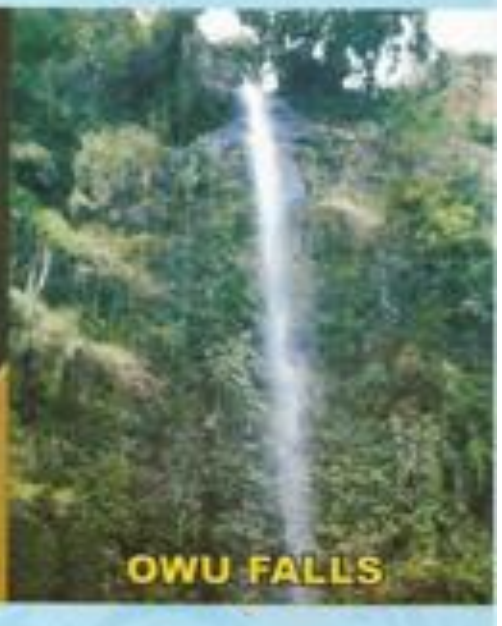
NIGERIAN MINING AND GEOSCIENCES SOCIETY
(NMGS)

52nd Annual INTERNATIONAL CONFERENCE & EXHIBITION



ILORIN 2016

FIELD EXCURSION GUIDE

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OKEGBALA-OREKE QUARTZITE RIDGE AND OWU FALLS

INTRODUCTION

The 52nd International conference of the Nigerian Mining and Geosciences Society holding in the west central Nigerian city of Ilorin, tagged Ilorin 2016 is an annual gathering of geoscientists in Nigeria as well as international participants. One core aspect of this annual gathering of Geologists, Mining Engineers, Petroleum Geologists and other affiliated professionals is field excursion which gives ample opportunity for enriching participants of the local geology of the host location. The choice of the excursion routes for this year has three areas in focus. The opportunity to understand the interesting cultures of the area, the rich geology that the metasediments and their tectonic significance to our understanding of the global perspectives of western Nigeria Pan-African historical reconstruction, and lastly the recreational ecstasy provided by the dissected quartzite ridge that created the over 120m high Owu Falls. This excursion is designed to give participants a most rewarding experience, fulfilment and a worthwhile culmination of this international conference. The route from Ilorin to Oke-Onigbin, Okegabala, Ijara-Isin, Isanlu-Isin-Kajola back to Isanlu-Isin through Owa Onire and terminating at the Owu Falls (Figure 1) promises to be a wonderful educational as well as a tourist landmark journey for not just members and participants but for members' spouses and investors alike.

