Estimation of Depth of Magnetic Anomalies Using Standard Euler Deconvolution method in Talle Jar Area, Kurdistan Province

Mohammad Ali Shahrabi[1], Masoud Doostzadeh[2], Naser Hafezi Moghaddas[3]

[1] *M.Sc. Geophysics, University of Tehran, md.shahrabi@ut.ac.ir*
[2] *M.Sc. Geophysics, Ferdowsi University of Mashhad,*
[3] *Professor, Department of Geology, Faculty of Sciences, Ferdowsi University of Mashhad, nhafezi@um.ac.ir*

ABSTRACT
Depth estimation of the ore anomalies in the different basins is the main goal in geomagnetic explorations. The depth estimation of this kind of anomalies can be done using different methods, in the cases where the bedrock is magnetized. In processing and interpreting ground magnetic data, the depth of buried anomaly can be calculated in several ways. In this paper, the estimation of magnetic anomalies due to magnetic scans in the Talle Jar region of Kurdistan province is investigated using Euler method. Investigations in this area, including a relatively large anomaly in the south of the region, yielded a depth of 10 to 20 m for this anomaly, which is consistent with the preliminary results of field observations.
Keywords: Magnetic method, Euler Deconvolution, Talle Jar

INTRODUCTION
In geophysical exploration by magnetometry two quantities may be measured: the magnitude of the total magnetic field or the magnetic gradient, which reflects the variations of the magnetic field between the two points above the Earth's surface. Since the magnetic field has two poles and is also linear, so the interpretation of the related maps is more complicated than other geophysical methods. Due to the importance of the application of magnetic data, many efforts have been made to improve the accuracy of depth estimation methods. Hartmann et al. developed the Werner method for analyzing magnetic discontinuities using vertical and horizontal derivatives of the total magnetic field intensity. Thompson [1] devised a method based on the Eulerian homogeneous equation that has been developed by Reid et al. [2], Barbosa et al. [3], Cooper [4]. In this paper, the results of applying that method to real data are presented. Data processing was performed using GeoSoft oasis montaj software.

SURVEYING
Talle Jar area is located in Kurdistan province, south of Bukan and north of Baneh. To obtain complete details of the position of the anomalies in the area, ground magnetometry investigation was designed and implemented. The investigation network is a rectangle measuring 310 meters by 500 meters and the distance between the lines being 10 meters and the length of the data gathering steps being 10 meters. The location of the harvest zone is indicated on the geological map of the area. The data were collected using a proton magnetometer manufactured by Sinterx, Canada, which provides us with general magnetic field data.

WINDOW SIZE
Window-based Euler deconvolution is commonly applied to magnetic and sometimes to gravity interpretation problems. For the deconvolution to be geologically meaningful, care must be taken to choose parameters properly [5]. To apply the Euler method to the data, due to the large volume of data harvested in magnetic or gravitational methods and the lack of precision and quality required in the one-time and total processing of the data as a whole. The grid is defined as a square Euler window that moves over the grid and performs processing within the grid. This window should have two characteristics:

-Must be large enough to accommodate substantial changes to the field.
- It should be small enough to not cause a multi-dimensional effect on the window. This means that the window in a position contains only one fountain.

