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Sub-surface Structural Configuration of the Chitradurga Schist Belt as Inferred from Bouguer Gravity data analysis

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Abstract: *The NW-SE trending Chitradurga Schist Belt (CSB) from Sarangapatnam to Gadag in Dharwar Craton, of Indian peninsular Shield is interesting both from the Geological and as well as Geophysical points of view. However relatively few Geophysical studies over the Chitradurga Schist Belt have been reported. In this paper a new Bouguer gravity map of Chitradurga -Gadag region were analysed qualitatively and quantitatively to understand the geological structures in this region. The qualitative analysis consist of gradient analysis (Horizontal, Vertical ,Analytical signal and Tilt derivatives) were brought out the disposition of the schist belt contacts, shear zones, two (F1 & F2) major deep faults are running NW-SE , nine (f1 to f9) small local faults trending in NW-SE, N-S , five gravity lows (L1 to L5) and three gravity high (H1 to H3) lineaments were delineated. Based on these inferred features comparing with known geological control, schist belt as three mineral potentional zones were delineated, northern (A), Central (B) and (C) zones.*

Quantitative analysis from GM-Sys modelling inversion 10 profiles over the study region brought out nature of the crust and estimated the thickness of Younger Granites , schist belts and sub-surface crustal layers configuration. The supra crustal layers average depth of Younger granite is varies from 0.31Km to 2.79Km, Chitradurga schist belt ranging between 0.52Km to 8.48Km, and the average depths of Peninsular gneissic , upper crustal layer and deeper crustal layers ranging from 8.2Km to 13.1; 18.9Km to 23.8Km and 30.7Km to 34.57Km respectively.

The sub-surface configuration of each of these layers were obtained by digitizing the corresponding crustal structure and presented as 3D contour map reveal structural complexity with plunging synclines, anticlines and refolded along E-W trending warps.

Keywords: *Anticline, Syncline, Upwarps, Plunging, Structural configuration*

I. Introduction

It is well known that the Archaean-Proterozoic Dharwar craton is distinguished by complex course of geological evolution [11], [17], [5]. The three major rock constituents of the craton in chronological order of decreasing age are peninsular gneisses, schist bets and younger granites. The schist belts and numerous enclaves of a wide variety of volcano sedimentary material (2900-2600 Ma), two major types of schist are identified in the Dharwar craton, the older, eastern Kolar type and the younger ,western Dharwar type. The auriferous Chitradurga-Gadag schist belt lies west of Closepet granite and is one of the longest schist belts of Dharwar craton, it is widely studied by earth scientists not only from the point of view of mineralization but also for its tectonic framework, as its eastern margin is a suture zone and is believed to be the dividing line between the western and eastern Dharwar cratons proposed by [7] Earlier geophysical studies in the region include gravity [23], [8] and[13] Petrophysics and crustal configuration [15], [14] and Heat flow study by [6] latest Geophysical study gravity and Magnetic studies by [19] mapping CSB and integration with the available radiometric maps and Geology has brought out characteristics of background values between Arms of CSB and main schist belt.

Here, an attempt has been made combining the all available gravity data sets with our new data for investigations oriented towards understanding the tectonic and structural configuration of the Chitradurga Schist Belt (CSB).

II. Geology:

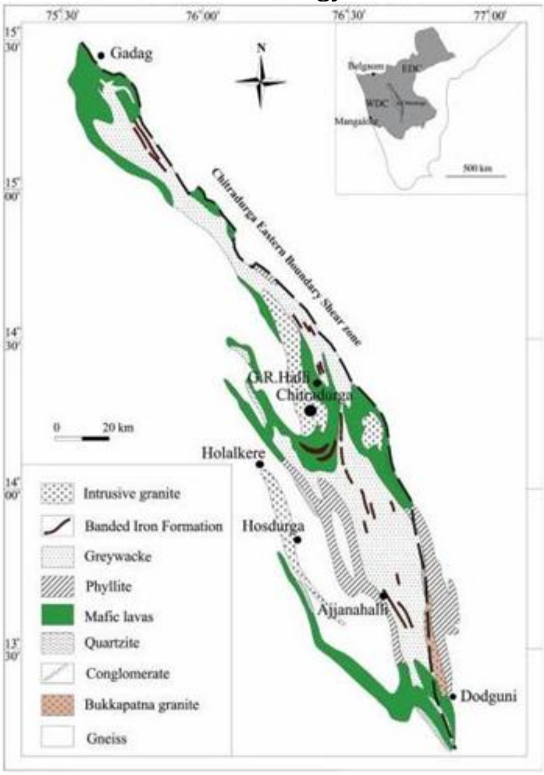

Figure.1. Geology map of the (Chitradurga Schist Belt) study area.
(modified after Jayananda et al., 2011a, b; Radhakrishna and Vaidhyanadhan, 2011)

Chitradurga Schist Belt (CSB) lies west of Closepet granite and is one of the longest schist belts of Dharwar craton with a north-south (N-S) [24], NNW-SSE trend extending from Srirangapatna in south (Karnataka, India) to Gadag in north. Figure.(1) Shows the geology of the study area of and adjacent region in the CSB. The region, bounded on western part of India extends from latitude 12°30' to 15°45'N and longitude 75°20' E to 77°E and covers an area of it attains a maximum width of 40 km near Chitradurga and occupies over 6000 sq.km area with a strike length of 460 km compressing thick sequence of metasediments and metavolcanics belonging to the Dharwar Supergroup. It exposes the complete succession of cratonic rocks such as Sargur and Dharwar supracrustals, basement and intrusive gneisses and younger K-rich granitoids [18].

