Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SCG68-01 Room:502 Time:April 30 09:00-09:15

Vp/Vs ratio in the southernmost Japan Basin and its transition area, Japan Sea deduced from the seismic survey

SATO, Takeshi[1*] ; NO, Tetsuo[1] ; KODAIRA, Shuichi[1] ; TAKAHASHI, Narumi[1] ; KANEDA, Yoshiyuki[1]

[1]JAMSTEC

The Japan Sea is one of very well studied back-arc basins in the northwestern Pacific. To clarify the formation process of the back-arc basin in the Japan Sea, many seismic surveys using ocean bottom seismographs (OBSs) and control sources have been conducted in the sea. The Japan Basin, which located in the northern to eastern Japan Sea, has an oceanic crust formed by seafloor spreading (Hirata et al., 1992; No et al., submitted). On the other hand, the ocean-continent transition area between the Japan Basin and the continental shelf in the eastern margin of this sea may have a thick oceanic crust (No et al., submitted). However, it is unknown the origin and the nature of this thick oceanic crust, due to the lack of the information about lithology in the transition area. To understand the origin and the nature of this thick oceanic crust, it is necessary to obtain the information lithology in the crust of the transition and the basin areas. For this study, we will present the Vp/Vs ratio of the crust from the southernmost Japan Basin to its transition area.

From the southernmost Japan Basin to the continental shelf off the west of Aomori and the northern Oga Peninsula, seismic surveys using OBSs and an air-gun array were undertaken. In vertical record sections of several OBSs, not only the first arrived phases but also later phases reflected from interfaces in the crust and uppermost mantle are visible. Moreover, in horizontal record sections of several OBSs, converted phases from P- to S-waves are apparent. In this study, we have obtained the S-wave velocity structure using travel times of these converted phases. Then, we have obtained the Vp/Vs ratio in the crust from the southernmost Japan Basin to its transition area using the obtained P- and S-wave velocity structures.

In the southernmost Japan Basin off west of Aomori, the Vp/Vs ratio in the sedimentary layer of shows 4 to 8 and has a lateral variation. The Vp/Vs ratios in the crustal upper and lower parts show around 1.85 and 1.8, respectively. On the other hand, in the transition area, the Vp/Vs ratio in the crustal upper part is similar to that in the southernmost Japan basin. This Vp/Vs ratio may show that the nature of the whole crust in the basin area and of the crustal upper part in the marginal area has an oceanic origin. Therefore, the crusts in southernmost Japan Basin and in its transition area are suggested as an oceanic crust and a thick oceanic crust, respectively. The oceanic crust formed by the opening of the Japan Sea may extend to the transition area of the southernmost Japan Basin.

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Crustal structure study of the Sea of Japan: Recent results and future perspectives

NO, Tetsuo[1*] ; SATO, Takeshi[1] ; KODAIRA, Shuichi[1] ; ISHIYAMA, Tatsuya[2] ; SATO, Hiroshi[2] ; TAKAHASHI, Narumi[1] ; OIKAWA, Nobutaka[1] ; KANEDA, Yoshiyuki[1]

[1]JAMSTEC, [2]ERI, Univ. of Tokyo

In recent years, crustal structure study of the Sea of Japan has advanced. Various new seismic data have been obtained in the Sea of Japan; for example, the two ship seismic surveys study (Sato et al. 2007) and onshore-offshore seismic survey (Earthquake Research Institute, 2013) conducted by the University of Tokyo, and 2D/3D seismic reflection survey conducted by R/V SHIGEN (JOGMEC, 2013).

