Review Article

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UNESCO Global Geoparks: a strategy towards global understanding and sustainability

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Geodiversity – the abiotic component of nature – is subject to everyday individuals' choices. The use of some of its elements in geoparks – by fostering economic sustainable development of local communities through the promotion of geotourism and education – represents a successful path to global sustainability, as argued in detail in the present work. By connecting local actions and global challenges, and assuming the role of local culture as a crucial tool to achieve global sustainability, the UNESCO Global Geoparks can be envisaged as best practice examples of realizing the aims and goals of the International Year of Global Understanding and source of inspiration for other global challenges, such as the seventeen UN Sustainable Development Goals 2016–2030.

Introduction

Three global scientific organizations jointly proclaimed 2016 as the "International Year of Global Understanding" (IYGU) – the International Council for Science, the International Social Science Council, and the International Council of Human Sciences and Philosophy. The IYGU emphasizes the role of global understanding to face current social, cultural, and economic changes, and focuses on the global sustainability of local actions. It seeks to integrate natural and social sciences to address the ways in which we inhabit an increasingly globalized world, specifically how we transform nature (IYGU, 2016).

Geodiversity elements are non-living components of nature, namely minerals, rocks, fossils, soils, landforms and their landscapes, and active geological/geomorphological processes. These geodiversity elements constitute the Earth's surface, forming different geodiversity patterns. Since the down of human civilization, geodiversity elements have been used to produce shelter, tools, and food. During the last centuries, minerals and rocks are being extensive and increasingly used to meet the demand of our highly technological societies and to produce energy. For most people, geodiversity elements are seen as irrelevant "rocks" or "stones" or eventually as raw materials used for the benefit of society after being exploited from the Earth's crust. Nevertheless, geodiversity elements have other types of uses that do not imply their extraction nor destruction and still bringing great advantages to the society (Brilha, 2016). The benefits that society gains from geodiversity are known as geosystem services or abiotic ecosystem services that include regulating, supporting, provisioning, and cultural services (Gray, 2011; Gray et al., 2013).

Amongst the cultural services, scientific, educational, and tourist/recreational uses are being implemented in a pioneering way in territories known as geoparks. Geoparks are innovative ways to envisage nature conservation, land-use planning, and sustainable development of local communities. By representing socio-economic solutions compatible with a respect for the environment and the protection of nature and land, geoparks are referred as a main geoethics theme by the International Association for Promoting Geoethics (IAPG, 2016). Their creation and management strongly call for the reconciliation of the global and the local, as they represent local projects with a global reach, and show how the required sustainable change starts from the bottom, a strategy that converges with assumptions inherent to the IYGU (IYGU, 2016). As so, geoparks can be seen as one among the plurality of pathways to achieve global sustainability and a particular sociocultural way of interpreting natural conditions by a community (Werlen, 2016; Werlen et al., 2016); understanding its origin, evolution and current dynamics will assist on the need of inspiring concrete strategies for local projects with a global reach (Werlen, 2015) displaying other exceptional natural and cultural values, and to the shift on to a world in which humanity lives in harmony with nature (Gill, 2017; Stewart and Gill, 2017), as declared by the subscribers of the 2030 Agenda for Sustainable Development (UN, 2015).

Origin and Evolution of Geoparks

The original concept of geopark was developed in Europe in the late 1980's. It refers to a territory, which includes a particular geological heritage and a sustainable territorial development strategy (EGN, 2000).

Despite having a few decades, the concept still raises common misunderstandings, particularly to an increasing number of newcomers to this subject: a geopark is a new category of protected area; a geopark is the same as a geological park; a geopark is a statutory designation to protect geological heritage; a geopark is just about geology. Whilst

the answer is negative for these four statements, it should be stressed the role of a geopark as a strategic development plan for a territory with significant geological heritage that should be conserved (Henriques et al., 2011), together with other natural and cultural assets, in order to promote economic sustainable development of local communities through the promotion of geotourism and education.

