JOINING GEOTOURISM WITH CULTURAL TOURISM: A GOOD BLEND

Stefan Rosendahl[1]

Marta Marçal Gonçalves[2]

Abstract

The Algarvian coast (Southern Portugal) is known for its beaches. However, many tourists don't want to spend their whole holidays only at the beach, so cultural tourism can fill a gap together with natural tourism. Important branches of natural tourism of Algarve are bird-watching and guided tours, which may include visits to geologically interesting sites (Geotourism). These activities are aimed to people with sporting and scientific interests.

Algarve has a big potential for Geotourism due to the large number of geologically interesting places and areas. Geotouristic activities joined with the observation or visit of cultural, mainly vernacular subjects (for instance: terraces and cultural landscapes, agricultural and ethnological traditions, villages) result in a more complete touristic offer than each part isolated and can be done all over the year. The creation of a Geopark by UNESCO, for instance, includes both natural and cultural heritage.

Like the cultural heritage, the geological heritage should be valorized by tracking paths for hiking with information tables, guided visits, folders and so on, to be disseminated by the tourist information offices, apps, new technologies, hotels and other touristic installations. When touristic activities lead to a better knowledge of the natural and cultural sites, their conservation may be easier, because the local residents are getting conscious about their value. Regular visits of the sites are used to control their condition. Thus, Geotourism and cultural tourism contribute to the preservation of the geological heritage and the landscape, which is also an environmental and cultural heritage.

Keywords: Geotourism, cultural tourism, Algarve, Portugal, natural heritage, vernacular heritage, sustainability.

[1] Instituto Superior Dom Dinis, Av. 1º de Maio, 164, 2430 Marinha Grande, Portugal, Tel: +351 96 781 1384, E-mail: srosendahl56@gmail.com.

[2] Universidade do Algarve, Campus da Penha, Faro, Tel. 289800100, E-mail: mgoncal@ualg.pt.

1. INTRODUCTION

In every year, the beaches and the mild climate of Algarve (southern Portugal) attract a lot of tourists, Portuguese and foreigners. The number of the visitors is growing: from 2009 to 2017, the overnight stays per 100 habitants rose from 2918,5 to 4586,9. This corresponds to an increase of 57,2% (PORDATA, 2018). In the same period of time, the total revenues of the algarvian hotel establishments climbed from 521.848.000€ to 1.076.233.000€, what means an increase of 106,6% in 9 years (*ib.*). Since several years, tourism is the most important economical branch of Algarve.

The touristic infrastructure of the Algarve is well developed. It includes, besides the famous beaches, a lot of hotels, hostels and private accommodations, restaurants, golf courses, riding and water sport possibilities, boat and sailing tours, discotheques, as well as other leisure and sportive activities. The region can be reached by the international airport of Faro. The highway A2 and a railway line connect Algarve with Lisbon, whereas the highway A22 ("Via do Infante") crosses Algarve from west to east and leads to Spain.

In Algarve, there are two Natural Parks, the Natural Park of Ria Formosa (in the eastern part) and the Natural Park of south-western Alentejo and Vicentine Coast (in the western part and Alentejo coast). The Natural Reserve of the Sapal of Castro Marim and Vila Real de Santo Antonio is located in eastern Algarve, and the Protected Landscapes of Rocha da Pena and Fonte da Benémola in central Algarve.

In the last years the tourist's habits have been changing. Many visitors don't want to stay at the beach during the whole day, they would rather become acquainted with the cultural and natural heritage of the region. This heritage comprises architectonical landmarks, historical and natural monuments, landscapes, traditions, regional food, and others. The geological heritage of the Algarve, called a "raw diamond" by some Portuguese geologists, is not well promoted, although the region has a long geological history and geological sites, which could be attractive to visitors and which should be protected.

For the elaboration of this article the following methodology was used: bibliographic and internet research, study of topographic and geologic maps, discussions with colleagues and specialists, and visits to the locations and museums. The preparation and orientation of guided visits in the field, whose participants were specialists and geologically interested tourists, and the related experiences were an invaluable contribution to this work.

In the last years, several works about geotourism in general were published (Brilha, 2005; R. Dowling, 2009; Garofano, 2012; Hose, 2012; Hurtado, Dowling, & Sanders, 2014; Olson & Dowling, 2018), among others, and their number is rising. There are publications about geotourism in Lisbon, Portugal, (M. L. Rodrigues, Machado, & Freire, 2011), Algarve (Rosendahl, 2014), Monsagro, Salamanca province, Spain (Martínez-Graña, Serrano, González-Delgado, Dabrio, & Legoinha, 2017), which focusses the use of digital

technologies, La Garrotxa, Catalonia, Spain (Planagumà & Martí, 2018), at locations in Poland and Czech Republic (Chylińska & Kołodziejczyk, 2018), and other regions and sites. Vernacular heritage and drystone walls in Algarve experience a growing interest since several years (Gonçalves, Prates, & Rosendahl, 2017), despite the low number of publications.

2. CULTURAL TOURISM AND HERITAGE

The General Assembly of the UNWTO (United Nations World Tourism Organization) agreed in 2017 that *"cultural tourism is a type of tourism activity in which the visitor's essential motivation is to learn, discover, experience and consume the tangible and intangible cultural attractions/products in a tourism destination. These attractions/products relate to a set of distinctive material, intellectual, spiritual and emotional features of a society that encompasses arts and architecture, historical and cultural heritage, culinary heritage, literature, music, creative industries and the living cultures with their lifestyles, value systems, beliefs and traditions"* (UNWTO, 2018b).

