



RV Kairei “Cruise Report”

KR15-01

Trench Biosphere Expedition for the Izu-Ogasawara

Trench

Mar. 13, 2015-Mar. 19, 2015

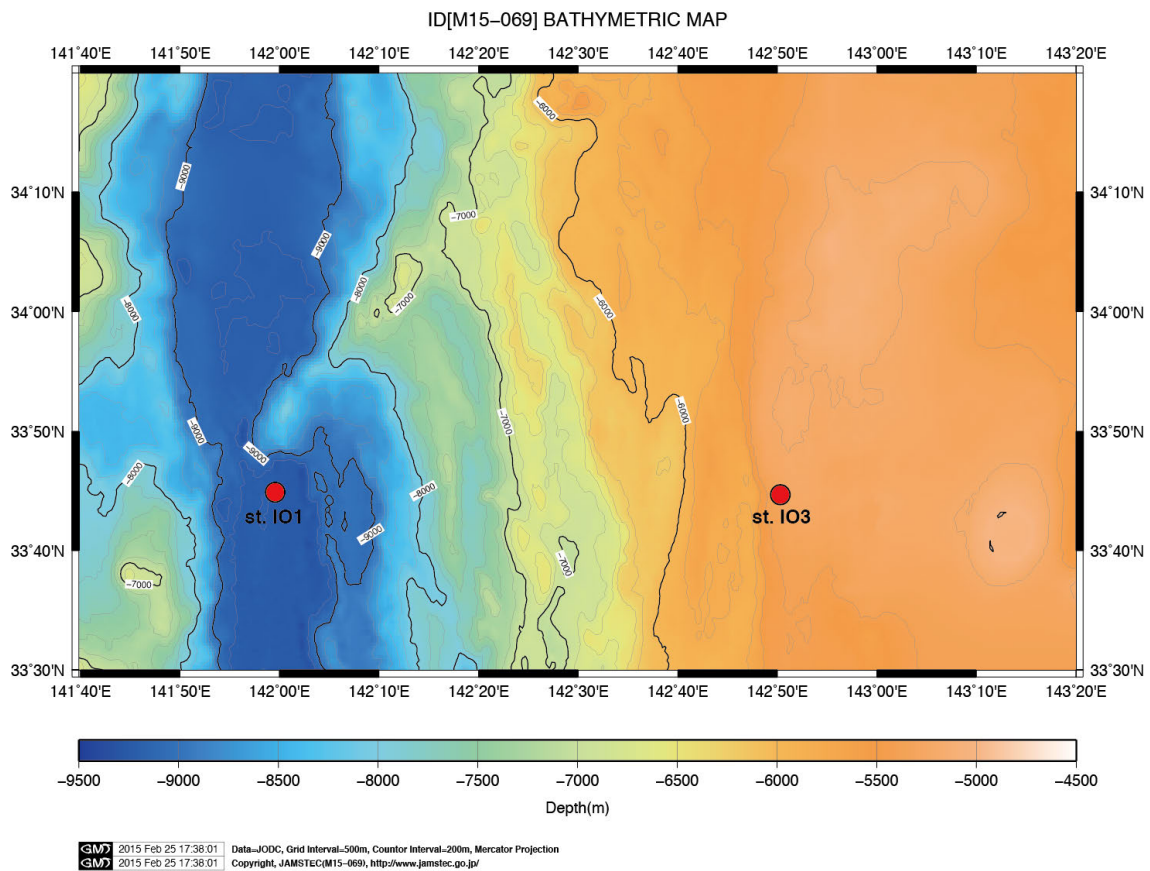
Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

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1. Cruise Information

- Cruise ID: KR15-01
- Name of vessel: RV Kairei
- Title of the cruise: Trench Biosphere Expedition for the Izu-Ogasawara Trench
- Title of proposal: Biogeochemical exploration of the hadal biosphere in the Izu-Ogasawara Trench
- Cruise period: 13 Mar 2015- 19 Mar 2015
- Ports of departure / call: Yokosuka (JAMSTEC) / arrival: Yokosuka (JAMSTEC)
- Research area: Izu-Ogasawara Trench, Off Boso Peninsula, Western Pacific
- Research Map



2. Researchers and crews

- Chief scientist & Representative of the Science Party: Takuro Nunoura

Marine Functional Biology Group

Research and Development (R&D) Center for Marine Biosciences

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

- Science party

I. Onboard Scientists

Hidetaka Nomaki

Department of Biogeochemistry

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

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Research and Development (R&D) Center for Marine Biosciences

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Miho Hirai

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Fukui Prefectural University

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Center for Marine Environmental Studies (CMES)
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Tomohiro Mochizuki
Earth-Life Science Institute
Tokyo Institute of Technology

Phurt Harnvoravongchai

Department of Bioengineering
Graduate School of Bioscience and Biotechnology
Tokyo Institute of Technology

II. Marine Technician

Takuya Onodera
Nippon Marine Enterprises, LTD.

III. Operation team of KAIKO

1st ROV Operator	Homare Wakamatsu
2nd ROV Operator	Seiji Shigetake
2nd ROV Operator	Yudai Sakakibara
2nd ROV Operator	Junya Nikura

IV. CTD operation team

Hirokatsu Uno
Marine Works Japan, LTD.

Rei Ito
Marine Works Japan, LTD.

V. Captain and crew of the R/V KAIREI

Captain	Takafumi Aoki
Chief Officer	Akihisa Tsuji
2nd Officer	Kazuki Miyake
3rd Officer	Yusuke Ishii
Chief Engineer	Takashi Ohta
1st Engineer	Wataru Kurose
2nd Engineer	Saburo Sakaemura
3rd Engineer	Kota Kataoka
Chief Radio officer	Hiroyasu Saitake
2nd Electronic Operator	Toshihiko Yuasa
Boat Swain	Masanori Ohata
Able Seaman	Yasuo Konno
Able Seaman	Saikan Hirai
Sailor	Hiroataka Shigeta

Sailor	Kosei Kawamura
Sailor	Sho Suzuki
Sailor	Hideaki Namata
No.1 Oiler	Toshikazu Ikeda
Oiler	Keiya Taniguchi
Oiler	Ryo Sato
Assistant Oiler	Ryo Matsuuchi
Assistant Oiler	Aoi Takamiya
Chief Steward	Yukio Tachikii
Steward	Tatsunari Onoue
Steward	Kanji Mae
Steward	Toru Wada
Steward	Jun Sato

3. Observations

I. Major objectives

It has been revealed that both microbial ecosystems in hadal sediments and waters in the Challenger Deep of the Mariana Trench are distinct from those in the adjacent abyssal plain and overlaying deep waters, respectively (Glud et al. 2013, Nunoura et al. 2015). The objective of the project is to observe the hadal biosphere in Izu-Ogasawara Trench and to understand the geochemical and geophysical backgrounds of the uniqueness of the trench biosphere especially the impacts of inter-trench current between the Japan Trench and the Izu-Ogasawara Trench.

In this cruise, we took both water and sediment samples on a northern part of the Izu-Ogasawara Trench by using a 11K camera system and a CTD rosette water sampler in order to reveal geochemical and geophysical impacts of the Izu-Ogasawara Trench on microbial ecosystems associated with the trench environments as follows.

1. To compare the microbial diversity and activities between the trench water and the abyssal water above the trench.
2. To compare the benthic microbial and meiofaunal ecosystem between the trench bottom and adjacent abyssal plain.
3. To estimate the impacts of inter-trench currents between the Japan and Izu-Ogasawara Trenches by comparing microbial and geochemical information from those trench environments.

