

## **Magnetotellurics: The scalable EM exploration tool**

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Magnetotellurics (MT) is a natural-source electromagnetic geophysical method that has the advantage over all other EM techniques in that it is completely scalable. Exactly the same physics, instrumentation, and processing, analysis, and inversion codes can be used to model lateral and vertical variations in electrical resistivity at depths from hundreds of metres to hundreds of kilometres. Time variations of eight orders of magnitude, from thousands of Hertz to thousands of seconds, ensure imaging at all depths, albeit with increasingly broad spatial averaging. Recent advances in all aspects of MT result in increasing this resolving power, driven by the inherent uniqueness property of MT responses that sets the method apart from spatially averaging potential field methods. Such range of operation offers great utility for mineral exploration, where the new paradigm is to model from the mineral systems at lithospheric-scale to ore bodies at the mining-scale.

Particularly there is increasing appreciation of the need for mineral systems mapping as a cost-effective way of focussing exploration activities within a continent in the search for world-class deposits. A regional-scale broadband MT survey (BBMT, site spacing of order 10 km) will identify mantle and crustal resistivity anomalies that can be associated with pathways and conduits bringing mineralized fluids to the surface. Targeting audio-magnetotelluric surveys (AMT, site spacing of order 1 km) will localise anomalies of interest, and high resolution AMT surveys (site spacing of order 100 m) over the anomalies will resolve ore body dimensions, geometries and resistivity contrasts sufficiently for drill location. Subsequent to initial drilling, the ore body resistivity model can be further refined through re-inversion incorporating drillhole information as prior constraints.

Examples will be shown of Mt mapping all scales, from mineral systems mapping to targeting to ore body resolution.