The UNWTO estimated in 2017 that more than 39% of all international tourism arrivals were carried out to enjoy cultural heritage (UNWTO, 2018a), giving cultural tourism an important share in global tourism. However, the main focus of this way of tourism seems to change from the tangible heritage towards the consumption and participation of cultural practises (Richards, 2018), for example, intangible heritage like traditions, gastronomy, etc., or "adventure trips" and "experiences". The same author observed that cultural tourism escaped from a niche-market, attended by people with relatively high education levels and high income, to a mass tourism event with a much wider range of participants.

In recent times, the concept of heritage has evolved from an elitist concept, identifying heritage with culture (historical heritage), to a broader type of approach, integrating cultural and/or natural assets, as well as objects that were not initially part of the concept, such as the vernacular heritage (Galindo González & Sabaté Bel, 2009; ICOMOS, 1999b, 1999a; Silva Pérez, 2008; Vecco, 2010). Thus, it opens the way for the consideration of diverse elements as heritage.

The importance of a place can be augmented by the cultural significance of the heritage, supported by its social, cultural, economic and natural aspect. The difficulty herein is how to preserve that heritage (Deom & Thiffault, 2012).

From the economic point of view, it is the scarcity of an asset that increases its value: the heritage is considered as a unique, irreplaceable and nonrenewable good, whereby it receives economic value. Therefore its deterioration and disappearance represents an irremediable loss (Mariotti, 2012). In this way, the conservation of heritage elements must

be based on the capacity of society to recognize its values, which serves as the basis for its cultural identity (Vecco, 2010). Today, heritage is considered as an important economic asset for the development of regions, an identity resource and a territorial legacy (Silva Pérez, 2008).

Economic development and heritage preservation have been placed on opposing sides for a long time, but it is in their union that economic and social value resides, contributing to development (Petronela, 2016). However, not all goods have "monumentality" related to the idea of perpetuating a given good: goods of popular culture (vernacular) are primarily utilitarian, not made to last beyond the period in which they are needed, they do not possess a symbolic aspect, and they are not usually the demonstration of wealth or power of its owner. Thus, the "monumentality" of the good must not be fundamental to its preservation, but rather the context in which the object arose, that is, the social meaning attributed to it (Gonçalves, 2016; Homero, 2006).

As human beings, we define ourselves as belonging to a given group, constantly constructing our collective identity, so that each individual recognizes himself as belonging to a community (Díaz Iglesias & Guerra Iglesias, 2010). In this sense, heritage plays an important role, since, from generation to generation, it ensures the definition of the sense of identity and continuity of humanity (Petronela, 2016). The links between the past, the present, the future, the spirit and the *being* of various cultures are established, when the intrinsic values of heritage are valued (Villacis-Mejía, Torres-Matovelle, Pons-García, & Tanda-García, 2016).

The phenomenon of globalization, related to the phenomenon of construction and deconstruction of identities, caused a quick reaction from people, rediscovering their idiosyncrasies as a factor of differentiation and identity (Moraes, 2014). In this sense, tourism helps areas that once were isolated, to become accessible. Tourism not only promotes a more connected world, but also promotes these connections (*ib.*), being a privileged vehicle for the preservation and safeguarding of the heritage, since it can cover a great diversity of people (Batista & Gonçalves, 2017).

Tourism combines endogenous and exogenous resources, being important in the economic context, as is the case in the Algarve. Tourism is simultaneously a transversal activity and, thus, it can lead to social, economic and environmental gains (E. Oliveira & Manso, 2011). This allows a reinvestment of money that can be used to preserve the heritage and as a support for its long-term survival (Villacis-Mejía et al., 2016). But tourism can also have interactions and its consequences, because it is based on human mobility; in this way, tourism must be treated and approached from a holistic perspective (Moraes, 2014), avoiding the risk of loss of heritage tourist attractions or loss of authenticity.

3. GEOTOURISM

Tourism is a recreational activity based on subjective and aesthetic criteria. On the other hand, geology is a scientific discipline with objective criteria. So, tourism and geology are very different fields of study. Nevertheless, they can co-exist and find a synthesis in geotourism (Garofano, 2012).

There are several definitions of geotourism. One of them, *"geotourism is sustainable tourism with a primary focus on experiencing the earth's geological features in a way that fosters environmental and cultural understanding, appreciation and conservation, and is locally beneficial"* (R. Dowling, 2009, p. 16), considers geotourism as a tool to join natural and cultural subjects in tourism, contributing to the conservation of nature and to local and regional development.

For some authors (M. L. Rodrigues et al., 2011, p. 283), geotourism in strict sense means *"a tourism segment focused on the sustainable usufruct (by geotourists and local communities) of the geoheritage fruition"*. In this sense, geotourism is limited to the geological heritage. However, the same authors (p. 283) consider geotourism in a broad sense as *"a tourism segment mainly focused on the sustainable usufruct (by geotourists and local communities) of the geoheritage fruition, which can be added the cultural heritage (material and immaterial) of the areas"*, joining geological heritage with cultural heritage. This concept can be used as a sustainable way of promotion, development *(ib.)* and protection of areas with a rich and miscellaneous heritage.

Hose (2012, p.11) defined modern global geotourism as *"the provision of interpretative and service facilities for geosites and geomorphosites and their encompassing topography, together with their associated in situ end ex situ artefacts, to constituency-build for their conservation by generating appreciation, learning and research by and for current and future generations"*. In this definition, cultural heritage has importance only in connection with a geosite. Meanwhile, selected cultural aspects are playing a growing role as geotourism attractions (Chylińska & Kołodziejczyk, 2018).

