Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MIS27-P01 Room:Convention Hall Time:May 24 17:15-18:30

Rotation Angle of Shikoku Basin: Discremination of drilling induced magnetization from VRM by great circle analysis

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The IODP Expedition 322 penetrated sediments-basement boundary and recovered successive cores at Site C0012, subduction input in Nankai Subduction Zone. The collected basement samples are composed of alternating beds of pillow basalts and hyaroclastite and were retrieved by rotary core barrel drilling system. Paleomagnetic measurements were conducted to understand the polarity, paleolatitude and tectonic rotation. In total, 29 minicores or blocks were collected from the basaltic basement rocks. Paleomagnetic results suffers from intense secondary magnetization during drilling. AF demagnetization field up to 10 mT was generally enough to remove the overprint to allow interpretation of polarity of magnetization.

Paleomagnetic measurements on basaltic basement rocks from Site C0012 (538-561m CSF) show that the stable magnetization has reversed polarity. Paleolatitude was calculated from 7 samples as 28.0+-7.6 degrees N and the expected latitudinal translation is 522+-844km. Magnetic anomaly map can be produced using the recently compiled dataset by Quesnel et al. (2009). Preliminary interpretation based on the simple magnetization model assuming the constant thickness of the magnetized layer (Okino, personal communication), the magnetic anomaly crossing the Kashinosaki Knoll corresponds to anomaly C6Ar (20.7-21.1Ma; ATNTS2004).

We also attempted to reconstruct tectonic rotation related to the development of Shikoku Basin using secondary magnetization component acquired during Brunhes normal polarity chron. A whole round sample used for anelastic strain recovery (ASR) is the best sample for that purpose allowing us to measure a block collected from the center of the core, which has least drilling overprint. We collected multiple sub-samples from the center of ASR sample and carefully measured with stepwise AF demagnetization and thermal demagnetization experiments. However, the results indicate that the secondary magnetization is not directing the magnetic north during the Brunhes chron. In order to extract the information carried by the viscous remanent magnetization (VRM) acquired during the Brunhes, we conducted great circle analysis described by Kirschvink (1980). This allowed us to recognize four components including the VRM. The results shows that the angles between VRM and primaly component of reversed polarity are around 10˜20 degrees suggesting no significant rotation since the formation Shikoku Basin.

Keywords: Shikoku Basin, drilling induced magnetization, viscous remanent magnetization, great circle regression analysis, IODP Hole C0012A, Basaltic Basement

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MIS27-P02 Room:Convention Hall Time:May 24 17:15-18:30

Stress-drop estimation from geophysical logs in Shikoku basin of Exp. 322-C0011, NanTro-SEIZ

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Nankai Trough region in southeast Japan is invested the comprehensive studies of the subduction zones. For understanding the stress state and geological properties in the shallower Shikoku basin, two sites were drilled in open-ocean sediments. The resistivity Logging while Drilling was run in C0011A and full cored was applied in C0011B which preparing for the measurements of physical prosperities (MultiSensory Core Log, MSCL.). In the LWD logging, the notability breakout anomaly was observed in the depth 615 mbsf. NanTroSEIZE scientists developed many researches about the stress orientation and magnitude estimation by logging data in Nankai Trough. In this study, we constrained the possible horizontal principal stress azimuth and magnitude in entire C0011A borehole. The dislocation of breakout orientation indicated this drilling drilled through the fault and stress drop can be determined by the fault geometry. The close 90 degree rotation implied the 100% stress drop which the magnitude equal to 2.5 MPa. Our simulation displays the magnitude of horizontal principal stresses before and after the fault slip. The low rock strength (0˜20MPa) and weak fault would be the necessary conditions to satisfy the dislocation model and the observations.

Keywords: stress drop, breakout, logging, Logging while drilling, stress polygon

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MIS27-P03 Room:Convention Hall Time:May 24 17:15-18:30

Evaluation of the Present Stress Field for the Nankai area through the Slip DeFicit Model

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After the 2011 Tohoku-Oki, Japan, earthquake, many studies have investigated the stress state in the Nankai trough area, where is one of the possible area for the next devastating earthquake. For understanding the stress state and geological properties in Nankai, several drilling projects have been conducted in the shallow part of the Kumano and Shikoku basin. Among them, the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) has involved in many studies on the stress orientation and magnitude estimation by logging datum in the Nankai Trough. Due to limitation by the technology and the processing of drilling, the real stress orientation and magnitude in Nankai near the subduction zones is still controversial. In this study, we develop the Slip DeFicit Model (SDM) to estimate the stress tensor and associated with the Fine-scale boreholes datum. SDM is assumed that the regional stress is dominated by the slip deFicit during aseismic period. The tectonic loading in the rest part of the system has been released through other aseismic behaviors, such as creeping or small earthquakes. Using this model, the stress tensor can be analyzed at different depths in the drilling sites. Comparing to the logging data, the modeled stress tensors in terms of magnitude and orientation are consistent with the stress states in the site C0009, C00012, C0002, and C0006. Based on SDM, the stress tensor at deeper depth in the drill sites can be evalutated.

Keywords: Slip DeFicit model, Nankai trough, stress tensor, subductiuon zone, logging

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MIS27-P04 Room:Convention Hall Time:May 24 17:15-18:30

Provenance change in around 3Ma at IODP Site C0011, off Nankai Trough

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Sr-Nd-Pb isotope ratios and chemistry of silicate portion of hemipelagic mud taken from IODP site C0011 suggest that Asian dust flux had rapidly decreased since 3 Ma. Asian dust is known to originate from soils of inland China, which are characterized by much higher Sr, Pb and much lower Nd isotope ratios than those of Japanese rocks and sediments. Results of isotopic analysis of silicate portion show that the isotope ratios of Sr and Pb decrease, and that of Nd increases upward rapidly across the horizon corresponding to 3Ma in age. This indicates the rational decrease of Asian dust particles in the sediments since 3Ma. Because the paleomagnetostratigraphy of C0011 shows that the sedimentary rate had rapidly decreased since 3 Ma (Expedition 333 Scientists, 2011), the rational decrease of Asian dust in the sediments means the decrease of its flux to this site at that time. Decrease of biogenic flux of silica or carbonates cannot explain the slowed depositional rate considering the fact that there is no increase in bulk Al_2O_3/SiO_2 at around 3 Ma, and that bulk CaO and content of calcium carbonate had rather increased since 3Ma. Because there is no period of significant decrease in Asian dust flux to the North Pacific since its rapid increase at 3.6 Ma (Rea, 1994), the decrease of the flux at Site C0011 may reflect some local events around Shikoku Basin. Such events considerable include cutoff of the dust path to Shikoku Basin by the uplifted Japan island arc and the entrainment of surficial suspended particles by the Kuroshio current, which is estimated to have started to influence the sea surface of site C0011 around 3 Ma due to the plate motion.

Keywords: Nankai Trough, Shikoku Basin, Hemipelagite, Sr-Nd-Pb isotopes, Asian dust

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MIS27-P05 Room:Convention Hall Time:May 24 17:15-18:30

Structural styles and stress field of the Nankai accretionary prism: insights from geophysical logging

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The stage-1 expeditions in the Nankai Trough area by IODP drilling performed geophysical logging measurements. By analyzing these data-sets, structural geometry and stress fields in both of large and small scales have been identified. This presentation includes recent achievements of such research.

