Fundamental structure model of island arcs and subducted plates in and around Japan -II

*Takaya Iwasaki[1], Hiroshi Sato[1], Masanao Shinohara[1], Tatsuya Ishiyama[1], Akinori Hashima[1], Makoto Matsubara[2], Yumi Amemiya[3]

1. ERI, the University of Tokyo, 2. NIED, 3. OHTI

The eastern margin of the Asian continent is under complicated tectonic environment, dominated by subduction and collision of the Pacific (PAC), Philippine Sea (PHS) and Eurasia (EU) plates. Crustal activities in and around the Japanese Islands, which have a wider range spatial extent with different time scale, are dominated by strong interplate interactions. The 2011 Tohoku earthquake (M=9.0) produced a large amount of coseismic and post-seismic crustal deformations and remarkable changes in seismic activity in in broader region of easternmost Asia, providing good opportunities to study response of trench-arc system due to a mega thrust earthquake on the plate boundary. Quantitative understanding for such phenomena requires to develop fundamental structure models including plate boundaries and crust and uppermantle structures from the fore- to back-arc provinces. This paper presents results of our research aiming to construct key items for fundamental structure models for island arcs, namely, (1) topography, (2) plate geometry, (3) fault models, (4) the Moho and brittle-ductile transition zone, (5) the lithosphere-asthenosphere boundary, and (6) petrological/ rheological models.
Our modelling area is set 12°-54° N and 118°-164° E to cover almost the entire part of Japanese Islands together with Kuril, Ryukyu and Izu-Bonin trenches. Geometry of the subducted Pacific and PHS plates are modelled through the two steps. In the first step, we constructed "base" models, which have rather smooth surfaces in our whole model area, from earthquake catalogues provided by JMA, USGS and ISC. As the second step, regional plate configuration with shorter wave-length (<50-100 km) is constrained particularly in the vicinity of Japan from recent results by seismic tomography, RF analysis and active source experiment. Our analysis indicates that the plate boundaries in the regional models are systematically shallower than those from the base models in a depth range of 10-50 km. This probably indicates that the regional models represent the structural boundary of the subducted plate, while the base models its mechanical boundary. In the Kanto area, the geometry of the PHS plate is very complicated due to the existence of the triple junction and the collision of Izu-Bonnin arc to the EU plate. We defined the plate geometry of the PHS plate from results of active seismic experiments and seismic tomography studies as well as natural earthquake observation (Sato et al., 2005; Nakajima & Hasegawa, 2007; Hirose et al., 2008a,b, Nakajima et al., 2009, Sato, 2009, Uchida et al., 2010). The northern margin of the PHS plate under the NE Japan arc west of the Japan trench is based on the result by Uchida et al. (2010), which is almost consistent with the southern end of aftershock distribution and major aftershock fault of the 2011 Tohoku earthquake.
So far, detailed Moho structure was presented by several authors (Zhao et al., 1994; Shiomi et al., 2009; Katsumata, 2010; Igarashi et al., 2011; Matsubara et al., 2016). We intends to combine these results with global crust model (crust 1.1, Laske et al. 2013), to generate Moho depth models for EU, PHS and PAC plate in our model region. We are newly developing software packages necessary for this work. As an example, the Moho model by Katsumata (2010) beneath the Japanese islands is extended to the surrounding region using crust 1.1 model. For the PAC and PHS plates, the Moho depths beneath the subducted oceanic crust are assumed from our plate boundary model, which are merged to those beneath the oceanic basin. These models are still tentative, and should be revised by incorporating structural information from active source experiments.

