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Automatic Interpretation of Potential Field Data Applied to the Study of Overburden Thickness and Deep Crustal Structures, South Australia

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Contents

Abstract

Determination of overburden thickness is important in geology and mineral exploration.

AUTOMAG, a computer program system which was developed by the author from the original Naudy technique and applied to high resolution magnetic data, provides an effective way of determining the thickness of overburden and the weathered zone in areas of metamorphic and igneous basement rocks. The method also can be applied to much greater depths, e.g. magnetic basement underlying sedimentary basin.

AUTOMAG which uses a SUN SPARC 2 workstation and VAX-780 computer is at least five to ten times as fast as several standard methods of depth estimation used by the exploration industry and it also yields width, dip and susceptibility of magnetic causative bodies. The results are presented as a series of sections showing magnetic profile, similarity coefficients and estimated depths.

AUTOMAG has been tested on simple and complex synthetic data, using a set of basic models (dyke and edge with finite depth extents, and an extended thin plate model) designed to be suitable for most geological situations. The results from airborne magnetic data have been compared with the information obtained from a ground magnetic survey and drill holes in the Eyre Peninsula, South Australia; this shows that AUTOMAG provides reliable information about the thickness of overburden.

Spectral analysis was used with gravity data provided by the South Australian Department of Mines and Energy in the Eyre Peninsula area ($30°S$ to $35°S$ and $133°E$ to $139°E$) to determine the density structure of the crust. Applying an anomaly separation filtering in the frequency domain and combining with the information from the energy spectra of the Bouguer gravity data, several depth slice maps in the study area have been constructed. Depth estimations determined from spectral analysis in the Eyre Peninsula area indicate a density boundary which is between 32 to 38 kilometres deep. This is consistent with previous seismic estimations of the depth of the Mohorovičić discontinuity in this area. Felsic Gawler Range Volcanics are underlain by dense rocks, which may be a large, zoned, mafic magma chamber of underplated mantle material.

Suggestion for further work to develop AUTOMAG and spectral analysis technique are made in Chapter 8.