

# Pedagogical Geosciences tools to explain Naturtejo Geopark in both non-formal and formal environments

## *Herramientas pedagógicas utilizadas para la explicación de la Geología del Geopark Naturtejo en ambientes formales e informales*

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**Resumen:** El Geoparque del Naturtejo se incluye en la Red Europea de Geoparques bajo el auspicio de la UNESCO que contempla el patrimonio Geológico en una estrategia de desarrollo sostenible. Este patrimonio geológico, de excepcional interés científico adquiere además, una nueva perspectiva de valor si se observa como recurso natural, geo-recurso, incorporado ya de pleno a la oferta de uso público del parque. Asimismo fomenta el desarrollo local mediante la conservación, la educación y el (geo)turismo. Puesto que la Educación no se termina en la escuela, el Geoparque trabaja para difundir el patrimonio al público, adecuando determinadas estrategias que incluyen herramientas apropiadas, estrategias específicas y guías especializados.

**Palabras clave:** Geoparque Naturtejo, patrimonio geológico, herramientas pedagógicas, interpretación.

**Abstract:** *Naturtejo Geopark, European and Global Geopark under UNESCO, fosters sustainable development through conservation, education and (geo)tourism. In the base of this project is an outstanding geological heritage, supported by interpretation strategies prepared to a wide range of public: inhabitants, visitors, children, tourists, geotourists, students, teachers and heterogeneous groups. As Education does not finish in the school, the Geopark works to communicate heritages to the public fitting particular strategies, with proper tools, specific strategies and specialized guides.*

**Key words:** *Naturtejo Geopark, geological heritage, pedagogical tools, interpretation.*

### LEARNING IN NATURTEJO GEOPARK

Naturtejo Geopark, part of the European and Global Geopark Network under UNESCO, is located in the centre of Portugal, in the border with Spain. This includes an outstanding Geological Heritage where conservation, education and (geo)tourism are the basis to foster sustainable development. Using 16 geomonuments, geological icons, the outstanding landscape of the Geopark is intended to be explained immersing visitors into 600 million years of Earth History (Neto de Carvalho & Rodrigues, 2010). The Geological Heritage Inventory includes about 170 geosites, but their use depends on their values and vulnerability. The territory presents 8 typologies of geological heritage that reflect a vast Geodiversity: Geomorphology, Palaeontology, Hydrogeology, Stratigraphy/Sedimentology, Geomining Heritage, Petrology/Mineralogy, Tectonics and Museums & Collections, with a huge potential for education. For interpretation geosites must have high didactical value and cannot have vulnerability. The scientific value is important for students in higher levels, but it is not important for general public. The aesthetic value is crucial for general public and increases the enthusiasm and curiosity for students. Finally the tourist value is also essential for general public, to attract and increase

the interest of students. The interpretation can be a strategy for geoconservation, as it leads to understanding, creating or changing beliefs, leads to appreciation, with positive meanings, that conducts to raise awareness to conservation (Ham., 2009).

As the 21st century paradigms of the society changed, the education inside and outside the schools must follow these transformations. Geosciences enable successfully to develop the new skills for this century, that privilege observation, analysis capabilities, reflection proficiency, critical thought and problems solving. Naturtejo Geopark territory has 4617 km<sup>2</sup> to develop these abilities with students and teachers in the Educational Programmes but also with general public in (Geo)tourist Programmes, events for raising awareness and several thematic sessions and visits.

### FORMAL EDUCATION ENVIRONMENT

In Geopark Naturtejo there are Educational Programmes prepared according to the curricula of the Portuguese Ministry of Education and addressed to all education levels, from kindergarten till university (Catana, 2009). In the programme “School Meets the Geopark”, students and teachers visit geosites (Fig. 1), museums, make walking trails, boat trips, visit science

centres, always guided by the Geopark specialised team. There is also the programme “Geopark Goes to School”, where the geopark’s team operates several activities inside the classroom or around the school, and special annual programmes like the “Anim’a Rocha” (which may be translated as Hearten Rock). As the contents of the programmes are adapted to the target, the programmes can be an addition for the curricula, an extension of the classroom, promoting the direct contact with natural phenomena, with field observations and practical activities, that contribute for learning and to develop new skills, where the student must have an active role in its own learning.

All the geosites visited in the Educational Programmes have high educational value, reduced vulnerability and the majority of them have site interpretation (panels or tables). With some special groups of university students there are visits to geosites with moderate vulnerability, to raise awareness for geoconservation. The aesthetical value of the sites is also important, but in this case sometimes may not exist, because the scientific value associated with the didactic value are more important.



