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GEOTOURISM OF AXUM AND YEHA MONUMENTS, NORTHERN ETHIOPIA

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Abstract: Ethiopia constitutes one of the most significant environmental, religious and cultural reserves on Earth. The study aims to assess the geotourism of the monuments. The study has been conducted using literature review, fieldwork, data collection and production of geotourism maps and interpretations. Geosites are important resources for geotourism development in Ethiopia along the Historic route of Ethiopian tourism. This route is the main tourism corridor of the country in which geotourism knowledge is very important. Among the major geotourism sites in the study area are, Axum Stelea and its Quary Site, archaeological sites, monasteries, Adwa Volcanic Mountain Chains, palaces, rock-hewn churches, and viewpoints. Therefore, the study has concluded that knowing and understanding the geotourism (which includes geosites and historical heritages) is very important for the development of tourism in Tigray, Ethiopia.

Key words: tourism, geotourism, sustainable development, Geosite, Aksum, Yeha, Tigray

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INTRODUCTION

Geotourism is defined as tourism that focuses on an area's geology and landscape as the basis of fostering sustainable tourism development. It begins with an understanding of the Abiotic (non-living) environment, to build greater awareness of the Biotic (living) environment of plants and animals as well as the cultural environment of people, past and present (Dowling, 2013). Geotourism is a concept that focuses on geology and landscape, integrating tourism into the conservation of geosite and geological diversity (Enes et al., 2022). Geosites often determine natural scenery and landforms, the main attractions for geotourism. Even though the term "geosite" tends to emphasize the rock, fossil and landform record created by natural processes during protracted intervals of geological evolution, it was never disassociated from cultural heritage (Migoń and Migoń, 2022). Geosites are landforms with a specific shape, which alone or in collaboration with other bioecological or anthropic elements can become objects of heritage (Ilieș and Josan, 2009). Geosites are defined as geological objects that have acquired a scientific, cultural/historical, aesthetic and socio-economic value due to human perception (Reynard, 2004a). Ethiopia hosts numerous geosites, some of which have been granted UNESCO World Heritage status, though defined as cultural and/or natural heritage sites when registered (Figure 1). These include the stelae of Axum (granted World Heritage status in 1980); the rock-hewn churches of Lalibela (1978); the Semien Mountains National Park (1978); the Fasiledes Castle in Gondar (1979); the prehistoric sites of Tiya heritage (1980); the lower Valley of the Awash River (1980); the lower Valley of the Omo (1980); the Muslim Holy city of Harar (2006); and the Konso Landscape (2011) (Figure 1) (Asrat et al., 2009).

Infact, Ethiopia constitutes one of the most significant environmental and cultural reserves on Earth, strewn with unique and significant geological and archaeological monuments. The underlying geological feature often determines natural scenery and landform, and defines many tourist attractions all over the world. So, geology is often the most important factor controlling natural scenery and landforms (Asrat et al., 2009). Archaeological and ancient cities of Ethiopia like Axum and Yeha are important geotourism destinations (ibid). Many tourist sites around the world exist, in general, for geotourism reasons. This fact is more evident in Ethiopia: there still-active Great Ethiopian Rift Valley, which encompasses many of the national parks and wildlife sanctuaries; the chain of Rift Vally lakes and the world-famous archaeological and anthropological sites like Axum and Yeha; the unique Afar rift, where active volcanic activities in Erta'ale and formation of new oceanic crust can be witnessed; the Semien and Bale massifs; the Tis-Isat fall along the mighty Blue Nile River; and the Sof-Omar are all there because of unique geological processes (Asrat et al., 2012, Tessema et al., 2021). Ethiopia is also one of the few places in the world where its cultural history, religious manifestations and civilization are imprinted in rocks: the rock-hewn churches of Lalibela and Central and Eastern Tigray, and the stelae of Axum are all there because of the unique geological materials available. Furthermore, geomorphological

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and geological features, notably the isolation of the north-western highlands from the external world by the harsh Afar depression close to the sea, determined the route of Ethiopian history (Asrat et al., 2009) (Figure 1).

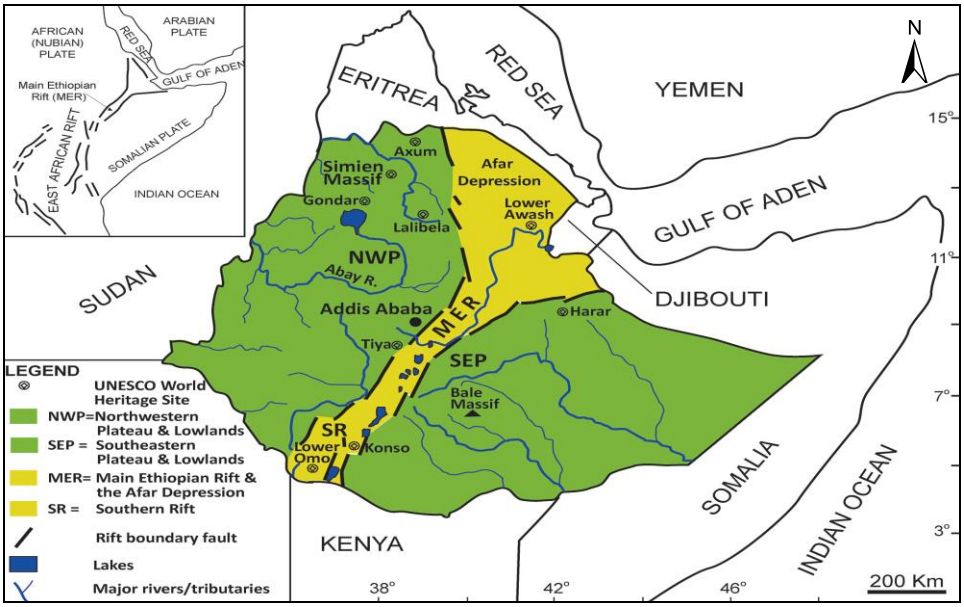

Figure 1. Location Map of the World Heritage Sites in Ethiopia, and other geographic features (Modified from Asrat et al., 2012)

