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GEOTOURISTIC VALUES OF THE NORTHWESTERN ETHIOPIAN PLATEAU AS AN OPPORTUNITY FOR DEVELOPMENT

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Abstract. Various countries and regions are constantly seeking new development opportunities. This is particularly important in areas with low levels of development. Geotourism as a branch of special tourism (sustainable, sightseeing, qualified, environmental) may present such an opportunity, and the geotourist values of the Northwestern Ethiopian Plateau should be treated as a factor conducive to the development of this part of Ethiopia. However, before preparing an offering addressed to specific groups of tourists, it is necessary to develop a catalogue of geotourist resources. This is quite easy for large landforms (the Abyssinian Rift, the Blue Nile Gorge, laccoliths in Tigray), while the recognition of geological values (rocks occurring on the surface of the area and in exposures, mineral deposits) and objects related to human activity in prehistory (e.g., megaliths) and historical times (stelae, churches and monasteries carved in rocks) requires the involvement of well-trained geologists, archaeologists and other specialists. In recent years, considerable progress has been observed in the recognition of the geotourist values of the Northwestern Ethiopian Plateau, as evidenced by numerous publications. There are also studies presenting an offer for those interested in geotourism or geoarchaeology.

Key words: geotourism, Northwestern Ethiopian Plateau, geosite, sustainable development

Introduction

The first, now widely accepted definition of geotourism was published by Hose (1995), who described geotourism as: "providing such means and services that would enable tourists to develop knowledge and understanding of the geology and geomorphology of the place visited (including its contribution to the development of Earth sciences) and would go beyond the level of ordinary aesthetic sensations". Wikipedia (2023a) defines geotourism as: "a form of tourism based, among others, on geological objects, closely related to applied geology, protection of inanimate nature and geological education". The scope of geotourist interest may include both natural objects and geological and geomorphological processes (e.g., volcanoes, shifting dunes, accumulations of rocks, minerals and fossils), as well as anthropogenic objects presenting collections of rocks, minerals and fossils, objects related to the exploitation of minerals, architectural objects due to the rock material used, or stone objects from archaeological excavations (Miśkiewicz *et al.* 2007). In this approach, the "geo" prefix refers

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not only to geology, but to broadly understood Earth sciences (Zagożdżon, Zagożdżon 2010), even with some elements of a cultural nature (Osadczuk, Osadczuk 2008; cf. also Kowalczyk 2010).

In some definitions of geotourism, the prefix "geo" refers not to geology, but to geography. This approach is represented by the US Travel Association (TIA) and the National Geographic Society, which define geotourism as tourism aimed at promoting the unique geographical character of a place – its environment, culture and heritage, for the benefit of local communities (Stueve *et al.* 2002).

According to Kowalczyk (2010), such an understanding of geotourism would equate it with sustainable tourism.

For the case of Ethiopia, Asrat *et al.* (2008, 2012) adopted the "unorthodox" formula, recognising that geotourism is: "a form of cultural and environmental tourism that can develop in areas of geological elements attractive to visitors with special interests". They admitted that there are numerous unique rock formations in Ethiopia that are often associated with their use for cultural purposes, and hence their connection with historical and archaeological objects. Geotourism consists in getting acquainted with these objects, which are usually referred to as "geosites", and less often as "geotopes" *(*Asrat *et al.* 2008; Migoń 2012).

It should be added that similar problems with the definition are caused by the use of the term "geoheritage", as evidenced by the multilingual versions of this entry in Wikipedia (2023b).

Purpose and scope of the study

The aim of the study was to present the geotourist values of selected sites located in those areas of the Northwestern Ethiopian Plateau that are most often visited by tourists mainly seeking contact with cultural monuments. For this purpose, data were collected by the authors from travel guides (Carillet *et al.* 2009; Briggs 2010), geological studies (Asrat 2002; Williams 2006, 2020; Cieśluk *et al.* 2014), and above all a fundamental study on geotourism in Ethiopia (Asrat *et al.* 2008). The literature data were enriched with field observations of a co-author (Florek) who visited all of the locations cited in the text in 2011. This gave rise to an assessment of the geotourism potential of the Northwestern Ethiopian Plateau, both in natural and economic terms, and the possibility of indicating factors limiting the exploitation of that potential.