II. Scientific objectives of participants

Molecular analyses for hadal and abyssal waters and sediments

Takuro Nunoura, Miho Hirai (JAMSTEC) and Izumi Orita (Tokyo Institute of Technology)

In order to know the nitrogen cycles in abysso-pelagic waters and sediments, we will examine tag sequencing, clone analyses and quantitative PCR targeting functional genes and SSU rRNA genes related to aerobic and anaerobic nitrification for both sediment and water samples. In addition, metagenomic and metatranscriptomic analyses for both water and sediments and single cell genomic analysis for water samples will be conducted to know the adaptation mechanisms for had-pelagic environments and the role of trench microbial ecosystems in water. In addition, we will compare genomic traits of piezophilic bacteria isolated from the trench bottom and metagenomic sequences in order to investigate the genomic traits to the high pressure environments.

Microbial cell analysis

Michinari SUNAMURA (Univ Tokyo) and Shunichi URAYAMA (JAMSTEC)

Microbial cell densities and activities are essential factor for microbial ecology. In this cruise, I aim to determine 1.) microbial cell densities, 2.) microbial respiration activities at a single cell level, and 3.) microbial community structures thorough the water column from the surface to 9250-m-deep seawater.

1.) Densities of microbial cell in the seawater samples are quantified on board using flow cytometer (Attune NxT, Thermo). 15 mL of the seawater samples were subsampled in sterilized plastic tubes and stored in refrigerator at 4°C until analysis. 200µl of the samples were applied to 96 wells plate and then 10 µl of x80 SYBR Green I (Invitrogen, final concentration at 4X) were added to each well. After 20 minutes incubation for staining ds-DNA in the cell, 50µl of the samples were applied into flow cytometer and determined microbial cell density and cell size. Density of chrolophyll containing cells was also detemined based on auto fluorescence as an indicator of phototrophic populations.

2.) Microbial respiration is one of the important factors to determine the microbial activities. Formazane has been used to measure the respiration activities through electron transfer system. CTC is a fluorescent chemical of formazane family. CTC-added seawater-sample was incubated at 15°C and 4°C for 2 to 6 hours with and without specific inhibitors for ammonium oxidation (ATU and GC7) to estimate the respiration of archaeal ammonium oxidation. CTC positive cell densities were measured by flow cytometer on board. Further analysis is planning after this cruise.

3.) MS obtained a few hundreds-milliliters of seawater for microscopic cell analysis, e.g. total cell density, cell size, and FISH. Microbial cells in the seawater was fixed by addition of 1/10 neutralized formalin (final formaldehyde concentration is ca. 3.5%) and incubated in refrigerator at 4°C for 12-24 hours. Microbial cells in the formalin fixed samples were filtered on polycarbonate membrane filter (0.2um pore size, ADVANTEC) on board. The filter sample are brought back to laboratory and preserve at -80°C until analysis.

Protists in deep-ocean

Ryuji Kondo and Misaki Momoki (Fukui Prefecture Univ)

The ‘microbial loop’ is known as a dynamic component of the food web in marine systems. Heterotrophic nanoflagellates (HNF) are significant consumers of bacteria in aquatic environments. In this cruise, HNF abundance will be investigated in the water column and the bottom sediments of the Izu-Ogasawara Trench. We will also try to isolate and cultivate the HNF in order to know their physiology and taxonomic position.

Comparison of meiofaunal community structure in the Izu-Ogasawara Trench

1. Introduction

Trenches present one of the last frontiers of deep-sea exploration (Rex & Etter 2010). Trenches distribute along oceanic plate subduction zone and their water depths sometimes exceed 10,000 m depth. Due to its remoteness from the ocean surface, little is known about biological compositions and biogeochemical cycles at the Trench area. Although meiofauna exceed megafauna and macrofauna in density and biomass in the deep sea (e.g. Rex et al. 2006) and affect major ecological processes such as nutrient cycling and sediment stability (Snelgrove et al. 1997), few previous studies have reported meiofaunal assemblages around trenches. Here, we investigated the faunal compositions of meiofauna at the bottom of the triple junction and adjacent abyssal plain. Sediment samples will be collected by using a deep-sea free fall camera system.

2. Materials and Methods

Sediment samples were collected in three deployments of the deep-sea free fall camera system (FFCS) from the bottom of the triple junction and adjacent abyssal plain. Both sampling gear can equip 60 cm length core tube (inner diameter = 74 mm). Free fall camera system sampling were carried out at the Station IO1 (FFCS cast 1, water depth = 9,250 m, triple junction), Station IO3 (FFCS cast 2, water depth = 5,257 m, abyssal plain eastwards of the triple junction) and Station IO1 (FFCS cast 3, water depth = 9,242, triple junction) on 15th, 16th and 18th March 2015, respectively.

Two cores from each deployment were sliced into 5 layers; 0–1, 1–2, 2–3, 3–4 and 4–5 cm below the sea floor. Half volume of sediment in each layer were sampled for meiofauna and then fixed with Rose-Bengal formalin.

3. Future works

The sediment samples for meiofaunal works will be sieved with 32 μ m mesh. All the stained specimens of benthic foraminifera and metazoan meiofauna will be picked out from the sediments. For harpacticoid copepods, which are one of the dominant taxa in meiofaunal ecosystem, all specimens will be identified at genus or species level. We will compare the community structure in meiofauna between hadal and abyssal depths. In addition, community data will be compared with those from the Ryukyu and Kuril Trenches (Kitahashi et al. 2012; Kitahashi et al. 2014).

Oxygen concentration and pH profiles at Izu-Ogasawara Trench and adjacent deep-sea floor

Hidetaka Nomaki (JAMSTEC)

Trenches distribute along oceanic plate subduction zone and their water depths sometimes exceed 10,000 m depth. Due to its remoteness from the ocean surface, little is known about biological compositions and biogeochemical cycles at the Trench area. Here, we measured dissolved oxygen concentration and pH profiles of the surface 30 cm of sediments collected from Izu-Ogasawara Trench and adjacent abyssal plain.

Sediment samples were collected using a free-fall camera system which can equip three 60 cm length core tubes (inner diameter = 74 mm). Free-fall camera system samplings were carried out at the Station 1 of the Izu-Ogasawara Trench bottom (water depth = 9250 m) on 15th and 18th March 2015, and at the Station 2 of the abyssal plain (water depth = 5257 m).

On board, dissolved oxygen concentrations were measured at 2 cm intervals with optical oxygen sensor through polycarbonate core tubes immediately after the core recovery. Dissolved oxygen concentrations and pH profiles were also measured using microelectrode. They were measured from approximately 5 to 10 mm above the sediment surface to 30 to 40 mm depth in the sediment in 200- μ m steps by microelectrodes with a tip diameter of 100 μ m.

Prokaryotic activity in the Izu-Ogasawara Trench and adjacent abyssal plain

Hidetaka Nomaki, Takuro Nunoura (JAMSTEC), and Taichi Yokokawa (Ehime University)

Marine prokaryotes play important roles on marine biogeochemical cycle. Despite increasing knowledge on the diversity of prokaryotes in marine ecosystems, little is known about their metabolic activities in sediments. Here, we focused on the prokaryotic activities regarding carbon substrate utilizations in the sediments. Uptake of four different ¹⁴C-labeled substrates were investigated under atmospheric pressure condition. Sediment samples were mixed with radio-isotope-labeled substrates and incubated at in situ temperature for 48 hours. Ethanol was added for killed control conditions. To estimate the contribution of archaea to total prokaryotic substrate incorporation, GC7 was used to inhibit archaeal activity. To stop the growth of ammonia oxidizers, inhibitors to ammonia oxidation (TAu) were added into a part of the samples. The incubation was terminated by adding ethanol, and the samples were kept at -20 dC.