Tigray is also one of the few places in the country where historical manifestations of culture and religion are imprinted in rocks: the rock-hewn churches of central and eastern Tigray, the stelae of Axum, and the Temple of Yeha, etc are all there because of the unique geological materials available (Asrat et al., 2009). Geotourism combines abiotic, biotic, and cultural aspects. In Tigray in northern Ethiopia, the Orthodox Christian religion is a dominant component of culture, that highlights the importance of geology and the wider natural environment, and creates great visibility for it (Nyssen et al., 2020). Tigray is home to 121 rock-hewn churches, believed to represent the single largest group of rock-hewn architecture in the world. Eighty of these churches, dating from the 5th to 14th centuries AD, as well as a small number of masonry and timber-built churches, which include some of the oldest timber structures surviving worldwide (6th – 10th centuries AD), are located in the Sacred Landscapes of Tigray (UNESCO, 2018). This culture has continued to this day, and many of the local housing, stelae, tombs, and modern architectural works make use of the numerous stone deposits in the area, including sandstone, marble, and granite, an indication that rocks play an important role in the country's industrial revolution and tourism development (Heldal and Walle, 2002). It can be further proposed that geotourism is an important opportunity for the development of the tourism industry, and it contributes to efforts in alleviating poverty and unemployment and getting hard currency. Thus, the concepts of geotourism play an important role in local economic development and sustainable rural development by increasing the number of tourists. However, less attention is given by the tourism industry to the geotourism features underlying the major tourist attractions of the region of Tigray in particular and the country in general. Tigray is named the cradle of human civilization to indicate the numerous natural and cultural tourism heritages found in its sovereigns (Daniel and Teklebrhan, 2019). This indicates its geotorism need to be investigated to satisfy tourists.

The available tourist guides and brochures on these sites rarely mention the nature of the geosites, let alone their scientific significance. Ethiopia's cultural and political history and its fauna and flora are relatively well documented, but its geotourism is not, because the local guides are self-appointed, misinforming tourists, providing them with incorrect information (legends) and no materials addressing them. The only existing works partly relevant to such purposes are gray pieces of literature (e.g., Demissie, 1988; Gerster, 1968, 1970), specialized works on specific sites (e.g., Asrat, 2002, Asrat et al., 2009; Phillipson, 1997, 1998; Schuster, 1994), too general (e.g. Hancock et al., 1990), written in local languages (e.g., Aubert, 1997; Hagege, 2000; Mercier, 2000), highly specialized scientific works on the geology of the sites under consideration (e.g., Asrat et al., 1998; Ayalew et al., 2002; Bosellini et al., 1997, Hagos et al., 2010, 2017) or highly specialized geotourism works (Hagos et al., 2017; Asrat et al., 2012). However, studies related to geotourism are lacking in the country and the study area in particular although tourism has been identified as a major sustainable development sector currently targeted by the regional and federal governments. There are only a few related studies like geotourism in Ethiopia (Asrat, 2009), geotourism in around Lake Tana (Tessema, 2021), geotourism in Tembien, Tigray (Nyssen, 2020), and Palaeoenvironmental research at Hawelti–Melazo: Tigray, northern Ethiopia (Hardt, 2023).

So, the main objective of this research work is, to introduce the geotourism attractions in Aksum and Yeha areas. Specifically, it aims to introduce the geotourism and geosite attractions, geoheritages, and their links to sustainable tourism development, and provide information about geotourism of the destination.

METHODOLOGY AND FACILITIES

To understand the geotourism potential of the study area, the fellowing steps in every geological work: data collection and literature review, fieldwork; integration of collected data into databases, production of geological maps

and computer analysis; data interpretation and report compilation; and ultimately publishing and printing. An extensive literature survey collection of published and unpublished materials, including maps, reports, aerial photos, satellite imagery, etc from Ethiopian Mapping Agency, Aksum University, Ministry of Culture and Tourism, Tigray Tourism Bureau and private material collections from surveyors was conducted as indicated in Figure 3. Detailed maps and descriptions of all the major tourist attractions were prepared from such resources.

Fieldwork was conducted in Yeha and Axum, where all relevant sets of geological, geomorphological, and cultural information were collected; representative rock samples were collected for further laboratory analyses as well as photographic documentation of the sites was under consideration.

All the field data were organized, recorded, stored, and analyzed using Geographic Information System (GIS) at the Department of Geology, Aksum University. Finally, the field observations and geological maps were used to describe the role of the geological processes and the resulting rocks in the construction of monuments and archaeological sites. In short, flow chart of the methodology is as follows.

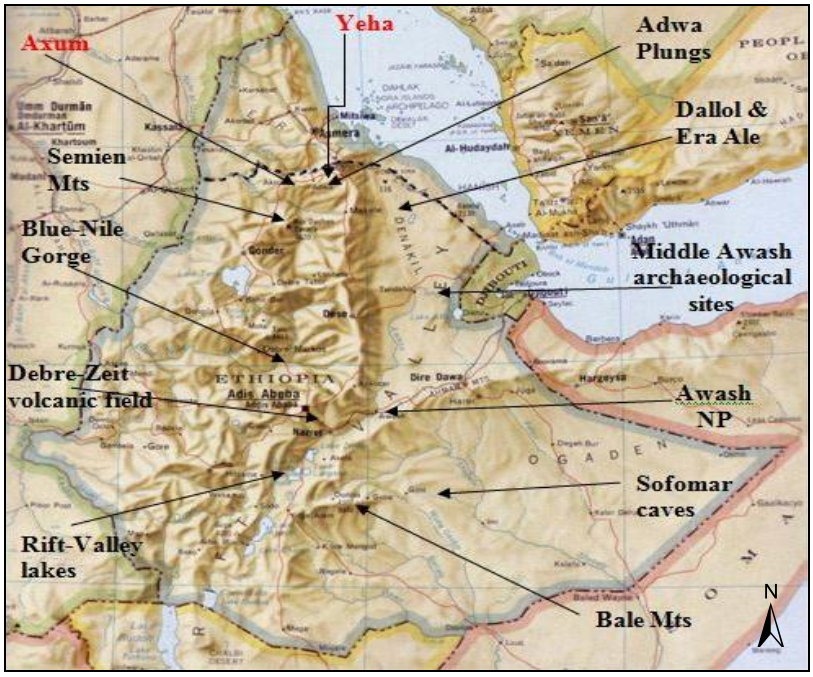

Figure 2. Location Map of the selected Ethiopia's geological and geomorphological attractions and the red in color shows the study areas (Source: Mulugeta, 2017