From 2007 to 2012, we conducted marine seismic surveys using the multichannel seismic reflection system and ocean bottom seismometers; the surveys covered the area between the Japanese coast of the Sea of Japan and the Yamato and Japan Basins. Based on the results, the crustal structure of the eastern margin of the Sea of Japan was classified into three types: island arc crust, thick oceanic crust, and oceanic crust (Sato et al. 2014; No et al. submitted). In addition, our studies found that the contractive deformation zones of the eastern margin of the Sea of Japan are associated with the crustal structure distribution. Further, seismic data suggests that the crustal structure in the south (off Yamagata to Niigata) differs from that of the north (off Akita to Nishi-tsugaru). These differences are critical in understanding the relation between the spatial distributions of the seismogenic and contractive deformation zones (JAMSTEC, 2013). These results can contribute to the review of long-term evaluations of earthquake occurrence potentials and the discussion of the seismogenic study in the eastern margin of the Sea of Japan.

In 2013, new projects have been observing and studying earthquakes and tsunamis in the Sea of Japan. *Integrated Research Project on Seis* scheduled in 2014 in order to conduct a seismic survey in the blind areas of the existing observations, which are in the southwest region of the Sea of Japan and off western Hokkaido. The addition of new observation data will advance the study of crustal structure in the Sea of Japan. In this study, we aim to improve the accuracy of the position and size of the source faults in the Sea of Japan. In addition, we investigate the relation among tectonic history, crustal structure, and factors that form source faults in the Sea of Japan. In the future, we aim to clarify the seismogenic zone of the Sea of Japan using new seismic data.

Keywords: the Sea of Japan, crustal structure, MCS, OBS

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Results of 2013 Off-Joetsu and Hokuriku survey for the integrated research project on seismic and tsunami hazards around

SATO, Hiroshi[1*] ; ISHIYAMA, Tatsuya[1] ; SHIRAISHI, Kazuya[2] ; ABE, Susumu[2] ; KATO, Naoko[1] ; KURASHIMO, Eiji[1] ; TAKEDA, Tetsuya[3]

[1]Earthquake Research Institute, Univ. Tokyo, [2]JGI. Inc., [3]NIED

An obvious convergent plate boundary cannot be recognized in the Sea of Japan, and convergence accommodates in defused wide area of the back arc. To estimates Tsunami and seismic hazards along the coastal area of Sea of Japan, more detailed survey to identify source faults are needed. A new research project funded by MEXT named "the integrated research project on seismic and tsunami hazards around the Sea of Japan" began in FY 2013. To obtain the information of source faults, we performed deep seismic reflection profiling off-Joetsu and Hokuriku area in the central part of Honshu, Japan. We used two vessels; a gun-ship with 3020 cu. inch air-gun and a cable-ship with a 2-km-long, streamer cable with 156 channels and 480 cu. inch air-gun. Common-mid point reflection data were acquired along 9 seismic lines with total 715 km in length. The seismic profiles portray the structure of failed rift basins, such as Toyama trough and Sado strait, bounded by rift axis reverse faults with rift axis vergence, which represents reactivation of boundary faults between mafic intrusion and pre-rift basement. Noto Peninsula is marked by syn-rift normal faults and their reactivation by shortening deformation. The back arc side of the SW-Japan arc experienced NS trending shortening deformation in the latest Miocene. From the Noto peninsula, undeformed Pliocene sediments covers folded Miocene. Some normal faults reactivated as active strike-slip and reverse faults. The survey results contributed to construct source faults models of Tsunami and seismic hazards estimation.

Keywords: Sea of Japan, source fault, crustal structure, seismic reflection profiling, Off-Joetsu, off-Hokuriku

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Lithospheric Structure of the Hidaka Collision Zone, Hokkaido, from Reanalysis of 1998-2000 Hokkaido Transect Data IV

IWASAKI, Takaya[1*] ; TSUMURA, Noriko[2] ; ITO, Tanio[3] ; SATO, Hiroshi[1] ; KURASHIMO, Eiji[1] ; HIRATA, Naoshi[1] ; ARITA, Kazunori[4] ; NODA, Katsuya[5] ; FUJIWARA, Akira[5] ; ABE, Susumu[5] ; KIKUCHI, Shinsuke[6] ; SUZUKI, Kazuko[7]

[1]Earthquake Research Institute, the Univsesity of Tokyo, [2]Chiba University, [3]Teikyo Heisei University, [4]Hokkaido University, [5]JGI. Inc., [6]JAPEX, [7]Schlumberger Ltd.