Keywords: island arc, plate boundary, Moho, fundamental structure, active margin, subduction zone

Crust and uppermost mantle structure of the Japanese Islands inferred from receiver function analysis

*Toshihiro Igarashi[1], Takashi Iidaka[1]

1. Earthquake Research Institute, University of Tokyo

Recent travel time inversion analyses have elucidated crust and mantle structures of whole areas in the Japanese Islands. However, they estimated only spatial changes with relatively long wavelength, and it was difficult to extract clear velocity discontinuities. Also, the resolution of their S-wave velocity structures near the ground surface was insufficient than that of P-wave velocities. Therefore, the spatial distributions of the crustal velocity discontinuities and the Moho depths are poorly understood. In this study, we show the crust and uppermost mantle velocity structures and the velocity discontinuities beneath the Japanese Islands from receiver function analyses.

We improved an estimation method of crustal velocity structure beneath each seismic station by Igarashi et al. [2011]. This method searches the best-correlated receiver function between observed one calculated from teleseismic seismograms and synthetic one based on assumed crustal velocity structure by using a grid search method. We constructed velocity structures which consist of a sediment layer, one to three crustal layers and two upper mantle layers. They cover both the crustal velocity structures and Moho depths of the Japanese Islands estimated by previous researchers. We use seismic stations installed by the National Research Institute for Earth Science and Disaster Resilience, the Japan Meteorological Agency and Earthquake Research Institute, the University of Tokyo. We selected the 13,736 teleseismic events, which have the epicentral distance between 30° and 90°, magnitude greater than 4.5, and occurred in the period from September 1989 to February 2016.

The estimated crustal structure is characterized by areas with low-velocity layers. In several plains and basins, we identify a thick sediment layer. The surrounding areas of active volcanoes correspond to the low-velocity zones in the crust. The Itoigawa-Shizuoka Tectonic Line seems to a border of crustal velocity structure. The southwestern side has the relatively stable high-velocity areas, whereas the northeastern side is heterogeneous spatially. In the lower crust, low-velocity structures are distributed in the eastern part of the Niigata-Kobe Tectonic Line and some part of the Median Tectonic Line. There are low-velocity zones around the Moho discontinuity along the middle part of the island arc. The crustal thickness tends to increase in mountain regions and decrease toward the surrounding areas with some undulations. The Moho discontinuity of the subducting Philippine Sea plate has distinct velocity change near the southern coastline of the Japanese Islands, and the velocity contrast is larger than that of the overriding plate. We suggest that S-wave velocity transition layers exist in the uppermost mantle just beneath the Moho discontinuity in broad areas of the Japanese Islands. The transition layers probably indicate crustal evolution or melting around the Moho discontinuity of the island arc.

Difference in erupted magma volume inferred from the crustal density structures of the Izu-Bonin-Mariana arc and the northeast Honshu arc

*Kenta Mishiro[1], Yoshiyuki Tatsumi[2], Katsuya Kaneko[1]

1. Graduate School of Science, Kobe University, 2. Kobe Ocean-Bottom Exploration Center

Volcanic activities in the Izu-Bonin-Mariana (IBM) arc and the northeast Honshu arc are caused by subduction of the Pacific plate. Because these arcs are similar features (e.g., subduction rates and linear density of active volcanoes), it is inferred that magma generation rates in both the arcs are similar. Nevertheless, erupted magma volume at the IBM arc (10.22 km^3/km) is much larger than that at the northeast Honshu arc (1.80 km^3/km). Moreover, major composition of magma erupted at the IBM arc is basaltic while that at the northeast Honshu arc is andesitic. In this study, we try to explain these differences between the two arcs on the basis of crustal structures of the two arcs.

The IBM arc is the juvenile oceanic arc and the crustal thickness is about 25 km. Inferred from P-wave velocity, the rhyolitic crust is located at 0-5 km depth, the andesitic crust is located at 5-11 km depth and the basaltic crust is located at 11-25 km depth in the IBM arc (Takahashi et al., 2008). The northeast Honshu arc is the mature continental arc and the crustal thickness is about 35 km. Inferred from P-wave velocity, the rhyolitic crust is located at 0-5 km depth, the andesitic crust is located at 5-25 km depth and the basaltic crust is located at 25-35 km depth in the northeast Honshu arc (Iwasaki et al., 2001).