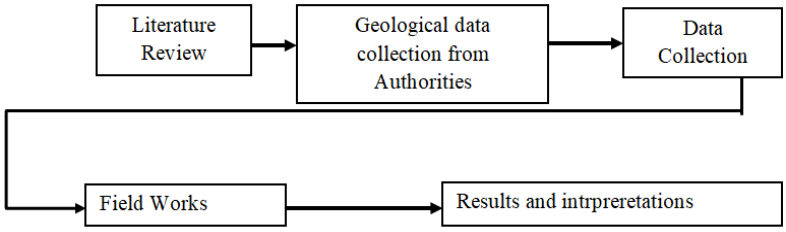

Figure 3. Structure of the Research Methodology

RESULT AND DISCUSSIONS

The Geotourism Site of Yeha (Pre-Axumite Heitage Site) Geological and geomorphological setting of Yeha

As shown from Figure 2 and 4, the geology of the Yeha region consists mainly of large volcanic plugs made of phonolite to alkali-trachyte (Asrat et al., 2009). The site of Yeha is located some 29 km northeast of the town of Adwa.

Philllpson (1998, p.176) describes the setting of the site in the following terms: "Yeha lies in a well-watered valley with deep fertile soils, surrounded and sheltered by mountains," and attributes the selection of this site to the exceptional fertility of the soil. However, although he described the site well, the selection of the site seems to be attributed more to the strategic location of the site, being surrounded by mountain edifices than to the 'exceptional" fertility or "broadness" of the valley. The site is located in a narrow valley surrounded by phonolite plugs that have been eroded to fill the narrow valley with colluvial deposits, which are intercalated with alluvial sediments to form the soil.

These findings are similar to the findings of Asrat et al., (2009). The Adwa phonolite plugs and domes, probably Pliocene in age, are found above the trap sequence and in places above the Precambrian Basement, northeast of Adwa in an area of about 20 km by 30 km (Asrat et al., 2009). They generally follow a northeast-southwest orientation, probably indicating their eruption along a weak line oriented in the same direction (Hagos et al., 2017; Asrat et al., 2009).

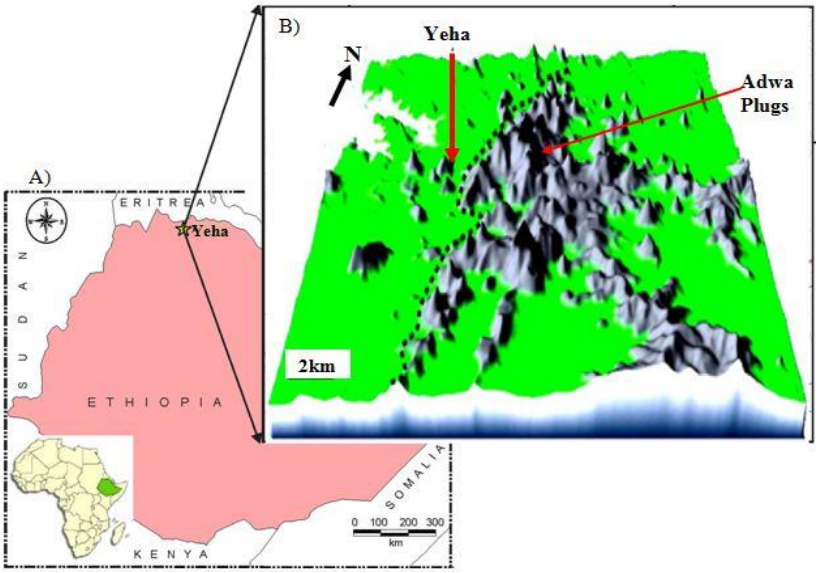

Figure 4. A) Location map of the study area in the northern part of the Ethiopian highlands (Modifed from Hagos et al., 2017) and B) Digital Elevation Model (DEM) of Yeha and surrounding Adwa plugs (Author, 2021)

The plugs are generally phonolitic to trachytic in composition, forming generally inverted, cone-shaped isolated peaks and circular domes, whose shapes were later modified by differential weathering (Hagos et al., 2012; Asrat et al., 2017). Yeha is located at the foot of one such phonolite plug, with the curious shape of a "sitting lion".

This is a result of differential weathering of the phonolite-trachyte dome. Therefore, it is one of the oldest towns in Ethiopia that has great value for geotourism.

Monuments in Yeha-A Geoheritage Site

As can bee ssen from Figure 5, Yeha is legendary for the outstanding monument called the Temple; however, there are alternative remains of archeologic importance settled in proximity to the positioning of the Temple. Archaeological investigations by the Deutsche Axum- Expedition in 1906 and later by Francis Anfray within the early 1970s during a neighborhood referred to as Grat Beal Gebri, settled some two hundred m northeast of the site of the Temple, unearthed a series of massive square-sectioned monolithic pillars that, due to lack of appropriate conservation after their excavation, are now badly deteriorated (Phillipson, 1998).

Francis Anfray additionally unearthed a series of rock-cut graves, one in every of which can have belonged to at least one of the D'MT rulers (Fattovich, 1990), on the lower southwestern slopes of the outcrop on which the Temple stands. Vertical shafts cause one or a lot of tomb chambers, the contents including plethoric pottery, copper-alloy sickles, and alternative tools, associated degreed an alabaster vessel (Phillipson, 1998).

The monuments are sustained for many years since ancient times with the help of rock nature that was made of. Therefore, they have geotourism value where tourists need to know how the history of tombs, the temple, and palaces are integrated into the geological characteristics of the destination. The destination is also surrounded by valleys, mountains, and ancient irrigation channels that mix nature and human interventions.

