International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-9, September 2016
ISSN: 2395-3470
www.ijseas.com

2D-Euler Deconvolution Analysis for Subsurface Delineation in Kimwarer, Kerio valley, Kenya

Kimeli C.J[1], K'Orowe M.O[1], Githiri J.G[1]
[1]Department of Physics, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

Abstract
2D Euler deconvolution technique was applied on the selected profiles of the reduced ground magnetic data collected in Kimwarer area. In order to evaluate groundwater potential of Kimwarer, faults and fractures which are groundwater conduits had to be delineated. The study area covered was fifteen square kilometers. Qualitative interpretation involving generation of contour anomaly map for magnetics was carried out. Euler Deconvolution solutions were obtained using structural index of 0.5 that gave well clustered solutions and discontinuities over the anomalous zone. Faulted zone was identified to the north-east of Kimwarer area.

Keywords: *Euler Deconvolution, Groundwater potential, Qualitative interpretation and Faults.*

1. Introduction

The area of study is Kimwarer location, which is within Elgeyo-Marakwet County. It is bounded by latitudes0° 20′ N and 0° 25′ N and Longitudes 35° 35′ E and 35° 40′ E. The area is largely semi-arid characterized by unreliable rainfall. This study is carried out with the view of delineating faults or fractures responsible for secondary porosity which is important in evaluation of groundwater potential.
Crystalline rocks, which from their similarity to other rocks covering wide areas of Kenya have been assigned to the Basement System, considered to be of Precambrian age, are exposed on the lower slopes of the Elgeyo Escarpment in the north-west of the area. They underlie the Elgeyo basalts and Uasin Gishu phonolites, and exposures generally end close to the foot of the escarpment where they are covered by Quaternary deposits. Kimwarer geology involves exposure of sediments confined to a large outcrop stretching three miles south-east from Kimwarer and two much smaller outliers on fault blocks south-west part of Kimwarer. Rocks in the area surrounding Kimwarer are generally a yellow or cream siltstone apparently comprising of a reddish brown pale silicate coupled by traces of grains of quartz. Siltstone bedding planes are characterized by layers of light brown chert of an inch depth. The upper layers are light-colored sandstones or siltstones similar to those just described, still with cherty layers, gradually darkening in color downwards through grey and purple clays and agglomerates with scattered boulders to the contact with the underlying purple Kijabe type Samburu basalt. Section of Endo River bank at Chepsiri at 40 feet has only the light-colored sediments exposed and the coarse fragments of quartz and feldspar, derived from Basement System rocks.

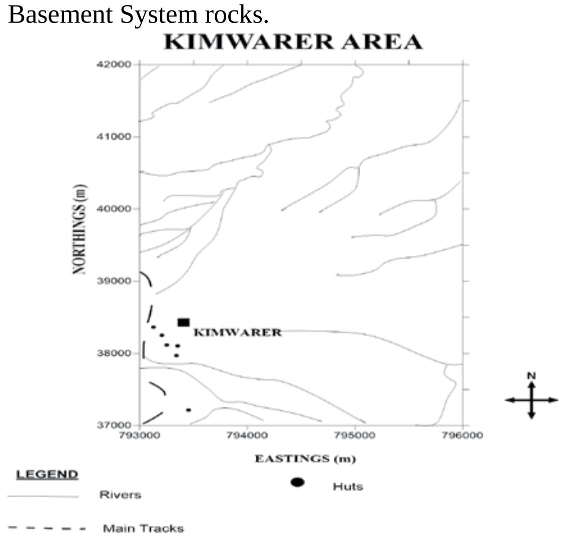

Figure 1. Location map for the study area

2. 2D-Euler Deconvolution Technique

2.1 Theory

Euler deconvolution is a data enhancement technique for estimating location and depth to magnetic anomaly source. By use of structural indices related to different magnetic sources and gradient of total magnetic field, Euler's Eq (1) can be applied accurately to determine depth estimates of the sources where x_0, y_0,z_0 are the coordinates of the magnetic source whose total field intensity T and regional value B are measured at position defined by $x,\ y,\ z$ with N as structural index.

$$(x-x_0)\frac{\partial T}{\partial x}+(y-y_0)\frac{\partial T}{\partial y}+(z-z_0)\frac{\partial T}{\partial z}=N(B-T) \qquad (1)$$

In two dimensional cases, as for magnetic anomaly, the equation has only two unknowns x_0 and y_0 to be evaluated since N is theoretically known. N value of 0.5 is best for faults by magnetic method. Regions of clustered Euler solutions with discontinues are normally of interest when delineating faults.

