Mapping IOCG Prospectivity, South Australia

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INTRODUCTION

Iron Oxide Copper Gold (IOCG) mineral systems have a range of non-unique geological and geophysical features which can provide diagnostic exploration vectors in isolation. However due to variation within the mineral system, a combination of inter-related parameters provide more robust targeting criteria formulated within a (GIS) model of the system. For example, IOCGs are associated with gravity and magnetic highs (in themselves non-unique) with a relatively diagnostic offset between anomaly maxima related to the different spatial variation in magnetite and hematite. This is a direct mineralogical reflection of redox reaction fronts differentiating reduced and oxidised iron species. Techniques for combining and comparing gravity and magnetic geophysical data can therefore be used as criteria for mapping IOCG prospectivity.
This analysis focuses on three regions within the eastern Gawler Province where prospective units are buried under younger sedimentary cover (Figure 1).

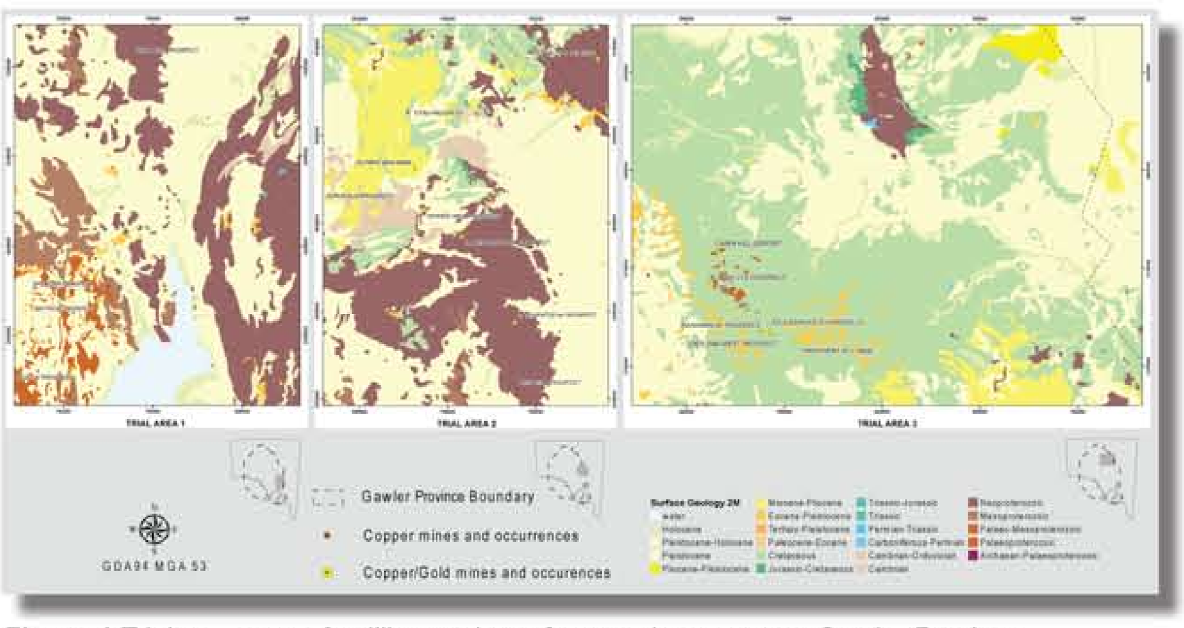

Figure 1 *Trial areas over 2 million scale surface geology, eastern Gawler Province.*

METHODOLOGY

The regional fields are removed from Bouger gravity and reduced to pole total magnetic intensity (TMI) data (Figure 2) by subtraction of upward continued values. Each dataset is input into an automated geoprocessing routine (Figure 3) which contours the input grid and then generates regions that encapsulate geophysical highs (Figure 4). These regions are defined by the analyst as a perimeter distance threshold. For the trial datasets, distances of <= 30 kilometres were used for gravity and <= 60 kilometres for TMI.

From the resulting regions, a second geoprocessing routine (Figure 5) selects gravity and magnetic anomalies associated by reasonable proximity limits (within 1km), generating 2-D regions suitable as inputs into IOCG mineral potential models. Extreme anomaly offsets are discounted because they are probably caused by unrelated geological phenomena. The final result is displayed in figure 6, which shows gravity highs (red) and proximal magnetic highs (blue) draped over a surface geology image.

Worming is then used to generate structural information, highlighting anomalous "edges" associated with crustal scale or higher order structure. These are indicative of possible fluid pathways and structural traps for both heat engine/source rocks and deposition of mineralisation. The resulting datasets are draped over a depth to basement grid to visualise a combined measure of IOCG prospectivity (Figure 7).

