International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-7, Issue-6, March 2019

Magnetic Susceptibilities and Fault Surface Anomalies. The Study of Land Magnetic Data & Interpretations.

Syed Kaiser Bukhari

Abstract: The aim of the study is to bring the relationship between crustal magnetism and the reflection of fault surfaces. The land magnetic surveys has been carried along the two nearly linear profiles of 11km length each at a spacing of 1km. The interpretation of data revealed the presence of two faults, thereby indicating the relevance of magnetic susceptibilities towards fault detections. The effect of diurnal variations were analyzed and their anomalous effects was eliminated by the collection and interpretation of base magnetic data. The IGRF data was also collected to analyze the variations produced by total reflective crustal magnetism. In contemporary to this, the bypass filters were applied along with the pole reduction methods to validate the results of the study.

Key words: Crustal magnetism, Ground magnetic surveys, Total magnetic intensity, Faults.

I. INTRODUCTION

The evolution of potential fields was massive for bringing up the information about the earth's interior.[2] [4] [5] [6] [9] [11] [14] [18] [19] However, the geophysical study were comprehensive, the geo-magnetic potential fields were found applicable to the various research fields including sub surface geological features.[3] [7] [13] [15] The earth's outer core, which produces more than 80% of magnetism, leads the well-mechanized magnetic wave propagations towards the surface and sets our planet earth as a magnet. The magnetic processes in the atmospheric ionosphere brings itself as an external field when described in the context of earth's crustal and main magnetic fields. However, the expertise of methodology can be found immensely significant by the proper numerical interpretation of the magnetic data and to accesses the authentic information about sub-surface features.[1] [12] [17] [20] [21] various scientists, researchers and students have proved the importance of magnetic data for the identification of various earth's surface and sub surface features.[8] [10] [16] The aim of our study is to relate the magnetic data in the earth's faulted structures, as they remain the main incursion of earthquakes and to evaluate the significance of magnetic measurements in the earth system sciences. This study was carried in the southern region of India (Fig.1) in the fields if Dharwar craton.

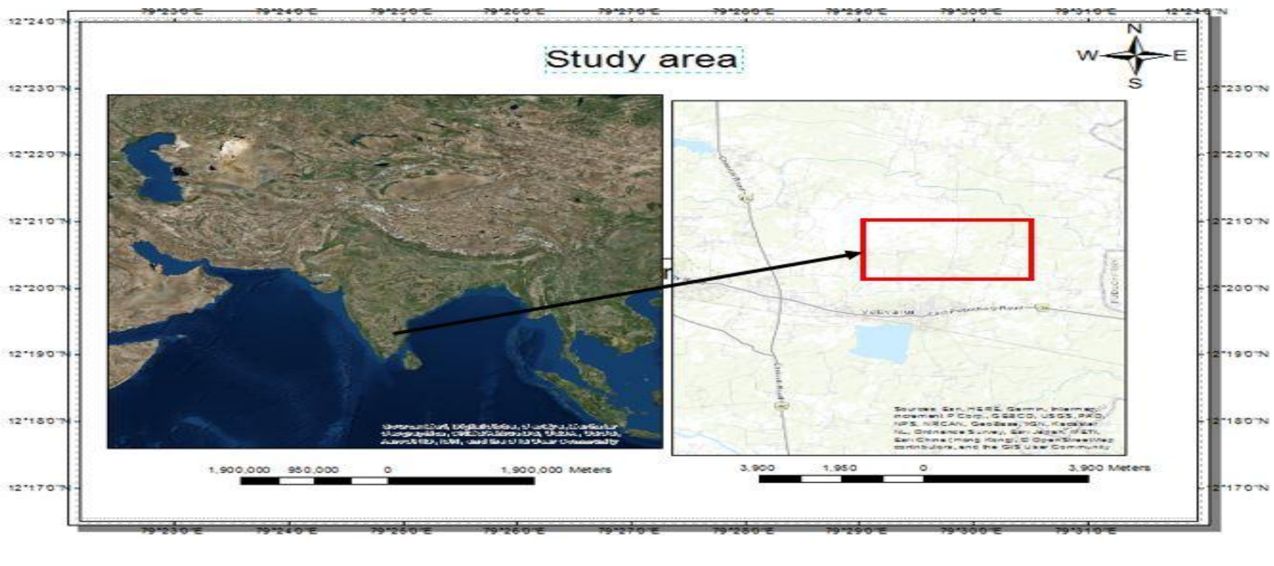

Figure 1: The map represents the study area and ☐represents the survey location

Revised Manuscript Received on 30 March 2019.
* Correspondence Author
Syed Kaiser Bukhari, Department of Civil Engineering, National InstituteSof Technology Srinagar,

