FIELD AND STRUCTURAL GEOLOGY OF THE DUNGULBI AREA, NORTHEASTERN NIGERIA

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ABSTRACT

Basement rocks of the Dungulbi area of Northeastern Nigeria were assessed and found to comprise of Pre-Cambrian basement rocks invaded by Pan-African granites generally referred to as the 'Older Granites'. The area was composed mainly of Migmatite gneiss, granite gneisses and calc-alkaline granites. The tectonic structures in the study area trend mostly NE – SW and subordinately NW-SE and N-S conform with the regional deformational structures which occurred during the Pan African thermotectonic events in the Nigerian basement.

Keywords: Dungulbi, Calc-alkaline granites, Pan-African, Older Granite, Northeastern Nigeria

1.0 INTRODUCTION

The Dungulbi area is located within latitude: 10º16'01.11"N and 10º19'00.4"N and longitude: 09º55'02.10"E and 09º58'01.42"E, the study area covers an area of 25km^2 and rise to the height of approximately 580m above mean sea level in some areas. The geology of the Dungulbi area is mainly characterised by metamorphic and plutonic rocks (basement complex) of the neoproterozoic belt of north-eastern Nigeria. Some of the rocks found within the area are characterised by intensive deformation which are imprints of Eburnean (2.2-1.9Ga) and Pan African (750-450Ma) orogenic events (Ogezi, 1977). The rocks within the area also exhibit

foliations planes and other structural features are usually found trending in the N–S direction which a distinguish characteristics of the Pan-African orogenic event.

2.0 GEOLOGIC SETTING

The Dungulbi area is located in the Northern Basement complex of Nigeria (Fig 1) and is the composed of mainly metamorphic and plutonic rocks with granite gneisses and migmatite gneisses representing the metamorphosed rock units and Pan African granites represent the plutonic rock units found in the area (Fig 2).

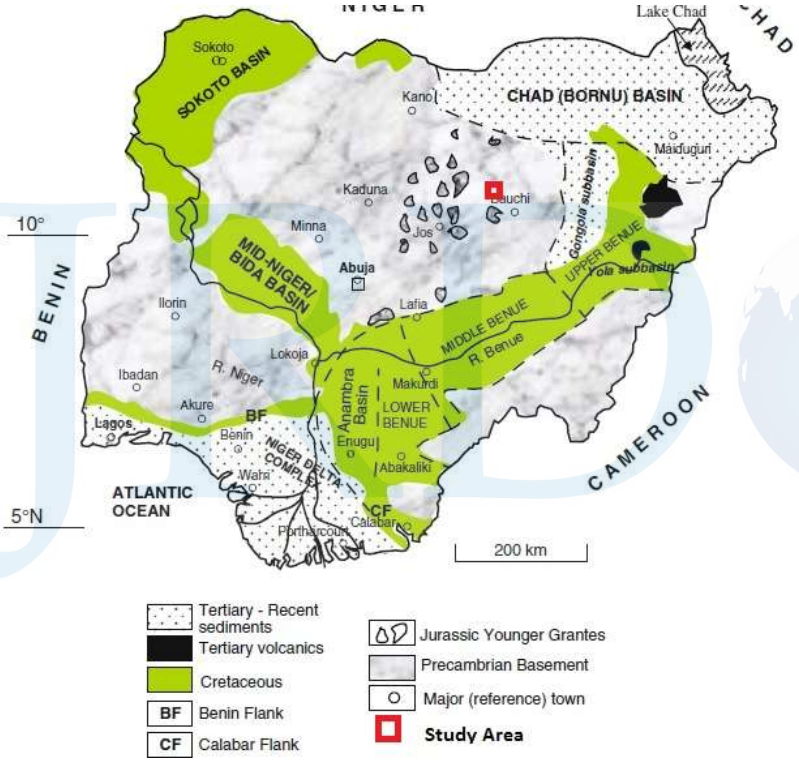

Fig 1. Geologic Map of Nigeria showing the study area (Modified from Obaje, 2009)

