

TALUS CAVES: GEOTOURIST ATTRACTIONS FORMED BY SPHEROIDAL AND EXFOLIATION WEATHERING ON AKURE-ADO INSELBERGS, SOUTHWESTERN NIGERIA.

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Abstract

Spheroidal weathering of granites in Akure-Ado axis have resulted in the formation of talus caves as well as smooth rock boulders which are dramatically arranged, thereby giving the formation an overall aesthetic value to the observer. Unique talus boulders exist in Akure inselbergs, southern margin of the Ikere-Ado batholith. This paper looks at the uniqueness of these formations as well as their economic potentials for leisure and recreation purposes. Much attention has been given to Olumo Rock in Abeokuta, Riyom Rock and the Shere Hills both in Jos Plateau. With the clamour for developing other sources of revenue beside oil, the Akure-Ado inselbergs require attention toward proper development and packaging as potential tourist sites with the aim of enlarging the nation's reserve of tourism products as they will draw local as well as international tourist traffic.

Keywords: Sustainable tourism, Talus Cave, Spheroidal weathering, Exfoliation, Granite pluton, Basement complex, Akure area, Ikere Batholith.

Introduction

The inselbergs of Akure-Ado area are essentially part of the Ikere-Ado batholith which is composed of porphyritic granitic basement and stretches across the boundary between Ondo State and Ekiti State. Basement complex rocks underlie at least sixty percent of Nigeria's landmass (Figure 1). They are Precambrian in age and numerous works have emphasized their polycyclic crystalline nature, younger metasedimentary succession, and a suite of intrusive syn- to late- tectonic granitoids with associated pegmatites and aplites (Rahaman, 1976; Ajibade, 1976; Oluyide, 1988; Odeyemi, 1976; Odeyemi et al., 1999; Anifowose & Borode, 2007; Adepelumi et al., 2008). They have mostly been subjected to various cycles of deformation resulting in their folding, fracturing and emplacements at different times in the geologic past (Rahaman, 1988).

Granite magmas get exposed to lithostatic and tectonic stresses on their way to the surface (Vidal & Vaqueiro, 2007). The tectonic stress is generated during the magma emplacement and is able to produce structures in the rock that are affected under different stress regimes: plastic, ductile, brittle, elastic according to the magma consolidation/cooling grade. The stresses impose structures and other mechanical discontinuities on

the affected material which essentially affect the peripheral zones of the magmatic body and are due to the interactions between the magma and the walls of the host rock.

Mechanical processes such as surface-parallel fracture systems (exfoliation joints) as well as chemical processes (spheroidal jointing and weathering) in rocks have overtime immensely modified basement landscapes, producing massive cavities of varying sizes among weathered boulders, which are referred to as talus caves. Vidal & Vaqueiro (2007) have also attempted a classification of granite caves based on their modes of formation and three major types were highlighted: Caves developed along major fracture planes (type-1), those associated with residual block fields (type-2) and the tafone type of cavity (type-3) which is linked to the elastic deformation stage of the massif. Although few works have been published in this subject, many references on cavities developed in granite rock do exist (Chabert and Courbon 1997). Perhaps the reason, which explains its apparent neglect, is the size of these cavities, which are always smaller than the ones developed in soluble rocks (Vidal & Vaqueiro, 2007). Our study therefore emphasizes the geo-tourism potentials offered by these talus formations within the Akure-Ado axis.

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The Study Area

The Akure-Ado Terrain is a typical inselberg landscape with massive steep-sided and dome shaped granite outcrops dotting the entire landscape. Ikere-Ado batholith is one of the largest batholiths in southwestern Nigeria with its highest point of over 2000ft on the Amoye inselbergs of Ikere-Ekiti. The batholith covers an area of about 646km² and is composed of porphyritic Older Granites and cross-cutting charnockites (Figure 2) that were emplaced in migmatite and gneiss country rocks during the Pan African (550±50Ma) according to Odeyemi, 1998. The batholith is bounded by shear joints which also dissect it into a massive, steep sided and dome-shaped block of rocks (Gilbert, 1904). Odeyemi et al. (1999) also observed that the fractures exhibit a radial polymodal pattern in which six main azimuth peaks are discernible, among which the 280°-290° (WNW-ESE) and 70°-80° (ENE-WSW) trends, as well as the 340°-350° (NNW-SSE) and 20° - 30° (NNE-SSW) trends form two sets of diagonal shear faults which cut the batholiths into large blocks. The high degree of fracturing on the batholiths may be related not only to its depth of emplacement, but also to shrinkage effects due to compressive forces acting on the intrusive body during its emplacement. These fractures are conduits through which rain water percolates into the subsurface and serve as underground recharge routes for groundwater in the community. The contribution of the knowledge provided by further studies on the fractures will help in promoting groundwater exploration techniques in this seemingly difficult terrain.