The Dharwar Supergroup is grouped into two subgroups viz. older Bababudan Group and younger Chitradurga Group, [22]. The regional structure of the CGB has been described as second generation central anticline flanked by first generation synclines on either side [10]. These structures are refolded along E-W trending warps formed during deformation of different stages [19]. CSB is widely known for its mineral potential, particularly gold mineralization, and is being exploited since long [20].

It is widely studied by earth scientists not only from the point of view of mineralization, twenty six gold incidences in different host rocks of the CGB are reported along the eastern extremity of the CGB and in proximity to the CBSZ. Three most important gold deposits occurring along the close proximity of the CBSZ are Ajjanahalli, G.R.Halli and Gadag. Gadag Gold Field (GGF) is located in the northern part of the Chitradurga schist belt In the Dharwar Craton of southern India (figure.2). The CGB, also known for its copper and iron mineralization, is interpreted to have formed as a result of collision tectonics and closure of a basin between two juvenile continental crust blocks [12].

III. Gravity Data Base:

A total of 941 gravity observations were made with a station interval of 500 meters, along available roads and paths in the Gadag study area (Figure.1) with the Model G941 LaCoste & Romberg Gravimeter. Along with existing data from NGRI [1], [2], [3] and GSI and CEG [13], [14] and latest publication of GSI [19], might provide more information about the structure of the Chitradurga-Gadag Schist Belt.

IV. Qualitative Analysis:

The colour shaded Bouguer gravity map of the area (GSI & NGRI-2006). Between 12°30'N to 15°45'N latitude and 75°20'E to 77°E longitude is shown in the (Figure.2). This map shown some prominent five gravity lows (L1 to L5) and three gravity highs (H1 to H3), the lows are extending of negative anomaly is not limited to any geological formation but is predominant over granite gneisses and schist as well but the gravity low probably a result of several granites batholiths expose in this region L1 prominent at Sasival in SW part (-100mGal to -104mGal), L2 is pronounce gravity low (L2) of -104 mGal central at Huliyar extending in the direction of NW-SE up to Holalkere, another prominent negative anomaly low (L3) -96mGal has been observe to the south of Brahmasagara trending in the direction of E-W curvature type, L4 is characterizes by broad gravity low 100 mGal at North of Brahmasagara and start at Brillicrodu and trending NW-SE direction and L5 -110mGal at western boundery of Gadag and CT schist belt and broad gravity L5 conforming to its orchard shape. The gravity lows might be explaining thickness of the crust or Moho due to isostatic compensation. From the Bouguer gravity contour map, three gravity highs (H1),(H2) and (H3), H1 is starting from North of Nagamaga its passing through the Yadiyur upto Anabur and it is trending NW-SE direction with folding contour, another gravity High (H2) is small extending almost NE-SW direction Harchadagalli and H3 is runs Harchadagalli south to Gadag north and it is trending NW-SE direction.

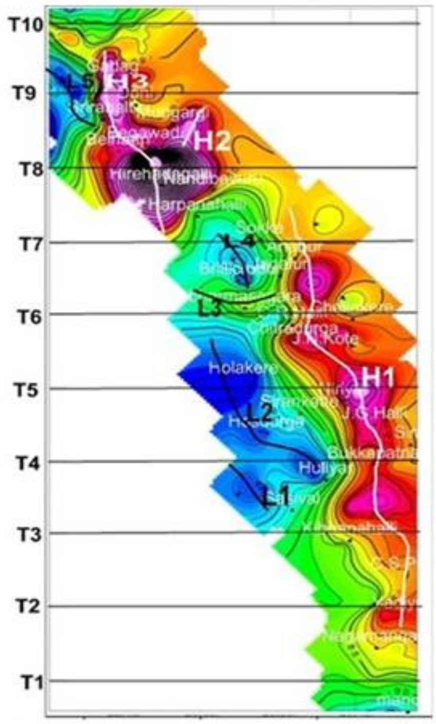

Figure.2. Bouguer Gravity map of the Study Area.

Based on the distribution of density variations and there structures where the gravity highs NE-SW to NW-SE consider as the low density inclusion. The strike slip fault in the region and also this co-inside with changes of phases of metamorphism from green schist phases to the North of 14°30', the NW-SE trending are seen up to 15°30'.

V. Gradient Analysis:

The horizontal gradients along the X-directions represent the rate of change of the gravity field in the corresponding directions (Figures.3). That is, the x gradient highlights anomalies with large components disposed along the y-axis, and vice-versa. However, in the study area, the Chitradurga Greenstone Belt (CGB) schist belt by and large, trends in the NS and the NW - SE directions, the horizontal gradient maps are indicative of subtle signatures defining local extents of sub-bodies and faults.

