DIDACTIC UNIT II

EUROPEAN GEOLOGICAL HERITAGE

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DIDACTIC UNIT II: EUROPEAN GEOLOGICAL HERITAGE

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MODULE 1: Basic concepts of Geological Heritage

1.1. Introduction and Definitions

The first module in this Unit includes a set of definitions and concepts related to Geological Heritage and Conservation. Most of them are included in the compilations by Sharples (2002) and Carvavilla et al (2012).

1.1.1. Geodiversity

This is a relatively recent concept, comparable to Biodiversity. It that refers to the range of geological features that characterizes a given territory, taking in consideration natural elements such as minerals, rocks, fossils, soils, and natural resources, as well as processes of significant value including the sedimentary, structural, geomorphological and volcanic processes. Geodiversity is the true reflection of the geological history of our planet and, jointly with Biodiversity, comprehensively covers all the Abiotic Diversity on Earth. Although this definition of Geodiversity is not unique, is broadly accepted by the scientific and educational community. The other acceptations differ in the inclusion (or exclusion) of values related to geomorphology, edaphology, geography, climate and/or landscape.

Despite the fact that Geodiversity is a clearly booming concept, it is still far away from the degree of recognition that society and public administrations grant to Biodiversity. This, in fact, is a secular handicap because the term Natural Diversity (which conceptually covers Geo- and Bio- diversity) emerged directly from Biodiversity and since then, it has been primarily interpreted from a biocentric perspective.

The introduction of the term Geodiversity and the strong support provided by international organizations such as UNESCO, IUGS, ProGEO, EGN and GGN (for more details see Module 3 in this Didactic Unit and Module 2 in Didactic Unit IV), and countries like United Kingdom, United States, Australia, Spain and Portugal have gradually pushed the ideas that: (1) the Natural Environment consists of two clearly differentiated but interconnected parts, one biotic (biodiversity) and another abiotic (geodiversity); and (2), the adequate recognition and correct use of both terms will provide a more holistic and reliable conception of Nature.

1.1.2. Geological Heritage or Geoheritage

Only a little part of the immense geodiversity is recognised, known to mankind and just those identified geodiversity assets, which are considered meaningful to be worthy of conservation measures, belong to the geoheritage. In accordance, the term Geoheritage or Geologial Heritage refers to the natural heritage of areas with high geological value, because of their scientific, educational, aesthetic and/or inspirational interest, that must be conserved for the benefit of present and future populations. Geological heritage is what we like and want to protect within geodiversity. It has a cultural context.

It is therefore defined as the amount of geological features, including stratigraphic formations, geological structures, geomorphological landscapes, paleontological and mineralogical sites, etc., of significant value to recognize, study and interpret the geological history of a given region or territory. Geological heritage has also an intangible component, including the geological interpretation of geodiversity, myths, geographical names, etc.

In the Andalusian Strategy for Integrated Management of Geodiversity, the main reasons to protect Geodiversity and Geological Heritage are clearly exposed:

- They represent scientific and didactic resources, which permit not only to interpret the past of the Earth and life evolution, but also to better understand current processes and to elaborate management strategies for future foreseeable situations.
- They represent habitats, ecosystems and landscapes support, as well as of the relationshipos and dynamic processes that happen in them.
- They are socioeconomic assets for sustainable development in rural areas.
- They are fundamental part, since their origin, of human culture and its activities in the territory.

The range of the geological heritage is not static, losses (deterioration etc) and gains (research, exploration etc.) elements over time. In addition, the term Geological Heritage does not refer exclusively to in situ elements but also to palaeontological, mineralogical or petrological collections of special relevance. As occurs with Geodiversity, this definition is not unique, although it is broadly accepted. Conceptually, Geological Heritage encompasses a set of concepts that define specific aspects within it:

- **Palaeontological Heritage**

Remains or parts of organisms, impressions and traces of their vital activity that have been preserved in the geological record, and whose uniqueness, exceptionality, representativeness, scientific, educational or cultural interest make them stand out. At the same time, they allow to reconstruct the geological evolution of an area, the community of organisms that inhabited in a particular place at a given time, its biological evolution and the environment in which they lived.

Fig. 2.1. Ammonite-rich limestone outcroping in Sierras Subbéticas UNESCO Global Geopark, Spain

- **Mining and Archaeo-Industrial Heritage.**

Geological heritage conformed by all those remains inherited from industrial and mining activities that are important for the understanding of the industrial society as a whole or to show the development and evolution of the mining and industrial activity in a given place.

Fig. 2.2. Killhope Lead Mining Museum, North Pennine UGGp

Geomorphological Heritage

Non-renewable natural resources of scientific, cultural or educational value that allow us to recognize, study or interpret the configuration of the Earth's surface and the processes involved. This definition includes unitary geomorphological elements (escarpments, terraces, ridges, etc.), physiographic spaces that configure the natural environment (river canyons, karst cavities, volcanic reliefs, etc.) and even the human perception of all of them, i.e., the landscape.

Fig. 2.3. The Murciélagos Cave, Sierras Subbéticas UNESCO Global Geopark, Spain

Hydrogeological Heritage

All those areas where water has special interest due to: (1) its natural beauty, (2) its historical relevance, (3) its importance or specific use at a given time, (4) the architectural beauty directly related to the use of water, and (5) its importance within the total amount of resources of a community.

Fig. 2.4. The fountain Fuente del Rey. Sierras Subbéticas UNESCO Global Geopark, Spain

1.1.3. Geoconservation

In general, conservation of the natural environment is understood as the amount of measures and actions aimed at maintaining and/or recovering the natural value of a particular place or natural element. When this refers specifically to geological elements, it is called geoconservation. This has particular connotations, since geodiversity and geological heritage refer to abiotic, mostly non-renewable, elements. However, in a broader sense, the aim of geoconservation is to identify the geodiversity values in connection withbiodiversity and cultural values for a proper management and conservation.

According to Gray (2005), geodiversity must be conserved for two fundamental reasons: Its great value and high degree of threats.

Conservation of geological heritage and geodiversity are relatively recent issues. Although there are examples and experiences of geoconservation dating back to the end of the 19th century, the study and systematic application of conservation-oriented techniques is rather new.

As occurs with the concept of Geological Heritage, Geoconservation includes several sub-definitions. Some of them refer to the jointly conservation of both biotic and abiotic elements, while others are specifically oriented to the abiotic world.

- **Geological resource o georesource.**

Although the term Geological Resource commonly refers to those geological materials that can be extracted from nature and used for various purposes, there is another less utilitarian definition of such term. According to the National Park Service of U.S., the Countryside Agency and the Joint Nature Conservation Committee, geological resource consists of those geological elements that provide information on the origin and evolution of the Earth, and those geomorphological features that help describe and interpret the landscape as well as the geological processes (including erosion, seismic and volcanic activity, glaciations and hillside processes).

According to this definition, the term geological resource not only refers to economically valuable materials (water, oil, minerals, construction materials, ornamental resources, etc), but also to those that serve to increase knowledge about the evolution of the planet or the human history, and are able to fill intellectual or spiritual needs.

- **State of conservation.**

Situation of the natural integrity of a resource or a site and level of affection to its environmental value.

- **Natural Integrity**

In relation to the previous term, natural integrity is understood as the level of maintenance of its environmental value, including other natural features and processes.

- **Sensitivity**

Susceptibility of a geological resource to suffer changes or degradation caused by anthropic activity. The opposite term, less used, is Robustness: degree to which a geological resource can absorb modifications induced by human activity without losing or degrading its major characteristics.

- **Potentially Damaging Operations (PDO)**

Uses of the territory that may pose a threat to the conservation of the natural conditions of a site.

- **Environmental stress**

The phenomenon that causes disturbance, and that can weaken or rejuvenate the ecosystem, such as a fire.

- **Impact**

It commonly refers to the positive or negative effect of an action upon a natural resource, geological in this case. It is called affection when the effect is negative and impairment when it is very severe.

- **Modification**

Alterations of a site to make a series of uses compatible with its natural value.

- **Recovery**

Recovery is understood as the degree to which an altered resource has regained to its former state.

- **Restoration**

This term refers to the recovery of reference conditions by mean of the human action.
Restoration is the first step in the recovery of a place, which will be considered recovered when acceptable conditions are reached and continuous active interventions are no longer necessary, with independence that periodic maintenance could be needed.

- **Reference conditions**

Conditions and processes representative of an area. The originals before the transformation.

- **Regeneration**

In relation to Natural Integrity, Regeneration is defined as the natural recovery after degradation or modification. This term is not very common in geology due to the mostly non-renewable nature of geological elements.

- **Mitigation**

Reduction of the impact/stress intensity.

- **Resilience**

Term that refers to the natural or internal capacity of a system to be recovered.

- **Reclamation**

Actions oriented to improve the conditions of a given site during the restoration process, which will be suspended once the site reaches its former natural state.

- **Maintenance**

Continuous protective action of the site diversity (Australian Heritage Commission, 2003).

- **Preservation**

Preservation refers to the maintenance of geodiversity and the natural value of a site.

- **Degradation**

Degradation of a given geological resource or place refers to the anthropically derived loss of quality, integrity or value caused by anthropic modifications.

- **Degraded areas**

Those areas whose natural conditions (including the natural processes that take place in them) have been severely modified by the action of one or more stress-causing processes. That is, areas that have suffered a severe negative impact.

