IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG)
e-ISSN: 2321–0990, p-ISSN: 2321–0982.Volume 2, Issue 6 Ver. II (Nov-Dec. 2014), PP 01-05
www.iosrjournals.org

Negative Gravity Anomaly over Granite Bodies of Kanigiri Area, Prakasam District, Andhra Pradesh, India

M.R.S.Sampath Kumar[1], G.Swathi[2] , M. Jyothi Prakash[3]
[1](Department of Geophysics, Andhra university, Visakhapatnam, India)
[2](Department of Geophysics, Andhra university, Visakhapatnam, India)
[3](Department of Geophysics, Andhra university, Visakhapatnam, India)

Abstract: *A detailed gravity data obtained from SRTM agency over a part of Prakasam Alkaline province has been interpreted. Interms of depths, attributing different densities and density contrast a two dimensional modeling has been attempted. A gravity profile between 15.4 N Latitude and 79.5 E Longitude of 100km from Kandukuru to H.M.Padu traversing Kanigiri plutonic complex has been selected. The basement depth has been estimated as 3.2 km on an average. The nature of the negative gravity anomaly has been interpreted interms of geology, geochemistry. The physical parameter density is essential in interpreting gravity anomaly. An attempt has been initiated to explain interms of geochemical and geological process. Further "negative" nature of the anomaly has been explained.*

Keywords: *Alkali Granite, Gabbro, Negative Bouguer Anomaly, Pluton, Density Contrast.*

I. Introduction

Bouguer anomalies in India reflect the major structural trends of the sub- continent and show good correlation with the surface geology. [1],[2],[3],[4]and[5] contributed to the analysis of the gravity data in terms of isostasy and geological structure in India. The results of gravity surveys over various exposed and buried acid intrusions are summarized by several workers. It is found that the acid intrusions considered are almost invariably associated with negative bouguer anomalies[6], which are certainly often caused by direct density contrast between the less dense acid intrusive and the denser country rock.

II. Geological Background

The Kanigiri area is known as plutonic igneous complex, in which several plutonic rocks comprising gabbro/norite, alkaline granite, magmatised quartzo felspathic gneiss schist are present. The pluton in this area having a NW-SE trend. It has been established , that the origin of these rocks are structurally controlled by reactivation of faults and seismicity. The area lies between the rivers Pennar and Krishna has witnessed three episodes of folding. Further in this area Musi, Paleru, Manneru rivers are flowing from west to east, whose flow is controlled by NW-SE lineaments. Several east- west gravity profiles were marked, using the satellite data from SRTM with 90 meter resolution, and the data is reduced to obtain bouguer gravity anomalies. In the present study a gravity profile length of 100 km from Kandukuru to H.M. Padu crossing the Kanigiri pluton has been utilized. The area from west to east consists of migmatised quartzo felspathic gneiss /schist followed by alkali granite granite gneiss, and gabbro norite and on the east side is the laterite. The location map of the study area is shown in fig1.

The geological formation and their mechanism infers the plutonic rocks in this area are formed after crystallization in deeper layer with slow cooling under great pressure with a retention of volatile constituents. In general, rock types from granite to diorite are characteristic plutonic associates of mountain building activity . As the area is covered with Kanigiri hills, the diorite is absent here. The area is said to be Prakasam Alkaline province, chemically, alkali rocks are characterized by high percentage of alkalies in relation to silica and alumina. In the normal granite type there is always a subordinate quality of plagioclase. In alkali granite, this mineral dissappers. However the other major rock type available in the region is the gabbro. This is a very important and abundant set of plutonic igneous rock, which contain biotite, hornblende, ilmenite and magnetite are accessories. Apart from these the area comprises the geneisses and schists on either side of the alkaline granites. These are formed by the metamorphism of basic igneous rocks and tuffs, and of certain sediments of mixed composition and also by the contact action of granite upon calcareous sediments with addition and interchange of material

III. The gravity Anomaly And Subsurface Structure:

In early 1930 Qureshy and others prepared a Bouguer anomaly map using 31000 gravity observations. They are computed using the International Gravity Formula assuming 2.67 g/cc as density. The east coast of

India is associated with values higher than -50mgals, becoming positive at places, and thus exhibiting the continental margin.