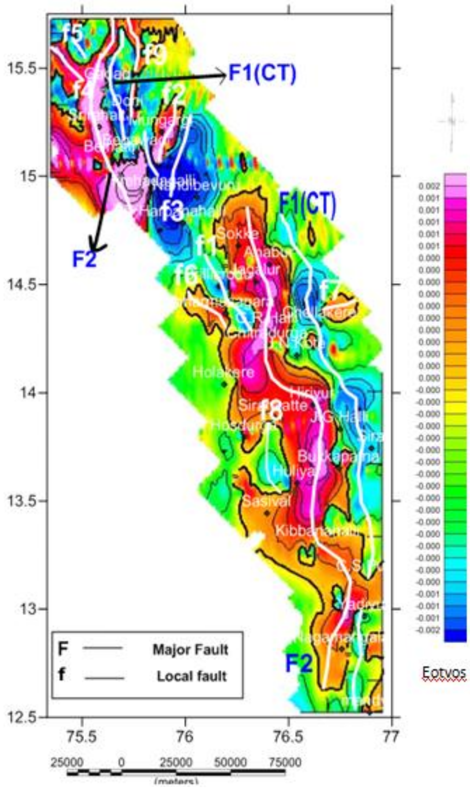

Figure 3. Horizontal derivative map of the Chitradurga Schist Belt

Vertical gradient map (Figure 4), on the other hand are based on the concept that the rate of change of gravity field with elevation is much more sensitive to changes in rock densities near the ground surface than at depth, therefore such maps constitute a useful technique for demarcation of geological boundaries, details of which are obscured in the original map.

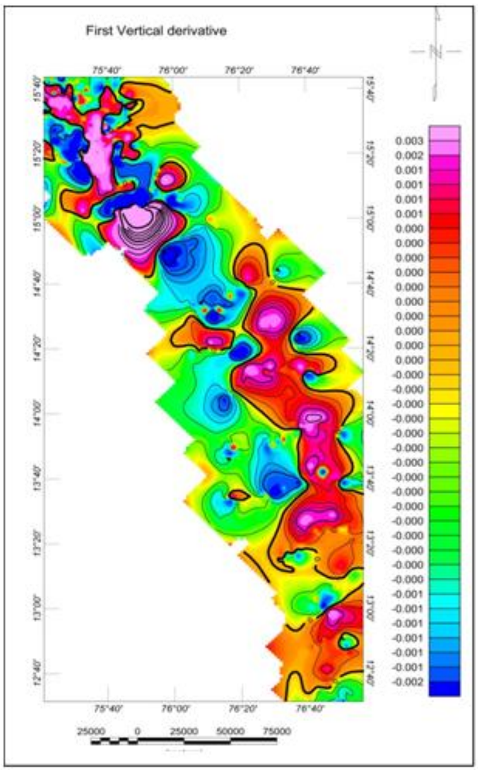

Figure 4. First Vertical derivative map of the Chitradurga Schist Belt.

VI. Analytical signal:

The analytical signal amplitude being the square root of the sum of the squares of the horizontal (x) and vertical (z) components of the field encompasses information of the gravity field variation along the orthogonal axes completely defining it. Precise delineation of structural features and boundaries of causative sources is possible on this map. For targets with adequate contrast with respect to host rocks, the peak values in the contour map position the body. From figure (5) evident that clearly based on that Analytical signal map five sector (A,B,C,D,E) were identified that is North, Central and Southern blocks. The first, second bodies i.e A-block and B-blocks in Notherns identified and some of deposition of gold occurrences located in these blocks like Gadag gold mine, Kanganhosur etc. In Central region of Chitradurga-Gadag schist C-block and D-blocks are identified, in these blocks most of deposition of gold occurrences located like Chikkannanahalli, Ajjanahalli gold deposites. All of these blocks are separated by small local faults it is shown in the Figure.(6).

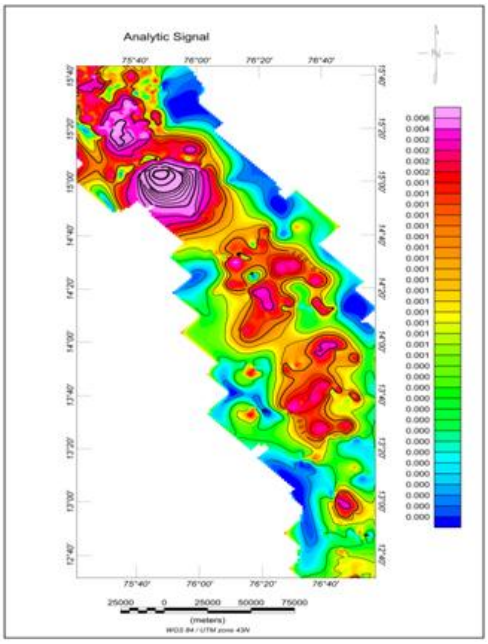

Figure.5. Analytical Signal map of the Chitradurga Schist Belt.

