Annals of Geographical Studies
Volume 2, Issue 3, 2019, PP 8-15
ISSN 2642-9136

Evolution, Structure and Age-Determination of Basement Complex in the South Niger Regime of Neo-Proterozoic (750 Ma) Era

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ABSTRACT

In this present study, the structural evolution of the Southern Maradi Basement was marked by two (2) phases of major structuring of Eburnean and Pan-African, each one characterized by several episodes of deformations. The Eburnean D1 deformation phase included three (3) stages (D1a, D1b, D1c) The D1a ductile, NW-SE trending shortening stage was responsible for the schistocity/foliation of N500 orientation in average. The D1b stage, also ductile was characterized by the reactivation of the large shearing zones of N500 orientations, in average. The D1c stage, which was relatively semi-ductile was marked by the reactivation of the large shearing zones. The D2a episode was marked by a pure flattening foliation of N200 to N500 trending, in average, strongly straightened and related to an E-W to NW-SE trending shortening The D2b episode was marked by a simple shear dextral mylonitic foliation.

Keywords: *Evolution, Structure, Age determination, Basement Complexes, Neo-proterozoic, Niger.*

INTRODUCTION

It is believed that the Pan African Orogeny resulted from ocean closing movement between the Congo and West African Cratons (Grant, 1969; Ajibade et al, 1987) The Orogenic belt which resulted from the Himalayan type is characterized by a series of westerly dipping napped-like folds in the eastern plate, with the deformation spreading eastwards, away from the suture zone. An important thrust zone of Pan African age is accompanied by an Ophiolite suite in Ghana (Grant, 1969) Togo and Dahormey. The Dahormey suture can be traced northwards, separating old Crystalline Basement of two provinces and is suggestive of a geosuture between two impinging litho spheric plates (Ajibade, 1988) The Ophiolite which then represents part of the ancient sea floor, thrust upward between (Kankara and Farouk, 2015)the two plates, and are only preserved along the geo-suture (Ajibade, 1988)The opening and closing of an intra-cratonic ocean between 1,100my and 600my respectively led to the crustal thickening of the Dahomeyan which produce deformation of meta sediments and formation of Older granites (Grant, 1969, and Ajibade et al, 1987) The reactivation is probably due to thermal and metamorphic effects. Mc Curry (1976) suggested that if correlation between Biuem formation, Ahaggar and anti-Atlas are correct, the ocean should be up to 3,000km long and 1000km wide, hence the ocean is comparable in size with the Red sea. Also, events that took place at the plate margins were related to evolution of the northern Nigerian and southern Maradi basement during the late Proterozoic, as suggested by Ajibade in 1988.

The geological History of Southern Maradi-Northern Nigeria is also synonymous to geological History of the Nigerian Basement rock, generally lying in the vast region east of west African craton that was affected by the Pan African Orogenic event about 650 Ma ago (Kogbe,1976; Arthaud et al., 2008). Evidence from the cratonic margin in Hoggar and Pharussian, Ghana and Togo indicates that the west African region that was affected by Pan-African, east of the craton has evolved through plate tectonics involving continents to continent collision and subduction, an incomplete anatexis or melting of the oceanic crust and formation of acidic magma, leading to the emplacement of older granites at the late Precambrian to early Paleozoic period (Woakes et al., 987).The older granites have yielded almost uniformly Pan African. The field occurrence of these granites however shows that they are not of the same age (Kogbe, 1976; Ajibade, 1986).

Since the down of the geologic times about nine orogenic movements took place, such as fracturing of earth (Sparks, 1976). Intensive folding occurred in the Pre-Cambrian. The three more recent Orogenic cycles are Caledonian, Hercinian and Alphine. The Alphine is the last of the major Orogenic movements, almost 30 my ago. Mountain ranges were squeezed up and over thrust on a very great scale. The geological History of the area of Funtua NE is similar to the geological History of the Nigerian Basement. It generally lies in the vast area of east of west African craton that was affected by the Pan African Orogeny about 650+150 Ma ago. Evidence from the cratonic margin in Hoggar and Pharussian, Ghana and Togo indicates that the Pan African belt in western part of Africa, east of the craton has evolved through plate tectonics involving continents to continent collision and subduction, incomplete melting of crust and formation of magma, leading to the emplacement of the older granites during the late Precambrian to early Paleozoic period.