Keywords: IODP, geophysical logging, geologic structure, stress, accretionary prism

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Accretion process of sediments below Kumano basin by analyzing cuttings from IODP Exp.319, the first riser drilling

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The structure, stress condition and rock properties of accreted sediments in the Nankai Trough have been studied by reflection seismology and deep sea drillings. Accretion processes have been suggested by onland geological studies that the sediments are circulated with undergoing lithification and deformation in shallow subduction zone driven by the plate motion. However the process in the modern Nankai Trough has yet to be elucidated. We discuss the accretion process of the Nankai Trough accretionary prism below Kumano basin by clarifying thermal structure and materials by vitrinite measurement and whole rock chemical analyses, respectively, using cuttings samples from IODP The Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) the first scientific riser drilling Expedition 319 at Site C0009. We also introduce the use of the cuttings samples for academic research, which becomes important in the upcoming riser drilling expeditions of NanTroSEIZE and in the future ocean drilling in general.

Cuttings were collected with an interval of every 5 m from 703.9 to 1604 m and cores were recovered from 1509.7 m to 1593.9 m below sea floor (mbsf). Due to poor consolidation of drilled sediments, cuttings samples typically consist of sand and silt floating in a matrix of mixed sedimentary and drilling muds, and solid rock chips were not retrieved above 802.7 mbsf. Visual description based on macro- and micro-scopic observation, XRD and XRF analysis, rocks properties and the age of washed cuttings (i.e. grains without mud) were made throughout the hole, which allowed to establish some indexes to estimate lithology. Four lithologic units (Unit I ? IV) were defined at Site C0009 based on compositional and textural variations of cuttings samples, which are believed to closely reflect lithologic changes of drilled sequences, and show good consistency with logging data. Unit IV is believed to be accreted sediment by mainly age and the textural change of sediments. Dissoluble element ratios (Ti/P) and clay content ratios in the samples analyzed by XRF and XRD are different from that in basin sediment, which also might support Unit IV are accreted materials. XRD and XRF analyses on cuttings samples provide useful information to estimate difference of lithology. Comparison of cuttings and cores at corresponding depth indicates compositional and textural differences between the cuttings and core samples, which could reflect mixing of cuttings in drill hole.

Paleop-maximum Temperature (i.e. highest temperature rock experienced) of drilled sediments is estimated by vitrinite reflectance measurement in cuttings and core samples. Vitrinite is common in all units and the results show 0.2 ? 0.3 % in reflectance which are indicative of 50 ? 60 oC when considering sedimentary age. The reflectance (temperature) slightly increases depth-ward. There is no large temperature difference between the units including unconformity, which suggests that the temperature distribution is similar to the past or present gethremal gradient and that the accreted sediments (Unit IV) have not subducted, accordingly. Our attempt further connects to the detailed discussion on ongoing accretion processes when we reach to the greater depth in the planned future expeditions of NanTroSEIZE.

Keywords: Accretionary prism, Vitrinite, Riser drilling, cuttings, NanTroSEIZE

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Outline of the Japan Beyond-Brittle Project (JBBP) for geothermal energy development in ductile zone

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Geothermal energy is one of the most promising solutions for global warming, shortage of energy resources, and national energy security. Utilization of geothermal energy has not been promoted during the last 10 years in Japan because of cost consideration, amount of generated electricity per a power plant, various uncertainties and risks, although Japan has 3rd world largest potential of hydrothermal energy. Engineering approach to artificially create geothermal reservoirs (EGS: engineered geothermal systems) in granitic basement has been highlightened recently because of applicability to many of the sites where permeable fracture system and satisfactory water charge can not be found, and EGS projects are under way in many countries. However, some critical problems have been experimentally identified, such as low recovery rate of injected water, unexpectedly small improvement in permeability, and occurrence of large induced seismicity (Majer et al., 2007).

We understood that such problems in the EGS development can not be evaded because they are highly related to the nature of brittle rock mass, and, hence, propose a new concept of the engineered geothermal development where reservoirs are created in ductile basement (see figure). We expect that power generation using the EGS reservoirs in ductile zone especially in Northeast Japan have advantages, namely: (a) homogeneous rock properties and stress make it simpler to design and control the reservoir, (b) nearly full (100%) recovery of injected water from hydraulically closed reservoir can be achieved, (c) sustainable energy production would be realized by controlling water injection rate, (d) shallower brittle-ductile transition depth in the Northeast Japan (Muraoka and Yano, 1998) can effectively reduces costs for drilling and operational risks, (e) widely distributed ductile zones in relatively shallow depth in the Northeast Japan have potential for a large quantity of power generation, (f) possible common characteristics of the ductile zones brings universal design/development methodology free from the site dependency, and (g) induced/triggered earthquakes with disastrous magnitude do not occur from/around the reservoirs.

Scientific and technological breakthroughs are indispensable to realize the EGS system in ductile zones. Hydraulic stimulation, the most important process to create artificial fracture systems, has been commonly used in geothermal and oil industries, and experimental/theoretical studies have been made to understand physics behind the stimulation. Meanwhile, few investigations on the hydraulic stimulation in the ductile zone have been ever made. Control factors of the human created fracture systems in the ductile zone, including stress, constitutive laws, homogeneity of physical properties, and presence of liquid/gas, should be clearly investigated, and methods for design and modeling of the EGS reservoir should be derived based on the clarified control factors. Monitoring of the reservoir extension is another key issue to be considered. Induced seismicity has been widely used for monitoring in the previous EGS projects, however, considering the depth and temperature of the target and expected magnitude of the seismicity, the seismic monitoring may not have sufficient ability to provide information on the behavior and characteristics of the reservoir. New principles and technology development for the monitoring must be investigated.

We referred to the development of EGS system in the ductile zone as ”Japan Beyond-Brittle Project (JBBP)” and have initiated project preparation. First few years will be spent for scientific investigation and technology development, and deep borehole will be penetrated into ductile zone in Northeast Japan afterwards. We expect that feasibility of the EGS system in the ductile zone can be demonstrated from information from the borehole and multi-level hydraulic stimulation in the brittle-ductile transition zone.

Keywords: EGS, JBBP, Ductile zone, Hydraulic stimulation, Geothermal power generation

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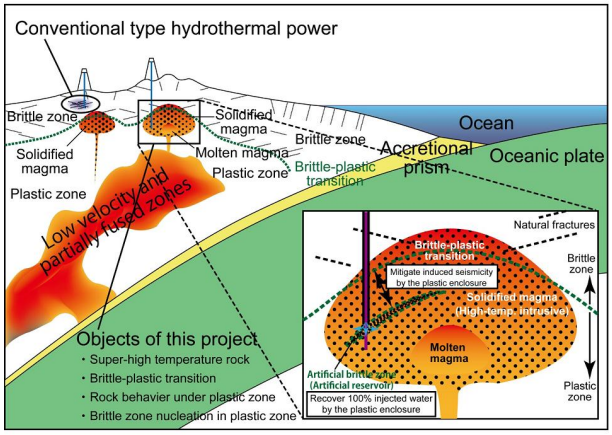

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MIS27-P08 Room:Convention Hall Time:May 24 17:15-18:30

Deep structures and melt-fluid migration in the Hole 1256D Superfast-Spread Crust

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ODP-IODP Hole 1256D drilled through the upper oceanic crust of the Cocos plate formed at the superfast spreading East Pacific Rise ~15 Ma ago (220 mm/yr). This hole penetrated, for a first time in the history of scientific ocean drilling, the upper gabbro layer of an intact oceanic section during IODP Expedition 312. IODP Expedition 335 deepened the hole by ~ 20 m and recovered cores and cobbles of basalts with granoblastic texture (granoblastic dikes) beneath two bodies of gabbroic rocks (Gabbro 1 and Gabbro 2). Recovered basaltic materials contain cross-cutting relationships between dioritic magmatic veins and hydrothermal veins, and between opx-bearing veins and hydrothermal veins. Here we present the structures in the sheeted dikes and gabbros, and deduce melt-fluid transport system in the deep part of the superfast-spread crust.

