

Gold Exploration Using Aeromagnetic Method in Bauchi North East Nigeria

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INFORMATION

Article history

Received 07 August 2023

Revised 05 September 2023

Accepted 12 September 2023

Keywords

Aeromagnetic susceptibility

Magnetic susceptibility

Magnetic survey

Bauchi,

Rimin Zyam

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ABSTRACT

Rimin Zyam an area within Bauchi was investigated for possible mineralization of gold and other important metallic minerals. The host rocks are low to medium grade migmatites that were formed during the Pan- African orogeny with composition ranging between intermediate to mafic which corresponds to gabbroic to dioritic compositions. The mineralization is as a result of intruding by late mineralizing fluid into the Pan-African migmatites in the area. The type of mineralization in the area are mainly vein filing and replacement deposits. Based on the aeromagnetic images of the area, different magnetic susceptibility contrast was identified between the migmatites, younger granites and other sedimentary cover in the area. The migmatites have higher magnetic susceptibility and high intensity of interconnected fractures that are trending NW-SE, NE-SW and minor E-W that are interconnected. These fractures are regional and may serve as conduits for hydrothermal mineralization. Because of the sharp contrast, ground magnetics was recommended especially within the migmatites in order to airmark areas for possible drilling. The aeromagnetic images show large anomalies to the east of the study area which is an indication of magnetic responses for gold ore mineralization. These points that have high anomalies are suitable points for drilling.

1. Introduction

Aeromagnetic survey is an important geophysical technique that reveal the subsurface geology and structure of an area. It is a technique that is used in mineral prospecting, geological mapping of structures and lineaments as well as the tectonic setting. Metamorphic and igneous rocks have higher magnetic susceptibilities than sedimentary rocks. (Essam et al., 2003). Gold ore have no specific magnetic anomaly, their susceptibilities can be low or high depending on the host rocks (Dentith, 1994).

It is important to understand the difference in magnetic anomaly between gold ore body that is within a strongly magnetized rock and the one that is within a low or non-magnetic rocks. This will be significant in targeting drillholes. Geophysical studies are important tool that minimize cost of exploration by characterizing or separating different mineralization from its surrounding country or host rocks (McMickan et al., 1993). Regional aeromagnetic image from

Nigerian Geological survey Agency (NGSA) was used as a guide to delineate areas with magnetic responses.

2. Geology of Study Area

The area is about 30km away from Bauchi metropolis to the west (Fig. 1). The area is underlying by Precambrian basement rocks of migmatite Gneiss complex (MGC) that are 2.8-2.7 Ga in age, which composed of migmatites, orthogneiss and para-gneisses and some ultra-basic rocks. They show upper to medium amphibolite facie metamorphic facie (Rahman, 1988).

The MGC's were intruded by low grade schist during the Kibaran orogeny, they range between quartz schist, mica schist, quartzites and concordant amphibolites (Obiora, 2005). They are generally trending NE-SW with some trending N-S, they are responsible for most gold mineralization in Nigeria, with quartz veins serving as carries of the gold in most places (Annor, 1995). The schist belts



were intruded by Pan-African granitoids during the Pan-African orogeny (600Ma±150), they range between migmatites, older granites and gneisses (Rahman, 1988) (Fig. 1).

3. Magnetic Survey

Aeromagnetic survey was done by Nigerian Geological Survey Agency (NGSA), using a 3x scintrex CS3 Casium Vapour magnetometer with 80meter sensor and a flight line spacing of 500 m interval. The tie line spacing is 5000 m with NW- SE and NE-SW flight line trend and tie line trend

respectively. Data correction was done by Fugro Airbone Services as part of pre-processing treatment. The pre-processed data for the study area was acquired from the NGSA as residual magnetic intensity data.

Analytical magnetic and residual map of the area shows the area has different analytical signals, areas toward the north west, south western and some parts of south eastern part of the study area, have higher intensity than other areas that have moderate to low intensity, these could be as a result of presence of high magnetic minerals in the area (Fig. 2 and 3).

