Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SEM037-01 Room:301B Time:May 26 10:45-11:00

On the electrical conductivity structure beneath the back arc region of SW Japan based on both land and seafloor data

Takuto Minami[1*], Hiroaki TOH[1], Takafumi Kasaya[2], Masashi Shimoizumi[3], Naoto Oshiman[4]

[1]Graduate School of Science, Kyoto Univ., [2]JAMSTEC, [3]Kyushu Polytechnic College, [4]Disaster Prevention Research Institute

The back-arc region of southwest Japan is an area of high seismicity. In this region, it has been pointed out that the subducting Philippine Sea plate affects the seismic and volcanic activities in that region. However, the precise relation has not been revealed yet. It is because the subsurface structure near the coastline area is actually difficult to infer precisely using the land observation data alone. Taking this into consideration, an EM research group, including Kyoto University and Tottori University, started the seafloor observation off the San-in region. Now, seafloor EM data have been obtained at 10 sites in total. However, there are not avalable 2-D or 3-D inversion codes for use near the coastline with adeguate ability to describe precise bathymetry. For example, Ogawa and Uchida (1996)'s 2-D inversion code, which is a finite element method (FEM) code often used to delineate conductivity structures beneath, is limited for rectangular elements to describe the bathymetry near coastlines. In our study, we adopted Utada (1987)'s FEM forward code because it adopts triangular elements which can readily express the arbitrary inclinations of the bathymetry in concern. We further improved it to achieve the accuracy in discription of bathymetry as well as the theoretical responses for both land and seafloor sites. The improvements are as follows:

1. We adopted the differentiation method of Li et al. (2008) to calculate more precise responses.
2. We improved the code so that we can use electric and magnetic fields that are observed at different sites.
3. We developed a code which generates the numerical mesh which precisely express the bathymetry near coastline by triangular elements.

To examine the accuracy of the improved code, we compared the responses calculated by the new code with the analytical solution in the hemi-cylindrical geometry (Ward and Hohnmann, 1988). As a result, we found the differences between two responses very small.

Finally, we tried to explain the observed data on the NS land-sea array extending to the north from the boundary between Tottori and Hyogo Prefecture. The 2-D modelling yielded a 2-D conductivity structure whose RMS is 3.3, and found following two noticeable features of the 2-D section.

1. A conductive anomaly found at 10 to 25km depths beneath the region near the coastline is extending seaward as far as 100km off the San-in region.
2. There appears a large conductive anomaly in the deeper extending part 50km to 200km off the San-in region.

In this presentation, we report the improvement of Utada (1987)'s FEM forward code and the result of the 2-D modelling.

Keywords: magnetotellurics, electrical conductivity structure, land-sea array, finite element method

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SEM037-02 Room:301B Time:May 26 11:00-11:15

Incorporation of seafloor topographic effects into marine 3-D MT inversion

Noriko Tada[1*], Kiyoshi Baba[2], Hisashi Utada[2]

[1]JAMSTEC, [2]ERI, University of Tokyo

In recent years, seafloor magnetotelluric (MT) observation is carried out by using an increasing number of ocean bottom electromagnetometers (OBEMs) not only along a line but also in 2-D array. Thus, imaging electrical conductivity structures under the seafloor in 3-D is now feasible, if we have a capable tool to invert obtained EM responses.

We would like to emphasize that a 3-D treatment is indispensable especially for marine MT, because the electric and magnetic fields observed at the seafloor are heavily distorted by the rugged seafloor topography and the distribution of land and sea which are generally 3-D. It is very important to properly treat the distorted electric and magnetic fields for an accurate estimation of the conductivity structure beneath seafloor that is generally more resistive than seawater by several orders of magnitude. This problem may be solved by making a huge forward calculation covering a sufficiently wide area, but it is not practical simply because of the computational burden. Here we assume that the distorted electric and magnetic fields are separated into long-wavelength (more than a few tens of km) and short-wavelength (less than a few tens of km) components. Then we propose their separate treatment: The long-wavelength parts are incorporated into a 3-D inversion code (WSINV3DMT; Siripunvaraporn et al., 2005), and effects of the short-wavelength topographies are corrected with other 3-D forward code (e.g. FS3D; Baba and Seama, 2002).

The WSINV3DMT is one of 3-D inversion codes that are now of practical use, but the original WSINV3DMT is not applicable to marine MT data because of two reasons. 1) MT responses are calculated only at flat Earth surface. 2) We have to use fine mesh design because an observation site must locate exactly at the center of the top surface of a block, which needs large memory that even a highest performance computer can not handle. We coded an extended version of the WSINV3DMT by solving the two problems shown above so that it can be applied to the marine MT responses. Topographies longer than length of calculation blocks (the long-wavelength topographies) are incorporated into the extended version of the WSINV3DMT by converting the lateral change in volume fraction of seawater and crustal rock in a calculation block into the lateral change in conductivity, conserving horizontal conductance.