- **Protection**

Protection refers to a specific conservation technique aimed to provide legal status to a specific site or geological resource. It entails the design of a specific management plan based on the definition of a regime of use that generally derives in its declaration as Protected Natural Space.

Although Conservation and Protection are often used as synonyms, they are some differences between these two terms. Protection (usually after declaration of a Protected Natural Space) is one of the management techniques used in geoconservation, but it is not the only one, while Conservation is a much broader term, which encompasses all those techniques focused on ensuring the appropriate maintenance of a place.

- **Replication**

Identification of multiple examples of a geological feature with special significance that must be conserved.

- **Leave no trace (LNT)**

This is one of the most used slogans in Protected Natural Spaces. It tries to convey to visitors the need to preserve reserved areas leaving no evidence of human presence. In reserved areas within certain North American National Parks, it is even a mandatory norm.

1.2. Legal Base concerning the Geological Heritage.

Although the terms Geological Heritage and Geodiversity have no unique and unequivocal definitions, there is an increasing, although relatively recent, consensus in the need for conservation, because the threats that Geological Heritage and Geodiversity have to face are essentially the same all over the world. Each country faces the recognition, use and protection of the Geological Heritage with different ability and degree of responsibility, and this largely depends on the legislation and regulation on geoconservation developed in each case.

All countries have a well-established and more or less well-refined system of Protection Figures for Natural Areas. Figures with different degrees of protection such as Natural Parks, Biosphere Reserves, Natural Monuments, etc., were initially conceived to protect wildlife. Given that wildlife is settled in a landscape, this is also covered by the aforementioned protection system. It was precisely this conjecture the one formerly used by many countries in the development of their respective geoconservation laws and regulations. Such regulations are the same everywhere. While some have a legislative system in which bioconservation and geoconservation are treated equally by law, the vast majority have developed regulations on geoconservation totally subordinated to bioconservation. There are even countries in Europe without true awareness of the Geoheritage and its management need.

1.3. Organization and policies.

In Europe, there are as many organizational forms and polices of Geoheritage management as countries. As a general rule, it is possible to envisage a broad structure in all the countries consisting of two main groups or sectors, the governmental and the non-governmental sector. Within the government sector, the administration and development of management policies related to the geological heritage depend on agencies linked to the Ministry with competences in Environment (occasionally the one with competences in Culture) as well as regional and even local government agencies and entities. The greater or lesser competence of the different administrative spheres depends on the degree of decentralization that each country has in terms of environment.

Within this government sector, there are natural spaces management bodies (nationally and/or regionally based) with legislative and administrative capacity, and also, agencies, including geological services, or museums, with no administrative role, but with the capability of managing the geosites inventory characterizing the geological heritage.

The non-governmental sector is composed by all those scientific, environmental and/or protectionist societies related to the geological heritage.

A generalized problem that geoheritage specialist from many European countries adduced is the virtual absence of people with geological background/knowledge in management positions. This play against the adoption of adequate protection and conservation measures for the Geological Heritage.

1.4. Site selection and Registration of Geosites

As occurs with the organization and policies related to the Geological Heritage, there is not a single model for geosites selection and registration, nor are all the European countries at the same level of development. However, many of them have based or inspired their geosite selection and registration methods on the proposal that Wimbledon et al (1995) devoted to the selection of geosites in the UK. A common first step taken in many countries has been the accurate definition and determination of the scope of the terms site, geosite, geotope or any analogous names intended to define places of high geological interest (see Figure 2.5). The next step consists of the definition of the classification fields and the selection criteria.

Whereas, in terms of classification fields, geosites are generally classified according to their Sedimentological, Mineralogical, Structural/Tectonic, Petrological, Paleontological, Geohistorical, Geomorphological or Hydrogeological affinity, the most

commonly used classification criteria are scientific, didactic, ecological, touristic, cultural, preservation, representativeness, uniqueness, accessibility and beauty. However, neither these are all the classification criteria used in Europe nor are all used at the same time by a single country. This is only the list of the most repeated criteria. This information is expanded in module 7, dedicated entirely to the Particularities and Situation of the European Geological Heritage.

Depending on each country, the initial proposal for a geosite may be raised by individuals, academics, geological services or conservation societies. The approval of each proposal is usually conceded by a committee of experts, which in many cases collaborate or is linked to the geological services. Although this is the most extended procedure, there are also particular cases like Hungary, where caves. springs, sinkholes and certain fossils directly obtain ex lege protection.

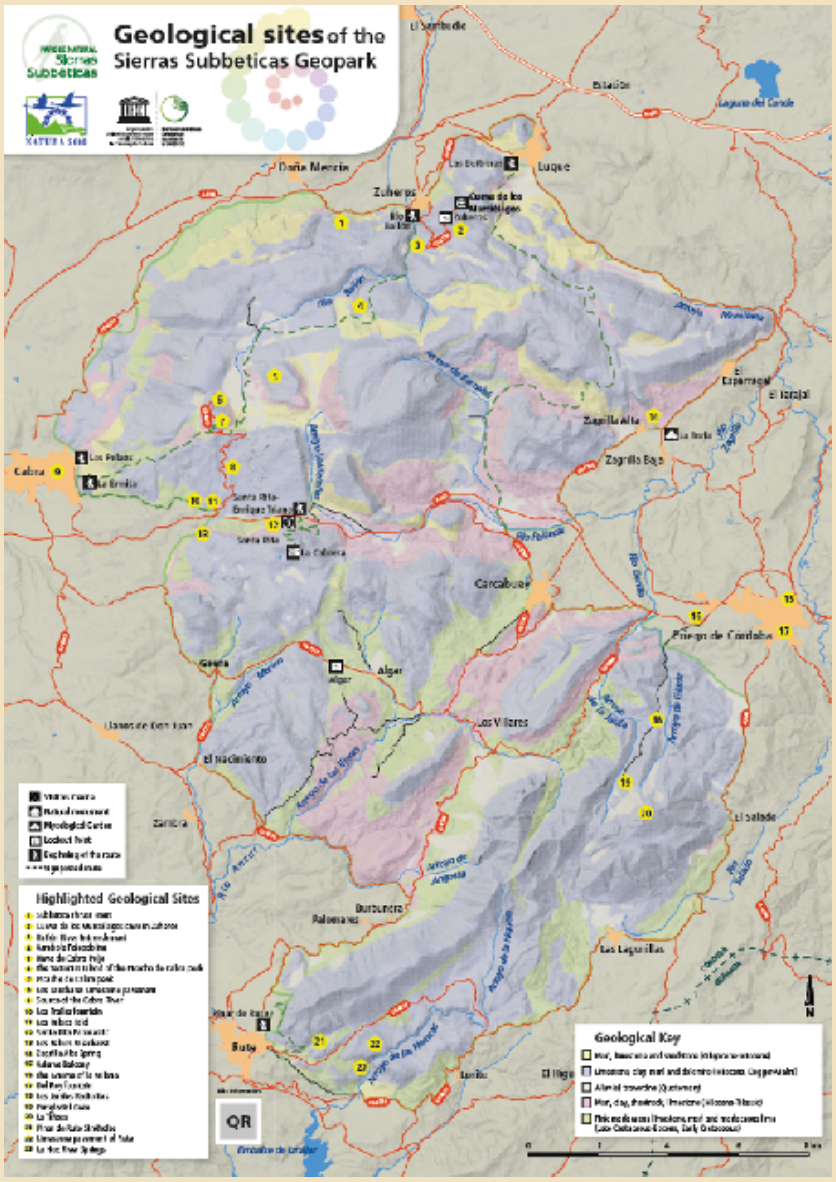

Fig. 2.5. Geological map of Sierras Subbéticas UNESCO Global Geopark indicating, in yellow, the location of the geological sites.

Together with the classification, an assessment of the geosites is usually carried out in order to know and publicize the current state and the required protection. In that sense, geosites can be found in three different states: (1) geosites with protection requirements (2) geosites already covered by larger protection figures such as National Parks, Natural Parks, Protected Spaces, etc. that do not require any additional protection.; and (3) geosites not protected and without specific protection needs.

Depending on the territorial organization of each country, there may be geosites inventories at national, regional and even local levels. Although this could be understood as a duplicity problem, the regional or local inventories created in some countries, such as UK or Spain, have often served as a stimulus for the recognition and protection of additional Geological Points of Interest.

The GEOTUR Guide shall know what Geological Heritage is and its importance. She/He shall use conservation terms properly and become familiar with her/his own country's conservation policies, especially those refered to Geoconservation and to her/his working territory.

MODULE 2: Management and conservation of Geological Heritage in Europe

2.1. Management and governance.

This management field covers a complete set of actions destined to highlight the Geological Heritage. It has a twofold effect, one linked to the conservation, surveillance, maintenance and rehabilitation of the Geoheritage, and on the other associated with the development of educational, informative and geotouristic related activities. Eventually, the management if the Geological Heritage pursues the connection between Geoconservation and Sustainable Socio-Economic Development.

In Europe, the management of the Geological Heritage is clearly disparate, but fortunately, there are very few countries where the Geological Heritage is not managed even in terms of protection. There, the term Geo-resource has an exclusively economic meaning, and is related to extractive activities carried out in mines, quarries and/or hydrocarbon wells, or to the development of tourist sites in outstanding geological environments without any minimal measure of conservation.

At the other hand, those countries with clear awareness of the needs of the geological heritage have large differences in their own management systems, depending on whether or not the geosites fall
within areas previously protected such as Natural Parks, National Parks or figures with similar range at national or regional level.

