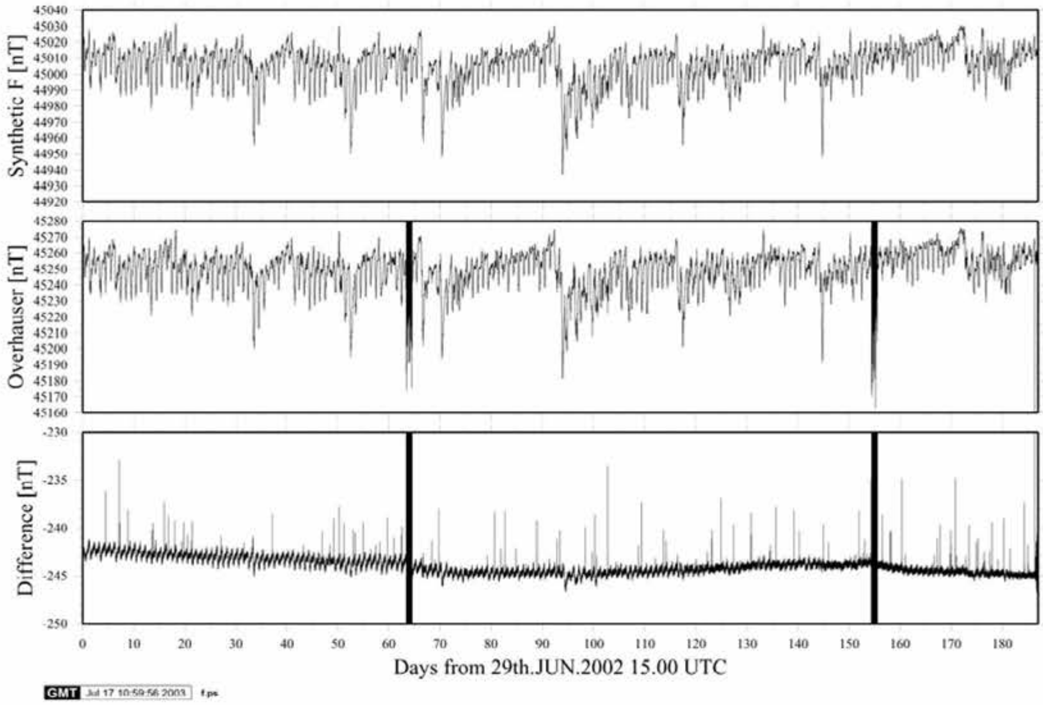


Fig. 3.1.1 Comparison of the geomagnetic total force. Synthetic total force using 3-component fluxgate data, absolute total force measured by the Overhauser magnetometer and difference inbetween from top to bottom, respectively. The noises around 1st/SEP/'02 and 1st/DEC/'02 are those caused by FOG operation.

Figure 3.1.2 shows the 3-component geomagnetic variations at the seafloor in the original measuring coordinates for over 380 days. The length and the quality of the 3-component fluxgate data are quite satisfactory. A slight positive drift seen in Z-component will disappear in the subsequent tilt correction. The only crucial problem in the 3-component data is the step-like noises seen in both X- and Y-component. Careful examination revealed that they were not actually 'step noises' but the baselines of X- and Y-component drifted away for over several tens of hrs. We suspect that it is due to the decrease of the positive fluxgate excitation power. However, it is unknown why it did not occur in Z-component. A rough estimate of SFEMS's orientation at the seafloor using these two nearly horizontal geomagnetic components is approximately 239 degrees clockwise from the geomagnetic north. Since the predicted westward declination by IGRF2000 is about 3 degrees, the estimate of SFEMS's orientation coincides well with that of FOG measurements as we shall see later in this section.

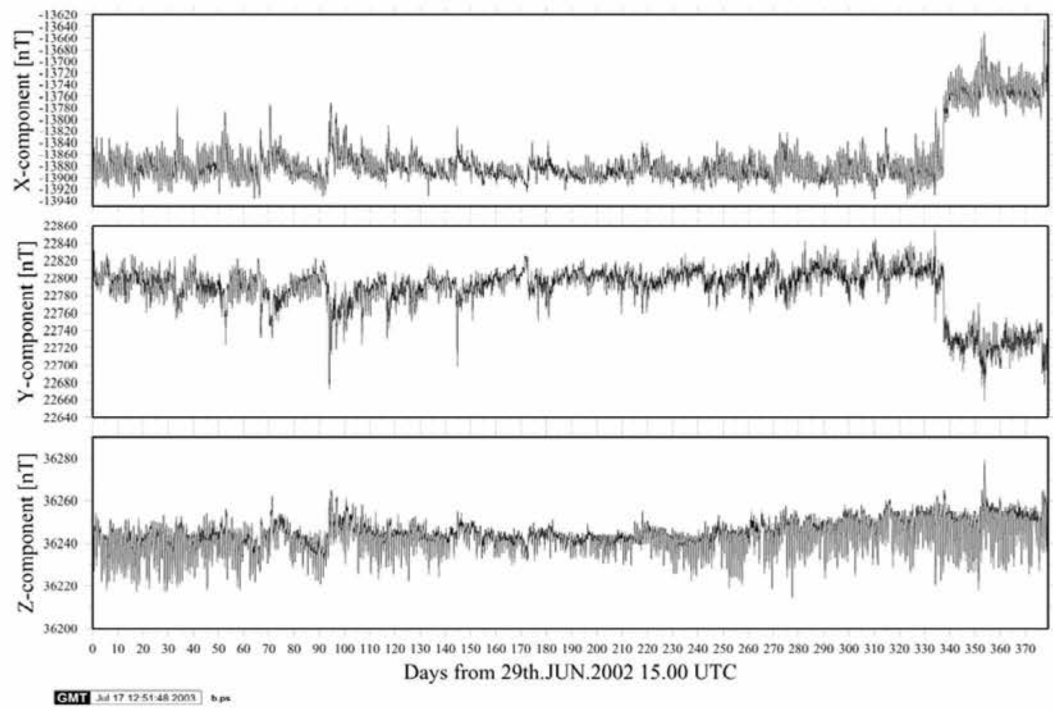


Fig. 3.1.2 3-compoent geomagnetic field at the seafloor for about 380 days. The reason for the step-like noises seen both in X- and Y-component is unknown.

Figure 3.1.3 shows tilt and temperature variations at the seafloor. It is obvious that X-component of tilt is noisier than Y-component, since the two tilts are plotted by exactly the same scale of 0.02 deg/div. The noise levels are approximately 72 arc seconds and 36 arc seconds for X- and Y-tilt, respectively. Those high noise levels will be significantly reduced by adding analog filters with a suitable time constant. The step-like noise in temperature coincided with those observed in horizontal geomagnetic components. This is the reason why we suspect the cause for those step-like noises to be the insufficient power supply in the positive fluxgate excitation.

It is probable that decreased electric currents at the time of the geomagnetic measurements significantly lowered the ambient temperature within the OBEM housing.

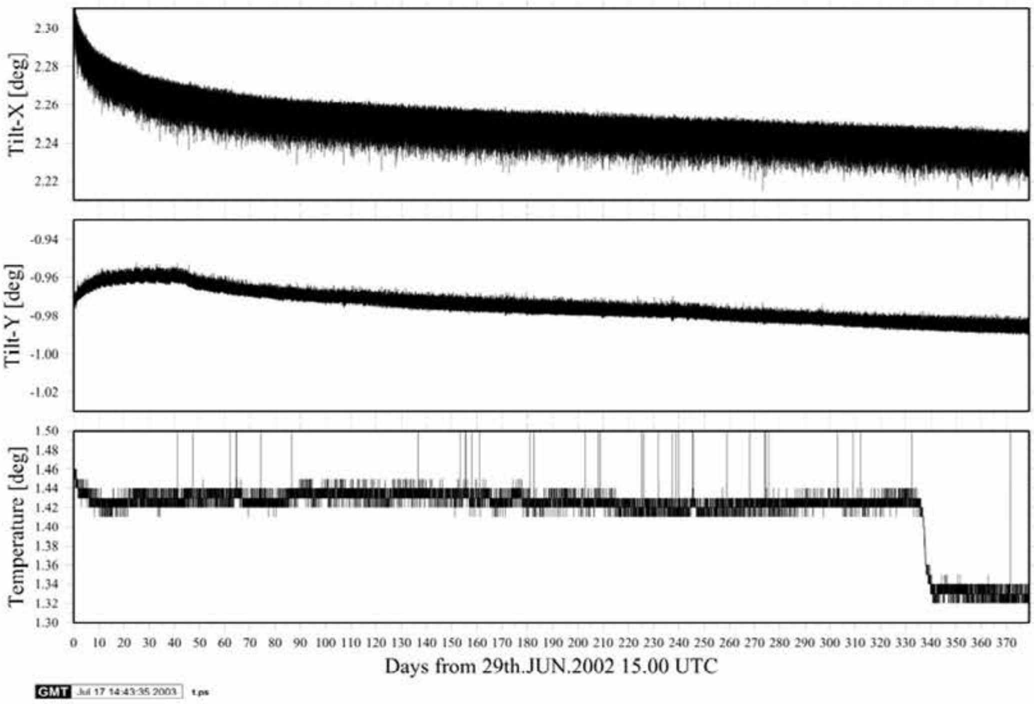


Fig. 3.1.3 Two-component of tilts and temperature from top to bottom, respectively. The step change of temperature seems coincided with those of horizontal geomagnetic components.

Figure 3.1.4 summarizes the result of three FOG operations at the seafloor. Each operation lasted 28 hrs to yield SFEMS's orientation with respect to the true north every minute. FOG were scheduled to start at 00:00 UTC on 1st/SEP/'02, 1st/DEC/'02 and 1st/MAR/'03, respectively. The global average of the orientation is calculated as 234.1169495 degree. The average is based on a sum of 5040 independent samples. Since the nominal accuracy of each sample is supposed to be 0.2 degree, the error of the global average can be reduced by a factor of the square root of the number of samples, if we assume the distribution of each sample's population as Gaussian. It, therefore, is as small as 10 arc seconds. In addition, the value of the global average is quite compatible with that of the geomagnetic estimate, as we mentioned earlier. The discrepancy is only 2 degrees, which will be made further smaller when the geomagnetic data are pertinently corrected for tilts, temperature and so on.