For the treatment of the effect for the short-wavelength topographies, we tested two ways through the inversions of synthetic data. In either case, we assume that the effect is expressed as a complex coefficient matrix to the MT impedance tensor for regional structure. The synthetic data is generated based on a real observation array and topography in the Philippine Sea (Shiobara et al., 2009). 1) Correction method: The data is corrected for effect according to Baba and Chave (2005) and then the corrected MT responses are inverted using the extended version of the WSINV3DMT. 2) Incorporation method: We further modified the extended version of the WSINV3DMT to input both MT responses and the topographic effect term which is separately simulated by forward modeling. In the inversion, sensitivity of the full (non-corrected) MT impedance to the conductivity is calculated, neglecting the coupling between the topographic effect term and subsurface structure. Both tests show that the inversions recovered given anomalies (a resistive and a conductive anomalies) beneath the seafloor. However, the second method is found to provide better result than the first one because the second one rather than the first one has good agreements in the amplitude and size of anomalies. In this presentation, results of synthetic test will be presented and the importance of taking into account the topographic effect will be discussed.

Keywords: Marine magnetotellurics, 3-D inversion, Topographic effects, Upper mantle resistivity structure, Ocean bottom electromagnetometer

Japan Geoscience Union Meeting 2011
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SEM037-03 Room:301B Time:May 26 11:15-11:30

Shallow resistivity structure of Sakurajima volcano - Re-analysis of the audio-frequency magnetotelluric data

Wataru Kanda[1*], Yasuo Ogawa[1], Koki Aizawa[2], Shinichi Takakura[3], Sakurajima Volcano EM field experiment group[4]

[1]VFRC, Tokyo Institute of Technology, [2]ERI, Univoersity of Tokyo, [3]Inst. Geo-Resour. Env., AIST, [4]Universities and AIST

The 10th joint observation campaign of Sakurajima volcano was carried out under the framework of the 7th national project for prediction of volcano eruptions in 2007 fiscal year. Sakurajima volcano EM field experiment group (SVEMG) investigated the shallow resistivity structure by using the AMT (audio-frequency magnetotelluric) method as a part of the joint observation campaign, and presented the inferred 2-dimensional resistivity structure in the Japan Geoscience Union Meeting 2008 (SVEMG, 2008). However, the consideration of the resistivity structure was insufficient because a preliminary analysis had been made to data processing. As we made re-analysis of the data, we report on the result.

The measurement was done on Oct. 30th through Nov. 4th, 2007. Because the explosive Bulcanian eruptions often occur at the craters of Minami-dake that is a summit of Sakurajima volcano, we measured the electromagnetic fields at the frequencies of 1 to 10400 Hz along the three lines set on the northern, western, and southeastern flanks of the volcano. The observation sites were 27 in total. Because the measuring frequency is 1-10400Hz, information on the resistivity structure from the vicinity of surface to the depths of 1-2km can be obtained. The data quality was mostly good. The analysis was done by using the data of the frequency range between several thousand and 2Hz except a few sites.

As a result of the preliminary analysis, features of the following resistivity structures were clarified. The surface layers showed high resistivity (100-1000 ohm-m), probably corresponding to the lava. A low resistive layer of several ohm-m was widely found over the volcanic edifice at depths of 200 to 1000m, which would reflect a fracture zone filled with seawater. This conductive layer is likely to be deep beneath areas in the southwestern part of Sakurajima between the Nabeyama pumice cone erupted in 764, and the crater that effused lavas in 1914. Contrary, such depression of the conductive layer was not found around the Taisho crater located on the western flank.

These results were obtained from two-dimensional inversions, where the strike direction of the 2-D structure was assumed in the direction of each measurement line. However, the strike directions presumed by Groom-Bailey Decomposition showed almost north-south against all three lines. It means that two-dimensional strike was assumed in a direction almost orthogonal to a particular measurement line. Because three lines were set to surround the volcanic edifice, a three-dimensional analysis is necessary to explain all the data set without contradiction. Based on these, we will report a result of three-dimensional analysis of the data.