Based on the model of a typology of cultural tourists (McKercher, 2002, *apud* Hurtado, Dowling, & Sanders, 2014), an adapted model of geotourist's typology was presented, as the visit of geosites is often less emotional than a cultural tourism experience. This new model classifies the geotourist using the following categories (Hurtado et al., 2014):

1. The purposeful geotourist (very high motivation/positive experience). The visit of a geosite is the main motive of a travel. The visitor's experience is positive because of his interest in the geosite and his desire to learn more.

2. The intentional geotourist (high motivation/positive experience). Besides the desire to visit a geosite, there are other motives for the journey. The visitor enjoys to be informed, having a positive experience.
3. The serendipitous geotourist (medium motivation/positive experience). Geotourism is a moderate motivation for the decision to visit a geosite. At the site, the experience is positive.
4. The accidental geotourist (low motivation/positive experience). Geotourism is no motive for the travel. The tourist may not have knowledge of the existence of the geosite before the visit. At the site, the experience is positive.
5. The incidental geotourist (low motivation/negative experience). The choice of destination was not made because of an interest in geotourism. The experience gained at the geosite is negative.

Nowadays, the aim of geotourism is to contribute to the dissemination and conservation of geologically interesting and important sites. Therefore, the 3 G's of modern geotourism are geointerpretation, geoconservation and geohistory (Hose, 2012). The first two items corroborate the approach to sustainable geotourism at the geosites. The last one, geohistory, provides the reasons of the need of their establishment, as well as their philosophical and scientific basis (*ib.*).

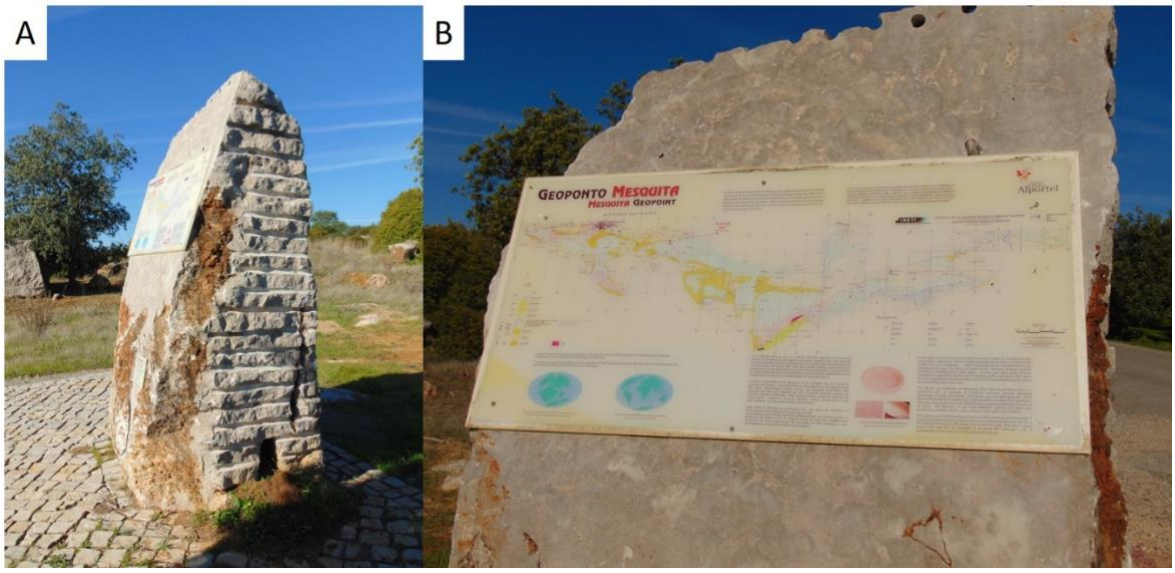
Geointerpretation can be defined as *"the art or science of determining and then communicating the meaning or significance of a geological or geomorphological phenomenon, event, or location"* (*ib.*, p.17). The information given to geotourists has to be understandable for not-geologists without sacrificing scientific accuracy (Garofano, 2012). The media of communication comprise folders which show the most important geological features of the site, geological guidebooks about the region with optional chapters about the fauna, flora and cultural heritage, information tables which are put up in "strategic" locations and give a scenic overview, besides the geological content, tours leaded by trained guides, and others. The internet and the social networks, as well as mobile application technologies are now share media to spread information about sites and trails in the cities as well as in the countryside (Martínez-Graña et al., 2017).

As examples can be listed: the guidebook of the National Park Subbetic Mountains in southern Spain (*Guía del Parque Natural Sierras Subbéticas y su entorno*, 2008), the information point at the geological site of Mesquita (not classified as a geopoint), made of the local Upper Jurassic recifal limestone and located in central Algarve (figure 1), and the panoramic train which passes at the former quarry with volcanic ashes of the Croscat volcano (La Garrotxa, Catalonia, Spain), whose driver was trained to teach about the volcanic phenomena on the way (figure 2). The panoramic train is a part of several touristic attractions

in La Garrotxa to disseminate the knowledge about the region and to attract tourists (Planagumà & Martí, 2018).

In many cases the environment of a geosite attract the tourist's attention initially more than the geological structure of the site. Once the interest for the place woke up, a visitor may be more receptive for more complex geological contexts (Hose, 2012). Therefore, a geosite and his information media should be designed in an attractive way. However, geointerpretation means not only the transmission of information. It has an equally important role to awaken concern for a geosite and to arouse empathy for geoconservation (*ib.*).

