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Karst as Important Resource for Geopark-Based Tourism: Current State and Biases

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Abstract: The United Nations Educational, Scientific and Cultural Organization (UNESCO) Global Geoparks initiative balances the conservation of geological heritage with its use in purposes of tourism industry. However, the resources of geoparks and the current state of their use are yet to be fully understood. The phenomenon of karst (caves, sinkholes, etc.) appears to be a valuable geopark resource because it attracts numerous visitors interested in geo-, eco-, and speleotourism. Of 140 global geoparks, 37% exploit karst resources. These are located chiefly in Europe and Southeast Asia. Just a few geoparks are fully based on karst features and the others use this resource together with other geological heritage resources. Global geoparks tend to emphasize either particular karst elements or entire karst landscapes. Many interesting features (e.g., gypsum and salt karst) are underrepresented in global geoparks. The UNESCO Global Geoparks initiative should become more phenomenon-focused to offer full representation of karst resources. For some countries like Russia and the United States, where geoparks have not been created yet, the consideration of karst resources may provide significant advantages in the strategic development of geopark-based geotourism.

Keywords: cave; geological heritage; geopark; karst; natural resource; pseudo-karst; UNESCO

1. Introduction

Geological resources are important for modern society because of many reasons, not only extraction of minerals, hydrocarbons, and construction materials. It was recently realized that these resources may have significant value as a natural heritage which requires proper conservation and as a basis for tourism development which brings socio-economic benefits (additional income to local and national budgets, facilitation of sustainable development, etc.). The relevant ideas have been presented in the works of Brilha et al. [1], Gordon [2], Gray [3], Hose [4], Ólafsdóttir and Tverijonaite [5], Prosser [6], and Ruban [7]. The powerful approach to the simultaneous conservation and tourism-based exploitation of the geological heritage resource, namely the UNESCO-based initiative of global geoparks, has been developed during the past two decades. The purposes, expected outcomes, and true achievements of this initiative have been analyzed and described comprehensively by Farsani et al. [8,9] and Henriques & Brilha [10]. Further important relevant knowledge can also be found in the very new work of Gabriel [11], Han et al. [12], and Justice [13]. Global geoparks represent particular geological features or entire geological landscapes that are of outstanding uniqueness and, therefore, of international importance. On the one hand, the very recognition and conservation of geological heritage are offered in such establishments. On the other hand, geoparks allow the efficient promotion of this geoheritage by attracting crowds of tourists, offering highly-professional geoeducational programs, and establishing links to the ethnocultural landscape.

The number of UNESCO Global Geoparks is 140 and these are located in dozens of countries [14]. This should be regarded as a true success of the above-mentioned initiative. However, geological heritage resources are very diverse and their different types are of different importance for

geoparks. As a result, a close view of the utility of particular types for the growth of geopark-based geotourism is necessary. Karst is a relatively wide-spread, scientifically interesting, and aesthetically attractive phenomenon [15–18]. Generally, this phenomenon is powered by the dissolution of some rocks (chiefly carbonates like limestones and dolostones) by water. As a result, specific landforms appear on the Earth's surface (epikarst features—karren, sinkholes, dolines, etc.) and beneath it (endokarst—caves). Karstification leads to the appearance of some unusual geological formations, such as speleothems (stalactites and stalagmites in caves). Non-carbonate karst is also known—in particular, spectacular caves may develop in gypsum and salt formations. Moreover, pseudo-karst may appear in volcanic and granitic domains. The objective of the present brief paper is to provide the first synthesis of the knowledge of the karst phenomenon (sensu lato) in the network of the UNESCO Global Geoparks. This is necessary to realize its importance as a resource and to characterize the current state and biases in the exploitation of this resource.