Mineral assemblages, P-wave velocity structure and density structure of these crusts are estimated by using Perple_X (Connolly, 2005). First, we estimate compositional structures of the crusts which reproduce observed P-wave velocity structure of the crusts (Takahashi et al., 2008; Iwasaki et al., 2001), then evaluate density structures of the crusts. The estimated density structure of the IBM arc is about 2800 kg/m^3 in the middle crust and 3100-3200 kg/m^3 in the lower crust while that of the northeast Honshu arc is about 2750-2900 kg/m^3 in the middle crust and 3150-3200 kg/m^3 in the lower crust.

An ascending magma forms a magma chamber at a level with neutral buoyancy. Assuming that the ascending magma is a mantle-derived primary basalt magma with 1.65 wt% H_2O and 20 % crystals by crystallization, the density comparison between the crusts and the ascending magma indicate that the depth of the magma chamber is less than 5 km for the IBM arc and 14-21 km for the northeast Honshu arc.

For eruption of the magma in the chamber, the magma needs water saturation by crystallization and foaming. Because the magma chambers at the IBM arc is shallower and has lower water solubility than at the northeast Honshu arc. Based on experimental results by Williams and McBirney (1979), the magma is saturated in water by about 50 % differentiation for the IBM arc while about 80 % for the northeast Honshu arc, suggesting that eruptable magmas are 50 % and 20 % of the ascending magma for the IBM and the northeast Honshu arcs, respectively. In addition, the magma by 50 % differentiation is basaltic while by 80 % differentiation is andesitic (Tatsumi and Suzuki, 2009). Namely, these simultaneously explain the two differences between the IBM and the northeast Honshu arcs, the erupted magma volume and composition.

We conclude that the crustal density structure is one of important factors governing volcanic activity in arcs.

Keywords: erupted magma volume, crustal structure, IBM arc, northeast Honshu arc

Structural Features around the LFT Zone beneath Western Shikoku based on Converted *Ps* amplitude variations

*Katsuhiko Shiomi[1]

1. National Research Institute for Earth Science and Disaster Resilience

Low-frequency tremors (LFTs) in the Nankai region southwest Japan are actively distributed along the down-dip limit of the recurrent megathrust source regions. This fact implies that the LFT activities might be strongly related to stress changes in the source regions along the Philippine Sea plate. To understand the mechanisms of LFTs, knowledge about the structural features both inside and outside of the LFT active zone is important. In this study, we investigated variation of converted *P*-to-*S* (*Ps*) phase amplitude from receiver functions (RFs) along the subducting oceanic Moho. Teleseismograms recorded at the NIED Hi-net and F-net seismic stations were used. Since converted phase amplitude depends on its ray parameter, we selected earthquakes with ray parameter range from 0.050 to 0.077, and applied amplitude correction coefficients. We read converted *Ps* amplitudes of RFs with reference to the previous studies [e.g. Shiomi *et al.*, 2008; 2015]. Since the selected events were not uniformly distributed in back azimuth (BAZ, θ), we calculated an average and its standard deviation for each 5-degree bin. Then, we fit a simple function constructed with $\sin\theta$, $\sin2\theta$ and bias component to the data with the least square fitting algorithm. The bias components, named 'standard amplitude' by Shiomi and Park [2009], gradually decayed as the oceanic Moho becomes deep. As the slab's dip angle beneath western Shikoku is almost constant, this feature reflects a gradual phase transition from amphibolite to eclogite with water release in the oceanic crust. At almost all stations, $\sin\theta$ component is dominated. This component corresponds to the contribution from the dipping interface mainly, and the estimated plunge azimuth (305±10deg) is consistent with the previous models. On the other hand, at the several stations located at the northern edge of the active LFT zone, 4-lobed backazimuthal distribution was dominant. This means that the oceanic crust beneath the down-dip edge of the LFT zone becomes anisotropic caused by the phase transition. Our observation implies that water dehydrated from the oceanic crust rises to the inter-plates, and the LFTs become active.

