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Geodiversity as a precious national resource: A note on the role of geoparks

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ABSTRACT

Geodiversity can be defined as either number of geological heritage types or qualitative characteristics of the unique geological environment. Geodiversity can be used for the purposes of science, education, and tourism, and, thus, this is a precious resource requiring efficient exploitation for production of socio-economic benefits. Geoparks are ideal instruments of the geodiversity resource exploitation. Their efficacy on the international scale is clear, but their role in countries is yet to be discussed. The assessment of the dominant geological heritage types in all geoparks (members of the UNESCO Global Geoparks) of seven countries with their big number (China, France, Germany, Italy, Japan, Spain, and the United Kingdom) suggest that about a half of the known types are represented in the geoparks of each of these countries. However, the exploitation of the geodiversity resource on the national level is not full because some types are missed and those available differ by the relative importance. It appears that the UNESCO Global Geopark network does not match the national interests ideally (partly because the UNESCO initiative is not aimed at the national level by definition). It is recommended that countries should develop their own policy of efficient geodiversity resource exploitation via geopark creation. As much geological heritage types as possible should be represented in geoparks, and the very ideas of geodiversity and geoparks should be promoted actively among the broad public and the policy-makers.

1. Introduction

From the economic point of view, the geological environment is considered traditionally as a "container" of industrial and energy resources, such as iron ore, coal, and oil. However, it has become clear in two past decades that there is yet the other precious resource linked to this environment, namely the geological heritage. The latter is the entity of unique (very rare or very typical) geological features that are valuable for the society and require conservation (cf. Prosser et al., 2006; Henriques et al., 2011; Wimbledon and Smith-Meyer, 2012; Prosser, 2013; Bruno et al., 2014). Geological heritage has been discussed already in the terms of the resources policy, particularly, by Cairncross (2011), Ruban (2012), Wimbledon and Smith-Meyer (2012), and Tiess and Ruban (2013). The recent works of Jaeckel et al. (2016, 2017) are also relevant to this discussion. Modern management of the geological environment is impossible without heritage value consideration.

The central concept in the modern theory of geological heritage is geodiversity. Different (even very contrasting) meanings of the latter have been proposed (Nieto, 2001; Stanley, 2001; Zwolinski, 2004; Serrano and Ruiz-Flaño, 2007, 2009; Ruban, 2010, 2011; Knight, 2011; Brown et al., 2012; Crawford and Black, 2012; Gordon et al., 2012; Erikstad, 2013; Gray, 2013; Pereira et al., 2013; Solarska et al., 2013; Bradbury, 2014; Brilha, 2016; Necheş, 2016; Plyusnina et al., 2016; Thomas, 2016; Habibi and Ruban, 2017). Generally, geodiversity can be understood as either number of types of geological features on a given territory or quasi-philosophical category relevant to the people's admiration of the geological uniqueness, complexity, and beauty (but these two definitions are not mutually excluding). Anyway, geodiversity is an important and economically-valuable resource for the society. It can be used for scientific investigations, education, and tourism. All three bring evident socio-economic benefits, both direct and indirect. Combination of different geological features on the same territory permits more complex research programs, offer excellent opportunity for student field excursions, and attract geology amateurs. All these activities, especially geotourism, bring real economic benefits to the local communities.

Similarly to mining, benefits from the geodiversity can be obtained via its effective exploitation for the scientific, educational, and tourism purposes. The UNESCO Global Geopark network appears to be very suitable approach for such an exploitation. Geoparks are established to provide adequate conservation of unique geodiversity localities (Eder, 2008; Farsani et al., 2011, 2012, 2014; Henriques et al., 2012; Lazzari and Aloia, 2014; Ruban, 2016; Štrba et al., 2016). In fact, the very existence of a geopark stresses the importance of the area from the geodiversity point of view. Moreover, a geopark offers infrastructure for

