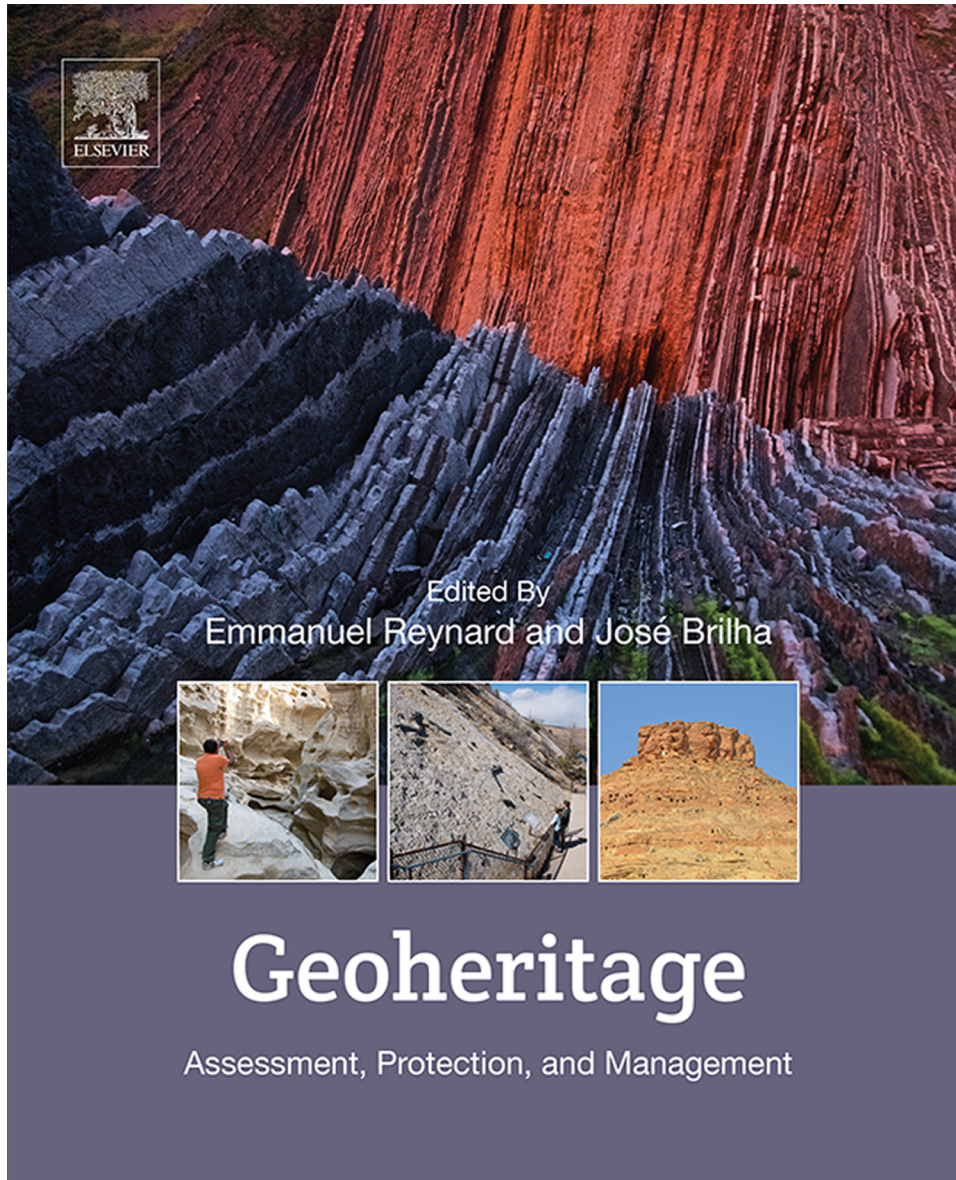


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GEOHERITAGE: A MULTIDISCIPLINARY AND APPLIED RESEARCH TOPIC

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TWENTY-FIVE YEARS OF DEVELOPMENT

For the last 25 years, since the International Conference on the Protection of Geological Heritage organised in Digne-les-Bains, France, in 1991 (Martini, 1994), there has been a growing scientific interest in topics related to geoheritage (geoconservation, geotourism, geoparks) and a large set of territorial initiatives have emerged all around the world.

The development of geoconservation – i.e., the policies, methods and actions aiming at conserving geoheritage, both *in situ* (geosites, geodiversity sites; Brilha, 2016) and *ex situ* (e.g., collections in museums) – is very differentiated, both temporally and spatially. Some countries or regions (e.g., the United Kingdom, Tasmania) have developed articulated policies and taken concrete measures to protect their geoheritage for more than 20 years, whereas in the vast majority of countries it is only very recently that the interest of political authorities for geoheritage has emerged, and the geoheritage is not or only very partially protected. However, the situation has evolved considerably and even if much remains to be done in order to better protect geoheritage throughout the world, there are indicators that actions carried out up to now are beginning to give results.