In general the bouguer anomaly map in the sub- continent reflects the major geological and structural trends. In this paper, we are confined to southern part of Indian shield, which is composed of several plateaus and are characterized by predominately oblate anomalies. Marked "lows" are observed over granitic bodies and sedimentary basins and "highs" are observed over the metavolcanics, metasediments and uplifted horst blocks. Over the southern part of the Indian shield, south of 20^0N, Bouguer anomalies generally range between -5 to -110 mgals. The southern shield is, however a dissected plateau with lighter than average upper crust. The negative anomalies as mentioned could be expected over such a region. The large negative anomalies are caused by large thickness of tertiary and mesozoic sediments in various sedimentary basins of Southern India. This phenomenon could be a departure from isostatic equilibrium in this region. The downwrap of 2- 3 km of lithosphere could produce a negative effect of this order [7].

In order to elucidate this phenomenon of negative values of gravity over granite bodies, Ongole and its surrounding areas, which are parts of Andhra Pradesh and are adjacent to Bay of Bengal. Prakasam district of Andhra Pradesh has its different entity in geological history as Prakasam mafic complex with innumerable plutons all around the district.

The past history in evolution of east coast of India during the process of movement of India and the plate reconstruction explains the deformation of the area. During Late Jurassic – Early Cretaceous when the West Australia- India rifted propagated further in the south westerly direction, the deformations could be resulted in this region as horsts and grabens[8]. In order to explain the crustal structure below this area, in relation to acid intrusions, gravity and elevation data from SRTM satellite has been utilized. The data is processed to obtain bouguer gravity anomaly data with a 90 m resolution. The data has been interpreted using GRAV2D software [9], with suitable density contrast purely based on the geological formations and their respective densities [10], are incorporated in the subroutine and at the 10^{th} iteration there is a best fit between observed and calculated anomaly as shown in fig3. [11], [12], [13], have explained several large negative anomalies due to granitic and gneissic bodies of substantial thickness which outcrop extensively in south India. Detailed work in this particular area has not been quoted elsewhere in the literature. Magnetic and seismic studies has been carried earlier by [14] and [15] on regional scale. However detailed magneto metric and electrical resistivity surveys were carried out in recent years by the author and only qualitative results of gravity are given here. The bouguer gravity anomaly map along with geology and density are shown in fig2and 3.