Discussion

Shrinkage fractures which had initially developed on the solidified granite intrusion at depth, gets exploited by first of all by underground water and later by surface streams which exposed them. The process of talus formation begins with the formation of an irregular weathering front at depths in the subsurface (Figure 3), which might be associated with variation in the concentration of fractures on different parts of the intrusive body (Campbell, 1997). Subsurface exploitation of fractures by weathering is followed by the erosion

of the regolith/overburden and the exposure of the weathering front. The upstanding blocks with rounded, domical forms, bounded by orthogonal fractures are termed inselbergs. The down-thrown flanks may be characterized by sparse collections of in-situ talus boulders, while the predominance of spheroidal and onion-skin (exfoliation) weathering on the inselbergs produce talus boulders which may roll down and collect downhill. The boulders may be transported either by stream action (during flooding) or gravity. Talus caves are those openings formed between the piled-up boulders and among which some, have explorable interconnected passages of considerable length (*Encyclopædia Britannica*). The latter constitutes our focus in this study.

The effects of spheroidal and exfoliation jointing on the batholith is penetrative across the entire Akure-Ado landscape and they seem to be the macro representations of the mega-fractures observable from space (Anifowose & Kolawole, 2010).

During field visits, it was observed that some specific zones within the batholith suggested a higher likelihood of accommodating talus cave formation than some other zones. The deepest fractures on the batholith probably hold most talus formations since they actively serve as viable accumulation zones for boulders produced from spheroidally-weathered blocks. This is evident in the siting of some picturesque talus caves at a location in Iju area, located within a fracture on the batholith. This type of location may not always be potential sites for talus accumulation as a result of concentrated stream action which most often characterizes interconnected fractures on a batholith. This is observable in the location of the Owa cave at the mouth of one of the longest and deepest fractures on Idanre batholith (Anifowose & Kolawole, 2010). There have also been reports of another talus cave located within this same fracture, at an area near Utaja village.

The margins of batholiths also seem to serve as viable collection zones for talus boulders as these areas are often characterized by steep drop-offs of the batholith wall, as seen in Iho-Eleeru Cave (Isarun), on the western boundary of the Ikere

Batholith. In Akure area, located on the southern fringes of the batholith; numerous talus caves of various forms have also been found.

An attempt at reviewing the Type-2 talus caves, referred to as those associated with residual block fields, may reveal an inconsistency with the classification presented by Vidal & Vaqueiro (2007), since the term 'residual' exclusively suggests that the resultant talus caves were formed in-situ. Therefore, we may refer to the Type-2 category of talus caves as those associated with 'accumulated block fields'. This can then be further sub-divided into two broad categories based on talus-source proximity and geometric form of talus blocks forming the cave. The talus-source proximity sub-division may suggest talus caves formed by in-situ or residual talus blocks, as well as those formed by transported talus blocks. Based on the geometry of talus blocks, we may have those caves formed by massive and competent exfoliation sheets, and those formed by spheroidal blocks. Larger radius of curvature of exfoliation sheets produce large blocks (Jahns, 1943) which are later displaced as a result of gravity faulting, along a curved fracture plane and formed talus caves at the base. This is observed at Aba Cave located at the foot of a steep inselberg, as well as at Fegbele Cave, both in Akure. Examples of talus caves formed from spheroidal blocks can be seen at Iho-Eleeru Cave, Kinihun Cave, and Olokuta Rocks (Ado Ekiti). The sphericity of the boulders supporting the hanging wall of Kinihun Cave may suggest the influence of paleo-stream channels at the time of cave formation.

