Earthquake-induced electromagnetic field due to electrokinetic effect

*Yongxin Gao[1], Hengshan Hu[2], Xiaofei Chen[3]

1.School of Civil Engineering, Hefei University of Technology, Hefei, China, 2.Department of Astronautics and Mechanics, Harbin Institute of Technology, Harbin, China, 3.School of Earth and Space Sciences, University of Science and Technology of China, Hefei, China

Electromagnetic fields generated by earthquake events were usually reported and have drawn a lot of attentions. They can be detected before, during and after the seismic arrivals after earthquake rupture started, and are referred to as the co-rupture, coseismic and post-seismic EM signals, respectively. The co-rupture EM signal is of great importance since it arrives earlier than the seismic waves, especially the destructive shear and surface waves and has potentials in earthquake early warning and hazard reduction. The coseismic EM signal arriving simultaneously with the seismic waves are also valuable since it contains the information of the subsurface medium in the vicinity of the EM sensors. However, how these kind EM signals are generated is still controversial. Several possible mechanisms have been proposed to explain the earthquake-induced EM signals, e.g., the electrokinetic effect, the piezoelectric effect, the motional induction effect, etc.

In this study, we present the theoretical simulations of the earthquake-induced EM signals on the basis of the electrokinetic effect. This result shows that due to the electrokinetic effect the earthquake can generate co-rupture EM signal, which arrives immediately after the onset of the earthquake and much earlier than the seismic arrivals. It arrives at different EM sensors simultaneously. The earthquake can also generate coseismic EM field which arrives simultaneously with the seismic waves. Besides, our simulations indicate that when the earthquake fault rupturing stops and the seismic waves pass far away, the magnetic field vanishes while the electric field near the fault remains, decaying slowly and lasting for hundreds of seconds. The near-fault poseismic electric fields hold similar features to some field observations in literature. We apply our theoretical simulations to explain the coseismic EM data observed during the 2004 M_w6 Parkfield earthquake. By using a finite fault source model obtained via kinematic inversion, we calculate the electric and magnetic responses to the earthquake rupture are calculated. The result shows that the synthetic electric signals agree with the observed data for both amplitude and wave shape, especially for early portions of the records after the earthquake. Our simulations supports the electrokinetic effect as the reasonable mechanism for the generation of the earthquake-induced electric fields.

This work is supported by the National Natural Science Foundation of China (grants 41474038 and 41204039).

Keywords: earthquake, electromagnetic fields, electrokinetic effect

Detection of precursory anomalies using the four -component borehole strain meter (SKZ-1)

Xiangyang Kong[1], Kaizhi Su[2], *Yukio Fujinawa[3], Yoichi Noda[4]

1.Earthquake Administration of Shandong Province, China, 2.Institute of Crustal Dynamics, CEA, China, 3.Mieruka Bousai LtdEarthquake Administration of Shandong Province, China, 4.Tierra Tecnica

High sensitive crustal monitoring has a long history to investigate anomalous precursory variations of earthquakes by means of several kinds of sensors as borehole volumetric sensors (Sacks and Evertson,1971), borehole extension sensor by Gladwin (1984), three component volumetric strain meter by Sakata (2004) and Ishii and Yamauchi (2007). In China the four component strain meter with high performance was developed by Su Kaichi (1977) and has been used in earthquake-prone provinces since 2006.The configuration of four sensing units at intervals of 45 degree provides a simple indicator (consistent factor) of the sensor functioning and regime of the crust assumed to be plain strain in normal state to detect candidates of anomalous variation without little ambiguities. The observation at ten sites in several provinces of China for some 10 years has proved profitable performance of the sensor: high stability and high degree of resolution to detect local and regional anomalous variations near hypocenter. In the normal stage the variations consist of steady diurnal variations due to earth tide, steady trends due to the crustal stress adjustment after construction of the borehole, and installment of the sensors. There are little urban noises with the result of the consistent factor being almost constant value of 0.99.
Here we present analyses of anomalous variations detected by use of the correlation coefficient of two independent plain strain components before two major earthquakes near the network: YiLiang M5.7earthquake and LuDian M6.5 earthquake. In the imminent sage of the Yiliang earthquake, obvious strain anomalies with periods of several days, several weeks appeared simultaneously in four components at the nearest YiLiang site of the epicenter distance15.5km. The correlation coefficients for those anomalies are well below reaching 0.2 compared with the ordinal value 1.0. At DaGuan site of larger distance 30km, there appeared no significant anomalies with the factor remaining the normal value near 0.99 or so. Analyses show that the correlation coefficient can be used to objectively detect anomalies to define the successive stage of earthquake occurrence from normal to relaxation stages.
A multiple observations using the four component strain meters, groundwater meters and electromagnetic sensor are expected to substantially contribute to investigation of the nucleation process of natural earthquakes. Present finding may contribute to efficient data analysis to detect candidate of anomalies from using big amount of continuous multiple data with higher sampling rate.

