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Testing bold ideas

Magnetotellurics has excited with its ability to paint the big picture about where to explore. However, can this technology even define a prospect and tell precisely where to drill? An innovative junior explorer is putting it to the test. By **David Upton**

The magnetotellurics technology has developed rapidly over the past five years thanks to world-leading research in Australia, led by the University of Adelaide's Professor Graham Heinson.

MT surveys are similar to electromagnetic surveys in measuring the electrical resistance of the subsurface. Resistivity contrasts can tell a lot about the nature and the geometry of rocks below the surface. Even better, rocks with especially low resistivity can suggest the location of valuable metal sulphides.

EM measures the response to a current induced by transmitters, and has a limit of about 500m.

MT can image the subsurface down to depths of 300km and beyond, albeit at much lower resolution.

It achieves this by relying on natural or telluric currents created by solar winds and lightning strikes in the equatorial region.

This depth capability has excited big-thinking explorationists because it can reveal the kind of crustal-scale features that often act as conduits for mineralising fluids all the way from the mantle to mineable depths.

MT has also won hefty support from Australia's geoscience agencies because it will allow an exponential leap in knowledge of Australia's crust and help crack the code for successful exploration under cover.

The technology is shaping up as the next big thing in pre-competitive data, taking over from aeromagnetic data in the 1990s and 2000s, and gravity before that.

Geoscience Australia is leading a national MT survey known as the Australian Lithospheric Architecture Magnetotelluric Project – or AusLAMP – based on more than 1000 receiver stations on a 50km grid.

The 50km grid size means MT is just the first step in exploration targeting.

However, could much tighter grids improve resolution right down to prospect scale?

Heinson's groundbreaking work on the Gawler Craton has already shown that tighter grids can really sharpen resolution.

His map of Olympic Dam and its surrounds, based on a series of traverses of MT receivers, shows conductive "fingers" swirling up from the mantle underneath Olympic Dam, Wirrda Well and three other locations that could be the location of lookalike iron oxide-copper-gold deposits.

These slender "fingers" help define exploration sites, however, are still not at a scale that could be used to make decisions about where to drill.

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The Gawler Craton's two largest explorers, BHP and OZ Minerals, are working with Heinson to build on his original work, but are not sharing their results – at least not any time soon.

The good news is an innovative junior by the name of Ausmex Mining Group is doing a similar exercise with Heinson in full public view at its Burra project in South Australia. Ausmex is targeting IOCGs. This makes sense because Burra is in similar position to Olympic Dam and Carrapateena on the eastern margin of the Gawler Craton, although there has always been controversy about Burra's deposit style, which includes nickel, cobalt, zinc, gold and rare earths.

Ausmex put together a tenement package of 7010sq.km around the historic Burra copper mine, 150km north of Adelaide, after newly released AusLAMP data revealed a big centre of highly conductive, shallow crust.

The AusLAMP results added to the long-held view that Burra had not revealed its real potential.

Burra was Australia's first copper mine, with underground extraction of very high-grade supergene and secondary ore beginning in 1845.

Burra's Monster Mine produced 50,000 tonnes of copper by the time it closed in 1877.

Mining resumed by open cut in the early 1970s and ceased in 1981.

Ausmex is certainly not the first modern explorer to take a fresh look at Burra.

PNX Metals, formerly Phoenix Copper, spent many years and several million dollars searching for an economic deposit.

PNX still holds tenements in the area, all of which are subject to a farm-in with Ausmex, but has shifted its attention to the Northern Territory.

The Burra project is being driven by Ausmex non-executive director, Geoff Kidd.

He told *Australia's Mining Monthly* that previous exploration was heavily influenced by the abundant outcrops in the Burra area.

"When we started to look at it, it was obvious a number of companies had been

there before and drilled a lot of holes based on the outcropping mineralisation, all of it without success," he said.

"I came to the conclusion that, if we did the same thing, we were likely to get the same result. So, instead of concentrating on the outcrop, we needed a new way to really work out what's going on there."

Kidd said early conversations with the Geological Survey of South Australia led to a fresh approach based on MT.

"There is a really close association between GSSA and Adelaide University and they interact really well," he said.

"All of a sudden, I was there talking with Graham [Heinson] and the penny dropped that MT could be the answer for us. It was really fortuitous that the AusLAMP results were coming out at that time."

The first step by Ausmex was to commission Professor Heinson's team to conduct an in-fill MT survey at Burra, bringing the 50km AusLAMP grid down to just 10km.

This is the first time an explorer has leveraged AusLAMP in this way, which means the Burra project is being watched closely – in Australia and the rest of the world – as a pioneering application of one of the biggest initiatives in public geoscience in decades.

The initial results are highly encouraging, with 2D and 3D inversion modelling of data from the 10km grid dramatically improving the resolution of electrically conductive structures. What AusLAMP defined as an anomaly with a diameter of about 60km has been sharpened into seven discrete zones, measured in kilometres rather than tens of kilometres.

The shallow depth of these conductors is particularly exciting. Modelling shows they start at depths of 2km, however, they could be much closer to the surface because 2km is the upper limit of standard MT arrays.

The results have encouraged Ausmex to further reduce the grid size to 5km and introduce audio magnetotellurics, which uses higher frequencies to image the subsurface at mineable depths. This latest phase is expected to wrap up early in the June quarter.

Heinson said he was "very pleased" with the results to date and endorsed the decision to go to the 5km grid in conjunction with AMT.

