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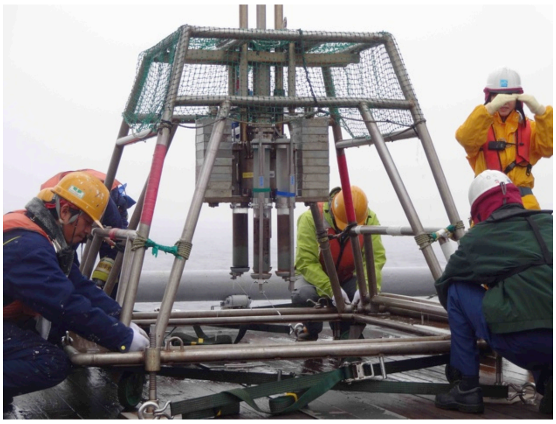
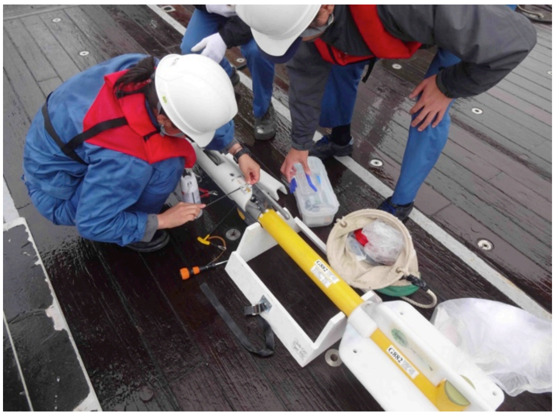
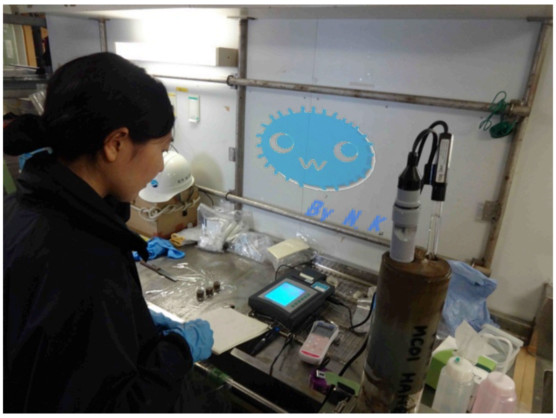
R/V MIRAI "Cruise Report"

MR13-05







Western North Pacific and Bering Sea

13rd August, 2013 – 26th August, 2013

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

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6. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

1. Cruise information

1.1 Cruise ID

MR13-05

1.2 Name of Vessel

R/V MIRAI

L x B x D 128.58m x 19m x 6.9m

Gross Tonnage 8,679 tons

Call Sign JNSR

1.3 Cruise title

Investigation of iron forms within sediment-water interface in Bering Sea

1.4 Chief scientist

Saburo Sakai (Japan Agency for Marine-Earth Science and Technology)

1.5 Cruise participant

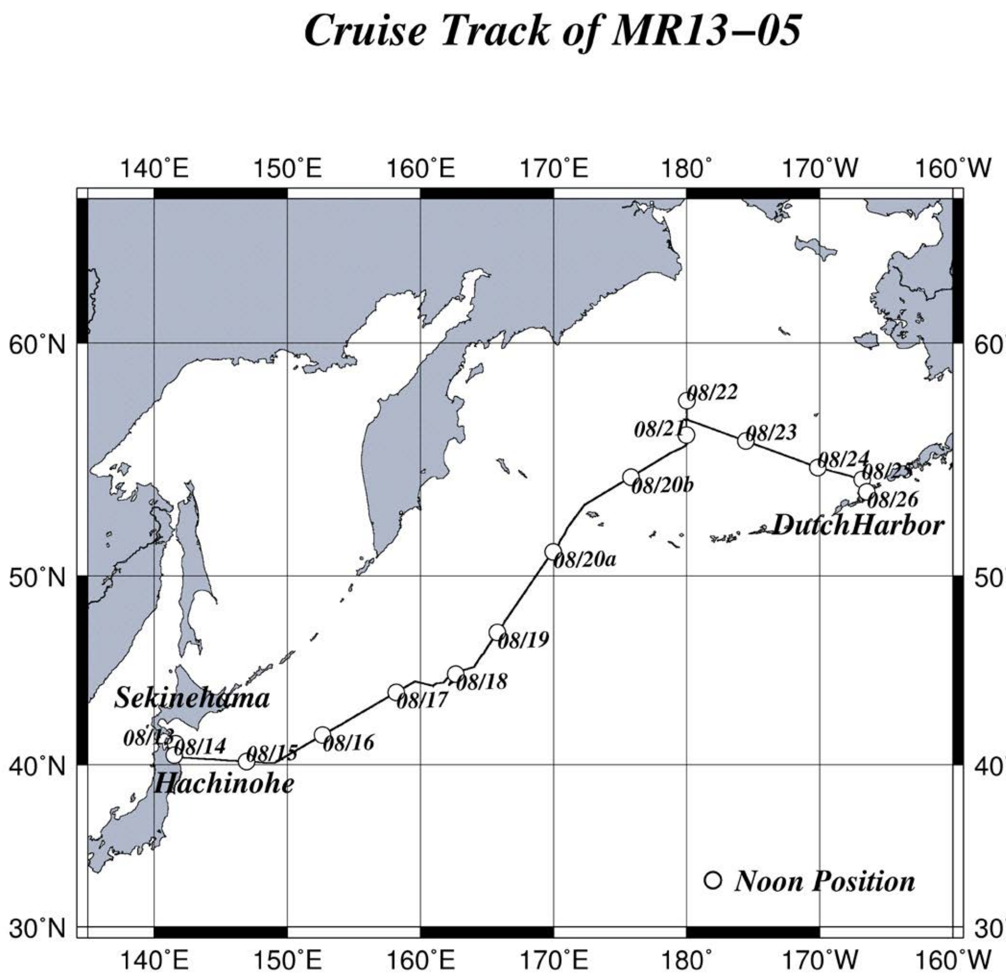
NO	NAME	ORGANIZATION	POSITION
1	Saburo Sakai	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Research Scientist
2	Noriko Kawamura	Japan Coast Guard Academy	Associate Professor
3	Shinya Okumura	Global Ocean Development Inc.	Technical Staff
4	Miki Morioka	Global Ocean Development Inc.	Technical Staff
5	Yasumi Yamada	Marine Works Japan Ltd.	Technical Staff
6	Misato Kuwahara	Marine Works Japan Ltd.	Technical Staff
7	Yusuke Sato	Marine Works Japan Ltd.	Technical Staff
8	Hirokatsu Uno	Marine Works Japan Ltd.	Technical Staff
9	Rei Ito	Marine Works Japan Ltd.	Technical Staff
10	Kentaro Shiraishi	Marine Works Japan Ltd.	Technical Staff

1.6 Cruise period (port call)

13rd Aug., 2013 (Sekinehama, Japan) – 14th Aug., 2013 (Hachinohe, Japan) – 26th Aug., 2013 (Dutch harbo , US)

1.7 Cruise area and map

The western North Pacific and Bering Sea (40ºN – 58ºN, 140ºE – 165ºW)



2. Outline of MR13-05

2.1 Objectives of this cruise

[On board study]

Iron is an essential element for planktons, and is dissolved as bivalent or trivalent ions under anoxic and acid conditions. It is thus important to investigate iron forms and/or the diffusion rate within sediment-water for bio-productivity in the ocean. The multiple corer can recover undisturbed surface sediments with bottom water. In order to investigate chemical conditions, pH and dissolved oxygen (DO) in the cores were measured on board (Kawamura; JCGA).

[Not on board studies]

This cruise was also implemented for five tasks of “not on board study”. (1) To study the distribution and optical characteristics of ice/water clouds and marine aerosols using a two-wavelength polarization Mie Lider (Sugimoto; NIES). (2) To understand the optical characteristics of aerosols and gas concentrations (CO, O_3) using MAX-DOS methods (Kanaya; JAMSTEC). (3) To study the distribution and optical characteristics of marine aerosols by using a ship-norne sky radiometer (Aoki; Toyama Univ.). (4) To measure the sea surface magnetic field by cesium magnetometer and sub-bottom profile to get a new knowledge about tectonic history of the mid-Cretaceous Pacific Plate (Nakanishi; Chiba Univ.). (5) To measure the sea surface gravity, sea surface magnetic field and cesium magnetometer, in order to standardize the marine geophysical data, and in order to apply to the ocean floor geodynamics studies (Matsumoto; Ryukyu Univ.).

2.2 Science proposals of this cruise

NO	NAME	ORGANIZATION	PROPOSAL TITLE
1	Noriko Kawamura	Japan Coast Guard Academy	Investigation of iron forms within sediment-water interface in Bering Sea
2	Nobuo Sugimoto	National Institute for Environmental Studies	Study of distribution and optical characteristics of ice/water clouds and marine aerosols
3	Yugo Kanaya	Japan Agency for Marine-Earth Science and Technology	Regional-wide observations of gases and aerosols in the maritime atmosphere toward elucidation of global biogeochemical cycles
4	Kazuma Aoki	Toyama Univ.	Maritime aerosol optical properties from measurements of Ship-borne sky radiometer
5	Masao Nakanishi	Chiba Univ.	Tectonic history of the mid-Cretaceous Pacific Plate
6	Takeshi Matsumoto	Ryukyu Univ.	Standardization of marine geophysical data and its application to the ocean floor geodynamics studies

*The studies from No.2 to No.6 are “not onboard study”

2.3 Scientific gears of MR13-05 activity

・Multiple corer (3 stations)
・Chemical properties measurement of sediment (Portable DO and pH sensor)
・Visual core description (Core photograph and smear slide)
・MSCL and soft X-ray measurement of sediment
・ADCP continuous observation
・Sea surface water monitoring system
・Meteorological observation system
・Seabeam3012, Sub-bottom Profiler: Bathy2010
・Geophysical continuous observation (Magnetometer, Gravity meter, Cesium Precession Magnetometer)

2.4 Cruise track and log

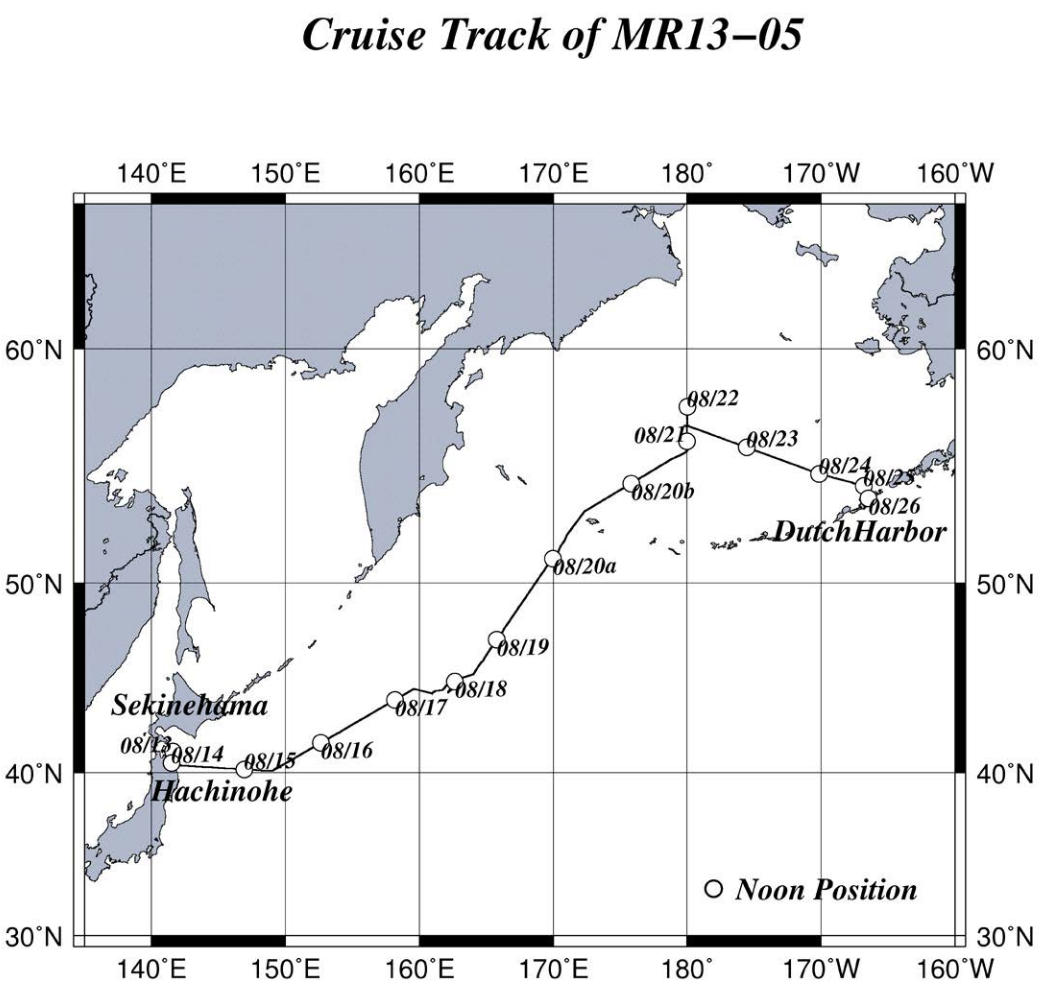


Fig.2.4 Cruise track of MR13-05

Table 2.4. Cruise Log of MR13-05..

U.T.C.		S.M.T.		Position		Event logs
Date	Time	Date	Time	Latitude	Longitude	
8.12	23:50	8.13	08:50	41-13N	141-36N	Departure from Sekinehama
8.13	07:10	8.13	16:10	40.24N	141-30N	Arrival at Hatinohe
	06:50	8.14	15:50	40.24N	141-30N	Departure from Hatinohe
8.14	09:00	8.14	18:00	-	-	Continuous observations start
8.15	13:00	8.15	22:00	-	-	Time adjustment +1 hour (SMT=UTC+9h)
8.16	12:00	8.16	22:00	-	-	Time adjustment +1 hour (SMT=UTC+10h)
8.17	05:21	8.17	15:21	44-21.73N	158-56.42E	XCTD #01 (for MBES)
	05:32		15:32	44-22.87N	158-59.07E	Calibration for magnetmoter #01
	06:30		16:30	44-23.33N	158-59.79E	Cesium magnetometer towing start
	08:56		18:56	44-38.00N	159-36.08E	Survey Line in
8.19	11:00	8.19	22:00	-	-	Time adjustment +1 hour (SMT=UTC+11h)
8.18	13:40	8.19	00:40	45-24.00N	164-00.00E	Survey Line out
	20:57		07:57	46-36.25N	165-11.81E	Cesium magnetometer towing finish
8.20	20:10	8.20	07:10	53-20.00N	172-20.00E	US EEZ in
	07:38		18:38	52-24.00N	171-11.E	Crossed Date Line
8.20	09:00	8.20	22:00	-	-	Time adjustment +1 hour (SMT=UTC-11h)
8.21	15:58	8.21	04:58	55-54.23N	179-53.44E	XCTD #02 (for MBES)
	17:00		06:00	-	-	Arrival at St.1
	19:03		08:03	56-00.09N	179-59.91E	Multiplecorer penetrate (WD=3821m)
8.21	08:00	8.21	22:00	-	-	Time adjustment +1 hour (SMT=UTC-10h)
8.22	20:36		10:36	-	-	Departure from St.1
	00:36		14:36	-	-	Arrival at St.2
	00:43		14:43	57-00.04N	179-39.99W	Multiplecorer penetrate (WD=3798m)
	04:50		18:50	57-00.00N	179-50.30E	Calibration for magnetmoter #02
	05:18		19:18	-	-	Departure from St.2
	16:00	8.22	06:00	-	-	Arrival at St.3
	17:55		07:55	58-00.01N	179-59.98E	Multiplecorer penetrate (WD=3760m)
8.23	21:00		11:00	-	-	Departure from St.3
	01:06		15:06	-	-	Arrival at St.2
	01:09		15:09	57-00.02N	179-59.60W	Multiplecorer penetrate (WD=3799m)
	04:00		18:00	-	-	Departure from St.2

8.24	07:00	8.24	22:00	-	-	Time adjustment +1 hour (SMT=UTC-9h)
	19:30	8.25	10:30	-	-	Continuous observations finish
8.25	06:00		22:00	-	-	Time adjustment +1 hour (SMT=UTC-8h)
8.26	17:40	8.26	09:40	53-54.21N	166-31.54W	Arrival at Dutch Harbor

3. General observation

3.1 Meteorological observations

(1) Personnel

Saburo SAKAI	***JAMSTEC: Principal Investigator***
Shinya OKUMURA	***Global Ocean Development Inc., GODI***
Miki MORIOKA	***GODI***
Ryo OYAMA	***MIRAI crew***

(2) Objectives

Surface meteorological parameters are observed as a basic dataset of the meteorology. These parameters bring us the information about the temporal variation of the meteorological condition surrounding the ship.

