

EVALUATION FEATURES OF FOSSIL AND COASTAL
GEOSITES: SELECTING ASSESSMENT CRITERIA
FOR GEOTOURISM PURPOSES

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Abstract

Fossil deposits are among the most attractive geosites in nature parks and geoparks. The Register and Cadastre of the Bulgarian geological phenomena includes several outstanding fossil deposits estimated as geosites of national significance. However, they are assessed according to the general methodology for evaluating all classes of geosites: geomorphological, paleontological, petrographical, etc., so their specific characteristics remain in the background. This also applies to coastal geosites which are not present in the Register at all, except for a few dune fields. This article discusses indicative criteria that can be used to create an expert card to assess fossil and coastal geosites based on their common feature – fossils, and their scientific and tourist value. The aim is to identify possible common features and to develop a set of criteria highlighting the specific characteristics of the fossil and coastal geosites. In this way, their value will be enhanced beyond the basic level of significance established on the basis of general criteria such as aesthetic, ecological, cultural, etc. values that are not sufficiently indicative of the true scientific and tourist value of fossil and coastal geosites.

Key words: geosites, evaluation criteria

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Introduction. Geoheritage and geopark conservation is now an integral component of education, tourism, planning and management all over the world. Fossil deposits are the subject of particular scientific and public interest on a global scale. World-famous fossil sites such as Ediacara in Australia, Burgess Shale in Canada, Solnhofen in Germany, and many others, have gained popularity because of their key role in elucidating the organic evolution of Earth. Vast fossil fields, which give the names of famous natural parks such as “Petrified Forest” in Arizona, “Dinosaur Park” in Utah and Colorado, “Cretaceous Park” in China, etc., are the subject of all-season tourism. Another class of geosites that attract thousands of visitors – coastal geosites – are closely related to sea-level fluctuations, forming ancient marine terraces with rich fossil communities left on them. What these two classes of geosites have in common – the presence of fossils – is a good basis for creating a set of common evaluation criteria. In this paper some indicative criteria highlighting the specific characteristics of fossil and coastal sites that can be used to create an expert card for tentative evaluation of geotopes are proposed.

Issue status and recent achievements of Bulgarian geoconservation. So far, no fossil deposits of global significance have been identified in our country. Some of the well-studied fossil-bearing outcrops of Silurian graptolites, Carboniferous megaflora, Jurassic molluscs, Cretaceous orbitolines, corals and molluscs, Tertiary nummulites and molluscs, and Pliocene vertebrates are included in the Register and Cadastre of the Bulgarian geological phenomena. They are evaluated according to a common methodology [1], modified later for geosites in a park environment [2].

A new method for evaluation of geosites based on the so-called “thematic geodiversity” [3] suggests individual approach to each geopark according to its geological features and socio-economic prerequisites in the context of its geotouristic potential. It requires clear identification of one main theme underlying the geopark concept, and secondary themes enhancing its geodiversity.

Some of the fossil deposits included in the Register and Cadastre can gain global popularity only as part of a UNESCO Geopark, which unfortunately does not exist in Bulgaria. Fossil deposits of graptolites in Sofia Balkan and lepidophytes near Svoge in the frame of the first scientifically defined geopark “Iskar defile” [4] have great potential to become key geosites of national value.

Geological phenomena in “Rila” Geopark are characterized by recently published methodology developed especially for geomorphosites in alpine environment [5]. The standard description in the form of scientific dossiers is a proper way to illustrate the genesis of the alpine landscapes.

“Burgas Lakes” Geopark is in initial stage of establishment but its main theme is logically related to the coastal landforms: estuaries, lagoons and ancient marine terraces used for illustration of the sea-level fluctuations in the past. In this regard, a methodology to assess the tourism potential of coastal geosites is quite necessary.

The development of the latest project “East Balkan” Geopark puts on the

agenda the valorization of fossil geosites which cannot be properly evaluated with the existing methodology. Their depiction will allow better management, conservation and promotion of geotourism in the East Balkan and its coastal areas.

Priority criteria for evaluating fossil and coastal geosites. In addition to the standard general criteria (completeness, rarity, representativeness, sensitivity, etc.), some specific criteria such as presence in the Internet and museum environment, educational programmes, public awareness and historical value for Bulgarian geology should be added for a more accurate evaluation of fossil and coastal sites.

