

Intra Crustal Magnetic Interface in and around Ramadugu, Vattikod and Somavarigudem Lamproite Areas of Nalgonda District. T. S, Eastern Dharwar Craton

Ramadass G.¹, Sriramulu G.² & Preeti M.³
^{1,2,3} Department of Geophysics, Osmania University, Hyderabad-500007

Abstract: Structural analysis using ground Total magnetic Intensity data collected over parts of Ramadugu, Vattikod and Somavarigudem to demarcate magnetic lineaments, infer Intra crustal magnetic interface and the effects of such features on the tectonic events in the survey areas. Trend characteristics of magnetic lineaments were brought through the magnetic Intensity, high pass filter map and tilt derivatives. The configuration of the intra crustal magnetic interface was obtained by Euler deconvolution solutions and digitizing the respective values are contoured for magnetic basement is ranging from 1.2 km to 4.4 km. The zones of intersection of structural features combined with shallow occurrences of the gneissic basement in the region which could have acted as potential sites for lamproites emplacement.

Introduction and Geology

Among the Geophysical methods, magnetic method is the oldest, simple, most, reliable and mostly used technique has been a key component of diamond exploration programmes in India. The Eastern Dharwar craton is significant from both the geological and geophysical points of view characterized as it is by a complex evolutionary history and a vast store house of valuable minerals. The broad geological configuration of the Archaean to Proterozoic craton comprises a suite of greenstone belts, volcanic, granitic rocks, Paleo to Meso proterozoic platform sedimentary basins, mafic dyke swarms and Mesoproterozoic kimberlites and lamproites [11]. The greenstone belts of the EDC are generally regarded as representing composite tectono stratigraphic terranes formed from accretion of plume derived as well as subduction derived, magmatic episodes and range in age from 2.5 to 2.9 Ga [5].

Kimberlites / lamproites intrusions within cratons usually are localized [12] in zones of high magmatic permeability, as defined by the repeated intrusion of various types of igneous rocks. While kimberlites / lamproites are generated in the mantle, often reactivated fault/fracture systems [4,16] their intrusion into the crust, these intrusives tend to occur in cluster or fields, within the large scale distribution possibly controlled by shallow zones of weakness such as faults (linear lows) or the margins of databases dykes (magnetic highs) [9]. They are associated with large scale structural features like regional and local lineaments, the intersection of major lineaments, domal structures, fracture corridors, disjunctive zones radial features and resultant structural features formed due to emplacement of diapiric granites [13] opines that the regional trend of kimberlites / lamproites rocks in the Dharwar craton is possibly related to crustal warping and closely related deeply penetrating faults. These are clearly discernible on Total magnetic intensity, because of Kimberlites / lamproites generally have higher magnetic susceptibility than surrounding gneisses and granites and are additionally prone to retain remnant magnetism. As a consequence magnetic anomalies are commonly associated with Kimberlite / lamproites intrusions although the association can be subtle. Crater facies kimberlites often displays anomalously low magnetic susceptibility relative to surrounding country rocks, reflecting the proportion of entrained non susceptibility sediments.

The present work is aimed by the need to obtain a clearer perception of magnetic intra crustal magnetic interface and structural configuration in parts of Ramadugu, Somavarigudem and Vattikod lamproite fields in the Nalgonda district Telangana, India .

The study area is located NW margin of the Cuddapah basin part of the Eastern Dharwar craton, Nalgonda district, T.S state, bounded by Longitudes 79° 5' to 79° 25' and Latitudes 16° 42' to

16° 58' (Fig. 1). The area consists mainly of granite gneisses and granitoid suit of rocks of Achaean age associated with older metamorphic. Meta basalts, namely pyroxenites, amphibolites, biotite schist, migmatites and basic dykes of dolerite and gabbroic composition [1,2,3] (Fig.1). The Peddavura Schist belt occurs near Peddavura village. This belt is trending in the NNW-SSE direction, is runs for about 20 Km with a variable width of 500 m to 2 Km, is flanked on either side by the peninsular gneissic complex. A number of dolerite dykes and quartz reefs traverse these rocks trending N-S, E-W, NE-SW and NW-SE direction.

