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# STRUCTURAL ANALYSIS OF TOTAL MAGNETIC INTENSITY MAP OF PARTS OF DEGEMA, RIVERS STATE, NIGERIA, USING OASIS MONTAG GEOPHYSICAL COMPUTER SOFTWARE

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**Abstract**

The obtained aeromagnetic map by the Nigerian geological survey agency (NGSA) which covers part of Degema Rivers State were qualitatively analysed with the sole aim of identifying regions suitable for oil and gas (hydrocarbon) and mineral entrapment, highlighting lineament structures with their trend patterns and further deducing the effect of the findings as it connects to all and gas viability of the area by utilising qualitative analysis. Regional-residual separation was carried out on the aeromagnetic map, using polynomial fitting of degree two. Applying some data enhancement methods upon the residual map produces some gradient maps that show structures and aligning or trending in the NE-SW, E-W, N-S, NS-SE directions. These structures brought about features and faults that stimulated the movement and accumulation of oil and gas within the area. Qualitatively, this shows that the area has the promise for the explanation of oil and gas.

***Keywords:*** Structural Analysis, Total Magnetic Intensity, Oasis Montag, Geophysical, Computer Software

## Introduction

Magnetic survey is basically carried out to survey the subsurface geology using colour variations or magnetic anomalies found on the total magnetic intensity map (TMI). Susceptibility or magnetization difference of the rocks in the subsurface of the Earth produces the anomaly (Maritta, 2007). This survey can be carried out on the sea, land and air. Whenever the survey is carried out in the air we, call it aeromagnetic survey. During magnetic survey, a device called magnetometer is hauled on an aircraft. Areas where disclosure is sufficient, aeromagnetic survey has become an essential unit of exploration plan (Michael et al*.,* 2014). The working speed and less number of labour makes aeromagnetic survey carried out at any site extremely attractive (Abdusalam et al., 2011).

To assist in oil, gas and mineral exploration, this survey is undertaken. What the magnetic method estimates is the spacial changes in the geomagnetic field of the Earth. colour variations or anomalies in the magnetic field are as a result of disparity in the magnetic properties of the rocks or difference in the chemical property of the Rockd (Michael & Steven, 2014). Contrast in magnetization can cause an important change in the magnetic field of the rocks estimated on the locality of the estimation (Emujakporue et al., 2015). Generally, susceptibility of rocks differ from one rock type to another, it is dependent on the type of rock and the vicinity in which it is located. Magnetic anomalies can be as a result of faults, dykes and lava flows. Usually, magnetic surveys are carried out in units of nano Tesla (nT). Responsible for the contrast in magnetic values are the induced and remnant magnetism (Maritta, 2007).

In West Africa and the world at large, the area of study and its environs is classified among the vital productive oil and gas areas. Sands that are not consolidated and sandstones which is mainly within the Formation of Agbada are known to be the birthplace of oil and gas in the Niger Delta (Aizebeokhai & Olayinka, 2011). In the world, Niger Delta basin is known for its oil and gas promise. Consequently, ample investigations have been completed and still presently going on with different goals. Oladele and Ojo, (2013) pronounced that numerous research work in Niger Delta have been directed on seismic survey of tertiary deltaic oil and gas bearing sequence with minute observation paid to the basement structures.

It has been known that understanding the framework of the basement brings to bear important control on the system of petroleum and structural deposition of the sedimentary section overlying. Like the Niger Delta basin that is a thick sedimentary topography, in imaging the basement under the sedimentary segment, regional aeromagnetic field data sets can be used, especially if sources of magnetization within the sedimentary segments are more feeble than the rocks found in the basement, as this will possess sway or control on the hydrocarbon bearing promise of the basin since migration and accumulation of hydrocarbon and mineral enhancement structures will be unearthed (Okiwelu et al., 2014). Significant elements like correlation between deeply seated basement architectural framework, regional structural behaviour and hydrocarbon quarry have been absent in the Delta (Okiwelu et al., 2014). The study will add to the average understanding of the thickness of the sediments or depth to the magnetic basement within the area and will promote the likely drift and entrapment of oil, gas and mineral.

