A case study in the resolution of depth extent in modelling of magnetic anomalies over shallow sources in rugged terrain

A high resolution helimag survey flown for a coal resource study in rugged terrain near Rylestone in New South Wales revealed several high amplitude anomalies, some coincident with hilltops. The principal objective in interpretation of these anomalies was to determine whether they are due to volcanic layers of restricted depth extent overlying the coal measures, or due to intrusive bodies that cut through the coal measures. It was not possible to reliably discriminate between these sources by inspection of the grid or profile data, and to constrain source depth extent it was necessary to model each anomaly.

The principal difference between bodies of different depth extent that match a particular anomaly is a corresponding variation in their apparent susceptibility values. Therefore knowledge of magnetic susceptibility is important in constraining ambiguity of source depth extent. Magnetic susceptibility measurements on core samples are available from the area, but these show a high variability, and the presence of reverse anomalies indicates that the apparent susceptibility of these bodies also depends on the contribution of unknown remanent magnetization intensities. Multi-profile inversion of complete anomalies, with the model field computed at the sensor elevation, provided some discrimination is simultaneously solving for both depth extent and apparent susceptibility. Single profile inversions however were generally unable to resolve depth extent without applying the constraint of a known apparent susceptibility value.

Model sensitivity tests were also conducted to determine the significance of survey parameters such as terrain clearance and line spacing for the planning of future projects, and to investigate the capabilities and limitations of modelling these anomalies directly from grids.