The Hole 1256D is located at the boundary between C5Br and C5Bn.2n (15.16 Ma) and inclines ~5 degree from vertical to the west. Results of GPIT logging imply that the upper part of the hole has reversed magnetic polarity, whereas granoblastic dikes and gabbros have normal polarity. Gabbro 1 yielded zircon U-Pb ages of 15.04 +- 0.18 Ma and 15.06 +- 0.30 Ma. U-Pb age for Gabbro 2 was 15.20 +- 0.17 Ma.

Structural orientations measured on the Exp. 312 cores with respect to the conventional IODP reference frame and AMS orientations were reoriented into a geographic reference frame using paleomagnetic data and assuming the magnetic structure obtained by GPIT tool. We also assumed that there was no significant tectonic tilting. Restored Sheeted dikes dip steeply to WSW toward the paleo-EPR axis. Kmax axes of AMS fabric parallel to the dike strike and mostly sub-vertical Kmin axes suggest that the magma transferred horizontally and underwent compaction during solidification. The recovered upper boundary between Gabbro 2 and the granoblastic dikes was irregular, and sub-parallel to the sheeted dike planes. However, textural banding and flow foliation in gabbros tend to dip gently to the east. Diorite veins in granoblastic dikes have irregular boundaries with various orientations and often accompany amphibolite alteration halo. X-ray CT images show inhomogeneous distribution of heavy mineral phases (Fe-oxides?) and light mineral phases (Qz?) in the melt channel implying flow differentiation occurring at hand specimen scale. Opx veins also exhibit irregular shape. Both dioritic and opx veins are cut by amphibole-bearing hydrothermal veins that accompany alteration halos of various width. Dips of amphibole veins exhibit a bimodal distribution: one shallower than ~30 degrees and other steeper than 60 degrees and dipping mostly to SW. S-poles to veins are plotted on a great circle on a stereographic projection about an axis (sigma 2 direction) plunging sub-horizontally to the NW. Brittle fractures also have the same tendency. Restored orientations of structures imply that, since the formation of the sheeted dike complex until formation of the brittle fractures, the crust dominantly underwent extension parallel to the spreading direction. Melt and fluid were likely to transfer subhorizontally through dike planes and through intersections of fracture planes, respectively.

Keywords: oceanic crust, structure, melt migration, paleomagnetism, dating, superfast spreading ridge

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Outline of the GONAF: A deep geophysical observatory at the NAFZ

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We will start drilling under the GONAF (Geophysical Observatory at the North Anatolian Fault) project in 2012, which is partly supported by ICDP.

The North Anatolian Fault Zone (NAFZ) is the most active plate-bounding strike-slip fault in Europe that follows an EW trend offshore through the Sea of Marmara within less than 20 km south of Istanbul. The fault has produced a series of large and devastating earthquakes during the 20th century starting in 1939 in eastern Anatolia and then systematically propagating westwards. The most recent M>7 earthquakes occurred in 1999 near Izmit and Duzce and temporarily produced accelerated seismic activity along the NAFZ south of the greater Istanbul area below the Sea of Marmara now representing a seismic gap of up to 150 km length. This part of the NAFZ is the only segment that has not been activated in the present series and may have accumulated a slip deficit of up to 4-5 m since the last event in 1766. Recent estimates indicate a 35-70% probability for the occurrence of a M>7 earthquake close to the population center of Istanbul by 2034. Owing to post-seismic stress redistribution after the 1999 Izmit earthquake the eastern part of the seismic gap along the Princes Islands segment is likely subjected to enhanced stresses.

The principal scientific objective is to study physical processes acting before, during and after the expected M>7 earthquake along the Princes Islands segment of the NAFZ by monitoring microseismic activity at significantly reduced magnitude detection threshold and improved hypocentral resolution. It is also intended to study wave propagation characteristics of a large earthquake using downhole seismic recordings at two different spots along the expected rupture and potentially close to its initiation point.

GONAF is focused on the installation of a deep borehole seismological observatory. Combining GONAF recordings with existing nearby surface arrays and regional permanent stations will allow to substantially improve monitoring conditions along the entire Princes Islands segment by lowering the magnitude-detection threshold by at least one order of magnitude thus allowing to study the spatial and temporal evolution of microseismic activity prior to the expected Marmara earthquake with unprecedented detail. GONAF will involve two vertical chains of downhole short-period and broadband seismometers allowing to record the entire frequency band of the seismic wavefield close to the fault from two different azimuths. Prior to the long-term installation of the seismological observatory we will use the GONAF boreholes to also measure heat and gas/fluid flow and to determine orientation and magnitude of local stresses for the first time in the entire Marmara region. This will in turn allow to test and calibrate existing stress models.

GONAF will give new insight into physical processes acting prior and potentially also during and after a large (M>7) earthquake at a major transform fault zone during the seismic cycle. Moreover, GONAF is expected to address fundamental questions related to rupture dynamics, temporal changes of material properties and to refine and calibrate ground shaking models and near-real time hazard assessment for the mega-city of Istanbul with its >13 million inhabitants.

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Paleo-elevation and subsidence of ˜145 Ma Shatsky Rise inferred from CO2 and H2O in fresh volcanic glasses

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Shatsky Rise is a large Mesozoic oceanic plateau located in the northwest Pacific. It consists of three massifs, Tamu, Ori and Shirshov Massifs, which formed along the trace of a mid-ocean ridge triple junction. Because of this setting, Shatsky Rise is uniquely suited to testing plume head versus ridge-controlled hypotheses of oceanic plateau genesis. We estimated paleo-eruption depths of Shatsky Rise massifs based on dissolved CO2 and H2O of volcanic glasses and core descriptions that were cored from five drilling sites of Integrated Ocean Drilling Program (IODP) Expedition 324. The elevation of Shatsky Rise is estimated to be 2500-3500 m above the surrounding seafloor, which is consistent with a mantle plume formation if the average crustal thickness and density of Shatsky Rise are 21 km and 2.9-3.0 g/cm3, respectively. Short-term subsidence, which may be due to rapid isostatic adjustment of volcanic load, was detected from the downhole depth estimate profile of one drill site. Post-emplacement subsidence of Shatsky Rise was etimated to be ˜3000m, which can be explained by thermal subsidence models. A slight increase of total subsidence was observed from the center of Tamu Massif (˜2700m) toward Ori Massif (˜3400m), implying existence of large buoyant mass, perhaps a refractory mantle root or prolonged magmatic crustal growth beneath the rise center.

This research was supported by IODP After Cruise Research Program, JAMSTEC.

