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The Geology of Part of Paiko Sheet 185 (North West), Nigeria

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Abstract— *The mapped area which is located between latitude 6°36'N—6°42'N and longitude 9°26'E—9°30'E on the Paiko sheet 185 North—west covers and approximate area of 80km^2 in Paikoro Local Government Area of Niger State. The mapped area covered in this project is composed of granites of the older granites suite of the Nigerian Basement complex which can be distinguished into; leucocratic granite which is the most extensive and covers about 50% of the total area. Biotite granite which forms 35—40% and is the second largest outcrop of rocks in the mapped area which are mostly abundant in the western portion and finally gramodiorite which makes up 10% of the total area is found in the North—Central portion of the mapped area.*
The textures of the various granitic rocks varies from medium to coarse grained textures.

I. INTRODUCTION

The study area lies within the north central portion of the Nigerian Basement Complex rock which is characterized by three lithofacies: the migmatite gneiss complex, the low schist belt and the older granites (Olarewaju, et al, 1996; Olasehinde, 1999).Particular to the area is the granite-gneiss and granitic rocks of different grain sizes, outcropping at different locations within the area with noticeable fractures and joints. The joints are of two generations depending on their orientations, some trending NNE-SSW and the other NE-SW. In most cases the joints are filled with Quartzofeldsparthic veins, while others are fairly well exposed along the river channel. The values of the joints directions range between 120° and 160°. Foliation was also noticed on some of the outcrops in the area. The outcrops in the area are randomly located at the south eastern parts

Aim of the Mapping Project

The aim of this mapping project is to train students in the various aspects of geological field mapping with the view of helping the students to accurately identify and describe rock types in the field.

This exercise is also arrived at helping the students acquire basic mapping techniques with a view to matching field relations with classroom work and the production of a geological map of the area based on the acquired data.

Location Extent And Accessibility

The mapped area is located between latitude 6°36 and—6°42'N and longitude 9°26'E—9°30'E on the Paiko sheet 185 Northwest.

The mapped area extends approximately 7.4km in length and 10.5km in breadth. The extent of the mapped area is approximately 80km^2 on a scale of 1:40,000.

The mapped area is accessible by the Minna — Suleja highway which divides the area into two parts. Footpaths leading to the various villages give easy access to different parts of the mapped area.

Climate Vegetation and Land Use

The mapped area lies within the middle belt region of Nigeria. It is characterized by two major seasons; A dry season which lasts for about six to seven months from November to April with very low humidity accompanied by the North—East trade winds which is usually the harmattan periods. Maximum temperature conditions between 30°C and 36°C are recorded between December and Mid—January.

There is also the rainy season which lasts for about five to six months usually begins from April to November. This is usually characterized by a high humidity and excessive heat.

The average annual rainfall is between 150 — 250mm and usually peaks between July and September. This is usually brought about by the south—East trade winds which are moisture laden.

The vegetation in this area is typically that of the guinea savanah which is characterized by shrubs and very tall grasses with scattered trees of different species such as mango, cashes mahana, and sheabutter which are of economic importance. The grasses include elephant grass, goat weed, Northern gamba etc.

The major agricultural activities in the areas are subsistence farming and cattle rearing by the nomadic fulanis. Farming which is at a subsistence level include crops like yam, rice, guineacorn, millet, cowpea, and grundnuts.

Relief and Drainage

The area generally has a gentle topography with occasional hills. However, the eastern portion of the area has a rugged topography with ridges running from the north to southern portion. They stand up to 1500 ft about the surrounding country.

The area is drained mainly by River maidna with smaller stream channels running north south of the area. The area is usually swampy during the rainy season and dry during the dry season.

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II. Previous Work

There are no published reports on the geology of the area however, the area (sheet 185) has been mapped by the geological survey of Nigeria but neither the map nor the description has been published. Ajibade (Personal communication 1992) is currently preparing the geological map of 1:250,000 sheet 142 Minna (which includes the Paiko sheet). He has carried out mapping in all parts of the sheet including the present area

The mapped area is an integral part of the Nigerian basement on which much publication has been made among these publications are that of Oyawoye (1972) Grant (1969) Rahaman (1976) Ajibade (1990).

The area lies within the Northwestern province of the Nigerian Basement complex in which the first detailed work was carried out by Truswell and Cope (1963) who mapped the now classical kusheriki area. They were so impressed by the parallel structures and transitional contact between the different metamorphic units in the area and conclude that the griessic complex, the schist formations and the older granites in the area were formed during a single orogenic event. On the basis of the then available age data, mainly K—Ar and Rb—Sr mineral and whole rock datum lay between 480ma and 540ma, Truswell and Cope (1963) concluded that the basement rocks in the area and Nigeria in general, could not be older than the Cambrian.

The Nigerian Basement which is composed of three major rock groups, the migmatite gneiss complex, with N—S trending, low grade schist belts and the older granites. Several theories have been proposed about the age and evolution of the Nigerian basement.

Grant (1969) was the first person that recognized the evidences at the eastern margin of West African craton which showed that, the frontal region of the Pan African craton, spaned through an onegenic cycle during which deep sea sediments and volcanics were deposited in an unstable tectonic settling. Orogenesis, thus caused thrusting of rocks from east to west.

