

Total magnetic investigations for structural mapping in gas show area in the Tadipatri Region, South Western margin of the Cuddapah Basins

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Abstract

In order to get in sights in to the subsurface structure and lithology in Tadipatri area where gas is gushing out along with the ground water from irrigation wells in the year of 2007, in few villages of Putluru and Yellanur mandals of Ananthapur District A.P, South western part of Cuddapah basin. Magnetic investigations are carried out along all available approach roads and tracks in the region with a station interval of 200 m to give a fairly even distribution of magnetic values for the entire region covering the total an area of 10 sq.km. From qualitatively analysis of Magnetic data with analytical techniques, brought out several lineaments faults, fractures and geological contacts. From Total Magnetic Intensity (TMI) structural map inferred subsurface structures, a total eight highs and two lows seven faults were inferred revealing the structural configuration of the region. From 1st Vertical Derivative and tilt maps were brought out deep seated sills and shale bodies in the Gas show area. From Coefficient of Variation Map of magnetic data clearly delineated eight tectonic disturbed zones (A, B, C, D, E, F, G & H) various faults and other lineaments/dykes. They are emplaced in the south western region of the Cuddapah basin during a crust – mantle interaction and acted as a source for the outcropping dykes, sills and flows are responsible by methane gas leakage. The sills are presumably acting as cap rocks for the gas rising from deeper levels.

Keywords: Qualitative analysis, magnetic lineaments, buried sill bodies, Tadipatri shales, boundary of the causatives.

Introduction

Cuddapah basin is one of the most prominent areas in Peninsular India which presents a complicated geological setting. This basin poses many problems to geoscientists regarding economic mineral and hydrocarbon exploration. The basic geological and geophysical surveys were carried [1,2,3,4]. These studies are confined to systematic geological mapping and regional geophysical surveys over the Cuddapah basin. Several monographs and reviews are available [5, 6] while the Granite-Gneissic complex and the schistose rocks of the Dharwar system constitutes the surrounding country of the Cuddapah basin, the eastern boundary of the basin falls close to the Eastern Ghat Mobile belt (EGMB). Several alkaline rocks and carbonates are reported from the region east of the Cuddapah basin boundary adjacent to Eastern Ghat Mobile belt (EGMB) [7,8]. These are suggested to be related to several up thrust delineated from the DSS studies [9]. Recent findings of methane gas reported from wells near Tadipatri region, few villages of Putluru and Yellanur mandals of Ananthapur district in the south western region of the Cuddapah basin [10], Andhra Pradesh. The teams of ONGC, NGRI, Mines and Geology, the Revenue department were visited the area. Results of analysis from ONGC report showed that ONGC report showed that 89% of methane (CH₄) is present in the gases emanating from these wells. [11] make this basin and its surroundings a very interesting region for further studies both from the view point of mineral resources as well as for understanding of its structure and tectonics.

The present paper deals with the total magnetic investigations across the Tadipatri chosen area of the South Western region of Cuddapah basin, qualitative analysis of the magnetic data to obtained the structures, lineaments, joints and faults which are responsible for gas emanations.

Geology of the study area

The present study area situated in the western part of the Cuddapah basin is situated in Andhra Pradesh, South India. It occupies an area of 13,000 sq miles [12]. It is a huge depression filled with Pre-Cambrian sediments highly consolidated and recrystallised in denser form, overlying the Achaean basement complex. The formation near the western margin comprise Gulcheru quartzites, Vempalli limestones, Pulivendla quartzites and Tadipatri shales and they have gentle dips about 12°. These formations are intensely traversed by basic sills, dykes and flows. The main geological formations of the section in the area are the Tadipatri shales of Chitravati group. They are dominantly arenaceous and argillaceous with subordinate limestones. Although they are excellently suited for preserving fossils, they are devoid of them and are considered as unfossiliferous Pre-Cambrian sediments in all geologic reports and publication of the geology of Cuddapah basin. The igneous activity in Cuddapah basin confined to the area near the western margin where the Cuddapahs are exposed. Trap sills are found in Vempalle limestones and dolomites and Tadipatri shales. These sills are parallel to each other and individual thickness varies from a few feet to a few hundred feet. They follow stratigraphic contacts and bedding planes and they extended parallel to the strike of the sedimentary formations for long distances, all along the western margin from Papagni river on the south to the Krishna River on the north mineralization of asbestos and barites is attributed to the contact phenomena of basic igneous traps with sedimentaries in Pulivendla region.