A later regional folding phase probably in late Eburnean resulted in a local anticlinal dome which affected both the migmatites and the meta sedimentary sequences. In the late Pan African, a deep weathering process resulted in the vast excessive wearing of upper portions of the anticlinal structure exposing the eastern and western limbs within which the carbonate and schist occur as truncated alternated bands with the basement migmatites. The region is underlined by igneous inserlbergs and low-lying migmatite rocks of the basement, which also bear the promonent relief, which appear as massive ridges and isolated dome-shaped structures. The average elevation is between 305-630m above sea level. The extended and dissected peneplained landscape in which the higher part form the drainage divides of streams flowing towards north and south into Atlantic ocean form major features in northern Nigeria. It is also believed that the denudational History of Funtua NE or episode began with marine transgression from the Tethys sea which extended southwards from North Africa in the late Maastrichtian times resulting in the deposition of marine sediments. This region comprise of different rocks which were formed during different periods of geological History.

Geological Characterization

Almost all the base formations that occurred during the period extending from Neo-proterozoicto Cambrian (750 Ma-500 Ma) were affected by the later orogenesis which was Pan-African thermo tectonic event (Villeneauve & Cornee 1994; Trumpette, 1997; Caby, 2003) The Pan-African orogenesis (600 + 150ma) is the last re-activation which has affected the whole region (Kankara, 2015) Since the down of the geologic times about nine orogenic movements took place, such as fracturing of earth (McCurry, 1976). Intensive folding occurred in the Pre-Cambrian. The three more recent Orogenic cycles are Caledonian, Hercinian and Alphine. The Alphine is the last of the major Orogenic movements, almost 30 my ago. Mountain ranges were squeezed up and over thrust on a very great scale. The geological History of the area south Maradi and northern Nigeria is similar to the geological History of the Nigerian Basement. It generally lies in the vast area of east of West African Craton that was affected by the Pan African Orogeny about 650+150 Ma ago. Evidence from the Cratonicmargin in Hoggar and Pharussian, Ghana and Togo indicates that the Pan African belt in Western part of Africa, east of the Craton has evolved through plate tectonics involving continents to continent collision and subduction, incomplete melting of Crust and formation of Magma, leading to the emplacement of the older granites during the late Precambrian to early Paleozoic period.

Materials and Methods

Geological Context of the Study Area

Grant (1969), Fitches (1985), Burke and Dee way (1976) and Ajibade (1987) believed that Pan African Orogeny resulted from ocean closing movement between the Congo and west African Cratons (Ayres, 1985; Shackleton, 1976) The orogenic belt which resulted from the Himalayan type is characterized by a series of westerly dipping napped-like folds in the eastern plate, with the deformation spreading eastwards, away from the suture zone. An important thrust zone of Pan African age is accompanied by an Ophiolite suite in Ghana (See Figure 2.3) (Grant, 1969; Macdonald, 1974; Rudnick and Gao, 2000), Togo and Dahormey. The Dahormey suture (Burke et al.,1976) can be traced northwards separating old crystalline basement of two provinces and is suggestive of a geosuture between two impinging litho spheric plates (UNESCO, 1971; Ajibade, 1980) The Ophiolite which then represent part of the ancient sea floor, thrust upward between (Kent,

1981) the two plates, and are only preserved along the geosuture (Boher et al., 1992; Ajibade, 1988)The opening and closing of an intra cratonic ocean between 1100my and 600my respectively led to the crustal thickening of the Dahomeyan which produce (Black, 1980) deformation of meta sediments and formation of Older granites(Grant, 1969, and Ajibade et al, 1987). The reactivation is probably due to thermal and metamorphic effects.

