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

SCG67-P01 Room:Convention Hall Time:May 22 18:15-19:30

Acoustically transparent deposits possibly originated from 7300 BP Kikai Koya PDC

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Kikai caldera (Matsumoto, 1943) is a mostly submerged highly active caldera complex located in 40 km off Kyushu Island. The caldera is considered to be the source of Akahoya tephra (Machida and Arai, 1978) which date was determined as 7300 cal. BP (Fukusawa, 1995). The climactic ignimbrite of the eruption was Koya-Takeshima PDC (pyroclastic density current), which extent was reached the deep inland of Kyushu (Ono et al., 1982). Recent work by Maeno and Taniguchi (2007) provided much detailed insights for the escalating evolution of magma-water interaction in the eruption, however present mostly subaqueous setting prevents further understanding of its geographical distribution and morphology. Here we report with the observation of seismic reflection, relatively thick (100˜ m) and acoustically transparent layer that can be compared to Koya-Takeshima PDC because of its substantiality.

The seismic reflection observations were held in two survey cruises (KT-10-18 and KT-11-11) in 2010 and 2011 using a research vessel Tansei-maru of JAMSTEC (Japan Agency for Marine-Earth Science and Technology). The sound source was a 150 cubic inches G-I gun with 10 seconds of shot interval, and a 48-channled 1.2 km-length streamer cable was used for acquisition. Totally 24 profiles were obtained with the speed of 4 knots.

The caldera has 20 km wide rim and 10 km wide inner ring fracture. They were previously speculated as two different calderas of outer-older one and inner-newer one (e.g. Yokoyama et al., 1966), however it is unlikely according to our interpretation because both of their structure is fresh. At the southeastern end of the caldera, the rim is appeared as a major fault for caldera basin subsidence, which the latest displacement can be expected for 400 m in maximum. The inner fracture is the deepest structure in the caldera (˜600 m), which is characterized as poorly deposited subcircular valleys surrounding the central rise of the caldera.

The distinctive transparent layer is named A3 in our interpretation. We assume that because of its wide distribution (most areas in Kikai except the central rise) and voluminosity (40˜ cubic km), A3 is the submarine counterpart of the climactic Koya-Takeshima PDC. The morphology of A3 is highly constrained by its bottom uncomformitive terrain therefore A3 is possibly some kind of flow deposits at least. It shows the maximum thickness at the southwestern caldera rim (˜150 m) while it quickly loses its transparency and turned into chaotic facies at the caldera outskirts. The chaotic counterpart extends every direction from Kikai caldera with the constant thickness of about 100 m. Absence of A3 equivalent facies at the central peaks of the caldera supposes the area was a topographical high at the A3 outbreak.

Keywords: Kikai caldera, Seismic reflection observation, Submarine volcano, Marine geology, Caldera formation

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Geochemical variation of backarc basin basalts and magma genesis in the Shikoku Basin

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The Shikoku Basin is a back arc basin located Westside of the Izu-Ogasawara (Bonin) arc, spreading was from 25Ma to 15Ma (Okino et al., 1994, 1999). The drilling of the Deep Sea Drilling Project (DSDP), Ocean Drilling Program (ODP) and Integrated Ocean Drilling Program (IODP) recovered the backarc basin basalt (BABB) of the Shikoku Basin. Sites 442, 443 and 444, located at the central Shikoku Basin, was operated during the DSDP Leg58 and recovered BABB and post-spreading volcanism basalts. Site 808, southeast of the Kyushu Island, was operated during the ODP Legs 131 and 196. Site C0012, south of the Kii Peninsula, was operated during the IODP Leg ex-333. Sites 808 and C0012 is located near the Nankai Trough, and BABB was recovered from under thick sediment. In this study, we compare Petrographical and geochemical characteristics of these BABBs, arc volcanics of the Kyushu-Palau Ridge and those of Izu-Ogasawara active arc, and consider the origin of difference of these characteristics and environment of BABB volcanism.