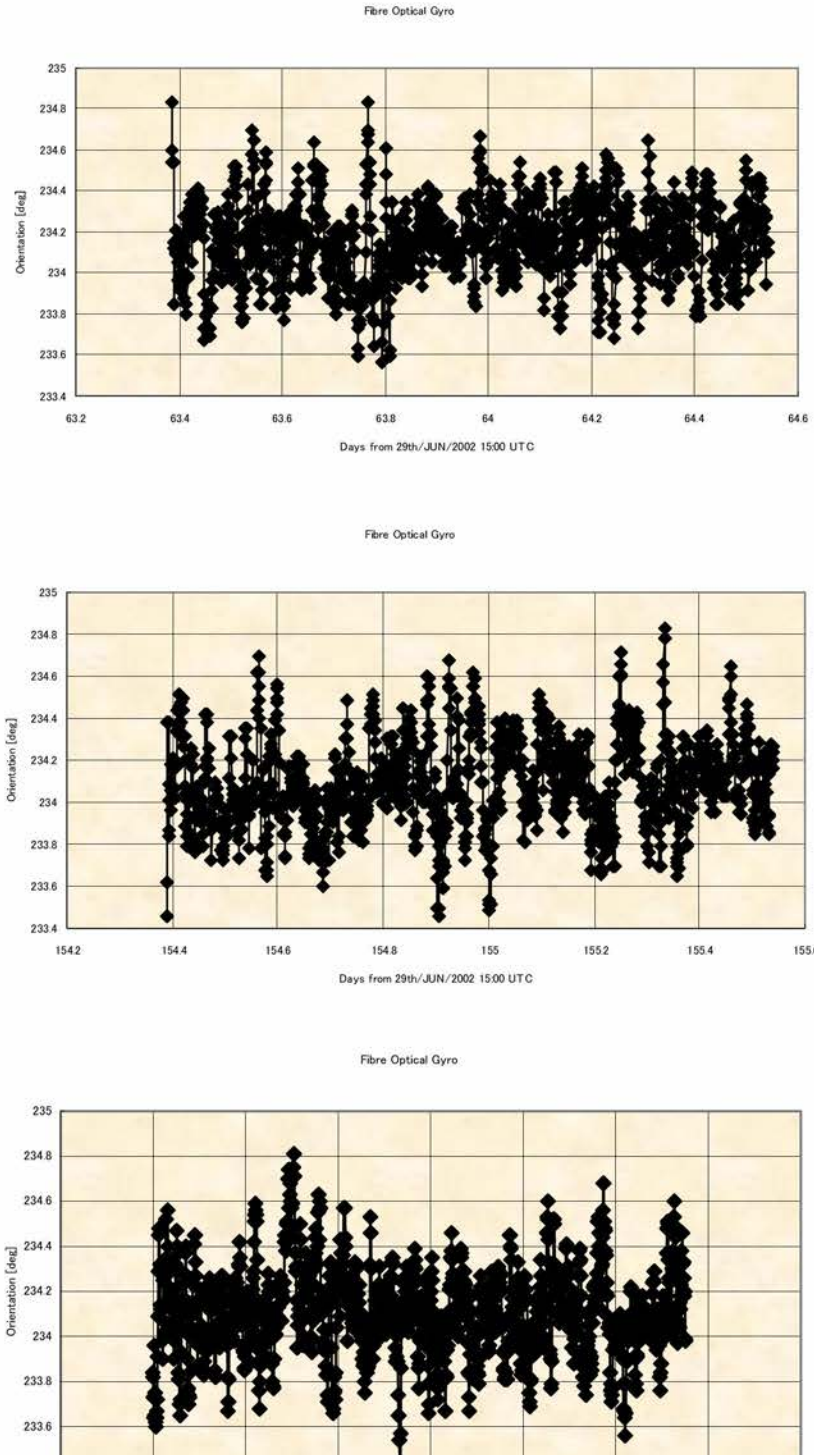
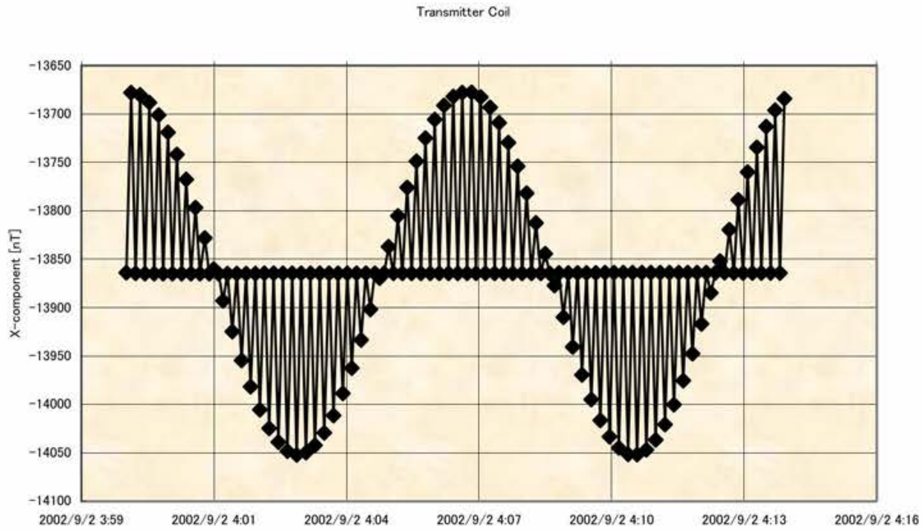
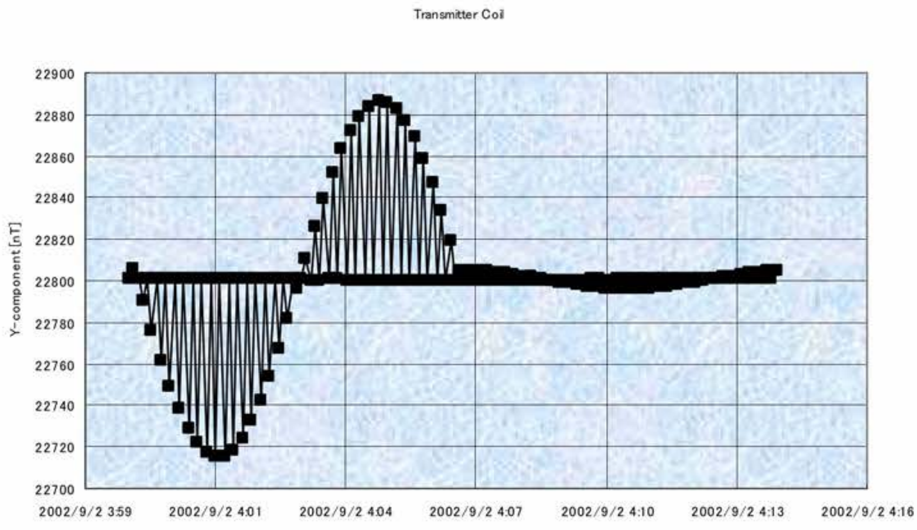
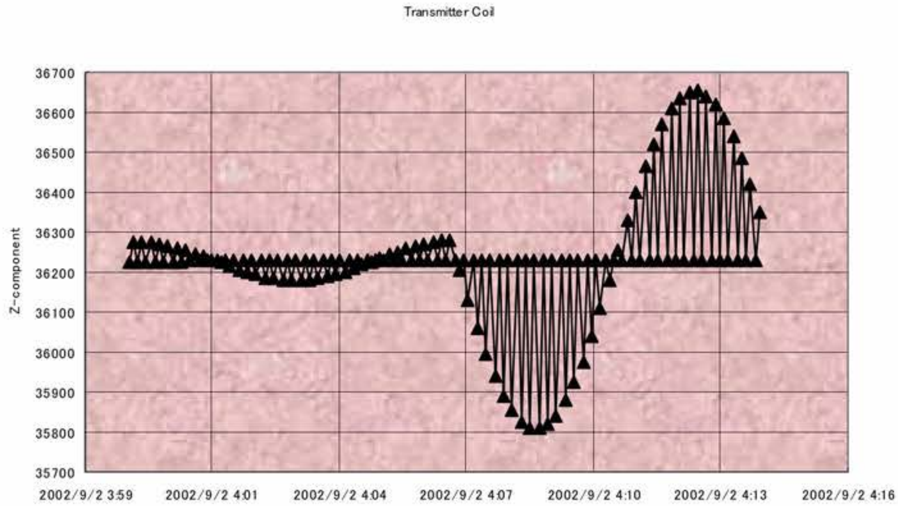


Fig. 3.1.4 Three FOG operations conducted for 28 hrs each on 1st/SEP/'02, 1st/DEC/'02 and 1st/MAR/'03 from top to bottom, respectively. The averaged orientation of SFEMS at the seafloor is 234.1169495 deg with respect to the true north.

Finally, we show the result of transmitter coil measurements (TCMs). Triaxial transmitter coils were attached/aligned to FOG in order to detect the misalignment between the FOG coordinate and the fluxgate magnetometer. For this purpose, each TCM were specially designed to generate dipole field of selectable magnitudes at the place of fluxgate sensors. TCM's were scheduled to be done just after each FOG operation for 20 min. In the first half of each TCM, the applied magnetic moment was rotated within XY plane which in the second half, if was rotated within XZ plane. The following 9 diagrams show three sets of TCM. 3-component magnetic variations are plotted for each set. Amplitudes of the TCM's were assigned as 100, 50 and 75 nT, respectively.







Transmitter Coil
Z-component
36700
36600
36500
36400
36300
36200
36100
36000
35900
35800
35700
2002/9/2 3:59
2002/9/2 4:01
2002/9/2 4:04
2002/9/2 4:07
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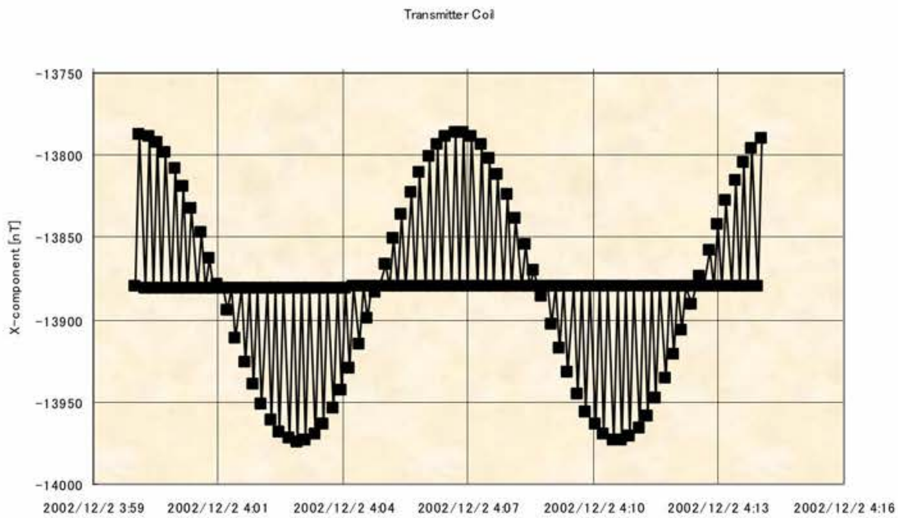
2002/9/2 4:13
2002/9/2 4:16



Transmitter Coil
X-component [nT]
-13750
-13800
-13850
-13900
-13950
-14000
2002/12/2 3:59
2002/12/2 4:01
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2002/12/2 4:07
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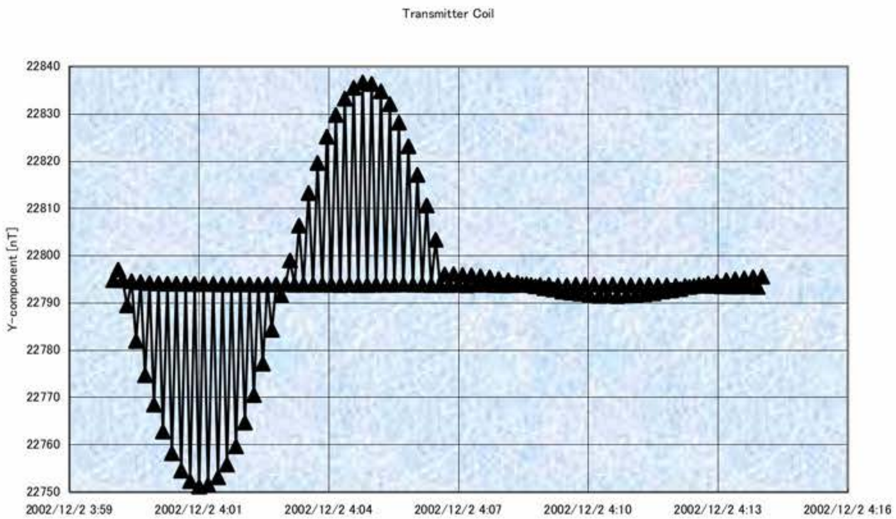
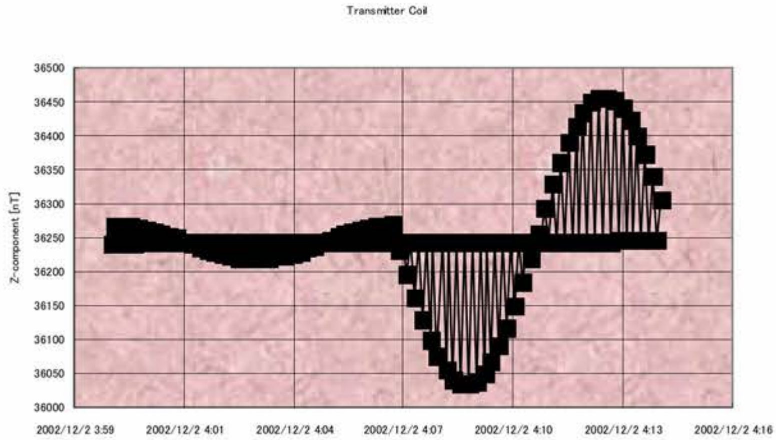
2002/12/2 4:13
2002/12/2 4:16



Transmitter Coil
Y-component [nT]
22840
22830
22820
22810
22800
22790
22780
22770
22760
22750
2002/12/2 3:59
2002/12/2 4:01
2002/12/2 4:04
2002/12/2 4:07
2002/12/2 4:10
2002/12/2 4:13
2002/12/2 4:16


Transmitter Coil
Z-component [nT]
36500
36450
36400
36350
36300
36250
36200
36150
36100
36050
36000
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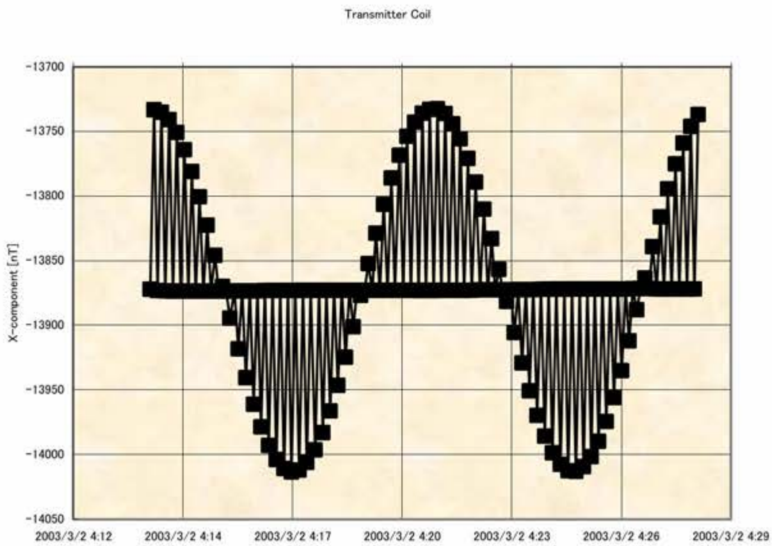
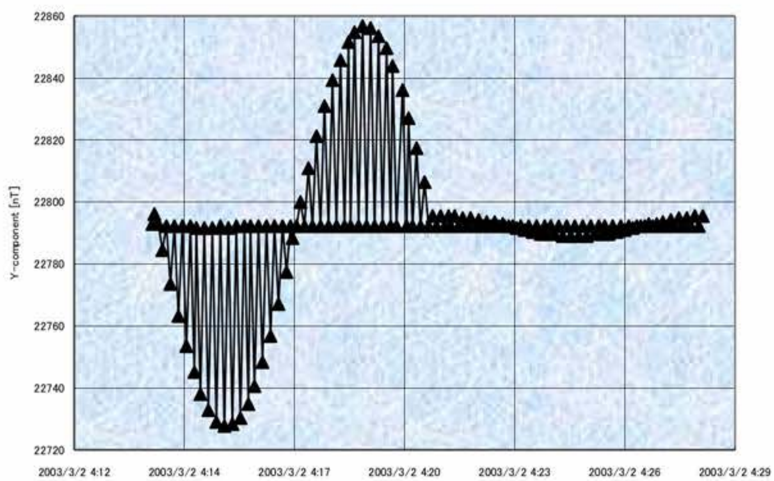