When the Geological Heritage is not emplaced in previously protected areas, it generally lacks a specific management plan, being therefore completely at the expense of physical and anthropic agents. Even those countries that have developed a specific legal protection figure to encompass all the geological Points of Interest in their territory have not stablished physical conservation measures in all the points, especially in those from isolated areas.

Countries like Hungary have developed strategies to implement individualized management plans to geosites already protected. When this occurs, the following reviewable 4-stages plan is established:

1. Detailed evaluation of natural assets.
2. Assessment of their potential anthropic and natural impact.
3. Establishment of protection objectives and strategies.
4. Specification of actions to be taken.

Geosites located in previously protected areas are generally covered by measures and infrastructures directly designed for the protection of the biological diversity. There is even a paradox that some areas have no emphasis (protection, disclosure, enhancement ...) on the geological features, despite the fact that geoheritage was the main reason for the establishment of a protective measure. Nevertheless, there is an increasing awareness of the specific characteristics/needs of the geological heritage, both inside and outside previously protected areas.

Management and decision making in relation to the Geoheritage do not always depend on the same institution nor belong to the public domain. In general, when the Geoheritage is protected, it is managed by the institution in charge of the hosting protected area.

When the Geoheritage is located outside a protected area it can be managed by Universities, museums, independent agencies or environmental entities of national and international scope, such as WWF. As a result, not all the protected geosites in a country have the same protection status. One case particularly relevant in terms of protection is Rumania. In this country, the geosites are covered by a Law that allows associations, organizations, and other entities to develop protection management plans. As a result, circa 50% of Rumanian geosites are protected by public institutions or private persons.

Generally, when the Geoheritage is included in a specific management/conservation program, and this is particularly true in Geoparks, geological parks or comparable protected areas, they are involved in sustainable development strategies that promote, not just the maintenance of geosites. (cleaning and improvement protection), but also the local development and geoturims.

In that sense, Geoparks also exercise an important awareness task. Indeed, it is precisely this awareness of geoconservation and promotion of the Geological Heritage one of the most important demands of all the actors related to a greater or lesser extent with the Geoheritage.

The United Kingdom, on the contrary, represents a paradigm of advanced approach in geoheritage management. They have a clear distinction between natural spaces and reserves exclusively managed to inform and provide visitors with a good experience and areas with specific scientific interest. Each of these protected natural areas has its specific management plan. For more information, see Module VII.

Regardless of the level of development that each country has in terms of management and governance, those authorities with competence in Geoheritage manifests several shortcomings and desires that in many cases could applied to the entire European territory. The most relevant shortcomings/desires are:

- Generalized deficit of knowledge and awareness regarding Geoheritage.
- Lack of protection of isolated geosites or sites located outside previously protected
- areas.
- Necessity of revision and unification of geosite inventories, because many European
- countries have obsolete lists or have national and regional geosites inventories excessively overlapped. There are even countries with geosites located in already protected areas that still requires protection assessment.
- Need for regulation and personnel devoted to the systematic physical management of
- the Geoheritage.
- To increase the communication with other geological scientific and educational communities.
- To extend the stimulus that Geoparks represent in terms of protection, education, awareness and sustainable development to other territories, in order to establish a solid connection between protected geosites and geotourism.
- To extend more widely the use of the geoheritage in education, outside or inside a Geopark, because geoheritage has a great potential for the development of case studies, field trips, interpretive routes, and for raising public awareness of its scientific value.

From a purely constructive perspective, this list can be understood as a development panel and a niche of potential opportunities related to the Geoheritage.

2.2. Conservation policies and strategies in Europe.

As a general rule, geoconservation is not well integrated into European policies and initiatives related to the Natural Environment. Although the degree of integration differs between countries, it is always in a very subordinate position with respect the policies and initiatives addressed to the Biodiversity conservation.

Probably, the European country with the most effective policies in geoconservation is Russia. There, geoconservation is always linked to the development of educational and research activities. Protected areas, including those that have been protected by the Geoheritage interest, or those in where the Geoheritage has a relevant role, have departments of science, and in many cases departments of education, with specialized staff offering conferences, fieldtrips, exhibitions and even publishing their own proceedings.

In historical terms, the first European movements in favour of the geoconservation began in the 17th Century. Certain geosites very seriously threatened became protected by specifically addressed measures. From the 19th Century onwards, the establishment of Natural Parks, not only in Europe but also in North America, offered great opportunities to the protection of the Geological Heritage. However, this occurred in an indirect way, because their designation as protected geosites was related to their scenic qualities or their value in the history and culture of a given territory. In the mid-20th Century, the conservation programs gainedimportance, although these were focused on the flora and fauna protection within small areas. The International Union for the Conservation of Nature and Natural Resources (IUCN) was founded in 1948 and numerous national agencies for the protection of biodiversity and geological heritage were also created. Both elements, the biotic and the abiotic, were treated and managed independently even though the protected areas frequently overlapped.

One of the first movements in favour not only of the conservation, but also of the sustainable socio-economic development of areas with an outstanding geology took place in the 1980s. Specifically, in 1984 the Reserve Geologique de Haute Provence, France was declared as part of a French national network of natural heritage in France with very high level of protection. The area, very rich in geological and geomorphological heritage, was scientifically best-known for its Mesozoic fossiliferous sequences and the occurrence of diverse Globally Important Stratigraphic Reference Sections and Points, i.e., those internationally agreed to define the lower boundary of a stage on the geologic time scale. Since then, the Reserve gradually increased the educational activity related to the geoheritage, adopting phrases like “Learn to read the Earth” and “Where the memory of the Earth is protected”. This initial impulse leaded in 1991 to the Declaration of the Right and Memory of the Earth, the Digne Declaration, that was adopted in the First International Symposium on the Conservation of our Geological Heritage organized by the European working group on Earth Science Conservation and the “Conférence Permanente des Réserves Naturelles de France” in partnership with ProGEO.

Although the emphasis of much of the earlier activity related to the geoheritage was focused on rising awareness and geoconservation, the incipient benefit of geoturism put the Reserve´s focus on the economic development for the benefit of local people. In the 1990s this innovative idea, evolved in the concept of Geopark, as proposed in the 30th International Geological Congress in Beijing, China in 1996. This new figure, not adopted by UNESCO until 2004, would be definitely sustained by three strategic pillars: geoconservation, education and regional economic development. But, inside Europe, four areas with outstanding geoheritage, the Haute Provence Reserve, the Maestrazgo Cultural Park, in Spain, Lesbos, in Greece and Vulkaneifel, in Germany developed in 1997 a LEADER project that finished in 2000 with the establishment of the European Geoparks Network, one of the most important European impulses in favour of geodiversity (see more information about the initial definition, development and state of the art of the European Geoparks Network in Didactic Unit IV). In 2004, the Global Geopark Network was created in partnership with UNESCO.

Fig 2.6. Haute Provence Geological Reserve, one of the first protected areas due to its geological heritage

The project was founded by the European Union LEADER II programme. The LEADER is an European initiative conceived to support and revitalize rural areas that was skilfully used by these four areas to develop the network. But the European Union have never developed a strategy or plan exclusively focussed on Geodiversity, in contrast to what occur with Biodiversity. See for example, the Natura 2000, the Habitat Directive or the EU 2020 Biodiversity Strategy.

The stimulus provided by the Digne Declaration, not only derived in the designation of several European geoparks and the subsequent erection of the European Geoparks Network, but truly represented the definite impulse for the protection policies of Geodiversity virtually in all the European countries. The statement of statutory-based laws aimed to protect the natural environment was followed by the establishment of a set of criteria for the evaluation and validation of points with geological interest, and the subsequential identification and cataloguing of geosites in each territory. Such task was carried out by specific agencies, entities related to the scientific/university domain or the corresponding National Geological Surveys.

Although the conservation policies addressed to the Geological Heritage have followed a similar strategy in the vast majority of European countries, a plan entailing law formulation, establishment of validation criteria for the evaluation of geosites and final identification/declaration, not all countries have developed each of these stage at the same level, commenced at the same time or have progressed at the same rhythm.

Apart from the Geopark movement, there is an increasing awareness in Europe of the great value of the Geoheritage as well as its protection needs, because it is directly threatened by urbanization processes, development of large infrastructures, mining activity, land use changes, erosive processes, etc. But not all the conservation policies in Europe are oriented towards geoconservation mechanisms.

A relatively recent line of work with a clear holistic philosophy pursues the integration of the geological heritage with theconservation of biodiversity and landscape, the management and use of natural resources, the historical and cultural heritage, and the geotourism and socio-economic development of local communities.

This strategy represents a better integration and greater recognition of geoconservation in the European environmental policies, but at the same time also represents a source of opportunities.

Although there is an open debate on the kind of connection that has to be established between ecosystem and human being (i.e., does the ecosystem have to be protected by itself or does it have to be protected for its direct or indirect utility?), the integration of the biotic, abiotic and anthropic components of a landscape clearly represents a substantial improvement in the protection and sustainability of the natural environment, including the Geological Heritage.

In line with this idea, some European countries have already established a new generation of laws intent to comprehensively protect the biological, geological and landscape diversity while recognizing the environment as the basis of any human activity.

At the European level, apart from the aforementioned International Declaration of the Rights of the Memory of the Earth (Digne Declaration, 1991), other initiatives dealing with geoconservation in a more integrating way have also been developed. Among them the most important are the European Manifesto on Earth Heritage and Geodiversity (2004) and Declaration of Reykjavik, approved at the 8th International ProGEO Symposium in 2015.