Keywords: Shatsky Rise, volanic glass, water, CO2, subsidence, elevation

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3-dimensional imaging service of X ray CT scan data obtained from deep-sea core sample

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Recently, X-ray CT scanning on cored sediment sample has been frequently performing in several institutes before splitting the core sample to research internal structure of the sediment. These scanned data produces 3-dimensional graphic on screen after processing the data using rendering software. Researcher can cut the graphic freely and to see inner structures of sediment sample without physical destruction as like actual discrete sampling from split half of a core section. Additionally, the visualized graphic can be easily reconstructed again using original data and that is great advantage on visual sampling for many scientists in future. Integrated Ocean Drilling Program (IODP) has added the X-ray CT scanning of the core section to standard measurement on board D/V Chikyu in order to record digital archive of core samples and to search geological structures before splitting.

Scanned data are stored into special file of which format is DICOM (Digital Image and Communication in Medicine) with several information of scanning, setting and inventory of sample. DICOM format has been developed along to innovation of medical scanners such as X-ray CT and MRI to accommodate patient information and scan settings. The characteristic format of DICOM produces and helps quick and easy scanning in a hospital, however, the format lost general compatibility among different model of scanners instead of individual settings of each patient and equipment. Generally, researcher uses a software, DICOM viewer, to handle the file on personal computer so that purchasing personally control assembly of a scanner is not realistic. Drawing 3-dimensional graphic requires high speed processing unit and big size of memory, although the viewer software makes it possible to create easily visualized image from DICOM files. Another problem is that a file size of a core section of which standard length is 150cm becomes to be huge, from ten to hundred MB, although it depends on scanning resolution. Consequently, total size of scanned files at a coring hole will be from hundreds MB to a few TB. Therefore, contriving adequate plan to download files based on several measurement results is required to save time to research files and resources of personal hardware.

Can’t we create more suitable, quick and easy method to handle huge number of the digital archives of core samples scanned in each expedition and/or coring ? Researcher’s burdens to create 3-dimensional graphic of samples such as time and cost will be resolved, if brand-new drawing technique is released. We study the innovative-drawing method of DICOM file for geology by developing a new algorism of high-spec GPU to calculate 3-dimensional information ordered from user. In this method, user sends request information of rotation and/or cut through special browser on PC, then, GPU creates 3-dimensional image from a DICOM file and sends back a JPEG file of a snapshot of the image to user. The communication speed on network to create a 3-dimensional graphic will be fast and quick, and quality of a snapshot of the image on screen is expected to be almost same as a DICOM viewer. We also aim to research a method to access the DICOM files via handy tablet PC and smart phone for an interactive-imaging service of geological core samples everywhere.

Keywords: core sample, X-ray CT image, 3-dimensional graphic, virtual core, DICOM format, cloud

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Volcaniclastic facies associations of Tamu Massif, Shatsky rise

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Shatsky Rise, a large oceanic plateau in the northwest Pacific, was formed during the Late Jurassic and Early Cretaceous at a rapidly spreading triple junction. Formation style of Shatsky Rise was poorly understood and sedimentary processes of volcaniclastics were not clarified.

Integrated Ocean Drilling Program (IODP) Expedition 324 cored five sites from Shatsky Rise, with one site (U1346) on the summit of Shirshov Massif and two sites each on Ori (Sites U1349 and U1350) and Tamu (Sites U1347 and U1348) massifs. Cores from Site U1348 are a thick sequence (˜120 m) of volcaniclastic sediments topped with shallow-water carbonaceous sandstones. The volcaniclastic rocks from Site U1348 are generally highly altered, but a single interval containing fresh glass shards. We have examined sedimentary processes of the Tamu Massif based on facies analysis.

Shipboard Scientists have suggested that the thick sequence of volcaniclastic sediments is composed of four stratigraphic units, from Unit III to VI (Sager et al., 2010; Proc. IODP vol. 324). Our detailed facies analysis subdivided the Site U1348 section into six units. The clasts in Units III to VI are almost entirely composed of volcanogenic material, and are predominantly composed of various sized altered glass fragments and partly composed of carbonaceous sandstones. The sedimentary features of Units III to VI are inclined layers and foreset beds, mainly composed of parallel stratified altered vitric glass. Graded bedding (normal and reversed) and laminations are present throughout the section. We classified volcaniclastic rock of the section into 9 facies associations as a result of facies analysis.

The 9 facies are (1)-(3) three types of resedimented hyaloclastites (mainly mass flows), (4) in-situ hyaloclastite, (5) mixed facies of resedimented hyaloclastites / in-situ hyaloclastite, (6) low-density turbidites, (7) high-density turbidites, (8) grain flow deposites, and (9) mixed facies of cabonate clasts / epiclastics. The hyaloclastite are primary volcaniclastics, and turbidites and grain flow deposites are mostly epiclastics. Mixed facies of cabonate clasts / epiclastics is subdivided into 2 types.

The presence of hyaloclastite and turbidites, and no evidence of shallow marine sedimentary structures (e.g. wave ripples) indicate deposition of the volcaniclastic sediments in submarine environments at depths below wave base. The inclined layers may have been deposited as part of the ”slope apron” of a volcano. The gradual observed increase of dip with increasing depth in the core, implies decrease slope dip upward through time, possibly related to the progradation of a volcano slope apron.

This research was supported by IODP After Cruise Research Program, JAMSTEC.

Keywords: Shatsky Rise, Tamu massif, facies analysis, submarine volcano, sediment gravity flow, hyaloclastite

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MIS27-P13 Room:Convention Hall Time:May 24 17:15-18:30

Paleoposition of Intertropical Convergence Zone in the east Pacific inferred from glacial-interglacial magnetic changes

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Magnetic properties are increasingly used for paleoclimatic and paleoceanographic studies. Utilizing recently developed proxies, an environmental magnetic study was conducted on the uppermost 12 m sediments of IODP Site U1337 in the eastern equatorial Pacific. This interval is above the Fe-redox boundary, and covers the last ~800 kyr. The site is located near the present southern boundary of the Intertropical Convergence Zone (ITCZ), and thus expected to be sensitive to variations of its position. Ratio of anhysteretic remanent magnetization susceptibility to saturation isothermal remanent magnetization (kARM/SIRM), first-order reversal curve diagrams, and IRM acquisition curves indicate that the magnetic mineral assemblage consists of dominant biogenic component and minor terrigenous component. Two groups, the biogenic soft (BS) and hard (BH), are identified for the biogenic component, which probably correspond to different magnetofossil morphology. The BH component, probably carried by elongated magnetofossils, increases in sediments of glacial periods, which are probably in less oxic conditions due to increased ocean productivity. This demonstrates that magnetofossil morphology, which can be discriminated by rock-magnetic technique, is a sensitive indicator of slight oxic-suboxic environmental fluctuations in sediments. Temporal variations of the terrigenous component, most likely transported as eolian dust, were estimated from kARM/SIRM ratio and S-ratio; significant glacial-interglacial variations occurred at Marine Isotope Stage (MIS) 10 and before, but not after. In addition, coeval upcore increases in sedimentation rates and the BH component were observed, suggesting increased productivity. These observations may indicate that the position of ITCZ was southward than today at ~250 ka and before.

Keywords: environmental magnetism, ITCZ, eolian dust, biogenic magnetite, IODP, east Pacific

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Relative geomagnetic paleointensity estimation from the IODP Site U1331 and U1332 sediments for Eocene and Oligocene

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Integrated Ocean Drilling Program (IODP) Expeditions 320 and 321 recovered sediment cores from equatorial Pacific. Cores taken from Sites U1331 and U1332 covered Eocene and Oligocene (Expedition 320/321 Scientists, 2010). Although many efforts have been made to reveal relative geomagnetic paleointensity variations in geologic time, those prior to ca. 3 m.y. have been not yet reported except a few studies.

