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Geology, Mineral Wealth and Tourism Potentials of Ekiti State, South-Western Nigeria

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Abstract: ***This paper investigated various rocks, numerous mineral resources deposits and different areas with tourism potentials in Ekiti State, Southwestern Nigeria to elucidate possible economic benefits. Exhaustive geological fieldwork revealed that the study area is underlain by migmatite-gneiss-quartzite-complex, schist, granite, charnockite and pegmatite. Mineral endowments of Ekiti broadly fall into igneous, sedimentary and metamorphic groups depending on the host rocks. The igneous potentials are metallic Ta-Nb-Sn mineralization and industrial minerals (lepidolite, quartz, feldspar, micas) and gem tourmaline. Other potentials are massive igneous rocks (granite, charnockite and microgranite) which form myriads of crystalline aggregates that are useful for rock chippings and concrete mixing in construction industries. Talc deposit is associated with schist while metamorphic rocks abound in almost inexhaustible quantities. Other economic potentials of Ekiti include clastic sedimentary materials (cobbles, gravels, channel sand, laterites), bauxitic clays, kaolin and several clay deposits located in different parts of Ekiti. Ekiti equally pride herself in scenic tourists' resources, warm spring Arinta fall and a Memorial Park. These potentials, if adequately harnessed could be of tremendous economic benefits that can spur Ekiti State into industrial hub.***

Keywords: Ekiti, mineral endowments, metallic Ta-Nb-Sn mineralization, industrial minerals, talc, gem tourmaline, scenic tourist resources

1. Introduction

Rocks being the most tangible evidence of geological evolution are equally a major host to economic minerals as well as being useful in engineering construction. Rocks weather to produce soil on which we move and carry out all activities. The scenic tourism resources of the world are locked within rocks and accounts for its notable springs, waterfalls, beaches and spectacular hills. All underground water resources of the earth reside within rocks. Rocks support plants growth, the consequence of which balances the air budget of the ecosystem. Life on earth would probably be unimaginable without rocks. Rocks as aggregate of minerals are produced by geological processes and the economic geological assessment of any region predates exploitation of its mineral resources. Hence, the importance of rocks cannot be overemphasized.

The evolution and subsequent advancement of societies is directly related to the utilization of its mineral resources. The nineteenth century's expedition by the Europeans and the eventual scrabble for colonies were not for mere territorial expansion but mostly to acquiring mineral wealth (Elueze, 1998). Mineral resources played a vital role in the early developmental history of Nigeria and form the backbone of her industrial growth and sources of energy.

Sequel to the discovery of oil in exploitable quantities in the Niger Delta region caused emphasis to shift from solid minerals to the oil sector and activities in the mining sector nosedived and dwindled to almost a virtual stagnation in the early 90s. This happened because the planning, exploration, development, and exploitation of solid minerals were not based on purposefully planned programmes to facilitate revolutionization and survival of the industrial sector but political arrangements engraved on self-enrichment policies. The relatively long gestation period and high-risks on capital investment in the mining sector all contributed to why artisanal mining are thriving and are still flourishing in many parts of Nigeria. At present, Nigeria's economy largely depends on foreign earnings from sale of crude oil. However, the future of global oil market has been constantly threatened by series of oil glut leading to incessant fall in crude oil prices. The advent of electric cars will cause a paradigm shift forcing down the demands for oil in the future. The Corona Virus Pandemic (COVID-19) of the early 2020 witnessed oil producing nations begging buyers of petroleum products as several oil vessels were stranded on the high seas. This incident is an eye opener to why the solid mineral sector in Nigeria needs dedicated effort geared towards its revitalization. Thus, this study focussed on the economic geologic assessment and mineral wealth of Ekiti State with a view to reveal possible economic benefits.

2. Study Area

Ekiti lies between Latitude 7.84°N and 8.27°N and Longitude 4.82°E and 5.60°E. It falls within north eastern part of southwestern Nigeria. It is bothered in the north by Kwara State, to the northeast by Kogi State, to the south and southeast by Ondo State, and to the west by Osun State. Ekiti was carved out of the Old Ondo State in October 1, 1996. The state covers 6353km^2 with a population density of 350/km^2 and a population of approximately 3.3 million (Census, 2016). During pre-colonial period, the area that is now Ekiti was at various point ruled by the Oyo Empire, Benin Empire and finally the Ekiti formed by the Ekiti Confederacy in the latter half of 1800s. The traditional occupation of the indigenous Ekiti people revolves around agriculture, they are typically farmers producing yam, rice, cocoa and cassava and plantain. Key minor industries are mining, lumbering and tourism. Ekiti covers an upland zone forming extension of the Yoruba Hills which rises over 250 m above the mean sea level. Ekiti enjoys tropical climate with two distinct seasons (rainy and dry seasons). The raining season spans between April and October while the dry season is from November to March. The temperature ranges from 21-28°C with high humidity. Ekiti is endowed with numerous natural resources. It is potentially rich in granitic and charnockitic rocks and mineral deposits like kaolin, columbite, lepidolite, baryte, aquamarine and tourmaline among others.

Ekiti area can boast of some geological investigations. However, these researches were carried out by different authors in segments. Among these are: the geochemical studies of its basement rocks (Fadipe, 1988; Oyinloye and Adebayo, 2005; Oyinloye and Obasi, 2006; Okunlola and Akinola, 2010; Talabi, 2013; Akanmu et al., 2019); petrogenesis (Okunlola and Okoroafor, 2009; Akinola and Okunlola, 2014); tectonic and geodynamic studies (Oyinloye, 2007); geophysical investigations and groundwater potentials of the aquifer systems (Oyinloye and Ademilua, 2005; Talabi and Ogundana, 2014); effect of artisanal mining activities on groundwater quality (Talabi et al., 2015; Akinnagbe et al., 2018); geotechnical investigations (Afolagboye et al., 2015; Akinola, 2013) and industrial application of the clay deposits (Elueze and Bolarinwa, 1995; Olaolorun and Oyinloye, 2010; Akinyemi et al., 2014; Akinola and Obasi, 2014; Oyinloye et al., 2019). A few other investigations include stream sediment study around Okemesi and Ijero-Ekiti (Ayodele, 2016; Ayodele et al., 2017).

3. Geological Setting

Ekiti is underlain by migmatite-gneiss, schistose rocks and granitoids. Migmatite-gneiss unit which is of Archaean-Paleoproterozoic age account for its dominant parts. The unit is basal to all other lithologies and forms the country rock. The schistose rocks are pelitic assemblages of low metamorphic grades. The schist is restricted to north-western part of Ekiti. The granitoids are members of the Older Granites suites in Nigeria and represent deep-sited bodies formed during Neoproterozoic (Pan-African) magmatism.

On a regional scale, result of the geological investigations conducted between 1905-1908 (Mineral Survey of Nigeria) produced among others, gold mineralization (Ilesha), tinstone and columbite (Ijero-Ekiti), limestone (Ewekoro), marble (Igbetti) and clay deposits in different parts of Southwestern Nigeria. The disbanding of the Mineral Survey gave rise to the Geological Survey of Nigeria (GSN) in 1919 (now Nigerian Geological Survey Agency) which carried out among others, evaluation of the gold occurrence around Ilesha. This activity attracted attention to the geology of Ilesha and its neighbouring areas which include Ekiti. The Precambrian basement of southwestern Nigeria has been investigated and its geology described in Russ, (1957); Jones and Hockey, (1964); Oyawoye, (1964); Burke and Dewey, (1972); McCurry, (1973, 1976); Turner, (1983); and Rahaman et. al. (1988). Ekiti as part of this extensive terrain lies almost at the centre of the basement complex of southwestern Nigeria (Fig.1). Previous researchers revealed the basement rocks host several mineral endowments. For this reason, Ekiti domain (particularly, the Ijero axis) has been subjected to constant geological investigation by corporate organizations, Universities and private individuals. Despite these investigations; however, the minable tonnage of these minerals has not been ascertained. The mineral wealth of Ekiti as a whole has not been presented in any single write up but has been taken in segments. This research investigates the economic potentials of Ekiti under four broad headings based on the rocks hosting them. These potentials are grouped into magmatic (Igneous) deposits, metamorphic deposits, and sedimentary (residual or weathering) deposits. The first group has granite pegmatite as host and includes Ta-Nb-Sn, tourmaline, lepidolite and other primary pegmatite minerals (quartz, feldspars and micas). The second group include talc deposits and other basement rocks of metamorphic origin like migmatite-gneiss, schists and quartzite. The third group includes great diversities of residual clay deposits, laterites, channel sands, and gravels. The last is the tourism-related potentials which include warm springs, caves, parks and forest reserves.