It is well known that coastal areas usually have a well-developed tourist infrastructure, so the integration between coastal tourism and geotourism seems very attractive. The most direct link between them is the collision between the sea and the land, showing ongoing geological processes. However, to demonstrate their interaction in a geological sense, they must be seen in their dynamics over time, not in their static state, showing merely natural beauty devoid of geological history. In addition, interpretive and explanatory materials are needed to present modern geological processes to the general public.

In order to attract the attention of tourists who visit the coast to spend their vacation, you need to offer some kind of story that is both compelling and reliably based on geological facts. The legends about the maiden who threw herself from the steep cliffs to avoid falling into the hands of the bloodthirsty conquerors, or about the mermaids who kidnapped the young prince into the sea abyss, are already quite boring and cause condescending smiles. To catch the visitors' eye you should offer something more genuine, provoking questions and discussions. Fossils are always a good option, especially when they are abundant and collectable. Of course, dinosaurs are preferable, but they are very rare. Collecting practices exist in many countries where exposed rocks provide an inexhaustible source of fossils. In Bulgaria such outcrops exist in the Silurian graptolite shales between Sofia and Svoge, orbitolina-bearing beds in the Urgonian rocks, Eocene nummulitic sands in Pobiti Kamani area, and of course gastropods and bivalves in the Neogene rocks.

In the case of coastal environment, a good option for demonstration are ancient marine terraces situated tens of meters above the modern sea level with abundant seashells deposited during the high sea-level. This topic is especially relevant in the context of modern paranoia about the "climate changes" greatly overexposed by the media and unscrupulous scientists that has caused a global panic among the world's population. The scientific explanation for the presence of seashells far from the seashore is a good reason to explain global warming and cooling as normal natural processes that existed long before humans appeared on earth and have nothing to do with human activity and greenhouse gases. Cyclically repeating glacial and interglacial ages due to astronomical forcing (Milankovitch cycles), which are responsible for the formation of ancient marine terraces, are a particularly suitable topic for geo-education both at school level and for visitors.

Coastal geosites approach the category “geomorphosite”, first defined as “a landform to which a value can be attributed” [6]. The attributes that can give value to a landform are of scientific, cultural, socioeconomic, and scenic type. Many authors perceive geomorphosites as geomorphological landforms that have acquired scientific and additional values (cultural/historical, aesthetic, and/or social/economic) due to human perception or exploitation. In fact some of the coastal geosites (e.g. marine terraces), are close to the definition of AVANZINI et al. [7] considering geomorphosites part of a larger category encompassing those elements of the landscape which, besides being spectacular, can give a significant contribution to our understanding of the geological history of the area.

In recent years many methodologies for assessing geosites have appeared [8–11]. At the same time, new interpretations of the terminology relating to the terms geosite and geomorphosite have also arisen. GREGORI et al. [12] subdivided geomorphosites into two groups: 1) with geomorphological features together with cultural/historical and scenic values (e.g., medieval villages near or over landforms), and 2) with predominant scientific values, e.g., peculiarities of the geomorphological processes or the special nature of the landforms. Many authors follow the method for assessing “scientific value” and “additional values” of geomorphosites proposed by REYNARD et al. [9]. The category “scientific value” refers to the integrity, representativeness, rareness and paleogeographical value, whereas “additional values” includes ecological impact, aesthetic, cultural and economic value. In this context BRILHA [11] suggests that a geosite of scientific value be referred to as a “geosite”, and a geosite of touristic value – “geodiversity site”.

The Bulgarian methodology for selection of sites for the Register and Cadastre of the Bulgarian geological phenomena [1] is based on the achievements mainly of British [13] and Australian (Tasmanian) geoconservationists [14]. Two main categories of geological phenomena “geosites of aesthetic value” and “geosites of scientific value” are distinguished. The expert card for preliminary field assessment includes 16 of the most common criteria with different weights in the numerical estimation, varying between 3 and 8 points. On the basis of the numerical evaluation, the significance level of the geosite on a geographical (spatial) context is determined: global, continental, national, regional and local. SINNYOVSKY [2] revised this card in order to adapt it to the evaluation of geosites in a park environment replacing “geosite of scientific value” and “geosite of aesthetic value” with the later introduced terms from Brilha [11] “geosite” and “geodiversity site”.