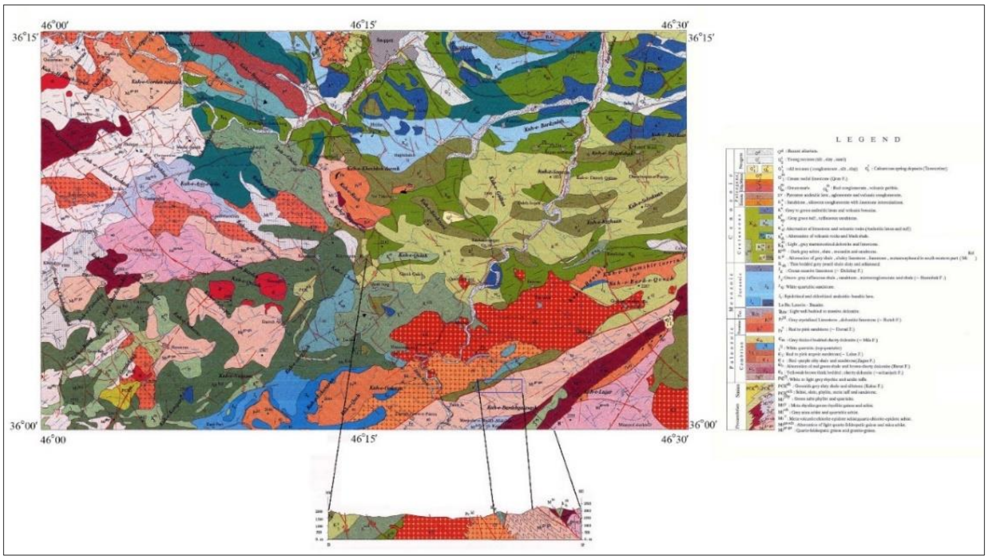


Figure 1. The location of the area on the geology map of Saqqez region

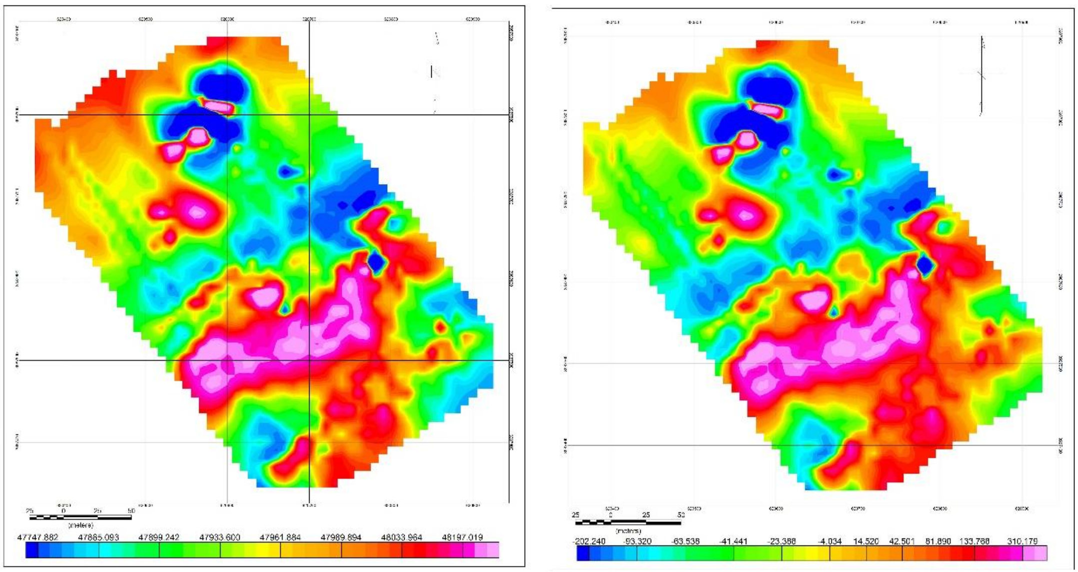
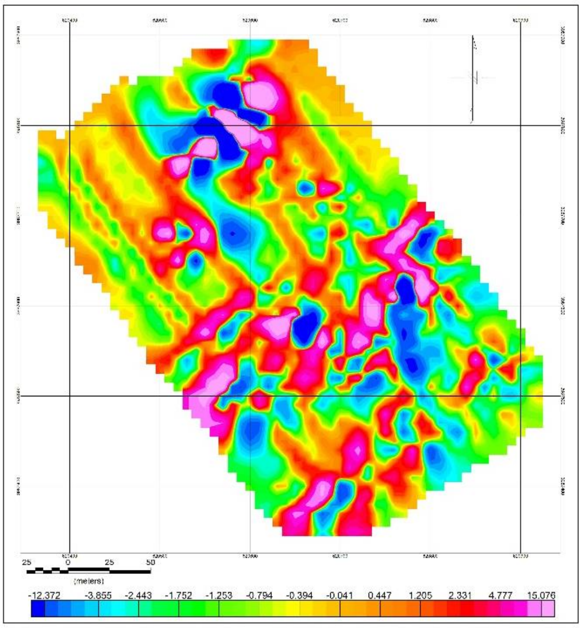
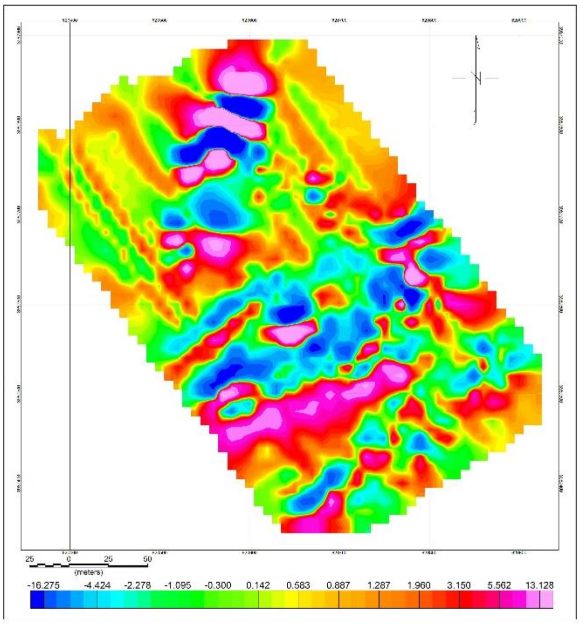