Mc Curry (1973) suggested that if correlation between Biuem formation, Ahaggar and anti-Atlas are correct, the ocean should be up to 3,000km long and 1000km wide, hence the ocean is comparable in size with the Red sea. Also, events that took place at the plate margins were related to evolution of the Nigerian basement during the late Proterozoic, as suggested by Ajibade in 1987 (UNESCO, 1971)

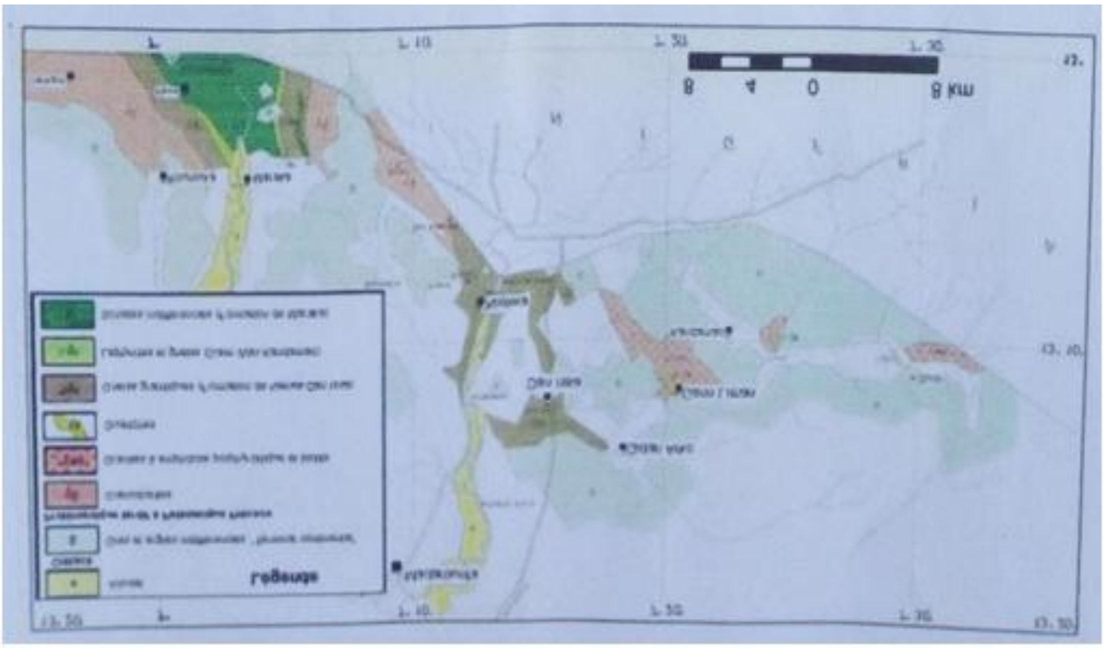

Figure1. *Geological map of the study area*

Data Collection and Analysis

Some works of geological cover carried out by the present researchers, coupled with the geophysical map of major structures have contributed towards modifying and completing the figure 1 (the map). This procedure enabled the present research to make the map of the area and to proceed with the geological section.

The fourth stage consisted of a micro tectonic analysis on samples collected from field and in laboratory which enabled the researcher to determine the different deformation stages. The rock samples collected based on radiometric dating were analysed at Activation Laboratory Ontario, Canada.

Results and Interpretations

Correlation and Geochronology

It is widely accepted that the oldest rocks are the migmatite gneiss complex (2,000+200my) (Rahman, 1988) Rocks of the complex were formed in the Archean times that were deformed several times before the last event of older granites formation. Mc Curry (1976) suggest that the low grade younger metasediments are probably equivalent to the geosynclinal Katanga metasediments and that they are deposited about 1,800-1,000my (Annor, 1998) One of the major events documented was the Eburnean (2000ma) (Ajibade et al, 1987).

The first authentic Eburnean age of 2,280+ 30ma was obtained from Rb-Sr single whole rock sample of migmatite from Kaduna (Ajibade, 1988). Grant(1969) also obtained indications of Eburnean and older ages scattered between 600ma and 3100ma reference line and Malumfashimigmatitesschists which show a scattered age between 600ma and 2,400ma reference line age (Ajibadeetal, 1987) The Ebuenean is basically considered to be a granite forming episode and was likely affected by syntectonic igneous activity, sedimentation and metamorphism. Evidence for Kibaran orogeny comes from Rb-SrIsochron age of 1120my from Ile-Ife gneissic granite (Touqarinov, 1968; Grant, 1969) and phyllites of schist belts in NW Nigeria. Another example from Ile-Ife granite gneiss has confirmed a U-Pbisochron chronology of 1820+20my (Rahaman, 1988), Igbeti gneiss also yielded a Rb-Srisochron chronology of 1902+18my (Rahman, 1983) The dating of migmatism was Pan African, that ranges from 650 my and the formation of super crustal rocks must have ended before this period. A Rb-Srisochron chronology of 566+17 my on younger metasediments from Birnin Gwari Schists formations was also obtained (Ajibade, 1988) A Rb-Sr on rock data from mylonites found in Zungeru (Ajibade, 1988) have yielded age varying from 600my to 700my which suggest a major deformation in the region affected by Pan African. Based on the available radiometric data the schist belt of NW Nigeria contains late Proterozoic sediments and younger volcanic rocks which were later modified and metamorphosed during the Pan African orogeny about 650 million years (Ajibadeet al, 1987; Annor, 1998)

