Global Jour. of Engg. & Tech.
Volume 2, Number 3 (2009) 475-484

STRUCTURAL TRENDS OF IJEDA-ILOKO AREA AS INTERPRETED FROM TOTAL COMPONENT OF GROUND MAGNETIC DATA

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Abstract : Ground magnetic survey of Ijeda and Iloko towns in Oriade Local Government Area of Osun state Southwest Nigeria was performed. The study was carried out using high resolution proton precision geometric magnetometer which involves the use of Total Component of the ground magnetic anomaly data running through traverses 7, 8, 9 and 13. This research focuses on delineation of faults in this part of the highly mineralized Ilesa schist belt. The field data was qualitatively and quantitatively interpreted and the results gave values for the Total component measurements of ground magnetic anomaly which varied between a minimum negative peak value of about -330 gammas and a maximum positive peak value of about 80 gammas. Depth to the basement rock was estimated using half slope method. Information on wide range of magnetic intensities over the different rock types in this area were obtained from the quantitative interpretation using linear trends. The results generated were used to delineate rock boundaries, bedrock topography major and minor faults.

1.0 Introduction

Ijeda and Iloko towns are located in the northeastern part of the highly mineralized Ilesa schist belt southwestern Nigeria. The area is bounded by Latitudes 7º37'000"N and 7º41'100"N and Longitudes 4º43'500"E and 4º50'700"E. The traverses of interest covered from Ijeda Secondary School gate to Iloko Community Model Grammar School, T_7 (NE – SW); also from Iloko junction along Ilesa-Akure Express road to Iloko Community Model Grammar School gate, T_8 (SW – NE), from Ijeda to Ijebu-jesa town, T_9 (SE – NW) and from off the Ijeda-Iloko road to a farm settlement, T_{13} (Figure-1). A base station was selected at Orisunbare town closed to the surveyed area where the magnetometer was been continuously returned to correct for diurnal variations of earth magnetic field and some other external sources of interferences such as vehicular and other man made structures (Kayode, 2006).

The study area lies within tropical climate marked by the alternating wet and dry seasons. Temperature is moderately high during the day and also varies from season to season. Due to the passage of the sun on its way to and from the tropic of cancer, this resulted to two periods of high temperatures as recorded annually. The first period occur in March - April and the second period in November - December. The average daily temperature varies between about

Keywords : magnetic intensities, residua! ground magnetic, geomagnetic sections, rock boundaries, bedrock topography, Ijeda-Iloko.

20ºC (for a very cold day) and about 35ºC (for a very hot day). The coolest period is in the middle of the raining season i.e. July-August (Kayode, 2006).

Previous study has shown that this area is underlain by Precambrian rocks typical of the basement Complex of Nigeria Figure-2 (Rahaman, 1976). Some of the main rock types found in this area are granite-gneiss, which occupies most part of the eastern flank; amphibolites complex and schist occupies most part of the study area; muscovite schist and quartzite and quartz-schist form part of the rock units (Kayode, 2006; Ajayi, et al. 2003; Folami, 1992; Ajayi, 1981, Elueze, 1986). The topography is gentle with few local outcrops in the north-eastern and northwestern part.

There has been conflicting reports on the nature and lateral shift of the major faults in this are which necessitated this research. However, this is a preliminary study; more comprehensive reports would be published on this zone in the nearest future.

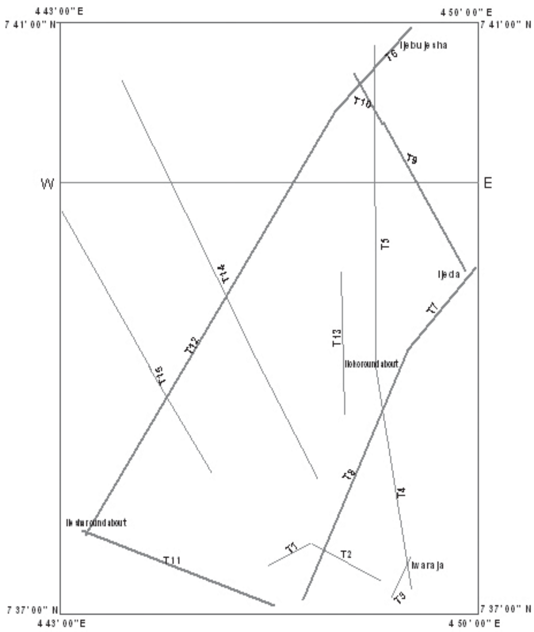

Figure-1 : Base map of the study area showing geophysical layout.

