International Journal of Innovative Environmental Studies Research 6(4):19-25 Oct.-Dec., 2018
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Geology and Petrographic Analysis of Undifferentiated *Banded* and *Mylonitic gneiss* Rocks in Funtua Sheet 78, NE, Northwestern Nigeria

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ABSTRACT
The aim of petrographic analysis is to find the ratio and percentages of certain elements in a rock. Petrographic work of twenty (20) samples of Banded and mylonitic gneiss rocks was done with primary aim of attempting to understand the mineralogy, texture and modal composition of all the rock samples. The Petrographic analyses were undertaken using Olympus model polarizing microscope at Ahmadu Bello University, Zaria in the year 2011.The study reveals that Quartz in metamorphic rocks are polychrystalline, an indication of rocks that have been metamorphosed. The microscopic study revealed the presence of basically the same mineralogical assemblages in all the rock samples namely; quartz, plagioclase feldspars. There are also another group of minerals such as zircon, biotite, muscovite, and others like microcline. The lithologic types display variations in mineralogy and texture and they are related to the color variations. Based on the thin section study, gneisses truly exist. The names assigned on each rock were based on the identification of mineral assemblages or paragenesis.
Keywords: Geology, Granite gneiss, Petrography, Mineralogy, Funtua NE, NW Nigeria

1. INTRODUCTION

Banded gneiss (Table 1) occur as subordinates in the mylonitic (Table 2) and porphyroblastic granite gneisses ranging from millimeter to scale banding to light and dark alternating bands of between 20-30cm in thickness (see plate ii) There seems to appear an area where dark minerals concentrate, (Bassey, 2009a; Bassey, 2009b) known as melasome and light minerals concentrate at the bottomed part, known as leucosome. This is witnessed in plate xxix under plane polar. There is a sign of foliation in granite gneisses at the upper part of a thin section but not well defined (see plates vi & vii) Still in that plate, groundmass of quartz and feldspar occur which is a major feature of foliated rocks.

Study Area

The Funtua NE is part of Lower Paleozoic terrain of NW Nigeria. Geographically, the area cut across Kankara, Bakori, Malumfashi and Faskari Local Government areas in Katsina State and covers a total land area of approximately 745.29km^2. The study area of Funtua north east (FTNE) falls within longitudes and latitudes 7^0 15',7^0, and 11^0 45', 12^0 00' (see plate iv; Figure 1; Table 1) The area is characterized by series of discontinuous ridge of inselbergs (gneiss and granite) (Kankara, 2014) in the western side which made it a slightly rugged landscape. Some areas around far western and eastern parts are inaccessible due to intense flooding especially in the rainy season.

METHODOLOGY

Twenty (20) major lithological units were identified and sampled during the mapping (reconnaissance survey and actual field investigation), using a 1:50,000 scale and this covered a total land area of approximately 153km^2. Each lithological unit have been described in accordance with reference to their locations in the map provided. For the geological mapping, Banded and mylonitic gneiss were identified

(Kankara, 2014) (plates ii and v) Laboratory analysis of thin section was carried out to ascertain the various percentages of minerals.

Table 1: Geochronometric Samples Description, Locality and Co-Ordinates of Banded Gneiss

