Representation of geologic time in the global geopark network: A web-page study

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ABSTRACT

Geologic time is a fundamental geological category that should be of interest to geopark visitors. The compilation of on-line information from all 120 UNESCO Global Geoparks located in 33 countries permits an analysis of the different ways geologic time is represented by this network. It is established that the major time units from the Proterozoic to the Neogene are represented by the global geoparks more or less equally, which is an unexpected achievement. The documented situation is highly favourable for two important tasks. First, the global geopark network has the potential to improve the general public's knowledge of geologic time. Second, such publicity may facilitate equal attention to the work of scientists on different intervals of geological history. However, the promotion of the relevant knowledge needs some adjustments in order to be most effective. Moreover, different preferences shown by "antiquity"-oriented and "modernity"-oriented tourists should be taken into account.

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1. Introduction

Geological tourism (geotourism) is a rapidly growing global activity (Dowling, 2011; Dowling & Newsome, 2010; Hose & Vasiljević, 2012; Ruban, 2015; Štrba, Kršák, Molokáč, & Adamković, 2016), and one of its main manifestations is the appearance of the global geopark network guided by the UNESCO and established in 2004 (Dowling, 2014; Farsani, Coelho, & Costa, 2012, 2014; Henriques, Tomaz, & Sa, 2012; Lazzari & Aloia, 2014; Palacio Prieto, 2013; Štrba et al., 2016; UNESCO, 2016). This network includes now 120 geoparks created in 33 countries (Fig. 1), from which several geoparks cross political boundaries. The countries with the largest number of geoparks are China, Spain, and Italy. Geoparks are created for tourist-oriented promotion of geological knowledge via demonstration of unique and/or peculiar geological features in connection with nature and culture; they also serve educational and scientific purposes (Farsani et al., 2014; UNESCO, 2016). Of course, geological heritage conservation (geoconservation) is also among the key problems they solve. Geoparks seem to be interesting, first of all, to "devoted" persons, including professional geologists, students, and rock and fossil amateurs. However, the latter would be satisfied with the traditional geosites (geological monuments), for which standard procedures of conservation and management are well-known. Geoparks are targeted toward the general public to strengthen the "ordinary" people's awareness of geology (UNESCO, 2016), and this is their main function.

Geoparks attract recognizable tourist flows and, therefore, contribute effectively to local sustainable socio-economic development (UNESCO, 2016). Global geoparks are those geoparks that bear the most outstanding examples of the geological environment and they constitute members of the UNESCO Global Geoparks network. The latter has some features of the global action networks (Glasbergen, 2010), and its fast development should be regarded in the context of globalization and multipolarity (Hołowiecka & Grzelak-Kostuska, 2013; Antonescu & Stock, 2014; Arkhipov & Yeletsky, 2015; Wolff, 2015; Huebener, O'Brien, Porter, Stockdale, & Zhou, 2016). Geopark visitors (like all geotourists) include many occasional and non-devoted visitors, geology and palaeontology amateurs, students, and professionals (e.g., Hose, 2000).

Time is an important consideration in tourist perception of destinations and particular attractions, and, particularly, the age of objects has a significant influence on aesthetic judgments (Kirillova, Fu, Lehto, & Cai, 2014). As known from the practice of archaeology-based heritage tourism, the idea of the past is very attractive to visitors if even perception of this past is not so easy (Mytum, 2003). A fundamental geological category is geologic time as measured in either relative units (eons, eras, periods) or absolute units (millions of years abbreviated as Ma) (Fig. 2). For scientists this allows geological objects to be considered within a temporal frame, and for the broad public this permits "feeling" for the "antiquity" of rocks and fossils from the "deep past", which extends far prior to the appearance of "humankind" (e.g., Clary & Wandersee, 2014). The global geoparks provide the best option for informing the public about geologic time, even if they need also to offer appropriate interpretations (Clary & Wandersee, 2014). On the one hand, they are

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Fig. 1. World distribution of the UNESCO Global Geoparks (see Supplementary material for more details).

among the most efficient tourist attractions specialized in geology (together with museums). On the other hand, they are created in geologically unique places that often are ideal for studying geologic time, and not only because of the available rock and fossils, but also because of the comfortable infrastructure (easy access to the objects, some research facilities, presence of well-maintained exhibits, etc).

Evidently, the members of the UNESCO Global Geopark network, i.e., individual geoparks, taken together should represent each time slice more or less equally. If the majority of geoparks exhibit Jurassic rocks and fossils, whereas only a few inform about the Silurian, this will only increase bias in our vision of geologic time. In contrast, it appears that the network serves its purpose well if it enables visitors to realize a non-biased vision. In the other words, the UNESCO Global Geopark network taken entirely can either improve an awareness of geologic time or disorient the tourists. However, this important aspect of geotourism has not been considered previously in the literature. An objective of the present study is to understand how well the Global Geopark network treats the concept of geologic time, i.e., whether this representation is adequate with regard to the number of geoparks informing about each time unit. Attention is paid to the information geoparks themselves distribute on-line because their web-pages are the main sources of interpreted knowledge about the geological phenomena they exhibit.

2. Material and method

The UNESCO Global Geopark network includes 120 geoparks. Although some large countries with complex geology (Russia, USA, etc.) and some other countries with national geopark networks (e.g., Taiwan — see Migon, 2012) have not joined it up to now, this does not diminish the potential of this network as an internationally-representative entity of tourist attractions exhibiting a broad spectrum of geological phenomena. This network is large enough to reflect all intervals of geologic time. The information about each geopark can be analyzed in order to understand the age of geological objects that are located therein. Then, such kinds of information can be compiled in order to appraise the number

of geoparks that inform effectively about each time unit. It is sensible to concentrate attention only on the high-rank relative time units, namely periods of the Phanerozoic and the two Precambrian eons. On the one hand, this level of precision is ideal for delivering the knowledge to tourists, who are often non-professionals. On the other hand, more precise age determinations of certain rocks and fossils is sometimes debated by scientists.

For the purpose of the present analysis, all 120 global geoparks are considered. Their descriptions are obtained chiefly from the network's official web-pages, because specific publications (e.g., brochures) are available only locally. Of course, geological studies in these parks would bring more detailed information about the age of the objects within their territory. However, it would be a formidable task to visit all available geoparks and to check the age of all formations. Moreover, it is important to deal with information that is available not in rocks (and, thus, clear to only professionals), but in sources accessible to tourists. In other words, the promoted information about the geologic time in geoparks has to be examined. It should be added that web-pages seem to be the main information source for the majority of geotourists. Professional publications do not suit ideally the purpose of this study because, on the one hand, they are often focused on highly specific issues, and, on the other hand, they are not important geotourist sources. The three main Internet sources dedicated to the global geoparks are http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/, http://www.globalgeopark.org/, and http://en.unesco.org/geoparks. In the case of insufficient information, the official web-pages of the geoparks and some other relevant sources are checked.

It is surprising to realize that a significant incompleteness exists in the knowledge of geologic time in the studied sources. Up to 1/4 of them do not provide even the most elementary information about the geologic ages represented in a given geopark, and 1/3 or even more of them do this in an inappropriate way, making this knowledge hard-to-find and hard-to-perceive. This is unexpected because of the importance of geologic time to the mission of geoparks. Sometimes, geologic time is specified on the analyzed web-pages too generally with an