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Basin structure from gravity and magnetic anomalies in the central part of Cauvery basin, India.

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ABSTRACT
The gravity and magnetic data along three profiles across the central part of Cauvery basin of India have been collected and interpreted with variable density contrast in order to deduce the structure of the sedimentary basin. The first profile is taken from Vridhachalam to Kilyanjiyur covering a distance of 100 km and the second starts from Niddamangalam and ends at Niybankurichchi covering a distance of 120 km and the third is from Pudukottai to Mallipatnam covering a distance of 50 km. The gravity lows and highs have clearly indicated various sub-basins and ridges. The density logs from ONGC, Chennai, show that the density contrast decreases with depth in the sedimentary basin, and hence, the gravity profiles are interpreted using variable density contrast with depth. From the Bouguer gravity anomaly, the residual anomaly is constructed by graphical method correlating with well data and subsurface geology. The residual anomaly profiles are interpreted using polygon and prismatic models. The maximum depths to the granitic gneiss basement are obtained as 6.41km, 8.70 km and 5.20 km for the first, second and third profiles respectively. These studies are useful to refine the subsurface geological studies.The regional anomaly is interpreted as Moho rise towards coast. The aeromagnetic anomaly profiles are also interpreted for charnockite basement below the granitic gneiss group of rocks using prismatic model.

Key words: Cauvery basin, Gravity, Variable density contrast, Granitic gneiss basement, Magnetic, Charnockite basement.

INTRODUCTION

The Cauvery basin is located between 9ºN-12ºN latitudes and 78º30'E - 80º30'E longitudes on the east coast of India and covers 25,000 sq. km on land and 35,000 sq. km offshore. It consists of six sub-basins and five ridge patterns. The basement is comprised Archean igneous and metamorphic complex predominantly granitic gneisses and to a lesser extent khondalites. Sastri et al (1973, 1977 and 1981) and Venkatarengan (1987) provided the earliest details on stratigraphy and tectonics of the sedimentary basins on the east coast of peninsular India. The Cauvery basin has come into existence as a result of fragmentation of the eastern Gondwanaland which began in the Late Jurassic (Rangaraju et.al, 1993). Lal., et al (2009) have provided a plate tectonic model of the evolution of east coast of India and the NNE-SSW trending horst and grabens of Cauvery basin are considered to be placed juxtaposing fractured coastal part of Antarctica, located west of Napier Mountains.

The Cauvery basin is a target of intense exploration for hydrocarbons by the Oil and Natural Gas Corporation (ONGC) of India and has been extensively studied since early 1960. This is one of the promising petroliferous basins of India. Many deep bore-wells have been drilled in this basin in connection with oil and natural gas exploration. These wells revealed a wealth of information about the stratigraphy and density of the formations with depth.

The Cauvery basin is for the most part covered by Holocene deposits. Sediments of late Jurassic to Pleistocene age crop out in three main areas near the western margin of the basin and gently dip towards the east. The oldest sediments in this basin are Sivaganga beds of late Jurassic age. The maximum sediment thickness of the basin is about 6000m (Prabhakar and Zutshi, 1993). ONGC conducted gravity and magnetic surveys in the Cauvery basin in 1960s (Kumar, 1993) and presented the Bouguer gravity anomaly map. Avasthi et al (1977) have published gravity and magnetic anomaly maps of Cauvery basin. Verma (1991) has analyzed few gravity profiles in the Cauvery basin. Subrahmanyam et al (1995) have presented offshore magnetic anomalies of Cauvery basin. Ram Babu and Prasanti Lakshmi (2004) have interpreted aeromagnetic data for the regional structure and tectonics of Cauvery basin.

The geological and geophysical work clearly delineated the presence of a number of ridges and sub-basins trending in NE-SW directions (Prabhakar and Zutshi, 1993 and Hardas, 1991): They are: i. Pondicherry sub-basin ii. Tranquebar sub-basin iii. Tanjavur sub-basin IV. Nagapattinam sub-basin v. Palk Bay sub-basin and vi. Mannar sub-basin; and i. Madanam Ridge ii. Kumbakonam Ridge iii. Karaikal Ridge iv. Mannargudi Ridge v. Mandapam Ridge. The gravity and magnetic surveys are carried out on the entire Cauvery basin along nine profiles, at closely spaced interval, and placing the profiles at approximately 30

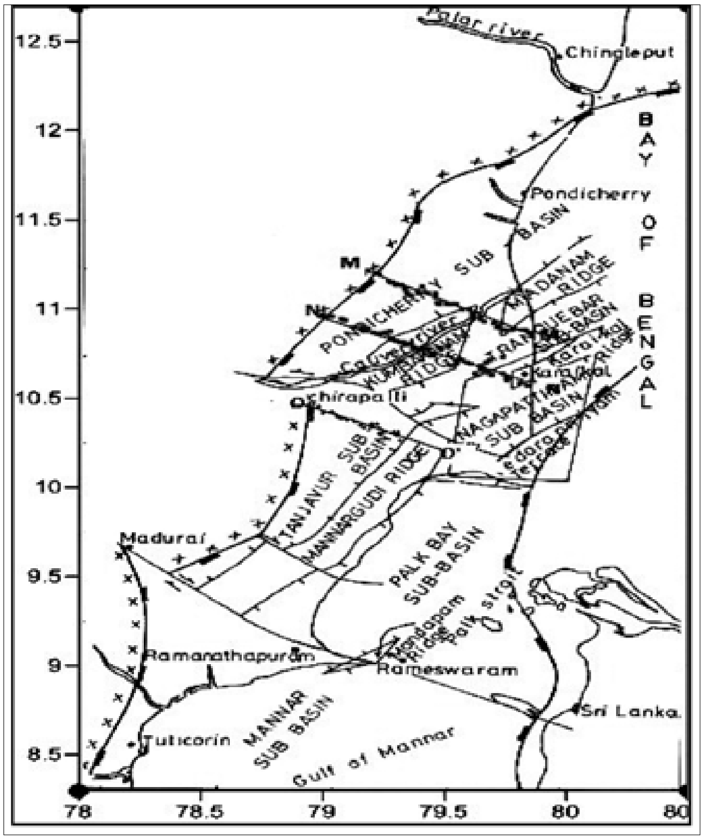

Figure 1. Tectonic elements of Cauvery basin (after Prabhakar and Zutshi,1993).

km interval and perpendicular to various tectonic features. In this paper three gravity and magnetic anomaly profiles are presented along the lines shown on the tectonic map of Prabhakar and Zutshi (1993) Figure 1 in the central part of Cauvery basin.