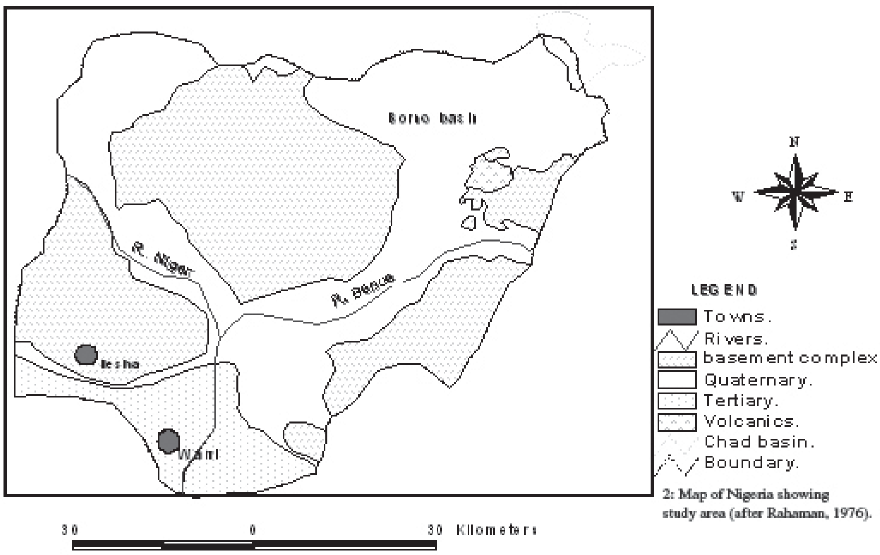

Figure-2 : Map of Nigeria snowing study area (after Rahaman, 1976)

1.2 Local Geological Setting

The major rock associations of Ilesa area form part of the Proterozoic schist belts of Nigeria, which are predominantly, developed in the western half of the country. In terms of structural features, lithology and mineralization, the schist belts of Nigeria show considerable similarities to the Achaean Green Stone Belts. However, the latter usually contain much larger proportions of mafic and ultramafic bodies and assemblages of lower metamorphic grade (Glusegun, et al., 1995; Ajayi, 1981, Rahaman, 1976).

Rocks in this area are structurally divided into two main segments as shown in Figure-3, by two major fracture zones often called the Iwaraja faults in the eastern part and the Ifewara faults in the western part (Folami, 1992, Elueze, 1986). However, this study focuses on the northern part of the former faults zone. The area west of the fault comprises mostly amphibolites, amphibole schist, meta-ultramafites, and meta-pelites. Extensive psammitic units with minor meta-pelite constitute the eastern segment. These are found as quartzites and quartz schist. All these assemblages arc associated with migmatitic gneisses and are cut by a variety of granitic bodies (Olusegun, et al., 1995, Rahaman, 1976).

The rocks of the Ilesa district may be broadly grouped into gneiss-migmatite complex, mafic-ultramafic suite (or amphibolite complex), meta-sedimentary assemblages and intrusive suite of granitic rocks. A variety of minor rock types are also related to these units. The gneiss-migmatite complex comprises migmatitic and granitic, calcereous ami granulitic rocks. The mafic-ultramafic suite is composed mainly of amphibolites and amphibole schist and minor meta-ultramafites, made up of anthophillite-tremolite-chlorite and talc schist. The meta-sedimentary assemblages, chiefly meta-pelites and psammitic units are found as quartzites and