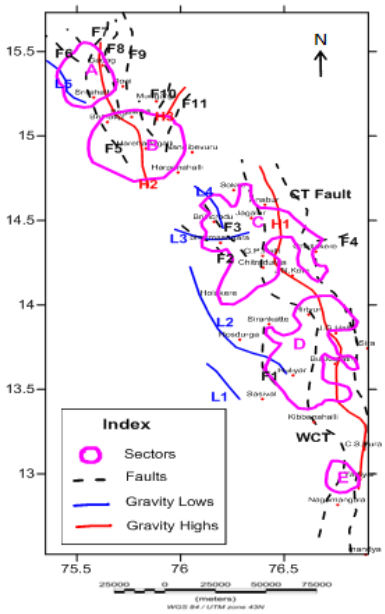

Figure.6. Integrated Structural map of Study area (CSB)

Bouguer gravity minimum value -99.2 mGal and Maximum -49.7 mGal in Gadag schist belt three maximum highs observed over the Gadag region. Low anomalies observe three zones (gravity lows) that is observe western part of the Gadag, high are separated by gravity lows, low gravity observe at Northern sector at Doni (L5). Figure.2 shown the Bouguer gravity color shaded new gravity map of the study Area (latitude 12°30' to 15°45' N and longitude 75°20' E to 77° E). The map is characterized by gravity anomalies along the CT schist belt has a total range of -99.2mGgal (min) to -49.mGals (max), range of maximum at near Gadag (Nothern part), Jagalur (Central part) and Huriyur (Central part) and Kibbanahalli (Southern part) and lows were observe at Sirihutti (Nothern part), Brillicrodu (Central part) and Holakere(Central part), Huliyar (Southern part) and Sasival (Southern part).

Gadag sector:

Bouguer gravity anomaly contour map of the region with locations of towns / villages marked on it. The Bouguer gravity values were contoured at an interval of 2 mGals to give a representative picture of the gravity variation in the region. From Figures (5), it can be seen that the region has an overall Bouguer gravity relief of approximately 40 mGals with Bouguer amplitudes increasing from -100 mGals to -60 mGals. The distinct feature of this map is the elongated N-S trending high zone that Compasses to the Gadag schist belt. The Gadag high (HI) corresponds to a gravity anomaly of approximately 20 mGals. Further north, the trend of HI changes from NNW to N-W (H2) indicating the changes in the trend of the schist belt towards the west.

The general decrease in Bouguer gravity in the South and North and NE suggests a corresponding deep occurrence of the host rocks in the SW and NE it is evident that gravity high zone (H1 and H2) are discontinues suggested a NE-SE fault On the other hand, the lows on either side of the Gadag high, L I that runs NW-SE and L2 and L3 which run approximately N-S, show up as anomalies of 5-7 mGals magnitudes.

Central Sector:

The Chitradurga schist belt is widest in the central part (Hosdurga-Hiriyur) with equal distribution of linear patches of metavolcanics (gravity highs) and meta sedimentary (gravity low) A narrow patch of gravity high characterizes the southern part. General trend of Chitradurga Schist Belt (CSB) is NW-SE (Nothern and Central parts) to near N-S (Southern part), southern part is devoid of any meta-sedimentaries. In the central sector three gravity high zones are characterizes in the NW-SE directions and southern part low amplitude gravity high is observe similarly in central sector zone L3 low gravity are observe at Brillicrodu.

Southern Sector:

L1, L2 and L4 are observes at southern and central part of CSB. L1 at Sasival is trending NW-SE, L2 at Huliyar to Hosdurgs NW-SE and changing direction near North-South direction. L4 at NW-SE at Brillicrodu has reflected by electrical gravity closer and indicating the narrow disposition and intrusion granites and L5 is observed at North near Srirahalti.

In the northern sector there are two gravity highs, H1 gravity zone is falling in the Chitradurga - Gadag schist belt zone, situated to the north-east of the Shimoga belt. It has a linear extent of more than 300 km. The belt is quite narrow, just about 50 km wide and elongated accurately in a almost N-S direction [23]. On Bouguer gravity map (Fig. 2) has brought out the Chitradurga fold closures is very well expressed as a positive axis flanked on either side by a gravity low. The gravity low may be suggest that the schistose formations have relatively shallow depth continuity within in the gneissic basement. Interestingly, the younger Chitradurga granite forming the core of Chitradurga closures is characterized by a gravity low. The region has an overall Bouguer gravity relief of approximately 40 mGal with Bouguer amplitudes increasing from -100 mGals to -60 mGals. The distinct feature of this map is the elongated, slightly arcuate, N-S trending high zone (H2) that corresponds to the Gadag Schist. Further, the fault F2 is abutting the gravity high.

