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UPWARD CONTINUATION PORTRAYAL OF FEATURES IN THE SCHIST BELT OF NIGERIA USING GEOSOFT OASIS MONTAJ

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ABSTRACT

Updward continuation analysis of magnetic data of the Schist belt of North-Central Nigeria was carried out with a view to see the deep seated structures with respect to higher altitude. The MAGMAP filtering utilities in Geosoft Oasis Montaj Software was then applied to the magnetic grids to enhance the data for easy interpretation. The MAGMAP filter used in processing the magnetic data is the upward continuation filter. From the continuation map, it is seen that the study area is highly faulted with a lot of cross cutting features (including magnetic dykes) most of which trend in the NE-SW direction. A major fault F1-F1 that transcends across Odogbe and even beyond the study area in the NE-SW direction has been well delineated in the upward map.

Keywords – Upward Continuation filter, Magnetic Data, Schist Belt, Features, MAGMAP, Geosoft Oasis Montaj

INTRODUCTION

The study area falls within the basement complex of Nigeria also known as the Schist belt. The Nigerian Schist belts consist dominantly of Schists, phylites and quarzites with minor volcanic rocks, banded iron formations and conglomerates. It occurs in 300 to 400 km wide zone and predominantly west of longitude 8◦ E, which trends NNE, parallel to the boundary between the Pan-African province and the West African Craton (Turner, 1983, Fitches *et al.*, 1985, Adekoya, 1986). The Nigerian Schist belts are thought to have been deposited in back-arc basins which developed after the onset of subduction at the West African cratonic margin at about 1000 Ma. Closure of the ocean at the cratonic margin at about 600 Ma led to deformation, metamorphism and emplacement of the Older Granites in Nigeria. Uplift, acid volcanism and development of faults and shear zones were the last manifestations of the Pan-African event. There is, however, increasing evidence to show that the Pan-African collision involved more of an aggregation of crustal blocks rather than between the West African craton and the Pan-African belt as a single entity. Two well-defined NE–SW (and NNE–SSW) trending fault systems (the Anka and Kalangai-Ifewara faults) cut and displace earlier N–S structures in the Nigerian Pan-African basement. The scale of movement and displacement and the occurrences of felsic–mafic–ultramafic rocks along these faults suggest that they might be crustal sutures of the Pan-African collision. The purpose of magnetic surveying is to investigate the subsurface based on the variation in the observed magnetic field result from the differences in the magnetic properties of the underlying rocks, or in some cases cultural sources (Olowofela *et al.*, 2012). However, the study carried out by Nwankwo *et al.* (2008) on Sedimentary Formation of Northern Nupe basin found depth to magnetic basement to vary from 0.52-4.38 km while depth range of 0.24-1.74 km was attributed to shallow sources. Also, Onuba *et al.* (2011) evaluated aeromagnetic anomalies over okigwe Area, South-eastern Nigeria using Half-slope method to obtain the average depth of the deeper magnetic sources ranging from 2.0-4.99 km while the shallow magnetic sources ranges from 0.4-1.99 km. This work helps to make known the deep seated features in this region as further researches can be made to link these features with shallow seated features.

MATERAL AND METHODS

Study area

The study area is located within the Schist belt of the basement complex of North Central Nigeria specifically $8^{0}00'00''$N to $8^{0}30'00''$N and $5^{0}30'00''$E to $6^{0}00'00''$E (Isanlu Sheet 225).

The Schist Belts comprise low grade, meta-sediment-dominated belts trending N–S which are best developed in the western half of Nigeria as shown in Figure 1. The structural relationships between the Schist belts and the basement were considered by Truswell and Cope (1963) to be conformable metamorphic fronts and it was Ajibade *et al.* (1979) who first mapped a structural break.

The Schist belts have been mapped and studied in detail in the following localities: Maru, Anka, Zuru, Kazaure, Kusheriki, Zungeru, Kushaka, EGBE-ISANLU, Isheyin Oyan, Iwo and Ilesha where they are known to be generally associated with gold mineralisation.