In 1971, UNESCO approved the Man and the Biosphere Programme (MAB) as an intergovernmental scientific programme aiming the establishment of scientific basis for the improvement of relationships between people and their environments. Since that time, 669 sites in 120 countries became members of the World Network of Biosphere Reserves.

One year later, UNESCO adopts the Convention Concerning the Protection of the World Cultural and Natural Heritage and since then accepts state parties' nominations of properties of cultural and/or natural value considered to be of "Outstanding Universal Value" (OUV) for inscription into the World Heritage List. The aim is to assure a permanent protection of properties that have exceptional cultural and/or natural significance. In June 2017, 1052 properties from 165 countries are included in the World Heritage List, 814 due to cultural value (77%), 203 due to natural value (20%), and 35 with both values (3%) (Fig. 1).

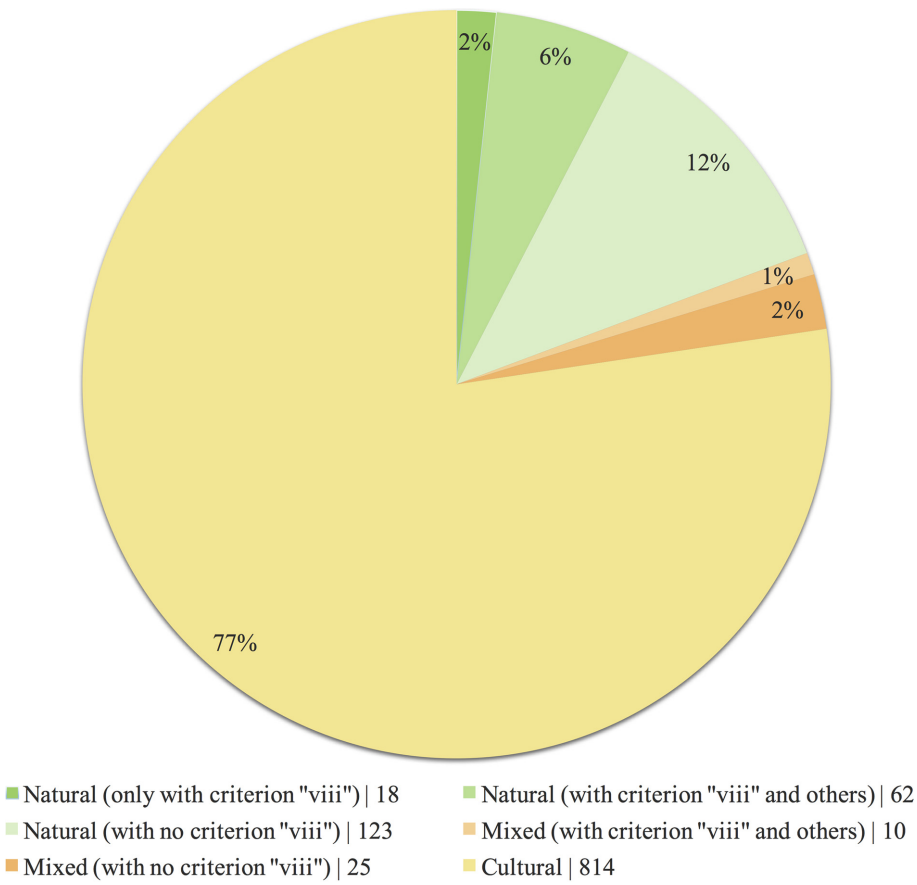

Figure 1. The "Outstanding Universal Value" of the 1052 properties included in the UNESCO's World Heritage List is assessed based on 6 cultural criteria and 4 natural criteria (UNESCO, 2017a). Criterion "viii" is the only one directly related to geological heritage. Of all World Heritage properties, 2% (18) were selected considering criterion "viii" alone and 62 more (6%) were justified by this criterion in association with other natural criteria (data as of June 2017, UNESCO, 2017a).