Geosites in Ethiopia, their types and significance

Ethiopia's landforms are closely related to geological structure and tectonic conditions. There are three distinguished areas that differ fundamentally from one another:

- The Northwestern Plateau (the Ethiopian Plateau) constituting a Precambrian–Miocene trap, compared by some with the Deccan trap. The greater part of it is a wavy highland (2000––2500 m a.s.l.), the surface of which is covered with thick rock waste, formed mostly of basalt. It is bounded to the north by the Simien Mountains, whose highest peak – Ras Dashen (4620 m a.s.l.) is the fourth highest peak of Africa. The highlands are cut by deep river valleys running to the west or south-west. These are the valleys of the Abay (Blue Nile), Tekeze and Omo rivers as well as their tributaries. The plateau is bounded to the east by a huge meridian fold, which forms a high and steep slope cut by long and narrow rifts formed during the formation of the edge of the Afar Depression. In turn, the surface of the Southeastern Plateau falls gently towards the west and south-west;
- The Southeastern Plateau (the Somalian Plateau) on the surface of which there are mainly Palaeozoic and Mesozoic sediments, in the western part covered with Oligocene–Miocene basalts. To the west, the upland is enclosed by the mountain ranges of Hararge and Arsi-Bale-Sidamo; to the east, it falls to the Ogaden Plain (Fig. 1);
- The Abyssinian Rift, which is the northern part of the Great African Rift, crosses the Northwestern Ethiopian Plateau. The edges limiting it display a translocation of sedimentary rocks and basalts formed from the Precambrian to the Neogene. There are numerous volcanoes on the outskirts of the northern part of the Abyssinian Rift, and in 1974 the site of the 3.5-million-year-old *Australopithecus afarensis*, better known as Lucy, was discovered on its slopes. This megaform is divided into three secondary forms:
    - The Afar Depression, where, at the bottom of the Danakil Valley, is located the Dalol

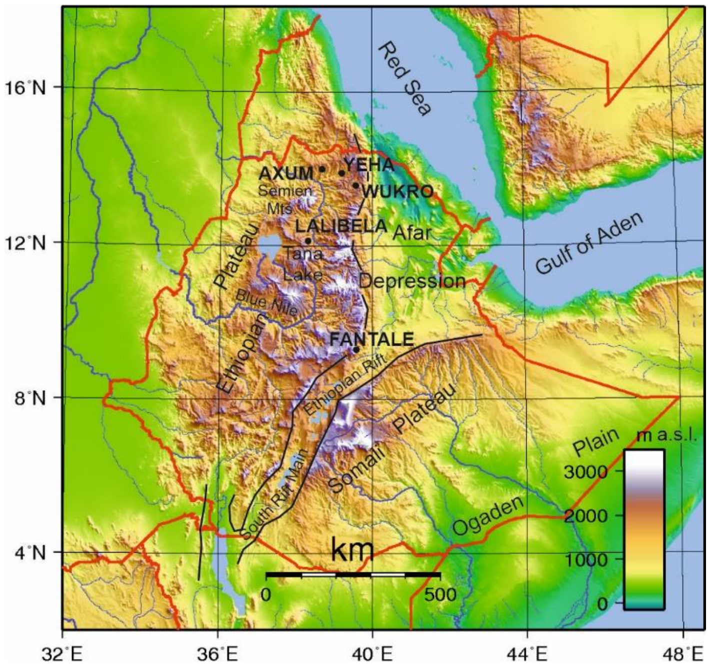


Fig. 1. Location of geosites in the North-western Ethiopian Plateau mentioned in the article (Wikimedia 2023; modified)

Depression (120 m b.s.l.), which is very tectonically active with numerous volcanic phenomena and a hot desert where salt is extracted;

- The Main Abyssinian Rift, stretching from the Awash Valley in the north-east to Lake Chamo in the south. The bottom of the rift in this section is interspersed with lakes of tectonic origin and numerous small grabens and horsts, also tectonically conditioned;
- The South Rift (Chew Lake Rift – Bahir Rift) – the southern part of the Abyssinian Rift, reaching the border with Kenya.

