GEOHERITAGE
and GEODIVERSITY







CREDITS

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Cover images:
1. Svartifoss fall (Iceland)
2. *Kronosaurus boyacensis* (Colombia)
3. Arches National Park (USA)
4. Pitón de la Fournaise (Reunion Island, France)
5. Pirite (Spain)
6. Mount Fuji (Japan)
7. Folds in Ugab river area (Namibia)

In Spain, the study of geoheritage (i.e., geological heritage) began in the 1970s, promoted by scientists at the Geological Survey of Spain (Instituto Geológico y Minero de España – IGME). Nowadays, numerous universities, research centres and scientific institutions and societies have also joined IGME in this endeavour. IGME is a public research institution providing service and consultancy for public administrations at different levels. IGME's Research Unit on Geological Heritage and Mining Heritage is in charge of the study of these two types of heritage, the development of protocols and methodologies for their research, as well as public outreach and dissemination of the information obtained.
http://www.igme.es/patrimonio/

At the international level, the European Association for the Conservation of Geological Heritage (ProGEO) has been involved with the conservation and management of geological sites of interest since the late 1980s. http://progeo.ngo/

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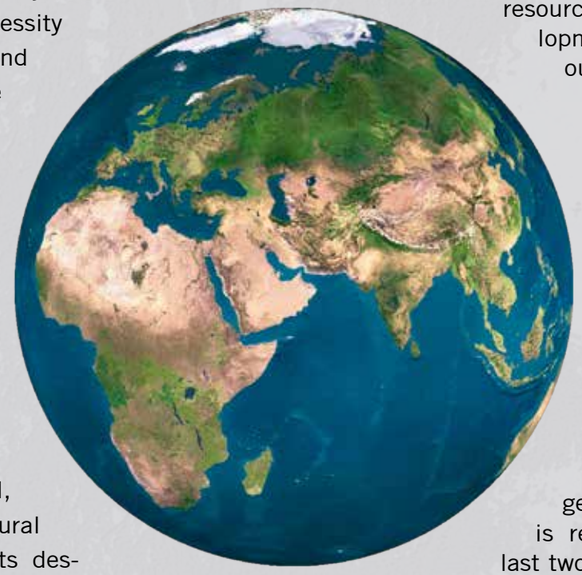
INTRODUCTION

GEODIVERSITY AND GEOLOGICAL HERITAGE

Geodiversity and geoheritage are amongst the most recent study areas incorporated into the Earth Sciences. Their investigation was born out of a new way of understanding our relationship with the Earth. Over time, society has changed its perception of nature. Nowadays, it is considered a right, a necessity and a duty to protect it and to promote its sustainable development. Geological elements of interest fall within this understanding of nature: they form an important part of natural heritage, and their value to society demands they be preserved.



Geoheritage belongs to all, and forms part of the natural richness of our planet. Its destruction is almost always irreversible. Once destroyed and lost, so too is a part of the Earth's history, and future generations are then excluded from knowing it directly. The preservation of geoheritage is therefore a responsibility - indeed an obligation – of public administrations and of society in general.

As a collection of the most representative, unique and interesting elements of the geological record, geoheritage is a legacy that we must pass on to future generations, and our duty in the name of social and scientific progress.

Geoheritage may also be an important resource for the sustainable development of rural areas. Public outreach based on scientific knowledge helps promote geotourism. Certainly, geoheritage provides a link between science and society, a connection of vital importance given the ever greater participation of the general public in problems that affect people and their environment.

The systematic study of geodiversity and geoheritage is relatively new. During the last two decades, the concepts of geodiversity and geoheritage have become more widely known. But how are these subjects studied? Are there any applications to that knowledge? This booklet explains the main concepts related to geodiversity and geoheritage, with the intention of unifying criteria and serving as a reference for anyone interested in these topics. •


Lanzarote and Chinijo islands UNESCO Global Geopark (Spain)

GEODIVERSITY

The term **geodiversity is an abbreviation of geological diversity,** and refers to the spatial diversity of elements resulting from geological processes and events that have occurred during Earth's history. The term geodiversity should not be used to refer to the elements themselves. Why? Because geodiversity refers to **the variety** of geological elements (rocks, minerals, fossils, soils, landforms, formations, geological units and structures) present in a territory at a particular moment, and which are both the product and the record of Earth's evolution. Geodiversity includes these records as parts of a gigantic "puzzle of puzzles", with millions of pieces that are not always easy to fit together, and sometimes with missing pieces. The higher the number of different pieces of the puzzle a territory has, the more geodiverse it is, and the more complete geological record it will have.

