

the frequency domain analyses of seismic-electric abnormal signals

Xia Yaqin(1) Duan Yuxiao(1), Jin Ling(2)

**Research Institute of Earthquake Prediction in Beijing University of Technology,
Beijing 100022, China.**

xiazi@bjut.edu.cn

Abstract In the paper, the study objects are three kinds of typical seismic-electric abnormal signals, which had been received by our seismic-electrical observation system. Using theory of Fourier Transform and Wavelet Transform to analyze them. The result of the analyses shows the foregoing seismic-electrical signals are useful ground-wave signals. Keyword seismic-electric abnormal signals, Fourier Transform, Wavelet Transform, frequency domain character

Shallow depth investigation via seismoelectric method in the north of Tehran, Iran

M. Montahaei M.A.Riahi

institute of geophysics, tehran university, Iran

mmontaha@ut.ac.ir

Seismoelectric (SE) is a prospecting method, based on seismic-electromagnetic waves in which seismic sources are used to generate this phenomenon and common electrodes used in geoelectric method record the SE signals. In this method the boundaries of the subsurface layers are determined by recording the horizontal component of the electric field of an electromagnetic wave, produced by a seismic wave passing an elastic or electrochemical contact. In this paper the design of the field experiment in the north of Tehran has been outlined. After removing noise in the electroseismic data an interpretation of the field data is presented and comparing with seismic data it's demonstrated that how and where the different electroseismic signals originated in the subsurface. Finally these obtained results showed that this method is reliable and suitable in the field of exploration geophysics.

Self potential monitoring at Onikone Geyser

Y. Ogawa(1) Y. Ogawa(1), M. Matsuo(2). N. Ujihara(3), and K. Aizawa(4)

(1)Volcanic Fluid Research Center, Tokyo Institute of Technology (2)Volcanic Fluid Research Center, Tokyo Institute of Technology (3)Volcanic Fluid Research Center, Tokyo Institute of Technology (4)Volcanic Fluid Research Center, Tokyo Institute of Technology

oga@ksvo.titech.ac.jp

A geyser, as a proxy for a volcano, will be useful in studying the eruption environment. We carried out multi-electrode monitoring of a geyser at Onikobe caldera, NE Japan. This geyser has a 140-second continuous flushing with the interval of 18 minutes. The height of the flushing water reaches 16m. We deployed 12 Pb-PbCl₂ electrodes within 10m around the hole. We successfully measured the temporal changes of self potentials which were due to the flashings. We inverted a point source of SP (which corresponds to a divergence of the fluid velocity). The point source stays in the reservoir until it gets full and moves toward the hole during flushing.

Comparison of galvanic and induction excitation in probing deep earth structures.

R. Logunovich (1) M. N. Berdichevsky (2)

(1) Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation RAS (2) Moscow State University

r.logunovich@gmail.com

There are two following types of electromagnetic (EM) excitation of core and mantle conductors in the earth. 1. Galvanic-type excitation is related to electric currents that leak from the sedimentary cover through the highly resistive lithosphere and propagate then within deep conductors. The contribution of such conductors to observed EM fields depends on the resistance of the lithosphere. Highly resistive lithosphere is potentially able to shield the presence of deeper conductors. 2. Induction-type excitation is due to a local induction excited within the deep (sub-lithospheric) conductors and depends very little on the value of lithosphere's resistance. If induction excitation takes place then the data become more informative about earth structures. To compare the possible effect of induction-type excitation with that of galvanic-type we performed a number of numerical tests, using powerful forward modelling code x3d (Avdeev et al., 2002). The models under consideration include the highly resistive lithosphere and the core and mantle 3-D conductors of various resistivities. Our results show that the galvanic-type excitation dominates over the induction-type at periods that are typical for MT soundings and for many reasonable values of the resistivity structure in the earth. Such a shielding can significantly reduce the impact of deep conductors on the MT data.

Geophysical characterization of the Carboneras fault

M. Coll (1), M. Garreta (1), P. Queralt (1), J. Ledo (1), X. Moreno (2), E. Masana (1), E. Gracia (2)

(1) Universitat de Barcelona, (2) Unitat de Tecnologia Marina, Centre Mediterrani d'Investigacions Marines i Ambientals, CSIC, Barcelona.

MiquelColl@ub.edu

A joint GPR and ERT study of the Carboneras fault is presented. The aim of this study was to localize the most favourable areas to place a trench for paleoseismological investigations. The Carboneras fault is one of the longest geological structures in surface in the eastern part of the Betics (Eastern Betics Shear Zone, EBSZ). The geophysical data was acquired over alluvial deposits not affected by the fault. Here we present two parallel profiles crossing the fault at normal angle. The ERT data was acquired using a Wenner-Schulmberger dipole with a 2 m separation between electrodes. The GPR data was acquired using the 25, 50, 100 and 200 MHz antennas.