Sample No.	Description/ Lithological Name	Nature of Outcrop	Locality	Co-ordinates	
				Elvtn.	Long/Lat.
FTNE 17	Banded Gneiss	Lowlying	At Kwakware Village	1802ft	$11^0$50.91'N $7^0$29.87'E
FTNE 21	Banded Gneiss	Lowlying	500m South of Burdugau	1809ft	11050.98'N $7^0$16.89'E
FTNE 11	Banded Gneiss	Lowlying	River Kyanka	1810ft	$11^0$48.92'N $7^0$16.89'E
FTNE 105	Banded Gneiss	Low lying	U/Maikomo	1792ft	$11^0$46.49'N $7^0$20.00'E
FTNE 79	Banded Gneiss	Low lying	At U/Gambo	1823ft	$11^0$47.50'N $7^0$29.58'E
FTNE 129	Banded Gneiss	Low lying	At Gidan Dan Azuba	1807ft	$11^0$48.61'N $7^0$29.32'E
FTNE 147	Banded Gneiss	Low lying	2km 500m West of U/Maikomo	1809ft	$11^0$46.42'N $7^0$15.62'E
FTNE 118	Banded Gneiss	Low-lying	Nome of U/Gambo	1800ft	$11^0$46.42'N $7^0$28.62'E
FTNE 113	Banded Gneiss	Low-lying	Near G/Bala village	1759ft	$11^0$49.87'N $7^0$29.50'E
FTNE 131	Banded Gneiss	Low-lying	SW of U/Gambo 1.5km	1781ft	$11^0$46.29'N $7^0$29.30'E
FTNE 62	Banded Gneiss		Another, 1km SW of Kwakware	1868ft	$11^0$51.10'N $7^0$29.50'E
FTNE 72	Banded Gneiss		River Kusunbodi	1809ft	$11^0$47.16'N $7^0$17.28'E
FTNE 58	Banded Gneiss		At Dan Agajuwa village	1808ft	$11^0$51.00'N $7^0$28.50'E
FTNE 59	Banded Gneiss		Close to River Burdugau (G)	1812ft	$11^0$48.61'N $7^0$29.61'E
FTNE 60	Banded Gneiss		Near Dan Aguta	1817ft	$11^0$48.59'N $7^0$29.62'E
FTNE 29	Banded Gneiss		At Mainashi	1801ft	$11^0$47.59'N $7^0$28.06'E
FTNE 30	Banded Gneiss		At Gidan Mati	1806ft	$11^0$48.50'N $7^0$29.66'E
FTNE 74	Banded Gneiss		Anguwan Maikawo	1796ft	$11^0$48.82'N $7^0$28.61'E
FTNE 75	Banded Gneiss		1Km north of Gidan Mati	1798	$11^0$48.71'N $7^0$29.15'E
FTNE 70	Banded Gneiss		Another deposit 1Km West of Sullubawa	1812ft	$11^0$47.00'N $7^0$29.53'E

Table 2: Geochronometric samples description, locality and coordinates of Mylonitic gneiss

Sample No.	Description/ Lithological Name	Nature of Outcrop	Locality	Co-ordinates	
				Elvtn.	Long/Lat.
FTNE 18	Mylonitic Gneiss	Whaleback	At Kwakware	1789ft	$11^0$50.77'N $7^0$26.78'E
FTNE 22	Mylonitic Gneiss	Whaleback	500m West of Danmarke Village	1792ft	$11^0$52.98'N $7^0$26.78'E
FTNE 63	Mylonitic Gneiss	Whaleback	Tudun Amiru, near Mararraba road	1798ft	$11^0$48.00'N $7^0$29.66'E
FTNE 157	Mylonitic Gneiss	Whaleback	1km NE of Mainashi	1808ft	$11^0$47.68'N $7^0$29.58'E
FTNE 46	Mylontitic Gneiss	Lowlying	U/Gambo NE of Burdugau (G)	1718ft	$11^0$47.61'N $7^0$29.92'E
FTNE 142	Mylontitic Gneiss	Lowlying	2km, south of Ung. Gambo	1785ft	$11^0$47.06'N $7^0$29.42'E
FTNE 89	Mylontitic Gneiss	Lowlying	15km S of Burdugau (K)	1792ft	$11^0$50.31'N $7^0$29.21'E
FTNE 115	Mylontitic gneiss	Lowlying	Another Outcrop close to Tudun Amiru	1790ft	$11^0$48.00'N $7^0$29.38'E
FTN 100	Mylontitic Gneiss	Lowlying	500m S of Burdugau (K) Bridge	1786ft	$11^0$50.79'N $7^0$29.50'E
FTNE 152	Mylontitic Gneiss	Lowlying	Gidan Gobirawa	1808ft	$11^0$50.00'N $7^0$29.56'E
FTNE 48	Mylonitic Gneiss	Low-lying	At Gidan Bala	1761ft	$11^0$49.90'N $7^0$29.82'E
FTNE 49	Mylonitic Gneiss	Low-lying	Sw of (1Km) Danmarke	1752ft	$11^0$52.80'N $7^0$26.51'E
FTNE 50	Mylonitic Gneiss	Low-lying	At Dannakwa bo village	1768ft	$11^0$53.12'N $7^0$23.00'E
FTNE 51	Mylonitic Gneiss	Low-lying	At River Mabai	1809ft	$11^0$50.69'N $7^0$20.01'E
FTNE 55	Mylonitic Gneiss	Low-lying	Another Outcrop E of Gidan Gambo	1816ft	$11^0$47.70'N $7^0$29.90'E
FTNE 57	Mylonitic Gneiss	Low-lying	Close to River Baure	1812ft	$11^0$59.33'N $7^0$23.51'E
FTNE 77	Mylonitic Gneiss	Low-lying	Another deposit Kankara - Malumfashi Road	1828ft	$11^0$55.81'N $7^0$21.06'E