Keywords: strain meter, pre-seismic anomalies, detection method

Development of radon detector for atmosphere

*Kiyotaka Ninagawa[1], Isao Yamamoto, Tohru Okabayashi[2]

1.Department of Applied Physics, Okayama University of Science, 2.Department of Medical Risk and Crisis Management, Chiba Institute of Science

An increase of the radon in underground water at Nishinomiya City[1] and an increase of the radon in atmosphere[2] at the southern part of Hyogo Prefecture earthquake in 1995 were reported. Moreover, in the case of Tohoku Region Pacific Coast Earthquake, the data of the exhaust air monitor in the radiation facility of Fukushima Medical College (Fukushima) has been reported that the peak duration was long, and the peak decreased rapidly before the earthquake[3].
We had measured radon concentration in a pit of Kurashiki mine, and in the atmosphere in Chiba Prefecture, Chiba. We used a Radon Monitor of SUN NUCLEAR Corporation, Model 1028 in the Kurashiki, and Pylon Trace Environmental Level Radon Gas Detectors (abbreviated to TEL) in Chiba. The TEL is composed of ZnS(Ag) scintillator and a Photomultiplier. Its output spectra have continuous distribution. Then counts depend on discrimination level, and have sometimes shift of background counts. On the other hand PIN photodiode have been developed for high sensitive radon detector, and used in Super-Kamiokande[4]. This time we produced a usual detector of atmospheric radon, using PIN photodiode.
We use a Si PIN photodiode, S3204-09 (Unsealed), supplied by Hamamatsu Photonics K.K. We constructed a radon detection system, using a stainless pot as air container, H4083 as charge amplifier, C4900-01 as High voltage power supply module, 4419 (CLEAR-PULSE) as Pulse shape amplifier, MCA-Lite (Laboratory Equipment Corporation) as Multi Channel Analyzer and a Personal computer as data analysis. Output of the multi-channel analyzer showed clear alpha peaks of ^{218}Po and ^{214}Po of radon daughters from Uranite. However, the Si PIN photodiode showed peak large shift. It were overcome by coating surface of white ceramic with carbon tape. We introduced atmosphere to the PIN photodiode, using air pomp, flowmeter and silica gel for dehumidification. It showed same peaks of radon daughters, and we observed daily alteration of their intensity.
References
1) Igarashi G., Saeki T., Takahata N., Sano Y., Sumikawa K., Tasaka S., Sasaki Y. and Takahashi M.: Groundwater radon anomaly before the Kobe earthquake, *Science*, 269, 60-61, 1995
2) Yasuoka, Y. and Shinogi, M.: Anomaly in atmospheric radon concentration: a possible precursor of the 1995 Kobe, Japan, earthquake. *Health Physics*, 72, 759-761, 1997
3) Nagahama H., Yasuoka Y., Suzuki T., and Homma Y.: Radon Variation in the Air Before the 2011 Tohoku Earthquake (Mw =9.0), Programme and Abstracts, A32-09, The Seismological Society of Japan. 2011, Fall Meeting.
4) Nemoto, M., Tasaka S., Hori H., Okumura K., Kajita T., and Takeuchi Y. : Development of High Sensitive Radon Detector with Electrostatic Collection. *Radioisotopes*, 46, 710-719, 1997 (Japanese)

Keywords: Radon detection, atmosphere, earthquake

Observational study of atmospheric electricity parameters(atmospheric electricity field (AEF), atmospheric ion concentration (AIC), and radon concentration) at Asahi, Boso Peninsula, Japan

*Junpei Omura[1], Peng Han[2], Chie Yoshino[2], Katsumi Hattori[2], Michikuni Shimo[3], Toshiharu Konishi[4]

1.Department of Science, Chiba Uiversity, 2.Graduate School of Science, Chiba University, 3.Fujita Health University, 4.OHYO KOKEN KOGYO CO.,LTD.

