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R/V Shinsei Maru "Cruise Report"

KS-17-J08C

Researches on marine ecosystem dynamics in the Tsunami affected area off Sanriku

Off Sanriku

May 28, 2017 – June 15, 2017

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

Project: Analyses of Changes in East Japan Marine Ecosystems,
Tohoku Ecosystem-Associated Marine Sciences (TEAMS)

Contents

1. Cruise Information

1.1 General Information

(1) Cruise ID KS-17-J08C

(2) Name of vessel R/V Shinsei Maru

(3) Title of the cruise Researches on marine ecosystem dynamics in the Tsunami affected area off Sanriku

(4) Title of proposal

Cruise Proposal Researches on marine ecosystem dynamics in the Tsunami affected area off Sanriku

Project Analyses of Changes in East Japan Marine Ecosystems, Tohoku Ecosystem-Associated Marine Sciences (TEAMS)

(5) Cruise period May 28, 2017 ~ June 15, 2017

(6) Ports of departure / call / arrival

Port of departure: Yokosuka (May 28, 2017)

Port of call: Ishinomaki (June 5,2017 ~ June 7, 2017)

Port of arrival: Yokosuka (June 15, 2017)

1.2 Research Area

(1) Research area Off Sanriku

Research area surrounded by two latitude longitude lines, 38º00’N and 39º30’N, and two longitude lines,141º15’E and 144º00’E, without land.

(2) Cruise Track

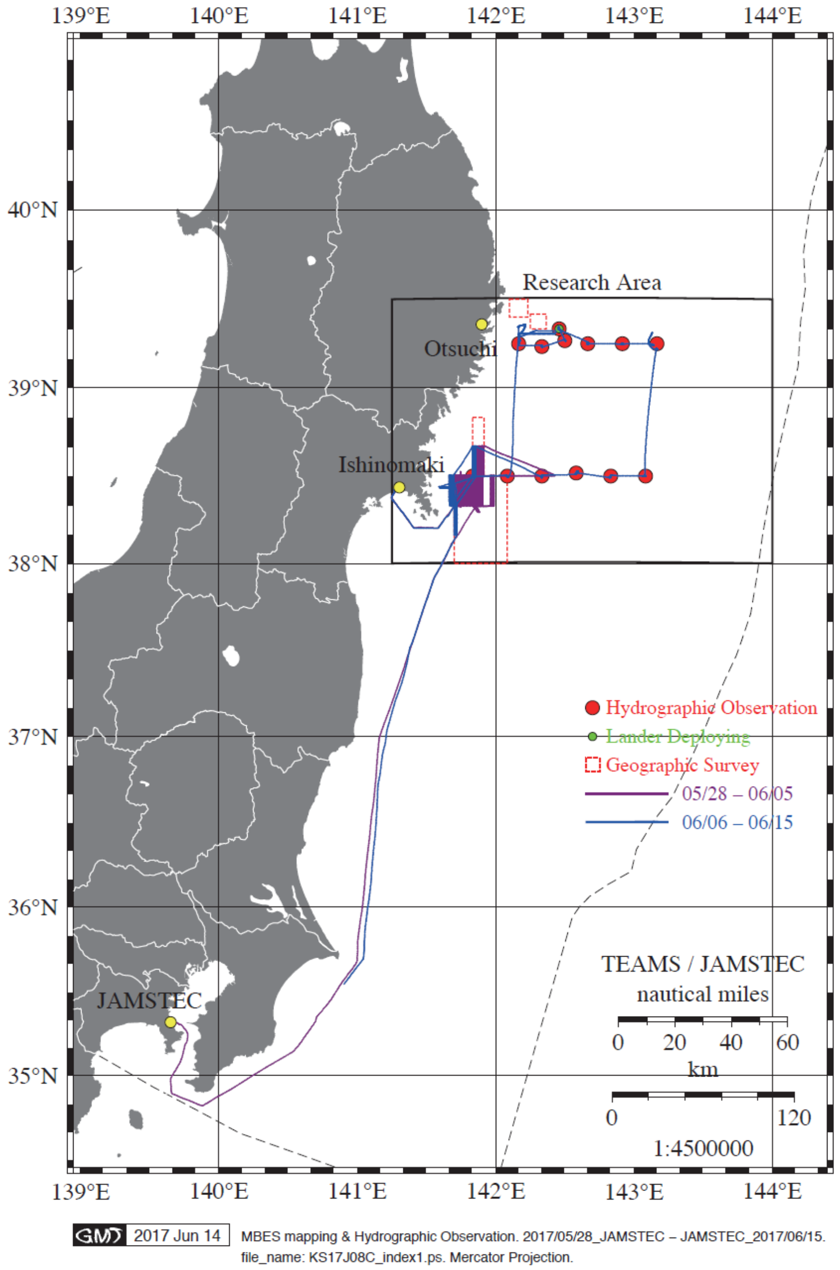

Fig. 1.2-1 Cruise Track of R/V Shinsei−Maru, KS−17−J08C, from 28th May, 2017 to 15th June.

1.3 Cruise Log

KS-17-J08C Shipboard Log: Date Time Log			Position/Weather/ Wind/Sea condition (at Noon)
Date	**Time(UTC)**	**Description**	
28May17	**Leave YOKOSUKA for research area**		
	9:00	Scietists embarked on SHINSEIMARU	35-38.9N, 139-44.4E Off TSURUGISAKI / Fine but cloudy / North-3 (Gentle breeze) / 2 (Sea Smooth), 1 (Low Swell Short), Visibly: 8'
	10:00	Let go all shore line, left JAMSTEC, proceeded to research area (OFF SANRIKU)	
	11:00-11:30	Carried out onboard education & training for scientists	
29May17	**Arrive at Research area, and start to MBES mapping survey**		
	7:40	Arrived at research area (OFF ONAGAWA)	38-24.1N, 141-51.4E OFF KINKASAN / Fine but cloudy / SSW-4 (Moderate breeze) / 2 (Sea Smooth), 1 (Low Swell Short), Visibly: 8'
	7:42	Comenced to MBES mapping survey	
	8:20	Released XBT @ (38-23.8994N, 141-50.9993E)	
	19:30	Released XBT @ (38-24.4270N, 141-57.7963E)	
30May17	**Carry out MBES mapping survey**		
	8:42	Released XBT @ (38-23.6870N, 141-52.3969E)	38-26.0N, 141-52.8E OFF KINKASAN / Fine but cloudy / SSW-4 (Moderate breeze) / 2 (Sea Smooth), 2 (Low Swell Long), Visibly: 6'
31May17	**Carry out MBES mapping survey**		
	9:39	Released XBT @ (38-26.7516N,141-50.2043E)	38-26.8N, 141-50.0E OFF KINKASAN / Fine but cloudy / South-3 (Gentle breeze) / 1 (Sea Calm), 1 (Low Swell Short), Visibly: 4'

01Jun17	**Carry out MBES mapping survey**		
	9:57	Released XBT @ (38-26.7516N,141-50.2043E)	38-23.2N, 141-47.2E OFF KINKASAN / Fog / SE-4 (Moderate breeze) / 2 (Sea Smooth), 1 (Low Swell Short), Visibly: 2'
02Jun17	**Carry out MBES mapping survey**		
	8:15	Suspended MBES mapping survey due to large swell	38-23.3N, 141-49.9E OFF KINKASAN / Fog / North-4 (Moderate breeze) / 2 (Sea Smooth), 4 (Moderate Average), Visibly: 1'
	14:15	Resumed MBES mapping survey	
	18:05	Released XBT @ (38-27.6296N, 141-44.6138E)	
03Jun17	**Carry out MBES mapping survey**		
	10:25	Released XBT @ (38-25.4869N, 141-42.8005E)	38-25.5N, 141-42.6E OFF KINKASAN / Cloudy / West-5 (Fresh breeze) / 3 (Sea Slight), 3 (Moderate Short), Visibly: 8'
	18:16	Finished MBES mapping survey	
	18:54-23:29	Carried out SBP survey	
04Jun17	**Carry out MBES mapping survey**		
	2:23	Comenced to MBES mapping survey	38-30.0N, 141-53.8E OFF KINKASAN / Fine but cloudy / NW-5 (Fresh breeze) / 2 (Sea Smooth), 2 (Low Swell Long), Visibly: 8'
	10:35	Released XBT @ (38-38.0336N,141-54.0003E)	
05Jun17	**Arrive at ISHINOMAKI-KO**		
	8:03	Released XBT @ (38-35.9501N, 141-51.5958E)	38-15.3N, 141-21.5E ISHINOMAKI Bay / Fine but cloudy / NW-4 (Moderate breeze) / 2 (Sea Smooth), 1 (Low Swell Short), Visibly: 8'
	9:03	Finished MBES mapping survey	
	9:10	Left research area for ISHINOMAKI-KO	
	14:00	Arrived at ISHINOMAKI	
	16:00	scientists disembarked SHINSEIMARU	

