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Aeromagnetic Mapping of Tectonic Accidents at South of Haut-Sassandra (Côte d'Ivoire)

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Abstract: *This study is about the reinterpretation of aeromagnetic geophysical data, acquired in 1976. These data allowed the mapping of regional tectonic accidents of the Precambrian basement of the South of Haut-Sassandra (Central-West of Côte d'Ivoire). The methodology used is based on fracture extraction, based on the analysis of aeromagnetic geophysical data. The results make it possible to identify geomagnetic anomalies oriented preferentially NE-SW. The mapped major tectonic accidents intersect this direction and are oriented mainly NW-SE (N120 ° to N150 °). Like these fractures, there are dextral and senestral Geological faults. The geometric properties of the highlighted tectonic accidents according to those of the fractures of the geological map of the study area.*

Keywords*: Geophysical, aeromagnetic, fractures, dextral and senestral geological faults, Côte d'Ivoire*

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I. Introduction

Aeromagnetic geophysics has long been used for mapping geological formations and tectonic accidents that affect them. It is mainly used to discriminate structures that control ore deposition. This is the main application of magnetic method in mineral exploration. The aeromagnetic approach allows to obtain structures of the deep formations, from the measurement of magnetic susceptibility contrasts of the rocks [1]. From the magnetic susceptibility contrasts of the rocks, the aeromagnetic geophysical method, allows to identify the major tectonic accidents. In order to improve knowledge of the deep geological structures of southern Haut-Sassandra (central-West Côte d'Ivoire), we reinterpreted the aeromagnetic data from the geophysical campaign carried out in 1976. Surveys are made following North-South flight lines by Kenting Earth Sciences Ltd. These prospections are part of a program of cooperation between the Government of Canada and Côte d'Ivoire under the auspices of the Canadian International Development Agency. Haut-Sassandra is part of the Precambrian basement that covers 97.5% of the Ivorian territory. The Precambrian basement is subdivided into two domains, the Archean and Proterozoic domains separated by the North-South Sassandra fault. The study area is located east of the fault and is part of the Proterozoic domain, whose so-called birrimian formations were structured during the Eburnean orogeny (2500-1500 Ma). Magmatic and metamorphic rocks (Fig. 1) are essential of rock formations in southern Haut-Sassandra. Magmatic rocks are essentially granitoids and dioritoids. The granitoids are composed of biotite, chlorite, albite and muscovite granites, leucogranites and granodiorites. These rocks are in the form of elongated massifs in the NE-SW direction. The dioritoids consist of albite quartz diorites [2]. It is located in the middle of the shale of the Hana-lobo unit near Laminedougou. The metamorphic rocks are mainly migmatites and schists. Structurally, we observe a north-south tectonic phase which is one of the sub-vertical accidents of great amplitude. She is responsible for the Sassandra River accident and North-South oriented fractures in the region [3].