Interpretation of GPR profiles allows the interpretation of some fractured zones, the ERT models show lateral resistivity changes associated to lithological variation due to the fault activity. These models are compared with the trench images that were open last fall.

A magnetotelluric study on Bam's fault zone

B. Oskooi

Institute of Geophysics, University of Tehran, Iran

boskooi@ut.ac.ir

Bam lies within the western of two north-south strike-slip fault systems located on each side of the aseismic Lut desert (central Iran). An earthquake devastated the town on 26 December 2003. A magnetotelluric study across the faults has been conducted to find out the electrical characteristics of the region. The eastern fault is clearly seen on the ground with an offset of about 10 m and also on the satellite photos. The western fault is hidden. There is a strong research idea about the exact location and the depth to the bedrock in the region which is fulfilled by the present MT study.

Electromagnetic imaging using the VLF-EM method around surface fault rupture of Fethiye-Burdur, Turkey

M. Bayrak (1) M. Bayrak (1), A. Gürer (2), Ö.F. Gürer (3)

(1) Istanbul University, (2)Istanbul University, (3) Kocaeli University

mbayrak@istanbul.edu.tr

Very low frequency electromagnetic (VLF-EM) survey was carried out across fault rupture of Fethiye-Burdur Fault Zone (FBFZ), Turkey, to characterize features of shallow faults and explore the possible location of the subsurface faulting where the surface rupture is covered by basins. VLF-EM parameters such as the apparent resistivity, phase, real and imaginary components were acquired using 19.6 kHz (GBZ, Oxford, England) radio station. VLF-EM field real and imaginary components then were filtered using Karous & Hjelt Filter and result plotted as real and imaginary 2-D current density pseudosections over the survey lines. The pseudosections were examined for significant anomalies that could be related to fault ruptures. Also, VLF-EM measurements in the region show that the surface faults continue beneath the sedimentary covers of the basins.

Study of historical magnetotelluric data recorded at Ebro Observatory (Spain)

J.J. Curto (1) C. Pallares (1) and A. Marcuello (2)

(1) Observatori de l'Ebre, CSIC - Universitat Ramon Llull, (2) Universitat de Barcelona

jjcurto@obsebre.es

The Ebre Observatory is one of the oldest geophysical observatories in Spain, which was established in 1904 and it is still working since then. This observatory has long magnetic and telluric data series. While geomagnetic field is still measured nowadays, telluric measurements however had to be stopped in the seventies because of the increase of electric man-made noise. In this work we present these magnetotelluric data that allow to study very high periods ($> 0,1$ Ms). Induction arrows as well as tensorial impedance (apparent resistivity and phase curves) for this area are shown.

**Geoelectrical characterization of the deltaic Tordera aquifer
(NE Spain)**

**A. Marcuello (1) E. Falgàs (1), J.L. Plata (2), J.J. Ledo (1), P. Queralt
(1), F. Rubio (2)**

(1) Universitat de Barcelona, (2) Instituto Geológico y Minero de España

alex.marcuello@ub.edu

The deltaic Tordera aquifer is a coastal alluvial aquifer system, which is composed of at least two aquifers separated by an aquitard with an irregular lateral extension. In order to describe its main geoelectrical features and gain knowledge about the hydrogeological parameters, two perpendicular profiles were acquired using three geoelectrical techniques (electrical resistivity tomography, time-domain electromagnetics and audiomagnetotellurics). In this work the integrated geoelectrical model is presented, which is in agreement with the hydrogeological model of two aquifers. It clearly shows the seawater intrusion near the coastline as well as other conductive anomalies, which are associated to preferred paths of that intrusion, associated to paleochannels.

Parameter sensitivity maps of geoelectric methods

S. Szalai (1) L. Szarka (1)

(1) Geodetic and Geophysical Research Institute of the Hungarian Academy of Sciences, H-9400 Sopron POB 5, Hungary

szalai@ggki.hu

Parameter sensitivity maps allow a better understanding of various geoelectric responses, and they are also helpful in designing optimal new arrays for specific problems. We constructed systematic parameter sensitivity maps for various geoelectric arrays, and in this paper several examples are presented, among others for non-linear and focussed arrays. Our parameter sensitivity values are computed from the response of a small-size cube in a homogeneous subsurface at three different depths. Instead of 3D numerical modelling results we consider the small cube as a superposition of three electric dipoles, corresponding to the electric charge accumulation at the opposite cube faces. We apply simple analytical formulas and we present the parameter sensitivity values separately for the individual dipoles. Several theoretical and practical aspects are discussed. We recommend a methodical use of parameter sensitivity maps in geoelectric prospecting