**Location and Geology of the Study Area:** By Port Harcourt, the area of study is bounded easwards and by Oloibiri it is bounded westwards. The study reclined between latitude $4^o30^I$ - $5^o0^I0^{II}$ and longitude $6^o30^IE$ - $7^o0^I0^{II}E$ with an estimated area of three thousand twenty five square kilometers ($3025km^2$) within the sedimentary basin of Niger Delta. The area is revealed to be swampy as depicted in the geologic map, (Figure 1). The geologic map also shows Sombreiro Warri Deltaic Plain, Benin Formation Creeks.

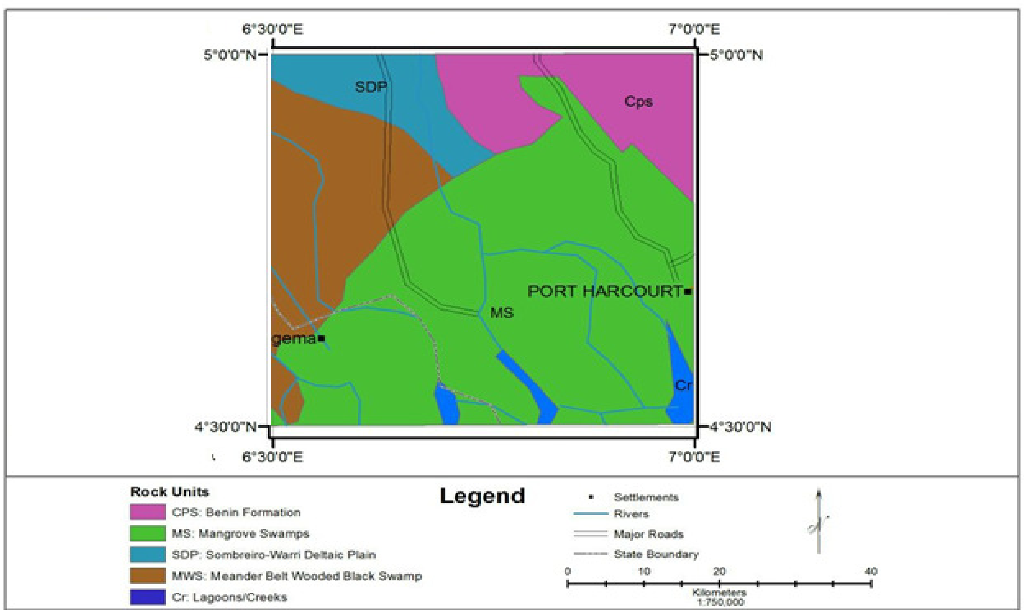


*Fig. 1. Geologic map of the study area (obtained from the Nigerian Geological Survey Agency, NGSA, Abuja)*

## Materials and Methods

The digitised total magnetic intensity map (aeromagnetic data), figure 2, extends over Degema area of Rivers State, Nigeria. The aeromagnetic map used for this research were acquired from the Nigerian Geological survey Agency (NGSA) Abuja using a scale of 1 is to 100,000 (1:100000) in half degree sheet. The airborne survey were flown at five hundred meters (500m) line spacing, eighty meters (80m) mean clearance and tie line of two kilometers (2km). For data processing, Oasis Montaj 6.4.2 software was utilized.


