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STRUCTURAL CHARACTERISTICS OF BASEMENT ROCKS IN KANYANG AREA, BOKI LGA, CROSS RIVER STATE

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ABSTRACT

Kanyang is part of Mukuru sheet 305NW, Boki Local Government Area of Cross River State. The area is part of the foot of the Bamenda massif of Cameroon extension into the Cross River Plain, which have undergone polyphase deformation. Field mapping and measurements of planar and linear features shows dominant trends in the N-S and NE-SW directions while minor E-W and NW-SE trends are also present. Three phases of deformational episode have been recognized D1, D2 and D3 with pinch and swell, ptygmatic and ghost structures in the rocks of this area. These small scale geological structures are in conformity with the orientation of Mbe Mountain which is a major topographical feature in the area. These structural imprints on the rocks in the study area are indicative of Pan-African orogeny in an extensional tectonic environment. The minor NW-SE trends are interpreted as signets of pre-Pan-African deformational events in the Kanyang area. The area is characterized by high temperature and pressure rocks which appear mainly as banded medium to coarse grained metamorphic rocks such as granulite, eclogite, schist, quartzite and ironstone. There is also unmappable dolerite intrusion in the area. Minerologically, the average modal composition shows that the rocks in the area consist of quartz, k-feldspar, plagioclase, sillimanite, augite, omphacite, and almandine garnet, as the major minerals while opaque are accessory minerals.

Keywords: Rocks deformation, metamorphism, magmatism, structural features, Pan African, Kanyang, SE Nigeria.

INTRODUCTION

Kanyang is located within the Boki Local Government Area of Cross River State. It lies between latitude 06 ^{o} 15’ 3.5’’N to 06 ^{o} 15’ 5’’ N and longitude 009 ^{o} 2’ 9’’E to 009 ^{o} 2’ 10’’E. Kanyang area form part of the Precambrian Basement Complex of the Southeastern Nigeria. They are flanked in the northeast-southwest (NE-SW) by Benue Trough and in the southeast by Cameroon Volcanic Line. The Obudu Plateau and the Oban Massif are the only Precambrian Basement outcrop in Southeastern Nigeria (Ukaegbu 2003, Ukaegbu and Oti 2005). It is flanked to the West by West African Craton (WAC) and lies to the Northeast of the Gabon- Congo Craton (GCC) (Wright et al., 1985). Oluyide (1988) observed that imprints of earlier structures are preserved in the basement rocks.

The Basement Complex of Nigeria comprises of migmatite gneiss, the schist belt (metasediment); the older granites (pan

African granites) and granitoids (granodiortes, charnockites and granites) and undeformed acid and basic dykes. For instance, Ferré et al., (2002) reported that the crystallization of granulite facies of the Pan-African northern Nigeria was possible because of the heat supplied from the abundant anhydrous charnockites and monzodiorites in the area. Egesi and Ukaegbu (2010a and b) observed that parts of Bansara and Mukuru has attained high grade regional metamorphism up to granulites facies metamorphism. The area is characterized by thick equatorial rainforest vegetation and rugged topography which may stand as a barrier to detailed geological studies. This paper aim to identify the rocks and structures within the Kanyang area.

Geological Setting

The area form part of the Precambrian belt of poly-deformation, which lies within the reactivated Pan African Basement Complex of Southeastern Nigeria. Kanyang area is accessible through the Ikom – Obudu highway which traverses through the entire length of the mapped area is the main road to the area and another dry season road from Boje-Ashuban-Katabang-Kanyang also traverse the area from the west (Fig.1.1).