06Jun17	**Ported in ISHINOMAKI-KO**		
	8:30	Scietists embarked on SHINSEIMARU	38-25.2N, 141-16.1E ISHINOMAKI Bay / Fine but cloudy / SSE-3 (Gentle breeze) / 1 (Rippled Calm), 0 (No Swell), Visibly: 8'
	08:50-09:30	Load "Lander" onto SHINSEIMARU	
07Jun17	**Leave ISHINOMAKI-KO for research area**		
	9:00	left ISHINOMAKI-KO, proceeded to research area (OFF KINKASAN)	38-18.6'N, 141-41.2'E OFF KINKASAN / Cloudy / SSW-3 (Gentle breeze) / 1 (Rippled Calm), 1 (Low Swell Short), Visibly: 8'
	10:00-10:35	Onboard education & training for scientists	
	13:00	Arrived at research area (OFF KINKASAN)	
	13:15-13:27	NORPAC-NET@D-3 (D = 200m, w.o. = 179m)	
	13:35-14:09	FRRF@D-3 (D = 200m, w.o. = 180m)	
	14:29-15:14	CTD@D-3 (D = 200m, w.o. = 189m)	
	16:25-16:40	NORPAC-NET@D-4 (D = 480m, w.o. = 300m)	
	16:48-17:26	FRRF@D-4 (D = 480m, w.o. = 200m)	
	17:53-19:03	CTD@D-4 (D = 480m, w.o. = 486m)	
	19:30	Sift to OFF OTSUCHI	
08Jun17	**Hydrographic observation**		
	0:15	Arrived at research area (OFF OTSUCHI)	39-18.4'N, 142-17.4'E OFF OTSUCHI / Overcast / South-5 (Fresh breeze) / 3 (Slight), 2 (Low Swell Long), Visibly: 6'
	08:56-15:52	Search for Bio-Tracking System	
	15:53-16:12	NORPAC-NET@O-1 (D = 350m, w.o. = 300m)	
	16:15-16:52	FRRF@O-1 (D = 350m, w.o. = 200m)	
	17:18-18:24	CTD@O-1 (D = 350m, w.o.= 349m)	
	19:35-19:57	NORPAC-NET@O-2 (D = 830m, w.o. = 300m)	
	20:01-20:37	FRRF@O-2 (D = 830m, w.o. = 200m)	
	20:54-22:16	CTD@O-2 (D = 830m, w.o. = 841m)	
	23:30-23:46	NORPAC-NET@O-3 (D = 1,100m, w.o. = 300m)	
	23:50-24:26	FRRF@O-3 (D = 1,100m, w.o. = 200m)	

09Jun17	**Hydrographic observation, Lander deploy**		
	00:44-02:14	CTD@O-3 (D = 1,100m, w.o. = 1,119m)	39-15.0'N, 142-40.0'E OFF OTSUCHI / Overcast / SW-5 (Fresh breeze) / 4 (Moderate), 3 (Moderate Short), Visibly: 8'
	03:02-03:18	NORPAC-NET@R-2 (D = 1,000m, w.o. = 300m)	
	03:22-03:35	FRRF@R-2 (D = 1,000m, w.o. = 200m)	
	6:00	Deployment "Lander"@R-2	
	06:19-06:43	Calibration for "Lander" position	
	07:07-09:04	CTD@R-2 (D = 1,000m, w.o. = 1,119m)	
	10:17-10:31	NORPAC-NET@O-4 (D = 1,470m, w.o. = 300m)	
	10:40-11:11	FRRF@O-4 (D = 1,470m, w.o. = 200m)	
	11:27-13:15	CTD@O-4 (D = 1,470m, w.o. = ???m)	
	14:27-14:42	NORPAC-NET@O-5 (D = 1,760m, w.o. = 300m)	
	14:46-15:01	FRRF@O-5 (D = 1,760m, w.o. = 200m)	
	15:34-17:33	CTD@O-5 (D = 1,760m, w.o. = ???m)	
	20:35-20:50	NORPAC-NET@O-6 (D = 1,930m, w.o. = 300m)	
	20:53-21:30	FRRF@O-6 (D = 1,930m, w.o. = 200m)	
	21:43-23:50	CTD@O-6 (D = 1,930m, w.o. = ???m)	
10Jun17	**Hydrographic observation**		
	0:00	Shift to "D-8"	38-30.0'N, 142-54.4'E OFF ONAGAWA / Fog / SSW-4 (Moderate breeze) / 2 (Smooth), 1 (Low Swell Short), Visibly: 0.1'
	4:00	Arivved at "D-8"	
	07:54-08:18	NORPAC-NET@D-8 (D = 2,150m, w.o. = 300m)	
	08:11-08:46	FRRF@D-8 (D = 2,150m, w.o. = 200m)	
	08:57-11:05	CTD@D-8 (D = 2,150m, w.o. = ???m)	
	12:23-12:37	NORPAC-NET@D-7 (D = 1,510m, w.o. = 300m)	
	12:40-13:18	FRRF@D-7 (D = 1,510m, w.o. = 200m)	
	13:35	Launced CTD@D-7	
	14:15	Suspended CTD operation due to rough sea	
	14:45	Recovered CTD	
	17:56-19:45	CTD@D-7 (D = 1,510m, w.o. = 1,524m)	
	21:04-21:20	NORPAC-NET@D-6 (D = 1,300m, w.o. = 300m)	
	21:36-22:13	FRRF@D-6 (D = 1,300m, w.o. = 200m)	

11Jun17	**Hydrographic observation & MBES mapping survey**		
	00:48-02:19	CTD@D-6 (D = 1,300m, w.o. = 1,298m)	38-34.3'N, 141-51.2'E OFF ONAGAWA / Fine but cloudy / South-3 (Gentle breeze) / 2 (Smooth), 1 (Low Swell Short), Visibly: 8'
	03:42-03:58	NORPAC-NET@D-5 (D = 830m, w.o. = 300m)	
	04:01-04:37	FRRF@D-5 (D = 830m, w.o. = 200m)	
	04:38-05:08	Calibration for flow meter of NORPAC-NET	
	05:32-06:55	CTD@D-5 (D = 830m, w.o. = 833m)	
	9:31	Commenced MBES mapping survey off ONAGAWA	
	13:43	Released XBT @ (38-35.9414'N, 141-51.0008'E)	
12Jun17	**MBES mapping survey**		
	9:59	Released XBT @ (38-22.7060'N, 141-40.8101'E)	38-26.0'N, 141-40.6'E OFF ONAGAWA / Cloudy / NE-2 (Light breeze) / 1 (Rippled calm), 0 (No Swell), Visibly: 8'
13Jun17	**MBES mapping survey**		
	9:25	Released XBT @ (38-26.1990'N, 141-37.8157'E)	38-27.7'N, 141-41.1'E OFF ONAGAWA / Fine but cloudy / SSE-3 (Gentle breeze) / 3 (Slight), 1 (Low Swell Short), Visibly: 8'
	18:59	Finished MBES mapping survey	
	19:00	Left research area for JAMSTEC	
14Jun17	**To JAMSTEC**		
	16:50	Anchor in 24m of wataer at TATEYAMA-Wan	35-05.4'N, 140-28.6'E OFF KATSUURA / Overcast / SW-6 (Strong breeze) / 4 (Moderate), 3 (Moderate Short), Visibly: 5'
15Jun17	**Arrive at ISHINOMAKI-KO**		
	6:30	Weigh anchor, left TATEYAMA-Wan for JAMSTEC	
	9:00	Arrived at JAMSTEC	
	12:00	Scientists disembarked SHINSEIMARU	

2. Researchers

(1) Chief scientist

Shuichi Watanabe

Project Team for Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC

(2) Representative of the science party

Chief Scientist of Cruise Proposal

Shinji Tsuchida

Project Team for Analyses of Changes in East Japan Marine Ecosystems, Tohoku Ecosystem-Associated Marine Sciences

Project

Team for Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC

Project Leader

Katsunori Fujikura

Director, Project Team for Analyses of Changes in East Japan Marine Ecosystems, Tohoku Ecosystem-Associated Marine Sciences

(3) Science party

Scientists and Technicians on board

May 28, 2017 ~ June 15, 2017

Shuichi WATANABE (Project Team for Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC)

May 28, 2017 ~ June 5, 2017

Hiroshi MATSUNAGA (Marine Works Japan)
Somomi MINAMIZAWA (Nippon Marine Enterprises, LTD.)
Wataru TOKUNAGA (Nippon Marine Enterprises, LTD.)

June 5, 2017 ~ June 15, 2017

Kazumasa OGURI (Project Team for Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC)

June 6, 2017 ~ June 15, 2017

Shinsuke TOYODA (Marine Works Japan)
Yasuhiro ARII (Marine Works Japan)
Akira WATANABE (Marine Works Japan)
Misato KUWAHARA (Marine Works Japan)

Masahiro ORUI	(Marine Works Japan)
Emi DEGUCHI	(Marine Works Japan)
Toru KODERA	(Nippon Marine Enterprises, LTD.)

Scientists on land

Takafumi KASAYA	(Project Team for Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC)
Masahide WAKITA	(Project Team for Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC)

and

Members of Project Team for Analyses of Changes in East Japan Marine Ecosystems, Tohoku Ecosystem-Associated Marine Sciences

(4) “Shinsei-Maru” Crew member

May 28, 2017 ~ June 15, 2017

Shinya RYONO	Captain
Takeshi EGASHIRA	Chief Officer
Tetsuo SHIRAYAMA	2nd Officer
Hiroya MURE	3rd Officer
Tadashi ABE	Chied Engineer
Wataru KUROSE	1st Engineer
Naohito TADOOKA	2nd Engineer
Tokinori NASU	Chief Electronics Operator
Shunsuke FUKAGAWA	2nd Electronics Operator
Hideo ISOBE	Boat Swain
Katsuhiko SATO	Able Seaman
Yukio ISHII	Able Seaman
Nao ISHIZUKA	Able Seaman
Shinya UENO	Able Seaman
Tatsunori TAKAHASHI	Sailor
Kyohei MURAI	Sailor
Toshikazu IKEDA	No.1 Oiler
Katsuyuki MIYAZAKI	Oiler
Masayuki FUJIWARA	Oiler
Kota AIZAWA	Oiler
Shotaro SUMITOMO	Assistant Oiler

	Katsuyuki OMIYA	Chief Steward
	Yukihide CHIKUBA	Steward
May 28, 2017 ~ June 5, 2017		
	Takamasa Ochiai	3rd Engineer
	Kazuki Ono	Additional Crew
	Hiroyuki OBA	Steward
June 5, 2017 ~ June 15, 2017		
	Kazuki Ono	3rd Engineer
	Toru MURAKAMI	Steward

3. Observation

3.1. Overview

The project of Tohoku Ecosystem-Associated Marine Sciences (TEAMS) aims to investigate marine ecosystems that were drastically changed by the disaster, to understand the process of recover from the damages of the Great East Japan Earthquake, and to help the reconstruction and sustainable development of fisheries. For achieving that projects objectives, the roles of our unit, Research Unit for Ecosystem Monitoring, is to research the basic hydrographic structure and the long-term change of marine environments, to conduct the geographical survey, and so on.