Transmitter Coil
X-component [nT]
-13700
-13750
-13800
-13850
-13900
-13950
-14000
-14050
2003/3/2 4:12
2003/3/2 4:14
2003/3/2 4:17
2003/3/2 4:20
2003/3/2 4:23
2003/3/2 4:26
2003/3/2 4:29


Transmitter Coil
Y-component [nT]
22860
22840
22820
22800
22780
22760
22740
22720
2003/3/2 4:12
2003/3/2 4:14
2003/3/2 4:17
2003/3/2 4:20
2003/3/2 4:23
2003/3/2 4:26
2003/3/2 4:29

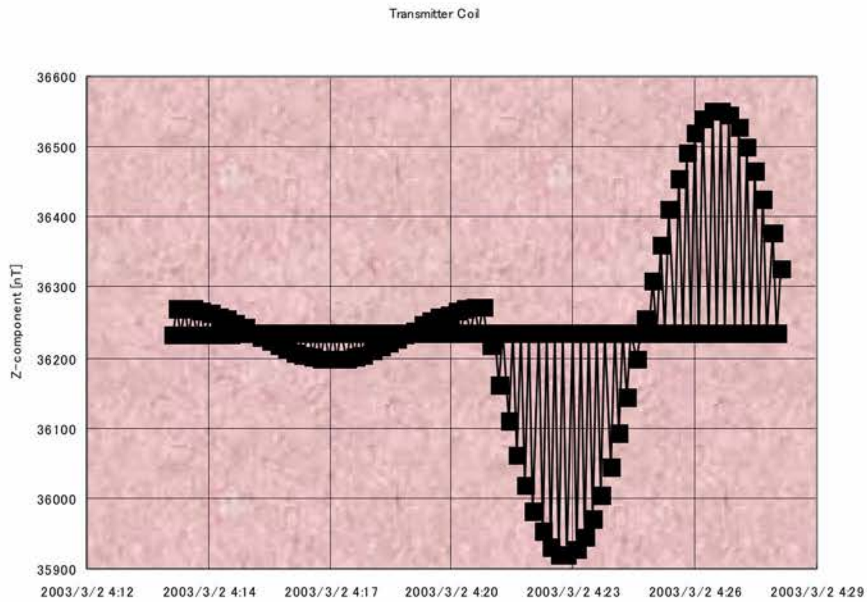


Fig. 3.1.5 Results of transmitter coil measurements. Triaxial transmitter coils attached/aligned to FOG generate artificial magnetic field to be received by the fluxgate magnetometer. This figure consists of three sets of the measurements for each magnetic component. The measurements were scheduled on 2nd/SEP/'02, 2nd/DEC/'02 and 2nd/MAR/'03 for about 20 minutes each just after the FOG operations. The applied magnetic dipole moments rotated in the same manner for the three measurements. The only difference was the magnitude of the applied magnetic dipole moments which were 100, 50 and 75 nT, respectively.

3.2 SFEMS Deployment

(I) Specification of SFEMS

We used the third generation of SFEMS. It measures three components magnetic field variation by a fluxgate magnetometer, total geomagnetic intensity variation by an Overhauser magnetometer, two horizontal component of electric field variation, two components of instrument tilt, azimuth by a fibre optical gyroscope (FOG), and temperature variation. The Overhauser magnetometer was placed at the top of the SFEMS. Four glass spheres were attached to the titanium frame, in each of which a) battery packs, b) a cluster of fluxgate magnetometer, voltmeter and tilt meter, c) FOG, and d) an interface firmware with flash memory were packed, respectively (Plate 3.2.1). Four polypropylene pipes project from the frame and silver–silver chloride electrodes were attached at the tip of each pipe. Five electrodes were selected among a pool of 16 electrodes after aging over 3 days. Figure 3.2.2 shows the result of the aging test. The SFEMS was also equipped with lead weights and a pair of radio beacon and flashing light. In recovery, SFEMS releases the weight by an acoustic command from the sea surface, and then pops up by its own buoyancy. The radio beacon and flashing light have pressure switches which are turned off under water pressure. When SFEMS pops up to the sea surface, they start working and help to spot SFEMS. The flashing light has a light sensor as well which turns on the light when it is dark. It is very useful to find SFEMS at night.

(II) Deployment

Measurement parameters are listed in Table 3.2.3. SFEMS's master clock was set to GPS time before deployment, and will be compared again after recovery to correct for timing error. Measurement start time except the gyroscope was synchronized to that of OBEM, which was set to several days after the deployment. Sampling intervals were set to 60 sec. Electric dipole lengths are also listed in Table 3.2.3. Since the FOG measurement is much more power-consuming than any other measurements, working time of FOG was set to about several days in total. The FOG operation, therefore, was scheduled to one day per 3 months as shown in Table 3.2.3. Information of the radio beacon, flashing light, and acoustic release system mounted on SFEMS is also listed in Table 3.2.4.

The deployment of the SFEMS was finished successfully at a planned position. SFEMS was picked up by ship's A-frame and calmly deployed. After deployment, SFEMS was traced by acoustic ranging. An acoustic transpducer was moored from the deck and slant ranges were measured. The acoustic system was manufactured by Nichiyu-giken Inc. Acoustic communication was very smooth without any significant noises. We confirmed arrival of SFEMS at the seafloor, and the settled position was estimated by acoustic ranging at 3 different locations at the sea surface surrounding the drop site (see Figure 3.2.5 and Table 4.2.1). The standard error of the acoustic positioning was 82.7 m.

3.3 Surface Geophysical Survey

Magnetic survey was conducted by a surface-tow proton magnetometer within an area of 8 nm by 8 nm around SFEMS after deployment. The survey started at the southeast corner and ended at the southwest corner. Main profiles oriented in the north-south direction with a spacing of 7/8 nm. The proton magnetometer was towed at a speed of 12 knots.

The result of the survey is shown in Fig. 3.3.1 with locations of SFEMS installation sites. It is evident that the SFEMS locations are on a strong positive magnetic anomaly having north-northeast to south-southwest lineation. The anomaly belongs to 'Japanese Lineation Set', which has a maximum amplitude of as large as 250 nT at the surface around the SFEMS region. This explains the large site correction observed by our previous SFEMS data. The geomagnetic total force recovered in July of 2002 showed a large discrepancy between IGRF2000 prediction and actual measurements. The discrepancy more than 2000 nT had been attributed to the site correction, which was confirmed by this magnetic survey.

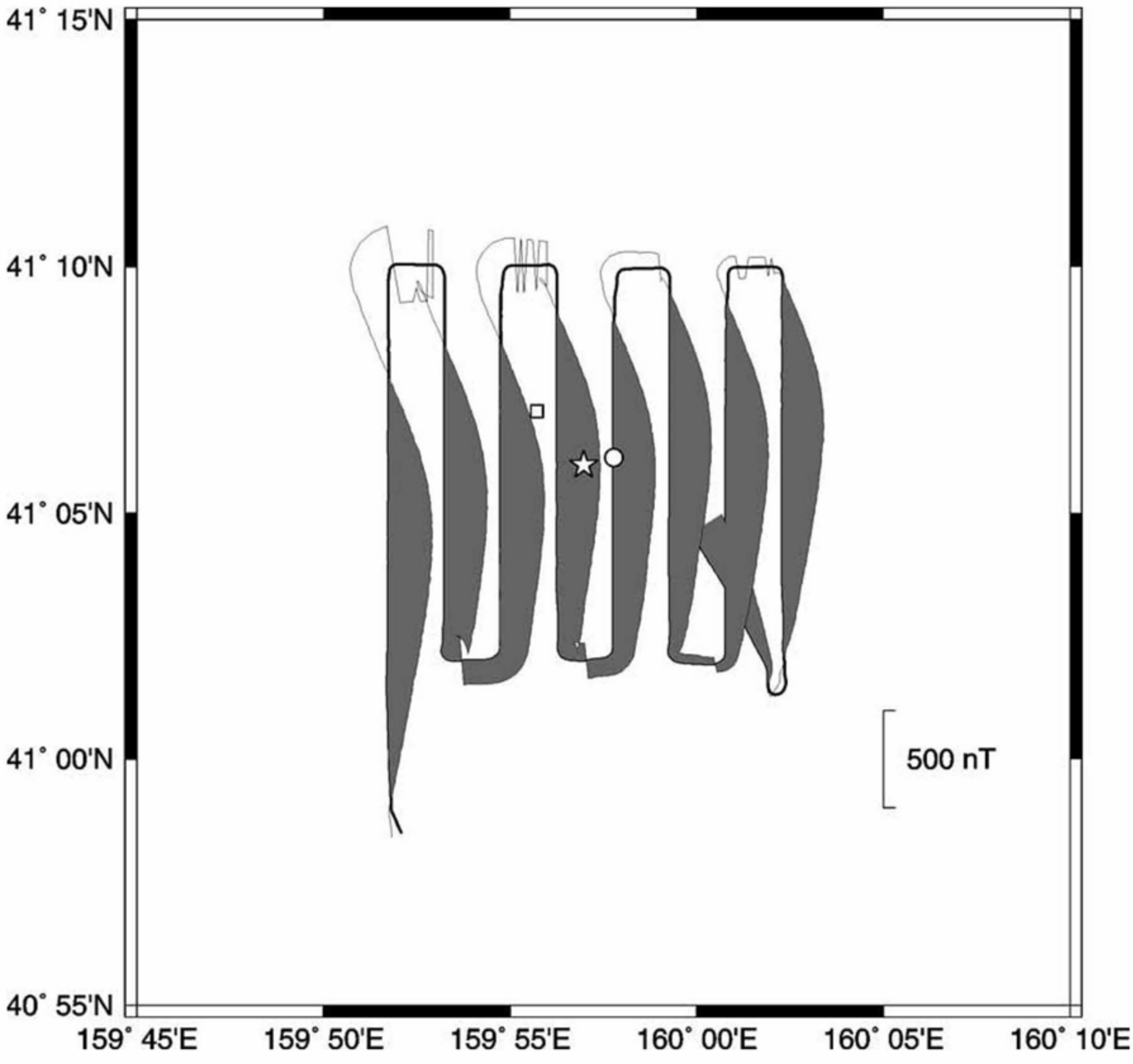


Fig. 3.3.1 Ship's track and the sea surface magnetic anomaly along the track at the time of the surface tow of the proton magnetometer. The symbols are locations of SFEMS's which were recovered in JUL/2002 (square) and JUL/2003 (circle) and installed in JUL/2003 (star), respectively. It is clear that all the site locate in the middle of a strong positive magnetic anomaly.

3.4 OBEM Deployment

(I) Introduction

The final goal of this OBEM observation is to conduct a three-dimensional (3-D) electrical conductivity distribution in the mantle beneath the Pacific region and discuss the dynamics of mantle convection, core-mantle coupling with the semi-global scale. The most interested target is the upper mantle upwelling beneath the outer-rise, which seems to be connected with the Pacific slab subduction beneath the Japanese Island Arc. Interpreted a 3-D electrical conductivity distribution and a seismic tomography, simultaneously, the mapping of water content, temperature anomalies and chemical heterogeneity in the mantle will be able to discuss.

We deployed two OBEMs, one of which is the eastern side of the Japan trench, and the other almost places over the center of the low seismic velocity area of the upper mantle in the Pacific region. This observation has the aspect of pilot survey for the investigation project of the mantle upwelling in the western Pacific region for five years to come. Analysis of data by magnetotelluric (MT) method can estimate electrical conductivity structure about 10 km to several hundred km depth. It is also expected that the feature of whole western Pacific trench - arc - back-arc system can be imaged by compiling MT data in the Sea of Japan, northwestern Japan and the northwestern Pacific. The OBEMs will observe electromagnetic field variation during about one year. We just deployed the OBEMs in this cruise and will recover them in another cruise next year.

(II) OBEM

We use two types of OBEM; OBEM-MELT type (TT4) and OBEM99 type (TT6) owned by Earthquake Research Institute (ERI), University of Tokyo (Plate 3.4.1 and 3.4.2). All the OBEMs can measure three components magnetic field variation, two horizontal component of electric field variation, and two components of instrument tilt. Besides, OBEM99 can measure temperature variation. The TT4 records difference values on the flash-memory, whereas the TT6 records variation values itself. Fluxgate sensor, magnetometer, voltmeter, and tilt meter is packed in a glass sphere to stand water pressure and batteries are sealed with the other one. OBEM-MELT type has another glass sphere which contains an acoustic transponder. Silver–silver chloride electrodes are attached to the tips of pipes. All electrode is WHOI-type supplied by Clover Tech. Inc. Nine electrodes were selected after aging test during 1 or 2 days. Figure 3.4.3 shows the result of the aging test. We list specifications of OBEMs and measurement parameter in Table 3.4.4 and 3.4.5, respectively. Clock system of the

OBEMs is the same as the SFEMS. Measurement starts after several days from deployment because the electrodes take time to come to equilibrium to surrounding seawater. Sampling intervals are set to 60 second. Electric dipole lengths are also listed in Table 3.4.5. The OBEMs have lead weights, radio beacons and flushing lights. The two OBEMs will be also recovered by popping up by self-buoyancy, as the SFEMS. We list the information of the radio beacons, flushing lights, and acoustic release system mounted each OBEM in Table 3.4.6. The two OBEMs mount a leading buoy-rope system. The buoy fixed the top of a bucket which folds 10m long rope fixed to frame of the OBEM. The buoy is released from the bucket when the lead weight is released, and then drag out the folded rope in the bucket. We can easily catch the OBEM from shipboard by catching the buoy and hauling on the rope.