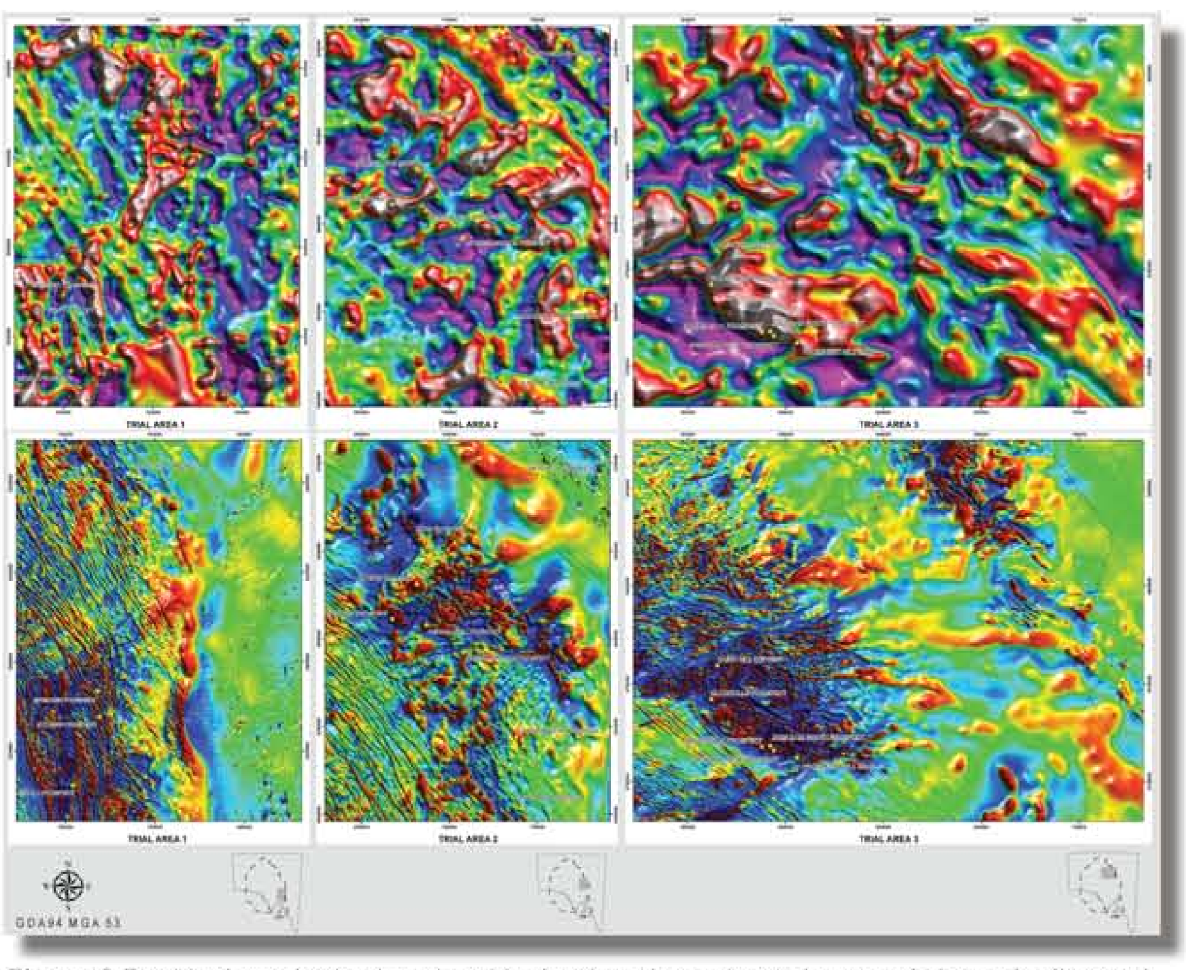

Figure 2 *Residual gravity (top) and residual reduced to pole total magnetic intensity (bottom).*

DISCUSSION

The locations of the copper/gold and copper mineral deposits in the trial areas were sourced from PIRSA's "MINDEP" mineral deposit database. Many of the copper/gold deposits, mines and occurences are spatially coincident with the regions delineated by the process. The exceptions are either occurrences that are outside of the IOCG province in a different depositional setting and therefore do not fit the IOCG defining criteria (for example, sedimentary copper deposits in the Adelaide Geosyncline), or copper/gold deposits that do not fit the assumption of corresponding gravity and magnetic anomalies. A number of the copper ocurrences appear coincident with gravity and magnetic highs, while others are not. This may indicate the possibility that some copper deposits (as stored in the PIRSA database) are IOCG style deposits with low gold content.