4. Materials and Methods

This research was based on review of major researches carried out at Ekiti State Nigeria. However, visits were made to different parts of Ekiti where economic mineralization and their host occur. Journeys were made to the different localities and necessary on sight observations were made and recorded as appropriate. Basic geological tools used are Global positioning system (GPS), compass clinometer, sledgehammer, measuring tape, hand trowel and a Nikkon COOLPIX L820 digital camera. The author's familiarity with the terrain facilitated the investigation and visit to the villages in Ekiti. Already existing topographic and geological map of Ekiti State also serve as a guide.

5. Results

5.1. Minerals of Igneous origin associated with Pegmatite

5.1.1 Rare metal (Ta-Nb-Sn)

Rare metal (Ta-Nb-Sn) potential of Ekiti is associated with the granite pegmatite of Ijero-Aramoko pegmatite field (Okunlola, 2005; Okunlola and Akinola, 2010). The Nigerian pegmatite occurrences have hitherto been worked for cassiterite (SnO_2) since 1950s. Recent findings revealed the rocks host appreciable concentration of tantalum and niobium accounting for over 200 tonnes of mined concentrate between 1998 and 2001 (Okunlola, 2005). Mining output between 1944 to 1970 is 247 tonnes of cassiterite, 13 tonnes of columbite and 5 tonnes of tantalite (Schaetzl, 1971). Emofurieta (1977) using geochemical indices discriminated between pegmatite occurrences in Ijero, Ikoro, Aramoko and Osu areas. The author reported those bodies in Ekiti are mineralized while those in Osu are barren. Matheis (1987) on the lithological framework, geochemistry, and geochronology of Ijero pegmatite recognized two morphological types which he called the massive, and the dipping-dyke type.

Matheis (1987) believed the Ijero massive pegmatite is particularly rich in schorl (black variety of tourmaline) and large clusters of quartz-tourmaline aggregates occurs at the contact between biotite schist and the massive pegmatite. The steeply dipping complex pegmatite is mineralized and the massive type is non-mineralized. Subsequent investigations have been carried out by different authors.

Okunlola, (2005) reported that the tantalite (Ta_2O_5) and niobium (Nb_2O_5) which is associated with granite pegmatite of the Ijero-Aramoko pegmatite field is stibio-tantalite and cassiterite-rich ferro-tantalite types. Okunlola, (1998) had earlier described the Ijero Pegmatite field as marginal enrichment of Ta-Nb mineralization. The author believed the poor enrichment is attributable to the schistose host rocks. Pegmatite which intrudes gneissic basements (e. g., Nassarawa-Keffi area in north central Nigeria) has greater Ta-Nb potentials (Okunlola and Ocan, 2009). The author indicates that pegmatite from Ijero-Aramoko field is comparable to the Ibadan-Oshogbo field in terms of Ta-Nb potentials. The Ijero pegmatite field contains lower enrichment when compared with the Tanco pegmatite in western Australia (Okunlola and Akinola, 2010). Akinola (2014) reported the Ijero pegmatite is lepidolite sub-type. The contribution of Ekiti to the Nigeria economy and the entire world has been enormous; at a time, Nigeria alone contributed approximately 90% of the world tantalite, most of which were sourced from Ijero-Ekiti (African Atlases, 2002).

5.1.2 Lepidolite

Lepidolite has a chemical formular which ranges between polylithionite KLi_2 Al (Si_4O_{10}) (F, OH) $_2$ and trilithionite K ($Li_{1.5}Al_{1.5}$) ($AlSi_3O_{10}$) (F, OH) $_2$ in a lepidolite solid solution series. However, lepidolite is popularly called lithium mica and often given as K ($LiAl_3$) ($AlSi_3$) O_{10} (OH, F) $_2$. The flaky nature of lepidolite makes it unambiguous and easy to identify. Lepidolite is a special type of mica; it is uncommon and occurs only in substantial quantities in granite pegmatite that contain appreciable amount of lithium. The rarity of geochemical situations favouring lepidolite formation such as its confinement to environment containing sufficiently high lithium concentrations makes lepidolite a rare mineral because these geochemical situations rarely occur. The small size of lithium ion makes it not readily substituted by other ions in minerals; hence, it is a late stage differentiates of magmatic crystallization in any plutonic system. As other ions are depleted, the residual fluid becomes progressively enriched with lithium. In Ijero-area, the intrusive pegmatite bodies hosting the mineral are steeply dipping and of varied dimensions. Hence, the depths at which lepidolite is intercepted varies from one locality to the other. The lepidolite mineral sample from Oke Asa has equidimensional texture (Fig.2a), that of Ateokuta area is fine-grained and the one in Ijero-Ekiti is medium-grained. Lepidolite in Ijero area occurs in close association with tourmaline and other pegmatite minerals (muscovite, feldspars and quartz) in the albitized zones of the complex pegmatite. Lepidolite occur in three areas around Ijero-Ekiti, these are, Ilukuno zone (Oke Igbo-Aba), Ijero zone (Ateokuta and Ijero), and Olumere Camp area (Oke-Asa) (Okunlola and Akinola, 2010). Samples from each locality is distinguished by its unique colour and texture. Lepidolite from Ilukuno is pinkish and fine-grained, that of Ijero is medium-grained with silvery white resinous-lustred flakes. In Oke-Asa area, the mineral occurs as coarsely grained bodies. Beside the classic use of lepidolite as a major ore of lithium, it is also useful in making lithium storage batteries, ceramic wares and smelting of aluminium ores. It may be crushed for use as flake mica, it is useful in making glass and enamel and as a minor gemstone. Lepidolite crystal contains a high amount of lithium, which is also used in anti-anxiety medication. Lithium salts such as lithium carbonate (Li_2CO_3), lithium citrate ($Li_3C_6H_5O_7$) is useful as Mood stabilizers and are applied in the treatment of bipolar disorder in psychiatric treatment as they counteract both mania and depression. It reduces stress and helps to reorganize old social and emotional behaviours which is why lepidolite is called "stone of transition". Lithium chloride and lithium bromide which can all be derived from lepidolite are extremely hygroscopic and are frequently used as desiccants (drying agent). Lithium is useful as a flux to promote fusing of metals in welding and soldering. Lithium niobite ($LiNbO_3$) is extensively useful telecommunication accessories in mobile phones and optical modulators.

The Li content of lepidolite from Oke-Igbo Aba is higher probably because the pegmatite intruded a gneissic host rock. The average Li content of lepidolite from Ijero-Aramoko pegmatite field is lower than the minimum value (2%) required for use as ore of lithium (Akinola, 2014). Yin et al., (1995) reported that topaz-lepidolite granite is a major, low-grade Ta-Nb-Li deposit which can be exploited via open-pit mining. The lithological feature of Ijero lepidolite is like the topaz-lepidolite granitoids and Ta-rich cassiterite of Southern China which composed dominantly of albite, lepidolite and quartz, with topaz, K-feldspar, amblygonite, and accessory zircon, monazite, pollucite, columbite-tantalite, microlite. The amount of recoverable lepidolite in Ekiti area is not certain.

5.1.3 Tourmaline

Like feldspar, tourmaline is a family of closely related minerals, it is a common accessory mineral in igneous and metamorphic rocks. However, it often forms nice crystals in pegmatite. Tourmaline is a mineral of universal interest, it is highly valued in Gem trade, coveted by mineral collectors, useful in crystal technology and of special interest in mineralogy. The tourmaline group has a general formula AX_3Y_6 (BO_3) $_3Si_6O_{18}$ (OH, F) $_4$. The "A" can be either calcium or sodium. The "X" can be aluminium, iron, lithium or magnesium. The "Y" is usually aluminium but can be chromium or iron. Some potassium can be in the "A" position, some manganese can be in the "X" position and some vanadium in the "Y" position, but these elements are not usually represented in the formulas of the tourmaline members. Tourmaline is piezoelectric, pleochroic and isostructural. Tourmaline like quartz can occur in varieties of colours ranging from green (elbite), canary yellow (dravite), red-pink (rubellite), black (schorl), neon blue (indocolite), siberite (purple), to those with fascinating intermix of colours like watermelon, liddicoatite, bicolour and so on (Henry et al., 2011). The varieties of colours are sometimes a reflection of the geochemistry of the environment as different impurities tend to impart their hues. For instance, the reddish-pink variety have titanium within its crystal lattice. However, Li et al. (2018) indicated that the colourful tourmaline is usually characterized by small amounts of transition metals. The pink contains Mn^{2+} and the green Fe^{3+}. Tourmaline is probably respected in Gem trade because it does not rust or tannish when exposed to air and it can be shaped without crumbling. Tourmaline occurrence is restricted in to the mineralized pegmatite zones of Ijero-Ikoro and Aramoko areas of Ekiti. Mining activities are ongoing in many of the inclined pegmatite dykes to source this gem during the dry season when the mines are not waterlogged. However, schorl is almost ubiquitous in the area and are left as gangue of lesser values when the beautiful green-coloured elbite is the most sought for. Despite the value attached to this mineral gem, the quantity or minable tonnage is not known.

