

MIS022-01

Room:201B

Time:May 23 08:30-08:45

Depositional sequences and isotope analyses of the samples from IODP Exp. 317, Canterbury Basin, New Zealand

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INTRODUCTION

Integrated Ocean Drilling Program Expedition 317 was devoted to understanding the relative importance of global sea level (eustasy) versus local tectonic and sedimentary processes in controlling continental-margin sedimentary cycles. In order to achieve these objectives, upper Miocene to Recent sedimentary sequences were cored in a transect of three sites on the continental shelf (landward to basinward, Sites U1353, U1354, U1351). Highest recovery was achieved in cores of upper Pliocene (3.5 Ma) to Recent sediments. We also drilled one site (Site U1352) on the continental slope, reaching a depth of 1927.5 m below sea floor and obtaining Eocene samples.

CORRELATION OF SEISMIC SEQUENCE BOUNDARIES AND DISCONTINUITIES IN THE CORES

Nineteen regional seismic sequence boundaries (U1-U19, in ascending order) were identified in the middle Miocene to recent shelf-slope sediment prism of the offshore Canterbury Basin (Lu and Fulthorpe, 2004). Discontinuities identified in cores may correlate to U19-U8 at Site U1353, and to U19-U10 at Sites U1354 and U1351. We estimate the ages of the discontinuities, based on shipboard analyses, to correspond to both Marine Isotope Stages (Lisiecki and Raymo, 2005) and global sequence boundaries (Haq et al., 1987).

STABLE ISOTOPE MEASUREMENTS OF THE ORGANIC MATTER AND FORAMINIFERA TESTS

We are analyzing carbon isotope ratios of organic matter in the sediments and oxygen isotopic ratios of foraminifer tests. Carbon isotope ratio indicates whether the origin of the organic matter is terrestrial or marine. Samples for stable isotope analysis of organic carbon are treated with HCl to dissolve calcium carbonate. Analyses are carried out at the Faculty of Science, Shinshu University, using an elemental analyzer (FlashEA1122, ThermoQuest Ltd.) and a mass spectrometer (Delta V, ThermoQuest Ltd.). The analytical precision was less than 0.2 per mil in carbon for C.

We picked benthic foraminifera tests of *Nonionella flemingi* from core samples from slope Site U1352. Our first attempt started from the depth between 500 and 250 m. The depositional age is between ~1 and ~2 Ma. The measurement intervals are basically 2 m for 10,000 years duration. But some parts have 10 m spaces. We prepared 40 tests of *Nonionella flemingi* from each depth, and selected 50 - 100 µg weight (four to eight foraminifera tests) for measurements. We measured oxygen isotope and stable carbon isotope ratios of the calcium carbonate. The analyses were carried out at the Kochi Core Research Center using a mass spectrometer (IsoPrime, Isoprime Ltd.). We occasionally measured two or three groups of the sample from the same depth for confirmation of uniformity of the data. We do not find any data variations by different groups. The analytical precision was less than 0.04 per mil. Total number of the measurements is ~100 samples for 89 horizons. We identify most of the marine isotope stages (Lisiecki and Raymo, 2005) between MIS 23 and 61.

REFERENCES

- Haq et al., 1987, *Science*, 235, 1156-1167.
- Lisiecki and Raymo, 2005, *Paleoceanography*, 20, PA1003.
- Lu and Fulthorpe, 2004, *Geol., Soc. Amer. Bull.*, 116, 1345-1366.

Keywords: sea level change, Canterbury Basin, offshore New Zealand, marine isotope stage

MIS022-02

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Mg isotope geochemistry of pore-waters in shelf cores from IODP Expedition 317; Canterbury Basin, New Zealand

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Magnesium is a major element in the geosphere, biosphere, and hydrosphere. In seawater, Mg^{2+} is the fourth most abundant ion with a concentration of 55 mM. The dominant source of Mg to the ocean is chemical weathering of the continental crust, transported via riverine runoff. The Mg sinks are hydrothermal alteration of oceanic crust, limestone dolomitization, and ion-exchange reactions of clay minerals in marine sediments. Profiles of decreasing magnesium in porewaters have been observed in many anaerobic marine sediments such as in the near shore sediments. Cation exchange under reducing conditions results in magnesium removal from porewater, and this removal process account for 5-10 % of the Mg^{2+} brought to the sea by river (Bischoff et al., 1975). These diagenetic chemical reactions are thought to be reflected in the isotopic composition of the pore fluids. Recent developments in inorganic mass spectrometry allowed Mg stable isotope systems to be explored by cosmochemists and geochemists. By this time, little is known about the Mg isotope geochemistry in the interstitial waters of marine sediments. The effects of diagenesis on Mg isotopic composition are of interest in relation to the use of Mg isotope as a tracer of the oceanic mass balance of Mg. It has been demonstrated that modern seawater is isotopically homogeneous (de Villiers et al., 2005) but it should not be maintained following geochemical weathering, authigenic mineral precipitation and ionic exchange among various components. The elemental and isotopic compositions of sedimentary porewater have been extensively used to constrain diagenetic chemical reactions following burial.

In this study we analyzed Mg isotope values of porewater from Integrated Ocean Drilling Program (IODP) Expedition 317 Canterbury Basin Sea Level: Global and local controls on continental margin stratigraphy. This expedition was devoted to understanding the relative importance of global sea level change versus local tectonic and sedimentary processes in controlling continental margin sedimentary cycles. Therefore, the recovered sediments provide geochemically unexplored deep-penetrated cores at shallow shelf sites. Cores were drilled in the eastern margin of the South Island of New Zealand. Upper Miocene to recent sedimentary sequences were cored in a transect of three sites on the continental shelf (Sites U1351, U1353 and U1354) and one on the continental slope (Site U1352). Continental slope Site U1352 represents a complete section from modern slope terrigenous sediment to hard Eocene limestone.

We use Mg isotope ratios of sedimentary porewaters to evaluate the role of Mg-carbonate precipitation/dissolution, Mg-adsorption/desorption between sediments/rocks and porefluid on the Mg isotope composition with the help of other tracers, providing a geochemical framework for an evaluation on the Mg isotope variability. Our aim are to assess the effect of diagenetic processes on the Mg budgets of porewater and bulk sediments using Mg isotope ratios, and to constrain the effect of chemical reactions in the sediments to global Mg isotope cycles.

Keywords: IODP, pore-water, Mg isotope, MC-ICP-MS

MIS022-03

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High-frequency paleoceanographic fluctuation of the Bering Sea: scientific results of the IODP Expedition 323.

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The IODP Expedition 323 in the Bering Sea was the first expedition to recover continuous marine sediment sections to investigate high-resolution paleoceanography at the most northern region of the North Pacific during 5 Ma. Drill sites explored in the Bowers Ridge region (Sites U1340 and U1341) provide complete sequences for the last 5 myrs, including Northern Hemisphere Glaciation (NHG), and drill sites at the continental slope of the Aleutian Basin (Sites U1343 and U1344) provide complete sequences for the last 2 myrs, including the Mid Pleistocene Transition (MPT) with drastic changes in the character of glacial-interglacial cycles.

Post cruise age models of the drilled sequences are constructed using oxygen isotope stratigraphy, tephrochronology, and optically stimulated luminescence (OSL) dating, along with onboard bio- and magneto-stratigraphy. Astronomical calibration of high-resolution non-destructive core measurement data provides additional age control, and shows that sedimentation rates during interglacials are two to three times higher than that of glacials.