Figure 5. The overview of the Historic temple and monastery of Yeha (A); the temple under restoration (B); overview of the ancient and archaeological town of Yeha(C), and Grat Beal Gebri Ruined Palace (D).
(Source: A joint project of DAI and the Antiquities Authority of Ethiopia, 2017 (A), and B, C, D Teklebrhan, 2020)

Temple of Yeha (Hillocked Heritage)

According to Asrat et al., 2009, this Temple stands on a rocky hillock composed of a trachytic material, surrounded by plugs. Within the same enclosure and rocky hillock, a modern church stands next to the Temple. The Temple is considered by the locals to belong to the sacred church precinct, obliging tourists to dully follow the norms of the church while visiting the Temple. The Temple is a rectangular building measuring 18.5 x 15 m whose plain walls, without apertures other than a single entrance, still survive to a maximum height of more than 11 m. Regular rectangular blocks of up to 3 m in length were used to construct the wall, without the use of any mortar. Great precision has been exercised to dress the outer faces, edges, and corners, giving an impression that the lines among the blocks were carvings in a

super monolithic structure. The main wall of the Temple is well preserved (Asrat et al., 2009). According to Phillipson, (1998) the Temple about a thousand years after its initial construction, was subsequently converted into a Christian church. These results are coherent with the findings of Phillipson (1998) and Asrat et al. (2009).

The interior of the building, though less preserved than its exterior, presents an amazing construction style in which it is possible to see that the wall, whose total thickness is about 60 cm, is not just a single structure: there are two walls interconnected to each other by smaller blocks of stone that serve as anchors. The Temple's floor is built, with 5 layers of blocks which are different in size, which is some of them measuring 1 m by 50 cm, others 1 m by 1 m. Close to the back wall of the interior part of the building is a rectangular hole. Though the architectural perfection is what makes the Temple interesting at first glance, it has much more to offer for a curious geotourist. The Temple is entirely built of fine-grained sandstone blocks that show striking uniformity in composition and texture, implying that they must have been quarried from a massive sandstone bed. The sandstone is quartzose-arenite with some silicification, although types of cement may vary from calcite to Fe-oxides, as can be observed in the reddish-to-brownish staining on the weathered surface of the blocks. However, on some occasions, phonolitic rocks from nearby plugs were also used as construction materials (Asrat et al., 2009). Even though the quarry of these sandstones was not clear, according to Asrat et al. (2009), these sandstones were quarried from 50 km east or southeast of Yeha and these sandstones are called Tekeze sandstone.

Apart from the Temple, there are some interesting features in the church precinct. Two roughly shaped granite stelae three meters high are erected in front of the main entrance to the Temple. However, the date of the erection and its purpose are not clear. A modern church, which stands next to the Temple, is an interesting structure. In recent times, this church, contributed a lot to the conservation of the existing ruins of the Temple (because church precincts are generally safe from destruction even during times of war. Moreover, the modern church either incorporates in its walls or safety houses in its treasury some carvings and slabs that probably were once part of the Temple structure. The walls of the modern church incorporate two finely carved stones depicting a frieze of stylized ibex figures, while three stone slabs with Sabean texts, two of them from the same inscription with raised lettering and another incised (Phillipson, 1998; Asrat et al., 2009), are kept in the church treasury and exhibited by the clergy to curious tourists.

Figure 6. A & B Closer view of the edges and corners of the walls, C) Ancient stone slabs with Sabaean inscriptions found at Yeha, D) Ancient Rockhewn Tomb in Yeha E) The Temple of Yeha as seen from its entrance toward the East, with surrounding plugs F) Regular & rectangular sadstone and occasional phonolite blocks of up to 3 rn in length were used to construct the walls of the Temple, without the use of any mortar (Source: Shutter and Alamy Stocks; Teklebrhan, 2020)

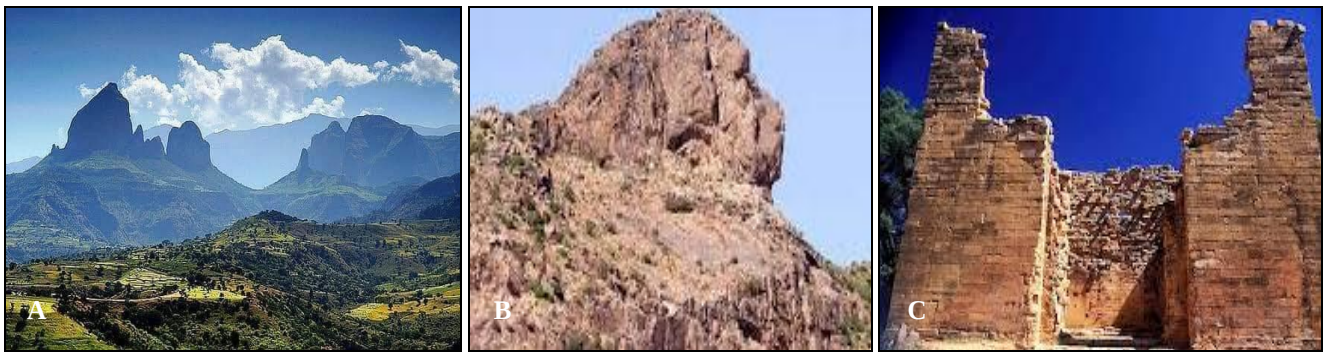

Figure 7. Yeha Temple (C) is located in the Adwa Mountain chains (A) at the foot hill (B) of a phonolite plug with the curious shape of "a sitting lion" (Source: A & B by Teklebrhan; C by Brilliant Ethiopia Tours)

Axum (Monuments of Ancient Civilization) - Geological and geomorphological setting of Axum