In this cruise, we conducted the geographic survey off Onagawa in which area was not covered with previous cruises, for creating a detailed bathymetric map of the Sanriku coast after the earthquake and tsunami. We also conducted the hydrographic observation using CTD-system to obtain the information of hydrographic structure at 13 stations and to collect seawater samples for analyzing biological and chemical components. Lander was deployed at about 1,000m depth off Otsuchi to conducting long-term monitoring of marine environments near the seafloor.

3.2. List of the observations and activities

(1) Bathymetric survey by Multi-narrow Beam Echo Sounding system (MBES) and SeaBeam equipped on-board.
(2) Sub-bottom structure with the Sub-Bottom Profiler (SBP) system equipped on-board.
(3) CTD casts and water sampling for biogeochemical analysis.
(4) Continuous surface hydrographic observation using CT-DO system equipped on-board and fast repetition rate fluorometer FRRF.
(5) Assessment of phytoplankton photosynthesis by fast repetition rate fluorometer (FRRF).
(6) Zooplankton collecting using NORPAC net.
(7) Survey of zooplankton distribution with quantitative echo sounder equipped on-board.
(8) Deploying Lander in 1,000m depth off Otsuchi.

3.3. Shipboard observation and survey

3.3.1 Continuous surface hydrographic observation

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)
Toru KODERA (Nippon Marine Enterprises, LTD.)
Somomi MINAMIZAWA (Nippon Marine Enterprises, LTD.)
Wataru TOKUNAGA (Nippon Marine Enterprises, LTD.)
Shinsuke TOYODA (Marine Works Japan)
MATSUNAGA (Marine Works Japan)

(1)Objects

Temperature, salinity and of the surface seawater were measured continuously to understand the environment on the cruise track.

(2)Equipment

Continuous measurement system on the Shinsei-maru was used.

(3)Preliminary Results

The results of TS distribution on the cruise track were shown in Figure 3.3.3-1.

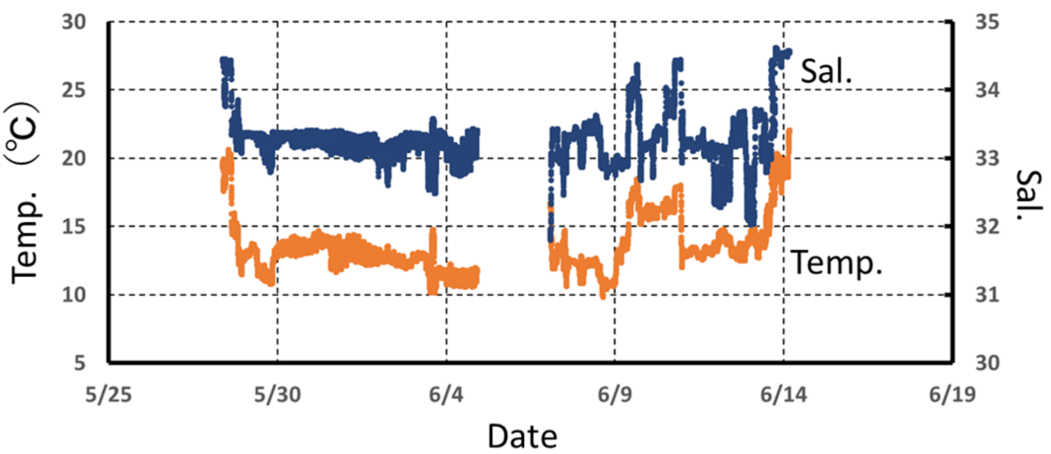

Figure 3.3.1-1. TS distribution on the cruise track.

3.3.2 Bathymetric survey

Takafumi KASAYA (JAMSTEC)
Toru KODERA (Nippon Marine Enterprises, LTD.)
Somomi MINAMIZAWA (Nippon Marine Enterprises, LTD.)
Wataru TOKUNAGA (Nippon Marine Enterprises, LTD.)

(1) Objects

The objective of MBES survey is collecting continuous bathymetric data as basic seafloor condition off Tohoku datasets.

(2) Equipment

Bathymetric data, sub-bottom imaging and water sound velocity measurements were conducted using following facilities.

Multibeam echo-sounder system (SeaBat7125SV2. TELEDYNE RESON Inc.)

Specification

Frequency:	200kHz or 400kHz
Number of Beam:	512 beams(@400kHz), 256 beam(@200kHz)
Width of Beam:	0.5×1.0°(@400kHz) 1.0×2.0°(@200kHz)
Swath width:	128°(45°~165°)
Depth range:	0.5~450m
Depth Resolution:	6mm
Transmission wave:	CW
Pulse length:	33~300μs

Multibeam echo-sounder system (SeaBeam 3020. ELAC Nautik Inc.)

Specification

Frequency:	20kHz
Number of Beam:	301 beams
Width of Beam:	1.0×1.0°
Swath width:	~150°
Depth range:	50~11000m
Depth Resolution:	8cm
Transmission wave:	CW
Pulse length:	1, 2, 3, 5, 7, 10, 14, 20 ms

Parametric sub-bottom profiler (TOPAS PS18, Kongsberg Maritime, Inc.)

Specification

Primary frequency:	15 - 21kHz
Second frequency:	0.5 - 6.0kHz
Output power:	>32kW
Beam width Primary:	~3.5°
Beam width Secondary:	~4.5°
Source level(4kHz):	>204dB//uPa@lm
Range resolution:	<0.3m
Penetration capability:	>200m
Depth range:	<2 - >10,000m

Beam steering sector across/along: 80°20°

Expendable Bathythermograph (XBT)

Specification

XBT probe TSK T-10 (Tsurumi Seiki Co. Ltd.)

Max depth 300 m

Available Ship speed 10 kt

Measure Time 48 second

Sampling interval:	50 msec
Detectable Temperature:	-2.22~35.55 deg. C
Temperature accuracy:	±0.2 deg. C
Depth accuracy:	5 m or 2% of depth

XBT probe TSK T-6

Max depth 460 m

Available Ship speed 15 kt

Measure Time 73 second

Sampling interval:	50 msec
Detectable Temperature:	-2.22~35.55 deg. C
Temperature accuracy:	±0.2 deg. C
Depth accuracy:	5 m or 2% of depth

XBT probe TSK T-7

Max depth 760 m

Available Ship speed 15 kt

Measure Time 123 second	
Sampling interval:	50 msec
Detectable Temperature:	-2.22~35.55 deg. C
Temperature accuracy:	±0.2 deg. C
Depth accuracy:	5 m or 2% of depth

(3) Result

As a hull-mounted multi-narrow beam echo sounder, a “SeaBeam 3020” and “SEABAT 7125” were equipped on the R/V Shinsei-maru. To get the accurate sound velocity of water column for ray-path correction of acoustic multi-beam signal, we used the deeper depth sound velocity profiles that were calculated from temperature and fixed salinity (34.5psu) profiles from XBT data by the equation in Mackenzie (1981) during the cruise, which were obtained in the point listed in Table 3.3.2-1.

Bathymetric and SBP survey during this cruise was conducted in the area shown in the Fig. 3.3.2-1 and 3.3.2-2, respectively.

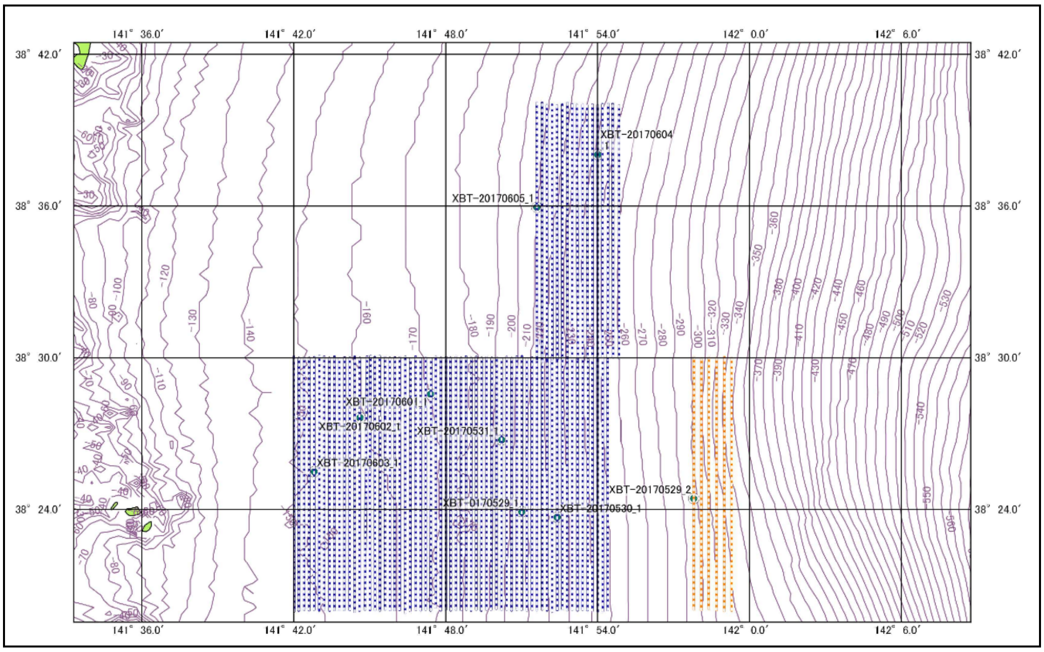

Fig. 3.3.2-1 MBES survey lines off the Onagawa Bay (Blue lines were “SEABAT”and Orange lines were “Seabeam”) .