Marine primary productivity changes dramatically during the Plio-Pleistocene. Si /Al ratio measured using non-destructive XRF scanning by TATSCAN-F2 is consistent with discrete biogenic silica content, and exhibits large glacial-interglacial cycles. The productivity is relatively high, similar to that of the present Green-belt, during the interglacial periods with increasing glacial-interglacial variability after NHG, and even larger amplitude variations during last 500 kyrs. Significant large peaks of biogenic carbonate detected by TATSCAN-F2 occur during every deglaciation period (in the early stage of warming) during the Pleistocene. The increase in biogenic carbonate is related to enhanced terrigenous nutrient supply mainly from the continental shelf exposed during the glacial periods. During the middle and later part of the interglacial, carbonate content becomes significant low due to restoration of ocean circulation to a state similar to the present.

Sea-ice history was reconstructed by the ice-rafted debris (IRD). IRD is defined by counts of coarse (>1mm) grains using transparent X-ray images (TATSCAN-X1), and by counts of coarse fraction (0.160?0.900 mm) using grain-size analysis; IRD has a positive correlation with the abundance of diatom ice-algae. Time series data of the IRD abundance shows significant changes, relating to sea-ice expansion, Alaskan glacier discharge, and sea level changes in the last glacial cycle.

Marine primary productivity, ocean circulation, sea-ice expansion of the Bering Sea may play an important role during the MPT and NHG, especially through its impact on surface and bottom water circulation in the Arctic and the Pacific oceans.

MIS022-04

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Climate and Sea-level changes since the last glacial maximum: Preliminary results from IODP Expedition 325 the Great Bar

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Sea-level was lower by as much as 120 m and climate was colder globally during the last glacial maximum (LGM) at around 20 ka. Because the environmental changes since the LGM comprise the largest magnitude changes during the Earth's recent history, data of this period recorded in geological archives are important for understanding climate dynamics and ecological responses. The history of environmental changes are best recorded in fossil coral reefs from the LGM, and hence Integrated Ocean Drilling Program (IODP) Exp. 325 was designed to recover samples of these fossil reefs on the shelf edge of the Great Barrier Reef (GBR). Three major objectives of Expedition 325 are to 1) establish the course of sea level change, 2) define sea-surface temperature variations, and 3) analyze the impact of these environmental changes on reef growth and geometry for the region over the period of 20 ? 10 ka. This expedition compliments Exp. 310 "Tahiti Sea Level" that in 2005 recovered Postglacial coral reef cores around Tahiti between 41.6-117.5 meters below sea level that span ~ 16 to ca. 8 ka.

The offshore phase of Exp. 325 was conducted from February to April 2010 to core a series of fossil reef preserved along the shelf edge of the Great Barrier Reef at three geographic locations (Hydrographers Passage, Noggin Pass and Ribbon Reef). A total of 34 boreholes across 17 sites were drilled in four depth transects ranging from 42.2 to 167.2 meters below sea level. Wireline logging operations at four boreholes provided continuous geophysical information about the drilled strata. According to the Onshore Science Party at the IODP Bremen Core Repository (Germany) in July 2010, high-quality fossil coralgal frameworks are found in a number of horizons of different cores thus recording high energy reef settings, which crucial for precise reconstructions of sea level and sea-surface environmental change. Ages obtained so far range from > 30 to 9 ka, indicating successful capture of the period of interest. This includes the time into and out of the LGM, the 19ka-Mwp, Mwp-1a, t he Younger Dryas, the Bolling-Allerod, and Heinrich Events 1 and 2. The fact that there are very limited number of fossil coral records spanning these intervals, and even fewer from tectonically stable, passive margin settings far from the confounding influence of ice sheets, only highlights further the importance of the new Exp. 325 cores.

We will summarize Exp. 325's preliminary results and their broader implications for understanding global sea level and paleoclimate changes, as well as how coral reefs respond to environmental stress.

Keywords: Great Barrier Reef, Coral reef, sea level, paleoclimatology, paleoceanography, IODP

MIS022-05

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Sea-level change, climate variability and reef development during the last deglaciation

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Integrated Ocean Drilling Program (IODP) Expedition 310 "Tahiti Sea Level" was conducted from October to November 2005 (Offshore Party) and from February to March 2006 (Onshore Party) (Camoin, Iryu et al., 2007, *Sci. Drill.*, 5, 4-12). The objectives of this expedition were : 1) to establish the course of postglacial sea-level rise in Tahiti, 2) to define variations in sea surface temperature for the region during the 10-20 ka time window, and 3) to analyze the impact of sea-level and environmental changes on reef growth and geometry. In this presentation, we show summaries of scientific results of the objectives (2) and (3).

The response of coral reefs to sea-level and environmental changes during the last deglacial sea-level rise at Tahiti has been reconstructed from chronological, sedimentological and paleontological analyses of drill cores obtained by drilling the relict reefs occurring beneath the modern fore-reef slopes. Changes in the composition of corallgal assemblages coincide with variations in reef growth rates and therefore characterize the response of the upward-growing reef pile to a non-monotonous sea-level rise and coeval environmental changes. Reefs accreted continuously, mostly through aggradational processes, at mean growth rates of 10mm/year during the 16-10ka period, indicating the lack of any catastrophic impact on reef development such as the temporary break or cessation of reef growth. An incipient drowning and a general backstepping of the reef complex have been evidenced during the 14.6-13.9ka time window, coeval with the MWP-1A, implying that reef growth gradually lagged behind sea-level rise (Camoin et al., in review, *Geology*). Paleontological analysis of cored material allowed to identify twenty-six coral species, twelve coral genera and twenty-eight coralline algal species. Based on these data, and in comparison with modern and fossil analogs, seven coral and four algal assemblages have been identified in the deglacial reef sequences, each representing a specific environment (Abbey et al., 2011, *Glob. Planet. Change*, doi:10.1016/j.gloplacha.2010.11.005). Reef initiation pattern and timing varied at sites based on the available substrate, and early colonizers suggest water conditions at all sites were unfavorable to sensitive corals, such as *Acropora*, prior to ca. 12.5 ka. Mainly shallow water (i.e. less than 10-15 m water depth) corals and coralline algal assemblages developed continuously at all sites from 16 ka to ~8 ka, suggesting that changes in corallgal assemblages were more influenced by factors such as turbidity and water chemistry than sea-level rise alone.

Sr/Ca ratios and oxygen isotopes of fossil Tahiti corals suggest that a shift toward lower temperature by ~1.5 degrees Celsius and higher oxygen isotope composition by ~0.2 per mill at the sea surface from 14.2 to 12.4 ka (Asami et al., 2009, *EPSL*, 288, 96-107). Along with previously published deglacial coral records, our results provide new evidence for a significant cooling of the western to central tropical South Pacific Ocean during the Northern Hemisphere Younger Dryas episode, which are not consistent with foraminiferal Mg/Ca-derived sea surface temperature records from the equatorial Pacific Ocean. Higher Ba/Ca ratios and Cd content together with lower reconstructed SSTs using U/Ca ratios in the coral specimens between 12.7 and 9.8 cal ka compared to around 15 cal ka suggest that upwelling and/or entrainment of subsurface water into mixed layer was enhanced around Tahiti during this period. This finding is consistent with previous reports and supports the idea that the South Pacific was characterized by La Nina-like conditions at least from 12.7 to 9.8 cal ka.

Keywords: Integrated Ocean Drilling Program, Sea-level change, Paleoclimate, Coral reef, Last deglaciation, Tahiti

MIS022-06

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Drilling atoll-rim in the North Male Atoll, Maldives: sedimentary structure and Holocene reef development

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⁵Asian Institute of Technology

We drilled 53.5m into the former reef-crest on the atoll-rim, the North Male Atoll, Maldives. The core site (Male Core-site) is located in a reclaimed land in the southeastern part of Male Island. This study presents Quaternary sedimentary structure and the Holocene reef development in the atoll-rim. The Holocene reef structure and development are also observed at a lagoon reef slope of the northeastern Male Reef where a failure happened and forming an exposure of reef interior.