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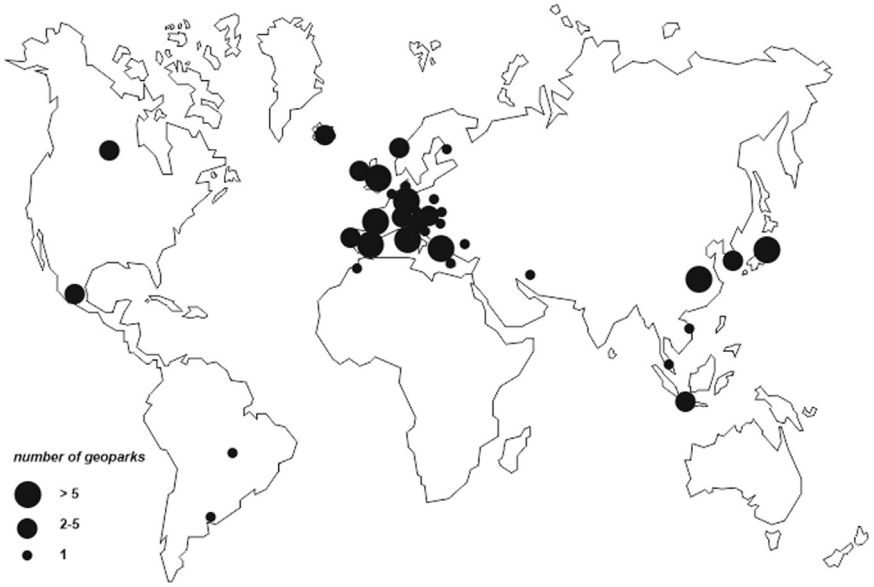

Fig. 1. World distribution of the UNESCO Global Geoparks (compiled from http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/list-of-unesco-global-geoparks/).

research, education, and tourism. Generally, the exploitation of the geodiversity resource is the most efficient in the form of geoparks. Presently, more than a hundred of geoparks are established in a few dozens of countries under the auspice of the UNESCO (Fig. 1). However, it should be remembered that the geological resource exploitation is important, first of all, to countries. The present paper is aimed at examination of the role, which the global geoparks play in the representation of geodiversity on the national scale. The basic conceptual idea is as follows: if all geoparks serve the exploitation of the geodiversity resource, the geoparks of any given country should represent the national geodiversity fully in order to make this resource more precious to the society.

2. Material and method

The current knowledge of the UNESCO global geoparks is summarized on the official web-page of this network (http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/list-of-unesco-global-geoparks/). Many countries boast by the one or two geoparks, which cannot represent their national geodiversity fully. However, there are several countries with a bigger (> 5) number of geoparks. These are China, France, Germany, Italy, Japan, Spain, and United Kingdom (Table 1). These countries are suitable to the purpose of the present analysis.

According to Ruban (2010) and Ruban and Kuo (2010), there are 21 specific geological heritage types characterizing the broad spectrum of geological phenomena, namely stratigraphical, palaeontological, sedimentary, igneous, metamorphic, mineralogical, economical, geochemical, seismical, structural, palaeogeographical, cosmogenic, geothermal, geocryological, geomorphological, hydrogeological, engineering, radiogeological, neotectonical, pedological, and geohistorical types. The coexistence of these types determines geodiversity (Ruban, 2010). Many geoparks are essentially complex and comprise several types. This is why the most valuable heritage features, i.e., dominant types (Ruban, 2010), should be distinguished.

Table 1
Countries with big number of geoparks.

Country	Number of UNESCO global geoparks	
	National geoparks	Transnational geoparks
China	35	
France	6	
Germany	5	1
Italy	10	
Japan	8	
Spain	11	
United Kingdom	6	1

A total of 83 geoparks in the noted six countries are considered in this study (Table 1). This is ~ 2/3 of all global geoparks (as in June 2017; the list of geoparks changes permanently). The official and standardized descriptions of the global geoparks presented on the above-mentioned web-page of the UNESCO Global Geoparks network permit to interpret dominant types for all geoparks considered in this study. No more than 4 dominant types (most important) are specified to prohibit the data "noise". The information accumulated in this way allows later to establish the number of dominant geological heritage types that occur in the geoparks on the national scale. This enables understanding of how significant is the exploitation of the geodiversity resource in the geoparks of any given country. It should be added that the countries with big number of geoparks (Table 1) are characterized by large or relatively large size and very complex geological structure, and, thus, they possess hypothetically almost all types of the geological heritage that deserve being presented in geoparks.

3. Results

The geoparks of China, France, Germany, Italy, Japan, Spain, and the United Kingdom differ significantly (Table 2). Some represent the only dominant type, and some represent several dominant types. Moreover, the combination of the types within the geoparks and within the countries are also different. However, the geodiversity serves as a precious resource in all cases, which can be demonstrated with two examples, namely the Hong Kong UNESCO Global Geopark in China and the Cabo de Gata-Níjar UNESCO Global Geopark in Spain. The former represents various geological features, including those belonging to the stratigraphical (record of the 400–55 Ma time span) and igneous (columnal volcanic rocks) dominant types. And it is the local geodiversity, which makes this area attractive to researchers, educators, and tourists (Wang et al., 2015). The latter is also rich in the geological heritage: igneous (Cenozoic volcanic range) and geomorphological (modern and ancient coastal and alluvial landforms) types