Specific criteria for the evaluation of fossil and coastal geosites.

Seven criteria based on four indicators are ranked according to their importance for evaluating fossil and coastal geosites, based on a numerical score for each indicator (1–4) for estimation of their geoconservation value (Table 1): public awareness, availability of in situ museums, availability of special attributes of the geosite in ex situ museums, promotion in scientific publications, degree of study of the fossils, form of education on the subject in local schools, historical value for Bulgarian geology.

T a b l e 1

Criteria, indicators and parameters proposed for quantitative assessment of some specific features of fossil and coastal geosites

| Criteria/Indicators | Parameters |
|--|------------|
| A. Public awareness | |
| Publicly available information in an electronic environment (website, social networks, etc.): mode of life, time of existence, coastline migration | 4 points |
| Demonstration of on-site digital materials (movies, computer-generated animations) in visitor centres and in situ museums | 3 points |
| Paleoenvironment reconstructions such as professionally arranged expositions in museums or local visitor centres | 2 points |
| Paleoenvironment dioramas and other illustrations in local tourist offices or school expositions | 1 point |
| B. Availability of in situ museums | |
| Geological museum with professionally determined fossils and rocks | 4 points |
| Natural history museum with a separate exposition of fossils and rocks | 3 points |
| Museum collection in a publicly accessible building (visitor centre, tour desk) | 2 points |
| School fossil collection for educational purpose | 1 point |
| C. Availability of special attributes (fossils, minerals) in ex situ museums | |
| In foreign museums | 4 points |
| In specialized central museums (national museums, university museums) | 3 points |
| In regional natural history museums | 2 points |
| In amateur collections | 1 point |
| D. Promotion of fossils in scientific publications | |
| New genera and species are first described in international magazines | 4 points |
| New genera and species are first described in national magazines | 3 points |
| Data of fossils are published in regional magazines | 2 points |
| Data of fossils are available in amateur publications | 1 point |
| E. Degree of study of the fossils | |
| Determined by professional paleontologists dealing with this group | 4 points |
| Defined at the genus level by paleontologists dealing with related groups | 3 points |
| Determined by broad-profile geologists at an order or class level | 2 points |
| Amateur definitions or popular names (snails, slugs, devil's nail, etc.) | 1 point |
| F. Form of education on the subject in local schools | |
| The topic is included in the regular natural science education curricula | 4 points |
| The topic is included in curricula for an optional form of natural science education programmes | 3 points |
| The topic is the subject of extracurricular activities (clubs, open classes) | 2 points |
| The topic is the subject of ad hoc lectures by guest lecturers | 1 point |
| G. Historical value for Bulgarian geology | |
| The topic is present in publications of the first explorers of Bulgarian land | 4 points |
| The topic is the subject of research by scientists of local origin | 3 points |
| The topic is related to the local crafts and culture (construction, art) | 2 points |
| The topic is present in local legends and lore | 1 point |

A. Public awareness. This criterion indicates the possibility of accessing up-to-date information about the geosite features. According to FREY et al. [15] the main task of geotourism is the transfer and communication of geoscientific knowledge and ideas to the general public. Dissemination of data needs effective and attractive way to reach the tourists using modern demonstrative techniques: interpretive materials based on scientific geosite dossiers presenting the scientific information in the form accessible to the general public: history of investigations, names of famous explorers, books, publications, works of art, museums, presence of special geo-elements in local construction, legends, traditions, spiritual impact. Sometimes geosites of high scientific value or aesthetic appeal, of continental or even of global value, remain hidden from the general public due to a low degree of popularity, limited within local sources of information. When wide access to as much information as possible is available, visitors can make a decision whether to visit a geosite or not. Good public awareness requires well-interpreted materials because an easy access to strictly scientific information cannot reach ordinary tourists.

B. Availability of “in situ” museums. Museums are scientific units – integral parts of the geoparks – that preserve cultural and natural heritage. A geological museum within the geopark is the perfect way to preserve on-site the local geodiversity. The first attempts at geoconservation of geo-elements are the so-called “cabinets of curiosities” or “wonder-rooms” that emerged in the sixteenth century in Europe as precursors to natural history museums. They stored objects belonging to the natural history – geology, archaeology, history, ethnography, works of art, and antiquities. The first Museum of Practical Geology founded in 1837 in London aimed, as summarized by curators HUNT and RUDLER [16]: “to exhibit the rocks, minerals, and organic remains, illustrating the maps and sections of the Geological Survey of the United Kingdom”. Specialized geological museums in Bulgaria are the university museums in the Sofia University and the University of Mining and Geology.