The Axum area consists of the Neoproterozoic basement rocks with low-grade volcanic, volcano-sedimentary, and plutonic rocks (Tadesse, 1997). These rocks are unconformably overlain by ~40-m-thick horizontal Mesozoic sedimentary rocks and on top accompanied by wide-spread magmatic rocks that covered large parts of the area with a thick layer of Tertiary volcanics (trap basalts and phonolite-trachyte plugs). The volcanic rocks of Axum are composed of three main lithologic units of Tertiary age (Figure 6 B; Hagos et al., 2017). The first volcanic rock, the flood basalt sequence (late Oligocene basalts; Hofmann et al., 1997), forms a gently undulating plateau surface that is intruded by numerous volcanic plugs belonging to the Axum-Adwa trachyte formation (phonolitic and trachytic plugs). The second volcanic suite, the post-trap basalt sequence (basalts of the Miocene to Pliocene ages), fills the deeply incised canyons of the southern Axum area and is supposed to be the northern extension of the Semien shield volcanoes in the northwestern portion of the Ethiopian high lands. The third volcanic type is the Axum phonolite/trachyte plugs (Figure 8B). These plugs stand out as circular hills as these rocks are more resistant to erosion than the surrounding plateau basalts. These include the hills of Gobo-Dura, Mai-Koho, and Bete-Giorgis (Figure 8B). Gobo-Dura and its surrounding areas belong to the historical quarry locations for Axum (Ferrari et al., 2015). The phonolites and trachytes occur as steep-sided plugs and lie within an E–W belt extending from the western margin of the northern Afar Depression, between Adigrat and Senafe, via Adwa and Axum, westward to the Shire area. At Axum, the phonolite and trachyte domes are well clustered and lie unconformably on the Arabian-Nubian shield, Cretaceous sandstone, and Oligocene flood basalt of the region (Hagos et al., 2017).

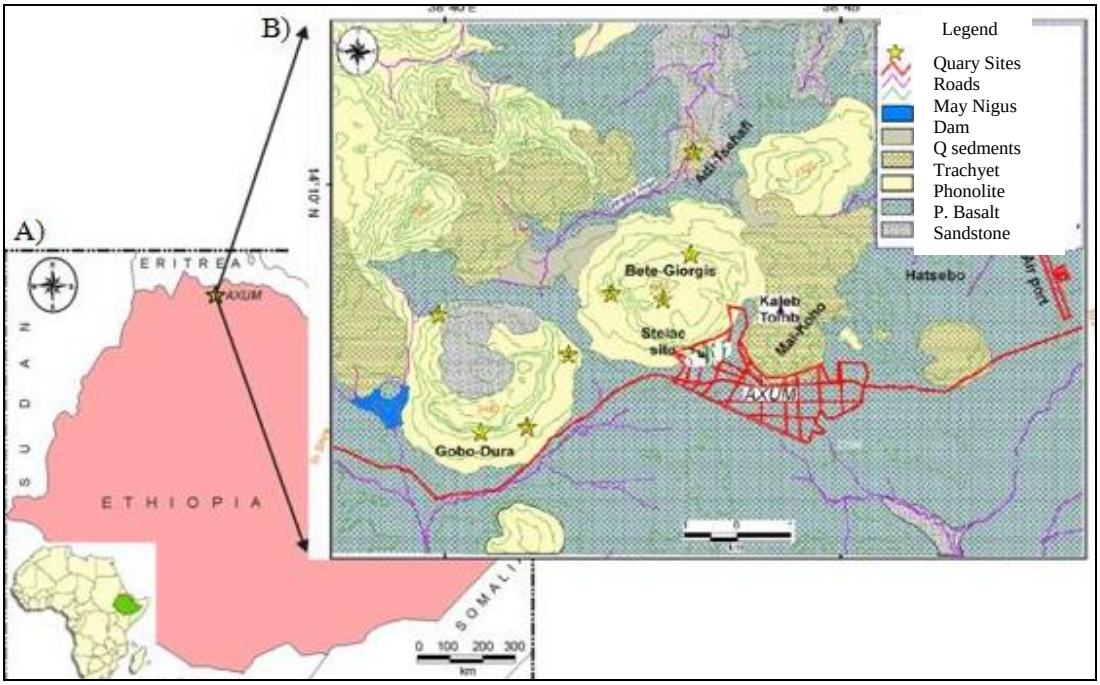

Figure 8. A) Location map of the study area in the northern part of the Ethiopian highlands and B) geological map of Axum showing the well-known archeological and quarry sites of the area (Source: Modified from Hagos et al., 2017)

Table 1. The chracterstics of the six stelae, according to their tag numbers (Source: Phillipson, 1998)

Tag number	Name and location	Height & Weight	Unique nature	Section of ground level
Stela 6	Northern storeyed stela & NE of Enda Yesus Church	15.3 m&43tons	Monolith with 4 storeys, 3 carved faces	1.47x0.78m
Stela 5	The stelae by the stream & E of Enda Yesus Church	15.8 m&75tons	6 storeys, 4 carved faces	2.35x1.00m
Stela 4	The stelae in front of Enda Yesus & just outside of Enda Yesus Church	18.2 m&56tons	6 storeys, 4 carved faces	1.56x0.76m
Stela 3	The Upright storeyed stela & SW of the main stela	20.3 m&160tons	Monolith with 10 storeys, 3 carved faces, -the trademark of Axum	2.65x1.18m
Stela 2	The 2nd largest stela	24.6 m&170tons	Monolith with 11 storeys, 4 carved faces -Taken to Rome and return	2.32x1.26m
Stela 1	The great fallen stela & SW of the erect stelae	33 m&520tons	Monolith with 13 storeys, 4 carved faces -Found fallen and brokn the trade mark of Axum	3.84x2.35m

Monuments in Axum: The Stelae

Axum is famous in the world, due to its beautiful, numerous, variety, number and architectural style. The major locations of stelae in the town are northern, western, and southeastern of the town.

A. Northern stelae field/Main Stelae Field

The area extends for some 700 m along the foot of Bete Ghiorgs Hill and has visible remains of 120 stelae in this area (Phillipson, 1998; Asrat et al., 2009). The original number of stelae may have been much greater, as some are completely buried

beneath thick artificial debris, while others may have been removed for re-use. The stelae show great variety, from unworked stone slabs less than a meter in length to huge and elaborately carved stelae of 30 m in length. The majority of the carved stones are completely dressed to a generally rectangular or sub-rectangular cross-section with flat sides and a rounded/conical apex, devoid of other decoration. However, this stelae field and Axum are famous for six elaborately carved stelae depicting buildings of up to 13 storeys. The six stelae, according to their tag numbers (Phillipson, 1997, 1998), are expressed in Table 1 below.