5.2 Industrial Minerals associated with Pegmatite in Ekiti

5.2.1 Quartz

Quartz is a hard, durable and chatter-resistant crystalline silicate mineral. Quartz is composed of silicon and oxygen atoms that are linked together in a continuous framework of SiO_4 (silicon–oxygen tetrahedra), with each oxygen shared between two tetrahedra to give an overall chemical formula SiO_2. Quartz is such a ubiquitous mineral that it could easily lack popularity among other minerals sought by rock collectors. Fortunately, it can occur in such a variety of colours with fascinating display of beauty and forms. The variable conditions under which it forms, the presence of impurities and the several colouring agent accounts for the many varieties and disguises. Quartz can be in crystalline form; it could also form cryptocrystalline aggregates. The later contains crystals so small that high magnification is required. Crystalline varieties of quartz are differentiated based on their colours for instance, rock crystal is colourless, smoky quartz is colourless with some black tint or grey, amethyst is lavender or purple, citrine is yellow or yellowish-brown and rose quartz is pinkish. Among the cryptocrystalline varieties are chrysoprase (a bright green), blood stone (a dark green with red patches), jasper (a brown to reddish brown), onyx (layered in black and white). There are also innumerable kinds of cryptocrystalline quartz known as agate that exhibits markings of internal impurities in bands. Because quartz is readily available in nature, it frequently replaces other substances (as pseudomorphs) while retaining their external appearances. Quartz often makes natural moulds and casts of numerous other minerals. In liquid form, it is a good cementing material which binds more effectively than either calcite or clay. It is insoluble in acids and a main component of sandstone, quartzite or sand. Quartz is also common in metamorphic and acid igneous rocks. Quartz is recognized by its Concordia fractures, a hardness of 7 and a specific gravity of 2.7. Under favourable conditions, quartz display hexagonal crystal structure terminating in pyramids and sometimes many modified forms. The beauty of many quartz crystals is enhanced when it is laced with needles of rutile, flakes of mica or even needles of tourmaline. In Ekiti, particularly Ijero area, immensely large rock crystals are left-overs during mine workings, especially those that cut through the blocky quartz core of the zoned pegmatite (Akinola, 2013). In such instances, the well-formed plane surfaces arose from well-ordered internal atomic structure. A huge boulder of quartz remaining as remnant of worked pegmatite was intercepted on the slope of Oke-Asa hills (Fig.2b). Apart from its uniqueness as building stones, modern technology has proved quartz to be very useful in electronics. Quartz as a "pacemaker" keeps the hands of the electronic display precisely on time. The property of quartz that makes this possible is piezoelectricity. (a pure equi-dimensional quartz grain will produce residual electricity when vibrated). Furthermore, quartz is useful in making gauges that measure high pressure in underwater cables. It is the major ingredient in abrasives (sandpaper) and louver blades in glass industries. Even though quartz is ubiquitous, the quantity that can be extracted from the pegmatite dyke and other rocks within Ekiti is not estimated.

5.2.2 Feldspar

Feldspar is a large family of mineral species with similar chemistry. The entire feldspar family have so many characteristics in common that it is sometimes difficult to distinguish them. The members are grouped into chemical and structural subdivisions. The two major classifications are those that contain potassium (K-feldspar) or orthoclase and those containing sodium and calcium called plagioclase feldspars. The potassium feldspars include microcline, orthoclase, and sanidine. Microcline is easy to recognise due to its crosshatched twinning under the microscope, plagioclase usually occur as albite recognizable by its albite (Carlsbad) twinning. Microcline is stable under higher pressure, and so, is less common in volcanic rocks. Feldspar forms a common mineral aggregate in Ijero-Ekiti area, the main host rock is granite pegmatite which have complex internal structures. Because of the process of its origin in coarse-grained granitic rocks, microcline often grows into large well-formed crystals. However, crystals with good faces are uncommon. Giant feldspar lumps are characteristic of Ijero-Ekiti massive pegmatite (Fig.2c).

In Ijero-Ekiti, feldspar occurs as principal component in all the zones where the large pegmatite bodies are exposed. Feldspar generally has a hardness of 6, a Specific Gravity of 2.6 making it useful in abrasive. Colour ranges from white, pink, flesh or brown. Feldspar tends to be blocky with two cleavage directions at nearly right angles to each other. Feldspar is a common rock-forming mineral, it crystallizes in igneous environments but are also present in many metamorphic rocks. When they occur in sedimentary rocks, they are indicators of provenance and maturity of detrital/clastic sediments. The general formula for the common feldspar is X Al (1-2) Si $_{(3-2)}$ O_8, where X can be sodium (Na) and (or) potassium (K) and (or) calcium (Ca). When Na^{+1} and Ca^{+2} substitute for X, it implied that an increase in Al has to be accompanied by reducing Si, this is to preserve electrical neutrality and a balanced chemistry e. g., $NaAlSi_3O_8$ and $CaAl_2Si_2O_8$, the more Ca in the crystal, the more Al that will have to balance the charge. A section of the weathered pegmatite along Ikoro road in Ijero-Ekiti is being worked for its feldspar and has constantly provided raw material for a local abrasive industry in the last three decades (Akinola, 2013). Many other ceramic industries across southwestern Nigeria depend on feldspar for the production floor tiles. When feldspars become weathered, it ultimately become clays.

5.2.3 Micas (Muscovite and Biotite)

Muscovite and biotite are the commonest minerals in the mica group. They are aluminosilicates of potassium and iron/magnesium with chemical formula KAl_2 $(AlSi_3O_{10})$ $(OH_2, F)_2$ and K (Mg, Fe) $_3$ $(AlSi_3O_{10})$ $(OH)_2$ respectively. The minerals have specific gravities ranging between 2.7 and 3.1 and a hardness of 2.5 to 3.0. Being a phyllosilicate, mica is an excellent example of species that splits (cleavage) so well in one direction. A single piece of any mica would separate into numerous thin, elastic sheets so thin perhaps as to be almost invisible. The elastic sheets are such that it flexes back to original shape when bent. It has a vitreous to pearly lustre. Muscovite and biotite usually occur together in two-mica granites and are generally widespread in occurrence throughout Ijero-Ekiti. A micaceous environment is easily recognised by series of shinning, transparent and flexible sheets of mica flakes variously distributed around the hill sides in and around Ijero-Ekiti. All the areas where the pegmatite outcrops, weathering activities have chattered and dislodge several sheets of muscovite. At Ijero, Oke-Asa, Ateokuta and Oke-Igbo Aba hills, there are giant muscovite books that are removed during mine workings (Akinola, 2013). Micas also occur in recognisable amounts in many clay deposits. Mica constitutes one of the eight major rock-forming minerals. Mica is industrially used in the manufacture of insulators.