The example of the Shikoku Basin BABB, the Site C0012 BABB was recovered under the more than 500m thickness of sediment and drilled 100m thickness of basement. These BABB are aphyric pillow (upper) and massive flow (lower part), and show variable degree of alteration, gel-paragonite, fibro-paragonite to zeolite deposition. SiO_2 and MgO contents of these basalts are 47-55 and 5-8 wt%. The many basalts have 1.5-1.8 wt% of TiO_2, higher than island arc volcanics from the recent Izu arc and the Kyushu-Palau Ridge. These basalts show enrichment of alkali elements. The Alkali basalts are recovered from the Site 444 and the Kinan Seamount chain near the spreading axis of the Shikoku Basin. However, the element ratios associated with enrichment of parent material of these basalts are different from these alkali basalts, similar to BABB from the Sites 442-444. We considered that the enrichment of alkali element in these basalts is the effect of albitization and paragonitization. The enrichments of Na and K are different strata, assumed to different alteration temperature; Na and K were enriched under higher and lower temperature.

Ishizuka et al. (2011) and Haraguchi et al. (2012) pointed out that the across-arc variation of bulk chemical characteristics of arc volcanics in the Izu arc is described by replacement of mantle under the Izu arc from depleted to enriched composition at the beginning of spreading of the Shikoku Basin. The BABB in the Shikoku Basin is assumed to produce from this enriched mantle. However, the element ratios associated with mantle enrichment show regional differences. Therefore, we consider that the mantle enrichment in the Shikoku Basin show regional differences.

Keywords: Backarc basin basalts, Incompatible element ratio, Parent material of magma

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New GANSEKI: Major System Revision and Improved Usability

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Every year, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) collects hundreds of rock samples from deep seafloor using its research vessels and submersibles. Deep seafloor is one of the fields which are not easily accessible for individual researchers. Seafloor rock samples are precious materials because they are rare, costly, and technically difficult to obtain. Recent researches related to seafloor mineral resource exploring and its industrial development attract broad public attention. People from various fields other than natural history sciences are getting interested in seafloor rock samples.

For the better use of JAMSTEC rock samples and associated data, it is important that they are utilized for not only specific research plans of individual cruses but also other general scientific and educational purposes. JAMSTEC has been maintaining rock sample collection and associated databases, and publicizing them to domestic/foreign activities of research, education, and public relation. Users can access these rock samples and associated data through the rock sample database ”GANSEKI [1]”. GANSEKI was established on the Internet in 2006 and its contents and functions have been continuously enriched and upgraded since then.

JAMSTEC also maintains various samples and data other than rock samples, including such as sediment core samples, biological samples, cruise and dive information, visual images and movies. Close relationship among these databases is important for better usability and wider application. In 2012, the whole cruise information database ”DARWIN [2]” was released on the Internet, replacing the previous data site for research cruises. The major revision of GANSEKI in 2013 was planed to deal with the various improvements in JAMSTEC data management.

The previous GANSEKI already had functions to exhibit meta-data of sample recovery, inventory data of rock sample collection and associated data such as geochemical data and photo images. Samples in the previous GANSEKI were also searchable from the international geochemical portal site ”EarthChem [3]”. In spite of these advantages, there were some points to be improved in the previous GANSEKI, such as absence of linkage to cruise and dive information databases, inflexibility of available geochemistry data types, and awkward procedures for image browsing. The major revision of GANSEKI includes replacement of database core system. The newly designed interface provides much improved searchability and visibility for both users and curatorial staffs. Multiple references to other databases such as DARWIN, numerical search of geochemical data, and thumbnail browsing of thin-section images and sample photos are comfortably available in the new GANSEKI.

References: [1] ”GANSEKI (Geochemistry and Archives of Ocean Floor Rocks on Networks for Solid Earth Knowledge Information)” http://www.godac.jamstec.go.jp/ganseki/. [2] ”DARWIN (Data Research System for Whole Cruise Information in JAMSTEC)” http://www.godac.jamstec.go.jp/darwin/e. [3] ”EarthChem” http://www.earthchem.org/.

Keywords: rock sample, curation, database, seafloor

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Development of observation method for seafloor hydrothermal flow based on acoustic image

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We have been developing a method of observation for seafloor hydrothermal flow. The system is based on acoustic video camera 'DIDON'. DIDSON (Dual-Frequency IDentification SONar) is acoustic lens-based sonar. It has sufficiently high resolution and rapid refresh rate that it can substitute for optical system in turbid or dark water where optical systems fail.