Despite the national and international efforts carried out for the development of geoconservation, despite the fact that there is greater social awareness about the effects of geological processes such as volcanoes or earthquakes, and despite the fact that the abiotic environment is nowadays interpreted and preserved as the substrate of the biological activity, it is obvious that geoconservation has not progressed nor has the same national and international political support than bioconservation.

Gordon et al (2018) identified four critical areas of action for the promotion of geoconservation and its integration within the environmental policies:

1. Integration of Geoconservation into Civil Society.
2. Improvement of the scientific basis for Geoheritage conservation.
3. Integration of Geoheritage conservation Nature conservation, ecosystem approach and sustainable development.
4. Integration of Geoheritage conservation in protected areas, planning and management.

1. *Integration of Geoconservation into Civil Society*

To progress from geoconservation being an activity interesting only for Geoscientists and people with professional training and knowledge to one of broader interest, the following actions are required:

a) The use of intelligible language when interpreting geoheritage to the widest audience.

b) The continuous adaptation of Geoheritage to the values and demands of a continuously changing society.

c) Increase the level of interaction with other conservation experts and with civil society, promoting participation in debates on conservation and environmental management or facilitating citizen participation in geo-environmental volunteers.

d) Ensure that the Geosciences are an integral part of the educational curriculum in primary and secondary school.

e) Promote Geoheritage integrating geotourism into the tourism strategies and policies of the different territories.

2. Improvement of the scientific basis for Geoheritage conservation.

Geoconservation could reach a broader audience with a more robust scientific base and an interdisciplinary approach integrating natural, cultural and geoheritage values. Apart from incorporating the geoheritage in the academic curricula of geoscience specialists as well as in the teachings of other disciplines such as biological sciences, geography and engineering, it is required:
a) Broader consensus on the definition of critical terms such as geodiversity, Geoheritage and geoconservation.
b) Unification and globalization of the methodologies employ in the selection and evaluation of geosites.
c) Raise public awareness about the vulnerability of the physical environment and the subsequent need for geoconservation.
d) Become aware of the need for marine environment conservation.

3. Integration of Geoheritage conservation Nature conservation, ecosystem approach and sustainable development.

It is necessary to focus efforts on including geodiversity and geoconservation in those protocols, practices and strategic work programs on Nature, Land, Environment and Sustainable Development that are intended to be developed at any administrative level, from European to local. On the other hand, political managers and bioscientists have to be persuaded that geodiversity, as substratum of biodiversity, is essential for the development of ecosystems.

4. Integration of Geoheritage conservation in protected areas, planning and management.

Efforts must be made to assure the inclusion of geoconservation in the planning and management of protected areas, either because of the Geoheritage own value or as a substratum of the biodiversity, culture and society under protection. Geoconservation needs to consider the geoethical, cultural and ecological values when developing management plans.

2.3. Educational, interpretational/scientific activities

Environmental education is essential to understand the natural, social and economic processes occurring in the natural environment. As stated above, the preponderance of plans, guidelines and initiatives focused on the protection of biodiversity undoubtedly affects the development of educational and training policies related to geodiversity.

The root of this disparity lies in the scarce incidence of the geosciences in the compulsory educational curricula of the different countries, together with the fact that Geological Sciences are rarely taught independent from Biology or Geography. At University level, there are still few European countries where Geoheritage or Geoconservation have been incorporated to the curriculum of regulated geological teachings. Definitely, this tendency needs to be reversed for society to be fully aware of the intrinsic value of Geoheritage.

The educational and interpretive activities related to the Geoheritage depends on the degree of protection of Geosites rather than the country or region where is located. Geosites of national and international relevance, and especially those located in Geoparks, are usually part of educational programs or initiatives highly diverse. Unfortunately, this does not extend to isolated or physically/administratively unprotected geosites.

The most commonly used didactic and educational resources based on Geoheritage include:

- Publication of interpretative articles, maps, brochures and multimedia material.

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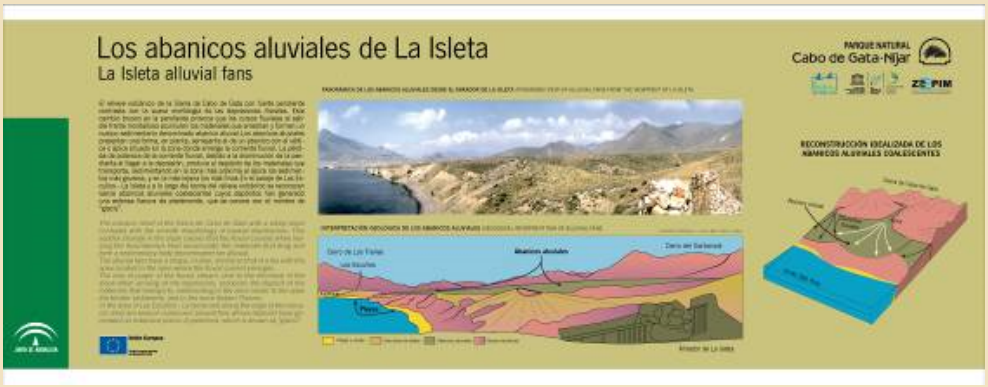


Fig. 2.7. La Isleta alluvial fans. Interpretative panel from Cabo de Gata-Nijar UGGp

- Workshops, conferences, and fieldwork addressed to primary and secondary schools.

Fig. 2.8. School excursion in the Suevite quarry Itenbürg, Germany.

- Non-conventional activities related to geology, including exhibitions, and artistic activities such as painting, sculpture, films, poetry, etc.

Fig. 2.9. Geopainting Workshop in Sierras Subbéticas Geopark, Spain

- Educational packages for students, teachers, professionals and local educators focused on geoeducation, conservation and sustainable development.

Fig. 2.10. Environment Educational Program offered to primary school pupils by the Government of Andalusia, Spain.

- Specialization courses on Geoheritage addressed to natural guides..

Fig. 2.11. Specialized course on geoturism

- Celebration of thematic days to raise awareness on geodiversity and Geoheritage, such as the Spanish case of Geolodía.

Fig. 2.12. Celebration of the Geoloday 2010 Sevilla, in Sierra Norte de Sevilla, Spain

- Development of activities within the framework of weeks with international recognition such as Science Week or Heritage Week.

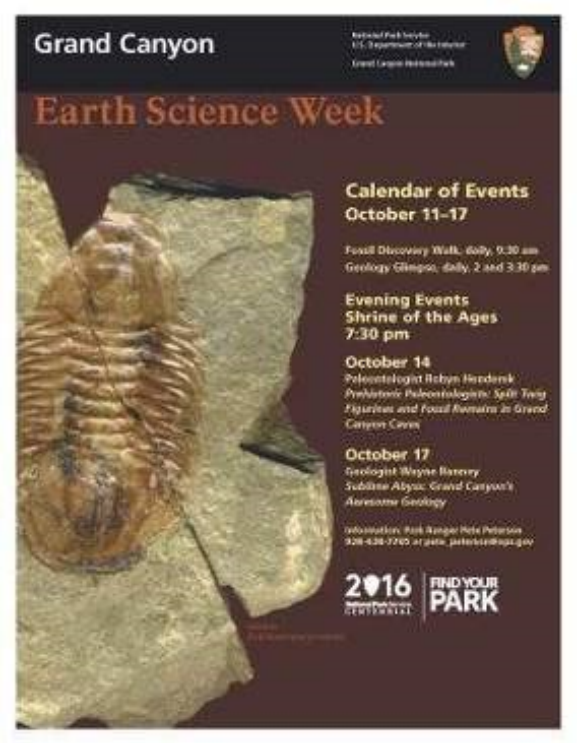


Fig. 2.13. Earth Science Week in Grand Canyon National Park, USA

- Yearly celebration in all European Geoparks, and at the same time (end of May - beginning of June), of the European Geoparks Week, a framework that concentrates a large number of didactic/educational activities.

Fig. 2.14. Europea Geoparks Week 2019 in Madonie Geopark, Italy

Human and physical facilities intended to cover programs and activities related to Geoheritage are very diverse and always depend on the organizing institution. Geoparks are, with no doubt, the institutions with the greatest coverage in this regard, given their intrinsic relationship with Geoheritage. Apart from own made brochures, maps and interpretive panels, they also have geologists and professionals specialized in Geoheritage dissemination. Outside geoparks, the educational and interpretative resources are scarce, and the existence of geologists or analogous professionals in positions related to teaching and dissemination of Geoheritage is clearly deficient. Fortunately there are some exceptions to this tendency such as the Grand Canyon and the Hawaii Volcanos National Parks in USA, and even the Aggtelek National Park in Hungary, with strong geoscientist basis and geologists working on them.

2.4. Facilities for tourism.

The geoturistic activities in Europe are wide-ranging, but certainly scarce compared to other tourism sectors linked to Nature. This fact, far from represents a severe impediment or a handicap for tourism companies, is considered nowadays a real niche of opportunities.

The current society, clearly sensitized to nature conservation and the effects of climate change, is more permeable than ever to environmental information. In the history of the human being, there has never been so much interest and so widespread in the physical environment. In this context, an important pedagogical labour is required to raise public awareness of an idea repeatedly exposed in this module: the physical environment that concerns society as a whole has an abiotic basement that needs protection and can be understood and known with the help of Geoheritage.