This study concentrates on paleomagnetic and rock magnetic measurements on the Site U1331 and U1332 sediment cores. The measurements include stepwise alternating field demagnetization of the natural remanent magnetization (NRM), the anhysteretic remanent magnetization (ARM) and the isothermal remanent magnetization (IRM). The magnetostrartigraphy constructed from the NRM data show that the sedimentary section extends from 29.166 to 41.358 Ma for U1331 (10-90 mcd), and from 23.030 to 41.358 Ma for U1332 (20-125 mcd).

Intensity variation of ARM and IRM is within about a factor of six throughout the core. Ratio of ARM to IRM (ARM/IRM), that is index parameter for degree of magnetostatic interactions and/or proxy of magnetic grain size, differs between Eocene and Oligocene. These suggest that we should divide the cores into Eocene and Oligocene intervals in order to try relative paleointensity (RPI) estimation. RPI estimates have been done by using ARM and IRM as normalizers for NRM. RPIs by ARM and IRM generally show consistent variations. However, several experimental results imply that RPI by IRM may be more preferable. We will report the RPI estimates from the U1331 and U1332 cores and compare these estimates.

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Variations in higher plant terpenoid compositions in the eastern equatorial Pacific sediments over the last 30 Ma

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We analyze terrestrial plant-derived biomarkers (higher plant terpenoids; HPTs) in sediments recovered during the IODP Expeditions 320/321, the Pacific Equatorial Age Transect (PEAT), to reconstruct variations in terrestrial input in the eastern equatorial Pacific Ocean, as well as to evaluate transport systems of terrigenous matter from land to ocean. Terrestrial plant-derived organic molecules in these pelagic areas are considered to be mainly transported through atmosphere by aeolian system. The HPTs such as sesqui-, di- and triterpenoid are major constituents of plant resin, cuticle and supportive tissues. These groups possess different taxonomic origin (i.e. gymnosperms and angiosperms), so that their compositions in the PEAT sediments could be recorded climatic system such as wind strength and direction, and atmospheric circulation, and moreover, the environmental information in the hinterland of continental area(s).

In this study, we perform organic solvent extraction from freeze-dried sediment samples, and separate the extract to four fractions by using silica gel column chromatography. Each separated fractions are analyzed by gas chromatography / mass spectrometer (GC/MS). Because of extremely low concentration and frequent coelution for the HPTs, we quantify by selected ion monitoring (SIM) chromatogram with the representative ions of the compounds.

We could identify the HPTs such as cadalene (sesquiterpenoid), abietane type diterpenoids and oleanane type triterpenoids. The total concentrations of HPTs were 0.03-7.90 ng/g and increased over the last 10 Ma. Paleo-latitudinal distributions of the ratios of the Ole/(DT+Ole) ratio, which is oleanoids to the sum of the oleanoids and diterpenoids, show the highest values near the equator (1^{o}S to 3^{o}N). Oleanoids are relatively abundant only in 0^{o}N to 2^{o}S until the middle Miocene, while the northernmost latitudinal samples are predominated by gymnosperm-derived diterpenoids. Oleanoid-dominant samples appear in northern latitude (0^{o}N to 3^{o}N) during the late Miocene and Pleistocene sediment samples. The result agreed with the general trends of higher plant wax-derived n-alkane ratios ($C_{31}/(C_{29} + C_{31})$), in which the lowest values were observed near the equator, presumably associated with zonal transport of higher plant wax from the tropical South America. The oleanoids mainly originate from angiosperm wax, and therefore, the transport mechanism may be the same as n-alkanes. The rainforest is major vegetation in The tropical South America is characterized by the major cover of rainforest which vegetation is predominated by the angiosperms. Atmospheric transport via aeolian dust from the semiarid and arid region of the central East Asia and North America can also contribute in significant portion of n-alkanes and HPTs in the eastern equatorial Pacific Ocean. The HPTs transported from such arid and/or cool hinterlands might be more abundant in diterpenoids, compared to that from tropical South America. In the study area, the intertropical convergence zone (ITCZ) behaves as a barrier to southward transport of dust from the Asia with its high rainfall, resulting higher deposition of aeolian dust in the latitude. The a little northward areas from the suggested zonal transport shows higher concentrations of HPTs and low Ole/(DT+Ole) ratio. Hence the latitudinal positions of the paleo-ITCZ may correspond to this area.

It is suggested that the latitudal shift of locations that HPT concentrations and compositions are associated with the change in atmospheric circulation in study area, and that the ITCZ located southward during the early to middle Miocene.

Keywords: Pacific Equatorial Age Transect (PEAT), InIntertropical Convergence Zone, aeolian transport, Higher Plant Terpenoid

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The radiolarian biostratigraphy in east equatorial Pacific Ocean (IODP Exp. 321 Site U1338)

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The radiolarian biostratigraphy has been already performed on 119 core catchers and core (mostly two per core) on shipboard. We examined 172 additional material (mostly four per core) collected for establishing the higher resolution biostratigraphy of radiolarians.

A total of 291 samples were collected from Hole U1338A. The sampling interval was about 1.5 to 3.0 m. The samples were processed with hydrochloric acid and hydrogen peroxide, and washed through the 63 micro meter sieve. The residues were dried and mounted on the slide glass with Canada balsam. Total of 500-1000 individuals were observed at each sample.

The radiolarian assemblages of Site U1338 show good to moderate preservation except in the lowermost portion (lower Miocene). Tropical radiolarian biostratigraphy was used for establishing the radiolarian zones of Site U1338. The radiolarian stratigraphy spans the interval from the uppermost part of Zone RN16-17 (late Pleistocene) to uppermost part of RN3 (early Miocene). Fifty eight 58 radiolarian biostratigraphic datum events have been recognized in Site U1338. The biostratigraphy of radiolarians generally agree with the shipboard biostratigraphic data of other microfossils: nannofossil, foraminifera and diatom except for some small inconsistencies.

Keywords: Radiolaria, Biostratigraphy, east equatorial Pacific Ocean

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deep-sea benthic foraminiferal assemblage in the eastern equatorial Pacific since the latest middle Miocene

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Our research objective is to study the influences of the climatic and oceanographic changes on deep-sea benthic foraminifera from the middle Miocene to Pleistocene. The mid-Miocene climatic optimum was followed by rapid global cooling, when Antarctic ice sheets expanded. In the middle Miocene to Pliocene, there are paleoceanographic events, such as ”carbonate crash” (12-9 Ma) and ”biogenic bloom” (6.7-4.5 Ma). These events are strongly influenced by ocean circulation changes. Such oceanographic changes enhanced the evolution of marine organisms.

Samples used in this study were collected in the eastern equatorial Pacific (Hole U1338B, IODP expedition 321), and studied interval is 12 to 0 Ma.

The relative abundance of high-productivity taxa increased at ca. 7-5 Ma, corresponding to high TOC interval (biogenic bloom). Long-term trend of benthic foraminiferal assemblage revealed that major faunal changes occurred at around 6-5.5 Ma and 2 Ma. The former period is the Messinian to the Pliocene transition period, and the relative abundance of Cibicidoides mundulus decreased and the relative abundance of Epistominella exigua increased. Cibicidoides mundulus and Nonion affine increased after the latter period. Epistominella exigua is good indicator of the influence of seasonal surface primary production. On the other hand, Cibicidoides mundulus prefers a low organic content substrate related to NADW (north Atlantic deep water). Thus, these foraminiferal changes are associated with the global oceanographic changes related to these factors.