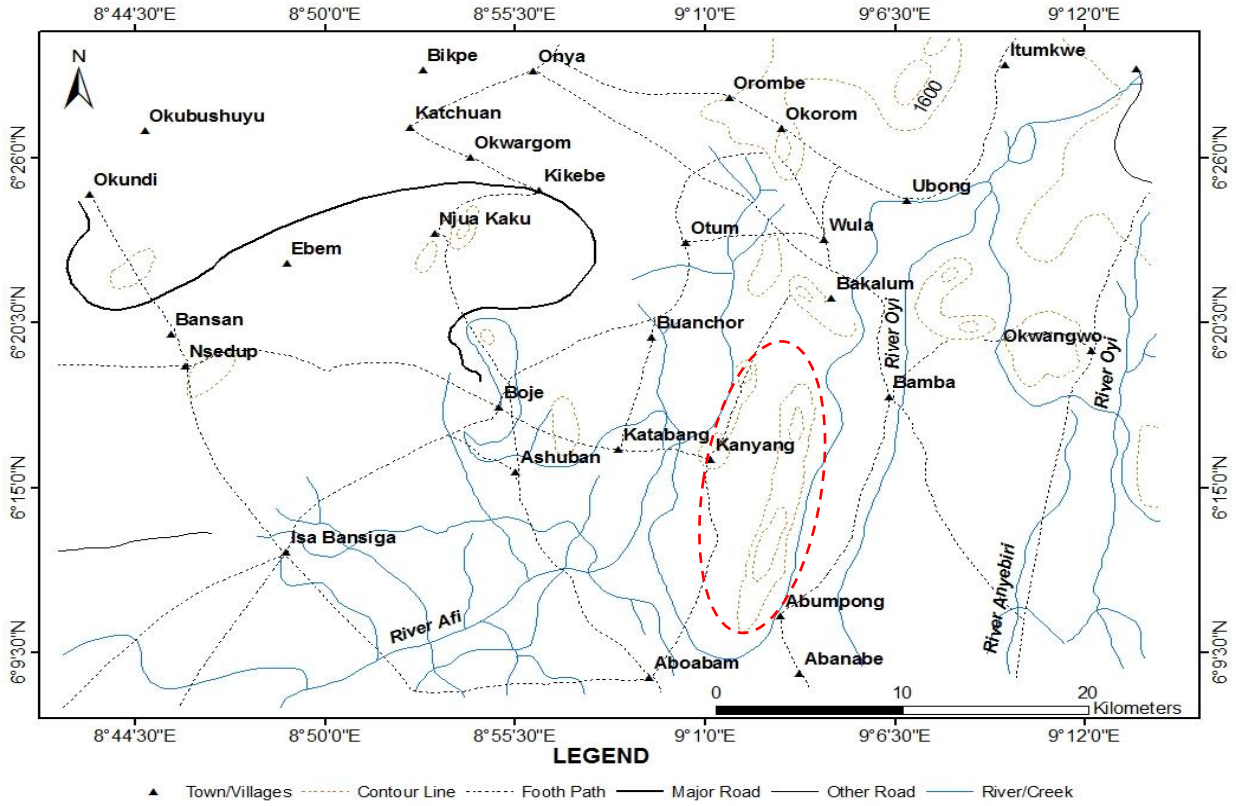

Figure. 1.1: Location Map of the Study Area, Boki L.G.A Cross River State.

The drainage patterns are radial and dendritic, the Afi river display youthful and mature stages of rivers classification on the highland with rapid downcut, high gradients waterfalls and irregular courses and on the lowland towards the south smother, longer

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profile, without waterfalls and rapids in the area. The vegetation of Kanyang 1 area is equatorial rainforest in nature (Iloeje, 1972). The rocks found in the study area are mainly granulites, eclogites, charnockites and minor dolerite intrusive. The rocks in the area have undergone varying stages of structural deformation which manifest as foliations, folds, faults, etc. caused by tectonism. (Fig.1.2) is the Geological map of the Kanyang area.