The Holocene/Pleistocene boundary of Male Core-site is around 9.5m below MSL. On the other hand, the entire reef structure at the lagoon-slope exposure is Holocene down to 25m deep. The pre-Holocene topography in the southern part of the North Male Atoll is higher at the rim and lower beside the lagoon.

More than 40m of Pleistocene reef sequence is observed in this core where four reef units are defined from lithofacies. In each reef unit, coral-algal bindstone accumulated on the top of loose reef sediments which include coral framestone.

In the Holocene reef structure at Male Core-site, coral-algal bindstone forms the uppermost 3.3m below the former reef surface, and reef sediments accumulated below the bindstone. The rigid reef structure is also observed at the upper 2m of the lagoon-slope exposure. AMS ages of the coral/algal samples tell the development of the atoll-rim reef after 8 ka.

Keywords: atoll, drilling core, coral reef development, sedimentary structure, Holocene, Maldives

MIS022-07

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Unique hydrogeological mode of a submarine hydrothermal system within volcanoclastic sediment

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Submarine hydrothermal systems have been located not only in mid-oceanic ridges of the plate spreading region, but also in the plate convergent region. In such setting where the seafloor is dominantly covered with volcanoclastic material erupted with felsic magmatism, a hydrothermal fluid circulation system is expected to be spread within sediment layer of significantly high porosity. IODP Exp.331 drilled through an active hydrothermal field at the Iheya North Knoll in the Okinawa Trough, which provided the first opportunity to access directly the subseafloor to reveal the unique hydrogeological mode that may support biosphere and stimulate mineralization. While bulky sedimentation of volcanic clasts dominantly composed of tubular pumice was notable along the slope of the knoll, prevalent hydrothermal alteration was recognized in the vicinity of the hydrothermal center even at very shallow depth. Together with observation of extremely high temperature gradient, the intense and prevalent hydrothermal alteration is attributed to a result of fluid intrusion and occupation extended laterally within the sediment layer. Stratified occurrence of sulfide mineralization, sulfides with clastic texture in the upper interval and siliceous volcanic breccias with sulfide vein in the lower interval, was notable, which is naturally comparable to structure of the Kuroko type deposit where stratiform ore bodies are recognized as concordant with the surrounding sediment layers. The large fluid reservoir laterally extended within porous volcanoclastic sediment would contain large space and surface inside for hydrothermal interactions and stimulate the gradual progress, which should be favorable for formation of a large size ore deposit. The unique hydrogeological mode could be attributed to one of key factors to explain that majority of VMSD was associated with felsic magmatic activity.

Keywords: Volcanic massive sulfide deposit, submarine mineral resources, felsic magma, hydrothermal alteration, volcanoclastic sediment, submarine hydrothermal fluid circulation

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Primary report on IODP 329 Expedition on South Pacific Gyre Microbiology

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Integrated Ocean Drilling Program (IODP) riser-less drilling expedition (#329) was conducted in the region of the South Pacific Gyre. Our principal objectives are to: (1) document the habitats, activities, composition and biomass of microbial communities in subseafloor sediments with very low total activity, (2) test how oceanographic factors (such as surface ocean chlorophyll content and organic flux to the seafloor) control variation in sedimentary habitats, activities and communities from gyre center to gyre margin, (3) quantify the extent to which these sedimentary communities may be supplied with electron donors by water radiolysis, a process independent of the surface photosynthetic world, and (4) determine how basement habitats, potential activities and communities vary with crustal age and hydrologic regime in a region of fast seafloor spreading and thin sediment cover. To meet these objectives, the entire sediment columns at seven sites and the upper 100 m of basement at three sites were investigated. The initial outcomes will be presented in addition to the outline of this expedition.

Keywords: Deep biosphere, South Pacific gyre, subseafloor life

MIS022-09

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IODP Expedition 327: Juan de Fuca Ridge-Flank Hydrogeology

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Integrated Ocean Drilling Program (IODP) Expedition 327 focus on understanding fluid-rock interactions in young, upper ocean crust on the eastern flank of the Juan de Fuca Ridge, delineating the magnitude and distribution of hydrologic properties; the extent to which crustal compartments are connected or isolated; the rates and spatial extent of ridge-flank fluid circulation; and links between ridge-flank circulation, crustal alteration, and geomicrobial processes. Expedition 327 installed seafloor borehole observatories (CORKs) in basement holes to allow borehole conditions to recover to a more natural state after the dissipation of disturbances caused by drilling, casing, and other operations; provide a long-term monitoring and sampling presence for determining fluid pressure, temperature, composition, and microbiology; and facilitate the completion of active experiments to resolve crustal hydrogeologic conditions and processes.

During Expedition 327, two basement holes were cored and drilled at Site U1362. Hole U1362A was cored and drilled to 528 meters below seafloor (mbsf) (292 meters subbasement [msb]), subjected to geophysical logging and hydrologic testing, and instrumented with a multilevel CORK observatory. Hole U1362B was drilled to 359 mbsf (117 msb), subjected to a 24 h pumping and tracer injection experiment, and instrumented with a single-level CORK observatory. Both CORK observatories include monitoring of pressure and temperature and downhole fluid and microbiology sampling. In addition, part of an instrument string deployed in Hole U1301B during Expedition 301 was recovered, and a replacement string of thermal sensors was installed. Finally, a program of shallow sediment coring was completed adjacent to Grizzly Bare outcrop, a suspected site of regional hydrothermal recharge. Thermal measurements and analyses of pore fluid and microbiological samples from a series of holes aligned radially from the outcrop edge will elucidate rates of fluid transport and evolution during the initial stages of ridge-flank hydrothermal circulation.

Keywords: IODP, Hydrogeology, Anisotropy, Crustal-scale properties, Microbiology

MIS022-10

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Preliminary results of IODP Expedition 330: Louisville Seamount Trail

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The Louisville Seamount Trail is a 4,300 km long volcanic chain that is inferred to have been built in the past 80 Myr as the Pacific plate moved over a hotspot. It is the South Pacific counterpart of the much better studied Hawaiian-Emperor Seamount Trail. Paleomagnetic studies on drill cores of ODP Leg 197 from the Emperor seamounts revealed a ~15 degree southward motion of the Hawaiian hotspot prior to 50 Ma, calling into question whether the primary Pacific hotspots constitute a fixed frame of reference. Two end-member geodynamical models have been considered; (1) the Hawaiian and Louisville hotspots have moved in concert, (2) they have moved independently (mantle flow model, which predicts little latitudinal motion of Louisville hotspot). IODP Expedition 330 seeks to test these models using modern paleomagnetic and geochronological techniques. Another primary objective of the expedition is to determine the magmatic evolution and melting processes of Louisville volcanoes. Prior to Expedition 330, the only dredged samples recovered have been alkali basalts, which suggest that shield-building stage in the Louisville volcanoes is mostly alkalic, in sharp contrast to the massive tholeiitic shield-building stage of Hawaiian volcanoes. Geochemical and isotopic studies of the rocks recovered during Expedition 330 will allow us to map the fundamental differences between Louisville and Hawaiian hotspot volcanism.

Expedition 330, from 13 December 2010 to 12 February 2011, planned to drill ~350 m into the igneous basement of four seamounts of different ages, from 50 to 80 Ma, along the Louisville Seamount Trail. It was expected that by drilling to such depths we would be able to sample a sufficient number of lava flows required to average out the secular variations of the geomagnetic field, and as a result be able to obtain a reliable estimate of the paleolatitude of the hotspot at the time each of the seamounts was formed. So far we have occupied five sites on four seamounts, and drilling is still ongoing while this abstract is being written. At Site U1374 on Rigel Guyot with an estimated age of ~73 Ma, we reached 522 mbsf with an extraordinarily high average core recovery of 88%. The rock samples obtained during this expedition will enable us to fulfill the scientific objectives after onboard and post-cruise research.