The total electron content anomaly preceding the large earthquake is one of the most promising precursory phenomena in the upper atmosphere. Lithosphere-Atmosphere -Ionosphere coupling (LAI coupling) model has been proposed to explain the earthquake-related phenomena in the atmosphere and ionosphere. We evaluate the possibility of chemical channel of LAI coupling through the monitoring of atmospheric electricity parameters such as the atmospheric electricity field (AEF), atmospheric ion concentration (AIC), and radon concentration. In this paper, we will report about the property of atmospheric electricity parameters observed at Asahi station (ASA), Boso Peninsula, Japan. AIC, AEF, atmospheric radon concentration, radon exhalation quantity from the ground, and weather elements have been observed at ASA. First, we compare seasonal variation, daily variation, and response to precipitation of atmospheric electric parameter observed at ASA and those at Kiyosumi station (KYS).
Variations of AIC and AEF before precipitations are quite similar at both stations; AIC increases quickly when a precipitation starts and AEF begins to be disturbed three hours before rain starts. But the variations after stopping precipitation have individual properties. Both parameters keep high values for a few hours at ASA and it takes longer than KYS to back to the normal level. Daily variation in each season also differs in each site. In summer, AIC takes minimum value at 15:00 LT. in the daily variation at ASA. But at KYS, it takes maximum value at 15:00 LT. In winter, AEF decreases from 09:00 LT to noon and gradually increases in daily variation. In other seasons, it takes maximum value at 20:00 LT and fluctuated in relatively large range. Daily variation of AEF in winter is mostly similar to the typical daily variation at KYS for all season.
Radon exhalation quantity variation has a clear negative correlation with 3 hours delay to the air pressure variation. Each season differs in daily pattern. AIC and AEF variations show lag correlation with radon exhalation quantity variation. To extract anomalous radon variation related to earthquakes, we should set a network of Radon monitoring and establish a model of radon variation for the future detailed analysis.

Keywords: Lithosphere-Atmosphere -Ionosphere coupling, atmospheric ion concentration, atmospheric electricity field, Radon exhalation quantity

Multi-parameter satellite geochemistry for validation of atmospheric pre-earthquake signals associated with major seismicity. Case study for Xinjiang, China and Baja, California

*Dimitar Ouzounov[1], Yeju Cui[1,2], Nikolaos Hatzopoulos[1]

1.Center of Excellence in Earth Systems Modeling & Observations (CEESMO) , Schmid College of Science & Technology Chapman University, Orange, California, USA, 2.Institute of Earthquake Science, China Earthquake Administration, Beijing, China

We are presenting the development of satellite geochemistry for multi-sensor validation of short-term atmospheric phenomena preceding major earthquakes. The purpose of this study is to explore the synergetic physical link between (1) satellite thermal infrared radiation (STIR) with anomalous distribution main trace gases :(2) Carbon dioxide (TCCO2), (3) Ozone (TCO3), (4) Methane (TCCH4) and (5) carbon monoxide (TCCO), associated with major seismicity. The science rationale for multidisciplinary analysis is based on concept Lithosphere-Atmosphere-Ionosphere Coupling (LAIC) (Pulinets and Ouzounov, 2011), which is based on the gas emission from the lithosphere during the earthquake generation and explains the synergy of different processes and anomalous variations, usually named short-term pre-earthquake anomalies. We analyzed retrospectively several major earthquakes in two deferent seismo-tectonic regions: XinJiang province in China and in Baja, California including M7.2 of March 20, 2008 in China and M7.3 of April10, 2010 in Baja by systematically analyzing multi-sensor satellite atmospheric chemistry and ground temperature/ humidity observations. Meteorological satellite data include NOAA POES and AQUA/AIRS polar orbit satellites. In both cases satellite data shows (STIR, TCCO2, TCO3, TCCH4, TCCO) building atmospheric anomalies 1-20 days before the main shock. This probably is connected with enhances of the degassing rate of the lithosphere, which can provide additional source for flux emission near major faults in the area. The hourly in-situ atmospheric observation show similarly in the air temperature increases and drop in the relative humidity, probably as result of additional atmospheric ionization observed before the three earthquake events. Our initial results suggest that systematic use of multi-parameter satellite geochemistry can be used for additional physical validation of pre-seismic processes associated with the major earthquake events.