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Keywords: Low-frequency tremor, Ps converted phase, Philippine Sea plate

Seismic reflector above the non-volcanic tremor along the Philippine Sea Plate

*Takashi Iidaka[1], Toshihiro Igarashi[1], Takaya Iwasaki[1]

1. Earthquake Research Institute, University of Tokyo

The Philippine Sea plate is subducting beneath the southwestern Japan. Many studies have been done in this area. One of the interesting phenomena at the subduction zone is non-volcanic tremor occurs at the plate boundary (Obara, 2002). Many large earthquakes have occurred at the Nankai Trough region. To know the seismic structure, several seismic explorations using artificial sources have been done at the region. The configuration of the Philippine Sea plate and P-wave structure were estimated by the seismic experiments (e.g, Kodaira et al., 2002; Iidaka et al., 2004; Iwasaki et al., 2016). Igarashi and Iidaka (2017) studied that receiver function analyses to estimate the plate boundary of the Philippine Sea slab and S-wave velocity structure in the crust and uppermost mantle beneath the Japanese Islands. The S-wave velocity structures were estimated using a grid search method between the observed receiver function and synthetic calculation. The P-wave and S-wave seismic structures are compared with the source area of non-volcanic tremor.
It is remarkable characteristic of the seismic experiments in this region that the clear reflected wave around the plate boundary was detected. The clear reflected wave was explained as a reflected wave at the top of the extremely low-velocity layer, which was located at the top of the subducting Philippine Sea slab (e.g, Kodaira et al., 2002; Iidaka et al., 2004). The P-wave velocity values of the thin layer were 3 km/s and 2 km/s in the Nankai and Tokai regions, respectively (Kodaira et al., 2002; Iidaka et al 2004). Similar strong reflector was also detected at the eastern part of the Kii Peninsula (Iwasaki et al., 2016). The locations of the strong reflectors are compared with the source area of the non-volcanic tremor. In the Nankai region, the depth of the reflector was located at 10 km –30 km (Kodaira et al., 2002). The source area of the tremor is located at the deepest part of the low velocity layer. In the Tokai region, the extremely low velocity layer is located just above the source area of the tremor. Iwasaki et al. (2016) also reported that the strong reflector was located just above the source area of the tremor in the eastern part of the Kii peninsula. At the three areas, the strong reflector was located above the source area of tremor. The seismic structure of the S-wave structure at the tremor area was characterized to be high-velocity mantle wedge and low-velocity oceanic crust (Igarashi and Iidaka, 2017). It is expected that the low velocity layer seems to be related to the dehydration of the oceanic crust.
The non-volcanic tremor had been reported at many subduction zones. Song et al. (2009) reported the ultra low velocity layer in the Mexico subduction zone. The ultra low velocity layer is located at top of the slab. The low velocity layer is located in shallower than tremor area. The extremely low-velocity layer has been reported at several subduction zones. The research of the characteristics of the low-velocity layer is very important to know the source of the non-volcanic tremor.

Keywords: plate boundary, reflector, non-volcanic tremor

Seismic structure beneath Ryukyu arc, Japan, inferred from S-wavevector receiver functions

*Takumi Murakoshi[1], Hiroshi Takenaka[2], Masanao Komatsu[2], Nobuyuki Yamada[3]

1. National Defense Academy, 2. Okayama University, 3. University of Teacher Education Fukuoka

This study describes the seismic images of the crust and uppermost mantle beneath the Ryukyu arc, Japan by using S-wavevector receiver function (SWV-RF) analysis at virtual subsurface receivers. The SWV-RF has a great advantage that the problem of unclearly seismic images beneath very thick sedimentary basin due to the records include strong effect of reverberation within the sedimentary layer can be overcome (Takenaka and Murakoshi, 2010, AGU). In this study, we applied the SWV-RFs from broadband seismic records of the F-net (NIED) and ETOS (JMA) to obtain the seismic images of Moho and subducted Philippine Sea plate beneath the Ryukyu arc, Japan. In this presentation, we will show the estimated seismic structure beneath the Ryukyu arc, which is derived from the depth-converted SWV-RFs.