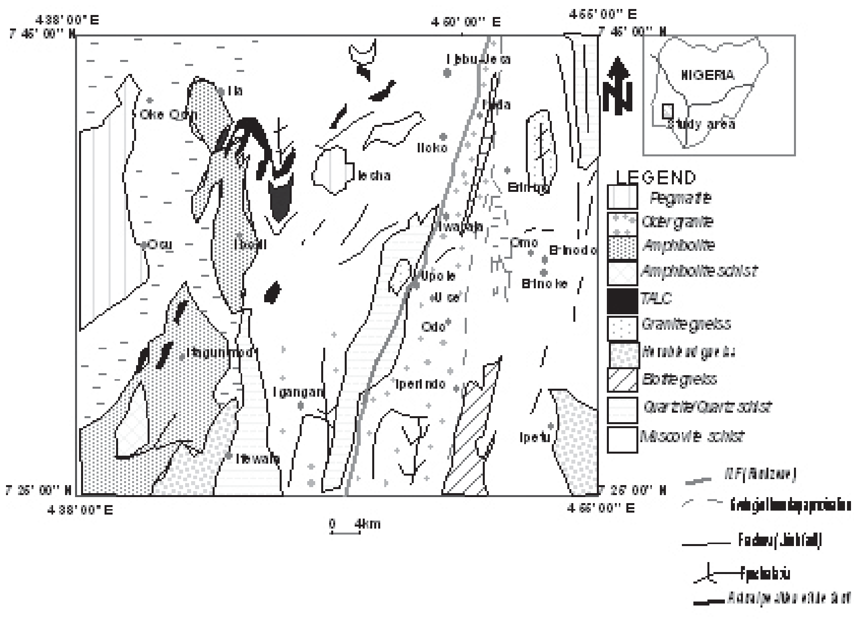

Figure-3 : Generalized geological map of Ilesa schist belt SW Nigeria (after Elieze, 1982).

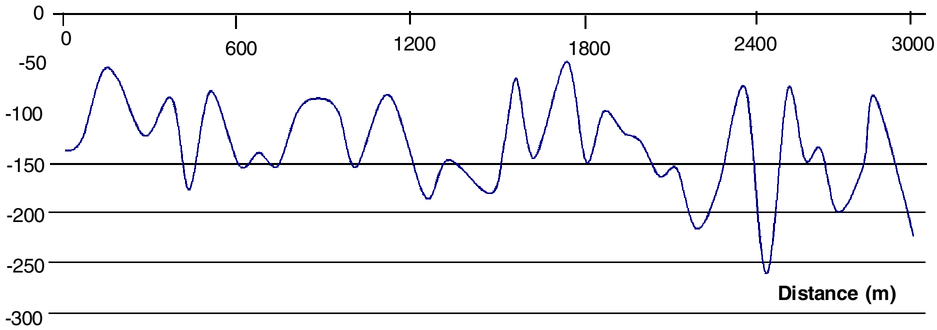

Figure-4.1a : Total Relat Mag Intensity along Traverse 7 (NE - SW) of Ijeda - Iloko area

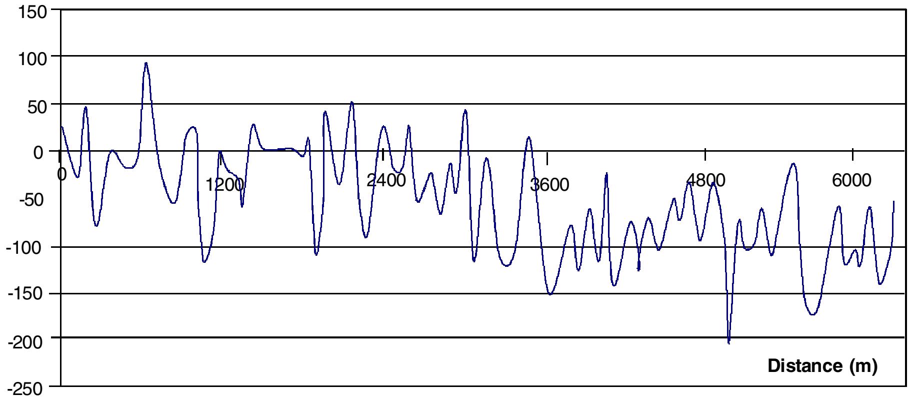

Figure-4.1b : Total Relat Mag Intensity along Traverse 8 (SW - NE) of Ijeda - Iloko area

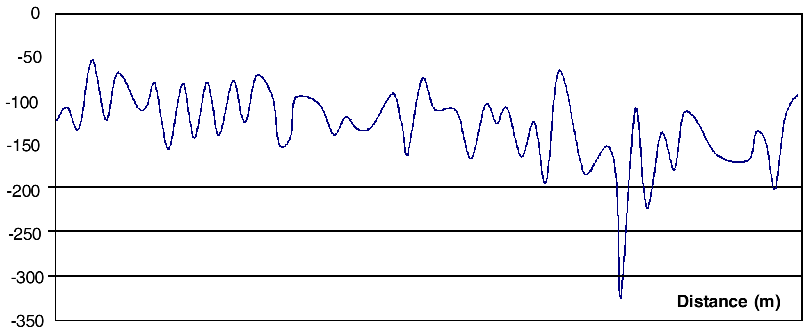

Figure-4.1c : Total Relat Mag Intensity along Traverse 9 (SE - NW) of Ijeda - Iloko area