The eastern margin is a thrust Fault (CT) marked (Fig 3, 4, & 5) whose marked by a strong mylonite zone, Schist belt primarily consist of mafic and ultramafic rocks with meta sediments (Greywacke, Conglaramerate and banded iron formations) and granite intrusive [26] along margins of Chitradurga schist belt (CT). The usually show gravity highs and lows related to mafic and falsie intrusive and crustal thickening**.**

Tilt Derivative:

The gravity tilt derivative (Figure.7), used to derive the local wave number, it will show that the combination of the tilt derivative and its total horizontal derivative, vertical derivative are highly suitable for mapping shallow basement structure and mineral exploration target and that they have distinct advantages over many conventional derivatives. The Chitradurga Green Schist belt are clearly demarked the CT fault and boundaries. There are very few granitic intrusions in the western block. Based on these differences a major tectonic divide along the Chitradurga–Gadag schist belt, known as the Chitradurga Boundary Fault, is proposed. Difference of opinion exists over the location of this fault, although there is general agreement over the importance of this feature in the evolution of the Dharwar Craton. In view of these differences, the location of the Chitradurga Boundary Fault is shown as a grey band in Fig. 1. Several pieces of geological evidence, such as the presence of the recumbent fold belts and thrusts [9], crustal shortening as indicated by the folds, consistent east-dipping axial schistocity, and the presence of deep-water marine sediments such as greywackes, oceanic tholeiites, komatites and intermediate acid volcanics and bedded sulphides along Chitradurga Gadag schists, led [27] to suggest that the Chitradurga Boundary Fault may be an Achaean suture located along the Chitradurga–Gadag schist belts. On the basis of geochronological and geochemical considerations, however, [22] believe that the Chitradurga Boundary Fault is located along the western margin of the Closepet granites.

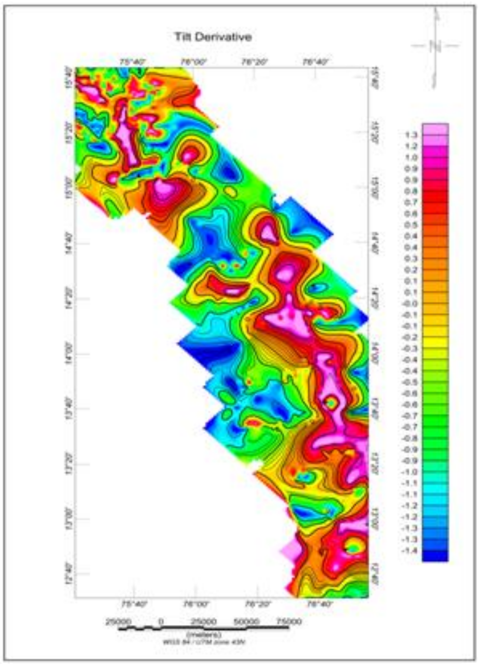

Figure.7. Tilt Derivative map of the Chitradurga Schist Belt.

VII. Quantitative Analysis:

The objective of Quantitative Analysis of the gravity data in the Chitradurga schist belt (CSB) area was to understand the subsurface structural configuration of the area from the inversion of 10-West-East profiles parallel (T1,T2,T3,T4,T5,T6,T7,T8,T9 and T10)- N-S (12°40' to 15°40') distance of 36.66 km of length 40-50km digitized from the Bouguer Gravity contour map (Figure.2).

The software used for inversion is the GN-SYS (2009), a gravity/magnetic modelling software of Geosoft Inc. A 4-layer earth models was assumed for crustal configuration down to the Moho - a top layer of peninsular gneiss that forms the basement to the supra-crustal (younger granites -2 .6.gm/ cc; schists 2.9gm/cc), the upper crustal layer, deeper crustal layer bounded at its lower end by the Moho. The corresponding densities assumed by the earlier studies [14], are 2.67gm/cc, 2.72gm/cc, 2.85gm/cc and 3.3gm/cc respectively.

It is to be noted that though the profile length are too short to justify interpretation of the entire crustal column, a measure of geological control is obtained from independent estimates for crustal thickness in the region [14], [15] and [7]. Further GM-SYS software does not require a regional to be subtracted from the Bouguer Anomaly as the entire crustal configuration down to the Moho is modelled by means of assumed 4-layer earth was iteratively modified for best fit between observed and computed Gravity anomaly profile. The error in best fit was found to vary between 0.1 to 1 %, which is well within acceptable limits.