5.3 Crystalline Rocks of Igneous Origin

5.3.1 Granite.

Granite is one of the commonest rocks in Ekiti State. The granites are an extension of a granite-charnockite association that extends from Idanre in Ondo State into the Ado-Ekiti areas and beyond into Omu-Aran in Kwara State. The segment of the rocks that falls within Ekiti axis extends over 35 km in length. It occurs as prominent topographic features of Ikere-Ekiti, Ado-Ekiti, Iworoko, Ifaki, Usi, and Orin-Ekiti. Some are also found around Oye, Ikole and Itapa areas of the state. These massive bodies are dominantly coarse to porphyritic in texture but varies slightly in composition. Some are biotite granite, others contain hornblende (biotite hornblende granite), some vary between granodiorite and adamellite. Granite forms the two most prominent hills (Orole and Olosunta) within Ikere-Ekiti township. The towering qualities and the steep slopes of these vegetation-barren rocks are enough to enchant and arrest the curiosity of tourists from all works of life. However, the frequency of touristic participation in these sites is not documented in any database. Smaller granite plutons around Ado-Ekiti (Yinka quarry, Old-Iyin Road and Ikere, Afao (IBD Impes) Ikole, and many other areas have been sources of stone aggregates to support road and building constructions. Many of these quarries are still in operation till date. Granite is classified as a strong rock in Engineering Geology, as such, large boulders of the rocks are frequently used in building embarkments for dams. It is equally useful for surfacing in Parks, kitchen and laboratory slabs tops and when polished, it is beautiful for floor and wall tiles. The main requirements for building stones are strength, durability, workability, appearance (beauty), and availability. To be useful as building stone, the rock must possess a minimum compressive strength of 31 N/mm^2. The relatively available granite outcrops in Ekiti-State meets all the above specifications (Afolagboye et al., 2015). The volume of Granite in Ekiti is enough to supply crushed stones that are almost inexhaustible.

5.3.2 Charnockite

Charnockite is generally regarded as rocks which have diverse origin, it could be form through igneous and metamorphic processes (Kilpatrick and Ellis, 1992). The origin of charnockite in the basement complex of Nigeria has been a subject of debate. Ekwueme and Kroner (2006) believed the rock has metamorphic origin and called it granulite around Obudu area in south-eastern Nigeria. However, the close association of granite with charnockite in Ekiti area and the occurrence of the two rocks on a single outcrop suggests they are contemporaneous and have similar origin. The result of geochronological investigation of charnockite and granite in Idanre area tend to reinforce the igneous origin (Akinola et al., 2021). Charnockite is of great geologic significance partly due to the controversy that surrounds its origin and partly due to its aesthetic values particularly when polished (Ademeso, 2009).

Olarewaju (1987) recognized three textural units in the basement area of Ekiti. However, Oyinloye and Obasi, (2006) indicated that only two of the three major textural varieties were popular around this domain. These are: (i) the coarse-grained charnockite; and (ii) the fine-medium grained gneissic charnockite. In places, both the charnockite types exist as low-lying outcrops, which are exposed. Elsewhere, the coarse-grained charnockite type occurs as hills. The coarse-greenish type often occurs in close association with the porphyritic older granite in the field. Presently, most of the rocks brought to construction site around Ado-Ekiti and its environs are sourced from the rocks. Reliable information from the quarry workers revealed that because the rocks are of lower average elevations makes it preferable to the towering granites and its more accessible to blasting as their equipment can be mobilized to blasting sites with ease. Charnockite in Ado-Ekiti met the requisite strength for use as quarry stone for construction (Afolagboye et al., 2015).

5.3.3 Dykes

The basement complex of Ekiti State like other basement areas of southwestern Nigeria is characterized by series of aplite, pegmatite, quartzite and dolerite dykes. Undeformed dykes were regarded as representing the terminal phase of the Pan-African tectono-thermal activities as they are relatively young and undeformed (Obaje, 2009). Their cross-cutting relationship with their host rocks is always an indication of their younger age. These rocks are unique in that they occur as planar structures with sharp contacts within their hosts and a distinctive mineralogy. However, the dykes are mostly small and not mappable at the scale of map of Ekiti State. Pegmatite dykes are common around Ado-Ekiti and Ijero, aplite dykes, dolerite dykes, microgranite dykes and several quartz veins crisscross the entire basement. Except for training purposes, these dykes are not big enough to command significant economic relevance.

5.3.4 Pegmatite

Pegmatite in Ekiti State falls into three categories. The first is as planar and horizontal bodies which intrudes major lithologies of their host. Such type is distinguishably recognizable by its colour, texture and structure. These pegmatite intrusive bodies are of simple type with granitic mineralogy (quartz + feldspar ± mica). The second type (earlier reported by Matheis, (1987)) is steeply inclined and are mineralized. This type is common in Ikoro and Ijero-Ekiti area. The third is the massive type which occur around Aramoko and Ijero-Ekiti. In the later location, several

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massive pegmatite units are evidently seen with their large lumps of feldspar in the vicinity of the Ijero-Ekiti town while smaller pegmatite are common around Ori-Apata Nathaniel area of Ado-Ekiti metropolis (Fig.2d).

5.3.5 Microgranite

Microgranite differs from the common granite by its fine grains. This unit is of restricted occurrence in Ado-Ekiti and environs where it occurs as highly denuded bodies, it intrudes the porphyritic granite of Okeyinmi area of the metropolis. Strength characteristic of the rock (Afolagboye et al., 2016) reflects that it is stronger than granite probably due to its fine texture. This rock is blasted (Fig.3a) to produce raw materials for sub-base in heavy construction (Fig.3b). The rock when polished forms a good material for floor tiles.

5.4 Metamorphic Minerals

5.4.1 Talc Unit

Hess, (1993) and Highley, (1974) defined talc as a hydrothermal product of basic and ultrabasic rocks. Talc is essentially a hydrous magnesium silicate with chemical formula $Mg_3Si_4O_{10}$ $(OH)_2$ belonging to a class of silicates and a subclass of phyllosilicates in a larger group called clays. In southwestern Nigeria, talc-bearing rocks are exclusively confined to the schist belts of the basement complex. Within this region, four compositional varieties have been reported, namely: talcose, tremolite, anthophyllite and chlorite types (Elueze and Akin-Ojo, 1993). In southwestern Nigeria, talc occurs in notable localities such as in Iseyin district (Durotoye and Ige, 1991); Obaluru-Araromi (Akin-Ojo, 1992); Baba-Ode area (Okunlola et al., 2002); Erin-Omu area (Okunlola and Anikulapo, 2006); Oke-Ila (Bolarinwa, 2001).

The talc in Ijero-Ekiti is an addition to the list of talc occurrences within the eastern flank of Ife-Ilesha schist belt. The petrochemical characteristics and industrial features of this talc body have been presented (Okunlola et al., 2011). The talc body occur towards southern part of Ijero town along Ijero-Ajeje road where it is exposed as rounded mounds on either side of the road. It occurs as slippery boulders with colour between light brown and grey. The obviously weathered within the same vicinity appear whitish grey. It is mostly occurred as lenses within a narrow N-S trending strip. The geomorphological characteristic is essentially low-lying discontinuous outcrops. A fresh cut surface displays uneven fracture with striations typical of radiating tremolite crystals with a dull to pearl lustre and a fibrous habit. Its softness, characteristic soapy feel are its distinguishing features on the field. The talc can be scratched with the fingernails and leaves a white powdery flake when rubbed on the palm. Talc is useful in the industry in application involving ceramics, paints, rubber, paper, refractory, plastics, pharmaceuticals and textile among others. However, the use of talc for any of these purposes follows some specifications. The functional assessment of the Ijero talc revealed it is useful in the production of paints, plastics, rubber and textiles. However, the talc body does not meet industrial requirements for ceramics, refractory and pharmaceuticals (Okunlola et al., 2011). To assess the tonnage of this talc deposit will involve drilling to ascertain its three-dimensional configuration. So, in the absence of sample drilling and detailed study, the volume of the talc deposit cannot be computed.

5.5 Metamorphic rocks

5.5.1 Schist

Although schist looks attractive when fresh, yet, it is rarely used as a building material as it is not strong enough. The limited use of schist as a building material is limited because of its low strength. Principally, it comprises of platy minerals and structural defects that are often observable to the unaided eye. Schist is thought to be a product of continental margin of a Benioff zone where pelitic sedimentary rocks including shale and mudstones are compressed, heated and chemically altered. This region transforms these pelites into platy phyllosilicates minerals like muscovite, biotite, and chlorite. The stepwise metamorphic transformation follows a sequential order from shale to slate and then phyllite. Further transformation converts the schist into gneiss which is of granular and coarser texture. Despite its lower strength level, some schists are found in building as decorating materials for walls and as ornamental stone for jewellery. Records have it that houses built using schist in the 1800s are still standing today in Australia.

Schist in Ekiti State have been proved to be of sedimentary origin and of similar composition to the Franciscan greywacke (Akinola and Okunlola, 2014). The schist units in Ekiti State are located within northern parts of Ijero-Ekiti. Its overwhelming presence is noticeable in Ipoti-Ekiti and form low-lying foliated rock underlying Odo-Owa town. The schist is of two types, they are biotite schist and amphibole schist and are both extensive. The engineering investigation on the schistose units shows it falls below minimal values for use as building stones.