Marine virus exploration

Syun-ichi Urayama (JAMSTEC) and Tomohiro Mochizuki (Tokyo Tech. ELSI)

Viruses are the most abundant biological entities in the world's oceans (approximately 4×10^{30} , Suttle 2007). However, their virological properties and genetic compositions are not yet well known.

During the KR15-01 cruise, the water column and the bottom sediments were taken from the Izu-Ogasawara Trench. The goal of the virus research team was to analyze the viral communities using culture independent metagenomics and culture dependent isolations. Metagenomic is an extremely powerful tool to investigate the viral community. However, the lack of known strains from corresponding environment results in significant amount of “unknown” sequence reads. To compensate, using the collected water and sediment samples, attempts will be made to isolate new viral strains.

Prokaryotic activity throughout the water column of the Izu-Ogasawara Trench

Taichi Yokokawa (Ehime University)

Purpose

Marine prokaryotes play important roles on carbon flux in the oceans. Despite evolving understanding about the importance and the diversity of prokaryotes in marine ecosystems, the data are scarce regarding prokaryotic activity in the water columns of open oceans, particularly in deep water realm. In this cruise, I focused on the prokaryotic abilities to utilize substrates in metho-, bathy and hadopelagic waters. Substrates uptakes were evaluated using radio-labeled tracer experiments.

Materials and Methods

Immediately after sampling of 12L-Niskin water, I transferred seawater sample into the bottles, added radio-labelled substrates (bicarbonate, leucine, D-aspartic acid, L-aspartic acid, and amino acids mixture), and incubated at in situ temperature (± 2 °C) in the dark. One killed blank was prepared for each sample. Incubation periods were one hour and two to three days for the upper (0 – 250 m) and deeper (300 – bottom) water layers, respectively. Radioactivity measurements of microbial cells by liquid scintillation are operated with in a month.

Ammonia-oxidization in deep-ocean

Syota Takino, Yasuhito Ito, Kazuki Shinoda, Keisuke Koba (Tokyo University of Agriculture and Technology) and Akiko Makabe (JAMSTEC)

Ammonia oxidization is one of the most important autotrophic processes in the ocean. We investigated ammonia-oxidizing rates along the profile from surface to 9500m-depth with ^{15}N -tracer technique. Water samples were collected from different depth with Niskin Go-Flo samplers and incubated in 125mL-glass vials without headspace to maintain the dissolved oxygen level for ca. 12hr to 7 days. Use of different inhibitors that are effective for archaea and bacteria would allow us to evaluate if archaea

contribute ammonia oxidation more than bacteria in the surface water and in the deep water. We also used different nitrogenous compounds such as ammonium and urea to see what can be the actual substrate for the ammonia oxidation in the deep sea. Some of the incubated samples (from surface to 500m-depth where ammonia-oxidation activity is expected to be high) were filtered with 0.45micrometer filter on board within 24hrs and the filtrates were frozen for the further analysis. Other samples will be filtered after the cruise in JAMSTEC as well. The ^{15}N -nitrate measurement will be carried out in JAMSTEC with denitrifier method (Sigman et al. 2001). The results will be complementary to the measurements of microbial activities done by Dr. Yokokawa in the same cruise.

Profiles of nutrient concentrations and nitrate isotopic ratios in deep-ocean

Syota Takino, Yasuhito Ito, Kazuki Shinoda, Keisuke Koba (Tokyo University of Agriculture and Technology) and Akiko Makabe (JAMSTEC)

Natural abundance of ^{15}N and ^{18}O of nitrate can tell us the balance between ammonia oxidization and nitrate respiration (denitrification) in the ocean, thus we collected the samples for this analysis. Water samples were collected from different depth with Niskin Go-Flo samplers and directly transferred from Niskin to the 100mL-plastic syringe with 0.45micrometer filter. Immediately after the transfer, we prepared the filtrate in 125mL plastic bottles. Ammonium concentrations were preliminary measured by OPA method (Holmes et al. 1999) and will be reanalyzed in JAMSTEC later. Nitrite, nitrate and phosphate concentrations will be measured by colorimetric methods together with ^{15}N and ^{18}O natural abundances of nitrate with denitrifier method (Casciotti et al. 2002) in TUAT later.

Viral ecology in hadopelagic environments

Roberto Danovaro (*Department of Life and Environmental Sciences, Polytechnic University of Marche, Italy*)

Viruses are by far the most abundant biological entities in the world's oceans (approximately 4×10^{30} , Suttle 2007). Recent estimates suggest that every kg of deep-sea sediment contains 10^{12} viruses and 10^{11} prokaryotes (Sogin et al 2006). Recent studies revealed that viral infection in aquatic sediments can be the major cause of mortality for benthic prokaryotes (Danovaro et al 2008). Viral lysis transforms infected microbes into organic detritus, which can then be used again by non-infected prokaryotes and/or contribute to biogeochemical cycles. Extracellular DNA is likely to play a key role in both processes (Dell'Anno & Danovaro 2005) and can be a reservoir of genes (1 kg of deep-sea sediment can contain 10^{13} copies of 16S rRNA genes; Corinaldesi et al 2011). The main purpose was to investigate the

dynamics in virus - prokaryotes interactions in the sediments from the Off Boso area including the Izu-Ogasawara trench.

For the sediment samples, UNIVPM research team will conduct analyses for the determination of viral abundance and production, total prokaryotic abundance, abundance of Bacteria and Archaea, extracellular enzymatic activities, extracellular and intracellular DNA concentration.

Photosynthetic bacteria in the deep-sea

Yusuke Tsukatani, Shinji Masuda and Tomohiro Mochizuki (Tokyo Institute of Technology)

Green photosynthetic bacteria thrive under low-light conditions with efficient light-harvesting protein complexes called chlorosomes. Green bacteria have been isolated from ecological niches with extremely low-light illumination conditions, such as 100 m below the surface of Black Sea, and from environmental samples near hydrothermal vents of about 2400 m in depth (as for the latter case, light source is probably geothermal radiation, not sunlight). Photosynthetic bacteria have primitive and simpler photosynthetic protein apparatuses compared to plants and cyanobacteria, and therefore are good materials to study fundamental mechanisms and evolution of photosynthesis. We would like to isolate so-far-unknown species of phototrophic bacteria with novel, simpler, and/or evolutionarily transient photosynthetic systems, hopefully from marine samples deeper than 100 m (deepest using sunlight) or bottom of the ocean.

A sedimentary process around the Boso triple junction

Kiichiro Kawamura, Keita Yoshimoto (Yamaguchi University)

We study paleocurrent directions and sedimentation rates of the core sediments to verify a sedimentary process around the Boso triple junction as follows.

- 1) For the paleocurrent direction study, we analyze X-CT and magnetic properties. With this study, we can decipher the sediment source of the core samples.
- 2) For the sedimentation rate study, we measure volcanic glass indexes. With this study, we can verify the average sedimentation rates in a geological time scale.
- 3) Furthermore, we provide physical properties data using MSCL.

4. Instruments

I. 11K Free Fall Camera System

A free fall camera system was used for the sampling of surface sediments and incubation experiments of sediments and water in situ. The free fall camera system was made by MARITEC, JAMSTEC, and consisted of CTD, a transponder, release weights, a battery, a deep-sea camera, two lights, and three sediment samplers attached to tripod aluminum frame.