The igneous activity in Cuddapah basin took place during late Cheyair, Nallamalai or immediately after Nallamalai times and it is not probable that the intrusion of all the sills is at one

and the same time. These sills and flows have been formed in Tadipatri shales and limestones. In the adjacent Archaeon country rocks, vertical basic dykes are exposed in swarms. As they are of large depths, they produce, broad magmatic anomalies. On the contrary sills produce local fluctuations or erratic anomalies as they are shallow. By applying this criterion it is possible to distinguish anomalies due to feeders from those of sills.

Geological and sedimentological studies are helpful to understand the depositional environment and subsidence history of a sedimentary basin while the geophysical studies help in deciphering the structural configuration of the basin [13]. Beginning with [14], the Cuddapah basin is one of the well studied Proterozoic basins in the Peninsular India, both geologically and geophysically [15,16,17,3, 18,1,19, 2].

Magnetic Data acquisition and Analysis

The Tadipatri area of Cuddapah basin (latitude 14°45' -14°50' and longitude 77°55'-78°05'E) lie in the villages Komatikuntla, Chintapalle, Shanagalaguduru, Balapuram,

Vengannapalle, Goparajupalle and Yellanur and in Putluru mandals of Ananthapur district of Andhra Pradesh. Magnetic observations are taken using the Model-600 Proton precession Magnetometer, along all available approach roads and tracks in the region with a station interval of 200 m to give a fairly even distribution of magnetic values for the entire region covering the total an area of 10 sq.km. A detailed observations are taken along 4 km long four profiles each separated by approximately 1 km, at a station interval of 10 m interval where gas is gushing out. The layout map of magnetic observations is shown in Fig.1. A total 704 stations are occupied (Corresponding to scale of 1:50,000). The N-S and E-W extends of this area that falls under Survey of India (SOI) Toposheet No. D44G1 and D43L13. The position of the observation points was taken by using Global Position System (GPS) with an accuracy of 1m, to ensure reliability and accuracy of the radiometric and GPS elevation, location of geographic coordinates several observations (20%) are repeated. The overall effective accuracy obtained for the magnetic data is +/- 1 nT.

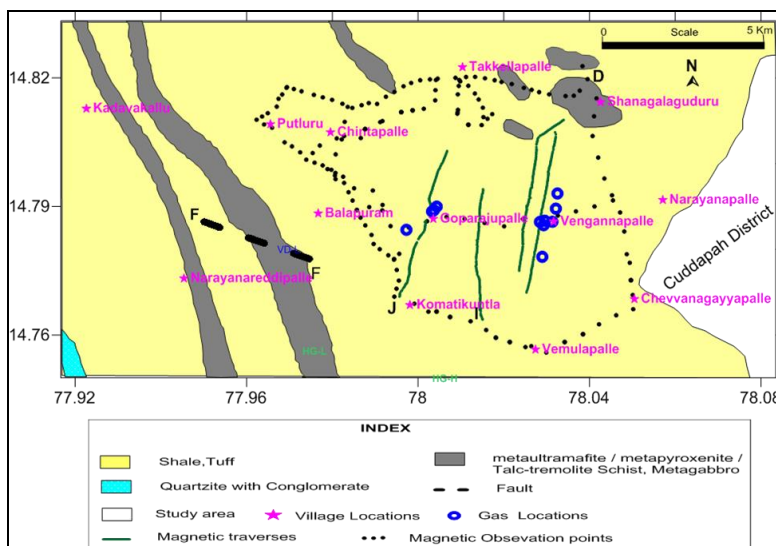


Fig 1: Geological and Magnetic layout map of the study area, Ananthapur District, AP. [33]

Total Magnetic Intensity

The magnetic observations were subjected to diurnal variation which is most important correction in a magnetic survey is diurnal correction, which arises due to the variation during a day in the earth's magnetic field. This requires a correction for this change in case the survey in a region is spread over more than one day. For this purpose a datum level is chosen for example the first reading on first day of the survey or any other value. Diurnal correction implies that the reading on that particular day is reduced to the first reading at base station on that day. Therefore, the difference between selected datum level and the first reading of a particular day to which all other readings of that day have been reduced through diurnal correction is added or subtracted to the reading on that day to bring all the recorded data in a particular survey to a common datum.