B. Western stelae field (Gudit stelae field)

The name of these stelae was after the queen who is said to have sacked Axum around the 10th century AD is located on the western outskirts of the town, immediately beside the road leading to the Shire and the south of the Dungur ruins. It extends over an area of some 500x200 m and the area has been intensively cultivated, resulting in much modification of the site. However, traces of several hundred stelae, mostly small and undressed, can be seen. Only about a score of them are still upright. The fallen stelae include a few larger, dressed examples with rectangular cross-sections and rounded tops, but they are undecorated. Phillipson, (1998) and Asrat et al. (2009), similarly describe these stelae.

C. Southeastern stelae field and Ezana Garden

This is the smallest of the three stelae fields of Axum, located at the southeastern outskirts of the town, with only a single erect stela to be seen currently. However, three other fallen stelae and a small number of smaller, rougher stelae were recorded in this area in 1906 (Phillipson 1997). The missing fallen stelae may have been subsequently destroyed or may have been re-erected in the "Ezana Garden" located 200 m west of this site, or possibly in the garden of the Touring Hotel in the center of the modern town (Phillipson, 1997; Asrat et al., 2009). The standing stelae in this site are 8 m long, erected in a socket excavated from the rock of the hillside. It has a rectangular cross-section, with rough but straight tapering surfaces and a rounded head damaged at the rear. Although what makes Axum interesting from a geotouristic point of view is the enormous amount of its material culture, notably the stelae, the section of construction materials, and how the slabs of stone were produced/quarried, transported, carved, and erected may indicate the extent of civilization and technological advancement the Axumites enjoyed. The symbolic representation of the stelae may also shed light on the customs of this civilization. These points are discussed at some length in the following sections.

Origin of the Stelae

Similar to Hagos et al. (2017), Axum town lies on a basaltic cover and is surrounded by hills composed of phonolyte in Gobo Dura and Bete Ghiorgs and the May-Qoho rhyolitic trachytic domes. A close inspection of the phonolytes indicates that they are syntenic in composition, with nepheline phenocrysts. Though no prominent alignment of minerals is observed, the rocks are slightly foliated at their margins, implying that they were probably syntectonic in origin (Asrat et al., 2017). Based on field observation in the stelae and Gobo Dura Hill, some 4 km west of the main stelae field, leaves no doubt that most of the stelae were carved from stone slabs quarried on this hill. The phonolytes in both Gobo-Dura and Bete Ghiorgis were affected by vertical and horizontal joints. Those joints were specifically prominent at the Gobo Dura Hill, where they resulted in very big and almost detached slabs at the hillside. This structural weakness of the phonolytes may have facilitated the quarrying process, as it would only suffice to destabilize the jointed blocks to get slabs of stone, which could be later carved into huge stelae. The presence of numerous undressed or partially dressed slabs abandoned at the foot of the Gobo-Dura Hill was clear evidence of the fact that one of the major sources of stone slabs for dressing stelae was this very site. On the other hand, the Bete Ghiorgis trachytes, which are close to the main stelae field, are affected by frequent vertical joints, producing big slabs at the slope facing the stelae field, though not big enough to cave. However, Bete Ghiorgis can also be a good candidate as a source of slabs for some stelae, especially the smaller ones. These descriptions are also supported by the findings of (Asrat et al., 2009; Hagos et al., 2017).

Mechanism of slab qurry, transport and dressing

Even though there is no clear archaeological evidence to shed light on these processes, the prints left on some of the stelae and unfinished stelae may give some clues that intended breaks were marked by pecked lines, along which were cut series of rectangular sockets on huge slabs of rocks that were originally destabilized from the hillside along the vertical joints are observed at the foot of Gobo-Dura Hill. These prints and unfinished stelae may be produced either naturally or human-made, which were removed to Axum and erected without the marks being fully obliterated by subsequent dressing. Although the tools used in the process of quarrying, transporting, and dressing have not yet been identified, wooden wedges were likely inserted into the sockets and made to expand percussion, by insertion of metal wedges or by application of water, thus fracturing the rock (Phillipson, 1998; Asrat et al., 2009). The presence of several unfinished stelae and other undressed stones at the main sites of erection suggests that, in many instances, the blocks thus extracted from the quarries were transported to their intended usage site without much subsequent preparation, and that final shaping and dressing were carried out at the final site of erection rather than at the quarries (Phillipson, 1998; Asrat et al., 2009).

How were the stelae Erected?

The main stelae field where some stelae remain erect may give some clue to how the stelae were erected, though the site has been completely changed due to subsequent modifications and landscaping to create the present stelae park, with its flat and open appearance. In what must have been a rocky hillside, a series of traces was built, the whole eventually retained by a massive stone wall that still survives, though much altered and almost totally rebuilt (Phillipson, 1998; Asrat et al., 2009). However, the subsequent landscaping resulted in the infilling of the ground for up to 4m, partially or covering the earlier platforms and terraces on which stelae had been set.

What was the purpose of erecting the stelae? What do they represent?

The stelae at Axum can be generally grouped into two major classes: 1) the large stelae carved in the representation of multi-storey buildings, and 2) the small, plain stelae. Although some of the stelae depict buildings of up to 13 storey, there is no evidence that actual buildings in Axum ever achieved more than two or, at most, three storey (Phillipson, 1998) can be seen in Figure 9 A. It is now generally believed that the stelae in pre-Christian times, and probably later, marked burial sites. This is observed in many places in Axum, especially in the three stelae fields, though it is still far from certain that all burial sites are marked by stelae and/or all stelae mark a burial site.The standing stelae in the southeastern stelae field are erected close to the Tomb of Bazen, which lies some 10 m from it. The main stelae field was extensively used for human burials, and the numerous stelae may have been used to mark these burial sites. A notable example may be the largest fallen stelae, which lies over the largest megalithic tomb in Axum. Some small burial sites and tombs have also been found at the Gudit stelae field. The description of the study in terms of erecting purpose and type of representation is similar to the findings of both Phillipson (1998) and Asrat et al. (2009).

