



Review of Hellyer Corridor Magnetic Data

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Introduction

The recently discovered mineralization known as the Fossey deposit contains a significant amount of magnetite. It is difficult to evaluate whether this deposit would have been observed in the magnetic data because it lies under the power lines that disrupt the magnetic signatures in the area. Jovan Silic completed forward modeling of a body with the same size and magnetic susceptibility as the Fossey mineralization. The goal of this project is to process the magnetic data to locate anomalies that look like the forward modeled anomaly.

Additionally, we ran our structure detection filter over the magnetic data to aid in interpretation of faults in the area.

There are several generations of magnetic data collected over the Hellyer corridor. The highest quality dataset is the airborne magnetic data from the 1993 Mackintosh survey. These data were selected for the processing done here. For the broader structure detection, the 2001 West Tasmania survey from MRT was used because it has broader coverage than the Mackintosh survey.

Processing Methods

The forward model indicates that the expected signature of the body is a discrete anomaly that is radially symmetric with approximately 100m radius. Fathom has two processing methods that can be used to highlight discrete anomalies in potential field data. These are the gradient and phase-based blob detection methods described in Appendix 1. These filters were used to highlight anomalies that have the potential to be a Fossey-like body.

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The filters were run in a mode that is independent of the amplitude of the signature so that they are just looking for discrete bodies. These bodies were then attributed with the amplitude of the signal above background so that can be compared with the expected anomaly amplitude from the forward modeling. The expected amplitude is approximately 5-30 nT depending on the size and depth of the body.

The structure detection method is an amplitude independent edge detection method that is good for highlighting subtle structure in magnetic data. It can be trained to look for structure that is parallel or cross to a given trend. The method is described in greater detail in Appendix 1.

Discrete Anomaly Detection Results

The results show that there are some anomalies similar to the Fossey forward model in the Hellyer data. Most anomalies have higher amplitude than expected for Fossey. The map in Figure 1 shows the anomalies colored by their amplitude. The cooler colors (particularly the shades of blue) are the anomalies that are similar to Fossey.

The filter was also used to identify lows in the data in case magnetite destructive alteration may be of interest. The results are shown in Figure 2. There is an anomaly coincident with Mt Charter.

Overall the processing seems to have been successful. The data are quiet enough that a Fossey-sized anomaly can be seen and the processing highlighted several such anomalies.

The phase-based results are not shown here but are generally similar to the gradient-based approach. There are always some anomalies that appear with one filter and not the other because the symmetry calculation is done in very different ways. All anomalies are considered to be valid, discrete bodies.