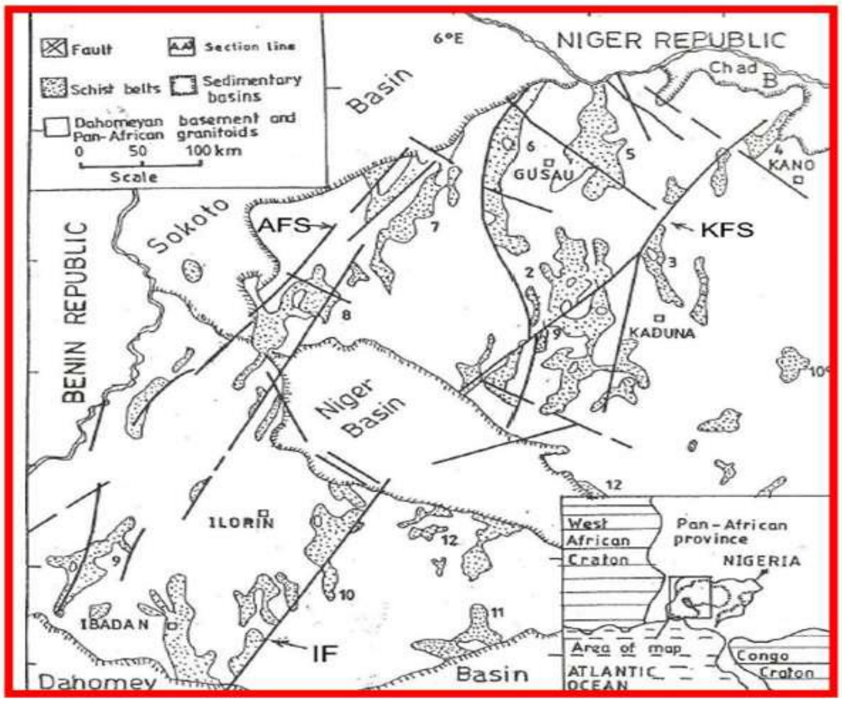

Figure 1: Simplified geological map of the Northern and Southern part of Western half of Nigeria, showing the distribution of the Schist belts and the location of major lineaments (modified after GSN, 1994). The Schist belts are: 1. Zungeru-Birnin Gwari, 2. Kushaka, 3. Malumfashi, 4. Kazaure, 5. Wonaka, 6. Maru, 7. Anka, 8. Zuru, 9.Iseyin-Oyan River, 10.Ife-Ileshe, 11.Igarra-Kabba-Lokoja, 12. Toto, AYI = Anka-Yauri-Iseyin fault system, KZI = Kalangai-Zungeru-Ifewara fault system

Nigerian Geological Survey Agency provided the magnetic data used for this study. Magnetic gradient was the measured parameter. The geomagnetic gradient was removed using International Geomagnetic Reference Field (IGRF). The magnetic data were sampled at a rate of 0.1 sec using the Scintrex Cesium SC-2 (proton precession magnetometer). Geophysical processing consisted of gridding magnetic airborne survey data using a variety of software. The major software used to process and enhance the data is the Geosoft (Oasis Montaj). By a mathematical process involving surface integration, it is possible to calculate the distribution that a given potential field would have if it were measured at a higher level (upward continuation). The effect of the upward continuation is that short wavelength features are smoothed out because one is moving away from the anomaly.

Upward continuation is a way of enhancing large scale (usually deep) features in the survey area. Also upward continuation tends to accentuate anomalies caused by deep sources at the expense of anomalies caused by shallow sources (Mekonnen, 2004). Upward continuation minimizes the effects of short wavelength (higher wavenumber) components associated with more local, shallow anomaly sources, thus, it can be used as an effective smoothing technique for the separation of anomalies due to deeper sources (Sharma, 1976). The Geosoft Oasis Montaj version 6.4.2 was used to carry out the upward continuation of the magnetic data of Isanlu sheet 225.

RESULT

From the upward continuation filter at 500m we were able to get the map below (Figure 2). From this map we could see different features (F1-F8). The red coloured portions indicate high magnetic susceptibility while the blue coloured portions indicate low magnetic susceptibility. The features (F6, F7 and F8) exhibited high magnetic susceptibility. The F1 and F2 transcend several kilometers.