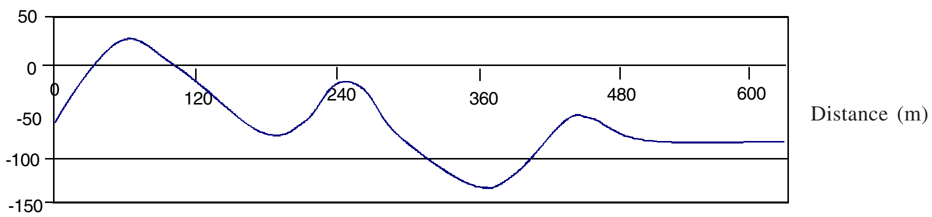

Figure-4.1d : Total Relat Mag Intensity along Traverse 13 (S - N) of Ijeda - Iloko area quartz schist. The intrusive suite consists essentially of Pan African (c.600 Ma.) Granitic units. The minor rocks include garnet-quartz-chlorite bodies, biotite-garnet rock, syenitic bodies, and dolerites (Kayode, 2006, Folami, 1992, Rahaman, 1976).

2.0 Ground Magnetic Studies

Qualitative interpretation relies on the spatial patterns, which can be recognized by the geophysicists or geologists. The total ground magnetic anomalies are highly variable in shape and amplitude. However, faults, lineaments, dykes, and folds are usually easily identified than features given by some number of sources, which can produce an anomaly that may result in complexities in the interpretations (Folami, 1992; Rose, 2002, Regnieri et al., 2002, Cui et al., 2003, Green, 2004).

A plot of the field data corrected for diurnal variations relative to the base station against distance along each profile as shown in Figures-4.1 (a - d) was carried out. The plots show a magnetic anomaly signature, which varies over the different rock types. The differences in the magnetic properties present in each rock unit results inthe contrast between the magnetic anomalies signatures. However, rock contacts, intrusions and the effect of fissures also contribute to the magnetic anomaly (Kayode, 2006, Folami and Ojo, 1991).

2.1 Depth to Basement Calculations

The depth estimation of the basement in the area and identification of the rock boundaries was carried out using half slope method (Kayode, 2006, Folami, 1992). Table-1 shows the depth estimate from the ground magnetic data collected along the four traverses which form the area of interest in the report. The location of inflection points which is an indicative of rock contacts couple with the pre-knowledge of the geology of the study area during the fieldwork, enables the geomagnetic sections of the area to be drawn Figures-4.2(a-d).

Table-4.3 : Total Relative Magnetic Intensity

Profile	Quartzite	Amphibolites	Muscovite	Undifferentiated	Overburden
7	121m	194m	-	-	194m
8	100m	100m	75m	-	100m
9	165m	150m	-	60m	150m
13	-	75m	-	-	75m

2.2 GROUND MAGNETIC INTERPRETATIONS

2.2.1 Traverse 7 (NE - SW)

The magnetic signature obtained for the Total relative magnetic intensity plot along this traverse shows a considerable varying amplitude from a minimum negative peak value of about -260 gammas at a distance of about 2500m from the initial station position and a maximum peak value of about -50 gammas at a distance of about 1740m sec Figure-4.la.

Two rock units were delineated from the corresponding geomagnetic section shown in Figure-4.2a. These are:

(a) The Amphibolites complex : Amphibolites schist covers most part of this traverse from the initial station position and extended to about 2500m. The depth to the magnetic basement within this rock unit varies from about 90m to about 170m.

