Geoevents, Geological Heritage, and the Role of the IGCP

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ABSTRACT BOOK
LIBRO DE RESUMENES
GEOCONSERVATION IN PORTUGAL: AN UPDATED PERSPECTIVE ABOUT GEOSITES INVENTORY, LEGAL SETTING, CONSERVATION AND EDUCATIONAL ISSUES

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Introduction

The first references about the necessity to protect sites with geological relevance date back from the beginning of the 20th century (Brilha 2005; Brilha 2009; Brilha & Galopim de Carvalho, 2010; Ramalho 2004). However, these were isolated efforts with no practical consequences for their conservation. It was only during the eighties that more effective initiatives took place, mainly conducted by the National Natural History Museum and by the Geological Survey. During the last decade, geoconservation in Portugal has started increasing in importance, and become more apparent in different domains. A not small part of this successful approach is due to a more aware geological community working together under the scope of the national ProGEO group created in 2000. Slowly, geoconservation issues are being recognized by different sectors of Portuguese society, including politicians, teachers, park managers, geologists, and so on. Nevertheless, geoconservationists still battle for the real involvement of state institutions related with nature conservation and land-use management. This paper aims to present a brief updated status of Portuguese geoconservation, emphasizing the geosites inventory, the legal setting, educational issues and main initiatives.

Legal setting

During the last forty years Portugal has implemented several laws supporting nature conservation denoting, not only a significant evolution of national policies, but also the need to integrate international and European legislation into the national legal framework.

Showing a significant delay compared with other European countries, Portugal published its first nature conservation law in 1970, the European Year of Nature Conservation. One year later, the first protected area was created – the Peneda-Gerês National Park – about one century after the establishment of the Yellowstone National Park, considered the first national park in the world.

Even so, the Portuguese environmental legislation began to include geoconservation principles only in 2000 (Brilha, 2010). The National Strategy of Nature Conservation and Biodiversity (2001) identifies the need to increase knowledge, conservation and interpretation of geological heritage. Also, the Land Use Policy National Program (2007) recommends direct action for the characterization and classification of geological heritage.

But the really important legislation for geoconservation is the newest law on Nature Conservation and Biodiversity (2008). Following ProGEO-Portugal proposals, for the very first time “geosite” and “geological heritage” are correctly defined and their conservation justified as one of the aims for the management of protected areas. Damaging geosites inside protected areas is now considered an illegal action, subject to penalty. In the Azores and Madeira Archipelagos there is also appropriate legislation for the conservation of geosites.

As in many other countries, fossils are considered a cultural heritage and therefore are also
protected under the respective law. Finally, the European Landscape Convention, the Natura 2000 Network and the National Ecological Network regulations achieve indirect geosites protection.

**National initiatives**

Geosites inventory

Previous knowledge about Portuguese geological heritage was dispersed and uncompleted justifying the urgent establishment of a geoconservation strategy by the geological community. This was the main reason why a working group comprising geoscientists from twelve Portuguese institutions launched, and is now concluding, a three-year project aimed at the identification, classification and conservation of the most relevant geosites by Portuguese authorities (Brilha et al., 2008). Amongst the different outcomes expected for this project (sponsored by the national science agency) the following are emphasized: i) an on-line database of the geosites representative of the Portuguese geological frameworks; ii) legislative proposals focusing on geoconservation; iii) an inventory of the most important Portuguese geosites to be submitted to national authorities, requesting their classification and integration into the National Network of Protected Areas; iv) scientific cooperation between Portuguese and Spanish geoconservationists for the identification of geosites with Iberian relevance, according to the methodology proposed by ProGEO and IUGS. This ongoing project will also deliver some public outreach outcomes, namely: i) fieldtrips, conferences, brochures for non-specialists and a web-site; ii) lifelong learning actions on geoconservation addressed to secondary school teachers; iii) report on geoconservation and geotourism to be submitted to all national authorities involved in nature conservation, land-use planning and tourism; iv) illustrated book about the Portuguese geological heritage.

