Australian Government
Geoscience Australia

AUSGEO news
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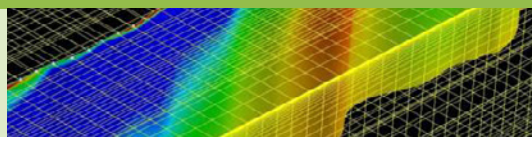
New National Magnetotelluric (MT) survey gets underway

Comprehensive national survey



Ned Stolz

An exciting new project to image the deep-crustal electrical conductivity of the Australian continent commenced in Victoria in November. The Australian Lithospheric Architecture Magnetotelluric Project (AusLAMP) is aimed at acquiring MT soundings across Australia on a grid of approximately 50 km (1/2 degree geodetic). This visionary, big-picture program has been made possible by the new funding Geoscience Australia received in November 2012 for the acquisition of pre-competitive data.

Electrical conductivity imaging allows characterisation of the deep-crust and upper mantle, and can define fundamental blocks of crust, as well as delineate major sutures and boundaries. This information is of significant importance to researchers

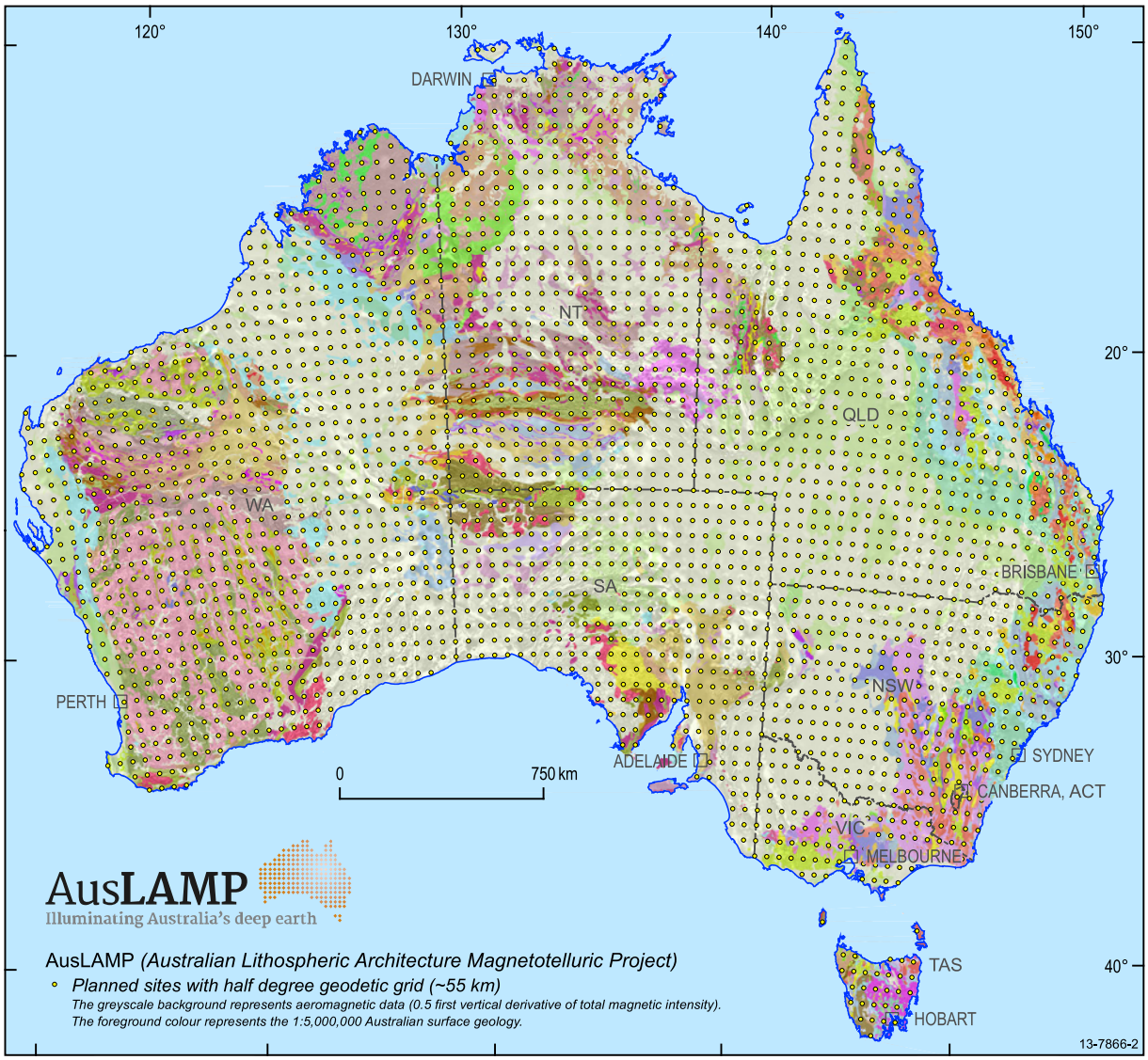


Figure 1. Map of Australia showing the distribution of 50 km by 50 km AusLAMP stations. The background shows the surface geology with Precambrian rocks in darker colours.

attempting to reconstruct the tectonic evolution of the Australian continent. The information also provides fundamental clues to resource explorers about large-scale structures which control mineral deposition and hydrocarbon basin formation. Conductivity images will complement information from national gravity and tele-seismic surveys which map the density and seismic-velocity of the crust and upper mantle.