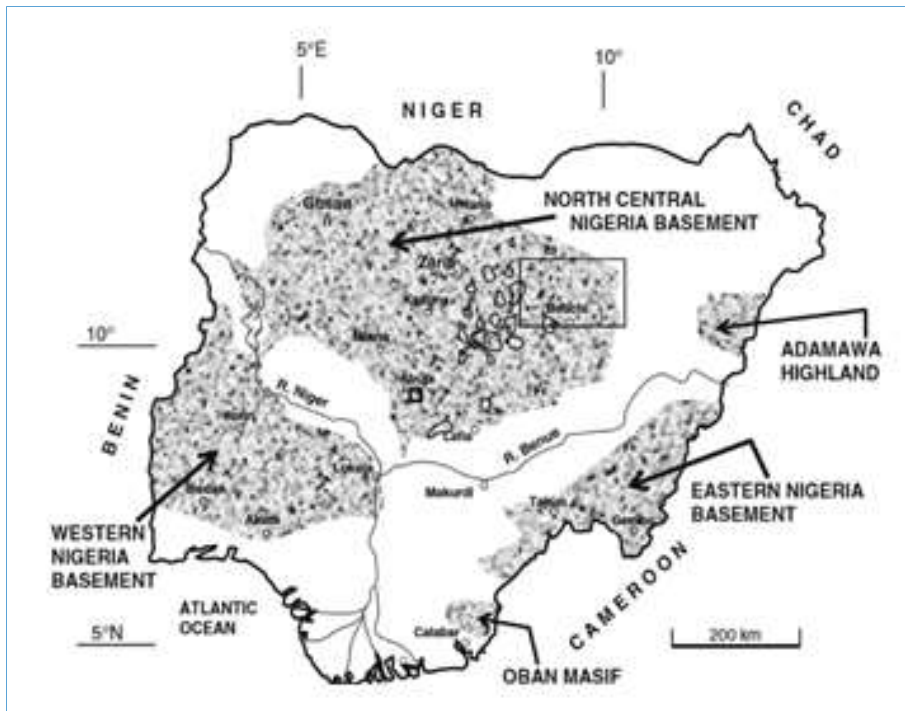


Fig. 1. Geology map of Nigeria showing the study area (Modified from Jibrin et al., 2018)