The Hidaka region in the central part of Hokkaido Island, Japan, is known as an arc-arc collision zone ongoing from the middle Miocene. In 2012, we started reinterpretation for a series of seismic reflection/refraction surveys from 1994 to 2000 in this collision zone. In this analysis, we used integrated and sophisticated processing and analysis techniques. including CRS/MDRS method for seismic reflection data and refraction tomography both very dense arrival time data from both the reflection and refraction/wide-angle reflection data. The most important finding so far obtained is a clear image of the NE Japan Arc subducting eastward under the northern part of the collision zone. However, the following problems are remained unsolved.

(1) Shallow structure beneath the Hidaka Collision zone is still unsolved. Particularly, the structure just east of the Hidaka Main Thrust is not sufficiently evaluated from our seismic data.
(2) Delamination of the Hidaka crust as in the southern part of this collision zone is not unclear. Our CRS/MDRS processing for the reflection data provided no positive evidence for the delamination.
(3) Deeper collision structure of the NE Japan Arc and the Kuril Arc is still not constrained. It is necessary to elucidate the subducting structure of the NE Japan Arc from amplitude data as well as travel time data.

In this paper, we focus the items (1) and (3) from seismic refraction/wide-angle reflection approach. Previous refraction tomography elucidated a thick (4-5 km) undulated sediments in the hinterland, the outcrop of crystalline crust beneath the Hidaka Metamorphic Belt with higher Vp and Vp/Vs and an enormously thick (>8-10 km) sedimentary package beneath the foreland. In order to obtain the more reliable structure model, we intensively revised the travel time data obtained both from seismic reflection/wide-angle reflection line and reflection lines. The seismic tomography using these revised data sets indicate a clearer high velocity (>6.1 km/s) anomaly just east of the HMT. We also recognized some wide-angle reflections around 5-10 km deprth beneath the HMT, from which we expect to determine the finer structure at the collision front. Our present analysis indicates the wide-angle reflection data sample a part of the lower crust of the subducting NE Japan Arc beneath the fold-and-thrust belt. According to the preliminary result, its velocity is ranging from 6.5-7.0 km/s. By combining the amplitude analysis, we expect to estimate the more reliable Moho depth of the NE Japan Arc than in the previous analyses.

Keywords: active source seismic experiment, collision, arc, crustal structure, lithosphere

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Seismic crustal structure beneath the southeastern part of northeast Japan by dense seismic array observation

KURASHIMO, Eiji[1*] ; SATO, Hiroshi[1] ; ISHIYAMA, Tatsuya[1] ; HIGASHINAKA, Motonori[2] ; ABE, Susumu[2] ; IWASAKI, Takaya[1]

[1]ERI, Univ. Tokyo, [2]JGI, Inc.

The 2011 Tohoku-Oki Earthquake (Mw9.0), that occurred on the Japan Trench off the eastern shore of northern Honshu, Japan, generated enormous crustal deformations. Seismic activity in northeastern Japan increased significantly after the 2011 Tohoku-Oki Earthquake. Detailed crustal structure and deep geometry of the active fault is important to constrain the process of earthquake occurrence. Active and passive seismic experiments were conducted to obtain a structural image beneath the southeastern part of NE Japan (Sato et al., 2013). The geometry of the active faults have been revealed by seismic reflection profiling (Sato et al., 2013). Natural earthquake data set is useful to obtain a deep structural image. Forty portable seismographs were deployed along a 70-km-long line between Souma and Takahata during the period from August 16, 2012 to December 24, 2012. Each seismograph consisted of a 1-Hz 3-component seismometer and off-line data recorder (Shinohara et al., 1997). Waveforms were continuously recorded at a sampling rate of 200 Hz. In the area of the present study, deep seismic reflection profiling was conducted using vibrators (Sato et al., 2013). The off-line recorders observed the controlled seismic signals as well as natural earthquakes. During the seismic array observation, the JMA located 2956 earthquakes in a latitude range of 37.2-38.5 N and a longitude range of 139.6-141.3 E. We selected 200 earthquakes, all of which occurred near the survey line. In order to obtain a high-resolution velocity model, a well-controlled hypocenter is essential. Due to this, we combined the seismic array data with permanent seismic station data. The arrival times for the first P- and S waves obtained from local earthquakes and Vibrator shots were used in a joint inversion for earthquake locations and three-dimensional Vp and Vp/Vs structures, using the iterative damped least-squares algorithm, simul2000 (Thurber and Eberhart-Phillips, 1999). Permanent seismic stations observed the controlled seismic signals as well as natural earthquakes. We added the arrival time data of these controlled sources into the dataset to improve the shallow velocity structure. The depth section of Vp structure along the survey line shows that lateral variation of the Vp value at a shallow depth. This lateral variation correlates with the surface geology along the profile.