Keywords: IODP, Louisville Seamount, hotspot, mantle dynamics, paleomagnetism

MIS022-11

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Shipboard paleomagnetic results from IODP Expedition 330 (Louisville Seamount Trail): an overview

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One of the primary objectives of the IODP Expedition 330 was to retrieve cores of a sufficient number of volcanic rock units (lavas and volcanoclastics) at each target seamount of the Louisville Seamount Trail to precisely determine the late Cretaceous to early Paleogene (about 80 to 50 Ma) paleolatitude of the Louisville hotspot. Cores composed mainly of various lithologies of volcanic edifices and shallow marine sediments were retrieved from 6 sites (U1372 to U1377) at 5 seamounts of the trail. Detailed paleomagnetic and rock magnetic investigations for discrete samples currently being undertaken at onshore laboratories will provide data that constrain the hotspot paleolatitude. Onboard the JOIDES Resolution, we carried out magnetic measurements for archive half-cores and discrete samples (8 cc cubes) to obtain preliminary results. The remanent magnetization of archive halves was measured at 2 cm intervals using the automated pass-through DC-SQUID cryogenic rock magnetometer. An integrated in-line AF demagnetizer was used to progressively demagnetize the core. Remanent magnetization directions for each 2 cm measurement were calculated using principal component analysis (PCA) with an automated procedure. Remanent magnetization in discrete samples was measured with a spinner magnetometer. Discrete samples were subjected to stepwise alternating-field or thermal demagnetization. In general, relatively well-defined PCA directions were obtained from archive half-core measurements (for core pieces >9 cm in length), and they are consistent with characteristic remanent magnetization directions of discrete samples. Also, the anisotropy of magnetic susceptibility (AMS) was determined for all discrete samples. The shipboard results will be used to calculate preliminary paleolatitude estimates for individual seamounts drilled.

Keywords: IODP, Expedition 330, Louisville Seamount Trail, Louisville hotspot, paleolatitude, paleomagnetism

MIS022-12

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Long-term borehole observatory installation during Exp 332.

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Tonankai earthquakes are magnitude 8 class earthquakes known to occur every 100-150 years in the Nankai Trough, south of Japan. In order to monitor and watch detailed seismic process in the vicinity of its epicenter, we plan to establish a network of long-term borehole observatory in NantroSEIZE program in the IODP in three locations with different seismic characteristics; C0009 above the seismically coupled plate interface to cause Tonankai earthquake, C0002 near the edge of the seismically coupled zone, and C0010 above the aseismic part of plate interface of incoming Philippine sea plate and penetrating one of splay faults from the plate boundary. The C0010 and the C0009 Site were drilled during the Exp 319 in 2009. A pressure and temperature monitoring package called "Smart-Plug" was installed in the C0010A hole in 2009 for monitoring the pore-fluid pressure in the splay fault and seafloor.

During IODP Exp 332 in December 2010, we have successfully recovered the Smart-Plug from C0010A and replaced with further improved observatory package called "Genius plug", adding water-sampler (osmo-sampler) and in-situ microbial package.

In the IODP Exp 332, we also installed the first planned permanent seafloor borehole observatories in the NantroSEIZE program in IODP Hole C0002G. Strainmeter, tiltmeter and seismic sensors were cemented near the bottom of 980 m seafloor borehole to ensure stable environment required for these geodetic measurement, where distance to the Tonankai seismogenic fault is approximately 6 km. In the same borehole, we can also measure pore-fluid pressure in three depths and temperature in 5 depths. The borehole observatory in C0002G is currently measuring pore-fluid pressure in the accretionary prism, sediment basin, and seafloor. In March, 2011, we plan to start long-term seismic and geodetic observation in the C0002G borehole observatory. We expect the strainmeter, tiltmeter, pore-fluid pressure, and broadband seismometer data from quiet and stable environment in Hole C0002G and C0010A will produce a key observation defining slip behavior of the subducting plate in zone between seismically coupled and decoupled plate interface.

MIS022-13

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Long Term Borehole Measurement System installation using LWD in Exp332

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¹JAMSTEC

During Expedition 332, LWD (Logging While Drilling) and MWD (Measuring While Drilling) were conducted at site C0002G in the framework of NanTroSEIZE drilling program. This is the first time challenging program to confirm the location of lithological unit boundaries by use of LWD results comparing with previous drilling efforts in Expedition 314 (C0002A) and 315 (C0002B) in 2007. LWD measurements for Expedition 332 included only resistivity and natural gamma, rather than the comprehensive suite of logging already conducted at site C0002A, located 50-meters East from site C0002G. LWD data can be indicated the boundary between Units II and III, the Quaternary lower Forearc Basin sediments, and Pleistocene Forearc Basin sediments to confirm the depth of lithologic boundaries in order to ensure suitable placement of the LTBMS (Long Term Borehole Monitoring System). The tools included both MWD and LWD capabilities, to enable real-time measurement of drilling parameters as well as storing data for retrieval when tools reach the surface. Measurements are made during drilling operations. The array resistivity system has 2 receivers and 5 transmitters with 2MHz and 400 kHz frequencies. They can be provided both natural gamma ray and resistivity values in memory and real time modes in combined with MWD tool with high quality.

Keywords: Logging while drilling, CDEX, D/V Chikyu, IODP, NanTroSEIZE, LTBMS

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Room:201B

Time:May 23 12:00-12:15

Summary of IODP Expedition 333: Drilling of Subduction input sediments, and mass transport deposits

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Expedition 333 was conducted to core a slope site for NanTroSLIDE (Nankai Trough Submarine Landslide History) project and input sites on the Shikoku Basin as a part of the NanTroSEIZE (Nankai Trough Seismogenic Zone Experiment) project. A stack of mass transport deposits (MTDs) recognized in 3-D seismic data of the slope basin seaward of the megasplay fault, was cored at Site C0018 in order to establish a mass-movement event stratigraphy and analyze rheological property to constrain sliding mechanism. Several MTDs were recovered, comprising various kinds of deformation structures formed during sliding. A rhythmic turbidite sequence was recovered beneath the MTD sequence, suggesting a significant change of sedimentary environment around 1Ma.

In the input site, C0011 on the northwest flank of Kashinosaki Knoll, and C0012 on top of the Knoll were cored. The late Pleistocene ? late Miocene Shikoku Basin facies and an underlying volcanoclastic sand facies were recovered at C0011. Shipboard measurements reveal pronounced physical property changes occurring within the Shikoku Basin facies. The same change is also recognized in Muroto and Ashizuri input sites offshore the Shikoku Island. The recovered sequence at Sites C0012 reveals a similar lithology to that of C0011. However, at Sites C0012 the sequence involves an early Pleistocene-late Pliocene hiatus of a few m.y. Steeply inclined bedding in the interval of 15-85 mbsf suggests that the hiatus is due to a large-scale slumping. Site C0012 was deepened up to 630.5 m, and heterogeneous alternation in recovered basaltic rocks was found. Strata temperature data were obtained during HPCS operation at both C0011 and C0012 sites. Preliminary estimation reveals the higher temperature gradient at C0012. Analysis of sediment and basaltic basement composition, geomechanical experiments and hydrological modeling will provide a complete characterization of incoming sediments and igneous basement prior to their arrival at the subduction front and seismogenic zone.