Main Phases of Deformation

The structural study of southern Maradi formations shows that the deformations are integrated into a field of regional constrain associated with pronounced shearing corridors having an average orientation defined as NE-SW and N-S. The analysis of the deformation has brought the existence of at least three (3) major stages, noted D1, D2, and D3.

Phase D1 of Paleoproterozoic Deformation

The cartographical and petro-structural correlations of migmatitic and paleoproterozoic gneiss both at northern Nigeria and the magmatic gneiss of southern Maradi have enabled us to attribute all paleoproterozoic age equivalent of Southern Maradi.

The first phase of deformation which was essentially ductile, noted D1 was marked by three (3) Episodes; D1a, D1b, and D1c. The D1a episode has contributed in the culminating of the migmatitic gneiss into place. It is characterized by anisopac folds of flow affected by some ductile shearings (Figure 8a). In the paleororoterozoic provinces of Nigeria, Snelling (1964) and Talaat et al (2010) have described some S1 foliations deformed in asymmetric and anisopac folds of flows.

Into the migmatitic gneiss, the folding seems to be of the same period as the phenomenon of anatexis as it is confirmed by the presence of paleosomes (gneiss) and neosomes (granite) deformed (Figure 8A) The strong dispersion of the folds axis denote the high ductility of material. In the gneissic part of the migmatite, the quartzofeldspathic beds are represented by ductile shearing. Locally, the presence of biotites (melanosomes) in the migmatitic gneiss implies that the conditions of partial fusion are achieved (Figure 8B)

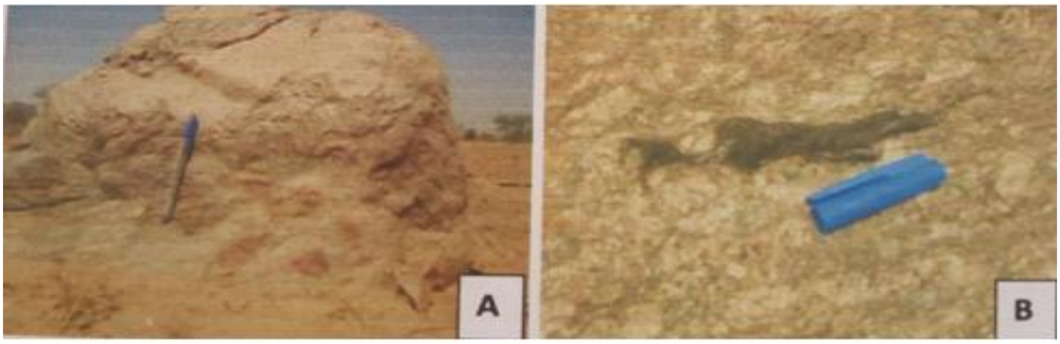

Figure2. *Migmatitic gneiss affected by phase D1a, in (A) anisopac folds of flow, in (B), melanosomes (biotite)*

The meta-volcano sedimentary schist intruded into the gneissic and migmatitic complex. At later stages, both were intruded by Pan-African granitoids. The eruptive rocks of the gneissic and migmatitic complex which show numerous enclaves of restites (biotite) and some unisepac folds showing some signs of beginning of a partial fusion. (Figures 8A and 8B) These observations are in line with those achieved by Abubakar, (2012) in the Zworokoand Afao sector, where this author brought some deformational structures of interior structural level among others. Some ductile shearing affecting some disharmonious foliations and folds. According to Abubakar (2012), the metamorphism would be the amphibolite faciestypes. The Episode D1b is characterized by a regular foliation S1 oriented at N20o to N50o strongly straightened, in relationship with a ductile and coaxial deformation through pure flattening nature. This deformation, associated with the formation of gneiss crossed by ribbons has been related to an average direction of shortening of N110o (Figure 9)

