Delivering pre-competitive data for onshore energy exploration: Geoscience Australia programs in Western Australia

by

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The Onshore Energy Security Program (OESP) is a five-year scheme announced in 2006 designed to reduce risk in exploration and development of onshore energy resources in Australia. The program received $58.9 million of funding to acquire and deliver pre-competitive geophysical and geochemical data as well as value-added geological interpretations and other products for the exploration industry. Projects within the scheme were implemented either at the continental scale, or were focused on particular geological regions identified as having potential to host undiscovered energy resources. The main components of OESP are:

- An Australia-wide airborne geophysical survey (AWAGS) to improve the quality of airborne radiometric and magnetic images for uranium and geothermal energy exploration
- A national geochemical survey to provide consistent baseline information about chemical concentrations in the crust, particularly radioelements such as uranium and thorium
- Regional-scale (100 km to 1000 km) deep-crustal reflection seismic surveys targeting areas prospective for hydrocarbon, uranium, and geothermal energy resources
- Regional-scale Airborne Electromagnetic surveys targeting geological areas with potential for uranium mineralization
- A national project aimed at improving the quality of pre-competitive data and knowledge for targeting geothermal energy systems
- Regional-scale interpretations of the geodynamic framework of major energy provinces based on seismic, potential-field, and other geoscientific datasets.

A full description of OESP projects can be found on the Geoscience Australia website:

<http://www.ga.gov.u/minerals/research/oesp/index.jsp>

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Paterson Province AEM Survey, Western Australia

Regional Airborne Electromagnetic (AEM) surveys are a major component of OESP. The surveys aim to map regional-scale geological features such as unconformities and paleochannel systems that may be controlling uranium mineralization. Production of interpretation products continues apace for the Paterson Province AEM survey flown during 2007 and 2008. The drillhole database compiled to assist with interpreting the AEM data has been released to the public as a standalone product. The database includes locations for over 6500 publicly available drillholes in the Paterson region and logs for over 4300 of these holes (Fig. 1).

Sample-by-sample layered earth inversion (LEI) results including geo-located conductivity–depth sections and depth-slice grids will be released in March 2010. An example of an interpreted LEI conductivity–depth section is shown in Figure 2. The results will be summarized in a report that includes a selection of data products, a reference model description, and validation of the inversions using public-domain drillhole logs. Another important product is the percent data influence (PDI), which indicates the boundary between the data-driven and the model-driven results of the inversion. Since the PDI indicates the effective depth penetration of AEM, Geoscience Australia (GA) has used this parameter to create an AEM 'Go-map' showing where AEM is expected to map beneath surface materials.

The AEM project team will present key results from the Paterson AEM survey to industry and other stakeholders at a one-day workshop in Perth planned for April 2010. In August GA will release an interpretation report describing the geological and energy implications of the AEM survey. The report will highlight the use of regional-scale AEM surveys for decreasing exploration risk in frontier exploration areas for a variety of commodities, particularly uranium.

Kidson–Paterson seismic line

The Canning Basin represents a vast geological frontier in northwestern Australia. The Kidson Sub-basin is a southern