DIDSON equipped on the submersible Shinkai6500 could capture sliced images of the seafloor hydrothermal flows at the Rodriguez segment of the Central Indian ridge, in YK09-13 Leg.1 cruise. We could identify shadings inside the acoustic movie images of the hydrothermal flows. Silhouettes of the hydrothermal flows varied from second to second, and the shadings inside them also varied. These variations were thought to be corresponded to internal structures and flows of the plumes. These are only a few acoustic video images of the hydrothermal plumes. Results from this observation show that DIDSON has a potential of equipment for hydrothermal flow observation.

We performed a tank experiment so that we will have acoustic images of water flow under the control of flow rate. The purposes of the tank experiment were to delineate water flow images in the tank and to get clue to estimate the volume of the water flow.

Water was heated in the hot tub and pumped to the water tank through the silicon tube. We observed water flows discharging from the tip of the tube with DIDSON. Flow rate had been controlled and temperatures of the discharging water and background water had been measured. The proposed method to observe and measure hydrothermal flow is the one to utilize a sheet-like acoustic beam. Scanning with concentrated acoustic beam gives distances to the edges of the hydrothermal flows. And then, the shapes of the flows can be identified even in low and zero visibility conditions.

Preliminary result of the tank experiment showed that 3D images of water flows in the tank could be reconstructed with the proposed method. We have been trying to estimate the volumes of water flows based on the reconstructed images, on the assumption that the water flows were in a constant state of movement.

We will report the overview of the tank experiment and proposed observation method in this presentation.

Keywords: seafloor hydrothermal flow, acoustic video camera

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

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Availability to the ocean floor geoscience of the deep-sea videos

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The deep-sea videos are important to assess geological, topographical, temporal variation in deep-sea environments and to understand the diversity of deep-sea organisms and their ecology. For example, video observations are essential to elucidate behavior of deep-sea animals, and the georeferences can be used to construct distribution maps of those organism as shown on the marine biodiversity database of JAMSTEC, Biological information system for marine life (BISMaL).

In Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is holding a vast amount of deep-sea videos taken by manned/unmanned submersibles. The videos are given annotation (ex. living organism, geological phenomena and topographical characteristic) and opened to public via the Internet. We are holding the optimization of quality with the trend and introduce Panorama technique using the deep-sea videos. We are aiming at utility value of the deep-sea videos.

In this presentation, we introduce our works and discuss about availability to the ocean floor geoscience of the deep-sea videos.

Keywords: deep-sea video, research data, utilization promotion

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

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The three-dimensional conductivity structure beneath the Philippine Sea and the western Pacific Ocean

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The electrical conductivity of the upper mantle beneath the Philippine Sea and the western edge of the Pacific Ocean was imaged in three-dimension (3-D) for the first time from marine magnetotelluric (MT) data.

We performed 3-D inversion analysis for the MT responses at 25 sites, which were obtained by a previous study (Baba et al., 2010) as a part of the Stagnant Slab Project (Shiobara et al., 2009). 21 sites of all sites were located on the Philippine Sea plate, while 4 sites were on the Pacific plate. The inversion scheme that we applied in this study was newly developed for this study to treat the effect for both regional large-scale and local small-scale topographic changes on MT responses (Tata et al., 2012; Baba et al., submitted) because the bathymetry and land/ocean distribution are known to significantly affect seafloor MT responses because of high contrast in the conductivity between seawater and crustal rocks..

The area imaged in this study is more than 3,000 x 3,000 square kilometers. The resolution of the electrical conductivity structure is at least 500 km x 500 km. This is small enough to discuss differences or similarities among basins in the Philippine Sea plate. And also we can discuss differences/similarities between the Philippine Sea mantle and the Pacific mantle from the electrical conductivity structure.

The best electrical conductivity model shows four features. (1) The conductivity of the Philippine Sea mantle is higher than that of Pacific mantle for the depths shallower than 200 km, and become almost equal to that of Pacific mantle in deeper parts, suggesting thinner young Philippine Sea Plate and thicker old Pacific Plate. (2) A conductive anomaly is located below 125 km depth beneath the Sikoku and Parece-Vera Basins. (3) A resistive anomaly is located at shallower than 40 km depth beneath the Daito and Oki Daito ridges. It might reflect complex tectonic history such as paleo Daito Ridge island arc-trench system (Tokuyama, 1995). (4) A resistive anomaly is located at shallower than 240 km at the northern part of the Shikoku Basin, which indicates the subducted Pacific Plate.

