The electrical lithosphere beneath the Kaapvaal Craton: Links to kimberlites

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A magnetotelluric (MT) transect across the southern African Kaapvaal craton and its surrounding terranes has revealed complex structure in the lithospheric mantle. Models derived from the MT data show regions of resistive lithosphere that are about 200-250km thick. Unlike seismic tomography models, the resistive lithosphere does not form a single contiguous block beneath the continent, but instead is fragmented. One gap in the resistive lithosphere underlies one of the main regions of kimberlites and diamond production. In contrast, there are no diamondiferous kimberlites where we see thick resistive lithosphere.

Analysis of POLARIS MT data from the Slave Craton, Northwest Territories, Canada

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Since December, 2004 5-component, long-period MT data have been acquired continuously, apart from interruptions, at five locations on the Slave craton in northern Canada and transmitted by satellite in near real-time to a downlink station in Ottawa. The MT fields are digitized at 8 Hz, and the magnetometers are Narod ring-core fluxgates. This paper gives examples of the recordings, discuss problems encountered, and show the first estimates of the MT transfer functions. These recordings are being undertaken as part of the Portable Observatories for Lithospheric Analysis and Research Investigating Seismicity (POLARIS) project (www.polarisnet.ca).

Deep geological structure of the In Ouzzal Granulitic Terrane (NW Hoggar, South of Algeria) obtained along 100 km magnetotelluric profile

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The In Ouzzal Granulitic Terrane is an elongated north-south bloc of more than 400 km long and 80 km wide in its northern limit and becomes thinner to the south until it disappears in its south edge at the Malian boundary. This terrane is considered as an Archaean exotic bloc remobilized during a Paleoproterozoic ultrahigh temperature metamorphsm. The boundaries of the In Ouzzal granulitic terrane with the branches of the Panafrican belt represents possible sutures along which eclogites and blueschist are identified. With the exception of few regional geophysical studies, there is no geophysical data in the area to define crustal structure. In order to study the deep geological structure of the In Ouzzal, a first MT survey was carried out in the area in march 2005 during which nine broadband (MT/AMT) and three high frequency (AMT) magnetotelluric soundings were acquired along 100 km east-west profile. MT data show a complex structure of the crust and upper mantle beneath In Ouzzal bloc for periods longer than 1 second. A conductive crust is revealed beneath the center of the profile and present a huge resistivity contrast with the crust under the profile two extremities. Very important geological implications concerning In Ouzzal Granulitic Terrane are presented.

Key words: Archaean, In Ouzzal Granulitic, magnetotellurics

Study on the Mantle eclctrical conductivity structure in eastern China

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The GDS and super-long-period MT observation technique is focused on study electric conductivity structures of the upper mantle and the mantle transition zone beneath eastern China by use of long period continuous recording data from geomagnetic and geoelectric stations in China. GDS response functions at more than 20 observatories have been obtained through processing the geomagnetic data. Very long period(>1000000 s) MT response transfered from GDS transfer founction obtained in eastern China(the eastern part of the north-south seismic zone). The electric conductivity structures of the upper mantle and the mantle transition zone beneath the target area are imaged by inversion of MT and GDS responses. The main layer boundaries of conductivity down to depth 1000 km and lateral variational characteristcs of the mantle transition will be inferred.

On the mantle geoelectrical structure in the vicinity of the Trans-European suture zone in Central Europe. CEMES project

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Deep magnetotelluric (MT) soundings were carried out at 12 geomagnetic observatories of the Central and Eastern Europe within CEMES (Central Europe Mantle geoElectrical Structure) project. MT apparent resistivity and phase curves were combined with magnetovariational (MV) sounding curves, obtained using the historical observatory data. We present and compare the results of 1D inversion of the combined MT & MV curves, performed independently by four authors using different algorithms. These results have been rather different and the averaged ones are constructed finally. They characterize mantle conductance structure beneath the East-European Craton and the Phanerozoic Western and partly Central Europe, separated by Trans-European Suture zone.

EarthScope Magnetotelluric Program - the USArray Backbone MT Array

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The National Science Foundation's EarthScope program is an ambitious decade-long effort in three parts: (1) "USArray" to examine the structure of the North American Continental lithosphere; (2) "Plate Boundary Observatory" to examine active plate boundary processes; and (3) "San Andreas Fault Observatory" to observe in situ fault processes. Within USArray, seismic, magnetotelluric and geodetic arrays are being constructed. The MT component consists of a "Backbone" of seven quasi-permanent MT observatories currently being installed at sites in Oregon, California, New Mexico, Missouri and planned for installation in Wisconsin, Ohio and Maine. An array of twenty additional temporary stations will comprise a "Transportable Array" that will occupy a grid nominally 70 km on a side, in selected areas of geodynamic importance. This paper describes the configuration and goals of the Backbone array, as well as details of the instrumentation, telemetry and data flow planned. Further details may be found at http://www.emscope.org - as well as a portal to data that will be freely available in the public domain to the global EM community.