(III) Deployment

We successfully deployed two OBEMs at planned position. Figure 3.2.5 shows site locations with bathymetry map from multi narrow beam and satellite altimetry. The OBEM sites are arranged with a distance of about 5 degrees in longitude. The site name is NWP0301 (west) and NWP0302 (east), respectively. NWP0302 located over the center of the low seismic velocity area of the upper mantle in the Pacific region. The OBEMs are launched from the deck, and then sink to seafloor by self-weight, as the SFEMS. Acoustic communications were very fine at both sites, when the slant ranges were measured. They don’t settle in planed position exactly because they drift on the way to seafloor due to ocean flow. The OBEMs’ positions were also confirmed by “three-point calibration” (Table 4.2.1). RMS misfit was 7.70 for WP0301 and 1.57 for WP0302. The OBEMs moved in 500-800 m from the deployed positions. In addition, with regard to WP0302, the deployment and the three-point calibration were derived in different days, judging from the forecast of the sea situation and the cruise planning (Cf. Section 4.1 and Fig.1.2.2).

Figure Captions

Plate 3.2.1 Photograph of SFEMS just before deployment.

Figure 3.2.2 Aging test of the electrodes.

Table 3.2.3 Observation parameters of SFEMS observation.

Table 3.2.4 Information of the flushing light, radio beacon, and acoustic release system for SFEMS.

Figure 3.2.5 SFEMS location superimposed on the sea-beam bathymetry map.

Plate 3.4.1 Photograph of OBEM-MELT type just before deployment.

Plate 3.4.2 Photograph of OBEM99 type just before deployment.

Figure 3.4.3 Aging test of the electrodes.

Table 3.4.4 Specification of OBEMs

Table 3.4.5 Observation parameters of OBEM observation.

Table 3.4.6 Information of the flushing lights, radio beacons, and acoustic release system for OBEMs.

Figure 3.4.7 OBEM locations superimposed on the sea-beam bathymetry map.

Plate 3.2.1

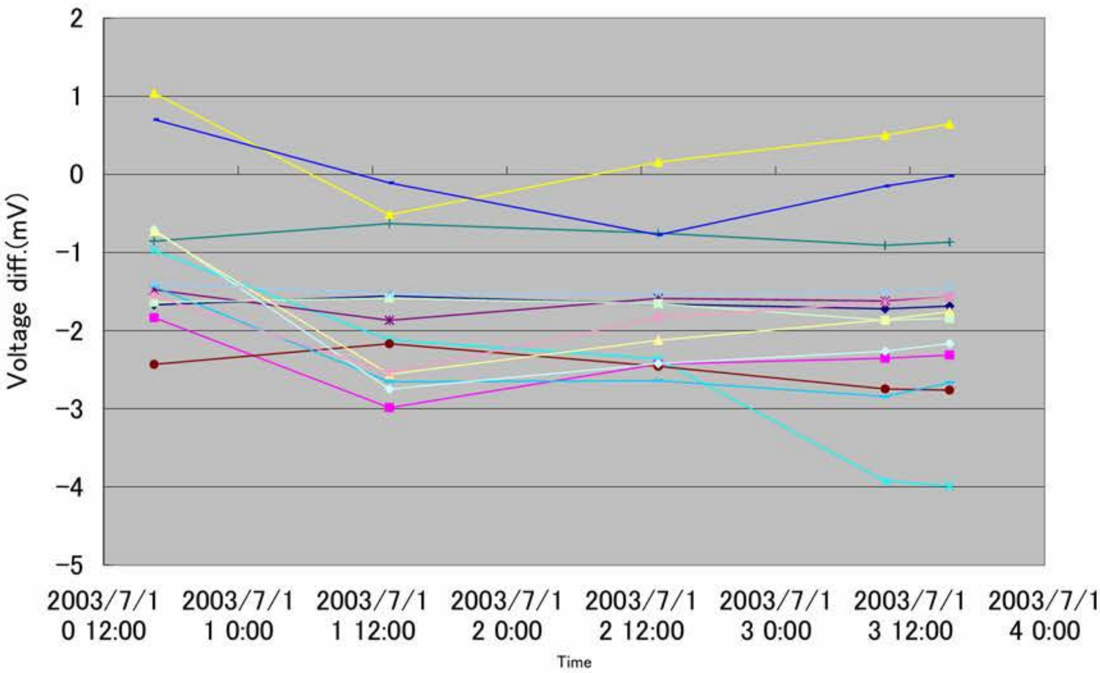


Figure 3.2.2

Table 3.2.3

Site Name	SFEMS ID	Setting Time (UTC)	Start Time (UTC)	Sampling Int. (sec.)	Electric Dipole
WP-2	ST3	2003.07.13 07:17:32	2003.07.19 14:58:00	60	4.78
					Duration (points
Gyroscope Schedule			2003.09.01 00:00:00	60	1440
			2003.12.01 00:00:00	60	1440
			2004.03.01 00:00:00	60	1440
			2003.06.01 00:00:00	60	1440

Table 3.2.4

Site Name	SFEMS ID	Flashing Ligh	Radio Beacon		Acoustic Release System	
			Frequency	Code	Vender	Release Code
WP-2	ST3	mounted	43.528MHz	JS190	Nichiyu	3-G

