Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-01 Room:103 Time:May 24 09:00-09:15

Preliminary results of IODP Expedition 338: Operational aspects

Kyuichi Kanagawa[1*], Brandon Dugan[2], Gregory Moore[3], Michael Strasser[4], Sean Toczko[5], Lena Maeda[5], IODP Expedition 338 Scientists[6]

[1]Chiba University, [2]Rice University, [3]University of Hawaii, [4]ETH, [5]JAMSTEC, [6]IODP Expedition 338

The Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) is a multi-disciplinary scientific project designed to investigate fault mechanics and seismogenesis along subduction megathrusts through reflection and refraction seismic imaging, direct sampling, in situ measurements, and long-term monitoring in conjunction with laboratory and numerical modeling studies. As part of the NanTroSEIZE program, operations during Integrated Ocean Drilling Program (IODP) Expedition 338 were planned to extend and case riser Hole C0002F located at the southeastern margin of the Kumano forearc basin, begun on Expedition 326 in 2010, from 856 meters below the sea floor (mbsf) to 3600 mbsf.

Riser operations extended the hole to 2005.5 mbsf, collecting a full suite of logging- and measurement-while-drilling (LWD/MWD), mud gas and cutting data. However, due to damage to the riser during unfavorable winds and strong current conditions, riser operations were cancelled. Hole C0002F was suspended at 2005.5 mbsf, but left for re-entry during future riser drilling operations, which will deepen the hole to penetrate the megasplay fault at about 5000 mbsf. Contingency riserless operations included coring at Site C0002 (200-505, 902-940 and 1100.5-1120 mbsf), LWD at Sites C0012 (0-709 mbsf) and C0018 (0-350 mbsf), and LWD and coring at Sites C0021 (0-294 mbsf) and C0022 (0-420 mbsf).

Combined primary riser operations and contingency riserless operations at Site C0002 allowed to sample the upper part of the forearc basin sediments and gas hydrate zone, the basal Kumano Basin-to-accretionary prism unconformity, and the upper portion of the inner wedge with cores, drill cuttings, mud gas sampling, and an extensive suite of LWD logs.

Site C0018 is located within a depocenter for downslope mass transport in a slope basin seaward of the megasplay fault, and was drilled and sampled during Expedition 333 targeting mass-transport deposits (MTDs). Site C0021 is located ˜2 km NW of Site C0018 and at a more proximal site for MTDs observed at Site C0018. LWD at Site C0018 provided logging data to characterize the sedimentary section and MTDs, which are correlatable with the previous core and seismic data. LWD and coring at Site C0021 provided data for correlation to Site C0018. Together the sites provided constraints on the lateral variability of MTDs within the basin, which relates to the nature, provenance, and kinematics of the submarine landslides.

Site C0022 is located in the slope basin between previously drilled Sites C0004 and C0008. LWD and coring at this site penetrated through the tip of the megasplay fault, and provided constraints on the activity of this megasplay fault.

Site C0012 is located in the Shikoku Basin on the crest of a prominent basement high (Kashinosaki Knoll) on the subducting Philippine Sea plate, where coring down to 630.5 mbsf had been conducted during Expeditions 322 and 333. LWD operations at this site provided logging data to characterize the sedimentary section and the upper portion of the oceanic crust, which are correlatable with the previous core and seismic data.

Keywords: IODP Expedition 338, C0002, C0012, C0018, C0021, C0022

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-02 Room:103 Time:May 24 09:15-09:30

Porewater chemistry of seafloor sediments based on the onboard analyses Expedition 338 at Nankai Trough

Harue Masuda[1*], Tomohiro Toki[2], IODP Expedition 338 Scientists[3]

[1]Osaka City University, [2]University of Ryukyus, [3]Rice Univ. and others

During IODP Expedition 338, sediments were sampled from Site C0002 at Kumano Basin and Site C0022 on the frontal arc slope of Nankai Trough. At Site C0002, the sediments were obtained from the depths between 200 - 500 mbsf (meters below seafloor), 900 - 940 mbsf, and 1100 ? 1120 mbsf. Porewater was analyzed after squeezing using the standard onboard analytical procedures. Porewater from the sediments at 1111 mbsf was extracted using GRIND method after testing the appropriateness of this method. Here, the tested results of GRIND method and porewater chemistry of the Site C0002 are described.

GRIND method was originally developed for the sediments and rocks, for which standard squeezing (standard method, hereafter) did not provide adequate volumes of pore?fluid. However, it would also be applicable to extract the porewater from small volume of the sediment samples. 40 g sediment was ground with 5 mL ultrapure water in a ball mill, and the water was squeezed using the standard method. As results, chlorinity was comparable (RD <2%) with that obtained using the standard method, and major ions, Br, sulfate, Na, Mg and Ca, and minor ions, B, Li and Sr are useful if 5-10 % difference of concentration from that obtained using the standard method can be acceptable. Among the major ions, K concentration was always ca. 20 % higher and phosphate ca. 15 % lower than those obtained using the standard method. Most of the minor and trace metal concentrations (Fe, Mn, Si, Ba, V, Cu, Zn, Rb, Mo, Cs, Pb, U) obtained using the GRIND method were much larger than those obtained using the standard squeezing method, probably due to extraction of adsorbed elements onto the sediment particles via desorption in addition to the dissolved components. Thus, the GRIND method cannot be applicable for the minor and trace metals except Li and Sr, of which RD are <10%.