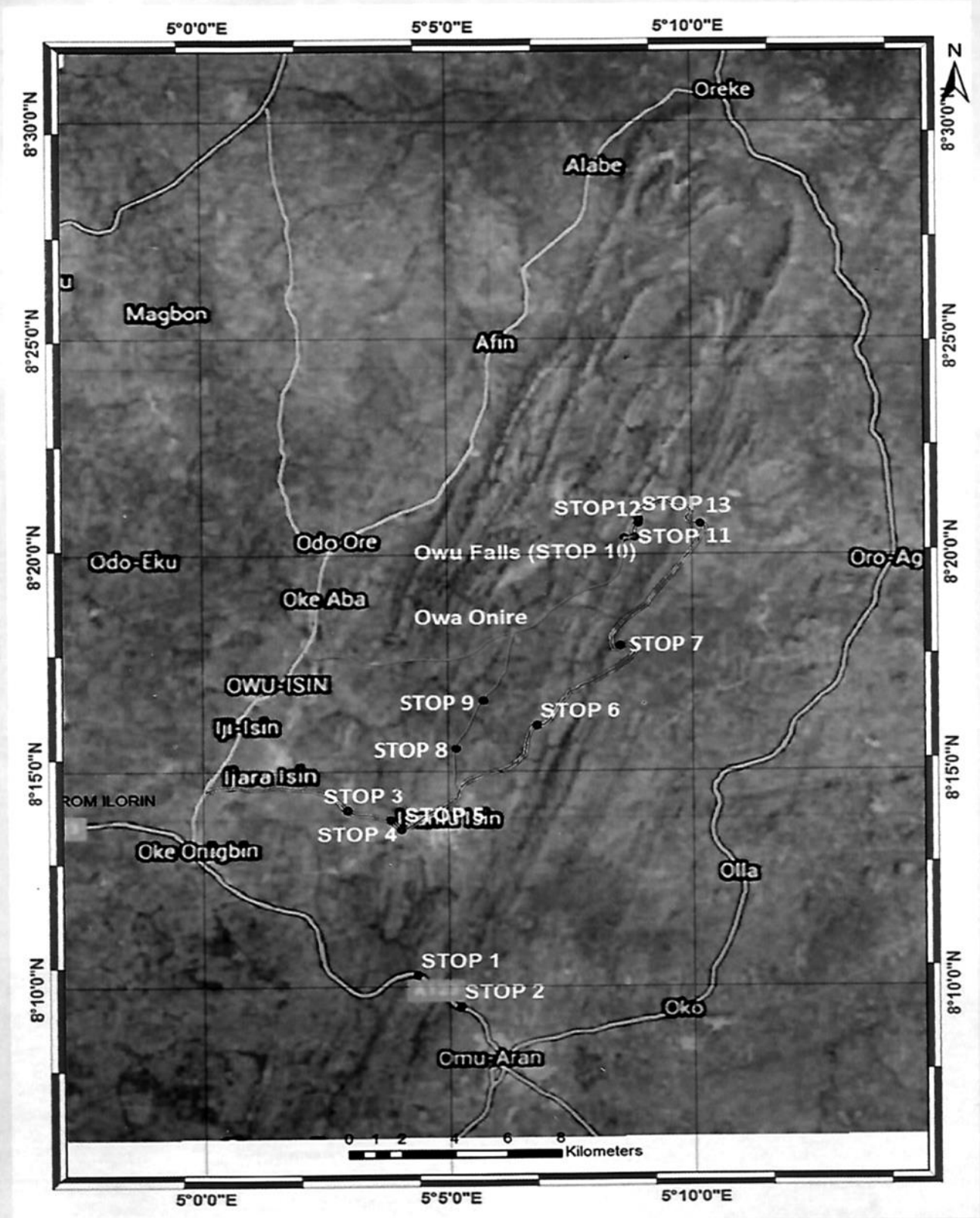


Figure 1: Google Earth Map of Omu-Aran-Oreke area showing the outline of the quartzite ridge.

Regional Geology

Oyawoye (1965, 1972), Rahaman (1971, 1976), Cooray (1972), McCurry (1976), Elueze (1981), Caby (1981), Olarewaju (1982), Dada (1989, 1998 and 1999) previously studied the general geology and geochronology of the basement rocks of Nigeria. The crystalline rocks in Nigeria are distributed in a circular area in the north central, a roughly triangular area in the west which runs into the Benin Republic, and a rectangular area broken into three parts by sedimentary cover rocks on the eastern border of Nigeria with Cameroun Republic. The crystalline rocks are divided into three main groups: Basement complex, Younger granites and Tertiary to Recent volcanics. The Precambrian rocks of Nigeria, collectively known as the basement complex, are exposed in nearly half the total area of the country. The other half is made of Cretaceous and younger sedimentary cover rocks (Fig. 2). Basement complex rocks are subdivided into Migmatite-Gneiss complexes; the Older Metasediments; the Younger metasediments; the Older Granites (Pan-African Granitoids); and the Younger Granite (Mesozoic) alkaline ring complexes and volcanic rocks.

Polycyclic Migmatite-Gneiss Complex (MGC)

The Migmatite Gneiss Complex (MGC) is the commonest rock type in the Nigerian basement. It comprises two main types of gneisses: the biotite gneiss and the banded gneiss. Very widespread, the biotitic gneisses are normally fine-grained with strong foliation caused by the parallel arrangement of alternating dark and light minerals. The banded gneisses show alternating light-coloured and dark bands and exhibit intricate folding of their bands. The Migmatite Gneiss complex is the oldest basement rock now profoundly altered by metamorphic and igneous processes.

The petrological division of the MGC includes: A grey foliated biotite acid or biotite hornblende quartz feldspathic gneiss of tonalitic to granodioritic composition, which is also known as the "grey gneiss" (Rahaman, 1981). Mafic and ultramafic components which when present, often outcrop as discontinuous boudinaged lenses or concordant sheets of amphibolites with minor amounts of biotite-rich ultramafic. Except where it constitutes the palaeosome to the migmatite, these are present in grossly subordinate amounts to the grey gneisses. Felsic components are a varied group of rocks consisting essentially of later intrusions of pegmatites, aplite, quartz-oligoclase veins, fine-grained granite gneiss, porphyritic granites etc. The three components may or may not be present together on a single outcrop. The Migmatite Gneiss complexes are Archaean (Dada, 1989; Bruguier *et al.*, 1994; Kroner & Ekwueme, 2002). Another important type of migmatite in the Nigerian basement is the Agmatite, in which schistose or gneissic rocks (palaeosome) are dissected into irregular blocks by quartzo-feldspathic dykes and pegmatites (metasome) (Oyawoye, 1970).

Metasediments

The Palaeoproterozoic Older Metasediments (Oyawoye, 1972) which are of sedimentary origin and have undergone prolonged, repeated metamorphism; and now occur as quartzites (ancient sandstones), schists, marble (ancient limestones), and other calcareous and relics of highly altered clayey sediments and igneous rocks. Ferruginous quartzites and talc schists also occur.

Most parts of the Basement complex are underlain by belts of roughly north-south trending, slightly metamorphosed Neoproterozoic sedimentary and volcanic rocks known as the Younger Metasediments. The major rock types are ancient shaly rocks now quartz- biotite-muscovite schist. These change laterally

into coarse-grained feldspar-bearing micaceous schists. Others are schists with graphite, phyllites and chlorite. The metasediments contain most of the gold deposits in Nigeria in the northwest around Maru, Anka, Yauri and Birnin Gwari (SW of Kaduna); and those of Okolom, Alagbede, Iperindo and Itagunmodi in southwestern Nigeria.