Keywords: NanTroSEIZE, NanTroSLIDE, input site, submarine landslide

MIS022-15

Room:201B

Time:May 23 12:15-12:30

Sediment composition analysis and FT dating of the Shikoku Basin sediments drilled in the IODP Exp.322

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Sedimentary rocks in the Shikoku Basin had been drilled and recovered at Sites C0011 and C0012 during the IODP Exp.322 in the NANTROSEIZE project by the drilling vessel "Chikyu". The recovered sedimentary rocks spanned from 20 to 5 Ma and include following six lithologic units above basaltic basement; Unit I: Late Miocene to Holocene hemipelagic mud intercalated by volcanic ash layers, Unit II: Late Miocene tuffaceous sandstone interbedded with hemipelagic mudstone, Unit III: Middle to Late Miocene hemipelagic mudstone, Unit IV: Middle Miocene turbidite sandstone and mudstone interbedded with hemipelagic mudstone, Unit V: Early to Middle Miocene hemipelagic mudstone interbedded with tuff beds and volcanoclastic turbidites, Unit VI: Early Miocene pelagic mudstone. This study attempts to provide some implications for the tectonic, volcanic and climatic evolution of Southwest Japan based on sandstone petrography, palynological analysis, organic carbon analysis, tephra analysis and fission-track dating of the lithologic units I to V.

Four fission-track ages of 15.1 ± 0.5 Ma, 16.1 ± 1.2 Ma, 15.8 ± 0.5 Ma, 14.7 ± 0.9 Ma were dated from tuff beds in the Unit V at Site C0011. A fission-track age of 13.2 ± 0.7 Ma was dated from volcanoclastic sandstone in the Unit V at Site C0012. Both turbidite sandstone in the Unit IV at Site C0011 and volcanoclastic sandstone in the Unit V at Site C0012 contain biotite, garnet, zircon and apatite. Refractive indices of plagioclase in these sandstones indicate that they have characteristics of the Type I composition of Yamashita et al. (2007). Mineral assemblages of sandstone and fission-track ages of the Unit IV and V indicate that origin of sandstone might have been the Kumano Acidic Rocks in the Kii Peninsula. Uplift of the Kii Peninsula at around 15 Ma (Hasebe et al. 1993) may have caused erosion and transportation of abundant acidic rock grains from the Kii Peninsula.

Tuffaceous sandstones in the upper part of Unit II yield characteristic mineral assemblages, which consist of pumice, volcanic glasses (<30%), opx, cpx and hornblend. These tuffaceous sandstones might have been derived from the Izu-Bonin back arc felsic volcanoes in Late Miocene or from other origins.

Four palynological zones I to IV in descending order have been identified within hemipelagic mudstone intervals in the Unit I to V at Site C0012. The palynological zones I - III, equivalent of the Unit V - III in Middle Miocene to early Late Miocene, had characteristic taxa in warm climate. A genus *Tsuga* had increased within the palynological zone IV, equivalent of the Unit II and I. This indicates cooling in climate in Late Miocene. The pollen assemblages lack both tropical and subtropical elements and are consistent with those derived from lowlands to lower slopes in Southwest Japan. However, abundance of fossil pollen was one order or more less than that reported from land sections and wells in Japan. These characteristics in pollen assemblages might provide significant implications for the paleo-position of the drilled sites as well as paleoclimate reconstruction of Southwest Japan.

Keywords: IODP, Shikoku Basin, turbidites, composition, Fission-Track dating

MIS022-16

Room:201B

Time:May 23 12:30-12:45

Improving techniques for the challenging scientific drilling targets: IODP science services perspective

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Integrated Ocean Drilling Program (IODP) is an international marine research program that explores the Earth history and structure as recorded in seafloor sediments and rocks, and monitors subseafloor environments. First time in the scientific ocean drilling history, three drilling platform has been operating at global locations since 2009, and began planning for the new and ambitious program beyond the end of current IODP from October, 2013.

Since the initiation of IODP in 2003, various new techniques were initiated across three platforms, Chikyu, JOIDES Resolution and Mission Specific Platform (MSP), under the science services from Implementation Organizations. For the new challenges in the various IODP expeditions, those new techniques covering laboratory and downhole measurements, extended widely in measurement types and improved their capability and efficiency. Further addition of riser technology and very shallow locations for MSP brought wider choice of new logging and coring tools, rigfloor parameter, and very high-resolution slim-hole logging tools. All these large volume of data with wider choice of software further enhanced the integrated studies like cuttings/core-log-seismic integration for the very deep-riser holes.

In focus of improved techniques, science services across three platforms in IODP are thoroughly reviewed.

Keywords: IODP, Drilling, Logging, Science Service

MIS022-P01

Room:Convention Hall

Time:May 23 14:00-16:30

The changes of paleoceanography from benthic foraminiferal assemblages on the continental shelf of the Canterbury Basin

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The Quaternary benthic foraminiferal assemblages in cores at continental shelf of the Canterbury Basin (Hole U1353 and U1354 of IODP Exp. 317), were examined to understand the paleoceanographic history. The purpose of Exp. 317, is to understand the relative importance of eustasy and tectonic and sedimentary processes in controlling the development of continental margin sedimentary cycles (sequences). Sites U1353 and U1354 provide a high resolution record of recent glacial cycles covering the Holocene and late Quaternary in a continental shelf setting.

In the Pleistocene section, two alternating benthic foraminiferal assemblages were recognized. One assemblage consists mainly of *Notorotalia inornata* and *Elphidium charlottense* associated with *Zeaflorilus parri*, suggesting a shallow inner shelf environment. The other consists of *Notorotalia aucklandica*, *Nonionella flemingi* and *Anomarinoides sphericus*, implying a deeper depositional environment down to outer shelf.

Thus, these alternation of two assemblages is considered to represent the frequent paleo-depth changes between inner shelf and outer shelf or deeper. We will discuss the relationship between faunal changes and eustatic sea level changes.

Keywords: fossil benthic foraminifera, paleoceanography, the continental shelf of the Canterbury Basin, late Pleistocene, IODP Exp. 317

MIS022-P02

Room:Convention Hall

Time:May 23 14:00-16:30

Plio-Pleistocene fossil ostracodes of continental shelf cores at IODP Site U1354 (Exp. 317), Canterbury Basin

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Integrated Ocean Drilling Program (IODP) Expedition 317 was devoted to understanding the relative importance of global sea level (eustasy) versus local tectonic and sedimentary processes in controlling continental margin sedimentary cycles. The expedition recovered sediments from the Eocene to recent period, with a particular focus on the sequence stratigraphy of the late Miocene to recent, when global sea level change was dominated by glacioeustasy. Drilling in the Canterbury Basin, on the eastern margin of the South Island of New Zealand took advantage of high rates of Neogene sediment supply, which preserved a high-frequency (0.1-0.5 m.y.) record of depositional cyclicity. Ostracodes are benthic micro-crustaceans that widely inhabit marine, brackish, and non-marine environments. Shallow marine species have more restricted habitat and respond sensitively to environmental changes. Therefore they are a useful tool for high-resolution analyses of paleoenvironmental changes.

We investigated samples during Plio-Pleistocene sections from Site U1354(Hole U1354B and C; 75-375 m below seafloor; ~1.2 to 4.3 Ma), which is in an intermediate position within the three shelf sites transect of Expedition 317. Samples were examined at 1.5 m depth intervals (~15-20 kyr intervals) at 75-110 m below seafloor and 10 m (~100 kyr) intervals at under 110 m below seafloor. Fossil ostracodes occurred from all 41 samples that we used. Numbers of ostracode species and specimens/g sample increase upward. Five species of ostracodes *Argilloecia* sp., *Callistocythere* sp., *Cytheropteron* cf. *abyssorum*, *Hemicytherura* sp., and *Munseyella brevis* were contained abundantly through whole samples. Relative abundance (%) of *Munseyella brevis*, that lives on the shelf area at east of the south land of New Zealand, versus *Argilloecia* sp. that lives in cold and deep sea and *Cytheropteron* cf. *abyssorum* that lives around Antarctica shifted constructively. These changes are supposed to be relative sea level changes. We expect to reveal detailed environmental changes by using data of such as calcareous nannofossils stratigraphy.