IV. Figures and Tables

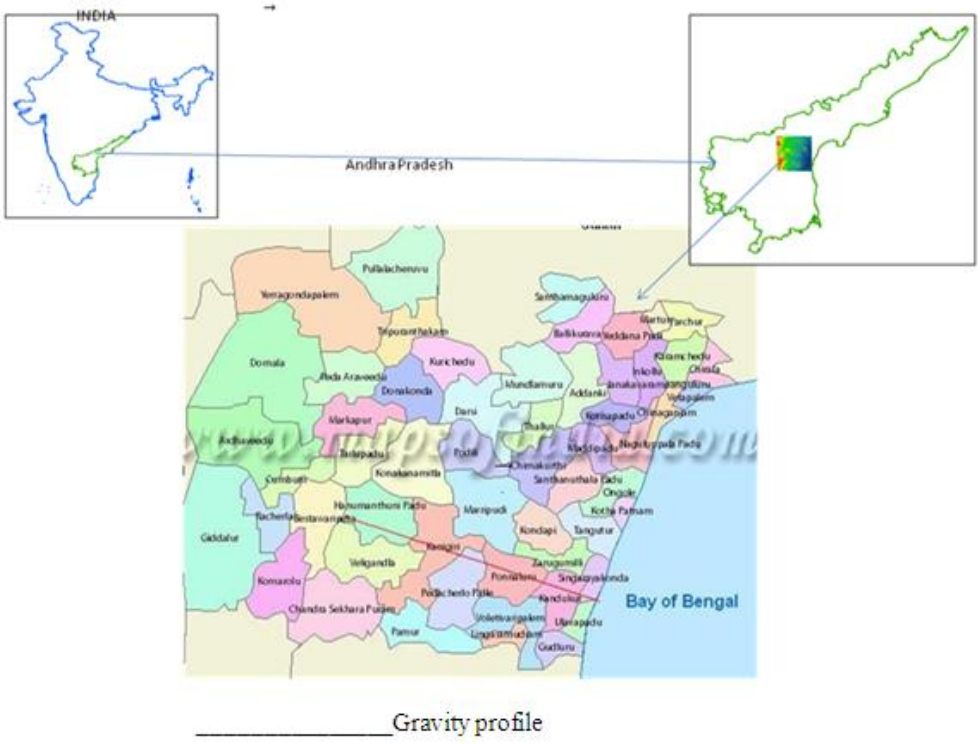

Fig1. Location Map of The Study Area

Migmatised quartzo felspathic Gneiss/ Schist	Quartz-Chlorite-Sericite Schist	Alkali Granite	Granite Gneiss	Gabbro/ Norite	Migmatised quartzo felspathic Gneiss/Schist	White to black sands
2.6-2.9 g/cc	2.6-2.75 g/cc	2.53- 2.62 g/cc	2.62- 265 g/cc	3.01 g/cc	2.6-2.9 g/cc	>3 g/cc