The promotion of Geoheritage is not only an issue that concerns governments but also a stimulus for the Nature tourism sector, a segment traditionally unconnected to the geology and geoheritage. In line with this idea, some European countries have developed promotion programmes of Geoheritage in order to stimulate the interest of tourism companies. This has generally occurred in areas with well recognized geoheritage and particularly in Geoparks.

The different levels of administration have created facilities for geotourism in order to increase the interest of society in Geology and Geoheritage. Such facilities include monographs, booklets, brochures, articles, panels, maps, photos, films, radio and TV reports, as well as itinerant and permanent exhibitions in museums. Gradually, this effort is percolating into tourism companies, which find it increasingly feasible and profitable to include geological features in their tourism offer.

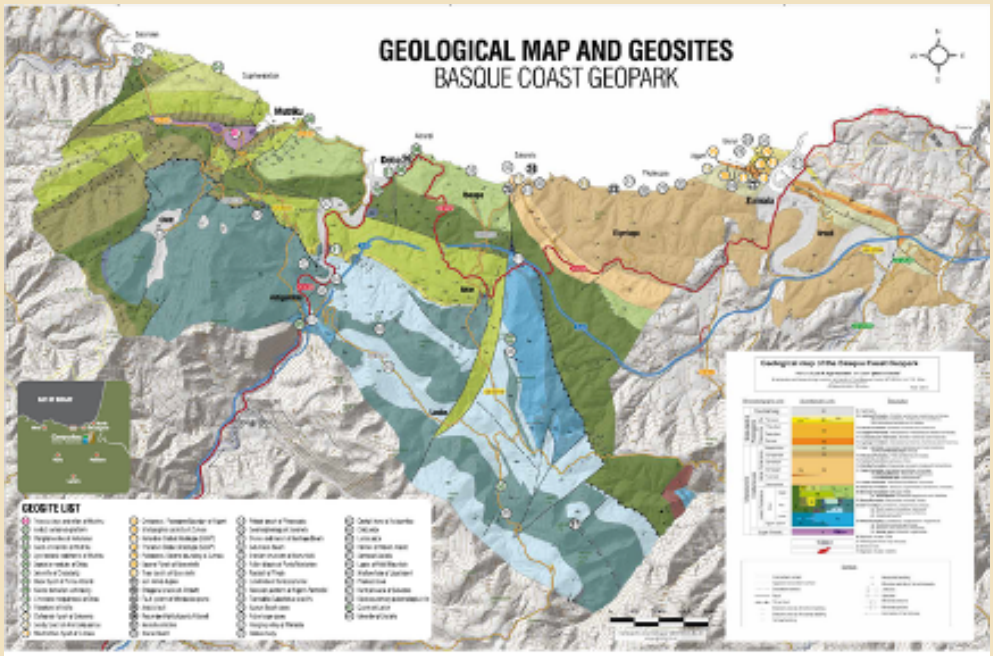


Fig. 2.15. Examples of panels, posters, and maps with geological information oriented to the tourism sector.

In general, the stimulus of the public sector in relation to Geoheritage and the corresponding response of the tourism sector are still scarce. Apart from a demanded budget enlargement, a deep pedagogic effort is clearly required in order to raise society's awareness of the intrinsic value of Geoheritage. It is essential that this activity is carried out by professional specialized in geotourism, both in the public and private sectors. It is similarly essential that the knowledge stimulus and the socio-economic development associated to Geoheritage entail geo-conservation plans.

In that sense, it is worth to mention the case of Iceland, where the relationship between Nature tourism and Geoheritage management is very particular.

In Iceland, the tourism sector represents about 10% of the GDP, and within it, the Nature tourism, preferred by more than 80% of tourists, is clearly the prime business. The beauty of the landscape in Iceland is directly related to its extraordinary Geoheritage value, which indeed, is largely related to its location over the Mid-Atlantic Ridge.

Therefore, it can be affirmed that the geoheritage represents is in Iceland the main economic engine of the tourism sector, and thiss one of the main sectors of the economy. Despite these paradigmatic data, there is no strategic plan to manage and reconcile the incessant tourist activity with the need to protect vulnerable areas. This is especially evident in places where active nature tourism is overcrowded. Here, travel agencies do not exercise any protection over geosites. This Icelandic case, more than any other, exemplifies the need to integrate economic development and conservation.

The GEOTUR Guide shall become familiar with the evolution of the Geodiversity management, in comparison to Biodiversity; with the existing tourism/educational facilities in her/his territory, as well as with some anecdotes related to Geoconservation in other countries.

MODULE 3: Particularities and Situation of the European Geological Heritage

3.1. Geological contextualization of Geosites in European countries.

The increasing societal awareness about the need to define and protect the Geoheritage and the subsequential occurrence of legal frameworks enabling this task, have favoured the emergence of international protection initiatives intended to compile Sites of Geological Interest with international relevance. The first initiative in this regard appeared in 1990. Sponsored by UNESCO and with the collaboration of the IUGS, it was called Global Indicative List of Geological Sites (GILGES).

EXPLANATORY BOX

UNESCO: United Nations Educational, Scientific and Cultural Organization.

It is an United Nations organization founded on November 16, 1945, whose mission is "is to promote international cooperation and understanding in the field of education, social and human sciences, natural sciences, environment, culture, information, communication, informatics and thus contribute to the consolidation of peace throughout the world". UNESCO pursues these objectives through five major programs, each one with a global objective.

PROGRAM	OBJETIVE
Education.	To achieve quality education for all as well as lifelor learning.
Culture.	To promote cultural diversity, intercultural dialogu and a culture of peace.
Natural Sciences.	To mobilize scientific knowledge and policies related science with a view to sustainable development.
Social and Human Sciences.	To address new ethical and social problems.
Communication and Information.	To build integrating knowledge societies usir information and communication.

IUGS (International Union of Geological Science)

This is one of the largest and most active international organizations on Earth. Founded in 1961, the IUGS main objective is to promote the study of geological problems that are of direct interest to society, governments, industry and scientific/academic groups, through international support and interdisciplinary cooperation. The key points currently addressed are the development of international standards, education in geosciences, provision of information on Earth sciences and advice on environmental management and geological risks.

ProGEO: European association for the Conservation of the Geological Heritage

It is an NGO society aimed to promote the protection of important geological sites and landscapes, as well as the diverse heritage of geological features with scientific, educational, tourist and cultural relevance. They try to give geoconservation a stronger voice, and to act as a forum for the discussion of significant nature conservation issues, advising and influencing policy makers. In terms of geoheritage, ProGEO has several achievements. It was a pioneer institution in geoconservation, organised European and regional conferences, is supporting Geoheritage publications, issued in 2012 a book about geological heritage of Europe and it conservation and tried to established criteria for site inventory. ProGEO is an affiliated organization of the IUGS and a member of the IUCN (International Union for Conservation of Nature).

ProGEO´s major objectives are:-

- To promote the conservation of Europe's rich heritage of landscape, rock, fossil and mineral sites.
- To inform a wider public of the importance of this patrimony, and of its relevance to modern society.
- To advise, in our countries and in Europe as a whole, those responsible for protecting our Earth heritage.
- To organise and participate in research into all aspects of planning, science, management and interpretation that are relevant to geoconservation.
- To involve all countries in Europe, exchanging ideas and information in an open forum, and taking a full part in conservation in a global setting, including the formulation of conventions and legislation.
- To work towards an integrated European listing of outstanding geoscience sites, thus enabling full support to be given to the work of other international bodies, as well as to national initiatives towards site protection.
- To achieve an integrated approach to nature conservation, promoting a holistic approach to the conservation of biological and physical phenomena.

This former list, which responded to the UNESCO's attempt to include geology within the World Heritage Program (see Cowie, 1993), failed in lacking a true database. This fact made the geosites very difficult to compare and catalogue, providing more relevance to geosites with high scenic relevance instead of those that best represented the geology of a given place.

The following universal cataloguing project, named GEOSITES, was initially conceived by the IUGS, in 1995, and subsequently supported by UNESCO. Contrary to GILGES, this proposal incorporated a detailed work methodology by which the countries involved were advised to compile a list of internationally recognized sites of special relevance to the geological sciences. This would contribute to the promotion of geosciences at an international level, as well as to the conservation of geological resources for scientific and educational purposes.

The GEOSITES project was managed by the Global Geosites Working Group (GGWG), whose major terms of reference were:

1- To compile the Global Geosites list.
2- To construct the Geosites database of key sites and terrains.
3- To use the Geosites inventory to further the cause of geoconservation and thus support geological science in all its forms.
4- To support regional and/or national initiatives aiming to compile comparative inventories.
5- To participate in and support meetings and workshops that examine site selection criteria, selection methods or conservation of key sites.
6- To assess the scientific merits of sites in collaboration with specialists, research groups, associations, commissions, subcommissions etc.
7- To advise IUGS and UNESCO on the priorities for conservation in the global context, including World Heritage.

The main purpose of GEOSITES was not an inventory of isolated Points of Interest. Inspired by a methodology previously developed by the Great Britain, GEOSITES proposed a selection and cataloguing method based on the previous establishment of “Geological Frameworks”. The selected geosites would not only be sites with high didactic, academic, scientific and geohistoric interest, but the most representative points within each Framework.

The concept of Framework, apart from refers to areas characterized by a specific regional geological context, can also represent certain tectonic, metallogenetic, geochronological, stratigraphic, paleontological, etc. events or contexts. According to the philosophy of GEOSITES, the national proposals should subsequently be compared

with those of other countries located in the same regional geological context in order to identify the geological frameworks that best explain the earth history and the most representative geosites on a global scale.