Long Period Telluric-Magnetotelluric Measurements from the Tonga-Kermadec subduction zone, North Island, New Zealand

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A phase tensor analysis of long period (102 ¨C 104 seconds) magnetotelluric (MT) measurements from a 180 km long profile parallel to the Pacific plate subduction direction beneath the North Island, New Zealand is reported. This profile, which extends northwestwards from the accretionary wedge of recent marine sediments along the south east coast of the North Island, spans the width of the Taupo Volcanic Zone (TVZ); a region of active back-arc spreading and active volcanism. At the south eastern (trenchward) end of the profile, minimum principal phases between 100 and 1000 second period are low (¡Ü 25¡ã) but increase north westward towards the TVZ. The pattern of minimum principal phase is consistent with the northwest ward subduction of a resistive Pacific plate with a more conductive mantle wedge beneath the TVZ.

At its south eastern end, measurements consisted of MT sites near the coast and about 40 km inland with six telluric sites in-between. Results were obtained for the period range from 102-104 sec with a recording period of 1 month. The phase tensor ellipses from the telluric sites form a coherent pattern with the adjacent MT sites and show that it is sufficient to observe the magnetic field at widely spaced sites with denser electric field only measurements in-between.

A resistivity cross section of western Turkey by long period magnetotellurics

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Deep electrical resisitivity structure of western Turkey was studied along a ~250 km profile, crossing Istanbul, Sakarya, Tavsanli and Afyon geologic zones. Data were collected at 18 long-period (20 -13000 sec.) magnetotellurics sites in two survey campaigns. Before interpreting by two-dimensional inversion (using original code developed by Ogawa and Uchida, 1996), the data were processed through a tensor decomposition technique, namely Groom-Bailey decomposition that serves to remove the surplus effects of distortion causing three-dimensional bodies and to determine the appropriate geo-electric strike. Several two-dimensional inversion analyses were done for TM and TE modes. The electrical resistivity models in different modes are presented and are correlated with the up-to-date tectonic models concerning Aegean extension.

POLARIS magnetotelluric survey of the Grenville Province, Ontario, Canada

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Magnetotelluric (MT) measurements were made at 47 sites in Ontario, Canada in the POLARIS project to image the electrical resistivity structure of the lithosphere of the Proterozoic Grenville Province. 22 sites are either colocated with, or within 10 km of, POLARIS seismograph sites permitting joint MT-seismic studies. Geoelectric strike directions align with the local geological fabric and after correction for distortion exhibit partial directional correlation with shear-wave splitting fast directions. Distortion and variogram analyses suggest the MT responses are from dominantly 2D resistivity structures. Analyses of the MT data set will include 2-D modelling and inversion of data from denser profiles of sites.

Electrical conductivity beneath the Andean back-arc in Argentina near 36.5 S

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S. Mendoza Province, south of the Nazca flat slab, has widespread recent basaltic volcanism, but no historic activity. Over the last 1 MY, the basalt has evolved from having a slab signature to OIB. In early 2005, we collected 18 MT sites from 67 to 70 W along 36.7 S, near the large caldera Payún Matrú. For a subset of these significantly 3D data, we can justify a regional strike determined from phase tensors and induction vectors of about N 19 W at periods below 200 s and N 33 W at longer periods. Minimum structure 2D inversions of both period ranges imply resistive crust except near the surface. There is no high conductivity clearly causally related to the basaltic volcanism. At the west end of our profile there is lower crustal to upper mantle conductivity that decreases and deepens eastward, which seems more likely to be related to the active Andean volcanic arc.

Regional scale electrical structures delimiting the Rio de la Plata craton at 31.5S, Argentina.

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Magnetotelluric (MT) data were obtained along a 550 km almost west-east profile at around 31.5º S, extended from La Rioja to Entre Rios provinces in Argentina. New MT data, corresponding to the twelve most eastern sites, allowed to complete the determination of the crystalline basement depth below the Chaco-Paranense basin and characterize different geological structures up to upper mantle depths. From dimensionality analysis it was obtained that electrical structures are almost one dimensional (1D) for periods less than 30 s (representing an average depth of about 7 km in the model) while for longer periods they are mainly two-dimensional (2D). In the last case a strike direction oriented parallel to the surface geological strike (around N 6°E) was found. Previously, a resistivity model for the western part of the profile permitted to delimitate the Rio de la Plata craton border which was identified with the suture between it and the Pampean terrain. The model obtained including the new data showed that the bottom of the sedimentary basin extends to a depth of about 5 - 6 km in the central part and tends to be shallower to the eastern end. The craton is the geological structure with the highest resistivity values (¿1000 ohm-m) and a sharp decrease of resistivity appears at a depth of about 200 km, which can be interpreted as the lower limit of the Rio de la Plata craton. The possibility of anisotropy effects in the upper mantle is discussed.

POLARIS long-term magnetotelluric observatories in the Northwest Territories and Southern Ontario, Canada

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The Canadian POLARIS project integrates seismic and magnetotelluric (MT) data acquisition. Seismic and MT observatories share the same satellite telemetry system. Data are publicly available in near real-time on the web. The first POLARIS long-term MT observatories were operational during a two-year period (2004-6) in the diamondiferous region of the Northwest Territories where environmental conditions were particularly challenging. The next three POLARIS MT observatories are being deployed in Southern Ontario. In this densely-populated area, cultural noise is prevalent. MT sites were selected by analyzing shorter-duration recordings at POLARIS seismograph sites and excluding places with high galvanic distortion and unacceptably high noise levels.