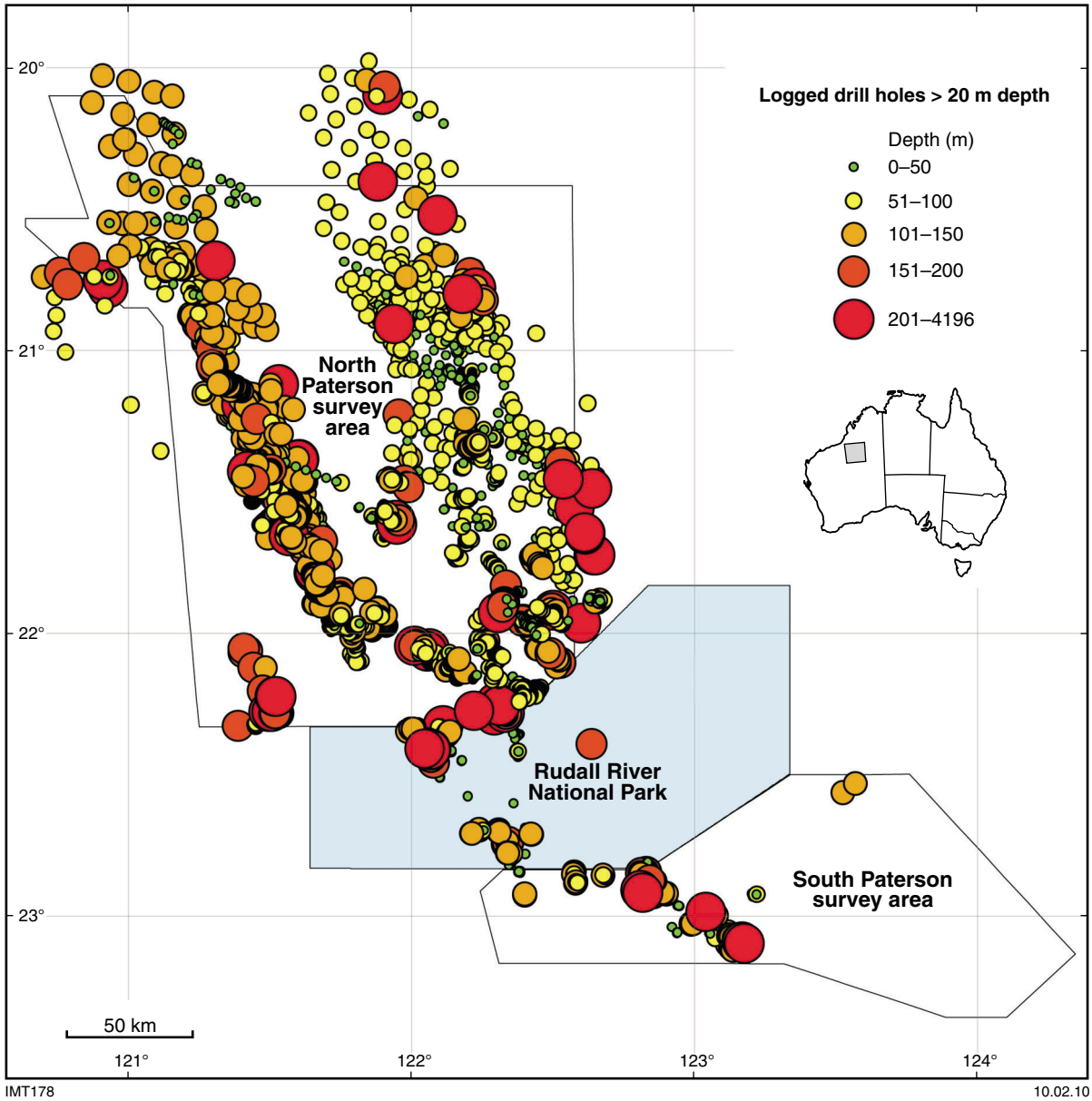

Figure 1. Location and depth of drillholes included in the recently released database, shown with the survey boundaries of the Paterson AEM Project. Inset map shows the location of the Paterson region in northwest Western Australia.

depocentre of the onshore Canning Basin, and is known to contain up to 7 km of Early Ordovician to Cretaceous sedimentary rocks, representing the most complete stratigraphy in the region. Very little data from previous exploration efforts are available and they are of old vintage.

Given that a thick sequence of Ordovician sedimentary rocks is likely to include mature source rocks, the Kidson Sub-Basin may represent a major hydrocarbon province analogous to those encountered in China's Tarim Basin. For this reason, the sub-basin is being targeted in a major deep reflection seismic acquisition project in 2010. This will be the last seismic line to be completed by GA under OESP.

Funding for the project has been secured, and includes a significant contribution from GSWA under their Exploration Incentive Scheme (EIS). A transect of over 750 km along the Canning Stock Route is proposed (Fig. 3), extending from the Crossland Platform in the northeast to the Paterson Province in the southwest. Negotiation by GA and GSWA staff in late 2009 has ensured cooperation from the traditional owners for this vast region.

The Kidson–Paterson seismic line will be one of the logistically most difficult projects ever undertaken by GA. The region is extremely remote with poor roads and sparse infrastructure. The Canning Stock Route is very narrow and crosses a number of sand dunes, which present a challenge to moving seismic equipment and vibroseis trucks. Accommodation and messing for the acquisition crew will also be difficult due to lack of water and suitable camp-sites.