II. DATA AND METHODS

The land magnetic data was collected by two proton procession magnetometers, a walking type and a base station. The base station was set fixed in the eastern side of the survey line without the presence of noise that would have created by the electrical materials like electric lines or any other metals. The base magnetometer was processed by measuring the magnetic intensities after every 15 minutes to examine the fluctuations caused by the external magnetic field. The survey line for walking magnetometer was drawn linear or nearly linear on the topographical sheets and the magnetic intensities were taken at an interval of 150mts. The survey line was chosen based on least noise in the region and all the areas like cities were avoided to be the part of this survey. The procedures has been repeated twice along the profiles named as P1 and P2 of 11km length each and 1km apart from each other. However, the direction of the two profiles were same so that they will follow the parallel distance between them (Fig 2). In contemporary to this data, the IGRF data was also collected and processed for interpretation mechanisms. In addition to this, all the relevant data like topography, lithology and elevations were collected to evaluate the validity of magnetic data's. The diurnal corrections were applied in order to bring the accurate total magnetic intensities. The low and high pass filters, reduction to pole and vertical derivatives were found useful in bringing up the signal of abrupt magnetic anomalies and thereby delineating faulted subsurface. The noise created by the features other than the land have been eliminated by the various magnetic interpretations in Geosoft oasis montaj.

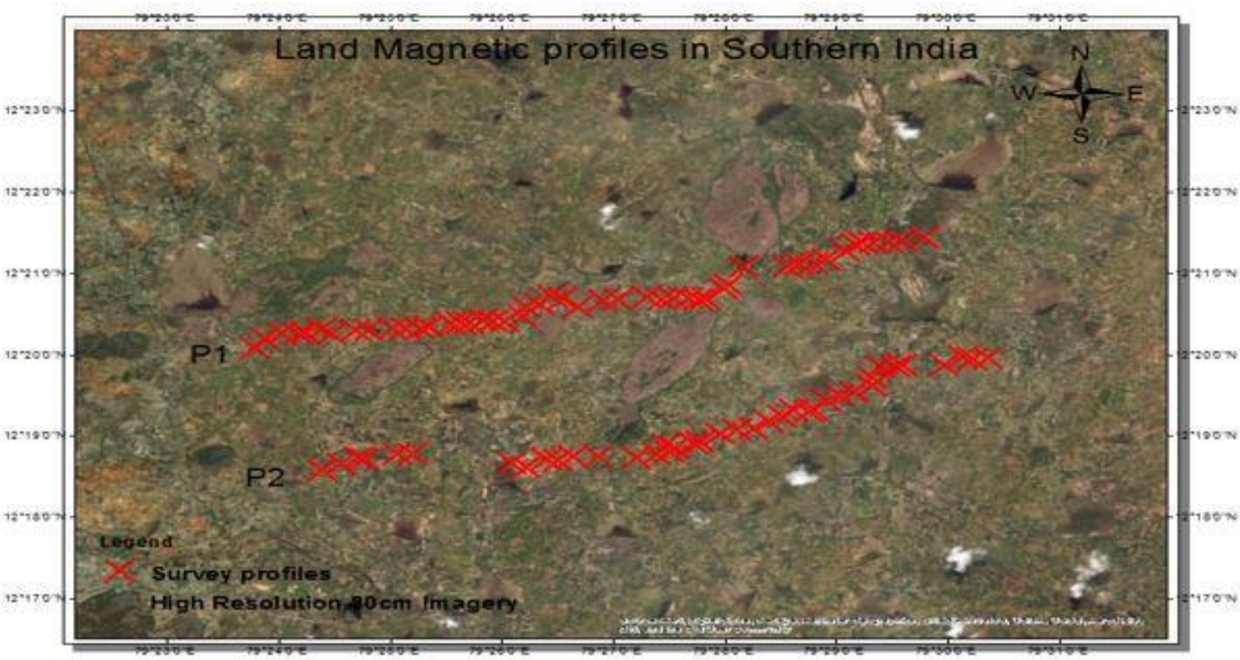

Figure 2: P1 and P2 represent the survey lines in cross reds.