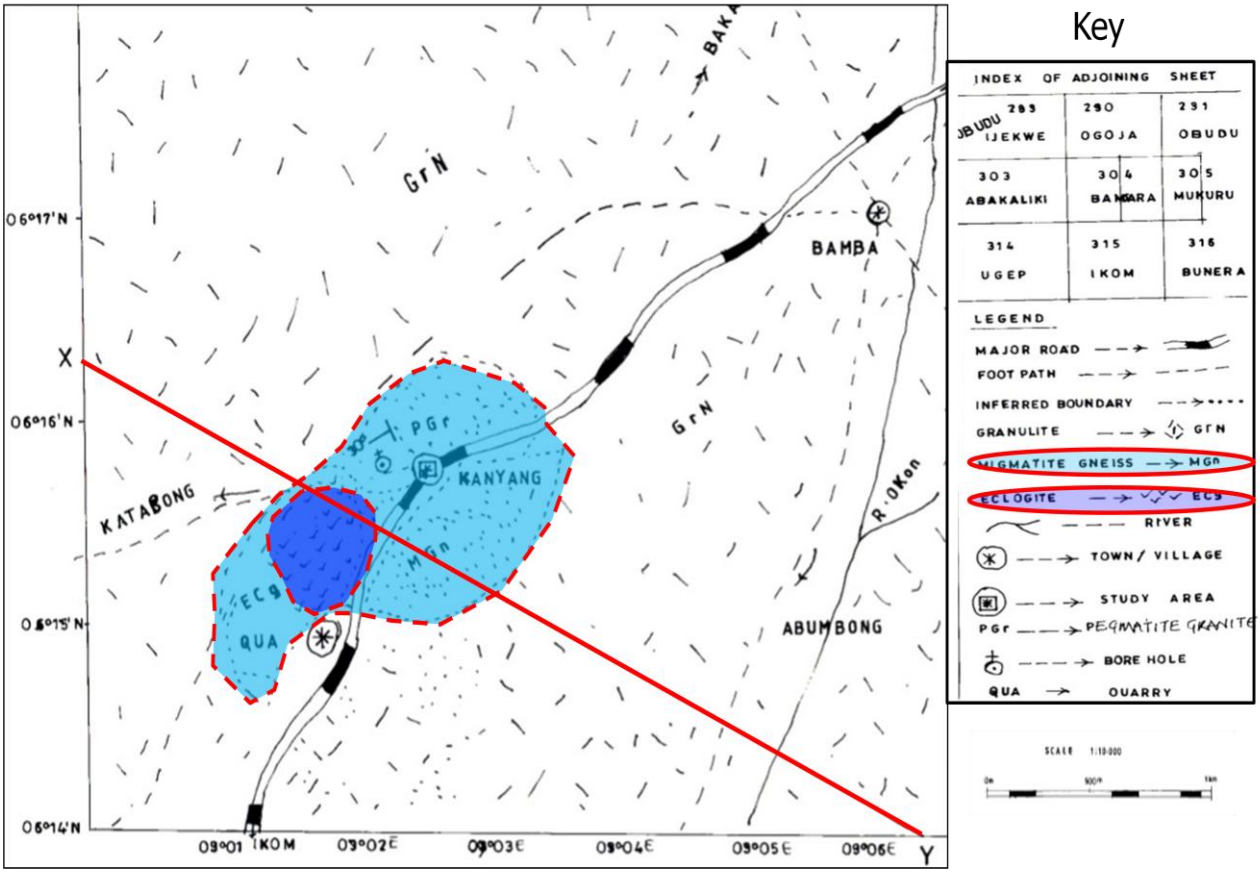
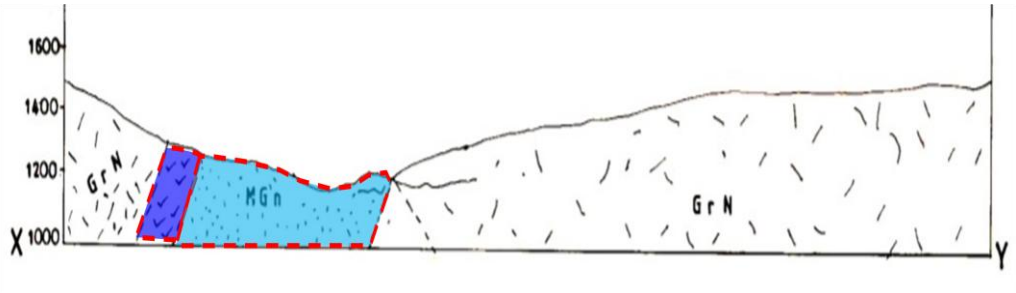


Figure. 1.2: Geologic Map of the Mukuru Area, Boki Southeastern Nigeria



Cross Section of X-Y

RESULTS

Petrology

Kanyang presents a wide variety of high-grade metamorphic rocks. Some of these metamorphic rocks are granulites, migmatites, schists and quartzites (Figs. 2 and 3). According to Ekwueme (1990, 1994) on the rocks of nearby Obudu Plateau and Oban massif, these metamorphic rocks were evolved by two phases of prograde metamorphism, which affected the study area. The first phase of prograde metamorphism was a widespread amphibolite facies metamorphism of Barrovian type during which kyanite and sillimanite assemblages were formed while the second phase of prograde metamorphism was also widespread but of a higher grade up to the granulite facies.

