Analysis & 3D visualisation of Gawler potential field data: new constraints on 3D geological models

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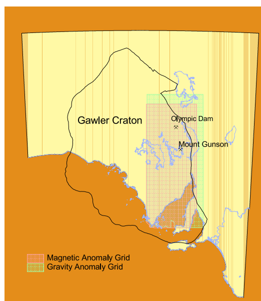

Figure 1. Locality Map

New Compilations Of Magnetic And Gravity Data

New compilations of airborne residual total magnetic intensity and ground gravity data of the eastern Gawler craton are shown in Figures 2 and 3. Data are from State and Commonwealth surveys, and open file company surveys.

Figure 2 is derived from a composite grid of approximately 100 surveys; individual grids were merged using Gridmerge, part of the Intrepid processing system.

These new compilations allow for accurate derived products, as the integrity of both long-and short-wavelength information is preserved.

Filtering of TMI data

Two examples of enhancements of TMI data are shown.

Directional filtering has been applied to remove short-wavelength signatures of the Neoproterozoic Gairdner Dyke Swarm (Figure 4). This provides a clearer image of the deeper sources mainly associated with the Mesoproterozoic Gawler Range Volcanics.

A first vertical derivative convolution filter has been applied and is shown in Figure 5, highlighting the short-wavelength content of the data, including the network of faults. In particular, it reveals a major structure trending NE-SW through Olympic Dam. This structure has only a subtle magnetic expression, which probably results from enhancement and destruction of magnetite during at least two fluid migration events.

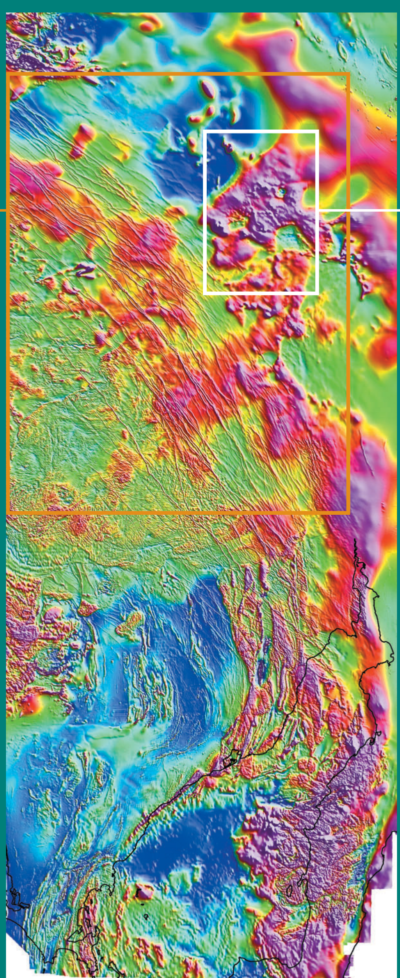

Figure 2. Gradient-enhanced (NE illumination) Residual Total Magnetic Intensity, reduced to the pole, of the Olympic Copper Gold Province (OCGP) of South Australia. This compilation was derived from grids of many separate surveys and merged by a new method into a single compilation (Minty, 2000). Independent tests of such compilations have been undertaken for several areas across Australia (Milligan et al., 2001). The areas outlined have been enhanced in detail in Figures 4 & 5.

Figure 4. Directional filtering of residual total magnetic intensity data removes anomalies of the Gairdner Dyke Swarm and enhances features in the Gawler Range Volcanics.

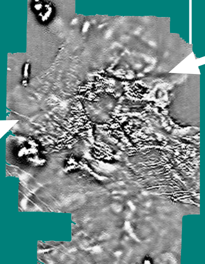

Figure 5. First Vertical Derivative of the Residual Magnetic Intensity, reduced to the pole, of the Olympic Dam area. The 1979 dataset has been reprocessed and image-enhanced to show short-wavelength detail. In particular, the newly-named Jubilee Fault has been highlighted.

Automatic Trend Analysis

An application of the vector analysis of multi-scale edges is shown in Figure 3. This type of analysis has previously been undertaken with lineaments mapped from remotely-sensed data (e.g., Fisher et al., 1985). Best-fitting straight lines were computed for the vectors, where the correlation coefficient exceeds 0.85 (the vectors are highly linear). The orientation of these vectors is shown spatially, and also as rose diagrams. These vectors may represent fundamental fractures in the basement, and the spatial textural variation is clearly evident, allowing discrimination of different structural domains.