At Site C0002, continuous profiles of porewater chemistry are obtained down to 1050 mbsf combining the results of previous and present expeditions. 10 samples from the above former two intervals were analyzed using both standard squeezing and GRIND methods, and the deepest porewater chemistry was obtained for the sediment at 1111 mbsf only using the GRIND method.

Chlorinity decreased from 550 mM of the porewater from the seafloor sediment to 350 mM down to 400 mbsf, increased to 480 mM down to 800 mbsf, then decreased to 450 mM at 1111 mbsf. The boundary between Units I (upper forearc basin sediment) - II (lower forearc sediment) and II-III (basal (starved) sediment) are 140 and 830 mbsf respectively. The depletion of chloriniy occurs in Unit II due to the contribution of freshwater from gas hydrates. Similar depletion of the concentration in the Unit II are observed for Na, K, Mg, B, Sr, Ba and Rb. Alkalinity, phosphate and ammonium increase in Unit I and decrease in Unit II, suggesting that those are released via decomposition of organic matters and then removed by precipitation (P) and decomposition (ammonium). Br increases in Unit I due to decomposition of biogenic material (probably algae), similar to P and ammonium, while in and below Unit II, it changes in accordance with Cl. Ca and Li increase in Unit II probably due to dissolution of biogenic and/or detrital minerals. In Unit IV (upper accretionary prism), chlorinity alkalinity and Na decreased, while Ca increased with depth in Unit IV. Variations of each element correspond to the lithological units, suggesting that the porewater chemistry is partly controlled by the interaction between porewater and sediments including mircrobiology of each sediments, which comprise different mineralogy and chemistry.

Keywords: porewater, gas hydrate, Kumano Basin, GRIND method

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-03 Room:103 Time:May 24 09:30-09:50

JFAST: Drilling to the Plate Boundary to Investigate the Large Slip of the 2011 Tohoku-oki Earthquake

James Mori[1*], Fred Chester[2], Nobu Eguchi[3], Sean Toczko[3], Emily Brodsky[4], Shuichi Kodaira[3], Expedition 343 Scientists[5]

[1]Kyoto Univ., [2]Texas A&M Univ., [3]JAMSTEC, [4]Univ. California Santa Cruz, [5]IODP

The 2011 Tohoku-Oki earthquake produced the largest fault slip ever recorded for an earthquake, up to 50 meters on the shallow portion of the subduction megathrust. This region of the plate boundary was not expected to have large slip during earthquakes, so the huge co-seismic displacements and resultant devastating tsunami were a shocking surprise to the seismological community. In response to the earthquake, the Integrated Ocean Drilling Program (IODP) rapidly planned and carried out Expedition 343 (JFAST) to investigate the rupture mechanisms and physical conditions that produced the large slip. During April/May and July 2012, three boreholes located at a site close to the Japan Trench about 90 km east of earthquake epicenter, successfully reached the plate boundary fault at depths of about 820 meters below seafloor. These boreholes enabled geophysical logging, core sampling and installation of a temperature observatory in the vicinity of the fault zone.

Analyses of core samples obtained from the plate boundary decollement show a narrow zone (less than 5 meters) of highly deformed fabric in a clay layer. The pronounced localization of deformation within this material suggests coseismic weakening during past earthquakes. Estimates of the level of dynamic friction during the recent earthquake are expected from the temperature monitoring that was installed during the expedition. Also, laboratory experiments on the retrieved core samples will give estimates of the frictional properties of the fault rocks. Combining investigations of the physical, chemical, and mechanical properties of the fault zone along with determinations of the local stress state from borehole breakouts, will provide information to help explain the very large slip that occurred during the earthquake.

Keywords: JFAST, Tohoku-oki earthquake, IODP, Sea-floor Drilling, Fault Friction, Japan Trench

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-04 Room:103 Time:May 24 09:50-10:05

Subseafloor biosphere in plate boundary of Japan Trench forearc

Ken Takai[1*], Shinsuke Kawagucci[1], Uta Konno[1], Tsuyoshi Ishikawa[2], James C. Sample[3], IODP Expedition 343 Scientists[4]

[1]BIOGEOS, JAMSTEC, [2]KICSR, JAMSTEC, [3]Northern Arizona Univeristy, [4]IODP Exp 343 Scientists

The 11 March 2011 (Mw 9.0) Tohoku-oki earthquake source exhibited a compound rupture. The amount of slip increased up dip from the hypocenter to where the maximum slip of more than 50 m occurred near the trench. Large slip near the trench caused the strong impulsive peak of the tsunami. The Japan Trench Fast Drilling Project (JFAST) sailed April 1 to May 24 and was a rapid-response IODP expedition (IODP Exp 343) with a primary scientific objective to identify slipping fault(s) by LWD and retrieving core samples from across the plate boundary. The IODP Exp 343 had another objective as well. It was to justify the possible existence of earthquake-sustained subseafloor biosphere in the seismogenic subduction systems that had been hypothesized based on previous observations and laboratory experiments of abundant mechanochemical hydrogenogenesis by fault activities.

Since many geophysical observations predicted that the 3.11 Tohoku-oki earthquake provided the large seafloor displacement probably induced by large fault slip(s) along certain fault(s) in somewhere of the deep subseafloor environment at the Site C0019, we predicted that the possible earthquake-induced H2 concentration anomaly occurred at the time of slipping and was still preserved in the core sample of the Site C0019 even 14 months after the Tohoku-oki earthquake. A great spike in H2 concentration at around 700 m below seafloor (mbsf) may represent the earthquake-induced H2 concentration anomaly followed by the fault slipping caused by the Tohoku-oki earthquake. The LWD measurement and other pore-water chemistry data also suggested the existence of fault.