The next step will combine our result with other parameters such as seismic velocity structures in order to understand an evolution of the Philippine Sea plate in detail.

Keywords: 3-D conductivity structure, Philippine Sea, Marine MT method, Inversion

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

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Origin of the petit-spot melt suggested from electrical conductivity structure

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Petit-spot is young volcanic activity on very old (about 130 Ma) oceanic plate characterized as a clump of small knolls which erupted strong to moderate alkaline basalt. This volcanic field is associated with neither any plate boundaries nor hot spots. To elucidate the magma generation process of this new-type volcanic activity, marine magnetotelluric (MT) surveys were carried out using ocean bottom electromagnetometers (OBEMs) in May - August, 2005 and in May, 2007 - August, 2008. Total nine OBEMs were deployed and seven of those were successfully recovered with good quality data. We compiled data at two other sites collected in July, 2003 - November, 2004 and analyzed the nine sites data in total in this study. We first estimated a one-dimensional (1-D) electrical conductivity structure model which explains the data of all sites averagely correcting topographic effect on the observed MT responses. Then, we carried out 3-D inversion analysis using the 1-D model as the initial and prior model. The 3-D inversion program that we used is WSINV3DMT (Siripunvaraporn et al., 2005) but modified for seafloor MT data by Tada et al. (2012).

The obtained 3-D model shows two distinct features. 1) The lithospheric mantle beneath the petit-spot field at 37.5N, 149.8E (Yukawa Knolls) is relatively more conductive than surrounding area. The conductivity is about 0.003 S/m at about 70 km depth. This feature is depicted as thinned resistive layer in the vertical section. 2) High conductivity (~0.1 S/m) layer at around 200 km depth is not isolated beneath the petit-spot field but rather distribute widely beneath the survey area except for the area to the northwestern area of the Yukawa Knolls. Checker board inversion and forward modeling tests support that these features are reasonably resolved by the data.

The electrical conductivity can be converted into temperature or melt fraction under some assumptions, using results of conductivity measurement of minerals in laboratories. We take the partition of H_2O and CO_2 in minerals and melt and the condition of partial melting into account for the conversion based on Hirschmann (2010). Then, the electrical conductivity at 200 km depth can be explained by small fraction (0.004-0.033%) of hydrous silicate melt but the temperature is unrealistically high (1600-1700 C) but explained by 0.25% of carbonated melt on realistic temperature (1400 C) above the solidus of peridotite including H_2O and CO_2. The sampled petit-spot lavas are very vesicular, indicating that significant amount of H_2O and CO_2 were dissolved in the incipient melt. From the above discussion, we speculate that the asthenospheric mantle is partially molten and the melt is extracted to the lithosphere (and partly to the seafloor) by the petit-spot activity.

Keywords: petit-spot, northwestern Pacific, electrical conductivity, ocean bottom electromagnetometer, magnetotellurics

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

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Using STCM data, relationship between spreading rate and magnetic boundary strike in mid ocean ridge

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Previous study using STCM data which were obtained Icebreaker SHIRASE and R/V MIRAI at 2003 and 2004 have suggested the results about spreading rate and stability of spreading in the Southeast Indian Ridge(SEIR) classified intermediate spreading ridge.

The results shows that the standard deviation of the MBS (Magnetic Boundary Strike) calculated from ISDV (Intensity of the Differential Vectors) is the low in 90E area characterized East Pacific Rise(EPR) type axial high, and the high in the 110E area showed the feature of Mid Atlantic Ridge(MAR) type axial valley at JpGU2012 meeting.

In this study, the standard deviation of MBS and half spreading rate were analyzed STCM data obtained by R/V MIRAI in East Pacific Rise of fast spreading ridge and Mid Atlantic Ridge classified slow spreading ridge.

The results were standard deviation of MBS is low and half spreading rate is stable in east of MAR, whereas standard deviation of MBS is the high and half spreading rate is unstable in west of MAR. Although, standard deviation of MBS is the low in west and the high in east of EPR, half spreading rate is variability in both areas. Therefore, there was no clear relationship about stable of MBS and half spreading rate. Moreover, the results in this study were different topographic compared to previous study in SEIR.

