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A NOTE ON THE GEOMORPHOLOGY, GEOLOGY, ORIGIN AND ECONOMIC POTENTIALS OF OWU WATERFALL, OWA-KAJOLA, SOUTHWESTERN NIGERIA

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ABSTRACT
The Omu-Aran quartzite ridge is part of the surface expression of a major, deep-seated, regional dextral fault in south-western Nigeria- the Ifewara Lineament. This structure is host to the magnificent Owu waterfall which has attracted visitors from all walks of life both locally and internationally. The geomorphology, scenery and other side attractions make the waterfall a place to visit at any period of the year. The origin of the waterfall is attributed to the inter-banding of micaceous lithologic layers with the more massive quartzite layers; multiple fractures; intense weathering; and erosion. This spectacular waterfall, which is a potential source of revenue, is grossly underutilized compared to other tourist centres in the country as a result of poor attention from governments and private investors. The great potential as a tourist attraction with its attendant side attractions as well as a source of electricity will not only serve as a source revenue generation and improving the economy of the surrounding communities, but will also generate fund for government and reduce, to a notable extent, the problem of rural-urban migration.

Keyword: *Geomorphology, waterfall, ridge, origin, potentials*

1.0 INTRODUCTION

The Omu-Aran Quartzite Ridge in south-western Nigeria is a gigantic ridge of regional extent (Fig. 1), which is an extension of the Ifewara- Iperindo- Illa-Orangun-Omu-Aran regional quartzite ridge (Adedoyin et al, 2019; Akinde et al, 2019). This mega structure is a lineament, the Ifewara-Zungeru Lineament, that is now occupied by ancient meta-sediments which have been severely deformed and largely infolded into the pre-existing rocks of the Migmatite-Gneiss Complex upon which the original sediments were deposited. The lineament is associated with the principal intercontinental fractures that are associated with the tectonic evolution of the Trans Saharan Belt of Africa and the Boborema of Brazil. It forms the conspicuous topographic expression of the ridge in Sheet 224 (Osi) NW, which is very domineering, towering above all other topographic features, near and far, and is the host to the gigantic Owu-waterfall around Owa-Kajola, about 80Km north-east of Ilorin.

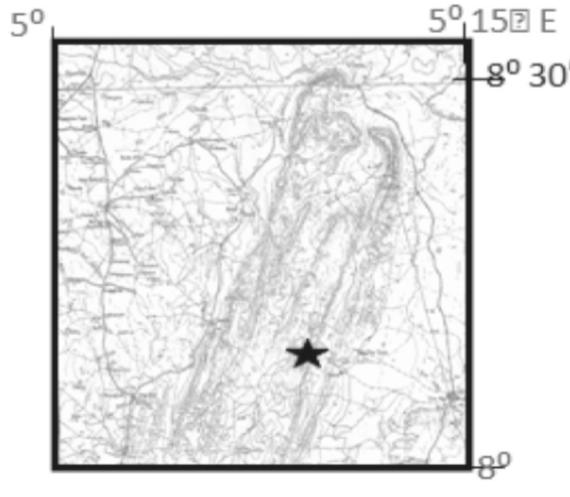

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Fig. 1: Position of the water fall on Sheet 224 (Osi) NW

The waterfall, which has attracted several visitors from Nigeria and abroad since the 1920s, with some of the visitors camping for a few nights, has played host to individuals and groups of people (Fig. 2).

Fig. 2: Visitors at Owu waterfall; in the pool area (above), and directly under the torrents (below).

A good example is the group of spouses of geoscientists during the 2016 International Conference of the Nigerian Mining and Geosciences Society (NMGS) at Ilorin, as a side attraction for the non-geoscientists and an opportunity to have a glimpse at the geology of the northern end of the Ilesha Schist belt and indeed, the regional Ifewara mega shear by the participating geoscientists. Because there has been no published work on the structure, geology, origin and the economic potentials of this great waterfalls, it therefore the aim of this work to address same.

2.0 MATERIALS AND METHODS

3.1 Geomorphology

The Owu waterfall is hosted on a sharp cliff face of the quartzite bodies of Dyon Hills, at the northern end of Omu-Aran quartzite ridges. The area comprises several NNE-SSW trending quartzite ridges that are separated by deep, sub-parallel valleys and gorges with many minor subsidiary ridges which coalesce with the major ones. Around the waterfall, the height above sea level is over 150m but the actual point of cascade is about 490m above sea level. The river that feeds the waterfall is the Owu River, which is a perennial river. It takes its source, as a spring, from the western part and flows in an easterly direction on a relatively gentle slope. The pool area, which is always very cool and soothing, is semi-circular in plan, with big boulders of quartzite away from the foot of the cliff.