All these forms, due to their shape and origin, can be treated as important geosites. Problems with the perception of them result from their size. Standing on the western edge of the main part of the Abyssinian Rift, you can observe only the central part of the eastern edge and only in clear weather; this view is permanently obscured in the southern part of the rift by lush vegetation, and in the Afar Depression area by the vastness of the depression. Observers have easy access to minor landforms, e.g. single volcanic cones, deeply incised river valleys, often with the character of canyons, such as the river valley of the Blue Nile (Abay) (Fig. 2), tectonic fissures (Fig. 3, Fig. 4), faults (Fig. 5), contemporary lava or volcanic inselbergs. Furthermore, thanks to Ethiopian and foreign geologists and geomorphologists, their content is increasingly well investigated (Asrat 2002; Tadesse *et al.* 2003; Williams 2006, 2020; Asrat *et al.* 2008, 2012; Ferrari *et al.* 2015; Hagos *et al.* 2017; Teklebrhan *et al.* 2023).

Fot. 1. The valley bottom of the Blue Nile Gorge (Abay) near Goha Tsiyon (150 km south-east of Tana Lake) (*photo by W. Florek 2011*)

In the opinion of the already-cited Ethiopian authors (Asrat 2002; Asrat *et al.* 2008, 2012; Teklebrhan *et al.* 2023), the geosites in the North-western Ethiopian Plateau most deserving of interest are those associated with human activity in prehistory and historical times. The oldest of them are

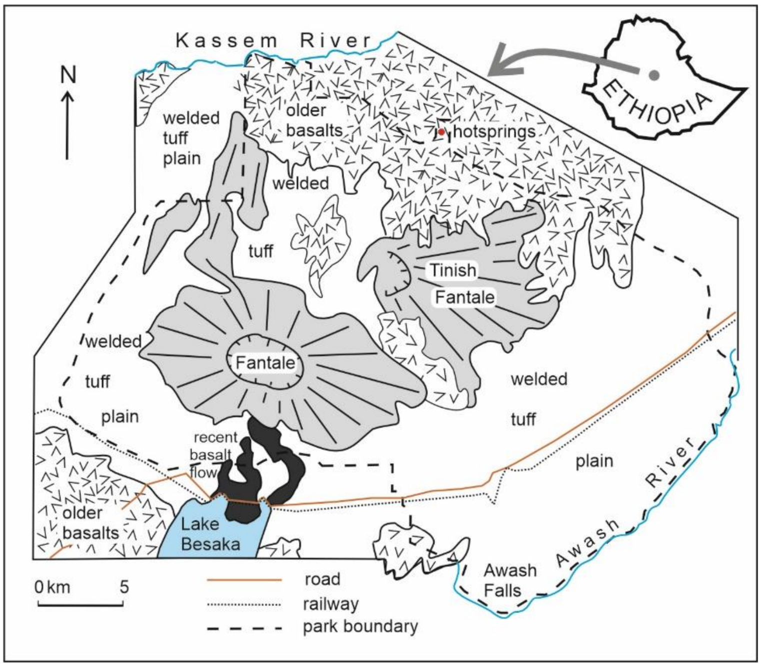


Fig. 2. Simplified geological map of the Awash National Park area, about 200 km east of Addis Ababa (after Williams 2006)

Fot. 2. A tectonic fissure at Lake Beseka, on the slope of the Fantale caldera (Awash National Park) (*photo by W. Florek 2011*)

Fot. 3. Blue Nile Gorge (Abay); faults in Mesozoic limestone and gypsum (*photo W. Florek 2011*)

located in the north, in the province of Tigray, near Yeha and are dated to *ca* 2500–2800 years ago and associated with the pre-Axum state of Damot. This area is famous for numerous, several-hundred-metre-long remnants of Pliocene phonolite laccoliths (Fig. 6) that on a clear day are visible from even ~100 km away.