Keywords: resistivity structure, Sakurajima volcano, hydrothermal system

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SEM037-04 Room:301B Time:May 26 11:30-11:45

Temporal changes in electric resistivity at Sakurajima volcano from magnetotelluric observation (February to July, 2010)

Koki Aizawa[1*], Takao Koyama[1], Hideaki Hase[1], Makoto Uyeshima[1]

[1]ERI, the Univ. of Tokyo

Continuous magnetotelluric (MT) measurements were conducted from February to July, 2010 at Sakurajima volcano. Six observation sites were established at locations approximately 2~3 km away from the summit crater. The sampling frequency were 32Hz (15:00~20:00 UT), 1024Hz (17:00~18:00UT), and 32768Hz (23:10~23:11). By applying the comb filter to reduce the harmonics of 60Hz and the robust MT response function estimation code (Chave and Thomson, 2004), we obtained the impedance tensor in the frequency range of 10,000 ~ 1Hz. The diagonal component of impedance tensor (Zxy, Zyx) showed temporal variations in apparent resistivity of approximately +- 20% and phase of +- 3 %, which is similar to the previous observations in May 2008 to July 2009 (Aizawa et al., 2011, JVGR). The results are also similar to the previous paper in that the polarity of apparent resistivity change is not the same, and in that there are time lags of resistivity change. In this presentation, we will show the temporal change of the resistivity structure by the inversion, and will discuss the mechanism of the electric resistivity change.

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SEM037-05 Room:301B Time:May 26 11:45-12:00

Survey of resistivity structure of Izu-Oshima volcano by using Active, a kind of CSEM method

hiroyuki nagatake[1*], Takao Koyama[1], Makoto Uyeshima[1]

[1]Earthquake Research Institute

ACTIVE is the system proposed for monitoring of resistivity changes in the underground structure of an active volcano (Utada et al.2007). The system consists of a transmitter, that is grounded wire and making alternative pulse DC current, dipole used to generate a controlled transient electromagnetic (EM) field and an array of receivers, that is induction coil and monitoring induction current with 1000Hz sampling, used to measure the vertical component of the transient magnetic field at various distances, with automatic operation of both units. We can estimate the resistivity structure and its changes by requiring response functions, which is the ratio of magnetic field of each sites divided by current of transmitter for each frequency.

We carried out a resistivity survey by using Active over the caldera of the Izu-Oshima Volcano, Central Japan, in January 2011. This survey aimed to monitor temporal changes in underground resistivity structure. At the same time we carried out MT survey there. So we could also compare the result with MT survey. This study will show the result of this survey and required techniques, 3D modeling, inversion and so on.

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SEM037-06 Room:301B Time:May 26 12:00-12:15

Electrical conductivity of sedimentary medium measured by electromagnetic pulses in the earth

Minoru Tsutsui[1*], Munetoshi Kamitani[1], Taka Nakatani[1], Toshiyasu Nagao[2]

[1]Kyoto Sangyo University, [2]Tokai University

In order to confirm electromagnetic (EM) pulses which might be generated by strong stress impacts to the earth crust when the earthquakes occurred, we have been observing them by a sensor system inserted into a borehole of 100 m in depth.

One of observation sites is in the campus of Seto Marine Biological Laboratory of Kyoto University in Shirahama town, Wakayama prefecture, where is on a narrow peninsula. Since the sedimentary layer around the borehole at the site was composed of shells and sandstone, it was expected that sea water easily penetrate into the sedimentary layer and that EM waves from the sky would be rapidly decayed with the depth in the layer. However, we found that almost all of EM pulses detected at the bottom in the borehole were lightning generated ones which were counted to 10000 per day in the rainy season.

Under such the observation condition, we could clearly estimate the electrical conductivity of the sedimentary medium in the layer by using waveforms of the rapidly decayed EM pulses. It was, however, required that EM pulses used for the estimations of the conductivity should be linearly polarized in the both regions, above the ground and in the earth, because it was hard to compare amplitudes and phases between waveforms of ellipsoidal polarized pulses. Although, in general, if linearly polarized EM waves were obliquely incident to the ground their polarizations in the earth become ellipsoidal, when its incidence into the ground was vertically the penetrated waves in the earth represent linear polarization. Thus we have to select EM pulses with linear polarization at the both points for the estimation of electrical conductivity of the sedimentary medium.

For this purpose, we used tri-axial magnetic search coils at the depth of 95 m in the borehole and on the ground for checking polarizations of detected EM pulses. Waveforms of six analogue pulses of three directional components of a magnetic pulse detected at each detecting point were captured into a personal computer through a multi-channel AD convertor with a sampling period of 32 micro second. The timing of waveform capturing was triggered by a pulse of magnetic east-west component detected at the 95 m depth as pre-triggering AD conversions.

The measured results were as follows. A dominant frequency of detected EM pulses was about 5 kHz, the amplitude and the phase detected at the 95 m-depth were respectively depressed to 1/22 and had 83 micro-seconds delay against those detected on the ground. From these results, we obtained the conductivity of the sedimentary layer was 0.067 S/m. Using this value, the propagation velocity of the EM pulse in the sedimentary medium was 1/345 of the light velocity. Thus the travel time of the EM pulse from the ground surface to the depth of 95 m was coincident with the value of the delay time between waveforms. Therefore it has been proved that the obtained value of the electrical conductivity by this method was valid.

