IMPROVED METHODS FOR INTERPRETING MAGNETIC GRADIENT TENSOR DATA

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Recent technological advances suggest that we are on the threshold of a new era in applied magnetic surveys, where acquisition of magnetic gradient tensor data will become routine. In the meantime, modern ultrahigh resolution conventional magnetic data can be used to calculate gradient tensor elements from TMI or TMI gradient surveys. Until the present, not a great deal of attention has been paid to processing and interpretation of gradient tensor data. New methods for inverting gradient tensor surveys to obtain source parameters have been developed for a number of elementary, but useful, models. These include point pole, line of poles, point dipole (sphere), line of dipoles (horizontal cylinder), thin and thick dipping sheets and sloping step models. A key simplification is the use of eigenvalues and associated eigenvectors of the tensor. Rotational invariants can be expressed as combinations of eigenvalues. The scaled source strength (e.g. p/r^3 for a point pole, m/r^4 for a point dipole) is a particularly useful quantity that can be calculated from the eigenvalues. Gradient tensor data collected over the Tallawang magnetite skarn deposit in New South Wales will be presented to illustrate the methods.
A number of methods have been proposed for locating dipole-like sources from spot measurements or isolated profiles of magnetic gradient tensor data. In particular, there is an inherent four-fold ambiguity in obtaining solutions for dipole location and orientation of its moment from point-by-point analysis of gradient tensors. This paper presents a new, simple and efficient method for uniquely determining the location and magnetic moment of a dipole source from a short segment of gradient tensor data that is relatively free of contamination from background gradients. A separate algorithm, which deconvolves gradient tensor data along a profile by separating scalar and vector aspects of the dipole inversion problem, will be described. This enables contamination from background gradients to be estimated and removed, thereby improving estimation of dipole parameters. Besides the geological applications, these algorithms are readily applicable to the detection, location and classification (DLC) of magnetic objects, such as naval mines, UXO, shipwrecks, archaeological artefacts and buried drums.

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