Acknowledgement: We have used F-net data (NIED), ETOS data (JMA) and deep subsurface structure model by J-SHIS (NIED).

Keywords: reciever function, Ryukyu arc, crustal structure

Crustal structure in the margin of the Japan Sea back-arc basin off Hyogo to Tottori deduced from the seismic survey

*Takeshi Sato[1], Tetsuo No[1], Seiichi Miura[1], Shuichi Kodaira[1]

1. Research and Development Center for Earthquake and Tsunami, Japan Agency for Marine-Earth Science and Technology

The Japan Sea is one of back-arc basins in the northwestern Pacific. It has been inferred from geophysical, geological, and petrological data that the back-arc opening of the Japan Sea was taken from the Early Oligocene to the Middle Miocene (e.g., Kano et al., 2007). After 3.5 Ma, in the eastern and southwestern margin of the sea, the crustal shortening occurred by a strong compression (e.g., Sato, 1994, Itoh et al., 1997). Therefore, in these regions, deformation zone such as fault-fold belts have developed because of the extension associated with the opening and shortening, and the destructive earthquakes occurred (e.g., Okamura et al., 2007). Recent results of seismic surveys in the eastern margin of this Sea revealed that the crustal structure formed by the back-arc opening had a connection with the distribution of this deformation zone (e.g., No et al., 2014). This show that it is necessary to clarify the back-arc opening process in order to the understand deformation process including active faults and folds. Even though the southern margin of the Japan Sea is interpreted as the region of the complex formation process (e.g., Jolivet and Tamaki, 1992), we have little information of the detailed opening and deformation processes in this margin because of a lack of the crustal structure. To obtain the structure and this information, we conducted the active-source seismic survey using ocean bottom seismographs (OBSs) and multi-channel streamer (MCS) in this margin from the Yamato back-arc basin to the coastal area of the southwestern Japan arc off Hyogo to Tottori in 2016. The seismic survey using 50 OBSs, a tuned air-gun array (7,800 cu. inch) and MCS system was conducted from the coastal area off Hyogo, Oki Trough, Oki Ridge, Yamato Basin to the Kita-Oki Bank. This survey line has about 225 km length. The MCS survey was also conducted in this margin off Tottori. The survey line of this MCS survey is same as the line by Sato et al. (2006). In 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. Also, the MCS profile clearly images the sedimentary layer and the undulations of the basement.

The Oki Ridge has about 23 km of the crustal thickness. The upper part of the crust with P-wave velocity of 5.4-6.2 km/s corresponding to the continental upper crust has about 10 km. This shows that the Oki Ridge may have the character of the continental crust. On the other hand, the crustal thickness and the distribution of P-wave velocity in the Yamato Basin differs from that in the Oki Ridge. The upper part to middle part of the crust from the Oki Trough to the coastal area has a large lateral variation.

Keywords: Crustal structure, Japan Sea, arc-back-arc basin

Seismic image across the epicentral area of 2016 Tottoriken-chubu earthquake to the southern part of Yamato basin

*Hiroshi Sato[1], Tatsuya Ishiyama[1], Naoko Kato[1], Shigeru Toda[2], Shinji Kawasaki[3], Susumu Abe[4], Akira Fujiwara[3], Tanaka Yasuhisa[3], Johan S Claringbould[1], Anne D Van Horne[1]

1. Earthquake Prediction Research Center, Earthquake Research Institute, The University of Tokyo, 2. Aichi University of Education, 3. Japex Geosicence Institute, 4. Japan Petroleum Expolaration Co., Ltd.