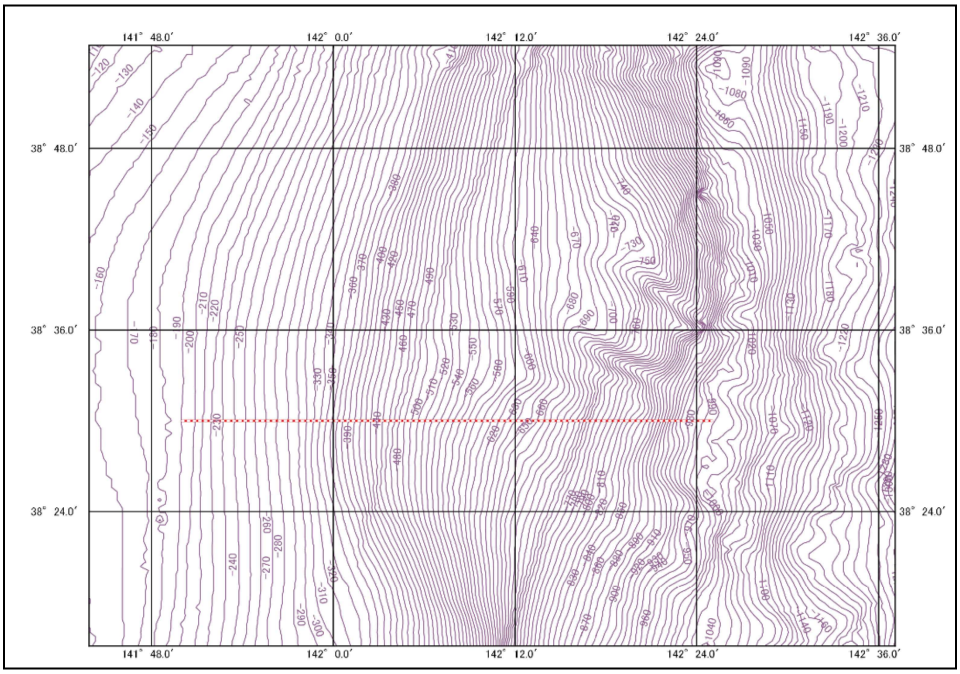

Fig. 3.3.2-2 SBP survey lines off the Onagawa Bay .

Table 3.3.2-1 XBP measurement point list

Date	Time(JST)	Latitude	Longitude	Prove Type
2017/5/29	8:20:46	38-23.8994N	141-50.9993E	T-10
2017/5/29	19:30:00	38-24.4270N	141-57.7963E	T-6
2017/5/30	8:42:25	38-23.6870N	141-52.3969E	T-10
2017/5/31	9:39:22	38-26.7516N	141-50.2043E	T-10
2017/6/1	9:57:46	38-28.5579N	141-47.3974E	T-6
2017/6/2	18:05:19	38-27.6296N	141-44.6138E	T-6
2017/6/3	10:25:10	38-25.4869N	141-42.8005E	T-6
2017/6/4	10:35:42	38-38.0336N	141-54.0003E	T-7
2017/6/5	8:03:26	38-35.9501N	141-51.5958E	T-7
2017/6/11	13:43:40	38-35.941N	141-51.001E	T-7
2017/6/12	9:59:54	38-22.706N	141-40.810E	T-7
2017/6/13	9:25:07	38-26.199N	141-37.816E	T-7

3.4. Hydrographic observations

3.4.1. CTD observation and water sampling

Shuichi WATANABE	(JAMSTEC)
Masahide WAKITA	(JAMSTEC)
Shinsuke TOYODA	(Marine Works Japan)
Yasuhiro ARII	(Marine Works Japan)
Akira WATANABE	(Marine Works Japan)
Misato KUWAHARA	(Marine Works Japan)
Masahiro ORUI	(Marine Works Japan)
Emi DEGUCHI	(Marine Works Japan)

(1) Objective

Investigation of oceanic structure and water sampling.

(2) Parameters of CTD system measurement

Temperature
Conductivity
Pressure
Dissolved Oxygen
Dissolved Oxygen voltage
Transmission % and beam attenuation coefficient and voltage
Fluorescence
Formazin turbidity unit
Photosynthetically Active Radiation
Altimeter

(3) Instruments

CTD system

(On deck)

Deck unit: SBE11plus (S/N 11-0956, Sea-Bird Electronics, Inc.)

(Under water)

Under water unit: SBE9plus (S/N 09P71874-1133, Sea-Bird Electronics, Inc.)

Carousel water sampler: 24-position SBE32 Carousel Water Sampler
(S/N 3271874-0929, Sea-Bird Electronics, Inc.)

Water sampler: 12-litters water sampler, 24 bottles
(O.T.E. Standard Water Sampler Model 110, Sea-Bird Electronics, Inc.)

Altimeter: Benthos PSA-916T (S/N 58905, Teledyne Benthos, Inc.)

(sensors)

Pressure sensor: Digiquartz pressure sensor (S/N 127419, Sea-Bird Electronics, Inc.) Calibrated Date: 24 Jan 2013

Temperature sensors: SBE03plus (S/N 03P5760, Sea-Bird Electronics, Inc.)
Calibrated Date: 10 Jan. 2017

Conductivity sensors: SBE04C (S/N 044205, Sea-Bird Electronics, Inc.)
Calibrated Date: 10 Jan. 2017

Dissolved Oxygen sensor: SBE43 (S/N 432525, Sea-Bird Electronics, Inc.)
Calibrated Date: 07 Jan. 2017

Transmissonmeter: C-Star (S/N CST-1590DR, WET Labs, Inc.)
Calibrated Date: 24 Jan. 2013

Fluorescence: Chlorophyll Fluorometer (S/N 3569, Seapoint Sensors, Inc.)

Turbidity: Turbidity meter (S/N 13371, Seapoint Sensors, Inc.)

Biospherical PAR Light sensor:
QSP-2300 (S/N 70482, Biospherical Instruments Inc.)
Calibrated Date: 24 Jan. 2013

Biospherical Surface PAR Light sensor:
QSR-2200 (S/N 20443, Biospherical Instruments Inc.)
Calibrated Date: 24 Jan. 2013

Submersible Pump
SBE5T(S/N 056957, Sea-Bird Electronics, Inc.)

Bottom contact swich (Sea-Bird Electronics, Inc.)

(3) Methods

CTD/ Carousel Water Sampler was deployed from starboard on working deck.

The CTD raw data were acquired on real time using the Seasave-Win32 (ver.7.21f) provided by Sea-Bird Electronics, Inc. and stored on the hard disk of the personal computer. Seawater was sampled during the up cast by sending fire commands from the personal computer. We stayed for 1 minute at above 900 m layers before fire command to stabilize CTD. At deeper layer, we stayed for 30 seconds. 14 casts of CTD measurements were conducted (Table 3.4.1-1).

Used utilities of SBE Data Processing-Win32 (ver.7.21i) and SEASOFT, and data processing procedures were as follows:

(The process in order)

DATCNV: Convert the binary raw data to engineering unit data. DATCNV also extracts bottle information where scans were marked with the bottle confirm bit during acquisition. The duration was set to 2.0 seconds, and the offset was set to 0.0 seconds.

WILDEDIT: Mark extreme outliers in the data files. The first pass of WILDEDIT obtained an accurate estimate of the true standard deviation of the data. The data were read in blocks of 100 scans. Data greater than 2 standard deviations were flagged. The second pass computed a standard deviation over the same 100 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to pressure, depth, temperature and conductivity.

FILTER: Perform a low pass filter on pressure and depth with a time constant of 0.15 second. In order to produce zero phase lag (no time shift) the filter runs forward first then backward

WFILTER: Perform a median filter to remove spikes in the fluorescence, transmission, turbidity, PAR and Surface PAR data. A median value was determined by 49 scans of the window.

ALIGNCTD: Convert the time-sequence of sensor outputs into the pressure sequence to ensure that all calculations were made using measurements from the same parcel of water. Dissolved oxygen data are systematically delayed with respect to depth mainly because of the long time constant of the dissolved oxygen sensor and of an additional delay from the transit time of water in the pumped pluming line. This delay was compensated by 5.0 seconds advancing dissolved oxygen sensor (SBE43) output (dissolved oxygen voltage) relative to the temperature data.

CELLTM: Remove conductivity cell thermal mass effects from the measured conductivity. Typical values used were thermal anomaly amplitude alpha = 0.03 and the time constant 1/beta = 7.0.

LOOPEDIT: Mark scans where the CTD was moving less than the minimum velocity of 0.0 m/s (traveling backwards due to ship roll).

DERIVE: Compute the Practical Salinity, potential temperature and sigma-theta.

BINAVG: Average the data into 1-dbar pressure bins.

BOTTLESUM: Create a summary of the bottle data. The data were averaged over 3.0 seconds.

Configuration file: 9p-1133_KS-17-J08 C.xmlcon

9p-1133_KS-17-J08C_A.xmlcon (without a PAR sensor: StnO-6, D-8)

(4) Preliminary Results

During this cruise, 14 casts of CTD observation were carried out. Date, time and locations of the CTD casts are listed in Table 3.1-1. Stn.D-7 cast1, data was only profile data, because of rough sea state.

(5) Data archive

These data obtained in this cruise will be submitted to the Data Management Group and the Research Unit for Ecosystem Model and the Data Management, Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC. These will be opened on “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” (http://www.godac.jamstec.go.jp/darwin/e) and on the Research Information and data Access Site of TEAMS (RIAS, http://www.i-teams.jp/catalog/rias/e/index.html).