Fot. 4. Yeha area: Pliocene phonolite laccoliths (*photo W. Florek 2011*)

Objects that are extremely important and interesting from both geological and historical point of view are located in Axum and its surroundings. This area is almost flat and lies at an altitude of about 2,000 m a.s.l. To the north, it is surrounded by isolated hills of ~100 m high. The plateau is made of heavily weathered porphyritic basalt. Meanwhile, the hills have diverse geneses and geological structures: Gobedra (Gobo Dura)

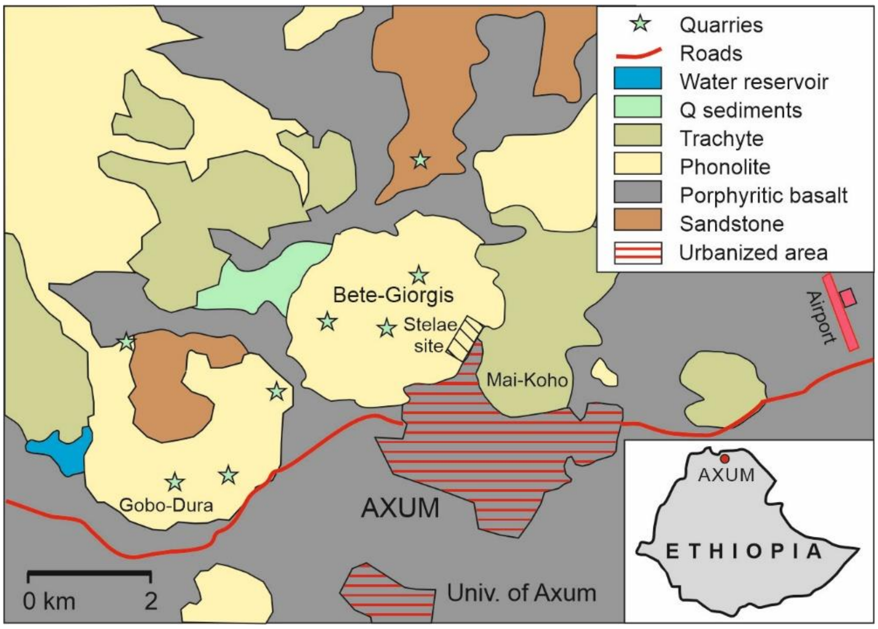


Fig. 3. Geological map of Axum showing the well-known archeological and quarry sites of the area (Asrat *et al.* 2008; Hagos *et al.* 2017; modified)

Fot. 5. Axum – 26-m-high granite (granitoid) stela (*photo by W. Florek 2011*)

Fot. 6. Gobedra Hill (Goba Dura) on the west of Axum: traces of processing of granitoids intended for stelae (*photo by W. Florek 2011*)

and Bete Giorgis are the result of granitoid intrusions that took place in the Proterozoic, while the eastern Mai Qoho and other smaller hills are rhyolite-trachyte domes formed in the Pliocene (Fig. 7) (Asrat *et al.* 2008; Teklebrhan *et al.* 2023). Already in 300 BC, the city of Axum was the capital of the kingdom of the same name and, in the 4th century AD, the oldest Christian temple was built here. The most striking objects in Axum are granite (granitoid) stelae, erected here by successive rulers for several hundred years (the last one was erected at the beginning of Christianity). They are grouped in three fields: a northern (main) field, where the largest are located, a western field (Gudit) and a south-eastern field, where the three smallest stelae stand. The tallest (or rather, the longest) of the stelae is 30 m long and today lies shattered next to the second largest, which measures 26 m (Fig. 8). All stelae today located in those three fields were made of granite (granitoid) extracted from a quarry located ~4 km west of Axum on Gobedra Hill (Gobo Dura). Abandoned objects have been preserved in the quarry (Fig. 9), which is now disused, probably due to technical defects in the granite. Thanks to this, it was possible to accurately describe the processes by which the granite was mined and processed.