3.2 Geology

The area comprises well foliated NNE-SSW striking, westerly dipping micaceous quartzite. In places, massive quartzite layers are inter-banded with centimetre-scale layers of strongly foliated quartz-schist. Small rafts of mica schist, which had apparently been infolded into the quartzite, were identified at high altitudes. Within the deep valleys, small exposures of marble and weakly migmatized gneisses were also identified.

The quartzite is well jointed, and in many cases, exhibits intersection lineations, and axial plane schistosity (Fig. 3).

In terms of foliation, a few of the exposures are phyllitic, with closely spaced foliation planes while some are widely spaced and exhibit outstanding microlithons and the rest are massive.

The massive types are not common and occur sporadically along the strike of the quartzite bodies. Quartz rods, mullions, shear zones and faults also occur in the rocks. Fracturing has made many of the exposures to be un-emplaced and it takes some level of field experience to be able to define the strike direction because the blocks have been shifted substantially.

In other cases, high degree of weathering has made the foliation to become grotty. Care was taken in order to make accurate readings in such cases, because strike and dip readings in such situations are difficult to determine and thus must be done through established fabric trend methods.

Fig. 3: Sub-vertical foliations and axial plane schistosity in quartzite, about 400m east of the waterfall.

Although the dip of the quartzite bodies is widely varied, it is usually on the high side especially about 100m west of the waterfall where the rock strikes in a NNW-SSE direction and dips almost vertically towards the east. Around waterfalls, the quartzite dips at about 60° towards the west.

Petrography

The colour of the rock varies between dirty-brown and milky white both at outcrop level and in hand specimens. It is medium to very coarse grained. In hand specimens, quartz and muscovite were identified with quartz taking most of the volume percentage. Sometimes, soft, powdery, whitish material could be identified. It is likely to be a product of chemical alteration of alkali feldspar that was deposited with the parent sedimentary load which was essentially arkosic sandstone. Major evidences of this were seen in form of widespread kaolin occurrences in the area.

Therefore, the mineralogy is simple, consisting of quartz + muscovite ± plagioclase ± biotite + opaque ± garnet (Fig. 4). Quartz makes up to 90% of the total volume. The mineralogical content may vary between massive and foliated varieties. In the massive varieties, there is diminution of muscovite and an increase in quartz content. In such a case, muscovite may be between 3-5% while in the foliated varieties the muscovite content is much higher (>7%). The quartz is subhedral to anhedral and sometimes displays straight grain boundaries. The rock displays a very strong preferred orientation of the platy minerals and micas.

Muscovite usually occurs as individual or small group of crystals with weak preferred orientation in the massive variety. But it occurs in groups with strong preferred orientations and sandwiched between elongated quartz grains in the foliated varieties. It is usually sericitized, like the feldspar, indicating effect of chemical alteration. Occurrence of plagioclase is not widespread but occurs as scattered crystals with no definite direction in some of the quartzite samples. The twinning is usually exsolved and may, therefore sometimes, resemble quartz in thin-section. Biotite is not as common as muscovite, only occurring occasionally in the rock. It sometimes alters to muscovite as a result of retrograde metamorphism. A rampant feature in quartzites, especially in zones of intense shearing, is the alteration of feldspar to

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muscovite, chlorite and pinnite especially along foliation and fracture planes.

Structures

The most prominent brittle structures in the area are joints and faults. They occur in all rock types and in different manners and directions. Fractures pervade all rock types but are more prominent in quartzite due to the competence of the rock. They occur even on micro and macro scales. Most of the fractures identified are compressional in origin while the rest are dilatational. After fracturing, most of them became filled with mineral matter, especially, iron oxide, silica and feldspar. Others include tourmaline, chlorite, and actinolite.

Different joint sets occur in the area and the dimension of joints in various rocks was also determined, to a large extent, by the rock competence. Several joint sets occur in the area but the dominant ones are the NW-SE and NNE-SSW, and minor but not less important ones are the NE-SW and ENE-WSW trending fractures along which there are seldom occurrences of movement. Late-kinematic shear fractures with ESE-WNW orientations are numerous (see Dada et al, 2016) and are more or less perpendicular to the first (dominant) set. The shear fractures are more regularly spaced and trend at approximately 105°. The rosette diagram of the joint directions in the area is shown (Fig. 4) below.