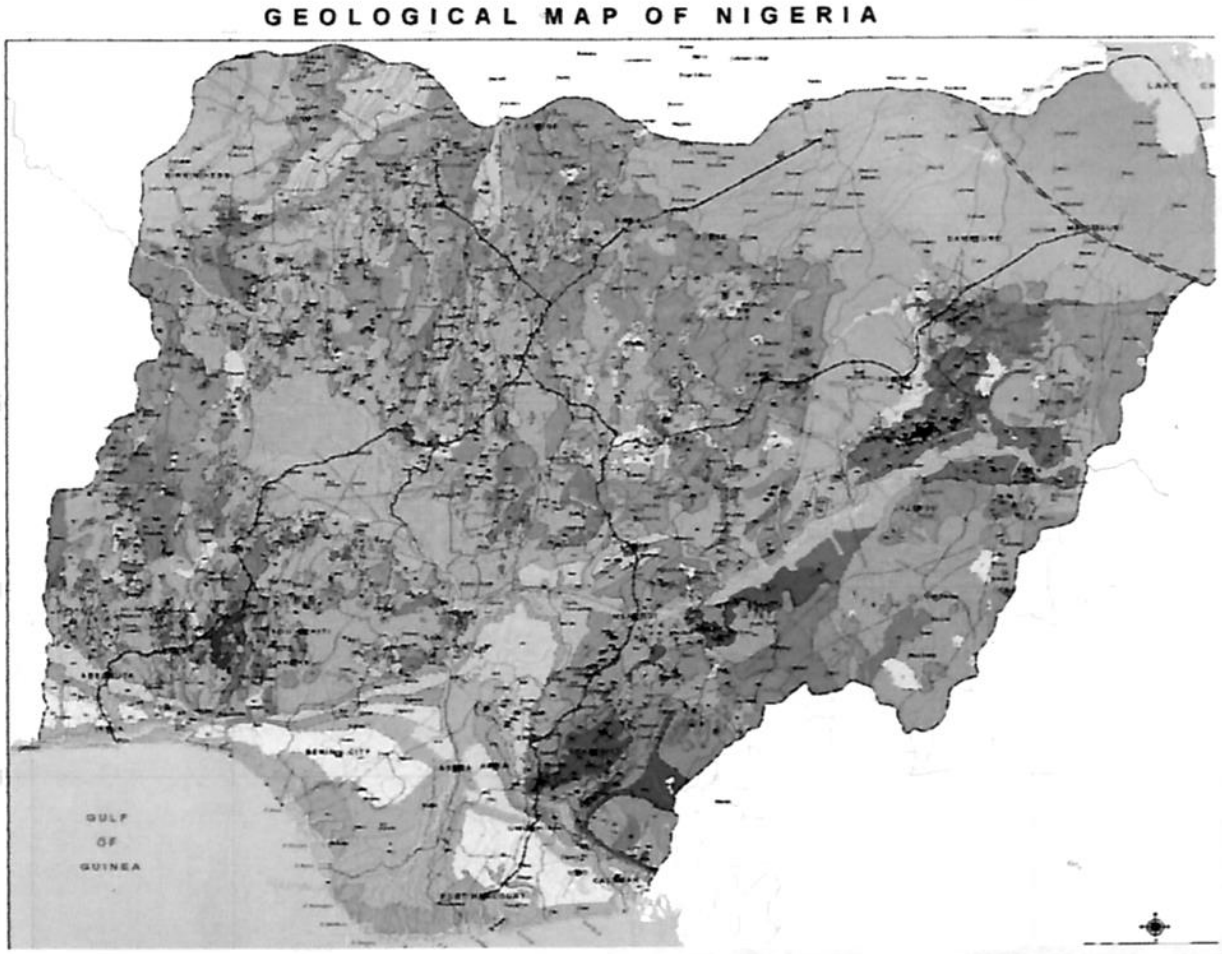


Figure 2: Generalized geological map of Nigeria (Nigeria Geological Survey Agency)

Pan African Granitoids

The term "Pan African granitoids" covers a group of rocks that include biotite and biotite-muscovite granites, syenites, charnockites, diorites, monzonites (Bauchite), serpentines, anorthosites, etc. previously called "Older Granites" as

a name introduced by Falconer (1911) to distinguish this suite of rocks based on morphology and texture from Jurassic, anorogenic, peralkaline "Younger Granites" in north central Nigeria. There is enormous variety in the granite composition of these rocks. The Older Granites, e.g. the coarse-grained biotite-hornblende granites, have concordant foliation with the MGC or schists (Oyawoye 1965) though they vary in composition, texture and colour. They are widespread throughout the Basement Complex and occur as large circular masses within the schists and the older Migmamite Gneiss complexes.

Regional and Local Structural Aspects

The regional structural geology of the Nigerian Basement Complex has been reviewed over the years dating back to the work of Oyawoye (1972), through extensive modification to the present Nigeria Geological Survey Agency map. The polycyclic basement has developed and preserved variable and distinctive trends since the Archaean to the Pan-African. N-S planar structures have been thought to be the dominant trends in the basement, with sub-optimal relicts of EW-NE-SW and NW-SE trends (Oyawoye, 1972).

According to Ball (1980), the Pan-African tectonic event is marked by NNE-SSW and NW-SE conjugate fracture systems of strike-slip faults mostly with sinistral sense which cross cut older structures including N-S basement trends.

The general trend of discussions on the Nigerian basement structures is the consensus that the several generations of folding precede the fracture systems which were exploited probably by the Pan-African plutonism (Oluyide 1988).

Details of the systematics involved in the stress related strain records of the polycyclic basement rocks needs to be closely studied in order to categorically

assess the evolution of the rocks. The significance of the study of the tectonic setting of the basement is that it adds geological juice to our interpretations.