(3) Methods

Surface meteorological parameters were observed throughout the MR13-05cruise. We used two systems for the observation, during this cruise.

i) MIRAI Surface Meteorological observation (SMet) system

Instruments of SMet system are listed in Table.3.1.1 and measured parameters are listed in Table.3.1.2. Data were collected and processed by KOAC-7800 weather data processor made by Koshin-Denki, Japan. The data set consists of 6-second averaged data.

ii) Shipboard Oceanographic and Atmospheric Radiation (SOAR) system

SOAR system designed by BNL (Brookhaven National Laboratory, USA) consists of major three parts.

a) Portable Radiation Package (PRP) designed by BNL - short and long wave downward radiation.
b) Zeno Meteorological (Zeno/Met) system designed by BNL - wind, air temperature, relative humidity, pressure, and rainfall measurement.
c) Scientific Computer System (SCS) developed by NOAA (National Oceanic and Atmospheric Administration, USA) - centralized data acquisition and logging of all data sets.

SCS recorded PRP data every 6 seconds, while Zeno/Met data every 10 seconds. Instruments and their locations are listed in Table.3.1.3 and measured parameters are listed in Table.3.1.4.

For the quality control as post processing, we checked the following sensors, before and after the cruise.

i. Young Rain gauge (SMet and SOAR)

Inspect of the linearity of output value from the rain gauge sensor to change Input value by adding fixed quantity of test water.

ii. Barometer (SMet and SOAR)

Comparison with the portable barometer value, PTB220CASE, VAISALA.

iii. Thermometer (air temperature and relative humidity) (SMet and SOAR)

Comparison with the portable thermometer value, HMP41/45, VAISALA.

(4) Preliminary results

Fig. 3.1.1 shows the time series of the following parameters;

Wind (SMet)
Air temperature (SMet)
Relative humidity (SMet)
Precipitation (SMet, rain gauge)
Short/long wave radiation (SMet)
Pressure (SMet)
Sea surface temperature (SMet)
Significant wave height (SMet)

(5) Data archives

These meteorological data will be submitted to the Data Management Group (DMG) of JAMSTEC just after the cruise.

(6) Remarks

i. SST (Sea Surface Temperature) data were available in the following periods.
09:00UTC 14 August - 00:07UTC 21 August 2013
03:36UTC 21 August - 19:02UTC 25 August 2013

Table.3.1.1 Instruments and installations of MIRAI Surface Meteorological observation system

Sensors	Type	Manufacturer	Location (altitude from surface)
Anemometer	KE-500	Koshin Denki, Japan	foremast (24 m)
Tair/RH	HMP155	Vaisala, Finland	compass deck (21 m)
			starboard and port side
	with 43408 Gill aspirated radiation shield		R.M. Young, USA
Thermometer (SST)	RFN1-0	Koshin Denki, Japan	4th deck (-1m, inlet -5m)
Barometer	Model-370	Setra System, USA	captain deck (13 m)
			weather observation room
Rain gauge	50202	R. M. Young, USA	compass deck (19 m)
Optical rain gauge	ORG-815DR	Osi, USA	compass deck (19 m)
Radiometer (short wave)	MS-801	Eiko Seiki, Japan	radar mast (28 m)
Radiometer (long wave)	MS-200	Eiko Seiki, Japan	radar mast (28 m)
Wave height meter	MW-2	Tsurumi-seiki, Japan	bow (10 m)
			port side stern (8 m)

Table.3.1.2 Parameters of MIRAI Surface Meteorological observation system

Parameter		Units	Remarks
1	Latitude	degree	
2	Longitude	degree	
3	Ship's speed	knot	MIRAI log, DS-30 Furuno
4	Ship's heading	degree	MIRAI gyro, TG-6000, Tokimec
5	Relative wind speed	m/s	6sec./10min. averaged
6	Relative wind direction	degree	6sec./10min. averaged
7	True wind speed	m/s	6sec./10min. averaged
8	True wind direction	degree	6sec./10min. averaged
9	Barometric pressure	hPa	adjusted to sea surface level 6sec. averaged
10	Air temperature (starboard)	degC	6sec. averaged
11	Air temperature (port side)	degC	6sec. averaged
12	Dewpoint temperature (starboard)	degC	6sec. averaged
13	Dewpoint temperature (side)	degC	6sec. averaged
14	Relative humidity (starboard)	%	6sec. averaged
15	Relative humidity (port side)	%	6sec. averaged
16	Sea surface temperature	degC	6sec. averaged
17	Rain rate (optical rain gauge)	mm/hr	hourly accumulation
18	Rain rate (capacitive rain gauge)	mm/hr	hourly accumulation
19	Down welling shortwave radiation	W/m^2	6sec. averaged
20	Down welling infra-red radiation	W/m^2	6sec. averaged
21	Significant wave height (bow)	m	hourly
22	Significant wave height (aft)	m	hourly
23	Significant wave period (bow)	second	hourly
24	Significant wave period (aft)	second	hourly

Table.3.1.3 Instruments and installation locations of SOAR system

Sensors (Zeno/Met)	Type	Manufacturer	Location (altitude from surface)
Anemometer	05106	R.M. Young, USA	foremast (25 m)
Tair/RH	HMP45A	Vaisala, Finland	foremast (23 m)
	with 43408 Gill aspirated radiation shield	R.M. Young, USA	
Barometer	61202V	R.M. Young, USA	foremast (23 m)
	with 61002 Gill pressure port	R.M. Young, USA	
Rain gauge	50202	R.M. Young, USA	foremast (24 m)
Optical rain gauge	ORG-815DA	Osi, USA	foremast (24 m)

Sensors (PRP)	Type	Manufacturer	Location (altitude from surface)
Radiometer (short wave)	PSP	Epply Labs, USA	foremast (25 m)
Radiometer (long wave)	PIR	Epply Labs, USA	foremast (25 m)
Fast rotating shadowband radiometer		Yankee, USA	foremast (25 m)

Table.3.1.4 Parameters of SOAR system

Parameter		Units	Remarks
1	Latitude	degree	
2	Longitude	degree	
3	SOG	knot	
4	COG	degree	
5	Relative wind speed	m/s	
6	Relative wind direction	degree	
7	Barometric pressure	hPa	
8	Air temperature	degC	
9	Relative humidity	%	
10	Rain rate (optical rain gauge)	mm/hr	
11	Precipitation (capacitive rain gauge)	mm	reset at 50 mm
12	Down welling shortwave radiation	W/m^2	
13	Down welling infra-red radiation	W/m^2	
14	Defuse irradiance	W/m^2	

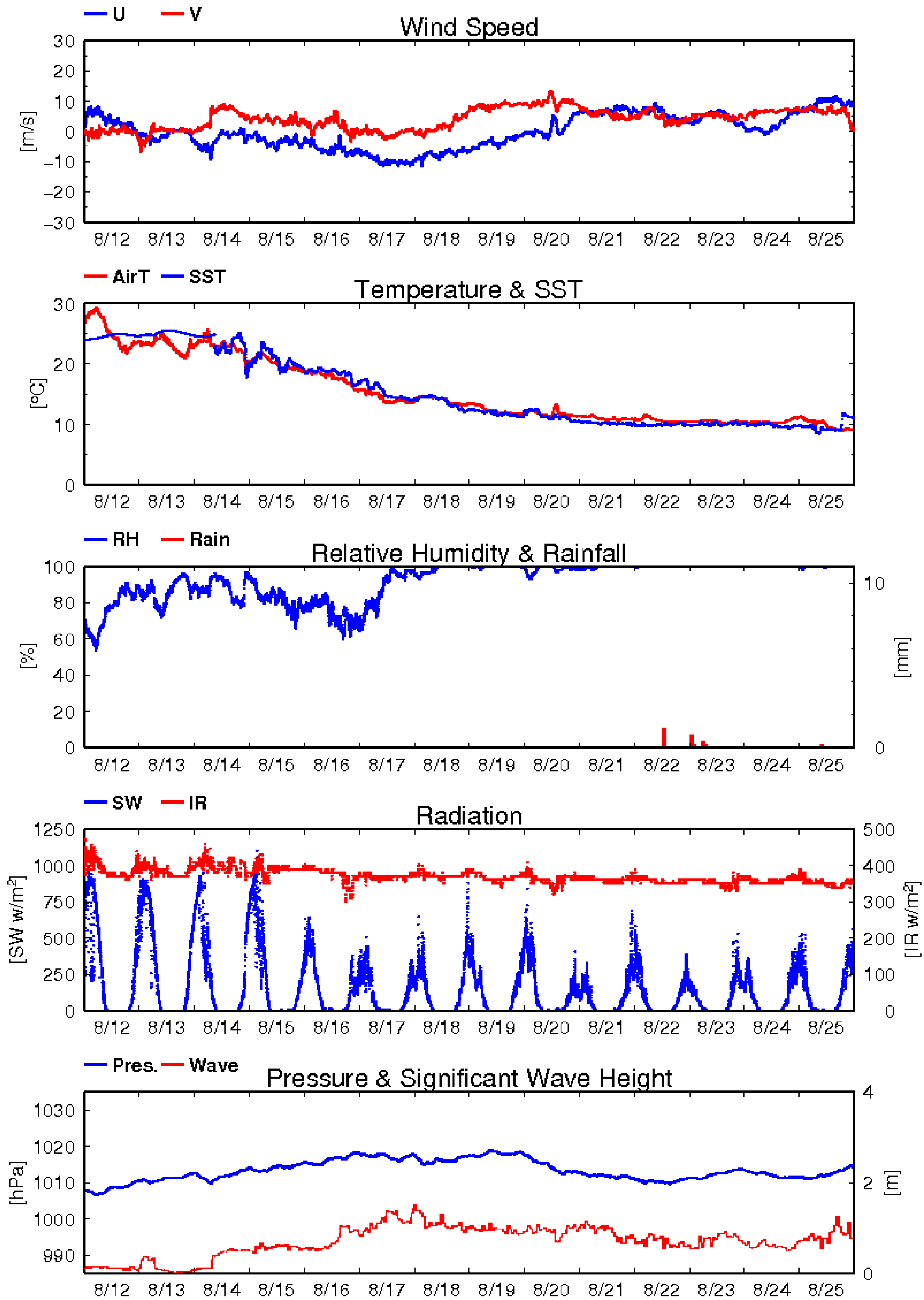


Fig.3.1.1 Time series of surface meteorological parameters during the MR13-05 cruise

3.2 Surface meteorological observation

3.2.1 Ceilometer observation

(1) Personnel

Saburo SAKAI	***JAMSTEC: Principal Investigator***
Shinya OKUMURA	***Global Ocean Development Inc., GODI***
Miki MORIOKA	***GODI***
Ryo OYAMA	***MIRAI crew***

(2) Objectives

The information of cloud base height and the liquid water amount around cloud base is important to understand the process on formation of the cloud. As one of the methods to measure them, the ceilometer observation was carried out.

(3) Parameters

1. Cloud base height [m].
2. Backscatter profile, sensitivity and range normalized at 10 m resolution.
3. Estimated cloud amount [oktas] and height [m]; Sky Condition Algorithm.

(4) Methods

We measured cloud base height and backscatter profile using ceilometer (CL51, VAISALA, and Finland) throughout the MR13-05 cruise from the departure of Sekinehama on 12 August, 2013 to arrival of Dutch harbor on 26 August, 2013 except for U.S.A EEZ.

Major parameters for the measurement configuration are as follows;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode Laser
Transmitting center wavelength:	910±10 nm at 25 degC
Transmitting average power:	19.5 mW
Repetition rate:	6.5 kHz
Detector:	Silicon avalanche photodiode (APD)
Measurement range:	0 ~ 15 km
	0 ~ 13 km (Cloud detection)
Resolution:	10 meter in full range
Sampling rate:	36 sec
Sky Condition	0, 1, 3, 5, 7, 8 oktas (9: Vertical Visibility)
	(0: Sky Clear, 1: Few, 3: Scattered, 5-7: Broken, 8: Overcast)

On the archive dataset, cloud base height and backscatter profile are recorded with the resolution of 10 m.

(5) Preliminary results

Fig. 3.2.1 shows the time series of the lowest, second and third cloud base height.

(6) Data archives

The raw data obtained during this cruise will be submitted to the Data Management Group (DMG) in JAMSTEC.

(7) Remarks

1. Window cleaning;

    04:28UTC 13 August

    10:28UTC 20 August

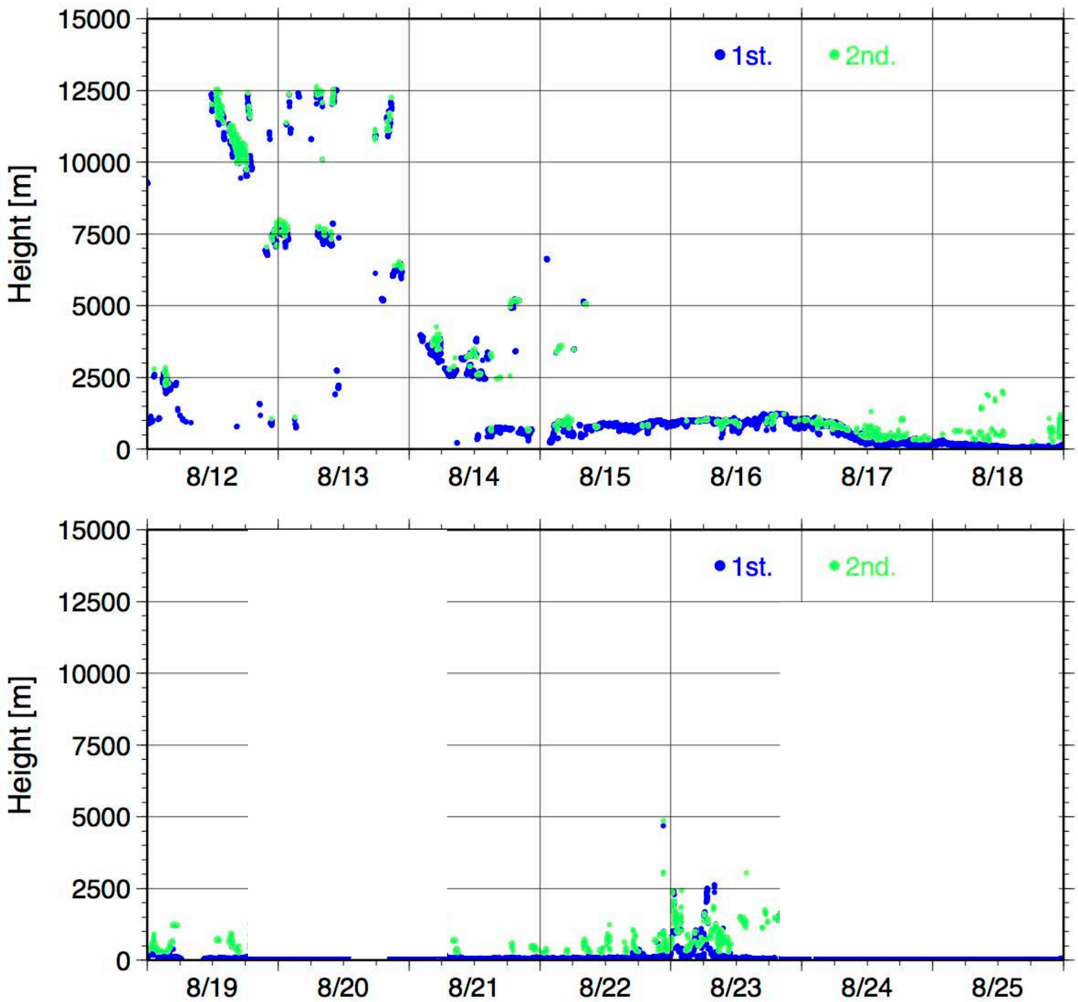


Fig.3.2.1 Lowest, 2nd and 3rd cloud base height during the cruise.

3.2.2 Lider observations of clouds and aerosols

(1) Personnel

Nobuo SUGIMOTO (NIES)

Ichiro MATSUI (NIES)

Atsushi SHIMIZU (NIES)

Tomoaki NISHIZAWA (NIES)

(Lidar operation was supported by Global Ocean Development Inc. (GODI).)

(2) Objectives

Objectives of the observations in this cruise is to study distribution and optical characteristics of ice/water clouds and marine aerosols using a two-wavelength polarization Mie lidar.

(3) Description of instruments deployed

Vertical profiles of aerosols and clouds are measured with a two-wavelength polarization Mie lidar. The lidar employs a Nd:YAG laser as a light source which generates the fundamental output at 1064nm and the second harmonic at 532nm. Transmitted laser energy is typically 30mJ per pulse at both of 1064 and 532nm. The pulse repetition rate is 10Hz. The receiver telescope has a diameter of 20 cm. The receiver has three detection channels to receive the lidar signals at 1064 nm and the parallel and perpendicular polarization components at 532nm. An analog-mode avalanche photo diode (APD) is used as a detector for 1064nm, and photomultiplier tubes (PMTs) are used for 532 nm. The detected signals are recorded with a transient recorder and stored on a hard disk with a computer. The lidar system was installed in a container with a glass window on the roof, and the lidar was operated continuously regardless of weather. Every 10 minutes vertical profiles of four channels (532 parallel, 532 perpendicular, 1064, 532 near range) are recorded.

(4) Preliminary results

The two wavelength polarization Mie lidar worked well and succeeded in getting the lidar data during the observation period. Examples of the measured data are depicted in Fig. 1. The figure indicates that the lidar could detect water clouds formed at the top of the PBL formed at 1km (e.g., 00-12UTC, 17 Aug. 2013) and ice clouds in the upper layer. The lidar could also detect aerosols in the PBL (00-12UTC, 17 Aug. 2013). Clouds formed at the top of PBL or fogs frequently appeared in this observation period. There were few cases that the lidar could observe aerosol layers since the lidar signals were attenuated due to optically thick clouds or fogs formed in lower layers.