5.5.2 Quartzite

Quartzite is formed when quartz sand or sandstone undergoes metamorphism under the influence of increasing heat and pressure within the earth. The increasing heat is attributable to geothermal gradient and the pressure is related to the confining pressure of the overlying rocks and compressive force operating at convergent plate boundaries. These two components in addition to chemically active fluids are the basic requirements for recrystallization which is initiated at grain boundaries.

Quartzite in Ekiti-State is of restricted occurrence, it is found in areas around Okemesi, Ado-Ekiti and Ayegunle. The Okemesi quartzite is an extension of Ilesha Fold Belt into Ekiti state and appear massive but bedded and steeply inclined (Fig.3c). On the other hand, the geomorphological attribute of Ado-Ekiti quartzite revealed it is massive, hummocky, non-bedded and ferruginized with reddish clay. The one along Ayegunle was exposed by road cut and a smaller outcrop was exposed by mine workings along Ayegunle-Oke-Oro Road. The quartz grains in the quartzite are relatively pure being made up of approximately 95% quartz. The petrogenetic investigation of the Okemesi quartzite (Okunlola and Okoroafor, 2009) reveals sedimentary source with a composition that is comparable to those of post Archean pelitic-supracrustal rocks. The duo suggested arkose sedimentary progenitor for the rock and are of low-grade post Archean terrigenous sedimentation sourced from possible mixture of granite and tonalities. Investigation of the engineering properties of the quartzite in Ijero-Ekiti area meets the engineering specification for building stone and for road construction. The quartzite in Ado-Ekiti along other basement rocks were investigated (Afolagboye et al., 2015) and the results revealed it possesses strength characteristic within the range acceptable for road construction.

5.5.3 Migmatite-gneiss

Among others, migmatite forms the most extensive rock Ekiti State. Apart from being the most widespread, it is the oldest unit in the basement complex. The rock is made of assortment of structurally heterogenous rocks that are derived through widespread migmatization. The structural variants may have resulted from petrological differences between the different starting rocks. Usually, this unit is low-lying in the entire region, it is also basal to all forms of magmatic intrusions and orogenic processes. The polymetamorphic rock is evidently most complex and most varied. Oyinloye and Obasi, 2006; Talabi, 2013 indicated the rock is the country rock to the granite intrusive in and around Ado-Ekiti. The rock hosts all other lithologies (Akinola, 2013).

Migmatite-gneiss unit encountered around Ado-Ekiti possesses strength values that falls within the range recommended for construction (Afolagboye et al., 2015). This rock unit is blasted for construction around Ikole in northern part of the state. The equivalence of this rock unit around Ijero area include migmatite, biotite gneiss and calc gneiss. Engineering investigation reveals these rocks are strong enough for construction works and as building stones. The problem with quarrying the rock lies in its low altitude, its low-lying nature makes water a problem during quarrying.

5.6 Sedimentary rocks

Even though, Ekiti lies within the basement complex terrain of southwestern Nigeria, yet it is not without its own share of sedimentary deposit. The geodynamic study of most Precambrian terrains reflects copious evidence that the entire surface of the earth is constantly changing. A place that was once under the sea or ocean in geologic past might be occupied by desert today. In likewise manner, all the towering granite inselbergs that characterized the rugged terrain of the Ekiti were at a time situated below the earth surface in geologic past. The granite was overlain by several kilometres thick overburden. Consequently, the exposure of these units to the Earth's surface subject them to denudation and weathering producing the numerous disaggregated components of rocks through physical and chemical weathering processes. As these detrital residues are transported along the river channels, nature tend to sort them according to sizes by gravity. At the lower course of the rivers, the velocity and transporting capacity of the river diminishes and are deposited as clastic materials. The size of the particles ranges from boulders, cobbles, gravels, sand, silts and clay. Geological processes such as those involving hydrothermal activities may equally generate special in-situ clays without them being transported. However, hydrothermal process has not been recorded in southwestern Nigeria. Some parts of Ekiti are known for specific sedimentary deposits. The fact that sedimentary deposits like sand are not brought from the neighbouring state clearly indicate that Ekiti is self-sufficient in these building materials. Enormous building sand, channel sand for block making and plaster sand is sourced from Afao-Ekiti, Ora Ekiti (along River Ilagbe), Ipao Ekiti and Oke-Ako. Along the channel of River Ureje in Ado-Ekiti, large volume of channel sand abounds for loading and the price is relatively cheap due to proximity to construction sites.

5.6.1 Cobbles and gravels

Being a basement complex area with extensive quartzite exposures, tectonic activities cause these rocks to undergo fracturing which ultimately lead to rock chattering. The dismembered components usually accumulate as cobbles and gravels in the vicinity of the main rock bodies. These residues when transported becomes rounded during their journey to areas where they are deposited, cobbles first and then gravel and so on. As nature sort things out according to size, all materials of equal dimensions are deposited together to form extensive deposit that serves as building aggregates.

Cobbles and gravels harvesting is common around Effon-Alaaye, Ilukuno, Ayegunle and Afao. Other areas include Ipao-Ekiti, Ikole-Ekiti and other areas where there is prevalence of quartz rubbles such as Ajebandele areas of Ado-Ekiti (Fig.3d). Usually, these raw materials are in greater demand during the dry season when construction works is at its peak. The cobbles and gravels are often used by builders that found granite chips too expensive. Because they are locally sourced, the effect of mining this resource abound in many localities as depressions in which water collects after distorting the evenness of village neighbourhood. Such effects are common around Olorunsogo area of Ado-Ekiti.

5.6.2 Sand

Sand is one of the most valuable sedimentary deposits in Ekiti State. It is sold to the cement block makers and private individuals renovating apartments. Sand is mixed with cement, granite/gravel and water in recommended proportions for making German floor, it is reinforced with iron rods to build pillars and beams for decking. Sand that contains little silt is equally useful for wall plastering, block setting and locally made rings for casing hand-dug wells. It is equally a useful ingredient for moulding electric poles, and versatile for flooring, copping, walkways and pavements. In modern day Ekiti, many people particularly elites seem to shy away from using mud clays to build houses. This fact indicates the demand for these sedimentary products will be on the rise in the future. Sand is harvested in various localities around Ado-Ekiti metropolis, Afao-Ekiti, Ijero-Ekiti, Omuo Ekiti, Ikole, Ekiti, Igbemo Ekiti, Ode-Ekiti and several other places. Information about where these resources are located within the State are at the fingertips of Tipper drivers, block makers and many site engineers. The texture and colour of these sands sometimes vary, and the prices is according to their grades. The best and most expensive is channel sands because it contains no clay impurities. Sand harvesting is usually undertaken by artisans who makes their livelihood excavating them along the river banks, while labourers gather them to areas where it will be accessible to the trucks for loading. It is noteworthy that within Ado-Ekiti suburbs, there are more than ten localities where building sand is harvested. At one time, the Government of Ekiti State imposed some tax on the mining site to generate revenues for the Government. However, all efforts to gather reliable data on recoverable tonnage was met with stiff oppositions but the tax is rated on per tipper load basis. In some parts of Ekiti State, the building sand is so popular that it forms large percentage of lands covering the suburbs of Afao Ekiti.