Figure 1. Geological site of Mesquita, central Algarve. A – Block of Upper Jurassic recifal limestone with traces of the exploration tools. B – Information table showing the geological context of the site on a sanded surface of the block with its structures and fossils.



Source: Authors.

Figure 2. Panoramic train at the Croscat Volcano, La Garrotxa (Catalonia, Spain).

Source: Lavaparc (https://lavaparc.com/?lang=en).

Geoconservation means *"the act of protecting geosites and geomorphosites from damage, deterioration or loss through the implementation of protection and management measures"* (*ib.*, p. 16). It is a consequence of geointerpretation, as the knowledge of a site may contribute to its conservation. An important role in this kind of protection is played by the local residents: once they know its value, they can defend the site, developing their sense of belonging (Rosendahl, 2014). Institutions like the Geoparks are an important tool for the dissemination of knowledge and the protection (UNESCO, 2017). Meanwhile, because of the growing number of visitors some geosites are overcrowded and may be damaged by this impact. In these places, the conservation must be assured by management measures like controlling and managing site access, viewing platforms, tour guides and others (R. K. Dowling & Newsome, 2017).

It is obvious that the use of geologist's most typical tool, the hammer, should be forbidden in classified and protected geosites. However, in some shale quarries at the world famous location of Holzmaden, embedded in the Geopark Swabian Alb (Germany) and known by the finds of fossil Lower Jurassic ichthyosaurs (marine reptiles), with an age of about 185 million years, it is allowed to look for fossils using hammer and chisel (Geopark Schwäbische Alb, n.d.).

On the other hand, in the opinion of some geologists the best conservation method of interesting locations is to keep them secret. The less public knowledge exists about them, the lower would be the possibility that the site might be damaged or destroyed. There are important geological, paleontological and mineralogical locations in the world that have been

damaged and plundered with machines like pneumatic hammers (Rosendahl, 2014). Such a maltreatment of a site was detected by the authors of this article in 2010, at the location of Las Ermidas (Córdoba, Andalusia, Spain), where the limestone of Lower Cambrian age, about 520 million years ago (Perejón, Liñan, & Quesada, 2004), contains an important fauna of archaeocytha fossils, an extinct group of sessile organisms and probable precursors of sponges. In the Spanish communities of Aragon and Catalonia, for instance, the collecting of fossils, even in small amounts, is forbidden and may be punished by law (Löser, 2009). However, nowadays it is quite impossible to hide the really interesting places in a world where information is shared so easily via the social networks, so there is the risk that more damaging may result by an uncontrolled access. Besides, there would be no or only low advantage for the local residents.

Geohistory can be defined as *"study, evaluation and application of a systematic narrative of geological and geomorphological discoveries, events, personages and institutions contextualized within contemporary socio-economic and cultural trends"* (Hose, 2012, p. 12). Geosites can play an important role in the study of the geological context of a region, for instance, at the locality of Lochsite (Glarn Alpes, Switzerland), where the structure of the Alps as a pile of thrusted rock nappes was unveiled at the end of the 19th century (Herwegh et al., 2008). Such key localities must be preserved and their access must be available, just like the geological publications and the memory of the early researchers (Hose, 2012).

While some definitions of geotourism (R. Dowling, 2009; Hose, 2012) are quite restricted to geological topics, other natural (fauna and flora) and cultural (buildings, traditions, gastronomy, etc.) heritage should be explained on a guided tour or on a trail, following the definition in a broad sense (M. L. Rodrigues et al., 2011). The ABC approach of geotourism (Dowling 2013 *apud* Olson & Dowling, 2018) includes the Abiotic (geology, climate), Biotic (fauna, flora) and Cultural (human) components of an area, both past and present. Thus, the visitor may be enabled to understand the context of a region (Rosendahl, 2014) and to be familiar with the *genius loci* (Chylińska & Kołodziejczyk, 2018), in an urban as well as in a rural space: the typical building materials, the way of working with stones, what soils are necessary for agriculture, the kind of cattle which is farmed, the local food, the dependence of the availability of water on the type and permeability of the substrate, the way of implantation of drystone walls, and so on. This type of sustainable tourism can be improved and become more attractive by the use of digital technologies, like QR codes, videos, geoapps and video games, which are used, for instance, in a geotouristic trail in Monsagro, Salamanca province, Spain (Martínez-Graña et al., 2017), or the site Wikipiedras, created in Catalonia (Spain) for the location of drystone heritage ("Wikipedra. Construccions de Pedra Seca," n.d.).