FTNE 76	Mylonitic Gneiss	Low-lying	2km South of G/Kura Village	18166ft	$11^0$53.70'N $7^0$26.20'E
FTNE 67	Mylonitic Gneiss	Low-lying	Another deposit 500m West of Danmarke	1818ft	$11^0$53.14'N $7^0$27.00'E
FTNE 61	Mylonitic Gneiss	Low-lying	NE of Bagoma	1816ft	$11^0$56.68'N $7^0$19.81'E

RESULTS AND INTERPRETATIONS

Geology

Repeated reactivations involving migmatization and granitization have progressively obliterated older supracrustal sequences of which only remnants are now preserved so that at least the upper continental crust retains a bulk composition near that of granodiorite. At first sight, the distribution of age provinces on maps gives the impression that the total area of continental crust has been growing steadily since the Achaean, by a process of lateral accretion (Amos, 1989). Successive orogenesis appeared to have added new areas of regional metamorphic and granitic rocks, thus progressively increasing the total extent of continental crust. The true picture is not quite so simple. The ages used to define provinces give the approximate time of the last orogenic deformation and metamorphism, according to the radiometric dates yielded by the majority of the rocks in that region. In most of the age provinces, however, some rocks give ages much older than the majority, and these are often called relict ages. Such rocks have preserved a record of earlier regional deformation and metamorphic events.

In this present study twenty (20) major outcrops of migmatites were identified during the mapping exercise; the outcrops are seen on Table 1. The area is made up of Precambrian rock units, which are divided into two broad units based on changes in lithology between the differentiated basement complex sensu strict (porphyritic granite, gneiss) and metasediments. Usually in the area there are some intrusions of gneiss found on older granites but often exist rarely. The contact between metasediments and basement complex are sharp and covered many locations. There is a gradual change between augen gneiss and gneissic granites. There is also a sharp change between the gneisses because of the variation in the color, textures, mineral compositions, poor exposure or weathering of augen gneisses (Hanson, 1978)

The area Funtua Sheet 78 NE was mapped using a 1:50,000 scale and this covered a total land area of approximately 153km^2. The Funtua NE is part of Nigerian Basement. The Banded and mylonitic gneiss lithological unit have been described in accordance with reference to their locations in the map provided. The south-western portion of the study area contains mostly prominent Banded and mylonitic gneiss which are mainly low-lying. The southeastern and eastern part of the area was however characterized by scarce outcrops.

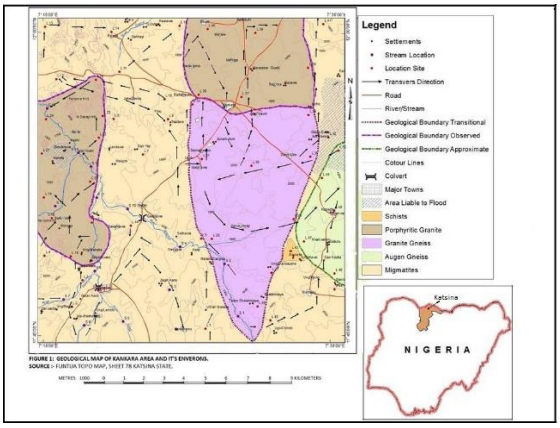

Fig. 1: Geological map of the study area showing the older granites; Plate i: Quartz-rich pegmatite within a migmatite along Zango-Bakarya road.

The light granulose quartzo-feldspathic bands consist principally of quartz, secondary quartz, microcline and small amounts of plagioclase with a few mafic and accessory minerals (Ezepue, 1992) About 13% microcline constitutes this rock, exhibiting a polysynthetic crosshatched twinning. The texture is medium grained and is slightly foliated. In hand specimen major minerals that are identified are: quartz, feldspar and biotite. The textural descriptions show that it has subhedral granular crystals which are composed mainly of quartz, orthoclase, biotite and microcline. It is holocrystalline. Visual estimate shows the following average percentages of minerals: Quartz-20%; Chlorite-18%; Biotite-18%. These are major minerals. The minor minerals or accessories are: Apatite, magnetite and Zircon, which constitute 4%.Thin section examinations, (Bowden & Kinnaird, 1984) reveal a finely granulated almost cryptocrystalline groundmass containing a few recognizable quartz grains with occasional small rotated Augen of very strained quartz plagioclase and microcline.

Biotite

This shows a highly colored and strongly pleochroic shades of brown or light brown. It exhibits perfect cleavage on the tabular plates which dictates fragment orientation. Linear aggregates which show evidence of chloritization to muscovite, appear to be patchy in form with a characteristic "birds-eye maple" feature. Biotite is about 10% and it is the most abundant mafic mineral. It is pleochroic in nature from brown to brownish coloured, and occasionally greenish and a ragged feature. Dark schistose bands are generally without microcline but consist of brown biotite, muscovite, large almandine garnet quartz and some oligoclase.