The most interesting and crucial objects from a historical and geological point of view are the rock-hewn churches constituting monoliths of impressive size. The most famous is the complex of churches in Lalibela and its immediate vicinity. Lalibela is located in the northern part of the Northwestern Ethiopian Plateau. The entire area was eventually formed by Neogene volcanism (from the Eocene to the Miocene), the products of which are basalt, basaltic slags (scoria), rhyolites and ignimbrites (Fig. 10). After the volcanic processes were completed, the surroundings of Lalibela were tectonically lifted and cut by river erosion. The resultant morphology of the area is highly diverse: the city itself lies at the ordinates of 2,430–2,550 m a.s.l., but the hills east of the city reach 3,600 m a.s.l., and the bottoms of river valleys lie 300–500 m below the city (Asrat *et al.* 2008). Most of the churches in Lalibela were carved in basalt slags (scoria), which are characterised by a red-brown colour turning pink in places where fresh, unweathered surfaces are exposed and volcanic bombs of diameters up to 30 cm are embedded in a fine-grained tuff mass. The contact between the basalt slags that filled the depressions in the trap and the low-lying basalts is clearly visible at the bases of the churches of St George (Bete Giorgis) (Fig. 11, Fig. 12) and St Gabriel (Bete Gabriel). The complex of churches in Lalibela and the accompanying passages, paths, steps, hermit chambers and even artificial stream beds were built in the 12th century by the king of Lalibela. There are many stories and legends associated with this event, and today the churches themselves may be considered one of the wonders of the world (Karasiewicz 2016). However, visiting them requires a full day's drive from Addis Ababa; in recent years, a small airport to the south-west of the city has been increasingly used for this purpose.

Architecturally similar, but petrographically different, are the complexes of churches and monasteries in the vicinity of Wukro, a small town in the east of the Tigray province on the road leading to the city of Adigrat, which lies at the border with Eritrea. The churches occurring here (and there are over 120 of them) are older than those of Lalibela, and according to various sources they were created between the 4th and 10th centuries (Briggs 2010). The substrate there consists of Proterozoic crystalline rocks. In many places, they are covered with postglacial sediments, including tillites formed at the turn of the Carboniferous and Permian periods (Fig. 10). Sandstone and other sedimentary rock assemblages formed mainly in the fluvial environment at the turn of the Carboniferous and Permian (Enticho) and Triassic and Jurassic (Adigrat) periods are much more widespread. Formations of sedimentary rocks in the north of the area are covered with Oligocene and Miocene basalt (Fig. 13) (Asrat *et al.* 2008). The monolithic churches in this area (but also tombs) were carved in sandstones that were formed here from the Carboniferous, through the Permian to the Jurassic. They are diverse in grain size, mineral composition, structure (layering) and colour (from grey, through shades of yellow, to reddish). A significant part of the sandstone formations comprise monoclinic sequences whose exposed, often several-hundred-metre-long (up to ~700 m) exposures were used to hew churches and monasteries. The most frequently visited church of this group is the Wukro Cherkos church. It lies near the road leading to Adigrat, several kilometres north of Wukro (Fig. 14). Visiting any of the other facilities in this area requires renting an off-road car or sometimes quite arduous hiking.