**Azimuthal Geoelectric Characterization of Fracture Flow
in the New Jersey Highlands Bedrock**

DeBonne N. Wishart DeBonne Wishart(1), Lee D. Slater (2)

Rutgers, The State University of New Jersey

debonnewishart@yahoo.com

The analysis of groundwater flow in fractured bedrocks is complex as anisotropy is often masked by subsurface heterogeneity at the field scale. We propose that the azimuthal resistivity survey (ARS) combined with the azimuthal self potential (ASP) technique increases the potential to delineate groundwater flow paths in fractured bedrocks. We performed geoelectrical investigations at eight sites in the New Jersey Highlands using asymmetric azimuthal arrays (self potential (SP), electrical resistivity (ER), and induced polarization (IP)) to (1) improve the characterization of hydraulic anisotropy associated with the strike of dominant fractures sets and (2) distinguish anisotropy from heterogeneity in the subsurface.

Conductivity in small-world networks

Arne Lüllmann

Institut für Geophysik Universität Göttingen Germany

arne.luellmann@geo.physik.uni-goettingen.de

We investigate the electrical properties of small-world networks, which evolve from regular lattices of ohmic resistances due to the replacement of several regular by shortcut-connections. The networks combine diverse characteristics of random and regular networks like low average path lengths as well as high cluster-coefficients. These phenomenons have an effect on the macro-parameters of the electrical networks. It is possible to achieve higher bulk conductivities by modifying the network structure while using the same amount of conductive material as in regular lattices. With regard to the conduction mechanism in crustal structures, measured impedances can be explained with a lower requirement of conductive material.

Perturbation of magnetotelluric signals and its relation to precursory phenomena for the low magnitude seismic activity in Koyna region, Western India

Sarana Basava, K. Haritha, T.Srinivasulu, M.V.C.Sarma, G.Virupakshi and T.Harinarayana

National Geophysical Research Institute, Hyderabad – 500 007, India

sbasava@hotmail.com

Seismic activity continuously for four decades in a small region of about 200 km near Koyna region has attracted many earth scientists for detailed investigation in the area. The region is investigated not only to understand the deep Crustal structure but also monitored to record precursory signals. The region is well known for frequent low magnitude earthquakes of 4 and 5. Thus the area became an excellent laboratory to monitor various geophysical parameters. During monsoon season of 2005, the reservoir in Koyna has reached the maximum level of about 657 meters and during April-June 2006 also the monsoon is very active. Based on the past experience of increase seismic activity due to fast loading and unloading of water levels in the reservoir, prediction of an earthquake of magnitude about 5 has been inferred near Koyna. Utilizing this opportunity for a possible occurrence of an earthquake of magnitude 5 multi-parametric experimental observations have been conducted by National Geophysical Research Institute. Towards this direction continuous monitoring of magnetotelluric signals have been taken up near Koyna on an experimental basis during 14th to 25th November 2005. GMS-05 magnetotelluric digital data acquisition system has been installed at Waghini site near Koyna to record the signals. During this period an earthquake has occurred with magnitude of 4.1 on 21st November 2005. The perturbation of these signals are compared with the magnetic field variations recorded at a near by station using LEMI system and analyzed. The magnetotelluric signals due to seismic activity have been analyzed in the form of frequency analysis of the time series data, the scalar apparent resistivity values, polarization parameters and their possible relation with the seismic activity are presented.

Geoelectrical Investigations for the Detection and Characterization of Groundwater and Geological Features in Area No. 3 of Gol-e-Gohar Iron Ore Mine, Iran.

Azadeh Hojat (1), Saeed Karimi Nasab(2), Abolghasem Kamkar Rouhani(3)

(1)Institute of Geophysics, Tehran University, P.O. Box 14155-6466, Tehran, I. R., Iran, (2)Mining Engineering Department, Shahid Bahonar University of Kerman, Kerman, Iran, (3)Faculty of Mining and Geophysics, Shahrood University of Technology, Shahrood, Iran

ahojat@ut.ac.ir

Various problems caused by the presence of groundwater in Area No. 1 of Gol-e- Gohar Iron ore mine, have made mining experts seek appropriate methods for preventing the flow of groundwater into the mine pit. Due to the expected negative influence of subsurface water on the mining activities in Area No. 3 of this mine, a suitable drainage system should be designed and established before commencement of mining activities.