Keywords: benthic foraminifera, paleoceanography, Miocene, Pliocene, equatorial Pacific, IODP Expedition 321

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Mid- Late Miocene marine Os isotopic fluctuation and burial fluxes of Re, Os and Ir into deep-sea deposits

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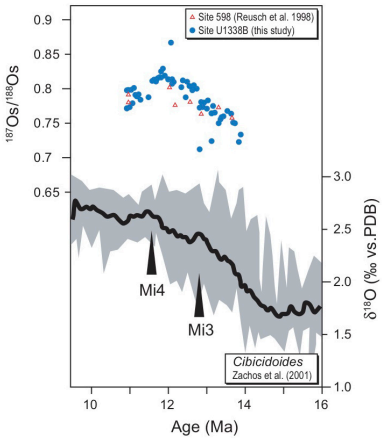
Temporal variations in $^{187}Os/^{188}Os$ and burial fluxes of Re, Os and Ir into deep-sea deposits were studied using late to middle Miocene nannofossil ooze from IODP Exp. 321 (PEAT II; Pacific Equatorial Age Transect II) from the time interval investigated ranges from 14 Ma to 11 Ma with sampling resolution of about 40 kyr.

Marine Os isotopic ratio ($^{187}Os/^{188}Os$ ratio) increases monotonically from 14 Ma to 11.8 Ma, reaches a local maximum at 11.8 Ma, and decreases continuously to 11 Ma. This broad peak around 11.8 Ma was not apparent in previous low-resolution data (Reusch et al., 1998). The causes of change of Os isotopic trend at 11.8 Ma are still uncertain. Based on the similarity of trends between oxygen-carbon isotopes from benthic foraminifera (Zachos et al., 2001) and marine Os isotopes (Fig.), some relationship with global climatic changes is expected.

Burial fluxes of Re, Os and Ir range 0.04 - 36 ng/cm^2/kyr, 60 - 330 pg/cm^2/kyr and 18 - 28 pg/cm^2/kyr, respectively. Burial fluxes of Os and Ir are within the range of the published data from Quaternary pelagic calcareous oozes (Burton et al., 2010: Cave et al., 2003: Dalai and Ravizza, 2006, 2010: Kyte et al., 1993). On the other hand, studied values of Re burial fluxes are out of the range of Quaternary pelagic calcareous oozes (Burton et al., 2010). Especially, Re burial fluxes at the two horizons of 12.1 Ma and 11 Ma are over 15 pg/cm^2/kyr. Re is sensitive tracer for moderately reducing conditions when oxygen is present in bottom waters but rapidly consumed from interstitial waters (Morford et al., 2005). It was suggested that accumulation flux of organic carbon increased suddenly at 12.1 Ma and 11 Ma around the eastern Equatorial Pacific.

Keywords: Os, Miocene, Paleoceanography, IODP, PEAT



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MIS27-P19 Room:Convention Hall Time:May 24 17:15-18:30

Fluctuations of stable carbon isotope ratio in organic matter - example from the IODP Site U1352 offshore Canterbury -

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IODP Expedition 317 drilled three sites on the continental shelf and one site on the slope of the offshore Canterbury, on the eastern margin of the South Island of New Zealand, for understanding the relative importance of global sea level versus local tectonic and sedimentary processes in controlling continental margin sedimentary cycles. Samples using this study are collected from Site U1352 located on the upper continental slope and this site was suitable for providing age control for the studies. Its water depths is 344m, and core recovery was nearly 100% above 550m depth from the sea floor.

Global climate changes have been studied on the basis of the oxygen isotope and stable carbon isotope records derived from marine foraminifers. However, in the southern hemisphere ocean, stable carbon isotope ratios of marine organic matters are considered to depend on latitude change, and temperature of surface seawater (Rau et al . ,1982).

This study aims to examine whether stable carbon isotope ratios derived from marine organic matter can correspond to Marine Isotope Stage (MIS), namely compare stable carbon isotope fluctuations derived from marine organic matters with oxygen isotope curve derived from marine foraminifers.

The measurement intervals are ˜10,000 years durations based on the rates of deposition.

Spikes of stable carbon isotope ratios coincide with these of oxygen isotope and stable carbon isotope of foraminifers. Based on our isotope data together with nannofossil datums, we identify most of the marine isotope stages since MIS 63 (1.76 Ma).

Keywords: stable carbon isotope ratio, marine organic matter, Marine Isotope Stage

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MIS27-P20 Room:Convention Hall Time:May 24 17:15-18:30

Paleoenvironments of the Plio-Pleistocene strata in Canterbury Basin based on fossil ostracode assemblages

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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. Drilling in the Canterbury Basin, off the South Island of New Zealand, takes advantage of Plio-Pleistocene samples, which preserves a high-frequency (0.1?0.5 m.y.) record of depositional cyclicity. The Pliocene and Pleistocene periods are characterized by cyclic sea-level changes induced by glacial and inter-glacial climatic shifts. Numerous investigations found cyclic sea-level changes caused by glacio-eustasy from the Plio-Pleistocene sequences. However, it is little known vertical and temporal changes of the paleodepth corresponding to glacial and interglacial cycles through long-term periods of the Plio-Pleistocene. The object of this study is to reveal Plio-Pleistocene sea-level changes and their vertical and temporal distributions on the continental shelf of Canterbury Basin. We used the samples which were collected in sites U1354 (water depth 113.4 m) and U1353 (water depth 84.7 m) on the continental shelf. Samples less than 20 cc were freeze-dried and washed through a 63 micrometer opening sieve. The residues were dried and then divided into aliquot parts containing around 200 specimens using a sample splitter. As a result, 116 fossil ostracode species belonging to 48 genera and 136 species belonging to 57 genera were identified from 81 samples of U1354 and from 40 samples of U1353, respectively. Q-mode factor analysis was proceeded by using total 81 samples of U1354 and 29 samples of U1353. The vertical changes of varimax factor loadings indicate that at least thirteen and eight transgressive-regressive cycles were recorded in sediments of U1354 (3.3 to 0.5 Ma) and U1353 (3.7 to 1.5 Ma), respectively. , Total seventeen transgressive-regressive cycles were recognized between 3.7 to 0.5 Ma due to comparison of both cores based on the biostratigraphy The amplitude of paleodepth changes and the cycles of about 40.000 year reveal that some cycles were induced by glacio-eustasy. In addition, four high stand periods could be compared with MIS G7, G1, 61, and 59.

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Response of reef-building corals to post-glacial sea level rise: IODP Expedition 325

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Major objectives of the Integrated Ocean Drilling Program (IODP) Expedition 325 (GBREC: Great Barrier Reef Environmental Changes) include reconstructing histories of sea-level change, sea surface temperature variation and reef growth since the Last Glacial Maximum (LGM), and analyzing the responses of reef-building corals to post-glacial sea level rise. Submerged reef structures were drilled along four transects in three localities (Hydrographers Passage, Noggin Pass, and Ribbon Reefs) on the shelf edge seaward of the modern Great Barrier Reef. A total of 34 boreholes were cored at 17 sites ranging in depth from 42 to 167 meters below present sea level.