Investigating Australia's lithospheric architecture is one of the key research themes of the Uncover initiative, launched by the Australian Academy of Science in 2012 to address Australia's declining resource discovery rate. AusLAMP is a national collaboration led by Geoscience Australia with contributions from AuScope (a component of the National Collaborative Research Infrastructure Strategy), universities, research organisations and the State and Northern Territory geological surveys. The acquisition phase of AusLAMP will collect over 2800 MT soundings across Australia over several years. A map showing the proposed approximate location of the AusLAMP stations is presented in Figure 1.

The MT Method

Magnetotelluric imaging measures the Earth's response to naturally occurring magnetic and electrical signals generated by solar activity and lightning strikes. An MT station uses dipoles with electrodes and a magnetometer to continuously record two components of the electric-field and three components of the magnetic field as a time-series. A typical field set-up for MT is shown in Figure 2.

Figure 2. An AusLAMP MT station set-up for continuous recording of electric and magnetic signals in the field.

The time-series measurements are converted to a set of frequency-amplitude/ phase responses—the lower the frequency, the deeper the source of the Earth response. In order to image the deep crust and upper mantle it is necessary to measure very low frequencies, which correspond to long periodicities of up to six hours. To ensure the MT measurement captures strong natural signals at such long periods involves recording continuously for about four weeks.

Converting the magnetic and electric field response from hundreds of MT stations into a coherent image of the deep Earth electrical conductivity structure requires a sophisticated mathematical inversion algorithm. Geoscience Australia has established a powerful MT inversion capability by installing newly developed programs on high performance computers at the National Computational Infrastructure facility at the Australian National University. This software inverts MT measurements to a 3-D Earth conductivity model (Figure 3) and can split large computational problems into smaller components that are then solved in parallel. This will enable the AusLAMP data to be inverted to a very large model thousands of kilometres in the east and west dimensions and hundreds of kilometres in the depth dimension.

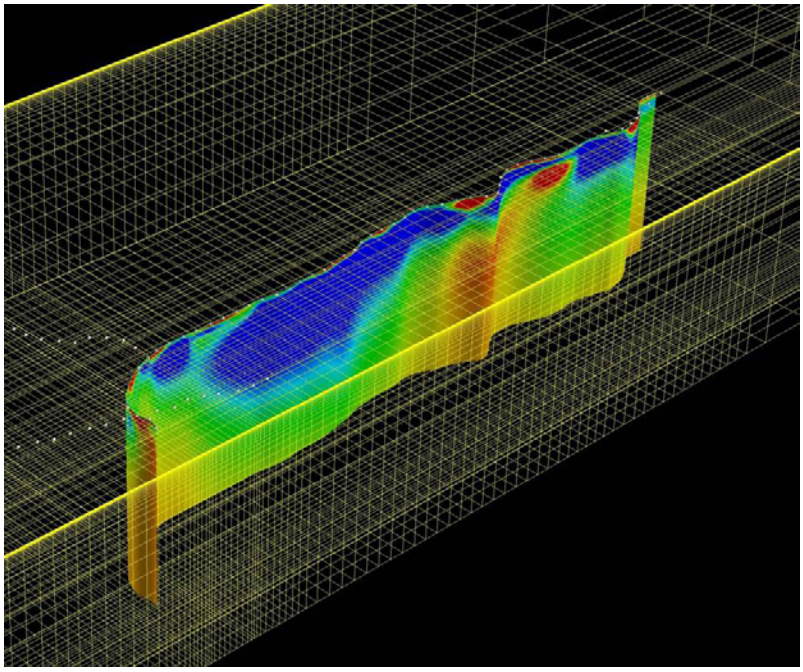


Figure 3. A deep-crustal resistivity image produced by 3D inversion of a transect of long-period MT stations. The profile is approximately 300 km long and the depth extent is about 100 km.

AusLAMP

Establishing MT stations which are robust and secure enough to record continuously for four weeks is a major logistical exercise requiring state of the art equipment, batteries, solar panels, data loggers and communication devices. Initially, AusLAMP will use long period MT equipment purchased through AuScope, maintained by the University of Adelaide and accessed through the ANSIR facility for deep Earth imaging. Approximately 25 sets of AuScope equipment are available at the current time but these must be shared between all the MT researchers in Australia, and cannot be used for AusLAMP exclusively.

The Geological Survey of Victoria provided funding for Geoscience Australia field technicians to begin deploying 10 sets of long period MT equipment in Victoria during November 2013. A series of field visits will recover and re-deploy equipment throughout 2014 so that the entire State is covered by about 95 stations. Deployment will then move on to another State, depending on funding and equipment availability. Geoscience Australia is enthusiastic about collaborating and cooperating with as many organisations as possible to ensure that adequate resources can be made available to complete this visionary, nation-building survey. All data and results will be posted on a dedicated AusLAMP website as soon as they are deemed fit-for-purpose. Australian and international researchers and explorers will be encouraged to access the data and incorporate results into their individual modelling and research programs.

Related articles and websites

AuScope Earth Imaging
http://auscope.org.au/site/imaging.php

ANSIR
http://ansir.org.au/index.php

Geoscience Australia MT
www.ga.gov.au/minerals/disciplines/geophysics/magnetotellurics.html

Uncover
www.science.org.au/policy/uncover.html

For more information

phone Jingming Duan on +61 2 6249 9310
email jingming.duan@ga.gov.au or
email graham.heinson@adelaide.edu.au

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