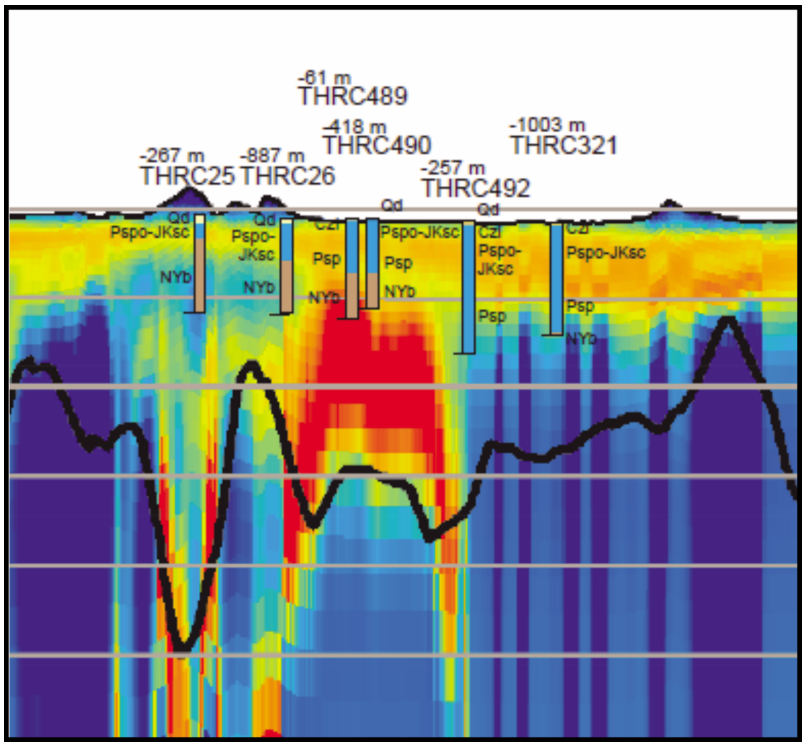

Figure 2. Drillholes with logged geology overlain on a conductivity–depth section derived from a layered earth inversion of AEM data from the Paterson Project. Hot colours indicate conductors whereas cool colours indicate resistors. The orange near-surface material corresponds to Permian (or Jurassic) sedimentary rocks and the red zone at depth corresponds to Broadhurst Shale of the Yeneena Basin. The thick black line indicates the percent data influence (PDI), or the depth to which the AEM system is effectively penetrating.

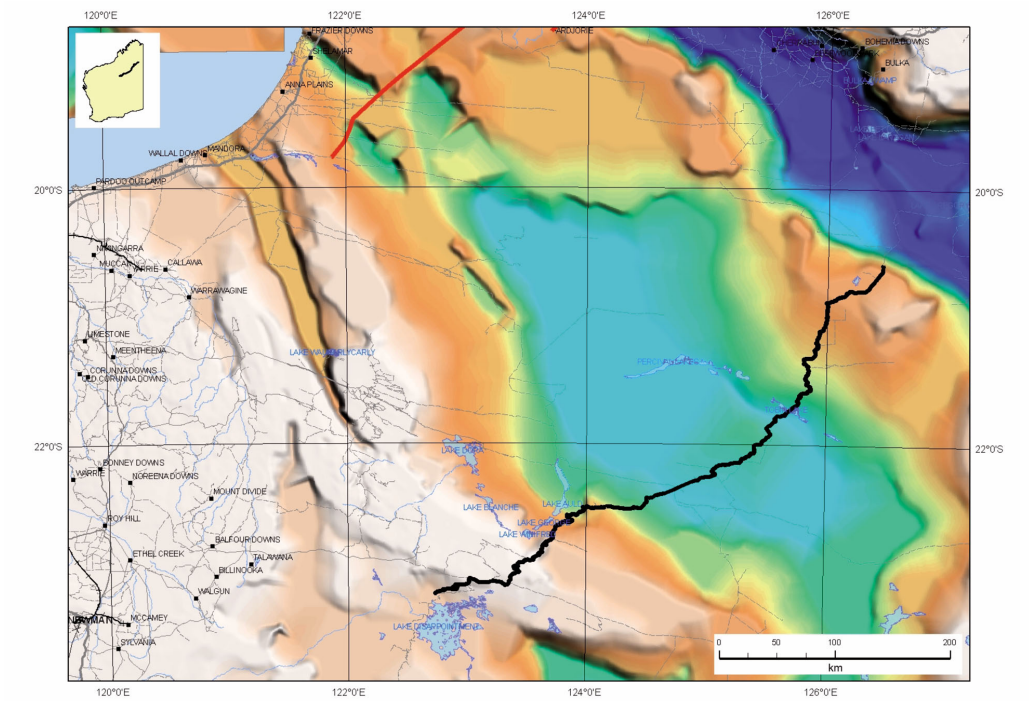

Figure 3. SEEBASE™ depth to basement image (hot colours = shallow, cool colours = deep) of the Canning Basin region in northwest WA showing the planned location of the Kidson–Paterson seismic line. Length of the proposed line shown is 776 km.