The monolithic churches of northern Ethiopia, although built at the expense of a huge amount of work and constituting architectural pearls, for the most part do not look particularly impressi-

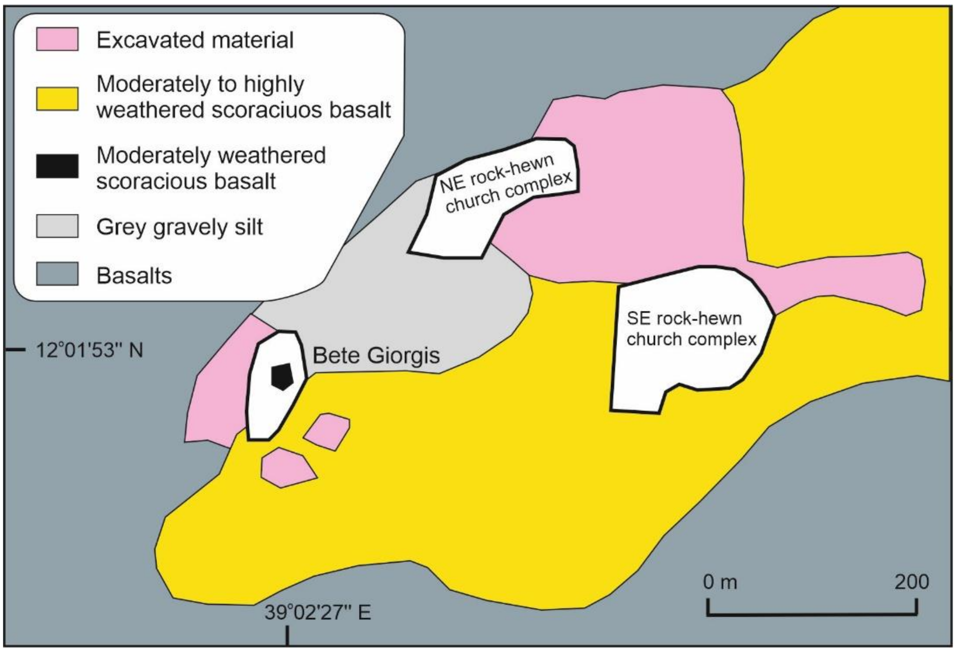
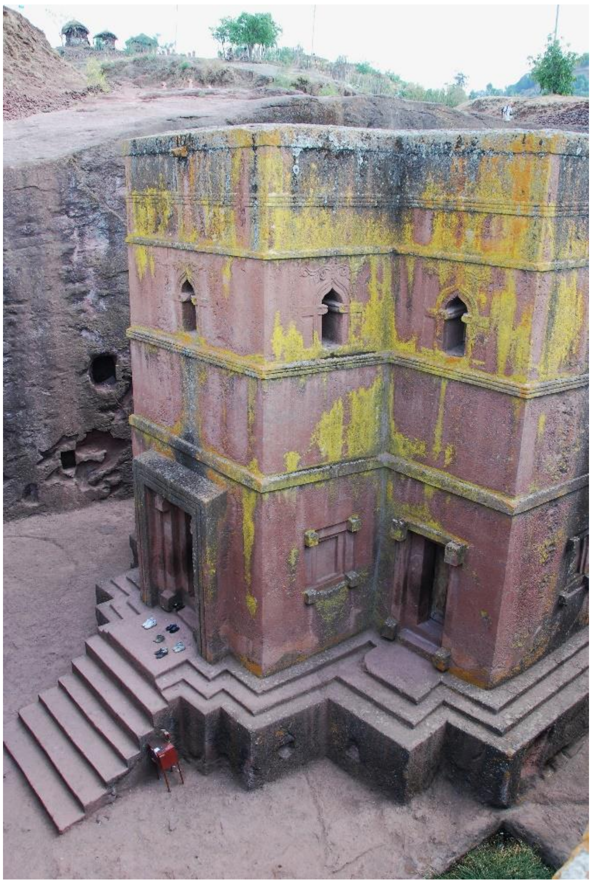


Fig. 4. Simplified geological map of the Lalibela area (after Ayallew 2004, modified by Asrat *et al.* 2008)