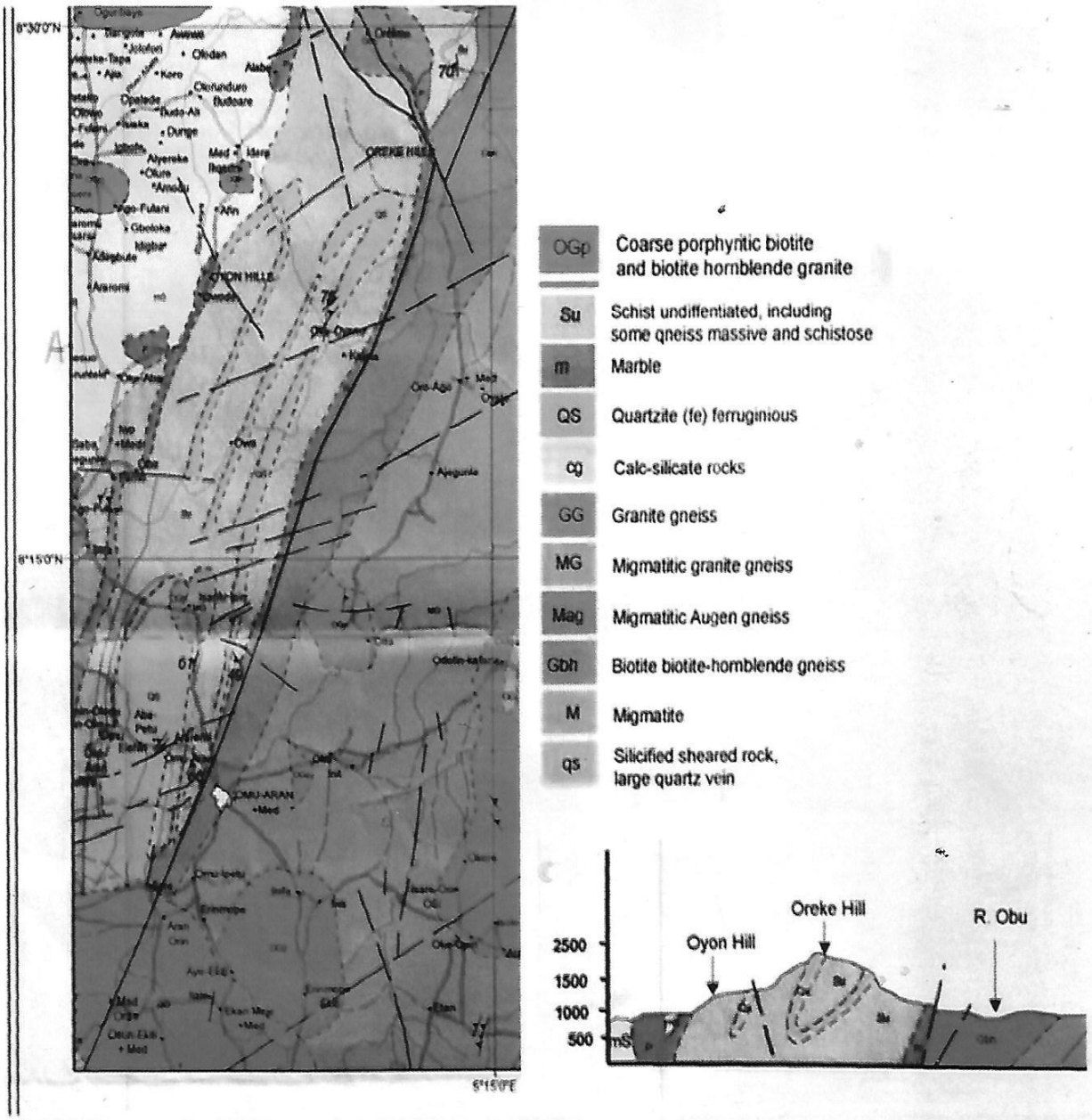


Fig. 3: Geological Map of Okegbala-Oreke NE-SW fault zone (Nigeria Geological Survey Agency, 2008