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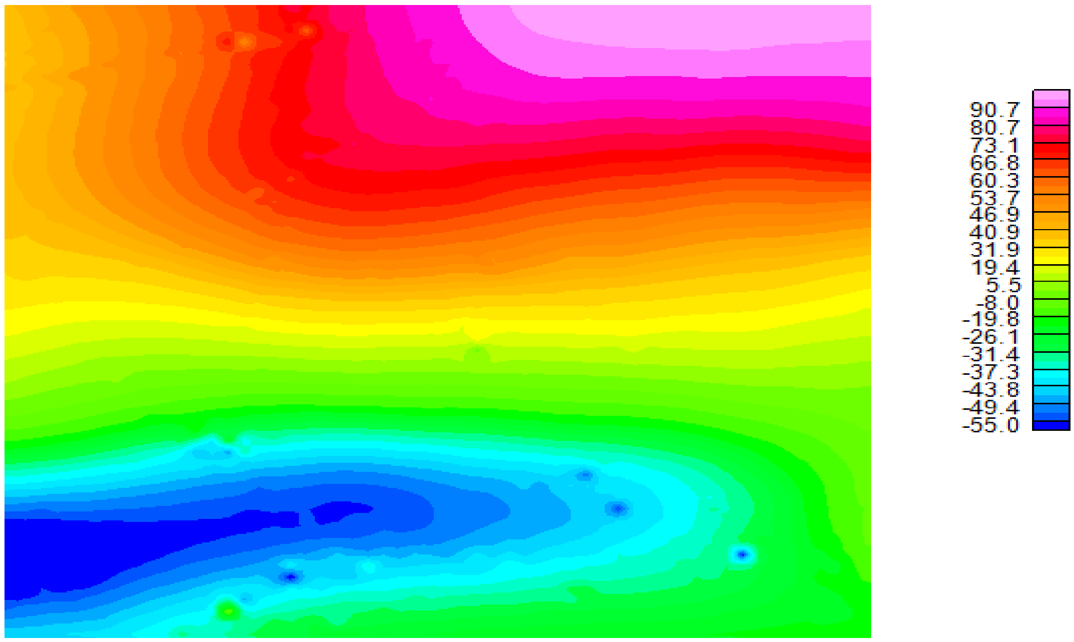


**Figure 2.** *Aeromagnetic raster map of the study area*

**Data Enhancement Techniques Undertaken for This Research Work**
Data enhancement carried out by the Nigerian Geological Survey Agency (NGSA) are geomagnetic correction and diurnal correction. The geomagnetic correction is done utilising the IGRF (INTERNATIONAL GEOMAGNETIC REFERENCE FORMULA) model for year 2010. The magnetic field's daily changes are filtered by arranging cross over points that are numerous over different positions within the survey plan. To emphasize established features of the source, enhancement and filtering techniques such as regional-residual separation were applied to the aeromagnetic map (total magnetic intensity map) using the Oasis Geosoft software.

**Regional-Residual Separation:** The aeromagnetic map acquired by the Nigerian Geological Survey Agency is an overlap of shallow seated and deeply seated anomalies (magnetic sources) hence it is necessary to carry out regional residual separation. This process was important because it separates the magnetic effects as a result of shallow and deeply seated magnetic bodies.

By removing the regional field from the total magnetic intensity map, the residual and the regional magnetic field maps were generated. This was achieved using the polynomial fitting technique with the support of the Oasis montaj software version 7.2. A clue about the terrain of the study area is given by the regional-residual separation.

**Results**
Analysing qualitatively, the results consist of the residual aeromagnetic map and the regional aeromagnetic map.

**The Regional Aeromagnetic Map**
The regional aeromagnetic map was generated due to regional-residual separation carried out on the total magnetic intensity map. Zones with long wavelengths are depicted in the regional map and with east-west (E-W) structural trends. The aeromagnetic values range between - 57.1 nanotesla to 89.0 nanotesla. Associated with the northern region of the map are magnetic values that are high (yellow, red and violet colours), while associated with the southern portion of the map are magnetic values that are low (blue and green colours).