Seven coral assemblages are identified based on coral taxonomy and morphologies. Their paleoenvironments are inferred by comparison with modern coral communities of the Great Barrier Reef and range from shallow wave-exposed to deep low-energy reef habitats. The initial post-glacial coral assemblage is dominated by shallow-water massive-submassive-branching Isopora associated with branching Acropora and Seriatopora. The deeper assemblages consist mainly of encrusting to submassive Montipora and encrusting Agariciidae. Horizontal changes in coral assemblages along transects, from proximal to distal cores, probably reflect the changing reef geomorphology and hydrodynamic regime during sea level rise. Vertical changes within a core reflect an increase in water depth followed by a drowning of the coral community and the formation of the submerged reef tops. As sea level rose, shallow reef assemblages re-established further upslope and accumulated several meters of reef structure before drowning in turn.

Keywords: IODP Expedition 325 GBREC, Great Barrier Reef, corals, last deglaciation, sea level rise, paleoenvironmental changes

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Large benthic foraminiferal assemblages from shelf slope cores of the Great Barrier Reef: IODP EXP. 325

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The Integrated Ocean Drilling Program (IODP) Expedition 325 was conducted in 2010 on tectonically stable continental shelf slopes of the Great Barrier Reef (GBR) to understand sea-level changes, paleoceanographic changes and the history of coral-reef developments since the Last Glacial Maximum. A total of 34 boreholes in four transects were cored in depths ranging from 42 to 167 meters below sea level. Large benthic foraminifers are unique tools to reconstruct the past environmental histories (e.g., Fujita et al., 2010) for reef systems including paleo-water depths, and hence we aim to employ this method for GBR samples to reconstruct sea-level changes and reef development processes. Unconsolidated sediment samples from cores taken in three transects (HYD_01C, HYD_02A and NOG_01B) were used for grain-size and foraminiferal analyses, and multivariate analyses of foraminiferal assemblages were performed. Operculina spp. was common in a gravel fraction; it was particularly abundant in muddy sediments in the lower part of cores from deep shelf slopes. A total of 25 taxa of large benthic foraminifers were identified in a coarse sand fraction. Four foraminiferal assemblages (A, B, C, and D) were delineated by Q-mode cluster analysis and they correspond to distinct sedimentary environments; namely back reefs (assemblage A), fore-reef slopes with either high energy (assemblage B) or low energy condition (assemblage C), and deep shelf slopes (assemblage D). The assemblage A which is dominated by Baculogypsina sp. and Calcarina spp. would be a key to reconstruct past sea levels. The current study is indicative of the potential for reconstructions of paleo-sea-levels using large benthic foraminiferal assemblages.

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Mid-late Pleistocene tephrostratigraphy of C9001C and C9002A/B cores off Shimokita, Tohoku Japan

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We report the tephrostartigraphy in the core C9001C and C9002A/B corrected by RV CHIKYU off Shimokita Peninsula. The recovery of sediment at Hole C9002A is 0 - 26.2 mbsf, Hole C9002B is 23.3 -70.8 mbsf and Hole C9001C is 0 - 365 mbsf, respectively. The upper part of sediment of the Hole C9001C, 0 -158 mbsf, was correlated to the core C9002A/B by two widespread tephras, Spfa-1 and Aso-4, completely (Aoike et al., 2010). Domitsu et al.(2010) integrated the age model based on the oxygen isotopic stratigraphy of foraminiferal fossils and tephrochronology, microbiostratigraphy, and magnetostratigraphy and mentioned to the core C9001C covered mid-late Pleistocene and the bottom age of the core C 9001C was the base of the Brunhes Chron.In this study, we observed sediment cores, and described tephra deposits in detail. Some of them are overlooked at the initial core description.

Tephra deposits are fine ash layer to pumice layers, the sand layer which heavy minerals concentrated, and bright layer and spots which suggested that fine volcanic glass shards fall out. We corrected eleven samples from the core C9002A, twenty samples from the core C9002B, and thirty-six samples from the core C9001C. Tephra samples were dissolved in water and washed by ultrasonic cleaner. After decantation, the upper water was discarded and deposited samples were dry up. All samples are sieved by 63 micrometer, 125 micrometer, 250 micrometer and observed by stereomicroscopy. When the need arises, major-element chemistry of volcanic glass shards determined by EPMA, and refractive indices of volcanic glass shards and heavy minerals were measured.

In the core C9002B, Spfa-1 at 30m and Aso-4 at 53m have already reported by Aoike et al.(2010). Tephra layer at 52.8m is correlated to tephra provided from Kuttara volcano based on the major element chemistry of volcanic glass shards. Tephra at 52.8m just above Aso-4 at 53 m should be correlated to Kt-6 or Kt-7. In the core C9001C, Two tephra bed provided from Osore volcano and Shiobara-Otawara tephra provided from Shibara caldera in north Kanto district were detected. Suzuki et al. (2012, JpGU) discuss about these correlations in detail.

Chronology of Shiobara-Otawara tephra and two tephras from Osore volcano were discussed with widespread tephras in Kanto-Kinki districts, and stratigraphy of marine terraces in Shimokita Peninsula. In this report, we cast whether there is no room for reconsideration about the boundary of MIS8/7 settled by Domitsu et al.(2010), or not.

Keywords: Chikyu, Shimokita Peninsula, tephrochronology, Kuttara volcano, Osorezan-Tanabu tephra, Shiobara-Otawara tephra

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Preliminary results of paleoceanographic study of IODP Expedition 334

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The East equatorial Pacific marginal sea off Costa Rica is one of the most important region to understand latitudinal shift of Intertropical Convergence Zone (ITCZ) and ventilation changes in intermediate waters of south or north origin during the Quaternary. We successfully obtained excellent sediment core samples from the upper slope and continental self off Costa Rica during Intergrated Ocean Drilling Program (IODP) Expedition 334 (Costa Rica Seismogenesis Project; CRISP) of the D/V Joides Resolution. In these cores, we selected cores U1378B and U1379C as reasonable cores for our Quaternary paleoceanographic study. Now we are analyzing benthic foraminiferal assemblages, organic carbon contents, and Corg/N ratio from these cores. Moreover , we will analyze foramniferal oxygen isotope ratio and carbonate content in core U1378B to construct the isotope stratigraphy and reconstruct intermediate water ventilation changes related with glacial- interglacial climate shift. The preliminary results of biostratigraphic ages obtained from core U1378B indicate high sediment accumulation rate of about 283-296 m/my in the upper 34-35m. The result is based on the extinction horizon (120 kyr) of planktonic foraminifera Globigerinoides ruber (pink specimens). Thus, the sedimentary horizon would correspond to the peak last interglacial event of marine isotope stage 5. We will report on preliminary results of paleoceanographic analyses in these cores. We thank IODP cruise staff for their kind support during the CRISP cruise.

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MIS27-P25 Room:Convention Hall Time:May 24 17:15-18:30

Logging data from gas hydrate production well

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For the 2nd onshore production test of gas hydrate at Mallik 2L-38, lots of pre-studies had been done in order to ensure the identification of the gas hydrate by logging measurements with various principles. The logging data at gas hydrate interval where is interbedded sand and shale at Mallik (Dallimore and Collett, 1997) can be consistent with the behavior of the ones at Japanese deep sea field. Since this resemblance of lithology will not be affected by the condition as permafrost at Mallik, the behavior of log data at gas hydrate interval will help to optimize the logging program and to predict the measurements for Japanese gas hydrate projects.