III. RESULTS AND DISCUSSIONS

The base station data have been processed to evaluate the effect of sun's activity and the diurnal corrections were then plotted in a graph. The diurnal variations of the magnetic base data of profile (P1) show the intensities from 40175nt-40260nt. However, the diurnal variations of P2 were found varying from 40620nt- 40670nt (Fig 3). The IGRF data plotted for P1 show little variance in the overall magnetic field and was seen around 41180nt while the IGRF data at the second survey show little more variance of 41188nt-41203nt and was later correlated for survey data interpretations(Fig 4). The magnetic processing of data in grid analysis of P1 show the variance in the anomalies thereby indicating the changes of interior from whole of the survey profile.

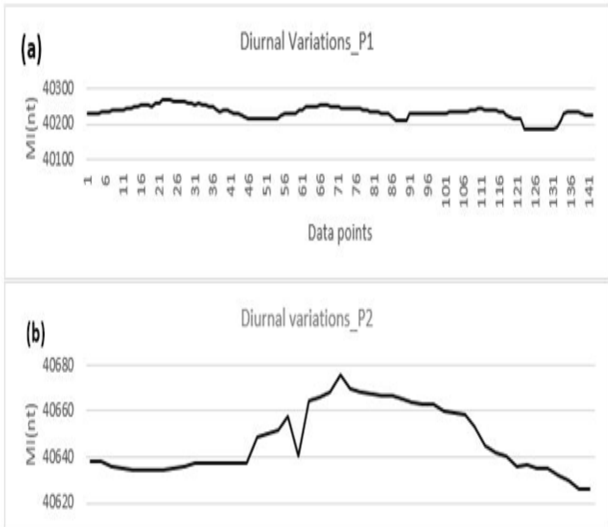

Figure 3: a) represents the diurnal variations of P1 and b) represents P2

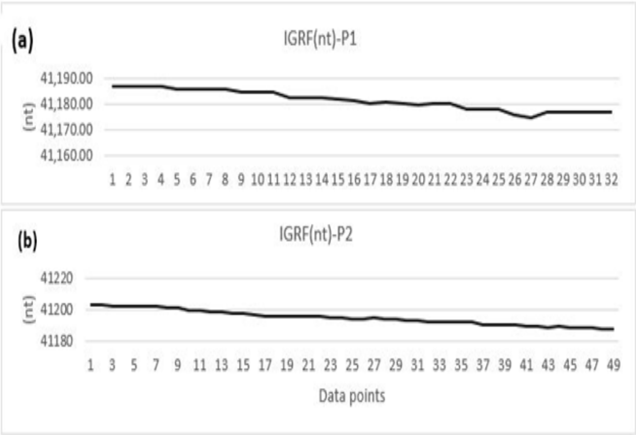

Figure 4: a) represents the IGRF variations of P1 and b) represents P2

The grid analysis of general data show magnetic lows varying from 1052.8nt to the maximum of 21.1nt (Fig 5a). However, the maximum magnetic lows were found until the 8kms of survey profile 1 from east to west and minimum low's towards the last phase of west at 45.7nt to 21.1nt. The lows were indicating the presence of faults, which are produced by the intense shearing at the fault lines due to tectonic stresses. The results were examined further by using the bypass filters to see the changes produced by them. The low pass filters used (Fig 5b) show the change behavior of the gridded data especially at the western extent of P1 and can be due to the rock discrepancies in the area like joints or surface rock fractures. However, the high pass filters (Fig 5c) validates the output of main gridding and show maximum correlations with the results. The P2 data interpretations and gridding (Fig 6a) show less anomaly variations from the ground interior but validates the presence of major fault in the region. However, the low pass filter (Fig 6b) and high pass filter (Fig 6c) of P2 show variance of magnetic low's and high's when compared to the main gridded data of P2. The P2 show maximum total magnetic intensities varying from 710.7nt to 68nt low and a minimum proportion of 1058.8nt- 806nt.