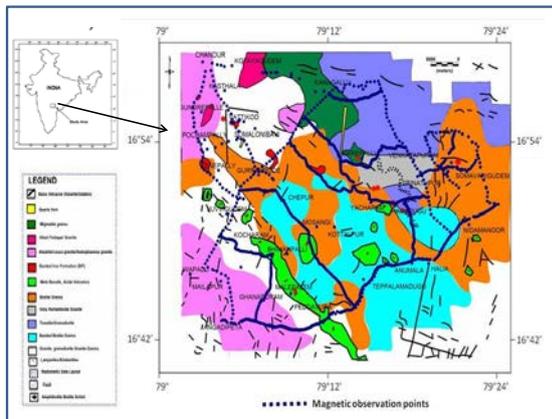


Figure 1. The Geology map and Radiometric observations layout map of the study area.

Magnetic data acquisition and analysis

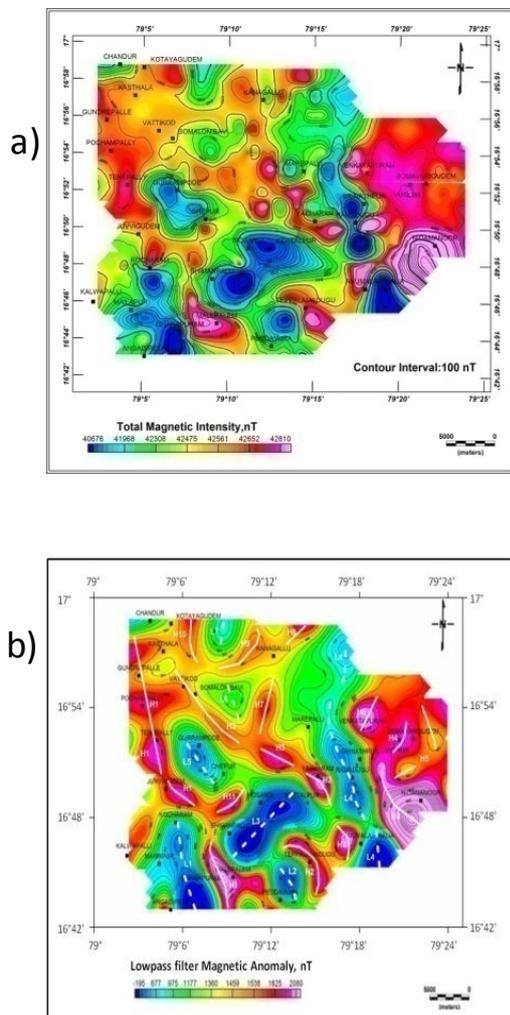
As variation in susceptibility are more marked in the magnetic method is very useful for obtaining information on the faults, other tectonic features. Intrusive and magnetic interface that contribute to the structural configuration of the region. Accordingly, a total magnetic intensity measurement were carried out along all available approach roads and tracks in the study area with a station interval of 200 m using a Model-600 Proton precession Magnetometer in an area of approximately 7000 Sq.Km, (latitude 16° 42' N to 16° 58' N and longitude 79° 05'E to 79° 25'E) in and around Ramadugu Lamproites, Nalgonda district (Corresponding to the scale of 1:50,000). The N-S and E-W extend of this area that falls under Survey of India (SOI) Topo sheet No. E44T1, E44T2 and E44T5. 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.

Figure 2a shows Total magnetic Intensity after diurnal correction correction Intensity map of the study region (contoured interval of 100 nT) along the locations of villages, shows the distinct pattern of 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 magmatic activity. Some of the features are associated with basinc / ultrabasic / younger acidic intrusive that indicates zones of magnetic permeability.

The magnetic anomalies in the area range from 31769 nT in the northwestern side to about 44781 nT in the northeastern side, with the general trend of the contours being NW-SE. The conspicuous feature in this map is the NW-SE trend that corresponds with Peddavura schist belt and is characterized by steep magnetic gradients. Broadly, while magnetic highs are recorded over basic dolerite dyke and the correlation of lows over fracture zones is evident. The basic dyke is investigated and appears to be characterized by N-S, E-W, NE-SW and NW-SE trends, observed closures of the hard rocks 41400 to 44781 nT can be general be 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 dykes are later tectonic activity and so are important in the emplacement of lamproites.