Gas hydrate bearing formation is usually represented as higher resistivity and velocity interval (e.g. Sager et al., 2000), and there are not so much reports about the other conventional logs. But these conventional logs can be also used for the interpretation of gas hydrate. For example, gas hydrate in pore spaces makes the neutron porosity be overestimated than the one of formation filled with water. On the other hand, nuclear magnetic resonance porosity regards the volume of gas hydrate as matrix. Therefore the separation of two porosity curves can show the range of gas hydrate distribution. Although it is not so difficult to find the gas hydrate interval in the ideal condition as above, the other conventional logs like gamma-ray density are also essential because we have to consider about the effects of clay and so on, practically.

To use the logging results for research, it is necessary to understand the uncertainties of data. Logging data is affected by the movement of acquisition device, deviation, borehole size, drilling mud and its invasion, lithology, relative dips, formation fluid type and salinity, temperature, pressure and everything. Loggings are based on various acquisition principles, and are affected by the environmental factors caused by acquisition principles. In the other word, the environmental factors caused by acquisition principles enable to measure the arbitrary information. Therefore the lack of environmental corrections and principle specific processing will be the critical issues of data quality. After all processing, we can start to interpret the tool and parameter limitations. If there are still some gaps between the measurements of laboratory and the ones of field, the quality of logging and cores, the limitation of acquisition principles, the limitation of processing and the resolution of measurements should be considered.

Thank to the cooperation of MH21 consortium, this study was carried out. The logging data were acquired in 2nd onshore production test of gas hydrate at Mallik 2L-38 carried out mainly by the Minister of Natural Resources Canada and Japan Oil, Gas and Metals National Corporation (JOGMEC) in 2007 and 2008 winter. And the processed results obtained under ”Additional petrophysical analysis for 2nd onshore production test” committed by JOGMEC were partially referred.

Reference:

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Keywords: hydrate, logging, interpretation, Mallik

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Petrological and geochemical analysis of basalts in forearc & subducting slab offshore Costa Rica, IODP Exp. 334, CRISP

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The Costa Rica Seismogenesis Project (CRISP) is designed to understand the processes that control nucleation and seismic rupture of large earthquakes at erosional subduction zones. Integrated Ocean Drilling Program (IODP) Expedition 334 penetrated the slope sediments of the overriding Caribbean plate at Sites U1378 and 1380, the entire sequence of the slope sediments and the upper part of the acoustically defined basement at Site U1379, and sediments and oceanic crust of the incoming Cocos plate at Site U1381. In order to constrain the tectonic setting of the drill site and fluid rock interaction within the basaltic crust, which is a potential fluid source for the seismogenic zone, basalts were petrologically and geochemically analyzed. Basalt clasts from poorly sorted matrix-supported breccia were recovered at the top of the acoustically defined basement at Site U1379. Some of the clasts contain prehnite and pumpellyite, indicating prehnite-pumpellyite facies metamorphic conditions, similar to the Osa melange onshore Costa Rica. At Site U1381, sequences of pillow basalts are intercalated with calcareous mudstone as part of the oceanic crust. The pillow basalts are characterized by plagioclase and pyroxene phenocrysts with microcrystalline to fine-grained groundmass with variable extent of alteration. The basalts were cut by numerous veins mostly consisting of calcite. Groundmass alteration is especially evident along veins, fractures and vesicules, associated with clay minerals and pyrites. Based on our data, the origin of the basalt clasts in the forearc basement, and fluid-basalt interaction in the subducting oceanic crust will be discussed.

Keywords: IODP Expedition 334, Costarica Seismogenesis Project, CRISP, basalt, fluid, oceanic crust

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Geological structures controlling hydrothermal circulation system in the eastern flank of the Juan de Fuca Ridge

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Hydrothermal fluid in the ridge flank influences physical state and evolution of the crust and mantle. Global advective heat loss from ridge flanks is more than 3 times as large as that at the axis, and the ridge-flank mass flux is at least 10 times as large. To reveal hydrothermal fluid system in the ridge flank, intensive drilling operations (ODP Leg 168, IODP Exp. 301 and 327) were conducted in the eastern flank of the Juan de Fuca Ridge (Fisher et al. 2011). Before these drilling campaigns, we believed a largely 2D view of the dominant fluid-circulation pathways across the ridge flank. However, in the eastern flank of the Juan de Fuca ridge, the hydrothermal flow occurs largely parallel to the ridge (Hutnak et al., 2006). The basement outcrops could be fluid entry and exit points to and from the crust.

Drill string packer experiments in upper basement indicate a layered crustal structure with permeabilities of 10^{-12} to 10^{-11} m^2 (Becker and Fisher, 2008). Additional hydrogeologic analyses completed using the formation pressure response to the long-term flow of cold bottom seawater into basement at Site U1301 in the 13 months after drilling, as observed at Site 1027 (2.4 km away) (Fisher et al., 2008). The large-scale cross-hole tests indicate lower crustal permeability than smaller-scale single-hole tests. This result was unexpected because larger scale testing tends to give greater permeability values. The difference between these permeabilities may be reconciled by azimuthal anisotropy in basement hydrogeologic properties.

In this study, we extracted 3D structures of crust surface and faults distribution from seismic profiles in order to reveal geological structures controlling hydrological properties in the ridge flank. Three seismic surveys acquired over 100 seismic lines in the eastern flank of the Juan de Fuca ridge (e.g., Nedimovic et al., 2008). Although these seismic surveys were two-dimensional, the densely-distributed survey lines enable us to extract 3D subseafloor structures around the drill sites. By interpolating the horizons extracted on each profile, we constructed 3D geometry of the crust surface and fault planes. By considering anisotropic characteristics in the interpolation process, we clearly obtained geometry of crust surface. The detailed fault distribution as well as basement geometry can explain the permeability anisotropy observed by the hydrological experiments (Fisher et al., 2008).

When we compare the drilling results and seismic profiles, we can roughly distinguish the fractured zone vs. massive zone within oceanic crust on seismic profile; the lithology boundary seems to be consistent with the seismic characteristics (e.g., quality factor). From logging (e.g. borehole image) data, furthermore, the preferred fracture orientation can be estimated as ridge-parallel direction. By integrating seismic-logging-core data, we evaluate the permeability anisotropy as well as its scale-dependence.

Keywords: IODP Exp 327, Seismic reflection analysis, Eastern flank of Juan de Fuca plate, downhole logging

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Environmental reconstruction in the Southwestern Pacific by fossil corals obtained from IODP Exp. 325

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Sea-level during the Last Glacial Maximum (LGM) has been observed as much as ca. 130 m below its present value for sites remote from former ice sheet (far-field sites). Regions far from areas of previous glaciation are sensitive to glacial meltwater influx and have therefore provided useful constraints on the temporal variation and magnitude of this influx from the LGM to the present day. Fossil coral records contain evidence of a dramatic sea level rise in excess 20 m within the last deglaciation, termed meltwater pulse 1A (mwp-1A). Although this event would have had a significant effect on global climate, the relationship between mwp-1A and the climate system remains a subject of debate. In addition, climatic variations such as seasonality and/or an El Nino/Southern Oscillation (ENSO) variation during Holocene and the LGM have been still open to question, especially in tropical to sub-tropical regions. IODP Great Barrier Reef Environmental Changes Expedition (Exp. 325) collected coral samples which covered around the LGM to the early Holocene. In this study, geochemical tracers, such as d18O, Sr/Ca and Mg/Ca, contained in skeletons of fossil corals were analyzed and we will discuss past marine environments in the Southwestern Pacific reconstructed by fossil corals.

Keywords: IODP, Great Barrier Reef, coral, climate change