2. Materials and Methods

The conceptualization of karst as a geopark resource is required. Several lines of evidence are as follows. First, many karst features are of heritage value (geomorphological and "pure" speleological heritage) because these are either unusual and rare landforms or "windows" into the dynamic geological environment [15,19–21]. Second, karst objects have been essential sites of nature-based tourism long before the very appearance of the idea of geological heritage and geotourism; for instance, many caves are open to excursions or attract amateur speleologists [15,22]. Third, karst features are distinguished by significant, sometimes outstanding aesthetic attractiveness [23,24] and their natural beauty directly appeals to the criteria of beauty expected of a tourist destination/attraction [25]. Fourth, karst phenomena are closely tied to the archaeological, historical, and ethnocultural peculiarities of some areas (e.g., some caves were populated by ancient humans or served as shelters in historical times). Fifth, many karst features are of socio-economic importance because they provide clean water and host artificial water reservoirs. In total, this evidence implies that the karst phenomenon is very interesting to both occasional (ordinary) tourists and dedicated geotourists. As such, its manifestations can be employed in the development of tourism activities and the generation of economic profit. Taking into account the number of visitors of big caves (e.g., up to 800,000 visitors (annually) of the Postojna Cave in Slovenia, up to 200,000 visitors (annually) of the Carlsbad Caverns in the USA, and up to 500 visitors (daily) of the Big Azish Cave in Russia), this profit is really recognizable. Therefore, karst should be understood as an important resource in tourism.

The analyzed resource is exploited in many forms (from caves opened to guided excursions to caves proclaimed as UNESCO heritage sites) but geoparks boast some additional advantages. First, these are essentially aimed at both conservation and tourism development, which allows the minimization of damage by visitors. Second, geoparks attract many dedicated geotourists, as well as representatives of academia and students, which facilitates geoeducation. Third, geoparks put karst into a proper geological context, which is very important for a comprehensive understanding of karst in the frame of modern geological knowledge. Fourth, there is a specific infrastructure in geoparks that facilitates an in-depth understanding of the essence of the karst phenomenon. Fifth, geoparks establish links between geological and ethnocultural landscapes. These considerations imply that karst is a really valuable resource for geopark-related tourism.

Official descriptions of all 140 UNESCO global geoparks [14] serve as the main source of information in the present analysis. The content of each description has been screened in order to extract all information attributed to karst, caves, and other relevant features. As all descriptions are standardized, professional, and aimed at listing all key geological heritage features, the results of this content analysis are really representative and the chance of missing some important information is very low. The individual webpages of geoparks were also consulted in cases of uncertainty pertaining to the official descriptions. Although these webpages sometimes provide detailed information, they are not used as the main source of information because of two reasons. First, these are often directed at

tourists, and, thus, present information in a popularized mode and emphasize only some features. Second, these differ essentially and are non-standardized.

The extracted information permits the classification of geoparks into three categories:

fully karst-based geoparks are those geoparks of which their value as geological heritage is chiefly restricted to unique karst feature(s);

partly karst-based geoparks possess important karst features that constitute geopark value, but only together with some other, similarly important unique geological formations;

occasional karst-involving geoparks also include some more or less unique karst features, but these are definitely less important than the other geological formations, the consideration of which permitted the creation of the geopark.

It is necessary to make a distinction between these three categories to understand the philosophy of karst resource exploitation in the UNESCO Global Geoparks network.

Secondly, the extracted information permits the indication of some general karst peculiarities which are used in geoparks. These peculiarities can be outlined tentatively and empirically (i.e., these are only those mentioned in the official geopark descriptions) with the subsequent calculation of the number of geoparks representing each of them. This approach allows an understanding of the diversity of the karst resource.

3. Results

The content analysis of the official descriptions of the UNESCO global geoparks implies that 52 of them represent the karst phenomenon (Table 1). This is 37% of existing geoparks. Such a wide distribution of the specific natural phenomenon underlines the big importance of karst resources for geopark-related geotourism. In geoparks, karst features are either offered for display (close views and panoramic views) or direct experience (cave excursions and tourist routes across karst landscapes).