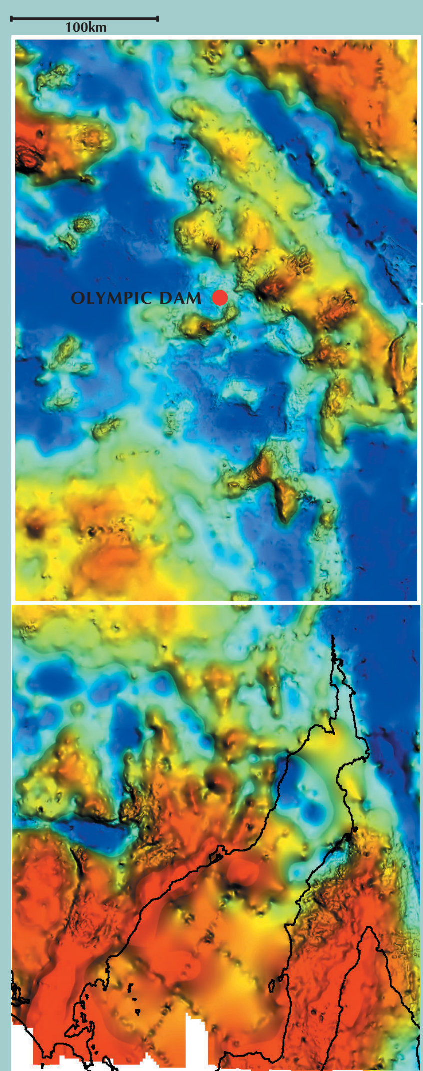

Figure 3. Gradient-enhanced (NE illumination) gravity of the eastern OCGP. Optimal gridding used the method of Murray (1998). The area outlined is analysed in detail.

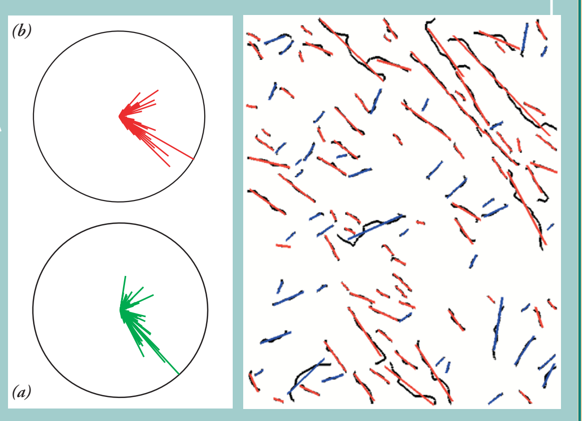

Figure 6. Trend analysis of gravity multi-scale edges, for the northern half of Figure 3. Rose diagram (a) shows variation of length with direction, diagram (b) shows the directions as a histogram, using 3-degree bins. Upward continued level 3,290km.

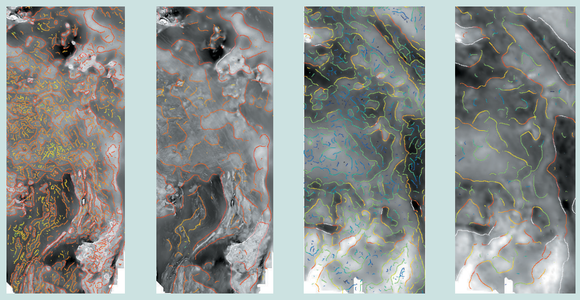

Figure 7. Susceptibility contrasts in the magnetic data (a), (b) and density contrasts in the gravity data (c), (d) mapped by multi-scale edge analysis (Archibald et al., 1999). (a), (c) "worms' upward continued 800m (b), (d) "worms" upward continued 12km.

Multi-scale Edge Analysis

Multi-scale edge analysis was applied to the magnetic and gravity grids. Examples for two levels of upward continuation are shown in Figure 7. These are now being used for more detailed interpretations of the data. Lower levels of continuations map near-surface sources in the cover, higher levels of continuation map basement structures.

Worm points are more efficiently analysed if converted to vector strings. These may then be combined into surfaces to form sheets, coloured by the maximum horizontal gradient attribute (Figure 8).

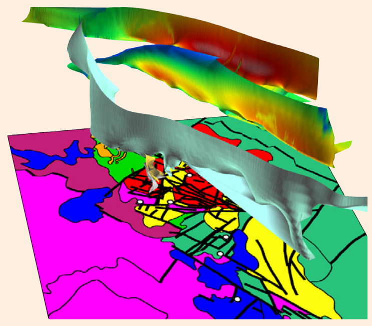

Figure 8. Examples of gravity worm sheets for the Olympic area, with the interpreted geology below.

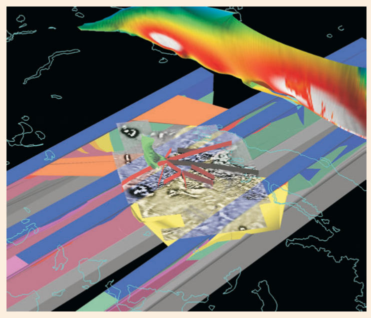

Figure 9. Several derivative geophysical products incorporated into a modern 3D visualisation environment.

3D Visualisation

Modern 3D visualisation environments are used to provide a synthesis of all geophysical and geological information. The examples are derived from the potential field data, including worm sheets and modelled cross-sections.

References

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