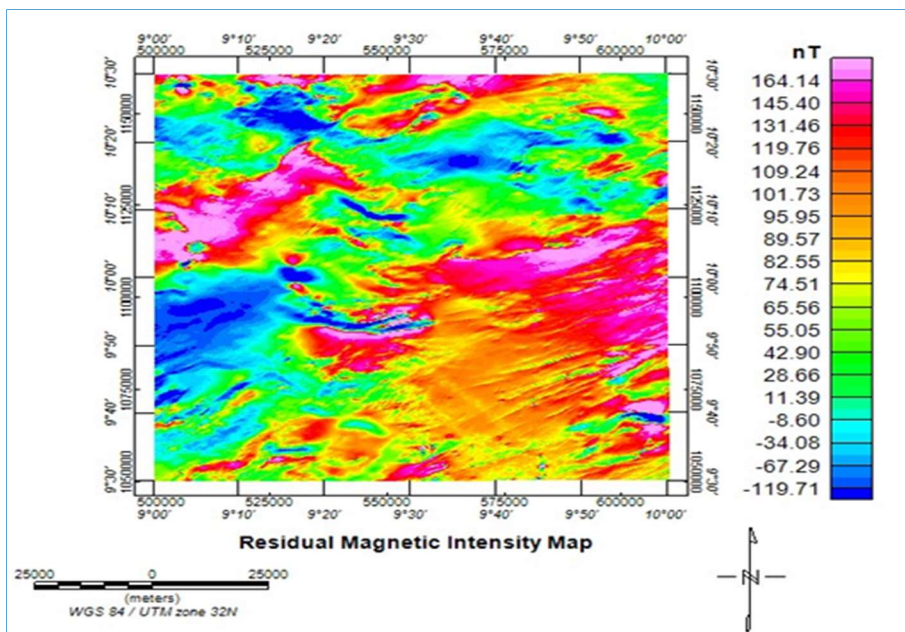


Fig. 2. Residual magnetic map of the study area

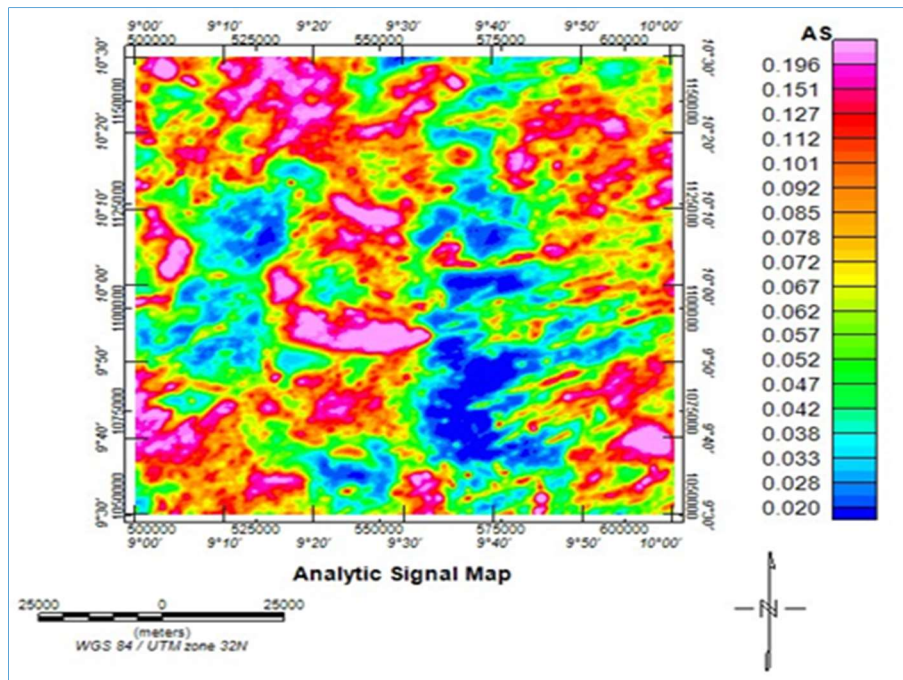


Fig. 3. Analytical map of the study area

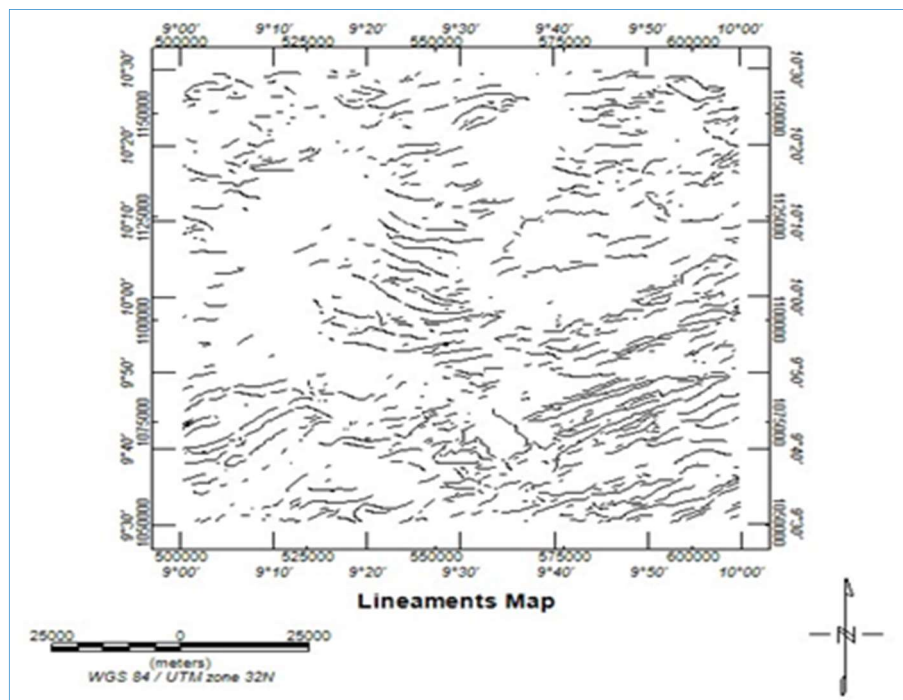


Fig. 4. Lineament extracted map of the study area

According to Alexander et al. (2015) magnetic anomaly from aeromagnetic data is an indication of magnetic mineral content of the rocks especially in basement rocks. Most of the areas with high magnetic intensity are migmatites and other areas of ring complexes of the younger granites, all these areas are basement rocks. Areas with low magnetic intensities are areas with sediment cover. Areas with high magnetic anomalies are mineralized zones, with possible gold and copper mineralization (ElGalladi et al., 2022). From lineaments extracted, regional structures are NNW-

SSE and NNE-SSW are the major trend and minor E-W lineaments may serve as controls for the mineralization (Fig. 4). Most of the positive anomalies are related to mineralization that are close to the surface or other rock units that have high magnetic susceptibility like granite intrusions or other volcanic rocks. Although these are good indicators, it is highly recommended that ground magnetics should be done in the area in order to confirm the aeromagnetic data and also geochemical mapping should be incorporated before drilling.

5. Conclusion

Aeromagnetic data of Rimin Zyam was assessed, areas with high and low magnetic anomalies were identified and airmark for possible drilling, NNW-SSE and NNE-SSW are the dominant structural trends. They may server as conduits for mineralization of magnetic minerals. Ground magnetics and geochemical analysis was recommended in the area in order to identify suitable points for drilling.

The magnetic images were used in delineating the mineralized zones and the different geologic zones. Some areas have high concentration of magnetic mineral while other areas have low concentration of magnetic minerals, residual map and lineament map reveal areas of shear zones that are characterized by high magnetic anomaly and extensive lineaments around the area that are trending NE-SW, E-W and NW-SE with the NE-SW fractures dominating.

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