Table 3.4.1-1 KS-17-J08C CTD cast table

Stnnbr	Castno	Date(UTC)	Time(UTC)		BottomPosition		Depth	Wire	HT Above	Max	Max	CTD	Remark
		(mmddyy)	Start	End	Latitude	Longitude		Out	Bottom	Depth	Pressure	Filename	
D-3	1	060717	05:39	06:09	38-29.99N	141-50.13E	199.1	189.0	9.2	189.5	191.0	D3_1	
D-4	1	060717	09:05	09:56	38-30.02N	142-04.86E	494.7	486.0	9.2	473.9	478.0	D4_1	
O-1	1	060817	08:30	09:16	39-15.11N	142-09.99E	358.6	349.0	7.8	345.1	348.0	O1_1	
O-2	1	060817	12:02	13:11	39-14.03N	142-20.06E	851.7	841.0	8.7	826.0	834.0	O2_1	
O-3	1	060817	15:52	17:08	39-16.11N	142-30.08E	1113.9	1118.0	8.8	1102.6	1114.0	O3_1	
R-2	1	060817	22:20	23:58	39-19.94N	142-27.67E	997.1	1000.0	9.9	984.1	994.0	R2_1	
O-4	1	060917	02:36	04:08	39-14.99N	142-39.97E	1468.5	1494.0	8.6	1456.7	1473.0	O4_1	
O-5	1	060917	06:42	08:26	39-15.00N	142-55.02E	1766.3	1789.0	8.5	1755.0	1776.0	O5_1	
O-6	1	060917	12:52	14:44	39-13.13N	143-10.01E	2109.1	2145.0	8.7	2108.0	2135.0	O6_1	
D-8	1	061017	00:07	01:57	38-30.05N	143-04.98E	2088.9	2171.0	8.0	2135.7	2163.0	D8_1	
D-7	1	061017	04:43	05:39	38-29.94N	142-49.98E	1555.5	1527.0	9.1	1497.2	1514.0	D7_1	no smplimg water
D-7	2	061017	09:06	10:38	38-29.94N	142-49.99E	1504.9	1524.0	7.6	1498.2	1515.0	D7_2	
D-6	1	061017	15:56	17:14	38-31.37N	142-35.34E	1287.4	1298.0	10.1	1278.3	1292.0	D6_1	
D-5	1	061017	20:44	21:49	38-30.10N	142-20.11E	828.8	833.0	9.3	820.1	828.0	D5_1	

3.4.2. Determination of salinity in seawater

Shuichi WATANABE	(JAMSTEC)
Masahide WAKITA	(JAMSTEC)
Shinsuke TOYODA	(Marine Works Japan)
Akira WATANABE	(Marine Works Japan)

(1) Objective

To measure bottle salinity obtained by CTD casts.

(2) Sampling on board

Seawater samples were collected with 12 liter water sampler attached CTD system and bucket. The salinity sample bottles of the 250ml brown grass bottles with screw caps were used for collecting the sample water. Each glass bottle was rinsed three times with the sample water and filled up with sample water to the bottle shoulder. The salinity sample bottles were sealed with plastic inner caps and screw caps because we took into consideration the possibility of storage for about a month. These caps were rinsed three times with the sample water before use. The bottle will be kept on the laboratory for less than 1 month before the salinity measurement. The number of samples is total of ~200 for CTD casts.

(3) Data Archive

The salinity will be measured as soon as possible after this cruise. All measured data will be submitted to JAMSTEC Data Management Office (DMO).

3.4.3. Determination of dissolved oxygen in seawater

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)
Misato KUWAHARA (Marine Works Japan)
Emi DEGUCHI (Marine Works Japan)

(1) Objectives

Determination of dissolved oxygen in seawater by Winkler titration.

(2) Parameter

Dissolved Oxygen（unit : μmol・kg -1）

(3) Sampling on board

Following procedure is based on an analytical method, entitled by "Determination of dissolved oxygen in sea water by Winkler titration", in the WHP Operations and Methods (Dickson, 1996).

(3-1) Reagents

Pickling Reagent I: Manganese chloride solution (3 mol dm^{-3})
Manganese chloride: Kanto Chemical Co.,Inc.

Pickling Reagent II: Sodium hydroxide (8 mol dm^{-3}) and sodium iodide (4 mol m^{-3}) mixture solution
Sodium hydroxide: Wako Pure Chemical Industries, Ltd.
Sodium iodide: Wako Pure Chemical Industries, Ltd.

Sulfuric acid solution (5 mol dm^{-3})
Sulfuric acid: Wako Pure Chemical Industries, Ltd.

Sodium thiosulfate solution (0.15 mol dm^{-3})
Sodium thiosulfate: Kanto Chemical Co.Inc.

Potassium iodate solution (0.001667 mol dm^{-3})
Potassium iodate: National Institute of Advanced Industrial Science and Technology

(3-2) Instruments

Semi-automatic titrator was composed as follow.

Burette for sodium thiosulfate and potassium iodate;

EBU-610 / APB-620 manufactured by Kyoto Electronic Co. Ltd. with 10 cm3 of titration vessel

Detector;

Automatic photometric titrator (DOT-05) manufactured by Kimoto Electronic Co. Ltd.

(3-3) Sampling

Seawater was collected with CTD water sampler bottle attached to the CTD-system sampler at each depth. Seawater for oxygen measurement was transferred from sampler to a volume calibrated flask (ca. 100 cm^3). The flask was filled smoothly minimizing turbulence and avoiding aeration, from the bottom using a tube which extends from the CTD water sampler bottle drain to the bottom of the glass sample bottle. Seawater was overflowed about three times volume of the flask. Temperature was measured by the digital thermometer during the overflowing. Two reagent solutions (Reagent I and II) of each 1 cm^3 volumes were added immediately into the sample flask. The stopper was then inserted carefully into the flask and the sample flask was shaken vigorously to mix the contents and to disperse the precipitate finely throughout. After the precipitate has settled at least halfway down the flask, the flask was shaken again vigorously to disperse the precipitate. The sample flask containing pickled samples was kept in a laboratory at least two hours.

(3-4) Procedure of Dissolved Oxygen Determination on Board

●Standardization of the sodium thiosulfate solution

A standard of potassium iodate solution was prepared at the laboratory in land. This concentration is listed in Table 3.4.2.-1. Preparation procedure in the laboratory was that 1.7835 g pure potassium iodate dried in an oven at 130 ºC and weighed out accurately was dissolved in deionized water and diluted to final volume of 5 dm^3 in a calibrated volumetric flask.

Ten cm^3 of the standard was placed in a clean flask using a volume-calibrated dispenser. Then 90 cm^3 of deionized water, 1 cm^3 of sulfuric acid solution, and each 1 cm^3 of pickling reagent solution II and I were added into the flask in order. This mixture solution was titrated with our titrator. End Point of titration was detected with the DOT-05 and Amount of titrated volume of sodium thiosulfate was obtained. This procedure repeated at least 5 times. Concentration of titrant was calculated with averaged volume and the morality of the standard. Calculated concentration is listed in Table 3.4.2-1.

●Determination of the blank

One and 2 cm^3 of the standard potassium iodate solution were added to two flasks

respectively using a calibrated dispenser. One hundred cm^3 of deionized water was put into the flasks with a magnetic stirring bar. One cm^3 of sulfuric acid solution, and each 1 cm^3 of pickling reagent solution II and I were added in order with stirring. These mixture solutions in the flasks was titrated with our titrator.
The blank was calculated from the difference between the titers of 1 cm^3 and 2 cm^3 KIO_3 mixture solutions. The results of 3 times blank determinations were averaged.

●Dissolved Oxygen Determination of sample

Sulfuric acid solution (1 cm^3) was added into the sample and a magnetic stirrer bar was put into the flask. Sample was immediately stirred and titrated by sodium thiosulfate solution. The end point was detected with DOT-5. Temperature of sodium thiosulfate during titration was recorded by a digital thermometer. Dissolved oxygen concentration (μmol kg-1) was calculated by sample temperature during sampling, salinity of the CTD sensor, and titrated volume of sodium thiosulfate solution without the blank. Table 3.4.3-2 shows results of the standardization and the blank determination during this cruise.

Table 3.4.2-1 Concentration list of KIO_3 solutions

KIO_3 ID	Molarity
K1504G10	0.001667
K1504G07	0.001667

Table 3.4.3-2 Results of the standardization and the blank determinations during this cruise.

Date	KIO_3 ID	$Na_2S_2O_3$	DOT-05		Stations
			E.P. (cm^3)	Blank (cm^3)	
2017/06/08	K1504G10	T1505W	0.6616	0.009	D3, D4, O1, O2, O3, R2, O4, O5, O6, D8, D7, D6, D5
2017/06/12	K1504G07	T1505W	0.6604	0.010	

(3-5) Repeatability of sample measurement

Replicate samples were taken at every CTD casts. Total amount of the replicate sample pairs of good measurement was 20. The standard deviation of the replicate measurement was 0.22 μmol kg^{-1} that was calculated by a procedure in Guide to best practices for ocean CO2 measurements Chapter4 SOP23 Ver.3.0 (2007). Results of replicate samples diagram shown in Fig.3.4.3-1.