The gravity anomalies are interpreted with variable density contrast for granitic gneiss basement and the aeromagnetic profiles are interpreted for the chornockite basement below the granitic gneiss group of rocks.

Gravity and Magnetic Surveys

The gravity, magnetic and DGPS(Differential Global Position System) observations are made along three profiles across the various tectonic features (Prabhakar and Zutshi, 1993) in the central part of Cauvery basin as shown in Figure 1. Gravity measurements have been made at approximately 1.5 to 2km station interval. Gravity readings are taken with Lacoste-Romberg gravimeter and Position locations and elevations are determined by DGPS(Trimble). The HIG (Haiwaii Institute of Geophysics) gravity base station located in the Ist class waiting hall of Vridhachalam railway station is taken as the base station. The latitude and longitude of this base are 11°32'06.45885"N and 79°18'59.19866"E respectively. The gravity value at this base station is 978227.89 mgals. With reference to the above station, auxiliary bases are established for the day to day surveys. The Bouguer anomaly for these profiles is obtained after proper corrections viz (i) drift (ii) free air (iii) Bouguer and (iv) normal. The Bouguer density is taken a value of 2.0gm/cc after carrying out density measurements of the surface rocks. The gravity observations are made along available roads falling nearly on straight lines as shown in Figure 1. The maximum deviations from the straight lines at some places are around 5 km.

Total field magnetic anomalies are also observed at the same stations using Proton Precession Magnetometer but the data is later found to be erroneous. In order to get magnetic picture, aeromagnetic anomaly maps in topo sheets 58M, 58N, 58J, 58K, 58O, 58L, 58H covering the total Cauvery basin on land from GSI are procured and anomaly data is taken along these three profiles. The total field magnetic anomalies are observed at an elevation of 1.5 km above msl. IGRF corrections are made for this data using standard computer programs and the reduced data is used for interpreting magnetic basement.

Variation of Density Contrast with Depth

The density data with depth from 26 wells in Cauvery basin, drilled by ONGC, have been collected. The granitic gneiss basement is assumed to be having an average density

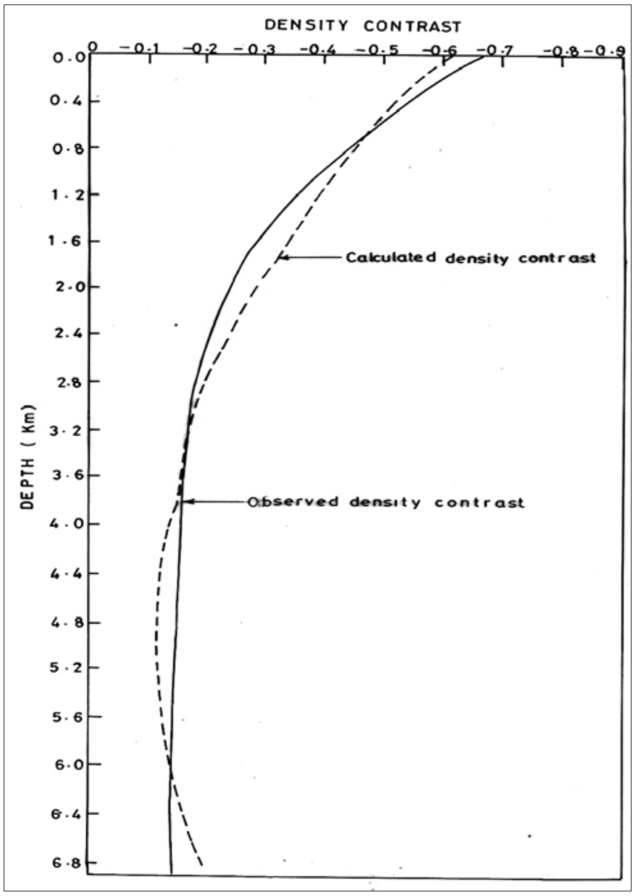

Figure 2. Variation of density contrast with depth.

of 2.7gm/cc. This value is subtracted from the well densities to obtain the density contrast with depth in the basin. After plotting these values against depth, a mean curve representing the variation of density contrast with depth has been drawn and shown in Figure 2.

The well log density is available up to a depth of 4.5km. However, the curve is extended up to a depth of 6.8km as the maximum depths deduced from the gravity anomalies are around this value. The density contrast is about –0.67gm/cc at the surface and falls to –0.18gm/cc at 6.0 km depth. The decrease of density contrast is due to compaction, age etc. of the sedimentary strata. Hence, the interpretation of the gravity anomalies cannot be carried out with the assumption of a constant density contrast. The variation of density contrast with depth is approximated to a quadratic function (Bhaskara Rao, 1986) such as $\Delta\rho(z) = a_0+a_1z+a_2z^2$, where a_0, a_1, a_2 are the constants to be found. Accordingly, the variation of density contrast is fitted to a quadratic function and the coefficients are solved by the least squares method. The values of the coefficients so obtained for a_0, a_1, a_2 are -0.60012, 0.19931 and -0.02039 respectively.