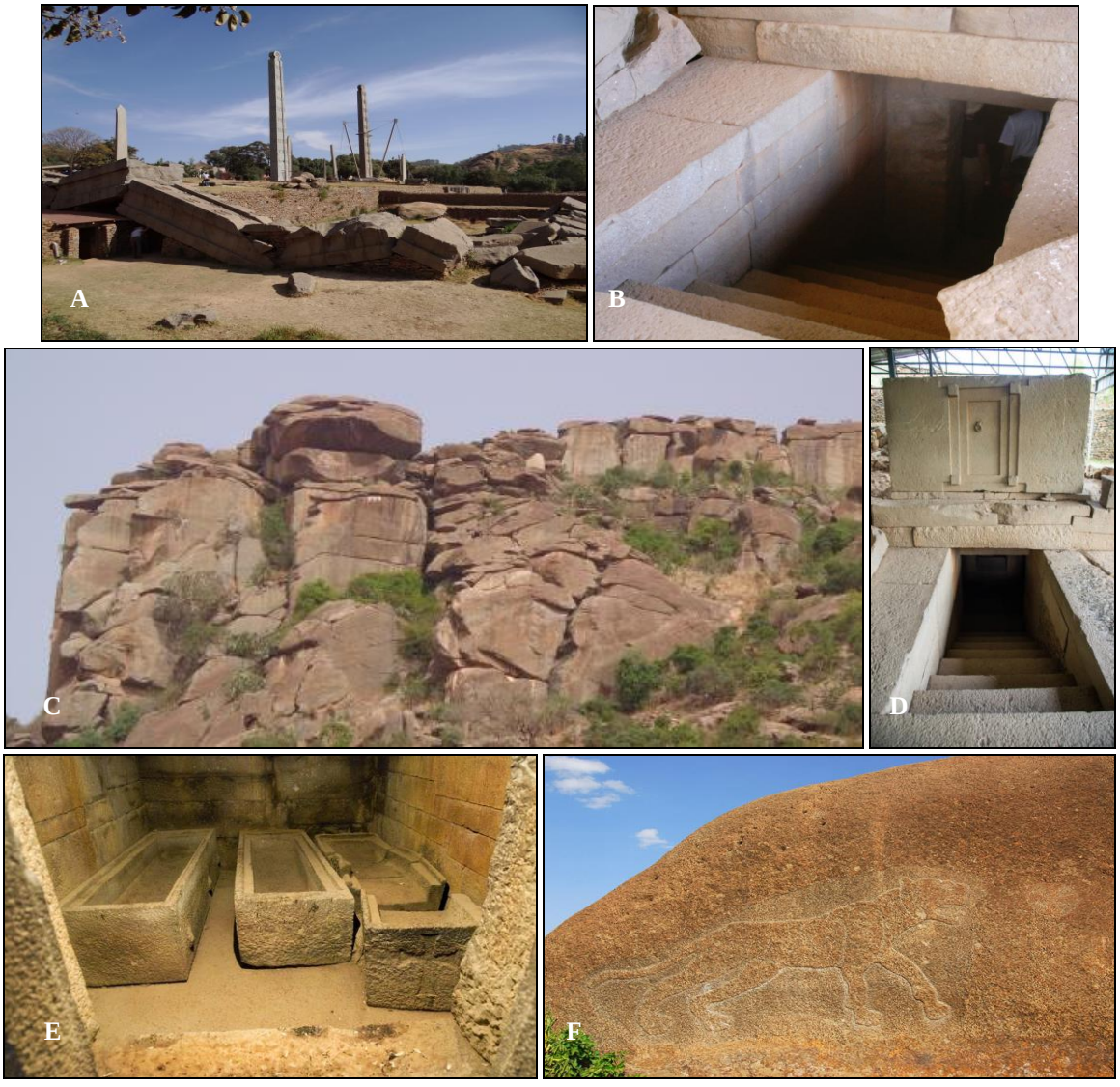

Figure 9. A) Two upright stelae and fallen stelae, B) false door substructure designed by a flight of steps, C) Closer view of the Gobo Dura Hill; note the vertical joints that resulted in huge slabs of phonolyte ready to fall (topple), D) front View of the false door, E) Tombs of Kaleb and Gebremeskel and F) Lion of Gobo Dura, carved in phonolitic rock

Tombs

Although Axum is known for its magnificent stelae, what these stelae represent in the burial sites is also equally impressive. Much of the information about the Axumite civilization was unearthed from such tombs, catacombs, and burial sites as inddicated in Table 2. Numerous sites have been recognized in many parts of Axum. Some of the most important ones are described below.

Palaces and other buildings

Remains of buildings of significant proportions, which were occupied by the Axumite elite, are found in two places in Axum: in the southwestern part, where three large structures, Enda Mika'el, Enda Sem'on, and Ta'akha Maryam, were investigated in 1906 by the Deutsche Axum-Expedition; and farther to the west, outside the modern town, where a smaller but better-preserved structure known locally as the "Palace of the Queen of Sheba" or the "Ruins of Dungur" is located (Figure 10).

The three structures are, however, obscured and damaged beneath recent buildings (Phillipson, 1997, 1998). However, other similar elite or non-elite buildings in and around Axum may be waiting for accidental or systematic discovery.