C. Availability of special attributes of the geosite (fossils, minerals and rocks) in “ex situ” museums. There are many outcrops in Bulgaria first investigated by foreign scientists. For example, one of the earlier explorers of our land – the Viennese professor Franz Toula – is the author of many new foraminifera, coral, mollusk, echinoid, and bryozoan taxa, the holotypes of which are stored in the Natural History Museum of Vienna. Of course, the most common practice is to store geodiversity elements in the national university museums. Regional museums are also an option for the preservation of geological heritage, but they usually store objects of cultural and historical heritage.

D. Promotion of fossils in scientific publications. Following up the previous comment, many of the earlier geological investigations carried out by foreign geologists are published in European magazines. The most prestigious Bulgarian publishing series is the “Fossils of Bulgaria” of the Bulgarian Academy

of Sciences in which paleontological descriptions of many fossil groups studied by generations of Bulgarian paleontologists are published. Another academic magazine “Paleontology and Stratigraphy” and universities’ annuals have also provided their pages for professional paleontological researches. Regional publishers are definitely not among the disseminators of the geological and paleontological heritage. Rather, materials about sensational finds such as skeletal elements of fossil vertebrate fauna (e.g. Ezerovo, Dorkovo) appear sporadically.

E. Degree of study of the fossils. Paleontology lies on the border between biology and geology. Paleontology studies the remains of ancient animals and plants, called fossils. It is often defined as the scientific study of life that existed before the beginning of the Holocene epoch. From this point of view, the seashells left on the ancient marine terraces should be considered fossils, even though they have not undergone any stage of fossilization. Fossils require professional determination carried out by experts, well acquainted with the morphology, structure and taxonomic classification of a given group of organisms. Paleontologists usually deal with animals and plants that have disappeared off the face of the earth a long time ago, so precise reference to the literature is required. In fact, professionally determined fossils are evidence of a professionally developed geopark.

F. Form of education on the subject in local schools. Geo-education at all levels is an important element of any geopark concept. Efforts to introduce geological topics into the curricula of primary and secondary schools are highly appreciated. Geo-education is focused on dissemination of geological knowledge through school curricula, management courses, evening courses, outdoor classrooms, etc. The school courses are addressed both to children and their teachers. The evening courses are targeted at local tourism guides and curators of visitor centres and local museums. Geoparks should engage with educational institutions – universities, specialized schools and learned societies such as Bulgarian geological society. Developing of guide-books with geological description of geosites and geotrails is a good practice to support teachers and tour-guides. The geo-education activity should be under the strong control of the Geopark authorities.

G. Historical value for Bulgarian geology. All geological sites, characterized for the first time at the end of the 19th and the beginning of the 20th century, are potentially of historical value for Bulgarian geology. Many of them are investigated by the first explorers of our land – French, Austrian, German, Serbian, and Bulgarian geologists. In regard to fossils, the name of Franz Toula stands first among all explorers. In 1875, during his geological traverses in the West Balkan he identified the first Bulgarian fossils near Belogradchik, published in the Series of the Österreichische Akademie der Wissenschaften [17]. The studies of the Black Sea coastline were carried out by Bulgarian and Soviet geomorphologists in the middle of the last century. In the 60s of the 20th century, the ancient marine terraces along the Bulgarian Black Sea coast were recognized, correlated

and named after the “standard” Soviet terraces by FEDOROV et al. [18]. The sites where they were first characterized with fossil fauna are potential geosites of scientific and historical value for Bulgarian geomorphology.

Conclusion. The fossil deposits are an essential part of the Bulgarian geological heritage. The valorization of fossil and coastal geosites taking into account their specific criteria requires a new approach to their assessment. There are at least two reasons for this: estimation of new proposals for the Register and Cadastre of the Bulgarian geological phenomena as well as for aspiring geoparks. These criteria are a necessary addition to the main criteria underlying the category “scientific value” and together with them can serve to develop an expert card for evaluation of fossil and coastal sites in geoparks and nature parks.

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