Keywords: Mid ocean ridge, Magnetic anomaly

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Active topographic features on the oceanward plate of the Japan Trench near the hypocenter region of the 2011 Tohoku Ear

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The trench-outer rise earthquake near the Japan Trench occurred after the 2011 Tohoku Earthquake. Several studies pointed out high occurrence probability of trench-outer rise earthquake after the 2011 Tohoku Earthquake in near future. Trench-outer rise earthquakes occur by reactivation or creation of normal faults caused as the oceanic lithosphere approaches a subduction zone and bends into the deep-sea trench. Bending-related faults in the oceanward trench slope are ubiquitous structures of oceanic plates incoming to trenches. In general, the faults are formed parallel or subparallel to the bending axis of the incoming plate, namely the trench axis. Oceanward slopes of several trenches have bending-related structure with a strike different from the trench axes (e.g. Kobayashi et al., 1998). In these areas, abyssal hill fabric was reactivated instead of the creation of new faulting parallel to the trench axis.

The Cretaceous Pacific Plate (132-138 Ma) is subducting along the Japan Trench (Nakanishi et al. 1992). The strike of the Japan Trench changes at around 38N from about N08E in the northern part to N30 E in the southern part. The outer swell of the Japan Trench is slightly less clear compared to that of the Kuril Trench. Its crest is deeper than 5,200 m and situated about 80 km east of the Japan Trench axis. The outer swell is distinctly identified north of 37N in the Japan Trench, north of the Joban Seamounts. The outer swell is obscure around the Joban Seamounts.

The bathymetric map around the Japan Trench by Nakanishi (2011) demonstrated that most of bending-related topographic structures exist in the oceanward trench slopes deeper than 5600 m. The map also revealed that bending-related topographic structures are developed parallel to the trench axis or inherited oceanic spreading fabric. Most of bending-related topographic structures in the northern segment of the Japan Trench are subparallel to the trench axis. The bending-related topographic structures are confined to areas less than 80 km away from the trench axis. Topographic expressions of these north of 39 40N are a half graben, an asymmetric graben and ridges, which is similar to that of the western Kuril Trench. The height of bending-related topographic structures does not show any gradual trenchward increase. Some of bending-related topographic structures north of 40 N have the same strike as those of Kuril Trench. In the middle region of the northern segment between 38 50N and 39 40N, bending-related escarpments form symmetric grabens subparallel to the trench axis Gradual growing of the bending-related topographic structures is observed in this area. Trench-subparallel escarpments decrease in relief southward and a dominant set of escarpments become roughly parallel to the seafloor spreading fabrics striking at large angles to the trench axis. Between 38 N and 39 15N, several elongated escarpments have a strike perpendicular to seafloor spreading fabrics.

The sidescan images exposes numerous knolls, petit-spot volcanoes, on the Pacific Plate around 38N (Hirano et al., 2008). The knolls are covered with thin or no pelagic sediments, implying that they were formed by recent volcanism, not related with any plate boundaries.

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Keywords: bending-related topographic features, petit-spot volcanoes, trench-outer rise earthquake, oceanic spreading fabric, Japan Trench

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Seafloor mapping of the 1998 Papua New Guinea earthquake and tsunami source area

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The 1998 Papua New Guinea earthquake and tsunami occurred on 17 July 1998 off the northern coast of the New Guinea Island. The maximum wave eight of 15m was recorded near Sissano Lagoon near the town of Aitape. After the hazardous tsunami JAMSTEC dispatched DOLPHIN-3K (ROV) and SHINKAI2000 (manned submersible) in 1999 and 2001 and total 13 dives were carried out to figure out the large-scale slump in the source area. Since an over-all seafloor geological route map of the source area has not been made so far, the author compiled all the visual observation through all the 13 dives together with other results of the offshore geophysical survey and made the final version of the seafloor geological survey route map. The result shows that a slump which might generate the hazardous tsunami is located 10km off the northern coast along the amphitheatre. The total volume of the collapsed area at the slump is estimated to be about 5.4km3.