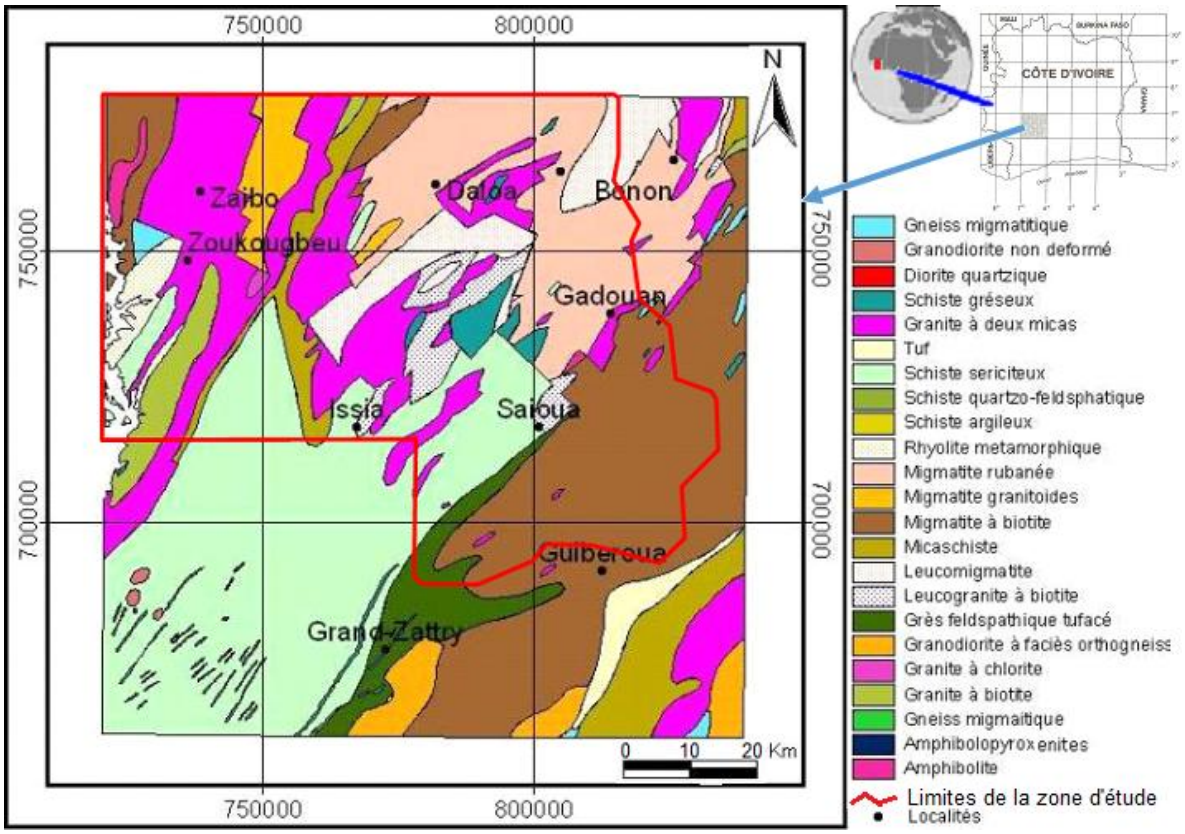

Figure 1: Geological map of the square degree of Daloa [4]

II. Material And Methods

2.1. Geomagnetic data processing

The structural mapping of the study area required the elaboration of several maps, from the total geomagnetic field. For this, several treatments are performed to better appreciate the contacts and geological structures. The different treatments are carried out using the Geosoft software.

2.1.1 Elaboration of the total geomagnetic field map

Total geomagnetic field map is made as a result of prior corrections of the Earth's magnetic field data. These are corrections of altitude, latitudes and diurnal variation. In this case, the values of the geomagnetic field depend exclusively on the heterogeneity of the underlying geological formations [5].

2.1.2 Elaboration of the map of the reduced geomagnetic field at the equator

At low magnetic latitudes (less than 45°), magnetic anomalies are asymmetrical with respect to their source. To remedy this, a transformation is applied to reduce the values of the magnetic field to the magnetic equator. This allows the magnetic anomalies to be placed at the exact position of their source. However, the polarity of the anomalies will reversed and the magnetic rock will appear as "minima" rather than "maxima" [6, 7]. The transformation is applied to the map of the total magnetic field.

2.1.3 Elaboration of the horizontal gradient map

This map highlights the geomagnetic discontinuities. It brings out geomagnetic contacts and discontinuities. The horizontal gradient of the first degree facilitates the structural reading of geomagnetic maps. The transformation is applied to the map of the reduced geomagnetic field at the equator.

2.1.4 Hanning filter

It is used to smooth the maps obtained after applying the transformations above. This filtering allows the polishing of the contours of the cards so that they are more readable.

2.2 Elaboration of the structural map

The major tectonic accidents of the study area are highlighted by analyzing the map of the magnetic field reduced to the equator and the horizontal gradient map. This is the interpretation of contours discontinuities of the geomagnetic values.