Fig. 2(a) is the contour map of Total magnetic intensities for the study area contoured with an interval 20 nT. The magnetic signature range from a low of 40727 nT along the parts of margin of the study area at the eastern and northern part of the

study area, to a high of greater than 42520 nT at the western and Northeastern part study area. From this map it is seen many magnetic highs and lows. At some places, steep gradients between them are described as prominent magnetic lineaments, which are attributable to the complex assemblage of features of varied dimensions and directions from different phases of magnetic activity. Some of the features are associated with basic acidic intrusive that indicate zones of magnetic permeability.

IGRF computed Total magnetic intensity

The present total magnetic investigations area is a relatively small spatial extent, the coordinates for the each observation points for IGRF calculated using Geo-soft software, GM-Sys 2010, Oasis Montej 2010, International Geomagnetic Reference Field (IGRF) of the study area was removed from the reduced to diurnal magnetic data. Fig. 2(b) shows the IGRF calculated contour map of the total magnetic intensity (Regional) of the Tadipatri region (contoured interval of 1nT) along the locations of villages. The contour map of IGRF

calculated total magnetic intensity in the study region with a contour interval of 1 nT (Fig.2b) regional magnetic response is ranging from 41458 nT to 41474 nT, contours are trending NW-SE direction with increasing from south to northern part of the area, indicating there is a fill of sediments more in the Southern part of area, then in the northern part of the area. The

regional trends attributed to effect of deeper heterogenic of the crust. Fig.2(c) and 2(d) the contour maps of variation in the inclination and declination in the study area were found to vary 16.42° to 16.52° and -1.59° to -1.6° respectively in the study area.

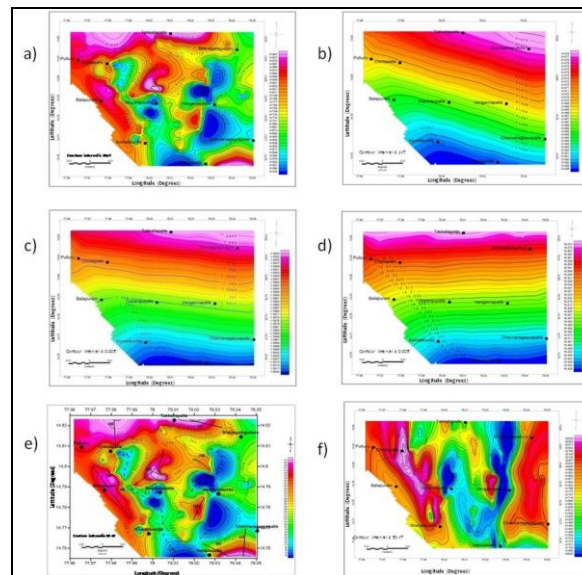


Fig 2. a): Total Magnetic Intensity contour map, b) IGRF calculated Total Magnetic Intensity contour map, c) Declination contour map, d) Inclination contour map, e) IGRF corrected Total magnetic Intensity contour map, f) Reduction to Pole Magnetic contour map of the study area.

IGRF Corrected Total Magnetic Intensity (TMI)