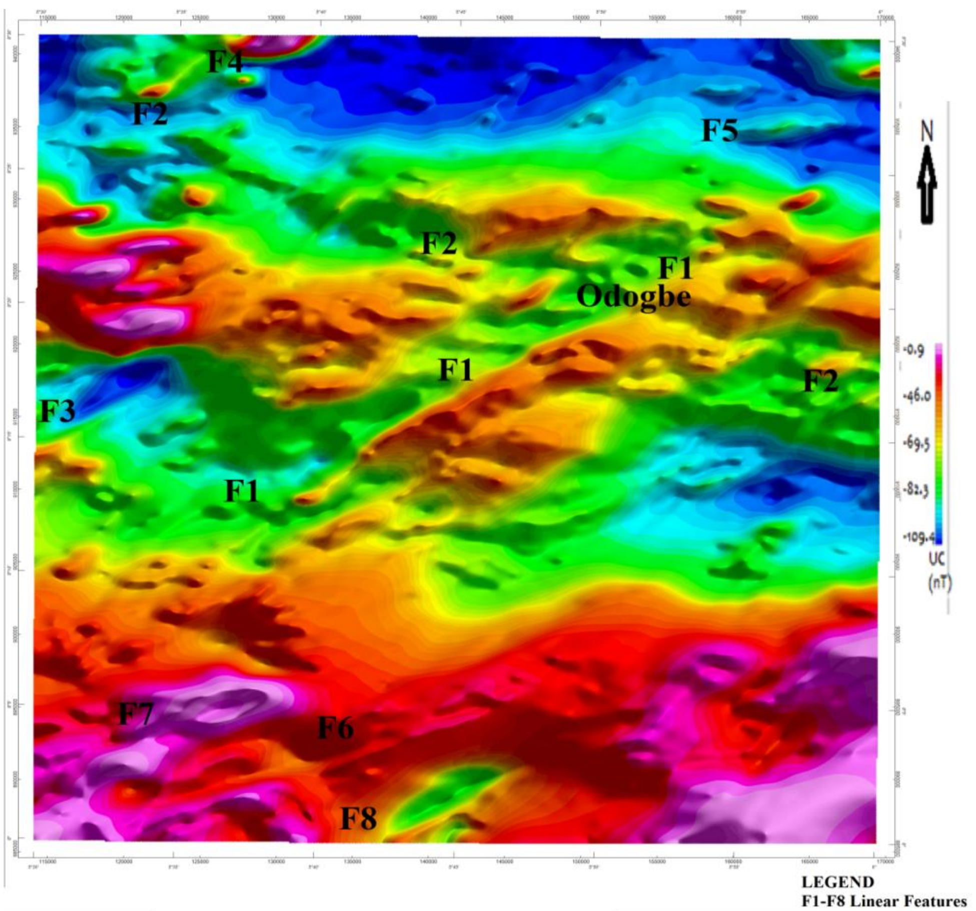

Figure 2: Map of upward continuation at 500m on the RTP of Isanlu sheet 225

DISCUSSION

Structures are interpreted from the aero-magnetic data where they terminate as a series break in smooth magnetic signature and they serve as marker units within the stratigraphy (Murphy, 2007). The upward continuation filter smoothens out high frequency anomalies that originated from shallow sources and enhances anomalies that originate from deeper structures (Oxford University Press, 1999). Ohioma *et al.*, (2017) carried out a reduction to pole of the total magnetic intensity of this study area. It was noticed that the degrees of magnetization were similar with that of the upward continuation in Figure 2 with red colour indicating high magnetic susceptibility and blue colour indicating low magnetic susceptibility. An earlier study by Bansal *et al.* (2010) shows that the application of scaling spectral method on Bouguer anomaly of Kucth indicates variation in the depth of anomaly sources. From the upward continuation to height of 500m (Figure 2), the deep seated linear features F1-F8 are well delineated. A number of dykes with its characteristic signature of having high magnetic susceptibility (F6, F7, and F8), major faults (F1, F2) and minor faults (F3, F4 and F5) are identified. Features such as F1, F3 and F6 are seen to be trending NE-SW which are in the same direction with the strike direction of features in Figure 1.

CONCLUSION

In the study area, the structures mapped from the magnetic data are complex in nature such as faults and dykes. These structures were found mainly in the Northern and central parts, with most of them striking NE-SW. A notable feature in the study area is the magnetic dyke (linear streamlined feature having high magnetic susceptibility) that occurs at the lower part of the study area trending NE-SW. This feature may be due to volcanic activities during the period of deformation. The NE trending shear zone (F1 feature in Figure 2) is interpreted as a major fault that is formed during the regional deformation, this shear zone may have reached mantle-derived mafic magma. From this map, it is seen that the study area is highly faulted with a lot of cross cutting features most of which trend in the NE-SW direction. A major fault F1-F1 that transcends across Odogbe and even beyond the study area in the NE-SW direction has been well delineated. This conforms to the strike direction of lineaments in this area as recorded in the literature (Figure 1).

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