The **study of the geodiversity of a territory involves analysing the variety of geological elements present, and the different relationships amongst them.** Geodiversity can be measured with objective, quantitative indicators based on geostatistical calculations of the number, variety and distribution of the geological elements in an area. The geodiversity of a territory is one of its intrinsic properties and characteristic attributes. Geodiversity underpins biodiversity, landscape, climate, and even the cultural and economic aspects of the area. Geodiversity studies usually involve the analysis of natural, strictly geological elements and processes, amongst which the study of landforms (i.e., geomorphology) is also important.

While geodiversity bears some relationship with geoheritage, they are quite different concepts: **geodiversity refers to the variety of elements, while geoheritage refers to the elements with value.** For instance, a geological site may not be geodiverse, but may be geoheritage of great value, and vice versa. Even when there are no specific geological elements of interest, if an area has a high geodiversity, that diversity may also be valuable itself and thus the area should be considered geoheritage. This is the reason why practical management efforts towards nature conservation focus directly on geoheritage instead of on geodiversity: by protecting those few selected sites (i.e., the geoheritage), the geodiversity will be indirectly preserved. Hence, efforts should be directed towards the preservation of geological heritage, which should be representative of a territory's geodiversity.

The geodiversity of a territory conditions, to a large extent, its biodiversity. Understanding this relationship, and that between geodiversity and landscape, helps us better manage our natural heritage and natural diversity. The geological evolution of a region and its resulting geological elements is what determines its geodiversity. In many cases, this geodiversity will condition the type of landscape present. However, the relationship is not always direct: **Some elements contributing to a territory's geodiversity** (for example, fossils) **may have no reflection at the landscape level.** Moreover, the concept of landscape is wide and complex, and usually also includes components and processes outside the scope of the geological sciences. In any case, analysing the relationship between geodiversity and landscape can be very useful, especially for territorial planning. ●

GEODIVERSITY

Cryogenian glacial deposits (Namibia)

Moeraki boulders (New Zealand)

Uyuni salt flat (Bolivia)

Archean foliated granites (Tanzania)

Leucogranite intrusion. Sagarmatha National Park and UNESCO WH (Nepal)

GEOHERITAGE

Geoheritage is formed by geological elements with special interest, mostly scientific, but also educational or touristic. Geoheritage is a part of natural heritage, and includes all elements resulting from geological processes, whether objects, features, landforms or structures, important to any field of geology, such as geomorphology, stratigraphy, tectonics, petrology, mineralogy, palaeontology, hydrogeology, etc. Reference to the geoheritage identified for each of these fields is made with specific terms such as mineralogical, geomorphological or palaeontological heritage among others. Each of them has its peculiarities, but all form part of geoheritage in its widest sense.

Like any other type of heritage, geoheritage has both an objective component (i.e., the elements that make it up) and a subjective component that can change (i.e., the value of the elements). As mentioned above, the type of heritage is determined by the type of element. Thus, for example, a fossil with high value is palaeontological heritage, and a landform with high value is geomorphological heritage. Both are different types of geological elements and part of nature, so both are geoheritage and part of natural heritage.

The assessment of geoheritage value requires the use of objective criteria to allow its estimation and comparison. **Value assessment usually considers three factors: intrinsic value, potential for use, and risk of degradation.** Only when all three factors are taken into account, can conclusions be reached to improve geoheritage management. Evidently, the value of the elements under study should be established by a specialist in the respective element: petrologist, palaeontologist, mineralogist, sedimentologist, geomorphologist, etc. Management of geoheritage requires four types of actions: 1, inventories; 2, legislation; 3, site conservation (geoconservation sensu stricto); and 4, public outreach. All four must be considered and implemented for proper sustainable management of geoheritage. **The objective of geoheritage assessment is to identify those most valuable geological elements, so that their preservation can be promoted and their sustainable use can be enabled.** The methodology used in geoheritage inventories should allow to properly identify, assess and protect the selected sites or specimens, and to educate society about their relevance.