5.6.3 Clay deposits

The word clay is sometimes used in different ways. Principally, it is often used as a rock type, as a mineral in the phyllosilicate group, and as grain size particles that are less than 0.002mm in diameter. Different kinds of clay are known, these include kaolin or kaolinite, ball clay, illite, montmorillonite, attapulgite, talc etc. Each of these have slightly different mineralogy which results in different industrial applications, but all have sizes that are smaller than silt-sized particles. Montmorillonite is a very soft clay mineral that is formed by precipitation from water solution as microscopic crystals. The individual crystals of montmorillonite clay are loosely bound; thus, water may be easily incorporated into the crystal structure to make the clay swell. It is a clay type extensively used as drilling mud. Attapulgite is a naturally mined clay with needle-like clay minerals composed of magnesium-aluminosilicate. Major workable deposits are rare, attapulgite is sometimes called "salt gel. " Kaolin, also called China clay, is a soft white clay that is essentially used as ingredient in the manufacture of porcelain. It is widely used in the making paper, rubber, paint, and many other products. Kaolin is named after the hill in China (Kao-ling) from which it was mined for centuries. Kaolinite is a clay mineral, part of the group of industrial minerals with the chemical composition $Al_2Si_2O_5$ $(OH)_4$. It is a layered silicate mineral with one tetrahedral sheet linked through oxygen atoms to one octahedral sheet of alumina i. e., structurally, it composed of silicate sheets (Si_2O_5) bonded to aluminium oxide/hydroxide layer Al_2 $(OH)_4$ called gibbsite layers and repeating layers of the mineral are hydrogen bonded together. The purest form of kaolinite is the China clay which is pure white in colour, and some occur in Ijero-Ekiti (Fig.4a). Other kaolin deposits are formed in-situ from chemical alteration of pegmatite and some formed the sub-base for buildings around Oke-Owa area, north of Ipoti-Ekiti (Fig.4b). Clay deposits are in different parts of Ekiti State. Popular among them is the Ire clay deposit and the Ara clay deposit. Several others have been identified around Ilukuno area. The former has provided raw materials for the Ire-Ekiti Burnt Brick Industry which has suffered several years of neglect due to inconsistent Government policies occasioned by successive change in administration of the State. During this period, the Ire block industry became moribund. At present, activities have returned to the industry after concerted efforts to resuscitate it. The Ire Block Industry depends on raw material from a clay deposit located in the outskirt of Ire town. The industry has rolled out burnt bricks for construction purposes across the length and width of Southwestern Nigeria. The Ara clay deposit has supported a cottage pottery for many decades by providing raw material for the industry. To be useful for pottery, the clay must be plastic enough to make it mouldable. The plasticity must be adequate and should fall within certain range of shrinkage values to prevent cracking. The clay unit has been evaluated by series of workers for industrial specification and application. However, till date, the tonnage of the clay deposit has not been ascertained. The students of Department of Geology, Ekiti State University are carrying out further investigations to identify new deposits around Ilawe, and Igbara-Odo areas. Ijero-Ekiti area is the most popular spot of economic mineralization in Ekiti State. The area consists of kaolin deposit (Akinola, 2014). Kaolinitic clay has also been reported from Ikere Ekiti (Talabi et al., 2012), Ilukuno Ekiti, (Olaolorun and Oyinloye, 2010). Even though many of these deposits have been reported, there mode of origin has not been very clear because residual clays are formed when weathered materials are transported and deposited in a basin or in some cases depressions adjourning mountainous environment. Kaolinitic clays are formed *in-situ*, thus they are not transported. Among the clay types identified in Ekiti State are ball clay, kaolinite, illite, and talc. Ball clays are kaolinitic sedimentary clays that commonly consist of kaolinite (20–80%), mica (10–25%), quartz (6–65%) and other impurities like chlorite. It is fine-grained and plastic in nature. Unlike most earthenware clays, it produces a fine quality white-colour when fired, which is the key to their popularity with potter. Ball clay is the main plastic material used in clay bodies of all types. It is much more plastic than kaolin but also has much higher dry shrinkage value and higher iron contents. Illite is a group of closely related non-expanding clay. Its structure is a 2: 1 sandwich of silica tetrahedron – alumina octahedron – silica tetrahedron layers. Illite is any of a group of mica-type clay minerals widely distributed in marine shales and related sediments. The clay deposits in Ekiti have not been evaluated for their recoverable tonnage.

5.6.4 Bauxitic Clay Deposit

Bauxite, the principal ore for smelting aluminium is named after Les Baux Province, the village where the first deposits were discovered. Petrography and geochemistry of basement rocks of Orin-Ekiti and its implications for bauxitization have been reported (Talabi et al., 2017). Bauxite is formed from a reddish clay rock material called laterite, it is mostly found in tropical and subtropical climate where weathering allows chemical alteration in rocks to allow leaching. Bauxite is primarily comprised of aluminium oxide (alumina), silica, iron oxides and titanium dioxide. Bauxite does not have a specific composition, it is a mixture of hydrous aluminium oxides, aluminium hydroxides, clay minerals, and insoluble materials such as quartz, hematite, magnetite, siderite, and goethite. Bauxite consists mainly of aluminium mineral gibbsite ($Al(OH)_3$), boehmite (γ-AlO (OH)) and diaspore (α-AlO (OH)), mixed with geothite (FeO (OH)) and haematite (Fe_2O_3), kaolinite ($Al_2Si_2O_5$ (OH)) and small amounts of anatase (TiO_2) and ilmenite ($FeTiO_3$) or FeO. Bauxite can be formed from different rock type including gabbro (Wolfenden and Haile, 1963). Bauxite ore deposit originate either by *in-situ* weathering of aluminium silicate rocks or by allochthonous sedimentation after erosion of bauxite soil blankets (Talabi et al., 2017). Even though the basement rocks of Orin-Ekiti were evaluated in relation to bauxitization by these authors; However, there are no clear indications of the geological extent, the quality assessment or tonnage that is recoverable in the bauxite deposit. Patterson et al., (1986) believed rocks that are generally or moderately high in alumina content and a relatively large percentage of soluble constituents are predisposed to laterization and bauxitization. Nevertheless, most rocks of granitic origin in Nigeria have appreciably high alumina content. Yet the authors did not specify the threshold value above which bauxite mineralization could be predicted.

5.6.5 Laterite and Lateritic Deposits

Ekiti State in Nigeria lies close to the equator, this implies the region have tropical climate. This climate is characterized by relatively high humidity and temperature that range between 25°C to 31°C and heavy rainfall between May to September. The rugged terrain of Ekiti State contains massive rock outcrops that are constantly exposed to weathering which is accelerated by the undulating topography. The alternating dry and wet seasons subjects these rocks to extensive physical and chemical weathering leading to massive disaggregation of the to form lateritic deposits.

The abundance of laterite and lateritic soils which is pliable when wet and hardens when dry with its characteristic reddish coloration has been a regular occurrence in most parts of Ekiti-State. The prevalence of lateritic soils attests to widespread laterization and selective leaching. Laterites, lateritic soils and other weathering products are not only useful for brick making but are equally useful as fillings in engineering construction as they are compressible and composed of non-swell clays. However, despite their common use as primary raw materials for building, only little attention was paid to the economic potentials of this rocks. Up till present, laterite and lateritic soils can supply raw material for all existing block industries in the State. Laterite is useful to ameliorate the deficiencies in any clay deposit. Laterization is a chemical weathering process that generates residual soils. Despite the ubiquitous nature of laterite and widespread use as filling materials, these materials have not been adequately subjected to engineering tests. Quartzite that shows evidence of lateritization is intercepted along the Secretariat (Bank) Road in Ado-Ekiti (Fig.4c). Lateritic clay deposits overlying the basement complex are common around Ado-Ekiti (Fig.4d), other areas include Ikere-Ekiti, Ijero-Ekiti, Ilawe, Igbara-Odo, Ifaki, Orin, Aramoko, Ilasa, and Oke-Ako among others.

5.6.6 Kaolin

Kaolin is a product of *in-situ* weathering of granitic rocks. It can also form from rocks that are rich in feldspars. One of the factors that favour formation of kaolin is the downward movement of chemically active fluids that allows selective leaching. On a larger scale, it is also formed by hydrothermal fluids rising from depth through aluminium-rich silicate rocks. When this happens, granitic rocks are reduced to an unconsolidated mass of quartz and mica sand, with white kaolinite clay. One of the requirements for kaolin formation is feldspar. The nature of feldspar is that it weathers more rapidly than rock components like quartz and muscovite. This is probably due to its ability to absorb water under humid conditions and its tendency to form large mineral aggregates with cleavage planes. Kaolin is a common phyllosilicate mineral. It lends it name to the Kaolinite Group; a member of a large general group known as the Clays. Kaolinite's structure is composed of silicate (Si_2O_5) sheets bonded to aluminium oxide/hydroxide layers (Al_2OH_4) called gibbsite layers. Gibbsite is an aluminium oxide mineral that has the same structure as these aluminium layers in kaolinite. The silicate and gibbsite layers are tightly bounded together with only weak bonding existing between these silicate/gibbsite paired layers (called s-g layers). The weak bond between these s-g layers causes the cleavage and softness of this mineral. Kaolinite shares the same chemistry as the mineral halloysite, dickite and nacrite but different structures. Kaolinite is by far the most common clay mineral and most clay deposits contain at least some kaolinite. It is quite possible to have a clay deposit that is almost 100% pure kaolinite.