Due to stress buildup by the upcoming Nankai Trough megathrust earthquake, SW Japan has been in seismically active period for last 20 years. In terms of the mitigation of earthquake and tsunami hazards, to construct seismogenic source fault models is first step for evaluating the strong ground motions and height of tsunamis. Since 2013, we performed intense seismic profiling in and around the southern part of the Sea of Japan to construct source fault models. In 2016, a180-km-long onshore –offshore seismic survey was carried out across the volcanic arc and back-arc basins (from Kurayoshi to the Yamato basin). Onshore section, CMP seismic reflection data were collected using four vibroseis trucks and fixed 1150 channel recorders. Offshore part we acquired the seismic reflection data using 1950 cu inch air-guns towing a 4-km-long streamer cable. We performed CMP reflection and refraction tomography analysis. Obtained seismic section portrays compressively deformed rifted continental crust and undeformed oceanic backarc basin, reflecting the rheological features. These basic structures were formed during the opening of the Sea of Japan in early Miocene. The sub-horizontal Pliocene sediments unconformably cover the folded Miocene sediments. The opening and clock-wise rotation of SW Japan has been terminated at 15 Ma and contacted to the young Shikoku basin along the Nankai trough. Northward motion of Philippine Sea plate (PHS) and the high thermal regime in the Shikoku basin produced the strong resistance along the Nankai trough. The main shortening deformation observed in the seismic section has been formed this tectonic event. After the initiation of the subduction along the Nankai trough, the rate of shortening deformation was decreased and the folded strata were covered by sub-horizontal Pliocene sediments. The amount of shortening is largest in the inverted half-grabens located near the coast of Honshu island. The thrusting trending parallel to the arc has been continued from Pliocene to early Pleistocene along the limited fault system. The change in the direction of the motion of PHS at 1 Ma produced major change in stress regime from NS compression to EW compression in the back-arc. Following the change of stress regime, former reverse faults reactivated as strike-slip fault. Reuse of pre-existing faults are common, and crustal deformation concentrates relatively narrow zone in the back-arc failed rifts. Two-months after from our survey, Mw 6.2 Tottoriken-chubu earthquake occurred just beneath the onshore part of the seismic line. The source fault corresponds to the boundary of abrupt change in P-wave velocity, however there were no surface ruptures and distinctive geologic faults. The bottom of seismogenic layer corresponds to TWT 4.5 sec., which is almost the top horizon of reflective middle crust.

Keywords: 2016 Tottori-ken Chubu earthquake, Crustal structure, Seismic reflection profile, Opening of the Sea of Japan

Earthquake source fault model for Kanto area based on seismic reflection profiling and geologic data

*Tatsuya Ishiyama[1], Hiroshi Sato[1], Naoko Kato[1], Susumu Abe[2]

1. Earthquake Research Institute, University of Tokyo, 2. Japan Petroleum Exploration Co., Ltd.

We present a new earthquake fault model for the Kanto region including Tokyo metropolitan area, based on interpretation of the seismic reflection data coupled with geologic data including surface geology and borehole stratigraphy. The Tokyo metropolitan area, underlain by Neogene and Quaternary sediments more than 5 km thick, is currently deformed by blind thrusts that could generate hazardous earthquakes. Deep seismic reflection profiles indicate that newly identified, steeply dipping blind thrusts are reactivated normal faults originally formed by middle Miocene extensional tectonics. Despite very slow (less than 0.1 mm/yr) late Quaternary slip rates, our work suggests the presence of prev, iously unrecognized faults that pose more seismic hazards to Tokyoand urges more intense efforts to shed more light on the recent slip rates, magnitude and recurrence of the past earthquakes on them.