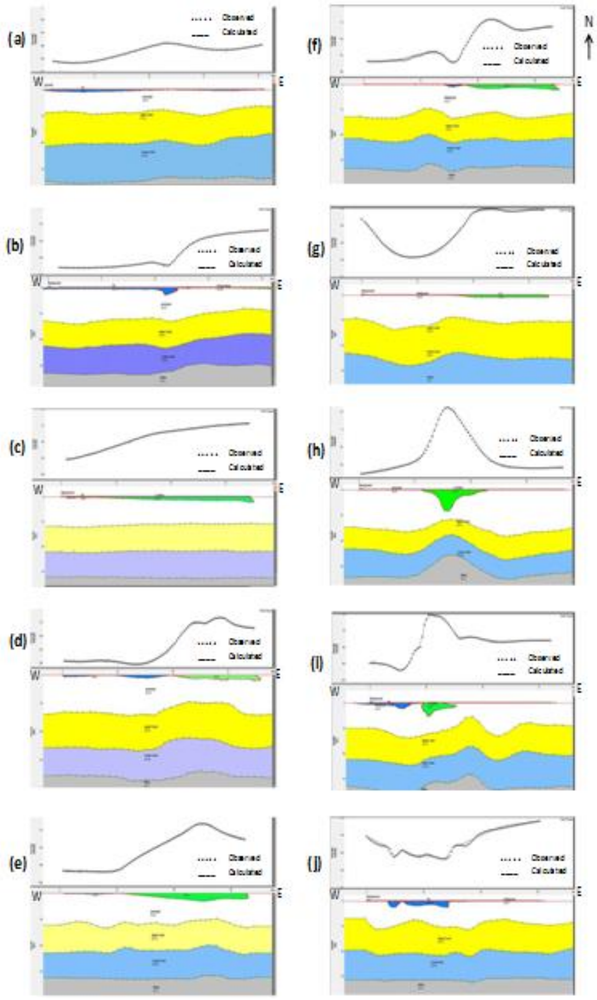

Figure.8.(a). Interpretation Section of the Gravity Traverse – T1 at 12° 40', (b) Interpretation Section of the Gravity Traverse – T2 at 13°. (c) Interpretation Section of the Gravity Traverse – T3 at 13° 20'. (d) Interpretation Section of the Gravity Traverse – T4 at 13° 40'. (e) Interpretation Section of the Gravity Traverse – T5 at 14°. (f) Interpretation Section of the Gravity Traverse – T6 at 14° 20'. (g) Interpretation Section of the Gravity Traverse – T7 at 14° 40'. (h) Interpretation Section of the Gravity Traverse – T8 at 15°. (i) Interpretation Section of the Gravity Traverse – T9 at 15° 20'. (j) Interpretation Section of the Gravity Traverse – T10 at 15° 40'.

Traverse-1: This traverse (Figure.8a) runs from west to east along Latitude-12°40' is approximately 44km in length the crustal section along this profile is for the major part marked by gentle undulations. The topmost layer comprising younger granites is exposed at surface almost completely, where the higher density peninsular gneissic layer, is exposed to shallow depth. As compared to the deeper layers, these layers have an irregular shape. While the younger granitic intrusions, most evident between 2.75 to 44 km from the western to east of the profile, have a maximum thickness of 0.8km, the peninsular gneissic (P.G) have a variable thickness ranging from 0 to 10 km.

There are two dipping faults i.e F1(CT), F2(West of the Chitradurga Schist belt is indicated at the 19.43km and 34.70 km which is marked by all the underline layers which were infer from qualitative analysis (Figure.3, 4, & 5). Surface expressing of these fault the contact between the Younger granite and Peninsular gneissic. Peninsular thickness is minimum 6km, maximum 10km, Upper crustal a thickness is minimum 16km, maximum 21km and Deeper crustal thickness is minimum 32km, maximum 35km.

Traverse-2: This traverse (Figure.8b) running along the latitude-13° the north of Yadiyur with 36.66 km south of T1 traverse, exhibit comparatively more regular crustal structure from west to east is approximately 45km The topmost layer comprising younger granites and Chitradurga Schist exposed at station between 2.25 to 27.48 km have a maximum thickness of 2.79km and CT schist 27.48 to 45km from the western to east of the profile, have a maximum thickness of 0.52km , the peninsular gneissic have a variable thickness ranging from 0 to 14 km.

One dipping fault i.e F2 (west of CT) is indicated at 30.797km which is marked by all the underline layers which were infer from qualitative analysis. Surface expressing of these fault the contact between the Younger granite and Peninsular gneissic. Peninsular thickness is minimum 8km, maximum 14km, Upper crustal thickness is minimum 17km, maximum 23km and Deeper crustal thickness is minimum 29km, maximum 33km.

Traverse-3: This traverse (Figure.8c) running along the latitude- 13°20' north of Kibbanahalli with 36.66 km ' south of T2 Traverse, representing. The younger granitic is most evident between 1.85 to 9 km from the western to east of the profile, have a maximum thickness of 0.42km and Chistradurga Schist (CT) 9Km to 62km from the western to east of the profile, have a maximum thickness of 2.05km , the host rocks have a variable thickness ranging from 0 to 12 km.

There are two dipping faults i.e F1(CT),F2 is indicated at the 13.74km and 44.65km which is marked by all the underline layers which were infer from qualitative analysis. Surface expressing of these fault the contact between the Younger granite and Peninsular gneissic. Peninsular thickness is minimum 10km, maximum 12km, Upper crustal thickness is minimum 21km, maximum 22km and Deeper crustal thickness is minimum 32km, maximum 32.72km.

Traverse-4: This traverse (Figure.8d) running along latitude 13°40' near of Hiriyur have three dipping faults i.e F1(CT), F2(west of CT) and small fault f8 along west to east is have marked at 15.67km, 43.37km and 65.75km which is marked by all the underline. Surface expressing of these fault the contact between the Younger granite and Peninsular gneissic. Thickness peninsular gneissic is minimum 9km, maximum 14km , Upper crustal thickness is minimum 22km, maximum 26km and Deeper crustal thickness is minimum 33km, maximum 37km.