FIGURE 1. Educational Programme in the Fraga da Água d’Álta Waterfalls geomonument.

## NON-FORMAL ENVIRONMENT

Non-formal education takes place outside the school context, and can happen in several contexts, during all the life long. Naturtejo Geopark is a privileged place to learn in a relaxed environment, during a walking trail, a boat trip, a visit to a science centre, with friends or family, during vacations or a weekend, just passing or living there. Geotourist Programmes are proposed by Naturtejo for different kinds of public, with different levels and diverse approaches on Geodiversity. The interpretation strategies used in these cases demand a strong scientific support to offer the proper interpretation of the landscape, of the territory transformations and the geoconservation is also the first concern. The geosites with higher tourist potential have necessarily high educational value, providing the understanding of the Geodiversity (Rodrigues, 2009). Geosites with high vulnerability cannot be used in tourism.

Naturtejo Geopark has about 500 km of walking trails, 115 of them with geological interest, through geosites and geomonuments, designated as Geotourist Trails (Rodrigues & Neto de Carvalho, 2009).

## PEDAGOGICAL TOOLS AND DIDACTICAL STRATEGIES: GEOSCIENCE

Geosciences are seen in a lower level than other sciences and one of the priorities of Naturtejo Geopark is to provide strategies and tools to interpret Geodiversity. For all kind of visitors, Geology is framed with an holistic approach: fauna, flora or human settlement can be seen as consequence of Geology, traditional architecture can be related with local rocks, and archaeological remains can be related with ancient mining exploitations. The “Smugglers Trail” between Portugal and Spain recreates smuggling coffee and wolfram through Erges River canyon. Medieval castles in Penha Garcia, Monsanto, Idanha-a-Nova or Vila Velha de Ródão, built to defend the Portuguese borders are implanted in granite and quartzite resistance reliefs, sites where was possible to control the lands. This Geodiversity is the support of Biodiversity with rock nesting fauna (Vulture and Black Stork), flora with impressive relic colonies of Juniper and fungi.

In this work is presented some tools and approaches used in Naturtejo Geopark guided visits. It is essential to foster the curiosity of the visitants, to involve them, provoking them: “why these soils are so fertile for agriculture?” or “why can we find gold in this river?”, “why there are marine fossils in the top of the hills?” and also with questions from the daily news, because everyday media provide news about fuel prices, earthquakes or floods. It is also interesting to link the news with the subject of the visit and connect the visitors personal experiences with the visit to the Geopark.

The guided visits are the most complete and adapted for the visitor, however some people prefer an autonomous tour. For them there are interpretative panels and leaflets, brochures, thematic maps, audio guides, and almost every material can be downloaded in the Naturtejo Geopark website ([www.naturtejo.com](http://www.naturtejo.com)). The 16 geomonuments have specific signage and interpretation *in situ* but also in digital format with photos and videos (André et al.. 2011). Moreover there are many other geosites with panels and brochures.

The use of all senses is important in Geosciences, to feel the texture of rocks, minerals and fossils, to understand the patterns of ripple marks or fault grooves, to experience the weathering of an altered granite, to distinguish sand from clay. On the other hand, to better know mining techniques, physical properties from some minerals, panning for gold in Naturtejo Geopark is an activity that can be done by everybody, also to look for tin and wolfram and with the company of old miners, who tell their own experiences, the best methods, also

the socio-economical contexts of the 20th century, when that activities were very important in the region (Fig. 2). To understand better the extinct trilobites and their predator *Orthoceras*, students (and everybody) can observe two giant floating models, at the Penha Garcia Ichnological Park and, during Summer times, why not swim with them?



FIGURE 2. Geotourists panning for gold in the Ocreza River, Portas de Almourão geomonument.

The magnitude is the main obstacle to understand geological processes, the time, the rock deformation and erosion, the preservation of life remains are abstract concepts not only for students but also for adults who did not study Geosciences in school. Let's see for example the mountains, large scale structures, plentiful in Naturtejo Geopark, in different contexts are apparently permanent reliefs that cover multiple, invisible but very complex, building processes and also apparently very "effortless" erosion phenomena that sometimes lead to complete flattening (Fig. 3a). Nowadays digital tools provide very interesting programmes with animations, compressing in a few seconds or minutes, millions of years and presenting 3D simulations that show processes that cannot be "seen" by human perception in Nature. Unfortunately the use of digital tools outdoor has yet some limitations due to lightness. In the Geopark there are tools, based on the same principles but in different materials, very portable, to be carried in the field, adapted to different ages. When the tools are being prepared it is regarded *who* will be its target, *where* will be it used, what is its *main goals*, *when* (in the interpretation strategy) shall it be apply and what kind of *impact* it is expected of it. Sometimes tools specially designed for students can be used easily with general public, but the opposite is more difficult.

