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Interpretation of Magnetic Anomalies in Astmal Area using the Largest Eigenvalue

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Extended Abstract

Summary

Edge detection of causative bodies is crucial in interpretation of potential field data. Among the various edge detection methods, eigenvalue methods are majorly used to discriminate the gravity anomalies. The present investigation is, however, about to employ the eigenvalue methods to detect the magnetic anomalies. To this end, the largest eigenvalue method was applied to the total intensity of the magnetic data in Astmal area besides the vertical derivative, tilt angle and analytical signal methods in order to interpret the magnetic anomalies. In aids of the mentioned methods, the geomagnetic target map was prepared and integrated with the geological information. Results indicated that the mineralizing fluids infiltrate the faults and fractures of the area. Also, dykes might play important roles in formation of the Astmal magnetite deposit.

Introduction

The edge detection of geologic contacts are widely used as a significant tool in geophysical explorations. Different techniques in this area often utilize high-pass filters based on horizontal or vertical derivatives of the potential field data. Typically, various filters such as vertical derivative, total horizontal derivative, analytic signal, tilt angle, theta map, STM, TDX, ILP, etc recognize the edges of the potential field data; nevertheless, they cannot delineate the edges of the sources clearly. Having developed the measuring techniques for potential field gradient tensor data in recent years, some more accurate methods have been presented to detect the edges of causative sources which are based on the curvature and eigenvalues of the potential field gradient tensor matrix. Oruç et al. (2013) and Zhou et al. (2013) made use of eigenvalues of the curvature gravity gradient tensor for the edge detection of gravity anomalies. This study investigated the outcomes of applying the largest eigenvalue, smallest eigenvalue and determinant methods on synthetic magnetic anomalies. The largest eigenvalue method has finally been chosen for interpretation of magnetic anomalies of Astmal area, Eastern Azerbaijan, Iran.

Methodology and Approaches

The structural tensor matrix represents partial derivatives of the potential fields in x, y directions. The eigenvalues of this matrix can be applied to detect the edges of causative bodies of an anomaly. Its zero contours specify the horizontal locations of the edges of bodies. In order to delineate the edges of the sources, Oruç et al. (2013) used the largest eigenvalue for the positive contrast density of sources and smallest eigenvalue for situations with the negative contrast density. In this study, results of applying these methods on synthetic magnetic anomaly data along with noise and without noise, were investigated. Then, the largest eigenvalue method was used to interpret the real magnetic data extracted from Astmal area to contribute in providing its structural map. Finally, the results of the magnetic methods with geological data were integrated.

Results and Conclusions

The results of applying the eigenvalue and tilt methods on synthetic magnetic data showed that the largest eigenvalue method of the total intensity data can display the edge of the bodies more accurately. Besides, the largest eigenvalue method has the highest performance in separation of deeper bodies. Therefore, locations of faults, dykes and magnetic bodies of Astmal area have been indicated by vertical derivative, tilt angle, analytical signal and eigenvalue methods. The data of magnetometry and geology have been integrated to disclose that the fluid infiltration through the faults and fractures of this area causes magnetic mineralization.