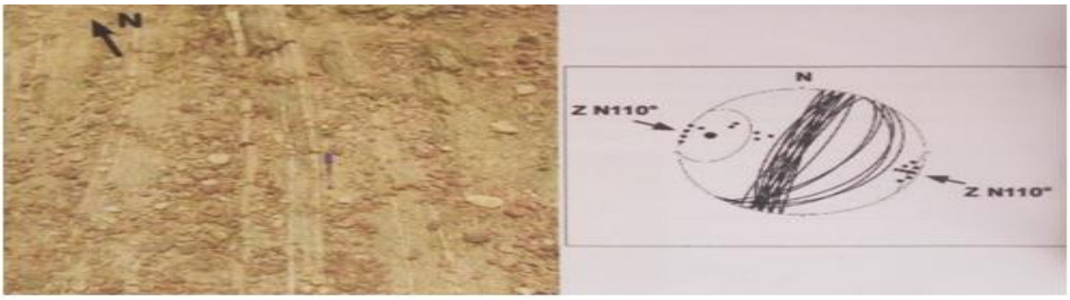

Figure3. *Foliation, SI by pure flattening oriented N20° to N45° in a Pan-African gneiss. The average direction of shortening is N110° (D1b).*

The Episode D1c corresponds to a period of mylonitization with S/C factory. It (this period) is characterized by a semi-ductile deformation in a shearing process (Figure 10) The granitoid veins of quarts and schist are in varied degrees affected by this period of mylonitisation.

This semi-ductile mylonitic deformation is related to an average direction of global shortening E-W. It was also described by Dada et al. (1993) and Holt (1982) in the pegmatitic gneiss provinces in northern Nigeria.

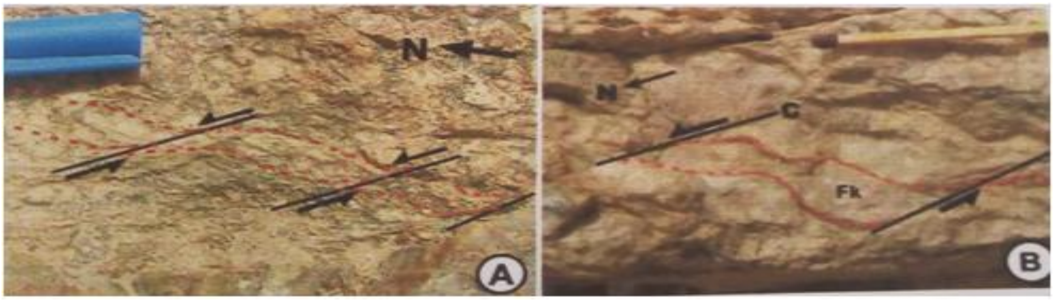

Figure4. *Deformation period related to the D1C episode. A and B: two examples of mylonitic gneiss with signoid fabric in left direction.*

Phase D2: Pan-African Deformation

This has been identified in the schist and in the granitoids in continuity with Pan-African provinces of Northern Nigeria (Wonaka and Katsina schist regions) To explain these deformations followed by metamorphism, an orogenesis of collision type has been suggested (Bruguier et al, 1994; Burry et al, 2012) implying a formation of subduction zone (Bath & Kalsbeek, 2013). The radiometric dating realized in Nigeria (600+150 Ma) has contributed to attribute an age to the crustal thickening consequent to this collision.

Two periods of Pan-African deformation have been distinguished: D2a and D2b. The Episode D2a which is ductile is characterized by a schistosity/foliiation S2 having variable orientations from N300 to N500, associated with a coaxial deformation by pure pattering nature (Figure 11), in the same condition as of green schist. The dominant mineral quartz and feldspars were squeezed and stretched in symmetrical manners. The foliation associated with isoclinal folds is compatible with a shortening of outcrops found in far west of the area. This stage of D2 deformation has two episodes (D2a and D2b).