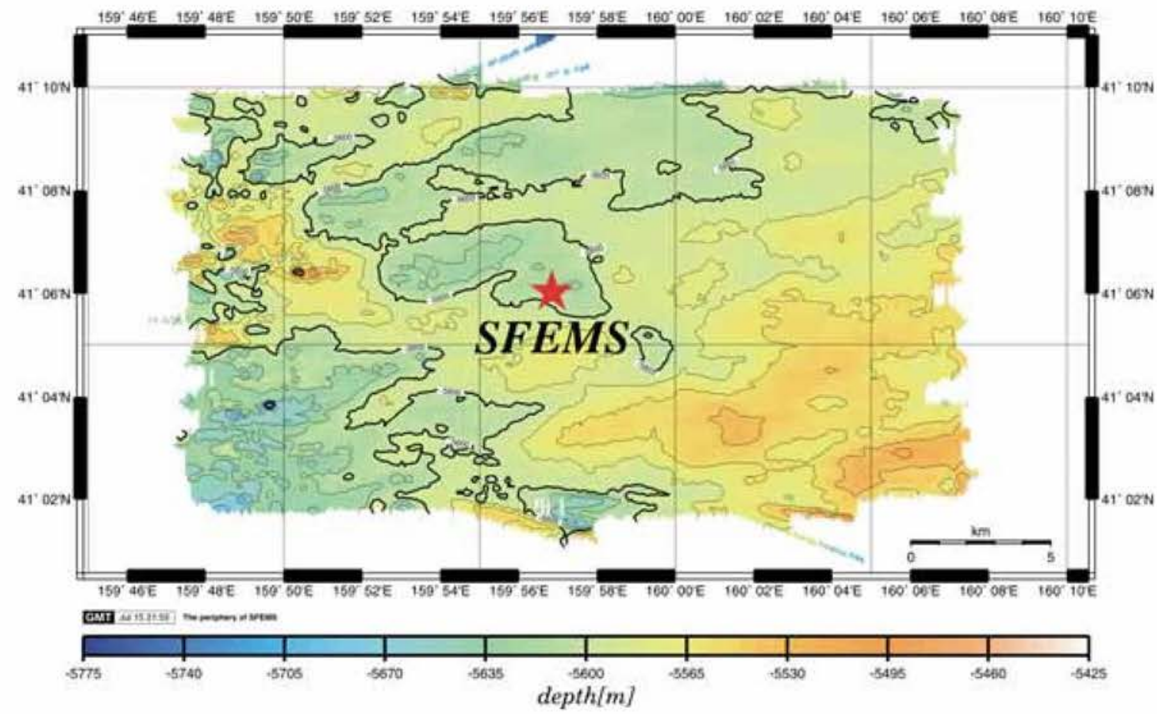


Figure 3.2.5

Plate 3.4.1

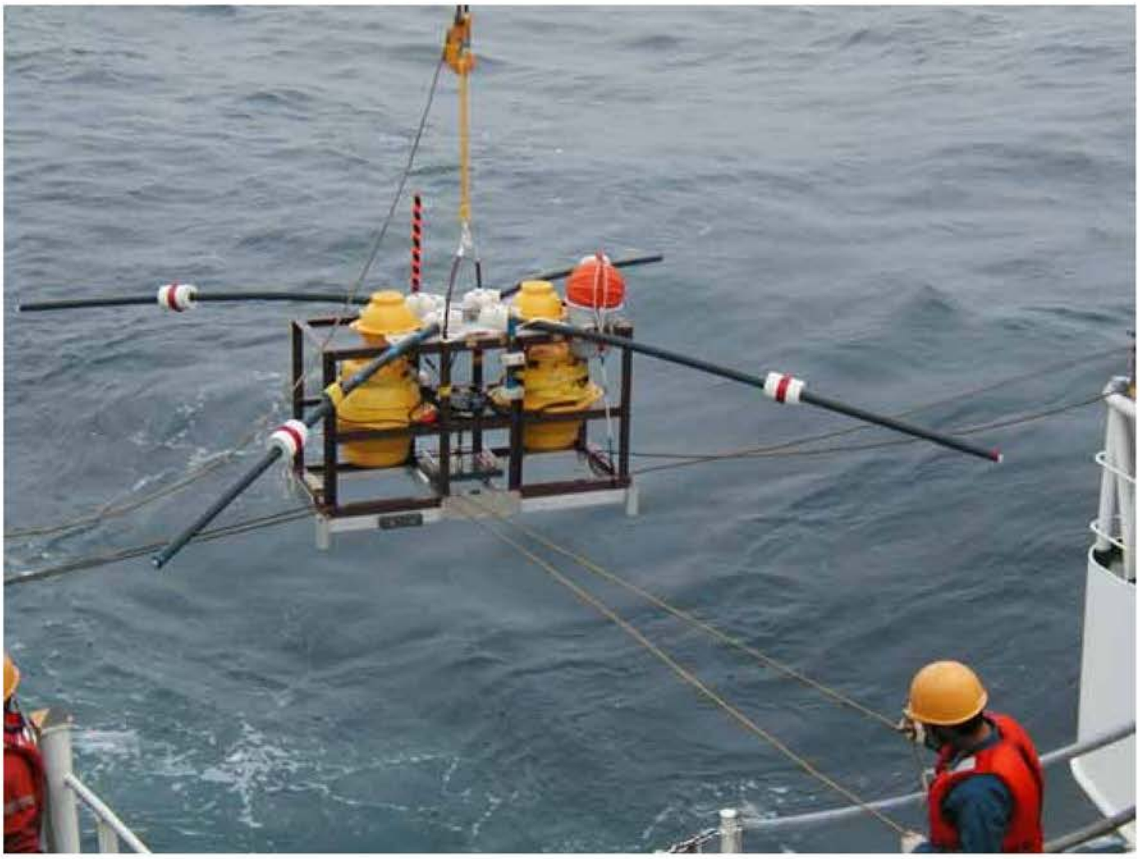


Plate 3.4.2

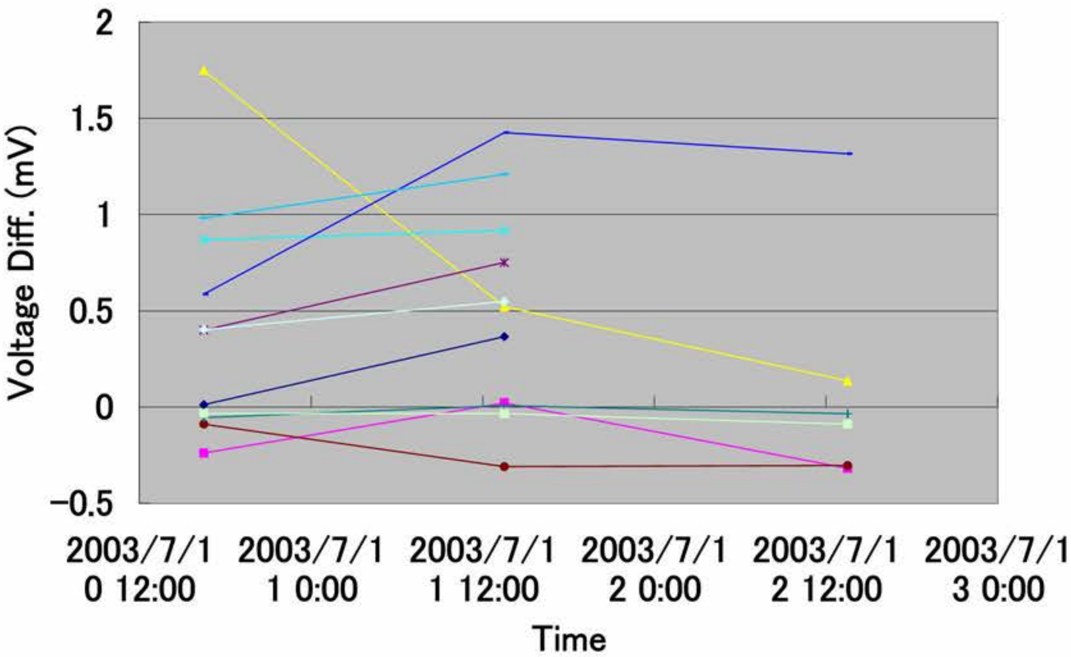


Figure 3.4.3

Table 3.4.4

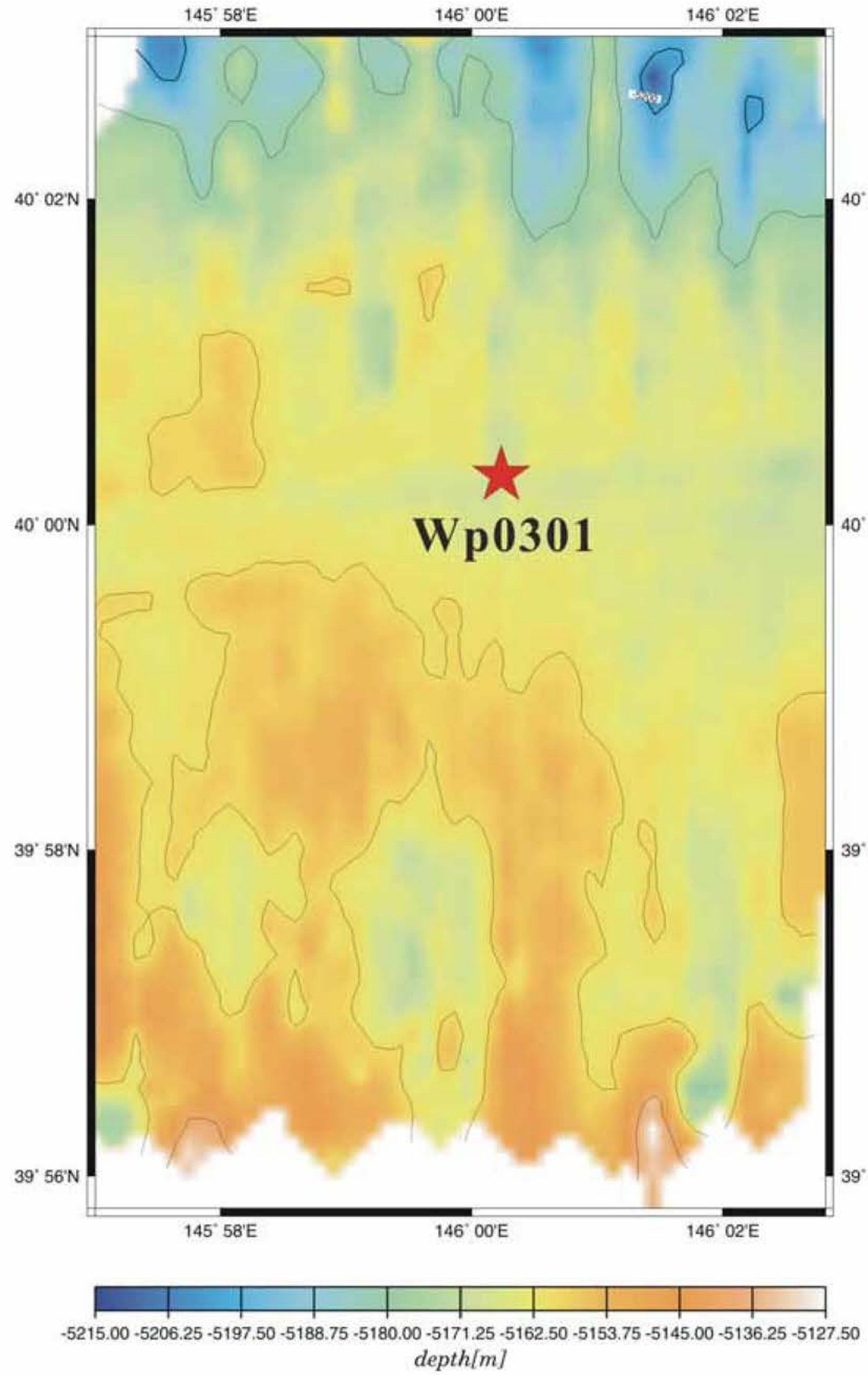
OBEM TYPE	FILEDS	DYNAMIC RANGE	LSB	NOTE
OBEM-MELT	Magnetic field diff.	1 byte (8 bits)	0.1nT	N, E positive
	Electric field diff.		0.3051758 μV	N, E positive
	Tilt diff.		1/600 degree	N down, E down positive
OBEM99	Magnetic field	2 bytes (16 bits)	10 pT	N, E positive
	Electric field		0.3051758 μV	N, E positive
	Tilt		0.00026 degree	N down, E down positive
	Temperature		0.01deg. C	Non negative

Table 3.4.5

Site Name	OBEM ID	Setting Time (JST)	Start Time (JST)	Sampling Int. (sec.)	Electric Dipole
WP0301	TT6	2003.7.10 18:36:04	2003.7.20 00:00:00	60	5.285
WP0302	TT4	2003.7.11 15:44:01	2003.7.20 00:00:00	60	5.23

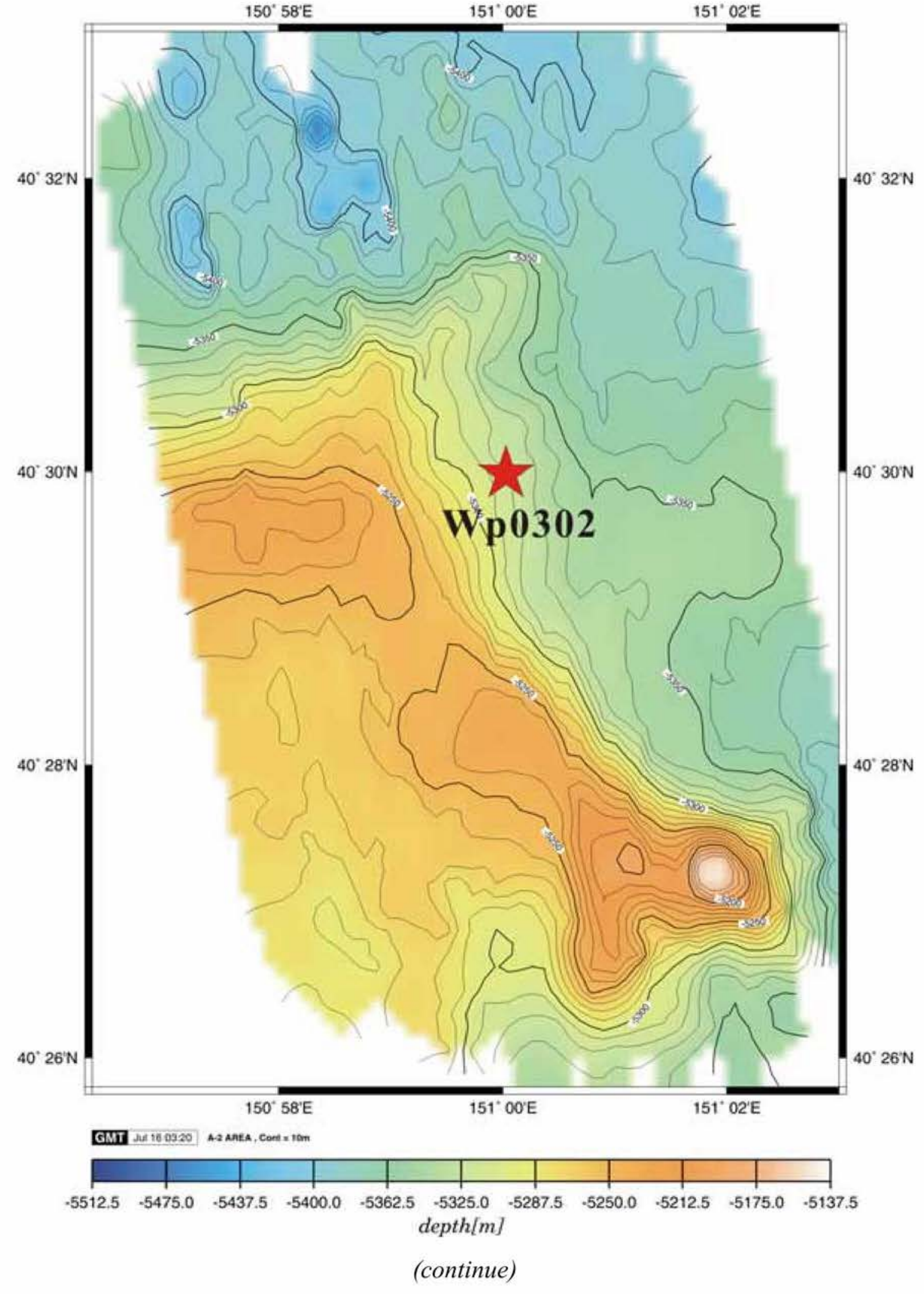
Table3.4.6

Site Name	OBEM ID	Flashing Ligh	Radio Beacon		Acoustic Release System	
			Frequency	Code	Vender	Release Code
WP0301	T06	mounted	43.528MHz	JS1105	Nichiyu	3-D
WP0302	T04	mounted	43.528MHz	JS1084	Benthos	C(Tx:11.0kHz,



145° 58'E
146° 00'E
146° 02'E
40° 02'N
40° 00'N
39° 58'N
39° 56'N
Wp0301
-5215.00 -5206.25 -5197.50 -5188.75 -5180.00 -5171.25 -5162.50 -5153.75 -5145.00 -5136.25 -5127.50
depth[m]

Figure 3.4.7


150° 58'E
151° 00'E
151° 02'E
40° 32'N
40° 30'N
40° 28'N
40° 26'N
Wp0302
A-2 AREA , Cont = 10m
-5512.5
-5475.0
-5437.5
-5400.0
-5362.5
-5325.0
-5287.5
-5250.0
-5212.5
-5175.0
-5137.5
depth[m]

(continue)

Cruise Logs

4.1 Shipboard Log

Date & Time	Note	Ship position/Weather /Wind direction/Wind force/Sea condition/Swell/Sight(at noon)
11-Jul-03		(39-37N, 141-59E)
9:00	Departure from Miyako	/Cloudy/NNE/1/1/1/6
9:20	Stand by Port Miyako due to bad sea condition around A-1 area	
10:00-10:30	Briefing about ship's life and safety	
15:50	Transit to A-1 area from Miyako Bay	
12-Jul-03		(40-00N, 146-12E)
5:00	Arrive at A-1 area	/Rain/ENE/4/3/3/6
05:00-05:30	Topograhic survey using the Sea Beam system	
6:14	A OBEM enter the water	
8:47	Land a OBEM on sea floor	
09:20-11:16	Determine the position of a OBEM	
11:20	Transit to A-2 area	
13-Jul-03		(40-33N, 151-52E)
5:50	Arrive at A-2 area	/Fog/W/2/2/5/0.2
05:50-06:17	Topograhic survey using the Sea Beam system	
6:44	A OBEM enter the water	
9:12	Land a OBEM on sea floor	
	Transit to A-3 area	
14-Jul-03		(41-06N, 159-57E)
11:50	Arrive at A-3 area	/Cloudy/SE/6/3/3/6
12:06	Call to old SFEMS	
12:12	Send a release command to old SFEMS	
12:35	New SFEMS enter the water	
14:50	Old SFEMS arrive at the surface	
15:15	Old SFEMS on Deck	
15:28	XBT measurment	
15:32-16:57	Determine the position of new SFEMS	
17:03	Launching of proton magnetometer	
17:32-23:26	Topograhic survey using the Sea Beam system	
23:57	Recovery of proton magnetometer	
	Transit to A-2 area	
15-Jul-03		(39-04N, 158-54E)
	Transit to A-2 area deturning to south due to rough sea	/Fog/S/6/5/4/0.3
16-Jul-03		(40-24N, 151-29E)
13:20	Arrive at A-2 area	/Cloudy/SW/2/2/3/7
13:25-14:21	Determine the position of a OBEM	
	Transit to Yokosuka	
17-Jul-03	Transit to Yokosuka	(37-55N, 144-01E) /Fine/NE/3/2/2/10
18-Jul-03		
10:00	Arrive at JAMSTEC	

4.2 Positions of ocean bottom instruments (Table 4.2.1)

Site Name	Instrument	Serial No.	Deployed position (WGS-84)			Estimated settled position (WGS-84)		
			Latitude	Longitude	Depth	Latitude	Longitude	Depth
WP-2	SFEMS	ST-3	N41° 05.9211'	E159° 56.9093'	5609m	N41° 05.9855'	E159° 56.9660'	5648m
WP03-01	OBEM	TT-6	N39° 59.9351'	E146° 00.0131'	5164m	N40° 00.2083'	E146° 00.0241'	5136m
WP03-02	OBEM	TT-4	N40° 30.6460'	E150° 59.8244'	5306m	N40° 30.2258'	E150° 59.8872'	5239m

4.3 Field notes of OBEM deployment

(TT6)