After Diurnal correction, another correction, which needs to be applied to the magnetic data is the IGRF correction. IGRF implies International Geomagnetic Reference Field, which pertains to the normal earth's magnetic field. In order to obtain the anomalous part of the observed magnetic field, the normal earth's magnetic field at the point of observations is subtracted from the observed magnetic field. This normal correction was made using the Geosoft software [32], is a supporting software of the GM-sys (Oasis Montej), processing and analysis module. The contour map of IGRF corrected total magnetic intensity in the study area with a contour interval of 20 nT Fig. 2(e) while the contour maps of variation in the absolute field. After IGRF corrected the magnetic data showed a range of -29 nT to 480 nT. The TMI map presents a broad NE-SE trending magnetic anomaly with its centre located south of the study area. It is interesting to note that the NW-SE trending magnetic contours in the region trend to show an abrupt local change in their orientation at the northern limb of anomaly where they turn to near E-W direction indicating the influence of and E-W trending structural features. Further west, this linear zone indeed hosts a dipolar anomaly with amplitude of about 100 nT. The E-W trending magnetic featured, indicative of a similar linear subsurface structural feature cuts across mainly the southern half of the Vemulapalle - Shanagalaguduru. Total magnetic intensity map (Fig.2e) of Tadipatri area reflects the geology and lineaments /faults of the region very well. While comparison of the magnetic signatures with geology of the region not many inferences are made because the study area lies in the western part of Cuddapah basin exhibit subtle magnetic signatures. The magnetic highs (red colour) and lows (blue colour) are indicative of bipolar nature in conjunction of subsurface faults

in metagabbro terrain. NE-SW and NW-SE lineaments over sedimentary formations magnetic low and highs are reflected as magnetic lows surrounded by highs, as this is typical signature of Cuddapah sediments, mostly N-S, E-W, NE-SW and NW-SE direction, eight highs (H1 to H8), H1 (trending in NW-SW), H2 (south of Chevannagayyapalle in the NE-SE), H3 (South of Vengannapalle, elliptical contours characterized trending NE-SW direction), H4 (Balapuram to Komatikuntla, also trending NE-SW with small spatial extent), H5 (north of Goparajupalle extending in NE-SW suddenly abrupt change in direction NW-SE), H6 (situated northern part of Vengannapalle, NW-SW direction). H7, (north of Shanagalaguduru, extending NW-SE), H8 (situated north of Chintapalle trending in the N-S direction). All isolated magnetic high closures observed over a study, few basic / ultra basic dykes are available as intrusive Sill bodies appears to be characterized by observed magnetic high closures. The highest magnetic intensity values 496 nT observed at the north western part of study areas.

Two magnetic lows (L1 to L2), L1 (trending NW-SE direction lies south east side of the Komatikuntla village), L2 (north of Vengannapalle to further south) trending NW-SW direction are seen in Fig. 2(e). These prominent magnetic lows are exhibiting non magnetic source or less amount of magnetization, the study area might be of high magnetic susceptibility acting as the source of these intense variations in the magnetic intensity. It can be general attributed to the variation in susceptibility of rocks units in zones of fracturing / shearing / faulting or superposition by later metamorphic events. Thus, the flexures of linear second order anomaly trends reflect occurrences of sills are later tectonic activity and so are important in the study area. The magnetic contour map is characterized by rather moderate fluctuations of the field,

and is consistent with the magnetic response of a gently dipping sill which is generally characterized by significant anomalies at its edges and moderate to mild fluctuations over the middle part of the sill body [20].

Reduction to the Pole

The shape of magnetic anomaly depends on the shape of the causative body, and also depends on the inclination and declination of the local earth’s magnetic field, and the orientation of the body with respect to magnetic north. Reduction to the pole (RTP) transforms the observed magnetic anomaly into the anomaly that would have been measured if the magnetization and ambient field were both vertical as if the measurements were made at the magnetic pole. To minimize the dipolar nature of the field, the reduced –to- pole (RTP) magnetic anomaly map is calculated for total intensity map of the study region. This method requires knowledge of the direction of magnetization often assumed to be parallel to the ambient field, as would be the case of remnant magnetization is either negligible or aligned parallel to the ambient field, If such is not the case, the reduced – to – the – pole operation will yield unsatisfactory results.

The area under study and surrounding were subjected to various tectonic events along the geologic time. Each of these tectonic event has changed the structural setting of the area where these changes were appeared on the RTP magnetic contour map (Fig.2f), contour interval is 50 nT general variation is 40934 nT to 42526 nT. Contours are trending mostly north south direction fig.(2f) and enhanced the structural and lineaments (NW-SE and NE-SW) of the study areas.