Figure 2: Field Photograph showing sharp contact between granulites and dolerite, the compass clinometer is on the granulites in Kanyang 1

Figure 3: Field Photograph showing dolerite intrusive at Kanyang 1.

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The granulites are characterized by very large crystals of garnet which can be chisel out, while eclogites consists of omphacite and opaque minerals in the study area. The rocks are light grey in colour and the foliation planes in these rocks trend predominantly in the N-S to NE-SW directions. However, relicts of NW-SE and E-W structural trends are present. Other structural features in these gneissic rocks include linear leucocratic features, normal fault, and pinch and swell Figs. 4 - 8.). Generally, the widespread rock in the study area is granulite with about 50%, quartzite about 15%, schist and migmatite about 35% and others such as dolerite <1%.

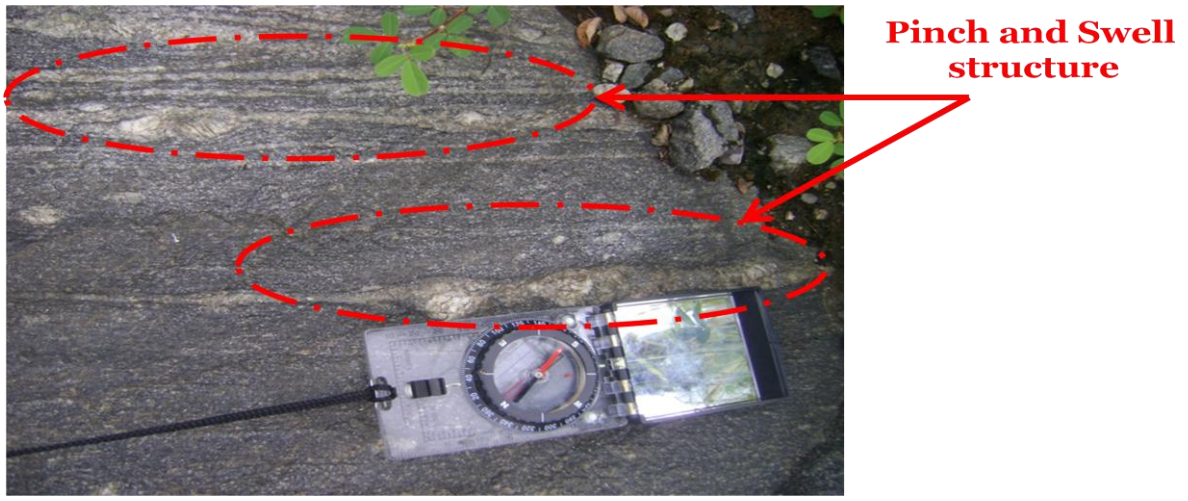

Figure 4: Field Photograph showing granulites with leucocratic linear, pinch and swell structures.