Traverse-5: This traverse (Figure.8e) running along latitude 14° near to Hiriyur west to east with 36.66 km south of T4-traverse on this profile average thickness of the constant layers There are two dipping faults are identified from the bouguer gravity (Figure.2) i.e F1(CT), F2is indicated at the 5.93kmand 30.79km. Peninsular thickness is minimum 9km, maximum 13km, Upper crustal thickness is minimum 19km, maximum 23km and Deeper crustal thickness is minimum 31km, maximum 32km.

Traverse-6: This traverse (Figure.8f) running along latitude 14°20' upto Chellakere with 36.66 km south of traverse T5. Along this profile the response from Younger Granite (YG) and Chitradurga Schist Belt (CSB) is evident which agrees with known geology of the area, there is a significant expression for the inferred four dipping faults i.e f6, f1, F1(CT) and F2 is indicated at the 19.727 km, 30.739km, 43.52km and 67.32km which is represents up to Moho. The peninsular gneissic infer depth is a minimum 9km, maximum 13km , Upper crustal thickness is minimum 19km, maximum 23km and Deeper crustal thickness is minimum 31km, maximum 34km.

It is interesting to note that on the northern profiles between T8-T7 there is a sudden shift in trend of the schist belt from NW-SE to N-S might be due to NE-SW fault, the configuration of the crustal thickness have more homogeneous.

Traverse-7: This traverse (Figure.8g) runs along latitude-14°40' near Sokke from west to east is approximately 188km with 36.66 km south of traverse T6. While the Chitradurga schist 42.06 to 88km from the western to east of the profile, have a maximum thickness of 0.86km, the peninsular gneissic have a variable thickness ranging from 0 to 13km. The upper crustal layer is some what in irregular shape layer and comparatively thinner than on other southern profile. It appears that it is the deeper layers contribute more to the bouguer gravity.

There are two dipping faults i.e F1(CT), F2 is indicated at the 37.13km and 57.73km which is marked by all the underline layers which were identified. Surface expressing of these faults the contact between the Younger granite and Peninsular gneissic. Peninsular thickness is minimum 8km, maximum 13km, Upper crustal thickness is minimum 22km, maximum 27km and Deeper crustal thickness is minimum 36km, maximum 40km.

Traverse-8: This traverse (Figure.8h) runs along latitude-15° near of Harehadagalli with 36.66 km south of traverse T7 from west to east through the is approximately 112km, have a marked with agrees with the known geology of the and response on the bouguer gravity is a bell shaped anomaly.

Qualitative along T8 travel indicate result similar to each profiles. The total layer varying peninsular thickness is minimum 11km, maximum 18km. The total layer varying Upper crustal thickness is minimum 17km, maximum 27km and Deeper crustal thickness is minimum 25km, maximum 35km.

Traverse-9: This traverse (Figure.8i) runs along latitude-15°20' through the south of Gadag with 36.66 km south of traverse T8 similar to previous profile faults .There are three dipping faults i.e f4, F1(CT) and F2(west of CT), is indicated at the 4.75km,18.248km and 26.737km. Peninsular gneissic thickness is minimum 5km, maximum 13km, Upper crustal and Deeper crustal thickness is minimum 17km, maximum 24km and minimum 28km, maximum 35km respectively, through the associated adulation of crustal layers is lesser on this profile Younger granite have a very marked expression at about 17.69km from the western to eastern of the profile.

Traverse-10: This traverse (Figure.8j) runs along latitude-15°40' west to east with 36.66 km south of traverse-T9 is the northern most profile in the study area and measuring 68km length is shorter than other profile shown in figure the peninsular gneissic along this profile has seen.

There are three dipping faults i.e F1(CT), F2 and small fault f9 is indicated at the 15.76km, 21.445km and 26.77km. Peninsular thickness is minimum 7km, maximum 11km Upper crustal and deeper crustal thickness is minimum 19km, maximum 22km and minimum 30km, maximum 32km respectively. The details of the interpreted subsurface layers information shown in table-1.

Tabled-1.

Traverse No.	**Figure No.**	**Length of the traverse (Km)**	**At Latitude (Degree)**	**Supra Crustal (YG* & CSB**) Thickness (Km)**	**Peninsular Gneissic Range (Km)**	**Upper Crustal layer (Km)**	**Deeper Crustal layer (Km)**	**Inferred Structural Features at distance (km)**
T1	8a	44	12°40'	YG(0.8)	6-10	16-21	32-35	F1(19.43), F2(34.70)
T2	8b	45	13°00	YG(2.79), CSB(0.52)	8-14	17-23	29-33	F2(30.797)
T3	8c	62	13°20'	YG(0.42), CSB(2.05)	10-12	21-22	32-32.7	F1(13.74), F2(44.65)
T4	8d	84	13°40'	YG(1.08), CSB(1.92)	9-14	22-26	33-37	F1(15.67), F2(43.37) & f8(65.75)
T5	8e	108	14°00	YG(0.31), CSB(3.00)	9-13	19-23	31-32	F1(5.93), F2(30.79)
T6	8f	104	14°20'	YG(0.81), CSB(2.15)	9-13	19-23	31-34	f6(19.72), f1(30.73), F1(43.52) & F2(67.32)
T7	8g	188	14°40'	CSB(0.86)	8-13	22-27	36-40	F1(37.13), F2(57.73)
T8	8h	112	15°00	CSB(8.48)	11-18	17-27	25-35	F1(16.12), F2(40.27) & f3(48.79)
T9	8i	80	15°20'	YG(2.17), CSB(5.13)	5-13	17-24	28-35	f4(4.75), F1(18.24), F2(26.737)
T10	8j	68	15°40'	YG(2.47)	7-11	19-22	30-32	F1(15.76), F2(21.44), f9(26.77)