Keywords: dense seismic array observation, seismic tomography, the 2011 Tohoku-Oki Earthquake

SCG68-06 Room:502 Time:April 30 10:15-10:30

Shallow geologic structure around the northern part of the Futaba Fault, northeast Japan, based on gravity survey

KOSHIYA, Shin[1*] ; TERUI, Kyoko[2] ; YONEZAWA, Kenta[1] ; SATO, Hiroshi[3] ; KATO, Naoko[3] ; ABE, Susumu[4] ; HIGASHINAKA, Motonori[4]

[1]Faculty of Engineering, Iwate Univ., [2]Graduate School of Engineering, Iwate Univ., [3]ERI, Univ. of Tokyo, [4]JGI, Inc.

The Futaba Fault, bounding the eastern margin of the Abukuma Mountains, is known as a left lateral fault in the Cretaceous and Paleogene period with a remarkable fracture zone of a few hundreds meter win width. It trends NNW-SSE and divides into two branches between which the Wareyama horst develops. During early to middle Miocene, E-W extensional stress field caused large normal displacement along the western fault to form a half graben filled with sediments including breccia. In late Miocene, it had been a right lateral fault. In present, the eastern fault is active, along which left lateral offsets with western upheaval ingredient are geo-morphologically observed. Thus the Futaba Fault has experienced the complicated history of development. In this study, we modeled two dimensional shallow geological structure across the faults mainly based on gravity survey. The gravity survey was conducted across the faults with a G-type gravity meter (G827; LaCoste and Romberg Inc.) along two E-W survey lines, one of which is ca. 12 km long, (line 1), and the other of which is ca. 13km long (line 2). Each interval of observation sites is about 200 m. The elevation of observation sites was surveyed with a electric level and a RTK-GPS. Acquired gravity data was processed to obtain Bouguer anomaly mostly according to the methodology of Geological Survey of Japan, AIST (2004). We assumed that the density for Bouguer and terrain corrections were 2.2 g/cm^3. In each survey line, Bouguer anomalies after trend correction show the highest value around the Wareyama horst consisting of pre-Paleogene basement rocks and a few maxima in the western side of the horst. We assume four layers in our model, which have densities of 2.00 g/cm^3 (layer 1), 2.2 g/cm^3 (layer 2), 2.55 g/cm^3 (layer 3), and 2.67 g/cm^3 (layer 4) , respectively. The interpretation of the model is as follows. Layer 1 is correlated to the surface covers and Pliocene sedimentary rocks, layer 2 lower to middle Miocene sedimentary rocks, layer 3 Miocene breccia and layer 4 basement rocks. We will discuss the shallow structure across the faults in detail.