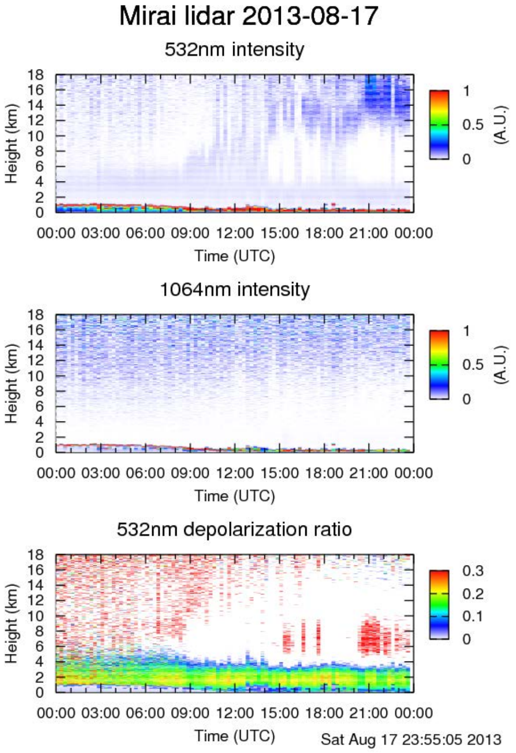


Fig.1. Time-height sections of backscatter intensities at 532nm and 1064nm and total depolarization ratios at 532nm measured on 17 August 2013.

(5) Data archive

- Raw data

temporal resolution 10min / vertical resolution 6 m

data period (UTC): . Aug 13, 2013~Aug 19, 2013 / Aug 21, 2013~Aug 23, 2013

lidar signal at 532 nm, lidar signal at 1064 nm, depolarization ratio at 532 nm

- Processed data (plan)

cloud base height, apparent cloud top height, phase of clouds (ice/water), cloud fraction

boundary layer height (aerosol layer upper boundary height),

backscatter coefficient of aerosols, particle depolarization ratio of aerosols

* Data policy and Citation

Contact NIES lidar team to utilize lidar data for productive use.

3.2.3 Aerosol optical characteristics measured by Ship-borne Sky radiometer

(1) Personnel

Kazuma Aoki (University of Toyama) Principal Investigator / not onboard
Tadahiro Hayasaka (Tohoku University) Co-worker / not onboard
(Sky radiometer operation was supported by Global Ocean Development Inc.**)**

(2) Objectives

Objective of this observation is to study distribution and optical characteristics of marine aerosols by using a ship-borne sky radiometer (POM-01 MKII: PREDE Co. Ltd., Japan). Furthermore, collections of the data for calibration and validation to the remote sensing data were performed simultaneously.

(3) Methods and Instruments

The sky radiometer measures the direct solar irradiance and the solar aureole radiance distribution with seven interference filters (0.34, 0.4, 0.5, 0.675, 0.87, 0.94, and 1.02 μm). Analysis of these data was performed by SKYRAD.pack version 4.2 developed by Nakajima *et al*. 1996.

@ Measured parameters

- Aerosol optical thickness at five wavelengths (400, 500, 675, 870 and 1020 nm)
- Ångström exponent
- Single scattering albedo at five wavelengths
- Size distribution of volume (0.01 μm – 20 μm)

GPS provides the position with longitude and latitude and heading direction of the vessel, and azimuth and elevation angle of the sun. Horizon sensor provides rolling and pitching angles.

(4) Preliminary results

Only data collection were performed onboard. At the time of writing, the data obtained in this cruise are under post-cruise processing at University of Toyama.

(5) Data archives

Aerosol optical data are to be archived at University of Toyama (K.Aoki, SKYNET/SKY: http://skyrad.sci.u-toyama.ac.jp/) after the quality check and will be submitted to JAMSTEC.

3.2.4 Tropospheric aerosol and gas profile

(1) Personnel

Yugo KANAYA (JAMSTEC RIGC, not on board)
Hisahiro TAKASHIMA (JAMSTEC RIGC, not on board)
Fumikazu TAKETANI (JAMSTEC RIGC, not on board)
Xiaole PAN (JAMSTEC RIGC, not on board)
Yuichi KOMAZAKI (JAMSTEC RIGC, not on board)
Takuma MIYAKAWA (JAMSTEC RIGC, not on board)
(Operation was supported by Global Ocean Development Inc.)

(2) Objectives

• To clarify transport processes of atmospheric pollutants from the Asian continent to the ocean
• To investigate processes of biogeochemical cycles between the atmosphere and the ocean
• To advance validation of satellite observations of atmospheric composition

(3) Description of instruments deployed

(3-1) MAX-DOAS

Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS), a passive remote sensing technique measuring spectra of scattered visible and ultraviolet (UV) solar radiation, was used for atmospheric aerosol and gas profile measurements. Our MAX-DOAS instrument consists of two main parts: an outdoor telescope unit and an indoor spectrometer (Acton SP-2358 with Princeton Instruments PIXIS-400B), connected to each other by a 14-m bundle cable that consists of 60 cores with 100-μm radii. On the roof top of the anti-rolling system of R/V Mirai, the telescope unit was installed on a gimbal mount, which compensates for the pitch and roll motion of the ship. The line of sight was in directions of the starboard and portside of the vessel. The integration time for UV and visible spectra recording (centered on 340 and 452 nm) was set to 0.20 and 0.08 s. Measurements were made every 30 min at elevation angles of 1.5, 3, 5, 10, 20, 30, 90, 150, 160, 170, 175, and 177 degrees.

For the selected spectra recorded with elevation angles with good accuracy, DOAS spectral fitting was performed to quantify the slant column density (SCD) of NO_2 (and other gases) and O_4 (O_2-O_2, collision complex of oxygen) for each elevation angle. Then, the O_4 SCDs were converted to the aerosol optical depth (AOD) and the vertical profile of aerosol extinction coefficient (AEC) using an optimal estimation inversion method with a radiative transfer model. Using derived aerosol information, retrievals of the tropospheric vertical column/profile of NO_2 and other gases were made.

(3-2) CO, O_3, and black carbon (BC)

Carbon monoxide (CO) and ozone (O_3) measurements were also continuously conducted during the cruise. For CO and O_3 measurements, ambient air was continuously sampled on the compass deck and drawn through ~20-m-long Teflon tubes connected to a gas filter correlation CO analyzer (Model 48C, Thermo Fisher Scientific) and a UV photometric ozone analyzer (Model 49C, Thermo Fisher Scientific) in the Research Information Center.

BC was measured by an instrument based on laser-induced incandescence (SP2, Droplet

Measurement Technologies). Ambient air was sampled from the flying bridge by a 3-m-long conductive tube and then introduced to the instrument.

(4) Preliminary results

N/A (All the data analysis is to be conducted.)

(5) Data archive

The data files will be submitted to JAMSTEC Data Management Group (DMG), after the full analysis is completed, which will be <2 years after the end of the cruise.

3.3 Shipboard ADCP

(1) Personnel

Saburo SAKAI	***JAMSTEC: Principal Investigator***
Shinya OKUMURA	***Global Ocean Development Inc., GODI***
Miki MORIOKA	***GODI***
Ryo OYAMA	***MIRAI crew***

(2) Objectives

To obtain continuous measurement of the current profile along the ship's track.

(3) Methods

Upper ocean current measurements were made in MR13-05 cruise, using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system. For most of its operation the instrument was configured for water-tracking mode. Bottom-tracking mode, interleaved bottom-ping with water-ping, was made to get the calibration data for evaluating transducer misalignment angle in the shallow water. The system consists of following components;

1. R/V MIRAI has installed the Ocean Surveyor for vessel-mount ADCP (frequency 76.8 kHz; Teledyne RD Instruments, USA). It has a phased-array transducer with single ceramic assembly and creates 4 acoustic beams electronically. We mounted the transducer head rotated to a ship-relative angle of 45 degrees azimuth from the keel
2. For heading source, we use ship's gyro compass (Tokimec, Japan), continuously providing heading to the ADCP system directory. Additionally, we have Inertial Navigation System which provide high-precision heading, attitude information, pitch and roll, are stored in ".N2R" data files with a time stamp.
3. DGPS system (Trimble SPS751 & Fugro Multifix ver.6) providing precise ship's position.
4. We used VmDas software version 1.46.5 (TRDI) for data acquisition.
5. To synchronize time stamp of ping with GPS time, the clock of the logging computer is adjusted to GPS time every 1 minute.
6. Fresh water is charged in the sea chest to prevent bio fouling at transducer face.
7. The sound speed at the transducer does affect the vertical bin mapping and vertical

velocity measurement, is calculated from temperature, salinity (constant value; 35.0 PSU) and depth (6.5 m; transducer depth) by equation in Medwin (1975).

Data was configured for "8 m" intervals starting about 23 m below sea surface. Data was recorded every ping as raw ensemble data (.ENR). Also, 60 seconds and 300 seconds averaged data were recorded as short-term average (.STA) and long-term average (.LTA) data, respectively. Major parameters for the measurement, Direct Command, are shown in Table 3.3.1.

Table 3.3.1 Major parameters

Bottom-Track Commands	
BP = 001	Pings per Ensemble (almost less than 1,200m depth)
Environmental Sensor Commands	
EA = 04500	Heading Alignment (1/100 deg)
EB = +00000	Heading Bias (1/100 deg)
ED = 00065	Transducer Depth (0 - 65535 dm)
EF = +001	Pitch/Roll Divisor/Multiplier (pos/neg) [1/99 - 99]
EH = 00000	Heading (1/100 deg)
ES = 35	Salinity (0-40 pp thousand)
EX = 00000	Coordinate Transform (Xform:Type; Tilts; 3Bm; Map)
EZ = 10200010	Sensor Source (C; D; H; P; R; S; T; U)
C (1): Sound velocity calculates using ED, ES, ET (temp.)	
D (0): Manual ED	
H (2): External synchro	
P (0), R (0): Manual EP, ER (0 degree)	
S (0): Manual ES	
T (1): Internal transducer sensor	
U (0): Manual EU	
Timing Commands	
TE = 00:00:02.00	Time per Ensemble (hrs:min:sec.sec/100)
TP = 00:02.00	Time per Ping (min:sec.sec/100)
Water-Track Commands	
WA = 255	False Target Threshold (Max) (0-255 count)
WB = 1	Mode 1 Bandwidth Control (0=Wid, 1=Med, 2=Nar)
WC = 120	Low Correlation Threshold (0-255)
WD = 111 100 000	Data Out (V; C; A; PG; St; Vsum; Vsum^2; #G; P0)
WE = 1000	Error Velocity Threshold (0-5000 mm/s)
WF = 0800	Blank After Transmit (cm)
WG = 001	Percent Good Minimum (0-100%)
WI = 0	Clip Data Past Bottom (0 = OFF, 1 = ON)
WJ = 1	Rcvr Gain Select (0 = Low, 1 = High)
WM = 1	Profiling Mode (1-8)
WN = 100	Number of depth cells (1-128)

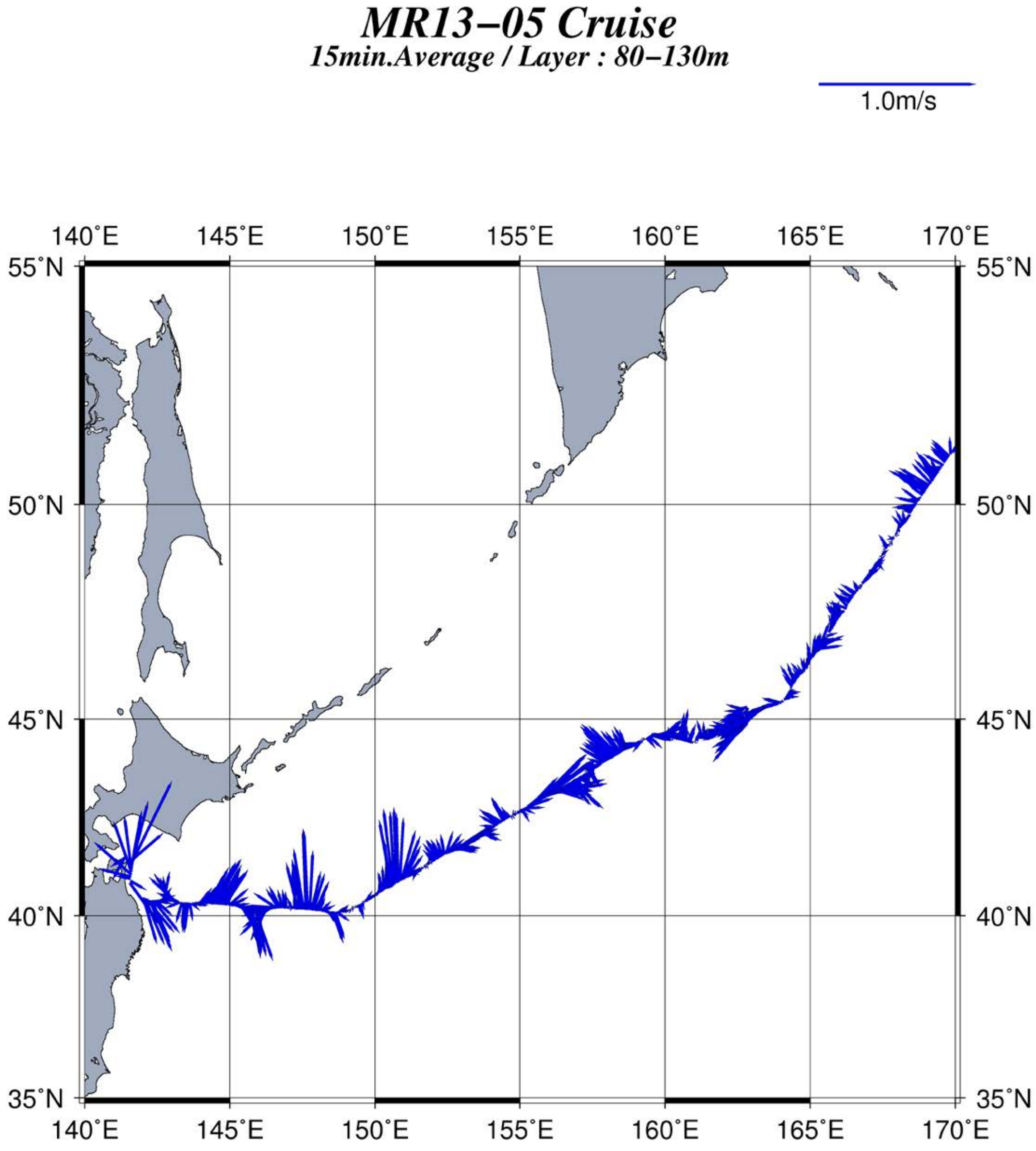
WP = 00001	Pings per Ensemble (0-16384)
WS = 800	Depth Cell Size (cm)
WT = 000	Transmit Length (cm) [0 = Bin Length]
WV = 0390	Mode 1 Ambiguity Velocity (cm/s radial)

(4) Preliminary results

Fig. 3.3.1 shows the surface (about 100 ~ 200 m, 30-min averaged) current vector along the ship's track.

(5) Data archives

These data obtained in this cruise will be submitted to The Data Management Group (DMG) of JAMSTEC, and will be opened to the public via JAMSTEC home page.



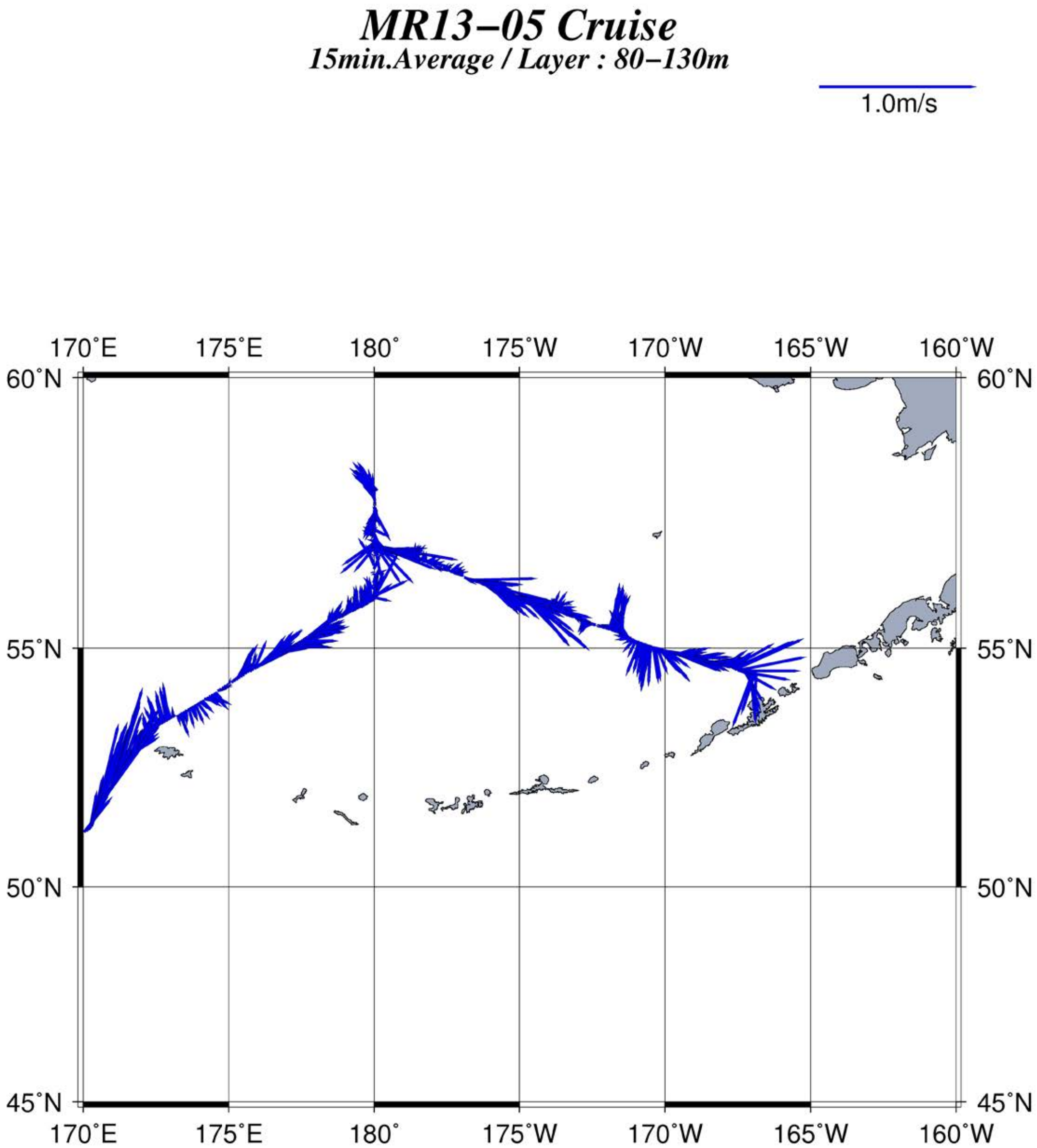


Fig. 3.3.1 The surface current vector along the ship's track.