III. Results

3.1 Map of the total geomagnetic field

The map of the total geomagnetic field (Fig. 2) reflects the magnetic field values between 30980 and 31300 nT. It shows that the magnetic susceptibility of geological formations in the study area is non-homogeneous. The magnetic anomalies are elongated in the direction NE-SW (birimian orientation), as is the case of geological formations in Côte d'Ivoire. Two large sets of geomagnetic units are identified. High geomagnetic facies formations and low geomagnetic facies rocks are distinguished. There are also zones with intermediate geomagnetic relief. The latter are located at the interface of two zones with an extreme magnetic signature (magnetic and non-magnetic). They constitute zones of contact between two geomagnetic zones. In the NW-SE direction, the zones with weak magnetic field (K1 and K2) alternate, with that of the zones with high magnetic fields (M1 and M2). In areas with weak magnetic fields, magnetic pockets are observed, and vice versa.

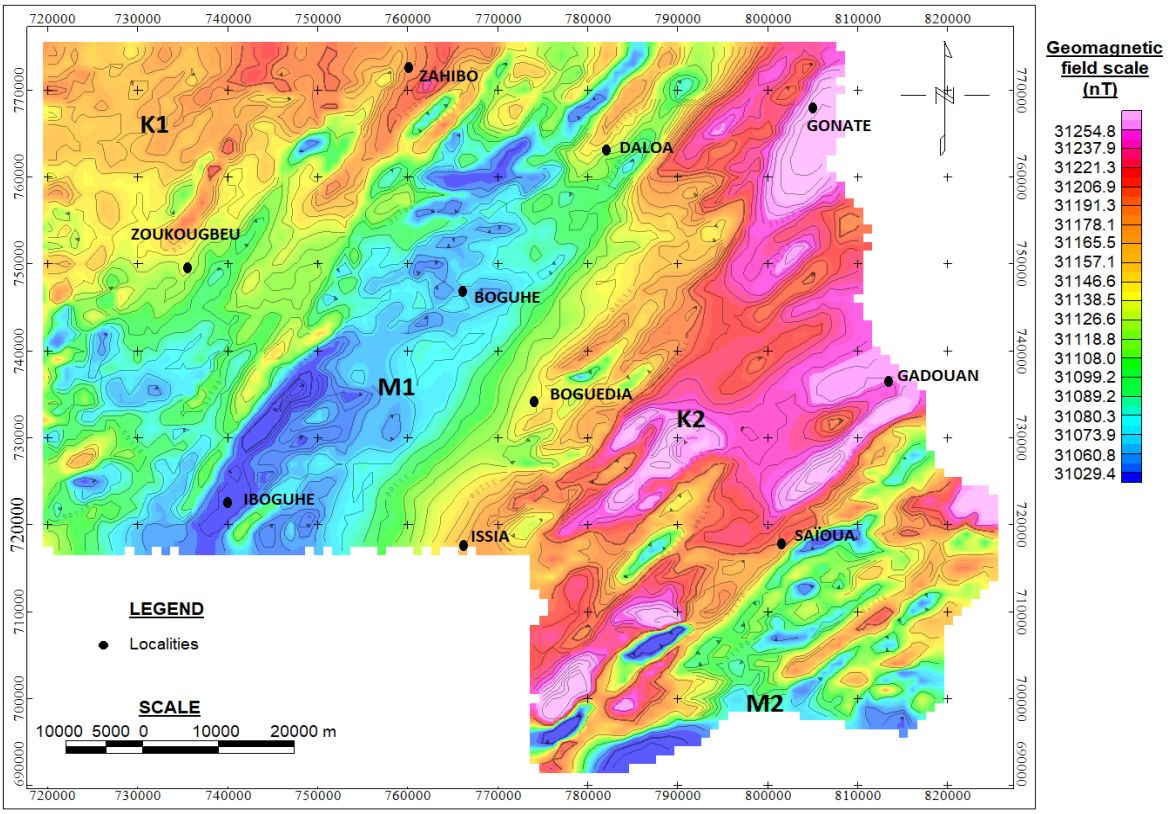

Figure 2: Total magnetic field map of the study area

3.2 Structural Analysis of Geomagnetic Signatures

3.2.1 Structural Analysis from the Reduced Field Map to the Equator

The map of the field reduced to the equator is characterized by the fact that the rocks, which are the sources of the natural magnetizations, are placed exactly in line with the magnetic anomalies observed. As in the previous case we observe elongated magnetic signatures oriented in the birrimian direction (NE-SW). The same alternation of non-magnetic and magnetic fields is also observed in the NW-SE direction (Fig. 3). This map shows contours of values of the geomagnetic field more regular. Geomagnetic field contour analysis allows the extraction of major fractures that affect the basement of the study area. These tectonic accidents are of various sizes and orientations. The longest ones reach 50 km. These fractures are predominantly oriented NW-SE.