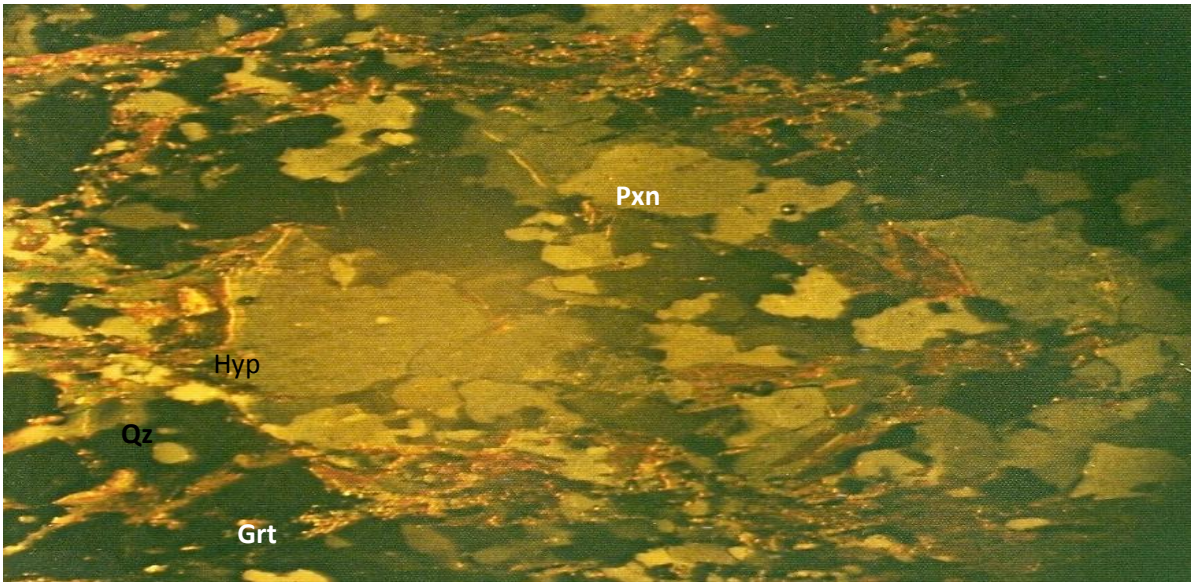

Figure 5. NE Sample Rock Type: Granulite Locality: Kanyang 1 (X40)

This rock contains mostly Pyroxene-hypersthene. The foliation is defined by aligned garnet mineral sandwiched between quartz grains.

The schists in the study area are not quite widespread and they are not as prominent as granulite rocks. They form low hills and are inundated with unmappable pegmatite and dolerite dykes. There are two varieties of schists in the study area namely: banded schist and banded garnet-mica-schists. Both types of schists are medium grained in texture, dark grey in colour due to the abundance of ferromagnesian minerals and they are usually highly
weathered. Foliation trends of quartzite in metasediments are pronounced (Fig.8).

Figure 6a: Field Photograph showing eclogite at Kanyang quarry.

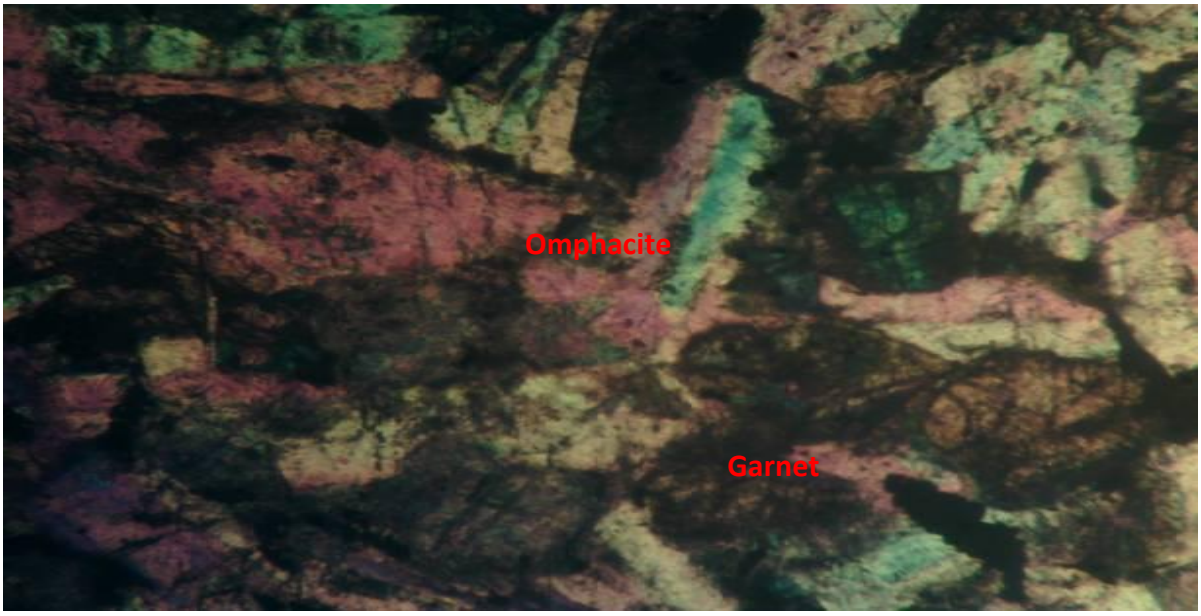

Figure 6b: Photomicrograph of eclogite at Kanyang area showing garnet and omphacite.