Interpreters need to "paint pictures" and create stories to help visitors to "see" abstract concepts and appreciate the significance of the landscape (Hughes & Ballatyne, 2010). For this purpose one imperative strategy is the introduction to the geological thought, to assist visitors reading Geodiversity. This may be done for example, provoking visitors with James Hutton's principle: "the present is the key to the past". Naturtejo

Geopark has Neoproterozoic and Ordovician metasedimentary formations that testimony the Gondwanan ocean margin and the visitor must look for rock formation, trying to recognize modern structures, like worm burrows (Fig. 3b), ripple marks or metamorphized quartz sand grains which characterize that paleoenvironment.

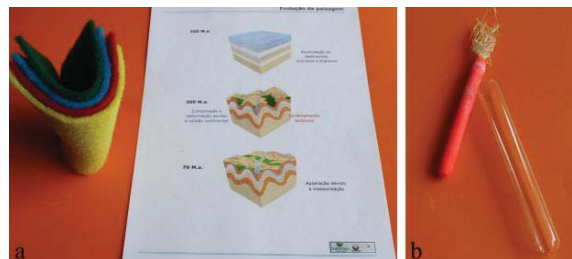


FIGURE 3. Pedagogic tools: a) strata deformation dynamic model and mini-poster with regional geological history; b) worm and worm burrow models.

Understanding Geology is also to read rocks, to look at them and ask them questions and observe them carefully to listen the answers: "Which minerals compose you?"; "Which rock were you long before?"; "What process did form you?"; "In which context were you formed?"; "How old are you?"; "How did you appeared in this place?". To help this "conversation" between people and rocks there are some simple tools. As example, for a quartzite, visitors can feel a polished sample where it is possible to see crystal-like quartz grains, a sandstone, quartz sand, a mini-poster with the deposition and the metamorphic processes. To react to all the questions it is necessary to observe the geosites and to connect all the factors from brainstorm and to generate meaningful learning.

Depending on the subject of the activity/visit there are several rock/mineral/fossil collections organized according to several topics. For example, "Granite box" contains one sample of granite rock and one of each main mineral constituent (quartz, feldspar, biotite and moscovite); "Wolfram kit" presents the mineral context of this mineral, one log, different samples of wolfram, tourmaline (sometimes used as frauds by old miners), and others minerals from the local setting (Fig. 4).

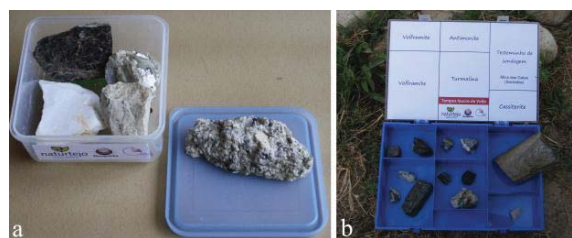


FIGURE 4. Pedagogic tools: a) "Granite box": granite and its main minerals; b) "Wolfram kit".

In October, 2008 Skâl International, one of the most important tourism organizations in the world awarded Naturtejo Geopark Educational Programmes with the Ecotourism Award.



Naturtejo Geopark integrates the EU project “GEOschools - teaching geosciences in secondary schools”. The main goals are: bridging the gap between scientific knowledge and school knowledge in geosciences, increasing the knowledge of teachers and the ability of students in valuing and appreciating geosciences, improving educational skills of geosciences in European school environment, establishing and sustaining a consortium on research and initiatives on geosciences education and supporting education for sustainability (Fermeli et al., 2011). These goals gather the work developed in the Geopark since 2006, when it was integrated in the European and Global Geoparks Network, under UNESCO.

## CONCLUSIONS

Naturtejo Geopark is one piece in the puzzle of the world Geodiversity, represented in 50 European Geoparks distributed by 18 countries, and a total of 89 Geoparks in 27 countries around the world under the auspices of UNESCO. These are ideal sceneries to find out Geology and to learn how to understand landscapes.

Interpretation tools and strategies do not need to be expensive and complex, but effective, well structured and capable to get the targets. If the public is provoked it is forced to think, to question previous own conceptions, to incorporate personal experiences with the Geopark’s experience. With a proper interpretation strategy, the visitor increases knowledge, “meaning making” and raises awareness for geoconservation.

School visitors demand different approaches, regarding their curricula with methodologies that integrate the contents from the classroom with natural environment.

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