There are large deposits of kaolin at Ateokuta near Ijero-Ekiti. The mineral is currently extracted in small open cast mines to support a local industry. Ijero Hills is decorated with several gemstone pits with kaolin horizons sometimes reaching 3 metres in thickness. It is white in colour with earthy luster. Crystals are translucent with perfect cleavage in one direction. It has a hardness of between 1.5 and 2.0, specific gravity of 2.6.

5.7 Tourism potentials

Tourism which involves travelling for pleasure forms the merging point between geology, geography, archaeology and history. Geology determines how the natural landscape looks and form the basis of all ecological and cultural components of a tourist destination, geography controls the distribution of a group of people in a natural environment and their culture. Because of its geologic connotations and its scientific basis, tourism which relate the interaction between geology, ecology and culture, the new name 'tourism earth-science' has been proffered for geo-tourism since early 1980s (Chen et al., 2015). Rocks, landforms and geological formations are fundamentally basal to our ecosystem and makes Earth liveable. Landforms arose from endogenous and exogenous geological processes. Even though, the indigenous Ekiti is monoethnic, the ecologically and culturally diverse Nigerian society today provide various tourism attractions while the variety of cultures provides various cultural tourist facilities which manifested in socio-cultural differences among the different ethnic groups in the country (Africa Atlases-Nigeria, 2002). Tourism development and management at the Ekiti State level is controlled under the institutional framework of State Tourism Boards and the Local Government Tourism Committee. The private sector involvement in the industry is guided by Federation of Tourism Associations of Nigeria (FTAN).

Ekiti tourism resources fall under three main categories: these are Parks (Fajuyi Memorial Park, Ado-Ekiti), Scenic resources and spectacular hills, (Orole Hill and Olosunta Hill, Ikere-Ekiti) and Warm Spring (Ikogosi-Ekiti) (Fig.5)

5.7.1 The Adekunle Fajuyi Memorial Park

The Park was built in memory of Colonel Adekunle Fajuyi, an indigen of Ado-Ekiti who lost his life in the first military coup in Nigeria. The Park is a pleasant place located in a serene environment that ensured so much fun in the heart of Ado-Ekiti metropolis. The Park is safe for family and visitors enjoying quality time while in Ado-Ekiti and its suburbs. The Park is specifically located at the intersection of three major (Ado-Iworoko, Ado-Iyin and Ado-Ikere) roads in the Ekiti State Capital. It is a tourist attraction that is intended to generate internal revenue for Ekiti State. The Park has amusement facilities for children, this includes a fountain, a game gallery, restaurant and bar, children playground, and mini museum. The Park is notable for several events, occasions, meetings, religious retreats, political rallies, social functions, seminars and workshops. The museum provides historical fact about Adekunle Fajuyi's exploits and events that led to the Nigeria Civil war between 1967-1970. Recently built in the neighbourhood of the park is a befitting event hall that can conveniently accommodate about thousands of people. The Park is located close to strategic places like the Adunni Olayinka Memorial building and the Federal High Court Complex. Also located within the periphery of the park are notable eateries (Tantalizer, Captain Cook, and Chicken Republic). Within working distance from the Park is the Ekiti State Civic Centre, the Cathedral Church of Emmanuel, The Ekiti Police Headquarter, Ekiti State Mutual Building (an Internal Revenue arm) of the Ekiti State Government, and the Ekiti State Governor's Office. However, all the aforementioned have impacted the economic activities of the state tremendously. The creation of Ekiti State out of the Old Ondo State has necessitated development of Ado-Ekiti, the State Capital. The provision of social amenities like motorable roads, electricity and water by Government and the unrelenting efforts of the private sector has greatly improved the living standards of Ekiti people. Hospitality businesses are booming, Private Institutions are springing up and the State Capital is bustling with activities. However, the economic dividends of the park to Ado-Ekiti and Ekiti State at large cannot be ascertained as at the time of this research as sufficient information about frequency of patronage are not available.

5.7.2 Scenic resources

The undulating topography of Ekiti State and the breath-taking landscape occasioned by towering rocks of granitic origin is an attractive scenery to behold; as such, it has always been a place of interest for sightseeing and tourism. These lofty hills apart from creating beautiful sceneries, it has provided profound influence on the ecological biodiversity of the area. For instance, Ikere-Ekiti and environ receives rainfall in excess of what is obtained in the towns that are far away from it and this ultimately become sources of rivers that punctuated the rocky terrane. The orographic rainfall occasioned by the hills have tremendous impacts on the agricultural potential of the region while the lush vegetal signature of the non-mountainous areas has become homes for several rare species of animals. In addition, the ancient town is noted for the custody of antiquities of both cultural and historic heritage of Ikere ancestry. Historically, it was established that the mountainous terrain serves as protection for the indigenes during the war. Till date, the frequency of both local and international tourist's visitation to the ancient town has not been documented reliably.

5.7.3 The Ikogosi Warm Spring

Ikogosi is an ancient town in Ekiti State, it is a town whose popularity has extended far beyond other towns of same size due to the warm spring. The Ikogosi Warm spring is a tourist attraction where warm and cold springs took their sources from the same hill and meet at a confluence downslope. Each of the water maintain their thermal properties. Evidence show that the warm spring is about 70°C and the cold spring 37°C. Due to the tourism potential of the area, several developmental activities have been recorded along this axis of the state. It is noteworthy however, that foreign and indigenous visits have tremendously improved the business of providing hospitality services for tourists travelling for holidays in Ikogosi-Ekiti. In recent times, Ikogosi has witnessed rapid development particularly in the area of providing standard accommodation facilities for tourists; there are standard hotels whose facilities meet with the international standards to cater for as many visitors and for as long as they wish to stay. This unique opportunity was enjoyed by the researcher during the fieldwork. Despite the promising tourism potential of Ekiti State, there are hitches in gathering reliable statistics on frequency of visit from the local tourist officers. The State Ministry informed that most visit is related to students on holidays or excursion, and few non-indigenous tourists on vacation.

6. Conclusion

The investigation among other things revealed that Ekiti area in the basement complex of SW Nigeria is notable for some mineral endowments. Administrative works are concentrated at the State Capital (Ado-Ekiti) while The economic minerals of the state and mining activities take place around Ijero-Ekiti. The host rock responsible for this mineralization is pegmatite.

Observable topographic feature of the state is dictated by massive rocks that are prevalent and extensive covering many parts of the State. However, the concentration of the rocks varies from one place to another. Massive rocks like granite, quartzite, charnockite, and migmatite-gneiss are common. The rocks (granite, charnockite, quartzite and migmatite gneiss) rarely, if ever, form major source of economic minerals but possess strength requirement that support construction works.

It was also observed that despite several mineral occurrences, like metallic Ta-Nb-Sn mineralization, kaolin, gem tourmaline and talc deposit, efforts have not been channelled into determining the minable quantities of these potential mineral occurrences. It is therefore suggested that geophysical investigations to ascertain the underground geometry and reserve be undertaken.

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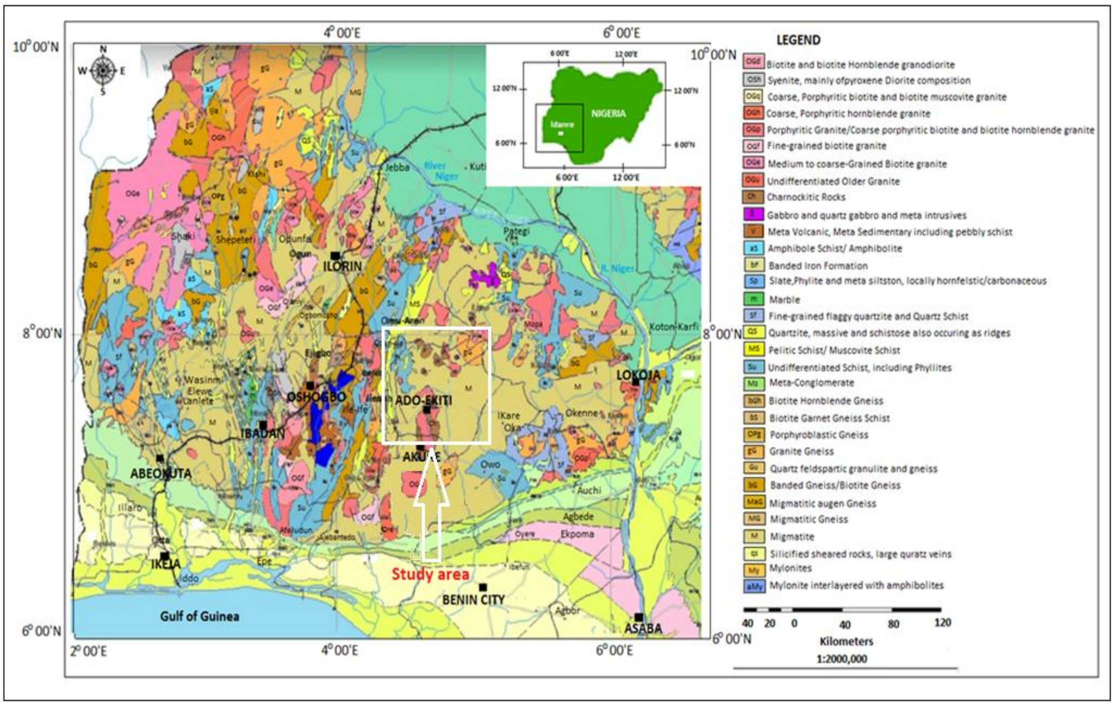