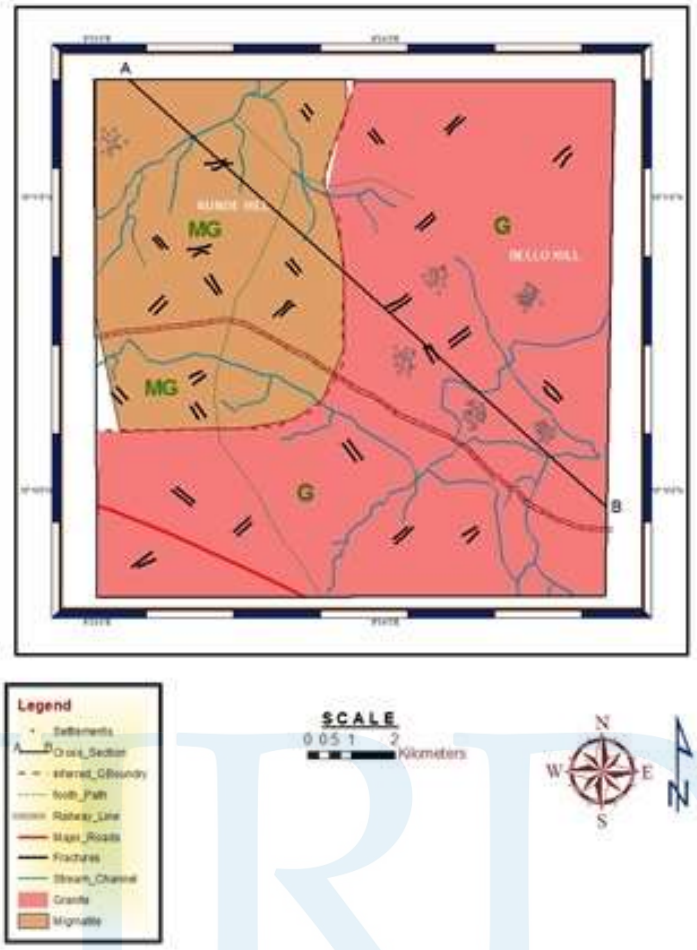

Fig 2. Geologic Map of the Dungulbi Area

3.0 SAMPLING AND ANALYTICAL TECHNIQUE

The samples were taken in a well grided manner to enable collection of representative rock samples of the different rock units in the Area. Petrological observation was conducted using a Microscope at the Department of Geology, Modibbo Adama University of Technology, Yola. The samples were prepared, mounted and viewed both under plane and polarized light.

4.0 FIELD GEOLOGY AND PETROGRAHY

4.1 Field Studies

The Area under study is comprised of calc-alkaline and some alkaline granites. Geological structures such as quartz veins, pegmatite dykes, folds, joints and fault zones were also observed in the granitic rocks.

4.1.1 The Older Granite Complex

The granite of the study area covers about 50% of the total study area. Field observations indicate that they are massive and vary widely in texture. The minerals are randomly oriented

and show well oriented tabular feldspars (typically perthitic microcline or orthoclase) with plagioclase (calcic albite or oligoclase) and/or flaky biotite grains. They are porphyritic with phenocrysts of quartz and feldspar in a groundmass of biotite and hornblende. They are medium to coarse grained with average grain size between 1mm-30mm (0.1cm-3.0cm).

Fig 3. Outcrop of the Older Granite

4.1.2 The Migmatite-Gneiss Complex

The gneisses are coarse-grained, banded crystalline rocks with phanerictic mineral grains for the

dark colored mineral the biotite occur in association. The banding arises from the segregation of various minerals that are present into dark-colored (melanocratic) and lightcolored (leucocratic) layers. The dark bands consist of dark minerals such as biotites and horneblende whereas light bands consist of light coloured minerals such as quartz and feldspar. The thickness of the bands is between 2mm to 2cm. The rock are intensely deformed resulting in the formation of joints, shear zones and fractures.

Fig 4. Outcrop of Migmatite Gneiss

4.2 Petrography

4.2.1 Migmatite

The following properties of the migmatite were observed under the microscope as shown in plate (1): Abundant of colourless minerals that comprises quartz, plagioclase and orthoclase respectively.

Biotite crystals are generally appeared to be brownish in colour.they have a perfect cleavage in one direction and exhibit pleochroism from light brown to dark brown or dirty brown and has low relief.

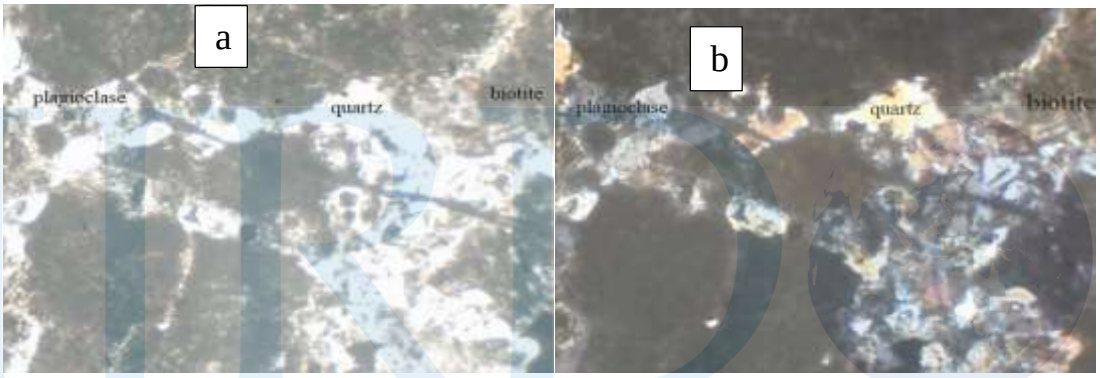

Plate 1: Photomicrograph of migmatite under XPL and PPL.