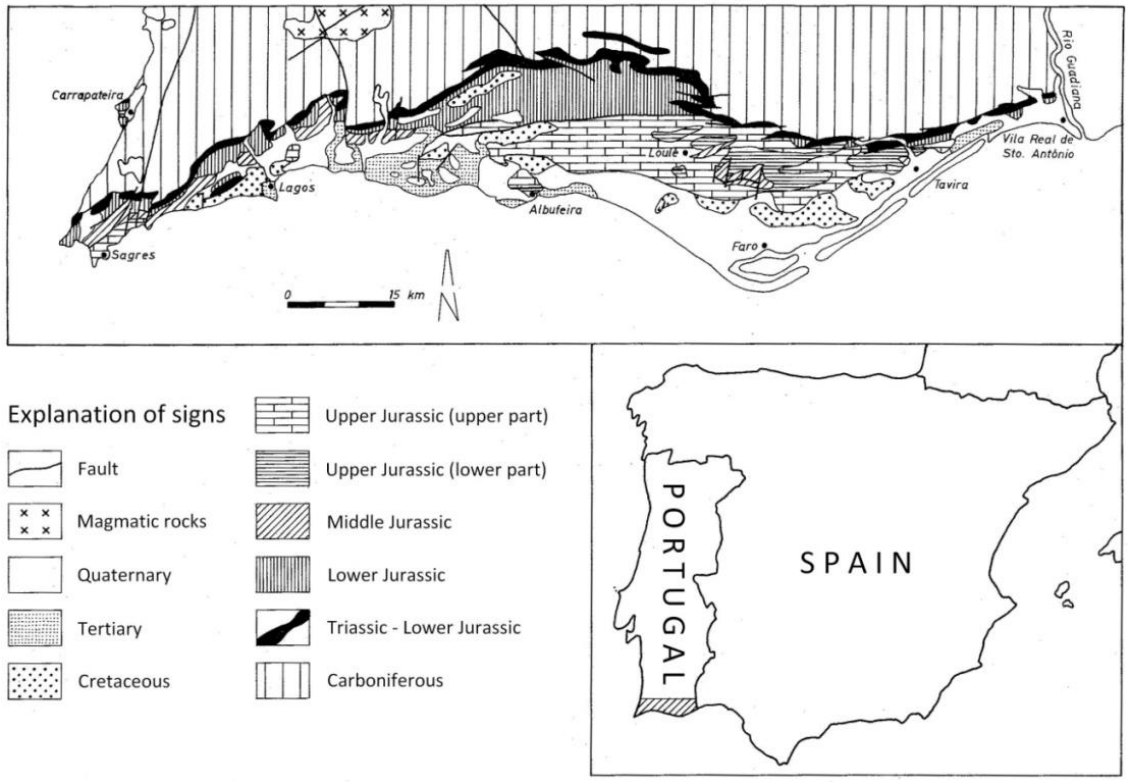
Geotourism should guarantee the sustainability of the implantation and maintenance of the geosites (Brilha, 2005). In this sense geotourism may be considered as a kind of ecotourism, which can be defined as *"responsible travel to natural areas that conserves the environment, sustains the well-being of the local people and involves interpretation and education"* (TIES, 2015). However, geotourism has some advantages to ecotourism, because it is not restricted to seasonal variations and it does not depend on the fauna's habits (fossils cannot run away). Moreover it may retract tourists from overcrowded touristic sites, it complements the offer in touristic areas, and it promotes the local handicraft creating motives related to the local geological features (Brilha, 2005).

Next to its natural and cultural importance, geotourism and geoparks can contribute to the local or even regional development, because it attracts people to go to sites they cannot find in the cities. Near the locations, more jobs and economic support may be created to satisfy the demand for guided tours, interpretation, food and accommodation, increasing the local businesses (R. Dowling, 2009). Local craftsmen can develop and sell replicas of fossils, other geo-related ventures products might be generated, like geomenus in georestaurants (Farsani, Coelho, & Costa, 2011). Ancient skills will be preserved by the offer of workshops, for instance, how to build a drystone wall. Such enterprises and others are capable to slow down the emigration of people from the rural areas, preventing a greater loss of population.

4. GEOLOGICAL HISTORY OF ALGARVE

The so-called "Algarve basin", constituted by Mesozoic and Cenozoic deposits (figure 3), has an extension of about 140 km from the São Vicente Cape in the west to the Guadiana River in the east, and is up to 25 km wide. In the north it is limited by the carboniferous rocks of the South Portuguese Zone, which is a part of the Iberian Massive and corresponds to the Paleozoic basement of the younger formations (Terrinha et al., 2013), and which constitutes the mountains of Caldeirão, Espinhaço do Cão, for instance.

Figure 3. Geological sketch of Algarve.



Source: Rosendahl (1985)

The carboniferous sandstones and shales of "flysch"-type, deposited during the Carboniferous period, about 360 to 310 million years ago (International Commission on Stratigraphy, 2018), have suffered metamorphism and folding during the variscan orogeny, which took place from about 390 million to 250 million years ago and had affected a big part of western and central Europe (J. T. Oliveira et al., 2013). From the Carboniferous to the Lower/Middle Triassic, about 260 million years ago (International Commission on Stratigraphy, 2018), there was a gap in sedimentation which lasted several tens of million million years. The first Mesozoic deposits of Triassic age are red sandstones and clays ("Silves Formation") with volcanic intercalations, which overlie the carboniferous formations with an angular discordance (Terrinha et al., 2013).

During the Jurassic period (about 201 to 145 million years ago) and until the end of the Cenomanian system (Upper Cretaceous), with an age of about 94 million years (International Commission on Stratigraphy, 2018), the region of the today's Algarve corresponded to a marine basin. In its northern part, limestones of the Lower to Middle Jurassic period, about 201 to 163 million years ago (*ib.*), were deposited in a wide marine platform. Their layers are barely deformed and more or less horizontal. In the south of a fault zone, which divides the area structurally in an east-west-direction, Upper Jurassic formations, mainly of shallow water, with an age from about 164 to 145 million years (*ib.*) appear. Limestones, marls with

ammonites and reef structures with corals are typical. The Jurassic deposits are thicker and more or less folded, especially in the eastern Algarve (Terrinha et al., 2013).