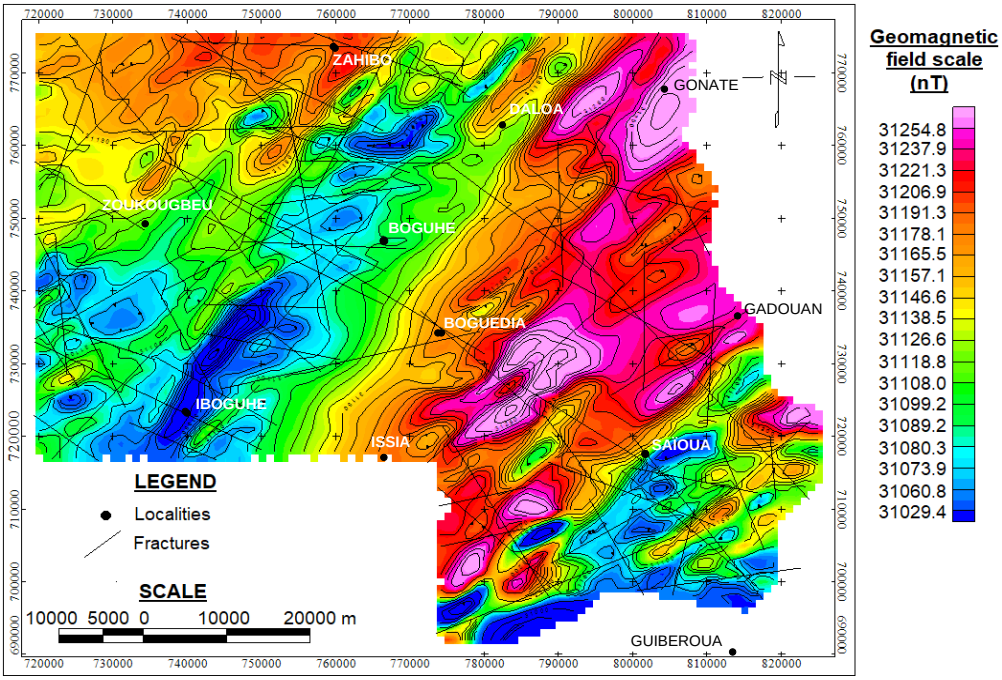

Figure 3: Fractures on the map of the geomagnetic field reduced to the equator

3.2.2 Structural Analysis from the horizontal magnetic gradient map

The map of the first-degree horizontal gradient reveals the geomagnetic characteristics of surface structures. It allows to better appreciate the nature of the tectonic phenomena that took place in the region. The geomagnetic field of the horizontal gradient in the study area ranges from -0.034 nT / m to 0.24 nT / m (Fig. 4). This small variation is due to the small amplitude of the geomagnetic field in the study area. The map of the horizontal gradient shows a various magnetic relief. It shows that the geomagnetic formations are oriented NE-SW, as is the case with the geological formations of the region. The tectonic accidents identified, from this map are predominantly oriented NW-SE. These tectonic accidents are mainly faults with dextral and senestral. Dextral faults are most common in the North, East and South-East of the study area. The senestral faults are in the South, the Central-East and the North-West. These faults (dextral or senestral) are oriented preferentially NW-SE.