OBEM99 Check Sheet 1/4

航海名：KR03 OBEM名：TT6 観測点名：NWP0301

電極の選定

N：0304006 S：0304019 E：0303006 W：0304008

GND：0304009

電位差チェック（GND電極に対する電位差）

N：0.203 mV S：0.542 mV E：-0.340 mV W：-0.159 mV

電極ケースに入れて電位線との接続：☑ 防水処理：☑

キャップをはずす ☑

下部台座の組立

おもりの固定：☑ 空中重量：41.5 kg

接触面への絶縁材貼り付け：☑ サブウェイト 4.5kg×2 取り付け ✓

メインフレーム

バランスウェイトの固定：☑ OBEM 球側 空中重量：2 kg

切り離し装置の接続

だるまの取り付け：☑

電池球とトランスデューサーとの接続、デューサーをフレームに固定：☑

切り離しケーブル・プラス側（電触部）と

だるまの接続（シャックルを通す）：☑

切り離しケーブル・マイナス側とだるまの接続：☑

おもりとだるまの接続：☑

おもりつりあげ（ターンバックルをしめる）☑

トランスポンダー動作テスト（日油技研 LA-G（改））

切り離しコード：3-D

電池球に切り離しケーブルを接続（切り離し装置の電源 ON）：☑

スリープ解除

コールモードで送信（16 回応答）：☑

Ranging test

距離モードで送信（~~16~~ 1 回応答）：0 m

Releasing test

コマンドモードで送信（32 回応答）：☑

電圧 13V を確認：14.46 V

コマンドリセット（コールモードで送信）、電圧 0V を確認：☑

※一度トラポンダをOFFにした（7/10）

↓

再度 ON

1コール 16応答 OK 7/12

(TT6)

OBEM セットアップ

パソコンの時計を基準時計（ GPS ）に合わせる：☑
電池球と本体球の接続（LED5 回点灯）：☑
本体球とパソコンを接続（OBEM の RS 入出力 ON）し
　OBEM99SET を起動：☑
System Reset（LED5 回点灯）：☑
Clock Set：☑
　OBEM からの返答：03/07/10, 18:36:04 JST
Monitor（Active monitor）：☑
Memory Erase（フラッシュメモリの初期化）：☑
Memory Test（メモリへの読み書きテスト）：☑
再度 Memory Erase（フラッシュメモリの初期化）：☑
Memory Blank Check（メモリ初期化の確認 高速モード）：☑
Timer Start
　測定間隔：60 秒
　測定開始時刻：03 年 7 月 20 日 0 時 0 分 0 秒
　(UTC / JST)
　現在の OBEM 時刻：03 年 7 月 10 日 18 時 56 分 38 秒
　(UTC / JST)
プログラム終了、ケーブルをはずし（OBEM の RS 入出力 OFF）、
　ダミーキャップをつける：☑

電極アーム

~~関接部の固定：~~
電極ケース接続：☑
電位線を通す：☑
浮力体の固定：☑
本体フレームへの固定：☑
電位線と本体球との接続：☑
電極間距離：＿＿＿ m
N-S 5.285
E-W

ビーコン・フラッシャー

ビーコン

型番：TB30E　シリアル番号：~~T1 886117~~ 3361176
周波数：43.528 MHz
コード：JS1105
圧力スイッチ：☑
本体フレームへの固定：☑

フラッシャー

型番：FL-6000　シリアル番号：~~5291022~~ 5291043
圧力スイッチ：☑
光スイッチ：☑
本体フレームへの固定：☑

余ったケーブルをさばく：☑
投入準備全て OK？：☑

OBEM99 Check Sheet 4/4 TT6

NY-3D

25 | 892 → 36
2h 24m?

スラスラ 伊えても 静か。

投入

時刻：2003年 7月 12日 06時 14分 秒 (UTC/JST)
位置：Lat. 39°59.9351, Lon. 146°00.0131 測地系：WGS84
水深：~~5172~~ m 5164m

測距

N39°59.9351 E146°00.0131

時刻	距離	時刻	距離	
06:20	m	08:30:39	4706 m	ほぼ原点
06:22	294 m	08:31:15	4725 m	
06:23	333 m	08:40:09	5024 m	
06:24	359 m	08:41:03	5043 m	
06:38	857 m	08:42:04	5079 m	水深
06:39	892 m	08:43:02	5118 m	5166 m
06:40 (40°00N, 146°00E)	930 m	08:44:00	— m	着たらしい。
07:00	1643 m	08:45:19	5156 m	
07:01	1685 m	08:46:01	5155 m	
07:28	2621 m	08:47:00	5166 m	
07:29	2650 m		m	
07:30	2693 m		m	
~~07:58~~	~~m~~		m	
07:59	3670 m		m	
08:00	3716 m		m	

平均降下速度：36 m/min 着底確認：☑. 39-59.9446 146-00.018

位置決定

	船位		距離	
投入点より北へ2マイル	Lat. 40°02.0074' N	Lon. 145°59.9923' E	6120 m	9:20
	Lat. 02.0079'	Lon. 59.9989'	6120 m	
	Lat. 02.0073'	Lon. 146°00.0056'	6125 m	
南西2マイル	Lat. 39°59.0058'	Lon. 145°57.7854'	6438 m	10:24
	Lat. 58.9911'	Lon. 57.7870'	6442 m	10:25
	Lat. 58.9808'	Lon. 57.7886'	6450 m	10:26
南東2マイル	Lat. 39°58.9673'	Lon. 146°02.3427'	6525 m	11:16
	Lat. 58.9652'	Lon. 02.3464'	6527 m	11:17
	~~Lat. 58.9632~~	~~Lon. 02.3503~~	~~m~~	~~11:17~~
	Lat. 58.9621	Lon. 02.3521	6514 m	11:18
	Lat.	Lon.	m	

推定着底位置：Lat. 40°00.2083' N, Lon. 146°00.0241' E 水深：5136.2 m 標準誤差 7.70

投入点より 北へ 506m 東へ 15m } 流された

KR0308 : TT6

３点キャリブレーション結果

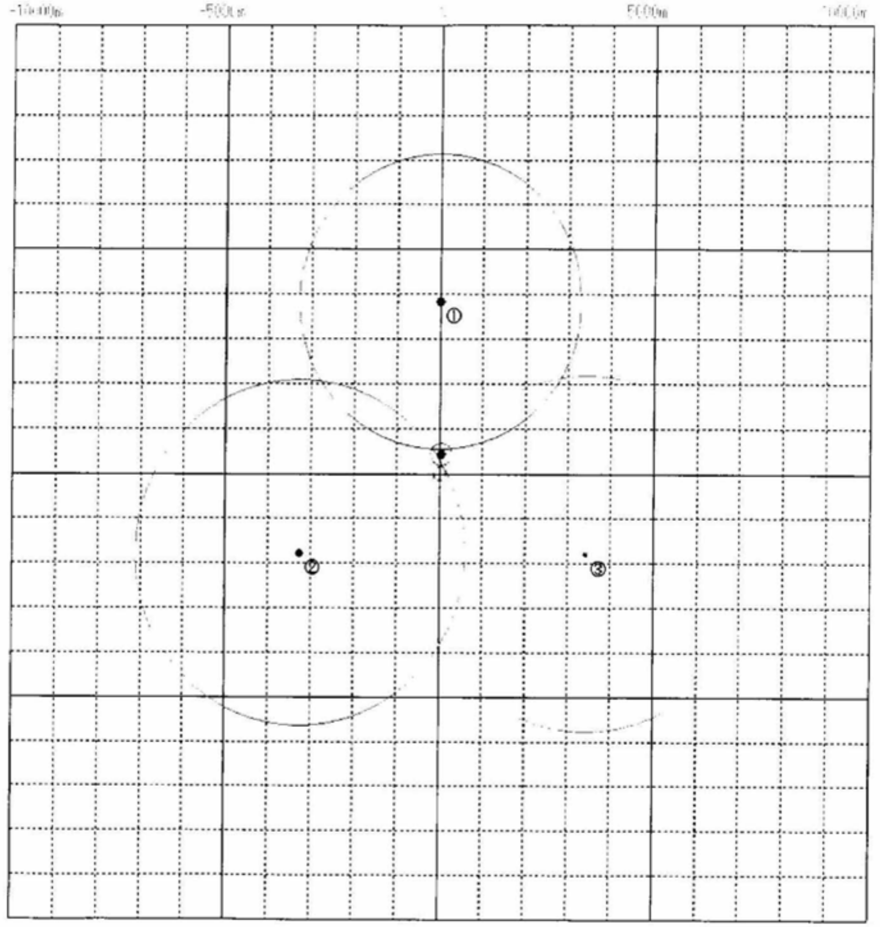
2003/07/12　11:21:06
STATION =　ST
DATUM　=　WGS84

投入位置	39-59.9346N	146-00.0126E	5.165m
1 回 目	40-02.0084N	146-00.0079E	6.125m
2 回 目	39-58.9778N	145-57.7882E	6.450m
3 回 目	39-58.9616N	146-02.3528E	6.514m

補正位置
40-00.1685N　146-00.0348E　5165m

投入位置と補正位置の偏差
X = 32.7m　　Y = 432.5m
4.3°　　433.7m

印刷



TT4

航海名：KR03　OBEM 名：TT4　観測点名：NWP03012

電極の選定

N：030300 5　S：030310　E：0303008　W：0303007

電位差チェック（E 電極に対する電位差）

N：-0.013 mV　S：-0.061 mV　W：-0.336 mV

電極ケースに入れて電位線との接続：☑　防水処理：☑

下部台座の組立

おもりの固定：☑　空中重量：41.5 kg

接触面への絶縁材貼り付け：☑　サブウェイト 4.5kg X2 取り付け ✓

切り離し装置の接続

だるまの取り付け：☑

切り離しケーブル・プラス側（電触部）と

だるまの接続（シャックルを通す）：☑

切り離しケーブル・マイナス側とだるまの接続：☑

おもりとだるまの接続：☑

トランスポンダー動作テスト（Benthos TR-6000）

デッキユニット（DS-7000）

受信周波数	Tx：11 kHz	10 kHz
	Rx：10 kHz	11 kHz
切り離しコード：C		

マグネットスイッチをはずす（トラポンのスイッチ ON 4 回応答）：☐ ← なし

Ranging test

ranging mode で 1 call（1 回応答）：☑

マグネットスイッチ付け OFF 後、応答なし確認
スイッチ取りはずしたが鳴かず。

Releasing test

テスト用抵抗とテスターの接続：☑

command mode でコマンド送信（4 回応答）：☑

電圧 24V を確認：25.6V

ranging mode で 1 call（5 回応答）：☑

テスト抵抗をはずし、電圧 0V を確認：☑

ranging mode で 1 call（1 回応答）：☑

TT4

OBEM セットアップ

パソコンの時計を基準時計（ GPS ）に合わせる：[✓].
電池球と本体球の接続（LED10 回点灯）：[✓]. 2003/07/11 15:38 JST
本体球とパソコンを接続し OBEMMELTSET を起動：[✓].
System Reset（LED10 回点灯）：[✓].
Clock Set：[✓].

測定モード：1バイト差分 B

OBEM からの返答：2003/07/11 15:44:01 (JST)

Memory Check：[✓].
Memory Init：[✓].
Monitor：[✓].
Timer Start

測定間隔：60 秒

測定開始時刻：2003 年 7 月 20 日 00 時 00 分 00 秒

(UTC / JST)

~~現在の OBEM~~ 時刻：2003 年 7 月 20 日 15 時 57 分 ~~秒~~

Timer Start を設定した (UTC / JST)

プログラム終了、ケーブルをはずしダミーキャップをつける：[✓].

電極アーム

間接部の固定：[✓].
電極ケース接続：[✓].
電位線を通す：[✓].
浮力体の固定：[✓]. ロール型（白小 14個）
本体フレームへの固定：[✓].
電位線と本体球との接続：[✓].
電極間距離：5.23 m

2.28×2+67

4.56
67
5.23

ビーコン・フラッシャー

ビーコン

型番：TB-309　シリアル番号：5290658
周波数：43.528 MHz
コード：JS1086

圧力スイッチ：☑.
本体フレームへの固定：☑.

フラッシャー

型番：FL6000　シリアル番号：~~5291043~~ 5291022

圧力スイッチ：☑.
光スイッチ：☑.
本体フレームへの固定：☑.

余ったケーブルをさばく：☑.
投入準備全て OK？：☑.