The Mesozoic sedimentation ends in the Algarve region with shallow water deposits of the Cenomanian system in the Cretaceous period, about 94 million years ago (International Commission on Stratigraphy, 2018). After a gap of about 70 million years, shallow water and continental formations of Neogene age, from about 23 to 2,5 million years ago (*ib.*) cover the older ones with an angular discordance (Terrinha et al., 2013). Quaternary landforms and deposits, with ages less than 2,5 million years (International Commission on Stratigraphy, 2018) can be seen in beach terraces and the dunes and islands of the Ria Formosa. At the end of the Cretaceous period, about 72 million years ago, magmatic rocks took place and built up the today's Serra de Monchique.

5. GEOSITES AND GEOLOGICAL HERITAGE IN ALGARVE

In the Portuguese Law on Nature Conservation and Biodiversity (República Portuguesa, 2008), a geosite is defined as an *"area of occurrence of geological elements with recognized scientific, educational, esthetical and cultural value"*. A classified geosite is protected by this law and its damaging is considered as an act of felony which is subject to penalties. The same law defines the geological heritage as a *"set of geosites that occurs in a certain area and that includes the geomorphological, paleontological, mineralogical, petrological, stratigraphical, tectonic, hydrogeological and pedological heritage, among others*".

The geological heritage is a part of the natural heritage, which is composed of biotic and abiotic elements. All life on Earth depends on the fine crust of rocks, soils and water at the planet´s surface. The geological heritage comprises locations and objects with geological and paleontological importance which represent the memory of the Earth, where its development and the evolution of the living creatures are testified (J. de C. Rodrigues, 2009). This record is fragile and its destruction is irreversible.

The geosites are the "display windows" of the geological heritage. They are important and classified because they testify the past of the Earth, appearing in a particularly interesting way and being not frequent or even unique sites, they have scientific interest, permitting a deeper knowledge of the geological evolution of the regional or local territory, they possess pedagogic value, giving examples of geological phenomena to the public, and they are touristically interesting, being geological tourism a branch with a growing tendency (Ramalho, 2004).

Several locations have been classified as geosites in Algarve (Brilha & Pereira, 2012; LNEG, 2010; PROGEO, 2014), most of them having touristic potential. There are several

not classified geological sites which also may be interesting for tourism. The following sub-chapters will describe four of the most important geological places of Algarve.

4.1 Telheiro Beach

At the north side of the Telheiro Beach (west of Vila do Bispo), folded and steeply incident carboniferous shales and sandstones with an age of about 360 million years are overlied by red marls and sandstones of Triassic age, whose age is about 260 million years (International Commission on Stratigraphy, 2018). Their layers are nearly horizontal and cut the older formations in a sharp angle (figure 4). This structure is an angular discordance which shows a gap in sedimentation of about 100 million years (Reis & Pimentel, 2012). During this period, the Variscan Mountains have been folded during the closing up of the former continents of Gondwana and Laurussia, about 322-290 million years ago, whose collision built up the super-continent of Pangea. Then, erosion wore out the mountains and the interior of Pangea leaving only a plain landscape behind. Rivers and lakes on this plain deposited sands and clays, which were later transformed into the red sandstones and clays of the Silves Formation, about 240 million years ago. The site is classified as a geosite (LNEG, 2010) and can be reached only by walking or with a cross-country vehicle.

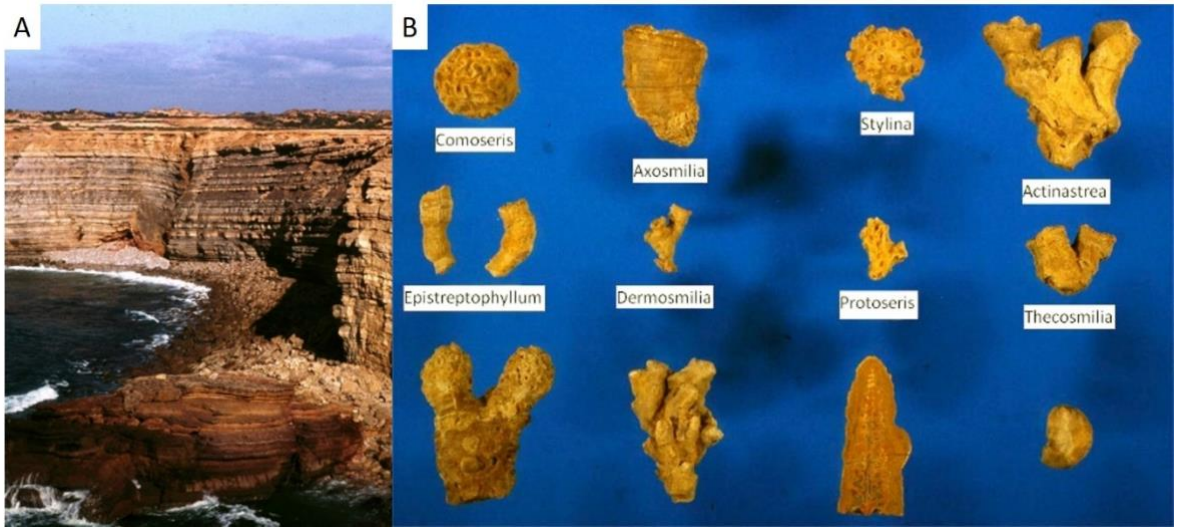
Figure 4. Angular discordance at Telheiro Beach. Note the almost vertical layers of the Upper Carboniferous shales, the sharp discordance line and the subhorizontal layers of the red Triassic Silves Formation.

