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Qualitative interpretation of magnetic anomalies of Tikmehdash area using variogram analysis

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Summary

Regional - local (residual) anomaly separation has always been one of the crucial steps in magnetic data interpretation. Therefore, a variety of methods has been proposed for this issue, mostly based on Fourier transform. The focus of this research is to use the spatial filtering method to map the regional and local anomalies individually. For this purpose, factorial kriging (FK) method was applied on the magnetic data obtained from Tikmehdash area in northwest of Iran. The results of applying the FK method on the data were compared with the results of using upward continuation on the same data to evaluate the efficiency of the method. Besides, the FK method has been used alongside high-pass filtering to investigate local anomalies. Consequently, the advantages of using the FK method were recognized. The results of this study show the superiority of the FK method to identify the faults in the area that were not evident in the total intensity magnetic map. Overall, we introduced a robust and solid method for separation of magnetic anomalies that can be utilized for further studies.

Introduction

Separation of regional and local anomalies is widely used to interpret magnetic data. Magnetic anomalies are the superposition of various anomalies with different shapes and depths. Generally, it is assumed that the regional (low-frequency) anomalies are caused by deep magnetic sources. On the other hand, local (high-frequency) anomalies are believed to be related to shallow sources. The usual methods like upward continuation, high-pass and low-pass filtering methods, are based on Fourier transform. Sensitivity to the regular data grid and overlapping of the anomalies in the frequency domains are two main problems when applying the Fourier-based techniques. Kriging is a geostatistical method that concerns with data that are spatially related. It estimates the unknown value of a specific sample by weighting the samples in its neighborhoods. FK is developed for filtering purposes in geostatistics. It is widely used in geochemistry and geophysics. In this research, the FK method is used to separate regional anomalies from local ones.

Methodology and Approaches

Kriging uses variograms to estimate the unknown values in a specific location using the known values of the samples around them. Variograms show the dependencies of the data related to the distance between them. A nested variogram is caused by combination of different variograms, each of them is related to a specific scale of variation. Each component of the nested variograms can be shown individually by FK. Regional and local anomalies in magnetic data can be determined by using the FK approach.

Results and Conclusions

Regional anomalies map created by the FK method displays the faults in the study area that complies with the geological map. The faults were not detectable in the total magnetic intensity map. The results of this study show that the FK method determines the location of the faults more accurately than the upward continuation method. Furthermore, in contrast to the high-pass filtering method, the results indicate that local anomalies map created by using the FK method is a noise-free map and only shows the local sources.