The first aim of this geoconservation strategy is completed with the definition of the frameworks representing the most important geological features in Portugal and covering the different types of geoheritage, e.g. palaeontological, petrological, geomorphological, tectonic or stratigraphic heritage. Twenty-seven frameworks were defined, according to their scientific value, at both national and international level, resulting from a discussion forum within the working group: Neoproterozoic-Cambrian Metasediments in Central-Iberian Zone; Palaeozoic Marbles of the Ossa-Morena Zone; Ordovician of Central Iberian Zone; Paleozoic (Ordovician to Lower Devonian) succession of the Barrancos region; Exotic Terranes of NE Portugal; Geotraverse of the Portuguese Variscan Fold Belt; Geology and metallogenesis of Iberian Pyrite Belt; Marine Carboniferous of the South Portuguese Zone; Continental Carboniferous; Pre-Mesozoic granitooids; The Iberian W-Sn Metallocenic Province; Gold mineralization in North Portugal; Meso-Cenozoic tectonic evolution of the West Iberian Margin; Late Triassic SW Iberian rupture of the Pangea; Jurassic record in the Lusitanian Basin; Cretaceous rocks of the Lusitanian Basin; Dinosaur footprints of western Iberia; Meso-Cenozoic of the Algarve; Cenozoic basins of the western Iberian margin; Landforms and river network of the Portuguese Iberian Massif; Karst systems of Portugal; Active and fossil coastal cliffs; Low coasts of Portugal; Neotectonics in mainland Portugal; Glacial and periglacial landforms and sediments; Volcanism of the Azores Archipelago in the America-Eurasia-Africa triple junction; Volcanism of the Madeira Archipelago. The geological frameworks with international relevance were defined in a previous work (Brilha et al., 2005) and have been reconsidered and included in this approach.

This inventory aims to be the most complete and updated information about the Portuguese geological heritage, including the list of the most relevant geosites for scientific, educational and tourism uses, and sorted according to their importance and need for conservation. As it is aimed
to be the background for a national policy for geoconservation and for the acceptance of geoheritage issues in nature conservation and land-use strategies, it is also expected that this work will contribute to the enhancement of public awareness on geological heritage as an important natural resource with major strategic importance for every country.

The scientific characterization of each framework is also now complete, with the identification of the most representative geosites, which were proposed by about seventy geoscientists with expertise in each geological context. So far, more than three hundred geosites have been identified and characterized.

At Azores Archipelago, the Working Group on Volcanic Caves of Azores (GESPEA), created in 2002 by the Regional Government joining experts from the local university and NGOs, is responsible for the inventory of volcanic caves in the territory. Almost 300 caves are included in the Azorean Speleological Inventory database. The inventory of other geosites located inside Azorean protected areas is also complete (Lima, 2007); 59 geosites were identified, most of them with national and international scientific relevance. Regarding the Madeira Archipelago, its geological heritage is presently under study, promoted by a Regional Government initiative. So far, more than one hundred geosites have been already recorded.

Geosite conservation

Protected areas

The protected areas network covers about 8% of the surface of Portugal’s mainland. At the present time, there are 32 protected areas with national relevance and managed by the INCB: one National Park, nine Natural Reserves, thirteen Natural Parks, two Protected Landscapes and seven Natural Monuments. The autonomous regions of Azores and Madeira hold special legislation and consequently the protected areas on these archipelagos have a slightly different categorization. Moreover, about 20% of the Portuguese territory is included in the Natura 2000 Network.

The seven referred Natural Monuments have been designated according to their geological features. Dinosaur footprints at Ourém, Careneque, Lagosteiros, Pedra da Mua, and Pedreira do Avelino Natural Monuments; Jurassic sedimentary record of worldwide significance for Cabo Mondego Natural Monument; and Ordovician quartzite ridges for Portas de Ródão Natural Monument. Also the Protected Landscape of the Fossil Cliff of Costa da Caparica was created for geomorphological reasons. Many other protected areas display interesting geological features but, in most cases, they are not included in the management plans or conservation projects (Pereira et al., 2010).