The precarious balancing and arrangement of spheroidally-weathered rock boulders can be considered as a process of geo-mechanical self organization. Gnammas are also common features within the Akure area of the batholith. The homogeneity of the granite within this area as well as the long time/and high frequency of water-bedrock contact within the pits may have greatly contributed to their relatively-great depths.

Geo-Tourism Potentials

Picturesque rock formations in different parts of the world, because of their aesthetic and visual appeal have constituted economic resources to the societies in which they are located. Talus

formations are particularly of special significance because of their rarity and form. This is due to the fact that they are mostly formed in the tropics as high temperature and humidity is required for their formation.

In Nigeria, Olumo Rock (Ogun State), Agbaku Cave (Oyo State), Riyom Rocks and Shere Hills (Plateau State), as well as Gwoza Caves (Borno State) are among the few talus caves and rock formations recognized by the Nigerian Government to be of tourism status. It must therefore be emphasized that if Olumo Rock could attract as much attention within the country because of its historical significance in serving as a shelter for the ancient Egba people during inter-tribal war.

Iho Eleeru Cave should be accorded even a greater measure of attention as it plays a significant role in the archeological history of West Africa. An intensive and extensive archeological exploration of the cave site resulted in the discovery and excavation of the remains of a skeleton which was apparently buried in a standing position, holding a pot with sixteen inlets (Shaw & Daniels, 1984). This ground-breaking discovery of the remains of prehistoric man unquestionably points to the origin of Yorubas which challenges the long-standing belief of Arabian Peninsula origin. The cave was noted to date back to 9200BC, and owes its rediscovery in 1922 to Chief Obele, a hunter who chanced upon it during a hunting expedition. Oral history has it that, a long time ago, the ancestors of the people of Iloro who were predominantly potters, decided to settle at the foot of the cave. Many years later, they were attacked by the neighbouring Ado settlers. The invasion was so sudden and ferocious that the people of Iloro were forced to flee into the surrounding forest for safety. After the intruders had left, the people were distraught to discover that their art works (potteries), had been reduced to ashes, hence the name "Iho Eleeru", which means "Hole of Ashes" or "Cave of Ashes" (personal communication with Asarun of Isarun, the Traditional Ruler of Isarun).

Numerous prehistoric artifacts were also recovered from the site of the cave. They include ancient pottery works bearing the typical African Art impressions; as well as pieces of flint and chalcedony used as cutting tools by prehistoric

Yoruba man. Iho Eleeru Cave is also surrounded by several large rocks which also have their own peculiarities. For instance, one of the rocks was found to have clear engravings which are claimed to be Ifa divinations. The engravings bear similarities with those found at Idanre Hills (Anifowose & Kolawole, 2010). This is an area in Akure (Ondo State) which has been noted for its picturesque talus caves, and is being considered for conservation status by the State Government, not just because of the awe-inspiring caves but because of the discovery of an endangered species of Terrapin turtles existing in some gnammas on the inselbergs.

It has been observed that the government's tourism database is highly deficient in accounting for the numerous natural tourism potentials the country's landmass is blessed with, hence the slow development of its tourism industry.

Conclusion

An attempted subdivision of talus caves associated with residual block fields has been made. The talus caves dotting the Akure-Ado inselberg landscape have a high potential to be transformed into geo-tourist attractions coupled with the historical artifacts and history that qualify some of them to be upgraded to a UNESCO World Heritage status.

To attract more tourists locally and, especially internationally, and in order to generate foreign exchange and to cushion economic hardships by providing means of income for the people, these cave sites should be developed into geo-parks and equipped with facilities and special side attractions for tourists such as archeological and geo-museums, cable cars or elevators, mini zoos and tourist chalets. Fortuitously, adventurous tourists who have interest in mountain-climbing visit the numerous awe-inspiring inselbergs in Idanre area during the local climbing festival. With this in place, local economies will be improved through job creation and revenue generation. Further studies that will encompass associated speleothematic features observed in some of the caves within the study area are being considered.