Source: Authors.

4.2 Carrapateira

Carrapateira is located at the western coast of Algarve, in a distance of about 14 km north of Vila do Bispo. On the top of the cliff, limestones and marls of Lower Kimmeridgian age, about 156 million years ago (International Commission on Stratigraphy, 2018), contain a rich fauna of well-preserved fossil corals and other fossils (figure 5). More than 40 different species of Upper Jurassic corals were identified in this place (Rosendahl, 1985), so it was characterized by a specialist of Mesozoic fossil corals as belonging to the "top ten worldwide" (Hannes Löser, oral communication, 2011). Because of its paleontological richness and the spectacular landscape of the cliffs, the location was classified as a geosite (LNEG, 2010). Furthermore, the view from the Pontal promontory to the western Portuguese coast and the Bordeira Beach are other scenic values.

Figure 5. A – Cliff with limestone and marl layers near Carrapateira. B – Some Upper Jurassic corals and other fossils (sponges, gastropods) found on the cliff.



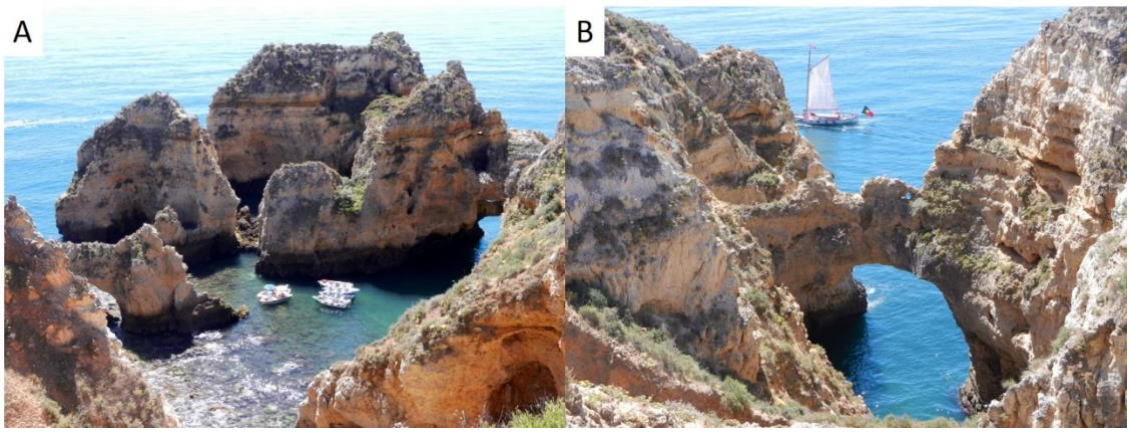
Source: Authors.

4.3 Ponta da Piedade, Lagos

The tourist spot of Ponta de Piedade, at the south of Lagos, shows Miocene fossiliferous limestones with an age of about 15 million years (International Commission on Stratigraphy, 2018). The main fossil group are pectinid shells and oysters. The rocks were affected by a

well-developed karstic erosion (Reis & Pimentel, 2012), having resulted a bizarre landscape with caverns and rock arches which can be visited by boats and stairways (figure 6). The site is classified as a geosite (LNEG, 2010).

Figure 6. Karstic coast of Ponta de Piedade, Lagos. A – General view. B – Rock arch.



Source: Authors.

4.4 Lagoa dos Cavalos

In the hills at the south-west of Santa Catarina da Fonte do Bispo (central Algarve), a coral bed with long branched corals can be seen in a sequence of Lower Kimmeridgian limestones (figure 7), with an age of about 156 million years (International Commission on Stratigraphy, 2018). One species dominates the fauna, which means that the paleo-environment was not optimal for the corals (Rosendahl, 1985). An almost straight line cuts the coral bed upper part. This cut may have been originated by a storm or, less spectacularly, the line shows the fossil low tide water level in relation to the corals. This place is not classified as a geosite, but nevertheless it is a very interesting location.

Figure 7. Branched fossil corals in Upper Jurassic Limestones near Lagoa dos Cavalos.

Source: Authors.

Some other geologically interesting sites in Algarve (Brilha & Pereira, 2012; LNEG, 2010; PROGEO, 2014) with touristic potential are, for instance, the Salema beach (Lower Cretaceous dinosaur trace fossils; classified as geosite), the Salt Mine of Loulé (classified as geosite; access only with permission of the mine´s management), and the Ria Formosa (recent lagoonal and sandy barrier system; classified as geosite).

6. DRYSTONE WALLS

Why do the authors mention drystone walls in this article? The walls made of stones without mortar represent a link between natural and cultural vernacular heritage. Natural heritage, because they are made of local stones, because the geological setting of an area may determine if a drystone wall is necessary or not, because they create a lot of ecological niches and habitats for animals and plants, and because they mould typical landscapes. Cultural vernacular heritage, because they are made by man to resolve several problems in agriculture. The inclusion of dry-stone walls in a guided geotouristic visit will help to understand geological and geomorphological features of the terrain, as well as their context with the rural way of life. These walls are also an example of a practical utilization of stone.

Agriculture is an activity that has always been very important for Man's survival, especially after he has become sedentary. If man needs to adapt to the environment that surrounds him, terraces appear, related to agriculture, typical of the Mediterranean basin, favoring dryland crops such as olive trees and facilitating the establishment of the population, drawing an interaction between man and Nature (Gonçalves, 2016; Gonçalves et al., 2017).