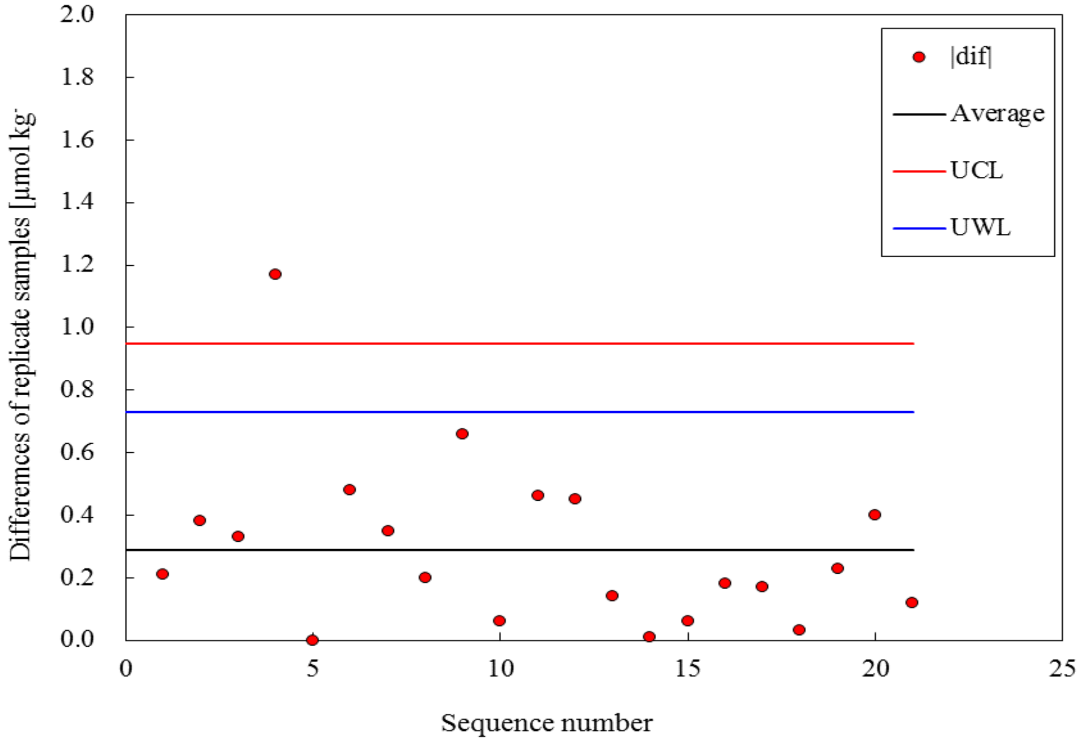

Fig.3.4.3.-1 Differences of replicate samples against sequence number

(4) Data archive

After all data will be submitted to Chief Scientist, these data will be opened on “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” (http://www.godac.jamstec.go.jp/darwin/e) and on the Information and data Access Site of TEAMS (RIAS), TEAMS (http://www.i-teams.jp/catalog/rias/e/index.html) the Research Unit for Ecosystem Model and Data Management, Analyses of Changes in East Japan Marine Ecosystems, JAMSTEC.

(5) References

Dickson, A.G., Determination of dissolved oxygen in sea water by Winkler titration. (1996)

3.4.4. Determination of nutrients in seawater

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)

Yasuhiro ARII (Marine Works Japan)

(1) Objectives

Determination of nutrients in seawater samples.

(2) Parameters

The determinants are nitrate, nitrite, silicate, phosphate and ammonia in the Sanriku.

(3) Sampling

Sample for nutrients analysis was collected from 12-litters water sampler mounted on the CTD-rosette system were transferred into four 10 ml acryl resin tubes which made in the SANPLATEC Co., Ltd.) and kept in the frozen store.

(4) Analysis

The nutrients will be analyzed using a continuous flow analytical method on land.

(5) Preliminary result

No result was obtained on board. After analysis of nutrients on the laboratory, we will obtain the distribution maps of nutrients.

(6) Data Archive

All data will be submitted to JAMSTEC Data Management Office (DMO).

(7) References

Aoyama M., J. Barwell-Clarke, S. Becker, M. Blum, Braga E. S., S. C. Coverly,E. Czobik, I. Dahllof, M. H. Dai, G. O. Donnell, C. Engelke, G. C. Gong, Gi-Hoon Hong, D. J. Hydes, M. M. Jin, H. Kasai, R. Kerouel, Y. Kiyomono, M. Knockaert, N. Kress, K. A. Krogslund, M. Kumagai, S. Leterme, Yarong Li, S. Masuda, T. Miyao, T. Moutin, A. Murata, N. Nagai, G.Nausch, M. K. Ngirchechol, A. Nybakk, H. Ogawa, J. van Ooijen, H. Ota, J. M. Pan, C. Payne, O. Pierre-Duplessix, M. Pujo-Pay, T. Raabe, K. Saito, K. Sato, C. Schmidt, M. Schuett, T. M. Shammon, J. Sun, T. Tanhua, L. White, E.M.S. Woodward, P. Worsfold, P. Yeats, T. Yoshimura, A.Youenou, J. Z. Zhang, 2008: 2006 Intercomparison Exercise for Reference Material for Nutrients in Seawater in a Seawater Matrix, Technical Reports of the Meteorological Research Institute No. 58, 104pp.

3.4.5. Determination of Chlorophyll-*a* in seawater

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)
Masahiro ORUI (Marine Works Japan)
Shinsuke TOYODA (Marine Works Japan)
Akira WATANABE (Marine Works Japan)
Yasuhiro ARII (Marine Works Japan)
Misato KUWAHARA (Marine Works Japan)
Emi DEGUCHI (Marine Works Japan)

(1) Objective

Phytoplankton biomass can estimate as the concentration of chlorophyll-*a*, because all oxygenic photosynthetic plankton contain chlorophyll *a*. The objective in this study is to investigate the vertical distribution of phytoplankton biomass through fluorometric determination.

(2) Reagents

N,N-dimethylformamide (Wako Pure Chemical Industries, Ltd.)
Chlorophyll-*a* (Sigma-Aldrich Co.)
1N Hydrochloric acid (Wako Pure Chemical Industries, Ltd.)

(3) Instruments

Turner Design Fluorometer (10-AU-005)

This fluorometer was set for “Non-acidification method” and “Acidification method” and was calibrated against a chlorophyll *a*.

Table 3.4.5-1. Setting conditions of Turner Designs Fluorometer (10-AU-005) for “Non-acidification method” and “Acidification method”.

	Non-acidification method	Acidification method
Excitation filter (nm)	436	340-500
Emission filter (nm)	680	>655
Lamp	Blue Mercury Vapor	Daylight White

(4) Sampling

Sample water for chlorophyll *a* measurement was collected from 10-12 depths between the surface and up to 300 m. About 0.25 dm^3 seawater was filled up in the dark bottle from Niskin bottle after rinsing one time.

(5) Instruments and Methods

Water sample (0.25 dm^3) for chlorophyll *a* was filtered through 25mm-diameter Whatman GF/F filter under less than 0.02 MPa. Phytoplankton pigments retained on the filters were immediately extracted in a polypropylene tube with 7 ml of N,N-dimethylformamide (Suzuki and Ishimaru, 1990). The tube was kept at –20°C under the dark condition to extract chlorophyll *a* for 24 hours or more. Fluorescence of each sample was measured by the fluorometer. We applied two methods for fluorometric determination of chlorophyll *a*: "Non-acidification method" (Welschmeyer, 1994) and "Acidification method" (Holm-Hansen et al., 1965). Analytical condition of each method was listed in table 1.

(6) Preliminary Results

The results of total chl-*a* at 2 observation lines were shown in Figure 3.4.5-1.

(7) Data archives

After all data will be submitted to Chief Scientist, these data will be opened on "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" (http://www.godac.jamstec.go.jp/darwin/e) and on the Information and data Access Site of TEAMS (RIAS, http://www.i-teams.jp/catalog/rias/e/index.html).

The processed data file of pigments will be submitted to the JAMSTEC Data Management Group (DMG) within a restricted period. Please ask PI for the latest information.

(8) Reference

Suzuki, R., and T. Ishimaru (1990) An improved method for the determination of phytoplankton chlorophyll using N, N-dimethylformamide, J. Oceanogr. Soc. Japan, 46, 190-194.

Holm-Hansen, O., Lorenzen, C. J., Holmes, R.W. and J. D. H. Strickland (1965) Fluorometric determination of chlorophyll. J. Cons. Cons. Int. Explor. Mer. 30, 3-15.

Welschmeyer, N. A. (1994) Fluorometric analysis of chlrophyll *a* in the presence of chlorophyll *b* and pheopigments. Limnol. Oceanogr. 39, 1985-1992.

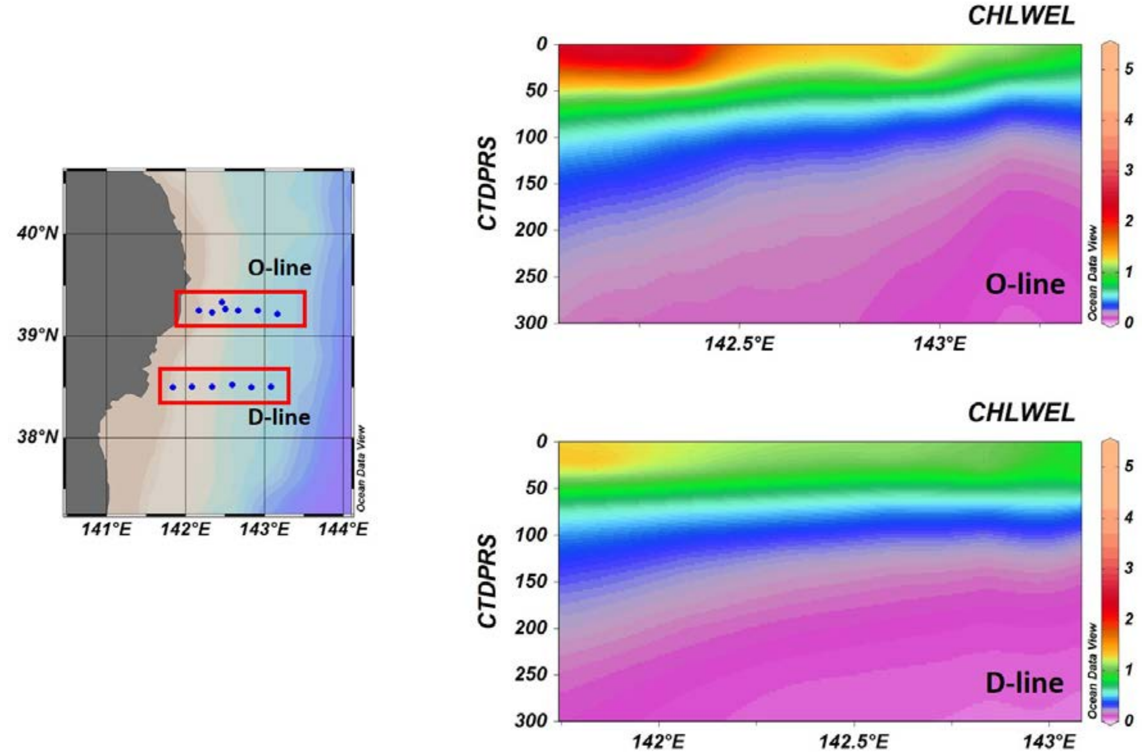

Figure 3.4.5-1. Vertical distribution of chlorophyll *a* (non-acidification) at 2 observation lines