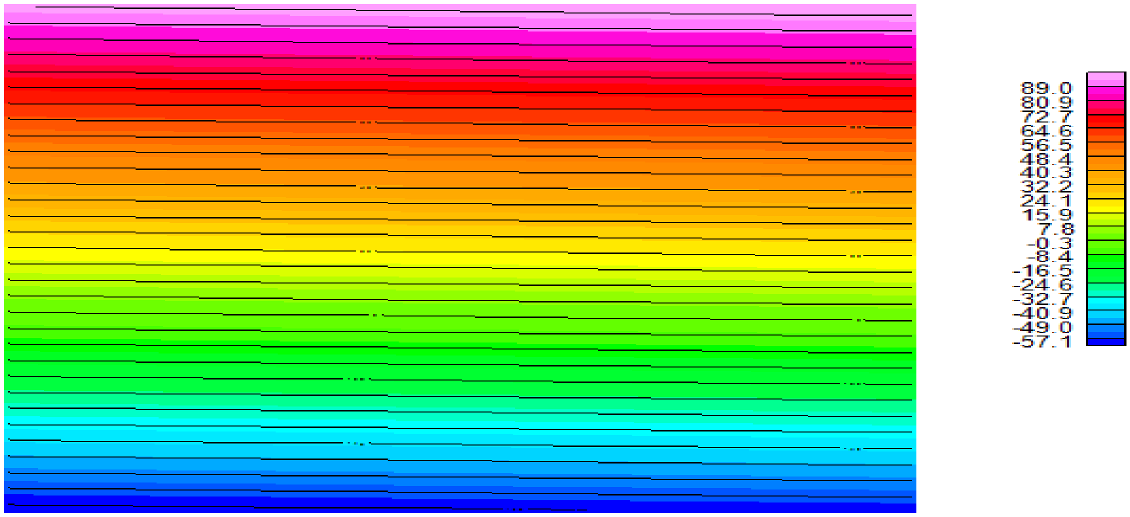


*Figure 3:* The regional aeromagnetic map

**Aeromagnetic Residual Map**

Similar to the regional map, recidual map is generated due to regional residual separation. shallow bodies are amplified or enhanced on the residual map. It highlights short wavelength magnetic bodies aligned or trending along the northeast-southwest (NE-SW) and east-west (E-W) directions at the northern and southern ends of the map. The range of the aeromagnetic values is between - 29.89 nanotesla(nT) to 21.5 nanotesla(nT).

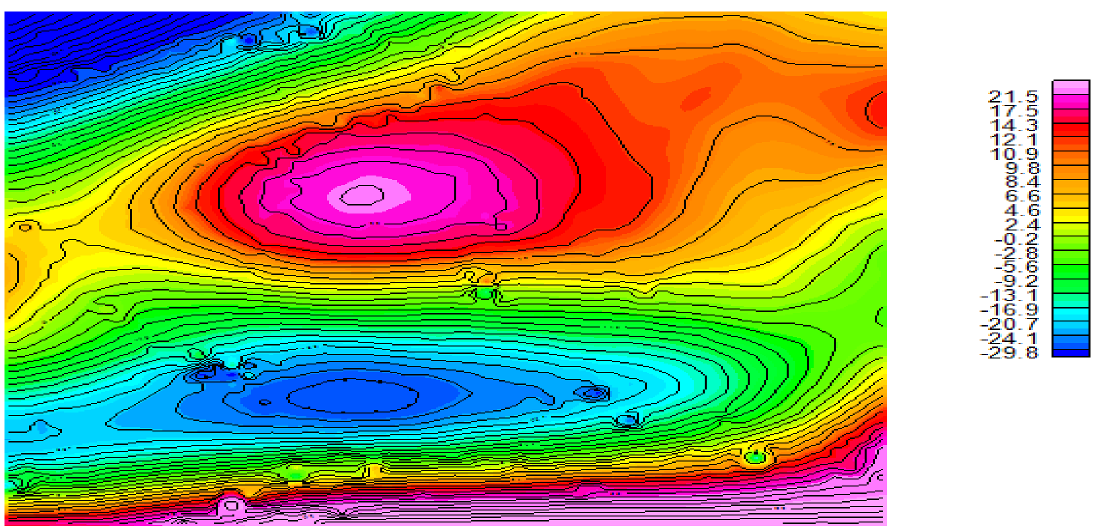


**Figure 4.** The residual aeromagnetic map (nT)

The residual map shows fields that correspond to the high pass filter as confirmed by the smoothness of the anomalies or magnetic signatures. The residual map also gives hint on the structures for possible oil and gas and emplacement. The magnetic zones can be grouped into magnetic low (yellow, red and violet colours) and magnetic high (blue and green colours). This grouping is possible due to the revealed colour variations.In figure figure 4b, magnetic highs and lows are depicted using arrows, dash and straight lines. Areas below the thick lines constitutes the magnetic low while areas below the straight thick lines are the magnetic high zones. The double and single directional arrows shows magnetic low while the double line shows magnetic zones that are weathered. model of magnetic aureole is the single directional arrow below the magnetic high area (Gunn *et al.,*1997).

