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Towards the resolution of dipping contacts in the Capricorn Orogen using AEM

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The Capricorn Orogen is an under explored region of central Western Australia due to the thick and sometimes conductive regolith covering the region [3]. The Orogen is composed of a series of deformed sedimentary basins formed between ca. 2200 Ma and 750 Ma [3]. The early orogenic events across the orogen are recognised as the main cause for major tectonothermal events, resulting in structurally complex and geologically favourable regions for gold and base metal mineralisation [5]. To improve knowledge about the mineral prospectively of the Capricorn Orogen, a 5 km spaced, TEMPEST Airborne electromagnetic (AEM) survey was acquired in 2013. 1D AEM modelling of this data is useful for exploration as it provides an effective tool for mapping regolith as a first step in establishing prospectively across the region, but is also useful for mapping specific shallow basin lithologies and mineral potential within the Capricorn basins [4]. However, 1D inversions are known to have limitations when modelling steeply dipping structures [1]. It is therefore necessary to understand how well 1D inversion works in resolving lithology contacts within the complex Capricorn Basins.

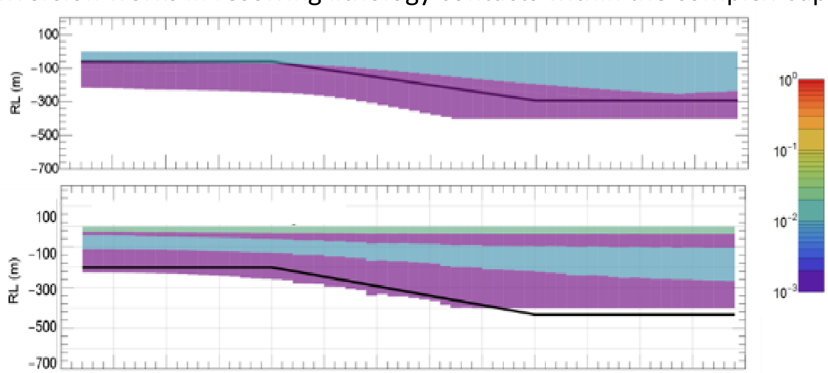

Figure 1. Inversions of a 25° dipping conductive wedge of 100Ωm, (top) in a resistive basement of 1000Ωm (bottom) 100m below a 50Ωm, 40m thick regolith, in a 1000Ωm resistive basement.

Methods

The applicability of using 1D methods in the Capricorn was tested using 2.5D models based on known and interpreted lithologies from the Capricorn Orogen and resistivities based on core measurements. Results were evaluated by inverting forward models under a number of common assumptions regarding the extent of geological knowledge (Figure 1). The forward response was calculated using the CSIRO ArjunAir forward modelling code [6]. The Geoscience Australia Layered Earth Inversion (GA-LEI) code [2] was then used to invert the responses.

Conclusions

This study found that structures with a dip greater than 25° were unlikely to be imaged accurately by a 1D layered earth inversion (Figure 1). Even when prior knowledge of either the conductivity or thickness are used to constrain these values, results are not improved. When such lithological contacts are present, a 2D or 3D AEM inversion code may be more appropriate for modelling these dipping conductive features. If cover is present with a conductivity greater than 50 Ωm, it is difficult to resolve the dip and thickness of a dipping conductive wedge (Figure 1). While AEM data provides an efficient tool for surveying large geological terrains, knowledge of the limitations that 1D AEM inversion codes have in environments such as the Capricorn is valuable when making geological interpretations.

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