Figure5. *Schistosity S2 by pure flattening with N500 orientation. The shortening direction is N1400 in the schists observed a 'oarinoarass'*

Such a deformation phase, marked by a schistosity/foliation oriented NE-SW has been described by Mignon, 1970; Talaat et al,2010; Ogeizi, 1977 and Kankara, 2015 in the schist belt of Anka and Wonaka in the North western Nigeria. According to the radiometric dating through the K-Ar and Rb-Sr methods on the total rock, this phase of deformation has various ages ranging from 516 -+20 Ma (Grauch et al, 2006) to 496 50 Ma (Ogeizi, 1977). The D2b episode was responsible of mylomitic foliation showing an S/C fabric often in right direction. It (episode) is associated with a right sigmoid fabric of quartz crystals around some quartzofeldspathic 'eyes' (fig.10A). The datings realized through K-Ar methods, on the total rock have enabled to date this last episodes of Pan-African deformation. Thus, the following radiometric ages have been obtained: 505+ 15 Ma in respect of Marakaschists, 475+ 10 Ma, in respect of GarinWali gneiss, and 508+ 10 Ma about the Chingue gneiss.

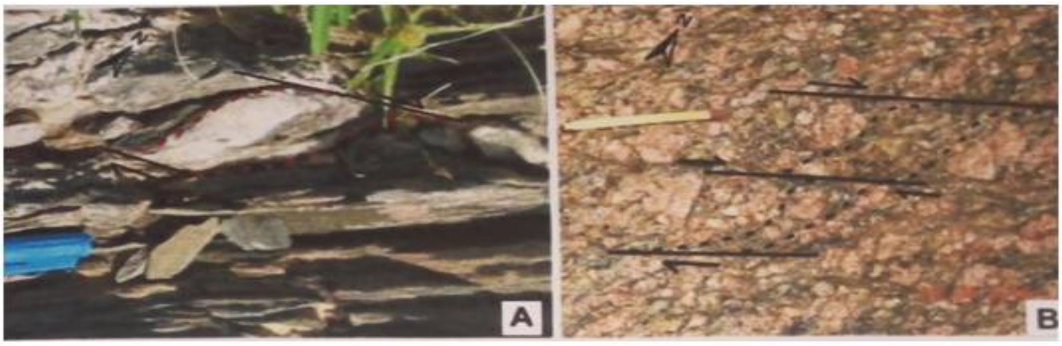

Figure6. *Schistosity/mylonitic foliation associated with the D2b episodes showing an s/c fabric. As well in A as in B the s/c fabric brought to the fore right movement. In B the plans S are underlined by some syanematic re-crystalization of quartz.*

Post Pan-African Deformation Phase

The phase D3 essentially brittle is characterized by two episodes of schistosity of fracture (D3a and D3b). The episodes D3a is characterized by sub-vertical S3 schistosity oriented N30 to N120. This schistosity is well marked in the Maraka schist (Fig 11). It is removed towards right by S4 schistocity (Figure 13) slightly leaned in the N40 direction, linked to the episodes D3b. This last episode D3b affects all the interior structures.

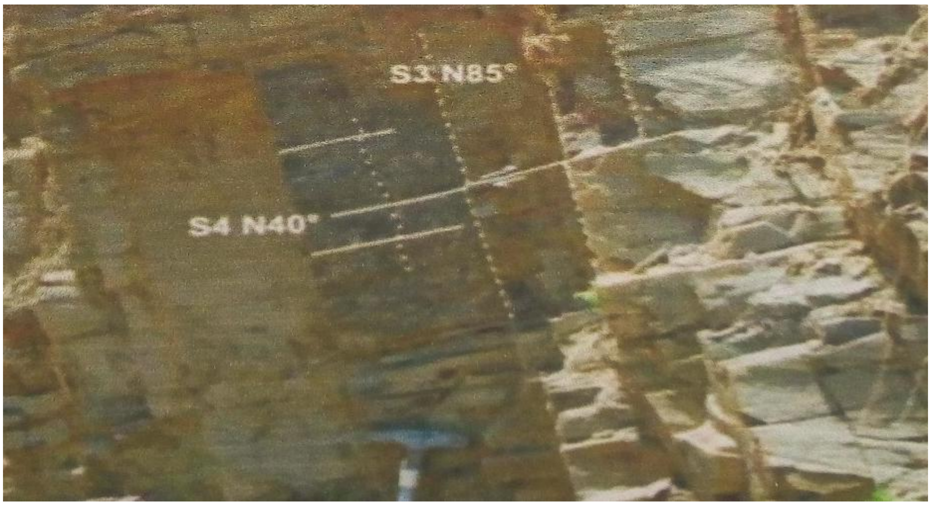

Figure7. *Schistosity of S3 fracture, sub-vertical, oriented from N800 to N100 removed towards the right side by another 54 shistosity lightly leaned, with a N400 direction.*