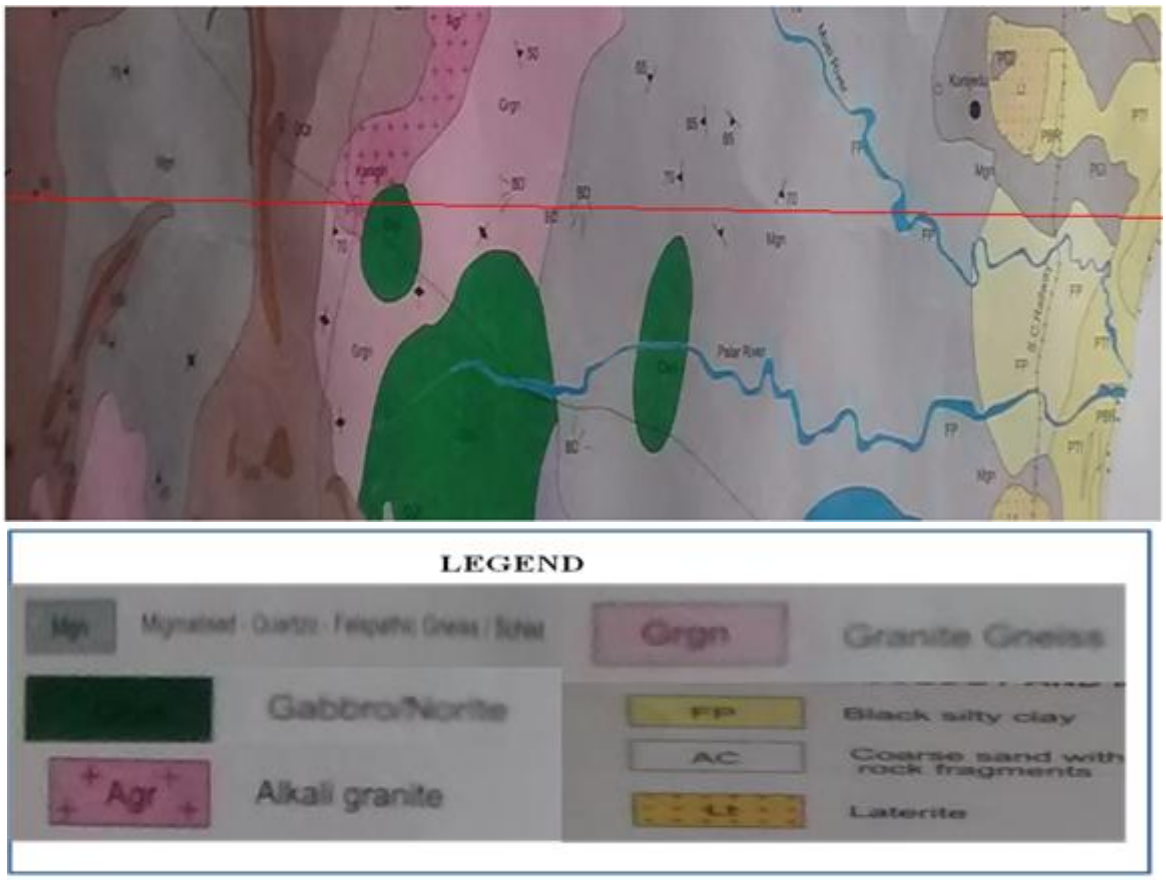

Fig2: Geology map of Kanigiri pluton, along with densities in respective areas, Prakasam district, Andhra Pradesh (Reproduced from district resource map of GSI)

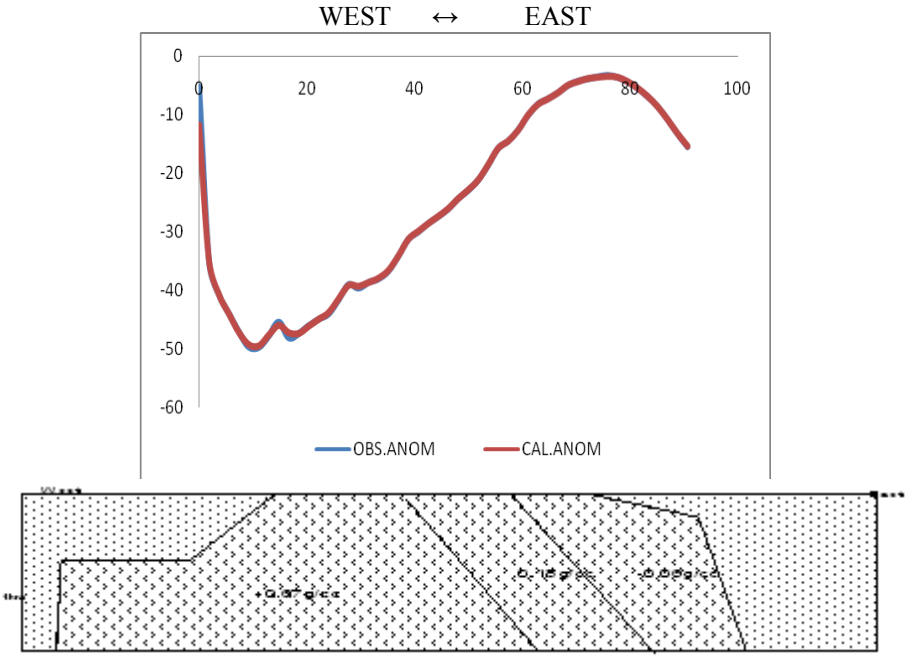

Fig3: An Observed Gravity Profile Across Kanigiri Granite, Prakasam District,Andhra Pradesh, Compared With the Anomalies Calculated For The Two-Dimensional Model

V. Conclusions

The variations of igneous rocks may be due to differentiation and assimilation of magma. In differentiation the process where by a magma, originally homogeneous. Splits up into contrasted parts, which may form separate bodies of rock, or may remain within the boundaries of a single unitary mass. However in assimilation, a foreign rock material either in liquid or solid form, is incorporated within a magma. In this context it is the concerned that the magma is associated or dissociated with different foreign bodies and forming gabbro. Formation of schistose structure and gneissose structure on either side of the granite/gabbros bodies of kanigiri area shows a considerable amount density contrast. The alkali granite emerged in between gabbro /norite, magmatised quartzo felspathic gneiss/schist posses less density, when compare to formation on either side. The magnetized gabbro- felspathic gneiss schist posses density of 2.6- 2.9 g/cc where as alkali granite posses 2.5-2.65 g/cc. This is followed by gabbro/norite is 3.01 g/cc .