Not only H2 but also CH4 and other pore-water chemical characteristics in the core samples were of great geochemical and biogeochemical interest because the core samples that covered the whole sequence of plate boundary zones in the forearc regions of the subduction systems. There have been known only 3 forearc regions in the history where the ODP-IODP operation recovered the whole sequence of core samples penetrating the inter-plates boundary. Our pore-water chemistry demonstrated very unique profiles of abundance and isotopic composition of CH4, other hydrocarbons and sulfur compounds. These chemical profiles predicted the possible incidence and functions of novel subseafloor biosphere associated with spatially extended faulting structures and hydrothermal circulation of fluids in the deep inter-plates boundary.

Keywords: subseafloor biosphere, plate boundary, forearc, fault slipping, methane, molecular hydrogen

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-05 Room:103 Time:May 24 10:05-10:20

Biogeochemical dynamics of amino acids in deep-subsurface marine sediments

Yasuhiko T. Yamaguchi[1*], Yoshito Chikaraishi[2], Yoshinori Takano[2], Nanako O. Ogawa[2], Hisami Suga[2], Yusuke Yokoyama[3], Naohiko Ohkouchi[2]

[1]Department of Earth and Planetary Science, The University of Tokyo, [2]Institute of Biogeosciences, JAMSTEC, [3]Atmosphere and Ocean Research Institute, The University of Tokyo

Amino acids in sediment pore waters are key compounds in metabolic activities of sedimentary microbes and in remineralization of carbon and nitrogen. However little is known about their biogeochemical dynamics (e.g., sources and transformation processes) in deep-subsurface sediments.

As a new approach to constrain the sources of dissolved amino acids in sediment pore waters, this study reports and compares compound-specific d15N and enantiomer ratio (%D) of total hydrolysable amino acids (THAA) in solid phase and dissolved hydrolysable amino acids (DHAA) in pore waters from the same sediment samples. Samples were collected from deep-subsurface sediments (down to 172.9 m below seafloor) at the Sagami Trough (NW Pacific) during D/V Chikyu cruise CK09-03 (Expedition 905: December 2009).

In the sediments deeper than 9 mbsf, average %D values of DHAA were 25.9% in alanine, 24.8% in aspartic acid, 11.3% in serine, and 16.3% in glutamic acid, and average %D changes from THAA were +15.3% in alanine, -0.4% in aspartic acid, -8.1% in serine, and 4.6% in glutamic acid. Compound-specific d15N analysis showed that d15N values of alanine are higher in the DHAA than the THAA and that d15N values of glycine and glutamic acid are similar between the two fractions (d15N-DHAA - d15N-THAA = +5.8 permil, +1.9 permil, -0.3 permil, respectively). These results suggest that the DHAA fractions have different d15N and %D signatures from the THAA fractions, and that hydrolysis of the THAA could not be the sole source of the DHAA. Alternatively, the d15N and %D signatures of DHAA are consistent with the idea that in situ release of proteinaceous materials from sedimentary microbial biomass (such as peptidoglycan of Gram-positive bacteria) is an important source of DHAA. This suggests that recycle of dissolved amino acids by microbes would be an important process during amino-acid degradation and microbial metabolism in the deep-subsurface sediments.

Keywords: Deep biosphere, Organic matter, Nitrogen isotope, Amino acids, Bacteria

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-06 Room:103 Time:May 24 10:20-10:40

Exploration of the Deep Coalbed Biosphere off Shimokita (IODP Expedition 337): Overview and Perspectives

Fumio Inagaki[1*], Kai-Uwe Hinrichs[2], Yusuke Kubo[3], IODP Expedition 337 Scientists[3]

[1]Kochi Institue for Core Sample Research, JAMSTEC, [2]MARUM and Department of Geosciences, University of Bremen, Germany, [3]Center for Deep-Earth Exploration (CDEX), JAMSTEC

Among the least characterized Earth systems that can be addressed by scientific ocean drilling are deeply buried hydrocarbon reservoirs in sediments along continental margins. In particular, the role of subseafloor microbial ecosystems for the formation and fate of these reservoirs remains poorly understood. The IODP Expedition 337 was the first expedition dedicated to subseafloor microbiology that used riser-drilling technology on the drilling research vessel CHIKYU. The drilling site C0020 is located in a forearc basin formed by the subduction of the Pacific Plate off the Shimokita Peninsula at a water depth of 1,180 meters. During Expedition 337, we penetrated a 2.466 meters-deep sedimentary sequence with a series of coal (i.e., lignite) layers at around 2 km below the seafloor. Hole C0020A is currently the deepest hole in the history of scientific ocean drilling. Riser drilling at Site C0020 provided an unprecedented record of dynamically changing depositional environments in the former forearc basin off the Shimokita Peninsula during the late Oligocene and Miocene. This record is comprised of a rich diversity of lithological facies reflecting environments ranging from warm-temperature coastal back-swamps to cool water continental shelf. The use of riser-drilling technology in very deep sediments created both unique opportunities and new challenges the study of subseafloor life. Downhole logging operations yielded data of unprecedented quality that provide a comprehensive view of sediment properties and water mobility at Site C0020. Onboard analysis of gas chemistry and isotopic compositions provided the first indication of the existence of a subseafloor biosphere in deep coalbed horizons. Expedition 337 also provided a test ground for the use of riser drilling technology to address geobiological and biogeochemical objectives and was therefore a crucial step toward the next phase of deep scientific ocean drilling.