Keywords: Futaba fault, gravity anomaly, active fault

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Structural characters of active faults, crustal architecture, and permanent deformation of the Hokuriku region

ISHIYAMA, Tatsuya[1*] ; SATO, Hiroshi[1] ; KATO, Naoko[1] ; TAKEDA, Tetsuya[2] ; KURASHIMO, Eiji[1]

[1]Eathquake Research Institute, University of Tokyo, [2]NIED

We discuss in this study about characters of crustal architectures around the Toyama trough revealed by new seismic reflection and refraction profiles and seismic tomography, and active structures based on Neogene geology and tectonic geomorphology. As revealed by onshore offshore deep seismic reflection profiling across the Toyama trough funded by MEXT named as The Integrated Research Project on Seismic and Tsunami Hazards around the Sea of Japan since 2013, crustal architectures across the Toyama trough is characterized by three domains: (1) crustal thrust wedge comprising the northwestern flanks of the Hida Mountains, (2) Neogene sedimentary basin near the axis of the Toyama trough, and (3) reactivated normal faults as thrust (or obliquely slipping) faults beneath the Noto peninsula, comprising structural higher domain west of the Toyama trough. These structural patterns and permanent, late Quaternary crustal deformation recorded by tectonic geomorphology are quite similar to adjacent Neogene sedimentary basins in the backarc failed rifts in the Sea of Japan, including northern Fossa Magna, Niigata, and Akita.

SCG68-08 Room:502 Time:April 30 11:00-11:15

Phase changes and temperature of the subducted crust of Philippine Sea slab beneath Kanto, Japan

ISHIKAWA, Masahiro[1*] ; NAKAGAWA, Shigeki[2] ; SAKAI, Shin'ichi[2] ; HIRATA, Naoshi[2] ; SATO, Hiroshi[2] ; KASAHARA, Keiji[3]

[1]Graduate School of Environment Information Sciences, Yokohama National University, [2]Earthquake Research Institute, The University of Tokyo, [3]Association for the Development of Earthquake Prediction

The Philippine Sea plate subducts beneath the Greater Tokyo Area of Japan. Devastating M8-class earthquakes occurred on the upper surface of the Philippine Sea plate, examples of which are the Genroku earthquake of 1703 (magnitude M8.0) and the Kanto earthquake of 1923 (M7.9). A M7 or greater (M7) earthquake in this region may occur either on the upper surface or intra slab of Philippine Sea plate. To evaluate seismic hazard in the Greater Tokyo Area of Japan we need to clarify the lithological properties of Philippine Sea slab. This study presents an interpretation of the crustal and mantle structure of the Philippine Sea slab beneath Kanto based on recent MeSO-net seismic tomography data. The seismic tomography reveals that P wave velocity of the subducted crust of the Philippine Sea slab increases stepwise at 30 km and 40 km depths beneath the Kanto area. The cause of these two stepwise increases in P wave velocity of subducted crust is expected to correspond to metamorphic phase changes. Mineralogical assemblages of forearc basalt composition of the Izu arc was calculated by Theriak-Domino software, and the phase diagram shows that phase changes to garnet amphibolite and eclogite can account for these two stepwise increase in P wave velocity of the subducted crust of the Philippine Sea slab.

Keywords: slab, phase change, slab temperature, Kanto, Philippine Sea Plate, crust

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Geologic structure in and around the Beppu Bay estimated by gravity analysis

YAMAKITA, Satoshi[1*] ; KUDO, Takeshi[2] ; ITO, Tanio[3]