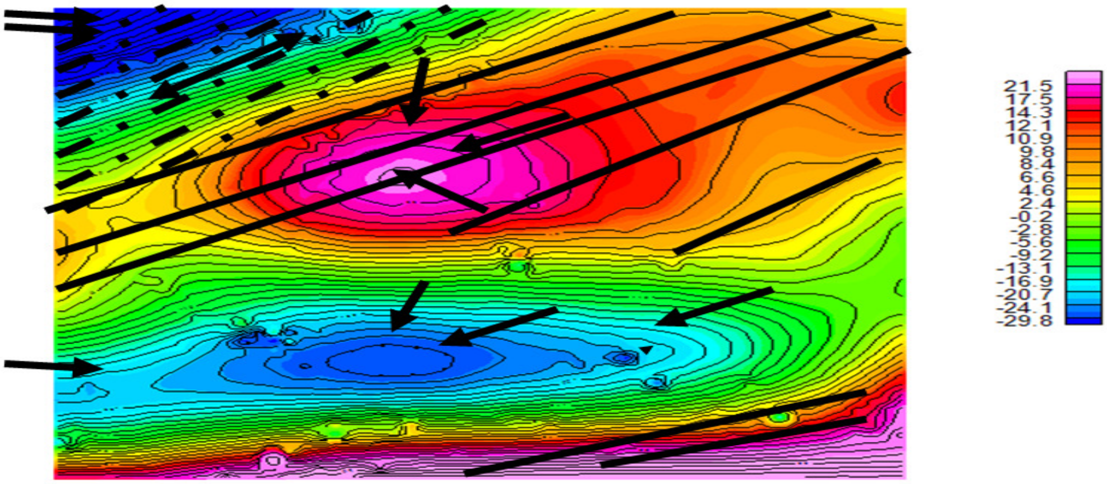


**Figure 4b.** The aeromagnetic residual map showing magnetic highs and lows

**Discussion**

Qualitatively generated into a map composed of cluster of colours called the Total Magnetic Intensity (TMI) map is the aeromagnetic data which covers parts of Degema. Colour disparity are obvious by first examining the TMI map. At different positions of the map, the colour contrast display the magnetic intensity values. The colour difference are possible as a result of magnetization difference of the surface rocks. The map is made up of the yellow colour, violet colour, green colour, light blue and the blue colour. Accompanying the TMI map is a legend revealing negative and positive magnetic intensity values. The positive values depicts areas that are responsive magnetically whereas the values that are negative depicts magnetically quiet areas.

Typical of sedimentary regions are the magnetically quiet or subdued areas (magnetic low points) of the area under study whereas the responsive areas are the areas or regions which are magnetically high as exclaimed by Onuba *et al.,* (2011). He further mention that it is either as a result of metamorphic or igneous rocks. The magnetic low regions are obvious at the southern part of the map based on the difference of intensity of magnetic responses. At the northern part of the map the magnetic highs are evident. The range of the aeromagnetic values is between -55 nanotesla to 90.7 nanotesla. Within the southern area of the map, minimum magnetic intensity values of -55 nanotesla, while dominating within the northern part of the map is maximum value of 90.7 nanotesla. Critical inspection of the magnetic low which occurs at the southern part of the map discloses the blue colour enclosed inside the light blue colour. This is due to the overlap of magnetic units whereas the light blue colour is due to magnetic units undergoing weathering action. Highlighted in the modified contour map are contours of various behaviours. The contours differ from being jointly or closely stationed, joint or close, relatively joints or closed, smooth to being parallel, linear, broadened, elliptical and irregular.

The TMI map is an overlap of regional and residual fields trending in the east-west (E-W) and north-east south-west (NE-SW) directions but with the structures aligned in the NE-SW directions dominating. Deep seated and shallow seated magnetic bodies gives rise to the regional and residual anomalous affects. Regional-residual separation becomes obligatory in order to make known the economic promise of the area under study. Carrying out the regional-residual separation using the Geosoft software generated the residual map which gives insight about the occurrence of bodies of mineral or structures of sediments by making obvious some hidden features.