We are now conducting observations for detecting earth-origin EM pulses and to identify their source locations on real-time basis by a network with two or three observation sites. If we found an earth-origin EM pulse and determined its source location, we can obtain differential path lengths between path distances from the source location to each observation site. On the other hand, we can obtain time differences in detections of EM pulse at each observation site. Using the differences of path lengths and the time differences, we can obtain propagation velocity, and then we can obtain electrical conductivity in the medium near the depth of EM source location.

Keywords: electromagnetic (EM) pulses, measurement of electrical conductivity, detection of EM waves in a borehole

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SEM037-07 Room:301B Time:May 26 12:15-12:30

An audio-frequency magnetotelluric survey along the 2010-East-profile across the Yasutomi and Kuresaka-touge faults

Satoru Yamaguchi[1*], Takahiro Kubota[2], Satoshi Ueda[3], Hideki Murakami[4], Shigehiro Katoh[6], Naoto Oshiman[5]

[1]Graduate School of Sci., Osaka City Univ, [2]Faculty of Science, Osaka City Univ., [3]Graduate School of Science, Kobe Univ., [4]Faculty of Science, Kochi Univ., [5]DPRI, Kyoto Univ., [6]Museum of Nature and Human Activities

The Yamasaki Fault System (YFS) of southwest Japan is a typical left-lateral strike-slip fault system that extends for over 80 km along a general strike of N60W?S60E. The northwestern part of the system consists of the Ohara, Hijima, Yasutomi, and Kuresakatouge faults and the southeastern part of this fault system consists of Biwako and Miki faults. Many micro-earthquakes have been recorded along the fault system (Shibutani, 2004), along with large historical earthquakes such as the magnitude 7.1 Harima Earthquake of 868 AD (Okada et al., 1987).

An audio-frequency magnetotelluric (AMT) survey was undertaken at nine stations along a profile across the Yasutomi and Kuresakatouge faults. MT responses of a frequency band between 10,400-0.35Hz were obtained at eight stations. After analyses of dimensionality and a regional strike of the resistivity structure beneath the study area, the apparent resistivity and phase data for both TM and TE modes were inverted simultaneously using the code of Ogawa and Uchida (1996). This preliminary resistivity model is characterized by (1) a near surface conductive zone between the Yasutomi and Kuresakatouge faults, (2) a moderately deep conductive zone beneath the Yasutomi fault, and (3) a moderately deep conductive zone to the south of the Kuresakatouge fault.

Keywords: conductivity, active fault, magnetotelluric

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SEM037-08 Room:301B Time:May 26 12:30-12:45

Resistivity Structure beneath Kyushu by the Network-MT Data: Imaging of the Volcanic Formation along the Subduction Zone

Maki Hata[1*], Naoto Oshiman[2], Ryokei Yoshimura[2], Makoto Uyeshima[3]

[1]Graduate School of Science, Kyoto Univ., [2]DPRI, Kyoto Univ., [3]ERI, Univ. of Tokyo

The Kyushu district is a typical high angle subduction zone in Japan, at which the hot Shikoku basin and the cold Philippine sea plate subduct beneath the Eurasian plate, and many quaternary active volcanoes, as the Aso volcano, the Kuju volcano and Kirishima volcano, are located along the volcanic front. And it is important to investigate structure beneath Kyushu for understanding the volcanic formation. In the Kyushu district, the Network-Magnetotelluric (MT) observations, which used telephone line networks of several tens kilometers electrode spacing for the measurement of voltage differences (Uyeshima, 1990), were carried out from 1993 to 1998 to cover the whole island of Kyushu. We reanalyzed these data sets, which have geoelectromagnetic information from the crust to upper mantle, in order to determine regional scale electrical conductivity structure and applied two-dimensional (2D) inversion analyses using the REBOCC inversion code (Siripunvaraporn and Egbert, 1999) to the Network-MT impedance responses. Here we adjusted appropriate the horizontal and vertical smoothing factors according to the intervals of the observation sites along each profile across the characteristic geology, tectonics and volcanoes. And we were able to get a rough grasp of the resistivity structure beneath whole Kyushu. Further, we found that a conductive block exists beneath the volcano of which the bottom extends to the backarc side and the forearc side including the Philippine Sea plate is resistive. Then we also carried out a three-dimensional (3D) inversion analyses to check the 3D effects on the obtained 2D imaging, especially, the ocean effect surrounding the Kyushu district. In this presentation, we would like to explain details on the 2D resistivity structure related to the subducting Philippine Sea plate and the active volcanoes as well as and checking 3D effects on the 2D imaging, and also introduce the future direction of this study.