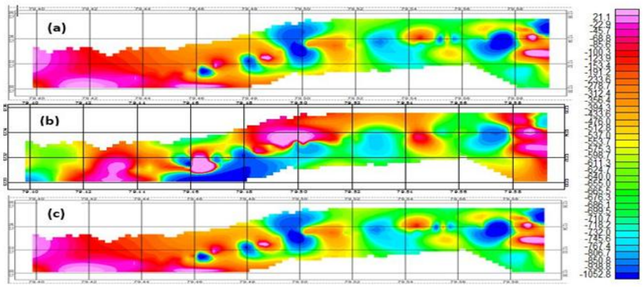

Figure 5: a) Gridding of total magnetic intensity for P1. b) Low pass filter. c) High pass filter

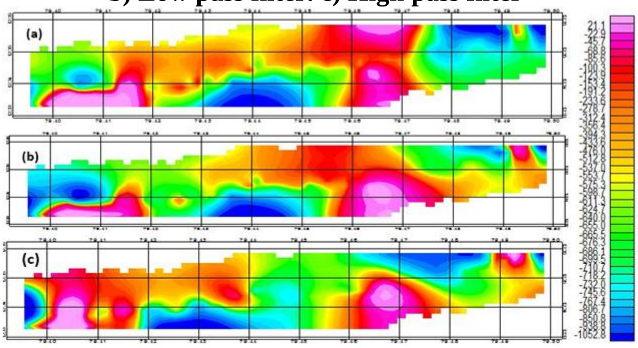

Figure 6: a) Gridding of total magnetic intensity for P1. b) Low pass filter. c) High pass filter

The profile data was then represented in the graphical format by applying the significant filters like RTP and certain vertical derivatives. The P1 show much fluctuations at two points which was then related by the fault locations and a little variance at the starting phase of P1 from the east and was considered as the lithological contacts(Fig 7a).The interpretations and representations of P2 (Fig 7b) validities the presence of the same features/faults and litho-contacts on the graph. The upward and downward continuation of both the profiles were plotted in a single graph (Fig 7c), thereby validating our results and show the presence of one major fault in the area other than the minor fault magnetic reflexes and litho contacts.

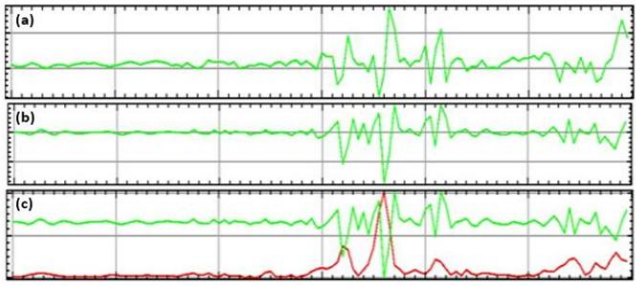

Fig 7: a) Anomaly curve of P1, b) Anomaly curve of P2 c) Comparison of anomaly curves

IV. CONCLUSION

The modelling of magnetic data based on geophysical techniques demonstrate the significance towards the identification of sub-surface faults. The earth system scientists can bring a lot of information about the geological structures that are deep beneath and are the major incursion to the earthquake shakes. The study can be highly useful in identifying the sub-surface contradictions that can be analyzed, modelled and remedial measures can be taken to align our infrastructures not against the nature but with the nature to save the precious live.