3.4.6. Determination of carbonate species (dissolved inorganic carbon and total alkalinity) in seawater

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)
Emi DEGUCHI (Marine Works Japan)

(1) Objective

Concentration of CO_2 in the atmosphere is now increasing owing to human activities such as burning of fossil fuels, deforestation, and cement production. The ocean plays an important role in buffering the increase of atmospheric CO_2. Approximately 30% of the total amount of anthropogenic CO_2 emitted into the atmosphere has accumulated in the global ocean [IPCC, 2013]. Ocean acidification is a direct consequence of the ocean absorbing large amounts of the anthropogenic CO_2. The CO_2 uptake by the oceans has led to lowering both pH and $CaCO_3$ saturation states with regard to the mineral phases due to increasing hydrogen ions (H^+) and declining carbonate ion (CO_3^{2-}), respectively. Because oceanic biological activity has an important role concerned to Carbon cycle in the ocean through its photosynthesis and respiration, the chemical changes associated with ocean acidification have the potential to affect ocean biogeochemistry and ecosystems in a myriad of ways. Therefore, it is important to clarify the mechanism of the oceanic CO_2 absorption and ocean acidification and to estimate CO_2 absorption capacity and decrease of pH and $CaCO_3$ saturation states in recent years. When CO_2 dissolves in water, chemical reaction takes place and CO_2 alters its appearance into several species. Concentrations of the individual species of the CO_2 system in solution cannot be measured directly, but calculated from two of four parameters: total dissolved inorganic carbon (DIC), total alkalinity (TA), pH and pCO_2. This study presents the distribution of DIC and TA in the Sanriku.

(2) Sampling

Seawater samples of DIC and TA were collected by 12 liter seawater sampler mounted on the CTD system. Seawaters were sampled in a 150 ml glass bottle for DIC and a 100 ml glass bottle for TA. These bottle was previously soaked in 1 M HCl solution at least 6 hours and was cleaned by fresh water for 7 times and Milli-Q deionized water for 3 times. A sampling silicone rubber tube with PFA tip was connected to the Niskin bottle when the sampling was carried out. The glass bottles were filled from the bottom, without rinsing, and were overflowed for 20 seconds. After collecting the samples on the deck, the glass bottles were carried to the laboratory. Within one hour after the sampling, 2 % by the bottle volume (2 ml) was removed from the glass bottle and poisoned with 0.1 % by volume (0.1 ml) of over saturated solution of mercury chloride. Then, the samples were sealed by rubber and aluminum caps. All samples preserved at ~ 5 °C cold until analysis.

(3) Analysis

DIC and TA samples are measured by using coulometric and potentiometric techniques, respectively, according to Dickson et al., 2007. The DIC and TA values will be calibrated with certified reference material provided by Prof. A. G. Dickson (Scripps Institution of Oceanography) and KANSO.

(4) Preliminary result

No result was obtained on board. The distributions of DIC and TA will be determined as soon as possible after this cruise.

(5) Data Archive

All data will be submitted to JAMSTEC Data Management Office (DMO).

(6) Reference

Dickson A. G., L. C. Sabine, J. R. Christianet (2007) *Guide to best practices for ocean CO2 measurements.* Sidney, British Columbia, North Pacific Marine Science Organization, 176pp. (PICES Special Publication, 3)

3.4.7. Determination of dissolved organic carbon (DOC) and total dissolved nitrogen (TDN) in seawater

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)

(1) Objective

Variabilities in the dissolved organic carbon (DOC) in seawater have a potentially great impact on the carbon cycle in the marine system, because DOC is a major global carbon reservoir. A change by < 10% in the size of the oceanic DOC pool, estimated to be ~ 700 GtC (IPCC, 2007), would be comparable to the annual primary productivity in the whole ocean. In fact, it was generally concluded that the bulk DOC in oceanic water, especially in the deep ocean, is quite inert based upon 14C-age measurements. Nevertheless, it is widely observed that in the ocean DOC accumulates in surface waters at levels above the more constant concentration in deep water, suggesting the presence of DOC associated with biological production in the surface ocean. This study presents the distribution of DOC off the Sanriku.

(2) Sampling

Seawater samples of DOC and TDN were collected by 10 liter Niskin bottles mounted on the CTD/Carousel Water Sampling System and brought the total to ~300. Seawater from each Niskin bottle was transferred into 60 ml High Density Polyethylene bottle (HDPE) rinsed with same water three times. Water above the 200m depth is filtered using precombusted (450°C) GF/F inline filters as they are being collected from the Niskin bottle. After collection, samples are frozen upright and preserved at ~ -20 °C cold until analysis in our land laboratory. Before use, all glassware was muffled at 550 °C for 5 hrs.

(3) Analysis

Prior to analysis, samples are returned to room temperature and acidified to pH < 2 with concentrated hydrochloric acid. DOC/TDN analysis was basically made with a high-temperature catalytic oxidation (HTCO) system improved a commercial unit, the Shimadzu TOC-L (Shimadzu Co.). In this system, the non-dispersive infrared was used for carbon dioxide produced from DOC during the HTCO process (temperature: 680 °C, catalyst: 0.5% Pt-Al_2O_3). Non-purgeable dissolved nitrogen compounds are combusted and converted to NO which, when mixed with ozone, chemiluminescene for detection by a photomultiplier

(4) Preliminary result

No result was obtained on board. The distributions of DOC and TDN will be determined as soon as possible after this cruise.

(5) Data Archive

All data will be submitted to JAMSTEC Data Management Office (DMO).

3.4.8. Determination of oxygen isotope ratio of H_2O in seawater

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)

(1) Objective

The submarine ground fresh water discharge provides direct transport pathways for both water and other materials between the land groundwater system and the marine environment. The continental marginal sea is influenced by a huge amount of fresh water from ground water and river which is distributed widely on the continental shelf. The fresh water from ground water and river will affect salinity, biological activity, ocean circulation and cycle of geochemical properties. During the KS-17-J08C cruise, to evaluate the effect of fresh water off Sanriku, we have collected seawater samples for oxygen isotope analysis. Because oxygen isotope ratio of fresh water (δ18O) from the ground and rivers is different from sea water, causes of salinity changes can be quantitatively estimated from the salinity- δ18O relationship.

(2) Sampling

Seawater collected in 12-litters water sampler mounted on the CTD-rosette system were transferred into 10 ml glass vials for $\delta^{18}O$ analysis.

(3) Analysis

The oxygen isotope ratios will be automatically determined using a mass spectrometer with a CO2-H2O equilibration unit on land.

(4) Preliminary result

No result was obtained on board. After analysis of oxygen isotope on the laboratory on land we will obtain the distributions of Oxygen isotope ratio of H2O.

(5) Data Archive

All data will be submitted to JAMSTEC Data Management Office (DMO).

3.4.9. Measurement of Phytoplankton abundance in seawater

Shuichi WATANABE (JAMSTEC)
Masahide WAKITA (JAMSTEC)

(1) Objective

The objective of this study is to estimate phytoplankton abundances and species richness in winter off Sanriku of the north-eastern Japan. Phytoplankton abundances and species richness were measured with microscopy for large size phytoplankton.

(2) Sampling

Samplings were conducted only using Niskin bottles, except for the surface water, which was taken by a bucket. Samplings were carried out at all CTD-water sampling stations.

(3) Methods

Water samples were placed in 500 ml plastic bottle. Samples were fixed with neutral-buffered formalin solution (1% final concentration). The microscopic measurements are scheduled after the cruise.

(4) Preliminary result

No result was obtained on board. The distributions of phytoplankton abundance will be determined as soon as possible after this cruise.

(5) Data Archive

All data will be submitted to JAMSTEC Data Management Office (DMO).

3.5. Continuous and vertical Fast repetition rate fluorometry (FRRF) observations

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(1) Objective

During the past decade, the utilization of active fluorescence techniques in biological oceanography brought significant progress in our knowledge of phytoplankton productivity in the oceans. Above all, the fast repetition rate (FRR) fluorometry reduces the primary electron acceptor (Qa) in photosystem II (PSII) by a series of subsaturating flashlets and can measure a single turnover (ST) fluorescence induction curve in PSII. The PSII parameters, such as the potential photosynthetic activity (Fv/Fm) and the functional absorption cross-section of PSII, derived from the ST fluorescence induction curve can be used to estimate gross primary productivity. In the present study, to gain a better understanding of variability in phytoplankton productivity off the Sanriku, we measured the PSII parameters and primary productivity using the FRR fluorometry.

(2) Methods

Using the FRR fluorometer (Kimoto Electric Co., Ltd., Japan), the vertical variation in PSII parameters and primary productivity were examined off the Sanriku. The FRR fluorometer attached to the RINKO profiler (JFE Advantech Co., Ltd.) was moved up and down between surface and 200 m at the rate of 0.2 m s-1 using a ship winch. The RINKO profiler can measure the vertical profiles of water temperature, salinity, pressure, dissolved oxygen, chlorophyll and turbidity. The profiling rate of the observation buoy was set to minimal in order to detect small scale variations (~0.5 m) in measurements.

(3) Preliminary result

The distributions of Temp., Salinity and Chl-a abundance obtained RINKO profiler are shown in Fig. 3.5-1.