2.2 Methodology

Geometrics 856 Proton Precession Magnetometer was used to measure total magnetic field to a resolution of 0.1nT. Ground magnetic data was collected in the W-E Direction along four straight profiles. The profiles were 3 km long each, with a distance separation of about 1 to 1.5 Km from each other.
Magnetic measurements were taken at every 200m meters station along each profile, with the base station readings taken after very two hours at a base station centrally located within the study area for diurnal corrections. A total of 72 measurement points were established and coordinates taken using a global positioning system (GPS), data was subjected to diurnal and geomagnetic corrections and a total magnetic intensity contour map of contour interval of 20nT plotted, using Surfer 10 software as shown in figure 3.

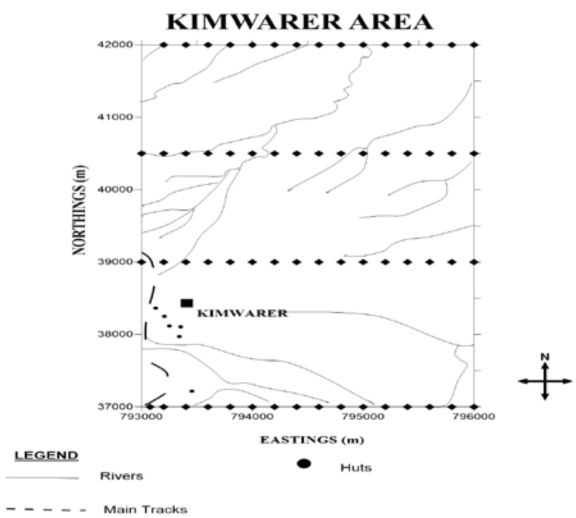

Figure 2.Magnetic profiles over the study

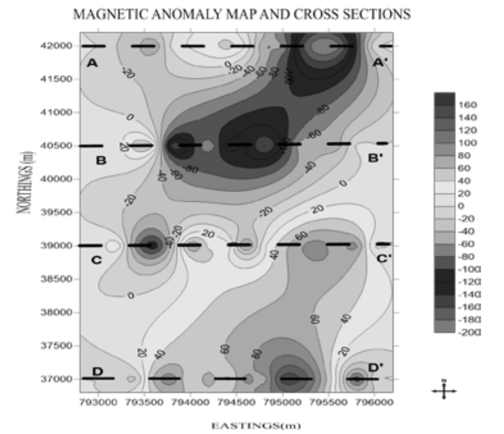

Figure 3. Total intensity contour map

2.3 Results and discussions

The Euler solution for magnetic profile AA' was calculated using structural index 0.5 which best represents faults. Horizontal and vertical gradients show great fluctuations along the profile which represent lateral variations in magnetization. There is a discontinuity at about 1 kilometer profile length an indication of a possible fault as shown in figure 4

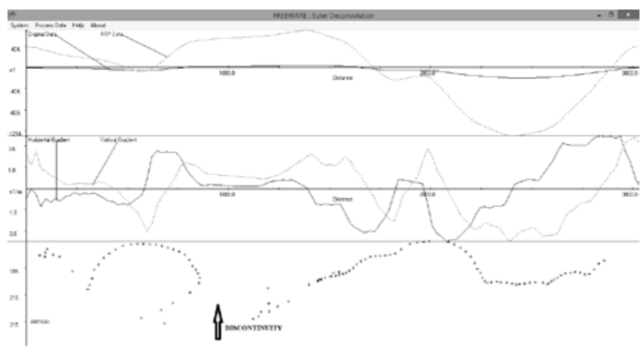

Figure 4. Profile AA' Euler depth solutions

The Euler solutions for magnetic profile BB' was calculated using structural index 0.5 which best represents faults. Abrupt horizontal and vertical gradients fluctuations from about 0.5 kilometer to 2.2 kilometer which represent lateral variations in magnetization. There is a discontinuity at the beginning of the profile length a possible indication of a fault as shown in figure 5.

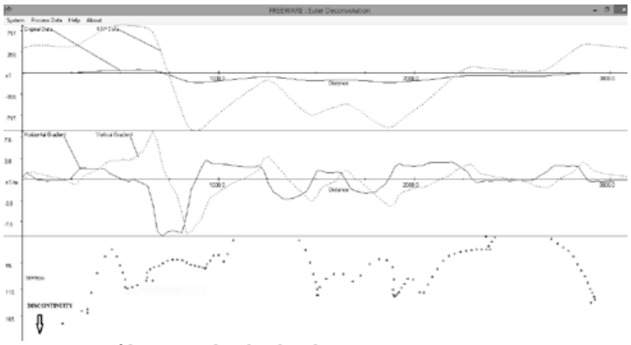

Figure 5. Profile BB' Euler depth solutions

The Euler solutions for magnetic profile CC' was calculated using structural index 0.5 which best represents faults. Great fluctuations in the horizontal and vertical gradients along profile distance 0.2 kilometer to 2.8 kilometer an indication of lateral variations in magnetization. There is a discontinuity at 2 kilometer profile distance an indication of a possible fault as shown in figure 6.