Keywords: IODP Expedition 337, Deep Biosphere, Deep Carbon Cycle

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-07 Room:103 Time:May 24 11:00-11:15

Physical properties of sediment cores and cuttings in Sanrikuoki Basin at Site C0020, IODP Expedition 337

Sumito Morita[1*], Wataru Tanikawa[2], Masafumi MURAYAMA[3], Fumio Inagaki[2], Kai-Uwe Hinrichs[4], Yusuke Kubo[5]

[1]Geological Survey of Japan, AIST GREEN, [2]KCC, JAMSTEC, [3]KCC, Kochi University, [4]Univ. of Bremen, MARUM & Dept. Geosci., [5]CDEX, JAMSTEC

Physical properties which should be affected by local diagenesis process are very important to evaluate sedimentary formations below the seafloor. A series of physical properties measurements were carried out in laboratory on D/V Chikyu, using core samples and cuttings from a riser drill hole at Site C0020 in northern Sanrikuoki Basin off Shimokita Peninsula. As routine, measurements with multi-sensor core logger were performed, moisture and density (MAD), P-wave velocity and electric resistivity were measured using discrete core samples, and thermal conductivity was measured on half cores. Cuttings recovered by the riser drilling system were also applied to MAD analysis, being separated into four categories: original bulk and sieved size categories of >4.0, 1.0?4.0, and 0.25?1.0 mm. Cubic samples cut off from the cuttings were applied to the P-wave velocity analysis and the electrical impedance analysis. In addition, anelastic strain recovery analysis was made on the vessel using some whole-round cores and vitrinite reflectance analysis was also performed on some coaly samples. As a result of the MAD analysis, porosity of siltstone, sandstone, and shale gradually decreased to the greater depth. Porosity corresponds to lithologic variation. For example, porosity of carbonate-cemented sandstone and siltstone has much lower values than non-cemented sandstone and siltstone. The carbonate-cemented rocks have also higher thermal conductivity than the others, and indicate specific CT values on X-ray computed tomography analysis. The cuttings also show a gradual decrease in porosity but have generally higher values than the core samples. Discrete core samples are likely more representative of in-situ porosity than cuttings. Vitrinite reflectance indicates basically low maturity.

Keywords: physical properties, core, cuttings, coal, IODP, Expedition 337

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-08 Room:103 Time:May 24 11:15-11:30

Coordination of NanoSIMS and cell sorting to reveal microbial metabolic activity in sediment of the South Pacific Gyre

Yuki Morono[1*], Motoo Ito[1], Terada Takeshi[2], Fumio Inagaki[1]

[1]Kochi Institute for Core Sample Research, JAMSTEC, [2]Marine Works Japan, Ltd

The South Pacific Gyre (SPG) is characterized as the most oligotrophic open ocean environment. The sediment is rich in oxygen but poor in energy-sources such as reduced organic matter, and hence harbors very low numbers of microbial cells in relatively shallow (˜20 meters below the seafloor) subseafloor sediment (D'Hondt et al., 2009; Kallmeyer et al., 2012). In such an energy-limited sedimentary habitat, only a small size of microbial community persists living functions with extraordinary low oxygen-consumption rate (Roy et al., 2012). However, because of the current technological limitation, deeper habitats of the SPG remain largely unknown.

During IODP Expedition 329, sediment samples recovered from whole sedimentary column down to the sediment-basement interface were successfully recovered, providing an unprecedented opportunity to tackle some technological challenges to clarify if indigenous life is present, and if any, what is the microbiological and biogeochemical characteristics in such extreme environments.

To evaluate small biomass in the SPG sedimentary habitat accurately, we made modification on a cell separation technique. Cell recovery ratio was monitored with an image-based cell enumeration technique (Morono et al., 2009). The control samples were prepared by mixing E. coli cells in sterilized sediment. Increasing sediment volume resulted in lower recovery of microbial cells. Cell recovery rates in the SPG sediment samples, which contain small zeolitic mineral grains, were generally lower than those in other oceanographic settings (i.e., organic-rich continental margin sediments). To gain cell recovery rate, we examined multiple density gradient layers. After multiple modifications, we cold increase cell recovery rate up to 80-95%. In addition, cell enumeration using flow cytometry showed consistent numbers with microscopy-based cell count.

We then used the above-mentioned technique for deciphering eco-physiology of microbial life in the SPG sediments. During Expedition 329, we have initiated incubation with stable isotope-labeled substrates such as bicarbonate, glucose, amino acids, acetate, and ammonium (Morono et al., 2011) under the (micro-)aerobic condition. One of the critical technological challenges in this project is to harvest low concentrations of sedimentary microbial cells for the single-cell-based microbiological analysis. Using a new cell separation technique and sorting, we successfully sorted enough number of microbial cells in small spots on the membranes (i.e., 10^3 to 10^5 cells per spot). Preliminary results from NanoSIMS analysis showed incorporation of substrates after 1.5-years incubation of microbial cells in subseafloor sediments of the SPG.

Keywords: NanoSIMS, Subseafloor biosphere, South Pacific Gyre, Stable Isotope Probing

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-09 Room:103 Time:May 24 11:45-12:00

Plio-Pleistocene sea-level changes in Canterbury Basin, off New Zealand based on fossil ostracode assemblages

Megumi Nakamura[1*], KUSUNOKI, Satoko[1], YAMADA, Katsura[2], HOYANAGI, Koichi[2]

[1]Graduate School of Science & Technology, Shinshu Univ., [2]Faculty of Science, Shinshu Univ.

