Geological interpretation of near-surface IP and SPM effects in AEM data.

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SUMMARY

All available inversion software for airborne electromagnetic (AEM) data can fit a non-dispersive conductivity model to the observed responses. Recent research has attempted to permit this conductivity model to be frequency dependent, commonly using a Cole-Cole parameterisation of the induced polarization (IP) effect; but this parameterisation both slows down and destabilises the inversion. Fundamental inductive responses are controlled by the product of conductivity, magnetic permeability and frequency. Little has been published on inverting data affected by frequency dependent magnetic permeability, or super-paramagnetism (SPM), best characterised by a Chikazumi model, which effects are also seen in AEM.

Because both IP and SPM effects are small, and usually only obvious at late delay times, the aim of this research was to determine if these IP and SPM effects can be stripped from the data after being approximated with simple dispersive models. We were able to use a thin sheet model to automatically do this. The stripped data can be inverted using a non-dispersive conductivity model. The IP and SPM parameters fitted independently at each fiducial prove to be spatially coherent, and geologically sensible, and as such are very useful in interpretation in their own right.

The Musgrave Province of South Australia, prospective for magmatic nickel-copper, PGE's, orogenic and intrusive gold, and iron oxide copper gold (IOCG) mineral systems, is characterized by an extensive conductive transported cover overlying an in-situ regolith. AEM is used as a key exploration technology in these environments. Inverting for conductivity/resistivity and IP simultaneously suggests that deeper parts of the palaeovalley sedimentary sequences are, in places, chargeable. However, available drilling, suggests that most of the responses are primarily associated with shallow regolith (transported materials). Accounting for AIP and SPM effects in the processing and inversion of data from high powered AEM systems in settings such as the Musgrave Province can inform the geologist of the complexities of cover, complexities that are not apparent through the interpretation of commonly employed regolith mapping technologies such as remote sensing.