For this cruise, we newly designed two in situ incubation systems. The first incubation system is set inside of sediment sampler tube, which has 7.4 cm inner diameter. After landing on the seafloor, triggers are released and stable isotope tracer is injected onto sediment surface or into the sediments in the tubes. The second incubation system is a water sampler, which includes chemicals and/or stable isotope labeled substrates. After certain time, trigger is released and surrounding bottom water is introduced into the sampler.

II. CTD Water Sampling

(1) Personnel

Takuro Nunoura	(JAMSTEC): Principal investigator
Rei Ito	(MWJ): Operation leader
Hirokatsu Uno	(MWJ)

(2) Objective

Investigation of oceanic structure and water sampling.

(3) Parameters

Temperature (Primary only)
Conductivity (Primary only)
Pressure
Dissolved Oxygen (Primary only)
Altimeter

(4) Instruments and Methods

CTD/Carousel Water Sampling System, which is a 12-position Carousel water sampler (CWS) with Sea-Bird Electronics, Inc. CTD (SBE9plus), was used during this cruise. 12-liter Niskin Bottles were used for sampling seawater. The sensors attached on the CTD were temperature (Primary only), conductivity (Primary only), pressure, dissolved oxygen (Primary only) and Altimeter. Salinity was calculated by measured values of pressure, conductivity and temperature. The CTD/CWS was deployed

from working deck.

The CTD raw data were acquired on real time using the Seasave-Win32 (ver.7.23.2) 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 usually stop for 30 seconds to stabilize then fire.

Data processing procedures and used utilities of SBE Data Processing-Win32 (ver.7.23.2) and SEASOFT 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 3.0 seconds, and the offset was set to 0.0 seconds.

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

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 plumbing line. This delay was compensated by 3 seconds advancing dissolved oxygen sensor output (dissolved oxygen voltage) relative to the temperature data.

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 1000 scans. Data greater than 10 standard deviations were flagged. The second pass computed a standard deviation over the same 1000 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to pressure, depth, temperature, conductivity and dissolved oxygen voltage.

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 $1/\beta = 7.0$.

FILTER: Perform a low pass filter on pressure 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

SECTIONU (original module of SECTION): Select a time span of data based on scan number in order to reduce a file size. The minimum number was set to be the starting time when the CTD package was

beneath the sea-surface after activation of the pump. The maximum number of was set to be the end time when the package came up from the surface.

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 dissolved oxygen (SBE43).

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

BOTTOMCUT (original module): Bottom cut deletes discontinuous scan bottom data if it's created by BINAVG.

DERIVE: Compute salinity, potential temperature, and sigma-theta.

SPLIT: Separate the data from an input .cnv file into down cast and up cast files.

Configuration file
KR1501B.xmlcon

Specifications of the sensors are listed below.

CTD: SBE911plus CTD system

Under water unit: SBE9plus (S/N: 09P42423-0357, Sea-Bird Electronics, Inc.)

Pressure sensor: Digiquartz pressure sensor (S/N 42423)

Calibrated Date: 04 Apr. 2014

Temperature sensors: SBE03Plus (S/N: 03P5329, Sea-Bird Electronics, Inc.)

Calibrated Date: 28 Oct. 2014

Conductivity sensors: SBE04C (S/N: 043889, Sea-Bird Electronics, Inc.)

Calibrated Date: 29 Oct. 2014

Dissolved Oxygen sensors: SBE43 (S/N: 430949, Sea-Bird Electronics, Inc.)

Calibrated Date: 11 Nov. 2014

Altimeter: PSA-916T (S/N: 1239, Teledyne Benthos, Inc.)

Carousel water sampler: SBE32 (S/N: 3227443-0389, Sea-Bird Electronics, Inc.)

Deck unit: SBE11plus (S/N 11P9833-0344, Sea-Bird Electronics, Inc.)

5. Cruise log

Shipboard Log (KR15-01 15/03/13 - 15/03/19)				
Date	Time	Description	Remark	Position/Weather/Wind/Sea condition (Noon)
13.Mar.15	9:00	Departure from JAMSTEC		03/13 12:00(JST)
	10:00-10:45	Onboard seminar		34-42.0N 139-43.2E
	11:00-11:10	Scientists meeting		Off Suzuki-Minami
	11:30	Let go anchor, arrived Tateyama-Wan		b
				WSW-7(near gale)
14.Mar.15				4(sea moderate)
				3(moderate short)
	08:30-09:10	Scientists meeting		03/14 12:00(JST)
	11:30	Heaving anchor, left Tateyamawan		35-00.6N,139-50.1E
	18:30-18:50	Scientists meeting		Tateyama-Wan
15.Mar.15				c
				WSW-3(gentle breeze)
				1(calm)
				1(low swell sea)
	3:00	Arrived at research area(Off Boso)		03/15 12:00(JST)
16.Mar.15	5:00	Standby for research		33-45.1N,142-00.0E
	5:59	Deployed 11K FF sampling camera system		Off Boso
	06:22-08:11	Carried out CTD survey		be
	8:45	11K FF sampling camera system left the sea bottom		ENE-4(moderate breeze)
	08:48-09:16	Carried out calibration for 11K FF sampling camera system		3(sea slight)
	13:33	11K FF sampling camera system left the sea bottom		1(low swell sea)
	16:24	11K FF sampling camera system floated		
	16:55	Recovered 11K FF sampling camera system		
	5:00	Standby for research		03/16 12:00(JST)
	5:42	Deployed 11K FF sampling camera system		33-45.1N,142-00.0E
17.Mar.15	7:11	11K FF sampling camera system left the sea bottom		Off Boso
	07:14-07:40	Carried out calibration for 11K FF sampling camera system		o
	8:14	11K FF sampling camera system left the sea bottom		West-3(gentle breeze)
	9:47	11K FF sampling camera system floated		2(sea smooth)
	10:16	Recovered 11K FF sampling camera system		1(low swell sea)
	10:30	Left the research area for Tokyo-Wan	Due to forecast rough sea	
				03/17 12:00(JST)
	15:30	Heaving anchor, left Yokosuka-Ko No. 4 Area for research area		35-19.7N,139-41.1E
				Yokosuka-Ko No.4 Area
18.Mar.15				m
				0(calm)
				0(calm)
				0(no swell)
	3:00	Arrived at research area(Off Boso)		03/18 12:00(JST)
19.Mar.15	7:45	Standby for research		33-45.1N 141-59.8E
	8:13	Deployed 11K FF sampling camera system		Off Boso
	08:30-12:52	Carried out CTD survey		be
	10:56	11K FF sampling camera system left the sea bottom		West-3(gentle breeze)
	11:34	11K FF sampling camera system left the sea bottom		2(sea smooth)
	16:24	11K FF sampling camera system floated		1(low swell sea)
	17:45	Recovered 11K FF sampling camera system		
	18:10	Left research area for Yokosuka		
	11:30	Arrived at Yokosuka JAMSTEC		03/19 12:00(JST)
		Scientists disembark "KAIREI"		35-19.1N 139-39.0E
				JAMSTEC

6. Observatories

I. Camera system observatory

a. 1st deployment

Date: Mar 15, 2015 (5:45) – Mar 15, 2015 (16:55) (LTC)

Site: IO1 (Izu-Ogasawara Trench)

Deploy (in): 5:45-6:00

On the bottom: 33-44.9976 N, 142-00.2709, 9250.4 m (8:45)

Release from the bottom: 13:33

Refloated: 16:24

Objective:

- 1) Taking trench bottom surface sediments and waters.