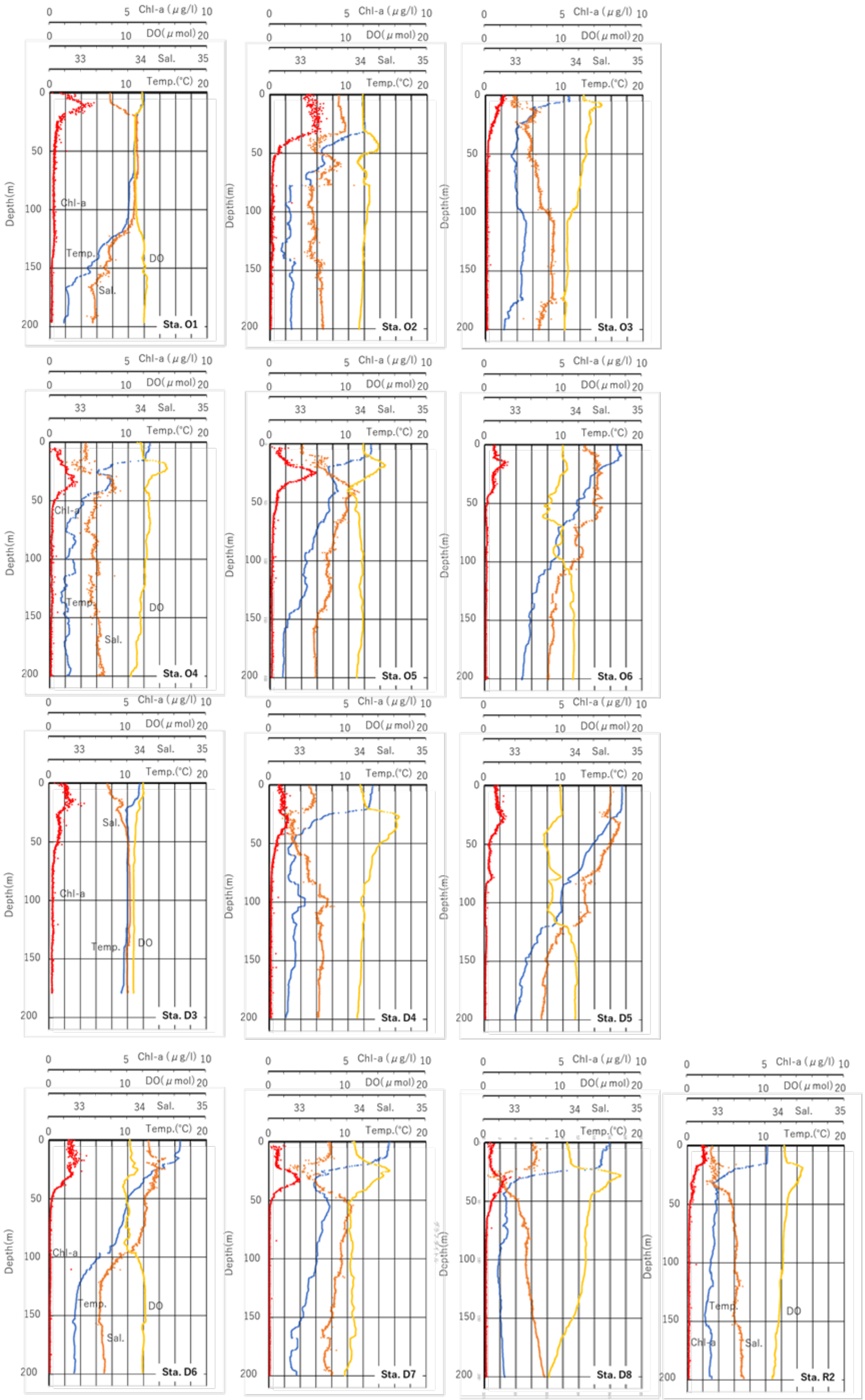

Fig.3.5-1 Vertical profiles of Temp., Salinity and Chl-a abundance obtained RINKO profiler each station.

(4) Data Archive

All data will be submitted to JAMSTEC Data Management Office (DMO).

3.6. Zooplankton distribution by NORPAC net and quantitative echo sounder (QES)

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(1) Objectives

The objective of this study is to estimate zooplankton abundances and species richness in winter off Sanriku of the north-eastern Japan. Zooplankton abundances and species richness were measured with microscopy for large size phytoplankton and is compared against the zooplankton distribution by quantitative echo sounder (QES).

(2) Sampling by NORPAC net

Samplings were vertically hauled by using a NORPAC net (335 μm mesh, NMG52) with a cod end. Plankton samplings were carried out at all CTD-water sampling stations. Plankton sample were placed in 500 ml plastic bottle and were fixed with neutral-buffered formalin solution (10% final concentration). The microscopic measurements are scheduled after the cruise.

(3) Observation by QES

In comparison with zooplankton distribution during NOPAC net sampling, we operated the Kongsberg EK 60 scientific echo sounder system equipped on board. The Kongsberg EK 60 scientific echo sounder system is designed for fishery research, as follows.

Technical specifications

Operation frequency:	18, 38, 70, 120, 200, 300 kHz
Operation modes:	Active, Passive and Tes
Transmission power:	Adjustable in steps
Ping rate:	adjustable
Maximum ping rate:	20 pings per sec
Data collection range:	0 to 15,000m
Receiver instantaneous dynamic range:	150 dB

Receiver filtering:	Matched digital filters
Receiver noise figure:	4 dB
Split beam:	Complex digital demodulation
Synchronization:	Internal and external

120 kHz echogram display at H-4 point, 17, March,2017

The view displays the current depth. The echogram contains information about the acoustic values. The Scope view provides oscilloscope visualization of the last ping. The view draws a range of horizontal symmetrical color line. The distance from the vertical center axis and the line color reflects the receiver echo scatter. The color scale view visualizes the mapping of echo strength into one out of 12 colors, light blue for weak signals and dark brown for strong signals. Basically, echo discrete color represents a 3 dB range of echo signal strength implying that the next color is selected every time the echo strength doubles. For example, horizontal axis means time series and color scale means reflective strength. The oblique line shows a sounding scatter of architect material (NORPAK net). The horizontal blue line at 100m depth shows observed strong reflection relative to back ground noise.

(4) Preliminary result

No result was obtained on board. The distributions of zooplankton abundance will be determined as soon as possible after this cruise.

(5) Data Archive

All data will be submitted to JAMSTEC Data Management Office (DMO).

3.7. Lander

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(1) Objective

To understand seasonal changes at lower continental slope influenced by marine environments changes and unexpected events such as earthquakes at sea floor, a lander system installed monitoring instruments is deployed in lower continental slope, off Otsuchi bay.

(2) The lander

The lander frame was equipped with titanium pipes to prevent electrolytic corrosion during the deployment. Six glass spheres are mounted on upper part of the frame, and 91 kg of iron ballast was attached under an acoustic releaser (TMR-6005B, Kaiyo-denshi). ADCP-CTD-DO turbidity sensors (RDCP600, Xyrem) and the battery are put on the top of the frame. On the side, a HDTV camera (GZ-V570 modified, JVC Kenwood and a handmade timer circuit) and two LED lights (Handmade) are mounted. The electric power for the camera and the lights are supplied from Li-ion battery (14.8 V/40Ah, Handmade) placed on the payload. The lander recovery is carried out to release the ballast sending the acoustic command to the releaser. In case the releaser does not work and to identify exact location to ROV, ROV homer is attached. To identify the location when the lander is ascended on the sea surface by ballast release on schedule or any troubles, ARGOS transmitter is enclosed on the top glass sphere. Detailed information of the lander and the instruments are shown in tables 3.7.1 and 3.7.2, respectively.

Table 3.7.1. The lander weights.

Weight in air with ballast (kg)	Weight in air without ballast (kg)	Weight in fresh water with ballast (kg)	Weight in fresh water without ballast (kg)
367.8	276.8	58.0	-21.5

Table 3.7.2. The settings of the instruments. ARGOS transmitter is scheduled to activate on 15th Jun. RDCP600 was powered on at 16:00 on 8th Jun. Still and video recording sequence was started at 0:00 on 8th Jun.

Releaser	ROV	ARGOS ID	Measurement	Still image	Video recording

code and ID	Homer ID		interval of RDCP600	acquisition interval	time and the interval
OP1/ 10.5 A	31	Dec: 109215 Hex: 44DC4D2	1 hour	6 hours	5 min/1 week

Fig. 3.7.1. The lander system.

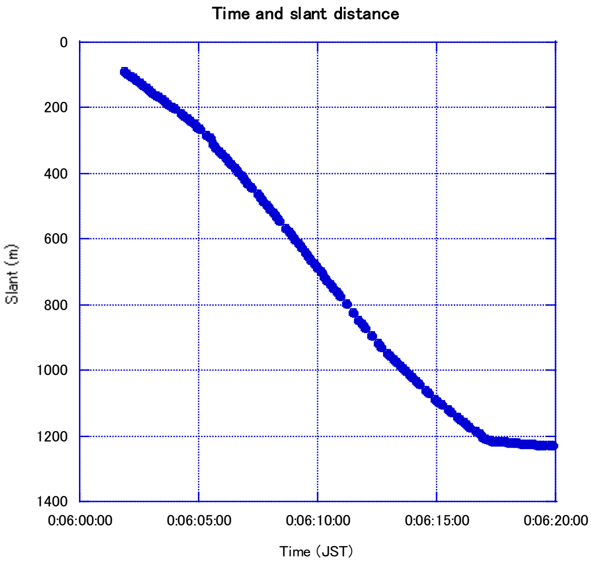

Fig. 3.7.2. Time and the slant distance of the lander.

(3) The deployment and the location

The lander was released on deck at 6:00 (JST) on 9th Jun. The descending position (slant distance) was tracked by transponder control unit (SCM-12, Kaiyo denshi) on board. The landing was confirmed at 6:17 (Fig. 3.7.2). The approximate descending speed was estimated to 70 m/min.

The landed location was determined by three-point survey (Table 3.7.3).

Table 3.7.3. Location of the lander.

Latitude	Longitude	Water depth
39° 19.7525' N	142° 27.5121' E	947 m

(4) Data Archive

The data, photos and videos will be obtained after the recovery of the lander.

All data will be submitted to JAMSTEC Data Management Office (DMO)

4. Notice on Using

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

This cruise report is a preliminary documentation as of the end of the cruise.
This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for latest information.
Users of data or results on this cruise report are requested to submit their results to the Data Management Group of JAMSTEC.