Note: Q = Quartz, O = Orthoclase, P = Plagioclase, B = Biotite and C = Chlorite.

4.2.2 Granite

In thin section, the rock consist of k-feldspars which include microcline and micropethite.they occur as phenocryst, and anhedral and they appear cloudy due to alteration. Some crystals of this mineral are seen to enclose other minerals mostly biotite. Under plane polarized light, quartz occur as smaller rounded phenocryst. It is colourless, clear anhedral and occurs as clusters. It is fractured and it occurs as myrmekitic intergrowth with plagioclase and also as replacement grains or inclusion in microcline. Biotite crystals are generally brownish or reddish in colour. They have a perfect cleavage in one direction.They are subhedral and have inclusions

of quartz and opaque minerals. They exhibit pleochroism from light brown to dark brown or dirty brown. Hornblende is the chief mafic constituent and is generally greenish in colour. It is pleochroic from light green to dark green.the accessory minerals in the sample are opaque minerals.

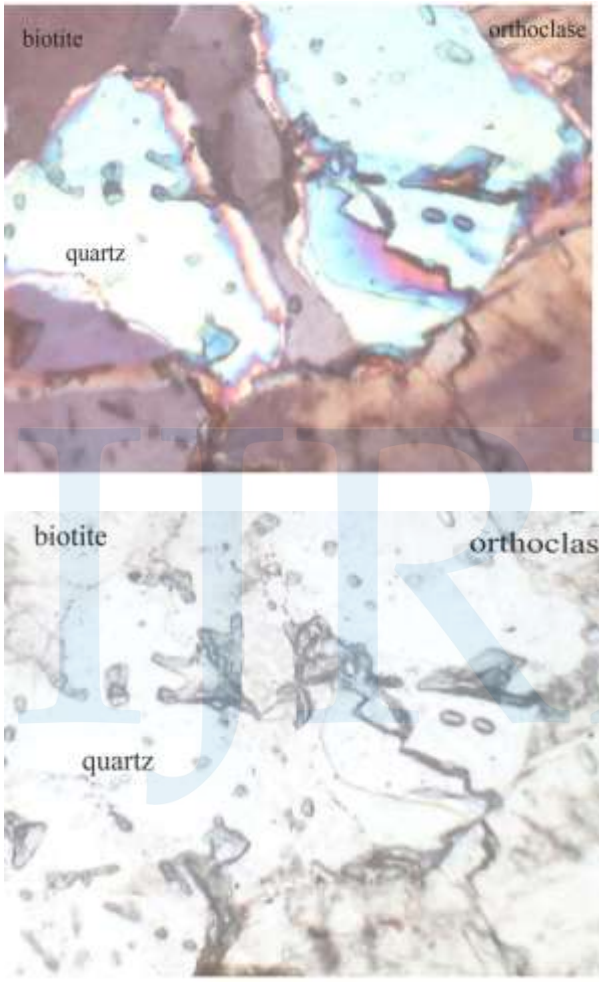

Plate 2: photomicrograph of granite under XPL and PPL.

Note: Q = Quartz, B = Biotite, C = Chlorite, O = Orthoclase and P = Plagioclase.

4.3 STRUCTURES

4.3.1 Joints

Joints are fractures or cracks found in rocks along which there has been no displacement. They are fractured surfaces along which separation without any movement had occurred. The granite

and migmatite exposures in the study area are characterized by several joints, majority of the joints identified were striking in N-S and NNE-SSW direction.

Fig 3. Photograph showing the occurrence of joints on granite outcrop.

The data of the fractures/joints are plotted on a rose diagram (plot), in order to determine the dominant trends and also their intensities. Below is a table showing the frequency strikes and the back-azimuth of fractures/joints.

TABLE 1: The table below shows the frequency distribution of fractures/joints.