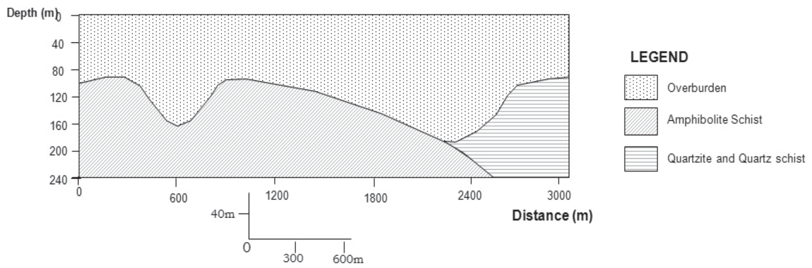

Figure-4.2a : Corresponding geomagnetic Section along Traverse 7 (NE - SW) of Ijeda - Iloko Area

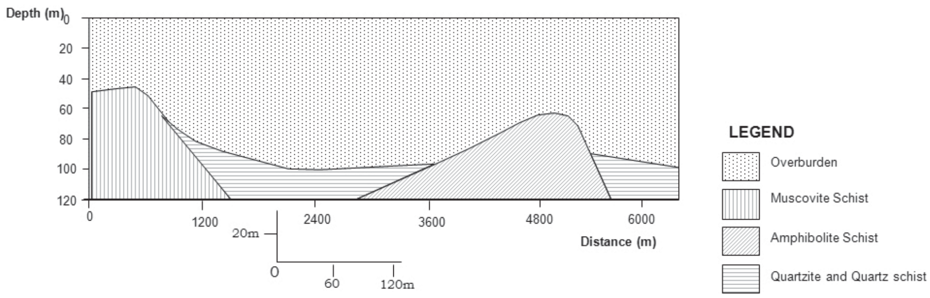

Figure-4.2b : Corresponding geomagnetic Section along Traverse 8 (SW - NE) of Ijeda - Iloko Area

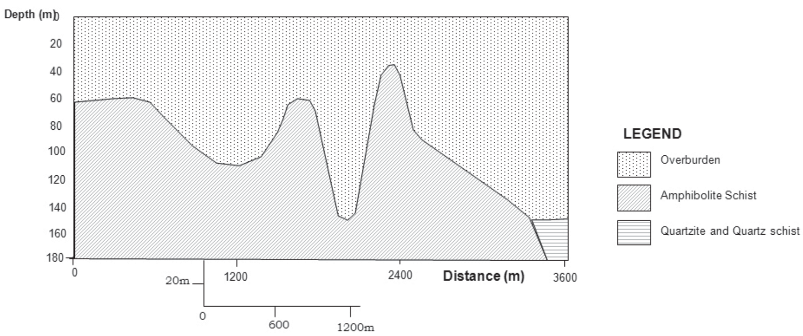

Figure-4.2c : Corresponding geomagnetic Section along Traverse 9 (SE - NW) of Ijeda - Iloko Area

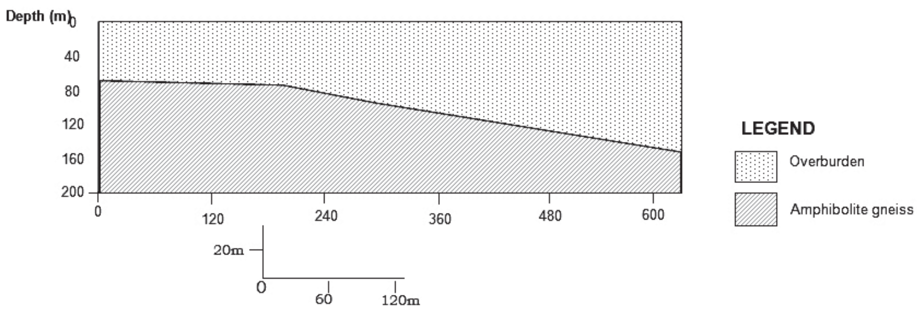

Figure-4.2d : Corresponding geomagnetic Section along Traverse 13 (S - N)

(b) Quartz schist and Quartzite : This rock unit was delineated from about 2500m towards the end of the profile with depth to the magnetic basement fairly at about 40m.

2.2.2 Traverse 8 (SW - NE)

The profile along traverse 8 shows a considerable varying amplitude from a minimum negative peak value of about -220 gammas at a distance of about 5000m from the initial station position and a maximum positive peak value of about 80 gammas at a distance of about 600m as shown in Fig.-4.1b. Three rock units were delineated from the corresponding geomagnetic section as shown in Fig.4.2b. They are.

(a) Muscovite schist : Muscovite schist forms the first rock unit starting from Iloko junction and extended to about 1300m towards Orisunmbare quarters. Depth to the magnetic basement within this rock unit is about 50m.