Low pass Filtering

With a view to eliminating the high frequency noises a low

pass filters (cut of frequency 0.0035 cycles/sec) was applied to the data fig. 3(a) shows the color-shaded contour map of the low pass filtered out put of the Total magnetic Intensity map in the study area.

In the present investigations the low pass contour map presented in the fig 3(a) reflecting eight (H1 to H8) highs and five (L1 to L2) lows are delineated, which are representing deep seated source are trending similar to Total magnetic intensity map with steep gradients reflecting the faults / contact zones, at discrete placed prominent magnetic linear feature are attributable to the complex assemblage of features of geologic settings some of the features are associated with basic sill bodies in active of magnetic anisotropy behavior. While magnetic highs are recorded over intermittent occurrences of sill bodies and low response over shales and limestones were registered probable because of the study area lies the south western part of the Cuddapah sediments.

High pass filter map Fig. 3(b) representing the residual anomalies with near surface features the anomaly ranging from -69 nT to 66 nT, number for positive (red colour) negative (Blue color high frequency isolated bodies are very shallow nature.

Horizontal derivative

The horizontal gradients (Nabighain, 1984) along the X direction shown in Fig.3(c) with a contour interval of 5000 nT/km represent the rate of change of the magnetic field in the corresponding directions that is the X - gradient highlights anomalies with large components disposed along the Y- axis and vice-versa. It displays detailed information about the structures, contacts and the tectonic setting of the study area. However, in the study region shows varying trends NW-SE, NE-SW and E-W.

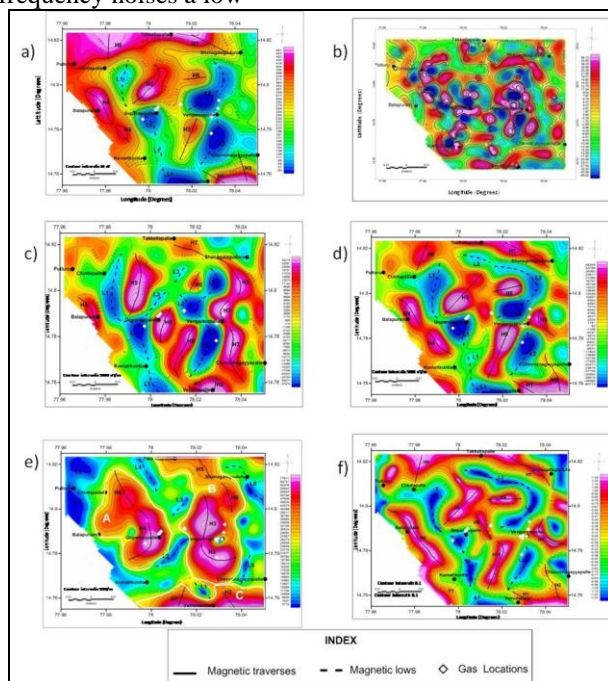


Fig 3.a): Low pass filter Magnetic Anomaly map of the study area, b) Residual magnetic map of the study area c) Horizontal derivative of the magnetic anomaly in X direction, d) Vertical derivative of the magnetic anomaly map, e) Analytical Signal of the magnetic anomaly map, f) Tilt derivative of the magnetic anomaly.

Horizontal gradients of magnetic anomalies are clearly noticed over edges of tabular bodies. For near surface bodies with near-vertical contacts, the maximum horizontal gradient of magnetic as measured along the profile will occur nearly over the contact ^[21], the maximum or minimum horizontal gradients reflecting high and low gradients trends are shown in fig. 3(c) often useful in defining the lateral and vertical extent and geological contacts/faults more sharply contour maps as also give an estimate of the depth of the source body and the location and dip of its edges.