Fault geometry on Miura-hanto fault group revealed by an integrated seismic profile using various resolution seismic reflection data

Hidefumi Tanoguchi[1], *Shintaro Abe[2], Noriko Tsumura[1], Hiroshi Mori[3], Ryoyu Arai[4], Yasuhira Aoyagi[5]

1. Chiba University, 2. AIST, Geological Survey of Japan Research Institute of Earthquake and Volcano Geology, 3. Shinshu University, 4. Kawasaki Geological Engineering Co.Ltd, 5. Central Research Institute of Electric Power Industry

To evaluate how intraplate earthquakes affect the deformation of the surface layer and growth of active faults, it is important to elucidate the continuity of the faults from seismogenic layer to the shallow part. Around the Miura-hanto fault group (MHFG) targeted in this study, several seismic reflection surveys were conducted to clarify fault geometries and those activities. Further long seismic survey line was set crossing at high angle with the trend of the MHFG from Sagami bay to Tokyo bay to reveal the geometry of the Philippine Sea plate’ s upper surface.
Since spatial resolutions of these surveys arranged from several centimeter to several hundred meter order, it makes us possible to discuss a detailed fault geometry of MHFG from the sea bottom to the depth of the PHS plate boundary by creating integrated profile.
This integrated profile shows that Takeyama fault and Kitatake fault continue from the shallow part to the deep part with their dip loosening. If these faults are extended with their tilts as they are, they seem to merge into an interface derived from the Philippine Sea Plate (PSP). In other words, the MPFG may change those dip angles from steep to gentle as increasing depth and it may be branch faults from the PSP which continues to the deeper part.
In order to understand earthquakes which are expected to occur at the MHFG, we checked a velocity structure around the faults and examined a spatial relationship between it and distribution of local earthquakes’ hypocenters. Then we found that very few earthquakes were observed at the depths between surface and 10km along the estimated faults where P wave velocities show approximately 5km, while most of local earthquakes occurred in the depth deeper than 10km. In the source region of another intraplate earthquake such as Iwate-Miyagi earthquake, Okada et al, (2012) estimated a P wave velocity structure and revealed that the aftershocks are concentrated within the region of Vp>6km/s. Their results might indicate that such part of the faults can radiate the usual seismic waves. Therefore, the shallower part of MHFG down to the depth pf 10 to 15km, accompanied with the displacement at the source region, may deform without generating string ground motion.

Keywords: Miura-hanto fault group, Active fault, Seismic reflection survey

Fault Distribution and Structural Characteristic in the northern Nansei-Shoto Islands, Japan

*Rei Arai[1], Shoshiro Shimizu[1], Nobuaki Sato[1], Minako Katsuyama[1], Goro Ando[1], Narumi Takahashi[1], Shigeyoshi Tanaka[1], Yoshiyuki Kaneda[2]

1. Japan Agency for Marine-Earth Science and Technology, 2. Kagawa University

The Nansei-Shoto Islands, located along the Ryukyu Trench which extends over 1,200 km from Kyushu, Japan to the Taiwan collision zone, had experienced less seismic history in comparison to the other subduction zone such as the Nankai Trough and the Japan Trench.
Over the past few hundred years, there were a dozen of M7+ class earthquakes had occurred within this subduction zone, and the most of them caused miner damages except the 1771 Great Yaeyama Tsunami and the 1911 Kikai Island Earthquake, the largest historic earthquake observed along the Nansei-Shoto subduction zone. Due to a large percentage of the population of an island lives in coastal region, earthquake generated tsunami is the most life threatening factor. Through decades, various studies had been done identifying offshore faults which could possibly cause an earthquake and tsunami.
In this project, as a part of "the Comprehensive evaluation of offshore fault information project" by the Ministry of Education, Culture, Sports, Science and Technology, JAMSTEC has carried out collecting seismic reflection data from various institutes and private companies combined with reflection/refraction data from JAMSTEC seismic projects. Also in order to obtain unifying high resolution seismic profile out of seismic data from different survey ages and various survey specifications, the original data were reprocessed by state-of-the-art data processing methods which capable of interpreting subsurface structures and fault morphology.
The forearc structure of the northern Nansei-Shoto subduction zone is very different to the southern subduction zone. In the southern subduction zone, the Philippine Sea plate subducts beneath the steep slope continental shelf with minimum volume of accretionary prism, while in the northern subduction zone, the extensive accretionary prism has been developed in front of the continental shelf. The factor of the difference is likely the amount of sediment supply from the incoming oceanic plate. Also the incoming oceanic plate shows a complicated morphology of ridges, sea mounts such as Amami Plateau and Kikai Sea Mount, and its high relief feature probably cause the complex faulting in the accretionary prism (Kasahara and Sato, 1997).
At the margin of the northern Okinawa Trough, there are numbers of normal faults develop in the thick continental shelf sediments, which exhibits the Trough increases its depth gradually without distinctive edges seen in the southern Okinawa Trough. Faults identified in the northern Okinawa Trough are classified into two types; normal faults resulted from the present trough's growing tectonics, and at the southwestern offshore of Kyushu where NW-SE extensional tectonics fields dominates, lateral transforming faults are identified which presumably continuous from Kyushu region.