Benthos

投入

時刻：2003 年 7 月 13 日 06 時 44 分 20 秒 (UTC / JST)
位置：Lat. N 40° 30.646', Lon E 150° 59.8284' 測地系：WGS84
水深：5306 m

スラスタと同時測距可

測距

備考	時刻	距離	時刻	距離	備考
	06:50	226.9 m	09:08	5281.3 m	
	06:52	299.1 m	09:10	5287.9 m	
	06:54	373.1 m	09:11	5287.2 m	
予定 9:09 —	07:11	1009.0 m	09:12	5287.5 m	←着底
	07:12	1048.1 m		m	
GAIN 04 ↑	07:31	1732.6 m		m	
	07:32	1771.5 m		m	
GAIN 05 ↓	08:10	3185.0 m		m	
	08:11	3222.8 m		m	
予定 9:07 —	08:13	3299.3 m		m	
	08:40	4297.8 m		m	
	08:41	4337.0 m		m	
	08:42	4368.3 m		m	
	09:05	5178.7 m		m	
	09:06	5217.1 m		m	

平均降下速度：36.5 m/min 着底確認：☑

位置決定

備考	船位 Lat.	船位 Lon.	距離	時刻
投入点より南東 2マイル	40° 28.8485' N	151° 02.1927' E	6668.9 m	13:26 (JST)
	8477'	1902'	6669.6 m	12:27:00
	8465'	1858'	6668.9 m	12:27:30
北 2マイル	40° 32.0807'	150° 59.6860'	6271.1 m	13:54:00
	0812'	6825'	6271.6 m	54:30
	0817'	6793'	6271.7 m	55:00
南西 2マイル	40° 28.9355'	150° 57.5149'	6659.0 m	14:19:00
	9340'	5122	6658.8 m	19:30
	9339'	5104'	6659.4 m	20:00
			m	

推定着底位置：Lat. 40° 30.2258' E, Lon. 150° 59.8872' N 水深：5238.6 m 標準誤差 1.37

投入点より 南へ 778 m
東へ 151 m

A-2 AREA

FormGraph

3点キャリブレーション結果

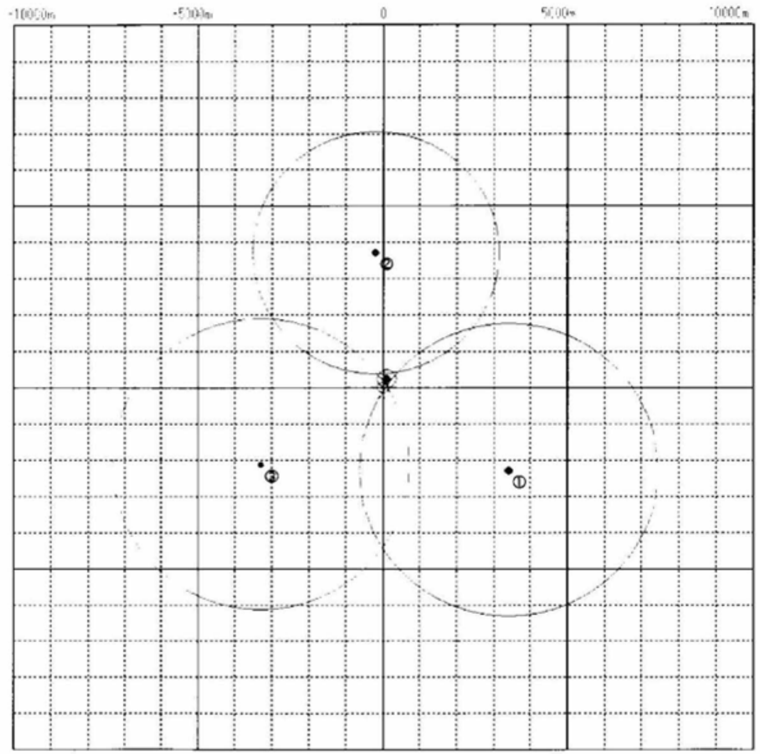
2003/07/16　14:23:15
STATION =　ST
DATUM　=　WGS84

投入位置	40-30.0743N	150-59.8147E	5.310m
1 回 目	40-28.8453N	151-02.1871E	6.669m
2 回 目	40-32.0826N	150-59.6774E	6.272m
3 回 目	40-28.9334N	150-57.5087E	6.659m

補正位置
40-30.2069N　150-59.8819E　5310m

投入位置と補正位置の偏差
X = 96.9m　　Y = 245.4m
21.6′　　263.8m

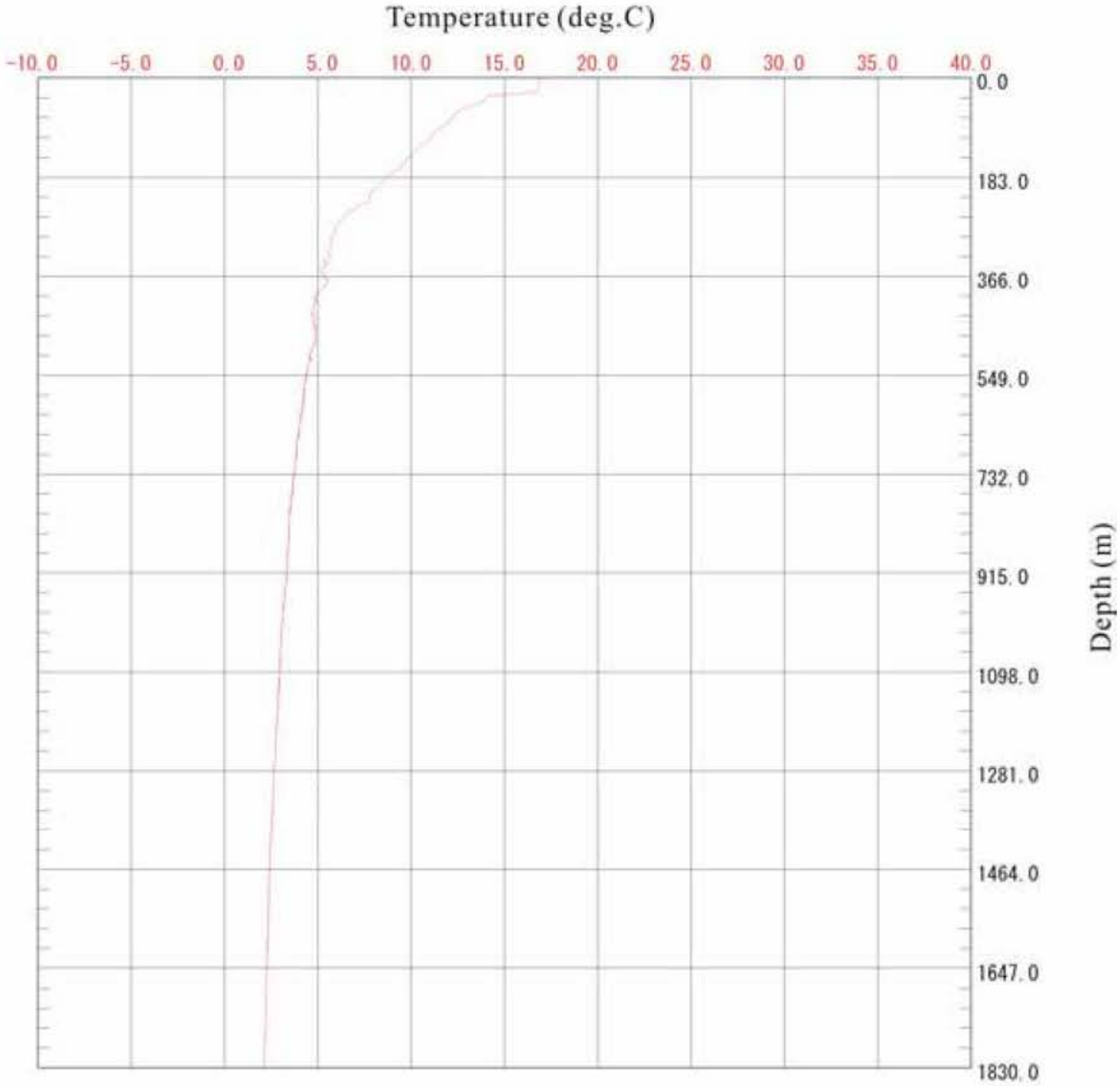
印 刷



かいれい 15.7.16

4.3 XBT data

Date	July 14th, 2003	Probe Type	T05
Time	06:28:29 UTC	Max.Depth	1830m
Latitude	N41° 05.9251'	No.of Data	5821
Longitude	E159° 56.9764'		

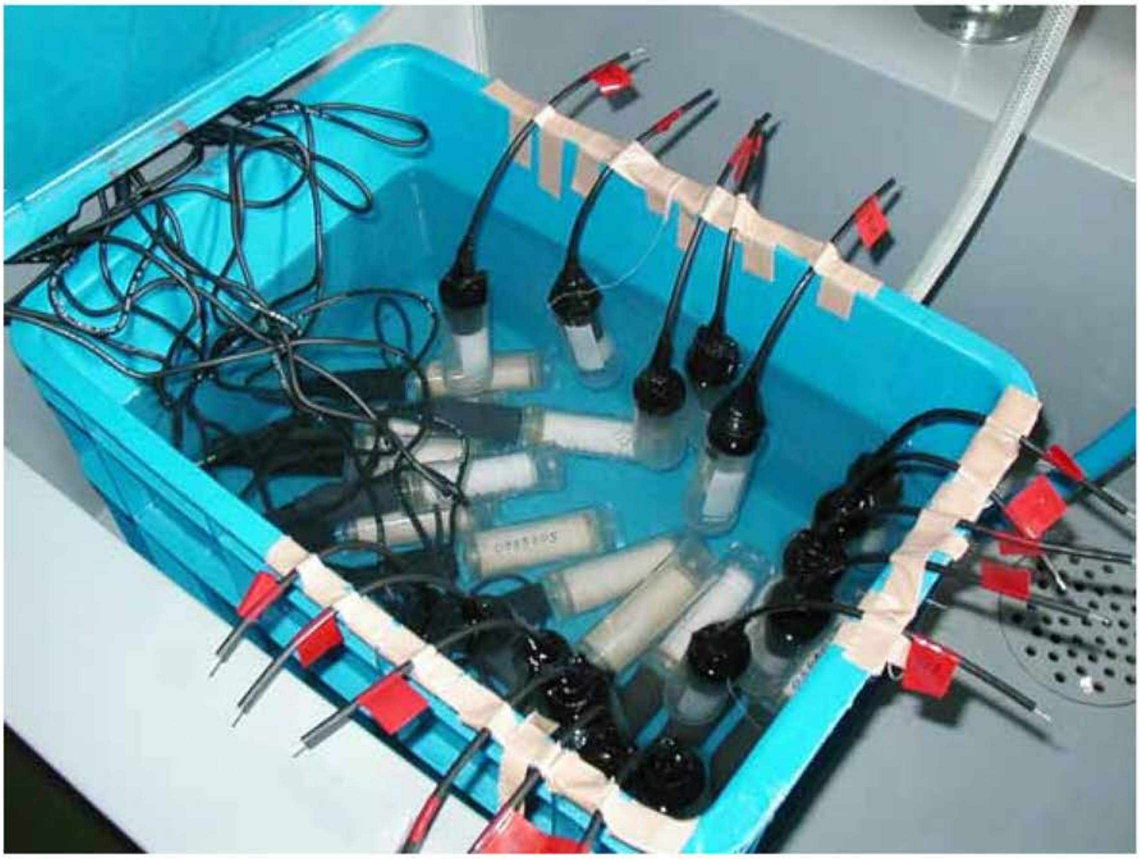


Photographs

Dry Laboratory (1)

Dry Laboratory (2)

Under aging electrodes



Standing-by ocean bottom instruments

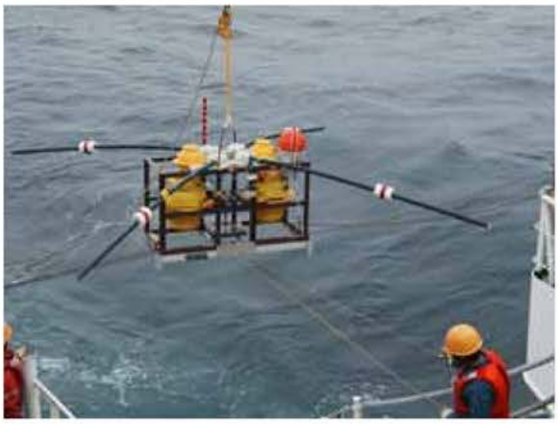
Acoustic transponder

The part of separating weight

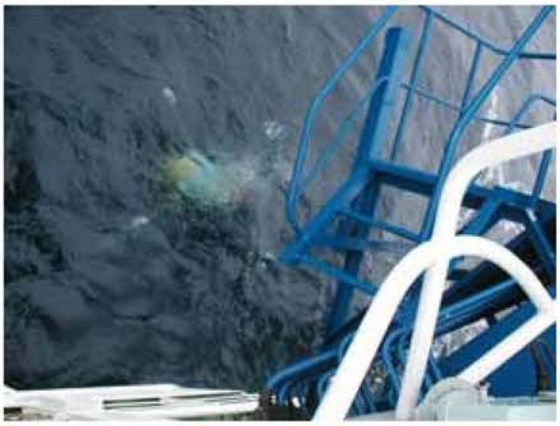
OBEM Deployment at WP03-01

OBEM Deployment at WP03-01(II)

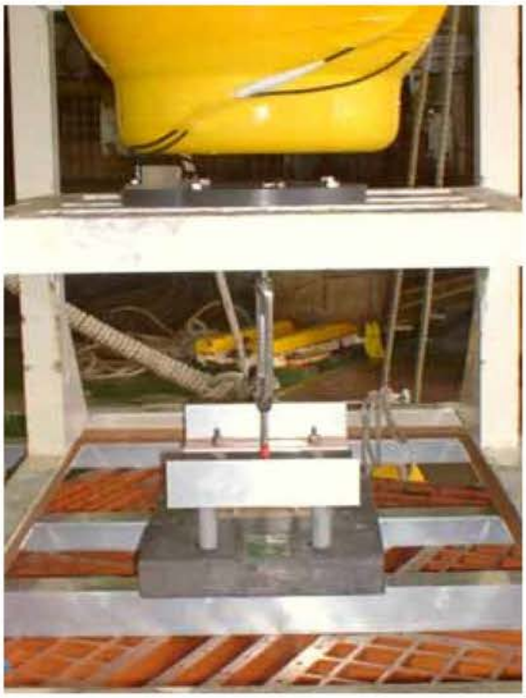
OBEM Deployment at WP03-01(III)