Many European countries, including the Great Britain, for its inspirational attitude with regard the GEOSITES project, but also Ireland or Spain, have remained faithful to this methodology. With the stimulus of ProGEO these countries defined the Geological Contexts where the geosites were subsequently integrated. See for example the Spanish Geological Context here listed.

1. The Iberian Variscan Orogen.
2. The Lower and Middle Paleozoic stratigraphic successions.
3. The Carboniferous of the Cantabrian Zone.
4. The Iberian Pyrite Belt.
5. Mercury minerals from the region of Almadén .
6. The Rifting of Pangea and the Mesozoic successions of the Betic and Iberian Cordilleras.
7. Lead-Zinc and Urgonian Iron minerals from the Basque-Cantabrian Basin.
8. Continental Mesozoic fossils and ichnofossils.
9. The Cretaceous-Paleogene Boundary (K/Pg).
10. The Synorogenic Sub-Pyrenaic Basins.
11. The olistostrome units of the Betic forelandbasin.
12. The Miocene extension in the Alboran Domain.
13. Neogene and Quaternary volcanism of theIberian Peninsula.
14. Buildings and volcanic morphologies of the Canary Islands.
15. Messinian Evaporitic Episodes.
16. The continental Cenozoic basins and the associated fossil sites of the Spanish Levante.
17. Vertebrate sites of the Spanish Pliocene and Pleistocene.
18. Fluvial network, sediment associated and Apalachian reliefs of the Iberian Massif.
19. The Iberian Peninsula coastline.
20. Karst systems in carbonates and evaporites of the Iberian Peninsula and Balearic Islands.
21. Ophiolitic complexes of the Iberian Peninsula

After more than two decades of continuous activity and the establishment of several national and regional inventories of geosites, the GEOSITES project was abandoned due to budget shortages and lost of consensus about objectives and perspectives.

In 2003, IUGS UNESCO and the International Geological Union (IGU) developed a joint initiative called GEOSEE aimed to promote “activities demonstrating the value of geological heritage and the beauty of landscapes.” It was conceived as an umbrella organization to coordinate and to insert geoscientific knowledge into such activities with a solid geo-scientific base, and to claim a role in geoscience education, culture, communication and sustainable development. The project was closed three year after because it proved to be too ambitious.

Since the completion of the project GLOBAL GEOSITES, and with the brief exception of GEOSEEE, the international impulse to create a unified lists of global geosites with an unique selection protocol has been clearly diminished.

Countries like Italy have classified the geosites according to the major geological disciplines (stratigraphy, palaeontology, geomorphology, etc.), while others, like France, have developed a comprehensive selection system that assesses the geosites according to the geological nature, as well as the degree of vulnerability and specific protection needs.

Although not all countries have followed the same geosite selection system, it is possible to extract natural geological areas or "contexts" common to most of the inventories repeated in which the geosites are grouped. Tue most important "contexts" are:

- Stratigraphic successions associated to a certain time interval:

Fig. 2.16. Armorican Quartzite Succession (Ordovician) from Courel Geopark, Spain

- Tectonic, igneous or metamorphic processes associated with the development of the Cadomian, Caledonian, Variscan or Alpine orogens.

Fig. 2.17. Zumaia Flysch in the Bask Coast, a deposit associated to the Alpine orogeny

- Fossil content

Fig. 2.18. Ammonite rich level in Hate Provence Geopark, France

- Structures and geomorphological processes where karst, and particularly caves, are clearly the most repeated features.

Fig. 2.19. La Nava Polje, Sierras Subbéticas Geopark, Spain

- Processes and events related to the Quaternary Geology, including glaciers, sedimentary deposits and coastal structures.

Fig. 2.20. Monsul beach at Cabo de Gata–Nijar Geopark, Spain

- Singular geological features like specials formations, minerals or types of rock, meteoritic craters, etc.

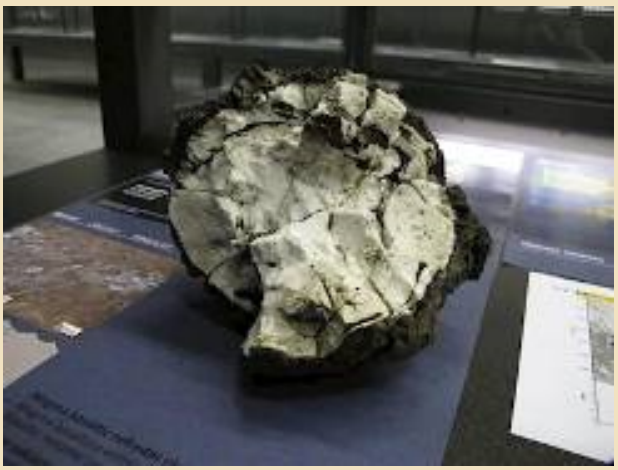


Fig. 2.21. Pyroclast of mixed composition (restingolita) from the 2011 eruptions occurred in front of El Hierro Geopark and exposed at the Barcelona Natural Sciences Museum, Spain.

The evaluation criteria and/or the justifying parameters used for geosites selection differ throughout Europe, even among those countries that adopted the protocols stated by GLOBAL GEOSITES.

In that senses, the Great Britain, a pioneer country in Geoconservation and the inspiring father of GLOBAL GEOSITES, has supported a very practical approach for site inventory and management. Their Geodiversity Action Plans aim to identify geodiversity features in different administrative units, linking them with other values, organisations and institutions concerned in providing solutions to integrate them in development plans. To do this, they developed a geosite assessment process entailing three classification fields that depend on the level of (international) importance, exceptionality or representativeness of the geosites. In detail, these are:

- Sites of international importance for the Geological Sciences.
- Sites of great relevance for presenting exceptional characteristics.
- Sites of national interest for being representative of the geological history of the country.

The other European countries did not followed such subdivision protocol, but most of them have stablished classification and selection criteria (fair or somewhat more veiled) based on representativeness of the geological phenomenon or interval represented, aesthetic characteristics, educational/informative importance, rarity (uniqueness), geological diversity or association with other natural or cultural elements.

Currently, the IUGS International Commission on Geoheritage (ICG), through its Heritage Sites and Collections Subcommission (HSCS) is the international organization in charge of promoting the selection of internationally reputed geosites and developing protocols for their identification.

The HSCS web portal (https://geoheritage-iugs.mnhn.fr) disseminates news and information related to its conservational activity and the development of its projects. One of these projects collects and shows very intuitively the legal and regulatory bases in geoconservation of those countries that collaborate with the Subcommittee. The legal development in most European countries and their implication with this project are particularly noteworthy.

The portal also provides access, via Google Maps, both to the inventory of georeferenced geosites formerly documented with the project GLOBAL GEOSITES and to the official listing of the Global Boundary Stratotype Sections and Points (GSSPs) of the IUGS. More interestingly, the HSCS also develops a project that provides access to the geoheritage inventories eveloped by the countries. Many European countries

already shows their geosites information through this portal, but not all, either because their respective national geosite listings are incomplete or unfinished or simply because they have not agreed to send such information to the HSCS. The centralizing activity carried out by this subcomission is indispensable taking into consideration the disparity of organizations and agencies that are responsible for managing and disseminating the information related to the geological heritage in each country.

3.2.European Geosites and Geoparks

EUROPEAN GEOSITES

Currently, there is no single official list of geosites either internationally or at European level. The former inventory from the GLOBAL GEOSITES Project (https://geoheritage-iugs.mnhn.fr) has an international scope and includes a large number of points within Europe, but it is an outdated list.

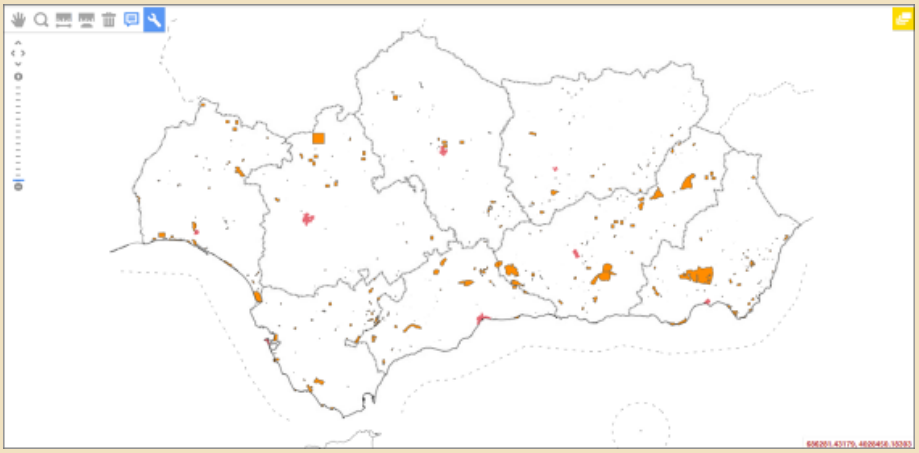
The fact that many countries have based their geosites lists on the protocols stated by the GLOBAL GEOSITES project, while others have developed their own selection and assessment methodologies, make it impossible to establish a single global list. This means that countries are not only responsible of the geoheritage protection, but its diffusion too. In this context, it is noteworthy again the IUGS labour of providing access to numerous national geosite inventories with international relevance.