Indeed, the 650-500 Ma period would be characterized by the setting up of post-tectonic volcanism varying from alkaline to calc-alkaline associated with a brittle deformation, representing the ultimate sign of the Pan-African orogenesis (Van Breeman et al, 1977; Liegeois et al, 2003) According to PRDSM (2005), this brittle deformation is marked as well in Hoggar (Niger) as in Nigeria by a combined system of separation towards rights in the NE-SW direction and towards left in the NW-SE direction, corresponding to a shortening globally with E-W orientation (Tougarinov et al, 1968; Caby, 1989) This brittle deformation has been considered as the ultimate tectonic episode of the Pan-African orogenesis at the continental scale.

Conclusion

The integration of the cartographical, geophysical, radiometric and of the relative chorological data shows that the structural evolution of the basal geology of Southern Maradi is marked by two major tectonic phases: Eburnean and Pan-African, and in addition, another episode that was less pronounced than the former two events.

This study has enabled the researchers to reveal the superposition of Pan-African and Eburnean deformation phases, and to provide a regional dimension to the structural evolution of the deformation of south Maradi.

Following the example of northern Nigerian sector, the base of southern Maradi is composed of more ancient blocks, of paleo-proterozoic age, which were reactivated during the Pan-African events. This event dated from 600 + 150 Ma, has been the last reactivation which covered all the areas dated from the paleo-proterozoic age to Cambrian.

References

[1] Abubakar, Y. I. (2012) An Integrated Technique in Delineating Structures: A Case study of Kushaka Schist Belt, Northwest Nigeria. International Journal of Applied Sciences and Technology, Vol. 2, No. pp. 10

[2] Ajibade, A. C., Rahman, M. A. and Woakes, M. (1987). Proterozoic Crustal Development. In the Pan-African Regime of Nigeria. Copyright on American Geographical Union.

[3] Ajibade, A. C. (1988). Structural and Tectonic Evolution of the Nigerian Basement with Special Reference to NW Nigeria. International Conference on Proterozoic geology and tectonics of highgrade terrain. University of Ile-Ife, Nigeria, 22

[4] Annor, A.E. (1998). Structural and Chronological relationship between the low grade Igarraschist and its adjoining Okenemigmatite-gneiss terrain in the Precambrian exposure of South west Nigeria. Journal of Minning and Geo1ogy 34: 197-194

[5] Bath, N., and Kalsbeek, F. (2013) U-Pb Geochronology of Metasedimentary Schist in Akwangaarea of North Central Nigeria and its implications for the Evolution of Nigerian Basement Complex . Global Journal of Geological Sciences. Vol., 12, 2014: 21-30.

[6] Bruguier, O., Dada, S., and Lancelot, J. R.,(1994) Early Archean Component (3.5 Ga) within a 3.05Ga Orthogniessfrom Northern Nigeria: U-Pb Zircon Evidence. Earth and Planetary Science Letters, 125, 89-103.

[7] Bury, K. et al. (2012) Rapport de mission de Terrain dans le Sud Maradi (CRGM) p 8-17. Caby, R. (1989). Precambrian Terranes of Benin-Nigeria and Northeast Brazil and the Late Proterozoic South Atlantic fit. Geological Society of America Special Paper, 230. 145 – 158.

[8] Caby, R. (2003) Terrane Assembly and Geodynamic Evolution of Central Western Hoggar, a 730 Metacratonic Black in the Pan-African Belt of Northern African Continent. Precambrian Research Vol., 36 p 335-344.

[9] Dada, S. S., Tubosun, I. A., Lancelot, J. R., Lar, A. U. (1993) Late Archean U-Pb age for the reactivated Basement of North-eastern Nigeria. Journal of African Earth Sciences 16, 405-412.