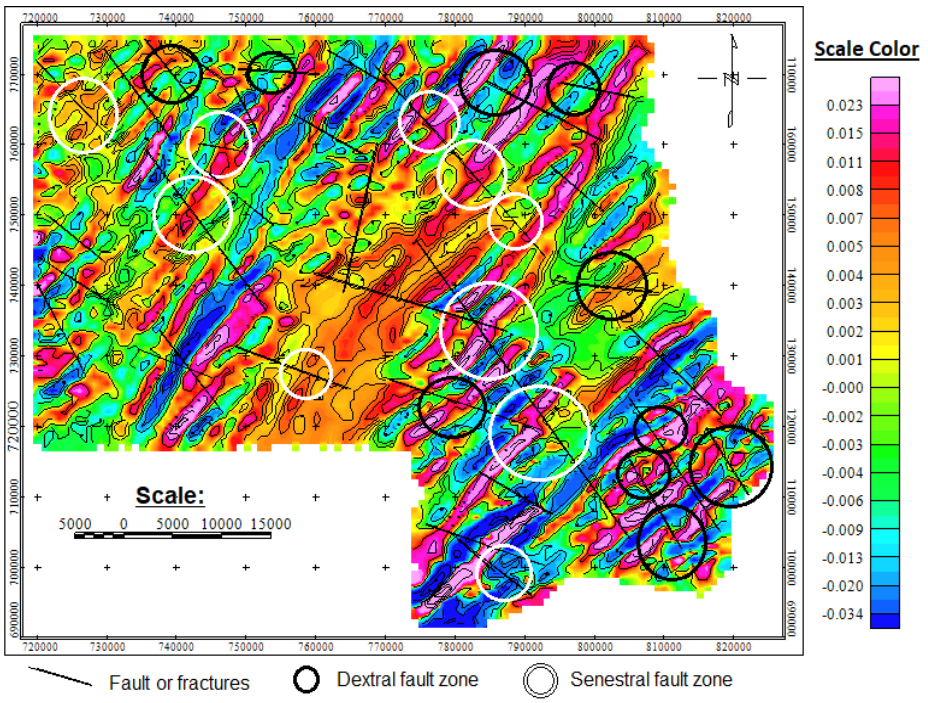

Figure 4: Fractures and faults extracted from the horizontal magnetic gradient map

3.2.3 Structural Synthesis Map

The structural synthesis map shows that the fractures are oriented predominantly NW-SE (Fig. 5). This map corresponds to the synthesis of mapped tectonic accidents. It is obtained from the map of the reduced field at the equator and the horizontal gradient. The directional study of the classes of geomagnetic fractures shows that geomagnetic fractures of directions N120° to N150° are the most important. They represent 13%. Fractures N110-120° and N150° to N170° are second, with 6-8% of the total. Regional accidents N0° to N110° and N170-180° the least represented, with less than 5% of the total.

The comparison of the fractures extracted from the geological map to the geomagnetic fractures shows that certain fractures of the geological map coincide perfectly with those identified from the geomagnetic map (Figure 6). Their respective directional "rosaces", in number and cumulative length, have similarities. The majority orientations correspond to directional classes N120° to N140° for fractures of the geological map and N120° to N150° for geomagnetic fractures.