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SEM037-P01 Room:Convention Hall Time:May 26 14:00-16:30

Piezomagnetic fields arising from the propagation of teleseismic waves in magnetized crust with finite conductivity

Ken'ichi Yamazaki[1*]

[1]DPRI, Kyoto Univ.

To determine whether the piezomagnetic effect is a plausible mechanism in explaining variations in the magnetic field that occur synchronously with the propagation of teleseismic waves, a set of solutions are derived for the electromagnetic field. The situation is considered in which the Earth's conductivity has a stratified structure and seismic waves are expressed as a plane wave. The piezomagnetic field in this situation is expressed by an analytically closed form. Using the obtained solution, quantitative aspects of the piezomagnetic field that accompanies seismic Rayleigh waves with an amplitude of 1 cm are discussed. It is shown that the finite conductivity of the Earth's crust sometimes acts as an enhancer of the magnitude of the piezomagnetic field. However, the expected piezomagnetic field is substantially small. Even in the case that the initial magnetization around the observation site is as large as 5 $Am^{?1}$, the expected amplitudes in the piezomagnetic field are at most 0.1 nT. This result means that the piezomagnetic effect is not a reasonable mechanism to sufficiently explain variations in magnetic fields that occur synchronously with ground motions, if the initial magnetization is horizontally uniform.

Keywords: Rayleigh wave, piezomagnetic effect, electrical conductivity, electromagnetic field, enhancement

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SEM037-P02 Room:Convention Hall Time:May 26 14:00-16:30

Characteristics of frequency transfer function between electric field and ground velocity for natural earthquakes

Mayu Kuriki[1*], Masaki Matsushima[1], Yasuo Ogawa[1], Yoshimori Honkura[1]

[1]Tokyo Institute of Technology

Several mechanisms have been proposed to account for electromagnetic field variations associated with earthquakes, but most of them are insufficient in explaining characteristic variations observed at the time of seismic-wave arrival. A new mechanism called the seismic dynamo effect has been attracting considerable attention. It claims electric field generation due to the resonance-like motion of ions contained in groundwater excited by seismic wave under the Earth's magnetic field. Although this mechanism is found to be successful in explaining an observational feature of circular polarization of horizontal electric field variation (Honkura et al., 2009), more convincing evidence is still required. For verification of this mechanism, we analyzed data acquired for earthquakes in the vicinity of Wakuya in 2009 and 2010, aftershocks of the 2007 Noto Hanto Earthquake, and aftershocks of the 2008 Iwate-Miyagi Nairiku Earthquake, in terms of transfer functions between the ground velocity as the input and the electric field as the output. To estimate transfer functions, we used data recorded by a short-period seismometer of velocity type and two pairs of Pb-PbCl2 electrodes with data loggers. The sampling rate was 200 Hz. The dipole length was in the range between 15 m and 20 m in both the NS and EW directions.

In the case of aftershocks of the 2007 Noto Hanto Earthquake, we stacked transfer functions for five aftershocks, and then clear peaks appeared at frequencies lower than expected from the mechanism. This result made us realize the necessity of considering the boundary condition at the ground surface. The electric field generation in this case stems from three ions in groundwater: HCO3-, Cl- and Na+. In the case of earthquakes in the vicinity of Wakuya in 2009 and 2010, we estimated the averaged transfer function from 19 datasets. Although the result turned out to be unclear, we could interpret it in terms of the same mechanism operative in a deep groundwater layer together with the ground However, a problem of anisotropy still remains. On the other hand, stacking of transfer functions for 19 traces from 16 aftershocks of the 2008 Iwate-Miyagi Nairiku Earthquake yielded smoother transfer functions, but definitive characteristics were not found, although some groundwater layers seem to be responsible for complicated characteristics, particularly at frequencies higher than 22 Hz.

Keywords: the seismic dynamo effect, electric field variation, earthquakes

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SEM037-P03 Room:Convention Hall Time:May 26 14:00-16:30

Effect of solar daily variations on MT and GDS signals

Hiroaki TOH[1*]

[1]DACGSM, Kyoto Univ.

One-dimensional (1-D) electrical conductivity profiles of the oceanic mantle beneath the Pacific Ocean often show a peak in asthenospheric depths irrespective to ages of the seafloor above it (e.g., Lizzaralde et al., 1995; Toh and Motobayashi, 2007; Baba et al., 2010). It, therefore, might be interpreted as a ubiquitous feature of the oceanic mantle, whose cause can be attributed to onset of partial melting, presence of water or a combination of both. However, a so-called 'semi-global reference' electrical conductivity model for the North Pacific Ocean (Utada et al., 2003) lacks in the asthenospheric conductor.