High-resolution analysis of fossil ostracode assemblages was examined to clarify detailed sea-level change during the late Pliocene and early Pleistocene in IODP (Integrated Ocean Drilling Program) sites U1353 (85 m water depth), U1354 (113 m) and U1351 (122 m), which are located on the continental shelf of Canterbury Basin, off New Zealand. Forty, eighty and nineteen samples from Plio-Pleistocene strata of U1353, U1354 and U1351 were chosen respectively. In addition, the samples from core top in each shelf site and a slope site (344 m water depth) were also used to reveal recent ostracode assemblages in the study area. At least, 178 ostracode species belonging to 70 genera were identified, and many of them inhabit in the recent continental shelf around New Zealand (e.g. Swanson, 1979). We examined 103 samples containing more than 40 ostracode specimens and 78 taxa which occupied more than 3.5% of total relative abundance in any samples for Q-mode factor analysis. As a result, first six varimax factors explained 69.3% of total variance and their factors were interpreted as follows: Factor 1, inner-middle shelf (40-80 m); Factor 2, middle-outer shelf (80-200 m); Factor 3, middle-outer shelf (50-180 m); Factor 4, middle-outer shelf (75-125 m); Factor 5, lagoon/estuary and inner shelf(0-50 m); and Factor 6, outer shelf (ca. 200 m). Vertical paleobathymetric shifts were reconstructed based on Q-mode factor analysis and lithofacies. At least, seven, fourteen and three transgressive-regressive cycles with the amplitude of ca. 25-115 m water depth were recognized in U1353, U1354 and U1351, respectively. These paleobathymetric changes can be correlated with the LR04 stack curve (Lisiecki & Raymo, 2005) based on the frequency of cycles, the datum of trustworthy microfossil bioevents and unconformities. Thus, some high-stand and low-stand periods might coincide with MIS M2, G10, G10-7, G6-4, G3, G2, G1, 104, 103, 102, 101, 100, 99, 63, 62, 61, 60, 59, 43, 42, 41 and 40. In this study area, these paleobathymetric changes were strongly influenced by sea-level fluctuations because the rates of sediment accumulation and basin subsidence were nearly equal and they canceled each other.

Keywords: IODP Exp.317, Ostracode assemblage, Plio-Pleistocene, New Zealand, Sea-level change

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-10 Room:103 Time:May 24 12:00-12:15

Application of compound-specific radiocarbon dating to IODP Exp.318 U1357A core

Masako Yamane[1*], Yusuke Yokoyama[1], Yosuke Miyairi[1], Hisami Suga[2], Hiroyuki Matsuzaki[3], Naohiko Ohkouchi[2]

[1]AORI, Univ. Tokyo, [2]Biogeos, Univ. Tokyo, [3]Grad. Sch. Eng., Univ. Tokyo

Radiocarbon (^{14}C) dating of Antarctic margin sediments is difficult, because these sediments generally lack calcareous foraminifera. Moreover, the sediments are subjected to contamination of relict organic matter eroded from the Antarctic continent (*e.g.* Ohkouchi *et al*., 2003), leading to older radiocarbon ages of bulk sedimentary organic matter. Compound-specific (CS) ^{14}C dating targets short-chain (C_{14}, C_{16} and C_{18}) fatty acids isolated from sediments. These compounds are derived from various organisms, but they are little contained in relict organic matter because the decomposition rate is relatively fast (Ohkouchi *et al*., 2003). Therefore, CS ^{14}C dating is unaffected by relict organic matter from Antarctic continent (Ohkouchi and Eglinton, 2008) and can provide accurate age. The aim of this study is establishment of accurate age model of U1357A core using CS ^{14}C dating. U1357A core (66o24.7991'S, 140o25.5008'E; 1014.9 m water depth; 186.6 m core length) was drilled at Adelie Basin located on the continental shelf off Wilkes Land, Antarctica during Integrated Ocean Drilling Program (IODP) Expedition 318 by D/V JOIDES Resolution (Expedition 318 Scientists, 2011). Lithology of this core is diatom ooze with lamination. We measured CS ^{14}C ages from 13 samples. Target compound is mainly $C_{16:0}$ fatty acid. In some samples, $C_{16:1}$ fatty acid and cyclopheophorbide a were used for CS ^{14}C dating. Samples were processed chemically using the protocol of Ohkouchi *et al*. (in review). Purification of target fatty acids uses high performance liquid chromatography - evaporative light scattering detector (HPLC-ELSD) system in JAMSTEC. Purification of CO_2 and graphitization were undertaken by dedicated high vacuum line of University of Tokyo (Yokoyama *et al*., 2010), and the measurement of ^{14}C was conducted by Accelerator Mass Spectrometry (AMS) at University of Tokyo (Matsuzaki *et al*., 2007). ^{14}C ages were calibrated using CALIB 6.02 and the Marine09 calibration curve (Reimer *et al*., 2009) with a reservoir age of 1144 +/- 120 years (Hall *et al*., 2010). We successfully obtained 13 CS ^{14}C ages. CS ^{14}C ages showed the deepest samples is last glacial period (21,957 +/- 260 cal. BP) and other samples are Holocene (9,663 +/- 190 cal. BP to modern). This suggests that; i) there is hiatus between 176.65 meters below seafloor (mbsf) and 181.66 mbsf of this core, ii) this core has a continuous record of the past ˜10,000 years.