Figure. 2 Left: **The whole field intensity map in the region shows two anomalies in the region. Right: The residual field intensity map, the effect of a regional magnetic field is reduced from the data and the field left is only the field due to the anomaly. The two anomalies continue to be well seen.**

DISCUSSION

In order to apply the Euler process, we need to select the structural index and Euler window size. The structural index estimated for the major anomaly in the region is between 0.8 and 1.2, as the anomaly is a vertical magnetic dyke. Different size windows were selected for general solution of the Euler method. The error estimation of depth (standard deviation) in the deconvolution method processing was selected of 5, 10 and 15%. It can be seen that by selecting the upper values for structural index the number of solution point is reduced. On the other hand, selecting bigger window sizes leads to more solution points. It is better to choose the window size big enough to reach to the results to be more concentrated and included on the trend of anomalies.


25 0 25 50
(meters)
-12.372 -3.855 -2.443 -1.752 -1.253 -0.794 -0.394 -0.041 0.447 1.205 2.331 4.777 15.076


25 0 25 50
(meters)
-16.275 -4.424 -2.278 -1.095 -0.300 0.142 0.583 0.887 1.287 1.960 3.150 5.562 13.128

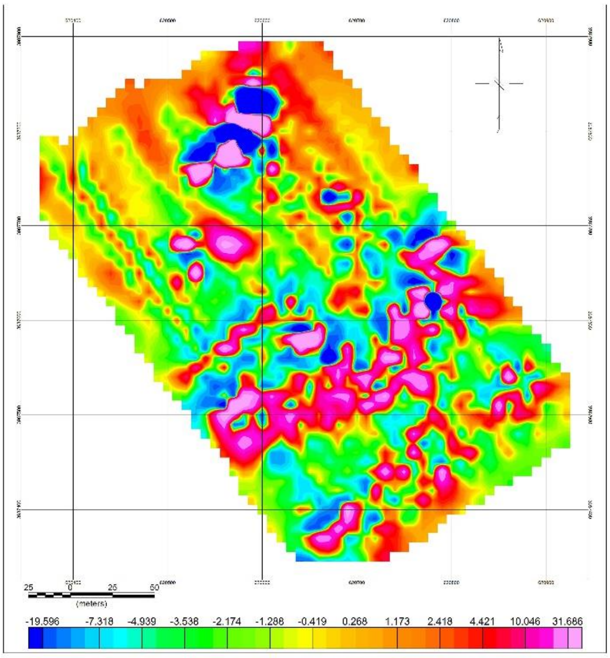


Figure 3. **Derivatives of the magnitude of the total magnetic field up-left: in the x direction, up-right: in the y direction and down center: in the z direction**

If we still do not get the desired result, we must increase the effective size of the window by changing the grid cell size in several ways. Applying different conditions to the Euler process in this region showed that the best solutions are obtained for structural index value of 1, window size of 8 to 8 meters, and the error determination of the depth of 5% which are plotted on the intensity map of the whole field in the figure 4. According to the geology of the area, there is an anomaly at the boundary between gneiss-limestone and intra-gneiss mass in the southern part which is in line with the main fault of the region. The results of magnetic studies indicate that the mineralization continues to a depth of 30 meters.