Fot. 7. Lalibela: Bete Giorgis Church hewn in Miocene basalt slags (scoria) (*photo by W. Florek 2011*)

Fot. 8. Lalibela: Bete Giorgis Church; in the wall, visible contact of basalt with basalt slags (scoria) (*photo by W. Florek 2011*)

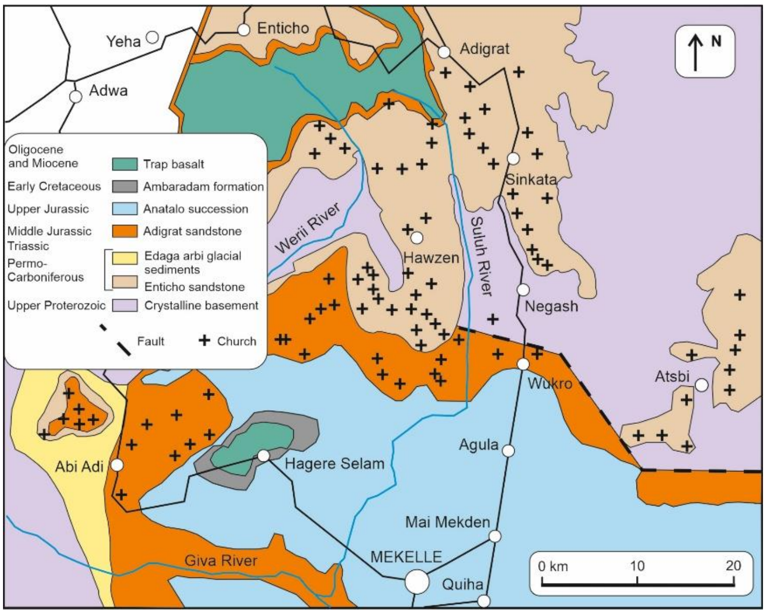


Fig. 5. Simplified geological map of central and eastern Tigray, northern Ethiopia (Asrat 2002)

Fot. 9. Wukro. Cherkos Church, carved in sandstones of the Carboniferous Enticho formation (*photo by W. Florek 2011*)

Fot. 10. Wukro. Visible manifestations of the destruction of 15th-century paintings covering the ceiling of Cherkos Church (*photo by W. Florek 2011*)

ve. This results from the properties of the rocks into which they were hewn. Both the sandstones occurring in the Wukro area and the slag basalts and tuffs in Lalibela are quite permeable, and in the rainy season they soak up water that penetrates inside, promoting the weathering of rocks (and not only their surfaces), while also destroying wall paintings (most of the currently existing ones were created around the 15^{th} century) (Fig. 15). Sacred objects, and above all, magnificent copies of manuscript books, including the Bible, are also endangered. These threats were noticed quite a long time ago; hence attempts were made to cover the churches with makeshift roofs, usually of wood. Currently, in Lalibela, thanks to funds from the United Nations and the European Union, sturdy, expansive canopies are being created that protect the churches effectively from rain. However, they also completely spoil the aesthetic effect.

Discussion

According to Migoń (2012), the recipients of the geotourist offering can be divided into three groups that differ in their degrees of preparedness to receive the transmitted content:

- professionals with appropriate expert training who are familiar with specialist terminology and the basics of individual disciplines in the Earth sciences (geologists, geographers, geoarchaeologists);
- people with a passion for educational tourism but without specialised training;
- people visiting geotourist facilities without special motivation, often "along the way", who are in no way prepared to receive relatively advanced knowledge.

Tourists of the first group are, understandably, quite rare, while those in the other two groups appear much more often, but it requires skilful communication to serve these groups both substantively and effectively, often through the use of well formulated questions designed to stimulate interest in the issues of Earth sciences.

