

ISSN : 2395-647X

Vol. 4, No. 3, September 2018



International Journal of Geology and Earth Sciences



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Research Paper

TILT DERIVATIVE TECHNIQUE-MAGNETIC ANALYSIS FOR DELINEATION OF SUBSURFACE FEATURES, ANANTAPUR DISTRICT, ANDHRA PRADESH

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Received on: 13th July, 2018 <https://doi.org/10.32937/IJGES.4.3.2018.38-41> Accepted on: 25th August, 2018

Magnetic method is the simplest method to identify the geological features which are prevailing in the subsurface. The study area is located in western part of the Cuddapah Basin which mainly comprised Tadipatri shales and sills. Tilt derivative technique is used to delineate the faults and hidden sills in the subsurface and constructed a structural map. There are twenty faults are identified in this area which are trending mainly in two directions NW-SE and NE-SW. The hidden sill segments are the source for high magnetic anomalies in the middle part of the study area and these segments also trending in same direction as sill outcrops in the northern part.

Keywords: Tadipatri shales, Hidden sills, Sill outcrops, Faults, Sill segments

INTRODUCTION

The study area covered about 20 km², located in Putluru and Yellanuru mandals, Ananthapur district, Andhra Pradesh. This area is situated between latitudes 14°45'-14°50'N and longitudes 77°55'-78°05'E. This area is totally covered with agricultural fields. The prime objective of the present study is to identify the presence of sills, dykes, faults and fractures in the subsurface stratum. To identify these features, the magnetic studies and its tilt derivative filter were applied.

GEOLOGY

The study area situated in the intra cratonic

Proterozoic Cuddapah Basin which occupies an very important place in Indian geology. Tadipatri shales of Chitravati group are the main geological formations in this area. Based on geology, volcanic rocks like dykes and sills intruded into Vempalle limestones and Tadipatri shales. This igneous activity is restricted to the southwestern margin of the Cuddapah basin and The present study area also present in this region (Murty, 1964; Sen and Narasimha Rao, 1967; King, 1872; and Nagaraja Rao *et al.*, 1987).

The sills are present in the western side and in the northern part of the survey area as out crops. These sills are consist of metapyroxenite

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and metagabbro. A fault can be seen in NW direction lies in the middle of the study area (GSI, 2001).

MAGNETIC DATA ANALYSIS

Magnetic measurement were carried out along four traverses T1-T4, about 4 km long and station intervals of 25 m. These are oriented in the NNE trending perpendicular to major Fault in this area. These are not equally spaced because of inaccessibility. Diurnal corrected Total magnetic Intensity colour contour map (Figure 1) is prepared with a contour interval of 20 nT. The magnetic anomaly ranges are from 40898 nT to 42215 nT.

The magnetic images are show high and low magnetic anomalies correspond to susceptibility contrast of the geological features. In this map low magnetic anomalies are noticed in the east

and west due to shales and highs are observed in the north due to exposed sills. In the middle part also show high anomalies infers the presence of high magnetic bodies, concealed sills in the subsurface.

TILT DERIVATIVE CONTOUR MAP

Generally the total magnetic field strength and depth of source body effects the magnetic anomaly amplitudes and the lower amplitude anomalies may be suppressed at the expense of higher amplitudes (Oruc and Keskinsezzer, 2008). To derive the clear picture of the subsurface geological features which cause these anomalies the edge detection filter, tilt derivative technique is most useful tool without diminishing the long-wavelength information.

Tilt derivative is the ratio of the vertical derivative and the horizontal derivative and tilt derivative is:

$$\theta = \tan^{-1} \frac{\partial f / \partial z}{\partial f / \partial h}$$

where f / z and f / h are the first vertical and horizontal derivatives, of the Total magnetic Intensity (Miller *et al.*, 1994; and Verduzco *et al.*, 2004).