In 1997, the 29th session of the UNESCO General Conference approved a decision to undertake steps to "promote a global network of geosites having special geological features". Hence, two years later the Division of Earth Sciences presented the proposal: "UNESCO Geoparks Programme – a new initiative to promote a global network of geoparks safeguarding and developing selected areas having significant geological features" (Patzak and Eder, 1998; UNESCO, 1999). It is worthy to note a small change between the terms used in the above mentioned 1997 decision and the proposal presented in 1999. While the former refers "global network of geosites" the later mentions "global network of geoparks". It should also be underlined that keywords that today are common in the geoparks' community, such as "geotourism", "geoproducts", "sustainable development", "education", "geoheritage conservation" were already refereed in this proposal as aims/strategies to be developed by geoparks. This proposal reflected the discontent of some sectors of the Earth Sciences community about the lack of an international recognition of geosites and also the conclusions of the 1st International Symposium on the Conservation of the Geological Heritage, held in Digne-les-Bains (France) in 1991 (Martini, 1994; UNESCO, 1999; Jones, 2008). In fact, the MAB programme was, and still is, fundamentally based on biodiversity (Bridgewater, 2016) and the World Heritage Convention is too restrictive in what concerns the OUV recognition of geological sites (Fig. 1). The aim of the "UNESCO Geoparks Programme" was also to support national initiatives for the preservation of important geological sites in line with sustainable development (Erdelen, 2006).

However, in 2001 the Executive Board of UNESCO at its 161st session, "noting the recommendation of the MAB International Coordinating Council and its Bureau against inclusion of a geosites/geoparks programme as part of the World Network of Biosphere Reserves" decided to propose to the Director-General "not to pursue the development of a UNESCO geosites/geoparks programme, but instead to support *ad hoc* efforts with Member States as appropriate" (UNESCO, 2001). This decision was also due to budgetary constraints (Eder and Patzak, 2001) and marks the ending of a first attempt to create a geoparks programme in UNESCO. Nevertheless, this setback opened the door to the beginning of a strong collaboration with the European Geoparks Network that was established one year before (2000), with no formal relation with these initiatives that were happening in UNESCO at the same time.

Meanwhile, the term "geopark" was already being used in Germany. In 1989, the Gerolstein District Geopark was established with three main aims: to protect geosites, particularly fossil sites, to foster geotourism, and to promote local economic development (Bitschene, 2015). This geopark was created by the Eif-

elverein after the development in 1986 of a first set of geotourism activities (Frey et al., 2006; Frey, 2012). The Gerolstein District Geopark was enlarged in 2000 to become the Vulkaneifel Geopark, one of the four founding members of the European Geoparks Network. In China, under the guidance of the UNESCO's Earth Science Division, eleven geoparks were designated in 2000 by the National Geopark Evaluation Committee, established under the auspices of the Ministry of Land and Resources (Xun and Milly, 2002; Chen et al., 2015). This was the beginning of the Chinese Network of National Geoparks that had already 241 geoparks by the end of 2014 (Chen et al., 2015).

The European Geoparks Network (EGN) was founded in 2000 joining four territories: the Geological Reserve of Haute-Provence (France), the Petrified Forest of Lesvos (Greece), the Geopark Vulkaneifel (Germany), and the Maestrazgo Cultural Park (Spain). The idea to develop this innovative network started in 1996, during the geoheritage session of the 30th International Geological Congress held in Beijing (China). Guy Martini and Nickolas Zouros, both geologists from France and Greece, respectively, that were participating in this congress and already involved individually in projects linking geology and local development, shared a vision of a collaborative network to promote the protection of the European geological heritage through the sustainable economic development of the territories where these geosites occur (Zouros, 2004). In 2001, a formal agreement was signed between EGN and the UNESCO's Division of Earth Sciences, whereby UNESCO gave the network its endorsement (Zouros, 2004; Zouros and McKeever, 2009). EGN geoparks were defined as territories with clear defined boundaries, sufficient surface area for true territorial economic development and a certain number of geological sites of particular importance in terms of their scientific quality, rarity, aesthetic appeal and educational value. A geopark could also include sites with archaeological, ecological, historical, or cultural interest (McKeever and Zouros, 2005).