The authors of the study "Geotourism in Ethiopia" (Asrat *et al.* 2008) decided to address their work primarily to a group standing, as it were, on the border of the first two, distinguished by Migoń (2012): students and school learners. They also recognised, like Williams (2020), that the beneficiaries of their project should be tourism agencies, tourism industry enterprises, as well as the authors of subsequent studies that should cover other areas of Ethiopia and address other issues in the field of geotourism. In Ethiopia, there are numerous occurrences of interesting rocks and minerals, e.g., obsidian is abundant on the edge of the African Rift, and in the vicinity of Axum there are beautiful and valuable specimens of red opal. The latter are often subject to illegal trade, which is risky for tourists, as the export of any specimens of minerals, fossils or rocks from Ethiopia is limited only to those cases where the person concerned has the written consent of the Ministry of the Environment. Such restrictions undoubtedly discourage tourists from the first group, especially geologists and geology students, from coming to Ethiopia. It should be added here that the total number of tourists visiting Ethiopia is growing very slowly (in 2010 – – 468,000, in 2016 – 871,000) (UNWTO Tourism Highlights 2018), so for now, all the content of this article applies to a small group of people.

Ethiopia's geotourist offer relating to the Northwestern Ethiopian Plateau and its reception

To sum up, it can be stated that geotourism belongs to the prospective directions of tourism development in Ethiopia, including sustainable (special, educational) tourism on the Northwestern Ethiopian Plateau. In addition, skilfully "smuggling" geotourist content into general tourist information in travel guides can significantly contribute to this. For years, this has been hindered by the fact that the authors of the most popular travel guides are most often humanities graduates, who often neglect content relating to Earth sciences. A good example of this is the author of the travel guide to Ethiopia published by Bradt – Philip Briggs (a historian?) and the author of the last update of this guide John Blatt (a philosopher) (Briggs 2010). The result is that the information it contains on the geology of the described places is very sparse and misleading, there is little information on physical geography, and the extensive list of recommended readings does not include a single item on physical geography or geology! A guidebook published in the Lonely Planet series (Carillet *et al.* 2009) exhibits similar "values". Some of the foreign geologists and geomorphologists who have conducted or are conducting research in Ethiopia are trying to remedy this. These publications are launched in small volumes and are amateurishly distributed, which limits the circle of potential recipients. An example of such a mini guide is the description of the geology of the Awash National Park area, mostly located in Afar Depression (Williams 2006). Websites are also quite poor in geological content. This shows how much remains to be done in the field of geotourism information relating to Ethiopia. The shortcomings in the field of tourist infrastructure (road network, different class of hotels, communication) are also worth mentioning. Infrastructure should also be understood as the proper preparation of geotourist facilities, supplying them with information boards regarding the geological and geomorphological values of geosites, the safety of their sightseeing, as well as proper signposting. Noteworthy progress has been made in this area in many countries, as evidenced by examples from New Zealand (Pijet-Migoń, Migoń 2015), Malaysia (Mordal 2014) or Tanzania (Żaba, Gaidzik 2011). No less important is the preparation of staff serving the needs of tourists.

The latest publications provide reliable information about the development of the offering for hiking and horse-riding trips, the purpose of which is to present the values of the landform, geological elements, and above all archaeological sites rich in elements of geological heritage (geoheritage) (Teklebrhan *et al.* 2023). This applies primarily to the area of Axum and Yeha in Tigray, the Lalibela Region and the Simien Mountains, but also to the area of Lake Tana (Tessema *et al.* 2022).

A sign of positive change is also an article recently published in the "GeoJournal of Tourism and Geosites". Its authors (Teklebrhan *et al.* 2023) did not limit themselves to presenting the geological and geohistorical values of the area of Axum, Adwa and Yeha (northern Ethiopia), but presented a proposal for a three-day escapade whose itinerary guarantees rich contact with the geological, historical and ethnographic values of the area. In turn, the content of an article published in the journal *Sustainability* (Tessema *et al.* 2022) proves that the tourist potential of the Northwestern Ethiopian Plateau has been noticed and considered worthy of more serious studies enabling its assessment, including in the context of the expected benefits for the economic development of Ethiopia.

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