S/N	CLASS INTERVAL	FREQUENCY
1	0 - 30º	5
2	31 - 60º	11
3	61 - 90º	16
4	91 - 120º	9
5	121 - 150º	10
6	151 - 180º	9

Table 1. Frequency distribution table for fractures/joints

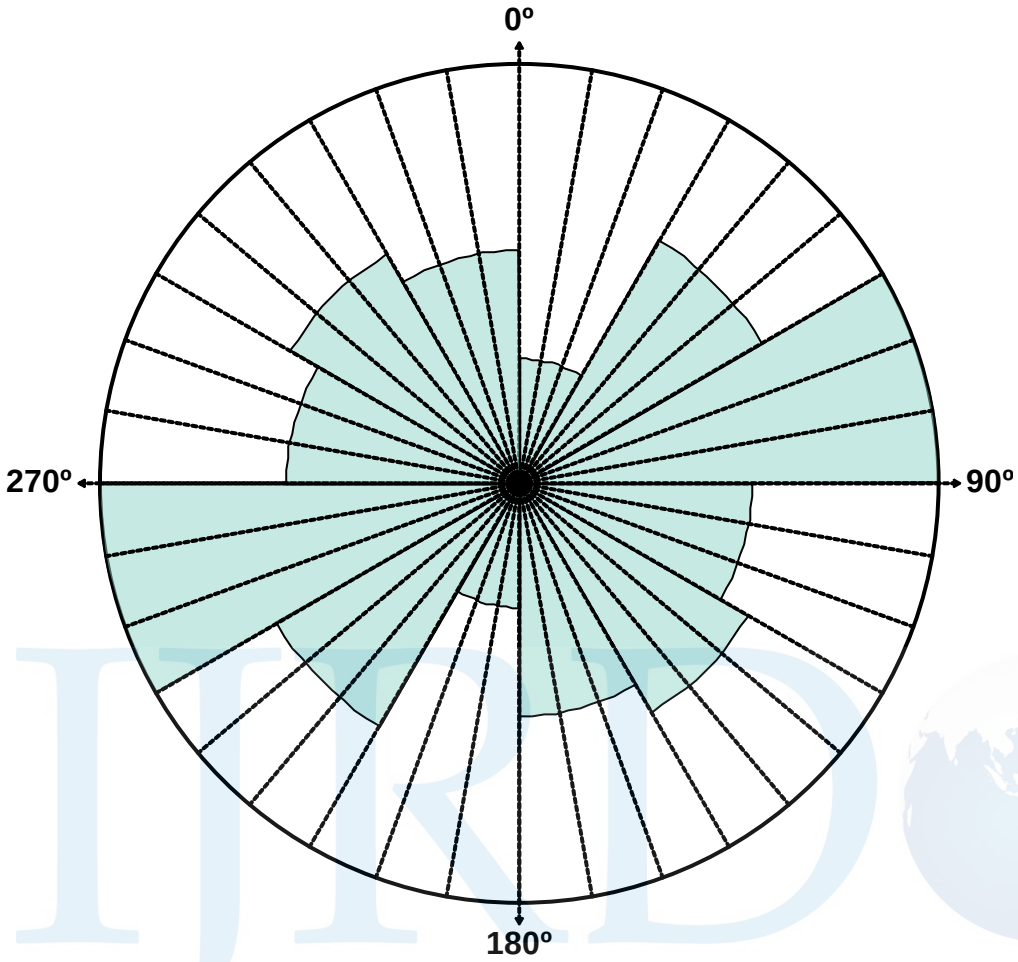

Fig 4. Rose diagram showing the Trends of the Fractures/Joints found within the study Area.

4.3.2 Veins

A vein in geology can be defined as a fissure or fracture containing minerals. The veins observed in the study area include; quartz and pegmatite veins, defining the history of last stage of magma crystallization (pneumatolithic stage).

4.3.3 Dykes

The joints weakness lines can easily be filled by materials resulting from igneous activities such as pegmatites or dolerites materials which form dykes. In the study area the dykes are pegmatitic in nature. The minerals that can be identified are the feldspars and quartz.

Fig 5. Pegmatite dyke exposed by a stream channel.

5.0 DISCUSSION

The Dungulbi area shows a variety of rocks representative of orogenic events that affected the basement of rocks, Migmatite and granite gneisses significant of Eburnean and Pan African events and Calc-alkaline concordant granitoids commonly referred to as the 'Older Granites' of Nigeria representative of intrusions during the Pan-African orogenic event (McCurry and Wright, 1971; Rahaman and Lancelot, 1984). The tectonic structures in the study area trend mostly NE – SW and subordinately NW-SE and N-S conform with the regional deformational structures which occurred during the Pan African thermotectonic events in the Nigerian basement (McCurry, 1976).

6.0 CONCLUSION

Field studies and petrographic investigations indicate that the Dungulbi area consists of granites, granite gneisses and migmatite gneisses. The granites of the Dungulbi area are high-K calc-alkaline synonymous with the Pan-African granitoids of Nigeria (Rahaman and Ocan, 1978; Rahaman and Lancelot, 1984). This magmatic suite is metaluminous to peraluminous. Earlier workers classifiy the Pan-African granitoids as pre, syn and post tectonic granite which were formed during the Pan African thermotectonic events in the Nigerian Basement Complex. Further geochemical and isotope studies of the Dungulbi rocks is ongoing.

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