Apart from the national inventories of geosites with international relevance aforementioned, some countries, as for example the Great Britain, France, or Spain, have developed parallel lists of geosites of national interest. The different assessment categories for geosites, i.e., relevant stratigraphic sections, fossil content, geomorphological processes, etc., are exactly the same used by the different countries for ordering / classifying their geosites with international relevance. The criteria that define the international or national character of each proposal is then related with the evaluation and validation standards specified by each country.

As a rule, these national-level inventories are not accessible from the IUGS portal. Therefore, the organization/s responsible of Geoheritage management in each country are responsible of the geosite list diffusion.

There are even some countries with a third order classification and cataloguing protocol. Regions in Italy, Autonomous Communities in Spain, or Counties in the Great Britain, have developed regional geodiversity management strategies that enable the generation of geosite inventories classified according to their scientific, didactic and tourist interest.

These lists in no way compete with the international or national inventories. At the contrary, they also try to identify and evaluate the geoheritage, at regional scale, in order to formulate appropriate protectionmeasures and promote its geoturistic use, when possible.



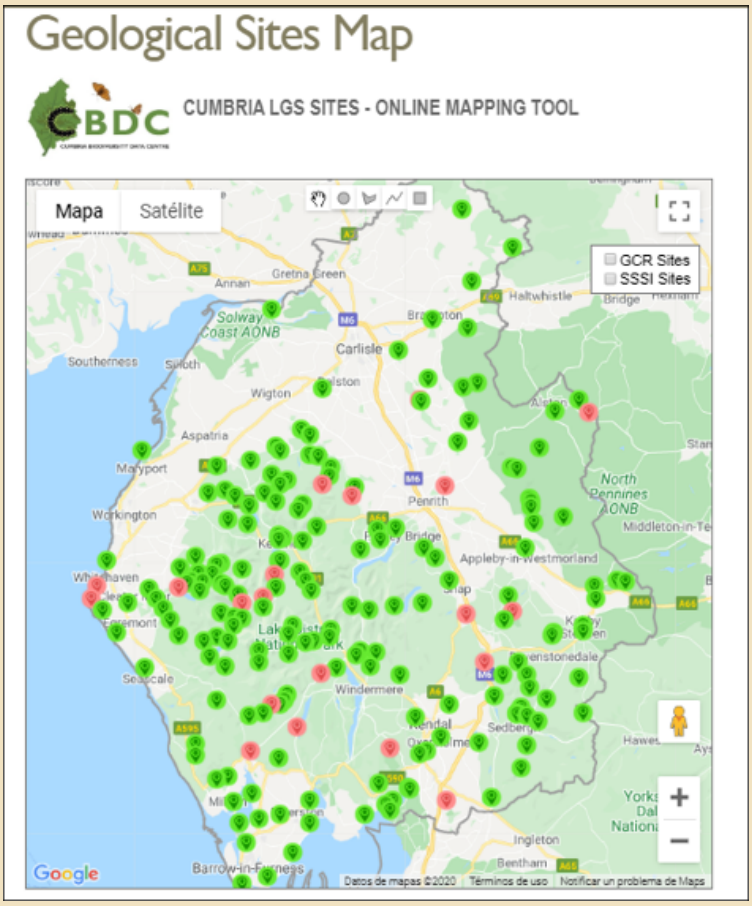


Fig. 2.22. Andalusian inventory of Georesources and Cumbria Local Geological Sites, United Kingdom

EUROPEAN GEOPARKS

Geoparks are territories with a rich geological heritage and an own development strategy. They are geographical areas with well-defined limits and enough space to ensure such development. Although they are not protective figures by themselves, clearly contribute to the protection and promotion of the geological heritage. In fact, they are the territories that most clearly seek to increase awareness of geodiversity and promote best practices in protection, education and nature tourism. Didactic Unit IV, entirely devoted to the figure of Geoparks, provides relevant information on the erection, evolution and achievements of these special territories.

The Case Study on Geoheritage of SIERRAS SUBBETICAS

A) LEGAL BASE AND GEOCONSERVATION

A.1) Legal bases and geoprotection figures applied to the Geopark. bases and protection figures that apply to the geoheritage within your Geopark.

We must state that the territory of Sierras Subbéticas Geopark was declared Natural Park in 1998. In that sense, the entire territory is protected by law (Act 2/1989) and by the Natural Park's management plans (PORN and PRUG). The Regional Government of environment is the same entity that manages the Natural Park and the Geopark. In this sense, all the geological sites are subject to conservation measures and protected by law, in the same way as all the geological sites are integrated in the conservation and management plan. Through these plans, any action undertaken in the Geopark's territory requires authorization.

A.2) Regulatory bases applied to the Geopark.

Two master plans lay down the guidelines for the management of Sierras Subbéticas Natural Park and UGGp: PORN (Plan for the Regulation of Natural Resources); PRUG (Subbéticas Use and Management Strategic Plan). These two documents divide the territory into three categories (areas A, B and C) with different use and exploitation directives.

- Areas A) They are Reserve Zones, the highest level of protection, areas with exceptional environmental values where the management of uses is subordinated to conservation. Public use (hiking, cycling, horseback riding, active tourism), educational activities and scientific research requires authorization. Many geosites are located within Reserve Zones.

- Areas B) They correspond to Special Regulation Zones, i.e., areas of high environmental values with intermediate level of protection. Uses and activities are managed to be compatible with conservation. Public use and educational activities do not require authorization. Scientific research does. Some of the geosites are located in these zones.

- Areas C) The lowest level of protection corresponds to the Common Regulation Zones. They are areas with medium to low environmental values. Uses and activities are managed to enable the use of resources and the recovery of ecosystems. Public use and educational activities do not require authorization. Scientific research does. Very few geosites are located in these zones.

The Case Study on Geoheritage of SIERRAS SUBBETICAS

In the case of caving activities, regardless of the area in which they are located, they are only allowed to federated people belonging to cave clubs because it is understood that they are people with the appropriate training and physical conditions required for this type of activity.

A.3) Examples of geoconservation activities.

There are several activities that are regulated in the Natural Park. The permissiveness of such activities depends on the level of protection of the different areas (A, B or C) as stated above. Some of the regulated activities are:

Agro-livestock and forestry farms activities
Installation of infrastructures
Sport practices
Minerals and fossils collection
Access to particular areas

In detail, the following activities are forbidden in the Reserve Zones (i.e., the most protected areas), where most of the geosites are located:

Vegetation removal
Construction of new infrastructures and buildings
Earthworks
Mining exploitation
Non-scientific collection of minerals and/or fossils

B) GEOSITES

B.1) Geosites where geoturistic and/or educational activities are limited or not allowed.

Climbing and biking are regulated and not allowed in certain areas due to conservation reasons.
Fossils collection is not allowed.
Geosites with very high scientific value are intentionally not publicised.
Access to some other geosites are controlled by permission requests, or, in the case of the Murciélagos Cave, by entrance acquisition.

The Case Study on Geoheritage of SIERRAS SUBBETICAS

B.2) Examples of Geosite's visitors capacity evaluation. The visitor capacity of the geosites in your geopark has ever been evaluated? How it was the evaluation process? Which actors (administration, private stakeholders, researchers, conservationist associations...) were involved in the process?.

Considering that some geosites (like La Nava Polje, for example) suffer excessive tourism pressure during certain dates, there is a study currently underway to evaluate the load capacity of these geosaites in order to establish a daily influx rate. Once this study is completed, it will be submitted for deliberation to the Geopark Committee, the social participatory body with representatives of the administration, private stakeholders, researchers, conservationist associations, etc.

Regarding the Murciélagos Cave, the potential impact of tourism was analysed in 1990, before its opening. This study determined that a regulated touristic activity could be compatible with geoconservation, and recommended at the same time that some areas were excluded from tourist use. Taking in mind that this study was carried out more than 30 year ago and that the number of visitors is constantly wronging, an updating study is required.

B.3) Geopark Geosites inventory.

The geosites from Sierras Subbeticas UGG are listen in four different inventories. There are 4 geosites listed in the International Inventory GEOSITES, 19 in the Andalusian Inventory of Georesources that are also included into the Spanish Inventory of Sites of Geological Interest, and 11 more locally designated. This local list includes also geosites listed in the Andalusian and Spanish inventories.

The differences in terms of conservation depends not on the nature of the inventory but on the level of protection provided by the Natural Park. The differences in promotion depends on the uniqueness and sensitivity of the given geosites. As stated above, some of the international geosites are deliberately not publicized due to their very high scientific value.

The inventories are, almost by definition, active lists. The Andalusian Inventory of Georesources, created in 2004 was updated in 2011. The Spanish Geological Survey provides very detailed information about the procedures and protocols that must be follow to promote potential geosites for evaluation.

The Case Study on Geoheritage of SIERRAS SUBBETICAS

C) MANAGEMENT AND GEOTURISM

C.1) Examples of Geotouristic /didactic activities compatible with conservation.

Example 1: Los Lanchares lapiaz, the Picacho de Cabra peak, the tectonics island of the Picacho de Cabra and the Nava de Cabra Polje are four of the most renowned and visited geosites in Sierras Subbéticas UGGp. To visit the last three geosites it is necessary to go through the first one, Los Lanchares lapiaz, where there is a continuous rehabilitation program covering several quarries developed in the 80s. This is a magnificent example of coexistence of geoturism and rehabilitation.

Example 2: The government of Andalusia sustains up to eleven conservation and recovery programs for threatened species. Some of them, like the plans for recovery and conservation of ghouls, wetland birds, or fish and invertebrates from epicontinental aquatic environments, as well as the plan for protection of high summit species, apply to Sierras Subbéticas. All kind of educational and geoturistic activities in the geopark have to be necessarily coordinated with these plans. This is then an example of coexistence of geoturism and conservation.