Keywords: IODP Exp. 317, Canterbury Basin, fossil Ostracode, Plio-Pleistocene

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MIS022-P03

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Paleoceanography based on Pliocene and Pleistocene diatom floras from the Canterbury Basin (IODP Ex. 317)

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Diatom analyses of the upper Pliocene and Pleistocene sediments (from ca 2,780 to 290 ka after results of onboard calcareous nannoplankton biostratigraphic research) in the Canterbury Basin continental slope (Hole U1352B of Integrated Ocean Drilling Program Expedition 317) revealed strong warm and cold fluctuations which might coincide with global benthic foraminiferal $\delta^{18}O$ records, in addition to three times trans- and degression events, although the preservation and occurrences were generally poor and rare and the diatom biostratigraphic events were unknown. Moreover, abundant occurrence of diatom resting spores from ca 1,700 to 1,000 ka may indicate that eutrophication advanced around coastal region after upwelling strengthened, and nutrients supplied unstable and sporadically from 1,250 to 1,000 ka.

Keywords: IODP Expedition 317, New Zealand, diatoms, nannofossils, paleoceanography, Canterbury Basin

MIS022-P04

Room: Convention Hall

Time: May 23 14:00-16:30

Quaternary tephrostratigraphy in IODP exp.323 cores (U1343 and U1344) collected from the Sea of Bering

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Tephra layers constitute valuable stratigraphic markers. In this study, we analyzed eighty-two tephra samples in IODP exp.323 cores (U1343 and U1344) collected from the Sea of Bering, describe their petrographic and geochemical characters, and reveal tephrostratigraphy.

Sediments cores U1343 (water depth 1956 m) and U1344 (water depth 3174 m) were collected from the center part of the Sea of Bering and near the Bering Self sloop. Sediment mainly constitutes of diatomaceous clay to silt. The core U1343 include total forty-eight tephra samples from four Hole cores, 13 samples in Hole U1343A (total length: 201.5 mbsf), 9 samples in Hole U1343C (total length: 234.2 mbsf), one sample in Hole U1343D (total length: 8.5mbsf), and 25 samples in Hole U1343E (total length: 744.3mbsf). Paleomagnetism suggests that sediments in the Hole U1343A and Hole U1343C are the continuous records during last 800 ka approximately, and the bottom of sediment in Hole U1343E reach at the 2.1Ma. The core U1344 include thirty-four tephra samples from three Hole cores, 27 samples in Hole U1344A (total length: 745.0 mbsf), 6 samples in Hole U1344D (total length: 286.5 mbsf), and one sample in Hole U1344E (total length: 202.8 mbsf). Paleomagnetism suggests that sediments in the Hole U1344D and Hole U1344E are the continuous records during last 600 ka approximately, and the bottom of sediment in Hole U1344A reach at the 1.9Ma.

Tephra samples were (1) washed by ultrasonic cleaner, (2) sieved by 63, 125 and 250 micrometer size and to recover the 63-125 micrometer size fraction, and (3) grains examined under a binocular/polarizing microscopes to describe their form, color and mineral assemblage. The chemical compositions of volcanic glass shards in the 63-125 micrometer size fraction were determined using a wavelength dispersive electron probe micro-analyzer operated at 15 kV and using a 10 nA beam current and a 10 micrometer beam diameter to minimize loss of Na and K.

Most of tephra samples include rounded rock fragments, rounded and weathered minerals, quartz and plagioclase. Furthermore, foraminiferal fossils and diatom fossils are contaminated in most samples. In every tephra sample, volcanic glass shards in the 63-125 micrometer size fraction are observed and also volcanic glass shards are concentrated under the 63micrometer size. On basis of major-element composition of glass shards in 82 samples, SiO₂ in glass shards is between ca.53 wt% to ca.78 wt%. Vitric tephra samples which are characterized by high-SiO₂ content (ca. 71wt% to 78 wt%) were found in five in the core U1343, and two in the core U1344. They are rich in clear and bubble-wall type volcanic glass shards and rarely heavy minerals. The size fraction of volcanic glass shards is concentrated under 63 micrometer.

Rock fragments and minerals are considered as to be transported by seasonal sea-ices and ice-bergs, not to fall out accompanying volcanic eruptions, because almost they are almost rounded. On basis of major-element composition of volcanic glass shards, eighty-two samples can be divided to two groups (Type 1: high CaO-MgO type, Type 2: low CaO-MgO type). Also, SiO₂ of Type 1 tephra is ca.58-63wt% and Type 2 is ca.65-78wt%. Such geochemical characters suggest that Quaternary tephra beds in the central of the Sea of Bering have been provided from at least two volcanic zones.

Five tephra beds in the core U1343 are divided to Type 2. Furthermore, three of them and two of them in different Hole are correlates respectively: 93.825 mbsf in Hole U1343E (ca 0.37Ma; thickness is 3.5 cm), 97.835 mbsf in Hole U1343C (ca.0.29Ma: thickness is 2 cm), and 98.868 mbsf in Hole U1343A (ca.0.33Ma: thickness 4cm). SiO₂ contents in three samples are ca.75wt%. 190.850 mbsf in Hole U1343E (ca.0.78Ma: thickness is 1 cm) and 193.795 mbsf in U1343C (ca.0.78Ma: thickness 2 cm) are correlated each other. SiO₂ contents in two samples are ca.78wt%.

With collaboration of the IODP Exp.323 science party

Keywords: tephrostratigraphy, the Sea of Bering, Quaternary, EPMA

MIS022-P05

Room:Convention Hall

Time:May 23 14:00-16:30

Pleistocene foraminiferal oxygen and carbon isotope records in the Bering Sea (IODP EXP. 323 Site U1343)

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Sea ice history in the northern hemisphere provides insight to understand the cooling mechanism since the Northern Hemisphere Glaciation (NHG). IODP Expedition 323 recovered first appropriate sediments in the Bering Sea to see sequential record during whole Pleistocene. Among the seven sites drilled during this expedition, Site U1343 is situated at the Beringian slope that is proximal to the current seasonal ice-margin. To augment shipboard data, we have generated oxygen and carbon isotope record of planktic and benthic foraminifers. Inter-species calibration of benthic foraminiferal oxygen isotope provides well-established composite oxygen isotope record during last 2.1 Ma. Oxygen isotope stratigraphy during last 0.6 Ma reasonably matches to the biostratigraphy age-model on-board. Carbon isotope of both planktic and benthic foraminifer above 200m CCSF-A shows partial contamination from the interstitial water with light ^{13}C , produced by the bacterial activity in the Sulfate-Methane Transition Zone. Concurrence of colored foraminifer shells presence at those contaminated interval suggests the alteration process between foraminifer shells and the interstitial water. Contaminated data can simple be excluded by using statistical model and the presence of colored shells. Oxygen and carbon isotope records shows notable shift after the Mid-Pleistocene Transition (MPT). Long-term trend of foraminiferal oxygen and carbon isotope with changes in the sea-ice related flora indicate progressive sea-ice formation after the MPT. This sea-ice formation is attributed to the less ventilation between surface and deep water, hence formation of the oxygen minimum water around 2000m depth in the Bering Sea.