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

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Study for observation and analysis method in urgent seafloor geodetic observation

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Japan Hydrographic and Oceanographic Department (JHOD) and the Institute of Industrial Science, University of Tokyo, have been developing a system for precise seafloor geodetic observation with the GPS/Acoustic combination technique and carrying out campaign observations on the landward slope of the major trenches around Japan, such as the Japan Trench and the Nankai Trough.

When a large earthquake occurs near a seafloor reference point, JHOD has carried out seafloor geodetic observations urgently and reported seafloor movements to the Headquarters for Earthquake Research Promotion of Japan as soon as possible. However, it is sometimes difficult to secure sufficient observation time because the survey vessels of Japan Coast Guard have to do other works for the disaster response. Therefore, to make the most of every opportunity, we have to know the observation precision for a shorter observation time. In addition, it is desirable to analyze observation data and obtain preliminary results onboard although in present, we analyze observation data after the survey ship comes back because on-land GPS data is required in KGPS analysis.

In this presentation, we report the way of urgent observation and analysis to report preliminary result as soon as possible, in case that a large earthquake occurs near a seafloor reference point in the future.

Keywords: Seafloor geodetic observation

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Development of a new method for GPS/Acoustic seafloor observation using multi-buoy system

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We are developing a method for observation of seafloor crustal deformation using kinematic GPS and acoustic ranging system. The system measures seafloor crustal deformation by determining position of benchmarks on the seafloor using a vessel which link-up GPS and acoustic signals. Acoustic ranging is used to measure distance between the vessel and seafloor benchmarks. And kinematic GPS is used to locate the moving vessel every 0.2 seconds. Now we have deployed 4 seafloor benchmark units at Suruga Bay and 4 units at Kumano Basin. At each survey site, three seafloor transponders are settled to define a benchmark unit. In this system, each measurement takes about ten hours and both sound speed structure and the benchmark unit positions were determined simultaneously for the each measurement using a tomographic technique. This tomographic technique was adopted on assumption that the sound speed structure is horizontally layered and changes only in time, not in space. However, when sound speed structure has a heterogenity, the assumption of a horizontally layer causes error in the determination of seafloor benchmarks. So we are developing a new system using multi-buoy. In this system, multi-buoy plays role of vessel. Doing observation by the buoys, we can estimate spatial variation of sound speed structures every moment. In November 2012, first observation of seafloor crustal deformation using the buoys was held in Suruga Bay. In this study, we estimate a spatial variation of sound speed structures and, at the same time, defined some problems in this system. From checking of the waveform data, we found that there are differences in the yield of data. These differences are caused by the observation system itself. We estimate that when the difference of acoustic path is less than 413m, the buoys do not make a record of the waveform data. We estimated a spatial variation of sound speed structures by evaluating residuals of one-way travel-time between the buoys and the seafloor benchmarks. As a result, we found large scale (between the different buoys) spatial variation of sound speed structure. But small scale (between the same buoys) spatial variation was not detected. To estimate a small scale spatial variation, attitude of the buoys should be monitored by motion sensors like gyrocompass. From approximate calculation, it is predicted that traveltime errors of 0.16ms at maximum can be removed by introduction of a good motion sensor.

Keywords: seafloor crustal deformation, moored buoy, GPS/Acoustic, sound velocity, spatio-temporal variation

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Gamma-ray fluctuation observed on deep seafloor off Hatsushima Island in Sagami Bay after the 2011 Tohoku Earthquake

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Long-term gamma-ray observation with NaI(Tl) detector attached to the cabled observatory on deep seafloor at a depth of 1175 m off Hatsushima Island in Sagami Bay has been carried out since 2000. It has multi-channel (256 ch) pulse height analyzer and energy spectra of gamma-ray can be obtained.

Temporal fluctuation of net area of each peak in the energy spectra, which corresponds to radiation dose rate, of Bi-214 (U series), K-40 and Tl-208 (Th series) between January 2010 and December 2012 was studied this time. Although each peak shifts to lower channel as time passes because of the aging of the equipment, in order to prevent discontinuity, ROI (Range of Interest) for each peak was set constant and spectra were averaged for one day. Because of the trouble at the shore station caused by typhoon, the observation stopped from 21st September to 5th October in 2011.