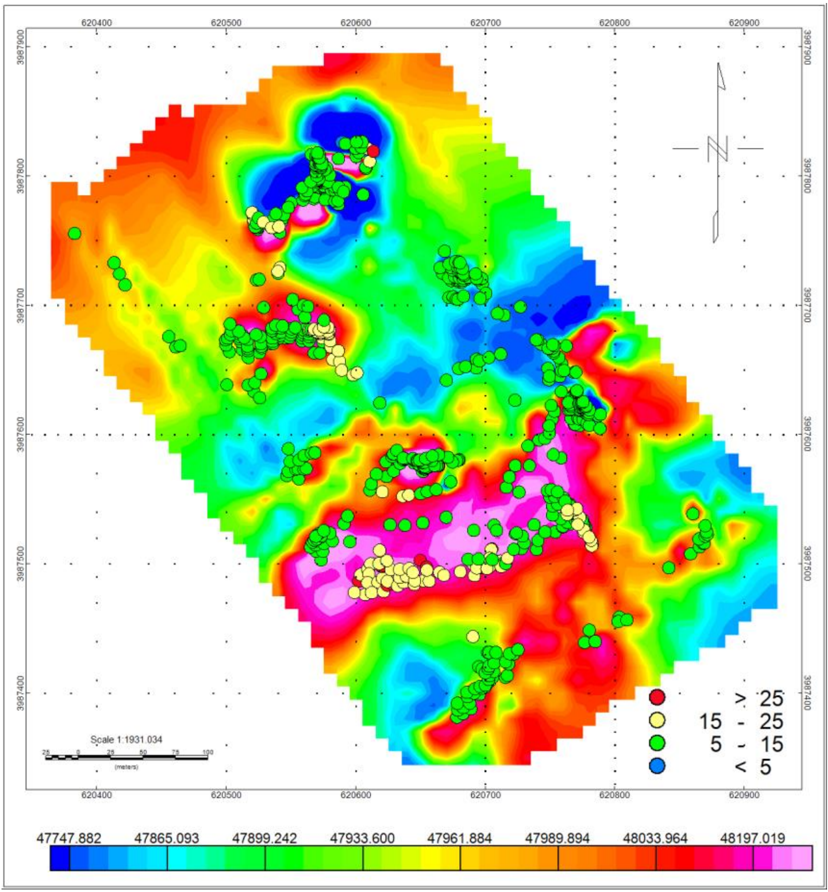


Figure 4. **The magnitude field of the total magnetic where the Euler solution points are displayed on it.**

CONCLUSION

The Euler method is a fast semi-automatic method to find the depth of buried anomalies whose results strongly depend on the choice of structural index, Euler window size and depth calculation error. The Euler method well determines the depth of anomalies. The geological information of the study area and the experience of the processor is crucial to reach the best results. This method provides useful additional information about the depth of all points, and the final result of modeling is independent of residual magnetic field. There are two anomalies in the area that are determined by the Euler method. The depth of the smaller anomaly on the up-right corner is 10 to 20 meter and the depth of the bigger dyke anomaly on the down-right is 10 to 25 meter.

REFERENCES

1. Thompson, D., EULDPH: A new technique for making computer-assisted depth estimates from magnetic data. Geophysics, 1982. 47(1): p. 31-37.
2. Reid, A.B., et al., Magnetic interpretation in three dimensions using Euler deconvolution. Geophysics, 1990. 55(1): p. 80-91.
3. Barbosa, V.C., J.B. Silva, and W.E. Medeiros, Stability analysis and improvement of structural index estimation in Euler deconvolution. Geophysics, 1999. 64(1): p. 48-60.
4. Cooper, G., Euler deconvolution with improved accuracy and multiple different structural indices. Journal of china university of Geosciences, 2008. 19(1): p. 72-76.
5. Reid, A.B., J. Ebbing, and S.J. Webb, Avoidable Euler errors–the use and abuse of Euler deconvolution applied to potential fields. Geophysical Prospecting, 2014. 62(5): p. 1162-1168.