Keywords: compound-specific radiocarbon dating, Southern Ocean, Adelie Basin, Holocene, IODP

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-11 Room:103 Time:May 24 12:15-12:30

The preliminary results on drilling Paleogene drift sediments off Newfoundland, IODP Expedition 342

Tatsuhiko Yamaguchi[1*], NORRIS, Richard[2], WILSON, Paul[3], BLUM, Peter[4], NISHI, Hiroshi[5], YAMAMOTO, Yuhji[6], MORIYA, Kazuyoshi[1], KANEKO, Masanori[7], TAKAGI, Haruka[8], MATSUI, Hiroki[5], IODP Expedition 342 Scientific Party[4]

[1]Kanazawa Univ., [2]Univ. California, San Diego, [3]Univ. Southarnpton, [4]Texas A & M Univ., [5]Tohoku Univ., [6]Kochi Univ, [7]JAMSTEC, [8]Waseda Univ.

In June and July 2012, the R/V JOIDES Resolution for IODP Expedition 342 drilled the seafloor off Newfoundland. This cruise successfully recovered high quality cores from nine sites (U1403 to U1411) across a depth transect ranging from 3022 to 4944 m water depth. The recovered sedimentary sequence consists of carbonate clay to oozes, recording Cretaceous to Miocene climatic and oceanographic events, including the K/Pg boundary, the Paleocene/Eocene thermal maximum, Middle Eocene climatic optimum, and the Eocene-Oligocene transition.

The shipboard biostratigraphy and magnetostratigraphy provide high-quality age models of the sediments. The models are consistent and correlative between the cores. In all the sites, Pleistocene foraminifer ooze caps the Miocene clay and Eocene calcareous ooze. The pre-Pliocene sediments are dated to 102 to 15 Ma. Sedimentation rates indicate rapid accumulation in middle Eocene (47-40 Ma; $>$ 3 cm/k.y.) and in the Oligocene-Miocene sediments (26-22 Ma; $>$10 cm/k.y.).

The Expedition aims to evaluate changes in the carbonate compensation depth (CCD) through the Eocene hyperthermal events. Shipboard analytical results of the recovered sediments allow us to reconstruct the history of the CCD in the North Atlantic. Carbonate contents in the sediments suggest the CCD was deeper than ˜4.5 km depth through the late Cretaceous to the early Eocene and as deep as ˜4.5-3.5 km after the early Eocene.

Another main objective of the expedition was to obtain high deposition rate records of the transition form the early Eocene climatic optimum ˜50 Ma, though the development of northern hemisphere ice sheets in the Oligocene and Miocene. We recovered expanded records of the middle Eocene that include numerous carbonate accumulation events that are possibly correlative with those in the equatorial Pacific. In the early Oligocene sediments, we found sand-sized lithics, possibly correlating with expansion of ice sheets around Greenland. We also recovered an exceptionally expanded record of the Oligocene/Miocene boundary. Many of the mid-depth sites display well developed lithologic cycles that likely reflect astronomical forcing. Other objectives were to understand overturning of deep-water masses in the North Atlantic and to tune bio- and magneto-stratigraphic events astronomically. We found exceptionally well-preserved calcareous and siliceous microfossils in the sedimentary succession of the cores. The biostratigraphy, magnetostratigraphy, cyclostratigraphy, and geochemistry of the microfossils will provide high-quality data for understanding North Atlantic paleoceanography and calibrating geochronology of the Eocene and Oligocene.

Keywords: IODP Exp 342, Paleogene, paleoceanography, North Atlantic

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-12 Room:103 Time:May 24 12:30-12:45

Early and Middle Eocene radiolarian assemblages in the eastern equatorial Pacific Ocean (IODP Leg 320 Site U1331)

Shin-ichi Kamikuri[1*], IODP Leg 320/321 (PEAT) member[1]

[1]Faculty of Education, Ibaraki University

Quantitative faunal analyses of radiolarians were used to reconstruct paleoceanographic conditions spanning the interval from Zones RP8 (early Eocene) to RP16 (middle Eocene) in pelagic sequences recovered at Integrated Ocean Drilling Program (IODP) Site U1331 in the eastern equatorial Pacific Ocean. On the basis of relative abundance data from the low to high latitudes reported in the previous literature, paleoceanographic indices were identified: (1) species indicative of warmer conditions include Stylosphaera coronata coronata, Phormocyrtis embolum, Dendrospyris didiceros, Phormocyrtis cf. proxima, and Thyrsocyrtis triacantha; (2) species indicative of cooler conditions include: the Lophocyrtis aspera group, the Lithocyclia ocellus group, Hexacontium sp. A, Hexacontium sp. B, Thecosphaerella glebulenta, and Lithelius sp. A.

Two warming and at least six cooling events in the early to middle Eocene were identified from radiolarian assemblage variations. The paleoclimatic trends can be summarized as follows: warming in C23n.2n to C21r (˜51.5-49.0 Ma), and C18n (40.2-39.0 Ma); cooling in C21r (48.5-47.8 Ma), lower C20r (46.2-45.2 Ma), top C20r to C20n (44.0-43.0 Ma), top C20n to C19r (43.0-41.7 Ma), C19n to C18r (41.7-40.2 Ma), C18n.1n (39.0-38.5 Ma). These cooling events corresponded to the ELi and BLi events, which were identified in benthic foraminiferal d18O of the Southern Ocean.