In 1992, at the Earth Summit in Rio de Janeiro, geoheritage was not one of the central issues that were debated. Throughout the 350 pages and the 40 chapters of the Agenda 21 (United Nations, 1992), the terms ‘geoheritage’, ‘geodiversity’ or ‘geoconservation’ are never used and a reference to geology only appears in three pages: in chapter 9, in objective 9.7, which requires an improvement in the understanding of the relationship between land and atmospheric processes; in chapter 10, which states that land resources, including geological resources, should be managed in an integrated manner; and finally, in chapter 22, where a measure requires investigations to be carried out to improve the deposition of radioactive material. Section 2 (Conservation and management of resources for development) contains the 14 chapters dealing with terrestrial resources; it focuses mainly on biological resources (five chapters) and on pollution and waste (five chapters). Some special environments (mountains, oceans) are also discussed. As for the three conventions arising from the Earth Summit (biological diversity, climate change, desertification control), none explicitly refer to the geological heritage.

The Millennium Declaration (United Nations, 2000), the aim of which is to enhance human dignity, equality and equity, does not put any emphasis on geoheritage. Nevertheless, georesources are

placed on the same level as living species – ‘prudence must be shown in the management of all living species and natural resources’ – even if in the section dedicated to the protection of the environment, the four articles do not mention the protection of geological resources. In 2015, United Nations member countries adopted the 17 Sustainable Development Goals ‘to transform our world’ at the 2030 horizon (United Nations, 2015). Geoheritage and the protection of geological resources are still not mentioned among the goals and the related indicators, but georesources are put at the same level with other natural resources of the planet (articles 3, 9, 33). Unfortunately, none of the 17 Sustainable Development Goals treats specifically of georesources, but Goal 12.2 aims ‘to achieve the sustainable management use of natural resources’; indirectly geological features are considered.

In the area of tourism, the World Tourism Organisation – the specialised organisation of United Nations for tourism issues – has promoted ecotourism and sustainable tourism since the 1990s. In 2012, a resolution on the ‘Promotion of ecotourism for poverty eradication and environment protection’ was adopted by the Second Committee of the United Nations General Assembly, and 2 years later the General Assembly adopted the resolution ‘Promotion of sustainable tourism, including ecotourism, for poverty eradication and environment protection’ (resolution A/RES/69/233) (United Nations, 2014). These documents promote the development of sustainable forms of tourism respecting the environment and local societies. These resolutions do not concern specifically geotourism but may include the development of geotourism within the context of sustainable tourism, as was the case of the 2017 International Year of Sustainable Tourism for Development (www.tourism4development2017.org, accessed 12.08.17).

Geoheritage issues are not at the core of the political agenda of the United Nations as are biodiversity conservation or climate change issues. Nevertheless, both at the International Union for Conservation of Nature (IUCN) and UNESCO levels, there have been recently several improvements that have put geoheritage and geodiversity issues on the agenda of these two important international institutions.

After decades of focus on the protection of biological heritage, IUCN has recognised recently the importance of geological features as integral parts of nature at the same level as biological elements (Crofts et al., 2015; Larwood et al., 2013), and in 2014 it established a Geoheritage Specialist Group within the World Commission on Protected Areas (WCPA) (Woo, 2017). This group follows four main objectives: (1) to establish Best Practice Guidelines for geoheritage management in protected areas; (2) to revise the IUCN study on volcanic sites of outstanding values (Wood, 2009); (3) to revise criterion (viii) for World Heritage recognition; and (4) to initiate a ‘Key Geoheritage Site’ concept.

Initiated in 2000 by four geoparks in four European countries (France, Germany, Greece and Spain), the idea that sustainable territorial development could emerge from the protection and enhancement of the geological heritage was recognised in November 2015 by UNESCO with the creation of the International Geoscience and Geoparks Programme. Now 127 territories in various parts of the world – mainly in Europe and China – are designated by UNESCO and are part of the Global Geoparks Network. Initiatives for the development of new geoparks abound, in particular in developing countries.

It is clearly that the main improvements on geoheritage and geoconservation have been made within scientific circles. Created in 1993, ProGEO – The European Association for the Conservation of the Geological Heritage – is one of the key organisations that has organised tens of seminars, conferences and symposia aimed at improving knowledge and experience exchanges

concerning geoconservation. One main achievement was the launch of the journal *Geoheritage* in 2009, where now most of the innovative research on geoheritage, geoconservation and geotourism is published. ProGEO has also published a synthesis on geoheritage and geoconservation in Europe (Wimbledon and Smith-Meyer, 2012). Specialised associations have also developed activities towards a better comprehension of geoheritage. Examples are the International Association of Geomorphologists, which created in 2001 a specific working group focussing on geomorphological heritage (Reynard and Coratza, 2013); the International Commission on Stratigraphy (ICS), which defines Global Stratotype Sections and Points (GSSPs) at the global level (see Finney and Hilario, 2018); or the International Palaeontological Association (IPA), which has established the PaleoParks Initiative to 'protect endangered sites and to catalog and make public information concerning established parks of any nature that protect fossils in the ground' (Lipps, 2009). Also the International Union of Geological Sciences (IUGS) has recently reactivated its activities on geoheritage initiated in the late 1980s, namely with the establishment in 2016 of the International Commission on Geoheritage.