Geographically, karst-related global geoparks are concentrated in Europe (especially in southern Europe) and Southeast Asia (Figure 1). This geographical pattern results from the correspondence between the by-country distribution of geoparks and the distribution of karst in the world. For instance, some countries boasting numerous and very diverse karst features (e.g., Russia and the United States) do not participate in the UNESCO Global Geoparks initiative. Geoparks are also absent or relatively few in Africa, Australia, and Latin America, where impressive examples of karstification can be found. Nonetheless, the significance of karst resources for geopark development in China, Greece, Italy, and Spain is indisputable. There are many geoparks in these countries [14] and a significant portion of them employ karst features (Table 1).

The philosophy of karst resource exploitation differs between global geoparks (Table 1). Twenty two of them (42% of all karst-related geoparks) exploit this resource, but only jointly with some other geological features. Partly, this can be explained by the fact that the karstified geological formations are also interesting from sedimentary, palaeontological, and palaeogeographical points of view. Twenty four geoparks (46%) deal with less important karst features that are regarded as particular manifestations of geodiversity. Finally, only six geoparks (12%) are fully (almost) based on karst resources. Such geoparks (the majority are Chinese) employ either large territories sculptured by karst processes or single, but big elements (e.g., caves). These results allow two inferences. First, the importance of karst resources for geoparks is slightly less if many karst features are only additional or auxiliary constituents of the local geological heritage offered to tourists. Second, attempts to create big-size geoparks representing geodiversity rather than emphasizing particular phenomenon also make karst resources less important. Generally, it is possible to conclude that this resource is exploited in the UNESCO Global Geoparks network chiefly in combination with other geological heritage (and sometimes archaeological and ethnocultural—see below) resources.

Table 1. Karst resource in the UNESCO Global Geoparks (only geoparks with karst features are listed).

Geopark	Country	Karst Resource		
		Fully Karst-Based Geopark	**Partly Karst-Based Geopark**	**Occasional Karst-Involving Geoparks**
Styrian Eisenwurzen	Austria		+	
Famenne-Ardenne	Belgium		+	
Xingwen	China	+		
Yandangshan	China			+
Fangshan	China		+	
Funiushan	China		+	
Leye Fengshan	China	+		
Shennongjia	China			+
Yanqing	China		+	
Dunhuang	China			+
Zhijindong Cave	China	+		
Guangwushan-Nuoshuihe	China		+	
Zhangjiajie	China			+
Shilin	China	+		
Danxiashan	China			+
Papuk	Croatia		+	
Bohemian Paradise	Czechia			+
Massif des Bauges	France			+
Causses du Quercy	France	+		
Harz, Braunschweiger Land	Germany			+
Swabian Alb	Germany		+	
Sitia	Greece		+	
Vikos-Aoos	Greece			+
Chelmos Vouraikos	Greece		+	
Psiloritis	Greece			+
Lesvos Island	Greece			+
Novohrad-Nygrad	Hungary & Slovakia			+
Gunung Sewu	Indonesia	+		
Qeshm Island	Iran			+
Burren & Cliffs of Moher	Ireland		+	
Marble Arch Caves	Ireland & United Kingdom		+	
Adamello-Brenta	Italy			+
Alpi Apuani	Italy		+	
Beigua	Italy			+
Madonie	Italy		+	
San'in Kaigan	Japan		+	
Mudeungsan	Republic of Korea			+
Jeju Island	Republic of Korea			+
Langkawi	Malaysia		+	
Magma	Norway			+
Sierra Norte de Sevilla	Spain			+
Villuercas Ibores Jara	Spain			+
Central Catalonia	Spain			+
Las Loras	Spain			+
Basque Coast	Spain		+	
Sobrarbe-Pirineos	Spain		+	
Sierras Subbeticas	Spain		+	
Satun	Thailand			+
Fforest Fawr	United Kingdom			+
English Riviera	United Kingdom		+	
Dong Van Karst Plateau	Viet Nam		+	
Non Nuoc Cao Bang	Viet Nam		+	