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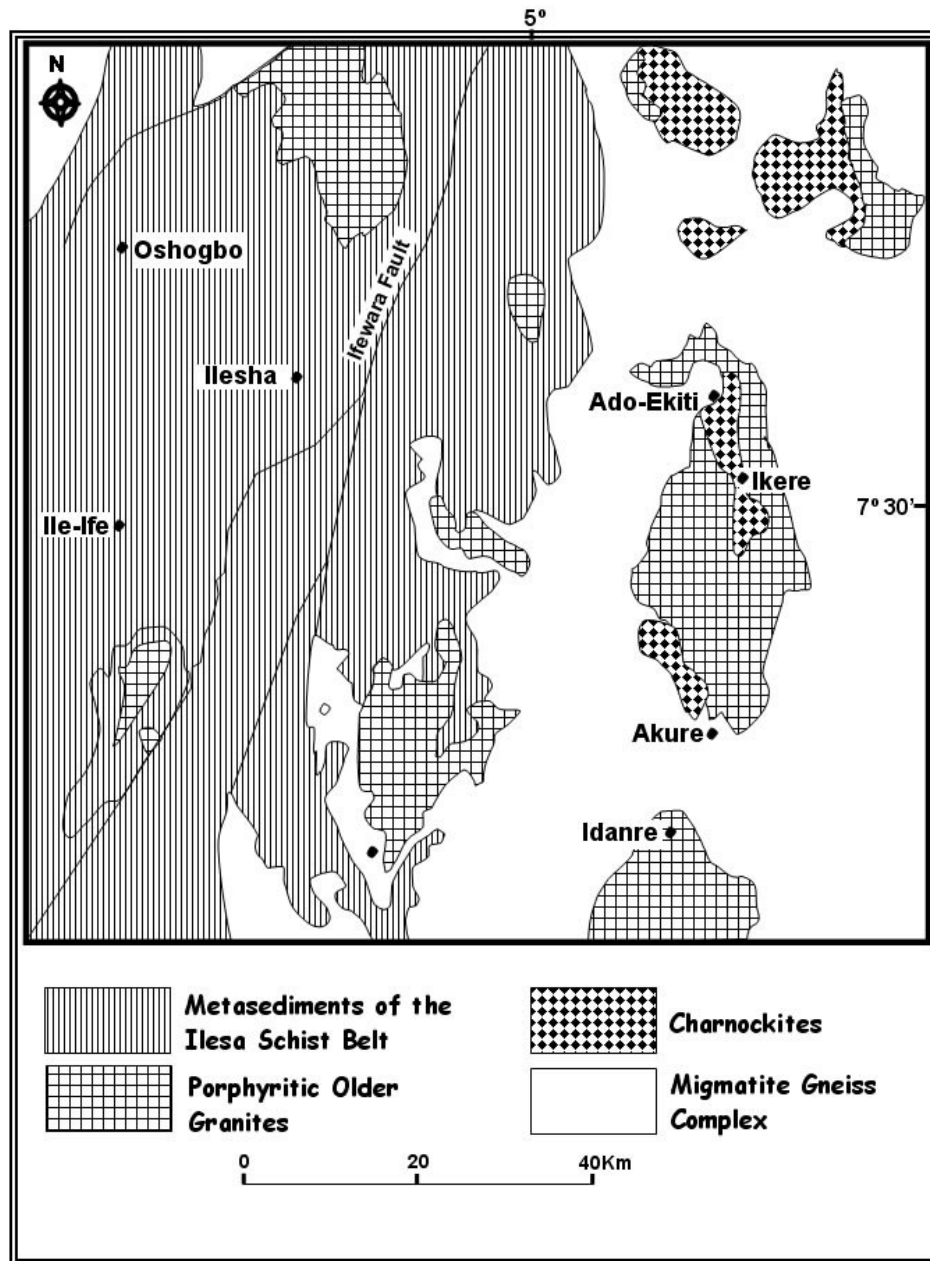


Figure 1 Geological map of SW Nigeria showing the study area (After Odeyemi et al.; 1999)