OUTCROP DESCRIPTIONS/GEOLOGY OF THE OKEGBALA - OKERE AREA

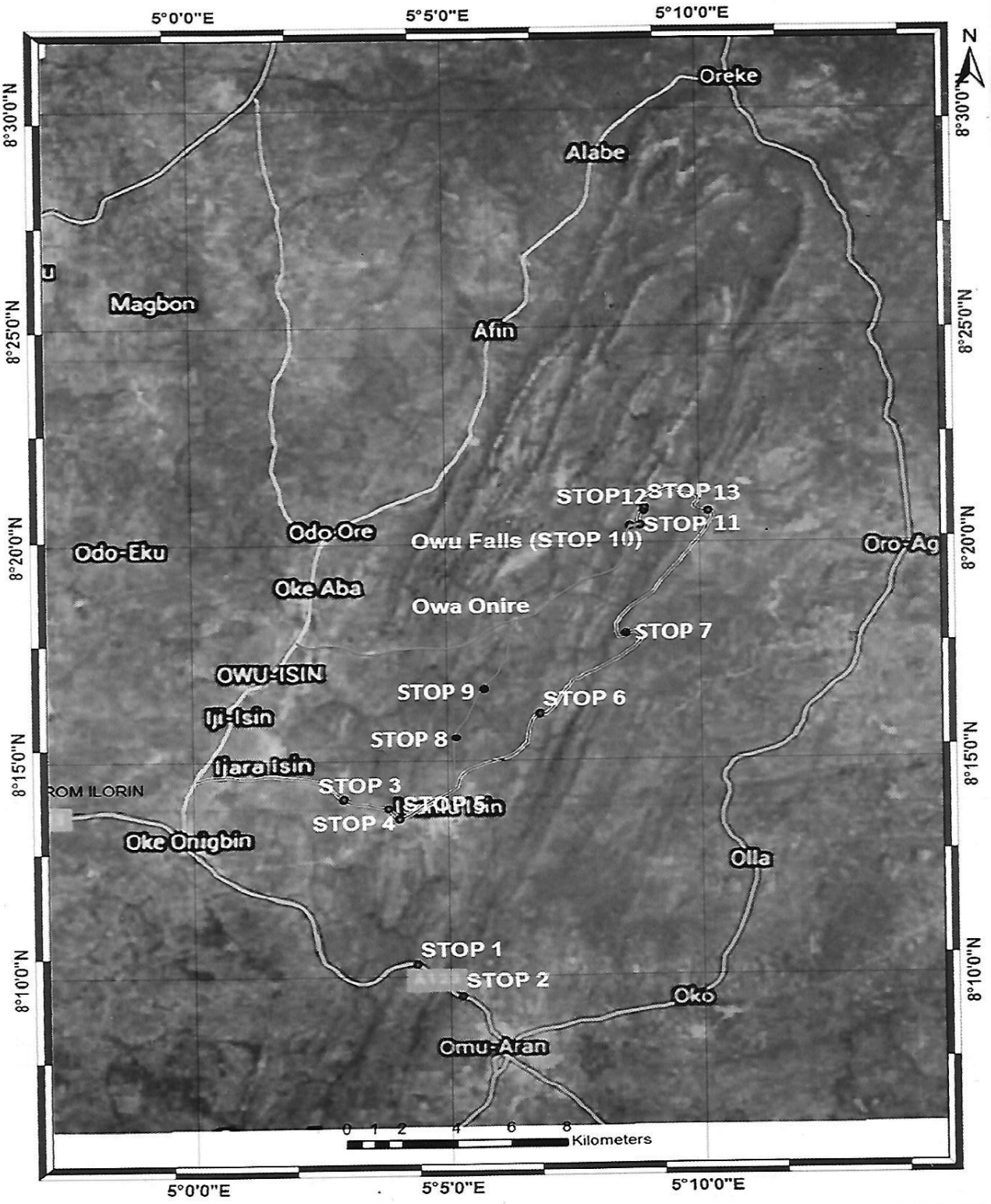


Figure 4: Google Earth Map Showing Location of Stops.

Stop 1: Road cut along the Ilorin – Lokoja Highway.

Latitude: N8° 10.401`

Longitude: E5° 4.257`

This is an interesting exposure which clearly suggests that the Okegbala – Oreke quartzite ridge is an anticlinorium. It probably represents the axial surface of the fold defining a NNE-SSW trend and with limbs dipping to the west and east. Several sub-vertical fractures trending ESE-WNW are observable.



Figure 5: Picture of quartzite body defining an anticlinal structure.

Stop 2: Road cut about 2km southeast of Stop 1

Latitude: N8° 09.661`

Longitude: E5° 05.073`

At this location, highly quartzitic bodies are exposed. They stand out between the weathered more schistose rocks. Here the dips are exclusively eastwards, a marked deviation from the dominant westerly dips observed in other places.



Figure 6: Quartzite body showing easterly dips.

Stop 3: Road cut along the Ijara Isin – Isanlu Isin road.

Latitude: N8° 14.096`

Longitude: E5° 2.952`

This quartzite ridge exposed at a road cut displays foliations ranging in size from 10mm to 20cm thick. Lithologically, the foliation is defined by pellitic or psammitic layers alternating with light muscovite-quartz bands. The quartz-muscovite bands in places are about 20cm thick. The nearly N-S foliations dip sub-vertically (60°-75°) to the west. The ridge appears to be gently folded with the fold axis concordant with the general strike of the foliation planes. The westward dips have been generally truncated by 110° fracture systems.