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Figure 7: Field Photograph showing granulites with pegmatite at Kanyang area

Figure 8: Lineated Quartzite in metasediments at Kanyang

Structural Geology

Nigerian Basement Complex is believed to have undergone deformation caused by tectonic activities which produced varieties of structural features on the rocks. In the study area (Kanyang 1), structural features like fractures, foliation, lineation, joints, cleavages, faults, folds, pinch and swell (Fig. 4) were observed. Figure 9 shows D1 linear stage, D2 ghost structure stage and D3 tight to isoclinal fold stage.

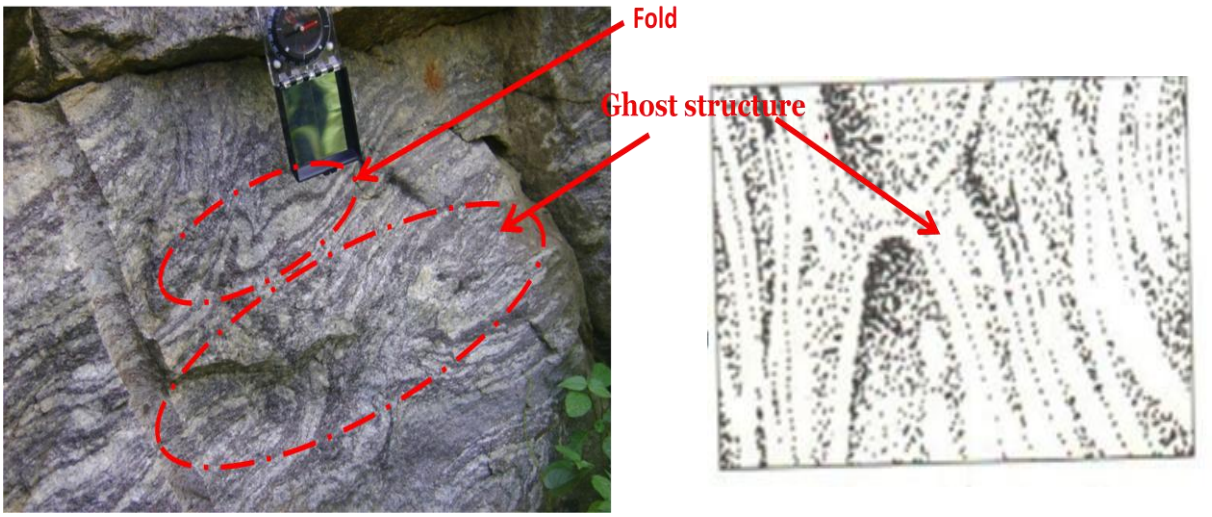

Figure 9a: Field Photograph showing granulite with folds and ghost structure at Kanyang.
Figure 9b: Ghost structure features Source; Bishop *et al., 2007*

Folds like recumbent, open, tight and isoclinals are present on the rocks. Quartz and feldspars (perthites and antiperthites) minerals are pre-dominant. The granulite consists of pegmatite component which forms layers or veins with clusters of mesoscopic feldspar and quartz grains. The ghost structure in granulites is in a N-S trend at Kanyang. The linear features fold axis, fault planes and quartzite minerals in granulite are trending mainly 20° to 45° NE-SW, indicating that they are structural imprints of the Pan-African Orogeny and they are the most predominant. While the NW-SE trending linear features of quartzite are the minor subordinate trends indicating that they are signet of Pre-Pan African events (Figs 10 and 11).