Vertical derivative

The first vertical derivative is the theoretically equivalent to observing the vertical gradient directly with a magnetic gradiometer. A vertical derivative map enhances the response from shallow sources, suppressing deeper ones by enhancing high wave number components of the spectrum. Thus, closely spaced sources can be better differentiated on derivative map. The 1st vertical derivative, $n=1$ sharpens the anomaly amplitudes, thus helping in the identification of more geological features, which are obscured in the original map. Fig.3(d) is a plot of the vertical derivative of the total magnetic intensity (with a contour interval of 5000 nT/km) of the study region. In the present study, the sill bodies at depth thus mainly contribute to the magnetic anomaly with magnetic highs (red colour) and lows (blue colour), consequently from the known geology of the area it can be broadly inferred that while the highs correspond to Sill and other intrusive, the surrounding lows can be attributed to shales and sedimentary rocks. This map is dominated by essentially NW-SE and NE-SE striking trends on maxima or minima representing the geological contacts/faults etc.

Analytical signal

The analytic signal ^[21] is a function related to magnetic fields by the derivatives,

Analytic signal

$$A(x,y) = \sqrt{(\partial T/\partial x)^2 + (\partial T/\partial y)^2 + (\partial T/\partial z)^2}$$

Where T is the observed field at x and y While this function is not a measurable parameter, it is extremely interesting in the context of interpretation, as it is completely independent of the direction of magnetization and the direction of the inducing field. This means that all bodies with the same geometry have the same analytic signal. Furthermore, the peaks of analytic signal functions are symmetrical and occur directly over the edges of the wide bodies and directly over the centers of narrow bodies.

The analytical signal ^[23, 24, 25, 26] Fig.3(e) contour interval 5000 nT/km gives finer resolutions of magnetic anomaly trends and locations and disposition of causatives ^[21] the anomaly square root of the ^[23,25] sum of squares of the horizontal (X and Y) and vertical derivatives (Z) along the orthogonal axes of the anomaly resolves the anomaly maps. It encompasses information of the magnetic field variation along the orthogonal axes completely defining it. Consequently, structural features and boundaries of causative sources can be determined more accurately.

From the analytical signal map of the magnetic in the signal shaded anomaly map of study area is represented in Fig.3(e) of the study region is reflecting similar trends observed in total magnetic intensity map enhanced structural trends due to shallow depths and well reflected the major structural trends in

the study areas. From the analytical signal of Magnetic anomaly in the region three prominent clusters marked A, B, C are observed ENE - WSW trending closures in the Goparajupalle and south of Vemulapalle in the south of the study areas (Closures A to C). Geologically the closures A corresponds to the shale's, Cluster C and correspond to a general geology of Sills. However, from cluster A and C, it can be inferred that in the Study region, the sill belt is not a single massive unit rather it is dispersed and shows a trend varying from N-W to NW-SE.

Tilt Derivative

Tilt derivative utilizes the ratio of the vertical derivative to the absolute value of the horizontal derivative and θ the tilt angle or tilt derivative ^[27, 28] defined as

$$\Theta = \tan^{-1} (\partial f/\partial z) / (\partial f/\partial h)$$

Where $\partial f/\partial z$ and $\partial f/\partial h$ are the first vertical and total horizontal derivatives, respectively of the Total magnetic Intensity.

It may be noted that the tilt angle is restricted to lie between $+90^\circ$ and -90° ^[29] regardless of the amplitudes of the vertical and horizontal derivatives. The tilt angle has the attractive property of being positive over the sources, crosses through zero at or near the edge of a vertical sided source and is negative outside the source region ^[27, 28, 29].

But basically in this study interpretation of Tilt angle (Fig. 3(f)) is restricted to structural trends. As discussed above. Tilt derivative maps are study area enhanced the structural trends, which can be attributed to major lineaments, faults and structural fabric of the study area. The distinct feature of tilt derivative map is the similar to the First Vertical Derivative map, high zone that corresponds to the Sill bodies and lows are correlated with shale's. This highs and lows are aligned N-S to NNW-SSE in the northeastern part of the region.

For comparative analysis structural features inferred from Total magnetic Intensity map, Horizontal gradient, Vertical gradient, Analytical signal and Tilt derivatives for the study area have been presented in Fig.6 indicates the NW-SE, NE-SW trending faults and E-W faults as well as N-S cross structural features constitute the major trends. From Vertical and Tilt Derivative techniques there are seven faults (F1-F7) delineated.