REFERENCES:

1. Achache, J., Abtout, A., and LeMouel, J.L., (1987) The downward continuation of Magsat crustal anomaly field over Southeast Asia, J. Geophys. Res., 92, 11584-96.
2. Anand S.P., Mita Rajaram, Majumdar T,J. and Bhattacharyya. R. 2009. Structure and tectonics of 85°E Ridge from analysis of Geopotential data, Tectonophysics 478, 100 - 110, doi:10.1016/j.tecto.
3. Arkani-Hamed, J., Langel, R. A., and Purucker, M. E., (1994) Magnetic anomaly maps of Earth derived from POGO and Magsat data, J. Geophys. Res., 99, 24075- 24090.
4. Blakely R.J. (1995) Potential theory in Gravity and Magnetic applications. Cambridge /University Press, Australia.
5. Blakely, R.G., (1995) Potential Theory in Gravity and Magnetic Applications, Cambridge University Press.
6. Christensen, N.I., Mooney, W.D., (1995), Seismic velocity structure and composition of continental crust: a global view. J. Geophys. Res. 100, 9761–9788.
7. Clark, D.A., and Emerson, D.W., (1991) Notes on rock magnetization characteristics in applied geophysical studies, Exploration Geophysics, 22, 547-55.

8. Corell, L. and Grouch, V.J.S. (1985), Mapping basement zones from magnetic data in the san juan basin; New Mexico: presented at the 52nd Annual International Meeting, Society or exploration, geophysicists, Dallas U.S.A. CrossSection: Its Properties and Use for Automated Anomaly Interpretation: Geophysics, 37, 507-517
9. Dar et al., (2015), A Gravity and Bathymetric Study in the South East Continental Margin of India, J Remote Sensing & GIS, 4:3
10. Dar et al., (2017) Delineating Deep Basement Faults in Eastern Dharwar Craton through Systematic Methods of Geophysics and Remote Sensing vis-à-vis the Concerns of Moderate Seismicity, J Geogr Nat Disast , 7:1
11. Dobrin, B.M. and Carl, S.H. (1988). "Introduction to geophysical prospecting." McGraw-Hill. Book Co. pp. 366-407.
12. El Dawi, M.G., Tianyou, L., Hui, S. and Dapeny, L. (2004). "Depth estimation of 2-D magnetic anomalous sources by using Euler deconvolution method." American Journal of Applied Sciences.
13. Hahn, A., Ahrendt, H., Jeyer, J., and hufen, J. –H., (1984) A model of magnetic sources within the earth's crust compatible with the field measured by the satellite Magsat, Geol. Jb., A75, 125-56.
14. Hochstein, M.P. and Hunt, T.M. (1970). "Seismic, gravity and magnetic studies: Broadlands geothermal field." Geothermics, v. 2, p. 330-346. Kearey, P. and Brook, M. (1984). "An Introductory to Geophysical Exploration": Oxford, London, Blackwell Scientific Publications, 171-199p.
15. Hunt, C. P., Moskowitz, B.M. and Banerjee, S.K., (1995) Magnetic properties of Rocks and Minerals, In : Rock Physics and Phase Relations -A handbook of Physical constants, AGU Reference shelf 3, etd. Ahrens, T.J.
16. Mohmood Dar and Lasitha, (2015), Application of Geophysical Ground Magnetic Method for the Delineation of Geological Structures: A Study in Parts of Villupuram District, Tamilnadu, J Geol Geophys, 4:3
17. Nabighian, M. N. 1972. The Analytic Signal of Two Dimensional Magnetic Bodies with Polygonal
18. Palmasson, G. (1975). "Geophysical methods in geothermal exploration." Proceeding of the second UN Symposium on the development and use of geothermal resources, San Francisco, 2: 161-200.
19. Parasnis, D.S. (1986). Principles of Applied Geophysics, 3rd Ed., Chapman and Hall, New York, USA.
20. Peters, L.J. (1949). "The Direct Approach to Magnetic Interpretation and its Practical Application." Geophysics. 14:290-320.
21. Reid,A.B., Allsop,J.M., Granser,H Miliett,A.J and Somerton,W.I, 1990. Magnetic interpretations in three dimensions using Euler deconvolution. Geophys., .55, 8091

AUTHORS PROFILE

Dr. S.K Bukhari is an Associate Professor in the department of Civil Engineering, National institute of Technology Srinagar-India. He is specialized in Engineering Geology, Engineering Seismology, Rock Mechanics and Tunneling Technology and Remote Sensing and GIS.