Payload:

- 1) CTD
- 2) 3 Sediment samplers
- 3) 3 5L Niskin bottles

Results

Each three sediment cores and Niskin bottles of bottom waters were successfully retrieved. Niskin bottles were closed by using electric erosion triggers.

b. 2nd deployment

Date: Mar 16, 2015 (5:22) – Mar 16, 2015 (10:16) (LTC)

Site: IO3 (abyssal plain, Northwest Pacific)

Deploy (in): 5:22-5:43

On the bottom: 33-44.6074 N, 142-52.9801, 5256.8 m (7:14)

Release from the bottom: approx. 08:10

Refloated: 9:47

Objective:

- 1) Taking trench bottom surface sediments.

Payload:

- 1) CTD

2) 3 Sediment samplers

Results

Three sediment cores were successfully retrieved.

c. 3rd deployment

Date: Mar 18, 2015 (:) – Mar 18, 2015 (:) (LTC)

Site: IO1 (Izu-Ogasawara Trench)

Deploy (in):

On the bottom: 11-22.0533 N, 142-25.4486, 10901 m (19:13)

Release from the bottom: 06:06

Refloated: 9:40

Objective:

1) Taking trench bottom surface sediments and waters.

Payload:

1) CTD

2) 3 Sediment samplers

Results

Three sediment cores were successfully retrieved.

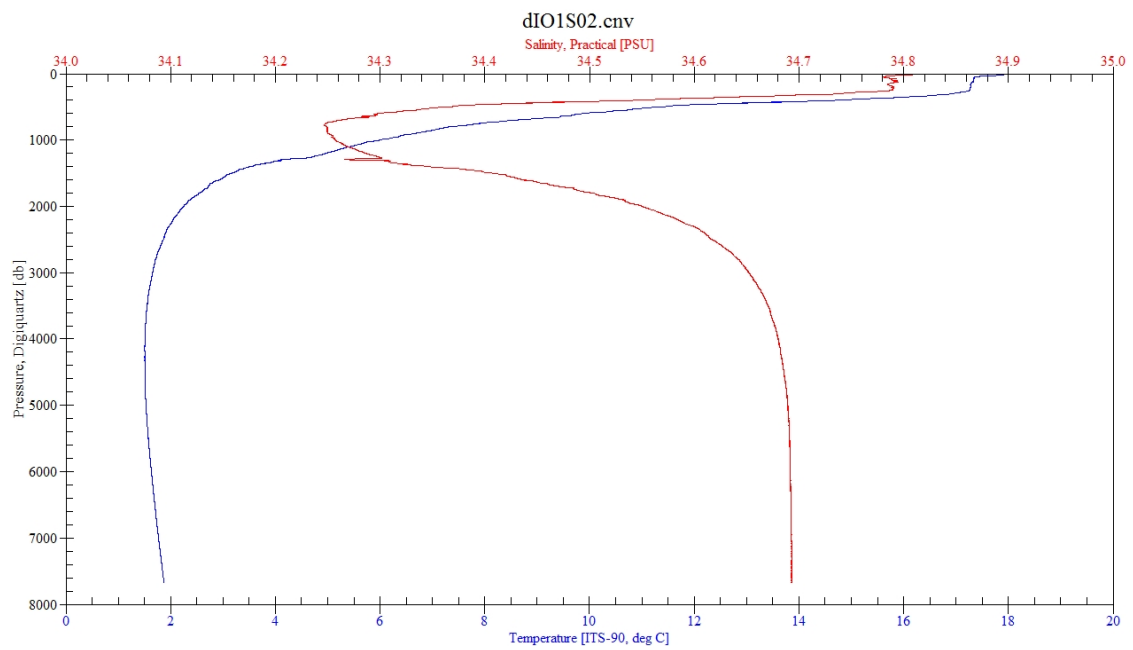
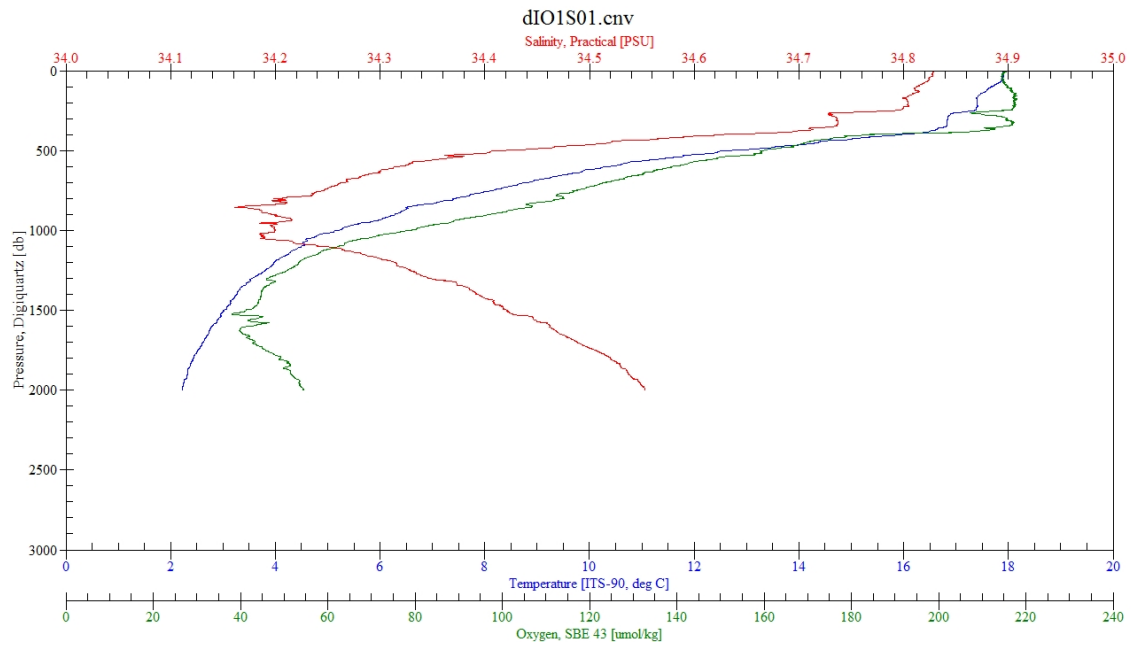
II. CTD water sampling

KR15-01 CTD casttable													
Stnnbr	Castno	Date(UTC)	Time(UTC)		BottomPosition		Depth	Wire Out	HT Above Bottom	Max Depth	Max Pressure	CTD Filename	Remark
		(mmddy)	Start	End	Latitude	Longitude							
IO1	1	031415	21:28	23:11	33-45.13 N	142-00.17 E	9251.0	2004.7	-	1978.3	2002.0	IO1S01	
IO1	2	031815	23:34	03:50	33-45.11 N	141-59.78 E	9247.0	7514.9	-	7501.0	7688.0	IO1S02	

(1) Preliminary Results

During this cruise, 2 casts of CTD observation were carried out. Date, time and locations of the CTD casts are listed in Table 7.1.

Vertical profile (down cast) of primary temperature, salinity and dissolved oxygen with pressure are shown in Figure 7.1.



CTD profile (IO1S01 and IO1S02)

(2) Data archive

All raw and processed data files were copied onto HD provided by Data Management Office (DMO).