[1]University of Miyazaki, [2]Chubu University, [3]Teikyo-Heisei University

Seismic profiling in the Beppu Bay and the Bungo Straight performed by Kyoto University and JGI inc. from 1988 to 1990 (Yusa et al., 1992) raised new progresses of studies on the geologic structure of the Median Tectonic Line (MTL) in Kyushu and the development of the Beppu Bay Sedimentary Basin (BSB) accompanying it (Yamakita et al., 1995; Ito et al., 1996). The P-wave velocity assumed by Yusa et al. (1992) for the rocks in Ryoke Belt, however, was too low for granitic and metamorphic rocks constituting this Belt, and it is likely that the dip of the MTL beneath it was underestimated. Besides, the structure of the basin in the innermost part of the Beppu Bay has remained uncertain because this part is located in the terminal part of the seismic lines. On the other hand, there are plenty of gravity data in and around the Beppu Bay (Yusa et al., 1992; GSJ, 2000; Gravity Research Group in Southwest Japan, 2001). It can be expected that these gravity data clarify the structure of BSB, combined with correct seismic profiles. Fortunately, a profile reprocessed with re-estimated P-wave velocity along the Bungo straight (J-line) was presented last year (Abe et al., 2013). Using this reprocessed profile and gravity data, we tried to determine the subsurface structure along the G-line of Yusa et al. (1992), trending N70E, 35 km long, from on-land area, across the Asamigawa fault (AF) and the Beppu Bay Central Fault (BCF), to the mouth of the Beppu Bay (Fig. A), occupied by Sanbagawa metamorophic rocks (Sm, ρ=3.0g/cm^3), Ryoke granitic and metamorphic rocks (Rk, ρ=2.8g/cm^3), lower (Bl, ρ=2.6g/cm^3) and upper (Bu, ρ=2.4g/cm^3) sediments of BSB. Assuming only the depth and form of the MTL estimated from the reprocessed profile of J-line and geologic constraints, and the position of the AF on the surface, we determine other subsurface structures to fit with the gravity data through traial and error (Fig. B). In this profile, the upper surface of the Ryoke basement almost coincides with that in the Yusa et al. (1992)'s profile. This fact suggests high reliability of this profile. We concluded the structure of BSB from this and Yusa et al.(1992)' s profiles as follows.

1. The innermost part of the BSB was formed by two listric normal fault systems, NE-dipping Asamigawa Fault System (AFS) and SW-dipping Beppu Bay Central Fault System (BCFS). Both systems formed roll-over structure in the sediments of BSB.

2. The AFS consists of three faults (I, II, III), which converge to the MTL. It is uncertain whether the fault AFS-II reaches the uppermost part of the sediments. The total amount of the vertical displacement of ASF may be up to 3000m, although it depends on the thickness of sediment in the SW-side on AF and the amount of erosion of Ryoke basement

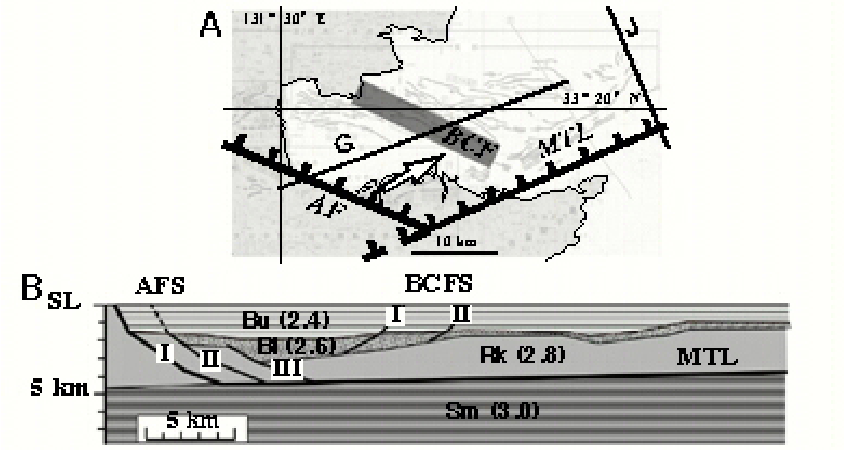
3. Two faults BCFS-I and BCFS-II vertically displaced the bottom of the Bu in 250m and 150m respectively and reach the uppermost part of it, although it is difficult to recognize in this figure because of its highly reduced scale. Both, however, did not displace the bottom of the Bl (= the upper surface of the Ryoke basement).

4. BSB is inferred to be formed and developed by eastward movements of the hanging wall (Ryoke basement), strike-slip on the MTL and downward on the AF. The BCFS was secondarily formed in eastward moving sediments.

These results are almost concordant with the model of a strike-slip basin proposed by Yamakita and Ito (1999), which assume a not vertical but moderately dipping strike-slip fault with a releasing bend. This model ignored the effects of secondary listric normal faults in sediments, dipping toward the main oblique normal fault forming the oblique ramp, but they contributed to the development of BSB to some extent. Their effects, however, are rather small as indicated by the fact that they did not displace the basement.