3.3 Origin

The Ifewara-Zungeru fault is a projection of a major oceanic transform (transcurrent) fault into the continent (Oluyide, 1988) and Odeyemi et al (1999) considers the structure to be of Pan African age. The prominence of major NE-SW and NW-SE fractures in the Basement Complex of Nigeria has been reported by many workers (e.g. Ball, 1980; Edet et al, 1994; etc.) and northern Africa, especially the regional Tibesti Lineament (Giraud et al, 2000).

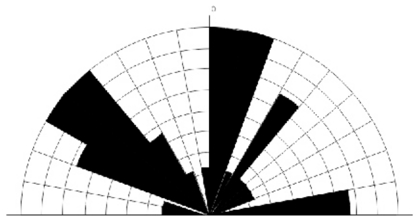

Fig. 4: Joint directions in quartzite around the waterfalls. n = 6

The origin of the waterfall has been ascribed to various reasons by different schools of opinion from, purely traditional to academic, but from geological point of view, it is hereby constrained to the nature of deformation of the associated rocks. The brittle nature of quartzite makes it very susceptible to brittle deformation by jointing and faulting. The relative abundance of mica and the level of chemical alteration may also greatly contribute to the dismemberment of an otherwise cohesive mass of quartzite.

The presence of major NNE-SSW fractures in the quartzite initiated the original weak points in the area and this was followed by the development of shear fractures of the late- to post- Pan African time. These sets of fractures were deep-seated and segmented the rock into big blocks. The deep fractures and the high dip angles placed the rocks in precarious state whereby any little tremor could dislodge the blocks. This is considered to have happened along a fracture either towards the end or after the Pan African time. This opinion is considered because the shear fractures which was one of the principal agents of the dislodgement of the quartzite boulders cross-cut the Pan African fabrics. Thereafter, the Owu River which had been flowing quietly on a very gentle slope was 'intercepted' by the newly-formed cliff along its course. The big boulders of quartzite in the pool area are evidences of the dislodgement.

3.4 **Economic potentials**

The Owu waterfall is considered to be

one of the highest in Africa according to the verbal claims of Kwara State Tourism Board and also by visitors who had seen most waterfalls in Africa, although this has not been confirmed. Therefore it is of high potentials for tourism and by extension, a source of revenue to all levels of government in the country. The grandeur of the waterfall can only be appreciated by visiting the site, especially with respect to the height, the torrential nature and rapidity with which water gushes out from the Owu River at the top, through a narrow nature-engraved bottle-neck, on to the sharp quartzite cliff. All of these also make it a spectacle of natural beauty and awesomeness. Only a handful of visitors can reach the top to behold the manner at which water is 'pumped' to the cliff, but for those who are interested in geology, geomorphology and mountain climbing as a way of exercise, it is a site to visit as most people who have been there still wish to go back.

The site can be visited at any period of the year, but because Nigeria experiences two major seasons in the year, the rainy and the dry seasons, each carries its peculiar characteristics with respect to the waterfall so that the decision as to the time of visit by the visitor becomes important and a matter of personal decision. The volume of water is at its peak during the rainy season but never threatening. The vegetation around the pool is also green and lush at that time too. During the rainy season, the sound of cascading water, like that of a talking drum, hitting the cliff surface and the pool could be heard over 3km away, especially at Owa-Kajola, in the night. The humidity around the pool becomes extremely high as one gets closer.

During the dry season, the panoramic view of the terrain can be easily observed because the grasses would have been consumed by the annual bush burning. Additional tourist attractions are the gangs of monkeys and bands of baboons that visitors may be opportune to spot from afar, especially in the early hours of the day. These groups of animals are interesting to behold as they move out of their hide-outs in search of daily bread. They too take some time to watch visitors from distance, with babies clutching to their mother's bellies while the leader is at the rear, playing the boss. During the dry season, the top of the waterfalls could also be reached with more success than in the rainy season, but that exercise is for the strong and agile and most people don't dare it. The lead author has been there only once (sleeping at the site overnight) out the many times that he has visited the waterfall