In general, radiolarian and opal mass accumulation rates (MARs) in the eastern equatorial Pacific had higher values in cooling conditions during the middle Eocene. The changes in biological productivity in the eastern equatorial Pacific were associated with cooling of tropical surface water.

The change in relative abundance of radiolarians and CaCO3 content at Site U1331 indicated that middle Eocene carbonate events (Carbonate Accumulation Events [CAEs]; Lyle et al, 2005) coincided with the cooling events of tropical surface water. At least CAE-2 and CAE-3 were associated with high biological productivity as well as cooling.

Keywords: Equatorial Pacific Ocean, Middle Eocene, Radiolaria, IODP

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-13 Room:103 Time:May 24 14:15-14:30

Taxonomic study of the Miocene species Paragloborotalia siakensis at IODP Site U1338 in the Eastern Equatorial Pacific

Hiroki Okada[1*], Hiroki Hayashi[1]

[1]Interdisciplinary Graduate School of Science and Engineering, Shimane University

Paragloborotalia siakensis (LeRoy) is an important index species of the middle Miocene. The top occurrence of this species defines the upper boundary of Zone N.14 (Blow, 1969). However, many workers have regarded this species as a junior synonym of *Globorotalia mayeri* (Cushman and Ellisor) (e.g. Bolli and Saunders, 1982). Recently, Zachariasse and Sudijono (2012) examined many specimens from the type area of *P. siakensis* and re-examined both holotypes of *P. siakensis* and *G. mayeri* using SEM microphotography. They concluded that these two species should be distinguished from each other. Further re-examinations have been required to identify the biostratigraphic and paleoceanographic significance of each species.

The species identified as *P. siakensis* and *G. mayeri* occurs dominantly in Miocene sequences around the Eastern Equatorial Pacific (e.g. Kennett et al., 1985). In this study, we conducted a taxonomic study of *P. siakensis* obtained from IODP Site U1338 in the Eastern Equatorial Pacific by means of morphometric methods. According to our results, the population from Site U1338 should be compared with the holotype of *P. siakensis*. In contrast, no specimen similar to the holotype of *G. mayeri* was detected.

We also investigated temporal size changes of *P. siakensis* from the middle Miocene interval of Site U1338. The maximum diameter of *P. siakensis* shows significant reducing (”dwarfing” of Witting, 1997) at cooling intervals inferred by alkenone and isotope data (Rousselle et al., 2013). Several planktonic foraminiferal species show such dwarfing patterns (Wade and Olsson, 2009) induced by environmental stress. It is possible to say that dwarfing of *P. siakensis* at Site U1338 might be induced by a shallowing of the thermocline in the Eastern Equatorial Pacific toward La Nina-like conditions.

Keywords: planktonic foraminifera, Integrated Ocean Drilling Program, Eastern Equatorial Pacific, biostratigraphy, taxonomy

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-14 Room:103 Time:May 24 14:30-14:45

Changes in coral assemblages in the Great Barrier Reef since the last glaciation

Marc Humblet[1*], Don C. Potts[2], Jody M. Webster[3], Yusuke Yokoyama[4], IODP Expedition 325 Scientists[5]

[1]Department of Earth and Planetary Sciences, Nagoya University, [2]Department of Ecology and Evolutionary Biology, University of California, [3]Geocoastal Research Group, University of Sydney, [4]Atmosphere and Ocean Research Institute, University of Tokyo, [5]IODP

Drilling into submerged reef structures along the shelf edge of the Great Barrier Reef was carried out during IODP Expedition 325 with the purpose of reconstructing sea level and environmental changes since the Last Glacial Maximum (LGM) and analyzing their impact on reef communities and reef growth. A total of 34 boreholes were drilled between 42 and 167 mbsl at 17 sites along four transects at three geographic locations (Hydrographers Passage, Noggin Pass, and Ribbon Reef). Two basic chronostratigraphic units can be recognized: a last glacial to deglacial reef sequence overlying older Pleistocene reefal and non-reefal deposits. The former varies in thickness from ˜5.5 m to ˜34 m and consists primarily of coralgal boundstone with various proportions of microbialite. In this study we analyze the variations in coral assemblages since the last glaciation. Exp. 325 cores show that diverse corals, including Faviids, *Acropora*, *Montipora*, and *Porites*, were growing during the last glacial period on the shelf edge. Their distribution was limited to the most distal boreholes during the LGM lowstand. The subsequent deglaciation saw the development of a shallow-water coral assemblage dominated by encrusting to massive *Isopora* and branching *Acropora* and *Seriatopora* as sea level rose. The tops of distal boreholes are marked by a shift to deeper assemblages dominated by encrusting *Porites* and *Montipora* reflecting reef drowning and the formation of submerged reef terraces. As sea level kept rising, a shallow-water *Isopora*-dominated assemblage re-established further upslope and formed a barrier reef before drowning in turn.