The automated routine has delineated magnetic anomalies related to the Gairdner dolerites resulting in thin, elongated anomalies not related to IOCG potential. Removal of these units is desirable in further modelling, as they will otherwise be incorrectly interpreted as prospective by data driven mineral potential models.

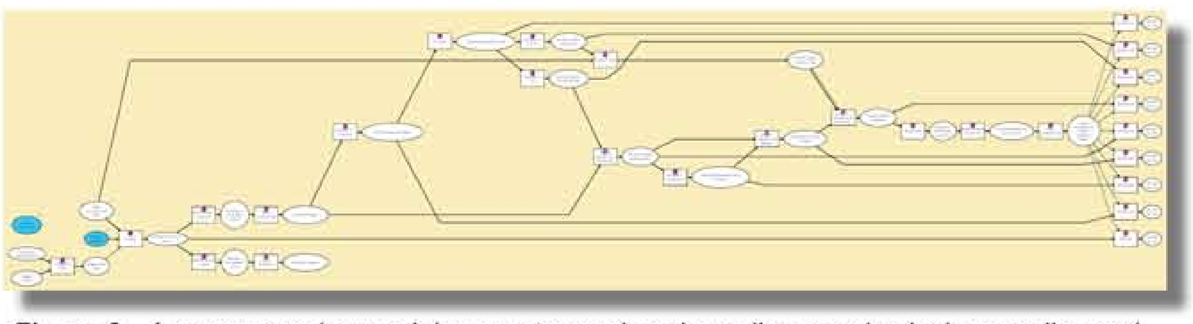

Figure 3 *A geoprocessing model generates regions bounding geophysical anomalies and then eliminates regions beyond the proximity threshold.*