3.4 Sea surface water monitoring

1. Personnel

Saburo SAKAI (JAMSTEC): Principal Investigator
Misato KUWAHARA (MWJ)

2. Objective

Our purpose is to obtain salinity, temperature, dissolved oxygen and fluorescence data continuously in near-sea surface water.

3. Instruments and Methods

The Continuous Sea Surface Water Monitoring System (Marine Works Japan Co. Ltd.) has four sensors and automatically measures salinity, temperature, dissolved oxygen and fluorescence in near-sea surface water every one minute. This system is located in the "*sea surface monitoring laboratory*" and connected to shipboard LAN-system. Measured data, time, and location of the ship were stored in a data management PC. The near-surface water was continuously pumped up to the laboratory from about 5 m water depth and flowed into the system through a vinyl-chloride pipe. The flow rate of the surface seawater was adjusted to be 3 dm^3 min^{-1}. Specifications of the each sensor in this system are listed below.

a. Instruments

Software

Seamoni-kun Ver.1.50

Sensors

Specifications of the each sensor in this system are listed below.

Temperature and Conductivity sensor

Model:	SBE-45, SEA-BIRD ELECTRONICS, INC.
Serial number:	4552788-0264
Measurement range:	Temperature -5 to +35 °C
	Conductivity 0 to 7 S m^{-1}
Initial accuracy:	Temperature 0.002 °C
	Conductivity 0.0003 S m^{-1}
Typical stability (per month):	Temperature 0.0002 °C

	Conductivity 0.0003 S m^{-1}
Resolution:	Temperatures 0.0001 ^oC
	Conductivity 0.00001 S m^{-1}

Bottom of ship thermometer

Model:	SBE 38, SEA-BIRD ELECTRONICS, INC.
Serial number:	3852788-0457
Measurement range:	-5 to +35 ^oC
Initial accuracy:	±0.001 ^oC
Typical stability (per 6 month):	0.001 ^oC
Resolution:	0.00025 ^oC

Dissolved oxygen sensor

Model:	OPTODE 3835, AANDERAA Instruments.
Serial number:	1519
Measuring range:	0 - 500 μmol dm^{-3}
Resolution:	<1 μmol dm^{-3}
Accuracy:	<8 μmol dm^{-3} or 5% whichever is greater
Settling time:	<25 s

Dissolved oxygen sensor

Model:	RINKO II, ARO-CAR/CAD
Serial number:	13
Measuring range:	0 - 540 μmol kg^{-1}
Resolution:	0.1 μmol kg^{-1} or 0.1 % whichever is greater
Accuracy:	1 μmol kg^{-1} or 0.1 % whichever is greater

Fluorometer

Model:	C3, TURNER DESIGNS
Serial number:	2300384

4. Measurements

Periods of measurement, maintenance, and problems during MR13-05 are listed in Table 3.4-1

Table 3.4-1 Events list of the surface seawater monitoring during MR13-05

System Date [UTC]	System Time [UTC]	Events	Remarks
2013/08/14	10:12	All of the measurements started and data was available	
2013/08/21	00:07	All of the measurements stopped.	Filter cleaning
2013/08/21	00:37	All of the measurements started.	Logging restart
2013/08/25	18:00	All of the measurements stopped.	

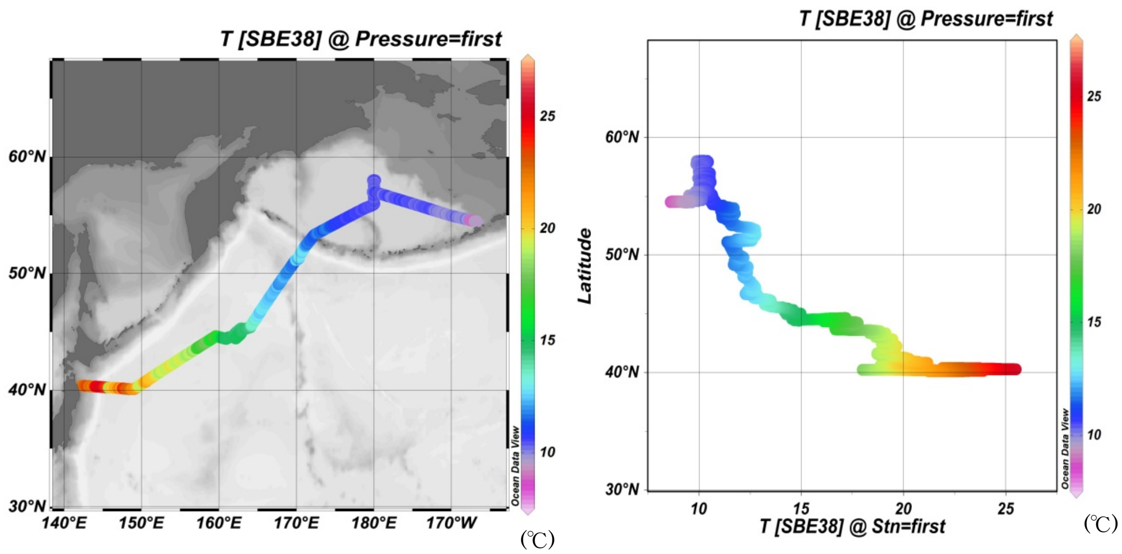
5. Preliminary Result

Preliminary data of temperature, salinity, dissolved oxygen and fluorescence at sea surface are shown in Fig.3.4-1.

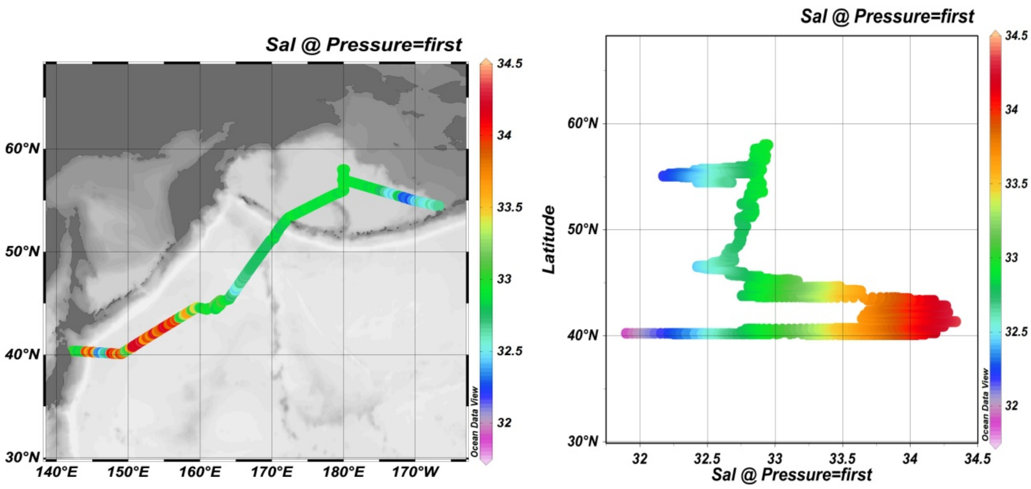
6. Data archive

These data obtained in this cruise will be submitted to the Data Management Office (DMO) of JAMSTEC, and will be opened to the public via "Data Research for Whole Cruise Information in JAMSTEC" in JAMSTEC home page.

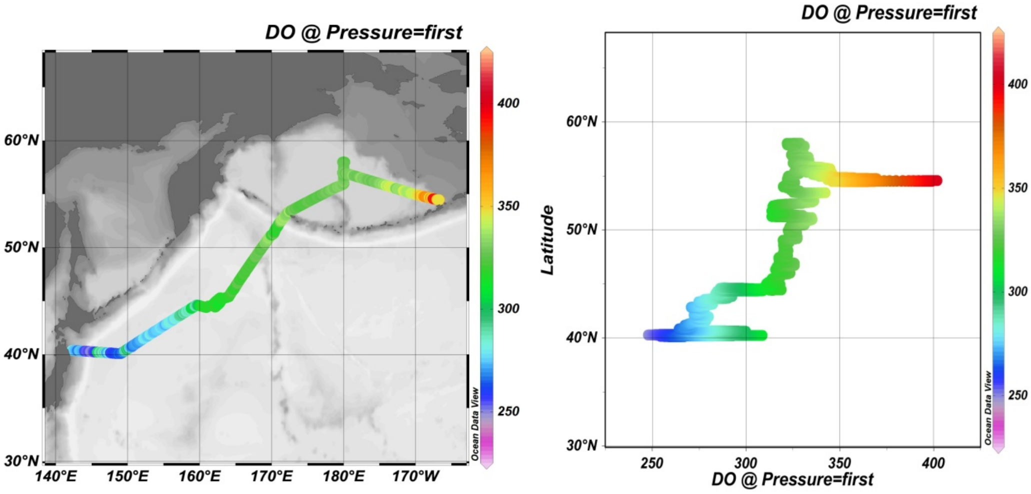
(a) Temperature



(b) Salinity

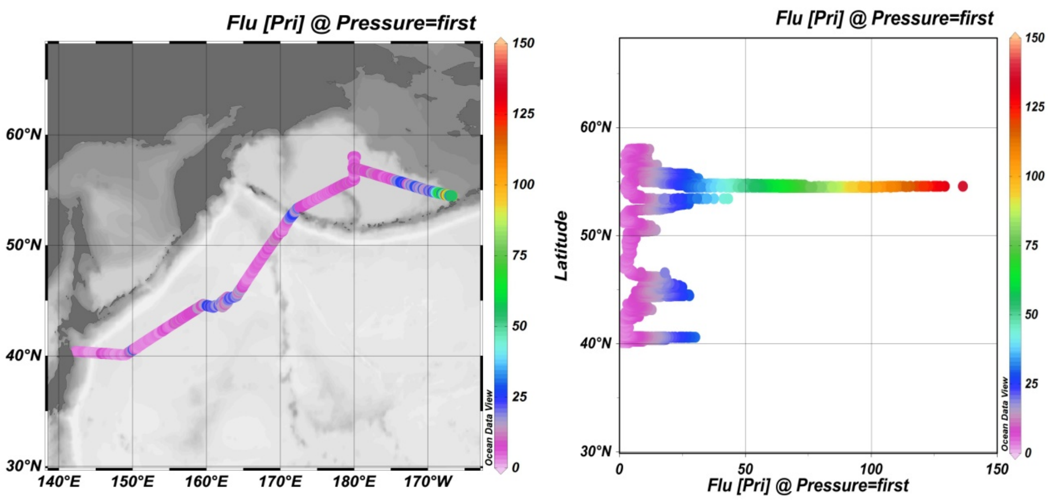


(c) Dissolved oxygen



(μmol kg⁻ (μmol kg⁻

(d) Fluorescence



(RFU) (RFU)

Fig.3.4-1 Spatial and temporal distribution of (a) temperature (b) salinity (c) dissolved oxygen and (d) fluorescence in MR13-05 cruise.

4. Geology

4.1 Multiple core samplings (MWJ)

(1) Personnel:

Yusuke SATO (Marine Works Japan Ltd.)
Yasumi YAMADA (Marine Works Japan Ltd.)
Kentaro SHIRAISHI (Marine Works Japan Ltd.)

(2) Instruments and Methods

Multiple corer (MC) consists of body (620 kg in weight) and four sub-corer attachments. Three acryl and a polycarbonate pipes are used for the sediment coring. Both pipes are 60 cm in length, and the diameter is 74 mm. Samples within polycarbonate pipe are measured physical properties (colors, normal photograph,) using a multi-sensor core logger, and collected for soft-x ray photograph.

(3) Winch Operation

The wire out speed is within 0.7~1.0 m/s. The MC is stopped at the depth about 30 or 50 m above the sea floor, then it is suspended during 3 minutes. After that, the wire is run in 0.2~0.3 m/s. The changes of wire tension value are used whether MC arrive or leave from the sea floor. The MC come back on the deck, sub-corer attachments are detached from the body.

(4) Results

Details of coring positions and core lengths are shown in Table 4.1.1. Operation logs are shown in Table 4.1.2.1~Table 4.1.2.4.

Table 4.1.1. Coring summary of MR13-05 (Multiple corer).

Date (UTC)	Core ID	Location	Lat	Lon.	Depth(m)	HAND No.	Core length(cm)	Tension max(t)	Remarks
2013/ 8/ 21	MC01	Bering Sea	56-00.0203' N	179-59.9792' W	3,821	HAND1	25.8	4.0	Polycarbonate pipe
						HAND2	26.3		
						HAND3	26.5		
						HAND4	26.8		
2013/ 8/ 22	MC02	Bering Sea	56° 59.9790' N	179° 59.9628' E	3,798	HAND1	0.0	4.2	Polycarbonate pipe
						HAND2	0.0		
						HAND3	0.0		
						HAND4	0.0		
2013/ 8/ 22	MC03	Bering Sea	58° 00.0144' N	179° 59.9858' W	3,760	HAND1	43.0	4.1	Polycarbonate pipe
						HAND2	47.1		
						HAND3	49.0		
						HAND4	51.3		
2013/ 8/ 23	MC02B	Bering Sea	57° 00.0021' N	179° 59.5942' W	3,799	HAND1	50.5	4.1	Polycarbonate pipe
						HAND2	50.7		
						HAND3	55.9		
						HAND4	50.9		

Table 4.1.2.1. Operation logs of Station 1.

Cruise Name:	MR13-05	Operator:	Yamada (MWJ)
Date: (UTC)	2013/8/21		
Core Number:	MC01		
Area:	Bering Sea		
Sampling Site:	St.1		
Corer type:	Multiple corer	Number of pipes:	4
Pipe length:	0.6m	MC weight:	620kg (full)
Option:	MC Camera, Nylon rope,		
Weather:	Fog	Wave height:	1.4m
Wind direction:	243 deg.	Wind speed:	8.7 m/s
Current direction:	54 deg.	Current speed:	0.3 knot

Time* (UTC)	Depth (m)	Wire length (m)	Latitude	Longitude	Tension (ton)	Wire speed (m/s)	Wire in/out (↑/↓)	Remarks
18:03	3820	-			-	-	-	Start the operation.
18:05	3820	0	56°00.0932' N	179°59.9101' W	0.5	0.3	↓	MC on surface**, Reset the wire length.
18:10	3817	200			0.5	-	-	Wire stop. Change the winch control.
18:17	3817	500			0.8	-	-	Wire stop. Start the swell compensator.
18:28	3820	1000			1.2	1.0	↓	
18:36	3820	1500			1.6	1.0	↓	
18:43	3820	2000			2.0	1.0	↓	
18:51	3820	2500			2.5	1.0	↓	
19:00	3820	3000			2.9	1.0	↓	
19:08	3820	3500			3.3	1.0	↓	
19:13	3820	3770			3.8	-	−	Wire stop (to stabilize the MC for 3 minutes)
19:16	3820	3770			3.7	0.3	↓	Wire out.
19:18:13	**3821**	**3805**	**56°00.0203' N**	**179°59.9792' W**	**Min. 3.1**	**0.3**	↓	**MC hit the bottom**, Wire out 3m.**
19:18	3821	3808			3.1	-	-	Wire stop. Wait 30 seconds.
19:18:54	3820	3808			3.1	0.3	↑	Wire in.
19:19:34	**3817**	**3799**	**56°00.0208' N**	**179°59.9812' W**	**Max. 4.0**	**0.3**	↑	**MC left the bottom**.**
19:25	3823	3500			3.6	1.0	↑	
19:33	3823	3000			3.2	1.0	↑	
19:41	3819	2500			2.8	1.0	↑	
19:49	3817	2000			2.4	1.0	↑	
19:57	3820	1500			1.9	1.0	↑	
20:05	3820	1000			1.5	1.0	↑	
20:14	3822	500			0.9	-	-	Wire stop. Stop the swell compensator.
20:21	3819	200			0.7	-	-	Wire stop. Change the winch control.
20:25	3822	0	55°59.9797' N	179°59.8164' E	0.5	0.1	↑	MC on surface.**
20:28	3818	-			-	-	-	MC on deck.