Keywords: earthquake precursor, forecasting, satelite, geochemistry, radon

A statistical investigation of z test on seismo-ionospheric anomalies in TEC associated earthquakes in Japan during 1999-2014

*AiLing Shih[1], Jann-Yenq Liu[1]

1.National Central University

Statistical analysis on seismo-ionospheric precursors (SIP) by using global ionosphere map (GIM) of the total electron content (TEC) in associated with 188 M≥6.0 earthquakes in Japan during 1999-2014. Various references days of -15, ±7, ±15, ±30 days to the earthquake are employed to find characteristics of SIP. Results show that both decrease (or negative) and increase (or positive) anomalies in the GIM TEC before the earthquakes are further examined by z test. The receiver operating characteristic curve is also applied to see whether the SIPs exist in Japan.

Keywords: earthquake, ionosphere

3D Structure of Ionospheric Disturbances Related to Large Earthquakes

*Mustafa Yagmur[1], Shinji Hirooka[1], Katsumi Hattori[1]

1.Chiba University

In this paper we have investigated the geomagnetic storms and Earthquake-related ionospheric disturbances. Following geomagnetic storms, the ionospheric peak electron density (Nmax) and total electron content (TEC) often increase or decrease very much from their quiet-time levels. These increase/decrease are known as positive and negative ionospheric storms. This paper deals with some extremely significant geomagnetic and Earthquake-related events in between 2000 and 2013 which involving positive and negative ionospheric variations having immense importance to space weather, with reference to TEC maps derived from a dual-frequency GPS receiver network (GEONET: GPS Earth Observation Network) built by the Geospatial Information Authority of Japan (GSI), as well as foF2 and hmF2 (maximum electron density height) derived from four ionosonde observatories in Japan and GNSS-RO data from COSMIC mission of NOAA/NSPO(USA-Taiwan joint mission). For comparison and discrimination of stormy and large Earthquake days, a 3D Structure of Ionosphere will be discussed in the presentation.

Keywords: Tomography, Ionospheric Disturbances, Geomagnetic Storms, Earthquakes, TEC

Assessment of Ionospheric TEC anomaly before large earthquake: Elimination of geomagnetic storm effects

*Katsumi Hattori[1], Peng Han[1], Shinji Hirooka[1]

1.Department of Earth Sciences, Graduate School of Science, Chiba University

The detection of electromagnetic perturbations prior to large earthquakes has been proposed as a useful way to monitor the crustal activities. One of the most promising candidates is the measurement of Total Electron Content (TEC). There have been many reports on TEC anomaly associated with large earthquakes from different parts of the world. To verify the relation between TEC anomalies and seismicity around Japan, statistical studies by superposed epoch analysis have been carried out. The results have indicated that before a M>6 earthquake there are clearly higher probabilities of positive TEC anomalies in Japan. These results indicate the correlation between TEC anomalies and sizeable earthquakes. Furthermore, by making use of long-term TEC data over Japan during 2000-2013 and applying Molchan's error diagram, we can evaluate the optimal parameter for earthquake forecasting. The results show that the TEC data contain potentially useful information on earthquake forecasts.
Further research on earthquake forecasting and promoting its utilization will greatly contribute to disaster risk reduction. By using an interdisciplinary or integrated approach, which connects science with technologies related to the ongoing earthquake forecast researches such as ULF geomagnetic and GNSS methods, earthquake forecasting will be demonstratively realized.

Keywords: Ionospheric TEC anomaly, statistical studies, Molchan's error diagram

Statistical Analysis on ULF magnetic anomaly and local seismicity around Kakioka, Japan

*Rui Du[1], Katsumi Hattori[1], Peng Han[1]

1.Graduate School of Science, Chiba University

To clarify and verify the ultra-low frequency (ULF) seismo-magnetic phenomena, we have performed statistical studies on the geomagnetic data observed at the Kakioka (KAK) station, Japan, during 2001-2010. We investigated the energy of ULF geomagnetic signals of the frequency around 0.01Hz using wavelet transform analysis. To minimize the influences of artificial noises and global geomagnetic perturbations, we used only the geomagnetic data observed at nighttime (LT 2:30 am-4:00 am) and exclude the geomagnetic anomalies when the energy of horizontal component is large.
Statistical results of superposed epoch analysis have indicated that ULF magnetic anomalies are more likely to appear before sizeable earthquake events ($Es>10^8$) rather than after them, especially 6-10 days before the events.
Finally, we have evaluated the precursory information of ULF geomagnetic signals for local sizeable earthquakes using Molchan's error diagram. We also compared our results with previous statistical studies at KAK. The above results have indicated that the ULF seismo-magnetic phenomena at KAK clearly contain precursory information and have a possibility of improving the forecasting of large earthquakes.