Geoconservation Award

Taking into account that some Portuguese municipalities are very active in geoconservation, the ProGEO national group implemented in 2004 the Geoconservation Award (GA) addressed to local administrations. This symbolic award aims: i) to recognise the best practices of geoconservation promoted by municipalities; ii) to foster discussion on the need for geological heritage protection; iii) to encourage municipalities to adopt strategies and procedures on geosites; iv) to raise awareness within society about the need for integration of geological heritage in nature conservation and land-use policies; and v) to promote geology in the media agenda.

Main established criteria to give the award to a municipality are based on the following actions: i) geosite inventorying and corresponding scientific support; ii) implementation of geosite conservation actions; and iii) valuing and interpretation strategies. Seven municipalities have already received the award. The “Natureza e Tejo” Municipalities Association (2007) and the
Arouca Municipality (2008) were recognized for their initiatives related with the creation of geoparks. Idanha-a-Nova Municipality (2004) was given the award after the implementation of geoconservation initiatives at Penha Garcia, a well-known geosite for its paleontological relevance. Valongo Municipality (2005) received the GA for the creation of a municipal park (Valongo Paleozoic Park) where the occurrence of trilobite fossils with high scientific value co-exists with remains of Roman mining works. Cantanhede Municipality (2006) was rewarded for the “Stone Museum”, an interpretation centre devoted to all aspects related with limestone (science, geological heritage, uses, etc.). Porto Municipality received this distinction in 2009 for the conservation and interpretation facilities of the urban geosite “Foz do Douro Metamorphic Complex”. Finally, Alcanena Municipality was given the 2010 award for “Carsoscópio”, an interpretative centre dedicated to the karst and to the preservation of hydrogeological heritage.

**Education and training**

One of the most remarkable aspects of Portuguese geoconservation is related to educational issues (Henriques, 2010). The secondary school curriculum integrates the concepts of geosite and geological heritage in the Geology course. In several universities, undergraduate degrees in Geology, Geography and Biology have also some modules on geoconservation. At the University of Minho, a Masters course on Geological Heritage and Geoconservation has been available since 2005 (Pereira et al., 2008). In other universities, master courses on Geology and Geography offer optional geoconservation modules. PhD theses related with geoheritage are also being produced pushing forward the research in such domains.

Contacts with the general public are also promoted. Presently, several educational and interpretation facilities are available in Portugal (table 1), despite the fact that, for some of them, the links with geoconservation are not clearly expressed. During the last 10 years, the “Geology in the summer” programmes, supported by the Ministry of Science and involving geologists from all over the country, organize hundreds of field trips for the general public.

**Geoparks and geotourism**

As in many other countries, geoparks are not clearly defined in the Portuguese legal framework. Nevertheless, the recent law on Nature Conservation and Biodiversity acknowledges areas that are recognized by international institutions such as UNESCO (Man and Biosphere areas, Ramsar areas, geoparks, etc), which is already a good starting point for a future official definition.

In 2003, Portugal started the process to create its first geopark. The Naturtejo Geopark was later integrated in the European and Global Geopark Networks (2006), being one of the largest geoparks in Europe. By mid-2009, the Arouca Geopark was the second Portuguese geopark to enter the networks; following preparatory work started three years before. Presently, new geoparks are being created, namely the Azores Geopark, under the leadership of the Secretary of Environment of the Azorean Regional Government (Nunes et al., 2009) and the Porto Santo Geopark in the Madeira Archipelago (under the direction of the respective municipality) (Cachão & Dias, 2008), both with the support of national universities, Naturtejo and Arouca Geoparks and the National Commission of UNESCO.