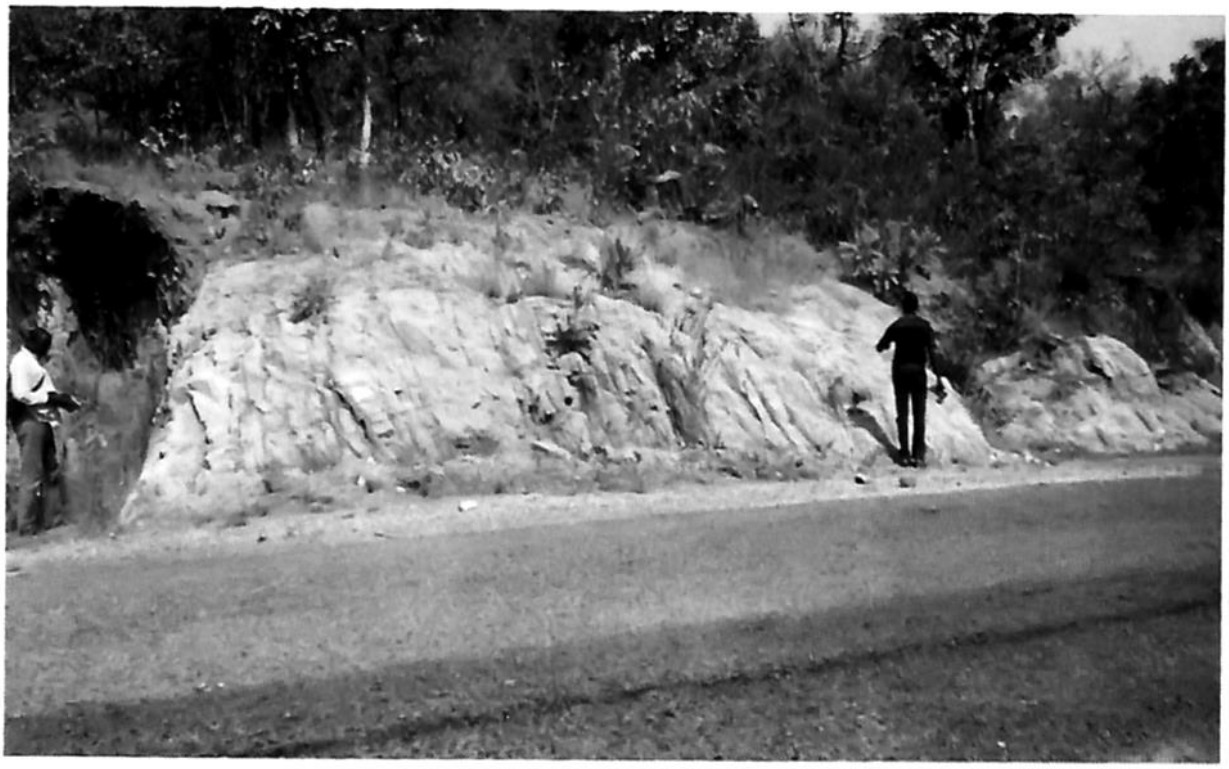


Figure 7: Westward dipping quartzitic bodies along Ijara-Isin – Isanlu-Isin road

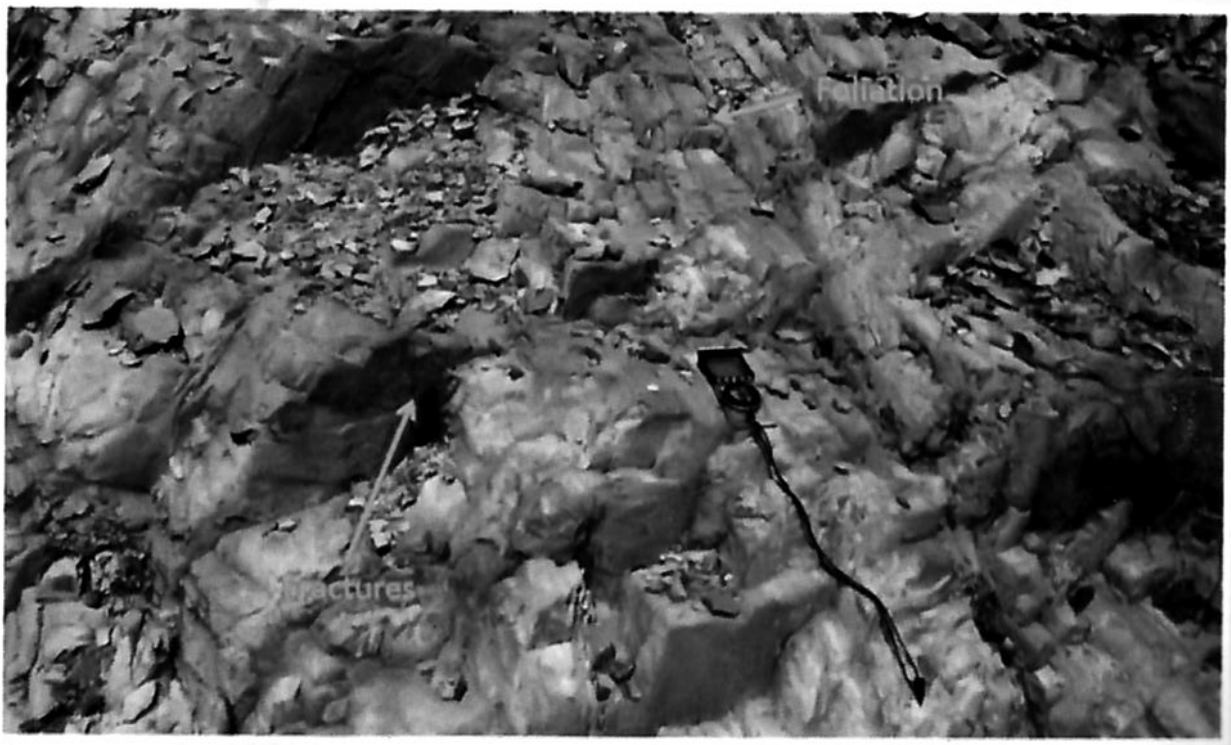


Figure 8: (ENE-WSW) fractures showing relationship with approximately (N – S) foliation