Every country has a rich and varied geoheritage. In many cases, it is associated with outstanding landscapes, but this is not always the case. Geoheritage also includes sites of exceptional (i.e., rare, unique, relevant) minerals, rocks and formations reflecting geological processes that took place millions of years ago, as well as palaeontological sites containing fossils of many types of organism and their activity, including the ancestors of modern humans. As time goes by, new places of geological interest are discovered that further enrich and diversify a country's natural heritage. ●

Hawai'i Volcanoes National Park and UNESCO WH (USA)

GEOHERITAGE

Geoparkea/Basque Coast UNESCO Global Geopark (Spain)

Iguaçú-Iguazú National Park and UNESCO WH (Brazil/Argentina)

PALAEONTOLOGICAL HERITAGE

Palaeontological heritage is a type of geoheritage which includes the direct remains of organisms, as well as their indirect remains (the result of their activity), preserved in the geological record, and to which a scientific, educational or touristic value has been assigned. Palaeontological heritage is called immovable when it refers to fossil sites or outcrops of special interest, usually because the fossils are well preserved, unique, abundant, diverse, or relevant for science (age indicators, historical site, type locality, etc.). Palaeontological heritage is called movable when it refers to fossils of special interest currently out of their place of origin, such as holotypes, collections in museums, research centres, exhibitions or visitors' centres. Such collections and museums have proliferated in recent years, and provide important scientific, educational and touristic resources.

Due to erosion, mining, building, public works, landfills and even plundering, palaeontological heritage is often vulnerable and at greater risk of degradation and destruction than other geoheritage components. **Fossils are of great interest to society, and are one of the elements of our natural heritage most prone to plundering.** Ornamental use can render fossils an economic and commercial resource, which generates conflict with public administrations and research centres, thus needing inventories and management plans to allow for their sustainable use. **Recognising the value of palaeontological heritage requires the promotion of its protection, as well as the dissemination of scientific information to society for its proper sustainable use.**

It is important to identify, assess and protect palaeontological sites of high value. Not all fossils need to be identified as palaeontological heritage, and only palaeontologists can assess their value. All national and regional laws that pertain to it should be respected by amateur and professional palaeontologists. ●

Permian mesosaurus. *Mesosaurus tenuidens* (Namibia)

Cretaceous wasp fossil in amber. *Hymenopteran, Scelionidae* (Spain)

Australopithecus. *Paranthropus boisei* (Kenya)

Jurassic ammonite. *Perisphinctes sp* (Madagascar)

GEOSITES

A geosite is an area with one or several geological elements which are selected as relevant due to their special value when compared with other similar elements at a specific scale (international, national, local). Geosites have received different names in different languages and countries: geotopes, Geological Sites of Special Scientific Interest (GSSSI), Geological Sites of Interest (GSI), etc. Geosites refer to immovable geoheritage, as opposed to moveable geoheritage, which refers to specimens in collections (fossils, minerals, rocks, meteorites, etc.).

Geosites are arranged in inventories or catalogues. In some countries, the term catalogue is reserved for inventories with official approval towards protection through legislation. Geosite inventories are essential for the proper management and conservation of geoheritage, and should include maps showing with clear boundaries the area covered by each geosite. This is the only way they can be adequately managed and incorporated into territorial planning and environmental impact assessment (EIA). Inventories are done at different scales or relevance levels, depending on the rank of the public administrations involved in their management: (a) international, such as the Global Geosites Project, (b) national, and (c) local, such as the inventories made for a region, province, municipality, etc.

The value of geosites lies basically on their scientific and educational interest, although they may also be of cultural, recreational or spiritual interest. Geosites are places that show unique processes, that provide explanatory models, that serve as a reference or pattern for comparison, that reflect important aspects related to environmental geology and active geological processes, that contain elements representative of the geological evolution of a region and its resulting geodiversity, and/or that are of cultural, social or environmental interest. Thus, inventories should not only incorporate the most representative, but also the most interesting geological elements of a territory. Some of the aspects most frequently considered to identify a geosite include: (a) the representativeness and/or special interest of the geological record and the chronostratigraphic interval represented, (b) outstanding landforms, (c) palaeontological content, (d) relevant tectonic elements and structures, (e) unique, rare or singular minerals, rocks and/or sedimentary structures, and (f) the possibility to identify past palaeogeographies and/or palaeoenvironments that reveal the regional geological evolution. The immense majority of geosites are non-renewable and therefore require proper management to prevent their loss. Waterfalls, springs and thermal waters are some of the few examples of renewable geosites, as appropriate management may help their recovery.