Keywords: Gravity analysis, Beppu Bay, MTL, Asamigawa Fault, Beppu Bay Central Fault

SCG68-09 Room:502 Time:April 30 11:15-11:30



SCG68-10 Room:502 Time:April 30 11:30-11:45

Structure and evolution of the lower crust constrained from alkaline basalts and xenoliths in southwest Japan

IGATA, Eri[1*] ; OMORI, Soichi[2] ; IWAMORI, Hikaru[3]

[1]Department of Earth and Planetary Sciences, Tokyo institute of technology, [2]The open university of Japan, [3]Japan Agency for Marine-Earth and Technology

The continental crust is unique to the Earth and, in spite of its small mass, is geochemically an important reservoir, concentrating about half of the radiogenic heat producing elements. In order to understand the differentiation history of the Earth, it is essential to decipher how and when the continental crust has been formed.

In contrast to the upper continental crust, which has been well surveyed with direct means, the lower continental crust is largely unknown in terms of composition, mineralogy and age distribution of formation. In this study, we investigate the xenoliths that have been derived possibly from the lower crust, in terms of petrology (mineral assemblages and their composition, modal abundances and bulk composition) and geochronology (zircon U-Pb age dating of both the xenoliths and the host basalt). Study area is located on the Kibi Plateau in southwest Japan. The xenoliths are classified into 4 types by petrography and EPMA analysis; Type 1, pyroxenite; Type 2, eclogitic gabbro; Type 3, anorthosite: Type 4, kyanite/garnet-bearing felsic granulite. Pseudosection and mineral stability analyses were performed by a thermodynamic program "Perplex". These analyses have revealed that pyroxenite is stable beneath the Moho and its seismic velocity estimated from pseudosection ranges from 7.23 to 7.65 km/s. Therefore pyroxenite corresponds to the olivine-pyroxenite layer under the Moho. Gabbro was formed at 8-10 kbar and 873-940 K and its velocity is higher than pyroxenite. Granulite is stable at 7.5- kbar and about 1000 K and its velocity is very low. In spite of the density gap between the eclogitic gabbro and granulite (3900 and 2740 kg/m^3), the analysis suggests that the felsic granulite exhibits a higher equilibration pressure and may even underlay the eclogitic gabbro. Moreover, composition of the lower crust becomes more felsic than previously thought.

Ages of the eclogitic gabbro xenolith and the host basalt coincide, showing 70 Ma. It is argued that the subducted sediments (now appear as felsic granulites) were subdcuted and underplated to the bottom of the lower crust during the last 30 million years or so. If such a mechanism operates worldwide, then the continental crust may have an intermediate to felsic composition even without a hypothetical process of lower crustal delimitation.

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SCG68-11 Room:502 Time:April 30 11:45-12:00

Three-dimensional seismic velocity structure beneath East Asia using adjoint tomography

MIYOSHI, Takayuki[1*] ; OBAYASHI, Masayuki[1] ; TONO, Yoko[1] ; TSUBOI, Seiji[1]