Keywords: foraminifer, oxygen isotope, carbon isotope, Bering Sea, Pleistocene

MIS022-P06

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Distribution of hydrothermal clay minerals in cores obtained by IODP Exp.311 from the Iheya North Knoll, Okinawa Trough

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An active hydrothermal field at the Iheya North Knoll, Okinawa Trough, was the subject of detailed investigations during the Integrated Ocean Drilling Program (IODP) Expedition 311, conducted in September, 2010. Five sites were drilled during the expedition : the active hydrothermal mound (Site C0016), 600 m northwest of the mound (Site C0015), 100 m east of the mound (Site C0013), 450 m east of the mound (Site C0014) and 1550 m east of the mound (Site C0017). Mineralogy and geochemistry of hydrothermal clay minerals of the core samples were studied in order to reveal physical and chemical condition below the seafloor based on their vertical and lateral distribution.

Grain size separation in silt (2-63 micrometer) and clay (<2 micrometer) fractions according to Stokes' law was performed by setting powdered core sediment in a standing cylinder. Mineralogy of the bulk sediment and of the clay fraction was determined by X-ray diffractometry (XRD). For the clay fraction, measurements were carried out on air-dried, ethylene glycol-saturated, HCl-treated and heated (200 - 300 degC) condition, in order to identify clay minerals. Morphology of the clay minerals was observed using transmission electron microscopy (TEM), at 200kV accelerating voltage in the Research Laboratory for High Voltage Electron Microscopy, Kyushu University. Chemical composition of the clay minerals was obtained in TEM observation using energy dispersive spectrometry (EDS).

Vertical distribution of clay minerals from site C0013 (100 m east of hydrothermal mound) was summarized followings, where dominant clay minerals were listed up.

UnitI (0 - 4.5~6.8 mbsf) : kaolinite, illite, pyrite and quartz from 1 mbsf; smectite, barite and sphalerite from 4.7 mbsf

UnitII (4.5~6.8 - 12 mbsf) : chlorite, chlorite-smectite mixed layer mineral, smectite, anhydrite, gypsum and pyrite

UnitIII (12 - 23 mbsf) : chlorite, anhydrite and pyrite

UnitIV (23 - 55 mbsf) : chlorite and quartz

Vertical distribution of clay minerals from site C0014 (450 m east of hydrothermal mound) was summarized as follows.

UnitI (0 - 12~16 mbsf) : quartz, muscovite and calcite dominantly; opaline silica, cristobalite, feldspar and chlorite (probably detrital) according to the onboard study

UnitII (12~16 - 29 mbsf) : kaolinite and smectite from 13 mbsf; smectite and cristobalite from 17-20 mbsf; illite-smectite mixed layer mineral and illite from 21-23 mbsf; chlorite and chlorite-smectite mixed layer mineral from 26-28 mbsf; quartz and pyrite

UnitIII (29 - 128 mbsf) : chlorite and illite; chlorite dominantly above 40 mbsf and illite dominantly below 40 mbsf; quartz and pyrite; anhydrite and gypsum from 65 mbsf

Diverse occurrence of clay minerals was notable in both Sites C0013 and C0014. The occurrence of clay minerals at the Iheya Knoll hydrothermal field is characterized by a systematic change with depths, from smectite near the seafloor, then mixed layer minerals, to chlorite and/or illite in the deeper portion. This change is likely to reflect an increase in temperature with depth. With analogical inference based on geothermal field studies, the temperature profile at Site C0014 is considered as 100 to 200 degC at 17 to 29 mbsf and > 200 degC below 29 mbsf. According to the onboard study report, measured temperatures at Site C0014 were 55 degC at 16 mbsf, 135~145 degC at 47 mbsf and > 210 degC at 50 mbsf. At Site C0013, the clay mineral change was observed at shallower depth (0 - 12 mbsf) than in Site C0014 and the dominant occurrence of chlorite below 12 mbsf indicates that temperature was > 200 degC. This vertical distribution is in accordance with larger temperature gradient in the vicinity of the center of the hydrothermal field.

Keywords: Iheya North Knoll Okinawa Trough, IODP Expedition 311, hydrothermal clay minerals, hydrothermal alteration, X-ray diffractometry (XRD), transmission electron microscopy (TEM)

MIS022-P07

Room: Convention Hall

Time: May 23 14:00-16:30

Petrology of large lava flow off the East Pacific Rise : Crystallization process of the large ponded lava from ODP hole

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Petrology of large lava flow off the East Pacific Rise : Crystallization process of the large ponded lava from ODP hole 1256C

Saeki, K. and Umino, S. (Dept. Earth Sci., Kanazawa univ.)

91°56.1'W on the 3650-m deep Guatemala Basin on the Cocos plate formed at ~15 Ma at the East Pacific Rise. A large off-ridge lava flow 75-100m in thickness and ca. 10 cubic kilometers in volume was drilled at site 1256, providing a unique opportunity to understand the inner structures and solidification and emplacement processes of an off-ridge large lava flow. Hole C penetrated a 35-m thick lava from 280 mbsf to 315 mbsf. We present mineral compositions and grain size analyses of the core sample from hole 1256C, and discuss the crystallization and emplacement processes of the large off-ridge lava flow.

Phenocrysts are olivine, clinopyroxene and plagioclase, and the groundmass minerals are clinopyroxene, plagioclase and magnetite. Varioles are present in the upper and in lower sections with a few biotite in granophyre veins in the middle. The lava flow consists mostly of NMORB with high-K2O EMORB intervened at a depth interval of 290-300 mbsf (Wilson, et al., 2003). High-K2O EMORB has high-Mg# (60~70) clinopyroxenes and is interpreted to have intruded into the solidifying lava body at the final stage of the lava emplacement.

Just above the EMORB is the level of the most differentiated lava that has low-Mg# (50~60) clinopyroxenes, granophyric veins and pods. Plagioclase and clinopyroxene crystals are largest in this level. These facts indicate that increase in water content in the residual liquid with the crystallization differentiation reduced magma viscosity and resulted in crystallization of biotite-bearing granophyre and the largest crystal sizes.

I compared olivine phenocryst size distribution and number density distribution with phenocrysts sedimentation model of Rowland and Walker (1988). In cases where phenocrysts sedimentation velocity faster than cooling rate of lava body, olivine phenocrysts have slightly in uppermost part and have very few in upper part. In upper two third of olivine phenocrysts increase rapidly to maximum volume and decrease by degrees for lower section. Two parts that lower section and direct top of layer of intruded EPMA suggests these similar pattern with lower section of phenocrysts sedimentation model. It shows two lower sections in this lava body. The fact cannot explain by one lava flow, more than once lava flow units grew together and then intruded EMORB at the center.

Pigeonite occurs through the whole section as a discrete crystal in some cases and more commonly enclosed by augite. Augite has Mg#60~75, Al₂O₃ 1.5~2.0 wt%, TiO₂ 0.6~0.8 wt% except 292 mbsf. Pigeonite has Mg#65~70, Al₂O₃ 0.8~1.1 wt%, TiO₂ 0.3~0.4 wt%. Pigeonite and augite in contact with each other is considered to be in equilibrium in terms of Fe-Mg distribution. However, augite crystals away from the contact with pigeonite inclusions are disequilibrium with the pigeonite. This suggests that augite including pigeonite was incorporated into the host magma which was unsaturated with pigeonite.