Keywords: offshore fault, seismic reflection survey, Ryukyu Trench, Okinawa Trough

Seismic Reflection Survey at Niitsuru Aizumisato Fukushima

*Shinobu Ito[1], Sawako Kinoshita[1], Kazuo Yamaguchi[1], Youhei Uchida[1], Takeshi Ishihara[1]

1. Geological Survey of Japan, AIST

We have tried to understand geological structure in Aizu Basin for utilization of geothermal energy. We conducted boring survey at Niitsuru area, Aizumisato in the 2016 fiscal year. Niitsuru area is where the Sagase River runs on an alluvial fan from southwest, turns toward southeast, and run together with the Miyakawa from south to north. The surface trace of the West Aizu Basin Fault Zone shows mainly NS direction, but the trace to the south of Niitsuru area shifts toward west to the north of Niitsuru area. The main trend of geological structure in Aizu Basin is NS direction, but the geological structure in Niitsuru area is relatively more complex. The boring survey is effective to understand geological structure. However, it is important to understand not only boring data but also spatial extent of geological structure. Seismic reflection survey is one of the most effective tools.

Fukushima Prefecture conducted seismic reflection survey at Yonezawa, on the south of Niitsuru area. The strike direction of the West Aizu Basin Fault at Yonezawa is almost NS. It is easy to conduct seismic reflection survey because some roads lead straightly east to west. On the other hand, a prefectural road and a railway (JR Tadami Line) block roads east to west at around the borehole in Niitsuru main area. Moreover, it is difficult to deploy a telemetry seismic recording system over railways without bridges. Therefore, we designed seismic reflection survey along three EW survey lines to the south of the borehole.

The survey was conducted from September 5 to 16 in 2016. The Aizumisato Niitsuru 1 Survey Line (AMN1) is deployed near the borehole, and the length of the line is about 440m. Whole survey line of AMN1 is located east of the railway, and we used only telemetry system. The Aizumisato Niitsuru 2 Survey Line (AMN2) is located about 500m south to the AMN1, and the length of the survey line is about 520m. We deployed both telemetry system and self-recording system because the survey line crosses the railway. The west end of the survey line is the prefecture road 59. The Aizumisato Niitsuru 3 Survey Line (AMN3) is located about 200m south to the AMN2. The survey line crosses the prefecture road the prefecture road 59. West of the road 59 is a paved road, but east is a dirt road. The length both of the west and the east is about 100m, and we fixed a deployment of the telemetry system. The sampling interval for AMN2 with both telemetry and self-recording system is 1ms, but that for AMN1 and AMN3 with only telemetry system is 0.5ms. We used horizontal single component geophones with GS32CT (f_o =10Hz). We also used a transportable vibrator system. Sweep frequency of the vibrator is 20 to 160Hz, sweep duration is 7s, and recording duration before cross correlation is 8s. Spatial intervals of both sweep points and recording points are 2ms, number of recording channels is 96, and sweep count at each sweep point is 5 to 10 corresponding to offset length.

We confirmed good shot records for telemetry system. On the other hand, it is impossible to see shot records for self-recording system without some processing. After the survey, we also confirmed shot records for self-recording system with telemetry system. We are going to apply seismic processing to these records.

Keywords: West Aizu Basin Fault Zone, seismic reflection survey