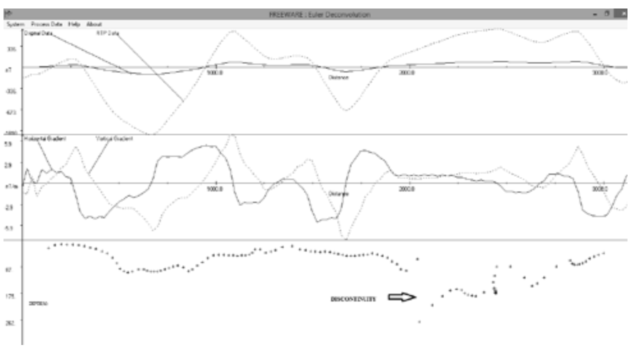

Figure 6. Profile CC' Euler depth solutions

The Euler solutions for magnetic profile DD' was calculated using structural index 0.5 which best represents faults. There are abrupt variations in horizontal and vertical gradients from about 0.5 kilometer to 2.8 kilometer profile distance an indication of lateral variations in magnetization. There is a discontinuity at the beginning of the profile and another at about 2.5 kilometer possible indications of faults as shown in figure 7.

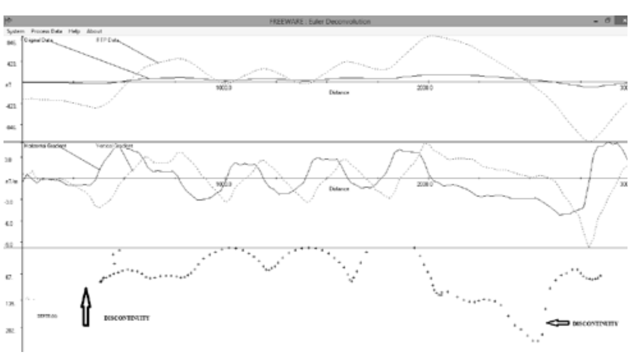

Figure 7. Profile DD' Euler depth solutions

3. Conclusion And Recommendation

Magnetic technique have been used to identify basement faulting and other locations of crustal weakness that may represent preferential fluid flow paths. Euler deconvolution technique was used to delineate faults using a structural index of 0.5. The depth of the fractured zone was found to be about 115 meters from the surface. The depth to source shown by the best clustered solutions and position of disjointed formation in profile AA', BB', CC' and DD' can be inferred that a fault exist in the north eastern part of Kimwarer area oriented in the NE-SW direction. More work need to be done on the southern part of the study area to delineate more faults beyond the boundaries of the study area.

Acknowledgements

Special thanks to Mr. Greg Stedman for his financial assistance, Jomo Kenyatta University of Agriculture and Technology physics department for availing survey equipment, field work assistance and professional pieces of advice.

References

1. J. Githiri, J. Patel, J. Barongo and P. Karanja, Application of Euler Deconvolution Technique in determining depths to magnetic structures in Magadi Area, South Kenya Rift. Journal of Agriculture Science and Technology, 13(1), 2011, 142-156.
2. Muturi E. N, Odondi K. M. and Gitonga G. J. (2014). Application of Integrated Geophysical Techniques for Groundwater Potential Evaluation in Hard Fractured Basement: Mutito Fault Zone, Kenya. In *2014 SEG Annual Meeting*. Society of Exploration Geophysicists.
3. Mosley P.N. (1993). Geological Evolution of the Late Preterozoic "Mozambique Belt" of Kenya Tectonophys, (221): 223-250.
4. Odero E,Odondi K.M and Gitonga G.J.(2015). 2D-Euler Deconvolution technique and Electrical Self-Potential analysis for subsurface structures delineation in Matuu, Machakos County, Kenya
5. P. Keary, M. Brooks and I. Hill. An Introduction to Geophysical Exploration. (London, Blackwell Scientific Publications, 2002).
6. Walsh J. (1969). Geology of The Eldama Ravine-Karbarnet area, *Rept.Geological* surv.Kenya.