Geoheritage elements that may be removed from the natural environment, as often occurs with fossils, meteorites or minerals, are known as moveable geoheritage. Given their frequent interest to society, these elements should form part of public museum collections, although in some cases private custody may be authorised. The rarity and special scientific value of meteorites suggest they be considered as national moveable geological heritage in all cases. ●

Giant´s Causeway UNESCO WH (United Kingdom)

GEOSITES

Itu Varbito Park (Brazil)

Ugab river folds (Namibia)

Bryce Canyon National Park (USA)

GEOCONSERVATION

Since geological sites and specimens cannot be recovered or restored once destroyed, geoheritage must be studied and managed in order to facilitate its conservation. Geoconservation is the conservation of geoheritage, and includes all those techniques and measures (strategies, programs and actions) designed to ensure the conservation of geoheritage. Geoconservation needs to be based on a good knowledge of the geological elements under consideration, the processes involved in their formation, an assessment of their value, fragility and risk of degradation, as well as of the current and potential threats to which they may be exposed. Geoconservation aims not only to prevent the destruction of geoheritage, but to correct and minimise potential threats.

When geoheritage is subject to the same active natural process that originated it, geoconservation should ensure that the process is maintained, allowing it to continue. Geoconservation should also procure the conservation of cultural, landscape, and aesthetic values related to geoheritage, along with their tourism, recreational and economic applications. Geoconservation must not only focus on scientific aspects, but should attempt a multidisciplinary perspective and provide other benefits to society, such as education, tourism or spirituality. The complexity of managing geoheritage demands it be undertaken by multidisciplinary teams.

Geoheritage frequently becomes visible thanks to human interventions such as geological sections exposed by road or rail trenches. This means that, in some cases, geosites may be modified for scientific or educational purposes, and that a certain degree of positive transformation may sometimes be advisable.

Lesvos Island UNESCO Global Geopark (Greece)

Burgess shale. Banff National Park and UNESCO WH (Canada)

Pyrenees National Park and UNESCO WH (France)

GEOCONSERVATION

At the 4th World Conservation Congress (Barcelona, 2008), the General Assembly of the International Union for the Conservation of Nature (IUCN) adopted a resolution entitled "Conservation of geodiversity and geological heritage". This resolution recognized that the conservation and management of geological heritage (i.e., geoheritage) needs to be integrated into national governments' goals and programs, and to promote local, national, regional and international geoconservation. The adoption of this resolution began a new phase to end the unjustifiable neglecting of geoheritage in nature conservation. It was an important first step within IUCN to halt the destruction of geoheritage, in an effort to stop the loss of the memory of the Earth. The resolution acknowledged that geological heritage constitutes a natural heritage of scientific, cultural, aesthetic, landscape, economic and/or intrinsic values, which needs to be preserved and handed down to future generations (IUCN Resolution 4.040).

Other later IUCN resolutions of interest to geoconservation have been the 5.048 and 6.083. All three of them explicitly recognise that geodiversity is part of natural diversity and geoheritage is part of natural heritage. Notably, also, all three resolutions acknowledge the scientific, cultural, aesthetic, landscape, economic, and intrinsic values of geoheritage, and the wider value and relevance of geodiversity in underpinning biological, cultural, and landscape diversity. They also state that both geodiversity and geoheritage must be considered in the assessment and management of natural areas. Resolutions 5.048 and 6.083 later called on the IUCN World Commission on Protected Areas (WCPA) to promote and support proper management of geoheritage in protected areas. ●

Molina-Alto Tajo UNESCO Global Geopark (Spain)

Geoconservation requires legislation to define mechanisms for the protection of geoheritage. The most important geoconservation system is provided by protected areas, the main aim of which is the conservation of natural heritage and natural diversity, thus including geoheritage and geodiversity. They are expected to be properly managed and to have a legal instrument that guarantees nature conservation and the practice of compatible activities as set out in their management plans.

The "Convention concerning the protection of the world cultural and natural heritage" (UNESCO, Paris, 1972) stated the difference between natural and cultural elements to be considered in the nomination of World Heritage Sites. The difference is basically based on the absence or presence of intentional human intervention. Although palaeontological heritage is undoubtedly of natural origin and a type of geological heritage, in some countries it has been managed by culture administrations. This has unfortunately led to conflicts which affect the correct management of fossils and fossil sites. It is thus important for nature and environmental public administrations to understand the need to assume their competences and properly manage this type of natural heritage. ●

Banff National Park (Canada)

Tongariro National Park and UNESCO WH (New Zealand)

Ordesa and Monte Perdido National Park. Sobrarbe-Pirineos UNESCO Global Geopark and WH (Spain)

A UNESCO Global Geopark (UGG) is an area officially recognised by the International Programme of UNESCO for Geosciences and Geoparks. UGG are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development.* The Global Geopark concept rests on three pillars: (1) internationally-relevant geoheritage, which is the base for (2) geoconservation and education initiatives, while (3) promoting local socioeconomic development.