7. Onboard data

I. Core description

Kiichiro Kawamura, Keita Yoshimoto (Yamaguchi University)

1. St. IO-01

1.1 Overall topographic feature around the Boso triple junction

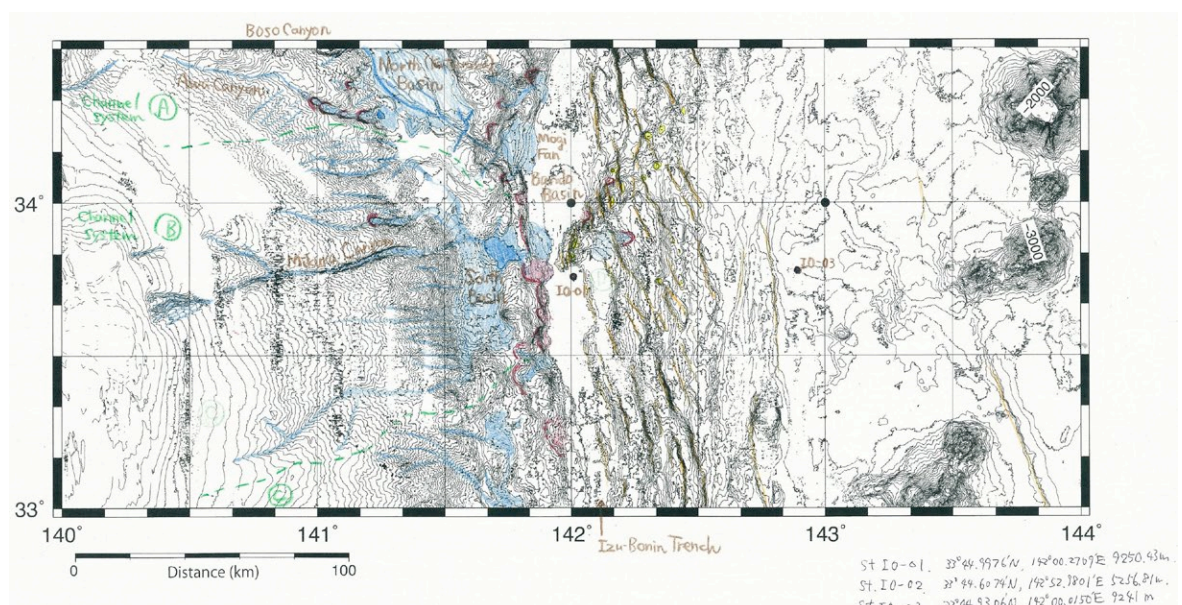
The Stations IO-01 L1 and L2 are located on a flat seabed at the bottom of the Izu-Bonin Trench. The water depths of IO-01 L1 and L2 are 9250.43 m and 9241 m, where is the south of the TTT-type Boso triple junction.

There are two channel sedimentary systems around the coring site. One is that the sediments are originally derived from the Sagami River and the Sagami Trough through the Boso (Awa) Canyon to the North Basin (or Katsuura Basin). The sediments are finally supplied to the Mogi Fan in the Bando Basin on the Boso triple junction (Soh et al., 1988). Based on the channel system feature, the sediments in the Mogi Fan might be composed mainly of terrigenous materials.

The other is the south channel system from the Mikura Canyon to the South Basin. Some of the overflow sediments should be supplied in a downslope basin at the bottom of the Izu-Bonin Trench. The sediments through this channel system might be composed mainly of volcanic materials from the Mikura Islands and the other Izu Islands.

This downslope basin is connected directly with the Bando Basin by a narrow (~1 km wide) straight. These two basins show a big gourd-shaped basin. The lander system with a deep-sea camera, two water samplers and three 60 cm corers (A, B, C) was landed on the downslope basin.

Furthermore, there are four thrust faults beneath the Bando Basin (Seno et al., 1987). Methane or other fluids might be diffused and/or transported along the thrust faults.



A detailed topographic map around the coring site. Solid circles indicate the coring sites of St. IO-01 (L1, L2), -03. Blue-colored areas indicate channels, basins and deep-sea fans. We can see two channel sedimentary systems; A and B. Green dotted lines show the system boundary. The channel system A is going to the Mogi Fan. The system B is going to the South Basin and a downslope basin at the Sites of the St. IO-01 L1 and L2. Arcuate-shaped red lines demonstrate presumable submarine landslide scars, and red-colored areas are presumable wasting masses. Orange straight lines indicate lineaments, which might be related to normal fault system.

1.2 Tentative core observation

1.2.1 St. IO-01 L1

Before the core sediment sampling, the bottom seawater up to ~5 cm from the core sediment top was collected for biological studies and other chemical analyses. The sample names of the seawater are named as St. IO-01L1 -1, -2, -3.

All the cores of St. IO-01L1 A, B, C are ~30 cm in length. On the basis of the tentative observation from the outer barrel and smear slide observations, there are mainly two sedimentary units; a surface oxidized layer of dark brown (10YR3/3) clay with diatoms at 0-8 cm and a grayish layer of olive black (5Y3/1) clay with diatoms at 8-30 cm. There are several tube-shaped burrows (presumably by benthic animals) of ~ 1.0 cm in diameter at 1-4 cm in the core depth. The sediment colors of this tentative observation is not critically correct, because of a core disturbance. Because the whole core samples at 0-5 cm were sampled using Biology and other chemical analyses, we could describe sedimentologically the core sample of St. IO-01L1A below 5 cm in core depth as section 1.3.1.

1.2.2 St. IO-01 L2

The sampling method for the bottom water in these cores is same as those of St. IO-01 L1. The sample names of the seawater are named as St. IO-01 L2 -1, -2, -3.

All the cores of St. IO-01 L2A, B, C are ~30 cm in length and the lithology is mostly same as that of the St. IO-01 L1A. We could describe in detail the lithology the split core sample of St. IO-01 L2A as section 1.3.2.

1.3 Core description

1.3.1 St.-IO-01 L1A

The sediments are ordinarily called as a “hemipelagic clay”, which is composed mainly of olive black clay with diatoms bearing volcanic ash, sponge spicules and radiolarians.

The total length of this core sample (St. IO-01 L1A) is 29.5 cm. We describe in detail the split core sample of 24.5 cm long at 5-29.5 cm as below.

At 5-9 cm, the surface oxidized layer of the clay with diatoms are laminated with “lighter” brownish

black (10YR3/2) and “darker” brownish black (10YR3/3) clayey lamina. The darker lamina is composed of many dark brownish clay aggregations of several micronmeter (probably manganese micronodules?). At 9 cm, there is a sharp base indicating probably a hiatus or so.

At 9-27.7 cm, olive black (5Y3/2) clay with diatoms is interbedded with fine sand lamina at 12, 13, 15, 16 and 23.5 cm in core depth. At 9-10 cm, the color changes olive brown (2.5Y4/3) due to probably diagenetic processes. There are two black (5YR1.7/1) scoriaceous layers of coarse-grain-sized and very-fine-grain-sized at 26.5-27.2 and 27.3-27.7 cm, respectively. The olive black layer at 9-26.5 cm might be deposited during one or several depositional events as a turbidite.

At 27.7-29.5 cm, the olive black (7.5Y3/2) diatom clay bearing volcanic ash, sponge spicules. This layer is in diatom rich, because of probably low sedimentation rate.

1.3.2 St.-IO-01 L2A

The lithology is mostly same as those of the St.-IO-01 L1A. The total length of this core sample (St. IO-01 L2A) is 33.0 cm.