With a view to eliminating the high - frequency noise, a low - pass filter (cut of frequency 0.003cycles/se.) was applied to data. Fig. 2b. shows the color shaded contour map of the low pass filtered output of the total Magnetic Intensity in the study area. It is similar to the Total magnetic intensity map and Low pass filtered output. The lows are obtained over the absence of Iron banded formations. Further, even the older metamorphic, basic intrusive and younger granites are associated with feeble magnetic signatures in the study area.

Figure 2.a) Colour contoured Total magnetic Intensity map of the study area. B) Low pass filter magnetic Anomaly map of the study area.



The distinct pattern of eleven magnetic high trends H1 (in between Ghanapuram to Mailapura), H2 (South of Teppalamadugu), H3 (in between Anumala – Halia) and H4 (east of Nidamanur) NW-SE direction, Whereas H5, H6, H7, H8, H9 and H11 are trending in NE-SW direction, which are discernible a small isolated high closures. The highs may be due to the upwards in the upper crustal layer and consequent thinning of the peninsular Gneissic layer. H10 falls at west of Kotayagudem in the N-S direction. Similarly seven lows and the steep gradient belts then at places that describe prominent magnetic linear are attributable to the complex assemblage of features of varied dimensions and direction resulting from different phases of magmatic activity, some of the features are associated with basic intrusive dykes that indicated zones of magnetic permeability. While comparison of the magnetic signatures with geology of the region not many inferences are made because the various forms of granites (migmatites, gneisses, pink/ grey granites and/or

biotite granites) are magnetically not much distinctive.

Seven magnetic lows L1 (in between Ghanapuram to Kacharam), L2 (East of Peddavura), L3 (in between Malepalem to Kottlapur), L4 (lies in the eastern part of the study region running in the direction of NW-SE continued up to Marepally east. Then the direction changes abruptly changing North - South. L5 is a small negative closure in the east - west direction, locate west of Marepally. L6 running from Chepur to Gurrampod. Significantly six lows L1 to L6 are trending in the direction of NW-SE, and L7 falls northern part of the study region and east of the Kottayagudem runs NS direction. These prominent magnetic lows are indicating there are relatively deep and or / non - magnetic source/or basement with a slope directed towards west. The alignment of closures from Ramadugu, magnetic lows are significant for lamproites exploration smaller off-shoot of larger intrusions migrates up through fault system in the form of pipes and deposit lamproites. Though it is very difficult to arrive at any pattern to the occurrence of Kimberlite / Lamproites deposits.

However, in general, the intersection of linear trends, bulging of contours, low second order magnetic anomalies, contact between dykes and gneisses (shear zones) are the favorable indicators [10] search for Kimberlite / Lamproites. shows the distinct pattern of highs (positive) and lows (negative) indicative of magnetic source are bipolar in nature

The magnetic lows in the study area appear to be associated with lamproites pipes at Ramadugu and occur in the form of small pockets in the central and northeastern part of the region at the intersection of various contour trends and have zigzag and actuate shapes. The existence of the inferred faults associated with these trend pattern in the radiant Peddavura-Ramadugu region are also likely to be associated with lamproites, might be confined to Archean and Proterozoic cratons are linked to upwelling mantle due to drifting or a mantle plume [6]. However, the geochemistry and petrogenetic modeling of RLF samples [3] suggest a predominant contribution of sub-continental lithosphere mantle to their magmas, with a limited contribution from connecting (asthenospheric) components. While comparison of the magnetic signatures with geology of the region not many inferences are made because the various forms of granites (migmatites, gneisses, pink/ grey granites and/or biotite granites) are magnetically not much distinctive. The magnetic highs and lows are in conjunction of subsurface faults in the granitic

terrain. Not with the composition of the granites, the study area covers various forms of granites along with little Peddavura schist. Few basic/ultrabasic dykes are available as intrusive rocks. An NW-SE trend to NE-SW trends of fault axes is evident in highs and lows in figure 2b Two other trends of magnetic high responses are also running in the same direction.