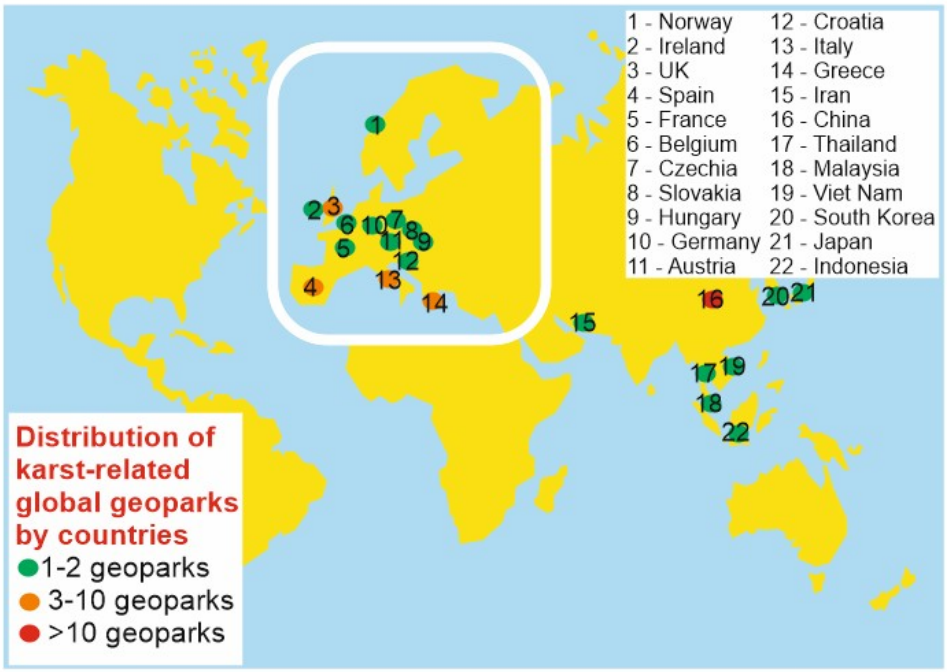

Figure 1. World distribution of karst-related geoparks.

The diversity of karst resources exploited for the purposes of geopark-related tourism is slightly questionable (Table 2). The principal distinction should be made between geoparks that represent isolated (if even concentrated) karst elements and those dealing with karst landscapes. The latter are characterized by the dominance of karst landforms and processes on a given territory, abundance of epikarst features, and the diversity and combination of elements on and beneath the Earth's surface. Geoparks of both categories are numerous (Table 2). The other types of features are represented in only limited portions of geoparks. What is especially notable is the little focus of the UNESCO Global Geoparks initiative on non-carbonate karst (gypsum and salt caves) and the unexpectedly significant attention paid to pseudo-karst features formed as a result of volcanic activity (Table 2). The general impression is that the creators of geoparks tended to consider the karst phenomenon as a whole or they preferred some obvious and easy-to-understand elements, such as caves. The entity of the global geoparks does not represent the true spectrum of karst features and processes [15]. However, the presence of many geoparks representing karst landscapes (Table 2) implies adequate attention to the complexity of the analyzed resource. Importantly, the above-mentioned archaeological, historical, and ethnocultural aspects of karst are reflected in global geoparks relatively well (Table 2).

Table 2. Karst peculiarities in the UNESCO Global Geoparks (only geoparks with karst features are listed).

Types of Karst Features	Number of Geoparks
Isolated typical karst elements (epikarst features, caves)	24
Karst landscapes	19
Specific epikarst forms (pinnacles, karst windows, karst peak clusters, "stone forests")	4
Phosphorite cave	1
Gypsum/salt cave	2
Tropical karst	2
Palaeokarst	3
Pseudokarst (volcanic)	4
Cave with fossils/artifacts	4
Caves of cultural value	4

4. Discussion

The results of the present analysis are ambivalent. On the one hand, these imply that the karst phenomenon is a really important resource for geopark-related tourism. On the other hand, the results show that this resource is exploited chiefly in combination with other geological heritage resources and in a very general mode. Two kinds of biases in the vision of this resource are evident. First, there is the geographical bias, which means the absence of karst-related geoparks in many karst-dominated geological domains. Second, there is the genetic bias, which means the absence of attention to the diversity of the analyzed phenomenon.