The idea of geoparks came about in the early 1990s, and in 2000 France, Germany, Greece and Spain became the founding members of the European Geoparks Network (EGN). In 2004, the concept extended worldwide giving rise to the Global Geoparks Network (GGN). Their bottom-up approach of combining conservation with sustainable development while involving local communities was becoming increasingly popular. Finally, in November 2015, the 195 Member States of UNESCO ratified the creation of a new label, the UNESCO Global Geoparks. This expresses tgovernmental recognition of the importance of managing outstanding geological sites and landscapes in a holistic manner. Since then, the number of geoparks has been increasing every year up to the current 147 UNESCO Global Geoparks present in 41 countries (May 2019). A UGG is declared following an exhaustive assessment, but its recognition as such is not for ever. A re-evaluation must take place every four years, and if the proper criteria are not met, a geopark may lose its membership and UNESCO recognition.

Geological parks, geological reserves and mining parks are other types of initiatives for geoconservation and mining heritage conservation. Their objectives are similar to those of geoparks, but they do not belong to the UGG and are not officially recognized by UNESCO. Both geoparks and these other type of parks provide excellent opportunities to promote the conservation of geoheritage and mining heritage on the basis of educational and geotourism initiatives. •

*(www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/)

Geoparkea/Basque Coast UNESCO Global Geopark (Spain)

UNESCO GLOBAL GEOPARKS

Sobrarbe-Pirineos UNESCO Global Geopark and WH (Spain)

Molina-Alto Tajo UNESCO Global Geopark (Spain)

Jeju Island UNESCO Global Geopark and WH (South Korea)

Arouca UNESCO Global Geopark (Portugal)

GEOTOURISM

Geotourism offers visitors the possibility to enjoy the geology of an area and learn about its origin and evolution. By focusing on particular geological elements, geotourists understand them beyond aesthetic enjoyment. Any geotouristic product requires the geology of the area in question be well known, and should furthermore prevent visits to degrading sites. Thus, before any geotourism activity is promoted, it is important to assess the fragility and vulnerability of the area, as well as to determine the risk of degradation related with the visit. Geotourism also requires the creation of teaching and recreational resources to help visitors enjoy and learn about the area's geology.

Any country may offer geotourism opportunities, both in the rural setting and within cities. Natural history museums and visitors' centres, together with sites and outcrops already prepared for people to visit, are essential elements in bringing geoconservation and geology to society. They frequently provide guided tours, information panels, pamphlets and self-guided tours. There are also many geological itineraries (paths or routes), look-out points, caves and mines that have been properly prepared for visits. Geoparks and geological parks are good examples of how geotourism can be an excellent resource for local socioeconomic development. •

Los Glaciares National Park and UNESCO WH (Argentina)

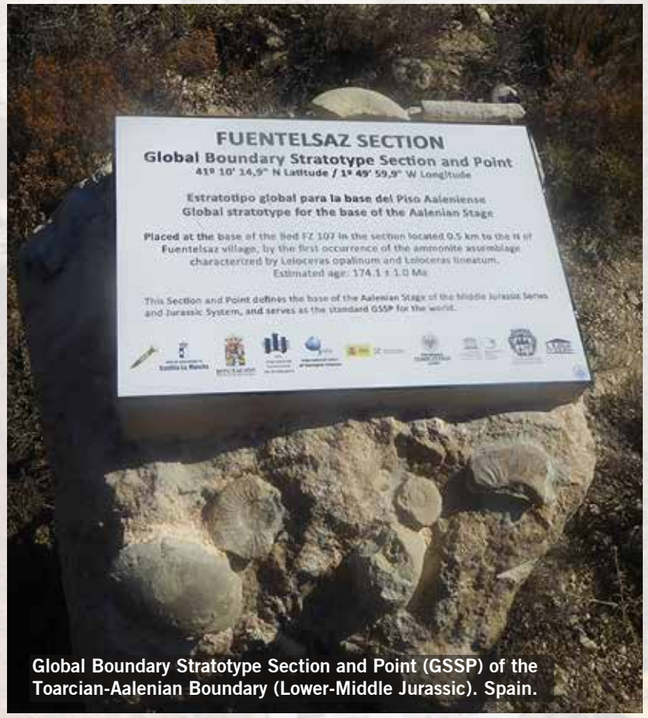
Mu Koh Ang Thong National Park (Thailand)