Although their reference model based only on periods longer than 1 day, one may argue that the reference model is valid even for asthenosphric depths because their data are free from noises in electromagnetic (EM) responses by solar daily variations (e.g., Sq). Utada et al. (2010) claimed that magnetotellutic (MT) responses without pertinent removal of Sq noises possibly contain fictitious curvature in the tidal band to give a false peak in the asthenosphere. On the other hand, it is also true that any 1-D electrical conductivity inversions without MT responses have little sensitivity in the upper mantle depths. It, therefore, is still an open question whether the asthenospheric conductor is only a fictitious image due to Sq noises or a real fact revealed by the seafloor MT data. It is required to find a proper correction method for the Sq noises in order to bridge the gap between the MT band and the geomagnetic depth sounding (GDS) band, the latter of which is originated from long-period ($>$ 2 days) temporal variations of the magnetospheric ring current.

To test the effect of solar daily variations on seafloor MT responses, we used a very long ($>$ 3 years) time-series observed by a seafloor geomagnetic observatory (Toh et al., 2004; 2006) in the Northwest Pacific Ocean (NWP). The 1-D electrical conductivity profile beneath NWP is known to be associated with an asthenospheric conductor with a peak depth and conductivity of ~200 km and ~0.1 S/m, respectively. Although the 1-D electrical model is based on an EM time-series carefully detided by BAYTAP-G (e.g., Tamura et al., 1991), we applied a new Sq removal method that subtracts a mean Sq variation estimated from the international five quietest days of each month (http://www-app3.gfz-potsdam.de/kp_index/quietdst/qd20000x.html) to the original time-series. We compared the new time-series with our former time-series in terms of power spectra, EM response functions and 1-D electrical conductivity profiles.

It was found that even though the Sq noises can affect the MT responses to some extent, it is difficult to deny the presence of the asthenospheric conductor. However, it was also shown that the conductor may have different quantitative features in terms of the peak depth and conductivity. It will be further argued whether it is appropriate to subtract Sq, i.e., the solar daily variations on quiet days, or SD (the solar daily variations on disturbed days).

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SEM037-P04 Room:Convention Hall Time:May 26 14:00-16:30

Preprocessing of Network MT electric field data contaminated by leak currents to obtain the accuracy MT response

Hideki Murakami[1*], Tomoe Mogami[2], Satoru Yamaguchi[3], Tsutomu Ogawa[4]

[1]Kochi Univ., [2]Kobe Univ., [3]Osaka City Univ., [4]Tokyo Univ.

We report a preprocessing method of Network-MT electric field data affected leak currents for obtaining the accuracy MT response. In general, it is difficult to obtain the accuracy MT response using Network-MT electric field data contaminated by leak currents produced by DC railways. We have obtained more accurate MT responses using multivariable analyses (PCA and FA) utilizing characteristics of Network-MT method as the preprocessing method.

Keywords: MT response, Network-MT data, leak currents, multivariable analysis

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Preliminary report on a 2D resistivity structure in the middle-western part of Tottori Prefecture, southwest Japan

Kentaro Osaki[1*], Ichiro Shiozaki[1], Yasuo Ikezoe[1], shinji Yamamoto[1], Tatsuya Noguchi[1], Naoto Oshiman[2], Ryokei Yoshimura[2], Hideki Murakami[3], Atsuki Kubo[3], Satoru Yamaguchi[4]

[1]Tottori Univ, [2]Kyoto Univ, [3]Kochi Univ, [4]Osaka City Univ

The purpose of this study is to estimate an electrical resistivity structure beneath the Middle-western Tottori prefecture in the eastern part of Sanin regions, southwestern Japan in order to clarify the relationship between deep crustal conductors and the seismicity in these regions. In this presentation, a preliminary report on a investigations of this study and a two-dimensional resistivity structure beneath these regions, based on the result of the wide band MT observations carried out from fall to winter of 2009, is given.

Our research group has shown that there is a clear relationship between resistivity and seismicity in the Sanin and Shikoku regions. We investigated deep crust resistivity structures in the measurement lines that traverse a linear seismic activity area along with the coastal part of Japan Sea, including Yoshioka and Shikano seismic fault of Tottori earthquake in 1943, M7.2 and the epicenters of the remarkable earthquakes in the eastern part of San-in region, for example, Western Tottori earthquake in 2000, M7.3, and so on. As the result, in the eastern part of San-in region, it was found that a conductive area exists in the deep crust part under the seismic region, which is a resistive area, along with the seismic activity area stretching nearly in the east and west direction. These studies suggest that high conductivity is possibly caused by the existence of deep crustal fluids, which probably play an important role in the inland earthquake occurrence mechanism of these regions.