The tilt angle is confined to lie between +90° and -90° regardless of the amplitudes of the vertical and horizontal derivatives. The tilt angle values are positive over the sources, zero at edges of source and is negative outside the source region (Salem *et al.*, 2007). This technique is insensitive to the depth of the source and resolve shallow and deep sources equally well (Mita Rajaram, 2009).

Based on geology map study area is covered with shales shows low values in the tilt derivative

Figure 1: Total Magnetic Intensity Contour Map of the Study Area with Layout of the Four Traverses (T1-T4)

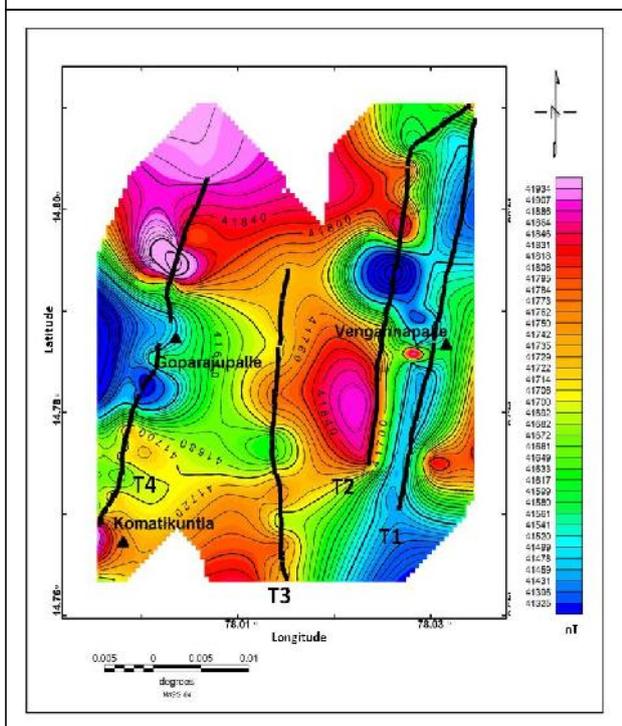
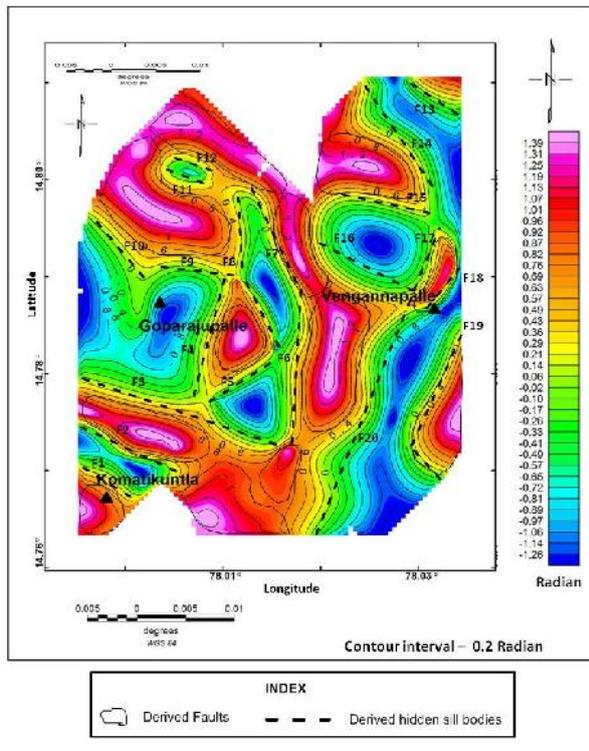


Figure 2: Tilt Derivative Contour Map of the Study Area Showing Inferred Faults and Hidden Sill Segments