GLOBAL GEOSITES PROJECT

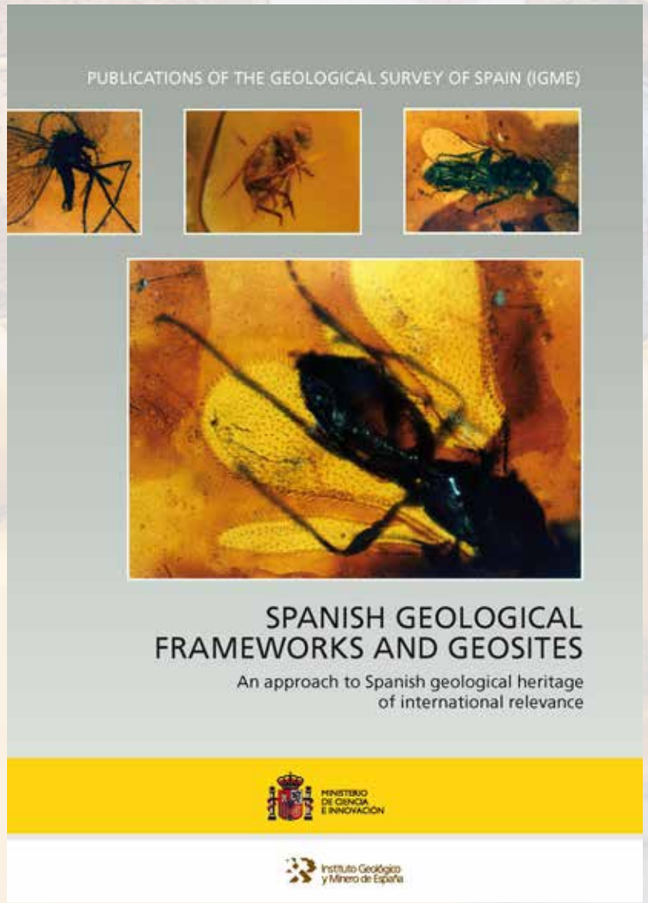
In the late 1990s, the International Union for the Geological Sciences (IUGS), under the auspices of UNESCO, promoted an ambitious world-wide initiative designed to produce a global inventory of geoheritage with international relevance: the Global Geosites programme. Given the complexity of the Earth's geological record, and the great diversity of elements it contains, the difficulty faced was the establishment of a methodology that would allow the selection of its most outstanding elements. The project eventually designed a methodology that does not involve the immediate, direct selection of geological sites of interest. Instead, it requires a prior step: choosing, within each country signed-up to the project, those geological domains or geological frameworks that are of relevance for the world's geological record. These geological frameworks refer to regional geological elements (such as tectonic, geomorphological or petrological elements), along with stratigraphic series and palaeontological associations.

In this prior step, those most representative sites illustrating each geological framework are chosen and termed Global Geosites. They are therefore not selected in isolation, but always within a geological framework previously selected for its international relevance.

In Spain, the geological survey (IGME) was in charge of the Global Geosites programme, and took 10 years (1997-2007) to develop in collaboration with over 70 researchers from different universities and research centres. Twenty internationally-relevant geological frameworks were identified in Spain, with their 142 representative geosites. In 2014, at the request of certain institutions, administrations and individuals, some adjustments were made to the terminology, one more framework was added, bringing the total to 21, and the area covered by some of the geosites was extended. •



Global Boundary Stratotype Section and Point (GSSP) of the Toarcian-Aalenian Boundary (Lower-Middle Jurassic). Spain.