The current state of karst resource exploitation in the UNESCO Global Geoparks can be explained as follows. Many important karst manifestations have been exploited successfully for the purposes of tourism in the form of natural tourist attractions (also those privately operated), protected areas, geosites, UNESCO heritage sites, etc. for decades if not centuries [15,19–22]. These localities are very numerous and have been included in the newly-formed global geoparks only occasionally. As a result, there are three competitors for karst resources, namely the tourism industry (not including geoparks), geological heritage-related activists, and representatives of the geopark community. Indeed, it is impossible to recommend a quick transfer of karst resources from other users to geoparks. However, it is very sensible that the UNSECO Global Geoparks network should try to become representative of karst and other unique geological phenomena. A more phenomenon-focused approach will contribute to the maturity of this UNESCO initiative. The recommended approach has two counterparts. One the one hand, the network administration should try to make a better representation of each major geological phenomenon in the global network of geoparks. On the other hand, the representatives of the geopark community should develop broader ways of thinking, which require a shift from a willingness to exploit the known geological heritage resources to the understanding of the needs of the entire network. As shown above, geoparks are ideal for karst-related tourist activities that provide the necessary professionalism of knowledge delivery to visitors. These also may attract significant investments (also from the local and national governments) that are necessary to build an infrastructure that is really comfortable for visitors and protects the geological heritage from occasional damage. As such, karst resources require a really efficient, rational exploitation for the purposes of geopark-related tourism.

Some countries boast interesting karst features but these do not participate in the UNESCO Global Geoparks initiative. A typical example is Russia, which has numerous manifestations of karst—for instance, the Lagonaki Highland in the Western Caucasus is characterized by karst landscape that is ideal for geopark creation (Figure 2). Similarly, a lot of diverse karst and pseudo-karst phenomena are known in the United States [26] but they have not yet been used in the creation of geoparks. The appearance of karst-related geoparks in these countries will contribute substantially to the global exploitation of the discussed resource by the UNESCO-related network. Moreover, karst resources that can facilitate the creation of geoparks in countries such as Russia and the United States. First, using any actively visited cave as a basis of a geopark will guarantee the income of the latter. Second, caves and some other karst features are easy to understand and aesthetically attractive to people with zero geological education, and, thus, their use for the purposes of geopark-related tourism will provide the necessary flow of visitors. This may work very well in countries where nature-based (including geological) and education-focused tourism is poorly developed or awareness of natural phenomena of potential tourists is limited. In the both cases, it is possible to conclude that karst resources are important for the very creation of geopark initiatives on a national scale.

Figure 2. Karren of the Lagonaki Highland (Western Caucasus, Russia).

5. Conclusions

The present study permits three general conclusions. First, many UNESCO Global Geoparks exploit karst as an important resource in tourism together with other geological heritage resources. Second, karst-related geoparks are concentrated in Europe and Southeast Asia and the diversity of karst is not reflected well by the UNESCO network. Third, the consideration of karst resources seems to be very important to countries where geopark creation has not started yet.

Undoubtedly, the UNESCO Global Geoparks network should expand to cover all types of karst phenomenon. Particularly, it is sensible to plan further geopark creation dependent not only on bottom-up initiatives but also on the real-world distribution of karst features. For this purpose, target areas for all karst types should be identified and representatives of the relevant national authorities should be encouraged to make geopark proposals.

Further investigations should be aimed at the examination of the vision of karst resources of geopark managers and officials of the geopark networks. National differences in the management of tourism-focused natural resources should be considered in this case.

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