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Magnetic gradient tensor inversion using Euler deconvolution

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Magnetic gradient tensor surveys would offers many advantages over conventional magnetic surveys. They have the benefits of vector surveys without the disadvantage of extreme sensitivity to orientation. Tensor elements are true potential fields, with desirable mathematical properties (important in areas with strong anomalies), allowing rigorous continuation, RTP, magnetisation mapping, etc. Direction to compact sources are defined directly from a few station measurements. Direct calculation of magnetic moments of compact sources is possible.

Superior Euler deconvolution solutions using tensor elements is also possible with improved accuracy using true measured gradients, along and across lines. While the routine measurement of the magnetic gradient tensor is some way off, in certain circumstances it is possible to calculate the gradient tensor from total magnetic intensity (TMI) information. Such circumstances include anomalies being no more than about 20 percent of the local Earth's field, where the field departs from being a true potential field, and adjacent lines being well levelled.

Euler deconvolution requires solving at least four simultaneous homogeneous equations to yield the location in 3D and the Euler structural index of the source. Combining two or more adjacent tensors provides an over-determined system which allows the covariance to be estimated and gives a measure of uncertainty.

This method extracts a wealth of information on the location and geometry of magnetic sources. However, the method is sensitive to departures of the TMI from being a true potential field, for very strong anomalies, in which case conversion to a true potential can be performed using an iterative method involving calculating components from the TMI and projecting the components onto the local field direction.