Bunke and Dewey (1972): Betrand and Caby (1978) worked in the south African part and sharai shield respectively and interpreted features along west African cratonic margin in terms of plate tectonics causing occurences of thrusted shield, dismembered ophiolites, positive gravity anomaly and that, there was collision between passive and active shields to east including Nigeria.

More recently, Turner (1983); Ajibade and Wight (1989) argued that the older granites of Nigeria cannot be explained in terms of one subduction zone because of the distance between the Nigerian basement and the cratonic margin. Thus they postulated that there must have been sutures in the basement that, the Togo—Benin—Nigerian basement represents allocthonous tenanes (collection) of different rock units) which were welded by Conies of continental collisions.

Geological Setting

The area under study is characterized by the rocks of the Nigerian basement complex. These rocks are mainly granites of different types which includes Leucocratic granite, granodiorite and biotite granite. The rocks occur as flat outcrop sometimes and have an average size of about 30x15m and forms hills occasionally.

Out of the three subdivisions of granites found in the study area, Leucogratic granite is most abundant and occupies about 50% of the total area mapped with superficial deposits in some areas. Biotite granite forms about 35—40% of the total mapped area and eqoahodiorite forming first 10% of the total mapped area at the North central portion

III. Lithology and Field Relations

General Description and Rock Types

The mapped area is made up of mainly granites. These are of three types and are part of the Older Granite suite emplace during the Pan African Orogeny.

The rocks are very well exposed, outcropping as inselbergs especially in the central portion of the area standing out of the immediate surroundings. They also occur as bouldery hills in many areas. The rocks are compositionally similar and can only be distinguished mainly by their textural relationship which has slight local variaitons. The granites were also intruded by pegmatites and quartz vein in some areas.

Leucocratic Granite

This is a light colored and homogenous coarse to medium grained granite. In the field, the rocks show evidences of weathering indicated by the scattered boulders of the rock on display on the outcrop.

Figure 1 In handspecimen, however, the predominant mineral is feldspar and quartz. Hiotite patches are also seen. In the thin section, the minerals identified are muscovite, plagioclase, quartz, Biotite, chlorite and microcline.

Quartz

This is a medium grained subhedral to enhedral crystal. It occurs in the intenstices between the muscovite and plagioclase.

Interference colors varies from white to grey to yellow. It has neither twinning, cleavage nor any form of mineral alterations. It constitutes a smaller composition in comparism with other minerals and forms about 20—25% of the rocks total mineral composition.

Mucovite

This forms one of the dominant minerals in the rock. It has a fan relief and shows a weak plleochroism. The crystal is

enhedral and tabular in shape. Under the analyzer, it shows interference colours ranging from pinkish blue to yellowish brown. It has a good twinning plane with alterations of minerals to flakes of sericites.

Plagioclase

This is a medium to coarse grained mineral. Interference colour ranges from light to dark grey. It exhibits twinning and good cleavage under the cross polar.

Chlorite

It has a green colour under high relief under plane polarised light. It occurs as anhedral, fine grained crystals. Under cross polar, it shows green interference colour and occurs as an alteration product of biotite.

Biotite

Biotite occurs as the least mineral constituent of the rock. It is subshedral to anhedral, pleochroic from brown to yellowish green or dark green in terms of interference colour under crossed polar.

Biotite Granite

These forms about 35 to 40% of the exposed outcrop in the mapped area. They are made up of mainly granites and granodiorites. They range from light to dark colours that are made up of dark, flaky minerals indicating abundance of biotite with quartz and feldspar.

They have a homogenous composition with local variations in grain sizes from medium to coarse grain. They are somewhat equigranular and show slight gradation southwards.

The rocks also have several joints which randomly cross—cut outcrops. These joints are filled with quartz veins appearing as dykes. The rocks are weathered to varying extents and have and approximate north—south trend.

In handspecimen, biotite granite is dark grey in colour, medium to coarse grained and equigranular.

In the thin section, the rock is medium to coarse grained. Essential mineral constituents are quartz, biotite, microchrie, epidote and opaque minerals.

Fig. 1. Showing the biotite component of the granite

Quartz

This forms up to 30% of ground mass as interstitial mineral. They are subhedral to anthedral grains seen as small, rounded irregular crystals with interlocking boundaries. They show strained extinction and have time grained pheriocryst textures.

Biotite

Biotite occurs as a dominant magic mineral in a lath—like pattern. It is medium grained (about 2mm) Biotite is pleochroic from yellowish green to dark brown.

Plagioclase

Plagioclase shows subhedral and rectangular crystals, exhibiting Lamellar twinning. They are clouded as a result of alteration or inclusion and are zoned.

Microcline

These have very large crystals, surrounded by muscovite and biotite grains. The show corss—hatch twining, anhedral and cloudy.

Granodiorite

Granodiorites are predominant in the North—central portion of the mapped are and constitutes about 10% of the mapped area.

The rocks are composed of quartz, microchie, plagioclase, biotite, muscovite and epidote.

Fig. 2. Granodiorite.