Hence this density contrast is sufficient to produce a negative gravity anomaly around kanigiri pluton, a magmatic origin can be suspected either by direct intrusion from the "granitic layer" or possibly by melting, differentiation, and intrusion of the "metamorphic "layer. It is difficult to understand how a granitization process could give a large negative anomaly. However enough density contrast is seen between the intrusion and surrounding strata and this may result in negative anomaly.

Reference

[1]. S.G.Burrard, 1912," On the origin of Himalayan mountains". Survey of India, , Prof.paper No.12.
[2]. Glennie,E.A., 1932,"Gravity anomalies and the structure of the Eath's crust", 3.Prof.Pap.,Surv. India, No.27.
[3]. B.L.Gulatee, , 1958, " Isostasy in India". Bull.Natn.Inst.Sci.India2, pp:6-10.
[4]. R.D. Oldham, 1917," The structure of the Himalayas and of the Gangetic plains as elucidated by geodetic observation in India". Geol.Sur.India Mem, Vol42, pp: 149-301.
[5]. Qureshy,M.N.,1964. "Gravity anomalies as related to regional tectonics of peninsular India".22nd session of Int.Geol.Congr.,New Delhi, 490-506.
[6]. M.H.P.Bott, 1953, Negative gravity anomalies over 'intrusions' and their relation to the structure of the earths crust. Geol.Mag. vol 80,pp: 257-267.
[7]. E.A Glenni, 1950," The Cuddapah Basin in India and crustal warping" . Mon.Not.R.Astr.Soc Geophy.Suppl, vol 6, pp:168-176.
[8]. N.K.lal, A.Saiwal and Anil.K.Kaul, 2009, "Evolution of East coast of India- A plate tectonic reconstruction. Journal Geol.Soc of India", Vol 73, pp:249-260.
[9]. D.Bhaskara rao and M.J.Prakash, 1997," Fortran-77 computer program for 2D and 2.5D analysis of gravity anomalies with variable density contrast". Bollettino Di Geophysica Teorica Ed Applicata, Vol.38, No3-7, pp: 187-209.
[10]. Crain's, Petro physical handbook.
[11]. M.N.Qureshy, N.Krishna Brahmam, P.S.Aravmadhu and S.M. Naqvi, 1968," Role of granitic intrusions in reducing the density of the crust and other related problems as illustrated from a gravity study of the Cuddapah Basin, India". Prol.Roy.Soc. A, Vol 304, pp:449-464.
[12]. M.N.Qureshy, N.Krishna Brahmam and P.S. Aravamadhu, 1970," A note on the gravity surveys on some granitic bodies of south India", J .Ind.Geosci.Assn, 11.

[13]. M.N.Qureshy, Waris E.K, 1980," A bouguer anomaly map of India and its relation to broad tectonic elements of the subcontinent". Geophys.J.R.Ast.Soc , Vol 61, pp:235-242.
[14]. Reddy,P.R.and Chandrakala,2004,"Seismicity in and around Ongole,Andhra Pradesh-An appraisal". J. Indian Geophys.Union,8,pp:143-146.
[15]. K.V.Swamy, P.Rama rao and I.V.Radha Krishna Murthy, 2008, " Magnetic anomalies and basement structure of the Eastern Ghats Mobile Belt and south west Krishna basin in parts of Prakasam District, Andhra Pradesh. Current Science". Vol 94, No2, pp: 262-268.