Interpretation

The gravity profiles are interpreted with quadratic density function by methods described by Bhaskara Rao and Radhakrishna Murthy (1986) using polygon model and Bhaskara Rao (1986) using prismatic model. The aeromagnetic anomalies are interpreted for charnockite basement below the granitic gneiss group of rocks assuming prism model. The computer program TMAG2DIN is taken from Radhakrishna Murthy (1998) for interpretation of magnetic anomalies.

Gravity profile along MM'

The profile (MM') runs from Vridhachalam (Latitude 11°32'06.45885 "N and Longitude 79°18'59.19866"E) to Kilyanjiyur (Latitude 10°51'03.0320"and Longitude 79°51'09.5347"N) covering a distance of 100 km and 67 stations are established along this profile Figure 4. The data is collected for four days from 9/3/2007 to 12/3/2007. This profile passes across Pondicherry sub-basin, Kumbakonam ridge, Tranquebar sub-basin and Karaikal ridge Figure 3.

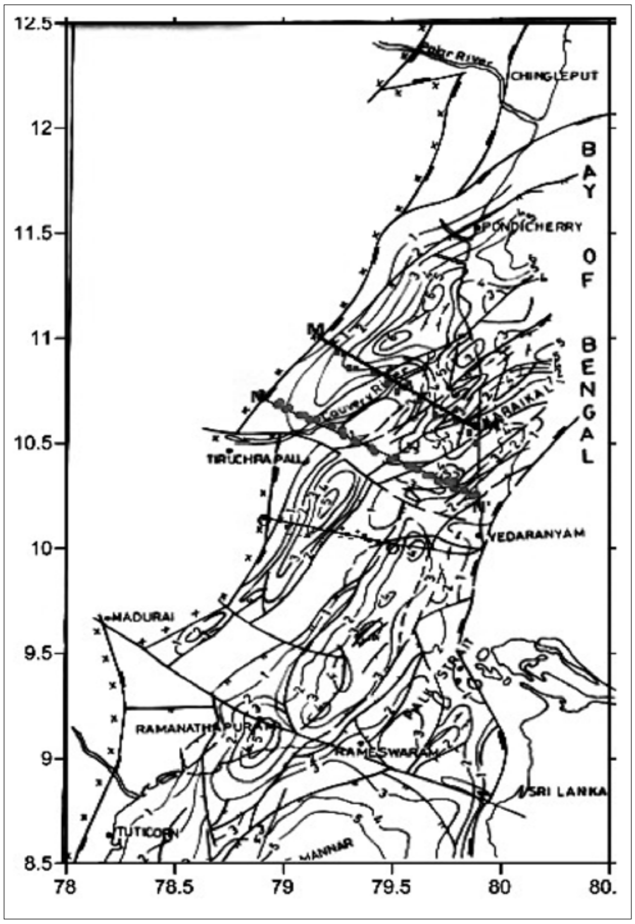

Figure 3. Basement configuration map of Cauvery basin (after Prabhakar and Zutshi,1993).

The profile is sampled at 5 km station interval .The minimum and maximum Bouguer gravity anomalies over the basins and ridges are given in Table 1.The profile is passing through three ONGC wells which shows granitic basement at depths, viz; 2590.00 meters (KU-17, Latitude 11°00'39.57"N and Longitude 79°32'20.37E"),2449.00 meters (KU-13, Latitude 11°04'35.00"N and Longitude 79°30'41.00"E) and 2200.00 meters (TR-1, Latitude 11°01'30.00"N and Longitude 79°48'36.00"E) as shown in Figure 4. The basement depths based on sub-surface geology (Prabhakar and Zutshi, 1993), shown in Figure 3, are plotted as dotted curve. Based on this data and by trial and error method of modeling, a smooth regional curve is drawn such that the interpretation of resulting residual anomalies with quadratic density function gives rise to the depths conforming to the depths given by wells and sub-surface geology. The regional is -4 mgals at the origin and continuously increases reaching a maximum of 32 mgals at 100 km distance from the land border of the basin. The regional is subtracted from the Bouguer anomaly and the residual is plotted as shown in Figure 4.

The minimum and maximum residual anomalies on the basins and ridges are given in Table 1.

The residual anomaly is interpreted with quadratic density function using polygon model (Bhaskara Rao and Radhakrishna Murthy1986) and also with prismatic model (Bhaskara Rao 1986).The depths are obtained by iterative method using Bott's method and the results at 10th iteration are plotted as polygon and prismatic models as shown in Figure 4. The errors between the residual and calculated anomalies in both the methods are below +0.1 mgals. The maximum and minimum depths over the basins and ridges are shown in Table 1. The regional is interpreted for Moho depths. For this, the normal Moho value outside the basin is taken as 42km from Kaila et al (1990) and the regional anomaly is obtained by removing a constant value of -4 mgals from the regional and a density contrast of +0.6 gm/cc is assumed between the upper mantle and crust. The depths to Moho are deduced from the regional anomaly by Bott's method and the Moho rise is plotted at the bottom of Figure 4 and the Moho is identified at 36.6 km depth near the coast to 42 km on land border of the basin in NW. The interpreted depths are nearly coinciding with the depths given by Prabhakar and Zutshi(1993) and drilled depths except at the deeper parts of Pondichery and Tranquerbar sub-basins , where the depths obtained by