IV. Structural Geology

Foliation

No major structures were found in the mapped area. However, foliation is seen in only one location where gneisses and granites occured together as migmatites.

Fig. 3. This has alignment of shining mica and felsic minerals and is fine to medium grained. The medium to coarse grained granite on the other hand has feldspar grains randomly oriented and hence very weakly foliated or not foliated depending on the degree of grain orientation.

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Joints and Fractures.

Joints and fractures little almost all the outcrops in the mapped area. However, there are two sets of joints prominent in the area. One trends North—South and the other E—W crosscutting each other on moat outcrops.

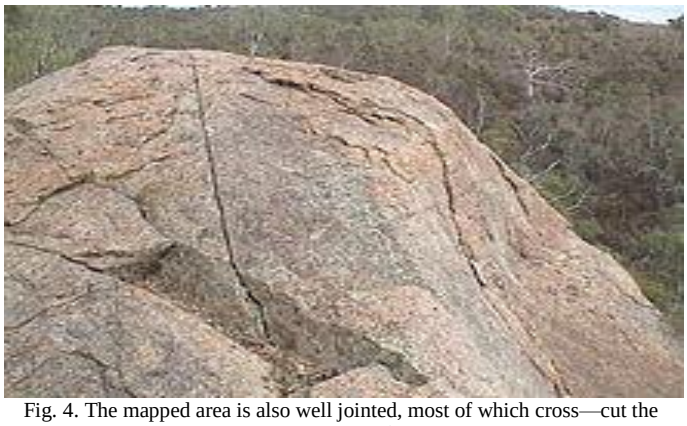

Fig. 4. The mapped area is also well jointed, most of which cross—cut the host granitic rocks and have been filled with quartz veins.

Folds

There were no major folds or faults in the mapped area. However, small recumbent and isoclinal fold with foliation parallel to the axial plane.

Fig. 5. Folds in rocks.

V. GEOLOGICAL HISTORY

The Nigerian basement has undergone a complex history of deformations and igneous activities that are yet to be unravelled.

Russ (1957), distinguished between the Older Granites, gneinic complex and the younger metasedimentary sequence which was folded, faulted and metamorphosed during which an earlier period of sedimentation, intrusion and metamorpism within the compled was recognized.

Grant (1969), recognized an ancient crystalline basement that has been reactivated during the Pan African Orogny during which the Older Granites suites was emplaced. Radiometric age dating from the cuptalline rocks in Nigeria are found to lie between 600±150 million years (Grant 1971).

Field relationships of three granites show that the granites have different ages (Ajibade, 1982) but are within the Pan—African (600±100 my) age spectrum.

Older Granites of the studied area may therefore represent reworked Older basement or deformed rocks that were partially melted and intruded as granites.

More recently, Turner (1983), Ajibade and Wright (1989), observed that the Older Granites are orogenic having calc—alkaline characteristics probably related to subduction zones. They therefore revealed that the Togo—Benin—Nigerian Basement of which the granites are part of the Older Granites suite of the Nigerian basement may represent allochionous terrains which became welded together by continental collision.

Origin and Emplacement of the Older Granites

The Older Granites suite of the Nigerian basement is relatively well studied.

The emplacement of this granite suite has been recognized as products of a major Pan African Orogeny that affected the Nigerian Basement complex.

Two modes of origin have been proposed for the Granite suite and the porphyritic granite in particular on the basis of field relations.

"Field relations show that the main phase of granite has been emplaced partly by intrusion and partly by replacement, though it is unclear which of these two modes predominate".

Jones and Hockney (1964). Similar conclusions were also arrived at by Stewartit (1953) Oyawoye (1959 and 1962) and Dempster (1965).

Cross—cutting field relationships, contacts of granites with the country rocks indicate granites were mostly intrusive in origin.

During the collision between the west African Craton and the Saharan Craton partial melting of the subduction slab is behaved to have led to the formation of various granite rocks which intruded into the Migmatite—gneiss and low grade schist belts.

Ajibade (1982) observed that there were three phases of granitic emplacement and that the rocks in the studied area probably belong to the first or first and second phases of emplacement.

Geology and Conclusion

The mapped area is poorly mineralized and the economic aspect of geology available in the mapped area is presently not fully exploited. The economic potentials of the geology of the mapped area is not fully exploited yet.

The major rock type is this area is granite and can be used for building and construction works.

Laterite

These are found in a few places. It can be used for rural ward surfacing. However, the iron content is very low for it to be industrially viable.

Quarrying

The mapped area has plenty of granite outcrops granites can be quarried and used for construction and building

purposes such as roads, dams, airports and residential houses. They could also be cut and polished for decorative purposes such as ornamental stones, tiles and granite tables.

Fig. 6. A quarry exists in Paiko although it is located outside the mapped area.

Clay

The mapped area has deposits of clay. The Chanchaga Clay Factory located at Paiko manufactures bricks and clay blocks for building constructions. This is the major geologically oriented economic activity in the mapped area.

VI. CONCLUSION

Field relationships have shown that granites are intrusive and of in a magmatic origin. The rocks of the mapped area are representative of the basement complex rocks of Nigeria.

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