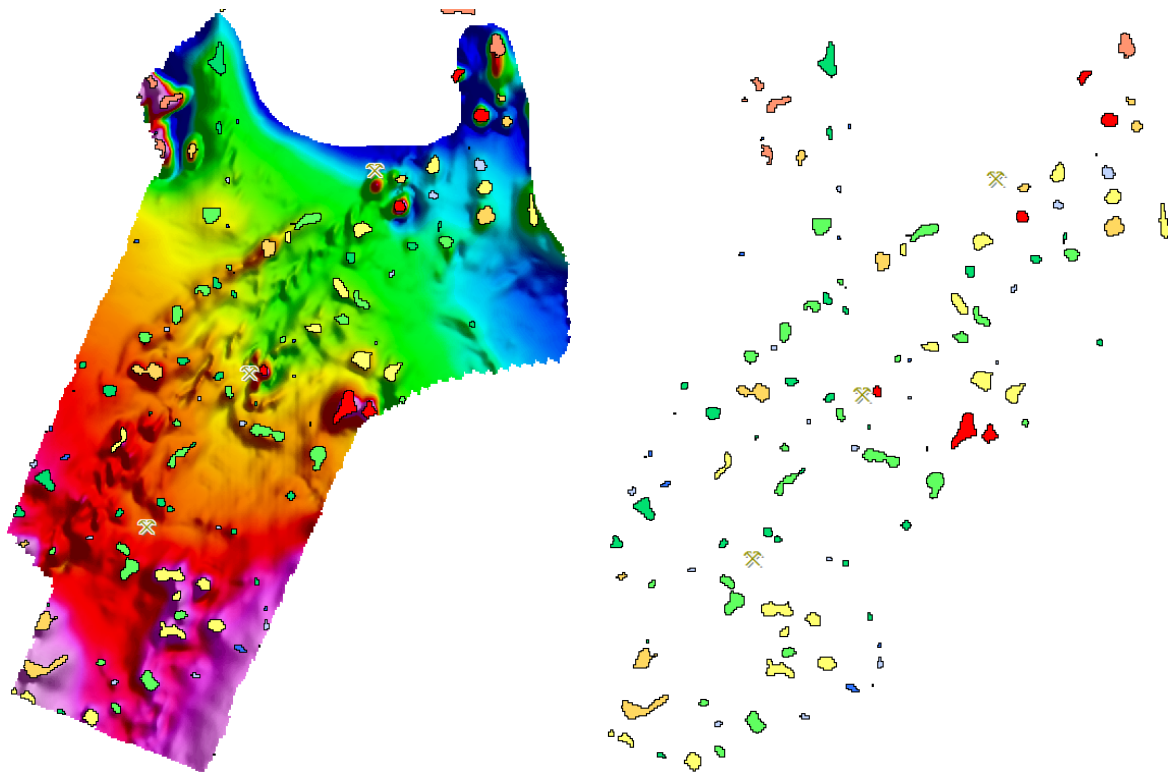


Figure 1. Discrete anomaly detection results for the gradient-based filter looking for positive anomalies. The hotter colors indicate stronger anomalies. In this case more subtle anomalies are of interest. The light and dark blue anomalies are of most interest.