OBEM Deployment at WP03-01(IV)



OBEM Deployment at WP03-02



OBEM Deployment at WP03-02

Standing-by SFEMS and Prof. Toh

Deployment of SFEMS

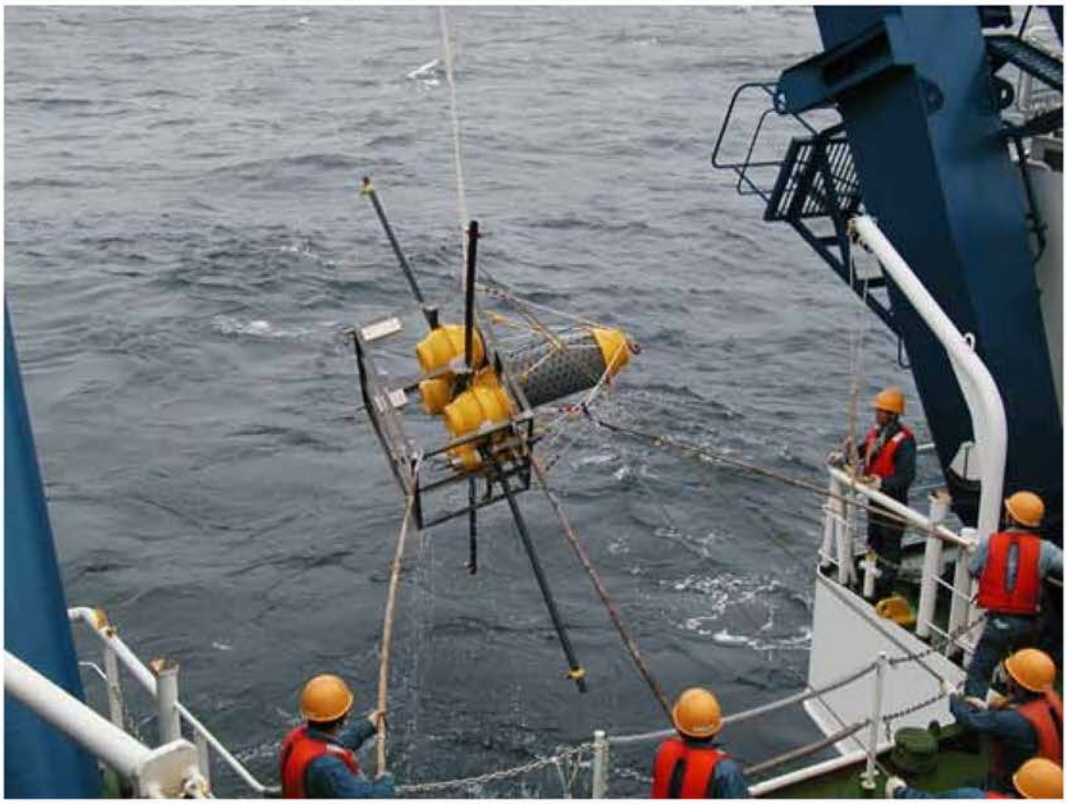
Deployment of SFEMS(II)

Recovered SFEMS (right)

Surfacing SFEMS (below)

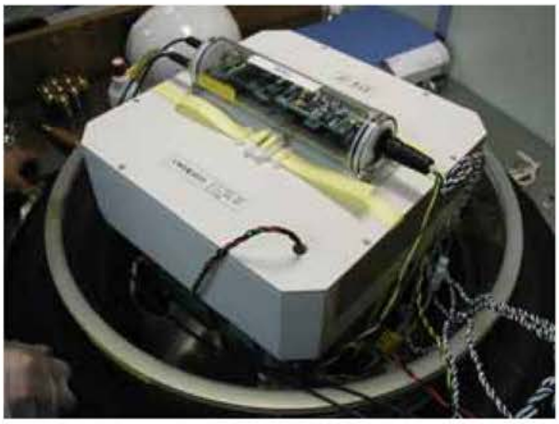
Recovered SFEMS (II)

Recovered SFEMS (III)



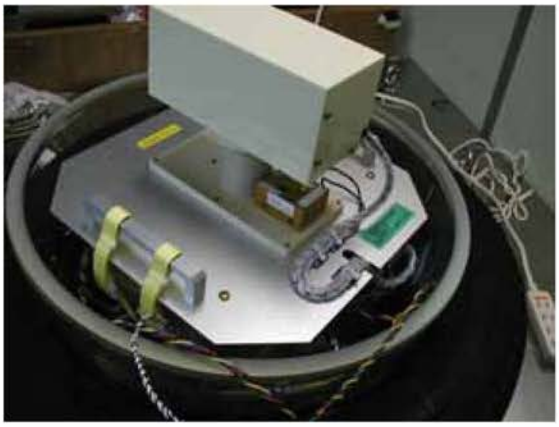
Recovered SFEMS (IV)

Opened Overhauser glass sphere of SFEMS

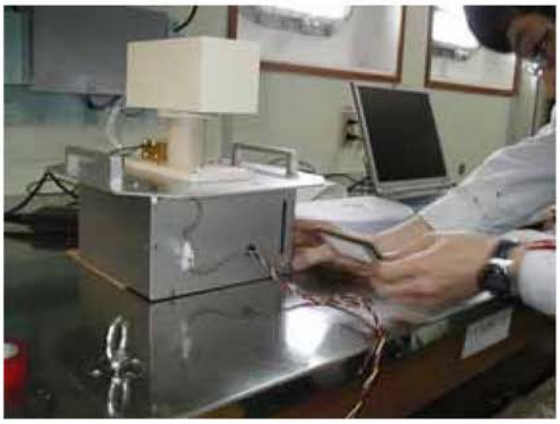


Data back-up

Opened OBEM glass sphere of SFEMS



Collecting compact flash media



Appendices

LIST

I. Outline Paper of this cruise (Japanese)
II. The previous plan of this cruise (Japanese)
III. Modified and fixed procedure of this cruise (Japanese)

I.　Outline Paper of this cruise (Japanese)

１．研究組織／提案者
東京大学／金沢敏彦

２．研究課題
海底長期広帯域地震・電磁気観測による地球深部構造イメージング

３．要望船舶名／希望潜航回数／調査必要日数
無人探査機「かいこう」　希望潜航回数　６回

４．提案分類
「長期観測系」

５．共同提案者／研究分担者

１．金沢敏彦	東大・地震研・教授	総括・開発評価	乗船する
２．深尾良夫	東大・地震研・教授	データ解析・解釈	乗船しない
３．歌田久司	東大・地震研・教授	データ解析・解釈	乗船しない
４．末広潔	海技セ・深海研究部・部長	データ解析・解釈	乗船しない
５．塩原肇	東大・地震研・助教授	観測・開発・解析	乗船する
６．三ケ田均	海技セ・深海研究部・副主幹	観測・解析	乗船しない
７．篠原雅尚	東大・地震研・助教授	開発・観測・解析	乗船する
８．藤浩明	富山大・理・助教授	開発・観測・解析	乗船する
９．海宝由佳	海技セ・深海研究部・研究員	観測・データ解析	乗船する
１０．荒木英一郎	海技セ・深海研究部・研究員	開発・データ解析	乗船する
１１．市来雅啓	海技セ・ＩＦＲＥＥ・研究員	開発・データ解析	乗船する
１２．山田知朗	東大・地震研・助手	観測・データ解析	乗船する
１３．中東和夫	東大・理学系・大学院生	観測・データ解析	乗船する

６．研究調査海域
海域：s. その他
研究対象：北西太平洋海盆・西フィリピン海盆

７．海域の範囲
北緯 19°00'～41°00', 東経 135°00'～160°00'

８．潜航希望水深
最浅水深　l.　5,001～5,500m
最深水深　m.　5,501～6,000m

９．事前調査の実施状況
＜事前調査の実施状況＞（400 字以内）
平成 12 年 10 月 29 日深海調査研究船「かいれい」KR00-07 航海において，西太平洋海盆海底孔内広帯域地震観測点 WP-2 のシステム起動と予備観測の開始を無人探査機「かいこう」ダイブ#175 にて，実施した．平成 13 年 7 月 27 日海洋地球研究船「みらい」MR01K04 航海において、WP-2 点近傍に絶対磁力計を搭載した海底電位磁力計を敷設した。平成 13 年 8 月 1,3,5 日同研究船「かいれい」KR01-11 次航海において，WP-2 観測点のシステム状況のチェック，予備観測データの回収，長期観測の開始を無人探査機「かいこう」ダイ

ブ#200～#202 にて実施した.
西フィリピン海盆海底孔内広帯域地震観測点 WP-1 のシステム起動とチェックは，平成 13 年度中に，無人探査機「かいこう」を用いて行うことが決定されている. *(351 字)*

＜海底障害物および潜航調査に支障をおよばすもの＞（400 字以内）
特になし *(4 字)*

１０．潜航／調査希望時期及びその理由
＜天候及び他のプロジェクトによる制限等を具体的にお書きください＞（400字以内）
北西太平洋　　　　　　７月～８月
北西太平洋海域は，年間のほとんどが天候不良の海域であり，潜航が可能となる時期は，夏期の７月または８月しかない．これ以外の時期では，海域で到達できても，潜航可能となる日がほとんど期待できない.

西フィリピン海盆　　　９月～１０月
西フィリピン海盆の海底孔内広帯域地震観測点WP-1は，平成14年の3月に，無人探査機「かいこう」により，システムのチェック・起動，観測開始を実施する予定である．観測開始後，比較的短い観測期間でデータを回収することで，システムの状況，観測データの質と量を判断することができると考えられる．そのために，観測開始後約６ヶ月で潜航を希望する． *(288字)*

＜その他条件＞（400字以内）
特になし *(4 字)*

１１．科学目的の概要（400 字以内）
本研究は、西太平洋域における広帯域地震・電磁気観測データを用い，日本を含む西太平洋下地球深部の高分解能イメージングを行う事を目的としている．その為，約1000kmスパンの観測網を目指し，西太平洋の島嶼に広帯域地震・電磁気観測点を設置した．しかし，島嶼のない海域においては，海洋底での観測が不可欠である．また，高い分解能で構造を求めるには，良質なデータが必要となる．海底掘削孔に地震計を設置・観測すれば，海域では最も良質な地震データがもたらされる．この観点から，北西太平洋及び西フィリピン海盆のODP掘削孔を利用して，孔内広帯域地震観測点を設置し，既に観測を開始した．その他にも，設置場所が自由に選べる自由落下方式の広帯域海底地震計と絶対磁力計を搭載した海底電位磁力計を開発し，観測を行っている．これらの広帯域地震・電磁気観測は，数年の長期にわたり観測を行い，十分な量と質のデータを蓄積する必要がある． *(400字)*

＜キーワード＞
西太平洋，地球深部構造，長期海底地震・電磁気観測，孔内地震観測，絶対磁力計

１２．研究計画の実施形態（400 字以内）
本研究計画は，西太平洋全域にわたる地震・電磁気観測を基本としており，周辺に島嶼のない北西太平洋海盆と西フィリピン海盆の二観測点のデータ回収及びメンテナンスがその主な実施内容である．また，所期の科学目的を達成する為には，長期にわたる海底広帯域地震・電磁気観測の継続が必要であり，本研究計画は，本年度だけで完了するものではなく，今後少なくとも３年程度継続する．システム・チェック，定期的データ回収等の理由から、各観測点で１年に１度程度の無人探査機による保守・整備を行う．２点の海底孔内地震観測点は，海半球ネットワーク地震観測網の一部であり，かつ最重要な観測点である．また，現在海底掘削孔での長期広帯域地震観測や海底での地磁気の連続絶対観測を実施しているのは，世界的に見ても我々だけであり，前者は今後の深海掘削計画（「IODP」や

「OD21」）で長期孔内計測を行うにあたり，極めて重要な情報を与える．*(397字)*

１３．本研究に係わる研究経費の予算の裏付け（400 字以内）
北西太平洋海盆及び西フィリピン海盆における海底孔内広帯域地震・電磁気観測点の設置は完了しており、今後は保守・整備に係わる費用が主なものとなる，これらの経費は，以下の研究費で充当する予定である．
・東京大学地震研究所海半球研究観測センター経費
・東京大学地震研究所地震地殻変動観測センター経費
・海洋底における地震・地殻変動ネットワーク観測基礎研究（東京大学地震研究所・海洋科学技術センター）による経費 *(197 字)*

ご意見・ご希望

特に無し.

II.　The previous plan of this cruise (Japanese)

ＫＲ０３−０８航海当初計画

深海調査研究「かいこう」調査潜航

課題名

（１）「長期にわたる海底広帯域地震･電磁気観測による地球深部構造イメージング」

代表研究者：金沢　敏彦（東京大学地震研究所）

調査内容　：

①「かいこう」による海底作業（中止）

・深海底掘削孔観測装置のデーターレコーダーの回収及び再設

・観測装置用海水電池の状況調査

②シングルチャンネルによる地殻構造探査及び広帯域海底地震計、構造探査用地震計の回収･設置（実施せず）

③海底電位差磁力計の回収・設置（実施）

期間　平成１５年7月１１日（金）〜7月２０日（日）までの１０日間
（宮古〜センター）