Wide-band MT observations were carried out from fall to winter of 2009 along a N-S line in the middle-western Tottori, where the Middle-western Tottori earthquake (Mj5.3) occurred in 2002. This area is also a western extension part of the seismic activity zone of Tottori earthquake in 1943, and Central Tottori earthquake in 1983, and is located in the eastern side of a seismic gap of the quaternary volcano Mt. Daisen.

An investigation was carried out from the beginning of November to the end of it in 2009. A total of 5 Phoenix measurement devices were used to observe three geomagnetic field and two electric field components. The numbers of observation points were eight in total. Unfortunately, a remarkable geomagnetic disturbance could not be recorded during the observation. A Preliminary 1-D model shows that there is a resistivity boundary in the crust beneath this area. However, the clear relationship between resistivity and seismicity in other Sanin regions may not have been found here as mentioned above. In this presentation, a preliminary report of 2-D resistivity modeling performed will be shown.

We would like to express sincere gratitude for the Nittetsu Mining Consultants Co. Ltd. kindly let us use their continuous geomagnetic records as remote references. This study was supported by the Ministry of Education, Culture, Sports, Science and Technology of Japan, under its Observation and Research Program for Prediction of Earthquakes and Volcanic Eruptions. Last of all, we would like to express our thanks to S. Tamai, S. Higashi, Y. Yamamoto, S. Ota and T. Kumada, geospheric structure and dynamics of Tottori University for their help during data acquisition.

Keywords: resistivity, MT, Tottori Prefecture, San-in region

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Resistivity Structure Analysis beneath the Eastern Marmara Sea by 2D OBEM Modeling.

Tulay Kaya[1*], Yasuo Ogawa[1], Takafumi Kasaya[2], Bulent Tank[3], M. Kemal Tuncer[4], Naoto Oshiman[5], Yoshimori Honkura[1], Masaki Matsushima[1]

[1]Tokyo Institute of Technology, [2]JAMSTEC, [3]Bogazici University, [4]Istanbul University, [5]Kyoto University

In this study, we perform Magnetotelluric method (MT hereafter) in the Sea of Marmara which is an inland sea located at north western Turkey as different from previous marine electromagnetic studies performed in open oceans. Turkey is seismically very active country that has hosted large destructive earthquakes throughout the history. Westward migration of big events along the North Anatolian Fault Zone (NAFZ), one of the main fault zones in the region of interest, and occurrence of the last two demonstrative earthquakes (Mw7.4 Izmit and Mw7.2 Duzce, 1999) at the eastern edge of the Sea of Marmara indicate that the next big event is most likely expected to occur at the Sea of Marmara. Previous MT studies clearly show the relation between the seismicity and resistivity variation near fault zones. Such as, generally the big earthquakes occur at asperity zones where high wave velocities and high resistivities are observed and locations of the fault zones widely overlap the resistivity transition zones. In order to reveal the extension of the NAFZ and crustal structure within the Sea of Marmara, Ocean Bottom Electromagnetic (OBEM) data at 16 sites were collected during three campaigns between 2008 and 2009. Site locations were arranged in accordance with 3D and 2D modeling. Chave and Thompson code (1987) was applied in order to obtain transfer functions from continuous electric and magnetic fields (three components). Strike analysis for east two profiles show almost 90 and 70 degree strikes for the long (P1) and short (P2) profiles respectively. These strikes are consistent with possible trace of the NAF around the Cinarcik Basin. Comparison of 3D and 2D forward modeling results demonstrates significant effect of the bathymetry on the data set. However, these effects are almost same in TM case and similar in TE that provides us to trust 2D modeling at least for TM mode. We performed 2D inversion modeling using Ogawa and Uchida (1996) code modified by us to account for the bathymetry effects on the measurements. According to 2D inversion results, there is a high conductivity anomaly located at a depth of upper mantle and bounded with resistive zones at the north and south beneath the eastern Marmara Sea. In this presentation, we show the OBEM data analysis and relation of the results with the structure beneath the Sea of Marmara.