(b) Quartz schist and Quartzite : Quartz schist forms the second rock unit, which was delineated at about 1300m from initial station position which extended to about 2800m at the first segment and also towards the end of the profile at about 5400m from the starting point. Depth to the magnetic basement within this rock type varies between about 70m to 90m at the first segment and about 80m in the last segment.

(c) Amphibolites schist : Amphibolites schist covers between about 2800m to about 5400m from the starting point. The depth io the magnetic basement varies from about 50m to about 100m.

2.2.3 Traverse 9 (SE - NW)

The magnetic signature obtained for the total relative magnetic intensity plot along this traverse shows complete varying negative amplitude from a minimum peak value of about -330 gammas at a distance of about 5000m from the initial station position and a maximum peak value of about 80 gammas recorded at a distance of about 2800m Figure-4.1c.Two rock units were delineated from the corresponding geomagnetic section as shown in Figure-4.2c. These are.

(a) Amphibolites schist : The Amphibolites complex covers almost 95% of the profile from the starting position to about 3000m. The depth to the magnetic basement varies between about 45m and about 140m at about 2000m from the initial station position.

(b) Quartzite and Quartz schist : The end part of the profile is cover by this type of rock unit with depth to the magnetic basement estimated to be about 140m

2.2.4 Traverse 13 (N - S)

The magnetic signature obtained for the total relative magnetic intensity plot along traverse 13 exhibit mostly negative amplitudes with the exception of point 2 about 60m from the initial station position. The depth of probing for this method differs from the other two methods. The traverse was characterized by complete varying negative amplitudes from a very low minimum peak value of about -140 gammas at a distance of about 360m from the initial station position and a maximum positive peak value of about 30 gammas at a distance of about 60m (Fig.-4. Id) were recorded.

The amphibolites schist was delineated from the corresponding geomagnetic section as shown in Fig. 4.2d with depth to the magnetic basement that varies from about 80m to about 140m.

3.8 Linear Trend Analysis

Linear trend analysis for the total component of the ground magnetic study of this area was obtained using typical Equations from Microsoft Excel package for the interpretations of the four traverses of interest (i.e. traverse 7, 8, 9 arid 13). These Equations are :

$$y = -1.0917x - 106.47 \quad (1)$$

$$y = -1.0408x + 1.4468 \quad (2)$$

$$y = -1.2137x - 98.049 \quad (3)$$

$$y = -8.0156x - 6.998 \quad (4)$$

$$\Delta r \text{ (residua])} = \Delta T \text{ (corrected field data)} - \Delta R \text{ (regional)} \quad (5)$$

Equations 1 to 4 were used to obtain the regional magnetic, ΔR values of this area along each of the traverses where x is the station position. The residual magnetic, Δr values were obtained using Equation (5) by subtracting the regional magnetic, ΔR values from the corrected field data values, ΔT. The results obtained were used to construct the residual ground magnetic map of the area.

4.0 The Residual Ground Magetic Map for Total Component

The residual ground magnetic map of the study area using linear trend analysis for total magnetic components is as shown in Figure 5. The area was divided into two regions; Positive magnetic anomaly region with highest value of about ($\Delta T \leq 0 \leq 300nT$) was recorded in the northwestern part of the study area. The negative anomaly region with the lowest value of