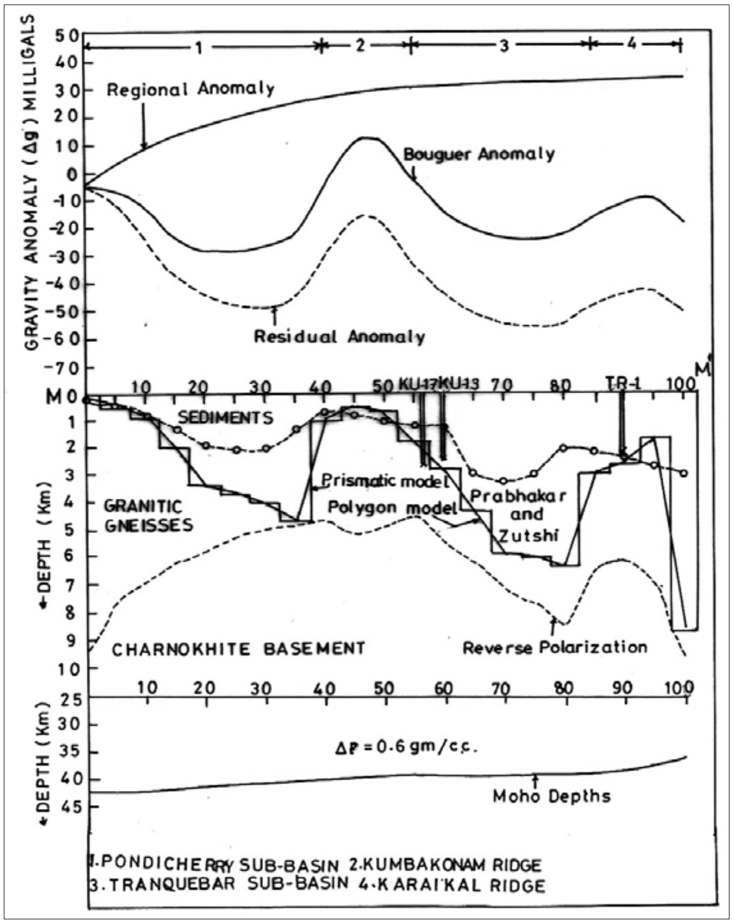

Figure 4. Interpretation of gravity anomaly profile along MM'

Table-1. Anomalies in mgals/Depths in km on various tectonic features

Profile	Type of anomaly /Depths	Pondicherry sub- basin	Kumbakonam ridge	Tranquebar sub-basin	Karaikal ridge	Nagapatnam sub- basin	Tanjavur sub-basin	Mannarggudi ridge
MM'	Bouguer(mgl)	-29.0	+12	+25.0	-10.0	-------	---------	---
MM'	Residual(mgl)	-49.0	-16.0	-56.0	-43.0	------	------	----
MM'	Depths(km)	3.6	0.6	6.0	1.7	-------	-------	----
NN'	Bouguer(mgl)	-32.0	0.0	-------	------	-65.0	-----	------
NN'	Residual(mgl)	-27.0	-19.0	--------	--------	-83.0	------	-------
NN'	Depths(km)	1.4	0.6	---------	------	8.7	-------	---------
OO'	Bouguer(mgl)	-----	------	------	-----	-----	-65.0	-35.0
OO'	Residual(mgl)	------	-------	------	------	-----	-51.0	-24.0
OO'	Depths(km)	------	-------	------	-------	------	4.40	1.10

gravity method are much larger. Here, the depths obtained by gravity method are likely to be more reliable as the Bouguer anomalies in these two basins are very low and the regional is estimated based on available drilled depths and subsurface geology, and is smoothly varying in conformity with Moho rise towards coast. Thus the results supplement the subsurface geological studies.

Magnetic profile along MM'

The magnetic data for the profile MM' is taken from three topo sheets (58M, 58J and 58N).To construct the profile, the observed stations are placed on topo sheets of the magnetic anomaly map and a mean straight line is drawn. The points of intersection of the magnetic contours with

Table 2. Results of magnetic interpretation

Profile	Polarization	Average value of total field(F)	Average value of inclination (i)	Angle between strike and magnetic north(α)	Calculated polarization angle (Φ)	Assumed polarization angle for best fit (Φ)	Assumed value of intensity of magnetization for best fit (J) in gammas	Regional at the origin (A)	Regional gradient (B)	Damping factor (λ)	Iterations carried out	Objective function
MM'	Normal	40302	5.71	22	15.94	+20.0	350	187.3	1.1	0.00	3rd	0.03
MM'	Reverse	40302	5.71	22	15.94	-20.0	350	234.9	0.2	0.00	3rd	0.05
NN'	Normal	40226	5.69	24	13.76	+20.0	470	321.8	-1.8	0.00	50th	218.79
NN'	Reverse	40226	5.69	24	13.76	-20.0	470	344.8	-2.1	0.00	50th	114.03
OO'	Normal	39981	4.50	24	11.01	+20.0	380	201.5	-2.4	0.00	50th	92.04
OO'	Reverse	39981	4.50	24	11.01	-20.0	380	228.3	-3.3	0.00	2nd	0.10

the straight line are noted and these values are plotted against the distance. IGRF corrections are made to this data using 1985and 1990 coefficients as the data was collected in different periods and the magnetic anomaly profile is constructed. The length of the magnetic anomaly profile is 100 km and is sampled at 5 km interval. The magnetic anomalies vary from 158 ηT to 280 ηT. The anomalies are interpreted for magnetic basement structure below granitic gneisses using prism model .The profile is interpreted by taking the mean depth of the basement at 9.5 km and constraining the depths to upper and lower limits of the basement as 2.0 km and 12.0 km respectively. The FORTRAN computer program TMAG2DIN to interpret the profiles is taken from Radhakrishna Murthy (1998). The program is based on the Marquadt algorithm and this seeks the minimum of the objective function defined by the sum of the squares of the differences between the observed and calculated anomalies. A linear order regional, viz; Ax+B, is assumed along this profile and the coefficients A and B are estimated by the computer. The profile is interpreted for different polarization angles (Φ) and intensity of magnetizations (J).The average value for the total field (F), inclination (i) and declination (d) along this profile and the measured angle between the strike and magnetic north (α) are given in Table 2. Based on this data,the polarization angle Φ is calculated to be 15.94°. But by trial and error, the best fit of the anomalies for Φ and J are given in Table 2. The values of the objective function, lamda (λ), regional at the origin (A), regional gradient (B) and the no. of iterations executed for normal as well as reverse polarization are also tabulated in Table 2.