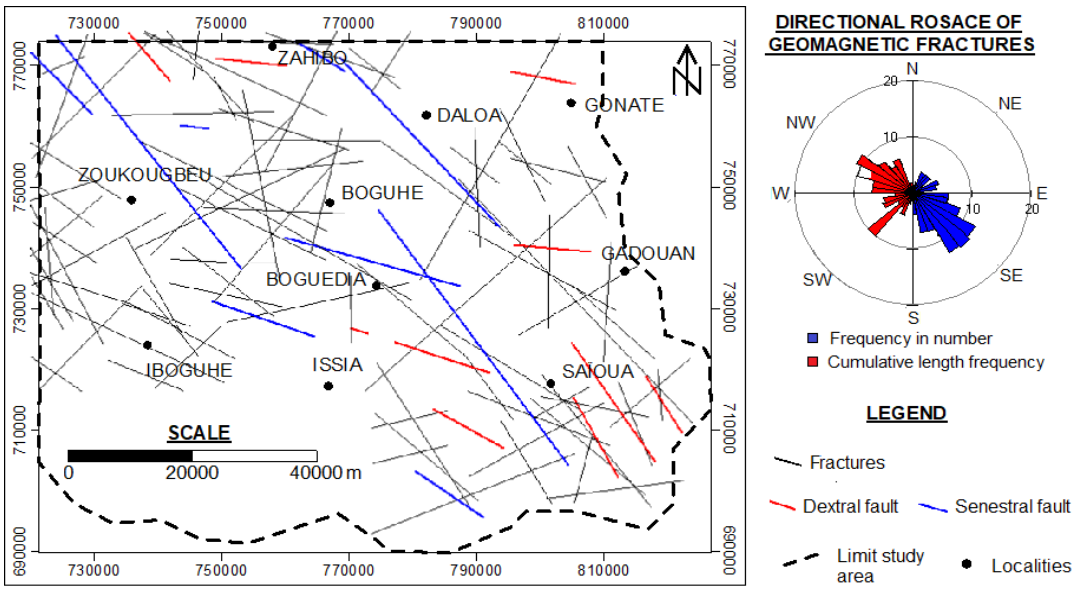

Figure 5: Structural Synthesis Map

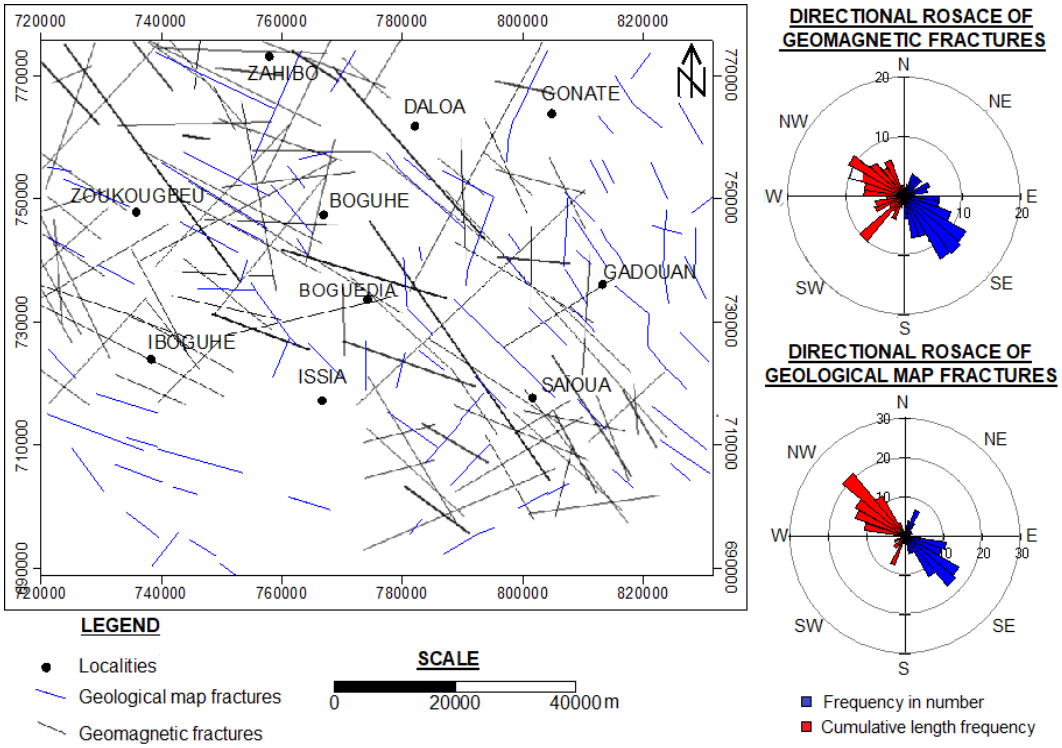

Figure 6: Fractures comparison from geological map to geomagnetic fractures

IV. Discussion

The aeromagnetic method has made it possible to discriminate several major tectonic accidents that affect the subsoil of southern Haut-Sassandra. According to authors of reference [1], this technique has long been used for mapping geological formations and tectonic accidents that affect them. It is mainly used to discriminate structures that have controlled ore deposition. The aeromagnetic approach makes it possible to obtain a geostructural map, on a large scale, of the geological formations. In Morocco, this technique is also used and has highlighted faults in the oasis of Figuig [8]. This is also the case in Nigeria where this technique is used to determine faults in the Lafiagi region of Nigeria [9]. Geomagnetic mapping of regional accidents are adapted to the geostructural study. The map of the reduced geomagnetic field at the equator makes it possible to identify, in the South of Haut-Sassandra, NE-SW oriented geomagnetic formations. This result corroborates that of author of reference [5], who worked on the quantification of a nickel deposit at Samapleu in the locality of Biankouma (western Côte d'Ivoire). It is an area locate next to our study area. Similarly, in Côte d'Ivoire, the geological formations of the Precambrian basement are predominantly NW-SE oriented. The geomagnetic anomalies obtained in this study correspond to the magnetic signature of the rock formations. Fractures in the study area are NE-SW oriented. Author of reference [5] gives similar results. In addition, the tectonic accidents highlighted in southern Haut-Sassandra correspond to the major fractures found on the geological map. These fractures also have similar principal orientations to those mapped from the geomagnetic data.

V. Conclusion

The objective of this study is *the reinterpretation of aeromagnetic geophysical data, acquired in 1976 to* improve knowledge of the deep geological structures of South Haut-Sassandra (Central-West of Côte d'Ivoire). The adopted methodology is based *on fractures extraction, from analysis of aeromagnetic geophysical data.*The results showed that the geomagnetic anomalies are oriented NE-SW, like all the geological formations of the region. The main tectonic accidents highlighted are oriented predominantly NW-SE. There are fractures direction N120° to N150°). These fractures correspond to those found on the geological map of South Haut-Sassandra. Dextral and senestral faults are also highlighted in the study area. These results will help in the search for ore controlled by tectonic phenomena.