Just after the off the Pacific coast of Tohoku Earthquake on March 11th in 2011, sudden increase of radiation does rate of Bi-214 occurred. It continued to increase until April in 2011. It began to decrease gradually in January until June in 2012. On the other hand, the fluctuations of those of Tl-208 and K-40 are not so significant except sudden decrease in February in 2012 which is probably caused by the work of ROV (Remotely Operated Vehicle) on seafloor near the observatory. The temporal fluctuation of Bi-214 might reflect crustal deformation, however, because of poor resolution in energy spectra, the Bi-214 peak might contain the dose rate of Cs-137 associated with atomic power plant accident to some extent. More detailed analysis would be necessary.

Keywords: Gamma-ray observation, deep seafloor off Hatsushima Island in Sagami Bay, Off the Pacific Coast of Tohoku Earthquake in 2011

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The phase velocity and arrival direction of infragravity waves observed by DONET

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The Infragravity wave (IG wave) creates periodic, horizontally propagating pressure fields at the deep seafloor. The displacement to pressure transfer function, called as the compliance, provides information about elastic wave velocity of ocean crust (Crawford et al., 1991). We have tried to detect the IG wave from DONET data and to measure the compliance continuously which aims to monitor the stress and the distortion beneath the Nankai Trough. In this study, we report the phase velocity and arrival direction of IG wave detected from DONET data.

We use the data of vertical component of broadband seismometer and those of quartz pressure gauge recorded from January, 2011 to December, 2012. The IG waves are detected by a slant stack method. We stack the waveforms in a frequency domain between 0.005 and 0.025 Hz. The slowness and direction which give the maximum rms amplitude, are considered as the phase velocity and arrival direction of IG wave.

Since the phase velocity of IG wave changes with water depth, the phase velocity with same wavelength changes at the depths of 2000 and 4000 m. We use the data observed at the stations which are installed at about 2000 m depth. Although the estimated phase velocity and arrival direction are unstable till Octorber, 2011, the stable results are shown after that. The 57% and 48% of results show the phase velocity of 123-127 m/s and arrival direction of 140 -160 deg from the north, respectively.

Although the origin of IG wave with stable arrival direction of 140-160 deg is one of the future subjects, we assume that the IG wave always comes from southeast with phase velocity of 125 m/s to the stations installed at about 2000 m depth. This stable IG wave would be detected by the stacked waveforms for a station or an array of 4 stations connected to each node and would provide us the localized compliance.

Keywords: Infragravity wave, DONET, compliance

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Bouguer gravity anomaly of Japan's adjacent seas

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The Japan Coast Guard (JCG) conducted bathymetric, marine gravity and magnetic, and seismic surveys for Continental Shelf Survey Project between 1983-2008. The survey area extends over 350 nautical miles from the coastline in the southern region of Japan. Since the project has been settled temporarily, we can now report the precise Bouguer gravity anomaly map of Japan's adjacent seas which has been newly compiled based on these survey results.

The drift correction, Eotvos correction and the up-to-date normal gravity formula were applied to the raw gravity data then the freeair gravity anomaly was obtained. Atmospheric correction was not applied. The gravity grid data was made in 1 km mesh. Bouguer gravity anomaly was calculated by applying a terrain correction under the assumption that the average density of oceanic crust was 2.67 g/cm3. For the terrain correction, the square pillar model of topography griddized 1 km x 1 km was made and the gravity effect of the model within 40 km radius was calculated by using half-infinite integral.

A topography model was made by using mainly bathymetric data which was collected by multibeam echo sounder on JCG's Continental Shelf Survey Project. Blank areas with no bathymetric data were complemented with ETOPO1. The effect of sediment layers was not entered into calculations. The new Bouguer gravity anomaly map took more exact terrain correction into account and covered wider areas; the southern part of Kyushu-Palau ridge, the surrounding of Minami-torishima island, the northern part of Izu-Ogasawara ridge, the surrounding of Amami Plateau, etc. compared to the previous map (Oikawa and Kaneda, 2007).