As the objective function for reverse polarization is small compared to normal polarization, the interpretation with reverse polarization is taken as the correct one and is plotted in Figure 4. For the reverse polarization, the linear order regional is as shown in Figure 5. The residual anomaly after removing the regional from the observed anomaly is plotted in the Figure. The differences between the residual and the calculated anomalies are negligible as shown in the Figure. The interpretations of the depths for normal and reverse polarizations for charnockite basement are shown in Figure 5.

The depths for these two interpretations are not much different. As the average susceptibility of the granitic gneiss is of the order of $10*10^{-6}$cgs units and that of charnockite is $2000*10^{-6}$cgs units, granitic gneiss basement cannot explain the observed magnetic anomalies. The modeling results place the charnockite basement 0 to 8 km below the granitic gneiss basement along this profile. The existence of charnockite basement below granitic gneisses was also noted by Narayaswamy (1975).

Gravity profile along NN'

The profile (NN') runs from Niddamangalam (Latitude 11°03'28.11274"N and Longitude 78°52'01.66903"E) to Niybankurichchi (Latitude 10°11'10.2612"N and Longitude 79°51'25.37467′′E) covering a distance of 120 km and 58 stations are established along this profile Figure 6. The data is collected for four days from 14/3/2007 to 17/3/2007. This profile passes across the Pondicherry sub-basin, Kumbakonam ridge and Nagapattinam sub-basin Figure 1 and the Bouguer anomalies are drawn in Figure 6. The minimum and maximum Bouguer gravity anomalies over the basins and ridges are given in Table 1.The profile is passing through five ONGC wells of which one (UG-2, Latitude10°.49'52.16" and Longitude 79°29'02.3"E) touches granitic gneisses basement at depth of 2500.00 meters and is plotted as continuous lines in Figure 6. The remaining four wells did not reach granitic gneiss basement and are plotted as dotted lines in Figure 6. These four wells were drilled to the following depths: 2201.10 meters (Nannilam-4,Latitude 10°47'25.1"N and Longitude 79°32'506.2"E),1660.00 meters (Mattur-5, Latitude 10°51'16.76"and Longitude 79°26'50.42"E), 3300.00 meters (Pozhakudi-51, Latitude 10°38'03.00"and

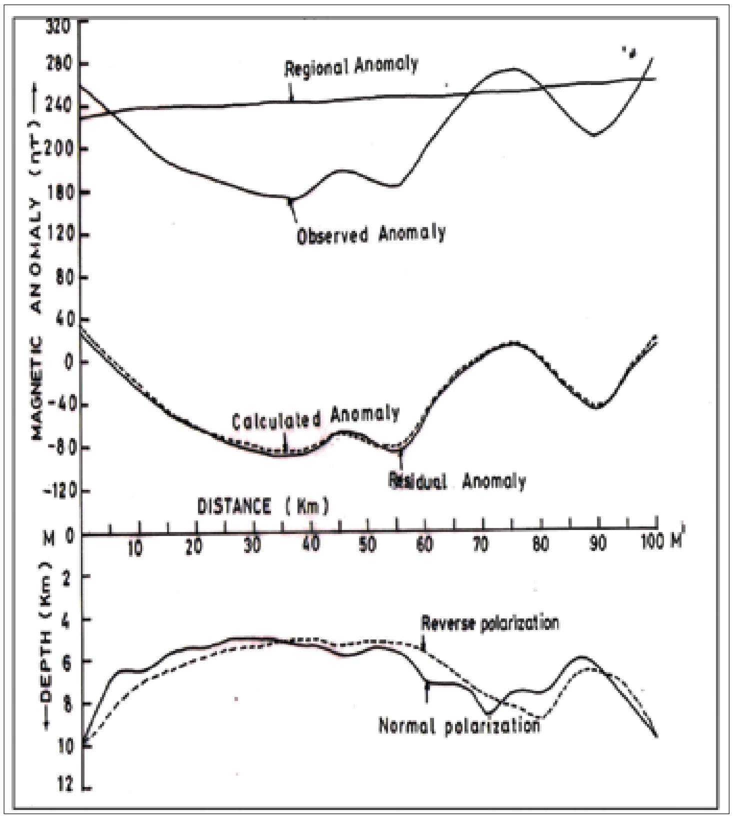

Figure 5. Interpretation of total field magnetic anomaly profile along MM'

Longitude 79°37'57.27"E) and 2400.00 meters (Thiuyur-1,Latitude 11°01'30.00"and Longitude 79°49'34.46"E) respectively as shown in Figure 6.

The basement depths based on sub-surface geology (Prabhakar and Zutshi, 1993) are plotted as dotted curve. Based on this data and using gravity modeling, the regional is assumed as a smooth curve as shown in the Figure. The regional is -14 mgals at the origin and continuously increases reaching a maximum of 20 mgals at 120 km distance from the land border of Cauvery basin. The regional is subtracted from the Bouguer anomaly and the residual is plotted as shown in the Figure. The minimum and maximum residual anomalies on the basins and ridges are given in Table 1. The residual anomaly is interpreted with quadratic density function using polygon and prismatic models .The depths are obtained by iterative method using Bott's method and the results at 10^{th} iteration are plotted as polygon and prismatic models as shown in Figure 6. The errors between the residual and calculated anomalies are below +0.1 mgals in both the cases. The maximum and minimum depths over the basins and ridges are given in Table 1. Here again, the interpreted depths are nearly coinciding with the depths given by Prabhakar and Zutshi(1993) and drilled depths except near the deeper parts of Pondichery and Nagapattinam sub-basins. The depths deduced by gravity method are likely more reliable as the Bouguer anomalies in these sub-basins are very low, and the regional is assumed based on available drilled depths and subsurface geology, and thus complements the subsurface geological studies.The regional is interpreted as Moho depths. For this, a constant value of -14 mgals is subtracted from the regional. The Moho is plotted at the bottom of Figure 6 and it shows that it reaches 36.0 km towards SE near the coast.