*LST: UTC -10h

**Latitude and Longitude was used the ship's position.

Table 4.1.2.2. Operation logs of Station 2.

Cruise Name:	MR13-05	Operator:	Yamada (MWJ)
Date: (UTC)	2013/8/22		
Core Number:	MC02		
Area:	Bering Sea		
Sampling Site:	St.2		
Corer type:	Multiple corer	Number of pipes:	4
Pipe length:	0.6m	MC weight:	620kg (full)
Option:	MC Camera, Nylon rope,		
Weather:	Cloud	Wave height:	1.5m
Wind direction:	239 deg.	Wind speed:	8.6 m/s
Current direction:	238 deg.	Current speed:	0.2 knot

Time* (UTC)	Depth (m)	Wire length (m)	Latitude	Longitude	Tension (ton)	Wire speed (m/s)	Wire in/out (↑/↓)	Remarks
0:43	3798	-			-	-	-	Start the operation.
0:45	3800	0	57°00.0735' N	179°59.9987' W	0.4	1.0	↓	MC on surface**, Reset the wire length.
0:49	3798	200			0.6	-	-	Wire stop. Change the winch control.
0:56	3798	500			0.9	-	-	Wire stop. Start the swell compensator.
1:07	3798	1000			1.2	1.0	↓	
1:15	3798	1500			1.6	1.0	↓	
1:23	3800	2000			2.1	1.0	↓	
1:31	3798	2500			2.4	1.0	↓	
1:39	3798	3000			2.9	1.0	↓	
1:47	3799	3500			3.3	1.0	↓	
1:52	3799	3750			3.6	-	−	Wire stop (to stabilize the MC for 3 minutes)
1:55	3798	3750			3.7	0.3	↓	Wire out.
1:57:44	**3798**	**3786**	**56°59.9790' N**	**179°59.9628' E**	Min. 3.0	**0.3**	↓	**MC hit the bottom**, Wire out 3m.**
1:57:55	3798	3789			3.0	-	-	Wire stop. Wait 30 seconds.
1:58:26	3800	3789			3.0	0.3	↑	Wire in.
1:59:26	**3799**	**3779**	**56°59.9796' N**	**179°59.9632' E**	**Max. 4.2**	**0.3**	↑	**MC left the bottom**.**
2:12	3803	3000			3.2	1.0	↑	
2:21	3801	2500			2.8	1.0	↑	
2:29	3798	2000			2.3	1.0	↑	
2:37	3801	1500			1.9	1.0	↑	
2:45	3799	1000			1.6	1.0	↑	
2:54	3802	500			0.9	-	−	Wire stop. Stop the swell compensator.
3:01	3802	200			0.7	-	-	Wire stop. Change the winch control.
3:05	3802	0	56°59.9455' N	179°59.8942' E	0.6	-	-	MC on surface.**
3:07	3800	-			-	-	-	MC on deck.

*LST: UTC -10h

**Latitude and Longitude was used the ship's position.

Table 4.1.2.3. Operation logs of Station 3.

Cruise Name:	MR13-05	Operator:	Yamada (MWJ)
Date: (UTC)	2013/8/22		
Core Number:	MC03		
Area:	Bering Sea		
Sampling Site:	St.3		
Corer type:	Multiple corer	Number of pipes:	4 Sampling pipes & 4 Dummy pipes
Pipe length:	0.6m	MC weight:	560kg
Option:	MC Camera, Nylon rope, Dumper		
Weather:	Cloud	Wave height:	1.1m
Wind direction:	239 deg.	Wind speed:	5.3 m/s
Current direction:	292 deg.	Current speed:	0.5 knot

Time* (UTC)	Depth (m)	Wire length (m)	Latitude	Longitude	Tension (ton)	Wire speed (m/s)	Wire in/out (↑/↓)	Remarks
17:55	3760	-			-	-	-	Start the operation.
17:57	3760	0	58°00.0193' N	179°59.9810' W	0.4	-	-	MC on surface**, Reset the wire length.
18:02	3761	200			0.6	-	-	Wire stop. Change the winch control.
18:10	3763	500			0.8	-	-	Wire stop. Start the swell compensator.
18:24	3761	1000			1.2	0.7	↓	
18:36	3760	1500			1.6	0.7	↓	
18:48	3760	2000			2.0	0.7	↓	
19:00	3760	2500			2.5	0.7	↓	
19:11	3760	3000			2.9	0.7	↓	
19:23	3760	3500			3.3	0.7	↓	
19:28	3760	3730			3.6	-	−	Wire stop (to stabilize the MC for 3 minutes)
19:31	3760	3730			3.6	0.2	↓	Wire out.
	3760	3742			3.6	0.17	↓	Slow wire out.
19:33:33	**3760**	**3746**	**58°00.0144' N**	**179°59.9858' W**	**Min. 3.0**	**0.17**	↓	**MC hit the bottom**, Wire out 3m.**
	3760	3749			3.0	-	-	Wire stop. Wait 30 seconds.
19:34:42	3760	3749			3.0	0.2	↑	Wire in.
19:35:04	**3760**	**3742**	**58°00.0123' N**	**179°59.9819' W**	**Max. 4.1**	**0.2**	↑	**MC left the bottom**.**
19:39	3760	3500			3.5	1.0	↑	
19:47	3760	3000			3.2	1.0	↑	
19:56	3761	2500			2.7	1.0	↑	
20:04	3760	2000			2.3	1.0	↑	
20:12	3760	1500			1.9	1.0	↑	
20:20	3762	1000			1.4	1.0	↑	
20:29	3760	500			0.9	-	-	Wire stop. Stop the swell compensator.
20:36	3760	200			0.6	-	-	Wire stop. Change the winch control.
20:41	3760	0	58°00.0379' N	179°59.9525' W	0.5	-	-	MC on surface.**
20:44	3760	-			-	-	-	MC on deck.

*LST: UTC -10h
**Latitude and Longitude was used the ship's position.

Table 4.1.2.4. Operation logs of Station 2B.

Cruise Name:	MR13-05	Operator:	Yamada (MWJ)
Date: (UTC)	2013/8/23		
Core Number:	MC02B		
Area:	Bering Sea		
Sampling Site:	St.2		
Corer type:	Multiple corer	Number of pipes:	4 Sampling pipes & 4 Dummy pipes
Pipe length:	0.6m	MC weight:	560kg
Option:	MC Camera, Nylon rope, Dumper		
Weather:	Rain	Wave height:	0.8m
Wind direction:	215 deg.	Wind speed:	5.2 m/s
Current direction:	112 deg.	Current speed:	0.5 knot

Time* (UTC)	Depth (m)	Wire length (m)	Latitude	Longitude	Tension (ton)	Wire speed (m/s)	Wire in/out (↑/↓)	Remarks
1:09	3805	-			-	-	-	Start the operation.
1:11	3801	0	57°00.0258' N	179°59.6076' W	0.4	-	-	MC on surface**, Reset the wire length.
1:17	3802	200			0.6	-	-	Wire stop. Change the winch control.
1:25	3800	500			0.8	-	-	Wire stop. Start the swell compensator.
1:38	3801	1000			1.2	0.7	↓	
1:50	3803	1500			1.6	0.7	↓	
2:01	3801	2000			2.1	0.7	↓	
2:13	3800	2500			2.4	0.7	↓	
2:24	3799	3000			2.9	0.7	↓	
2:35	3802	3500			3.3	0.7	↓	
2:41	3801	3770			3.6	-	−	Wire stop (to stabilize the MC for 3 minutes)
2:44	3799	3770			3.6	0.2	↓	Wire out.
2:46:35	**3799**	**3785**	**57°00.0021' N**	**179°59.5942' W**	**Min. 3.0**	**0.2**	↓	**MC hit the bottom**, Wire out 3m.**
2:46:52	3799	3788			3.1	-	-	Wire stop. Wait 10 seconds.
2:47:05	3799	3788			3.1	0.3	↑	Wire in.
2:47:40	**3799**	**3780**	**57°00.0012' N**	**179°59.5957' W**	**Max. 4.1**	**0.3**	↑	**MC left the bottom**.**
2:52	3799	3500			3.6	1.0	↑	
3:00	3802	3000			3.2	1.0	↑	
3:09	3799	2500			2.7	1.0	↑	
3:17	3799	2000			2.3	1.0	↑	
3:25	3802	1500			1.9	1.0	↑	
3:33	3801	1000			1.4	1.0	↑	
3:42	3799	500			0.9	-	-	Wire stop. Stop the swell compensator.
3:49	3800	200			0.6	-	-	Wire stop. Change the winch control.
3:55	3802	0	56°59.8866' N	179°59.5962' W	0.5	0.4	↑	MC on surface.**
3:57	3801	-			-	-	-	MC on deck.

*LST: UTC -10h
**Latitude and Longitude was used the ship's position.

4.2 MSCL (MWJ)

(1) Personnel:

Yusuke SATO ***(Marine Works Japan Ltd.)***

(2) Measured Parameters

A GEOTEK multi-sensor core logger (MSCL) has the sensors of gamma-ray attenuation (GRA), P-wave velocity (PWV), and magnetic susceptibility (MS). Whole-core samples are used for the logger measurements.

(3) Instruments and Methods

In order to equalize sediment temperature with room temperature, whole-core samples are kept in the laboratory one night. Measurements are conducted on the cores every 1 cm.

GRA is measured a gamma ray source and detector. These mounted across the core on a sensor stand that aligns them with the center of the core. A narrow beam of gamma ray is emitted by Cesium-137 (^{137}Cs) with energies principally at 0.662 MeV. The photon of gamma ray is collimated through 5 mm diameter in rotating shutter at the front of the housing of ^{137}Cs. The photon is absorbed the core. The detector comprises a scintillator (a 2” diameter and 2” thick NaI crystal).

GRA calibration assumes a two-phase system model for sediments, where the two phases are the minerals and the interstitial water. Aluminum has an attenuation coefficient similar to common minerals and is used as the mineral phase standard. Pure water is substituted as the interstitial-water phase standard. The actual standard consists of a telescoping aluminum rob (five elements of varying thickness) mounted in a piece of core liner and filled with pure water. GRA was measured with 10 seconds counting.

PWV is measured two oil filled Acoustic Rolling Contact (ARC) transducers, which are mounted on the center sensor stand with gamma system. These transducers measure the velocity of P-wave through the core and the pulse frequency.

MS is measured using Bartington loop sensor that has an internal diameter of 100 mm installed in MSCL. An oscillator circuit in the sensor produces a low intensity (approx. 80 A/m RMS) non-saturating, alternating magnetic field (0.565 kHz). MS was measured with 1 second.

After MSCL measurement, whole-core samples are longitudinally cut into Working and Archive halves by a splitting devise and a stainless wire.

(4) Results

The MS results are shown in Table 4.2.1~Table 4.2.3. The corrected depth is calibrated by the core length which is measured immediately after core-on-deck.

(5) Data archive

All data are submitted to JAMSTEC Data Management Group (DMG) and is currently under its control and will be opened public via “Data Research for Whole Cruise Information in JAMSTEC” on JAMSTEC website.

Table 4.2.1. MS results of Station 1.

Corrected Depth(cm)	Corrected Sect. Depth (cm)	SB Depth(m)	SECT Number	SECT Depth(cm)	CT Depth(cm)	PWAmp	PWVel m/s	Den1 gm/cc	MS1 x 10^-8 (m^3/kg)	Imp	FP	Remarks
		0.009	1	0.9	7.611	0						No data (Void space)
0.3	0.3	0.019	1	1.9	7.578	0	2292.889	0.1761			1.5234	Handle with care (Section top)
1.3	1.3	0.029	1	2.9	7.487	86	1524.847	1.173	8.457	1788.557	0.910	
2.3	2.3	0.039	1	3.9	7.476	99	1507.258	1.192	10.636	1796.807	0.898	
3.3	3.3	0.049	1	4.9	7.403	99	1512.359	1.198	13.216	1812.289	0.894	
4.3	4.3	0.059	1	5.9	7.407	99	1511.633	1.204	14.673	1820.671	0.890	
5.3	5.3	0.069	1	6.9	7.406	99	1505.285	1.233	15.097	1855.505	0.873	
6.3	6.3	0.079	1	7.9	7.407	99	1503.959	1.238	15.033	1861.108	0.870	
7.3	7.3	0.089	1	8.9	7.407	99	1505.488	1.239	15.768	1864.875	0.869	
8.3	8.3	0.099	1	9.9	7.407	99	1503.959	1.239	15.760	1863.919	0.869	
9.3	9.3	0.109	1	10.9	7.407	99	1503.959	1.239	15.771	1862.669	0.869	
10.3	10.3	0.119	1	11.9	7.406	99	1505.285	1.240	15.764	1865.813	0.869	
11.3	11.3	0.129	1	12.9	7.405	99	1505.081	1.241	16.508	1867.064	0.868	
12.3	12.3	0.139	1	13.9	7.404	99	1504.878	1.249	16.402	1879.594	0.863	
13.3	13.3	0.149	1	14.9	7.404	99	1506.409	1.258	17.026	1895.029	0.857	
14.3	14.3	0.159	1	15.9	7.403	99	1504.675	1.265	16.934	1903.813	0.853	
15.3	15.3	0.169	1	16.9	7.403	99	1501.623	1.277	16.781	1917.297	0.846	
16.3	16.3	0.179	1	17.9	7.403	99	1500.101	1.270	17.612	1904.320	0.850	
17.3	17.3	0.189	1	18.9	7.404	99	1500.304	1.274	18.281	1910.622	0.848	
18.3	18.3	0.199	1	19.9	7.403	99	1500.101	1.267	19.121	1900.228	0.852	
19.3	19.3	0.209	1	20.9	7.400	99	1499.494	1.264	19.931	1894.570	0.854	
20.3	20.3	0.219	1	21.9	7.395	99	1498.480	1.267	20.647	1898.970	0.851	
21.3	21.3	0.229	1	22.9	7.447	99	1496.885	1.266	21.696	1895.573	0.852	
22.3	22.3	0.239	1	23.9	7.606	94	1492.836	1.256	20.583	1875.432	0.858	
23.3	23.3	0.249	1	24.9	7.554	90	1503.284	1.277	19.281	1919.035	0.846	
24.3	24.3	0.259	1	25.9	7.626	88	1519.124	1.327	16.758	2016.204	0.815	
25.3	25.3	0.269	1	26.9	7.634	87	1528.328	1.275	14.046	1948.845	0.847	
25.8	25.8											Section Length 25.8

Table 4.2.2. MS results of Station 2B.