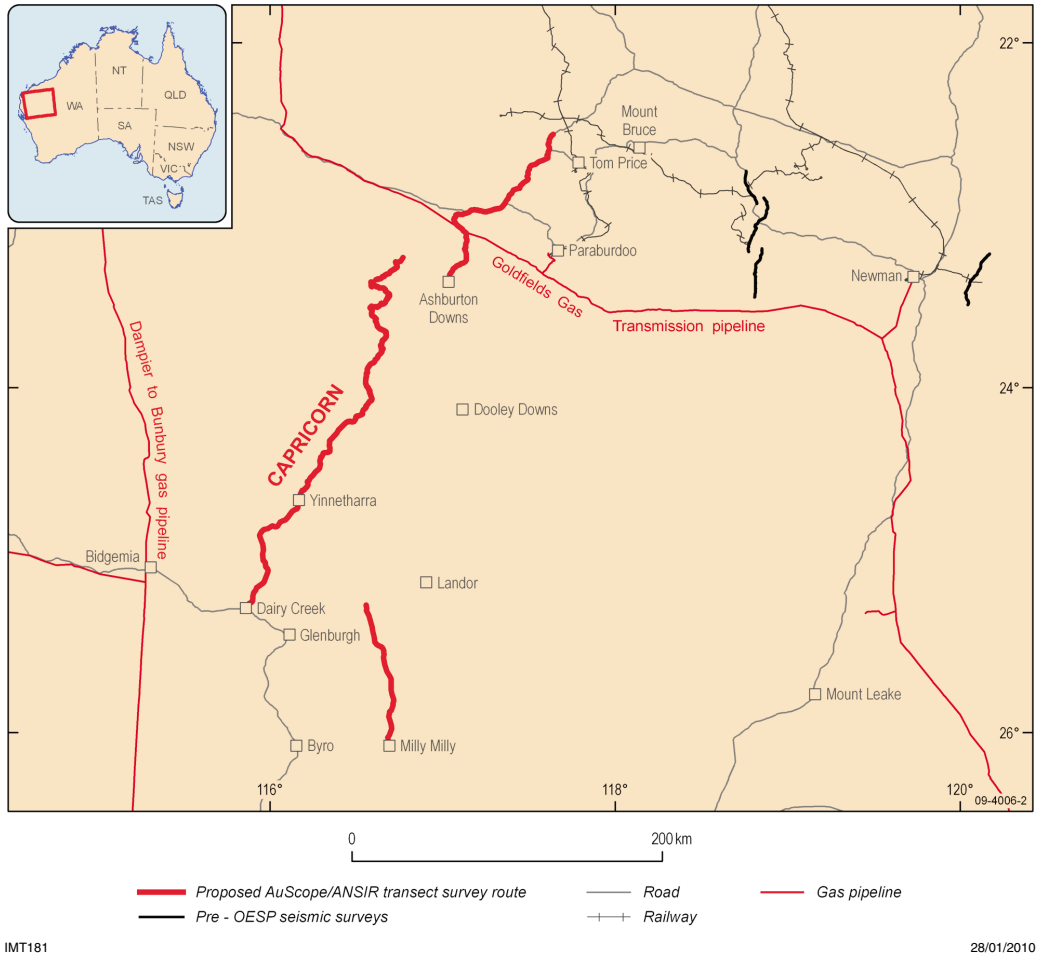

Figure 4. Location plan for the proposed Capricorn seismic line. The total length for the three line segments is about 570 km.

Seismic data acquisition is planned to commence in May. The survey is expected to take four months to complete, and will be the most expensive onshore seismic project GA has ever undertaken.

Capricorn seismic line

Other onshore seismic acquisitions being managed by Geoscience Australia in 2010 include the AuScope–GSWA-funded line in the Capricorn region and a GSWA-funded line in the northern Yilgarn. AuScope Earth Imaging is funded by the National Collaborative Research Infrastructure Strategy (NCRIS) to acquire deep crustal reflection seismic, passive seismic, and magnetotelluric data across interpreted major tectonic structures in the Australian continent. The Capricorn seismic traverse seeks to establish whether the Archean Pilbara and Yilgarn Cratons are directly linked beneath the Capricorn Orogen, or if they are separated by Proterozoic crust. It will also image the basement beneath the Proterozoic basins in the area such as the Ashburton and Earaheedy Basins. The location of the proposed transect is shown in Figure 4. Acquisition is expected to commence around June–July 2010.

Conclusion

OESP has been underway for three years and has successfully released a number of datasets that demonstrate the relevance of its programs to the resource exploration sector. National and regional projects are now well-established and occupied in processing, analysing, and reporting on acquired data to enhance the impact of the program. Datasets and products are focused on hydrocarbon, geothermal, and uranium energy systems, but will also assist companies exploring for base metals, gold, and other commodities, and can also be applied to land use management and groundwater assessments.