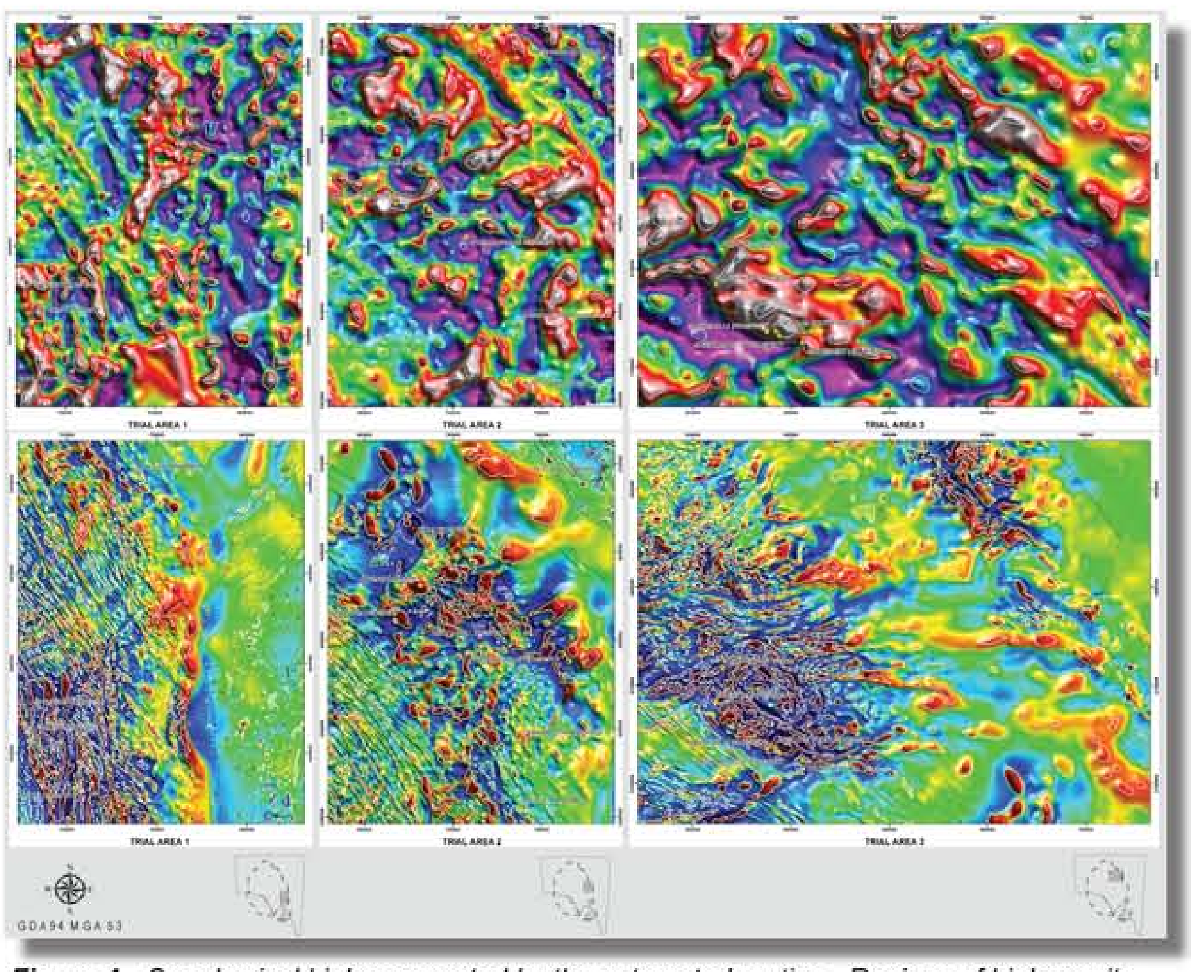

Figure 4 *Geophysical highs generated by the automated routine. Regions of high gravity (top) and magnetic intensity (bottom) are delineated in white.*

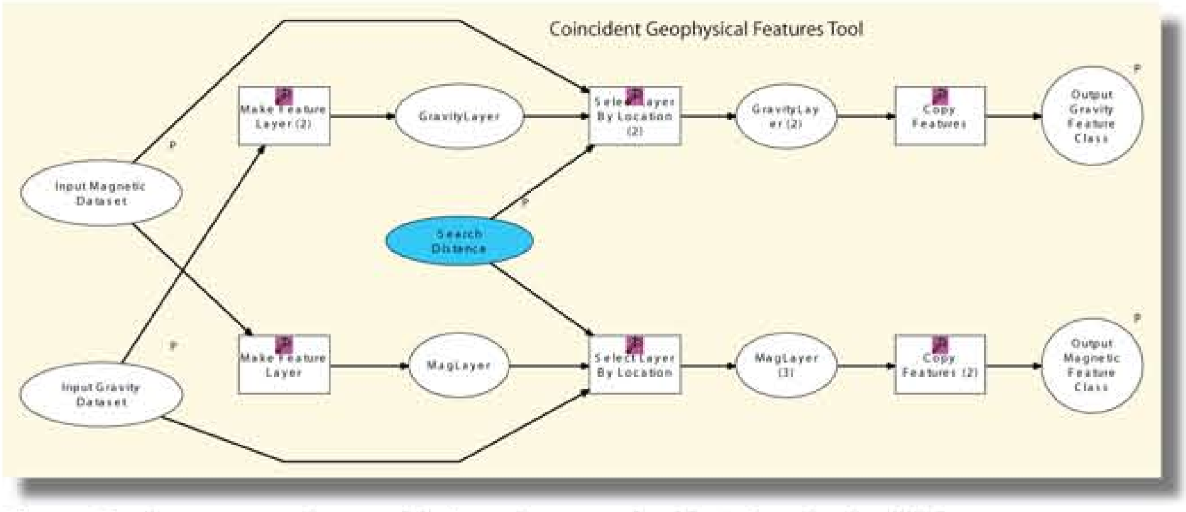

Figure 5 *A geoprocessing model discards non-coincident Geophysical highs (within 1000m).*