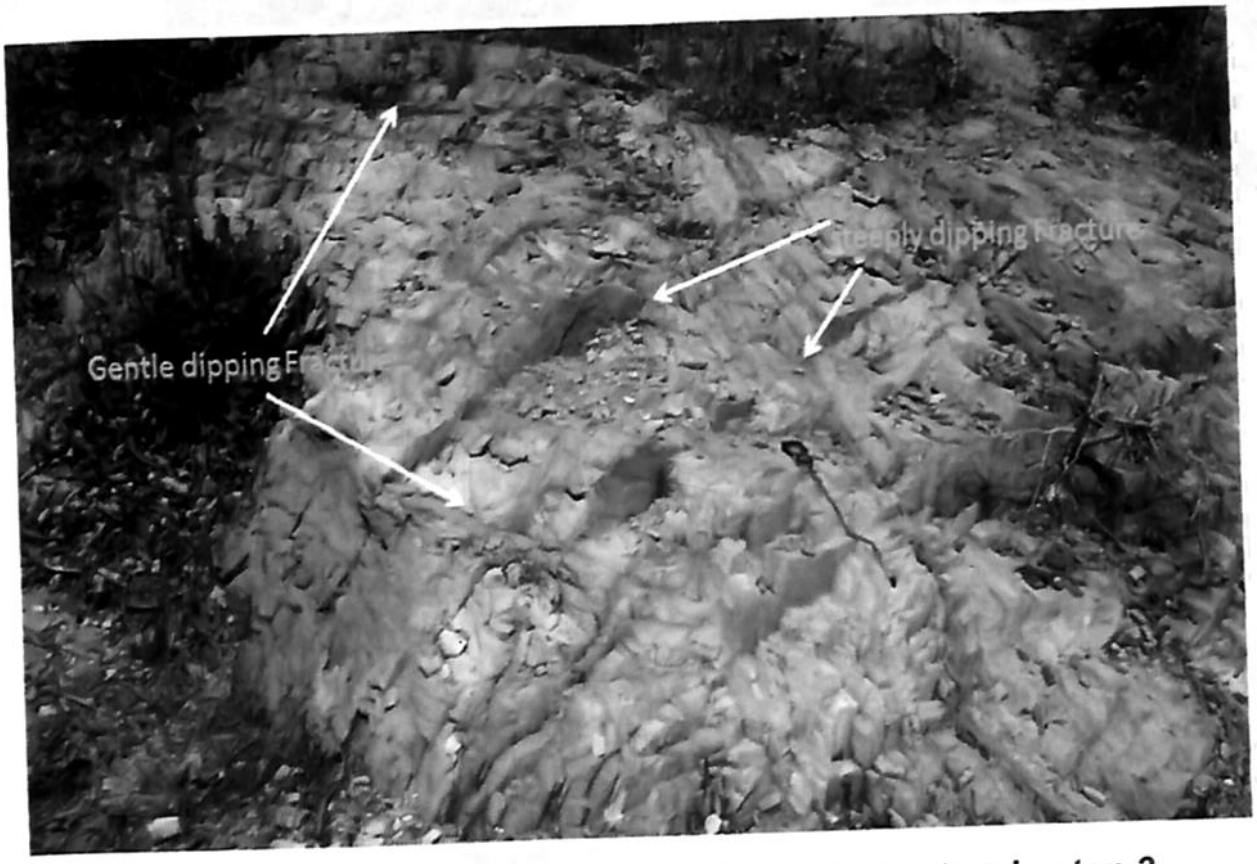


Figure 9: Picture showing the prevalent fracture system in stop 3

Two sets of fractures are prominent at this stop. The averagely E-W (91°-100°) southwards, steeply dipping fractures with values reaching 82° while the NNW SSE (140°-175°) set have more gentle dips of about (14°-40°) in the NE.

Stop 4: Road cut 2 along the Ijara Isin – Isanlu Isin road.

Latitude: N8° 13.837`

Longitude: E5° 3.829`

This location represents another fairly well exposed body of foliated quartzitic rocks. The exposure stretches for about 60m, with a consistent approximately N-S trend. It is characterized by extensive vertical-sub vertical fracturing also in the N-S and E-W directions. The foliations possess a trend of approximately 030° with dips of about 66° in the WNW direction.

N065°E trend with near vertical dips. Some of the quartzitic bands appear to be selectively lateritized.



Figure 11: North-South trending quartzitic bodies.

Stop 7: Road cut exposure of massive quartzitic body

Latitude: N8° 17.838`

Longitude: E5° 8.283`

Massive quartzite bodies exposed at the break of slope on a road-side cut along Isanlu-Isin – Kajola road showing two main joint sets which trend 276° and 294°. Here, the N-S trending rock outcrops in thick massive bands with a steep dip westerly.

Stop 8: Low ridge, quartzitic body along Isanlu-Isin – Owa Onire road

Latitude: N8° 16.960`

Longitude: E5° 6.630`

Along Isanlu-Isin – Owa Onire road, large in-situ angular boulders constitute a foliated quartzitic ridge which trends NNE-SSW over a distance of about 200m (with foliation strikes ranging from 015°-020°) and dips steeply westerly by 65°. The ridge outcrops for about 100m above the undulating country. Foliation is defined by alternating quartzitic and micaceous bands. Two main fractures here exhibit steep dips of about 78° with 118° and 138° strike orientations.

Stop 9: N-S trending quartzitic ridge along Isanlu-Isin – Owa Onire road

Latitude: N8° 17.708`

Longitude: E5° 6.677`

This is the northern extension of stop seven exposed along Isanlu-Isin – Owa Onire road where large in-situ boulders form more prominent N-S trending quartzitic ridge. Foliation here is also defined by alternating quartzitic and micaceous bands which dip westerly by 68°. Trends of two major joints are 100° and 115° dipping steeply by 80°.

Stop 10: Owu Falls

Latitude: N8° 20.393`

Longitude: E5° 8.610`

The Owu Falls showcases a classical water fall of an approximate height of 120m. This is defined by a quartzitic cliff face with open fold patterns close to the base. This site presents a unique geotourism spot. The geomorphology and hydrologic systems may also be discussed by participants.