Constituting artificial steps in the slopes (figure 8), the drystone walls favor new economies, contribute to increased infiltration of water into the soil, reduce water erosion, reduce the inclination of the hillsides, make them suitable for agriculture and for the construction of buildings that benefit from this new territory (Bellmunt i Chiva & Sogbe Mora, 2010). However, they require careful maintenance, which is difficult because there is a shortage of artisans and, once they have lost their agricultural use, they are no longer useful and suffer a growing deterioration (Gonçalves, 2016; Rebelo et al., 2006).

The drystone support walls constitute the majority of the terraced system in the Algarve: apparently the stones appear to be randomly fitted, however, the durability they exhibit demonstrates a sense of balance and a very refined art of stone rigging, which is not simple at all (Châtelain, 2009; Gonçalves et al., 2017). Belonging to the type of heritage most difficult to be recognized as such, the vernacular heritage is also the most difficult to preserve, and is still considered a "minor heritage", to which is not given much attention, partly because "it is always there", being neglected, abandoned and culturally devalued (Gonçalves, 2016; Gonçalves, Perez-Cano, Rosendahl, & Prates, 2018; Gonçalves et al., 2017). However, it is precisely this type of heritage that has a greater sense of identity and identification with the place, with the cultural roots of a community and with its land (Gonçalves et al., 2017).

Terraces are excellent representations of man-made nature, being an expression of the history and culture of the people of these places, and can also be interpreted as evocative and inspiring places, offering tourist opportunities that can foster their renewal and survival. They also allow the coexistence of new activities and agricultural activity, while allowing utilitarian alternatives that can ensure their survival, being plural and efficient (Bellmunt i Chiva & Sogbe Mora, 2010).

Figure 8. Drystone wall terraces in Algarve

Source: Authors.

There are still many terraced walls in the Algarve, in spite of the abandonment to which they are subject, since they no longer have a practical function, and consequently, landslides and landslips are increasingly frequent (Bellmunt i Chiva & Sogbe Mora, 2010; Rebelo et al., 2006). If they were assigned new functions, they would be preserved and maintained. Once the renewal and reutilization has begun, these spaces, with great tourism potential, allow this type of use and, with tourism, it is possible to transmit and highlight the cultural heritage (Gonçalves et al., 2017; Rebelo et al., 2006).

The intended tourism has to be a multi-purpose and a sustainable natural tourism (Rebelo et al., 2006), being an activity that maintains the cultural and ecological identity of the territories. However, if the primary and secondary sectors are not sustainable, the agricultural activity will end completely, and there will be no development of industries related to the products of the zone, so tourism will not be sustainable (Sánchez Arroyo & Herrera Perea, 1997). Terraces have the potential to lead to sustainable tourism, since, as is usual in vernacular constructions, they maintain the cultural and ecological identity of the area and imply a use with little impact on the environment in which they are inserted, requirements for tourism to be sustainable (Gonçalves, 2016).

7. CONCLUSIONS

The touristic infrastructure of the Algarve is well developed. Considering the geological and the cultural, mainly vernacular heritage in the rural areas of this region, there is a great potential for the development of touristic activities which may include visits to geologically

and culturally interesting sites. These activities will satisfy the tourist's curiosity on cultural and natural heritage. In many guided visits, the authors were asked about the aim of the visit by people outside the tourist's group. This shows that geotourism awakens interest and that it is a way to spread geological knowledge and to attract new supporters. The field activities should be supported by the installation of information tables, booklets, folders, and so on, written in a language which is understandable for not-geologists, as well as by the installation of smartphone applications, with QR codes, videos and other multimedia gadgets (Martínez-Graña et al., 2017). Besides the geology, also the cultural heritage will be better known, and attention will be drawn for its conservation and protection.

The actions of this kind of sustainable tourism are not restricted to visiting people, as also the residents should have better knowledge about their land, where cultural concerns are often considered as less important than economic ones (Olson & Dowling, 2018), and vernacular heritage is not recognized as such or taken as "minor" heritage. Basing on this knowledge, it will be possible to achieve a better and more efficient protection of the existing heritage. Also the design and sale of geo- and culture-related products, as well as the knowledge and preservation of ancient techniques, may be a way of conservation and contribute to local or regional development. The training and employment of local residents as field guides or for other tasks may be a weapon to fight emigration and to enrich the region (Farsani et al., 2011).

The touristic target group consists mainly in scientifically and culturally interested people, adults and children. As the guided tours and the instruction are paid, geotourism may be an economically interesting complement of tourism, which moreover enriches the existing touristic offer of a region. Geotourism does not depend on a season of the year and can be carried out at nearly every weather, like cultural tourism. The geosites should have an easy access or there should be a transportation facility for people with special needs, as it happens in many cultural sites.

The knowledge of the geological setting of a site is capable to be valuable complement to its cultural heritage and history, bringing in a natural component. The *genius loci* of a site, the local spirit provided by cultural and natural heritage, feeds cultural tourism (Chylińska & Kołodziejczyk, 2018). The geological history of the region, the environment of the rocks' origin, visible geological structures like a well-developed fold or the presence of fossils may increase the experience, especially when people know more about them. Consequently, a visitor will be able to capture the whole context of the visited area.

Geotourism and cultural tourism have very similar aims. Both pretend to disseminate knowledge about and to promote protection and conservation of the respective natural, tangible and intangible heritage. Joining carefully these two branches of tourism, the result

for the providers and customers may be a splendid win-win-situation, like a skillfully blended whisky.

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