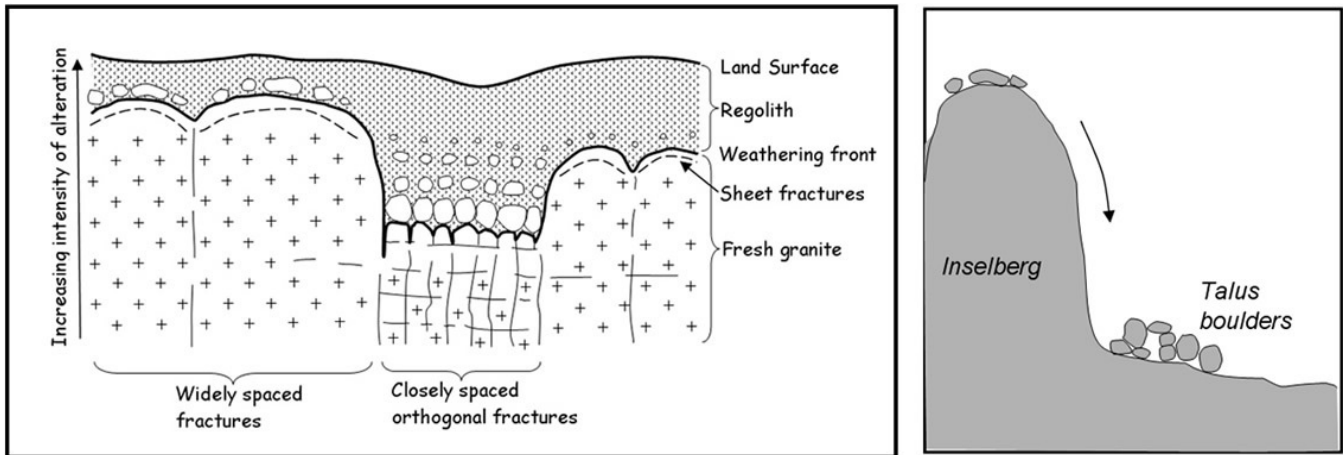


Figure 2 Schematic diagram illustrating the two-stage development of inselbergs (After Campbell, 1997)

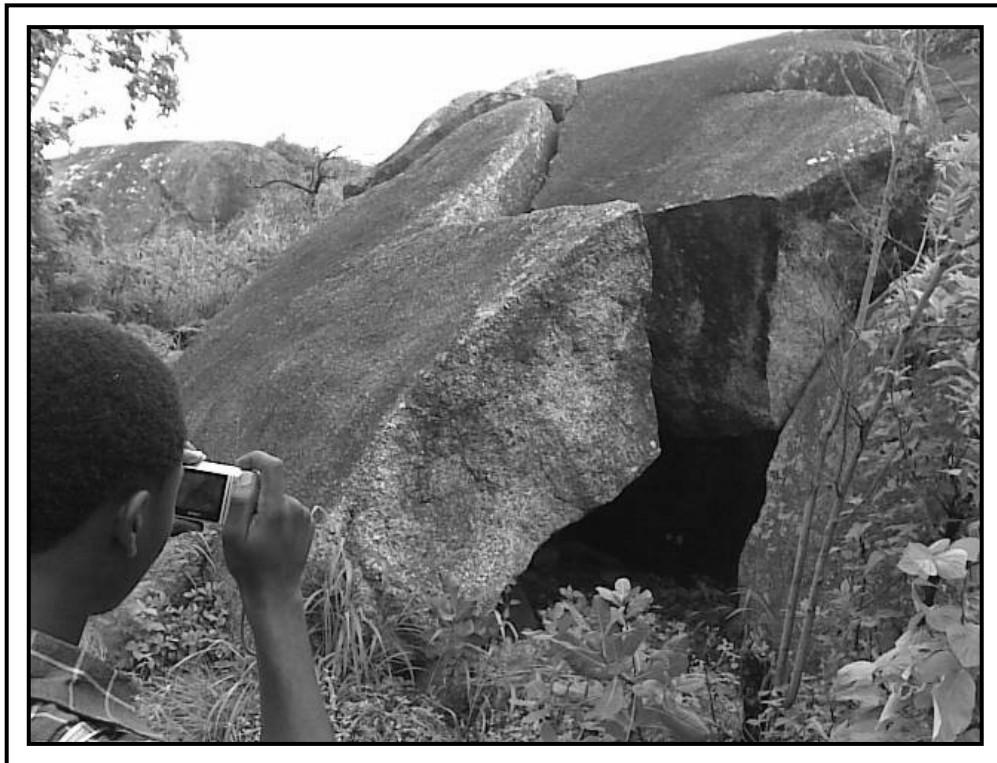


Figure 3 Entrance to Aba Cave, Akure.