Table 2. The characterstics of the tombs of Axum and its area(Source: Teklebrhan, 2019)

Tombs name	Location	Characterstics
Bazen	SW foot of the Mai Qoho hill	9.5 m long rock cut adit, with 16 steps leading down to the main chamber, from which 4 burial loculi lead off. 7 other smaller and irregularly shaped loculi lead off the adit, coupled with the records of stelae and rhyolitic in composition.
Brick Arches	East of the standing storeyed stelae	12 m long by 1.5 m wide adit lined at its roof with rough stones and leading 18 stone steps down. At the foot of the steps a horse-shaped brick arch, which gives access to the tomb, comprising 4 rock-cut chambers extending over an area of 10x12 m. It does not seem to be associated with any stelae now surviving.
Nefas Mewcha (Figure 9 D)	Beneath the fallen great stelae	The tomb covers a total area of 16x23 m and comprises a rectangular central chamber, presumably funerary in purpose, surrounded on 3 sides by a passage. Fallen stelae with huge granitic blocks, which were partly carved in situ.
Mausoleum (Figure 9 B)	Beneath the fallen great stela	Slab of 6.4x17.3x1.2m, weighing about 360 tons, which comprises 5 pairs of side chambers each measuring 6.6 m long and 1.7 m wide. They branched from the central chamber, which measures 16.7 m long, 1.9 m wide, and 2.3 m high. It is an intricate network of chambers capped rooed or walled with beautifully dressed huge granite slabs. Fallen stelae with huge granitic blocks, which were partly carved in situ.
Kaleb-Gebremeskel (Figure 9 E)	2 km north of the modem Axum town on a saddle between two hllls	Constructed side by side beneath a shared superstructure. Corner stones represent huge granite slabs. Two wings of the courtyard are aligned with each of the underground tombs. Approached by a stepped adit, fully roofed and constructed of huge, carefully dressed granite blocks of irregular shape. The northern Tomb of Kaleb comprises a longitudinal chamber from which three rooms open eastward.

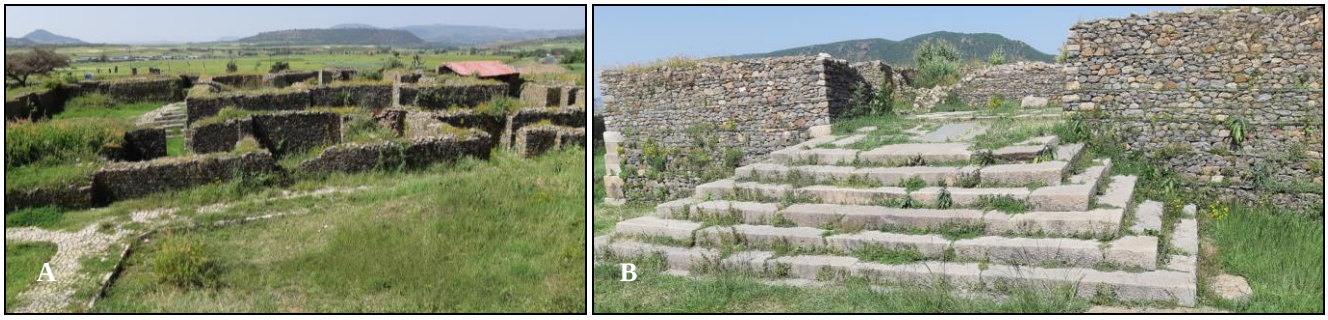

Figure 10. The ancient compound of Dungur (Queen Sheba) Palace comprising 53 ruined rooms(A) and the central part of the palace which was the main dinning chamer (B) (Source: Teklebrhan)

Proposed Geotourist Itinerary

Axum to Yeha Tourism Corridor of the Tigray region is one of the geotourist and heritage tourism destinations. Axum (World Heritage site) and Yeha (Tentative list) for their outstanding heritages mainly build from stones and rocks that impress geology lover tourists. They are very rich in natural and manmade heritages. The destination is home to amazing history, culture, landscape, rocks, and numerous religious resources dating back to Christian and pre-Christian periods, and archaeological findings of the pre-Aksumite period. The area presents huge potential geotourism resources as indicated in the discussion part of this paper.

Figure11. The geosites of Gobo Dura Quary site where the monolithic stalae of Axum were transported from (A & B) and Axum's Main Stelae Park

Geotourists can have the following itinerary to experience the geotourism attractions

Day 1: Axum (The ancient Quary site of Dura Hill, Stelea (the World's largest decorated monolithic stelae), rock-hewn church, archaeo-museum, tombs and graveyards, archeological sites, and heritages associated with Axumite civilization). Overnight stay will be in one of Axum's hotels.

Day 2: The next day geotourists will travel to Adwa Volcanic Mountain Chains and trek to different mountains that have rock-hewn churches and historical importance. Geotourists can trek on Raayo Mt, Forto Mt, Semayata, Gobo Soria Mt, the battlefield Adwa, and adjacent mountains. On your way, you will experience the touchy history of the Ethio-Italian war, mountains in the conference, monasteries, local activities, and other sites. Your overnight stay will be in Adwa City.

Figure 12. The Volcanic Mountains of Adwa Geotourist trails to the mountain of Soloda by foot and/or horse (A, B & C), and the geomap of Adwa Mounains (Source: Enda Emba Tour and Travel: Adwa, 2019 for images of A, B & C, and Mulugeta Feseha - Addis Ababa University, 2017)

Day 3: Yeha (Temple, church, palace, ancient resident area, museum, graveyard, archeological sites, lion shape Mt and heritages associated with Damat civilization). Overnight stay will be in one of Yeha's local houses which will help visitors to experience the hospitality of local people.

CONCLUSION

Tigray is one of the few places in the country where historical manifestations of culture and religion are imprinted in rocks: the rock-hewn churches of central and eastern Tigray, the stelae of Axum see Figure 11 C, and the Temple of Yeha, etc are all there because of the unique geological materials available.

The geology of the Yeha area consists mainly of large volcanic plugs made of phonolite to alkali-trachyte while the Axum area consists of the Neoproterozoic basement rocks with low-grade volcanic, volcano-sedimentary, and plutonic rocks. As a result, the major findings of this paper are: Axum is famous in the world, due to its beauty, numerous, variety, number, architectural styles, and the nature of rocks. Yeha also owns the oldest standing temple in sub-Saharan Africa and other geologically important heritages. They have geotourism values that are not yet well described by tourist guides. Axum and the souurounding Yeha act as tourist attractions (Figure 12) due to their geological and geomorphological resources. It is one of great potential for geotourist trails for up to three days itinerary. Therefore, this is one of the reasons hindering sustainable tourism development in the region. During the study, the deadliest war on Tigray from November 2020 to January 2023 was the major limitation.

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