Keywords: IODP Expedition 325 GBREC, Great Barrier Reef, Corals, Last Glacial Maximum, Reef initiation, Reef demise

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-15 Room:103 Time:May 24 14:45-15:00

Late Cenozoic paleoceanography in the northwestern Pacific and eastern Indian oceans based on calcareous nannofossils

Ryo Imai[1*], Tokiyuki Sato[2], Yasufumi Iryu[1]

[1]Institute of Geology and Paleontology Graduate School of Science, Tohoku University, [2]Institute of Applied Earth Sciences, Faculty of Engineering and Resource Science, Akita University

We report Miocene to Pleistocene paleoceanography in the northwestern Pacific and eastern Indian oceans based on calcareous nannofossil assemblages from the ODP holes 1210A and 762B. The coccolith productivity, relative abundance of *Discoaster* (a lower photic taxon) and coccolith size distribution of *Reticulofenestra* show good relationship and allow us to reconstruct a sea-surface stratification or mixing condition that associates a change in nutrient level. The low coccolith productivity, abundant *Discoaster* and large *Reticulofenestra* suggests relatively deep thermocline and nutricline (i.e., oligotrophic condition). In contrast, the high coccolith productivity, rare *Discoaster* and abundant small *Reticulofenestra* indicates relatively shallow thermocline and nutricline (i.e., eutrophic condition). The thermocline was deep and warm, oligotrophic water widespread during 13 to 9 Ma in both areas, which was followed by eutrophication from 9 Ma onward. The coccolith size distribution of *Reticulofenestra* suggests the stepwise eutrophication along with collapse of sea-surface stratification at 8.1, 6.5 and 5.0 Ma in the northwestern Pacific Ocean. Whereas abrupt eutrophication occurred at 8.9 Ma in the eastern Indian Ocean. The nannofossil assemblages indicate that the process and timing of eutrophication are different between the two areas during that period.

Keywords: Calcareous nannofossil, Cenozoic, Eutrophication, Coccolith size

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-16 Room:103 Time:May 24 15:15-15:30

Paleoinclinations of post-cruise samples from Canopus Guyot of the Louisville seamount trail (IODP Expedition 330)

Hiroyuki Hoshi[1*], Toshitsugu Yamazaki[2], Jeff Gee[3], Nicola Pressling[4]

[1]Aichi University of Education, [2]AORI, University of Tokyo, [3]Scripps Institution of Oceanography, UCSD, [4]Royal Holloway, University of London

IODP Expedition 330 sampled volcanic basement rocks at five sites on four guyots along the northwestern part (late Cretaceous to early Eocene age) of the 4300-km-long Louisville seamount trail. Shipboard paleomagnetic data were used for the calculation of paleolatitudes of each guyot, and we (Exp. 330 shipboard scientists) concluded that the Louisville hotspot has remained within 3-5^o of its present-day latitude of about 51^{o}S between 70 and 50 Ma (Koppers *et al*., 2012, *Nature Geoscience*, **5**, 911-917). In order to determine more reliable paleolatitude estimates, a number of discrete rock samples were collected for a post-cruise research. In this presentation, we will present the paleolatitude of Canopus Guyot (ca. 74 Ma) that was determined from analysis of post-cruise paleomagnetic data of Site U1372. In our post-cruise study, paleomagnetic measurements and stepwise demagnetizations (alternating-field and thermal methods) were conducted in magnetically shielded rooms, and characteristic remanent magnetization components were used to calculate lava unit-mean paleoinclinations. On the basis of inclination-only statistics of 20 lava unit-means, we obtained a paleolatitude of ca. 45^{o}S for Canopus Guyot, which is statistically indistinguishable from the paleolatitude estimate (ca. 43^{o}S) for this guyot determined from shipboard discrete sample data. The paleolatitude for Canopus is low compared to the present latitude of the hotspot, implying possible southward motion of the Louisville hotspot before 70 Ma.

Keywords: Louisville seamount trail, Louisville hotspot, Canopus Guyot, IODP Expedition 330, paleolatitude, paleomagnetic inclination

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS23-17 Room:103 Time:May 24 15:30-15:45

Preliminary report for IODP Expedition 345 Hess Deep Plutonic Crust

Natsue Abe[1*], Norikatsu Akizawa[2], Yumiko Harigane[6], Takashi Hoshide[6], Sumiaki Machi[2], Jinichiro Maeda[5], Toshio Nozaka[7], Marie Python[5], Kathryn Gillis[7], Jonathan Snow[8], Shipboard Scientific Party IODP Expedition 345[9]

[1]IFREE, JAMSTEC, [2]Kanazawa University, [3]AIST, [4]Tohoku University, [5]Hokkaido University, [6]Okayama University, [7]University of Victoria, B.C., [8]University of Houston, [9]IODP, Texas A&M University

IODP Exp. 345, Hess Deep Plutonic Crust was conducted drilling into the oceanic lower crust from December 13, 2012 to February 12, 2013. The principal objective for drilling at the Hess Deep Rift located in the equatorial Pacific was, to test competing hypotheses of magmatic accretion (gabbro glacia vs. sheet sill models) and hydrothermal processes in the lower ocean crust formed at the fast-spreading East Pacific Rise (EPR). These hypotheses make predictions that can only be tested by drilling, i.e., the presence or absence of systematic variations with depth in mineral and bulk rock compositions, presence or absence of modally layered gabbro, and the extent and nature of hydrothermal alteration and deformation.

The drilling was carried out in ~4850 m water depth under quite challenging borehole conditions. We recovered primitive plutonic lithologies; olivine gabbro, troctolite, gabbro, orthopyroxene-bearing gabbroic rocks. The recovered rocks exhibit cumulate textures similar to those found in layered mafic intrusions and some ophiolite complexes. Details of their mineralogical and petrologic evolution, however, are novel on the ocean floor.

Keywords: IODP Exp. 345, Hess Deep, Oceanic lower crust, Gabbro