The evolution of EGN in the first decade of the 21st century was remarkable. During 15 years, EGN expanded from 4 geoparks in 4 countries to 69 geoparks in 23 countries. In order to maintain a high quality standard of the network, all aspiring geoparks have to pass through a detailed process of desktop and field evaluation. In addition, all EGN members are obliged to pass through a revalidation process every four years, in order to check if the achieved results and the prospective actions are in agreement with the EGN principles. When the quality level is not acceptable by the network, this revalidation procedure may imply the loss of membership and the exit from the network.

Following the general model of EGN, the Asia-Pacific Geoparks Network was created in November 2007 (McKeever et al., 2010). Today, this network joins 42 geoparks of 6 countries from this part of the world. Similarly, the Latin American and Caribbean Geoparks Network was established in May 2017, joining 4 geoparks in 3 countries (Brazil, Mexico and Uruguay).

In spite of the UNESCO's decision back in 2001 of not initiate a new Geopark Programme inside the organisation, the Earth Science Division always maintained a close relation with the geoparks community. In fact, European geoparks were always proud to announce that EGN was an international network under the auspices of UNESCO. With the success of a growing EGN and some pressure from the international geological/geoconservationist community, the Earth Science Division accepted to establish a "Global Network of National Geological Parks (Geoparks) seeking UNESCO's assistance" (Zouros, 2004).

Hence, the Global Geoparks Network (GGN), initially known as "UNESCO Global Network of National Geoparks", was constituted in 2004 under the auspices of UNESCO (Eder and Patzak, 2004).

At the same time, it was decided to accept the operational guidelines for new geoparks to apply to GGN; to establish the Coordination Office of GGN at the Ministry of Land and Resources in Beijing, China; and to accept that EGN geoparks are integrated in the new global network without further procedures (Madonie Declaration), based on the EGN-UNESCO agreement signed back in 2001 (Zouros, 2004).

The new global network started with all EGN geoparks at that time (17) together with 8 geoparks selected from the Chinese Network of National Geoparks. These 25 geoparks were the beginning of a new collaborative tool that is getting more and more prominent worldwide with an increasing number of geoparks and countries involved (Fig.