Magnetic basement

Though there are many ways to get quantitative estimates of depth to an intra - crustal magnetic interface such as the local spectra method, analytical signal method [8] their drawback it, that they cannot accurately map the undulation in the basement as they give only average depths. To determine the subsurface configuration of the magnetic interface in the region quantitative analysis was attempted. Since low pass filtering has the added advantage of assisting delineation of this intra-crustal magnetic interface. [17] proposed a technique for analyzing magnetic profiles based on Euler's relation for homogeneous functions. The Euler deconvolution technique uses first-order x, y and z derivative to determine location and depth for various idealized targets (sphere, cylinder, thin dyke, pipe and contact), each characterized by a specific structural index. [12] extended the technique to 3D data by applying the Euler operator to windows of gridded data sets. [7] and [15] among others, helped in understanding the applicability of the technique. The Euler Deconvolution system (Figure 3) is based on Euler's homogeneity relationship, which does not assume any particular geologic model. Therefore, Euler deconvolution can be applied in a wider variety of geologic situation than conventional model-dependent techniques. The homogeneity of N (in the Euler's equation) may be interpreted as a structural index – a measure of the rate of change with distance of the field.

A '0' (zero) index implies that the field is a constant regardless of distance from the source model. In case of a gravity contact, the field would be infinite. These situations are physically impossible for real data and a zero index represents a physical limit, which can only be approached as the infinite dimensions of the real source increase. In practice, an index of 0.5 can often be used to obtain reasonable results when the index of 0 would otherwise be indicated (table 1).

Table 1. A zero Index

Geologic model	number of infinite dimensions	Magnetic SI	Gravity SI
sphere	0	3	2
pipe	1 (z)	2	1
horizontal cylinder	1 (x-y)	2	1
dyke	2 (z and x-y)	1	0
sill	2 (x and y)	1	0
contact	3 (x, y and z)	0	NA

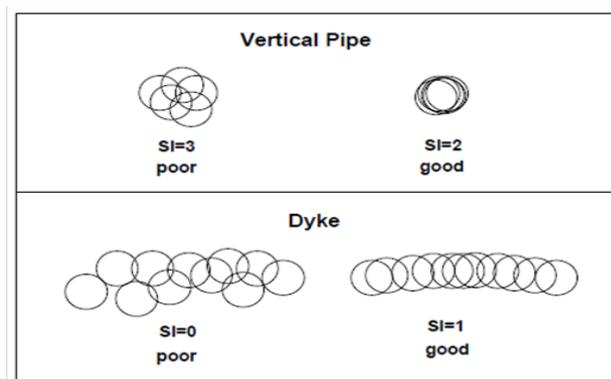


Figure 3. The Euler Solution on the Right Represent the Correct SI for a Magnetic pipe-like Body (top) and a Dyke (bottom) (after Reid et al., 1990).

In present study region assuming dyke models Euler solutions are obtained results shown in Fig 4a the output values are digitized are at each location then contoured map presented in fig. 4b.

Figure 4b is contour color map of the subsurface relief of the intra-crustal magnetic interface obtained by contouring the depth to the surface digitized from it is evident that this surface has an undulating topography, with depth to interface alternating from shallow (less than 1.2 km) to deep (greater than 4 km) in a NW-SE direction suggesting compressive forces aligned NE-SW. This is at some variance with the general NW-SW trend of structural and geologic features. This can be perhaps being attributed to the complex tectonic evolution comprising several phases of deformation in the region.

Pockets of deeper occurrence of magnetic interface are seen at five regions, i.e region at Mailapalem (4.2Km), Halia (4.3Km), Pochampalle, (4.3km), in between Vattikod to Kangallu (3.7KM), and low interface obtained at north of Gundrapaell (1.4km), Marepalley (1.2km), Yacharam (1.6km), Ramadu (1.6km) m and Somvarigudem (1.9km). While the former is reflected in the form of a low in the peninsular gneissic layer the latter is only partially

corroborated by geological formations in the study area.