"Ausmex's willingness to advance their exploration through the application of closer-spaced grids is unique and has great potential to revolutionise exploration for IOCG orebodies for the world exploration industry," he said.

Kidd said a tighter grid with receiver stations at 2.5km intervals might be the next stage.

He said he was confident MT would define drill targets by the middle of this year, with deep drilling to follow in the second half.

In the meantime, there has been fascinating news from Ausmex about the mineralisation style at Burra.

The company asked University of Queensland Emeritus Professor Ken Collerson, to turn his mind to the significance of the AusLAMP anomaly.

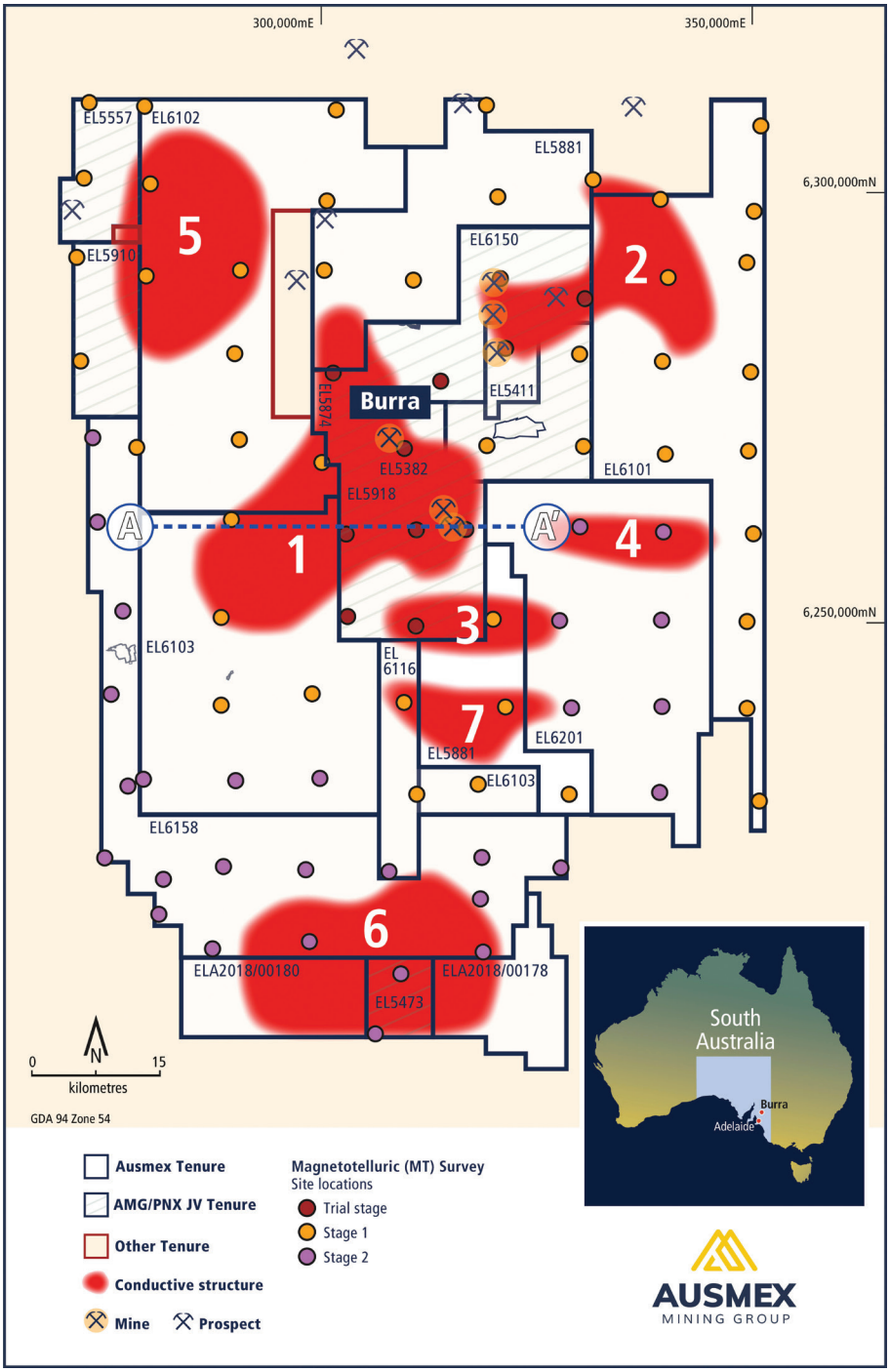
He analysed the composition of Burra's rare earths and concluded the hydrothermal fluids driving the mineralisation were similar to those at Olympic Dam and the Idaho cobalt belt in the US.

The Burra mineralisation also has similarities with China's Tier 1 Jinchuan deposit.

Burra and Jinchuan are dated at about 790 million years and 830 million years respectively.

Collerson points out that reconstruction of the Rodinia supercontinent suggests Burra drifted over the same mantle plume that created Jinchuan, the world's largest nickel-copper magmatic sulphide deposit which has more than 500 million tonnes at 1.2% nickel and 0.7% copper.

These are bold ideas that challenge the old thinking about Burra, however, maybe big concepts and fresh approaches such as MT are what are needed to finally understand the real nature and the potential of Australia's oldest copper mine.



Findings from Ausmex's magnetotellurics work.