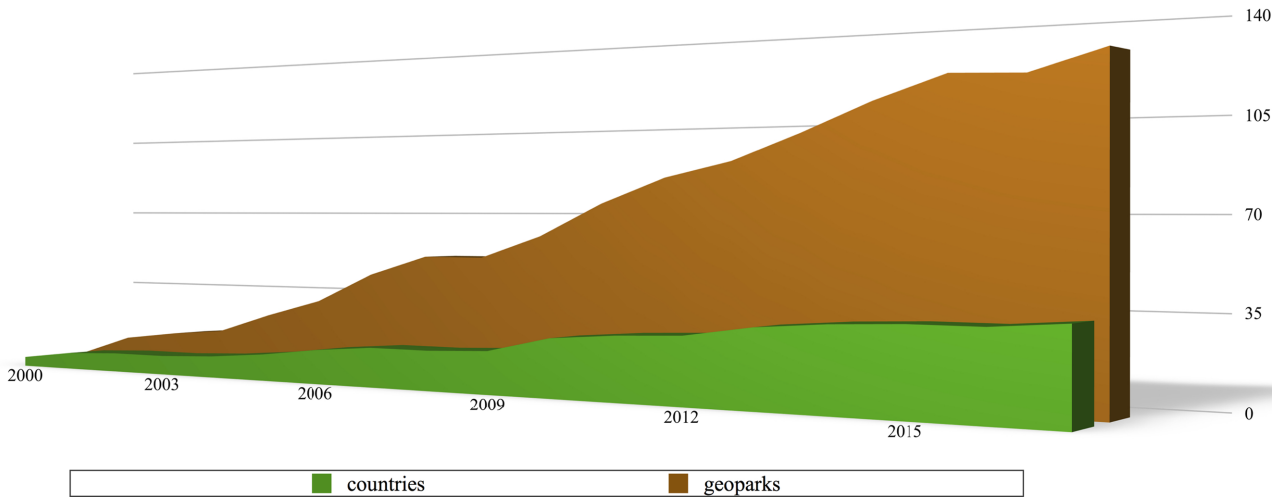

Figure 2. Evolution of the number of geoparks/countries in the European Geoparks Network (2000–2003) and in the Global Geoparks Network (2004–2017). Geoparks/countries that were excluded from the networks before 2017 were not included in the graph.

Figure 3. Worldwide distribution of UNESCO Global Geoparks (source: Chinese Geoparks Network & GGN Beijing Office, www.global-geopark.org).

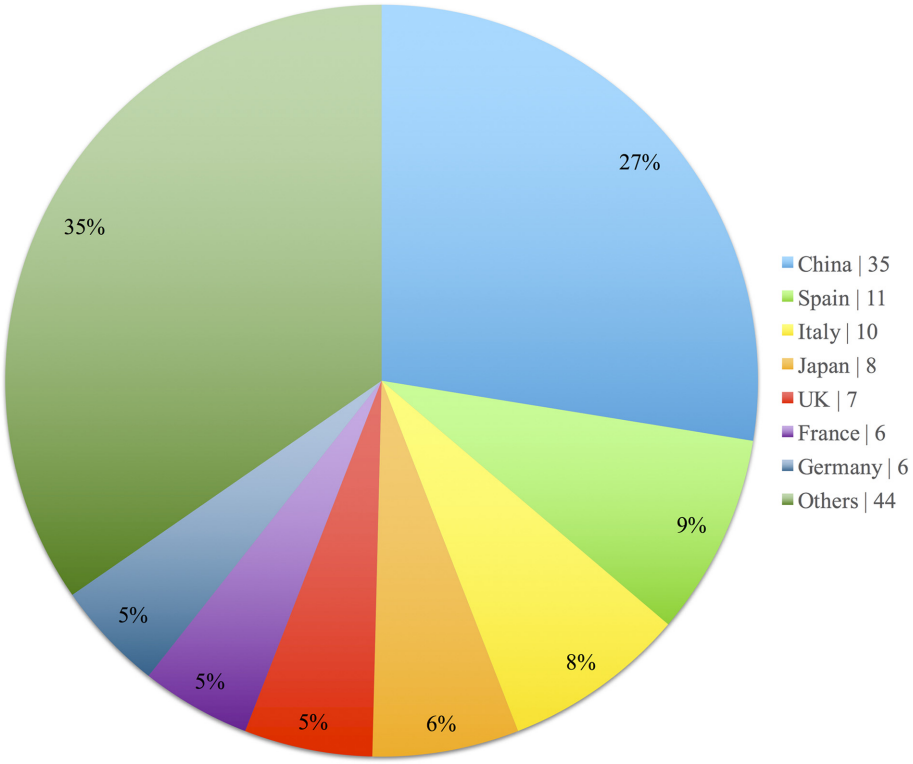

Figure 4. Countries with the higher number of UNESCO Global Geoparks (data as of June 2017, UNESCO, 2017b).

2). Today, GGN integrates 127 geoparks distributed by 35 countries in all continents (Fig. 3). The countries with a higher number of UNESCO Global Geoparks are China (35), Spain (11), Italy (10), Japan (8), the United Kingdom (7), France (6), and Germany (6) (Fig. 4).

Every two years, GGN organizes international conferences to promote the exchange of experiences between its members and also to host aspiring geoparks that are preparing projects to be submitted to GGN. The first conference was hold in 2004 in China, followed by Northern Ireland (2006), Germany (2008), Malaysia (2010), Japan (2012), Canada (2014), and The United Kingdom (2016).