Corrected Depth(cm)	Corrected Sect. Depth (cm)	SB Depth(m)	SECT Number	SECT Depth(cm)	CT Depth(cm)	PWAmp	PWVel m/s	Den1 gm/cc	MS1 x 10^-8 (m^3/kg)	Imp	FP	Remarks
		0.009	1	0.9	7.575	0						No data (Void space)
0.3	0.3	0.019	1	1.9	7.547	0	2278.684					Handle with care (Section top)
1.3	1.3	0.029	1	2.9	7.471	58	1522.519	1.183			0.904	
2.3	2.3	0.039	1	3.9	7.451	88	1504.645	1.238	5.909	1862.673	0.870	
3.3	3.3	0.049	1	4.9	7.4	99	1501.928	1.240	6.771	1862.043	0.868	
4.3	4.3	0.059	1	5.9	7.382	99	1501.322	1.227	8.423	1841.448	0.877	
5.3	5.3	0.069	1	6.9	7.381	99	1502.647	1.261	8.195	1895.060	0.855	
6.3	6.3	0.079	1	7.9	7.381	99	1502.647	1.249	8.273	1877.228	0.863	
7.3	7.3	0.089	1	8.9	7.379	99	1500.712	1.263	8.187	1895.904	0.854	
8.3	8.3	0.099	1	9.9	7.378	99	1498.984	1.259	8.216	1887.828	0.856	
9.3	9.3	0.109	1	10.9	7.379	99	1497.666	1.255	8.241	1879.778	0.859	
10.3	10.3	0.119	1	11.9	7.379	99	1497.666	1.244	8.314	1863.264	0.866	
11.3	11.3	0.129	1	12.9	7.379	99	1497.666	1.249	7.526	1871.207	0.862	
12.3	12.3	0.139	1	13.9	7.378	99	1497.463	1.240	8.343	1857.165	0.868	
13.3	13.3	0.149	1	14.9	7.376	99	1497.057	1.242	8.338	1859.299	0.867	
14.3	14.3	0.159	1	15.9	7.376	99	1497.057	1.236	8.379	1850.163	0.871	
15.3	15.3	0.169	1	16.9	7.375	99	1496.854	1.225	7.689	1833.468	0.878	
16.3	16.3	0.179	1	17.9	7.374	99	1496.651	1.232	7.645	1844.387	0.873	
17.3	17.3	0.189	1	18.9	7.374	99	1496.651	1.236	8.382	1850.467	0.870	
18.3	18.3	0.199	1	19.9	7.373	99	1496.448	1.239	7.607	1854.119	0.869	
19.3	19.3	0.209	1	20.9	7.372	99	1494.728	1.249	8.302	1867.477	0.863	
20.3	20.3	0.219	1	21.9	7.371	99	1494.526	1.239	7.615	1851.327	0.869	
21.3	21.3	0.229	1	22.9	7.371	99	1494.526	1.245	8.336	1860.156	0.865	
22.3	22.3	0.239	1	23.9	7.371	99	1494.526	1.229	8.440	1837.363	0.875	
23.3	23.3	0.249	1	24.9	7.371	99	1494.526	1.244	8.341	1859.241	0.866	
24.3	24.3	0.259	1	25.9	7.371	99	1493.012	1.238	8.379	1848.844	0.869	
25.3	25.3	0.269	1	26.9	7.372	99	1493.215	1.236	8.395	1844.898	0.871	
26.3	26.3	0.279	1	27.9	7.372	99	1493.215	1.239	8.373	1849.756	0.869	
27.3	27.3	0.289	1	28.9	7.373	99	1493.417	1.237	8.384	1846.719	0.870	
28.3	28.3	0.299	1	29.9	7.375	99	1492.311	1.257	8.241	1875.906	0.858	
29.3	29.3	0.309	1	30.9	7.376	99	1492.513	1.231	8.410	1837.881	0.874	
30.3	30.3	0.319	1	31.9	7.377	99	1491.207	1.237	8.372	1843.895	0.870	
31.3	31.3	0.329	1	32.9	7.376	99	1492.513	1.245	8.318	1858.217	0.865	
32.3	32.3	0.339	1	33.9	7.376	99	1492.513	1.246	8.312	1859.435	0.865	
33.3	33.3	0.349	1	34.9	7.375	99	1493.822	1.236	8.383	1846.112	0.871	
34.3	34.3	0.359	1	35.9	7.373	99	1494.931	1.249	8.301	1867.172	0.863	
35.3	35.3	0.369	1	36.9	7.372	99	1496.245	1.246	8.322	1864.790	0.864	
36.3	36.3	0.379	1	37.9	7.372	99	1497.765	1.260	8.234	1886.599	0.856	
37.3	37.3	0.389	1	38.9	7.37	99	1497.359	1.262	8.226	1889.364	0.855	
38.3	38.3	0.399	1	39.9	7.369	99	1495.636	1.248	8.322	1866.317	0.863	
39.3	39.3	0.409	1	40.9	7.367	99	1493.714	1.250	8.316	1866.561	0.862	
40.3	40.3	0.419	1	41.9	7.366	99	1495.027	1.252	8.303	1871.818	0.861	
41.3	41.3	0.429	1	42.9	7.365	99	1494.825	1.258	8.268	1880.391	0.857	
42.3	42.3	0.439	1	43.9	7.365	99	1496.343	1.253	8.300	1874.944	0.860	
43.3	43.3	0.449	1	44.9	7.365	99	1494.825	1.252	8.304	1872.124	0.861	
44.3	44.3	0.459	1	45.9	7.366	99	1493.512	1.253	8.297	1871.449	0.860	
45.3	45.3	0.469	1	46.9	7.368	99	1495.433	1.247	8.329	1865.095	0.864	
46.3	46.3	0.479	1	47.9	7.445	99	1488.405	1.249	8.075	1858.240	0.863	
47.3	47.3	0.489	1	48.9	7.562	92	1490.931	1.225	7.868	1826.634	0.877	
48.3	48.3	0.499	1	49.9	7.584	78	1504.165	1.230	7.775	1849.502	0.875	
49.3	49.3	0.509	1	50.9	7.579	85	1507.659	1.245	6.993	1877.384	0.865	
50.3	50.3	0.519	1	51.9	7.637	91	1525.265	1.272	5.358	1940.355	0.848	Section Length 50.5
51.3	51.3	0.529	2	0	7.628	74	1529.577	0.868	5.910	1327.419	1.097	Handle with care (Section end)

Table 4.2.3. MS results of Station 3.

Corrected Depth(cm)	Corrected Sect. Depth (cm)	SB Depth(m)	SECT Number	SECT Depth(cm)	CT Depth(cm)	PWAmp	PWVel m/s	Den1 gm/cc	MS1 x 10^-8 (m^3/kg)	Imp	FP	Remarks
		0.009	1	0.9	7.644	70						No data (Section top)
1.1	1.1	0.019	1	1.9	7.623	0	2315.614	0.6612			1.2246	Handle with care (Section top)
2.1	2.1	0.029	1	2.9	7.507	86	1523.645	1.13	0	1721.763	0.9359	
3.1	3.1	0.039	1	3.9	7.524	99	1514.798	1.1538	0.7706	1747.832	0.9213	
4.1	4.1	0.049	1	4.9	7.438	99	1511.174	1.1862	1.5495	1792.506	0.9014	
5.1	5.1	0.059	1	5.9	7.438	99	1509.641	1.1697	2.3569	1765.892	0.9115	
6.1	6.1	0.069	1	6.9	7.438	99	1508.11	1.1776	3.1215	1776.019	0.9066	
7.1	7.1	0.079	1	7.9	7.439	99	1508.313	1.1832	4.6583	1784.682	0.9032	
8.1	8.1	0.089	1	8.9	7.439	99	1509.844	1.1749	4.6913	1773.941	0.9083	
9.1	9.1	0.099	1	9.9	7.437	99	1510.971	1.2071	6.0932	1823.825	0.8885	
10.1	10.1	0.109	1	10.9	7.436	99	1507.705	1.2106	6.0776	1825.26	0.8863	
11.1	11.1	0.119	1	11.9	7.436	99	1506.178	1.1938	6.9334	1798.14	0.8966	
12.1	12.1	0.129	1	12.9	7.435	99	1505.975	1.1976	6.9144	1803.542	0.8943	
13.1	13.1	0.139	1	13.9	7.435	99	1507.502	1.2048	6.1095	1816.207	0.8899	
14.1	14.1	0.149	1	14.9	7.434	99	1507.299	1.2021	6.8909	1811.989	0.8915	
15.1	15.1	0.159	1	15.9	7.433	99	1507.096	1.2145	6.8233	1830.399	0.8839	
16.1	16.1	0.169	1	16.9	7.433	99	1508.626	1.216	6.815	1834.377	0.883	
17.1	17.1	0.179	1	17.9	7.431	99	1508.220	1.205	6.881	1817.748	0.890	
18.1	18.1	0.189	1	18.9	7.43	99	1506.488	1.205	6.884	1815.604	0.890	
19.1	19.1	0.199	1	19.9	7.429	99	1504.760	1.208	7.637	1817.078	0.888	
20.1	20.1	0.209	1	20.9	7.428	99	1506.083	1.230	7.498	1853.152	0.874	
21.1	21.1	0.219	1	21.9	7.428	99	1507.611	1.227	8.269	1850.163	0.876	
22.1	22.1	0.229	1	22.9	7.428	99	1507.611	1.225	8.282	1847.426	0.877	
23.1	23.1	0.239	1	23.9	7.428	99	1509.143	1.234	8.972	1862.103	0.872	
24.1	24.1	0.249	1	24.9	7.428	99	1512.215	1.214	9.123	1835.119	0.885	
25.1	25.1	0.259	1	25.9	7.429	99	1512.419	1.203	9.965	1819.669	0.891	
26.1	26.1	0.269	1	26.9	7.428	99	1510.677	1.212	10.661	1830.222	0.886	
27.1	27.1	0.279	1	27.9	7.427	99	1512.011	1.217	9.861	1839.675	0.883	
28.1	28.1	0.289	1	28.9	7.427	99	1513.552	1.215	10.632	1839.420	0.883	
29.1	29.1	0.299	1	29.9	7.424	99	1512.941	1.209	10.702	1828.794	0.888	
30.1	30.1	0.309	1	30.9	7.422	99	1510.994	1.221	11.359	1845.148	0.880	
31.1	31.1	0.319	1	31.9	7.42	99	1510.586	1.228	10.551	1854.897	0.876	
32.1	32.1	0.329	1	32.9	7.419	99	1510.383	1.234	10.507	1863.142	0.872	
33.1	33.1	0.339	1	33.9	7.418	99	1510.179	1.232	11.273	1861.003	0.873	
34.1	34.1	0.349	1	34.9	7.417	99	1509.976	1.234	10.509	1863.753	0.872	
35.1	35.1	0.359	1	35.9	7.416	99	1511.310	1.237	10.489	1869.633	0.870	
36.1	36.1	0.369	1	36.9	7.414	99	1509.365	1.225	9.842	1849.411	0.877	
37.1	37.1	0.379	1	37.9	7.412	99	1507.423	1.241	9.724	1870.725	0.868	
38.1	38.1	0.389	1	38.9	7.414	99	1504.770	1.236	9.755	1860.213	0.871	
39.1	39.1	0.399	1	39.9	7.595	99	1501.879	1.213	9.275	1821.912	0.885	
40.1	40.1	0.409	1	40.9	7.592	96	1504.260	1.225	8.487	1842.870	0.877	
41.1	41.1	0.419	1	41.9	7.559	74	1512.708	1.238	7.795	1872.832	0.869	
42.1	42.1	0.429	1	42.9	7.647	89	1544.225	1.253	6.095	1935.466	0.860	
43.0	43.0											Section Length 43.0

4.3 Core color reflectance (MWJ)

(1) Personnel:

Yusuke SATO ***(Marine Works Japan Ltd.)***

(2) Measured Parameters

There are different systems to quantify the color reference for soil and sediment measurements. The most common is the $L^*a^*b^*$ system, and it is referred to as the CIE (Commision International d'Eclairage) LAB system. It can be visualized as a cylindrical coordinate system in which the axis of the cylinder is the lightness variable L^*, ranging from 0% to 100%. The radii are the chromaticity variables a^* and b^*. Variable a* is the green (negative) to red (positive) axis, and variable b* is the blue (negative) to yellow (positive) axis. Spectral data can be used to estimate the abundance of certain components of sediments.

(3) Instruments and methods

Core color reference is measured by using the Konica Minolta CM-700d reference photo spectrometer (400 to 700 nm in wavelengths). This is a compact and hand-held instrument, and can measure spectral reflectance of sediment surface with a scope of 8 mm diameter.

The CM-700d has the specular component to be included (SCI) or excluded (SCE). SCE is selected in this study. The SCE setting is the recommended mode of operation for sediments. The light reflects at a certain angle (angle of specular reflection), and it is trapped and absorbed on the integration sphere.

Calibrations are conducted before the measurement of core samples using the white calibration piece (CM-700d standard accessories) without crystal clear polyethylene wrap.

The color of Archive half core was measured on every 2 cm through crystal clear polyethylene wrap. Measurement parameters are shown in Table 4.3.1.

Table 4.3.1. Measurement parameters.

Instrument	Konica Minolta Photospectrometer CM-700d
Software	Spectra Magic NX CM-S100w Ver.2.02.0002
Illuminant	d/8 (SCE)
Light source	D65
Viewing angle	10 degree
Color system	$L^*a^*b^*$ system

(4) Results

The core color data are shown in Table 4.3.4.1~Table 4.3.4.3. The depth is corrected by the core length which is measured immediately after core-on-deck.

(5) Data archive

All data are submitted to JAMSTEC Data Management Group (DMG). They are currently under its control, and will be opened public via "Data Research for Whole Cruise Information in JAMSTEC" on JAMSTEC website.

Table 4.3.4.1. Core color results of Station 1.

Core ID: MR13-05 MC01 HAND1	
Measurement date: 2013/8/23 (UTC)	Model: KONICA MINOLTA CM-700d
Viewing system: SCE Illuminant: D65	Software: SpectraMagic NX Ver.2.02 Observer: 10°
Interval: 2cm	Area: 8mm (MAV)

Shot No.	Data No.	Time	Section No.	Corrected Depth (cm)	Corrected Sect. Depth (cm)	L*a*b* spaces L*(D65)	a*(D65)	b*(D65)
1	Measurement#01	2013/8/23 20:53	-	1	1	30.66	6.43	14.4
2	Measurement#02	2013/8/23 20:53	-	3	3	29.77	6.49	14.94
3	Measurement#03	2013/8/23 20:53	-	5	5	29.38	5.57	13.8
4	Measurement#04	2013/8/23 20:54	-	7	7	29.43	4.9	13.31
5	Measurement#05	2013/8/23 20:54	-	9	9	30.87	5.76	15.94
6	Measurement#06	2013/8/23 20:58	-	11	11	33.98	5.31	16.14
7	Measurement#07	2013/8/23 20:58	-	13	13	36.5	2.84	14.37
8	Measurement#08	2013/8/23 20:58	-	15	15	31.41	2.6	12
9	Measurement#09	2013/8/23 20:59	-	17	17	41.31	-1.28	8.89
10	Measurement#10	2013/8/23 20:59	-	19	19	38.76	-2.27	8.13
11	Measurement#11	2013/8/23 20:59	-	21	21	39.84	-1.55	9.17
12	Measurement#12	2013/8/23 20:59	-	23	23	40.55	-1.6	6.41
				25.8	25.8			

Table 4.3.4.2. Core color results of Station 2B.

Core ID: MR13-05 MC02B HAND1	
Measurement date: 2013/8/23 (UTC)	Model: KONICA MINOLTA CM-700d
Viewing system: SCE Illuminant: D65	Software: SpectraMagic NX Ver.2.02 Observer: 10°
Interval: 2cm	Area: 8mm (MAV)

Shot No.	Data No.	Time	Section No.	Corrected Depth (cm)	Corrected Sect. Depth (cm)	L*a*b* spaces L* (D65)	a* (D65)	b* (D65)
1	Measurement#01	2013/8/23 21:41	-	1	1	35.39	-1.18	9.19
2	Measurement#02	2013/8/23 21:41	-	3	3	36.26	-1.12	8.86
3	Measurement#03	2013/8/23 21:42	-	5	5	36.77	-1	8.81
4	Measurement#04	2013/8/23 21:42	-	7	7	34.34	-1.47	8.82
5	Measurement#05	2013/8/23 21:42	-	9	9	32.79	-1.76	9.23
6	Measurement#06	2013/8/23 21:42	-	11	11	32.62	-1.3	9.99
7	Measurement#07	2013/8/23 21:42	-	13	13	32.55	-1.54	9.65
8	Measurement#08	2013/8/23 21:43	-	15	15	31.54	-1.59	9.99
9	Measurement#09	2013/8/23 21:43	-	17	17	31.82	-1.61	9.93
10	Measurement#10	2013/8/23 21:43	-	19	19	31.67	-1.64	9.68
11	Measurement#11	2013/8/23 21:43	-	21	21	32.29	-1.61	9.63
12	Measurement#12	2013/8/23 21:43	-	23	23	32.87	-1.58	9.27
13	Measurement#13	2013/8/23 21:43	-	25	25	34.32	-1.5	8.7
14	Measurement#14	2013/8/23 21:43	-	27	27	33.68	-1.55	8.72
15	Measurement#15	2013/8/23 21:43	-	29	29	32.58	-1.57	9.19
16	Measurement#16	2013/8/23 21:44	-	31	31	32.71	-1.6	9.05
17	Measurement#17	2013/8/23 21:44	-	33	33	32.71	-1.52	9.17
18	Measurement#18	2013/8/23 21:44	-	35	35	32.98	-1.54	9.15
19	Measurement#19	2013/8/23 21:44	-	37	37	32.08	-1.57	9.36
20	Measurement#20	2013/8/23 21:44	-	39	39	32.57	-1.59	9.51
21	Measurement#21	2013/8/23 21:44	-	41	41	32.18	-1.71	9.51
22	Measurement#22	2013/8/23 21:45	-	43	43	32.57	-1.6	9.37
23	Measurement#23	2013/8/23 21:45	-	45	45	32.47	-1.56	9.35
24	Measurement#24	2013/8/23 21:45	-	47	47	32.9	-1.57	9.29
25	Measurement#25	2013/8/23 21:45	-	49	49	32.27	-1.55	9.55
26	Measurement#26	2013/8/23 21:45	-	50.5	50.5	30.93	-1.62	10.07

Table 4.3.4.3. Core color results of Station 3.

Core ID: MR13-05 MC03HAND1	
Measurement date: 2013/8/24 (UTC)	Model: KONICA MINOLTA CM-700d
Viewing system: SCE Illuminant: D65	Software: SpectraMagic NX Ver.2.02 Observer: 10°
Interval: 2cm	Area: 8mm (MAV)

Shot No.	Data No.	Time	Section No.	Corrected Depth (cm)	Corrected Sect. Depth (cm)	L*a*b* spaces L*(D65)	a*(D65)	b*(D65)
1	Measurement#01	2013/8/24 0:02	-	1	1	38.75	0.91	15.66
2	Measurement#02	2013/8/24 0:02	-	3	3	35.74	-1.36	12.73
3	Measurement#03	2013/8/24 0:02	-	5	5	32.75	-1.45	11.65
4	Measurement#04	2013/8/24 0:02	-	7	7	32.24	-1.39	11.14
5	Measurement#05	2013/8/24 0:02	-	9	9	32.01	-1.39	10.84
6	Measurement#06	2013/8/24 0:02	-	11	11	31.12	-1.45	11.28
7	Measurement#07	2013/8/24 0:03	-	13	13	31.58	-1.44	10.98
8	Measurement#08	2013/8/24 0:03	-	15	15	32.1	-1.37	10.96
9	Measurement#09	2013/8/24 0:03	-	17	17	32.65	-1.37	10.4
10	Measurement#10	2013/8/24 0:03	-	19	19	31.75	-1.42	10.93
11	Measurement#11	2013/8/24 0:03	-	21	21	32.61	-1.33	10.54
12	Measurement#12	2013/8/24 0:03	-	23	23	33.06	-1.47	10.65
13	Measurement#13	2013/8/24 0:03	-	25	25	38.99	-1.7	9.16
14	Measurement#14	2013/8/24 0:04	-	27	27	39.68	-1.72	9.16
15	Measurement#15	2013/8/24 0:04	-	29	29	39.36	-1.54	8.85
16	Measurement#16	2013/8/24 0:04	-	31	31	39.95	-1.59	9.28
17	Measurement#17	2013/8/24 0:04	-	33	33	39.66	-1.43	8.63
18	Measurement#18	2013/8/24 0:04	-	35	35	39.49	-1.55	9.19
19	Measurement#19	2013/8/24 0:04	-	37	37	38.87	-1.51	8.92
20	Measurement#20	2013/8/24 0:04	-	39	39	39.19	-1.79	8.51
21	Measurement#21	2013/8/24 0:04	-	41	41	38.85	-1.8	8.3
22	Measurement#22	2013/8/24 0:05		43	43	37.85	-1.66	9.6

4.4 Visual core description

4.4.1 Core photograph (MWJ)

(1) Personnel:

Kentaro SHIRAISHI ***(Marine Works Japan Ltd.)***

(2) Instruments and methods

Each of Working half core photographs are taken using a digital camera (Camera body: Nikon D1x / Lens:Nikon Ai AF Zoom Nikkor 24～50mm F3.3～4.5D). The shutter speed is 1/30 sec, F-number is 5.6, and the sensitivity is ISO 125. File format of raw data is JPEG. Details for settings are included on property of each file.