[1]JAMSTEC

East Asia is the complicated region where tectonic plates meet. In many studies, travel-time tomography based on ray theory has clarified three-dimensional (3D) velocity structure of the Earth. On the other hand, the recent studies show waveform inversion based on wave theory can construct realistic 3D structure (e.g. Obayashi et al., 2010 SSJ; Miyoshi et al., 2013 SSJ). In the present study, we have inferred 3D heterogeneous structure precisely beneath the eastern Asia region by using adjoint tomography method. We selected 161 earthquakes (M $>$5.5, half duration $<$5 second) occurred in the region based on Global CMT catalog. Displacement seismograms used in this study were recorded at broadband seismic stations in the region. The average number of stations used in inversion is about 180. Theoretical waveforms were calculated using the spectral-element method (Komatitsch and Tromp, 2001). We used GAP-P2 mantle tomography model (Obayashi et al., 2009) as an initial 3D model of inversion. Both observed and theoretical waveforms were filtered between 12.5 and 100 second to extract time windows of P- and S-waves, and between 30 and 150 second to extract time windows of surface waves. We applied adjoint method (Liu and Tromp, 2006) for calculating the misfit kernel, which is related to velocities, and performed inversion by using the steepest descent method. The parallel computing of theoretical waveforms and misfit kernels were used 256 CPU cores of supercomputers, such as K computer at Riken. The computing time was required 0.1 million CPU hours in each iteration. We have iterated four times on inversion. The VR value was improved about 10% by using the revised model. The Vp and Vs of improved model showed a few percent slower than the initial model. The ratios of the velocity perturbation show slightly large value than the initial model at a depth of 100 km in a wide area of the eastern Asia region. Acknowledgements: We used F-net seismograms of the National Research Institute for Earth Science and Disaster Prevention. This study was supported by the strategic Programs for Innovative Research ”Field 3” Advanced prediction Researches for Natural Disaster Prevention and Reduction.

Keywords: adjoint method, tomography, velocity structure, East Asia

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Seismological evidence for a transition from ”hydrous” oceanic crust to typical oceanic crust in the Lau back-arc basin

ARAI, Ryuta[1*] ; DUNN, Robert[1]

[1]University of Hawaii

The Lau back-arc basin, associated with subduction of the Pacific plate beneath the Indo-Australian plate at the Tonga Trench, provides a superb study area to understand the interaction between plate subduction and back-arc spreading: Subducting oceanic lithosphere induces mantle corner flow within the mantle wedge above the subducting plate and releases a large amount of water and other elements into this wedge, producing heterogeneous chemical compositions and fluid gradients beneath the back-arc basin. While petrological studies suggest that the heterogeneity in the mantle source composition, mainly caused by slab-derived fluids, plays an important role for melt supply to the back-arc ridges, variations in thickness and internal structure of crust formed along back-arc ridges are poorly documented. On the basis of seismic tomography analyses, we present a structural model of crust formed along the Eastern Lau Spreading Center within the Lau back-arc basin as evidence for a transition from a “ hydrous ” type of oceanic crust to a more typical oceanic crust. The seismic data indicate that as the back-arc spreading center moved away from the active arc, the crust thinned from 8-9 km to ˜7 km, the lower crust changed from high P wave velocity values (7.2-7.4 km/s) to typical values for oceanic crust (7.0-7.2 km/s), and the upper-crustal volcanic layer changed from a thick low-velocity layer to a thinner layer with more typical wave speeds. The seismic results, in combination with other geophysical and geochemical data, suggest that crustal formation along the ELSC is strongly controlled by the influence of slab water: When a spreading center is near the active arc, water from the downgoing slab is entrained in the melting zone beneath the back-arc ridges where it enhances melting. Thereafter, the water enhances crustal differentiation within sub-ridge magma chambers. This creates an anomalous “ hydrous ” form of oceanic crust with a thick felsic volcanic layer and a mafic/ultramafic lower crust - features that are not typically observed in crust formed at mid-ocean ridges. The Lau basin has a zoned structure with an abrupt transition from this type of oceanic crust to more typical oceanic crust, which resulted from a rapid change in the influence of slab water as the ridge moved away from the arc. The unique geodynamic setting of the Lau basin, such as proximity of the back-arc ridges to the volcanic arc (<100 km), the relatively low subduction angle of the slab (˜45 degrees), and the fast subduction rate at the Tonga trench (>20 cm/yr), probably operate to effectively deliver slab-derived water far beyond the volcanic arc to the back-arc ridges and produce this “ hydrous ” oceanic crust in the back-arc basin. The abundance and high rate of production of the “ hydrous ” crust suggests that such crust may make up a significant proportion of the arc-like crust that forms continents.

Keywords: Back-arc basin, Crustal differentiation, Oceanic crust, Slab water, Seismic tomography, Eastern Lau Spreading Center