Magnetic profile along NN'

The magnetic data for the profile NN' is taken from two topo sheets (58J, 58N). IGRF corrections are made to this data using 1985 and 1990 coefficients as the data was collected in different periods and the magnetic anomaly profile is constructed. The length of the magnetic anomaly profile is 120 km and is sampled at 5 km interval. The magnetic anomalies vary from 100 ηT to 380 ηT along the profile Figure 7. The anomalies are interpreted for magnetic basement below granitic gneisses using prism models. After several trials, the profile is interpreted by taking the mean depth of the basement at 10.0 km and constraining the depths to upper and lower limits of the basement as 2.0 km and 12.0 km respectively. A linear order regional, viz; Ax+B, is assumed along this profile and the coefficients A and B are estimated by the computer.

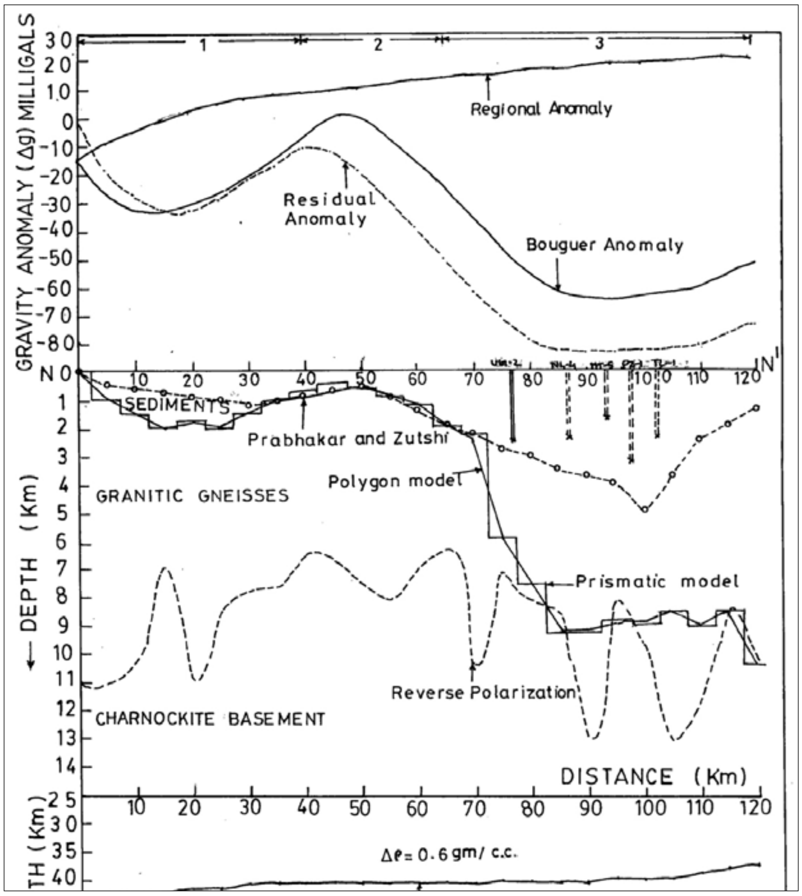

Figure 6. Interpretation of gravity anomaly profile along NN'

The profile is interpreted for different polarization angles (Φ) and magnetizations (J).The results of interpretation of the magnetic profile NN′are given in Table 2. Based on this data, the polarization angle Φ is calculated to be 19.88°. But by trial and error, the best fit of the anomalies for Φ and J are given in Table 2. The values of the objective function, lamda (λ), regional at the origin (A), regional gradient (B) and the no.of iterations executed for normal as well as reverse polarization are also tabulated in Table 2. The interpretation of the depths for normal and reverse polarization is shown in Figure 7. These two are nearly the same. However, the objective function for reverse polarization is small and hence is taken as the correct interpretation and these depths are plotted in Figure 6. The observed and the best fitting anomaly for reverse polarization are also shown in Figure 7.

For the reverse polarization, the linear order regional is as shown in the Figure. The residual anomaly after removing the regional from the observed anomaly is plotted in the Figure. The differences between the residual and the calculated anomalies are negligible as shown in the Figure. The charnockite basement depths for the reverse polarization are from 0 to 8 km below the granitic gneiss basement along this profile.

Gravity profile along OO'

The profile (OO') runs from Pudukottai (Latitude 10°34'53.52173"N and Longitude 78°40'33.48120"E) to Mallipatnam (Latitude 10°17'36.52173"N and Longitude 79°19'07.50000 "E) covering a distance of 50 km and 37 stations are established along this profile Figure 8. The data is collected for two days from 18/3/2007 to 19/3/2007. This profile passes across Tanjavur sub-basin and Mannargudi ridge. The minimum and maximum Bouguer gravity anomalies over the basin and ridges are given in Table 1. The profile is passing through three ONGC wells of which two wells touched granitic gneiss basement at depths, viz; 2200.50 meters (RJ-1,Latitude 10°23'03.13"N and Longitude 79°05'10.130"),and 3000.0 meters (Vadatheru-1, Latitude10°23'58.5" and Longitude 79°05'28.00′′E) and are plotted as continuous lines in Figure 8. The remaining well (Vadatheru -3, Latitude 10°27'28.00"N and Longitude 79°09'54.00"E) did not reach granitic gneiss basement and is drilled upto 4000.00 meters depth ,and is plotted as dotted lines as shown in Figure 8. The basement depths, based on sub-surface geology (Prabhakar and Zutshi, 1993), are plotted as dotted curve. Based on this data, the regional is assumed as a smooth