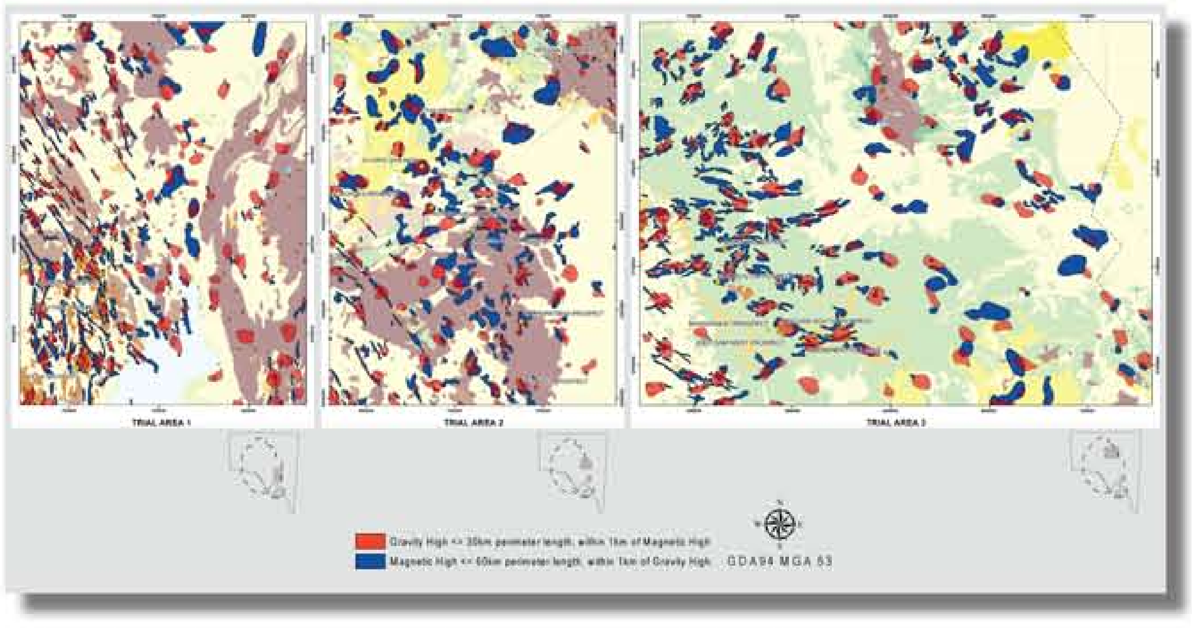

Figure 6 *Spatially associated geophysical gravity and TMI polygon datasets computed by the two geoprocessing routines - one measure of IOCG potential.*

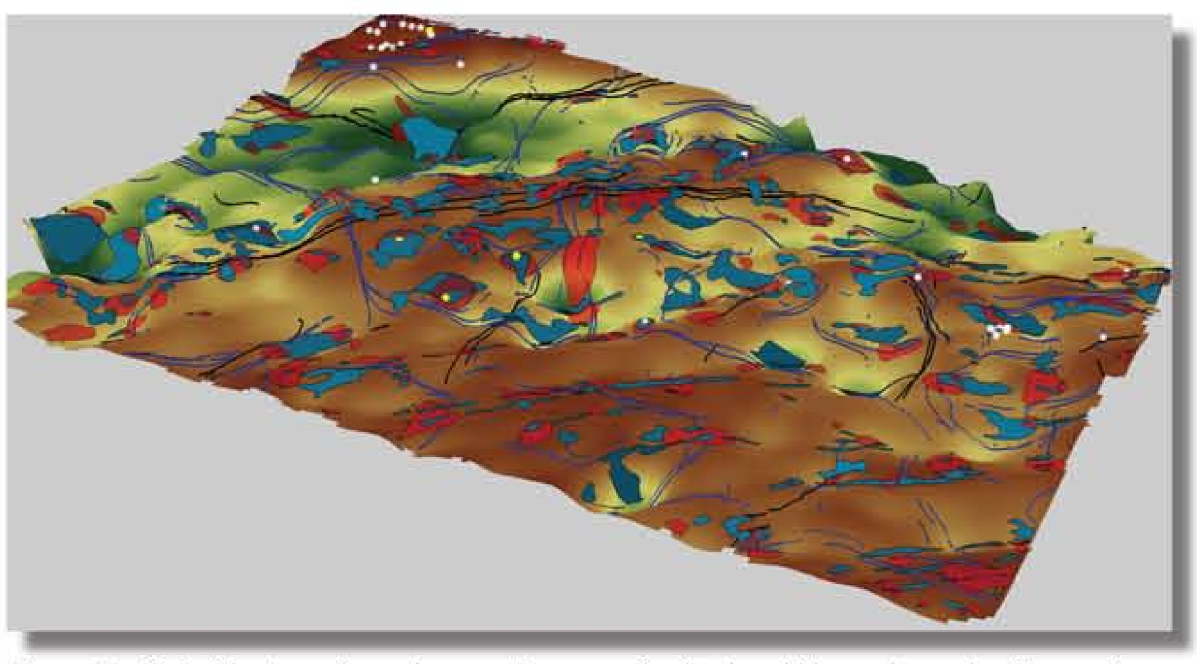

Figure 7 *Coincident gravity and magnetic anomalies (red and blue polygons), with gravity worms (black) and magnetic worms (blue) draped over depth to magnetic basement, trial region 2. A visualisation of possible crustal scale structure and associated regions with IOCG potential.*

CONCLUSIONS

The geoprocessing routine has successfully produced IOCG criteria for inclusion in mineral potential models.

The geoprocessing models capture of key contours from geophysical datasets have utility where there is a requirement to capture anomalous regions from a geophysical grid. Use of an automated pattern recognition routine to remove or classify the elongated magnetic dyke shapes from the delineated regions, would improve the overall result and is the next step in refining the process.

PACE

plan for accelerating exploration

HOT PROSPECTS

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