C.2) Example of successful collaboration with local touristic stakeholders.

Since 2019, Sierras Subbéticas UGGp organizes, together with local stakeholders from the nature tourist sector, a programme named Winter Geoparks. The aim of this programme, which is also attained in Cabo de Gata-Nijer UGGp, is stimulating the tourism in the territory during the winter season promoting at the same time the geoheritage and geological knowledge of the geopark.

Every winter weekend there is outdoor activity (i.e., hiking, biking, caching) promoted by a different tourism company. Previously, the geopark offer them information and field guidance about the geology and geoheritage of the selected areas.

The Case Study on Geoheritage of SIERRAS SUBBETICAS

D) GEOCONSERVATION AND GEOEDUCATION

D.1) Examples of didactic and educational resources based on geoheritage.

Sierras Subbéticas is enrolled in an educational project called "I am a Geoparker". This project, initiated by Villuercas-Ibores-Jara UGGp in 2017, tries to conform an international network of young students to share fragments of the Earth history with the rest of the world through the geoheritage of each territory. Primary Schools involved in the project promote educative activities linked to their geoparks. The pupils create then histories about people, land, history, culture and geology to be shared afterwards with students from other geoparks. In 2020, after two years enrolled in the project, there are two schools from Sierras Subbbéticas intensively involved on it. These schools found in the educational activities linked to the project a common core to develop actions in common, not only between the different areas of the same centre, but also between the two Schools. This is the real and somehow surprising magnitude of "I am a Geoparker" in Sierras Subbéticas.

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A) LEGAL BASE AND GEOCONSERVATION

A.1) Legal bases and geoprotection figures applied to the Geopark. bases and protection figures that apply to the geoheritage within your Geopark.

The Act No. LIII. of 1996 on Nature Conservation establishes the relevant legal base for the geoheritage preservation in Hungary. This nature conservation law protects the geological assets within protected natural areas of different categories. Beside these, the geological type section localities as geosites are protected, special fossils and minerals are protected without territory, when discovered, at once, ex lege become protected the caves in Hungary.

The Act No. 543/2002 Coll on Nature and Landscape Protection in Slovakia has a focus primarily on biodiversity conservation on protected areas. The preservation of geoheritage found on such designated areas can benefit from this fact. All of the 13 show caves are designated national nature monuments in Slovakia.

On local level municipalities and counties can protect natural areas including geoheritage, on national level regional nature conservation agencies are responsible for the management and protection of natural areas.

Special departments of rural-urban districts of governmental institutions are charged with regulatory authority for the environmental regulations' control and issuing permits.

Within the territory of the N-N Geopark the Bükk National Park Directorate (BNPD) is charged by the management of the geoheritage on the Hungarian and the Cerová vrchovina Protected Landscape Area (CVPLA) on the Slovak side as governmental agencies.

These organizations as stakeholders are represented within the geopark management structure. The geopark administration endorses their work and pulls in NGOs and scientific representatives in the geoheritage preservation of the crossborder geopark.

A.2) Regulatory bases applied to the Geopark.

In a protected area there are some common rules, like it is prohibited to light a fire, not to litter, must not harm or collect natural assets, etc. The environmental

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department of Nograd county's governmental agency is charged with regulatory authority for the protection measures within the Hungarian side of the geopark. Before its decision as a legal expert the Bükk National Park Directorate is asked for its opinion and the authority builds on that. The BNPD has a ranger service builds o**n** that builds on that. The BNPD has a ranger service for law enforcement, there are 7 rangers stationed within the geopark for monitoring natural resources and visitor behaviour within protected sites.

For example there is one ranger permanently stationed at Ipolytarnoc Fossils Nature Conservation Area to control the annual 60 thousand visitors between spring and fall.

There are vulnerable places where there are blocking gates, entrance is controlled, prohibited but for permitted scientific research, visitors' behaviour is monitored there. In some places of fossiliferous outcrops visitors can enter only by guides, people must not leave the trails, their group number is also controlled.

For safety reasons some fenced geosites (like Filakovo Castle hill, Baglyaskő and Ipolytarnóc) during weather extremities and winter time are closed within the geopark.

For biodiversity protection like when nestling of endangered birds of prey or mass migration of amphibians happen some sections got closed, notices got posted.

While crossing some sensitive areas on existing trails authority can control the number of people to attend as a group to less than 20 people at one time.

Unfortunate case when a pandemic breaks out like in the spring of 2020, visitor centres and fenced protected areas got closed in the geopark, during curfew weekends rangers monitored the presence of unwary people at Salgo and Karancs geosites.

A.3) Provide some examples of geoconservation activities regularly carried out by the management body or by any other stakeholder in your Geopark.

Usual activities are when outcrops are cleared from vegetation and debris, rubbish collected from geosites, these actions are carried out by geopark partners, NGOs, volunteers or school classes under the surveillance of nature protection entities.

Such events can be officially organized during special days, like Earth Day. Study trail systems can be maintained such a way too. Serious conservation measures can be made by the experts of the BNPD and the CVPLA, like in the case of petrified trees and other fossils, unstable cliff outcrops or in caves. Excavations and collecting geoheritage material need permissions.

Each year the Slovak part organizes a general meeting for its geopark members (settlements and stakeholders) of the organization. It holds board meetings from time to time and in every 3-4 months consults with the representatives of the Hungarian side of the geopark in order to plan, monitor and manage geoconservation activities within the geopark.

B) GEOSITES

B.1) Geosites where geoturistic and/or educational activities are limited or not allowed.

In A.2) section there are some detailed examples about this, yes, there are geosites, where activities are controlled in many ways and because of many reasons.

For instance in the Slovak part of geopark the main geosites are the Rocks of Belina, Profil of Čakanovce, Reservoir in Gemerský Jablonec, the Sharp Rock and the Šomoška, where the control is very strict, with the 5th degree of protection.

B.2) The visitor capacity of the geosites in your geopark has ever been evaluated? How it was the evaluation process? Which actors (administration, private stakeholders, researchers, conservationist associations...) were involved in the process?.

Most of the geosites within the geopark have not been pressured by geotourism so far, monitoring did not show deterioration of the geoheritage, that is why identifying and implementing visitor capacity has not been made.

On the Slovak side the geosites where tickets are taken and there is an entrance fee are evaluated. In the future, we plan to survey the geosites with a photo trap trail camera.

At geosites, which maintain visitor centres and have organized guiding tours the visitor capacity (as a component of visitor use management) is evaluated by surveys and monitoring. For example at Ipolytarnoc Fossils by the staff and experts of the BNPD, where the main analysis area was determined to be the narrow segment of the geological trail, where the visitor perception of crowding and the real visitor density was studied.

A threshold was identified for the number of visitors within a guided group, if the number exceeds it an extra, previously not scheduled guided tour is introduced.

B.3) Are the geosites in your geopark listed in different inventories? Is there any difference in terms of regulation, conservation or promotion? Is it possible to update the list on the basis of societal or administration proposal? How often is the list updated?.

The geosites on the Hungarian side are classified by different inventories of different organizations for scientific, geotourism and protection priorities. These lists can be updated due to new discoveries or deterioration and can be reclassified.
In Slovakia they update the geosite inventories every year. They are classified into 5 groups according to the degree of protection.

C) MANAGEMENT AND GEOTURISM

C.1) Examples of Geotouristic /didactic activities compatible with conservation.

The geopark stakeholders usually maintain the geosites with money from projects by entrepreneurs or by their own staff members, involving volunteers. In education, the geopark management organizes science competitions based on the geoheritage several times a year for the Slovak and Hungarian schools. In summer, children have opportunity to participate in Summer Camps, when they.

Volunteers and NGOs can participate in the maintenance of geosites, like in the case on this Earth Day, where the TETT Foundation NGO staff members collected rubbish at the Nogradszakal geosite, then cleaned the interpretation panels at the site's geotrail and as a final act got educated about the geoheritage there by the inspector geologist ranger of the BNPD.

C.2) The Geopark is committed to promote the economic development for the benefit of local people. Provide an example of successful collaboration with local touristic stakeholders.

The Slovak part of geopark successfully cooperate with 24 settlements and with 3 restaurants.

At the visitor centres local products and produce are sold, rural accommodation is advertised on the website of the geopark, tourism database has been collected and updated with collaboration of TDM.

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Geopark events and markets are organized for local craftsmen, the geopark management provides forum for local entrepreneurs, common development projects widen local geotourism offers.

The BNPD created a multilingual GUIDE@HAND mobile application for several platforms, which provides local tourism information beside the tracks of thematic nature trails and attractions, several stakeholders contributed to this smartphone's database. There is a strong cooperation among local museums, religious pilgrimage centers and nature conservation organizations to increase the tourism nights spent within the geopark by establishing shared visitor offers.

D) GEOCONSERVATION AND GEOEDUCATION

D.1) Examples of didactic and educational resources based on geoheritage.

The Slovak partner tries to help in education with workbooks, manuals and board games. Sometimes it takes schools on a trip in the Geopark to see what was learned.

Several educational materials were created and distributed among schools of the geopark's settlements. Nature conservation stakeholders provided training to geopark ambassadors. Scientific literature on geoheritage of the geopark was digitalized and made available free of charge.

New exhibitions, movie and high-tech interpretation methods of the BNPD provide insight to the Miocene epoch of the geopark.