Revealed on the regional map is the concealed east-west trend which is economically on importance in terms of exploring minerals, oil and gas. On the regional map, the magnetic values range from -57.1 to 89.0 nanotesla. The legend attached close to the map shows the magnetic values. Values ranging from -57.1 nanotesla to 15.9

nanotesla depict magnetic low portions (green and blue colours). These are seen around the southern part of the map.

High magnetic values are located at the central area of the map, with the yellow colour, violet and red colours. From the middle portion of the map to the northern area, high magnetic anomalies are located.

Generally, the magnetic signatures on the residual anomalous map aligns in the east-west (E-W) and north-east south-west (NE-SW) directions. After the regional-residual separation was done, seen at the northwestern portion of the map are low magnetic signatures representing sedimentary areas. To indicate these portions, dash thick lines are utilised. Within this portion are two magnetic low signatures; the area depicted with the thick double arrow points and the portion depicted with the double directional arrow. Highlighted with the thick double arrow points at the jointly or closely parked, parallel and linear magnetic signatures aligned or trending in the NE-SW. The section below the two thick directional lines are lying in the NE-SW as well and it is expected to be a viable signature housing oil and gas. Looking north eastwards and downwards are magnetic high anomalies lying within the regional thick lines. Areas possessing high magnetic values are ascribed to basement rocks that intruded into the sedimentary area. The magnetic high signatures and lying in the NE-SW direction, just below the magnetic highs are magnetic signatures which align in the east-west direction. Viewing further southwards is a magnetic signature with single and double arrow which possess a high frequency (short wavelength) and an elliptical shape as well as low relief. The elliptical nature of the shape depicts dykes that can house oil and gas. Finally, high anomalous signatures align in the east west directions as seen at the northern end of the map.

**Conclusion**

The qualitative analysis revealed structures trending in the E-W, N-S, NW-SE and NE-SW directions. This conforms to the result of other researches within the area of study in that, qualitatively, these structures aid the migration and entrapment of hydrocarbon.

**References**


Mariita, N.O, (2007). The magnetic method. Presented at Short Course II on Surface Exploration for Geothermal Resources, organized by UNU-GTP and KenGen, at Lake Naivasha, Kenya, 1-8.

Micahel, D. &Steven, M., (2014). Geophysics for the Mineral Exploration Geoscientist (1st edn). Cambridge University Press, 86-88.

Abdusalam, N. N., Mallam A., and Likkason, O.K, (2011).Evidence of some tectonic events in the Koton Kaifi area, Nigeria, from aeromagnetic studies. *Journal of Petroleum and Gas Exploration Research, 3* (1), 7-15.

Emujakporue, G &Ofoha, C., (2015). Qualitative interpretation of aeromagnetic data of parts of offshore Niger Delta, Nigeria. *Scientia Africana, 14*(1), 40-54.

Aizebeokhai, A. P. and Olayinka, I. (2011). Structural and stratigraphic mapping of Emi field, offshore Niger Delta.*J. Geol. Min. Res., 3*(2), 25-38.

Okiwelu, A.A., Obianwu, V.I., Eze,O., &Ude, I.A. (2014). Magnetic anomaly patterns, fault block tectonism and hydrocarbon related structural features in the Niger Delta basin. *Journal of applied geology and geophysics, l 2(1)*, 31-46.

Oladele, S. and Ojo, B. (2013). Basement Architecture in Part of the Niger Delta from Aeromagnetic Data and its Implication for Hydrocarbon Prospectivity. *The Pacific Journal of Science and Technology, 14*(2), 512-520.

Onuba, L. N., Anudu, G.K., Chiaghanam, O.I. and Anakwuba, E.K. (2011). Evaluation of Aeromagnetic Anomalies Over Okigwe Area, South-eastern Nigeria. *Research Journal of Environmental and Earth Sciences 3*(5): 498-507.

Gunn, P.J., Maidment, D. and Milligan, P.R (1997). Interpreting aeromagnetic data in areas of limited outcrop. *Journal of Austrian Geology and Geophysics, 17*(2), 175-185.