Keywords: ULF seismo-magnetic phenomena, statistical study, superposed epoch analysis (SEA), Molchan's error diagram

The self-potential variation induced by groundwater flow and the self-potential tomography

*Tomohiro Yamazaki[1], Katsumi Hattori[1], Tomomi Terajima[2]

1.Depart of Earth Sciences Faculty of Science , Chiba University, 2.Disaster Prevention Research Institute, Kyoto University

Landslide is one of the most severe natural hazards in the world and there are two types; rainfall-induced landslides and landslides triggered by an earthquake. To understand rainfall-induced landslide process by the self-potential approach, we struggle with the integrated research to clarify the coupling among hydrological, geotechnical, and electromagnetic changes. Our final goal is to develop a simple technology for landslide monitoring/forecasting using self-potential method. The previous laboratory experiments show that the self-potential variation has a relationship with the ground water condition and soil displacements. So, in this paper, we first demonstrate the numerical computations on the self-potential variation by the simulated groundwater flow, and compare the result with those observed by laboratory experiments. In the result, the simulated self-potential variation is consistent with observed one.
Then, we developed self-potential tomography to estimate the ground water condition. And we also characterize the pressure from the self-potential data, and compare the result with observed pressure head that is measured by pore-pressure gauge and found that the inverted pressure head is consistent with observed one. In addition, we apply the self-potential data observed by the flume test. The estimated pressure head from observed self-potential data shows the consistency with observed pressure head. And estimated pressure head also show the characteristic distribution before the landslide occurred. These facts are highly suggestive in effectiveness of the self-potential tomography to monitor groundwater changes associated with landslide. The details will be given in our presentation.

Keywords: Self-potential, Landslide, Tomography

A Mechanism Causing Temporal Variation in b-values Prior to a Mainshock

*Jeen-Hwa Wang[1]

1.Academia Sinica

Observations exhibit the temporal variation in b-values prior to a mainshock. The b-value starts to increase from the normal value at time t_1, reaches its peak one at time t_2, then begins to decrease from the peak one at t_2, and returns to the normal one at time t_3. As $t>t_3$, the b-value varies around the normal one or rightly decreases with time until the occurrence of the forthcoming mainshock at time t_4. The precursor time, $T=t_4-t_1$, of b-value anomalies prior to a forthcoming mainshock is related to the magnitude, M, of the event in a form: $\log(T)=q+rM$ (T usually in days) where q and r are two constants. In this study, the mechanism causing b-value anomalies prior to a mainshock is explored. From numerical simulations based on the 1-D dynamical spring-slider mode proposed by Burridge and Knopoff (1967), Wang (1995) found a power-law correlation between b and s, where the parameter s is the ratio of the spring constant (K) between two sliders to that (L) between a slider and the moving plate. The power-law correlation are $b\sim s^{-2/3}$ for the cumulative frequency and $b\sim s^{-1/2}$ for the discrete frequency. Since L of a source area is almost constant for a long time period, b directly relates to K. Lower K results in a higher b-value. Wang (2012) found $K=r_A v_p^2$, where r_A and v_p are, respectively, the areal density and P-wave velocity of a fault zone. Experimental results show that v_p is strongly influenced by the water saturation in rocks. The water saturation in the source area varies with time, thus leading to a temporal variation in v_p as well as K. This results in the temporal variation in b-values prior to a mainshock. The modeled result is consistent with the observed one.

Keywords: b-value, precursor time, spring-slider model, stiffmess ratio, saturation of water

Integrated earthquake forecast: combination of b-value monitoring and ionospheric precursors

*takaaki Kobari[1], Pen Han[1], Kastumi Hattori[1]

1.Department of Earth Sciences, Graduate School of Science, Chiba University

In recent years, there are many electromagnetic phenomenon preceding large earthquakes. Anomaly of the total electron content (TEC) is one of the most promising anomalies for the short-term earthquake forecast. On the other hand, it is reported that the b-value around the epicenter region decreases prior to the large earthquake. The b-value can compute using the Gutenberg Richter law. The lead time is around few or tens years. In this study, we investigate the effectiveness of the integrated analyses on the b-value for the middle-term forecast and TEC analysis for the short-term forecast. We select the Tokachi region as a test site. We will report the results of the b-value changes in space and time for the stress field change and GIM-TEC and/or GPS-TEC changes. In this report, we will focus on the two Tokachi-oki earthquakes in 2003 and 2008. They occurred on September 11, 2003 (M8.0) and September 26, 2009 (M7.1). In addition, we will show the results for other regions, if possible.