MINING HERITAGE

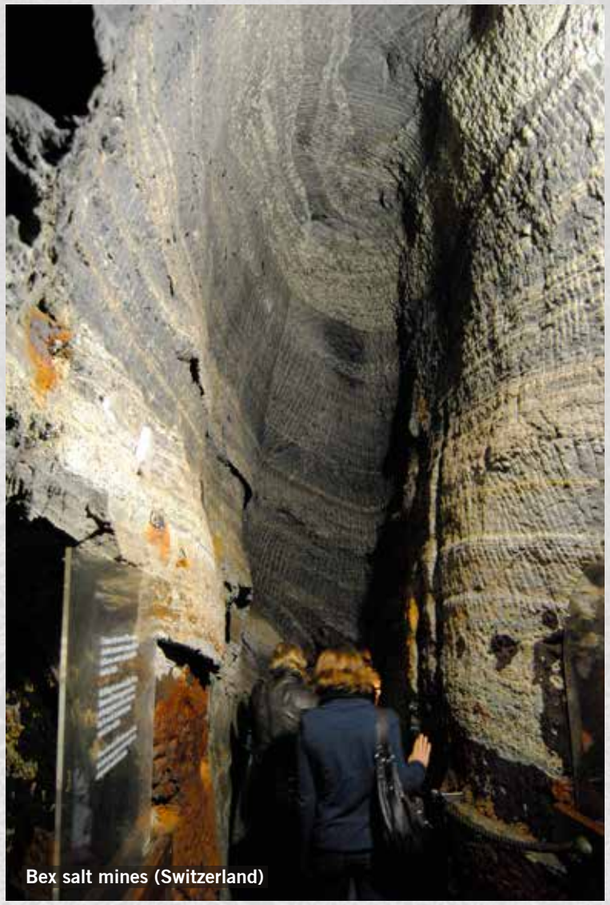
Mining heritage is a type of cultural heritage which refers to both surface and subterranean human-made elements related with mining (pits, quarries and galleries, machinery, equipment, buildings, knowledge, etc.), and which has historical, cultural or social value. It may include both movable and immovable structures related to past mining activity. Mining heritage is not part of geological heritage, because mines are not the result of geological processes. Mines result from human activity so, if relevant, they are a type of cultural heritage. Mining heritage may have links with geoheritage, as mining takes place on mineral and rock deposits, and also may have connections with other types of cultural heritage, such as archaeological, historical and industrial heritage, as well as with the history of economy, technology and civilizations.

The aim of mining heritage research is to locate the elements and determine their value, based on their characteristics and state of conservation. Their assessment helps decide if they should be considered heritage, in which case measures for their restoration, preservation and proper use must be proposed and undertaken. The methodology for the identification and assessment of such elements must estimate the industrial, technological, archaeological, historical, documental, social or landscape value of the mining elements, their sate of conservation, as well as their vulnerability and risk of degradation.

Centuries of mineral development around the world have resulted in a rich mining heritage. Its state of preservation is frequently not good, in part because of the mining process itself leading to the dismantling of the remains from previous periods, but also because of neglect and carelessness. However, over the last decades, many countries have woken up to the problem and there is growing interest in the study and preservation of mining heritage. Local and national associations working towards the defence of this type of heritage have managed to valorise it, and a substantial number of mining facilities and installations have been recovered and restored. Most of these efforts have been for tourism, although there are cases of old structures incorporated into protected areas. Some mines and mining landscapes have been registered as World Heritage, such as the copper and tin mines at Cornwall and West Devon (UK), the Wieliczka and Bochnia salt mines (Poland), the silver mines at Cerro Rico de Potosí (Bolivia), and the mercury mines in Almadén (Spain) and Idrija (Slovenia).

Too frequently, no specific legal instruments protect mining heritage, but legislation intended for other types of heritage can provide coverage for certain mining remains and help towards their protection, restoration and recovery for tourism. For example, legislation on historical heritage or cultural heritage may also help as legal instrument, commonly provided through national, regional or local norms. International recognition is also possible via several UNESCO initiatives, such as World Heritage or Global Geoparks. ●

Santa Catalina lead mine (Spain)



Bex salt mines (Switzerland)

CULTURAL INTEREST OF GEOLOGICAL HERITAGE

Quite frequently, **geoheritage may have a close relationship with cultural heritage** (historical, artistic, architectural) and/or with the traditions, beliefs and folklore of an area. It may even have religious significance and/or provide a mark of local identity. **However, geoheritage must not be confused with its associated cultural elements, because geological heritage is composed exclusively of abiotic elements of natural origin.** Neither historical monuments, works of art, maps, books and tools used by pioneering geologists and engineers, nor legends, beliefs and/or knowledge, may be part of geoheritage or geodiversity. Instead, those are the result of intentional human activity and are thus a part of culture. ●

Ries Geopark (Germany)

Notre Dame des Laves. Reunion Island UNESCO WH (France)

Batu caves (Malaysia)

Nozawa onsen (Japan)

PanAfGeo PROJECT

PanAfGeo Project: Geoscientific knowledge and skills in African geological surveys

PanAfGeo is a European-funded cooperation project with the objective of improving geoscientific knowledge and skills in African geological survey organizations (GSO). The European Commission funds a series of trainings through travel costs, lodging, meals and daily training allowance for each GSO trainee.

PanAfGeo aims to increase African-owned geological knowledge and skills for resource development, natural disaster prevention and mitigation, and geoconservation. The Geological Surveys of Europe (EuroGeoSurveys, EGS) and the Organisation of African Geological Surveys (OAGS) develop this ambitious pan-African project. This cooperation will strengthen the geological sector in Africa, and will therefore represent a step forward in the political commitment to the development of EU-Africa cooperation in this area. The cooperation also aims to further develop the capacity of the OAGS, to improve national education and training systems, and to support the development of a comprehensive Pan-African geological knowledge base.