Fault F1- situated in the western part of study area essentially contact between shales and sill bodes, this is running from komatikuntla to Putluru in NW-SW, F2- falls in the central part of study region trending N-S direction, Southern part of Vengannapalle to Takkallapalle. This is appeared to be deep seated faults where gas leakage were traced at Vengannapalle village. F3- falls northern part of Vengannapalle through Vengannapalle to shanagalaguduru. Surprisingly, there are multiple boreholes drills in this area. F4-running in the E-W direction, F5- extend from Komatikuntla to Vengannapalle and further more. This fault is separated by F1, F2, F3 faults indicate of strike slip fault and place a major role where ever cross over points, of other faults indicative of gas leakage. F6- a small extend and bounded by in the west part, passing in the NE- SW to SW- SE, and cutting the F1 fault in the north. F7-faults extend in the E-W direction similar to F4 fault, start from Putluru through South of Takkellapalle to Shanagalaguduru. It is inferring that the sill bodies exposed on the surface and further disappear, because of bodies down though below the subsurface and over all the integrated maps

from Tilt Derivative presented in fig.4 with borehole locations.

Coefficient of Variation:-

Coefficient of variation can be computed by the relation C.V

$$= \frac{\sigma}{\bar{x}} \times 100\% \dots 5.1$$

Where \bar{x} stands for mean and σ is the standard deviation.

We have chosen segment (5 – points) of the observations of magnetic detail traverses, the coefficient of variation was computed and presented in Fig.5. This coefficient of variation is useful in picking up the geological contacts and the tectonically disturbed zones faults along the traverses are shown in fig.5. From this Figure (A, B, C, D, E, F, G and H) magnetic zones are traced. These are tectonically disturbed zones might be responsible for gas emanations from subsurface to surface in the study areas.

All the reported occurrence of Gas shows fall on the southeast ward extension of this geological features (Sill) or very close to its (Fig.6).

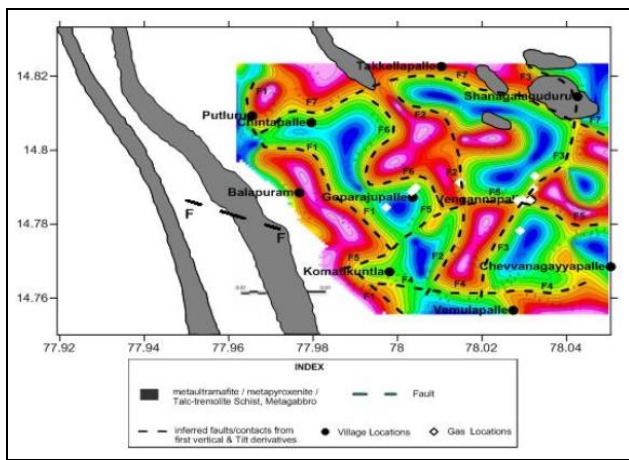


Fig 4: Tilt Derivative overlaid on the geology map.

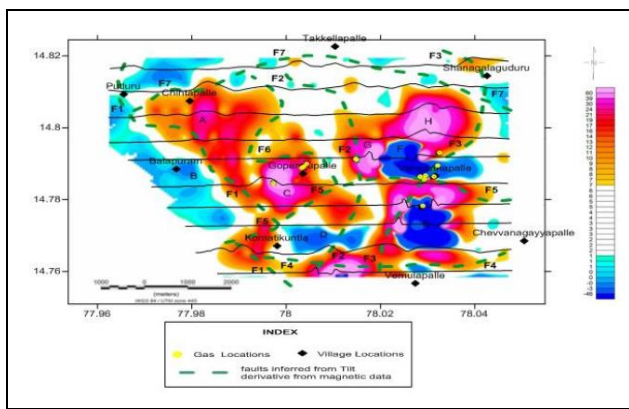


Fig 5: Coefficient of Variation profiles magnetic anomaly and image of the study area with probable disturbed zones (A, B, C, D, E, F, G & H).