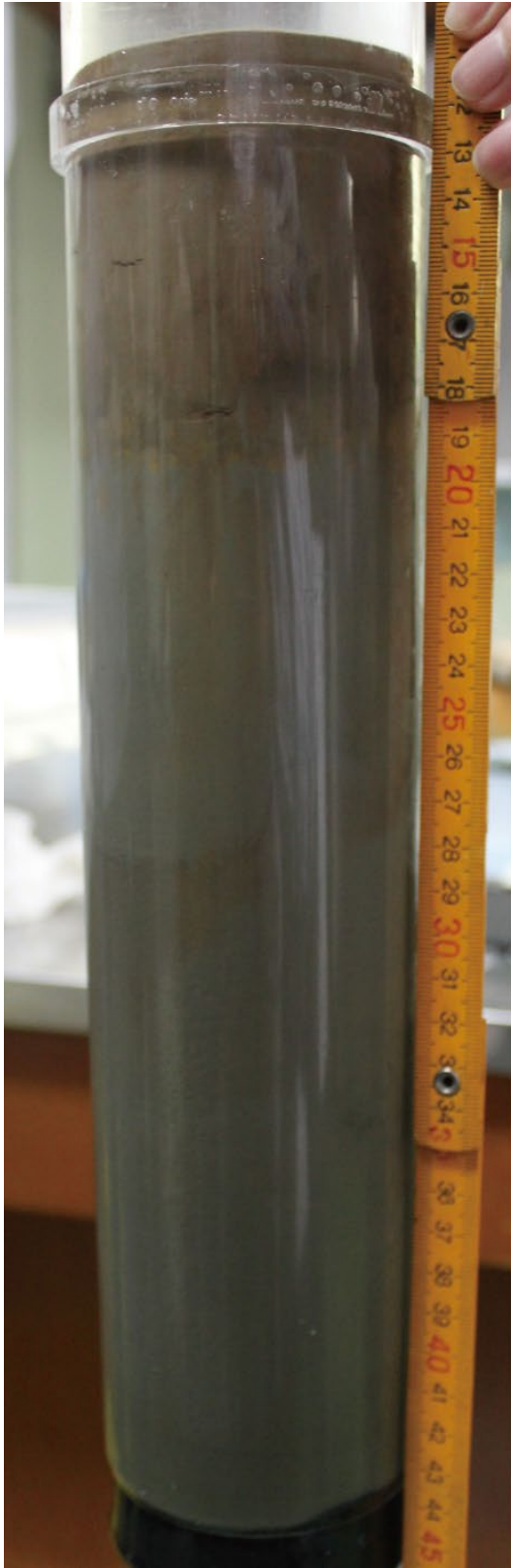
At 0-7 cm, the surface oxidized layer of the clay with diatoms are laminated “lighter” brownish black (10YR3/2) and “darker” brownish black (10YR3/3).

At 7-23.5 cm, olive black (5Y3/2) clay with diatoms is interbedded with fine sand lamina at 10, 10.5 and 19 cm in core depth. At 7-7.5 cm, the color changes olive brown (5Y3/2), because of probably diagenetic processes. There are two black (7.5Y2/1) scoriaceous layers of coarse-grain-sized and very-fine-grain-sized at 22-23 cm, respectively. This layer at 7-23.5 cm might be deposited during one depositional event as a turbidite.

At 23.5-33 cm, the olive black (10Y3/2) silt with diatoms. This layer would be a turbidite.



Photograph St. IO-01 L1A. Left: whole sample, Right: split sample.



Photograph St. IO-01 L2A. Left: whole sample, Right: split sample.

2. St. IO-03

2.1 Overall topographic feature on the abyssal plain

There are many normal faults on the abyssal plain nearby the trench axis in the Pacific plate. Recently these normal faults are thought to be one of the potential fluid conduits. The conduits might be related to the plate bending process due to plate subduction as follows.

At the Boso triple junction, the Philippine Sea plate subducts beneath the North American plate, and the Pacific plate subducts beneath both plates with a steep angle; the Philippine Sea plate and the North American plate. Because the Pacific plate should be bended largely before the subduction at the Izu-Bonin Trench, many normal faults are generally formed on the Pacific plate. They build a horst-and-graben structure of sub-parallel to the trench axis as a convex-concave topography on the Pacific plate.

On the basis of the detailed bathymetric map, the normal faults are in two directions around this study area. One is North-South (N-S) direction being a sub-parallel to the trench axis. The N-S normal faults should be formed by the plate bending with the subduction. The other is NNW-SSE direction being slightly oblique to the trench axis. The NNW-SSE lineaments are mostly correspondent with the direction of the primary fracture zone (perpendicular to the magnetic lineaments) in the Pacific plate (Nakanishi et al., 2011). These lineaments might become a weak plane to form the normal faults during the plate bending.

According to Yamano et al. (2008), there are sporadically high heat flow spots around 38-40°N of the Japan Trench area on the Pacific plate. It implies that a fluid advection might occur in places in the Pacific plate. They consider that the normal fault system due to the plate bending might relate to the fluid advection and be working as fluid conduits to form the high heat flow spots.

The St. IO-03 is located on the abyssal plane on the Pacific plate. The water depth was 5256.81 m. There are no clear lineaments around our station site, but there is one N-S lineament (probably a normal fault) at ~10 km west from the station site.

2.2 Tentative core observation

Before the core sampling, the bottom seawater up to ~5 cm from the core sediment top was collected for biological studies and other chemical analyses. The sample names of the seawater are named as St. IO-03 -1, -2 and -3.

The cores of St. IO-03A is 32 cm, B is ~21 cm, C is ~10 cm in length. All the cores should be originally ~30 cm in length, but the cores B and C would be shortened during the coring operation as following lines of evidence.

First evidence: we could see mud striations of several cm long inside the core barrel in the cores B and C.

Second evidence: it was difficult to release the lander system at this site. Although we tried to

release several times to call the release command from this vessel, the lander was not immediately released. Finally the lander system was released after several tens minutes from the first call.

Based on these lines of evidence, we consider that the sediments of several cm long were dropped out from the core barrel during “takeoff” from the seabed because of unknown reasons.

On the basis of the tentative observation from the outer barrel and smear slide observations of IO-03A, there are mainly two sedimentary units; a surface dark reddish brown (5YR3/2) sandy clay with at 0-5 cm and a dark reddish brown (5YR3/3) sandy clay at 8-32 cm. There are several tube-shaped burrows (presumably by benthic animals) of ~ 1.0 cm in diameter at 0-1 cm in the core depth. On the top of the core sample, there are several Mn coating pumices of several cm in diameter and a white benthic animal of ~0.5 cm having two legs. The sediment colors of this tentative observation is not critically correct, because of a core disturbance. Because the whole core samples at 0-5 cm were sampled using Biological studies and other chemical analyses, we could describe sedimentologically the core sample of St. IO-02A below 5 cm in core depth as follows.

2.3 Core description

The sediments are ordinarily called as a “pelagic clay” or “red clay”, which is composed mainly of brownish black clay bearing volcanic ash, diatoms, sponge spicules and radiolarians.

The total length of this core sample (St. IO-03A) is 32 cm, but we describe in detail the split core sample of 27 cm long at 5-32 cm as below.

At 5-12 cm, bioturbated dark reddish brown sandy clay (5YR3/2) is observed. It includes volcanic ash and diatoms.

At 12-22 cm, bioturbated medium-grain sized scoria-rich dark brown sandy clay is observed. This layer is darker color than other layers throughout the core. There are scoria-rich layers (but well bioturbated) at the top and the bottom of this layer. This layer might be higher sedimentation rate as a contourite or so.