This intense scientific activity has given rise to numerous publications in the journal *Geoheritage* and in thematic volumes of geoscience journals. Several books have been published. Murray Gray published *Geodiversity: Valuing and Conserving Abiotic Nature* in 2004, with a second edition in 2013 (Gray, 2004, 2013). Geotourism issues were addressed, e.g., by Dowling and Newsome (2006), Newsome and Dowling (2010), and Hose (2016a). Megerle (2006) published a synthesis book for the German-speaking community. Disciplinary books dealing with geoheritage were also published. This is the case of *Geomorphosites*, which addresses specific issues concerning geomorphological heritage (Reynard et al., 2009). Geomorphological heritage is also addressed in the series *World Geomorphological Landscapes of the World* (Migoñ, 2010; www.springer.com/series/10852, accessed 12.08.17). Syntheses on the state of geoheritage and geoconservation at the national level have been published in several countries; at the continental scale, it is worth citing *Geoheritage in Europe and its Conservation* (Wimbledon and Smith-Meyer, 2012). The history of the geoconservation movement was addressed in a special issue of the Geological Society of London (Burek and Prosser, 2008), and in 2016, the Geological Society published a synthesis on the history of geotourism (Hose, 2016b). Nevertheless, a specific comprehensive book on geoheritage, addressing various methodological and management issues concerning geoheritage was missing. It is the aim of this book to fill that gap.

OBJECTIVES OF THE BOOK

The book wants to show the state of the art concerning geoheritage in three domains, corresponding to the three keywords in the title: assessment, protection and management.

ASSESSMENT

A large part of the research carried out during the last 25 years has been dedicated to the selection, inventory, assessment and characterisation of geoheritage sites. Studies have been made on various scales (from regional to international initiatives), with various extents (whole geoheritage but also specific development in some Earth science disciplines, e.g., geomorphology, palaeontology, mines, etc.) and within various frameworks (research institutes, national parks, geoparks, etc.). The aim of

the book is to address conceptual and definition issues concerning geoheritage and geodiversity, and methodological issues concerning selection, inventory, assessment, and cartography of geosites.

PROTECTION

Protection of geoheritage is not a new trend but a renewed evolution of several initiatives going back almost to the 19th century, but not coordinated at the international level. In the 1990s, several proposals emerged both at regional (e.g., Tasmania, see [Sharples, 1995](#)), national (e.g., the Regionally Important Geological/geomorphological Sites (RIGS) in the United Kingdom), and international ([Martini, 1994](#)) levels. In the 2000s, the geopark initiative has been the catalyser of geoconservation, which became a territorial issue. The 2010s are the years of the recognition of geoheritage by the conservationist movement (IUCN, UNESCO), even if much work remains to be carried out to fully recognise geoheritage at the same level as other types of heritage (biological, cultural). The book aims to document the recent history of geoconservation and to address specific issues on the protection of geosites.

MANAGEMENT

Geoheritage is not only a scientific question. Selected and inventoried sites have to be managed, enhanced and monitored. Geosite and geopark managers face several challenges: protection *versus* exploitation of geosites; differences in management of *in situ* and *ex situ* geoheritage; integration with side fields of geoheritage, such as interpretation or geotourism. Moreover, with the development of the interest for geoheritage, there has been a widening of interested actors. Currently almost seven main groups of actors are dealing with geoheritage issues: (1) scientists, Earth science specialists; (2) policymakers; (3) planners; (4) conservationists (cultural heritage and nature conservationists); (5) specialists in tourism (and geotourism); (6) teachers; and (7) the public and society in general. All these actors have different objectives, strategies and perceptions of geoheritage, and there is a need for coordination. One aim of the book is to present experiences (action plans, monitoring experiences, interpretation, etc.) carried out on various scales and in different contexts – both geographical and disciplinary – that tend towards the sustainable management of geoheritage.

ORGANISATION OF THE BOOK

The book is organised into five sections.

Section 1 concerns *geodiversity*. The first chapter, by Murray Gray, shows that geodiversity is the backbone of geoheritage and geoconservation. In Chapter 2, Zbigniew Zwoliński and coauthors propose a typology of various approaches and methods developed during the last decade to assess and map geodiversity at various scales. The third chapter is oriented towards management. Lesley Dunlop and her colleagues present an instrument – the Geodiversity Action Plans – developed in the United Kingdom to manage geodiversity at various levels (local to national) and in various contexts (territories, but also companies), a tool that could be easily transferred to other contexts.