Figure 12. Panoramic view of the Owu Falls.

Stop 11:

Latitude: N8° 20.412`

Longitude: E5° 8.678`

As we ascend away from the base of Owu Falls, more outcrops of quartzite with trend of N340°E and a WSW dip of over 80° are exposed.

Stop 12: A road cut showing a highly fractured quartzitic body.

Latitude: N8° 20.478`

Longitude: E5° 8.798`

This exposure displays an array of consistent fracture planes approximately parallel to the foliation planes of the quartzitic body. The general trend of the foliation is N300°E with dips of 50° to the SW direction. The fractures range from N300°E to N320°E with dips of up to 80° in a generally northeasterly direction.

Stop 13: Highly fractured and folded ridge along Owu Falls – Kajola Road

Latitude: N8° 20.465`

Longitude: E5° 8.892`

Here the dominantly near N-S foliations begin to define a "wavy" pattern. This have been remarkably dissected by numerous bi-directional fractures intersecting approximately perpendicular to each other. The two dominant fracture trends are N30°E and N110°E. The N110°E fractures clearly dominates and dips at an angle of about 60° towards the north. This stop provides a platform for participants to appreciate the role of tectonism in the development of cliffs and valleys which provided an ideal landscape for the Owu Falls.

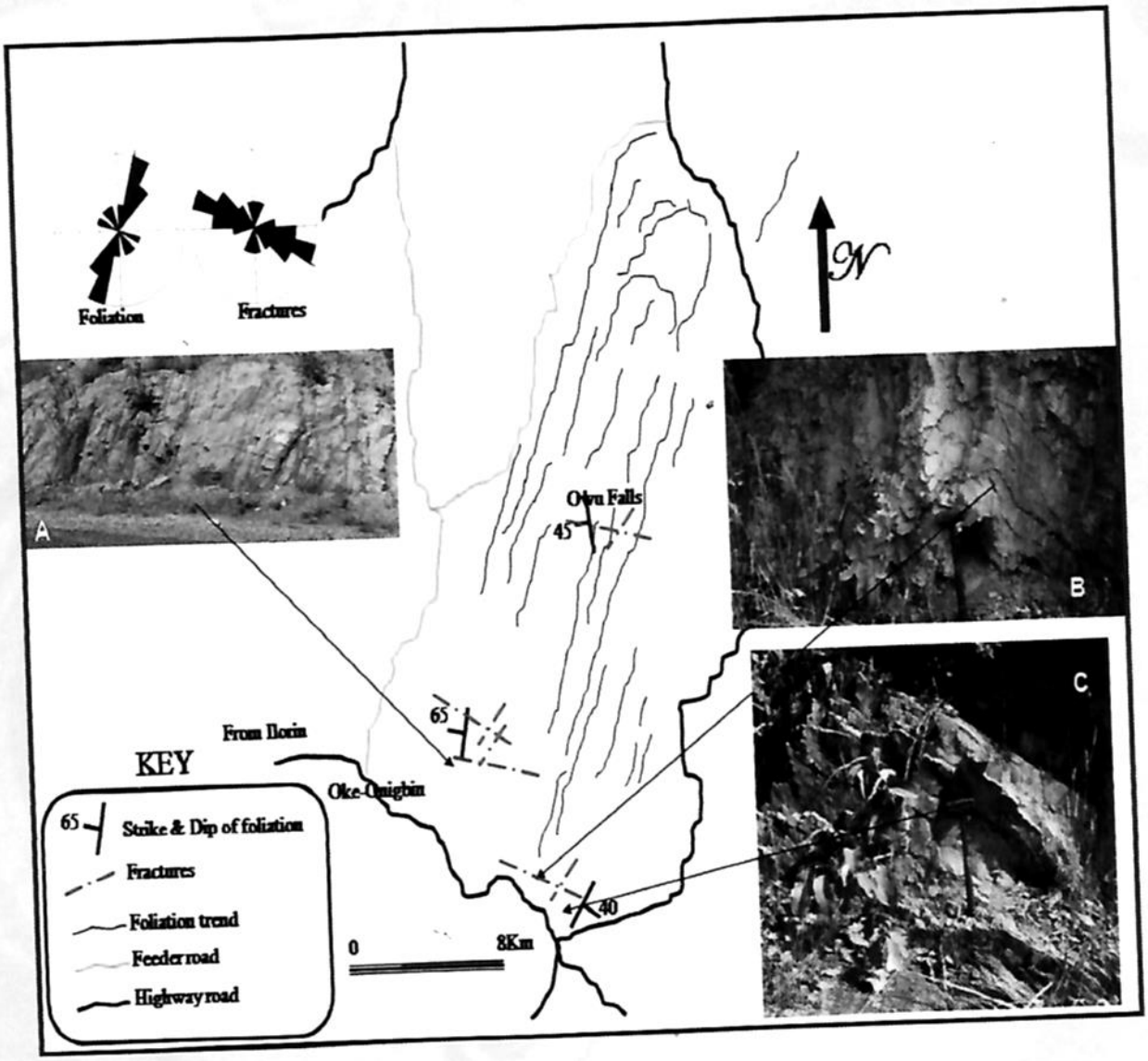


Figure 13: The structural outline and trend of different sections of the Okegbala-Oreke quartzite ridge. A: westward dipping west of the ridge; B: folding along the axis of the ridge and C: eastward dipping east of the ridge.