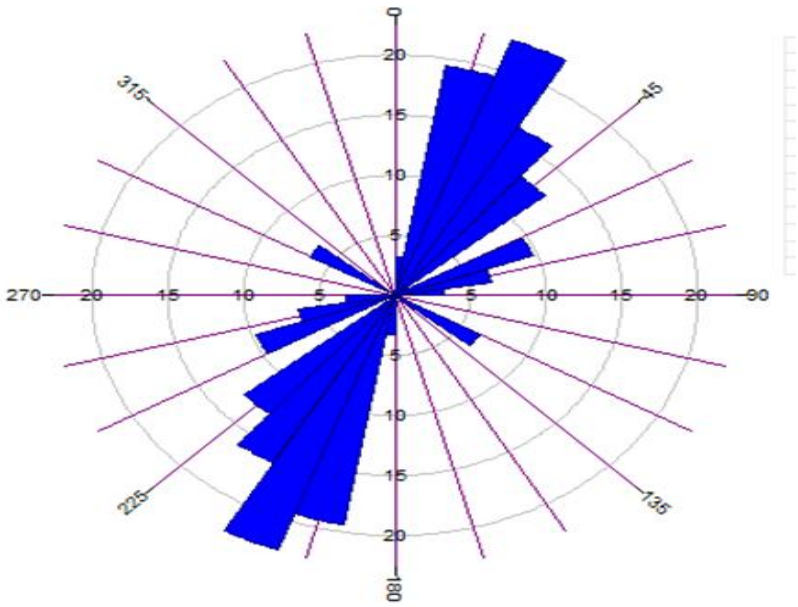

Figure 10: A Rose diagram showing lineation trends in granulites in NE-SW direction at Kanyang

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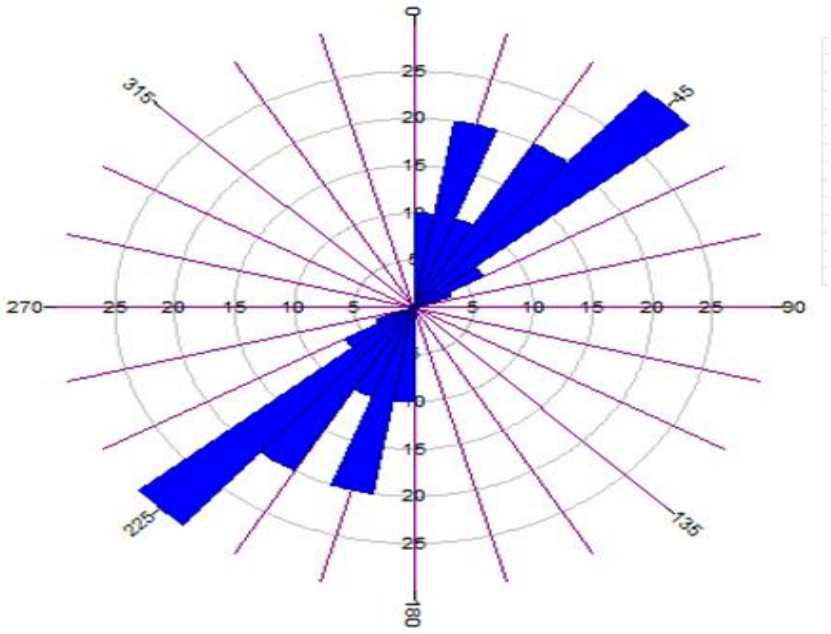

Figure 11: Rose diagram showing foliation trends in granulites for mainly trending NE-SW at Kanyang 1.

DISCUSSION

According to Orajaka (1971), the igneous rocks in the Obudu area are enderbite. Udo (1988), using satellite imageries observed fractures increases from west to east in southeastern Basement Complex and Egesi and Ukaegbu (2010b, 2013) using ground-truthing also confirmed it in parts of Bansara and Mukuru areas. The metamorphic rocks are strongly deformed in a N-S to NE-SW direction with ghost structures, pinch and swell structures, ptygmatic veins, showing evidence of extensional tectonics. No visible contact relationship between the granulites, migmatitic gneisses and schists was observed. From the interpretation of the results, the structural features (folds, fractures, mineral lineation, foliations) all mainly trend N-S to NE-SW directions with 20° to 45° which is similar with the research work of Ekwueme (1990), Egesi and Ukaegbu (2013) and lineament studies of Edet *et al., (1994*). The foliation trends are attributed to the Pan-African orogeny, which produced the most penetrative deformation observed in the study area. The structural features that trend in the E-W to NW-SE are referred to as relicts of the pre Pan-African orogeny. The Pan-African granitic rocks intruded the pre-existing lineaments in the area Ukaegbu (2003).

The Pan-African Orogeny which was a widespread deformational event in the West African Craton, produced major foliation directions with N-S to NE-SW trending structures in Kanyang area. The area is probably a geosuture zone as shown by the prominent Afi Mountain and Afi River in a N-S trending direction to the west. Foliations in Kanyang area are strong and pervasive, especially as noted in the N-S regionally trending of Mbe Mountain to the east. The result from the rose diagram shows that the foliation direction is mainly trending from NE-SW. The structural features D1, D2 and D3 indicated on the

ghost structures, and metamorphic aureoles observed in the area are probably related to the last deformational events (Pan-African orogeny) in the study area.

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