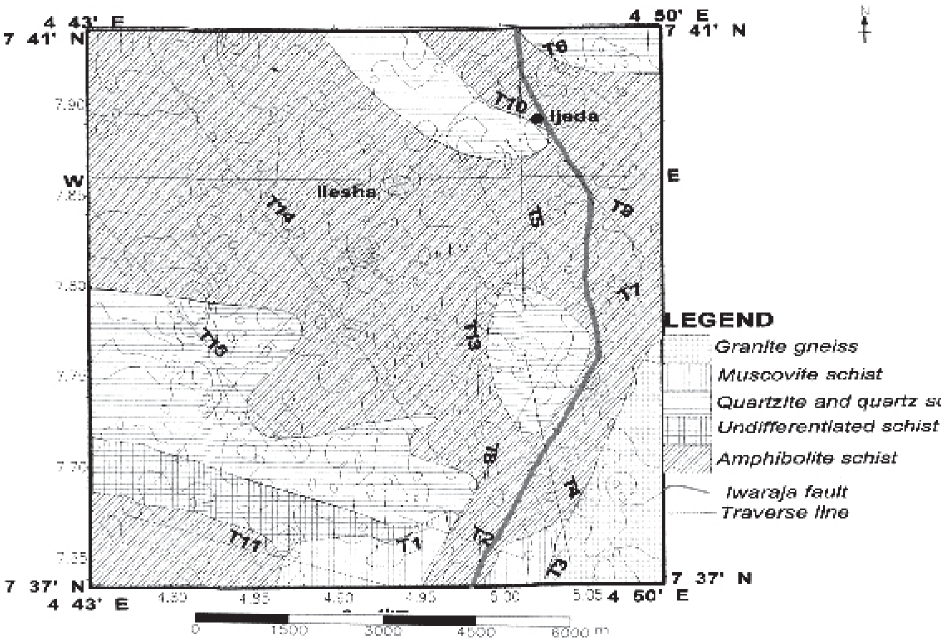

Figure-5 : Residual magnetic map of the study area using Linear Trend for Total component

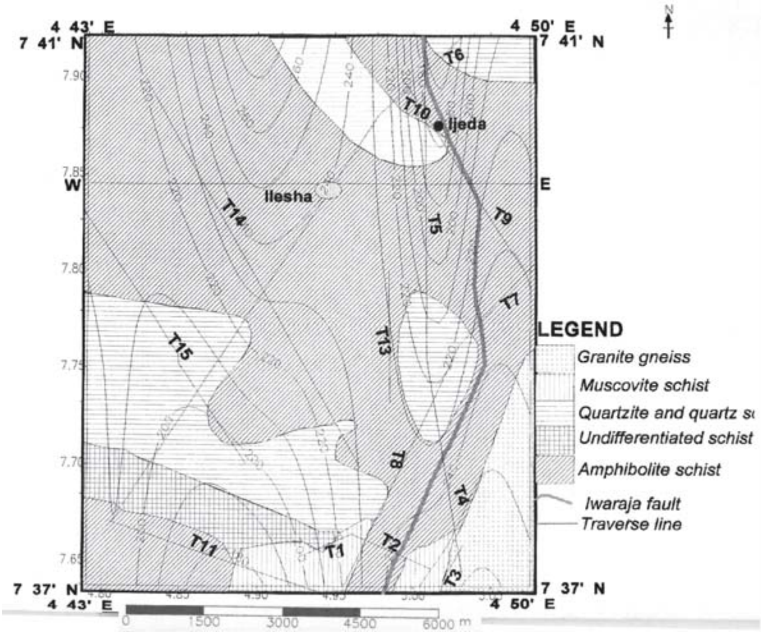

Figure-6 : Bedrock Relief map of the study area.

about ($\Delta T \geq 0 \geq -250$ nT) was recorded around the western, northeastern and central parts of this area. The map further reveals the major and minor rock contacts in the area. The highest magnetic value of about 130nT recorded in the northwestern part further confirms the earlier submissions (Kayode, 2006). This is an indicative of shallow subsurface geologic structure. The northeastern part through the eastern area towards the southern part of the area supports the previous reports on the existence of geological structures such as faults.

5.0 Conclusion

Using high resolution proton precision geometric magnetometer, the ground magnetic study of this area has helped in many ways to delineate the geologic structures. First, the geomagnetic sections of the study area helped in delineation of the different rock contacts and geological boundaries that are very useful in mapping the basement structures of the area. Secondly, the major subsurface structures that were delineated include Amphibolites, Quartz and Quartz Schist. Lastly, the main assumption here is the depths to the magnetic basement in each rock unit that were obtained using half slope method, with overburden thickness values that varies between about 40m to about 200m (Figure-6). These values may have been exaggerated because of the depth estimated method used (half slope). Tlic linear nature of the anomalies in this part of the schist belt suggests that the rocks may be bounded and offset by faults. The results further confirmed the area as high mineralized zone with the delineation of faults in this part of the schist belt. Therefore, the studies further support previous submissions on the lithologie units in this part of basement structures of southwestern Nigeria.

6.0 Acknowledgement

I wish to appreciate the efforts of Dr. Adelusi, A.O., Mr. Adiat, K.A. and Mr. Bawallah, M. for their assistance during the data collection and interpretations.

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