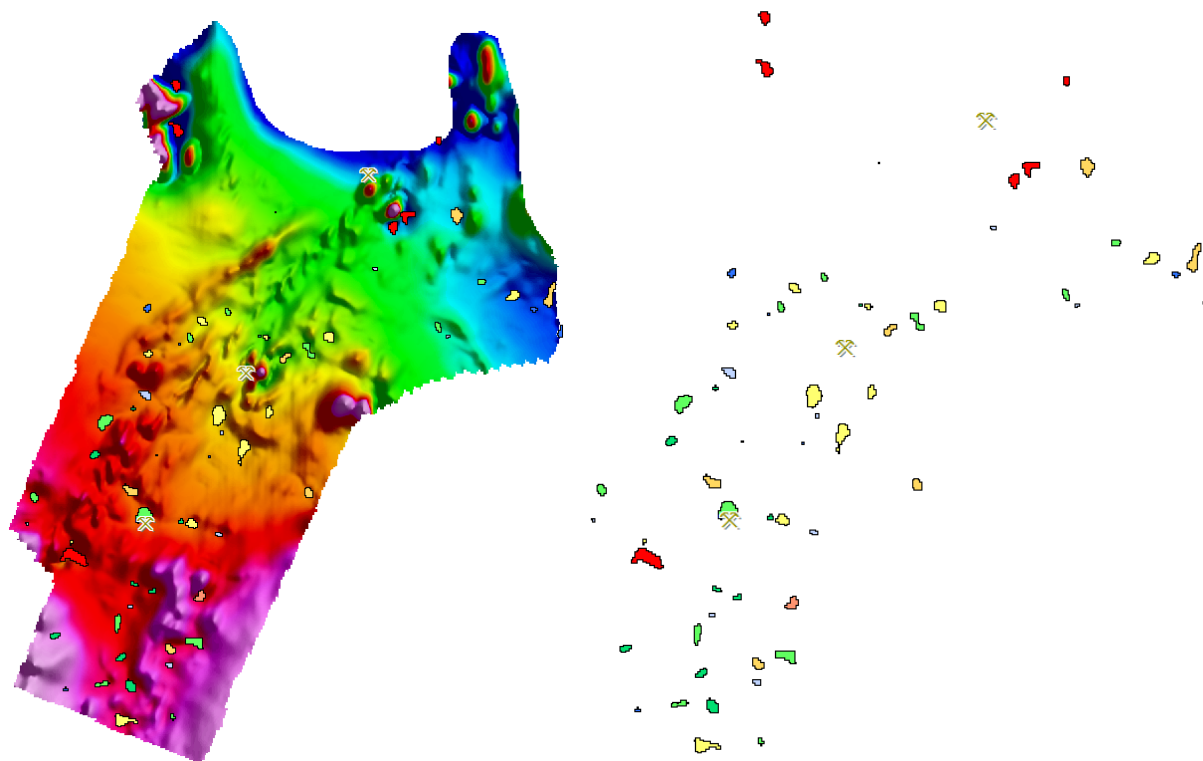


Figure 2. Discrete anomaly detection results for the gradient-based filter looking for negative anomalies. The hotter colors indicate stronger anomalies (i.e. more negative). There is a nice anomaly coincident with Mt Charter. Cultural artifacts at the two mines may be may be masking any anomalism that is present.



Structure Detection Results

Structure detection on these magnetic data is difficult. There is not a lot of structure that can be seen. Particularly if you view the data with the basalt cover included. Here we have windowed only the quieter southern portion and you can see some better detail. The parallel and cross feature extraction worked quite well however it is a simplistic view of the orientation of the belt. It was not possible to extract all the bends and folds in any automated fashion so the belt was treated as having a NE to NNE trend. This can be revisited if it is necessary to include all the detail of what the volcanic units are doing in this area.

The results are shown in Figure 2. The structure looks like a reasonable interpretation of the magnetic data. It is still necessary to compare how this structure compares with structures that have been mapped in the area.