[10] Grant, N. K. (1969) The Late Precambrian to Early Paleozoic Pan African orogeny in Ghana, Togo, Dahomey and Nigeria. Bull. Geol. 80C AM. Vol. 80. Pp. 187-214

[11] Grauch, V. I., Sawyer, D. A., Minor, S. A., Hudson, M. R., and Thompson, R. A. (2006) Gravity and Aeromagnetic Studies of Santo Domingo Basin Area, New Mexico, Chapter D of Cerrillos Uplift, the La Bajada Construction and Hydrogeological framework, Santo Domingo Basin, Rio Grande Rift, New Mexico. Edited by Scott A. Minor, US Geological survey, Denver, 63-86.

[12] Holt, R. W. (1982) Geotectonic Evolution of the Anka Belt in the Precambrian Basement Complex of N. W. Nigeria. Unpublished PhD Thesis, the Open University, Milton, Kenyas.

[13] Kankara, I. A. and Farouk, H A. (2015) Provisional Dating of Metasedimentary Rocks in South Katsina State, Northwestern Nigeria: Studies in Proterozoic Crustal Evolution. Journal of Physical Sciences and Environmental Studies. Vol. 1 (4), pp 55-61, October 2015 ISSN 2467-8775. Review http;// pearl research journals.org/journals/index.html.

[14] Liegeois, P. I., Latouche, L., Bougrara, M., Nacez, J., and Guiraud, M., (2003) The Late Metacraton (Central Hoggar, Tuareg Sheild, Algeria) Behaviour of an old Passive margin during the Pan-African Orogeny. Journal of African Earth Sciences, 37, p161-190.

[15] Mc Curry, P. (1976)A General Review of The Geology of The Precambrian To Lower Paleozoic Rocks of Northern Nigeria, A

Review. In Kogbe C.A. (ed) Geology of Nigeria. Elizabeth Pub. Co. Ibadan, pp 15-38.

[16] Mignon, R. (1970) Etude Geologiqueet Prospectiondu Damagaram Mounio et Sud Maradi, p 46-51 et 54.

[17] Ogeizi, A. E. (1977) Geochemistry and Geo chronology of Basement Rocks of N. W. Nigeria Unpublished Ph.D. Thesis, University of Leeds.

[18] PRDSM (2005). Projet de geophysique aero porteedans le secteur Sud Maradi, 55p.

[19] Rahaman, M.A. (1983). The Geology of North Western Nigeria. In: Precambrian Geology of Nigeria. A Publication of the Geological Survey of Nigeria.

[20] Rahaman, M. A. (1988) Precambrian Geology of Nigeria. In: Benin-Nigeria Geotraverse, International Meeting of Proterozoic Geology and Tectonics of High Grade Terrain.

[21] Snelling, N. I. (1964) Age Determination Unit. Inst. of Geol. Sciences, Annual Report, p30-40.

[22] Talaat, M., Ramadan, A. Mohammed, F. and Abdel, F. (2010) Characterization of Gold Mineralization in Garin Hawal Area, Kebbi State, Northwestern Nigeria, using Remote Sensing.

[23] Trumpette, R. (1997) Neo-proterozoic (600 Ma) Aggregation of Western Gondwana: A Tentative Scenario, Precambrian Research, 82, p 101-112.

[24] Tougarinov, A. I., Knorre, K. G., Shanin, L. I., and Prokofieva, L. N., (1968) Geochronology of Some Precambrian Rocks of southern West Africa. Canadian Journal of Earth Science, 5, 639-642.

[25] Van Breeman, O., Pidgeon, R. T., Bowden, P. (1977) Age and Isotopic studies of some Pan African Granites from North Central Nigeria. Precambrian Research, 4, 307-319.

[26] Villeneuve, M., Cornee, J. J. (1994) Structure, Evolution and Paleo geography of West African Craton and Bordering Belts during the Neo-proterozoic. Precambrian Res., 69 307-326.

Citation: *Kankara I. A, Ahmed Y, Djibo-Maiga A. W, "Evolution, Structure and Age-Determination of Basement Complex in the South Niger Regime of Neo-Proterozoic (750 Ma) Era", Annals of Geographical Studies, 2(3), 2019, pp. 8-15.*

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