In spite of the numerous geosites with aesthetic appeal, geotourism in Portugal is not yet fully developed requiring further involvement of the official entities linked with tourism promotion and development (Pereira, 2010). Nevertheless, there are already some relevant touristic initiatives concerning the promotion of mining heritage based on inactive quarries and mines (for example, Brandão, 2004; Cordeiro, 2010; Falé et al., 2008; Matos & Martins, 2003; Matos et al., 2008).
Table 1 – Portuguese educational and interpretational facilities, directly and indirectly, related with geological heritage. *Presently under reorganisation.

<table>
<thead>
<tr>
<th>Facilities</th>
<th>Location</th>
<th>Theme</th>
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<tbody>
<tr>
<td>Algar do Carvão</td>
<td>Terceira island (Açores)</td>
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<td>Algar do Pena</td>
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<td>Karstic caves</td>
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<tr>
<td>Carsoscópio (Ciência Viva Centre of Alviela)</td>
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<td>Karst features</td>
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<td>São Vicente (Madeira)</td>
<td>Volcanology</td>
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<tr>
<td>Cova dos Mouros Mining Park</td>
<td>Alcoutim</td>
<td>Mining</td>
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<tr>
<td>Ciência Viva Centre of Estremoz</td>
<td>Estremoz</td>
<td>Geology</td>
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<tr>
<td>Geological Interpretation Centre of Canelas</td>
<td>Arouca</td>
<td>Giant trilobite fossils</td>
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<td>Geological Museum</td>
<td>Lisboa (Geological Survey)</td>
<td>Mineral, rock and fossil</td>
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<tr>
<td>Geological Museum</td>
<td>Vila Real (University of Trás-os-Montes</td>
<td>Mineral, rock and fossil</td>
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<td>Geological Museum</td>
<td>e Alto Douro)</td>
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<td>Interpretation Centre of Capelinhos Volcano</td>
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<td>Interpretative Centre of Foz do Douro Geological Trail</td>
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<td>Iron Museum</td>
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<td>Lourinhã</td>
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<td>Machado Fagundes Volcanological Museum</td>
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<td>Mineralogical and Geological Museum</td>
<td>Coimbra (University of Coimbra)</td>
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<td>Mountain House</td>
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<td>Volcanology</td>
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<tr>
<td>National Natural History Museum</td>
<td>Lisboa</td>
<td>Mineral, rock and fossil</td>
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<tr>
<td>Natural History Museum*</td>
<td>Porto (University of Porto)</td>
<td>Mineral, rock and fossil</td>
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<tr>
<td>Ourém/Torres Novas Natural Monument</td>
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<td>Volcanological and Geothermal Observatory of Azores</td>
<td>São Miguel island (Açores)</td>
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Final considerations

Little by little geoconservation in Portugal is gaining strength: the geological community is considering this new topic as an applied science with relevance for research and teaching; the legal tools are now more suitable for the protection of geological heritage; students in schools and universities come in contact with relevant concepts; there is specific training for geoconservation
experts; park managers and local politicians are more aware of this subject; and the general public is more receptive to geosciences. All these successful steps are due to the development of collaborative work between experts from different institutions, some of them grouped together under the ProGEO-Portugal structure. Nevertheless, two major goals are still to be fulfilled: i) there is no structured strategy integrating the inventory, conservation, valuing, interpretation, and monitoring of geosites, and ii) there is no proper national institution responsible for the implementation of such geoconservation strategy. At this respect, the first flaw is being taken care of by an ongoing research project; the second one is more difficult to resolve because it is entirely dependent on political decisions.

Note - This paper is an update of the following text previous published: Brilha J. (2009) – Geological Heritage and Geoconservation in Portugal. Proc. 8th European Geoparks Conference, New Challenges with Geotourism, C. Neto de Carvalho & J. Rodrigues (Eds.), Idanha-a-Nova Municipality / Naturtejo Geopark, Portugal, 31-35. Both works are sponsored by the Fundação para a Ciência e a Tecnologia (Portugal), under the scope of the Centro de Geologia da Universidade do Porto and the research project “Identification, characterisation and conservation of geological heritage: a geoconservation strategy for Portugal” (PTDC/CTE-GEX/64966/2006).

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