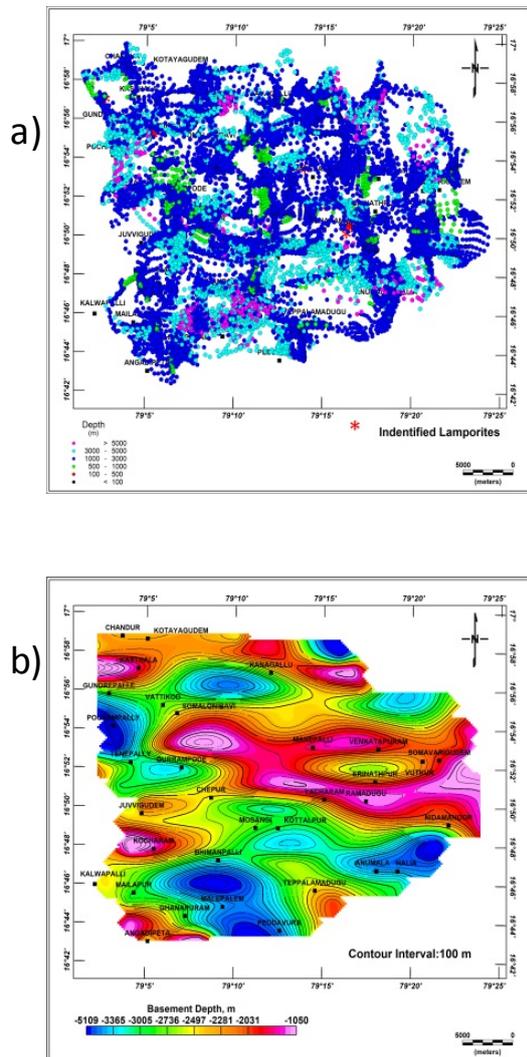


Figure 4.a) Locations of Euler Solutions parts of the study area. b) Magnetic Basement map of the study area.

The total magnetic surveys bring out complex patterns of highs and low magnetic interface suggestive of close association with structural features such as fault and fracture zones etc. They also aid in the determination of the disposition of ultra- basic intrusions and dolerite dyke clusters. These inferences, in turn may have bearing on kimberlite / lamproite emplacement. Further more, smaller off shoots of larger intrusions migrate up through fault systems in the form of pipes and deposits diamonds.

A general correspondence of potential zones for lamproites delineated from magnetic lows is seen at suitable structural features such as faults/fractures that serve a channels for their

emplacement. Shallow magnetic interface occur adjacent to the Ramadugu, Yacharam, Vattikod, Gundrapalle, Marepally and Somavarigudem lamproites, It is the structural disposition is similar to that north of Yacharam,, both regions lies along the flanks of crustal up warp criss-crossed by deeply penetrating faults. Lamproites are emplaced along NE-SW directions parallel or oblique to the foliation, joint, dyke and regional fault/fracture trends at Somavarigudem lamproites are observed close association with dolerite dykes The Vattikod have similar disposition of the magnetic interface at Ramadugu (Figure 4b), shallow occurrence flanking crustal unwraps -possible associated kimberlitic / lamproites occurrence can be inferred with certainly only if the structural. configuration indicated the presence of deep seated intersecting faults that provide the necessary channels of movement and crystallization of magma. The ten lamproites [1] at west of Vattikod village emplaced along WNW-ESE to NW-SE trending fractures in the granite-gneiss basement. Dolerite dykes are also observed emplaced along side of the lamproites in the WNW-ESE fractures.

Summary and conclusions

The configuration of the intra-crustal magnetic interface was obtained by using Euler deconvolution solutions and is very uneven with depth to alternating from shallow to deep in a NW-SE direction suggesting compressive forces aligned NE-SE. The shallow depth to the intra-crustal magnetic interface observed at Ramadugu, Yacharam, Vattikod, Gundrapalle, Marepally and Somavarigudem lamproites

Euler deconvolution of total magnetic data yielded depth to sources ranging from 1.2 km to 4.3km. The Euler deconvolution, shaded, all highlighted correlated on magnetic data on similar location which mark out traces of linear features. The linear features may be due to discontinuities resulting from faulting of host rock.

Magnetic lineaments inferred from the study trend prominently in the NE-SE.E-W and NE-SW directions. These features are correlated with trends of dykes, faults and quartz veins. Basement rock uplift may be caused by highly magnetic basic igneous intrusions, the depth to sources in the study area indicating surficial sources which may be attributed to thin cover overlying the basement rock.

The association of reported lamproites with the subsurface topographic configuration of the study area used to develop a plausible

structural/subsurface topographic criterion for their emplacement.

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