(3) Results

The core photographs are shown in Fig. 4.4.1.1~Fig. 4.4.1.3.

Fig. 4.4.1.1. Core photograph of Station 1.

Fig. 4.4.1.2. Core photograph of Station 2B.

Fig. 4.4.1.3. Core photograph of Station 3.

4.4.2 Visual core description (JCGA Kawamura)

(1) Personnel:

Noriko KAWAMURA *Japan coast guard academy*

(2) Method

Observation for visual core description (VCD) for core samples is made on split surface of working half sections. The split surface is scraped using a glass plate to expose fresh surface. Lithological and sedimentological features are described on a VCD spread sheet for the MC cores.

(3) Results

MC cores are composed of diatom ooze with sponge spicules and iron oxide (Fig.4.4.2.1~Fig.4.2.2.3). The sediment color of station 2 is not changed due to coring disturbance. The sediment colors are dark olive brown or dark olive upper part of the core, the color shows downward from olive brown to olive black at stations 1 and 3 (Fig.4.4.2.1, Fig.4.4.2.3). The boundaries are disturbed by benthic organisms, thus are unclear at station 1. While, the sharp line is recognized at station 3.

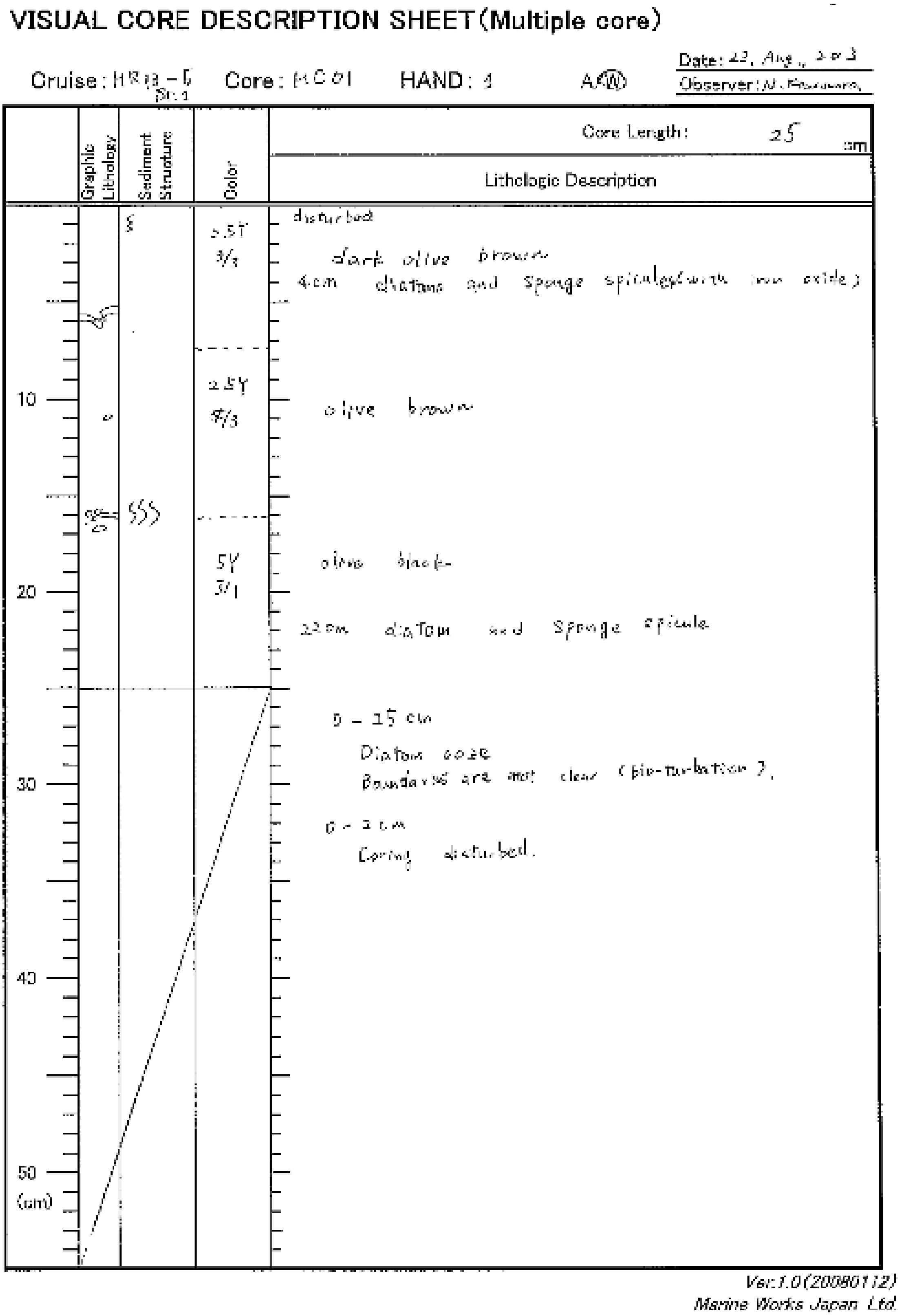


Fig. 4.4.2.1. Visual core description of Station 1.

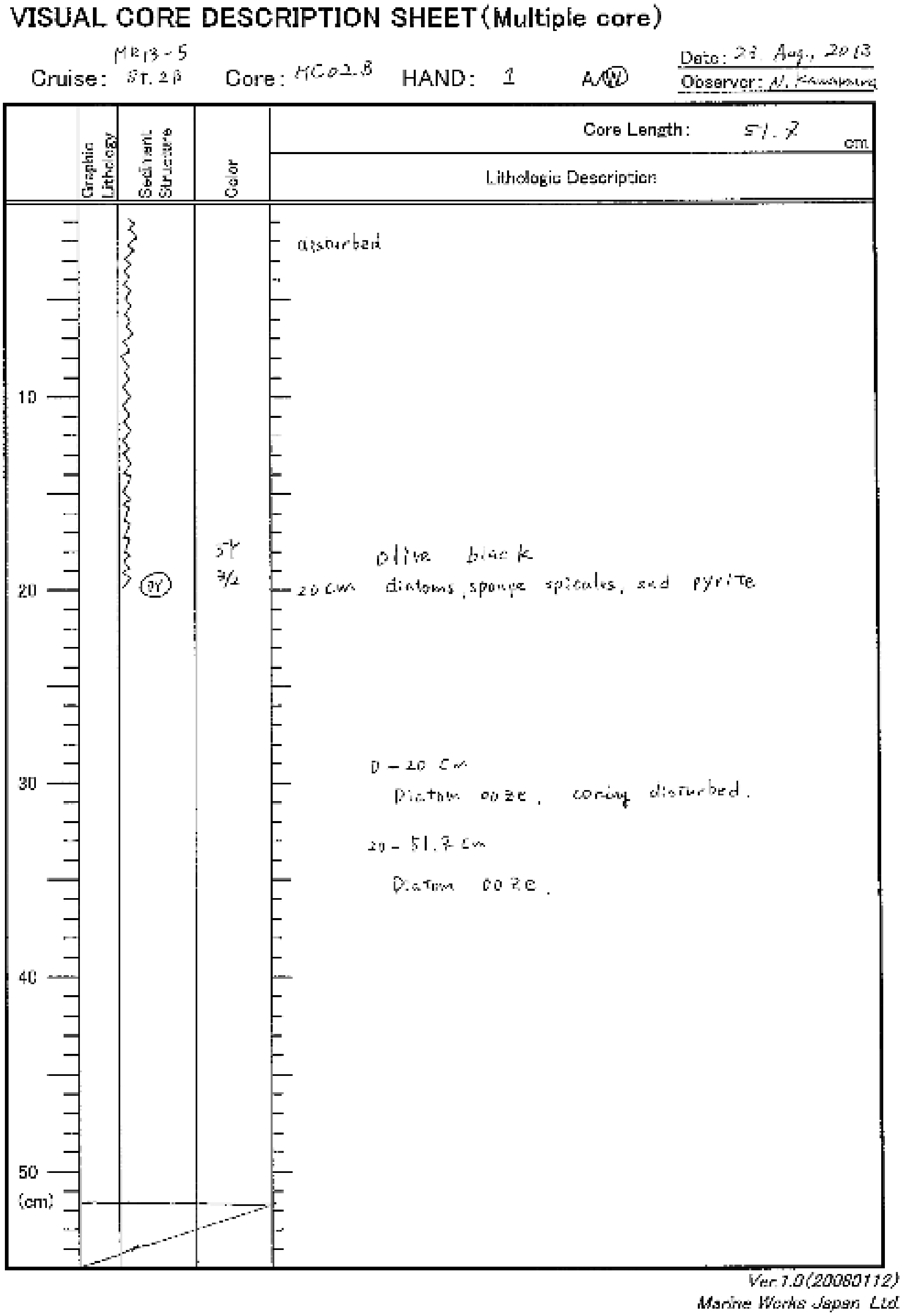


Fig. 4.4.2.2. Visual core description of Station 2B.

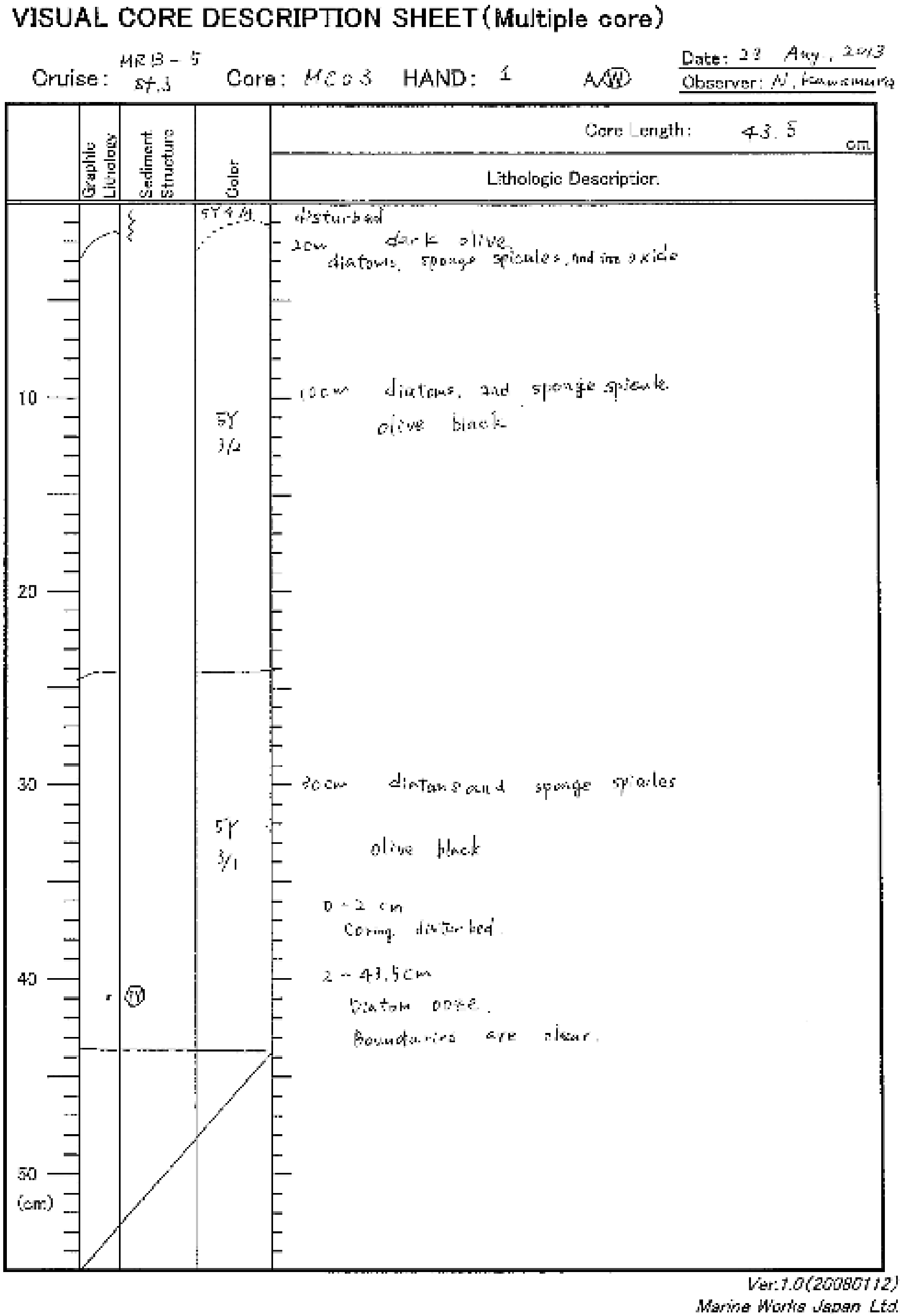


Fig. 4.4.2.3. Visual core description of Station 3.

4.5 Soft X-ray measurement (MWJ)

(1) Personnel

Yusuke SATO ***(Marine Works Japan Ltd.)***

(2) Instruments and methods

Sediment is sub-sampled by using a original plastic cases (200 mm x 3 mm x 7 mm) from Working halve cores. The cruise code, core number, HAND number, case number, and core depth(cm) are labeled on the cores. The core are tightly sealed to avoid exudation of pore water using by thin film seal PARAFILM.

Soft X-ray (45 kVp, 2 mA, and 140 seconds) photographs are taken to using the device SOFTEX PRO-TEST 150 on board. The condition of X-ray is decided from results of test photographs by each core. All photographs are developed into the negative films by the device FIP-1400 on board. These negative films are scanned by Epson Offirio ES-10000G and are preserved as electric files.

(3) Results

The soft X-ray photographs are shown in Fig.4.5.1~Fig.4.5.3.

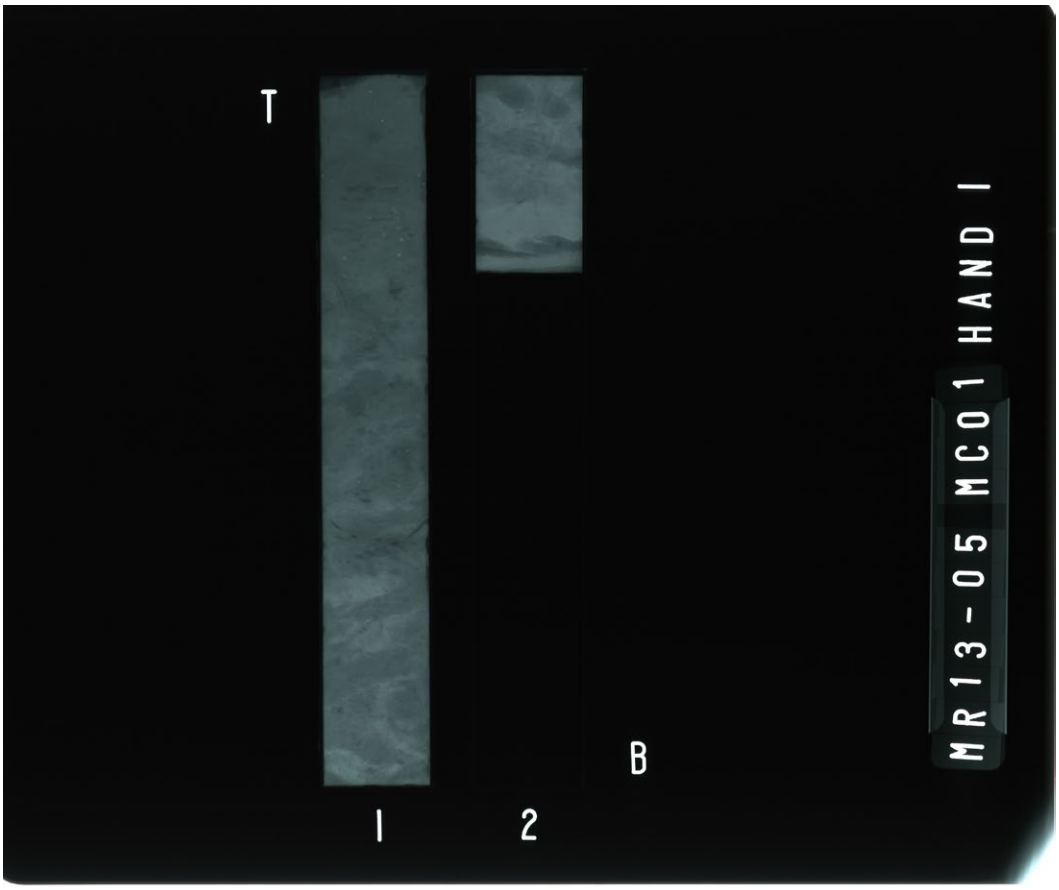


Fig.4.5.1. Soft X-ray photograph of Station 1.