Keywords: Sea of Marmara, North Anatolian Fault Zone (NAFZ), Ocean Bottom Electromagnetic (OBEM), Magnetotelluric, Resistivity

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(May 22-27 2011 at Makuhari, Chiba, Japan)

SEM037-P07 Room:Convention Hall Time:May 26 14:00-16:30

Preliminary result of OBEM survey around the Japan Trench

Hiroshi Ichihara[1*], Takafumi Kasaya[1], Kiyoshi Baba[2]

[1]IFREE/JAMSTEC, [2]ERI, University of Tokyo

Japan Tranch system is an interesting scientific research field to understanding subduction processes including interplate earthquakes and volcanic activities. We conducted natural source electro-magnetic surveys around Japan Trench using newly developed small ocean bottom electro-magnetometers (OBEMs) (Kasaya et al., 2009). The small OBEM consists of a 17-inch glass sphere involving data logger and battery, sensor unit (fluxgate magnetometer, tilt meter and thermo meter) in a small metallic pressure housing, and electrode arm unit with arm-folding system. The electrode arms are folded during surfacing, which enable easy recovery operation. 24bit and 16 bit AD converters are included for the electric field and the other measurements, respectively. Sampling rate can be settled between 0.125 and 240 seconds. The rate can be switched during observation, which enable to obtain wide-band MT/GDS responses.

We deployed the 6 small OBEMs and 5 conventional OBEMs across Japan Trench from 900m to 6000m deep during 2009-2010. In addition, 4 or 5 small OBEMs will be deployed in 2011. High quality data were obtained in some stations although geomagnetic disturbance had been weak. Preliminary analyses imply strong bathymetric and coastal effects in the MT/GDS responses. These effects will be deeply discussed in the presentation for 2-D/3-D resistivity modeling.

Keywords: magnetotelluric, subduction zone, OBEM, Japan Trench

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Three-Dimensional Crustal Resistivity Structure beneath Kanchanaburi province, Western Part of Thailand

Songkhun Boonchaisuk[1*], Ananya Satitpitakul[1], Chatchai Vachiratienchai[1], Patchawee Nualkhow[1], Puwis Amatyakul[1], Tawat Rung-Arunwan[1], Suntaree Unhapipat[3], Weerachai Sarakorn[3], Weerachai Siripunvaraporn[1], Yasuo Ogawa[4]

[1]Dep. Physics, Fac. Sci., Mahidol Uni., [2]ThEP Center, Thailand, [3]Dep. Math, Fac. Sci., Mahidol Uni., [4]Tokyo Institute of Technology

Kanchanaburi province located in the western part of Thailand (about 150 km from Bangkok) consists of two major fault zones: the NW-trending Three Pagodas Fault (TPF) and Sri Sawat Fault (SSF) zones. Both have produced large earthquakes in the past according to the paleoseismic studies. Two big earthquakes (5.3 and 5.9) in 1983 on the SSF zone were detected after a year of completion of the big hydroelectric power dam. During the December 2009 to February 2010, thirty nine stations were deployed covering most of the area of Kanchanaburi province and its fault zones. Phase tensor analysis reveals that the data is mostly 3-D. Three-dimensional inversion is therefore conducted with WSINV3DMT with data from 160 Hz to 200 s. Shallow part of the 3-D resistivity structures is consistent with geology of Kanchaburi. The L-shape conductor producing the phase greater than 90 degree can be observed in the north-western part at mid-depth. Both fault zones can be clearly seen from the 3-D resistivity model. The TPF zone appears to be vertical fault extending deep to the Moho. The SSF zone appears to be a thrust-fault dipping at about 60 degree and end at about 15 km depth. This indicates that the two big earthquakes on SSF were shallow earthquakes and reservoir induced.

Keywords: Magnetotelluric, 3D modeling, Crustal Resistivity Structure, Kanchanaburi

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3D magnetic structure of Sakurajima-volcano and Aira caldera.

Mitsuru Utsugi[1*], Wataru Kanda[2], Takao Koyama[3]

[1]Aso Vol. Lab., Kyoto Univ., [2]Vol. Fluid Res., Tokyo Inst. of Tech., [3]Earthq. Res. Inst.,, Univ. of Tokyo

In 2007, we carried out the aeromagnetic survey on Sakurajima volcano and Aira caldera to clarify the subsurface magnetic structure. This survey was conduced as a part of the Joint Observations of Sakurajima Volcano in 2007. On this campaign, various surveys, such as geodetic, geothermal, geochemical and geomagnetic surveys were done under the cooperation of the researchers at the university and institute of Japan. On our survey, we made helicopter-bone aeromagnetic mesurment with sampling time of 0.1 sec and observation area was NS22.5 x EW 16.5km area which include Sakurajima volcano and most part of Aira caldera. Total ?ight distance was about 2000km. From the obtained data, we tried to investigate the subsurface magnetic structure beneath Sakurajima volcano and Aira caldera by 3-D inversion. On this calculation, we used the iterative inversion scheme with minimum support stabilizing developed by Portniaguine and Zhdanov (2002). In our presentation, we will show the results of our 3D inversion.

Keywords: aero magnetic survey, 3D magnetic structure