

BRILHA J.B.R., DIAS G.T., MENDES A.C., HENRIQUES R., AZEVEDO I.C., PEREIRA R. (1999) - "The geological heritage of the Peneda-Gerês National Park (NW Portugal) and its electronic divulgation". *Towards the balanced management and conservation of the geological heritage in the new millenium*. D. Baretino, M. Vallejo & E. Gallego (Eds.). Sociedad Geológica de España, 315-318.

## **The geological heritage of the Peneda-Gerês National Park (NW Portugal) and its electronic divulgation**

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**Abstract:** The use of Information and Communication Technologies for the divulgation of the geological heritage must be faced as a priority. Due to their characteristics, the possibility of presenting geological features is greatly enhanced using multimedia materials distributed by Internet or in CD-ROM's. In this work we present the project under development, centered on the production of electronic materials regarding the diffusion of the geological heritage of the Peneda-Gerês National Park, the only National Park in Portugal.

**Key-words:** geological heritage, granitic rocks, environment, Internet

### **Introduction**

The Peneda-Gerês National Park (PGNP) is located in the northwestern region of Portugal (figure 1) occupying an area of 70.920 ha. It is the only National Park in Portugal (classified and established since 1971), the highest degree for protected areas in the country. Thus, the study of all the components of the Natural Heritage inside the PGNP is very important for the correct management of this important region. The PGNP presents remarkable features regarding the geological, biological, archeological and cultural aspects.



Figure 1 - Localization of the Peneda-Gerês National Park (PGNP).

### Geological setting

The area of the Park, just as all the Northwest region of Portugal, is dominated by granitic rocks that were emplaced in the continental crust during a process of continental collision that occurred 380 to 275 million years (Ma) ago (Variscan Orogeny). Different generations of granitic rocks occur in the PGNP, the most representative and extensive being the Peneda-Gerês pluton, composed of three granitic units (Mendes & Dias, 1990; Dias *et al.*, 1998). It had been emplaced at 290-296 Ma, controlled by the Gerês-Lovios fault. These units correspond to the younger granites in the PGNP area. They stand out in the landscape with a more vigorous relief, poorly covered by vegetation. Some of these granitic rocks were affected by hydrothermal alteration and were transformed to episyenites.

Sedimentary rocks of probable Silurian age (435 to 408 Ma) that were deformed and metamorphosed also occur (schists, metagreywackes and quartzites). During the Variscan, dykes and sills of basic rocks, quartz and aplite-pegmatites crosscutted the granites and metasediments. Some of the quartz and aplite-pegmatite dykes are mineralized and in the past mining exploration of tin, tungsten, molybdenum and gold was undertaken. Unfortunately, due to these mining activities, much of the mineralogical heritage of the Park has been destroyed through the years.

The most recent geological formations in the area of the Park are the fluvial, torrential and glacial deposits. In the Quaternary, more precisely in the Pleistocene (aprox. 1.8 to 0.01 Ma ago) important climatic variations occurred at a global scale and were characterized by glacial and interglacial periods with the glaciations reaching inclusively mid-latitudes. Although there are few landforms clearly glacial in origin, signs of these glaciations (U-shaped valleys,

moraines, glacial deposits, polished and striated granite surfaces) were identified in the Gerês and Peneda mountains (Coudé-Gaussen, 1981; Moreira, 1984; Moreira & Ribeiro, 1991).

An intense fracturation network affects the rocks and is well visible especially at higher altitudes with less vegetation where the younger granites outcrop (Gerês and Peneda mountains). This fracturation confines the rivers to deep and straight valleys. In the area of the Park it is well visible the presence of valleys with a NNE-SSW direction (Gerês and Senhora da Peneda valleys), ENE-WSW (Lima and Cávado rivers), NNW-SSE and N-S (direction of many secondary rivers). In clear relationship with fault and fracture systems it must be noted the occurrence of hot springs inside the PGNP area.

The action of the atmospheric agents over the granitic rocks, together with the fracturation, originates a landscape that is typical of granitic regions and that sometimes exhibits curious forms that can be observed at different scales (tors, gnammas, castle-kopje, etc) (Romaní *et al.*, 1990).

### **Advantages of an electronic divulgation**

The divulgation of the Geological Heritage can be greatly enhanced using the Information and Communication Technologies (ICT). The Internet provides an easy way to publish information to wide audiences regardless of their geographical location. During the last year multimedia contents for the divulgation of the geological aspects of the PGNP have been produced. This task is integrated in larger research projects which intend to spread by Internet all the aspects of the natural and cultural heritage of the Portuguese northern region.

The development of multimedia contents of the geological features and divulgation of virtual geological field trips are the major priorities regarding the geological heritage of PGNP. This task is being undertaken following several steps:

1. Organization of the available geological information;
2. Obtainment of complementary information (field data, mineralogical and petrological studies, image collecting);
3. Development of HTML pages;
4. Integration of the HTML pages in the website structure;
5. Production of CD-ROM's using the majority of the materials already available in the Internet but enhancing the multimedia character.

One of the major difficulties of this work is related to the adjustment of the scientific language present in the published literature to the electronic media, where the text must be

concise and, at the first level of information, unprovided of scientific terms unknown to the general public. Nevertheless it is possible to arrange all the information in increasing levels of complexity to reach all kind of users.

The integration of graphic designers in the team is also important, although the presence of geologists is essential during all the production work.

It is well known that the best way to diffuse geological features is using photographs or interpretative sketches. Nevertheless, due to the lens used in the camera, the photograph exhibits narrow vision field, uncontextualizing the geological feature in the overall view. Using computers it is possible to show true panoramic views in 360° with fine results for the divulgation on the Internet. This represents a benefit in relation to the static view printed on any field guide. These panoramic views can be achieved using the QuickTime® Virtual Reality technology (Apple Computers®). Several examples of the application of this software can be viewed on the web pages produced for the PGNP (<http://www.geira.pt/pnpg/>). Another possibility of this technology is the creation of virtual objects. These objects are appropriate for the representation of geological features where the visual aspect depends on the direction of observation (for instance, erosive forms, crystals, fossils...). Finally there is also the possibility of linking both panoramas and objects. This feature has a great application on the diffusion of geological heritage because the user can travel and interact with almost any geological feature, from macroscopic to microscopic scale. The links are obtained by point and click the cursor over a hot spot placed over a panoramic image. These hot spots remain invisible to the user.

### **Final remarks**

The need to increase the public awareness about the importance of the preservation of the Geological Heritage should be a priority to all the geoscientists. The ICT should be seriously regarded as a fundamental tool for this purpose due to their wide distribution and the fact that they allow the use of multimedia contents. These contents can be very attractive and really efficient in showing geological features. As a final consideration we should always keep in mind that there is no virtual reality technology that can substitute the scientific/pedagogic interest and the pleasure that a real visit to a place represents. These technologies should always be used as a tool of divulgation and motivation for real visits and not as a substitution of them.

*This work is carried out in the Centro de Ciências do Ambiente/Ciências da Terra (University of Minho) under the scope of the Geira Project (<http://www.geira.pt>) and Nónio Século XXI Program. Funding: Fundação para a Ciência e a Tecnologia, Interreg II, Feder and Ministério da Educação (Portugal).*

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