

Government-Funded Deep Geophysical Surveys to Encourage Mineral Exploration: Results from the Western Australian “Exploration Incentives Scheme”

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To encourage exploration in Western Australia (WA) the Western Australian Government, through the Geological Survey of Western Australia established an “Exploration Incentive Scheme” (EIS) in 2009. EIS has several components, one of which acquisition of deep geophysical datasets. “Terrane-scale” magnetotelluric (MT) and passive seismic datasets have been collected in several regions. The main objective of these surveys was locating major geological boundaries such as craton margins, suture zones and other transcrustal structures. These are known to be indicators of prospectivity at this scale. More recently, work has comprised “district (camp) scale” surveys, concentrating on defining components of mineral systems in the deep crust and mantle in the vicinity of known deposits.

Terrain-Scale Studies

The Capricorn Orogen is a region of Archean to Proterozoic rocks with a complex history of magmatism, metamorphism and deformation (Johnson et al., 2013). It contains several significant base metals and gold deposits, but it is generally considered to be under explored.

The deep geophysical component of the Capricorn Orogen study comprised acquisition of broad band and long period MT measurements. The seismic component of the experiment consisted of the deployment of two arrays of passive seismometers. The seismic data were analyzed using teleseismic methods, ambient noise methods and body-wave tomographic methods to produce a range of complementary interpretation products.

The availability of several types of geophysical data has proved to be essential in creating a reliable interpretation. A series of basement terranes have been identified, which are not exposed due to the thick overlying sedimentary basins. The mapping of fundamental geological (terrane) boundaries beneath the cover has allowed the most prospective regions in the overlying cover to be identified.

Camp-scale Targeting Studies

The Archean Yilgarn Craton is host to world-class orogenic gold deposits. MT surveys from near the Gruyere and Paddington-Kanowna gold deposits have identified conductive regions apparently related to alteration caused by mineralizing fluids (Dentith et al., 2018). These range from pipe-like regions directly below known deposits, to conductive regions in the lower crust and lower lithosphere, which may be fluid source zones or palaeo-reservoirs. Modelling of these data is on-going, seeking to constrain the nature of these features.

Discussion and Summary

In Western Australia, MT and passive seismic data has proved to be an excellent means of mapping large-scale crustal structures. Very interesting responses have been detected in camp-scale MT studies, with preliminary interpretations suggesting it is possible to map entire orogenic gold mineral systems. This combination of data allows much greater confidence to be placed in an interpretation.

References

- Dentith et al., 2018. Electromagnetic imaging of an Archean orogenic gold mineral systems: Gruyere deposit, Yilgarn Craton? Poster presented at GSWA Open Day, Fremantle.
- Johnson, S., et al. (2013), Crustal architecture of the Capricorn Orogen, Western Australia and associated metallogeny, Australian Journal of Earth Sciences, 60(6-7), 681-705.

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