Figure 1: Geological map of Southwestern Nigeria showing location of Ekiti State

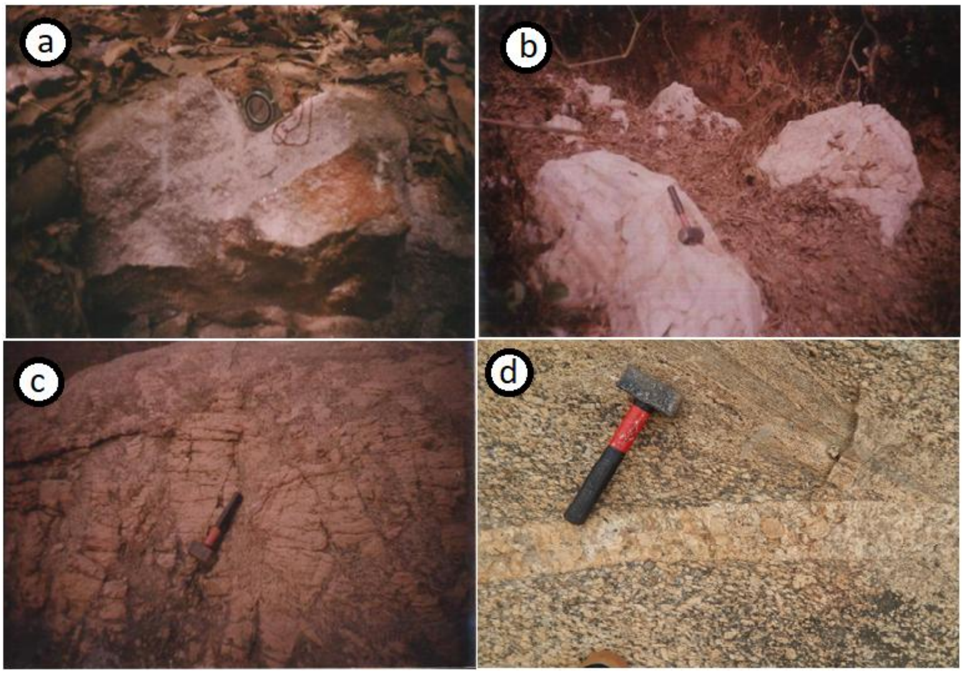

Figure 2: (a) sample of lepidolite with equidimensional grains in its in-situ position in Oke-Asa area of Ijero-Ekiti, (b) quartz leftovers representing remnants of worked pegmatite in Oke-Asa area of Ijero-Ekiti, (c) massive pegmatite outcrop with bulging porphyries of feldspars in Sabo area of Ijero-Ekiti, (d) one of the numerous pegmatite intrusive in the study area. This particular sample is from Ori-Apata Nathaniel in Ado-Ekiti (the planar intrusive unit has a texture and mineralogy that is distinct from the host granitic rock).

Figure 3: (a) a freshly blasted microgranite to make space for a building in Okeyimi area of Ado-Ekiti (b) The rock chips are sorted according to sizes desirable for sub-base materials in construction (c) Quartzite harvested from massive quartzite awaiting buyers between Itawure/Ita-Ido junctions near Oke-Mesi area of the State, (d) natural gravel deposit exposed beside a quartz rubble mining site of a major quartzite outcrop in Ajebandele area of Ado-Ekiti.

Figure 4: (a) A photograph showing exposure of a Kaolin deposit in Ijero-Ekiti, (b) Kaolin deposit formed in-situ by chemical decay of a pegmatite forming a sub-base to a building in Odo-Owa, near Ipoti-Ekiti, (c) Resizing massive quartzite into chips for construction through manual labour in Ado-Ekiti, (d) harvesting laterites and lateritic soils as engineering fill material along Secretariat (Bank) road, Ado-Ekiti.

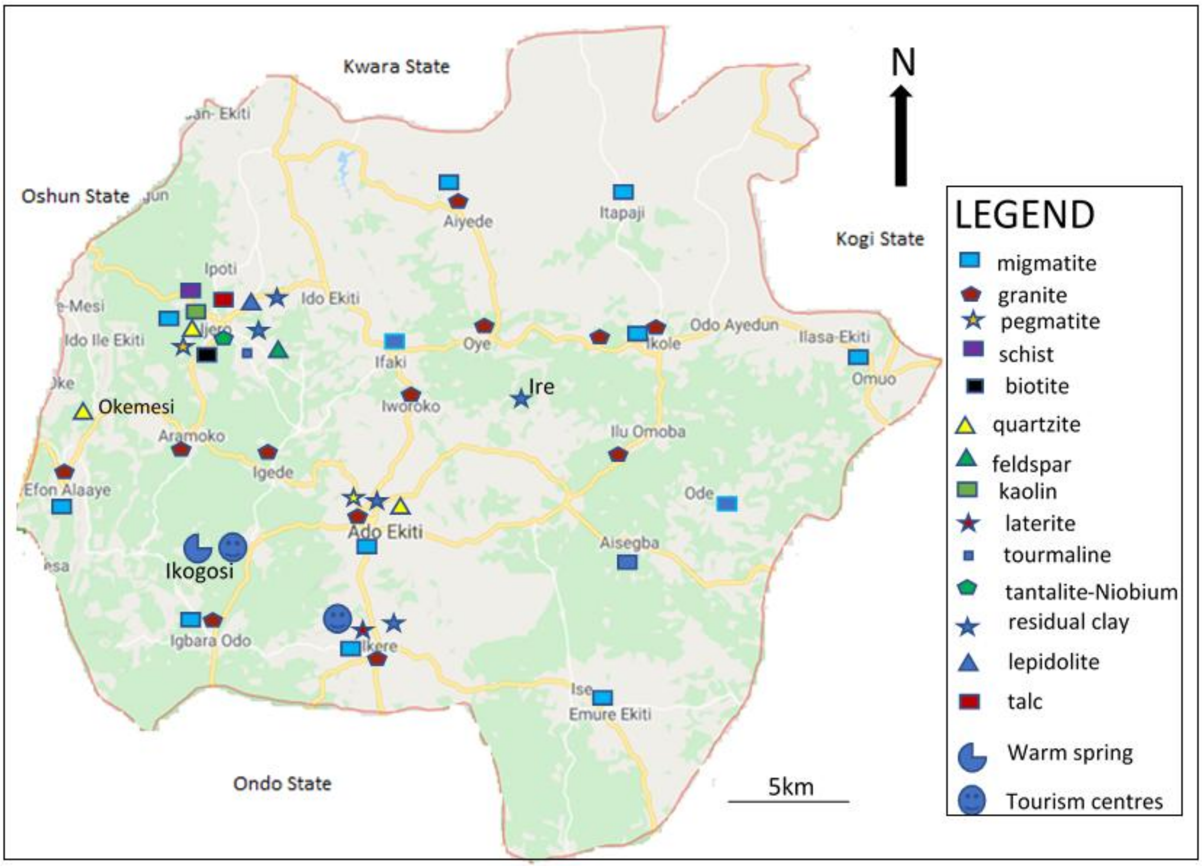

Figure 5: Map of Ekiti State, showing the rocks, mineral endowments and Tourism potentials.