References

[1]. E. Thomas, B. Mougin, N. Debéglia et J. Perrin, *Apports des levés géophysiques aéroportées à la recherche et la protection des ressources en eau : Application à la région du Léon (Finistère). Étude réalisée dans le cadre des opérations de service public du BRGM*, 2002-PIR-222, 2002.

[2]. P. Sonnendrucker, *Description géologique de la coupure Daloa 1d à 1/50 000.* Synthèse des travaux antérieurs, SODEMI, 1964.

[3]. H. Bonnot, *Rapport de fin de levé géologique du demi-degré carré nord de Daloa ; partie située à l'Est de la rivière Lobo à 1/ 200 000. Abidjan* : Direction de la géologie, 1985 27 p.

[4]. R. Ligban, *Caractérisation hydrogéologique et origine des eaux de sources naturelles dans le degré carré de Daloa (Centre-Ouest ; Côte d'Ivoire),* Thèse de doctorat, Université Nangui Abrogoua, (Abidjan, Côte d'Ivoire), 2013.

[5]. S. P. Djroh, *Études géophysique et géologique du gisement cupronickelifère a platinoïde de Samapleu. Essai de modélisation 3d par interprétation des données magnétiques et électriques,* Thèse de Doctorat 3ème cycle, Université de Cocody, Abidjan (Côte d'Ivoire), 2014.

[6]. M. Allard et D. *Bois, La géophysique appliquée à l'exploration minérale*. Montréal, Centre collégial de développement de matériel didactique, 1999.

[7]. J. Dawson et C. Robillard, *Rapport sur l'interprétation des levés aéroportés gravimétriques et Magnétiques effectués par uts geophysics en 2009 sur les blocs 17 et 25 pour petroma mali. Alberta*, Associated Geosciences Limited, 2012.

[8]. M. Amar, A. Manar et M. Boualoul, Apport de la cartographie aéromagnétique à l'identification structurale du système aquifère des sources de l'oasis de Figuig. *Bulletin de l'Institut Scientifique, 34*: 2012, 29–40.

[9]. K. A. Olawuyi, D. A. Bankole, G. O. Omosuyi, and O. A. Adelusi, Integration of Magnetic, Gravity and Geologic Data in Mapping Geologic Structures. A Case Study of a part of Lafiagi (Sheet 203), Southwestern Nigeria. *AAPG/SEG- International Conference & Exhibition, Melbourne, 13-16 Septembre 2015, Melbourne, Australia,* 2015, 359-367.

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