Keywords: off-ridge lava flow, olivine phenocrysts, pigeonite

MIS022-P08

Room: Convention Hall

Time: May 23 14:00-16:30

Magnetic fabric of sediments in a pre-subducting oceanic plate: results from IODP Expedition 322, Sites C0011 and C0012

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Recent progress of Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) has revealed dramatic segregation in stress and strain across the transect of Nankai accretionary prism. According to the results from the Integrated Ocean Drilling Program (IODP) Expedition 316, magnetic fabrics at the prism toe (Sites C0006 and C0007) was represented by typical vertical and horizontal maximum principle strain axis in the upper and lower part of the boreholes, respectively. The question arose was how that lower horizontal compression zone extends seaward, which can also be a clue to understand propagation of the decollement and/or initiation of deformation in the subducting sediments. Here we present preliminary results of magnetic fabric analysis of the presubducting sediments at Sites C0011 and C0012 recovered during Expedition 322. Results show generally oblate magnetic ellipsoids throughout the holes with slight increase in the degree of anisotropy. The minimum axis of the magnetic ellipsoid (K3) shows very steep inclination in both Sites C0011 and C0012, which suggests that the horizontal compression observed in Sites C0006 and C0007 does not extend to these input sites. The slight difference in the K3 between upper and lower part at Site C0012 may reflect the tectonic history at this unique location of the top of Kashinosaki Knoll, however, further investigation is necessary for discussion.

Keywords: Nankai Trough, NanTroSEIZE, accretionary complex, D/V Chikyu, Anisotropy of magnetic susceptibility

MIS022-P09

Room: Convention Hall

Time: May 23 14:00-16:30

Reconstruction of history of sand supply into the Kumano Forearc Basin by IODP Core-Log Integration

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Downhole logging data combined with core data are useful to determine physical properties and lithology of the formation. However, layer-by-layer analyses were not routinely conducted especially for marine siliciclastic sediments due to poor core recovery. We attempted to reconstruct poor recovery intervals in the Kumano Basin using core-log integration method.

During Integrated Ocean Drilling Program (IODP) Expeditions 314/315, Site C0002 was drilled, logged, and cored down to 1400 meters below seafloor (mbsf). Stratified structures are clearly imaged by a seismic reflection profile in the southern edge of the Kumano Basin including Site C0002 area. A 935m-thick basin fill and accretionary prism were drilled and logged with Logging-While-Drilling (LWD) at Hole C0002A and high quality data were continuously acquired. Coring operations were conducted at the intervals 0-204 and 475-1057 mbsf in Hole C0002B and C0002D. Although the two holes are close enough to correlate.

We compared lithology of the recovered cores with log data, mainly resistivity and natural gamma ray, in the two cored intervals. As the core recovery was good throughout the upper interval, clear correlations are recognized between the lithological variations and log responses. Most of the sand layers are characterized by low gamma ray and low resistivity values. In the lower interval, where cores were recovered by the RCB system, the core recovery was poor and the dominant lithology is mudstone. However, the log responses suggest that the lower interval are composed of alternating beds of sandstone and mudstone. The thickness of LWD-based mudstone coincides with the thickness of recovered sediments (=mudstone), suggesting that the recovered cores represent highly biased lithology due to extremely low recovery of sandstone.

The total recovery length of mud coincides with the total thickness of mud layers estimated from logging data even in the low recovery (37.6%) of the lower interval. It can be said that only muds were successfully recovered and most sands were washed out. Based on the core-log integration studies, the LWD-derived lithology can be applied for the entire section of the hole including non-cored and poorly recovered intervals. This study successfully reconstructed the history of sand supply into the Kumano Basin, and enables us to continuously estimate eustatic sea-level changes.

Keywords: Integrated Ocean Drilling Program (IODP), LWD (logging-while-drilling), resistivity, natural gamma ray, methane hydrate, core-log integration

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Time:May 23 14:00-16:30

3D X-CT core image analysis approaching with seismic interpretation

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We proposed new approach to analyze 3D X-CT core image with seismic interpretation software.

3D X-CT image has been recently used for analysis of core sample due to its non-distractive measurement and high resolution imaging. For example, all core samples acquired in JAMSTEC drilling research vessel CHIKYU are measured with 3D medical X-CT prior to other measurements. The data is utilized for quick look to determine sampling position and following measurement strategy. The data are also used farther research after the cruise.

A lot of commercial and free software for 3D X-CT image are sold and distributed, but they target medical users. Therefore the visualization, measurement and database are customized for medical examination and client database. Some commercial ones which handles 3D image are expensive.

On the other hand, many 2D/3D seismic visualization and interpretation software has been developed for oil industry and earth science. They have many geological and geophysical functions, for example structural interpretation, faults (fracture) modeling, arithmetical operation, image filtering used for fracture and texture analysis, attribute analysis, which can be very useful for core analysis as well.

We import 3D X-CT core image data measured with medical and industrial CT scanner to seismic interpretation software, and introduce the analysis results and potential.

Keywords: 3D X-CT, core analysis, seismic interpretation

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X-ray CT analysis and density estimation using a sediment core in cold-water coral mound provinces

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Three-dimensional quantitative analysis using X-ray computerized tomography (CT) analysis combined with X-ray radiographs and line-scan digital core images of a marine sequence recovered from near Challenger Mound in the Porcupine Seabight, off western Ireland during the Integrated Ocean Drilling Program (IODP) Expedition 307, is an effective method for core characterization. This allowed three-dimensional examination of complex shapes of corals fragments, dropstones, pebbles, and ice-rafted debris in sedimentary sequences. This paper confirms that X-ray CT proves to be a relatively quick and accurate method for high-resolution and non-destructive analysis of three-dimensional internal structures of core samples without the special sample preparation. A medical CT system at relatively low resolution provides an image of the large-scale features and allows correlation with core samples, and has generally been used due to their availability and relative ease of use. CT scanning just after coring and before splitting may be efficient to avoid a degradation of cores. Effective and efficient use of X-ray CT systems allows for the possibility for rapid systematic characterization of three-dimensional structural features, and may improve sub-sampling and core-processing procedures.

Because X-ray attenuation is sensitive to density variations, X-ray CT systems also offer the possibility of quantitative density measurement. Its rapid and quantitative results can easily be used to map subtle detailed density variations in three-dimensions. A relationship between CT numbers and measured densities by the GRA and the mass/volume method is consistent with previous studies. Standard conventional techniques for bulk density analysis in sediment cores use raw data from GRA or mass/volume method. Density values by standard conventional techniques represent the gross average. Neither have a spatial resolution better than X-ray CT data-derived density. Moreover, X-ray CT data-derived density offers advantages over these standard conventional techniques as it gives a three-dimensional distribution anywhere in the sample. Also, because of the simple process of the conversion from CT number to density, it is expected to reduce the possibility of human error.

Keywords: X-ray CT, bulk density, sediment core, Integrated Ocean Drilling Program (IODP), Expedition 307

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Upgrade development of a deep all core wire line drilling for sedimentary soft rock in coastal area

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In the all core drilling deeper than 200m in depth, it is generally adopted to a wire line (WL) core drilling method which have higher advantage of certainly and working efficiency than an usual drilling methods which is constantly entering and withdrawing all drill pipes, tubes and so on. However, a WL core drilling method was developed for the hard rocks, and the issue to be solved is the improvement of a coring technique for the soft rocks. We carried out the deep drilling survey to the depth of 1,004m. The drilling site locates the coastal area of Horonobe town in Hokkaido and the subsurface geology is composed of sedimentary soft rocks (mud, sand and conglomerate). It was concerned the occurrence of sloughing and the reduction of core collection rate. Therefore, we selected the PQ-WL drilling method combined with a high viscosity and low dehydrating drilling mud. And a new WL drilling tools, composed of the over-size reamer and the WL single core tube, have been developed to prevent an excessive rise of water pressure and to remove sloughed cuttings quickly. As a result, we have succeeded in keeping a high core collection rate (over average 90%) and getting a good quality core.

Keywords: Coastal area, Sedimentary soft rocks, All core wire line drilling, Upgrade development