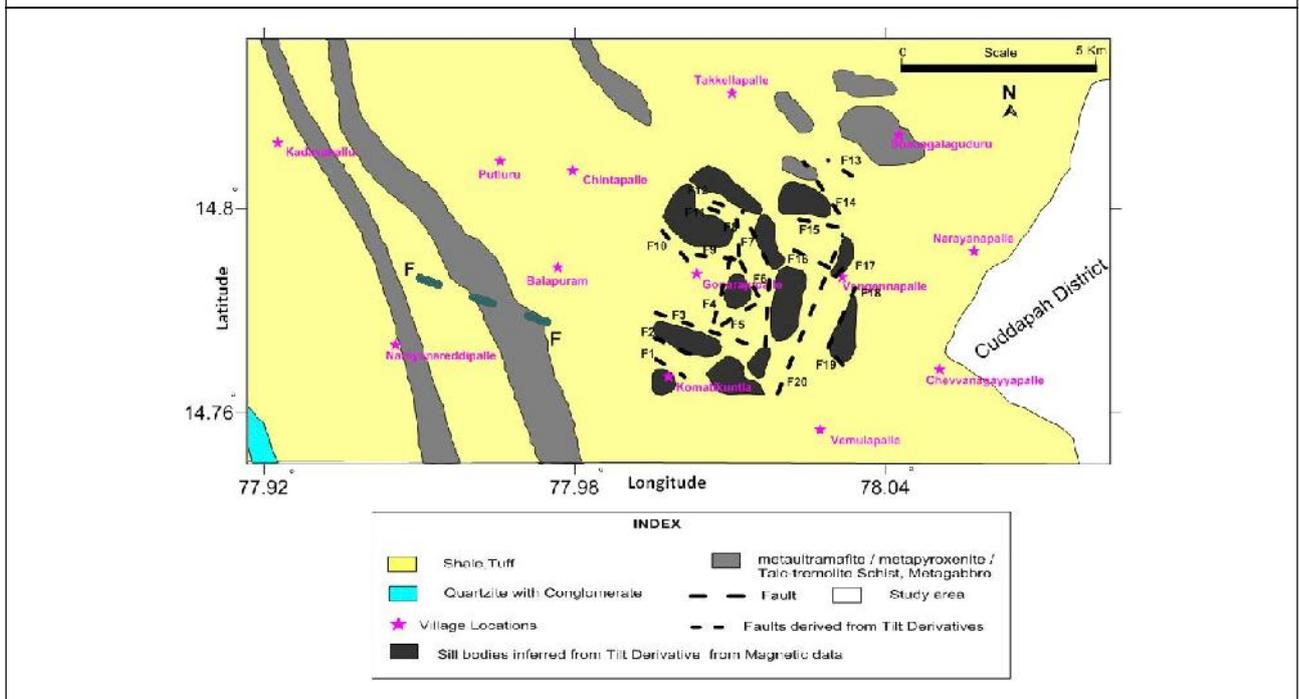


contour map (Figure 2) and sill outcrops are present in the north shows high values. But in the middle of the study area also show high values infers the presence of sill segments in the subsurface (as per geology sills or dykes are intruded in the shales) which are marked as hidden sills. The zero tilt derivative contours coincide with contacts between shales and sill segments and these may in turn represent faults in the area. These hidden sill segments and the derived faults (F1-F20) are overlaid on the geology map and prepared a structural map of the study area (Figure 3).

CONCLUSION

From the tilt derivative technique the edges of the high magnetic sources marked as outline of the sill segments and the inferred faults (F1-F20) which are separate the shale and sill formations show the subsurface structural pattern prevailing in the study area. It is clearly visible in this map

Figure 3: Structural Map inferred from Tilt Derivative Technique



(Figure 3) that multiple faults/fractures are present and these might be result sills into sill segments. The maximum faults are trending NW-SE, parrallal to main Fault and to existing exposed sills and other are in NE-SW parallal to buried sill segments.

ACKNOWLEDGMENT

One of the author (First) is highly acknowledged to the UGC (New Delhi) for awarding UGC (RFSMS) fellowship and Prof and Head, Department of Geophysics, Osmania University, Hyderabad, India, for providing the facilities in the department.

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International Journal of Geology and Earth Sciences

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