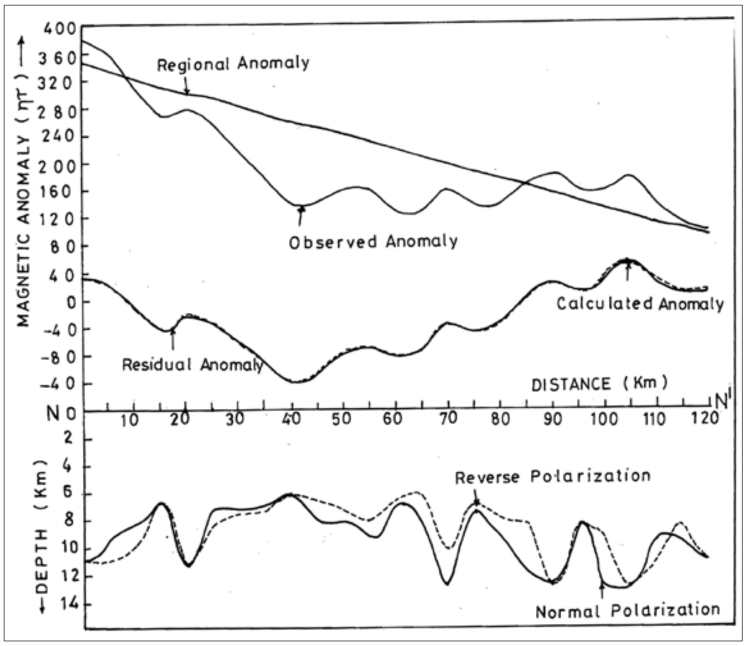

Figure 7. Interpretation of total field magnetic anomaly profile along NN'

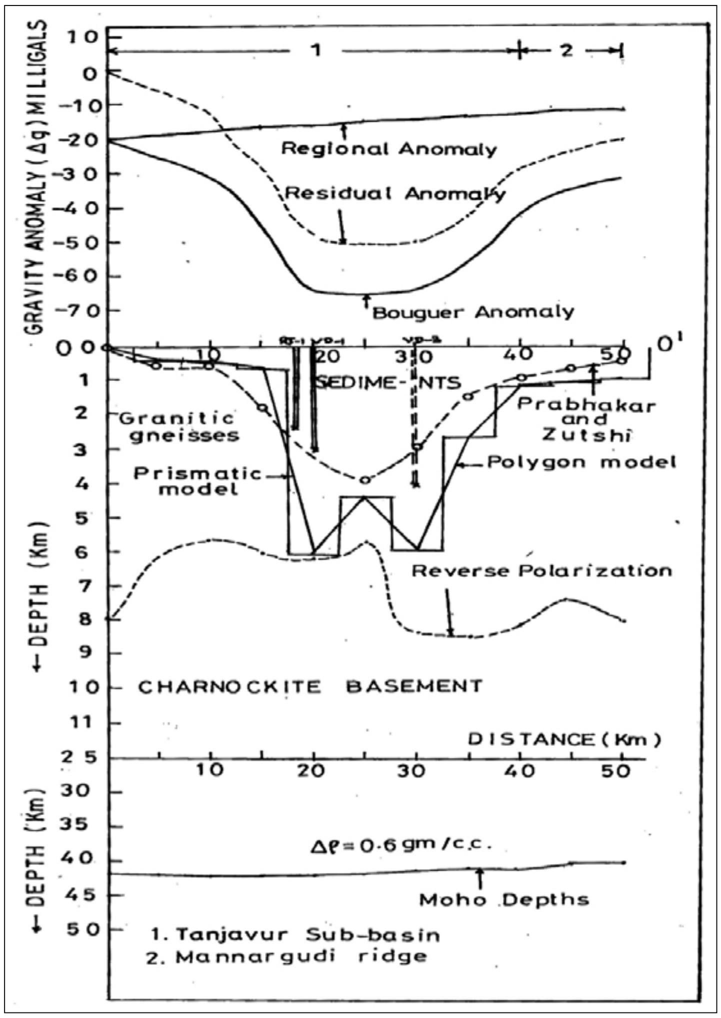

Figure 8. Interpretation of gravity anomaly profile OO'

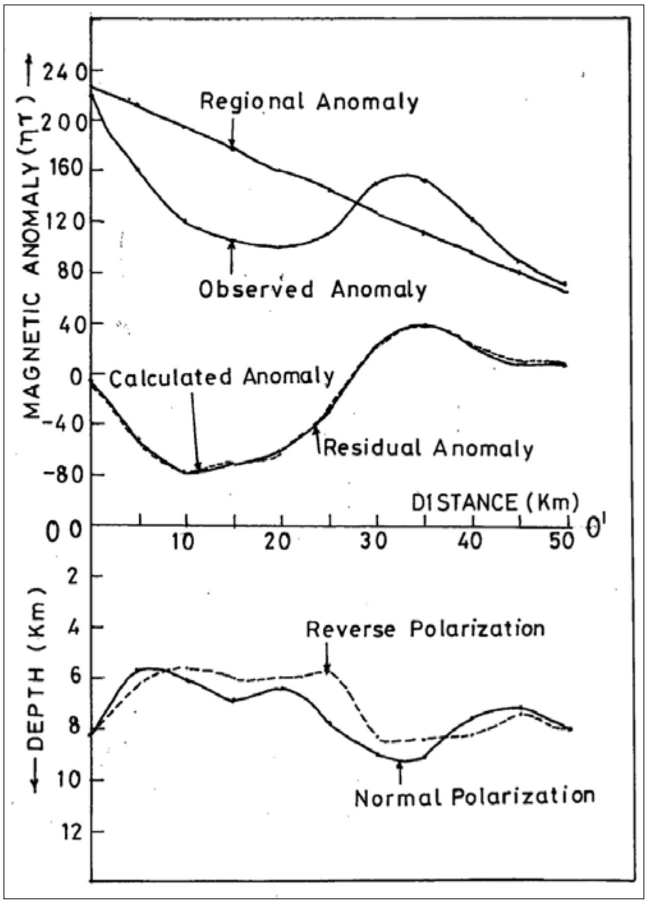

Figure 9. Interpretation of total field magnetic anomaly profile OO'

curve as shown in the Figure. The regional is -20 mgals at the origin and continuously decreases reaching a maximum of-12 mgals towards SE near the coast. The minimum and maximum residual anomalies on the basins and ridges are given in Table 1. The residual anomaly is interpreted with quadratic density function using polygon and prismatic models. The depths are obtained by iterative method using Bott's method and the results at 10^{th} iteration are plotted as polygon and prismatic models as shown in Figure 8.