Keywords: Earthquake, Electromagnetic, b-value, Ionosphere

Development of the quasi-real-time monitoring of volcanic lava activity using MODIS

*BYOUNGJIN AHN[1], Katsumi Hattori[2], Nicola Genzano[3]

1.Department of science, Faculty of Science, Chiba University, 2.Department of Earth Sciences, Graduate School of Science, Chiba University, 3.University of Basilicata

It is possible to quasi-realtime monitoring of volcanic lava activity could be possible if we can detect the thermal anomalies related to the exposure and lava dome of magma by satellite sensors such as MODIS. And it can be used to help for the volcano disaster prevention. In this study, we deal with seven volcanoes in Indonesia. First, we define the infrared radiation caused by the eruption and then, we use the statistical analysis for the radiation, and remove the cloud effects. Finally, we investigate the abnormal values against the background level of the temperature.
We introduce an evaluation function S to remove the spatial and temporal variation from the spatial difference of the brightness temperature data between the target point and reference point (5 km distance). When we compute the differences, we need to eliminate cloud effects adequately. To achieve this, we use the brightness temperature difference between bands of MODIS (BTD). In this study, we select the following combinations ; (1) Band34-Band35 (BTD(t)-μ < kσ, k=-2.0:), (2) Band31-Band27 (BTD(t)-μ < kσ, k=-2.6), (3) Band31-Band32 (|BTD(t)-μ| < kσ, k=-3.0), and (4) Band20-Band31 (|BTD(t)-μ| < kσ, k=-3.0). Where t, k, m, and s are the season, threshold for cloud identification, average, standard deviation for each distribution of BTD. Until the distribution satisfy the equation, we repeat the test. Then, we move to the next test. We perform this procedure up to test 4. Then we get the pixels without cloud. The result is evaluated using LIDAR data onboard CALIPSO, which has the almost same orbit and constellated with AQUA. After removing the cloud effect, we compute the deviation rate d. As results for 15 years data analysis for 7 volcanoes in Indonesia, when the deviation rate exceeds in target volcanoes 6σ, there is a tendency to have a lava volcanic activities. However, without removing the cloud effects, we find it is difficult to identify the anomaly related to the lava activities. Therefore, it is highly suggestive of the proposed method is valid for monitoring volcanoes and volcanic risk reduction.

Keywords: MODIS, Volcano, Remote Sensing

MT survey and its preliminary result at Boso Peninsula, Japan (2)

*Naoki Koizumi[1], Hao Cheng[1], Peng Han[1], Chie Yoshino[1], Katsumi Hattori[1], Mao Okuda[2], Kotaro Sugano[2], Midori Hayakawa[2], Toru Mogi[2], Shin'ya Sakanaka[3]

1.Graduate School of Science, Chiba University, 2.Graduate School of Science, Hokkaido University, 3.Department of Earth Science and Technology, Graduate school of Engineering and Resource Science, Akita University

A magnetotelluric (MT) survey is one of the methods to understand the underground electric properties. In Boso area, Japan, there are three main topic to perform the MT survey; (1) to estimate underground resistivity structures related to the plate boundaries, seamount, asperities, and slow slip events; (2) to obtain a regional realistic resistivity structure for the numerical simulation in generation and propagation mechanisms of electromagnetic precursors, and (3) to develop a new MT technique to reduce the cultivated noises such as DC-driven train system and factories. For challenges to solve them, we decided to carry out the MT survey in Boso area, Japan during 2014-2016. Due to sensing down to 100 km depth, we used induction and fluxgate magnetometers. We set 41 and 12 sites for induction and fluxgate type magnetometers, respectively.
The preliminary 1-D inversion results for 41 induction sites show that we can presume apparent resistivity about 1 km - 10 km depth from the surface, but relatively not clear about 100 m - 1 km and 10 km - 100 km depth from the surface. In addition, we found that the noises tend to be weaker in the southern region compared to the northern region.
To presume resistivity structure in Boso Peninsula, it is necessary to remove the artificial noises from observed MT data. The observed noises have characteristics of transient signals and processes in time domain are required such as singular spectrum analysis. Moreover, twe will analyze the observed data of 12 stations in which we used fluxgate type magnetometer to obtain lower frequency and deeper information.

Keywords: MT method, Boso Peninsula