*YG-Yonger Granite, **CSB-Chitradurga Schist Belt

VIII. Sub-Surface Topography of the Crustal layer:

The configuration of the layers classified into two types i) Subsurface crustal and ii) Upper and deeper (Moho) crustal layer along all profiles in the study region are digitized and present in 3D-contour images.

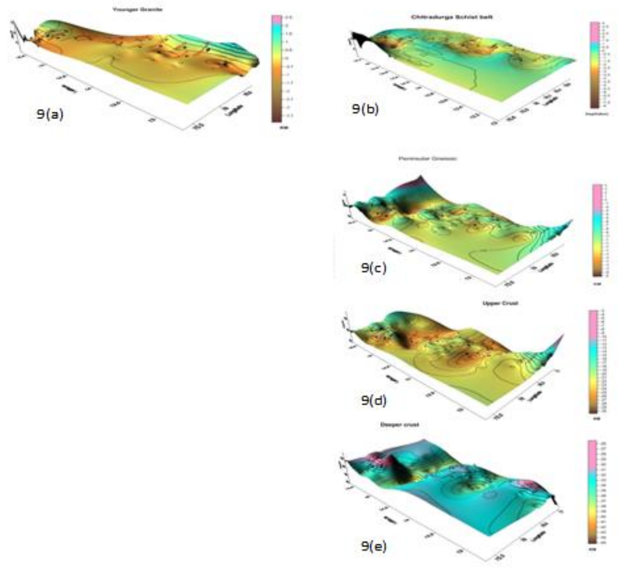

Figure 9.(a). 3-D View of younger granites. (b). 3-D View of Chitradurga Schist Belt.(c). 3-D View of Peninsular Gneissic layer. (d). 3-D View of upper crustal layer. (e). 3-D View of deepar crtustal layer.

From the 3-D contour images of the YG (Figure.9a.), which shown the zero shade (light green) for the lower part of the study area it is evident that they are present only in the western part. The YG exposures appear to be concentrated as circular features with maximum depth of 2.5 km and Chitradurga Schist belt (Figure.9b) showns the zero shade (light green) two highs of the study area it is evident that they are present Begawadi in North region and Sirankatte central part of the study area . The peninsular gneiss (Figure.9c) is very uneven in geometry, the exercise yielded the continuous of geological features based on the strike continuous of alternative gravity high and lows representing the syncline and anticline structures with topographic high and lows passing through the different formation. The high density metavolcanic low depicted high gravity high axis wise versa gravity lows, gravity low density (intrusion) are the anticline generally occupying the topographic highs and low axis. Its thickness varies from 0 to 18km the lower part is present in the North and one deep seated is located in North at Harpanahalli of the study area and the maximum depth of circular feature occurred at depth of 17km. While variations in this layer by themselves give only depth to basement, when taken in conjunction with the configuration of the Upper crustal layer, the presence of shallow faults can be inferred, and when taken in conjuction. The 3D view of Upper Crustal shown in Figure.9d. and Deeper Crustal layer shown in Figure.9e.

IX. Summary and Conclusion:

New gravity data of Gadag to Chitradurga Schist Belt (CSB) covering an Area 6000 sq.km from CSB to Gadag were analyse Qualitative and Quantitative. From qualitative analysis applying different gradient techniques i.e Horizontal Gradient (HDR), Vertical Gradient (VDR), Tilt Derivative and Analytical signal. were brought out structural configuration of the region. Bouguer Gravity highs and lows were demarked and represent by Schist belts and Younger Granite with anticline and syncline structures respectively. Based on analytical signal Three discontinuous segments of Gadag and Chitradurga schist belts are identified there are namely A-sector (villages: Gadag, Srirahalti), B-sector (vil: Belhatti, Bagawadi, Hirehadagalli), C-sector (vill:Jagalur, Brilicrodu, Bharmasagar, G.R.halli, Chitradurga and Chellakere), D-sector (vill: Hiriyur, J.G.Halli and Huliyar) and E-sector (vill: Yadijur), these five sectors are separated by a local deep-seated fault (NE-SW fault) further significantly it was found that CT fault is limited in it north ward extension by a major NE-SW fault. These zones are significant tectonic of the region segments and these were separated by NE-SW, NW-SE, N-S trending faults. The main segment of the Chitradurga - Gadag Schist Belts bounded Chitradurga Thrust fault and west by NNW-SS fault, two major faults (F1, F2) and minor faults nine identified.

The sub-surface configuration of each of these layers were obtained by digitizing the corresponding crustal structure and presented as 3D contour map reveal structural complexity with plunging synclines, anticlines and folded along E-W trending warps.

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