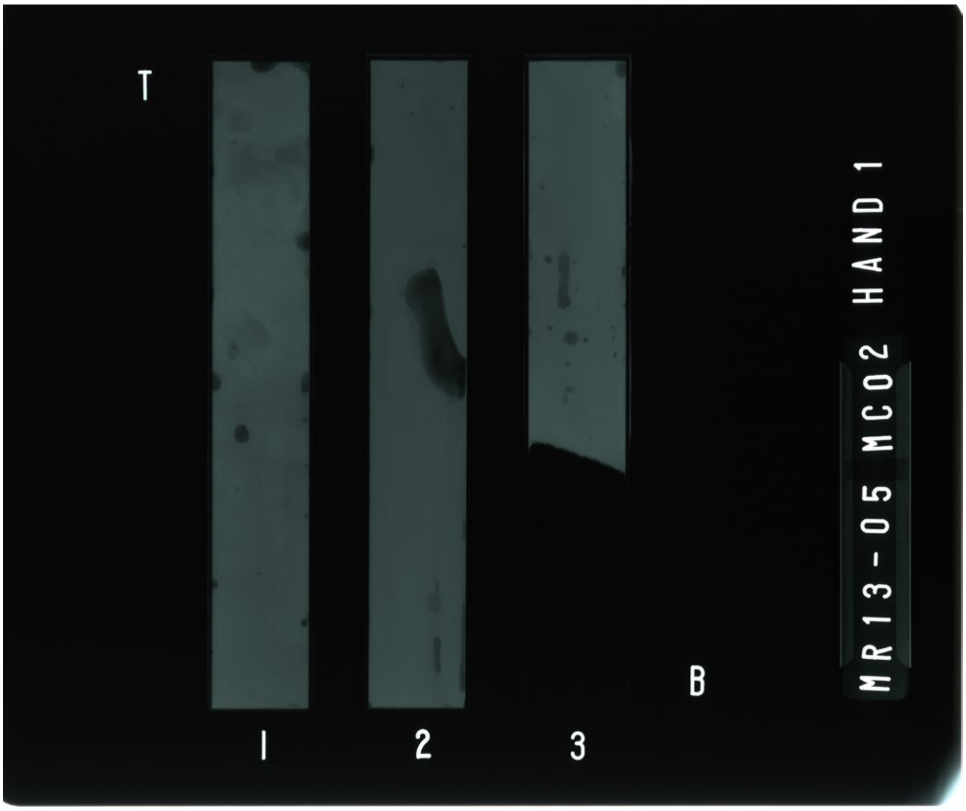


Fig.4.5.2. Soft X-ray photograph of Station 2B.

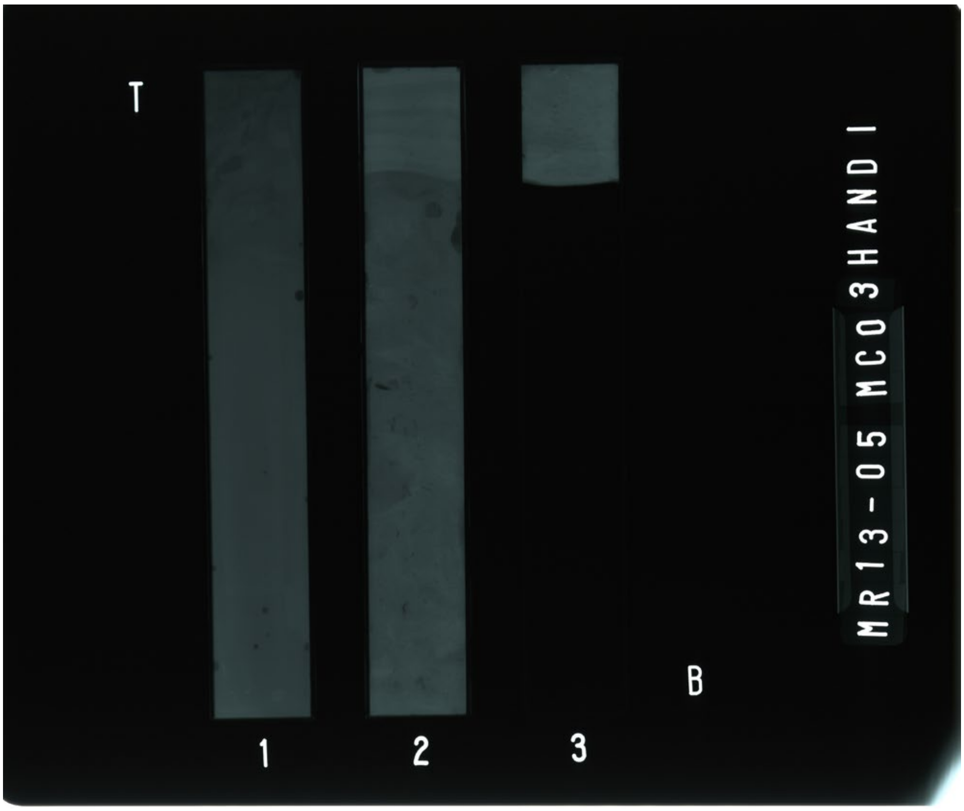


Fig.4.5.3. Soft X-ray photograph of Station 3.

4.6 Dissolved oxygen and pH in bottom and pore water (JCGA Kawamura)

(1) Personnel:

Noriko KAWAMURA ***Japan coast guard academy***

Saburo SAKAI ***JAMSTEC***

(2) Objectives /background

Many metals are dissolved and/or precipitated within sediments and across sediment-water interface. Iron an essential element for planktons, and is dissolved as bivalent or trivalent ions under anoxic and acid conditions. It is thus important to clarify iron forms within sediment-water for bio-productivity in the sea. In order to investigate chemical conditions of bottom and pore waters, pH and dissolved oxygen (DO) were measured on board.

(3) Instruments and methods

The pH and the dissolved oxygen (DO) of interstitial water are directly measured with the pH (Toa DDK Ltd.) and DO meters (OM-51-10 type, HORIBA Ltd.). The measurement procedures followed those of Passier et al., (1997). The recovered cores are cut and capped immediately on board after the core recovery during 2 hours. The measurement is carried out at every 1-15 cm in multiple cores.

(4) Results

The pH values range 7.3 and 7.8, and gradually increase with burial depth at all stations. DO values show minimum at 0-2 cm in burial depth at stations 2 and 3 (Table 4.6.1). While, the values gradually decrease with the depth at station 1. It is implied that relatively oxic condition at this stations.

(5) Data archive

All data are submitted to JAMSTEC Data Management Group (DMG). They are currently under its control, and will be opened public via “Data Research for Whole Cruise Information in JAMSTEC” on JAMSTEC website.

(6) Acknowledgements

I thank the shipboard technicians and engineers of MWJ for their assistance in the measurements. I am deeply grateful to the captain and his crews of the MR13-05 cruise.

(7) Reference

Passier, H. F. and M. J. Dekkers, G. J. de Lange, Sediment chemistry and magnetic properties in an a nomalously reducing core from the eastern Mediterranean Sea, *Chem. Geol.*, **152**, 287-306, 1998.

Table 4.6.1. Downcore plots of pH and DO. Bottom water depths are shown as "-".

Date	Station No.	Time	Burial depth (cm)	pH	DO (mg/L)
21/8/2013	1	10:45	-	7.3567	1.65
		10:47	0.5	7.455	0.81
		11:03	6.5	7.302	0.13
		11:10	11.5	7.428	0.06
		11:23	14	7.536	0.02
		11:33	17	7.654	0.01
22/8/2013	2	1800	-	8.026	1.58
		1810	0.9	7.685	0.00
		1827	5.9	7.700	0.00
		1840	10.9	7.726	0.00
		1844	18.4	7.720	0.00
		1850	26.9	7.808	0.00
		1853	33.9	7.685	0.00
22/8/2013	3	1055	-	7.488	1.75
		1120	1.3	7.341	0.00
		1126	6.9	7.494	0.00
		1135	9.9	7.521	0.00
		1140	11.9	7.523	0.00
		1143	19.9	7.590	0.00
		1154	24.9	7.662	0.00
		1156	25.9	7.700	0.00
		1157	40.9	7.722	0.00

5. Geophysical observation

5.1 Swath bathymetry

(1) Personnel

Takeshi MATSUMOTO	***University of the Ryukyus: Principal Investigator (not on-board)***
Masao NAKANISHI	***Chiba University: Principal Investigator (not on-board)***
Shinya OKUMURA	***Global Ocean Development Inc., GODI***
Miki MORIOKA	***GODI***
Ryo OYAMA	***MIRAI crew***

(2) Introduction

R/V MIRAI is equipped with a Multi-narrow Beam Echo Sounding system (MBES), SEABEAM 3012 Upgrade Model (L3 Communications ELAC Nautik) and Sub-bottom Profiler (SBP), Bathy2010 (SyQwest). The objective of MBES is collecting continuous bathymetric data along ship's track to make a contribution to geological and geophysical investigations and global datasets.

(3) Data Acquisition

The "SEABEAM 3012 Upgrade Model" on R/V MIRAI was used for bathymetry mapping during the MR13-05 cruise from 14th August to 25th August 2013.

To get accurate sound velocity of water column for ray-path correction of acoustic multibeam, we used Surface Sound Velocimeter (SSV) data to get the sea surface (6.62m) sound velocity, and the deeper depth sound velocity profiles were calculated by temperature and salinity profiles from XCTD and Argo float data by the equation in Del Grosso (1974) during the cruise.

Table 5.1.1 shows system configuration and performance of SEABEAM 3012 Upgrade Model. Table 5.1.2 shows system configuration and performance of Sub-Bottom Profiler, Bathy2010.

Table 5.1.1 System configuration and performance

SEABEAM 3012 Upgrade Model (12 kHz system)

Frequency: 12 kHz

Transmit beam width: 1.6 degree

Transmit power: 20 kW

Transmit pulse length: 2 to 20 msec.

Receive beam width: 1.8 degree

Depth range: 100 to 11,000 m

Beam spacing: 0.5 degree athwart ship

Swath width: 150 degree (max)

120 degree to 4,500 m

100 degree to 6,000 m

90 degree to 11,000 m

Depth accuracy: Within < 0.5% of depth or ±1m, whichever is greater, over the entire swath. (Nadir beam has greater accuracy; typically within < 0.2% of depth or ±1m, whichever is greater)

Table 5.1.2 System configuration and performance
Sub-bottom Profiler, Bathy2010 (3.5kHz system)

Frequency:	3.5 kHz
Transmit beam width:	23 degree
Transmit pulse length:	0.5 to 50 msec
Strata resolution:	Up to 8 cm with 300+ Meters of bottom penetration; bottom type dependant
Depth resolution:	0.1 Feet, 0.1 Meters
Depth accuracy:	±10 cm to 100 m, ±0.3% to 6,000 m

(4) Preliminary Results

The results will be published after primary processing.

(5) Data Archives

Bathymetric data obtained during this cruise will be submitted to the Data Management Group (DMG) in JAMSTEC, and will be archived there.

5.2 Sea surface gravity

(1) Personnel

Takeshi MATSUMOTO ***University of the Ryukyus: Principal Investigator (not on-board)***
Masao NAKANISHI ***Chiba University: Principal Investigator (not on-board)***
Shinya OKUMURA ***Global Ocean Development Inc., GODI***
Miki MORIOKA ***GODI***
Ryo OYAMA ***MIRAI crew***

(2) Introduction

The local gravity is an important parameter in geophysics and geodesy. We collected gravity data at the sea surface.

(3) Parameters

Relative Gravity [CU: Counter Unit]
[mGal] = (coef1: 0.9946) * [CU]

(4) Data Acquisition

We measured relative gravity using LaCoste and Romberg air-sea gravity meter S-116 (Micro-g LaCoste, LLC) during the MR13-05 cruise from 13 August 2013 on Sekinehama to 25 August 2013 on Dutch Harbor.

To convert the relative gravity to absolute one, we measured gravity using portable gravity meter (Scintrex gravity meter CG-5), at Sekinehama and Sekinehama as the reference points.

(5) Preliminary Results

Absolute gravity table is shown in Table 5.2.1.

Table 5.2.1 Absolute gravity

No.	Date Gravity	U.T.C.	Port	Absolute [mGal]	Gravity [cm]	Level [cm]	Gravity at Draft [mGal]	S-116 Sensor * [mGal]
#1	12.August	01:05	Serine	980371.95	263	640	980373.01	12663.39

*: Gravity at Sensor

= Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.2654

(6) Data Archives

Surface gravity data obtained during this cruise will be submitted to the Data Management Group (DMG) in JAMSTEC, and will be archived there.

5.3 Sea surface magnetic field

(1) Personnel

Takeshi MATSUMOTO ***University of the Ryukyus: Principal Investigator (not on-board)***

Masao NAKANISHI ***Chiba University: Principal Investigator (not on-board)***

Shinya OKUMURA ***Global Ocean Development Inc., GODI***

Miki MORIOKA ***GODI***

Ryo OYAMA ***MIRAI crew***

(2) Three-component magnetometer

(2-1) Introduction

Measurements of magnetic force on the sea are required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. We measured geomagnetic field using a three-component magnetometer during the MR13-05 cruise from 13 August to 25 August, 2013.

(2-2) Principle of ship-board geomagnetic vector measurement

The relation n between a magnetic-field vector observed on-board, Hob, (in the ship's fixed coordinate system) and the geomagnetic field vector, F, (in the Earth's fixed coordinate system) is expressed as:

$$\mathbf{H}ob = \mathbf{A}\ \mathbf{R}\ \mathbf{P}\ \mathbf{Y}\ \mathbf{F} + \mathbf{H}p \qquad \text{(a)}$$

where **R**, **R** and **Y** are the matrices of rotation due to roll, pitch and heading of a ship, respectively. $\widetilde{\mathbf{A}}$ is a 3 x 3 matrix which represents magnetic susceptibility of the ship, and **H**p is a magnetic field vector produced by a permanent magnetic moment of the ship's body. Rearrangement of Eq. (a) makes

$$\mathbf{B}\,\mathbf{H}ob + \mathbf{H}bp = \mathbf{R}\,\mathbf{P}\,\mathbf{Y}\,\mathbf{F} \quad \text{(b)}$$

where $\mathbf{B} = \mathbf{A}^{-1}$, and **H**bp = **-B H**p. The magnetic field, **F**, can be obtained by measuring **R**, **P**, **Y** and **H**ob, if **B** and **H**bp are known. Twelve constants in **B** and **H**bp can be determined by measuring variation of **H**ob with **R**, **P** and **Y** at a place where the geomagnetic field, **F**, is known.

(2-3) Instruments on R/V MIRAI

A shipboard three-component magnetometer system (Tierra Technica SFG1214) is equipped on-board R/V MIRAI. Three-axes flux-gate sensors with ring-cored coils are fixed on the fore mast. Outputs of the sensors are digitized by a 20-bit A/D converter (1 nT/LSB), and sampled at 8 times per second. Ship's heading, pitch, and roll are measured utilizing an Inertial Navigation System (Fiber Optical Gyro) installed for controlling attitude of a Doppler radar. Ship's position (GPS) and speed data are taken from LAN every second.

(2-4) Data Archives

These data obtained during this cruise will be submitted to the Data Management Group (DMG) in JAMSTEC, and will be archived there.

(2-5) Remarks

1. For calibration of the ship’s magnetic effect, we made a “Figure eight” turn (a pair of clockwise and anti-clockwise rotation). The periods were follows;
   i) 04:30 - 04:56UTC 17 August around at 44-22N, 158-58E
   ii) 18:50 - 19:15UTC 22 August around at 57-00N, 179-52E

2. The following time, recording was stopped due to the data communication error.
   i) 04:50UTC 20 August.

(3) Cesium magnetometer

(3-1) Introduction

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.

(3-2) Data Period

05:05UTC 17 August - 21:25UTC 18 August

(3-3) Specification

We measured total geomagnetic field using a cesium marine magnetometer (Geometrics Inc., G-882) and recorded by G-882 data logger (Clovertech Co., Ver.1.0.0). The G-882 magnetometer uses an optically pumped Cesium-vapor atomic resonance system. The sensor fish towed 500 m behind the vessel to minimize the effects of the ship's magnetic field. Table 5.3.1 shows system configuration of MIRAI cesium magnetometer system.

Table 5.3.1 System configuration of MIRAI cesium magnetometer system.

Dynamic operating range:	20,000 to 100,000 nT	
Absolute accuracy:	< ±2 nT throughout range	
Setting:	Cycle rate;	0.1 sec
	Sensitivity;	0.001265 nT at a 0.1 second cycle rate
	Sampling rate;	1 sec

(3-4) Data Archive

Total magnetic force data obtained during this cruise was submitted to the Data Management Group (DMG) of JAMSTEC, and archived there.