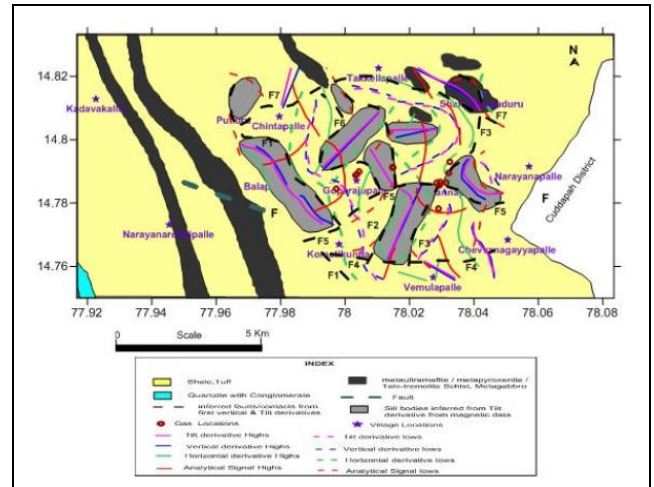


Fig 6: Structural map of the study region, as inferred from Total magnetic Intensity data analysis.

Summary

Analysis of Total magnetic intensity, analytical techniques map of the study region brought out subsurface structural features is inferred from analytical techniques gradient analysis of TMI Horizontal, vertical, tilt and analytical. The faults, fractures are derived from the tilt derivative map (fig.4) and Coefficient of variation maps (fig.5). The observed magnetic anomalies corresponds to major fracture zones cutting across the Sills in the region and also show that occurrence of the Gas shows is closely dependent on the location of bore wells with respect to these major fracture zones. The bore wells located in such zones and reaching the depth levels corresponding to fracture zone that also pass through the Sills, may be considered to be facilitating the outflow of the gas along with the water, thus showing consistency with the proposed model which envisages an important role of the sills in preserving the gas. The observation that locations of the gas shows fall on the intersection of faults in the study region.

The methane gas can be generated through several processes in nature viz., bacteriogenic, thermogenic, metamorphic reactions or mantle degassing [30]. The Papagani and Chitrvati groups of Cuddapah sediments are known to be Stromatolite rich and can act as useful source rocks for hydrocarbon generation [20] under favorable conditions of temperature and pressure. Vemulapalle –Tadipatri –Cumbum carbonate and carbonaceous argillite facies in the basin have yielded a wide range of Acritrachs and other microbiotic forms, indicative of intense biotic activities. The microbiota of Cuddapah sediments include cyanobacteria an important biotic element identified to be closely linked to generation of Proterozoic hydrocarbon deposits [31].

The occurrence of gas shows in the area are shown to be on to closely associated with the fractures and fault zones. This indicates that the natural leakage of gas in the Tadipatri area is dominantly fracture/fault and lineaments controlled. The subsurface structural features is inferred to be a magmatic intrusive emplaced in the south western region of the Cuddapah basin during a crust – mantle interaction and acted as a source for the outcropping dykes, sills and flows are responsible by methane gas leakage. The sills are presumably acting as cap rocks for the gas rising from deeper levels. The

existence of a massive subsurface basic intrusive body in the southwestern region of Cuddapah basin and the related igneous features like sills is suggested to be closely linked to the thermogenic origin of the gas in this part of the Cuddapah basin.

The coefficient of variation (CV) of the Total magnetic intensity maps delineated A, B, C, D, E, F, G and H zones of fractured zones which are favorable locations for gas leakage.

Conclusions

- The trends (NW-SE, NE-SW and E-W) of the magnetic lineaments are deduced from the analytical maps such as Horizontal X & Y, Tilt, Vertical, and derivative and analytical signal of the magnetic anomaly.
- The total magnetic Intensity map in the area brought the eight magnetic highs (H1 to H8) and two lows (L1 to L2) trending the NW-SE, NE-SW, E-W and N-S directions. Relationships among these trends suggest that the area was subjected to more than a single tectonic event.
- Coefficient of Variation (CV) of the magnetic anomaly delineated structurally disturbed eight zones (A, B, C, D, E, F, G and H) in the study areas might be responsible for gas leakage.
- The occurrence of gas shows in the study area are shown to be closely associated with the fractures and fault zones identified from magnetic method. This indicates that the natural gas leakage of gas in the Tadipatri area is dominantly fracture/fault controlled. The sills are acting as cap rocks for gas rising from deeper level.

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