Geoelectrical investigations using resistivity method were carried out in the area to determine groundwater conditions (e.g. porosity, permeability, depth and thickness of water-bearing formation) as well as subsurface geological features such as faults, depth to bedrock, and lithologic characteristics of geological layers. Alluvial overburden and moderate topographic conditions in Area No. 3 have made it practical to apply geoelectrical methods in the area. Twenty five resistivity soundings with maximum electrode spacing of 1400m were performed in the area. A square grid of 500 * 500 m was set up to cover the whole area.

One-dimensional interpretation of the sounding data showed the depth to water table to be 40-60m with an average thickness of 20-30m for the water-bearing formation. It was also inferred from the sounding data interpretations that the resistivity of the water-bearing formation was in the range of 12-26 Ω m, indicating high electrical conductivity of groundwater, interpreted to be due to high salinity and concentration of total dissolved solids (TDS) in the groundwater, as well as the clay content of the formation. This interpretation was confirmed by 2-D section results.

To investigate lateral resistivity changes and faulting systems, resistivity profiling is recommended. By applying induced polarization (IP) and self-potential (SP) methods, the ambiguities arising from the interpretation of resistivity data can be removed or reduced.

Comparison of GPR and ERT methods as tools to recognition the phosphatic deposit of Sidi Chennane (Morocco)

T. Teixidó (1), A. Kchikach (2), J. A. Peña (1), J. Khyati (2)

(1) IAGPDS, Universidad de Granada, (2) Faculté des sciences et techniques, Université Cadi Ayyad, Marrakech

tteixido@iag.ugr.es

Exploration of the phosphatic layers in Sidi Chennane deposit collides frequently with problems due to the existence of sterile bodies. The aim of this study is to localize these bodies, masked by the Quaternary cover, using the GPR and ERT profiles. The GPR data was acquired with 40 and 80 MHz antennas en the ERT data was acquired using a Wenner-Schlumberger and Dipole-Dipole dispositives with 5 m separation between electrodes. The profiles were made above visible sterile bodies (near of the exploitation trench) for improving the interpretation and comparison among results. This study concerns to the analysis of the results and the procedures optimizing the recognition of wide phosphatic areas with GPR method.

Recognition of the fault zone in Bam using the Controlled Source Tensor Magnetotelluric (CSTMT) method

Moghadas, D. * and Oskooi, B. *

* Institute of geophysics, Tehran University, P.O.Box 14155-6466, Tehran, Iran.

dmoghadas@ut.ac.ir

An earthquake devastated the town of Bam in southeast Iran on 26 December 2003, destroying over 50% of its buildings. Surface displacements and decorrelation effects reveal that over 2 m of slip occurred at depth on a fault that had not previously been identified. Bam lies within the western of two north-south, strike-slip fault systems located on each side of the aseismic Lut desert, which together accommodate the relative motion between central Iran and Afghanistan, part of the Eurasian plate.

In this paper we experienced Controlled Source Tensor Magnetotelluric (CSTMT) method to recognize the fault zone in Bam area. Data were collected along a profile with an approximately W-E direction and perpendicular to the fault. Data acquisition carried out by using ENVIROMT system from Uppsala University, Sweden. The CSTMT field measurements resolved well the conductors at upper levels using data for several frequencies in range 1000-20000 HZ.

Electrical crustal structure of the Alhoceima region (Morocco) and its relationship with earthquake activity

J. Ledo (1), E. Falgàs (1), A. Martí (1), O. Rosell (1), P. Ruano, P. Queralt, A. Marcuello,(1), J. Galindo-Zaldivar (2), A. Pedrera (2), A. Ruiz-Constan (2) O,Azzouz (3), L. Ameza (3), A. Chalouan (4), K. Bargach (4), M. Ahmamou (4), A. C. López-Garrido (5).

(1) Departament de Geodinàmica i Geofísica, Universitat de Barcelona, Spain. (2) Departamento de Geodinámica, Universidad de Granada, Spain. (3) Département de Géologie, Faculté des Sciences, Université Mohammed premier- Oujda. Morocco. (4) Département des Sciences de la Terre, Faculté des Sciences, Université Mohammed V, B.P. 1014, Rabat, Morocco. (5) IACT, CSIC-Universidad de Granada. Spain.

jledo@ub.edu

The Alhoceima region has suffered several seismic crisis that reached a maximum in the 6.4 magnitude earthquake occurred in February 2004. Seismic data suggests that this earthquake was associated to the NW-SE convergence between plates, that in this locality has produced an strike-slip fault with a NS or EW orientation. Within a Spanish-Morocco scientific cooperation frame, in February 2006, 21 broadband MT sites (period range: 0.001 s to 1000 s) were collected. In this work we present the preliminary results obtained from the analysis and 3D inversion of the magnetotelluric data.