The maximum and minimum depths over the basin and ridge are given in Table 1. The interpreted depths are nearly coinciding with the depths given by Prabhakar and Zutshi(1993) and drilled depths. The regional is interpreted for Moho depths. For this, the regional anomaly is obtained by removing a constant value of -20 mgals from the regional. The Moho depths are plotted at the bottom .It is observed that the Moho depths are decreasing towards the coast.

Magnetic profile along OO'

The magnetic data for the profile OO' is taken from two topo sheets (58J, 58N). IGRF corrections are made to this data using 1985 and 1990 coefficients as the data was collected in different periods and the magnetic anomaly profile is constructed. The length of the magnetic anomaly profile is 50 km and is sampled at 5 km interval. The magnetic anomalies vary from 72 ηT to 220 ηT. The anomalies are interpreted for magnetic basement structure below granitic gneisses basement using prism models. The profile is interpreted by taking the mean depth of the basement at 8.0 km and constraining the depths to upper and lower limits of the basement as 2.0 km and 9.0 km respectively. A linear order regional is assumed along this profile. The profile is interpreted for different polarization angles (Φ) and magnetizations (J). The results of interpretation of the magnetic profile OO' for normal and reverse polarization are given in Table 2 and interpreted depths are shown in Figure 9. These two are nearly the same. As the objective function for reverse polarization is small, these depths are taken as correct one and are plotted in Figure 8. The observed and the best fitting anomaly for reverse polarization are also shown in Figure 9.

For the reverse polarization, the linear order regional is as shown in the Figure. The residual anomaly after removing the regional from the observed anomaly is plotted in the Figure. The differences between the residual and the calculated anomalies are negligible as shown in the

Figure. The charnockite basement depths for the reverse polarization are from 0 to7.0 km below the granitic gneiss basement along this profile.

RESULTS AND DISCUSSION

The gravity and magnetic surveys have been carried out along three profiles laid perpendicular to various tectonic features, approximately at 30 km interval, in the central part of Cauvery basin. The subsurface geology and information available from the boreholes along these profiles are used to estimate the regional in the case of gravity anomalies. The residual gravity anomalies are interpreted for the thickness of the sediments in the basins and on ridges using variable density contrast. The density data obtained from various boreholes drilled in connection with oil and natural gas exploration is used to estimate variable density contrast, which is approximated by a quadratic function. The gravity anomalies are interpreted with polygon model (Bhaskara Rao and Radhakrishna Murthy 1986) and also with prismatic model (Bhaskara Rao, 1986), and the depths are plotted and these are nearly the same for both the methods: The basement for the sedimentary fill is the granitic gneiss group of rocks. The profile MM' passes across the Pondicherry sub-basin, Kumbakonam ridge, Tranquebar sub-basin and Karaikal ridge, and the depths obtained by gravity methods on these structures are 4.7 km, 0.6 km, 6.4 km and 1.70 km respectively, while those obtained by Prabhakar and Zutshi are 2.3 km and 3.2 km on Pondicherry and Tranquebar sub-basins respectively. This is a very glaring difference between gravity and sub-surface geological methods. The profile NN' passes across the Pondicherry sub-basin, Kumbakonam ridge, Nagapatanam sub-basin, and the depths obtained on these features by gravity methods are 1.4 km, 0.6 km and 8.7 km respectively. These depths nearly coincide with the depths given by Prabhakar and Zutshi except in SE-region of Nagapattinum sub-basin where they gave it as 5.5 km, which is very large difference. The profile OO' runs across the Tanjavur sub-basin and Mannargudi ridge, and the interpreted depths by the gravity methods on these structures are 4.4 km and 1.1 km respectively, and these depths nearly coinciding with depths given by Prabhakar and Zutshi and drilled depths. The regional anomaly is interpreted for Moho depths and it is rising towards coast along these profiles. The Moho depth outside the basin is taken as 42 km and the Moho depths near the coast are obtained as 36.6 km, 36.0 km and 39.5 km for the MM', NN' and OO' profiles respectively. As the regional is assumed based on drilled data and subsurface geological studies and is conforming to the rising Moho towards Coast, the depths deduced by gravity methods are more likely acceptable where little well depths are available.

The gravity studies clearly brought out the structure of the sedimentary basin along these three profiles and supplement the geological studies.

The aeromagnetic anomalies along these three profiles are also interpreted as a basement structure below the sediments. The magnetic basements do not coincide with the gravity basements. The depths obtained for chornackite basement for normal and reverse polarization are nearly the same. The best fit for the observed magnetic anomalies is obtained for chornackite basement structure 0 to 8 km below the granitic gneiss basement. The values of polarization angle and intensity of magnetization show that the anomalies are caused by remanent magnetization. The magnetic basement topography for the profiles MM' and NN' follows the granitic gneiss basement to some extent. A close fit with the observed magnetic anomalies is obtained for reverse polarization. However, the charnockite basement structures for normal and reverse polarizations are not much different. The interpretation of magnetic anomalies clearly brought out the existence of charnockite basement below the granitic gneiss basement. The observed magnetic anomalies can be best explained with the intensity of magnetizations 350, 450, and 450 gammas for MM', NN'and OO' profiles respectively. The modeling results for various profiles place the chornackite basement at 0 to 8 km below the granitic gneiss basement.

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