Plagioclase

This occurs in the form of oligoclase and constitutes about 30% of the rock volume. It occurs as colorless anhedral to subhedral crystals often sericitized, showing bent or twisted albite twin lamellae. Plagioclase forms about 39% of the rock volume occurring mainly as oligoclase, with anhedral to subhedral crystal shapes partly twisted with ablite twinning characteristics. They are invariably altered to sericite.

Microcline

Microcline exhibits the usual polysynthetic cross-hatched twin laws. Thin section examination shows large subhedral microperthitic microcline with good polysynthetic cross hatched twining. In granite gniesses, it can be found in between the equigranular crystals of quartz and weathered feldspars. It occur as turbid crystal with elongate crystals. It is non-pleochroic with low relief and parallel extinction.

Quartz

Quartz occurs as polycrystalline and as secondary quartz with a characteristic cluster appearance, due to granitization effects that occurred during an intense regional metamorphism (see plates I and iii) Quartz crystals are however resistant, occurring as pebbles on the exposed weathered surfaces. Quartz forms

about 32% of the total volume of the rock as noted in the petrographic analysis. It exist as large individual crystals and an irregular margin and vein-like interstitial grains of secondary quartz. Sometimes the yellowish color of quartz is an indication that it is thicker than 30 microns.

Muscovites

They almost occur at extinction and central positions with high relief. Many of the crystals show twinning and those near to the extinction position show the mottled appearance which is characteristics of all micas. It is yellowish in color. There are also parallel alignment in the muscovite minerals where most of them tend to be interstitials.

Zircon

Zircon is present as an accessory. It is minute and radioactive, nearly destroying the crystalline structures of the Biotite.

Texture

The gneisses are very variable in composition and texture as a result of the degree of deformation. Gneiss are metamorphic rocks in which minerals have been differentiated into parallel layers, creating a structure that is banding or laminating. Banded structure in these rocks are as a result of metamorphosis of igneous and granite gneiss rocks in which the quartz and feldspar are segregated into layers that are alternating with dark colored layers of minerals. The anatexis and pressure that brought about their formation often deform them, and in this, variety of textures and structures are obtained. Most gneisses and migmatites can be identified in the field through fabric structures.

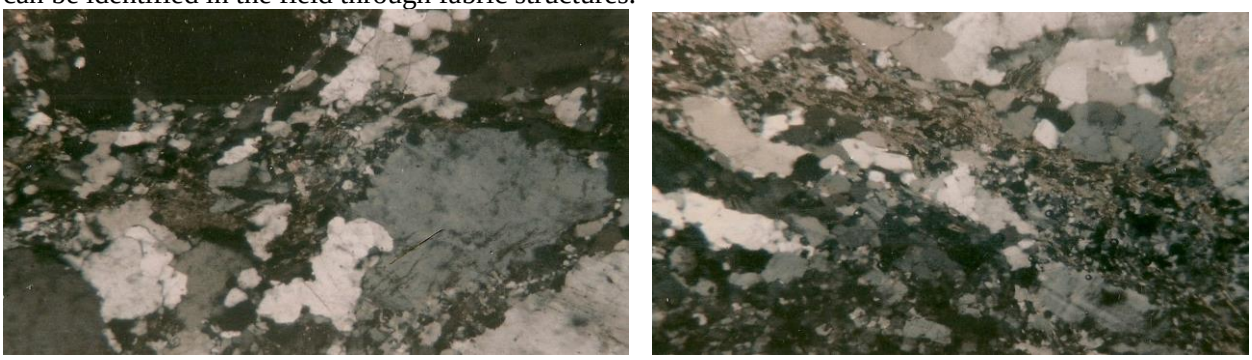

Plate ii: Microphotograph of foliated banded gneiss under plane polars. Magnificent=30x**,** and Plate iii: Microphotograph of plate showing polychrystalline quartz with sutured boundaries under cross ploars. Magnificent=30x.

Plate iv: Tudun Sha Tambaya village that characterize the southern part. Plate v: Mylonitic Gneiss at Kwakwaren-Nabadau

Plate vi: Banded Gneiss near Angwan Maikomo, SW of Kwakwaren-Nabadau. Plate vii: Banded Gneiss around Gidan Bala, south of Kwakwaren-Nabadau.

CONCLUSION

There appears to be a melasome; an area of dark minerals concentrations and Leucosome; an area where light minerals concentrates at the bottom. This photomicrograph has a sign of foliation at the extreme upper part, but not well defined.

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