GGN was never a formal UNESCO network but the Division of Earth Sciences, later converted into the current Division of Ecological and Earth Sciences, always played an important role in receiving the new applications from aspiring geoparks and participating in the GGN business meetings. Seven years after the establishment of GGN, a new attempt to formalize a UNESCO's geopark programme has begun.

The International Geoscience and Geoparks Programme of UNESCO

In 2011, the General Conference of UNESCO decided to "examine the feasibility of establishing a possible UNESCO geoparks programme or initiative, building on the existing success and experience of the Global Geoparks Network and geoparks" (UNESCO, 2012). In 2013, the Executive Board of UNESCO "requests the Director-General to convene a working group of representatives of Member States, the UNESCO Secretariat, and the Global Geoparks Network before the end of June 2013, for further consultations on the proposed initiative and its programmatic and legal implications, with a view to producing recommendations thereon" (UNESCO, 2013). The final proposal of this working group was approved by the Executive Board and presented to the General Conference at its 38th session.

Therefore, in 2015 UNESCO finally approved the International Geoscience and Geoparks Programme (IGGP), an umbrella comprising two activities: the current International Geosciences Programme (IGCP) and the new UNESCO Global Geoparks.

The International Geosciences Programme was renamed in 2003 after the former International Geological Correlation Programme (in fact, the origin of the acronym IGCP). Established in 1972 as a joint initiative with the International Union of Geological Sciences (IUGS), IGCP promoted scientific exchange through the correlation of geological strata and research data, focusing on basic geoscientific research and on making connections between events throughout the Earth's history. Since 2011, IGCP is focused in five main themes: Earth Resources, Global Change, Geohazards, Hydrogeology, and Geodynamic. Turner (2006) presents a detailed history of the beginnings of IGCP and its evolution throughout time.

The UNESCO Global Geopark is a new label created with the founding of IGGP. The aim was to set a "mechanism of international cooperation by which areas of geological heritage of international value, through a bottom-up approach to conserving that heritage, support each other to engage with local communities to promote awareness of that heritage and adopt a sustainable approach to the development of the area" (UNESCO, 2015).

The Global Geoparks Network was an informal structure during ten years. However, in 2014 it was converted into a legally constituted not-for-profit organisation in order to be able to participate in the general administration of UNESCO Global Geoparks. This administration is assured by several bodies (Table 1) that started to operate in 2016.

UNESCO Global Geoparks have increased the importance of geological heritage in these territories. The new guidelines clearly state that "a holistic concept of protection, education and sustainable development" must manage areas with "geological heritage of international value" represented by "sites and landscapes of international geological significance" (UNESCO, 2015). Together with the Convention Concerning the Protection of the World Cultural and Natural Heritage and the Man and the Biosphere Programme, UNESCO has now a third tool to promote the implementation of the 2030 Agenda for Sustainable Development approved by the United Nations. This is a great opportunity for geoparks and to engage geoscientists in the resolution of serious constrains that humankind is presently facing, as a result of the transformation of nature by human action (Werlen, 2015; Gill, 2017; Stewart and Gill, 2017).

To conclude this overview about the foundation and development of geoparks, it should be mentioned that in some countries exist networks of national geoparks, which sometimes is a source of misunderstandings among the general public, the media, and even in the geoscientific community. China and Germany are two examples where national geoparks co-exist with UNESCO Global Geoparks. National geoparks follow the same general principles as UNESCO Global Geoparks but neither have to comply with IGGP guidelines nor have to guarantee the same quality standards.

Geoparks and Global Understanding Challenges

As pointed by the IYGU promoters concerning the implementation of sustainable solutions for global problems, "we cannot afford to wait for the ideal decision-making body or a global jurisdiction – it may never happen" (IYGU, 2016). Instead, bottom-up initiatives i.e., everyday local choices towards sustainability are the appropriate strategy to overcome global changes. They require empowering individuals to change locally to have a global effect, and this calls for the global understanding as "knowledge alone about the existence and severity of a problem too rarely results in changes in actions" and "awareness does not change habits or routines" (Werlen, 2016).