Section 2 deals with *geoheritage*. It is organised into seven chapters. First, José Brilha presents an overview of inventorying and assessment issues, and proposes an integrative approach that could guide any work of evaluation and inventory of geoheritage. In Chapters 5 and 6, Paola Coratza and Fabien Hobléa on one hand and Kevin N. Page on the other hand focus on the specificities of two categories of geosites: geomorphological and palaeontological sites, respectively. Geomorphological heritage has to deal with aesthetic, scale and process dynamic issues, whereas the management of palaeontological heritage is facing the question of the economic value of geosites (fossil selling). In Chapter 7, Patrick De Wever and Michel Guiraud address the management issues of a specific type of geoheritage: collections stored in museums. Chapter 8 is written by Emmanuel Reynard and Christian Giusti and discusses the landscape and the cultural value of geoheritage. They stress the fact that considering a geological element (structure, fossil, mineral, landform) as geoheritage is clearly the result of a social process. Chapter 9 concerns mining heritage: Josep Mata Perelló and his coauthors show that mining heritage is at the interface between geoheritage (georesource) and cultural heritage (mining infrastructure); they also stress that reconversion of former mining areas as tourist attraction can be a way to support the economic transition in regions where most of the economy was depending on the exploitation of the mines. In Chapter 10, Stannley C. Finney and Asier Hilario analyse the relationships between geoheritage and geological time. They develop management issues concerning the Global Stratotype Section and Point (GSSP) initiative.

Section 3 addresses the challenges of the *conservation of geoheritage*. It is divided into four chapters. Chapter 11, by Colin D. Prosser and colleagues discusses principles of geoconservation and proposes a 'Generic Geosite Conservation Framework' to guide conservation activities. In Chapter 12, John E. Gordon and his coauthors discuss the integration of geoconservation in environmental policies, with both a historical perspective and a prospective view that proposes four main axes of development. Chapter 13 is dedicated to the links between geoheritage and the World Heritage List; Piotr Migoń discusses in particular the question of the 'outstanding universal value' in the field of geoheritage. Finally, in Chapter 14, Viola Maria Bruschi and Paola Coratza propose a synthesis of the challenges concerning the assessment of impacts of human activities and infrastructures on geoheritage, and the question of the integration of geoheritage with other components of the environment within Environmental Impact Assessment (EIA) procedures.

Section 4 deals with the question of the *uses of geoheritage*. In Chapter 15, John Macadam proposes a reflection on the issues geoscientists face when they want to disseminate Earth science knowledge towards nonspecialist publics. In the next chapter, Nathalie Cayla and Simon Martin discuss the value of digital technologies and visualisation tools for the management and dissemination of knowledge about geoheritage. Chapter 17 analyses the relationships between geoheritage management and geotourism. David Newsome and Ross Dowling show that geotourism may have either positive (beneficial) or negative (adverse) impacts on geoheritage. The section is concluded by a synthesis chapter on geoparks written by José Brilha, who stress that geoheritage is the core resource for geoparks and that it should be properly identified, assessed, conserved and managed.

Section 5 is dedicated to six short *case studies*. They cover several geographical realities in five continents as well as various management issues. In Chapter 19, based on the example of Ethiopia, Asfawossen Asrat addresses the challenges faced by developing countries in the management of their geoheritage. Chris Sharples and his coauthors propose, in Chapter 20, a synthesis of the actions developed by Tasmanian authorities (Australia) for managing geosites and geodiversity in coordination with the exploitation of the territory, in particular forest management. In Chapter 21,

Kyung Sik Woo and Lyoun Kim analyse the policy and the inventory tools developed to manage and protect caves in South Korea. Chapter 22, by Herbert W. Meyer, presents the case of Florissant Fossil Beds National Monument (USA); it demonstrates a multifaceted approach developed to ensure effective geoh heritage management. Another example of management at the local scale is presented by Gilson Burigo Guimarães and coauthors in Chapter 23: the Varvite Park, a Geological Monument in São Paulo State (Brazil). Finally, in Chapter 24, Andrés Díez-Herrero and his colleagues present a monitoring programme that was developed in two geosites in Spain to help their management.

In the *concluding chapter*, José Brilha and Emmanuel Reynard propose a personal perspective about the main challenges that should be addressed by international agencies and the scientific community, national administrations and local actors to manage geoh heritage on various scales (international, national and local) in the future decades.

It is certainly by combining these multiple approaches and by strengthening political lobbying by the members of the geoconservationist ‘community’ that geoh heritage will be fully recognised as a resource worthy of being conserved and transmitted to future generations.

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