At whatever period of the year one visits the waterfall, there is enough water to play with and enough fun to have but it is advised to have a full pack of basic needs like drinks, snacks and food because of the distance to the town. Also, for people visiting during the dry season, especially between December and February ending, it is strongly advised that thick clothing be carried along to fight the cold especially in the night. This period falls within the Harmattan season which could be very cold, at night, for people from tropical climate but rather soothing to those from colder climate. This season is due to the influx of dry, cold NE trade winds from the Sahara Desert. People planning to camp may therefore need to go with essential personal safety effects. The peculiar characteristics of the waterfall make it outstanding as a potential tourist centre (Fig. 5). Proximity to other tourist sites is an added advantage for tourists but it is sad that this natural wonder has been neglected by governments at various levels, and so, the site is in need of urgent attention by government and/or private investors.

The fact that the waterfall supplies constant volume of water, more or less, at

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all times of the year makes it a potentially great source of electricity. The erratic supply of electricity can be curbed substantially if the site is developed for that purpose, especially to the neighbouring communities. This will not only serve as a regular source of power to over thirty towns and villages but will also serve to ease the problem of inadequacy of power supply currently suffered by such overwhelming number of communities This will enhance economic progress and discourage migration to urban centres by rural dwellers.

Waterfalls are great sites for recreation and sources of revenue. Although they are not widely distributed, yet a few countries which are so blessed generate a lot of funds from them. From this point of view, the Owu waterfall can be developed to serve as added source of revenue not only to the government but also to the host community.

Fig. 5: Panoramic view of Owu waterfall (photographed from about 500m away, facing west)

4.0 CONCLUSION

The Owu waterfall in Owa-Kajola, south-western Nigeria, is a magnificent waterfalls hoisted on the highly fractured gigantic Omu-Aran quartzite ridge. The geology comprises a combination of meta-sediments that overlie migmatitc gneisses. Evolution of the waterfall is considered to be related to the extension of a major oceanic transform fault into the continent, leading to a major fault-induced narrow inland basin that was later filled with sediments. Associated Pan African structures suggest deformation at about 600±150 Ma, but do not preclude deformation and sedimentation during earlier times. Widespread brittle deformation, coupled with weathering and erosion, are considered to have resulted in the evolution of the spectacular waterfall which is a potential source of better livelihood for the surrounding communities, and revenue to government.

REFERENCES

Adedoyin, A.D., Ebiri E.P, Alebiosu MT (2019). Deformation mechanisms, timing and shear sense analysis of part of the Precambrian terrain of southwestern Nigeria. J. Fundam. Appl. Sci., 2019, *11(1), 154-172..* https://www-jfas.info (doi http://dx.doi.org/10.4314/jfas.v11i1.11)

Adedoyin, A.D. (2015). Geology and structural features of parts of Sheets 203 (Lafiagi) SW and 224 (Osi) NW, southwestern Nigeria.Unpubl. Ph.D. Thesis, Univ. Ilorin. 255pp.

Akinde, A.S., Adepelumi, A.A. and Dikedi, P.H. (2019). Ifewara Mylonite:Identifying the Neo-tectonic overprint using integrated geophysical methods. Journal of Geology and Geophysics. Doi:10.4172/2381-8719.100458

Ball, E. (1980). An example of very consistent brittle deformation over a wide intra-continental area:the late Pan African fracture system of the Tuareg and Nigerian shield. Tectonophysics, p169.

Dada, S.S., Goki, N., Oha, I. And Ajadi, J. (2016). Geotectonic, geomorphic and economic features of Okegbala-Oreke Quartzite ridge, West Central Nigeria.

Abstract. 52nd Annual International Conference and exhibitions of the Nigerian Mining and Geosciences Society. p88.

Edet, A.E., Teme, S.C. and Esu, E.O. (1994). Lineament analysis of ground water exploration in the Precambrian Oban massif and Obudu Plateau, SE Nigeria. J. Min, Geol.; 30(1):87-95.

Giraud, R., Doumnang, J.C., Carretier, S. And Dominguez, S. (2000). Evidence for a 6000km length NW-SE striking lineament in Northern Africa: The Tibesti Lineament. J.Geol. Soc. Lond. 157: 897-900.

Oluyide, P.O. (1988). Structural trends in the Nigerian Basement Complex. In: Oluyide P.O., Mbonu W.C.,Ogezi, A.E., Egbuniwe, I.G., Ajibade, A.C. and Umeji, A.C. (eds.) Precambrian Geology of Nigeria, Geological Survey of Nigeria, pp. 9-21.