One of PanAfGeo's work packages (WP6) is oriented towards capacity building in the specific tasks of geological surveys regarding geoheritage inventory, legislation, conservation and public use. WP6 has already organized three training sessions across Africa during 2017 and 2018. Training session WP6-1 took place in French in Marrakech, Morocco, in 2017, with fieldwork in the UNESCO Global Geopark of M'Goun, in the High Atlas Mountains. Training session WP6-2 took place in English in Dodoma, Tanzania, in 2018, with fieldwork in geosites around this city, including the UNESCO World Heritage Site of Kondoa. Training session WP6-3 took place in English in Windhoek, Namibia, also in 2018.

Each session of PanAfGeo WP6 training consists of a 6-days intensive course which develops the following main topics, including fieldtrips to geosites for practical training and debates on African examples:

- Basic concepts on geoheritage, geodiversity, geoconservation, geotourism and geoparks.
- Relationship between geodiversity, biodiversity and cultural diversity.
- Relationship between geoheritage and mining heritage.
- International conventions, norms and legislation relating to geoconservation.
- Methodology of inventories. Geosite identification, mapping and assessment. Planning and development of inventories. Geosite vulnerability and risk of degradation.
- Geoconservation in protected areas. Site monitoring and management recommendations.
- Geoparks and geotourism for local socioeconomic development.
- Public outreach initiatives. Interpretation of geoheritage.
- Geoconservation in landscape planning, territorial planning and urban planning.

The training is mainly oriented to staff of the geological surveys of Africa. The selection process takes into account regional-national representation and a gender balance, following the aim of strengthening skills of African GSOs' geoscientific staff. Other professionals attending the WP6 training come from public institutions and NGOs related to geoheritage conservation, including ministries, universities and research institutions. WP6 trainings are organized by the Geological Survey of Spain (IGME) in collaboration with African national GSOs and geoheritage experts. More information about the PanAfGeo project can be found at:
http://panafgeo.eurogeosurveys.org ●

PanAfGeo
Geoscientific Knowledge & Skills in African Geological Surveys

GLOSSARY

Geoconservation: Actions, methodologies and strategies designed towards the recovery, restauration and/or conservation of geoheritage. Geoconservation must be based on the analysis of value, vulnerability and risk of degradation. Compared to the conservation of other natural heritage, geoconservation is somewhat unique, since most abiotic elements are not movable and not renewable.

Geodiversity: A parameter measuring the diversity or variety of geological elements, including rocks, minerals, fossils, soils, landforms, geological units, geological formations, and landscapes resulting from the evolution of the Earth. The term geodiversity should not be used to refer to the elements, but just to their diversity.

Geoheritage or geological heritage: Geological elements with value. The elements may be geological formations and/or structures, landforms, minerals, rocks, meteorites, fossils, soils and any other result of geological processes. Their scientific and educational value are due to their record of (a) the origin and evolution of the Earth, (b) the processes that have shaped it, (c) past and present climates and landscapes, and (d) the origin and evolution of life. Value also results from enjoyment of the elements (geotourism) and from spiritual beliefs (sacred geosites).

Geological park: A territory with valuable geological heritage which has its own management system, the infrastructure and the resources to promote geological knowledge and geoconservation based on sustainable geotourism.

Geological sites of interest/geosites: Sites with geological elements chosen to be of high value using a methodology for the assessment and identification of geoheritage.

Geotourism: The promotion of sustainable tourism based on the public outreach and interpretation of geoheritage.

Mining heritage: A set of movable or immovable structures, documents, objects and other cultural elements resulting from past mining activity, to which a social group assigns value.

Palaeontological heritage: A set of direct remains of organisms, or of indirect remains (the result of biological activity), preserved in the geological record, which has scientific, educational or cultural value. Palaeontological heritage can be divided into immovable heritage (fossil sites) and movable heritage (museums and scientific collections).

UNESCO Global Geopark: A single, unified geographical area where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development (http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/).

Geoheritage is an important part of natural heritage which must be preserved for the benefit of future generations. Many geological elements are of special interest for science, education or tourism. These are the subjects of research in geoconservation, a discipline recently incorporated to the Earth sciences. This booklet attempts to be an easy reference document for those new to the field of geoconservation, as well as for those ready to delve deeper. It provides the basic concepts needed to understand the significance of geological heritage and geodiversity, as well as their assessment and proper management for sustainable use.

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