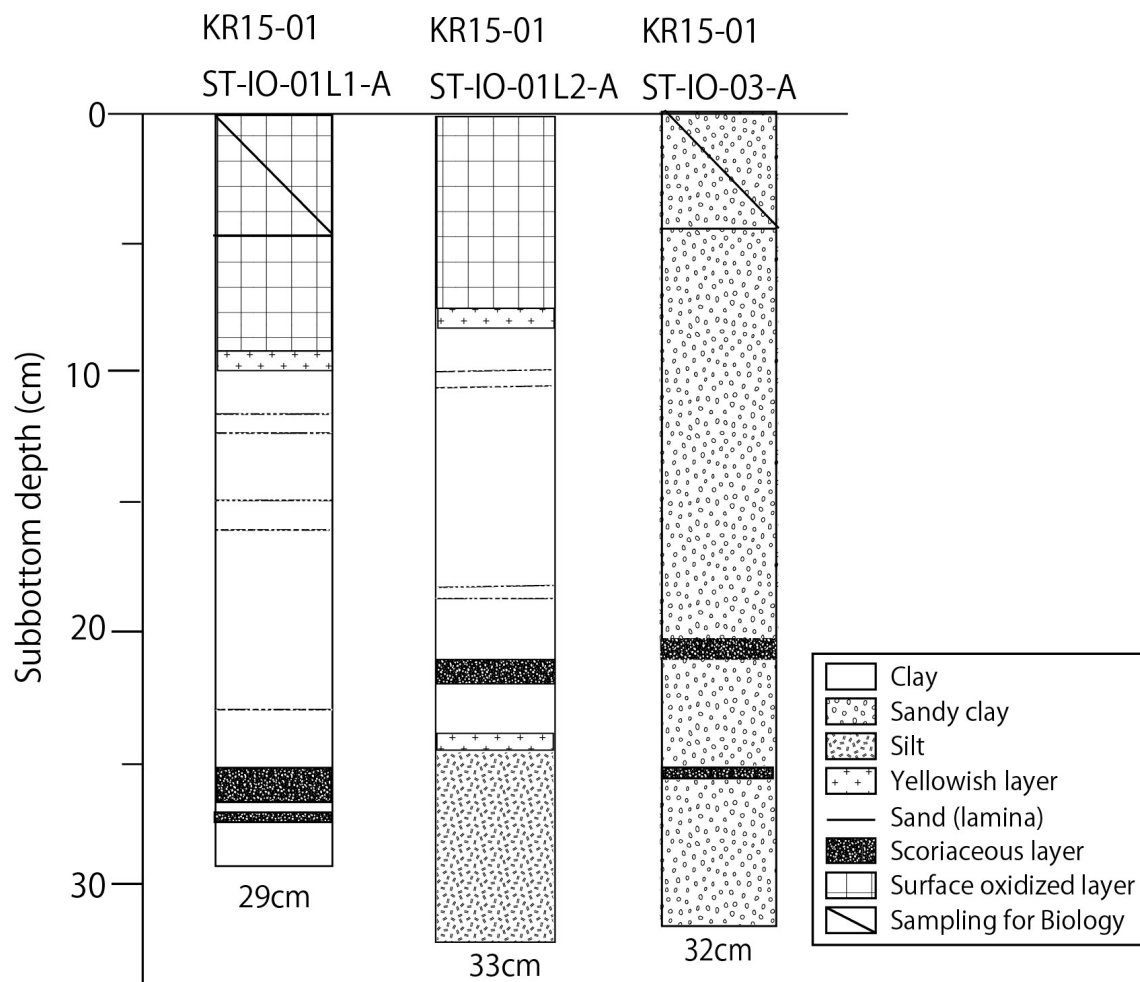
At 22-30 cm, bioturbated brownish black sandy clay is observed. This layer includes burrows and/or faint lamina filled with grayish yellow brown (10YR4/2) sandy clay at 26-27 cm.

At 30-32 cm, we observe same as 5-12 cm.



Photograph St. IO-03A. Left: whole sample, Right: split sample.

Core lithology



Graphic Lithology

Cruise: KR15-01

Core: ST.10-01 **L1**Section: **A**

A/W

GRAPHIC LITHOLOGY	SEDIMENT STRUCTURE	COLOR	Remarks	LITHOLOGIC DESCRIPTION
		10YR 3/2		
10		10YR 3/2		0-5 cm. Dark brown clay w/ diatoms bearing vol. ash, diatoms. [Sampling for biology]
20		5Y 3/2		5-9 cm. Brownish black clay w/ diatoms bearing vol. ash, diatoms
30		5YR 2/1		interbedded w/ brownish black clay (darker)
40		2.5Y 3/2		at 6.7-6.9, 7.3-7.7-8.0 cm
50				9-10 cm. Olive brown clay
60				10-27.7 cm. Olive black clay w/ diatoms interbedded w/ f.s. at 12, 11, 15, 16, 23.5 cm.
70				26.5-27.2 cm. (f.s. sized) interbedded w/ vol. ash at 26.5-27.2 cm. (f.s. sized)
80				27.3-27.7 cm. (f.s. sized)
90				27.7-29.5 cm. Olive black diatom clay
100 (cm)				
				section length: 29.5
				depth range in core: 5-29.5 cm

Observer: K. W. M. M.

Graphic Lithology

Cruise: KR15-01

Core: ST.10-01 **03**Section: **A**

A/W

GRAPHIC LITHOLOGY	SEDIMENT STRUCTURE	COLOR	Remarks	LITHOLOGIC DESCRIPTION
		5YR 3/2		
10		5YR 3/2		0-5 cm. Pale reddish brown clay sandy sampling for biology
20		5YR 3/2		5-12 cm. Dark reddish brown clay sandy
30		7.5YR 3/2		12-22 cm. Dark brown sandy clay interbedded w/ siltin. layer at 15 cm (c.s. size)
40		10YR 3/1		22-30 cm. Brownish black sandy clay included by burrow filled w/ grayish yellow brown sandy (10YR 9/2) clay at 26-27 cm.
50				30-32 cm. Same as 12-22 cm.
60				⊙ Burrow at 18 cm.
70				
80				
90				
100 (cm)				
				section length: 32.27 cm
				depth range in core: 5-32 cm

Observer: _____

Graphic Lithology

Cruise: KRIS-01

Core: ST. 10-0 L2

Section: A

A/W

Depth (cm)	GRAPHIC LITHOLOGY	SEDIMENT STRUCTURE	COLOR	Remarks	LITHOLOGIC DESCRIPTION
0					0-7 cm.
10			10YR2/5		Dark brown - Olive black clay w/ distor.
15			7.5Y2/2		interbedded w/ brownish black clay
20			7.5Y2/2		
25			10Y2/2		7-23.5 cm
30			10Y2/2		Olive black clay w/ distor.
35			10Y2/2		interbedded w/ f.s. lamination
40			10Y2/2		at 19, 10.5, 10 cm
45			10Y2/2		w/ 10.5, 10 cm
50			10Y2/2		at 22-23 cm
55			10Y2/2		23.5-23.5 cm
60			10Y2/2		Olive black silt w/ distor.
65			10Y2/2		23.5-24.0 cm
70			10Y2/2		color is orange color.
75			10Y2/2		hard yellowish layer at 7-7.5 cm
80			10Y2/2		(dull yellowish brown)
85			10Y2/2		
90			10Y2/2		
95			10Y2/2		
100			10Y2/2		

section length: 33

depth range in core: 0-33 cm

Observer: _____

○ About data

Include any information that may be necessary for analysis and QC planning and secondary use (publications, provisions, etc.)

8. Acknowledgements

We are grateful to Captain Mr. Aoki, Chief Officer Mr. Tsuji and Chief Engineer Mr. Ohta for their safe navigation and their skillful handling of “R/V Kairei”. Great thanks are due to “Kaiko” operation team represented by Mr. Wakamatsu and a CTD operation team (Mr. Ito and Mr. Uno) for their operations in sampling. We also appreciate Mr. Onodera for his any assistance in any aspects of the expedition. We thank all the JAMSTEC personnel who have supported us. Finally, we would like to appreciate all the person who supported directly or indirectly this cruise

9. 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.