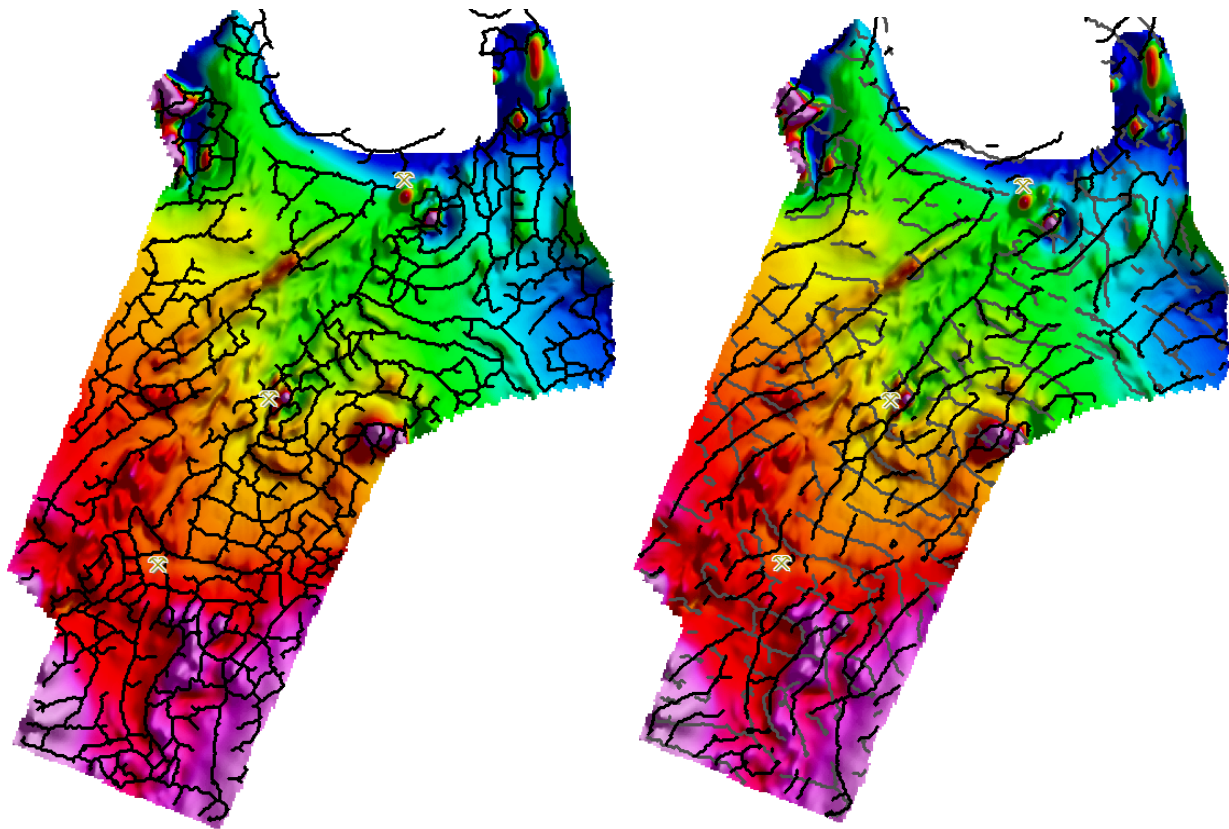


Figure 3. Detailed structure detection shown over the RTP magnetic image. The picture on the left shows the total structure while the one on the right has had belt parallel and cross features extracted separately. The orientation of the belt was just taken to be northeast to north-northeast so it is a simplistic approximation of the actual trend of the belt.

Appendix 1 – Processing Methods

Discrete anomaly detection

Discrete anomaly detection is done using radial symmetry algorithms. There are a lot of input parameters to these functions that can alter the outcome of the processing. The most important of these are the choice of method, the radius of the anomalies and the noise threshold.

Two methods were used to extract features.

- 1) A gradient-based filter that is independent of amplitude. This is useful for finding round features of unknown amplitude, such as intrusions associated with porphyry copper deposits or kimberlites.
- 2) A phase-based filter that is independent of amplitude. This is useful for finding round features of unknown amplitude that are very nearly circular, such as kimberlites and hematite IOCGs.

Both methods were used for this project since the exact features of the anomalies we are trying to locate are unknown. Moderate noise thresholds were chosen for both methods. This was done so that anomalies that are due to noise in the grid were not highlighted while subtle anomalies that are real were still highlighted.

Gradient-based filtering

The gradient-based radial symmetry filter operates in the space domain. The filtering is based on the x- and y-gradients and the horizontal gradient magnitude of the data. To locate positive anomalies, the gradients are used to determine points where the grid slopes away in all directions at the given radius. For negative anomalies, points where the grid slopes toward the point in all directions are located. If the magnitude independent method is used, all slopes are weighted equally and only symmetry is considered. If the magnitude dependent method is used, the symmetry measure is scaled by the steepness of the slope that points to, or away, from the radial anomaly.

Phase-based filtering

The phase-based radial symmetry filter operates in the frequency domain. It uses local phase to determine points that have symmetry at multiple scales. The standard phase-based filter locates bilateral symmetry in six to eight orientations in the data. The change in the symmetry measure with orientation can be used to determine how radially symmetric an anomaly is. If the symmetry value for an anomaly is similar in all orientations, it is likely to be round. If the symmetry value varies a lot for an anomaly, it is not likely to be round.

Structure detection

The structure detection filter is also a phase-based method that operates in the frequency domain. It uses local symmetry to determine points that have asymmetry at multiple scales. The user can choose the orientations that the filter looks at and in this case that is 6 orientations spread evenly from 0 to 180 degrees.

There are many possible inputs to the structure detection algorithms but the most important besides the number of orientations are the wavelength and the noise threshold. The wavelength is the starting wavelength and the filter looks at features between that value and roughly four times that value.

The noise suppression was set fairly low because the structures are pretty subtle in the Hellyer Corridor. A high noise suppression value would have eliminated structures that are real.