Seismic structure of oceanic crust such as its thickness is obtained by seismic survey and gives information on its creation process. However, it is not a practical way to conduct seismic surveys in all regions. The thickness of oceanic crust is generally one of the key factors in Bouguer gravity anomaly, and Bouguer gravity anomaly tends to increase when the thickness of oceanic crust gets thinner, if the density structure below the mantle is assumed to be constant. According to this relationship, it might be possible to estimate the thickness of oceanic crust for sea areas where seismic surveys have not been conducted. Therefore, we have reported the regional relationship between the thickness of oceanic crust and Bouguer gravity anomaly. We set conditions to choose areas: The effect of sediment layers is small and its structure is comparatively homogeneous, in order to make it easy to compare the relationships. As a result, the comparison was conducted in the areas constituted of oceanic crust.

The thickness of oceanic crust was extracted from the velocity structure model resulted from analysis of seismic refraction survey at sea areas where lineation of geomagnetism was observed. Sea areas were divided into three groups whose formation process of oceanic crust were different in order to compare them; the areas of Shikoku Basin and western part of Parece Vela Basin, the area of northern and eastern parts of West-Philippine basin, and the area of Minami torishima island's adjacent seas. Then datasets of the thickness of oceanic crust with Bouguer gravity anomaly were plotted. Each thickness of oceanic crust with Bouguer gravity anomaly shows the regional characteristic.

In the areas of Shikoku Basin and western part of Parece Vela Basin, the thickness of oceanic crust tends to decrease depending on the increase in Bouguer gravity anomaly. In the area of Minami torishima island's adjacent seas, on the other hand, Bouguer gravity anomaly changes between 340-440 mGal regardless of the thickness of oceanic crust is almost constant.

Keywords: Bouguer gravity anomaly

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Characteristics of Hf isotopic composition of basalts from northwestern part of the West Philippine Basin

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We report Hf isotope data of basalts from the West Philippine Basin (WPB). In the western part of WPB near to the Ryukyu trench, the Okinawa-Luzon Fracture Zone (OLFZ) exists, extending in the NE-SW direction. Shirahashi (2007, master's thesis of Univ. Ryukyus) reported that basaltic basement rock around the OLFZ have Sr-Nd-Pb isotopic composition similar to those of the isotopic Indian Ocean MORBs. In this study we analyzed the Hf isotope ratio of the same samples reported by Shirahashi (2007). All samples plot within the range of the Indian Ocean MORBs in eHf - eNd diagram, suggesting that they have Hf isotopic characteristic of the Indian Ocean MORB type. In addition, it has been suggested that Hf isotope ratios of other (and younger) back arc basin basalts in the Philippine Sea plate show Indian Ocean MORB type. This suggests that asthenosphere with the isotopic characteristic of Indian Ocean MORB type has involved since early stage of the the formation of the Philippine Sea plate.

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Nd and Hf isotopic compositions of the Oman ophiolite extrusive rocks

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The peri-Arabian ophiolite belt, from Cyprus in the west, eastward through Northwest Syria, Southeast Turkey, Northeast Iraq, Southwest Iran, and into Oman, marks a 3000 km-long convergent margin that formed during a Late Cretaceous (ca 100 Ma) episode of subduction initiation on the north side of Neotethys. The Oman ophiolite is the largest and best exposed ophiolite in the world that preserves the original structure of oceanic lithosphere formed at the Neotethys ridge system with fast spreading rate. The volcanic sequence in the Oman ophiolite are divided into three units from lower to upper: V1 (Geotimes Unit), V2 (Alley Unit) and V3 (Salahi Unit). There is a debate on the lava stratigraphy for the Lasail Unit.

This study reports new data on Hf?Nd isotope systematics for volcanic rocks from northern Oman ophiolite. On the trace element compositions, samples can be devided into three types; N-MORB type, ultra-depleted type, and U-shaped type. These broadly corresponds to V1, V2 and boninite, respectively. In a eHf(t) vs eNd(t) plot, all Oman lavas within the modern Indian ocean MORB-type mantle domain, suggesting that magma source region has Nd and Hf isotopic composition similar to those of Indian ocean MORBs. This is compatible with the previous suggestion based on Pb isotope systematics, that Neotethyan ocean domains share the Indian ocean MORB type mantle. Although most samples have eNd>8, few samples have low eNd(<6). Low eNd lavas include boninite-type and ultra-depleted type rocks; they have higher La/Sm values. It is likely that sediments as subduction components involved in petrogenesis of these low evalues.