To implement targeted local projects with a global reach is a challenging task, but the mechanisms and actors usually involved in the creation of a geopark can be of great usefulness to conceive other action plans fostering global understanding as a tool to achieve sustainable development goals.

Geoparks are living, working landscapes with exceptional geological heritage where science and local communities engage in a mutually beneficial way (UNESCO, 2015). As pointed by Ruban (2016), "the UNESCO Global Geopark network grows freely, i.e., via joining of the members (individual geoparks) depending on their own willingness". As so, they represent a creative sociocultural way of interpreting natural conditions and living the sustainability by a particular community and one among the plurality of pathways to achieve sustainable development goals, i.e., towards the protection of the planet "from degradation, including through sustainable consumption and production, sustainably managing its natural resources" (UN, 2015).

Several key factors can be identified to explain the success of geoparks, historically linked to an *ad hoc* initiative and now formally framed under the umbrella of UNESCO:

- The application to become a UNESCO Global Geopark is expertise-conducted but emerges from local will, i.e., it is a bottom-up initiative;
- Their management requires community involvement and the need to work across other disciplines besides Earth Sciences;
- Their evaluation, nomination, and revalidation is a self-regulated process conducted by members appointed by the Director-General of UNESCO on recommendation of GGN and of Member States, on the basis of the strict guidelines provided by the Council (UNESCO, 2015; Table 1).

Throughout all the steps towards the final nomination and further revalidation of a geopark, research, information, and education at all

Table 1. Structure of the administration of UNESCO Global Geoparks (UNESCO, 2015)

	Composition	Duties
Council	• Twelve ordinary members appointed by the Director-General of UNESCO on recommendation of the Global Geoparks Network (GGN) and of Member States. • The Director-General of UNESCO, the President of the GGN, the Secretary-General of the IUGS, the Director-General of the IUCN or their representatives are *ex officio* members without the right to vote.	• To advise the Director-General of UNESCO on the strategy, planning and implementation of UNESCO Global Geoparks and specifically i) raising and allocating funds; and ii) cooperation among the UNESCO Global Geoparks and with other relevant programmes; • To assess revalidated and new UNESCO Global Geopark nominations received from designated bodies in Member States; • To decide on whether new applications should be forwarded to the Executive Board for endorsement; • To accredit extensions for revalidated UNESCO Global Geoparks.
Bureau	• The Chairperson, the Vice-Chairperson and the Rapporteur of the Council. • The Director-General of UNESCO and the President of the GGN or their representatives are *ex officio* members without the right to vote.	• To prepare with the Secretariat the necessary documentation for the Executive Board of UNESCO in order for it to be able to provide a final endorsement of new UNESCO Global Geoparks nominations and extensions based on decisions of the Council; • To hold joint coordination meetings as required with the Bureau of IGCP; • To select the evaluation team for each application and revalidation.
Evaluation Teams	• Chosen by the Bureau from the roster of evaluators.	• To evaluate applications, extensions and revalidations for UNESCO Global Geoparks on the basis of the strict guidelines provided by the Council; • To prepare a report to the Council on the applications, extensions and revalidations evaluated.
Secretariat	• Provided by UNESCO.	• To maintain a roster of evaluators in conjunction with GGN.

levels, from university researchers to local community groups, are core features of the UNESCO Global Geopark concept. All these aspects converge to the need of developing strategies for targeted local projects with a global reach as a basis to implement the IYGU aims and goals (IYGU, 2016). As so, geoparks can be seen as an effective strategy to achieve global sustainability and the understanding of their current dynamics can assist on the need of inspiring other strategies for targeted local projects with global impact.

It is not argued that they represent the solution to be adopted worldwide; but they proved to be a sustainable strategy for the development of territories displaying exceptional geological heritage which can be adapted to the cultural context as well as to different social and economic contexts, thus contributing to the realization of the IYGU aims and ambitions.

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